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TECHNICAL MANUAL

for

VARIABLE FREQUENCY OSCILLATOR MODEL VOX-7

THE TECHNICAL MATERIEL CORPORATION

MAMARONECK, N.Y. OTTAWA, CANADA

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MAMARONECK, N.Y. OTTAWA, CANADA

IN2040

ISSUE DATE: FEBRUARY 1969

NOTICE

THE TECHNICAL MATERIEL CORPORATION
COMMUNICATIONS ENGINEERS
700 FENIMORE ROAD MAMARONECK, N. Y.

Warranty

The Technical Materiel Corporation, hereinafter referred to as TMC, warrants the equipment (except electron tubes,* fuses, lamps, batteries and articles made of glass or other fragile or other expendable materials) purchased hereunder to be free from defect in materials and workmanship under normal use and service, when used for the purposes for which the same is designed, for a period of one year from the date of delivery F.O.B. factory. TMC further warrants that the equipment will perform in a manner equal to or better than published technical specifications as amended by any additions or corrections thereto accompanying the formal equipment offer.

TMC will replace or repair any such defective items, F.O.B. factory, which may fail within the stated warranty period, PROVIDED:

1. That any claim of defect under this warranty is made within sixty (60) days after discovery thereof and that inspection by TMC, if required, indicates the validity of such claim to TMC's satisfaction.
2. That the defect is not the result of damage incurred in shipment from or to the factory.
3. That the equipment has not been altered in any way either as to design or use whether by replacement parts not supplied or approved by TMC, or otherwise.
4. That any equipment or accessories furnished but not manufactured by TMC, or not of TMC design shall be subject only to such adjustments as TMC may obtain from the supplier thereof.

Electron tubes*furnished by TMC, but manufactured by others, bear only the warranty given by such other manufacturers. Electron tube warranty claims should be made directly to the manufacturer of such tubes.

TMC's obligation under this warranty is limited to the repair or replacement of defective parts with the exceptions noted above.

At TMC's option any defective part or equipment which fails within the warranty period shall be returned to TMC's factory for inspection, properly packed with shipping charges prepaid. No parts or equipment shall be returned to TMC, unless a return authorization is issued by TMC.

No warranties, express or implied, other than those specifically set forth herein shall be applicable to any equipment manufactured or furnished by TMC and the foregoing warranty shall constitute the Buyers sole right and remedy. In no event does TMC assume any liability for consequential damages, or for loss, damage or expense directly or indirectly arising from the use of TMC Products, or any inability to use them either separately or in combination with other equipment or materials or from any other cause.

*Electron tubes also include semi-conductor devices.

PROCEDURE FOR RETURN OF MATERIAL OR EQUIPMENT

Should it be necessary to return equipment or material for repair or replacement, whether within warranty or otherwise, a return authorization must be obtained from TMC prior to shipment. The request for return authorization should include the following information:

1. Model Number of Equipment.
2. Serial Number of Equipment.
3. TMC Part Number.
4. Nature of defect or cause of failure.
5. The contract or purchase order under which equipment was delivered.

PROCEDURE FOR ORDERING REPLACEMENT PARTS

When ordering replacement parts, the following information must be included in the order as applicable:

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.

PROCEDURE IN THE EVENT OF DAMAGE INCURRED IN SHIPMENT

TMC's Warranty specifically excludes damage incurred in shipment to or from the factory. In the event equipment is received in damaged condition, the carrier should be notified immediately. Claims for such damage should be filed with the carrier involved and not with TMC.

All correspondence pertaining to Warranty Claims, return, repair, or replacement and all material or equipment returned for repair or replacement, within Warranty or otherwise, should be addressed as follows:

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

RECORD OF CORRECTIONS MADE

Change No.	Date of Change	Date Entered	Entered By

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Figure 1-1. Variable Frequency Oscillator, VOX-7

SECTION I

GENERAL INFORMATION

1-1. FUNCTIONAL DESCRIPTION

Variable Frequency Oscillator, VOX-7 (figure 1-1) is a solid state synthesized oscillator that provides a selectable radio-frequency (rf) between 1.6 MHz and 29.99999 MHz. The Variable Frequency Oscillator, VOX-7 (hereinafter referred to as the VOX-7, or the Oscillator) is used as a control oscillator for an exciter/transmitter or a laboratory rf signal generator. Standard BNC connectors located on the rear panel of the Oscillator interface the selected rf output, rf monitor, 1 MHz output and 1 MHz monitor with the external equipment. Provisions are also included on the rear panel to permit the selection of the oscillator's internal 1 MHz standard as a reference, or the selection of an external 1 MHz standard such as the CSS-2.

Optional capabilities of the Oscillator include provisions for remote tuning, one fixed intermediate frequency oscillator (IFO), and one beat frequency oscillator (BFO) injection frequency output. A switch is provided on the rear panel for selecting the IFO mode; a front panel switch is provided for selecting the BFO mode.

1-2. PHYSICAL DESCRIPTION

Figure 1-2 illustrates the top view of the VOX-7 with the top cover removed. The majority of the electronic components which constitute the Oscillator are mounted on 12 printed circuit boards which plug into Cinch connectors mounted in the chassis. The printed circuit boards are as follows: spectrum generator Z101, comb filters Z102 and Z103, dual mixer dividers Z104 and Z105, final mixer Z106, step generators Z110 and Z111, translator Z112, step generator Z113, output filter Z114, and rf output filter Z115. Two additional printed circuit boards, Z304 and Z305, are included as part of the power supply assembly. Two optional boards contain the circuits associated with the BFO and IFO functions. An extender card, which mates with the individual printed circuit boards and the Cinch connectors, is supplied with the Oscillator to facilitate maintenance, alignment, and troubleshooting procedures.

The Oscillator 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 mounted on the front panel and include seven frequency selector switches, rf, output level control, line fuses and spare fuses, power and standby switches, BFO selector switch, front panel meter for monitoring critical circuits, and a meter selector switch. Two switches are included on the rear panel for selection of the IFO mode and the 1 MHz reference frequency.

1-3. TECHNICAL SPECIFICATIONS

FREQUENCY RANGE:	1.6 to 29.99999 MHz
INCREMENTAL TUNING:	1.6 to 30 MHz in 10 Hz steps
FREQUENCY PRESENTATION:	direct reading
OUTPUT IMPEDANCE:	50 ohms
OUTPUT LEVEL:	Variable up to 1 watt
OUTPUT CONNECTION:	BNC
STABILITY AND ACCURACY:	1 part in 10^8 per day for a 15° C ambient change between 0° C and 50° C.
METERING:	Built in multi-meter monitors critical operating circuits Q1, Q2 and Q3, IFO, BFO and RF outputs.
ENVIRONMENTAL:	The unit will operate in any environment from 0° C to 50° C with any value of humidity up to 90%.
INSTALLATION DATA:	Size: 5-1/4 inches H x 19 inches W x 17 inches D. Weight: (approximately) 25 lbs.
POWER REQUIREMENTS:	115 or 230 vac, ±10%, 50-60 Hz, approximately 30 watts. Specify 230 vac when ordering, if such is desired.
COMPONENTS AND CONSTRUCTION:	All equipment manufactured in accordance with U.S. JAN/MIL specifications wherever possible.
OPTIONS:	One fixed IFO and one fixed BFO injection frequency; remote tuning.
EQUIPMENT SUPPLIED:	Mating plugs, connectors, and instruction manual.

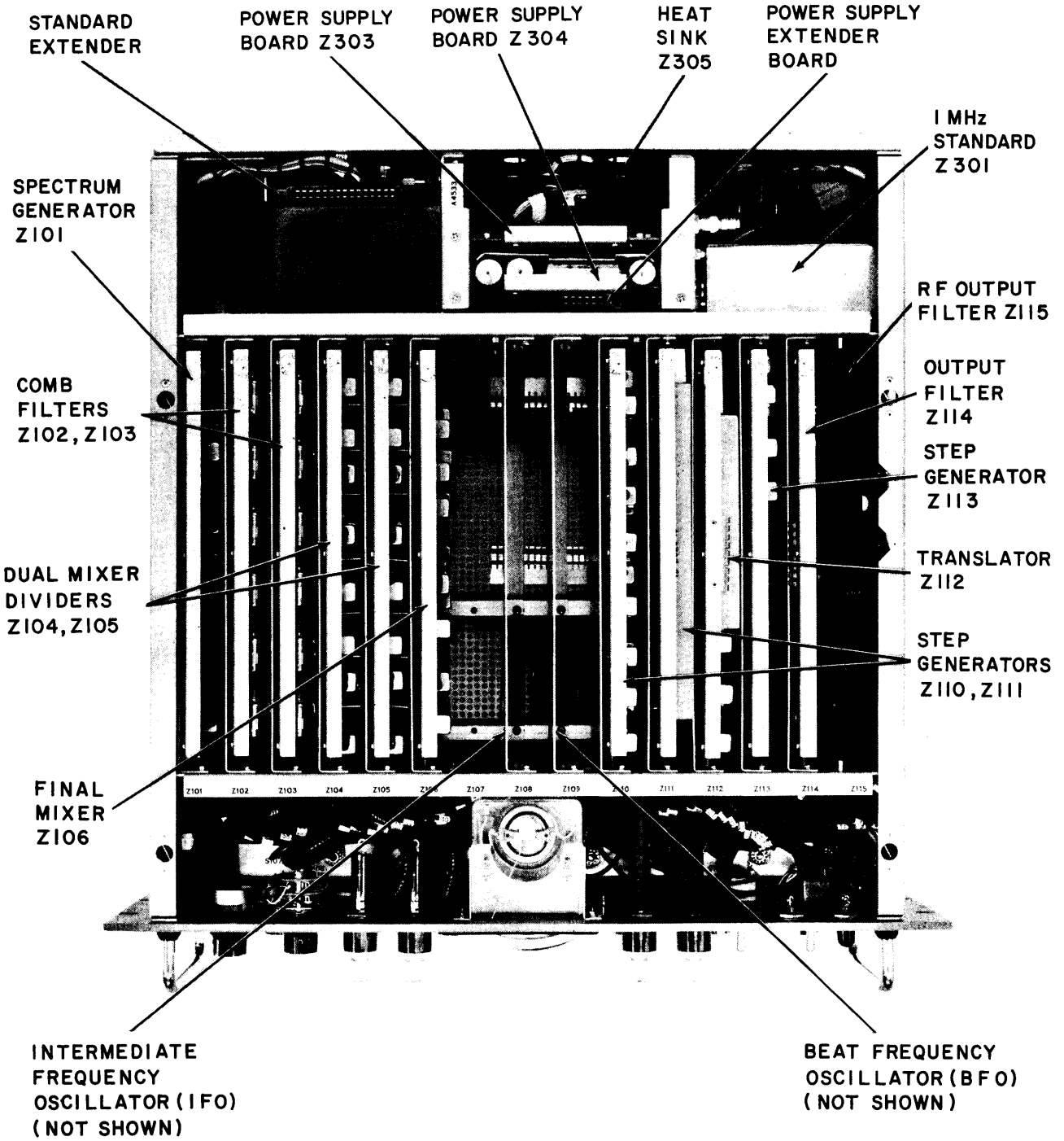


Figure 1-2. VOX-7 Top View

SECTION 2

INSTALLATION

2-1. GENERAL

The Oscillator is calibrated and tested at the factory prior to shipment. When the Oscillator 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 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 (figure 3-1, 9) to STANDBY; when line cord is connected to appropriate power source, voltage is extended through the power supply components.

The Oscillator 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 7-13. For 230 vac operation, replace line protective fuses with fuses having 1/2 the 115 vac fuse rating.

2-3. MECHANICAL INSTALLATION

The Oscillator 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 VOX-7 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.

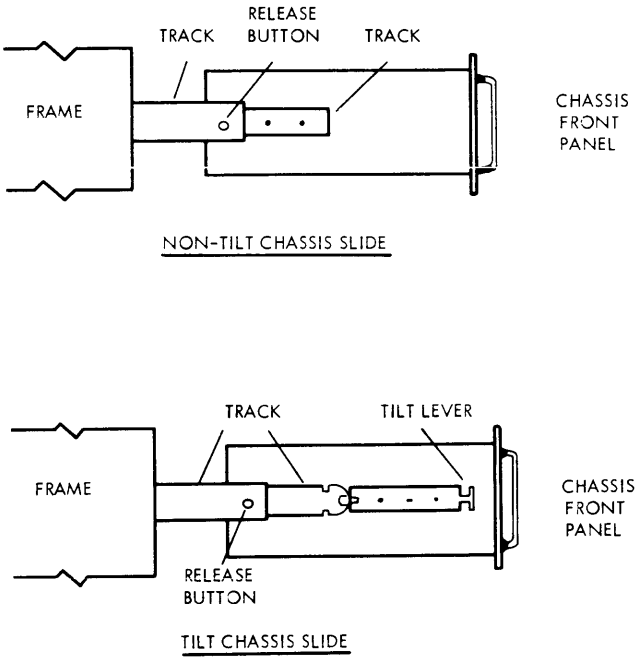


Figure 2-1. Tilt-Lock Slide Mechanism

2-4. ELECTRICAL INSTALLATION

All electrical connections between the VOX-7 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
J117 (IFO OUT)	Output for optional intermediate frequency oscillator
J118 (BFO OUT)	Output for optional beat frequency oscillator

TABLE 2-1. REAR PANEL CONNECTIONS (Continued)

Panel Designation	Function
J120 (1 MHz OUT)	1 MHz standard output jack
J121 (1 MHz MON)	1 MHz standard monitor jack
J122 (1 MHz IN)	Input for connection of external 1 MHz standard
J124 (RF OUT)	RF output jack
J125 (RF MON)	RF output monitor jack

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

Although the VOX-7 has been aligned and thoroughly checked against the manufacturer's specifications prior to shipment, it is necessary to ensure correct installation and proper Oscillator operating conditions by performing the following checkout procedures. Refer to Section 3 for location and functions of all operating controls and indicators.

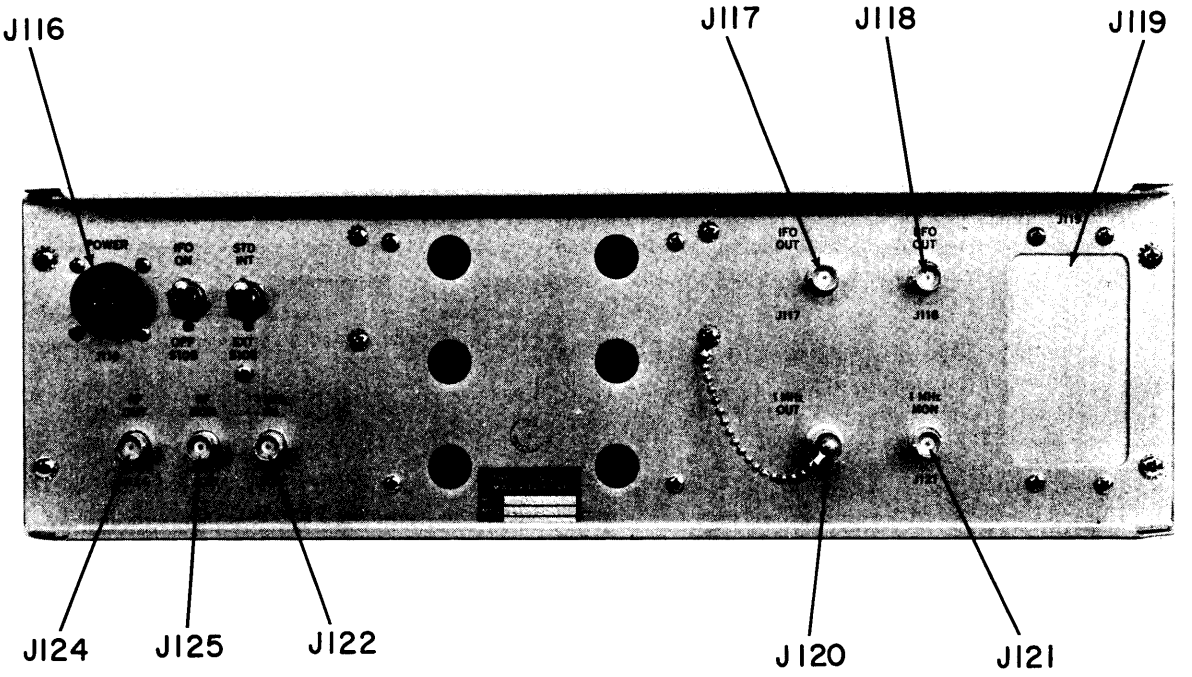


Figure 2-2. Rear Panel Connectors

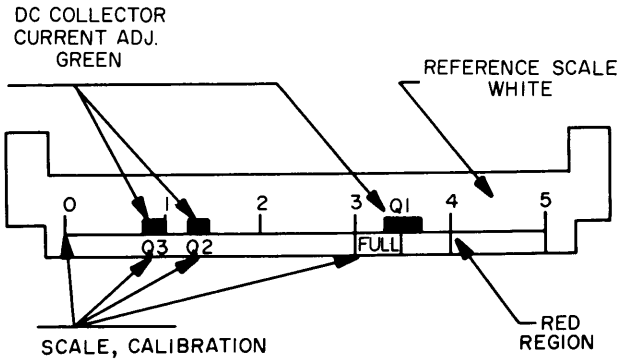


Figure 2-3. Front Panel Monitor Indicators

NOTE

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

a. Set ON/STANDBY switch (9) to STANDBY position. STANDBY indicator (7) shall illuminate amber.

b. Using the seven frequency selector switches (10), establish the desired rf.

c. On rear panel, set STD/INT switch S108 (figure 2-2) to INT position.

d. Set ON/STANDBY switch (9) to ON position. STANDBY indicator (7) shall extinguish and POWER indicator (8) shall illuminate red.

e. Set METER switch (2) to Q1 position. MONITOR meter (4) shall indicate in the green region marked Q1. (See figure 2-3.)

f. Set METER switch (2) to Q2 position. MONITOR meter (4) shall indicate in the green region marked Q2. (See figure 2-3.)

g. Set METER switch (2) to Q3 position. MONITOR meter (4) shall indicate in the green region marked Q3. (See figure 2-3.)

h. Set METER switch (2) to IFO position (if IFO option is installed). MONITOR meter (4) shall indicate FULL.

i. Set METER switch (2) to BFO position (if BFO option is installed). MONITOR meter (4) shall indicate FULL.

j. Set METER switch (2) to RF position. MONITOR meter (4) shall indicate zero with RF OUTPUT control full counterclockwise.

k. 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.

l. Remove VTVM and connect oscilloscope (Tektronix Model 541A, or equivalent) to RF OUT jack J124 (figure 2-2). Display waveform shall be a sharp undistorted sinewave with on modulation signal appearing on any position of the oscilloscope's time/cm scale.

m. Remove oscilloscope. Connect spectrum analyzer (Lavoie Model LA-40) to RF MON jack J125 (figure 2-2).

n. Measure distortion at the frequencies indicated in table 2-2. Distortion must be -60 db or less.

o. If VOX-7 is equipped with IFO option, connect oscilloscope to IFO OUT jack J117 (figure 2-2).

p. Set IFO ON switch (12) to ON. Oscilloscope shall indicate assigned IFO frequency.

q. If VOX-7 is equipped with BFO option, connect oscilloscope to BFO OUT jack J118 (figure 2-2).

r. Set BFO/OFF switch (6) to BFO position. Oscilloscope shall indicate assigned BFO frequency.

s. Disconnect all test equipment

TABLE 2-2. RF DISTORTION TEST FREQUENCIES

1.6 MHz	19.0 MHz
2.5 MHz	21.0 MHz
3.5 MHz	23.5 MHz
5.0 MHz	25 MHz
7.0 MHz	26.5 MHz
9.0 MHz	28 MHz
11.0 MHz	29.0 MHz
13.5 MHz	29.499 MHz
15.0 MHz	29.500 MHz
17.5 MHz	29.999 MHz

SECTION 3

OPERATOR'S SECTION

3-1. GENERAL

The VOX-7 provides rapid frequency selection in the 1.6 to 29.99999 MHz transmission range. Tuning over this frequency range is accomplished manually in incremental tuning steps of 10 Hz using the seven front panel frequency-select switches. Two VOX-7 options, when installed, provide for the selection of one fixed IFO and BFO frequency.

3-2. CONTROLS AND INDICATORS

All operator controls and indicators are located on the front and rear panel of the Oscillator. Figure 3-1 illustrates the locations of all operator controls and indicators, while table 3-1 lists the controls and indicators and provides the panel designation and 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 (six-position):	Selects circuit in VOX-7 to be monitored by MONITOR meter.
	Q1	Displays rf output transistor Q1 collector current (350 ma) on MONITOR meter
	Q2	Displays rf output transistor Q2 collector current (130 ma) on MONITOR meter
	Q3	Displays rf output transistor Q3 collector current (65 ma) on MONITOR meter
	IFO	Displays peak IFO output on MONITOR meter when IFO option is supplied
	BFO	Displays peak BFO output on MONITOR meter when BFO option is supplied
	RF	Displays peak rf output on MONITOR meter
3	SPARES (2) fuses	Spare lamp line voltage fuses
4	MONITOR meter	Monitor circuit selected by METER switch
5	LINE (2) fuses	1 amp line voltage fuses
6	BFO/OFF switch	Couples BFO injection frequency to BFO OUT jack J118 when BFO option is supplied

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

Item Number (Figure 3-1)	Panel Designation	Function
7	STANDBY indicator	Illuminates amber when ON/ STANDBY switch is positioned to STANDBY
8	POWER indicator	Illuminates red when ON/ STANDBY switch is positioned to ON
9	ON/STANDBY switch	When positioned to ON, applies 12 and 24 vdc to modules. When positioned to STANDBY, removes dc voltages from modules and illuminates STANDBY indicator
10	10 Hz, 100 Hz, 1 kHz, 10 kHz, 100 kHz, 1 MHz, and 10 MHz selector switches	Used to select the desired operating frequency
11	INT/EXT STD switch	Used to select the Oscillator internal 1 MHz frequency, or an external 1 MHz standard
12	IFO switch	Couples the IFO injection frequency to IFO OUT jack J117 when IFO option is supplied

3-3. OPERATING PROCEDURE

Before initially placing the VOX-7 in operation, perform the initial checkout procedure outlined in Section 2, Installation. To place the unit in operation:

NOTE

Verify that ON/STANDBY switch (figure 3-1, 9) is set to STANDBY.

a. Connect source of 115 vac, single phase power to connector J116 (figure 2-2). Observe that STANDBY indicator (figure 3-1, 7) illuminates amber.

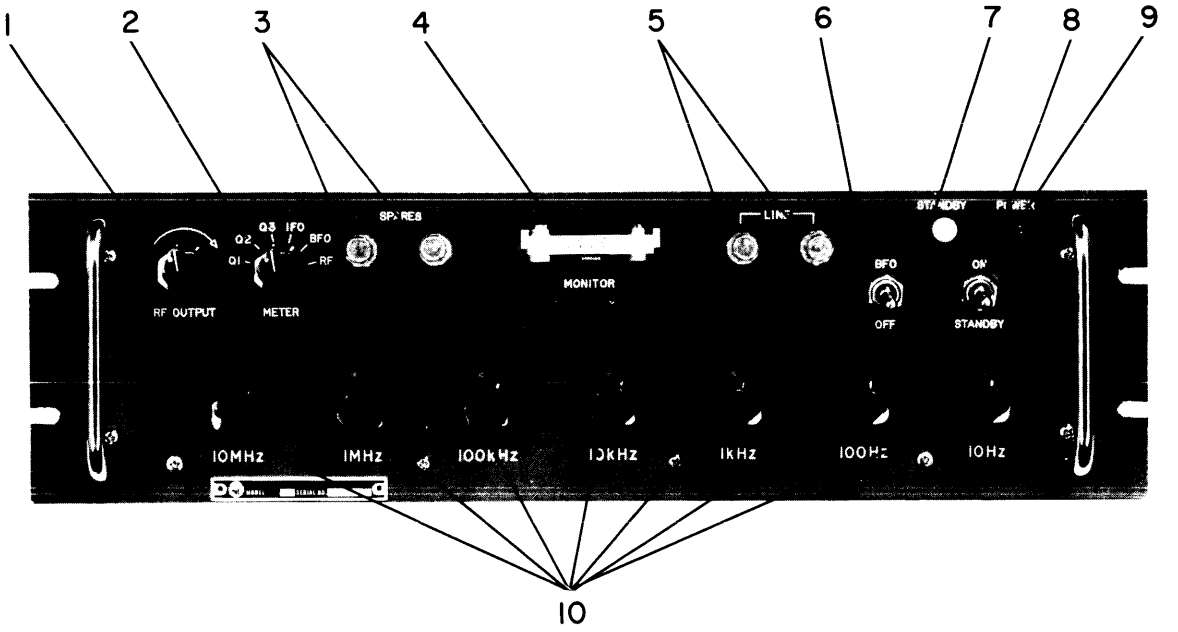
b. Make necessary interface connections on rear panel jacks. (See figure 2-2.)

c. Using the seven frequency selector switches (10) establish the desired rf operating frequency as displayed in the frequency readout windows.

d. Position the BFO switch (6) and IFO switch (12) to the desired mode, if applicable.

e. Set METER switch (2) to the circuit function to be monitored on MONITOR meter (4).

f. Set ON/STANDBY switch (9) to ON. Observe that STANDBY indicator (7) extinguishes and POWER indicator (8) illuminates red.



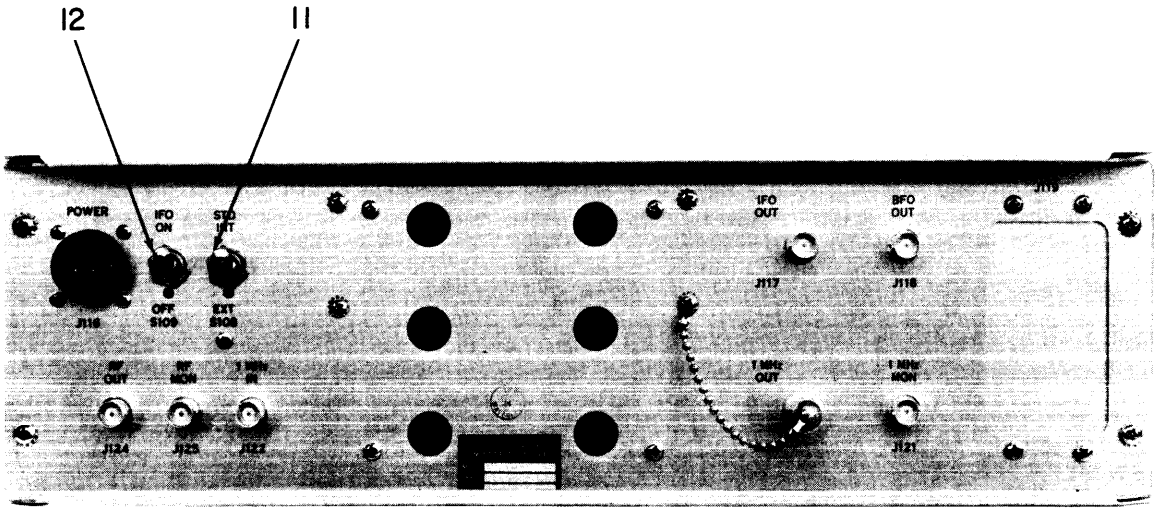


Figure 3-1. Controls and Indicators

SECTION 4

PRINCIPLES OF OPERATION

4-1. INTRODUCTION

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

NOTE

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

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

The VOX-7 is essentially an rf generator which provides a 1.6 to 29.99999 MHz output signal in discrete 10 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; step generators Z110, Z111 and Z113; frequency translator Z112; rf output Z115; output filter Z114; and a power supply assembly. The following paragraphs present brief descriptions of each of these sections.

a. SPECTRUM GENERATOR Z101. The spectrum generator develops eight fundament output frequencies which are derived from a stable 1 MHz standard in the power supply assembly. Firstly, the 1 MHz input is amplified and sent to the mixer-divider circuits for formulation of five discrete decimal integers to enable frequency selection in 10 Hz steps. Secondly, the 1 MHz input is clipped, divided 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 six additional output frequencies of 3, 8, 12, 13, 14 and 40 MHz. The 8 MHz output is applied to the mixer-divider section as the fundamental input frequency; the 3 and 40 MHz outputs are 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-filters at the appropriate harmonic of the 100 kHz spectrum input. The 1.0 to 1.9 MHz output range is applied to the 10 Hz, 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 five frequency channels that can be considered as a cascaded frequency counter; each channel is controlled by a frequency select switch to determine the appropriate 10's, 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 five channels; in the 10 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 10 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 10.99999 MHz results, with the last five digits representing the least significant five decimal places in the selected output frequency. The 10.0 to 10.99999 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 output frequency. Frequency ranges of 10.4 to 11.2 MHz, 12.3 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 high pass filter Z116 to the frequency translator.

e. TRANSLATOR Z112. The translator performs the function of producing a 1.6 to 29.99999 MHz output signal by modulating the 10 to 10.99999 MHz output signal from final mixer Z106 with the 3 MHz and 40 MHz signals from the spectrum generator, and the 104 to 132 MHz output range from step generator Z113. The 10.0 to 10.99999 MHz input is

amplified and modulated by 3.0 MHz to yield a resultant frequency of 13.0 to 13.99999 MHz; this frequency is then modulated by 120 MHz derived from the 40 MHz input multiplied by a factor of 3. As a result, the modulator yields a sum frequency between 133 and 133.99999 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 29.99999 MHz; this signal is filtered to provide a frequency rolloff below 1.6 MHz, thereby resulting in a 1.6 to 29.99999 MHz frequency range. This signal is amplified and applied through the RF OUTPUT control to rf output section Z115.

f. RF OUTPUT Z115, OUTPUT FILTER Z114 AND METERING CIRCUIT. The 1.6 to 29.99999 MHz output signal from the translator is amplified in rf output section Z115 and applied to output filter Z114. The filter network 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; these parameters are controlled by a METER switch and displayed on the front panel MONITOR meter. When the intermediate frequency oscillator (IFO) and beat frequency oscillator (BFO) options are included in the VOX-7, both of these output levels may also be displayed on the MONITOR meter when both the METER switch and IFO-BFO switch is set to the appropriate position.

g. POWER SUPPLY ASSEMBLY. The VOX-7 power supply operates from either 115 or 230 vac when the power transformer is properly wired. The power supply outputs are regulated dc voltages of +30, +24 and +12 volts for operation of the VOX-7 frequency generation circuits. The +24 and +12 vdc power supply outputs are applied to the STANDBY position of the STANDBY-POWER switch and are applied to the frequency generation circuits when set to the POWER position. The 1 MHz frequency standard, produced by an integrated circuit oscillator, is also included in the power supply assembly, and provides the 1 MHz stable input to spectrum generator Z101 whenever 115/230 vac power is applied to the VOX-7.

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 VOX-7. 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 six discrete frequency generators.

(1) In the 1 MHz output circuit, the 1 MHz frequency standard from Z301 in the power supply assembly is coupled through capacitor 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 the T1 secondary is supplied to 1 MHz OUT jack J120, and through isolation resistor R101 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 dual mixer-divider Z104 and to the optional intermediate frequency oscillator (IFO) section, Z108, when used.

(2) In the 1 MHZ spectrum generator circuit, the 1 MHz standard is coupled through capacitor C8 to the input of 1 MHz squarewave generator Q2. This stage essentially reacts as an over-driven amplifier with inverse feedback introduced 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 over-driven amplifier similar to squarewave generator Q2; the collector output signal is amplified by driver Q17 and applied to divider decade 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 the required low output impedance 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 five similar frequency determining circuits plus a frequency multiplier network. These circuits produce discrete frequencies of 3 MHz, 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

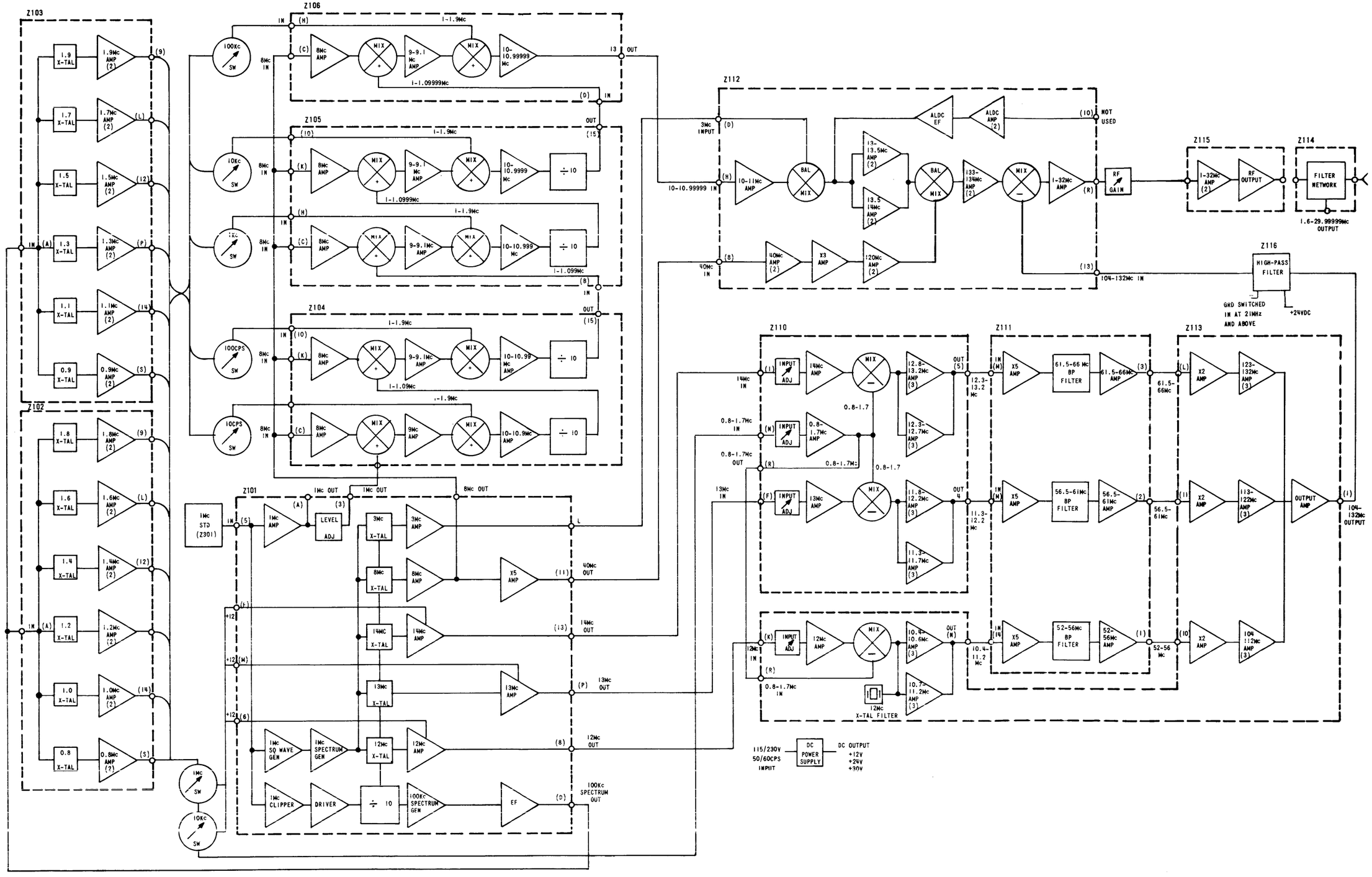


Figure 4-1. VOX-7, Functional Block Diagram

secondary winding of T11, to the inputs of dual mixer-divider Z104, dual mixer-divider Z105 and final mixer Z106, and is also coupled through C83 to the frequency multiplier circuit. Discrete frequencies of 3 MHz, 12 MHz, 13 MHz and 14 MHz are formulated in a similar manner; the 3 MHz output is applied to frequency translator Z112, while the 12 MHz, 13 MHz and 14 MHz outputs are applied to the step generator circuits, Z110 and Z113. It should be noted that +12 vdc is applied to the 13 MHz generator only when the selected frequency is above 12 MHz. (See figure 7-1.)

The 40 MHz frequency multiplier circuit consists of emitter follower Q13 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.

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 generators; 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 configuration and operation of each frequency generator is the same: 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 select switching in the VOX-7 is accomplished by seven rotary switches S101 through S107, with direct-reading dials, corresponding to frequencies of 10 Hz, 100 Hz, 1 kHz, 10 kHz, 100 kHz, 1 MHz and 10 MHz, respectively. (See figure 4-2.) The six discrete frequencies, generated on each of the comb filter boards, Z102 and Z103, are applied through 100-ohm series isolation resistors on respective terminal boards TB101 and TB102, prior to being sent to the selector switch networks.

Each of the first five selector switches (S101 through S105) receives 10 of the 12 discrete frequencies (1.0 MHz to 1.9 MHz) from terminal boards TB101 and TB102, and distributes them to dual mixer-dividers Z104 and 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. The remaining decks of switches S105, S106 and S107 perform the function of enabling appropriate circuits in step generator A, Z112, translator Z112, step generator Z113 and output filter Z114.

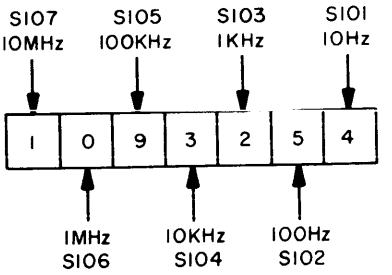


Figure 4-2. Frequency Selector Switch Readouts

d. DUAL MIXER-DIVIDERS Z104 AND Z105, AND FINAL MIXER Z106. (See figures 7-5 and 7-6.) The mixer-dividers and final mixer are essentially frequency shift modulators; their purpose is to shift a basic 8 MHz input signal such that a frequency component, as chosen by the frequency selector switches, is generated having five decimal places and representing tens (10 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 dual mixer-divider and the final mixer are similar, only dual mixer-divider Z104 is discussed. (See figure 7-5.)

The 8 MHz output from spectrum generator Z101 is supplied to the inputs of both halves of each dual mixer-divider and to the input of the final mixer. In dual 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 potentiometer R9 and modulator CR1, a matched pair of 1N995 diodes. The balanced modulator receives the standard 1.0 MHz output from spectrum generator 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 9.05 MHz amplifiers, Q2 and Q3. The tuned collector output developed across the coupling transformer T6 is applied to the second balanced modulator consisting of the T6 secondary, balance potentiometer R23 and CR2.

The second balanced modulator receives a 1 MHz to 1.9 MHz input signal from 10 Hz selector

switch S101, 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 signal from Q6 is applied to divide-by-ten decade Z1, producing the resultant frequency of 1.0 to 1.09 MHz.

Operation of the remaining half of the dual mixer-divider is similar to the preceding, where the 1.0 to 1.09 MHz signal is added to 8 MHz in the third balanced modulator (T12, R54 and CR3) to yield a resultant of 9.0 to 9.09 MHz. After being amplified, this signal is added in the fourth balanced modulator to a 1.0 to 1.9 MHz signal from 100 Hz selector switch S102, depending upon desired frequency; this results in a frequency of 10.0 to 10.99 MHz, thus satisfying the 100 Hz selection. The 10.0 to 10.99 MHz is divided by 10 to produce a 1.0 to 1.099 MHz output signal to the first balanced modulator in dual mixer-divider Z105.

Dual mixer-divider Z105 is identical to Z104 and functions to produce a resultant output signal between 1.0 and 1.09999 MHz, thereby satisfying selector switches S103 (1 kHz) and S104 (10kHz). Final mixer Z106 (figure 7-6) satisfies selector switch S105 (100 kHz) by modulating the 8 MHz signal with the 1.0 to 1.09999 MHz signal from Z105 to produce 9.0 to 9.09999 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 10.99999 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, 10.5 through 10.99999 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 7-7 through 7-9.) 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 DD139 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 sub-channels is similar in circuit configuration, only the 13MHz 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 difference frequency range of 11.3 MHz to 12.2 MHz, 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 supplied to step generator B, Z111. Depending upon the range value of the selected frequency, operating voltage of +12 vdc to the 13 MHz and 14 MHz circuits is controlled by 10 MHz frequency selector switch S107B (front) and 100 kHz selector switch S106C and E (rear), while a switched ground to the sub-channels is controlled by 100 kHz selector switch S106C (front). (See figure 7-1.)

(1) Step generator Z113 contains a frequency step circuit for the 12 MHz input, similar to the 13 and 14 MHz circuits previously described. (See figure 7-9.) The 13 MHz input is modulated by the 0.8 to 1.7 MHz input supplied 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 of those discussed for step generator Z110. Switched B+ voltage of +12 vdc is applied to either sub-channel, depending upon the range value of the selected frequency. The 10.4 to 11.2 MHz output is also applied to step generator Z111, step generator B.

(2) Step generator B, Z111, 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 the collector T2/C9 tank circuit 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 100 kHz selector switches. (See figure 7-1.)

(3) Step generator Z113 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 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 of 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 transformers 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 C112 and filter Z116 to translator Z112. Again, switched B+ voltage of +12 vdc is applied to each circuit depending upon the selected frequency.

f. TRANSLATOR Z112. (See figure 7-10.) Translator Z112 receives the 3 MHz and 40 MHz signals from spectrum generator Z101; the 10 to 10.99999 MHz signal from final mixer Z106; and the 104 to 132 MHz signal from high pass filter Z116. These signals are effectively shifted or translated to produce an output frequency range from 1.6 to 29.99999 MHz, depending upon the selected rf output frequency.

The 10 to 10.99999 MHz selectable frequency range input is applied to balanced mixer Q12, developed across the tuned collector tank circuit, T12/C81, and coupled to the balanced modulator consisting of T12 secondary, Balance Adjust potentiometer R71 and matched HP8403 diodes CR4 and CR5. With the 3 MHz input coupled to the balanced modulator via transformer T14 and C50, diode CR5 of the modulator outputs the sum, difference and two original frequencies to tuned coupling transformer T13 in the 13 to 13.5 MHz circuit, and 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, 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 13.99999 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 is not used in the VOX-7. Ordinarily, the ALDC circuit supplies each half of the 13 to 13.99999 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 13.99999 MHz amplifier sections.

The 40 MHz input from spectrum generator Z101 is applied 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 HP8403 diodes CR1 and CR2. As a result, the 120 MHz signal is modulated by the 13 to 13.99999 MHz signal from the secondary of transformer T18, resulting in the sum, difference and two original frequencies. With the secondary of transformer T7 tuned to the sum frequency, a signal range of 133 to 133.99999 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 through capacitor C10 to the cathode of mixer diode CR3, thereby resulting in a difference frequency range of 1.0 to 29.99999 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 sharp frequency rolloff below 1.6 MHz; thus, a 1.6 to 29.99999 MHz frequency range results and is coupled through C66 to 1.6 to 29.99999 MHz output amplifier

Q11. The collector output developed across autotransformer T11 is coupled through C70 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.

g. RF OUTPUT Z115 AND METERING CIRCUIT. (See figures 7-1 and 7-11.) RF output Z115 consists of three rf stages, Q1 through Q3. The 1.6 to 29.99999 MHz input frequency range from the RF OUTPUT control is applied 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 29.99999 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 rectifies the negative half-cycle; the positive half-cycle is then filtered to produce a dc level proportional to the amplitude of the rf output. This level is supplied to MONITOR meter M101 when METER switch S111 is in the RF position.

In the metering circuit (figure 7-1), +30 vdc and +24 vdc from the power supply assembly is coupled to METER switch S111B and through dropping resistors R107 through R109 to S111A and to rf output circuit Z115. Therefore, MONITOR 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 S111 is set to the Q1 (350 ma), Q2 (130 ma) or Q3 (65 ma) position. Potentiometer R106 provides a means of calibrating MONITOR meter M101. In all other positions (IFO, BFO and RF) of switch S111, one side of MONITOR meter M101 is returned to ground through S111A, while S111B connects the other side of the meter to the respective IFO, BFO or RF output. In these positions, the MONITOR meter displays relative amplitude of the output signals.

h. OUTPUT FILTER Z114. (See figure 7-12.) Output filter Z114 contains six relay-controlled bandpass filters, with each relay returned to the appropriate positions on the 10 MHz (S107), 1 MHz (S106) and 100 kHz (S104) switches relative to the selected rf output frequency. As a result, the switch-selected frequency 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 - 29.99999 MHz

i. POWER SUPPLY ASSEMBLY. (See figures 7-13 through 7-15.) Three subassemblies are incorporated into the power supply; namely, rectifier and filter capacitor board (A) Z304, regulator Z303, and heat sink Z305. (See figure 7-13.) 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 7-15). The rectified output voltage of 50 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 7-15) 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, cause respective 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. As a result, the +24 vdc and +30 vdc outputs are maintained at relatively nominal values. 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 7-13) is applied to output filter Z114 and to METER switch S111; the +24 vdc and +12 vdc outputs are applied to POWER-STANDBY 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 VOX-7. 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 downtime and the possibility of compromising important schedules. Paragraph 5-3b presents a listing of test equipment required for VOX-7 maintenance.

a. INSPECTION AND TEST. The following paragraphs describe equipment inspection and power supply checks to be performed on a weekly basis. Daily checks should be performed at the beginning of each operating day.

(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 VOX-7.

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	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.
Main Chassis Assemblies (cont)	4. Check printed circuit board jacks for tightness against chassis. 5. Check ground connections for security.
Front and Rear Panels	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 power supply checks on a weekly basis as follows:

(a) Check that line power cord is not plugged into 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 ±5%.

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

(f) Check voltage at pin of Z303; voltage should be +30 vdc ±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 checkout procedure for the VOX-7 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 VOX-7 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 of 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 VOX-7 are contained on 14 PC boards (15 with BFO option) 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 VOX-7 and in other TMC equipment, although they are assigned different "Z" 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 VOX-7 will usually manifest itself by lack of, or improper reading on the MONITOR meter, and can be quickly localized to a particular printed circuit board by the logical process of elimination. If a second VOX-7 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 VOX-7; 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 power supply voltages as outlined in paragraph 5-1 a. (2). If lamp is illuminated, proceed to step 2.

TABLE 5-2. TROUBLESHOOTING CHART
(Continued)

Step	Trouble	Probable Cause	Remedy
2	No rf output at any selected frequency. (continued)	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, replace Q1, Q2 or Q3 on rf output Z115 as indicated by meter reading.
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. Troubleshoot 1 MHz spectrum generator and 1 MHz square-wave generator on Z101.
6		Check for 100 kHz spectrum output at pin D of Z101.	If present, proceed to step 7. Troubleshoot 100 kHz spectrum generator channel on Z101.
7		Check for 1.6 to output 29.99999 MHz input to 1.6 to 29.99999 from MHz amplifier Q11 on translator Z112.	Replace 1.6 to 29.99999 MHz amplifier Q11.

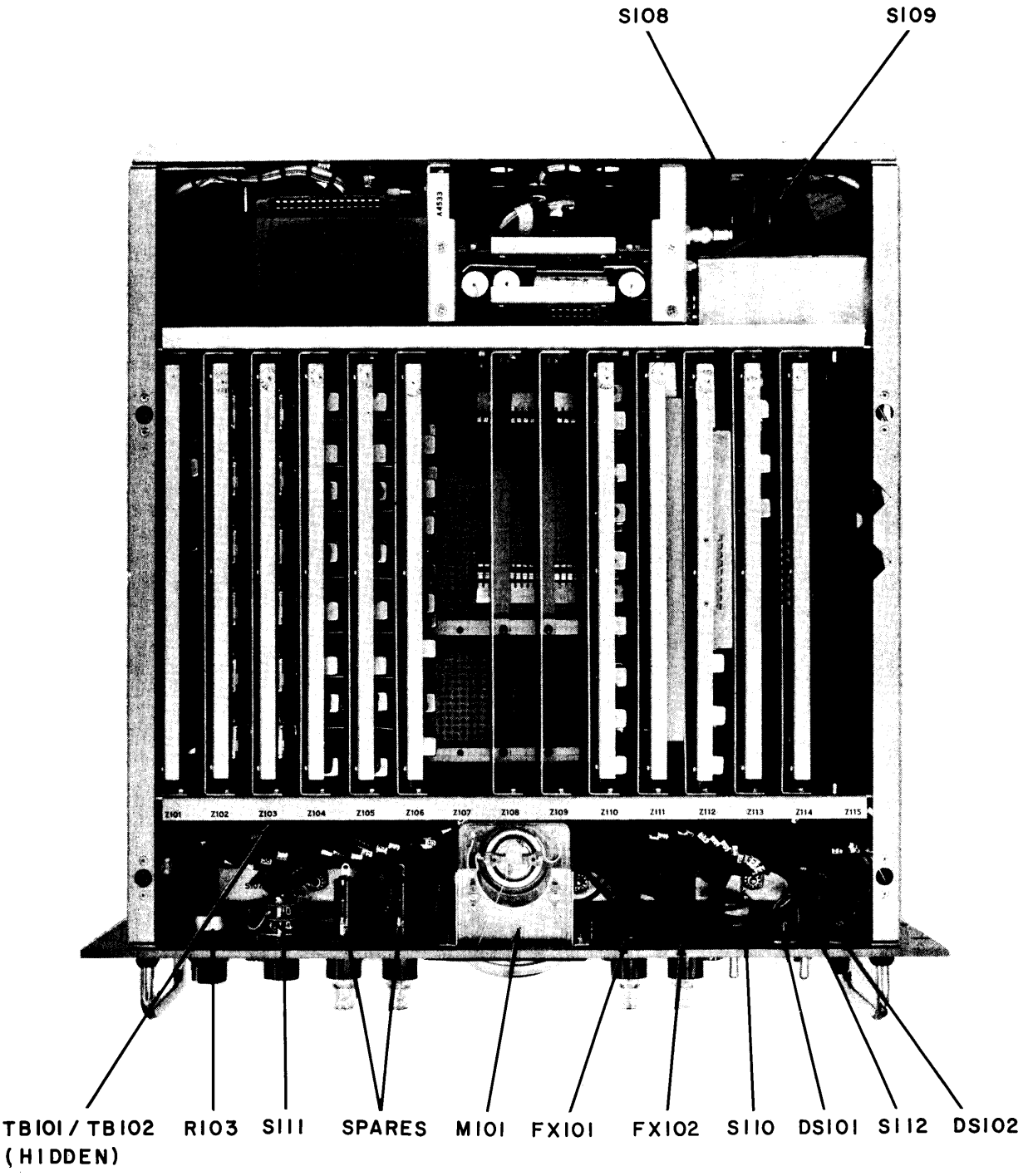


Figure 5-1. VOX-7, Top View, Location of Major Components

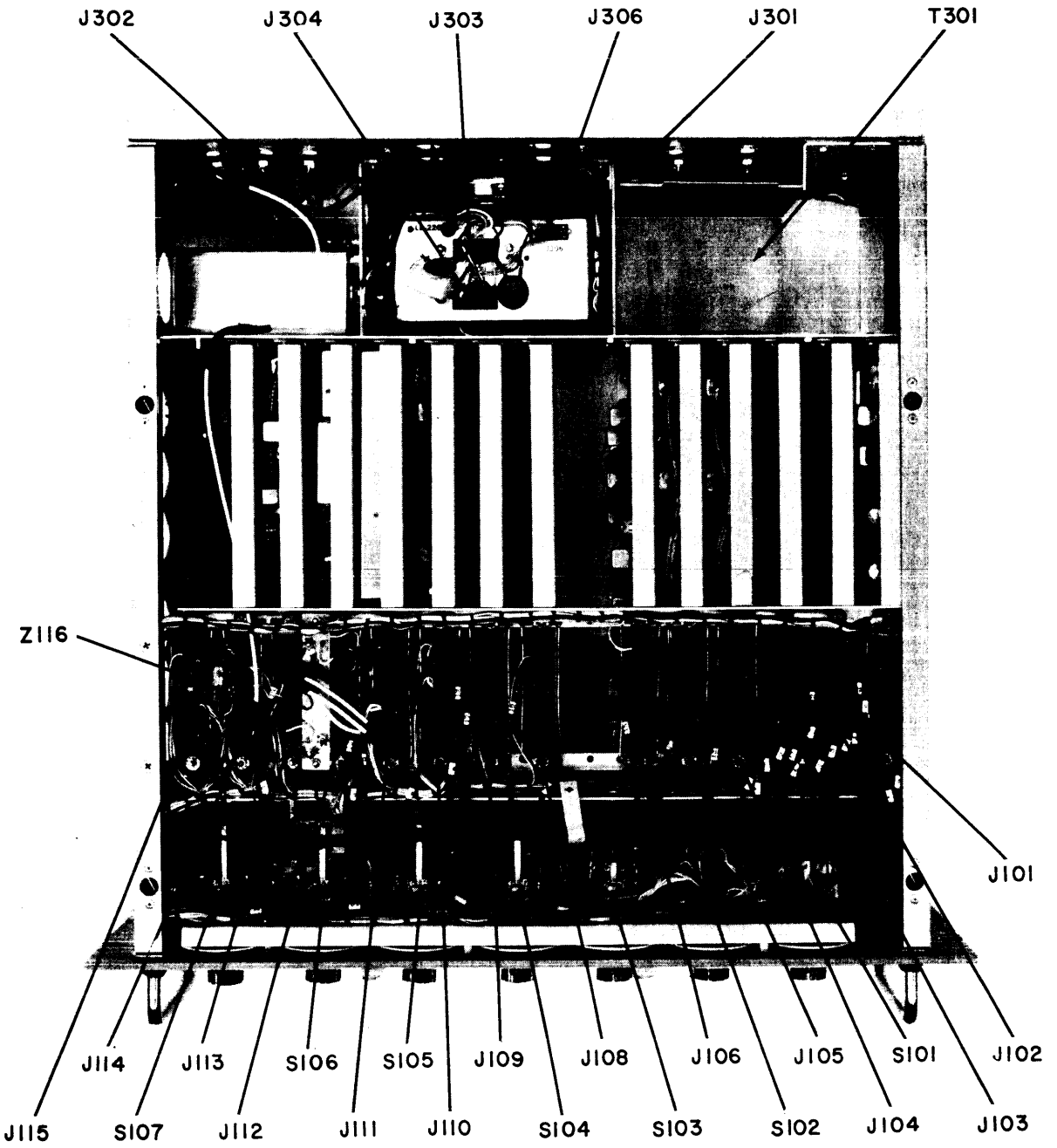


Figure 5-2. VOX-7, Bottom View, Location of Major Components

5-3. ALIGNMENT

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

b. EQUIPMENT REQUIRED. The following equipment is required for complete alignment of the Oscillator:

Signal Generator H.P. Model 606A
Scope Tektronix Model 541A, or equivalent
Spectrum Analyzer Lovoie Laboratories Inc., Model LA-40A, or equivalent
Audio Generator H.P. 200CD, or equivalent
30V, DC Power Supply
Telonic D-550 Attenuator, or equivalent
Millivolt Meter, Millivac MV-28B, or equivalent
VTVM Hewlett-Packard Model 410B, or equivalent
Voltmeter Simpson 260A, 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 indicator shall illuminate amber.

(2) Position ON/STANDBY switch to ON. POWER indicator shall illuminate red and STANDBY indicator shall extinguish.

(3) On board Z303, adjust potentiometer R3 and R12 fully clockwise.

(4) Connect voltmeter between J304-G (ground) and J304-A. Voltmeter shall indicate approximately 40 vdc.

(5) On board Z303, connect voltmeter to J303-E. Voltmeter shall indicate approximately 20 vdc.

(6) Connect voltmeter to J303-A. Voltmeter shall indicate approximately 40 vdc.

(7) Connect voltmeter between J303-F and ground. Adjust potentiometer R8 to obtain an indication of 12.3 vdc on voltmeter.

(8) Remove voltmeter from J303-F and connect oscilloscope. Maximum ac ripple shall not exceed 5 mv.

(9) Adjust potentiometer R3 until voltage level starts to drop, then back up slightly to obtain full voltage.

(10) Connect voltmeter between J303-4 and ground. Adjust potentiometer R18 to obtain an indication of 24.0 vdc on voltmeter.

(11) Remove voltmeter from J303-4 and connect oscilloscope. Maximum ac ripple shall not exceed 2 mv.

(12) Adjust potentiometer R12 until voltage level starts to drop, then back off to obtain full voltage.

(13) Connect voltmeter between J301-E and ground. Voltmeter shall indicate 30 vdc ±1 vdc.

(14) Position ON/STANDBY switch to STANDBY.

(15) Position METER switch to Q1.

(16) Connect ammeter to J115-J as shown in figure 5-3.

(17) Adjust potentiometer R106 (located at rear of METER switch) for an equal indication on MONITOR meter and voltmeter.

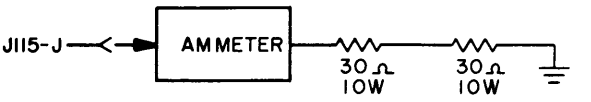


Figure 5-3. Power Supply Board Test Setup

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

(1) Position INT/EXT STD switch (located on rear panel) to INT.

(2) Connect oscilloscope between J101-A and ground. Adjust tuned transformer T1 for maximum output on oscilloscope.

(3) Connect oscilloscope between J101-3 and ground. Adjust level potentiometer R60 for 0.6 volt peak-to-peak.

(4) Connect oscilloscope to TP2 (collector of transistor Q3). Oscilloscope shall display a 1 MHz spectrum of 1.5 volts peak-to-peak.

(5) Connect oscilloscope to J101-D. Oscilloscope shall display a 100 kHz spectrum of 1.0 volt peak-to-peak.

(6) Using 10 MHz frequency selector switches, set rf frequency between 10 and 10 MHz. Set remaining frequency selector switches to blank position.

(7) Connect oscilloscope between TP3 and ground. Adjust tuned transformer T2 and variable capacitor C12 for maximum output.

(8) Connect oscilloscope between J101-8 and J101-J (ground). Set frequency between 11 and 20 MHz. Adjust tuned transformer T3 for maximum output (minimum 0.3 volt peak-to-peak).

(9) Connect oscilloscope between TP6 and ground. Adjust tuned transformer T8 and variable capacitor C50 for maximum output.

(10) Connect oscilloscope between J101-P and J101-R (ground). Adjust tuned transformer T9 for maximum output (0.3 volt peak-to-peak).

(11) Connect oscilloscope between TP9 and ground. Adjust tuned transformer T10 and variable capacitor C73 for maximum output.

(12) Connect oscilloscope between J101-5 and J101-15 (ground). Adjust tuned transformer T11 for maximum output.

(13) Connect oscilloscope between TP5 and ground. Set frequency between 0 and 10 MHz. Adjust tuned transformer T6 and variable capacitor C36 for maximum output.

(14) Connect oscilloscope between J101-3 and J101-12 (ground). Adjust tuned transformer T7

for maximum output. Output level shall be approximately 0.4 volt minimum.

(15) Connect spectrum analyzer to J101-11 and J101-10. Adjust variable capacitor C86 and C89 for maximum output (approximately 70 mv peak-to-peak).

(16) Connect oscilloscope between TP4 and ground. Adjust tuned transformer T4 and variable capacitor C27 for maximum output at all positions of MHz switch.

(17) Connect oscilloscope between J101-L and J101-K (ground). Adjust tuned transformer T5 for maximum output (approximately 1.5 volts peak-to-peak minimum).

e. COMB FILTER Z102. Before performing the following alignment procedure, set the 100 Hz, 1 kHz, 10 kHz and 100 kHz frequency selector switches to blank position.

(1) Connect oscilloscope between TP11 and ground. Adjust tuned transformer T11 and variable capacitor C54 for maximum output.

(2) Connect oscilloscope between J102-S and J102-15 (ground). Adjust transformer T12 for maximum output. Adjust potentiometer R42 for 0.7 volt peak-to-peak output.

(3) Connect oscilloscope between TP9 and ground. Adjust tuned transformer T9 and variable capacitor C43 for maximum output.

(4) Connect oscilloscope between J102-14 and J102-R (ground). Adjust transformer T10 for maximum output. Adjust potentiometer R35 for 0.7 volt peak-to-peak.

(5) Connect oscilloscope between TP7 and ground. Adjust tuned transformer T7 and variable capacitor C32 for maximum output.

(6) Connect oscilloscope between TP8 and ground. Adjust transformer T8 for maximum output. Adjust potentiometer R28 for 0.7 volt peak-to-peak.

(7) Connect oscilloscope between TP5 and ground. Adjust tuned transformer T5 and variable capacitor C22 for maximum output.

(8) Connect oscilloscope between TP6 and ground. Adjust transformer T6 for maximum output. Adjust potentiometer R21 for 0.7 volt peak-to-peak.

(9) Connect oscilloscope TP4 and ground. Adjust tuned transformer T3 and variable capacitor C11 for maximum output.

(10) Connect oscilloscope between TP3 and ground. Adjust transformer T4 for maximum output. Adjust potentiometer R14 for 0.7 volt peak-to-peak.

(11) Connect oscilloscope between TP1 and ground. Adjust tuned transformer T2 and variable capacitor C10 for maximum output.

(12) Connect oscilloscope between TP2 and ground. Adjust transformer T1 for maximum output. Adjust potentiometer R3 for 0.7 volt peak-to-peak.

f. COMB FILTER Z103. Align comb filter Z103 following the alignment procedure given for comb filter Z102 (paragraph e.).

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

(1) Connect oscilloscope probe from cathode of diode CR1 to ground.

(2) Ground 10 Hz frequency selector switch. Adjust tuned transformer T1 for maximum output.

(3) Connect oscilloscope to TP1. Adjust potentiometer R9 for minimum output. Output at cathode of diode of CR1 shall be 0.5 volt peak-to-peak minimum. Remove ground from 10 Hz frequency selector switch.

(4) Connect oscilloscope between cathode of diode CR3 and ground.

(5) Set 1 kHz frequency selector switch to blank position. Set 100 Hz frequency selector switch to 5. Adjust transformers T2 through T6 for maximum output.

(6) Connect oscilloscope between TP5 and ground and adjust potentiometer meter R23 for minimum output. Output at cathode of diode shall be 0.5 volt peak-to-peak minimum as 10 Hz frequency selector switch is rotated from 0 through 9.

(7) Set 100 Hz frequency selector switch to blank position.

(8) Connect signal generator to TP5 through a 220-ohm resistor; terminate line with a 47-ohm resistor. Adjust signal generator output for 10.4 MHz.

(9) Connect oscilloscope to TP5. Short TP6 to ground and adjust transformer T7 for maximum output.

(10) Remove short from TP6 and adjust transformer T8 for minimum output.

(11) Connect oscilloscope to TP7 and short TP8 to ground.

(12) Adjust transformer T9 for maximum output. Remove short from TP8 and adjust transformer T10 for minimum output.

(13) Connect oscilloscope to TP9 and adjust transformer T11 for maximum output. With a signal generator input of 10 mv, the output shall be 0.2 volt peak-to-peak over frequency range of 10 MHz to 11 MHz.

(14) Disconnect signal generator.

(15) Connect probe of oscilloscope at junction of coil L4 and resistor R46. With the 100 Hz frequency selector switch on position 5, the output shall be 0.6 volt peak-to-peak as the 10 Hz frequency selector switch is rotated from 0 through 9.

(16) Rotate 1 kHz frequency selector switch to blank position.

(17) Connect oscilloscope between cathode of CR6 and ground. Adjust transformer T12 for maximum output.

(18) Connect oscilloscope probe to TP10. Adjust R54 for minimum output. Output at cathode of diode CR6 shall be 0.5 volt peak-to-peak.

(19) Connect oscilloscope between cathode of diode CR4 and ground. Set 1 kHz frequency selector switch to position 5. Adjust transformer T13, T14, T15, T16 and T17 for maximum output.

(20) Connect oscilloscope to TP14. Adjust potentiometer R69 for minimum output. Output at cathode of diode CR8 shall be 0.5 volt peak-to-peak minimum as the 100 Hz frequency selector switch is rotated from 0 through 9.

(21) Set 1 kHz frequency selector switch to blank position.

(22) Connect signal generator to TP14 through a 220-ohm resistor; terminate line with 47-ohm resistor. Adjust signal generator output for 10.4 MHz.

(23) Connect oscilloscope to TP14. Short TP15 to ground and adjust T18 for maximum output.

(24) Remove short and adjust T19 for minimum output.

(25) Connect oscilloscope to TP16 and short TP17 to ground. Adjust transformer T20 for maximum output.

(26) Remove short from TP17 and adjust transformer T21 for minimum output.

(27) Connect oscilloscope between TP18 and ground. Adjust transformer T22 for maximum output. With a signal generator input of 10 mv, the output shall be 0.2 volt peak-to-peak minimum over the range of 10 MHz to 11 MHz.

(28) Disconnect signal generator and set 1 kHz frequency selector switch to position 5.

(29) Connect oscilloscope J104-15 and J104-R (ground).

(30) Rotate 100 Hz and 10 Hz frequency selector switches from blank position to position 9. Output shall be 0.6 volt peak-to-peak over a frequency variation from 1.0 to 1.0999 MHz.

h. MIXER/DIVIDER Z105. Align mixer-divider Z105 using the 10 kHz and 1 kHz frequency selector switches and following the procedure contained in paragraph g.

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

(1) Connect oscilloscope between cathode of diode CR2 and ground. Rotate 10 kHz frequency selector to blank position. Rotate 100 kHz switch to position 5. Adjust transformer T1 for maximum output.

(2) Connect oscilloscope between TP1 and ground. Adjust potentiometer R7 for minimum output.

(3) Output at cathode of diode CR2 shall be 0.5 volt peak-to-peak minimum.

(4) Adjust transformer T2 through T6 and T13 for maximum output.

(5) Short J106-H to J106-E. Connect oscilloscope between junction of diodes CR4/CR3 and ground. Adjust potentiometer R18 for minimum output. Output at cathode of diode CR3 shall be 0.5 volt peak-to-peak minimum.

(6) Rotate 10 kHz frequency selector switch to blank position. Connect signal generator to TP5 through a 220-ohm resistor. Connect ground lead to ground.

(7) Adjust signal generator for 10.4 MHz. Rotate 100 kHz switch to position 4.

(8) Connect oscilloscope between TP5 and ground. Short TP7 to ground. Adjust transformer T7 for maximum output.

(9) Remove short from TP7 and adjust transformer T8 for minimum output. Adjust transformer T10 for minimum output.

(10) Connect oscilloscope between TP8 and ground. Short TP9 to ground.

(11) Adjust transformer T9 for maximum output.

(12) Remove short from TP9 and adjust transformer T10 for minimum output.

(13) Remove translator Z112 from Oscillator. Connect a 47-ohm resistor between J106-12 and J106-13.

(14) Connect oscilloscope between TP10 and ground. Short secondary of transformer T12.

(15) Rotate 100 kHz frequency selector switch to position 5. Adjust signal generator for a frequency of 10.75 MHz.

(16) Adjust transformer T11 for maximum output. Remove short from transformer T12 and adjust transformer T12 for minimum output.

(17) Rotate 100 kHz frequency selector switch to position 4. Adjust signal generator frequency for 10.1 MHz. Short secondary of transformer T12.

(18) Adjust variable capacitor C36 for maximum output. Remove short from transformer T12 and adjust variable capacitor C48 for minimum output.

(19) Connect oscilloscope across the 47-ohm resistor (step 13). Set signal generator for 10.5 MHz, 100 mv output.

(20) Rotate 100 kHz frequency selector switch to position 4. Output shall be 0.2 volt peak-to-peak with generator frequency of 10 MHz to 10.5 MHz.

(21) Rotate 100 kHz frequency selector switch to position 5. Output shall be 0.2 volt peak-to-peak with a frequency input of 10.5 MHz to 11 MHz.

(22) Remove signal generator input and rotate 10 kHz frequency selector switch to position 5. Remove short from J106-H and J106-E.

(23) Rotate 100 kHz frequency selector switch from blank position to position 9. Output shall be 0.2 volt peak-to-peak minimum.

(24) Remove 47-ohm resistor from J106-12 and J106-13. Replace translator Z112.

j. STEP GENERATOR Z110. Align step generator Z110 as follows:

(1) Remove comb filters Z102 and Z103 from Oscillator. Set frequency selector switches to 03.000 MHz.

(2) Connect oscilloscope between collector of transistor Q1 and ground. Adjust potentiometer R1 for maximum level.

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

(4) Connect oscilloscope between collector of transistor Q1 and ground. Adjust potentiometer R1 for a level of 2 volts peak-to-peak.

(5) Connect oscilloscope between junction of diodes CR1/CR2 and ground. Adjust potentiometer R7 for minimum level.

(6) Connect test equipment as shown in figure 5-4.

(7) Set signal generator frequency to 1.05 MHz and output level to 100 mv peak-to-peak.

(8) Connect oscilloscope to J110-R and adjust potentiometer R28 for a level of 0.4 volt peak-to peak.

(9) Short Secondary transformer T3.

(10) Connect millivac model MV-28B millivoltmeter at junction of resistor R8 and capacitor C8.

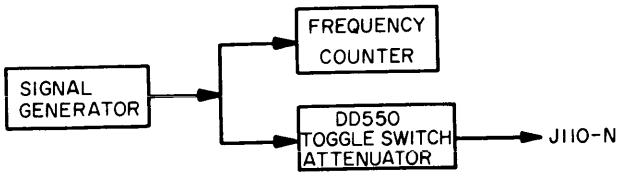


Figure 5-4. Step Generator Z110, Test Setup

(11) Adjust transformer T2 for maximum level indication on millivoltmeter.

(12) Remove short from transformer T3. Adjust T3 for dip or minimum indication on millivoltmeter.

(13) Repeat steps 10 through 12, using transformer T5 and collector of Q2 for step 10; transformer T4 for step 11; and transformer T5 for step 12.

(14) Repeat steps 10 through 12, using transformer T7 and collector of Q3 for step 10; transformer T6 for step 11; and transformer T7 for step 12.

(15) Connect oscilloscope between J110-5 and ground. Adjust transformer T8 for maximum level indication.

(16) Vary frequency of signal generator from 0.8 MHz to 1.2 MHz. Output shall be approximately 2 volts peak-to-peak at frequency of 13.2 MHz to 12.8 MHz correspondingly.

(17) Adjust signal generator to 1.55 MHz. Set frequency selector switches to 07.0000 MHz.

(18) Repeat steps 10 through 12, using transformer T11 and junction of resistor R9 and capacitor C9 for step 10; transformer T10 for step 11; and transformer T11 for step 12.

(19) Repeat steps 10 through 12, using transformer T13 and collector of transistor Q6 for step 10; transformer T12 for step 11; and transformer T13 for step 12.

(20) Repeat steps 10 through 12, using transformer T15 and collector of transistor Q7 for step 10; transformer T14 for step 11; and transformer T15 for step 12.

(21) Repeat steps 15 and 16, using transformer T16 for step 15. Use 1.3 MHz to 1.7 MHz and 12.7 MHz to 11.3 MHz for step 16.

(22) Remove oscilloscope from J110-5. Adjust frequency selector switches on front panel to 13.0000 MHz.

(23) Repeat steps 2 through 6, using resistor R61 and collector of Q9 for step 2; diode CR3 and transformer T17 for step 3; resistor R61 and collector of transistor Q9 for step 4; and diodes CR3/CR4 and resistor R67 for step 5.

(24) Repeat steps 10 through 12, using transformer T19 and junction of resistor R68 and capacitor C80 for step 10; transformer T18 for step 11; and transformer T19 for step 12.

(25) Repeat steps 10 through 12, using transformer T21 and collector of transistor Q10 for step 10; transformer T20 for step 11; and transformer T21 for step 12.

(26) Repeat steps 10 through 12, using transformer T23 and collector of transistor Q11 for step 10; transformer T22 for step 11; and transformer T23 for step 12.

(27) Repeat steps 15 and 16 using pin J110-4 and transformer T24 for step 15; and 0.8 MHz to 1.2 MHz and 12.2 MHz to 11.8 MHz for step 16.

(28) Repeat step 17 using 17.0000 MHz.

(29) Repeat steps 10 through 12, using transformer T26 and junction of R69/C81 for step 10; transformer T25 for step 11; and transformer T26 for step 12.

(30) Repeat steps 10 through 12, using transformer T28 and collector Q13 for step 10; transformer T27 for step 11; and transformer T28 for step 12.

(31) Repeat steps 10 through 12, using transformer T30 and collector of transformer Q14 for step 10; transformer T29 for step 11; and transformer T30 for step 12.

(32) Repeat steps 15 and 16, using J110-4 and transformer T31 for step 15; and 1.3 MHz to 1.7 MHz and 11.7 MHz to 11.3 MHz for step 16.

(33) Replace step generator Z110 in Oscillator.

k. STEP GENERATORS Z111 AND Z113. Align step generators Z111 and Z113 as follows:

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

(2) On Z113, connect oscilloscope at collector of transistor Q14. Adjust potentiometer R78 for maximum level.

(3) Connect oscilloscope at junction of transformer T11 and diode CR1. Adjust transformer T11 for maximum level.

(4) Connect oscilloscope at junction of capacitor C104 and resistor R88. Adjust variable capacitor C101 and resistor R84 alternately until minimum level is obtained.

(5) Connect oscilloscope at collector of transistor Q14. Adjust potentiometer R78 for 2 volts peak-to-peak.

(6) Connect test equipment as shown in figure 5-4. Set signal generator frequency to 1.6 MHz. Set output level to 100 mv peak-to-peak.

(7) Short secondary of transformer T13. 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 short and adjust transformer T13 for dip or minimum indication on meter.

(10) Repeat steps 7 through 9, using transformer T15 and 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 Q16 collector for step 7; transformer T16 for step 8; and transformer T17 for step 9.

(12) Place oscilloscope at J113-N and adjust transformer T18 for maximum level indication.

(13) Vary frequency of signal generator from 1.4 MHz to 1.8 MHz. Output level on oscilloscope

shall be approximately 0.1 volt peak-to-peak minimum at frequency of 10.6 MHz to 10.2 MHz correspondingly.

(14) Adjust signal generator to 1.075 MHz with output level set at 100 mv volts 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 Q18 collector for step 7; transformer T21 for step 8; and transformer T22 for step 9.

(17) Repeat steps 7 through 9, using transformer T24 and Q19 collector for step 7; transformer T23 for step 8; and transformer T24 for step 9.

(18) Repeat steps 12 and 13, using transformer T25 for step 12; and 0.8 MHz to 1.3 MHz and 11.2 MHz to 10.7 MHz for step 13.

(19) Replace comb filters Z102 and Z103 cards into unit.

(20) For card Z111, set frequency selector switches on front panel to 25.0000 MHz. Place millivolt meter on J111-1.

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

(22) Vary frequency selector switches on front panel from 21.0000 MHz to 31.0000 MHz in 1 MHz steps. Minimum level indication on meter shall be .04 volt. If necessary, stagger tune capacitors in step 18.

(23) Repeat steps 20 through 21, using 15.0000 MHz and J111-2 for step 20; C25, C30 and C41 for step 21; and 11.0000 MHz to 20.0000 MHz for step 22.

(24) Repeat steps 20 through 22, using 05.0000 MHz and J111-3 for step 20; C45, C49 and C62 for step 21; and 01.0000 MHz to 10.0000 MHz for step 22.

(25) On board Z113, repeat steps 20, 21, and 22 using 25.0000 MHz and J113-1 for step 20; C10, C16, C22 and C28 for step 21; and 0.4 volt rms for step 22.

(26) Repeat steps 20, 21, and 22 using 15.0000 MHz and J113-1 for step 20; C29, C40, C51 and C56 for step 21; and 0.4 volt rms for step 22.

(27) Repeat steps 20, 21, and 22 using 5.0000 MHz and J113-1 for step 20; C68, C75, C81, and C87 for step 21; and 0.4 volt rms for step 22.

1. TRANSLATOR Z112. Align translator Z112 as follows:

(1) Remove rf output Z115 from Oscillator. Set all frequency selector switches to blank position. Remove step generator Z113 from Oscillator.

(2) Connect test equipment as shown in figure 5-5. Connect signal generator between junction of resistor R73 and R75 and ground.

(3) With full attenuation on the toggle switch attenuator, adjust signal generator for 1 volt output at frequency of 13.30000 MHz. Set 100 kHz switch on front panel to position 3.

(4) Short secondary of transformer T15. Connect Millivac Model MV-28B across primary of transformer T13, observing proper ground. Set meter to 0.01 volt range.

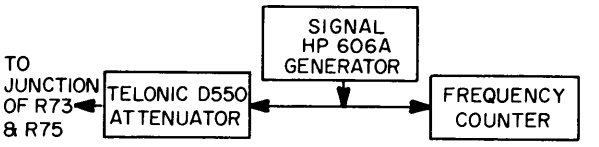


Figure 5-5. Translator Z112, Test Setup

(5) Remove attenuation from telonic attenuator until midscale reading is observed on meter. (Maintain reading on 0.01 scale of meter, using attenuator for the following steps.)

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

(7) Remove short from transformer T15. Adjust T15 for dip on meter.

(8) Short secondary of transformer T17 and connect millivac meter across secondary of transformer T16, observing proper ground.

(9) Change attenuation of telonic attenuator for midscale reading on meter. Adjust transformer T16 for peak indication on meter.

(10) Remove short from transformer T17. Adjust T17 for dip on meter.

(11) Connect meter TP7. Adjust transformer T17 for maximum indication on meter.

(12) Repeat steps 3 through 11, using 13.80000 MHz and position 8 for step 3; T20 and T19 respectively for step 4; T19 for step 6; T20 for step 7; T22 and T21 respectively for step 8; T21 for step 9; T22 for step 10; and TP9 for step 11.

(13) Remove signal generator and set frequency selector switches on front panel to 05.0000 MHz.

(14) Using oscilloscope, check for 10.5 MHz signal at level of 0.2 volt peak-to-peak minimum on J112-H, and for 3 MHz signal of approximately 90 mv peak-to-peak on J112-D.

(15) Adjust potentiometer R71 to mid-position. Tune transformer T12 for maximum indication on meter. (Meter connected to TP7 or TP9.)

(16) Unsolder lead from J112-D. Connect Millivac meter to junction of resistor R73 and R75, observing proper ground.

(17) Adjust potentiometer R71 for minimum indication on meter. Return all frequency selector switches on front panel to blank position.

(18) Using Millivac meter, check for 40 MHz signal at approximately 50 mv level on J122-B.

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

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

(21) Connect spectrum analyzer to TP3. Adjust potentiometer R36 for minimum 120 MHz indication. Reconnect lead to J112-D. Adjust frequency selector switches on front panel to 05.5000 MHz.

(22) Adjust variable capacitor C37 and C42 for maximum 133.5 MHz indication on spectrum analyzer.

(23) Connect spectrum analyzer to TP4. Adjust variable capacitors C48, C42 and C37 for maximum 133.5 MHz indication. Connect analyzer to TP5 and adjust variable capacitors C54, C48, C42 and C37 for maximum 133.5 MHz indication. Connect spectrum analyzer to TP6 and adjust variable capacitor C60, C54, C48, C42, and C37 for maximum 133.5 MHz indication.

(24) Replace step generator Z113. Connect oscilloscope to J112-R. Output level shall be 0.2 volt minimum at a frequency corresponding to the front panel frequency selector switches.

m. RF OUTPUT Z115. Before aligning rf output Z115, remove card from Oscillator and adjust potentiometers R1, R2 and R4 for maximum resistance. Check power supply for correct operating voltages. Reinstall rf output Z115.

(1) Set METER switch to Q1 position.

(2) Adjust potentiometer R4 until MONITOR meter is located in center of green region marked Q1.

(3) Set METER switch to Q2 position.

(4) Adjust potentiometer R2 until MONITOR meter is located in center of green region marked Q2.

(5) Set METER switch to Q3 position.

(6) Adjust potentiometer R1 until MONITOR meter is located in center of green region marked Q3.

(7) Connect a 50-ohm load to RF OUT jack located on rear panel of Oscillator. Connect VTVM across the load. Set frequency selector switches to 29.9999 MHz. Short J115-S to J114-B.

(8) Connect oscilloscope to J115-B.

(9) Adjust front panel RF CONTROL until oscilloscope indicates 100 mv peak-to-peak. VTVM shall indicate 3.55 vac.

(10) Remove short (step 7) insert Z114 into J114. Output shall not vary more than 0.2 volts.

n. OUTPUT FILTER Z114. Output filter Z114 cannot be aligned without a special factory test setup.

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, require 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 schematics contained in Section 7 and located on figures 5-6 through 5-19.

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 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 (space 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.

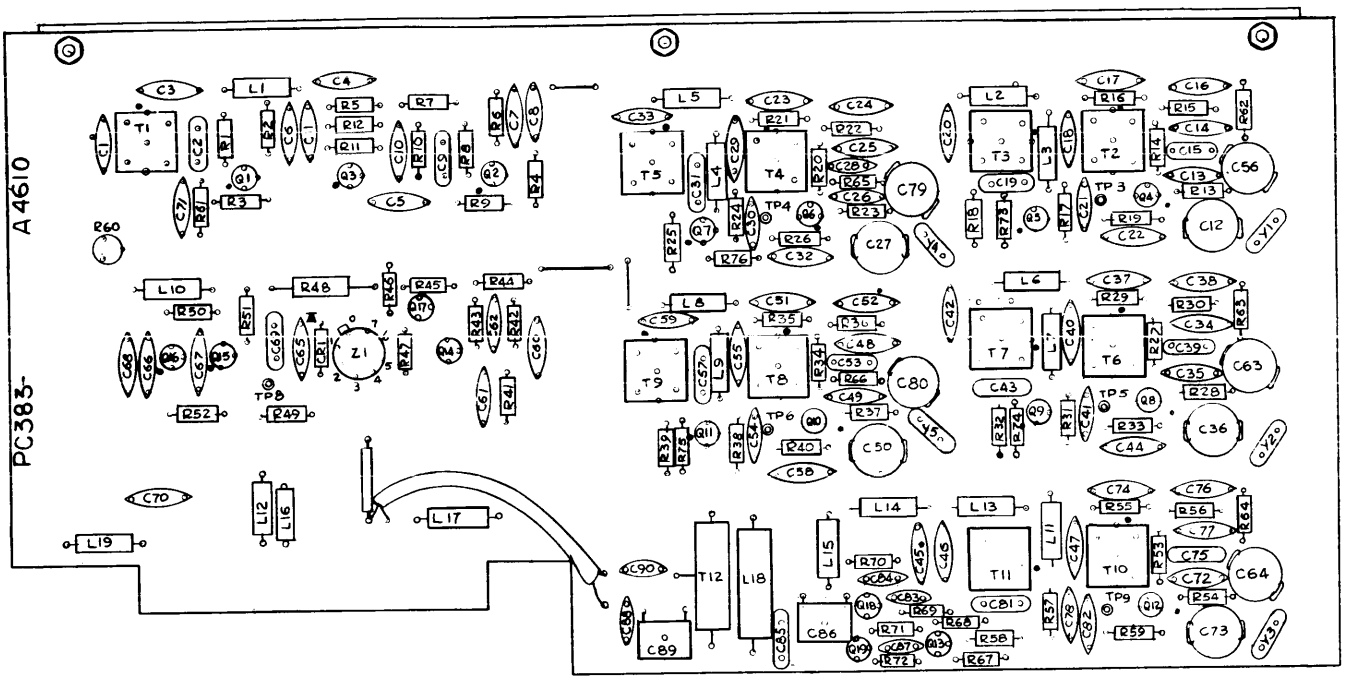


Figure 5-6. Spectrum Generator Z101, Board Component Locations

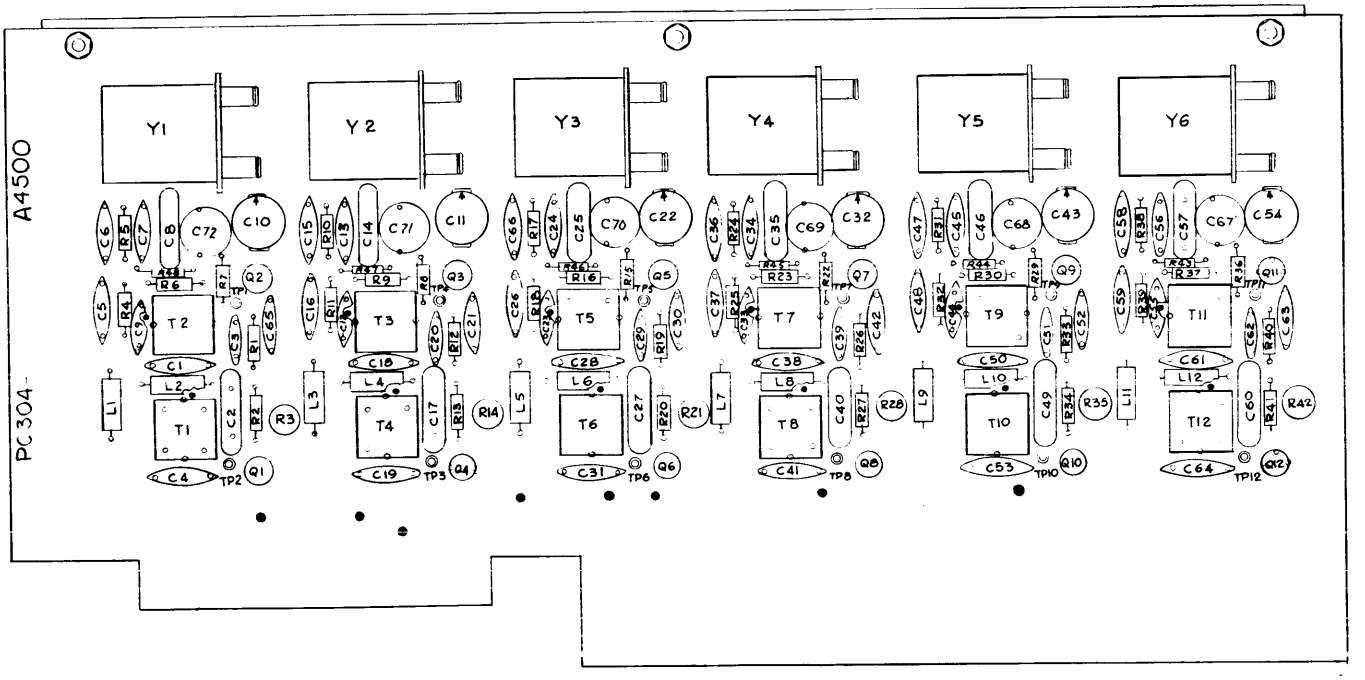


Figure 5-7. Comb Filter A Z102, Board Component Locations

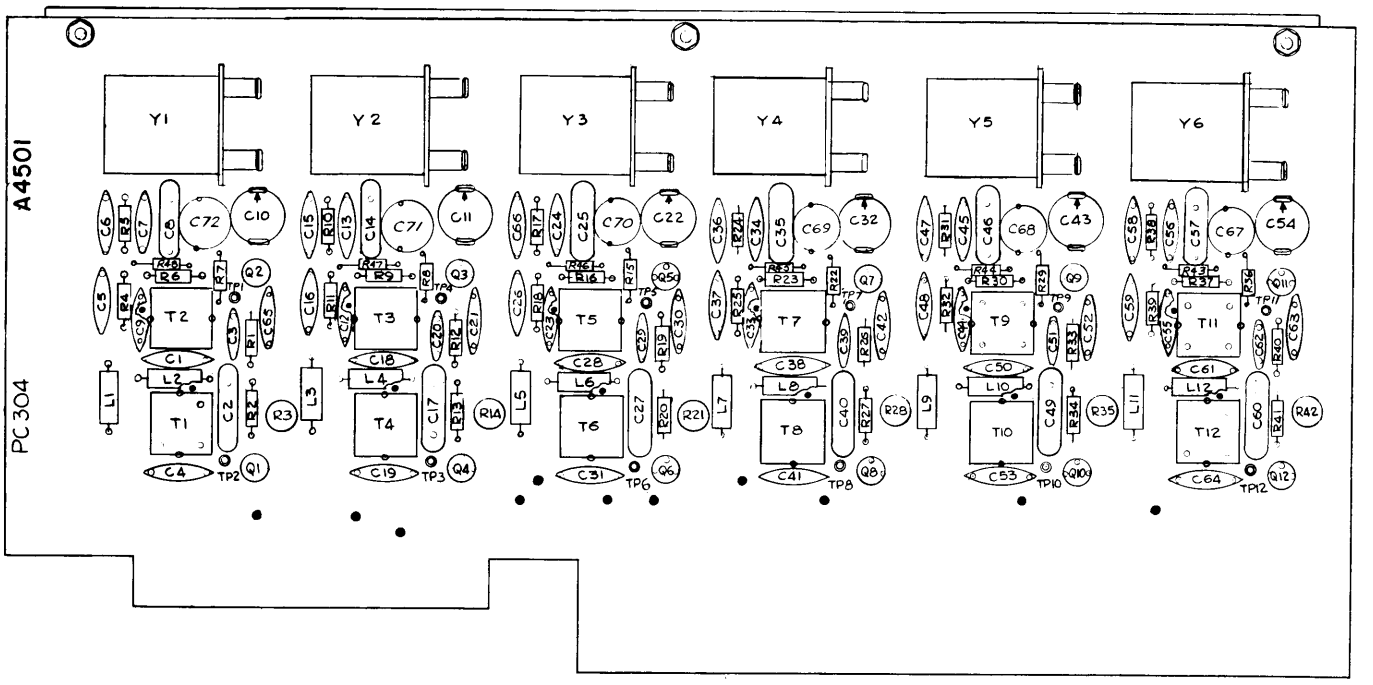


Figure 5-8. Comb Filter B Z103, Board Component Locations

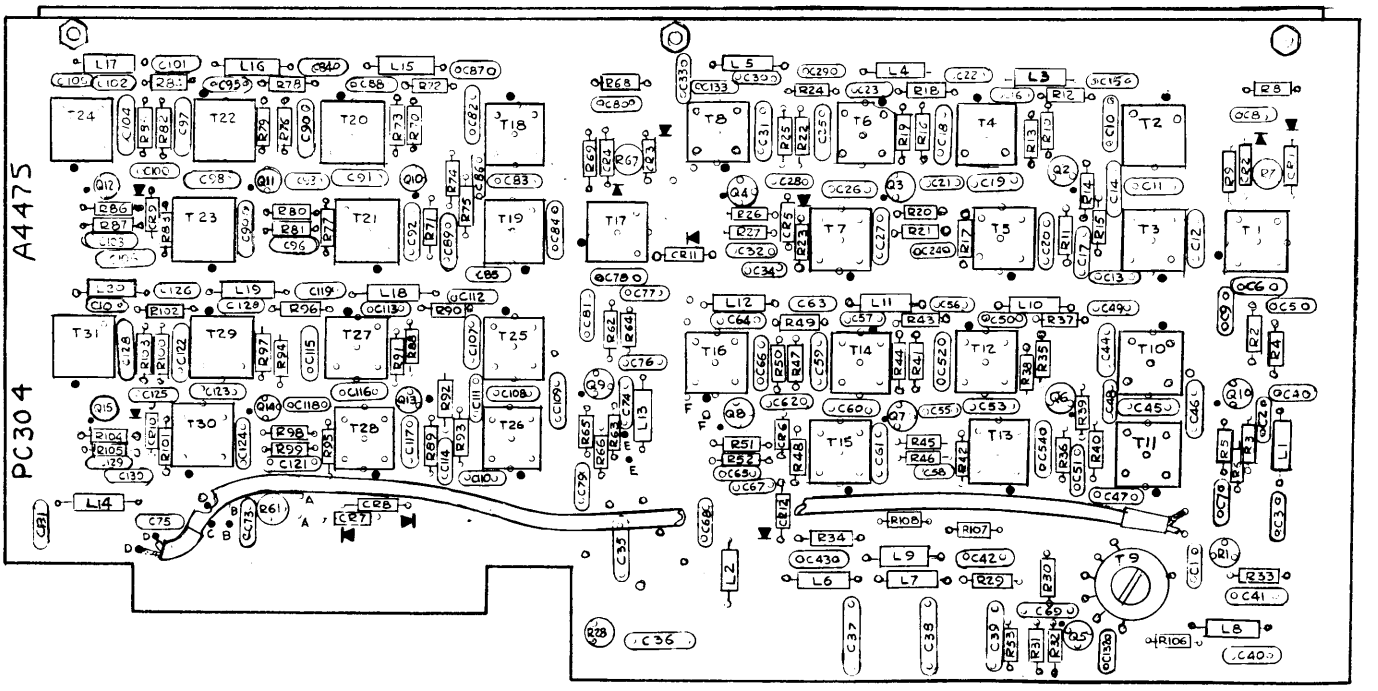


Figure 5-9. Dual Mixer-Dividers Z104 and Z105, Board Component Locations

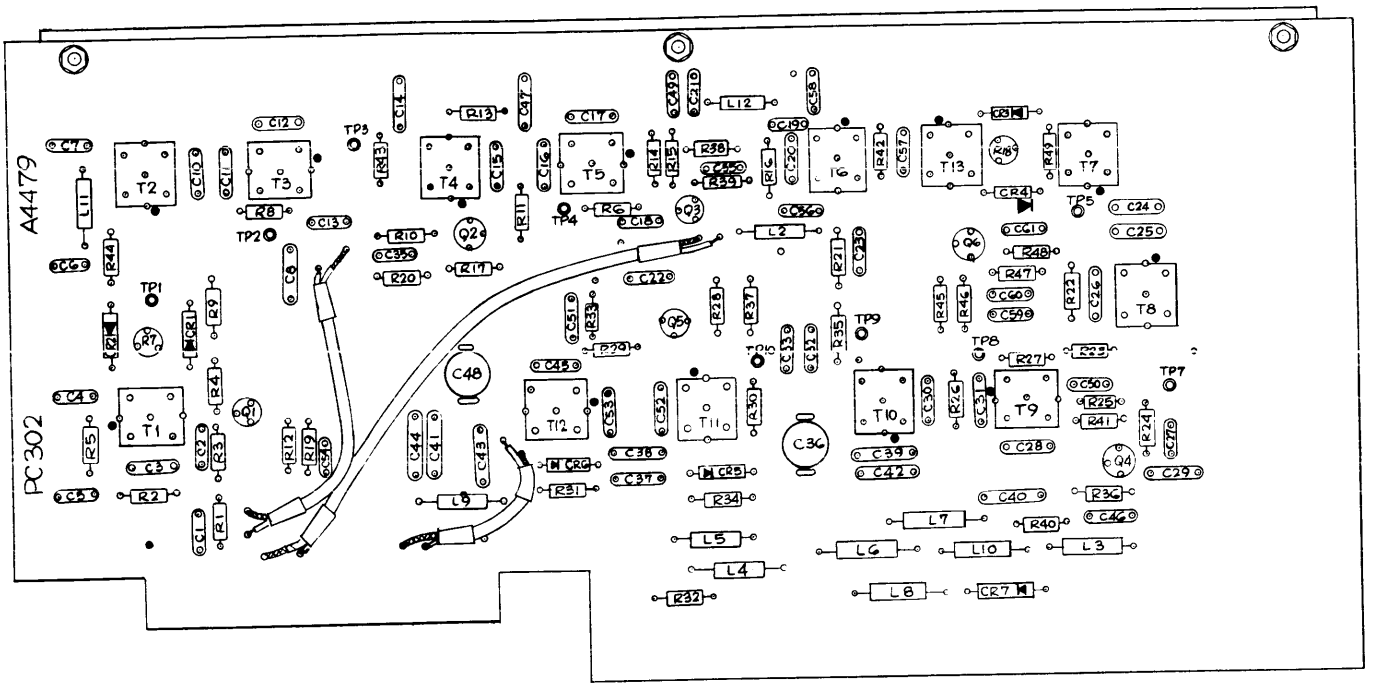


Figure 5-10. Final Mixer Z106, Board Component Locations

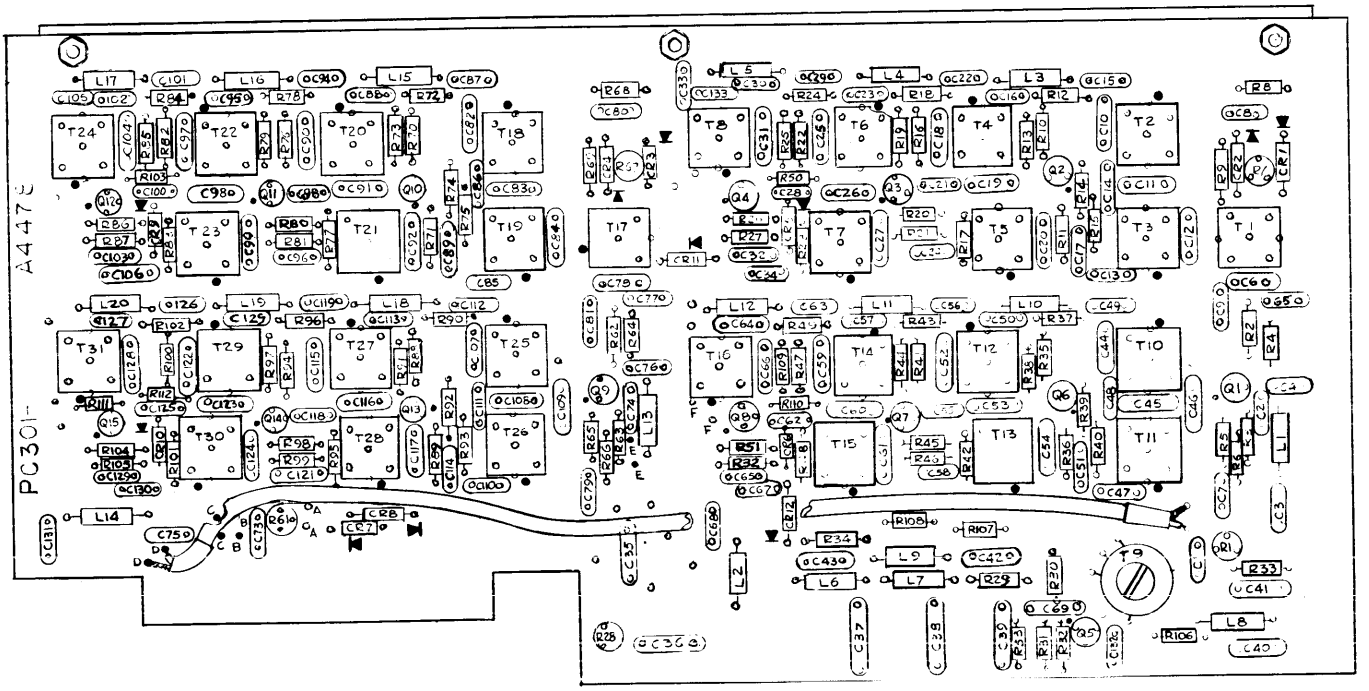


Figure 5-11. Step Generator Z110, Board Component Locations

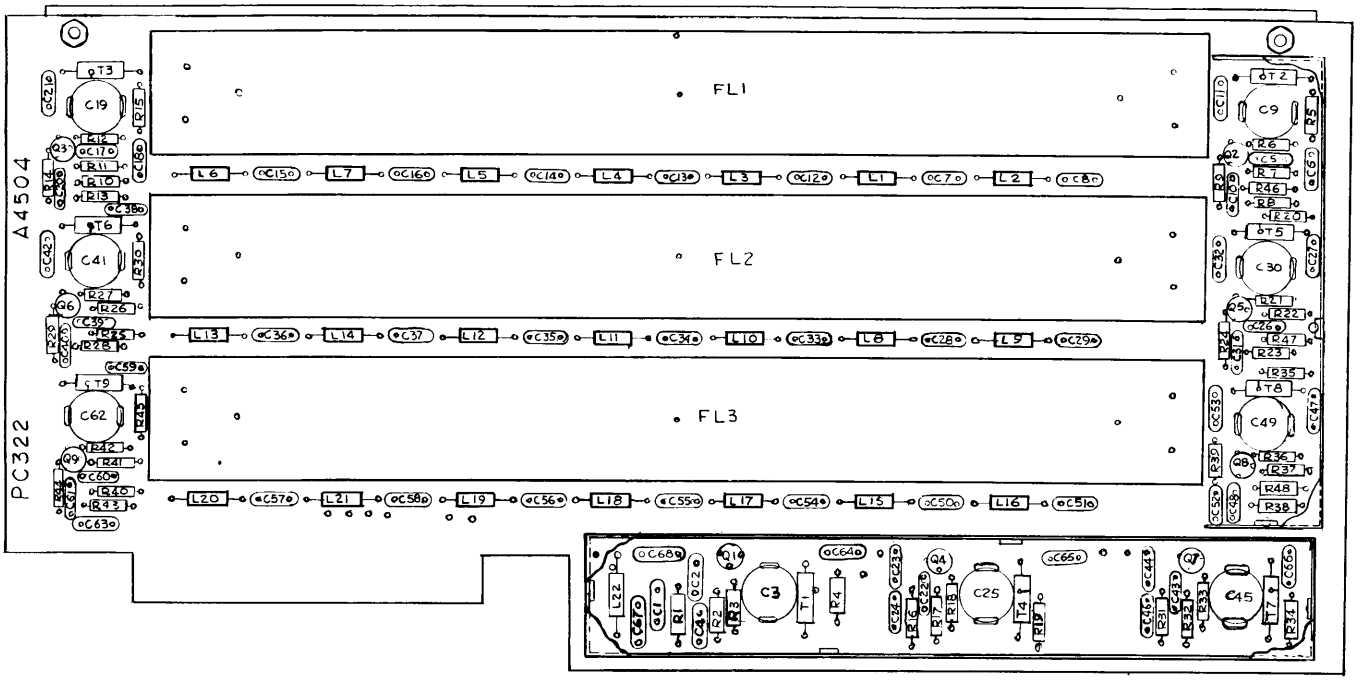


Figure 5-12. Step Generator Z111, Board Component Locations

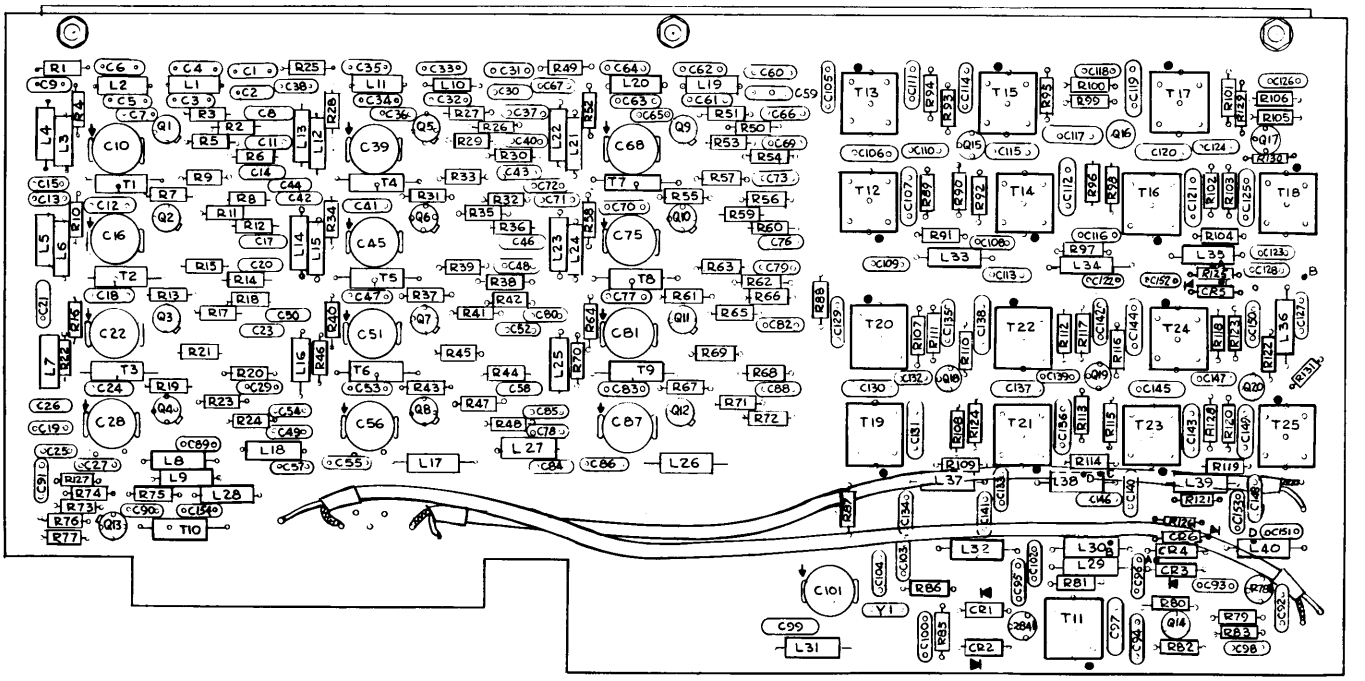


Figure 5-13. Step Generator Z113, Board Component Locations

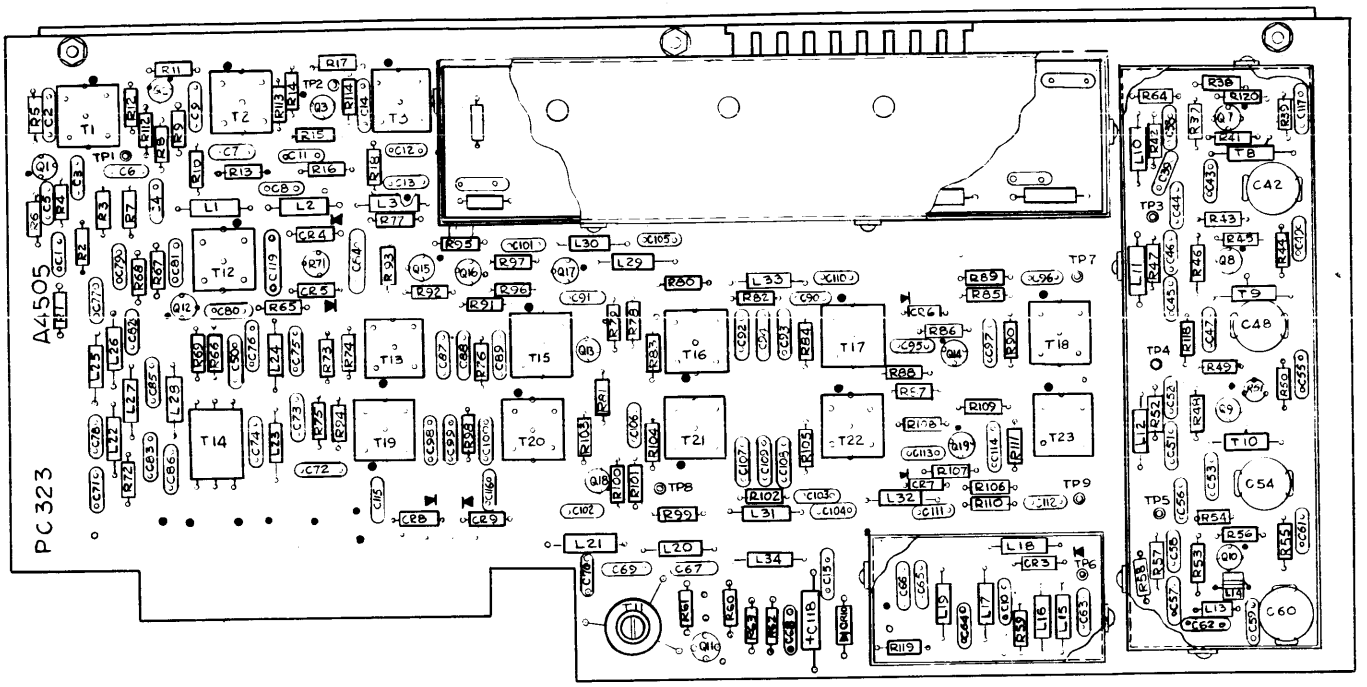


Figure 5-14. Translator Z112, Board Component Locations

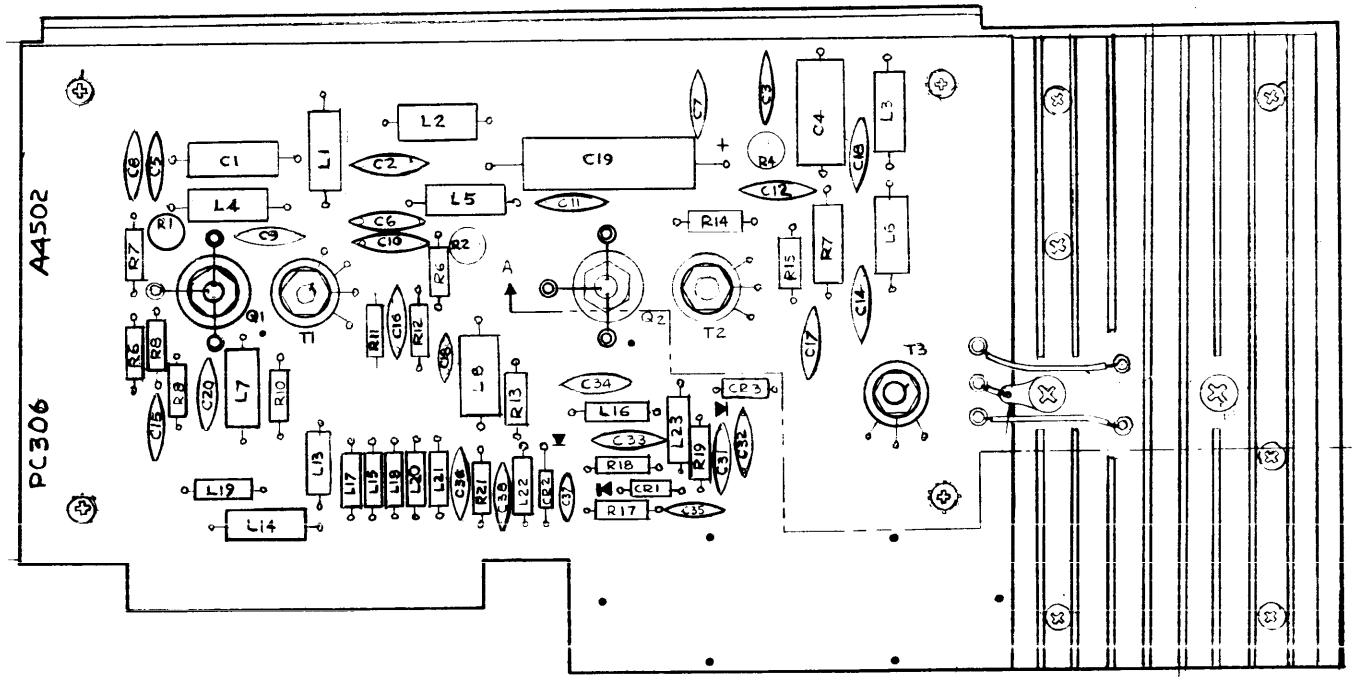


Figure 5-15. RF Output Z115, Board Component Locations

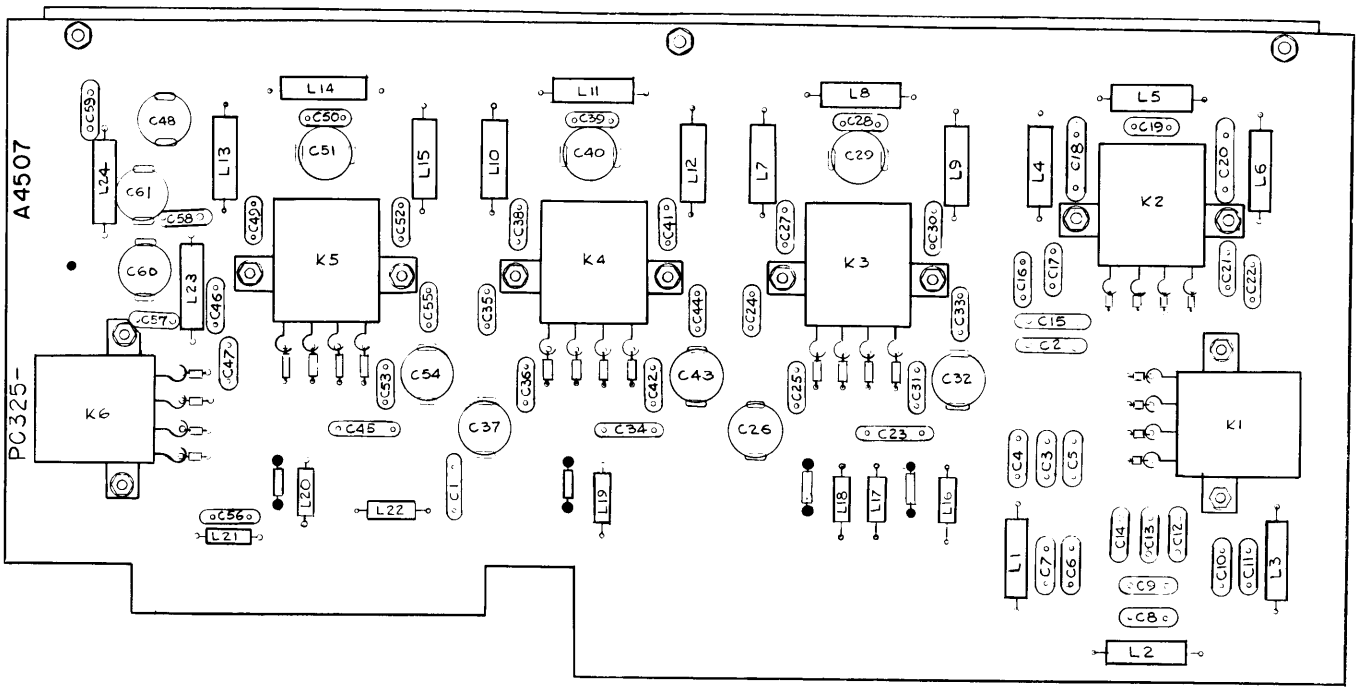


Figure 5-16. Output filter Z114, Board Component Locations

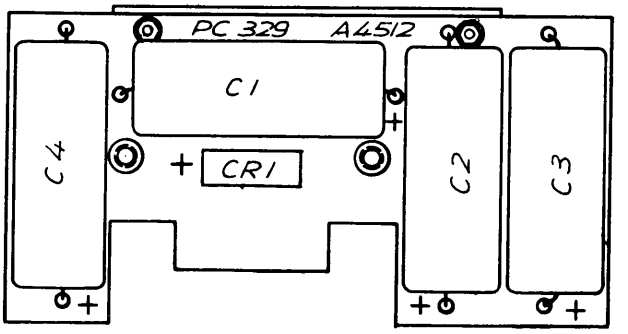


Figure 5-17. Rectifier and Filter Capacitor Board Z304, Board Component Locations

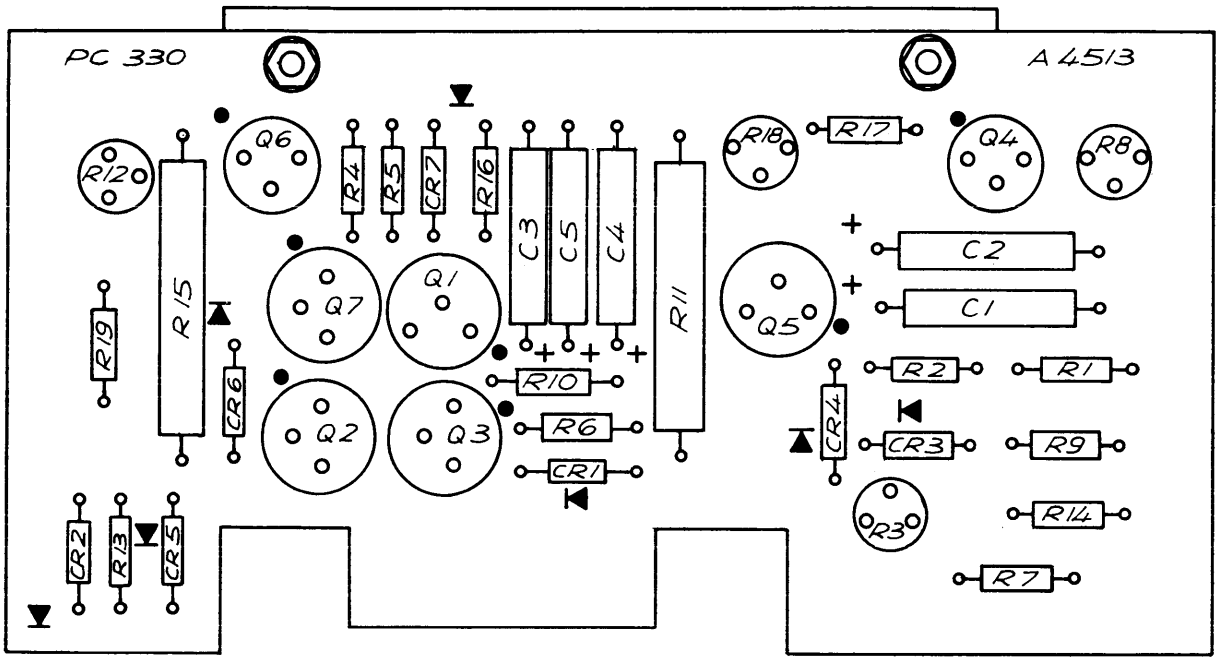


Figure 5-18. Regulator Board Z303, Board Component Locations

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
C2232	Capacitor, Fixed, Mica, 12 uuf, ±5%, 500 WVDC	'llC120J5S
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	

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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	

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, ±5%, ½watt	RC20GF221J
R84	Same as R38	
R85	Same as R38	

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, ±5%, ¼watt	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	

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
T10 thru T12	Same as T1	
T13 thru T16	Same as T2	
T17	Same as T6	
T18	Sameaas 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	

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, ±2%, 500 WVDC	CM111F121G5S
C7 thru C9	Same as C1	
C10	Capacitor, Fixed, Mica, 150 uuf, ±1%, 500 WVDC	CM111F151F5S
C11	Capacitor, Fixed, Mica, 5 uuf, ±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, ±2%, 500 WVDC	CM111E470G5S

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, ±½%, 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	

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	

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, ±1%, 500 WVDC	CM11lE680J5S
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	

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, ±10%, molded case	CL275-121
L2 thru L5	Same as L1	
L6	Coil, Radio Frequency, fixed, 2200 uh, ±10%, molded case	CL275-222
L7	Same as L6	
L8	Coil, Radio Frequency, fixed, 12 uh, ±10%, molded case	CL275-120
L9	Same as L8	
L10 thru L20	Same as L1	
Q1	Transistor	2N3646

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
Q2 thru Q15	Same as Q1	
R1	Resistor, Variable, Composition, 100 ohms, ±30%, 0.5 watts	RV124-1-101
R2	Resistor, Fixed, Composition, 8200 ohms, ±5%, ¼ watt	RC07GF822J
R3	Resistor, Fixed, Composition, 1000 ohms, ±5%, ¼ watt	RC07GF102J
R4	Resistor, Fixed, Composition, 330 ohms, ±5%, ¼ watt	RC07GF331J
R5	Resistor, Fixed, Composition, 47 ohms, ±5%, ¼ watt	RC07GF470J
R6	Resistor, Fixed, Composition, 68 ohms, ±5%, ¼ watt	RC07GF680J
R7	Resistor, Variable, Composition, 500 ohms, ±30%, 0.5 watts	RV124-1-501
R8	Resistor, Fixed, Composition, 100 ohms, ±5%, ¼ watt	RC07GF101J
R9	Same as R8	
R10	Same as R2	
R11	Same as R3	
R12	Same as R4	
R13	Resistor, Fixed, Composition, 1800 ohms, ±5%, ¼ watt	RC07GF182J
R14	Resistor, Fixed, Composition, 15 ohms, ±5%, ¼ watt	RC07GF150J
R15	Resistor, Fixed, Composition, 180 ohms, ±5%, ¼ watt	RC07GF181J
R16	Same as R2	
R17	Same as R3	
R18	Same as R4	
R19	Same as R13	

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
R20	Resistor, Fixed, Composition, 22 ohms, ±5%, ¼ watt	RC07GF220J
R21	Resistor, Fixed, Composition, 120 ohms, ±5%, ¼ watt	RC07GF121J
R22	Resistor, Fixed, Composition, 12000 ohms, ±5%, ¼ watt	RC07GF123J
R23	Same as R13	
R24	Resistor, Fixed, Composition, 820 ohms, ±5%, ¼ watt	RC07GF821J
R25	Same as R8	
R26	Resistor, Fixed, Composition, 27 ohms, ±5%, ¼ 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	

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	DESCRIPTION	TMC PART NUMBER
	Same as R24	
R50	Same as R8	
R51	Same as R26	
R52	Same as R15	
R53	Resistor, Fixed, Composition, 10 ohms, ±5%, ¼ 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	

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	

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	TT221
T10	Same as T2	

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	

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, ±2%, 500 WVDC	CM111F221G5S
C4 thru C7	Same as C1	
C8	Capacitor, Fixed, Mica, 1,200 uuf, ±5%, 500 WVDC	CM112F122J5S
C9	Not used	
C10	Same as C3	
C11	Capacitor, Fixed, Mica, 5 uuf, ±10%, 500 WVDC	CM111C050K5S
C12	Same as C3	
C13	Same as C1	
C14	Same as C1	
C15	Capacitor, Fixed, Mica, 270 uuf, ±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, ±½%, 500 WVDC	CM112F152DS
C23	Same as C22	
C24	Capacitor, Fixed, Mica, 130 uuf, ±2%, 500 WVDC	CM111F131G5S
C25	Capacitor, Fixed, Mica, 12 uuf, ±5%, 500 WVDC	CM111C120J5S
C26	Same as C24	
C27	Same as C1	

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	

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, ±10%, molded case	CL275-8.2
L3	Coil, Radio Frequency, fixed, 120 uh, ±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, ±5%, ¼ watt	RC07GF391J
R2	Resistor, Fixed, Composition, 56 ohms, ±5%, ¼ watt	RC07GF560J
R3	Resistor, Fixed, Composition, 8200 ohms, ±5%, ¼watt	RC07GF822J
R4	Resistor, Fixed, Composition, 2200 ohms, ±5%, ¼watt	RC07GF222J
R5	Same as R1	
R6	Resistor, Fixed, Composition, 220 ohms, ±5%, ¼ watt	RC07GF221J
R7	Resistor, Variable, Composition, 500 ohms, ±30%, 0.5 watts	RV124-1-501
R8	Same as R6	

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REF SYMBOL	DESCRIPTION	TMC PART NUMBER
R9	Resistor, Fixed, Composition, 120 ohms, ±5%, ¼ watt	RC07GF121J
R10	Resistor, Fixed, Composition, 1,800 ohms, ±5%, ¼watt	RC07GF182J
R11	Resistor, Fixed, Composition, 10000 ohms, ±5%, ¼watt	RC07GF103J
R12	Resistor, Fixed, Composition, 15 ohms, ±5%, ¼ watt	RC07GF150J
R13	Resistor, Fixed, Composition, 1000 ohms, ±5%, ¼ watt	RC07GF102J
R14	Resistor, Fixed, Composition, 4700 ohms, ±5%, ¼ watt	RC07GF472J
R15	Same as R11	
R16	Same as R1	
R17	Resistor, Fixed, Composition, 8.2 ohms, ±5%, ¼ watt	RC07GF8R2J
R18	Same as R7	
R19	Resistor, Fixed, Composition, 330 ohms, ±5%, ¼ watt	RC07GF331J
R20	Resistor, Fixed, Composition, 470 ohms, ±5%, ¼ watt	RC07GF471J
R21	Resistor, Fixed, Composition, 47 ohms, ±5%, ¼ watt	RC07GF470J
R22	Resistor, Fixed, Composition, 6800 ohms, ±5%, ¼watt	RC07GF682J
R23	Resistor, Fixed, Composition, 3300 ohms, ±5%, ¼ watt	RC07GF332J
R24	Resistor, Fixed, Composition, 12000 ohms, ±5%, ¼watt	RC07GF123J
R25	Resistor, Fixed, Composition, 560 ohms, ±5%, ¼ watt	RC07GF561J
R26	Same as R22	
R27	Resistor, Fixed, Composition, 270 ohms, ±5%, ¼ watt	RC07GF271J
R28	Same as R22	
R29	Resistor, Fixed, Composition, 33 ohms, ±5%, ¼ watt	RC07GF330J
R30	Same as R19	
R31	Resistor, Fixed, Composition, 1 meg ohm, ±5%, ¼ watt	RC07GF105J
R32	Resistor, Fixed, Composition, 47000 ohms, ±5%, ¼ watt	RC07GF473J
R33	Same as R6	

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	

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

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, ±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, ±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, ±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, ±5%, ¼ watt	RC07GF153J
R2	Resistor, Fixed, Composition, 3,300 ohms, ±5%, ¼ watt	RC07GF332J
R3	Resistor, Variable, Composition, 500 ohms, ±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	Resitor, 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	

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

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

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	

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
R9	Resistor, Fixed, Composition: 1000 ohms, ±5%, ½ watt	RC20GF102J
R10	Not Used	
R11	Resistor, Fixed, Composition: 47 ohms, ±5%, ½ watt	RC07GF470J
R12	Same as R9	
R13	Resistor, Fixed, Composition: 10 ohms, ±5%, ½ watt	RC20GF100J
R14	Same as R10	
R15	Resistor, Fixed, Composition: 2200 ohms, ±5%, ½ watt	RC20GF222J
R16	Not used	
R17	Same as R9	
R18	Resistor, Fixed, Composition: 220 ohms, ±5%, ½ watt	RC20GF221J
R19	Resistor, Fixed, Composition: 47000 ohms, ±5%, ½ watt	RC20GF473J
R20	Not used	
R21	Resistor, Fixed,Composition: 43,000 ohms, ±5%, ½ watt	RC20GF433J
T1	Transformer, Radio Frequency: fixed,	TZ220
T2	Transformer, Radio Frequency: fixed,	TZ219

A-4503

BFO

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
C901	CAP, VAR, COMP, 15-60uuf, 100 WVDC	CV112-5
C902	CAP, FXD, MICA, 1000uuf, ±1%, 500 WVDC	CM111F102F5
C903	CAP, FXD, MICA, 470uuf, ±1%, 500 WVDC	CM111F471F5
C904	CAP, FXD, CER, 10000uuf, GMV, 500 WVDC	CC100-16
C905	CAP, FXD, MICA, 10uuf, ±5%, 500 WVDC	CM111C100J5
C906	CAP, FXD, CER, 200000uuf, +80-20%, 25 WVDC	CC100-33
C907	Same as C904	
C908	CAP, FXD, MICA, 6200uuf, ±2%, 500 WVDC	CM111F622G5
C909	CAP, FXD, CER, 20000uuf, +80-20%, 25 WVDC	CC100-40
C910	Same as C906	
C911	Same as C906	
CR901	SCOND, DEV, DIO	IN758
L901	COIL, RF, FXD, 120uh, ±10%	CL275-121
L902	COIL, RF, FXD, 22uh, ±10%	CL275-220
Q901	TRANSISTOR	2N3646
Q902	Same as Q901	
R901	RES, FXD, COMP, 47000 ohms, ±5%, 1/4 watt	RC07GF473J
R902	RES, FXD, COMP, 4700 ohms, ±5%, 1/4 watt	RC07GF472J
R903	RES, FXD, COMP, 1000 ohms, ±5%, 1/4 watt	RC07GF102J
R904	RES, FXD, COMP, 15000 ohms, ±5%, 1/4 watt	RC07GF153J
R905	RES, FXD, COMP, 3300 ohms, ±5%, 1/4 watt	RC07GF332J
R906	RES, FXD, COMP, 560 ohms, ±5%, 1/4 watt	RC07GF561J
R907	RES, FXD, COMP, 68 ohms, ±5%, 1/4 watt	RC07GF680J
TP1	TERM, STUD.	TE0127-2

BFO

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
TP2	Same as TP-1	
Y901	CU, QTZ, -445 KHZ	CR46/u
XY901	SOC, XTAL	TS167-1

STEP GENERATOR B A-4504

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
C1	Capacitor, Fixed, Mica, 470 uuf, ±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, ±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, ±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, ±10%, molded case	CL275-121
L2	Same as L1	
L3	Same as L1	
L4	Coil, Radio Frequency, fixed, 47 uh, ±10%, molded case	CL275-470
L5	Same as L1	
L6	Coil, Radio Frequency, fixed, 10 uh, ±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, ±10%, molded case	CL275-0R47

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, ±5%, ¼ watt	RC07GF680J
R2	Resistor, Fixed, Composition, 3,900 ohms, ±5%, ¼watt	RC07GF392J
R3	Resistor, Fixed, Composition, 39000 ohms, ±5%, ¼watt	RC07GF393J
R4	Resistor, Fixed, Composition, 5600 ohms, ±5%, ¼ watt	RC07GF562J
R5	Resistor, Fixed, Composition, 330 ohms, ±5%, ¼ watt	RC07GF331J
R6	Resistor, Fixed, Composition, 8200 ohms, ±5%, ¼watt	RC07GF822J
R7	Resistor, Fixed, Composition, 1000 ohms, ±5%, ¼watt	RC07GF102J
R8	Resistor, Fixed, Composition, 150 ohms, ±5%, ¼ watt	RC07GF151J
R9	Resistor, Fixed, Composition, 10 ohms, ±5%, ¼ watt	RC07GF100J
R10	Resisotr, Fixed, Composition, 47 ohms, ±5%, ¼ 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	Transformer, Radio Frequency, fixed,	TX215-12
T2 thru T9	Same as T1	

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
C1	Capacitor, Fixed, Ceramic, 1000 uuf, GMV, 500 WVDC	CC100-29
C2	Capacitor, Fixed, Mica, 18 uuf, ±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, ±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, ±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, ±2%, 500 WVDC	CM111E470G5S
C44	Same as C38	
C45	Same as C39	

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, ±5%, 500 WVDC	CM11lE750J5S
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, ±1%, 500 WVDC	CM11lE680F5S
C65	Capacitor, Fixed, Mica, 33 uuf, ±2%, 500 WVDC	CM11lE330G5S
C66	Capacitor, Fixed, Ceramic, 20000 uuf, +80-20%, 25 WVDC	CC100-40
C67	Same as C15	

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, ±2%, 500 WVDC	CM111F511G5S
C73	Capacitor, Fixed, Mica, 120 uuf, ±2%, 500 WVDC	CM111F121G5S
C74	Capacitor, Fixed, Mica, 560 uuf, ±1%, 500 WVDC	CM111F561F5S
C75	Capacitor, Fixed, Mica, 430 uuf, ±2%, 500 WVDC	CM111F431G5S
C76	Capacitor, Fixed, Mica, 360 uuf, ±2%, 500 WVDC	CM111F361G5S
C77	Same as C4	
C78 thru C80	Same as C1	
C81	Capacitor, Fixed, Mica, 130 uuf, ±2%, 500 WVDC	CM111F131G5S
C82	Same as C1	
C83	Capacitor, Fixed, Mica, 390 uuf, ±1%, 500 WVDC	CM111F391F5S
C84	Same as C66	
C85	Capacitor, Fixed, Mica, 750 uuf, ±20%, 500 WVDC	CM111F751G5S
C86	Same as C83	
C87	Capacitor, Fixed, Mica, 110 uuf, ±5%, 500 WVDC	CM111F111J5S
C88	Capacitor, Fixed, Mica, 5 uuf, ±10%, 500 WVDC	CM111C050K5S
C89	Same as C87	
C90	Same as C1	
C91	Same as C1	
C92	Same as C87	

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	

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, ±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, ±10%, Molded case	CL275-1R0
L11 thru L13	Same as L10	
L14	Coil, Radio Frequency, fixed, .077 uh, ±4%	CL412-23
L15	Coil, Radio Frequency, fixed, 22 uh, ±10%, molded case	CL275-220
L16	Same as L10	
L17	Coil, Radio Frequency, fixed, 0.39 uh, ±10%, molded	CL2750R39
L18	Same as L10	
L19	Coil, Radio Frequency, fixed, 0.82 uh, ±10%, molded case	CL275-0R82

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	

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 ohma, ±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%, ¼watt	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	

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%, ¼watt	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	

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
R62	Same as R44	
R63	Resistor, Fixed, Composition, 8.2 ohms, ±5%, ¼ 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, ±5%, ¼ watt	RC07GF100J
R70	Not used	
R71	Resistor, Variable, Composition, 500 ohms, ±30%, 0.5 watts	RV124-1-501
R72	Same as R57	
R73	Same as R52	
R74	Resistor, Fixed, Composition, 390 ohms, ±5%, ¼ watt	RC07GF391J
R75	Same as R52	
R76	Resistor, Fixed, Composition, 18000 ohms, ±5%, ¼ watt	RC07GF183J
R77	Same as R7	
R78	Resistor, Fixed, Composition, 27000 ohms, ±5%, ¼ watt	RC07GF273J
R79	Resistor, Fixed, Composition, 22 ohms, ±5%, ¼ watt	RC07GF220J
R80	Same as R3	
R81	Same as R1	
R82	Same as R7	
R83	Same as R74	

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
R84	Same as R76	
R85	Resistor, Fixed, Composition, 56000 ohms, ±5%, ¼ watt	RC07GF563J
R86	Resistor, Fixed, Compsoition, 10000 ohms, ±5%, ¼ watt	RC07GF103J
R87	Same as R2	
R88	Same as R1	
R89	Resistor, Fixed, Composition, 820 ohms, ±5%, ¼watt	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	

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, ±5%, ¼ 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

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	

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REF SYMBOL	DESCRIPTION	TMC PART NUMBER
C1	Capacitor, Fixed, Mica, 100 uuf, ±1%, 500 WVDC	CM111F101F5S
C2	Capacitor, Fixed, Ceramic, 1000 uuf, GMV, 500 WVDC	CC100-29
C3	Capacitor, Fixed, Mica, 18 uuf, ±5%, 500 WVDC	CM111C180J5S
C4	Capacitor, Fixed, Mica, 130 uuf, ±5%, 500 WVDC	CM111F131J5S
C5	Capacitor, Fixed, Mica, 27 uuf, ±5%, 500 WVDC	CM111E270J5S
C6	Capacitor, Fixed, Mica, 91 uuf, ±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, ±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, ±5%, 500 WVDC	CM111C100J5S
C28	Capacitor, Variable, Ceramic, 5.5 to 18 uuf 200 WVDC	CV112-1
C29	Same as C7	

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
C30	Same as C2	
C31	Capacitor, Fixed, Mica, 82 uuf, ±1%, 500 WVDC	CM111E820F5S
C32	Same as C27	
C33	Capacitor, Fixed, Mica, 110 uuf, ±5%, 500 WVDC	CM111F111J5S
C34	Same as C5	
C35	Capacitor, Fixed, Mica, 75 uuf, ±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	

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	

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
C92 thru C96	Same as C2	
C97	Capacitor, Fixed, Mica, 180 uuf, ±2%, 500 WVDC	CM111F181G5S
C98	Same as C2	
C99	Capacitor, Fixed, Mica, 620 uuf, ±½%, 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, ±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	

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

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
CR2	Same as CR1	
CR3	Semiconductor, Device, Diode,	1N627
CR4	Same as CR3	
L1	Coil, Rado Frequency, fixed, .128 uh, ±10%	CL412-41
L2	Coil, Radio Frequency, fixed, .11 uh, ±10%	CL412-36
L3	Coil, Radio Frequency, fixed, 0.82 uh, ±10%, molded case	CL275-0R82
L4 thru C7	Same as L3	
C8	Coil, Radio Frequency, fixed, .205 uh, ±4%	CL412-38
L9	Same as L3	
L10	Same as L2	
L11	Coil, Radio Frequency, fixed, .085 uh, ±4%	CL412-37
L12 thru L16	Same as L3	
L17	Coil, Radio Frequency, fixed, .205 uh, ±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, ±4%	CL412-40
L27	Same as L3	
L28	Same as L3	

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
L29	Coil, Radio Frequency, fixed, 129 uh, ±10%, molded case	CL275-121
L30	Same as L29	
L31	Coil, Radio Frequency, fixed, 12 uh, ±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, ±5%, ¼ watt	RC07GF560J
R2	Resistor, Fixed, Composition, 1000 ohms, ±5%, ¼ watt	RC07GF102J
R3	Resistor, Fixed, Composition, 8200 ohms, ±5%, ¼ watt	RC07GF822J
R4	Resistor, Fixed, Composition, 2200 ohms, ±5%, ¼watt	RC07GF222J
R5	Resistor, Fixed, Composition, 18 ohms, ±5%, ¼ watt	RC07GF180J
R6	Resistor, Fixed, Composition, 220 ohms, ±5%, ¼ watt	RC07GF221J
R7	Resistor, Fixed, Composition, 12 ohms, ±5%, ¼ watt	RC07GF120J
R8	Same as R2	
R11	Resistor, Fixed, Composition, 22 ohms, ±5%, ¼ watt	RC07GF220J
R12	Same as R6	
R13	Same as R7	

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
R14	Same as R2	
R15	Same as R3	
R16	Same as R10	
R17	Resistor, Fixed, Composition, 10 ohms, ±5%, ¼ watt	RC07GF100J
R18	Same as R6	
R19	Same as R7	
R20	Resistor, Fixed, Composition, 1500 ohms, ±5%, ¼watt	RC07GF152J
R21	Same as R3	
R22	Same as R10	
R23	Same as R17	
R24	Resistor, Fixed, Composition, 180 ohms, ±5%, ¼watt	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, ±5%, ¼ 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, ±5%, ¼ watt	RC07GF470J

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	

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, ±5%, ¼watt	RC07CF332J
R74	Same as R20	
R75	Same as R10	
R76	Resistor, Fixed, Composition, 6.8 ohms, ±5%, ¼ watt	RC07GF6R8J
R77	Same as R10	
R78	Resistor, Variable, Composition, 100 ohms, ±30%,	RV124-1-101
R79	Same as R2	
R80	Same as R3	
R81	Resistor, Fixed, Composition, 330 ohms, ±5%, ¼ watt	RC07GF331J
R82	Resistor, Fixed, Composition, 4.7 ohms, ±5%, ¼ watt	RC07GF4R7J
R83	Same as R24	
R84	Same as R78	
R85	Resistor, Fixed, Composition, 120 ohms, ±5%, ¼ watt	RC07GF121J
R86	Same as R52	

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
R87	Resistor, Fixed, Composition, 100 ohms, ±5%, ¼ watt	RC07GF101J
R88	Same as R87	
R89	Same as R2	
R90	Same as R3	
R91	Same as R81	
R92	Resistor, Fixed, Composition, 1200 ohms, ±5%, ¼watt	RC07GF122J
R93	Resistor, Fixed, Composition, 15 ohms, ±5%, ¼ 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, ±5%, ¼ watt	RC07GF682J
R103	Same as R92	
R104	Resistor, Fixed, Composition, 820 ohms, ±5%, ¼ watt	RC07GF821J
R105	Resistor, Fixed, Composition, 27 ohms, ±5%, ¼ watt	RC07GF270J
R106	Same as R5	
R107	Same as R2	
R108	Same as R3	
R109	Same as R81	
R110	Same as R93	

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

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

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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, ±2%, 500 WVDC	CM111F681G5S
C4	Capacitor, Fixed, Mica, 430 uufd, ±2%, 500 WVDC	CM111F431G5S
C5	Capacitor, Fixed, Mica, 750 uufd, ±2%, 500 WVDC	CM111F751G5S
C6	Capacitor, Fixed, Mica, 820 uufd, ±2%, 500 WVDC	CM111F821G5S
C7	Capacitor, Fixed, Mica, 910 uufd, ±2%, 500 WVDC	CM111F911G5S
C8	Capacitor, Fixed, Mica, 560 uufd, ±1%, 500 WVDC	CM111F561F5S
C9	Capacitor, Fixed, Mica, 510 uufd, ±2%, 500 WVDC	CM111F511G5S
C10	Capacitor, Fixed, Mica, 1000 uufd, ±1%, 500 WVDC	CM111F102F5S
C11	Same as C10	
C12	Capacitor, Fixed, Mica, 200 uufd, ±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, ±2%, 500 WVDC	CM111F391G5S
C18	Capacitor, Fixed, Mica, 1100 uufd, ±½%, 500 WVDC	CM112F112D5S
C19	Same as C8	
C20	Capacitor, Fixed, Mica, 1300 uufd, ±1%, 500 WVDC	CM112F132F5S
C21	Capacitor, Fixed, Mica, 110 uufd, ±5%, 500 WVDC	CM111F111J5S
C22	Same as C7	
C23	Same as C1	
C24	Capacitor, Fixed, Mica, 360 uufd, ±2%, 500 WVDC	CM111F361G5S

FILTER A-4507

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
C25	Capacitor, Fixed, Mica, 330 uufd, ±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, ±1%, 500 WVDC	CM111F471F5S
C29	Same as C26	
C30	Capacitor, Fixed, Mica, 620 uufd, ±1%, 500 WVDC	CM111F621F5S
C31	Capacitor, Fixed, Mica, 36 uufd, ±5%, 500 WVDC	CM111E360J5S
C32	Same as C26	
C33	Same as C9	
C34	Same as C1	
C35	Capacitor, Fixed, Mica, 220 uufd, ±2%, 500 WVDC	CM111F221G5S
C36	Capacitor, Fixed, Mica, 150 uufd, ±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, ±5%, 500 WVDC	CM111C240J5S
C43	Capacitor, Variable, Ceramic, 9-35 uufd, 100 WVDC	CV112-2
C44	Capacitor, Fixed, Mica, 330 uufd, ±2%, 500 WVDC	CM111F301G5S
C45	Same as C1	
C46	Capacitor, Fixed, Mica, 130 uufd, ±2%, 500 WVDC	CM111F131G5S
C47	Capacitor, Fixed, Mica, 560 uufd, ±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, 1.68 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, ±4%,	CL412-8
L8	Coil, R.F., Fixed, .76 uh, ±4%,	CL412-10
L9	Coil, R.F., Fixed, 1.32 uh, ±4%	CL412-7
L10	Coil, R.F., Fixed, .52 uh, ±4%,	CL412-11
L11	Coil, R.F., Fixed, .47 uh, ±4%,	CL412-13
L12	Coil, R.F., Fixed, .78 uh, ±4%,	CL412-9
L13	Coil, R.F., Fixed, .34 uh, ±4%,	CL412-14
L14	Coil, R.F., Fixed, .31 uh, ±4%,	CL412-15
L15	Coil, R.F., Fixed, .48 uh, ±4%,	CL412-12
L16	Coil, R.F., Fixed, 120 uh, ±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, ±4%	CL412-16
L24	Coil, R.F., Fixed, .19 uh, ±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

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, ±5%, ¼ watt	RC07GF471J
R2	Resistor, Fixed, Composition, 1000 ohms, ±5%, ¼watt	RC07GF102J
R3	Resistor, Variable, Composition, 1000 ohms, ±30%, ½ watt	RV124-1-102
R4	Same as R2	
R5	Same as R2	

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, 1 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, 10000 ohms, ±30%, ½ watt	RV124-1-103
R19	Same as R17	

RESISTOR BOARD ASSEMBLY

A-4537

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
R129	RES, FXD, COMP, 100 ohms, ±5%, 1/4 watt	RC07GF101J
R130	RES, FXD, COMP, 470 ohms, ±5%, 1/4 watt	RC07GF471J
R131 thru R160	Same as R130	

RESISTOR BOARD ASSEMBLY

A-4589

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
R161	RES, FXD, COMP , 100 ohms, ±5%, 1/4 watt	RC07GF101J
R162	RES, FXD, COMP, 470 ohms, ±5%, 1/4 watt	RC07GF471J
R163 thru R192	Same as R162	

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
C304	CAP., FXD, MTLZ, .47uf, ±5%, 200 WVDC	CN114R47-5J
C305	CAP, FXD, CER, 100000uuf, +80%-20%, 300 WVDC	CC100-37
C306 and C307	Same as C305	
J301	CONN, RECP, ML	JJ242-5P
J302	CONN, RECP, RF	JJ211
J303	CONN, RECP, FML	JJ319-6DPE
J304	Same as J303	
J306	CONN, RECP, FML	JJ242-5S
L301	COIL, RF, FXD, 120uh	CL275-121
P301	CONN, PL, FML	PL225-8S
R301	RES, FXD, COMP, 470 ohms, ±5%, 1/4 watt	RC07GF470J
T301	XFMR, SD	TF0352
XZ301	SOC, EL TUBE	TS100-3
Z303	PC BD B	A-4513
Z304	PC BD A	A-4512

AS143

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
C130	CAP., FXD, CER, 1000uuf, GMV, 500 WVDC	CC100-29
C134 thru C139	Same as C130	
C140 thru C142	Same as C130	
R107	RES, FXD, WW, 1.0 ohms, ±.5%, .66 watt	RW126-4-1R0
R108 and R109	Same as R107	
S106	SW, ROTARY	SW441
S111	SW, ROTARY	SW439

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
C127	CAP., FXD, CER, 1000uuf, GMV, 500 WVDC	CC100-29
C128 and C129	Same as C127	

ENGINEERING MODIFICATION NOTICE

EMN NO. 20269

DATE 3-3-71 | THE TECHNICAL MATERIEL CORP. MAMARONECK NEW YORK | SHEET 1 OF 1

MODEL AFFECTED: MMX, LFE-1, VOX

SECTION AFFECTED: A-4513

ORIGINATOR: G. AUSTIN/R. GRIMES | APPROVAL: [signature] | FINAL APPROVAL: [signature]

DISTRIBUTION

DEPT.	EMN	DOC.	SIGN	DEPT.	EMN	DOC.	SIGN
ENG. CO-ORD				STOCK & INV.	1		
ENG. STDS.				QUAL. ASSUR.	2		
ENG. ADMIN.				MASTER FILE 0			
PURCHASING	1			MASTER FILE 1			
METHODS				MASTER FILE 2			
PROD. PLANNING	1			MASTER FILE 3			
DATA CONTROL							
MATL. CONTROL	1						

DOCUMENTS AFFECTED

TYPE: DWG ☒ LIST NPL ☒ ML ☐ SPEC ☐

DOCUMENT NO.	REV.	CHD.
A-4513	B	
A-4513	D	

DESCRIPTION

1. A-4513
   A. LEGEND
      1) ON ITEM 16, CHG R11 FR. RR114-1.0W2 TO RR114-1.0W.

2. A-4513 (NPL)
   A. SHT 1
      1) CHG R11 FR. RR114-1.0W2 TO RR114-1.0W.
      2) ON TITLE SHT., ADD R15 TO SYMBOLS NOT USED.

REASON FOR CHANGE

☐ TO AGREE WITH EMN NO. | PERTAINING TO:

☐ ERROR

OTHER:

DISPOSITION OF STOCK	DEPLETE ☐	DISCARD ☐	MODIFY ☐	CONFORMS ☐	NO STOCK ☐	NOT AFFECTED ☐	REMARKS
PRICE CHANGE	NONE ☐	INCREASED BY		DECREASED BY			
MODIFICATION EFFECTIVE	IMMEDIATELY (ALL NEW PARTS) ☐	SPECIFIC DATE	SERIAL NO.	MFGR. NO.	JOB NO.		REMARKS
	NEXT PROD. RUN ☐						

EFFECTED SUPPORTING DOCUMENTS (ENG. INFO.)

STATUS	LIST	ASSY	SCHEM	SPEC.					REMARKS
CHGD									
EMN NO.									
N/A									
CONF.									

MAIN CHASSIS ASSEMBLY

AX5044

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
J101	CONN, RECP, FML	JJ319A15DFE
J102 thru J106	Same as J101	
J109 thru J115	Same as J101	

SWITCH BRACKET ASSEMBLY

BMA111

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
A101	SW, ROTARY	AS144
C131	CAP., FXD, CER, 1000 uuf, CMV, 500 WVDC	CC100-29
R106	RES, VAR, COMP, 10000 ohms, ±10%, 1/2 watt	RV106UX8B103A
S101	SW, ROTARY	SW443
S102 thru S104	Same as S101	
S105	SW, ROTARY	SW442
S107	SW, ROTARY	SW440

FRAME ASSEMBLY

BMA113

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
TB101	RES, BD, ASSY	A-4537
TB102	RES, BD, ASSY	A-4589

VOX-7 SUB-ASSEMBLY

BMA114

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
A102	SW, ASSY, METER	AS143
C101	CAP., FXD, CER, 100000 ohms, +80%-20%, 100 WVDC	CC100-28
C102 thru C107	Same as C101	
C108	CAP., FXD, CER, 1000 uuf, GMV, 500 WVDC	CC100-29
C109	CAP., FXD, CER, 10000 ohms, GMV, 500 WVDC	CC100-16
C110	Same as C101	
C111	Same as C110	
C112	CAP., FXD, MICA, 100 uuf, ±5%, 100 WVDC	CM111E101F1S
C113	Same as C101	
C114	Same as C113	
C115	Same as C109	
C116	Same as C115	
C117	CAP., FXD, CER, 2X10000uuf, GMV, 1000 WVDC	CC100-23
C118	Same as C109	
C119	Same as C118	
C120	Same as C101	
C121	Same as C109	
C122	Same as C101	
C123	Same as C109	
C124	CAP., FXD, MTLZ, 1.0uf, ±5%, 50 WVDC	CN114-1R0-5J
C125	Same as C109	
C126	Same as C117	

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
C132	CAP., FXD, MICA, 1000uuf, ±1%, 300 WVDC	CM35F103F03
C133	Same as C132	
DS101	LAMP, INCAND	B1110-7
DS102	Same as DS101	
F101	FUSE&CTG, 3/8 Amp, 250v	FU102-.375
F101	FUSE&CTG, 3/4 Amp, 250v	FU102-.750
F102	FUSE&CTG, 3/8 Amp, 250v	FU102-.375
F102	FUSE&CTG, 3/4 Amp, 250v	FU102-.750
FL101	FILTER LP	FX287
J116	CONN, RECP, ML	MS3102A16S5P
J117	CONN, RECP,RF	UG625/U
J118	Same as J117	
J120	Same as J117	
J121 and J122	Same as J117	
J124 and J125	Same as J117	
L101	COIL, RF, FXD, 120uh	CL275-121
L102 and L103	Same as L101	
L104	COIL, RF, FXD, 8.2 uh	CL275-8R2
L105	Same as L101	
L106 thru L114	Same as L101	

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
M101	METER	MR191-12
MP1	KNOB	MP123-3FB
P302	CONN, PL, MIN	PL204
R101	RES, FXD, COMP, 1000 ohms, ±5%, 1/4 watt	RC07GF102J
R102	RES, FXD, COMP, 2200 ohms, ±5%, 1/2 watt	RC20GF222J
R103	RES, VAR-COMP, 100 ohms, ±10%, 2 watts	RV4NAYSD101A
R104	RES, FXD, COMP, 68 ohms, ±5%, 1/4 watt	RC07GF680J
R105	RES, FXD, COMP, 82 ohms, ±5%, 1/4 watt	RC07GF820J
R106	RES, VAR, COMP, 10000 ohms, ±10%, 1/2 watt	RV106UX8B103A
R107	RES, FXD, WW, 1.0 ohms, ±5%, .66 watt	RW126-4-1R0
R108 and R109	Same as R107	
R111	Same as R101	
R112	Same as R111	
R113	RES, FXD, COMP, 220 ohms, ±5%, 1/4 watt	RC07GF221J
R114	RES, FXD, COMP, 300000 ohms, ±5%, 1/4 watt	RC07GF304J
R115	RES, FXD, COMP, 47000 ohms, ±5%, 1/4 watt	RC07GF473J
R116	Same as R115	
R117	Same as R101	
R118	Same as R117	
R119	RES, FXD, COMP, 2200 ohms, ±5%, 1/4 watt	RC07GF222J
R120	RES, FXD, COMP, 3900 ohms, ±5%, 1/4 watt	RC07GF392J
R121	RES, FXD, COMP, 100000 ohms, ±5%, 1/4 watt	RC07GF104J
R122	RES, FXD, COMP, 47000 ohms, ±5%, 1/4 watt	RC07GF473J

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
R123	RES, FXD, COM, 2700 ohms, ±5%, 1/4 watt	RC07GF272J
R124	RES, FXD, COMP, 150 ohms, ±5%, 2 watt	RC42GF151J
R125	Same as R124	
R126	RES, FXD, COMP, 8200 ohms, ±5%, 1/4 watt	RC07GF822J
R128	RES, FXD, COMP, 1000 ohms, ±5%, 1/2 watt	RC20GF102J
R130	Same as R105	
R131	Same as R104	
R193	RES, FXD, COMP, 10000 ohms, ±5%, 1/4 watt	RC07GF103J
S108	SW, TOGGLE SPDT	ST12D
S109 and S110	Same as S108	
S111	SW, ROTARY	SW439
S112	SW, TOGGLE, DPDT	ST22N
S113	Same as S112	
S115	SW, ROTARY	SW445
TB103	TERM., BD-BARR	TM100-6
TB104 and TB105	Same as TB103	
XDS101	LIGHT, IND-WHT	TS153-5
XDS102	LIGHT, IND-RED	TS153-1
XF101	FUSEHOLDER	FH104-3
XF102	Same as XF101	
Z110	STEP GEN A	A-4478

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
Z111	STEP GEN B	A-4504
Z112	TRANSLATOR	A-4505
Z113	STEP GEN C	A-4506
Z114	FIL, OUTPUT	A-4507
Z115	RF OUTPUT	A-4502
Z305	HEAT SINK ASSY	BMA173

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
MP2	KNOB	MP123-3UB
Z101	SPEC GEN	A-4610
Z102	COMB FIL A	A-4500
Z103	COMB FIL B	A-4501
Z104	MIXER/DIV	A-4475
Z105	MIXER/DIV	A-4475
Z106	FNL MIXER	A-4479

HEAT SINK ASSEMBLY

BMA173

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

SPECTRUM GENERATOR

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
C401	Capacitor, Fixed, Ceramic, 20000 uuf, +60-40%, 150 WVDC	CC100-35
C402	Capacitor, Fixed, Mica, 2700 uuf, ±1/2%, 500 WVDC	CM112F272D5S
C403	Same as C401	
C404	Same as C401	
C405	Capacitor, Fixed, Ceramic, 200000 uuf, +80-20%, 25 WVDC	CC100-33
C406	Capacitor, Fixed, Ceramic, 10000 uuf, GMV, 500 WVDC	CC100-16
C407	Same as C406	
C408	Same as C406	
C409	Capacitor, Fixed, Ceramic, 20 uuf, ±5%, 500 WVDC	CM111C200J5S
C410	Same as C406	
C411	Same as C406	
C412	Capacitor, Fixed, Ceramic, 9-35 uuf, 100 WVDC	CV112-2
C413	Capacitor, Fixed, Ceramic, 1000 uuf, GMV, 500 WVDC	CC100-29
C414	Same as C406	
C415	Capacitor, Fixed, Mica, 270 uuf, ±1%, 500 WVDC	CM111F271F5S
C416 thru C418	Same as C406	
C419	Capacitor, Fixed, Mica, 320 uuf, ±1/2%, 500 WVDC	CM111F321D5S
C420	Same as C406	
C421	Same as C413	
C422 thru C425	Same as C406	
C426	Sameas C413	

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
C427	Same as C412	
C428	Capacitor, Fixed, Mica, 820 uuf, ±5%, 500 WVDC	CM111F821J5S
C429	Same as C406	
C430	Same as C413	
C431	Same as C428	
C432 thru C434	Same as C406	
C435	Same as C413	
C436	Same as C412	
C437	Same as C406	
C438	Same as C406	
C439	Capacitor, Fixed, Mica, 220 uuf, ±2%, 500 WVDC	CM111F221G5S
C440	Same as C406	
C441	Same as C413	
C442	Same as C406	
C443	Same as C439	
C444 thru C448	Same as C406	
C449	Same as C413	
C450	Same as C412	
C451	Same as C406	
C452	Same as C406	
C453	Capacitor, Fixed, Mica, 240 uuf, ±2%, 500 WVDC	CM111F241G5S

SPECTRUM GENERATOR

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
C454	Same as C413	
C455	Same as C406	
C456	Same as C412	
C457	Same as C453	
C458 thru C462	Same as C406	
C463	Same as C412	
C464	Same as C412	
C465	Same as C406	
C466 thru C468	Capacitor, Fixed, Ceramic, 200000 uuf, +80-20%, 500 WVDC	CC100-33
C469	Capacitor, Fixed, Mica, 180 uuf, ±2%, 500 WVDC	CM111F181G5S
C470	Same as C406	
C471	Same as C406	
C472	Same as C413	
C473	Same as C412	
C474	Same as C406	
C475	Capacitor, Fixed, Mica, 430 uuf, ±2%, 500 WVDC	CM111F431G5S
C476	Same as C406	
C477	Same as C406	
C478	Same as C413	
C479	Same as C412	
C480	Same as C412	
C481	Same as C475	

SPECTRUM GENERATOR

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
C482 thru C484	Same as C413	
C485	Capacitor, Fixed, Mica, 82 uuf, ±1%, 500 WVDC	CM111E820F5S
C486	Capacitor, Fixed, Ceramic, 15-60 uuf, 100 WVDC	CV112-6
C487	Same as C413	
C488	Capacitor, Fixed, Mica, 100 uuf, ±5%, 500 WVDC	CM111F101J5S
C489	Same as C486	
C490	Same as C413	
CR401	Semiconductor, Device, Diode,	M1LIN750
L401	Coil, RF, Fixed	CL275-121
L402 thru L414	Same as L401	
L415	Coil, RF, Fixed	CL275-120
L416	Same as L401	
L417	Same as L401	
L418	Coil, RF, Fixed	CL419
L419	Same as L401	
Q401	Transistor	2N3646
Q402 thru Q419	Same as Q401	
R401	Resistor, Fixed, Composition, 330 ohms, ±5%, 1/4watt	RC07GF331J
R402	Resistor, Fixed, Composition, 8200 ohms, ±5%, 1/4 watt	RC07GF822J
R403	Resistor, Fixed, Composition, 1000 ohms, ±5%, 1/4 watt	RC07GF102J

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
R404	Resistor, Fixed, Composition, 47 ohms, ±5%, 1/4 watt	RC07GF470J
R405	Same as R403	
R406	Resistor, Fixed, Composition, 33000 ohms, ±5%, 1/4 watt	RC07GF333J
R407	Same as R403	
R408	Resistor, Fixed, Composition, 10000 ohms, ±5%, 1/4 watt	RC07GF103J
R409	Same as R404	
R410	Same as R408	
R411	Resistor, Fixed, Composition, 180 ohms, ±5%, 1/4watt	RC07GF181J
R412	Same as R403	
R413	Resistor, Fixed, Composition, 560 ohms, ±5%, 1/4watt	RC07GF561J
R414	Resistor, Fixed, Composition, 470000 ohms, ±5%, 1/4 watt	RC07GF474J
R415	Same as R402	
R416	Same as R403	
R417	Resistor, Fixed, Composition, 15000 ohms, ±5%, 1/4 watt	RC07GF153J
R418	Resistor, Fixed, Composition, 3300 ohms, ±5%, 1/4 watt	RC07GF332J
R419	Resistor, Fixed, Composition, 270 ohms, ±5%, 1/4watt	RC07GF271J
R420	Same as R414	
R421	Same as R403	
R422	Same as R402	
R423	Same as R413	
R424	Same as R417	
R425	Same as R418	

SPECTRUM GENERATOR

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
R426	Same as R419	
R427	Same as R414	
R428	Same as R413	
R429	Same as R403	
R430	Same as R402	
R431	Same as R417	
R432	Same as R418	
R433	Same as R419	
R434	Same as R414	
R435	Same as R403	
R436	Same as R402	
R437	Same as R413	
R438	Same as R417	
R439	Same as R418	
R440	Same as R440	
R441	Resistor, Fixed, Composition, 4700 ohms, ±5%, 1/4 watt	RC07GF472J
R442	Resistor, Fixed, Composition, 100000 ohms, ±5%, 1/4 watt	RC07GF104J
R443	Same as R442	
R444	Same as R408	
R445	Resistor, Fixed, Composition, 2200 ohms, ±5%, 1/4 watt	RC07GF222J
R446	Resistor, Fixed, Composition, 3900 ohms, ±5%, 1/4 watt	RC07GF392J
R447	Same as R445	
R448	Resistor, Fixed, Composition, 180 ohms, ±5%, 1 watt	RC32GF181J

SPECTRUM GENERATOR

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
R449	Same as R408	
R450	Same as R413	
R451	Same as R403	
R452	Same as R403	
R453	Same as R414	
R454	Same as R413	
R455	Same as R403	
R456	Same as R402	
R457	Same as R417	
R458	Same as R418	
R459	Resistor, Fixed, Composition, 390 ohms, ±5%, 1/4watt	RC07GF391J
R460	Resistor, Variable, Composition, 5000 ohms, ±30% 1/4 watt	RV124-1-502
R461	Same as R411	
R462 thru R466	Resistor, Fixed, Composition, 100 ohms, ±5%, 1/4watt	RC07GF101J
R467	Resistor, Fixed, Composition, 27 ohms, ±5%, 1/4 watt	RC07GF270J
R468	Same as R462	
R469	Same as R408	
R470	Same as R408	
R471	Resistor, Fixed, Composition, 2700 ohms, ±5%, 1/4 watt	RC07GF272J
R472	Same as R441	
R473 thru R476	Resistor, Fixed, Composition, 120 ohms, ±5%, 1/4watt	RC07GF121J

SPECTRUM GENERATOR

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
T401	Transformer, RF	TT286-2
T402	Transformer, RF	TT286-16
T403	Transformer, RF	TT286-15
T404	Transformer, RF	TT286-8
T405	Transformer, RF	TT286-7
T406	Same as T402	
T407	Same as T403	
T408	Same as T402	
T409	Same as T403	
T410	Transformer, RF	TT286-14
T411	Transformer, RF	TT286-13
T412	Transformer, RF, Fixed,	TZ222
TP403	Terminal Stud	TE0127-2
TP405	Same as TP403	
TP406	Same as TP403	
TP408	Same as TP403	
TP409	Same as TP403	
Y401	Crystal, Unit, Quartz, 12 mhz	CR109-124
Y402	Crystal, Unit, Quartz, 14 mhz	CR109-138
Y403	Crystal, Unit, Quartz, 8 mhz	CR109-104
Y404	Crystal, Unit, Quartz, 3 mhz	CR109-150
Y405	Crystal, Unit, Quartz, 13 mhz	CR109-134
Z401		NW135

SECTION 7

SCHEMATIC DIAGRAMS

This section contains schematic diagrams for the VOX-7. Table 7-1 lists the figure numbers contained herein and the corresponding TMC schematic drawing numbers.

TABLE 7-1. LIST OF DIAGRAMS

Figure No.	Title	TMC Dwg. No.
7-1	Overall Wiring Diagram, VOX-7	CK1334
7-2	Spectrum Generator Z101, Schematic Diagram	CK1387
7-3	Comb Filter Z102, Schematic Diagram	CK1313
7-4	Comb Filter Z103, Schematic Diagram	CK1314
7-5	Mixer-Divider (Dual) Z104 and Z105, Schematic Diagram	CK1393
7-6	Mixer-Final Z106, Schematic Diagram	CK1319
7-7	Step Generator Z110, Schematic Diagram	CK1322
7-8	Step Generator Z111, Schematic Diagram	CK1323
7-9	Step Generator Z113, Schematic Diagram	CK1325
7-10	Translator Z112, Schematic Diagram	CK1324
7-11	RF Output Z115, Schematic Diagram	CK1327
7-12	RF Output Filter Z114, Schematic Diagram	CK1326
7-13	Power Supply Wiring Diagram	CK1453
7-14	Power Supply Z304, Schematic Diagram	CK1328
7-15	Power Supply Z303, Schematic Diagram	CK1291

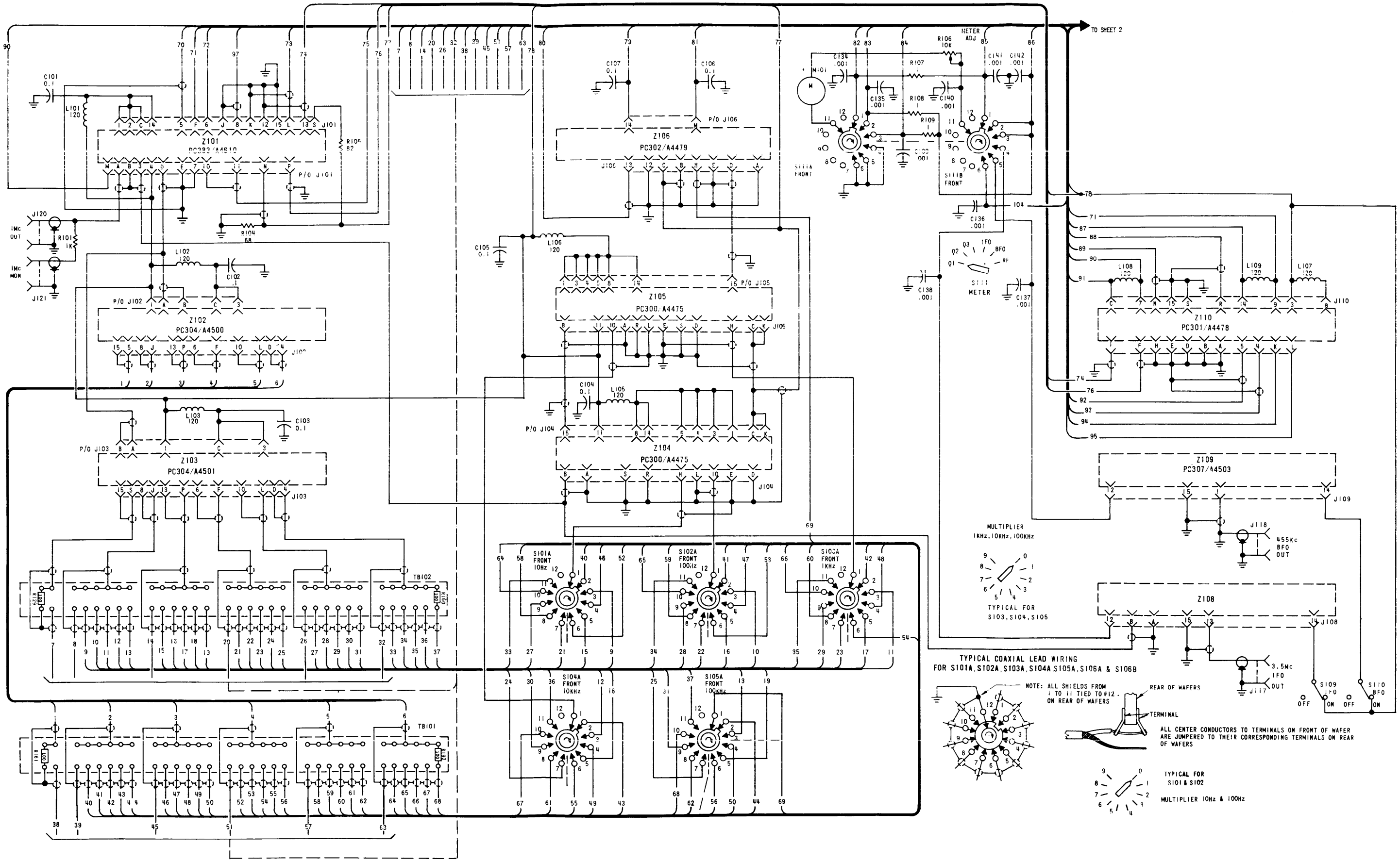
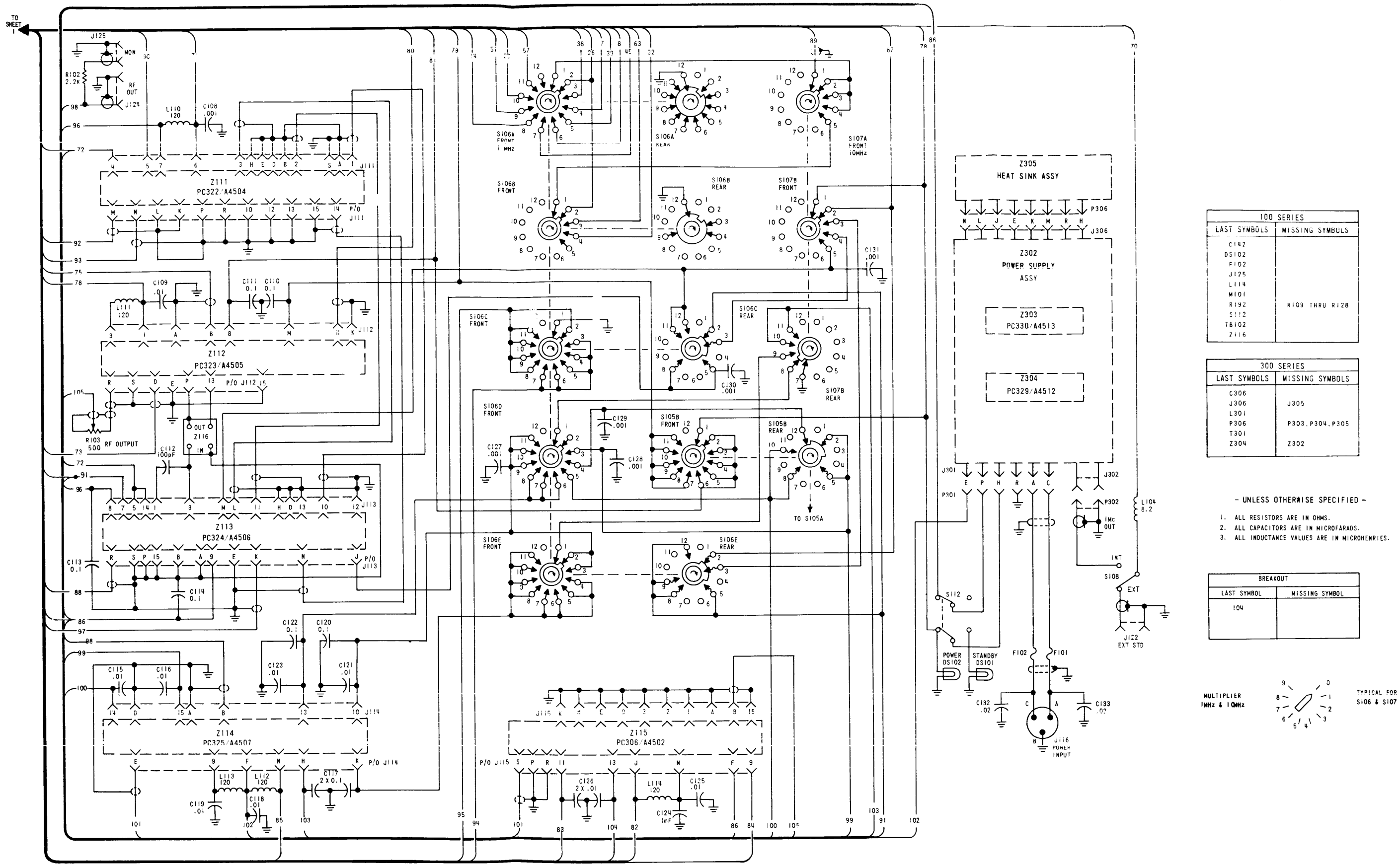


Figure 7-1. Overall Wiring Diagram, VOX-7 (Sheet 1 of 2)



100 SERIES	
LAST SYMBOLS	MISSING SYMBOLS
C142	
DS102	
F102	
J125	
L114	
M101	
R192	R109 THRU R128
S112	
TB102	
Z116	

300 SERIES	
LAST SYMBOLS	MISSING SYMBOLS
C306	
J306	J305
L301	
P306	P303, P304, P305
T301	
Z304	Z302

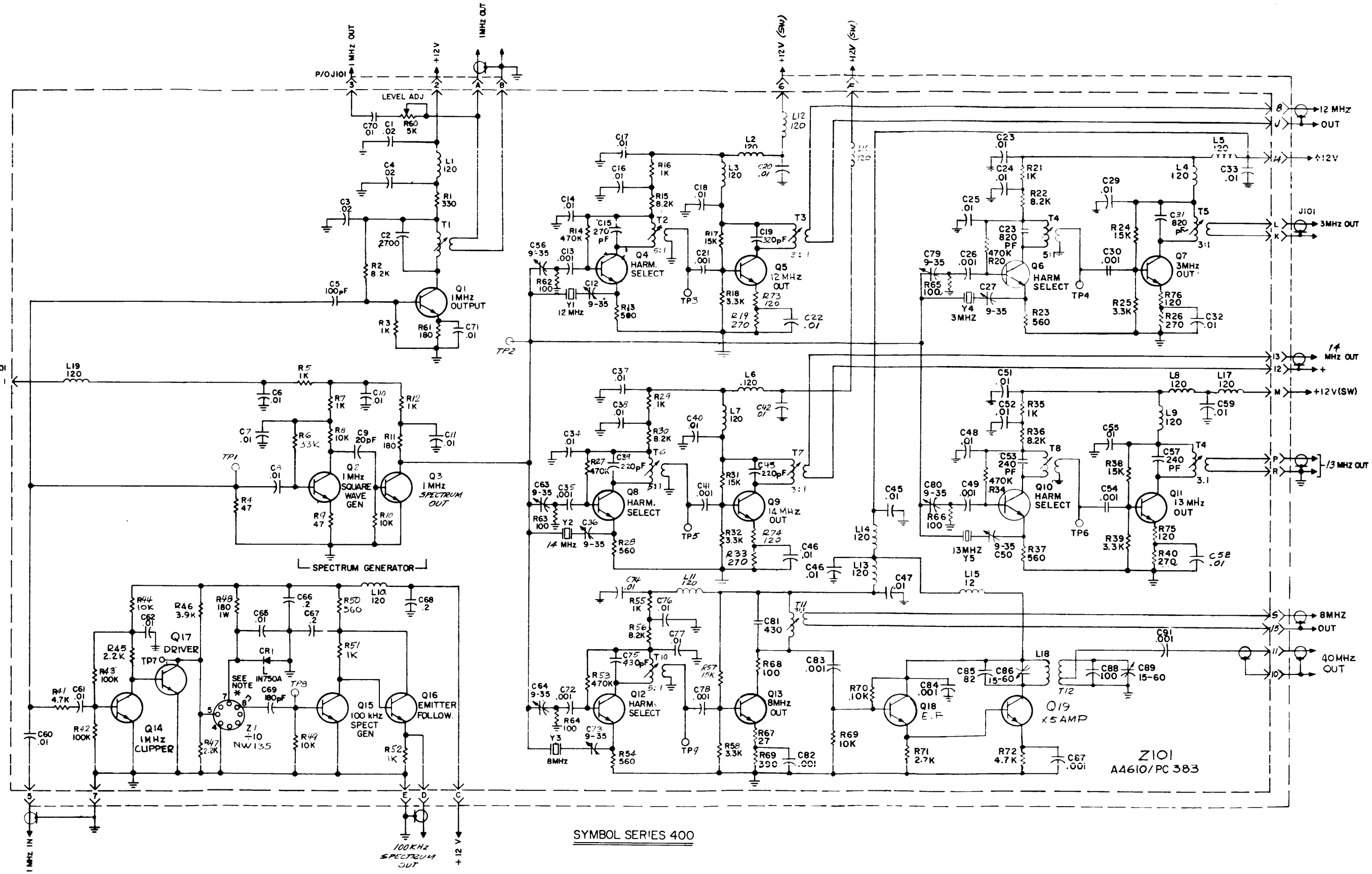
BREAKOUT	
LAST SYMBOL	MISSING SYMBOL
104	

- UNLESS OTHERWISE SPECIFIED -

1. ALL RESISTORS ARE IN OHMS.
2. ALL CAPACITORS ARE IN MICROFARADS.
3. ALL INDUCTANCE VALUES ARE IN MICROHENRIES.

Figure 7-1. Overall Wiring Diagram, VOX-7 (Sheet 2 of 2)

MISSING SYMBOLS



SYMBOL SERIES 400

Figure 7-2. Spectrum Generator Z101, Schematic Diagram

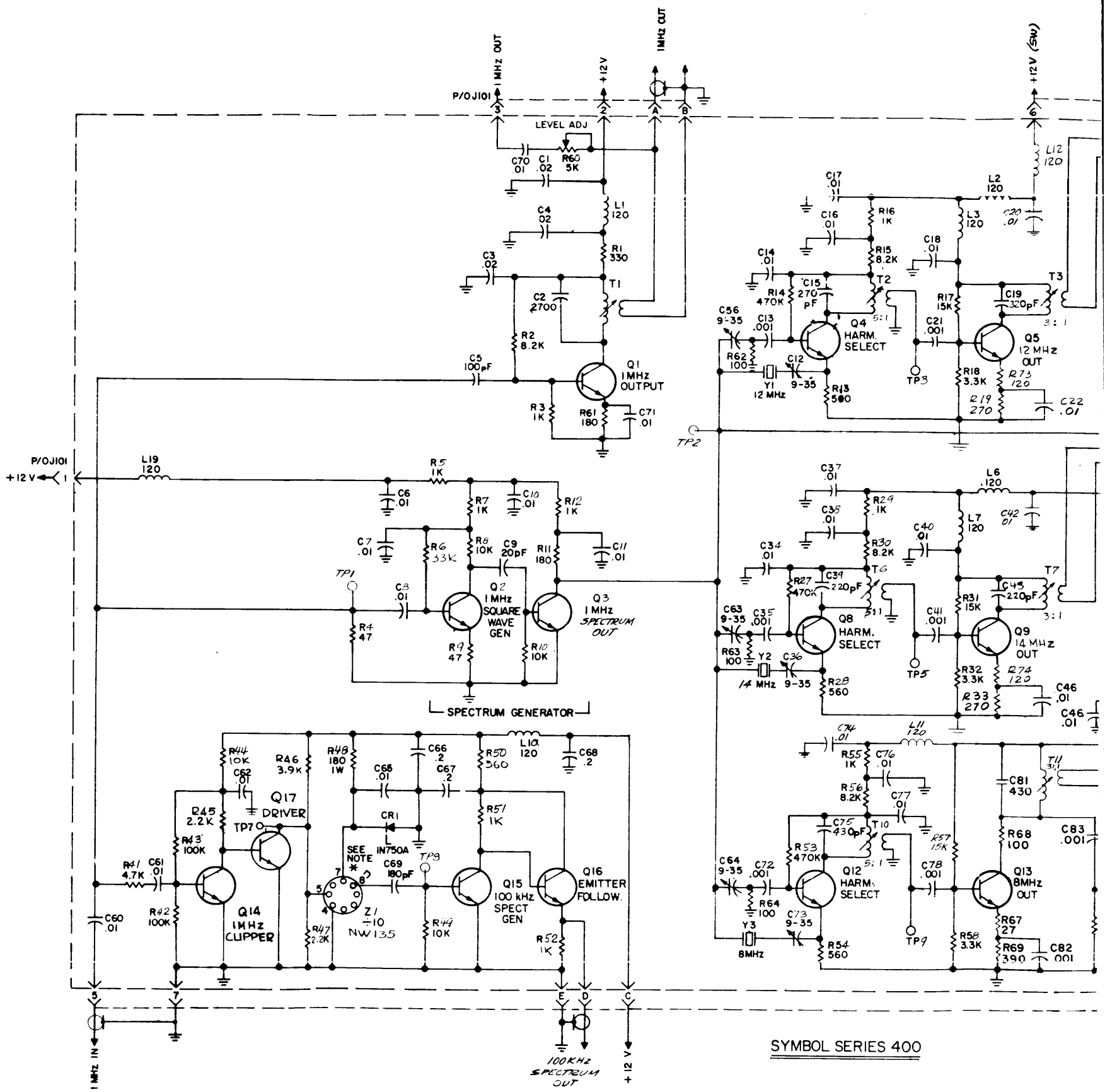
NOTE *

"n" SYMBOL DENOTES FLAT SIGNIFYING PIN 8 ON NETWORK.

UNLESS OTHERWISE SPECIFIED

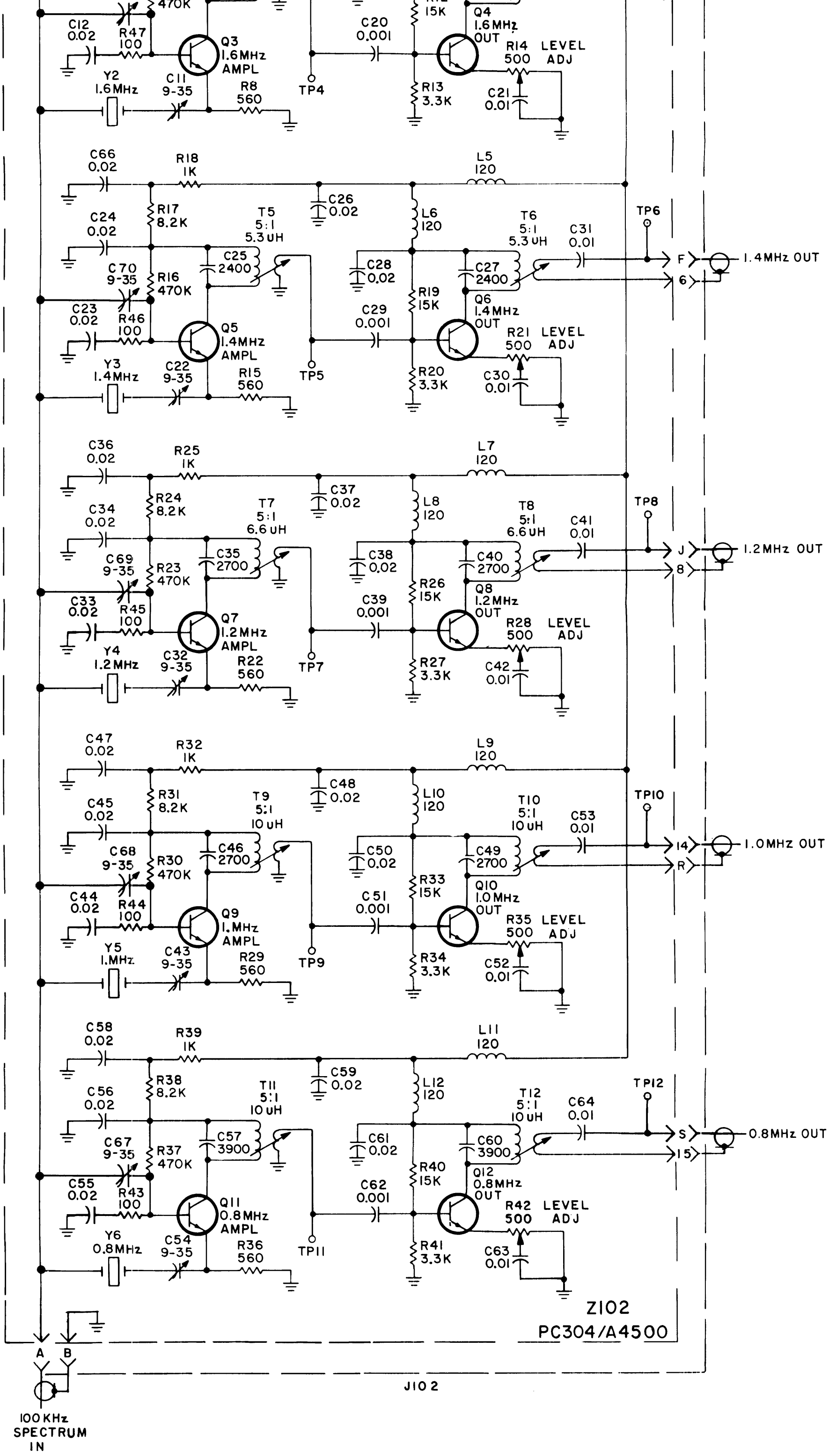
1. ALL RESISTANCE VALUES ARE IN OHMS, 1/4 W.
2. ALL DECIMAL CAPACITANCE VALUES ARE IN MICROFARADS, (.001) ALL WHOLE NUMBER VALUES ARE IN PICOFARADS, (100).
3. ALL INDUCTANCE VALUES ARE IN MICROHENRIES.
4. ALL TRANSISTORS ARE TYPE "2N3646"

LAST SYMBOLS		MISSING SYMBOLS
C90	T12	
CR1	TP9	
L19	Y3	
Q19		
R78	Z1	



SYMBOL SERIES 400

Fig



002692040

Figure 7-3. Comb Filter Z102, Schematic Diagram

SYMBOL SERIES 500

UNLESS OTHERWISE SPECIFIED

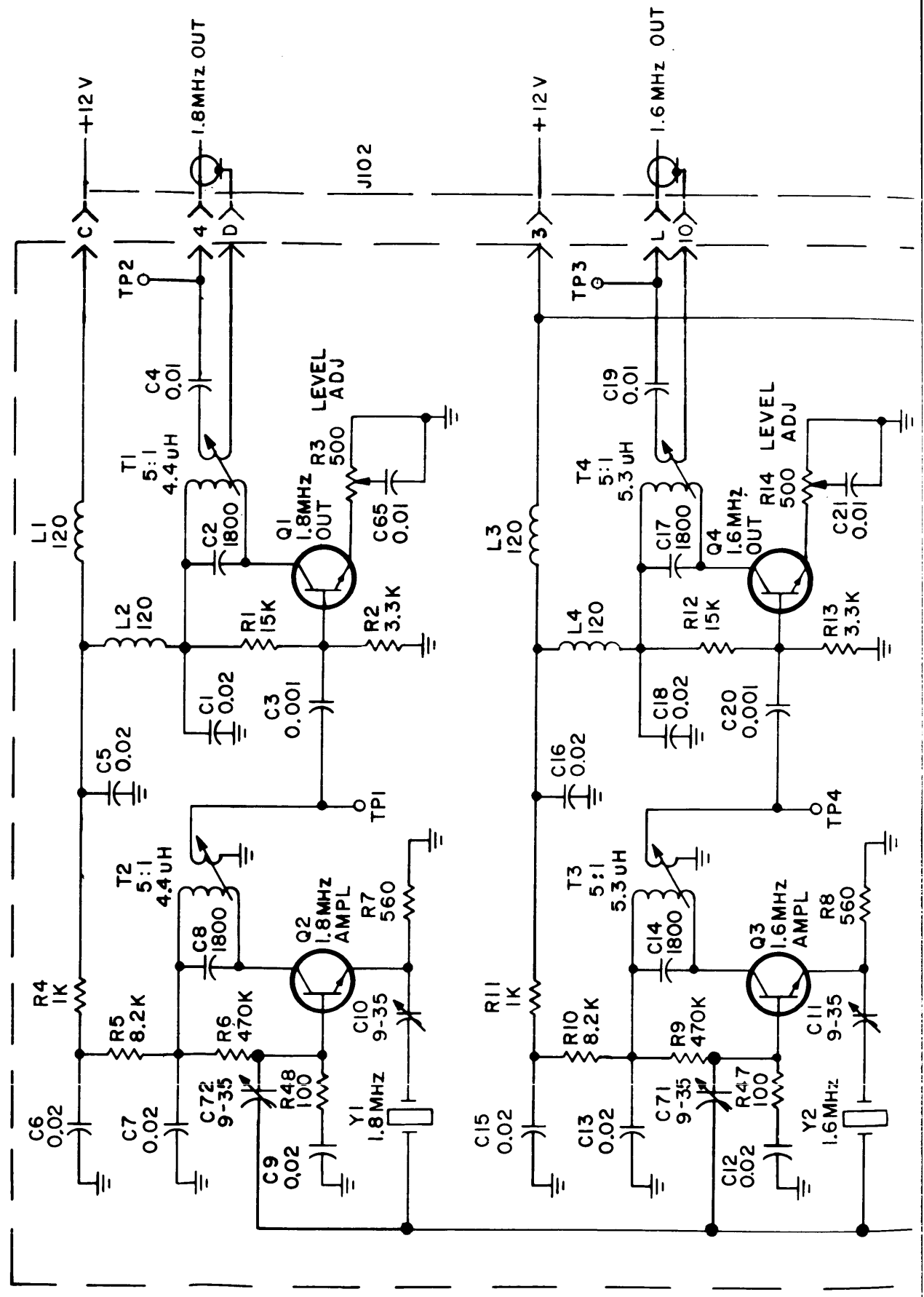
1- ALL RESISTANCE VALUES ARE IN OHMS, 1/4 W.

2- ALL DECIMAL CAPACITANCE VALUES ARE IN MICROFARADS, (.001)
ALL WHOLE NUMBER VALUES ARE IN PICOFARADS, (1800).

3- ALL INDUCTANCE VALUES ARE IN MICROHENRIES.

4- ALL TRANSISTORS ARE TYPE "2N3646".

LAST SYMBOL	MISSING SYMBOL
C72	
L12	
Q12	
R48	
T12	
TP12	
Y6	



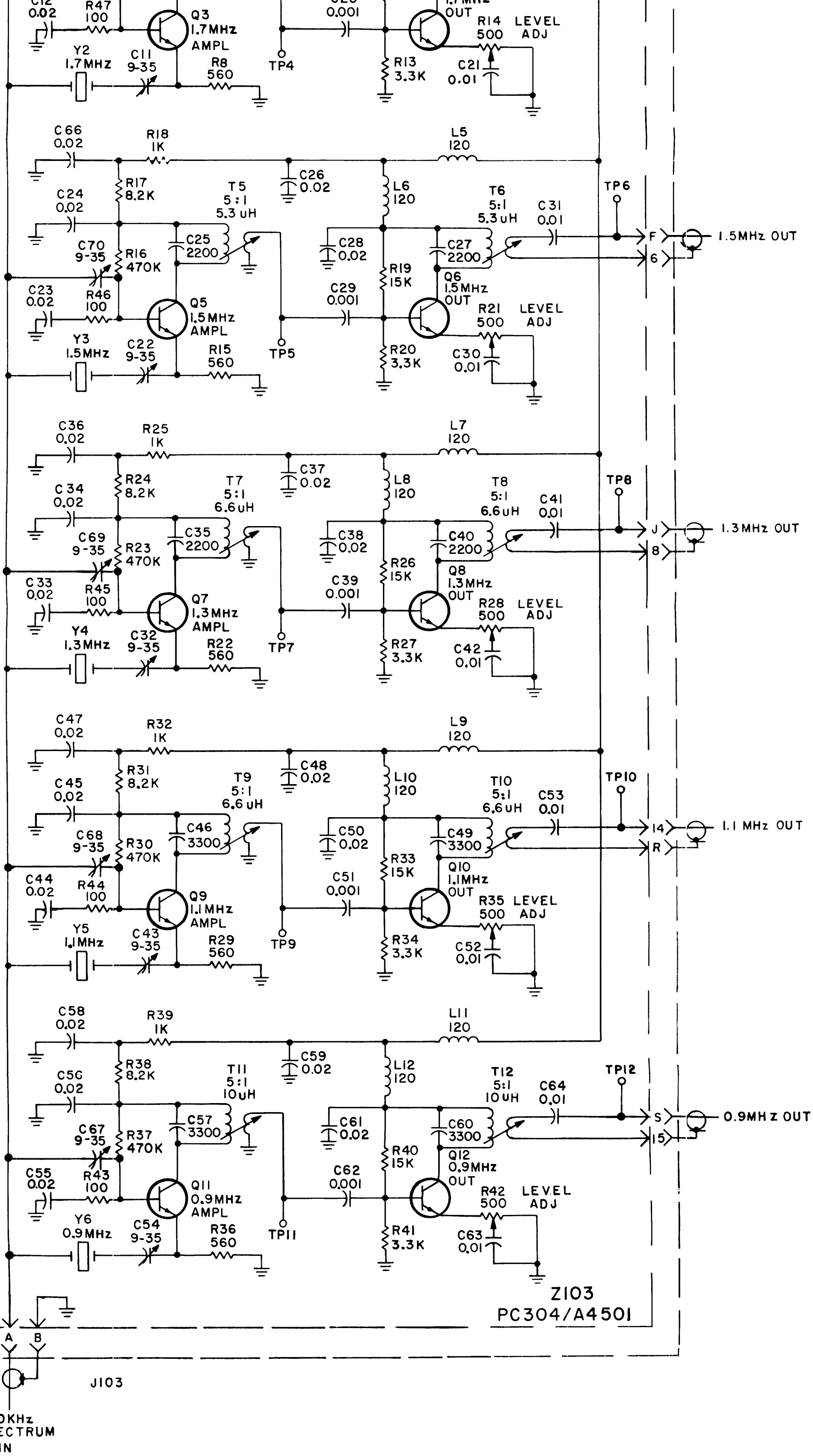


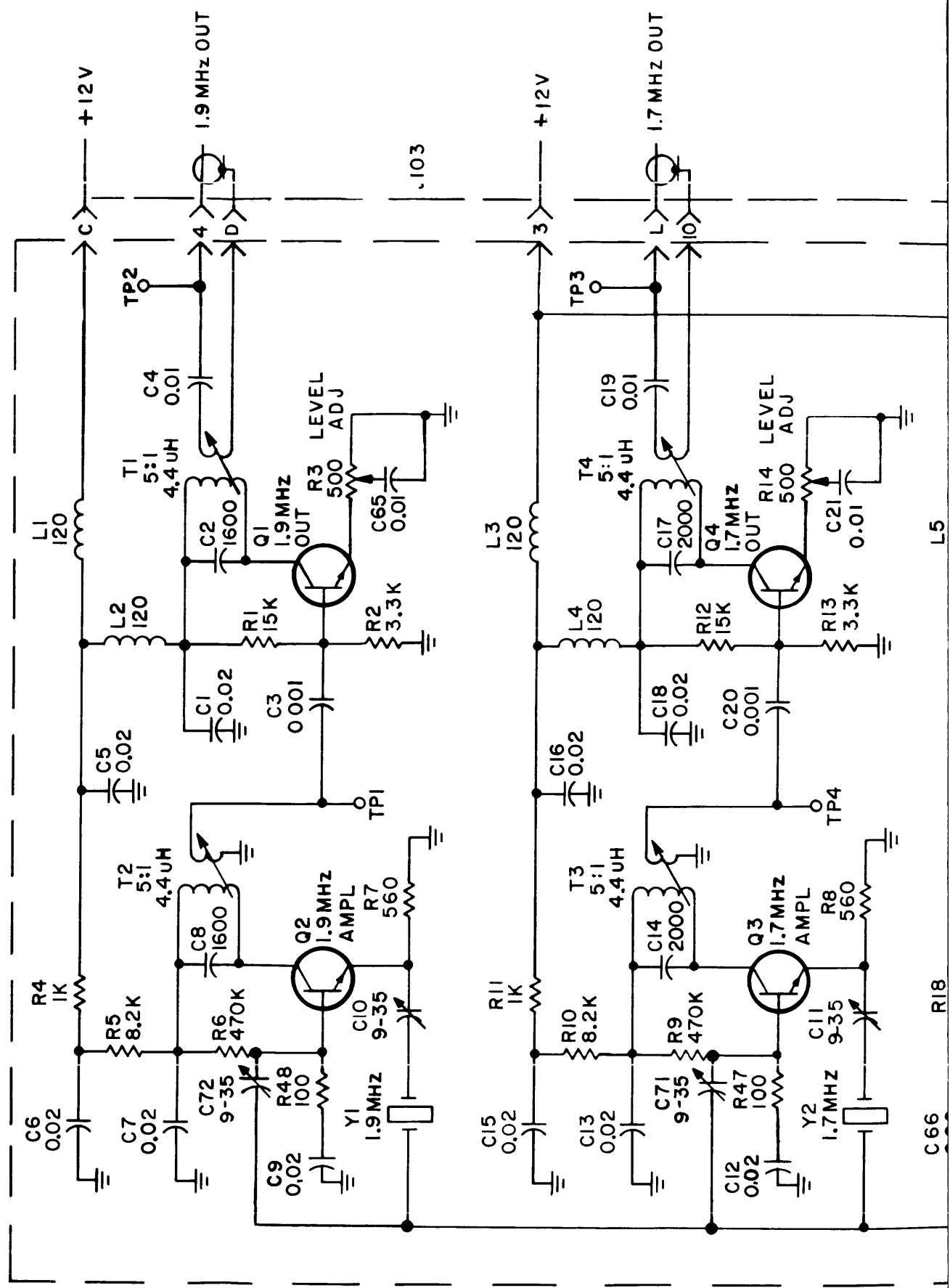
Figure 7-4. Comb Filter Z103, Schematic Diagram

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	



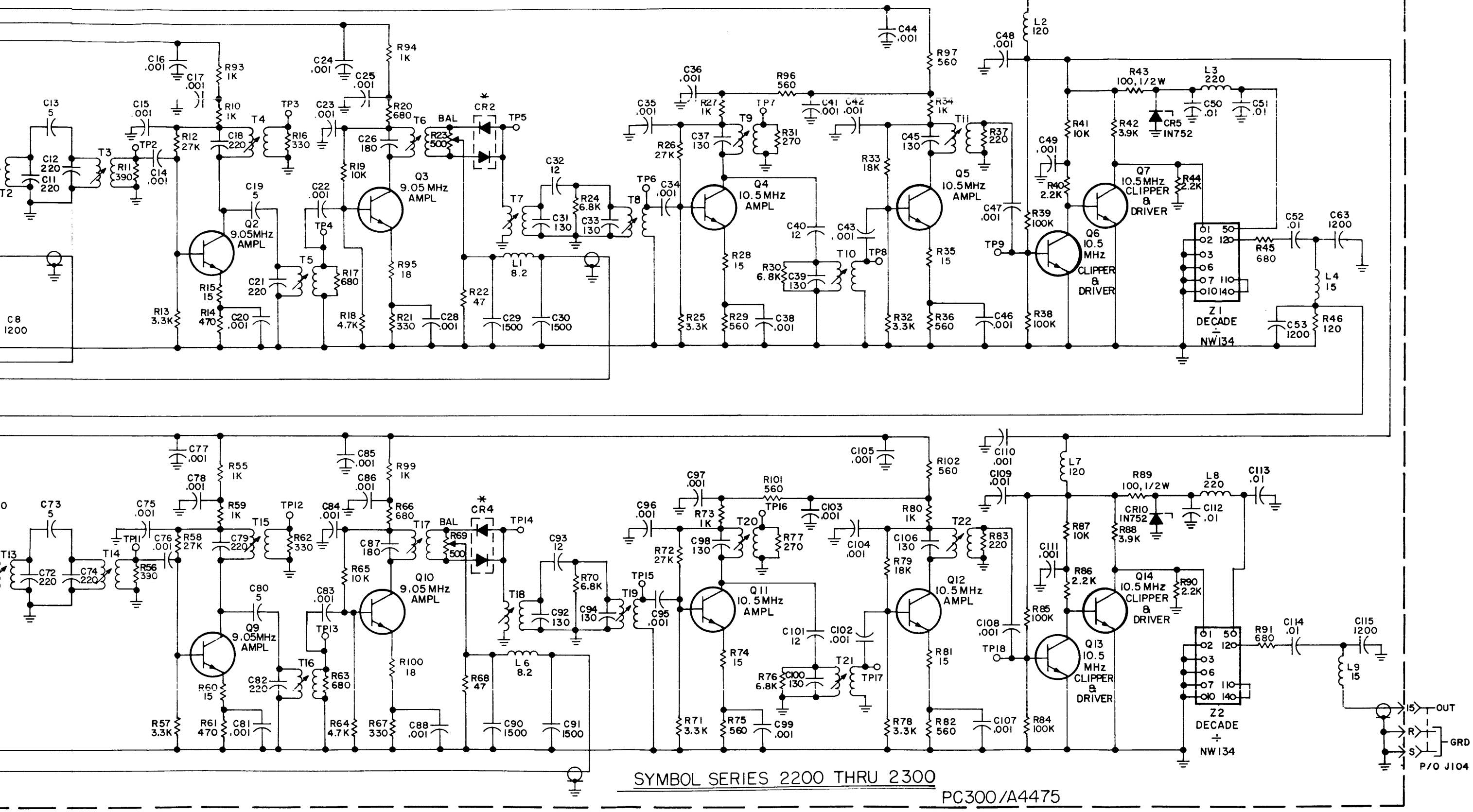


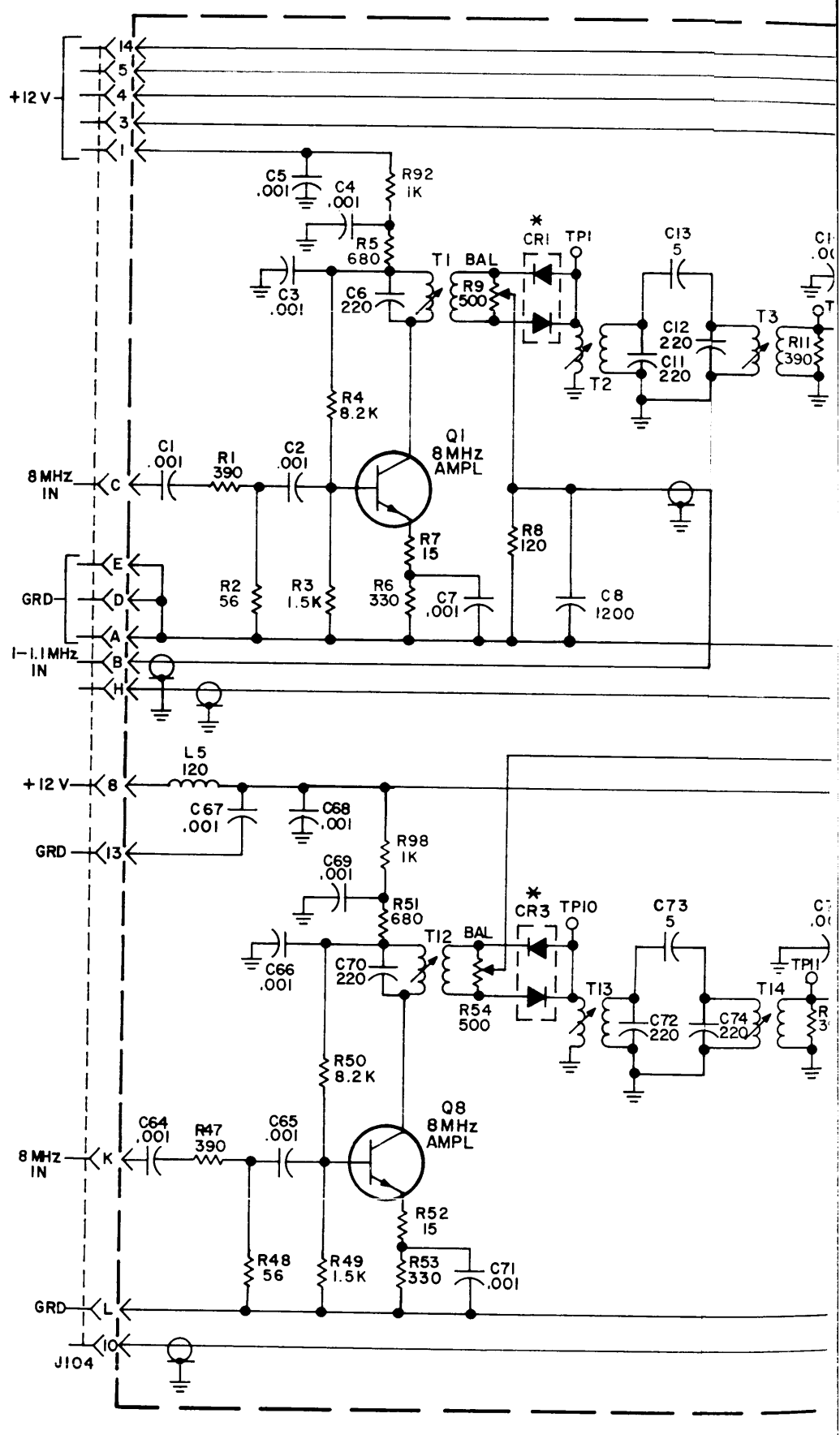
Figure 7-5. Mixer-Divider (Dual) Z104 and Z105, Schematic Diagram

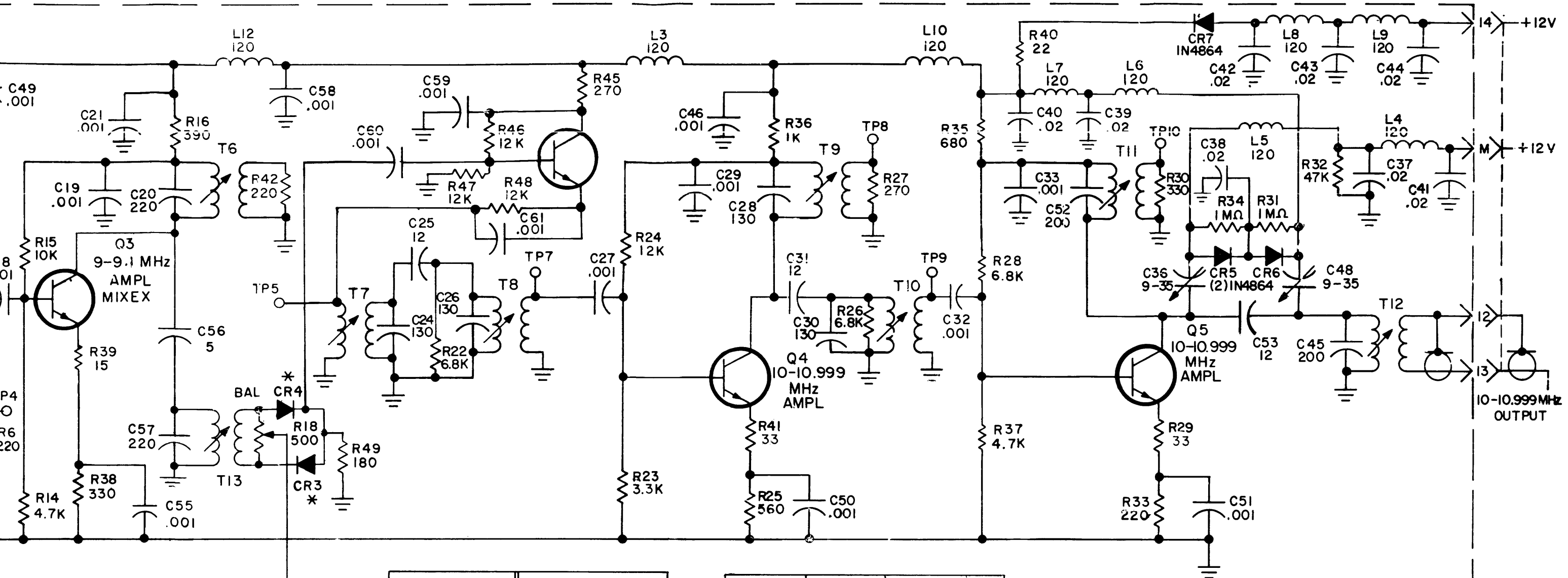
UNLESS OTHERWISE SPECIFIED

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	





LAST SYMBOLS	MISSING SYMBOLS
C61	C9,C34
CR7	
L12	L1
Q6	
R49	
T13	
TP 0	TP6

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

SYMBOL SERIES 800

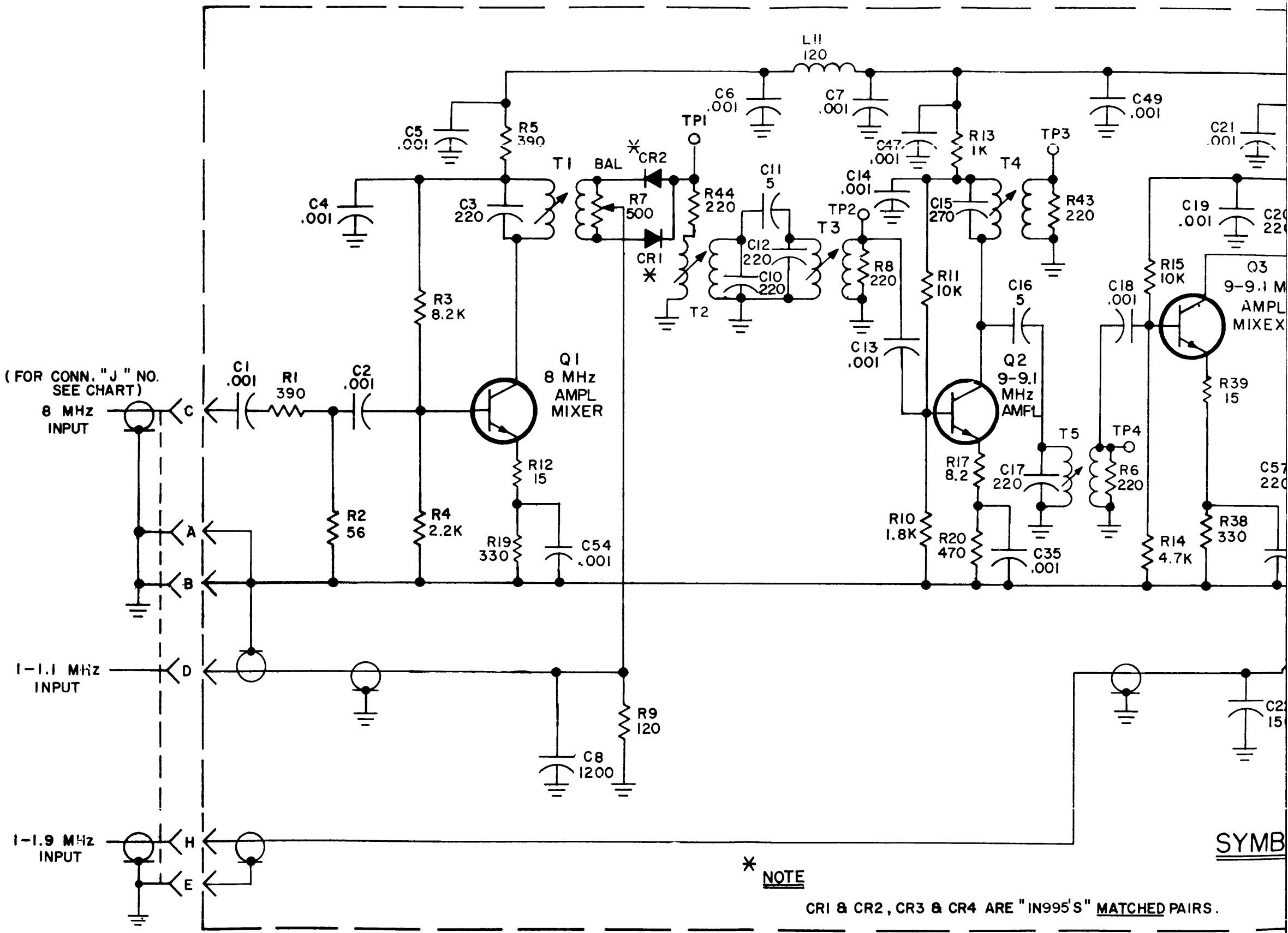
UNLESS OTHERWISE SPECIFIED

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".

PC302/A4479
(SEE CHART)

TCHED PAIRS.

Figure 7-6. Mixer-Final Z106, Schematic Diagram


L11
120
C6
.001
C7
.001
C49
.001
C5
.001
R5
390
TP1
T1
BAL
CR2
C4
.001
C3
220
R7
500
R44
220
C11
5
C47
.001
R13
1K
TP3
T4
C14
.001
TP2
T3
C15
270
R43
220
C19
.001
CR1
C12
220
C10
220
T2
R8
220
R11
10K
C16
5
C18
.001
R15
10K
Q3
9-9.1 M
AMPL
MIXEX
R3
8.2K
C13
.001
(FOR CONN. "J" NO.
SEE CHART)
8 MHz
INPUT
C
C1
.001
R1
390
C2
.001
Q1
8 MHz
AMPL
MIXER
Q2
9-9.1
MHz
AMPL
R39
15
R12
15
T5
TP4
R17
8.2
C17
220
R6
220
R2
56
R4
2.2K
R19
330
C54
.001
R10
1.8K
R20
470
C35
.001
R14
4.7K
R38
330
A
B
1-1.1 MHz
INPUT
D
R9
120
C8
1200
1-1.9 MHz
INPUT
H
E
SYMB
* NOTE
CR1 & CR2, CR3 & CR4 ARE "IN995'S" MATCHED PAIRS.

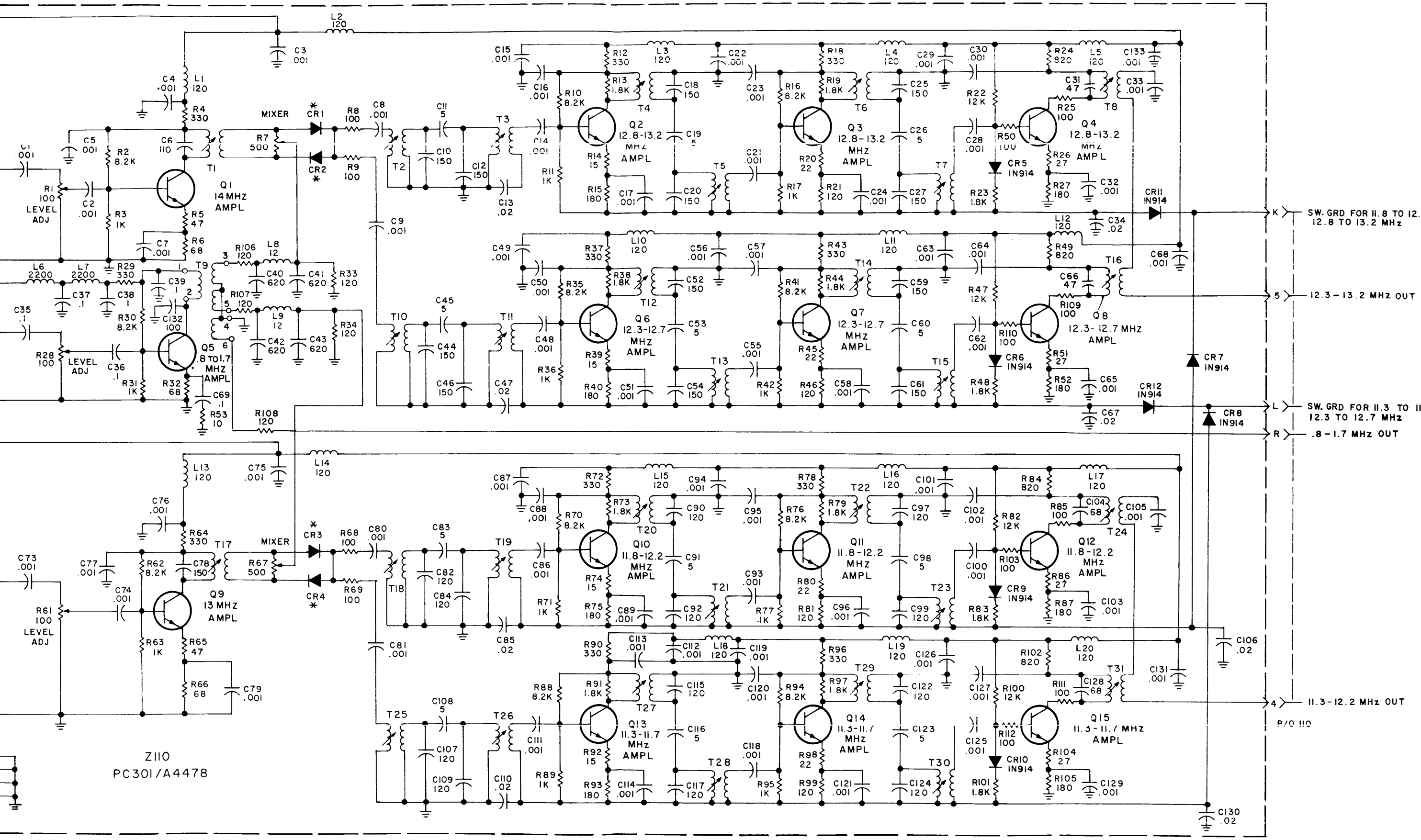


Figure 7-7. Step Generator Z110, Schematic Diagram

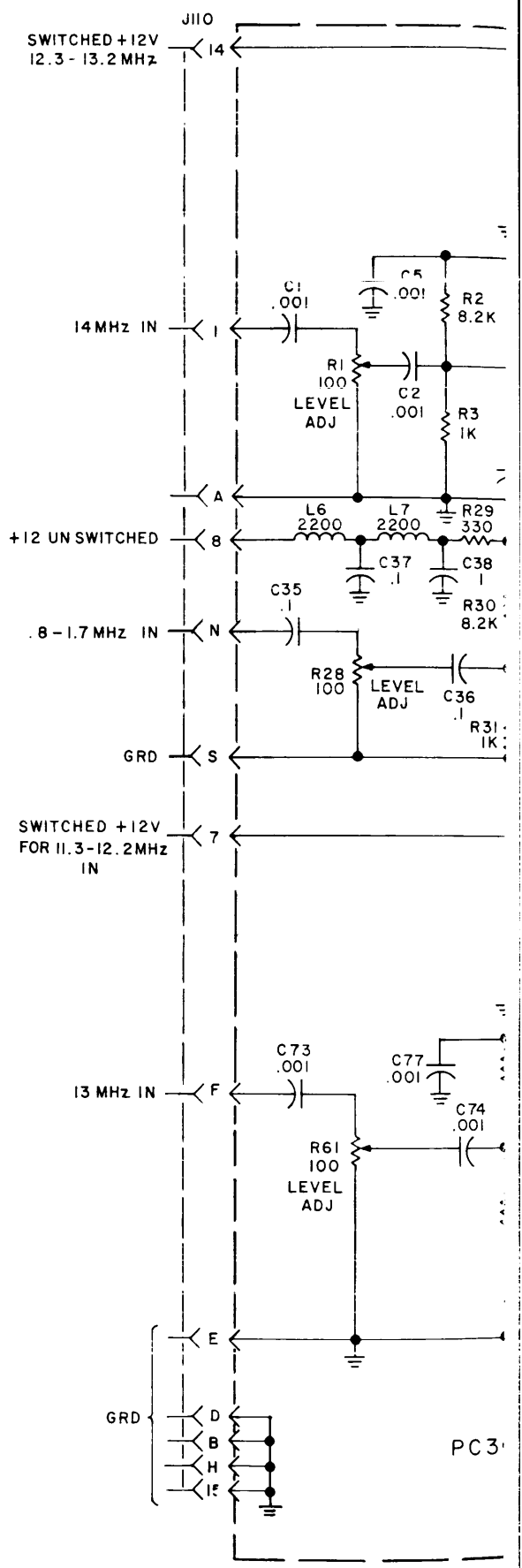
UNLESS OTHERWISE SPECIFIED

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	
R112	R54 THRU R60
T31	

SYMBOL SERIES 1200 - THRU 1300



P/O J111

1 — 52–56 MHz OUT

2 — 56.5–61 MHz OUT

3 — 61.5–66 MHz OUT

L13 10 · C36 100 · L14 120 · C37 .001

L8 120 · C28 .001 · L9 120 · L10 120 · L11 47 · L12 120

C29 .001 · C33 .001 · C34 470 · C35 .001

Q4 X5 AMPL

R20 330 · C27 .001 · C30 15-60 · T5 · C32 100

R21 8.2K · C65 100 · Q5 AMPL · C26 .001

R22 1K · R24 10 · R47 47 · R23 150 · C31 .001

FL 2
BAND PASS FILTER
56.5-61 MHz
FX281

R30 330 · C42 100 · C38 .001 · C41 15-60 · T6

R27 8.2K · Q6 AMPL · C39 .001

R25 47 · R26 1K · R29 10 · C40 .001 · R28 150

L20 10 · C57 100 · L21 120 · C58 .001

R34 5.6K · L15 120 · C46 .001 · C50 .001 · L16 120 · L17 120 · L18 47 · L19 120

C45 9-35 · T7 · Q7 X5 AMPL

C51 .001 · C54 .001 · C55 470 · C56 .001

R33 39K · R32 3.9K · R35 330 · C47 .001 · C49 9-35 · T8 · C53 100

C43 .001 · C66 100 · R36 8.2K · Q8 AMPL · C44 .001 · R31 68 · C48 .001

R37 1K · R39 10 · R48 47 · R38 150 · C52 .001

FL 3
BAND PASS FILTER
61.5-66 MHz
FX282

R45 330 · C63 100 · C59 .001 · C62 9-35 · T9

R42 8.2K · Q9 AMPL · C60 .001

R44 10 · R41 1K · R40 47 · C61 .001 · R43 150

NOTE: UNLESS OTHERWISE SPECIFIED

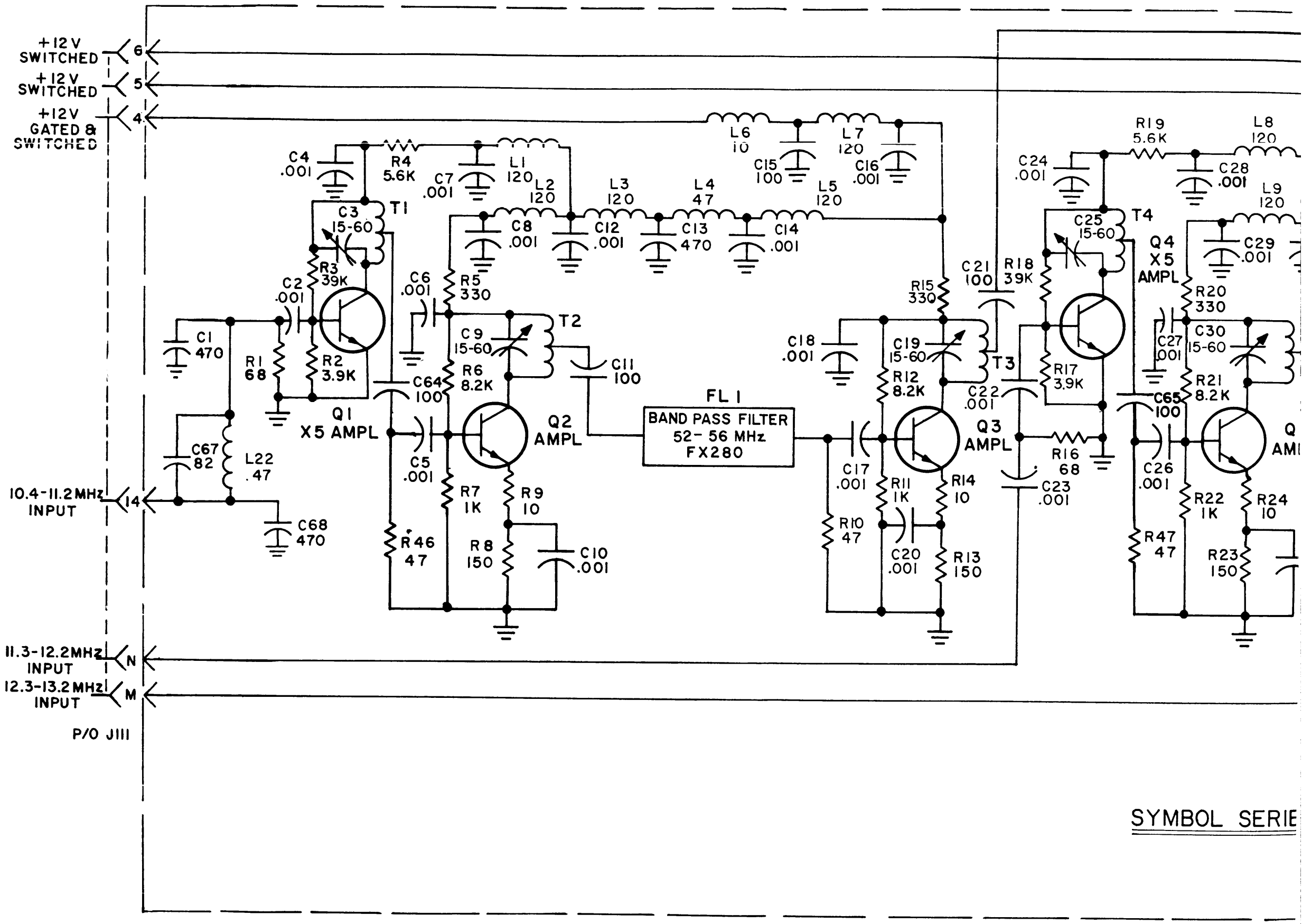
1-ALL RESISTANCE VALUES ARE IN OHMS, 1/4 W.
2-ALL DECIMAL CAPACITANCE VALUES ARE IN MICROFARADS.
ALL WHOLE NUMBER VALUES ARE IN PICOFARADS.
3-ALL INDUCTANCE VALUES ARE IN MICROHENRIES.
4-ALL TRANSISTORS ARE TYPE "2N3646".

PC322/A4504
Z111

SYMBOL SERIES 1400

LAST SYMBOLS	MISSING SYMBOLS
C68	
L22	
Q9	
R48	
T9	
FL3	

Figure 7-8. Step Generator Z111, Schematic Diagram



SYMBOL SERIE

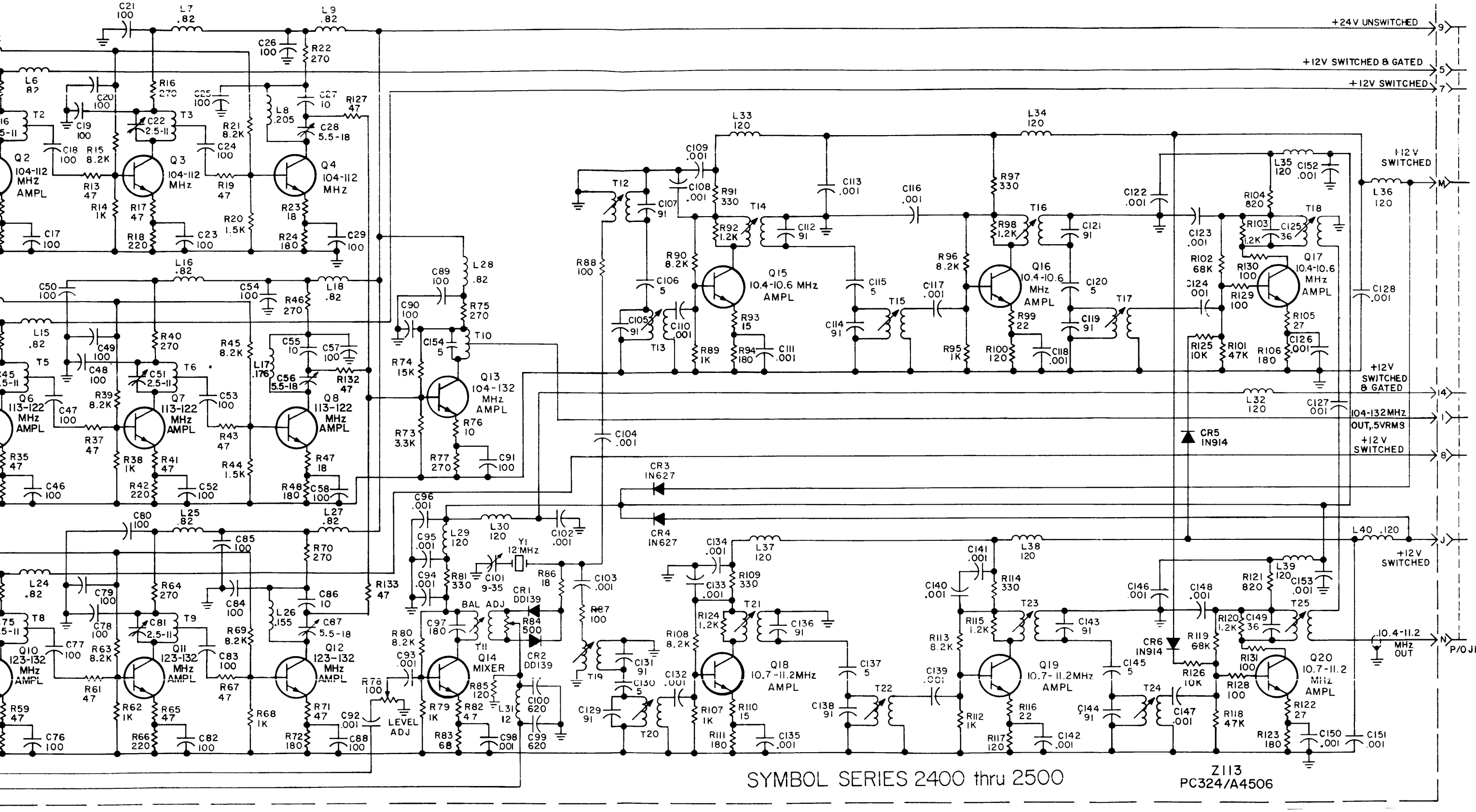


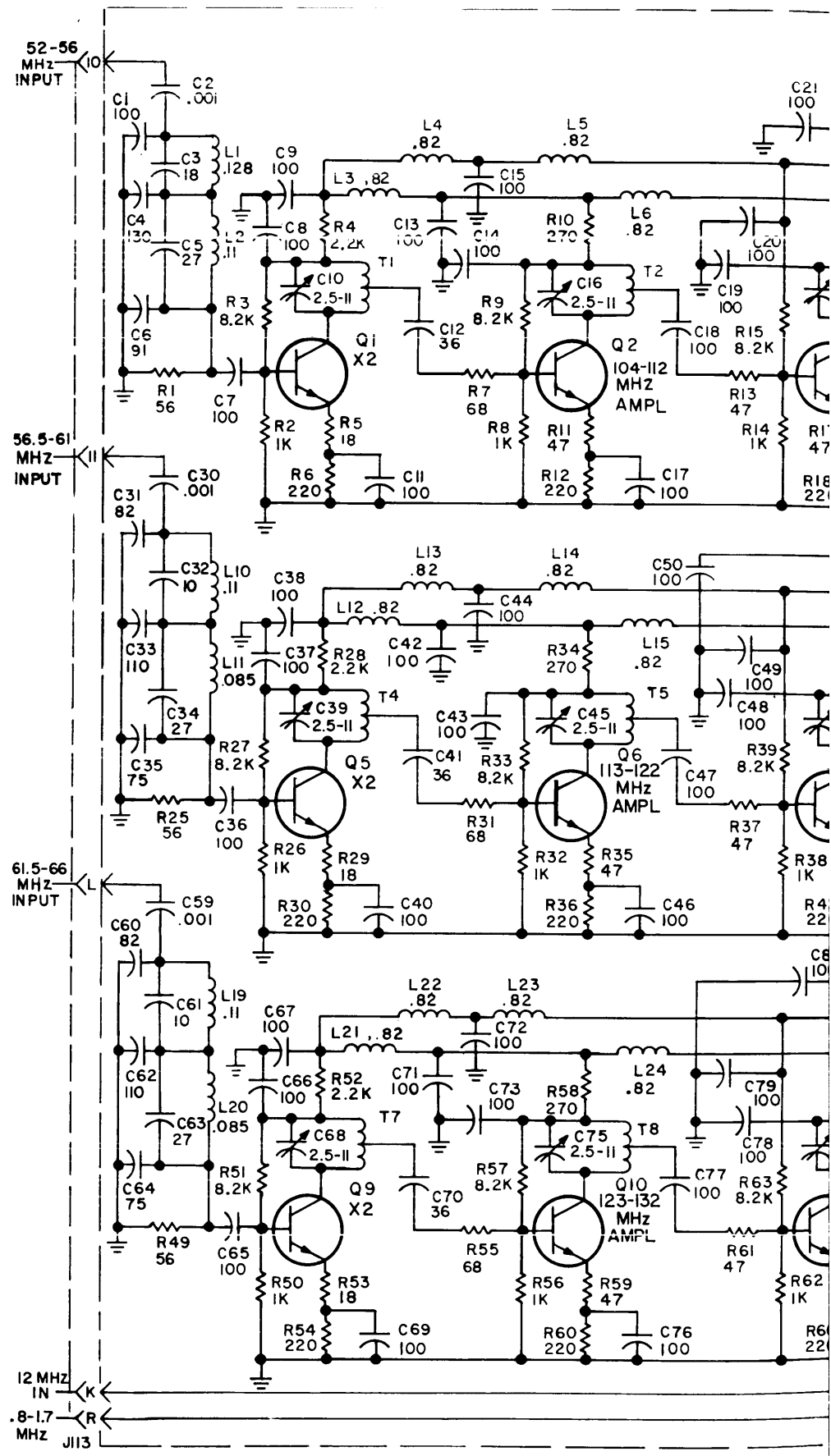
Figure 7-9. Step Generator Z113, Schematic Diagram

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	



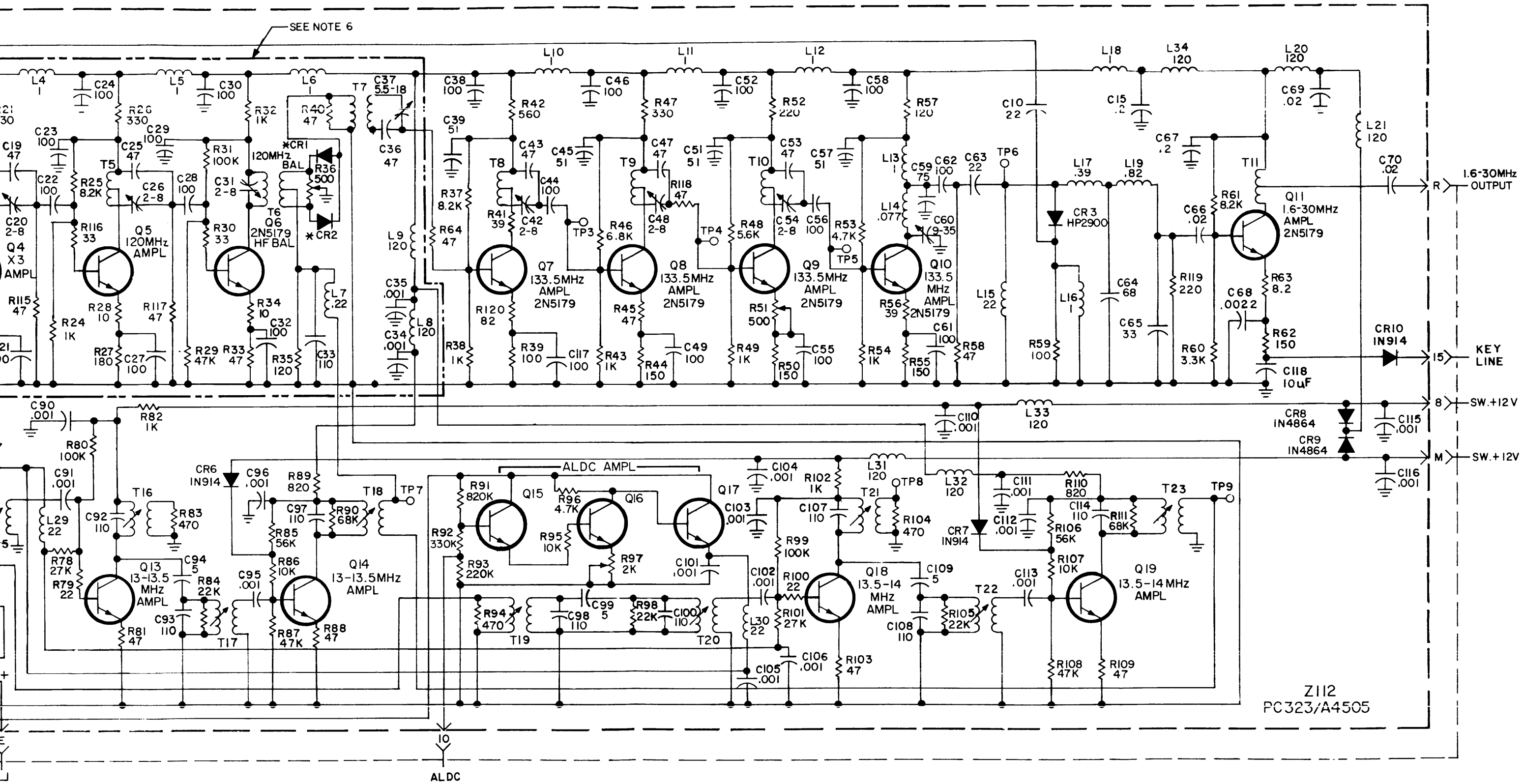


Figure 7-10. Translator Z112, Schematic Diagram

NOTES:
UNLESS OTHERWISE SPECIFIED

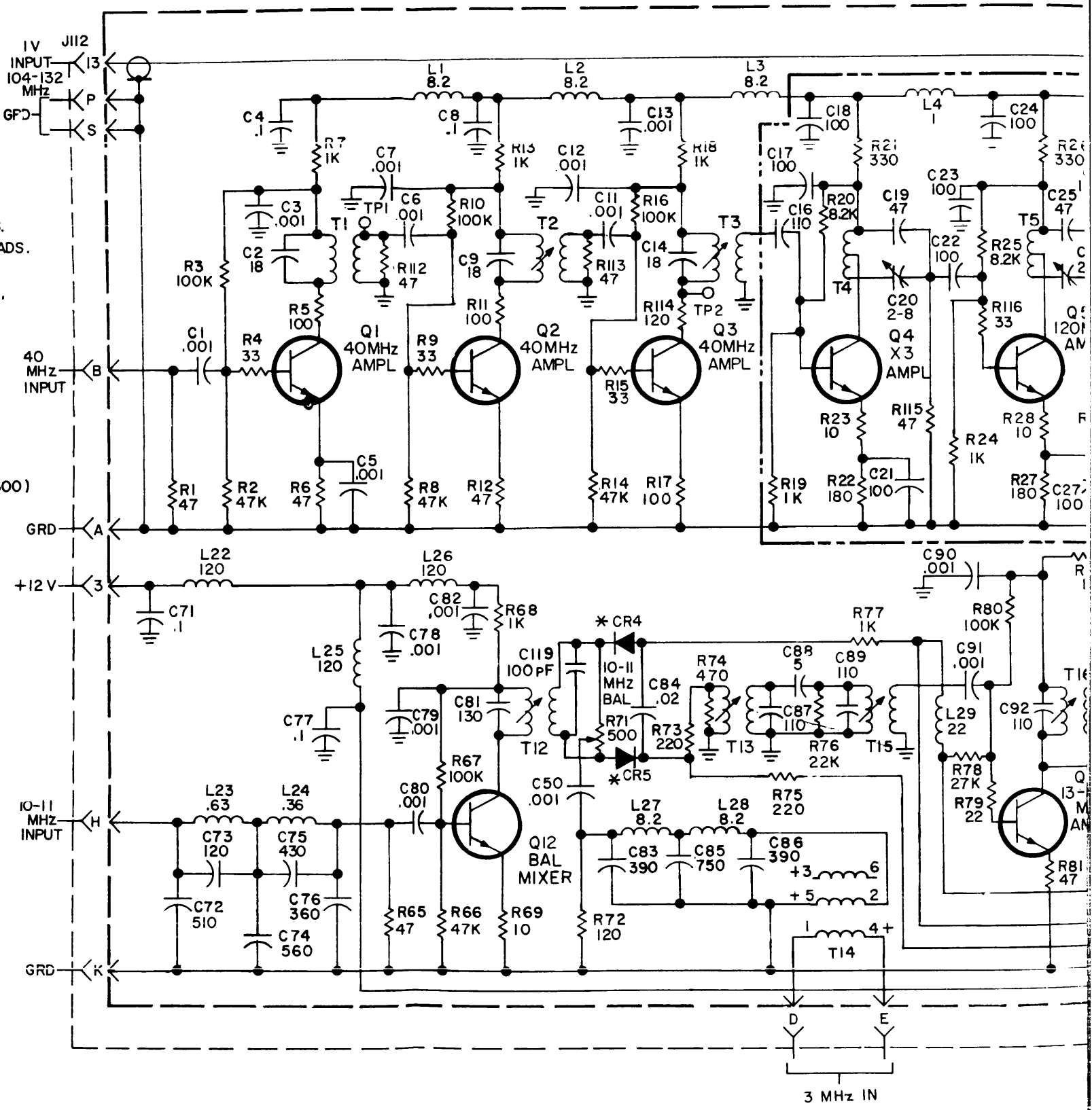
1- ALL RESISTANCE VALUES ARE IN OHMS, 1/4 W.
2- ALL DECIMAL CAPACITANCE VALUES (.001) ARE IN MICROFARADS.
ALL WHOLE NUMBER CAPACITANCE VALUES (47) ARE IN PICOFARADS.
3- ALL INDUCTANCE VALUES ARE IN MICROHENRIES.
4- ALL TRANSISTORS (EXCEPT THOSE INDICATED) ARE "2N3646".
*5- CR1 & CR2, CR4 & CR5 ARE "HP8403'S", 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	
R120	R70
T23	
TP9	

SYMBOL SERIES 2000 & 2100



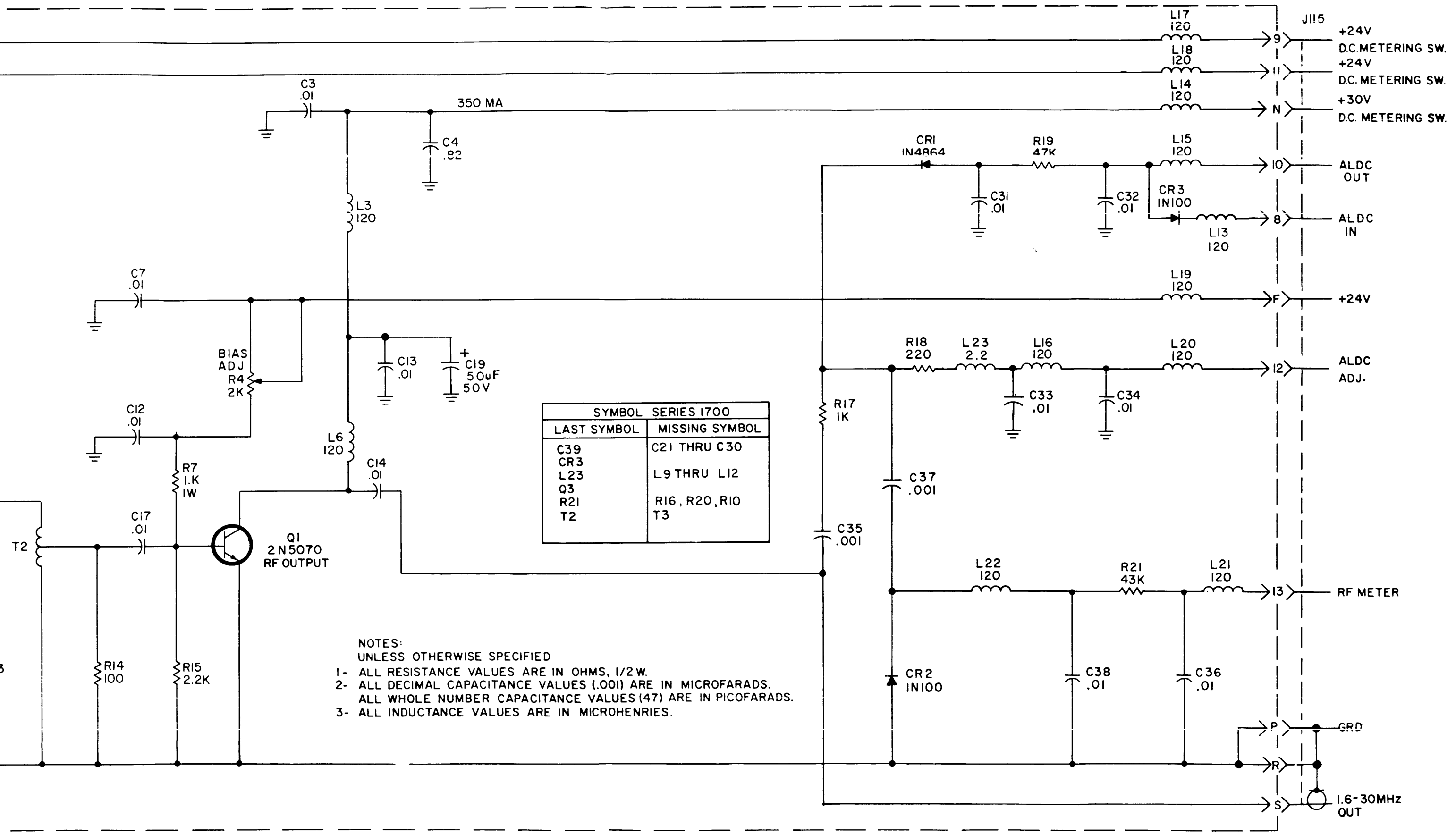
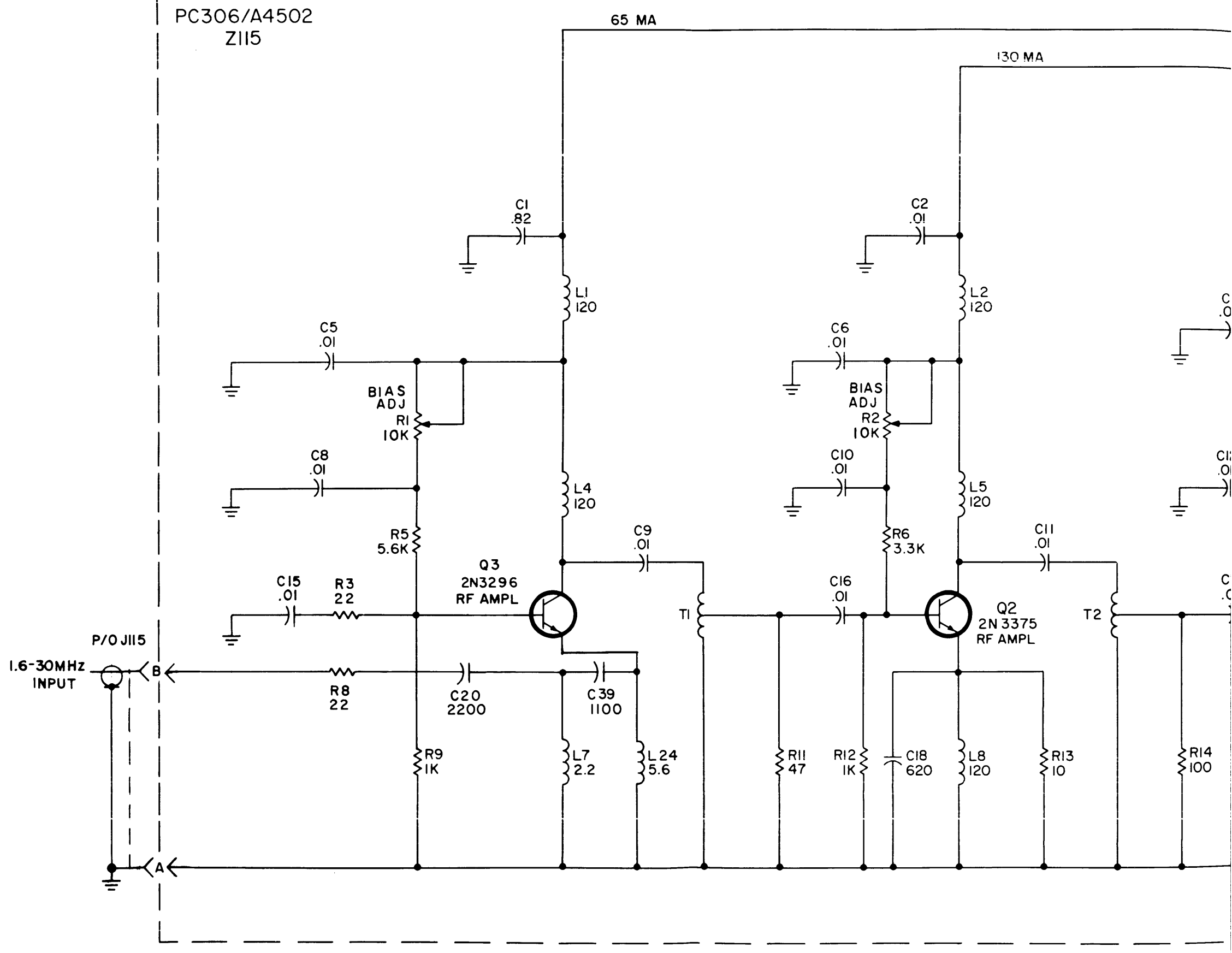


Figure 7-11. RF Output Z115, Schematic Diagram

PC306/A4502
Z115



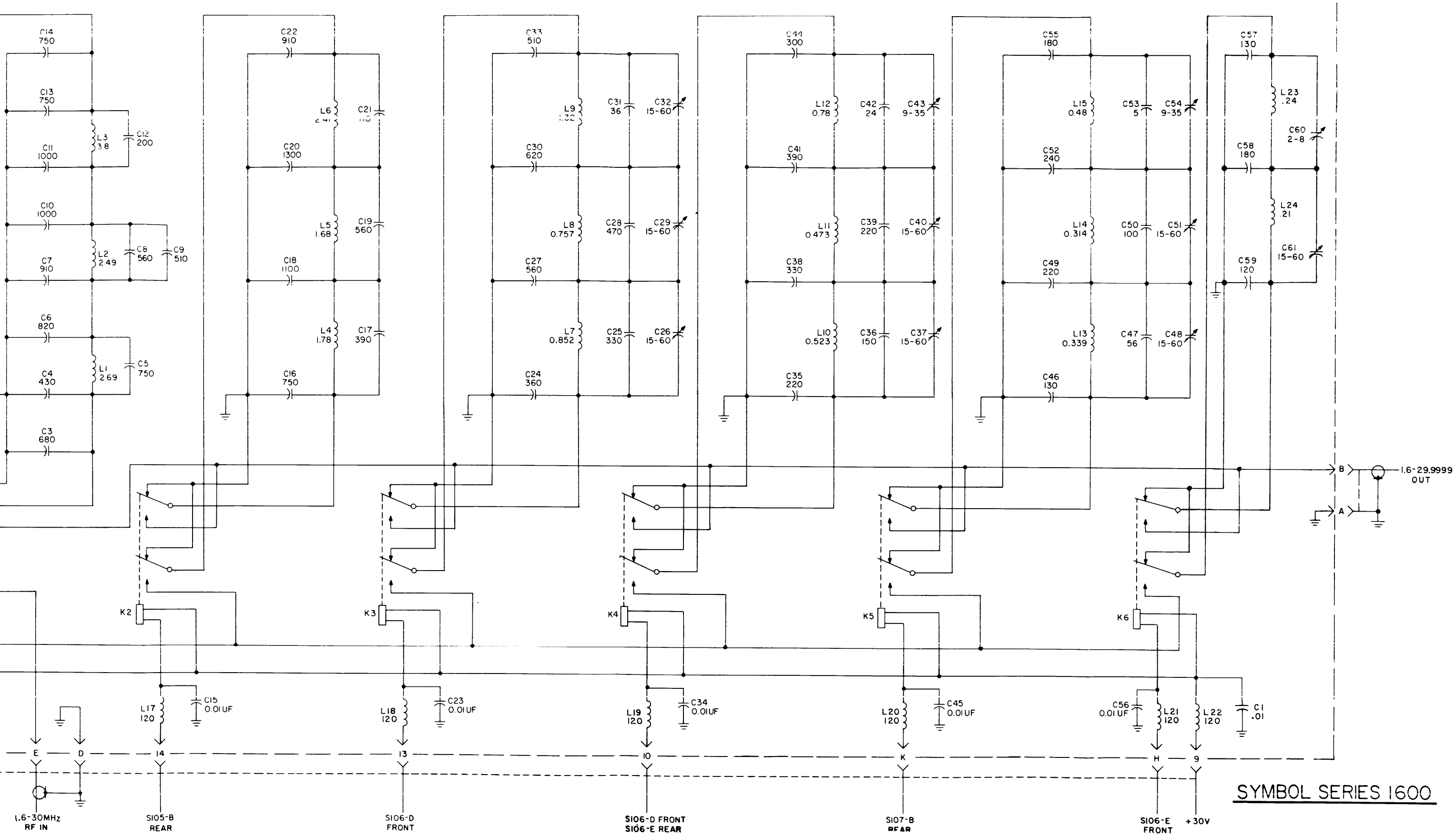


Figure 7-12. RF Output Filter Z114, Schematic Diagram

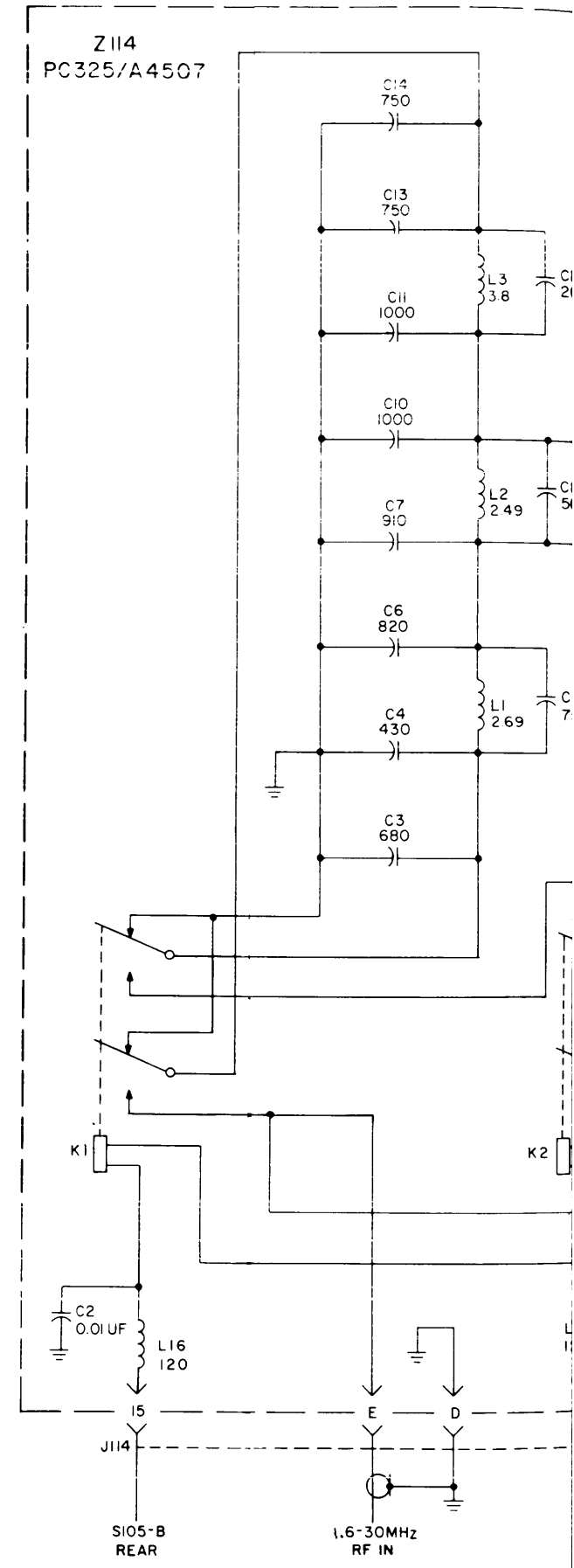
NOTE:

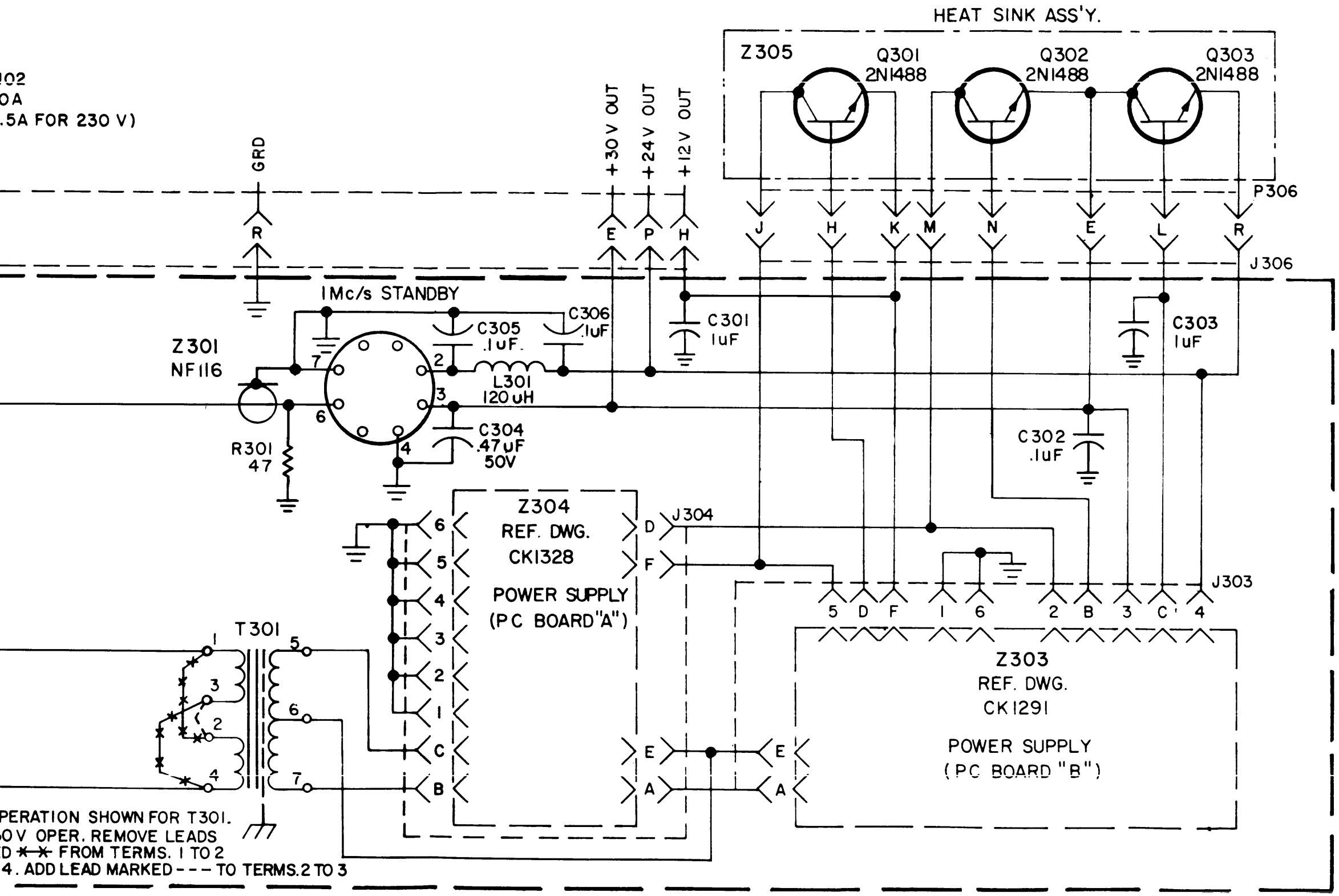
UNLESS OTHERWISE SPECIFIED

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.

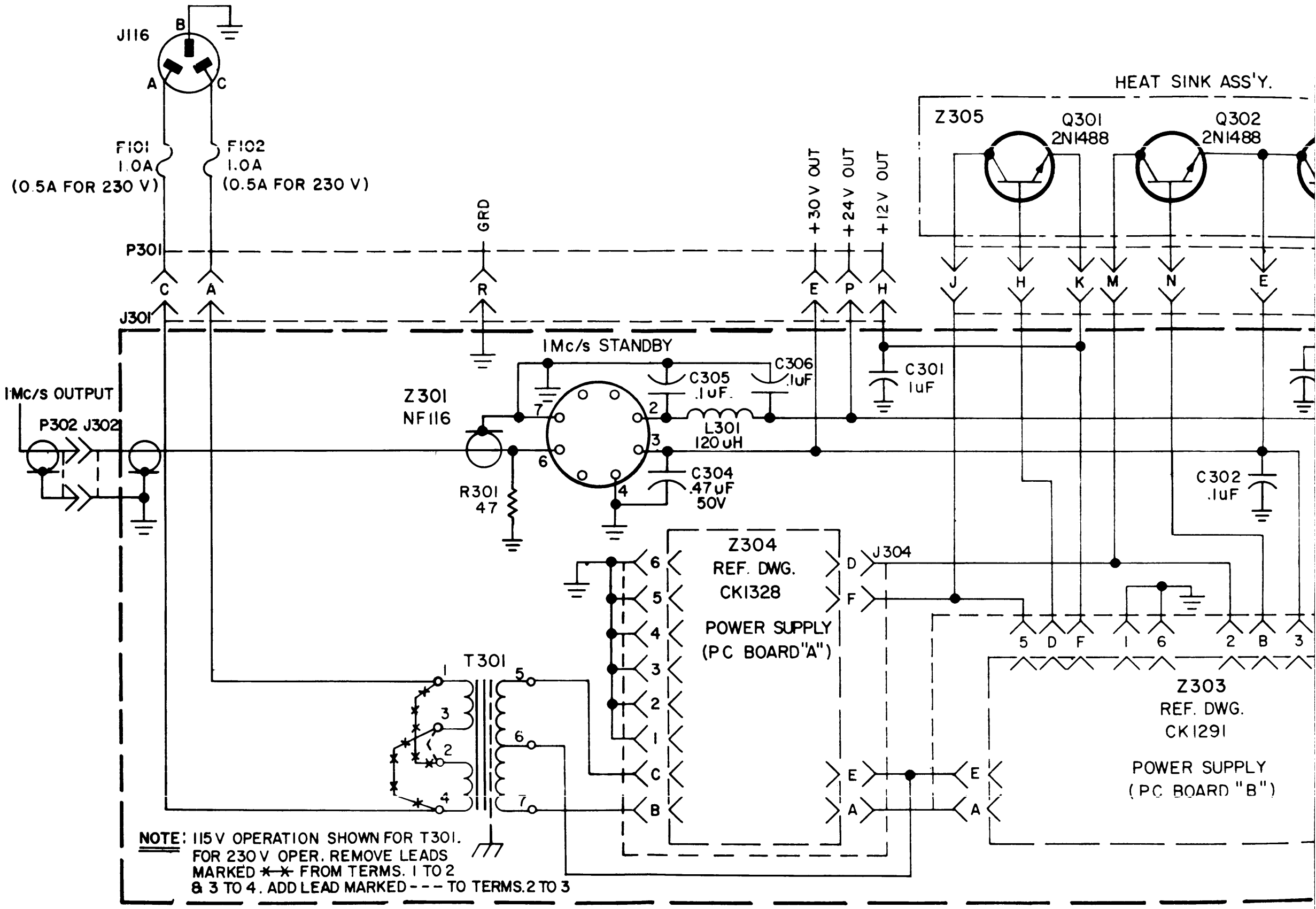
SYMBOL SERIES 1600	
LAST SYMBOL	MISSING SYMBOL
C61 K6 L24	





LAST SYMBOLS	MISSING SYMBOLS
C306	
J306	J305
L301	
P306	P305,P303,P304
R301	
Q303	
T301	
Z305	Z302

Figure 7-13. Power Supply Wiring Diagram


J116
B
A
C
F101
1.0A
(0.5A FOR 230 V)
F102
1.0A
(0.5A FOR 230 V)
P301
J301
GRD
+30 V OUT
+24 V OUT
+12 V OUT
HEAT SINK ASS'Y.
Z305
Q301
2N1488
Q302
2N1488
1Mc/s OUTPUT
P302 J302
1Mc/s STANDBY
Z301
NF116
C305
.1uF
C306
.1uF
C301
1uF
L301
120uH
C304
.47uF
50V
C302
.1uF
R301
47
Z304
REF. DWG.
CK1328
POWER SUPPLY
(PC BOARD "A")
J304
T301
Z303
REF. DWG.
CK1291
POWER SUPPLY
(PC BOARD "B")
NOTE: 115 V OPERATION SHOWN FOR T301.
FOR 230 V OPER. REMOVE LEADS
MARKED ✶–✶ FROM TERMS. 1 TO 2
& 3 TO 4. ADD LEAD MARKED - - - TO TERMS. 2 TO 3

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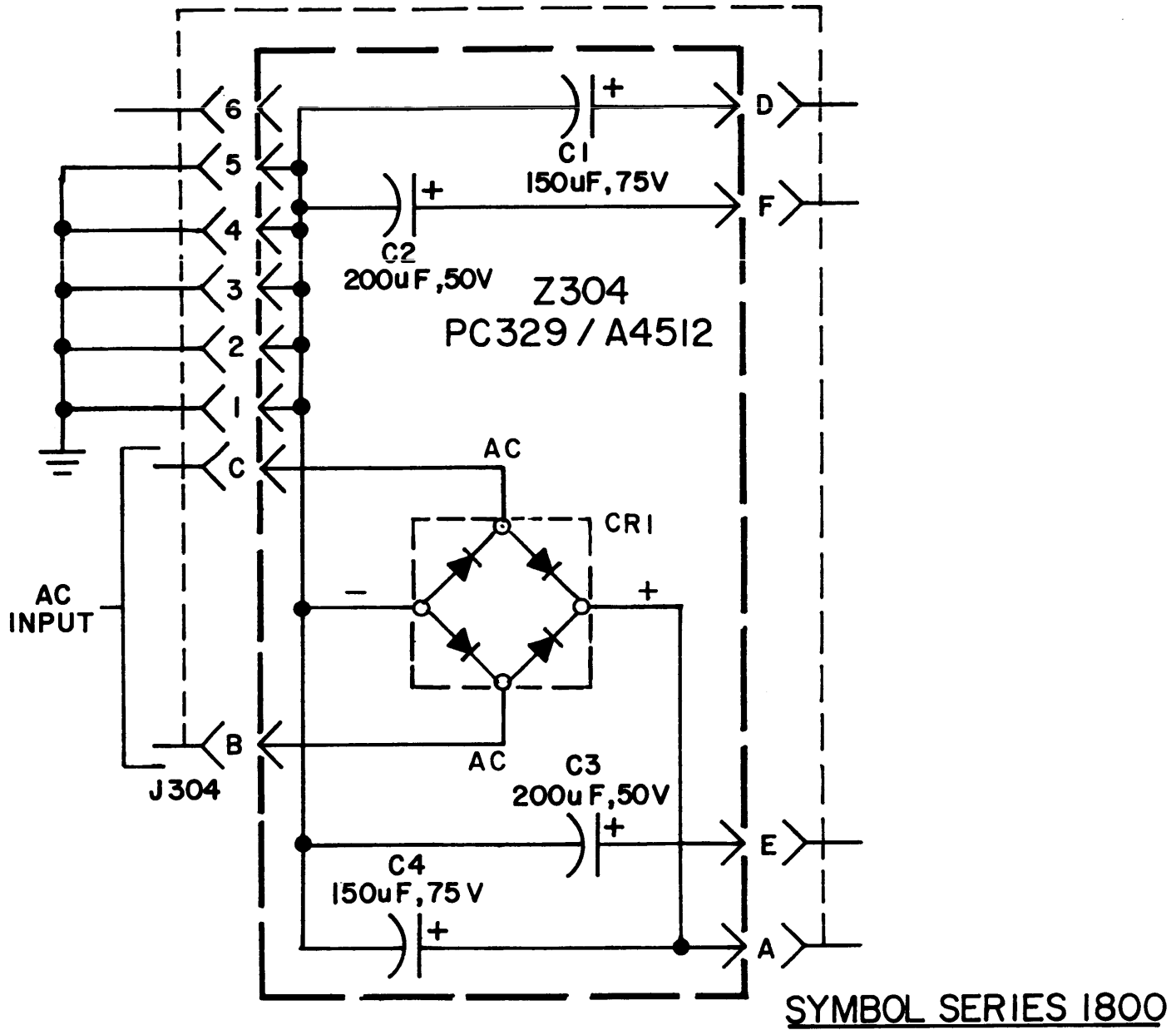


Figure 7-14. Power Supply Z304, Schematic Diagram

Z303
A4513/PC330

P/O J303

+12V

+24V

F 5 D 2 B 4

Q1 2N1481

Q2 2N1481

Q3 2N1481

R2 1K

R10 1.5K

3

C

P/O J303

R1 470

C1 25 50V

C2 25 50V

R4 1K

R5 1K

R6 10K

Q4 2N3638

Q5 2N1481

Q6 2N3638

C3 25 50V

Q7 2N1481

C4 25 50V

R18 10K

24V ADJ

12V CUR ADJ

R3 1K

CR1 IN100

R7 1K

12V ADJ

R8 1K

24V CUR ADJ

R12 1K

CR2 IN100

CR6 IN972B

C5 25 50V

CR7 IN753A

R16 4.7K

R11 1 5W

R15 1 5W

CR3 IN4619

CR4 IN753A

CR5 IN4619

R17 150

R14 1K

R19 150

R9 4.7K

R13 6.8K

E 1 6 A

P/O J303

+20V GRD +40V

SERIES 1900

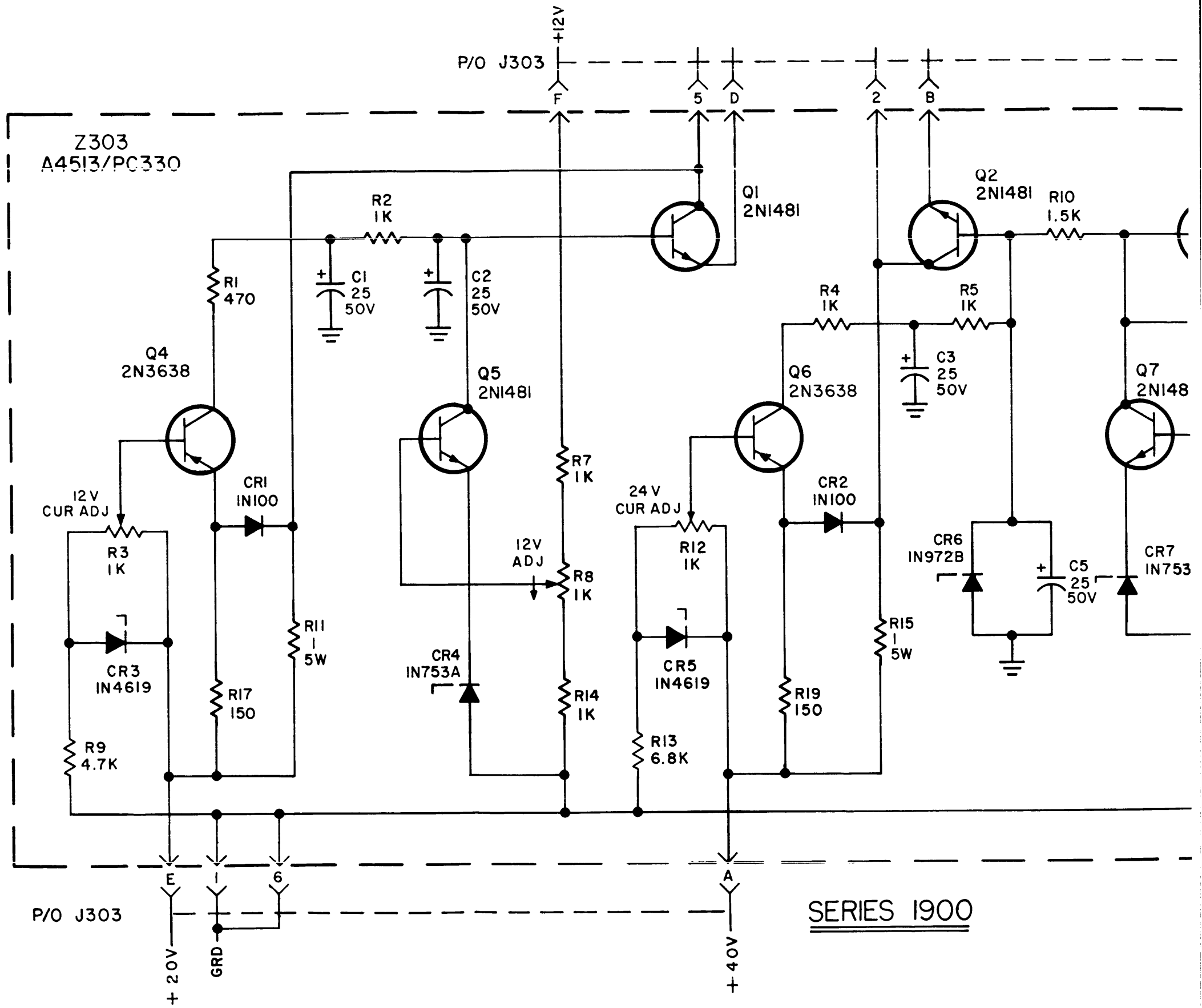
SYMBOLS	
LAST	MISSING
C1905 CR1907 Q1907 R1919	

UNLESS OTHERWISE SPECIFIED:

ALL RESISTANCE VALUES ARE IN OHMS, 1/4 WATT.

ALL CAPACITANCE VALUES ARE IN MICROFARADS.

Figure 7-15. Power Supply Z303, Schematic Diagram



SERIES 1900

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