PRELIMINARY

TECHNICAL MANUAL
for

LOW FREQUENCY EXCITER

MODEL LFE-( )

THE TECHNICAL MATERIEL CORPORATION

MAMARONECK, N.Y. OTTAWA, CANADA

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• WORLD WIDE SUPPLIERS • OF ELECTRONIC COMMUNICATIONS EQUIPMENT

THE TECHNICAL MATERIEL CORPORATION

MAMARONECK, N.Y. **OTTAWA, CANADA**

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NOTICE

RECORD OF CORRECTIONS MADE

Change No.	Date of Change	Date Entered	Entered By

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

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Figure 1-1. Front Angle Low Frequency Exciter, Model LFE

SECTION 1
GENERAL INFORMATION

1-1. FUNCTIONAL DESCRIPTION

Low frequency Exciter, Model LFE (figure 1-1), is a solid-state exciter that provides rapid frequency selection in the 30kHz- to 1.99999 MHz (mc/s) frequency range in 10 Hz (cps) steps with built-in stability of 1 part in 10^8 per day. The exciter provides continuously adjustable 250 mw output in AM, SSB, and optional ISB modes of operation or an output of up to 1 watt for CW, FSK, and FAX modes of operation.

Optional capabilities of the exciter include; a choice of internal standards that provide stabilities of 1 part in 10^8 or 10^9 per day, and plug-in circuitry for independent sideband operation. Also available is optional equipment for direct remote control of the LFE and the associated transmitter (refer to Technical Specification for more details.)

A direct-reading meter (mounted on the front panel) allows visual monitoring of all critical circuits and the r-f ouput of the unit.

1-2. PHYSICAL DESCRIPTION

The exciter is designed for installation in a standard 19-inch wide equipment cabinet. All controls and indicators necessary for the operation of the unit are located on the front panel. Removable top and bottom protective metal covers are provided. The LFE is 19 inches wide, 17 inches deep, and 5-1/2 inches high; the unit weights approximately 30 pounds.

1-3. TECHNICAL SPECIFICATIONS.

FREQUENCY RANGE:	30kHz- to 1.99999 mHz in 10 Hz incremental steps. For remote tuning, see OPTIONS/ACCESSORIES.
FREQUENCY PRESENTATION:	Direct reading.
MODES OF OPERATION:	CW, AM, AME, SB, FSK, FAX, (ISB, optional extra).

1-3. TECHNICAL SPECIFICATIONS (Cont)

OUTPUT POWER:	Continuously adjustable from 0 to 1 watt CW, FSK, FAX. Continuously adjustable from 0 to 250 mw PEP SSB, ISB, AM.
OUTPUT IMPEDANCE:	50 ohms nominal.
FREQUENCY STABILITY:	A standard of 1 part in 10^8 stability. 1 part in 10^9 per day (optional with external standard).
FREQUENCY CONTROL:	All frequency determining elements referenced to a built-in 1 mHz source.
METERING:	Built in multi-meter allows monitoring of critical circuits and RF output.
TUNING:	Digital frequency selection by front panel control.
SIGNAL/DISTORTION RATIO:	Distortion products are at least 40 db below either tone of a two tone test at 250 mw, which exceeds FCC requirement.
UNWANTED SIDEBAND REJECTION:	A signal at 500 Hz is at least 60 db down from PEP in the unwanted sideband.
SPURIOUS SIGNALS:	Spurious signals greater than 120 Hz removed from the carrier are at least 60 db below full PEP output.
HUM AND NOISE LEVEL:	Noise level is at least 60 db down from either tone of a two tone test.
CARRIER INSERTION:	-55 db to full output, continuously variable.
AUDIO RESPONSE:	1. Flat within ±1.5 db, 350-3500 cps (Hz), either upper or lower sideband. 2. A filter providing ±1.5 db, 250-3040 cps (Hz) is available on special order. 3. A filter providing ±1.5 db, 250-6080 cps (Hz) is available on special order.
AUDIO INPUT:	1. For ISB, 2 independent 600 ohms channels balanced or unbalanced, -20 dbm to +5 dbm 2. Built in microphone pre-amplifier for low level dynamic mike with front panel selection.

MIKE INPUT:	-55 db into 47,000 ohms, front panel jack.
AUDIO CONTROL:	Two front panel "fader" controls allow ease in selecting microphone or line input into either the upper or the lower sideband.
ALDC:	Will accept 0 to approximately -11 volts DC from ALDC circuit of an associated linear amplifier to improve linearity, limit distortion and deliver a relatively constant output level during high modulation peaks or load changes.
ENVIRONMENTAL CONDITIONS:	Designed to operate in any ambient temperature between 0° and +50°C, and any value of humidity up to 95%.
CW KEYING INFORMATION:	Key jack on front panel connection or rear panel for up to 300 wpm carrier keying in CW mode, dry contact.
FSK CAPABILITY:	
KEYING INPUT:	60 ma, 20 ma, 50 volt, 100 volt, either positive or negative with respect to ground.
KEYING SPEED:	Up to 75 baud (higher keying speeds available).
SHIFT:	850 cps (Hz), 425 cps (Hz), 212 cps (Hz).
FACSIMILE INPUT:	+1 to +10 volt will provide a linear shift of 800 cps (Hz).
INSTALLATION DATA:	Size: 5 1/4" H x 19" W x 18" D. Weight: Approximately 35 lbs.
PRIMARY POWER:	115/230 v ±10% 50/60 cps (Hz), single phase 60 watts.
LOOSE ITEMS:	Mating coaxial fittings (BNC) and two instruction manuals.
COMPONENTS AND CONSTRUCTION:	All equipment manufactured in accordance with JAN/MIL specifications wherever practicable.
OPTIONS/ACCESSORIES (Internal, Except As Noted)	(Priced Separately)
1. External Standard CSS-2	Provides 1 part in 10^9 stability.

OPTIONS/ACCESSORIES
(Cont)

2.	Bandwidth Capability:	6 kc (kHz) bandpass filters may be substituted for 3 kc (kHz) at additional cost.
3.	Remote Operation:	May be equipped for remote operation of the digital frequency selector and the mode switches by hardwire. Teletype digital format using external components is available on special order.
4.	Remote Control Panels:	Control panels for convenient performance of the above functions are available at extra cost. Please consult us on the most economical solution to your remote control requirements.
5.	Harmonic Suppression Filter:	Depending upon the Linear Amplifier to be utilized. Secondary harmonics will be attenuated 45 db below full PEP output, and all others at least 55 db below full PEP output.

SECTION 2
INSTALLATION

2-1. GENERAL

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

2-2. POWER REQUIREMENTS

CAUTION

BE SURE POWER IS SET AT STANDBY when line cord is connected to appropriate source, voltage is extended through the power supply components.

The exciter is designed for 115/230 volt, 50/60 cycle (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 7-14. For 230 vac operation replace line protective fuses with ones with 1/2 the rating.

2-3. MECHANICAL INSTALLATION.

The exciter 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 screws and washers (supplied).

When the unit is equipped with a tilt-lock slide mechanism, installation is as follows (refer to figure 2-1):

a. Pull out the center sections of the tracks, located in the equipment rack, until they lock in extended position.

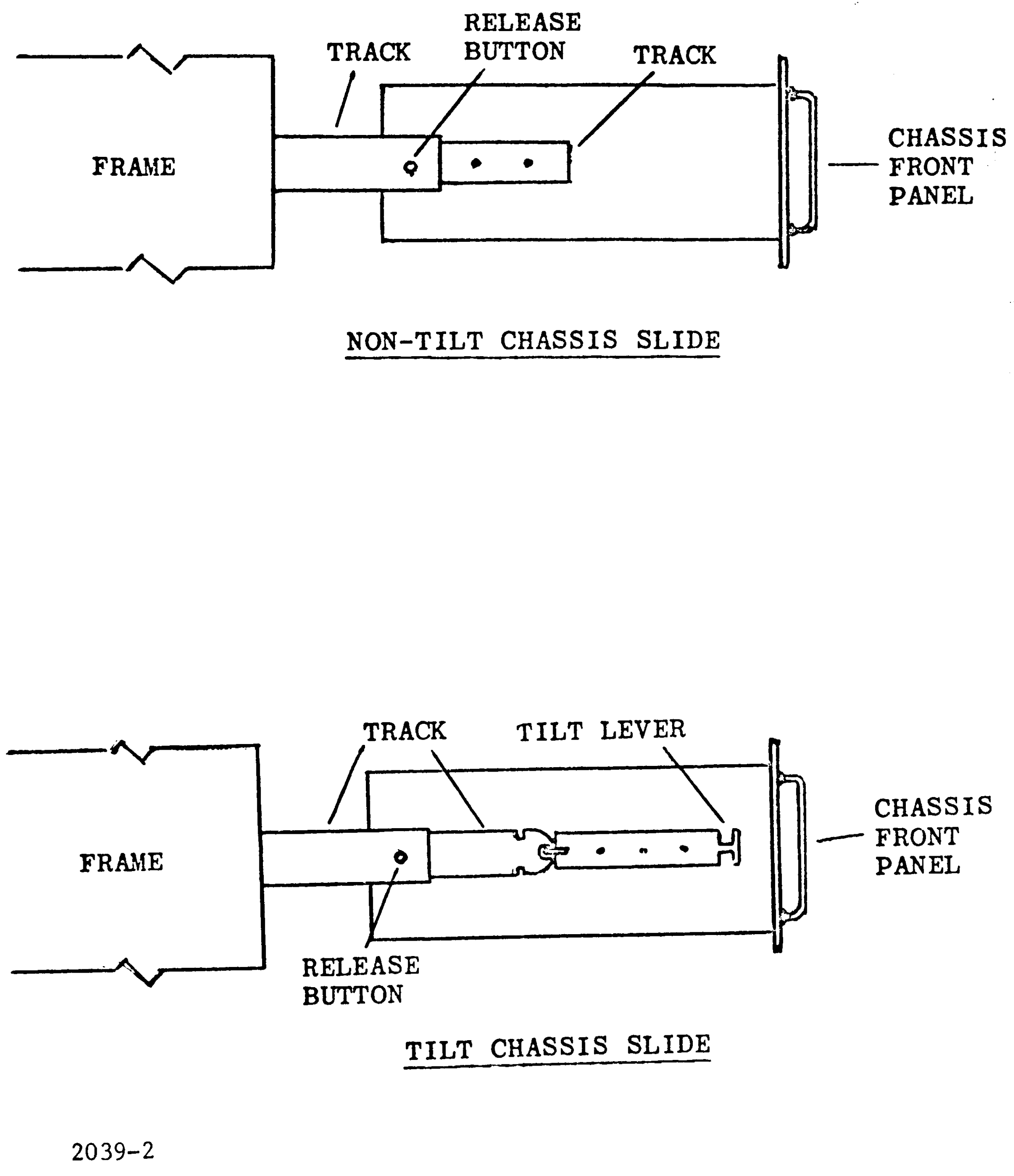

Figure 2-1. Tilt-Lock Slide Mechanism

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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. Depress 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.

2-4. ELECTRICAL INSTALLATION

All electrical connections between the exciter and related units are made at the rear of the unit.

Figure 2-2 used in conjunction with table 2-1 lists all rear panel connections and those termination requirements.

TABLE 2-1. REAR PANEL CONNECTIONS

PANEL DESIGNATION	FUNCTION
J116 (POWER)	Power input 115 vac or 230 vac.
J119	Used for remote control connection if supplied.
J120 1MHz OUT	1 MHz standard output jack.
J121 1MHz MON.	1 MHz standard Monitor jack.
J122 1MHz STD.	Input for connection of external 1MHz standard.
J123 ALDC	Connection of external ALDC control voltage.
J124 RF, OUT	RF output jack.
J125 RF, MON.	RF output monitor jack.
TB103 USB 1,2, and 3	600 ohm balanced input
4	Ground
5 and 6	Not used.
TB104 LSB 7,8, and 9	600 ohm balanced input
10	Ground.
11	Keyer input connection used for CW keying
12	Ground for external keyer when used.

PANEL DESIGNATION	FUNCTION
TB105 13 and 14	Connect FSK inputs for FSK transmission. (TTY battery loop)
15 and 16	FAK inputs
17 and 18	Dry contact keyer input for FSK mode of operation

2-5. INITIAL CHECKOUT PROCEDURE

Although the Exciter has been aligned and thoroughly checked against the manufacturer's specifications prior to shipment, it is necessary to insure correct installation and proper Exciter operating conditions by performing the following checkout procedure. Refer to Section 3 for location and functions of all operating controls and front panel indicators.

NOTE

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

a. Place power switch (10) to the STANDBY position. STANDBY Lamp (9) should light.

b. Connect a 600 ohm 1 millivolt single tone signal from an audio Two Tone Generator (TTG) or equivalent to terminals 1, 2, and 3 marked TB103 USB (refer to figure 2-2).

c. Connect FSK inputs to terminals 13 and 14 of TB105 (refer to figure 2-2).

d. Set S111 to match FSK input.

e. Set SENSE switch S109 (refer to figure 2-2) to desired position.

f. Connect a dry contact keyer to terminals 11 and 12 of TB104 (refer to figure 2-2).

g. Before placing power switch (10) to the ON position; be sure CARRIER control (8) is turned fully CCW; USB and LSB, MIKE/LINE adjustments are set at 0; and RF OUTPUT control (1) is turned fully CCW. Set the MODE switch (13) to

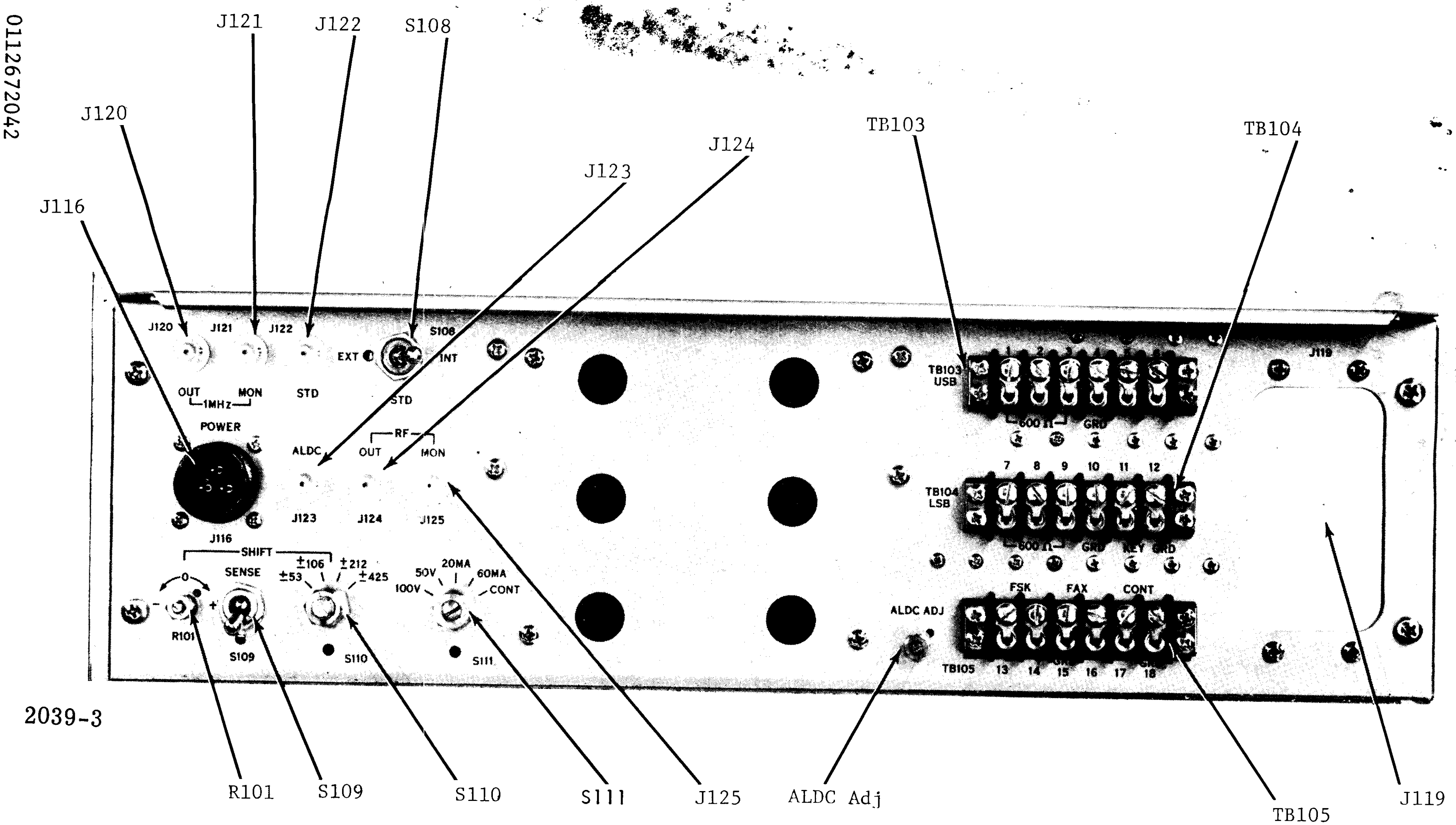

Figure 2-2. Rear Panel, LFE

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the USB position and select the frequency by setting the frequency selection switches (14) to the desired frequency shown in the windows displaying the numerical values.

h. Connect a Lavoie Model LA40A Spectrum Analyzer (or equivalent) to RF OUT jack J124 (refer to figure 2-2).

i. Power switch (10) should now be placed to the ON position and the EXCITER switch placed to the ON position when using a 600 ohm line input.

j. Set METER switch (2) to the USB position and adjust the MIKE/LINE switch marked USB (5) to appropriate level as indicated on MONITOR (6).

NOTE

Do not exceed red region.

Then set METER switch to the CARR. position and adjust CARRIER to desired level.

k. The output indicated by the Lavoie Model LA40A (or equivalent) spectrum analyzer should not exceed Carrier level may be checked also by

l. Reset the MIKE/LINE USB adjustment and the RF OUTPUT control to 0; place the power switch to the STANDBY position.

m. Disconnect the signal generator leads from the USB 600 ohm terminals and reconnect them to TB104, USB, 600 ohm terminals.

n. Reset the front panel controls to the LSB position and repeat steps g, and i thru k.

o. To check proper AM operations first repeat step 1, and set meter switch to AM position. Be sure signal input is set for two tones. Place power switch to the ON position and adjust the LSB, MIKE/LINE control to the desired level as indicated on MONITOR (6) then adjust the RF OUTPUT control to the desired level as indicated on the MONITOR.

p. The signal output should be checked (see step k).

SECTION 3
OPERATOR'S SECTION

3-1. GENERAL.

The exciter provides rapid frequency selection in the 30kHz- to 1.99999-mc (MHz) transmission range in 10Kc(kHz) steps. The exciter is used to control the output frequency of a transmitter in AM, CW, SSB, FSK, FAX, and ISB (optional extra) modes of operation.

Frequency selection, mode of operation, r-f output, carrier levels and input adjustments are controllable be means of the LFE front panel controls. Meter selections of various critical circuits in the unit are easily selected by a front panel meter switch and monitored. Table 3-1, used in conjunction with figure 3-1, provides functions and locations of the various unit panel controls and indicators. It is advisable that the operator familiarize himself with the functions and capabilities of the exciter controls and indicators before attempting to operate or tune the unit. The tuning procedures may vary in accordance with the desired mode of transmission. Therefore, reference to the applicable tuning procedures contaned in the following text will denote proper control and level settings for the desired mode of transmission.

TABLE 3-1. OPERATING CONTROLS AND INDICATORS

ITEM NUMBER (Figure 3-1)	PANEL DESIGNATION	FUNCTION
1	RF OUTPUT control	Adjusts level of RF OUTPUT.
2	METER switch	7-position selector switch. Selects circuits in system to be measured.
3	SPARES	Spare line voltage fuses.
4	LSB/MIKE/LINE gain control.	Adjusts level of LSB input

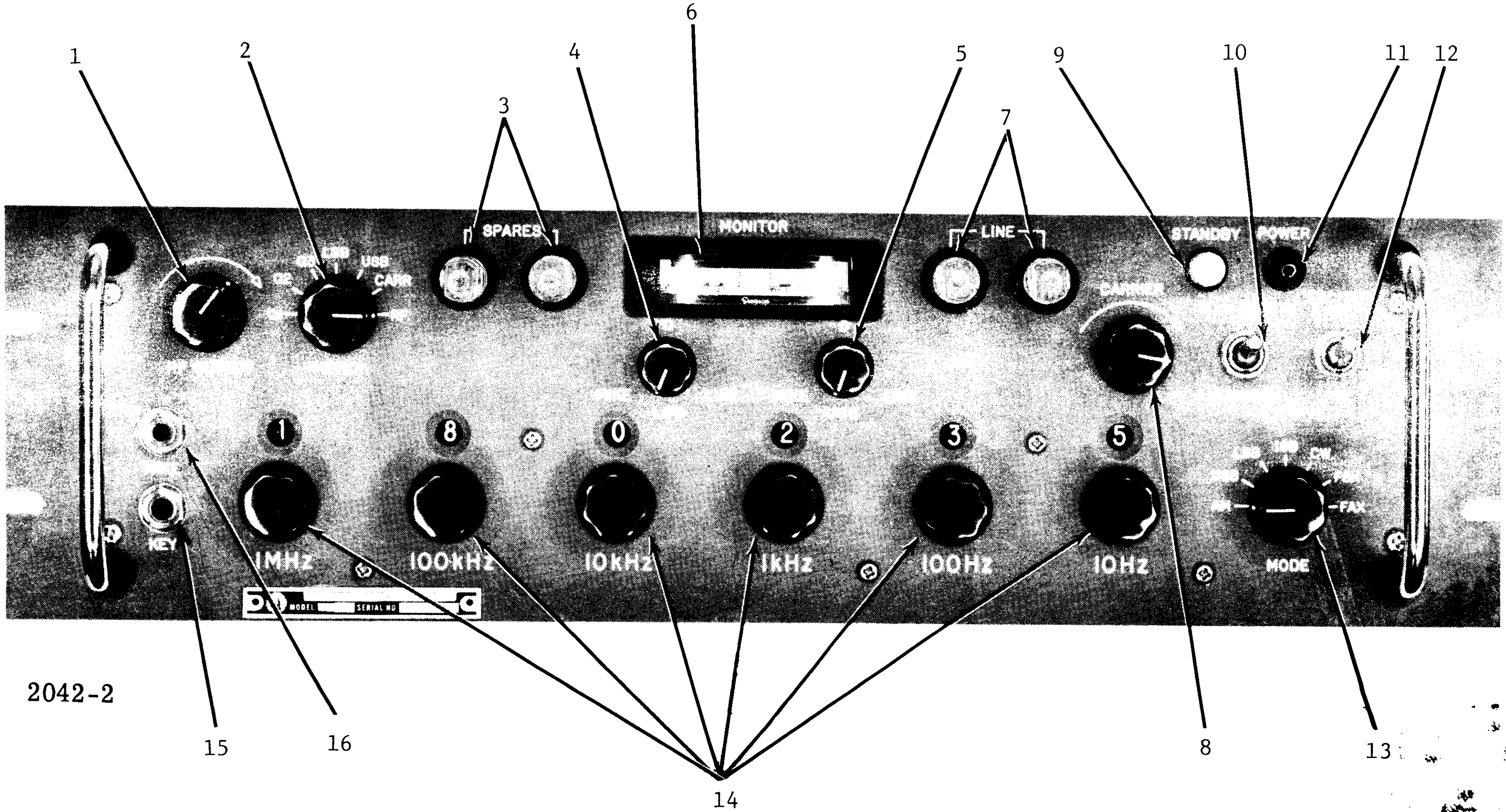

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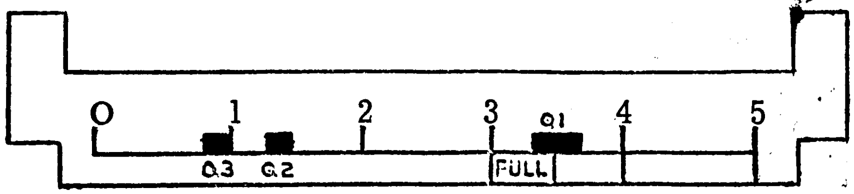
Figure 3-1. Controls and Indicators, LFE

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

ITEM NUMBER (Figure 3-1)	PANEL DESIGNATION	FUNCTION
5	USB MIKE/LINE gain control.	Adjusts level of USB input
6	MONITOR Meter	Monitors circuits selected by the Meter Switch.
7	Line Fuses	Protective fuses for Line voltage input to unit.
8	Carrier control	Adjusts amount of carrier to be used.
9	STANDBY Lamp	Indicator lamp lights when unit is in STANDBY condition.
10	ON/STANDBY Switch	When set at ON applies operate 12- and 24 vdc to all modules and when set at STANDBY opens operate 12- and 24 vdc to modules.
11	POWER lamp	Indicator lamp for power ON condition.
12	EXCITER Switch	Set at ON for all modes of operation using inputs other than a microphone. Set at PTT, when using the microphone input.
13	MODE Switch	Selects the various mode capabilities of the unit.
14	10MHz, 1MHz, 100- , 10- , 1KHz, 100Hz Switches.	Used to select the desired operating frequency in the 30 KHz- to 1.99999 mc (MHz) in 10 cycle increments. Each switch has a window displaying the numerical value of the frequency.
15	Key	Input for a dry contact keyer used for CW mode of operation.
16	Mike	Accepts a 47,000 ohm impedance Microphone.

3-2. PRELIMINARY OPERATING PROCEDURES.

Before attempting to set up the exciter, be sure the Initial checkout procedure outlined in Section 2 has been completed. The various MONITOR Scales (see figure 3-2) indicate the adjustments necessary for the proper R-F output level needed for an associated linear power amplifier. The operator should familiarize



SCALE = 2:1

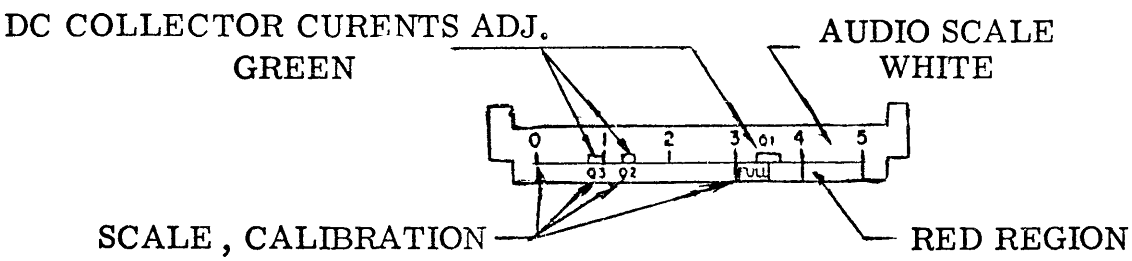


Figure 3-2, Front Panel Monitor Indicators himself with the equipment and the scales shown so as not to overdrive and cause damage to the associated equipment.

NOTE

Be sure POWER switch is set at STANDBY.

After the unit has been checked as outlined in Section 2, the following must be considered:

a. Mode of transmission desired.

b. Setting rear panel controls and switches pertaining to type of external FSK equipment used if FSK is the desired mode of operation.

3-3. SINGLE SIDEBAND WITH ANY DEGREE OF CARRIER INSERTION.

a. Set power switch (10) at ON.

b. Set EXCITER switch (12) at ON when using either the USB or LSB 600 line inputs. Set EXCITER switch at PTT when using a mike input.

c. Select the desired sideband with the MODE switch (13).

d. Select the desired operating frequency with the frequency selection switches (14).

e. Turn METER switch (2) at the desired sideband.

f. Connect a Mike to the front panel MIKE jack (16) if used.

g. Adjust the MIKE/LINE control of sideband used to appropriate level as indicated on MONITOR (6).

NOTE

DO NOT ENTER RED REGION. When mike input is used adjust level so as not to exceed red region with highest input from microphone.

h. Turn METER switch (2) to the CARR. position and adjust CARRIER control (8) to the desired level as plainly indicated on MONITOR (6).

i. Turn METER switch (2) to the RF position and adjust RF OUTPUT control (1) for the level of RF output indicated on MONITOR (6).

NOTE

Turn RF OUTPUT control (1) fully CCW before selecting different modes of operation.

3-4. INDEPENDENT SIDEBAND WITH ANY DEGREE OF CARRIER.

a. Set power switch (10) at ON.

b. Set EXCITER switch (12) at ON when using either the USB or LSB 600 line inputs. Set EXCITER switch (12) at PTT when using a mike input.

c. Set USB (5) and LSB (4) controls at 0.

d. Select the ISB position on the MODE switch (13).

e. Select the desired operating frequency with the frequency selection switches (14).

f. Turn the METER switch (2) to the LSB position and adjust the LSB MIKE/LINE control (4) for a MONITOR (6) indication of up to but not to exceed the red region.

g. Turn the METER switch (2) to the USB position and adjust the USB MIKE/LINE control (5) for a MONITOR (6) indication of up to but not to exceed, the red region

h. Turn METER switch (2) to the CARR. position and adjust CARRIER control (8) to FULL (refer to figure 3-2) or the desired level indicated on MONITOR (6).

i. Turn METER switch (2) to the RF position and adjust RF OUTPUT control (1) for the level of RF output indicated on MONITOR (6).

3-5. CONVENTIONAL AM OPERATION.

a. Set power switch (10) at ON.

b. Set EXCITER switch (12) at ON when using either the USB or LSB 600 line input. Set EXCITER switch at PTT when using a mike input.

c. Set MODE switch (13) at AM.

d. Select the desired operating frequency with the frequency selection switches (14).

e. Turn METER switch (2) to the AM position.

f. Connect a mike to the front panel MIKE jack (16) if used.

g. Adjust the MIKE/LINE control of sideband used to appropriate level as indicated on MONITOR (6).

NOTE

DO NOT ENTER RED REGION. When mike input is used adjust level so as not exceed red region with highest input from microphone.

h. Turn METER switch (2) to the RF position and adjust RF OUTPUT control (1) for the desired level of RF output indicated on MONITOR (6).

NOTE

Turn RF OUTPUT control (1) fully CW before selecting different modes of operation.

3-6. FREQUENCY SHIFT TELEGRAPH OPERATION.

a. Set power switch (10) at ON.

b. Set EXCITER switch (12) at ON.

c. Turn MODE switch (13) to FSK position.

d. Set frequency selection switches (14) to the desired center frequency.

e. Select appropriate FSK operation by setting switches S110 and S111 (refer to figure 2- 2).

f. Place SENSE switch S109 (refer to figure 2- 2) to desired amount.

g. Place meter switch to the RF position and adjust RF OUTPUT control for desired MONITOR (6) reading.

3-7. FAX (FACSIMILE) OPERATION.

a. Set power switch (10) at ON.

b. Set EXCITER switch (12) at ON.

c. Turn MODE switch to FAX position.

d. Set frequency selection switches (14) to the desired frequency.

e. Place meter switch to the RF position and adjust RF OUTPUT control for desired MONITOR (6) reading.

3-8. CW TELEGRAPH OPERATION.

a. Set power switch (10) at ON.

b. Set MODE switch to the CW position.

c. Connect key to KEY input (15).

SECTION 4
PRINCIPLES OF OPERATION

4-1. GENERAL.

The following text will discuss the operation of the LFE-(1) at a block diagram level and for ease of discussion the unit is divided into two major parts as follows (refer to Figures 4-1, 4-2).

4-2. OVERALL BLOCK DIAGRAM ANALYSES.

a. Block Diagram Analysis of The Sideband Exciter Modules. (See figure 4-1). - The Sideband Exciter consists of the following sections: Carrier Generator Section; Audio Input Control and Sideband Generator Section; FAX and FSK Section; Variable Crystal Oscillator; and Balanced Mixer and 3-mc Amplification Section. The following information is a description of each section.

(1) The Carrier Generator Section (Z112) produces two signals from a 1 mc signal and one signal from mixing an audio signal with a 250KC internally generated signal. The two signals generated from the 1mc signal are, a 250KC carrier signal used in the USB, LSB, ISB, CW, and FSK modes of operation, and a 2.75 mc signal used to produce the 3-mc signal in a later described section. The result of mixing the audio intelligence with the 250 KC frequency is a double sideband audio signal with the 250KC frequency as the carrier.

The 250KC output is originated by dividing the 1-mc frequency standard with two divider circuits and then amplifying the resultant. The output from the 250 KC amplifier stage is extended to; the CW position of the mode switch; the USB, LSB balanced modulators of the Sideband Generator Section; the balanced modulator of the DSB circuit (also contained in Z112); the keying circuit of the Frequency Shift Generator Section (Z111); and the amplified 250 KC output is also connected to the isolation circuit. The output from the isolation circuit is connected to a pin on the mode switch marked USB, LSB, ISB for selection of the 250 KC carrier frequency combined with the intelligence used for these modes of operation, CW keying and PTT operation are accomplished by opening and closing a path to ground controlling the 250 KC amplifier stage.

The 275 mc signal used to produce the final 3 mc output of the Sideband Exciter portion of the LFE-(1) is obtained by internally applying the 250KC frequency to a multiplier and filter circuit . A switch controlled voltage determines when this signal is produced.

The audio and 250KC mixer stages mix the MIKE input with a switch controlled 250KC carrier when the exciter is set for AM. The resultant amplified DSB audio signal with a 250KC carrier is connected to another wafer of the mode switch where it is applied to the mixer amplifier section.

(2) Audio input control and Sideband Generator Section (Z109) accepts either two 600 ohm line inputs connected first to two isolation transformers then to two independent MIKE/LINE gain controls or a mike input connected to the gain controls via a pre amplifier stage. These inputs are switch selectable audio intelligence that constitute the mode of operation of the Sideband Generator. The outputs from the gain controls are connected to the mode switch where the amplified mike input is connected to the Signal Generator Section for AM operation [see paragraph 4-1A(1)] or the USB and LSB line inputs are connected to the Sideband Generator circuits. The LSB and the USB line inputs are connected to two independent balanced modulators mixed with a 250KC signal then filtered and the outputs from these circuits are connected together. The combined USB and LSB signals (Independent Sideband) are connected along with the 250KC carrier frequency to the mode switch position marked USB, LSB, ISB.

(3) FSK and FAX Section (P/o Z111) voltage keys the input to the Variable Crystal Oscillator (VXCO) with various d-c control circuits thereby allowing for FAX, FSK and contact keying modes of operation. Frequency Shift Keying is accomplished by connecting an externally keyed current either directly (when contact keying is used) to the keyer circuit or via a switch set at the external

keyed current. This input controls the transformer rectifier circuit that changes the 250KC input signal to DC by converting the 250KC to a pulsating DC output. This DC output is either high or low depending on the setting of the SENCE switch that controls the three stages of DC amplification. The amplified DC output is combined with the DC output of the FAX DC regulator circuit (this application of DC depends on the mode in use) and then connected to a variable switch controlled potentiometer. The desired output of the potentiometer circuit is connected to the mode switch position marked FSK. The DC control circuit for FAX accepts both an externally generated keyed current and the DC output from the FAX, DC regulators to produce the DC control voltage applied to the FAX position of the mode switch.

(4) Variable Crystal Oscillator circuit operates from the keyed DC selected by the mode switch either for FSK, FAX or contact keying. This DC current is connected to the capacitance controlled 3 mc oscillator and the output frequency of this oscillator is connected to the noise limiter circuit (P/O Z111). The limiter eliminates unwanted peaks and the output is connected to the 3 mc output circuit (also P/o Z111).

(5) Balanced Mixer and 3 mc Amplifier Section functions as follows depending on the mode of operation selected. The Balanced Mixer stages accept the various intelligences; AM (double sideband w/250KC carrier); USB, LSB (with250-KC carrier; ISB (with 250KC carrier); CW (Keyed 250KC frequency). These signals are mixed with the 2.75mc signal (produced by the Signal Generator Section) and the resultant 3 mc signal is then amplified.

When FSK or FAX is the selected mode of operation the keyed 3 mc output signal from the limiter circuit (produced by the VXCO) is internally connected to the amplifier stages. Selecting FSK or FAX mode of operation eliminates the balanced modulator section by disconnecting the intelligence inputs to this stage and opening the bias circuit controlling the 2.75 mc signal generator circuit (P/O Z112).

b. Block Diagram Analysis of The Frequency Generation Section. (Refer to figure 4-2). - The frequency generation portion of the LFE-(1) is broken down into the following sections: Spectrum Generator Section; Comb Filter Sections A and B; Mixer Divider Section; and the Translator RF output Section.

(1) Spectrum Generator (Z101) uses a 1 mc signal to produce a low impedance 1 mc output connected to the 1 mc input to the signal generator and a 100KC spectrum output connected to comb filters A and B. Z101 also provides 1 mc spectrum generator controled crystal frequencies of 8 mc (used for Mixer Divider Section), 12 mc and 13 mc (switch selectable for input to the Translator Section) all these signals have the same stability as the 1 mc standard.

(2) Comb Filter Sections (Z102 and Z103) accept the 100KC spectrum generator signal and filter this input with 10 crystal controlled filter and amplifier circuits resulting in 10 frequencies from 1.0 mc to 1.9 mc. These frequencies are switch selectable for application to the Mixer Divider Sections. (refer to paragraph 4.4 for details)

(3) Mixer Divider Section (Z104, Z105 and Z107) provides three mixer divider circuits and a mixer circuit to produce from the three signal sources applied (1 mc, 8 mc and 1.0 to 1.9 mc) a signal in the frequency range of 10-10.99999 mc for use in the Translator Section. This is accomplished by mixing the 1.0 to 1.9 mc switch selectable input with stages of mixed and divided signals (see discussion in paragraph 4-5).

(4) Translator and RF output section (Z108, Z114, Z115) accepts; the 1-mc signal from the Spectrum Generator: the 10-10.99999 mc signal from the Mixer-Divider Section; the switch selectable 3 mc input; and translates these inputs by various stages to produce the amplified highly stable 30kHz to 1.99999mc filtered RF output signal.

4-3. DETAILED ANALYSIS OF THE SPECTRUM GENERATOR SECTION (Z101).

The 1-mc fundamental signal (furnished by an internal or external standard) is

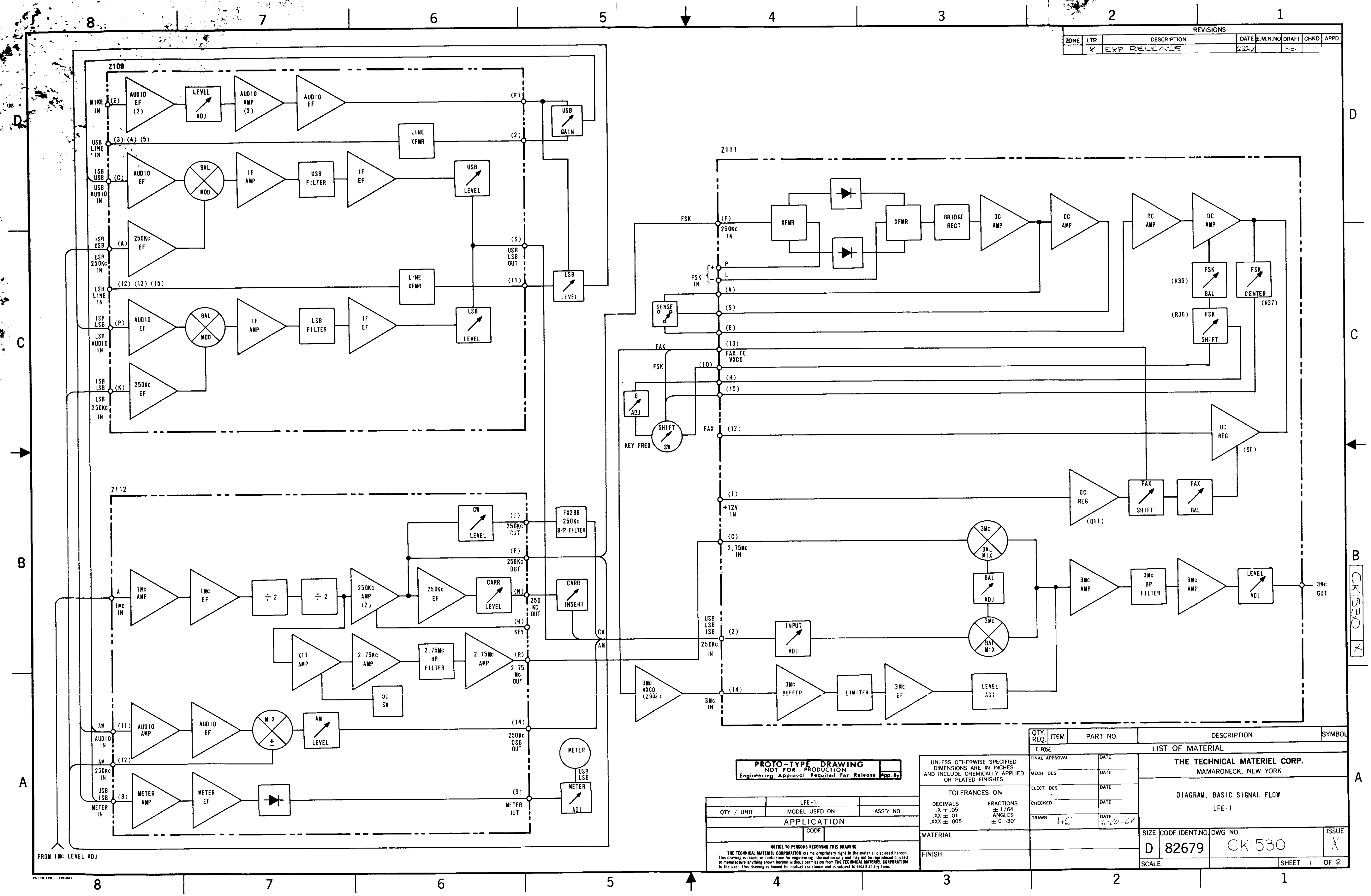


Figure 4-1 Block Diagram Of The Sideband Exciter Modules

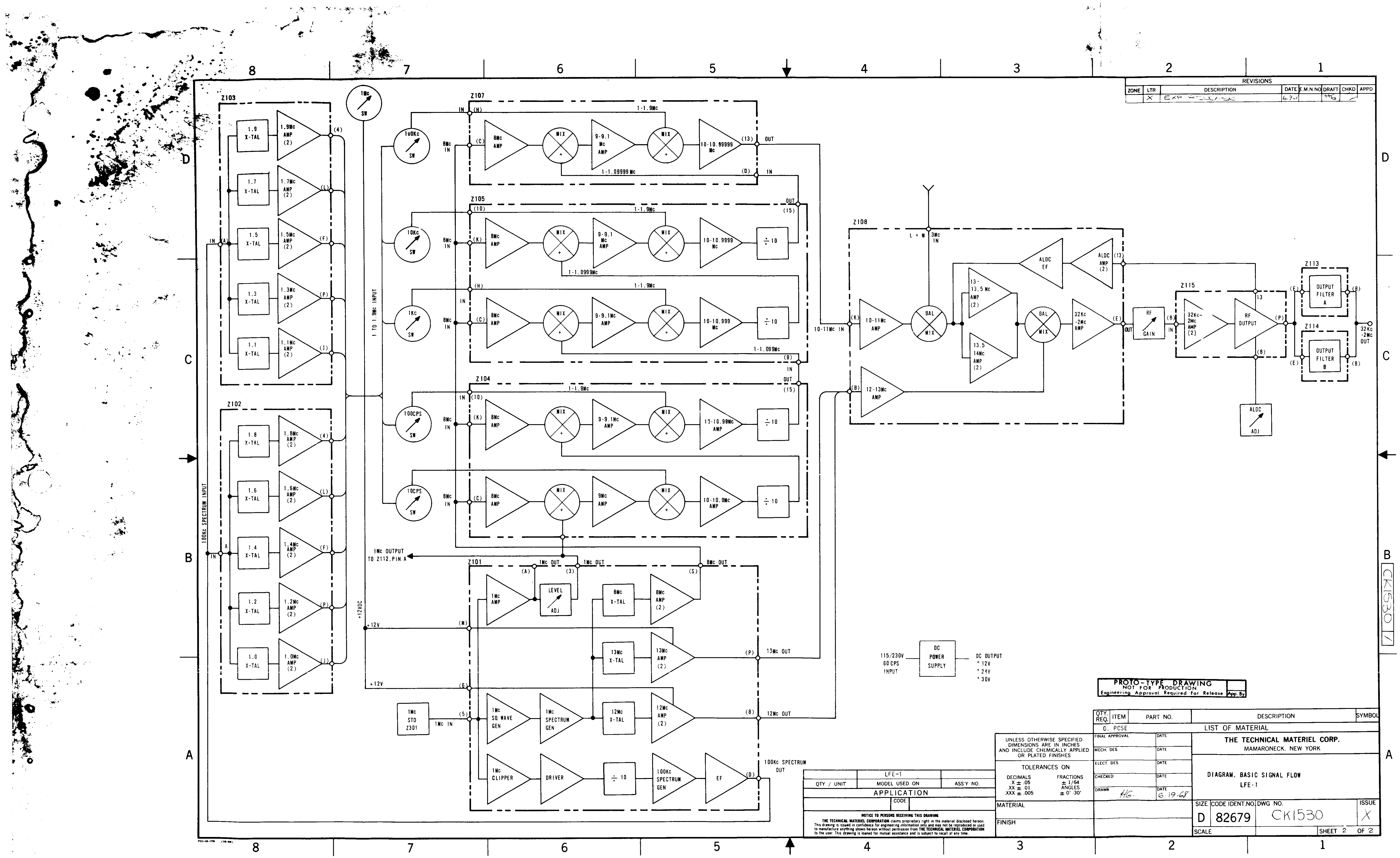


Figure 4-2 Block Diagram Of The Frequency Generation Sections

applied to the circuit sections on printed circuit board Z101 (figure 7-1), as follows:

a. The 1-mc input frequency is fed to the base of the 1-mc output amplifier consisting of transistor Q1 and then the output at the collector of Q1 is tuned by transformer T1. The output from T1 provides a low impedance 1-mc signal used for connection to the base circuit of Q (P/O Carrier Generator refer to figure 7-7), and to the balanced mixer of the Mixer-Divider Section Z109.

b. The 1-mc frequency is also fed to the base of the 1-mc clipper transistor (Q14) and the output at the collector is connected to the base of driver amplifier Q17. The amplified output is applied to decade counter (Z1), where the signal is divided by 10. The decade counter in turn feeds the resultant signal to the base of spectrum generator Q15, and to the emitter follower Q16 to furnish the low impedance 100-kc spectrum output that is connected to the ten crystals that are part of the Comb Filter Sections A/B (refer to figures 7-3/7-4

c. The 1-mc frequency is also applied to the base of the square wave generator (Q2) and then amplified by transistor Q3 which in turn furnishes harmonics of 1-mc to three separate harmonic selector and amplifier circuits. Each harmonic filter circuit is comprised of a crystal filter, a trimmer capacitor, two transistors, and a tuned transformer; since the three harmonic selector and amplifier circuits operate in the same manner to produce the 12, 13, and 8-mc output frequencies only the 12-mc harmonic selector circuit is described below.

The output of the spectrum generator (a 1-mc signal enriched in harmonics) is applied to the crystal filter Y1, variable capacitor C12, and transistor Q4, which permit only the 12-mc harmonics to pass and the resultant is further tuned by transformer T2. The output of T2 is applied to the output stage of transistor Q5 and tuned transformer T3. The amplified 12-mc and 13-mc output frequencies are connected to the Translator Section (Z108). The amplified 8 mc output frequency is connected simultaniously to the 8 mc amplifiers of all three Mixer Divider stages (Z104, Z105, and Z107).

4-4. DETAILED ANALYSIS OF THE COMB FILTER SECTIONS (Z102 and Z103). (Refer to figures 7-3, and 7-4).

The 100-kc spectrum frequency of printed circuit Z102 is fed to ten separate harmonic selector and amplifier circuits. Each harmonic filter circuit is comprised of a crystal filter, a trimmer capacitor, two transistors, and two tuned transformers; since the ten harmonic selector and amplifier circuits operate in the same manner to produce the output frequencies (refer to figure 7-3), only the 1.0-mc harmonic selector circuit is described, as follows:

The 100-kc spectrum frequency is applied to the crystal filter Y5 and variable capacitor C43, which permit only the desired 1.0-mc harmonics to pass, and the resultant frequency is fed to amplifier Q9 and then further tuned by tuned-transformer T9. The signal is then passed through the second stage of amplification and tuning, consisting of amplifier Q10 and tuned-transformer T10; the amplified 1.0-mc output frequency is routed to switch (#3S106A Front) for selectivity. Variable resistor R35 provides for output level adjustment.

4-5. DETAILED ANALYSIS OF THE MIXER-DIVIDER SECTIONS (Z104, Z105 and Z107).

NOTE

The output of the comb filter sections (Z102 and Z103) is first routed to the 1MC, 10MC, 100KC, 10KC, 1KC, and 100 cps frequency range selector switches. Selection of the KC digit of the desired output frequency is illustrated in figure 4-3, as an example.

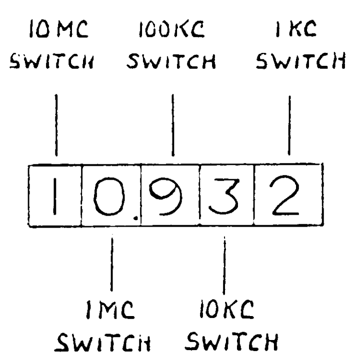


Figure 4-3. Frequency Selector Switch Readout.

The 8-mc signal taken from the output of the 8-mc amplifier (Q13) of Spectrum Generator (Z101) is fed to amplifier Q1 and to transformer T1, and to the balanced modulator consisting of diodes CR1 and CR2 in the Mixer Divider circuit Z104 (refer to Figure 7-5).

The 1 mc signal (the output at the 1 mc amplifier of the Spectrum Generator) is simultaneously applied to the same balanced modulator CR1 and CR2.

Therefore, the resultant 9.05 mc signal (the translation or sum of the 8-mc and 1.1 mc signals) is tuned and amplified by transformers T2 thru T6 and amplifiers Q2 and Q3. This highly tuned and amplified 9 mc signal is then mixed with the 1.0 to 1.9 mc signal (selected by the 100 cps frequency switch) applied to the secondary of T6 resulting in a 10-10.9 mc signal. The 10-10.9 is fed to the balanced modulator consisting od diodes CR3 and CR4; tuned by transformers T7 thru T11, transistors Q6 and Q7, and amplified by amplifiers Q4 and Q5; and then divided by the Decade Divider circuitry to a 1.0 to 1.09 mc signal. This resultant signal is connected to a balanced modulator in one half of the Mixer Divider circuit Z105.

The 8-mc signal is fed to amplifier Q1 and then to transformer T1 where the 1- to 1.09-mc signal is mixed with the 8-mc signal and the resultant signal is fed to the balanced modulator CR1 and CR2.

The resultant 9- to 9.09-mc signal (the translation of the 8-mc and 1- to 1.09-mc signal) is tuned and amplified via transformers T2, T3, T4, T5, T6, and amplifiers Q2, Q3, Q4. This tuned and amplfiied signal is applied to the secondary of T6 where it is mixed with the 10KC selected frequency the resultant signal is fed to the balanced modulator consisting of diodes CR3 and CR4.

The desired digit of the required frequency from 1-mc to 1.9-mc (selected by the 10KC frequency selector switch see figure 4-3) is connected to the balanced modulator consisting diodes CR3 and CR4. The resultant 10- to 10.99-mc is tuned by transformer T7 and T8, and fed to amplifiers Q5 and Q6 and transformer T9 which in turn feeds T10 and amplifiers Q7 and Q8 and transformer T11. Transformer T11 feeds the trigger circuit consisting of amplifiers Q9 and Q10, and the signal is then applied to the decade divider where the resultant 1- to 1.099-mc frequency is routed to Final Mixer Z106.

The same 8-mc signal is amplified by Q1 and fed to transformer T1 where the 1- to 1.099-mc output signal from Z105 is mixed with the 8-mc signal in the secondary of T1. Therefore, the resultant 9- to 9.099-mc signal (the translation or sum of the 8-mc and 1- to 1.099-mc signals) is tuned and amplified by transformers T2, thru T6 and amplifiers Q2, Q3. This signal is applied simultaneously with the desired frequency from 1-mc to 1.9-mc to the secondary of T6.

The desired digit of the required frequency from 1-mc to 1.9-mc (selected by the 100KC frequency selector switch see figure 4-3) is applied to the balanced modulator consisting of T7, T8, T9, T10, T11 and amplified by amplfiiers Q4 and Q5. This signal is then connected to the input of translator Z112.

the 100KC selector switch applies B+ to provide a tuning control for the 10 to 10.5-mc (lower half of the output signal) applied to output transformer T12. This control is accomplished through the variable capacitor C48 and C36. The B+ is also connected to the translator circuit Z112.

4-6. DETAILED ANALYSIS OF THE CARRIER GENERATOR SECTION (Z112).

The Carrier Generator circuits accept; th adjustable low impedance 1-mc signal from the Spectrum Generator Section; the audio input; the internally generated 250KC carrier signal output switch selectable for AM operation and by using various multiplier, divider, amplifier, and mixer circuits obtain; the 250KC carrier frequency output; the filtered 2.75 mc frequency output; and the double sideband output signal with a 250KC carrier.

The low impedance 1 mc signal is connected to the base of amplifier transistor Q13 amplified and the output at the collector of Q13 is connected to the base of emitter follower transistor Q1. The 1 mc output at the emitter of Q1 is connected to decade divided Z1 divided by two to a 500KC frequency and then connected to decade divider Z2 divided by two again to a 250KC frequency. Thw 250KC output of Z2 is simultaneously connected to base of amplifier transistor Q2 and the base of multiplier transistor Q11 (see the following paragraph for a circuit analysis of the 2.75 mc frequency generator). The 250KC input to the base of Q2 is amplified and the output at the collector is transformer coupled to the base of amplifier transistor Q3. The amplified 250KC output of Q3 is transformer coupled to; the CW position of the mode switch; the balanced modulator of the audio DBM output circuit; both the balanced modulators of the LSB, USB sideband generator circuit; and then connected to the base of emitter follower transistor Q4. The 250KC output at the emitter of Q4 is connected internally to a potentiometer (R27) for carrier level adjustment and the output of the potentiometer is externally connected to another potentiometer ( ) (for more carrier adjustment) and then to the mode switch (set for USB, LDB, ISB, nad CW) controlling the input to the 3 mc mixer stage in the Frequency Shift Genrator Section (P/o Z108).

The 250KC output from the decade divider Z2 is also connected ot thebase of multiplier transistor Q7 multiplied by eleven and the 2.75 mc output at the collector of Q7 is transformer coupled to the base of amplifier transistor Q8. The amplified 2.75 mc output of Q8 is transformer coupled to the base circuit of the 3 mc balanced mixer stage located in the Frequency Sjift Generator Section (Z108).

The AM input is connected to the base of audio amplifier Q10 amplified and the output at the collector of Q10 is connected to the base of audio emitter follower Q11. The audio output at the emitter of Q11 is connected to the emitter of mixer transistor Q12. The switch selectable 250KC internally generated signal is applied to the base of mixer transistor Q12 and the resultant (mixed double sideband audio signal with a 250KC carrier) is connected via the mode switch to the base of the 3 mc mixer transistor Q1 located in the Frequency Shift Generator Section (Z108).

4-7. DETAILED ANALYSIS OF THE SIDEBAND GENERATOR SECTION (Z109).

The Sideband Generator circuits; the USB and LSB isolation transformers T3 and

T4; the Mike input amplified by the pre-amplifier circuit and applied to the USB, LSB audio and 250KC balanced modulator circuits; constitute the USB and LSB Sideband intermediate frequency generation section.

The USB and LSB 600 ohm line inputs are connected to two isolation transformers (T3 and T4) located on Z107 where the outputs are connected to the front panel controlled potentiometers for independent MIKE or LINE gain control dependent on the type of input used.

The MIKE input is connected to the base of the first emitter follower transistoer Q1 where the output at the emitter of Q1 is connected ot the base of the second emitter follower transistor Q2. the output of this stage; of the pre-amplifier circuit, at the emitter of Q2, is connected to the base of audio amplifier transistor Q3 amplified and the output at the collector of Q3 is connected to the base of audio amplifier transistor Q4. The amplified audio output at the collector of Q4 is connected to the base of emitter follower Q5 where the output at the emitter of Q5 is connected to the front panel controlled potentiometer (R104, R105) marked MIKE/LINE.

The outputs of the potentiometers R104 and R105 are connected to the Mode switch where; the amplified Mike input is connected to Z109 (see circuit analysis of the Carrier Generator Section) when the Mode switch is set at the AM position; and the USB, LSB, 600 ohm LINE inputs are connected to the bases of audio emitter followers Q11 (LSB circuit) and Q6 (USB circuit). Since the USB and LSB balanced modulator circuit operate identically only the LSB balanced modulator circuit will be discussed. The LSB audio intelligence at the emitter of Q11 is connected to the balanced modulator (consisting of diodes CR6 thru CR8, and variable resistor R54) along with the internally isolated (see following paragraph for description) 250KC Carrier signal connected to the arm of variable resistor R54 and the mixed output is transistor coupled (T2) to the base of intermediate frequency amplifier Q12. The amplifier mixed signal at the collector of Q12 is connected to the LSB filter

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LF2 where only the LSB audio intelligence with a 250KC Carrier is connected to the base of emitter follower transistor Q13. The output at the emitter of Q13 is adjusted by resistor R67 and combined with the output of the USB balanced modulator circuit. These signals are connected to the base of the balanced mixer circuit located in the Frequency Shift Generator Section (Z108) via the Mode Switch position marked LSB, USB, ISB, and CW.

The 250KC Carrier frequencies that are mixed with the USB, LSB audio intelligences in the balanced modulators (via R54 in the LSB circuit) are obtained by the 250KC signal output from Z109. This output from Z109 is connected independently to the bases of two emitter follower transistors (Q9 and Q10 located in Z107) and there outputs at there respected emitters are connected to the LSB and USB balanced modulator circuits.

4-8. DETAILED ANALYSIS OF THE FREQUENCY SHIFT GENERATOR SECTION Z111 AND VARIABLE CRYSTAL OSCILLATOR SECTION (P/o POWER SUPPLY) (REFER TO FIGURES 7-9 AND 7-10).

The Frequency Shift Generator Circuits perform the following functions; converts both the FSK and FAX inputs to variable dc current for use by the Variable Crystal Oscillator Section (P/o the power supply circuit see figure 7-10); mixes either the Variable Crystal Oscillators output or the nominal 250KC signal from the Sideband Generator Section with the 2.75 mc input also from the Sideband Generator Section to obtain the 3 mc output signal. For ease of discussion each circuit will be analyzed separately.

The FSK and FAX circuits voltage key the input to the Variable Crystal Oscillator with dc ocntrol voltages obtained from the FAX and FSK inputs applied to the FAX and FSK dc regulator circuits. The frequency shifted keyed input (either dry contact keyed or an externally keyed dc current) is connected to the keyer circuit consisting of, transformers T2 and T4, diodes CR8 and CR9, and the full wave bridge rectifier comprising diodes CR10 thru CR13. This circuit connects a dc current, appropriately keyed, to the SEMSE switch controlled dc amplifier circuit consisting of dc amplifier transistors Q7 thru Q10. The keyed dc connected to the base of Q7 is simultaneously connected to the base of Q8 and to the SENSE switch low dc position where when placed at that position eliminates amplifier transistor Q8 from the circuit. With the SENSE switch placed at the high dc position the amplified output at the collector of Q8 is connected via the contacts of the SENSE switch to the base of Q9 amplified and the output at the collector of Q9 is connected to the base of Q10. The amplified output at the collector of Q10 is connected to the center of the external voltage divider, via the center frequency adjustable potentiometer R37, where one side is connected to the mode switch position for FSK and the other side os connected via the switch controlled potentiometer, and the frequency shift potnetiometers R35 and R35, to the emitter of Q10. This level control collector emitter circuit allows for accurate adjustments of the proper range of dc connected to the VXCO. The FAX circuit applies a regulated dc to the mode switch where when set at FAX regulates the VXCO. The FAX input is connected to the base of dc regulator Q6 and the output at the emitter of Q6 is connected to one side of the FAX shift potentiometer R27 and the other side is connected to the output of the dc rdgulator Q11. Adjusting the arm of potentiometer R27 produces the proper dc level connected to the FAX position of the mode switch. When FAX is the selected mode of operation the regulated dc control voltage from variable resistor R27 operates the Variable Crystal Oscillator circuit by changing capacitance of the crystal's control circuit.

<u>4-9. DETAILED ANALYSIS OF THE TRANSLATOR, RF OUTPUT AND FILTER SECTIONS (Z108, Z115 and Z113 or Z114). - (Refer to Figures 7-11, 7-12, and 7-13).</u>

The Translator module circuits accept; the 12 or 13 mc frequency from the Spectrum Generator; the 10- to 10.99999 mc switch selectable frequencies from the Mixer-Divider Section; the 3 mc signal from the Sideband Exciter portion; and translates these inputs to produce the desired output frequency in the range from 30 Hz to 2 mc that is connected to the RF amplifier stage. The circuits that accept the various above mentioned inputs will be identified by the input and discussed accordingly.

The 10- to 10.99999 mc selectable frequency range is connected to a balanced modulator circuit; consisting of transistor Q3, transformer T3 and diodes CR3 and CR4; where a 3 mc signal transformer coupled (T4) and balanced using potentiometer (R19) is also connected. The mixed outputs of CR3 and CR4 are both in phase; the output of CR4 is connected simultaneously to the 13- to 13.5 mc amplifier input circuit consisting of two tuned transformers (T7 and T8) and to the 13.5- to 14 mc amplifier input circuit consisting of two tuned transformers (T10 and T11). The output circuitry from the CR3 diode (part of the balanced modulator) connected to transistors Q4 and Q18 isolates the ALDC controlled input from the above mentioned transformer tuned circuits therefore the outputs of the two tuned transformer circuits normally used are connected to the independent ampplfier stages. Since the operation of both amplifier stages are identical only the 13- to 13.5 mc amplifier Q4 and the amplified output at the collector of Q4 is transformer coupled by tuned transformer T8 to the base of amplifier Q5. The amplified output of Q5 is tuned transformer coupled (T9) to the output of the 13.5- to 14 mc amplifier circuit connected to the secondary of T18. The resulting combined ALDC controlled frequencies from 13- to 14 mc are applied to the 32kHz to 2 mc balanced modulator along with the 12 or 13 mc dc switched signal.

The Automatic Load and Drive Control (ALDC) circuit in the Translator Section consisting of transistors Q6, Q7, Q8, and the input for this circuit, controls the input applied to the balanced modulator (CR3, CR4) and the level of both the amplifier stages. For a description of the remaining ALDC circuit refer to the following RF output section (Z115) analysis.

The 30kHz- to 1.99999 mc transformer coupled frequency from the collector of Q2 is connected to the RF amplifier ALDC control circuit (Z115) where the 30kHz- to 1.99999 mc RF signal undergoes two stages of amplification by RF amplifier transistors Q1 and Q2 and the amplified signal is then connected to the ALDC control circuit. The 30kHz- to 1.99999 mc input is connected to the base circuit of the amplifier transistor Q2 amplified and the output at the collector of Q2 is transformed coupled (T1) to the base of amplifier Q1. The amplified output at the collector of Q1 is transformer coupled to the ALDC controlled output circuitry. The ALDC control circuit automatically controls the level of the RF output signal. The output control voltage is connected to the Translator ALDC circuit ascertaining the level that the translator circuit is to operate.

The 30kHz - to 2 mc amplified RF output frequency range is connected to the Output Filter Section (Z113) where the RF signal is filtered. The range of the low pass filter circuit is between 30kHz and 1.99999 mc.

4-10. DETAILED ANALYSIS, POWER SUPPLY SECTIONS (Z301, Z302, Z303, Z304, and Z305).

The LFE power supply (comprising transformer T301, full wave bridge rectifier circuit (Z304, and power supply modules Z303, and Z305) is a current sensing regulated power supply with filter circuits and current limiter circuits. Under load conditions, the power supply provides +12-, +24-, and +30 VDC outputs for use in the appropriate modules. (Refer to figure 7-1).

The power supply also contains the DC controlled ovenized 3-mc oscillator and the 1 mc/s STANDARD. Refer to figure 7-10 for location.

SECTION 5
MAINTENANCE

5-1. PREVENTIVE MAINTENANCE.

In order to prevent equipment failure due to dust, dirt and other destructive elements, it is suggested that a schedule of preventive maintenance be set up and adhered to.

At periodic intervals, the equipment should be removed from its mounting for cleaning and inspection. All accessible covers should be removed and the wiring and all components inspected for dirt corrosion, charring, discoloring or grease. Remove dust with a soft brush or vacuum cleaner. Remove dirt or grease from other parts with any suitable cleaning solvent. Use of carbon tetrachloride should be avoided due to its highly toxic effects. Trichlorethylene or methylchloroform may be used, providing the necessary precautions are observed.

WARNING

When using toxic solvents, make certain that adequate ventilation exists. Avoid prolonged or repeated breathing of the vapor. Avoid prolonged or repeated contact with skin. Flammable solvents shall not be used on energized equipment or near any equipment from which a spark may be received. Smoking, "hot work", etc. is prohibited in the immediate area.

CAUTION

When using trichlorethylene, avoid contact with painted surfaces, due to its paint removing effects.

5-2. TROUBLESHOOTING.

a. GENERAL. - The circuits of the Exciter are contained in sixteen printed circuit plug-in modules mounted in the bottom side of the chassis (see figure 5-1). The card Z100 numbers are the circuit reference symbol numbers: "A" numbers are the card assembly part numbers by which they are identified and ordered. The "A" number appears printed on the card and again on the chassis wall adjacent to the card's receptacle, along with the card Z100 number. The plug end of each module

To Be Supplied

Figure 5-1. Bottom View, LFE

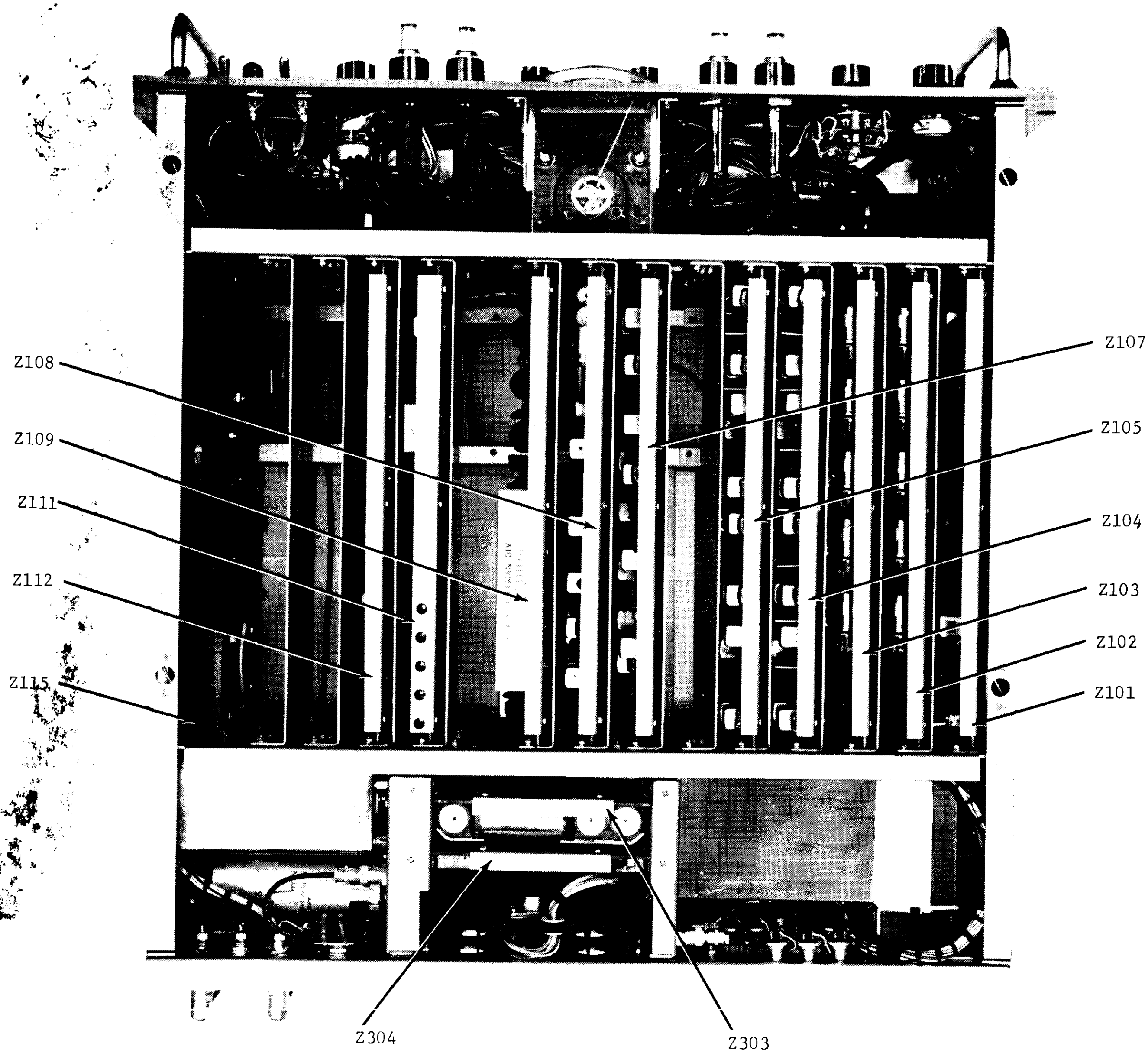

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Figure 5-2. Top View LFE

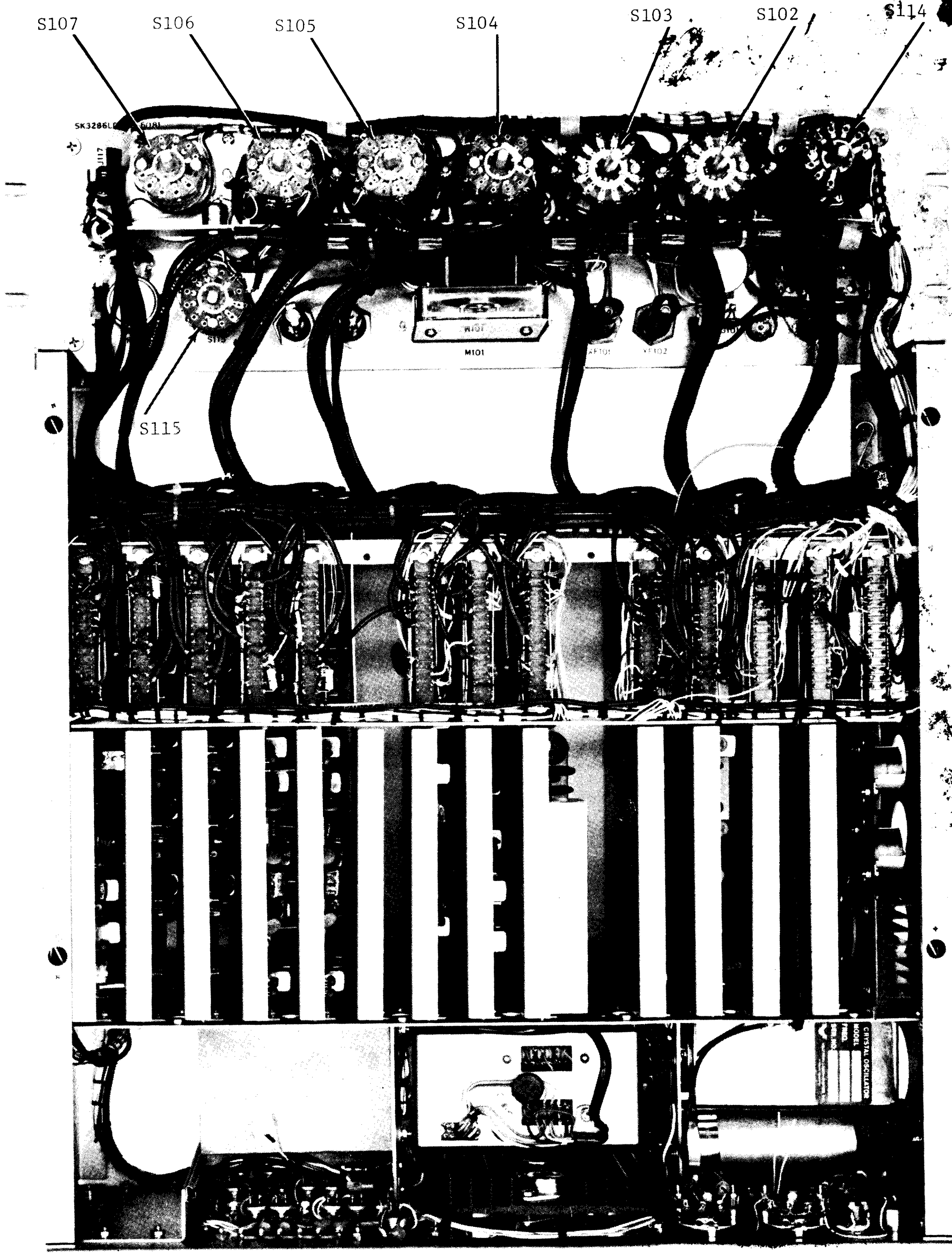

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Figure 5-3. Top View, Showing Selection Switches of The LFE contains keying notches and its receptacle in the bin floor, contains matching blocks to prevent inserting a module into the wrong receptacle. Some modules in the exciter and in other TMC equipment, although they are assigned different "Z" numbers, have the same "A" numbers and are identical and interchangeable. These modules have similar keying at their plug ends and in their receptacles. The larger power supply circuit components are mounted toward the rear of the exciter chassis; (see figure 5-2); smaller components are contained in printed card Z1304 mounted from the top side of the chassis (see figure 5-2).

The frequency selection switches, (described in paragraph 4-2c) are mounted on the rear surface of the front panel (see figure 5-3).

b. SPECIAL TOOLS AND TEST EQUIPMENT. - Special tools included in the shipment* and required for testing and repair are so shown in figure 5-4. Table 5-1 lists standard laboratory equipment required but not supplied.

TABLE 5-1. TEST EQUIPMENT

ITEM	MANUFACTURER
Signal Generator	Hewlett-Packard Model 606A
Scope	Tektronix Model 541A or equivalent
Spectrum Analyzer	Lavoie Lab. Inc. Model LA-40A
Audio Generator	Hewlett-Packard Model 200CD or equivalent
VTVM	Ballantine Model 314 or equivalent
Frequency Counter	Hewlett-Packard Model 5244L or equivalent
0-10V, DC Power Supply	
Attenuator	Telonic Model D-550
Millivolt Meter	Millivac Model MV-28B or equivalent
VTVM	Hewlett-Packard Model 1410B

* Shipment of system in which exciter is used.

c. WAVE SHAPES. - Table 5-3 indicates typical wave shape patterns that will aid in troubleshooting the LFE.

d. TROUBLESHOOTING PROCEDURE. - Troubleshooting time is greatly shortened if a set of spare plug-in modules are available. If the trouble is located in the modular circuitry (rather than in the power supply or switches), module substitution will determine this and, also, point out the faulty card. Furthermore, subsequent checking of pulse-forms to establish the faulty component (or broken conductor) on the module is localized to that one module. To do this, refer to table 5-3.

If module substitution fails to locate the trouble, it may be generally assumed that a power supply voltage is missing. When repairing any power supply modules or parts remove plug from line source. Set POWER switch at STANDBY and check voltage points as indicated in table 5-2, using a scope.

To bring the test points on a module or on its receptacle pins up for accessibility, make sure power is set at STANDBY, remove the module and insert card extender (see figure 5-4) in the module receptacle. Then plug the module into the top of the card extender. After completing this Power maybe returned.

NOTE

> Check to ensure that "Z" number card matches "Z" number printed on side of bin adjacent to bin receptacle. Because the card extender is keyed to fit into all receptacles, it is possible to connect a module to the wrong receptacle.

Figure 5-5 shows a typical module in test position. For each test point there is a numbered "TP" test point terminal on the module or a module receptacle pin test point on the Extender. Receptacle pins are identified by letters and numbers. Test points for the lettered pins are arranged in two rows on the Extender. Receptacle pins are identified by letters and numbers. Test points for the lettered pins are arranged in two rows on the Extender near the top; test points for numbered pins are located in two rows beneath the lettered rows.

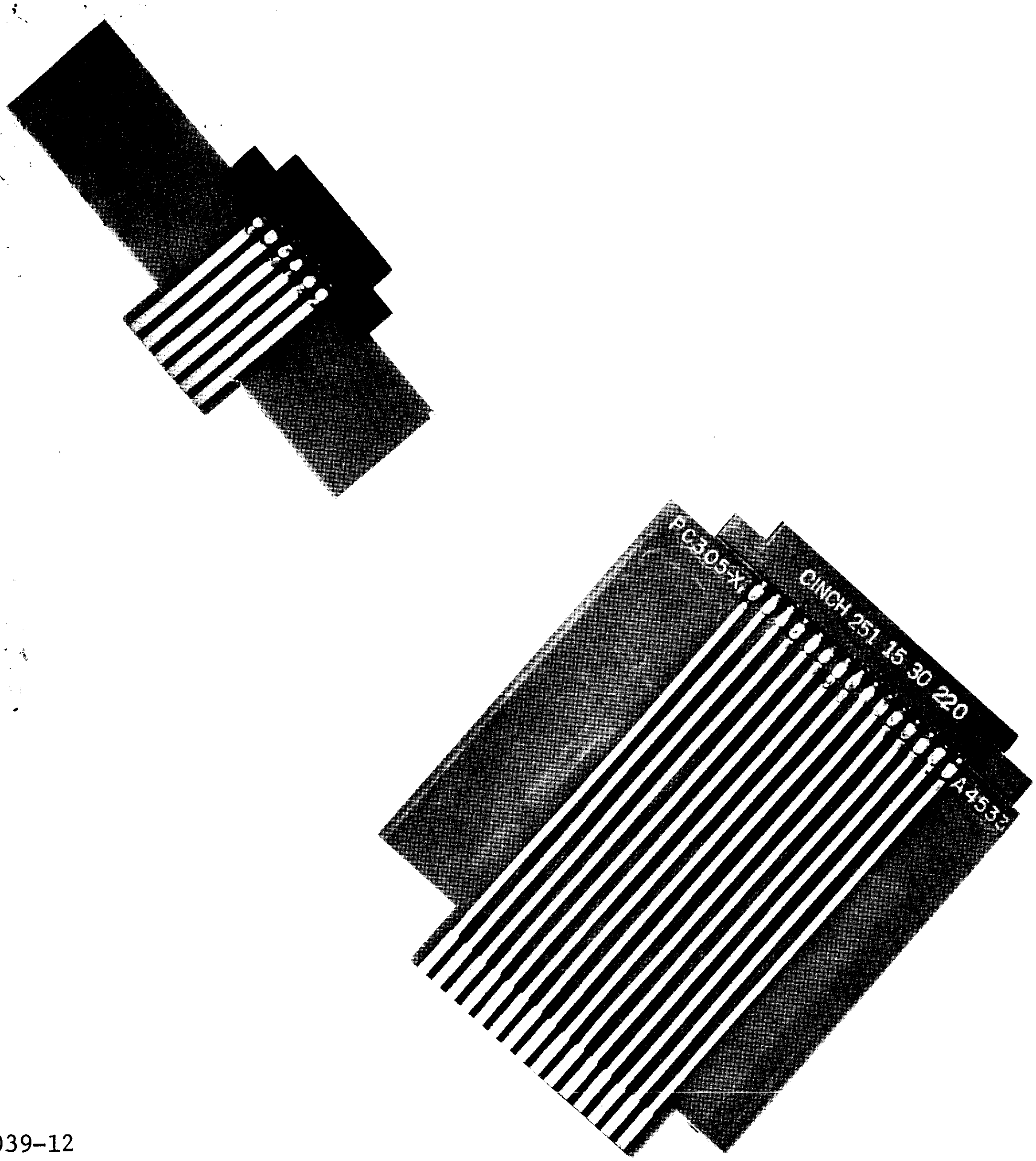

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Figure 5-4. Maintenance Tools

CAUTION

Apply probe only to "TP" test points on module or receptacle pin test points on the Extender. It is difficult to touch the probe to the miniature pins on the module without shorting it out and destroying the module.

If power supply voltages check out, check wiring continuity through switches, referring to figures 7-1a, and 4-1. Also check wire runs between card receptacles for broken or loosend wires, referring to figures mentioned.

5-3. REPAIR OF PRINTED CIRCUITRY.

a. INTRODUCTION. - Repair of the chassis-mounted power supply circuitry follows standard lab 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 5-7 thru 5-23.

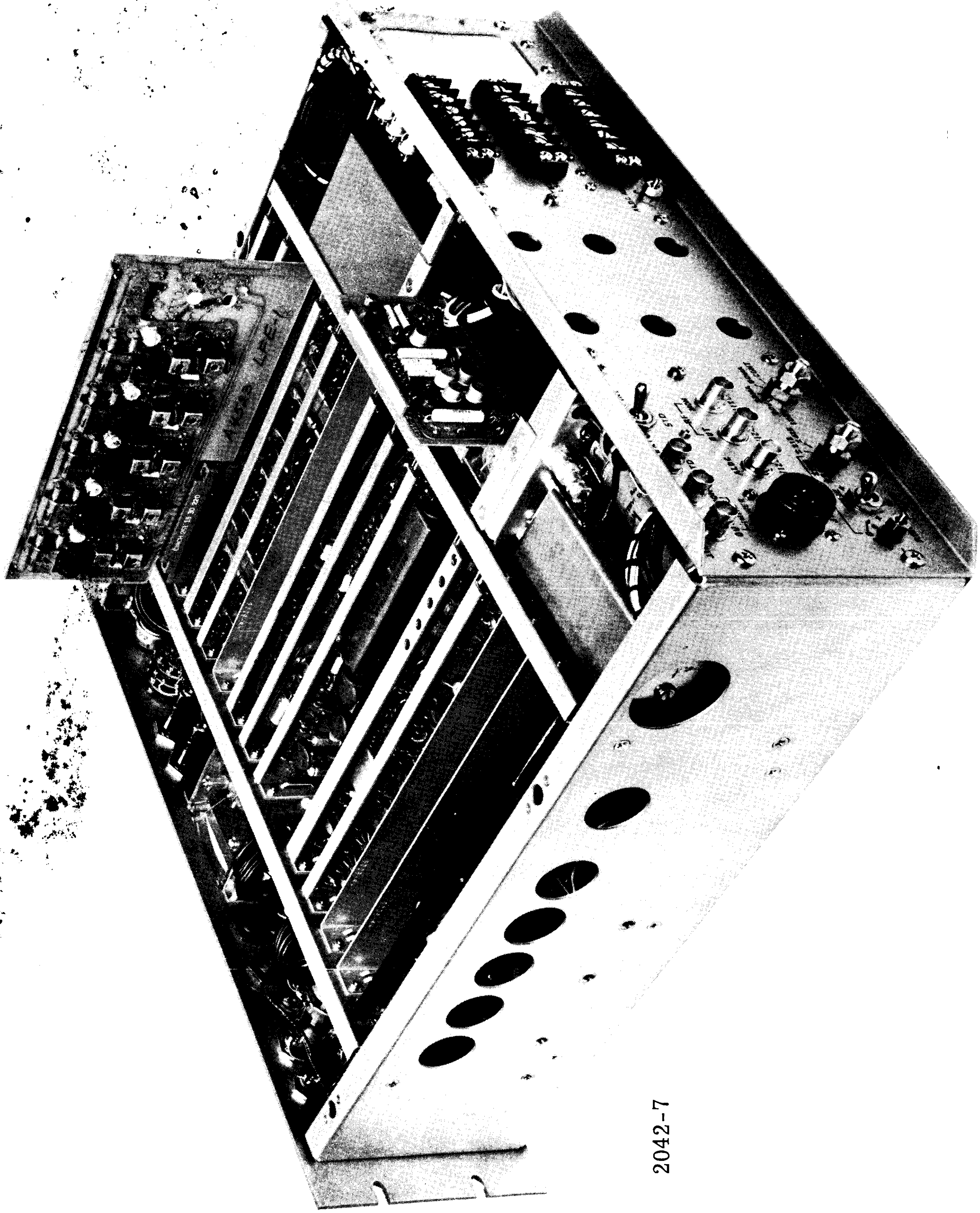
NOTE

Replacements of parts on the printed circuit boards requires the special tools and technique described in paragraph 5-3d.

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 components 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



2042-7

Figure 5-5. Module in Test Position

making point-to-point resistance tests, using needle point 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 exercises 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 a 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 ring the suspected circuit with a multimeter. To overcome this condition, thoroughly clean the carbonized area with solvent and a stiff brush. If this does not remove it, use a scraping tool (spade end of a solder-air tool or its equivalent) to remove the carbon or drill a hole through the leakage path to break the continuity of the leakage. When the drilling method is used, be careful not to drill into a part mounted on the other side.

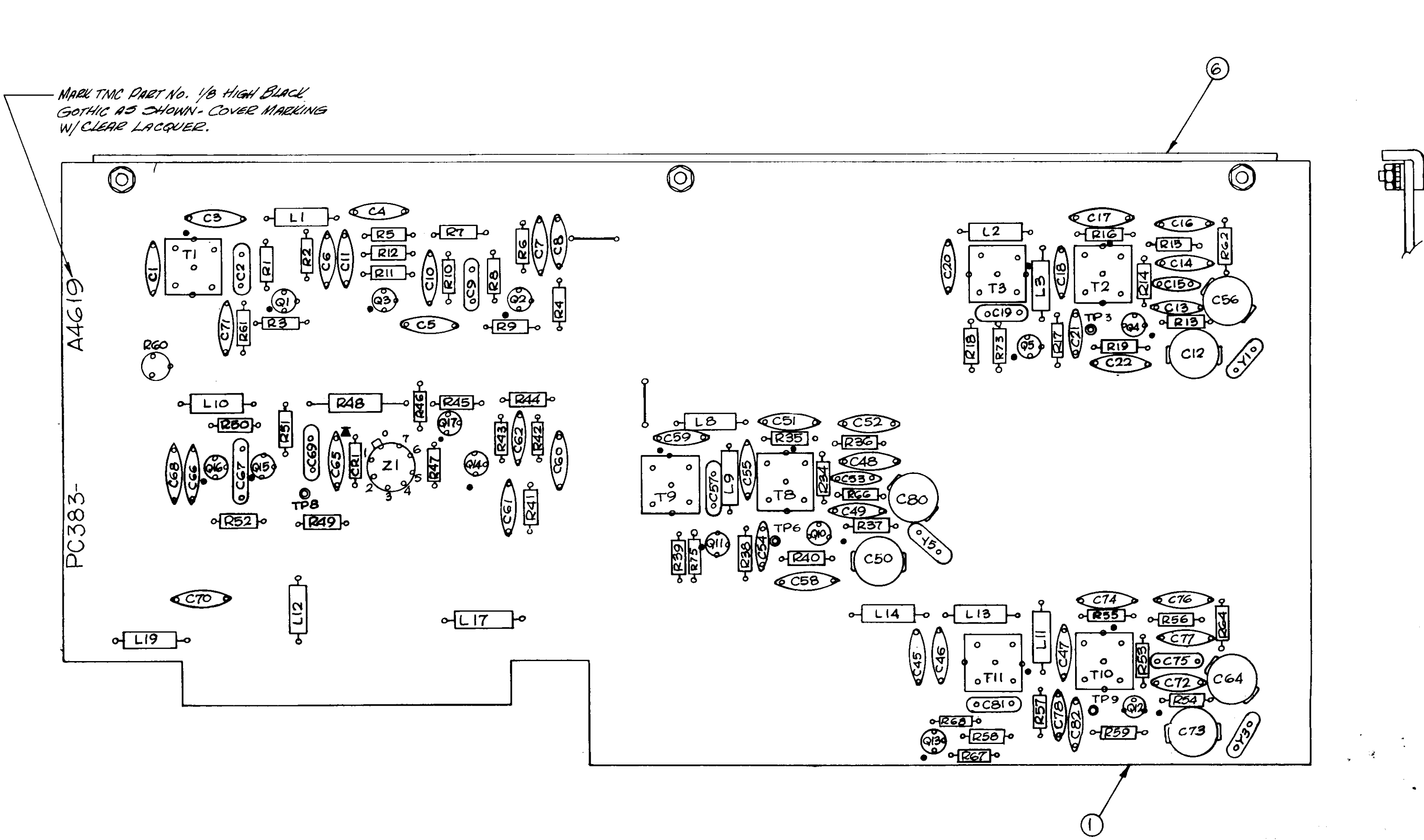
TABLE 5-2. POWER SUPPLY VOLTAGES

Power Supply Board "A"

INPUTS		OUTPUTS	
Frequency	60 cps	Frequency	DC
Level	40 rms	Level	+40V
Location	Pin C-B	Location	Pin A
Conditions	All	Conditions	All

Power Supply Board "B"

INPUTS			OUTPUTS			
Frequency	DC	DC	Frequency	DC	DC	DC
Level	+40V	+20V	Level	+12V	+24V	+30V
Location	Pin A	Pin E	Location	Pin F	Pin 4	Pin 3
Condition	All	All	Condition	All	All	All



ASSEMBLY NOTES

1- TO MOUNT COMPONENTS, INSERT LEADS THROUGH PLATED-THRU HOLES.
2- USE CAUTION WHEN APPLYING HEAT & SOLDER TO LEAD & FOIL.
3- CLEAN & INSPECT AS PER SGTG.
4- FOR ELECTRICAL COMPONENT PART NUMBERS REFER TO NPL A4619.
5- USE SYMBOL NUMBERS FOR ASSEMBLY REFERENCE.

Figure 5-6. Component Location Diagram Spectrum Generator Section (Z101).

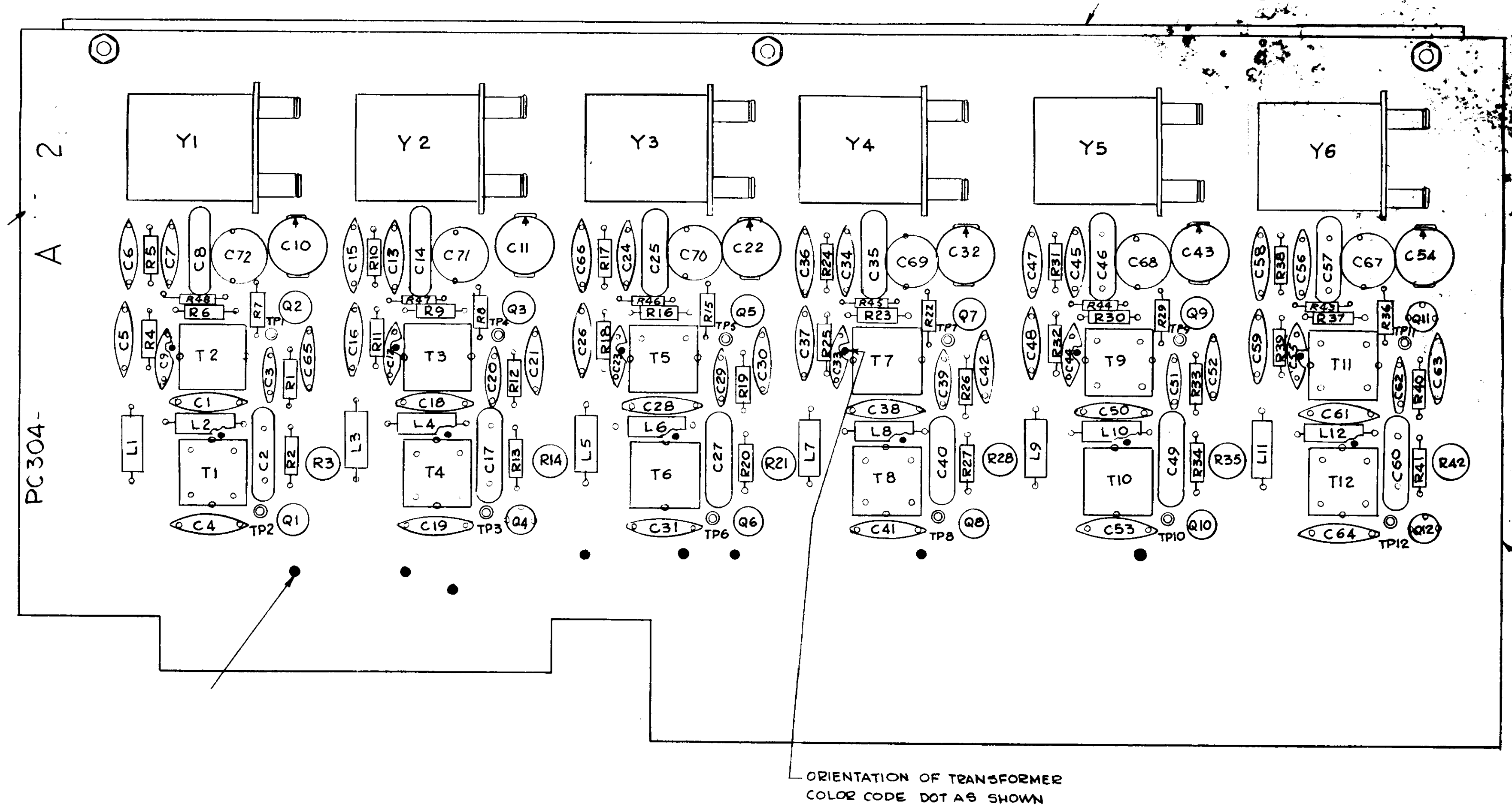


Figure 5-7. Component Location Diagram Comb Filter (Z102)

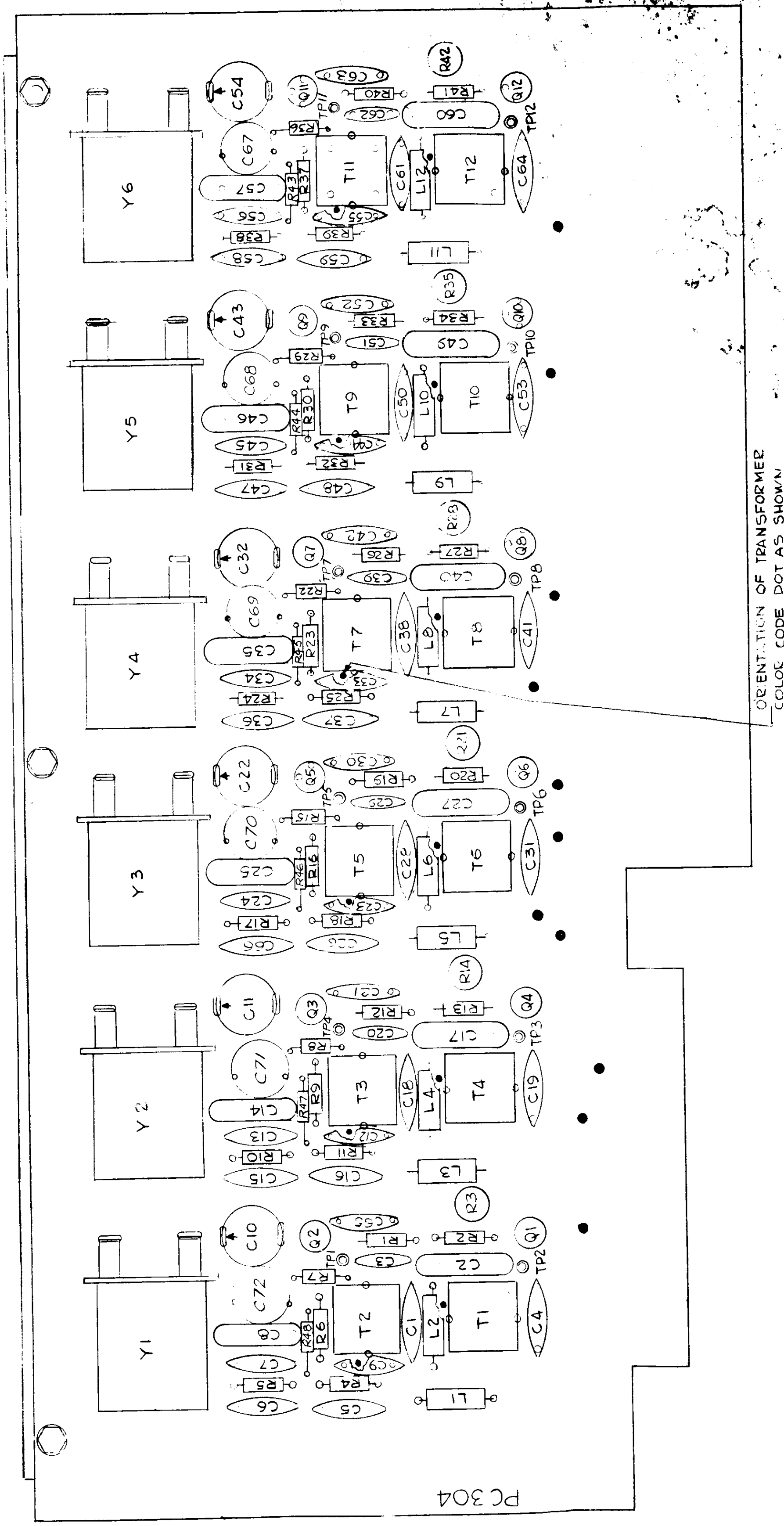
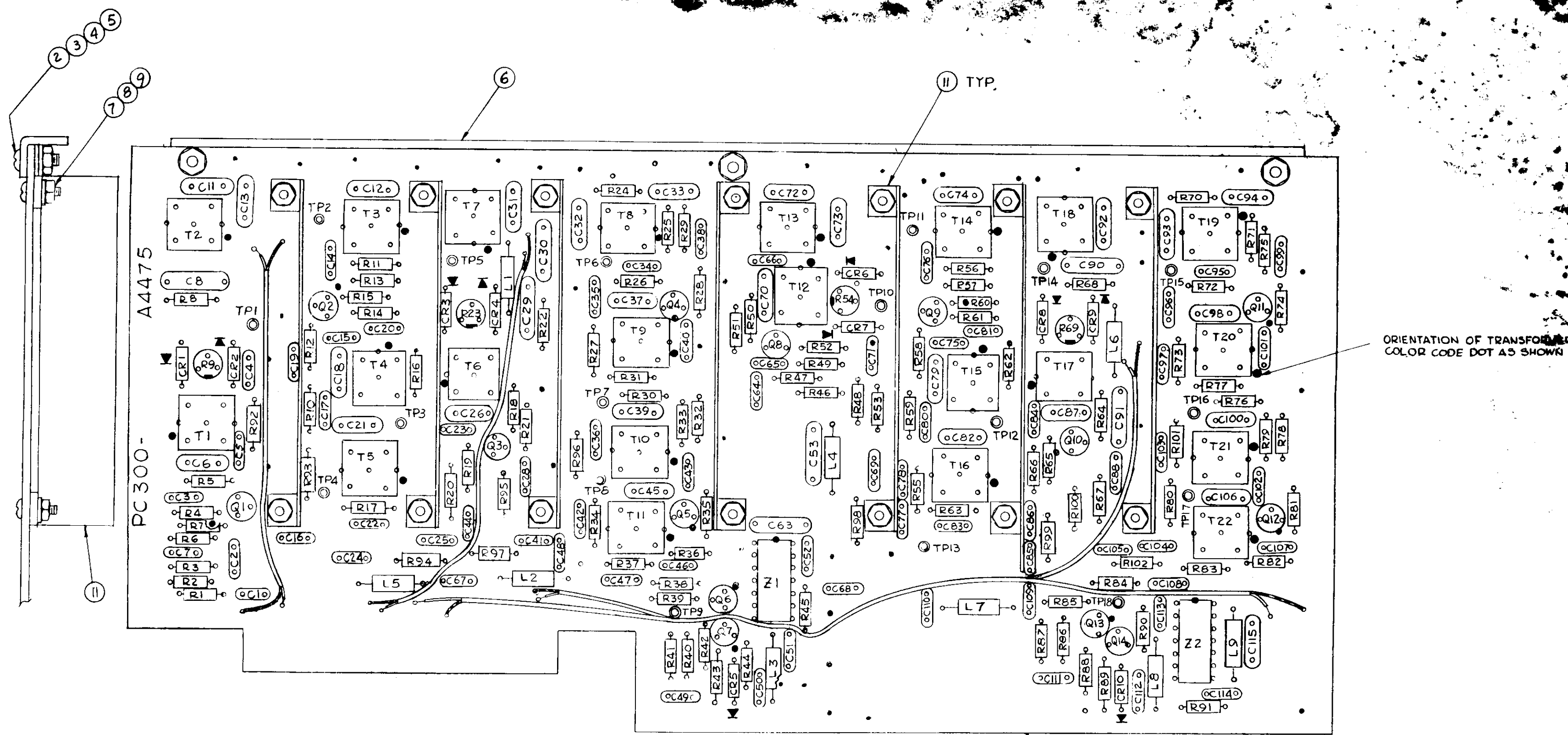


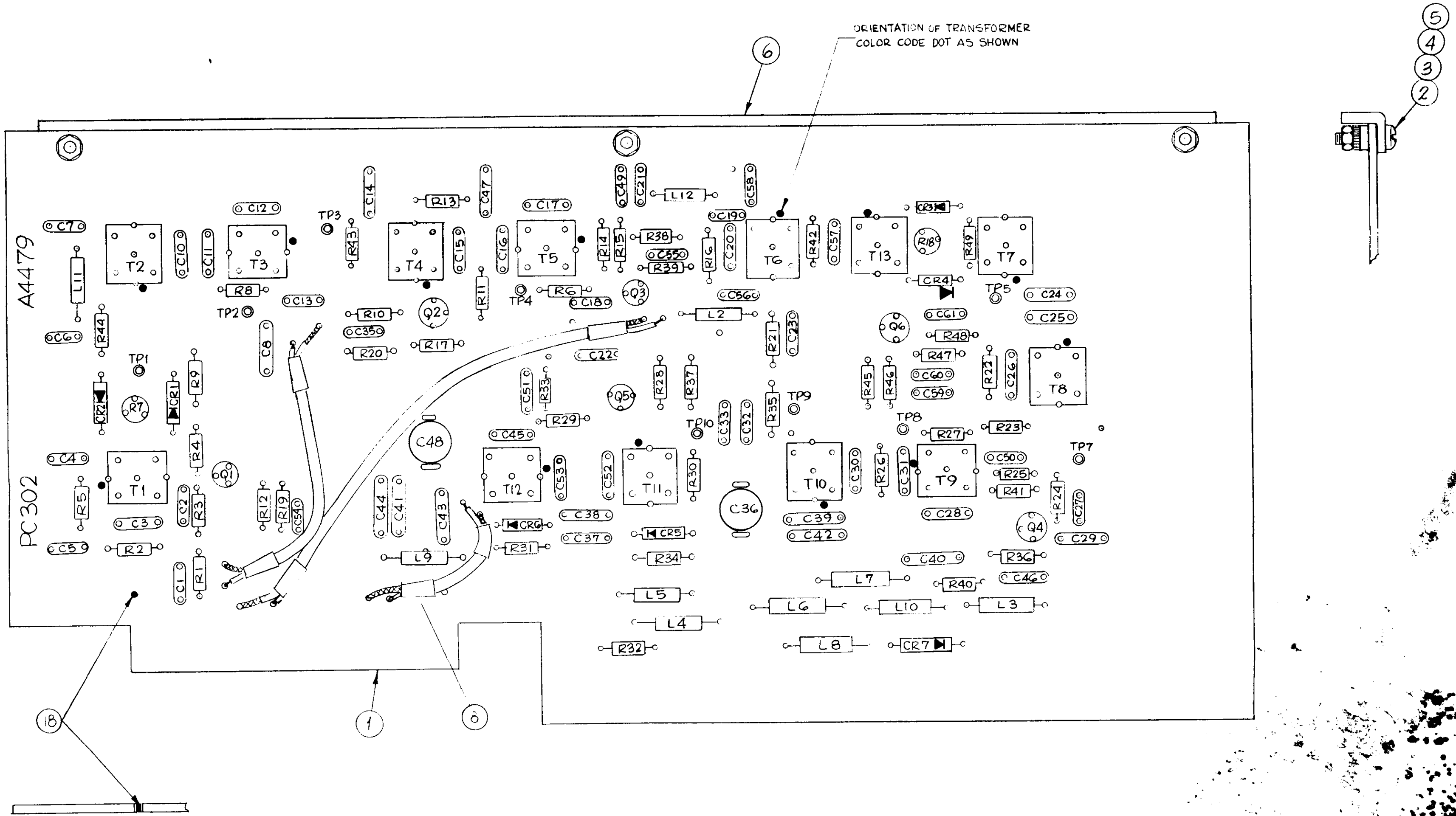
Figure 5-8. Component Location Diagram Comb Filter (Z103)



ASSEMBLY NOTES

1. TO MOUNT COMPONENTS INSERT LEADS THROUGH PLATED-THRU HOLES.
2. CAUTION WHEN APPLYING HEAT AND SOLDER TO LEAD AND FOIL.
3. CLEAN AND INSPECT AS PER SPEC S676.
4. FOR ELECTRICAL COMPONENT PART NUMBERS REFER TO NPL A4475.
5. USE SYMBOL NUMBERS FOR ASSEMBLY REFERENCE.

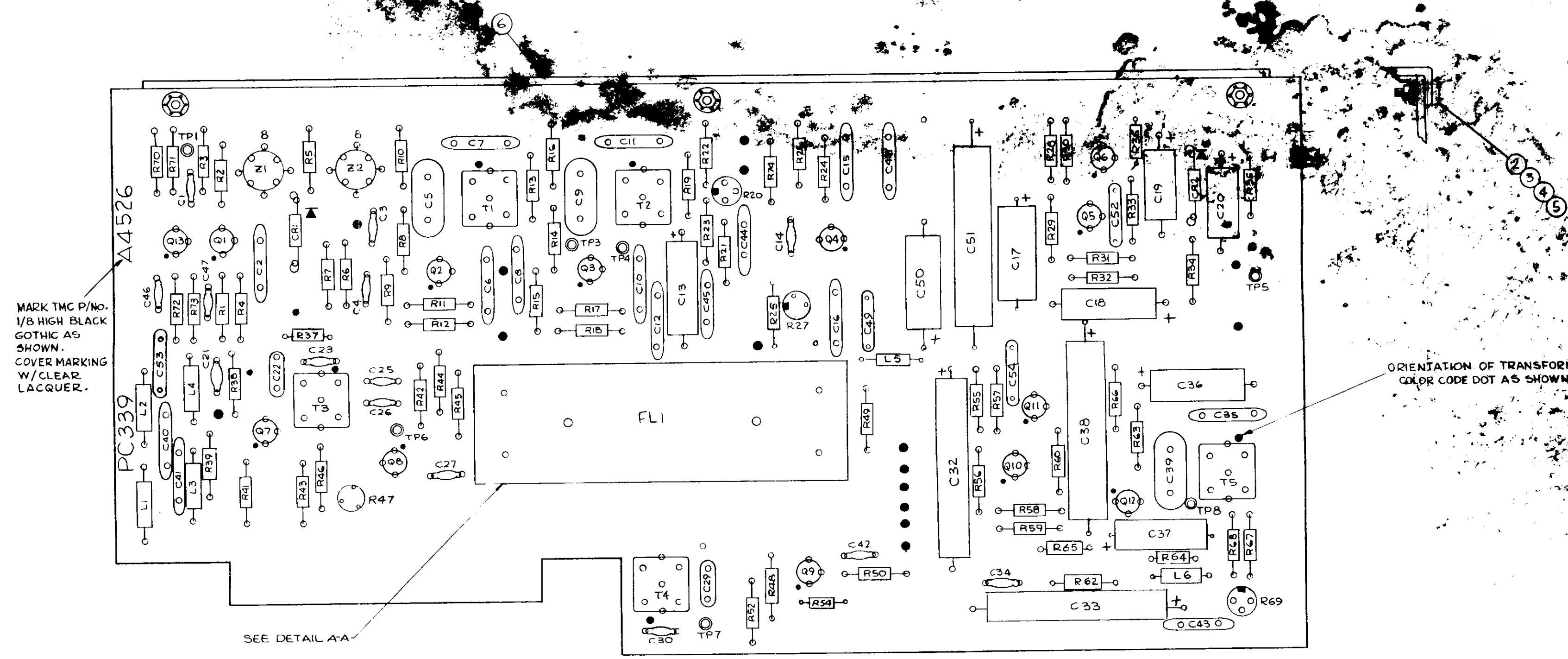
Figure 5-9. Component Location Mixer-Dividers (Z104 and Z105)

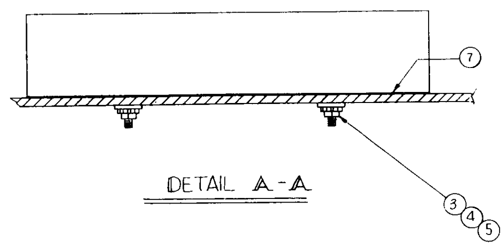


ASSEMBLY NOTES

1. TO MOUNT COMPONENTS INSERT LEADS THROUGH PLATED-THRU HOLES.
2. BE CAUTIOUS WHEN APPLYING HEAT AND SOLDER TO LEAD AND FOIL.
3. CLEAN AND INSPECT AS PER SPEC S676.
4. FOR ELECTRICAL COMPONENT PART NUMBERS REFER TO NPL A4479
5. USE SYMBOL NUMBERS FOR ASSEMBLY REFERENCE

Figure 5-10. Component Location Diagram Mixer Final (Z10?)

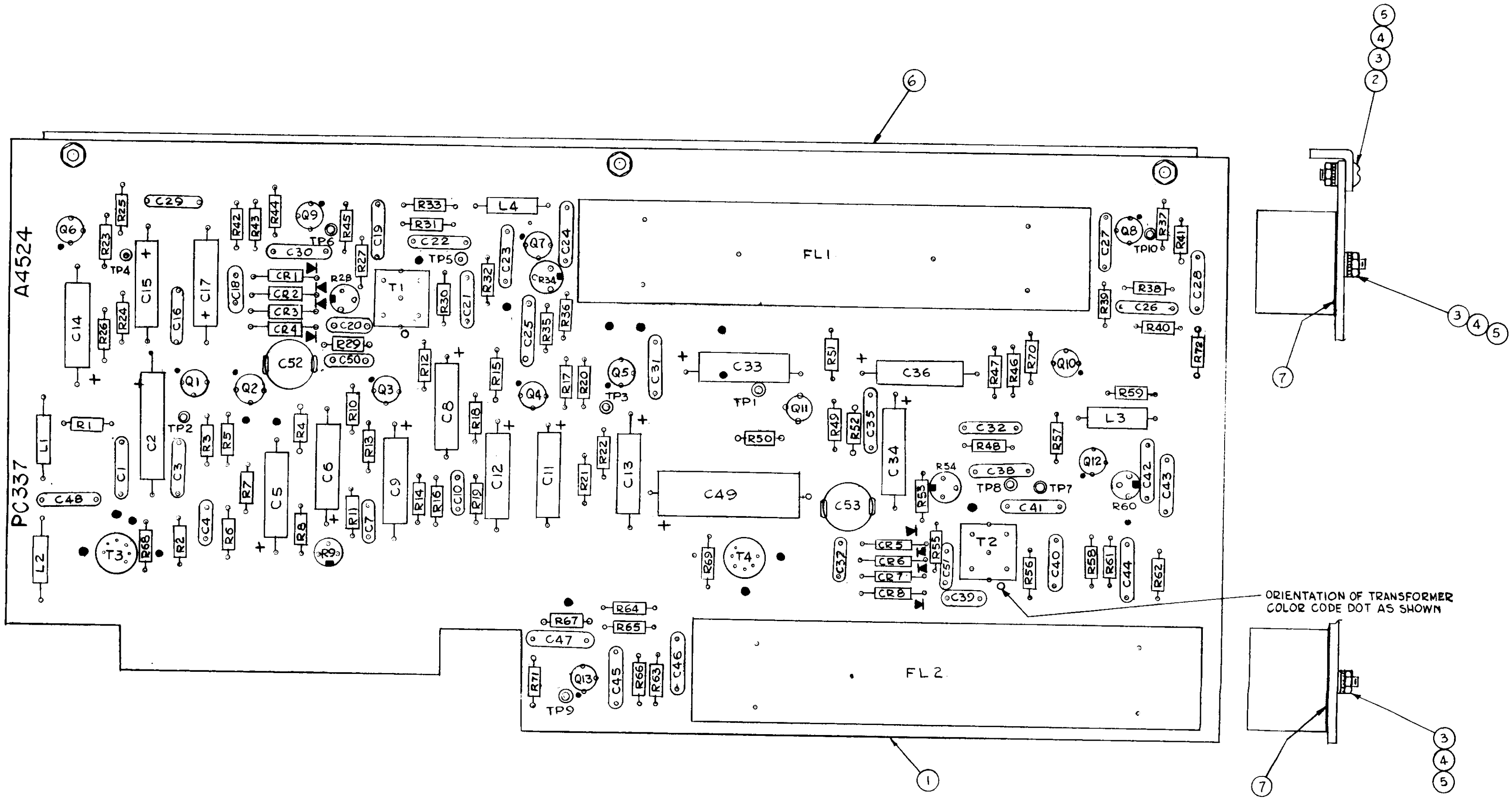




ASSEMBLY NOTES

1 – TO MOUNT COMPONENTS, INSERT LEADS THROUGH PLATED-THRU HOLES.
2 – CAUTION WHEN APPLYING HEAT AND SOLDER TO LEAD AND FOIL.
3 – CLEAN AND INSPECT AS PER 5676.
4 – FOR ELECTRICAL COMPONENT PART NUMBERS REFER TO NPL A4526
5 – USE SYMBOL NUMBERS FOR ASSEMBLY REF.

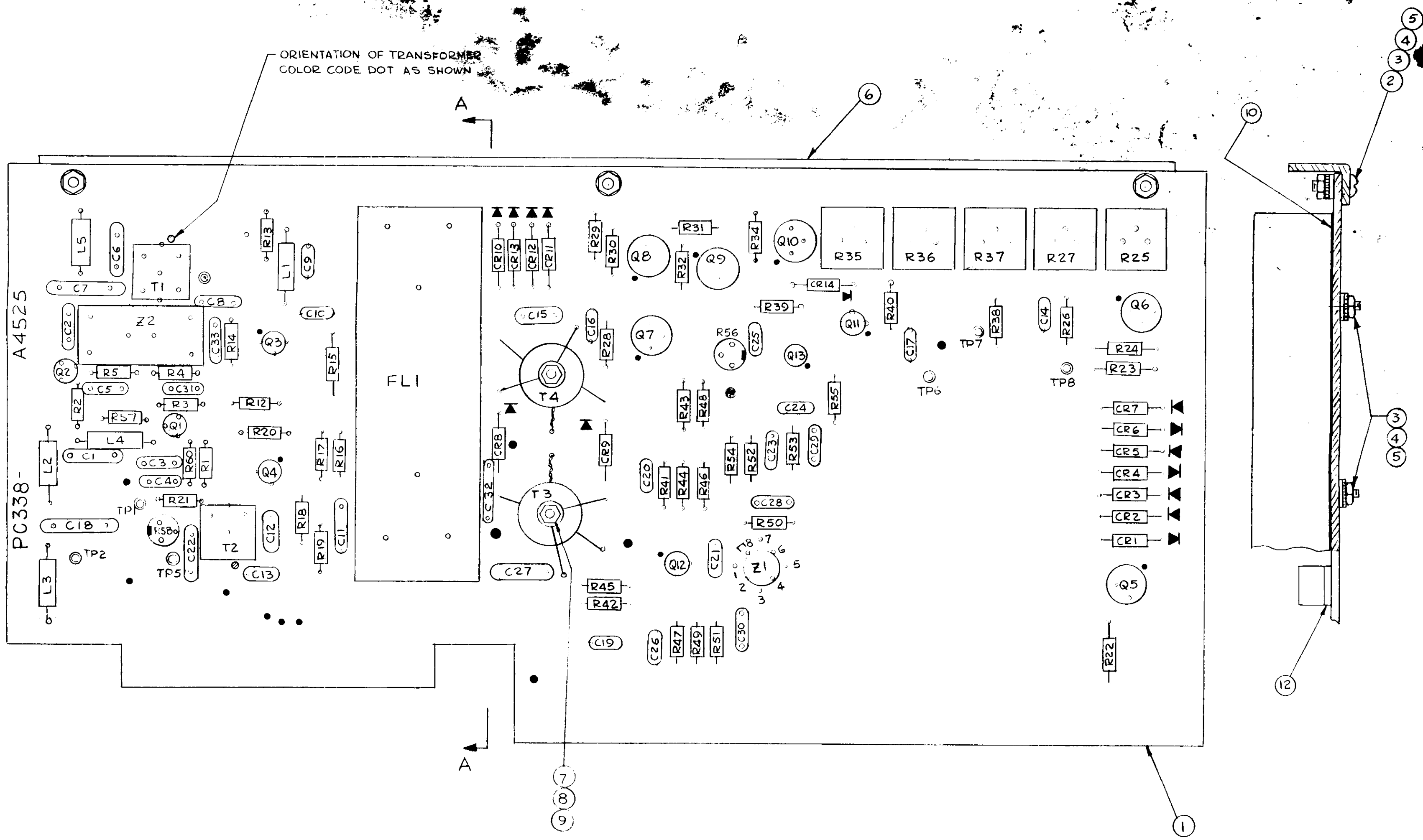
Figure 5-11. Component Location Diagram Carrier Generator Section (Z112)



ASSEMBLY NOTES:

1- TO MOUNT COMPONENTS, INSERT LEAD THROUGH PLATED THRU-HOLES.
2- CAUTION WHEN APPLYING HEAT & SOLDER TO LEAD & FOIL.
3- CLEAN & INSPECT AS PER 5-676
4- FOR ELECTRICAL COMPONENT PART NUMBERS REFER TO NPL A4524.
5- USE SYMBOL NUMBERS FOR ASSEMBLY REFERENCE

Figure 5-12. Component Location Diagram Sideband Generator Section (Z109)



— ASSEMBLY NOTES —

1- TO MOUNT COMPONENTS, INSERT LEAD THROUGH PLATED-THRU-HOLES.
2- CAUTION WHEN APPLYING HEAT & SOLDER TO LEAD & FOIL.
3- CLEAN & INSPECT AS PER S676.
4- FOR ELECTRICAL COMPONENT PART NUMBERS REFER TO NPL A4525.
5- USE SYMBOL NUMBERS FOR ASSEMBLY REFERENCE

Figure 5-13. Component Location Diagram Frequency Shift Generator (Z111)

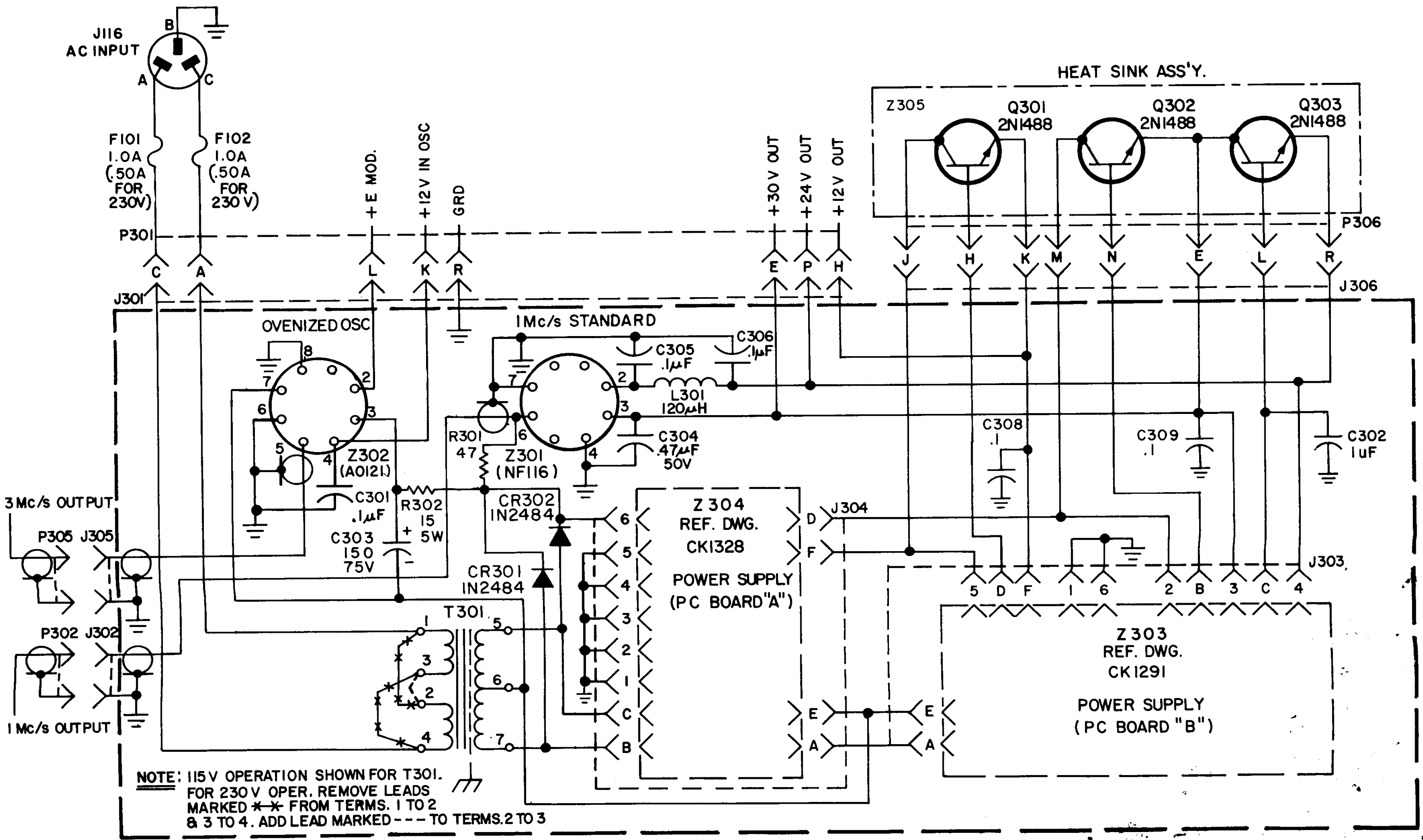
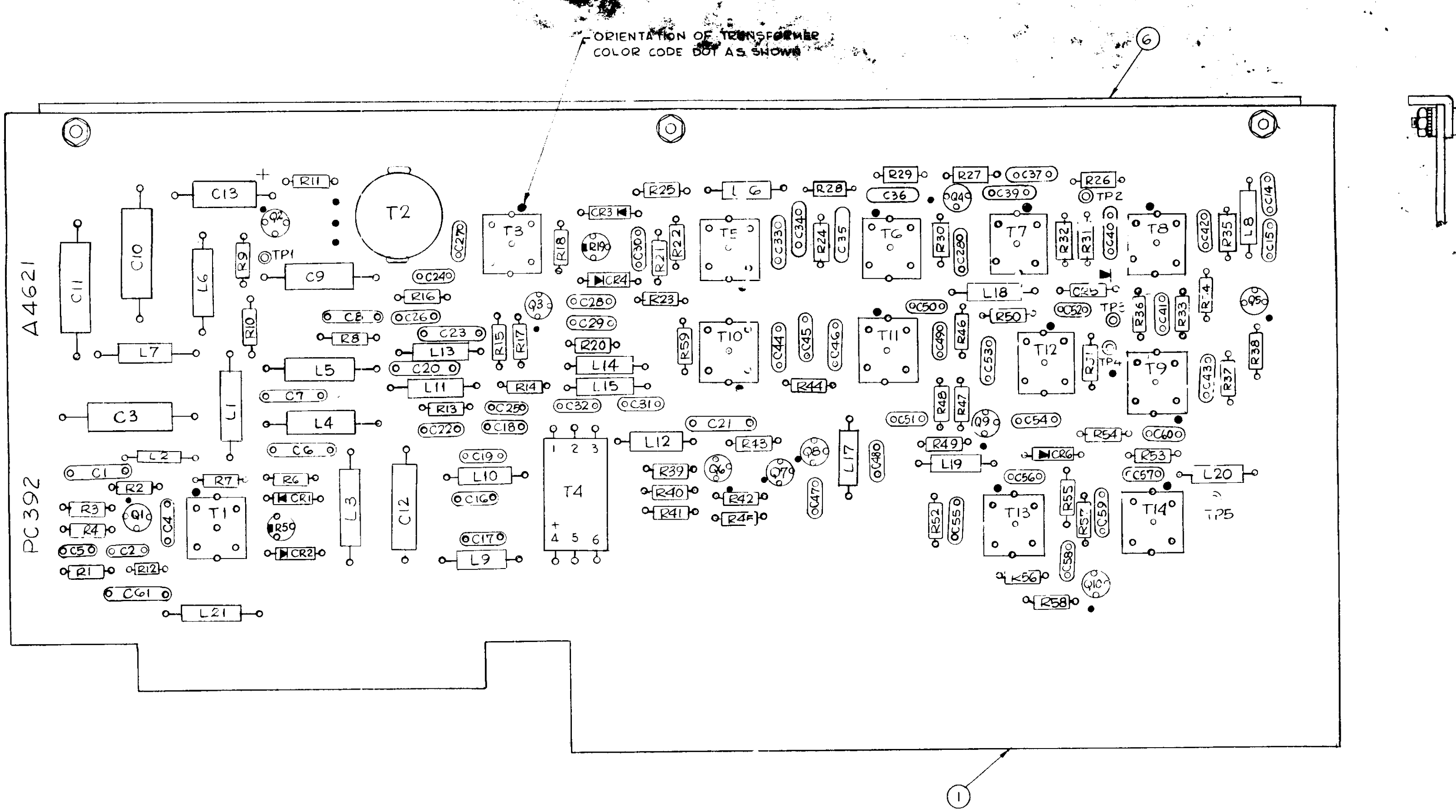


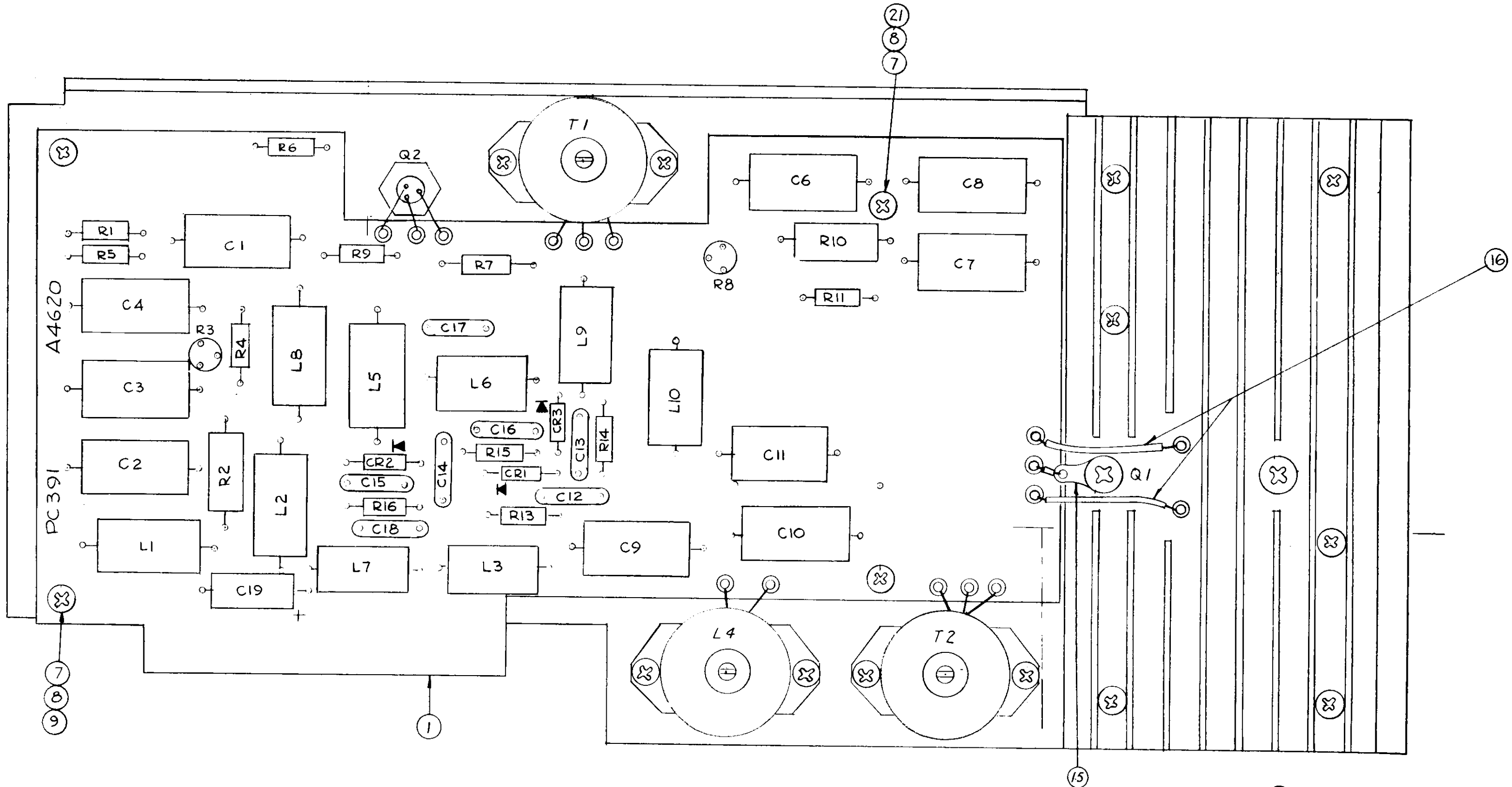
Figure 5-14. Component Location Diagram Variable Crystal Oscillator

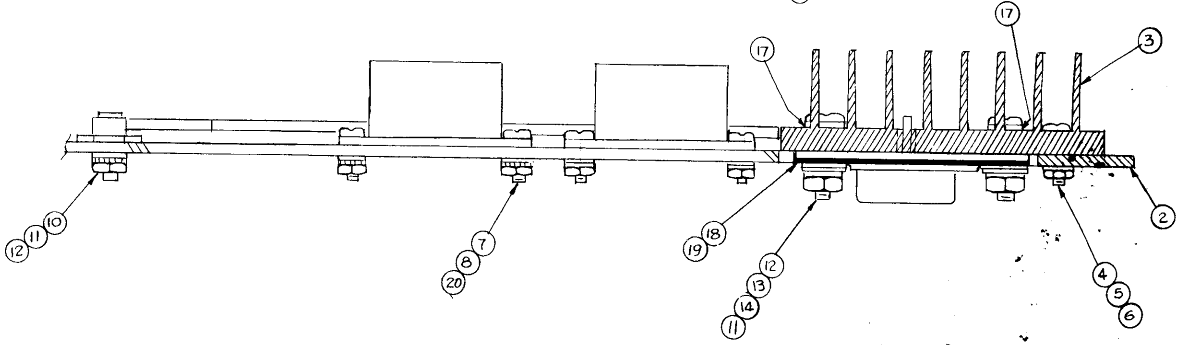


— ASSEMBLY NOTES —

1- TO MOUNT COMPONENTS, INSERT LEAD THROUGH PLATED-THRU-HOLES.
2- CAUTION WHEN APPLYING HEAT & SOLDER TO LEAD & FOIL.
3- CLEAN & INSPECT AS PER 5676.
4- FOR ELECTRICAL COMPONENT PART NUMBERS REFER TO NPL A4621
5- USE SYMBOL NUMBERS FOR ASSEMBLY REFERENCE.

Figure 5-15. Component Location Diagram Translator Section (Z108)

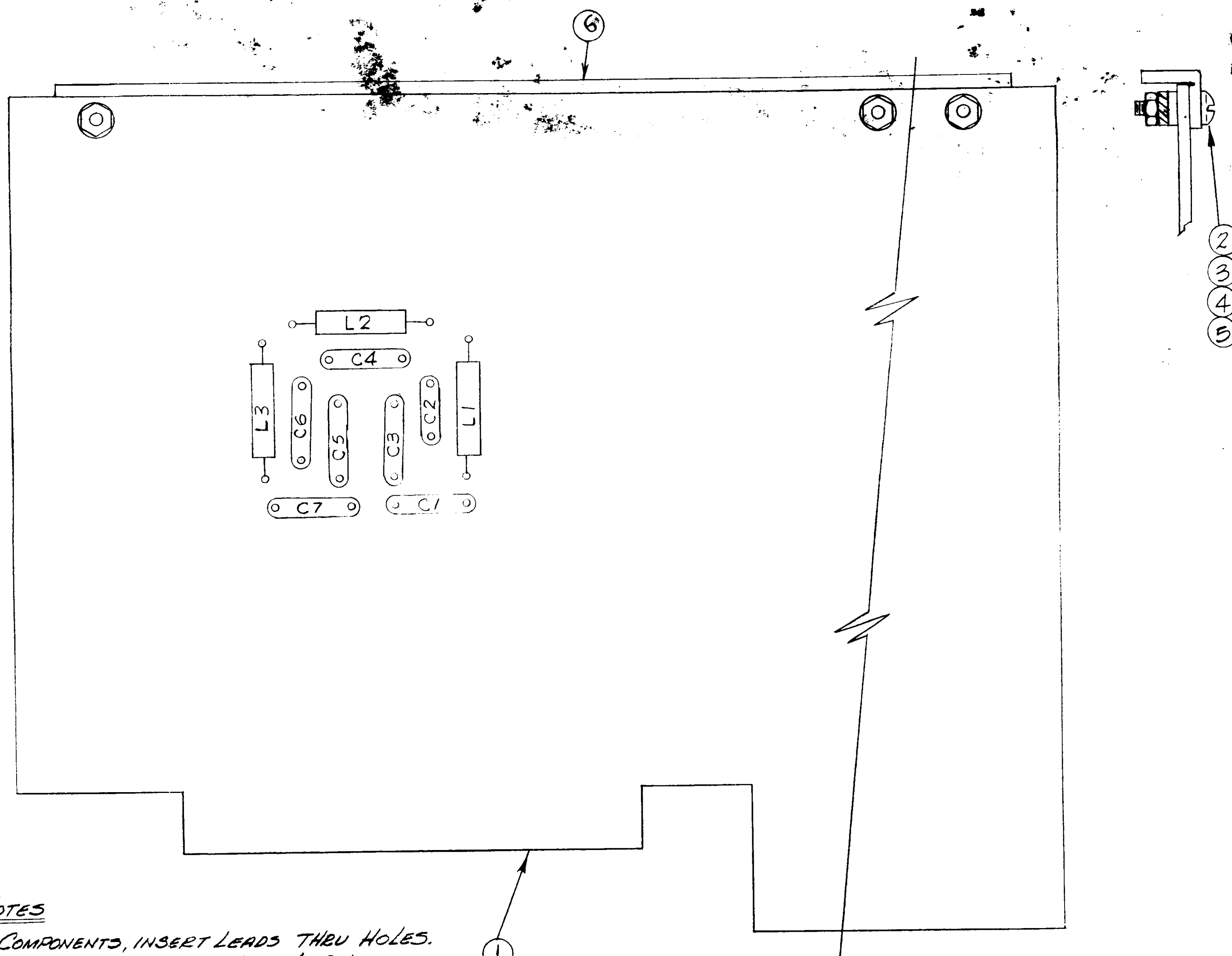




ASSEMBLY NOTES

1 - TO MOUNT COMPONENTS INSERT LEAD THROUGH PLATED THRU-HOLES.
2 - USE CAUTION WHEN APPLYING HEAT AND SOLDER TO LEAD AND FOIL.
3 - CLEAN AND INSPECT AS PER SPEC S676.
4 - FOR ELECTRICAL COMPONENT PAR NUMBERS REFER TO NPL A 4620
5 - USE SYMBOL NUMBERS FOR ASSEMBLY REFERENCE.
6 - USE ITEM 18 ON BOTH SIDES OF ITEM 19 WHEN ASSEMBLING.

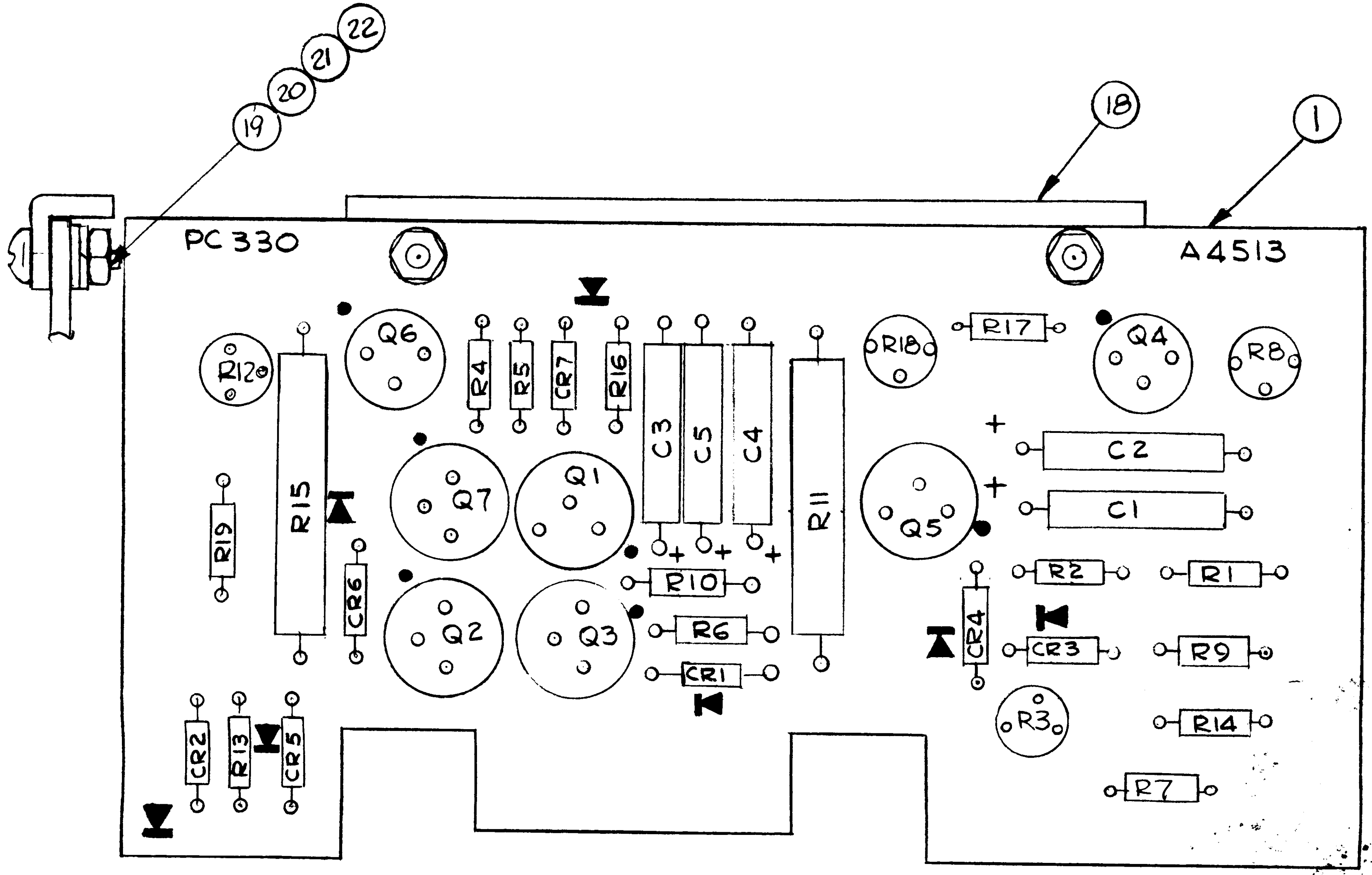
Figure 5-16. Component Location Diagram RF Output Amplifier Section (Z115)



ASSEMBLY NOTES

1- TO MOUNT COMPONENTS, INSERT LEADS THRU HOLES.
2- USE CAUTION WHEN APPLYING HEAT & SOLDER TO LEAD & FOIL.
3- CLEAN & INSPECT AS PER 5676.
4- FOR ELECTRICAL COMPONENT PT. NOS. REFER TO NPL A4653.
5- USE SYMBOL NOS. FOR REFERENCE.

Figure 5-17. Component Location Diagram Output Filter Section (Z113 or Z114)



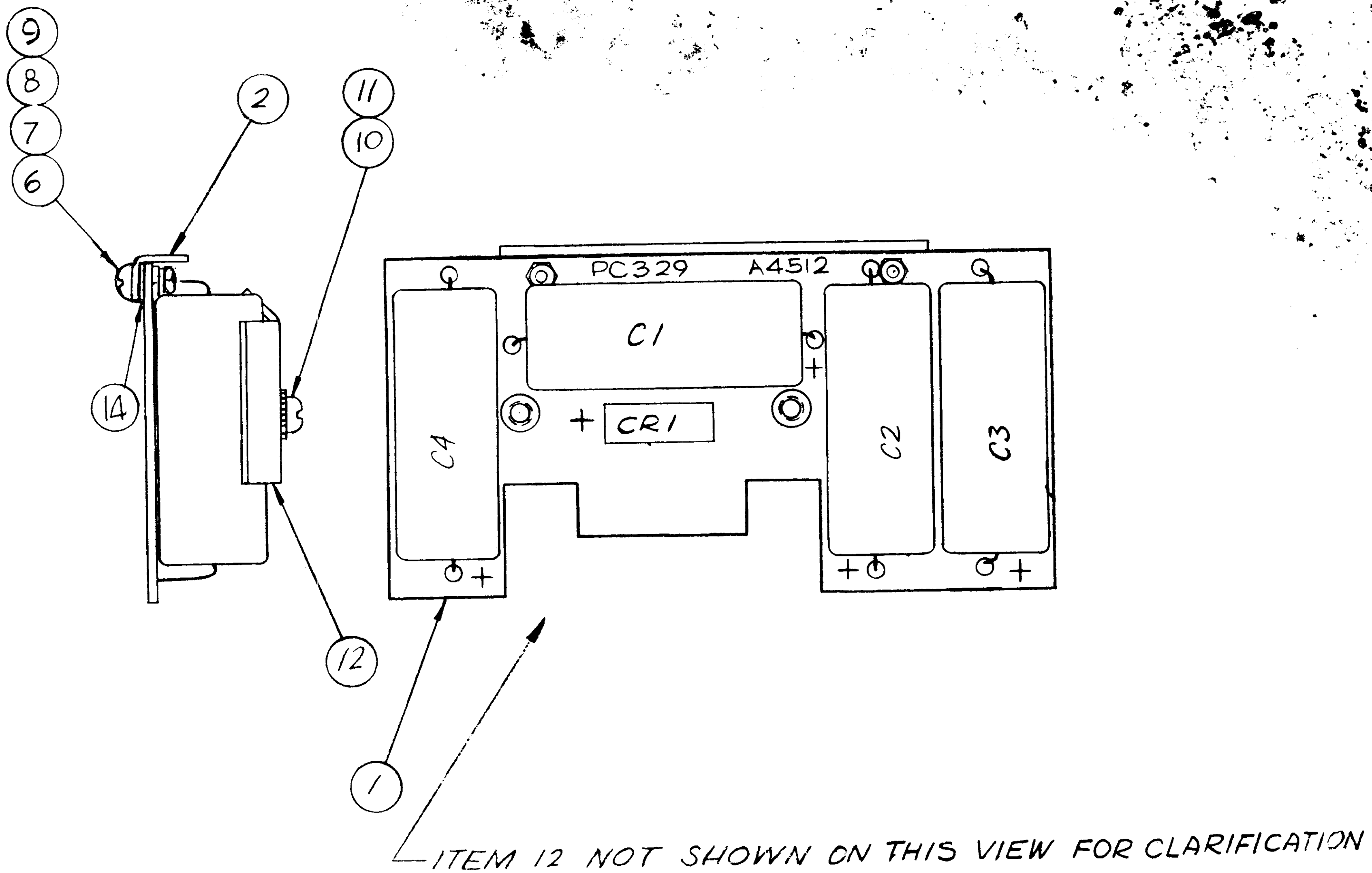
ASSEMBLY NOTES:

1-TO MOUNT COMPONENTS, INSERT LEAD THROUGH PLATED THRU-HOLES.

2-BE CAUTIOUS: WHEN APPLYING HEAT & SOLDER TO LEAD & FOIL.

3-CLEAN & INSPECT AS PER S-676

Figure 5-18. Component Location Diagram Power Supply (Z303)



✱ NOTE:

REFER TO NPL A4512 FOR ELECTRICAL COMPONENT PART NO'S.

USE SYMBOL NO'S FOR ASSY REF.

Figure 5-19. Component Location Diagram Power Supply (Z304)

SECTION 6 - PARTS LIST

To Be Supplied

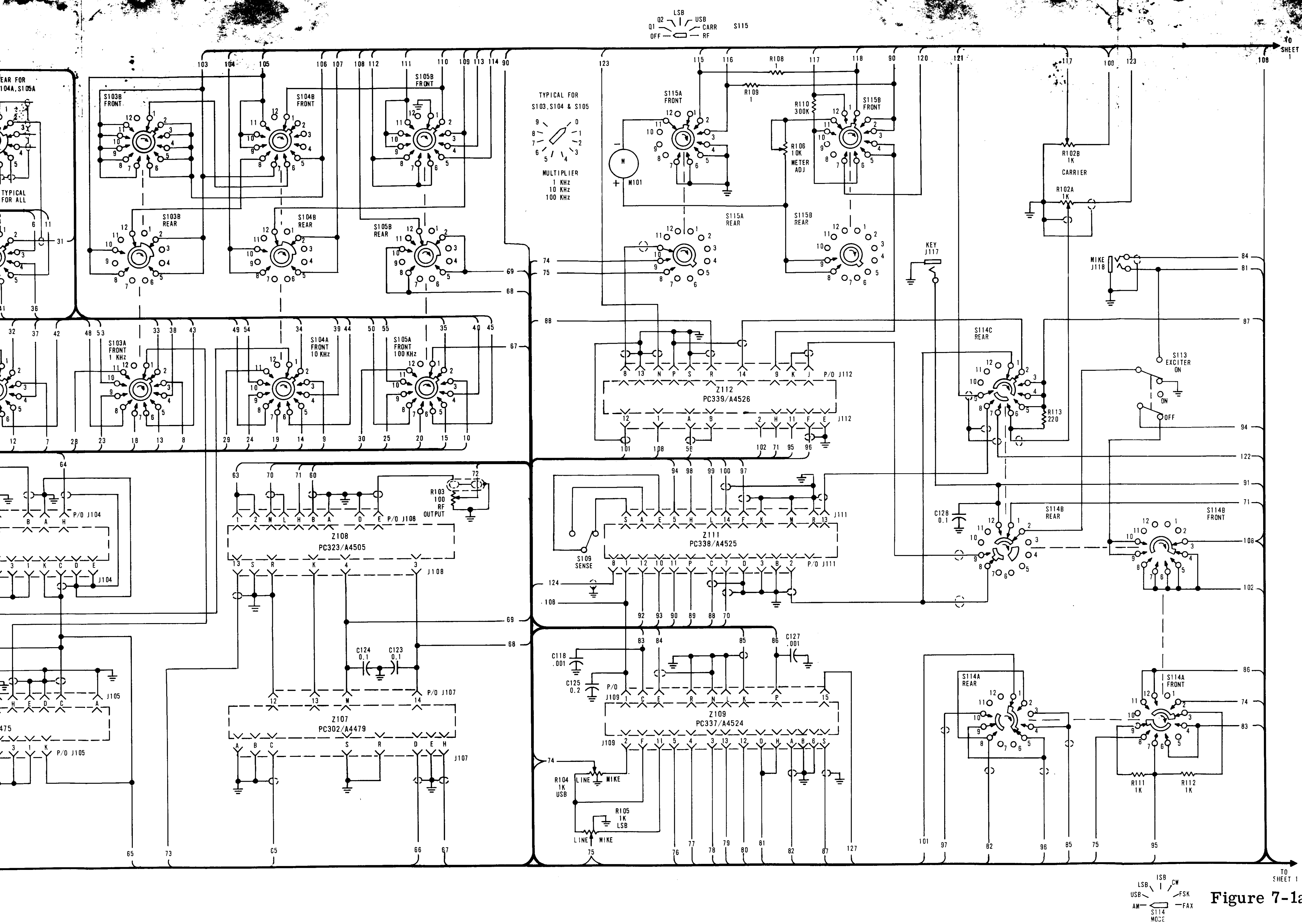
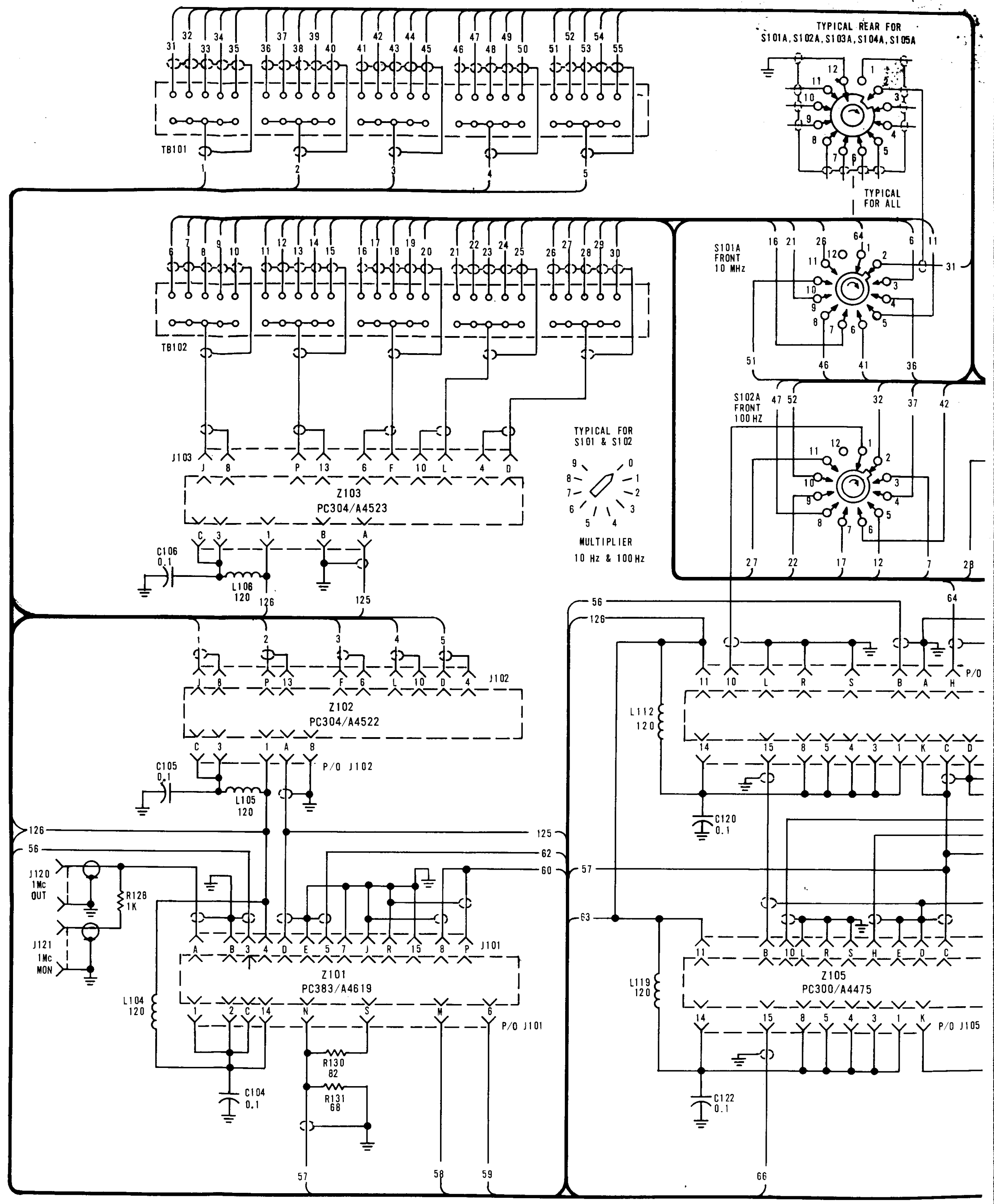
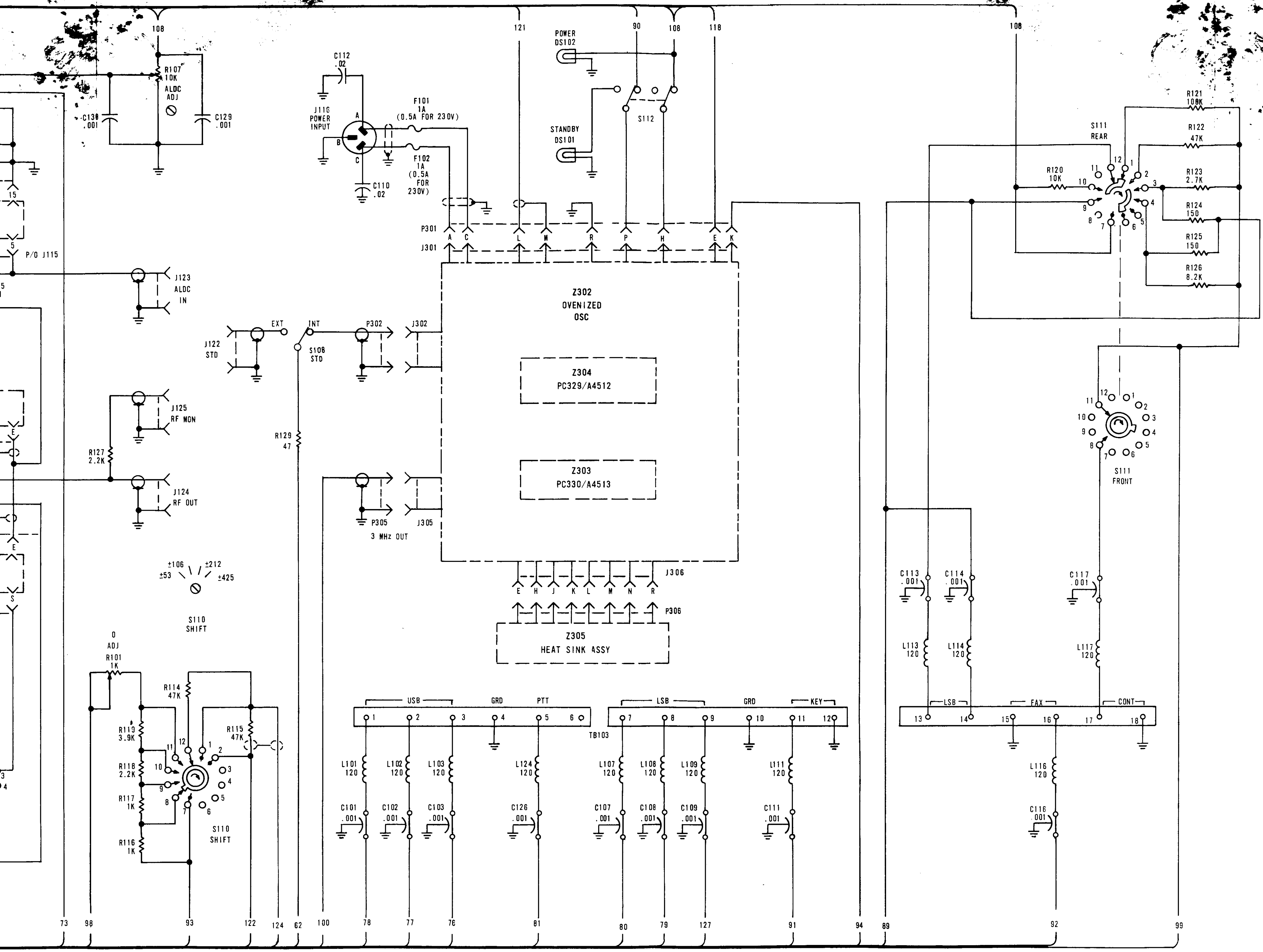


Figure 7-1a. Overall Wiring Diagram of LFE-1 (Sheet 1 of 2)


TYPICAL REAR FOR
S101A, S102A, S103A, S104A, S105A
TYPICAL
FOR ALL
S101A
FRONT
10 MHz
S102A
FRONT
100 HZ
TYPICAL FOR
S101 & S102
MULTIPLIER
10 Hz & 100 Hz
TB101
TB102
J103
Z103
PC304/A4523
C106
0.1
L106
120
J102
Z102
PC304/A4522
C105
0.1
L105
120
P/O J102
J120
1Mc
OUT
J121
1Mc
MON
R128
1K
J101
Z101
PC383/A4619
L104
120
C104
0.1
R130
82
R131
68
P/O J101
L112
120
C120
0.1
Z105
PC300/A4475
L119
120
C122
0.1
P/O J105



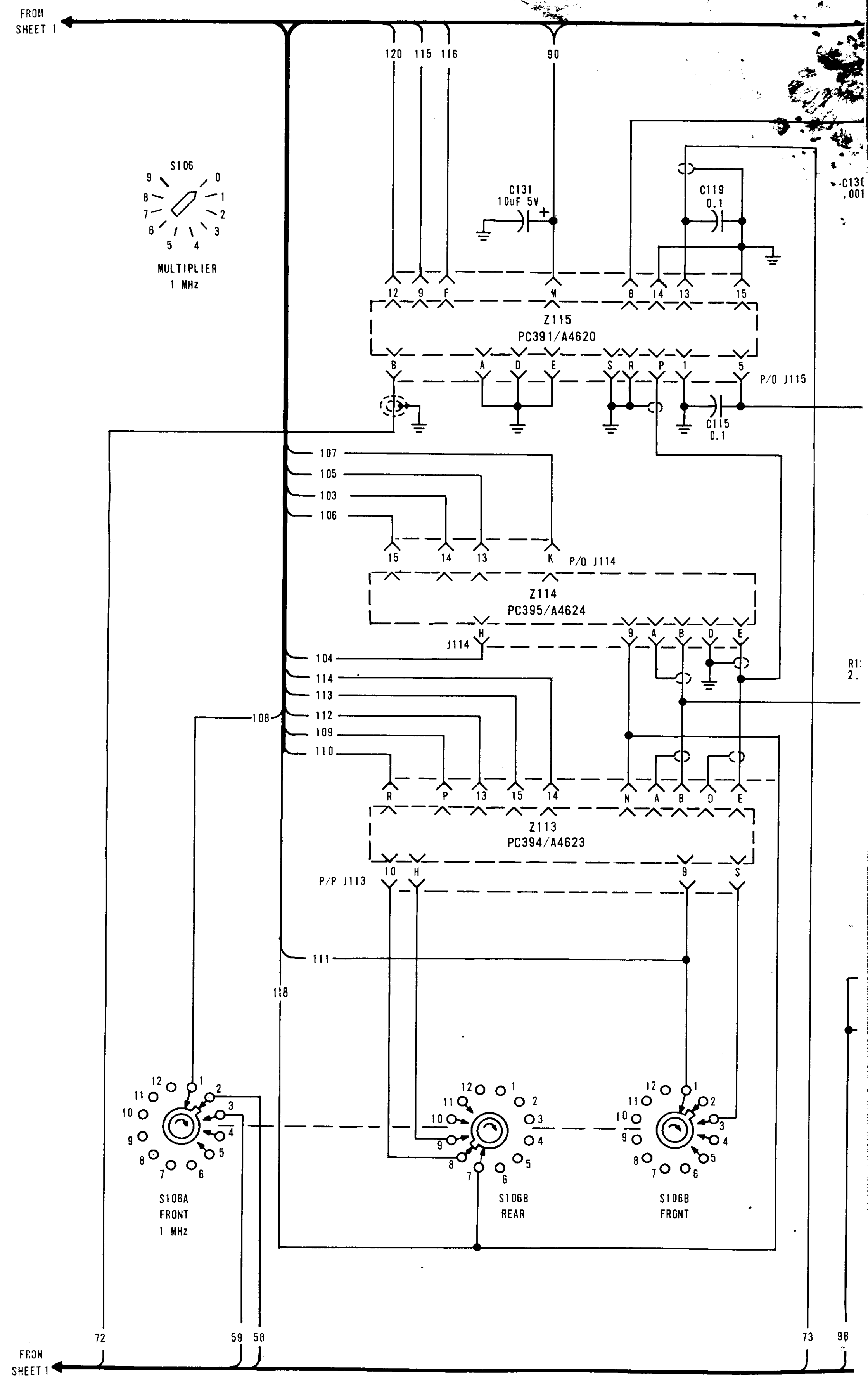
100 SERIES	
LAST SYMBOL	MISSING SYMBOLS
C131	C121
DS102	
F102	
J125	J106, J110
L124	L110, 115, 118, 120, L121, 122, 123
M101	
R160	
S115	S107
TB105	
Z115	Z106, 110

300 SERIES	
LAST SYMBOL	MISSING SYMBOLS
C307	C303
J306	
L301	
P306	P303, 304
R301	
T301	
Z305	

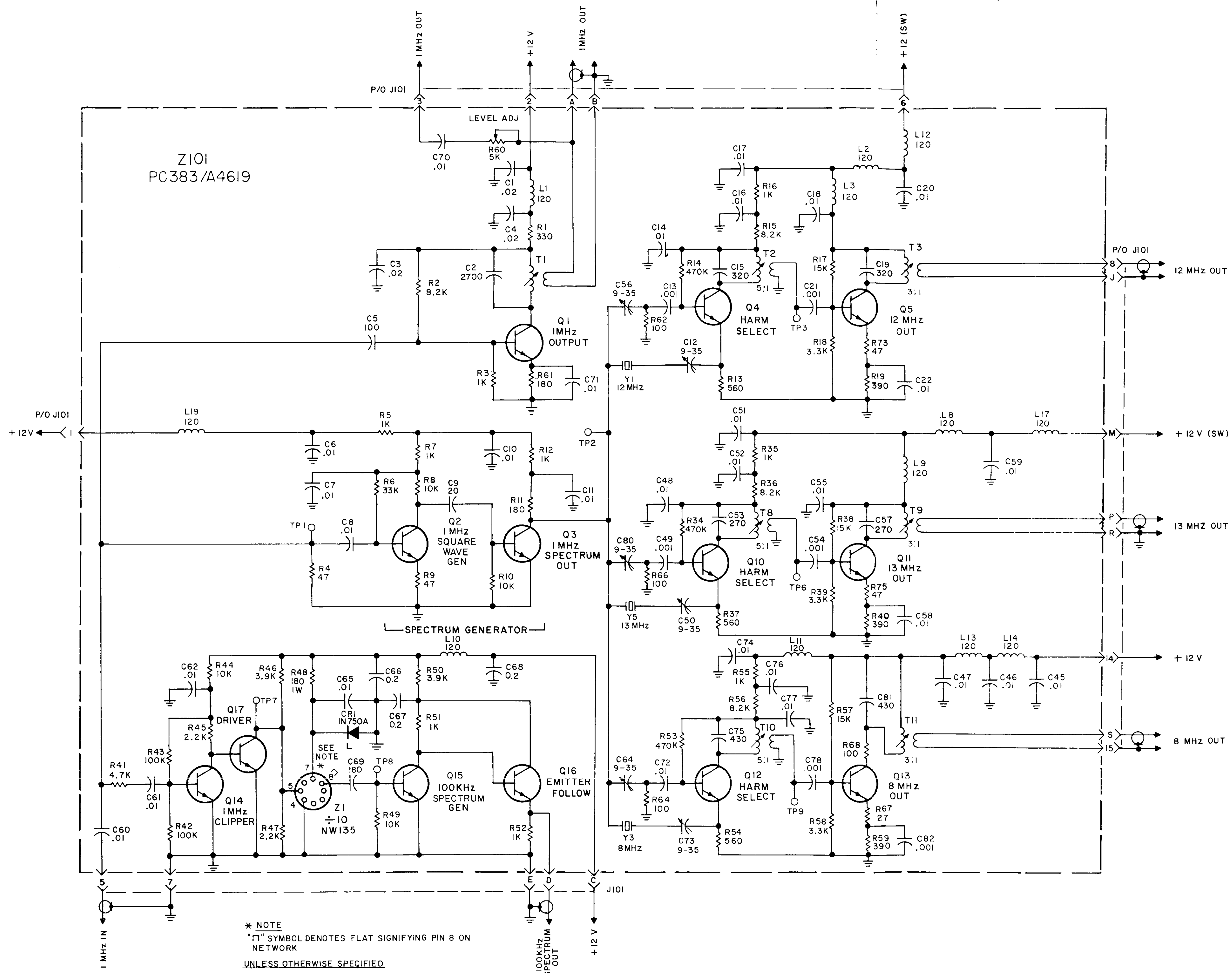
UNLESS OTHERWISE SPECIFIED:

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

Figure 7-1b. Overall Wiring Diagram of LFE-1 (Sheet2 of 2)



FROM SHEET 1
S106
MULTIPLIER 1 MHz
C131 10uF 5V
C119 0.1
C115 0.1
Z115 PC391/A4620
P/O J115
Z114 PC395/A4624
P/O J114
J114
Z113 PC394/A4623
P/P J113
S106A FRONT 1 MHz
S106B REAR
S106B FRONT
FROM SHEET 1



* NOTE

"⊓" 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 (270).
3-ALL INDUCTANCE VALUES ARE IN MICROHENRIES.
4-ALL TRANSISTORS ARE TYPE "2N3646".

Figure 7-2. Spectrum Generator Z101 Schematic Diagram

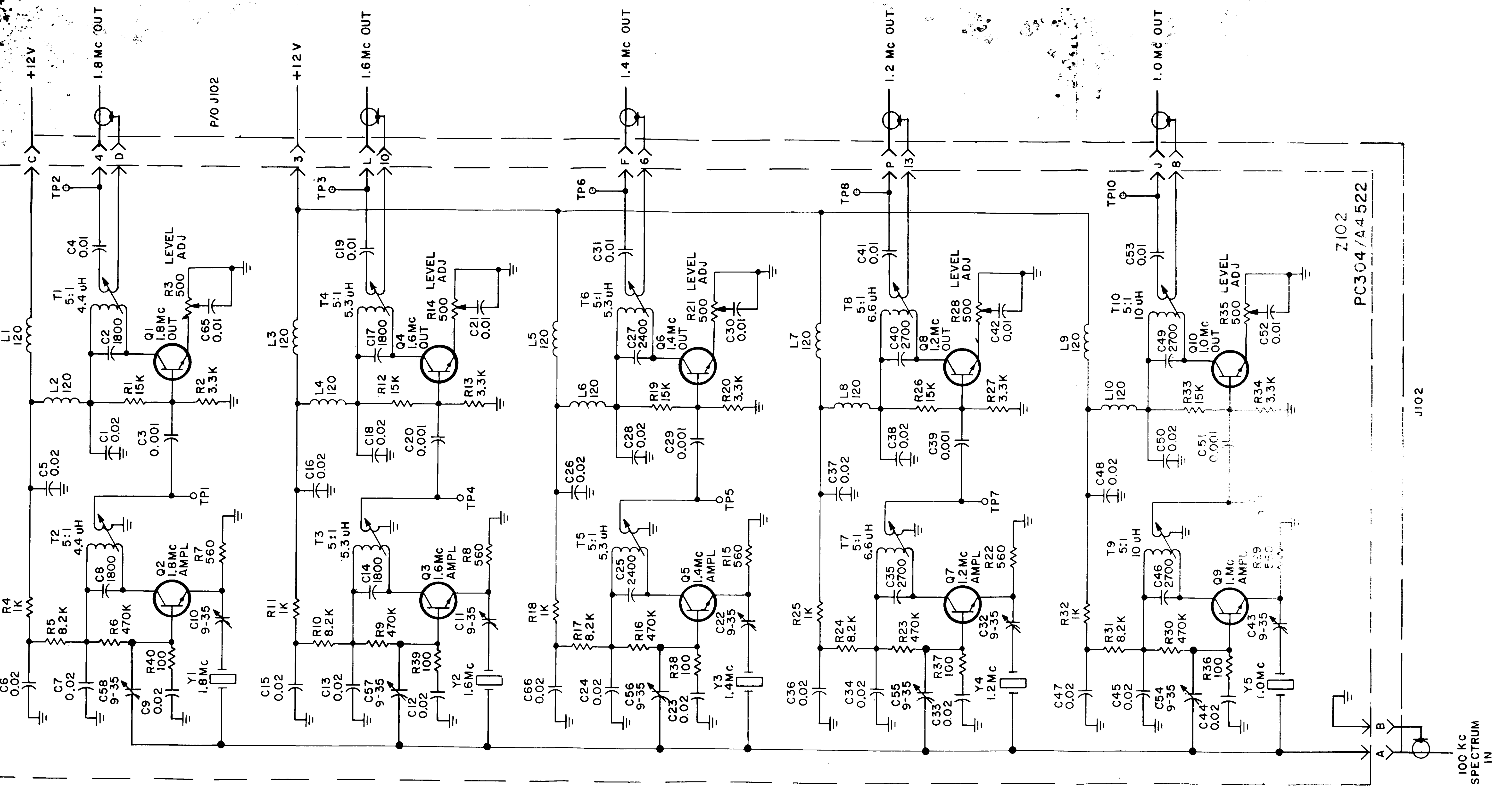
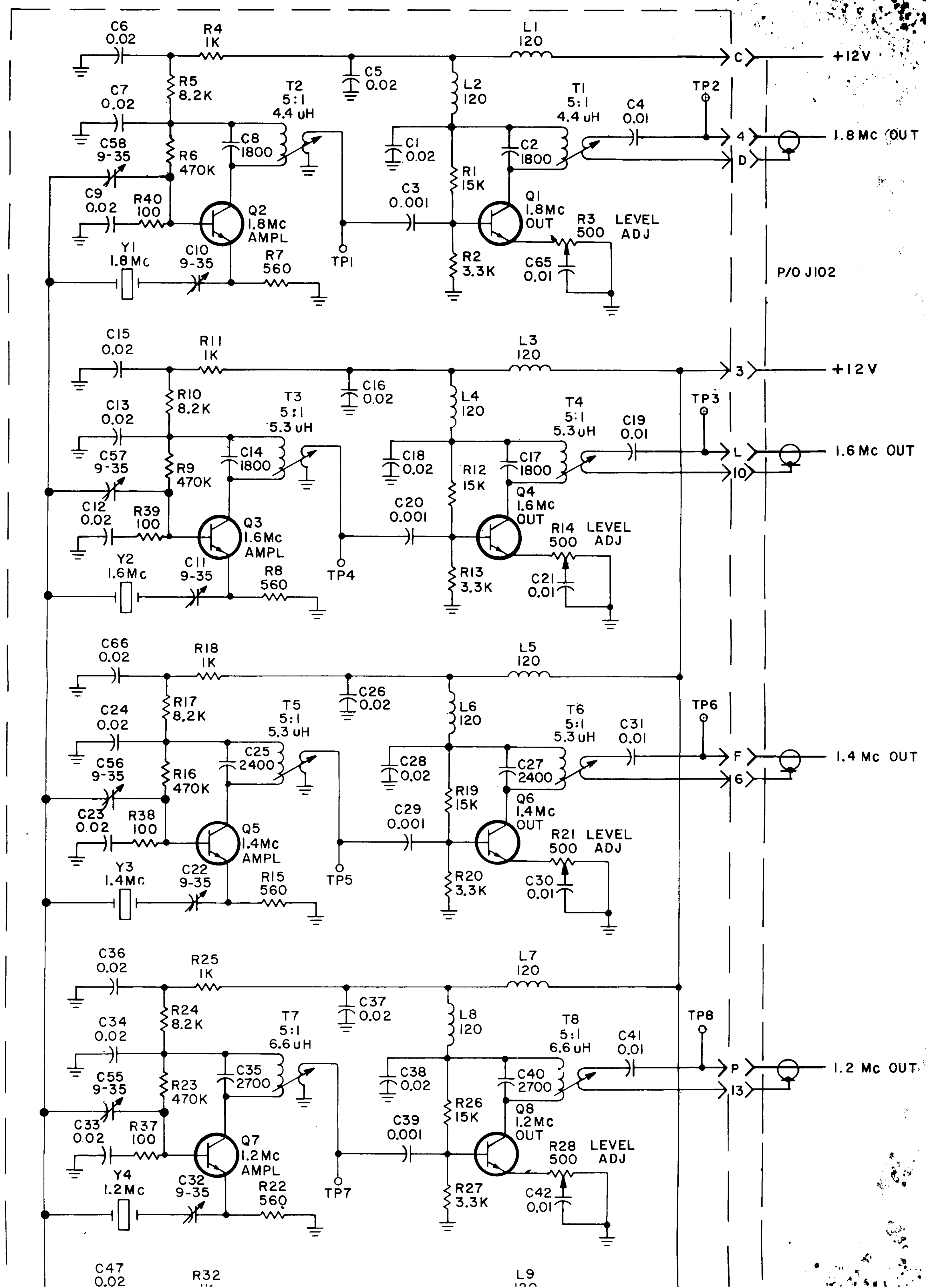


Figure 7-3. Comb Filter Z102
Schematic Diagram



C6 0.02
R4 1K
L1 120
C +12V
C5 0.02
R5 8.2K
C7 0.02
T2 5:1 4.4 uH
C8 1800
R6 470K
C58 9-35
C9 0.02
R40 100
Q2 1.8Mc AMPL
Y1 1.8Mc
C10 9-35
R7 560
TP1
L2 120
C1 0.02
R1 15K
C3 0.001
T1 5:1 4.4 uH
C2 1800
Q1 1.8Mc OUT
R3 500 LEVEL ADJ
C65 0.01
R2 3.3K
C4 0.01
TP2
4
D
1.8 Mc OUT
P/O J102
C15 0.02
R11 1K
L3 120
3 +12V
C16 0.02
R10 8.2K
C13 0.02
T3 5:1 5.3 uH
C14 1800
R9 470K
C57 9-35
C12 0.02
R39 100
Q3 1.6Mc AMPL
Y2 1.6Mc
C11 9-35
R8 560
TP4
L4 120
C18 0.02
R12 15K
C20 0.001
T4 5:1 5.3 uH
C17 1800
Q4 1.6Mc OUT
R14 500 LEVEL ADJ
C21 0.01
R13 3.3K
C19 0.01
TP3
L
10
1.6 Mc OUT
C66 0.02
R18 1K
L5 120
C26 0.02
R17 8.2K
C24 0.02
T5 5:1 5.3 uH
C25 2400
R16 470K
C56 9-35
C23 0.02
R38 100
Q5 1.4Mc AMPL
Y3 1.4Mc
C22 9-35
R15 560
TP5
L6 120
C28 0.02
R19 15K
C29 0.001
T6 5:1 5.3 uH
C27 2400
Q6 1.4Mc OUT
R21 500 LEVEL ADJ
C30 0.01
R20 3.3K
C31 0.01
TP6
F
6
1.4 Mc OUT
C36 0.02
R25 1K
L7 120
C37 0.02
R24 8.2K
C34 0.02
T7 5:1 6.6 uH
C35 2700
R23 470K
C55 9-35
C33 0.02
R37 100
Q7 1.2Mc AMPL
Y4 1.2Mc
C32 9-35
R22 560
TP7
L8 120
C38 0.02
R26 15K
C39 0.001
T8 5:1 6.6 uH
C40 2700
Q8 1.2Mc OUT
R28 500 LEVEL ADJ
C42 0.01
R27 3.3K
C41 0.01
TP8
P
13
1.2 Mc OUT
C47 0.02
R32
L9

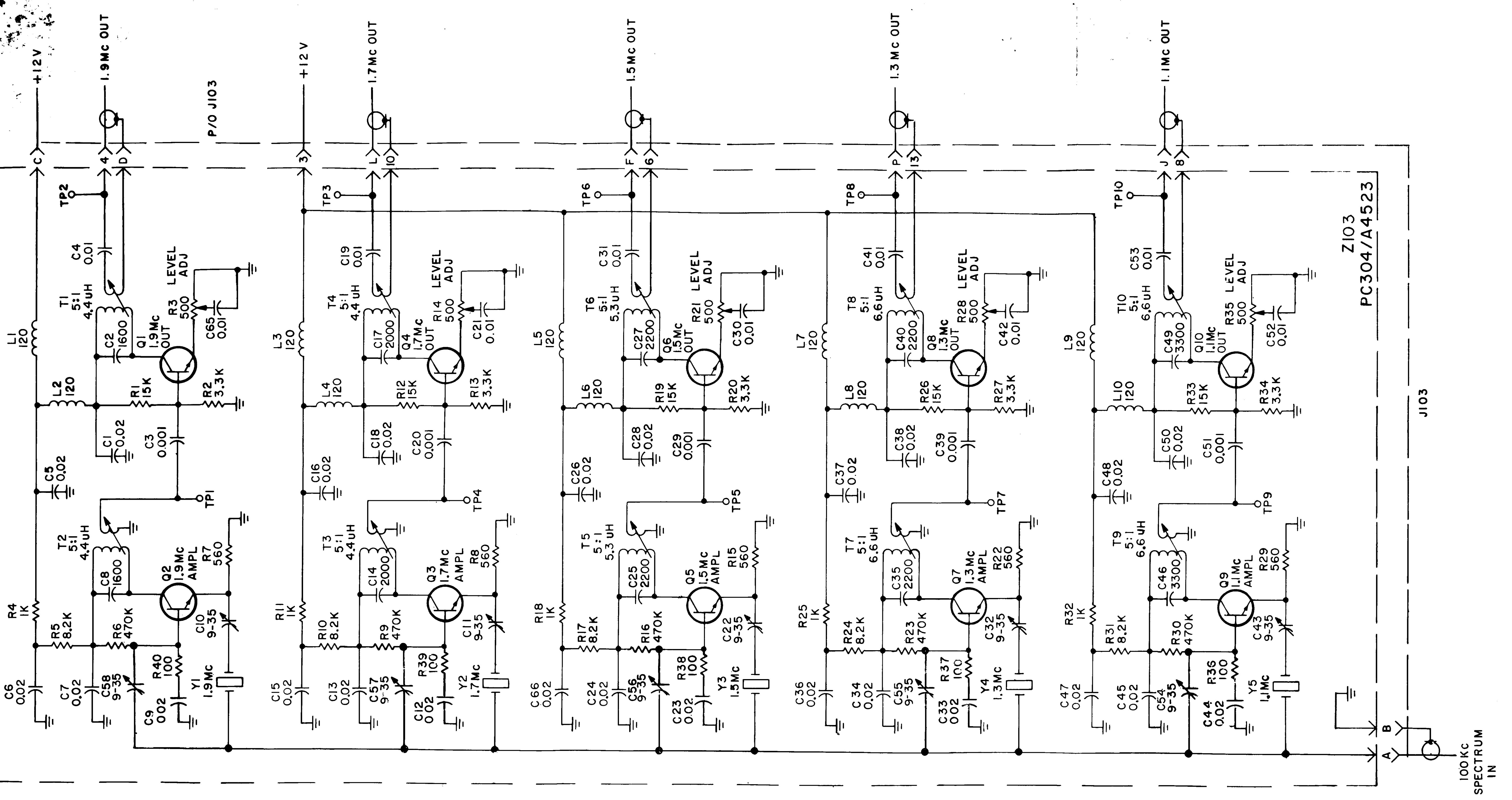
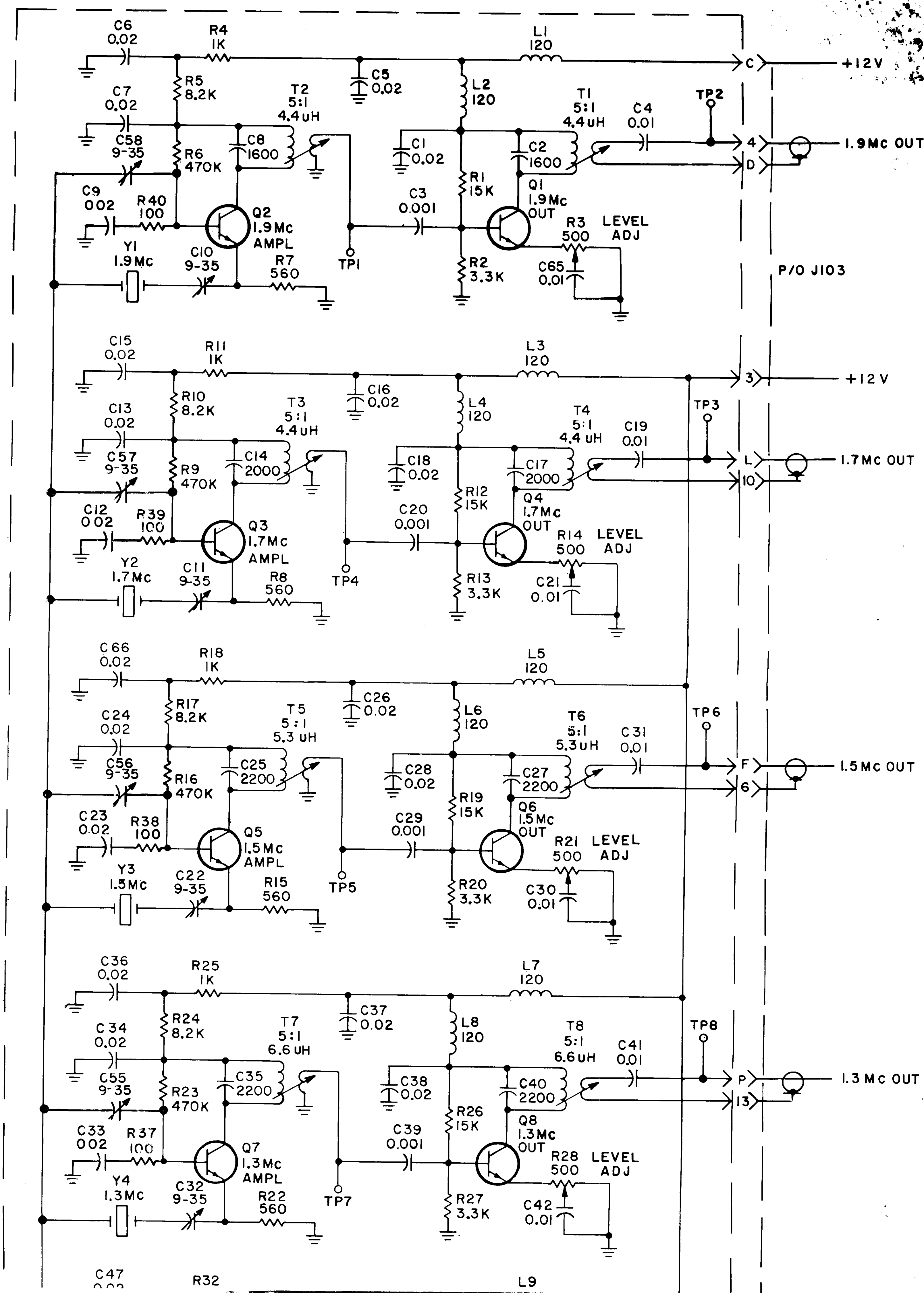


Figure 7-4. Comb Filter Z103 Schematic Diagram



C6 0.02
R4 1K
L1 120
+12V
C5 0.02
R5 8.2K
C7 0.02
T2 5:1 4.4uH
L2 120
T1 5:1 4.4uH
C4 0.01
TP2
1.9Mc OUT
C58 9-35
R6 470K
C8 1600
C1 0.02
C2 1600
C9 002
R40 100
C3 0.001
R1 15K
Q1 1.9Mc OUT
Q2 1.9Mc AMPL
R3 500
LEVEL ADJ
Y1 1.9Mc
C10 9-35
R7 560
TP1
R2 3.3K
C65 0.01
P/O J103
C15 0.02
R11 1K
L3 120
+12V
C16 0.02
R10 8.2K
C13 0.02
T3 5:1 4.4uH
L4 120
T4 5:1 4.4 uH
C19 0.01
TP3
C57 9-35
C14 2000
C18 0.02
C17 2000
1.7Mc OUT
R9 470K
R12 15K
C12 0 02
R39 100
C20 0.001
Q4 1.7Mc OUT
Q3 1.7Mc AMPL
R14 500
LEVEL ADJ
Y2 1.7Mc
C11 9-35
R8 560
TP4
R13 3.3K
C21 0.01
C66 0.02
R18 1K
L5 120
C26 0.02
R17 8.2K
L6 120
C24 0.02
T5 5:1 5.3 uH
T6 5:1 5.3uH
TP6
C31 0.01
C56 9-35
C25 2200
C28 0.02
C27 2200
1.5Mc OUT
R16 470K
R19 15K
C23 0.02
R38 100
C29 0.001
Q6 1.5Mc OUT
Q5 1.5Mc AMPL
R21 500
LEVEL ADJ
Y3 1.5Mc
C22 9-35
R15 560
TP5
R20 3.3K
C30 0.01
C36 0.02
R25 1K
L7 120
C37 0.02
R24 8.2K
L8 120
C34 0.02
T7 5:1 6.6 uH
T8 5:1 6.6 uH
TP8
C41 0.01
C55 9-35
C35 2200
C38 0.02
C40 2200
1.3 Mc OUT
R23 470K
R26 15K
C33 002
R37 100
C39 0.001
Q8 1.3Mc OUT
Q7 1.3Mc AMPL
R28 500
LEVEL ADJ
Y4 1.3Mc
C32 9-35
R22 560
TP7
R27 3.3K
C42 0.01
C47
R32
L9

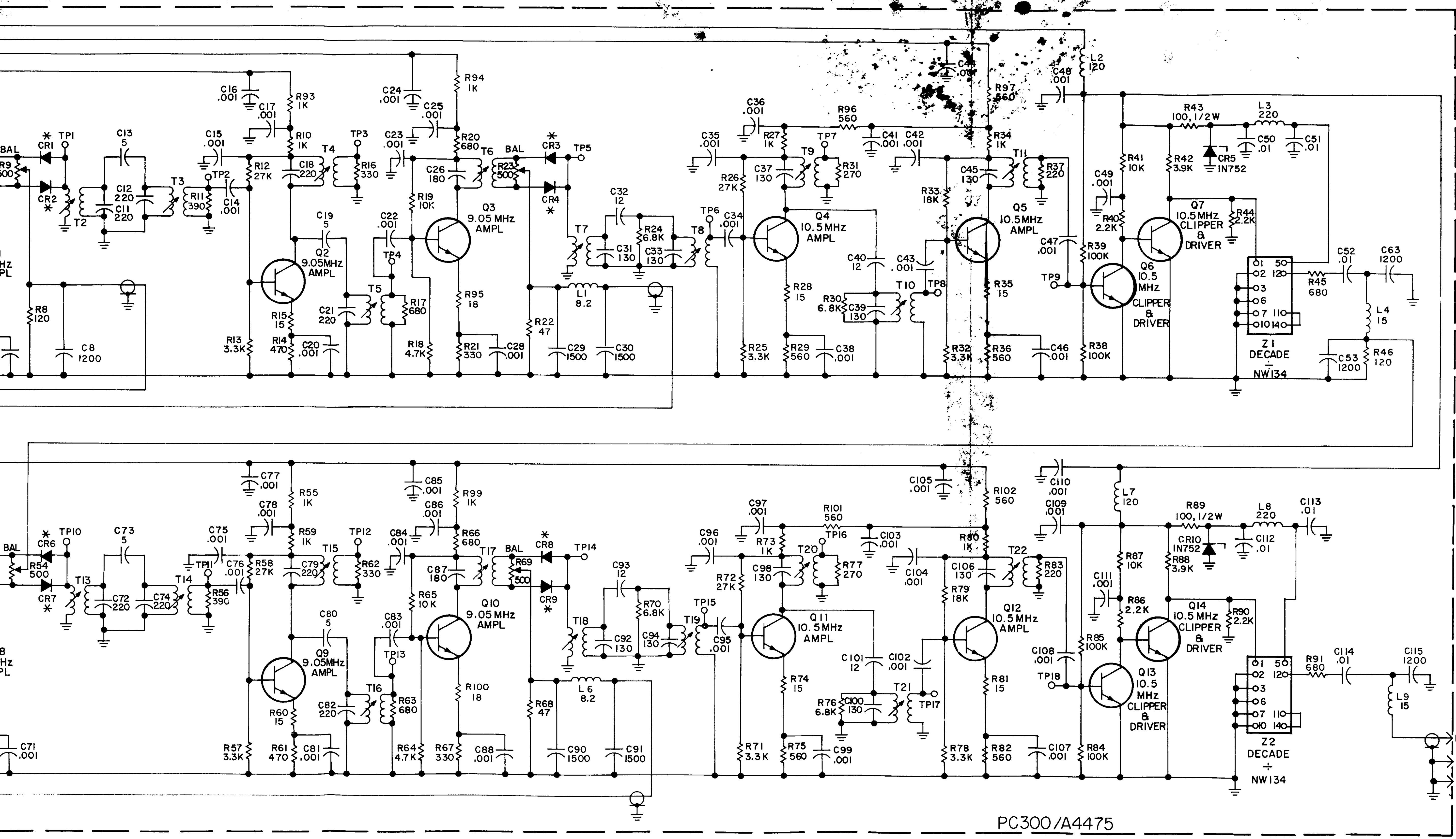
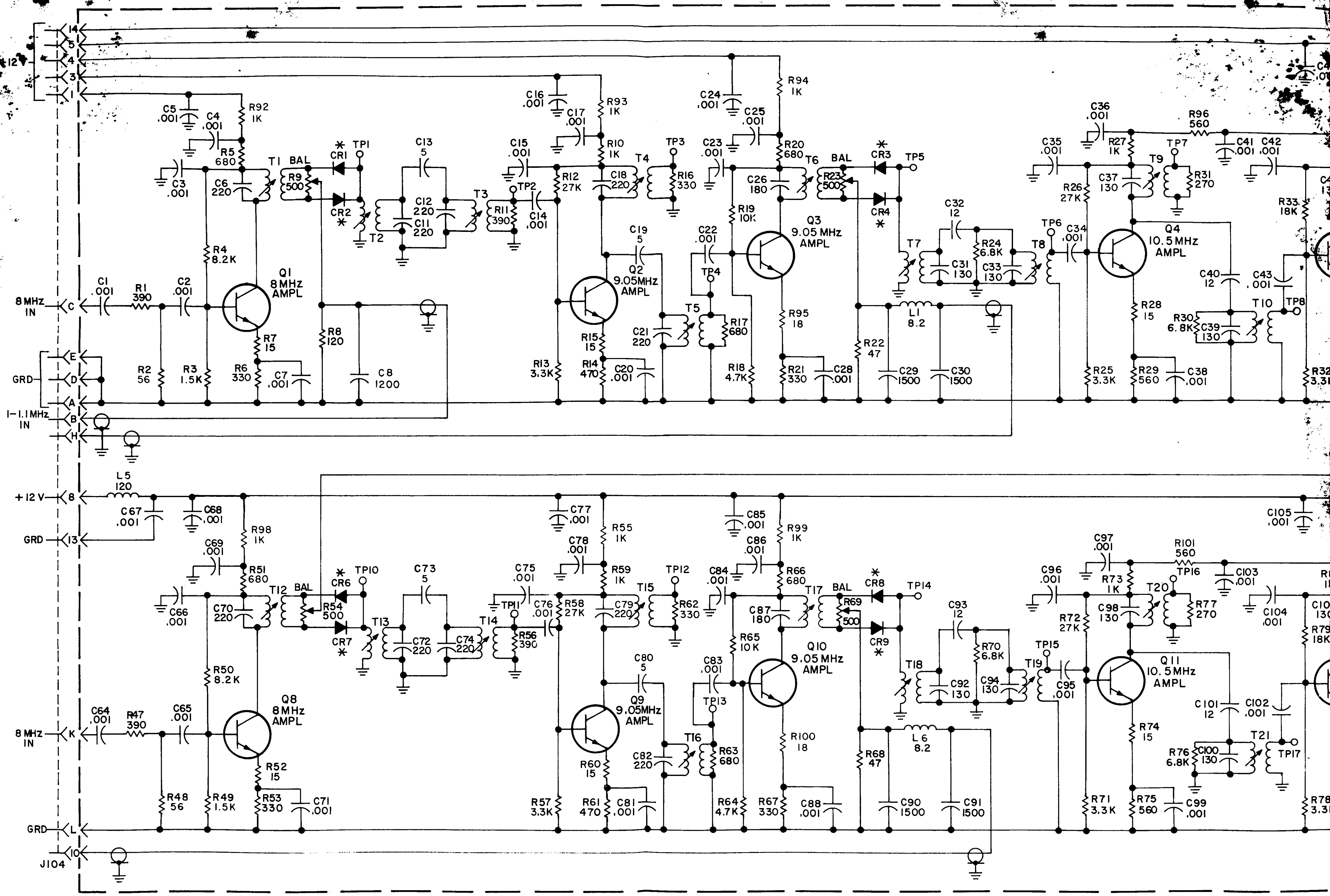


Figure 7-5. Mixer-Divider Z104
Z105 Schematic Diagram



Q1 8MHz AMPL
Q2 9.05MHz AMPL
Q3 9.05 MHz AMPL
Q4 10.5 MHz AMPL
Q8 8MHz AMPL
Q9 9.05MHz AMPL
Q10 9.05 MHz AMPL
Q11 10.5 MHz AMPL
8 MHz IN
GRD
1-1.1MHz IN
+12 V
GRD
8 MHz IN
GRD
J104

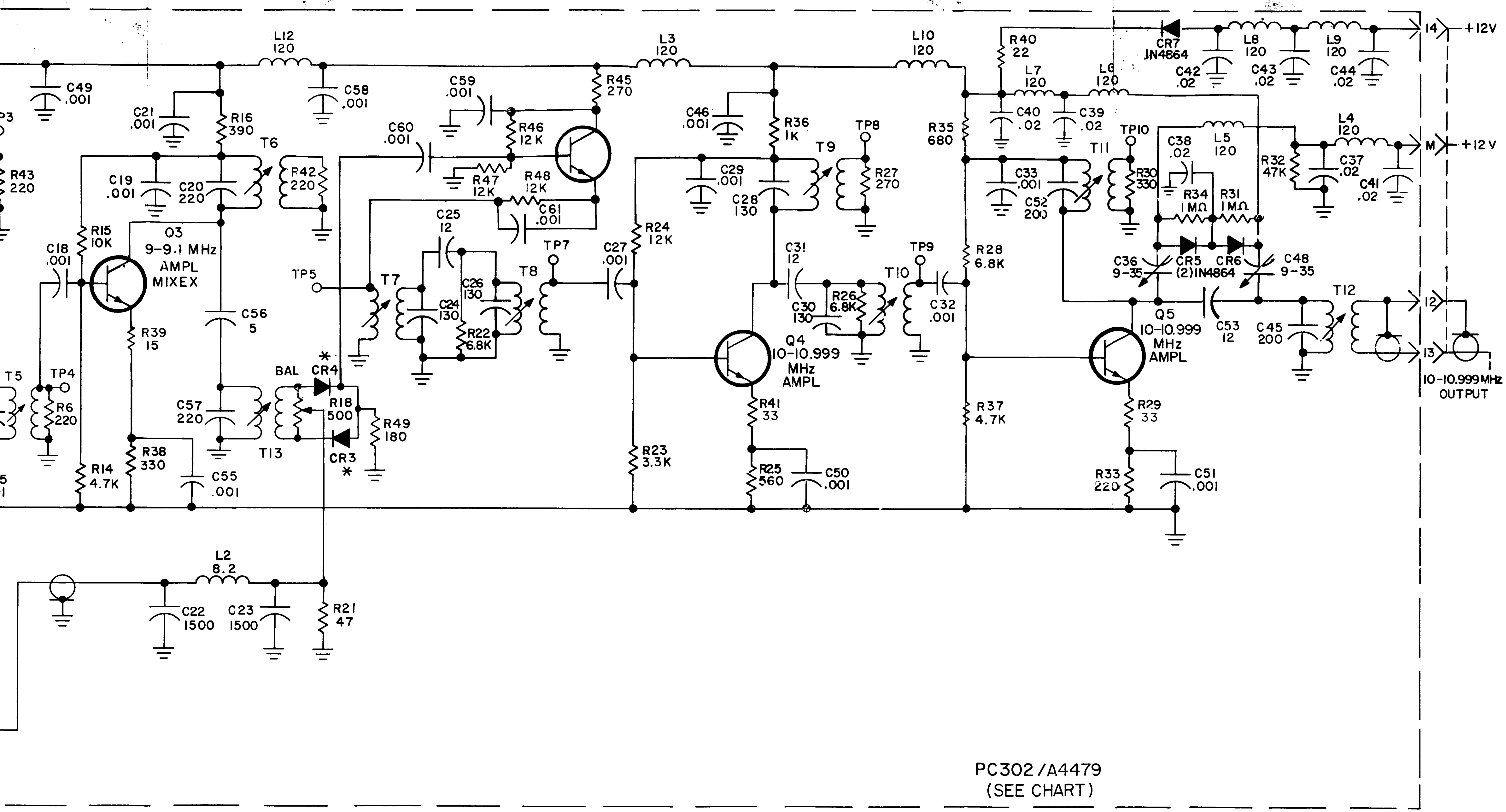
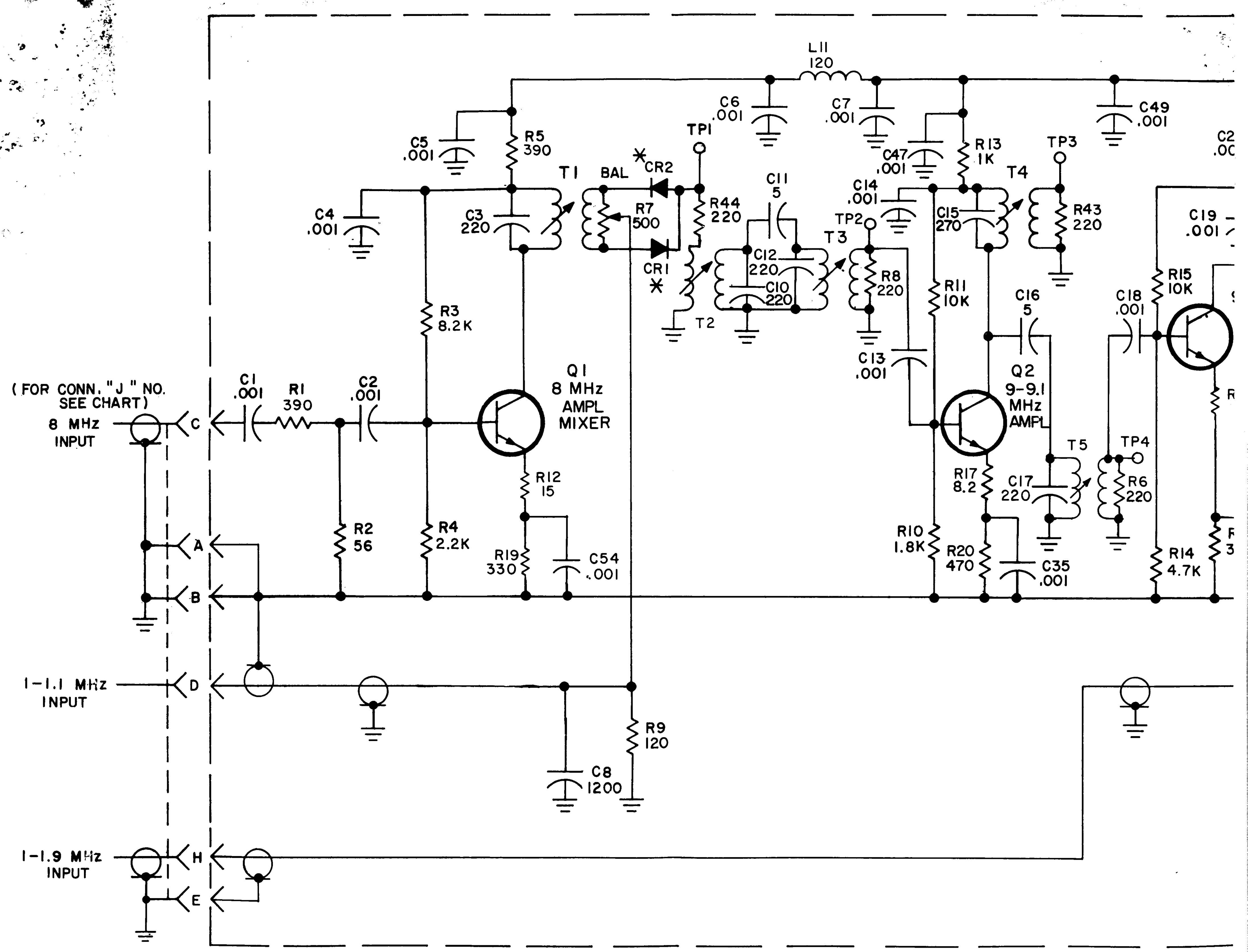
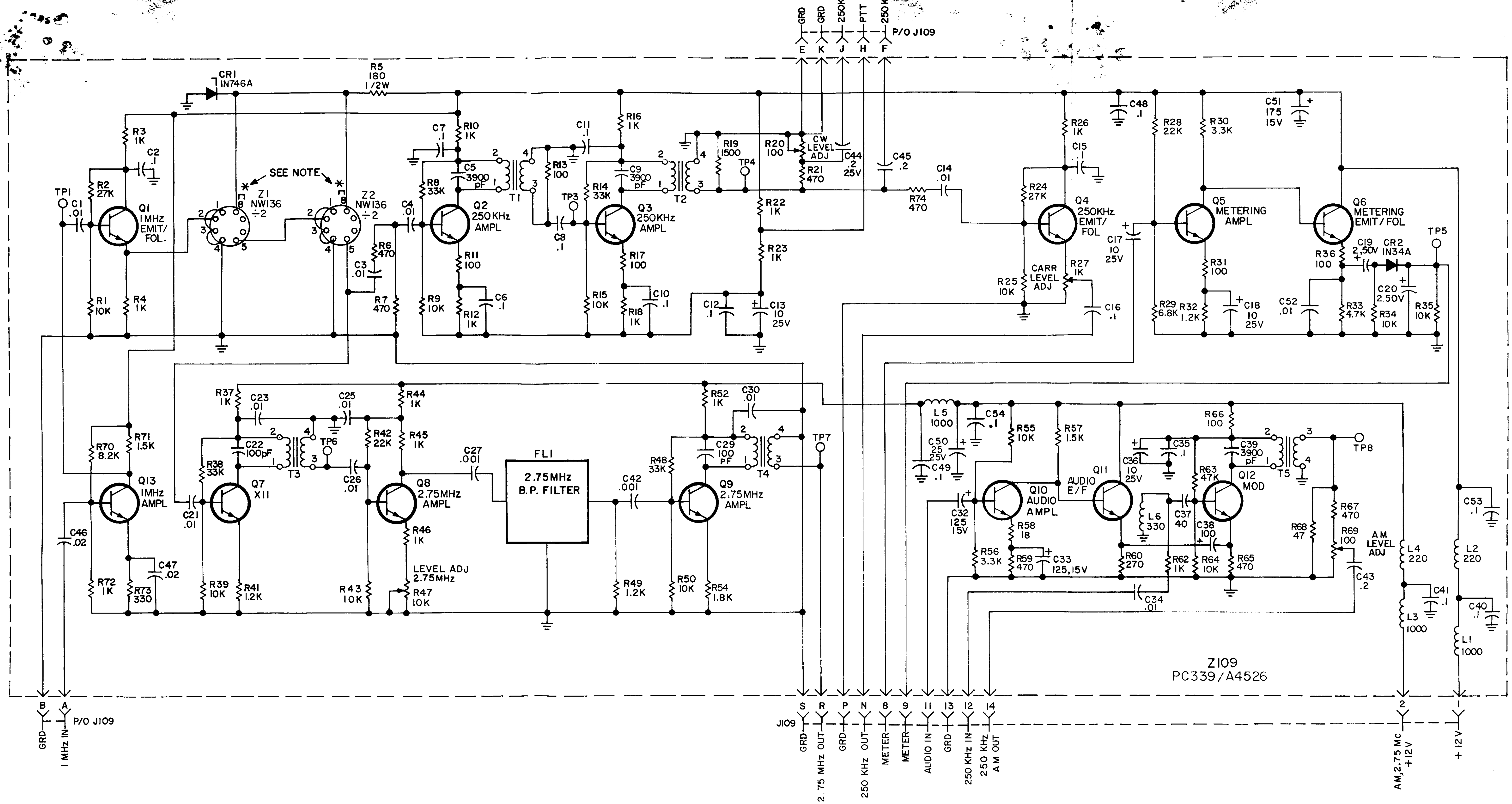


Figure 7-6. Mixer Final Z106 Schematic Diagram


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

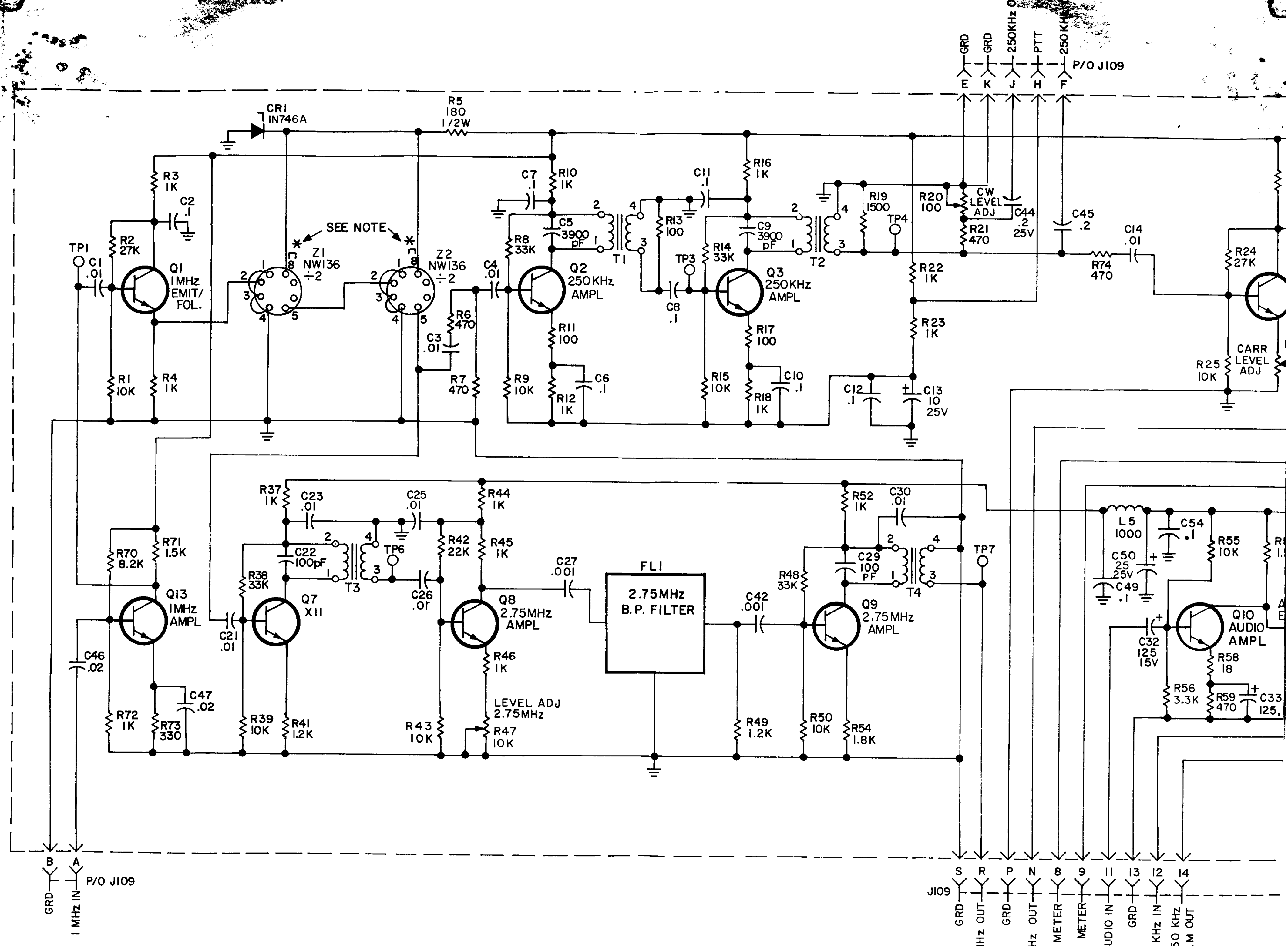


NOTES · UNLESS OTHERWISE SPECIFIED

1-ALL RESISTANCE VALUES ARE IN OHMS, 1/4 WATT.
2-ALL CAPACITANCE VALUES ARE IN MICROFARADS.
3-ALL INDUCTANCE VALUES ARE IN MICROHENRIES.
4-ALL TRANSISTORS ARE TYPE 2N3646.

* "⊓" SYMBOL DENOTES FLAT SIGNIFYING PIN 8 ON NETWORK.

Figure 7-7. Carrier Generator Z112 Schematic Diagram



<u>NOTES</u> · UNLESS OTHERWISE SPECIFIED

1-ALL RESISTANCE VALUES ARE IN OHMS, 1/4 WATT.
2-ALL CAPACITANCE VALUES ARE IN MICROFARADS.
3-ALL INDUCTANCE VALUES ARE IN MICROHENRIES.
4-ALL TRANSISTORS ARE TYPE 2N3646.

* "⊓" SYMBOL DENOTES FLAT SIGNIFYING PIN 8 ON NETWORK.

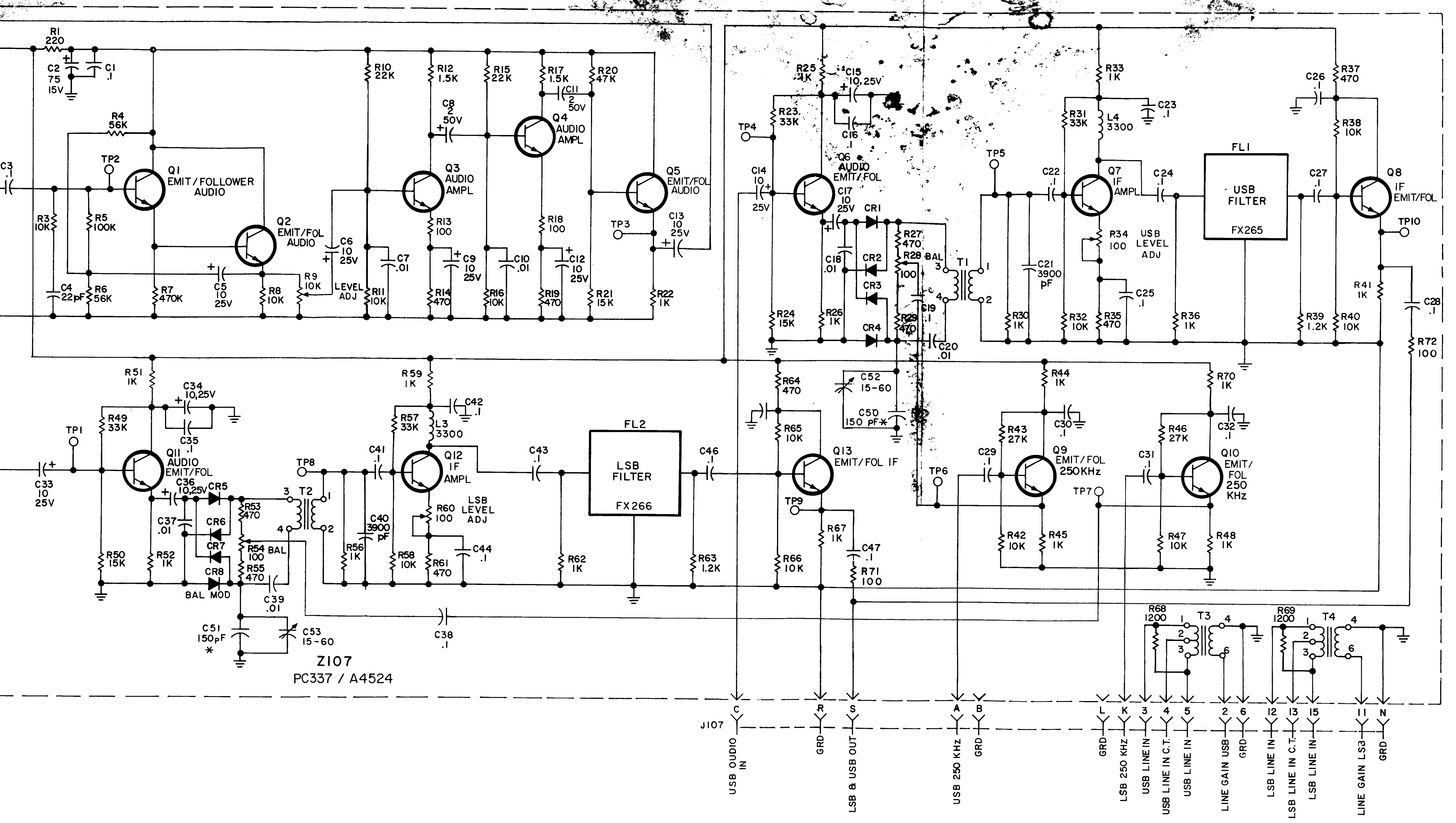
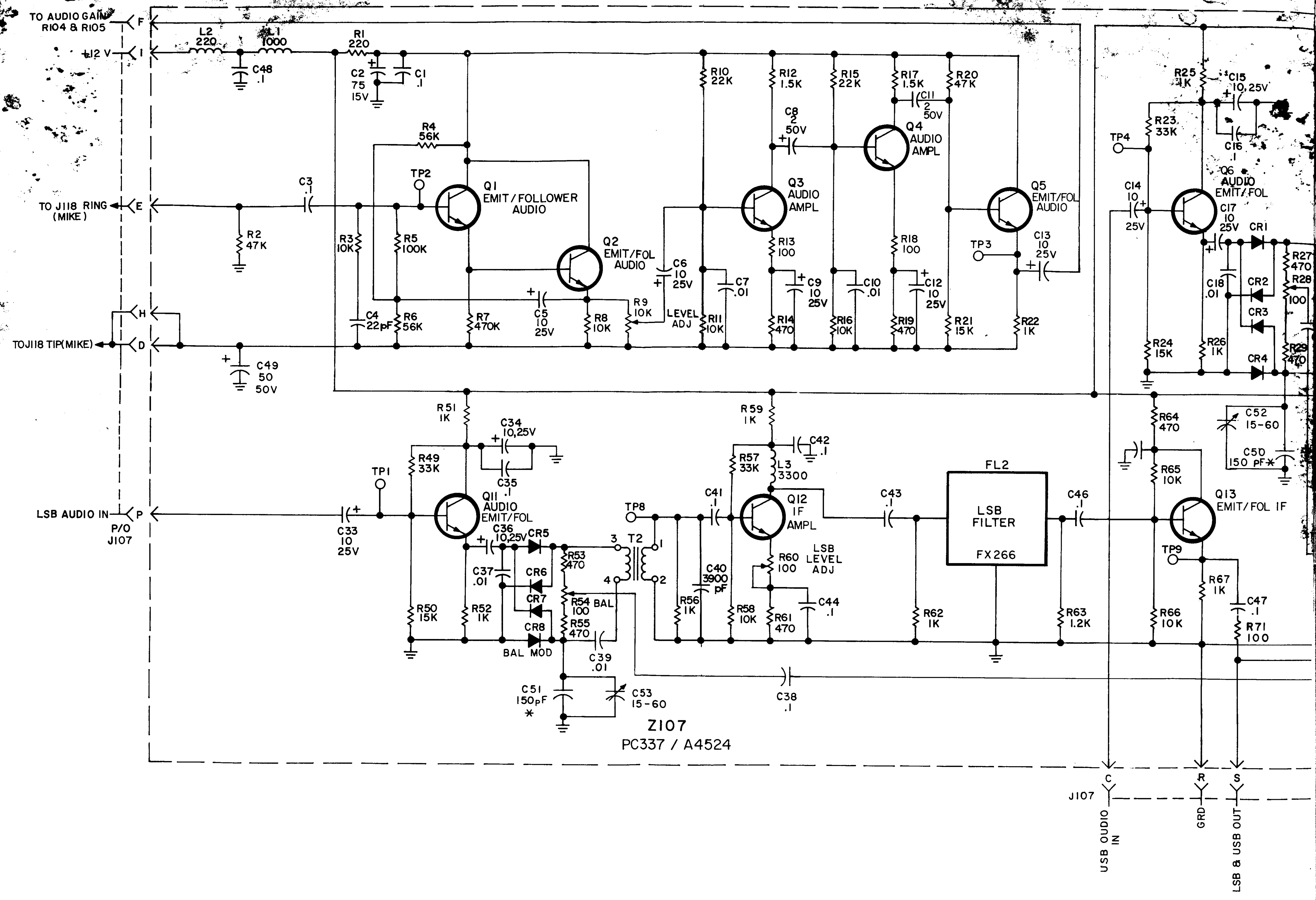


Figure 7-8. Sideband Generator Z109 Schematic Diagram


TO AUDIO GAIN R104 & R105
+12 V
TO J118 RING (MIKE)
TOJ118 TIP(MIKE)
LSB AUDIO IN
P/O J107
Q1 EMIT/FOLLOWER AUDIO
Q2 EMIT/FOL AUDIO
Q3 AUDIO AMPL
Q4 AUDIO AMPL
Q5 EMIT/FOL AUDIO
Q6 AUDIO EMIT/FOL
Q11 AUDIO EMIT/FOL
Q12 IF AMPL
Q13 EMIT/FOL IF
LEVEL ADJ
LSB LEVEL ADJ
BAL
BAL MOD
FL2
LSB FILTER
FX266
Z107
PC337 / A4524
J107
USB OUDIO IN
GRD
LSB & USB OUT

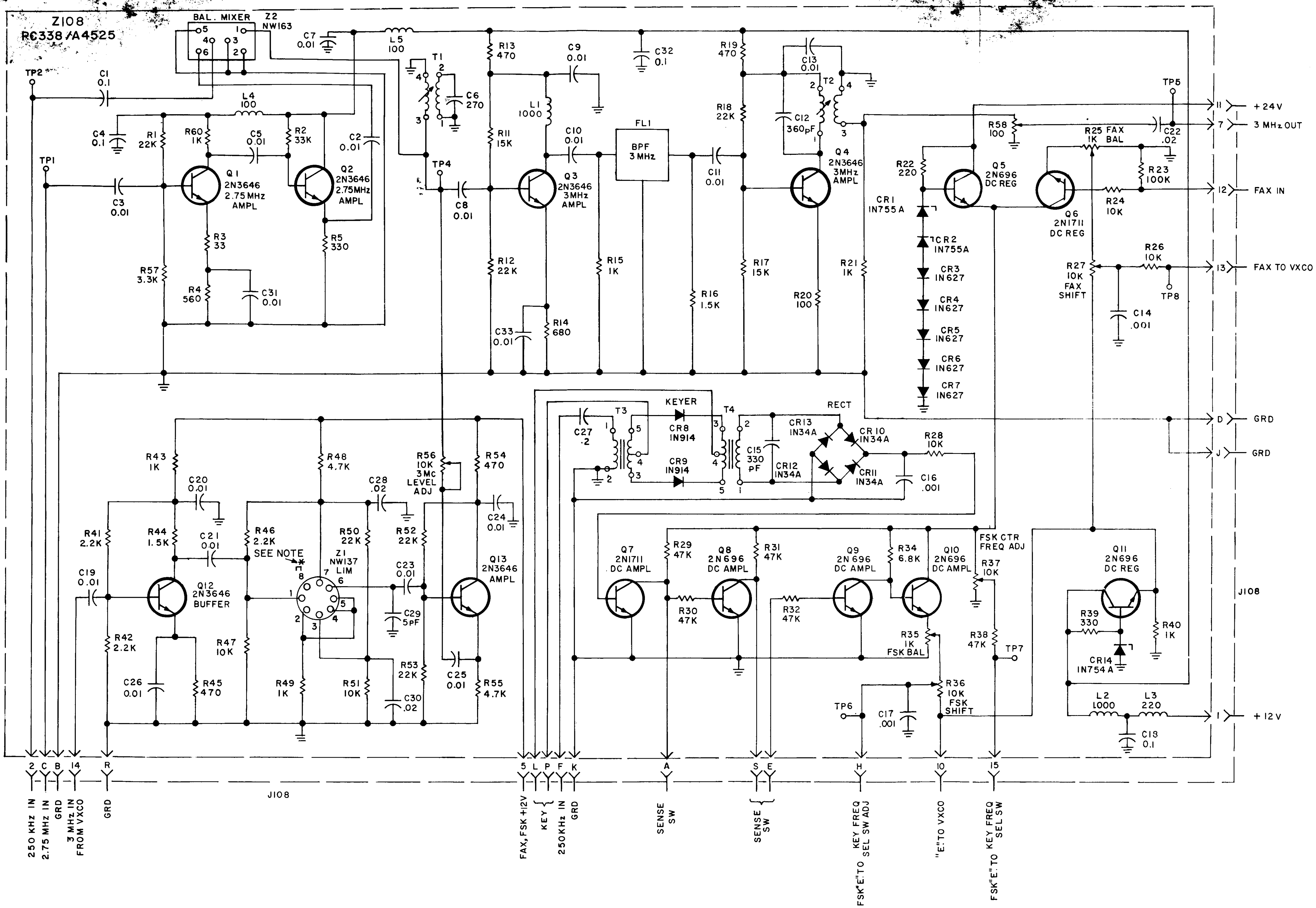


Figure 7-9. Frequency Shift Generator Z111 Schematic Diagram

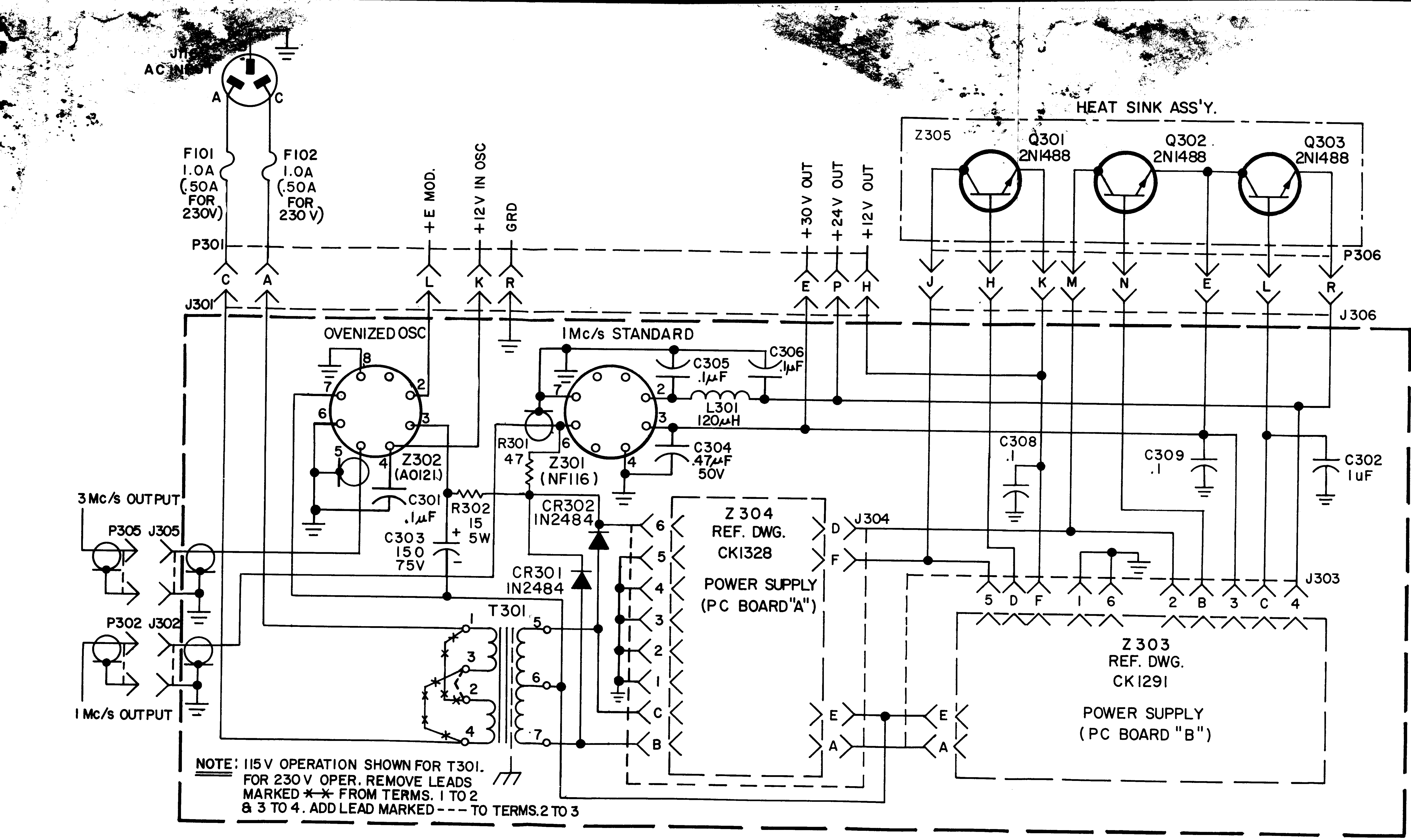
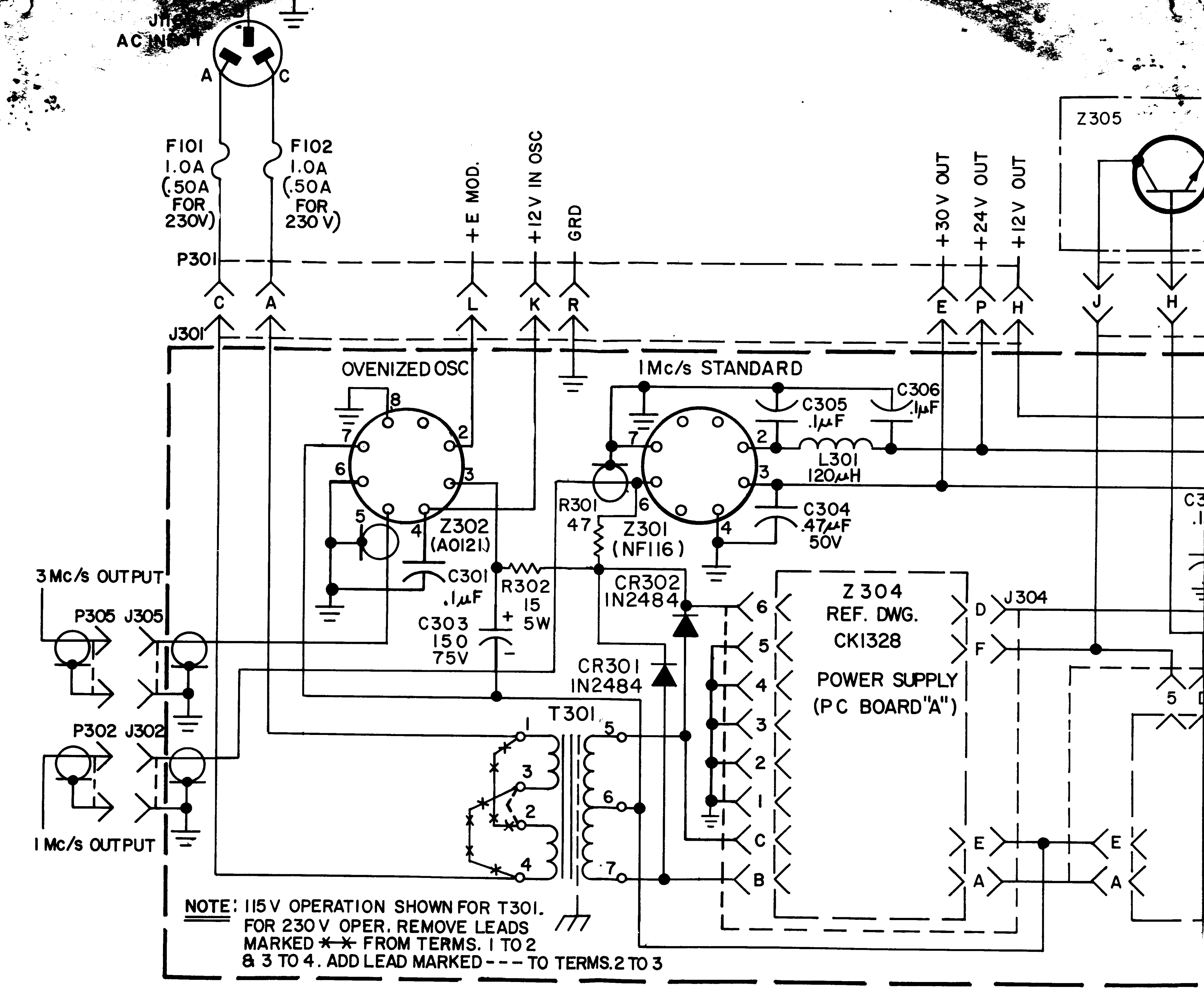


Figure 7-10. Variable Crystal Oscillator Schematic Diagram



NOTE: 115V OPERATION SHOWN FOR T301. FOR 230V OPER. REMOVE LEADS MARKED *-* FROM TERMS. 1 TO 2 & 3 TO 4. ADD LEAD MARKED - - - TO TERMS. 2 TO 3

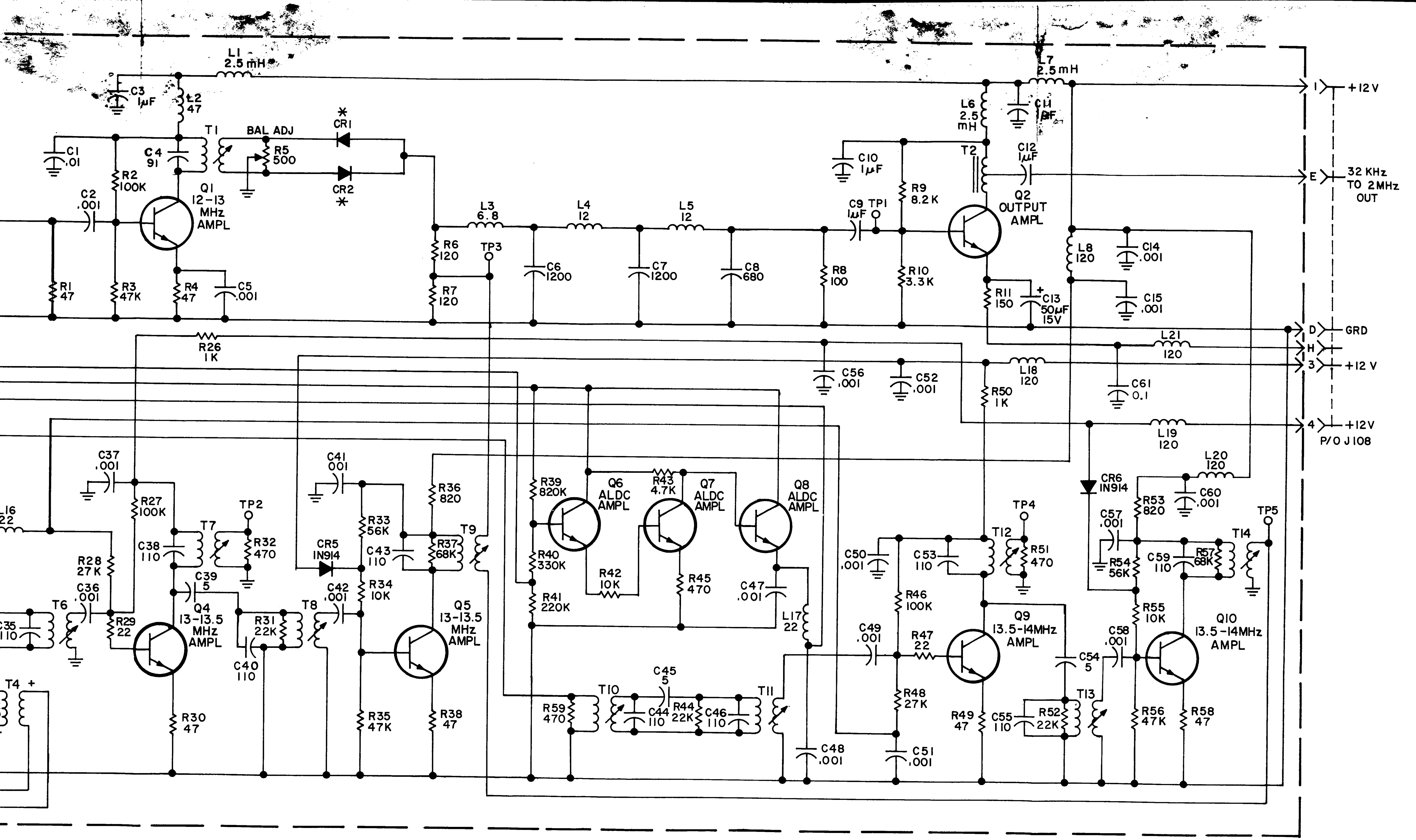
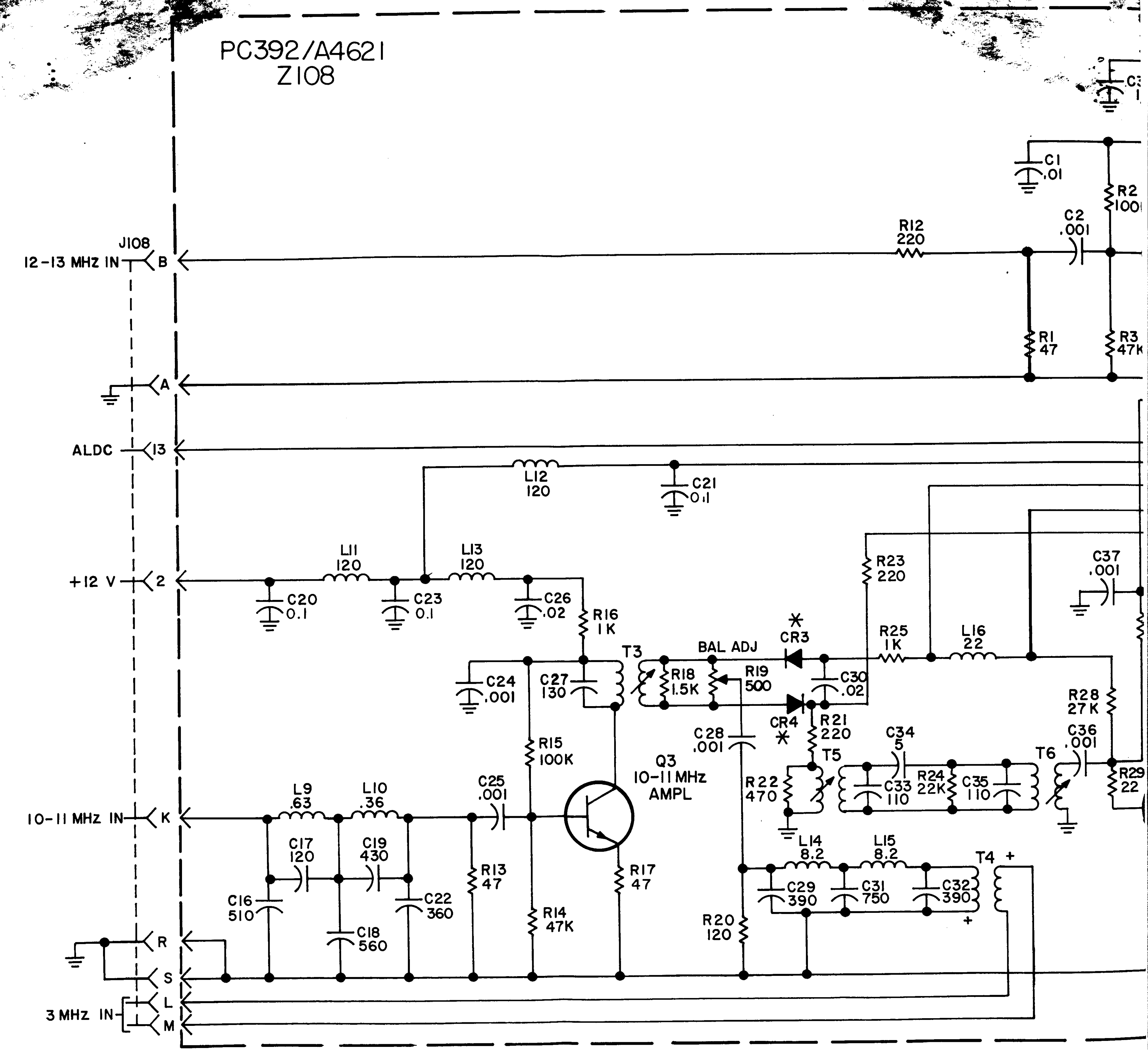


Figure 7-11. Translator Z108 Schematic Diagram



PC392/A4621
Z108
J108
12-13 MHz IN
B
A
ALDC
13
+12 V
2
10-11 MHz IN
K
R
S
L
M
3 MHz IN
C1 .01
R2 100
C2 .001
R12 220
R1 47
R3 47K
L12 120
C21 0.1
L11 120
L13 120
C20 0.1
C23 0.1
C26 .02
R16 1K
C24 .001
C27 130
T3
R18 1.5K
BAL ADJ
R19 500
CR3
CR4
C30 .02
R21 220
R23 220
R25 1K
L16 22
C37 .001
R28 27K
C36 .001
R29 22
T6
C28 .001
T5
C34 5
C33 110
R24 22K
C35 110
R22 470
Q3
10-11 MHz
AMPL
R15 100K
C25 .001
L9 .63
L10 .36
C17 120
C19 430
C16 510
C18 560
C22 360
R13 47
R14 47K
R17 47
L14 8.2
L15 8.2
T4
C29 390
C31 750
C32 390
R20 120

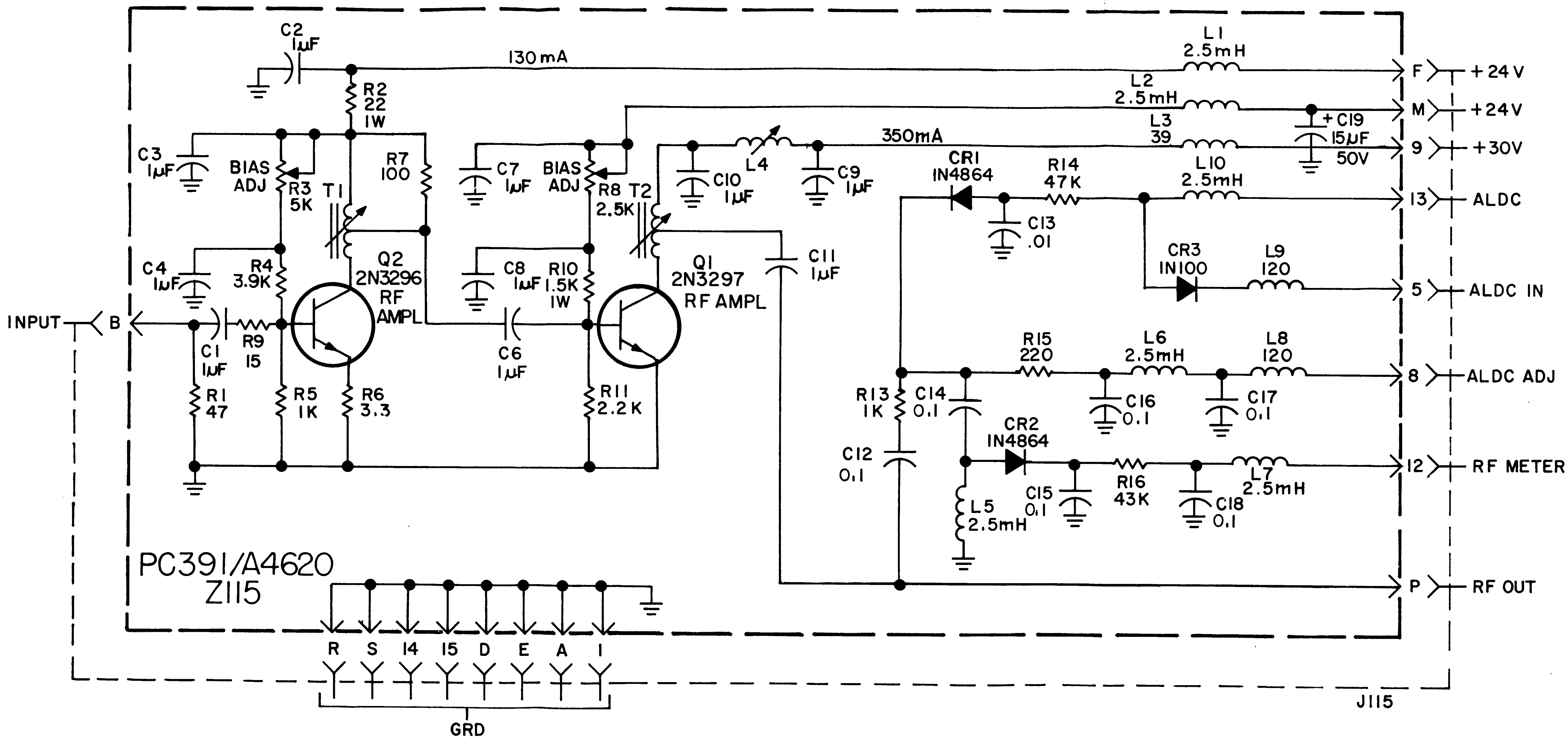
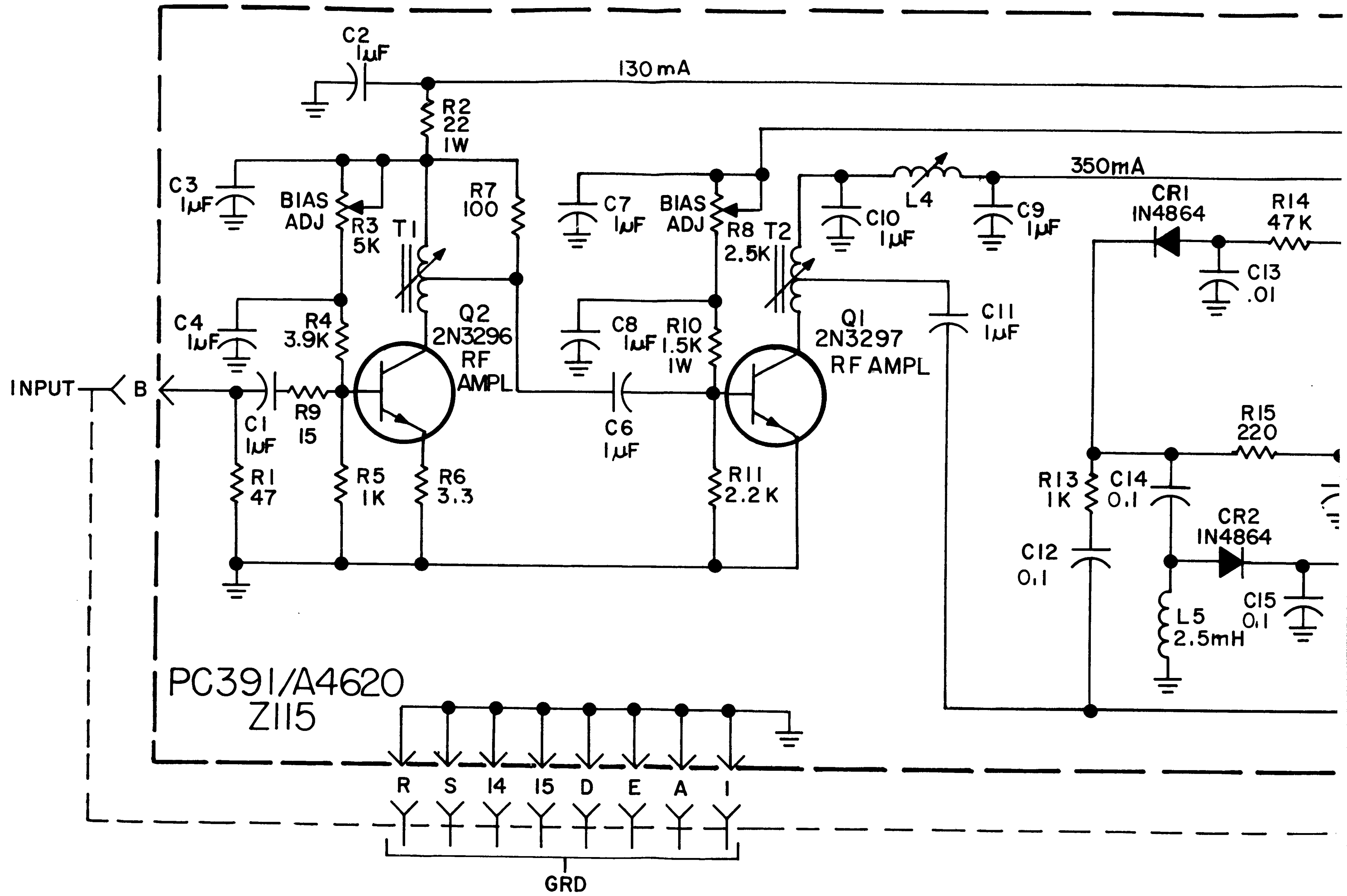


Figure 7-12. RF Output Z115 Schematic Diagram



C2 1µF
130 mA
R2 22 1W
350mA
C3 1µF
BIAS ADJ
R3 5K
T1
R7 100
C7 1µF
BIAS ADJ
R8 2.5K
T2
C10 1µF
L4
C9 1µF
CR1 IN4864
R14 47K
C13 .01
C4 1µF
R4 3.9K
Q2 2N3296 RF AMPL
C8 1µF
R10 1.5K 1W
Q1 2N3297 RF AMPL
C11 1µF
INPUT
B
C1 1µF
R9 15
C6 1µF
R15 220
R1 47
R5 1K
R6 3.3
R11 2.2K
R13 1K
C14 0.1
CR2 IN4864
C12 0.1
C15 0.1
L5 2.5mH
PC391/A4620
Z115
R S 14 15 D E A I
GRD

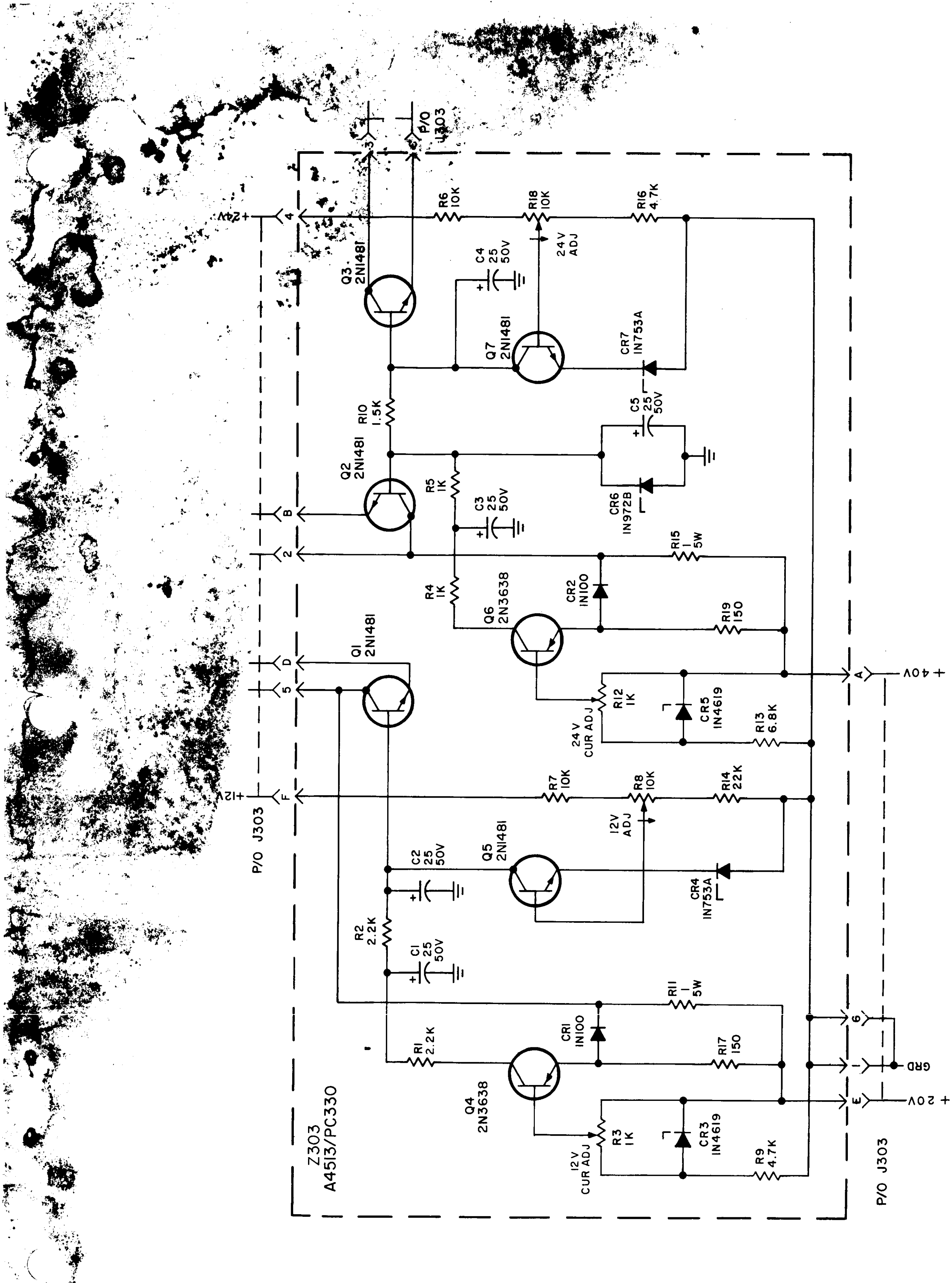


Figure 7-15. Power Supply Z303
Schematic Diagram

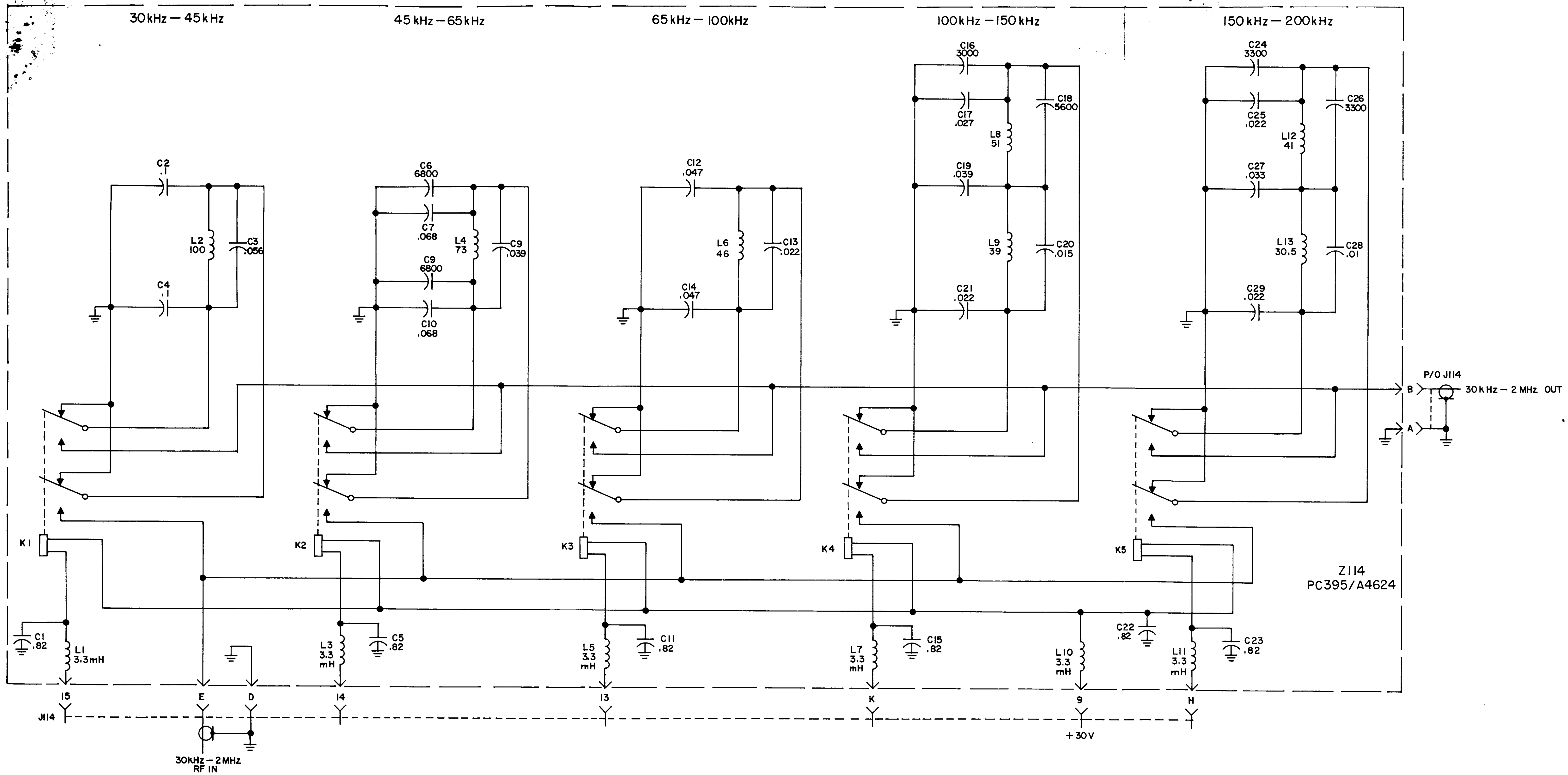
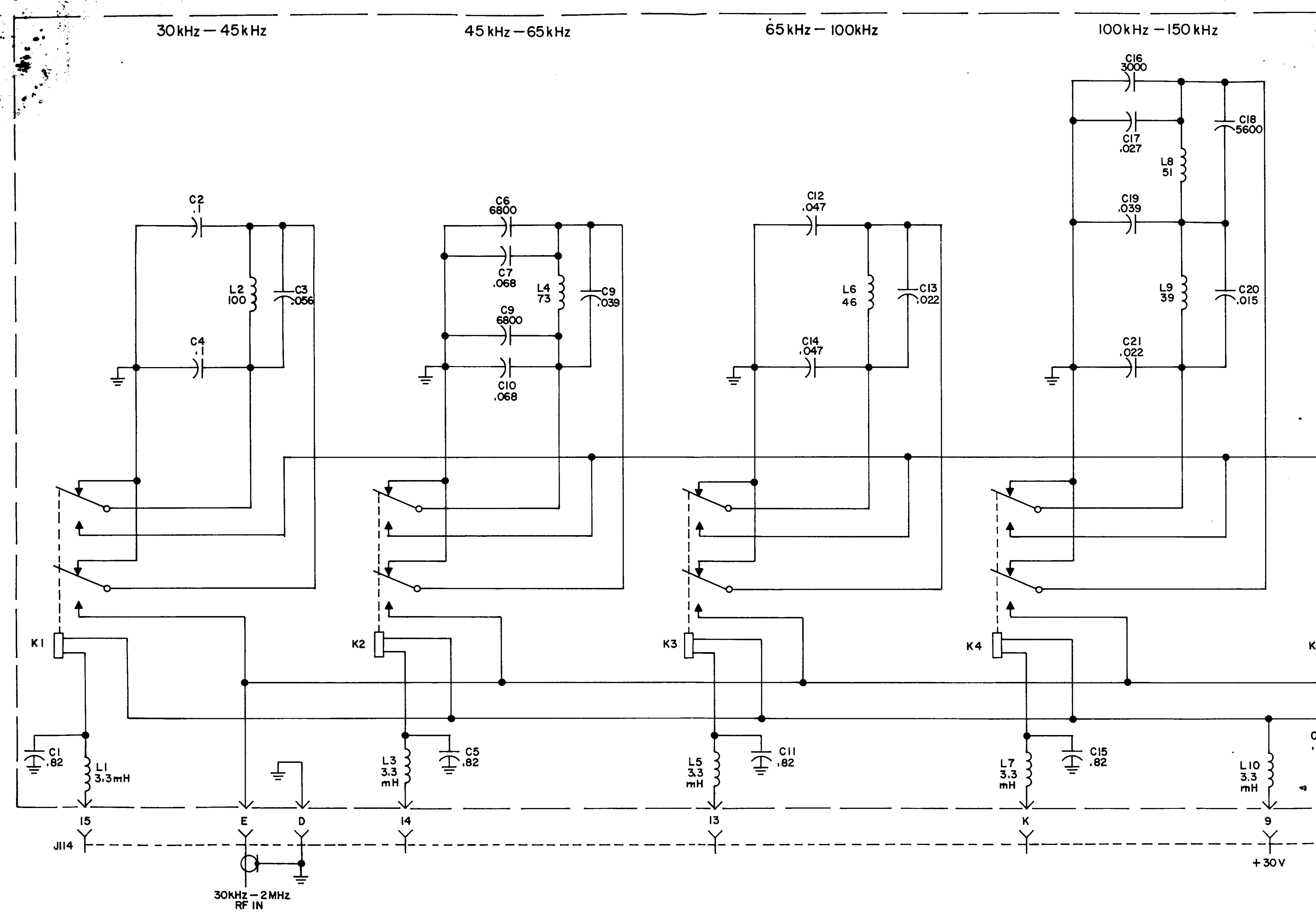


Figure 7-13. RF Filter Z113 or Z114 Schematic Diagram


30kHz — 45kHz
45kHz — 65kHz
65kHz — 100kHz
100kHz — 150kHz
C2 .1
C4 .1
L2 100
C3 .056
C6 6800
C7 .068
L4 73
C9 .039
C9 6800
C10 .068
C12 .047
L6 46
C13 .022
C14 .047
C16 3000
C17 .027
L8 51
C18 5600
C19 .039
L9 39
C20 .015
C21 .022
K1
K2
K3
K4
C1 .82
L1 3.3mH
C5 .82
L3 3.3 mH
C11 .82
L5 3.3 mH
C15 .82
L7 3.3 mH
L10 3.3 mH
15
E
D
14
13
K
9
J114
+30V
30KHz — 2MHz RF IN

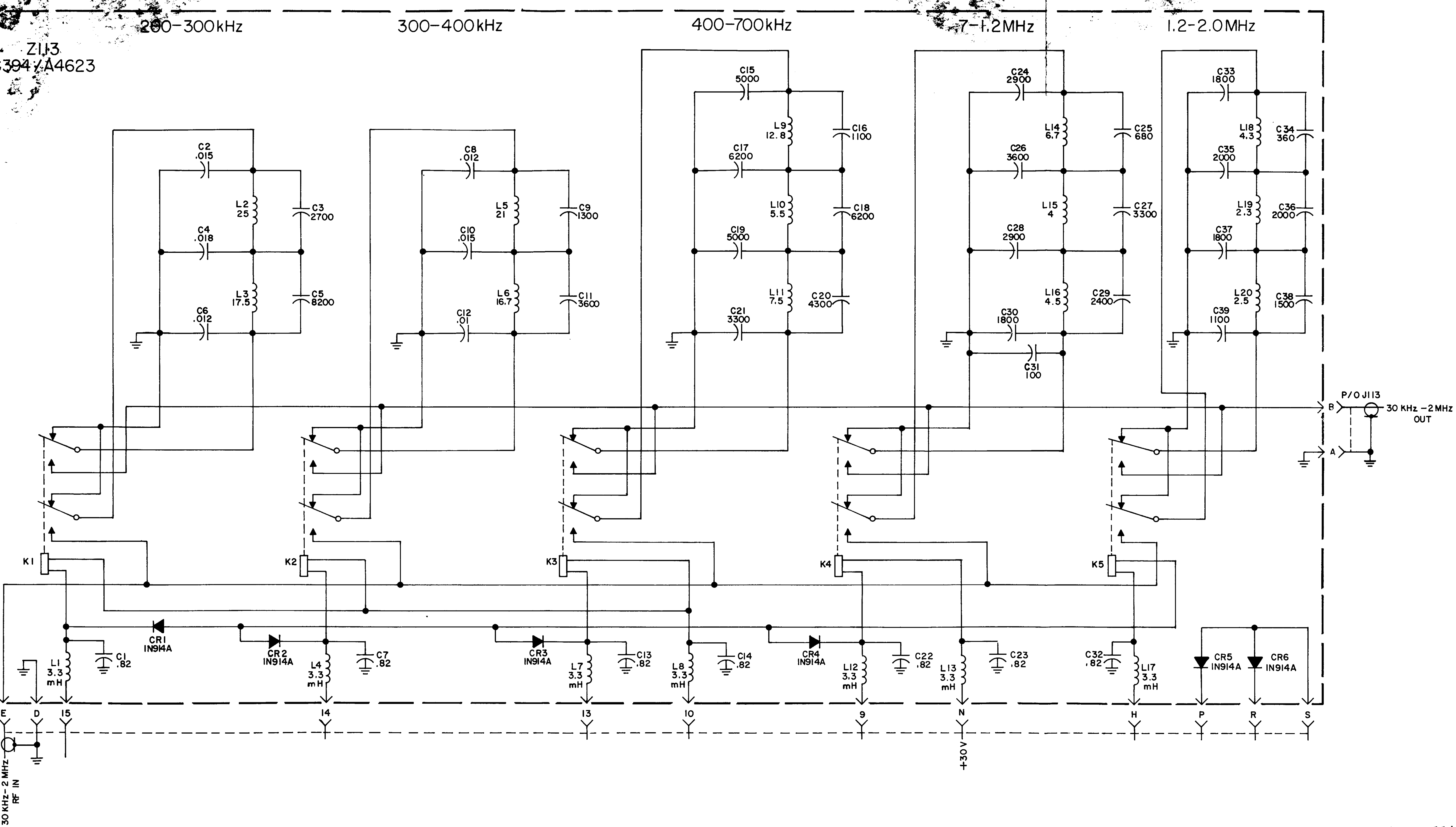
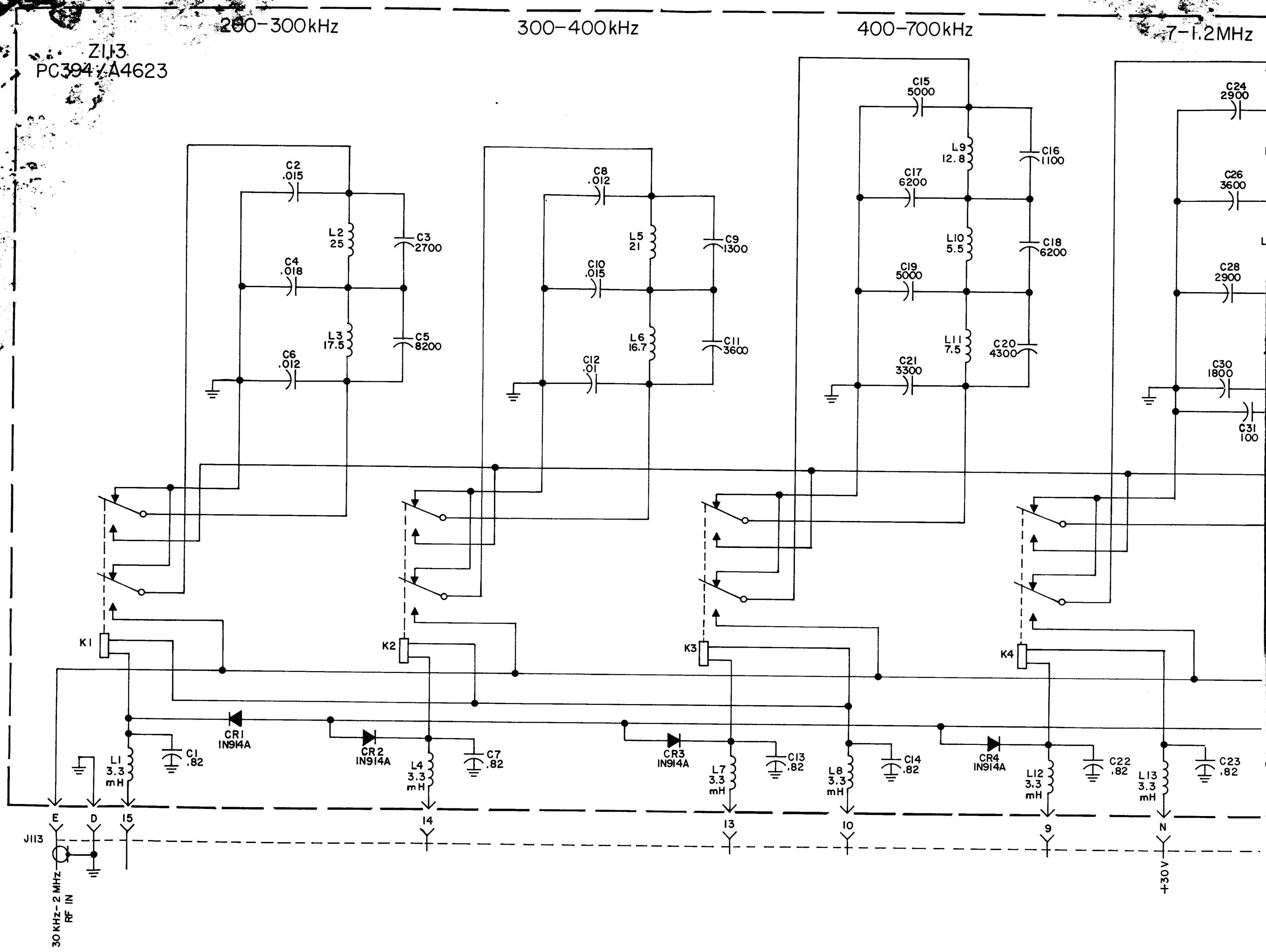
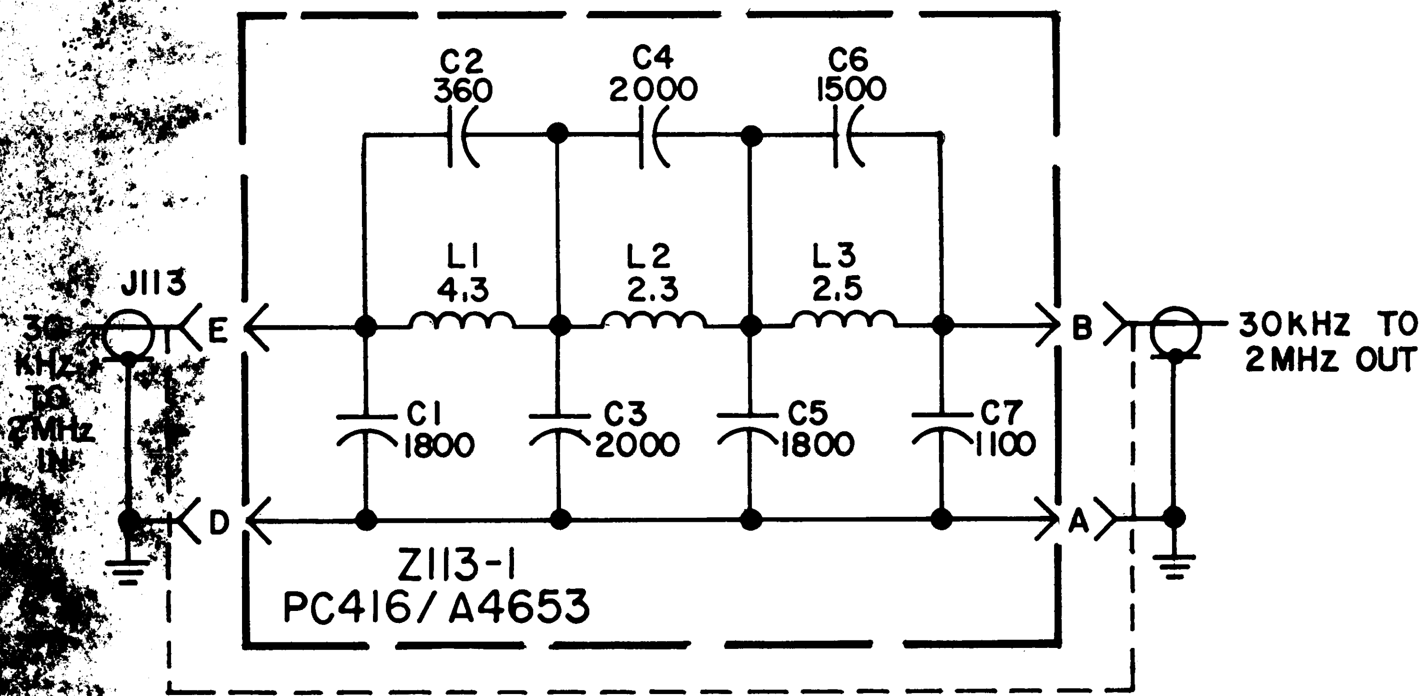


Figure 7-13. RF Filter Z113 or Z114
Schematic Diagram


Z113
PC394/A4623
200-300kHz
300-400kHz
400-700kHz
.7-1.2MHz
C2 .015
C4 .018
C6 .012
L2 25
L3 17.5
C3 2700
C5 8200
C8 .012
C10 .015
C12 .01
L5 21
L6 16.7
C9 1300
C11 3600
C15 5000
C17 6200
C19 5000
C21 3300
L9 12.8
L10 5.5
L11 7.5
C16 1100
C18 6200
C20 4300
C24 2900
C26 3600
C28 2900
C30 1800
C31 100
K1
K2
K3
K4
CR1 IN914A
CR2 IN914A
CR3 IN914A
CR4 IN914A
L1 3.3 mH
L4 3.3 mH
L7 3.3 mH
L8 3.3 mH
L12 3.3 mH
L13 3.3 mH
C1 .82
C7 .82
C13 .82
C14 .82
C22 .82
C23 .82
E
D
15
14
13
10
9
N
+30V
J113
30 KHz-2 MHz RF IN



SYMBOL SERIES 1200

LAST SYMBOLS

C7
L3

NOTE:

ALL CAPACITANCE VALUES ARE IN PICOFARADS.

ALL INDUCTANCE VALUES ARE IN MICROHENRIES.

Figure 7-13. RF Filter Z113 or Z114 Schematic Diagram

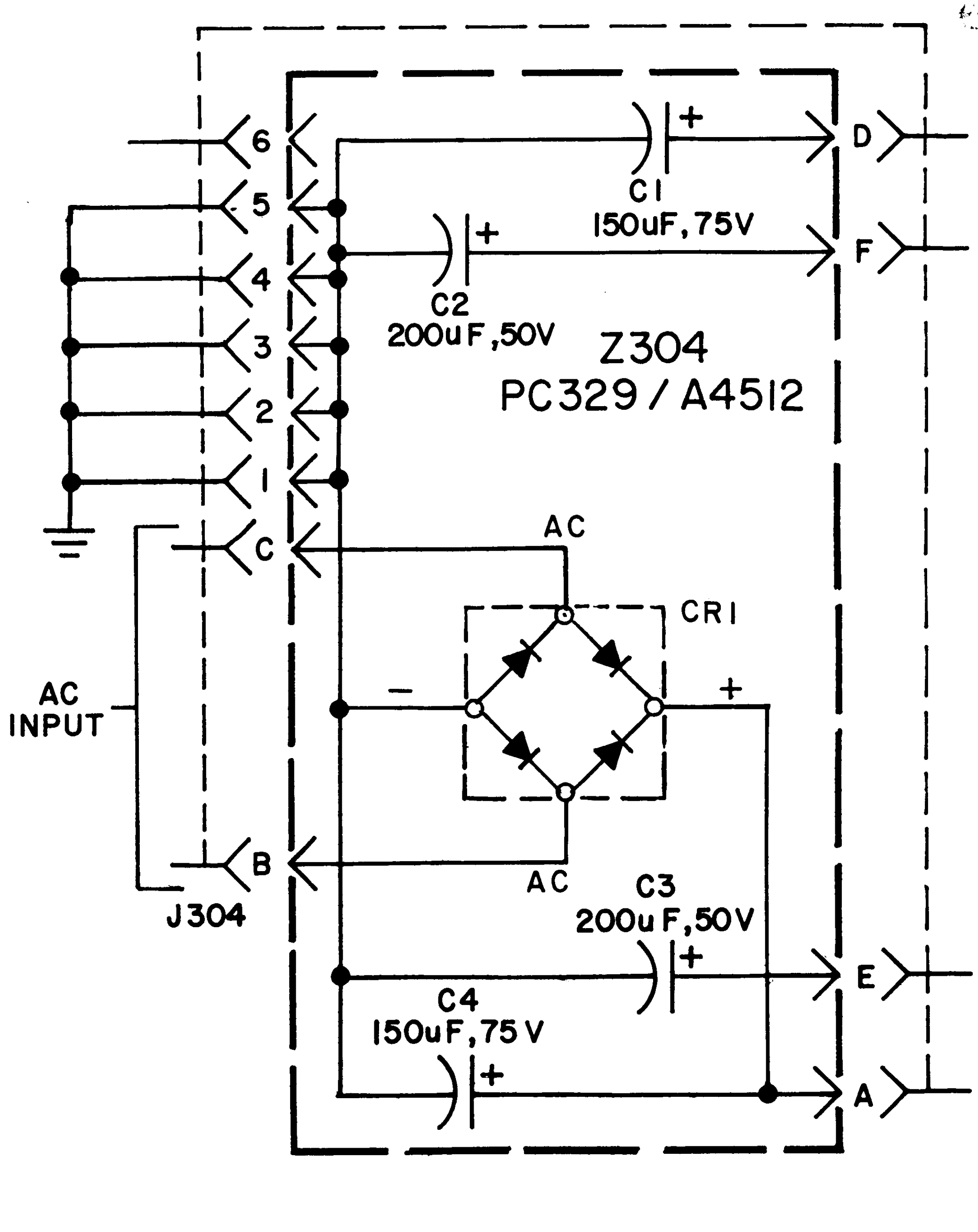


Figure 7-14. Power Supply Z304
Schematic Diagram