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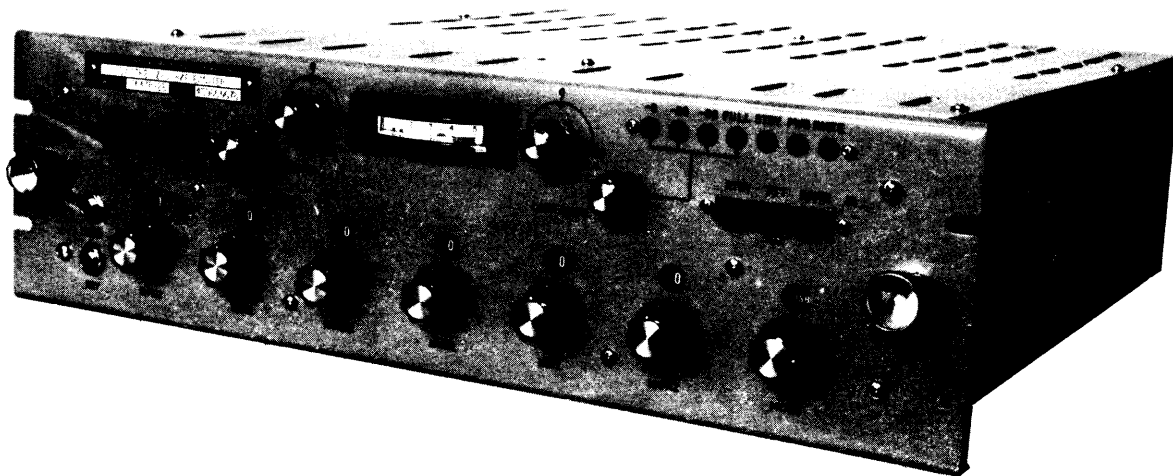


FIGURE 1-1 MULTI-MODE EXCITER MMX-2/B series

SECTION 1

GENERAL INFORMATION

1.1 Introduction

1.1.1 This manual presents operating and maintenance instructions for the Synthesized High Frequency ISB Exciter, Model MMX-2/Series B, designed and manufactured by The Technical Materiel Corporation (TMC) of Mamaroneck, New York 10543 U.S.A. This manual includes a general discussion of the equipment; preparation instructions for installation and use; operating instructions; principles of operation; maintenance data; and diagrams with parts lists.

1.2 Purpose and Use of Equipment

1.2.1 The MMX-2 exciter is a solid state device used to control the output frequency of a transmitter in a single sideband (SSB) transmitting system. It provides amplitude modulated (AM); amplitude modulated equivalent (AME); or two-channel independent sideband (ISB) intelligence on an RF carrier frequency between 1.6 and 29.9999MHz. The carrier frequency is selected in discrete 100Hz increments by means of six frequency selector switches on the front panel. The MMX-2 also features built-in frequency stability of one part in 10^8 per day, and provides continuously adjustable 250 milliwatt output in AM, AME, SSB and ISB modes. In addition, the exciter is capable of providing an output of up to one watt for continuous wave (CW); carrier frequency shift keying (FSK); and facsimilie (FAX) modes.

1.3 Identification and Model Differences

1.3.1 The MMX-2 is identified by a metal nameplate affixed to the front panel at the upper left-hand corner. When installed in a TMC transmitter system, this nameplate is transferred to the right-hand side of the chassis. The nameplate is lettered with the generic name, TMC model number, and serial number of the exciter. Similar information, including manufacturing lot number, is stamped on a metal foil attached to the rear panel.

1.3.2 Two models of the MMX-2 exciter "B" series are manufactured by TMC. Common elements of both are referred to in the manual as simply the MMX-2.

MMX-2/B	Synthesized HF/ISB Exciter
---------	----------------------------

MMXR-2/B	Synthesized HF/ISB Exciter (Remote)
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1.3.3 The MMX-2 is nomenclatured by the United States military as an MD-846/UR Modulator/Demodulator and as an O-1706 Oscillator. It is the standard RF drive unit in the 10KW transmitter AN/URT-37(V) and can be interchanged in the field as the primary drive unit for all TMC General Purpose (GPT) and High Frequency (HFT) Transmitters.

1.4 Functional Description

1.4.1 The MMX-2 exciter is a completely integrated RF drive unit that requires no tuning or peaking for proper operation. All frequency control elements, power supplies, amplifiers, and control circuits are designed in to the exciter. Only RF, audio, and AC power lines are required for proper operation to specification.

1.4.2 Front panel controls permit operator selection of the operating modes which include CW, AM, USB, LSB, ISB and FSK/FAX. A carrier control is included on the front panel to permit the operator to select the desired amount of carrier insertion. This level is normally pre-set at the time of manufacture for -6, -20, -30 and FULL (-55db) but can be changed to other values. Similarly, the optional FSK feature is pre-set for carrier shifts of ± 42.5 , ± 85 , ± 170 and ± 425 Hz, switch-selectable at the rear panel. These values can be changed as required.

1.4.3 Front panel controls include level adjusts for USB or LSB line/mike inputs and for RF output. A built-in meter indicates the operating levels of critical circuits in the exciter by monitoring internal test points. Two front panel jacks permit 55dbm low-impedance microphone and a dry contact keyer to be coupled to the exciter. Selection of voice operated relay (VOX) or press to talk (PTT) operation is accomplished by a front panel push button switch as are the functions of STANDBY/OPERATE and REMOTE/LOCAL.

1.4.4 Standard BNC-type connectors are provided on the rear panel to interface the standard 1MHz output frequency; the 1MHz monitor; the RF output; automatic load and drive control (ALDC); and the RF monitor with external equipment.

1.4.5 Heavy-duty printed circuit boards (PCB) are used at the rear panel to interface the exciter with audio input lines, remote control lines and transmitter interlock/switching circuits detailed in Section 2.

1.5 Physical Description

1.5.1 The majority of electronic components which constitute the exciter are mounted on removeable printed circuit cards which plug in to chassis-mounted connectors. The cards, as mounted to the chassis, are easily accessible from the front of the exciter by removal of protective covers.

1.5.2 A standard extender card and a special extender card for the power supply boards are included. These extender cards mate with the both the chassis-mounted connectors and the respective circuit cards. This assists in maintenance, alignment, and troubleshooting procedures.

1.5.3 The exciter chassis is designed for installation in a standard 19-inch (483mm) wide electrical operating cabinet. Removeable top and bottom protective covers are provided on the chassis. The exciter is convection cooled and requires a minimum of three (3) inches clearance for proper air circulation.

1.6 Specifications

1.6.1 Table 1-1 presents the pertinent electrical and mechanical specifications for the exciter.

1.7 Equipment Supplied

1.7.1 Table 1-2 presents the equipment and materials supplied with the exciter.

TABLE 1-1

TECHNICAL SPECIFICATIONS

OPERATING PARAMETERS

Frequency Range		2.0 to 29.9999MHz
	Optional	1.6 to 29.9999MHz
Frequency Selection		Direct synthesis in 100Hz steps
	Optional	16, 32 or 64 programmed channels
Frequency Display		Front panel digital
Frequency Stability		One part in 10^8 per day/15°C change
	Optional	One part in 10^9 per day/15°C change
Modes of Operation		CW/AM/AME/USB/LSB/2ISB (A1/A3/A3H/A3A/A3J/A3B)
	Optional	FSK/FAX (F1/F4)
Power Output		250 milliwatts PEP and Average CW
Input/Output Impedance		50 ohms (nom) unbalanced. BNC connector.
Tuning		Six front-panel rotary switches.
Remote Control	Optional	Interface circuits are available for remote monitoring and control of frequency, mode, RF level, carrier, mains power and status of the entire transmitting system including antennas.

AUDIO PARAMETERS

Audio Sideband Response		250-3040Hz ± 1.5 db CCIR. Others on request.
Equalized Filters	Optional	250-3040Hz 1.5db max. Others on request. Phase jitter: less than 5 degrees in two successive 10 millisecond periods. Envelope delay: Less than 500 microseconds, 600-2900Hz. Less than 150 microseconds for any 100Hz increment, 500-3050Hz.
Audio Input		1) Rear panel 600-ohm independent channels, balanced or unbalanced. -20 to +10dbm. 2) Front panel jack for low-level microphone. Built-in preamplifier, -55db into 47K.
Keying Input		1) Front panel CW key jack. 200 baud/dry contact 2) Rear panel FSK terminals. 75 baud and higher. Shift $\pm 42.5/85/170/425$ Hz. Others on request Input 20/60ma, 50 or 100 volts/dry contact Positive/negative to ground. 3) FAX: +1 to +10VDC produces 800Hz linear shift

TABLE 1-1

TECHNICAL SPECIFICATIONS
(Cont'd.)

TRANSMIT CHARACTERISTICS

Unwanted Sideband Rejection	500Hz tone minimum 60db below PEP
Spurious Signals	Minimum 60db below PEP
Intermodulation Distortion	Minimum 40db below either tone of a two-tone test at rated PEP.
Residual Noise and Hum	Minimum 70db below PEP. Power supply ripple minimum 55db below PEP.
Carrier Suppression	Selectable at 0/-6/-10/-20/FULL(-55db). Other values available on request.

ENVIRONMENTAL AND INSTALLATION

Cooling	Convection
Acoustic Noise	Less than 70db above reference level of 10^{-16} w/cm ² at 3.25 feet from the cabinet (normal conversation) when installed to TMC specifications.
Operating Conditions	0 to +50°C up to 95% R.H. at MSL
Storage Conditions	-30°C to +80°C up to 95% R.H. at MSL
Power Supply	Totally solid state 115 or 230VAC, 50/60/400Hz, single phase
Size and Weight	5.25"H X 19"W X 20"D (134mm X 483mm X 508mm) 36 pounds/16.4Kg installed.
Shipping Data	Commercial packing for U.S. domestic shipment. One container - 10" X 30" X 30" Total weight/cube - 58 pounds/5.2 cu. ft.

TABLE 1-2
EQUIPMENT SUPPLIED

QTY	PART NUMBER	DESCRIPTION
1	BMA106	Final Assembly, Model MMX-2 Exciter
1	*A0121	3MHz VCXO Crystal Oscillator
1	NF116-3	1MHz Frequency Standard Oscillator
1	LP155	Loose Items Package
2	120-042302	Technical Manual

*Supplied only with FSK/FAX option.

SECTION 2
INSTALLATION

2.1 Introduction

2.1.1 This section describes the requirements for preparing the exciter for use. It includes procedures for unpacking and inspection; electrical and mechanical installation considerations; and power requirements.

2.2 Unpacking and Inspection

2.2.1 The exciter is calibrated and tested at the factory prior to shipment. When it is received at the operating site, the external packing case should be inspected for obvious signs of mishandling and damage. Such signs could include crimped or crushed corners on the shipping container indicating the container had been dropped; or loose/broken sealing tape indicating rough handling by the carrier. With respect to damage to the exciter for which the carrier is responsible, the customer should file a claim against the carrier. TMC will assist in describing methods of repair and/or furnishing replacement parts if the exciter is damaged.

2.2.2 After inspecting the shipping container, the exciter may be unpacked. The exciter is normally shipped in heavy-duty, tri-wall cartons when the method of shipment is air freight or the destination is within the United States. All other shipments require the use of wood boxes built by TMC. The container number and contents are stenciled on the outside of each carton or box.

2.2.3 Various precautions must be observed in handling to prevent injury and/or damage to the exciter. The exciter with the loose items package and technical manuals are packed in a single shipping container which is placed in a second outer container. If a wood box is provided, the outer container is placed snugly inside the box.

2.2.4 The following information outlines the general uncrating methods to be used. Follow each step, keeping in mind previous discussions.

2.2.4.1 Remove wire straps or bands from around the shipping container with tin snips.

2.2.4.2 When a wood box is used and unless otherwise specified, remove nails from the top and two adjacent sides of the shipping container with a nail puller. DO NOT USE claw hammers, pinch bars or other leverage devices.

2.2.4.3 After the sides are removed, remove the top covering to expose the outer cardboard container. Strip off the pressure-sensitive tape from this container.

* * * * * CAUTION * * * * *

* * * * * CAUTION * * * * *
When using a knife to cut the pressure-sensitive tape, care
must be taken not to mar the exciter in the inner container.
* * * * * ***** * * * * *

- 2.2.4.4 Remove the inner container from the outer container.
- 2.2.4.5 If a barrier bag is encountered, remove the bag from the inner container.
- 2.2.4.6 Remove the pressure-sensitive tape from the inner container observing the same precautions discussed previously.
- 2.2.4.7 Remove dessicant bags, loose items package and technical manuals from the inner container.
- 2.2.4.8 Remove the top section of the plastic-encased form to expose the exciter. Note that the exciter sits in a second plastic-encased form that is contoured to the shape of the exciter when it is packed.
- 2.2.4.9 Carefully remove the exciter from the inner container.
- 2.2.4.10 Repack the packing material in reverse order. Retain this material, including the pre-contoured forms, for future use should repacking for shipment or storage become necessary.
- 2.2.5 After the exciter has been removed from the shipping container, it should be inspected on a bench for signs of damage. The following procedure is recommended:
 - 2.2.5.1 Inspect the front panel for nicks, scratches, discolored paint, or other obvious signs of mishandling.
 - 2.2.5.2 Check the meter plexiglass for scratches or cracks.
 - 2.2.5.3 Check the fuse housing and indicator lamp housings for cracks.
 - 2.2.5.4 Remove line fuse (rear panel) and check for correct value: 1.0 ampere for 115VAC line input and 0.5 ampere for 230VAC line input.
 - 2.2.5.5 Exercise all switches and controls on the front panel to check for ease of operation without unnecessary binding

- 2.2.5.6 Inspect the rear panel for scratches, nicks, etc.
- 2.2.5.7 Check the condition of all connectors for nicks, burred threads, dents or other signs of wear. Check for bent or broken pins and connectors.
- 2.2.5.8 Check the printed circuit board edges for cracks, nicks, and firm mounting.
- 2.2.5.9 Loosen the threaded screws securing the bottom cover and remove. Inspect the power transformer (T301) terminals to verify parallel connection of the primary winding for 115VAC operation or cross connection of the primary winding for 230VAC operation. Refer to Figure 2-1 for the proper connections. Recheck the line fuse for proper rating.
- 2.2.5.10 Replace the bottom cover and verify that a "230 volt" decal is affixed to the rear panel if the exciter is correctly wired for 230VAC operation. No decal is used for 115VAC operation.
- 2.2.5.11 Inspect the power cable assembly for frays, cuts, etc.
- 2.2.5.12 Recheck the loose items package and the "Equipment Supplied" list to verify that all items are present and accounted for. Complete the REGISTRATION CARD at the front of the manual and send with the requested information to TMC.

2.3 Power Requirements

2.3.1 The exciter is designed for operation at 115 or 230VAC, 50/60Hz single-phase primary power. Unless otherwise specified by the customer, the unit is shipped wired for 115VAC operation. For 230VAC operation, a wiring change is required on the primary of the transformer (Figure 2-1). Line fuse must be changed to 0.5 ampere rating for 230VAC operation.

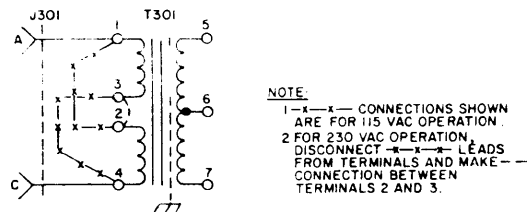


Figure 2-1. Primary power transformer wiring

2.4 Mechanical Installation

2.4.1 The exciter is equipped with a standard 19-inch (483mm) wide front panel for installation in a standard equipment rack. The exciter can be installed in the cabinet in one of two configurations.

2.4.1.1 Panel Mount. The exciter can be installed in the rack and held in place with four screws and washers supplied in the loose items package. In this configuration, the exciter is not equipped with chassis slides.

2.4.1.2 Chassis Slide Mount. The exciter can be supplied with extension chassis slides that are securely fastened to the side plates of the exciter and are provided with mating sections designed to be installed in the equipment operating cabinets. This method facilitates the servicing of the exciter by allowing the chassis to be pulled out from the operating cabinet on tracks for better access to top and bottom sections. The non-tilt slides can be provided at the request of the customer. Tilt slides are also available and enable the exciter to be rotated 90 degrees up or down when extended out from the operating cabinet.

2.4.2 When the exciter is equipped with chassis slides, the following procedure should be followed.

2.4.2.1 Pull out the center section of tracks, located in the equipment cabinet, until locked in the extended position.

2.4.2.2 Position the chassis slide section attached to the exciter in the tracks of this extended section. Ease the exciter into the cabinet until the release buttons engage holes in the tracks.

2.4.2.3 Press the release buttons and slide the exciter all the way into the cabinet. Secure the front panel of the unit to the cabinet with screws provided or by the panel locking devices installed on the front panel.

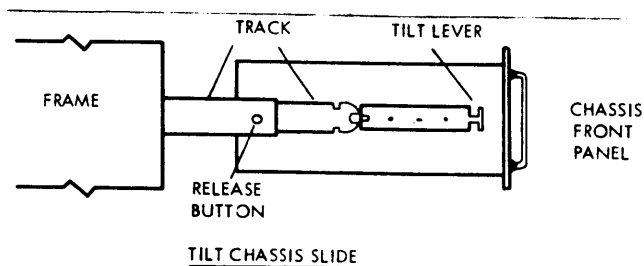


Figure 2-2. Typical chassis slide mounting

2.5 Electrical Installation

2.5.1 All electrical connections between the exciter and associated transmitter or interface equipment are made at the rear panel. Figure 2-3 illustrates all rear panel connections. Table 2-1 lists the panel designations and functions of the connections.

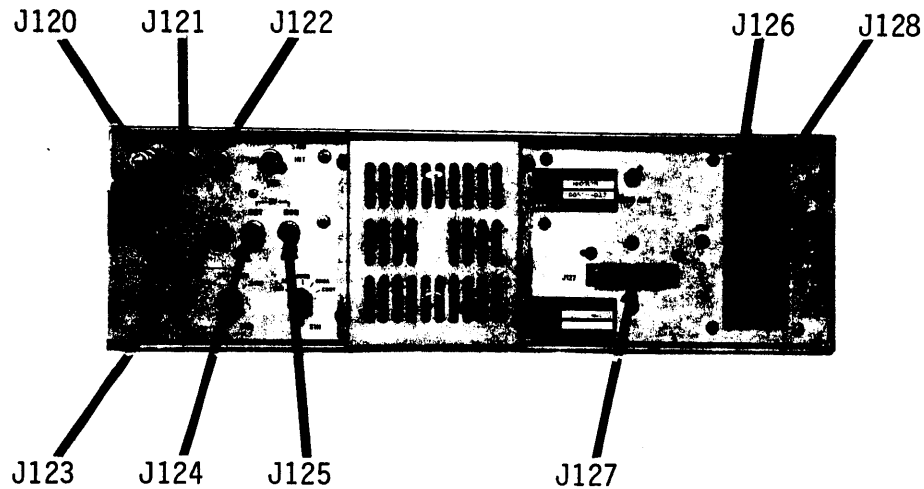


Figure 2-3. Exciter rear panel connections

2.6 Final Inspection

2.6.1 The final inspection procedure consists of a visual and mechanical check of the exciter to verify that it is ready for operation.

- 2.6.1.1 Ensure that all dust and foreign matter is removed.
- 2.6.1.2 Ensure that all external controls are operating properly.
- 2.6.1.3 Check for loose hardware, handles and knobs.
- 2.6.1.4 Verify that all covers are in place and fit properly.
- 2.6.1.5 Check all exterior surfaces for correct finish and absence of marks or scratches.
- 2.6.1.6 Check that all requested information, including model and serial numbers of the exciter, has been entered on the enclosed REGISTRATION CARD and mailed to TMC.

TABLE 2-1

REAR PANEL CONNECTIONS
(See Figure 2-3)

<u>Designation</u>	<u>Description</u>	<u>Function</u>
J116	POWER	Power input for 115/230VAC line voltage
J120	1MHZ OUT	1MHz standard signal output jack (BNC)
J121	1MHZ MON	1MHz standard signal monitor jack (BNC)
J122	1MHZ STD	1MHz standard input jack (BNC) from an external frequency source.
J123	ALDC	Input jack (BNC) for feedback voltages from an associated linear amplifier to improve linearity, limit distortion and deliver a relatively constant output level during high modulation peaks or load changes.
J124	RF OUT	RF output signal jack (BNC)
J125	RF MON	RF output signal monitor jack (BNC)
<p>* * * * * NOTE * * * * *</p> <p>Facing the exciter rear panel, the J126 PCB connector terminals are read from bottom to top with the numbers (1-22) on the left and the letters (A-Z omitting G,I,O and Q) on the right. Components are on the left side.</p> <p>* * * * * **** * * * * *</p>		
J126	TRANSMITTER	Input/Output connector for operation with an associated amplifier.
		<ol style="list-style-type: none"> 1) Transmitter control of bias ON/OFF 2) Transmitter tune/ready command 3) Antenna tuner 2.6-2.9999MHz control 4) Transmitter tune/ready command 5) Antenna tuner 2.3-2.5999MHz bandswitch 6) Antenna tuner 2.6-2.9999MHz bandswitch 7) Not used 8) 0 to 24VDC variable voltage line 9) Not used 10) Transmitter 5-7.999MHz bandswitch 11) Not used 12) Transmitter 4-4.999MHz bandswitch 13) thru 22) Not used

TABLE 2-1

REAR PANEL CONNECTIONS
(Cont'd.)

<u>Designation</u>	<u>Description</u>	<u>Function</u>
J126 (Cont'd)	TRANSMITTER	A) Ground B) Push to Talk (PTT) line from J127-5 C) Transmitter control of bias ON/OFF D) Not used E) +24VDC F) Antenna tuner 2-2.2999MHz bandswitch H) Antenna tuner 2-2.2999MHz bandswitch J) Antenna tuner 2.3-2.5999MHz bandswitch K) Transmitter 2.3-2.5999MHz bandswitch L) Transmitter 3-3.999MHz bandswitch M) Transmitter 2-2.2999MHz bandswitch N) Not used P) Not used R) Not used S) Transmitter 8-11.999MHz bandswitch T) Transmitter 2.6-2.9999MHz bandswitch U) Transmitter 12-15.999MHz bandswitch V) Not used W) Transmitter 16-23.999MHz bandswitch X) Not used Y) Transmitter 24-29.999MHz bandswitch Z) Ground

* * * * * NOTE * * * * *
 Facing the exciter rear panel, the J127 PCB connector terminals are read from right to left with the numbers (1-10) on the bottom and the letters (A-Z omitting G and I) on the top. Components are on the bottom side.
 * * * * * ***** * * * * *

J127	AUDIO/KEYING	Input connector for audio/keying interface with external equipment. 1) USB 600-ohm input terminal 2) USB 600-ohm center-tap terminal 3) USB 600-ohm input terminal 4) Ground 5) Push to Talk (PTT) terminal for relay contacts to external equipment. 6) Contact terminal for FSK operation. 7) LSB 600-ohm input terminal 8) LSB 600-ohm center-tap terminal 9) LSB 600-ohm input terminal 10) CW keying line
------	--------------	--

TABLE 2-1
REAR PANEL CONNECTIONS
(Cont'd.)

<u>Designation</u>	<u>Description</u>	<u>Function</u>
J127 (Cont'd)	AUDIO/KEYING	A) FAX input terminal B) FAX input terminal (Ground) C) Ground D) Ground E) FSK negative loop input terminal F) FSK positive loop input terminal H) Not used J) Not used K) Not used L) Not used
* * * * * NOTE * * * * * Facing the exciter rear panel, the J128 PCB connector terminals are read from the bottom to top with numbers (1-22) on the left and letters (A-Z omitting G,I,O,Q) on the right. The component side is on the left. * * * * * **** * * * * *		
J128 (Option)	REMOTE	Input/output connector for remote control of the exciter and accessories. 1) thru 3) 10MHz switch control 4) thru 8) 1MHz switch control 9) thru 13) 100KHz switch control 14) thru 18) 10KHz switch control 19) Ground 20) thru 22) Not used A) thru E) 1KHz switch control F) thru L) 100Hz switch control (Omit G,I) M) thru S) Mode switch control (Omit O,Q) T) 10MHz BIT 4 switch control U) thru V) Carrier switch control W) Ground X) 10MHz BIT 1 switch control Y) thru Z) Not used

SECTION 3
OPERATING INSTRUCTIONS

3.1 General Considerations

3.1.1 The MMX-2 exciter provides rapid RF frequency selection of AM, USB, LSB or two-channel ISB intelligence in the 1.6 to 29.9999MHz transmission range. Selection of frequency over this range is accomplished in incremental steps of 100Hz using six front-panel frequency select switches. In addition, the exciter contains provisions for operating CW, FSK and FAX modes. This selection is made by using a front-panel mode switch.

3.1.2 This section presents pertinent information for the operation of the exciter. Included are the functions of all controls and indicators; check-out procedures including pre-operational adjustments and control settings; step-by-step operating procedures for each function the exciter performs; emergency operating procedures; and shut-down procedures.

3.2 Controls and Indicators

3.2.1 All operator controls and indicators are located on the front and rear panels of the exciter. Figures 3-1 and 3-2 illustrate the front and rear panels respectively. Table 3-1 presents a listing of the front panel controls and indicators with an explanation of the function of each. In the same manner, Table 3-2 lists the rear panel controls.

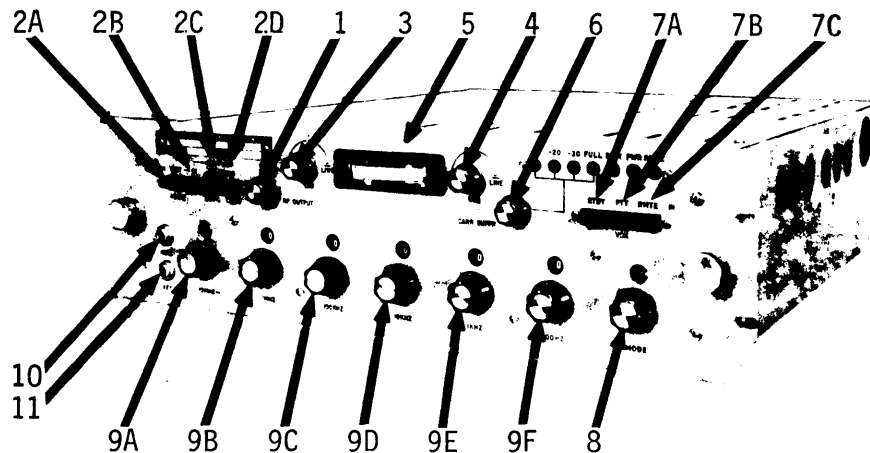


Figure 3-1. Front panel controls and indicators

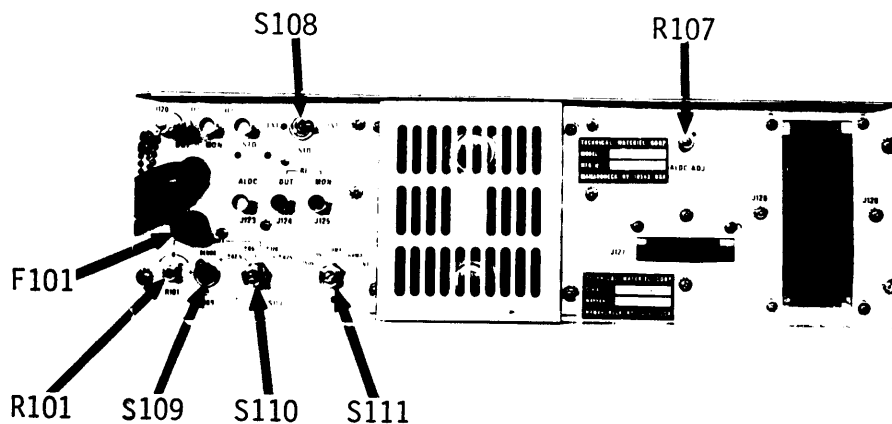


Figure 3-2. Rear panel controls.

3.3 Initial Checkout

3.3.1 The MMX-2 exciter is completely aligned and checked prior to shipment and requires no pre-operational adjustments. Upon receipt at the operating site, the initial checkout procedure outlined below should be executed. If an obvious malfunction is detected, refer to Section 5 Maintenance Instructions for proper corrective action.

3.3.2 The following test equipment is required for the initial check-out of the exciter.

Vacuum Tube Voltmeter Hewlett-Packard 410B or equal

Audio Oscillator Hewlett-Packard 200CD or equal

3.3.3 To verify the exciter operation on a minimum performance basis, the following initial checkout procedure should be followed.

* * * * * CAUTION * * * * *
 Make certain the STANDBY/OPERATE pushbutton (7A) is in the STANDBY (In) position. The power supply is energized when the power cable is connected to the appropriate power source with the STANDBY/OPERATE switch in either the STANDBY or OPERATE position.
 * * * * * ***** * * * * *

3.3.3.1 Connect the source of line power to connector J116 through the power cord provided. The red STBY lamp in the upper right-hand sector illuminates.

TABLE 3-1

FRONT PANEL CONTROLS AND INDICATORS

<u>Index</u>	<u>Control/Indicator</u>	<u>Function</u>
1	RF OUTPUT	Adjusts RF output power level
2	METER SWITCH	Four-position pushbutton switch for selecting internal circuits to be monitored on front panel meter
2A	TEST AF/RF	Controls monitoring of output transistors Controls monitoring of input audio level or RF output level.
2B	Q1	Controls monitoring of Q1 transistor collector current (350ma).
2C	Q2 RF AF	Controls monitoring of Q2 transistor collector current (130ma). Controls monitoring of RF output level. Controls monitoring of SSB audio input levels with Switch 2D.
2D	Q3 USB LSB	Controls monitoring of Q3 transistor collector current (65ma). Controls monitoring of USB audio input. Controls monitoring of LSB audio input.

* * * * * NOTE * * * * *

Use the following chart as a guide in operating Meter Switches. If a switch combination is not listed, the meter reading is not valid and should not be used.

POSITION	SWITCH				METER READING
	2A	2B	2C	2D	
	IN	IN	OUT	OUT	Q1 Collector Current
	IN	OUT	IN	OUT	Q2 Collector Current
	IN	OUT	OUT	IN	Q3 Collector Current
	OUT	N/A	IN	N/A	RF Output Power Level
	OUT	N/A	OUT	IN	USB Audio Input Level
	OUT	N/A	OUT	OUT	LSB Audio Input Level

N/A = Switch is out of the circuit and does not affect the meter readings.

* * * * * ***** * * * * *

TABLE 3-1

FRONT PANEL CONTROLS AND INDICATORS
(Cont'd.)

<u>Index</u>	<u>Control/Indicator</u>	<u>Function</u>
3	LSB MIKE/LINE	Adjusts level of LSB input
4	USB MIKE/LINE	Adjusts level of USB input
5	METER	Monitors circuit function selected by meter switches 2A-2D.
6	CARR SUPPR	Establishes the amount of carrier used by setting suppression levels at -20/-30/FULL (-55db) or others as required. A rotary three-position switch controls pre-set level and LED indicators display level value.
7	OPERATION SWITCH	Three-position pushbutton switch for selecting operating conditions.
7A	STANDBY	Controls application of power to all operating circuits. STANDBY (In) condition applies power to 1MHz frequency standard only while the OPERATE (Out) position applies power throughout exciter. STBY LED indicator displays for STANDBY condition and PWR indicator for an OPERATE condition.
7B	PTT	Controls use of Push to Talk (PTT) circuits to key exciter when a MIKE input is used. Switch is "In".
	VOX	Controls used of Voice Operated Relay circuits to key exciter when any mode other than a MIKE input is used. Switch is "Out".
7C	REMOTE	Controls local/remote feature of exciter. Exciter control is local with switch "Out"; remote with switch "In".
8	MODE	Rotary multi-contact switch that is used to select one of seven operating modes based on options supplied. Available modes include CW, AM, USB, LSB, 2ISB, FSK and FAX.

TABLE 3-1

FRONT PANEL CONTROLS AND INDICATORS
(Cont'd.)

<u>Index</u>	<u>Control/Indicator</u>	<u>Function</u>
3	LSB MIKE/LINE	Adjusts level of LSB input
4	USB MIKE/LINE	Adjusts level of USB input
5	METER	Monitors circuit function selected by meter switches 2A-2D.
6	CARR SUPPR	Establishes the amount of carrier used by setting suppression levels at -20/-30/FULL (-55db) or others as required. A rotary three-position switch controls pre-set level and LED indicators display level value.
7	OPERATION SWITCH	Three-position pushbutton switch for selecting operating conditions.
7A	STANDBY	Controls application of power to all operating circuits. STANDBY (In) condition applies power to 1MHz frequency standard only while the OPERATE (Out) position applies power throughout exciter. STBY LED indicator displays for STANDBY condition and PWR indicator for an OPERATE condition.
7B	PTT	Controls use of Push to Talk (PTT) circuits to key exciter when a MIKE input is used. Switch is "In".
	VOX	Controls used of Voice Operated Relay circuits to key exciter when any mode other than a MIKE input is used. Switch is "Out".
7C	REMOTE	Controls local/remote feature of exciter. Exciter control is local with switch "Out"; remote with switch "In".
8	MODE	Rotary multi-contact switch that is used to select one of seven operating modes based on options supplied. Available modes include CW, AM, USB, LSB, 2ISB, FSK and FAX.

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

<u>Index</u>	<u>Control/Indicator</u>	<u>Function</u>
9	FREQUENCY	Controls internal oscillators that are used to establish the desired operating carrier frequency.
9A	10MHZ	Controls selection of 10MHz digits (0-2)
9B	1MHZ	Controls selection of 1MHz digits (0-9)
9C	100KHZ	Controls selection of 100KHz digits (0-9)
9D	10KHZ	Controls selection of 10KHz digits (0-9)
9E	1KHZ	Controls selection of 1KHz digits (0-9)
9F	100HZ	Controls selection of 100Hz digits (0-9)
10	MIKE JACK	Input jack for a 47K-ohm microphone.
11	KEY JACK	Input jack for a dry contact CW keyer.

TABLE 3-2
REAR PANEL CONTROLS

<u>Index</u>	<u>Control</u>	<u>Function</u>
S108	EXT/INT STD	Selects either the internal or an external 1MHz standard signal source.
R107	ALDC ADJ	Controls internal ALDC voltages.
F101	LINE FUSE	Controls continuity of power for exciter. 1.0 ampere rating for 115VAC power. 0.5 ampere rating for 230VAC power.
R101	SHIFT CAL	Used for precision calibration of MARK/ SPACE frequency shift.
S109	SHIFT SENSE	Establishes sense + (positive) or - (negative) in the FSK operating mode.
S110	SHIFT	Determines the "mark" and "space" frequency shift above or below the carrier frequency. Switch selected at ± 42.5 , 85, 170 and 425Hz.
S111	F/S LOOP	Selects proper FSK loop input: 110 volts, 50 volts, 20 ma, 60 ma, CONT.

- 3.3.3.2 Position the RF OUTPUT control (1) fully counter-clockwise.
- 3.3.3.3 Using the six frequency select switches (9A-9F), set the output signal frequency to 29.9999MHz.
- 3.3.3.4 Rotate the CARR SUPPR switch (6) fully counter-clockwise.
- 3.3.3.5 Rotate the mode switch (8) to the ISB position.
- 3.3.3.6 Center the USB Line/Mike (3) and LSB Line/Mike (4) controls to the "0" position.
- 3.3.3.7 Set (In) meter switches TEST (2A) and Q1 (2B).
- 3.3.3.8 Connect the audio oscillator to the rear panel USB 600-ohm terminals J127-1/2/3. If the exciter is equipped with the LSB feature, connect also to the LSB 600-ohm terminals J127-7/8/9. Adjust the audio frequency for 1000 ± 50 Hz at 10 ± 0.5 volts.
- 3.3.3.9 Release (Out) the STANDBY switch (7A) by depressing it momentarily. The STBY indicator lamp extinguishes. The PWR indicator and the first CARR SUPPR indicator displays red indicating the exciter is in the OPERATE position
- 3.3.3.10 Verify that the meter indicates in the green region marked Q1. (See Figure 3-3).
- 3.3.3.11 Release the meter switch at Q1 and set (In) at Q2. The meter now indicates in the green region marked Q2.
- 3.3.3.12 Release the meter switch at Q2 and set (In) at Q3. The meter now indicates in the green region marked Q3.

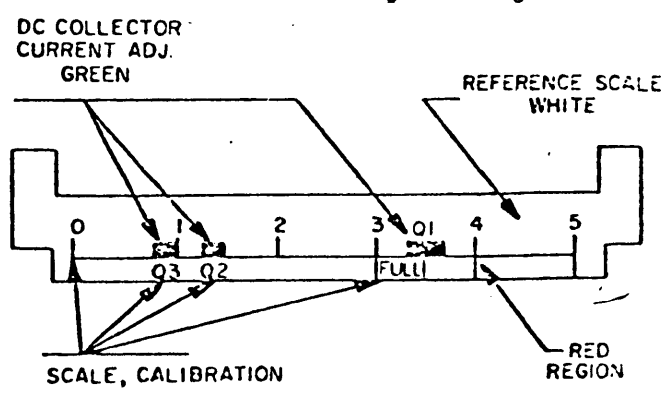


Figure 3-3. Exciter monitor meter scale.

- 3.3.3.13 Release (Out) the meter switches TEST (2A) and Q3 (2D). Set the meter switch RF (2C). The meter indicates zero with the RF OUTPUT control fully counter-clockwise.
- 3.3.3.14 Connect the VTVM to the RF OUT jack J126 across a 50-ohm load resistor.
- 3.3.3.15 Adjust the RF OUTPUT control for a minimum indication of 3.5 volts on the VTVM.
- 3.3.3.16 Release the meter switch RF (2C) and set USB (2D). Adjust the USB Line/Mike control for an indication of 2/5 full scale on the meter.
- 3.3.3.17 Release the meter switch USB (2D). Adjust the LSB Line/Mike control for an indication of 2/5 full scale on the meter.
- 3.3.3.18 Set the meter switch RF (2C). The meter indicates zero.
- 3.3.3.19 Rotate the CARR SUPPR switch clockwise. The meter indication increases to FULL when the carrier control is fully clockwise.
- 3.3.3.20 Disconnect all test equipment and remove power from the MMX-2 exciter.

3.4 Operating Procedures

3.4.1 The following procedure should be followed when placing the exciter in operation.

* * * * * CAUTION * * * * *

Verify that the STANDBY/OPERATE switch (7A) is depressed and set in the STANDBY position (In). In addition, all meter switches should be in the released (Out) position.

* * * * * ***** * * * * *

- 3.4.1.1 Connect the source of 115 or 230VAC, 50/60/400Hz, single-phase power, as appropriate, to the exciter rear panel connector J116 through the power cord provided. Observe that the front panel STBY indicator illuminates red.
- 3.4.1.2 Make the necessary interface connections from the rear panel connectors to the transmitter, audio/keying units, and optional remote units.

- 3.4.1.3 Turn RF OUTPUT control fully counter-clockwise before selecting different modes of operation.
- 3.4.2 The following procedure should be followed for single sideband operation with any degree of carrier insertion including AME full carrier.
- 3.4.2.1 Set the STANDBY/OPERATE switch (7A) to the OPERATE (Out) position. STBY lamp extinguishes and PWR lamp illuminates red.
- 3.4.2.2 Set PTT/VOX switch (7B) to the VOX (Out) position when using either USB or LSB 600-ohm line inputs. Set PTT/VOX switch to PTT (In) position when using the MIKE input.
- 3.4.2.3 Select the desired sideband with the MODE switch (8).
- 3.4.2.4 Set meter switch to monitor the audio input level of the desired sideband. Refer to the chart, page 3-3.
- 3.4.2.5 Connect a mike to the front panel MIKE jack if used.
- 3.4.2.6 Adjust the Mike/Line control of the sideband used to the appropriate level as indicated on the meter.
- * * * * * CAUTION * * * * *
- DO NOT ENTER THE RED REGION ON THE METER. When the mike input is used, adjust the level so as not to exceed red region with the highest input from the microphone.
- * * * * * ***** * * * * *
- 3.4.2.7 Select desired carrier suppression level with CARR SUPPR switch (6).
- 3.4.2.8 Set the meter switch RF/AUDIO (2C) to the RF position.
- 3.4.3 The following procedure should be followed for independent sideband with any degree of carrier.
- 3.4.3.1 Set the STANDBY/OPERATE switch to the OPERATE position.
- 3.4.3.2 Set the PTT/VOX switch (7B) to the VOX position when using either the USB or LSB 600-ohm line input. Set this switch to the PTT position when using the MIKE jack input on the front panel.
- 3.4.3.3 Set the USB and LSB Mike/Line controls to zero.

- 3.4.3.4 Select the ISB position on the MODE switch (8).
- 3.4.3.5 Set the meter switches for monitoring the LSB audio input level. Refer to chart, page 3-3 for the correct settings. Adjust the Line/Mike LSB control for a meter indication up but not exceeding the red region.
- 3.4.3.6 Repeat the previous step for the USB input.
- 3.4.3.7 Set the RF/AUDIO meter switch the RF position and adjust the RF OUTPUT control for the desired level of RF output as indicated on the meter.
- 3.4.4 The following procedure should be followed for conventional AM operation of the exciter.
 - 3.4.4.1 Set the STANDBY/OPERATE switch to the OPERATE position.
 - 3.4.4.2 Set the PTT/VOX switch to the VOX position when using either USB or LSB line inputs. Set the switch to the PTT position when using the MIKE input jack.
 - 3.4.4.3 Set the MODE switch (8) to the AM position.
 - 3.4.4.4 Connect a microphone to the MIKE jack if used.
 - 3.4.4.5 Adjust the Mike/Line control of the sideband used to the appropriate level on the meter. Refer to the chart, page 3-3, for correct switching.
 - 3.4.4.6 Set the RF/AUDIO meter switch to the RF position. Vary the RF OUTPUT control for the desired level of RF output as indicated on the meter.
- 3.4.5 The following procedure should be followed for Frequency Shift teletype operation.
 - 3.4.5.1 Connect the external dry contact keyer to CONT terminals (6) and (D) on J127. If a teletype unit is used, connect to FSK terminals (E) and (F).
 - 3.4.5.2 Set the STANDBY/OPERATE switch to OPERATE.
 - 3.4.5.3 Rotate the MODE switch to the FSK position.

- 3.4.5.4 Select the appropriate FSK operation by setting the FS LOOP (S109) and SHIFT (S110) switches to the appropriate positions.
- 3.4.5.5 Place the SHIFT SENSE switch to the desired sense, + or -, on the rear panel (S111).
- 3.4.5.6 Set the meter switch RF/AUDIO to the RF position. Adjust the RF OUTPUT control for the desired RF output level as indicated on the meter.
- 3.4.6 The following procedure should be followed for facsimilie operation.
 - 3.4.6.1 Connect the FAX machine to J127 terminals (A) and (B) on the rear panel.
 - 3.4.6.2 Set the STANDBY/OPERATE switch to OPERATE.
 - 3.4.6.3 Rotate the MODE switch to the FAX position.
 - 3.4.6.4 Set the meter switch RF/AUDIO to RF and adjust the RF OUTPUT control for the desired level as indicated on the meter.
- 3.4.7 The following procedure should be used for CW telegraph operation.
 - 3.4.7.1 Set the STANDBY/OPERATE switch to OPERATE.
 - 3.4.7.2 Rotate the MODE switch to the CW position.
 - 3.4.7.3 Connect the key to the input jack (11) on the front panel or to the key input terminals (10) and (C) on J127 at the rear panel.

3.5 Emergency Operation

3.5.1 The exciter operation can be continued under certain conditions when a circuit fails. For example, a failure of the step generator may affect only one range of output frequencies. If the failure is not common to all three ranges, operation of the exciter can continue on the remaining two ranges without interruption. Certain audio amplifier failures, such as AM, will not affect microphone or USB/LSB line audio inputs - provided that the 250KHz subcarrier is still intact. Similarly, if one sideband audio circuit fails, intelligence can still be transmitted on the other provided the 250KHz subcarrier is still present. If the 250KHz subcarrier or the 2.75MHz carrier fails, operation can continue in the FSK and/or FAX modes.

This is only possible if the 3MHz amplifier circuit on Z108 is operational. If an FSK failure occurs, which does not affect the 3MHz VCX0, operation in the FAX mode is still possible. In general, any failure of the modulated 3MHz subcarrier input to translator Z112 will prohibit operation of the exciter.

3.6 Shut-Down Procedures

3.6.1 To discontinue the exciter operation, simply set the STANDBY/OPERATE switch to the STANDBY position and disconnect primary power from J116 on the rear panel.

SECTION 4

PRINCIPLES OF OPERATION

4.1 Introduction

4.1.1 This section presents the theory of operation for the exciter and is divided into three parts. The first part describes the frequency synthesis technique used on the equipment and provides a typical selected frequency sample to illustrate operation of the synthesizer circuits. The second part presents a block diagram description of the equipment to specify which component boards are responsible for generating each of the exciter functions and to define signal flow between component board assemblies. This discussion is based upon simplified block and signal flow diagrams. The third part presents a detailed description of the individual circuits to better understand exciter operation and to identify the associated circuit controls and adjustments for operation and maintenance. These discussions are referenced to the interconnection and schematic diagrams that are contained in Section 6.

4.2 Frequency Synthesis

4.2.1 Six front-panel frequency selector switches provide selection of the carrier frequency in 100Hz increments from 1.6 to 29.9999MHz. The synthesizer uses a precision 1MHz signal from which are developed other basic signal frequencies, which in turn are used to synthesize the RF carrier output. The basic signal frequencies are applied to mixer-divider and mixer-multiplier circuits to derive discrete RF frequencies. A typical frequency synthesis is shown in Figure 4-1 to illustrate the synthesis process. Figure 4-1 illustrates a selected frequency of 21.7146MHz. The appropriate switch positions are shown darkened on the diagram. The basic 8MHz signal is mixed with the basic 1MHz signal to produce 9MHz. This is then mixed with the 100Hz switch-selected 1.6MHz signal to produce 10.6MHz which, when divided by 10, produces 1.06MHz. The "6" is the least significant digit of the desired frequency. The 1.06MHz frequency is then mixed with the basic 8MHz signal to produce 9.06MHz. This is mixed with the 1KHz switch-selected 1.4KHz signal to produce 10.46MHz which, when divided by 10, produces 1.046MHz. The "4" is the next significant digit of the desired frequency. The 1.046MHz frequency is then mixed with the basic 8MHz signal to produce 9.046MHz. This is mixed with the 10KHz switch-selected 1.1MHz signal to produce 10.146MHz which, when divided by 10, produces a 1.0146MHz signal. The "1" is the next significant figure of the desired frequency. The 1.0146MHz is then mixed with the basic 8MHz signal to produce 9.0146MHz. This is mixed with the 100KHz switch-selected 1.7MHz signal to produce a 10.7146MHz signal.

4.2.2 Generation of the two most significant digits (10MHz and 1MHz) is done in a different manner than the least four significant digits. These circuits use frequency multipliers and mixers to produce the desired frequencies. The selected 10.7146MHz signal is first mixed with the 3MHz

modulation frequency to produce a 13.7146MHz frequency. This 3MHz frequency is varied by the selected modulation to provide carrier frequency deviations in response to the selected modulation mode. However, for this discussion only, the center 3MHz frequency is described. The 13.7146MHz frequency is mixed with a 120MHz basic signal derived by multiplying the 40MHz basic signal by three. The output of the mixer will then be 133.7146MHz. The 1MHz switch-selected 0.8MHz signal is mixed with the 10MHz switch-selected 12MHz signal to produce an 11.2MHz frequency. This is first multiplied by five to produce 56MHz, and then multiplied by two to produce 112MHz. The 112MHz frequency is then mixed with the 133.7146MHz frequency to produce the final 21.7146MHz carrier signal. The 10MHz selector switch selects a 14MHz basic signal for the "0" digit position which is used to derive the 01MHz to 10MHz range of frequencies. A 13MHz basic signal is selected in the "1" digit position of the 10MHz selector to derive the 11MHz to 20MHz range of frequencies. The 12MHz basic signal is selected in the "2" digit position which is used to derive the 21MHz to 29MHz range of frequencies. The derivation of each of these discrete frequencies is listed in Table 4-1. The derivation of the 21MHz frequency is illustrated in Figure 4-1.

4.3 Block Diagram Analysis

4.3.1 The exciter is capable of providing amplitude-modulated (AM) operation; single-sideband suppressed-carrier (SSSC) or conventional single-sideband (SSB) operation; independent sideband (ISB) operation; continuous wave (CW) operation; frequency shift keyer (FSK) operation; and facsimile (FAX) operation. The RF output appears in the 1.6KHz to 29.9999MHz frequency range, and is selected in discrete 100Hz increments by means of six frequency selector switches. The exciter includes a spectrum generator; two comb filters; a frequency select switching network; a single mixer-divider; a dual mixer-divider; a final mixer; three step generators; a double-sideband generator; a carrier generator and AM amplifier; a frequency shift generator and converter; an RF translator and ALDC circuit; an RF output amplifier; a mode-switching network; and a power supply assembly. The following paragraphs present brief descriptions of each network assembly.

4.3.2 The spectrum generator (Z101) develops seven fundamental output frequencies which are derived from a stable 1MHz standard in the power supply assembly. Firstly, the 1MHz input is amplified and sent to the mixer-divider circuits for formulation of four discrete decimal integers to enable frequency selection in 100Hz steps. Secondly, the 1MHz input is clipped, divided by a factor of 10, and applied to a 100KHz spectrum generator. This output, containing the 100KHz fundamental plus harmonics, is applied to the comb filter circuits. Finally the 1MHz input is squared to produce a 1MHz spectrum containing the required harmonics for generation of four additional output frequencies of 8, 12, 13 and 14MHz. The 8MHz output is applied to the mixer-divider sections as the fundamental input frequency,

NOTE:

A SELECTED FREQUENCY OF 21.7146 IS SHOWN TO ILLUSTRATE THE SYNTHESIS PROCESS; THE CORRESPONDING SWITCH POSITIONS ARE SHOWN DARKENED.

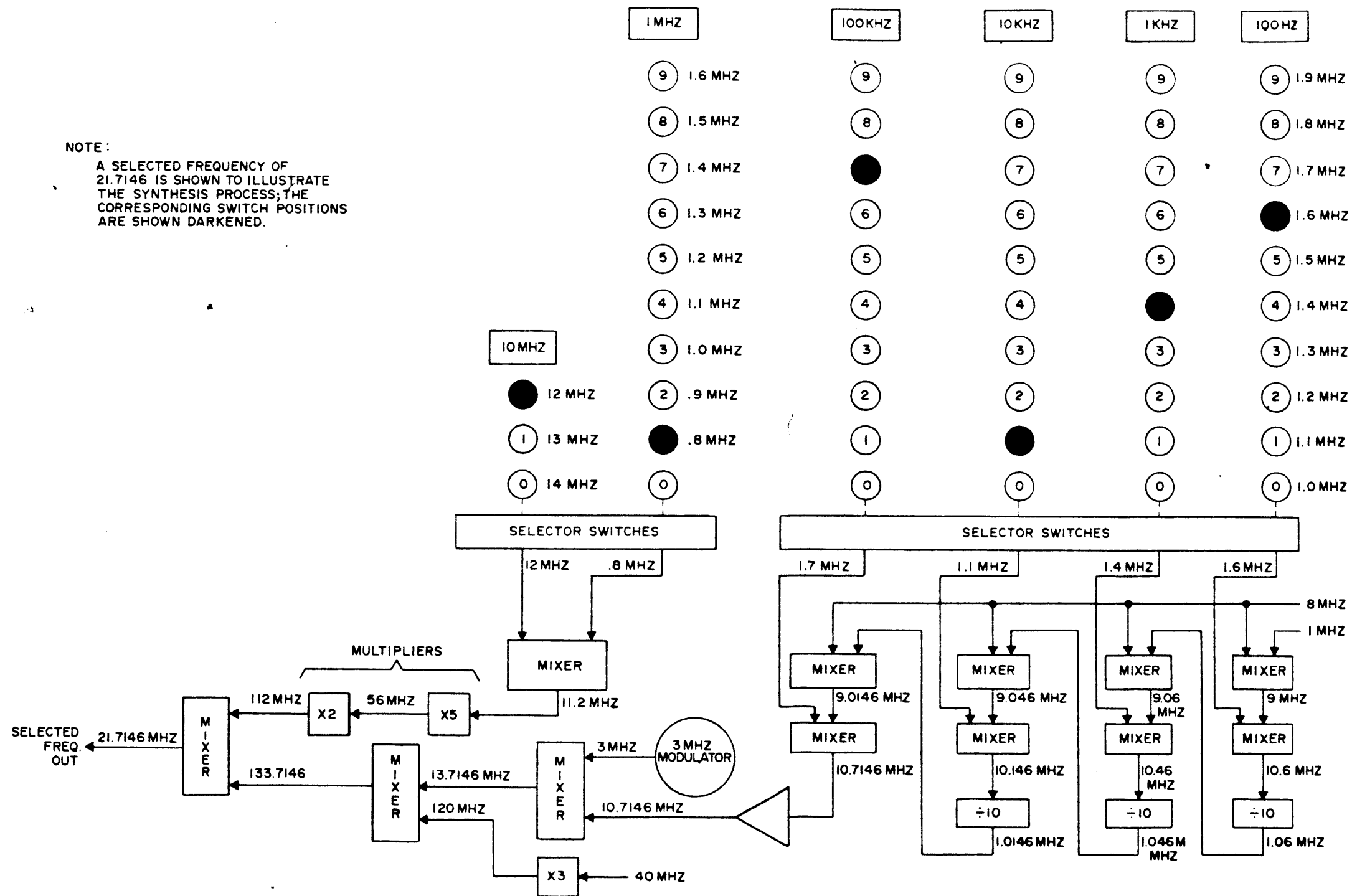


Figure 4-1. Frequency synthesis example

TABLE 4-1
FREQUENCY SYNTHESIS DERIVATION

$\begin{array}{r} 14.0 \\ - .8 \\ \hline 13.2 \\ \times 5 \\ \hline 66.0 \\ \times 2 \\ \hline 132.0 \\ \downarrow \\ 133.0 \\ -132.0 \\ \hline 01 \text{ MHz} \end{array}$	$\begin{array}{r} 14.0 \\ - .9 \\ \hline 13.1 \\ \times 5 \\ \hline 65.5 \\ \times 2 \\ \hline 131.0 \\ \downarrow \\ 133.0 \\ -131.0 \\ \hline 02 \text{ MHz} \end{array}$	$\begin{array}{r} 14.0 \\ -1.0 \\ \hline 13.0 \\ \times 5 \\ \hline 65.0 \\ \times 2 \\ \hline 130.0 \\ \downarrow \\ 133.0 \\ -130.0 \\ \hline 03 \text{ MHz} \end{array}$	$\begin{array}{r} 14.0 \\ -1.1 \\ \hline 12.9 \\ \times 5 \\ \hline 64.5 \\ \times 2 \\ \hline 129.0 \\ \downarrow \\ 133.0 \\ -129 \\ \hline 04 \text{ MHz} \end{array}$	$\begin{array}{r} 14.0 \\ -1.2 \\ \hline 12.8 \\ \times 5 \\ \hline 64.0 \\ \times 2 \\ \hline 128.0 \\ \downarrow \\ 133.0 \\ -128 \\ \hline 05 \text{ MHz} \end{array}$	$\begin{array}{r} 14.0 \\ -1.3 \\ \hline 12.7 \\ \times 5 \\ \hline 63.5 \\ \times 2 \\ \hline 127.0 \\ \downarrow \\ 133 \\ -127 \\ \hline 06 \text{ MHz} \end{array}$	$\begin{array}{r} 14.0 \\ -1.4 \\ \hline 12.6 \\ \times 5 \\ \hline 63.0 \\ \times 2 \\ \hline 126.0 \\ \downarrow \\ 133 \\ -126 \\ \hline 07 \text{ MHz} \end{array}$	$\begin{array}{r} 14.0 \\ -1.5 \\ \hline 12.5 \\ \times 5 \\ \hline 62.5 \\ \times 2 \\ \hline 125.0 \\ \downarrow \\ 133 \\ -125 \\ \hline 08 \text{ MHz} \end{array}$	$\begin{array}{r} 14.0 \\ -1.6 \\ \hline 12.4 \\ \times 5 \\ \hline 62.0 \\ \times 2 \\ \hline 124.0 \\ \downarrow \\ 133 \\ -124 \\ \hline 09 \text{ MHz} \end{array}$	$\begin{array}{r} 14.0 \\ -1.7 \\ \hline 12.3 \\ \times 5 \\ \hline 61.5 \\ \times 2 \\ \hline 123.0 \\ \downarrow \\ 133 \\ -123 \\ \hline 10 \text{ MHz} \end{array}$
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$\begin{array}{r} 13.0 \\ - .8 \\ \hline 12.2 \\ \times 5 \\ \hline 61.0 \\ \times 2 \\ \hline 122 \\ \downarrow \\ 133.0 \\ -122.0 \\ \hline 11 \text{ MHz} \end{array}$	$\begin{array}{r} 13.0 \\ - .9 \\ \hline 12.1 \\ \times 5 \\ \hline 60.5 \\ \times 2 \\ \hline 121 \\ \downarrow \\ 133 \\ -121 \\ \hline 12 \text{ MHz} \end{array}$	$\begin{array}{r} 13.0 \\ -1.0 \\ \hline 12.0 \\ \times 5 \\ \hline 60.0 \\ \times 2 \\ \hline 120 \\ \downarrow \\ 133 \\ -120 \\ \hline 13 \text{ MHz} \end{array}$	$\begin{array}{r} 13.0 \\ -1.1 \\ \hline 11.9 \\ \times 5 \\ \hline 59.5 \\ \times 2 \\ \hline 119 \\ \downarrow \\ 133 \\ -119 \\ \hline 14 \text{ MHz} \end{array}$	$\begin{array}{r} 13.0 \\ -1.2 \\ \hline 11.8 \\ \times 5 \\ \hline 59.0 \\ \times 2 \\ \hline 118 \\ \downarrow \\ 133 \\ -118 \\ \hline 15 \text{ MHz} \end{array}$	$\begin{array}{r} 13.0 \\ -1.3 \\ \hline 11.7 \\ \times 5 \\ \hline 58.5 \\ \times 2 \\ \hline 117 \\ \downarrow \\ 133 \\ -117 \\ \hline 16 \text{ MHz} \end{array}$	$\begin{array}{r} 13.0 \\ -1.4 \\ \hline 11.6 \\ \times 5 \\ \hline 58.0 \\ \times 2 \\ \hline 116 \\ \downarrow \\ 133 \\ -116 \\ \hline 17 \text{ MHz} \end{array}$	$\begin{array}{r} 13.0 \\ -1.5 \\ \hline 11.5 \\ \times 5 \\ \hline 57.5 \\ \times 2 \\ \hline 115 \\ \downarrow \\ 133 \\ -115 \\ \hline 18 \text{ MHz} \end{array}$	$\begin{array}{r} 13.0 \\ -1.6 \\ \hline 11.4 \\ \times 5 \\ \hline 57.0 \\ \times 2 \\ \hline 114 \\ \downarrow \\ 133 \\ -114 \\ \hline 19 \text{ MHz} \end{array}$	$\begin{array}{r} 13.0 \\ -1.7 \\ \hline 11.3 \\ \times 5 \\ \hline 56.5 \\ \times 2 \\ \hline 113 \\ \downarrow \\ 133 \\ -113 \\ \hline 20 \text{ MHz} \end{array}$
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$\begin{array}{r} 12.0 \\ - .8 \\ \hline 11.2 \\ \times 5 \\ \hline 56.0 \\ \times 2 \\ \hline 112 \\ \downarrow \\ 133 \\ -112 \\ \hline 21 \text{ MHz} \end{array}$	$\begin{array}{r} 12.0 \\ - .9 \\ \hline 11.1 \\ \times 5 \\ \hline 55.5 \\ \times 2 \\ \hline 111 \\ \downarrow \\ 133 \\ -111 \\ \hline 22 \text{ MHz} \end{array}$	$\begin{array}{r} 12.0 \\ -1.0 \\ \hline 11.0 \\ \times 5 \\ \hline 55.0 \\ \times 2 \\ \hline 110 \\ \downarrow \\ 133 \\ -110 \\ \hline 23 \text{ MHz} \end{array}$	$\begin{array}{r} 12.0 \\ -1.1 \\ \hline 10.9 \\ \times 5 \\ \hline 54.5 \\ \times 2 \\ \hline 109 \\ \downarrow \\ 133 \\ -109 \\ \hline 24 \text{ MHz} \end{array}$	$\begin{array}{r} 12.0 \\ -1.2 \\ \hline 10.8 \\ \times 5 \\ \hline 54.0 \\ \times 2 \\ \hline 108 \\ \downarrow \\ 133 \\ -108 \\ \hline 25 \text{ MHz} \end{array}$	$\begin{array}{r} 12.0 \\ -1.3 \\ \hline 10.7 \\ \times 5 \\ \hline 53.5 \\ \times 2 \\ \hline 107 \\ \downarrow \\ 133 \\ -107 \\ \hline 26 \text{ MHz} \end{array}$	$\begin{array}{r} 12.0 \\ -1.4 \\ \hline 10.6 \\ \times 5 \\ \hline 53.0 \\ \times 2 \\ \hline 106 \\ \downarrow \\ 133 \\ -106 \\ \hline 27 \text{ MHz} \end{array}$	$\begin{array}{r} 12.0 \\ -1.5 \\ \hline 10.5 \\ \times 5 \\ \hline 52.5 \\ \times 2 \\ \hline 105 \\ \downarrow \\ 133 \\ -105 \\ \hline 28 \text{ MHz} \end{array}$	$\begin{array}{r} 12.0 \\ -1.6 \\ \hline 10.4 \\ \times 5 \\ \hline 52.0 \\ \times 2 \\ \hline 104 \\ \downarrow \\ 133 \\ -104 \\ \hline 29 \text{ MHz} \end{array}$
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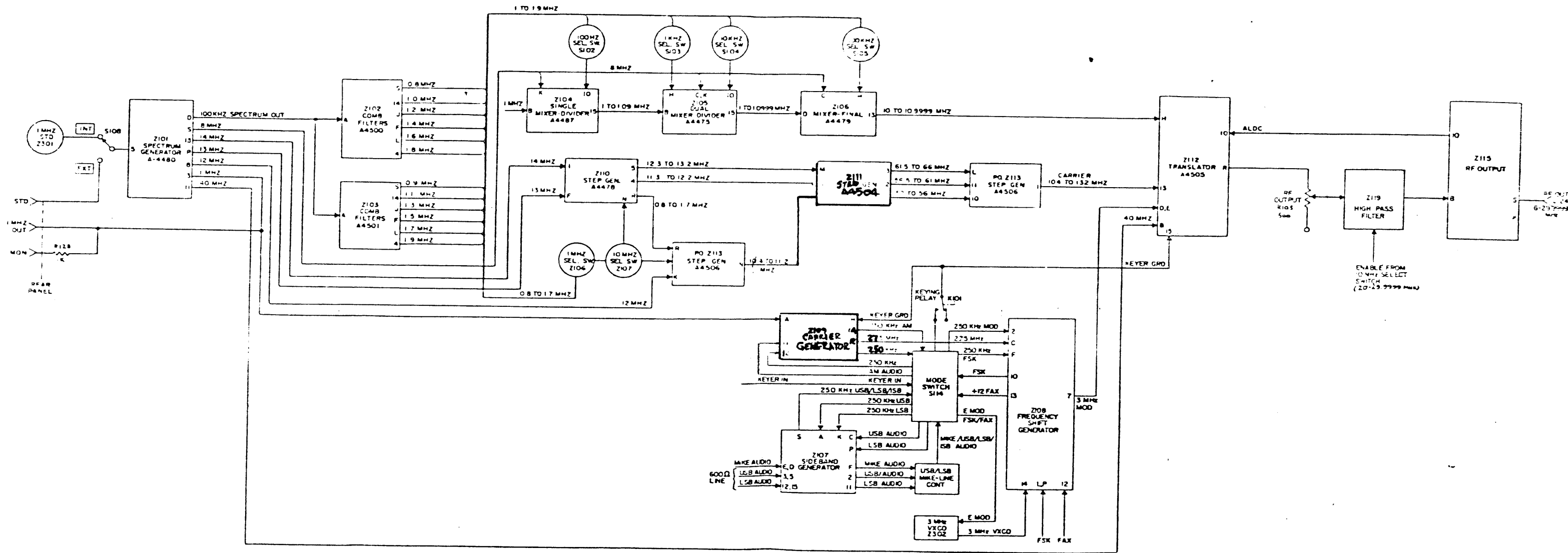


Figure 4-2. Simplified block diagram

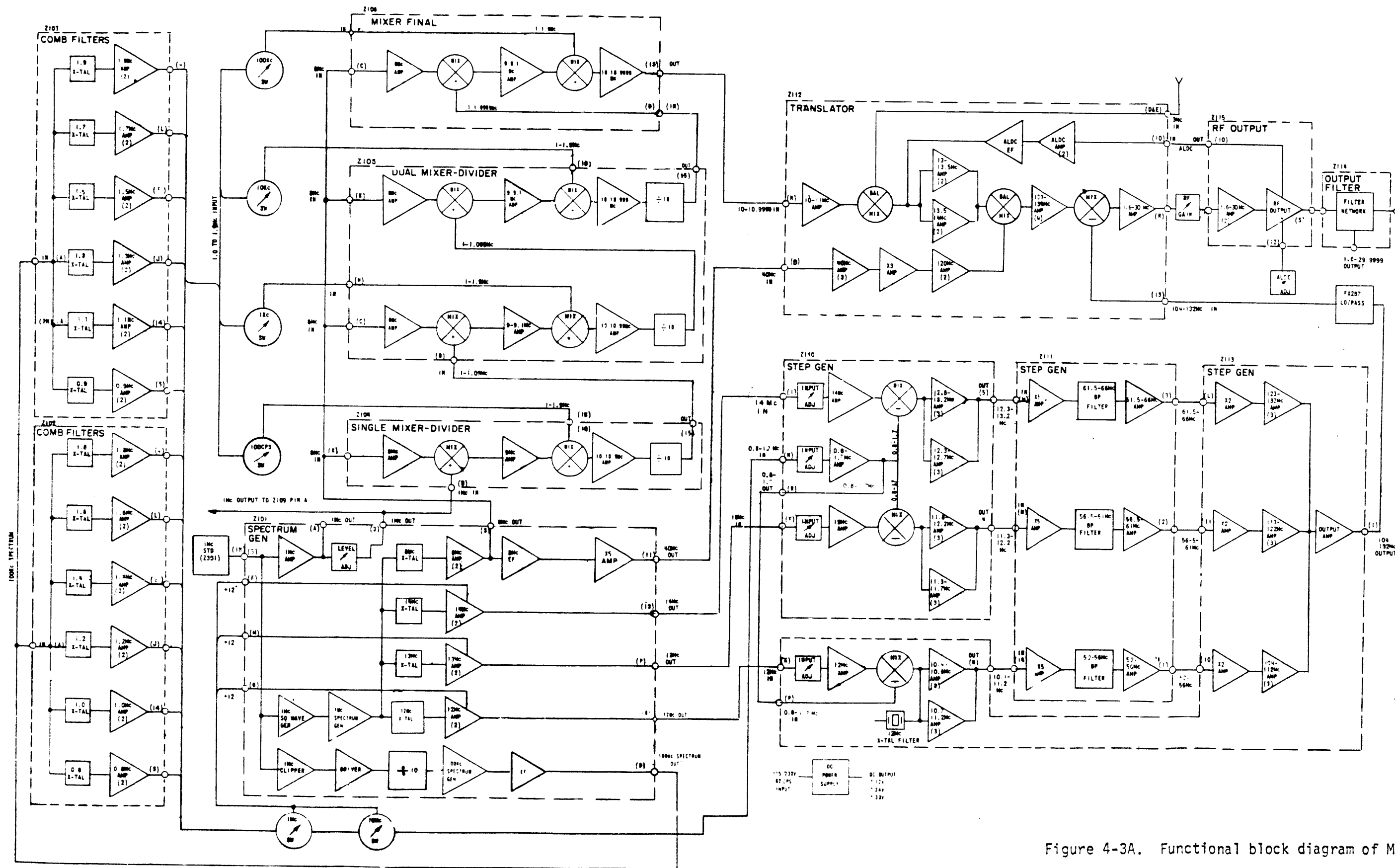


Figure 4-3A. Functional block diagram of MMX-2

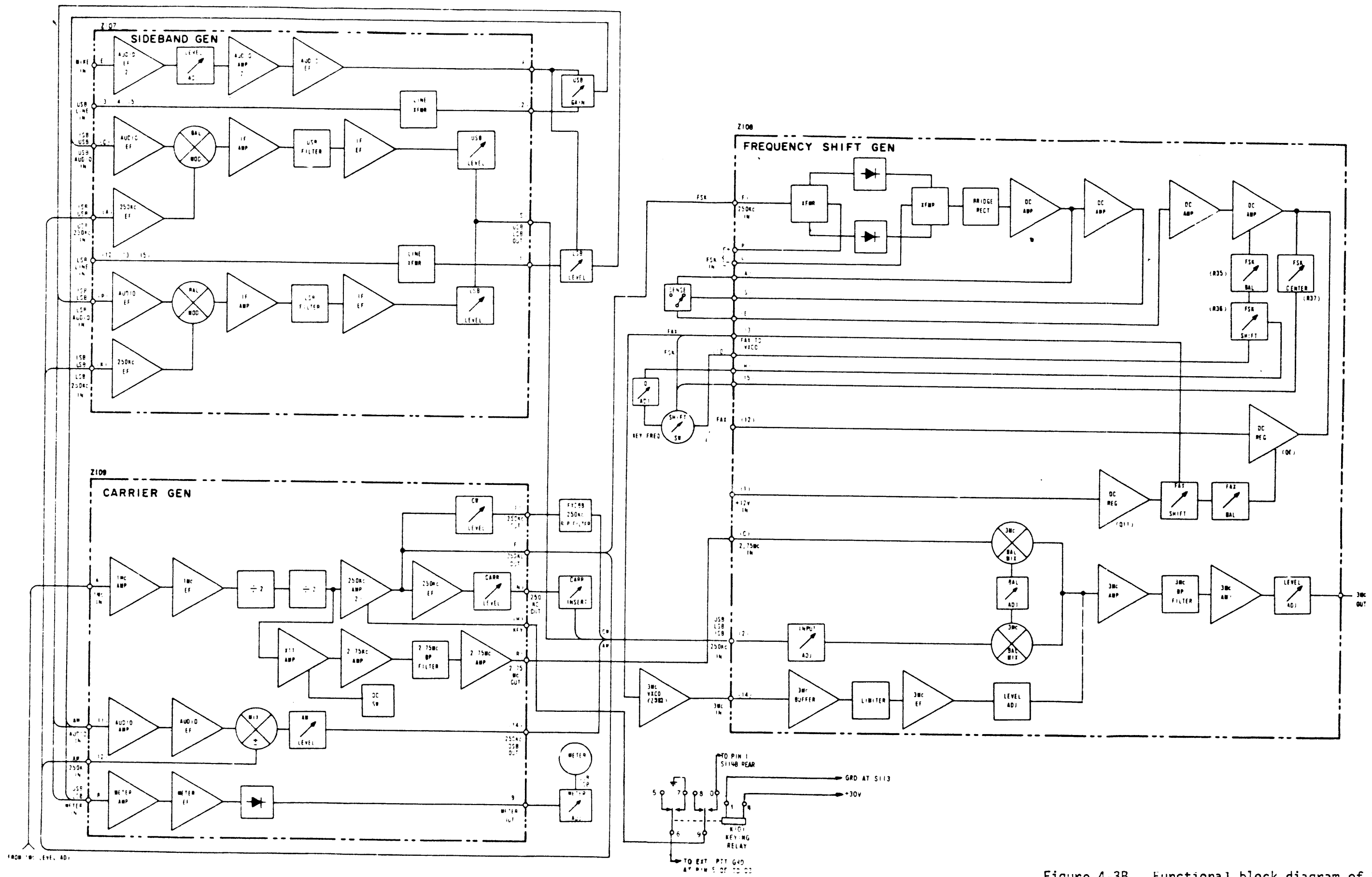


Figure 4-3B. Functional block diagram of MMX-2

and a multiplier which selects the fifth harmonic. This provides the 40MHz output which is coupled to the frequency translator for determination of the final output frequency range. The 12, 13 and 14MHz outputs are sent to the step generator circuits for derivation of the basic difference frequency range for use in the translator.

4.3.3 The 100KHz spectrum output from the spectrum generator is applied to the comb filter sections (Z102) and (Z103). These circuits produce 12 discrete output frequencies from 0.8 to 1.9MHz in 100KHz steps and apply them to the frequency select switch network. These frequencies are generated by exciting corresponding crystal-filters at the appropriate harmonic of the 100KHz spectrum input. The 1.0 to 1.9MHz output range is applied to the 100Hz, 1KHz, 10KHz and 100KHz select switches which control the mixer-divider sections. Only frequencies of 0.8 to 1.7MHz are applied to the 1MHz and 10MHz select switches which control the input to the step generator circuits.

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

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

4.3.6 The carrier generator (Z109) develops a basic sub-carrier or pilot frequency of 250KHz, and a 2.75MHz carrier frequency used for conversion and subsequent translation to an RF output frequency band of 3MHz. It also contains a meter amplifier circuit for upper and lower sideband audio translation to an equivalent level for display on the meter when USB or LSB is selected by the switch. In addition, an AM amplifier circuit is included and provides an audio amplitude-modulated 250KHz output when the AM mode of operation is selected.

4.3.6.1 The carrier generator receives a 1MHz standard frequency input from the power supply assembly via spectrum generator Z101, which is then supplied to both the 250KHz and 2.75MHz frequency generation circuits. In the 250KHz channel, the 1MHz input is divided by four to derive the basic 250KHz subcarrier frequency. A switched ground enable is applied from the mode switching network in the AM, USB, LSB, ISB and FSK modes to enable a 250KHz subcarrier output signal. In the CW mode, the ground enable is interrupted at the key rate thereby producing a 250KHz CW output. The 250KHz output is applied to the mode switching network for distribution to the various sections of the exciter in accordance with the mode switch setting, and to the CARRIER control network for carrier reinsertion when desired. In the FAX mode, the 250KHz channel is disabled.

4.3.6.2 The 2.75MHz channel produces an RF output by dividing the 1MHz input by four and then multiplying the resultant by 11 to derive the 2.75MHz translation frequency. Switched +12VDC to this channel and to the AM amplifier section is controlled by the mode switch and is present in the AM, USB, LSB, ISB and CW positions. The 2.75MHz output is supplied to the converter section of the frequency shift generator for translation to a modulated subcarrier centered at 3MHz.

4.3.6.3 The AM amplifier section develops an amplitude-modulated 250KHz signal in the AM mode of operation and consists of an audio amplifier and mixer circuit. In the AM mode, USB and/or LSB audio is routed to the audio amplifier stage and then to the mixer. The 250KHz subcarrier is amplified and applied to the mixer. The resultant amplitude-modulated 250KHz signal is then routed through the AM position of the mode switch to the 3MHz converter section of the frequency shift generator Z108.

4.3.7 The sideband generator (Z107) includes upper and lower sideband circuits which are similar in configuration and operation. The exception is the tuned frequency of the USB and LSB amplifier circuits. The sideband generator also contains a microphone audio preamplifier and an audio impedance-matching transformer for translation of external applied 600-ohm USB/LSB line audio to a 500-ohm audio output.

4.3.7.1 When a microphone input is used, the front panel VOX/PTT switch is set to the press-to-talk (PTT) position to furnish a PTT ground enable to the

carrier generator via the mode switching network. In all other modes, the switch is set to the VOX position which supplies a ground to the same point except in the case of CW operation. Microphone audio from 250 to 3040Hz (or others as requested) is applied to the sideband generator audio preamplifier circuit and then to the mode switching network for redistribution to either or both of the sideband generator modulator circuits.

4.3.7.2 Similarly, 600-ohm line audio from 250-3040Hz (or others as requested) is translated to a 500-ohm line output and applied to the mode switching network. In the USB, LSB and ISB modes, the audio is routed to the modulation input of the respective sideband generator. In the AM mode, the respective audio signal is applied to the AM generator in carrier generator Z109. USB and LSB audio amplitude is controlled by a respective front panel Mike/Line gain control.

4.3.7.3 The SSB modulation section of the sideband generator accepts both a 250KHz subcarrier input and the USB/LSB audio signal via the mode switch. These two signals are applied to a balanced modulator to derive the upper and/or lower sideband intelligence. The 250KHz subcarrier is suppressed. The resulting USB and/or LSB signals are supplied to the mode switching network and are then routed to the 3MHz converter section of frequency shift generator Z108.

4.3.8 The frequency shift generator (Z108) consists of two sections: the frequency shift generator and the 3MHz converter section. The frequency shift generator section operates in the frequency shift keyer (FSK) and facsimile (FAX) modes. It contains a 3MHz amplifier, a keyer-modulator and DC amplifier section, plus the FAX circuit. FSK operation is controlled by the SHIFT and FS LOOP switches. The 3MHz converter section operates in all other modes except FSK and FAX, and functions to produce an amplitude-modulated (AM) or single-sideband (SSB) RF carrier of 3MHz for use in the frequency translator Z112.

4.3.8.1 In the FSK mode, the 250KHz subcarrier is applied to the keyer modulator which also receives an external teletype input via the FS LOOP switch. Therefore, the subcarrier is effectively modulated by a current input representing teletype marks and spaces. The FS LOOP switch network is set to the appropriate voltage rating and, when a dry-contact keyer is used, the switch is set to the contact (CONT) position. The keyer-modulator thus produces a shift in frequency above and below the 250KHz center frequency. This shift is rectified and translated to a DC level which is then amplified and applied to the 3MHz variable crystal-controlled oscillator in the power supply assembly via the SHIFT switch network.

4.3.8.2 When FSK or FAX operation is selected, +12VDC is supplied to both the frequency shift generator and to the VCXO in the power supply assembly. As a result, the VCXO operates at the center frequency of 3MHz. Upon

application of the variable DC level from the SHIFT switch, the frequency of the VCXO is shifted above and below the center frequency, corresponding to respective marks and spaces, by an amount determined by the SHIFT switch setting (± 42.5 , ± 85 , ± 170 , ± 425 or others as requested). The frequency-shifted VCXO signal of 3MHz is re-applied to the 3MHz VCXO amplifier section of the frequency shift generator and then to the 3MHz amplifier circuit of the converter section.

4.3.8.3 In FAX operation, an externally applied FAX signal produces a variable DC level through a DC regulator circuit. This level is applied to the VCXO to produce the required frequency shift.

4.3.8.4 The converter section of Z108 accepts the 2.75MHz carrier from carrier generator Z109; the 250KHz AM, USB, LSB, ISB or CW input from the mode switching network; or the 3MHz VCXO input from the 3MHz VCXO amplifier in the frequency shift generator section.

4.3.8.5 In the AM mode, the 2.75MHz carrier and the amplitude-modulated 250KHz signal are mixed in a balanced modulator to produce a sum amplitude-modulated carrier of 3MHz, which is amplified and applied to translator Z112. In the USB, LSB and ISB modes, the input signals consist of the 2.75MHz carrier and USB and/or LSB audio with or without the 250KHz signal, depending on the amount of carrier suppression introduced by the carrier control network. This control permits stepped carrier reinsertion from zero (0) to full (55db) by attenuating the 250KHz input from the mode switching network. The attenuated 250KHz subcarrier from the carrier control is applied to the mode switching network where it is reinserted with the USB and/or LSB audio as a pilot carrier prior to being sent to the converter section of Z108. Therefore, the 250KHz USB, LSB or ISB signal is mixed with the 2.75MHz carrier to again produce a single sideband or independent sideband output with a 3MHz center frequency.

4.3.8.6 In the CW mode, the 250KHz input is interrupted at the keyer rate and thus results in a 3MHz CW output. In the FSK and FAX modes, the 250KHz and the 2.75MHz inputs are not present. The only input is the 3MHz VCXO signal from the frequency shift generator 3MHz amplifier section which is further amplified in the converter section and then applied to translator Z112.

4.3.8.7 A PTT relay K1 is energized whenever the PTT/VOX switch is set to the VOX position. As a result, when the CW mode is selected, the ground from the external key is coupled through the mode switch and the normally-closed contacts of the relay to both the carrier generator and the translator. This initiates CW operation.

4.3.9 The translator (Z112) performs the function of producing a 1.6 to 29.9999MHz output signal by modulating the 10 to 10.9999MHz output signal

from the final mixer Z106 with the 3MHz modulated center frequency from the frequency shift generator; the 40MHz signal from the spectrum generator; and the 104 to 132MHz output range from step generator Z113.

4.3.9.1 The 10.0 to 10.9999MHz input is amplified and modulated by the 3MHz input to yield a 13 to 13.9999MHz output. This frequency range is then modulated by the 120MHz derived from the 40MHz input multiplied by a factor of three. As a result, the modulator yields a sum frequency between 133 and 133.9999MHz. By subtracting the 104 to 132MHz signal, representing the two most significant digits of the selected frequency range, a difference output signal results in the range of 1.6 to 29.9999MHz. This output signal is applied through the RF OUTPUT control to RF output board Z115.

4.3.10 The 1.6 to 29.9999MHz output signal from the translator is amplified in RF output board (Z115). The RF output from Z115 is applied directly to the RF OUT jack J124 on the exciter rear panel. A metering circuit is included to monitor the collector currents of the three amplifiers on RF output board Z115, and the RF output level of the selected frequency. These parameters are selected by meter switches and displayed on the front panel meter.

4.3.11 The power supply operates from either 115VAC or 230VAC when the power transformer is properly wired. The power supply outputs are regulated DC voltages of +30, +24 and +12 volts for operation of the exciter circuits. The +24 and +12VDC power supply outputs are applied to the STANDBY position of the STANDBY/OPERATE switch and are applied to the exciter when this switch is set to the OPERATE position. The 1MHz and 3MHz frequency standards are produced by crystal-controlled oscillators. The 1MHz signal is applied to the spectrum generator while the 3MHz signal, when enabled in the FSK and FAX modes, is applied to the frequency shift generator.

4.4 Detailed Description

4.4.1 The following paragraphs present a detailed description of the circuits used to provide RF frequency generation, selection and translation in the exciter. These circuit descriptions are referenced to applicable simplified schematics, and to the circuit board schematics and interconnection wiring diagrams contained in Section 6.

4.4.2 The spectrum generator Z101 performs the function of generating both broadband and discrete frequencies for use in frequency translation sections. It consists of the 1MHz output circuit; the 1MHz spectrum generator; the 100KHz spectrum generator; and five discrete frequency generators.

4.4.2.1 In the 1MHz output circuit, the 1MHz frequency standard from Z301 in the power supply assembly is coupled through capacitor C5 to 1MHz output amplifier Q1. The Q1 collector is tuned by the combination of the primary winding of transformer T1 and capacitor C2. The 1MHz low-impedance output signal from the T1 secondary is supplied to 1MHz OUT jack J120 and through isolation resistor R102 to 1MHz MON jack 121. In addition, the 1MHz output is applied through level adjust potentiometer R60 to single mixer-divider Z104 and to carrier generator Z109.

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

4.4.2.3 The 100KHz spectrum generator consists of 1MHz clipper Q14, driver amplifier Q17, decade divider Z1, 100KHz spectrum generator Q15, and emitter follower Q16. The 1MHz frequency standard is coupled to the input of 1MHz clipper Q14, and overdriven amplifier similar to squarewave generator Q2. The collector output signal is amplified by driver Q17 and applied to the divider decade Z1. Zener diode CR1 regulates Z1 operating voltage at 12VDC. The resultant 100KHz squarewave output from Z1 is coupled through capacitor C69 to 100KHz spectrum generator Q15, which amplifies the 100KHz signal and sends it to output emitter follower Q16. This last stage provides the required low output impedance for comb filter sections Z102 and Z103, effectively isolating the spectrum generator from undesirable load changes.

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

4.4.2.5 The output signal from the 1MHz spectrum generator circuit is applied across the 8MHz series resonant circuit formed by 8MHz crystal Y3, trimmer capacitors C64 and C73, capacitor C72, resistor R64, and the base-emitter junction of harmonic select amplifier Q12. Since the eighth harmonic is present in the 1MHz spectrum, crystal Y3 oscillates at 8MHz. This input signal is amplified and applied to the tuned collector circuit consisting of transformer T10 and capacitor C75. Since this comprises a parallel-tuned circuit, this combination is highly selective and rejects all other frequencies. Resistor R53 provides the required regenerative feedback to reinforce or to sustain oscillations at 8MHz. The 8MHz output signal from transformer T10 is coupled through capacitor C78 to the 8MHz output amplifier Q13. The tuned collector output is transferred via the secondary winding of T11, to the

inputs of single mixer-divider Z104, dual mixer-divider Z105, and final mixer Z106. The 8 MHz signal is also coupled through C83 to the frequency multiplier circuit. Discrete frequencies of 12, 13 and 14 MHz are formulated in a similar manner. These latter frequencies are then applied to step generator circuits Z110 and Z113. It should be noted that +12 vdc is applied to the 13 MHz generator only when the selected frequency is between 11 and 20 MHz.

4.4.2.6 The 40 MHz frequency multiplier circuit consists of emitter-follower Q18 and (X5) amplifier Q19. The 8 MHz output from Q18 is directly coupled to (X5) amplifier Q19 whose collector circuit is L-C tuned to the fifth multiple of 8 MHz (40 MHz). The output signal developed across isolation transformer T12 and tuned by C89 to 40 MHz is coupled through capacitor C90 and supplied to frequency translator Z112.

4.4.3 Each of the comb filter boards Z102 and Z103 contain six independent discrete frequency generators. Comb filter A (Z102) provides generation of frequencies from 0.8 to 1.8 MHz in 0.2 MHz steps. Comb filter B (Z103) provides generation of frequencies from 0.9 to 1.9 MHz in 0.2 MHz steps. As a result, 12 discrete frequencies are provided at 100 kHz intervals from 0.8 to 1.9 MHz. The circuit configuration and operation for each frequency generator is the same. For example, the 0.8 MHz circuit consists of 0.8 MHz crystal Y6, 0.8 MHz amplifier Q11, and 0.8 MHz output amplifier Q12. Upon receipt of the 100 kHz spectrum signal from spectrum generator Z101, the circuit oscillates at the eighth harmonic and thus produces 0.8 MHz in the same manner as discussed for the 8 MHz discrete frequency generator. Level adjust potentiometer R42 varies the gain of 0.8 MHz output amplifier Q12, and thus the overall amplitude of the 0.8 MHz output signal at terminal J102-S.

4.4.4 Frequency select switching in the Exciter is accomplished by six rotary switches S102 through S107, with direct-reading dials, corresponding to frequencies of 100 Hz, 1 kHz, 10 kHz, 100 kHz, 1 MHz and 10 MHz, respectively. The six discrete frequencies, generated on each of the comb filters Z102 and Z103, are applied through 470-ohm series isolation resistors on switching board A5713 prior to being sent to the selector switch networks. Each of the first four selector switches (S102 through S105) receives 10 of the 12 discrete frequencies (1.0 MHz to 1.9 MHz) and distributes them to single mixer-divider Z104, dual mixer-divider Z105, and to final mixer Z106. Only frequencies of 0.8 MHz to 1.7 MHz are applied to switch S106A (1 MHz), and are distributed by switch S107 (10 MHz) to step generator A (Z110) for translation. The remaining decks of switches S105, S106, and S107 perform the function of enabling appropriate circuits in step generator A (Z110), step generator B (Z111), translator Z112 and step generator C (Z113).

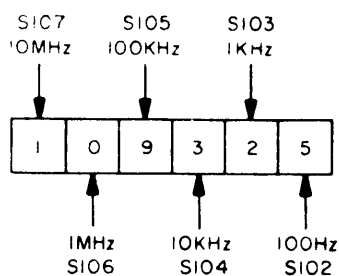


Figure 4-4. Frequency selector switch readouts.

4.4.5 The mixer-dividers Z104/Z105 and final mixer Z106 are essentially frequency shift modulators. Their purpose is to shift a basic 8 MHz input signal such that a frequency component, as chosen by the frequency selector switches, is generated having four decimal places and representing hundreds (100 Hz) through one-hundred thousands (100 kHz). The circuits accomplish the task of shifting the fundamental 8 MHz signal through the use of tuned, balanced-modulator and amplifier circuits. Because the circuit configuration and principle of operation for each mixer-divider is similar, only mixer-divider Z104 is discussed.

4.4.5.1 The 8 MHz output from spectrum generator Z101 is supplied to the inputs of each mixer-divider (to both halves of Z005) and to the input of the final mixer. In mixer-divider Z104, the 8 MHz input is applied to 8 MHz collector-tuned amplifier Q1. The 8 MHz signal developed across the T1 primary/C6 tank circuit is transferred to a balanced modulator consisting of the T1 secondary, Balance potentiometer R7 and modulator CR1/CR2. The balanced modulator receives the standard 1.0 MHz output from spectrum generator Z101 and produces sum and difference frequencies while attenuating the two original frequencies. Since the tuned primary of coupling transformer T2 is selective at 9 MHz, the sum of the two frequencies is transferred by coupling transformer T3 to the input of the first of two tuned 9 MHz amplifiers, Q2 and Q3. The tuned collector output developed across coupling transformer T6 is applied to the second balanced modulator consisting of the T6 secondary, balance potentiometer R23 and CR3/CR4.

4.4.5.2 The second balanced modulator receives a 1 MHz to 1.9 MHz input signal from 100 Hz selector switch S102, depending upon switch position (0 through 9). As a result, the 9 MHz signal is modulated as explained previously for 8 MHz, thereby resulting in a 10 MHz to 10.9 MHz signal. This output is tuned by transformers T7 through T11 and amplified by transistors Q4 and Q5. The 10 MHz to 10.9 MHz output signal from T11 is applied to Q6, the first of two direct-coupled clipper/driver stages. The output signal from Q7 is applied to divide-by-ten decade Z1, producing the resultant frequency of 1.0 to 1.09 MHz. This signal is applied to dual mixer-divider Z105.

4.4.5.3 Each half of dual mixer-divider Z105 is similar to Z104 and functions to produce a resultant output signal between 1.0 and 1.0999 MHz, thereby satisfying selector switches S103 (1 kHz) and S104 (10 kHz). Final mixer Z106 satisfies selector switch S105 (100 kHz) by modulating the 8 MHz signal with the 1.0 to 1.0999 MHz signal from Z105 to produce 9.0 to 9.0999 MHz. This signal is then modulated by the 1.0 to 1.9 MHz output from 100 kHz selector switch S105 to yield a 10.0 to 10.9999 MHz output to translator Z112. In the 0 to 4 positions of 100 kHz selector switch S105 +12 vdc is applied to final mixer Z106 through the tuned output network consisting of capacitors C36 and C48, and diodes CR5 and CR6. This network forms a high pass filter which effectively prevents the higher range of frequencies, 10 through 10.5999 MHz (positions 5 through 9 of switch S105), from appearing at the output. In positions 5 through 9 of switch S105, +12 vdc is applied to the circuit through an alternate pin (14), thereby making the tuned output filter inoperative above 10.4999 MHz.

4.4.5.1 The 8 MHz output from spectrum generator Z101 is supplied to the inputs of each mixer-divider (to both halves of Z005) and to the input of the final mixer. In mixer-divider Z104, the 8 MHz input is applied to 8 MHz collector-tuned amplifier Q1. The 8 MHz signal developed across the T1 primary/C6 tank circuit is transferred to a balanced modulator consisting of the T1 secondary, Balance potentiometer R7 and modulator CR1/CR2. The balanced modulator receives the standard 1.0 MHz output from spectrum generator Z101 and produces sum and difference frequencies while attenuating the two original frequencies. Since the tuned primary of coupling transformer T2 is selective at 9 MHz, the sum of the two frequencies is transferred by coupling transformer T3 to the input of the first of two tuned 9 MHz amplifiers, Q2 and Q3. The tuned collector output developed across coupling transformer T6 is applied to the second balanced modulator consisting of the T6 secondary, balance potentiometer R23 and CR3/CR4.

4.4.5.2 The second balanced modulator receives a 1 MHz to 1.9 MHz input signal from 100 Hz selector switch S102, depending upon switch position (0 through 9). As a result, the 9 MHz signal is modulated as explained previously for 8 MHz, thereby resulting in a 10 MHz to 10.9 MHz signal. This output is tuned by transformers T7 through T11 and amplified by transistors Q4 and Q5. The 10 MHz to 10.9 MHz output signal from T11 is applied to Q6, the first of two direct-coupled clipper/driver stages. The output signal from Q7 is applied to divide-by-ten decade Z1, producing the resultant frequency of 1.0 to 1.09 MHz. This signal is applied to dual mixer-divider Z105.

4.4.5.3 Each half of dual mixer-divider Z105 is similar to Z104 and functions to produce a resultant output signal between 1.0 and 1.0999 MHz, thereby satisfying selector switches S103 (1 kHz) and S104 (10 kHz). Final mixer Z106 satisfies selector switch S105 (100 kHz) by modulating the 8 MHz signal with the 1.0 to 1.0999 MHz signal from Z105 to produce 9.0 to 9.0999 MHz. This signal is then modulated by the 1.0 to 1.9 MHz output from 100 kHz selector switch S105 to yield a 10.0 to 10.9999 MHz output to translator Z112. In the 0 to 4 positions of 100 kHz selector switch S105 +12 vdc is applied to final mixer Z106 through the tuned output network consisting of capacitors C36 and C48, and diodes CR5 and CR6. This network forms a high pass filter which effectively prevents the higher range of frequencies, 10 through 10.5999 MHz (positions 5 through 9 of switch S105), from appearing at the output. In positions 5 through 9 of switch S105, +12 vdc is applied to the circuit through an alternate pin (14), thereby making the tuned output filter inoperative above 10.4999 MHz.

4.4.5.4 The 10 to 10.9999 MHz signal developed across tuned transformer T12, is coupled to amplifier Q7. The negative half-cycle at the output from Q7 is limited by diode CR8, while the positive excursion is amplified by Q8 and applied, as a dual input, to integrated circuit Z1. This last stage is one gate of a quadruple 2-input positive Nand gate chip, and functions as an inverter to maintain a linear output signal over the 10 to 10.9999 MHz frequency range. Zener diode CR9 provides a regulated 5.1 vdc for output stages Q8 and Z1, while the combination of R55 and C63 provides the necessary decoupling from fluctuations in the +12 vdc supply line.

4.4.6 The step generator circuits Z110, Z111 and Z113 receive the 12, 13 and 14 MHz frequencies from spectrum generator Z101, and the 0.8 to 1.7 MHz frequency range from 10 MHz selector switch S107. These inputs are amplified, mixed, filtered, and multiplied to obtain a 104 to 132 MHz frequency range which is applied to one input of translator Z112. Step generator Z110 receives 13 MHz and 14 MHz inputs which are applied to respective amplifier and mixer circuits. The 13 MHz frequency is amplified by Q9 and applied to the primary of tuned coupling transformer T17. Input signal amplitude is controlled by Level Adjust potentiometer R61. The 13 MHz output signal is developed across the balanced modulator consisting of the T17 secondary, Balance Adjust potentiometer R67 and matched DD139 diodes CR3 and CR4. Similarly, the 14 MHz input signal is amplified by transistor Q1 and applied to the balanced modulator in the collector circuit formed by transformer T1, Balance Adjust potentiometer R7 and matched diodes CR1 and CR2. The 0.8 to 1.7 MHz output from 10 MHz selector switch S107 is amplified by transistor Q5 and is coupled, via transformer T9, to both the 13 and 14 MHz balanced modulators. At this point, the 13 and 14 MHz channels are each split into two identical subchannels. Since each pair of sub-channels is similar in circuit configuration, only the 13 MHz section is discussed.

4.4.6.1 As previously mentioned, the balanced modulator produces the sum and difference frequencies while attenuating the two original frequencies. The sum and difference signals are coupled to the input of tuned transformers, T18 and T25 of the respective 11.8 to 12.2 MHz, and 11.3 to 11.7 MHz sub-channels. Both T18 and T25 are tuned to a portion of the difference frequency range of 11.3 MHz to 12.2 MHz, with T25 passing the 11.3 to 11.7 MHz segment and T18 passing the 11.8 to 12.2 MHz segment. The 11.3 to 11.7 MHz range is tuned by transformers T26 through T31 and amplified by Q13 through Q15. The 11.8 to 12.2 MHz range is tuned by transformers T19 through T24 and amplified by Q10 through Q12. The 11.3 to 12.3 MHz frequency range is obtained from the series-connected secondary windings of transformers T24 and T31 and is supplied to step generator B (Z111).

4.4.6.2 The 14 MHz section is similarly split into sub-channels of 12.3 to 12.7 MHz and 12.8 to 13.2 MHz and supplied to step generator B, Z111. Depending upon the range value of the selected frequency, operating voltage of +12 vdc to the 13 MHz and 14 MHz circuits is controlled by 10 MHz frequency selector switch S107B (front) and 100 kHz selector switch S106C and E (rear), while a switched ground to the sub-channels is controlled by 100 kHz selector switch S106C (front).

4.4.6.3 Step generator Z113 contains a frequency step circuit for the 12 MHz input, similar to the 13 and 14 MHz circuits previously described. The 12 MHz input is modulated by the 0.8 to 1.7 MHz input supplied from step generator Z110 in the tuned collector circuit of mixer Q14. The combination of crystal Y1 and trimmer capacitor C101 serves to filter the 12 MHz component of the modulated signal. At this point, the mixer output is split into twin sub-channels of 10.4 to 10.6 MHz and 10.7 to 11.2 MHz by the series of tuned transformers and amplifiers similar to those discussed for step generator Z110. Switched B+ voltage of +12 vdc is applied to either sub-channel, depending upon the range value of the selected frequency. The 10.4 to 11.2 MHz output is also applied to step generator B (Z111).

4.4.6.4 Step generator B, Z111, contains three identical multiplier-amplifier circuits for the respective three frequency range inputs from step generator A, Z110, and step generator C, Z113. Consider the 52 to 56 MHz multiplier-amplifier consisting of Q1, Q2, bandpass filter FL1 and output amplifier Q3. The 10.4 to 11.2 MHz output from Z113 is applied to the input of X5 multiplier Q1, whose tuned collector tank circuit T1/C3 produces the fifth harmonic, or a 52 to 56 MHz signal. This frequency band is amplified in Q2, and the tuned output across the collector T2/C9 tank circuit is coupled through C11 to bandpass filter FL1. Filter FL1 effectively rejects all frequencies except the 52 to 56 MHz band, applying this signal to output amplifier Q3. The 52 to 56 MHz signal across tuned collector tank circuit T3/C19 is coupled through C21 to step generator C (Z113).

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

4.4.6.6 Step generator Z113 accepts the three frequency ranges produced in Z111 and, using separate multiplier-amplifier circuits, amplifies them to produce a resultant 104 to 132 MHz output frequency range. This output signal is applied to translator Z112. Since the three multiplier-amplifier circuits are identical, only the 52 to 56 MHz circuit need be discussed. The 52 to 56 MHz input is coupled to the input of X2 multiplier Q1, whose collector tank circuit T1/C10 is tuned to the second harmonic, thereby producing a resultant frequency range of 104 to 112 MHz. This signal is then applied to the first of three cascade-connected amplifiers, Q2 through Q4, whose respective collector outputs are tuned by tank circuits C16/T2 and C22/T3 and the combination of L8 and C27/C28. The 104 to 112 MHz output signal is applied through summing resistor R127 to the input of 104 to 132 MHz amplifier Q13.

4.4.6.7 The frequency ranges of 113 to 122 MHz and 123 to 132 MHz are produced in a similar manner. The 113 to 122 MHz output is applied through summing resistor R132 to the input of Q13, while the 123 to 132 MHz output is applied through resistor R133 to the input of Q13. As a result, Q13, a broadband amplifier, effectively sums the three input ranges producing a net output signal of 104 to 132 MHz from T10 in the collector circuit. This frequency band is coupled through capacitor C128 and a low-pass filter to translator Z112. Again, switched B+ voltage of +12 vdc is applied to each circuit depending upon the selected frequency.

4.4.7 The carrier generator Z109 performs the function of producing a 250 kHz subcarrier frequency and a 2.75 MHz carrier frequency for translation to an AM, SSB, or ISB rf carrier signal of 3 MHz. The 250 kHz subcarrier and 2.75 MHz carrier are derived from the 1 MHz standard oscillator in the power supply assembly. The carrier generator includes a metering amplifier circuit for conversion of the USB and/or LSB audio signals to a proportional dc level for display on the front panel meter. In addition, an AM amplifier circuit is included for formulation of an amplitude-modulated 250 kHz subcarrier when the MODE switch is in the AM position.

4.4.7.1 In the 250 kHz channel of Z109, the 1 MHz standard input signal is supplied to amplifier Q13. The 1 MHz collector signal is applied to emitter-follower Q1 whose output is supplied to the first of two cascade-connected divide-by-2 integrated circuits (IC's) Z1 and Z2. The resultant 250 kHz squarewave output is both amplified by 250 kHz amplifier Q2, a tuned transformer-coupled stage, and is also applied to X11 multiplier Q7 in the 2.75 MHz carrier channel.

4.4.7.2 The signal developed across the tuned secondary of transformer T1 is coupled through capacitor C8 to a second 250 kHz tuned transformer-coupled amplifier, Q3. The 250 kHz output from the T2 secondary is coupled through capacitor C14 to emitter-follower Q4, and through C45 to the MODE switching network for distribution. The 250 kHz signal is also developed across the series combination of CW Level Adjust potentiometer R20 and resistor R21. The 250 kHz output from the junction of R20 and R21 is coupled through capacitor C44 to MODE switch S114B (rear) as the subcarrier frequency for CW operation. The 250 kHz output developed across Carrier Level Adjust potentiometer R27 in the emitter of Q4 is coupled through capacitor C16 to CARRIER control R102A for formulation of the 250 kHz pilot carrier reinsert signal. A switched ground input is supplied to the 250 kHz subcarrier generator section at the junction of resistors R22 and R23 from the keyer, when the PTT/VOX switch is in the VOX position and CW mode is selected. The MIKE input accomplishes the same thing in the AM, USB, LSB and ISB modes when the PTT/VOX switch is in the PTT position. The keyed ground is applied via the CW position of the MODE switch and enables 250 kHz amplifiers Q2 and Q3.

4.4.7.3 In the 2.75 MHz channel of Z109, the 250 kHz output from Z2 is applied to X11 multiplier Q7. The resultant 2.75 MHz signal developed across the collector circuit consisting of tuned transformer T3 and capacitor C22 is coupled to 2.75 MHz amplifier Q8 whose collector output is then supplied through 2.75 MHz bandpass filter FL1 to 2.75 MHz amplifier Q9. The 2.75 MHz output signal from the T4 tuned secondary is applied to the converter section of frequency shift generator Z108 to produce the modulated subcarrier centered about 3 MHz.

4.4.7.4 The metering amplifier circuit of Z109 consists of meter amplifier Q5, emitter follower Q6 and the half-wave rectifier and filter output consisting of diode CR2 and capacitors C19 and C20. This circuit receives either microphone or 500-ohm line audio from the USB/LSB MIKE/LINE controls via the USB or LSB positions of the meter switches, and provides conversion to a dc level proportional to signal amplitude for display on meter M101.

4.4.7.5 The AM amplifier section of Z109 performs the function of amplitude-modulating the 250 kHz subcarrier signal with audio intelligence in the 350 Hz to 7500 Hz range, and supplies it to the 3 MHz converter section of frequency shift generator Z108, when the MODE switch is positioned at AM.

4.4.7.6 With the MODE switch in the AM position, the 250 kHz subcarrier is applied to the AM amplifier from S114A (rear). USB and/or LSB audio is supplied from the AM position of S114A (front) to the AM amplifier. The audio input is coupled through C32 to a conventional audio amplifier, Q10, whose collector output is fed to amplifier Q11. The audio output from Q11 is developed across transformer T6. The secondary output from T6 is then applied to the tuned collector circuit of modulator Q12. The 250 kHz subcarrier frequency is coupled to the base of 250 kHz amplifier Q14. The collector output is coupled through capacitor C43 to the base of 250 kHz amplifier Q14. The collector output is coupled through capacitor C43 to the base of modulator Q12. Since the tuned collector of Q12 is modulated with the audio signal, the resultant collector signal across the T5 primary and C39 consists of a 250 kHz subcarrier whose amplitude fluctuates at the audio signal rate. The 250 kHz amplitude-modulated signal at the T5 tuned secondary is developed across AM Level Adjust potentiometer R69, and coupled through C38 to the AM position of MODE switch S114C (rear). With S114 in the AM position, the 250 kHz AM signal is then routed to the 250 kHz input of the 3 MHz converter section of frequency shift generator Z108.

4.4.8 The sideband generator Z107 contains upper and lower sideband circuits which are identical in configuration and operation. In addition, the sideband generator also includes a microphone audio preamplifier circuit. A 600-ohm to 500-ohm impedance matching circuit is also included for conversion of an external 600-ohm audio line input to a 500-ohm output when the mike input is not being used for AM, USB, LSB, or ISB operation.

4.4.8.1 The microphone audio preamplifier circuit consists of a cascade-connected microphone input amplifier, followed by two cascaded class A audio amplifier stages and an output emitter follower. Input audio is coupled to the cascode pair, Q1 and Q2, which present a high impedance of 47K-ohms to the external microphone. Capacitor C5 introduces degenerative feedback to audio input signals above 7.5 kHz. The audio signal developed across Level Adjust potentiometer R9 is R-C coupled to the first of two cascaded class A amplifiers Q3 and Q4. Bypassed emitter resistors in these stages introduce a small amount of degenerative feedback, thereby limiting distortion and improving the overall audio frequency response of the preamplifier section. The audio signal from output emitter follower Q5 is coupled through C13 to the MIKE half of USB and LSB MIKE/LINE controls R104 and R105, respectively. The audio signal is then routed to MODE switch S114A (front) for distribution to either the upper or lower sideband generators in USB or LSB operation; to both of the sideband generators when independent sideband (ISB) operation is desired, or to the AM amplifier circuit when AM operation is desired.

4.4.8.2 The SSB modulation circuit receives the audio input signal from the MODE switch. When the MODE switch is set to the USB or LSB position, audio is channeled to the respective sideband generator audio input and is used to modulate the 250 kHz subcarrier input from carrier generator Z109. In the ISB position of the MODE switch, audio signals are channeled simultaneously to both of the sideband generators to institute independent sideband (ISB) operation. In the USB circuit of Z107, input audio signals from MODE switch S114A (front), in the USB or ISB positions, is coupled through capacitor C14 to audio emitter follower Q6. Output signals at the emitter are R-C coupled to the balanced modulator consisting of diodes CR1 through CR4, where they are modulated by the 250 kHz subcarrier output signal from 250 kHz emitter follower Q9. The balanced modulator produces sum and difference frequency outputs, while the subcarrier and audio frequencies are attenuated. The sum and difference frequency outputs from the modulator are transformer-coupled via T1 to IF amplifier Q7. The sideband output at the collector of Q7 is coupled through C24 and USB filter FL1 to IF emitter follower Q8. In the upper sideband generator FL1 is tuned to the upper sideband frequency range from 250, 350 Hz to 257, 500 Hz (600-ohm line or microphone input). Conversely, in the lower sideband generator circuit, LSB filter FL2 is tuned to the lower sideband frequency range of 242, 500 Hz to 249, 650 Hz (600-ohm line or microphone operation). The filter consisting of the T1 tuned primary, capacitors C20 and C50, and a trimmer capacitor C52, presents a decided notch at 250 kHz, thereby fully suppressing the 250 kHz subcarrier center frequency. The sideband output from emitter follower Q8 is coupled through capacitor C28 and isolation resistor R72 to MODE switch S114C (rear) for carrier reinsertion.

4.4.9 Mode switching for the exciter is accomplished by MODE switch S114, which selects the desired mode of operation (AM, USB, LSB, ISB, CW, FSK and FAX) by routing audio, subcarrier and certain enables to the proper circuits of the exciter. Mode switching can be divided into areas of audio present in the AM, USB, LSB and ISB modes, and the remaining modes of CW, FSK and FAX operation.

4.4.9.1 In the audio modes (figure 4-5), microphone or 500-ohm line audio inputs from the upper and/or lower sideband generators are developed across half of the respective MIKE/LINE control and sent to MODE switch S114A (front). Consider upper sideband (USB) audio. Microphone audio from the audio pre-amplifier circuit is developed across the MIKE half of USB MIKE/LINE control R104 and is applied to contact 2 of S114A.

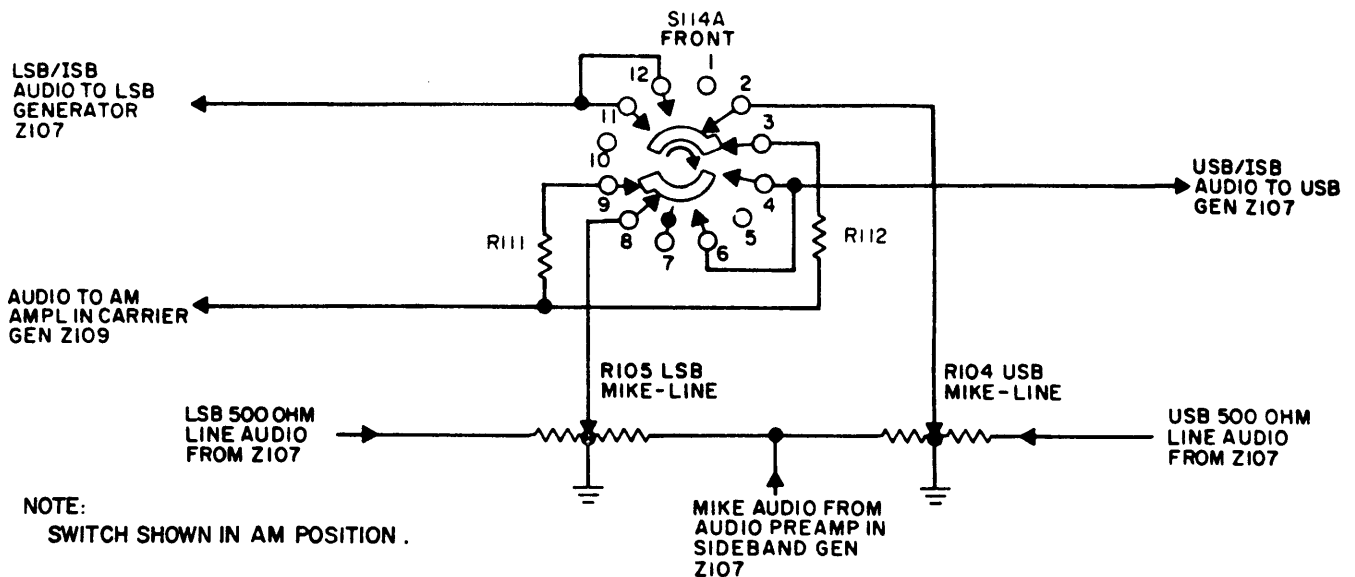


Figure 4-5. Audio mode switching, simplified schematic diagram.

When the 500-ohm audio input line is used, the USB generator supplies a 500-ohm line audio output which is developed across the LINE half of control R104. In either case, USB MIKE/LINE control R104 sets the amplitude of the USB audio signal. With the MODE switch in the AM position, the USB audio is coupled through contacts 2/3 of S114A and R112, to the AM amplifier in carrier generator Z109. In the USB position, the audio is coupled through contacts 2/4 of S114A to the upper sideband generator audio input. In the LSB position, LSB audio from LSB MIKE/LINE control R105 is coupled through contacts 8/11 of S114A to the lower sideband generator audio input. In the ISB position of S114A, both USB and LSB audio is sent simultaneously to the respective sideband generator audio input (if audio intelligence is desired on both).

4.4.9.2 The remaining decks of MODE switch S114 (C rear, B front and rear, and A rear) perform independent functions such as 250 kHz subcarrier and AM distribution and reinsertion, and CW, FSK and FAX selection. The 250 kHz subcarrier output from carrier generator Z109 is applied to S114A (rear) at contacts 9 and 5. With the MODE switch in the AM position, the subcarrier is channeled to the AM amplifier in Z109. In the USB, LSB and

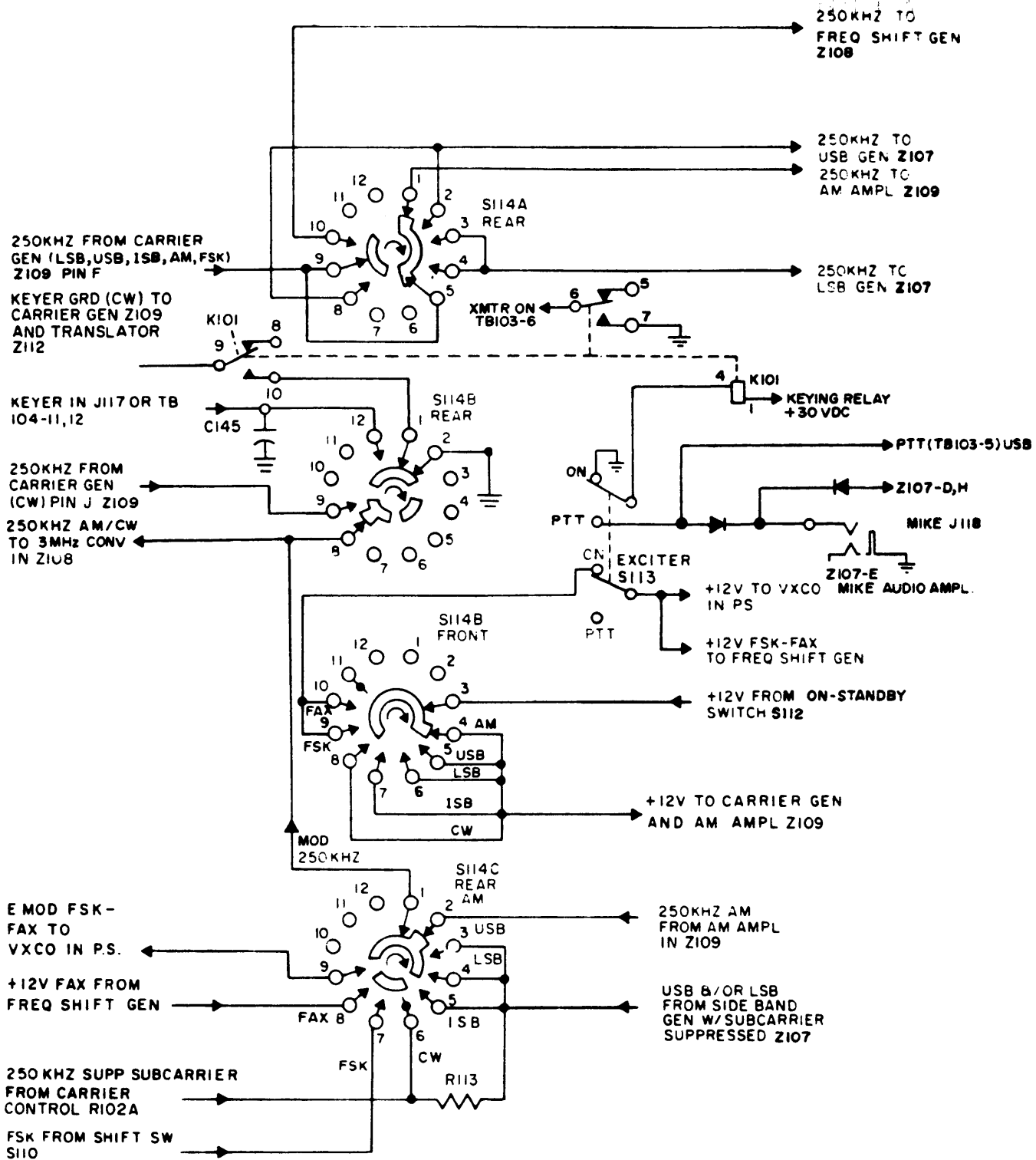


Figure 4-6. CW, FSK and FAX mode switching, simplified schematic diagram.

ISB positions, the 250 kHz subcarrier is applied to either the respective sideband generator circuit in Z107, or to both sideband generator circuits simultaneously. Deck S114B (front) of the MODE switch distributes +12 vdc operating potential to 2.75 MHz carrier generator and AM amplifier circuits in Z109 in the AM, USB, LSB, ISB and CW positions. In the FSK and FAX positions, +12 vdc is routed through the VOX position of the switch to frequency shift generator Z108 and the 3 MHz variable crystal controlled oscillator (VCXO) in the power supply assembly.

4.4.9.3 The amplitude-modulated 250 kHz output from the AM amplifier circuit in Z109 is supplied to the AM position of S114C (rear) and is supplied to the converter section of frequency shift generator Z108. In the USB, LSB, and ISB positions of S114C, sideband audio intelligence, with a suppressed 250 kHz subcarrier, is supplied from either, or both, sideband generator circuits to contacts 3, 4 and 5. The SSSC input is added to the 250 kHz subcarrier signal from CARRIER control R102A through isolation resistor R113. The amount of subcarrier injection depends on the position of R102A and consists of continuously variable injection from zero (0) to full. When subcarrier injection is desired, the resultant USB and/or LSB audio intelligence is accompanied by a 250 kHz pilot carrier and is supplied to the converter section of Z108.

4.4.9.4 Frequency shift keyer (FSK) and facsimile (FAX) operation is controlled by S114C (rear). For FSK operation, a variable dc current, proportional either to the keyed 250 kHz subcarrier frequency, or to an external teletype input, is applied to contact 7 of S114C from SHIFT switch S110. This signal is routed to the variable crystal controlled oscillator (VCXO) in the power supply assembly, thereby causing a shift in frequency above and below center frequency, which represents the marks and spaces. In FAX operation, a variable dc current from frequency shift generator Z108 is supplied to S114C at contact 8 and is routed to the VCXO. CW operation is controlled by S114B (rear), where a 250 kHz subcarrier frequency from the carrier generator is routed through contacts 9/8 to the converter section of Z108.

4.4.10 Frequency Shift Generator Z108. The frequency shift keyer consists of four distinct sections; namely, the 2.75 kHz converter section, the 3 MHz carrier and VXCO buffer-amplifier, the FSK keyer and modulator, and the FAX circuit.

4.4.10.1 The converter circuit performs the function of translating a modulated 250 kHz input signal to a modulated output centered at 3 MHz. The 250 kHz input can be an AM signal; USB and/or LSB intelligence with, or without, the 250 kHz subcarrier suppressed; or an interrupted 250 kHz input at an external keyed rate in the CW mode. In addition, in the FSK and FAX modes, a variable crystal controlled frequency of 3 MHz is supplied to the 3 MHz converter buffer-amplifier circuit for translation, while the 2.75 MHz carrier and 250 kHz inputs are not used. As discussed previously, when the MODE switch is in the AM, USB, LSB, ISB or CW positions, the 2.75 MHz channel in the carrier generator is enabled and supplies the 2.75 MHz carrier frequency to the converter channel of Z108. This input is amplified by 2.75 MHz input stage Q1 and fed to 2.75 MHz emitter follower Q2; the output from Q2 is applied to balanced modulator Z2. In the AM position of MODE switch S114, the 250 kHz input consists simply of a 250 kHz subcarrier, amplitude-modulated by audio intelligence in the 350 Hz to 7500 Hz range. When the AM signal is mixed with the 2.75 MHz input, the balanced modulator produces the sum and difference frequencies while attenuating the two original frequencies; the combination of tuned transformer T1 and capacitor C6 traps the 2.75 MHz signal. As a result, an amplitude-modulated sum frequency of 3 MHz results and is amplified by Q3. The collector output of Q3 is coupled through 3 MHz bandpass FL1 and is amplified by tuned-collector stage Q4. The 3 MHz AM tuned collector output of Q4 is developed across Level Adjust potentiometer R58 and is applied to translator Z112.

4.4.10.2 In the USB, LSB and ISB positions of MODE switch S114, the 250 kHz input to the converter section consists of upper and/or lower sideband audio intelligence in the 350 to 7500 Hz (600-ohm line or microphone input) ranges with the 250 kHz carrier suppressed or unsuppressed, according to the position of CARRIER control R102A. These signals are obtained from S114C (rear). Since the 2.75 MHz rf carrier input is also present in these modes, the balanced modulator produces upper and/or lower sideband signals with a center frequency of 3 MHz. If the 250 kHz subcarrier is suppressed, so also is the 3 MHz rf carrier -- the sum frequency of 2.75 MHz and 250 kHz. The upper and/or lower sideband signals are amplified in the same manner as the AM signal, and are sent to translator Z112.

4.4.10.3 In the CW position of MODE switch S114, the 250 kHz input is not modulated by audio intelligence, but is interrupted at a rate determined by a keyer input at KEY jack J117, or at terminals 11 and 12 of TB103 on the rear panel of the Exciter. This results in a keyed difference frequency of 3 MHz in the balanced modulator. The CW rf is then amplified, as before, and sent to the translator.

4.4.10.4 In the FSK and FAX modes of operation, the 3 MHz variable crystal controlled oscillator (VXCO) is enabled in the power supply assembly, and its frequency is varied by the dc current produced in the FSK and FAX circuit of the frequency shift generator. Since both the 250 kHz (AM, USB/LSB, ISB or CW) and 2.75 MHz inputs are inhibited in these modes, the 3 MHz FSK-FAX input is coupled directly to the input of 3 MHz amplifier Q12 in the VXCO buffer-amplifier, thus bypassing the 2.75 MHz amplifier and balanced modulator circuit.

4.4.10.5 Both FSK and FAX operation is initiated when MODE switch S114B (front) is set to either the FSK or FAX position, as previously indicated in the discussion of MODE switching. In either of these positions, S114B supplies a +12 vdc enable to both the 3 MHz crystal controlled-oscillator Z302 in the power supply assembly, and to the 3 MHz buffer-amplifier circuit in frequency shift generator Z108. With MODE switch S114 in the FSK position, S114A (rear) routes the 250 kHz subcarrier frequency from carrier generator Z109 to the frequency shift generator keyer circuit consisting of coupling transformers T3/T4 and keyer diodes CR8/CR9. The keyer circuit is, in effect, a modulator, in that the 250 kHz input is interrupted by a dc current representing marks and spaces from an externally connected dry-contact keyer or teletype at terminals 13 and 14 of TB105. (See fig.4-7) The keyer input is connected to the modulator through FS LOOP switch S111 which is set to the 100V or 50V positions when dry contacting keying is used, and to the 20 mA or 60 mA positions to match the dc battery loop when a teletype keyed input is used. The external keying rate is 200 WPM and 75 bauds.

4.4.10.6 By keying the 250 kHz subcarrier, a frequency shift above and below center frequency is obtained, corresponding to the marks and spaces of the teletype input. This signal is coupled through T4 to the full-wave bridge rectifier consisting of diodes CR10 through CR13; the resultant varying dc signal is then applied to a series of three dc amplifiers, Q7 through Q9, and an output amplifier, Q10.

4.4.10.7 Amplifier Q8 is inserted in the circuit when dc SHIFT SENSE switch S109 is in the (+) position; otherwise, in the (-) position Q8 is bypassed. The variable dc output is developed across FSK Shift potentiometer R36; the dc output is coupled to SHIFT switch S110. FSK Center Frequency Adjust potentiometer R37 sets the average level about which the dc signal varies, and thus the center frequency of the VXCO in the power supply assembly. DC regulator Q5 provides a regulated 24 vdc to the dc amplifier circuit from the +24 vdc supply input line; regulator Q11 supplies a regulated +12 vdc to SHIFT switch S110 and R36 from the +12 vdc MODE switch input. SHIFT switch S110 effectively sets the amplitude of the dc signal varying about the average dc level as set by R37. By changing the maximum amplitude, the shift in VXCO output frequency is correspondingly changed to provide the desired shift above and below center frequency. The varying dc output from the SHIFT switch is coupled through the FSK position of MODE switch S114C (rear) and sent to the 3 MHz VXCO in the power supply assembly.

4.4.10.8 With +12 vdc applied to 3 MHz oscillator Z302, and with the variable dc input present, representing keyer frequency shift, the frequency of Z302 varies about the 3 MHz center frequency by an amount dictated by SHIFT switch S110. This shifted frequency is applied to the buffer-amplifier section of frequency shift generator Z108. The input signal is amplified in buffer Q12, and applied to limiter Z1 which maintains amplitude within acceptable limits without destroying the frequency shift characteristics. The limiter output is applied to emitter follower Q13 and then through 3 MHz Level Adjust potentiometer R46 to the 3 MHz converter section.

4.4.10.9 In FAX operation, an externally applied facsimile input at TB105 terminals 15 and 16 is applied to dc regulator Q6. The facsimile input is a variable dc voltage and causes a shift in output voltage across FAX balance potentiometer R25. This varying voltage is developed across FAX Shift potentiometer R27 and is sent to the FAX position of MODE switch S114C (rear). When FAX is selected, this dc signal then modulates the VXCO in the power supply assembly in the same manner as FSK operation.

4.4.11 Translator Z112. Translator Z112 receives the modulated 3 MHz signal from the frequency shift generator Z108; the 40 MHz signal from spectrum generator Z101; the 10 to 10.9999 MHz signal from the final mixer Z106; and the 104 to 132 MHz signal from step generator Z113. These signals are effectively shifted or translated to produce an output frequency range from 1.6 to 29.9999 MHz, depending upon the selected rf output frequency.

4.4.11.1 The 10 to 10.9999 MHz selectable frequency range input is applied to balanced mixer Q12, developed across the tuned collector tank circuit, T12/C81, and coupled to the balanced modulator consisting of the T12 secondary, Balance Adjust potentiometer R71 and matched HP8403 diodes CR4 and CR5. With the modulated 3 MHz input coupled to the balanced modulator, via transformer T14 and C50, the modulator outputs the sum and difference frequencies, with modulation intelligence still intact, while attenuating the two original frequencies; this output is applied to tuned coupling transformer T13 in the 13 to 13.5 MHz circuit, and to tuned coupling transformer T19 in the 13.5 to 14 MHz circuit. With T13 and T15 tuned to the lower half of the sum frequency, a 13.0 to 13.5 MHz signal is applied to a series of two amplifiers, Q13 and Q14, tuned by transformers, T16 through T18. Similarly, with transformers T19 and T20 tuned to the upper half of the sum frequency, a 13.5 to 13.9999 MHz signal is applied to amplifiers Q18 and Q19, and tuned by transformers T21 through T23. Potentiometer R109 adjusts the gain of amplifier Q19. The upper half of the frequency range is then applied to the secondary of transformer T18; combined with the lower half of the frequency range developed across the primary; and applied to balanced modulator transformer T6 in the 120 MHz multiplier-amplifier section. The Automatic Load and Drive Control (ALDC) circuit consisting of Q15, Q16 and Q17, receives the ALDC level from RF output Z115. This circuit supplies each of the 13 to 13.9999 MHz circuits with a control voltage to maintain a relatively constant net output signal at the secondary of T18. The combination of modulator diode CR4 and resistor R77 effectively isolates the ALDC circuit from the input circuit to the 13 to 13.5 MHz and 13.5 to 13.9999 MHz amplifier sections.

4.4.11.2 The 40 MHz input from spectrum generator Z101 is applied to a series of three tuned amplifiers, Q1 through Q3; the tuned collector output from 40 MHz amplifier Q3 is coupled from the secondary of T3 through capacitor C16 to X3 multiplier Q4, thereby resulting in an output frequency of 120 MHz across transformer T4 in the tuned collector circuit. This signal is amplified and tuned in stages Q5 and Q6 and applied across the tuned collector circuit consisting of the T6 primary and trimmer capacitor C31. The 120 MHz signal is then coupled to the balanced modulator consisting of the T6 secondary, Balance Adjust potentiometer R36 and matched HP8403 diodes CR1 and CR2. As a result, the 120 MHz signal is modulated by the 13 to 13.9999 MHz signal from the secondary of transformer T18, resulting in the sum, difference and two original frequencies. With the secondary of transformer T7 tuned to the sum frequency, a signal range of 133 to 133.9999 MHz results; this signal is amplified by four subsequent tuned amplifier stages, Q7 through Q10, and is coupled to the anode of mixer diode CR3.

4.4.11.3 At this point, the 104 to 132 MHz signal from step generator Z113 is coupled through capacitor C10 to the cathode of mixer diode CR3, thereby resulting in a difference range of 1.0 to 29.9999 MHz. This signal is applied to a two-section L-type inductive filter consisting of inductors L17 and L19, and capacitors C64 and C65, which provide sharp frequency roll-off below 1.6 MHz; thus a 1.6 to 29.9999 MHz results and is coupled through C66 to 1.6 to 29.9999 MHz output amplifier Q11. The collector output developed across autotransformer T11 is coupled through C70 to RF OUTPUT control R103. Switched +12 vdc inputs are applied to the translator circuits, depending upon the selected range value of rf output frequency.

4.4.12 RF Output Z115 and Metering Circuit. RF output Z115 consists of three rf stages, Q1 through Q3. The 1.6 to 29.9999 MHz input frequency range from the RF OUTPUT control (or highpass filter Z119) is applied to cascade amplifier Q3 through a dual L-C filter consisting of L7, L24, C20 and C39. Potentiometer R1 establishes the operating bias of the input stage, while RF OUTPUT control R103 sets the desired input signal amplitude. The collector output of Q3 is coupled through C9 and autotransformer T1 to the first of two cascade-connected rf amplifiers Q2/Q1. The 1.6 to 29.9999 MHz signal output from Q1 is coupled through C14 and applied to RF OUT AND MON jacks J124 and J125, and to the rf metering and ALDC circuits. The signal to the metering circuit is coupled through isolation resistor R17 and capacitor C37 to diode CR2, which rectifies the negative half-cycle; the positive half-cycle is then filtered to produce a dc level proportional to the amplitude of the rf output. This level is supplied to MONITOR meter M101 when METER switch S115 is in the RF position. In the metering circuit, +30 vdc from the power supply assembly is coupled to METER switch S115B and through dropping resistors R108 through R110 to S115A and to rf output circuit C115. Therefore, MONITOR meter M101 is effectively placed in series with the collectors of each rf amplifier and the B+ supply voltage, thereby monitoring respective collector current of each amplifier when METER switch S115 is set to the Q1 (350 ma), Q2 (130 ma) or Q3 (65 ma) position. Potentiometer R106 provides a means of calibrating MONITOR meter M101. In all other positions (USB, CARR and RF) of switch S115, one side of meter M101 is returned to ground through S115A, while S115B connects the other side of the meter to the respective USB, CARR or RF output. In these positions, the MONITOR meter displays relative amplitude of the output signals.

4.4.13 Power Supply Assembly. Three subassemblies are incorporated into the power supply; namely, rectifier and filter capacitor board (A) Z304, regulator Z303, and heat sink Z305. Also included is power transformer T301, 1 MHz standard oscillator Z301 and 3 MHz VXCO Z302. Input power of either 115 or 230 vac is supplied to power transformer T301 via power input jack J116 and line fuses F101 and F102. For 115-volt operation, the primaries of T301 are connected in parallel and line fuses of 1.0-ampere value are used; for 230-volt operation, the primaries of T301 are connected in series and fuse

value is 0.5 ampere. The secondary output voltage, approximately 60 vac, is applied to the full-wave bridge rectifier on Z304. The rectified output voltage of 40 vdc is filtered by C4 and applied to regulator Z303. The centertap voltage from T301, approximately 30 vac, is filtered by capacitor C3 and also applied as +20 volts to regulator Z303.

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

4.4.14.2 Fluctuations in the +24 vdc output of Q303 is applied to a resistive divider consisting of R6, +24V Adjust potentiometer R18, and R16; R18 applies this positive voltage to dc amplifier Q7. Since the emitter of Q7 is maintained at a constant +15 vdc potential by zener diode CR7, variations in the output voltage, when compared with this stable reference, cause Q7 to provide more or less drive current to regulator drivers Q2 and Q3. As a result, the +24 vdc and +30 vdc outputs are maintained at relatively nominal values. The +12 vdc regulator, consisting of Q1, Q4, Q5 and Q301, is similar in operation to the +24 vdc/+30 vdc regulators.

4.4.14.3 The +30 vdc output from the power supply assembly is applied to output filter Z114 and to METER switch S115; the +24 vdc and +12 vdc outputs are applied to STANDBY/OPERATE switch S112.

SECTION 5

MAINTENANCE INSTRUCTIONS

5.1 Introduction

5.1.1 This section presents maintenance information for the exciter and includes both preventive and corrective maintenance instructions. Preventive maintenance consists of periodic inspection and cleaning. Corrective maintenance includes troubleshooting procedures, disassembly instructions, inspection and cleaning of disassembled parts, repair and replacement procedures, reassembly instructions, equipment checks and adjustments, and minimum checks for performance verification.

5.2 Tools and Test Equipment Required

5.2.1 Table 5-1 presents a listing of the tools and test equipment required for maintenance of the exciter.

5.3 Preventive Maintenance

5.3.1 In general, preventive maintenance provides a basis for recognizing future probable causes of equipment malfunction in the early stages of deterioration. Many such causes are apparent to the senses of sight, touch and smell. Therefore, by adhering to a stringent program of preventive maintenance involving periodic inspection and cleaning, the most probable causes of equipment malfunction can be avoided. This results in minimizing downtime and ultimately compromising important schedules.

5.3.2 A most important and least expensive tool in the preventive maintenance program is the sense of sight. A thorough visual inspection of an assembly or component for tell-tale signs of deterioration prior to failure can save hours of test and troubleshooting time after a complete breakdown. Table 5-2 presents an inspection checklist for the exciter.

5.3.3 In general, the exciter should be cleaned once a week using a soft camel's hair brush, forced air pressure of not more than 20psi, and a suitable cleaning agent such as tri-chloro-ethane.

* * * * * WARNING * * * * *
The fumes of trichloroethane are toxic. Provide thorough ventilation whenever used. DO NOT USE NEAR AN OPEN FLAME. Trichloroethane is not flammable but expose of the fumes to an open flame or hot metal forms toxic phosgene gas.
* * * * * ***** * * * * *

5.3.3.1 Remove dirt or grease from wiring and chassis surfaces using cleaning solvent. Dry with compressed air.

TABLE 5-1
MAINTENANCE TEST EQUIPMENT AND TOOLS

Item	Use	Model or equal
RF SIGNAL GENERATOR	RF signal source for check and adjustment	H/P 606A
OSCILLISCOPE	Waveshape and voltage analysis	Tektronix 541A
SPECTRUM ANALYZER	Display and adjust of frequency spectrum	H/P 410T/8553B/8552B
AUDIO OSCILLATOR	Audio signal source for check and adjustment	H/P 200CD
VTVM	Voltage measurements	H/P 3406A
VTVM	Voltage and current measurements	H/P 410C
ELECTRONIC COUNTER	Frequency measurements	H/P 5245L
VOM	Voltage/resistance measurements	Simpson 260
ATTENUATOR	Attenuation of signal source	Telonic TG-950
DC POWER SUPPLY	DC voltage source	H/P 6202B
RF CABLES (4)	Test setup interconnection	RG-58/U (BNC-BNC)
TEE-CONNECTOR	Test setup interconnection	BNC
TWO TONE GENERATOR	Tone generator source for check and adjustment	TMC Model TTG-2
RESISTOR - 50 OHM/10W	Current measurement setup	TMC Part RW109-7
RESISTOR - 10 OHM/10W	Current measurement setup	TMC Part RW109-4
RF CABLE	RF check and adjustment	Clip leads (One end)
DUMMY LOAD - 50 OHM/2W	RF check and adjustment	TMC Part RC42GF500J
ELECTRONIC MAINTENANCE TOOL KIT	Repair and replacement of parts	TMC Model KIT-17/T
VLF COMPARATOR	1MHz standard frequency stability test	H/P 117A

TABLE 5-2

INSPECTION CHECKLIST

Component/Assembly	Inspect For	Frequency
Line power cord	Cracks, nicks or fraying. Check the connector for burred threads or bent/broken pin inserts.	Weekly
Front and rear panels	1) Check panel surfaces for general cleanliness; check for scratches or nicks.	Weekly
	2) Check all control knobs for smooth action from limit to limit; check all switches for positive action.	Weekly
	3) Check meter face for cracks, nicks, scratches, etc; check indicator lamps for cracks.	Weekly
	4) Check line fuse housings for cracks; remove line fuses and check for the proper value; check for condition.	Weekly
	5) Check all input/output connectors for burrs, nicks, dents, etc; check power connector for burred threads, bent or broken pins, etc.	Weekly
	6) Check terminal boards on rear panel for cracks or nicks.	Weekly
Main chassis assemblies	1) Remove top and bottom covers from chassis and check overall chassis and components for dirt, dust, or other foreign matter.	Bi-weekly
	2) On bottom of chassis, check all PC board connector wiring for nicks, cuts, frays or worn/exposed areas.	Bi-weekly
	3) Remove and check all PC boards for cracks or broken printed wires or lands; check board components for looseness and evidence of deterioration from possible overheating.	Monthly
	4) Check PC board chassis connectors for bent/broken contacts and for firm mounting. Check all grounds.	Monthly

5.3.3.2 Remove dust and dirt from printed circuit boards using a soft camel's hair brush. Compressed air may be used on heavily populated boards.

5.3.3.3 Blow out accumulated dust and dirt from inaccessible chassis areas using compressed air.

* * * * * NOTE * * * * *
Direct the compressed air stream at an angle to the
component board to obtain best results without damage.
* * * * * ***** * * * * *

5.4 Corrective Maintenance

5.4.1 Corrective maintenance is the process of recognizing and locating a malfunction; replacing either the entire malfunctioning assembly or the one of the malfunctioning parts which comprise the assembly; inspection and cleaning; repair or replacement; reassembly; alignment and adjustment; and final equipment checks to verify minimum performance standards are met.

5.4.2 The circuits of the exciter are contained on printed circuit cards accessible from the top of the chassis. The cards are designated by circuit reference symbols beginning with the letter "Z". Numbers that are prefixed with the letter "A" represent the printed circuit assemblies; this number prefixed with the letter A is the TMC part number and should be used when ordering replacement assemblies. The "Z" prefix is lettered on both the card and the chassis adjacent to its corresponding receptacle. The power supply assembly heat sink is mounted against the rear panel of the main chassis. The two smaller power supply boards are mounted just forward of the heat sink, inside the chassis, and are removeable.

5.4.3 In general, a malfunction of the exciter will usually manifest itself by improper readings on the front panel meter. Such malfunctions can be quickly localized to a particular printed circuit board by a logical process of elimination. If a second set of printed circuit boards is available, troubleshooting can be facilitated by the board substitution method. In some cases, a particular board, when replaced, may require alignment or adjustment as outlined in Section 5.5. Table 5-3 presents a troubleshooting chart for the exciter. Refer to Section 6 for illustrations of top and bottom views of the exciter with applicable diagrams. Technicians should be thoroughly familiar with the operation of the exciter and should make frequent reference to the schematic and interconnection diagrams located in Section 6 when performing troubleshooting procedures. These diagrams contain both major (input/output signal lines) and minor (inter-circuit cross-points) test points. Whenever possible, test points are silk-screened directly onto the printed circuit card and identified by a "TP" prefix.

5.4.4 Disassembly of the exciter is presented in this section. It should be noted that the exciter is disassembled only to the extent that is necessary to effect repair and replacement of faulty components. In some instances, in order to gain access to a malfunctioning component, certain other assemblies must be loosened or removed. An exploded view of the exciter is illustrated in Figure 5-1.

5.4.4.1 The front panel of the exciter must be loosened and swung down to gain access to the rear of all panel controls and indicators, and to those components mounted directly behind the front panel. The panel is removed as follows:

5.4.4.1.1 Loosen and remove two screws (2) on each side of the panel (2).

5.4.4.1.2 Swing panel down carefully, without putting undue strain on panel cabling and wires, to expose rear of panel controls, and those components mounted on main assembly (44).

5.4.4.2 To gain access to and remove terminal boards TB101 and TB102, proceed as follows:

5.4.4.2.1 Remove front panel assembly as outlined in 5.4.4.1.

5.4.4.2.2 Unsolder and tag leads to terminal board (21 or 22).

* * * * * CAUTION * * * * *
Hold hand directly below terminal board in area where each
screw (24) is being removed. Nylon spacer (23) should fall
out after removal of screw.
* * * * * ***** * * * * *

5.4.4.2.3 Loosen and remove three nylon screws (24) securing terminal board (21 or 22) to main assembly (44). Nylon spacer (23) will fall out after each screw is removed.

5.4.4.2.4 Remove terminal board from main assembly.

5.4.4.3 Remove the meter from the front panel as follows:

5.4.4.3.1 Remove the front panel assembly as outlined in 5.4.4.1.

5.4.4.3.2 Loosen and remove two screws (16), lockwashers (15) and nuts (14) through top of meter housing, which secure meter (13) to mounting bracket (17)

5.4.4.3.3 Disconnect and tag leads to meter movement.

(...cont'd 5-28)

Table 5-3. Troubleshooting Chart

Symptom	Step	Test point	Test equipment required	Normal indication	If indication is normal	If indication is abnormal
No rf output in any mode	1	None		Power indicator illuminated	Proceed to step 3	Check that ON-STANDBY switch is in ON position and EXCITER switch is set to ON position (PTT position when using MIKE input). Check that STD switch on rear panel is in INT position. Check that POWER indicator is illuminated. If not, proceed to step 2. If so, proceed to step 8.
	2	Z301-H	VOM	+12 ±1.0 vdc	Replace POWER indicator DS102.	Proceed to step 3
	3	Z301-P	VOM	+24 ±1.0 vdc	Proceed to step 4	Proceed to step 5
	4	Z301-E	VOM	+28 ±2.0 vdc	Proceed to step 8	Proceed to step 5

Table 5-3. Troubleshooting Chart - Continued

Symptom	Step	Test point	Test equipment required	Normal indication	If indication is normal	In indication is abnormal
No rf output in any mode (continued)	5	Z303-E	VOM	+40 to +60 vdc	Proceed to step 6	Check power supply board Z303 regulator circuit in conjunction with pass transistors Q301 through Q303 on heat sink assembly Z305.
	6	Z303-A	VOM	+20 to +30 vdc	Proceed to Step 9	Same as step 5.
	7	Z304-B/C	VTVM (ac scale)	115 volts ac	Check rectifier CR1 on power supply board Z304; check capacitors C1 through C4.	
	8	Z101-3	Oscilloscope, Electronic Counter	1.0 MHz signal at 0.6 volt peak-to-peak.	Proceed to step 11.	Proceed to step 9.
	9	Z101-TP1	Oscilloscope, Electronic Counter	1.0 MHz signal at 0.8 volt peak-to-peak.	Check Q1 and associated circuit; check Level Adj. control R60 and capacitor C70.	Proceed to step 10.

Table 5-3. Troubleshooting Chart - Continued

Symptom	Step	Test point	Test equipment required	Normal indication	If indication is normal	If indication is abnormal
No rf output in any mode (continued)	10	J120	Oscilloscope, Electronic Counter	1.0 MHz signal at 1.0 volt peak-to-peak		Replace 1 MHz standard oscillator Z301.
	11	Z101-D	Oscilloscope, Electronic Counter	100 kHz spectrum signal at 2.0 volts peak-to-peak	Proceed to step 14	Proceed to step 12
	12	Z101-TP8	Oscilloscope, Electronic Counter	100 kHz spectrum signal at 2.5 volts peak-to-peak	Check transistors Q15 and Q16	Proceed to step 13
	13	Z101-TP7	Oscilloscope, Electronic Counter	1 MHz squarewave at 3.0 volts peak-to-peak	Check ÷ 10 decade Z1 and associated components	Check transistors Q14 and Q17
	14	Z101-TP2	Oscilloscope, Electronic Counter	1 MHz spectrum signal at 4.0 volts peak-to-peak	Proceed to step 15	Check transistors Q2 and Q3
	15	Z101-9	Oscilloscope, Electronic Counter	8 MHz signal at 0.5-2.0 volts peak-to-peak	Proceed to step 16	Check transistors Q12 and Q13; check 8 MHz crystal Y3.

Table 5-3. Troubleshooting Chart - Continued

Symptom	Step	Test point	Test equipment required	Normal indication	If indication is normal	If indication is abnormal
No rf output in any mode (continued)	16	Z101-11	Oscilloscope, Electronic Counter	40 MHz signal at 50 mv rms	Proceed to step 17	Check transistors Q18 and Q19
	17	Z101-8	Oscilloscope, Electronic Counter	12 MHz signal at 0.2 to 0.5 volt peak-to-peak with frequency output set to 21.0000 MHz	Proceed to step 18	Check transistors Q4 and Q5; check 12 MHz crystal Y1
	18	Z101-P	Oscilloscope, Electronic Counter	13 MHz signal at 0.2 to 0.5 volt peak-to-peak with frequency output set to 11.0000 MHz	Proceed to step 19	Check transistors Q10 and Q11; check 13 MHz crystal Y5
	19	Z101-13	Oscilloscope, Electronic Counter	14 MHz signal at 0.2 to 0.5 volt peak-to-peak with frequency output set to 02.0000 MHz	Proceed to step 20	Check transistors Q8 and Q9; check 14 MHz crystal Y2

Table 5-3. Troubleshooting Chart - Continued

Symptom	Step	Test point	Test equipment required	Normal indication	If indication is normal	If indication is abnormal
No rf output in any mode (continued)	20	Z106-13	Oscilloscope, Electronic Counter	10.0000 MHz signal at 0.2 volt peak-to-peak with all selector switches at 0 position. Frequency should increase in 100 Hz steps to 10.9999 MHz when 100 Hz, 1 kHz, 10 kHz, and 100 kHz selector switches are each rotated to 9.	Proceed to step 33	Proceed to step 21
	21	Z106-TPI	Oscilloscope, Electronic Counter	09.0999 MHz signal at 0.4 volt peak-to-peak with 100 Hz, 1 kHz, 10 kHz and 100 kHz selector switches at 9. Frequency should decrease in 100 Hz steps to 9.0000 as selector switches are rotated to 0.	Proceed to step 23	Proceed to step 22

Table 5-3. Troubleshooting Chart - Continued

Symptom	Step	Test point	Test equipment required	Normal indication	If indication is normal	If indication is abnormal
No rf output in any mode (continued)	22	Z106-0	Oscilloscope, Electronic Counter	1. 0.000 to 1.9999 MHz signal at 0.6 volt peak-to-peak as 100 Hz, 1 kHz, 10 kHz and 100 kHz switches are rotated from 0 to 9.	Check 8 MHz amplifier Q1; check balanced mixer CR1/CR2	Proceed to step 25
	23	Z105-TP5	Oscilloscope, Electronic Counter	10. 0.000 to 10.9999 MHz signal at 80 mv peak-to-peak as 100 Hz, 1 kHz, 10 kHz and 100 kHz switches are rotated from 0 to 9.	Check final mixer output circuit consists of Q4, Q5, Q7, Q8 and Z1.	Proceed to step 24
	24	Z105-H	Oscilloscope, Electronic Counter	1. 0.000 to 1.9999 MHz signal at 0.7 volt peak-to-peak as 100 Hz, 1 kHz, 10 kHz and 100 kHz switches are rotated from 0 to 9.	Check final mixer circuit consisting of Q6, Q3 and Q2.	Check comb filter boards Z102 and Z103; check wiring to switches S102 through S105; check wiring of 100 kHz spectrum input to Z102 and Z103.

Table 5-3. Troubleshooting Chart - Continued

Symptom	Step	Test point	Test equipment required	Normal indication	If indication is normal	If indication is abnormal
No rf output in any mode (continued)	25	Z105-TP14	Oscilloscope, Electronic Counter	1 to 1.0999 MHz signal at 20 mv peak-to-peak as 100 Hz, 1 kHz, 10 kHz and 100 kHz switches are rotated from 0 to 9.	Check dual mixer-divider output circuit consisting of Q11, Q12, Q13, Q14 and Z2.	Check 1.0000 to 1.9999 MHz input from selector switches and comb filter boards as in step 24. Proceed to step 26.
	26	Z105-TP10	Oscilloscope, Electronic Counter	9 to 9.099 MHz signal at 50 mv peak-to-peak as 100 Hz, 1 kHz, 10 kHz and 100 kHz switches are rotated from 0 to 9.	Check mixer circuit consisting of Q9 and Q10.	Proceed to step 27
	27	Z105-TP-U (Z1 Out)	Oscilloscope, Electronic Counter	1 to 1.099 MHz signal at min 0.5 volt peak-to-peak as 100 Hz, 1 kHz, 10 kHz and 100 kHz switches are rotated from 0 to 9.	Check 8 MHz amplifier Q8; check balanced mixer CR6/CR7	Proceed to step 28

Table 3. Troubleshooting Chart - Continued

Symptom	Step	Test Points	Test Equipment Required	Normal Indication	If Indication is normal	If Indication is abnormal
No. 11 output in test mode (continued)		Z105-108	Oscilloscope, Electronic Counter	1 to 1.00 MHz signal at 0.5 volt peak-to-peak as 100 Hz, 1 kHz, 10 kHz and 100 kHz switches are rotated from 0 to 9.	Check mixer circuit consisting of Q4, Q5, Q6, Q7 and Z1.	Check 1, 6000 to 1,9999 A Hz input from selector switches and comb filter boards as in step 24. Proceed to step 29.
	29	Z105-101	Oscilloscope, Electronic Counter	0 to 0.09 MHz signal at 0.5 volt peak-to-peak as 100 Hz, 1 kHz, 10 kHz and 100 kHz switches are rotated from 0 to 9.	Check mixer circuit consisting of Q2 and Q3.	Proceed to step 30
	30	Z105-9	Oscilloscope, Electronic Counter	1 to 1.00 MHz signal at 0.5 volt peak-to-peak as 100 Hz, 1 kHz, 10 kHz and 100 kHz switches are rotated from 0 to 9.	Check 8 MHz amplifier Q1; check balanced mixer CR1/CR2.	Proceed to step 31

Table 5-3. Troubleshooting Chart - Continued

Symptom	Step	Test point	Test equipment required	Normal indication	If indication is normal	If indication is abnormal
No rf output in any mode (continued)	31	Z104-TP7	Oscilloscope, Electronic Counter	10 to 10.9 MHz signal at 20 mv peak-to-peak as 100 Hz, 1 kHz, 10 kHz and 100 kHz switches are rotated from 0 to 9.	Check mixer circuit consisting of Q4, Q5, Q6, Q7 and Z1.	Proceed to step 32
	32	Z104-TP1	Oscilloscope, Electronic Counter	9 to 9.09 MHz signal at 50 mv peak-to-peak as 100 Hz, 1 kHz, 10 kHz and 100 kHz switches are rotated from 0 to 9.	Check mixer circuit consisting of Q2 and Q3; check 1 to 1.9 MHz input from switches as in step 24; check balanced mixer CR3 and CR4.	Check 8 MHz amplifier Q1; check balanced mixer CR1 and CR2.
	33	Z112-R	Oscilloscope, Electronic Counter	1.6 to 29.9999 MHz signal at 0.2 volt peak-to-peak, corresponding to setting of frequency select switches.	Proceed to step 56.	Proceed to step 34

Table 5-3. Troubleshooting Chart - Continued

Symptom	Step	Test point	Test equipment required	Normal indication	If indication is normal	If indication is abnormal
No rf output in any mode (continued)	34	Z112-10	VOM	Approximately -3 vdc	Proceed to step 35	Proceed to step 40
	35	Z112-13	Oscilloscope, Electronic Counter	104 - 132 MHz as selector switches are rotated from 1.6 to 29.9999 MHz	Proceed to step 36	Proceed to step 41
	36	Z112-D/E	Oscilloscope, Electronic Counter	3 MHz signal at 90 mv \pm 10 peak-to-peak	Proceed to step 37	Proceed to step 43
	37	Z112-TP3	Spectrum Analyzer	133.5 MHz signal with switches set to 05.5000 MHz	Proceed to step 38	Proceed to step 39
	38	Z112-TP6	Spectrum Analyzer	133.5 MHz signal with switches set for 05.5000 MHz	Check 1.6 to 30 MHz amplifier Q11	Check amplifiers Q8, Q9 and Q10.

Table 5-3. Troubleshooting Chart - Continued

Symptom	Step	Test point	Test equipment required	Normal indication	If indication is normal	If indication is abnormal
No rf output in any mode (continued)	39	Z112-TP7	Spectrum Analyzer	133.5 MHz signal with switches set for 05.5000 MHz.		Check transistors Q5 and Q6; check X3 amplifier Q4; Check 13 to 13.5 MHz amplifiers Q13 and Q14; check 13.5 to 14 MHz amplifiers Q18 and Q19; check Q12 and balanced mixer CR4/CR5.
	40	Z112-10	DC Power Supply VOM	Remove rf output board Z115 and connect supply (-) to J112-10; adjust for -2 vdc.		
		Z112-	Oscilloscope, Counter	1.6 to 29.9999 MHz signal at 0.2 volt peak-to-peak corresponding to setting of frequency select switches.	Check ALDC ADJ control R107; check ALDC circuit on Z115.	Check ALDC amplifiers Q15, Q16 and Q17.

Table 5-3. Troubleshooting Chart - Continued

Symptom	Step	Test point	Test equipment required	Normal indication	If indication is normal	If indication is abnormal
No rf output in any mode (continued)	41	Z113-1	Oscilloscope, Counter	104 to 132 MHz as select switches are rotated from 1.6 to 29.9999 MHz.	Check low pass filter FX287.	Proceed to step 42
	42	Z113-TP-BP (Q13 Base)	Oscilloscope, Counter	104 to 132 MHz as select switches are rotated from 1.6 to 29.9999 MHz.		Check amplifier Q13. NOTE: It is unlikely that no rf output would result from this point through the fault of the step generators; rf would be present on one or two ranges at least. Refer to step 61.

Table 5-3. Troubleshooting Chart - Continued

Symptom	Step	Test point	Test equipment required	Normal indication	If indication is normal	If indication is abnormal
No rf output in any mode (continued)	43	Z108-TP4	Oscilloscope, Counter	3 MHz signal.		Switch to FSK or FAX mode; if indication still abnormal, check amplifiers Q3 and Q4. Check band pass filter FL1. If indication becomes normal in FSK and/or FAX modes, proceed to step 44.
	44	Z108-TP2	Oscilloscope, Counter	Audio modulated 250 kHz signal at 50-150 mvpp with Z108 removed; MODE switch at ISB; and CARRIER control fully CW, CCW with switch type control.	Proceed to step 45	Proceed to step 46

Table 3-3. Troubleshooting Chart - Continued

Symptom	Step	Test point	Test equipment required	Normal indication	If indication is normal	If indication is abnormal
No rf output in any mode (continued)	45	Z108-TP1 (Z108-C)	Oscilloscope, Counter	2.75 MHz signal at 70 mv peak-to-peak with Z108 removed; MODE switch at ISB; and CARRIER control fully CW, CCW switch type control.	Check 2.75 MHz amplifiers Q1 and Q2; check balanced mixer Z2.	Proceed to step 50
	46	Z107-TP6	Oscilloscope, Counter	250 kHz signal with MODE switch at ISB and CARRIER control fully CW, CCW switch type control.	Proceed to step 47	Proceed to step 52
	47	Z107-TP10	Oscilloscope, Counter	Audio modulated 250 kHz signal with MODE switch at ISB and CARRIER control fully CW, CCW switch type control.	Check C28 and R72; check wiring between Z107 and S114C (rear); check wiring between S114C (rear) and Z108.	Proceed to step 48

Table 5-3. Troubleshooting Chart - Continued

Symptom	Step	Test point	Test equipment required	Normal indication	If indication is normal	If indication is abnormal
No rf output in any mode (continued)	48	Z107-TP4	Ballantine VTVM	USB audio in 3 kHz range at 16 mv rms from either mike or line input adjusted for 2/5 full scale reading on MONITOR meter.	Proceed to step 49	Check USB MIKE-LINE control; check S114A (front); check wiring from S114A (front) to Z107.
	49	Z107-TP-CK (FL1 Input)	Oscilloscope	Audio modulated 250 kHz signal at 200 mv peak-to-peak.	Check USB filter FL1 and Q8.	Check Q6 and Q7; check balanced modulator CR1 through CR4.
	50	Z112-TP-BZ	Oscilloscope	2.75 MHz signal at approximately 60 mv peak-to-peak.	Check Q9.	Proceed to step 51
	51	Z112-TP6	Oscilloscope, Counter	2.75 MHz signal at approximately 0.4 volt peak-to-peak.	Check X11 multiplier Q7.	Check 2.75 MHz amplifier Q8; check band pass filter FL1.
	52	Z112-TP4	Oscilloscope Counter	250 kHz signal at 1.4 volts peak-to-peak with MODE switch at AM.	Check capacitor C45.	Proceed to step 53

Table 5-3. Troubleshooting Chart - Continued

Symptom	Step	Test point	Test equipment required	Normal Indication	If indication is normal	If indication is abnormal
No rf output in any mode (continued)	53	Z112-TP-EX (Q7 Base)	Oscilloscope, Counter	250 kHz signal.	Check 250 kHz amplifiers Q2 and Q3.	Proceed to step 54
	54	Z112-TP1	Oscilloscope, Counter	1 MHz signal at 10 volts peak-to-peak.	Check 1 MHz amplifier Q1; check dividers Z1 and Z2 (-÷2)	Check 1 MHz amplifier Q13
	55	Z119-3	Oscilloscope, Counter	Same as step 33.	Proceed to step 56	Check relay K2601; check Z119 filter network.
	56		MONITOR meter: Set METER switch to Q1.	Meter indicates in green area marked Q1.	Proceed to step 57	Check rf amplifier stage Z115-Q1.
	57		MONITOR meter: Set METER switch to Q2.	Meter indicates in green area marked Q2.	Proceed to step 58	Check rf amplifier stage Z115-Q2.
	58		MONITOR meter: Set METER switch to Q3.	Meter indicates in green area marked Q3.		Check rf amplifier stage Z115-Q3.

Table 5-3. Troubleshooting Chart - Continued

Symptom	Step	Test point	Test equipment required	Normal indication	If indication is normal	If indication is abnormal
No rf output in AM mode only	59	Z112-TP-CA (Q12 Collect)	Oscilloscope, Counter	250 kHz signal at 0.8 volt peak-to-peak with Z107 removed.	Check AM Level adjust R69 and capacitor C38.	Check Q12 and Q14; check wiring through S114A (rear).
No audio sidebands in AM mode only	60	Z109-14	Oscilloscope, Counter	Same as step 44, except MODE switch in AM position and no audio modulation. 250 kHz sub-carrier present.		Check audio stages Q11 and Q10; check wiring from switch S114A (front)
No rf output above 21.9999 MHz	61	Z101-8	Oscilloscope, Counter	Same as step 17.	Proceed to step 62	Same as step 17.
	62	Z113-N	Oscilloscope, Counter	10.4 to 11.2 MHz as selector switches are rotated to frequencies above 22 MHz.	Proceed to step 63	Check 10.4 to 11.2 MHz channel on Z113 consisting of Q14 through Q20.

Table 5-3. Troubleshooting Chart - Continued

Symptom	Step	Test point	Test equipment required	Normal indication	If indication is normal	If indication is abnormal
No rf output above 21.9999 MHz (continued)	63	Z111-1	Oscilloscope, Counter	52 - 56 MHz signal as selector switches are rotated to frequencies above 22 MHz.	Proceed to step 64	Check 52 - 56 MHz circuit on Z111 consisting of Q3, bandpass filter FL1, Q2 and Q1.
	64	Z113-TP-BK (Q11 Base)	Oscilloscope, Counter	104 - 112 MHz signal as selector switches are rotated to frequencies above 22 MHz.	Check Q4.	Check Q1, Q2 and Q3.
No rf output in middle frequency range from 12 to 21 MHz	65	Z101-P	Oscilloscope, Counter	Same as step 18	Proceed to step 66	Same as step 18
	66	Z110-4	Oscilloscope, Counter	11.3 to 12.2 MHz signal as selector switches are rotated to frequencies between 12 and 21 MHz.	Proceed to step 67	Check 11.3 to 12.2 MHz channel on Z110 consisting of Q9 through Q15.

Table 5-3. Troubleshooting Chart - Continued

Symptom	Step	Test point	Test equipment required	Normal indication	If indication is normal	If indication is abnormal
No rf output in middle frequency range from 12 to 21 MHz (continued)	67	Z111-2	Oscilloscope, Counter	56.5 to 61 MHz signal as selector switches are rotated to frequencies between 12 and 21 MHz.	Proceed to step 68	Check 56.5 to 61 MHz circuit on Z111 consisting of Q6 bandpass filter FL2, Q5 and Q4.
	68	Z113-TP-BM (Q8 Base)	Oscilloscope, Counter	113 to 122 MHz signal as selector switches are rotated to frequencies between 12 and 21 MHz.	Check Q8.	Check Q5, Q6 and Q7.
No rf output in lower frequency range from 1.6 to 12 MHz.	69	Z101-13	Oscilloscope, Counter	Same as step 19	Proceed to step 70	Same as step 19

Table 5-3. Troubleshooting Chart - Continued

Symptom	Step	Test point	Test equipment required	Normal indication	If indication is normal	If indication is abnormal
No rf output in lower frequency range from 1.6 to 12 MHz	70	Z110-5	Oscilloscope, Counter	12.3 to 13.2 MHz signal as selector switches are rotated to frequencies from 1.6 to 12 MHz	Proceed to step 71	Check 12.3 to 13.2 MHz circuit on Z110 consisting of Q1 through Q4 and Q6 through Q8
	71	Z111-3	Oscilloscope, Counter	61.5 to 66 MHz signal as selector switches are rotated to frequencies from 1.6 to 12 MHz.	Proceed to step 72	Check 61.5 to 66 MHz circuit on Z111 consisting of Q9, bandpass filter FL3, Q8 and Q7.
	72	Z113-TP-B0 (Q12 Base)	Oscilloscope, Counter	123 to 132 MHz signal as selector switches are rotated to frequencies from 1.6 to 12 MHz.	Check Q12.	Check Q11, Q10 and Q9.

Table 5-3. Troubleshooting Chart - Continued

Symptom	Step	Test point	Test equipment required	Normal indication	If indication is normal	If indication is abnormal
No rf output in AM, USB, LSB, ISB or CW modes; FSK and FAX okay	73	Same as 44 through 49	Same as steps 44 through 49	Same as steps 44 through 49	Same as steps 44 through 49	Same as steps 44 through 49
No rf output in CW operation	74			EXCITER switch to ON position and keying relay K101 energized.	Check CR10 on Z112; check position of CW Level Adjust R20 on Z109.	Check that ground return is present at J109-H and J112-15 when keyer is energized.
No MONITOR meter indication in USB or LSB positions	75	Z112-TP-CC	VOM	DC signal of approximately 2 volts.	Check wiring to switch S115.	Check Q6 and Q5; check rectifier diode CR2 and associated filter capacitors.

Table 5-3. Troubleshooting Chart - Continued

Symptom	Step	Test point	Test equipment required	Normal indication	If indication is normal	If indication is abnormal
No audio using MIKE jack	76	Z107-TP3	Ballantine VTVM	40 mv rms	Check capacitor C13. Check wiring between MIKE jack and Z107.	Check mike audio amplifier consisting of Q1 through Q5.
No FSK operation	77		Switch to FAX operation	RF output should appear.	Check FSK circuit on Z108 consisting of Q7 through Q10; check keyer circuit CR8/CR9 and rectifier CR10 through CR13.	Check 3 MHz VXCO Z302 in power supply assembly.

- 5.4.4.3.4 Withdraw meter (13) through rear of front panel assembly.
- 5.4.4.4 Remove PC board connectors as follows:
 - 5.4.4.4.1 Remove PC board (25 through 38) from fault chassis connector.
 - 5.4.4.4.2 Unsolder and tag leads to connector (39).
 - 5.4.4.4.3 Loosen and remove two screws (42), lockwashers (41) and nuts (40) securing connector (39) to mounting rails (43). Lug for the ground buss will also come off.
 - 5.4.4.5 To remove the power transformer T301, proceed as follows:
 - 5.4.4.5.1 Loosen and remove four screws (67) holding power supply board mounting bracket (66) to chassis bracket (68), and carefully lift out bracket taking care not to put strain on wires.
 - 5.4.4.5.2 Unsolder and tag leads to transformer (76) terminals.
 - 5.4.4.5.3 Loosen and remove four nuts (78) and lockwashers (77) securing transformer (76) to side of chassis bracket (68) and remove transformer.
 - 5.4.4.6 Remove heat sink assembly Z305 as follows:
 - 5.4.4.6.1 Loosen and remove four screws (61), lockwashers (59 and 60) and nuts (58) securing heat sink (57) to inside of rear panel.
 - 5.4.4.6.2 Carefully lift heat sink assembly up and out (57).
 - 5.4.4.6.3 Carefully unsolder and tag leads to transistors.
 - 5.4.4.6.4 Remove faulty transistor from heat sink assembly (57) by removing two screws, lockwashers and nuts.
 - 5.4.4.6.5 Remove transistor and insulator from heat sink assembly (57).
 - 5.4.4.7 Remove rear panel assembly as follows:
 - 5.4.4.7.1 Loosen and remove four screws (50) and lockwashers (49) that secure rear panel assembly (48) to side panel assemblies (45 and 46).
 - 5.4.4.7.2 Loosen and remove four screws (70) and lockwashers (69) that secure rear panel assembly (48) to chassis bracket (68).

- 5.4.4.7.3 Carefully swing rear panel to gain access to panel-mounted components.
- 5.4.4.8 Remove power connector J116 from rear panel assembly as follows:
 - 5.4.4.8.1 Remove rear panel assembly (48) as outlined in 5.4.4.7.
 - 5.4.4.8.2 Unsolder and tag leads to power connector J116.
 - 5.4.4.8.3 Loosen and remove screws (56), lockwashers (55) and nuts (54) securing bulkhead connector (53) to inside of rear panel assembly (48) and remove connector.
- 5.4.4.9 Remove the 1MHz standard Z301 as follows:
 - 5.4.4.9.1 Remove four screws (67) securing power supply board mounting bracket (66) to chassis bracket (68) and carefully lift power supply board mounting bracket (66) up, taking care not to put undue strain on the wires.
 - 5.4.4.9.2 Loosen and remove four nuts (75) and lockwashers (74) that secure Z301 mounting studs to side of chassis bracket (68).
 - 5.4.4.9.3 Unplug Z301 (73) from socket and remove from chassis bracket (68).
- 5.4.4.10 Remove high pass filter board Z119 as follows:
 - 5.4.4.10.1 Remove front panel(1) as outlined in 5.4.4.1.
 - 5.4.4.10.2 Unsolder and tag leads to Z119 (79) terminals.
 - 5.4.4.10.3 Loosen and remove two screws (82) and flat washers (81) that secure Z119 to standoffs (80).
 - 5.4.4.10.4 Remove Z119.
- 5.4.4.11 Remove terminal boards Z103, Z104 and Z105 as follow:
 - 5.4.4.11.1 Remove rear panel assembly (48) as outlined in 5.4.4.7.
 - 5.4.4.11.2 Unsolder and tag leads to terminal board.
 - 5.4.4.11.3 Loosen and remove four screws (87), lockwashers (86) and nuts (85) - two at each end - securing terminal board to rear panel assembly (48). Metal plate (84) at each end of terminal board (83) will also come off.

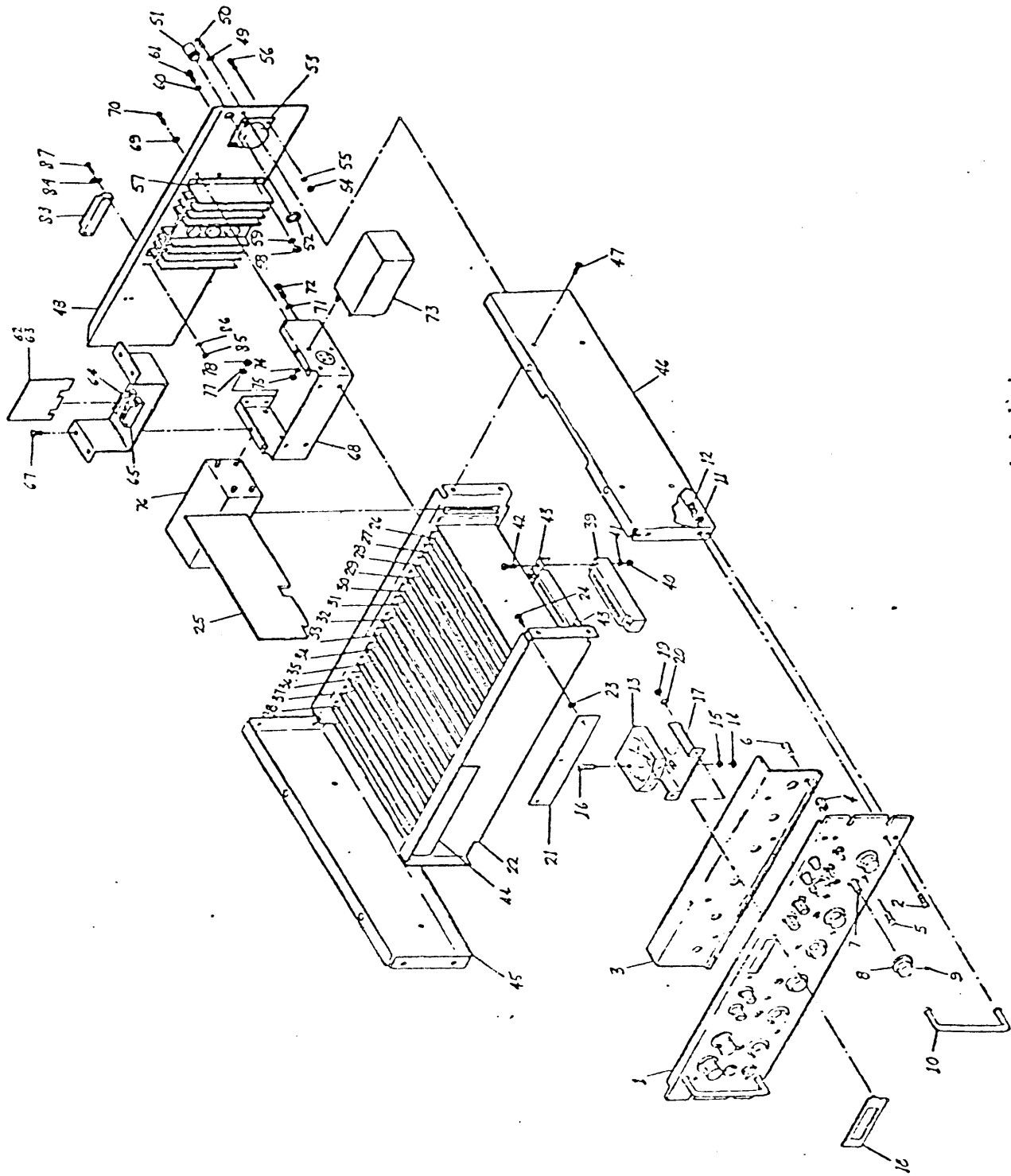


Figure 5-1. Exciter, exploded view

Legend for fig. 5-1:

1. Front Panel	30. PC Board	59. Lockwasher
2. Screw	31. PC Board	60. Lockwasher
3. Switch Bracket	32. PC Board	61. Screw
4. Spacer	33. PC Board	62. PC Board
5. Screw	34. PC Board	63. PC Board
6. Screw	35. PC Board	64. Connector
7. Switch	36. PC Board	65. Connector
8. Knob	37. PC Board	66. Mounting Bracket
9. Setscrew	38. PC Board	67. Screw
10. Handle	39. Connector	68. Chassis Bracket
11. Lockwasher	40. Nut	69. Lockwasher
12. Screw	41. Lockwasher	70. Screw
13. Meter	42. Screw	71. Lockwasher
14. Nut	43. Mounting Rail	72. Screw
15. Lockwasher	44. Main Assembly	73. Z301
16. Screw	45. Side Panel	74. Lockwasher
17. Mounting Bracket	46. Side Panel	75. Nut
18. Bezel	47. Screw	76. Transformer
19. Nut	48. Rear Panel	77. Lockwasher
20. Lockwasher	49. Lockwasher	78. Nut
21. Terminal Board	50. Screw	79. Z119
22. Terminal Board	51. BNC Connector	80. Standoff
23. Nylon Spacer	52. Locknut	81. Flat Washer
24. Nylon Screw	53. Power Connector	82. Screw
25. PC Board	54. Nut	83. Terminal Board
26. PC Board	55. Lockwasher	84. Plate
27. PC Board	56. Screw	85. Nut
28. PC Board	57. Heat Sink	86. Lockwasher
29. PC Board	58. Nut	87. Screw

5.4.5 Inspection of the exciter is covered in this section. The exciter contains no moving mechanical parts and requires no lubrication. The need for intricate mechanical inspection is unnecessary. However, certain electrical components such as PC boards, terminal boards, switches, resistors, capacitors, transformers, wiring, connectors, etc., can be visually checked for signs of deterioration due to mishandling, overheating or aging through use. The following paragraphs briefly discuss inspection methods for the electrical components.

5.4.5.1 Inspect all PC boards as follows:

5.4.5.1.1 Check for loose components.

5.4.5.1.2 Check all components for signs of deterioration due to overheating.

5.4.5.1.3 Check printed wiring (lands) for cracks or solder spillage. Cracks and solder bridges cause open and short circuits respectively.

5.4.5.1.4 Check board connector plug for cleanliness and absence of foreign matter which could cause shorts. Check for openings in printed wiring (lands) due to cracks.

5.4.5.1.5 Check overall board for general cleanliness, especially a board which has undergone component replacement.

5.4.5.2 Inspect all terminal boards as follows:

5.4.5.2.1 On terminal (resistor) boards TB101 and TB102, check for signs of component deterioration due to overheating. Check printed wiring for cracks and solder spillage. Check for cleanliness.

5.4.5.2.2 On terminal boards TB103, TB104 and TB105, check for cracks. Check that screw terminals are all tight and that all solder connections are clean and solid.

5.4.5.3 Inspect all switches and chassis-mounted electronic components as follows:

5.4.5.3.1 Check all rotary switches for solid mounting and positive detent action. Check switch wiring for nicks, cuts, abrasions, etc. Check switch-mounted components for solid connections or signs of deterioration due to overheating.

5.4.5.3.2 Check all connectors for burred threads, bent or broken pins, dents, and solid mounting.

5.4.5.3.3 Check all chassis-mounted components for signs of deterioration due to overheating. Check for solid connections and mounting.

5.4.6 Cleaning, in general, of electrical parts can be accomplished using a soft camel's hair brush and forced air pressure of not more than 20psi. Metal surfaces can be cleaned using a soft lint-free cloth that is dampened with a mild solution of detergent and water. Cleaning agents such as trichloroethane may also be used on bare metal surfaces.

* * * * * WARNING * * * * *
The fumes of tri-chloroethane are toxic. Provide thorough ventilation whenever used. DO NOT USE NEAR AN OPEN FLAME. Trichloroethane is not flammable but exposure of the fumes to an open flame or hot metal forms highly toxic phosgene gas. Do not use trichloroethane on painted surfaces.
* * * * * ***** * * * * *

5.4.7 Repair of the chassis-mounted power supply circuitry follows standard laboratory procedures. Repair of printed circuit boards and board receptacle wiring, however, requires the special tools and techniques as outlined herein. Section 6 contains information on all replacement parts and their circuit symbol numbers. These symbol numbers are also shown on both the schematics and parts lists for cross-referencing.

5.4.7.1 When replacing a part on a board, it is necessary to remove the old part from the board by melting the solder on all the component pins. The new part, however, is soldered to the board using conventional pin-by-pin methods.

5.4.7.2 Breaks in the conducting strip (land or 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 current in excess of 1ma) for making point-to-point resistance tests using needle probes. Insert one point into the conducting strip close to the end of the terminal, and place the other probe on the terminal or the 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 and then use a magnifying glass to locate the fault in the conductor.

* * * * * CAUTION * * * * *

* * * * * 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 1ma.
 * * * * * ***** * * * * *

5.4.7.3 Repair printed conductors as follows:

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

5.4.7.3.2 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.

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

* * * * * CAUTION * * * * *
 After repairs, check the board for solder drippings which
 may cause shorts if not removed prior to operation.
 * * * * * ***** * * * * *

5.4.7.3.4 Frequency, 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, clean the carbonized area thoroughly 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.

5.4.8 Reassembly of the exciter components is essentially the reverse of the disassembly procedures outlined in 5.4.4. When replacing components and/or assemblies, reference the component location diagrams in Section 6.

5-5. Alignment and Adjustment.

Alignment and adjustment of the Exciter consists of individual board alignments and a final overall alignment. It should be noted that board alignment may be required whenever a particular PC board is replaced or repaired, even though the replacement board in question has already been aligned and adjusted. At worst case, the replacement board should be checked to insure correct output parameters. This is necessary to insure compatibility of the new board with the remaining circuit boards of the Exciter. The following procedures present PC board alignment and adjustment, and the final overall alignment.

a. Board Alignments. The individual board alignments for the Exciter are presented in paragraphs 5-5 a. (1) through 5-5 a. (14), and are referenced to test setup diagrams, waveforms and schematics where applicable.

NOTE

Frequency tolerances of ± 1 count indicate the frequency in question $\pm 0.001\%$.

- (1) Power Supply Boards Z303 and Z304. (See figs. 5-2, FO-18 and FO-17.) Align the power supply boards as follows:
 - (a) Check that ON-STANDBY switch is in STANDBY position.
 - (b) Remove top and bottom covers from chassis.
 - (c) Remove rf output board Z115 from chassis and plug in ac line cord; STANDBY indicator illuminates amber.
 - (d) Place power supply board A Z304 on extender board and set ON-STANDBY switch to ON position. Allow 30-minute warmup period to elapse.
 - (e) With VOM, measure dc voltage at J304-A; it should be approximately +40 volts.
 - (f) Measure dc voltage at J304-E with VOM; it should be approximately +20 volts. Set ON-STANDBY switch in STANDBY position.
 - (g) Remove Z304 from extender board and replace in chassis connector.
 - (h) Place power supply board B Z303 on extender board; set ON-STANDBY switch to ON position.
 - (i) Measure dc voltage at J303-E with VOM; it should be approximately +20 volts.
 - (j) Measure dc voltage at J303-A with VOM; it should be approximately +40 volts.

(k) Turn R3 and R12 fully clockwise and measure dc voltage at J303-F; adjust R8 for exactly 12.0 volts (± 0.1 vdc).

(l) Connect VTVM to J303-F, and measure ac ripple; it should be no greater than 5 mv rms.

(m) Adjust R3 until voltage level just commences to decrease; then back control off slightly for full voltage.

(n) Measure dc voltage at J303-4 and adjust R18 for exactly 24.0 ± 1.0 volts.

(o) Connect VTVM to J303-4 and measure ac ripple; it should be no greater than 3 mv rms.

(p) Adjust R12 until voltage level just starts to drop; back off slightly to full voltage.

(q) Measure dc voltage at J303-3 with VOM; it should be +28 volts ± 2 volts. If voltage is too low, readjust R12 as in step (p), monitoring voltage at J303-3.

(r) Set METER switch to Q1 position.

(s) Connect VOM as indicated in figure 5-2.

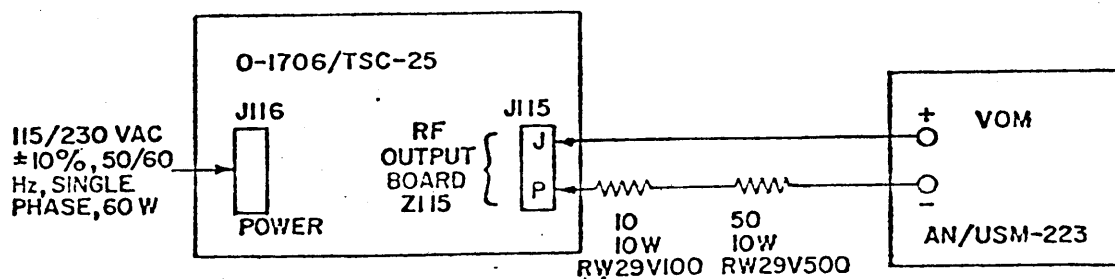


Figure 5-2. MONITOR meter, alignment setup.

NOTE

The Exciter front panel meter gradations 0-5 represent 0-500 milliamperes.

(t) Note VOM reading; for example, 450 ma.

(u) Adjust meter adjust control R106 (fig. FO-19), located at rear of meter switch, for same reading on MONITOR meter as obtained with VOM (4.5 on dial). Set ON-STANDBY switch to STANDBY position.

(v) Remove Z303 from extender board and install in chassis connector J303. Reinstall Z115.

(2) Spectrum Generator Board Z101. Align the spectrum generator board as follows:

(a) Remove top cover from chassis and remove rf output board Z115.

(b) Place Z101 on extender board and set ON-STANDBY switch to ON position. Allow 30-minute warmup period to elapse.

(c) Set STD switch on Exciter rear panel to INT position.

NOTE

For following steps, connect electronic counter to VERT OUTPUT jack of oscilloscope to monitor frequencies.

(d) Connect scope between J101-A and ground and adjust T1 for at least 1.0 volt peak-to-peak output at 1 MHz ± 1 count.

(e) Connect scope to J101-3, and adjust R60 for 0.6 ± 0.04 volt peak-to-peak at 1 MHz ± 1 count.

(f) Connect scope to collector of Q3; a 1 MHz ± 1 count spectrum signal of 1.5 to 2.0 volts peak-to-peak should be observed.

(g) Connect scope to J101-D; a 100 kHz ± 1 count spectrum signal of 1.5 to 2.0 volts peak-to-peak should be observed.

(h) With front panel selector switches set to 21.0000 MHz, connect scope to TP3. Adjust T2 and C12 for 50 to 150 mv peak-to-peak maximum output at 12 MHz ± 1 count.

(i) Connect scope between J101-8 and ground at J101-J. Adjust T3 for 0.2 to 0.5 volt peak-to-peak 12 MHz ± 1 count signal; readjust T2 and C12 for maximum output. Amplitude should be 0.2 to 0.5 volt peak-to-peak.

(j) With front panel selector switches set to 11.0000 MHz, connect scope to TP6. Adjust C50 and T8 for 50 to 150 mv peak-to-peak signal at 13 MHz ± 1 count.

(k) Connect scope between J101-P and ground at J101-R. Adjust T9 for 50 to 150 mv peak-to-peak 13 MHz ± 1 count signal; readjust C50 and T8 for 0.2 to 0.5 volt peak-to-peak signal.

(l) With front panel selector switch set at any position between 2 and 30 MHz, connect scope to TP9. Adjust C73 and T10 for 0.5 to 1.5 volt peak-to-peak 8 MHz ± 1 count signal.

(m) Connect scope between J101-S and ground at J101-15. Adjust T11 for 0.5 to 1.5 volt peak-to-peak 8 MHz ± 1 count signal; readjust C73 and T10 for maximum signal. Output should be 0.5 to 2.0 volt peak-to-peak.

(n) With front panel selector switches set to 02.0000 MHz, connect scope to TP5. Adjust C36 and T6 for 50 to 150 mv peak-to-peak 14 MHz ± 1 count signal.

(o) Connect scope between J101-13 and ground at J101-12. Adjust T7 for 0.2 to 0.5 volt peak-to-peak 14 MHz ± 1 count signal; readjust C36 and T6 for maximum output. Amplitude should be 0.2 to 0.5 volt peak-to-peak.

(p) Connect VTVM between J101-11 and ground at J101-10. Adjust C86 and C89 for minimum of 50 mv rms (about 150 mv rms). Frequency should be 40.0 MHz ± 1 count. Set ON-STANDBY switch to STANDBY position.

(q) Remove Z101 from extender board and install in chassis. Reinstall Z115.

(3) Comb Filter A Board Z102. Align the comb filter board as follows:

NOTE

For following steps, connect electronic counter to VERT OUTPUT jack of oscilloscope to monitor frequencies.

(a) Remove top cover from chassis and remove rf output board Z115.

(b) Place Z102 on extender board and set ON-STANDBY switch to ON position. Allow 30-minute warmup period to elapse.

(c) Set STD switch on Exciter rear panel to INT position.

(d) Place 100 kHz, 10 kHz, 1 kHz, 100 Hz switches to a blank position.

(e) Connect scope to TP11. Adjust C54 and T11 for 0.05 to 0.2 volt peak-to-peak 800 kHz ± 1 count output.

(f) Connect scope between J102-S and ground at J102-125. Adjust R42 for convenient level (0.7 volt peak-to-peak); adjust T12 for maximum 800 kHz ± 1 count signal. Readjust C54 and T11 for maximum and readjust R42 for 0.7 ± 0.05 volt peak-to-peak.

(g) Connect scope to TP9. Adjust C43 and T9 for 0.05 to 0.2 volt peak-to-peak signal at 1.0 MHz ± 1 count.

(h) Connect scope to J102-14 and adjust R35 for convenient level (0.7 volt peak-to-peak). Adjust T10 for maximum 1.0 MHz ± 1 count signal and readjust C43 and T9 for maximum. Readjust R35 for 0.7 ± 0.05 volt peak-to-peak.

(i) Connect scope to TP7. Adjust C32 and T7 for 0.05 to 0.2 volt peak-to-peak 1.2 MHz ± 1 count signal.

(j) Connect scope to J102-J. Adjust R23 for a convenient level (0.7 volt peak-to-peak). Adjust T8 for maximum 1.2 MHz ± 1 count signal and readjust C32 and T7 for maximum. Then readjust R23 for 0.7 ± 0.05 volt peak-to-peak.

(k) Connect scope to TP5. Adjust T5 and C22 for 0.05 to 0.2 volt peak-to-peak 1.4 MHz ± 1 count signal.

(l) Connect scope to J102-F. Adjust R21 for a convenient level (0.7 volt peak-to-peak). Adjust T6 for maximum 1.4 MHz ± 1 count signal and readjust T5 and C22 for maximum. Then readjust R21 for 0.7 ± 0.05 volt peak-to-peak.

(m) Connect scope to TP4. Adjust T3 and C11 for 0.05 to 0.2 volt peak-to-peak 1.6 MHz ± 1 count signal.

(n) Connect scope to J102-L. Adjust R14 for a convenient level (0.7 volt peak-to-peak). Adjust T4 for maximum 1.6 MHz ± 1 count signal and readjust T3 and C11 for maximum. Then readjust R14 for 0.7 ± 0.05 volt peak-to-peak.

(o) Connect scope to TP1. Adjust C10 and T2 for 0.05 to 0.2 volt peak-to-peak 1.8 MHz ± 1 count signal.

(p) Connect scope to J102-4. Adjust R3 for a convenient level (0.7 volt peak-to-peak). Adjust T4 for maximum 1.8 MHz ± 1 count signal and readjust C10 and T2 for maximum. Then readjust R3 for 0.7 ± 0.05 volt peak-to-peak.

(q) Set ON-STANDBY switch to ON position; remove Z102 from extender board and install in chassis. Reinstall Z115.

(4) Comb Filter B Board Z103. Align the comb filter board as follows:

NOTE

For following steps, connect electronic counter to VERT OUTPUT jack of oscilloscope to monitor frequencies.

(a) Remove top cover from chassis and remove rf output board Z115.

(b) Place Z103 on extender board and set ON-STANDBY switch to ON position. Allow 30-minute warmup period to elapse.

(c) Set STD switch on Exciter rear panel to INT position.

(d) Set 100 kHz, 10 kHz, 1 kHz, 100 Hz selector switches to a blank position.

(e) Connect scope to TP11. Adjust C54 and T11 for 0.05 to 0.2 volt peak-to-peak 900 kHz ± 1 count signal.

(f) Connect scope between J103-S and ground at J103-15. Adjust R42 for a convenient level (0.7 volt peak-to-peak). Adjust T12 for maximum (0.7 volt peak-to-peak) 900 kHz ± 1 count level and readjust C54 and T11 for maximum. Then readjust R42 for 0.7 ± 0.05 volt peak-to-peak.

(g) Connect scope to TP9. Adjust C43 and T9 for 0.05 to 0.2 volt peak-to-peak signal at 1.1 MHz ± 1 count.

(h) Connect scope to J103-14; adjust R35 for a convenient level (0.7 volt peak-to-peak). Adjust T10 for maximum 1.1 MHz ± 1 count signal and readjust C43 and T9 for maximum. Then readjust R35 for 0.7 ± 0.05 volt peak-to-peak.

(i) Connect scope to TP7. Adjust C32 and T7 for 0.05 to 0.2 volt peak-to-peak 1.3 MHz signal ± 1 count.

(j) Connect scope to J103-J. Adjust R28 for a convenient level (0.7 volt peak-to-peak). Adjust T8 for maximum 1.3 MHz ± 1 count signal and readjust C32 and T7 for maximum. Then readjust R28 for 0.7 ± 0.05 volt peak-to-peak.

(k) Connect scope to TP5. Adjust T5 and C22 for 0.05 to 0.2 volt peak-to-peak 1.5 MHz signal ± 1 count.

(l) Connect scope to J103-F. Adjust R21 for a convenient level (0.7 volt peak-to-peak). Adjust T6 for maximum 1.5 MHz ± 1 count signal and readjust T5 and C22 for maximum. Then readjust R21 for 0.7 ± 0.05 volt peak-to-peak.

(m) Connect scope to TP4. Adjust T3 and C11 for 0.05 to 0.2 volt peak-to-peak 1.7 MHz signal ± 1 count.

(n) Connect scope to J103-L. Adjust R14 for a convenient level (0.7 volt peak-to-peak). Adjust T4 for maximum 1.7 MHz ± 1 count signal and readjust T3 and C11 for maximum. Then readjust R14 for 0.7 ± 0.05 volt peak-to-peak.

(o) Connect scope to TP1. Adjust C10 and T2 for 0.05 to 0.2 volt peak-to-peak 1.9 MHz signal ± 1 count.

(p) Connect scope to J103-4. Adjust R3 for a convenient level (0.7 volt peak-to-peak). Adjust T1 for maximum 1.9 MHz ± 1 count signal and readjust C10 and T2 for maximum. Then readjust R3 for 0.7 ± 0.05 volt peak-to-peak.

(q) Set ON-STANDBY switch to STANDBY position; remove Z103 from extender board and install on chassis. Reinstall Z115.

(5) Single Mixer Divider Z104. Align the single mixer-divider as follows:

NOTE

For following steps, connect electronic counter to VERT OUTPUT jack of oscilloscope to monitor frequencies.

(a) Remove top cover from chassis and remove rf output board Z115.

(b) Place Z104 on extender board and set ON-STANDBY switch to ON position. Allow 30-minute warmup period to elapse.

(c) Set STD switch on Exciter rear panel to INT position.

(d) Set frequency selector switches to blank positions.

(e) Connect scope to cathode of CR1.

(f) Connect a jumper from J104-B to ground.

(g) Adjust T1 for 0.3 to 0.6 volt peak-to-peak signal at 8.0 MHz ± 1 count.

(h) Connect scope to TP1.

(i) Adjust R7 for less than 0.03 volt peak-to-peak signal.

(j) Reconnect scope to cathode of CR1; the signal should be 8.0 MHz \pm 1 count, 0.5 \pm 0.1 volt peak-to-peak minimum.

(k) Remove ground from J104-B and set R23 fully clockwise.

(l) Connect scope to TP5.

(m) Adjust T2 through T6 for 0.7 to 1.1 volt peak-to-peak signal at 9.0 MHz \pm 1 count.

(n) Connect scope to TP6. Adjust R23 for less than 50 mv peak-to-peak signal.

(o) Place 100 Hz selector switch to position 4.

(p) Connect a jumper from TP7 to ground.

(q) Adjust T7 for 20 mv minimum peak-to-peak signal at 10.4 MHz \pm 1 count.

(r) Remove ground from TP7.

(s) Adjust T8 for less than 0.02 volt peak-to-peak signal.

(t) Connect scope to TP8.

(u) Connect a jumper from TP9 to ground.

(v) Adjust T9 for 0.1 to 0.2 volt peak-to-peak signal at 10.4 MHz \pm 1 count.

(w) Remove ground from TP9.

(x) Adjust T10 for less than 50 mv peak-to-peak signal.

(y) Connect scope to TP10. Adjust T11 for 0.4 to 0.6 volt peak-to-peak signal at 10.4 MHz \pm 1 count.

(z) At TP10 signal should be 0.2 volt peak-to-peak minimum in all positions of the 100 Hz selector switch. If not, T11 can be slightly adjusted to obtain 0.2 volt peak-to-peak minimum output from 0-9 of 100 Hz selector switch.

(aa) Connect scope to pin J104-15. In all positions of 100 Hz selector switch, signal should be 0.5 volt peak-to-peak minimum (1.0 to 1.09 MHz). Set ON-STANDBY switch to STANDBY position.

(ab) Remove Z104 from extender board and install in chassis. Reinstall Z115.

(6) Dual Mixer-Divider Z105 Align the dual mixer-divider as follows:

NOTE

For following steps, connect electronic counter to VERT OUTPUT jack of oscilloscope to monitor frequencies.

- (a) Remove top cover from chassis and remove rf output board Z115.
- (b) Place Z105 on extender board and set ON-STANDBY switch to ON position. Allow 30-minute warmup period to elapse.
- (c) Set STD switch on Exciter rear panel to INT position.
- (d) Set all frequency selector switches to blank position, and set R9 fully clockwise.
- (e) Connect scope to cathode of CR1.
- (f) Adjust T1 for 0.5 to 1.0 volt peak-to-peak signal at 8 MHz ± 1 count.
- (g) Connect scope to TP1. Adjust R9 for less than 50 mv peak-to-peak signal.
- (h) Reconnect scope to cathode of CR1. The 8 MHz signal should be 0.4 volt peak-to-peak minimum.
- (i) Place 100 Hz selector to 5 and set R23 fully clockwise.
- (j) Connect scope to cathode of CR3.
- (k) Tune T2 through T6 for 0.5 to 1.5 volt peak-to-peak 9.05 MHz ± 1 count signal.
- (l) Connect scope to TP5.
- (m) Adjust R23 for less than 50 mv peak-to-peak.
- (n) Reconnect scope to cathode of CR3; amplitude should be 0.5 volt peak-to-peak minimum.
- (o) Place 1 kHz selector switch to 4, and 100 Hz selector switch to 0.
- (p) Connect scope to TP5.
- (q) Connect a jumper from TP6 to ground.

(r) Tune T7 for less than 100 mv peak-to-peak signal at 10.4 MHz ± 1 count signal.

NOTE

This adjustment will show two peaks. The correct one is that which appears with the tuning slug further into the transformer.

(s) Remove ground from TP6.

(t) Connect scope to TP5.

(u) Adjust T8 for less than 50 mv peak-to-peak signal at 10.4 MHz ± 1 count; again, correct peak is one with slug farther into transformer.

(v) Connect scope to TP7.

(w) Connect a jumper from TP8 to ground.

(x) Adjust T9 for 0.1 to 0.15 volt peak-to-peak 10.4 MHz ± 1 count signal (second peak).

(y) Remove ground from TP8.

(z) Tune T10 for less than 50 mv peak-to-peak 10.4 MHz ± 1 count signal.

(aa) Connect scope to TP9. Adjust T11 for 0.2 volt minimum peak-to-peak 10.4 MHz ± 1 count signal (single peak).

(ab) Move 100 Hz and 1.0 kHz selector switches from position 0 through 9; frequency at TP9 should change from 10 MHz to 10.99 MHz, and amplitude should be 0.2 volt minimum at all positions. If not, T11 can be slightly adjusted to obtain 0.2 volt peak-to-peak minimum output from 0-9 of 100 Hz and 1.0 kHz selector switches.

NOTE

If the amplitude is too low in the 9 positions of the frequency selector switches, repeat the alignment from step (o), with the 100 Hz switch at 4.

(ac) Connect scope to junction of L4 and R46; signal should range from 1.0 MHz to 1.099 MHz, at an amplitude of 0.5 volt peak-to-peak in all positions of 100 Hz and 1.0 kHz selector switches.

(ad) Place both 100 Hz and 1 kHz selector switches to a blank position.

- fully clockwise.
- (ae) Connect scope to cathode of CR6 and set R54
- ± 1 count signal.
- (af) Adjust T12 for 0.5 to 0.7 volt peak-to-peak 8 MHz
- MHz ± 1 count.
- (ag) Connect scope to TP10.
 - (ah) Adjust R54 for less than 50 mv peak-to-peak at 8
- signal should have a minimum amplitude of 0.4 volt peak-to-peak.
- (ai) Reconnect scope to cathode of CR6; 8.0 MHz ± 1 count
- clockwise.
- (aj) Connect scope to cathode of CR8 and set R69 fully
- selector switch to zero.
- (ak) Place 1 KHz selector switch to 5, and 100 Hz
- peak signal at 9.05 MHz ± 1 count.
- (al) Adjust T13 through T17 for 1.0 to 1.5 volt peak-to-
- mv peak-to-peak 9.05 MHz ± 1 count signal.
- (am) Connect scope to TP14 and adjust R69 for less than 50
- 9.05 MHz ± 1 count, at a minimum of 0.5 volt peak-to-peak.
- (an) Reconnect scope to cathode of CR8; signal should be
- switch to 0; and 100 Hz selector switch to 0.
- (ao) Place 10 kHz selector switch to 4; 1 kHz selector
- at 10.4 MHz ± 1 count.
- (ap) Connect scope to TP14.
 - (aq) Connect a jumper from TP15 to ground.
 - (ar) Adjust T18 for 20 mv minimum peak-to-peak signal
- Remove ground from TP15.
- (as) Remove ground from TP15.
 - (at) Adjust T19 for less than 50 mv peak-to-peak signal.
 - (au) Connect scope to TP16.
 - (av) Connect a jumper from TP17 to ground.
 - (aw) Adjust T20 for 0.1 to 0.15 volt peak-to-peak 10.4 MHz
- ± 1 count signal.
- Remove ground from TP17.
- (ax) Remove ground from TP17.
 - (ay) Adjust T21 for less than 50 mv peak-to-peak 10.4 MHz
- ± 1 count signal.
- (az) Connect scope to TP18.

(ba) Adjust T22 for maximum 10.4 MHz ± 1 count signal; it should be at least 0.2 volt peak-to-peak in all positions of 10 kHz selector switch (with corresponding changes in frequency). If not, T22 can be slightly adjusted to obtain 0.2 volt peak-to-peak minimum output from 0-9 of 10 kHz selector switch.

(bb) With 10 kHz, 1 kHz and 100 Hz selector switches at 9, check for 0.2 volt peak-to-peak minimum signal. If this value is not obtained, repeat alignment from step (ao) with the 1 kHz selector switch set at 5.

(bc) Connect scope to J105-15; amplitude should be 0.6 volt peak-to-peak minimum in all 0-9 positions of the 10 kHz, 1 kHz and 100 Hz selector switches. Frequency should vary from 1.0 MHz to 1.0999 MHz as these switches are rotated.

(bd) Set POWER ON-STANDBY to STANDBY position; remove Z105 from extender board and install in chassis. Reinstall Z115.

(7) Final Mixer-Divider Z106. Align the final mixer as follows:

NOTE

For following steps, connect electronic counter to VERT OUTPUT jack of oscilloscope to monitor frequencies.

(a) Remove top cover from chassis and remove rf output board Z115.

(b) Place Z106 on extender board and set ON-STANDBY switch to ON position. Allow 30-minute warmup period to elapse.

(c) Set STD switch on Exciter rear panel to INT position.

(d) Connect scope to cathode of CR2.

(e) Place 100 kHz selector switch to position 5, 10 kHz selector switch to a blank position, and all others to 0. Set R7 fully clockwise.

(f) Adjust T1 for 0.5 volt peak-to-peak signal at 8 MHz ± 1 count.

(g) Connect scope to TP1.

(h) Adjust R7 for less than 100 mv peak-to-peak at 8 MHz ± 1 count.

- (i) Reconnect scope to cathode of CR2; signal should have a minimum amplitude of 0.5 volt peak-to-peak at 8 MHz \pm 1 count.
- (j) Place 10 kHz selector switch to position 5. Set R18 fully clockwise.
- (k) Connect scope to cathode of CR3.
- (l) Adjust T2, T3, T4, T5, T6 and T13 for 0.4 volt peak-to-peak signal at 9.05 MHz \pm 1 count.
- (m) Connect scope to junction of CR3 and CR4.
- (n) Adjust R18 for minimum signal at 9.05 MHz \pm 1 count. Output at cathode of CR4 should be less than 0.2 volt peak-to-peak.
- (o) Place 100 kHz selector switch to position 4.
- (p) Connect scope to TP5.
- (q) Connect a jumper from TP7 to ground.
- (r) Adjust T7 for 0.02 to 0.1 volt peak-to-peak signal at 10.4 MHz \pm 1 count.
- (s) Remove ground from TP7.
- (t) Adjust T8 for less than 100 mv peak-to-peak signal at 10.4 MHz \pm 1 count.
- (u) Connect scope to TP8.
- (v) Connect a jumper from TP9 to ground.
- (w) Adjust T9 for 0.4 volt peak-to-peak signal at 10.4 MHz \pm 1 count.
- (x) Remove ground from TP9.
- (y) Adjust T10 for less than 0.2 volt peak-to-peak signal at 10.4 MHz \pm 1 count.
- (z) Connect scope to TP10.
- (aa) Place 100 kHz selector switch to position 7.
- (ab) Connect a jumper across secondary of T12.
- (ac) Adjust T11 for 0.4 volt peak-to-peak signal at 10.75 MHz \pm 1 count.
- (ad) Remove jumper from secondary of T12.
- (ae) Adjust T12 for less than 1.5 volts peak-to-peak signal at 10.7 MHz \pm 1 count.
- (af) Place 100 kHz selector switch to position 1.
- (ag) Connect a jumper across secondary of T12.
- (ah) Adjust C36 for 1.0 volt peak-to-peak signal at 10.1 MHz \pm 1 count.
- (ai) Remove jumper from T12.

(aj) Adjust C48 for less than 2.0 volts peak-to-peak signal at 10.1 MHz ± 1 count.

(ak) Repeat steps (z) through (aj).

(al) Connect scope to J106-13. Place all selector switches to 0; signal should be approximately 0.2 volt peak-to-peak and frequency should be 10.0000 MHz ± 1 count. Rotate 100 Hz, 1 kHz, 10 kHz and 100 kHz selector switches to 9; frequency should increase to 10.9999 MHz in 100 Hz, 1 Hz, 1 kHz and 100 kHz steps. Amplitude in any switch position should be 0.2 volt peak-to-peak minimum.

(am) If output cannot be obtained with 100 Hz, 1 kHz, 10 kHz and 100 kHz switches in the 0000 position or 9999 position, repeat steps (o) through (z) with the 100 kHz switch in position 3 (when there is no output at 0000) and in position 5 (if there is no output when the kHz switches are in positions 9999).

(an) Set POWER ON-STANDBY switch to STANDBY position and remove Z106 from extender board and install in chassis. Reinstall Z115.

(8) Carrier Generator Board Z109. Align the carrier generator as follows:

NOTE

For following steps, connect electronic counter to VERT OUTPUT jack of oscilloscope to monitor frequencies.

(a) Remove top cover from chassis and remove rf output board Z115.

(b) Place Z109 on extender board and set ON-STANDBY switch to ON position. Allow a 30-minute warmup period to elapse.

(c) Set STD switch on Exciter rear panel to INT position.

(d) Set R27 fully counterclockwise; set EXCITER switch to ON and MODE switch to AM.

(e) Connect scope to TP1; signal should be 1 MHz ± 1 count, 30 ± 1.0 volts peak-to-peak.

(f) Connect scope to TP3 and adjust T1 for maximum 250 kHz ± 1 count signal at approximately 0.5 to 1.0 volt peak-to-peak.

(g) Connect scope to TP4; adjust T2 for maximum 250 kHz ± 1 count signal at approximately 1.4 ± 0.1 volts peak-to-peak.

(h) Set R47 fully clockwise; connect scope to TP6 and adjust T3 for maximum signal at 2.75 MHz ± 1 count. Waveform should appear as shown in figure 5-3.

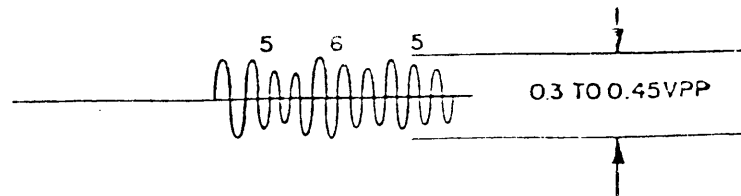


Figure 5-3. Carrier generator, 2.75 MHz alignment waveform.

(i) Connect scope to TP7. Adjust T4 for maximum signal; then adjust R47 for 70 ± 5.0 millivolts peak-to-peak at 2.75 MHz ± 1 count.

(j) Remove sideband generator card Z107 from chassis connector. Connect scope to collector of Q12 and adjust T5 for maximum 250 kHz ± 1 count signal at approximately 0.8 ± 0.1 volt peak-to-peak. Replace Z107 in chassis.

(k) Set ON-STANDBY switch to STANDBY position; remove Z109 from extender board and reinstall in chassis. Reinstall Z115.

(9) Sideband Generator Board Z107. Align the sideband generator as follows:

NOTE

Make certain that carrier generator Z109 is aligned and installed prior to the alignment of Z107.

(a) Remove top cover from chassis and remove rf output board Z115.

(b) Place Z107 on extender board and set ON-STANDBY switch to ON position. Allow a 30-minute warmup period to elapse.

(c) Set STD switch on Exciter rear panel to INT position. Set CARRIER control fully counterclockwise.

(d) Remove frequency shift generator card Z108 from chassis. Set R34 and R60 fully clockwise.

(e) Connect audio generator, with one side grounded, to USB terminal board TB103-1, -2, -3 on rear panel of Exciter as shown in figure 5-4.

(f) Using ac VTVM, set audio generator for 1 kHz output at 78 millivolts (-20 dBm).

(g) Set MODE switch and METER switch on front panel to USB position.

(h) Set USB MIKE-LINE control for 2/5 of full-scale reading on MONITOR meter (reading of 2).

(i) Connect VTVM to TP4; level should be approximately 16 millivolts rms (44 ± 5.5 mv peak-to-peak).

(j) Connect scope to TP5 and adjust T1 for 30 to 60 mv peak-to-peak signal. Adjust USB MIKE-LINE control for full-scale reading on MONITOR meter.

(k) Adjust R28 and C52 until two-tone waveform is symmetrical, with sharp, clear crossover, as viewed on the scope. (See fig. 5-5.)

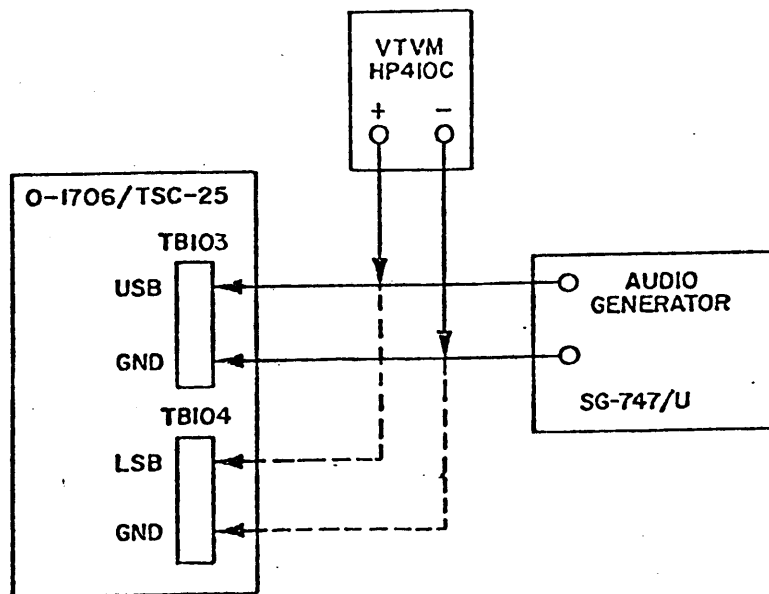


Figure 5-4. Sideband generator, test setup.

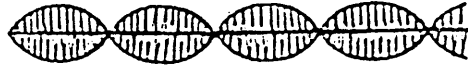


Figure 5-5. Sideband generator, two-tone waveform.

- (l) Reset USB MIKE-LINE control for 2/5 full scale on MONITOR meter.
- (m) Adjust R34 for 200 ± 50 mv peak-to-peak, with scope between collector of Q7 and ground.
- (n) Connect scope to output of USB filter FL1 (fig. FO-11); amplitude should be 30 to 50 mv peak-to-peak (one single frequency at 251 kHz ± 1 count).
- (o) Connect audio generator, with one side grounded, to LSB terminal board TB104 on rear panel of Exciter (fig. 5-4).
- (p) Using ac VTVM, set audio generator to 1 kHz, at 78 millivolts (-20 dBm).
- (q) Set MODE and METER switches on Exciter front panel to LSB position.
- (r) Set LSB MIKE-LINE control for 2/5 full-scale reading on MONITOR meter (reading of 2).
- (s) Connect VTVM to TP1: level should be approximately 16 ± 2.0 millivolts rms (44 ± 5.5 mv peak-to-peak).
- (t) Connect scope to TPS and adjust T2 for 0.04 to 0.07 volt peak-to-peak signal; adjust LSB MIKE-LINE control for full-scale reading on MONITOR meter.
- (u) Adjust R54 and C53 until two-tone waveform is symmetrical, with sharp, clear crossover, as viewed on scope (fig. 5-5).
- (v) Return LSB MIKE-LINE control for 2/5 full-scale reading on MONITOR meter.

(w) Adjust R60 for 200 \pm 50 mv peak-to-peak, with scope between collector of Q12 and ground.

(x) Connect scope to output of LSB filter FL2 (fig. FO-11); amplitude should be 30 to 50 mv peak-to-peak (one single frequency at 249 kHz \pm 1 count).

(y) Connect audio generator to front panel MIKE input jack or between J107-E and ground.

(z) Set audio generator to 1 kHz, at 1.0 mv rms, as measured with VTVM.

(aa) Connect a short jumper across C49.

(ab) Connect VTVM to TP3.

(ac) Adjust R9 for a level of 40 \pm 2.0 mv rms.

(ad) Set ON-STANDBY switch to STANDBY position; remove Z107 from extender board and install in chassis. Reinstall Z115 and Z108.

(10) Frequency Shift Generator Board Z108. Align the frequency shift generator board as follows:

NOTE

For following steps, connect electronic counter to VERT OUTPUT jack of oscilloscope to monitor frequencies.

NOTE

Make certain the FSK and FAX adjustments are not attempted until the 3 MHz oven has warmed up for one hour.

(a) Remove top cover from chassis and remove rf output board Z115.

(b) Set ON-STANDBY switch to ON position and allow 30-minute warmup period to elapse.

- (c) Set STD switch on Exciter rear panel to INT position.
- (d) Remove Z108 from chassis and plug in extender board at J108; set MODE switch to ISB position and adjust R58 fully counterclockwise. Turn CARRIER control fully clockwise.
- (e) Set EXCITER switch to ON position and connect scope to J108-C. A 2.75 MHz ± 1 count signal at 70 ± 5 mv peak-to-peak should be observed.
- (f) Connect scope to J108-2. A 250 kHz ± 1 count signal at 50 to 150 mv peak-to-peak should be observed.
- (g) Place Z108 on extender board in proper chassis slot.
- (h) Connect scope to TP4 and adjust T1 for 50 to 150 mv peak-to-peak signal at 3 MHz ± 1 count.
- (i) Connect scope to TP5 (J108-7) and tune T1 and T2 for minimum 3 MHz ± 1 count signal of 0.3 volt peak-to-peak.
- (j) Set MODE switch to FSK position. On rear panel of Exciter, set R101 to mid-range; set SHIFT switch S110 to ± 425 cycles, and SHIFT SENSE switch to + (up) position.
- (k) With scope still at TP5, adjust R56 for 0.05 to 0.1 volt peak-to-peak signal.
- (l) Insert Z108 into chassis without extender board. Note five holes for adjustments on top of card. These adjustments are 25-turn pots, identified in figure 5-6.

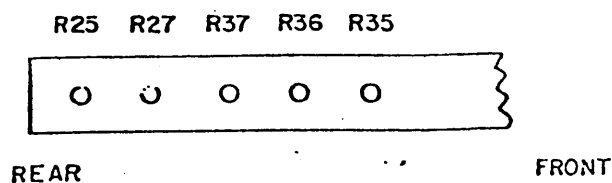


Figure 5-6. Frequency shift generator board Z108, adjustment locations.

- (m) Set R35 and R36 fully counterclockwise and adjust R37 for 3,000,000 cycles ± 1 count on frequency counter.
- (n) Adjust R36 for 2,999,575 cycles ± 1 count on frequency counter.

(o) Set SHIFT SENSE switch to - (down) position and adjust R35 for 3,000,425 cycles ± 1 count.

(p) Set SHIFT SENSE switch to +; readjust R36 for 2,999,575 cycles ± 1 count. Set SHIFT SENSE switch to - and readjust R35 for 3,000,425 cycles ± 1 count.

(q) Repeat step (p) until both frequencies are within 5 cycles of specified frequencies.

(r) Set SHIFT switch to ± 170 position, and SHIFT SENSE switch to +; counter should read 2,999,830 ± 15 cycles.

(s) Set SHIFT SENSE switch to -; counter should read 3,000,170 ± 15 cycles.

(t) Set SHIFT switch to ± 85 position, and SHIFT SENSE switch to +; counter should read 2,999,915 ± 10 cycles.

(u) Set SHIFT SENSE switch to -; counter should read 3,000,085 ± 10 cycles.

(v) Set SHIFT switch to ± 42.5 position and SHIFT SENSE switch to +; counter should read 2,999,957.5 ± 7 cycles.

(w) Set SHIFT SENSE switch to -; counter should read 3,000,042.5 ± 7 cycles.

(x) Set MODE switch to FAX position and set R25 fully clockwise.

(y) Connect variable power supply to FAX terminals on rear panel of Exciter, as shown in figure 5-7.

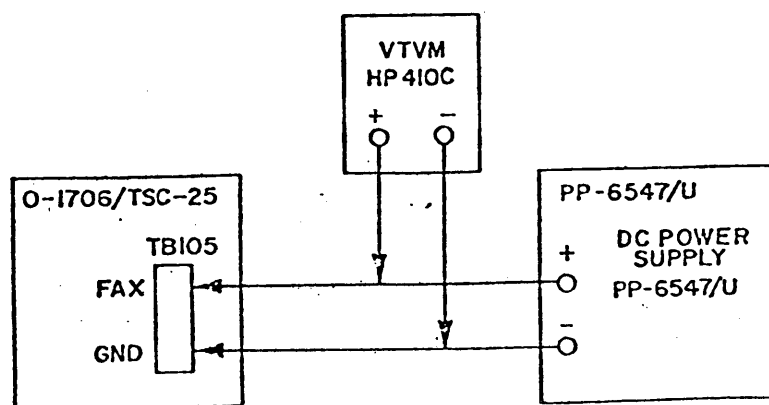


Figure 5-7. Power supply setup for FAX measurements.

(z) Using dc meter, adjust power supply output to +1.0 volt.

(aa) Adjust R27 for 2,999,600 \pm 5 cycles.

(ab) Adjust power supply output for +10 volts and adjust R25 for 3,000,400 \pm 5 cycles.

(ac) Repeat adjustment of R27 with +1.0 volt and R25 with +10 volts, until specified frequencies can be obtained within \pm 5 cycles.

(ad) Check linearity of FAX circuits by changing input voltage from +1 to +10 volts. For each change of 1 volt, frequency should change 89 \pm 50 cycles. A typical measurement is shown in table 5-4.

Table 5-4. FAX Voltage vs. Frequency

DC volts	Frequency
1	2,999,600 \pm 5 Hz
2	2,999,689 \pm 50 Hz
3	2,999,778 \pm 50 Hz
4	2,999,867 \pm 50 Hz
5	2,999,956 \pm 50 Hz
6	3,000,045 \pm 50 Hz
7	3,000,134 \pm 50 Hz
8	3,000,223 \pm 50 Hz
9	3,000,312 \pm 50 Hz
10	3,000,400 \pm 5 Hz

(ae) Set ON-STANDBY switch to STANDBY position.

Reinstall Z115.

(11) Step Generator A Z110. Align the step generator board as follows:

NOTE

For following steps, connect electronic counter to VERT OUTPUT jack of oscilloscope to monitor frequencies.

(a) Remove top cover from chassis and remove rf output board Z115.

(b) Set ON-STANDBY switch to ON position and allow a 30-minute warmup period to elapse.

(c) Set STD switch on Exciter rear panel to INT position.

(d) Remove comb filters Z102 and Z103 from chassis.

(e) Place Z110 on extender board and set front panel frequency selector switches to 03.0000 MHz. Set R1 fully counterclockwise.

(f) Connect scope to collector of Q1, and adjust R1 for 2.0 volts minimum peak-to-peak 14 MHz ± 1 count signal.

(g) Connect scope to anode of CR1 and adjust T1 for 1.0 volt minimum peak-to-peak signal.

(h) Connect scope to collector of Q1 and adjust R1 for a level of 2 ± 0.5 volts peak-to-peak.

(i) Connect scope to junction of CR1 and CR2, and adjust R7 for less than 250 mv peak-to-peak signal (symmetrical waveform).

(j) Connect signal generator, counter and attenuator as shown in figure 5-8.

(k) Set signal generator frequency to 1.05 MHz, at 100 mv rms, with attenuator set to zero.

NOTE

The 100 mv to the counter will allow continuous frequency monitoring. In all cases, set the generator frequency as close as possible to the specified frequency.

(l) Connect scope to J110-R and adjust R2S for 0.4 ± 0.05 volt peak-to-peak at 1.05 MHz ± 1 count.

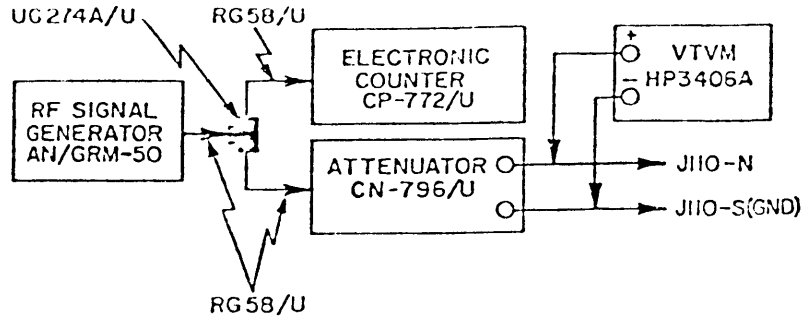


Figure 5-8. Step generator A Z110, test setup.

- (m) Place a small jumper across secondary of T3 and connect scope to junction of R8 and C8.
- (n) Adjust T2 for 50 mv minimum peak-to-peak indication on scope.
- (o) Remove short at T3 and adjust T3 for less than 100 mv peak-to-peak.
- (p) Connect a short jumper across secondary of T5 and connect scope to collector of Q2.
- (q) Adjust T4 for 0.2 volt peak-to-peak minimum indication.
- (r) Remove jumper from T5, and adjust T5 for less than 0.3 volt peak-to-peak.
- (s) Connect a short jumper across secondary of T7 and connect scope to collector of Q3.
- (t) Adjust T6 for minimum of 1.0 volt peak-to-peak.

(u) Remove jumper from T7 and adjust T7 for less than 2.0 volts peak-to-peak.

(v) Connect scope to J110-5 and adjust T8 for 2.0 ± 0.5 volts peak-to-peak indication.

(w) Carefully vary frequency of signal generator from 800 kHz to 1.2 MHz; scope level should be approximately 2 ± 0.5 volts peak-to-peak minimum, and output frequency should vary from 13.2 MHz to 12.8 MHz.

(x) Set signal generator to 1.55 MHz at 100 mv, as before. Set frequency switches for 07.0000 MHz.

(y) Connect a short jumper across secondary of T11 and connect scope to junction of R8 and C9.

(z) Adjust T10 for minimum of 50 mv peak-to-peak.

(aa) Remove jumper from T11 and tune T11 for less than 100 mv peak-to-peak.

(ab) Connect a short jumper across secondary of T13 and connect scope to collector of Q6.

(ac) Adjust T12 for a minimum of 0.2 volt peak-to-peak.

(ad) Remove jumper from T13 and adjust T13 for less than 0.3 volt peak-to-peak.

(ae) Connect a short jumper across secondary of T15 and connect scope to collector of Q7.

(af) Adjust T14 for a minimum of 1.0 volt peak-to-peak.

(ag) Remove jumper from T15 and adjust T15 for less than 2.0 volts peak-to-peak.

(ah) Connect scope to J110-5 and adjust T16 for 2.0 ± 0.5 volt peak-to-peak indication.

(ai) Vary frequency of signal generator from 1.3 MHz to 1.7 MHz. Output on scope should be 2.0 volts peak-to-peak minimum, and output frequency should be 12.7 to 12.3 MHz, correspondingly.

(aj) Remove signal generator from J110-N and place front panel selector switches to 13.0000 MHz. Set R67 fully counterclockwise.

(ak) Connect scope to collector of Q9 and adjust R61 for 2.0 \pm 0.5 volts peak-to-peak signal.

(al) Place scope at junction of CR3 and T17; adjust T17 for 1.0 volt peak-to-peak signal.

(am) Place scope on collector of Q9 and adjust R61 for a level of 2.0 \pm 0.5 volts peak-to-peak.

(an) Place scope at junction of CR3 and CR4; adjust R67 for 1.0 volt peak-to-peak indication.

(ao) Connect signal generator to J110-N, at 1.05 MHz, 100 mv peak-to-peak, as before.

(ap) Connect a short jumper across secondary of T19 and connect scope to junction of R68 and C80.

(aq) Adjust T18 for a minimum 50 mv peak-to-peak indication.

(ar) Remove jumper from T19 and adjust T19 for less than 100 mv peak-to-peak indication.

(as) Connect a short jumper across secondary of T21 and place scope on collector of Q10.

(at) Adjust T20 for a minimum of 0.2 volt peak-to-peak.

(au) Remove jumper from T21 and adjust T21 for less than 0.3 volt peak-to-peak.

(av) Connect a short jumper across secondary of T23 and connect scope to collector of Q11.

(aw) Adjust T22 for a minimum of 1.0 volt peak-to-peak.

(ax) Remove jumper from T23 and adjust T23 for less than 2.0 volts peak-to-peak.

(ay) Place scope at J110-4 and adjust T24 for 2.0 \pm 0.5 volts peak-to-peak indication.

(az) Carefully vary signal generator from 0.8 MHz to 1.2 MHz. Output on scope should be about 2.0 volts peak-to-peak minimum, and frequency should vary from 12.2 MHz to 11.8 MHz.

(ba) Adjust signal generator to 1.55 MHz and change front panel selector switches to 17.0000 MHz.

(bb) Connect a short jumper across secondary of T26 and connect scope at junction of R69 and C81.

(bc) Adjust T25 for 10 to 20 mv rms indication.

(bd) Remove jumper from T25 and adjust T26 for a minimum of 50 mv peak-to-peak.

(be) Connect a short jumper across secondary of T28 and connect scope to collector of Q13.

(bf) Adjust T27 for a minimum of 0.2 volt peak-to-peak.

(bg) Remove jumper from T28 and adjust T28 for less than 0.3 volt peak-to-peak.

(bh) Connect a short jumper across secondary of T30 and connect scope to collector of Q14.

(bi) Adjust T29 for a minimum of 1.0 volt peak-to-peak.

(bj) Remove jumper from T30 and adjust T30 for less than 2.0 volts peak-to-peak.

(bk) Place scope at J110-4 and adjust T31 for 2.0 ± 0.5 volts peak-to-peak maximum indication.

(bl) Carefully vary signal generator from 1.3 MHz to 1.7 MHz. Scope output should be about 2.0 ± 0.5 volts peak-to-peak minimum, and output frequency should vary from 11.7 MHz to 11.3 MHz.

(bm) Replace comb filters Z102 and Z103.

(bn) Remove signal generator.

(bo) Place scope at J110-5. Rotate front panel selector switches from 2.0000 MHz to 10.0000 MHz. If output is not approximately 2.0 ± 0.5 volts peak-to-peak, adjust R1 to obtain best results.

(bp) Place scope at J110-4. Rotate front panel selector switches from 11.0000 MHz to 20.0000 MHz. If output is not approximately 2.0 ± 0.5 volts peak-to-peak, adjust R61 to obtain best results.

(bq) Set ON-STANDBY switch to STANDBY position; remove Z110 from extender board and install in chassis. Reinstall Z115.

(12) Step Generator B Z111 and Step Generator C Z113. The following procedures for Z111 and Z113 are interrelated and must be performed in the order presented. Step generator Z113 is first partially aligned; step generator Z111 is aligned; and then alignment of Z113 is completed. Proceed as follows:

NOTE

For following steps, connect electronic counter to VERT OUTPUT jack of oscilloscope to monitor frequencies.

- (a) Remove top cover from chassis and remove rf output board Z115.
- (b) Place Z113 on an extender board and set ON-STANDBY switch to ON position. Allow a 30-minute warmup period to elapse.
- (c) Set STD switch on rear panel of Exciter to INT position.
- (d) Remove comb filters Z102 and Z103 from chassis.
- (e) Set front panel selector switches to 28.0000 MHz.
- (f) Set R84 fully counterclockwise; connect scope at collector of Q14 and adjust R78 for 2.0 volts peak-to-peak indication.
- (g) Connect scope at junction of T11 and CR1 and adjust T11 for a minimum of 1.0 volt peak-to-peak signal.
- (h) Connect scope to junction of C104 and R88 and adjust C101 and R84 alternately, in small increments, until less than 50 mv peak-to-peak signal is achieved.
- (i) Place scope at collector of Q14 and adjust R78 for a level of 2.0 ± 0.2 volts peak-to-peak.
- (j) Connect a signal generator to J110-N, as shown in the setup of figure 5-9. Set attenuation to zero unless otherwise directed.
- (k) Set signal generator for 1.6 MHz at 100 mv rms.
- (l) Connect a short jumper across secondary of T13 and connect scope at junction of R88 and C104.
- (m) Adjust T12 for minimum of 50 mv peak-to-peak.

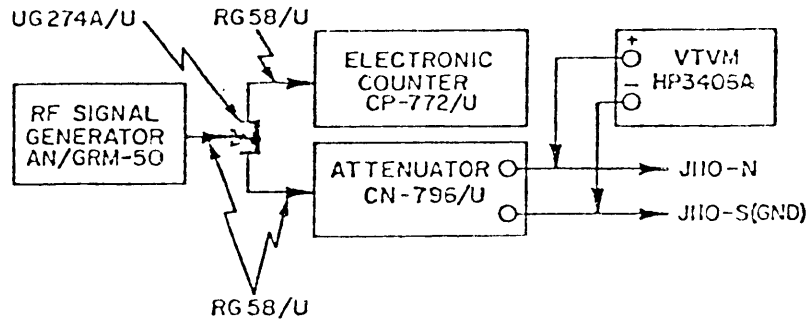


Figure 5-9. Step generators B and C, test setup.

- (n) Remove jumper from T13 and adjust T13 for less than 150 mv peak-to-peak.
- (o) Connect a short jumper across secondary of T15 and connect scope to collector of Q15.
- (p) Adjust T14 for a minimum of 0.2 volt peak-to-peak.
- (q) Remove jumper from T15 and adjust T15 for less than 1.0 volt peak-to-peak.
- (r) Connect a short jumper across secondary of T17 and connect scope to collector of Q16.
- (s) Adjust T16 for a minimum of 1.0 volt peak-to-peak.
- (t) Remove jumper from T17 and adjust T17 for less than 3.0 volts peak-to-peak.
- (u) Connect scope to J113-N and adjust T18 for 1.0 ± 0.2 volt peak-to-peak.

(v) Carefully vary signal generator from 1.4 MHz to 1.8 MHz. Output should be about 1.0 ± 0.3 volt peak-to-peak minimum, and frequency should vary from 10.6 MHz to 10.2 MHz.

(w) Set the signal generator to 1.075 MHz, with an output level of 100 mv rms, and set front panel selector switches to 23.0000 MHz.

(x) Connect a short jumper across secondary of T20 and connect scope to junction of R87 and C103.

(y) Adjust T19 for minimum 50 mv peak-to-peak indication.

(z) Remove jumper from T20 and adjust T20 for less than 150 mv peak-to-peak.

(aa) Connect a short jumper across secondary of T22 and connect scope to collector of Q18.

(ab) Adjust T21 for a minimum of 0.2 volt peak-to-peak.

(ac) Remove jumper from T22 and adjust T22 for less than 1.0 volt peak-to-peak.

(ad) Connect a short jumper across secondary of T24 and connect scope to collector of Q19.

(ae) Adjust T23 for a minimum of 1.0 volt peak-to-peak.

(af) Remove jumper from T24 and adjust T24 for less than 3.0 volts peak-to-peak.

(ag) Place scope at J113-N and adjust T25 for 1.0 ± 0.2 volt peak-to-peak indication.

(ah) Carefully vary signal generator from 0.8 MHz to 1.3 MHz. Output should be about 1.0 ± 0.2 volt peak-to-peak minimum, and frequency should vary between 11.2 MHz and 10.7 MHz.

(ai) Replace comb filters Z102 and Z103 in chassis.

(aj) Remove signal generator.

(ak) Place scope at J113-N and rotate front panel selector switches from 21.0000 MHz to 29.0000 MHz. If output is not approximately 1.0 ± 0.02 volt peak-to-peak, adjust R78 to obtain correct tolerance.

(al) Remove Z113 from extender board and install in chassis.

(am) Place Z111 on extender board and set front panel selector switches to 25.0000 MHz.

(an) Connect VTVM to J111-1.

(ao) Adjust C3, C9 and C19 for a minimum 0.2 vrms indication.

(ap) Vary front panel selector switches from 21.0000 to 29.000 MHz in 1 MHz steps; minimum VTVM indication should be a minimum of 0.2 vrms at each MHz position.

NOTE

If voltage is not constant, make slight adjustments of C3, C9 and C19 with front panel selector switches at 25.0000 MHz, until gain is equalized as much as possible.

(aq) Set front panel selector switches to 15.0000 MHz.

(ar) Connect VTVM to J111-2 and adjust C25, C30 and C41 for a minimum of 0.2 vrms.

(as) Vary front panel selector switches from 11.0000 to 20.0000 MHz in 1 MHz steps; minimum VTVM indication should be a minimum of 0.2 vrms.

NOTE

If voltage is not constant, make slight adjustments of C25, C30 and C41 with front panel selector switches at 15.0000 MHz, until gain is equalized as much as possible.

(at) Set front panel selector switches to 05.0000 MHz.

(au) Connect VTVM to J111-3 and adjust C45, C49, and C62 for a minimum of 0.1 vrms.

(av) Vary front panel selector switches from 02.0000 to 10.0000 MHz in 1 MHz steps; minimum VTVM indication should be a minimum of 0.1 vrms.

NOTE

If voltage is not constant, make slight adjustments of C45, C49 and C62 with front panel selector switches at 05.0000 MHz, until gain is equalized as much as possible.

(aw) Remove Z111 from extender board and install in chassis. Place Z113 on extender board.

(ax) Set front panel selector switches to 25.0000 MHz.

(ay) Connect VTVM to J113-1 and adjust C10, C16, C22 and C28 for maximum indication; minimum indication should be 0.3 volt rms.

(az) Set front panel selector switches to 15.0000 MHz.

(ba) Adjust C39, C45, C51 and C56 for maximum signal; minimum indication should be 0.3 volt rms.

(bb) Set front panel selector switches to 00.5000 MHz.

(bc) Adjust C68, C75, C81 and C87 for maximum signal; minimum indication should be 0.3 volt rms.

(bd) Remove Z113 from extender board and install in chassis. Reinstall Z115.

(13) Translator Z112. Align the translator as follows:

NOTE

For following steps, connect electronic counter to VERT OUTPUT jack of oscilloscope to monitor frequencies.

(a) Remove top cover from chassis and remove rf output board Z115, step generator C Z113 and spectrum generator Z101.

(b) Set ON-STANDBY switch to ON position and allow a 30-minute warmup period to elapse.

(c) Set STD switch on Exciter rear panel to INT position.

(d) Set frequency selector switches to blank positions.

(e) Place translator Z112 on extender board.

(f) Set R97 and R109 to approximately mid-range; set R51 fully counterclockwise.

(g) Connect signal generator to junction of R73 and R75 as shown in figure 5-10.

- (h) Set attenuator for full attenuation.
- (i) Set signal generator to 13.3000 MHz at 100 mv rms.
- (j) Set 100 kHz front panel selector switch to 3 and connect a short jumper across secondary of T15.
- (k) Connect scope across primary of T13, taking care to place scope ground lead on T13 ground lead. Adjust T13 for minimum of 50 mv peak-to-peak.
- (l) Remove jumper from T15 and adjust T15 for less than 50 mv peak-to-peak.

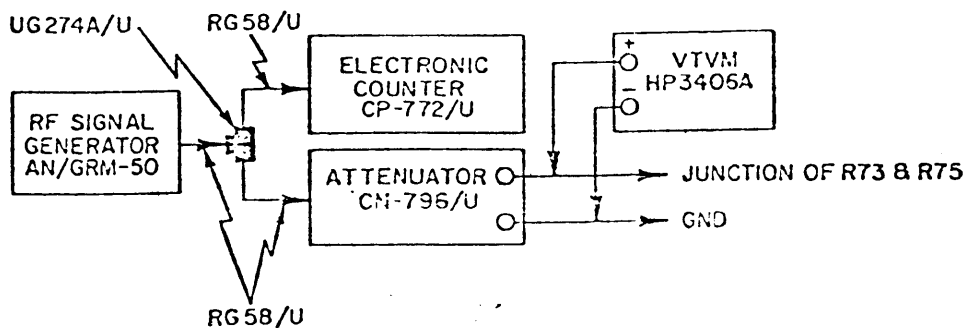


Figure 5-10. Translator Z112, test setup.

- (m) Connect a short jumper across secondary of T17.
- (n) Connect scope between collector of Q13 and ground.
- (o) Adjust T16 for a minimum of 1.0 volt peak-to-peak.
- (p) Remove jumper from T17 and adjust T17 for less than 1.0 volt peak-to-peak.
- (q) Connect scope to TP7 and adjust T18 for a minimum of 0.2 volt peak-to-peak.
- (r) Vary generator from 13.0 to 13.5 MHz; scope indicates 0.2 volt peak-to-peak, minimum. If not, adjust T18, T17 and T16 in that order.
- (s) Set signal generator for 13.8000 MHz at 100 mv rms.
- (t) Set 100 kHz selector switch to position 8.
- (u) Connect a short jumper across secondary of T20 and connect scope across secondary of T19, observing proper polarity.
- (v) Adjust T19 for a minimum of 50 mv peak-to-peak.
- (w) Remove jumper from T20 and adjust T20 for less than 50 mv peak-to-peak.
- (x) Connect a short jumper across secondary of T22 and connect scope at collector of Q18.
- (y) Adjust T21 for a minimum of 1.0 volt peak-to-peak.
- (z) Remove jumper from T22 and adjust T22 for less than 1.0 volt peak-to-peak.
- (aa) Connect scope to TP9 and adjust T23 for a minimum of 0.2 volt peak-to-peak. Vary generator from 13.5 to 14.0 MHz; scope indicates a minimum of 0.2 volt peak-to-peak. If not, adjust T23, T22 and T21 in that order.

(ab) Insert spectrum generator Z101. Remove signal generator. Place MODE switch to AM position; set frequency selector switches to 05.5000 MHz. Turn EXCITER switch to ON position.

(ac) Connect scope to J112-H; a 10.5 MHz ± 1 count signal at 0.2 ± 0.05 volt peak-to-peak should be observed.

(ad) Connect scope to J112-D; a 3 MHz ± 1 count signal, at about 90 ± 10 mv peak-to-peak, should be observed. If not, readjust R58 on Z108.

(ae) Adjust R71 to mid-position.

(af) With scope at cathode of CR4, adjust T12 for a minimum of 0.2 volt peak-to-peak.

(ag) Remove frequency shift generator board Z108 from chassis.

(ah) Connect scope to junction of R73 and R75, observing correct ground.

(ai) Adjust R71 for less than 50 mv peak-to-peak.

(aj) Return all front panel selector switches to blank position, except set 100 kHz switch to position 0.

(ak) Connect VTVM to J112-B; signal should be a minimum of 35 mv rms. Readjust C86 and C89 on Z101 if necessary.

(al) Connect VTVM to secondary of T3, observing proper ground polarity.

(am) Adjust T1, T2 and T3 for 0.8 to 1.2 vrms indication.

(an) Connect spectrum analyzer and VTVM to TP7 and adjust R36 to one extreme position.

(ao) Set up analyzer to observe spectrum at 120 MHz and adjust C20, C26 and C31 for minimum 150 mv rms 120 MHz ± 1 count indication on analyzer.

(ap) Connect spectrum analyzer and VTVM to TP3 and adjust R36 for maximum 10 mv rms 120 MHz ± 1 count signal.

(aq) Install frequency shift generator board Z108 into chassis.

(ar) Set front panel selector switches to 05.5000 MHz. Insure that R69 (AM level adjust) on Z109 is set at a high enough level to provide a sufficient 250 kHz signal. This will allow a reasonable 133.5 MHz level to be displayed on spectrum analyzer.

(as) Adjust C37 and C42 for a minimum 5.0 mv rms 133.5 MHz ± 1 count indication on spectrum analyzer.

(at) Connect spectrum analyzer and VTVM to TP4.

(au) Adjust C48, C42 and C37 for a minimum 5.0 mv rms 133.5 MHz ± 1 count indication.

(av) Connect spectrum analyzer and VTVM to TP5 and adjust C54, C48, C42 and C37 for a minimum 10.0 mv rms 133.5 MHz ± 1 count indication.

(aw) Connect spectrum analyzer and VTVM to TP6 and adjust C60, C48, C42 and C37 for a minimum 20.0 mv rms 133.5 MHz ± 1 count indication.

(ax) Install step generator C Z113 in chassis.

(ay) Connect scope to J112-R; output should be at a minimum level of 0.2 volt peak-to-peak, and frequency should correspond with setting of front panel selector switches.

NOTE

The level at J112-R will vary, depending on the carrier level setting of Z109.

(az) Connect dc power supply between J112-10 (-) and ground (+). Increase voltage from 0 to -10 volts. Output indication on scope at J112-R should decrease and drop to zero as dc voltage increases from approximately -1.0 to -4.0 volts.

(ba) Set ON-STANDBY switch to STANDBY position and install rf output board Z115.

(14) RF Output Board Z115. Align the rf output board as follows:

CAUTION

Do not adjust the rf output board until a complete alignment of power supply board B Z303 (para. 5-5 a. (1)) has been completed.

- (a) Remove top cover from chassis and perform power supply alignment as outlined in paragraph 5-5 a. (1), steps (c) through (v).
- (b) Before inserting Z115 for alignment, adjust R1 counterclockwise, R2 counterclockwise and R4 clockwise for maximum resistance.
- (c) Set STD switch to INT position and turn RF OUTPUT control on front panel fully counterclockwise; set MODE switch to ISB and place EXCITER switch to ON.
- (d) Turn CARRIER control fully clockwise and install rf output board Z115 on extender board. Recheck power supply voltages.
- (e) Place METER switch to Q1 position. On rf output board, adjust R4 until front panel meter reads in center of green region marked Q1.
- (f) Place METER switch to Q2 position. Adjust R2 until front panel meter reads in center of green region marked Q2.
- (g) Place METER switch to Q3 position. Adjust R1 until front panel meter reads in center of green region marked Q3.
- (h) Connect a 50-ohm load to RF OUT connector J124 on rear panel as shown in figure 5-11. Connect VTVM across load.

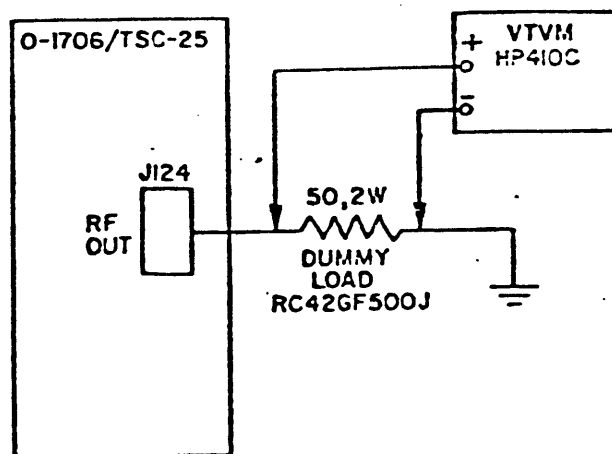


Figure 5-11 RF output board Z115 test setup

(i) Turn ALDC control on rear panel fully counterclockwise and set front panel selector switches to 29.9999 MHz.

(j) Connect scope to J115-B, and turn RF OUTPUT control on front panel clockwise until scope reading is approximately 30 to 80 mv peak-to-peak. VTVM should read approximately 3.0 ± 0.5 volts rms.

(k) Using a VOM, measure dc voltage at J115-12. It should vary from 0 to 12 volts as ALDC control is rotated on rear panel. Return ALDC control to its full counterclockwise position.

(l) Set ON-STANDBY switch to STANDBY position and reinstall Z115 in chassis connector.

b. Final Overall Alignment. The final overall alignment of the Exciter entails readjustments to spectrum generator Z101, and comb filters Z102 and Z103; mode level adjustments; and modulation level adjustments. The final alignment should not be attempted until after all individual circuit boards have been adjusted in accordance with the procedures in paragraph 5-5 a. (1) through (14).

(1) Preliminary Steps. Perform the following preliminary steps:

- (a) Insure that all cards are inserted and have been aligned.
- (b) Set STD switch to INT position and place RF OUTPUT control fully counterclockwise.
- (c) Set front panel selector switches to 25.0000 MHz.
- (d) Place CARRIER control fully counterclockwise.
- (e) Place MODE switch to ISB position.
- (f) Place EXCITER switch to ON position.
- (g) Connect two tones from generator to both 600-ohm side-band inputs (TB103 and TB104) on rear panel as shown in figure 5-12. Set output for 78 mv rms (-20 dB).
- (h) Set USB and LSB MIKE-LINE controls to 0 position.
- (i) Place ALDC control on rear panel fully counterclockwise.

(2) Spectrum Generator Board Z101. Perform final alignment of the spectrum generator as follows:

- (a) Set front panel selector switches to 25.0000 MHz.
- (b) Place Z101 on extender board and connect spectrum analyzer to J101-8.

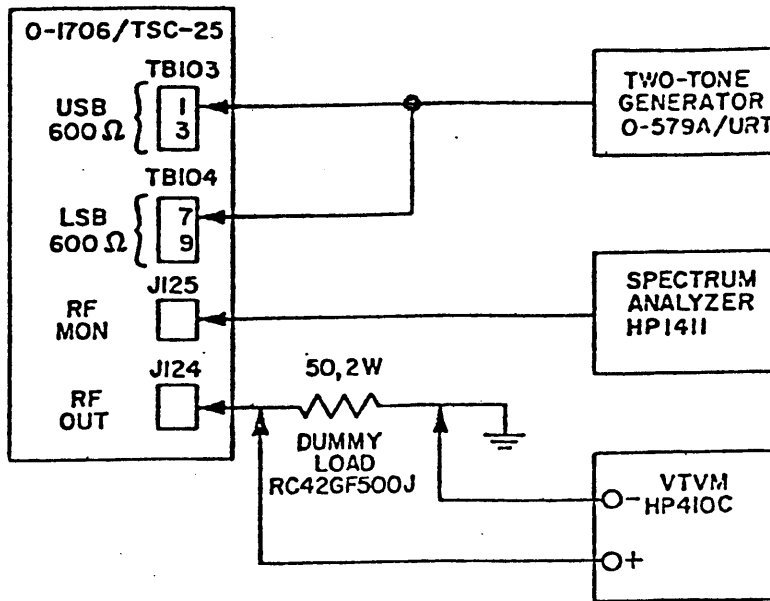


Figure 5-12. Final alignment, test setup.

(c) Set analyzer for a spectrum center at 12.0 MHz and adjust C56 so that 11.0 MHz and 13.0 MHz are at least 80 dB down from 12.0 MHz level.

(d) Set front panel selector switches to 15.0000 MHz and connect spectrum analyzer to J101-P.

(e) Set analyzer for a center display of 13.0 MHz. Adjust C80 so that 12.0 MHz and 14.0 MHz are down at least 80 dB from 13 MHz level.

(f) Set front panel selector switches to 05.0000 MHz and connect spectrum analyzer to J101-13.

(g) Set analyzer for a center display of 14 MHz. Adjust C63 so that 13.0 MHz and 15.0 MHz are at least 80 dB from 14.0 MHz level.

(h) Set front panel selector switches to any position and connect spectrum analyzer to J101-S; set analyzer for a center display of 8.0 MHz and adjust C64 so that 7.0 MHz and 9.0 MHz are down at least 80 dB from the 8.0 MHz level.

(i) Remove extender card and install Z101 in chassis connector.

(3) Comb Filter Boards Z102 and Z103. Perform final alignment of the comb filter boards as follows:

(a) Mount comb filter A Z102 on extender board, and remove comb filter B Z103 from chassis.

(b) Connect spectrum analyzer to J102-S and adjust for a center display of 0.8 MHz.

(c) Adjust C67 so that 100 kHz spurs above and below 0.8 MHz are down at least 80 dB from 0.8 MHz level.

(d) Connect spectrum analyzer to J102-14 and adjust for a center display of 1.0 MHz. Adjust C68 so that 100 kHz spurs above and below 1.0 MHz are down at least 80 dB from 1.0 MHz level.

(e) Connect spectrum analyzer to J102-J and set display for 1.2 MHz. Adjust C69 so that 100 kHz spurs above and below 1.2 MHz are down at least 80 dB from 1.2 MHz level.

(f) Connect spectrum analyzer to J102-F and set display for 1.4 MHz. Adjust C70 so that 100 kHz spurs above and below 1.4 MHz are down at least 80 dB from 1.4 MHz level.

(g) Connect spectrum analyzer to J102-L and set display for 1.6 MHz. Adjust C71 so that 100 kHz spurs above and below 1.6 MHz are down at least 80 dB from 1.6 MHz level.

(h) Connect spectrum analyzer to J102-I and set display for 1.8 MHz. Adjust C72 so that 100 kHz spurs above and below 1.8 MHz are down at least 80 dB from 1.8 MHz level.

(i) Remove comb filter A Z102 from chassis and insert comb filter B Z103 on extender board. Connect spectrum analyzer to J103-S and set display for a center of 0.9 MHz. Adjust C67 so that 100 kHz spurs above and below 0.9 MHz are down at least 80 dB from 0.9 MHz level.

(j) Connect spectrum analyzer to J103-14 and set display for a center of 1.1 MHz. Adjust C68 so that 100 kHz spurs above and below 1.1 MHz are down at least 80 dB from 1.1 MHz level.

(k) Connect spectrum analyzer to J103-J and set display for 1.3 MHz. Adjust C69 so that 100 kHz spurs are down at least 80 dB from 1.3 MHz level.

(l) Connect spectrum analyzer to J103-F and set display for 1.5 MHz. Adjust C70 so that 100 kHz spurs above and below 1.5 MHz are down at least 80 dB from 1.5 MHz level.

(m) Connect spectrum analyzer to J103-L and set display for 1.7 MHz. Adjust C71 so that 100 kHz spurs above and below 1.7 MHz are down at least 80 dB from 1.7 MHz level.

(n) Connect spectrum analyzer to J103-4 and set display for 1.9 MHz. Adjust C72 so that 100 kHz spurs above and below 1.9 MHz are down at least 80 dB from 1.9 MHz level.

(o) Insert comb filter A Z102 and comb filter B Z103 into chassis.

(4) Mode Level Adjustments.

(a) Connect spectrum analyzer to RF MON jack on rear panel of Exciter.

(b) Connect a 50-ohm, 2-watt resistive load (RC42GF500J) to RF OUT jack on rear panel; connect VTVM across 50-ohm load. (See figure 5-11.)

(c) Turn MODE switch to ISB; set CARRIER control fully counterclockwise. Switch audio input to two tones, and adjust USB and LSB MIKE-LINE controls for 4/5 full-scale readings on MONITOR meter in appropriate METER switch positions.

(d) Set front panel selector switches for any desirable frequency (for example 03.0000 MHz) and adjust RF OUTPUT control for a 2.5-volt indication on VTVM. Set analyzer to display 3.0000 MHz.

(e) Position Z107 on extender board. Touch up level of tones for equal display (fig. 5-13), by increasing or decreasing R34 (USB) or R60 (LSB) on sideband generator board Z107.

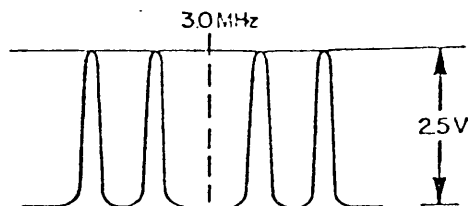


Figure 5-13. Equal two-tone display centered about 3.0 MHz.

(f) Attenuate display -3 dB, using input attenuator of analyzer. Turn CARRIER control fully clockwise and adjust R27 on carrier generator board Z109 for center tone at top line of analyzer, as shown in figure 5-14.

(g) Turn both USB and LSB MIKE-LINE controls to 0 position. Leave CARRIER control fully clockwise and readjust RF OUTPUT control for 2.5 ± 0.2 volts rms output indication.

NOTE

Do not change RF OUTPUT control for following adjustments unless otherwise specified.

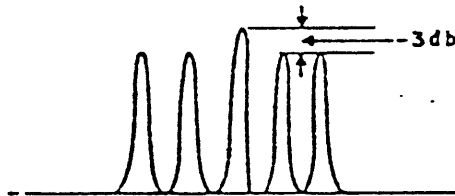


Figure 5-14. Center tone display at 3.0 MHz.

(h) Turn MODE switch to CW position and key unit by front panel key or at rear panel KEY input at TB104 (jumper across KEY terminals). Adjust R20 on Z109 for 2.5 ± 0.2 volts rms on VTVM.

(i) Unkey unit; output should drop to zero and analyzer display should be -60 dB minimum.

(j) Key unit; turn MODE switch to FSK position and adjust R56 on Z108 for 2.5 ± 0.2 volts rms on VTVM. Turn MODE switch to FAX position: level should remain the same.

(k) Turn MODE switch to AM position and adjust R69 on Z109 for 1.25 volts on HP VTVM (-6 dB ± 0.5 dB).

(l) With front panel CARRIER control at maximum clockwise position, observe voltages specified in table 5-5 on VTVM across load, and observe one signal on analyzer at dB level indicated, when MODE switch is changed.

Tabl 5-5. MODE Switch Setting vs. VTVM and Analyzer Indications

MODE Switch Setting	VTVM Reading (vrms)	ANALYZER Reading (dB)
AM	1.25	-6.0 (± 0.5 dB)
USB	2.5 ± 0.5	0.0
LSB	2.5 ± 0.5	0.0
ISB	2.5 ± 0.5	0.0
CW KEYED	2.5 ± 0.5	0.0
FSK	2.5 ± 0.5	0.0
FAX	2.5 ± 0.5	0.0

(m) Turn MODE switch to USB or LSB position and set CARRIER control fully clockwise. Set front panel selector switches for 29.0000 MHz and adjust RF OUTPUT control for 2.5 ± 0.2 vrms on VTVM.

(n) Move selector switches from 29.0000 MHz to 29.9999 MHz, and find frequency with lowest output; at this frequency, adjust R97 on translator board Z112 for maximum vrms signal. Return selector switches to 29.0000 MHz.

(o) Rotate 100 kHz, 10 kHz, 1 kHz and 100 Hz selector switches from 29.0000 MHz to 29.4999 MHz; rf output should be approximately constant at 2.5 ± 0.5 vrms. If not, try to obtain best results by slightly adjusting T18, T16 and T13 on Z112.

(p) Rotate 100 kHz, 10 kHz, 1 kHz and 100 Hz selector switches from 29.5000 MHz to 29.9999 MHz; output should be approximately constant at 2.5 ± 0.5 vrms. If not, try to obtain best results by slightly adjusting T23, T22 and T21 on Z112.

(q) When 29.5000 MHz to 29.9999 MHz section is adjusted as outlined in step (p), adjust R109 on Z112 so that when switching from 29.4999 MHz to 29.5000 MHz, output remains approximately constant at 2.5 ± 0.5 vrms.

(r) Turn RF OUTPUT control fully clockwise and adjust R58 on frequency shift generator board Z108 for approximately 5.0-volt rf output on HP VTVM. Check all frequencies; if any are found to be much lower than 5.0 ± 0.5 volts rms, readjust R58 on Z108.

(5) Modulation Level Adjustments and Check.

- (a) Connect Exciter in test setup as shown in figure 5-12.
- (b) Set front panel frequency selector switches to 12.0000 MHz. Turn MODE switch to USB position and set CARRIER control to maximum clockwise position.
- (c) Ensure that USB and LSB MIKE-LINE gain controls are at 0 position.
- (d) Adjust RF OUTPUT control for 2.5 ± 0.2 volts rms output indication on VTVM.
- (e) Adjust spectrum analyzer to indicate 0 dB; a single tone (carrier) should be displayed.
- (f) Turn CARRIER control to maximum counterclockwise position; signal on analyzer should drop to -55 dB or lower. Turn MODE switch to LSB position; signal should be at same level.

NOTE

Slight improvement of carrier suppression can be made by adjusting R28 and C52 for USB and R54 and C53 for LSB on sideband generator Z107, while viewing display on analyzer.

- (g) Adjust audio generator for two tones. Turn METER switch to LSB position and adjust LSB MIKE-LINE gain for 4/5 full-scale on MONITOR meter.
- (h) Adjust RF OUTPUT control for 2.5 ± 0.2 volts rms on VTVM.
- (i) Two tones should be displayed on analyzer. Adjust R71 on translator board Z112 for minimum (± 1 dB) distortion products. Distortion should be down -40 ± 1 dB from two tones.
- (j) Turn LSB MIKE-LINE gain control to 0 position. Turn METER switch to USB position, and set USB MIKE-LINE gain control to indicate 4/5 full-scale on MONITOR meter. Set MODE switch to USB position.
- (k) Distortion products should be down -40 ± 1 dB from two tones displayed on analyzer.

(l) Turn USB MIKE-LINE control to 0 position. Turn MODE switch to AM position and adjust audio generator for one tone.

(m) Using LSB or USB MIKE-LINE control, adjust tone display as shown in figure 5-15. Displayed carrier will be modulated so that sidebands are 7 ± 1 dB below carrier (reading of approximately 2 on front panel MONITOR meter). Distortion should be -37 dB minimum below carrier.

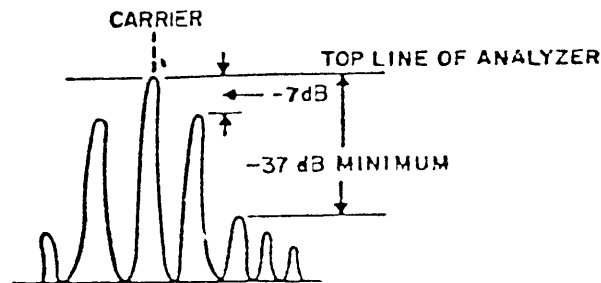


Figure 5-15. Carrier modulation display.

5-6. Equipment Check Procedures.

a. General. In general, after repair and/or replacement of parts has been accomplished, the Exciter should be subjected to a minimum performance check. Such a check is outlined in Section II - Preparation for Use and Installation - paragraph 2-5. This type of check will verify Exciter operation at a minimum performance level. However, if components have been replaced on any of the printed circuit boards, the alignment and adjustment procedures outlined in this section must be completed prior to carrying out the minimum performance check outlined in paragraph 2-5. The board alignment and adjustment procedures are presented in paragraphs 5-5 a. (1) through 5-5 a. (14); a final overall alignment procedure is presented in paragraphs 5-5 b. (1) through 5-5 b. (5).

b. 1 MHz Standard Frequency Stability Test. (See fig. 5-16.) Check the frequency stability of the internal 1 MHz standard oscillator as follows:

(1) Check that STANDBY-ON switch on Exciter is in STANDBY position.

(2) Connect 1 MHz MON jack J121 to input of HP 117A VLF comparator.

(3) Connect Exciter POWER connector to 115-volt, 60 Hz source, and set STANDBY-ON switch to ON position. Energize test equipment and allow a 30-minute warmup period to elapse.

(4) Set METER FUNCTION switch on HP 117A to PHASE COMPARISON position and observe PHASE COMPARISON RECORDER chart readout and front panel meter over a period of 1 hour. Frequency stability of Exciter internal 1 MHz standard should be at least 1 part in 10^8 /day.

(5) Deenergize setup and disconnect equipment.

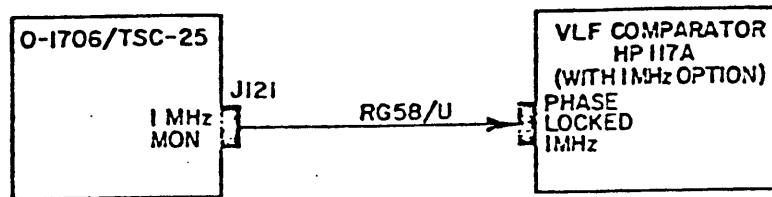


Figure 5-16. 1 MHz frequency stability test setup.

SECTION 6

DIAGRAMS AND PARTS LISTS

6.1 Introduction

6.1.1 This section contains schematic diagrams of all pertinent circuits; pictorial illustrations and photographs of subassemblies; and parts lists for all assemblies. It is intended to aid in troubleshooting the equipment and in identifying component parts.

6.2 Parts Lists

6.2.1 Wherever possible, the parts list is located immediately after its companion subassembly diagram and illustration. The list is a cross-reference between symbol designation and TMC part number. The illustration identifies the part by symbol number and in most cases this same symbol number is marked directly on the subassembly next to the part it identifies. Mechanical and electro-mechanical parts are stamped with the TMC part number and are listed on the overall parts lists.

6.2.2 To expedite delivery of replacement parts, use the REQUEST FOR SPARE PARTS form provided at the end of this section. If this form is not available, prepare a letter and include the following information.

6.2.2.1 USED ON assembly or, if not available, the model and serial number of the equipment containing the part in need of replacement. This information is displayed on the equipment nameplate.

6.2.2.2 SYMBOL NUMBER as identified in the parts list.

6.2.2.3 TMC PART NUMBER as identified in the parts list.

6.2.2.4 DESCRIPTION of the part as indicated in the parts list.

6.2.3 All requests for replacement parts should be addressed to a TMC field office, to your local TMC representative, or to the following:

THE TECHNICAL MATERIEL CORPORATION
700 Fenimore Road
Mamaroneck, New York 10543 U.S.A.

Attention: Spare Parts Group

6.3 Diagrams

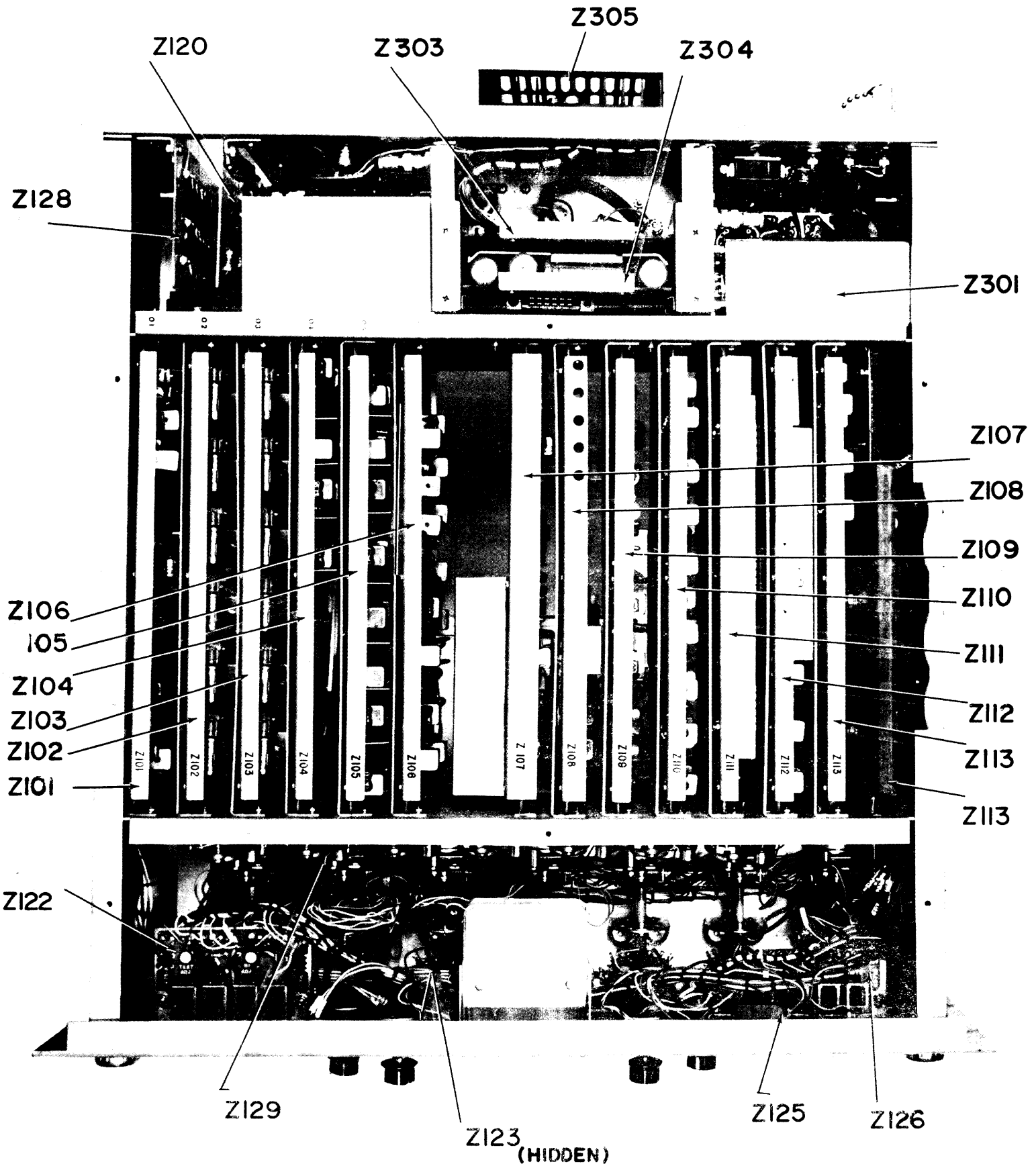
6.3.1 Table 6-1 identifies the assemblies and subassemblies presented in this section. All information is arranged alphanumerically by symbol.

TABLE 6-1
ASSEMBLY/SUBASSEMBLY LIST

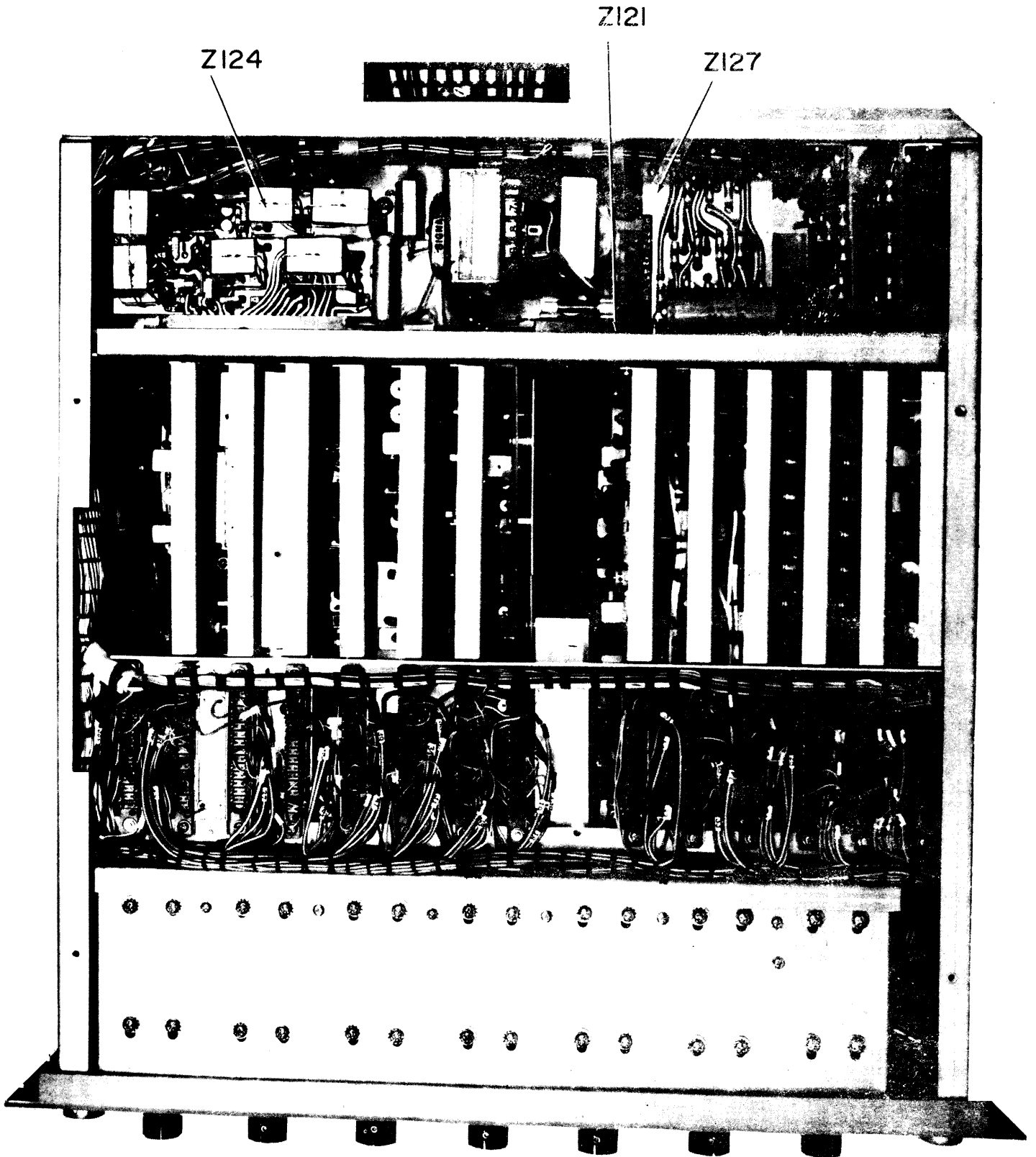
Symbol	Description	TMC Part No.	Page
	Top View, Location of Major Components.....		6-4
	Bottom View, Location of Major Components...		6-5
	Overall Schematic Diagram/Data.....		6-6
Z101	Spectrum Generator.....	A4480-1	6-21
Z102	Comb Filter A.....	A4500-1	6-26
Z103	Comb Filter B.....	A4501-1	6-31
Z104	Single Mixer-Divider.....	A4487-1	6-36
Z105	Dual Mixer-Divider.....	A4475-1	6-41
Z106	Final Mixer.....	A4479	6-47
Z107	Sideband Generator.....	A4524-1	6-52
Z108	Frequency Shift Generator.....	A4525-1	6-57
Z109	Carrier Generator.....	A4526-1	6-62
Z110	Step Generator A.....	A4478-1	6-67
Z111	Step Generator B.....	A4504-1	6-72
Z112	Translator.....	A4505-1	6-76
Z113	Step Generator C.....	A4506-1	6-82
Z114	Not Used		
Z115	RF Output.....	A4502-1	6-88
Z116	Not Used		
Z117	Not Used		
Z118	Not Used		
Z119	Not Used		

TABLE 6-1 (Continued)

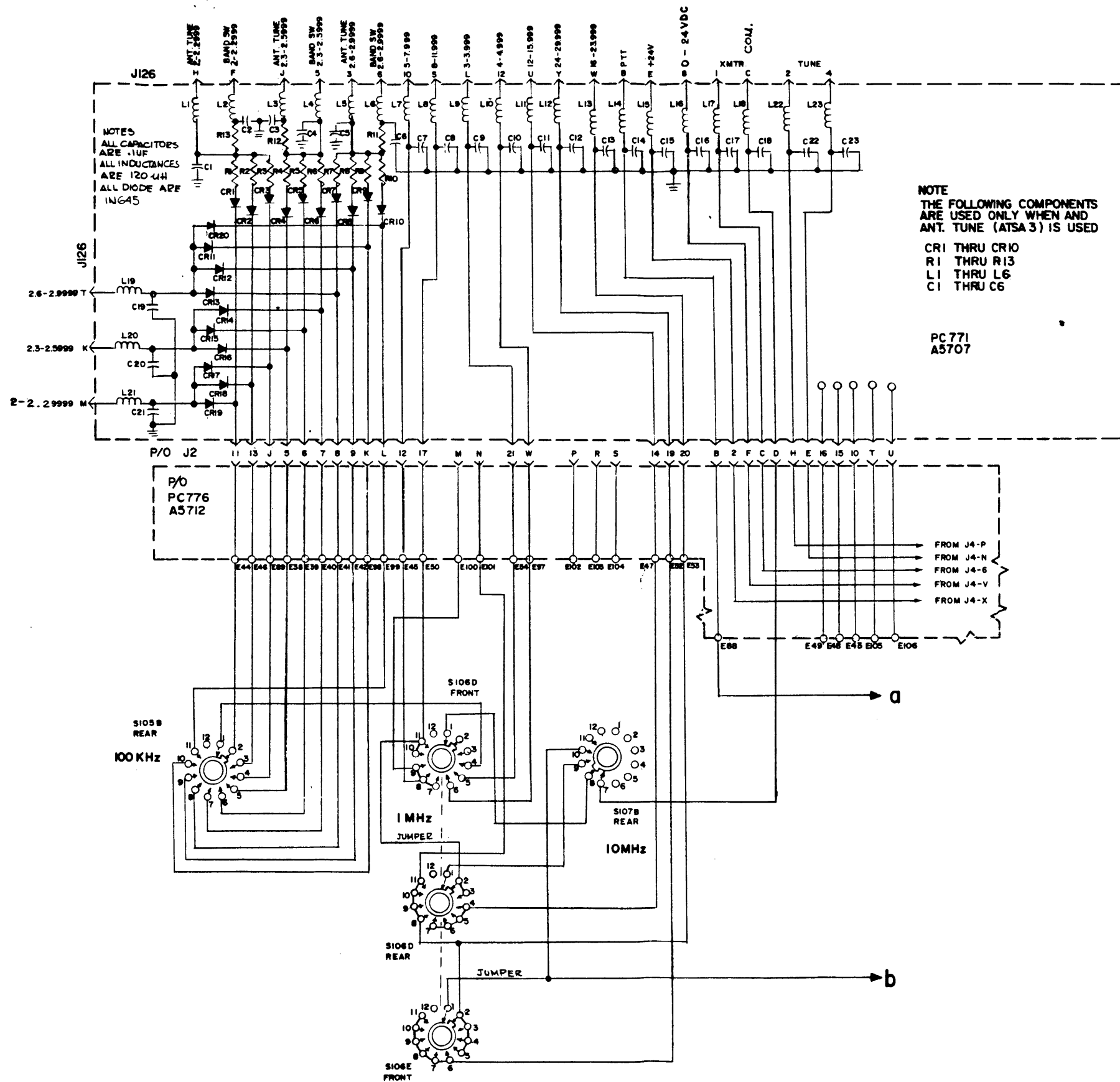
<u>Symbol</u>	<u>Description</u>	<u>TMC Part No.</u>	<u>Page</u>
Z120	Band Switching	A5707	6-92
Z121	Remote Control Mother Board.	A5712	6-96
Z122	Push Button Switch Assembly.	A5711	6-100
Z123	R.F. Switch Assembly	A5713	6-102
Z124	P.T.T./Carrier Tune.	A5709	6-105
Z125	Indicator Assembly	A5710	6-109
Z126	Push Button Switch Assembly.	A5719	6-111
Z127	Audio Decoupling	A5708	6-113
Z128	Remote Decoupler	A5706	6-115
Z129	Switch Circuit Assembly.	A5714	6-119
Z303	Power Supply B	A4513	6-123
Z304	Power Supply A	A4512	6-127



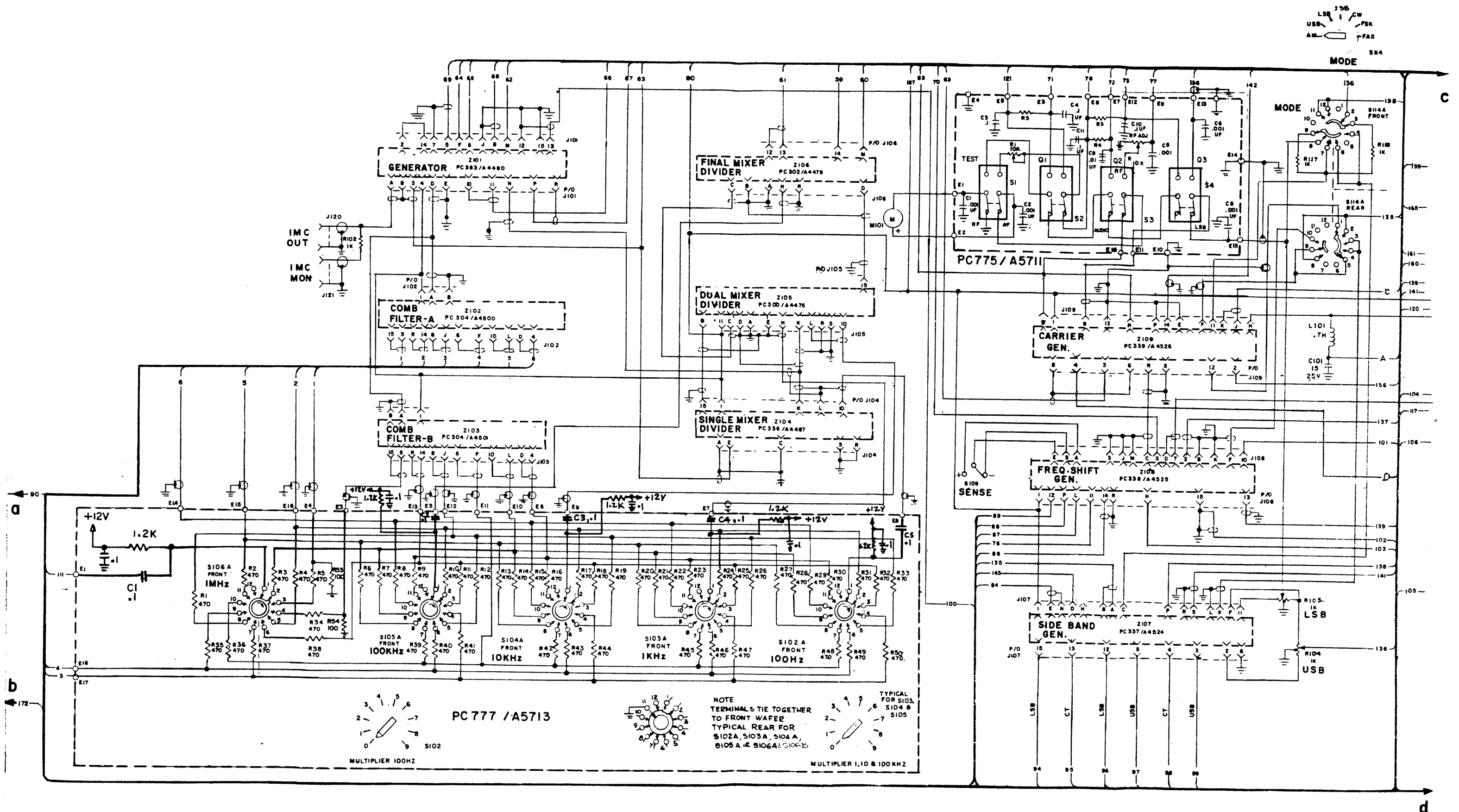
Top View, Location of Major Components



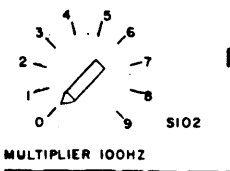
Bottom View, Location of Major Components



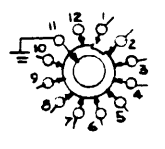
Overall Schematic Diagram



MODE
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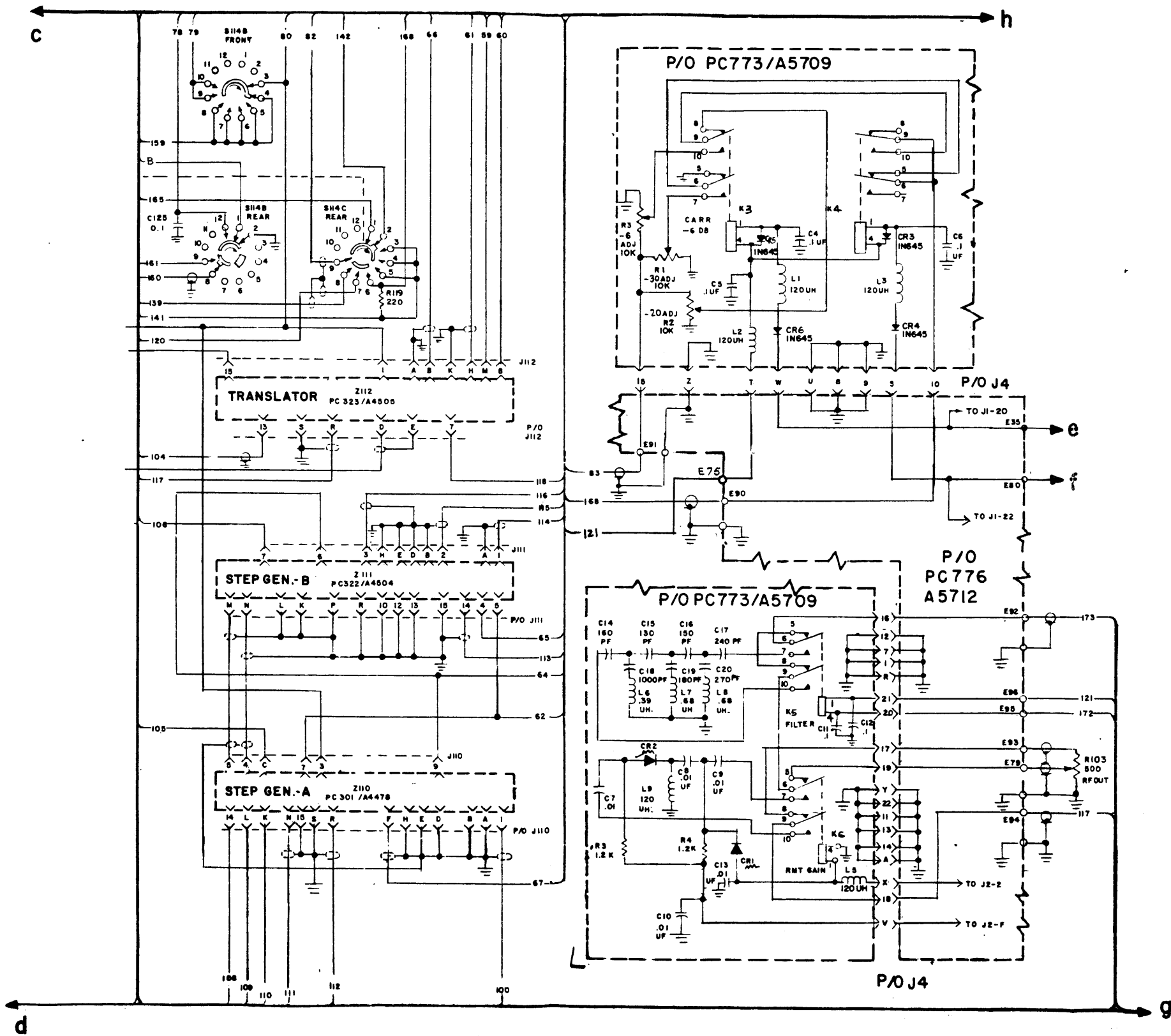


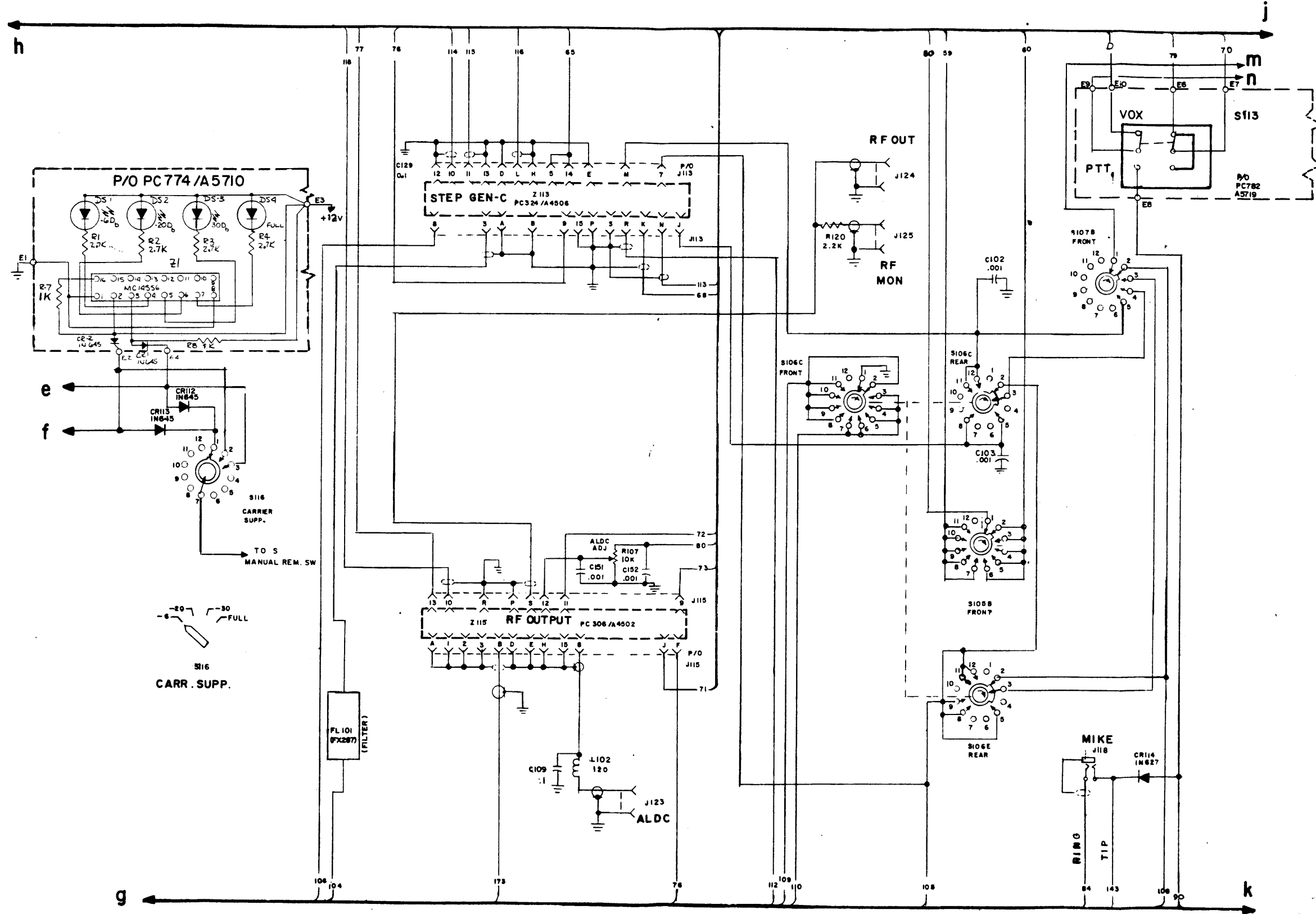
PC 777 / A5713

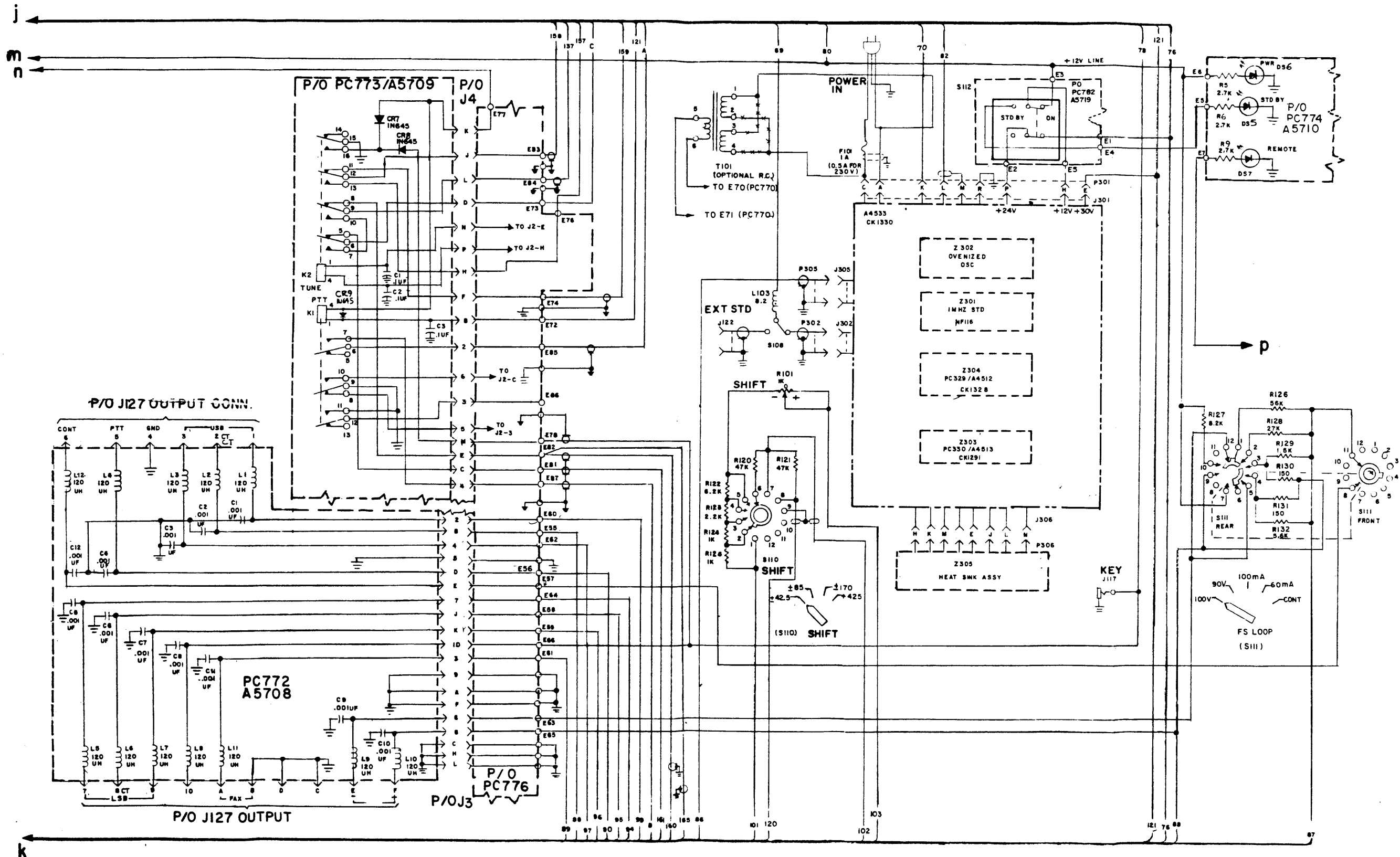


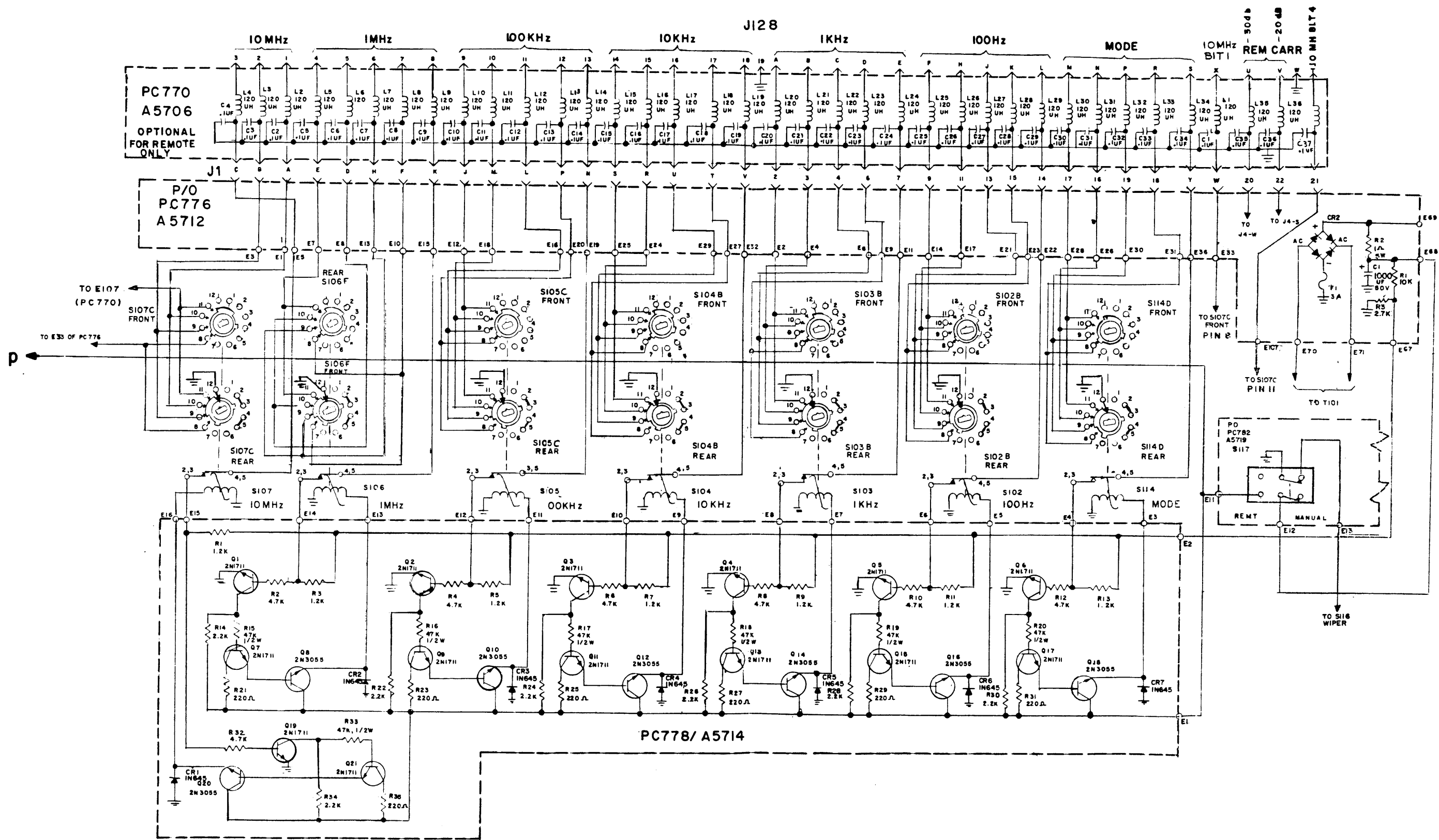
NOTE
 TERMINALS TIE TOGETHER
 TO FRONT WAFER
 TYPICAL REAR FOR
 S102A, S103A, S104A,
 S105A & S106A; S102B

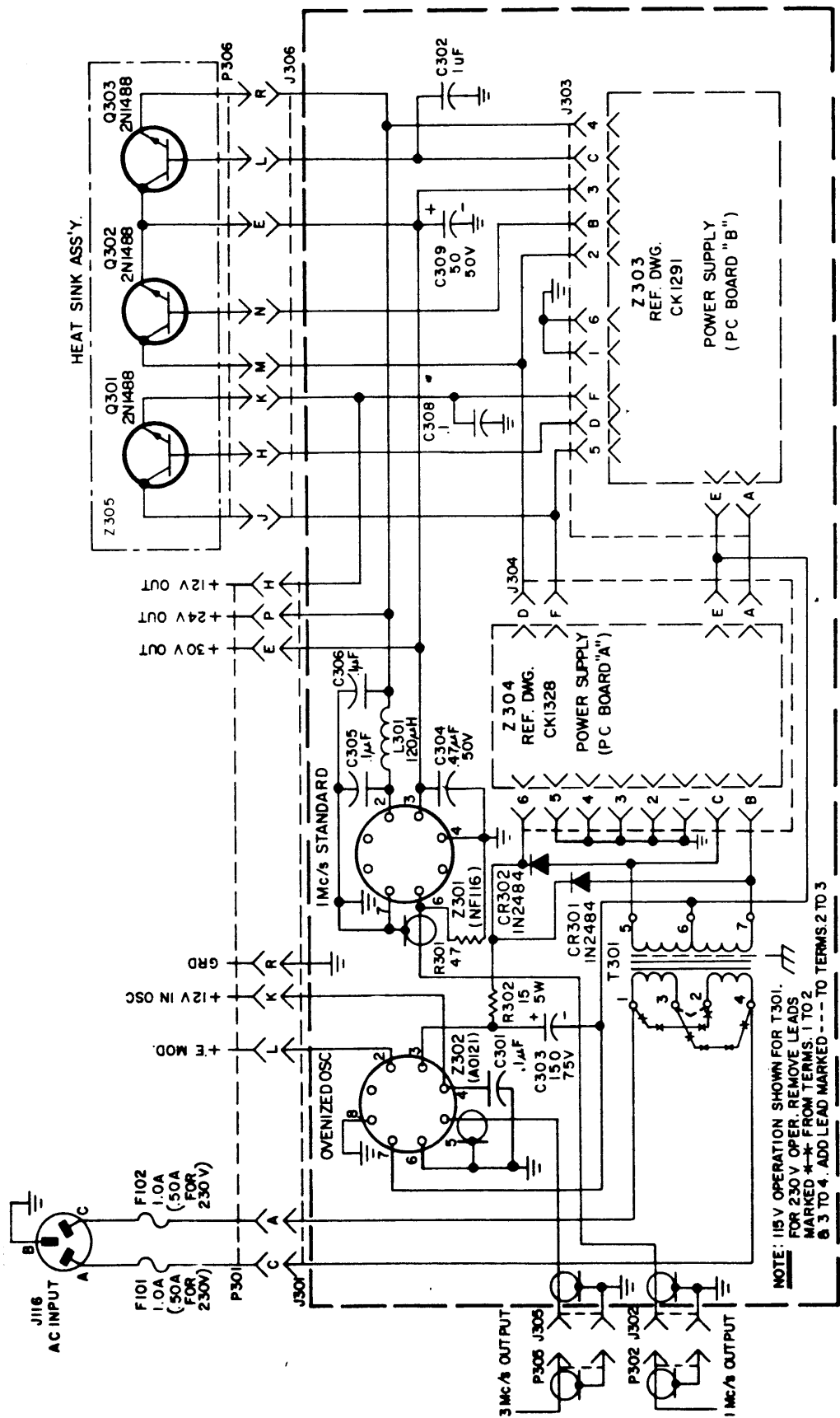












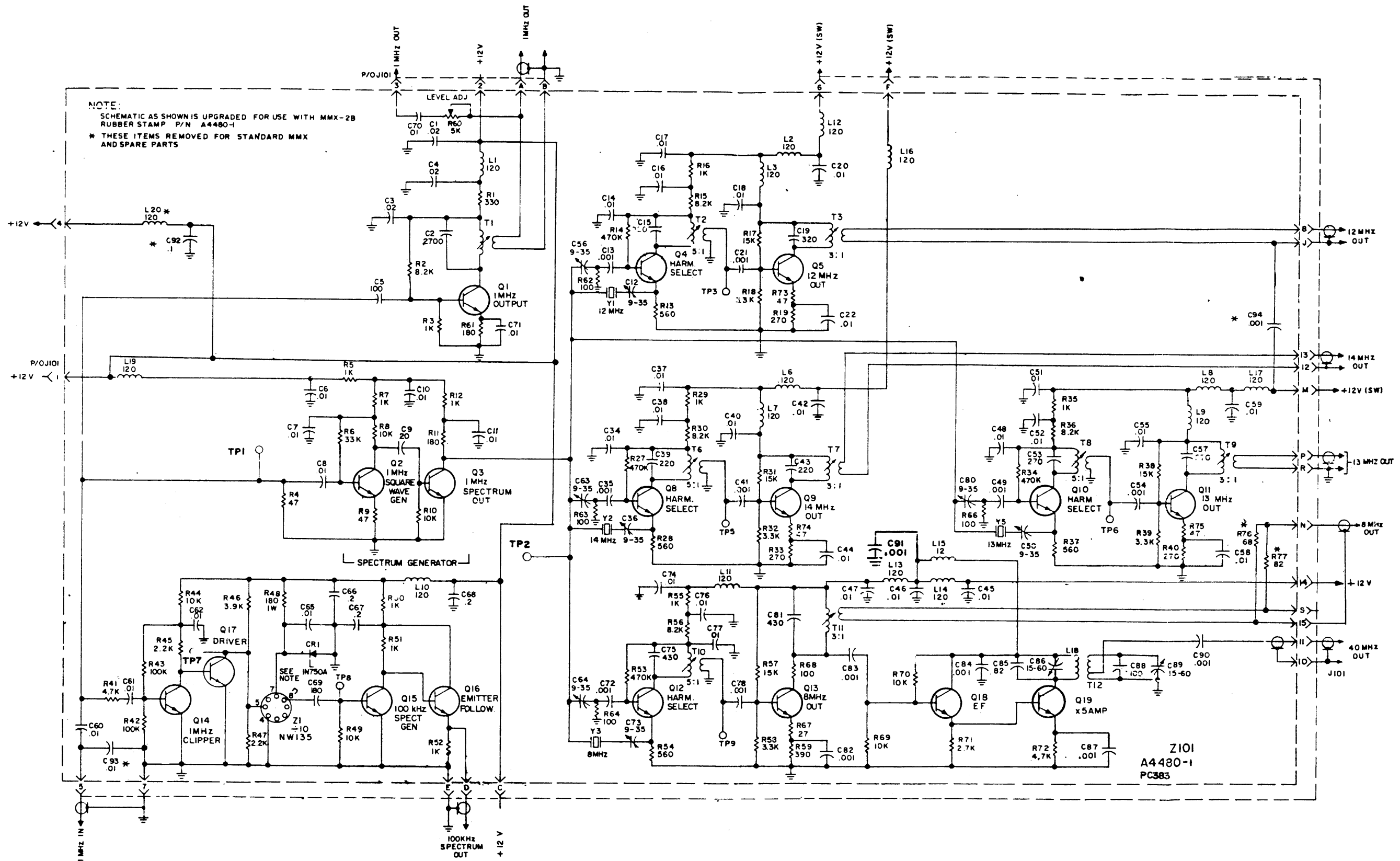
NOTE: 115V OPERATION SHOWN FOR T301.
 FOR 230V OPER. REMOVE LEADS
 MARKED *-* FROM TERMS. 1 TO 2
 & 3 TO 4. ADD LEAD MARKED --- TO TERMS. 2 TO 3

LAST SYMBOLS	MISSING SYMBOLS
C309 CR302 J306 L301 P306 Q303 R302 T301 Z305	C307 P303, P304

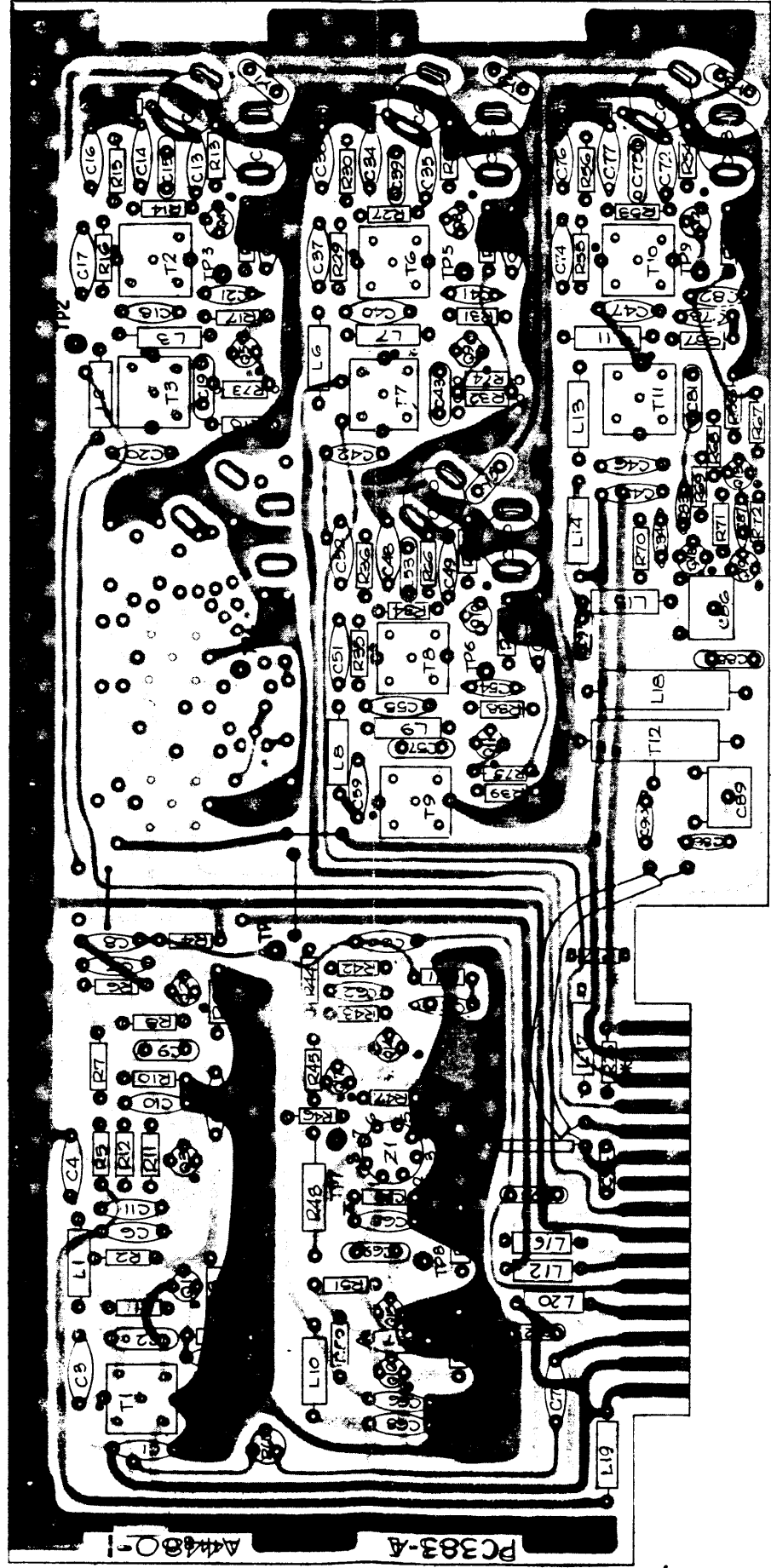
Power Supply Wiring Diagram

Part Number	Description	Used On	Qty	Symbol Number	S1200
A4475-1	MIXER DIVIDER	BMA533	1	Z105	
A4478-1	STEP GEN A	BMA533	1	Z110	
A4479	FINAL MIXER	BMA533	1	Z106	
A4480-1	SPEC GEN	BMA533	1	Z101	
A4487-1	MIXER/DIV ½ BD	BMA533	1	Z104	
A4500-1	COMB FIL A	BMA533	1	Z102	
A4501-1	COMB FIL B	BMA533	1	Z103	
A4502-1	RF OUTPUT	BMA533	1	Z115	
A4504-1	STEP GEN B	BMA533	1	Z111	
A4505-1	TRANSLATOR	BMA533	1	Z112	
A4506-1	STEP GEN C	BMA533	1	Z113	
A4512	PWR SUP BDA	AX795	1	Z304	
A4513	PWR SUP BDB	AX795	1	Z303	
A4524-1	SD BND GEN	BMA533	1	Z107	
A4525-1	FS GEN	BMA533	1	Z108	
A4526-1	CARRIER GEN	BMA533	1	Z109	
A5706	REMOTE DECPL	KIT441	1	Z128	
A5707	BND SW ASY	BMA538	1	Z120	
A5708	AUDIO DECPL	BMA538	1	Z127	
A5709	P. T. T. CARR TUN	BMA538	1	Z124	
A5710	INDICATOR ASY	BMA535	1	Z125	
A5711	PUSH SW ASY	BMA535	1	Z122	
A5712	REM CON MOTH BD	BMA538	1	Z121	
A5713	RF SW ASY	BMA535	1	Z123	
A5714	SW CKT ASY	KIT 441	1	Z129	
A5719	PUSH SW ASY	BMA535	1	Z126	
AS130	SW ASY, LOOP	BMA536	1	S111	
AS131	SW ASY, SHIFT	BMA536	1	S110	
BMA173	HEAT SK ASY	BMA536	1	Z305	
CC100-16	CAP, FXD, CER	BMA536	1	C309	
CC100-29	CAP, FXD, CER	BMA536	2	C310, C311	
CC100-37	CAP, FXD, CER	BMA536	4	C301, C305, C306, C308	
CE105-15-25	CAP, FXD, ELECT	BMA536	1	C101	
CE105-50-50	CAP, FXD, ELECT	BMA536	1	C309	
CE105-150-75	CAP, FXD, ELECT	BMA536	1	C303	
CL240-120	COIL, RF	BMA536	1	L302	
CL275-8R2	COIL, RF	BMA536	1	L103	
CL275-121	COIL, RF	BMA536	1	L301	
CN112A105M2	CAP, FXD	BMA536	1	C302	
CN114R47-5J	CAP, FXD	BMA536	1	C304	
FH100-3	FUSE HOLDER	BMA536	1	XF101	
FU102-1.0	FUSE	BMA536	1	F101	
FX287	OSC, XTAL, STD	BMA536	1	FL101	
JJ211	CONN RECP RF	AX794	2	J302, J305	
JJ242-5P	CONN RECP RF	AX794	1	J301	
JJ242-5S	CONN RECP RF	AX794	1	J306	
JJ319-6DPE	CONN RECP FML	AX794	2	J303, J304	

Part Number	Description	Used On	Qty	Symbol Number	S1200
JJ319A15DFE	CONN RECP FML	AX794	15	J101, J102, J103, J104, J105, J106, J107, J108, J109, J110, J111, J112, J113, J114, J115	
JJ033	JACK, MIKE	BMA535	1	J118	
JJ034	JACK, MIKE	BMA535	1	J117	
MR191-9	METER	BMA535	1	M101	
NF116-3	OSC, XTAL STD	AX795	1	Z301	
PL225-8S	CONN PL, FML	AX795	1	P301	
RC07GF102J	RES, FXD, COMP	AS131	2	R117, R118	
RC07GF152J	RES, FXD, COMP	AS130	1	R123	
RC07GF222J	RES, FXD, COMP	AS131	1	R119	
RC07GF273J	RES, FXD, COMP	AS130	1	R122	
RC07GF473J	RES, FXD, COMP	AS131	2	R115, R116	
RC07GF562J	RES, FXD, COMP	AS130	1	R126	
RC07GF563J	RES, FXD, COMP	AS130	1	R121	
RC07GF822J	RES, FXD, COMP	AS130	1	R193	
RC07GF102J	RES, FXD, COMP	BMA536	1	R102	
RC07GF222J	RES, FXD, COMP	BMA536	1	R120	
RC07GF470J	RES, FXD, COMP	BMA536	1	R301	
RC07GF151J	RES, FXD, COMP	AS130	2	R124, R125	
RE70G1R0	RES, FXD, WW	AS795	1	R302	
RV110-1	RES, VAR, COMP	BMA535	2	R104, R105	
RV4NAYS501A	RES, VAR, COMP	BMA535	1	R103	
RW107-10	RES, FXD, WW	AS795	1	R302	
ST103-11-62	SW, TOG SPDT	BMA536	2	S108, S109	
SW333	SW, ROT	BMA535	1	S116	
SW446	SW, ROT	AS130	1	S111	
SW447	SW, ROT	AS131	1	S110	
SW567	SW, ROT, SOL	KIT441	7	S102, S103, S104, S105, S106, S107, S114	
TF352	XFMR, SD	AX795	1	T301	
TF441	XFMR, SD	KIT441	1	T101	
UG625/U	CONN RECP RF	BMA536	6	J120, J121, J122, J123, J124, J125	
WS149	WAFER, SW	AX794	1	S106E	
WS150	WAFER, SW	AX794	2	S102B, S106B	
WS151	WAFER, SW	AX794	1	S106C	
WS152	WAFER, SW	AX794	1	S114C	
WS153	WAFER, SW	AX794	1	S114B	
WS154	WAFER, SW	AX794	1	S114A	
1N2484	SCOND, DEV DIO	AX795	2	CR301, CR302	

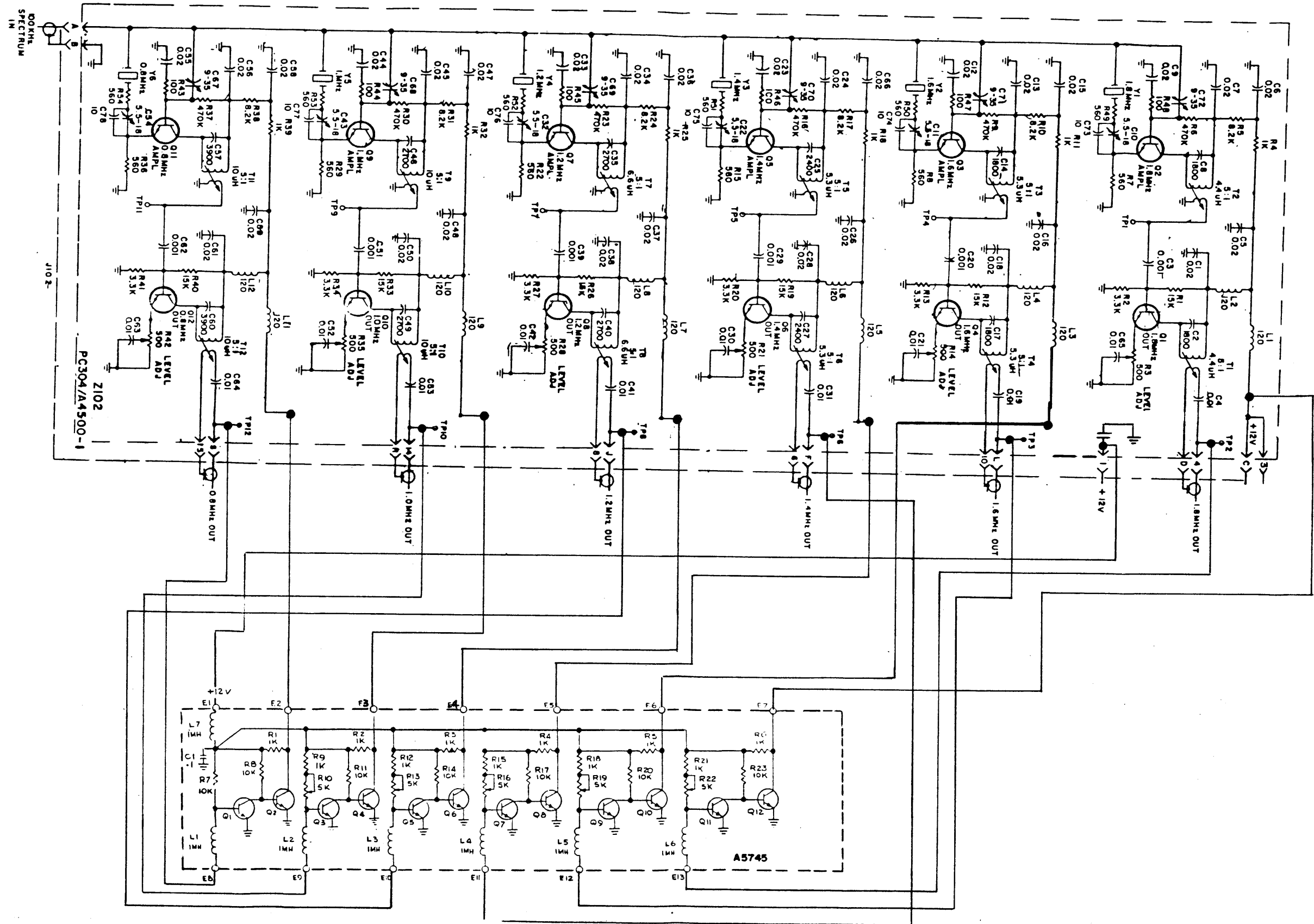


Z101 Spectrum (A4480)
 Generator



PART NUMBER	DESCRIPTION	USED ON ASSEMBLY	QTY PER UNIT	REFERENCE SYMBOLS
CC100-16	CAP., FXD, CER	A-4480-1	36	C6, C7, C8, C10, C11, C14, C16 C17, C18, C20, C22 C34, C37, C38 C40, C42, C44, C45, C46, C47, C48, C51, C52, C55, C58, C59, C60, C61, C62 C65, C70, C71, C74, C76, C77, C93
CC100-28	CAP., FXD, CER	A-4480-1	1	C92
CC100-29	CAP., FXD, CER	A-4480-1	15	C13, C21, C35, C41, C49, C54, C72, C78, C82, C83 C84, C87, C90, C91, C94 C66, C67, C68
CC100-33	CAP., FXD, CER	A-4480-1	3	C1, C3, C4
CC100-35	CAP., FXD, CER	A-4480-1	3	L15
CL275-120	COIL, RF, FXD	A-4480-1	1	L1, L2, L3, L6, L7, L8, L9, L10, L11, L12, L13, L14, L16, L17, L19, L20
CL275-121	COIL, RF, FXD	A-4480-1	16	L18
CL419	COIL, RF, FXD	A-4480-1	1	C9
CM111C200J5S	CAP., FXD, MICA	A-4480-1	1	C85
CM111E820F5S	CAP., FXD, MICA	A-4480-1	1	C88
CM111F101J5S	CAP., FXD, MICA	A-4480-1	1	C69
CM111F181G5S	CAP., FXD, MICA	A-4480-1	1	C39, C43
CM111F221G5S	CAP., FXD, MICA	A-4480-1	2	C57, C53
CM111F271F5S	CAP., FXD, MICA	A-4480-1	2	C15, C19
CM111F321D5S	CAP., FXD, MICA	A-4480-1	2	C75, C81
CM111F431G5S	CAP., FXD, MICA	A-4480-1	2	C2
CM112F272D5S	CAP., FXD, MICA	A-4480-1	1	Y1
CR109-124	CU, QTZ 12. MHZ	A-4480-1	1	Y5
CR109-134	CU, QTZ 13. MHZ	A-4480-1	1	Y2
CR109-138	CU, QTZ 14. MHZ	A-4480-1	1	Y3
CR109-139	CU, QTZ 8. MHZ	A-4480-1	1	C12, C36, C50, C56, C63 C64, C73, C80
CV112-2	CAP., VAR, CER	A-4480-1	8	C86, C89
CV112-6	CAP., VAR, CER	A-4480-1	2	Z1
NW135	NW DEC COUNT	A-4480-1	1	R62, R63, R64, R66, R68
RC07GF101J	RES, FXD, COMP.	A-4480-1	5	R3, R5, R7, R12, R16, R29, R35, R51, R52, R55 R50
RC07GF102J	RES, FXD, COMP.	A-4480-1	11	R8, R10, R44, R49, R69, R70
RC07GF103J	RES, FXD, COMP.	A-4480-1	6	R42, R43
RC07GF104J	RES, FXD, COMP.	A-4480-1	2	R17, R31, R38, R57
RC07GF153J	RES, FXD, COMP.	A-4480-1	4	R11, R61
RC07GF181J	RES, FXD, COMP.	A-4480-1	2	R45, R47
RC07GF222J	RES, FXD, COMP.	A-4480-1	2	R67
RC07GF270J	RES, FXD, COMP.	A-4480-1	1	R19, R33, R40
RC07GF271J	RES, FXD, COMP.	A-4480-1	1	R71
RC07GF272J	RES, FXD, COMP.	A-4480-1	3	R1
RC07GF272J	RES, FXD, COMP.	A-4480-1	1	
RC07GF331J	RES, FXD, COMP.	A-4480-1	1	

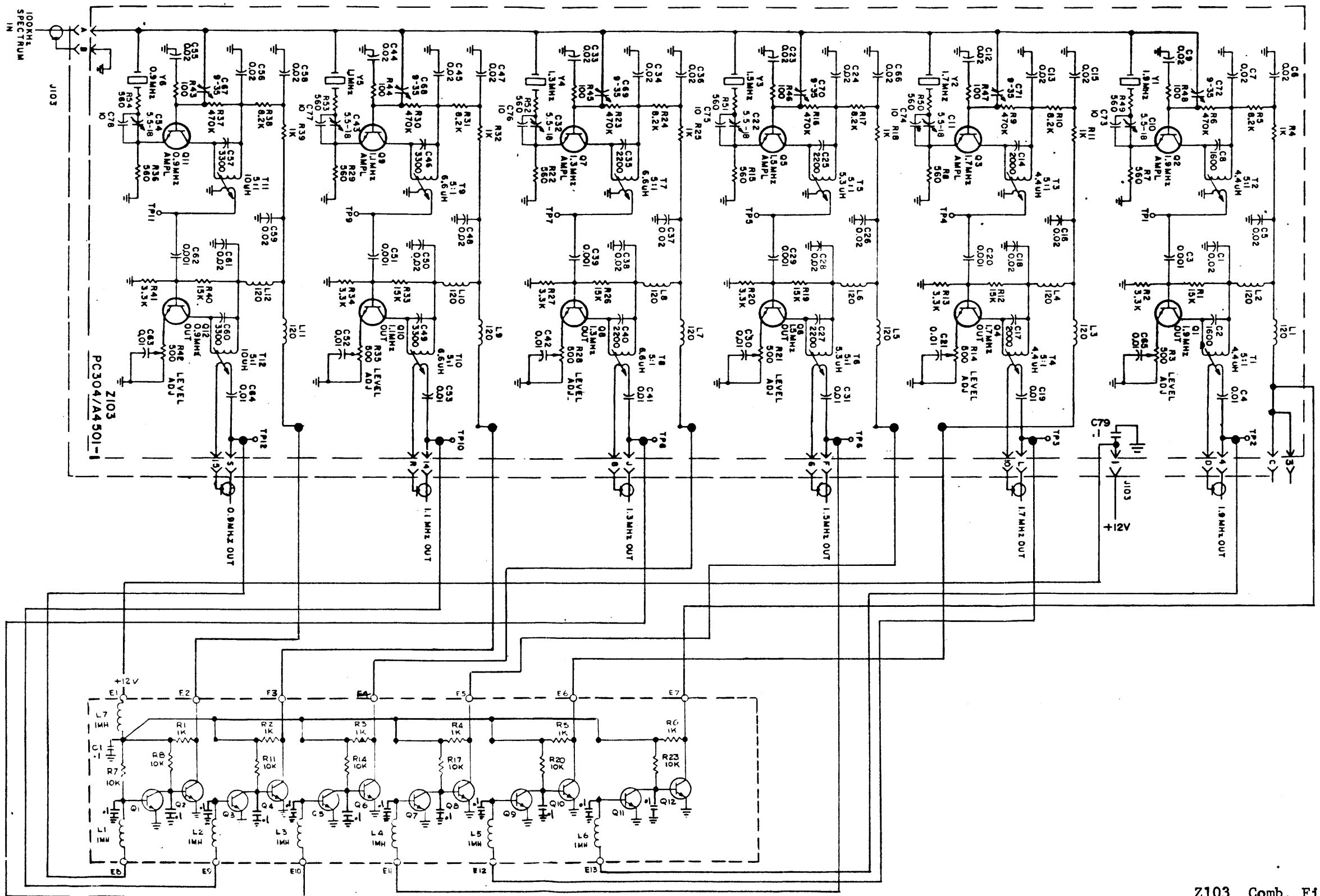
PART NUMBER	DESCRIPTION	USED ON ASSEMBLY	QTY PER UNIT	REFERENCE SYMBOLS
RC07GF332J	RES, FXD, COMP.	A-4480	4	R18, R32, R39, R58
RC07GF333J	RES, FXD, COMP.	A-4480	1	R6
RC07GF391J	RES, FXD, COMP.	A-4480	1	R59
RC07GF392J	RES, FXD, COMP.	A-4480	1	R46
RC07GF470J	RES, FXD, COMP.	A-4480	5	R4, R9, R73, R74, R75
RC07GF472J	RES, FXD, COMP.	A-4480	2	R41, R72
RC07GF474J	RES, FXD, COMP.	A-4480	4	R14, R27, R34, R53
RC07GF561J	RES, FXD, COMP.	A-4480	4	R13, R28, R37, R54
RC07GF680J	RES, FXD, COMP.	A-4480	1	R76
RC07GF820J	RES, FXD, COMP.	A-4480	1	R77
RC07GF822J	RES, FXD, COMP.	A-4480	5	R2, R15, R30, R36, R56
RC32GF181J	RES, FXD, COMP.	A-4480	1	R48
RV124-1-502	RES, VAR, COMP.	A-4480	1	R60
TEO127-2	TERM, STUD	PC383	9	TP1, TP2, TP3, TP5, TP6, TP8, TP9, TP4, TP7
TT286-13	XFMR, RF, ADJ	A-4480	1	T11
TT286-14	XFMR, RF, ADJ	A-4480	1	T10
TT286-15	XFMR, RF, ADJ	A-4480	3	T3, T7, T9
TT286-16	XFMR, RF, ADJ	A-4480	3	T2, T6, T8
TT286-2	XFMR, RF, ADJ	A-4480	1	T1
TZ222	XFMR, FXD, RF	A-4480	1	T12
1N750A	SCOND DEV, DIO	A-4480	1	CR1
2N3646	TRANSISTOR	A-4480	17	Q1, Q2, Q3, Q4, Q5, Q8, Q9, Q10, Q11, Q12, Q13, Q14, Q15, Q16, Q17, Q18, Q19



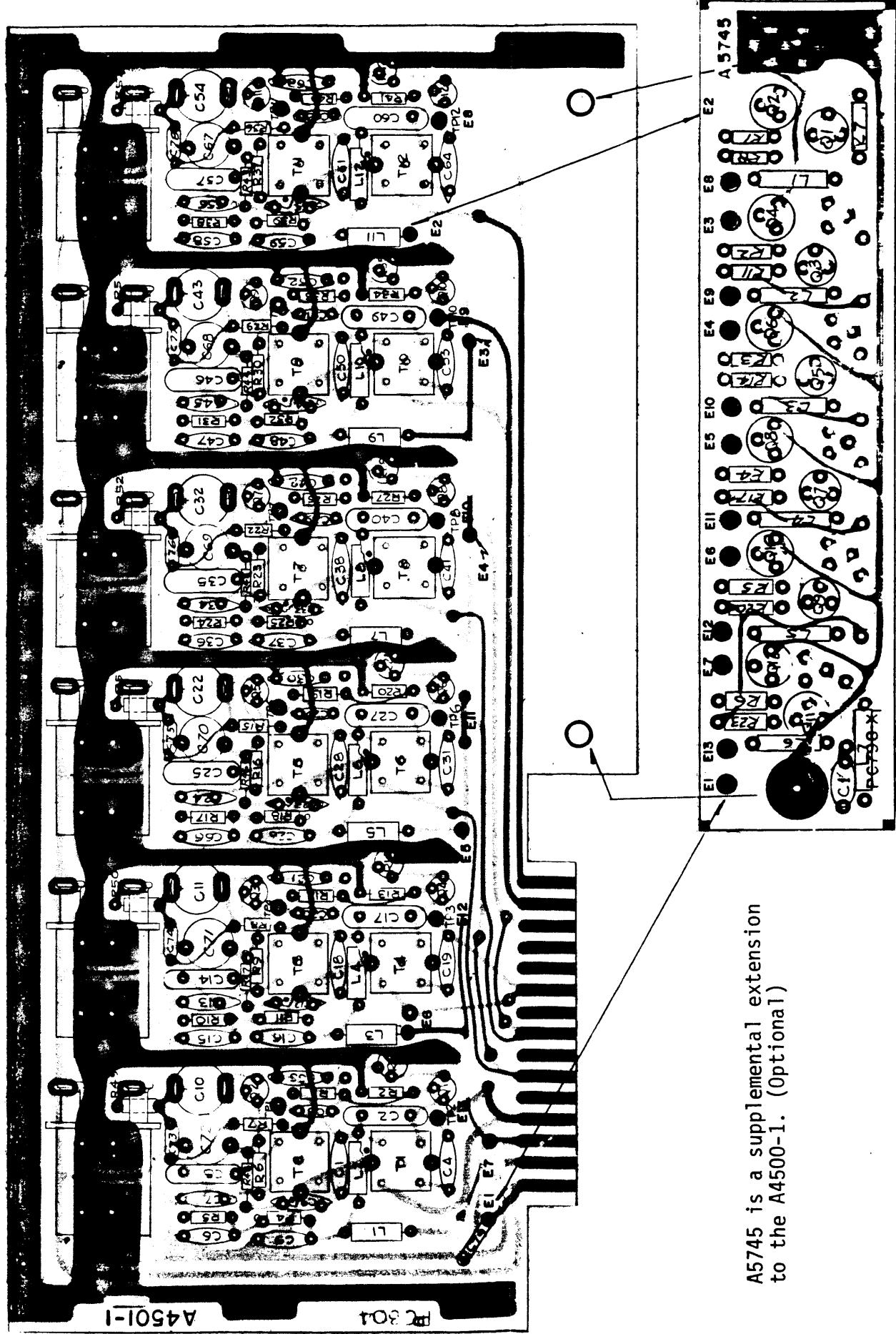
Z102 Comb. Filter A (A4500)

PART NUMBER	DESCRIPTION	USED ON ASSEMBLY	QTY PER UNIT	REFERENCE SYMBOLS
CC100-16	CAP., FXD, CER	A-4500-1	12	C19, C30, C31, C41, C42, C52, C53, C63, C21, C64, C4, C65
CC100-28	CAP., FXD, CER	A-4500-1	1	C79
CC100-29	CAP., FXD, CER	A-4500-1	6	C20, C29, C39, C3, C51, C62
CC100-35	CAP., FXD, CER	A-4500-1	30	C1, C5, C6, C7, C9, C12, C13, C55, C15, C16, C18, C23, C24, C26, C28, C33, C34, C36, C37, C38, C44, C45, C47, C48, C50, C56, C58, C59, C61, C66
CL275-121	COIL, RF, FXD	A-4500-1	13	L1, L2, L3, L4, L5, L6, L7, L8, L9, L10, L11, L12, L13
CM111C100J5S	CAP., FXD, MICA	A-4500-1	6	C73, C74, C75, C76, C77, C78
CM112F182G5S	CAP., FXD, MICA	A-4500-1	4	C2, C8, C14, C17
CM112F242G5S	CAP., FXD, MICA	A-4500-1	2	C25, C27
CM112F272F5S	CAP., FXD, MICA	A-4500-1	4	C35, C40, C46, C49
CM112F392G3S	CAP., FXD, MICA	A-4500-1	2	C57, C60
CR109-90	CU, QTZ .8 MHZ	A-4500-1	1	Y6
CR109-92	CU, QTZ 1.0 MHZ	A-4500-1	1	Y5
CR109-94	CU, QTZ 1.2 MHZ	A-4500-1	1	Y4
CR109-96	CU, QTZ 1.4 MHZ	A-4500-1	1	Y3
CR109-98	CU, QTZ 1.6 MHZ	A-4500-1	1	Y2
CR109-100	CU, QTZ 1.8 MHZ	A-4500-1	1	Y1
CV112-1	CAP., VAR, CER	A-4500-1	6	C10, C11, C22, C32, C43, C54
CV112-8	CAP., VAR, CER	A-4500-1	6	C68, C69, C70, C71, C72, C67
RC07GF101J	RES, FXD, COMP	A-4500-1	6	R43, R44, R45, R46, R47, R48
RC07GF102J	RES, FXD, COMP	A-4500-1	6	R4, R11, R18, R25, R32, R39
RC07GF153J	RES, FXD, COMP	A-4500-1	6	R1, R12, R19, R26, R33, R40
RC07GF332J	RES, FXD, COMP	A-4500-1	6	R2, R13, R20, R27, R34, R41
RC07GF474J	RES, FXD, COMP	A-4500-1	6	R6, R9, R16, R23, R30, R37
RC07GF561J	RES, FXD, COMP	A-4500-1	12	R7, R8, R15, R22, R29, R36, R49, R50, R51, R52, R53, R54
RC07GF822J	RES, FXD, COMP	A-4500-1	6	R5, R10, R17, R24, R31, R38
RV124-1-501	RES, VAR, COMP	A-4500-1	6	R3, R14, R21, R28, R35, R42
TE0127-2	TERM., LUG	PC304	12	TP1, TP2, TP3, TP4, TP5, TP6, TP7, TP8, TP9, TP10, TP11, TP12

PART NUMBER	DESCRIPTION	USED ON ASSEMBLY	QTY PER UNIT	REFERENCE SYMBOLS
TS167-1	SOC, XTAL	PC304	6	XY1, XY2, XY3, XY4, XY5, XY6
TT286-2	XFMR, RF, ADJ	A-4500-1	4	T9, T10, T11, T12
TT286-4	XFMR, RF, ADJ	A-4500-1	2	T7, T8
TT286-6	XFMR, RF, ADJ	A-4500-1	4	T3, T4, T5, T6
TT286-8	XFMR, RF, ADJ	A-4500-1	2	T1, T2
2N3646	TRANSISTOR	A-4500-1	12	Q1, Q2, Q3, Q4, Q5, Q6, Q7, Q8, Q9, Q10, Q11, Q12
CC131-39	CAP, FXD, CER	A5745	1	C1
CL275-102	COIL, RF	A5745	7	L1, L2, L3, L4, L5, L6, L7
RC07GF102J	RES, FXD, COMP	A5745	11	R1, R2, R3, R4, R5, R6, R9, R12, R15, R18, R21
RC07GF103J	RES, FXD, COMP	A5745	7	R7, R8, R11, R14, R17, R20, R23
RV124-1-502	RES, FXD, COMP	A5745	5	R10, R13, R16, R19, R22



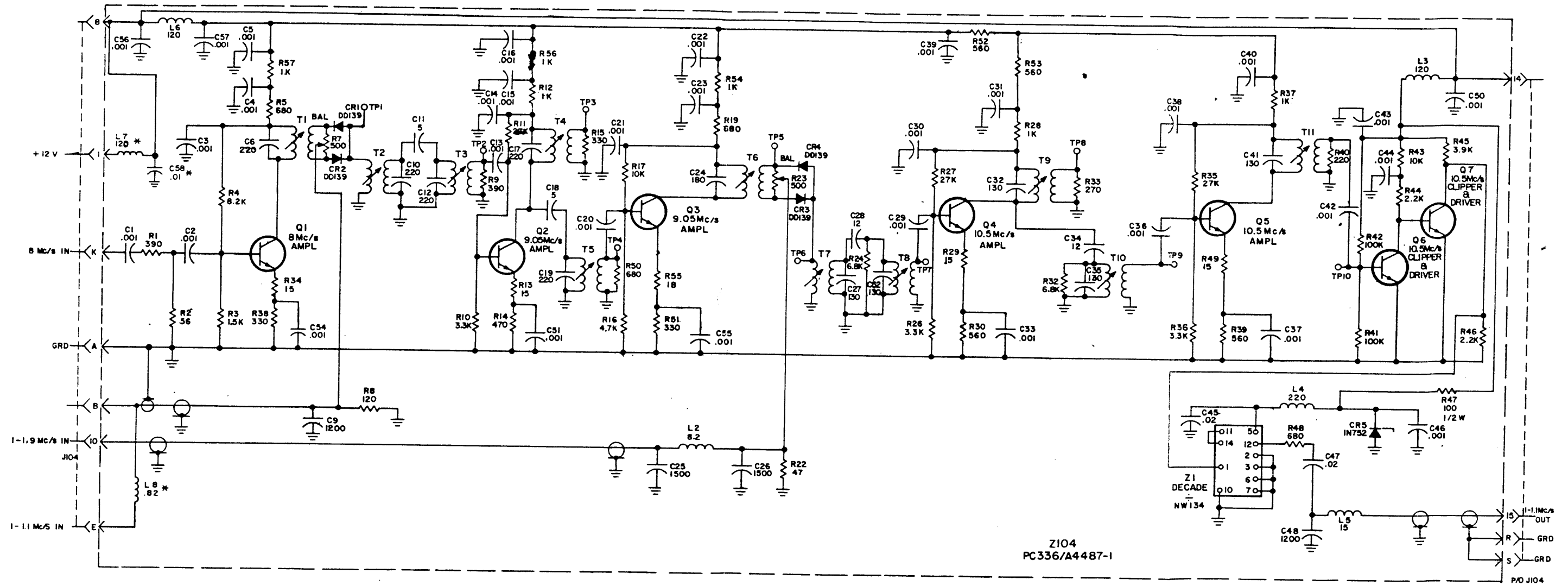
Z103 Comb. Filter B (A4501)



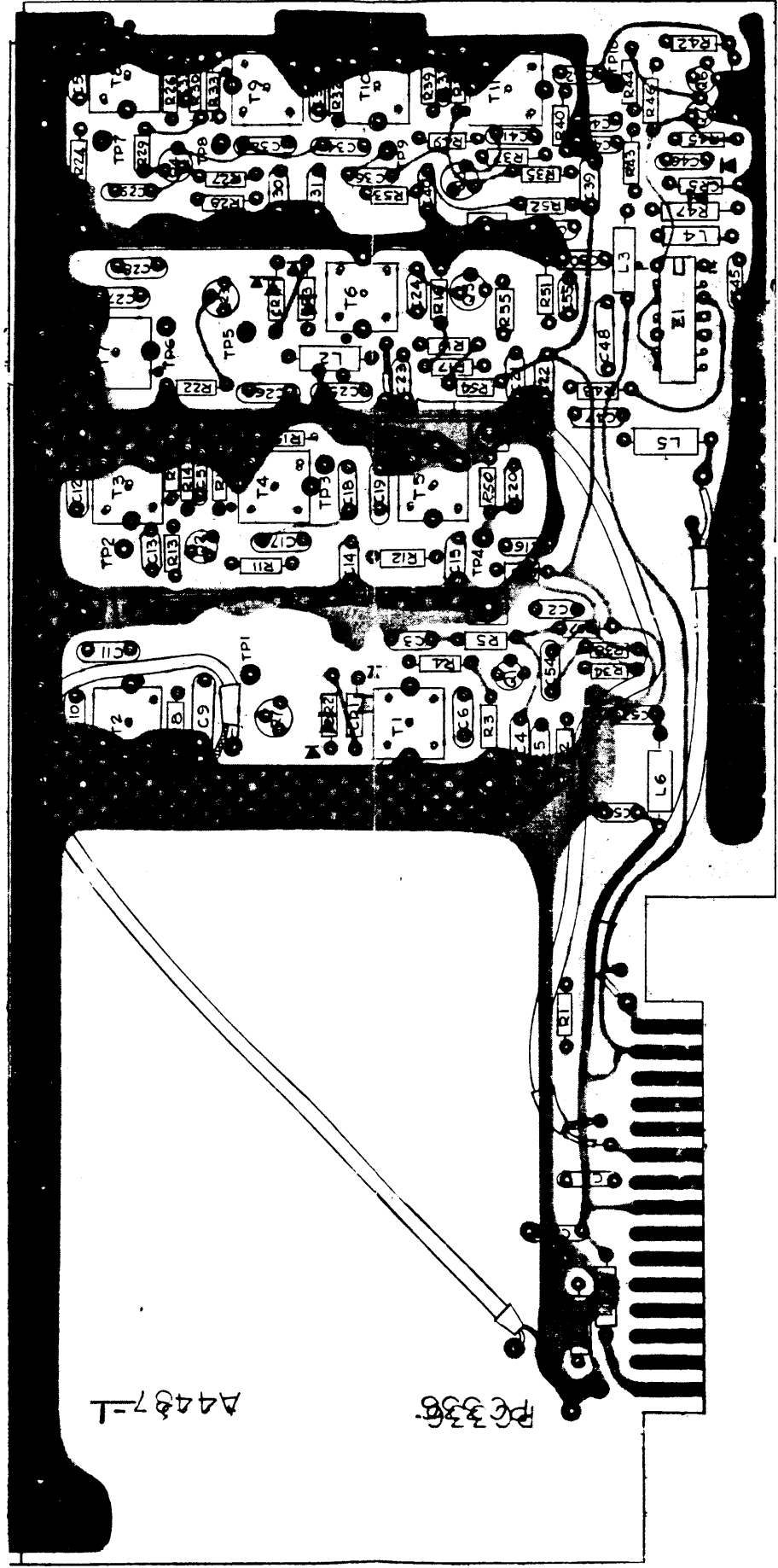
A5745 is a supplemental extension to the A4500-1. (Optional)

PART NUMBER	DESCRIPTION	USED ON ASSEMBLY	QTY PER UNIT	REFERENCE SYMBOLS
CC100-16	CAP., FXD, CER	A-4501-1	12	C4, C19, C30, C31, C41, C42, C52, C53, C63, C64, C65, C21
CC100-28	CAP., FXD, CER	A-4501-1	1	C79
CC100-29	CAP., FXD, CER	A-4501-1	6	C3, C20, C29, C39, C51, C62
CC100-35	CAP., FXD, CER	A-4501-1	30	C1, C9, C7, C5, C6, C12, C13, C15, C16, C18, C23, C24, C26, C28, C33, C34, C36, C37, C38, C44, C45, C47, C48, C50, C55, C56, C58, C59, C61, C66
CL275-121	COIL, RF, FXD	A-4501-1	13	L1, L2, L3, L4, L5, L6, L7, L8, L9, L10, L11, L12, L13
CM111C100J5S	CAP., FXD, MICA	A-4501-1	6	C73, C74, C75, C76, C77, C78
CM112F162G5S	CAP., FXD, MICA	A-4501-1	2	C2, C8
CM112F202G5S	CAP., FXD, MICA	A-4501-1	2	C14, C17
CM112F222F5S	CAP., FXD, MICA	A-4501-1	4	C25, C27, C35, C40
CM112F332F5S	CAP., FXD, MICA	A-4501-1	4	C46, C49, C57, C60
CR109-91	CU, QTZ .9MHZ	A-4501-1	1	Y6
CR109-93	CU, QTZ 1.1 MHZ	A-4501-1	1	Y5
CR109-95	CU, QTZ 1.3 MHZ	A-4501-1	1	Y4
CR109-97	CU, QTZ 1.5 MHZ	A-4501-1	1	Y3
CR109-99	CU, QTZ 1.7 MHZ	A-4501-1	1	Y2
CR109-101	CU, QTZ 1.9 MHZ	A-4501-1	1	Y1
CV112-1	CAP., VAR, CER	A-4501-1	6	C10, C11, C22, C32, C43, C54
CV112-8	CAP., VAR, CER	A-4501-1	6	C67, C68, C69, C70, C71, C72
RC07GF101J	RES, FXD, COMP	A-4501-1	6	R43, R44, R45, R46, R47, R48
RC07GF102J	RES, FXD, COMP	A-4501-1	6	R4, R11, R18, R25, R32, R39
RC07GF153J	RES, FXD, COMP	A-4501-1	6	R1, R12, R19, R26, R33, R40
RC07GF332J	RES, FXD, COMP	A-4501-1	6	R2, R13, R20, R27, R34, R41
RC07GF474J	RES, FXD, COMP.	A-4501-1	6	R6, R9, R16, R23, R30, R37
RC07GF561J	RES, FXD, COMP.	A-4501-1	12	R7, R8, R15, R22, R29, R36, R49, R50, R51, R52, R53, R54
RC07GF822J	RES, FXD, COMP	A-4501-1	6	R5, R10, R17, R24, R31, R38
RV124-1-501	RES, VAR, COMP	A-4501-1	6	R3, R14, R21, R28, R35, R42
TE0127-2	TERM., LUG	PC304	12	TP1, TP2, TP3, TP4, TP5, TP6, TP7, TP8, TP9, TP10, TP11, TP12

PART NUMBER	DESCRIPTION	USED ON ASSEMBLY	QTY PER UNIT	REFERENCE SYMBOLS
TS167-1	SOC, XTAL	PC304	6	XY1, XY2, XY3, XY4, XY5, XY6
TT286-2	XFMR, RF, ADJ	A-4501-1	2	T11, T12
TT286-4	XFMR, RF, ADJ	A-4501-1	4	T7, T9, T8, T10
TT286-6	XFMR, RF, ADJ	A-4501-1	2	T5, T6
TT286-8	XFMR, RF, ADJ	A-4501-1	4	T2, T3, T1, T4
2N3646	TRANSISTOR	A-4501-1	12	Q1, Q2, Q3, Q4, Q5, Q6, Q7, Q8, Q9, Q10, Q11, Q12
CC131-39	CAP, FXD, CER	A5745	1	C1
CL275-102	COIL, RF	A5745	7	L1, L2, L3, L4, L5, L6, L7
RC07GF102J	RES, FXD, COMP	A5745	11	R1, R2, R3, R4, R5, R6, R9, R12, R15, R18, R21
RC07GF103J	RES, FXD, COMP	A5745	7	R7, R8, R11, R14, R17, R20, R23
RV124-1-502	RES, FXD, COMP	A5745	5	R10, R13, R16, R19, R22



Z104 Single Mixer (A4487)
Divider

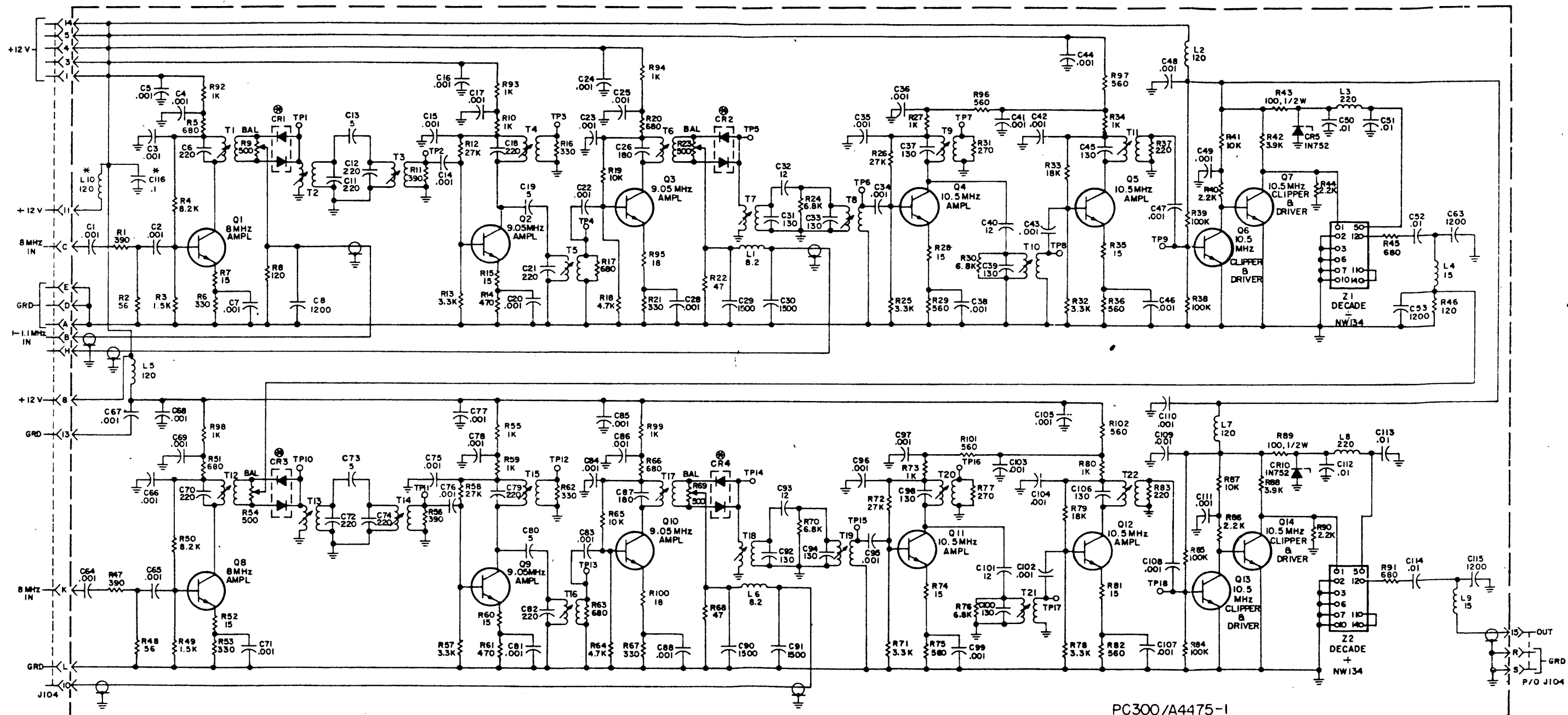


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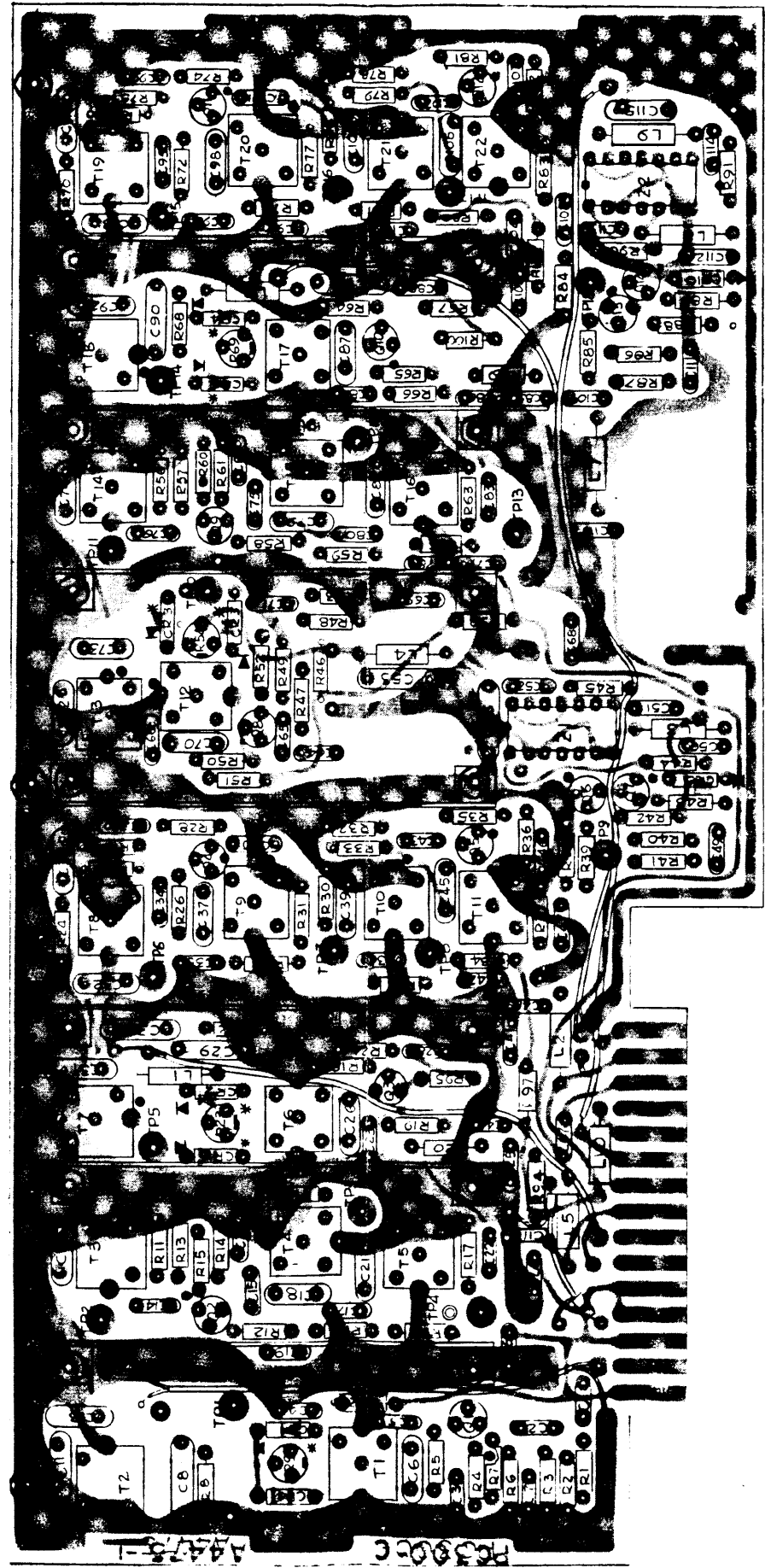
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PART NUMBER	DESCRIPTION	USED ON ASSEMBLY	QTY PER UNIT	REFERENCE SYMBOLS
CC100-29	CAP., FXD, CER	A-4487-1	32	C1, C2, C3, C4, C5, C13 C14, C15, C16, C20, C21 C22, C23, C29, C30, C31 C33, C36, C37, C38, C39, C40, C42, C43, C44, C46 C50, C51, C54, C55, C56, C57
CC100-40	CAP., FXD, CER	A-4487-1	2	C45, C47
CC100-43	CAP., FXD, CER	A-4487-1	1	C58
CL275-121	COIL, RF, FXD	A-4487-1	2	L3, L6
CL275-150	COIL, RF, FXD	A-4487-1	1	L5
CL275-221	COIL, RF, FXD	A-4487-1	1	L4
CL275-8R2	COIL, RF, FXD	A-4487-1	1	L2
CL275-OR82	COIL, RF, FXD	A-4487-1	1	L8
CM111C050D5S	CAP., FXD, MICA	A-4487-1	2	C11, C18
CM111C120J5S	CAP., FXD, MICA	A-4487-1	2	C28, C34
CM111F131J5S	CAP., FXD, MICA	A-4487-1	5	C27, C32, C35, C41, C52
CM111F181G5S	CAP., FXD, MICA	A-4487-1	1	C24
CM111F221J5S	CAP., FXD, MICA	A-4487-1	5	C6, C10, C12, C17, C19
CM112F122F5S	CAP., FXD, MICA	A-4487-1	2	C9, C48
CM112F152F5S	CAP., FXD, MICA	A-4487-1	2	C25, C26
DD139	SCOND DEV, DIO	A-4487-1	2	
NW134	NW FREQ DIV	A-4487-1	1	Z1
RC07GF102J	RES, FXD, COMP.	A-4487-1	6	R12, R28 R37, R54, R56 R57
RC07GF103J	RES, FXD, COMP.	A-4487-1	2	R17, R43
RC07GF104J	RES, FXD, COMP.	A-4487-1	2	R41, R42
RC07GF121J	RES, FXD, COMP.	A-4487-1	1	R8
RC07GF150J	RES, FXD, COMP.	A-4487-1	4	R13, R29, R34, R49
RC07GF152J	RES, FXD, COMP.	A-4487-1	1	R3
RC07GF180J	RES, FXD, COMP.	A-4487-1	1	R55
RC07GF221J	RES, FXD, COMP.	A-4487-1	1	R40
RC07GF222J	RES, FXD, COMP.	A-4487-1	2	R44, R46
RC07GF271J	RES, FXD, COMP.	A-4487-1	1	R33
RC07GF273J	RES, FXD, COMP.	A-4487-1	3	R11, R27, R35
RC07GF331J	RES, FXD, COMP.	A-4487-1	3	R15, R38, R51
RC07GF332J	RES, FXD, COMP.	A-4487-1	3	R10, R26 R36
RC07GF391J	RES, FXD, COMP.	A-4487-1	2	R1, R9
RC07GF392J	RES, FXD, COMP.	A-4487-1	1	R45
RC07GF470J	RES, FXD, COMP.	A-4487-1	1	R22
RC07GF471J	RES, FXD, COMP.	A-4487-1	1	R14
RC07GF472J	RES, FXD, COMP.	A-4487-1	1	R16
RC07GF560J	RES, FXD, COMP.	A-4487-1	1	R2
RC07GF561J	RES, FXD, COMP.	A-4487-1	4	R30, R52, R53, R39
RC07GF681J	RES, FXD, COMP.	A-4487-1	4	R5, R48, R19, R50
RC07GF682J	RES, FXD, COMP.	A-4487-1	2	R24, R32
RC07GF822J	RES, FXD, COMP.	A-4487-1	1	R4
RC20GF101J	RES, FXD, COMP.	A-4487-1	1	R47
RV124-1-501	RES, VAR, COMP.	A-4487-1	2	R7, R23
TE0127-2	TERM., STUD	A-4487-1	10	TP1, TP2, TP3, TP4, TP5, TP6, TP7, TP8, TP9, TP10

PART NUMBER	DESCRIPTION	USED ON ASSEMBLY	QTY PER UNIT	REFERENCE SYMBOLS
TT285-17	XFMR RF, ADJ	A-4487 -1	1	T6
TT285-2	XFMR, RF, ADJ	A-4487 -1	4	T2, T3, T4, T5
TT285-3	XFMR, RF, ADJ	A-4487 -1	2	T7, T9
TT285-4	XFMR, RF, ADJ	A-4487 -1	4	T1, T8, T10, T11
1N752	SCOND DEV, DIO	A-4487 -1	1	CR5
2N3646	TRANSISTOR	A-4487 -1	7	QL, Q2, Q3, Q4, Q5, Q6, Q7



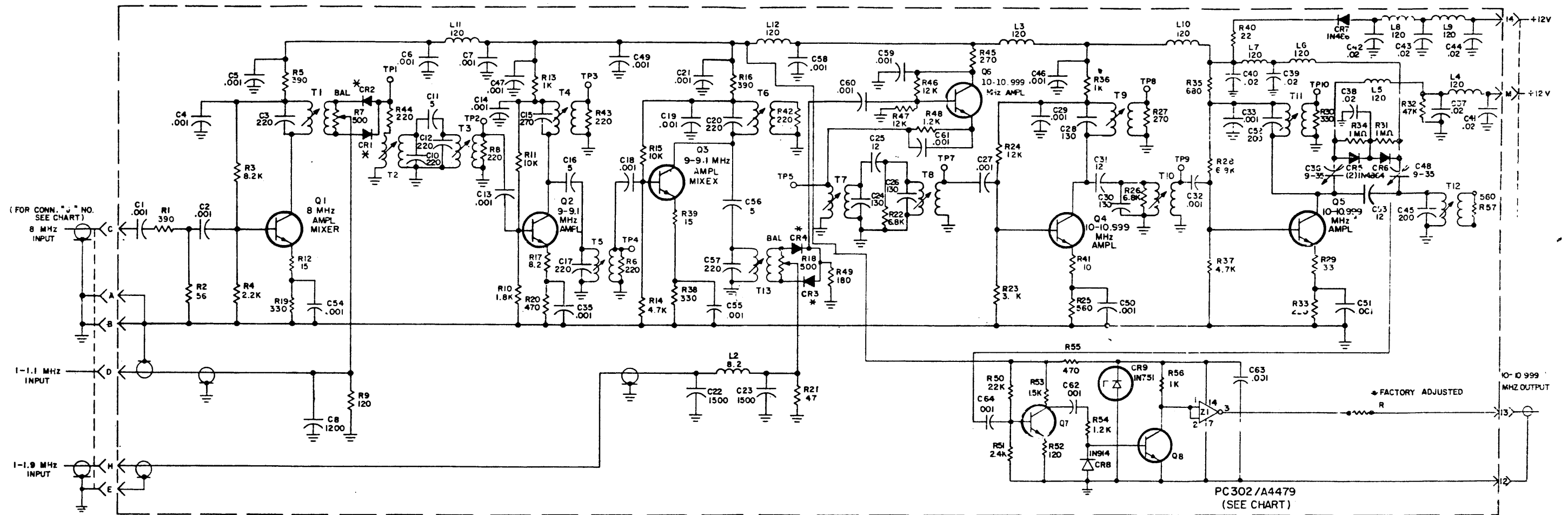
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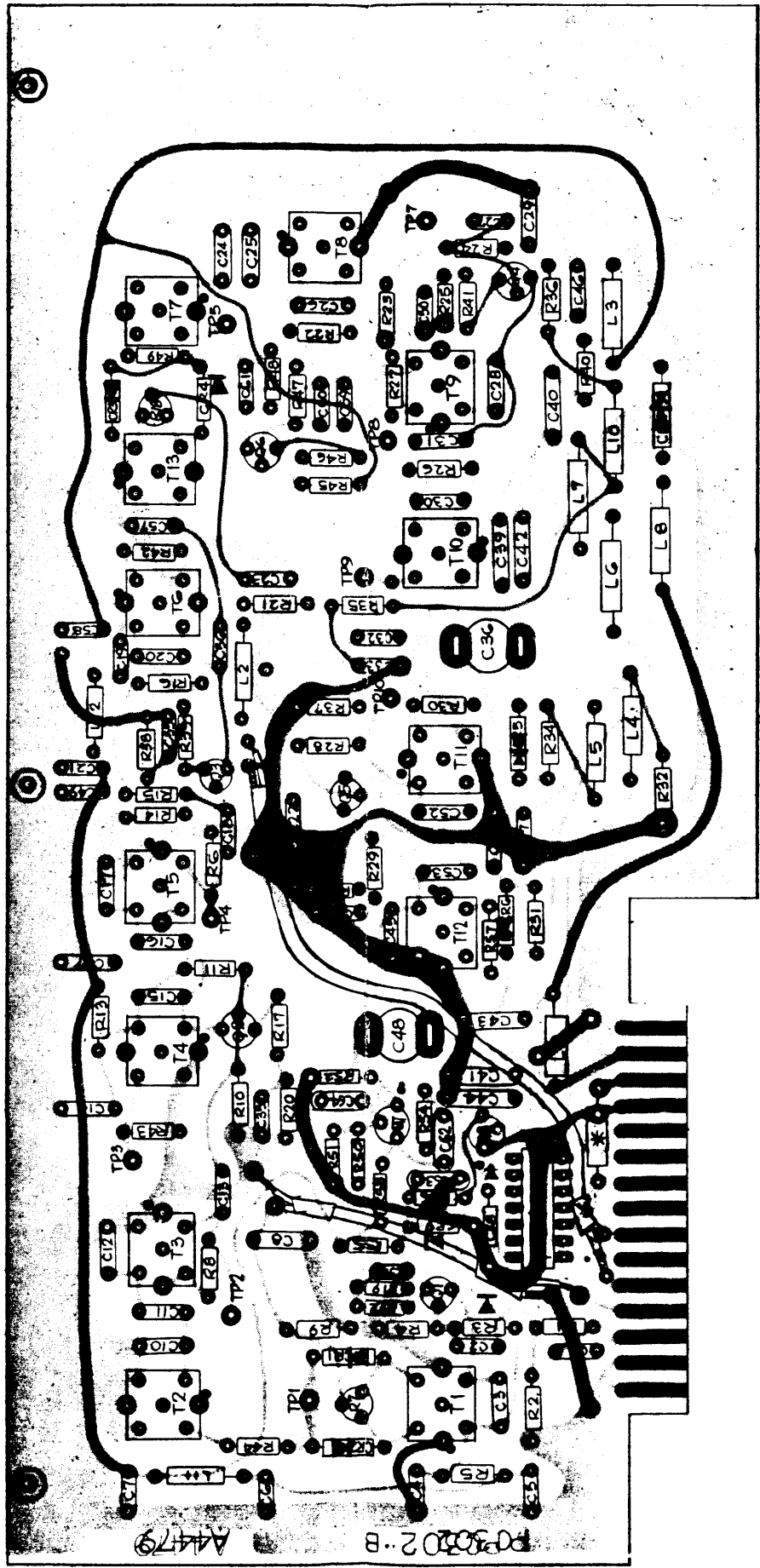


PART NUMBER	DESCRIPTION	USED ON ASSEMBLY	QTY PER UNIT	REFERENCE SYMBOLS
CC100-28 CC100-29	CAP., FXD, CER CAP., FXD, CER	A-4475 -1 A-4475 -1	1 58	C2316 C2201, C2202, C2203, C2204, C2205, C2207, C2214 C2215, C2216, C2217, C2220, C2222, C2223, C2224, C2225, C2228, C2234, C2235, C2236, C2238, C2241, C2242, C2243, C2244, C2246, C2247, C2248, C2249, C2264, C2265, C2266, C2267, C2268, C2269, C2271, C2275, C2276, C2277, C2278, C2281, C2283, C2284, C2285, C2286, C2288, C2295, C2296, C2297, C2299, C2302, C2303, C2304, C2305, C2307, C2308, C2309, C2310, C2311, C2250, C2251, C2252, C2312, C2313, C2314
CC100-41	CAP., FXD, CER	A-4475 -1	6	C2250, C2251, C2252, C2312, C2313, C2314
CL275-121	COIL, RF, FXD	A-4475 -1	4	L2202, L2205, L2207, L2210
CL275-150	COIL, RF, FXD	A-4475 -1	2	L2204, L2209
CL275-221	COIL, RF, FXD	A-4475 -1	2	L2203, L2208
CL275-8R2	COIL, RF, FXD	A-4475 -1	2	L2201, L2206
CM111C050D5S	CAP., FXD, MICA	A-4475 -1	4	C2213, C2219, C2273, C2280
CM111C120J5S	CAP., FXD, MICA	A-4475 -1	4	C2232, C2240, C2293, C2301
CM111F131G5S	CAP., FXD, MICA	A-4475 -1	10	C2231, C2233, C2237, C2239, C2245, C2292, C2294, C2298, C2300, C2306
CM111F181G5S	CAP., FXD, MICA	A-4475 -1	2	C2226, C2287
CM111F221G5S	CAP., FXD, MICA	A-4475 -1	10	C2206, C2211, C2212, C2218, C2221, C2270, C2272, C2274, C2279, C2282
CM112F122J5S	CAP., FXD, MICA	A-4475 -1	4	C2208, C2253, C2263, C2315
CM112F152D5S	CAP., FXD, MICA	A-4475 -1	4	C2229, C2230, C2290, C2291
DD139	SCOND DEV, DIO	A-4475 -1	4	CR2201, CR2202, CR2203, CR2204
NW134	DECAD COUNT	A-4475 -1	2	Z2201, Z2202
RC07GF102J	RES, FXD, COMP	A-4475 -1	12	R2210, R2227, R2234, R2255, R2259, R2273, R2280, R2292, R2293, R2294, R2298, R2299

PART NUMBER	DESCRIPTION	USED ON ASSEMBLY	QTY PER UNIT	REFERENCE SYMBOLS
RC07GF103J	RES, FXD, COMP	A-4475-1	4	R2219, R2241, R2265, R2287
RC07GF104J	RES, FXD, COMP	A-4475-1	4	R2238, R2239, R2284, R2285
RC07GF121J	RES, FXD, COMP.	A-4475-1	2	R2208, R2246
RC07GF150J	RES, FXD, COMP.	A-4475-1	8	R2207, R2215, R2228, R2235, R2252, R2260, R2274, R2281
RC07GF152J	RES, FXD, COMP	A-4475-1	2	R2203, R2249
RC07GF180J	RES, FXD, COMP	A-4475-1	2	R2295, R2300
RC07GF183J	RES, FXD, COMP.	A-4475-1	2	R2279, R2233
RC07GF221J	RES, FXD, COMP	A-4475-1	2	R2237, R2283
RC07GF222J	RES, FXD, COMP.	A-4475-1	4	R2240, R2244, R2286, R2290
RC07GF271J	RES, FXD, COMP.	A-4475-1	2	R2231, R2277
RC07GF273J	RES, FXD, COMP	A-4475-1	4	R2212, R2226, R2258, R2272
RC07GF331J	RES, FXD, COMP.	A-4475-1	6	R2206, R2216, R2221, R2253, R2262, R2267
RC07GF332J	RES, FXD, COMP.	A-4475-1	6	R2213, R2225, R2232, R2257, R2271, R2278
RC07GF391J	RES, FXD, COMP	A-4475-1	4	R2201, R2211, R2247, R2256
RC07GF392J	RES, FXD, COMP.	A-4475 -1	2	R2242, R2288
RC07GF470J	RES, FXD, COMP	A-4475 -1	2	R2222, R2268
RC07GF471J	RES, FXD, COMP	A-4475 -1	2	R2214, R2261
RC07GF472J	RES, FXD, COMP	A-4475 -1	2	R2218, R2264
RC07GF560J	RES, FXD, COMP	A-4475 -1	2	R2202, R2248
RC07GF561J	RES, FXD, COMP	A-4475 -1	8	R2275, R2282, R2296, R2297, R2301, R2302
RC07GF681J	RES, FXD, COMP	A-4475 -1	8	R2205, R2217, R2220, R2245, R2251, R2263, R2266, R2291
RC07GF682J	RES, FXD, COMP	A-4475 -1	4	R2224, R2230, R2270, R2276
RC07GF822J	RES, FXD, COMP	A-4475 -1	2	R2204, R2250
RC20GF101J	RES, FXD, COMP.	A-4475 -1	2	R2243, R2289
RV124-1-501	RES, VAR, COMP.	A-4475 -1	4	R2209, R2223, R2254, R2269
TE0127-2	TERM., STUD	PC300	18	TP2201, TP2202, TP2203, TP2204, TP2205, TP2206, TP2207, TP2208, TP2209, TP2210, TP2211, TP2212, TP2214, TP2215, TP2216, TP2217, TP2218
TT285-17	XFMR, RF, ADJ	A-4475-1	2	T2206, T2217
TT285-2	XFMR, RF, ADJ	A-4475-1	8	T2202, T2203, T2204, T2205, T2213, T2214, T2215, T2216
TT285-3	XFMR, RF, ADJ	A-4475-1	4	T2207, T2209, T2218, T2220

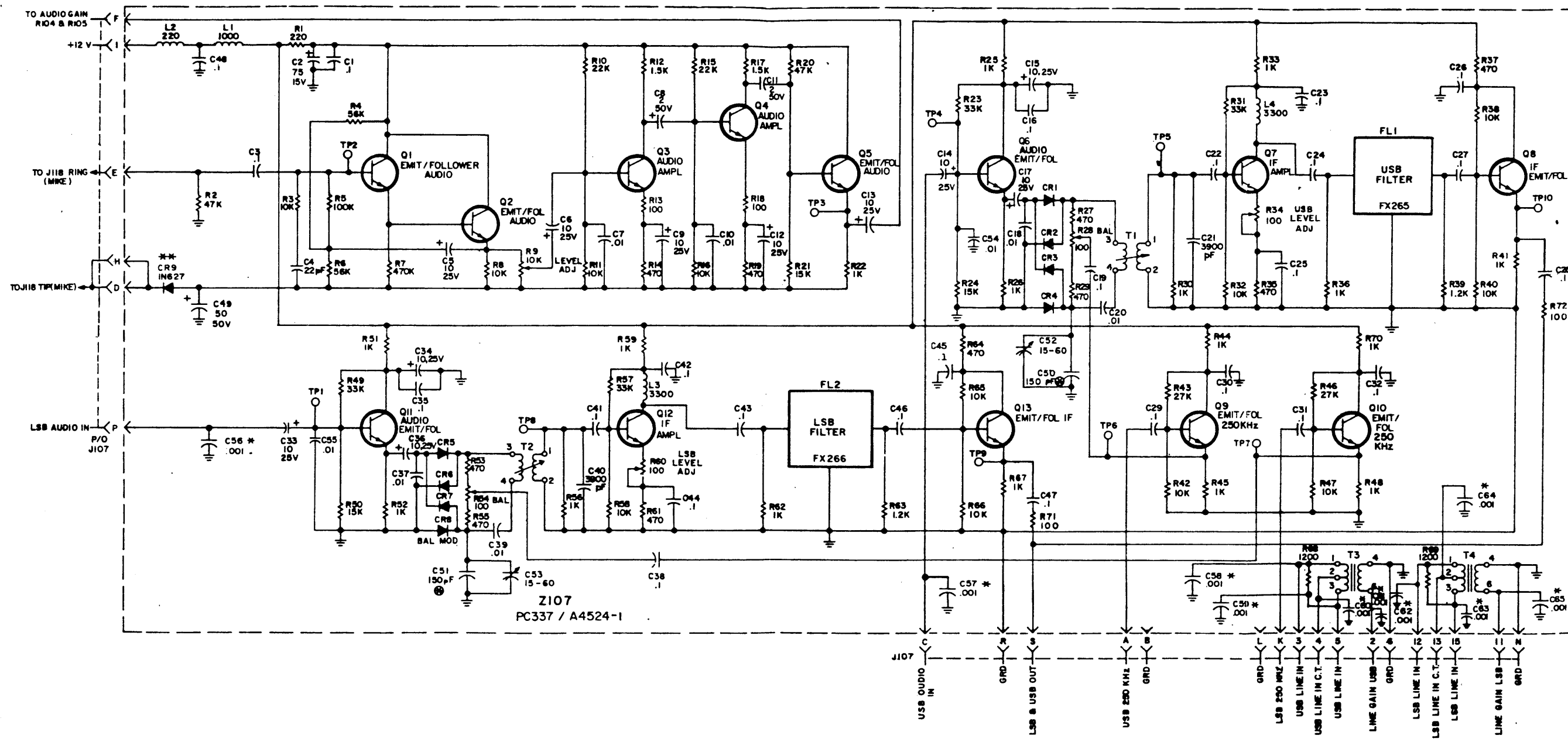
PART NUMBER	DESCRIPTION	USED ON ASSEMBLY	QTY PER UNIT	REFERENCE SYMBOLS
TT285-4	XFMR, RF, ADJ	A4475-1	8	T2201,T2208,T2210, T2211,T2212,T2219, T2221,T2222
1N752	SCOND DEV, DIO	A4475-1	2	CR2205,CR2210
2N3646	TRANSISTOR	A4475-1	14	Q2201,Q2202,Q2203,Q2204 Q2205,Q2206,Q2207,Q2208 Q2209,Q2210,Q2211,Q2212 Q2213,Q2214



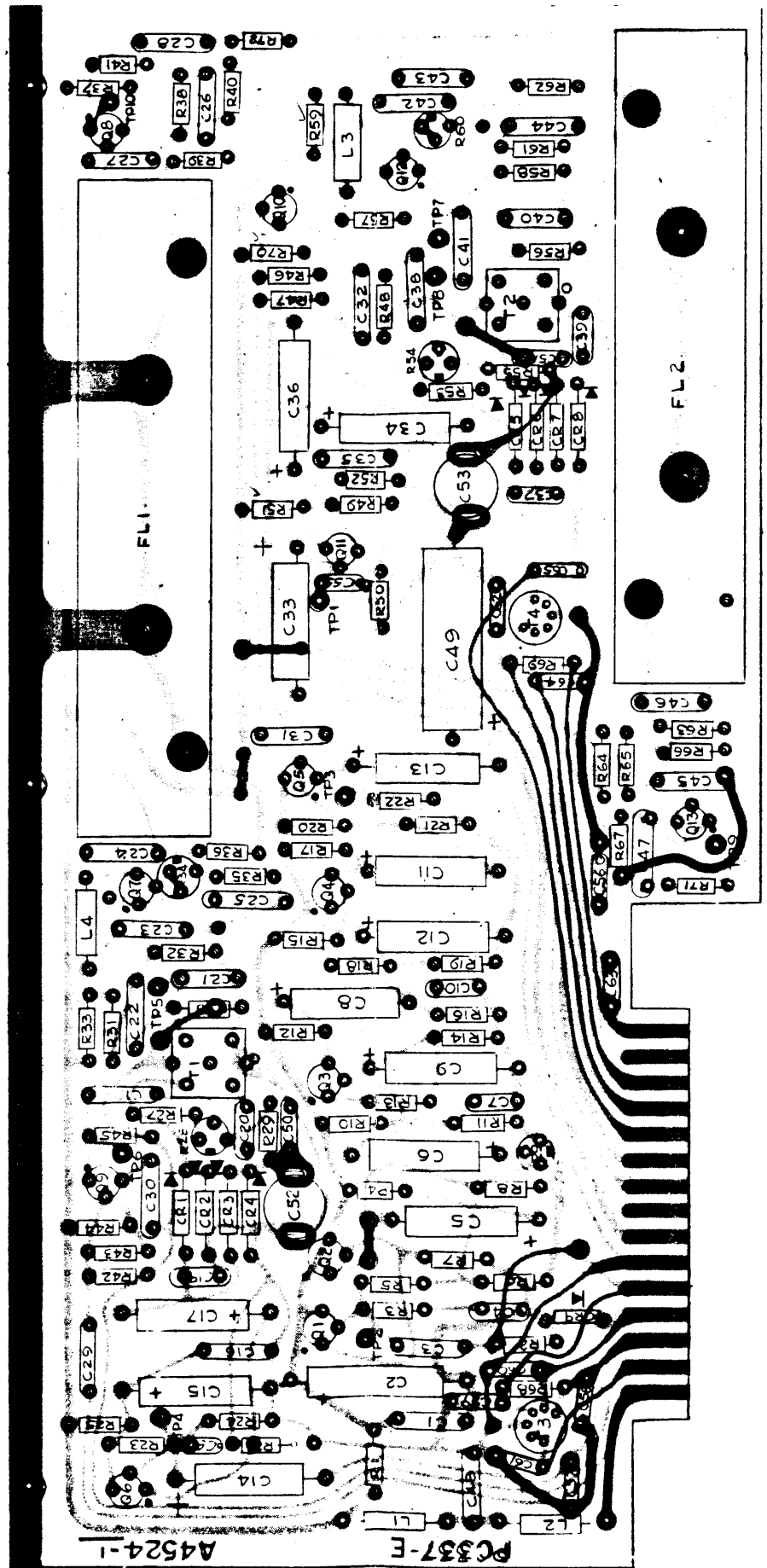


PART NUMBER	DESCRIPTION	USED ON ASSEMBLY	QTY PER UNIT	REFERENCE SYMBOLS
CC100-29	CAP., FXD, CER	A-4479	30	C1, C2, C4, C5, C6, C7, C13, C14, C18, C19, C21, C27, C29, C32, C33, C35, C46, C47, C49, C50, C51, C54, C55, C58, C59, C60, C61, C62, C63, C64
CC100-35	CAP., FXD, CER	A-4479	6	C39, C40, C41, C42, C43, C44
CC100-40	CAP., FXD, CER	A-4479	2	C37, C38
CL275-121	COIL, RF, FXD	A-4479	10	L3, L4, L5, L6, L7, L8, L9, L10, L11, L12
CL275-8R2	COIL, RF, FXD	A-4479	1	L2
CM111C050D5S	CAP., FXD, MICA	A-4479	3	C11, C16, C56
CM111C120J5S	CAP., FXD, MICA	A-4479	3	C25, C31, C53
CM111C201J5S	CAP., FXD, MICA	A-4479	2	C45, C52
CM111F131G5S	CAP., FXD, MICA	A-4479	4	C24, C26, C28, C30
CM111F221G5S	CAP., FXD, MICA	A-4479	6	C3, C10, C12, C17, C20, C57
CM111F271F5S	CAP., FXD, MICA	A-4479	1	C15
CM112F122J5S	CAP., FXD, MICA	A-4479	1	C8
CM112F152E5S	CAP., FXD, MICA	A-4479	2	C22, C23
CV112-2	CAP., VAR, CER	A-4479	2	C36, C48
DD139	SCOND DEV, DIO	A-4479	2	CR1/CR2, CR3/CR4
NW176	NTWK, NANDGATE	A-4479	1	Z1
RC07GF100J	RES, FXD, COMP	A-4479	1	R41
RC07GF102J	RES, FXD, COMP	A-4479	3	R13, R36, R56
RC07GF103J	RES, FXD, COMP	A-4479	2	R11, R15
RC07GF105J	RES, FXD, COMP	A-4479	2	R31, R34
RC07GF121J	RES, FXD, COMP	A-4479	2	R9, R52
RC07GF122J	RES, FXD, COMP	A-4479	2	R48, R54
RC07GF123J	RES, FXD, COMP	A-4479	3	R24, R46, R47
RC07GF150J	RES, FXD, COMP	A-4479	2	R12, R39
RC07GF152J	RES, FXD, COMP	A-4479	1	R53
RC07GF181J	RES, FXD, COMP	A-4479	1	R49
RC07GF182J	RES, FXD, COMP	A-4479	1	R10
RC07GF220J	RES, FXD, COMP	A-4479	1	R40
RC07GF221J	RES, FXD, COMP	A-4479	6	R6, R8, R33, R42, R43, R44
RC07GF222J	RES, FXD, COMP	A-4479	1	R4
RC07GF223J	RES, FXD, COMP	A-4479	1	R50
RC07GF242J	RES, FXD, COMP	A-4479	1	R51
RC07GF271J	RES, FXD, COMP	A-4479	2	R27, R45
RC07GF330J	RES, FXD, COMP	A-4479	1	R29
RC07GF331J	RES, FXD, COMP	A-4479	3	R19, R30, R38
RC07GF332J	RES, FXD, COMP	A-4479	1	R23
RC07GF391J	RES, FXD, COMP	A-4479	3	R1, R5, R16
RC07GF470J	RES, FXD, COMP	A-4479	1	R21
RC07GF471J	RES, FXD, COMP	A-4479	2	R20, R55
RC07GF472J	RES, FXD, COMP	A-4479	2	R14, R37
RC07GF473J	RES, FXD, COMP	A-4479	1	R32
RC07GF560J	RES, FXD, COMP	A-4479	1	R2

PART NUMBER	DESCRIPTION	USED ON ASSEMBLY	QTY PER UNIT	REFERENCE SYMBOLS
RC07GF561J	RES, FXD, COMP	A-4479	2	R25, R57
RC07GF681J	RES, FXD, COMP.	A-4479	1	R35
RC07GF682J	RES, FXD, COMP	A-4479	3	R22, R26, R28
RC07GF8R2J	RES, FXD, COMP	A-4479	1	R17
RC07GF822J	RES, FXD, COMP	A-4479	1	R3
RV124-1-501	RES, VAR, COMP	A-4479	2	R7, R18
TE0127-2	TERM., STUD	PC302	9	TP1, TP2, TP3, TP4, TP5, TP7, TP8, TP9, TP10
TT285-18	XFMR, RF, ADJ	A-4479	1	T12
TT285-2	XFMR, RF, ADJ	A-4479	4	T6, T2, T3, T4
TT285-3	XFMR, RF, ADJ	A-4479	2	T7, T9
TT285-4	XFMR, RF, ADJ	A-4479	4	T10, T8, T1, T13
TT285-6	XFMR, RF, ADJ •	A-4479	1	T5
TT285-7	XFMR, RF, ADJ	A-4479	1	T11
1N751	SCOND, DEV, DIO	A-4479	1	CR9
1N4864	SCOND DEV, DIO	A-4479	3	CR5, CR6, CR7
1N914	SCOND, DEV, DIO	A-4479	1	CR8
2N3646	TRANSISTOR	A-4479	8	Q1, Q2, Q3, Q7, Q8, Q4, Q5, Q6

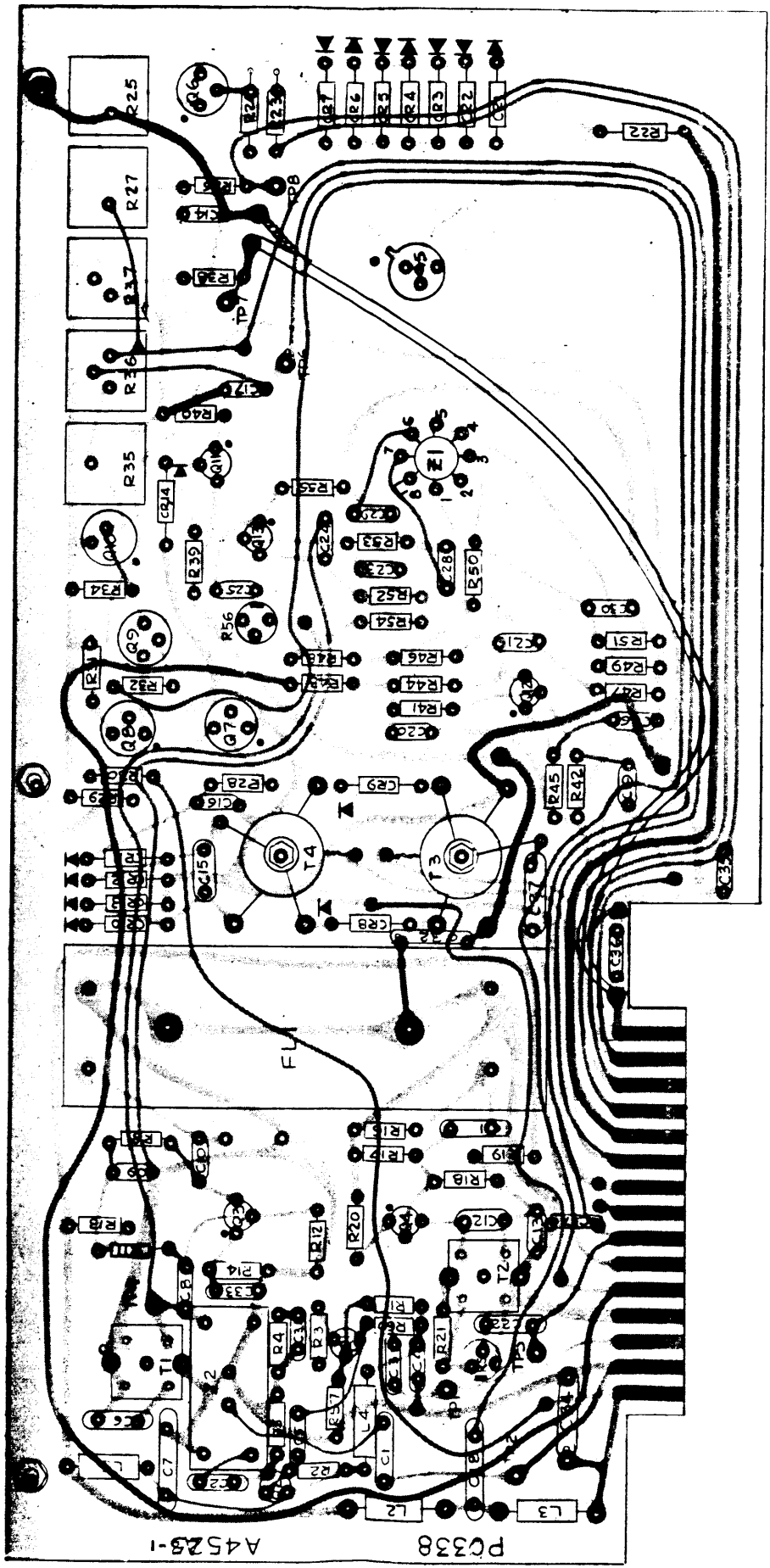


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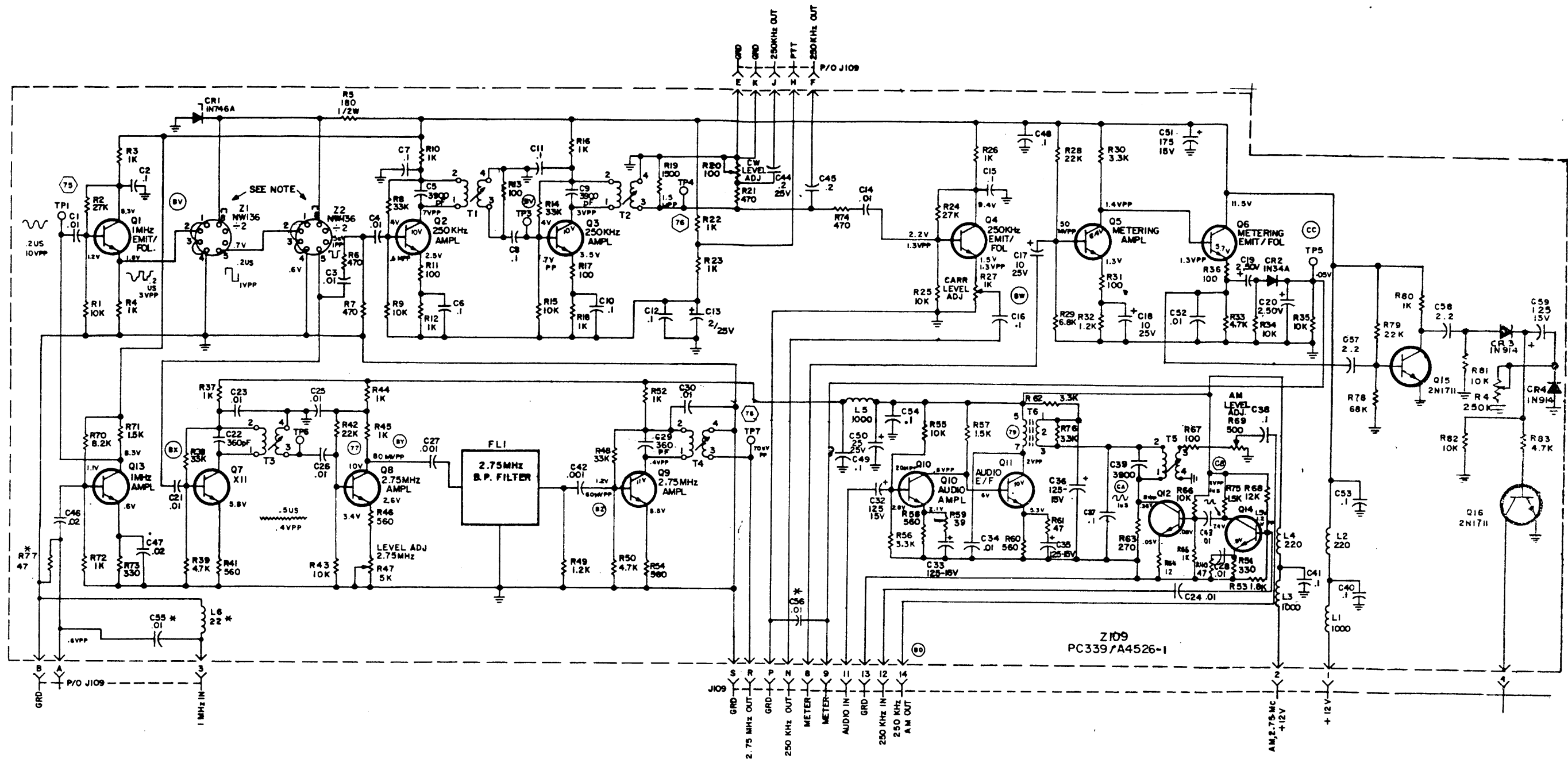
PART NUMBER	DESCRIPTION	USED ON ASSEMBLY	QTY PER UNIT	REFERENCE SYMBOLS
CC100-28	CAP., FXD, CER	A-4524 -1	25	C1, C3, C16, C19 C22, C23, C24, C25 C26, C27, C28, C29 C30, C31, C32, C35, C88, C41, C42, C43 C44, C45, C46, C47 C48
CC100-29	CAP., FXD, CER	A-4524 -1	10	C56, C57, C58, C59 C60, C61, C62, C63 C64, C65
CC100-41	CAP., FXD, CER	A-4524 -1	6	C7, C10, C18, C20 C37, C39
CC100-42	CAP., FXD, CER	A-4524 -1	2	C54, C55
CE105-10-25	CAP., FXD, ELECT.	A-4524 -1	11	C5, C6, C9, C12, C13 C14, C15, C17, C33 C34, C36
CE105-2-50	CAP., FXD, ELECT.	A-4524 -1	2	C8, C11
CE105-50-50	CAP., FXD, ELECT.	A-4224 -1	1	C49
CE105-75-15	CAP., FXD, ELECT.	A-4524 -1	1	C2
CL275-102	COIL, FXD, RF	A-4524 -1	1	L1
CL275-221	COIL, FXD, RF	A-4524 -1	1	L2
CL275-332	COIL, FXD, RF	A-4524 -1	2	L3, L4
CM111C220J5S	CAP., FXD, MICA	A-4524 -1	1	C4
CM111F151F5S	CAP., FXD, MICA	A-4524 -1	2	C50, C51
CM112F392F5S	CAP., FXD, MICA	A-4524 -1	2	C21, C40
CV112-5	CAP., VAR, CER	A-4524 -1	2	C52, C53
RC07GF101J	RES, FXD, COMP.	A-4524 -1	4	R13, R18, R72, R71
RC07GF102J	RES, FXD, COMP.	A-4524 -1	17	R22, R25, R26, R30 R41, R52, R33, R36 R44, R45, R48, R51 R56, R59, R62, R67 R70
RC07GF103J	RES, FXD, COMP.	A-4524 -1	12	R3, R8, R11, R16, R42, R47, R32, R38 R40, R58, R65, R66
RC07GF104J	RES, FXD, COMP.	A-4524 -1	1	R5
RC07GF122J	RES, FXD, COMP.	A-4524 -1	4	R39, R63, R68, R69
RC07GF152J	RES, FXD, COMP.	A-4524 -1	2	R12, R17
RC07GF153J	RES, FXD, COMP.	A-4524 -1	3	R21, R24, R50
RC07GF221J	RES, FXD, COMP.	A-4524 -1	1	R1
RC07GF223J	RES, FXD, COMP.	A-4524 -1	2	R10, R15
RC07GF273J	RES, FXD, COMP.	A-4524 -1	2	R43, R46
RC07GF333J	RES, FXD, COMP.	A-4524 -1	4	R23, R31, R49, R57
RC07GF471J	RES, FXD, COMP.	A-4524 -1	10	R14, R19, R27, R29 R35, R37, R53, R55 R61, R64
RC07GF473J	RES, FXD, COMP.	A-4524 -1	2	R2, R20
RC07GF474J	RES, FXD, COMP.	A-4524 -1	1	R7

PART NUMBER	DESCRIPTION	USED ON ASSEMBLY	QTY PER UNIT	REFERENCE SYMBOLS
RC07GF563J RV124-1-101 RV124-1-103	RES, FXD, COMP RES, FXD, COMP RES, FXD, COMP	A-4524-1 A-4524-1 A-4524-1	2 4 1	R4, R6 R28, R34, R54, R60 R9
TE0127-2	TERM, STUD	A-4524-1	10	TP1, TP2, TP3, TP4, TP5, TP6, TP7, TP8, TP9, TP10
TF0359 TT285-11	XFMR, AF XFMR, ADJ	A-4524-1 A-4524-1	2 2	T4, T3 T1, T2
1N541	SCOND DEV, DIO	A-4524-1	8	CR1, CR2, CR3, CR4, CR5, CR6, CR7, CR8
1N627	SCOND DEV, DIO	A-4524-1	13	Q1, Q2, Q3, Q4, Q5, Q6, Q7, Q8, Q9, Q10, Q11, Q12, Q13
2N3646	TRANSISTOR	A-4524-1	1	CR9

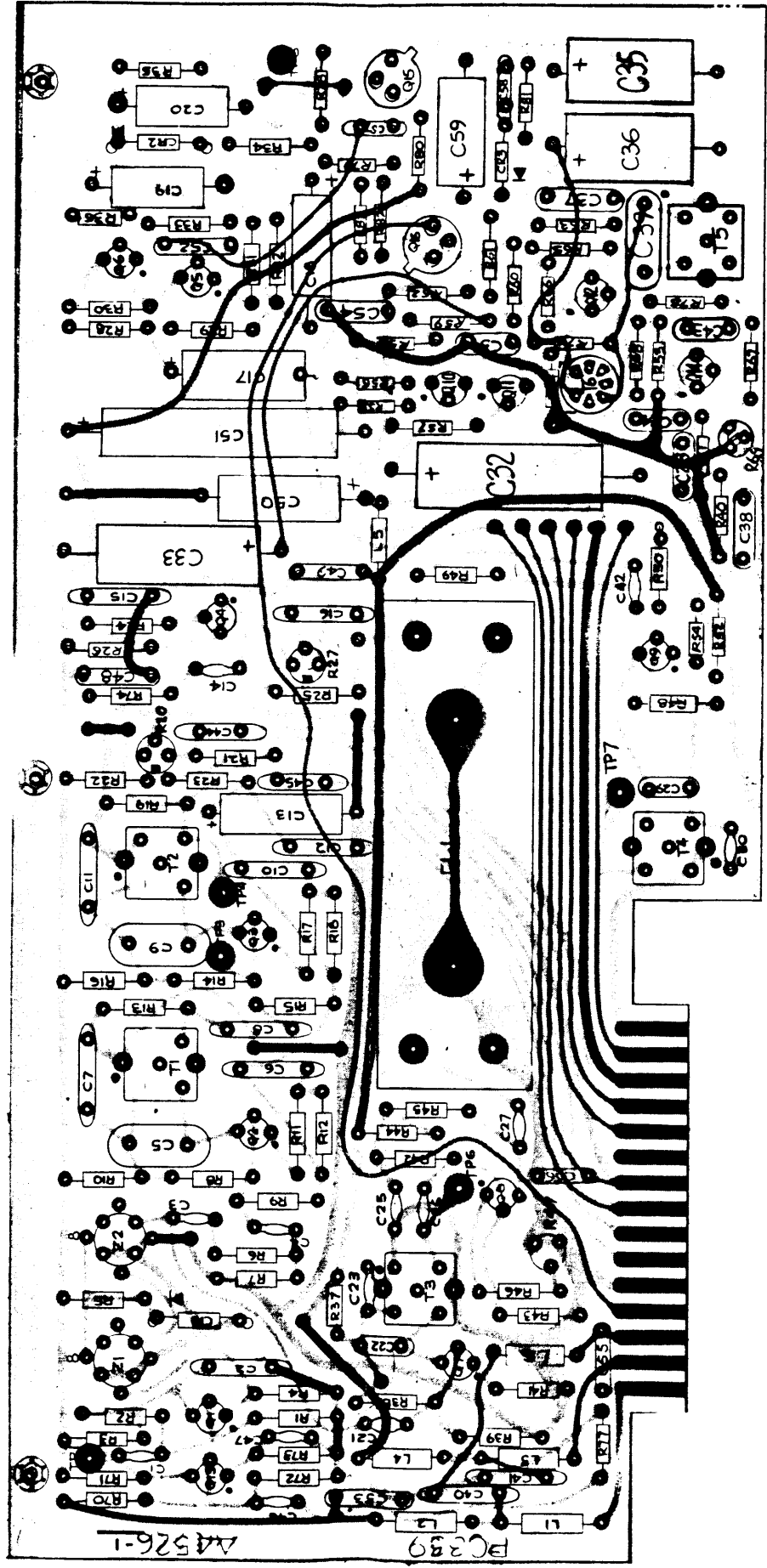


PART NUMBER	DESCRIPTION	USED ON ASSEMBLY	QTY PER UNIT	REFERENCE SYMBOLS
CC100-28	CAP., FXD, CER	A4525 -1	4	C1001, C1018, C1032, C1004
CC100-29	CAP., FXC, CER	A4525 -1	6	C1014, C1016, C1017, C1035, C1036, C1037
CC100-33	CAP., FXD, CER	A4525 -1	1	C1027
CCL00-40	CAP., FXD, CER	A4525 -1	4	C1022, C1028, C1030, C1038
CC100-41	CAP., FXD, CER	A4525 -1	18	C1003, C1005, C1008, C1009, C1010, C1011, C1013, C1019, C1020, C1021, C1023, C1024, C1025, C1026, C1031, C1002, C1033, C1007
CL275-101	COIL, RF, FXD	A4525 -1	2	L1004, L1005
CL275-102	COIL, RF, FXD	A4525 -1	1	L1002
CL275-221	COIL, RF, FXD	A4525 -1	1	L1003
CM111C150D5S	CAP., FXD, MICA	A4525 -1	1	C1029
CM111F331G5S	CAP., FXD, MICA	A4525 -1	1	C1015
CM111F361G5S	CAP., FXD, MICA	A4525 -1	2	C1012, C1006
FX268	FIL, BP	A4525 -1	1	FL1001
NW137	NW FREQ DIV	A4525 -1	1	Z1001
NW163	NW BAL. MIXER	A4525 -1	1	Z1002
RC07GF101J	RES, FXD, COMP.	A4525 -1	2	R1020, R1014
RC07GF102J	RES, FXD, COMP	A4525 -1	6	R1021, R1040, R1043, R1049, R1060, R1008
RC07GF103J	RES, FXD, COMP.	A4525 -1	5	R1024, R1028, R1047, R1051, R1026
RC07GF104J	RES, FXD, COMP.	A4525 -1	1	R1023
RC07GF152J	RES, FXD, COMP.	A4525 -1	2	R1016, R1044
RC07GF153J	RES, FXD, COMP.	A4525 -1	2	R1011, R1017
RC07GF182J	RES, FXD, COMP.	A4525 -1	1	R1012
RC07GF221J	RES, FXD, COMP.	A4525 -1	1	R1022
RC07GF222J	RES, FXD, COMP.	A4525 -1	2	R1041, R1042
RC07GF223J	RES, FXD, COMP.	A4525 -1	6	R1018, R1050, R1052, R1001, R1053, R1046
RC07GF330J	RES, FXD, COMP.	A4525 -1	1	R1003
RC07GF331J	RES, FXD, COMP.	A4525 -1	2	R1039, R1005
RC07GF332J	RES, FXD, COMP.	A4525 -1	1	R1057
RC07GF331J	RES, FXD, COMP.	A4525 -1	1	R1002
RC07GF471J	RES, FXD, COMP.	A4525 -1	4	R1013, R1019, R1045, R1054
RC07GF472J	RES, FXD, COMP.	A4525 -1	2	R1048, R1055
RC07GF473J	RES, FXD, COMP.	A4525 -1	5	R1029, R1030, R1031, R1032, R1038
RC07GF561J	RES, FXD, COMP.	A4525 -1	1	R1004
RC07GF682J	RES, FXD, COMP.	A4525 -1	1	R1034
RV119-3-102A	RES, VAR, WW-1W	A4525 -1	2	R1025, R1035
RV119-3-103A	RES, VAR, WW-1W	A4525 -1	3	R1027, R1036, R1037
RV124-1-101	RES, VAR, COMP.	A4525 -1	1	R1058
RV124-1-253	RES, VAR, COMP.	A4525 -1	1	R1056

PART NUMBER	DESCRIPTION	USED ON ASSEMBLY	QTY PER UNIT	REFERENCE SYMBOLS
TE0127-2	TERM, STUD	A4525-1	7	TP1001,TP1002,TP1004,TP1005,TP1006,TP1007,TP1008
TT285-16	XFMR, RF, ADJ	A4525-1	2	T1001,T1002
TZ21	XFMR, IF	A4525-1	1	T1003
TZ21	XFMR, TOROID	A4525-1	1	T1004
1N34A	SCOND DEV, DIO	A4525-1	4	CR1010,CR1011,CR1012,CR1013
1N627	SCOND DEV, DIO	A4525-1	5	CR1003,CR1004,CR1005,CR1006,CR1007
1N754A	SCOND DEV, DIO	A4525-1	1	CR1014
1N755A	SCOND DEV, DIO	A4525-1	2	CR1001,CR1002
1N914	SCOND DEV, DIO	A4525-1	2	CR1008,CR1009
2N1711	TRANSISTOR	A4525-1	2	Q1006,Q1007
2N3646	TRANSISTOR	A4525-1	6	Q1001,Q1002,Q1003,Q1004
2N696	TRANSISTOR	A4525-1	5	Q1012,Q1013 Q1005,Q1008,Q1009,Q1010 Q1011

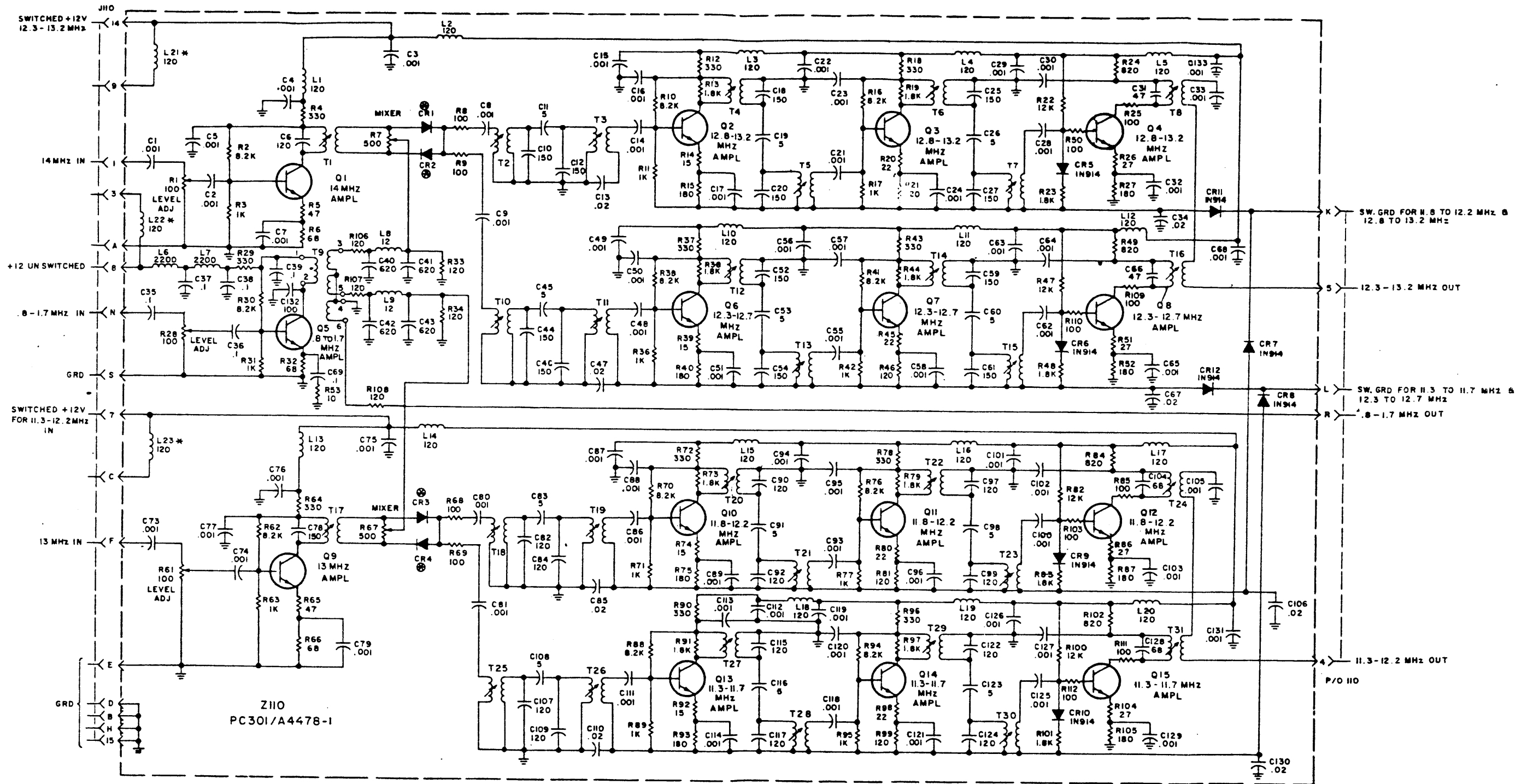


Z109 Carrier Generator (A4526)

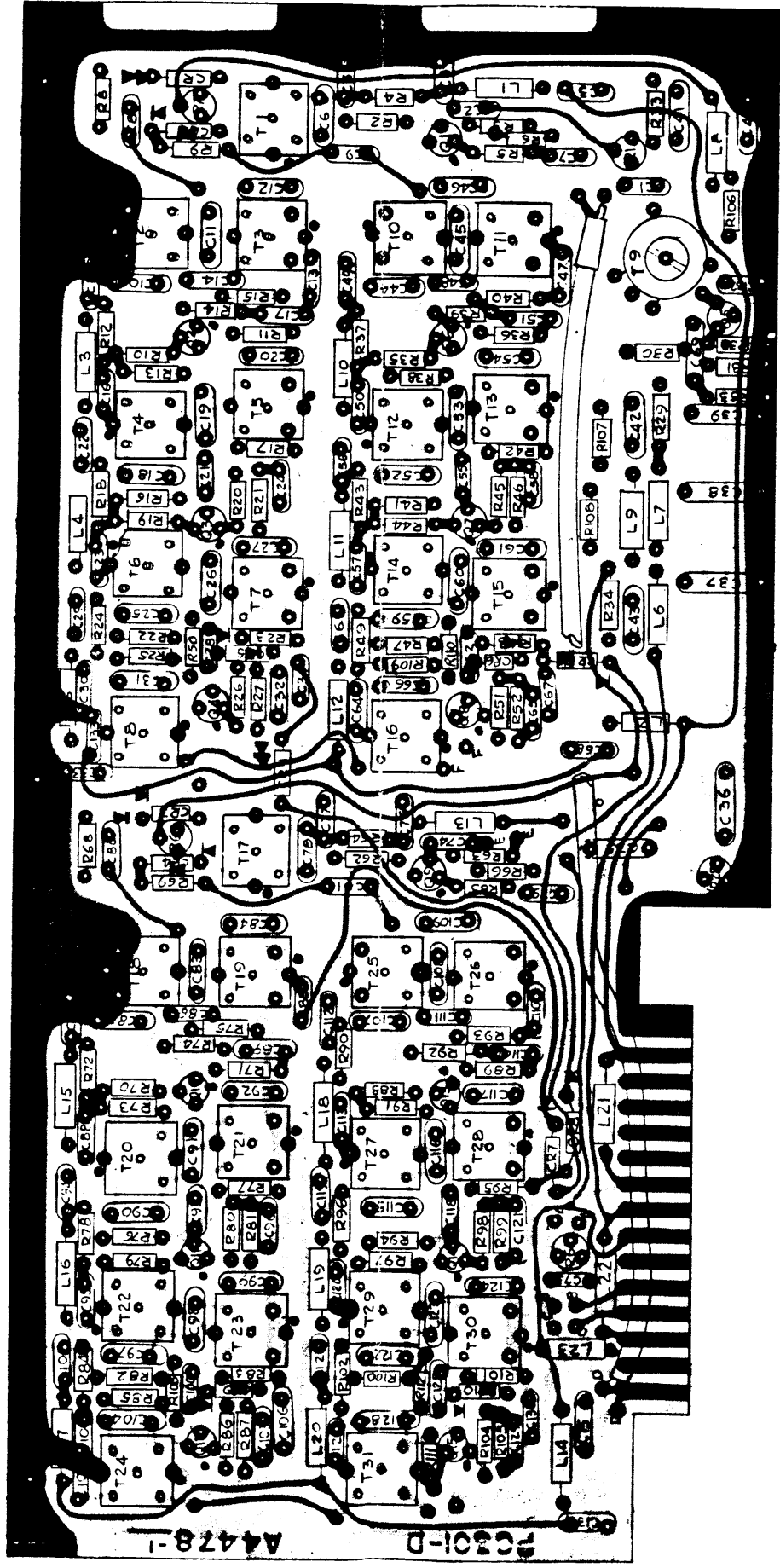


PART NUMBER	DESCRIPTION	USED ON ASSEMBLY	QTY PER UNIT	REFERENCE SYMBOLS
CC100-28	CAP., FXD, CER	A-4526 -1	17	C1102, C1106, C1107 C1108, C1149, C1110 C1111, C1112, C1115 C1116, C1137, C1140 C1141, C1148, C1153 C1154, C1138
CC100-29	CAP., FXD, CER	A-4526-1	2	C1127, C1142
CC100-33	CAP., FXD, CER	A-4526-1	2	C1144, C1145
CC131-5	CAP., FXD, CER	A-4526-1	2	C1158, C1157
CC100-40	CAP., FXD, CER	A-4526-1	2	C1146, C1147
CC100-41	CAP., FXD, CER	A-4526-1	16	C1101, C1103, C1104 C1114, C1121, C1123 C1125, C1126, C1130 C1128, C1155, C1134 C1124, C1143, C1152 C1156
CE105-2-25	CAP., FXD, ELECT.	A-4526-1	1	C1113
CE105-10-25	CAP., FXD, ELECT.	A-4526-1	2	C1117, C1118
CE105-25-25	CAP., FXD, ELECT.	A-4526-1	1	C1150
ØE105-125-15	CAP., FXD, ELECT.	A-4526-1	5	C1132, C1133, C1135 C1136, C1159
CE105-175-15	CAP., FXD, ELECT.	A-4526-1	1	C1151
CE105-2-50	CAP., FXD, ELECT.	A-4526-1	2	C1119, C1120
CL275-102	COIL, RF, FXD	A-4526-1	3	L1101, L1103, L1105
CL275-220	COIL, RF, FXD	A-4526-1	1	L1106
CL275-221	COIL, RF, FXD	A-4526-1	2	L1102, L1104
CM111F361F5S	CAP., FXD, MICA	A-4526-1	2	C1122, C1129
CM112F392F5S	CAP., FXD, MICA	A-4526-1	3	C1105, C1109, C1139
FX267	FIL, BP	A-4526-1	1	FL1101
NW136	NW FREQ DIV.	A-4526-1	2	Z1101, Z1102
RC07GF101J	RES, FXD, COMP.	A-4526-1	6	R1111, R1113, R1117 R1131, R1136, R1167
RC07GF102J	RES, FXD, COMP.	A-4526-1	16	R1103, R1104, R1110 R1112, R1116, R1118 R1122, R1123, R1126 R1137, R1180, R1144 R1145, R1152, R1165 R1172
RC07GF103J	RES, FXD, COMP.	A-4526-1	11	R1101, R1109, R1115 R1125, R1134, R1135 R1155, R1143, R1166 R1182, R1181
RC07GF120J	RES, FXD, COMP.	A-4526-1	1	R1164
RC07GF122J	RES, FXD, COMP.	A-4526-1	2	R1132, R1149
RC07GF123J	RES, FXD, COMP.	A-4526-1	1	R1168
RC07GF152J	RES, FXD, COMP.	A-4526 -1	4	R1119, R1157, R1171, R1175
RC07GF182J	RES, FXD, COMP.	A-4526-1	1	R1153

PART NUMBER	DESCRIPTION	USED ON ASSEMBLY	QTY PER UNIT	REFERENCE SYMBOLS
RC07GF223J	RES, FXD, COMP.	A4526-1	3	R1128, R1142, R1179
RC07GF271J	RES, FXD, COMP.	A4526-1	1	R1163
RC07GF273J	RES, FXD, COMP.	A4526-1	2	R1102, R1124
RC07GF331J	RES, FXD, COMP.	A4526-1	2	R1151, R1173
RC07GF332J	RES, FXD, COMP.	A4526-1	4	R1130, R1156, R1162 R1176
RC07GF333J	RES, FXD, COMP.	A4526-1	4	R1108, R1114, R1138 R1148
RC07GF390J	RES, FXD, COMP.	A4526-1	1	R1159
RC07GF470J	RES, FD, COMP.	A4526-1	3	R1140, R1161, R1177
RC07GF471J	RES, FXD, COMP.	A4526-1	4	R1106, R1107, R1121 R1174
RC07GF472J	RES, FXD, COMP.	A4526-1	4	R1133, R1139, R1150 R1183
RC07GF561J	RES, FXD, COMP.	A4526-1	5	R1141, R1146, R1154 R1158, R1160
RC07GF682J	RED, FXD, COMP.	A4526-1	1	R1129
RC07GF683J	RES, FXD, COMP.	A4526-1	1	R1178
RC07GF822J	RES, FXD, COMP.	A4526-1	1	R1170
RC20GF181J	RES, FXD, COMP.	A4526-1	1	R1105
RV124-1-101	RES, VAR, COMP.	A4526-1	1	R1120
RV-124-1-102	RES, VAR, COMP.	A4526-1	1	R1127
RV124-1-501	RES, VAR, COMP.	A4526-1	1	R1169
RV124-1-502	RES, VAR, COMP.	A4526-1	1	R1147
RV124-1-254	RES, VAR, COMP.	A4526-1	1	R1184
TE.0127-2	TERM, STUD	A4526-1	6	TP1101, TP1103, TP1104, TP1105, TP1106, TP1107
TF420	XFMR, AUDIO	A4526-1	1	T1106
TT285-11	XFMR, RF, ADJ	A4526-1	1	T1102
TT285-12	XFMR, RF, ADJ	A4526-1	1	T1101
TT285-22	XFMR, RF, ADJ	A4526-1	1	T1103
TT285-23	XFMR, RF, ADJ	A4526-1	1	T1104
TT285-15	XFMR, RF, ADJ.	A4526-1	1	T1105
1N34A	SCOND, DEV, DIO	A4526-1	1	CR1102
1N914	SCOND, DEV, DIO	A4526-1	2	CR1103, CR1104
1N746A	SCOND, DEV, DIO	A4526-1	1	CR1101
2N3646	TRANSISTOR	A4526-1	14	Q1101, Q1102, Q1103 Q1104, Q1105, Q1107 Q1108, Q1109, Q1110 Q1113, Q1111, Q1112 Q1106, Q1114

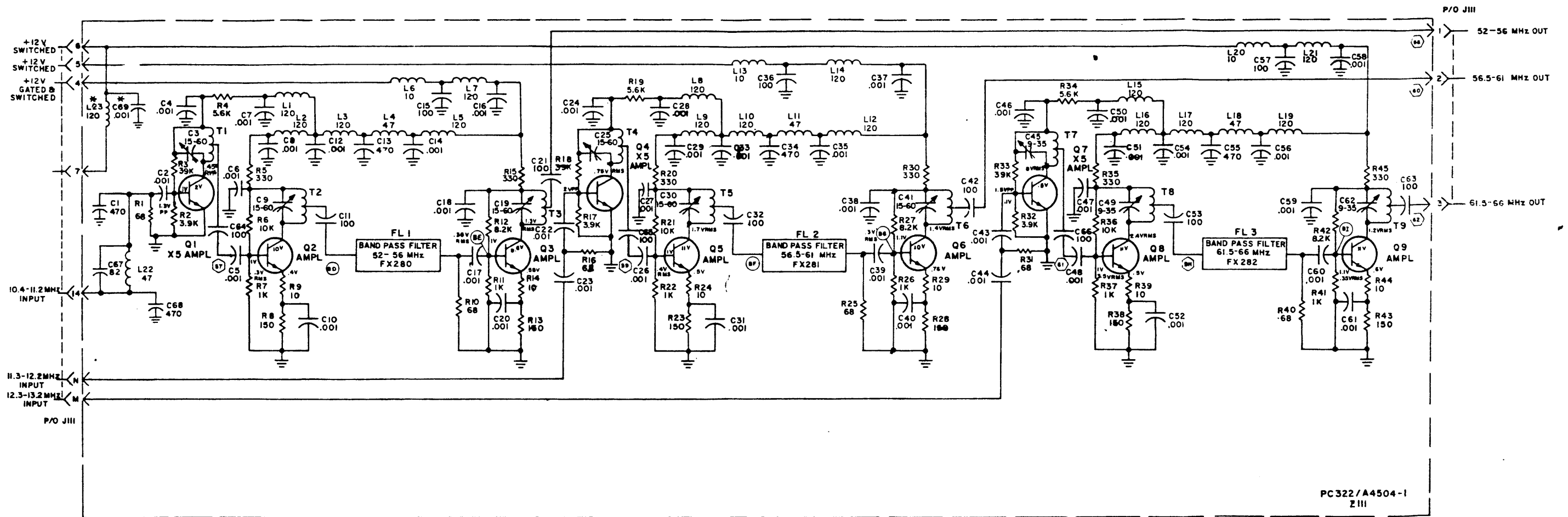


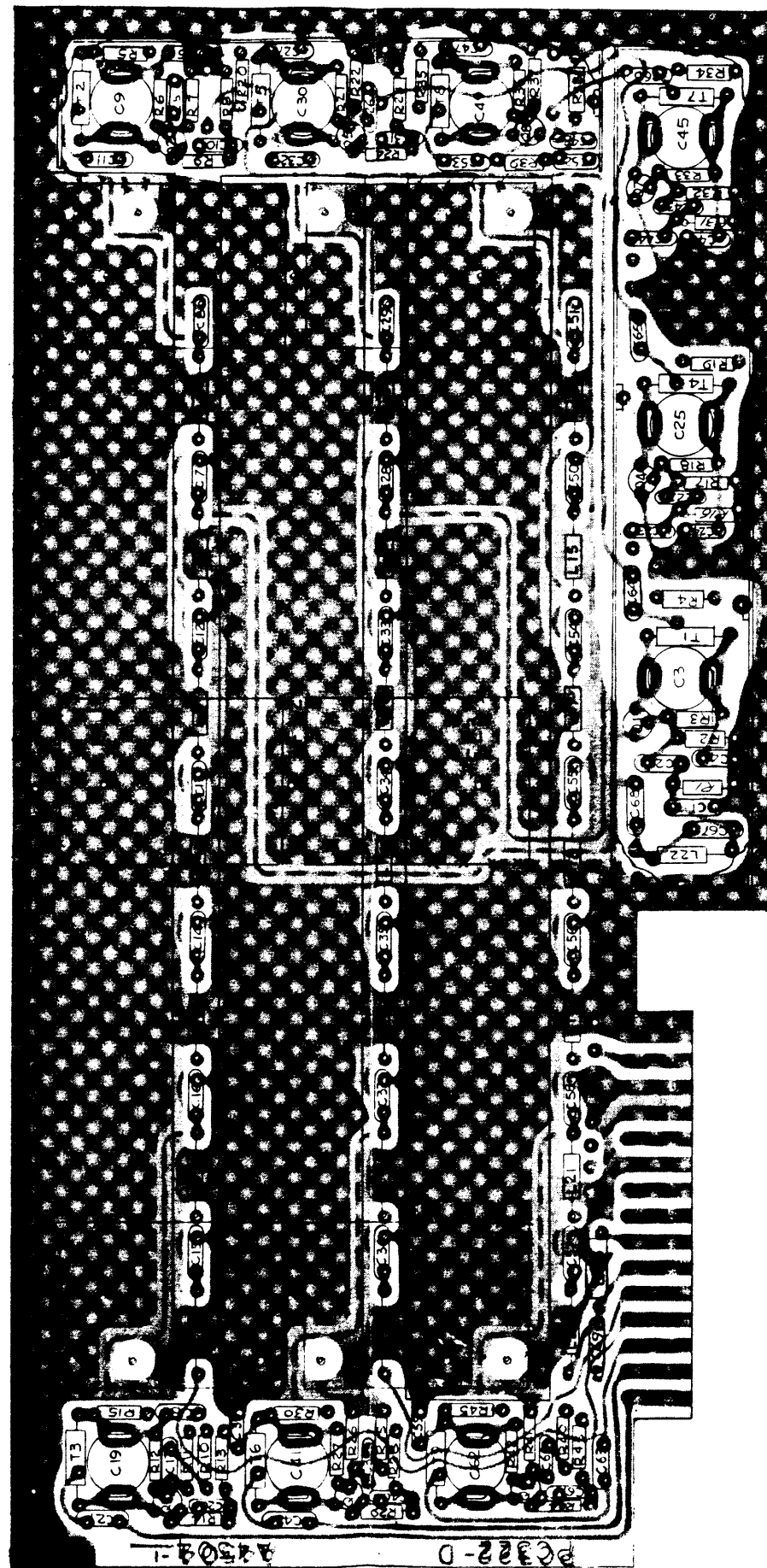
Z110 Step Generator A (A4478)



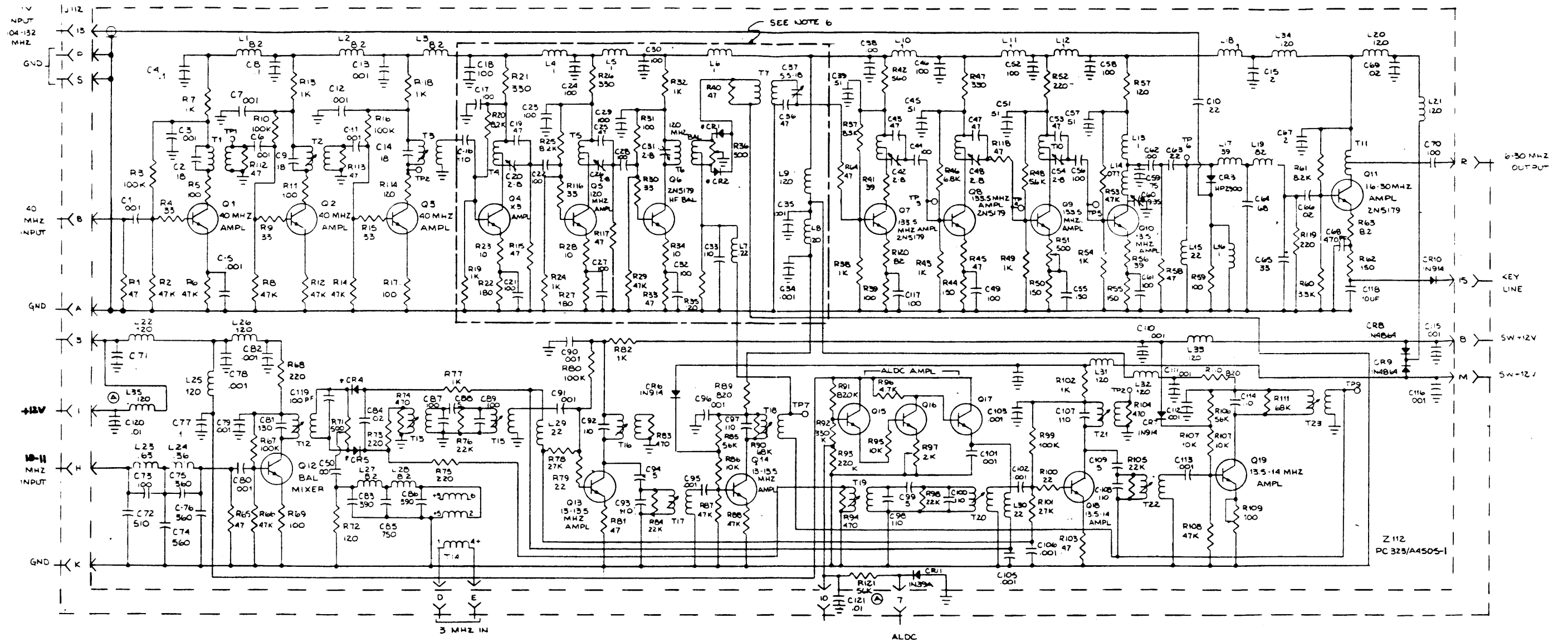
PART NUMBER	DESCRIPTION	USED ON ASSEMBLY	QTY PER UNIT	REFERENCE SYMBOLS
CC100-28	CAP., FXD, CER	A4478	6	C35, C36, C37, C38 C39, C69
CC100-29	CAP., FXD, CER	A4478	69	C1, C2, C3, C4, C5, C7, C8, C9, C14, C15 C16, C17, C21, C22 C23, C24, C28, C29 C30, C32, C33, C48 C49, C50, C51, C55 C56, C57, C58, C62, C63, C64, C65, C68 C73, C74, C75, C76 C77, C79, C80, C81 C86, C87, C88, C89 C93, C95, C95, C96 C100, C101, C102, C103, C105, C111, C112, C113, C114, C118, C119, C120 C121, C125, C126, C127, C129, C131 C133
CC100-30	CAP., FXD, CER	A4478	1	C132
CC100-40	CAP., FXD, CER	A4478	8	C13, C34, C47, C67 C85, C106, C110 C130
CL275-120	COIL, RF, FXD	A4478	2	L8, L9
CL275-121	COIL, RF, FXD	A4478	19	L1, L2, L3, L4, L5 L10, L11, L12, L13 L14, L15, L16, L17 L18, L19, L20, L21 L22, L23
CM111C050D5S	CAP., FXD, MICA	A4478	12	C11, C19, C26, C45 C53, C60, C83, C91 C98, C108, C116, C123
CM111E470G5S	CAP., FXD, MICA	A4478	2	C31, C66
CM111E680J5S	CAP., FXD, MICA	A4478	2	C104, C128
CM111F121G5S	CAP., FXD, MICA	A4478	13	C6, C82, C84, C90, C92, C97, C107, C109, C115, C117, C122, C124
CM111F151F5S	CAP., FXD, MICA	A4478	13	C10, C12, C18, C20 C25, C27, C44, C46, C52, C54, C59, C61 C78
CM111F621D5S	CAP., FXD, MICA	A4478	4	C40, C41, C42, C43
DD139	SCOND DEV, DIO	A4478	4	CR1, CR2, CR4, CR3
RC07GF100J	RES, FXD, COMP.	A4478	1	R53
RC07GF101J	RES, FXD, COMP.	A4478	12	R8, R9, R68, R50 R25, R109, R103, R85, R110, R111,

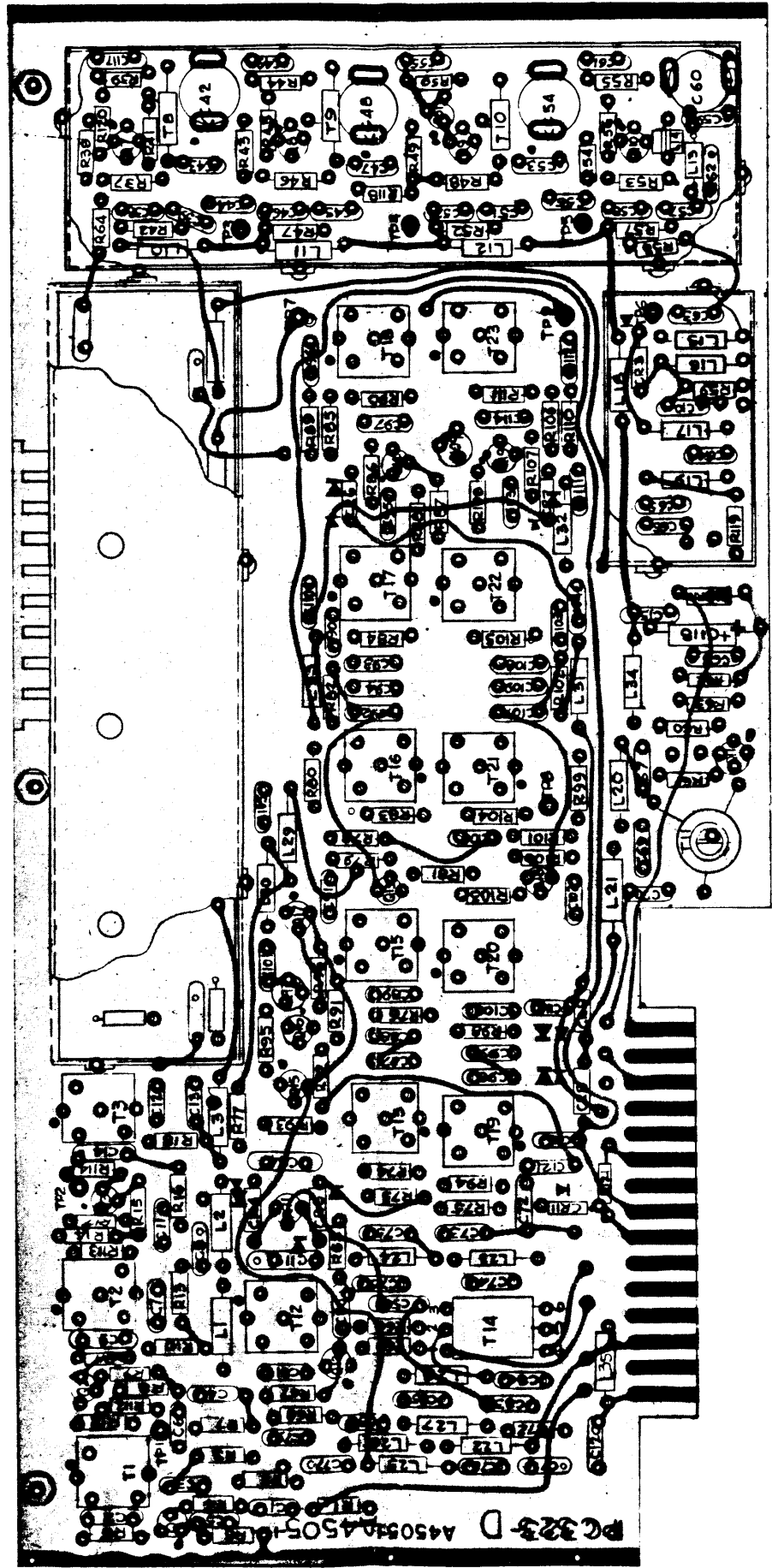
PART NUMBER	DESCRIPTION	USED ON ASSEMBLY	QTY PER UNIT	REFERENCE SYMBOLS
RC07GF102J	RES, FXD, COMP.	A4478	11	R3, R11, R17, R31 R36, R42, R63, R71 R77, R89, R95
RC07GF121J	RES, FXD, COMP.	A4478	9	R21, R33, R34, R46 R81, R99, R106 R107, R108
RC07GF123J	RES, FXD, COMP.	A4478	4	R47, R82, R22, R100
RC07GF150J	RES, FXD, COMP.	A4478	4	R14, R39, R74, R92
RC07GF181J	RES, FXD, COMP.	A4478	8	R15, R27, R40, R62 R75, R87, R93, R105
RC07GF182J	RES, FXD, COMP.	A4478	12	R13, R19, R23, R38 R44, R48, R73, R79 R83, R91, R97, R101
RC07GF220J	RES, FXD, COMP.	A4478	4	R20, R45, R80, R98
RC07GF270J	RES, FXD, COMP.	A4478	4	R26, R51, R86, R104
RC07GF331J	RES, FXD, COMP.	A4478	11	R4, R12, R18, R29 R37, R43, R64, R72 R78, R90, R96
RC77GF470J	RES, FXD,	A4478	2	R5, R65
RC07GF680J	RES, FXD, COMP.	A4478	3	R66, R6, R32
RC07GF821J	RES, FXD, COMP.	A4478	4	R24, R49, R84, R102
RC07GF822J	RES, FXD, COMP.	A4478	11	R2, R10, R16, R30 R35, R41, R62, R70, R76, R88, R94
RV124-1-101	RES, VAR, COMP.	A4478	3	R61, R1, R28
RV124-1-501	RES, VAR, COMP.	A4478	2	R7, R67
TT287-13	XFMR, RF, ADJ.	A4478	6	R23, T26, T28, T30 T21, T19
TT287-14	XFMR, RF, ADJ.	A4478	4	T20, T22, T27, T29
TT287-15	XFMR, RF, ADJ.	A4478	2	T18, T25
TT287-19	XFMR, RF, ADJ.	A4478	2	T1, T17
TT277-20	XFMR, RF, ADJ.	A4478	4	T8, T16, T24, T31
TT287-3	CAP., FXD, MICA	A4478	6	T13, T15, T3, T5, T7, T11
TT287-4	XFMR, RF, ADJ.	A4478	4	T4, T6, T12, T14
TT287-5	XFMR, RF, ADJ.	A4478	2	T2, T10
TZ221	XFMR, RF	A4478	1	T9
1N914	SCOND DEV, DIO	A4478	8	CR5, CR9, CR6, CR10 CR8, CR7, CR11, CR12
2N3646	TRANSISTOR	A4478	15	Q1, Q2, Q3, Q4, Q5 Q6, Q7, Q8, Q9, Q10 Q11, Q12, Q13, Q14 Q15





PART NUMBER	DESCRIPTION	USED ON ASSEMBLY	QTY PER UNIT	REFERENCE SYMBOLS
CC100-29	CAP., FXD, CER	A4504-1	42	C2, C5, C6, C7, C8 C10, C12, C14, C16 C17, C18, C20, C22 C24, C26, C27, C28 C29, C23, C33, C43 C31, C35, C37, C38 C39, C50, C44, C46 C47, C48, C4, C50 C51, C52, C54, C58 C59, C60, C61, C69
CC100-30	CAP., FXD, CER	A4504-1	12	C11, C15, C21, C53, C63, C32, C36, C42 C57, C64, C65, C66
CC100-7	CAP., FXD, MICA	A4504-1	3	C13, C34, C55
CL275-0R47	COIL, RF, FXD,	A4504-1	1	L22
CL275-100	COIL, RF, FXD	A4504-1	3	L6, L13, L20
CL275-121	COIL, RF, FXD	A4504-1	16	L1, L2, L3, L5, L7, L8, L9, L10, L12, L14, L15, L16, L17 L19, L21
CL275-470	COIL, RF, FXD	A4504-1	3	L4, L11, L18
CM111F471J5S	CAP., FXD, MICA	A4504-1	2	C1, C68
CM111F820J5S	CAP., FXD, MICA	A4504-1	1	C67
CV112-2	CAP., VAR, CER	A4504-1	3	C45, C49, C62
CV112-5	CAP., VAR, CER	A4504-1	6	C3, C9, C19, C25 C30, C41
FX280	FIL, BP	A4504-1	1	FL1
FX281	FIL, BP	A4504-1	1	FL2
FX282	FIL, BP	A4504-1	1	FL3
RC07GF100J	RES, FXD, COMP	A4504-1	6	R9, R14, R24, R29 R39, R44
RC07GF102J	RES, FXD, COMP	A4504-1	6	R7, R11, R22, R26 R37, R41
RC07GF103J	RES, FXD, COMP.	A4504-1	3	R6, R21, R36
RC07GF151J	RES, FXD, COMP.	A4504-1	6	R8, R13, R23, R28 R38, R43
RC07GF331J	RES, FXD, COMP.	A4504-1	6	R5, R15, @20 R30 R35, R45
RC07GF392J	RES, FXD, COMP.	A4504-1	3	R2, R17, R32
RC07GF393J	RES, FXD, COMP.	A4504-1	3	R3, R18, R33
RC07GF562J	RES, FXD, COMP.	A4504-1	3	R4, R19, R34
RC07GF680J	RES, FXD, COMP.	A4504-1	6	R10, R25, R40, R1 R16, R31
TZ215-12	XFMR, RF, FXD	A4504-1	9	T1, T2, T3, T4, T5, T6, T7, T8, T9
2N3646	TRANSISTOR	A4504-1	9	Q1, Q2, Q3, Q4, Q5 Q6, Q7, Q8, Q9

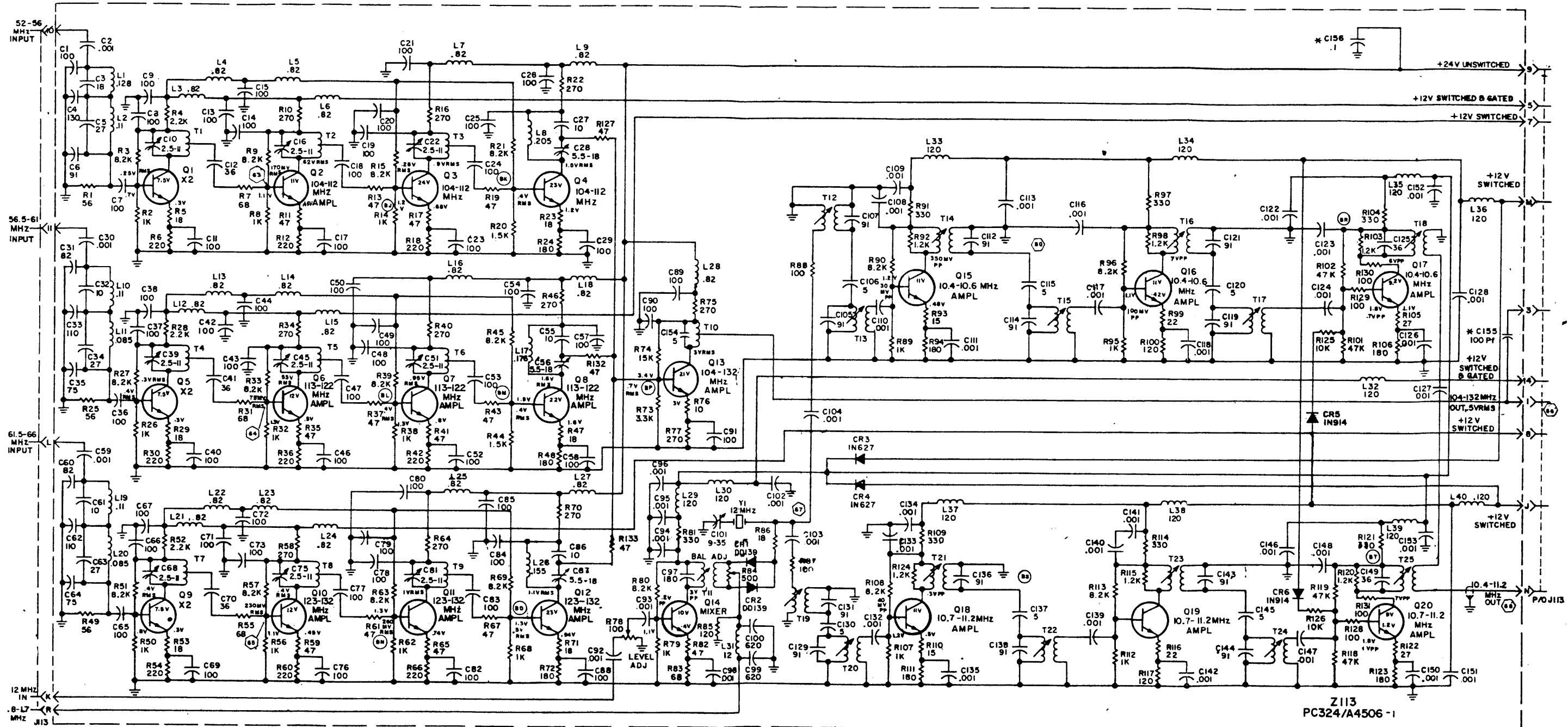




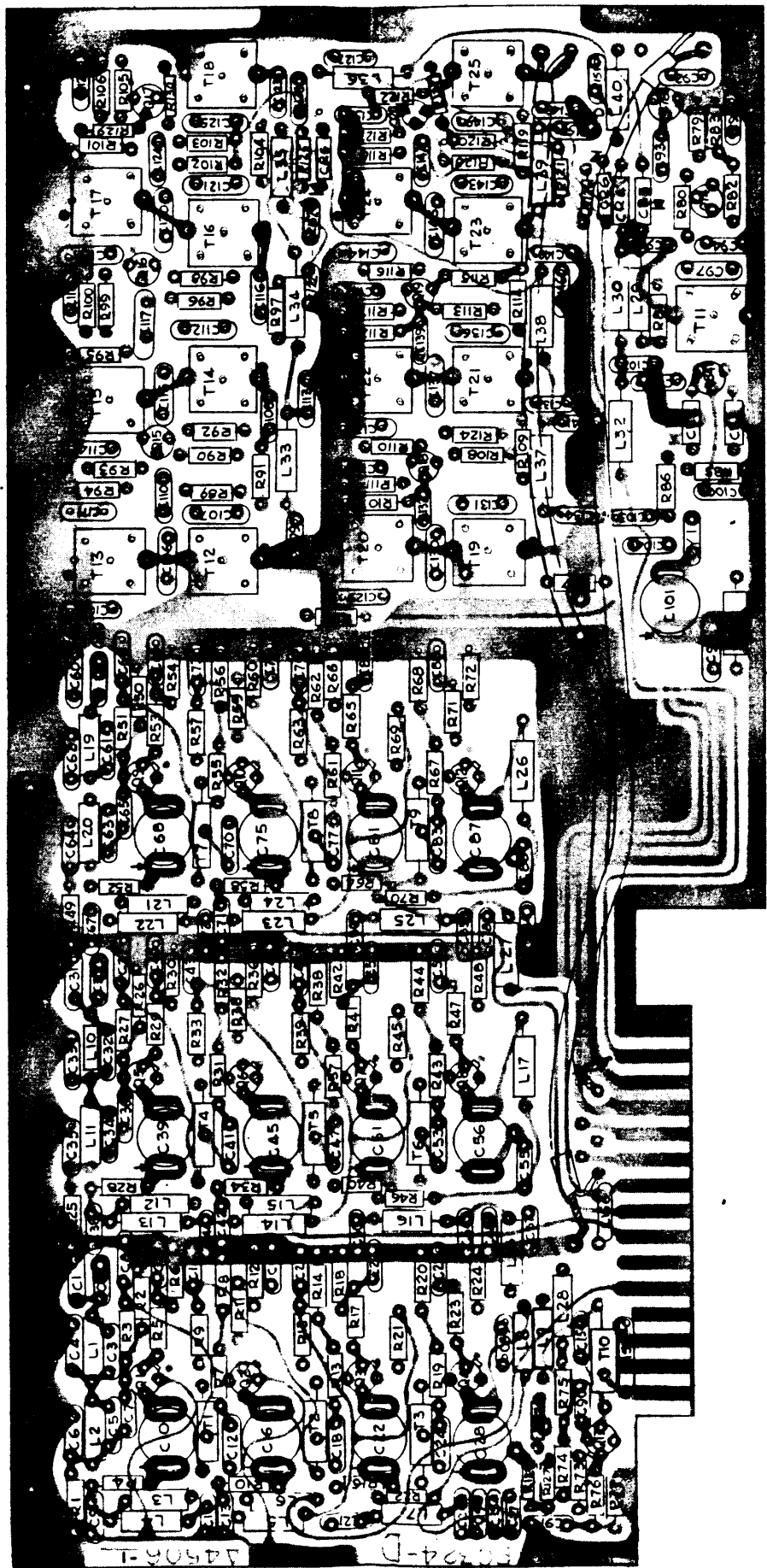
PART NUMBER	DESCRIPTION	USED ON ASSEMBLY	QTY PER UNIT	REFERENCE SYMBOLS
CC100-11	CAP., FXD, CER	A4505-1	1	C68
CC100-29	CAP., FXD, CER	A4505-1	29	C1, C3, C5, C6, C7 C11, C12, C13, C50 C78, C79, C80, C82 C90, C91, C95, C96 C101, C102, C103, C104, C105, C106 C110, C111, C112 C113, C115, C116
CC100-30	CAP., FXD, CER	A4505-1	12	C38, C44, C46, C49 C52, C55, C56, C58 C61, C62, C117, C119
CC100-33	CAP., FXD, CER	A4505-1	2	C15, C67
CC100-40	CAP., FXD, CER	A4505-1	3	C66, C69, C84
CC100-43	CAP., FXD, ELECT.	A4505-1	2	C120, C121
CE105-10-25	CAP., FXD, ELECT.	A4505-1	1	C118
5-OR39	COIL, RF, FXD	A4505-1	1	L17
5-OR82	COIL, RF, FXD	A4505-1	1	L19
5-1R0	COIL, RF, FXD	A4505-1	6	L10, L11, L12, L13 L16, L18
CL275-121	COIL, RF, FXD	A4505-1	10	L20, L21, L22, L25 L26, L31, L32, L33 L34, L35
CL275-220	COIL, RF, FXD	A4505-1	3	L15, L29, L30
CL275-8R2	COIL, RF, FXD	A4505-1	5	L1, L2, L3, L27, L28
CL412-23	COIL, RF, FXD	A4505-1	1	L14
CL412-24	COIL, RF, FXD	A4505-1	1	L33
CL412-25	COIL, RF, FXD	A4505-1	1	L24
CM111C150D5S	CAP., FXD, MICA	A4505-1	4	C88, C94, C99, C109
CM111C180J5S	CAP., FXD, MICA	A4505-1	3	C2, C9, C14
CM111C220J5S	CAP., FXD, MICA	A4505-1	2	C10, C63
CM111E330G5S	CAP., FXD, MICA	A4505-1	1	C65
CM111E470G5S	CAP., FXD, MICA	A4505-1	3	C43, C47, C53
CM111E510G5S	CAP., FXD, MICA	A4505-1	4	C39, C45, C51, C57
CM111E680F5S	CAP., FXD, MICA	A4505-1	1	C64
CM111E750J5S	CAP., FXD, MICA	A4505-1	1	C59
CM111F101G5S	CAP., FXD, MICA	A4505-1	2	C73, C70
CM111F111J5S	CAP., FXD, MICA	A4505-1	10	C87, C89, C92, C93 C97, C98, C100, C107 C108, C114
111F131G5S	CAP., FXD, MICA	A4505-1	1	C81
CM111F361G5S	CAP., FXD, MICA	A4505-1	2	C76, C75
CM111F391F5S	CAP., FXD, MICA	A4505-1	2	C83, C86
CM111F471J5S	CAP., FXD, CER	A4505-1	4	C4, C8, C71, C77
CM111F511G5S	CAP., FXD, MICA	A4505-1	1	C72
CM111F561F5S	CAP., FXD, MICA	A4505-1	1	C74
CM111F751G5S	CAP., FXD, MICA	A4505-1	1	C85
CV112-2	CAP., VAR, CER	A4505-1	1	C60
CV112-4	CAP., VAR, CER	A4505-1	3	C42, C48, C54
DD137	SCOND DEV, DIO	A4505-1	1	CR3

PART NUMBER	DESCRIPTION	USED ON ASSEMBLY	QTY PER UNIT	REFERENCE SYMBOLS
DD138	SCOND DEV, DIO	A4505-1	2	CR4, CR5
RC07GF101J	RES., FXD, COMP.	A4505-1	6	R69, R5, R11, R17 R39, R59
RC07GF102J	RES., FXD, COMP.	A4505-1	10	R7, R13, R18, R38 R43, R49, R54, R77 R82, R102
RC07GF103J	RES., FXD, COMP.	A4505-1	3	R86, R95, R107
RC07GF104J	RES., FXD, COMP.	A4505-1	6	R3, R10, R16, R67 R80, R99
RC07GF121J	RES., FXD, COMP.	A4505-1	3	R57, R72, R114
RC07GF151J	RES., FXD, COMP.	A4505-1	4	R44, R50, R55, R62
RC07GF220J	RES., FXD, COMP.	A4505-1	2	R79, R100
RC07GF221J	RES., FXD, COMP.	A4505-1	5	R52, R73, R75, R119 R68
RC07GF223J	RES., FXD, COMP.	A4505-1	4	R76, R84, R98, R105
RC07GF224J	RES., FXD, COMP.	A4505-1	1	R93
RC07GF273J	RES., FXD, COMP.	A4505-1	2	R78, R101
RC07GF330J	RES., FXD, COMP.	A4505-1	3	R4, R9, R15
RC07GF331J	RES., FXD, COMP.	A4505-1	1	R47
RC07GF332J	RES., FXD, COMP.	A4505-1	1	R60
RC07GF334J	RES., VAR, COMP.	A4505-1	1	R92
RC07GF390J	RES., FXD, COMP.	A4505-1	2	R41, R56
RC07GF470J	RES., FXD, COMP.	A4505-1	13	R45, R112, R113, R R118, R1, R6, R12, R58, R64, R65, R81 R88, R103
RC07GF471J	RES., FXD, COMP.	A4505-1	4	R74, R83, R94, R104
RC07GF472J	RES., FXD, COMP.	A4505-1	2	R96, R53
RC07GF473J	RES., FXD, COMP.	A4505-1	6	R2, R8, R14, R66 R87, R108
RC07GF561J	RES., FXD, COMP.	A4505-1	1	R42
RC07GF562J	RES., FXD, COMP.	A4505-1	1	R48
RC07GF563J	RES., FXD, COMP.	A4505-1	3	R85, R106, R121
RC07GF682J	RES., FXD, COMP.	A4505-1	1	R46
RC07GF683J	RES., FXD, COMP.	A4505-1	2	R90, R111
RC07GF8R2J	RES., FXD, COMP.	A4505-1	1	R63
RC07GF820J	RES., FXD, COMP.	A4505-1	1	R120
RC07GF821J	RES., FXD, COMP.	A4505-1	1	R110
RC07GF822J	RES., FXD, COMP.	A4505-1	2	R37, R61
RC07GF824J	RES., FXD, COMP.	A4505-1	1	R91
RV124-1-101	RES., VAR, COMP.	A4505-1	1	R109
RV124-1-501	RES., VAR, COMP.	A4505-1	2	R51, R71
RV124-1-202	RES., VAR, COMP.	A4505-1	1	R97
TE0127-2	TERM., LUG	A4505-1	9	TP1, TP2, TP3, TP4 TP6, TP7, TP5, TP8 TP9
TFO228U13	XFMR, PULSE	A4505-1	3	T1, T2, T3
TT285-2	XFMR, RF, ADJ.	A4505-1	10	T13, T19, T15, T16 T17, T20, T18, T21 T22, T23

PART NUMBER	DESCRIPTION	USED ON ASSEMBLY	QTY PER UNIT	REFERENCE SYMBOLS
TT285-4	XMFR, RF, ADJ.	A4505-1	1	T12
TZ215-1	XFMR, RF, FXD	A4505-1	3	T8, T9, T10
TZ220	XFMR, RF, FXD	A4505-1	1	T11
1N4864	SCOND DEV, DIO	A4505-1	2	CR8, CR9
1N914	SCOND DEV, DIO	A4505-1	3	CR6, CR7, CR10
1N36A	SCOND, DEV, DIO	A4505-1	1	CR11
2N3646	TRANSISTOR	A4505-1	11	Q1, Q2, Q3, Q12
				Q13, Q14, Q15, Q16
				Q17, Q18, Q19
				Q7, Q8, Q9, Q10
2N5179	TRANSISTOR	A4505-1	5	



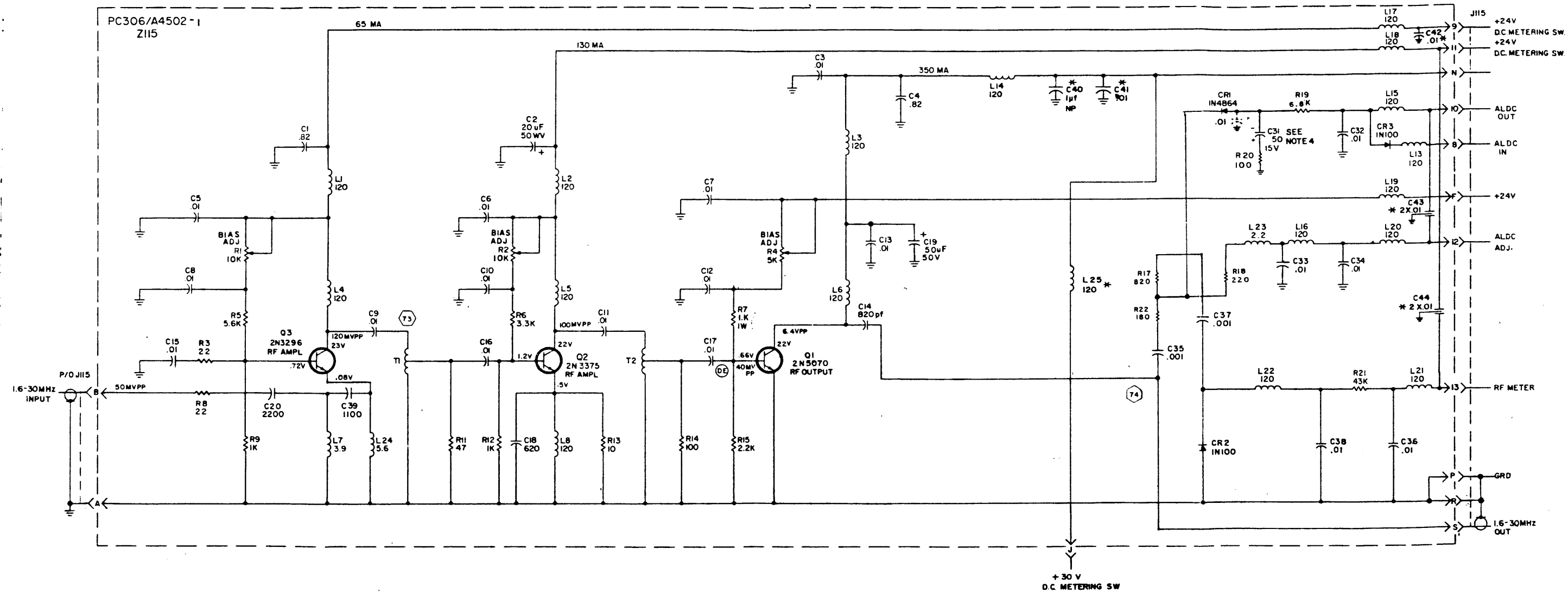
Z113 Step Generator C (A4506)

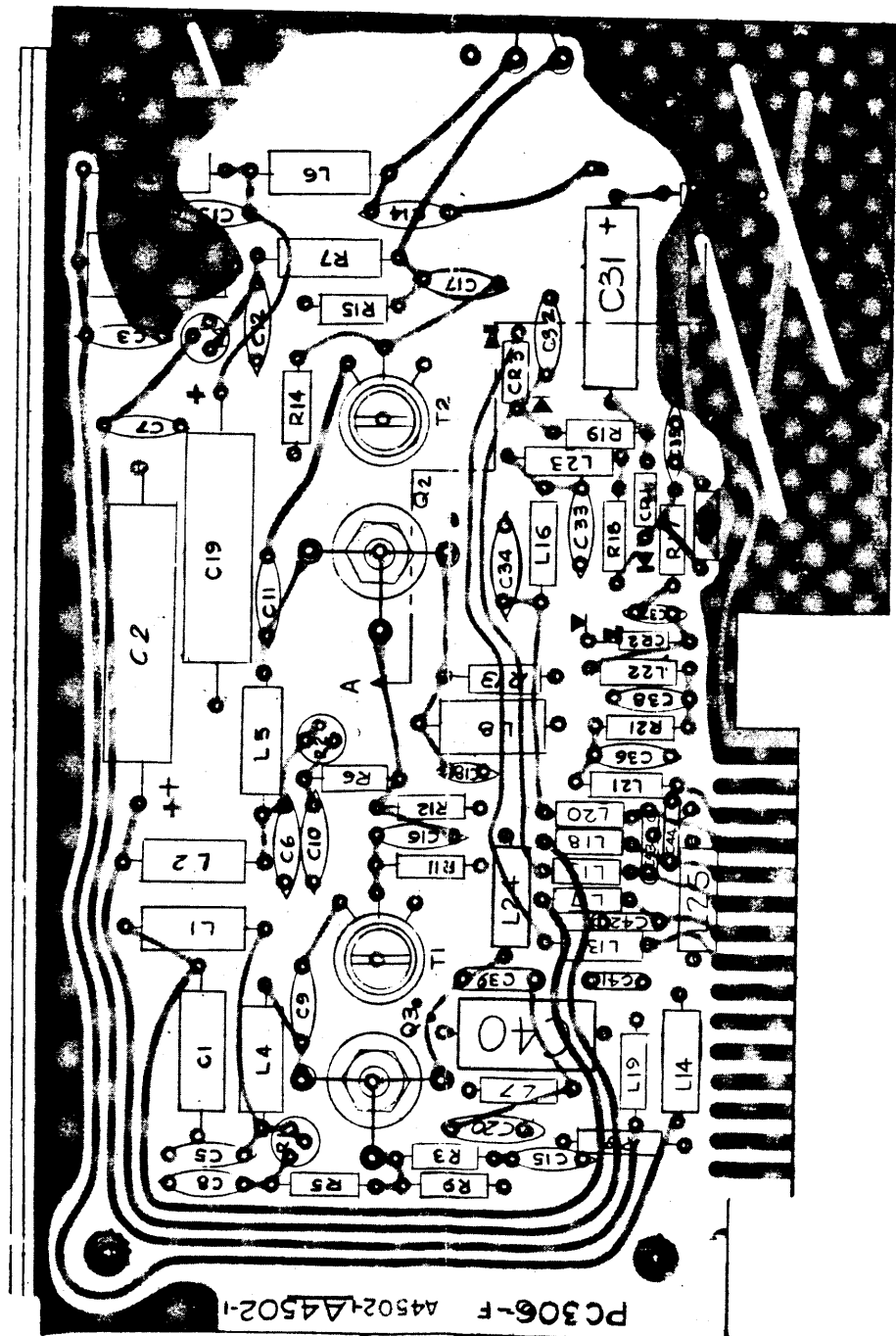


PART NUMBER	DESCRIPTION	USED ON ASSEMBLY	QTY PER UNIT	REFERENCE SYMBOLS
CC100-29	CAP., FXD, CER	A4506-1	41	C2, C30, C59, C92 C93, C94, C95, C96 C98, C102, C103 C104, C108, C109 C110, C111, C113 C116, C117, C118 C122, C123, C124 C126, C127, C128 C132, C133, C134 C135, C139, C140 C141, C142, C146 C147, C148, C150 C151, C152, C153
CC100-30	CAP., FXD, CER	A4506-1	54	C7, C8, C9, C11 C13, C14, C15, C17 C18, C19, C20, C21 C23, C24, C25, C26 C29, C36, C37, C38 C40, C42, C43, C44 C46, C47, C48, C49 C50, C52, C53, C54 C57, C58, C65, C66 C67, C69, C71, C72 C73, C76, C77, C78 C79, C80, C82, C83 C84, C85, C88, C89 C90, C91
CC100-32	CAP., FXD, CER	A4506-1	1	C156
CL275-OR82	COIL, RF, FXD	A4506-1	19	L3, L4, L5, L6, L7 L9, L12, L13, L14, L15, L16, L18, L21 L22, L23, L24, L25 L27, L28
CL275-120	COIL, RF, FXD	A4506-1	1	L31
CL275-121	COIL, RF, FXD	A4506-1	11	L29, L30, L32, L33 L34, L35, L36, L37 L38, L39, L40
CL412-36	COIL, RF, FXD	A4506-1	3	L2, L10, L19
CL412-37	COIL, RF, FXD	A4506-1	2	L11, L20
CL412-38	COIL, RF, FXD	A4506-1	1	L8
CL412-39	COIL, RF, FXD	A4506-1	1	L17
CL412-40	COIL, RF, FXD	A4506-1	1	L26
CL412-41	COIL, RF, FXD	A4506-1	1	L1
CM111C050D5S	CAP., FXD, MICA	A4506-1	7	C106, C115, C120 C130, C137, C145 C154
CM111C100J5S	CAP., FXD, MICA	A4506-1	5	C27, C32, C55 C61, C86

PART NUMBER	DESCRIPTION	USED ON ASSEMBLY	QTY PER UNIT	REFERENCE SYMBOLS
CM111C180J5S	CAP., FXD, MICA	A4506-1	1	C3
CM111E101F5S	CAP., FXD, MICA	A4506-1	1	C1
CM111E270J5S	CAP., FXD, MICA	A4506-1	3	C5, C34, C63
CM111E360J5S	CAP., FXD, MICA	A4506-1	5	C12, C41, C70 C125, C149
CM111E750J5S	CAP., FXD, MICA	A4506-1	2	C35, C64
CM111E820F5S	CAP., FXD, MICA	A4506-1	2	C31, C60
CM111F101J5S	CAP., FXD, MICA	A4506-1	1	C155
CM111F111J5S	CAP., FXD, MICA	A4506-1	2	C33, C62
CM111F131J5S	CAP., FXD, MICA	A4506-1	1	C4
CM111F181G5S	CAP., FXD, MICA	A4506-1	1	C97
CM111F621D5S	CAP., FXD, MICA	A4506-1	2	C99, C100
CM111F910J5S	CAP., FXD, MICA	A4506-1	13	C6, C105, C107 C112, C114, C119 C121, C129, C131 C136, C138, C143 C144
CR109-124	CU, QTZ 12 MHZ	A4506-1	1	Y1
CV112-1	CAP., VAR, CER	A4506-1	3	C28, C56, C87
CV112-2	CAP., VAR, CER	A4506-1	1	C101
CV112-3	CAP., VAR, CER	A4506-1	9	C10, C16, C22, C39 C45, C51, C68, C75 C81
DD139	SCOND DEV, DIO	A4506-1	2	CR1, CR2
RC07GF100J	RES, FXD, COMP.	A4506-1	1	R76
RC07GF101J	RES, FXD, COMP.	A4506-1	6	R87, R88, R128 R129, R130, R131
RC07GF102J	RES, FXD, COMP.	A4506-1	15	R2, R8, R14, R26 R32, R38, R50, R56 R62, R68, R79, R89 R95, R107, R112
RC07GF121J	RES, FXD, COMP.	A4506-1	6	R100, R85, R117
RC07GF122J	RES, FXD, COMP.	A4506-1	3	R92, R98, R103 R115, R120, R124
RC07GF150J	RES, FXD, COMP.	A4506-1	2	R93, R110
RC07GF152J	RES, FXD, COMP.	A4506-1	2	R44, R20
RC07GF153J	RES, FXD, COMP.	A4506-1	1	R74
RC07GF180J	RES, FXD, COMP.	A4506-1	7	R23, R29, R47, R53 R71, R86, R5
RC07GF181J	RES, FXD, COMP.	A4506-1	7	R24, R48, R72, R94 R106, R111, R123
RC07GF220J	RES, FXD, COMP.	A4506-1	2	R99, R116
RC07GF221J	RES, FXD, COMP.	A4506-1	9	R6, R12, R18, R30 R36, R42, R54, R60 R66
RC07GF222J	RES, FXD, COMP.	A4506-1	3	R4, R28, R52
RC07GF270J	RES, FXD, COMP.	A4506-1	2	R105, R122

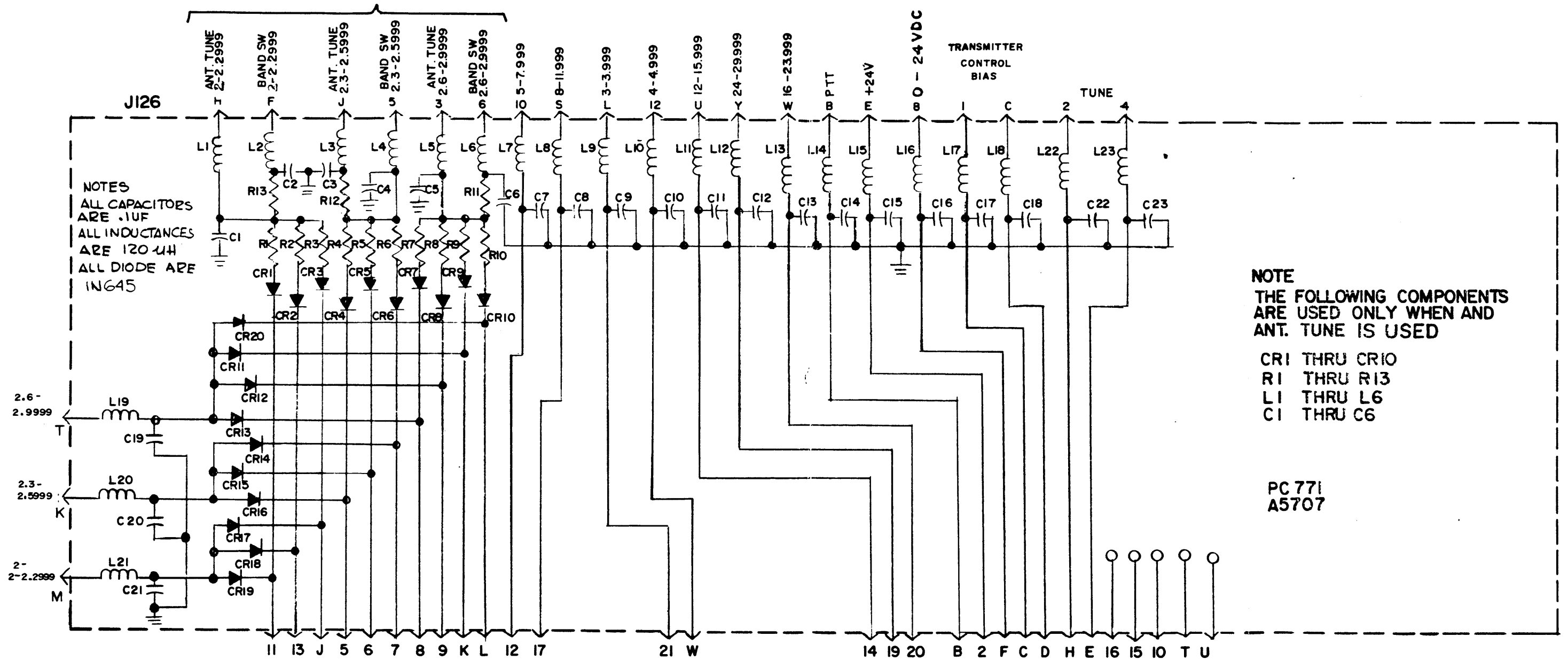
PART NUMBER	DESCRIPTION	USED ON ASSEMBLY	QTY PER UNIT	REFERENCE SYMBOLS
RC07GF271J	RES, FXD, COMP	A4506-1	11	R10, R16, R22, R34, R40, R46, R58, R64, R70, R75, R77
RC07GF331J	RES, FXD, COMP	A4506-1	7	R104, R81, R91, R97, R109, R114, R121
RC07GF332J	RES, FXD, COMP	A4506-1	1	R73
RC07GF470J	RES, FXD, COMP	A4506-1	16	R11, R13, R17, R19, R35, R37, R41, R43, R59, R132, R133, R61, R65, R67, R82, R127
RC07GF473J	RES, FXD, COMP	A4506-1	4	R102, R101, R118, R119
RC07GF560J	RES, FXD, COMP	A4506-1	3	R1, R25, R49
RC07GF680J	RES, FXD, COMP	A4506-1	4	R7, R31, R55, R83
RC07GF822J	RES, FXD, COMP	A4506-1	17	R3, R9, R15, R21, R27, R33, R39, R45, R51, R57, R63, R69, R80, R90, R96, R108, R113
RC07GF103J	RES, FXD, COMP	A4506-1	2	R125, R126
RV124-1-101	RES, VAR, COMP	A4506-1	1	R78
RV124-1-501	RES, VAR, COMP	A4506-1	1	R84
TT287-10	XFMR, RF, ADJ	A4506-1	4	T14, R16, R21, T23,
TT287-12	XFMR, RF, ADJ	A4506-1	6	T15, T24, T17, T20, T22, T13
TT287-19	XFMR, RF, ADJ	A4506-1	1	T11
TT287-21	XFMR, RF, ADJ	A4506-1	2	T18, T25
TT287-9	XFMR, RF, ADJ	A4506-1	2	T12, T19
TZ215-10	XFMR, RF, FXD	A4506-1	3	T7, T8, T9
TZ215-11	XFMR, RF, FXD	A4506-1	1	T10
TZ215-6	XFMR, RF, FXD	A4506-1	3	T1, T2, T3
TZ215-8	XFMR, RF, FXD	A4506-1	3	T4, T5, T6
1N627	SCOND DEV, DIO	A4506-1	2	CR3, CR4
1N914	SCOND DEV, DIO	A4506-1	2	CR5, CR6
2N3646	TRANSISTOR	A4506-1	7	Q14, Q15, Q16, Q17, Q18, Q19, Q20
2N5179	TRANSISTOR	A4506-1	13	Q1, Q2, Q3, Q4, Q5, Q6, Q7, Q8, Q9, Q10, Q11, Q12, Q13



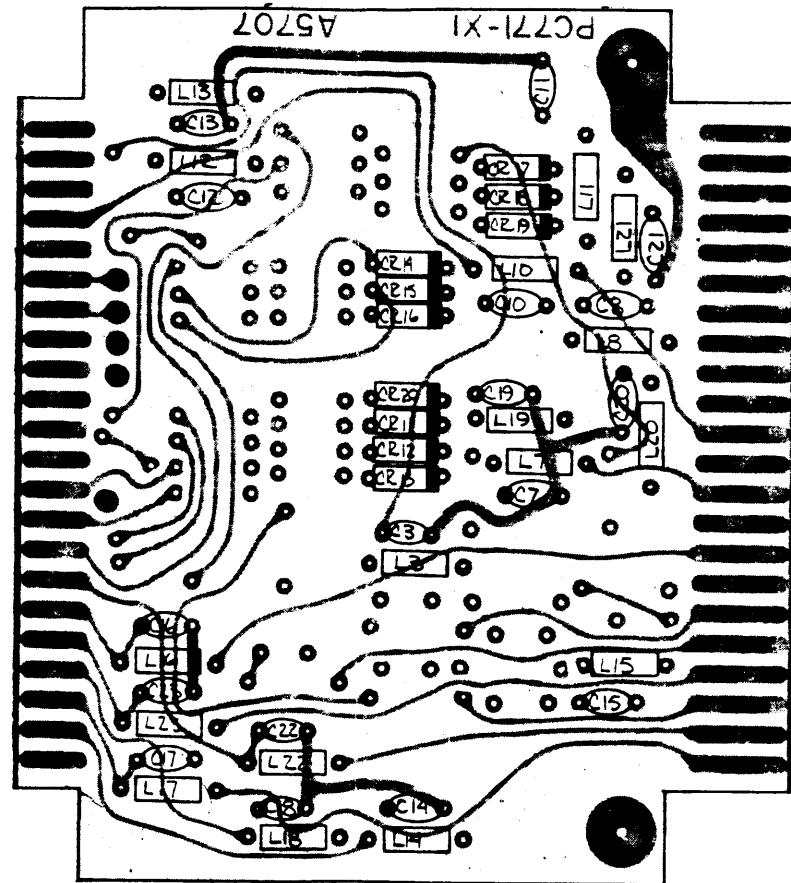


PART NUMBER	DESCRIPTION	USED ON ASSEMBLY	QTY PER UNIT	REFERENCE SYMBOLS
CC100-16	CAP., FXD, CER	A-4502-1	21	C1703, C1705, C1706, C1707, C1708, C1709, C1710, C1711, C1712, C1713, C1741, C1715, C1716, C1717, C1738, C1732, C1733, C1734, C1736, C1731, C1742
CC100-29	CAP., FXD, CER	A-4502-1	2	C1735, C1737
CC100-47	CAP., FXD, CER	A-4502-1	2	C1743, C1744
CE105-20-50	CAP., FXD, CER	A-4502-1	1	C1702
CE105-50-15	CAP., FXD, CER	A-4502-1	1	C1731
CE105-50-50	CAP., FXD, *ELECT	A-4502-1	1	C1719
CL240-120	COIL, RF, FXD	A-4502-1	7	L1701, L1702, L1703, L1704, L1705, L1706, L1708
CL240-3R9	COIL, RF, FXD	A-4502-1	1	L1707
CL240-5R6	COIL, RF, FXD	A-4502-1	1	L1724
CL275-121	COIL, RF, FXD	A-4502-1	11	L1713, L1714, L1715, L1716, L1717, L1718, L1719, L1720, L1721, L1722, L1725
CL275-2R2	COIL, RF, FXD	A-4502-1	1	L1723
CM111F621D5S	CAP., FXD, MICA	A-4502-1	1	C1718
CM112F112G5S	CAP., FXD, MICA	A-4502-1	1	C1739
CM112F821J5S	CAP., FXD, MICA	A-4502-1	1	C1714
CM112F222G5S	CAP., FXD, MICA	A-4502-1	1	C1720
CN-114-1R0-5J	CAP., FXD, MTLZ	A-4502-1	1	C1740
CN-114-R82-5J	CAP., FXD, MTLZ	A-4502-1	2	C1704, C1701
RC20GF181J	RES, FXD, COMP	A-4502-1	1	R1722
RC20GF220J	RES, FXD, COMP	A-4502-1	2	R1703, R1708
RC20GF433J	RES, FXD, COMP	A-4502-1	1	R1721
RC20GF470J	RES, FXD, COMP	A-4502-1	1	R1711
RC20GF473J	RES, FXD, COMP	A-4502-1	1	R1719
RC20GF100J	RES, FXD, COMP	A-4502-1	1	R1713
RC20GF101J	RES, FXD, COMP	A-4502-1	2	R1714, R1720
RC20GF102J	RES, FXD, COMP	A-4502-1	2	R1712, R1709
RC20GF181J	RES, FXD, COMP.	A-4502-1	1	R1722
RC20GF221J	RES, FXD, COMP	A-4502-1	1	R1718
RC20GF222J	RES, FXD, COMP.	A-4502-1	1	R1715
RC20GF332J	RES, FXD, COMP	A-4502-1	1	R1706
RC20GF562J	RES, FXD, COMP	A-4502-1	1	R1705
RC20GF821J	RES, FXD, COMP	A-4502-1	1	R1717
RC32GF102J	RES, FXD, COMP	A-4502-1	1	R1707
RV124-1-103	RES, VAR COMP	A-4502-1	2	R1701, R1702
RV124-1-502	RES, VAR, COMP	A-4502-1	1	R1704
TZ219	XFMR, RF	A-4502-1	1	T1702
TZ220	XFMR, RF	A-4502-1	1	T1701
1N100	SCOND DEV, DIO	A-4502-1	2	CR1702, CR1703
1N4864	SCOND DEV, DIO	A-4502-1	1	CR1701
2N3296	TRANSISTOR	A-4502-1	1	Q1703
2N3375	TRANSISTOR	A-4502-1	1	Q1702
2N5070	TRANSISTOR	A-5402-1	1	Q1701

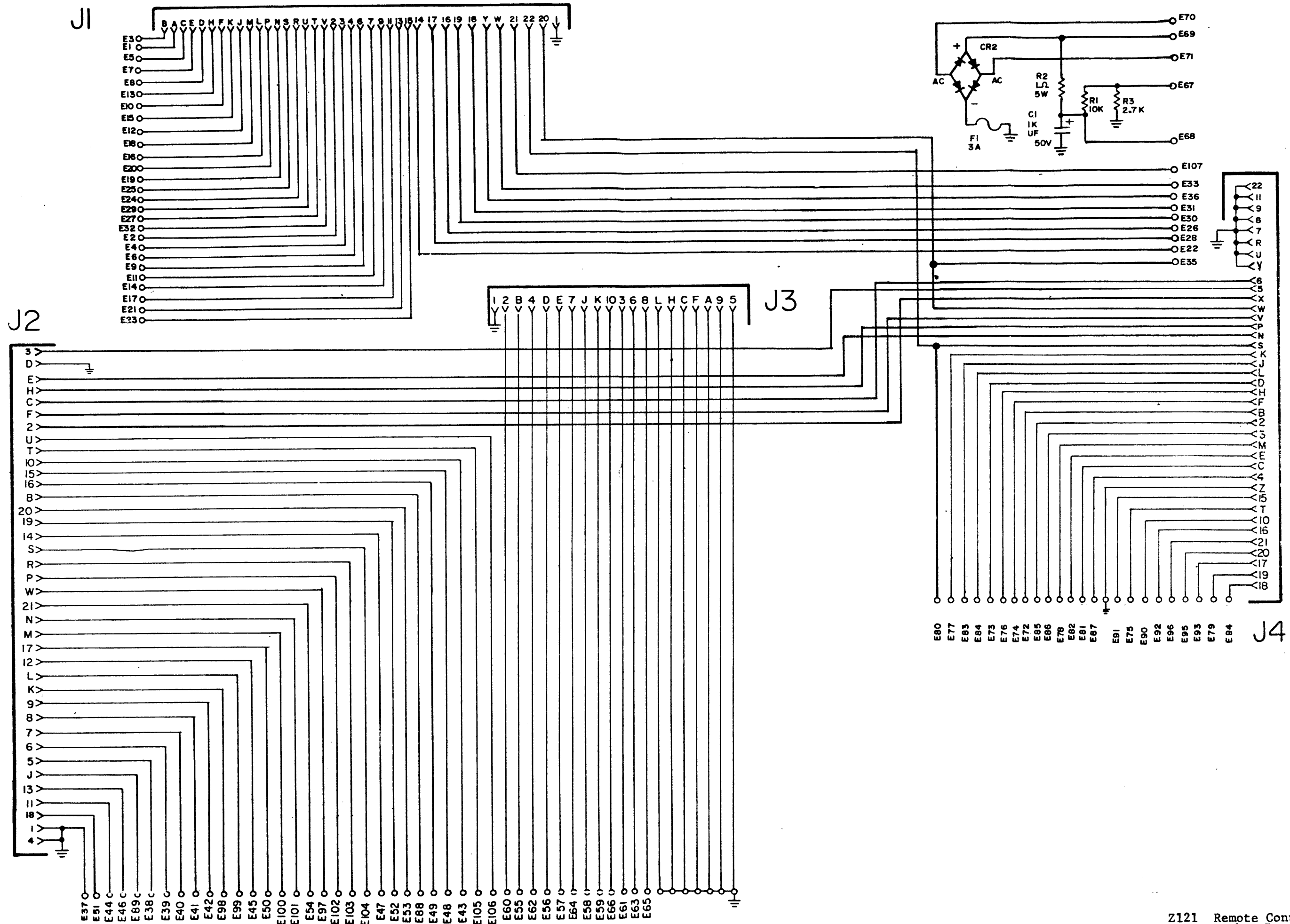
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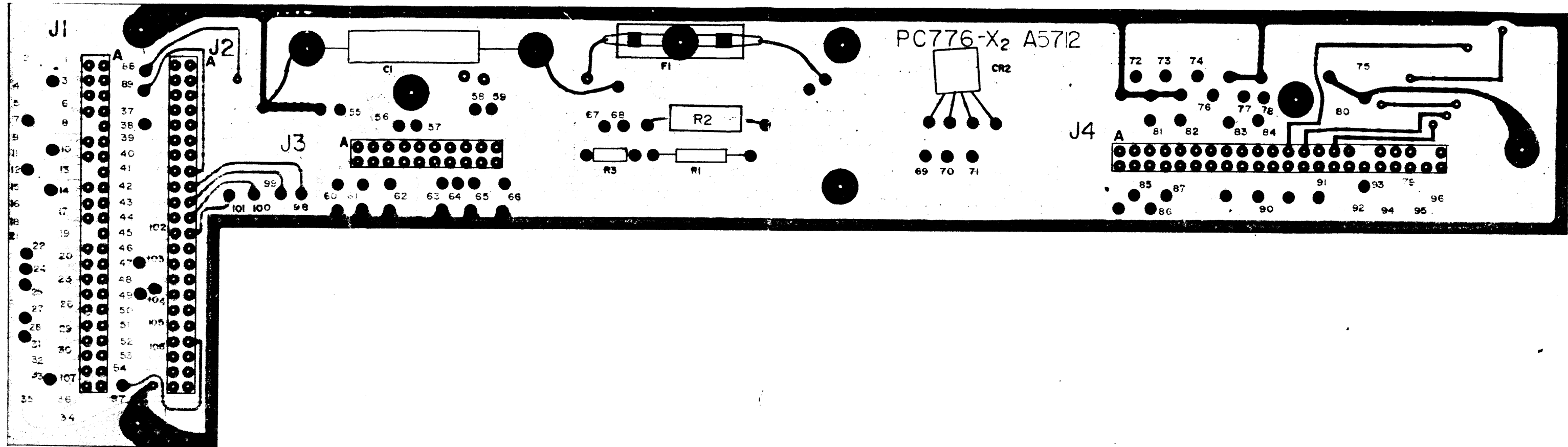


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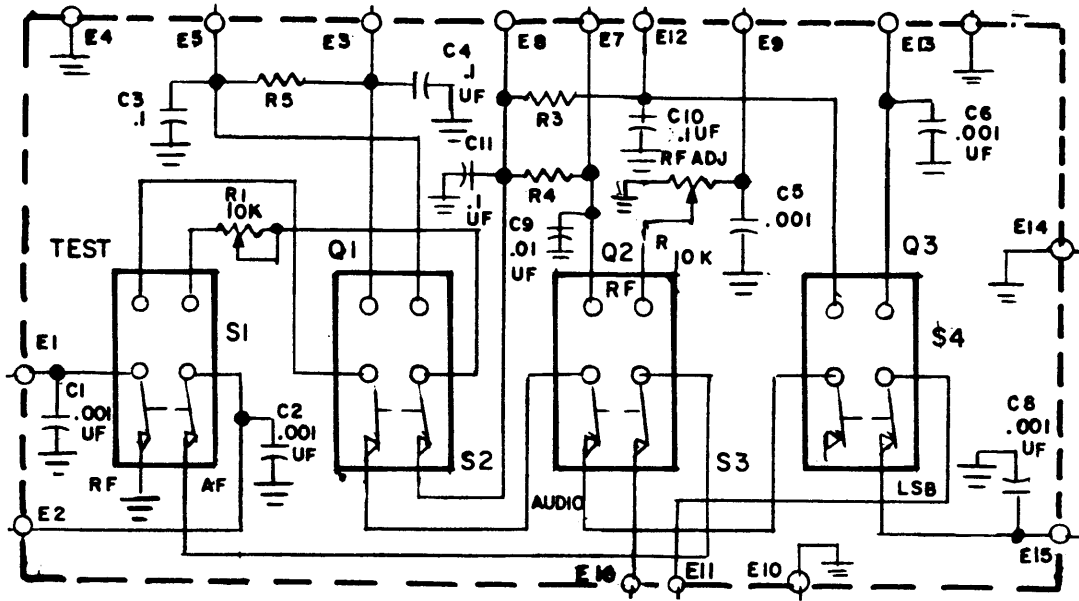


PART NUMBER	DESCRIPTION	USED ON ASSEMBLY	QTY PER UNIT	REFERENCE SYMBOLS
CC131-39	CAP, FXD, CER	A5707	23	C1, C2, C3, C4, C5, C6, C7, C8, C9, C10, C11, C12, C13, C14, C15, C16, C17, C18, C19, C20, C21, C22, C23
CL275-121	COIL, RF	A5707	23	L1, L2, L3, L4, L5, L6, L7, L8, L9, L10, L11, L12, L13, L14, L15, L16, L17, L18, L19, L20, L21, L22, L23
1N645	SCOND, DEV	A5707	20	CR1, CR2, CR3, CR4, CR5, CR6, CR7, CR8, CR9, CR10, CR11, CR12, CR13, CR14, CR15, CR16, CR17, CR18, CR19, CR20

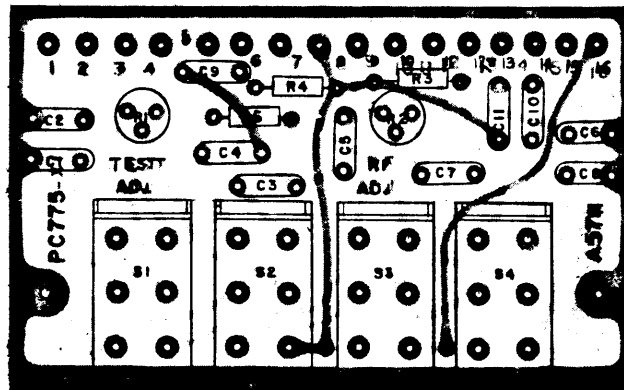




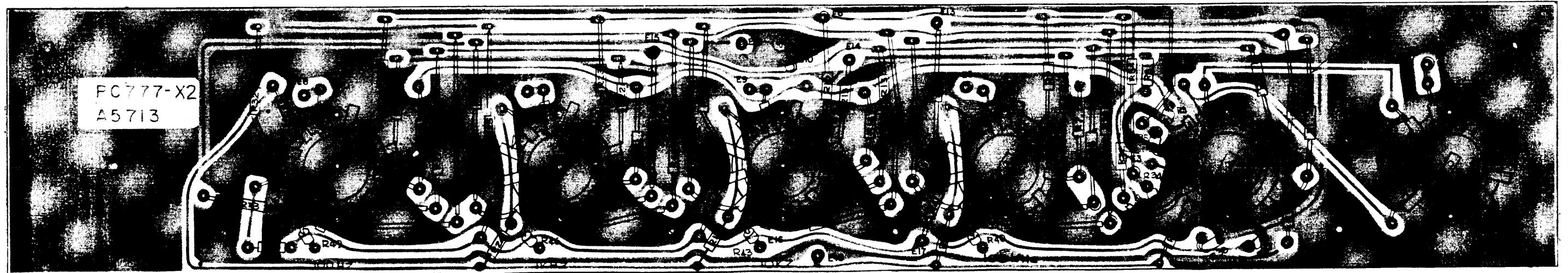
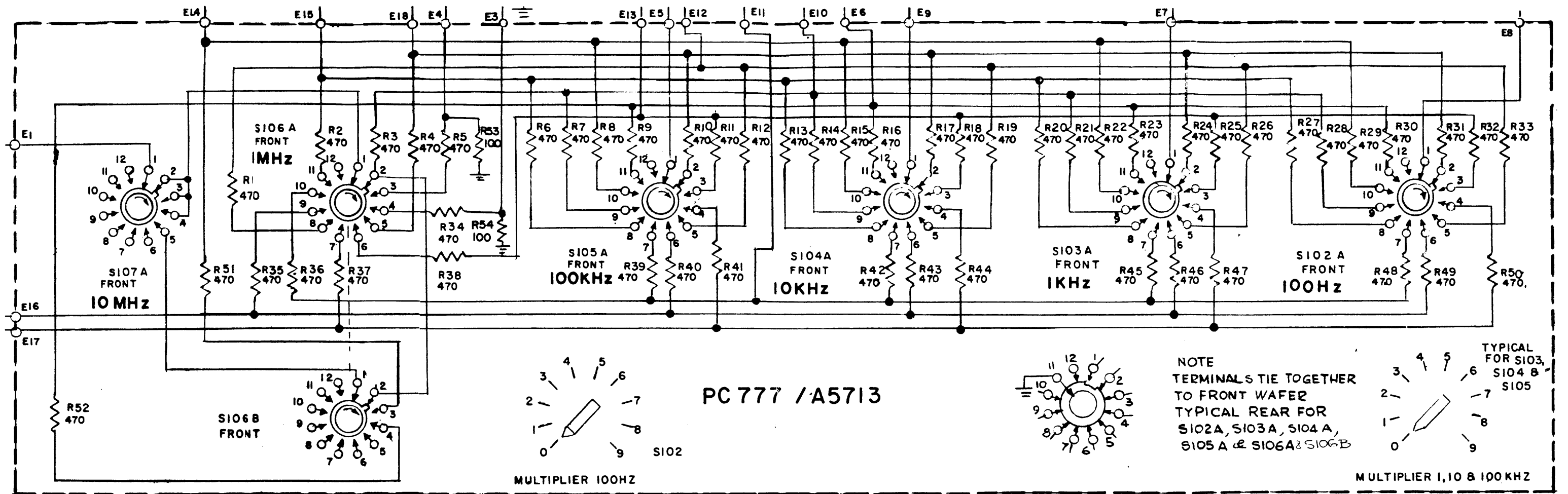
PART NUMBER	DESCRIPTION	USED ON ASSEMBLY	QTY PER UNIT	REFERENCE SYMBOLS
CE116-8VN	CAP, FXD	A5712	1	C1
DD130-200-3	RECTIFIER	A5712	1	CR2
FH105	FUSE HOLDER	A5712	1	XF1
FU102-3.0	FUSE	A5712	1	F1
JJ319-10-DPD	CONN, RECEP FEM	A5712	1	J3
JJ319-22DPD	CONN, RECEP FEM	A5712	3	J1, J2, J4
RC20GF103J	RES, FXD, COMP	A5712	1	R1
RC20GF272J	RES, FXD	A5712	1	R3
RR114-1W	1 OHM 5W	A5712	1	R2



PC 775 A5711

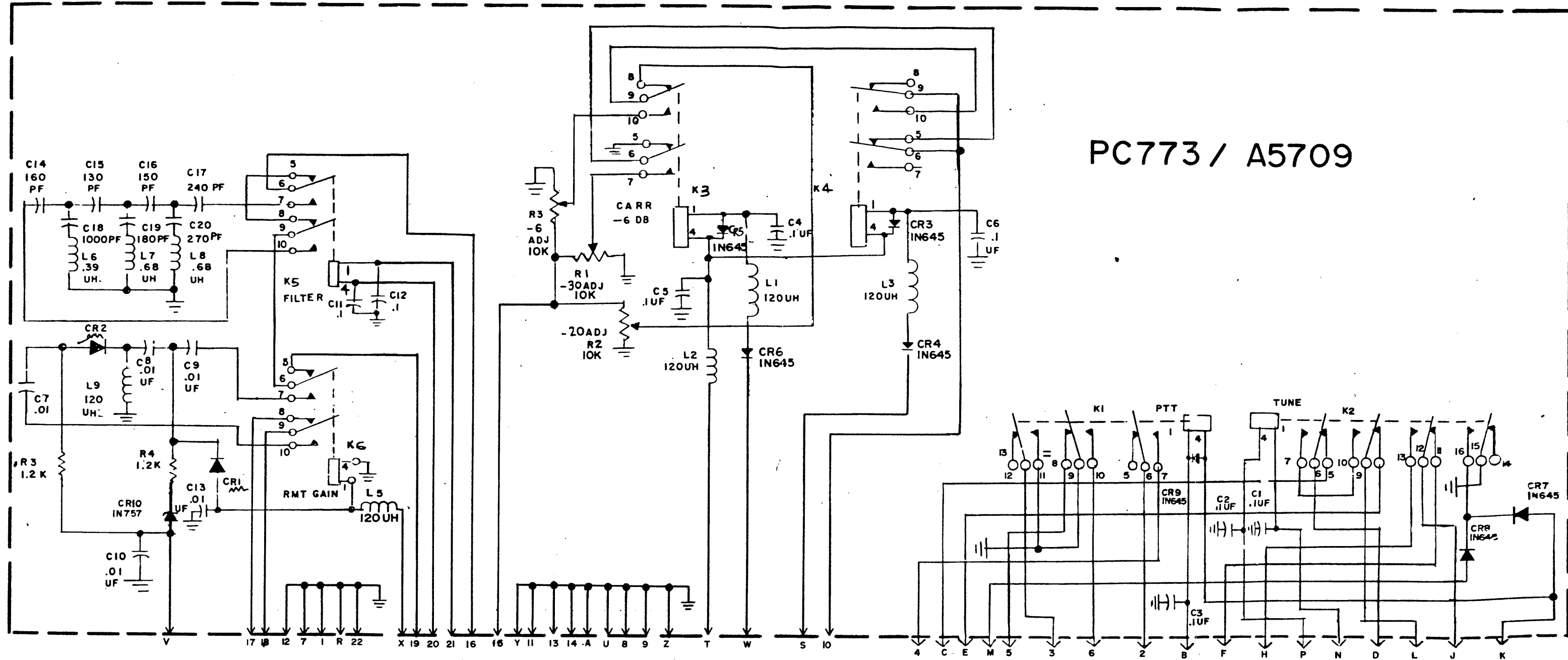


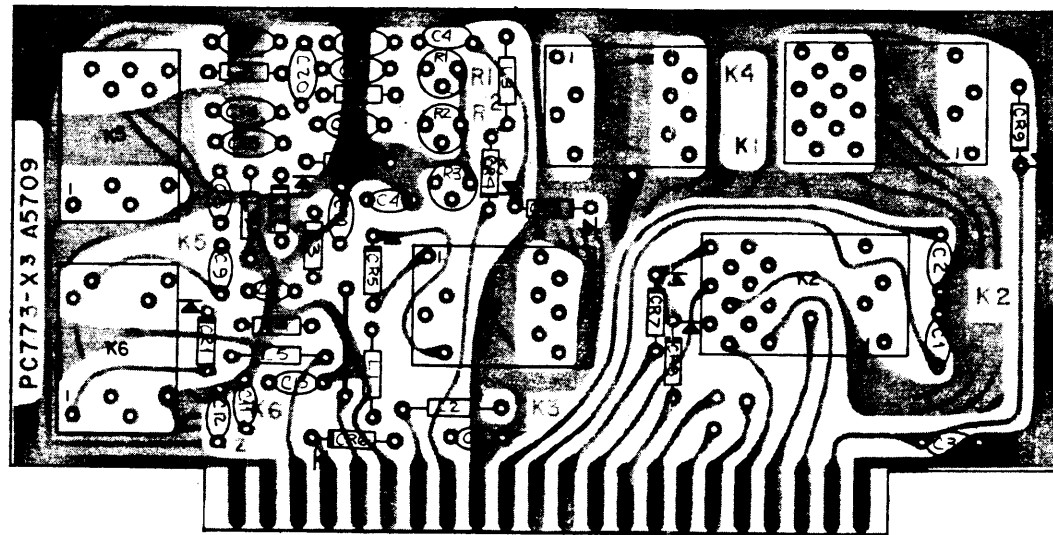
PART NUMBER	DESCRIPTION	USED ON ASSEMBLY	QTY PER UNIT	REFERENCE SYMBOLS
CC100-29 CC100-41 CC131-39 RC07GF1R0 RV124-1-103 SW559-P1	CAP., FXD, CER CAP., FXD, CER CAP., FXD, CER RES., FXD, COMP RES., VAR, COMP SWITCH, PUSH	A-5711 A-5711 A-5711 A-5711 A-5711 A-5711	5 1 4 3 2 4	C1, C2, C5, C6, C8 C9 C3, C4, C10, C11 R3, R4, R5 R1, R2 S1, S2, S3, S4



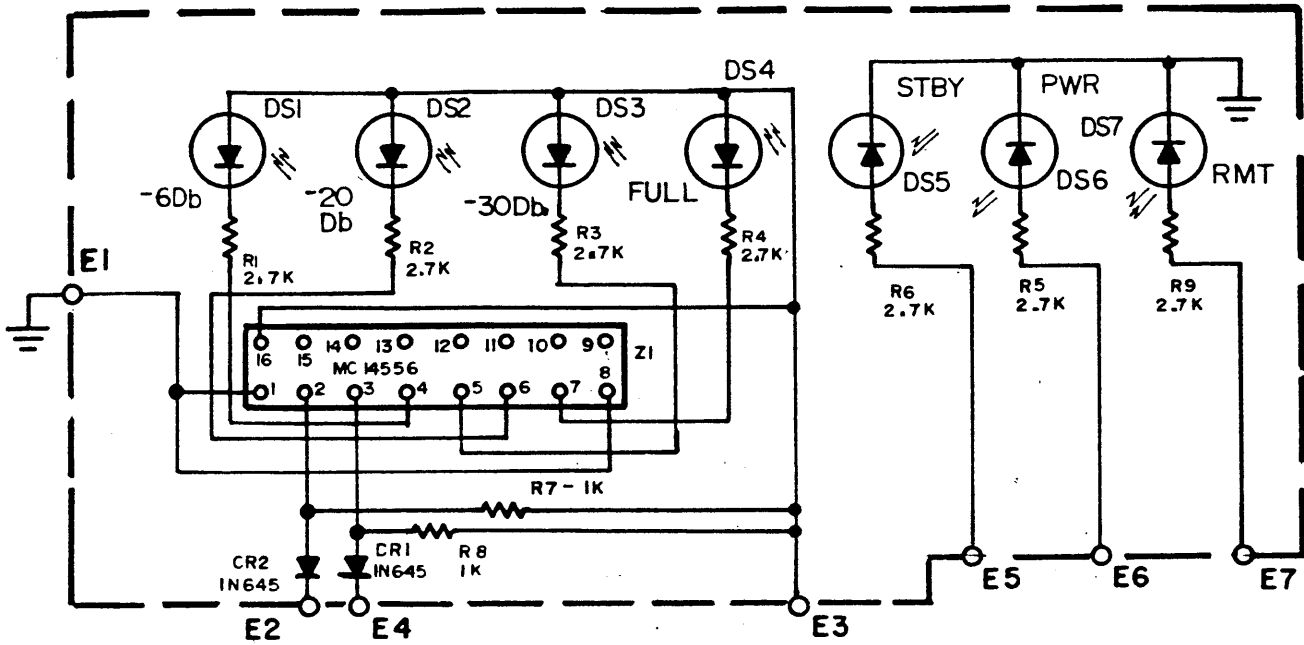
PART NUMBER	DESCRIPTION	USED ON ASSEMBLY	QTY PER UNIT	REFERENCE SYMBOLS
RC07GF101J RC07GF471J	RES, FXD, COMP RES, FXD, COMP	A5713 A5713	2 52	R53, R54 R1, R2, R3, R4, R5, R6, R7, R8, R9, R10, R11, R12, R13, R14, R15, R16, R17, R18, R19, R20, R21, R22, R23, R24, R25, R26, R27, R28, R29, R30, R31, R32, R33, R34, R35, R36, R37, R38, R39, R40, R41, R42, R43, R44, R45, R46, R47, R48, R49, R50, R51, R52
WS147	WAFER, SWITCH	A5713	7	S102A, S103A, S104A, S105A, S106A, S106B, S107A

PC773 / A5709

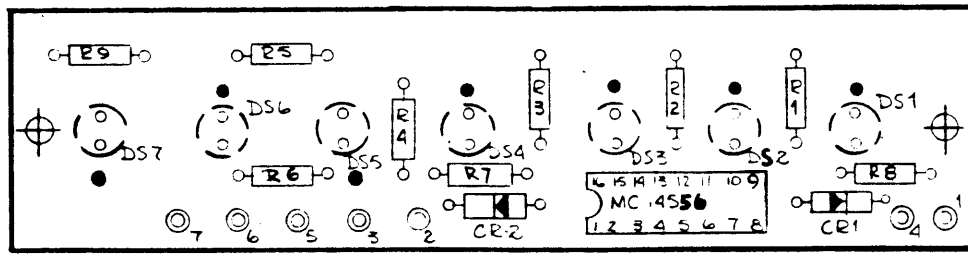




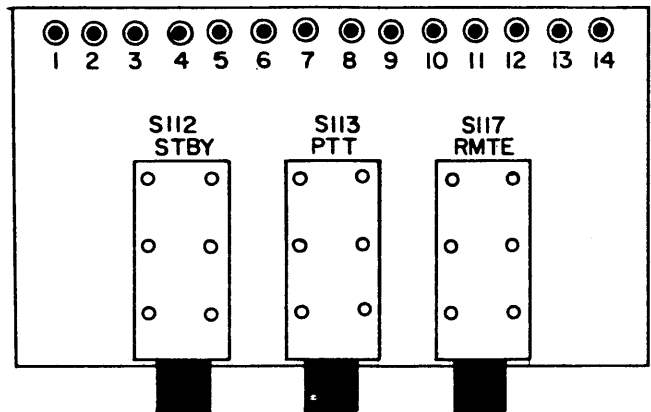
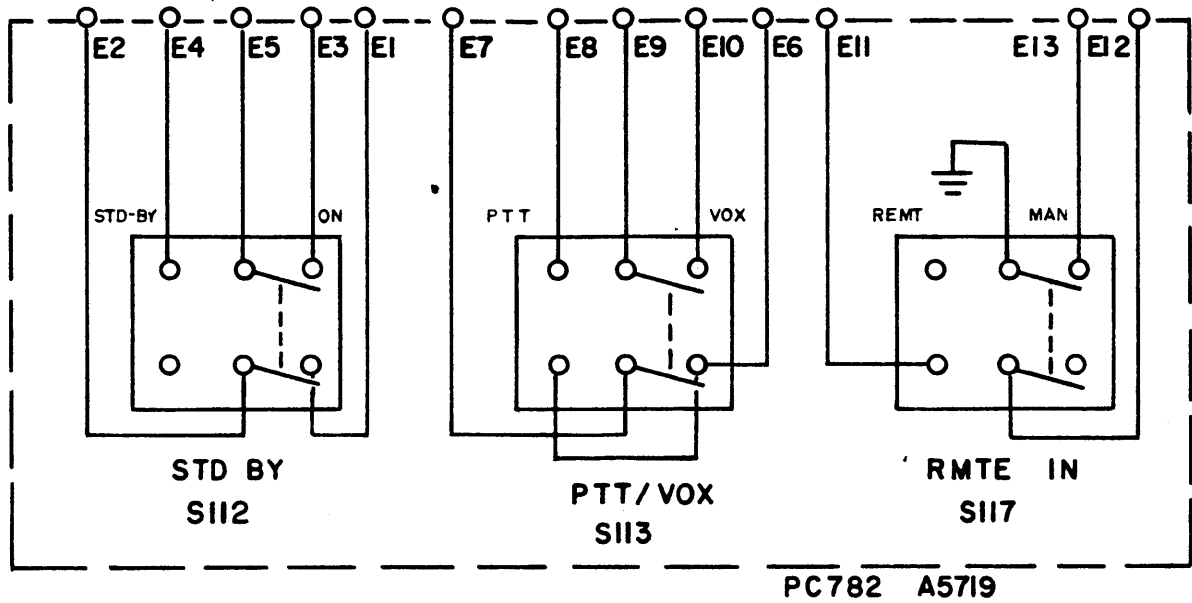
PART NUMBER	DESCRIPTION	USED ON ASSEMBLY	QTY PER UNIT	REFERENCE SYMBOLS
CC100-43	CAP., FXD, CER	A5709	5	C7, C8, C9, C10, C13
CC131-39	CAP., FXD, CER	A5709	8	C1, C2, C3, C4, C5, C6, C11, C12
CL275-121	CHOKE, RF	A5709	5	L1, L2, L3, L4, L5
CL275-OR39	CHOKE, RF	A5709	1	L6
CL275-OR68	CHOKE, RF	A5709	2	L7, L8
CM111F131J5S	CAP., FXD, MICA	A5709	1	C15
CM111F151J5S	CAP., FXD, MICA	A5709	1	C16
CM111F161J5S	CAP., FXD, MICA	A5709	1	C14
CM111F181J5S	CAP., FXD, MICA	A5709	1	C19
CM111F271J5S	CAP., FXD, MICA	A5709	1	C20
CM111F241J5S	CAP., FXD, MICA	A5709	1	C17
CM112F102J5S	CAP., FXD, MICA	A5709	1	C18
RC07GF122J	RES., FXD, COMP.	A5709	2	R4, R5
RL156-1	RELAY	A5709	4	K3, K4, K5, K6
RL156-8	RELAY	A5709	2	K1, K2
RR136	RES, CURR CONT.	A5709	2	CR1, CR2
RV124-1-103	RES., VAR	A5709	3	R1, R2, R3
TS171-4	SOCKET, RELAY	A5709	2	XK101, XK102
TS171-5	SOCKET, RELAY	A5709	4	XK104, XK105, XK106, XK103
1N645	SCOND, DEV, DIO	A5709	7	CR3, CR4, CR5, CR6, CR7, CR8 CR9
1N757	SCOND, DEV	A5709		CR10



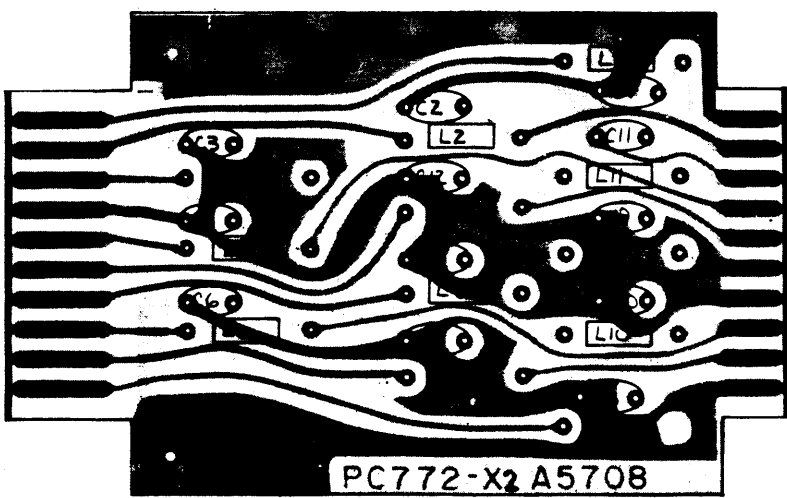
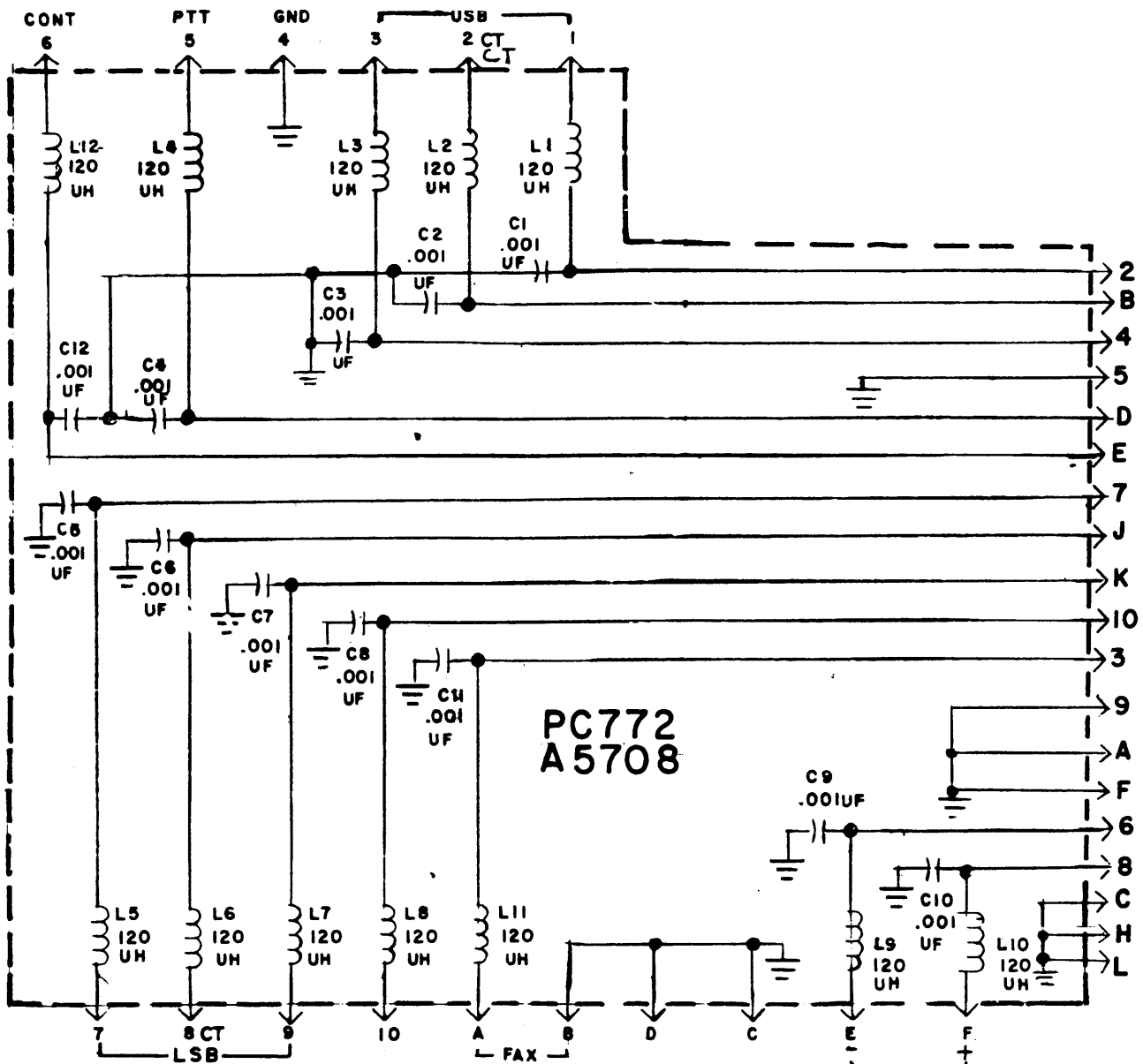
PC774 / A5710



PART NUMBER	DESCRIPTION	USED ON ASSEMBLY	QTY PER UNIT	REFERENCE SYMBOLS
BI 132 MC14556B RC20GF102J RC20GF272J 1N645	L. E. D. I. C. RES, FXD, COMP RES, FXD, COMP SCOND, DEV, DIO	A-5710 A-5710 A-5710 A-5710 A-5710	7 1 2 7 2	DS1, DS2, DS3, DS4, DS5, DS6, DS7 Z1 R7, R8 R1, R2, R3, R4, R5, R6, R9 CR1, CR2

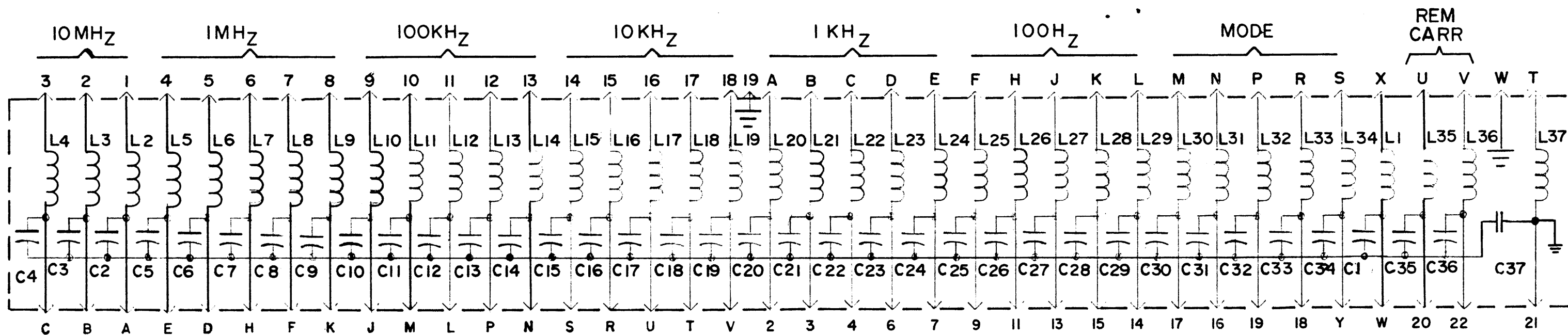


PART NUMBER	DESCRIPTION	USED ON ASSEMBLY	QTY PER UNIT	REFERENCE SYMBOLS
SW559-P1	SW PUSH	A-5719	3	S112, S113, S117



Z127 Audio Decoupling (A5708)

PART NUMBER	DESCRIPTION	USED ON ASSEMBLY	QTY PER UNIT	REFERENCE SYMBOLS
CC100-29	CAP, FXD, CER	A5708	12	C1,C2,C3,C4,C5,C6,C7, C8,C9,C10,C11,C12 L1,L2,L3,L4,L5,L6,L7, L8,L9,L10,L11,L12
CL275-121	COIL, RF	A5708	12	

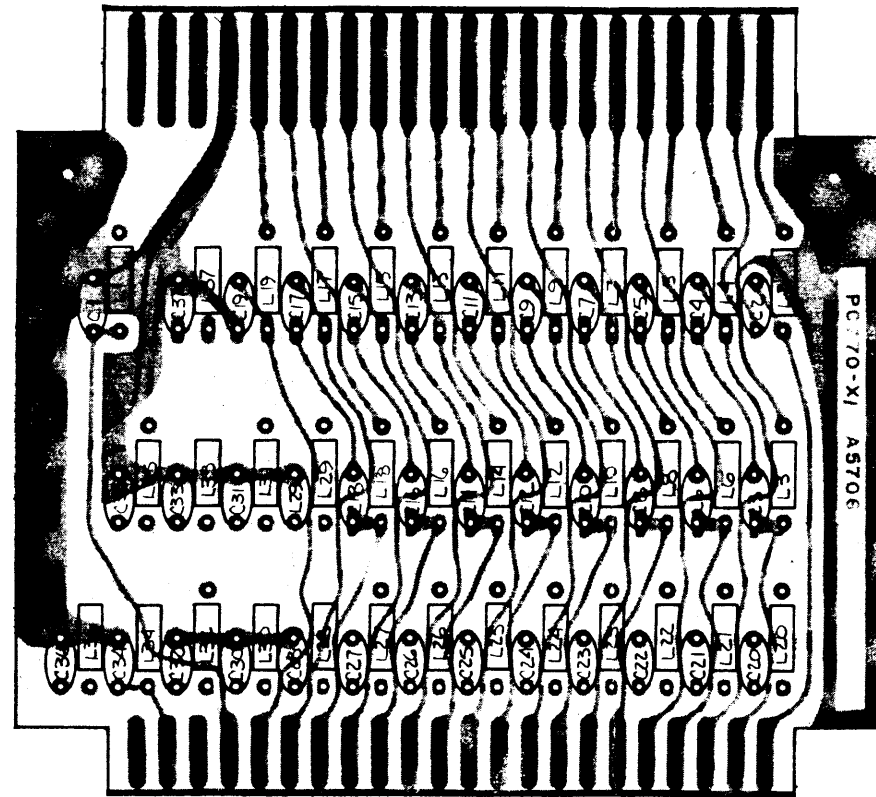


PC770/A5706

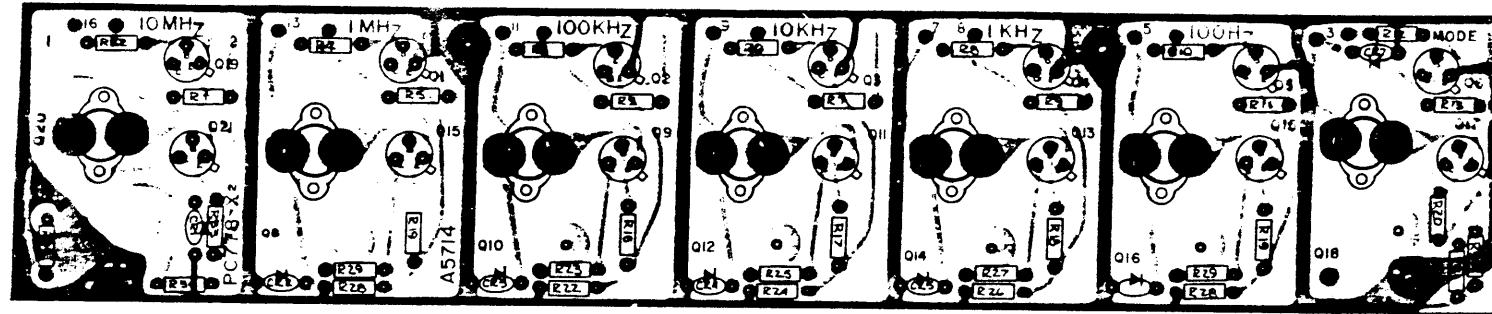
NOTE

L1 THRU L37 (120uh)

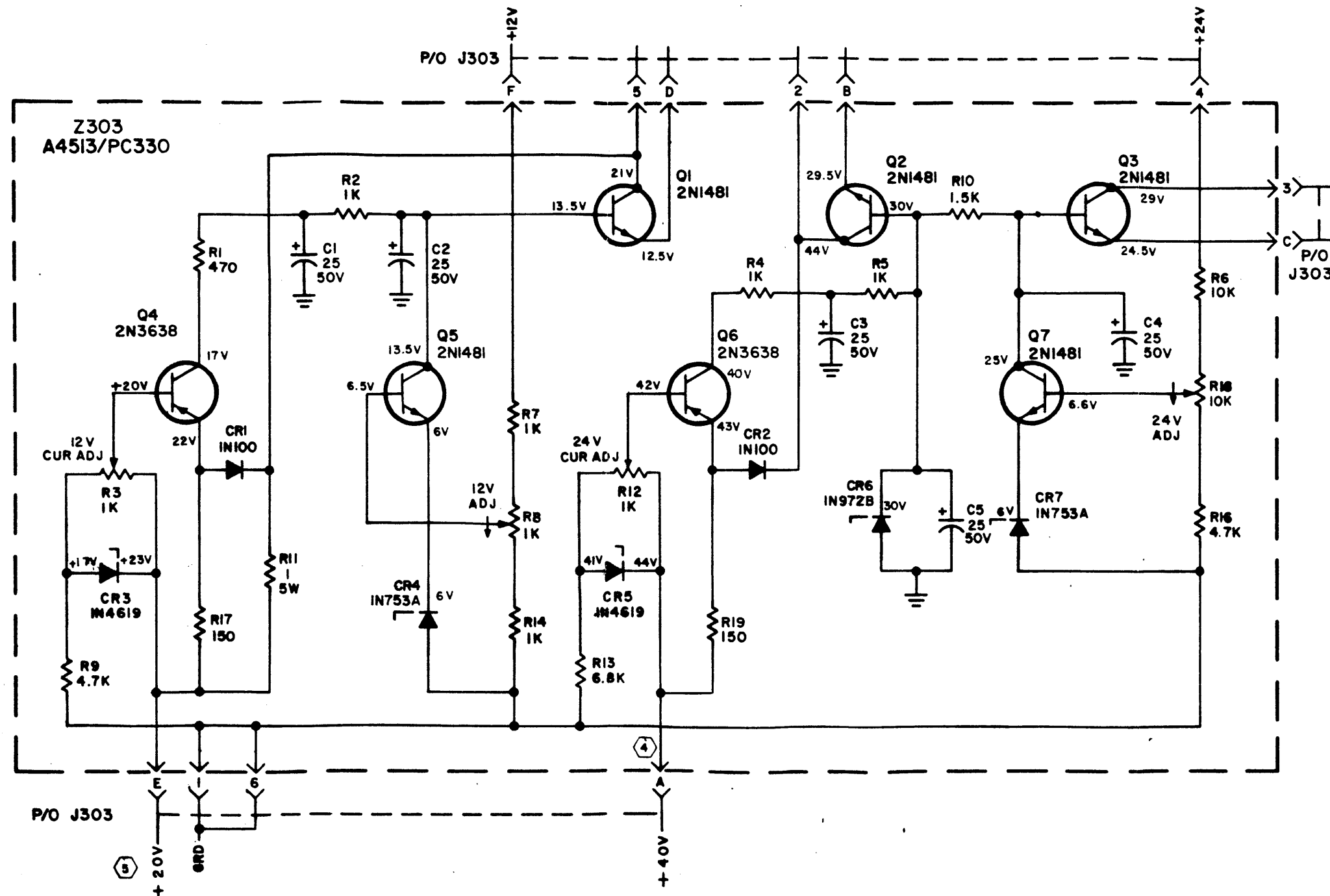
C1 THRU C37 (.1uf)

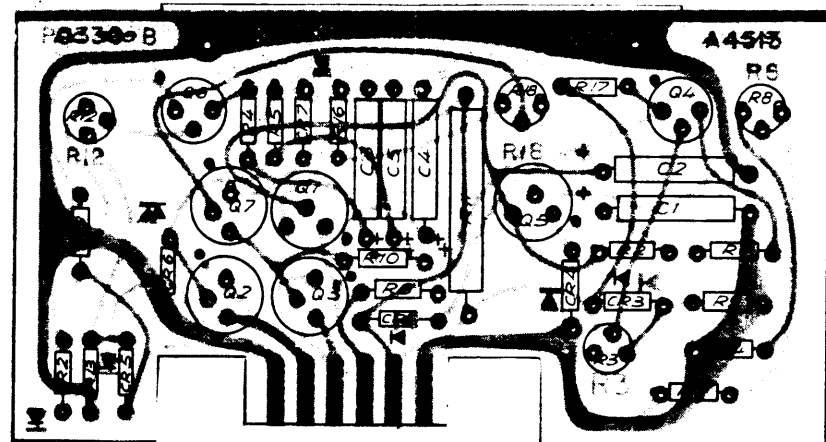


PART NUMBER	DESCRIPTION	USED ON ASSEMBLY	QTY PER UNIT	REFERENCE SYMBOLS
CC131-39	CAP., FXD, CER	A-5706	37	C1, C2, C3, C4, C5 C6, C7, C8, C9, C10 C11, C12, C13, C14, C15, C16, C17, C18 C19, C20 C21, C22, C23, C24, C25, C26 C27, C28, C29, C30 C31, C32, C33, C34 C35, C36, C37
CL275-121	COIL, RF	A-5706	37	L1, L2, L3, L4, L5, L6, L7, L8, L9, L10 L11, L12, L13, L14 L15, L16, L17, L18 L19, L20, L21, L22 L23, L24, L25, L26 L27, L28, L29, L30 L31, L32, L33, L34 L35, L36, L37

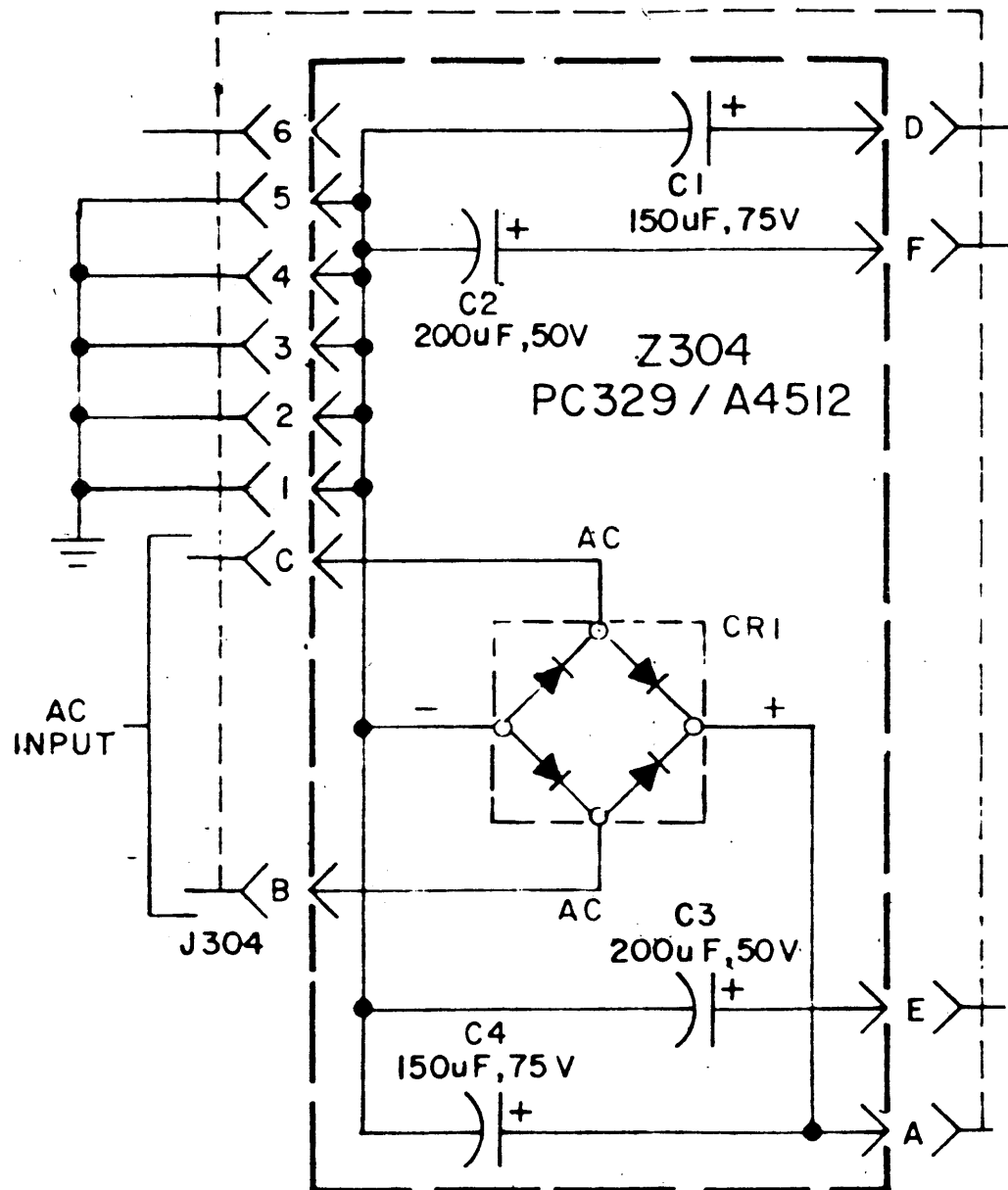


PART NUMBER	DESCRIPTION	USED ON ASSEMBLY	QTY PER UNIT	REFERENCE SYMBOLS
RC20GF122J	RES, FXD, COMP	A5714	7	R1,R3,R7,R9,R11,R13,R5
RC20GF221J	RES, FXD, COMP	A5714	7	R21,R23,R25,R27,R29,R31,R35
RC20GF222J	RES, FXD, COMP	A5714	7	R14,R22,R24,R26,R28,R34,R30
RC20GF472J	RES, FXD, COMP	A5714	7	R2,R4,R6,R8,R10,R12,R32
RC20GF473J	RES, FXD, COMP	A5714	7	R15,R16,R17,R18,R19,R20,R33
TS166-1	SKT SCOND DEV	A5714	7	XQ8,XQ10,XQ12,XQ14,XQ16,XQ18,XQ20
TS212	SKT SCOND DEV	A5714	14	XQ1,XQ2,XQ3,XQ4,XQ5,XQ6,XQ7,XQ9,XQ11,XQ13,XQ15,XQ17,XQ19,XQ21
1N645	SCOND DEV, DIO	A5714	7	CR1,CR2,CR3,CR4,CR5,CR6,CR7
2N1711	TRANSISTOR	A5714	14	Q1,Q2,Q3,Q4,Q5,Q6,Q7,Q9,Q11,Q13,Q15,Q17,Q19,Q21
2N3055	TRANSISTOR	A5714	7	Q8,Q10,Q12,Q14,Q16,Q18,Q20





PART NUMBER	DESCRIPTION	USED ON ASSEMBLY	QTY PER UNIT	REFERENCE SYMBOLS
CE107-6	CAP, FXD, ELECT	A4513	5	C1, C2, C3, C4, C5
RC07GF102J	RES, FXD, COMP	A4513	5	R2, R4, R5, R7, R14
RC07GF103J	RES, FXD, COMP	A4513	1	R6
RC07GF151J	RES, FXD, COMP	A4513	2	R17, R19
RC07GF152J	RES, FXD, COMP	A4513	1	R10
RC07GF471J	RES, FXD, COMP	A4513	1	R1
RC07GF472J	RES, FXD, COMP	A4513	2	R9, R16
RC07GF682J	RES, FXD, COMP	A4513	1	R13
RR114-1.0W	RES, FXD, WW-5W	A4513	1	R11
RV124-1-102	RES, VAR, COMP	A4513	3	R3, R8, R12
RV124-1-103	RES, VAR, COMP	A4513	1	R18
1N100	SCOND DEV, DIO	A4513	2	CR1, CR2
1N753A	SCOND DEV, DIO	A4513	2	CR4, CR7
1N972B	SCOND DEV, DIO	A4513	1	CR6
1N4619	SCOND DEV, DIO	A4513	2	CR3, CR5
2N1481	TRANSISTOR	A4513	5	Q1, Q2, Q3, Q5, Q7
2N3638	TRANSISTOR	A4513	2	Q4, Q6



PART NUMBER	DESCRIPTION	USED ON ASSEMBLY	QTY PER UNIT	REFERENCE SYMBOLS
CE105-150-75	CAP., FXD, ELECT	A-4512	2	C1, C4
CE105-200-50	CAP., FXD, ELECT	A-4512	2	C3, C4
DD144-6	RECT. SCOND DEV	A-4512	1	CR1

