PRELIMINARY TECHNICAL MANUAL for MULTI-MODE EXCITER MODEL MMXM-2

WORLD WIDE SUPPLIERS OF ELECTRONIC COMMUNICATIONS EQUIPMENT

THE TECHNICAL MATERIEL CORPORATION

MAMARONECK, N.Y. OTTAWA, CANADA

PRELIMINARY

TECHNICAL MANUAL

for

MULTI-MODE EXCITER

MODEL MMXM-2

THE TECHNICAL MATERIEL CORPORATION

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

IN-2039 Issue Date: June, 1967

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

CHANGE NO. 1

INSTRUCTION BOOK CHANGE NOTICE

Date September 26, 1968

Manual affected: MMXM-2 IN -2039

Please make the following changes in pen and ink in the instruction manual:

1- Page 4-22 In the last line, change "transistor Q1" to read "transistor Q3".

2- Page 4-32 In the second line, change "circuit Q3" to read "circuit Q1".

3- Page 4-32 In line three, change "Q3" to read "Q1".

4- Page 5-28 On PC306, change the designation of "Q1" to "Q3" and indicate "Q1" on the heat sink between the two leads extending to the right of "T3". Also change (Z114) to read (Z115).

5- Page 7-35/7-36 On Figure 7-16, change "Q1" to "Q3" and "Q3" to "Q1".

CHANGE NO. 2

INSTRUCTION BOOK CHANGE NOTICE

Date 4/17/68

Manual affected: Preliminary Technical Manual for Multi-Mode Exciter, Model MMXM-2 IN 2039

Page 3-3; Table 3-1; add to the FUNCTION column of Item 6 the following Carrier attenuation (figure 3-2 carrier calibration scale).

CARRIER LEVEL	CARRIER CONTROL (Nominal Position)	MONITOR SCALE SETTING (Nominal)
Full carrier	Fully Clockwies (320 degrees)	3.5
-6 db	Clockwise rotation (250 degrees)	3.0
-20 db	Clockwise rotation (160 degrees)	1.5
-40 db	Clockwise rotation (70 degrees)	0.0
Full suppression	Fully counter clockwise	0.0

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SECTION 1
GENERAL INFORMATION

1-1. FUNCTIONAL DESCRIPTION

Multi-Mode Exciter, Model MMX (figure 1-1), is a solid-state exciter that provides rapid frequency selection in the 1.6- to 29.9999 MHz (mc/s) frequency range in 100 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, AME, and optional ISB mode 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 standard or an external (CSS-2) that provides stability of 1 part in 10^9 per day, and plug-in circuitry for independent sideband operation. Also available is optional equipment for direct remote control of the MMX 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 MMX 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:	1.6- to 29.9999 MHz in 100 Hz incremental steps. For remote tuning, see OPTIONS/ACCESSORIES.
FREQUENCY PRESENTATION:	Direct reading.
MODES OF OPERATION:	CW, AM, AME, SSB, FSK, FAX, (ISB, optional extra).
OUTPUT POWER:	Continuously adjustable from 0 to 1 watt CW, FSK, FAX. Continuously adjustable from 0 to 250 mw PEP for SSB, ISB, AM, and AME.
OUTPUT IMPEDANCE:	50 ohms nominal.
FREQUENCY STABILITY:	1 part in 10^8 per day for ambient temperature change of 15°C within the range of 0-50°C 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 ohm 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 and connection on rear panelfor 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), or 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.

1-3. TECHNICAL SPECIFICATIONS. (Cont)

OPTIONS/ACCESSORIES

1.	External Standard CSS-2	Provides 1 part in 10^9 stability.
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.

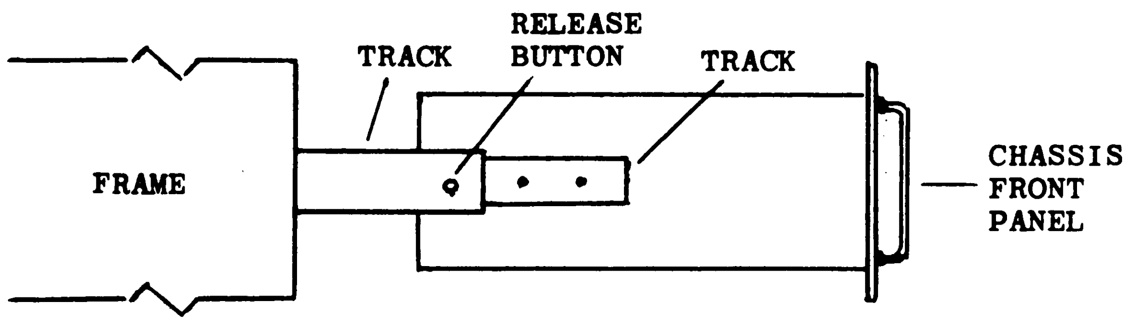
2-3. MECHANICAL INSTALLATION.

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).

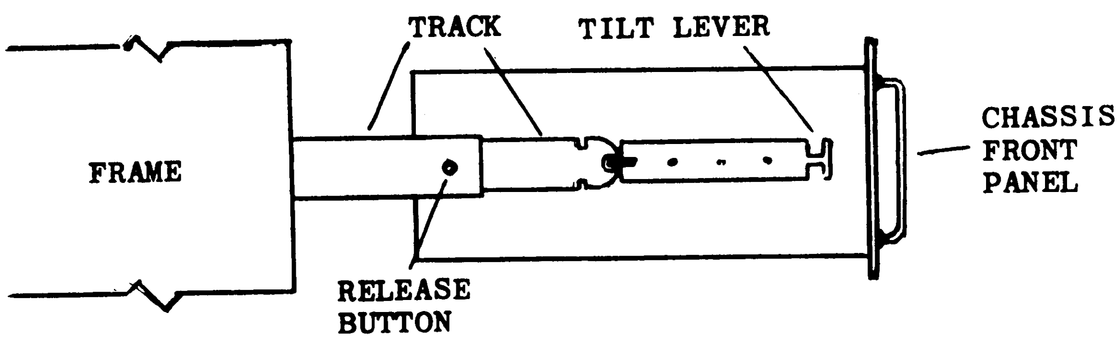
When the unit is equipped with a tilt-lock slide mechanism, installation is as follows (refer to figure 2-1):

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

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.



NON-TILT CHASSIS SLIDE



TILT CHASSIS SLIDE

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Figure 2-1. Tilt-Lock Slide Mechanism

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.

TABLE 2-1. REAR PANEL CONNECTIONS (Cont)

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

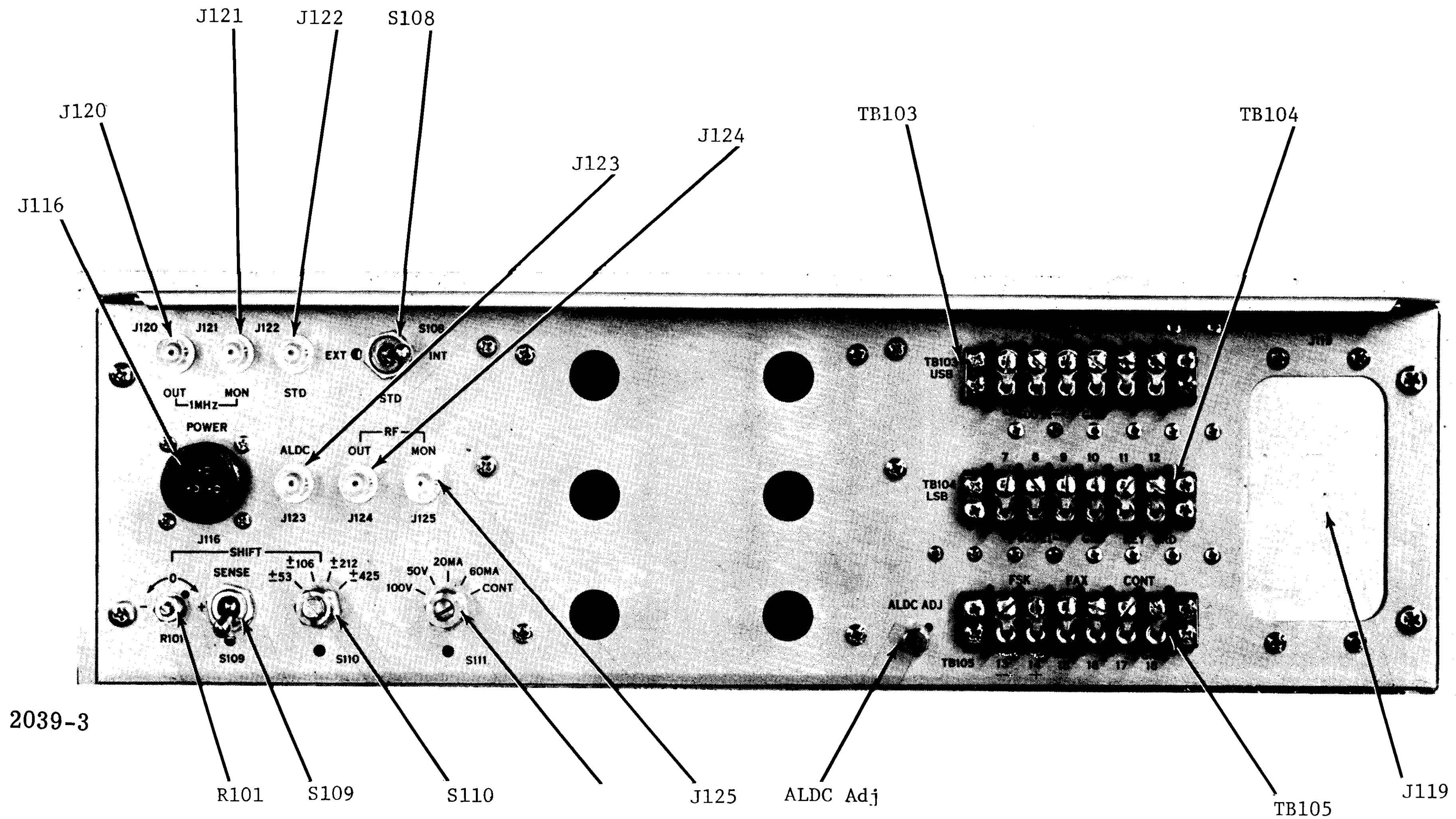

Figure 2-2. Rear Panel, MMX

the USB p osition 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 operation 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 1.6- to 31.999-mc (MHz) transmission range in 1Kc (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 by means of the MMX front panel controls. Meter selection 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 contained 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	Adjust 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.

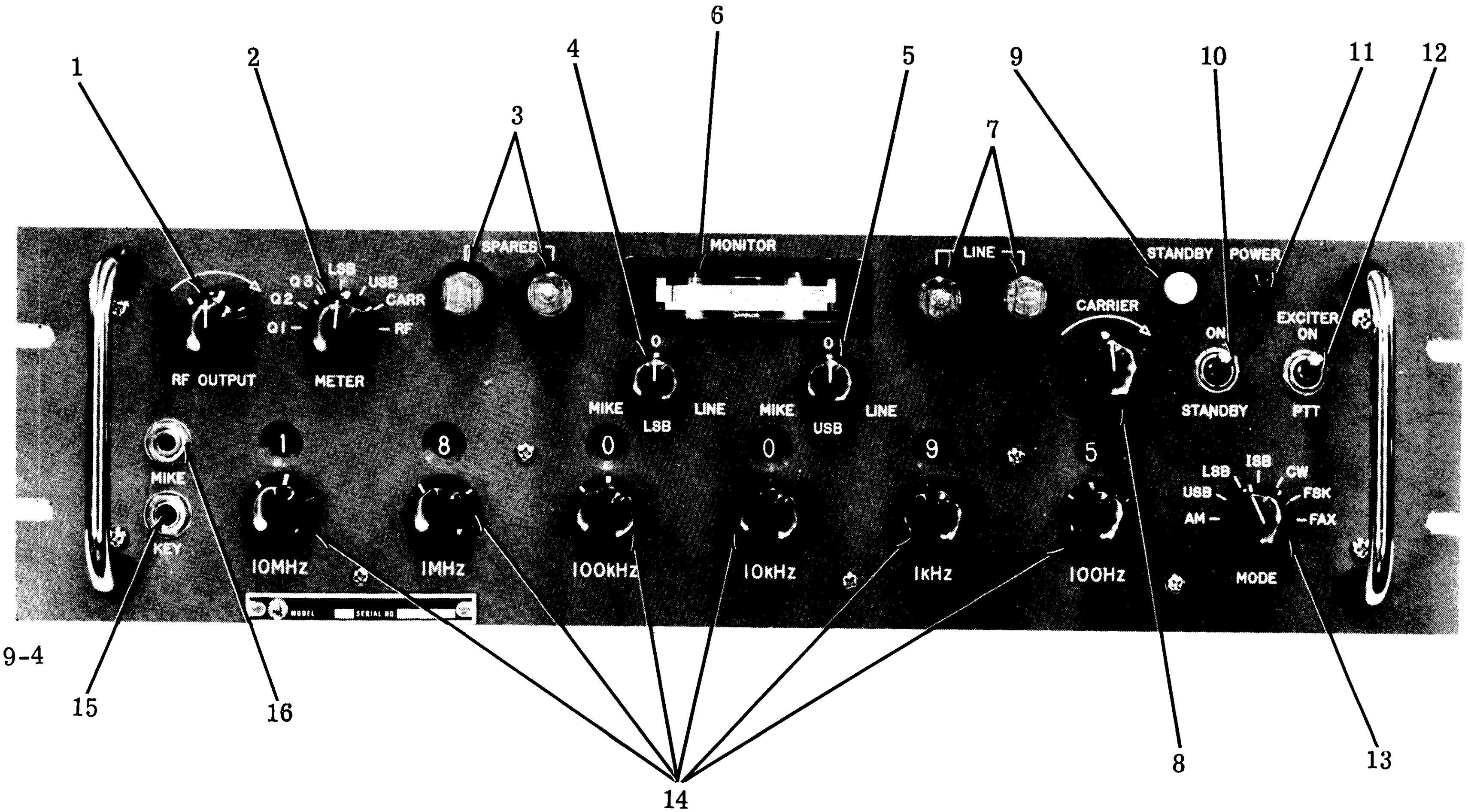

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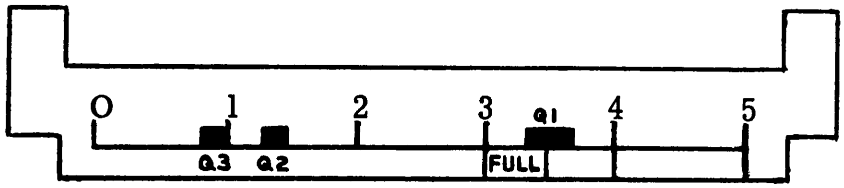
Figure 3-1. Controls and Indicators, MMX

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 1.6- to 31.999 mc (MHz) in 100 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

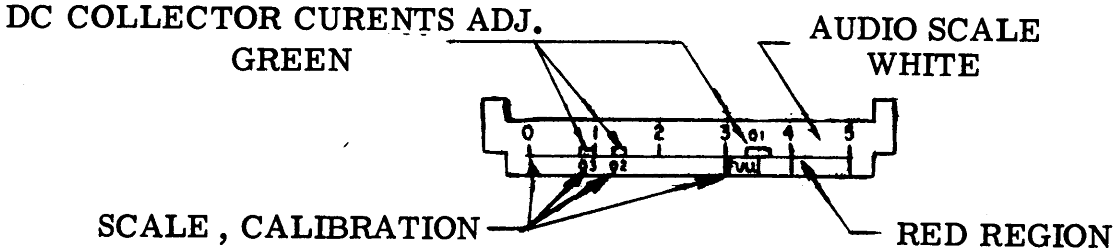


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Figure 3-2, Front Panel Monitor Indicators himself with the equipment and the scales shown so as not to overdrive and cause damage to the associated equipment.

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 MMX 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 Analyses 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 (Z109) 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 lmc 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 AM circuit (also contained in Z109); the keying circuit of the Frequency Shift Generator Section (Z108); 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 MMX 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 (Z107) 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 ¶ 4-2A(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 Z108) 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 a keyer to the internal current thereby keying the input to the keyer circuit or via a switch set at the externally 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 Z108). The limiter eliminates unwanted peaks and the output is connected to the 3 mc output circuit (also P/o Z108).

(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 (with 250-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 limitor 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 Z109).

b. Block Diagram Analyses of the Frequency Generation Sections (refer to figure 4-2). - The frequency generation portion of the exciter is broken down into the following sections: Spectrum Generator Section; Comb Filter Sections A and B; Mixer Divider Section; Step Generator A; Step Generator B; Step Generator C; 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), 40 MC (used for input to the Translator Section), 12 mc, 13 mc, and 14 mc (used for inputs to Step Generators A, B, and C) all these signals have the same stability as the 1 mc standard.

(2) Comb Filter Sections A and B (Z102 and Z103) accept the 100KC spectrum generator signal and filter this input with 12 crystal controlled filter and amplifier circuits resulting in 12 frequencies from 8 mc to 1.9 mc. These frequencies are switch selectable for application to the Mixer Divider sections and the Step Generator Sections. (refer to paragraph 4-4 for details)

(3) Mixer Divider Section (Z104 thru Z106) 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 10-10.999 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) Step Generator A (Z110) is configured to accept and mix, using two individual circuits, the 13 mc and 14 mc signals from the Spectrum Generator Section with the .8 to 1.7 mc input from the Comb Filters. The mixed outputs are each applied to two multiplier stages with a filter network between them (see Step Generators B and C).

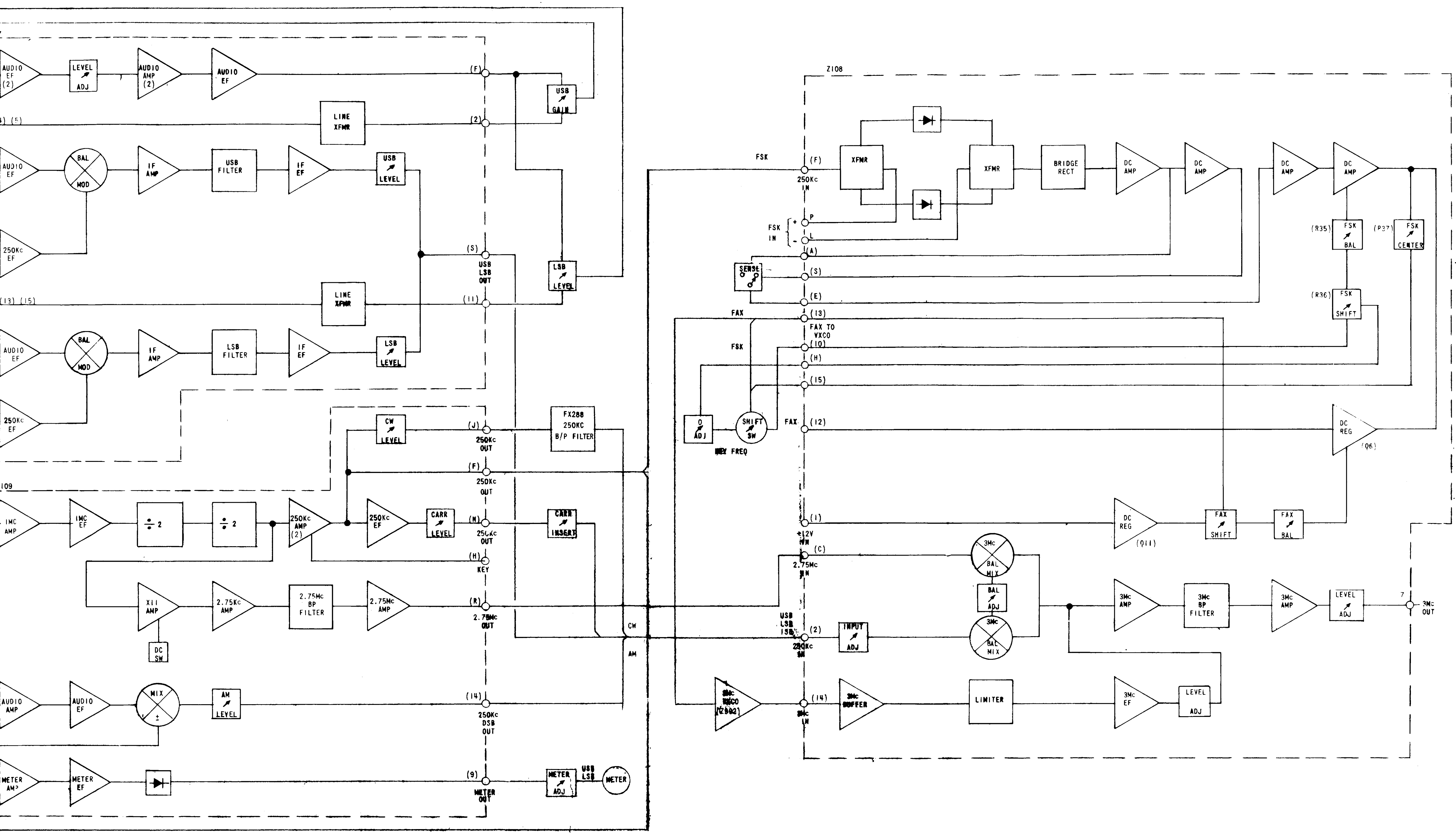
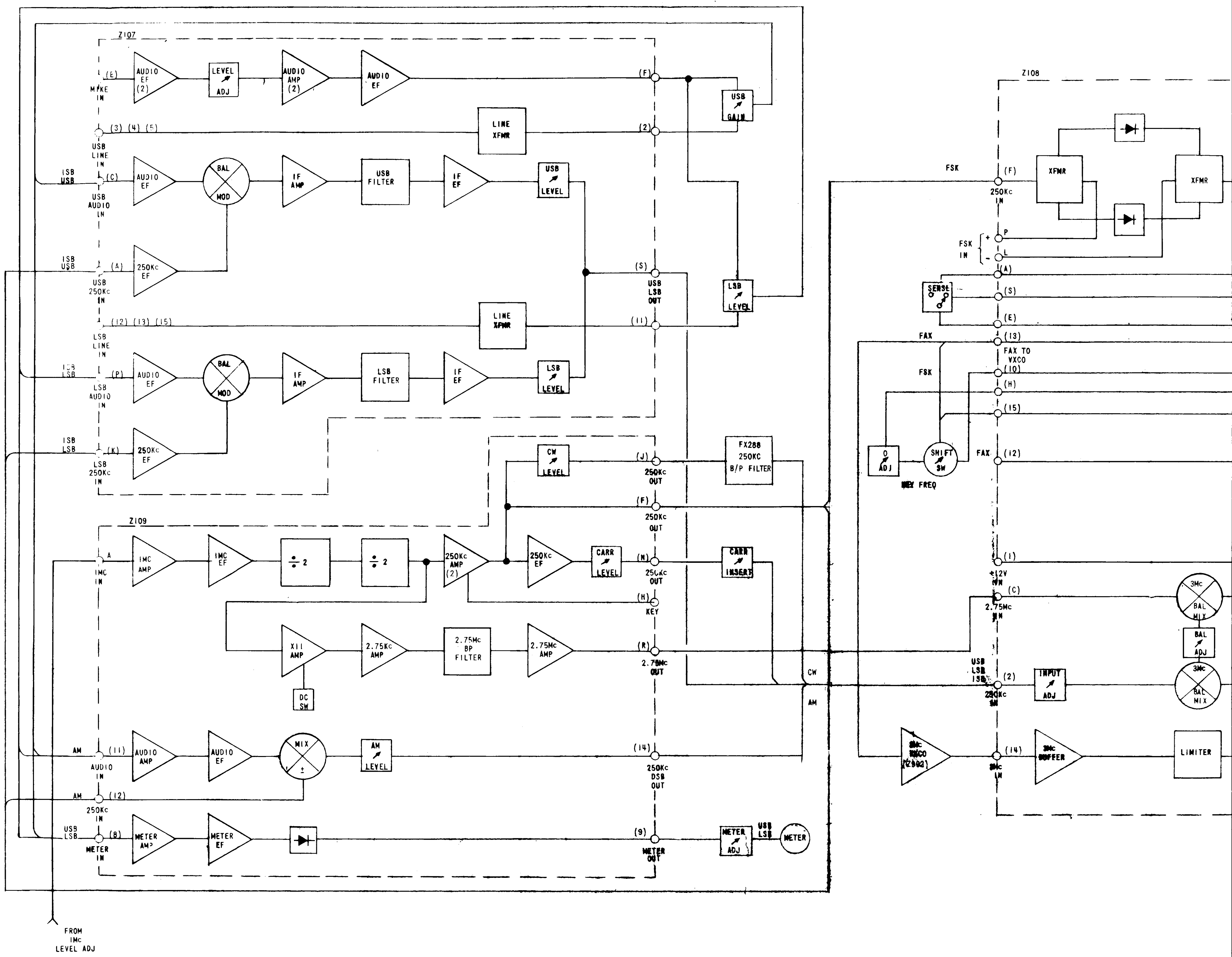


Figure 4-1. Block Diagram of
The Sideband Exciter Modules


Z107
MIKE IN
AUDIO EF (2)
LEVEL ADJ
AUDIO AMP (2)
AUDIO EF
USB GAIN
USB LINE IN
LINE XFMR
USB AUDIO IN
BAL MOD
IF AMP
USB FILTER
IF EF
USB LEVEL
USB 250Kc IN
250Kc EF
USB LSB OUT
LSB LEVEL
LSB LINE IN
LSB AUDIO IN
LSB FILTER
LSB 250Kc IN
Z109
IMC IN
IMC AMP
IMC EF
CW LEVEL
250Kc OUT
FX288 250KC B/P FILTER
250Kc AMP (2)
CARR LEVEL
CARR INSERT
KEY
XII AMP
DC SW
2.75Kc AMP
2.75Mc BP FILTER
2.75Mc AMP
2.75Mc OUT
CW
AM
AUDIO IN
AUDIO AMP
MIX
AM LEVEL
250Kc DSB OUT
METER IN
METER AMP
METER EF
METER OUT
METER ADJ
METER
FROM IMC LEVEL ADJ
Z108
FSK
250Kc IN
XFMR
FSK IN
SENSE
FAX
FAX TO VXCO
SHIFT SW
ADJ
KEY FREQ
+12V IN
2.75Mc IN
3Mc BAL MIX
BAL ADJ
INPUT ADJ
3Mc IN
3Mc BUFFER
LIMITER

CK1492A

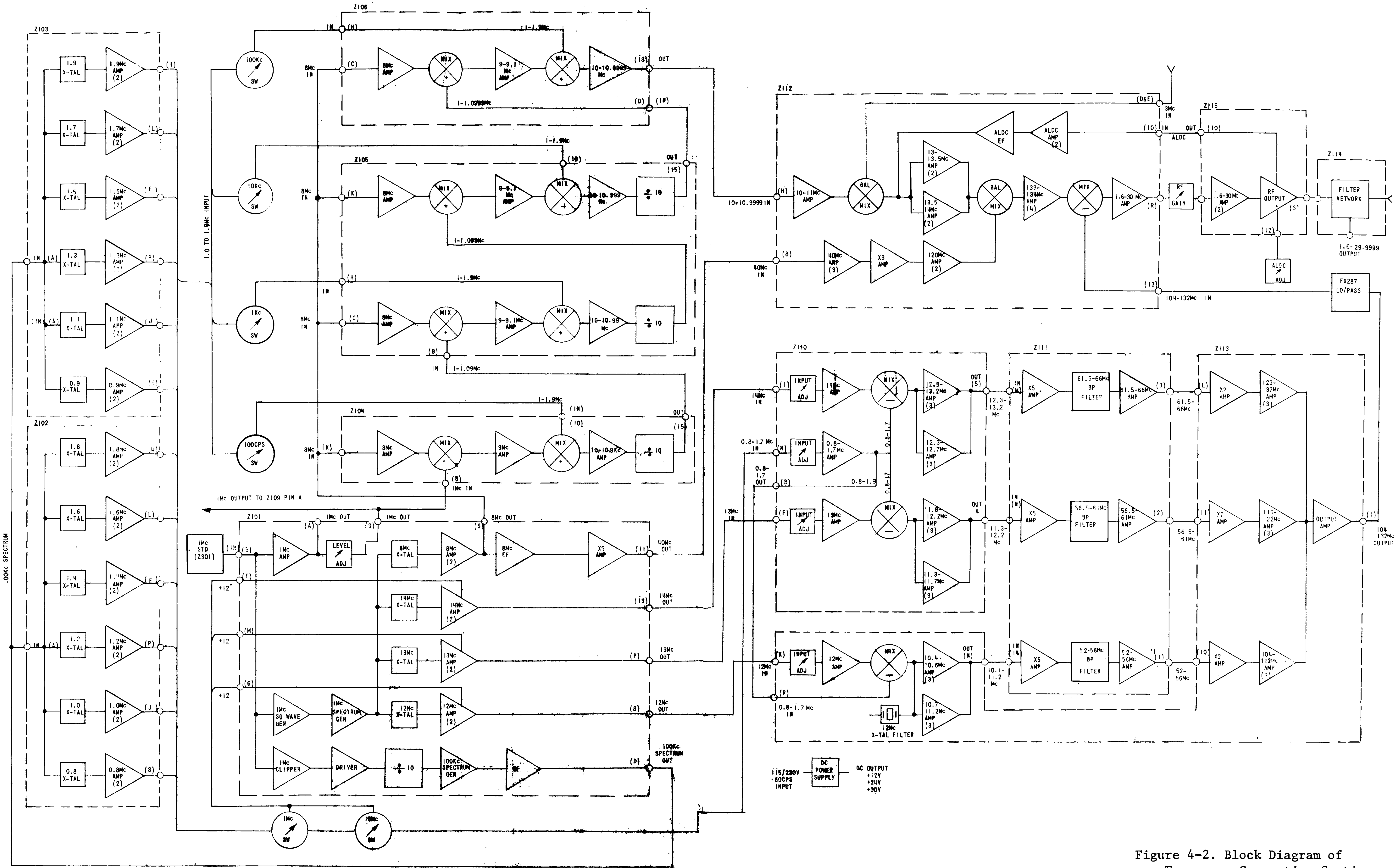
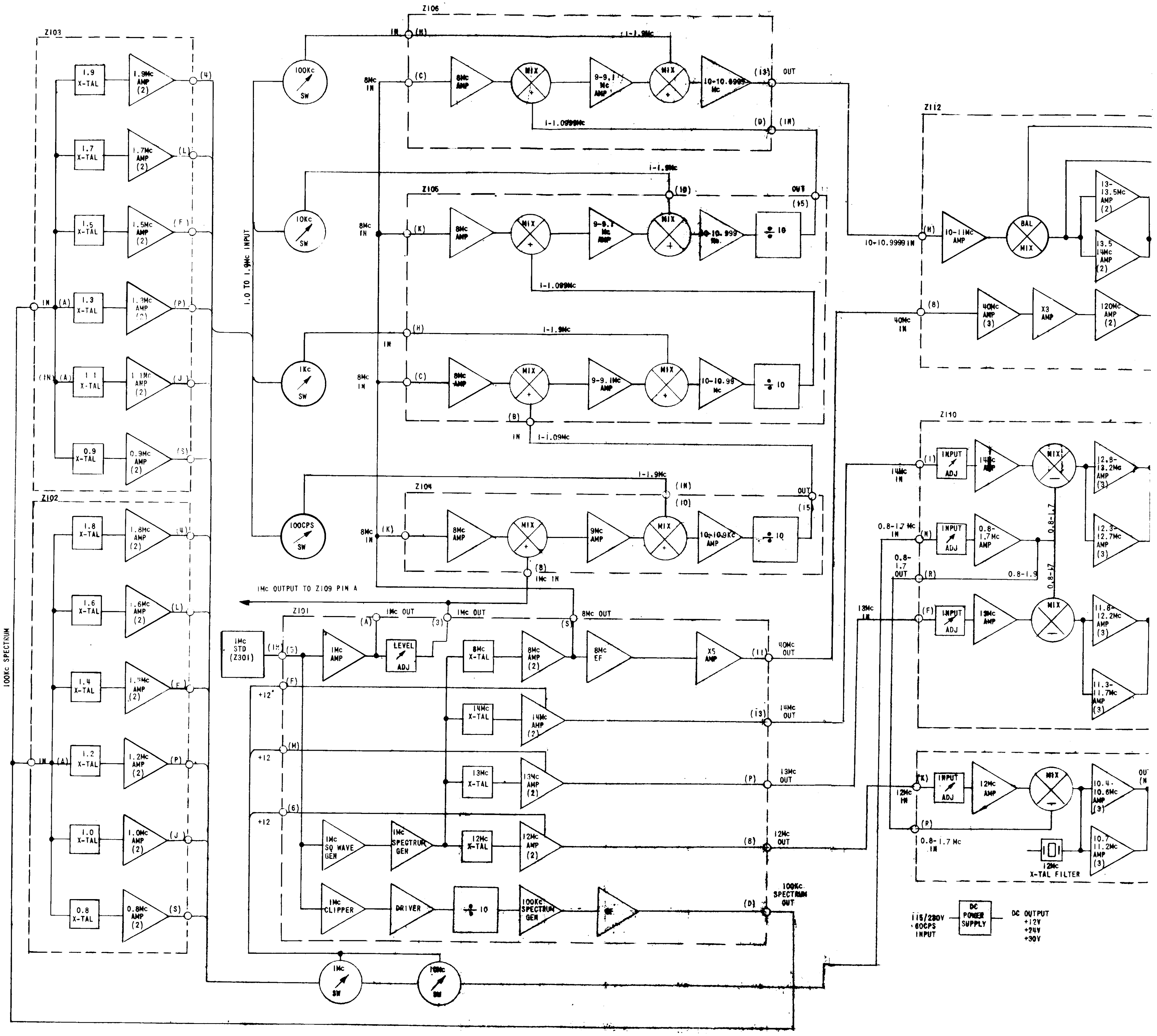


Figure 4-2. Block Diagram of Frequency Generation Sections

CK1492A


Z103
Z102
Z106
Z105
Z104
Z101
Z112
Z110
100Kc SW
10Kc SW
1Kc SW
100CPS SW
1Mc SW
1.0 TO 1.9Mc INPUT
100Kc SPECTRUM
1Mc OUTPUT TO Z109 PIN A
1Mc STD (Z301)
LEVEL ADJ
1Mc SQ WAVE GEN
1Mc SPECTRUM GEN
1Mc CLIPPER
DRIVER
100Kc SPECTRUM GEN
40Mc OUT
14Mc OUT
13Mc OUT
12Mc OUT
100Kc SPECTRUM OUT
10-10.9999 IN
40Mc IN
BAL MIX
X3 AMP
12Mc X-TAL FILTER
115/230V 60CPS INPUT
DC POWER SUPPLY
DC OUTPUT +12V +24V +30V
CK1492A

(5) Step Generator B (Z111) multiplies and filters the outputs of Step Generator A and the mixed signal output of Step Generator C (P/o Z113) to produce the three signals applied to the multiplier stages of Step Generator C.

(6) Step Generator C (Z113) accepts and mixes the 12 mc signal from the Spectrum Generator Section with the .8 to 1.7 mc input from the Comb Filters to produce the third signal applied to Step Generator B. Z113 also accepts and multiplies the outputs from Step Generator B.

The outputs from Step Generator B are amplified separately then amplified together and the resulting output is the switch selectable signal covering the range from 104 mc to 132 mc. The 104 mc to 132 mc signal is applied to the base circuit of amplifier transistor Q11 of the translator section.

(7) Translator and RF output sections (Z112, Z114, Z115) accept; the 104-132 mc signal from the Step Generators; the 40 mc signal from the Spectrum Generator; the 10-10.999 mc signal range from the Mixer-Divider Section; the switch selectable 3 mc input; and translates these inputs by various stages to produce the amplified highly stable 1.6-to 30.0mc RF output signal, which is amplified and filtered to a final 1.6 to 29.9999 mc frequency range (Z114).

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

The 1-mc fundamental signal (furnished by an internal or external standard) is applied to three circuit sections on printed circuit board Z101 (figure 7-2), 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 7-11), 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 twelve crystals that are part of the Comb Filter Sections A/B (refer to fig ures 7-2 and 7-3).

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 four 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 four harmonic selector and amplifier circuits operate in the same manner to produce the 12, 13, 14 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 output frequency is connected to the Step Generator C section Z113. The amplified 13-mc and 14-mc output frequencies are connected to the Step Generator A section Z110. The amplified 8 mc output frequency is connected simultaniously to the 8 mc amplifiers of all three Mixer Divider stages (Z104, Z105, and Z106) and in addition the 8 mc signal is internally applied to a multiplier stage.

The multiplier circuit accepts the high impedance 8-mc output of Q13 by using a high impedance matching collector circuit with the emitter follower transistor (Q18) to isolate the multiplier transistor Q19. The output of transistor Q18 is applied to the base of multiplier Q19 producing the output at the collector of Q19. The output is highly filtered by transformer T12 and capacators C86 and C89 which allow only the 40 mc signal to pass. The 40 mc signal is connected to the 40 mc amplifier that is part of translator (Z112).

4-4. DETAILED ANALYSIS OF THE COMB FILTER SECTIONS (Z102 and Z103).

(Refer to Figures 7-2, and 7-3).

The 100-kc spectrum frequency of printed circuit Z102 is fed to twelve 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 twelve harmonic selector and amplifier circuits operate in the same manner to produce the output frequencies (refer to figure 7-3), only the 0.8-mc harmonic selector circuit is described, as follows:

The 100-kc spectrum frequency is applied to the crystal filter Y6 and variable capacitor C54, which permit only the desired 0.8-mc harmonics to pass, and the resultant frequency is fed to amplifier Q11 and then further tuned by tuned-transformer T11. The signal is then passed through the second stage of amplification and tuning, consisting of amplifier Q12 and tuned-transformer T12; thee amplified 0.8-mc output frequency is routed to switch (#3S106A Front) for selectivity. Variable resistor R42 provides for output level adjustment.

4-5. DETAILED ANALYSIS OF THE MIXER-DIVIDER SECTIONS (Z104, Z105 and Z106).

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.

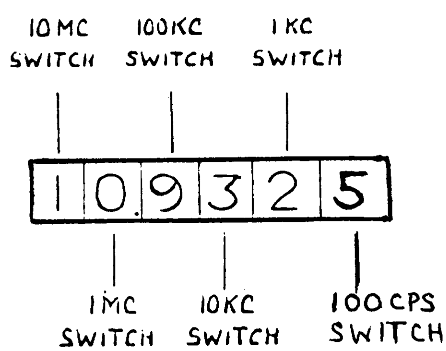


Figure 4-3. Frequency Selector Switch Readout.

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 of 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 amplified 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 4-4) is connected to the balanced modulator consisting of 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-) is applied to the balanced modulator consisting of T7, T8, T9, T10, T11 and amplified by amplifiers 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 copacitors C48 and C36. The B+ is also connected to the translator circuit Z112.

<u>4-6. DETAILED ANALYSIS OF THE STEP GENERATOR SECTIONS (Z110, Z111, and Z113)</u> - The Generator circuits accept; the 12-, 13-, and 14 mc frequencies from the Spectrum Generator Section; the 0.8- to 1.7 mc frequency range from the Comb Filter sections and by using various amplifier, mixer, filter, and multiplier circuits obtain the 104- to 132 mc Frequency Range used as the input to the Translator Section.

a. Step Generator (Z110) accepts the 13 mc and the 14 mc frequencies and applies them to amplifier and mixer circuits and since these circuits are identical only the 13-mc amplifier circuits will discussed. The 13-mc frequency (from the Spectrum Generator Section), connected to the base of transistor Q9, is amplified and the output at the collector of Q9 is connected to the primary of transformer T17 (P/o the balanced mixer circuit).

The .8- to 1.7 mc frequency range (from the Comb Filters Z102 and Z103) is connected to base of amplifier transistor Q5. The amplified output at the collector of Q5 is transformer coupled (T9) simultaneously to the balanced mixer circuit for connection to the 13 mc and 14 mc balanced mixers (at the secondaries of T17 and T1) and extended to the balanced mixer circuit located in Step Generator Z113.

The output of the balanced mixer (CR3, CR4) is simultaneously, transformer coupled (T18 and T19) to the base of amplifier transistor Q10, and transformer coupled (T25 and T26) to the base of amplifier transistor Q13. Amplifiers Q10, Q11 and Q12, amplify respectfully, the 11.8- to 12.2 mc frequency range and amplifiers Q13, Q14, and Q15, the 11.3 to 11.7 mc frequency range and since the remaining amplifier circuits are identical only the 11.3- to 11.7 mc frequency range amplifier circuitry will be discussed.

The amplified 11.30 to 11.7 mc frequency range at the collector of Q13 is transformer coupled (T27) to the base circuit of amplifier transistor Q14. The amplified output at the collector of Q14 is transformer coupled to the base circuit of amplifier transistor Q15. The amplified output of Q15 is transformer coupled (T31) and combined with the amplified 11.8 to 12.2 mc frequency range to produce the 11.3- to 12.2 mc frequency range connected to Step Generator Z111. The other amplifier circuits produce a combined 12.3- to 13.2 mc frequency range also used in Step Generator Z111. The .8- to 1.7 mc frequency range is extended to the Step Generator Z111 also.

Also contained in the Step Generator Z110 circuits are switched ground circuits for particular frequencies. These ground circuits are switch controlled by the frequency selection switches that determine the range of the frequency being used.

b. Step Generator (P/o Z113) mixes the 12 mc frequency from the Spectrum Gen- Z110 to produce the 10.4- to 11.2 mc frequency range. This signal is extended to Step Generator Z111 for filtration before it is reconnected to Z113.

The 12 mc frequency connected to the base of transistor Q14 is amplified and the output at the collector of Q14 is connected to the primary of transformer T11 (P/o the balanced mixer circuit).

The .8- to 1.7 mc frequency range (from the Comb Filters Z102 and Z103) is connected to the secondary of T11.

The output of the balanced mixer (T11) is simultaneously transformer coupled (T12 and T13) to the base of amplifier transistor Q15, and transformer coupled (T19 and T20) to the base of amplifier transistor Q18. Amplifierrs Q15 and Q18 amplify respectfully the 10.4- to 10.6 mc and the 10.7- to 11.2 mc frequency ranges and since the remaining amplifier circuits are identical only the 10.4- to 10.6 mc frequency range amplifier circuitry will be discussed.

The amplified 10.4- to 10.6 mc frequency range at the collector of Q15 is transformer coupled (T14 and T15) to the base circuit of amplifier transistor Q16. The amplified output at the collector of Q16 is transformer coupled (T16 and T17) to the base circuit of amplifier transistor Q17. The amplified output of Q17 is transformer coupled (T18) and combined with the amplified 10.7- to 11.2 mc frequency range to produce the 10.4- to 11.2 mc frequency range connected to Step Generator Z111.

Also contained in the Step Generator Z111 circuits are switched ground circuits for particular frequencies. These ground circuits are switch controlled by the frequency selection switches that determine the range of the frequency being used.

c. Step Generator Z111 accepts; the 11.3- to 12.2 mc frequency range from Step Generator Z110; the 12.3- to 13.2 mc frequency range also from Step Generator Z110; the 10.4- to 11.2 mc frequency from part of Step Generator Z113; and multiplies and filters these inputs separately to produce the three inputs to the Step Generator Z113. Since the circuits operate identically only the 52- to 56 mc will be discussed.

The 10.4- to 11.2 mc frequency range is connected to the base of multiplier transistor Q1 multiplied to a 52- to 56 mc frequency range at the collector of Q1. The multiplied frequency range is transformer coupled (T1) to the base of amplifier transistor Q2 amplified and the output at the collector of Q2 is transformer coupled (T2) to the input of the bandpass filter (Z1). The filtered 52- to 56 mc frequency range is connected to the base of amplifier transistor Q3 amplified and the output at the collector of Q3 is transformer coupled (T3)to Step Generator Z113. The 56.5- to 61 mc and the 61.5- to 66 mc filtered output frequency ranges are also connected to Step Generator Z113.

d. Step Generator Z113 accepts the three frequency ranges, described in the proceeding paragraphs, and uses seperate multiplier and amplifier circuits to combine and then amplify the resultants producing the 104- to 132 mc output frequency range. The output is connected to the Translator Z112. Since the three frequency range inputs are connected to three identical multiplier and amplifier circuits therefore only the 52- to 56 mc frequency range circuit will be discussed.

The 52- to 56 mc frequency range input is connected to the base circuit of Multiplier transistor (Q1) where the multiplied output at the collector of Q1 is a 104- to 112 mc frequency range. The multiplied output of Q1 is transformer coupled (T1) to the base of amplifier transistor (Q2) amplified and the output at the collector of Q2 is transformer coupled (T2) to the base of amplifier transistor Q3. The amplified output at the collector of Q3 is transformer coupled (T3) to the base of amplifier transistor Q4. The amplified output is connected to the base of amplifier transistor Q13. Also connected to the base of Q13 are the 113- to 122 mc and the 123- to 132 mc output frequency ranges of the two multiplier amplifier circuits. The resultant amplified combined frequency range at the collector of Q13 is the 104- to 132 mc output frequency range.

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

The Carrier Generator circuits accept; the 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 fre-

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. The 250KC output of Z2 is simultaneously connected to base of amplifier transister 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 DSB 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, LSB, ISB, and CW) controlling the input to the 3 mc mixer stage in the Frequency Shift Generator Section (P/o Z108).

The 250KC output from the decade divider Z2 is also connected to the base 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 Shift 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).

4-8. DETAILED ANALYSIS OF THE SIDEBAND GENERATOR SECTION (Z107)

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 potenteometers for indpendent 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 transister Q1 where the output at the emitter of Q1 is connected to 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 potentiometers (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 descussed. The LSB audio intelligence at the emitter of Q11 is connected to the balanced modulator (consisting of diodes CR5 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 transformer coupled (T2) to the base of intermediate frequency amplifier Q12. The amplified mixed signal at the collector of Q12 is connected to the LSB filter FL2 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.

4-9. DETAILED ANALYSIS OF THE FREQUENCY SHIFT GENERATOR SECTION Z108 AND VARIABLE CRYSTAL OSCILLATOR SECTION (P/o POWER SUPPLY)

(REFER TO FIGURES 7-13 and 7-14).

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 figure7-14); mixes either the Variable Crystal Oscillators output or the nominal 250KC signal from the Sideband Generator Section with the 2.75mc input also from the Sideband Generator Section to obtain the 3mc 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 control 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 SENSE 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 is connected via the switch controlled potentiometer, and the frequency shift potentiometers 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 regulator 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.

4-10. DETAILED ANALYSIS OF THE TRANSLATOR, RF OUTPUT AND FILTER SECTIONS (Z112, Z114 and Z115).- (Refer to Figures 7-14, 7-15, and 7-17).

The Translator circuits accept; the combined 104-to 132 mc frequency range from the Step Generators; the 10- to 10.9999 mc switch selectable frequencies from the Mixer-Divider Section; the 3 mc signal from the Sideband Exciter portion; the 40 mc signal from the Spectrum Generator Section; and translates these inputs to produce the desired output frequency in the range from 1.6-to 29.9999 mc that is connected to the RF amplifier stage. The circuits that accept various above mentioned inputs will be identified by the input and discussed accordingly.

The 10-to 10.9999 mc selectable frequency range is connected to a balanced modulator circuit, consisting of transistor Q12, transformer T12 and diodes CR4 and CR5, where a 3 mc signal,transformer coupled (T14),and balanced using potentiometer (R70),is also connected. The mixed outputs of CR4 and CR5 are both in phase; the output of CR5 is connected simultaniously to the 13-to 13.5 mc amplifier input circuit consisting of two tuned transformers (T13 and T15) and to the 13.5-to 14 mc amplifier input circuit consisting of two tuned transformers (T19 and T20). The output circuitry from the CR4 diode (part of the balanced modulator) connected to transistors Q13 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 amplifier stages. Since the operation of both amplifier stages are identical only the 13-to 13.5 mc amplifiers will be discussed. The 13-to 13.5 mc signal is connected to the base of amplifier Q13 and the amplified output at the collector of Q13 is transformer coupled by tuned transformer T17 to the base of amplifier Q14. The amplified output of Q14 is tuned transformer coupled (T18) 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 secondary of the 133.5 mc balanced modulator input transformer T6.

The 40 mc frequency is applied to the base of amplifier Q1 amplified and the output at the collector of Q1 is tuned transformer coupled by T2 to the base of amplifier Q3 where the output at the collector is tuned transformer coupled to the base circuit of multiplier transistor Q4. The resulting 120 mc output frequency at the tuned collector circuit of Q4 is connected to the base circuit of the 120 mc amplifier transistor Q5 amplified and the output at the collector is connected to the base circuit of the high frequency balanced modulator transistor Q6. The 120 mc output at the collector of Q6 is connected to the 133.5 mc balanced modulator input transformer (T6) and transformer coupled to the 13-to 14 mc output from the amplifier circuits. These frequencies are connected to diodes CR1 and CR2 and the resulting mixed 133.5 mc output is transformer coupled (T8) to the base of amplifier transistor Q7 amplified and the output at the collector of Q7 is tuned transformer coupled (T9) to the base of amplifier Q8. The amplified 133.5 mc output at the collector of Q8 is tuned transformer coupled (T10) to the base of amplifier transistor Q10 amplified and the output at the collector of Q10 is connected to the mixer base circuit of amplifier transistor Q11.

The 104-to 132 mc frequency range is connected also to the mixer base circuit of Q11 via diode CR3 and the resulting mixed 1.6-to 30 mc frequency range is applied to the base of amplifier Q11. The amplified 1.6-to 30 mc Translator output frequency range is connected to the RF output amplifier section (Z114).

The Automatic Load and Drive Control (ALDC) circuit in the Translator Section consisting of transistors Q15, Q16, Q17 and the input for this circuit, controls the input applied to the balanced modulator (CR4, CR5) 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 1.6-to 30 mc frequency from the Translator Section is connected to the RF amplifier ALDC control circuit (Z115) where the 1.6-to 30 mc RF signal undergoes three stages of amplification by RF amplifier transistors Q1, Q2 and Q3 and the amplified signal is then connected to the ALDC control circuit. The 1.6-to 30 mc input is connected to the emitter circuit of the amplifier transistor Q1 amplified and the output at the collector of Q1 is connected to the base of amplifier Q2. The amplified output at the collector of Q2 is connected to the base circuit of Q3 further amplified and the output at the collector of Q3 is transformer coupled to the ALDC control and 1- to 30 mc output circuitry. The ALDC control circuit is adjustable manually by two, potentiometers and 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 1- to 30 mc amplified RF output frequency range is connected to the switch relay controlled Output Filter Section (Z114) where a particular RF siganl is filtered according to the setting of the frequency selection switches, S105, S106 and S107. The selection of a frequency operates one of six relay controlled bandpass filter circuits (K1 thru K6) thereby filtering the switch selected frequency thru the bandpass filter for that frequency. The range of each relay controlled bandpass filter circuit is listed below:

Filter Circuit Identification	Frequency Range of Bandpass Filter
K1	1.6 mc-2.5 mc
K2	2.5 mc-4.0 mc
K3	4.0 mc-7.0 mc
K4	7.0 mc-12.0 mc
K5	12.0 mc-20.0 mc
K6	20.0 mc-29.9999 mc

4-11. DETAILED ANALYSIS, POWER SUPPLY SELECTION (Z301, Z302, Z303, Z304, and Z305)

The MMX power supply (comprising transformer T301, full wave bridg rectifier circuit (Z304, and power supply modules Z303, and Z305) is a current sensing regulated power supply with filter cirucits and current limiter ciruits. 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 7-14 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

2039-9

Figure 5-1 Bottom View, MMX

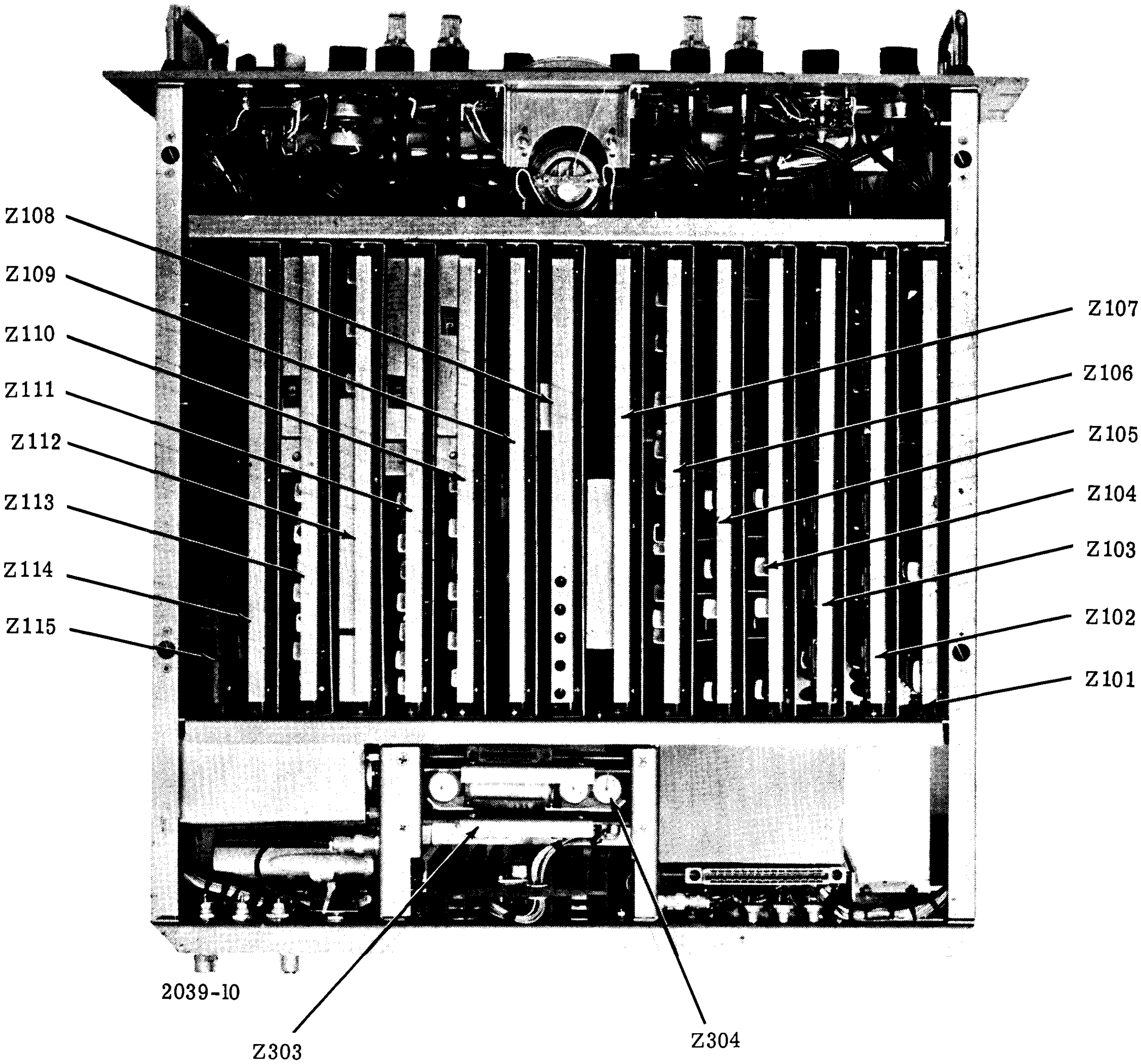
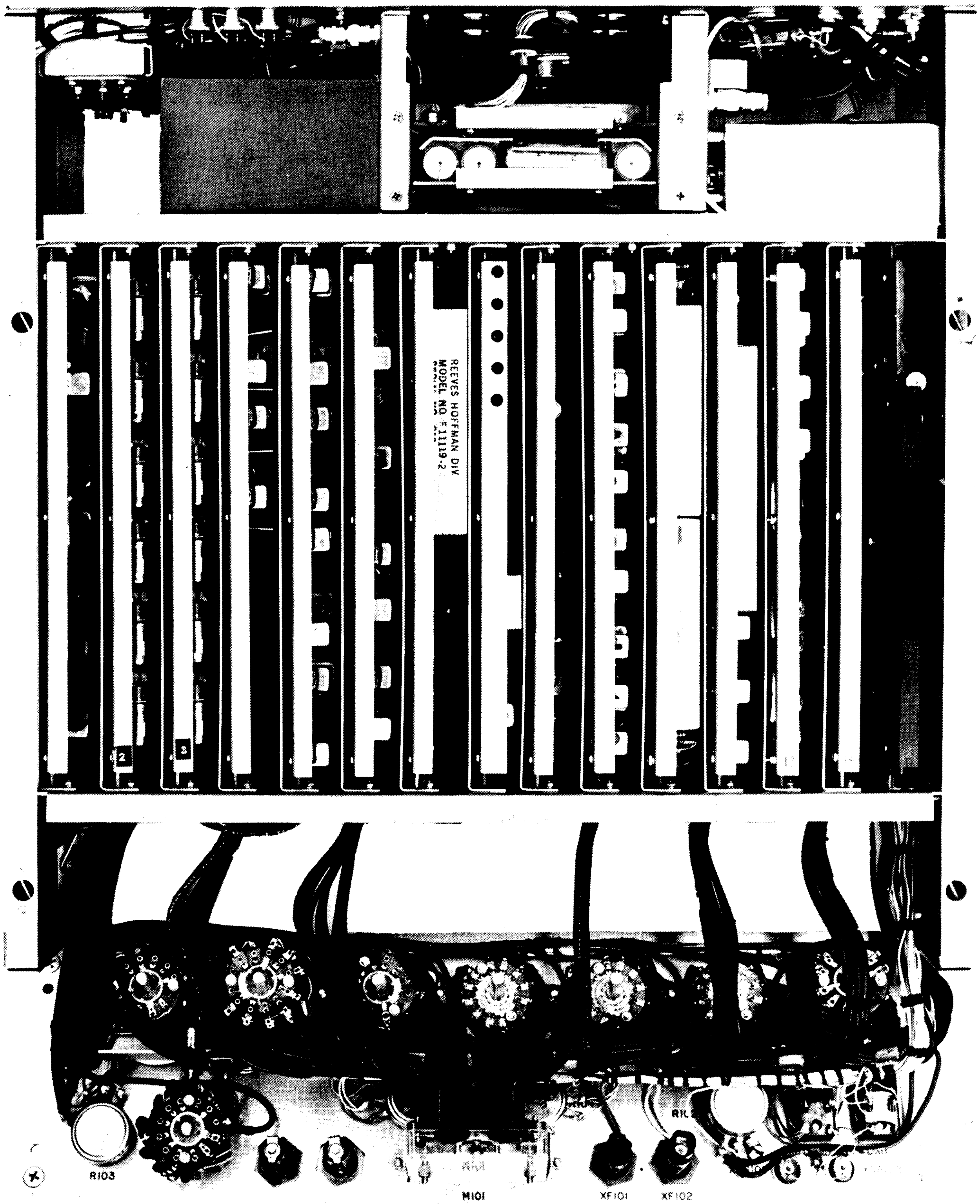


Figure 5-2. Top View MMX



2039-11

Figure 5-3. Top View, Showing Selection Switches Of The MMX 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 troublehsooting the MMX.

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.

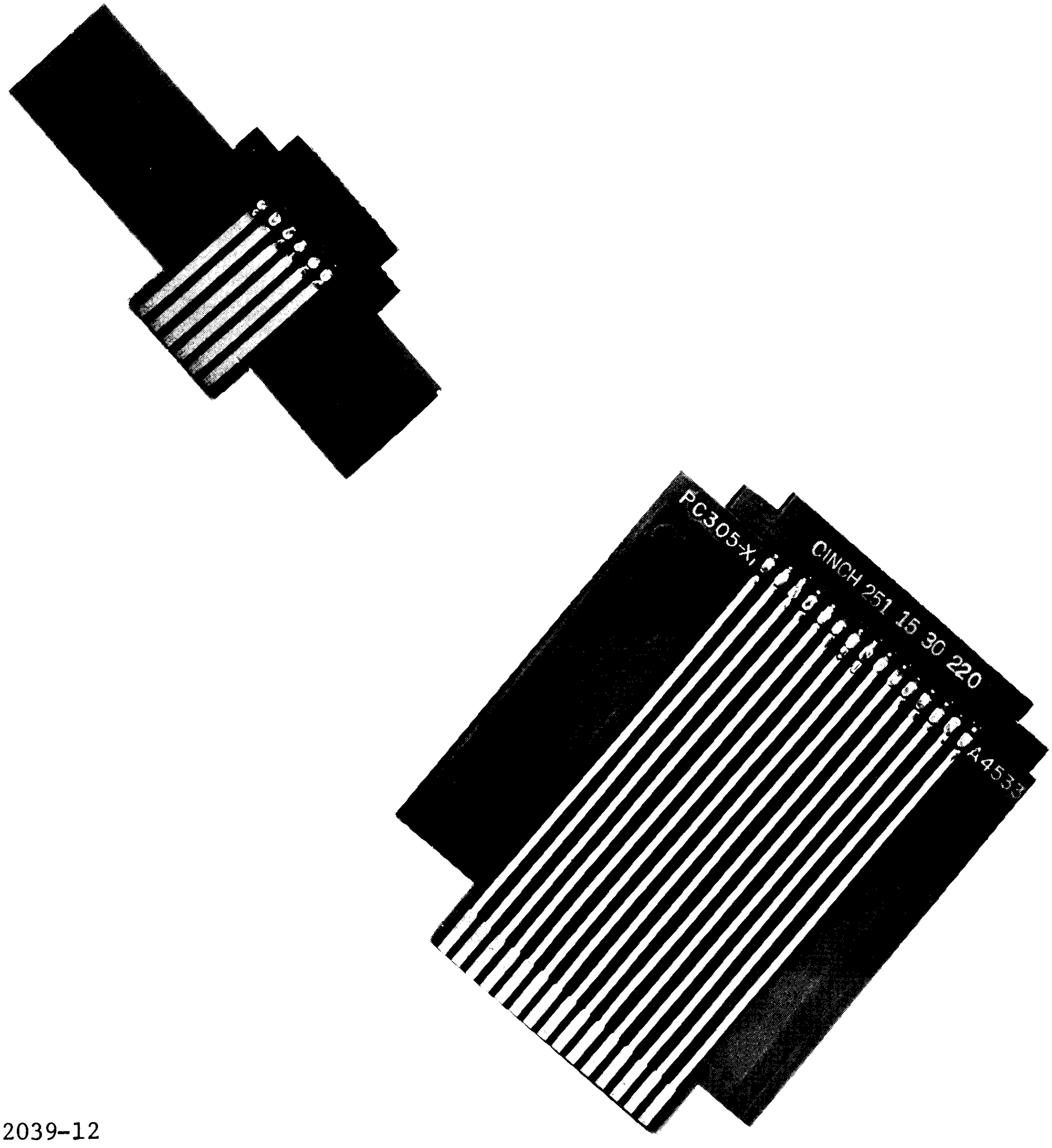
If module substitution fails to locate the trouble, it may be generally assumed that a power supply voltage is missing. When repairing any power supply modules or parts remove plug from line source. Set POWER switch at STANDBY and check voltage points as indicated in table 5-2, using a scope.

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.



2039-12

Figure 5-4. Maintenance Tools

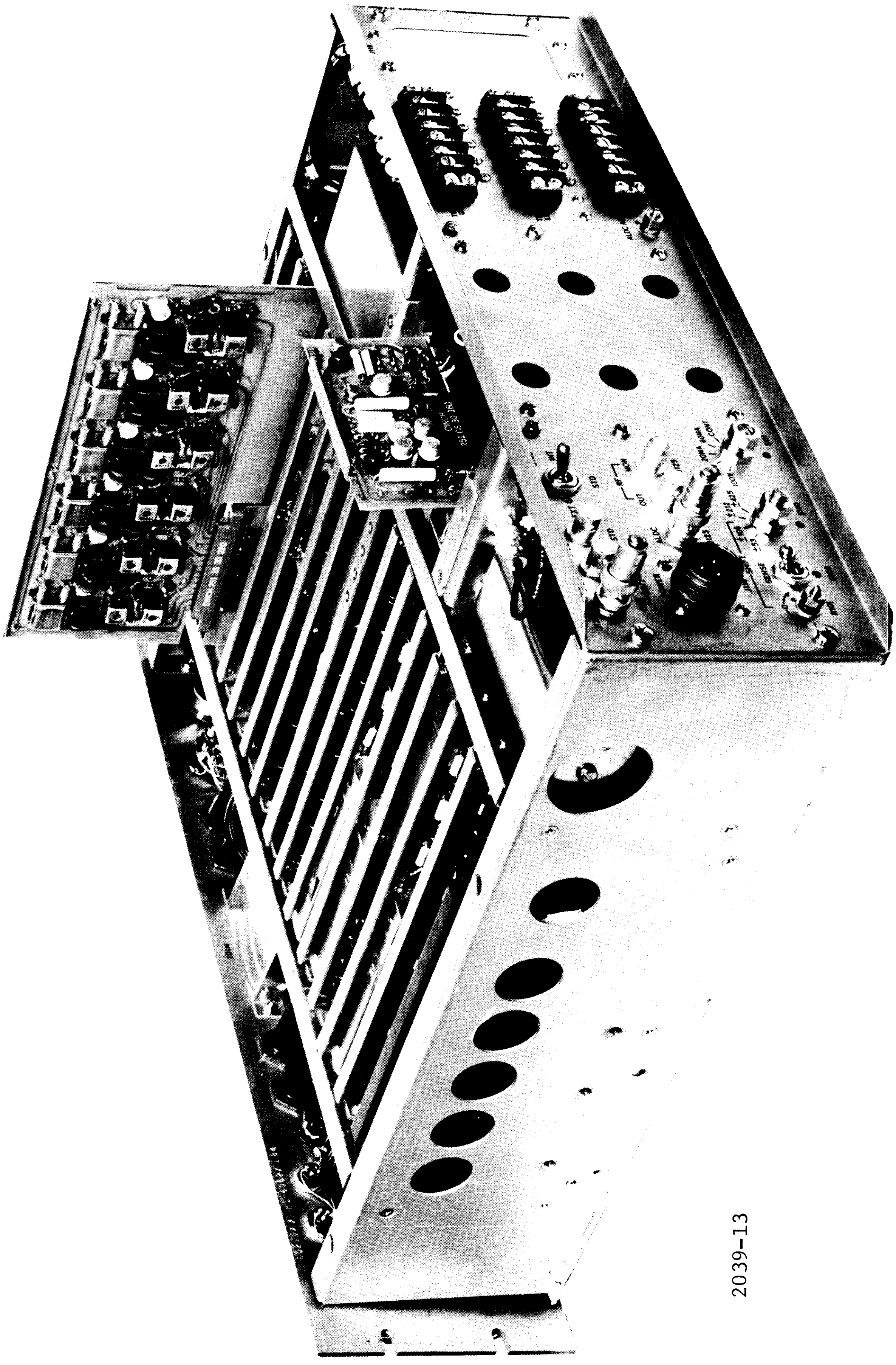

2039-13

Figure 5-5. Module in Test Position

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

e. REPLACEMENT OF WIRING ON CARD RECEPTACLES. - To remove or install wires connected to the module receptacles use a soldering tools.

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

Wave Shapes
To Be Supplied

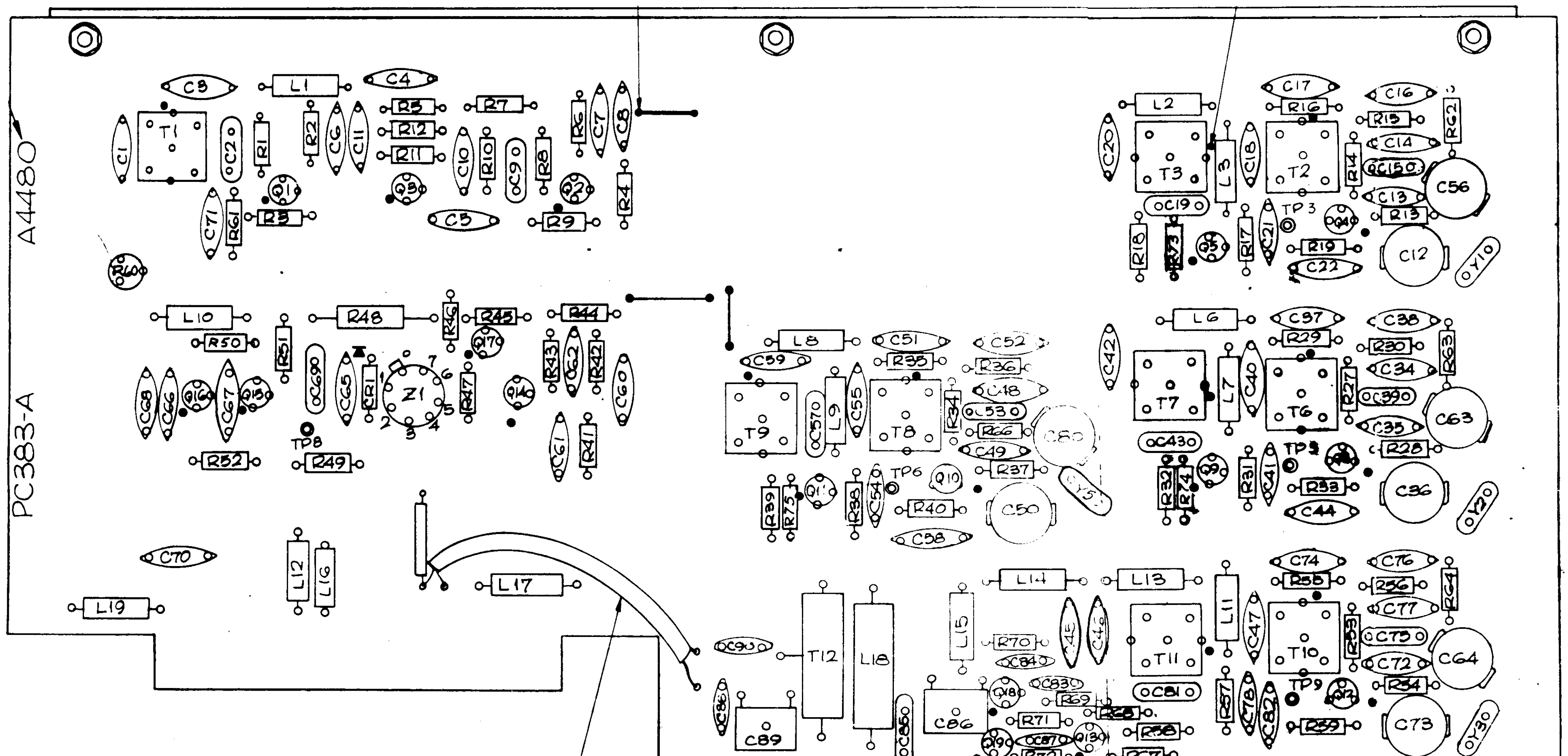


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Figure 5-6, Component Location Diagram Spectrum Generator Section (Z101).

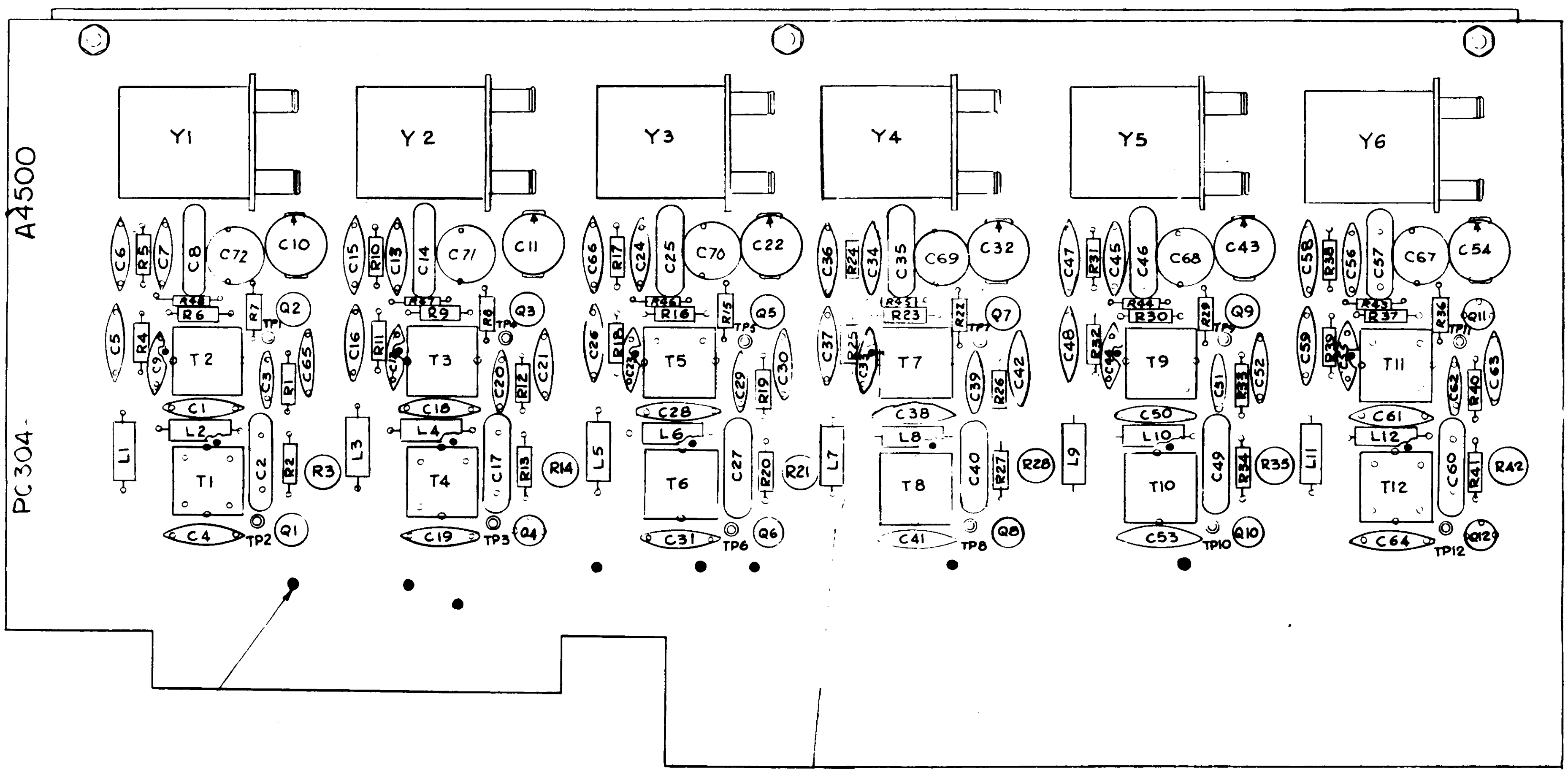


Figure 5-7, Component Location Diagram Comb Filter (Z102).

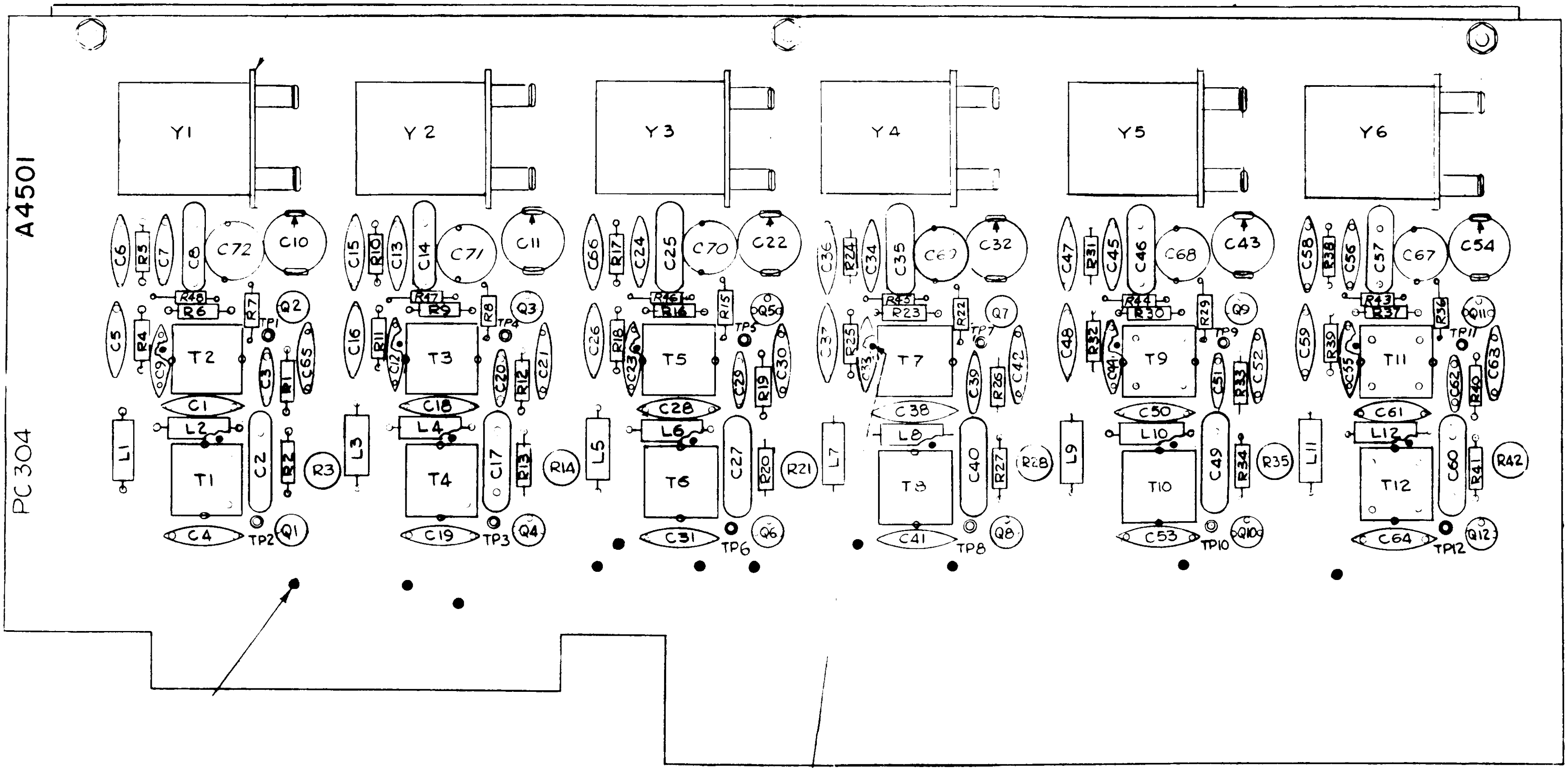


Figure 5-8, Component Location Diagram Comb Filter (Z103).

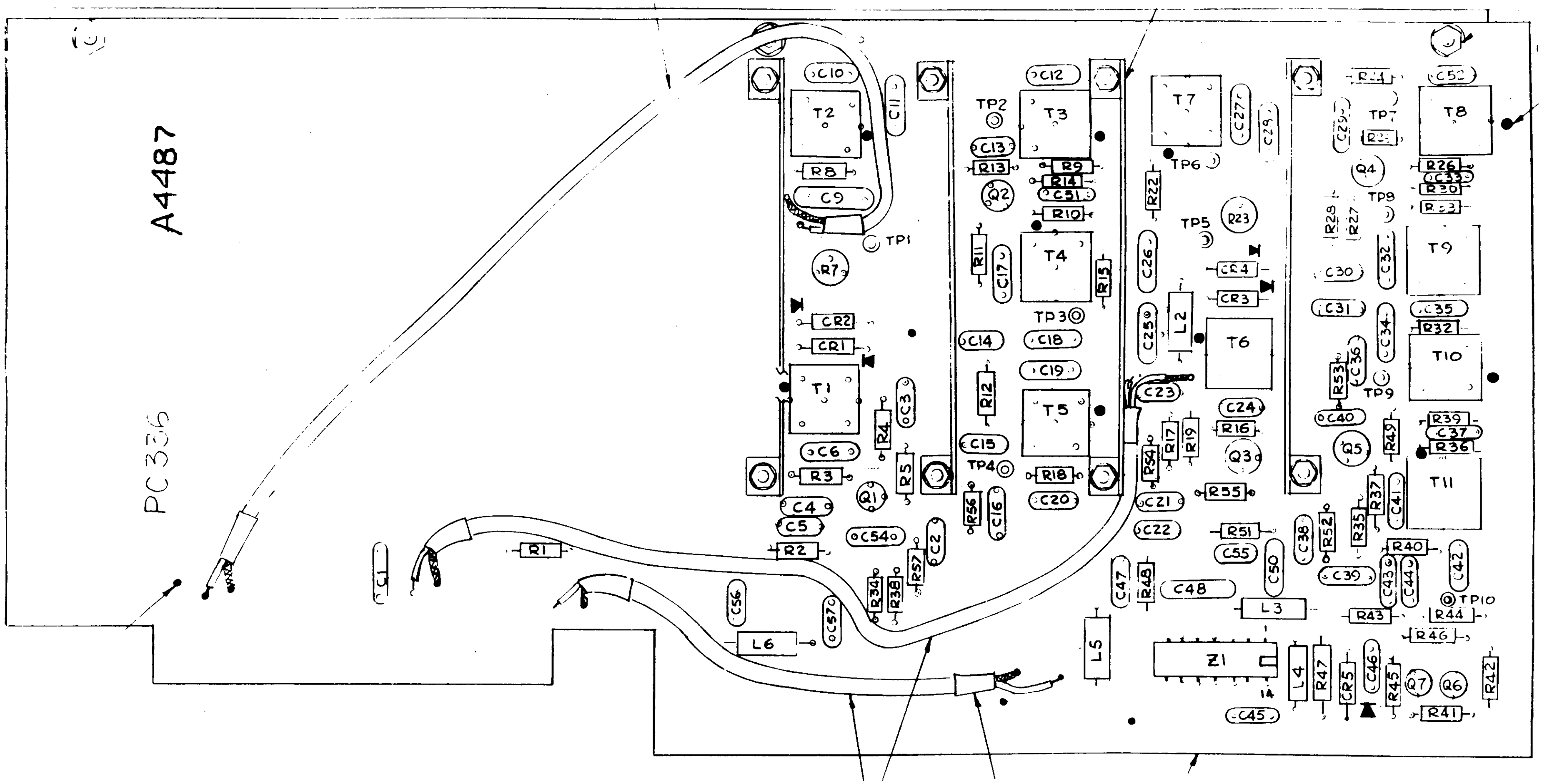


Figure 5-9, Component Location Diagram Mixer-Divider (Z104).

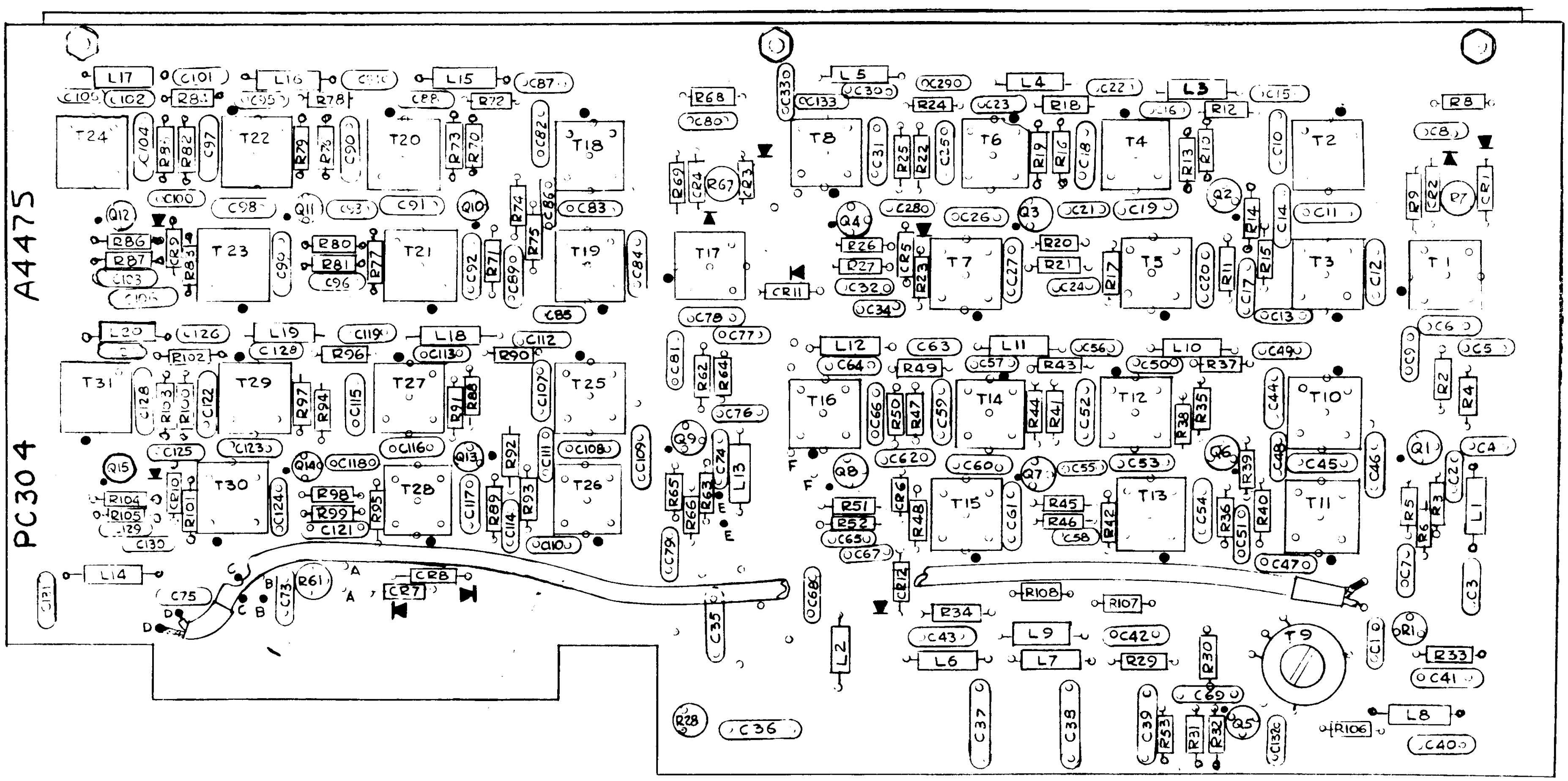


Figure 5-10, Component Location Diagram Mixer-Divider (Z105).

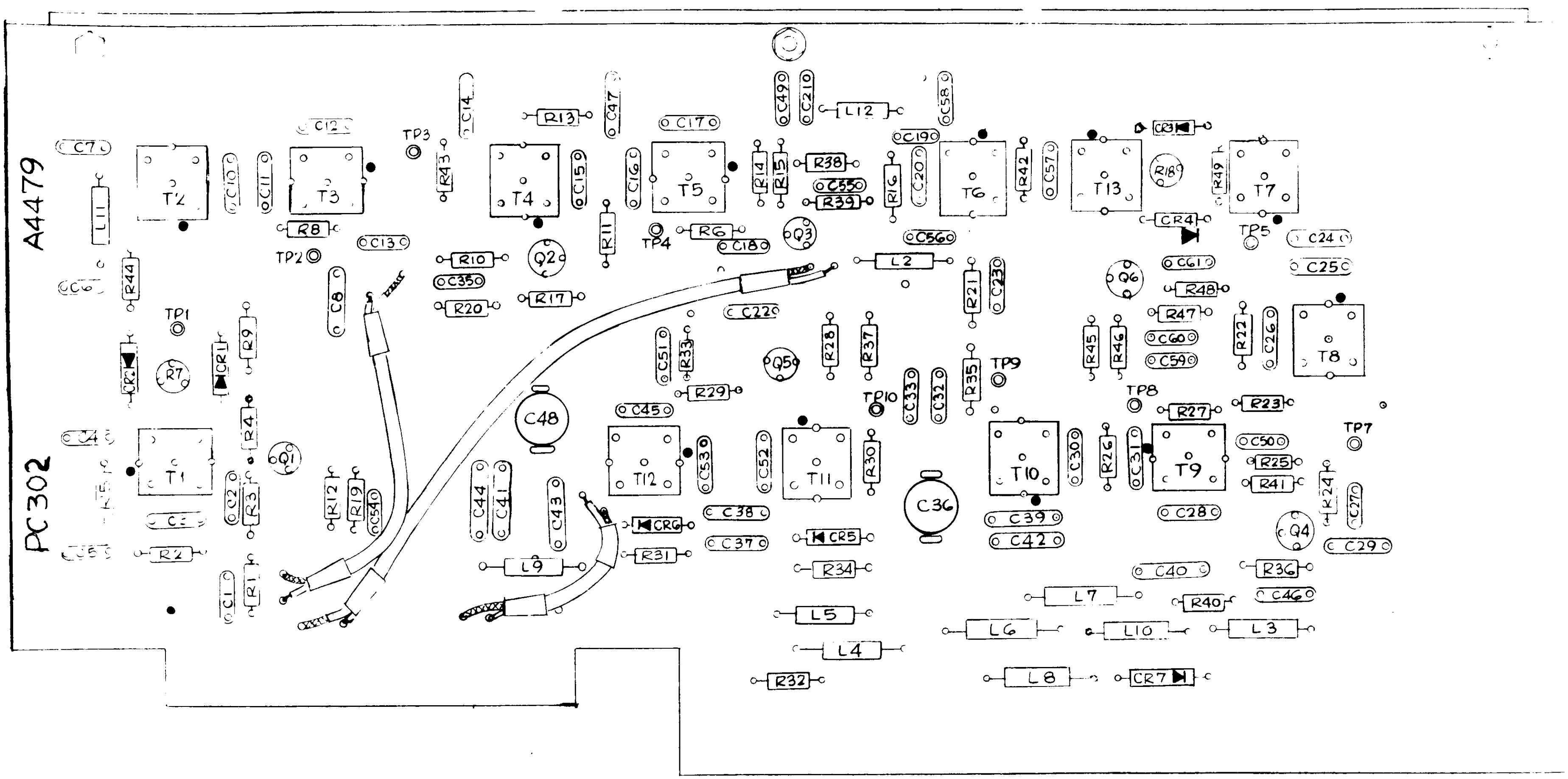


Figure 5-11, Component Location Diagram Mixer Final (Z106).

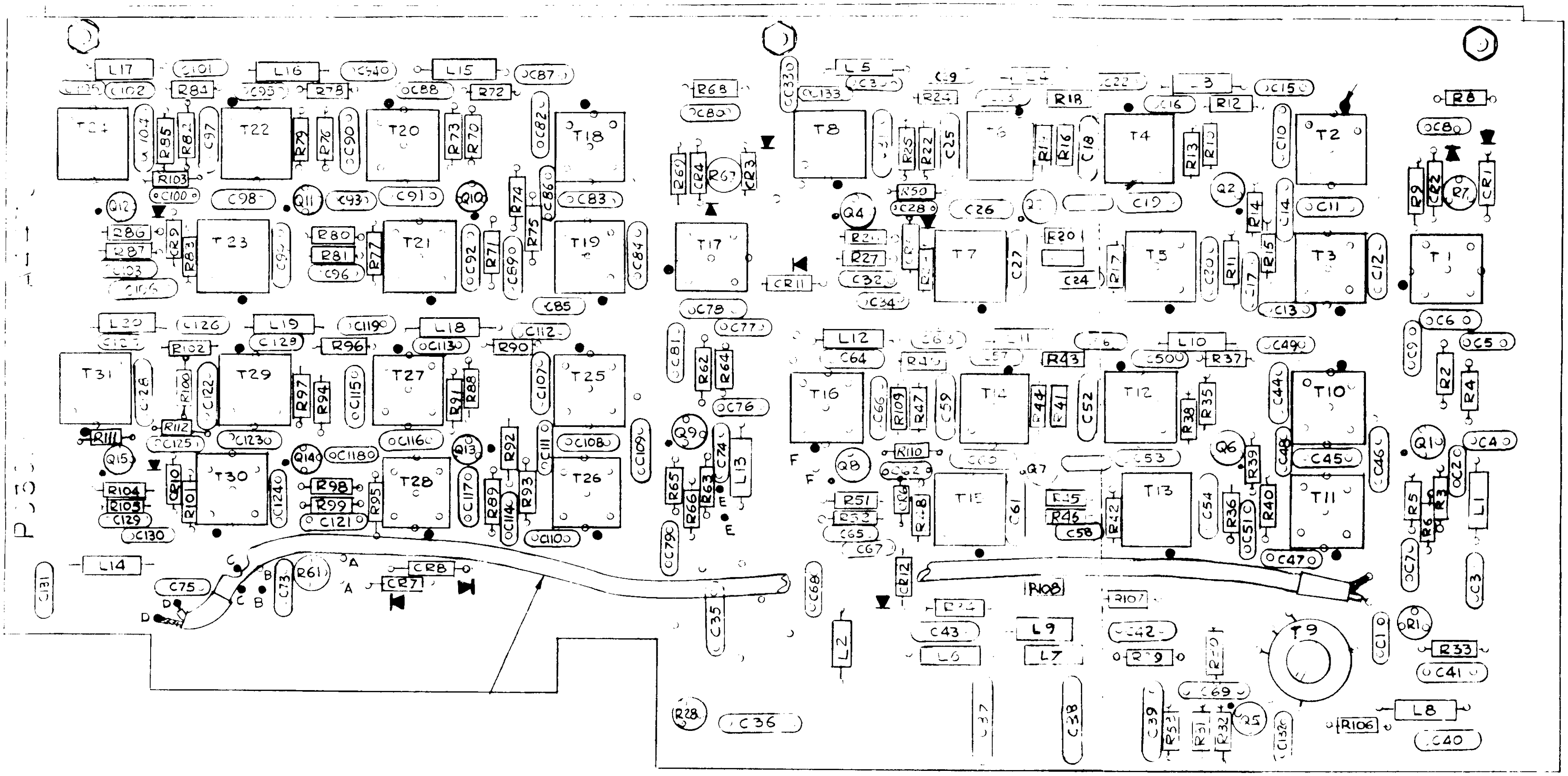


Figure 5-12, Component Location Diagram Step Generator (Z110).

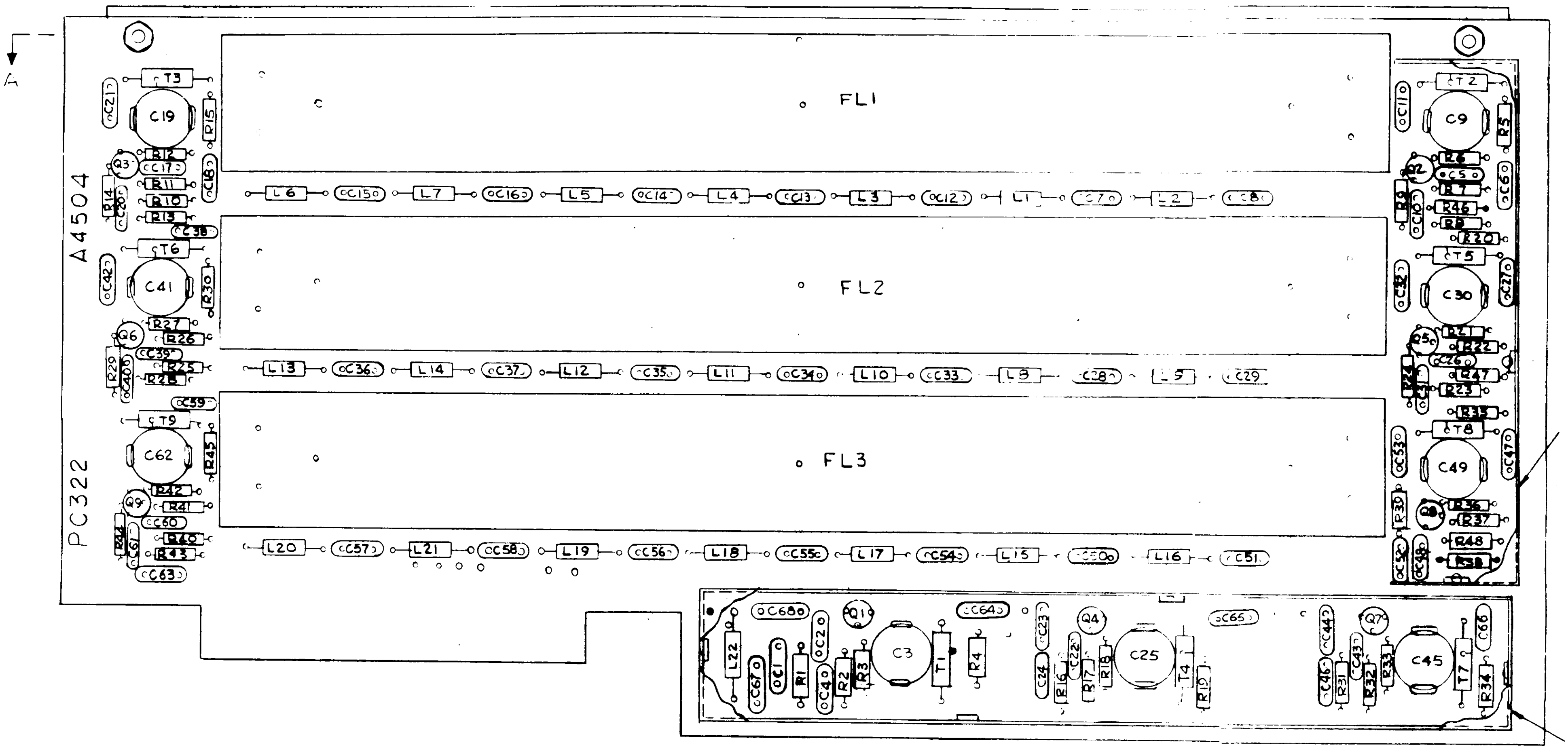


Figure 5-13, Component Location Diagram Step Generator (Z111).

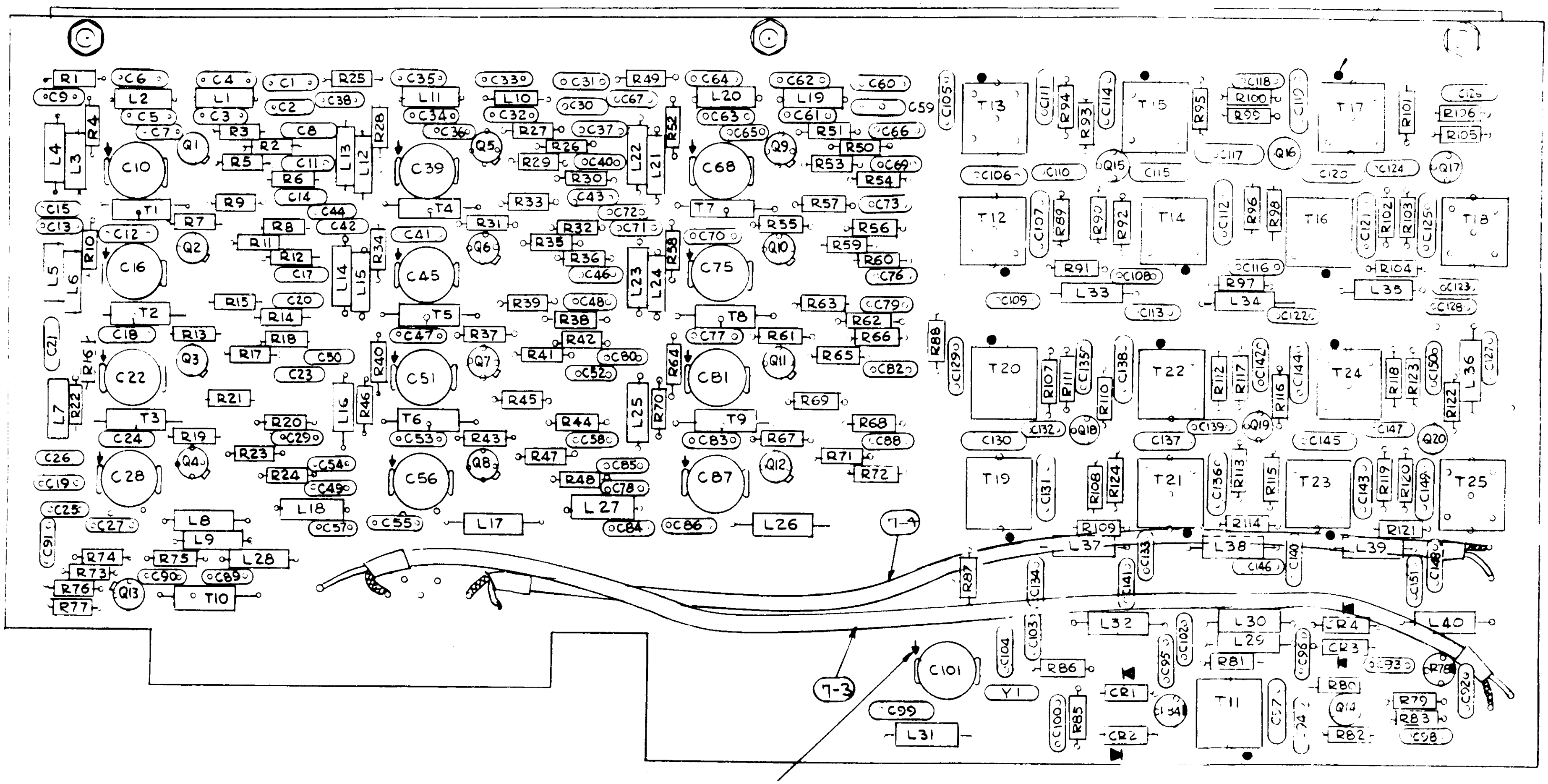


Figure 5-14, Component Location Diagram Step Generator (Z113).

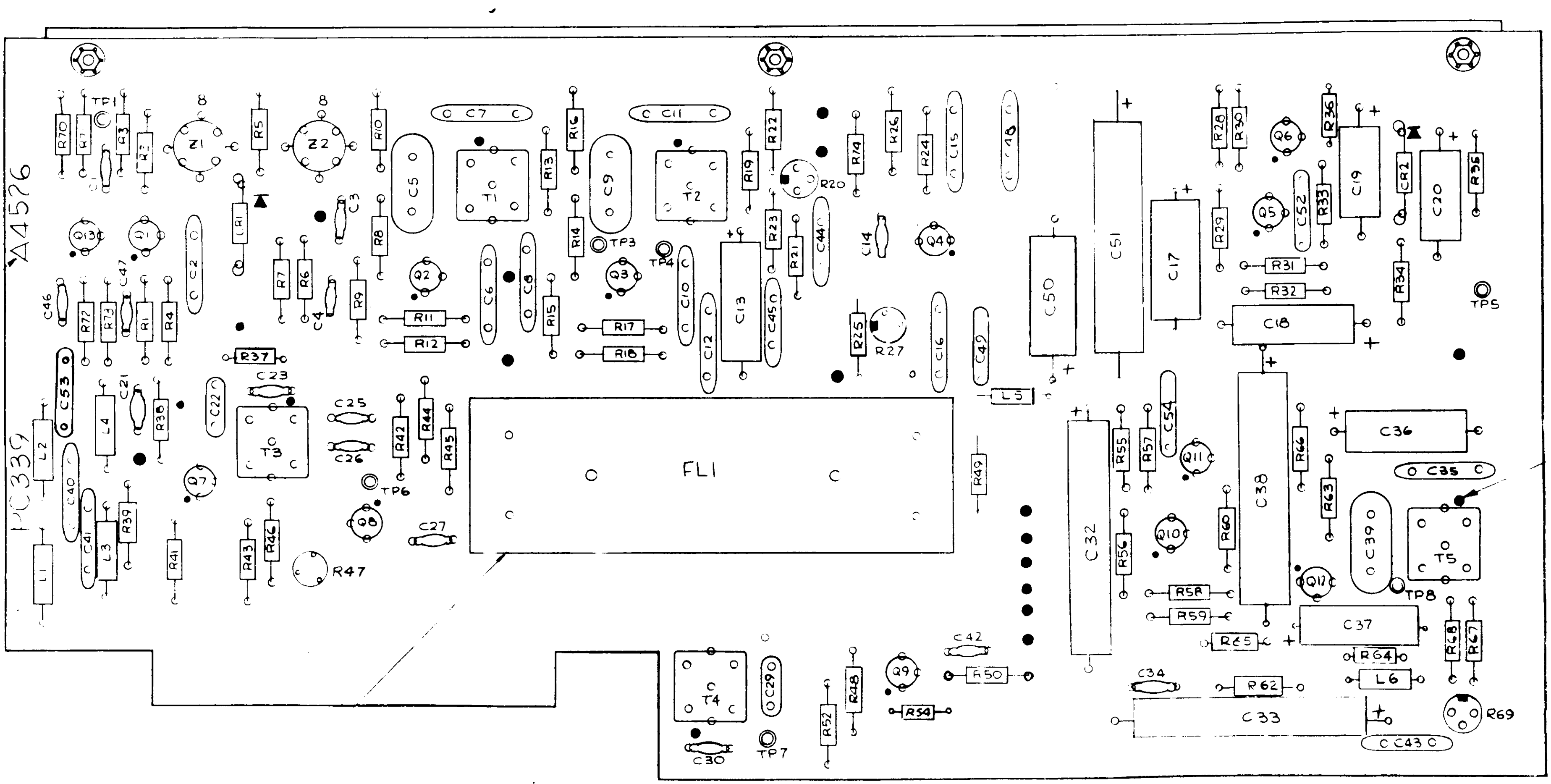


Figure 5-15, Component Location Diagram Carrier Generator Section (Z109).

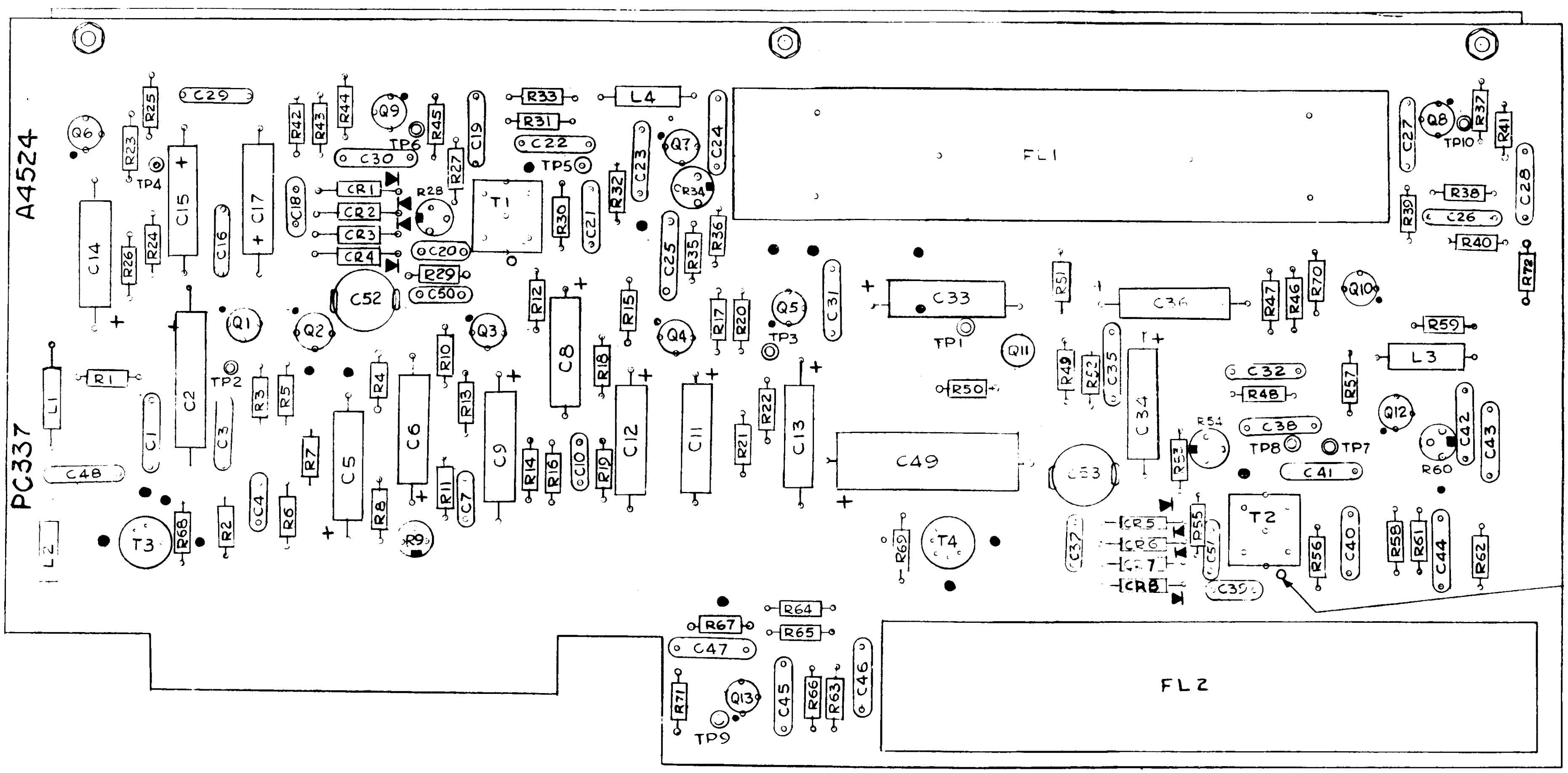


Figure 5-16, Component Location Diagram Sideband Generator Section (Z107).

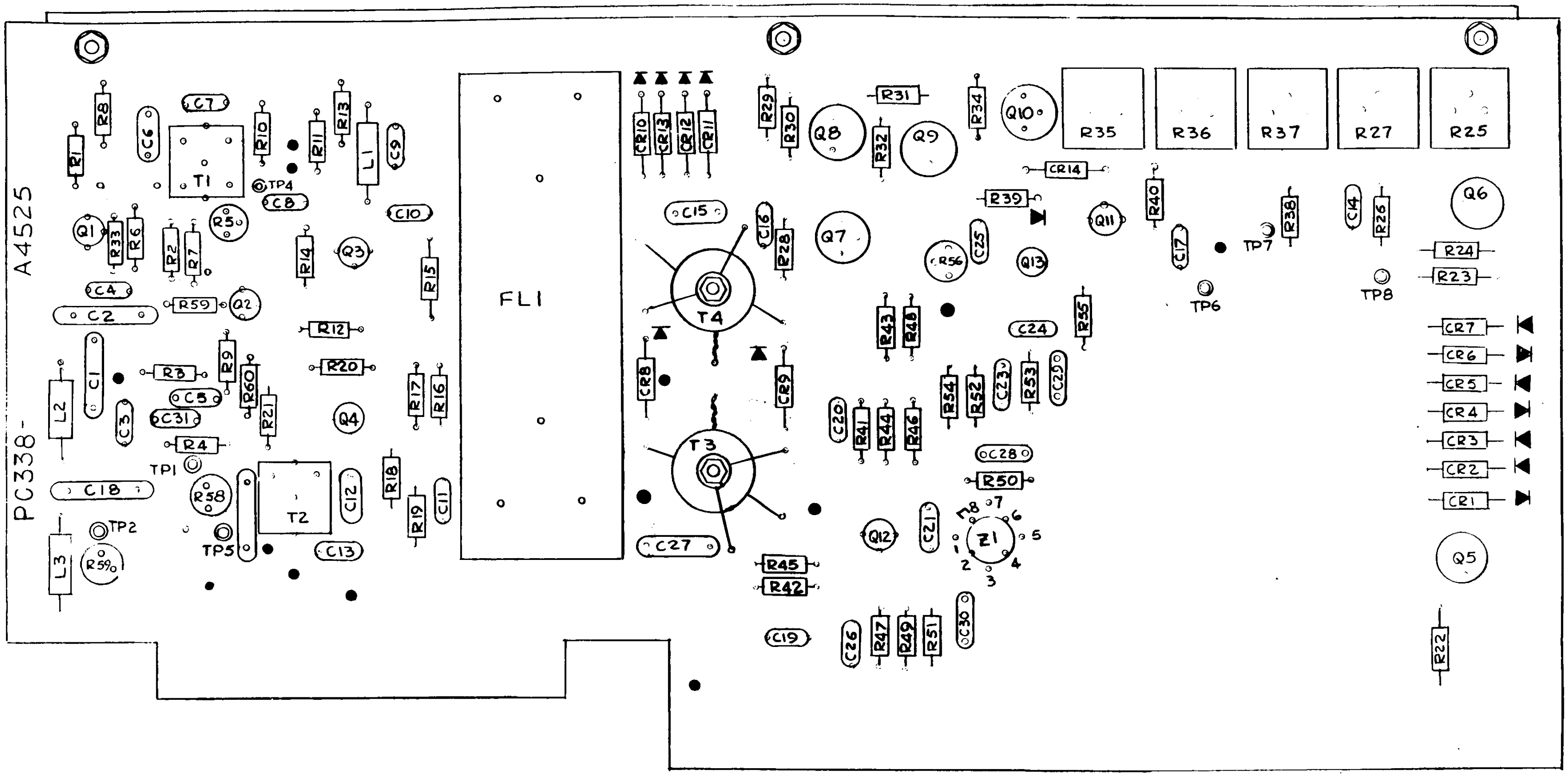


Figure 5-17, Component Location Diagram Frequency Shift Generator Section (Z108).

FOR COMPONENT LOCATION REFER TO FIGURE
7-14 (LOCATED IN SECTION 7)

Figure 5-18,Component Location Diagram Variable Crystal Osc.

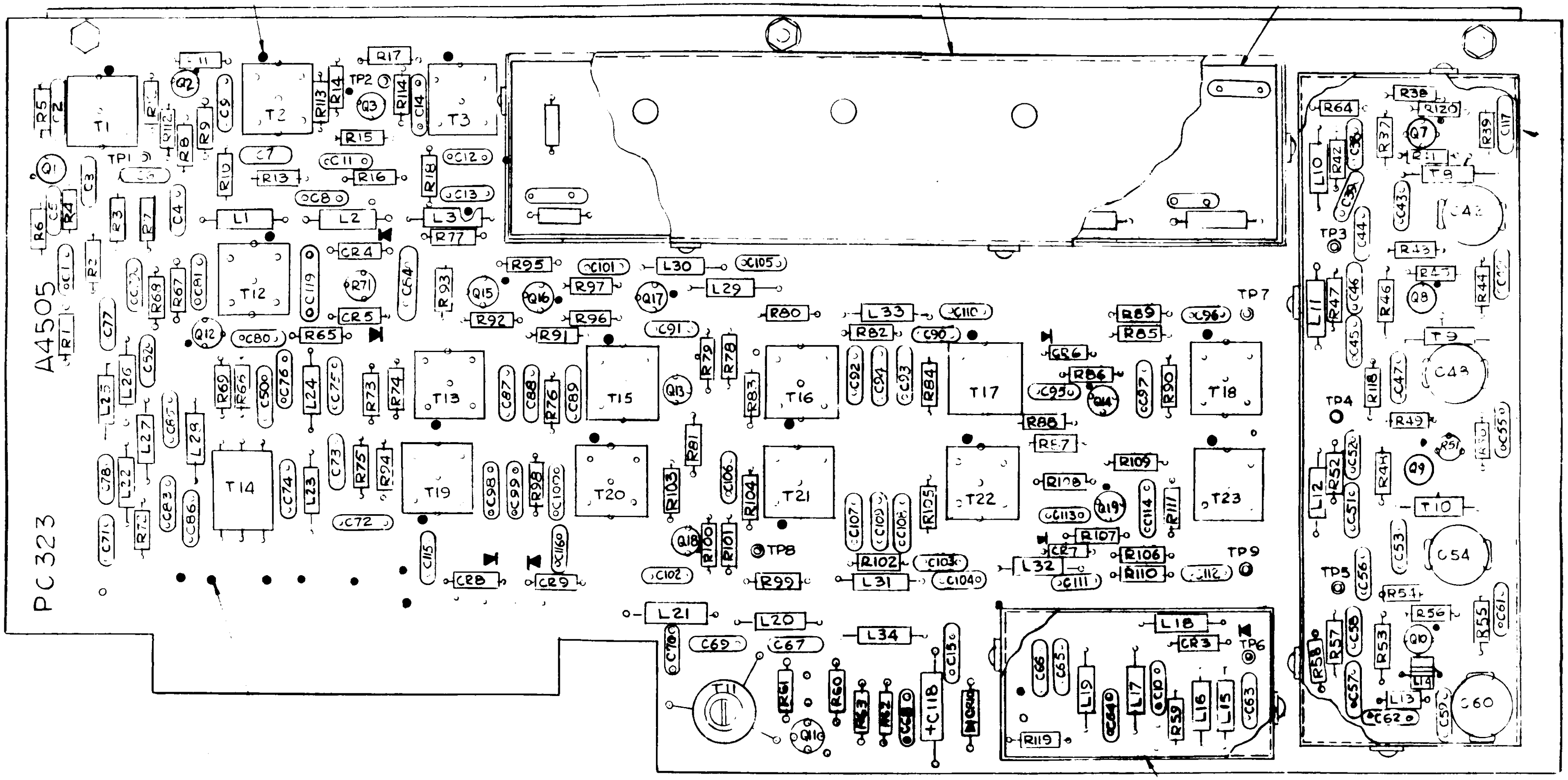


Figure 5-19, Component Location Diagram Translator Section (Z112).

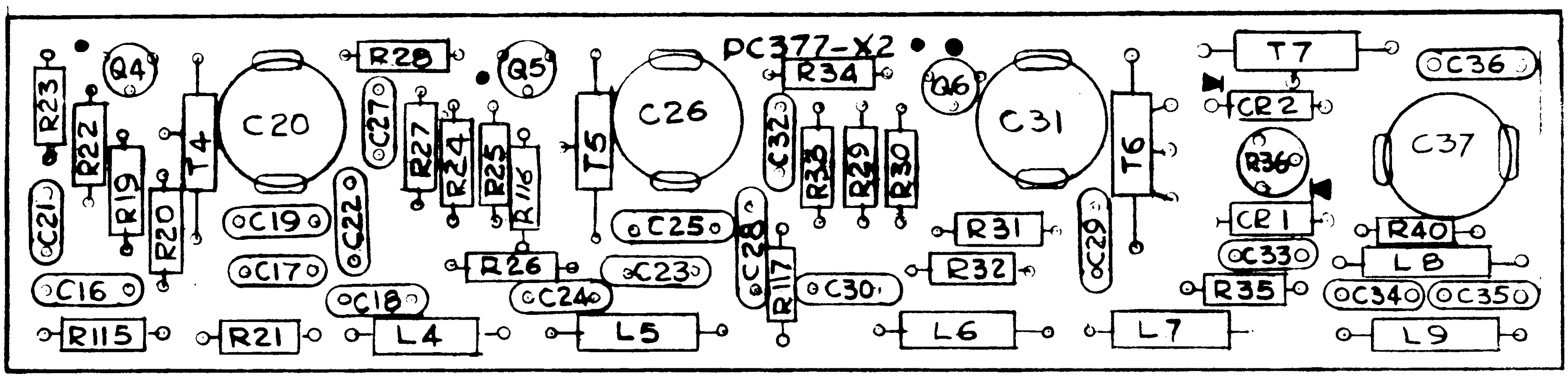


Figure 5-20, Component Location Diagram Part/of Translator Section (Z112).

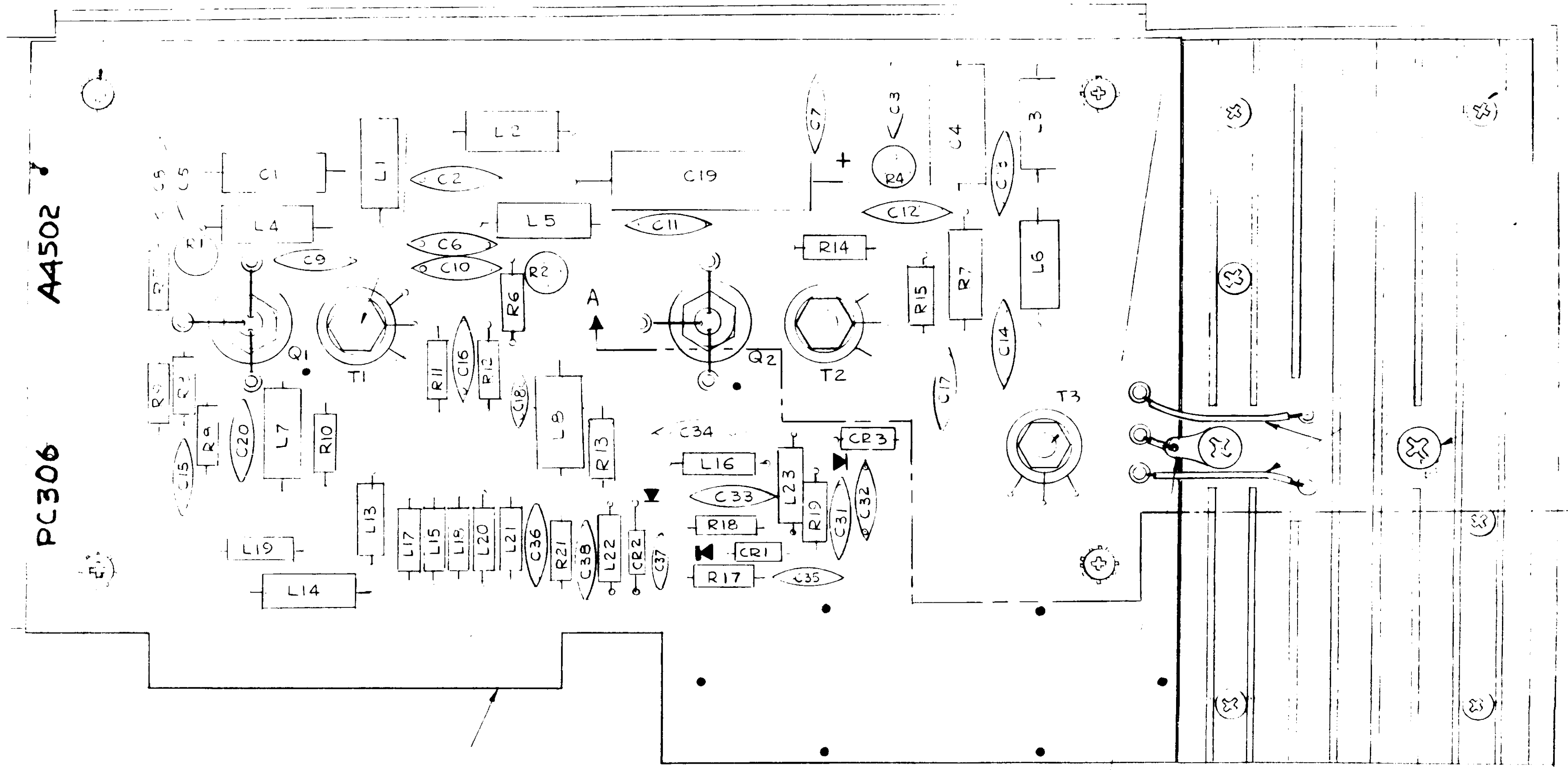


Figure 5-21, Component Location Diagram RF Output Amplifier Section (Z114).

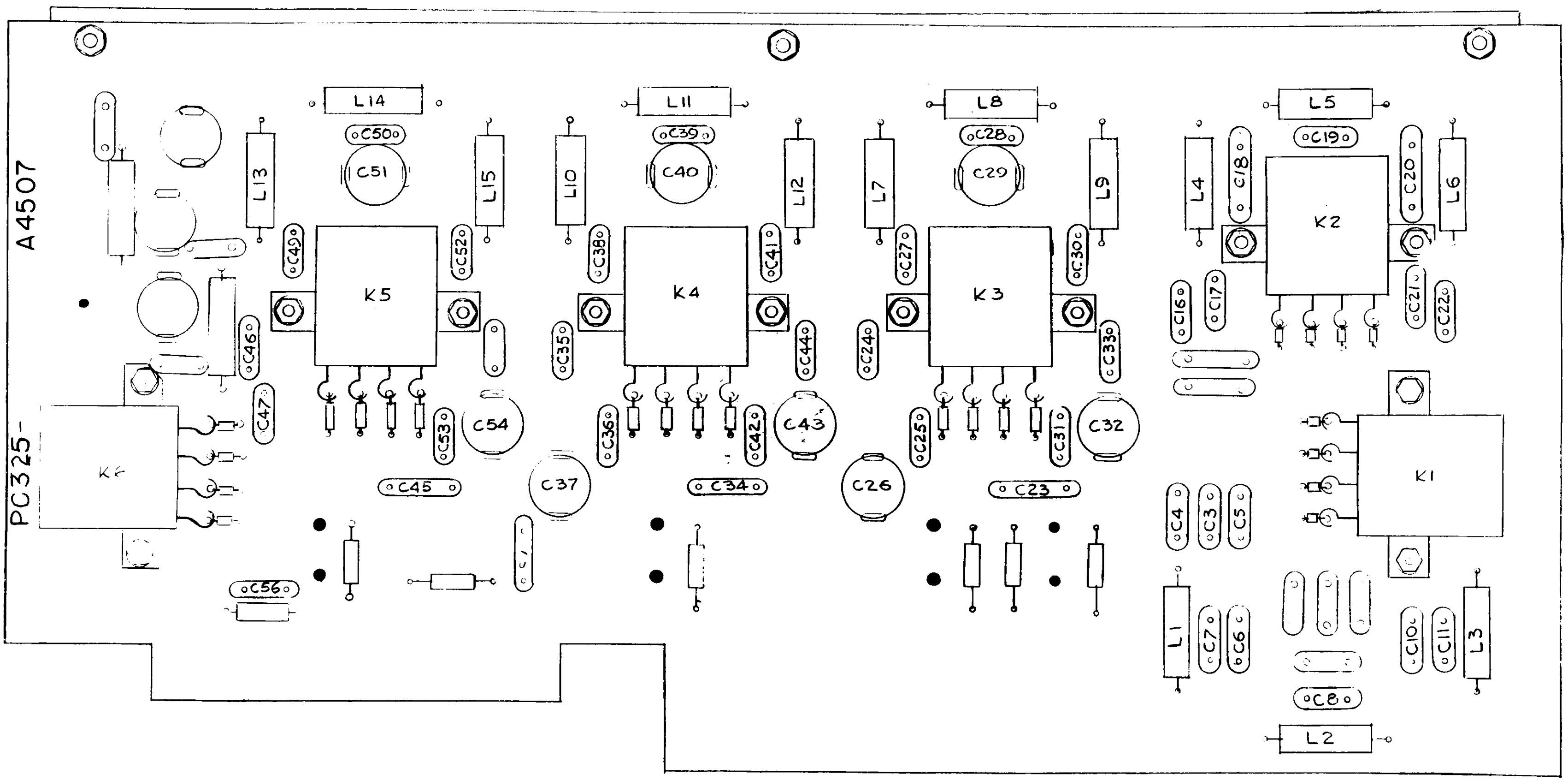


Figure 5-22, Component Location Diagram Output Filter Section (Z114).

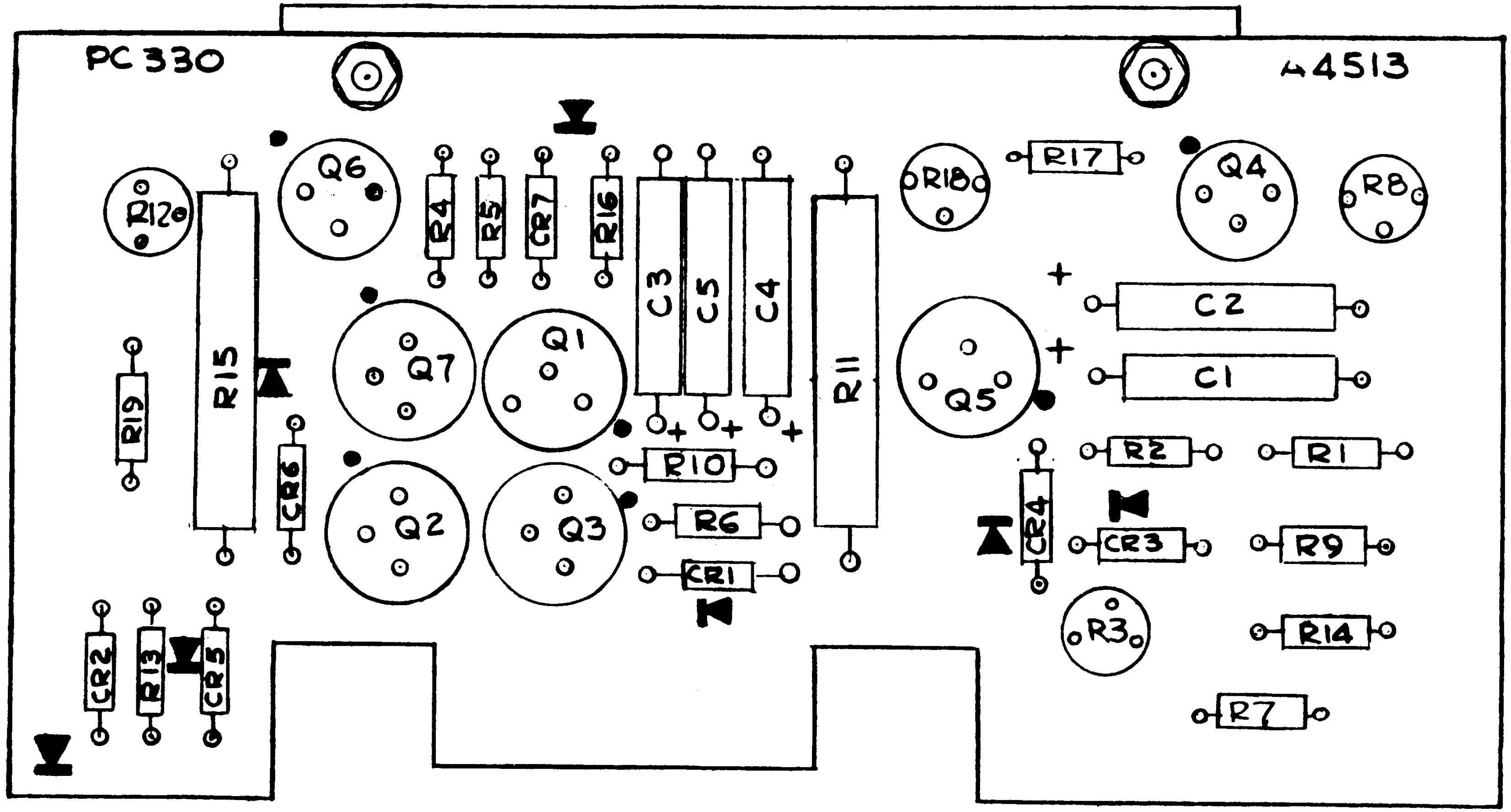


Figure 5-23, Component Location Diagram Power Supply (Z303).

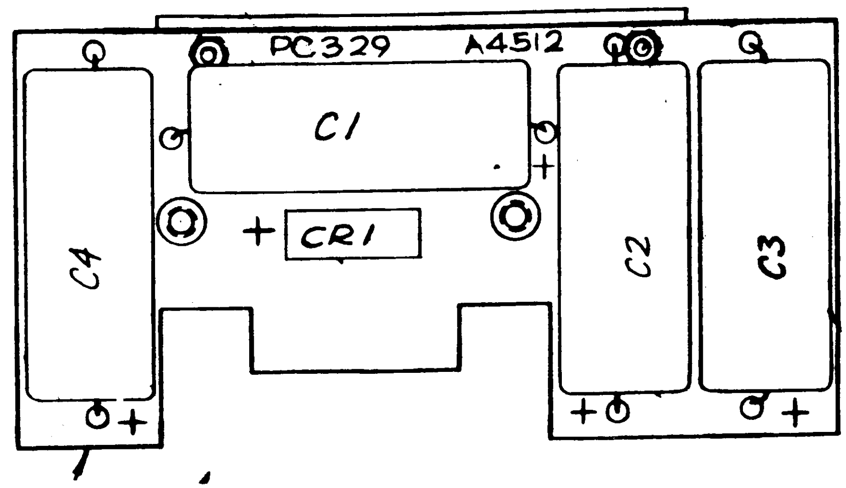


Figure 5-24, Component Location Diagram Power Supply (Z304).

SECTION 6 PARTS LISTS

TO BE SUPPLIED AT A LATER DATE

SECTION 7

SCHEMATIC DIAGRAMS

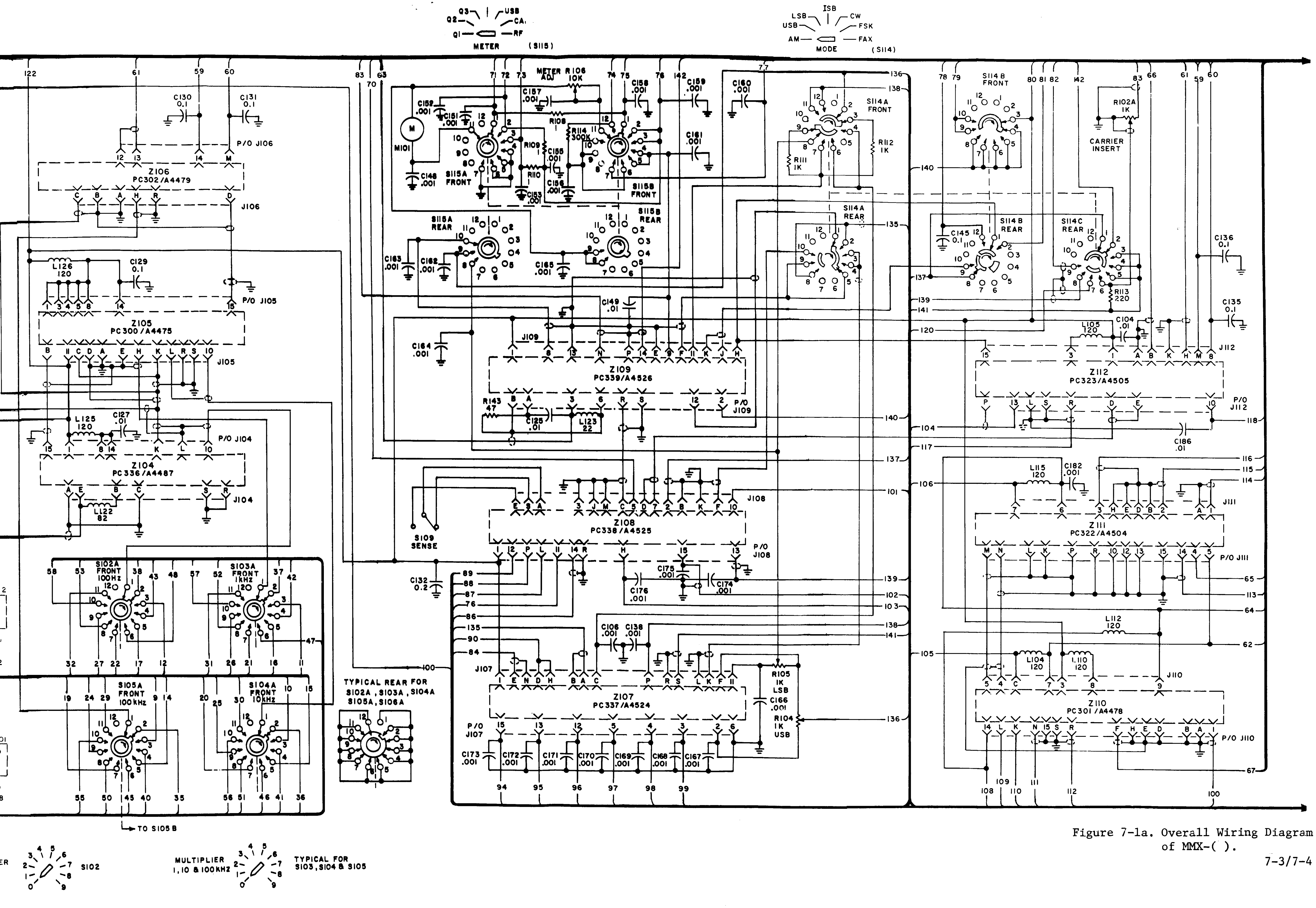
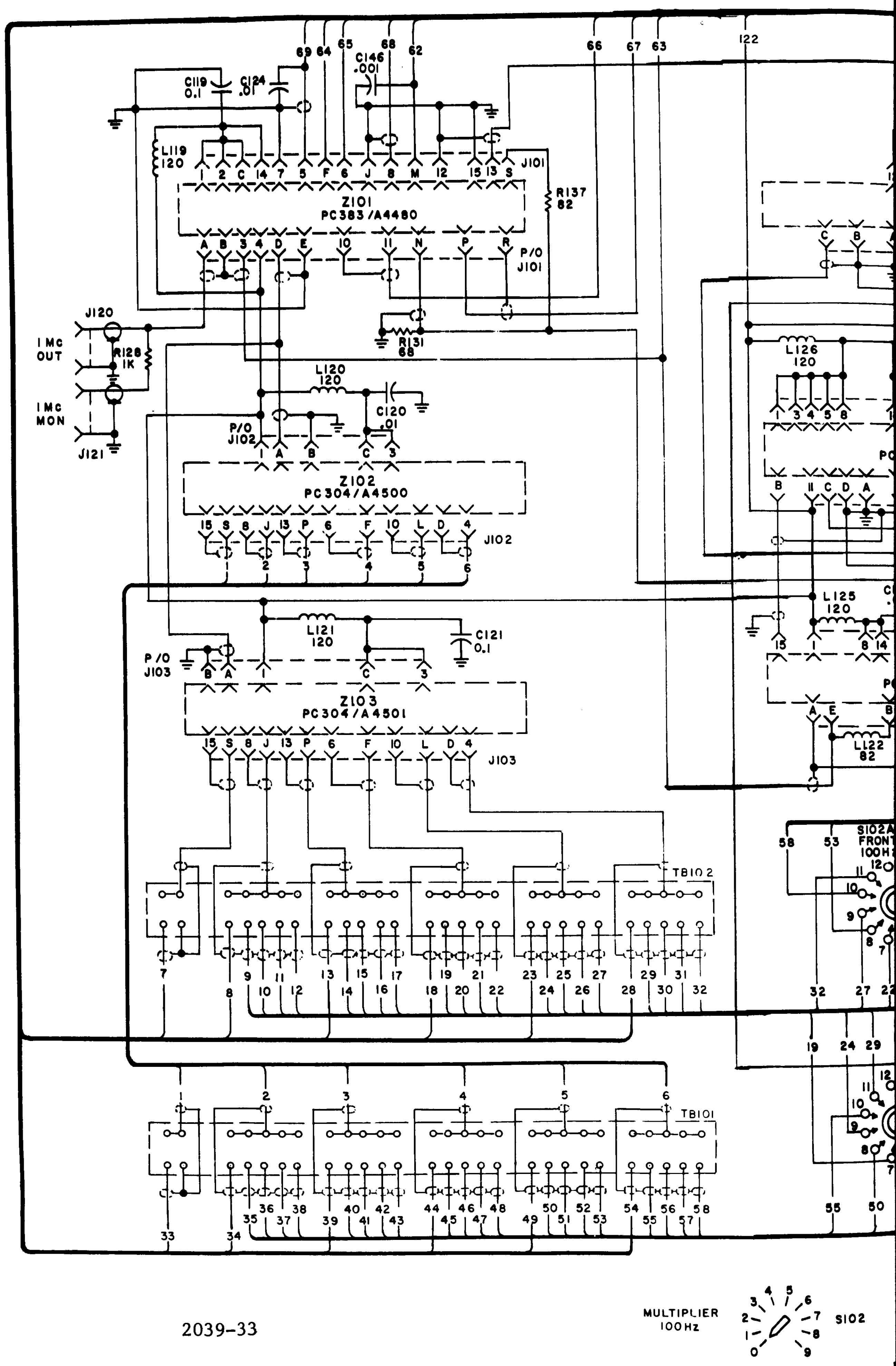


Figure 7-1a. Overall Wiring Diagram of MMX-( ).


Z101
PC383/A4480
J101
P/O J101
R137 82
C119 0.1
C124 .01
C146 .001
L119 120
R131 68
J120
1 Mc OUT
1 Mc MON
J121
R128 1K
L120 120
C120 .01
P/O J102
Z102
PC304/A4500
J102
L121 120
C121 0.1
P/O J103
Z103
PC304/A4501
J103
TB102
TB101
L126 120
L125 120
L122 82
S102A FRONT 100Hz
MULTIPLIER 100Hz
S102

2039-33

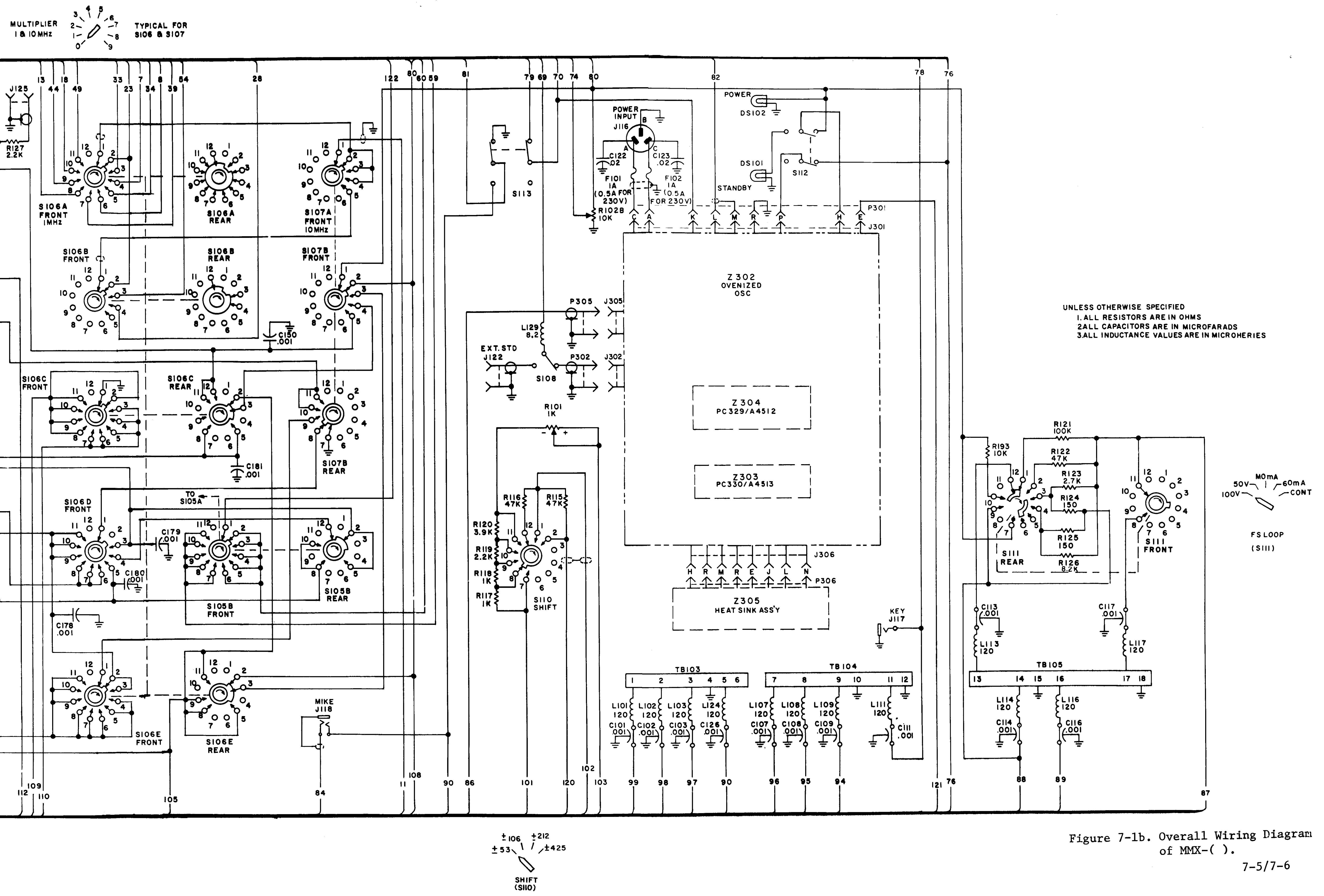
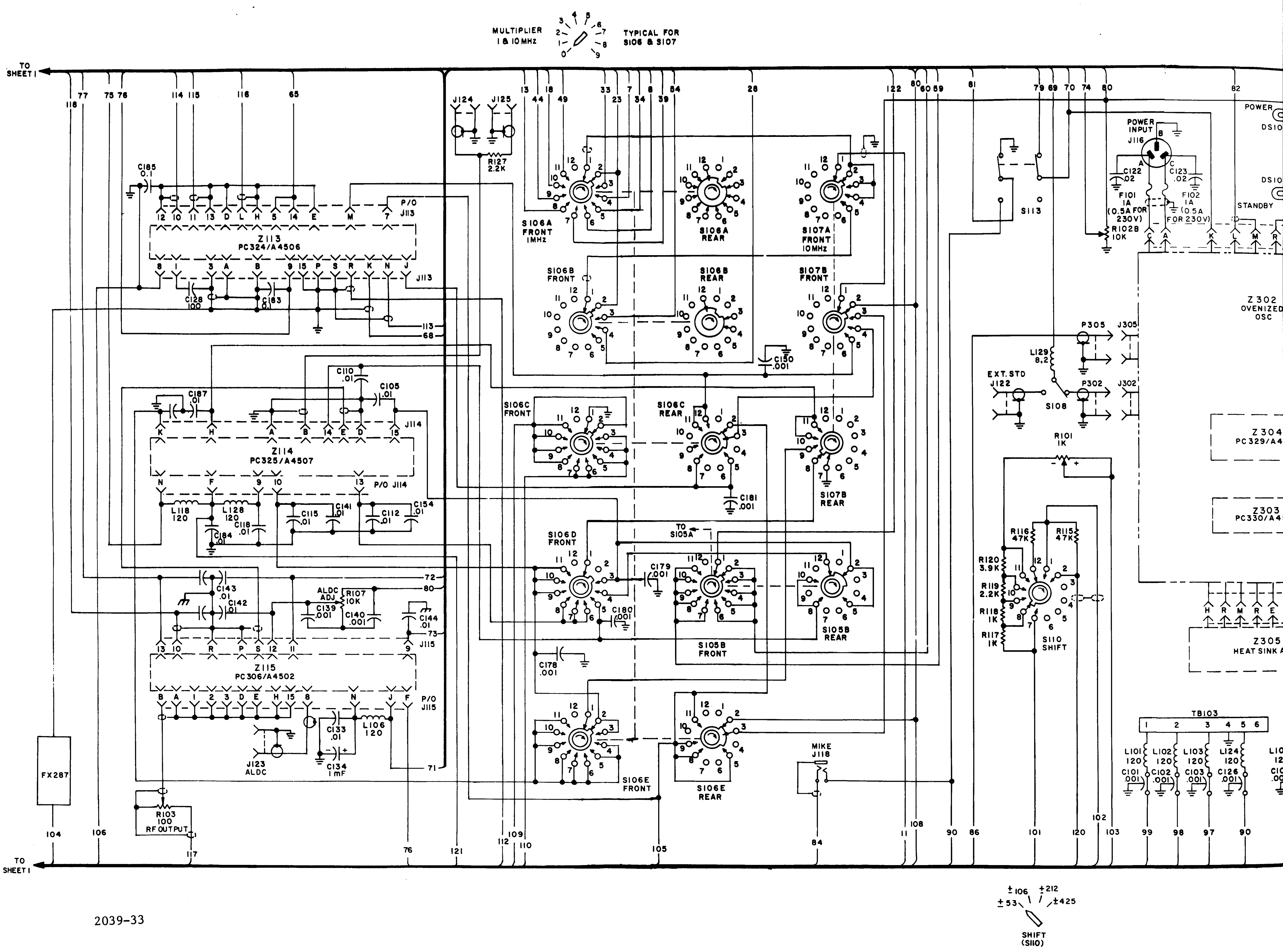
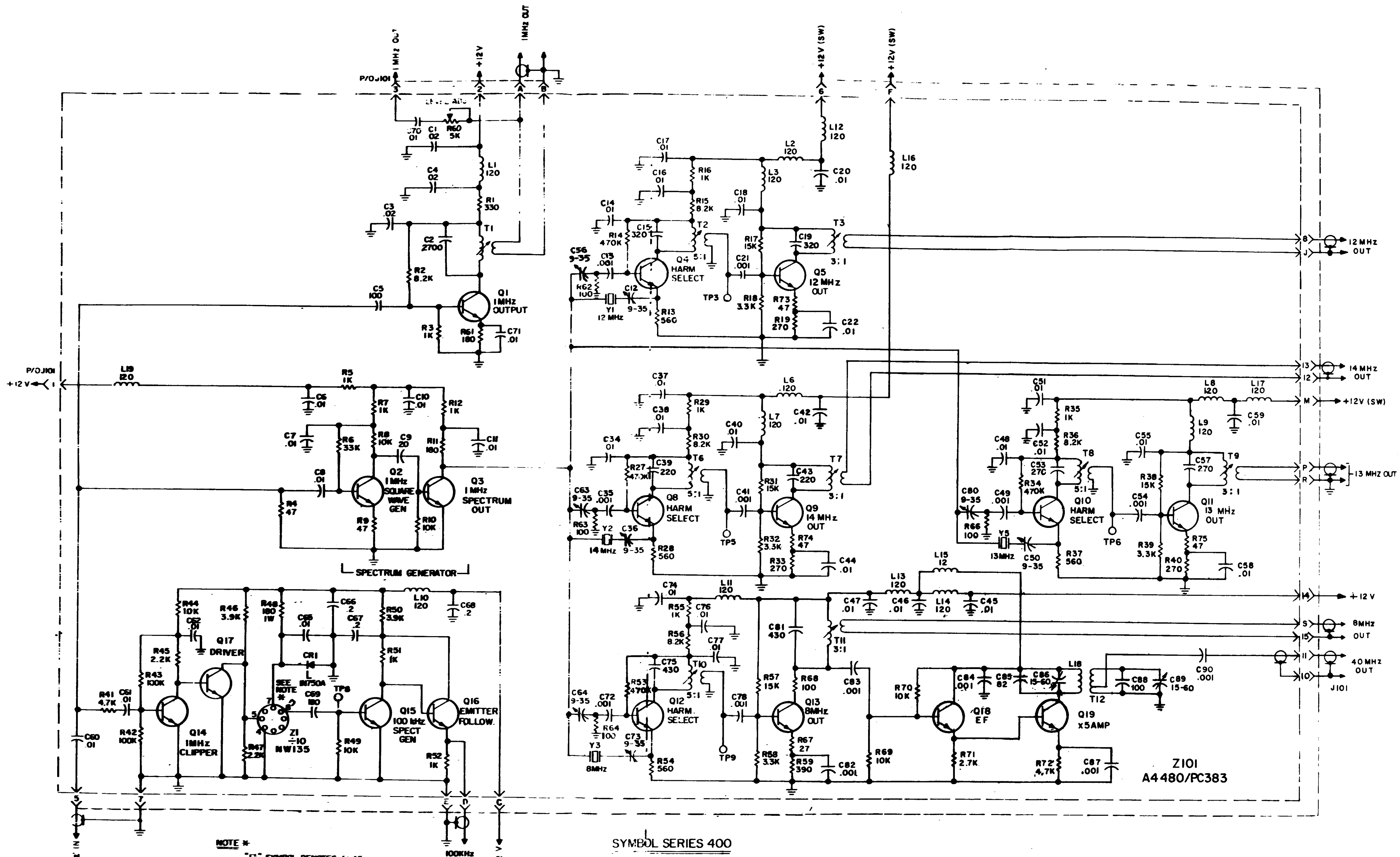


Figure 7-1b. Overall Wiring Diagram of MMX-( ).



MULTIPLIER 1 & 10 MHz
TYPICAL FOR S106 & S107
TO SHEET 1
Z113 PC324/A4506
Z114 PC325/A4507
Z115 PC306/A4502
Z302 OVENIZED OSC
Z303 PC330/A4
Z304 PC329/A4
Z305 HEAT SINK A
POWER INPUT J116
S106A FRONT 1MHz
S106A REAR
S107A FRONT 10MHz
S106B FRONT
S106B REAR
S107B FRONT
S106C FRONT
S106C REAR
S107B REAR
S106D FRONT
S105B FRONT
S105B REAR
S106E FRONT
S106E REAR
S110 SHIFT
S113
S108
EXT. STD J122
MIKE J118
J123 ALDC
ALDC ADJ
R103 100 RF OUTPUT
FX287
TB103
TO S105A
SHIFT (S110)

2039-33



SYMBOL SERIES 400

NOTE *-

"F" SYMBOL DENOTES FLAT SIGNIFYING PIN 8 ON NETWORK

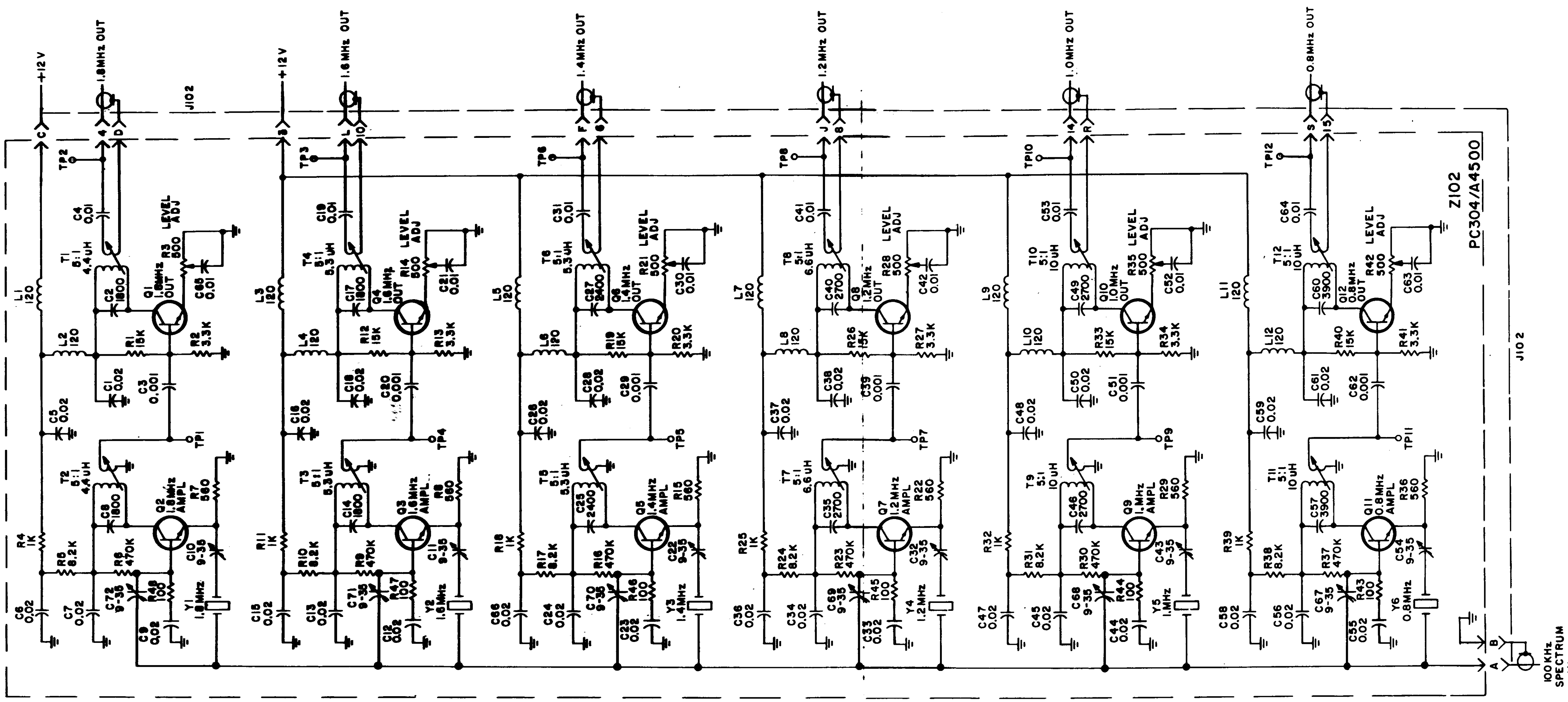
UNLESS OTHERWISE SPECIFIED
1 ALL RESISTANCE VALUES ARE IN OHMS, 1/4 W.
2 ALL DECIMAL CAPACITANCE VALUES ARE IN MICROFARADS. (.001).
ALL WHOLE NUMBER VALUES ARE IN PICOFARADS.
3 ALL INDUCTANCE VALUES ARE IN MICROHENRIES.
4 ALL TRANSISTORS ARE TYPE "2N3646"

LAST SYMBOLS	MISSING SYMBOLS
C90	C23 THRU C33, C79
CR1	
L19	L4, L5
Q19	Q6, Q7
R75	R20 THRU R26, R65
T12	T4, T5
TP9	TP4, TP1, TP2 & TP7
Y5	Y4
Z1	

2039-34

CK1396C

Figure 7-2. Spectrum Generator Z101 Schematic Diagram



2039–35

SYMBOL SE'RIES 500

LAST SYMBOL	MISSING SYMBOL
C72 L12 Q12 R48 T12 TP12 Y6	

UNLESS OTHERWISE SPECIFIED

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

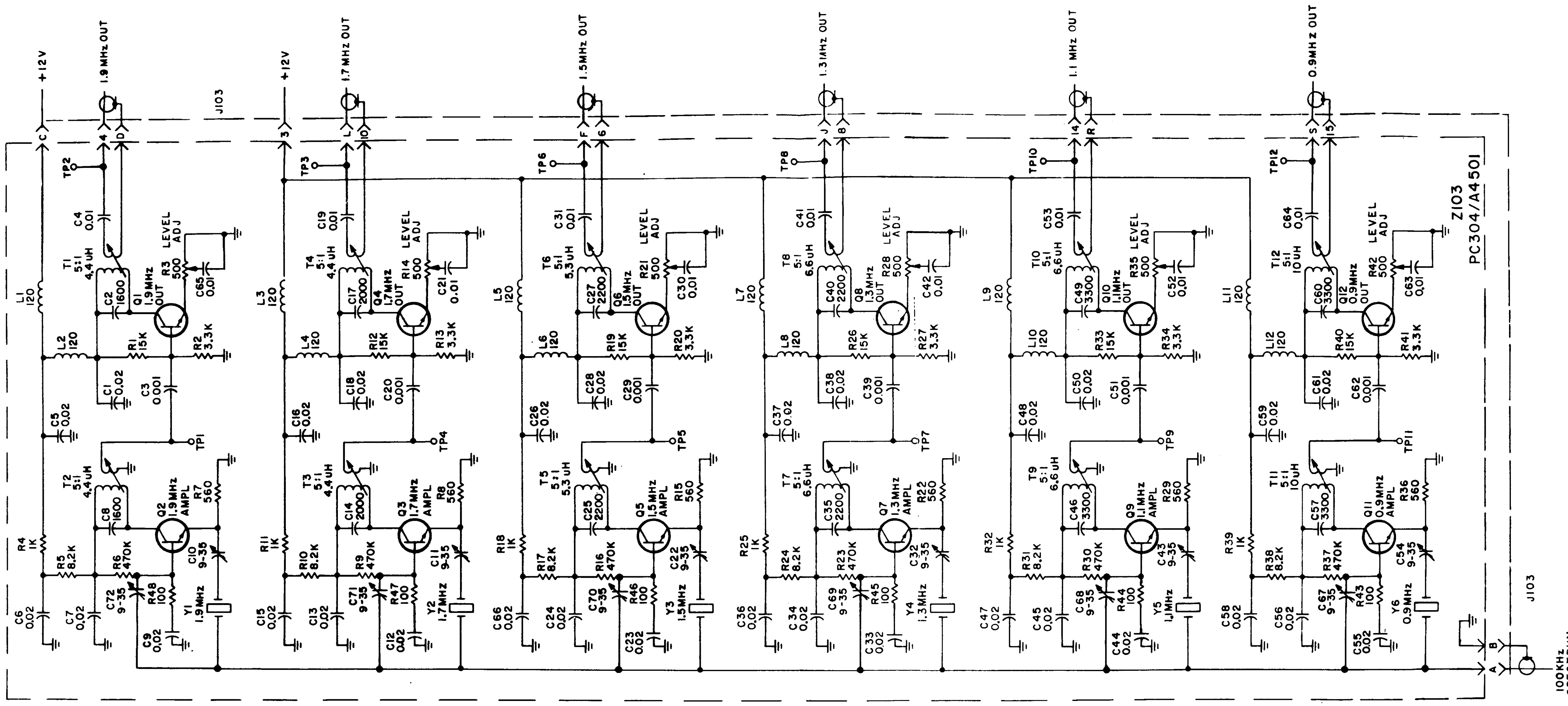
2- ALL DECIMAL CAPACITANCE VALUES ARE IN MICROFARADS, (.001). ALL WHOLE NUMBER VALUES ARE IN PICOFARADS, (1800).

3- ALL INDUCTANCE VALUES ARE IN MICROHENRIES.

4- ALL TRANSISTORS ARE TYPE "2N3646".

CK1313B

Figure 7-3. Comb Filter Z102 Schematic Diagram



2039-36

SYMBOL SERIES 600

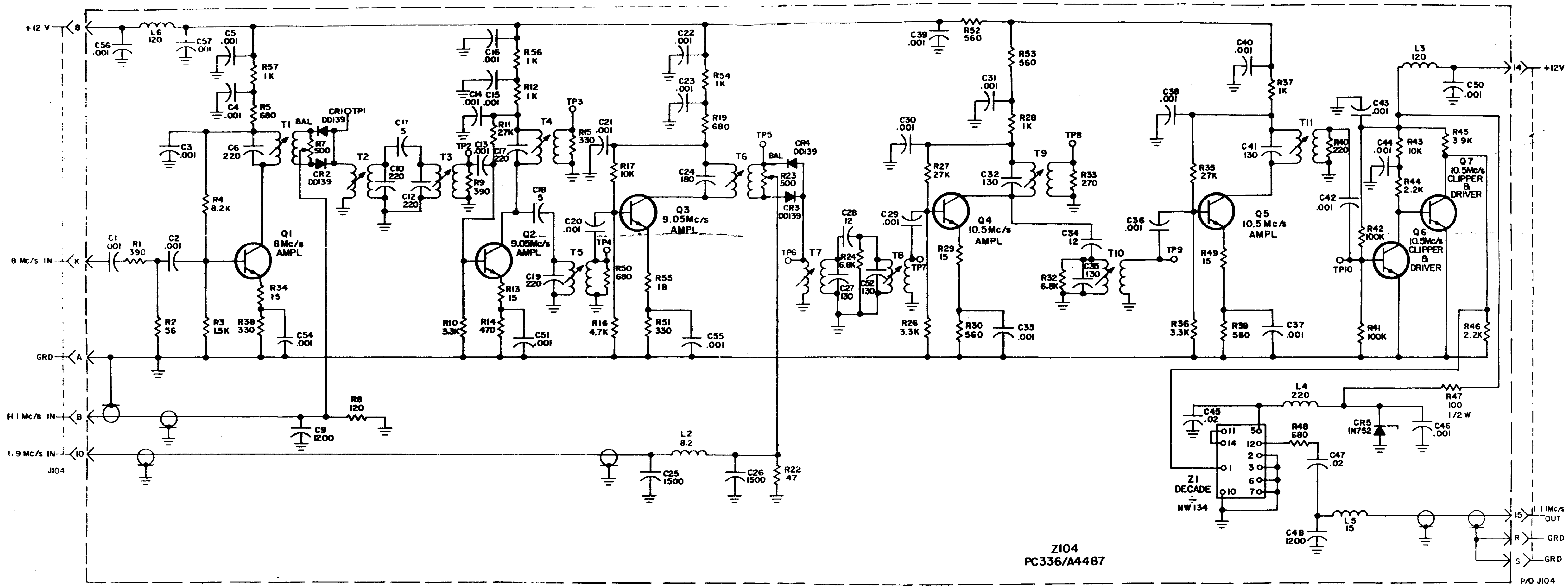
LAST SYMBOL	MISSING SYMBOL
C72	
L12	
Q12	
R48	
T12	
TP12	
Y6	

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.

Figure 7-4. Comb Filter Z103 Schematic Diagram

CK1314A



2039-37

SYMBOL SERIES 700

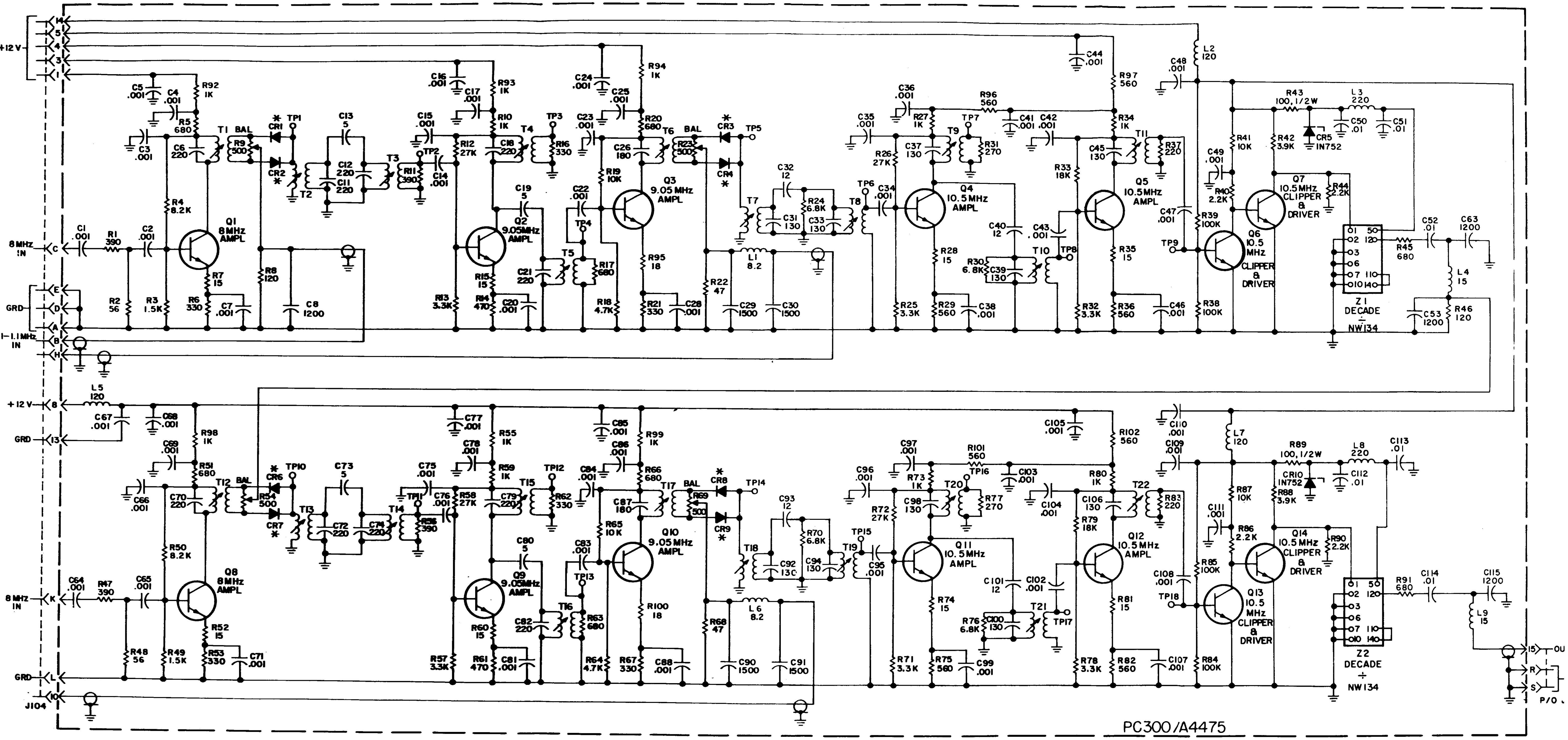
UNLESS OTHERWISE SPECIFIED

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".

LAST SYMBOLS	MISSING SYMBOLS
C58	C53,C49,C58,C7,C8
CR5	
L6	L1
Q7	R18, R20,R6
R57	R21, R25, R31
T11	
TP10	
Z1	

CK1318C

Figure 7-5. Mixer-Divider Z104 Schematic Diagram



2039-38

SYMBOL SERIES 2200 THRU 2300

UNLESS OTHERWISE SPECIFIED

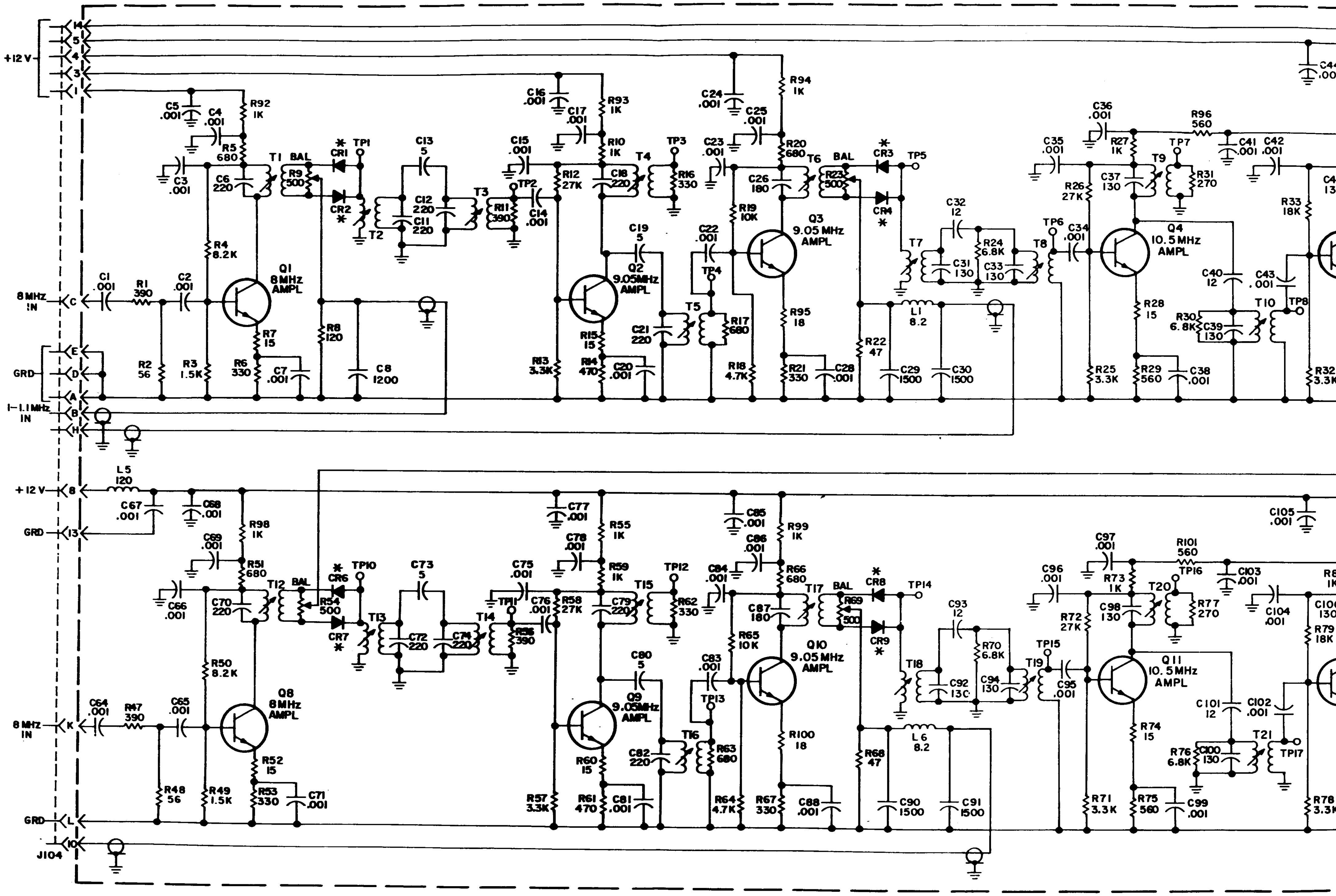
1 – ALL RESISTANCE VALUES ARE IN OHMS, 1/4 W.
2 – ALL DECIMAL CAPACITANCE VALUES ARE IN MICROFARADS.
ALL WHOLE NUMBER VALUES ARE IN PICOFARADS.
3 – ALL INDUCTANCE VALUES ARE IN MICROHENRIES.
4 – ALL TRANSISTORS ARE TYPE "2N3646".

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

* **NOTE**
CR1 & CR2, CR3 & CR4, CR6 & CR7, CR8 & CR9 (IN995'S) MUST BE MATCHED PAIRS.

CK1393C

Figure 7-6. Mixer-Divider Z105 Schematic Diagram



2039-38

SYMBOL SERIES 2200 THRU 2300

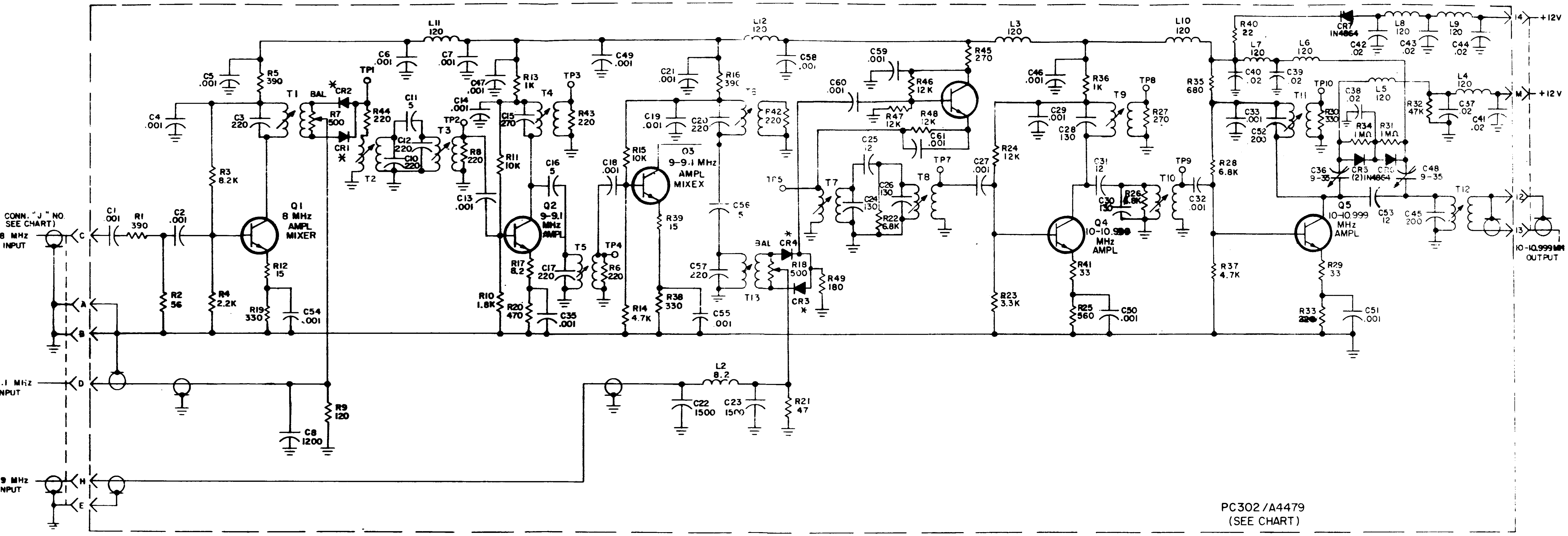
UNLESS OTHERWISE SPECIFIED

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".

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

* NOTE
CR1 & CR2, CR3 & CR4, CR6 & CR7, CR8 & CR9 (1N995'S) MUST BE MATCHED PAIRS.

CK1393C



2039-39

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".

SYMBOL SERIES 800

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

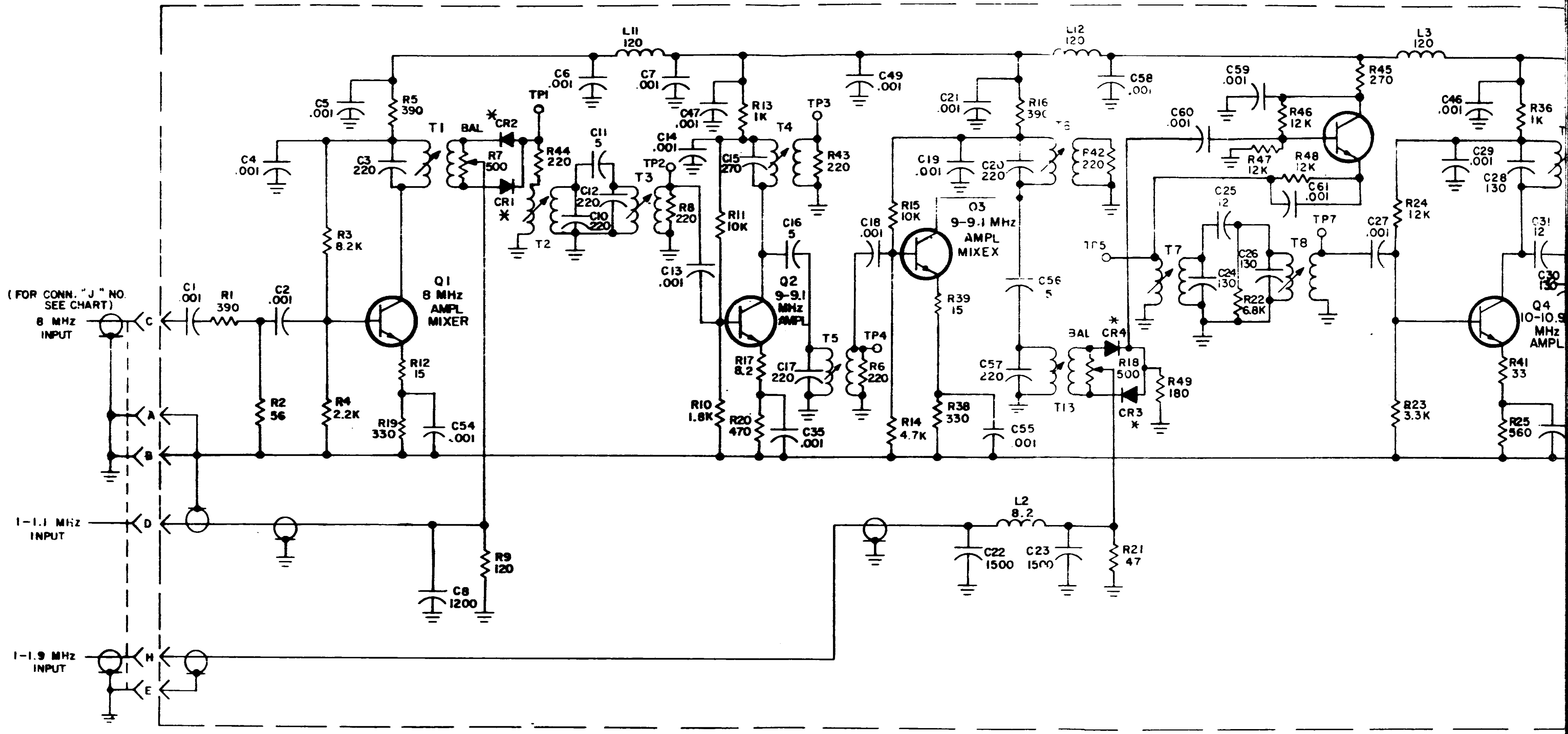
LAST SYMBOLS	MISSING SYMBOLS
C61	C9, C34
CR7	
L12	L1
Q6	
R49	
T13	
TP10	TP6

* **NOTE**

CR1 & CR2, CR3 & CR4 ARE "1N995'S" **MATCHED** PAIRS.

CK1319C

Figure 7-7. Mixer Final Z106 Schematic Diagram



2039-39

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".

SYMBOL SERIES 800

LAST SYMBOLS	MISSING SYMBOLS
C61	C9,C34
CR7	
L12	L1
Q6	
R49	
T13	
TP10	TP6

* NOTE

CR1 & CR2, CR3 & CR4 ARE "IN995'S" MATCHED PAIRS.

CK1319C

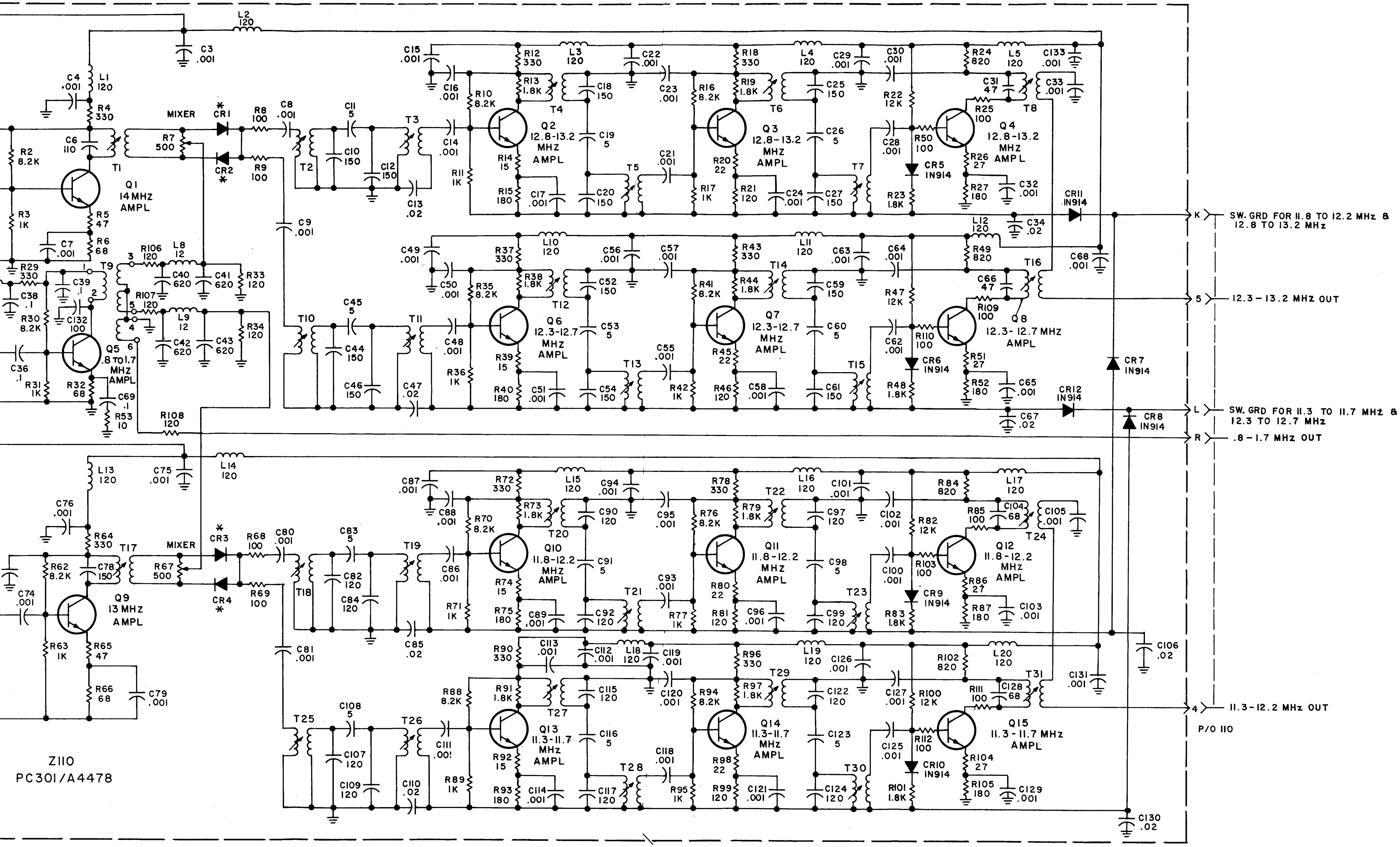
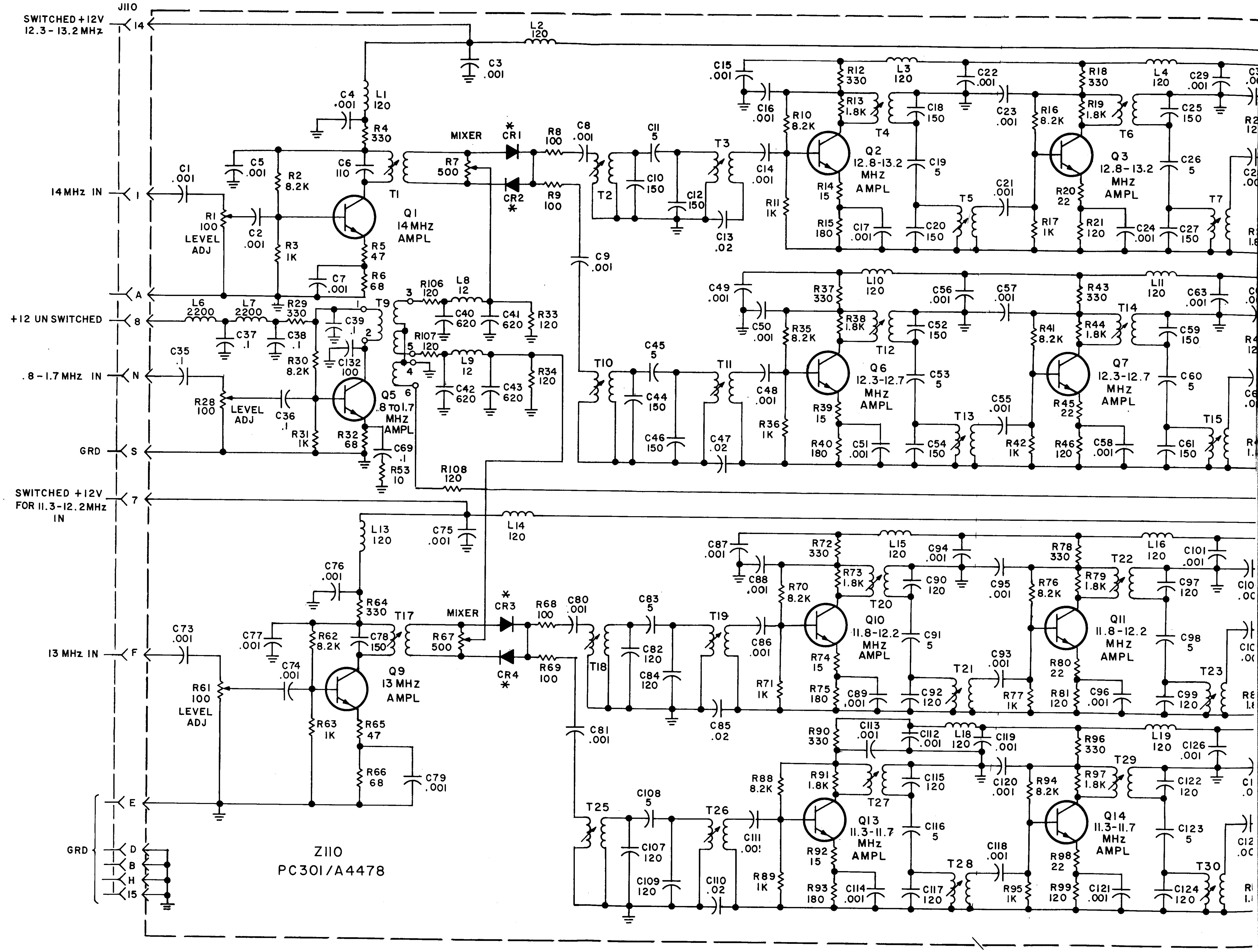


Figure 7-8. Step Generator Z110
Schematic Diagram



J110
SWITCHED +12V 12.3 - 13.2 MHz
14 MHz IN
+12 UN SWITCHED
.8 - 1.7 MHz IN
GRD
SWITCHED +12V FOR 11.3-12.2 MHz IN
13 MHz IN
GRD
MIXER
Q1 14 MHz AMPL
Q5 .8 TO 1.7 MHz AMPL
Q9 13 MHz AMPL
Q2 12.8-13.2 MHz AMPL
Q3 12.8-13.2 MHz AMPL
Q6 12.3-12.7 MHz AMPL
Q7 12.3-12.7 MHz AMPL
Q10 11.8-12.2 MHz AMPL
Q11 11.8-12.2 MHz AMPL
Q13 11.3-11.7 MHz AMPL
Q14 11.3-11.7 MHz AMPL
LEVEL ADJ
Z110
PC301/A4478

CK1322D

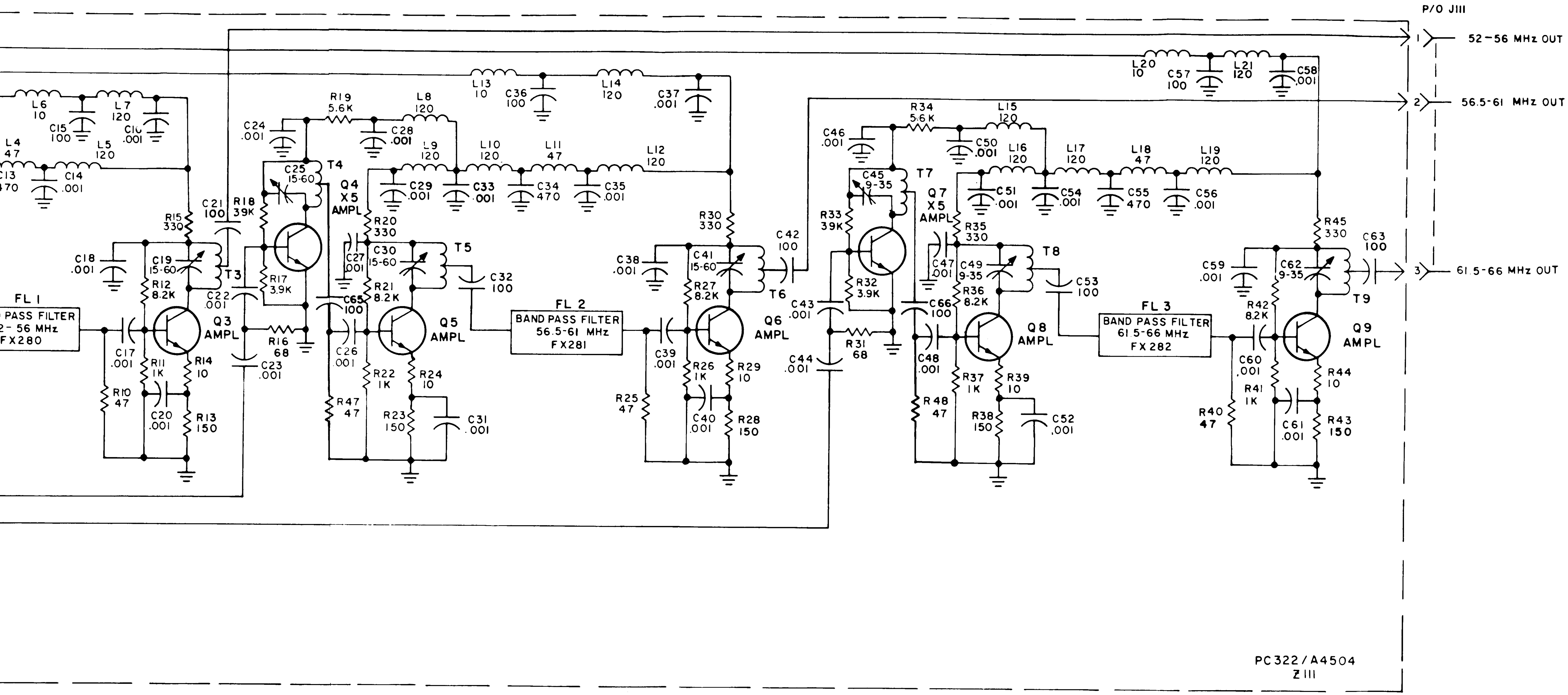
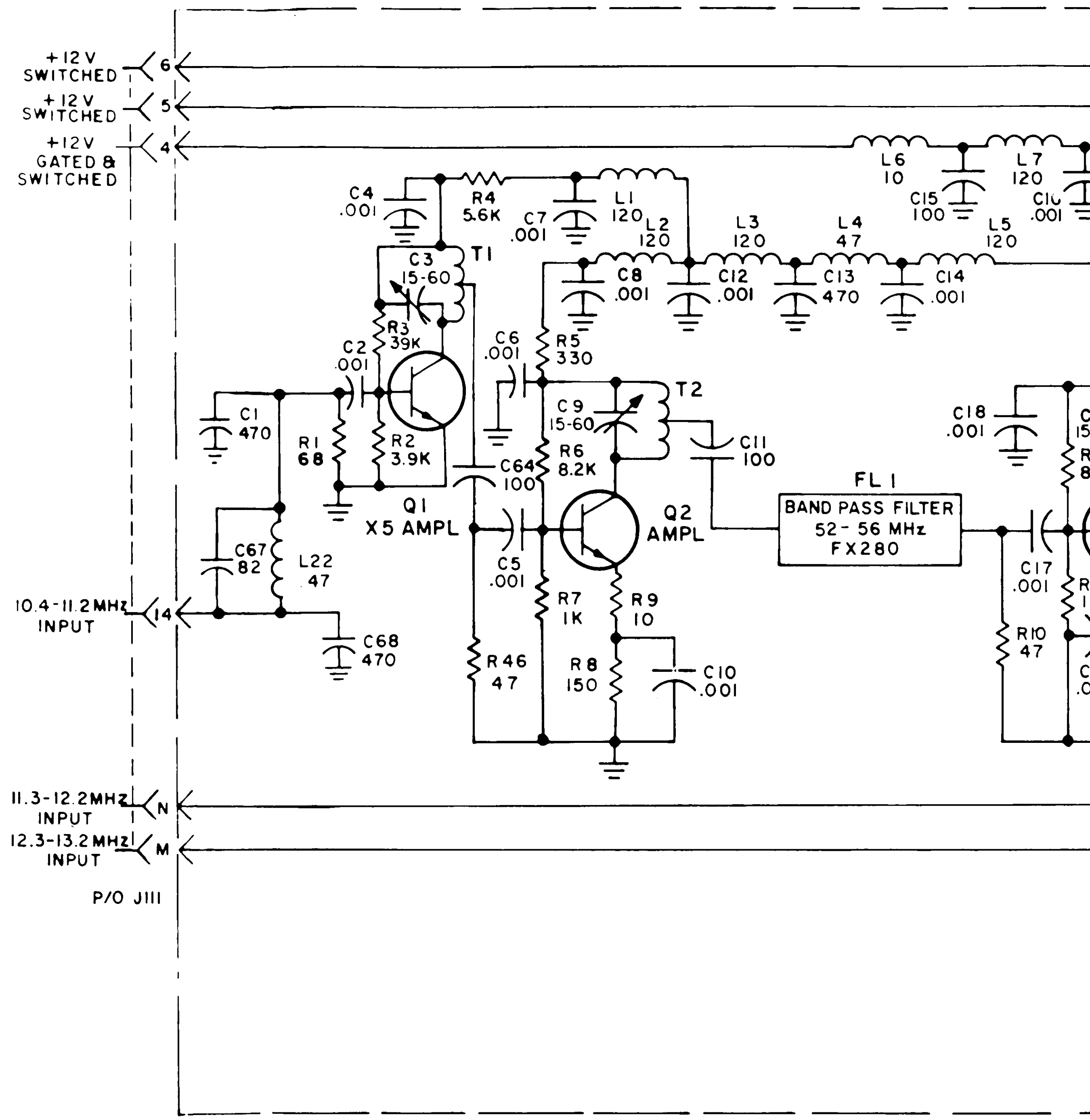


Figure 7-9. Step Generator Z111
Schematic Diagram



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".

CK1323C

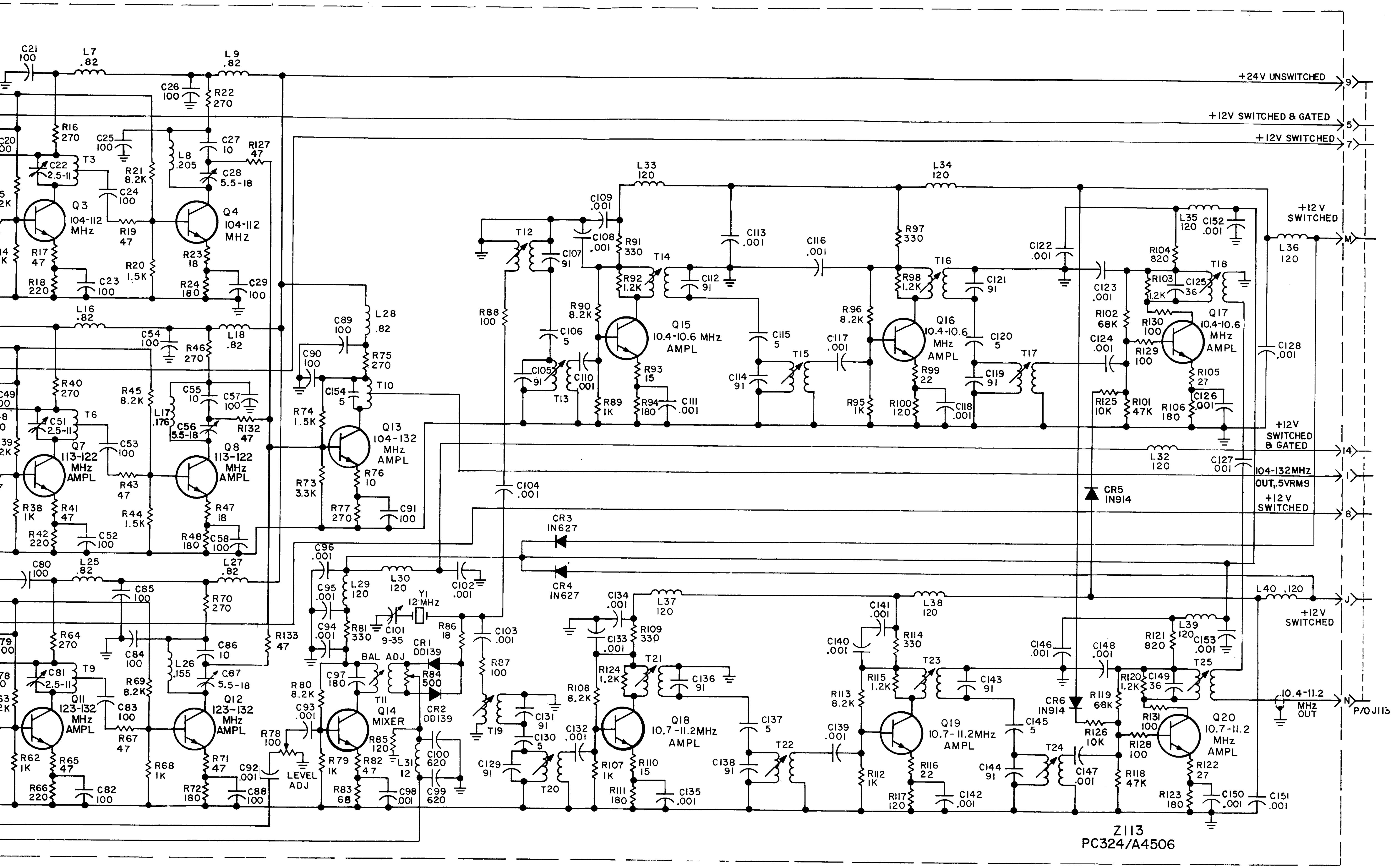
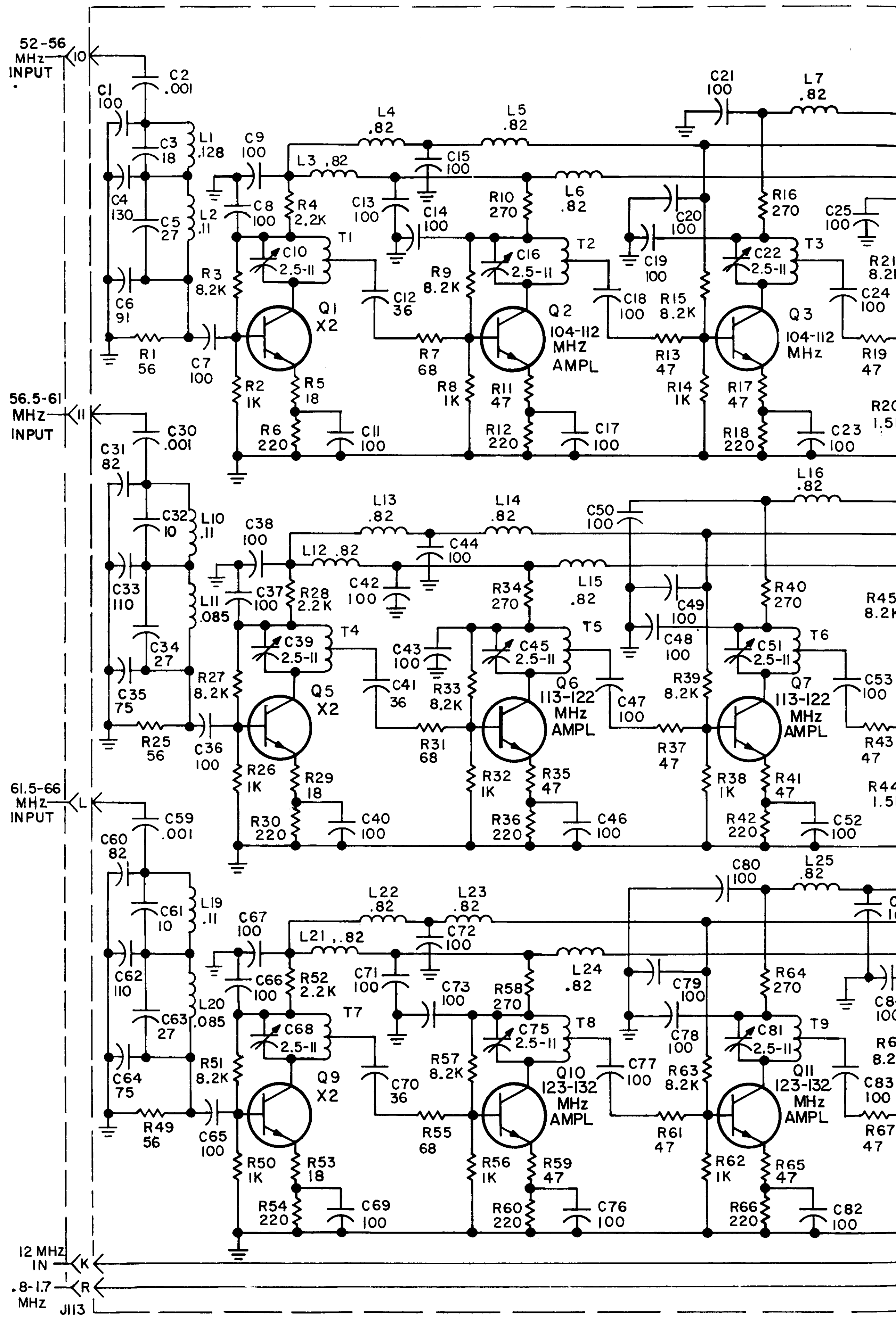
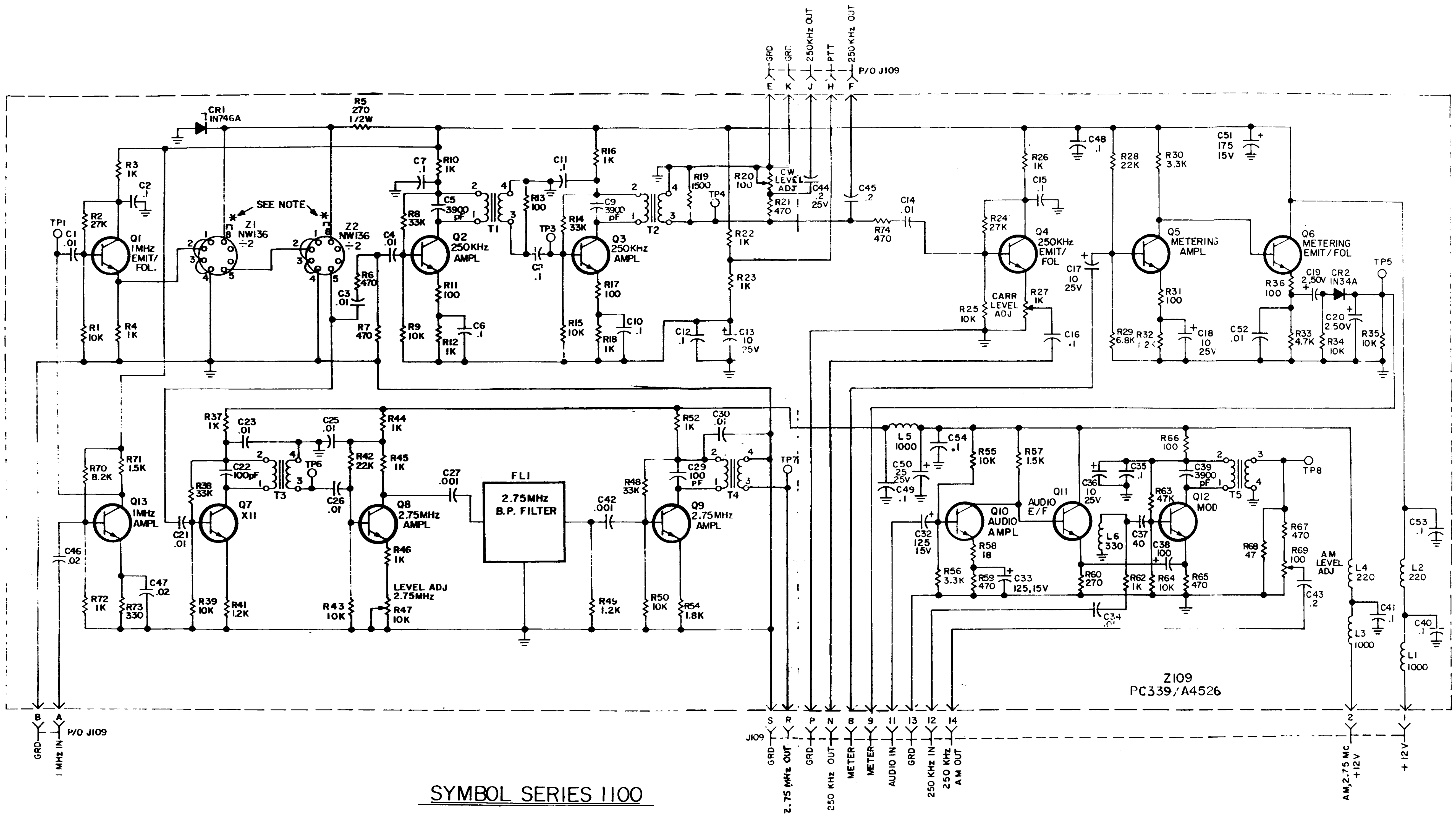


Figure 7-10. Step Generator Z113
Schematic Diagram



52-56 MHz INPUT
56.5-61 MHz INPUT
61.5-66 MHz INPUT
12 MHz IN
.8-1.7 MHz
J113
Q1 X2
Q2 104-112 MHZ AMPL
Q3 104-112 MHz
Q5 X2
Q6 113-122 MHz AMPL
Q7 113-122 MHz AMPL
Q9 X2
Q10 123-132 MHz AMPL
Q11 123-132 MHz AMPL

CK1325C



SYMBOL SERIES 1100

LAST SYMBOLS	MISSING SYMBOLS
C54	C24,C28,C31
CR2	
FL1	
L6	
Q13	
R74	R51, R61,R40,R53
T5	TP2
TP8	
Z2	

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.

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

CK1311D

2039-43

Figure 7-11. Carrier Generator Z1(
Schematic Diagram

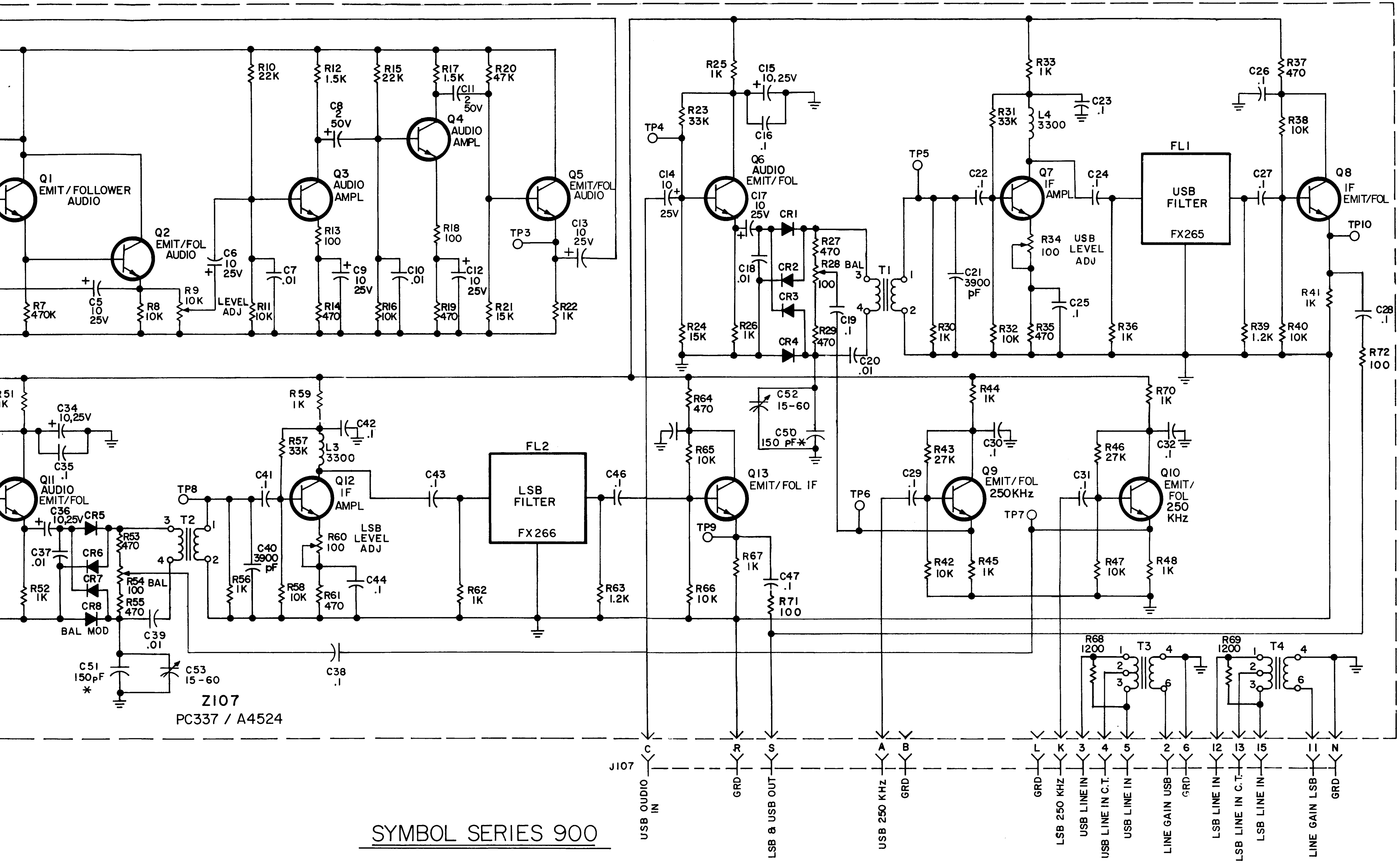
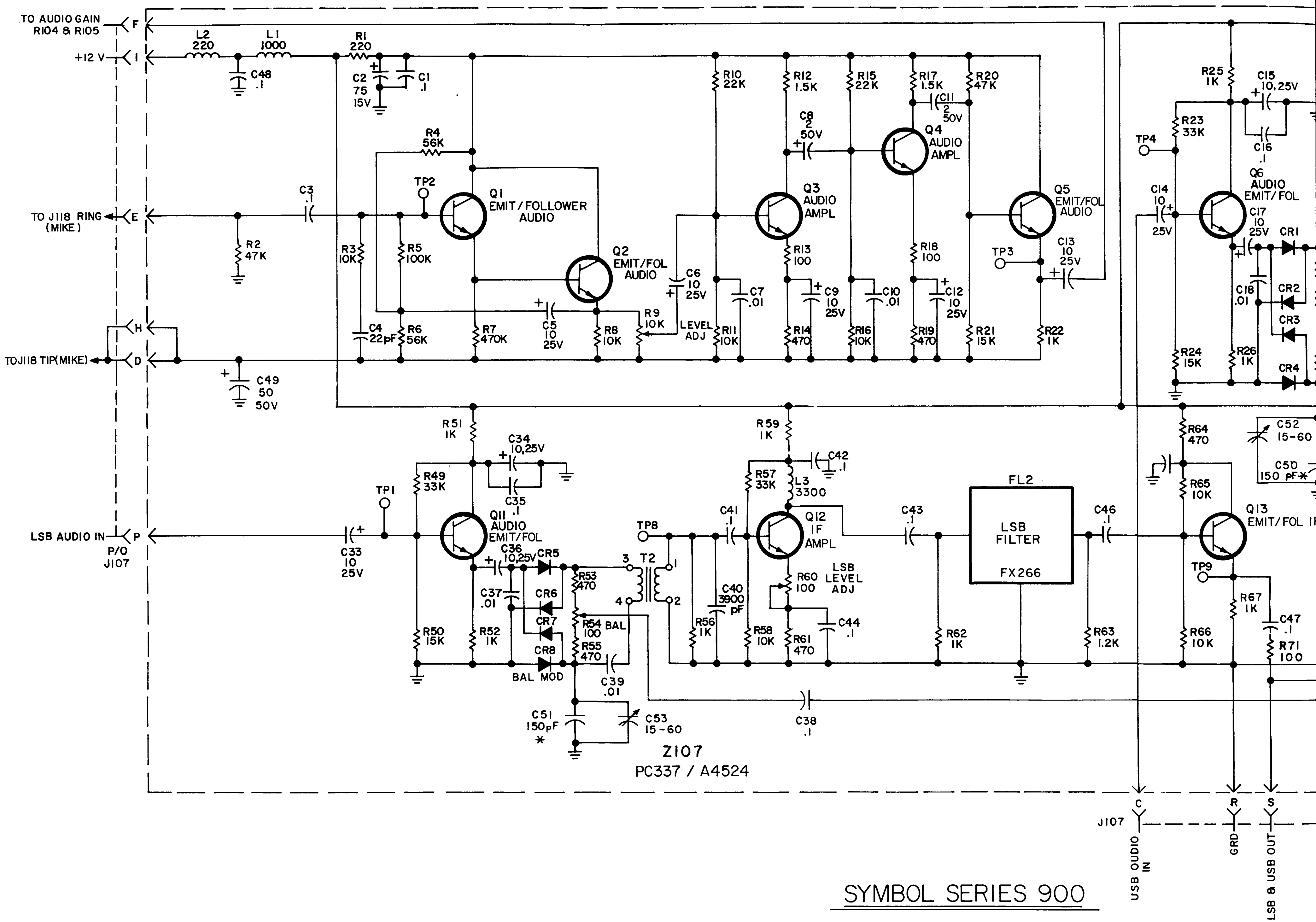
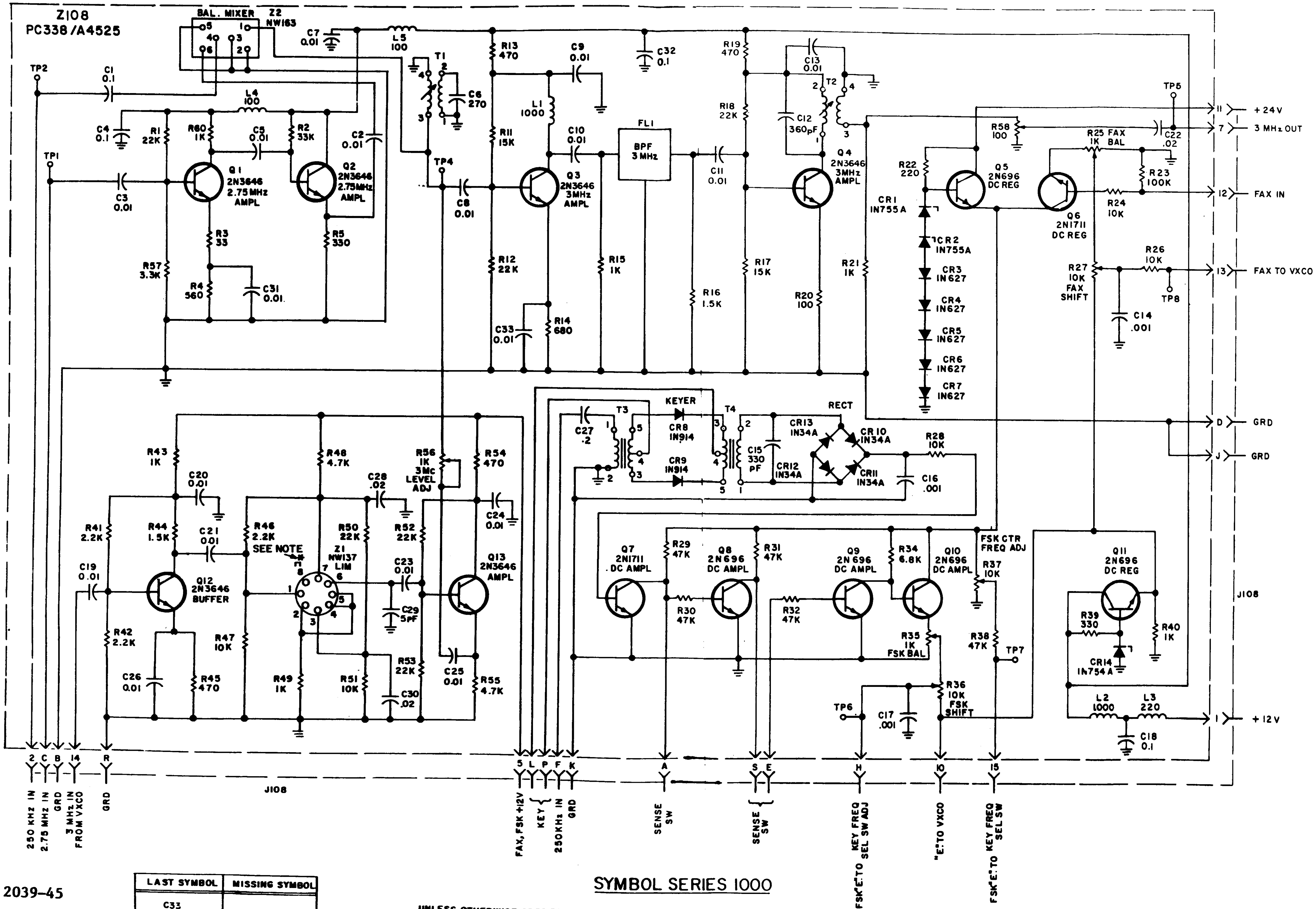


Figure 7-12. Sideband Generator Z107 Schematic Diagram



SYMBOL SERIES 900

CKJ308B



SYMBOL SERIES 1000

2039-45

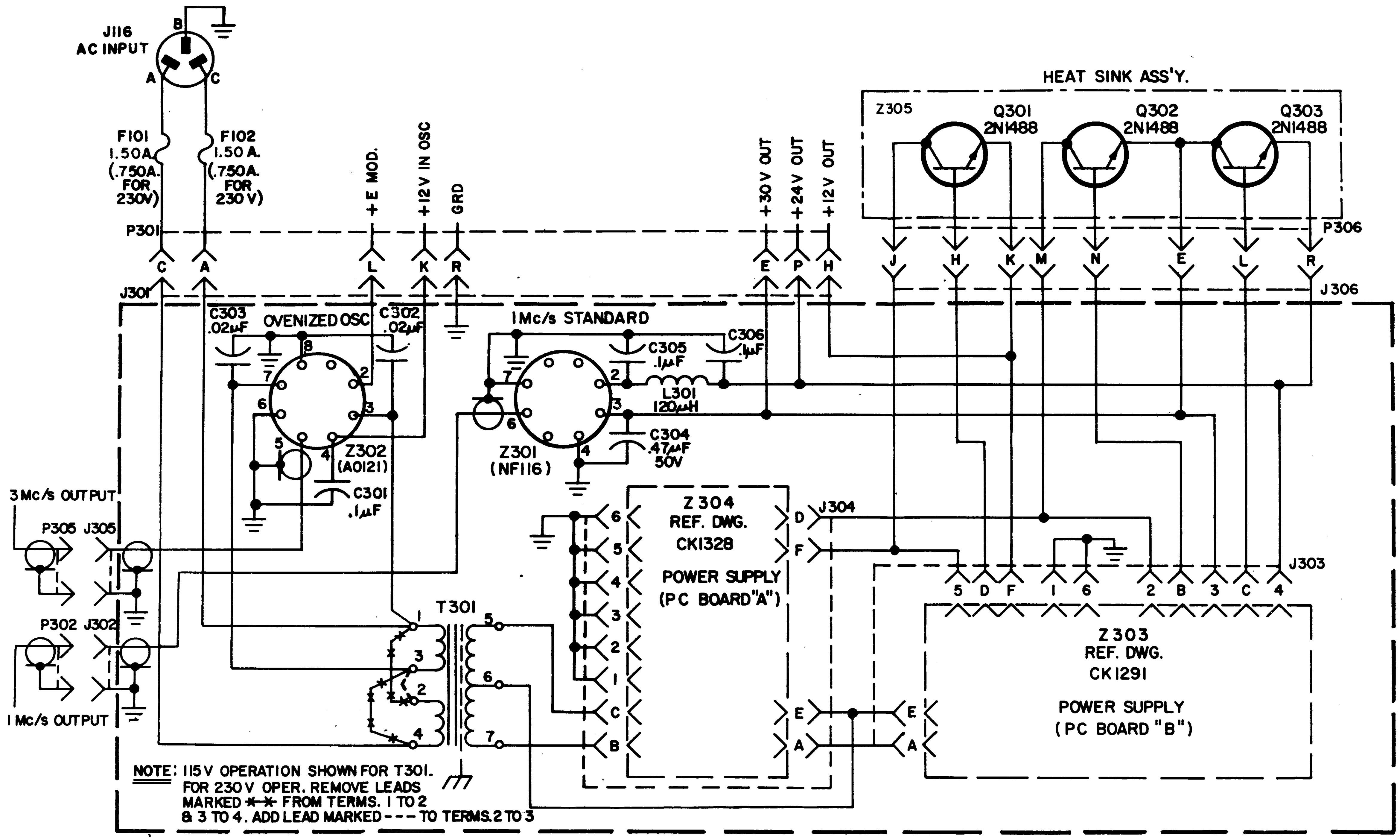
LAST SYMBOL	MISSING SYMBOL
C33	
CR14	
FL1	
L3	
Q13	
R60	R ,8,33,5
T4	
TP8	TP3
Z2	

UNLESS OTHERWISE SPECIED

1-ALL RESISTANCE VALUES ARE IN OHMS, 1/4 W.
2-ALL CAPACITANCE VALUES ARE IN MICR FARADS.
3-ALL INDUCTANCE VALUES ARE IN MICROHENRIES.
*"⊓" SYMB L DENOTES FLAT SIGNIFYING PIN 8 ON NETW RK

Figure 7-13. Frequency Shift Generator Z108 Schematic Diagram

CK1310B

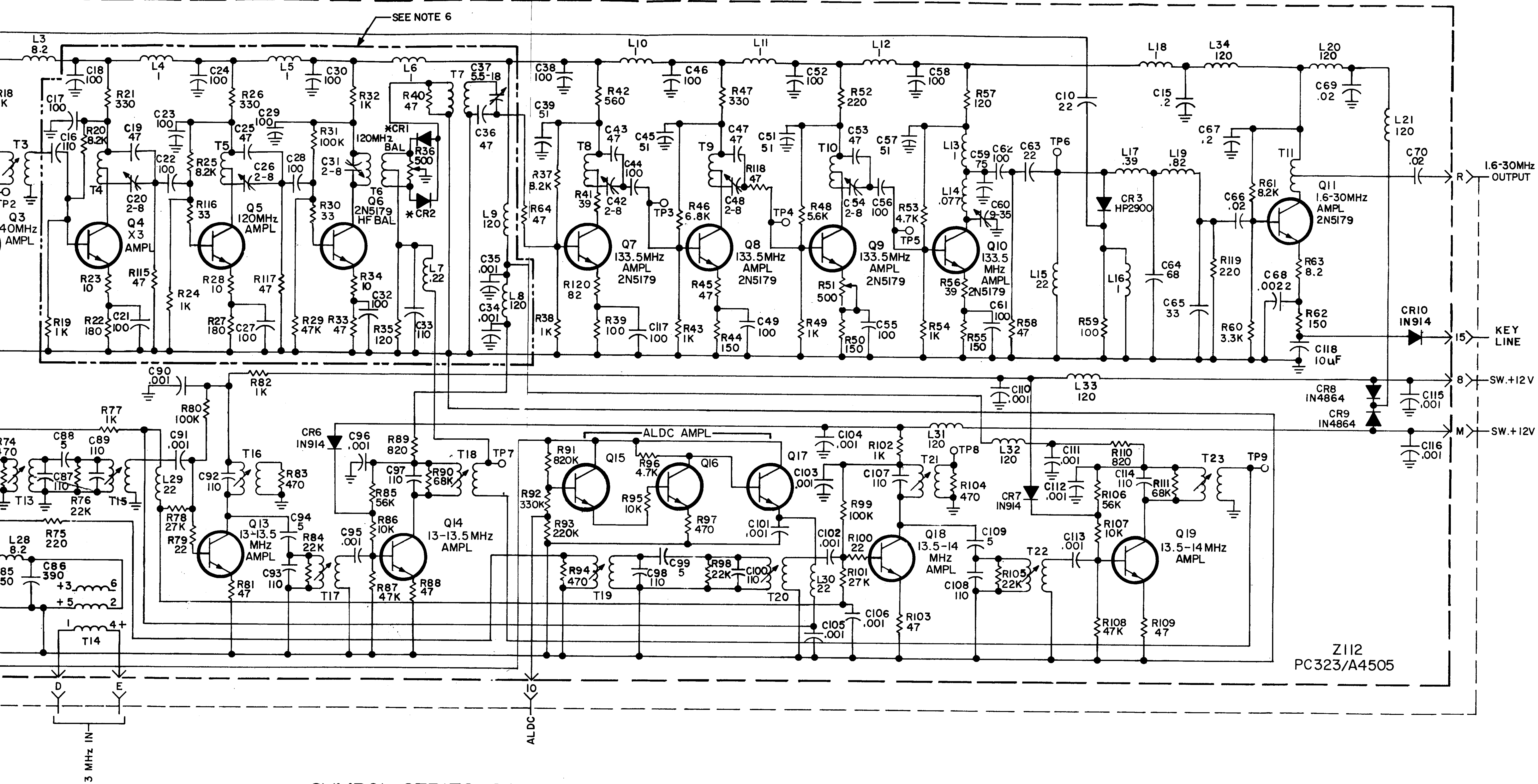


2039-46

LAST SYMBOLS	MISSING SYMBOLS
C306 J306 L301 P306 Q303 T301 Z305	P303, P304

CK13300

Figure 7-14. Variable Crystal Oscillator Schematic Diagram



SYMBOL SERIES 2000 & 2100

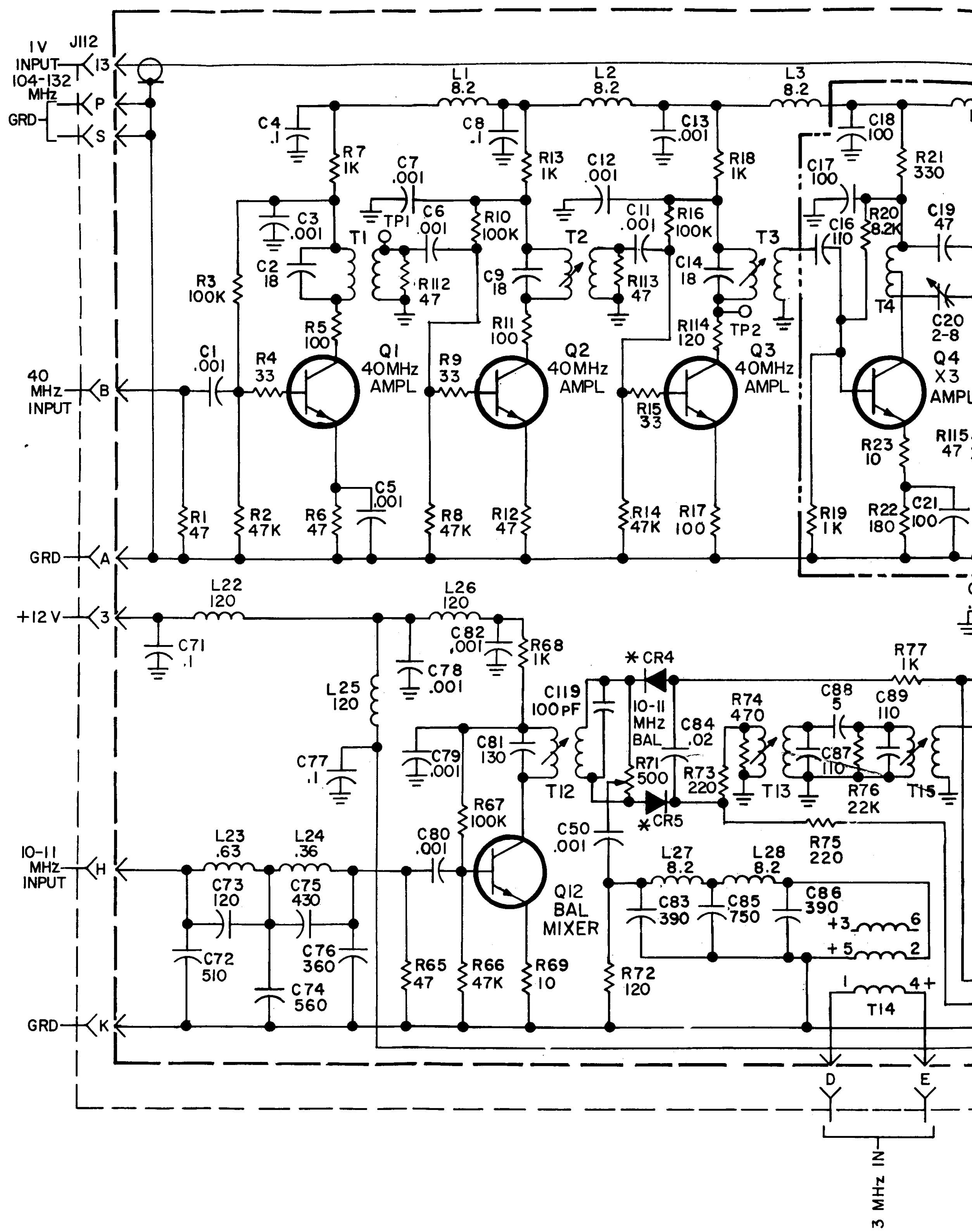
Figure 7-15. Translator Z112
Schematic Diagram

NOTES:
UNLESS OTHERWISE SPECIFIED

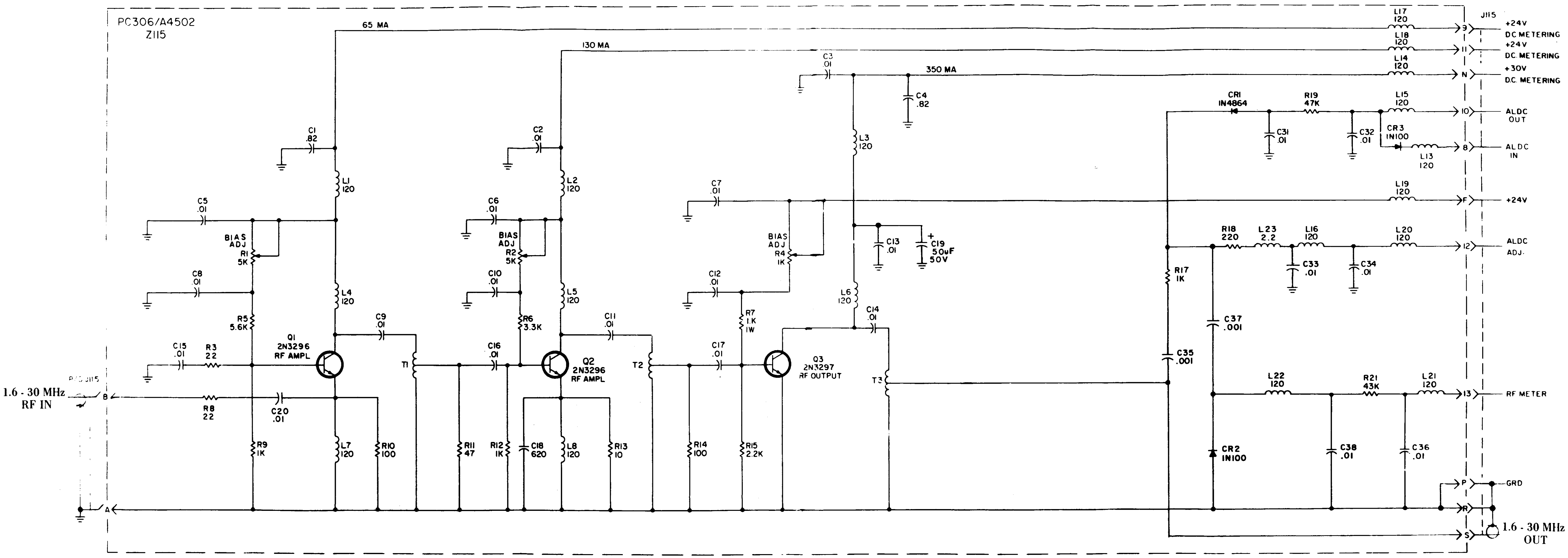
1- ALL RESISTANCE VALUES ARE IN OHMS, 1/4 W.
2-ALL DECIMAL CAPACITANCE VALUES (.001) ARE IN MICROFARADS.
ALL WHOLE NUMBER CAPACITANCE VALUES (47) ARE IN PICOFARADS.
3-ALL INDUCTANCE VALUES ARE IN MICROHENRIES.
4-ALL TRANSISTORS (EXCEPT THOSE INDICATED) ARE "2N3646".
*5-CR1 & CR2, CR4 & CR5 ARE "HP8403'S",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

NOTES: (CONT.)

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



CK1324E

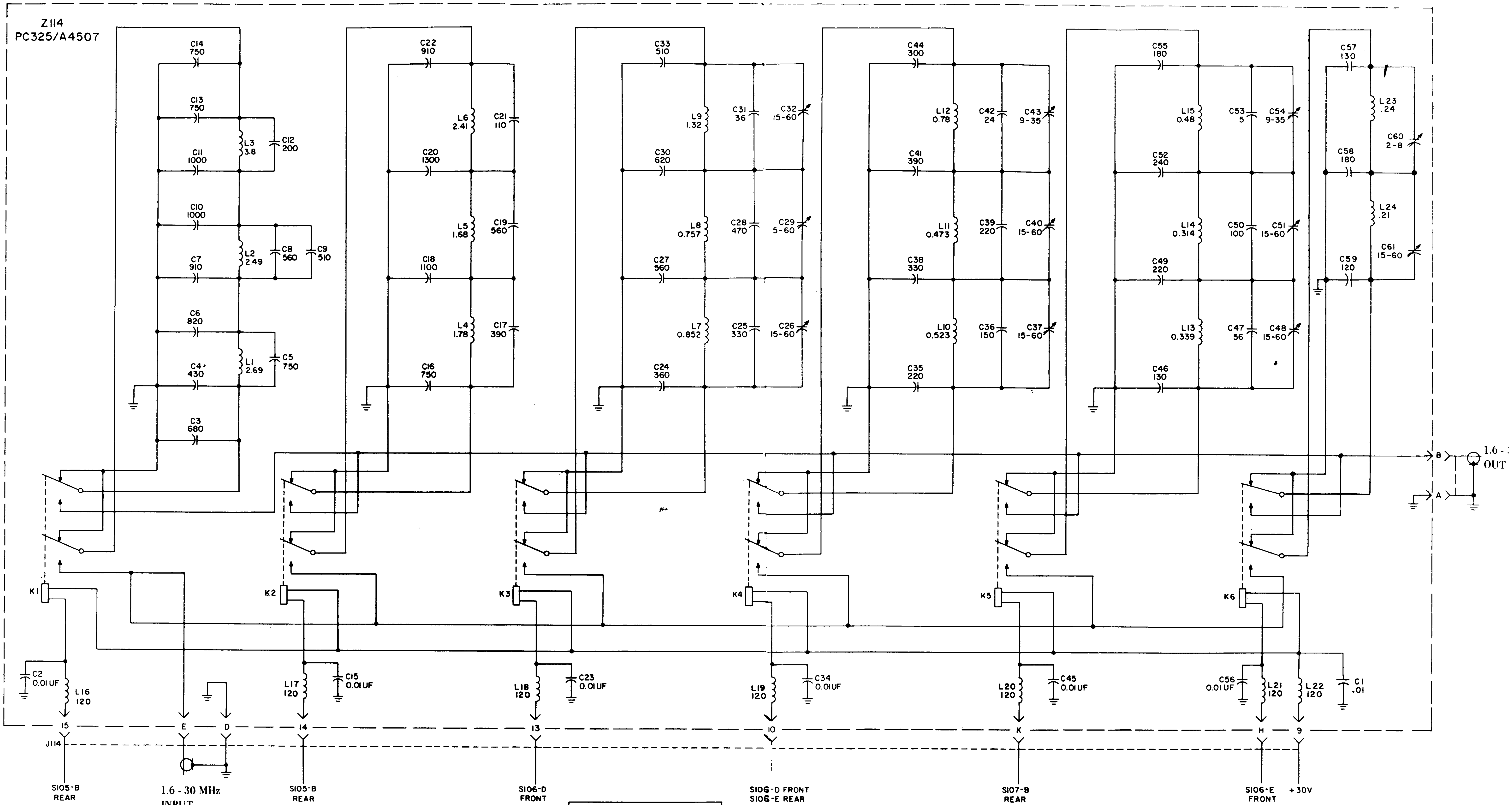


NOTES:
UNLESS OTHERWISE SPECIFIED
1- ALL RESISTANCE VALUES ARE IN OHMS, 1/2 W.
2- ALL DECIMAL CAPACITANCE VALUES (.001) ARE IN MICROFARADS.
ALL WHOLE NUMBER CAPACITANCE VALUES (47) ARE IN PICOFARADS.
3- ALL INDUCTANCE VALUES ARE IN MICROHENRIES.

SYMBOL SERIES 1700	
LAST SYMBOL	MISSING SYMBOL
C38 CR3 L23 Q3 R21 T3	C21 THRU C30 L9 THRU L12 R16, R20

CK1327B

Figure 7-16. RF Output Z115
Schematic Diagram



2039-49

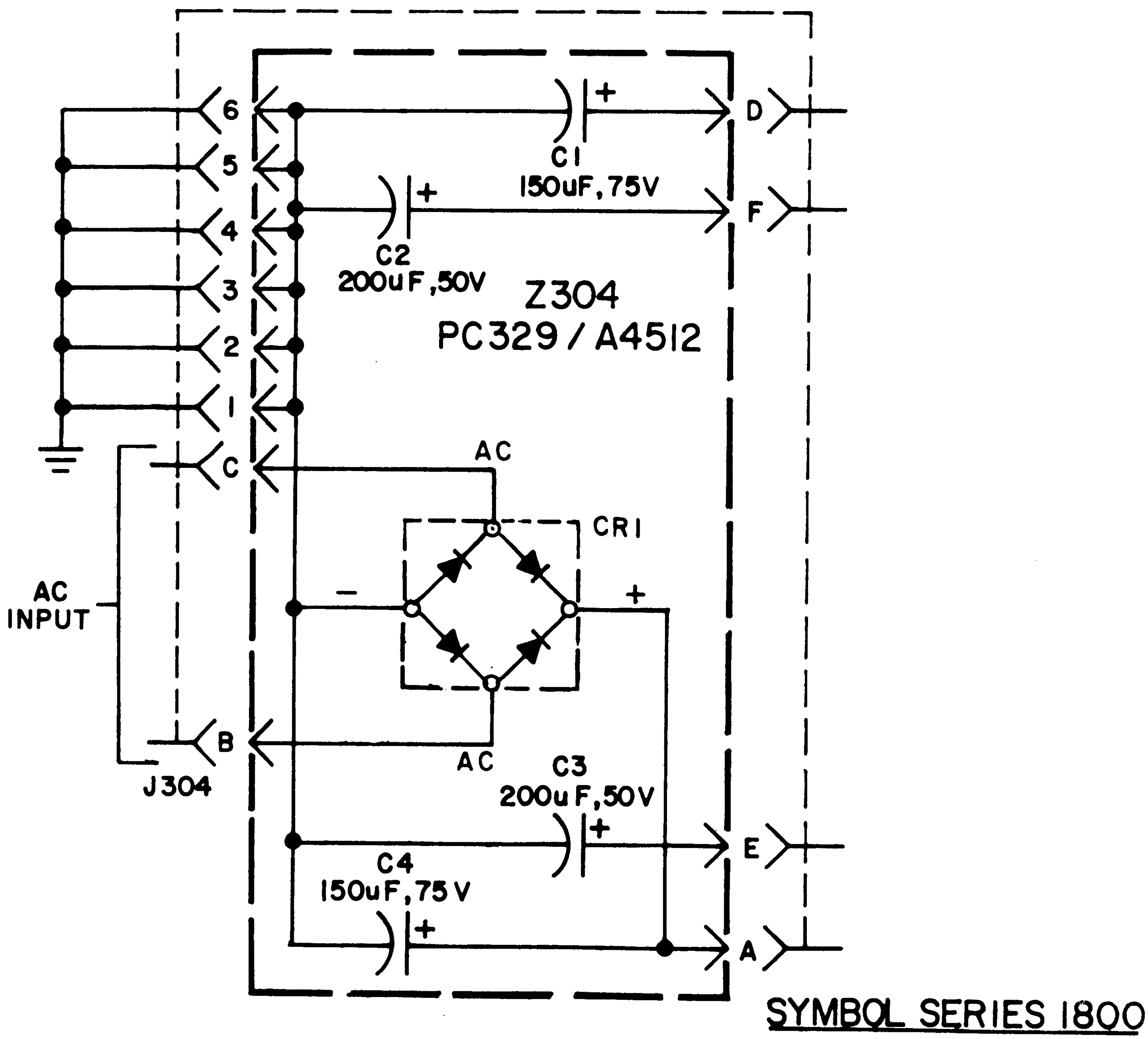
SYMBOL SERIES 1600

SYMBOL SERIES 1600	
LAST SYMBOL	MISSING SYMBOL
C61 K6 L24	

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.

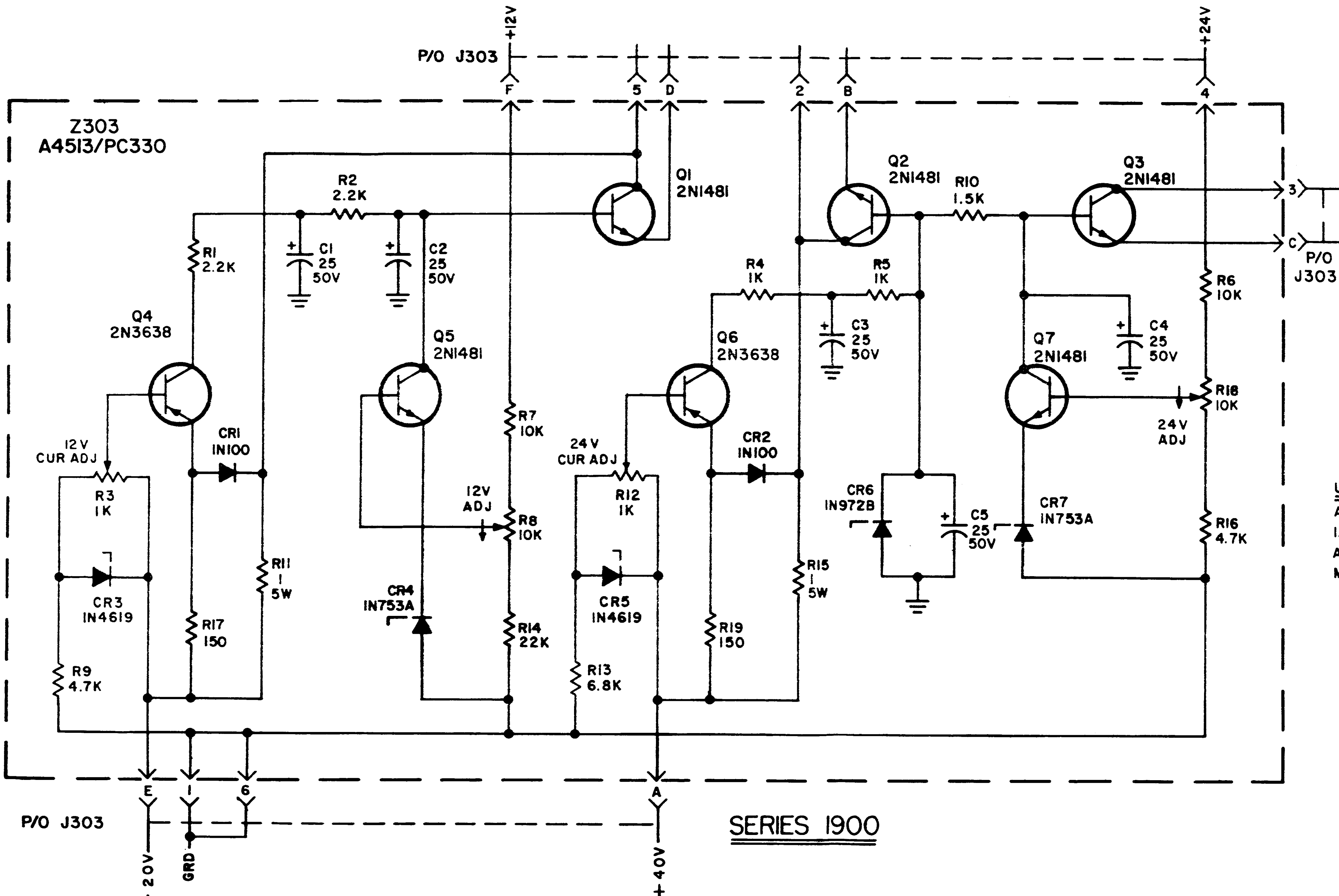
CK1326A

Figure 7-17. RF Filter Z114
Schematic Diagram



2039-50

Figure 7-18. Power Supply Z304
Schematic Diagram



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.

2039-51

Figure 7-19. Power Supply Z303 Schematic Diagram

CK12910