WORLD WIDE SUPPLIERS OF ELECTRONIC COMMUNICATIONS EQUIPMENT

Publication: 202019

Issue Date: May 1989

TECHNICAL MANUAL

MF/HF Synthesized Exciter

Model MMX-4

The Technical Materiel Corporation
700 Fenimore Road
Mamaroneck, New York 10543-0142 U.S.A.

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Warranty

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

TMC will replace or repair any such defective items, FOB factory, which may fail within the stated warranty period, provided:

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

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All inquiries should be directed to the following:

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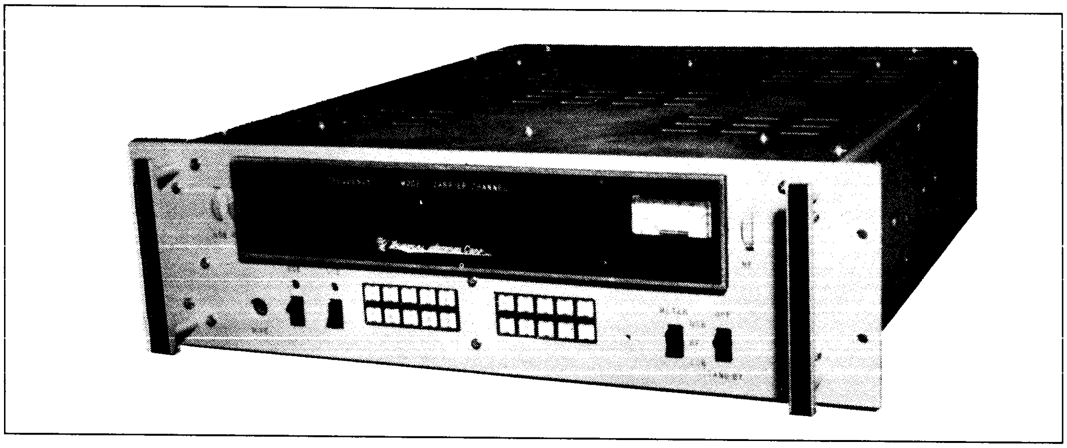


MF/HF Synthesized Exciter, Model MMX-4

THE TECHNICAL MATERIEL CORPORATION

COMMUNICATIONS ENGINEERS

1.1 Introduction

This manual covers operating and maintenance procedures for the MF/HF Synthesized Exciter, Model MMX-4, designed and manufactured by The Technical Materiel Corporation (TMC) of Mamaroneck, New York (United States).

1.2 Purpose and Use of Equipment

The MMX-4 exciter is a solid-state device used to control the output frequency in a single or independent sideband transmitting system. It provides amplitude modulated (AM); amplitude modulated equivalent (AME); single sideband (USB or LSB); or two-channel independent sideband (ISB) intelligence on an RF carrier frequency between 1.6 and 29.9999MHz. In addition, the exciter is capable of providing an output of up to 250 milli-watts for continuous wave (CW); carrier frequency shift keying (FSK); and facsimilie (FAX) modes. At reduced power levels, the exciter provides synthesized frequencies down to 400KHz. When combined with TMC's external multiplexor and equalized sideband filters, the MMX-4 can provide four-channel ISB operation to DCA/NATO specifications (See product bulletin for TMC Model SBG-5).

The MMX-4 features built-in frequency stability of four (4) parts in 10^7 per day with provision for using either internal or external 1MHz frequency standards with significantly higher stabilities. The output of the exciter in AM, AME, SSB and ISB modes is continuously adjustable up to 250 milliwatts - sufficient drive for transmitters operating at power levels of 10KW, 40KW and 200KW (See product bulletins for TMC Models HFT-10K, HFT-40K and HFT-200K).

1.3 Identification

The MMX-4 is identified by a metal nameplate affixed to the front panel at the upper left-hand corner of the unit. When installed in a TMC transmitter system, the nameplate is transferred to the right-hand side of the chassis. The nameplate is engraved with the generic name, TMC model number, and serial number of the exciter. Similar information, including the manufacturing lot number, is stamped on a metal foil and affixed to the rear panel.

One basic model of the MMX-4 exciter is manufactured and is referred to throughout this manual as simply the MMX-4 exciter. The exciter contains its own microprocessor and memory (RAM/ROM) banks. Data required by automated and remote transmitter systems for proper operation is "burned" into memory at the factory prior to delivery. In addition, BITE data on transmitter systems equipped with this option is accumulated and stored in the exciter until a memory dump is requested to a slave printer.

The MMX-4 is the latest version of the MMX series of multimode exciters which have been nomenclatured by the United States military as follows:

MD-846/UR Modulator/Demodulator
O-1706 Oscillator

The MMX series are used extensively throughout the world and provide the standard RF drive for the following transmitter systems:

HFT-10K	AN/URT-37(v)
GPT-10K	AN/FRT-39(v); AN/FRT-52; AN/FRT-65; AN/FRT-68
GPT-40K	AN/FRT-40(v); AN/FRT-54
GPT-200K	AN/FRT-62
SBT-1K	AN/FRT-70; AN/URT-19(v); AN/FRT-53; AN/FRT-56

The MMX-4 is totally compatible with all TMC General Purpose Transmitters (GPT); High Frequency Transmitters (HFT); Medium Frequency Transmitters (MFT/BCT); and Low Frequency Transmitters (LFT/GPT-L).

1.4 Function Description

The MMX-4 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 into the exciter. Only RF, audio and AC power lines are required for proper operation to specification.

Front panel controls permit operator selection of the operating modes which include CW, AM, USB, LSB, ISB, AME 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 to -6dB, -20dB, -30dB and FULL (-55dB) but can be changed in the field to other values. Similarly, the optional FSK feature is pre-set for carrier shifts of +/-42.5Hz, +/-85Hz, +/-170Hz and +/-425Hz. The carrier shift is selectable at the rear panel and can be changed in the field as required.

Front panel controls include level adjusts for USB or LSB line/mike inputs and for RF output. A build-in meter indicates RF output and audio levels of the exciter. A front panel jack permits a 55dBm low-impedance microphone or a dry contact keyer to be coupled to the exciter.

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

1.5 Physical Description

The majority of the electronic components which constitute the exciter are mounted on removeable printed circuit cards which plug in to the chassis and are easily accessible from the top and bottom of the exciter by removal of protective covers.

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 Technical Specifications

OPERATING PARAMETERS

Frequency Range	1.6 to 29.9999MHz 400KHz to 29.9999MHz at reduced power
Frequency Selection	Direct synthesis in 100Hz steps
Phase jitter	Less than five degress in two successive ten millisecond periods.
Frequency Stability	Four (4) parts in 10^7 per day/15°C change
Optional	One part in 10^9 per day/15°C change
Frequency Display	Front panel digital with blue-green lens
Modes of Operation	CW(A1), AM(A3), AME(A3H), USB/LSB(A3A,A3J), ISB(A3B).
Optional	FSK(F1) and FAX(F4)
Power Output	250mW PEP and Average (CW)
Input/Output Impedance	50 ohms (nominal) unbalanced, BNC-type connector
Control	Local control by depressing front-panel push-buttons
Optional	Remote monitor and control of frequency, mode, carrier and status.

AUDIO PARAMETERS

Audio Sideband Response	250-3040Hz, +/-1.5dB CCIR
Optional	250-6080Hz, +/-1.5dB CCIR Equalized Filters (Special order) 250-3040Hz, 1.5dB Maximum
Envelope delay	Less than 500usec, 600-2900Hz; Less than 150usec for any 100Hz step, 500-3050Hz
Audio Input	1. Independent 600-ohm channels, balanced or unbalanced -20 to +1-dBm; rear-apron terminals 2. Built-in microphone pre-amplifier for low-level dynamic input -55dB into 47K-ohms; front-panel jack.
Keying Input	1. CW key jack on front panel; 200-baud; dry contact 2. FSK: 75-baud or optional 200-baud; dry contact. Shift: +/-42.5/85/170/425Hz; Others on request. 3. FAX: +1 to +10vdc produces 800Hz linear shift. Audio FSK operation, single or multi-tone, is available using TMC Model TIS-3 tone keyer.

TRANSMIT CHARACTERISTICS

Unwanted Sideband Reject	500Hz tone is a minimum 60dB below PEP
Spurious Signals	Nominal 60dB below PEP
Intermodulation Distortion	Minimum 40dB below either tone of a two-tone test at 250mw PEP
Residual Noise and Hum	Minimum, 70dB below PEP. Power supply ripple 55dB below PEP.
Carrier Suppression	Selectable at -6, -20, -30, -55dB (FULL). Others on request.

ENVIRONMENTAL AND INSTALLATION

Cooling	Convection; requires three (3) inch clearance.
Operating Conditions	0 to +50°C; Up to 95% relative humidity at MSL.
Storgae Conditions	-30°C to +80°C; Up to 95% relative humidity at MSL.
Power Supply	Totally solid state. 115 or 230 volts AC +/-10%, 50/60/400Hz, single phase.
Size and Weight	5.25 inches high x 19 inches wide x 20 inches deep 13.4 cm wide x 48.3 cm wide 50.8 cm deep, 27 pounds (12.3Kg)
Shipping Data	Commercial packing for domestic U.S. (air) shipment. One (1) container - 10 x 30 x 30 inches (25.4 x 76.2 x 76.2 cm) Total weight - 58 pounds (26.4 Kg) Total cube - 5.2 cu.ft. (0.15 cu. meters)

TECHNICAL SPECIFICATIONS ARE SUBJECT TO CHANGE WITHOUT NOTICE

1.7 MMX-4 Product Group

MMX-4 **MF/HF Synthesized Exciter, CW/AM/AME/USB/LSB/2ISB/FSK**

MMX-4/U **MF/HF Synthesized Exciter, CW/AME/USB**

MMX-4/E **MF/HF Synthesized Exciter, [MMX-4 with extended range]**

Note: Other variations of the MMX-4 are available to suit applications.

Table 1.1

EQUIPMENT SUPPLIED

The major components supplied are listed as follows:

1 Each	BMA106	MMX-4 Final Assembly
1 Each	AO121	3MHz VCXO Crystal Oscillator (Installed)
1 Each	NF123	1MHz Frequency Standard Oscillator (Installed)
1 Each	LP155	Loose Items Package
1 Each	M202019	Technical Manual
1 Each	NF116-3	Optional External Standard Assembly

Section 2 - Installation and Set-Up

2.1 Introduction

This section covers the requirements for preparing the MMX-4 exciter for use. It includes procedures for unpacking and inspection; electrical and mechanical installation considerations; and power requirements.

2.2 Unpacking and Inspection

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.

After inspecting the shipping container, the exciter may be unpacked. The exciter, loose items package and technical manual are normally shipped in a single, heavy duty, tri-wall carton when the method of shipment is air freight or the destination is within the United States. All other shipments require the use of a wood box and sealed barrier bag which enclose the carton. The container number and contents are labelled on the outside of each carton or box.

2.3 Uncrating Method

When a wood box is used, remove nails from the top and two adjacent sides of the container with a nail puller. DO NOT USE claw hammers, pinch bars or other leverage devices which may crush the container and damage the exciter. After the sides are removed, remove the top covering to expose the barrier bag. Using a knife, open the barrier bag at the sealed end to expose the cardboard container.

- [ ] Remove the pressure-sensitive tape and staples from the cardboard container taking precautions not to crush the container.
- [ ] Remove the dessicant bags, loose items package and technical manual from the container.
- [ ] Remove the foam form and granules to expose the exciter. Note that the exciter is encased in plastic wrapping to prevent inadvertant damage to its surface finish.
- [ ] Carefully remove the exciter from the container and transfer it to a test bench.

- ☐ Remove the platic wrapping from the exciter and inspect the equipment for signs of external damage such as nicks, scratches, cracks, discolored paint or other signs of mishandling.

- ☐ Exercise all switches and controls on the front panel to check for ease of operation without mechanical binding.

- ☐ Check the condition of all connectors for damage such as bent or broken pins, burred threads or worn locks.

- ☐ Re-pack the packing material in the container in reverse order. It is useful to keep this container in storage for future use should further shipment of the exciter becomes necessary.

2.4 Power Requirements

The exciter is designed for operation at 115 or 230 volts AC, 50/60Hz single phase primary power.

Unless otherwise specified by the customer, THE EXCITER IS SHIPPED WIRED FOR 115VAC.

To verify that this setting is correct, take the following steps:

- ☐ Remove the top cover by loosening the threaded screws securing it the main chassis.

- ☐ Inspect the two power transformer input terminals to verify parallel connection of the primary winding for 115VAC operation. 230VAC operation requires cross-connection of the primary winding. Refer to Section 6 for the proper connections.

- ☐ Remove the line fuses on the rear panel (F103/F104) and check for the correct value: 1.0 ampere rating for 115VAC line input operation and 0.5 ampere rating for 230VAC line input operation.

- ☐ Replace the top cover and the line fuses.

- ☐ After checking the power cord for cuts or fraying, insert the three-pin circular connrector into J123 on the rear panel and secure by screwing on the threaded ring. DO NOT CONNECT TO THE POWER SOURCE.

2.5 Mechanical Installation

The exciter is equipped with a standard 19-inch (48.3cm) wide front panel for installation in a standard equipment rack. The exciter can be installed in the cabinet in one of two configurations.

2.5.1 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, which is standard for the MMX-4, the exciter is not equipped with chassis slides.

2.5.2 Chassis Slide Mount

The exciter can be supplied with extension chassis slides that are securely fastened to the side plates of the exciter. Each side plate is provided with mating sections designed to be installed in the equipment operating cabinet. 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 the top and bottom sections. Either tilt or non-tilt slides can be provided depending on customer preference. The tilt slides allow the exciter to be rotated 90 degrees up or down when fully extended.

2.6 Final Inspection

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

The following steps should be followed to complete the final inspection:

- ☐ Ensure that all dust and foreign matter is removed.
- ☐ Ensure that all external controls are operating properly.
- ☐ Check for loose hardware, handles and knobs.
- ☐ Verify that all covers are positioned correctly and secure.
- ☐ Check all exterior surfaces for correct finish and absence of marks or scratches.

3.1 Initial Check-out Procedures

Although the exciter was aligned and thoroughly checked against TMC's specifications prior to shipment, it is necessary to insure correct installation and proper operating conditions by performing the following checkout procedures. Refer to Figures 3.1A and 3.1B for the location and functions of all operating controls, connectors and indicators. If an obvious malfunction is detected, refer to Section 5 - Maintenance Instructions for proper corrective action.

The following test equipment is required for the initial checkout of the exciter:

Audio Oscillator Hewlett Packard 220CD or equivalent

3.2 CW Checkout Procedure

- ☐ Set the STBY/OPP switch (9) to STBY (Standby).
- ☐ Connect a source of 115VAC line power (or 230VAC if the exciter is wired for this rating) to connector J123. The READY prompt will appear on the front panel display (13) after a short delay.
- ☐ Connect a 47-ohm, 2-watt non-inductive load resistor to the RF output jack J118.
- ☐ Rotate the RF output control (1) downward to minimum output.
- ☐ STBY/OPP switch (9) to OPP (Operate). The ready prompt will appear on the front panel display (13) after a short delay.
- ☐ Select the keypad (10) switch marked TST and cycle each position on the keypad while observing the display (13). The display will indicate that each button is working properly by indicating the position selected on the front panel display. Example: Press the MOD keypad button and the characters MOD will be displayed. When all positions of the keypad have tested properly, selection of the enter position will terminate the initial test of the internal microprocessor and place the exciter in the enter mode. If too much time elapses in entering a new program, the exciter will revert to the last entry.
- ☐ Using the Keypad (10) entry switches on the front panel, set the output frequency to 29.9999MHz and press the ENT key.

Note: See Tables 3-1 and 3-2 for an explanation of call-outs below.

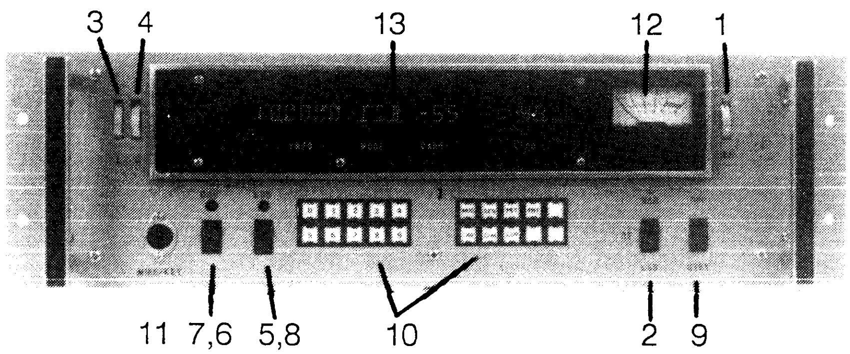


Figure 3.1A - Front Panel Controls and Terminations

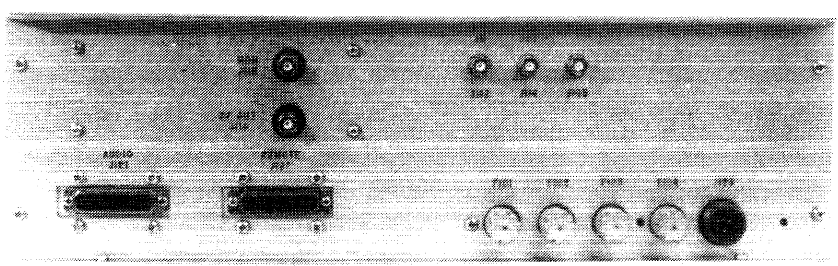


Figure 3.1B - Rear Panel Controls and Terminations

TABLE 3.1 Rear Panel Controls and Terminations

Index	Control	Function
F101	+5 volts	Controls continuity for +5 volts
F102	+12V/+24V/+28V	Controls continuity for +5V/+24V/+28VDC
F103	LINE FUSE	Controls continuity of power 1.0 ampere rating for 115VAC 0.5 ampere rating for 230VAC
F104	LINE FUSE	Same as F103
J105	ALDC	Controls internal ALDC voltages
J112	EXT STD INPUT	Provides for input of an external 1MHz standard
J114	INT STD OUTPUT	Provides for output of the 1MHz standard
J118	RF OUTPUT	Provides the exciter RF output signal
J119	RF MONITOR	Provides the output monitor signal
J121	AUDIO AND CONTROL	Termination for audio and control lines
J122	REMOTE	Termination for remote data lines
J123	AC LINE INPUT	Termination for AC power line input

TABLE 3.2 Front Panel Controls and Indicators

Control	Function
RF OUTPUT (1)	Adjusts RF output power level
METER SWITCH (2)	Selects internal circuits to be monitored on front panel meter
USB (2A)	Controls monitoring of the USB audio inputs
LSB (2B)	Controls monitoring of the LSB audio inputs
RF (2C)	Controls monitoring of the RF output level
LSB GAIN (3)	Adjusts level of LSB audio input
USB GAIN (4)	Adjusts level of USB audio input
LSB SOURCE (5)	Selects line or microphone input to the LSB circuits
USB SOURCE (6)	Selects line or microphone input to the USB circuits
USB MIKE IND (7)	Indicates USB audio source switch in microphone position
LSB MIKE IND (8)	Indicates LSB audio source switch in microphone position
OPERATE/STDBY (9)	Toggle switch for selecting operating conditions
KEYPAD (10)	Enables digital entry of output frequency and operating modes.
MIKE/KEY JACK (11)	Input jack for 47K-ohm microphone and dry contact CW keyer.
MONITOR METER (12)	Monitors circuit function as selected by meter switch 2A-2C.
DISPLAY (13)	Indicates the current operating parameters of the exciter.

- [ ] Using the keypad entry switch marked MOD, toggle through the operating modes until CW operation is indicated on the front panel display (13) and then press the ENT key.

- [ ] Place a ground on the rear panel connector pin P121-22 [EXTERNAL PTT] and pin P121-21 [KEY]. These grounds may alternately be placed on the front panel mike jack (11) pin P206-2 [PTT] and pin P206-3 [KEY].

- [ ] Position meter switch (2) to the RF position.

- [ ] Monitor meter (12) will indicate zero with the RF output control (1) at minimum [fully downward].

- [ ] Adjust the RF output gain control (1) for a minimum indication of 0.1 watts as indicated on the front panel meter (12).

- [ ] Select 15.0000MHz as the output frequency and repeat (12).

- [ ] Select 2.0000MHz as the output frequency and repeat (12).

3.3 SSB Checkout Procedure

- [ ] Using the keyboard entry switch marked MOD, select the ISB position and press ENT.

- [ ] Using the keypad entry switch marked CAR, select full carrier suppression [-55dB] and press ENT.

- [ ] Set the USB and LSB gain controls (4 and 3) downward to minimum levels.

- [ ] Connect the audio generator to the USB 600-ohm terminal pins J121-9 and J121-5. Set the audio generator frequency to 1000Hz (1KHz) at 1.0 volts RMS.

- [ ] Set meter switch (2) to USB (2A) and adjust USB gain control (3) for an indication of 2/5 full scale on the monitor meter (12).

- [ ] Place the meter switch (2) to monitor RF (2C). Adjust the RF gain control (1) for an output of at least 0.1 watts as indicated on the front panel meter (12).

- [ ] Without changing the RF gain control previously set, adjust the USB gain control (3) to minimum [fully downward] and toggle the CAR position on the keypad (10) to display -6dB of carrier suppression while monitoring the front panel meter (12) for an indication of approximately 0.025 watts.

☐ Connect the audio generator to the LSB 600-ohm terminal pins J121-1 and J121-5. Set the audio generator frequency to 1000Hz (1KHz) at 1.0 volts RMS.

☐ 9. Set meter switch (2) to LSB (2C) and adjust LSB gain control (3) for an indication of 2/5 full scale on the monitor meter (12).

☐ 10. Without changing the RF gain control previously set, adjust the LSB gain control (4) to minimum [fully downward] and toggle the CAR position on the keypad (10) to display -6dB of carrier suppression while monitoring the front panel meter (12) for an indication of approximately 0.025 watts.

☐ 11. Place the exciter in STANDBY condition and remove all test equipment. Remove power from the exciter.

3.4 Operating Procedures

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

VERIFY THAT THE STANDBY/OPERATE SWITCH (9) IS IN THE STANDBY POSITION.

3.4.1 Initial Interconnect Procedure

☐ Connect the 115VAC (or 230VAC if wired for that rating), 50/60Hz, single-phase power line source to the exciter rear panel connector J123.

☐ Complete the necessary interface connections from the rear panel connnectors to the power amplifier input; the audio/keying units; and the optional remote control units.

☐ Turn the RF OUPUT control (1) fully downward before selecting different modes of operation.

3.4.2 Single Sideband Operation

The following procedure should be followed for single sideband operation with any degree of carrier suppression.

☐ Set the STBY/OPP switch (9) to the OPP position. After approximately one second, the front panel display will indicate the "READY" prompt and the exciter may be tested or programmed to operate. The READY indication will extinguish after a few seconds, blanking display until data is entered.

☐ Select the desired sideband by toggling the mode switch to indicate the desired sideband on the front panel display.

☐ Set the meter switch (2) to monitor the audio input level of the desired sideband.

- ☐ Connect a microphone to the front panel MIKE jack if used.
- ☐ Adjust the MIKE/LEVEL control of the sideband used - control (3) for LSB or control (4) for USB - to the appropriate level as indicated on the meter (12). DO NOT ENTER THE RED REGION ON THE METER. When the mike input is used, adjust the level so as not to exceed the red region with the highest input from the microphone.
- ☐ Select the desired carrier suppression level by depressing the CAR key on the keypad (10) until the desired amount of suppression is indicated.
- ☐ Set the meter switch (2) to the RF position (2C).

3.4.3 Independent Sideband Operation

The following procedure should be followed for independent sideband operation with any degree of carrier suppression.

- ☐ Set the STANDBY/OPERATE switch (9) to the OPERATE position.
- ☐ Set the USB (4) and LSB (3) MIKE/LINE controls to the zero position [fully downward].
- ☐ Select the "ISB" mode position by toggling the MDE button on the keypad (10).
- ☐ Set the meter switch (2) for monitoring the LSB audio input level. Adjust the LINE/MIKE LSB control for a meter (12) indication up to but not exceeding the red region.
- ☐ Repeat the previous step for the USB input.
- ☐ Set the meter switch (2) to the RF position (2C) and adjust the RF OUPUT control for the desired level of RF output as indicated on the meter (12).

3.4.4 Conventional AM Operation

The following procedure should be followed for conventional AM operation of the exciter.

- ☐ Set the STANDBY/OPERATE switch (9) to the OPERATE position.
- ☐ USB (6) and LSB (5) source switches are set to the line position when using either the USB or LSB 600-ohm input so that the microphone indicator is OFF. When using the MIKE jack input on the front panel, place the USB/LSB source switch to the MIKE position, illuminating the indicator. Either USB or LSB line or MIKE audio may be used.
- ☐ Toggle the MDE button on the keypad (10) to the "AM" position.

☐ Connect a microphone to the MIKE jack (if used).

☐ Adjust the MIKE/LINE control of the sideband used to the appropriate level on the meter (12).

☐ Set the meter switch (2) to the RF position (2C). Vary the RF OUPT control for the desired level of RF output as indicated on the meter (12).

3.4.5 Frequency Shift Teletype Operation

The following procedure should be followed for frequency shift teletype operation.

☐ Connect the external dry contact keyer to terminal pins J121-16 and J121-18. If a teletype unit is used, connect to the FSK terminal pins J121-24 and J121-25.

☐ Set the STANDBY/OPERATE switch (9) to OPERATE.

☐ Toggle the MDE button to indicate "FSK" on the display.

☐ Add jumpers for the proper F/S loop type and shift values.

☐ Add jumper for the desired sense ("+" or "-").

☐ Set the meter switch (2) to the RF position (2C). Adjust the RF OUTPUT control for the desired RF outpuut level as indicated on the meter (12).

3.4.6 Facsimilie Operation

The following procedure should be followed for facsimilie operation. See Figure 3.2.

☐ Connect the FAX machine to connector pins J121-7 and J121-23.

☐ Set the STANDBY/OPERATE switch (9) to the OPERATE position.

☐ Advance the MDE button to indicate "FAX" operation.

☐ Set the meter switch (2) to RF and adjust the RF OUPUT control for the desired level as induicated on the meter (12).

3.4.7 CW Telegraphy Operation

The following procedure should be followed for CW telegraphy operation.

☐ Set the STANDBY/OPERATE switch (9) to the OPERATE position.

☐ Advance the MDE switch to "CW" operation.

☐ Connect the key to the inoput jack (11) on the front panel or to the key input terminals TB104-6 and TB104-21. PTT line must be grounded.

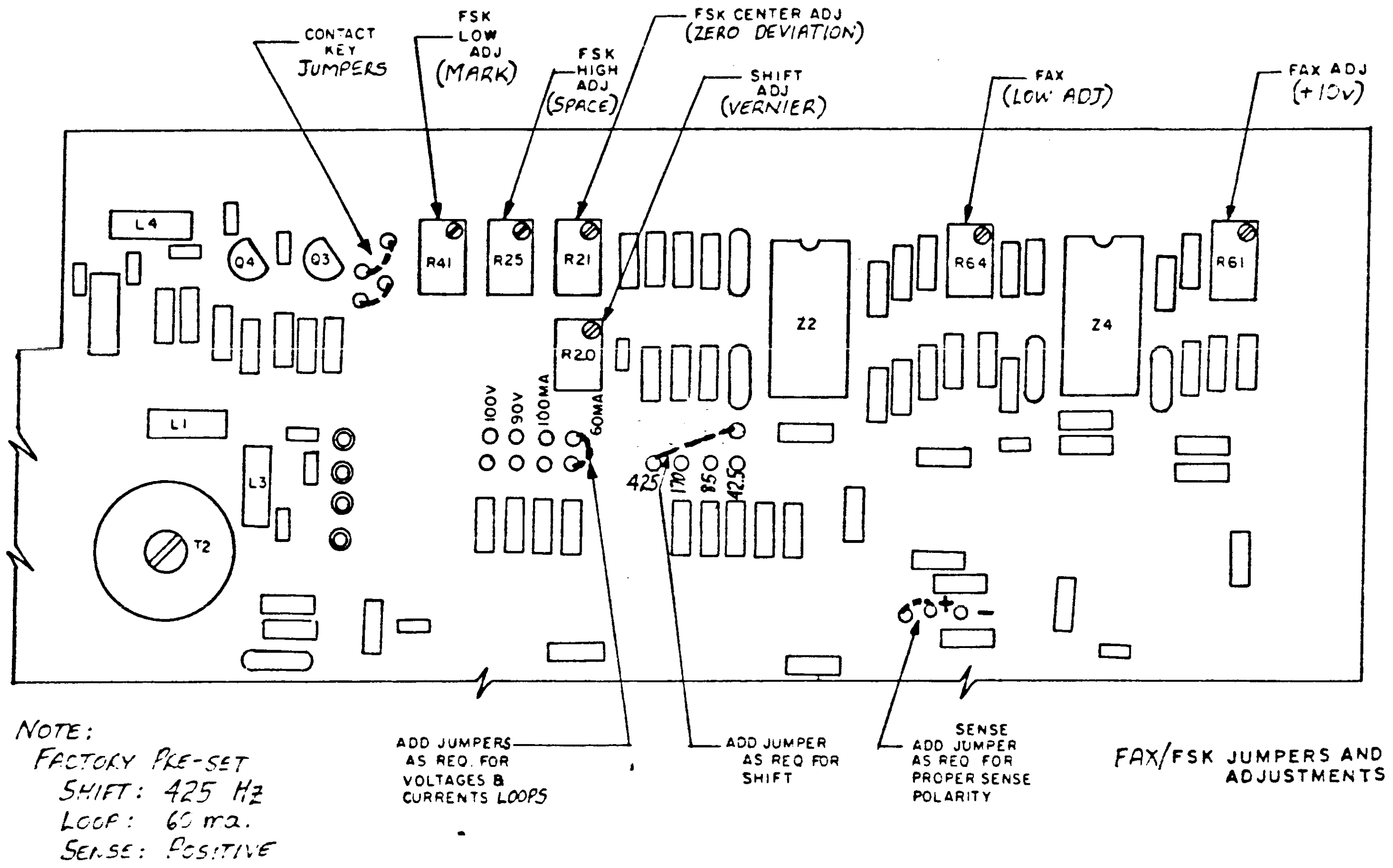


Figure 3.2
FSK/FAX Jumpers
and Adjustments

3.4.8 Shutdown Procedure

To discontinue the exciter operation, simply set the STBY/OPP switch to the STBY position and disconnect primary power from J123 on the rear panel.

4.1 Introduction

This section presents the theory of operation for the MMX-4 exciter and is divided into several sections. The first section describes the overall operation of the exciter on a functional level. The following sections describe each one of the component boards which generate each of the exciter functions. The discussions are based on simplified block and signal flow diagrams. Within each section, discussions refer to interconnect and schematic diagrams that are contained in Section 6 of the manual.

4.2 Functional Block Diagram Description

4.2.1 General

The MMX-4 exciter provides amplitude modulated A3 (AM) operation; amplitude modulated equivalent A3H (AME) operation; single sideband, suppressed carrier A3A,A3J (USB and LSB) operation; continuous wave A1 (CW) operation; frequency shift keyer F1 (FSK) operation; and facsimilie F4 (FAX) operation. Both FSK and FAX capability are optional. The RF output appears in the 2.0-29.9999MHz range, with operation as low as 400KHz at reduced output. Each frequency is selectable in discrete 100Hz increments by means of a keypad input on the front panel assembly. The exciter contains a spectrum generator; five tuned comb filters; five cascaded frequency counters (synthesizers); a final mixer (synthesizer); a "x2" multiplier; a "x5" multiplier; two sideband generators; a carrier generator and AM amplifier; a frequency shift generator; a converter (3MHz generator); a multiplier-mixer; an RF translator; and RF output amplifier; a front panel assembly consisting of a control microprocessor, keypad assembly, and microphone preamplifier; a power supply assembly; and a 1MHz standard and switch assembly. The following paragraphs provide brief descriptions of each of these sections.

To produce RF output frequencies in the range of 2MHz to 29.9999MHz (or 400KHz to 29.9999MHz at reduced output power), the exciter generates many RF frequencies. All of these frequencies are derived from the 1MHz reference signal. For the purpose of this discussion, the generation of output carrier and sidebands is divided into six sections:

1. Reference standard and spectrum generation
2. Generation of the 0.1/1/10KHz integers
3. Generation of the 100KHz integer
4. Generation of the 1 and 10MHz integers
5. Generation, keying and modulating of the subcarrier
6. Translation and amplification of the RF output signal
7. One MHz (1MHz) Reference Standard and Switch

Refer to Figures 4.1A and 4.1B for the Functional Block Diagram of the exciter and to Figure 4.2 for a schematic of the direct frequency synthesis scheme.

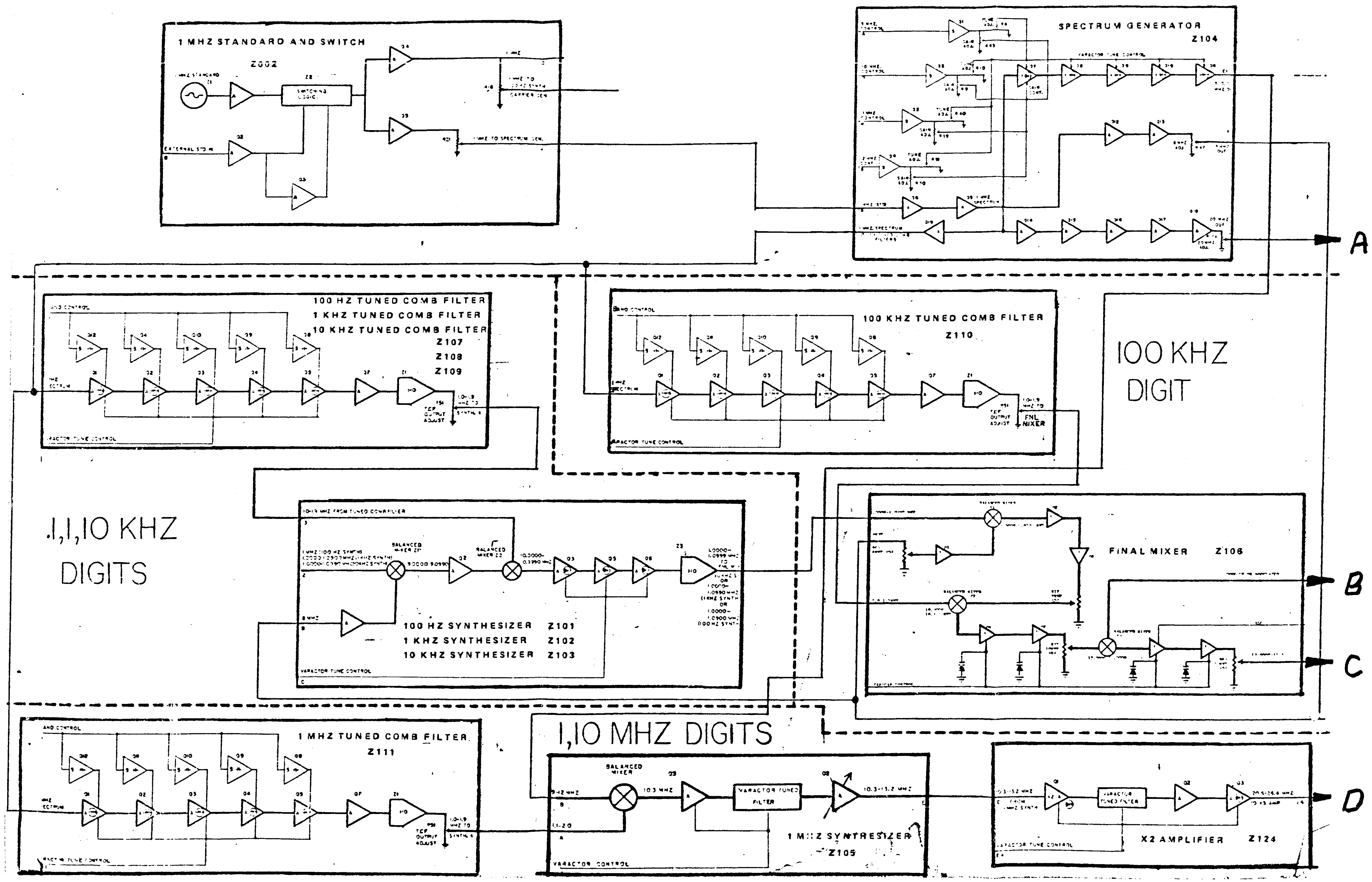


Figure 4.1A
Functional Block Diagram

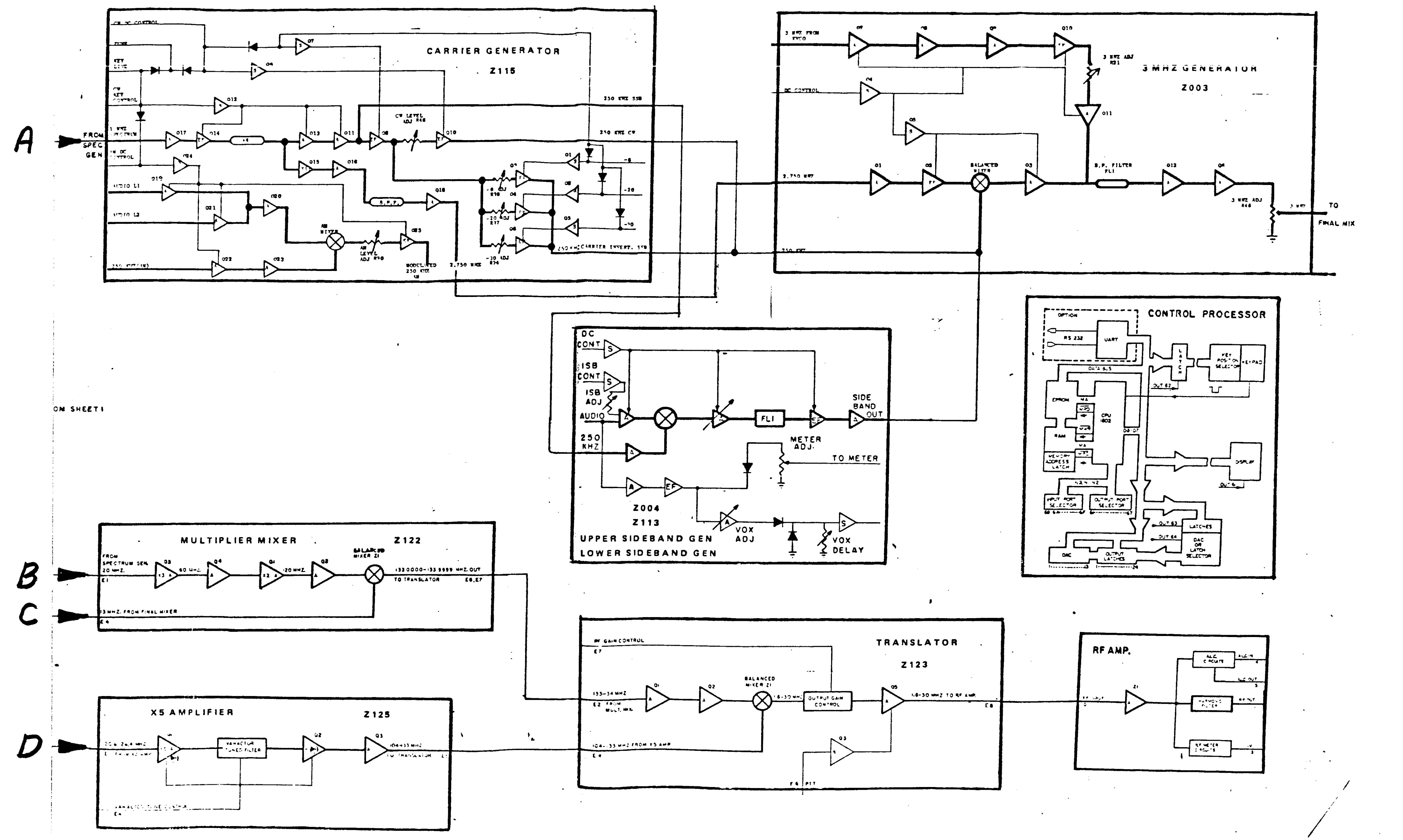


Figure 4.1B
Functional Block Diagram

NOTE:
1. A SELECTED FREQUENCY OF 21.7146 IS SHOWN TO ILLUSTRATE THE SYNTHESIS PROCESS

2. MHz POSITION — INJECTION FREQUENCY

MHz POSITION	INJECTION FREQUENCY
00–02 MHz	12 MHz
03–12 MHz	11MHz
13–22 MHz	10 MHz
23–30 MHz	09 MHz

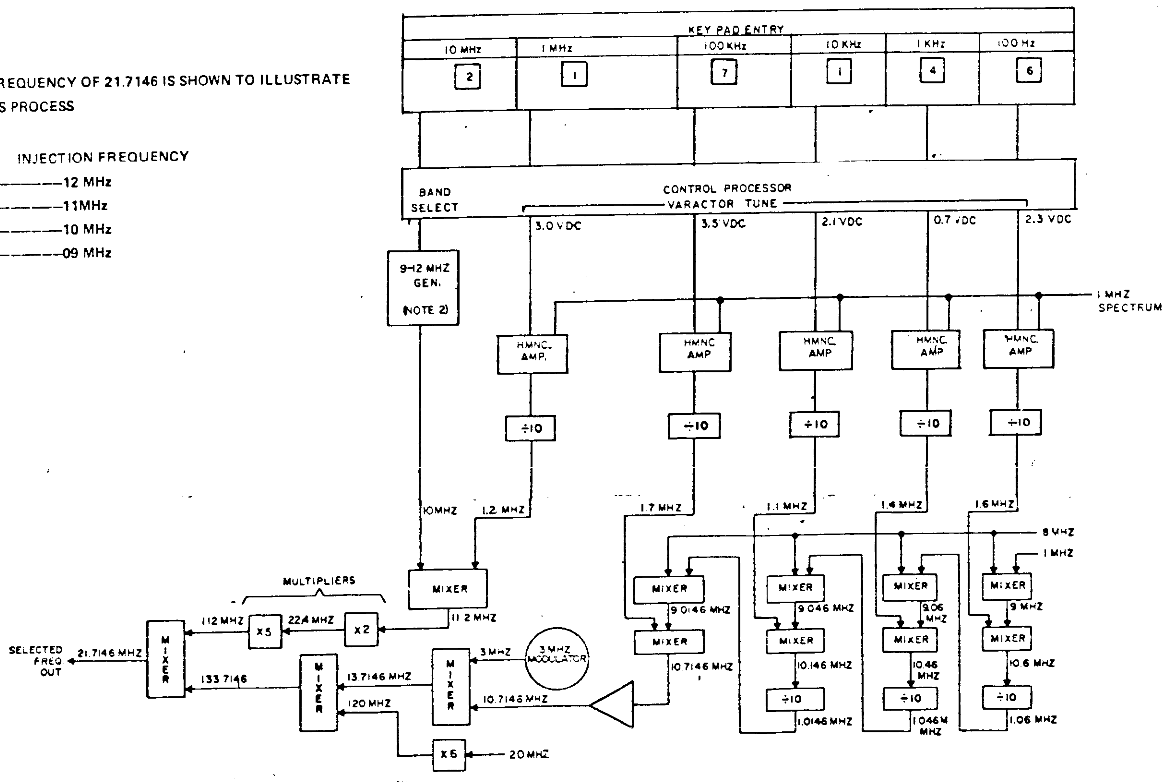


FIGURE
FREQUENCY SYNTHESIS EXAMPLE

Direct Frequency Synthesis
Figure 4-2

4.2.2 1MHz Switching Standard

This circuit (Z002) generates a 1MHz standard reference frequency that is used for generating all the primary reference frequencies created in the exciter. A highly stable temperature-compensated crystal oscillator is employed for stability and efficiency. The 1MHz standard signal is buffered, gated, amplified and then distributed to several card assemblies for further processing. An input is available at the rear panel for an external standard frequency. A sensing circuit monitors the level of the external standard frequency; if it should drop below 0.7vRMS, switching logic will receive an external standard override signal and automatically direct the 1MHz, amplifying and shaping circuits to the internal standard. This ensures that a reference standard signal will be immediately available to the exciter if the external standard signal is lost or of improper amplitude.

4.2.3 Spectrum Generator

This circuit (Z104) derives several discrete frequencies used for conversion and modulation in the exciter. The 1MHz standard frequency is first clipped and amplified and then sent to a 1MHz spectrum generator where it is squared. This squared output contains harmonics of the 1MHz fundamental for use in the comb filters. This 1MHz signal is rich in harmonics for generation of three other discrete frequencies: 8MHz, 20MHz and one of four discrete frequencies in the set 9, 10, 11 or 12MHz. The 8MHz output is applied to the synthesizers and mixer sections as the fundamental input frequency; the 20MHz output is coupled to the multiplier/mixer assembly for further multiplication; and the 9-12MHz generator section, through the action of the switching transistors, provides the correct fundamental input frequency to the MHz synthesizer for determination of the correct MHz integer. The control signals for the correct switching of the 9-12MHz circuits are generated by the microprocessor assembly in accordance with the desired output frequency selected on the front panel keypad.

4.2.4 0.1/1.0/10/100KHz and MHz Tuned Comb Filters

These circuits (Z107-Z111) generate ten discrete output frequencies from 1.0 to 1.9MHz in 100KHz steps. To accomplish this, the tenth through nineteenth (10th-19th) harmonic of the 1MHz spectrum is applied to "High-Q" varactor-tuned filter/amplifier stages which select the correct harmonic of the 1MHz spectrum input. A DC varactor tune voltage is supplied to tune the comb filter stages to the correct 1MHz step, as indicated by the 0.1/1/10/100KHz integer entered on the front panel assembly. The 10-19MHz signal is then divided by ten to yield 1.0-1.9MHz which is then applied to the corresponding synthesizer.

Although all five comb filters are electronically identical, the tuning procedure for the MHz filter is different and cannot be interchanged with the other comb filters.

4.2.5 0.1/1/10KHz Synthesizers

These circuits (Z101/Z102/Z103) consist of three frequency channels that can be considered a cascaded frequency counter. Each channel is controlled by a DC varactor tune voltage supplied by the front panel assembly to determine the appropriate 100s, 1000s and 10000s integers of the desired output frequency. In the 100Hz channel, 8MHz from the spectrum generator is then modulated by the 1MHz input to yeild a basic frequency of 9MHz. This frequency is then mixed with the 1.0-1.9MHz input from the 100Hz tuned comb filter. The 100KHz step selected by the tuned comb filter will correspond to the integer selected. This mix produces a sum frequency of 10.0-10.9MHz which is divided by ten to yield a 1.00-1.09MHz input to the next synthesizer. By modulating the 8MHz input to each successive channel with the net output of the previous channel and the desired frequency from the next higher frequency select position, a final output of 1.000-1.999MHz results. The last three integers represent the least significant three decimal places in the selected output frequency.

4.2.6 Final Mixer

This circuit (Z106) provides the 100KHz digit and also mixes the 3MHz signal from the 3MHz generator with the 10.0000-10.9999MHz created in the synthesizer section of the final mixer. Generation of the 100KHz step frequency supplied by the 100KHz tuned comb filter is identical in operation to the 0.1/1.0/10KHz synthesizers. The output of the 10KHz synthesizer is mixed with 8MHz from the specturm generator to yeild 9.000-9.999MHz to be mixed with the output of the 100KHz tuned comb filter which produces a 10.0000-10.9999MHz IF frequency. This 10.0000-10.9999MHz IF is not divided by ten as in the previous synthesizers but is instead modulated with a 3MHz carrier generated in the modulating circuits of carrier generator Z115, sideband generator Z004 and the 3MHz generator. Through varactor tuned amplifier stages, this creates a 13.0000-13.9999MHz IF frequency that is modulated by the four least significant integers selected on the front panel assembly and any modulated audio intelligence.

4.2.7 MHz Synthesizer

Along with the step frequency provided from the MHz tuned comb filter, this circuit (Z105) provides for the generation of the MHz digits. The operation of the MHz tuned comb filter is identical to that of the 0.1/1.0/10KHz tuned comb filters previously described. The operation of the MHz synthesizer is similar to that of the 0.1/1.0/10KHz synthesizers. The fundamental reference frequency, unlike the previous synthesizers, is one of four discrete frequencies. Either 9, 10, 11 or 12MHz is modulated by a 100KHz step frequency applied from the MHz tuned comb filter Z111. The shifting of the 9, 10, 11 or 12MHz to one continuous successive frequency range under control of the 1 and 10MHz frequency select input positions on the front panel assembly thereby derives the two most significant digits of the desired output frequency. The final mixer code does not contain a divider circuit and therefore its output is over a larger frequency range. This creates a 10.3-13.2MHz IF frequency that is applied directly to the x2 amplifier for frequency multiplication. Determination of the correct fundamental frequency is accomplished in the front panel assembly as described in the reference and spectrum generation section. (See Table 4-1 for Frequency Multiplication Scheme).

Table 4.1

Frequency Multiplication Scheme

MHz Position	f_o Reference	100KHz	Tune Control	MHz Output
0	12	1.3	8.16	13.3
1	12	1.2	8.16	13.2
2	12	1.1	8.16	13.1
3	11	2.0	8.16	13.0
4	11	1.9	6.85	12.9
5	11	1.8	6.85	12.8
6	11	1.7	6.85	12.7
7	11	1.6	5.58	12.6
8	11	1.5	5.58	12.5
9	11	1.4	5.58	12.4
10	11	1.3	4.53	12.3
11	11	1.2	4.53	12.2
12	11	1.1	4.53	12.1
13	11	2.0	3.58	12.0
14	10	1.9	3.58	11.9
15	10	1.8	3.58	11.8
16	10	1.7	2.71	11.7
17	10	1.6	2.71	11.6
18	10	1.5	2.71	11.5
19	10	1.4	2.06	11.4
20	10	1.3	2.06	11.3
21	10	1.2	2.06	11.2
22	10	1.1	1.52	11.1
23	9	2.0	1.52	11.0
24	9	1.9	1.52	10.9
25	9	1.8	0.95	10.8
26	9	1.7	0.95	10.7
27	9	1.6	0.95	10.6
28	9	1.6	0.50	10.5
29	9	1.4	0.50	10.4

4.2.8 Carrier Generator

This circuit (Z115) receives a 1MHz standard frequency input from the spectrum generator assembly, which is supplied to both the 250KHz and 2.750MHz frequency generation circuits. In the 250KHz channel, the 1MHz input is divided by four to derive the basic 250KHz subcarrier frequency. A control ground input from the front panel assembly is applied to enable the generation of the 250KHz subcarrier output signals. In the CW mode, a key ground is supplied to interrupt the enable and insert the 250KHz subcarrier at the key rate, thereby producing a 250KHz subcarrier CW output. The output is distributed to various sections on the carrier generator. The 2.750MHz channel produces an RF output by dividing the 1MHz input by four and then multiplying the resultant by eleven, which is then filtered to derive the 2.750MHz translation frequency. Note that 2.750MHz will only be present when a control ground enables the 250KHz subcarrier circuits. When in FSK or FAX operation, the 250KHz subcarrier and the 2.750MHz channel signals are not required. These signals are turned off when the control ground enable is removed from the 250KHz circuits. Since the 2.750MHz signal is derived from the 250KHz subcarrier, it will also be removed. The AM amplifier section, consisting of an audio amplifier and mixer circuits, develops an amplitude modulated 250KHz signal in the AM mode of operation. In the AM mode, the USB and/or LSB audio is routed to the audio amplifier stage and then to the mixer. The resultant amplitude modulated 250KHz signal is routed to the converter section of the 3MHz generator.

Carrier reinsertion is controlled through the application of a control ground applied to one of three carrier reinsertion control inputs. If no control ground is present on any of the reinsertion inputs, full carrier suppression will result. A tune ground signal normally supplied from the associated transmitter automatically switches the exciter to the CW mode regardless of the mode of operation selected on the front panel.

The sideband generator includes both upper and lower sideband which are similar in configuration and operation. The exception is the tuned frequency of the USB and LSB amplifier circuits. When a microhpone is used, microphone audio from 300Hz to 6700Hz is applied to the microphone preamplifier circuit on the keyboard motherboard assembly and then to the USB/LSB front panel audio select switches where it is applied to both upper and lower sideband amplifier circuits. Similarly, 600-ohm line audio from 350Hz to 6700Hz is applied to the front panel USB/LSB select switches. The select switches determine whether line or mike audio input will be applied to the front panel USB/LSB audio level control. In the AM mode, the audio input is coupled to the carrier generator for amplitude modulation of the RF AM carrier. The SSB modulation section of the sideband generator accepts both a 250KHz subcarrier and USB/LSB audio via the front panel level adjusts. 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 applied to the mode switching network and are then routed to the converter section of the 3MHz generator.

4.2.9 3MHz Generator

This circuit (Z003) contains two sections: the frequency shift buffer section and the converter section. The frequency shift generator section provides input buffering of the frequency shift (option) or facsimilie section (option) created in the frequency shift assembly (Z117). The converter section modulates the 2.750MHz carrier signal with the selected modulation signal (250KHz AM, USB, LSB, ISB or CW from the carrier and sideband generator boards). The modulated 3MHz sum signal is amplified and then applied to the final mixer assembly (Z106).

4.2.10 Multiplier/Mixer

This circuit (Z122) performs the function of producing an output frequency of 133.0000-133.9999MHz that is generated from the 20MHz primary reference signal applied from the spectrum generator assembly (Z104) and the 13.0000-13.9999MHz signal from the final mixer assembly (Z106). The 20MHz reference signal is first multiplied by a factor of two and amplified to yield 60MHz. It is then multiplied again by two and amplified to yield a 120MHz primary reference injection frequency. This 120MHz signal is then modulated with the 13.0000-13.9999MHz to produce 133.0000-133.9999MHz which is then applied to the translator assembly (Z123).

4.2.11 "x2" and "x5" Amplifiers

The operation of the "x2" amplifier (Z124) and "x5" amplifier (Z125) circuits is similar, differentiated only by the multiplication factor. The x2 multiplier assembly receives the 10.4-13.3MHz signal from the MHz synthesizer assembly (Z105) and through the action of varactor-tuned amplifier/filter circuits, multiplies the selected input frequency to an output frequency range of 20.8-26.6MHz. This is then applied to the x5 multiplier which yields an output opf 104-133MHz to be applied directly to the translator assembly (Z123). In order for the x2 and x5 multipliers to select the correct harmonic of the input frequency, a DC varactor tune voltage is supplied from the control microprocessor in the front panel assembly.

4.2.12 Translator

This circuit (Z123) performs the function of producing a 400KHz-29.9999MHz output signal by subtracting the 104-133MHz (applied from the x5 multiplier assembly) from the 133.0000-133.9999MHz developed in the multiplier/mixer assembly (Z122). A difference output signal results in the range of 400KHz to 29.9999MHz. In addition, a DC control voltage developed across RF output control potentiometer on the frfont panel assembly is applied to a varistor attenuator circuit which offers RF output gain control. In remote operation, this DC voltage may also be applied to the remote gain input rear panel audio and filter connector (J124). The output of the translator assembly is enabled by a ground applied from the PTT line. This PTT line ground is supplied from either the front panel mike jack, the rear panel audio input filter jack, or the control microprocessor in the front panel assembly.

4.2.13 Power Supply

This circuit operates from either 115VAC or 230VAC when the power transformer is properly wired. The power supply outputs are regulated voltage of +24VDC and +5VDC, and unregulated voltage of +28VDC for operation of the exciter circuits. The regulated voltage are both applied the exciter circuits through the front panel STBY/OPP switch, while the +28VDC unregulated supply output is applied directly to the 3MHz frequency standard and the RF output assembly.

4.2.14 Control Microprocessor

This integrated assembly accepts frequency and mode control information from the front panel keypad assembly and controls display of the current operating parameters, DC control voltages for the varactor-tuned circuits throughout the exciter, and control grounds.

4.3 MHz Standard and Switch

4.3.1 General Description

The 1MHz standard and switch assembly (Z002) generates an internal 1MHz reference frequency, looks for and/or selects an external reference frequency, amplifies, and buffers the 1MHz standard reference frequency. The assembly contains a 1MHz temperature-compensated crystal-controlled oscillator that offers four parts in 10^7 per day basic accuracy. The switching portion of the assembly is automatically controlled by the action of a quadruple two-input, positive nand gate.

4.3.2 Detailed Description

With the 1MHz standard output from the TCXO coupled to the base of transistor switch Q1, CR1 maintains a positive voltage of 0.7VRMS and maintains a constant input level to the base of Q1. The collector output of Q1 is then applied to Z2 which is pre-programmed to look for a 1MHz external reference signal at pin B. If an external reference signal is applied to pin B at a sufficient level to turn on Q2 (0.7VRMS), the external standard signal will be applied to the external detect circuits of transistor Q3. A voltage is developed across CR3 sufficient to turn on external detect transistor Q3 which places a ground on pins 2 and 13 of Z1. This will force selection of the external reference frequency instead of the internally generated reference frequency. The output of pin 6 of Z2 is then coupled to two tuned collector transistor amplifiers Q4 and Q5. The tuned collector output of Q5 is developed across the secondary of T1 and level adjust R16, and then applied to the carrier generator assembly (Z115) and the 100Hz synthesizer (Z107). An additional 50-ohm output from the T1 secondary is applied through Pin D and is available at the 1MHz output jack (J114) for external use. The standard reference frequency is also applied to the base of Q5 and then developed across the secondary of T2 and level adjust R21. The output signal at Pin J is then applied to the 1MHz spectrum generator assembly (Z104).

4.4 Spectrum Generator

4.4.1 General Description

The spectrum generator is used to develop six different fundamental RF output frequencies which are all derived from a stable 1MHz standard frequency developed in the 1MHz standard and switch assembly (Z002). These six frequencies are the 1MHz spectrum, 8MHz, 20MHz, and one of four discrete frequencies (9, 10, 11 or 12MHz). The 9-12MHz generator section consists of four high-Q varactor-tuned amplifier sections. Tuning is further controlled by four transistor switches which enable two preset potentiometers. One potentiometer is used to control the input gain of the first amplifier to maintain a smooth frequency response and the other is set for the correct varactor tune voltage for the selected fundamental frequency.

4.4.2 Detailed Description

The 1MHz applied from the 1MHz standard and switch assembly (Z002) is coupled through capacitor C58 to the input of the 1MHz square-wave generator Q6. This stage essentially reacts as an overdriven amplifier. The output square-wave is coupled through C39 and is amplified by 1MHz spectrum output amplifier Q5. This output signal consists of the 1MHz fundamental frequency plus harmonics, and is applied to each of the reference generator sections on the assembly. The collector output of Q3 is also applied to the 1MHz spectrum amplifier Q19 for further amplification. It is then output through Pin 10 to the tuned comb filter assemblies (Z107-Z111).

9-12MHz Generator Circuits - One of four discrete frequencies is created for use in the 1MHz synthesizer (Z005). Since the DC control of the "bandswitching transistors" is the same for all four frequencies, only the 9MHz signal will be used for this discussion. With the MHz position on the front panel assembly in any frequency position except 23-29MHz, transistor switch Q1, which is normally enabled, places a ground at the input to the adjustable voltage divider at the collector of Q1. This enables use of another voltage divider to set the peak response of the 9-12MHz generator circuits to the correct reference frequency as determined by front panel control.

High-Low Switch - With the MHz position of the front panel assembly set between 23MHz and 19MHz, a control ground from the front panel assembly is placed at the base of transistor switch Q1. With the collector output of Q1 high, a DC voltage is developed across gain potentiometer R83 and varactor-tune control potentiometer R4. R83 level is set so that the 9MHz output level can be adjusted to the same level as the other three reference frequencies. R4 is set to develop the correct amount of varactor DC tune voltage for the varactor-tuned output stages of Q7, Q8, Q9, Q10 and Q11.

20MHz Generator Circuits - The 20MHz generator is a sharply tuned filter/amplifier circuit designed to amplify the 20th harmonic of the 1MHz spectrum input signal. Due to the sharply-tuned resonate circuits, all other harmonics are filtered to provide a harmonic-free reference frequency of 20MHz. Q14, Q15, Q16 and Q17 are conventional tuned drain FET amplifiers. The filtering action of each tuned output stage is progressive through the circuit. Due to the loose coupling between stages and the sharp tuning of the filtered outputs along with the relatively low level of the 20th harmonic compared to the fundamental, loss must be compensated for through the gain of FET amplifiers Q14-Q17. The tuned drain output of Q17 is loosely coupled to the base of 20MHz amplifier Q18. The output of Q18 is then developed across the secondary of tuned transformer T15 which further filters the 20MHz signal and converts to the proper output impedance. With the output of the secondary of T15 coupled directly to the 20MHz level adjust potentiometer R74, the 20MHz operating level may be set. The 20MHz signal is then coupled through a short jumper to Pin 9 to be applied to the multiplier mixer assembly (Z122).

8MHz Generator Circuits - The 8MHz generator circuit consists of one tuned drain FET amplifier and one conventional transistor amplifier. Selection of the eighth harmonic of the 1MHz reference frequency is the same as explained in the 20MHz generator section of the spectrum generator. Due to the relatively high level of the eighth harmonic and a lower output level requirement, only one FET amplifier is required to achieve a satisfactory output level. With the tuned collector output of Q13 coupled to the 8MHz level set control, as in the 20MHz generator circuits, the output level of 8MHz is set and coupled to Pin 7 and applied to synthesizers and final mixer assemblies.

4.5 Tuned Comb Filters (0.1/1.0/10/100MHz)

4.5.1 General Description

To create a 1.0-1.9MHz step frequency in discrete 100KHz steps, the tuned comb filters must first select the 10th-19th harmonic of the 1MHz spectrum and then divide by a factor of ten to yield the output frequency range of 1.0-1.9MHz (1.1-2.0MHz in the MHz tuned comb filter). Operation of the tuned comb filters is essentially the same except that the selectable output range of 1.1-2.0MHz is used instead of the 1.0-1.9MHz generated in the MHz tuned comb filters. A five stage amplifier/filter circuit employing high "Q" varactor-tuned amplifiers develops the desired step frequency in 100KHz increments. Frequency agility is provided by a DC varactor tune voltage supplied by the microprocessor in accordance with the operating frequency selected on the front panel keyboard.

4.5.2 Detailed Description

A brief discussion follows on the operation of the various varactor-tuned stages with special attention given to the operating parameters of abrupt junction varactor diodes.

Most silicon diodes exhibit some amount of change in diode junction capacitance as the reverse bias applied to them is varied. A varactor diode simply takes advantage of this principle. Varactor tuning occurs across the depletion region and is mainly due to majority carriers in both regions moving away from the junction and producing a depletion region. This region may be varied by reverse bias voltage. This affects a change in junction capacitance and therefore a change in total capacitance. Referring to Figure 4.3, C_j represents a varactor diode junction capacitance and R_b represents bulk resistance. The "Q" of the varactor is determined not only by diode junction capacitance but also by the bulk resistance for a given frequency ($Q = X/R$). Varactor diodes are relatively sensitive to changes in their supply voltage and therefore

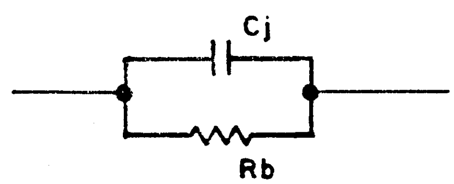


Figure 4.3 Varactor Diode Junction Representation

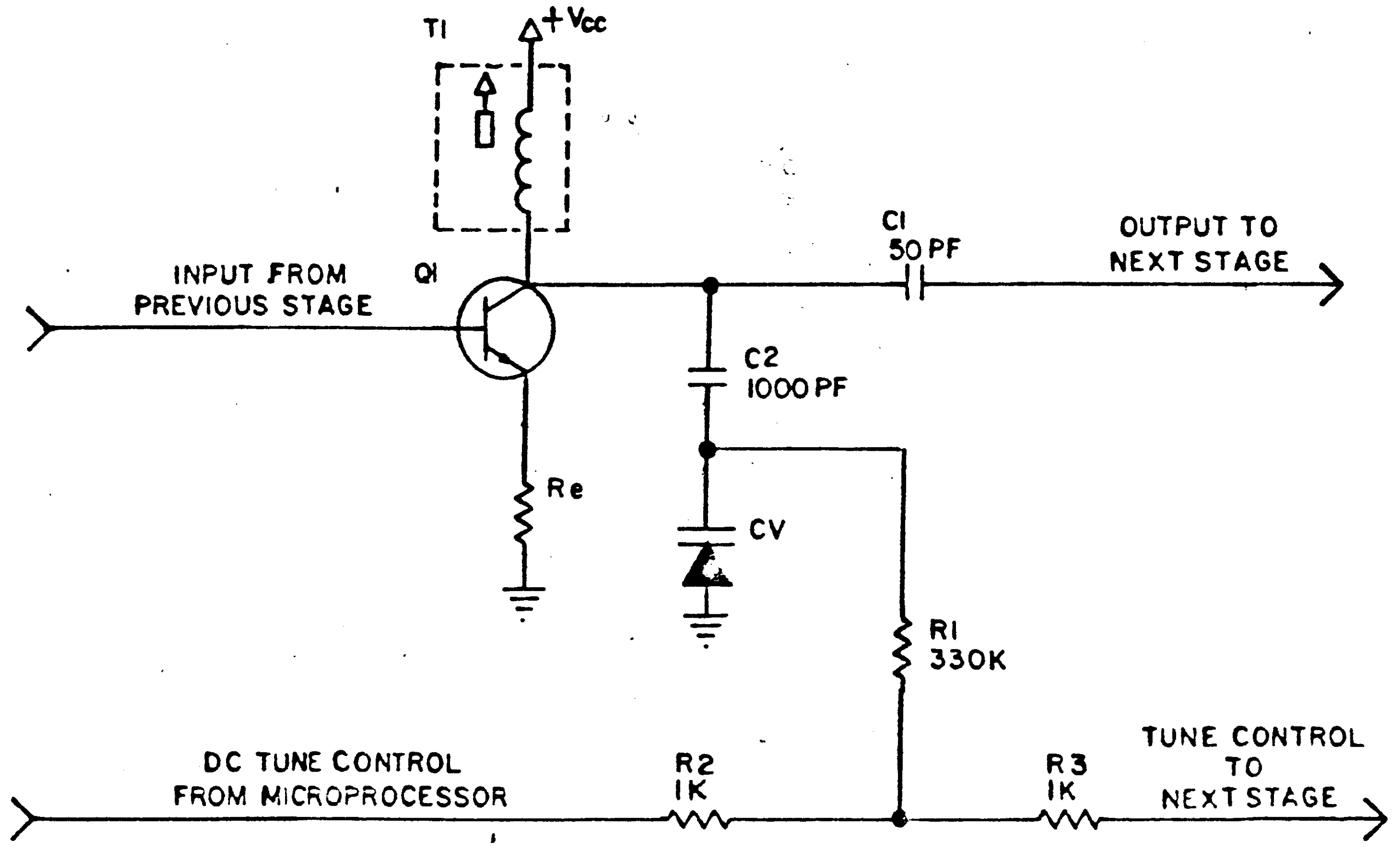


Figure 4.4 Varactor-tuned Stage

require heavy power supply regulation to assure stability. A pre-regulated +24VDC supply voltage is applied to a 12.0VDC zener diode on each of the RF assemblies containing varactor diode stages. Referring to Figure 4.4, which is a typical varactor-tuned stage in the exciter, the collector output signal at Q1 is developed across the parallel resonate circuit consisting of C1 and T1. Depending on the particular function of the circuit, the output is loosely coupled to the next stage. Capacitor C3 serves as a DC blocking capacitor which does not affect the tuning of the parallel resonate circuit due to its low value of capacitive reactance. Resistor R1 serves to isolate the tuned circuit from the other varactor-tuned stages controlled by the same tune line.

With the 1MHz spectrum applied to Pin B and coupled to Gate 2 of FET amplifier Q1, the tuned drain output of Q1 is developed across tuned transformer T1 and varactor diode CV1. This forms a frequency agile parallel resonate circuit that selects the proper harmonic frequency of the 1MHz spectrum signal as determined by the microprocessor from the desired operating frequency entered on the front panel keypad. With a 0, 1 or 2 digit entered on the associated frequency select positions on the front panel keypad, a control ground applied at Pin 5 is removed by the microprocessor. Switching transistor Q12 is biased on, which then provides a low impedance path for C4 to ground. This places C4 in parallel with the resonate circuit T1-CV1. This allows for a smoother frequency response across the 10-19MHz frequency range in the filter/amplifier circuits of the tuned comb filter. Four of the five stages are identical with each stage exhibiting approximately the same amount of gain. The last stage consisting of transistor Q5, tuned transformer T5, and varactor diode CV5 is biased to achieve a larger gain figure than the four previous stages. The 10-19MHz signal at the secondary of T5 is coupled through coupling capacitor C44 to the base of the driver transistor Q7 which performs two functions: squares the 10-19MHz signal and lowers the impedance of the 10-19MHz signal. The proper level of forward bias required for squaring of the signal in Q7 is set through level set R40. The emitter output of Q7 is applied directly to divide-by-ten decade Z1, producing the resultant frequency range of 1.1-1.9MHz (1.1-2.0MHz for the MHz tunedcomb filter). This is then applied to a low pass filter and shaping circuit consisting of RF chokes (L7, L8) and capacitors (C48-C50). The resultant sinusoidal output is developed across level set R51 and coupled to output Pin 4 to be applied to the associated synthesizer (See Table 4-2 and 4-3 for Varactor Tune Voltages).

4.6 Synthesizers (0.1/1.0/10KHz)

4.6.1 General Description

The synthesizers are essentially frequency shift modulators. Their prupose is to shift a basic 8MHz input signal such that a frequency component or step frequency - as input to the front panel keypad - is generated, representing the hundreds, thousands and ten thousands digits. The circuits accomplish the task of shifting the fundamental 8MHz through the use of varactor tuned, balanced modulator and amplifier circuits. Because the circuit configuration and principle of operation is the same for each synthesizer, only the 100Hz synthesizer will be discussed.

Table 4.2

Varactor Tune Voltages (0.1/1.0/10/100KHz Comb Filter)

Frequency (MHz)	Leve (Pin 5)l	Tuning VDC (Pin 6)
10	Low	0.25*
11	Low	2.1
12	Low	8.0
13	High	0.25
14	High	0.7
15	High	1.3
16	High	2.3
17	High	3.5
18	High	5.0
19	High	7.2

* Initial tuning voltage

Table 4.3

Varactor Tune Voltages (1MHz Comb Filter)

Frequency (MHz)	Level (Pin 5)	Tuning VDC (Pin 6)	Frequency Digit
13	Low	9.5	0
12	Low	3.0	1
11	Low	0.7*	2
20	High	6.7	3
19	High	4.8	4
18	High	3.4	5
17	High	2.1	6
16	High	1.4	7
15	High	0.7	8
14	High	0.25	9

* Initial tuning voltage

4.6.2 Detailed Description

The 8MHz output from the spectrum generator (Z104) is supplied to the inputs of each synthesizer and to the input of the final mixer. In the 100KHz synthesizer, the 8MHz input is applied to 8MHz transistor amplifier Q1. The 8MHz signal developed across the parallel resonate circuit of inductor L9 and capacitor C46 is coupled to a balanced modulator Z1. The balanced modulator also receives the standard 1.0MHz from the spectrum generator (Z104) and produces a sum frequency which is applied to the tuned transformer T1. The 9MHz signal at the secondary of T1 is coupled to the 9MHz amplifier Q2. The tuned drain output of Q2 developed across the secondary of T2 and the 1.0-1.9MHz from the 100Hz tuned comb filter assembly are coupled to balanced mixer Z2. As a result, the 9MHz signal is modulated as explained previously for 8MHz, thereby producing a 10.0-10.9MHz signal. The output is tuned by three frequency-agile varactor-tuned tank circuits consisting of transformers T4, T5, T6 and varactor diodes CV1, CV2 and CV4. These tank circuits act as peak filters which allow only the sum frequency to pass. The mircoprocessor supplies a varactor DC tune voltage which causes their internal junction capacitance to change. This allows fine tuning of the filter tanks. (See the tuned comb filter detailed description for a further discussion on varactor tuning.) The 10.0-10.9MHz signal at the secondary of T6 is applied to Q6 - the clipper driver stage - and the output signal from Q6 is applied to dual mixer divider Z3 where division of the 10.0-10.9MHz signal is accomplished to yield an output of 1.00-1.09MHz. This signal is then applied to the 1KHz synthesizer.

The remaining 1KHz and 10KHz synthesizer function the same with the output of each feeding the next to modulate the basic 8MHz primary signal. The output of the 1KHz synthesizer is from 1.000-1.099MHz, thereby satisfying the 1KHz digit. The output of the 10KHz synthesizer is from 10.0000-10.0999MHz, thereby satisfying the 10KHz digit (See Table 4-4 for Varactor Tune Voltages).

4.7 Final Mixer

4.7.1 General Description

The final mixer assembly is divided into two sections: the fourth and last channel of the of the synthesizers (100KHz) and the 13MHz generator section. The final mixer assembly (Z106) receives the 3MHz signal from the 3MHz generator assembly and the 1.0000-1.0999MHz output of the 10KHz synthesizer (Z103). The fixed reference frequency of 8MHz from the spectrum generator assembly (Z104) and a 1.0-1.9MHz step frequency from the 100KHz tuned comb filter (Z110) are applied to a balanced mixer. The sum output from this mixer is an IF of 9.0000-9.0999MHz and whose three least significant digits are identical to the three least significant digits entered on the front panel (0.1/1.0/10KHz). The 9.0000-9.0999MHz signal is then mixed with the 1.1-1.9MHz from the 100KHz tuned comb filter to create an IF of 10.0000-10.9999MHz that varies directly with the four least significant digits entered on the front panel assembly. This 10.0000-10.9999MHz IF signal is then mixed with the 3MHz signal from the 3MHz generator (Z003). The resultant positive mix of 13.0000-13.9999MHz has the sideband intelligence when in an audio mode or has just a carrier in the CW mode. The 13.0000-13.9999MHz signal is then applied to the translator assembly (Z123).

Table 4.4

Varactor Tune Voltages (0.1/1.0/10KHz Synthesizers)

Frequency Digit	Frequency (MHz)	Tuning VDC Pin C)
0	10.0	0.3
1	10.1	0.5
2	10.2	0.8
3	10.3	1.0
4	10.4	1.5
5	10.5	1.9
6	10.6	2.5
7	10.7	3.3
8	10.8	4.0
9	10.9	5.2

4.7.2 Detailed Description

The 8MHz primary reference signal is applied to Pin D and coupled to the base of 8MHz amplifier Q1. The collector output of Q8 is coupled through capacitor C75 to the input of the balanced mixer Z1. With the 1.0000-1.0999MHz step frequency from the 10KHz synthesizer applied to Pin 3 and coupled directly to Z1, the 8MHz primary reference frequency is modulated to create a 9.0000-9.0999MHz IF frequency that is developed across the tuned secondary of T1. T1 rejects all of the mix frequencies except the positive mix. The secondary output of T1 is then coupled to FET amplifier Q2. Q2 has a very high input impedance and will not load down the output of Z1. The tuned drain output of Q2 is loosely coupled through coupling capacitor C8 to tuned transformer T3 where it is further filtered and then coupled to the base of IF amplifier Q4. The tuned collector output of Q4 is developed across transformer T4 and level adjust potentiometer R17 where the correct amount of 9.0000-9.0999MHz insertion is set. With a 1.0-1.9MHz step frequency input from the 100KHz synthesizer and the 9.0000-9.0999MHz applied to Z2, the 9.0000-9.0999MHz is modulated by the 100KHz step frequency. This produces a 10.0000-10.9999MHz IF that is developed across the secondary of T5 and coupled to Gate 2 of the 10.0000-10.9999MHz amplifier FET Q5. The varactor-tuned drain output of Q5 is developed across the parallel resonate circuit consisting of tuned transformer T6, capacitor C27, capacitor C31 and varactor diode CR2. This stage is a high-Q frequency-agile network that changes peak tuning as the varactor DC control voltage changes. This allows a high degree of filtering for each 100KHz step while maintaining a smooth frequency response across the operating bandwidth. Each discrete frequency step of 100KHz has its own DC varactor tune control voltage which is determined in the front panel assembly in accordance with the desired operating frequency. The tuned drain output of Q5 is loosely coupled to a filter network consisting of tuned transformer T7, capacitors C35 and C37, and varactor diode CR3. This network further filters the 10.0000-10.9999MHz IF and applies it to the base of transistor amplifier Q7, where it is filtered and amplified as in the previous stage (Q5) just described. The tuned collector signal of Q7 is then developed across the secondary of T8 and level adjust potentiometer R37 where the correct level of 10.0000-10.9999MHz is set and then coupled to the balanced modulator Z3. With the 10.0000-10.9999MHz selectable frequency range input and the 3MHz signal applied to balanced modulator Z3, the modulator outputs the sum and difference frequencies while attenuating the original frequencies. This output is applied to the tuned coupling network consisting of tuned transformer T9, capacitors C44 and C45, and varactor diode CR5. It is loosely coupled to FET amplifier Q8. The signal at the tuned drain of Q8 is developed in the varactor tuned parallel circuit consisting of tuned transformer T10, capacitors C56 and C58, and varactor diode CR6. It is loosely coupled to a varactor-tuned input network consisting of tuned transformer T11, capacitors C60 and C63, and varactor diode CR7 through to the base of the transistor amplifier Q10. The collector output of Q10 is developed across the secondary of tuned transformer T12 and the 13MHz level adjust potentiometer R63.

4.8 MHz Synthesizer

4.8.1 General Description

The purpose of the MHz synthesizer is to mix, filter and amplify the frequencies used to create the 1MHz and 10MHz digits entered into the front panel assembly. The MHz synthesizer is a high-Q varator-tuned amplifier/filter which receives a reference frequency from the spectrum generator (Z104). Depending on the operating frequency selected by the front panel control, one of four references frequencies of 9, 10, 11 or 12MHz may be used to combine with the 1.1-2.0MHz output from the 1MHz tuned comb filter (Z111). The amplifier/filter section is varactor tuned to permit sharp tuning in discrete 100KHz increments by a DC voltage supplied by the front panel assembly. The amplifier filter stages are tuned to pass only the positive mix of Z1. This RF frequency is then applied to the x2 multiplier (20.8-26.6MHz) amplifier (Z124) for further multiplication.

4.8.2 Detailed Description

The 1.1-2.0MHz RF carrier from the output of the 1MHz tuned comb filter (Z111) is applied to Pin A and coupled directly to the balanced mixer Z1. This frequency will vary directly with the frequency selected on the 10MHz and 1MHz entry positions on the front panel assembly. One of four discrete frequencies (either 9, 10, 11 or 12MHz) is selected by front panel control and applied to Pin B. All of these injection frequencies are generated from the 1MHz reference in the spectrum generator (Z104). For the purpose of this discussion only 9MHz is used. With 9MHz and 1.3MHz applied to Z1, the plus mix of 10.3MHz is developed across the secondary of tuned transformer T1, capacitor C6, and varactor diode CV1. This is loosely coupled through C18 to Gate 2 of FET amplifier Q3. The tuned stages of T2, T3, T4, T5 and T6, along with their associated varactor diodes, form a continuously tuned cascaded filter network. The filter stages are very loosely coupled and therefore exhibit some loss from stage to stage. The filtered signals from the drain of Q3 are then applied to the base of amplifier Q2 through the filter network. Q2 has very high gain and develops its output signal across the center tap of transformer T7. T7 is a broadband center-tap transformer. The 10.4-13.3MHz output is then coupled to R29 level control. The signal is then applied to the 20.8-26.6MHz amplifier (Z124) for further up-conversion.

4.9 "x2" Amplifier

4.9.1 General Description

Multiplication of the basic 10.4-13.3MHz signal by a factor of two is accomplished by first amplifying the basic input frequency to a high level. Through high-Q filter circuits, all unwanted harmonic signals are removed. This leaves only the correct harmonic which is further amplified to produce a 20.8-26.6MHz signal and applied to the "x5" amplifier for further up-conversion.

4.9.2 Detailed Description

The 10.4-13.3MHz signal from the MHz synthesizer is applied to terminal E1 and then coupled through L1 and C3 to the base of transistor amplifier Q1. Q1 amplifies the basic 10.4-13.3MHz input signal for selection of the second harmonic by the subsequent filter circuits. The signal at the varactor tuned collector of Q1 is then applied to a five-stage cascaded filter network consisting of T1-T5 and CV1-CV6. A DC varactor tune voltage supplied from the front panel assembly is applied at E4 to "fine tune" the cascaded filter network. The second harmonic (20.8-26.6MHz) of the basic input frequency (10.4-13.3MHz) is applied to the base of transistor amplifier Q2 where the 20.8-26.6MHz signal is further amplified and filtered. The varactor tuned collector output of Q2 is then loosely coupled to the base of Q3 through coupling capacitor C25 to the base of transistor amplifier Q3. Q3 is biased for very high output gain across its broadband output transformer T7. The 20.8-26.6MHz signal at the tap of T7 is then supplied via E6 to the "x5" amplifier for further frequency multiplication.

4.10 "x5" Amplifier

4.10.1 General Description

Multiplication of the 20.8-26.6MHz signal by a factor of five is accomplished by first amplifying the basic input frequency to a high level. All the unwanted harmonic signals are removed through high-Q filer circuits. This leaves only the desired harmonic which is further amplified to produce a 104-133MHz signal to be applied to the final conversion circuits of the translator assembly.

4.10.2 Detailed Description

The 20.8-26.6MHz signal from the "x2" amplifier is applied to terminal E1 and then coupled through C1 to the base of transistor amplifier Q1. Q1 amplifies the basic 20.8-26.6MHz input signal for selection of the fifth harmonic by the subsequent filter circuits. The signal at the varactor tuned collector of Q1 is then applied to a four-stage cascaded filter network consisting of T1-T4 and CV1-CV4. A DC varactor tune voltage supplied from the front panel assembly is applied at E4 to "fine tune" the cascaded filter network. The fifth harmonic (104-133MHz) of the basic input frequency (20.8-26.6MHz) is applied to the base of transistor amplifier Q2 where the 104-133MHz signal is further amplified and filtered. The varactor tuned collector output of Q2 is then loosely coupled to the base of Q3 through coupling capacitor C24 to the base of transistor amplifier Q3. Q3 is biased for very high output gain across its broadband output transformer T6. The 104-133MHz signal at the tap of T6 is then supplied via E5 to the translator assembly for final frequency translation.

4.11 Multiplexer/Mixer

4.11.1 General Description

The multiplier/mixer assembly is a sharply tuned multiplier filter/amplifier and up-converter section that is used to create the 120MHz injection frequency. This injection frequency is then mixed with the 13.0000-13.9999MHz IF signal from the final mixer assembly (Z106). This creates an IF of 133.0000-133.9999MHz to be mixed and down-converted in the translator assembly (Z123).

4.11.2 Detailed Description

A 20MHz reference frequency is applied to the base of Q3, the x3 multiplier transistor, through coupling capacitor C16. The tuned collector output of Q3 is developed across the tuned circuit consisting of capacitor C22 and transformer T1. This tuned circuit selects the third harmonic of the 20MHz reference frequency to create the 60MHz reference frequency. This 60MHz signal is then loosely coupled through C24 to the sharply tuned harmonic harmonic filter consisting of capacitor C28 and tuned transformer T3. It is further coupled through to the base of 60MHz amplifier Q4 where it is further tuned and amplified. The tuned collector signal at Q4 is then loosely coupled to the x2 amplifier Q1 whose tuned collector output selects the second harmonic of 60MHz: 120MHz. This 120MHz reference is then loosely coupled to two sharply tuned filter stages consisting of capacitor C7 and tuned transformer T6, and capacitor C9 and tuned transformer T7. This filtered 120MHz reference frequency is then coupled to the base of the 120MHz amplifier Q2 where it is further filtered and amplified.

The 120MHz reference signal generated in the multiplier section is then applied to the balanced mixer Z1 where it is mixed with the 13.0000-13.9999MHz IF from the final mixer. Z1 selects the difference frequency signal from the final mixer. Z1 selects the difference frequency which is then coupled to the tuned stages of tuned transformer T9 and capacitor C17 and tuned transformer T10 and capacitor C19. These filter stages further eliminate the unwanted products of Z1 and ensure no spurious signals are present on this final IF frequency.

4.12 Translator

4.12.1 General Description

The translator assembly (Z123) performs down-conversion of the 133-134MHz IF signal by mixing it with the 104-133MHz reference frequency to produce the final output frequency range of 0.4-29.9999MHz. The assembly consists of an input amplifier stage; a balanced modulator; wave-shaping circuits; RF output level control circuits; and an output switching network which is used to attenuate the RF input to the RF amplifier assembly (A5840).

4.12.2 Detailed Description

The 133-134MHz signal is applied to the base of transistor amplifier Q1 through coupling capacitor C2. Q1 exhibits high gain to the input signal which is developed across the tuned parallel resonate circuit of tuned transformer T1 and capacitor C3. The 133-134MHz signal is coupled to a two-stage tuned filter network, which provides additional filtering, and then to the balanced mixer-driver transistor Q2. Due to the loose coupling between tuned stages T1, T2 and T3, the 133-134MHz signal must be amplified before being applied to the balanced mixer. The 104-133MHz is applied to terminal E4 and coupled to the balanced mixer Z1, and the 133-134MHz reference signal is coupled through capacitor C14 from collector Q2 to the balanced mixer. The mixer (Z1) develops a difference frequency (0.4-29.9999MHz) which is applied to a wave-shaping circuit consisting of L3, L4, L5, C17 and C20. Metal-oxide varistors (MOV) CR1 and CR2 act together to control the amount of RF output signal. With the RF gain control input applied, CR1 exhibits a value of series resistance and CR2 acts as a shunt resistance to the output signal path depending on the DC level applied to terminal E7. CR1 and CR2 are connected to compensate for the change in the output impedance seen by the balanced mixer Z1 under different gain settings. When CR2 is a low shunt resistance, CR1 is a hjigh value of series resistance, which places the base of Q5 near RF ground. Due to the high series resistance of CR1, a method of isolation between the output of the balanced mixer and the RF grounded base of transistor amplifier Q5 results. This offers a smooth response in gain control with a minimum amount of signal distortion. With no PTT found at terminal E6, transistor switch Q3, which is normally biased on, removes the forward bias applied through R17 and R18 to transistor amplifier Q5 and disabling it. When a PTT ground signal is present on Q3 base, Q3 is turned off and the ground is removed from the junction of R17 and R18, enabling transistor amplifier Q5. With Q5 enabled, the 1.6-29.9999MHz collector signal is developed across the tapped transformer T5 and applied to the RF amplifier assembly.

4.13 RF Amplifier

4.13.1 General Description

The RF amplifier assembly provides a nominal 20dB gain to the 50-ohm RF output level required. The RF amplifier assembly also contains a low pass filter to further attenuate harmonics above 34MHz to an acceptable level. The heart of the RF amplifier assembly is an RF power amplifier IC chip Z1 which is a thin film RF power linear hybrid amplifier. A high level of gain with low distortion and harmonics is achieved through the use of push-pull circuitry in Z1. A portion of the RF output is sampled and detected for use in the RF output metering circuits.

4.13.2 Detailed Description

Although the RF power amplifier assembly is designed for a one watt maximum output, all levels are measured around a 100-milliwatt output level to get maximum third order intermodulation distortion and harmonic figures. With the output of the translator (Z123) applied to the input of Z1, the RF amplifier increases the output voltage of the desired output frequency to a level approximatwely 20dB above that at its input. 100 milliwatts PEP is the nominal output power of the amplifier. Exceeding this level may cause the output signal to contain improper levels of third order intermodulation distortion and also harmonics of the fundamental.

With the output of the hybrid amplifier Z1 applied to the low pass filter circuits consisting of L5, L9, L10, L11, L12, L13 and capacitors ,C21, C22 and C23, RF output harmonic signals above approximately 34MHz are attenuated, thereby insuring a low level of harmonic frequency output. A portion of the RF output of Z1 is applied to the RF metering circuits through resistor R5 and capacitor C11 to the meter detect diode CR4 where a proportional DC voltage is developed. This voltage is then applied through Pin3 to the RF meter on the front panel assembly. Level adjust potentiometer R9 allows calibration of the front panel RF meter to indicate the correct level of the RF output signal.

4.14 Carrier Generator

4.14.1 General Description

A 1MHz reference standard frequency enters the carrier generator at Pin 2 and is applied first to the base of driver transistor Q17 and then to buffer Q14. The transistors are driven from cutoff to saturation, producing a semi-squarewave of sawtooth waveform which is applied to the input of the divide-by-four logic gate Z1 to create the 250KHz subcarrier. The divider triggers on the falling edge of the sawtooth waveform and applies its 250KHz reference frequency to Q11 and Q13, where it is filtered, amplified and keyed.

4.14.2 Detailed Description

In the CW mode, the DC bias for Q11, Q13 and Q14 is enabled by the key line control transistor Q12. This is controlled through L10 by the keyline control input at Pin R, which is a key closure to ground from the front or rear panel key jacks. A control ground is placed at CW DC control Pin 10 and coupled to CW DC control transistor switch QW9 and carrier insertion control switch Q7 through steering diode CR7. The collector output of Q7 then goes High, placing forward bias on 250KHz emitter follower Q8. The keyed 250KHz output at the secondary of T1 is then coupled to the base of the 250KHz emitter follower Q8. The emitter Q8 output is then coupled to the base of the CW emitter follower transistor Q10 through the CW level adjust R46. This level is set to the proper CW output level.

In the audio modes, the output of the secondary of T1 is applied through coupling capacitor C32 to the 250KHz output at Pin B. This is the 250KHz carrier frequency for all audio modes. The secondary output of T1 is also coupled to the base of the 250KHz emitter follower Q8 through coupling capacitor C38. Q8 will only be energized when sideband operation with reinserted carrieror CW operation is selected by the front panel control.

In SSB operation, a control ground is placed at the control transistor Q12 from CW key control input Pin N. This control ground keeps Q11, Q13 and Q14 constantly on and provides the 250KHz carrier. With no carrier insertion, the carrier insertion control switch Q7, which is normally enabled, removes the forward bias from the 250KHz transistor Q8 and the maximum amount of carrier rejection is obtained. If carrier reinsertion is entered into the front panel assembly, a control ground is placed at one of the three transistor switches Q1, Q2 or Q5, depending on the amount of reinsertion selected. The control ground is also applied to the base of the carrier insertion control switch Q7 through one of the steering diodes CR4, CR5 orCR6. The method of controlling the amount of carrier insertion is the same for any amount specified. For the purpose of this discussion, -6dB of carrier insertion is used. A control ground is applied to Pin D and coupled directly to the base of carrier insertion control transistor Q1. Q1 collector voltage goes high and places a forward bias on carrier insertion emitter follower Q3. The control ground at Pin D is also applied to the base of the carrier insertion control switch Q7 through steering diode CR5. With Q7 turned off, the low is removed from the forward bias circuit of Q8, turning it on. The signal at the emitter output of Q8 is then developed across the -6dB adjust potentiometer R98 where the correct level of carrier reinsertion is set and coupled into the base of the carrier insertion emitter follower Q3. With Q3 enabled, the 250KHz carrier is coupled to the carrier output Pin 9 for reinsertion to the carrier. A portion of the 250KHz is applied to the base of the "x11" multiplier Q15. The collector output of Q15 is developed across the secondary of T3 which selects the eleventh harmonic (2.750MHz) of the 250KHz reference signal. The unfiltered 2.750MHz is then applied to FL1 for removal of all undesired harmonics. Q18 then amplifies the signal and offers the correct output impedance through T4 to the output at Pin 6.

The AM amplifier section performs the function of amplitude-modulating the 250KHz subcarrier signal with audio intelligence in the 350Hz to 7500Hz range. It then supplies this signal to the 3MHz generator board (Z003) when selected by front panel control.

With the AM position selected, a control ground is placed at the base of Q24 from Pin 11. Q24 is normally biased on, removing forward bias from Q19, Q21, Q22 and Q25, effectively turning off the AM modulator circuit. With Q24 disabled, USB and/or LSB audio is supplied from the front panel audio level control through coupling capacitors C36 and C41 to the bases of audio amplifiers Q19 and Q21. Both collector outputs are tied to amplifier Q20 whose collector output is developed across transformer T6. The secondary output from T6 is then applied to the tuned collector circuit of modulator Q22. The 250KHz subcarrier frequency is coupled to the base of the 250KHz amplifier Q23. The collector output of Q23 is coupled through capacitor C61 to the base of modulator Q22. Since the tuned collector of Q22 is modulated with the audio signal, the resultant collector signal across the T5 primary and C66 consists of a 250KHz subcarrier whose amplitude fluctuates at the audio signal rate. The 250KHz amplitude modulated signal at the T5 tuned secondary is developed across AM level adjust R90 and coupled through

C77 to the base of the AM gating transistor Q25. The emitter output of Q25 is then coupled to the 250KHz AM output at Pin 15.

A tune ground signal normally supplied from the associated transmitter automatically switches the exciter to a CW mode of operation. Tune output at Pin M places a ground at Q7 through steering diodes CR2 and CR7, to CW control transistor Q9 and to divider stage control transistor Q12 through steering diode CR1. This causes the divider stages and the gating/amplifier stages to be energized in the CW mode regardless of the mode of operation selected on the front panel assembly.

4.15 Sideband Generator

4.15.1 General Description

The sideband generators (Z004 and Z113) are identical in configuration and operation. USB is used for this explanation.

The USB modulation circuit receives the audio input from the front panel level control. The input to the front panel level control can be either a 600-ohm line at the rear panel or a pre-amplified front panel microphone jack. Whether the front panel audio control switch is in microphone or line position, the USB gain control always sets the amplitude of the USB audio signal input to the USB sideband generator. These 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 then routed to the converter section of the 3MHz assembly (Z003). A sample of the audio is rectified to operate the audio input level meter and VOX circuits.

Mode switching at this point can be divided into three sections: audio, CW, FSK and FAX operation.

4.15.2 Detailed Description

With USB or ISB as the selected mode, audio signals developed across the AF gain control are coupled through C14 to the base of the audio emitter follower Q2. Output signals at the emitter are RC-coupled to the balanced modulator consisting of diodes CR1-CR4, where they are modulated by the 250KHz subcarrier. Output signals from the 250KHz emitter follower Q8 are also supplied to the mixer, which produces sum and difference frequencies and attenuates the subcarrier and audio frequencies. The sum and difference frequencies are transformer coupled via T1 to IF amplifier Q3. The sideband output at the collector of Q3 is coupled through C18 and USB filter FL1 to IF emitter follower Q4.

In the upper asideband generator, FL1 is tuned to the upper sideband frequency 250,350Hz. In the lower sideband generator, FL1 is tuned to the lower sideband frequency range of 242,500 to 249,650Hz. The filter consists of T1 tuned primary, capacitors C29 and C40 and trimmer capacitor C28. This network presents a decided notch, thereby fully suppressing the 250KHz subcarrier center frequency.

DC control transistor Q1 is biased on, removing forward bias from Q2, Q3, Q4 and Q8. This disables the output of the sideband generator and allows the use of other modes to create a 3MHz carrier. Control ground on Pin E from the processor is required to return normal bias to the amplifiers and allow sideband output at Pin 4 to the 3MHz mixer. During ISB operation, a control ground is placed at Pin C, disabling Q10 and enabling Q11, thereby placing R54 ISB adjust in the forward biasing circuit of Q2 audio amplifier. This allows the gain of Q2 to be preset, satisfying the requirements of ISB operation. Under USB operation, Pinc C is high and Q11 is disabled.

The metering circuit consists of meter amplifier Q5, emitter follower Q6, and the halfwave filter output consisting of diode CR7 and capacitors C36 and C37. This circuit receives either microphone or 600-ohm line input from the USB/LSB/MIKE/LINE controls via the USB or LSB positions of the meter switch S1, converting it to a DC level proportional to amplitude for display on the front panel meter. The sideband output from amplifier Q4 is coupled through C22 and R34 to output Pin 4 and then applied to the 3MHz assembly.

4.16 3MHz Generator

4.16.1 General Description

The 3MHz generator consists of two sections: the frequency shift amplifier and buffer section, and the converter section. The frequency shift amplifier and buffer operate in the frequency shift (FSK) and facsimilie (FAX) modes. The converter section operates in all other modes except FSK and FAX. It functions to produce an amplitude modulated (AM) or single sideband (SSB) RF carrier of 3MHz for use in the final mixer.

4.16.2 Detailed Description - Audio Modes

With any mode selected except FSK/FAX, a control high is placed at Pin E and coupled to the base of transistor switch Q4 through CR1. This turns on Q4 which then places a low at the base of transistor switch Q5. With Q5 disabled, forward bias voltage for the converter section will be enabled to 2.750MHz amplifier Q2 and Q3.

The 2.750MHz developed in the carrier generator circuitas Z115 is applied to Pin D and coupled through C3 to the base of 2.750MHz input amplifier Q1. This input is amplified and then applied to the 2.750MHz emitter follower Q2. The output from Q2 is applied to balanced modulator Z1 in the AM mode. The 250KHz input signal consists simply of a 250KHz subcarrier, amplitude-modulated by audio intelligence in the 350 to 7500Hz range. When the signal is mixed with the 2.750MHz input, the balanced modulator produces sum and difference frequencies while attenuating the two original frequencies. The combination of tuned transformer T1 and capacitor C20 traps the 2.750KHz signal. As a result, an amplitude-modulated sum frequency of 3MHz results and is amplified by Q3. The collector output of Q3 is coupled through the 3MHz bandpass filter FL1 and is amplified and filtered by tuned collector stages Q6 and Q12. The 3MHz tuned collector output of Q12 is developed across level adjust potentiometer R49 and is applied to the final mixer Z106.

With USB, LSB or ISB selected, the 250KHz input to the converter section consists of an upper and/or a lower sideband audio intelligence in the 300 to 3300Hz range with the 250KHz carrier suppressed or unsuppressed according to the amount of the carrier insertion control entered on the front panel.

Since the 2.750MHz RF carrier is also present in these modes, the balanced modulator produces upper and/or lower sideband signals with a center frequency of 3MHz. With the 250KHz subcarrier suppressed, the 3MHz carrier is also suppressed, i.e. the sum frequency of 2.750MHz and 250KHz. The upper and/or lower sideband signals are amplified in the same manner as the AM signal and are sent to the final mixer Z106.

In the CW mode, the 250MHz input is not modulated by audio intelligence but is interrupted at a rate determined by a keyer input at key jack J301 on the front panel or on the rear panel audio jack J121-21. This results in a keyed difference frequency of 3MHz in the balanced modulator. The CW RF is then amplified as before and sent to the final mixer.

4.16.3 Detailed Description - Frequency Shift Modes

When FSK or FAX operation is selected, a control ground is applied to Pin E through CR1 to the base of transistor switch Q4. Q4 then enables the forward bias to Q7, Q10 and Q11 (the FSK/FAX buffer amplifiers). The 3MHz signal from shift generator Z117 is applied at Pin F and capacitively coupled to the base of buffer-amplifier Q7 and applied to the base of Q8. Q8 and Q9 act together to maintain amplitude amplitude within acceptable limits without destroying the frequency shift characteristics. The limiter output at the collector of Q9 is applied to emitter follower Q10 and then applied through FSK/FAX level control R49 to amplifier Q11. Since the 2.750MHz amplifier are disabled in the FSK/FAX modes, the 3MHz output at the collector of Q11 is then injected directly into the 3MHz bandpass filter.

Section 5 - Maintenance Instructions

5.1 Introduction

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

5.2 Preventive Maintenance

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. 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 compromising important schedules.

The most important check in preventive maintenance is a thorough visual inspection of an assembly or component for tell-tale signs of deterioration prior to failure. This can save hours of test and troubleshooting time after a complete breakdown. Table 5-1 presents an inspection checklist for the exciter.

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

The fumes of tri-chloroethane are toxic. Provide adequate ventilation whenever used. DO NOT USE NEAR AN OPEN FLAME. Tri-chloroethane is not flammable but exposure to an open flame or hot metal forms toxic phosgene gas.

- [ ] Remove dirt or grease from wiring and chassis surfaces using the cleaning solvent. Dry with compressed air.

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

- [ ] Blow out accumulated dust and dirt from inaccessible chassis areas using compressed air. Direct the compressed air stream at an angle to the component board to obtain best results without damage.

Table 5.1

Inspection Checklist

FOR ALL PRINTED CIRCUIT BOARDS:

- ☐ Check for loose components.
- ☐ Check all components for deterioration due to overheating.
- ☐ Check printed wiring (lands) for cracks or solder spillage. Cracks and solder bridges cause open and short circuits, respectively. Breaks in the conducting strip on a printed circuit board can cause permanent or intermittent trouble. In many instances, these breaks will be so small that they cannot easily be located. To check out and locate trouble in the conducting strips, set up a multimeter that uses less than 1.0ma of current and make point-to-point resistance checks using needle probes. The meter should always indicate continuity.
- ☐ Check board connectors for cleanliness and absence of foreign matter which could cause shorts. Check for openings in printed circuit wiring (lands) due to cracks.
- ☐ Check overall board for general cleanliness.

FOR ALL SWITCHES AND CHASSIS-MOUNTED ELECTRICAL COMPONENTS:

- ☐ Check all switches for positive detect action. Check switch wiring for nicks, cuts, abrasions, etc. Check switch-mounted components for solid connections or signs of deterioration due to overheating.
- ☐ Check all connectors for burred threads, bent or broken pins, dents, and solid mounting.
- ☐ Check all chassis-mounted component for signs of deterioration due to overheating. Check for solid connections and mounting.

FOR ALL TERMINAL STRIPS:

- ☐ Check that screw terminals are all tight.
- ☐ Checks that all solder connections are clean and solid.
- ☐ Check for cleanliness.

5.3 Alignment and Adjustment

Alignment and adjustment of the exciter consists of individual board alignments and final overall alignment. Note that board alignment may be required whenever a particular PC board is replaced or repaired, even though the replacement board may already have been aligned and adjusted. In the worst case, the replacement board should be checked to insure correct output parameters. This is necessary to insure the new board is compatible with the remaining boards in the exciter. Proper alignment is covered in TMC factory test procedures. By following the torubleshooting procedures in Table 5.2, a qualified technician can essentially duplicate the factory alignment.

5.4 Corrective Maintenance

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

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 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, including heat sink, is mounted against the rear panel of the main chassis and is removeable. For the purpose of this manual, corrective maintenance extends down to the individual module or printed circuit card level.

The MMX-4 exciter modules are pre-set at the factory. Repair of these modules should not be attempted in the field unless proper test equipment is available and personnel familiar with both digital and analog circuits have been certified to perform delicate electronic repair.

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 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 further alignment or adjustment. Section 6 contains complete diagrams and schematics of the exciter. Qualified technicians, thoroughly familiar with the operation of the exciter, should make frequent reference to both schematics and interconnect diagrams when conducting troubleshooting procedures.

Table 5.2 presents basic troubleshooting procedures which localize operational problems to the module level.

Table 5.2

Troubleshooting Procedures to Module Level

Check of Power Supply

☐ If exciter does not operate, check for blown fuse on rear panel.

☐ Check for correct voltages at output of power supply as follow:

Pin 5	+5 vdc
Pin 1	+12 vdc
Pin 3	+24 vdc
Pin 9	+28 vdc

Check of CW Mode and Front Panel

☐ Set up exciter front panel as follows:

STBY/OPP Switch	OPP position
USB/LSB/RF Switch	RF Position (Center)
MIKE/USB Switch	USB Position (Light off)
MIKE/LSB Switch	LSB Position (Light off)
LSB Audio	Minimum (Down)
USB Audio	Minimum (Down)
RF Gain	Minimum (Down)

☐ Check function of all frequency, mode, carrier level, channel buttons, etc.

☐ Set up 5000.0KHz frequency in CW mode. Check to ensure CW key and PTT lines are grounded on rear plug, J121-21 for Key and J121-22 for PTT.

☐ Increase RF gain (Up). If meter reads, all stages of the exciter are functioning in CW mode at 5000.0 KHz.

Check of Least Significant Digits

☐ With front panel setup as above, enter 5111.1 and observe display. If display fails to read entry, a slight adjustment of the tune comb filters may be necessary. Repeat for 5222.2, 5333.3, 5444.4, 5555.5, 5666.6, 5777.7, 5888.8 and 5999.9.

☐ If tune comb filters require adjustment, remove the bottom cover of the exciter. With a scope and counter, check the output of the filter. Refer to Figure 6.13A for correct frequency and level output.

Table 5.2 (Continued)

Troubleshooting Procedures to Module Level

Z107, Z108, Z109 and Z110 are identical. Vari-Cap tuning voltages are also the same.

- ☐ Adjust R40 on the filter corresponding to the failed digit to produce the correct output. When R40 is touched, check all digits on the remaining filters to make sure all frequencies (0-9) are correct.

Check of 1MHz Digit

- ☐ Check the following frequencies in 1MHz steps. 1000.0 KHz to 10000KHz. If any of these frequencies do not function when selected, check Z111, the 1MHz Tuned Comb Filter, with a scope and counter for the correct frequency and level. Refer to Figure 6.13A. If any digit fails, a slight readjustment of R40 is needed.
- ☐ Re-check all digits for proper operation.
- ☐ Also check Vari-Cap voltages if re-adjustment above does not correct problem.

Check of 10MHz Digit

- ☐ Tune the exciter to the following frequencies

  2,000.0 KHz
  10,000.0 KHz
  15,000.0 KHz
  29,000.0 KHz

- ☐ If any of these frequencies fail to function, check the output of the Spectrum Generator at terminal E1 with a scope and counter. The following reading should be recorded:

  At 2MHz, output is 12MHz on E1
  At 10MHz, output is 11MHz at E1
  At 15MHz, output is 10MHz at E1
  At 20MHz, output is 9MHz at E1

- ☐ The output level should be 1.8-2.0 vpp. This is adjusted by the corresponding gain if the frequency is incorrect. Re-set with the frequency adjust control.

Table 5.2 (Continued)

Troubleshooting Procedures to Module Level

Check of USB/LSB Operation

- ☐ Program the exciter for USB at -55dB carrier suppression. Unground CW Key line on J121.

- ☐ Connect audio input to USB pins J121-9 and J121-13 with center-tap ground at J121-12. Connect audio input to LSB pins J121-1 and J121-5 with center-tap ground at J121-3.

- ☐ Using a two-tone generator or equivalent -10dB tone, adjust the USB audio level to 4/5 scale with the meter switch in the USB position. Repeat for LSB with the meter switch in the LSB position. Switch metter back to mid-position (RF output) and adjust the RF Gain for 250 milli-watts PEP output.

- ☐ If no output is obtained on sideband, check Z004 (Figure 6.6A) for approximately 30 milli-volts pp output.

Check of Carrier Adjust

- ☐ Check carrier levels with a two-tone signal generator, setting exciter audio to 4/5 scale as above (0dB reference). Program the carrier suppression to -6dB, -20dB or -30dB. If these carrier levels are incorrect, refer to Figure 6.19A, Carrier Generator. Adjust R98 for the proper -6dB carrier level; R97 for the proper -20dB carrier level; or R94 for the proper -30dB carrier level.

Detail Check of Exciter Operation

The following checks are performed only if a major malfunction, such as no output on any frequency, is detected during normal operation. All checks may not be necessary, but due to the complexity of the unit it is usually good practice to follow these procedures in sequence.

- ☐ Check 1MHz Switching Standard Z002 for following values:

Pin J	1.8 - 2.0v output at 1MHz
Pin 10	1.8 - 2.0v output at 1MHz
Pin A	+24vdc

Table 5.2 (Continued)

Troubleshooting Procedures to Module Level

☐ Check Spectrum Generator Z104 for following values:

Pin 10	3vpp	Square Wave Output
Pin 7	-6vpp	8MHz output
E3	1.3vpp	20MHz output
E1	1.8 - 2.0vpp	9MHz, front panel select 29MHz
		10MHz, front panel select 15MHz
		11MHz, front panel select 10MHz
		12MHz, front panel select 2MHz

A programmed low at the front panel on Pins 5, A, D, H and 8 sets up 9-12MHz (10MHz digit).

☐ Check Tune Comb Filter Z107 for the 100KHz digit; Z108 for the 10KHz digit; Z109 for the 1KHz digit; Z110 for the 100Hz digit; and Z111 for the 1MHz digit. Levels should read as follow:

Pin 4	Digits 0-9 0.7vpp
Pin 5	High digits 0,1,2 (Set up at front panel)
	Low digits 3,4,5,6,7,8,9
Pin 6	Var-Cap voltages (Set up at front panel)
	See chart on Figure 6.3A.

☐ Check 100Hz, 1KHz and 10KHz Synthesizers for the following values:

Pin F	0.7 vpp (1.0000-1.0999 MHz)
Pin B	0.27 vpp at 8MHz
Pin 2	0.7 vpp
Pin 3	0.5 vpp

All three synthesizers are identical. Check the output of each with a scope and counter. Scan 100Hz, 1KHz and 10KHz digits with a scope on the output of the 10KHz synthesizer. If OK< then all synthesizers are working. If not OK, then put scope on the output of the 1KHz synthesizer and re-check levels. Repeat down synthesizer chain until fault is located.

Table 5.2 (Continued)

Troubleshooting Procedures to Module Level

☐ Check Final Mixer Z106 for the following values:

Pin 10	100-200 mvpp at 13.0000 to 13.9999MHz
Pin K	0.7vpp at 1-1.9MHz (100KHz TCF input)
Pin 3	0.8vpp at 1.0000-1.0999MHz (10KHz from 110KHz Synth)
Pin A	80mvpp at 8MHz (8MHz from spectrum generator)
Pin 2	80mvpp at 3MHz (From 3MHz generator)

Final Mixer adds the 100KHz digit to the synthesizer chain 10.0000 - 10.9999MHz. This is then mixed with 3MHz to create 13.0000-13.9999MHz. Audio modulation is present in the 3MHz generator. Test 13.0000-13.9999MHz throughout its range for proper operation.

☐ Check Multiplier-Mixer Z122 for the following values:

E1	1vpp at 20MHz from the specturm generator
E4	100-200mvpp at 13.0000-13.9999MHz
E7	25mvpp at 133-134MHz

The 20MHz is amplified and tripled to 60MHz. This is then doubled to 120MHz with a reading of 0.15vpp at C14. This is mixed with 13.0000-13.9999MHz to give 133-134MHz output.

☐ Check Translator Z123 for the following values:

E2	25mvpp at 133-134MHz
E4	0.6vpp at 104-133MHz in 1MHz steps
E8	0.2vpp at 0.4-30MHz to final RF Amplifier
E6	Ground (PTT)
E7	0 to 18v for RF Gain

The 133-134MHz input is amplified and tuned (four stages) 0.2vpp at C14. This 133-134MHz is mixed with 104-133MHz to create the 0.4 to 29.9999MHz output.

Table 5.2 (Continued)

Troubleshooting Procedures to Module Level

☐ Check 1MHz Synthesizer for the following values:

Pin B	1.8-2.0vpp at 9, 10, 11 and 12MHz from spectrum generator
Pin A	0.65vpp at 1.1-2MHz (Mhz TCF)
Pin E	1.5vpp at 10.4-13.2MHz in 100KHz steps

Tune the exciter from 0 to 29MHz. Check the output frequencies using the chart in Figure 6.7A. Also check for proper Vari-Cap voltages.

☐ Check "x2" Amplifier Z124 for the following values:

E1	1.5vpp at 10.3-13.2 MHz from 1MHz synthesizer
E2	3vpp at 20.6-26.4MHz
E4	See chart in Figure 6.24A

The "x2" amplifier doubles the frequency to 20.6 to 26.4MHz.

☐ Check "x5" Amplifier Z125 for the following values:

E1	3vpp at 20.6 to 26.6MHz input
E5	4vpp at 104-133MHz output to translator
E4	See chart in Figure 6.25A

The 20.6 to 26.4MHz frequency is multiplied to create 104-133MHz, the mixing frequencies for the translator.

☐ Check RF Output moidule for the following values:

E10	0.2vpp at 0.4 to 29.9999MHz input
E1	250mw output at 0.4-29.9999MHz output
E1	RF to front panel meter
E4	ALC input
E5	ALC output

The RF Output card provides 250mw output and input to the metering circuits.

Table 5.2 (Continued)

Troubleshooting Procedures to Module Level

☐ Check the 3MHz Z003 for the following values:

Pin 2	30mvpp at 250KHz
Pin D	90mvpp at 2.75MHz
Pin F	100mvpp at 3MHz from the VCXO
Pin 1	70-200mv at 3MHz
Pin E	DC control from front panel provides low in FSK/FAX

The 3MHz generator mixes 250KHz from the sideband boards or carrier generator board with the 2.75MHz to produce 3MHz. When Pin E is grounded, the 3MHz VCXO is turned on for the FSK/FAX mode.

☐ Check the Carrier Generator Z115 for the following values:

Pin 2	1.8vpp at 1MHz
Pin 6	0.13vpp at 2.75MHz output to the 3MHz board
Pin 12	0.3vpp for audio in (AM)
Pin 13	0.3vpp for audio in (AM)
Pin 3	1.5vpp at 250KHz input
Pin 11	Ground (Turns on AM mode*)
Pin N	Ground (Turns on CW mode*)
Pin 15	-0.3vpp (AM output)
Pin 9	0.3vpp (Carrier output)
Pin J	Ground (-30dB carrier suppression*)
Pin C	Ground (-20dB carrier suppression*)
Pin D	Ground (-6dB carrier suppression*)
Pin 10	Ground (CW mode*)
Pin 5	0.3vpp (CW level output)
Pin B	1.7vpp at 250KHz output
Pin R	CW Key Line (Rear panel)

* HIGHs or LOWs are provided by the front panel mode or carrier suppression selects.

Table 5.2 (Continued)

Troubleshooting Procedures to Module Level

☐ Check tuning of the RF stages by confirming that all circuits are tuned for a peak to maximize output. There is no stagger tuning; most tuning is done with the exciter set up on 29.0000MHz. Peak the following circuits in order:

1MHz synthesizer at 29.0000MHz
"x2" Amplifier at 29.0000MHz
"x5" Amplifier at 29.0000MHz
Translator at 29.0000MHz
Multiplier-Mixer at 29.0000MHz
Spectrum generator
  - Pin 7 at 8MHz
  - E3 at 20MHz
  - E1 at 9-12MHz

Tuned Comb Filter (See chart on schematics)
100KHz, 10KHz, 1KHz (See chart on schematics)
Final Mixer (See chart on schematic)
Carrier Generator
  - T1 and T2 at 250KHz (Peak tune)
  - T3 and T4 at 2.75MHz (Peak tune)
  - T5 and T6 at 250KHz (Peak tune)

3MHz Generator
  - T1, T2 and T3 at 3MHz (Peak tune)

USB/LSB Audio Sideband
  - T1 at 250KHz (Fine tune for best carrier rejection)

1MHz Switching Standard
  - T1 and T2 at 1MHz (Peak tune)

☐ Adjust 1MHz Frequency Standard by removing cap screw and adjusting frequency with a short, insulated blade screwdriver. Do not leave adjustment cap off.

Only adjust standard after exciter has been on a continuous heat run of a minimum of 24 hours.

6.1 Introduction

This section contains schematic diagrams of all 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

Whenevr possible, the parts lists is located immediately after itws companion subassembly diagram and component layout illustration. The list is a cross-reference between symbol designation and TMC part number. The illustration identifies the part by symbol number. Mechanical and electro-mechanical parts are stamped with the TMC part number but are not listed on parts lists.

Ordering Information

To expedite the ordering of replacement parts, provide the following information to TMC Customer Service:

- Component TMC Part Number
- Description of the TMC Part
- Assembly Part Number (Used On)

Send or call in requests for replacement parts to:

THE TECHNICAL MATERIEL CORPORATION
700 Fenimore Road
Mamaroneck, New York 10543
UNITED STATES

Telephone: 914-698-4800
Facsimile (FAX): 914-698-4805
Telex: 137-358 TECHMAT MECK

6.3 Diagrams

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

Table 6.1

Assembly/Subassembly List

Symbol	Description	Circuit	Assembly
	Overall Interconnect	CK2293	
	Audio & Control Interconnect	CK2277	
	Front Panel Interconnect	CK2295	
Z001	Front Panel Interface	CK2290	A5841
Z002	1MHz SWG Standard	CK2281	A5842
Z003	3MHz Generator	CK2259	A5823
Z004	USB Audio Sideband	CK2261	A5820
Z005	1MHz Synthesizer	CK2278	A5816
Z101	100Hz Synthesizer	CK2275	A5814
Z102	1KHz Synthesizer	CK2275	A5814
Z103	10KHz Synthesizer	CK2275	A5814
Z104	Spectrum Generator	CK2274	A5824
Z106	Final Mixer	CK2276	A5815
Z107	100Hz Tuned Comb Filter	CK2269	A5821
Z108	1KHz Tuned Comb Filter	CK2269	A5821
Z109	10KHz Tuned Comb Filter	CK2269	A5821
Z110	100KHz Tuned Comb Filter	CK2269	A5821
Z111	1MHz Tuned Comb Filter	CK2269	A5821
Z113	LSB Audio Sideband	CK2261	A5820
Z115	Carrier Generator	CK2260	A5825
Z117	Frequency Shift	CK2263	A5826
Z121	Audio Input Filter	CK2264	A5828
Z122	Multiplier-Mixer	CK2279	A5827
Z123	Translator	CK2267	A5822
Z124	"X2" Amplifier	CK2266	A5817
Z125	"X5" Amplifier	CK2265	A5818
Z126	Remote Control Assembly		
	RF Output Assembly	CK2268	A5819
	Power Supply	CK2282	A5833
	Control Processor Assembly	CK2294	A6837
	Key Pad/Display Assembly	CK2292	A5836

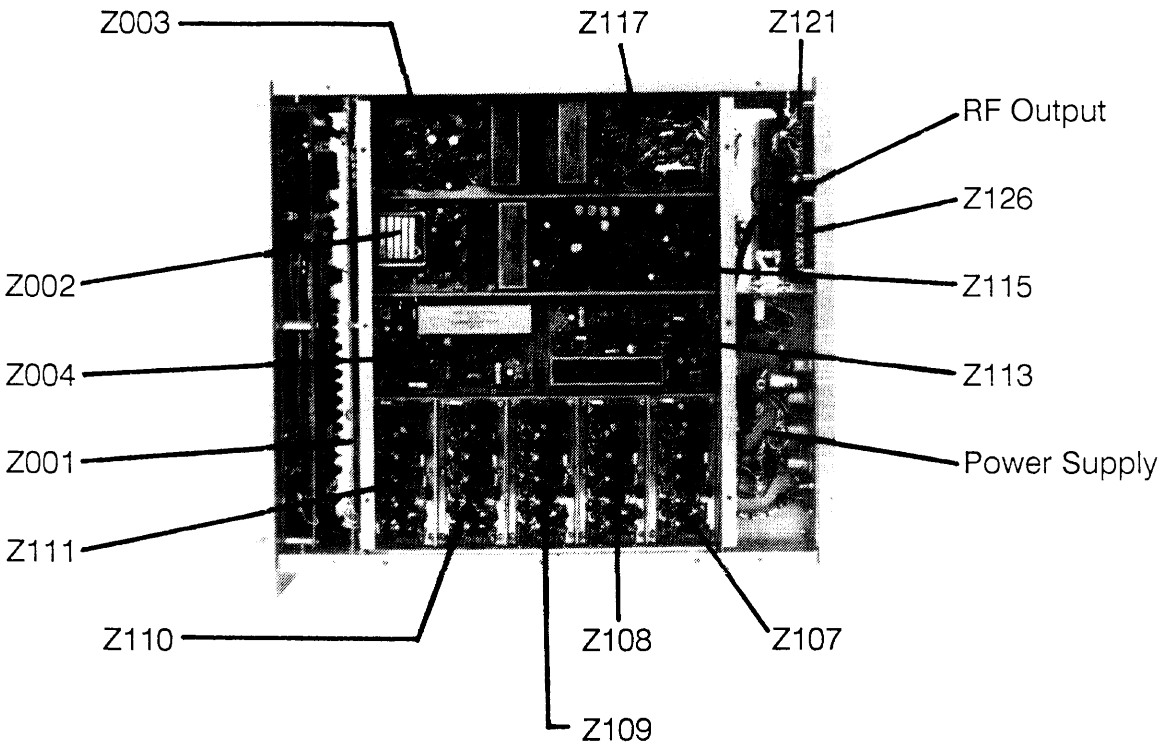


Figure 6-1A Chassis Top View

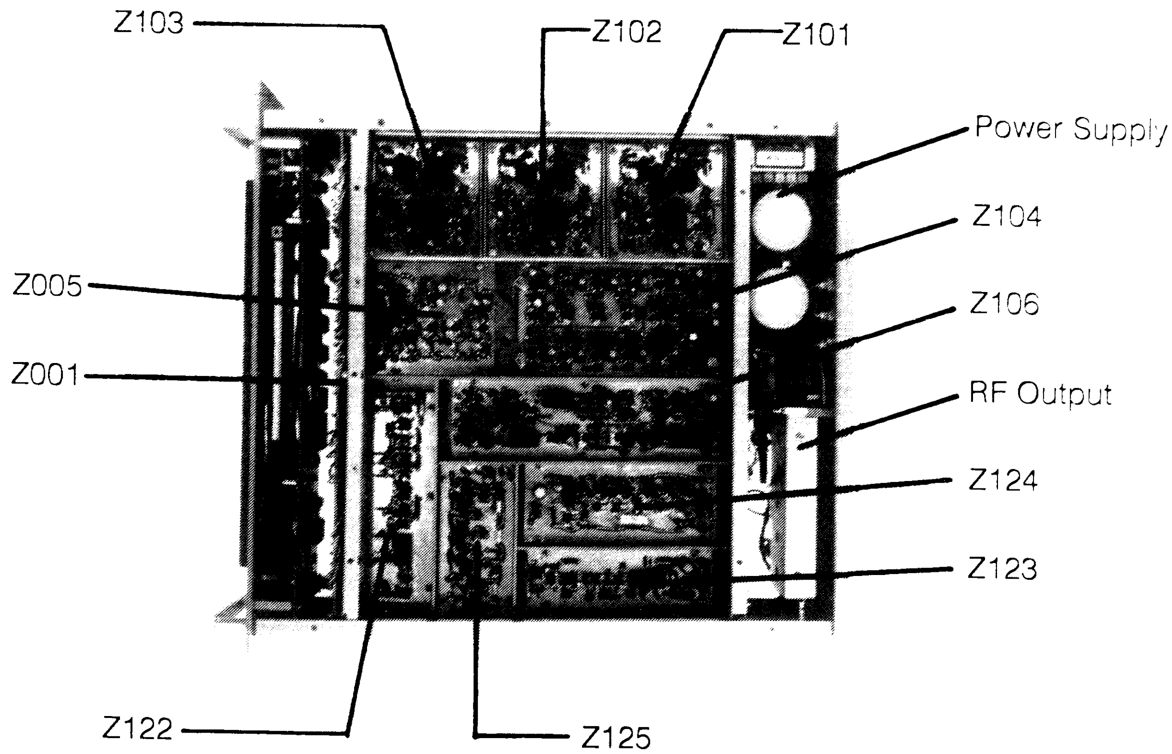


Figure 6-1B Chassis Bottom View

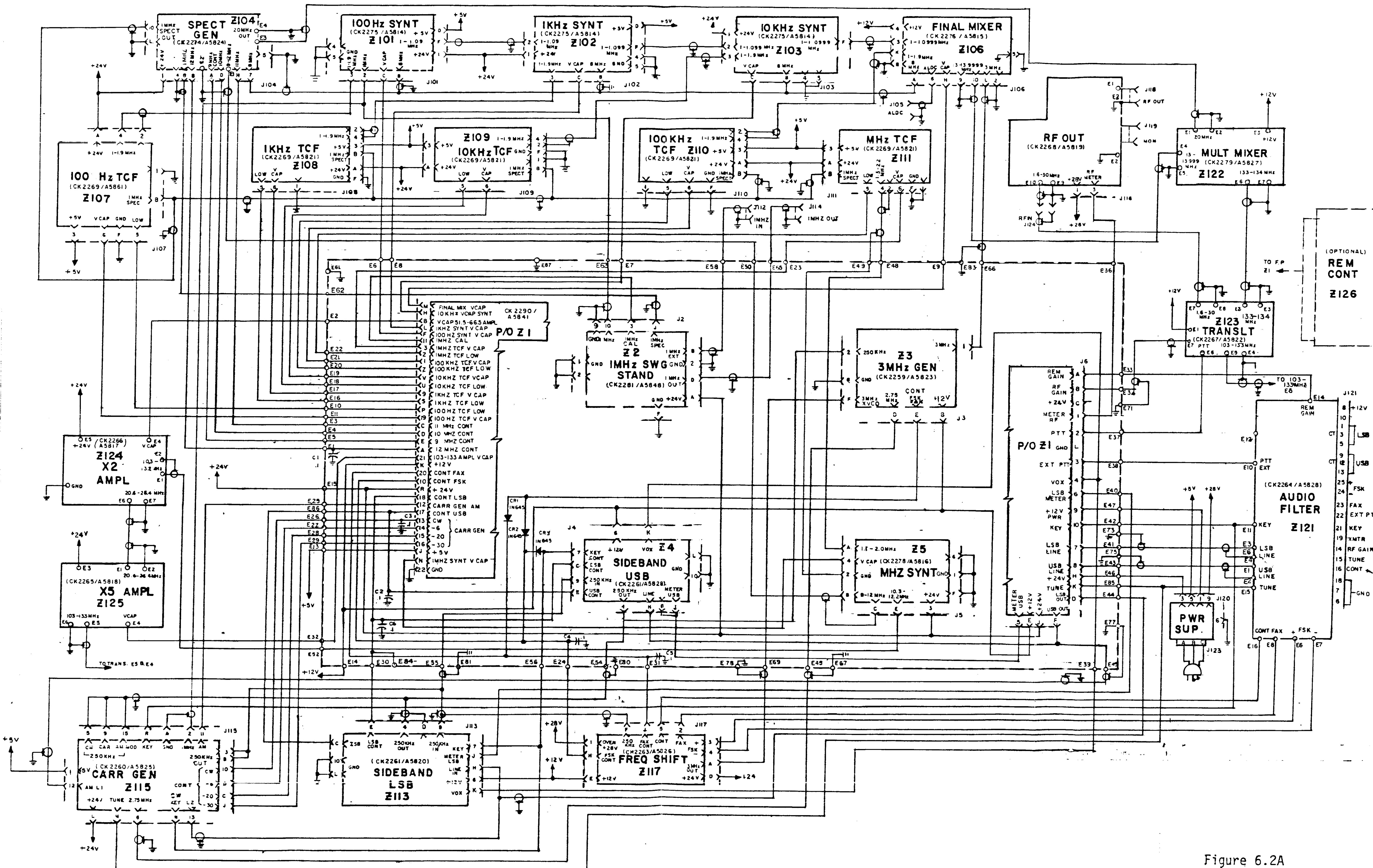


Figure 6.2A
Overall Interconnect

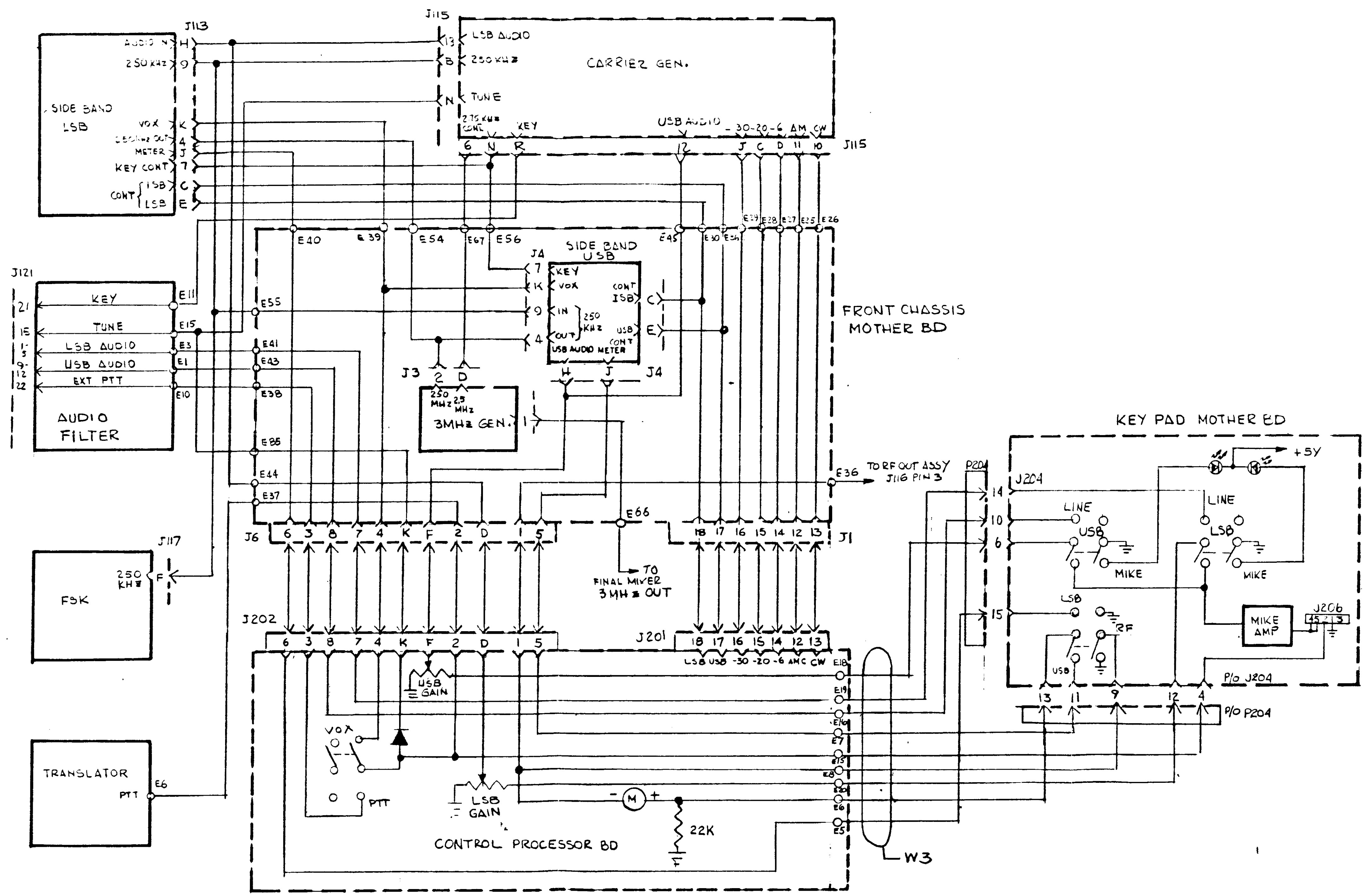


Figure 6.2B
Audio/Control Interconnect

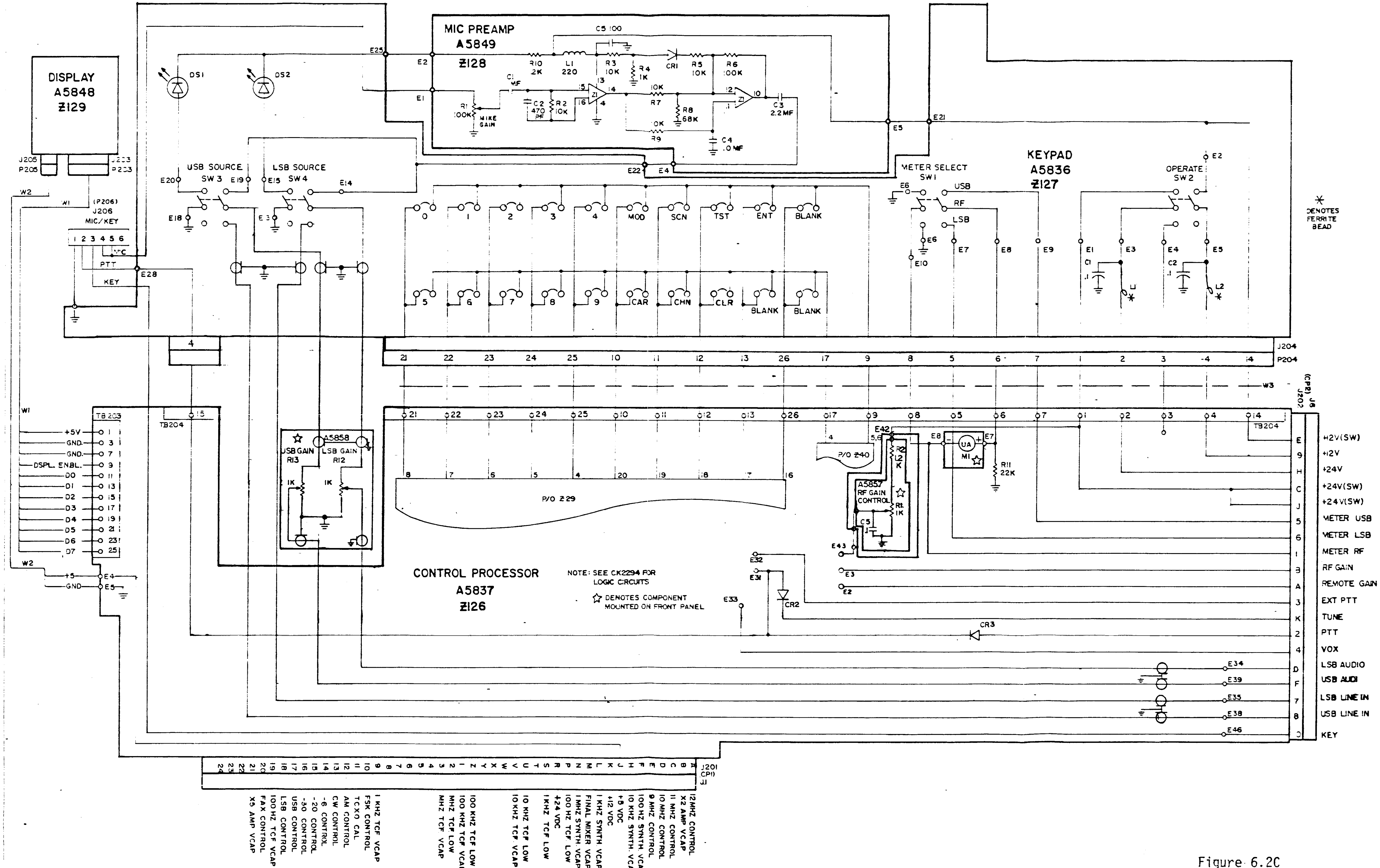


Figure 6.2C
Front Panel Interconnect

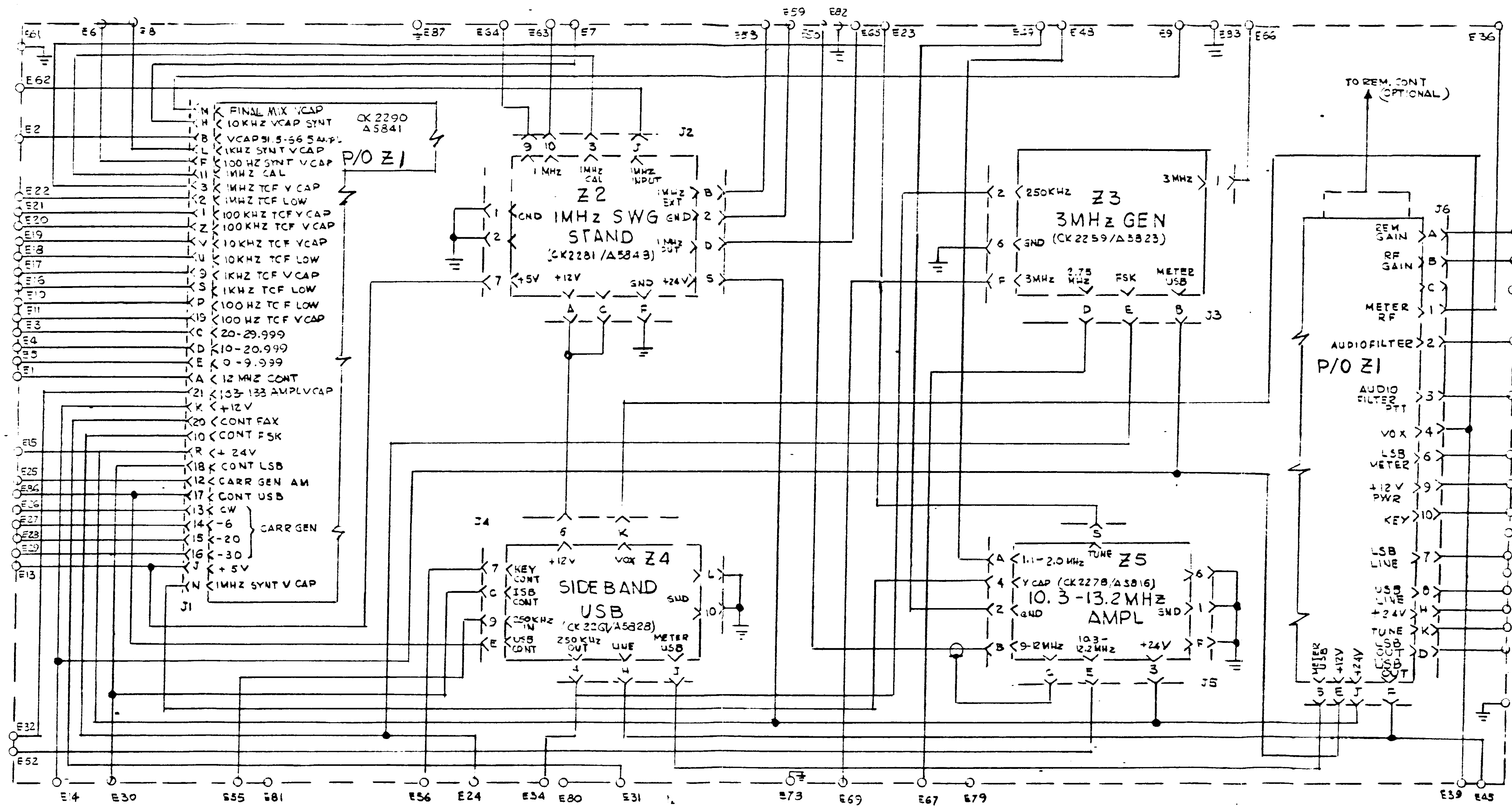


Figure 6.3
Front Panel Interface Z001

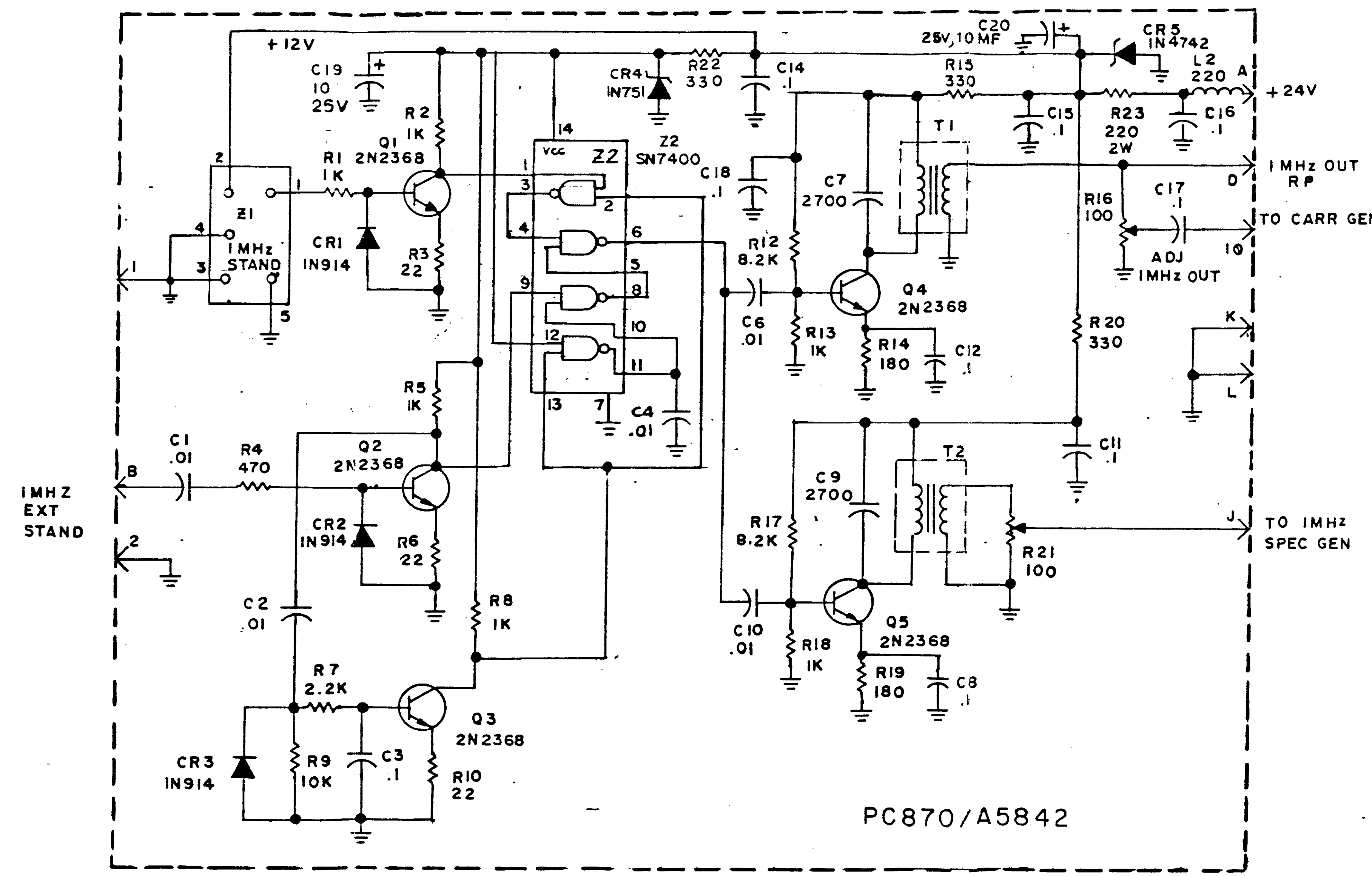


Figure 6.4A
1MHz Switching Standard
Z002 Schematic

Part Number	Description	Used On	Qty	Symbol Number	S1200
AO130	1MHz Standard	A5842	1	Z1	
CC131-32	Cap., Fixed, Cer., .01UF	A5842	5	C1, 2, 4, 6, 10	
CC131-39	Cap., Fixed, Cer., 1UF	A5842	7	C3, 5, 11, 14, 15, 16, 17	
CE122	Cap., Tant., Fixed	A5842	1	C20	
CL275-221	Coil, R.F., Fixed	A5842	2	C1, 2	
CM111E272JSS	Cap., Fixed, Mica	A5842	2	C7, 9	
NW*SN7400		A5842	1	Z2	
RC07GF102J	Resistor, Comp., Fixed	A5842	6	R1, 2, 5, 8, 13, 18	
RC07GF103J	Resistor, Comp., Fixed	A5842	1	R9	
RC07GF181J	Resistor, Comp., Fixed	A5842	2	R14, 19	
RC07GF220J	Resistor, Comp., Fixed	A5842	3	R3, 6, 10	
RC07GF222J	Resistor, Comp., Fixed	A5842	1	R7	
RC07GF331J	Resistor, Comp., Fixed	A5842	2	R15, 20	
RC07GF471J	Resistor, Comp., Fixed	A5842	1	R4	
RC07GF822J	Resistor, Comp., Fixed	A5842	2	R12, 17	
RV124-1-101	Resistor, Variable	A5842	2	R16, 21	
RV124-1-203	Resistor, Variable	A5842	1	R24	
TT285-2	Transformer, Tunable	A5842	2	T1, 2	
1N751	Semiconductor Diode	A5842	1	CR4	
1N914	Semiconductor Diode	A5842	3	CR1, 2, 3	
1N4742	Semi., Dio., Zener	A5842	1	CR5	
2N2368	Semiconductor, Trans.	A5842	5	Q1, 2, 3, 4, 5	

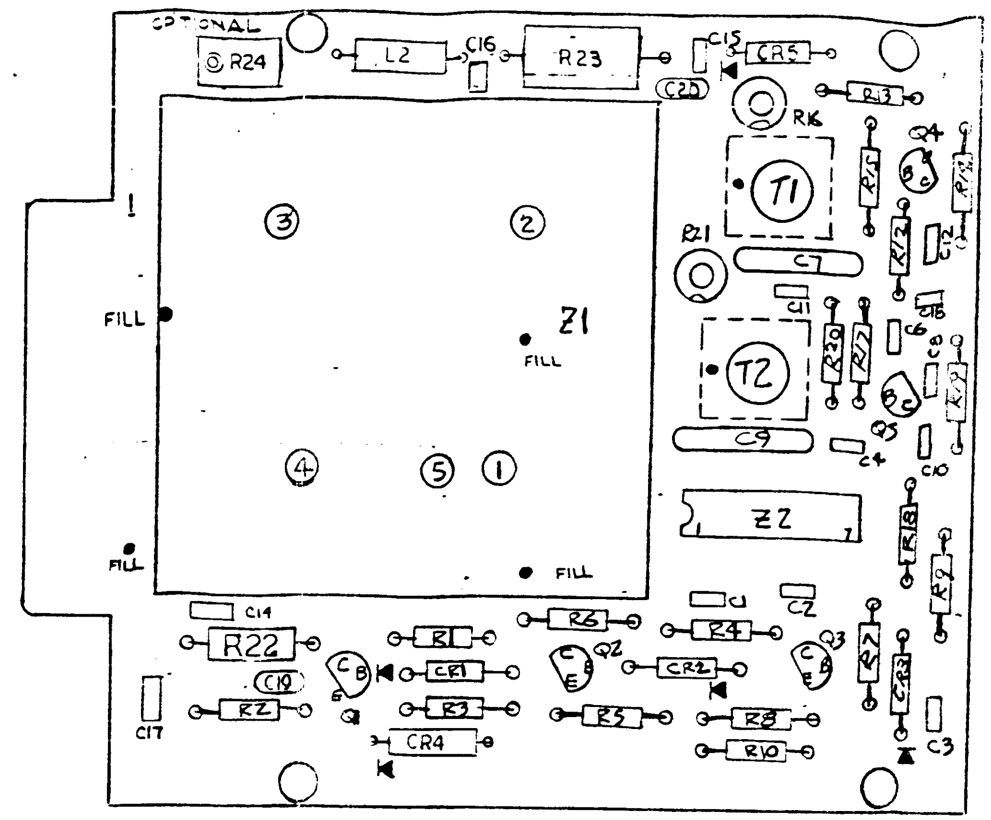


Figure 6.4B
1MHz Switching Standard
Z002 Component Identifier

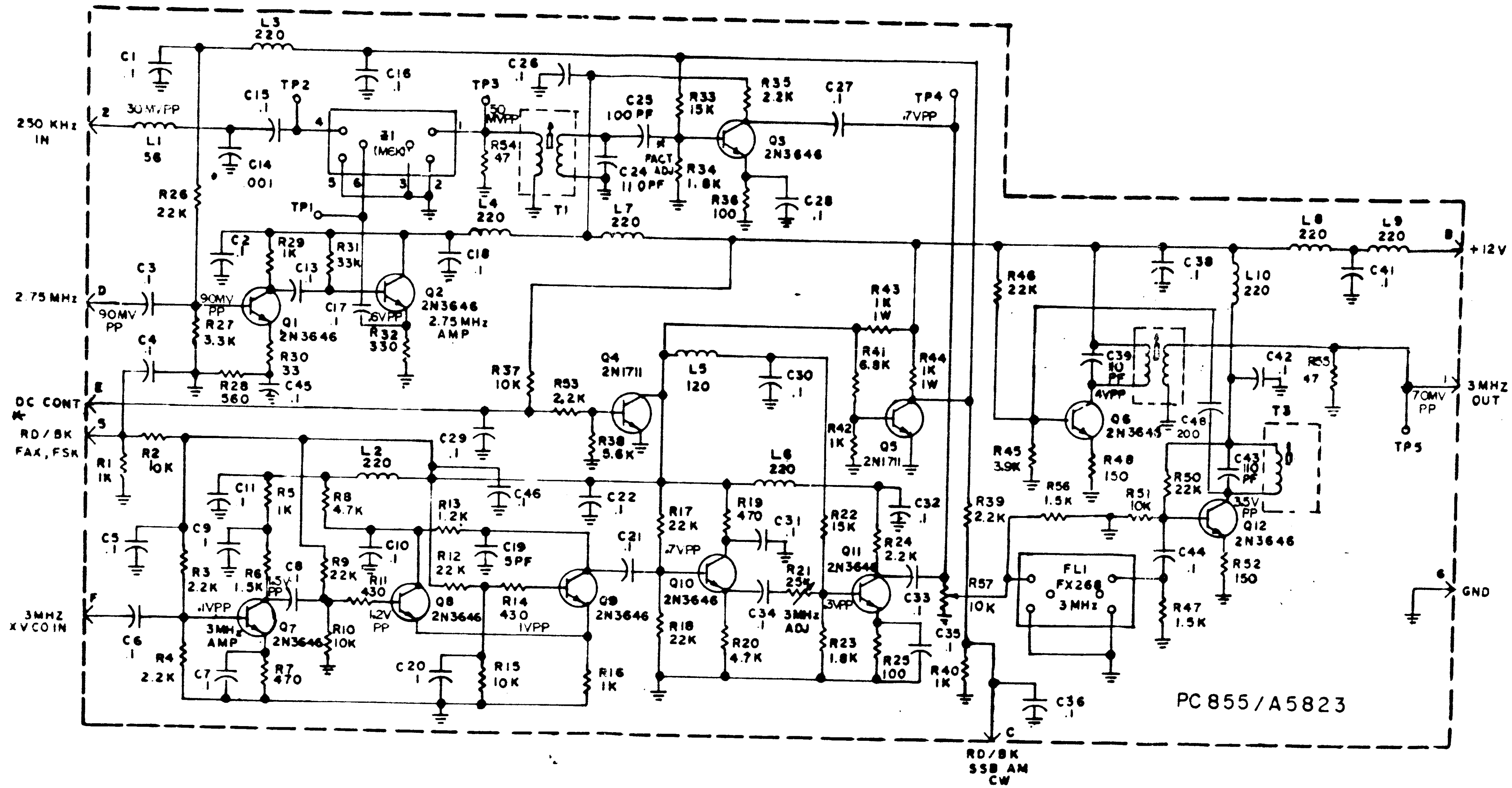


Figure 6.5A
3MHz Generator
Z003 Schematic

Part Number	Description	Used On	Qty	Symbol Number	S1200
CC131-24	Cap., Fxd., Cer.	A5823	1	C14	
CC131-39	Cap., Fad., Cer.	A5823	38	C1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 15, 16, 17, 18, 20, 21, 22, 23, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 40, 41, 42, 44, 45	
CL275-221	Coil, RF, Fxd.	A5823	9	L2, 3, 4, 5, 6, 7, 8, 9, 10	
CL275-560	Coil, RF, Fxd.	A5823	1	L1	
CM111E050J1SS	Cap., Fxd., Mica	A5823	2	C19, 25	
CM111E111J1SS	Cap., Fxd., Mica	A5823	3	C24, 39, 43	
FX268	Fil., BP.	A5823	1	FL1	
NW163	NW Bal. Mixer	A5823	1	Z1	
RC07GF101J	Res., Fxd., Comp.	A5823	4	R25, 36, 48, 52	
RC07GF102J	Res., Fxd., Comp.	A5823	6	R1, 5, 16, 29, 40, 42	
RC07GF103J	Res., Fxd., Comp.	A5823	5	R2, 10, 15, 37, 39	
RC07GF122J	Res., Fxd., Comp.	A5823	1	R13	
RC07GF152J	Res., Fxd., Comp.	A5823	2	R6, 47	
RC07GF153J	Res., Fxd., Comp.	A5823	4	R22, 33, 45, 51	
RC07GF182J	Res., Fxd., Comp.	A5823	2	R23, 34	
RC07GF222J	Res., Fxd., Comp.	A5823	5	R3, 4, 24, 35, 38	
RC07GF223J	Res., Fxd., Comp.	A5823	7	R9, 12, 17, 18, 26, 46 50	
RC07GF330J	Res., Fxd., Comp.	A5823	1	R30	
RC07GF331J	Res., Fxd., Comp.	A5823	1	R32	
RC07GF333J	Res., Fxd., Comp.	A5823	2	R27, 31	
RC07GF431J	Res., Fxd., Comp.	A5823	2	R11, 14	
RC07GF471J	Res., Fxd., Comp.	A5823	2	R7, 19	
RC07GF472J	Res., Fxd., Comp.	A5823	2	R8, 20	
RC07GF561J	Res., Fxd., Comp.	A5823	1	R28	
RC07GF682J	Res., Fxd., Comp.	A5823	1	R41	
RC32GF102J	Res., Fxd., Comp.	A5823	2	R43, 44	
RV124-1-501	Res., Var., Comp.	A5823	1	R49	
RV124-1-253	Res., Var., Comp.	A5823	1	R21	
TE0127-2	Term., Lug	A5823	5	TP1, 2, 3, 4, 5	
TT285-14	XFMR, RF, Adj.	A5823	3	T1, 2, 3	
1N645	Scond, Dev., Dio	A5823	1	CR1	
2N1711	Transistor	A5823	2	Q4, 5	
2N3646	Transistor	A5823	9	Q1, 2, 3, 6, 7, 8, 9, 10, 11, 12	
CK2259	Schematic	A5823	1		
PC855	Printed ckt. bd.	A5823	1		

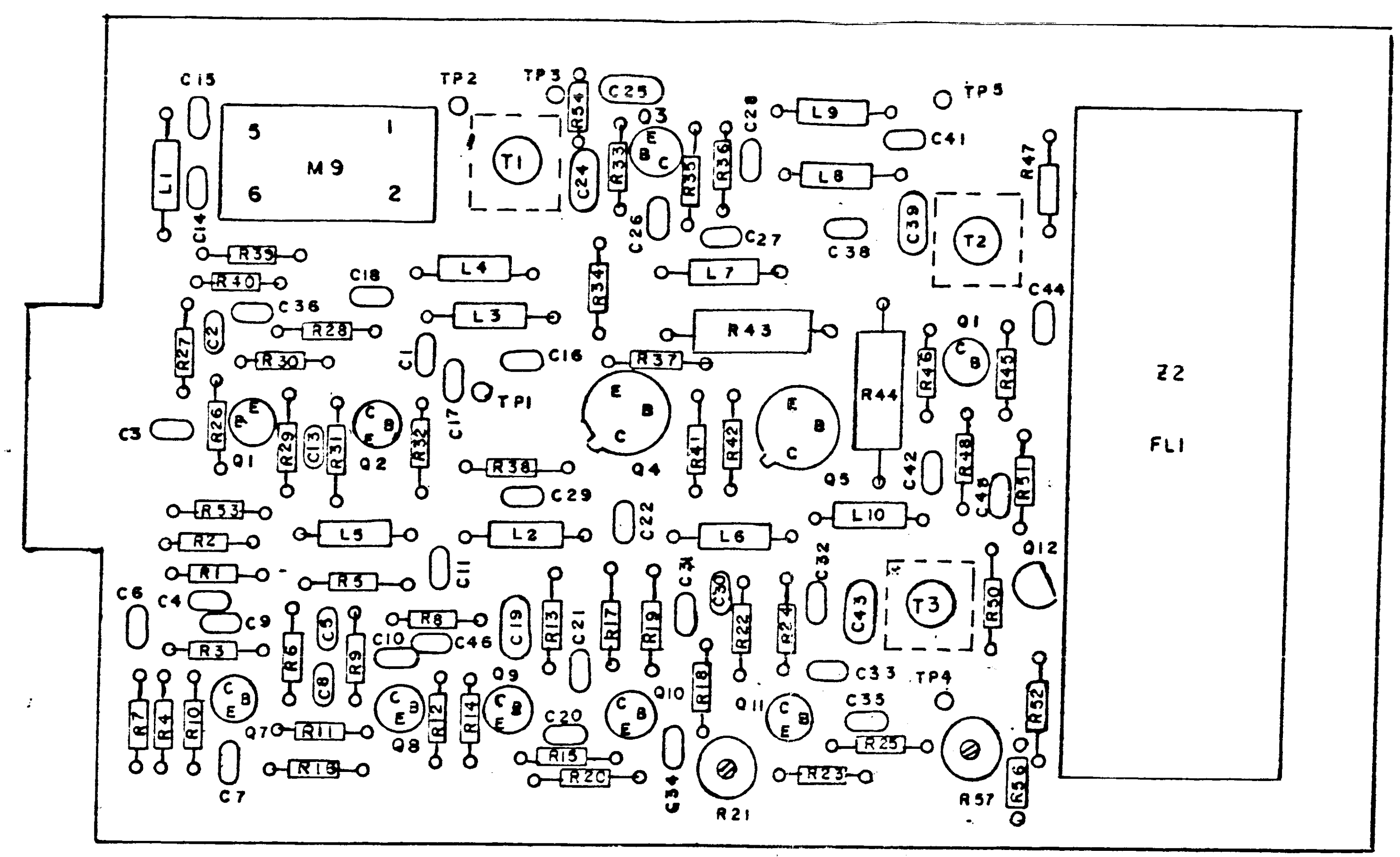


Figure 6.5B
3MHz Generator
Z003 Component Identifier

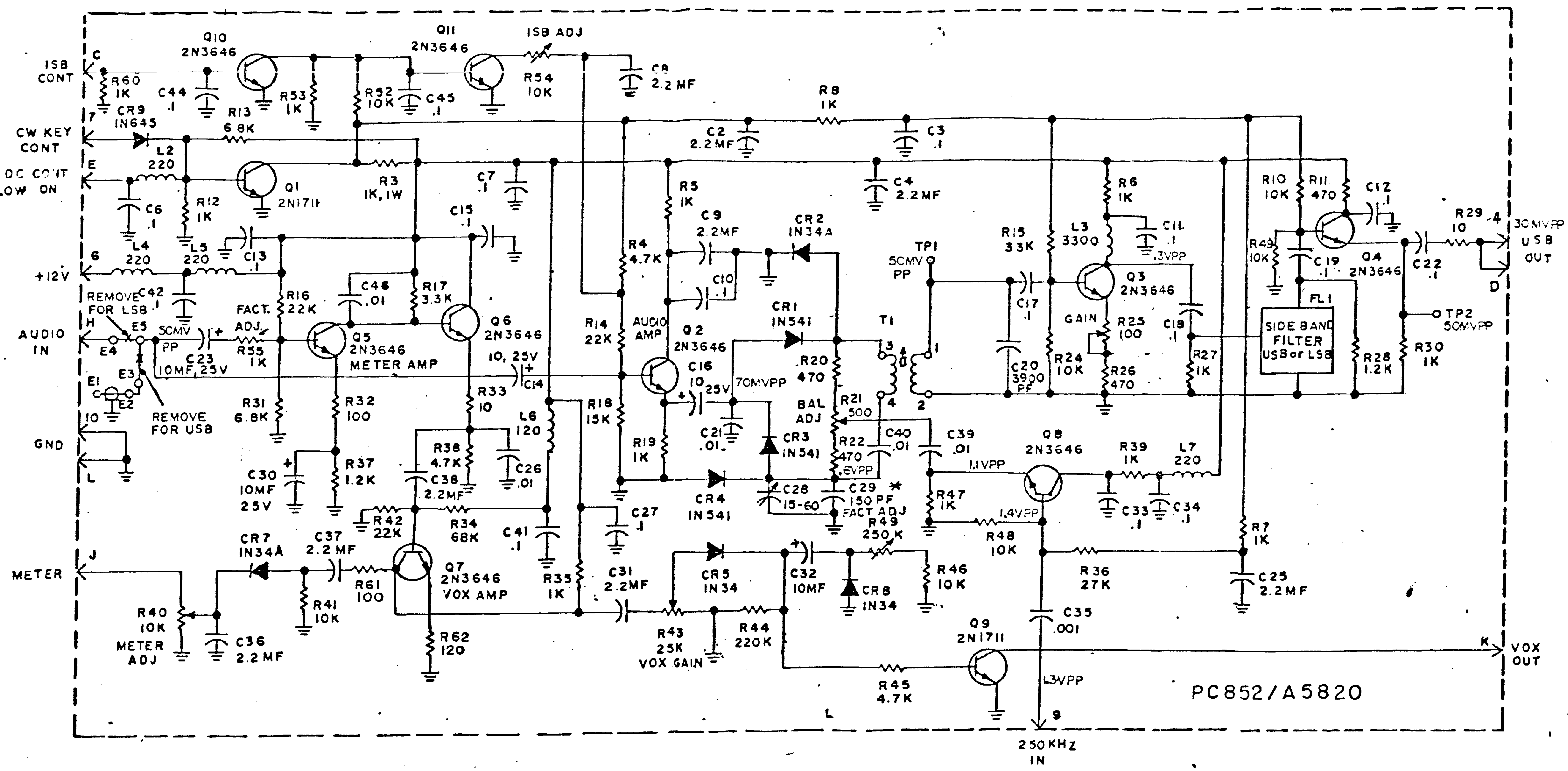


Figure 6.6A
USB Audio Sideband
Z004 Schematic

Part Number	Description	Used On	Qty	Symbol Number	S1200
CC131-24	Cap., Fxd., Cer. 1C00PF	A5820	1	C35	
CC131-19	Cap., Fxd., Cer. 150PF	A5820	1	C29	
CC131-32	Cap., Fxd., Cer. .01uf	A5820	4	C21,26,39,40	
CC131-39	Cap., Fxd., Cer. .1uf	A5820	22	C3,5,6,7,10,11,12,13,15 17,18,19,22,24, 27,33, 34,41,44,45,48,50	
CC131-48	Cap., Fxd., Cer. 2.2uf	A5820	9	C2,4,8,9,31,36,37,38,25	
CE105-5-25	Cap., Fxd. Elect.	A5820	1	C32	
CE105-10uf25v	Cap., Fxd. Elect.	A5820	4	C14,16,23,30	
CK2261	Schematic, Dia.	A5820	1		
CL275-221	Coil, RF 220uf	A5820	5	L2,4,5,6,7	
CL275-332	Coil, RF 220uh	A5820	1	L3	
CM111F392J1SS	Cap., Fxd., Mica.	A5820	1	C20	
CV112-5	Cap., Var., Mica.	A5820	1	C28	
1N541	Semiconduct. Diode	A5820	4	CR1,2,3,4	
1N645	Semiconduct. Diode	A5820	1	CR9	
1N914	Semiconduct. Diode	A5820	3	CR5,7,8	
RC07GF222J	Resistor, Fxd. Comp.	A5820	1	R61	
RC07GF101J	Resistor, Fxd. Comp.	A5820	3	R29,32,33	
RC07GF102J	Resistor, Fxd. Comp.	A5820	15	R5,6,7,8,9,12,19, ,27, 30,35,39,47,53,55,60	
RC07GF103J	Resistor, Fxd. Comp.	A5820	8	R10, ,24,41,44,46,48 49,52	
RC07GF122J	Resistor, Fxd. Comp.	A5820	2	R28,37	
RC07GF153J	Resistor, Fxd. Comp.	A5820	1	R18	
RC07GF223J	Resistor, Fxd. Comp.	A5820	3	R14,16,34	
RC07GF273J	Resistor, Fxd. Comp.	A5820	1	R36	
RC07GF332J	Resistor, Fxd. Comp.	A5820	1	R17	
RC07GF333J	Resistor, Fxd. Comp.	A5820	1	R15	
RC07GF471	Resistor, Fxd. Comp.	A5820	4	R11,20,22,26	
RC07GF472	Resistor, Fxd. Comp.	A5820	3	R4,38,45	
RC07GF682	Resistor, Fxd. Comp.	A5820	2	R13,31	
RC07GF683	Resistor, Fxd. Comp.	A5820	1	R42	
RC32GF102J	Resistor, Fxd. Comp.	A5820	1	R5	
RV124-1-101	Resistor, Var. Comp.	A5820	2	R21,25	
RV124-1-253	Resistor, Var. Comp.	A5820	1	R43	
RV124-1-254	Resistor, Var. Comp.	A5820	1	R49	
RV124-1-103	Resistor, Var. Comp.	A5820	2	R40,54	
TT285-11	Transformer, Tuned	A5820	1	T1	
2N1711	Semiconductor, Trans.	A5820	2	Q1,9	
2N3646	Semiconductor, Transistor	A5820	9	Q2,3,4,5,6,7,8,10,11	
FX265 *Optional	Filter, USB	A5820	1	FL1	
FX266 *Optional	Filter, LSB	A5820	1	FL1	

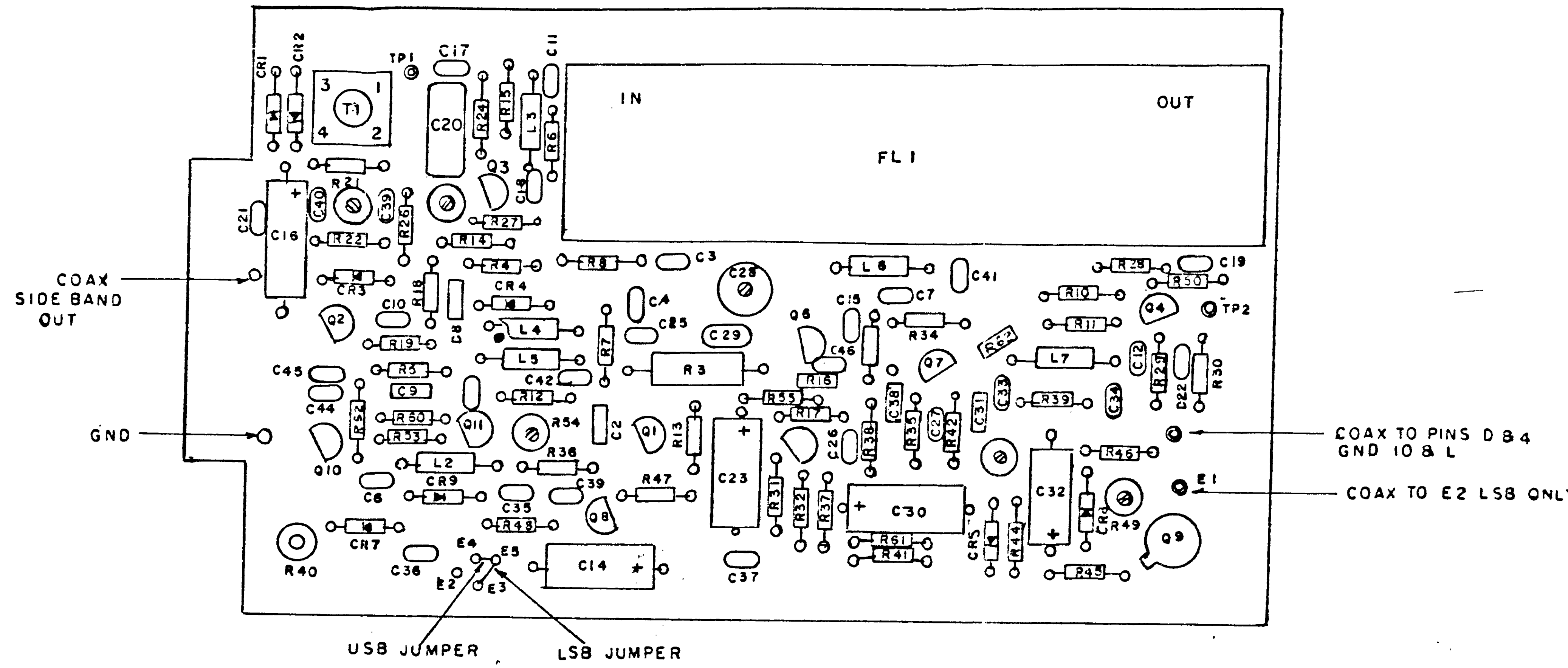
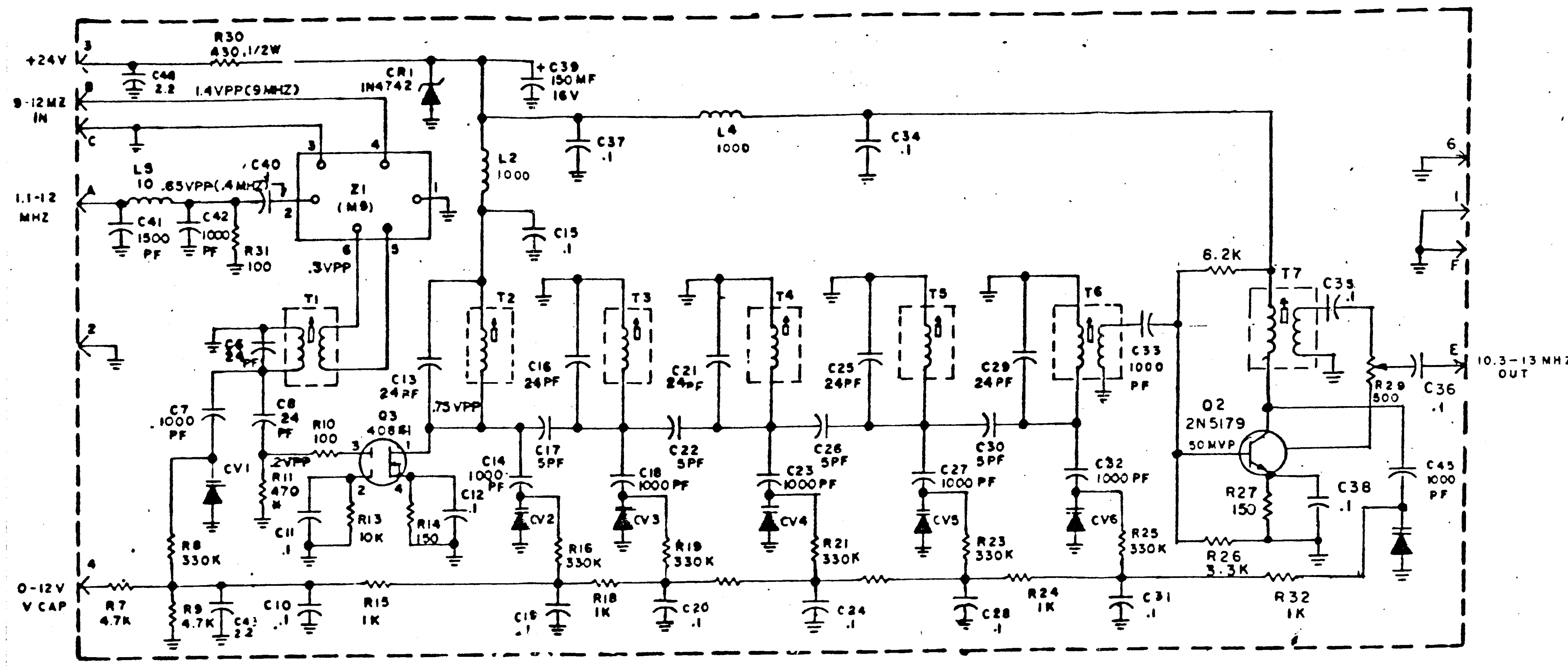


Figure 6.6B
USB Audio Sideband
Z004 Component Identifier



DIAL FREQ MHZ	TUNING V PIN 4	MHZ FREQ OUT PIN E
29	.6	10.4
28	.8	10.5
27	.85	10.6
26	1.1	10.7
25	1.35	10.8
24	1.5	10.9
23	1.7	11.0
22	1.85	11.1
21	2.1	11.2
20	2.3	11.3
19	2.6	11.4
18	2.9	11.5
17	3.1	11.6
16	3.4	11.7
15	3.7	11.8

DIAL FREQ MHZ	TUNING V PIN 4	MHZ FREQ OUT PIN E
14	4.0	11.9
13	4.3	12.0
12	4.6	12.1
11	5.0	12.2
10	5.35	12.3
9	5.9	12.4
8	6.1	12.5
7	6.7	12.6
6	7.0	12.7
5	7.5	12.8
4	8.0	12.9
3	8.7	13.0
2	9.1	13.1
1	9.8	13.2
0	10.2	13.3

VOLTAGES SHOWN TAKEN AT DIAL 29MHZ

Figure 6.7A
1MHz Synthesizer
Z005 Schematic

Part Number	Description	Used On	Qty	Symbol Number	S1200
CC131-24	Cap., Ceramic, Fixed	A5816	7	C7, 14, 18, 23, 27, 32, 33	
CC131-39	Cap., Ceramic, Fixed	A5816	14	[illegible] 10, 11, 12, 15, 19, 20, 28, 31, 34, 35, 36, 37, 38, 40	
CE105-220-16	Cap., Electrolytic	A5816	1	C39	
CL275-121	Coil, RF, Fixed	A5816	4	L1, 2, 3, 4	
CM111E050JSS	Cap., Mica, Fixed	A5816	4	C17, 22, 26, 30	
CM111E180JSS	Cap., Mica, Fixed	A5816	1	C8	
CM111E200JSS	Cap., Mica, Fixed	A5816	6	C6, 13, 16, 21, 25, 29	
CM111E561JSS	Cap., Mica, Fixed	A5816	1	C1	
DD149	Network Mixer	A5816	1	Z1	
MV2115	Diode Varactor	A5816	6	CV1, 2, 3, 4, 5, 6	
RC07GF101J	Res., Comp., Fixed	A5816	2	R10, 31	
RC07GF102J	Res., Comp., Fixed	A5816	5	R15, 18, 20, 22, 24	
RC07GF103J	Res., Comp., Fixed	A5816	1	R13	
RC07GF620J	Res., Comp., Fixed	A5816	1	R11	
RC07GF151J	Res., Comp., Fixed	A5816	2	R14, 27	
RC07GF332J	Res., Comp., Fixed	A5816	1	R26	
RC07GF334J	Res., Comp., Fixed	A5816	6	R8, 16, 19, 21, 23, 25	
RC07GF472J	Res., Comp., Fixed	A5816	2	R7, 9	
RC07GF822J	Res., Comp., Fixed	A5816	1	R28	
RC20GF431	Res., Comp., Fixed	A5816	1	R30	
RV124-251-1	Res., Comp., Variable	A5816	1	R29	
TT285-5	Transformer, Tunable	A5816	4	T2, 3, 4, 5	
TT285-5	Transformer, Tunable	A5816	1	T6	
TT285-6	Transformer, Tunable	A5816	1	T1	
TZ220	Toroid Fixed	A5816	1	T7	
2N3646	Semicond., Transistor	A5816	1	Q1	
2N5179	Semicond., Transistor	A5816	1	Q2	
40822	Semicond., Field Effect	A5816	1	Q3	

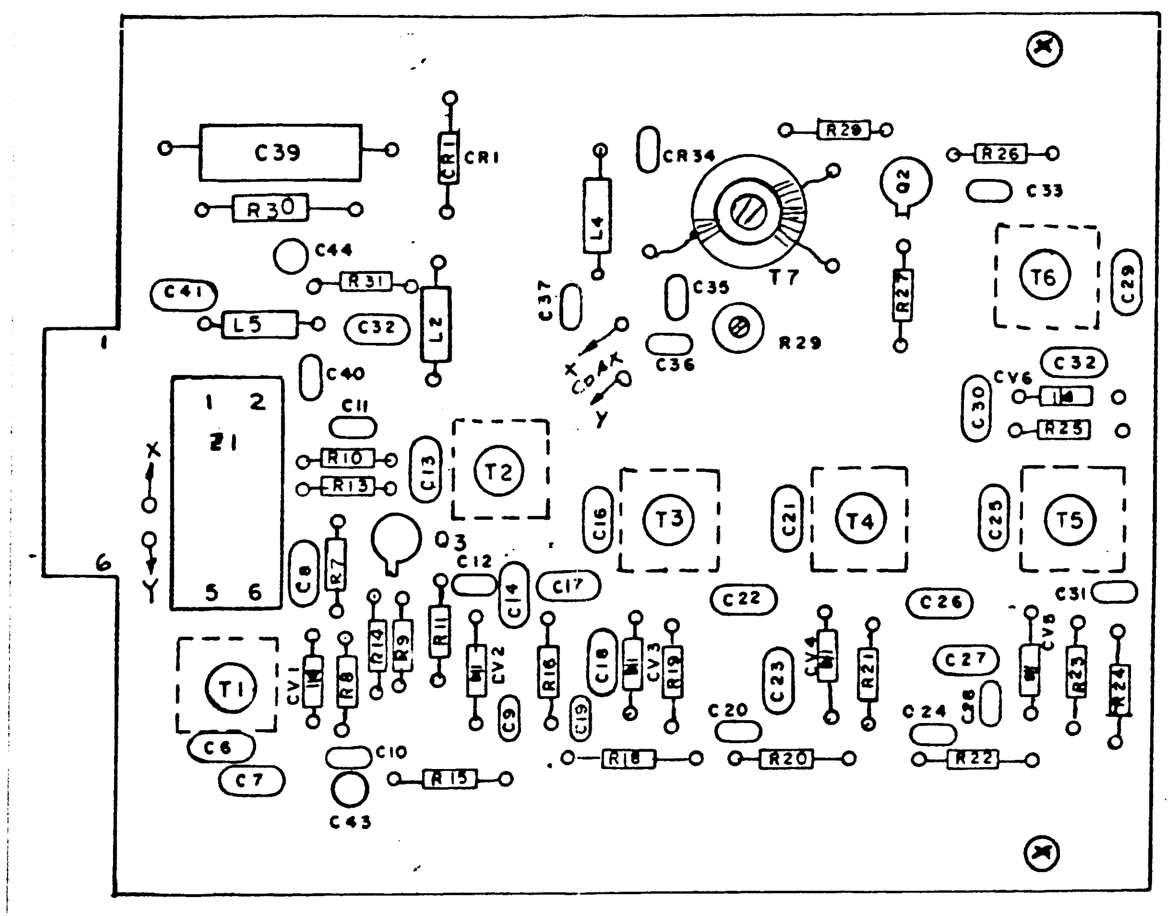
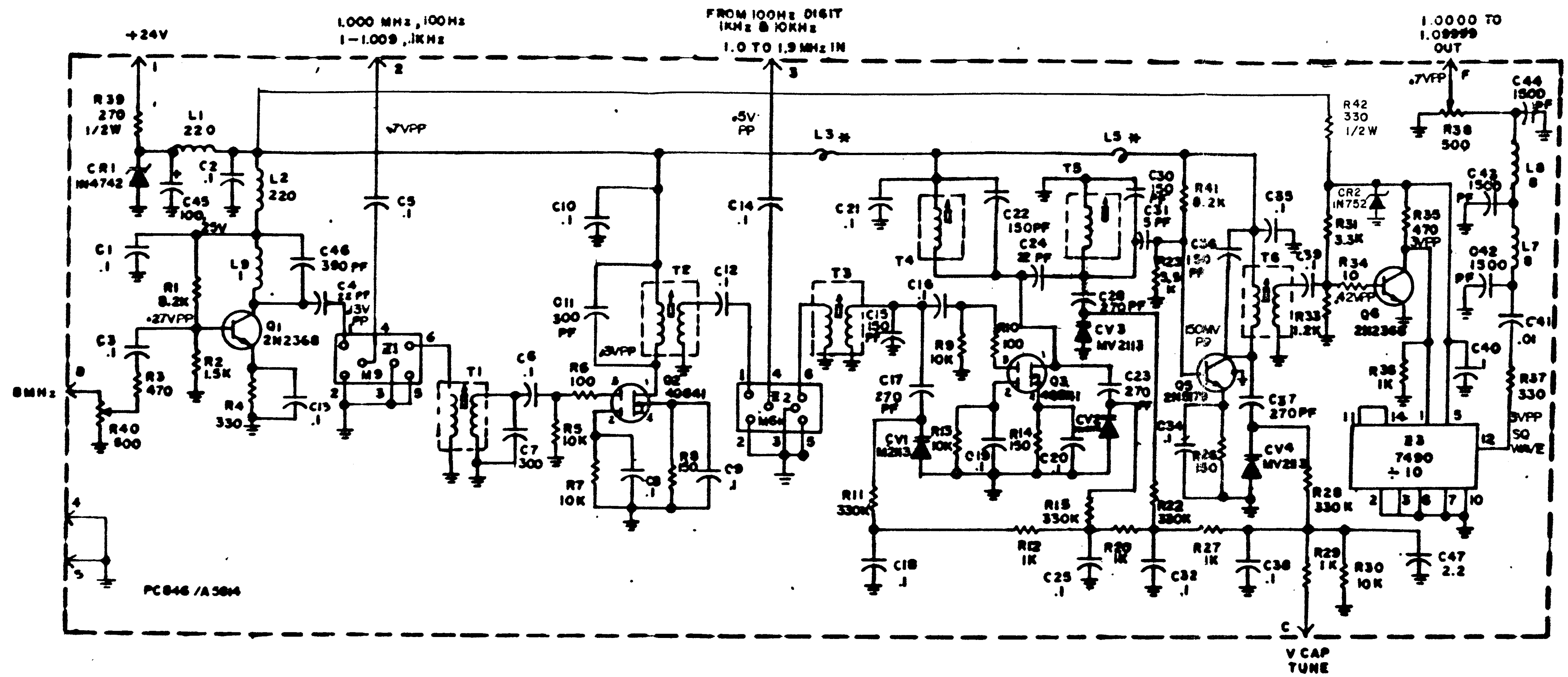


Figure 6.7B
1MHz Synthesizer
Z005 Component Identifier



** INIAL TUNINC		
FREQ. DIGIT	FREQ. MHZ	TUNING V PIN C
0	10	0.3 **
1	11	0.5
2	12	0.8
3	13	1.0
4	14	1.5
5	15	1.9
6	16	2.5
7	17	3.3
8	18	4.0
9	19	5.2

Figure 6.8A
100Hz Synthesizer
Z101 Schematic

Part Number	Description	Used On	Qty	Symbol Number	S1200
CC131-14	Cap., Fixed, Cer. 22PF	A5814	1	C39	
CC131-16	Cap., Fixed, Cer. 47PF	A5814	3	C41, 42, 43	
CC131-19	Cap., Fixed, Cer. 150PF	A5814	4	C15, 22, 30, 36	
CC131-18	Cap., Fixed, Cer. 100PF	A5814	1	C3	
CC131-21	Cap., Fixed, Cer. 300PF	A5814	2	C7, 11	
CC131-32	Cap., Ceramic	A5814	2	C40	
CC131-39	Cap., Ceramic	A5814	23	C1, 2, 4, 5, 6, 8, 9, 10, 12, 14, 16, 18, 19, 20, 21, 24, 25, 31, 32, 34, 35, 38, 44	
CE105-100-25	Cap., Electro	A5814	1	C45	
CI120	Bead, Ferrite	A5814	2	L3, 5	
CK2235	Schematic	A5814	1		
CL275-8RO	Choke, Fxd.	A5814	2	L3, 7	
CL275-221	Choke, Fxd.	A5814	3	L1, 2, 6	
CM111E122J15S	Cap., Fixed, Mica.	A5814	1	C41	
CM111E271J15S	Cap., Fixed, Mica.	A5814	4	C17, 23, 28, 37	
DD148	Network, Mixer	A5814	1	Z1	
DD149	Network, Mixer	A5814	1	Z2	
MV2113	Diode, Tuning	A5814	4	CV1, 2, 3, 4	
NW(SN7490)	Network, Divider	A5814	1	Z3	
PC846	PC Board	A5814	1		
RC07GF101J	Res., Carbon	A5814	2	R6, 10	
RC07GF102J	Res., Carbon	A5814	5	R12, 27, 29, 31, 36	
RC07GF103J	Res., Carbon	A5814	6	R5, 7, 9, 13, 23, 30	
RC07GF122J	Res., Carbon	A5814	1	R33	
RC07GF151J	Res., Carbon	A5814	3	R8, 14, 36	
RC07GF152J	Res., Carbon	A5814	1	R2	
RC07GF182J	Res., Carbon	A5814	1	R1	
RC07GF221J	Res., Carbon	A5814	1	R3	
RC07GF331J	Res., Carbon	A5814	1	R37	
RC07GF333J	Res., Carbon	A5814	4	R11, 15, 22, 28	
RC07GF471J	Res., Carbon	A5814	1	R35	
RC21GF271J	Res., Carbon	A5814	1	R39	
RV124-1-501	Res., Var.	A5814	2	R4, 38	
TT285-5NS	Xfmer., Adj.	A5814	6	T1, 2, 3, 4, 5, 6	
40822	Semicond., Fet.	A5814	3	Q2, 3, 5	
1N4742	Diode, Zener	A5814	1	CR1	
2N2368	Transistor	A5814	2	Q1, 6	
CC131-48	Cap., Fixed, Cer. 2,2mfd	A5814	1	C47	

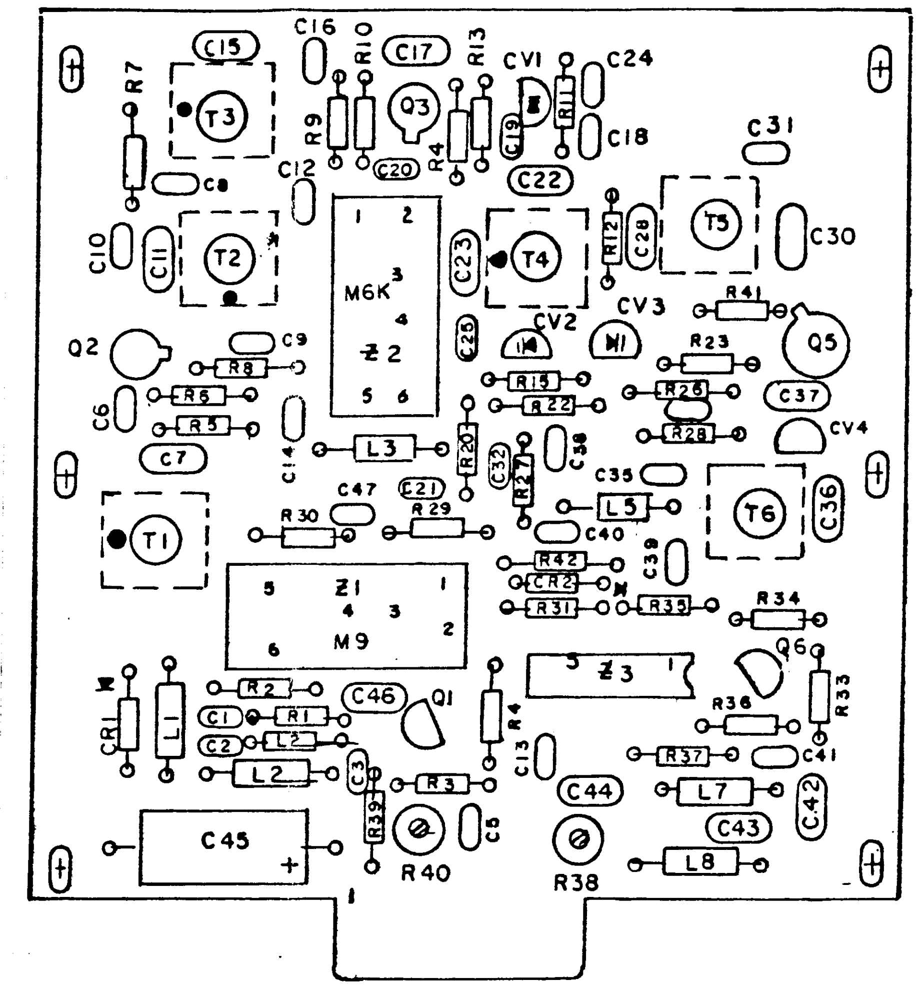


Figure 6.8B
100Hz Synthesizer
Z101 Component Identifier

Figure 6.9
1KHz Synthesizer
(See Figures 6.8A & B)

Figure 6.10
10KHz Synthesizer
(See Figures 6.8A & B)

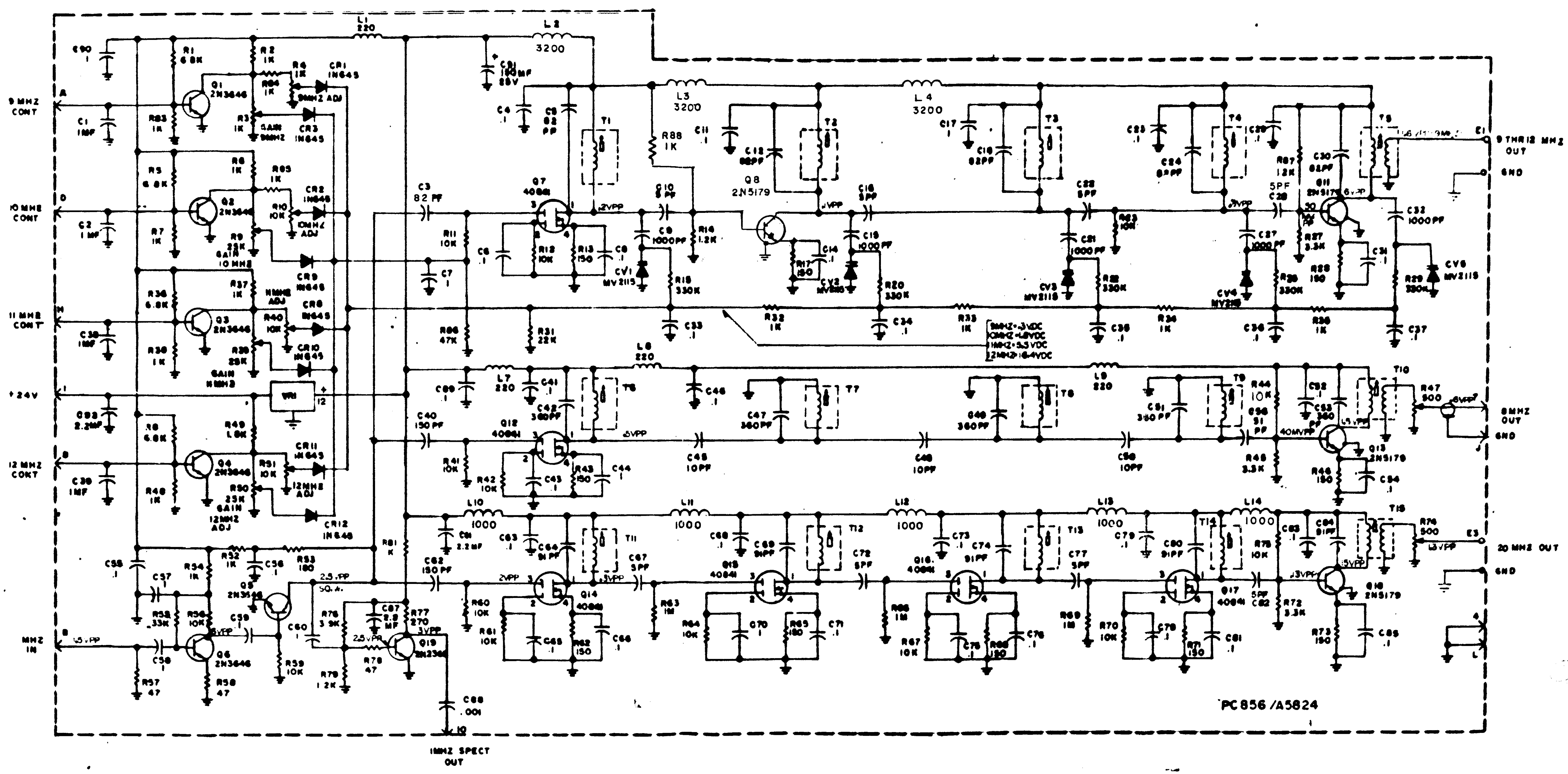


Figure 6.11A
Spectrum Generator
Z104 Schematic

Part Number	Description	Used On	Qty	Symbol Number	S1200
CC131-9	Cap., Fixed, Cer. 5.6PF	A5824	8	C10, 16, 22, 28, 67, 72, 77, 82	
CC131-12	Cap., Fixed, Cer. 10PF	A5824	3	C45, 48, 50	
CC131-16	Cap., Fixed, Cer. 51PF	A5824	1	C86	
CC131-24	Cap., Fixed, Cer. 1000PF	A5824	6	C9, 15, 21, 27, 32, 88	
CC131-19	Cap., Fixed, Cer. 150PF	A5824	3	C3, 40, 62	
CC131-21	Cap., Fixed, Cer. 330PF	A5824	5	C42, 47, 49, 51, 53	
CC131-39	Cap., Fixed, Cer. .1uf	A5824	54	C1, 2, 4, 6, 7, 8, 11, 13, 14, 17, 19, 20, 23, 25, 26, 29, 31, 33, 34, 35, 36, 37, 38, 39, 41, 43, 44, 46, 52, 54, 55, 56, 57, 58, 59, 60, 61, 63, 65, 66, 68, 70, 71, 73, 75, 76, 78, 79, 81, 83, 85, 87, 89, 90	
CE135-7	Cap., Elect. 225uf 16V	A5824	1	C91	
CI120	Ferrite Beads	A5824	13	L2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14	
CL275-221	Coil, RF Fixed 220uH	A5824	1	L1	
CM111E820JSS	Cap., Fixed Mica 82PF	A5824	5	C5, 12, 18, 24, 30	
CM111E910JSS	Cap., Fixed Mica 91PF	A5824	5	C64, 69, 74, 80, 84	
MV2115	Diode Varactor	A5824	5	CV1, 2, 3, 4, 5	
RC07GF102J	Res., Comp., Fixed	A5824	16	R2, 3, 6, 7, 32, 33, 34, 35, 37, 38, 48, 52, 54, 81, 84, 85	
RC07GF103J	Res., Comp., Fixed	A5824	16	R11, 12, 16, 19, 24, 41, 42, 56, 59, 60, 61, 64, 67, 70, 75, 23	
RC07GF105J	Res., Comp., Fixed	A5824	3	R63, 66, 69	
RC07GF122J	Res., Comp.	A5824	2	R79, 14	
RC07GF151J	Res., Comp., Fixed	A5824	12	R13, 17, 21, 25, 28, 43, 46, 62, 65, 68, 71, 73	
RC07GF182J	Res., Comp.	A5824	1	R49	
RC07GF184J	Res., Comp., Fixed	A5824	1	R53	
RC07GF223J	Res., Comp., Fixed	A5824	1	R31	
RC07GF271J	Res., Comp.	A5824	2	R77, 80	
RC07GF332J	Res., Comp., Fixed	A5324	3	R27, 45, 72	
RC07GF333J	Res., Comp., Fixed	A5824	1	R55	
RC07GF334J	Res., Comp., Fixed	A5824	5	R15, 20, 22, 26, 29	
RC07GF392J	Res., Comp.	A5824	1	R76	
RC07GF470J	Res., Comp., Fixed	A5324	3	R57, 58, 78	
RC07GF473J	Res., Comp., Fixed	A5824	1	R86	
RC07GF622J	Res., Comp., Fixed	A5824	2	R44, 87	
RC07GF682J	Res., Comp., Fixed	A5824	4	R1, 5, 8, 36	
RC32GF101J	Res., Comp.	A5824	1	R82	
RV124-101	Res., Variable Comp.	A5824	3	R30, 47, 74	
RV124-103	Res., Variable Comp.	A5824	3	R4, 10, 40, 51	
RV124-253	Res., Variable Comp.	A5824	4	R9, 39, 50	
TT285-5	Transformer, Tunable 11 Turns No Sec.	A5824	8	T1, 2, 3, 4, 6, 7, 8, 9	
TT285-5	Transformer, Tunable 11 Turns with Sec.	A5824	2	T5, 10	
TT285-10	Transformer, Tunable 8 Turns with sec.	A5824	1	T15	
TT285-10	Transformer, Tunable 8 Turns No sec.	A5824	4	T11, 12, 13, 14	
1N645	Semiconductor Diode	A5824	7	CR1, 2, 9, 8, 10, 11, 12	
1N4742	Diode, Zener	A5824	1	CR13	
2N2368	Semicond., Trans.	A5824	1	CR19	
2N3646	Semicond., Trans.	A5824	6	Q1, 2, 3, 4, 5, 6	
2N5179	Semicond. Trans.	A5824	3	Q11, 13, 18	
40822	Semicond. Field Effect	A5824	9	Q7, 8, 9, 10, 12, 14, 15, 16, 17	

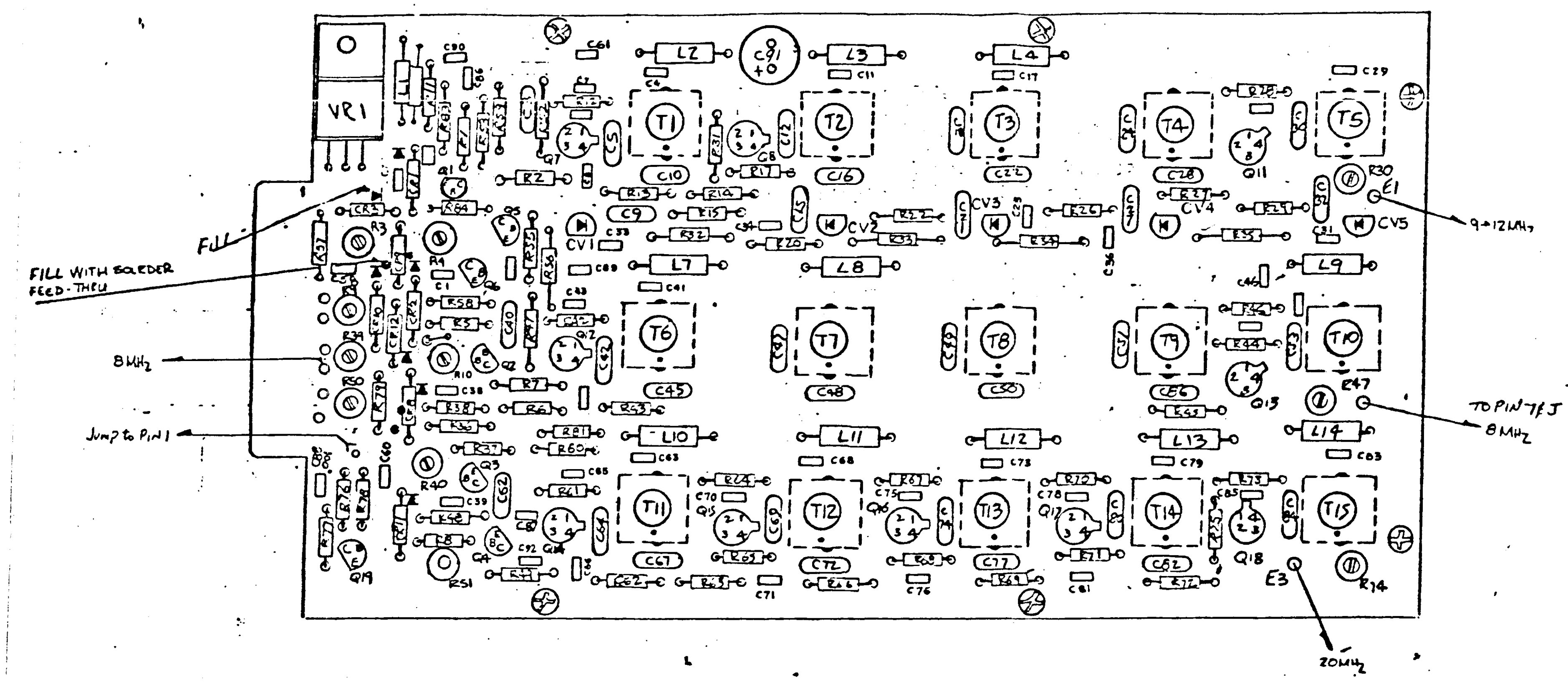
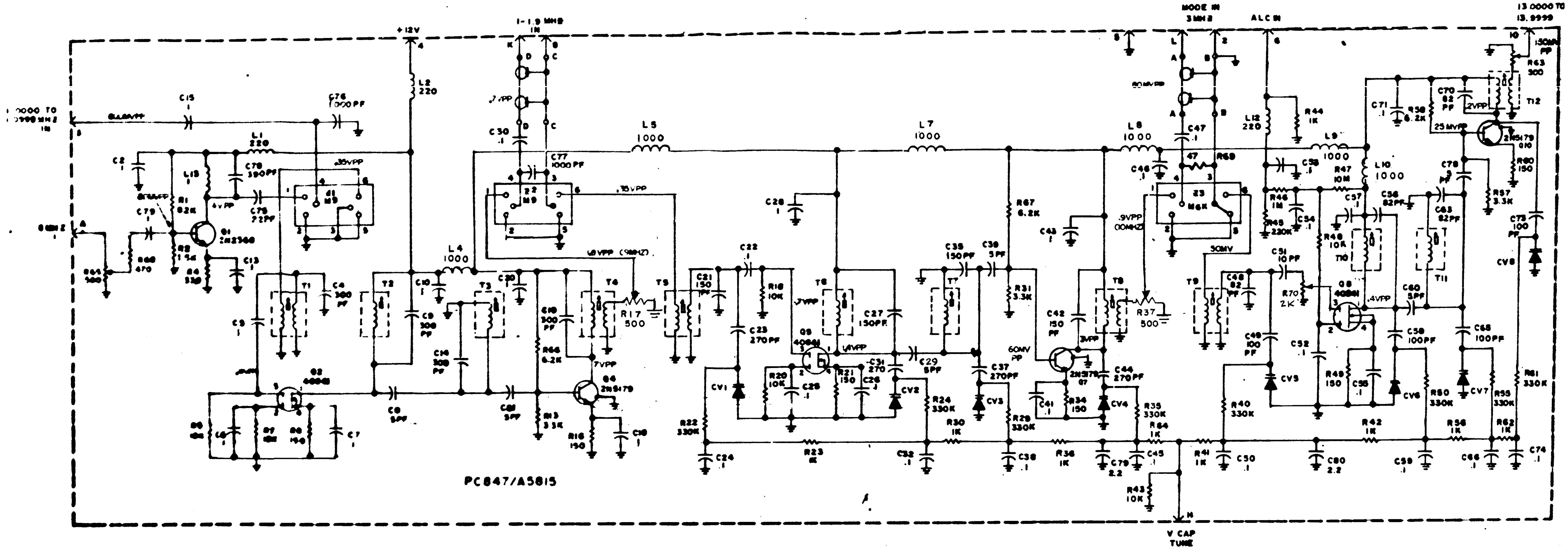
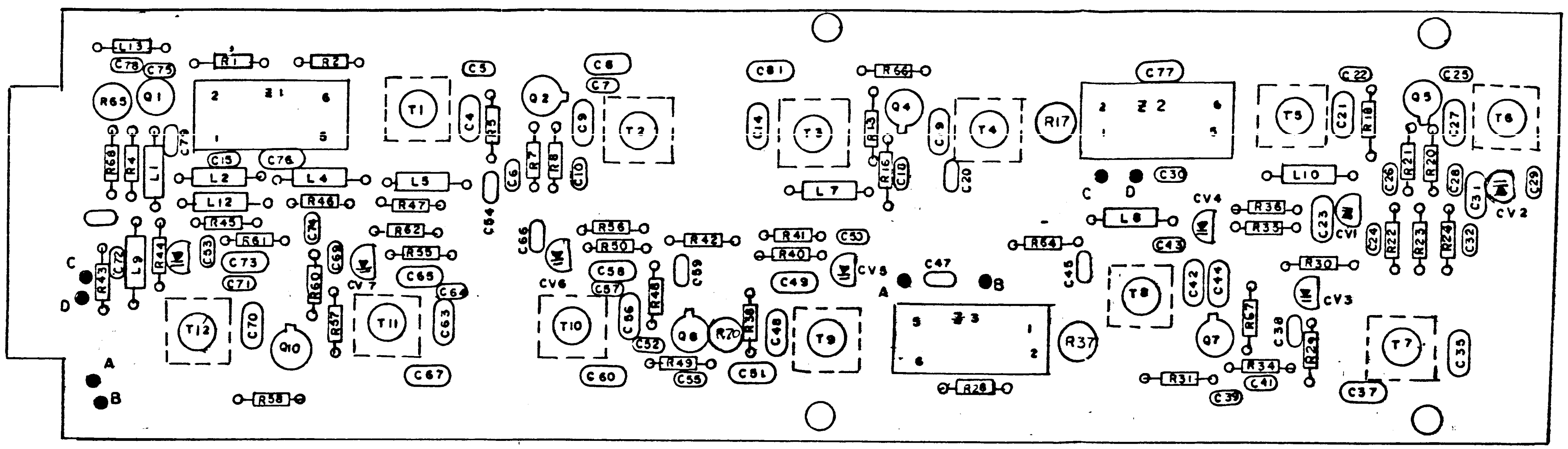


Figure 6.11B
Spectrum Generator
Z104 Component Identifier



DIGITS	TUNING V PIN H
.00	0.30 **
05	0.44
.10	0.64
.15	0.76
.20	1.0
.25	1.2
.30	1.45
.35	1.7
.40	2.0
45	2.46
50	2.65
.55	3.1
.60	3.5
.65	4.0
.70	4.66
.75	5.1
80	5.7
.85	6.36
.90	7.2
.95	7.9

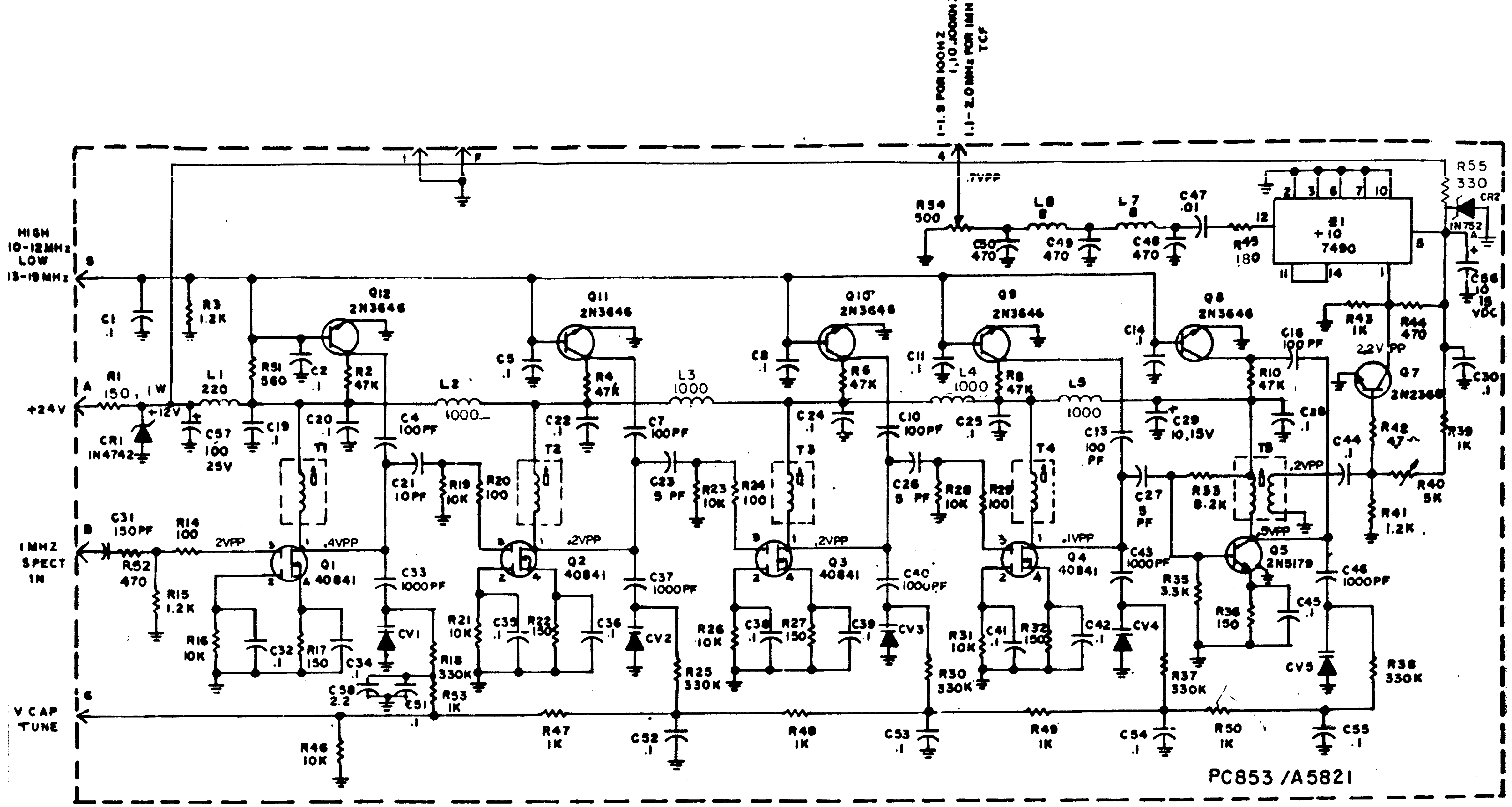
Figure 6.12A
Final Mixer
Z106 Schematic



Part Number	Description	Used On	Qty	Symbol Number	S1200
A5815	Assembly Drawing	A5815	1		
CC131-9	Cap., Fixed, Cer. 5.6PF	A5815	4	C8, 13, 36, 39	
CC131-12	Cap., Fixed, Cer. 10PF	A5815	4	C1, 51, 60, 67	
CC131-15	Cap., Fixed, Cer. 100PF	A5815	4	C49, 58, 65, 73	
CC131-19	Cap., Fixed, Cer. 150PF	A5815	4	C21, 27, 35, 42	
CC131-20	Cap., Fixed, Cer. 200PF	A5815	1	C75	
CC131-21	Cap., Fixed, Cer. 330PF	A5815	4	C4, 9, 14, 19	
CC131-39	Cap., Fixed, Cer.	A5815	38	C2, 3, 5, 6, 7, 10, 13, 15, 18, 20, 22, 24, 25, 26, 28, 29, 30, 32, 34, 38, 39, 40, 41, 43, 45, 47, 50, 52, 53, 54, 55, 57, 59, 66, 69, 71, 72, 74	
CI120	Ferrite Beads	A5815	7	L4, 5, 7, 8, 9, 10, 11	
CK2276	Schematic Diag.	A5815	1		
CL275-1RO	Coil, RF, Fixed	A5815	1	L13	
CL275-221	Coil, RF, Fixed	A5815	3	L1, 2, 12	
CM111E201JSS	Cap., Fixed, Mica	A5815	1	C35	
CM111E271JSS	Cap., Fixed, Mica	A5815	4	C23, 31, 37, 44	
CM111E391JSS	Cap., Fixed, Mica	A5815	1	C78	
CM111E820JSS	Cap., Fixed, Mica	A5815	4	C48, 56, 63, 70	
DD148	Network Mixer	A5815	1	Z3	
DD149	Network Mixer	A5815	2	Z1, 2	
MV2115	Cap., Voltage, Var.	A5815	8	CR1, 2, 3, 4, 5, 6, 7, 8	
RC07GF101J	Resistor, Fixed, Comp.	A5815	3	R6, 52, 58	
RC07GF102J	Resistor, Fixed, Comp.	A5815	9	R23, 30, 36, 41, 42, 44, 56, 62, 64	
RC07GF103J	Resistor, Fixed, Comp.	A5815	9	R5, 7, 13, 18, 20, 31, 48, 59, 43	
RC07GF105J	Resistor, Fixed, Comp.	A5815	1	R46	
RC07GF106J	Resistor, Fixed, Comp.	A5815	1	R47	
RC07GF151J	Resistor, Fixed, Comp.	A5815	7	R8, 12, 16, 21, 34, 49, 60	
RC07GF152J	Resistor, Fixed, Comp.	A5815	1	R2	
RC07GF221J	Resistor, Fixed, Comp.	A5815	1	R3	
RC07GF222J	Resistor, Fixed, Comp.	A5815	2	R38, 51	
RC07GF224J	Resistor, Fixed, Comp.	A5815	1	R45	
RC07GF331J	Resistor, Fixed, Comp.	A5815	1	R4	
RC07GF332	Resistor, Fixed, Comp.	A5815	1	R31	
RC07GF333J	Resistor, Fixed, Comp.	A5815	8	R22, 24, 29, 35, 40, 50, 55, 61	
RC07GF471J	Resistor, Fixed, Comp.	A5815	1	R68	
RC07GF562J	Resistor, Fixed, Comp.	A5815	1	R57	
RC07GF822	Resistor, Fixed, Comp.	A5815	1	R1	

Part Number	Description	Used On	Qty	Symbol Number	S1200
RV124-501	Resistor, Variable, Comp.	A5815	4	R17, 37, 63, 65	
TT285-5	Transformer, Tunable w/sec	A5815	6	T1, 4, 5, 8, 9, 12	
TT285-5	Transformer, Tunable no/sec	A5815	6	T2, 3, 6, 7, 10, 11	
2N2368	Semiconductor, Trans.	A5815	1	Q1	
40822	Semiconductor, Trans.	A5815	6	Q2, 4, 5, 7, 8, 10	

Figure 6.12B
Final Mixer
Z106 Component Identifier



100HZ 1KHZ 10KHZ 100KHZ Z107, Z108, Z109, Z110			1MHZ Z111			
FREQ MHZ	LEVEL PIN 5	TUNING V PIN 6	FREQ MHZ	LEVEL PIN 5	TUNING V PIN 6	FREQ DIGIT
10	HIGH	0.25 +	13	HIGH	9.5	0
11		2.1	12		2.8	1
12	HIGH	7.3	11	HIGH	0.7**	2
13	LOW	0.25	20	LOW	7.8	3
14		.75	19		8.5	4
15		1.3	18		3.9	5
16		2.6	17		2.3	6
17		4.2	16		1.6	7
18		6.2	15		.9	8
19	LOW	8.5	14	LOW	.35	9

Figure 6.13A
100Hz Tuned Comb Filter
Z107 Schematic

Part Number	Description	Used On	Qty	Symbol Number	S1200
CC131-32	Cap., Fixed, Cer.	A5821	1	C47	
CC131-39	Cap., Fixed, Cer.	A5821	28	C1, 2, 5, 8, 11, 14, 19, 20, 22, 24, 25, 28, 30, 32, 34, 35, 36, 38, 39, 41, 42, 44, 45, 51, 52, 53, 54, 55	
CE105-6-25	Cap., Fixed, Electro.	A5821	1	C56	
CE105-10-25	Cap., Fixed, Electro.	A5821	1	C29	
CE105-100-25	Cap., Fixed, Electro.	A5821	1	C57	
CI120	Ferrite Bead	A5821	4	L2, 3, 4, 5	
CL275-8RO	Coil, RF	A5821	2	L7, 8	
CL275-221	Coil, RF	A5821	2	L1, 6	
CM111F5RO	Cap., Fixed, Mica.	A5821	3	C23, 26, 27	
CM111F100	Cap., Fixed, Mica.	A5821	1	C21	
CM111F101	Cap., Fixed, Mica.	A5821	5	C4, 7, 10, 13, 16	
CM111F102	Cap., Fixed, Mica.	A5821	5	C33, 37, 40, 43, 46	
CM111F151	Cap., Fixed, Mica.	A5821	1	C31	
CM111F471	Cap., Fixud, Mica.	A5821	3	C48, 49, 50	
MV2113	Diode, Varactor	A5821	5	CV1, 2, 3, 4, 5	
NW*SN7490	Network Divider	A5821	1	Z1	
RC07GF101J	Resistor, Fxd., Comp.	A5821	4	R14, 20, 24, 29	
RC07GF102J	Resistor, Fxd., Comp.	A5821	7	R39, 43, 47, 48, 49, 50, 53	
RC07GF103J	Resistor, Fxd., Comp.	A5821	8	R16, 19, 21, 23, 26, 28, 31, 46	
RC07GF122J	Resistor, Fxd., Comp.	A5821	3	R3, 15, 41	
RC07GF151J	Resistor, Fxd., Comp.	A5821	5	R17, 22, 27, 32, 36	
RC20GF221J	Resistor, Fxd., Comp.	A5821	1	R1	
RC07GF331J	Resistor, Fxd., Comp.	A5821	1	R25	
RC07GF332J	Resistor, Fxd., Comp.	A5821	1	R35	
RC07GF334J	Resistor, Fxd., Comp.	A5821	5	R18, 25, 30, 37, 38	
RC07GF470J	Resistor, Fxd., Comp.	A5821	1	R42	
RC07GF471J	Resistor, Fxd., Comp.	A5821	2	R44, 52	
RC07GF473J	Resistor, Fxd., Comp.	A5821	5	R2, 4, 6, 8, 10	
RC07GF561J	Resistor, Fxd., Comp.	A5821	1	R51	
RC07GF822J	Resistor, Fxd., Comp.	A5821	1	R33	
RV124-50	Resistor, Variable	A5821	1	R54	
RV124-502	Resistor, Variable	A5821	1	R40	
TT285-5	Transformer, RF, Adj.	A5821	5	T1, 2, 3, 4, 5	
1N4742	Diode, Semi.	A5821	1	CR1	
2N2366	Transistor, Semi.	A5821	1	Q7	
2N3646	Transistor, Semi.	A5821	5	Q8, 9, 10, 11, 12	
2N5179	Transistor, Semi.	A5821	1	Q5	
40841	Transistor, Semi.	A5821	4	Q1, 2, 3, 4	

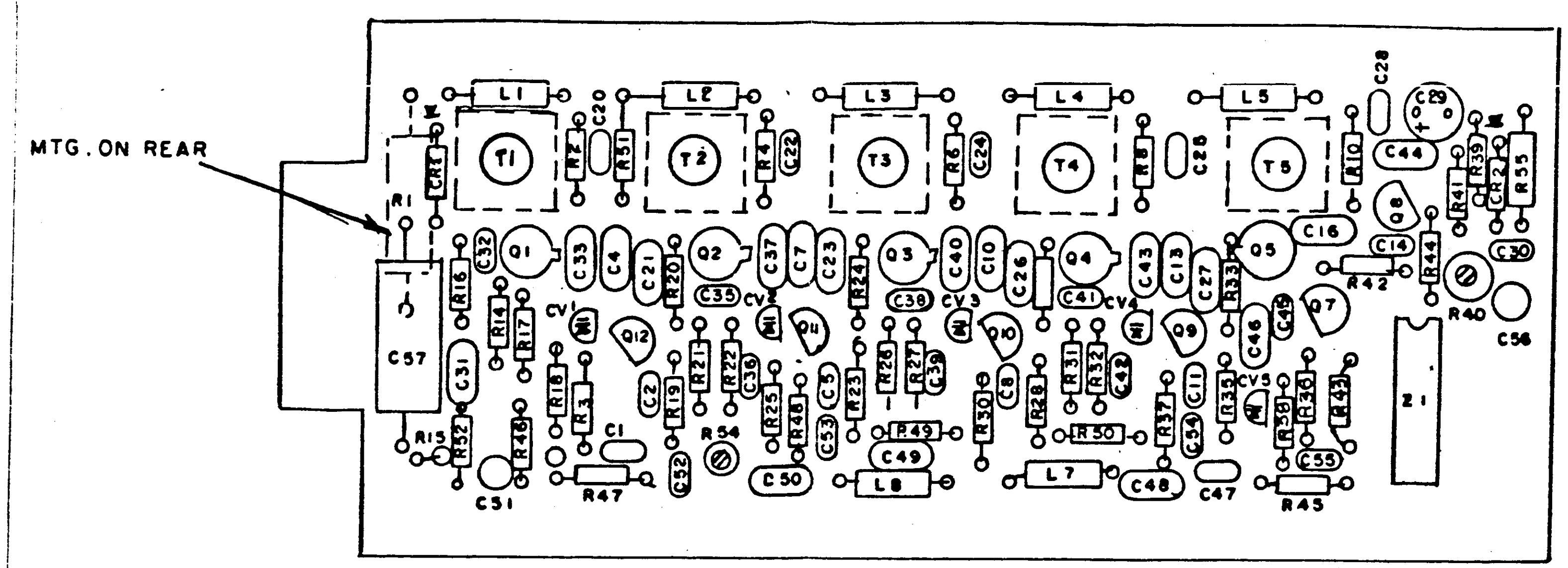


Figure 6.13B
100Hz Tuned Comb Filter
Z107 Component Identifier

Figure 6.14
1KHz Tuned Comb Filter
(See Figures 6.13A & B)

Figure 6.15
10KHz Tuned Comb Filter
(See Figure 6.13A & B)

Figure 6.16
100KHz Tuned Comb Filter
(See Figures 6.13A & B)

Figure 6.17
1MHz Tuned Comb Filter
(See Figure 6.13A & B)

Figure 6.18
LSB Audio Sideband
(See Figures 6.6A & B)

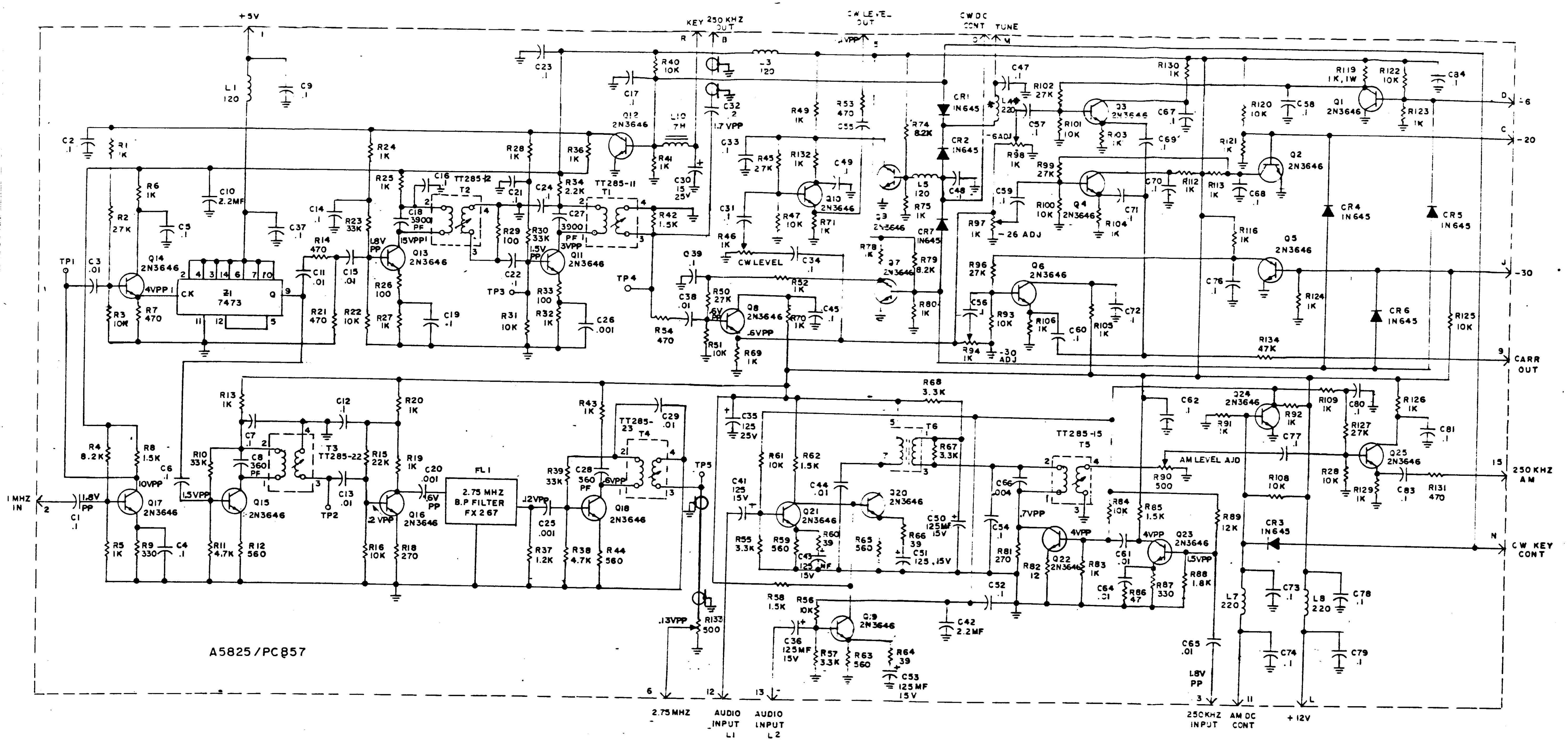
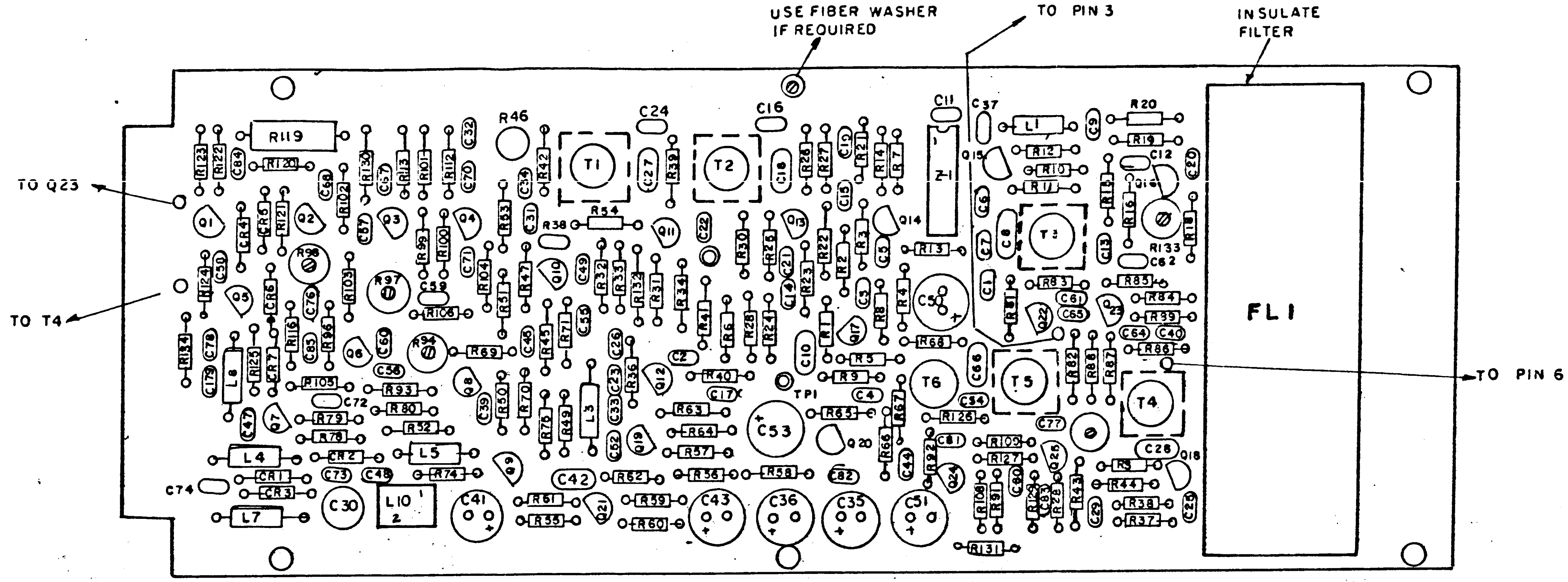


Figure 6.19A
Carrier Generator
Z115 Schematic



Part Number	Description	Used On	Qty	Symbol Number	S1200
CC131-24	Cap., Fxd., Cer. 2.2UFD	A5825	3	C20, 25, 26	
CC131-29	Cap., Fxd., Cer. 3300PF	A5825	1	C66	
CC131-32	Cap., Fxd., Cer. .01UFD	A5825	10	C3, 11, 13, 15, 29, 38, 44, 61, 64, 65	
CC131-39	Cap., Fxd., Cer. .1UFD	A5825	54	C1, 4, 5, 6, 7, 9, 12, 14, 16, 17, 19, 21, 22, 23, 24, 31, 33, 34, 37, 39, 40, 45, 46, 47, 48, 49, 52, 54, 55, 56, 57, 58, 59, 60, 62, 67, 68, 69, 70, 71, 72, 73, 74, 76, 77, 78, 79, 80, 81, 82, 83, 84, 85	
CC131-41	Cap., Fxd., Cer. .22UFD	A5825	1	C32	
CC131-48	Cap., Fxd., Cer. 2.2UFD	A5825	2	C10, 42	
CE135-1	Cap., Fxd., Elect. 15UF 25V	A5825	1	C30	
CE135-7	Cap., Fxd., Elect. 125UF 25V	A5825	7	C35, 36, 41, 43, 50, 51, 53	
CK2260	Dia., Schematic	A5825	1		
CL275-221	Choke 220UH	A5825	6	L1, 3, 4, 5, 7, 8	
CL501	Choke .7H	A5825	1	L10	
CM111F361F5S	Cap., Fxd., Mica	A5825	2	C8, 28	
CM112F392F5S	Cap., Fxd., Mica	A5825	2	C18, 27	
FX267	Filter, Band Pass	A5825	1	FL1	
NW7473	Network, Semicond.	A5825	1	Z1	
PC857A	Printed Circuit Bd.	A5825	1		
RC07GF101J	Resistor Carbon	A5825	3	R26, 29, 33	
RC07GF102J	Resistor Carbon	A5825	42	R1, 5, 6, 13, 19, 20, 24, 25, 27, 28, 32, 34, 36, 41, 43, 47, 48, 49, 52, 69, 70, 71, 75, 78, 80, 83, 91, 103, 104, 105, 106, 109, 112, 113, 116, 121, 123, 124, 126, 129, 130, 132	
RC07GF103J	Resistor, Carbon	A5825	20	R3, 16, 22, 31, 40, 51, 56, 61, 74, 79, 84, 93, 100, 108, 120, 122, 125, 128, 101, 47	

Part Number	Description	Used On	Qty	Symbol Number	S1200
RC07GF120J	Resistor, Carbon	A5825	1	R82	
RC07GF122J	Resistor, Carbon	A5825	1	R37	
RC07GF123J	Resistor, Carbon	A5825	1	R89	
RC07GF152J	Resistor, Carbon	A5825	5	R8, 42, 58, 62, 85	
RC07GF182J	Resistor, Carbon	A5825	1	R88	
RC07GF222J	Resistor, Carbon	A5825	1	R34	
RC07GF223J	Resistor, Carbon	A5825	1	R15	
RC07GF271J	Resistor, Carbon	A5825	2	R81, 18	
RC07GF273J	Resistor, Carbon	A5825	7	R2, 45, 50, 96, 99, 102, 127	
RC07GF331J	Resistor, Carbon	A5825	2	R9, 87	
RC07GF332J	Resistor, Carbon	A5825	4	R55, 57, 67, 68	
RC07GF333J	Resistor, Carbon	A5825	4	R10, 23, 30, 39	
RC07GF390J	Resistor, Carbon	A5825	3	R60, 64, 66	
RC07GF470J	Resistor, Carbon	A5825	1	R86	
RC07GF471J	Resistor, Carbon	A5825	7	R7, 14, 21, 53, 54, 111, 131	
RC07GF472J	Resistor, Carbon	A5825	2	R11, 38	
RC07GF561J	Resistor, Carbon	A5825	5	R12, 44, 59, 63, 65	
RC07GF822J	Resistor, Carbon	A5825	1	R4	
RC32GF102J	Resistor, Carbon	A5825	2	R92, 119	
RV124-1-102	Resistor, Var.	A5825	4	R94, 97, 98, 46	
RV124-1-501	Resistor, Var.	A5825	1	R90	
RV124-1-502	Resistor, Var.	A5825	1	R17	
TF420	Transformer, Audio	A5825	1	T6	
TT285-11	Transformer, Output	A5825	1	T1	
TT285-12	Transformer, Interstage	A5825	1	T2	
TT285-15	Transformer, Interstage	A5825	1	T5	
TT285-22	Transformer, Interstage	A5825	1	T3	
TT285-23	Transformer, Output	A5825	1	T4	
1N645	Diode, Semicond.	A5825	7	CR1, 2, 3, 4, 5, 6, 7	
2N3646	Transistor, Semicond.	A5825	25	Q1 thru Q25	

Figure 6.19B
Carrier Generator
Z115 Component Identifier

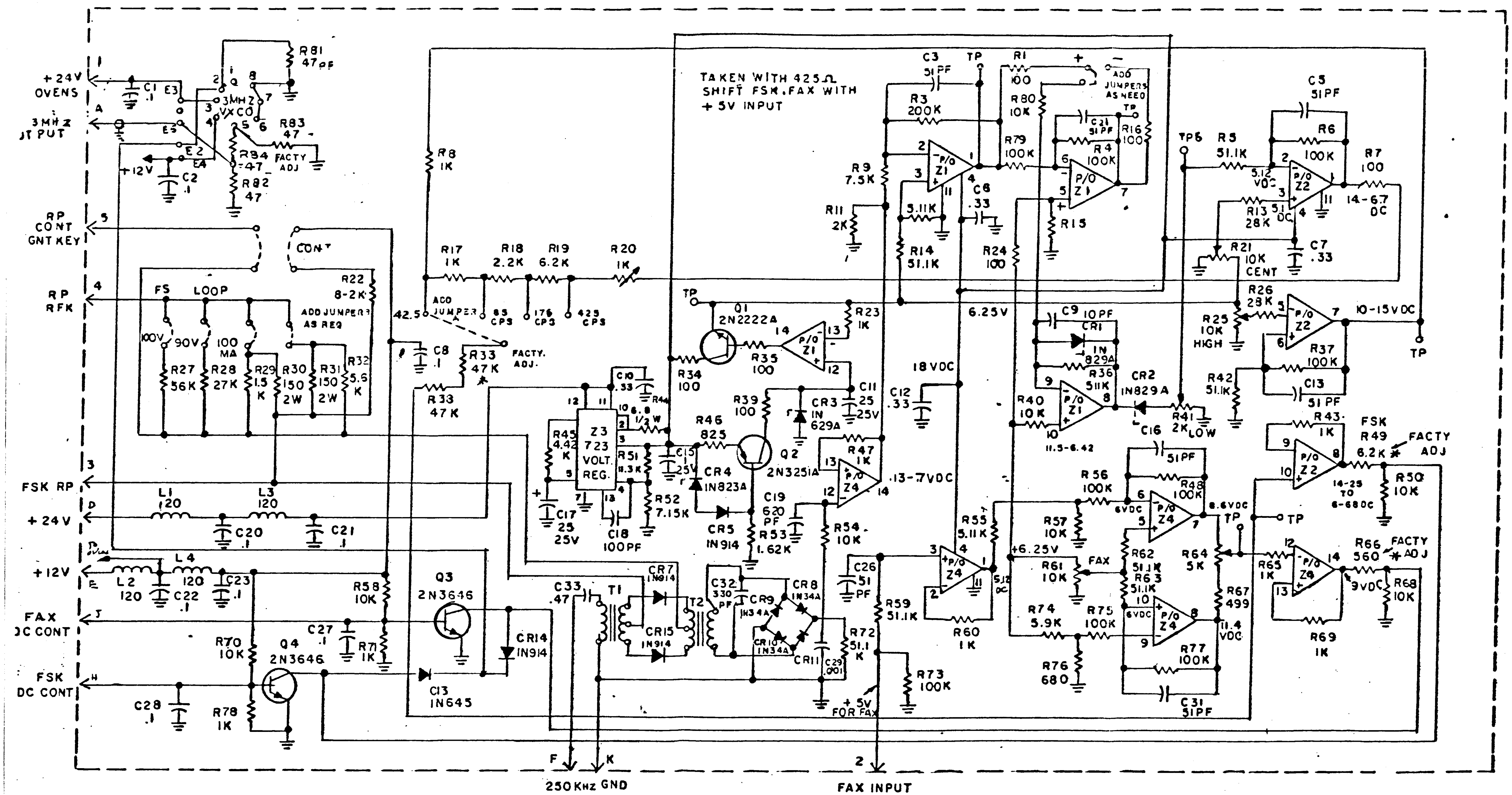
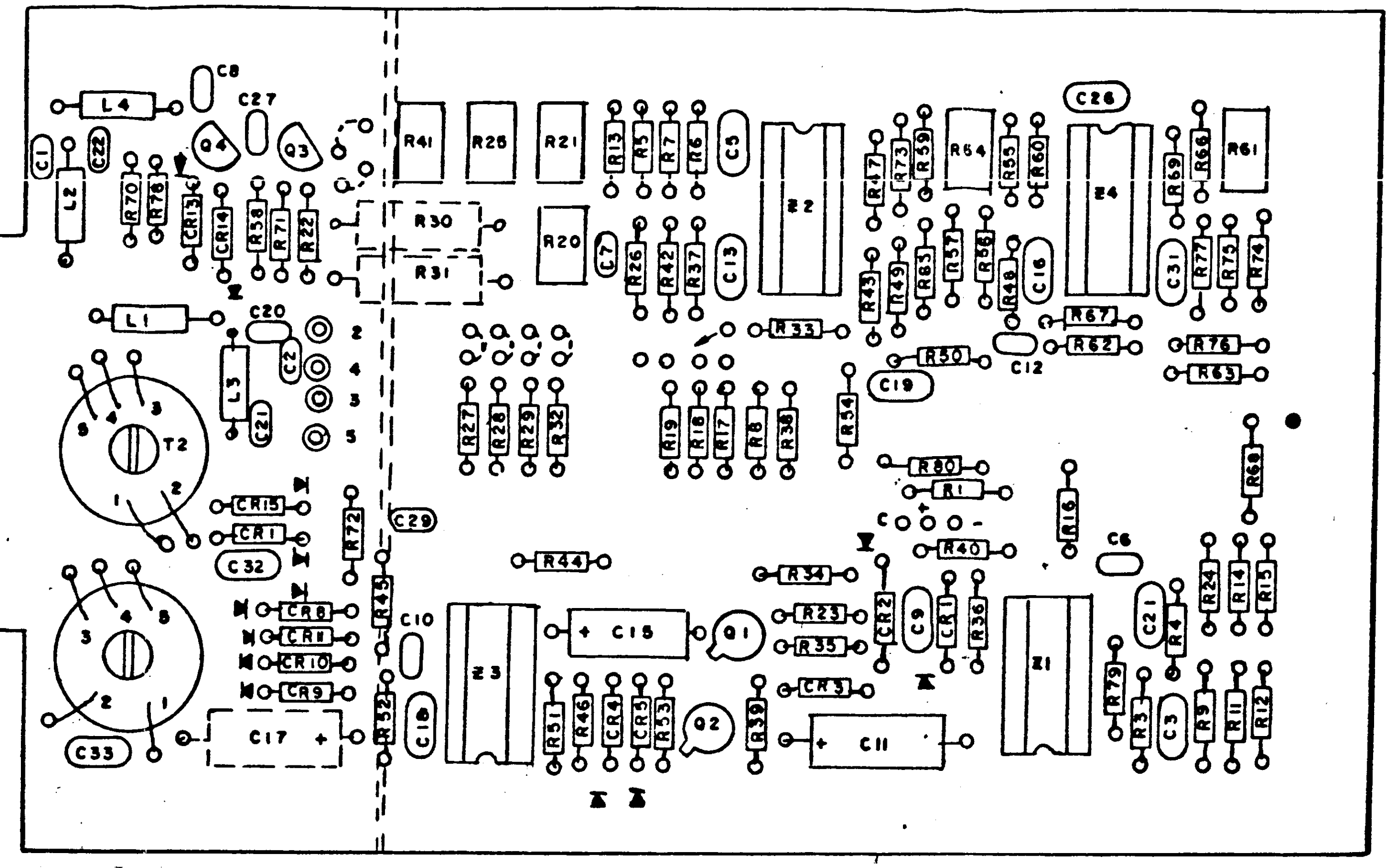
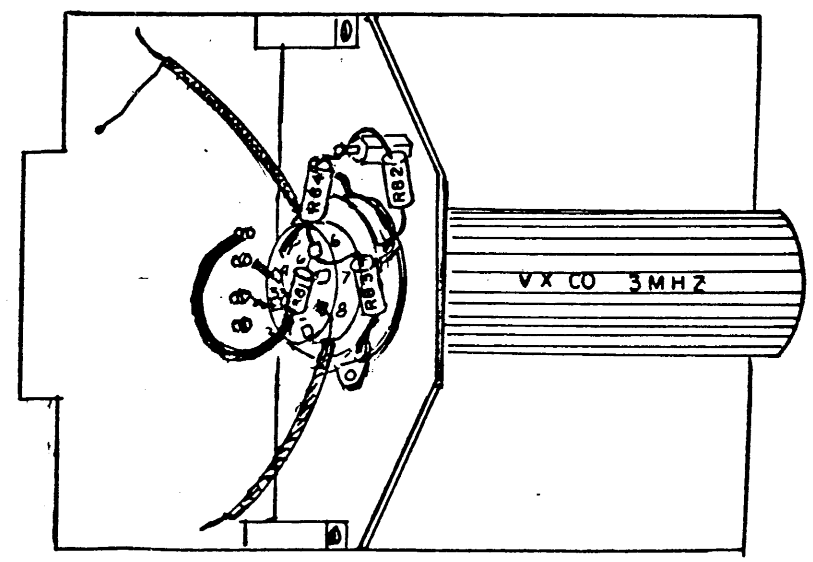


Figure 6.20A
Frequency Shift
Z117 Schematic

REFERENCE DESIGNATION	DESCRIPTION	TMC PART NUMBER
	Osc., Var.	A0105
C29	Cap., Fxd., Cer. (.001 UF)	CC131-24
C35	Cap., Fxd., Cer. (2.2UF)	CC131-48
C1,2,8,14,20,21,22 23,27,28	Cap., Fxd., Cer. (.1UF)	CC131-39
C33	Cap., Fxd., Cer. (.2UF)	CC131-50
C7,10,12,36	Cap., Fxd., Cer. (.33UF)	CC131-52
C15	Cap., Fxd., Elec.	CE105-1-25
C11,17	Cap., Fxd., Elec.	CE105-25-25
L1,2,3,4	Coil, RF, Fxd.	CL275-221
C9	Cap., Fxd., Mica	CM111F100J5S
C18	Cap., Fxd., Mica	CM111F101J5S
C32	Cap., Fxd., Mica	CM111F331J5S
C3,5,13,16,26,31, 34	Cap., Fxd., Mica	CM111F510J5S
	Plate, XVCO, Mounting	MS7168
	PC Board	PC858
R29	Res., Comp., Fxd.	RC07GF152J
R18	Res., Comp., Fxd.	RC07GF222J
R28	Res., Comp., Fxd.	RC07GF273J
R33,38	Res., Comp., Fxd.	RC07GF473J
R32	Res., Comp., Fxd.	RC07GF562J
R27	Res., Comp., Fxd.	RC07GF563J
R19	Res., Comp., Fxd.	RC07GF622J
R44	Res., Comp., Fxd.	RC21GFGR8J
R30,31	Res., Comp., Fxd.	RC42GF151J
R1,7,16,24,34,35, 39	Res., Comp., Fxd.	RN55C1000F
R8,17,23,47,60,65, 69,71,43	Res., Comp., Fxd.	RN55C1001F
R40,54,57,58,68,70 80	Res., Comp., Fxd.	RN55C1002F
R4,6,37,48,56,73, 75,77,79	Res., Comp., Fxd.	RN55C1003F
R51	Res., Comp., Fxd.	RN55C1132F
R53	Res., Comp., Fxd.	RN55C1621F
R11	Res., Comp., Fxd.	RN55C2001F
F3	Res., Comp., Fxd.	RN55C2003F
R13,26	Res., Comp., Fxd.	RN55C2802F
R66	Res., Comp., Fxd.	RN55C3011F
R45	Res., Comp., Fxd.	RN55C4421F
R67	Res., Comp., Fxd.	RN55C4990F
R12,15,55	Res., Comp., Fxd.	RN55C5111F

REFERENCE DESIGNATION	DESCRIPTION	TMC PART NUMBER
R5,14,59,62,65,72, 42	Res., Fxd. Comp.	RN55C5112F
R36	Res., Fxd., Comp.	RN55C5113F
R74	Res., Fxd., Comp.	RN55C5901F
R76	Res., Fxd., Comp.	RN55C6800F
R52	Res., Fxd., Comp.	RN55C7151F
R9,49	Res., Fxd., Comp.	RN55C7501F
R46	Res., Fxd., Comp.	RN55C8250F
R20	Res., Var., Comp.	RV140-3
R64	Res., Var., Comp.	RV140-4
R21,25,61	Res., Var., Comp.	RV140-5
	Socket	TS-211
T1	XMFR., IF	T2216
T2	XMFR., Torroid	T2218
	Socket, Tube	TS101-C-1
CR8,9,10,11	Semi, Cond., Dio.	1N34A
CR4	Semi, Cond., Dio.	1N823A
CR6,12,13,14	Semi, Cond., Dio.	1N645
CR1,2,3	Semi, Cond., Dio.	1N829A
CR5,7,15	Semi, Cond., Dio.	1N914
Q1	Semi, Cond., Trans.	2N2222
Q2	Semi, Cond., Trans.	2N3251
Q3,4	Semi, Cond., Trans.	2N3646
Z3	Network, IC	UA723
Z1,2,4	Network, IC	MC3503L





COMPLETE ASSY WITH AO 121

Figure 6.20B
Frequency Shift
Z117 Component Identifier

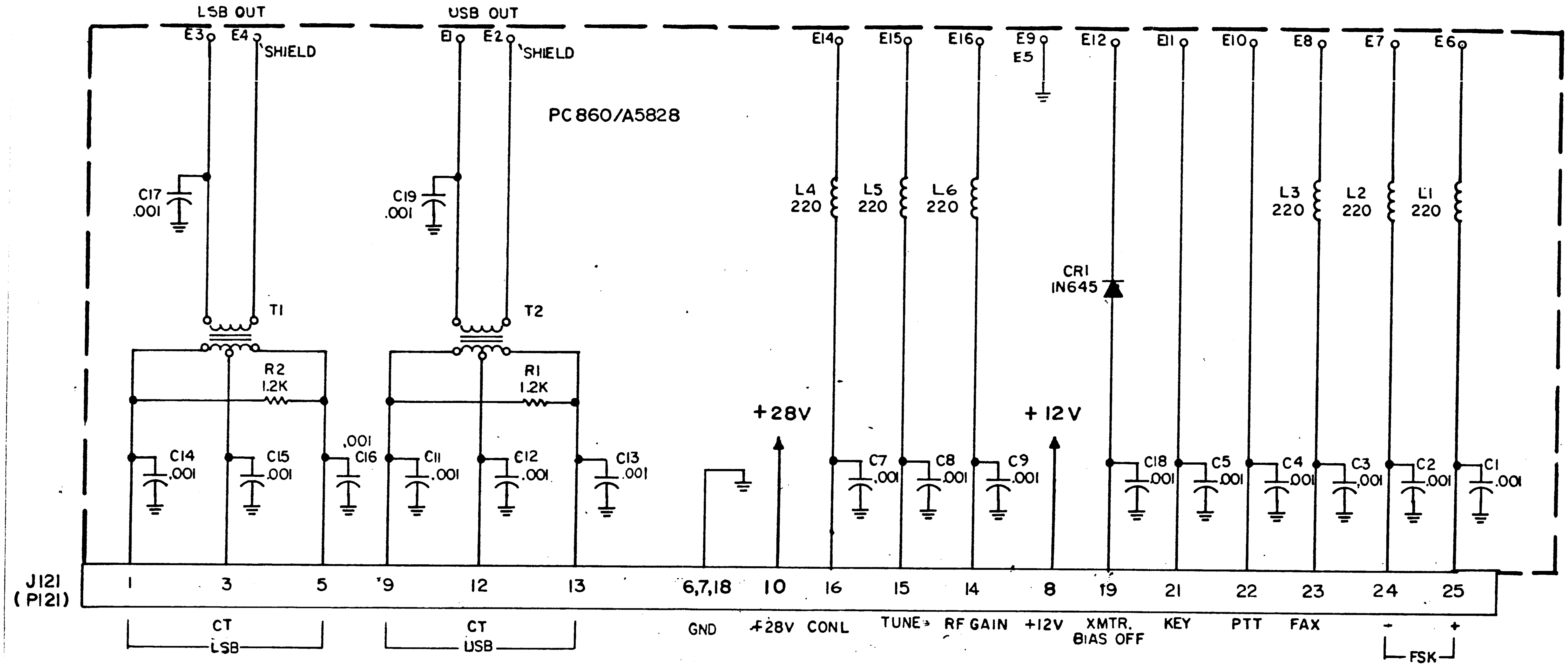


Figure 6.21A
Audio Input Filter
Z121 Schematic

Part Number	Description	Used On	Qty	Symbol Number
CC131-24	Cap., Fixed, Cer.	A5828	17	C1,2,3,4,5,7,8, 9,11,12,13,14,15, 16,17,18,19
CL275-221	Coil	A5828	6	L1,2,3,4,5,6
JJ313-2	Connector	A5828	1	J121
MS7127	Plate Mtg.	A5828	1	
PC860	Printed Circuit Bd	A5828	1	
TF359	Transformer	A5828	2	T1,2

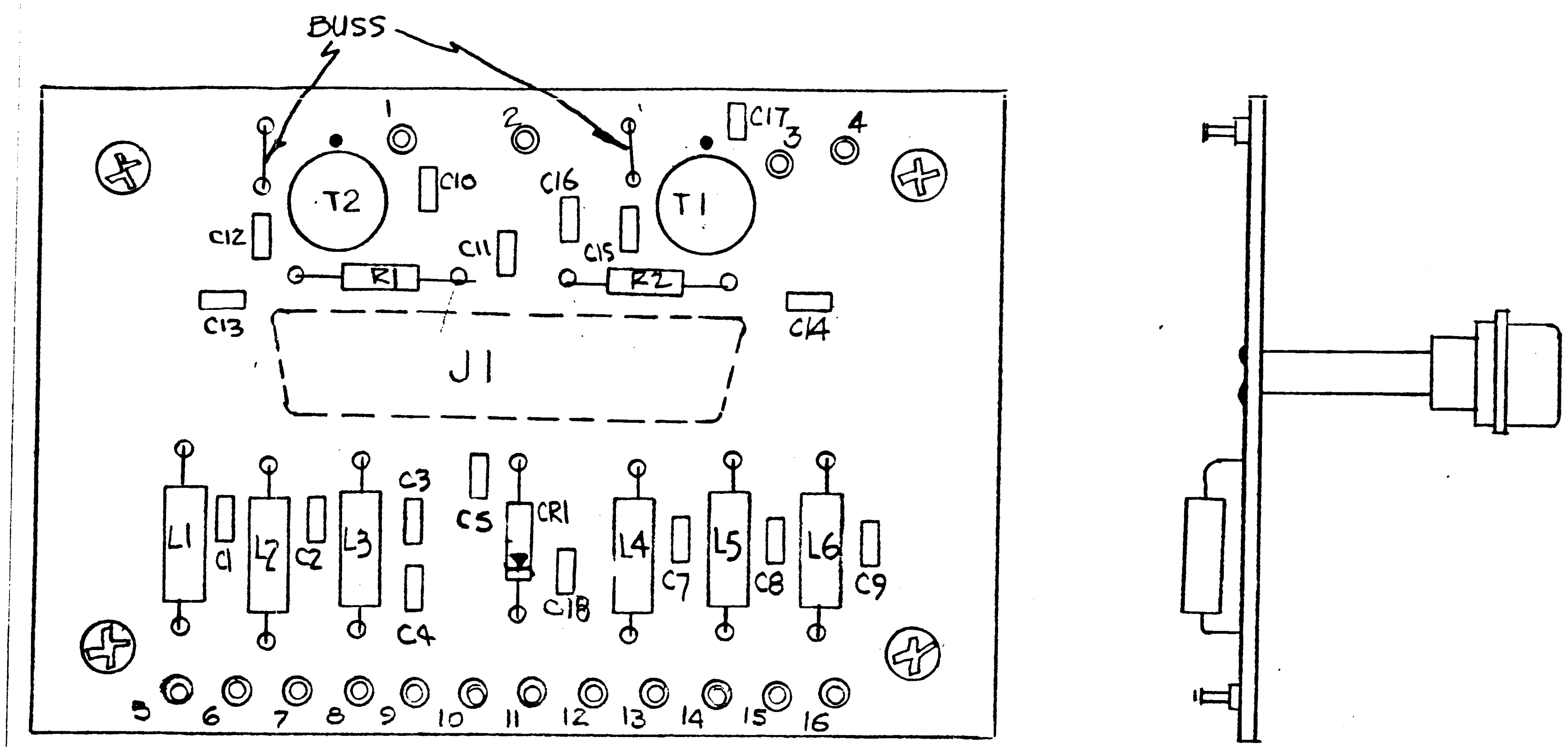


Figure 6.21B
Audio Input Filter
Z121 Component Identifier

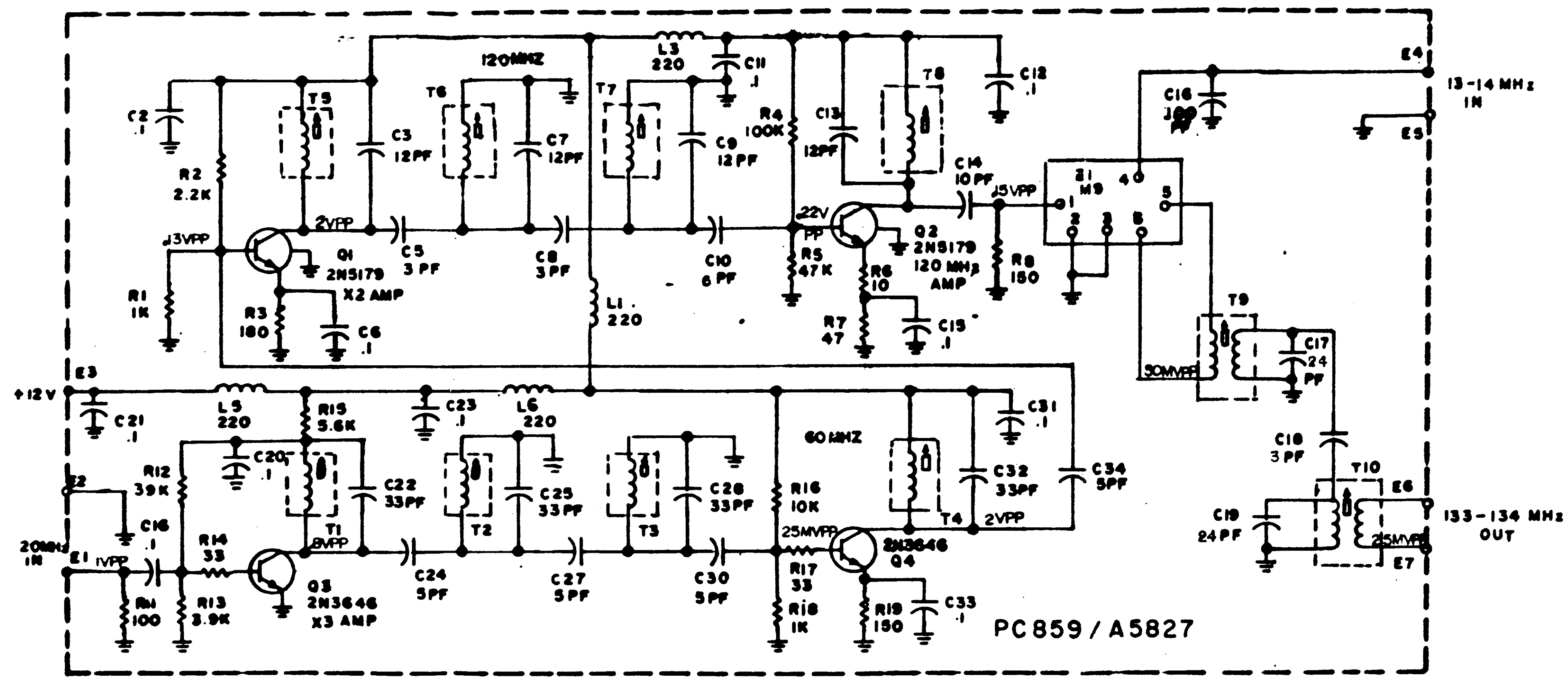


Figure 6.22A
Multiplier-Mixer
Z122 Schematic

Part Number	Description	Used On	Qty	Symbol Number	S1200
CC131-39	Cap., Fixed, Cer.	A5827	11	C2, 6, 11, 12, 15, 16, 20, 21, 23, 31, 33	
CL275-1RO	Coil, R.F., Fixed	A5827	1	L4	
CL275-121	Coil, R.F., Fixed	A5827	4	L1, 3, 5, 6	
CM111E1ROJSS	Cap., Fixed, Mica	A5827	1	C18	
CM111E3ROJSS	Cap., Fixed, Mica	A5827	3	C5, 8, 10	
CM111E5ROJSS	Cap., Fixed, Mica	A5827	4	C24, 27, 30, 34	
CM111E100JSS	Cap., Fixed, Mica	A5827	1	C14	
CM111E101JSS	Cap., Fixed, Mica	A5827	1	C16	
CM111E120JSS	Cap., Fixed, Mica	A5827	4	C3, 7, 9, 13	
CM111E150JSS	Cap., Fixed, Mica	A5827	2	C17, 19	
CM111E330JSS	Cap., Fixed, Mica	A5827	4	C22, 25, 28, 32	
RC07GF100JS	Resistor, Fixed, Comp.	A5827	1	R6	
RC07GF101JS	Resistor, Fixed, Comp.	A5827	1	R11	
RC07GF102JS	Resistor, Fixed, Comp.	A5827	2	R1, R18	
RC07GF103JS	Resistor, Fixed, Comp.	A5827	1	R16	
RC07GF104JS	Resistor, Fixed, Comp.	A5827	1	R4	
RC07GF121JS	Resistor, Fixed, Comp.	A5827	1	R9	
RC07GF151JS	Resistor, Fixed, Comp.	A5827	2	R8, 19	
RC07GF181JS	Resistor, Fixed, Comp.	A5827	1	R3	
RC07GF222JS	Resistor, Fixed, Comp.	A5827	1	R2	
RC07GF330JS	Resistor, Fixed, Comp.	A5827	2	R14, 17	
RC07GF392JS	Resistor, Fixed, Comp.	A5827	1	R13	
RC07GF393JS	Resistor, Fixed, Comp.	A5827	1	R12	
RC07GF470JS	Resistor, Fixed, Comp.	A5827	1	R7	
RC07GF473JS	Resistor, Fixed, Comp.	A5827	1	R5	
RC07GF562JS	Resistor, Fixed, Comp.	A5827	1	R15	
TT285-	Transformer, Tunable	A5827	2	T9, 10	
TT285-	Transformer, Tunable	A5827	4	T5, 6, 7, 8	
TT285-	Transformer, Tunable	A5827	4	T1, 2, 3, 4	
2N3646	Transistor	A5827	2	Q3, 4	
2N5179	Transistor	A5827	2	Q1, 2	

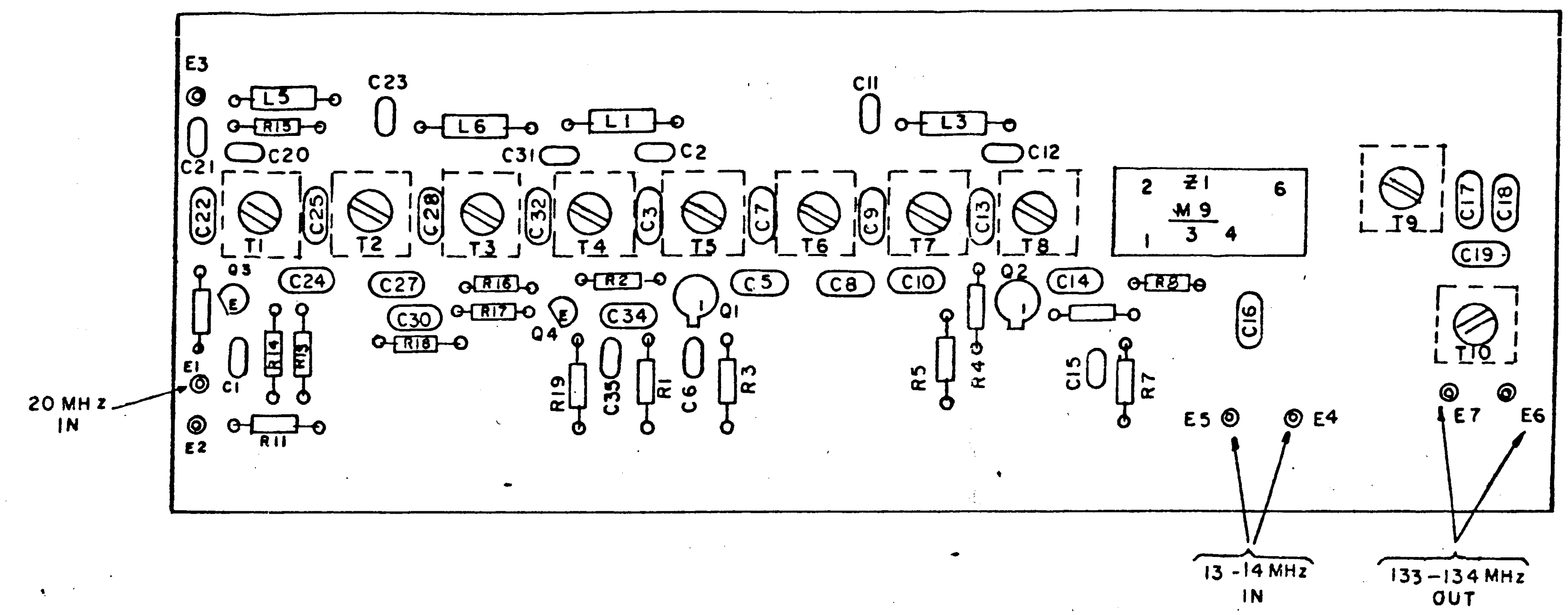


Figure 6.22B
Multiplier-Mixer
Z122 Component Identifier

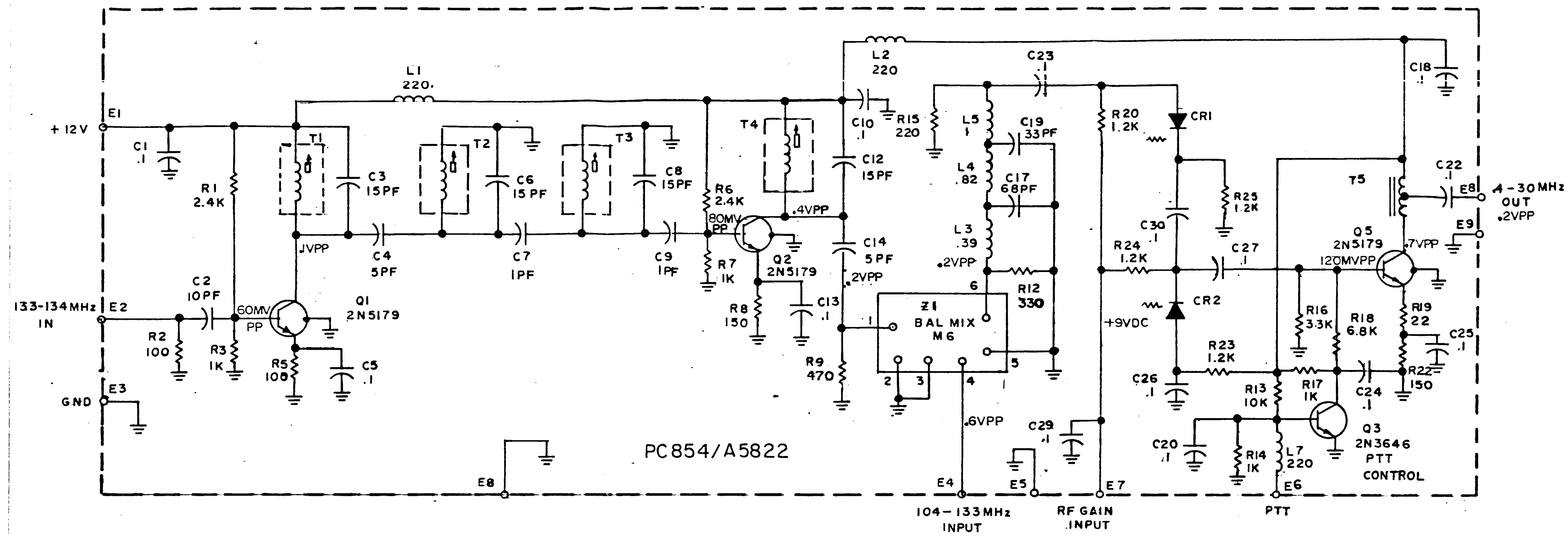


Figure 6.23A
Translator
Z123 Schematic

Part Number	Description	Used On	Qty	Symbol Number	S1200
CC131-1	Cap., Fixed, Cer. 1PF.	A5822	2	C7, 9	
CC131-9	Cap., Fixed, Cer. 5PF.	A5822	2	C4, 14	
CC131-12	Cap., Fixed, Cer. 10PF.	A5822	1	C2	
CC131-13	Cap., Fixed, Cer. 15PF.	A5822	4	C3, 6, 8, 12	
CC131-15	Cap., Fixed, Cer. 33PF.	A5822	1	C19	
CC131-17	Cap., Fixed, Cer. 68PF.	A5822	1	C17	
CC131-20	Cap., Fixed, Cer. 220PF.	A5822	1	C21	
CC131-39	Cap., Fixed, Cer. .1UF	A5822	14	C1,5,10,13,18,20,22,23 24, 25, 26, 27, 28, 29	
CL275-R39	Coil, R.F., Fixed	A5822	1	L3	
CL275-R82	Coil, R.F., Fixed	A5822	1	L4	
CL275-1RO	Coil, R.F., Fixed	A5822	1	L5	
CL275-221	Coil, R.F., Fixed	A5822	4	L1, 2, 7, 8	
NW 163	Network Mixer	A5822	1	Z1	
R07GF101JS	Resistor, Fixed, Comp.	A5822	5	R2, 5, 12, 15, 21	
RC07GF102JS	Resistor, Fixed, Comp.	A5822	4	R3, 7, 14, 17	
RC07GF103JS	Resistor, Fixed, Comp.	A5822	1	R13	
RC07GF122JS	Resistor, Fixed, Comp.	A5822	3	R20, 23, 24	
RC07GF151JS	Resistor, Fixed, Comp.	A5822	2	R8, 22	
RC07GF221JS	Resistor, Fixed, Comp.	A5822	1	R15	
RC07GF242JS	Resistor, Fixed, Comp.	A5822	2	R1, 6	
RC07GF332JS	Resistor, Fixed, Comp.	A5822	1	R16	
RC07GF390JS	Resistor, Fixed, Comp.	A5822	1	R4	
RC07GF430JS	Resistor, Fixed, Comp.	A5822	1	R19	
RC07GF682JS	Resistor, Fixed, Comp.	A5822	1	R18	
RR136	Semicond. Varistor	A5822	2	CR1, 2	
TT285-	Transformer, Tunable	A5822	4	T1, 2, 3, 4	
TZ237	Torriod, Fixed	A5822	1	T5	
2N3646	Transistor	A5822	1	Q3	
2N5179	Transistor	A5822	3	Q1, 2, 5	

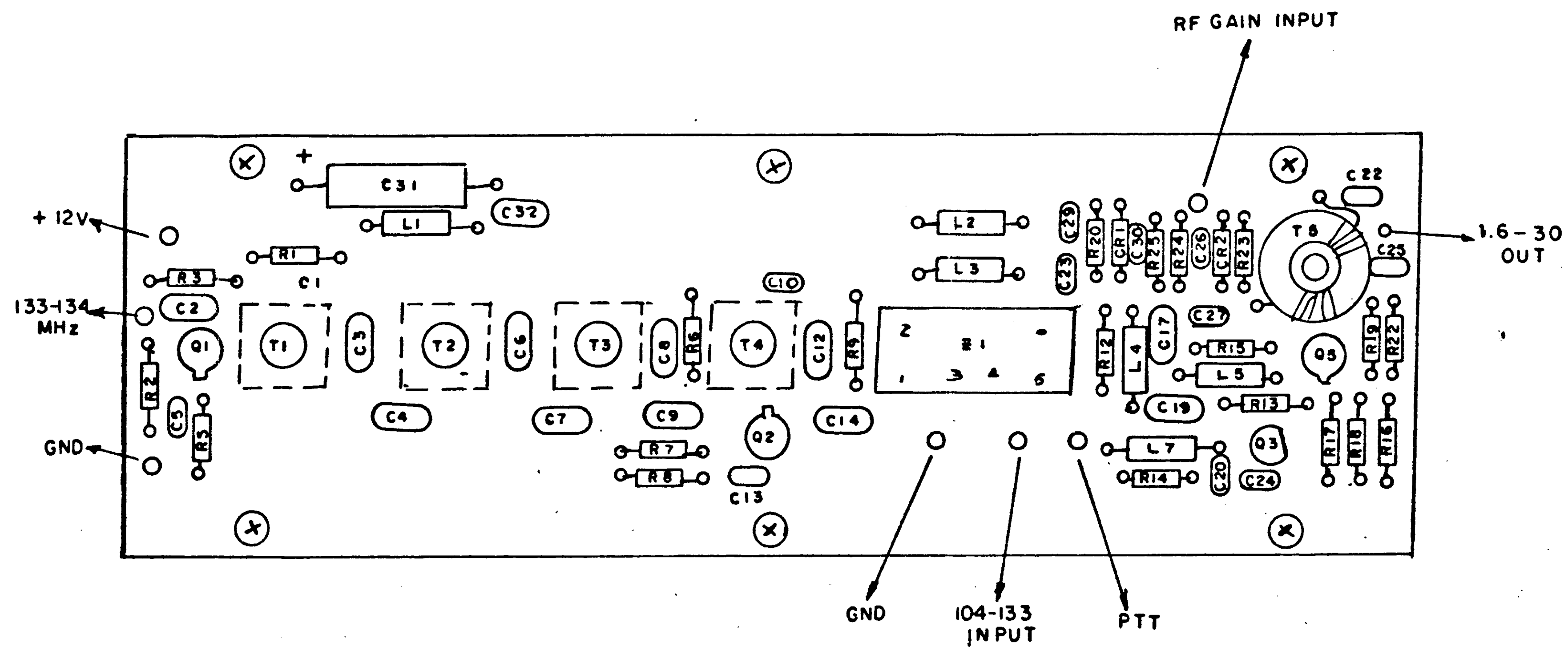


Figure 6.23B
Translator
Z123 Component Identifier

DIAL	FREQ	V.CAP
29	20.8	.8
28	21.0	.92
27	21.2	1
26	21.4	1.1
25	21.6	1.2
24	21.8	1.3
23	22.0	1.4
22	22.2	1.5
21	22.4	1.63
20	22.2	1.75

DIAL	FREQ	V.CAP
19	22.8	1.9
18	23.0	2.0
17	23.2	2.2
16	23.4	2.3
15	23.6	2.45
14	23.8	2.6
13	24.0	2.75
12	24.2	3.0
11	24.4	3.2
10	24.6	3.35

DIAL	FREQ	V.CAP
9	24.8	3.6
8	25.0	3.8
7	25.2	4.0
6	25.4	4.3
5	25.6	4.5
4	25.8	4.8
3	26.0	5.0
2	26.2	5.3
1	26.4	5.6
0	26.6	5.9

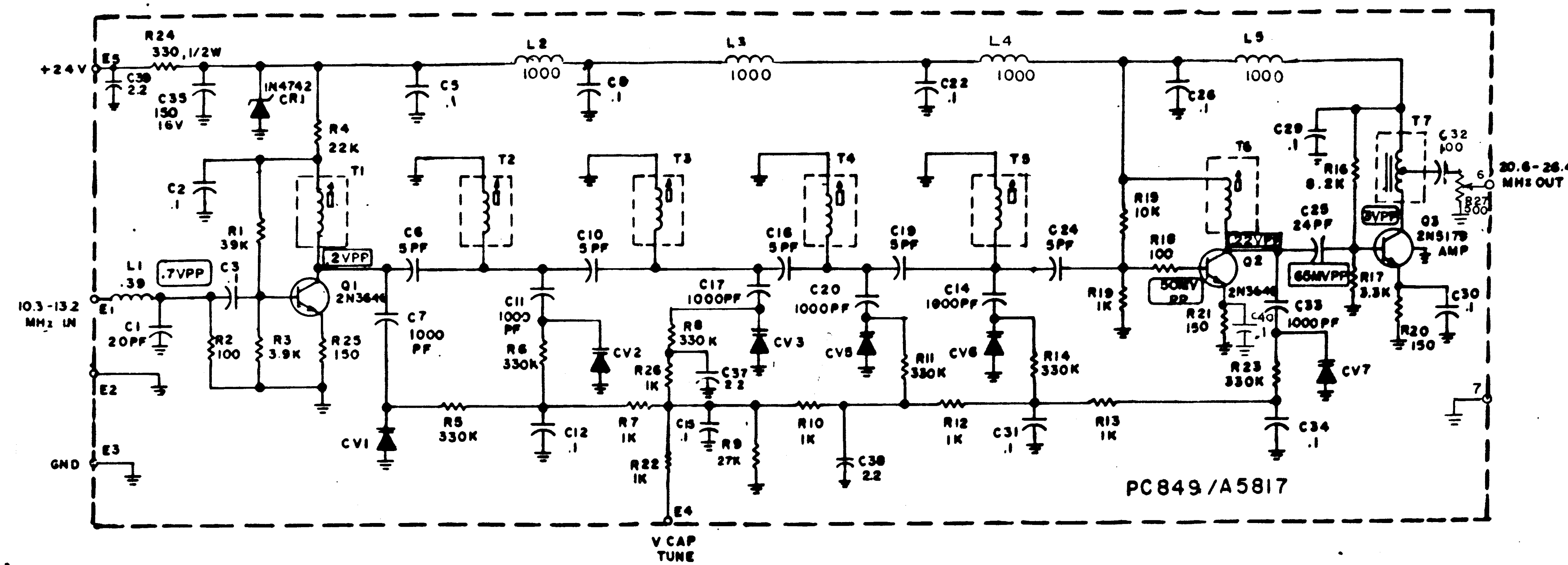


Figure 6.24A
"x2" Amplifier
Z124 Schematic

Part Number	Description	Used On	Qty	Symbol Number	S1200
CC131-48	Cap, Fixed, Ceramic	A5817	3	C37,38,39	
CC131-39	Cap., Fixed Ceramic	A5817	13	C2, 3, 5, 8, 12, 15, 21, 22, 26, 29, 30, 31, 34	
CE105-220-16	Cap., Elect.	A5817	1	C35	
C1120	Ferrite Beads	A5817	4	L2, 3, 4, 5	
CL275-3RO	Coil, RF Fixed	A5817	1	L1	
CM111E050JSS	Cap., Fixed, Mica	A5817	5	C6, 10, 16, 19, 24	
CM111E101J1SS	Cap., Fixed, Mica	A5817	1	C32	
CM111E200	Cap., Fixed, Mica	A5817	1	C24	
CM111E240J1SS	Cap., Fixed, Mica	A5817	1	C25	
CM111E361J1SS	Cap., Fixed, Mica	A5817	6	C7, 11, 17, 14, 33, 20	
MV2113	Vari-Cap., Diode	A5817	6	CV1, 2, 3, 5, 6, 7	
RC07GF101J	Resistor, Carbon	A5817	2	R2, 18	
RC07GF102J	Resistor, Carbon	A5817	6	R7, 10, 12, 15, 19, 13	
RC07GF103J	Resistor, Carbon	A5817	1	R9	
RC07GF151J	Resistor, Carbon	A5817	2	R20, 21	
RC07GF243J	Resistor, Carbon	A5817	1	R4	
RC07GF332J	Resistor, Carbon	A5817	1	R17	
RC07GF334J	Resistor, Carbon	A5817	6	R5, 6, 8, 11, 14, 23	
RC07GF392J	Resistor, Carbon	A5817	1	R3	
RC07GF393J	Resistor, Carbon	A5817	1	R1	
RC07GF822J	Resistor, Carbon	A5817	1	R16	
RC20GF331J	Resistor, Carbon	A5817	1	R24	
RV124-251	Resistor, Variable	A5817	1	R22	
TT285-10	Transformer Tunable	A5817	6	T1, 2, 3, 4, 5, 6	
TZ220	Toroid Fixed	A5817	1	T7	
1N4742	Semicond. Diode	A5817	1	CR1	
2N3646	Semicond. Transistor	A5817	2	Q1, 2	
2N5179	Semicond. Transistor	A5817	1	Q3	

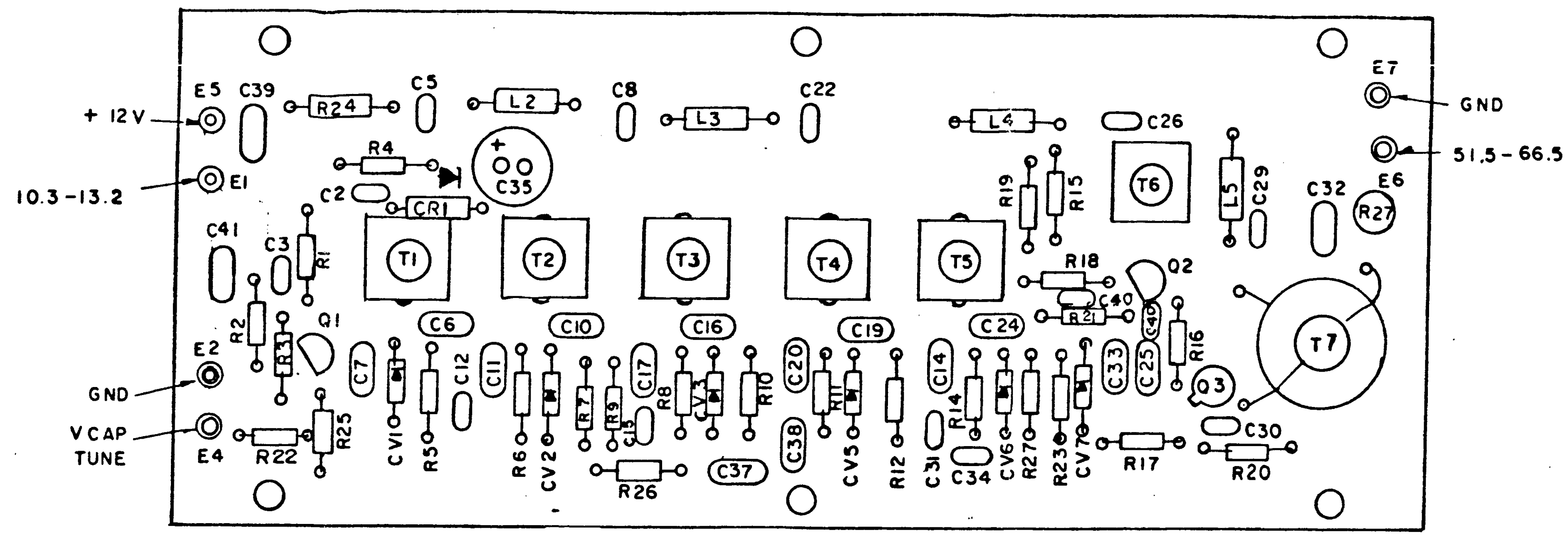


Figure 6.24B
"x2" Amplifier
Z124 Component Identifier

DIAL	X5FREQ	VCAP	DIAL	X5FREQ	VCAP	DIAL	X5FREQ	VCAP
			18	115		6	127	
29	104	.4	17	116	1.8	5	128	4.7
28	105		16	117		4	129	
27	106		15	118		3	130	
26	107	.65	14	119	2.2	2	131	6.0
25	108		13	120		1	132	
24	109		12	121		0	133	6.5
23	110	.9	11	122	3.0			
22	111		10	123				
21	112		9	124				
20	113	1.3	8	125	3.8			
19	114		7	126				

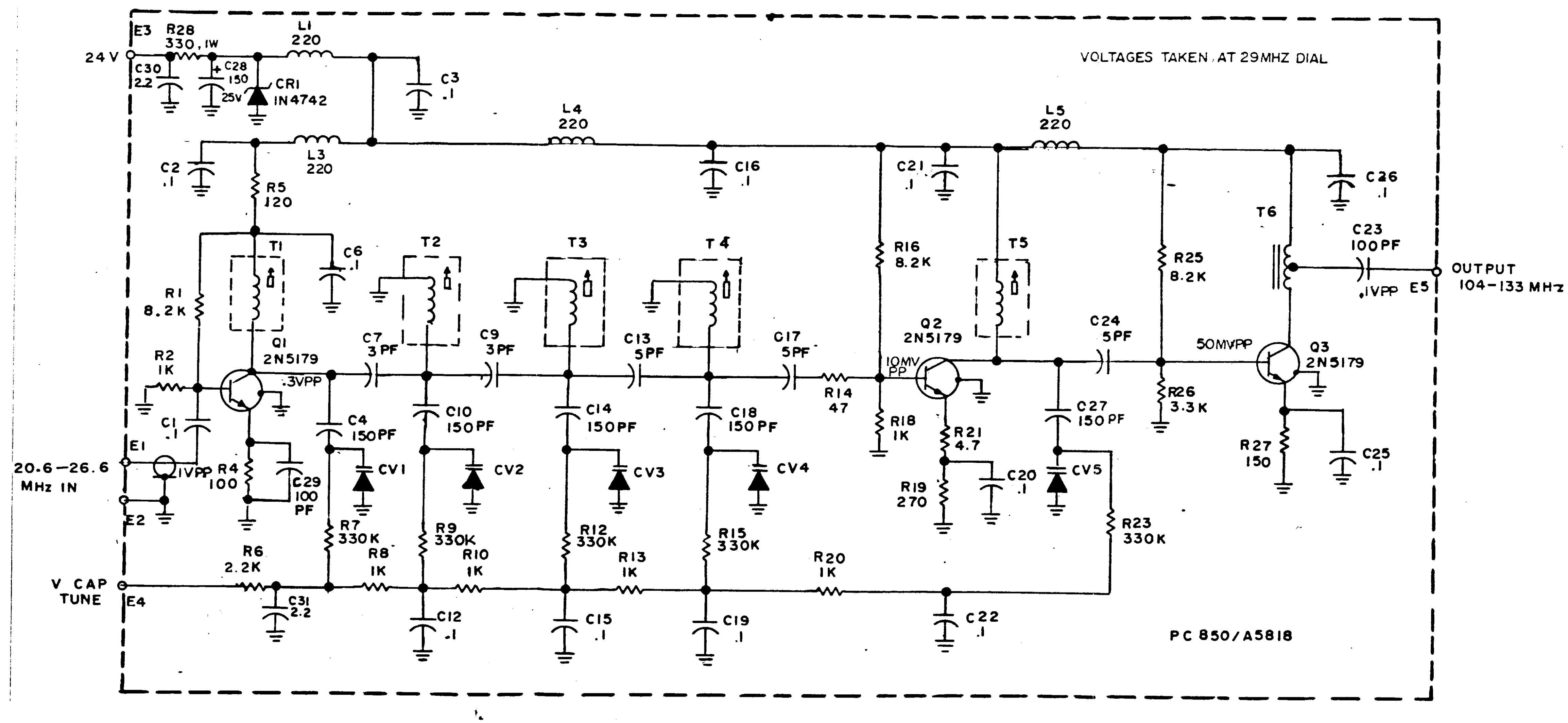


Figure 6.25A
"x5" Amplifier
Z125 Schematic

Part Number	Description	Used On	Qty	Symbol Number	S1200
CC131-48	Cap., Fixed, Cer., 2.2mf	A5818	2	C 29,30	
CC131-7	Cap., Fixed, Cer., 3.3PF	A5818	2	C7, 9	
CC131-9	Cap., Fixed, Cer., 5.6PF	A5818	3	C17, 24, 13	
CC131-18	Cap., Fixed, Cer., 100PF	A5818	1	C23	
CC131-19	Cap., Fixed, Cer., 150PF	A5818	5	C4, 10, 18, 27, 14	
CE105-220-16V	Cap., Electro.	A5818	1	C28	
CL275-121	Coil, RF, Fixed	A5818	5	L1, 2, 3, 4, 5	
1N4742	Semi, Diode	A5818	1	CR1	
MV2105	Diode Varactor	A5818	5	CV1, 2, 3, 4, 5	
RC07GF101J	Resistor, Comp., Fixed	A5818	1	R4	
RC07GF102J	Resistor, Comp., Fixed	A5818	7	R2, 6, 8, 10, 13, 18, 20	
RC07GF103J	Resistor, Comp., Fixed	A5818	2	R3, 11	
RC07GF151J	Resistor, Comp., Fixed	A5818	1	R27	
RC07GF222J	Resistor, Comp., Fixed	A5818	1	R5	
RC07GF271J	Resistor, Comp., Fixed	A5818	1	R19	
RC07GF332J	Resistor, Comp., Fixed	A5818	1	R26	
RC07GF334J	Resistor, Comp., Fixed	A5818	5	R7, 9, 12, 15, 23	
RC07GF470J	Resistor, Comp., Fixed	A5818	2	R14, 21	
RC07GF882J	Resistor, Comp., Fixed	A5818	3	R1, 16, 25	
TT285-24	Transformer	A5818	5	T1, 2, 3, 4, 5	
TZ220	Torroid Fixed	A5818	1	T6	
2N5179	Semicond. Transistor	A5818	3	Q1, 2, 3	

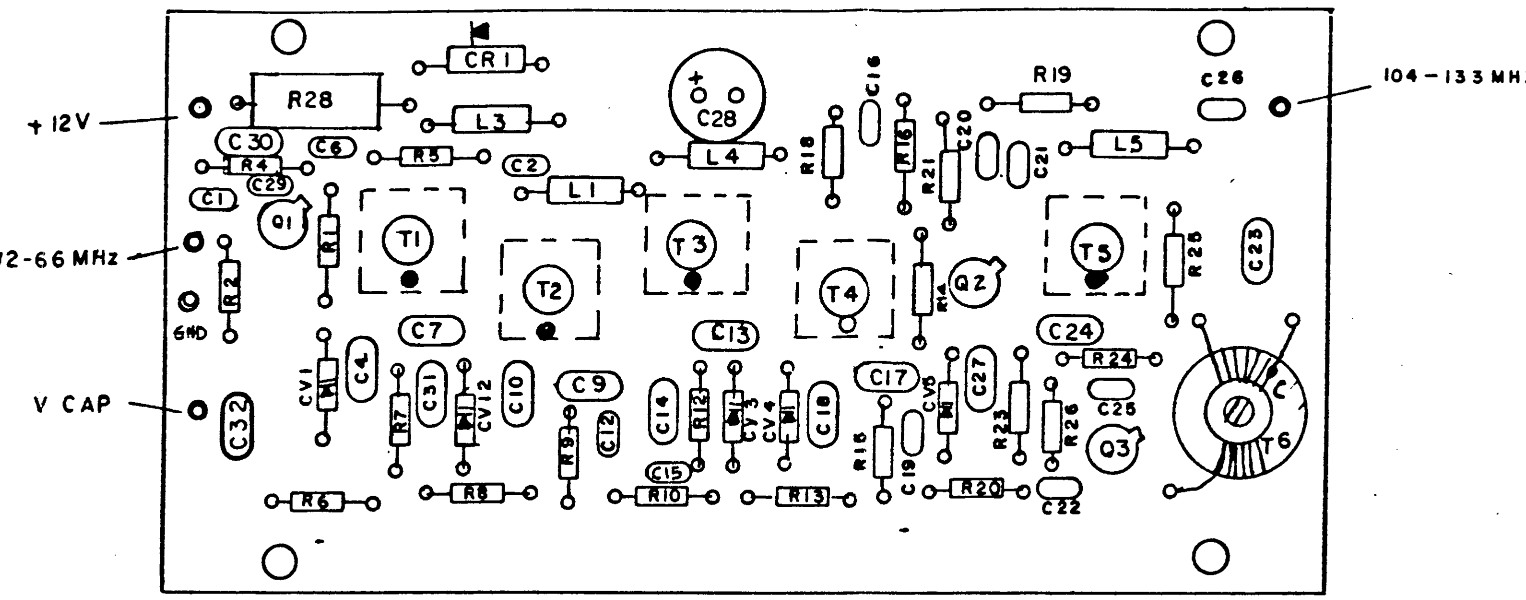


Figure 6.25B
"x5" Amplifier
Z125 Component Identifier

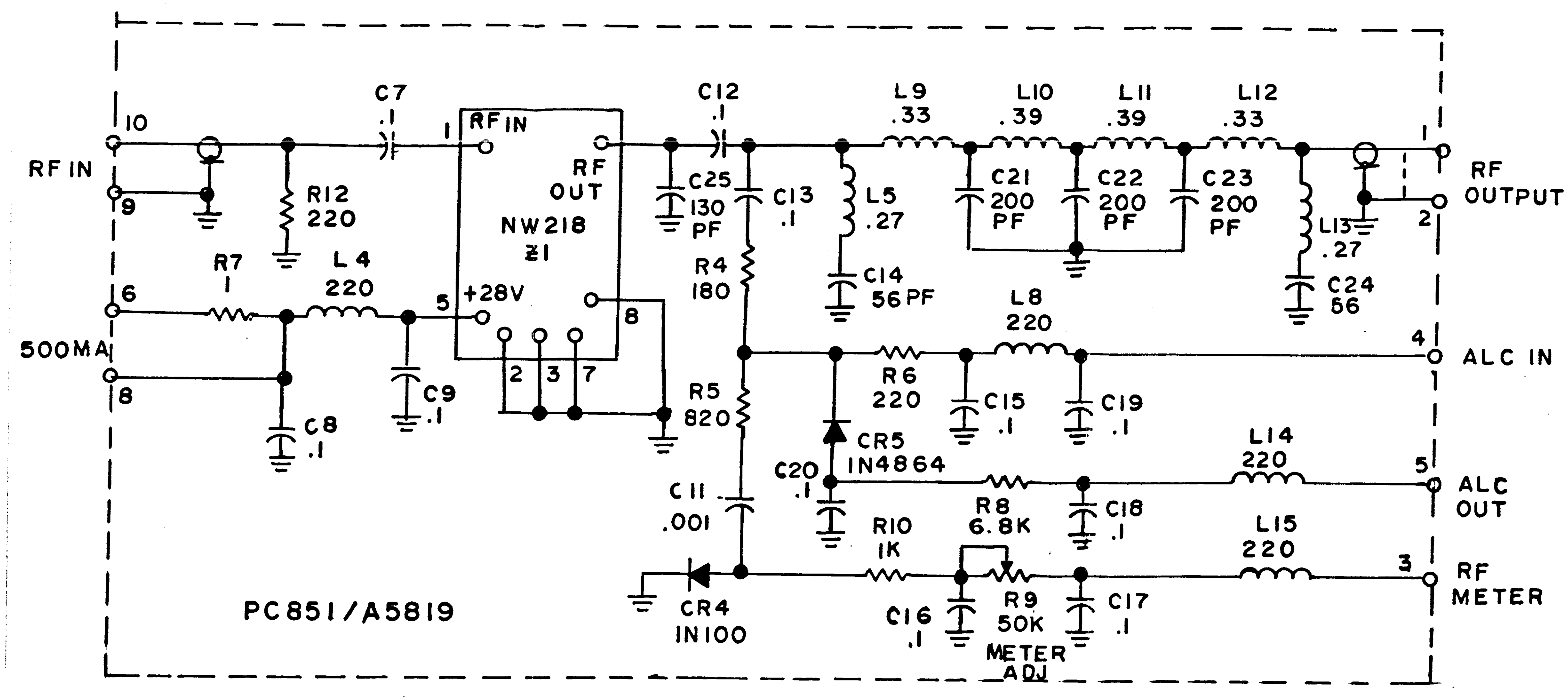


Figure 6.26A
RF Output Assembly
Schematic

Part Number	Description	Used On	Qty	Symbol Number	S1200
CC100-24	Cap., Fixed, Ceramic	A5819	1	C11	
CC100-32	Cap., Fixed, Ceramic	A5819	1	C10	
CC100-39	Cap., Fixed, Ceramic	A5819	11	C7, 8, 9, 12, 13, 15, 16, 17, 18, 19, 20	
CK2268	Schematic	A5819	1		
CL275-R27	Coil, RF, Fixed	A5819	2	L5, 13	
CL275-R33	Coil, RF, Fixed	A5819	2	L9, 12	
CL275-2R2	Coil, RF, Fixed	A5819	1	L8	
CL275-39	Coil, RF, Fixed	A5819	2	L10, 11	
CL275-120	Coil, RF, Fixed	A5819	3	L4, 14, 15	
CM111F131J5S	Cap., Fixed, Mica	A5819	1	C25	
CM111F201J5S	Cap., Fixed, Mica	A5819	3	C21, 22, 23	
CM111F560J5S	Cap., Fixed, Mica	A5819	2	C14, 24	
HD138	Heat Sink	A5819	1		
MS7160	Shield, PC Board	A5819	1		
MS7161	Cover, Shield	A5819	1		
RC07GF102J	Resistor, Fixed, Comp.	A5819	1	R10	
RC20GF1ROJ	Resistor, Fixed, Comp.	A5819	1	R7	
RC20GF103J	Resistor, Fixed, Comp.	A5819	1	R3	
RC20GF181J	Resistor, Fixed, Comp.	A5819	1	R4	
RC20GF221J	Resistor, Fixed, Comp.	A5819	2	R6, 11	
RC20GF473J	Resistor, Fixed, Comp.	A5819	1	R9	
RC20GF682J	Resistor, Fixed, Comp.	A5819	1	R8	
RC20GF821J	Resistor, Fixed, Comp.	A5819	1	R5	
RV124-503	Resistor, Variable	A5819	1	R9	
1N100	Resistor, Fixed, Diode	A5819	1	CR4	
1N4864	Resistor, Fixed, Diode	A5819	1	CR5	

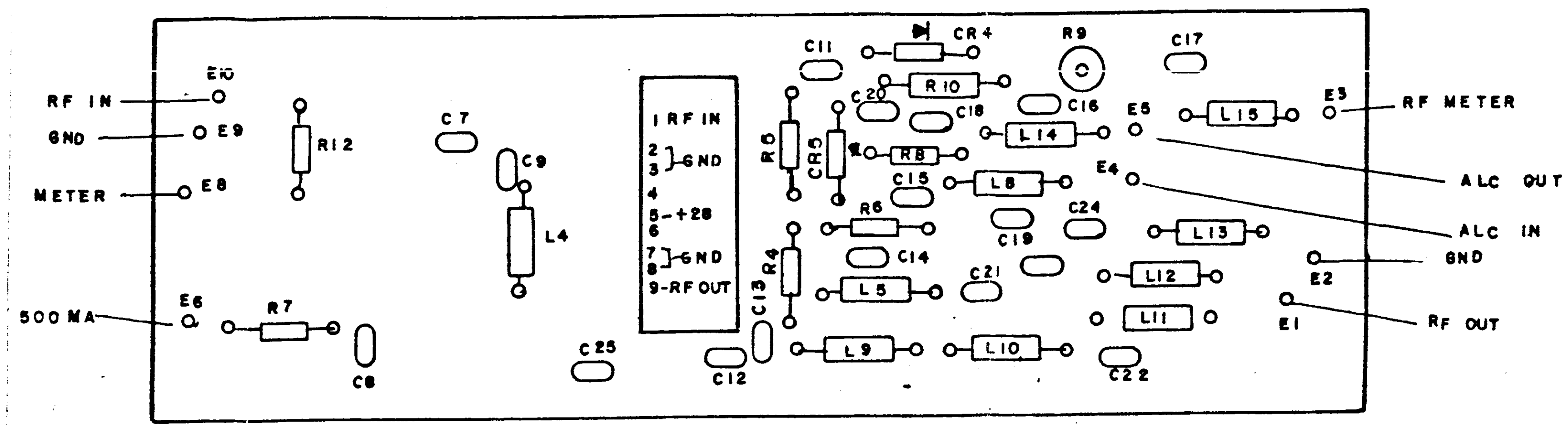


Figure 6.26B
RF Output Assembly
Component Identifier

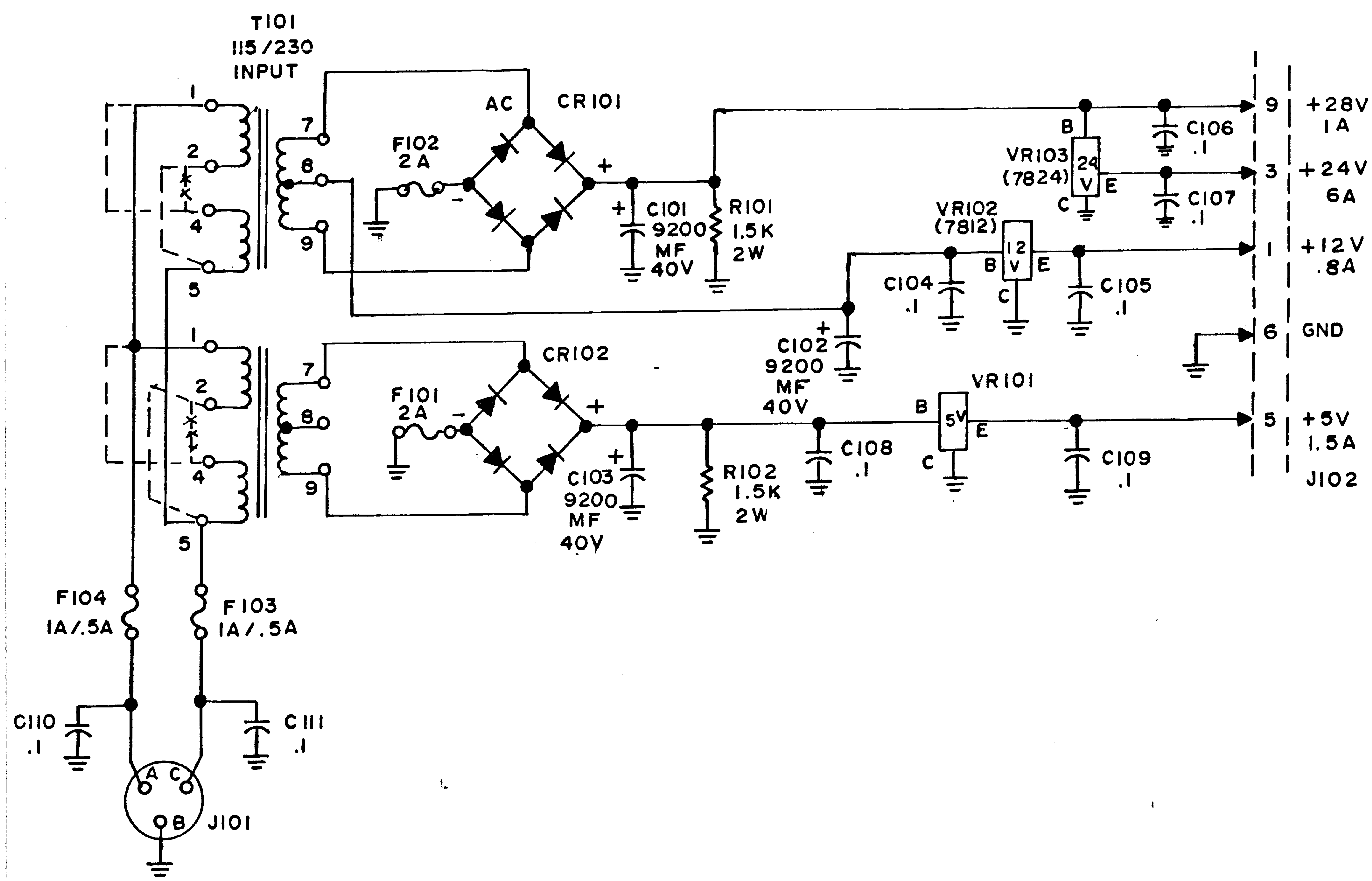


Figure 6.27
Power Supply
Schematic

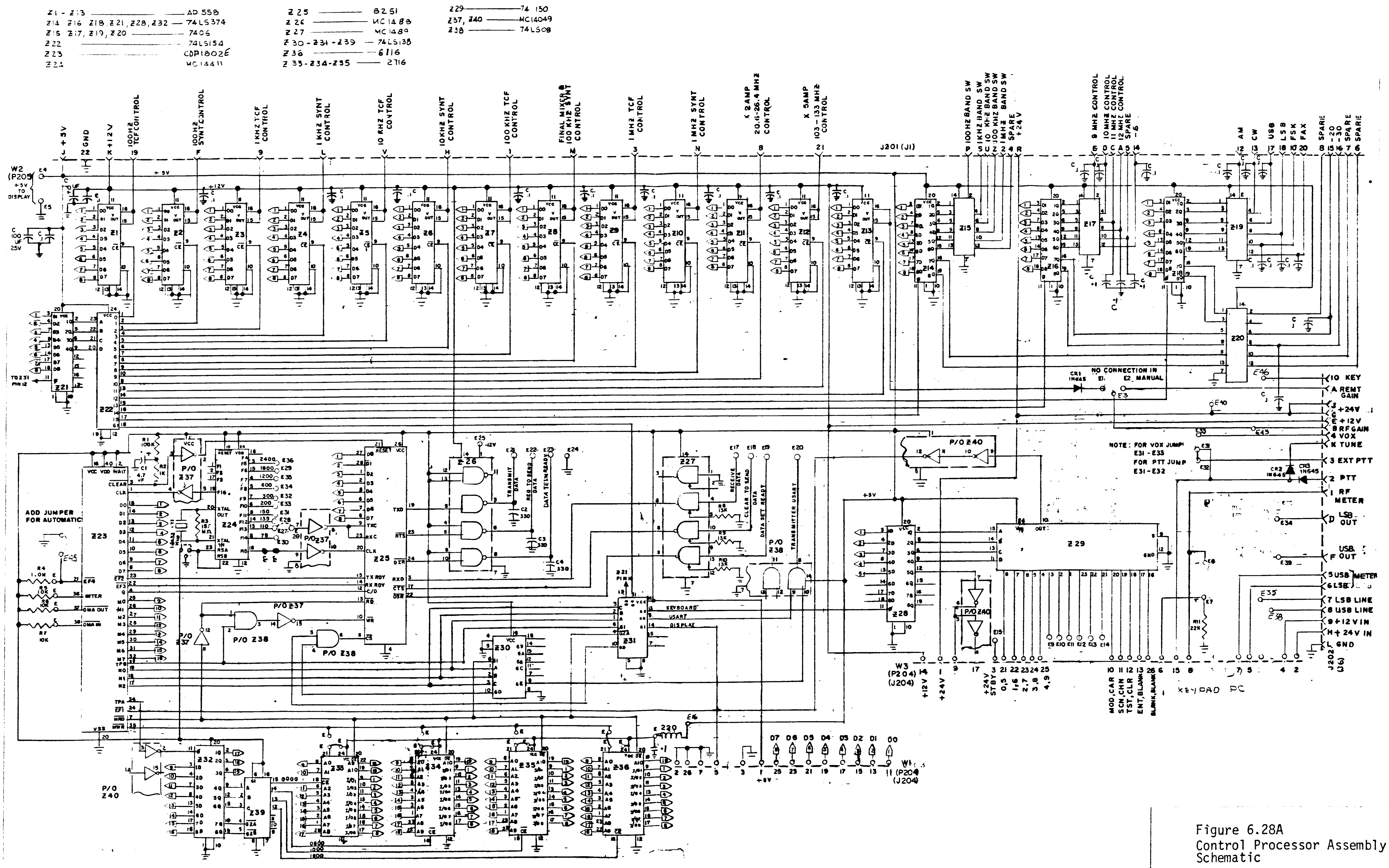


Figure 6.28A
Control Processor Assembly
Schematic

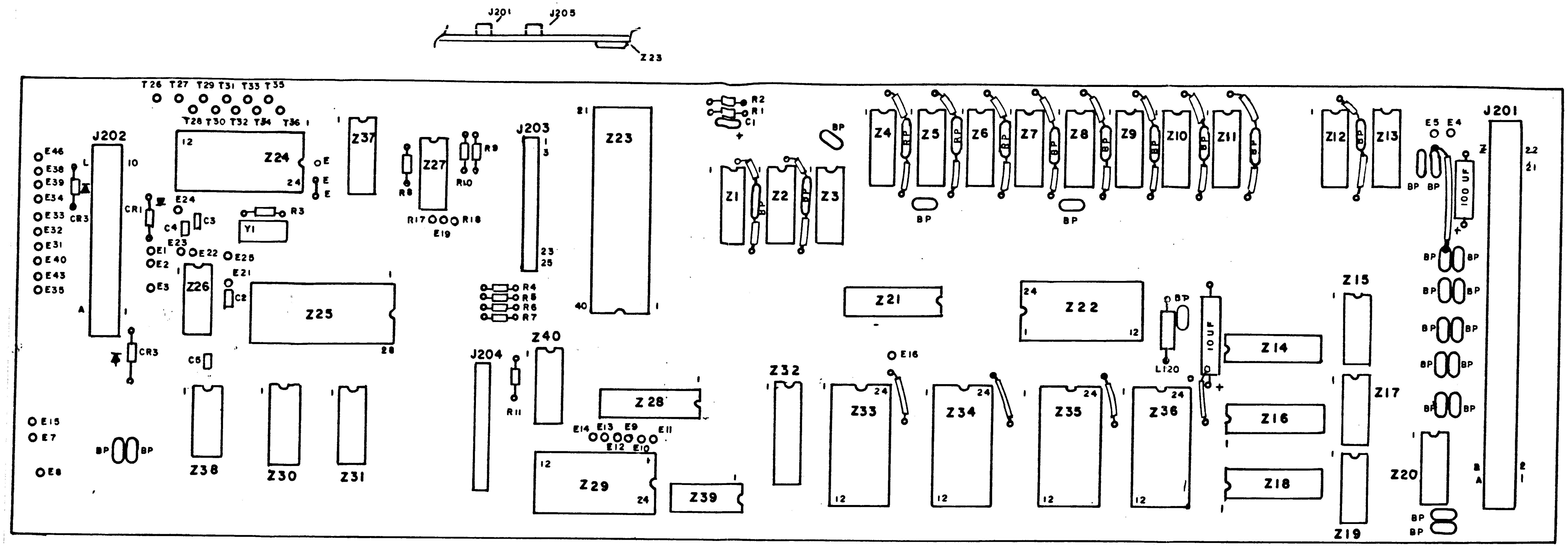


Figure 6.28B
Control Processor Assembly
Component Identifier

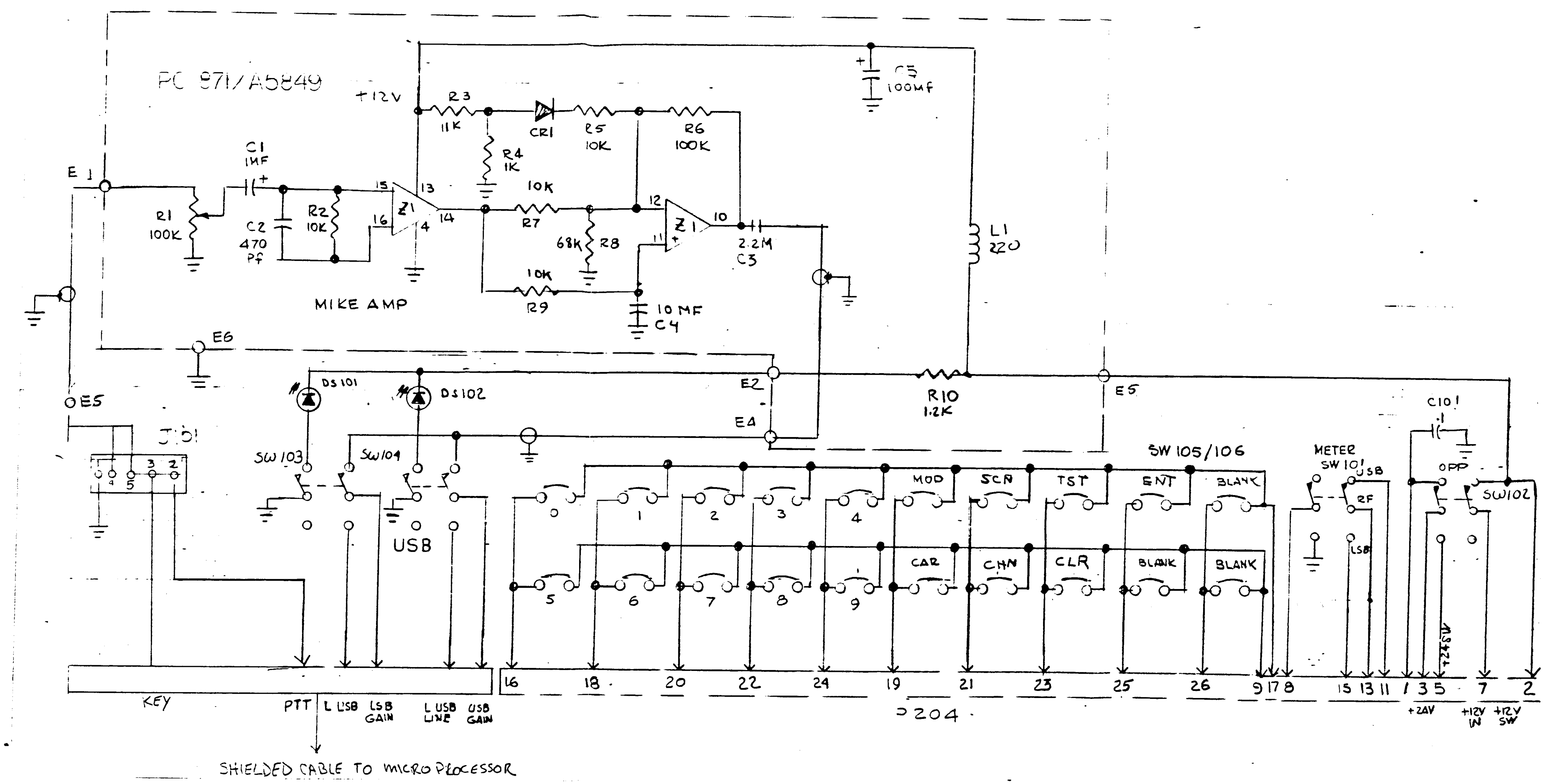


Figure 6.29
Key Pad/Display