

# ***W7FG VINTAGE MANUALS***

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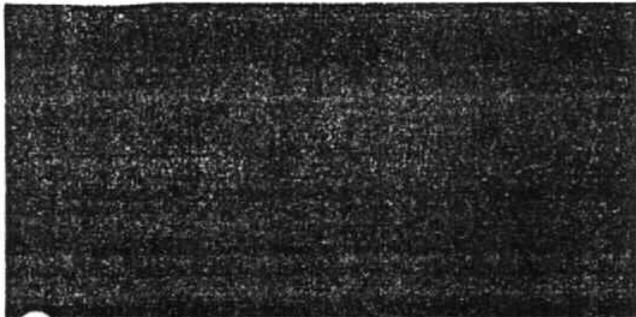
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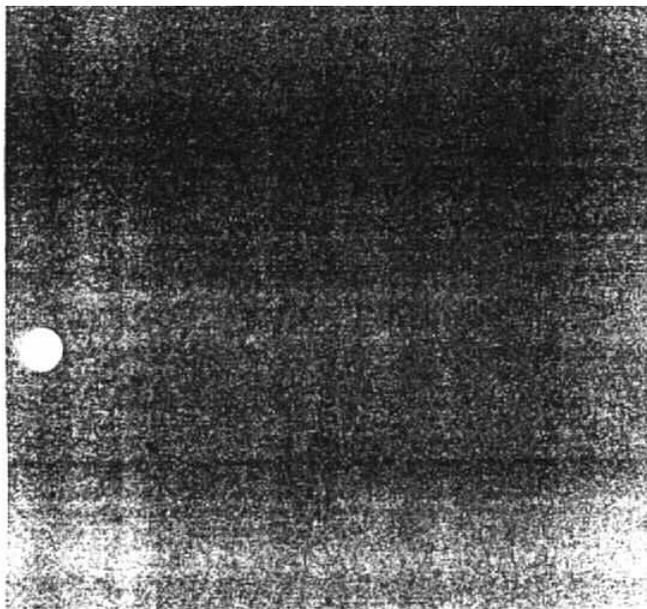
***FT-480R***

***SERVICE***



# MAINTENANCE SERVICE MANUAL FT-480R





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## FOREWORD

The purpose of this manual is to provide the reader with information critical to the operation and maintenance of the FT-480R transceiver. Technical details are geared for maximum comprehension by the technician or owner, rather than the design engineer. To this end, the descriptions have been kept brief, while photographs and drawings are utilized liberally.

Use of this manual is entirely at the owner's risk. While we believe the material presented herein to be correct and factual, we assume no liability for damage which may occur when this manual is used as a reference.

The FT-480R has had an enviable service record, and we trust that you will seldom have recourse to this manual. Should reference be necessary, though, we hope and trust that the information presented will be sufficient for your service needs.

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Yaesu Musen Company, Ltd.  
Tokyo, Japan

## SECTION 1 — GENERAL

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GENERAL

# FT-480R

## MICROPROCESSOR CONTROLLED 2 METER ALL-MODE TRANSCEIVER



### GENERAL DESCRIPTION

The FT-480R is a revolutionary, high performance USB, LSB, FM, and CW transceiver for the most demanding 2-meter operator. Controlled by a NMOS 4-bit microprocessor, the FT-480R features full PLL synthesis in 10 Hz, 100 Hz, 1 kHz, 20 kHz (US model), and 100 kHz steps. The extremely compact size of the FT-480R makes this model particularly well suited for mobile use.

The microprocessor chip allows never-before-possible operating flexibility. As many as four memory channels may be programmed to your favorite frequencies, and by switching to the MEMORY SCAN position, all four memory channels will be scanned.

Digital display of the operating frequency is provided. The front panel meter consists of a string of bright LED's, for easy monitoring of the received signal strength and transmitter

output.

The standard microphone features a PTT switch and up/down scanning controls, plus a tone call button for repeater operation.

Among the convenience features of your FT-480R are receiver offset tuning for CW and SSB, and a digitally synthesized dual VFO system.

The FT-480R has had an enviable service record, and we trust that you will seldom have recourse to this manual. We hope and trust, though, that the material presented herein will be sufficient for your requirements.

1-1

## GENERAL

### GENERAL

#### Frequency coverage:

\*143.500–148.500 MHz

#### Modes of operation:

SSB (USB, LSB), CW, and FM

## SPECIFICATIONS

#### Unwanted sideband suppression:

Better than 40 dB

#### Spurious emission (SSB):

At least 60 dB down

#### Frequency response:

300–2700 Hz (–6 dB)

**Synthesizer steps:**

SSB, CW 10 Hz, 100 Hz, 1 kHz  
 \*FM 1 kHz, 20 kHz, 100 kHz

**Power requirements:**

13.8 volts DC, negative ground

**Current consumption:**

DC 0.5 amps receive  
 DC 3.0 amps transmit

**Antenna impedance:**

50 ohms

**Case size:**

60 (H) x 180 (W) x 240 (D) mm

**Weight:**

Approx. 2.9kg

**TRANSMITTER**

**Power input:**

SSB 30 watts PEP  
 FM/CW 30 watts DC

**Carrier suppression:**

Better than 40 dB

**FM Deviation:**

±5 kHz

**Microphone impedance:**

600 ohms

**RECEIVER**

**Sensitivity:**

SSB, CW 0.5 μV for 20 dB S/N  
 FM 0.35 μV for 20 dB QS

**Selectivity:**

SSB, CW 2.4 kHz at 6 dB down  
 4.1 kHz at 60 dB down  
 FM 14 kHz at 6 dB down  
 25 kHz at 60 dB down

**Image response:**

Better than -60 dB

**Audio output impedance:**

8 ohms nominal

**Audio output:**

2.0 watts @ 10% THD

\* USA Model (Model A)

Model	Frequency Range (MHz)	Synthesizer Steps (Hz)						Tone Burst Frequency (Hz)	Preset Frequency (MHz)
		SSB, CW			FM				
		S	M	F	S	M	F		
A	143.5–148.5	10	100	1K	1K	20K	100K	1800	147.00
R	144.0–	10	100	1K	1K	25K	100K	1750	145.00

	146.0								
C	143.5– 148.5	10	100	1K	1K	25K	100K	1750	147.00
D	144.0– 146.0	10	100	1K	1K	12.5K	25K	1750	145.00
E	143.5– 148.5	10	100	1K	1K	12.5K	25K	1750	147.00

FT-480R Model Chart

### SEMICONDUCTORS

### GENERAL

IC:

MC1496G	1
MC14011B	4
MC14560B	2
MC14028B	1
MC14069B	1
MC14002B	1
μA78L05	3
μPC7808H	1
μPC577H	1
μPC1037H	1
μPC2002V	1
μPC7805H	1
μPD4094B	3
μPD1511-11	1
TC9122P	2

Transistor:

2SK19TM-GR	3
2SK30AY	1
2SK51	1
3SK59Y	2
3SK73Y	8
2SA715C	1
2SA733P/Q	19
2SC535A	5
2SC535B	3
2SC732TMBL	1
2SC945P	1
2SC945Q	40
2SC945K	1
2SC1383R	3

LED:

1S1007	4
1S1555	1
1S2209	14
U05B	1
1SS53	92
10D1	4
MV104	2
HZ11B-1	1
TLG-205	2
TLR-205	2
TLR-226	3
TLY-226	2
TLG-226	5

TC5081P	2
TC5082P	2
SN16913P	2
SN76514N	1
HD10551	2
MB8718A	1
TA7612AP	1

2SC1583	3
2SC1674L	2
2SC1815Y	5
2SC1815GR	3
2SC2002L	1
2SC2053	1
MPSA13	2

FCD:  
LD8231/F1P9C5 1

## FET:

2SK19TM-Y	1
-----------	---

## Diode:

1S188FM	18
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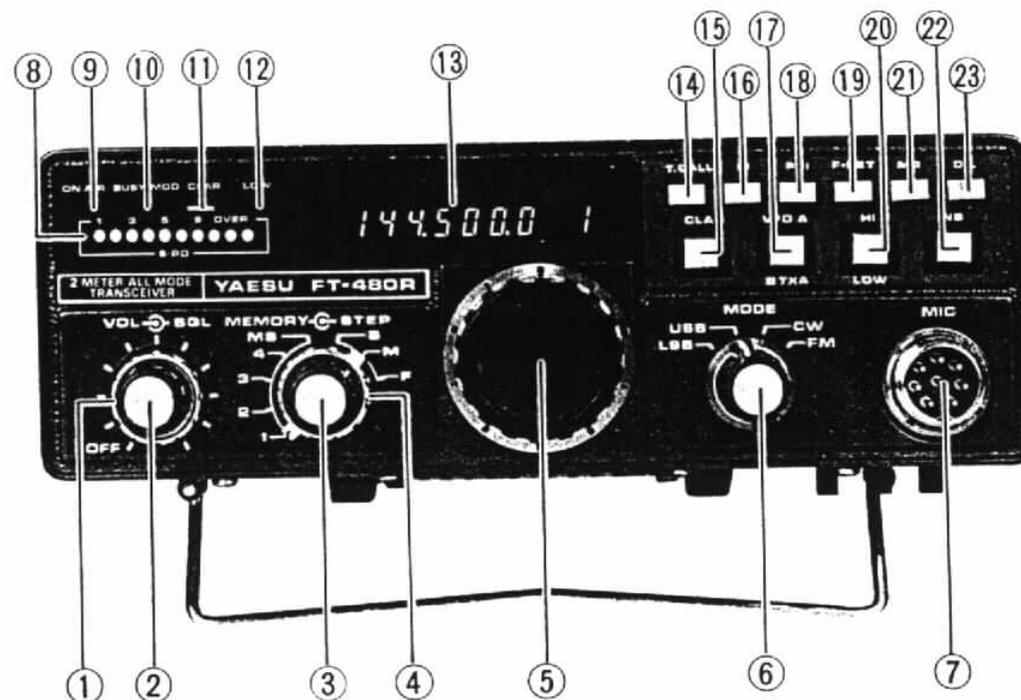
Specifications subject to change without notice or obligation.

## ACCESSORIES

- |    |                         |             |       |
|----|-------------------------|-------------|-------|
| 1. | Microphone              | (M3090028)  | 1 ea. |
| 2. | Power Cord              | (T9002805)  | 1 ea. |
| 3. | Spare Fuses (5A)        | (Q0000005)  | 2 ea. |
| 4. | Stand                   | (R0062300A) | 1 ea. |
| 5. | Miniature Phone Plug    | (P0090034)  | 2 ea. |
| 6. | Mobile Mounting Bracket | (R0062900)  | 1 ea. |
| 7. | TONE IN Connector       | (P0090174)  | 1 ea. |

## GENERAL

## FRONT PANEL CONTROLS AND SWITCHES



The FT-480R has been designed for ease of operation. However, the operator may not be familiar with some controls since the FT-480R utilizes modern computer technology. Be sure you thoroughly understand the function of each control and indicator before operating this equipment.

**(4) MEMORY**

This switch selects the MS mode (Memory Scan) or one of the four frequencies that the operator has programmed into memory. Memory scan control is exercised via the UP/DOWN switches on the microphone.

**(1) SQL**

The squelch control quiets the receiver in the absence of a signal on FM. It should be set to the point where the background noise just disappears, in order to provide maximum sensitivity.

**(2) VOL**

This control is the main ON/OFF switch for the transceiver, and it also sets the audio output level to the speaker. Clockwise rotation increases the audio output level.

**(3) STEP**

The 3 positions of this switch control the tuning rate of the main dial, as shown in Table 1.

STEP SWITCH POSITION	MAIN DIAL FREQUENCY COVERAGE PER STEP	
	SSB/CW	FM
S	10 Hz	1 kHz
M	100 Hz	*20 kHz
F	1 kHz	*100 kHz

Table 1

\* USA Model (Model A)

**(5) MAIN TUNING KNOB**

The tuning knob is used to control the receive and transmit frequencies over the entire 2 meter amateur band. It is activated when the DIL button is pushed.

When the transceiver is initially turned on, the display will indicate 147.000.0 MHz, and the dial may be turned from that point to the desired operating frequency.

**(6) MODE**

This switch selects the mode of operation: USB (upper sideband), LSB (lower sideband), CW (code operation), and FM (frequency modulation).

**(7) MIC**

The MIC jack is used for microphone input, PTT control, and scanner control lines.

**(8) S/PO**

A string of LEDs provides indication of signal strength and relative power output.

**(9) ON AIR**

This indicator lights up during transmission.

## GENERAL

**(10) BUSY/MOD**

This indicator has a dual function: it will light up when the channel is occupied, or indicate modulation during FM transmissions.

**(11) CLAR Indicator**

This lamp lights when the clarifier switch is pushed.

**(12) LOW**

This lamp lights when the HI/LOW switch is in the LOW position.

**(13) Digital Display**

The digital display indicates the operating frequency. In the priority mode, the character "P" will be illuminated at the far right-hand side of the window. Also, the memory channel in use will be indicated for easy reference.

**(14) T.CALL**

When this switch is pushed, the PTT line will close, and a 1750 Hz or 1800 Hz tone will be transmitted for accessing repeaters.

**(15) CLAR**

The clarifier switch allows  $\pm 10$  kHz offset of the receive frequency from the dial or memory frequency. Clarifier tuning is accomplished via the main tuning dial. When the CLAR switch is

**(19) F.SET**

This switch, when pressed, clears all digits of the operating frequency below the step frequency you are using.

**(20) HI/LOW**

This switch, when pressed, reduces the transmitter power from 10 watts to 1 watt RF output.

**(21) MR (Memory Recall)**

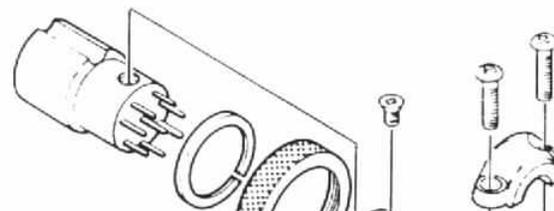
This button transfers frequency control from the main dial to the memory channels.

**(22) NB (Noise Blanker)**

This switch, when pressed, activates the noise blanker for minimizing pulse-type noise.

**(23) DIL (Dial)**

This switch, when pressed, transfers frequency control from the memory channels to the main tuning dial.



pushed, the scanning step selector should be set to 10 Hz or 100 Hz; if not, control will be returned to the main dial, with the clarifier being disabled.

#### (16) M (Memory)

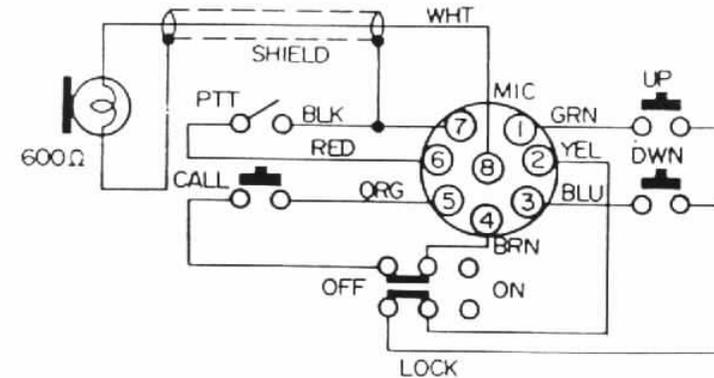
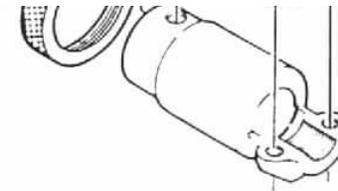
This switch is used for programming a frequency into memory.

#### (17) VFO A/B TXA

This switch, when pressed, allows split operation using the two internal VFOs.

#### (18) PRI

While operating in the dial tuning mode, the PRIORITY switch allows scanning of the main dial and one of the memorized frequencies every 5 seconds. The SCAN switch controls the stopping of the scanner on a busy or clear channel.

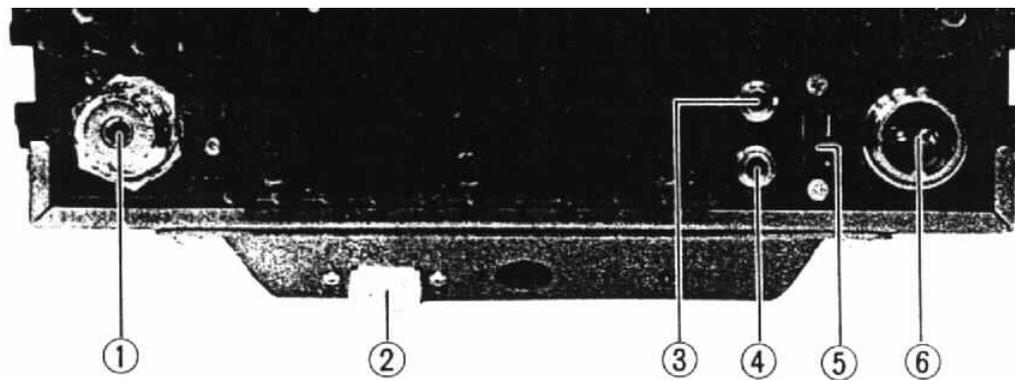


YM-40 MICROPHONE CONNECTIONS

## GENERAL

## REAR PANEL CONNECTIONS AND SWITCH



**(1) ANT**

This is the main antenna connector.

**(2) TONE IN CONNECTOR**

This connector is provided for the optional external FTS-64E Tone Encoder, which synthesizes 32 CTCSS or tone burst frequencies.

**(3) KEY**

This is the key jack for CW operation. The key-up voltage is 3.5 V, while the key-down current is approximately 1 mA.

**(4) EXT SP**

This is a miniature phone jack for connection to an external speaker. Insertion of a plug into this jack automatically cuts off the internal speaker.

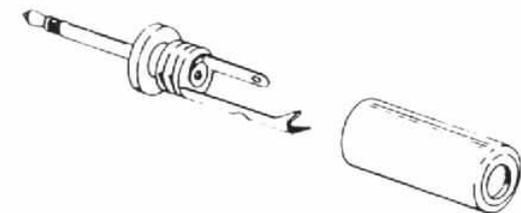
**(5) BACKUP**

When this switch is placed in the ON position, and DC power is still connected to the POWER connector, the memory circuit will still be held in operating condition. If DC power is removed,

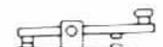
**(6) POWER**

This receptacle accommodates the power cord. A fuse rated at 5 amps is located in the power cord.

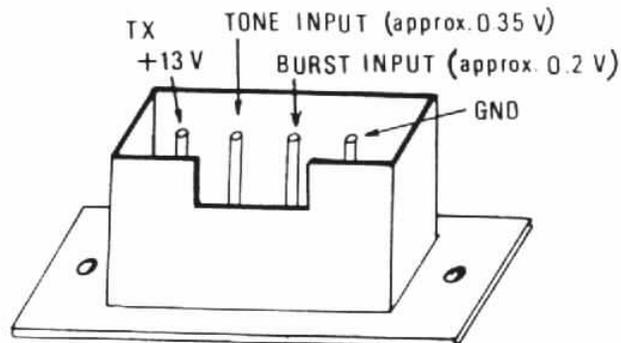
WHEN REPLACING FUSES, BE CERTAIN TO USE A FUSE OF 5 AMP RATING. OUR WARRANTY DOES NOT COVER DAMAGE CAUSED BY USE OF AN IMPROPER FUSE.



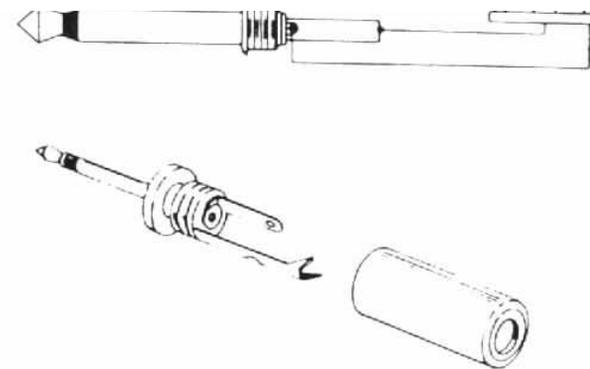
**EXTERNAL SPEAKER CONNECTIONS**



though, the memorized frequency will be lost.



TONE IN CONNECTOR

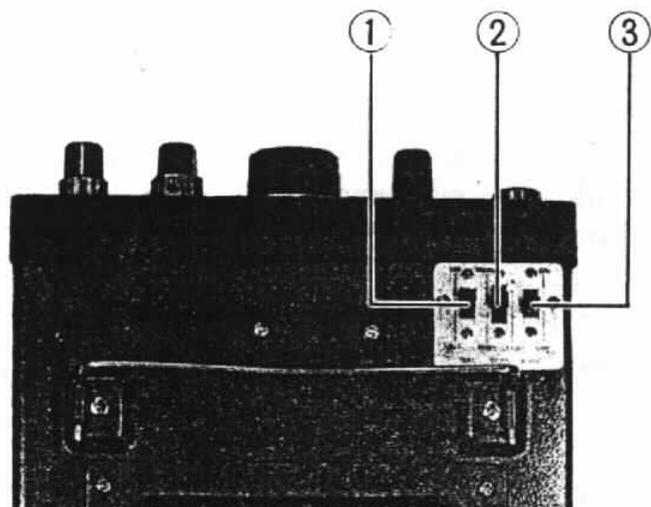


KEY CONNECTIONS

1-6

## UNDERSIDE CABINET SWITCHES

GENERAL

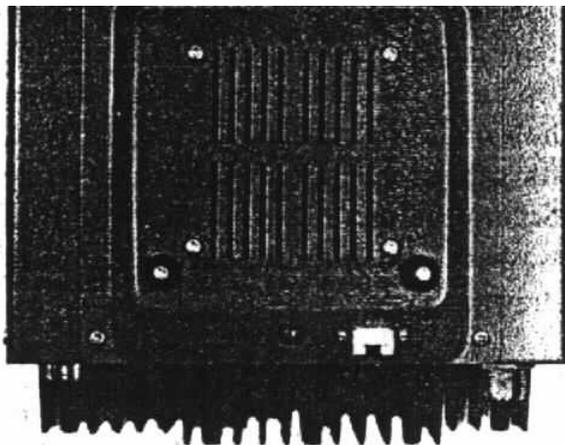


### (1) SAT (Satellite)

This switch allows the operating frequency to be changed while transmitting. This feature is useful especially for satellite operation, for it allows the operator to zero on the proper frequency within the satellite passband. Neither VFO A/B TXA nor the CLARIFIER function works when the SAT switch is placed in the ON position.

### (2) SCAN

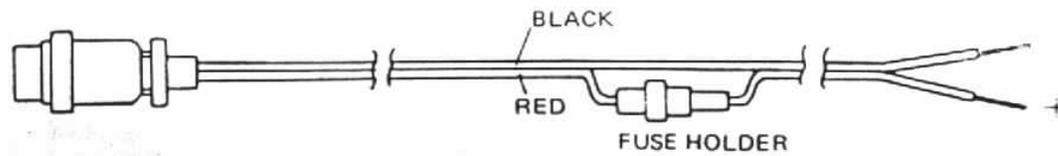
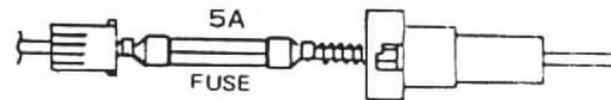
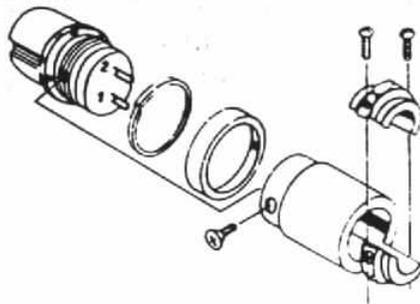
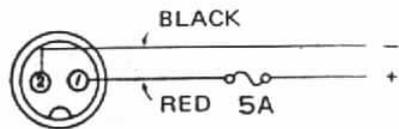
This switch will select scanning stop on a busy or clear channel in the FM mode. Manual operation



clear channel in the VHF mode. A tone scanning stop is also provided on all modes.

### (3) RPT (Repeater)

The switch will shift the transmitting frequency +600 kHz or -600 kHz for repeater operation.



**POWER CORD CONNECTIONS**

## GENERAL

## INSTALLATION

### ANTENNA CONSIDERATIONS

The FT-480R is designed for operation using an antenna presenting a 50 ohm resistive load. The automatic final transistor protection circuitry will reduce the power output to protect the transistors when a high antenna SWR is encountered. The SWR on the antenna should, if possible, be kept below 1.5 : 1 at all times to secure full output from the transceiver.

In most cases, coverage is a function of antenna height. The antenna for base station operation should be located as high and in the clear as possible. Vertical polarization is standard for FM communications in most areas, so be sure that your antenna is oriented appropriately. Popular antennas for base station use include the 5/8 wavelength vertical or one of the many stacked dipole arrays.

For accessing repeaters a long distance away, a

### MOBILE INSTALLATION

For mobile service, the FT-480R should be installed where the digital display, controls, and microphone are easily accessible for operation. The transceiver may be installed in any position without loss of performance. A suitable location would be atop the transmission tunnel. A universal bracket is supplied with your transceiver for mobile installation. Refer to Fig. 1 for mounting details.

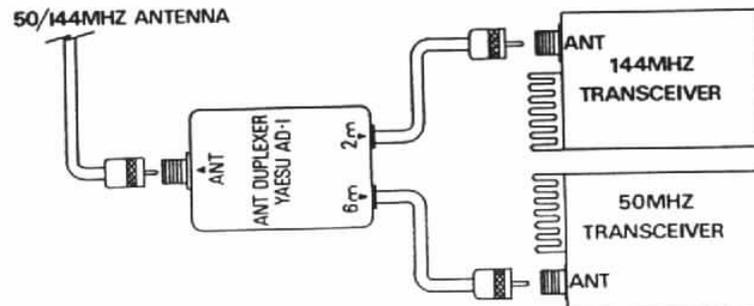
1. Use the universal mounting bracket as a template for positioning the mounting holes. Use a 3/16" diameter bit for drilling these holes, allowing clearance for the transceiver, its cables and microphone, and its controls. Secure the mounting bracket with the screws, washers, and nuts supplied, as shown in the drawing.

For accessing repeaters using a Yagi or other high gain directional array may be required.

For mobile applications, the most popular antennas are the 1/4 wavelength vertical and the 5/8 wavelength vertical, which shows approximately 3 dB gain over the 1/4 wavelength vertical.

Do not economize on coaxial cable, as much power can be wasted in lossy transmission line. For mobile use, the RG-58A/U type of coax may be used. To minimize loss, use the shortest length that is possible. For base stations, use type RG8A/U coaxial cable. For very long runs, type RG17A/U, aluminum-jacketed "foamflex" coax, or air dielectric "heliac" cable may be used.

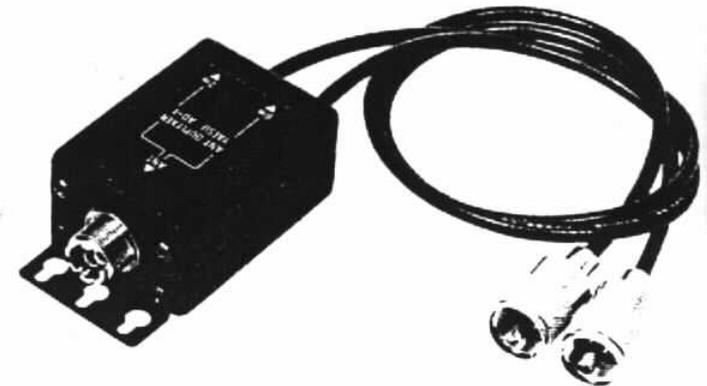
The optional antenna duplexer AD-1 allows the operation on both 50 and 144 MHz using a single antenna (RSL-50 or RSL145). See your Yaesu dealer.



AD-1 ANTENNA DUPLEXER

2. Ease the transceiver into the guide rail, and slide it into the desired position. Tighten the knobs on the outside of the universal bracket to secure the transceiver.
3. The microphone hanger may be installed wherever convenient for access to the microphone.

Power connections should be made directly to the automobile battery. Routing through the cigarette lighter may cause the lighter fuse to blow if the fuse is not of sufficient rating. As well, connection directly to the battery allows the memory circuits to remain activated when the ignition is turned off, using the BACKUP switch.



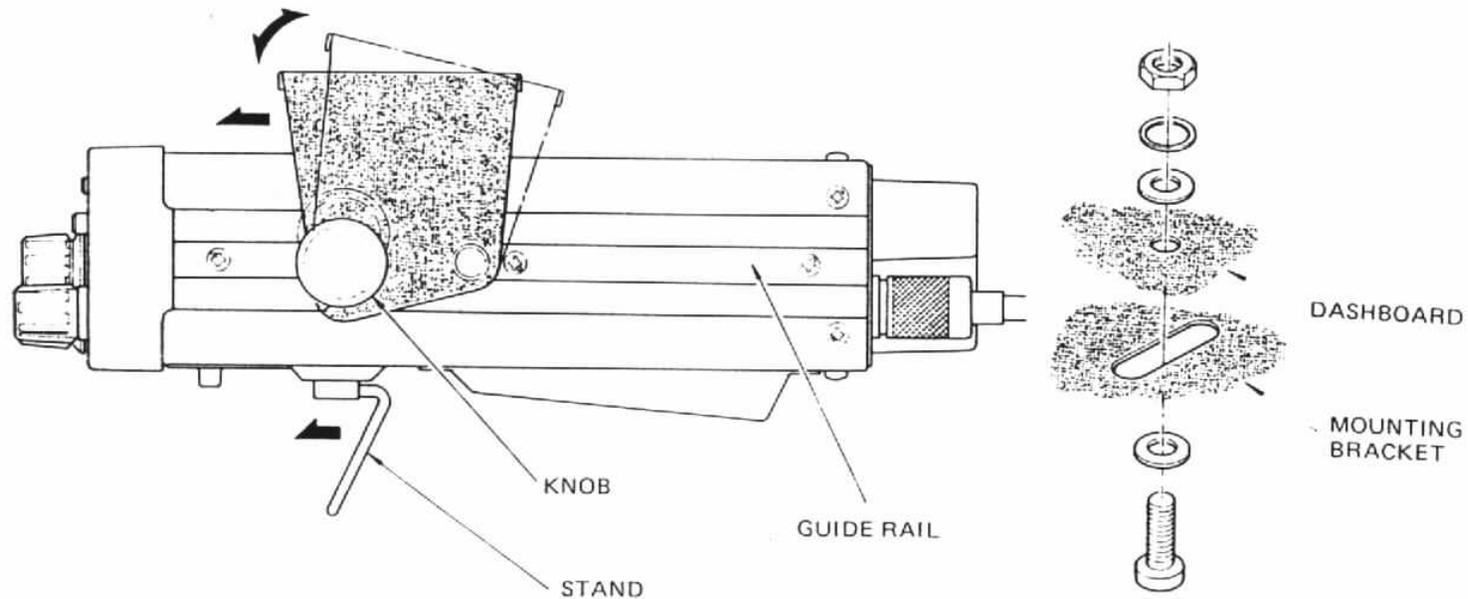


Figure 1

Connect the RED lead of the power cord to the POSITIVE (+) battery terminal, and connect the BLACK lead to the NEGATIVE (-) terminal. If it is necessary to extend the power cable, use #16 AWG insulated copper wire, and use the minimum length practicable to reduce voltage drop.

#### WARNING

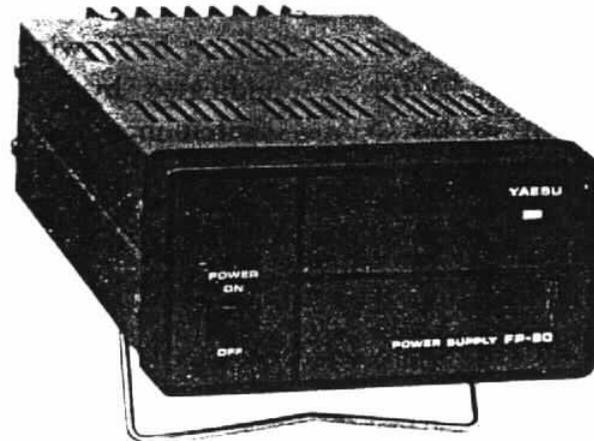
NEVER APPLY AC POWER TO THE REAR PANEL POWER JACK OF THE TRANS-

ceiver. Connect the power cable to the POWER receptacle on the rear apron, connect the coaxial cable from the antenna to the rear apron ANT receptacle, and connect the microphone to the jack appropriate for the microphone in use. An external speaker may be connected to the rear apron SP jack, if desired. Use the speaker plug supplied with the transceiver. Insertion of a plug into this jack automatically cuts off the internal speaker.

CEIVER. NEVER CONNECT A DC POWER SOURCE OF GREATER THAN 15 VOLTS TO THE REAR PANEL POWER JACK. ALWAYS REPLACE FUSES WITH A FUSE OF THE PROPER RATING. FAILURE TO OBSERVE THESE SIMPLE PRECAUTIONS WILL VOID ALL WARRANTIES ON THIS EQUIPMENT.

### BASE STATION INSTALLATION

A base station mounting stand is supplied with your transceiver, to provide easier viewing of the display and controls. A power supply capable of supplying 5 amps at 13.8 VDC is required for operation from AC mains. The FP-80 AC power supply option provides the required 13.8 VDC for the FT-480R transceiver. See your Yaesu dealer.



FP-80 POWER SUPPLY

## OPERATION

Operation instructions for the FT-480R are adequately described in the Instruction Manual; they will not be repeated here. A summary of the basic operations is found below.

### INITIAL CHECK

Before connecting the transceiver to the power supply, be certain that a fuse of the proper rating is in use, and that a 50 ohm antenna has been connected to the antenna jack.

### FREQUENCY SELECTION USING MAIN DIAL

When the transceiver is initially turned on, the digital display will read the preset frequency of 147.000.0 MHz. Press the DIL button to return control to the main dial after using the MEMORY, SCANNING, or PRIORITY modes.

### RECEIVER OPERATION

Preset the controls and switches as follows:

VOL ..... ON  
 MODE ..... Desired mode  
 SQL ..... Fully counterclockwise  
 STEP ..... Desired synthesizer step  
 VFO A/B TY A ..... VFO "A" position  
 SCAN ..... MAN position  
 RPT ..... SIMP position

When transmitting, the BUSY/SQL lamp should initially be turned off.

## FM MODE

Tune in an FM signal for a maximum and steady S-meter reading. Set the STEP switch to the M (20 kHz) position. When you change the operating mode from SSB/CW to FM, you may clear the display and operating frequency to the next lowest 20 kHz step by pressing the F STEP button. When the channel is clear, rotate the SQL control to the point where the background noise is just silenced. The BUSY/MOD lamp will light up when the squelch circuit is opened.

### TRANSMITTER

Before you transmit, be certain that an antenna or dummy load is connected to the antenna jack.

### SSB MODE

Set the MODE switch to SSB and close the microphone PTT switch. The ON AIR lamp will light up. Relative output power is indicated by the S.PO LEDs.

### CW MODE

Plug a key into the KEY jack on the rear panel. In the key-down condition, 8 to 9 LEDs will light up, and a 800 Hz side tone will be heard from the speaker. The HI/LOW switch may be used to select the desired power output.

All other switches should initially be turned off.

### SSB MODE

Set the step switch to the M or F position for scanning the band. When you get close to the desired station, set the STEP switch to the S (10 Hz) position in order to tune in the signal clearly.

### CW MODE

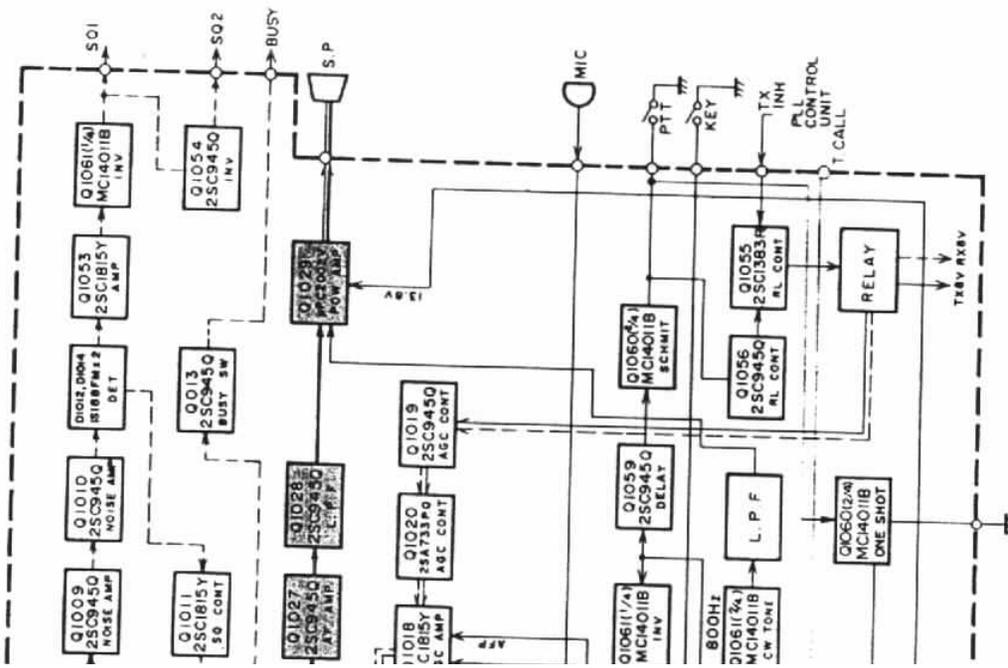
With the clarifier off, tune in a CW signal. When the incoming signal is tuned to a beat note of 800 Hz, your transmit frequency will coincide with that of the other station.

### FM MODE

Set the MODE switch to FM and close the microphone PTT switch. Your relative output power is indicated by the S.PO LEDs, and the HI/LOW switch may be used to select the desired power output.

## SECTION 2 — TECHNICAL NOTES

<b>BLOCK DIAGRAM</b>	
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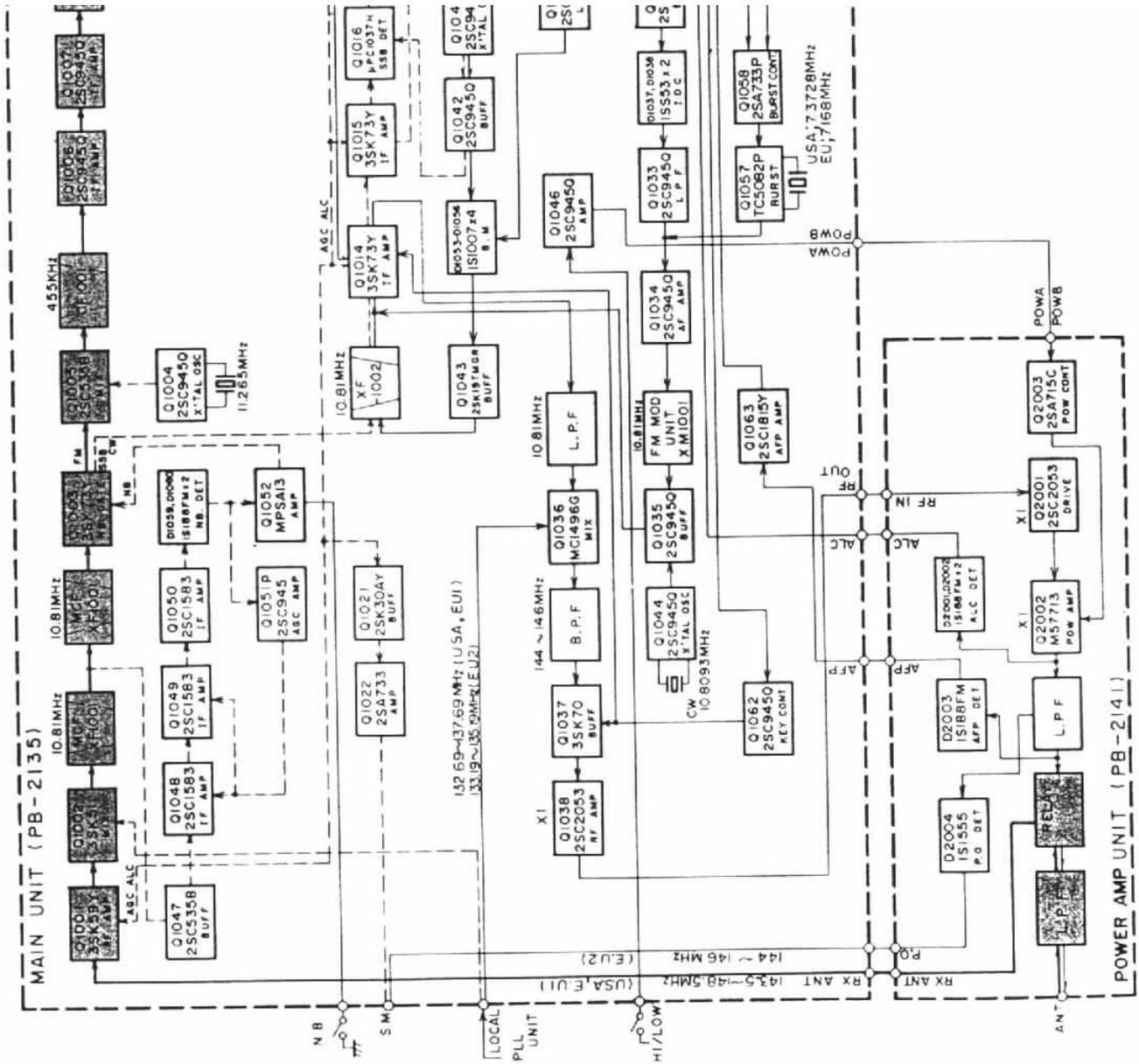
TECHNICAL NOTES

RX  
TX



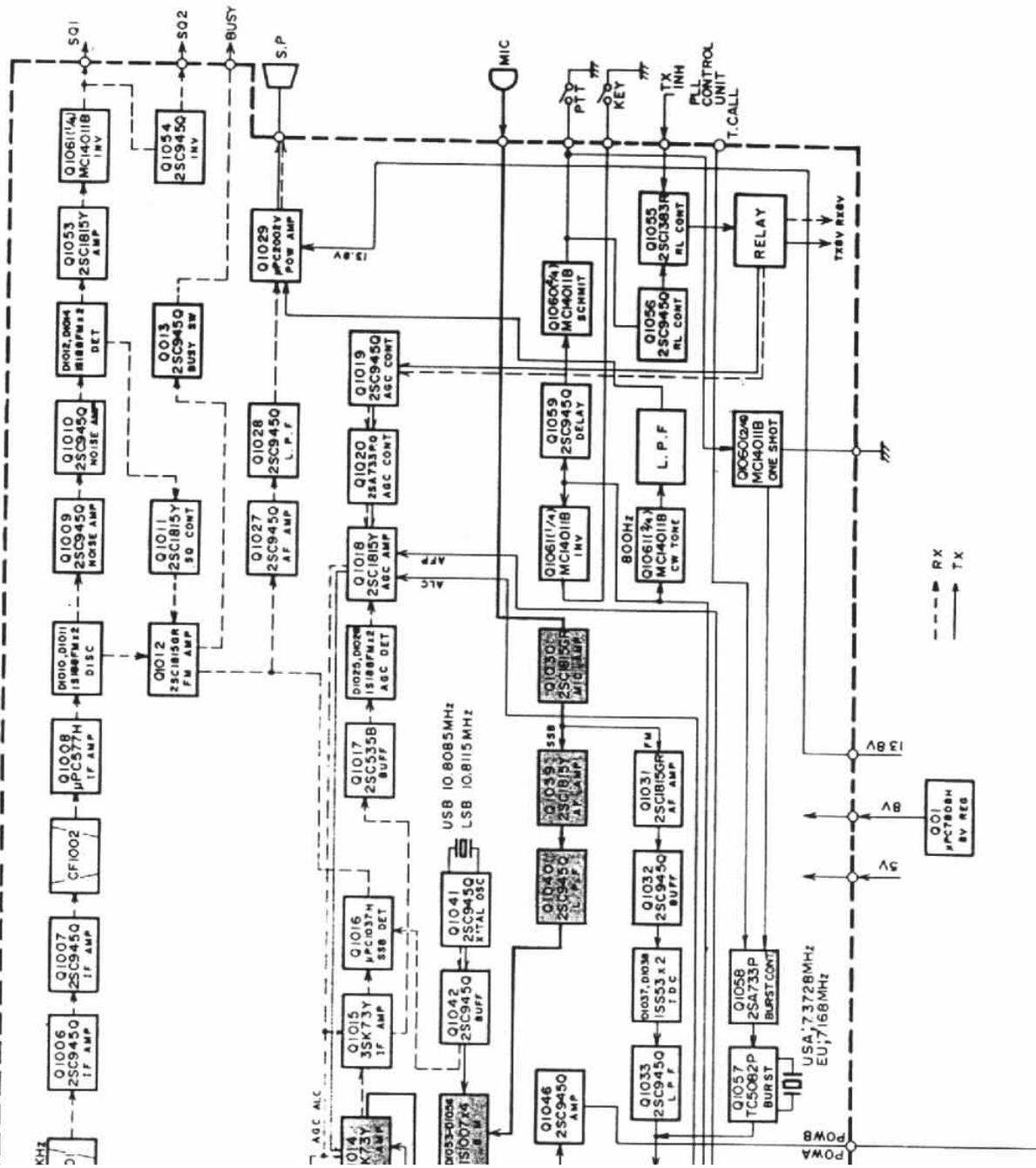


# FM RX BLOCK DIAG



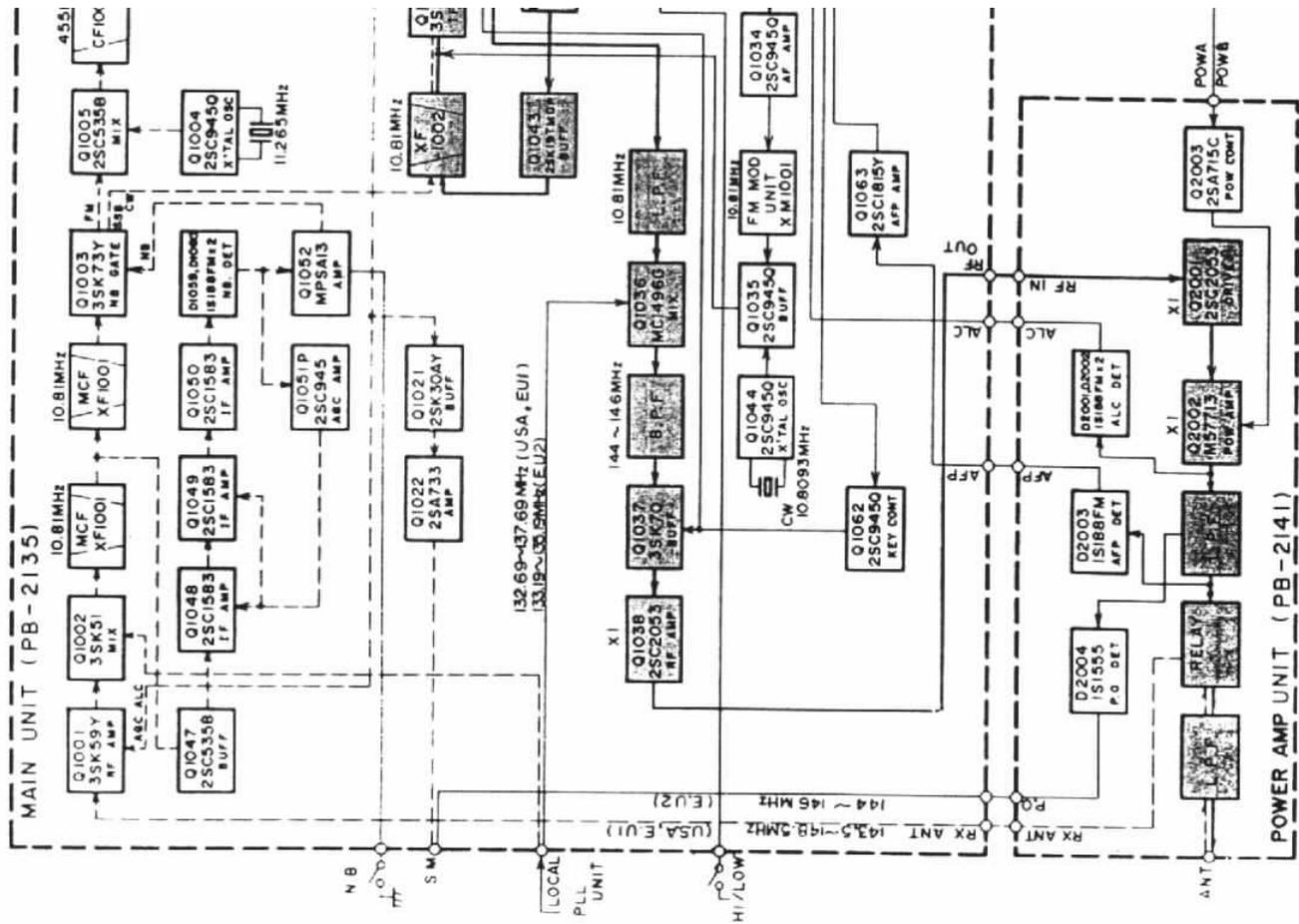
TECHNICAL NOTES

TX BLOCK DIAGRAM



--- RX  
 --- TX

# SSB

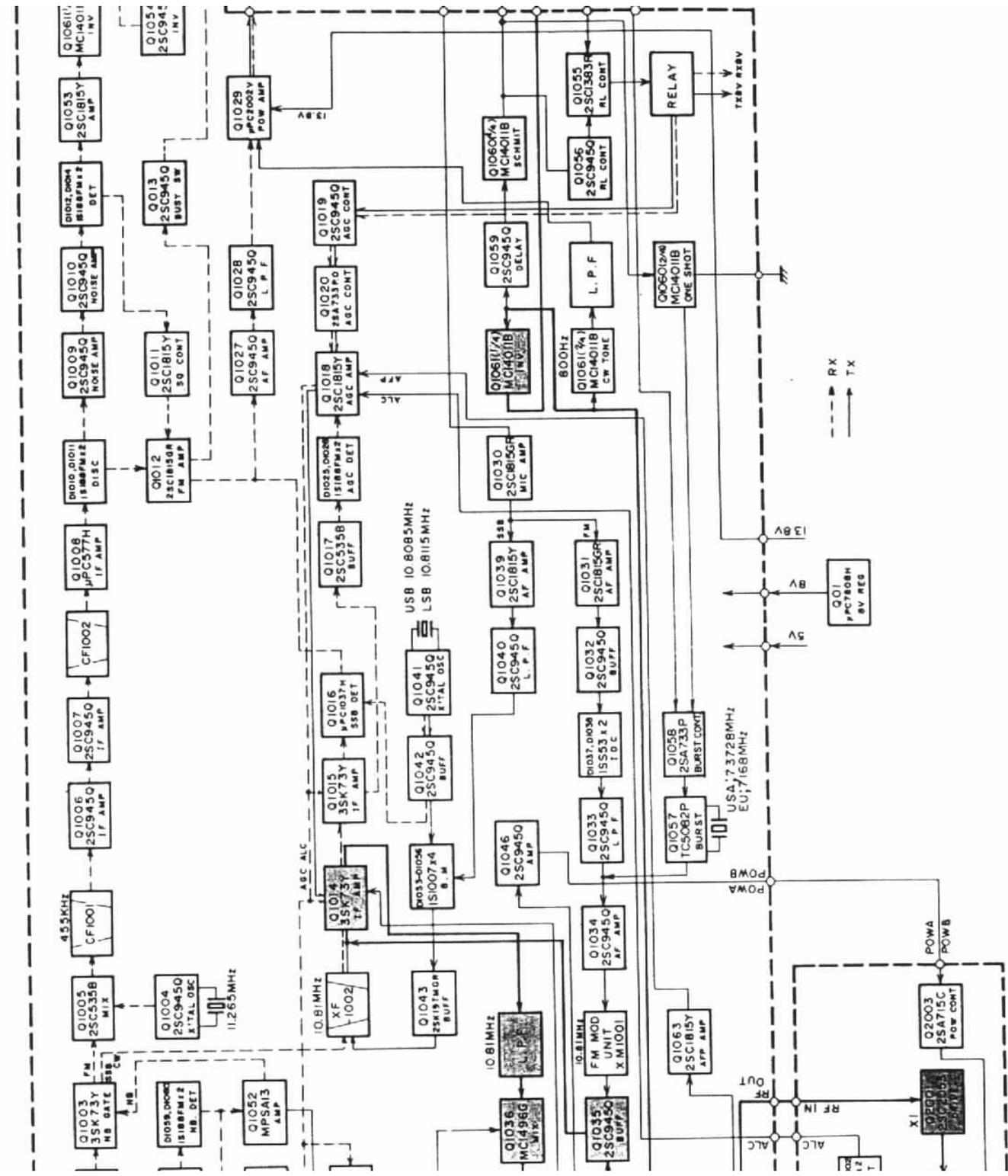


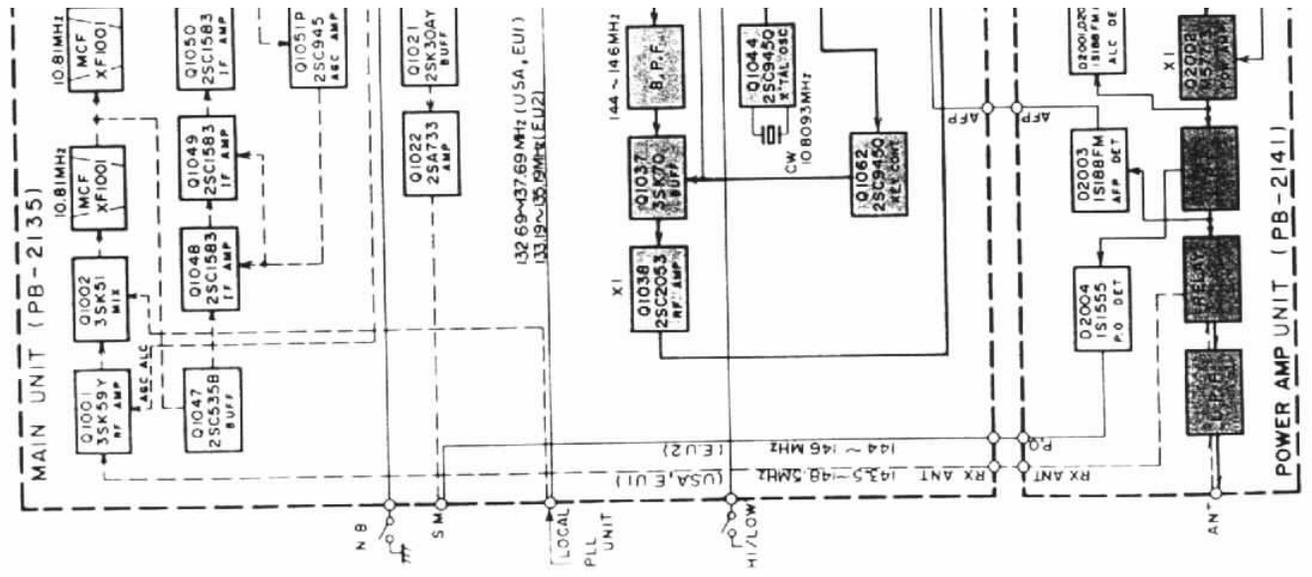
2-3

## TECHNICAL NOTES

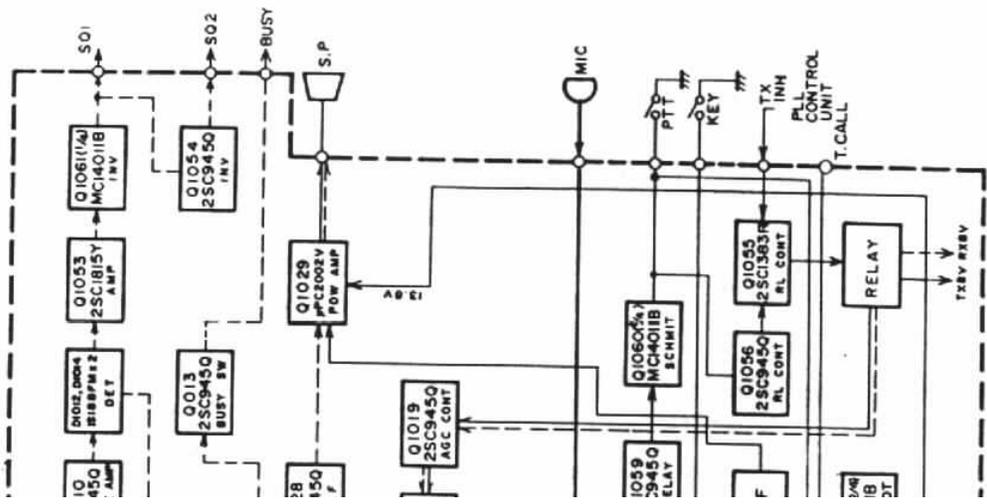


# CW TX BLOCK DIAGRAM



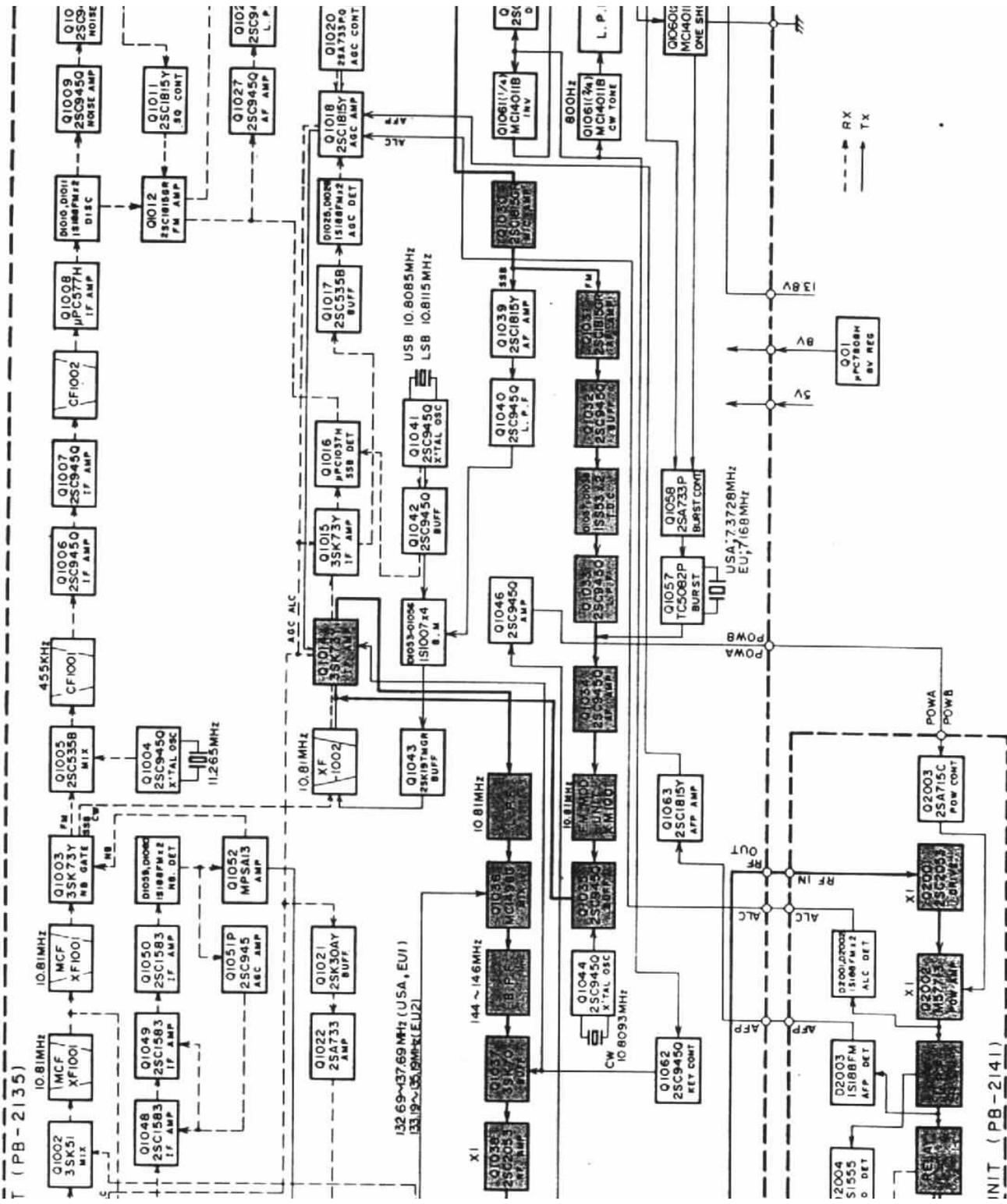


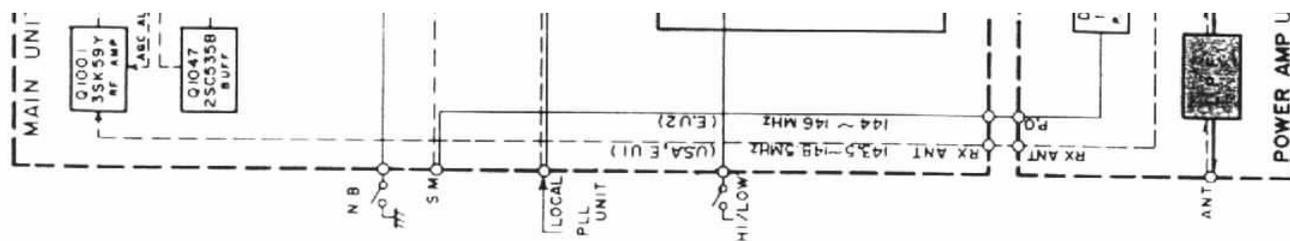
2-4



TECHNICAL NOTES

# FM TX BLOCK DIAGRAM





2-5

## TECHNICAL NOTES

### CIRCUIT DESCRIPTION

The block diagram and circuit description to follow will provide you with a better understanding of this transceiver. Please refer to the block and schematic diagram for specific circuit details.

#### RECEIVER

The RF signal from the antenna jack is applied to the MAIN UNIT through a low pass filter and the antenna relay, RL<sub>2001</sub>. The signal is amplified by Q<sub>1001</sub> (3SK59Y), a dual gate MOS FET with excellent rejection of cross modulation and intermodulation. The amplified signal is fed to the 1st mixer, Q<sub>1002</sub> (3SK51-03), where the RF signal is mixed with a local signal delivered from the PLL UNIT, resulting in a 10.81 MHz first IF signal.

The first IF signal is passed through a monolithic

The audio signals from each demodulator are passed to the active lowpass filter, which consists of Q<sub>1027</sub> and Q<sub>1028</sub> (2SC945Q) to eliminate the unwanted noise portion of the signal. The audio signal is then fed, through the AF gain control, to the audio output amplifier, Q<sub>1029</sub> (μPC2002V), providing about 2 watts of audio output to the speaker.

#### S-METER CIRCUIT

A portion of the amplified IF signal is fed to Q<sub>1017</sub> (2SC535B), a buffer amplifier, through C<sub>1080</sub>. The amplified signal is then applied to the AGC detector, D<sub>1025</sub>/D<sub>1026</sub>. The rectified signal is amplified by DC amplifier Q<sub>1018</sub> (2SC1815Y) for AGC control. This AGC voltage is delivered to the front panel S.P.O indicator to illuminate LED

crystal filter,  $\text{XF}_{1001}$  (108M30B), which has  $\pm 15$  kHz bandwidth, and amplified by  $\text{Q}_{1003}$  (3SK73Y), which acts as a switch driven by the NB (noise blanker) circuit. The amplified signal from  $\text{Q}_{1003}$  is fed to IF amplifiers for each mode.

FM mode signal is fed to 2nd mixer  $\text{Q}_{1005}$  (2SC535B), where the signal is mixed with an 11.265 MHz local signal, resulting in a 455 kHz 2nd IF signal.

The 2nd IF signal is passed through a ceramic filter,  $\text{CF}_{1001}$ , which has a  $\pm 4.5$  kHz bandwidth, and then fed to the FM mode IF amplifier.

The filtered signal is amplified by  $\text{Q}_{1006}$  and  $\text{Q}_{1007}$  (2SC945Q) and passed through  $\text{CF}_{1002}$ , which has a  $\pm 7.5$  kHz bandwidth. The filtered FM signal is amplified by  $\text{Q}_{1008}$  ( $\mu\text{PC577H}$ ) and demodulated by  $\text{CD}_{1001}$  and  $\text{D}_{1010}/\text{D}_{1011}$  (1S188FM). The demodulated FM signal is amplified by  $\text{Q}_{1012}$  (2SC1815GR) and then fed to the AF amplifier.

SSB and CW mode signals from the  $\text{Q}_{1003}$  are passed through a crystal filter,  $\text{XF}_{1002}$ , which has a very high shape factor, to improve adjacent frequency selectivity. The filtered SSB signal is amplified by  $\text{Q}_{1014}$  and  $\text{Q}_{1015}$  (3SK73Y), and then fed to the balanced demodulator,  $\text{Q}_{1016}$  ( $\mu\text{PC1037H}$ ), where a carrier signal is applied from the carrier oscillator  $\text{Q}_{1041}/\text{Q}_{1042}$  (2SC945Q); the detected audio output is then fed to the AF amplifier.

according to the input signal strength.

## SQUELCH CIRCUIT

A portion of the demodulated FM signal from the ceramic discriminator ( $\text{CD}_{1001}$ ,  $\text{D}_{1010}$ ,  $\text{D}_{1011}$ ) is fed to noise amplifiers  $\text{Q}_{1009}$  and  $\text{Q}_{1010}$  (2SC945Q) through  $\text{VR}_{1002}$  and the SQ Control ( $\text{VR}_{1b}$ ), and then rectified by  $\text{D}_{1013}$  and  $\text{D}_{1014}$ , a voltage doubling circuit. The rectified signal is fed to the base of  $\text{Q}_{1011}$  (2SC1815Y), the squelch control circuit.

When no carrier is present, the rectified DC voltage is applied to the base of  $\text{Q}_{1011}$ , to turn  $\text{Q}_{1012}$  (2SC1815GR) on. With conduction of  $\text{Q}_{1011}$ , the base of  $\text{Q}_{1012}$  is grounded, squelching the audio amplifier.

When a carrier is present, the rectified DC voltage is reduced; and the audio amplifier  $\text{Q}_{1012}$  then recovers to normal operation. The BUSY lamp switch,  $\text{Q}_{1013}$  (2SC945Q), is also activated by the rectified voltage from the demodulator to illuminate the BUSY lamp when a carrier is present.

## TECHNICAL NOTES

## NB (Noise Blanker) CIRCUIT

A portion of the IF signal from monolithic filter XF<sub>1001</sub> is amplified by Q<sub>1047</sub> (2SC535B), Q<sub>1048</sub>, Q<sub>1049</sub>, and Q<sub>1050</sub> (2SC1583). The output signal is rectified by D<sub>1059</sub> and D<sub>1060</sub>, producing a DC voltage. This DC voltage is amplified by Q<sub>1052</sub> (MPSA13) and fed to gate 2 of Q<sub>1003</sub>, the noise blanker gate. A portion of the DC voltage is amplified by Q<sub>1051</sub>, and then fed to Q<sub>1048</sub>, Q<sub>1049</sub> (2SC1583) as a noise blanker AGC voltage. When impulse-type noise is received, the induced DC voltage reduces the gain of Q<sub>1003</sub>, and blocks the signal path momentarily. The noise AGC control voltage is not, however, induced by such impulse-type noise, because the time constant of C<sub>1243</sub>/R<sub>1273</sub> is long. Normal signals, though, induce the noise blanker AGC voltage, reducing the gain of the noise amplifier, allowing normal signal flow at Q<sub>1003</sub>.

## TRANSMITTER

The discussion of the signal flow on transmit will be on a mode by mode basis.

## FM

The output audio signal at Q<sub>1030</sub> is amplified by Q<sub>1031</sub> (2SC1815GR) and Q<sub>1032</sub> (2SC945Q) and fed to the IDC circuit, consisting of D<sub>1037</sub> and D<sub>1038</sub>, which clips both positive and negative peaks to control the maximum possible deviation; the clipped signal is then passed through an active lowpass filter to eliminate harmonics above the speech range caused by clipping. The output signal is amplified by Q<sub>1034</sub> (2SC945Q) to a sufficient audio level and applied to the FM modulation module XM<sub>1001</sub> for modulation, and the maximum deviation is adjusted by VR<sub>1006</sub> prior to delivery to Q<sub>1014</sub>. The signal path is then identical to that of the SSB signal.

## CW

For CW, the 10.8107 MHz carrier signal is generated by Q<sub>1044</sub> (2SC945Q), amplified by Q<sub>1035</sub> (2SC945Q), and fed to IF amplifier Q<sub>1014</sub>.

The key line is connected to switching transistor Q<sub>1062</sub> (2SC945Q) through inverter Q<sub>1061</sub> (MC14011B), which controls the gate voltages at

## SSB

The audio input signal from the microphone is amplified by  $Q_{1030}$  (2SC1815GR) and  $Q_{1039}$  (2SC1815Y). The audio level is adjusted to the proper level by  $VR_{1007}$ , and is applied through an active lowpass filter,  $Q_{1040}$  (2SC945Q), to the ring modulator,  $D_{1053} - D_{1056}$ . Here the audio signal modulates the 10.81 MHz carrier signal delivered from the carrier oscillator  $Q_{1041}$  (2SC945Q) and buffer  $Q_{1042}$  (2SC945Q), resulting in a 10.81 MHz double-sideband signal. The signal is amplified by  $Q_{1043}$  (2SK19TM-GR) and fed to  $XF_{1002}$ , a crystal filter, where the unwanted sideband is sliced out. The SSB signal is then fed to a mixer  $Q_{1036}$  (MC1496G) and mixed with a local signal from the PLL Unit, resulting in a 143.5–148.5 MHz SSB signal.

The SSB signal is passed through  $T_{1010} - T_{1014}$ , which are tuned exactly to the operating frequency by varactor diodes, thus minimizing spurious radiation. The signal is then amplified by  $Q_{1037}$  (3SK70), and  $Q_{1038}$  (2SC2053) to the proper level for driving the power amplifier circuit.

..., which controls the gate voltages at  $Q_{1014}$  (3SK73) and  $Q_{1037}$  (3SK59Y), and thus turning the RF signal on and off.

The signal path is then identical to that of the CW signal.

An RC circuit connected to the base of  $Q_{1062}$  produces an ideal keying waveshape for click-free CW operation. The key line is also connected to side tone oscillator  $Q_{1061}$  (MC14011B) for monitoring of the code signal during CW operation. In order to operate on semi-break-in, the Schmitt trigger and delay circuit at  $Q_{1060}$  (MC14011B) activates the RX-TX changeover relay.

## POWER AMPLIFIER CIRCUIT

The RF signal from the Main Unit is amplified by  $Q_{2001}$  (2SC2053) and  $Q_{2002}$  (M57713) in the Power Amplifier Unit, delivering approximately 10 watts of RF output to the antenna through a lowpass filter.

## POWER CONTROL CIRCUIT

When the HI/LOW switch is set to the LOW position, the base of  $Q_{1046}$  is grounded through  $VR_{1012}$ , and the collector current of  $Q_{1046}$  is decreased. Because the output power of  $Q_{2001}$  is controlled by  $Q_{2003}$ , the drive level to  $Q_{2002}$  is decreased, thus reducing the RF output power to approximately 1 watt.

## TONE BURST CIRCUIT

When the T.CALL switch is pressed, the base of  $Q_{1058}$  (2SA733P) is grounded, and DC voltage is applied to tone burst oscillator  $Q_{1057}$  (TC5082P) to generate a 1750 Hz or 1800 Hz tone signal. The tone is superimposed on the transmit signal as long as the switch is held.

## ALC (Automatic Level Control) CIRCUIT

A portion of the output power from  $Q_{2002}$  is applied through  $C_{2020}$  to rectifiers  $D_{2001}$  and  $D_{2002}$  producing a DC voltage. The DC voltage is amplified by DC amplifier  $Q_{1018}$  (2SC1815Y) and fed to gate 2 of  $Q_{1014}$  to control its gain, thus preventing overdrive. The ALC level is adjusted by  $VR_{1003}$  for proper drive to  $Q_{2002}$ .

## AFP (Automatic Final Protection) CIRCUIT

phase comparator. The PLL produces local signals for the receiver and transmitter stages, using a synthesis scheme which produces 10 Hz steps.

## PLL Circuit Configuration

The local signal 132.6900 MHz – 137.6899 MHz is generated by  $Q_{3021}$  (2SK19TM-GR)VCO-1 in the PLL Loop 1, amplified by buffers  $Q_{3022}$  (3SK51) and  $Q_{3030}$  (2SC535A), and passed through BPF circuit to eliminate spurious radiation. The signal is then coupled to the Main Unit.

A portion of the signal from the buffer  $Q_{3022}$  is amplified by  $Q_{2023}$  (3SK51) and applied to the mixer  $Q_{2024}$  (SN76514N), where the signal is mixed with a heterodyne signal of 129 MHz from PLL Loop 2, and its frequency is divided by programmable divider  $Q_{3026}$  (TC9122P). The digital phase comparator  $Q_{3027}$  (MB8718) compares the phase of signal from the programmable divider with that of 40 kHz reference frequency obtained from crystal oscillator  $Q_{3007}$  (TC5082P) (via a 1/4 divider), producing an error-correction DC voltage. The output DC voltage is passed through an active lowpass filter consisting of  $Q_{3028}$  (2SK19TM-Y) and  $Q_{3029}$  (2SC732TM-BL), and fed to the VCO-1 to control its oscillation frequency.

In PLL Loop 2, a 64 MHz signal generated by the VCXO  $Q_{3015}$  (2SC1674L) is amplified by doubler amplifier  $Q_{3016}$  and buffer  $Q_{3020}$  (2SC535A) and fed to the mixer in PLL Loop 1. A portion of the output from  $Q_{3016}$  is further amplified by  $Q_{3017}$

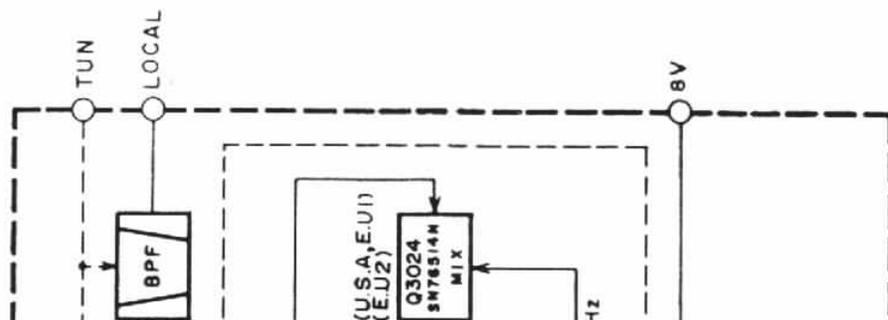
If the transmitter is activated without an antenna being connected, or if a high VSWR is present at the antenna jack, the reflected power is detected through T<sub>2001</sub> and D<sub>2003</sub>. The detected AFP voltage is applied through VR<sub>2002</sub> to Q<sub>1063</sub> (2SC1815Y) in the Main Unit. As the reflected power increases, the AFP voltage also increases, and consequently Q<sub>1063</sub> conducts. The voltage at gate 2 of Q<sub>1014</sub> (3SK73Y) then decreases, resulting in lower output power. When the transceiver is correctly matched to an antenna, full power output will be obtained.

PLL CIRCUIT

The PLL circuit is comprised of three PLL oscillators each consisting of a reference crystal oscillator, a programmable divider, a prescaler, and a

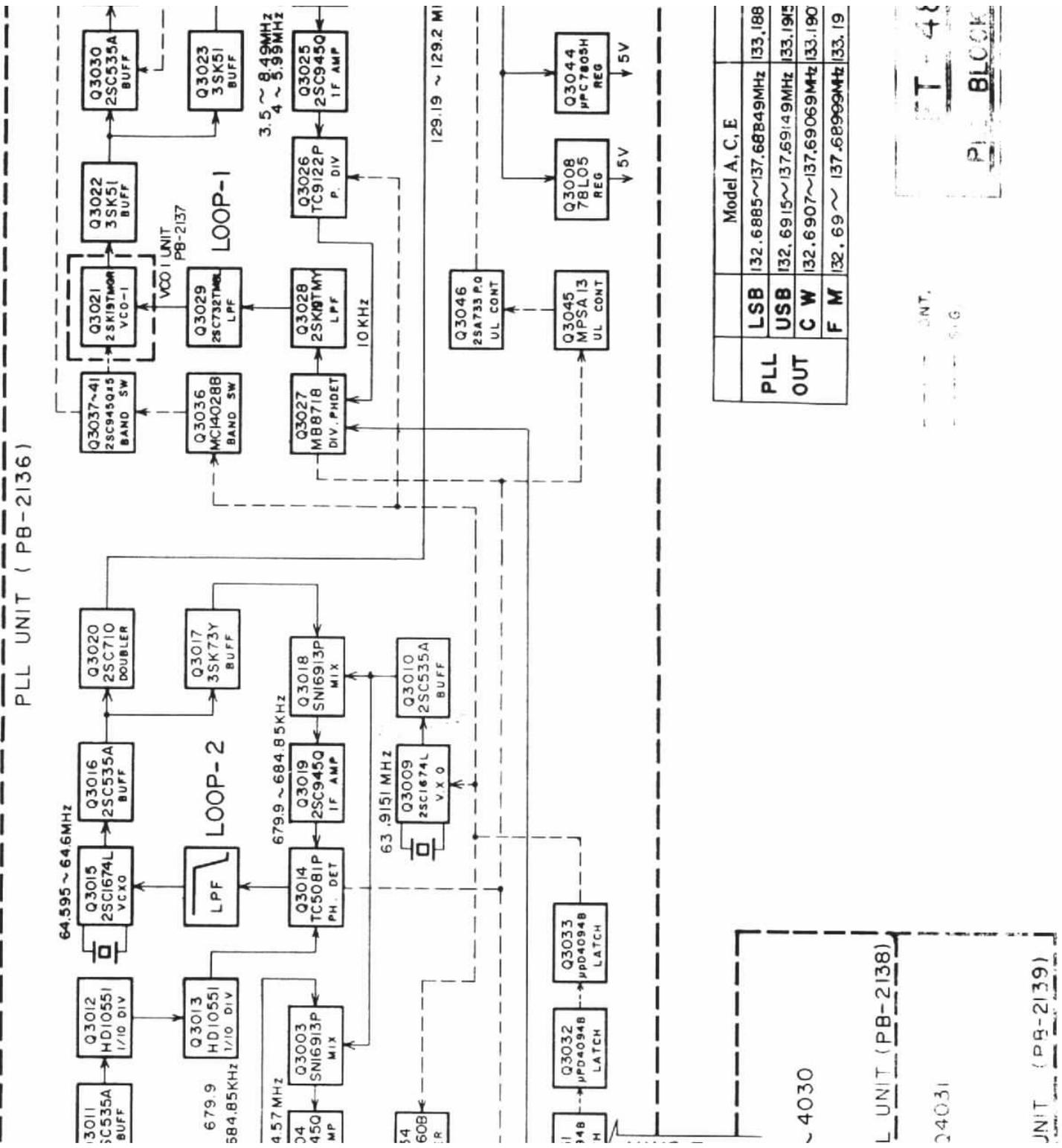
(3SK73Y) and applied to a mixer Q<sub>3018</sub> (SN16913P), where the signal is mixed with a 63 MHz signal generated by VCXO Q<sub>3009</sub> (2SC1674L), resulting in a 600 kHz signal. The 600 kHz signal is amplified by Q<sub>3019</sub> (2SC945Q) and fed to phase comparator Q<sub>3014</sub> (TC5081P), which compares the phase of the signal with that of the 600 kHz signal from PLL Loop 3, producing an error-correction DC voltage. The DC voltage is passed through a lowpass filter and fed to the VCXO to control its oscillation frequency.

TECHNICAL NOTES

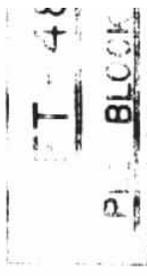


Model B, D	5
	~ 135.18849MHz
	~ 135.19149MHz
	7
	~ 135.19069MHz
	~ 135.18999MHz

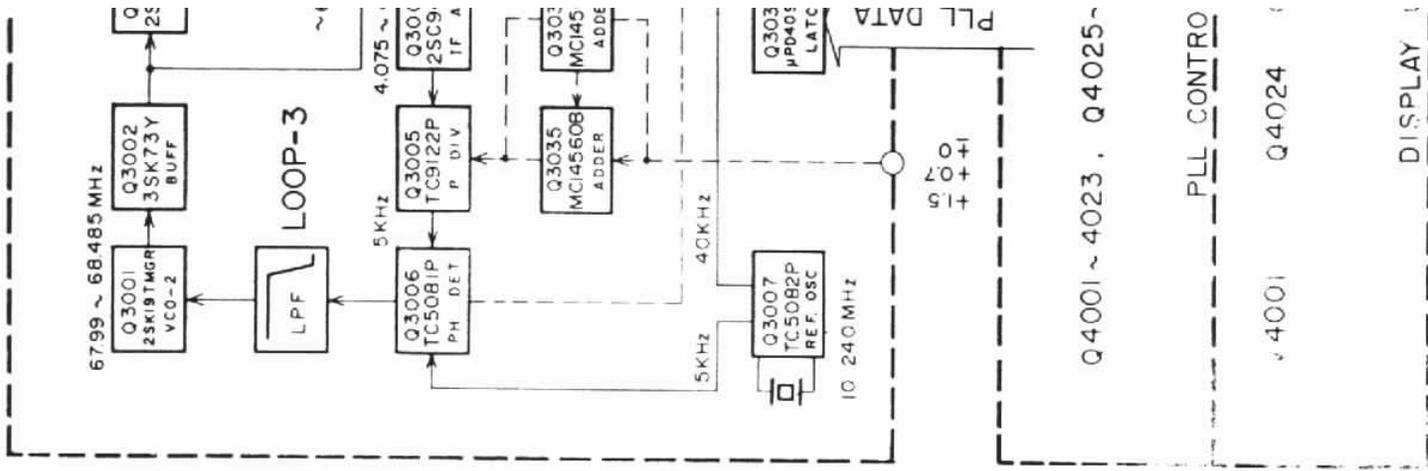
3OR  
DIAGRAM



Model A, C, E		
PLL LSB	132.6885 ~ 137.68849 MHz	133.188
OUT USB	132.6915 ~ 137.69149 MHz	133.195
C W	132.6907 ~ 137.69069 MHz	133.190
F M	132.69 ~ 137.68999 MHz	133.19



UNIT  
S-6



2-9

In PLL Loop 3, a 60 MHz signal is generated by VCO-2 Q<sub>3001</sub> (2SK19TM-GR) and applied through buffers Q<sub>3002</sub> (3SK73Y) and Q<sub>3011</sub> (2SC535A) to a prescaler, Q<sub>3012</sub>/Q<sub>3013</sub> (HD10551), which divides its frequency by 1/100, thus producing a 600 kHz signal. A portion of the output of Q<sub>3002</sub> is fed to mixer Q<sub>3003</sub> (SN16913P), where the signal is mixed with a 63 MHz signal which is generated by Q<sub>3009</sub> (2SC1674L), and applied through a programmable divider to phase comparator Q<sub>3006</sub> (TC5081P) which compares the phase of the signal with that of 5 kHz signal which is generated by Q<sub>3007</sub> (TC5082P), producing an error-correction DC voltage. The DC voltage is passed through a

lowpass filter and fed to the VCO-2  $Q_{3001}$  to control its oscillation frequency.

The frequency control signal from the PLL Control Unit is fed to Serial/Parallel converters  $Q_{3031}$  –  $Q_{3033}$  ( $\mu$ PC4094B) and converted into BCD code to control the dividing ratio of the programmable divider and the VCO and VCXO oscillating frequency in each PLL loop.

When any VCO is unlocked, an unlock signal from the phase comparater is fed to the unlock control circuit consisting of  $Q_{3045}$  (MPSA13) and  $Q_{3046}$  (2SA733), which controls buffer  $Q_{3030}$  (2SC535A) to mute the output from the PLL oscillator to prevent spurious radiation.

### PLL Control Circuit

In the PLL Control Unit, a 4 bit parallel processing CPU is used to control the operating frequency, UP/DOWN scanning, priority channel, or memory channel selections. The CPU has one input port, three I/O ports and four output ports. The CPU processes input data by means of the main dial or other control switches in accordance with the program stored in an ROM for control of the PLL frequency, indication of the operating frequency, or memory channels on digital display. The CPU is also furnished with a function to halt transmission when any VCO is unlocked, resulting in a fail-safe system.

## FP-80 POWER SUPPLY (OPTION)

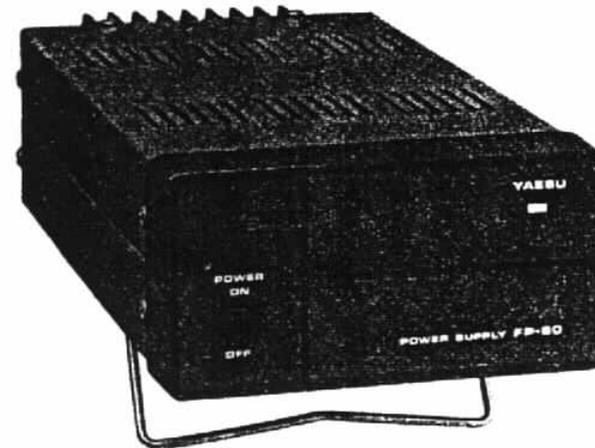
### TECHNICAL NOTES

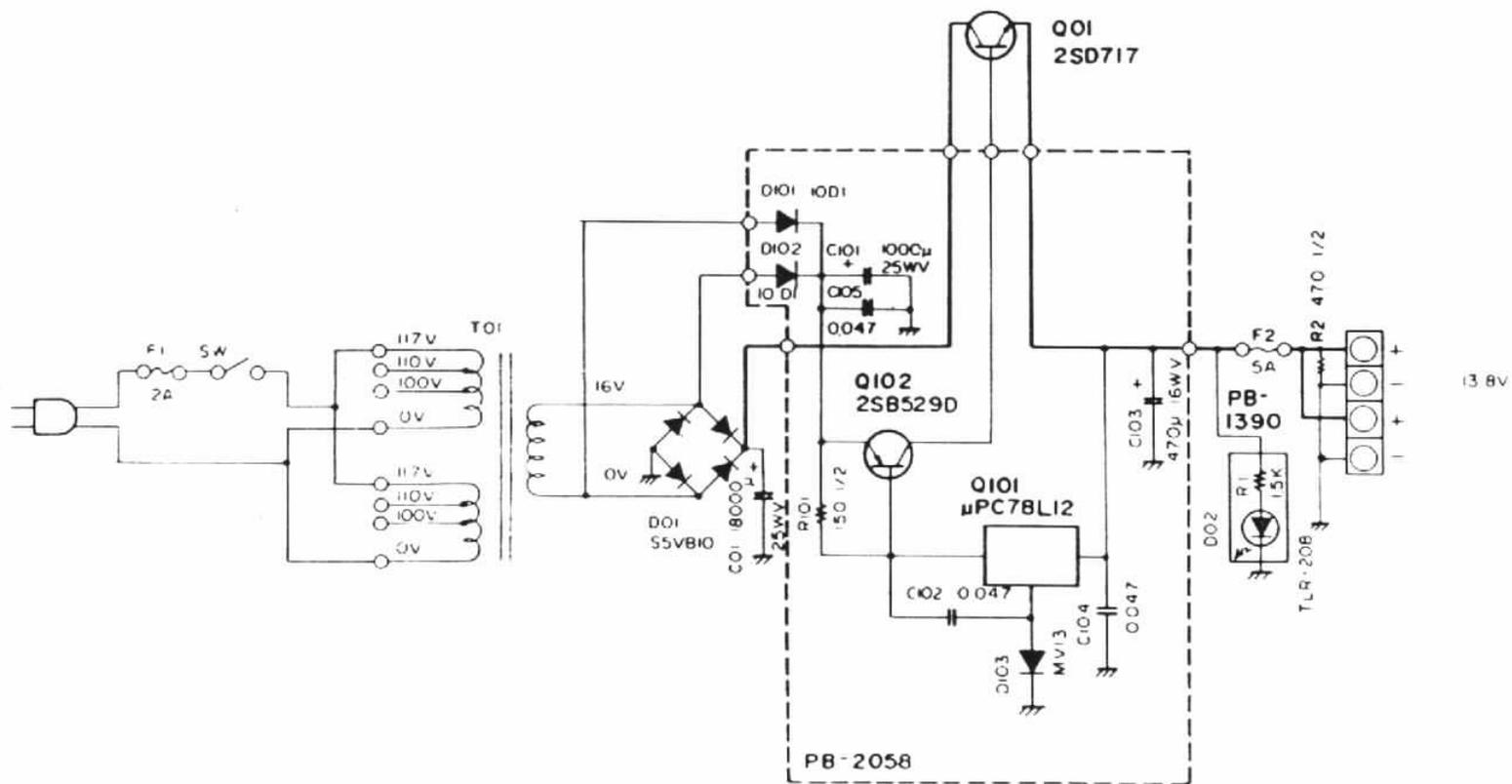
#### FP-80 Power Supply (Option)

The FP-80 power supply provides an output voltage of 13.8 volts DC at 4 amperes, with excellent regulation. For convenient base station installations, the FP-80 is capable of operating from 100 volts to 234 volts AC.

The 16 volt AC power delivered from the secondary winding of the power transformer is rectified by full-wave bridge  $D_{01}$  (S5VB10). The output from  $D_{01}$  is filtered and delivered to pass transistor  $Q_{01}$  (2SD717), supplying an output of 13.8 volts DC.

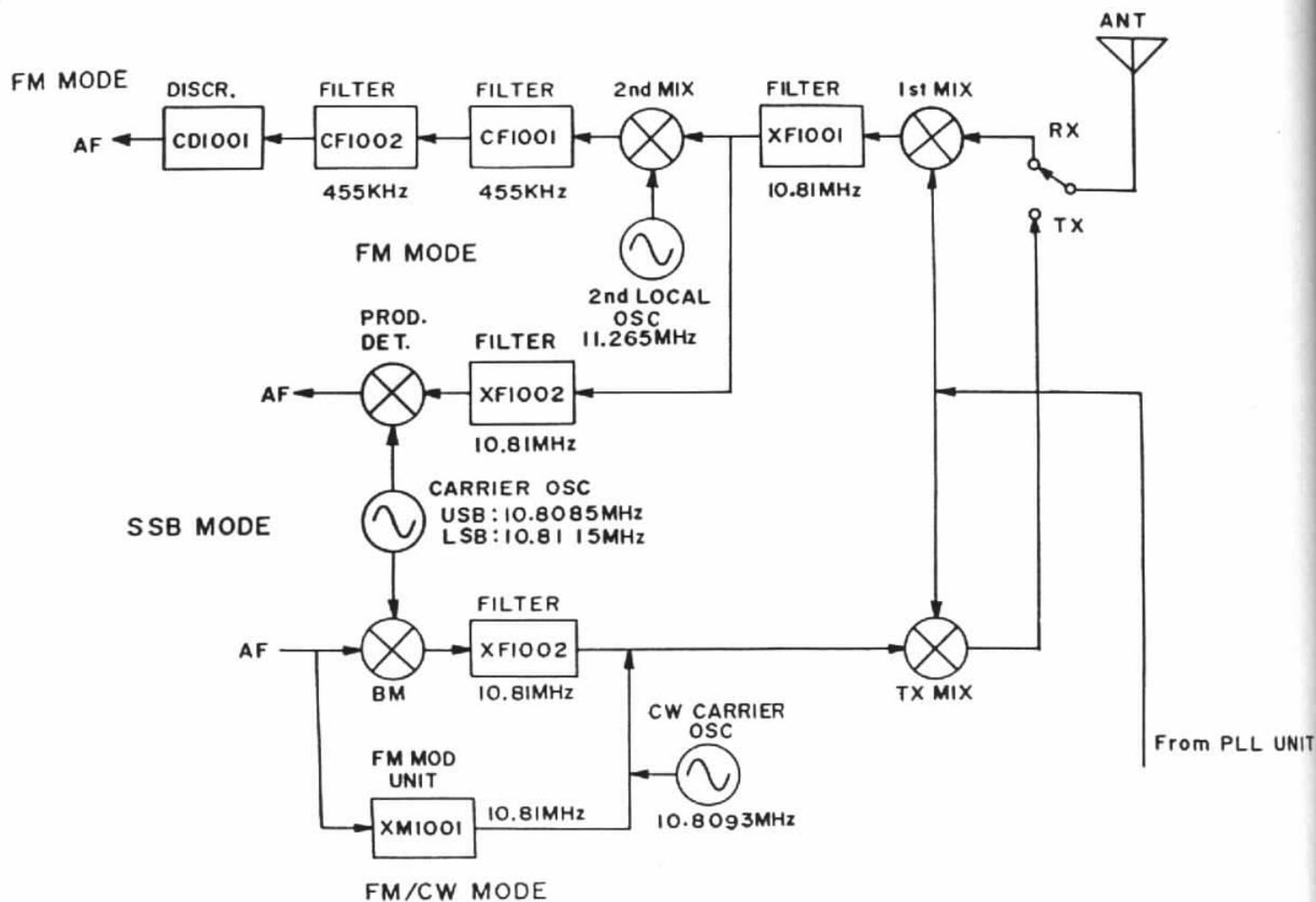
Voltage regulator  $Q_{101}$  ( $\mu$ PC78L12) delivers a reference voltage to  $Q_{01}$  through  $Q_{102}$ , providing a stabilized output.  $D_{101}$  and  $D_{102}$  provide the necessary DC voltage to the regulation circuit.





TECHNICAL NOTES

FREQUENCY RELATIONSHIPS



CRYSTAL DATA

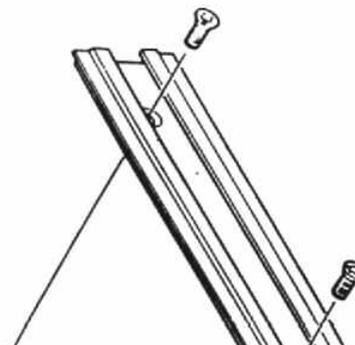
FUNCTION		HOLDER	RANGE (MHz)	MODE	LOAD C	SERIES R	DRIVE LEVEL
2nd Local	X <sub>1001</sub>	HC-18/U	11.265	Fundamental	30 pF	25 $\Omega$	2 mW
LSB Carrier	X <sub>1002</sub>	HC-18/U	10.8115	Fundamental	30 pF	25 $\Omega$	2 mW
USB Carrier	X <sub>1003</sub>	HC-18/U	10.8085	Fundamental	30 pF	20 $\Omega$	2 mW
CW Carrier	X <sub>1004</sub>	HC-18/U	10.8093	Fundamental	30 pF	20 $\Omega$	2 mW
1800 Hz Tone	X <sub>1005</sub>	HC-18/U	7.3728	Fundamental	30 pF	100 $\Omega$	2 mW
1750 Hz Tone	X <sub>1005</sub>	HC-18/U	7.168	Fundamental	30 pF	100 $\Omega$	2 mW
Reference	X <sub>3001</sub>	HC-18/U	10.240	Fundamental	30 pF	20 $\Omega$	3 mW
PLL Local	X <sub>3002</sub>	HC-18/U	63.915	3rd Overtone		25 $\Omega$	2 mW
PLL Local	X <sub>3003</sub>	HC-18/U	64.595	3rd Overtone		25 $\Omega$	2 mW
*CPU Clock	X <sub>4001</sub>	KMFC1008A	2.56	Fundamental	—	—	—

\* Ceramic resonator

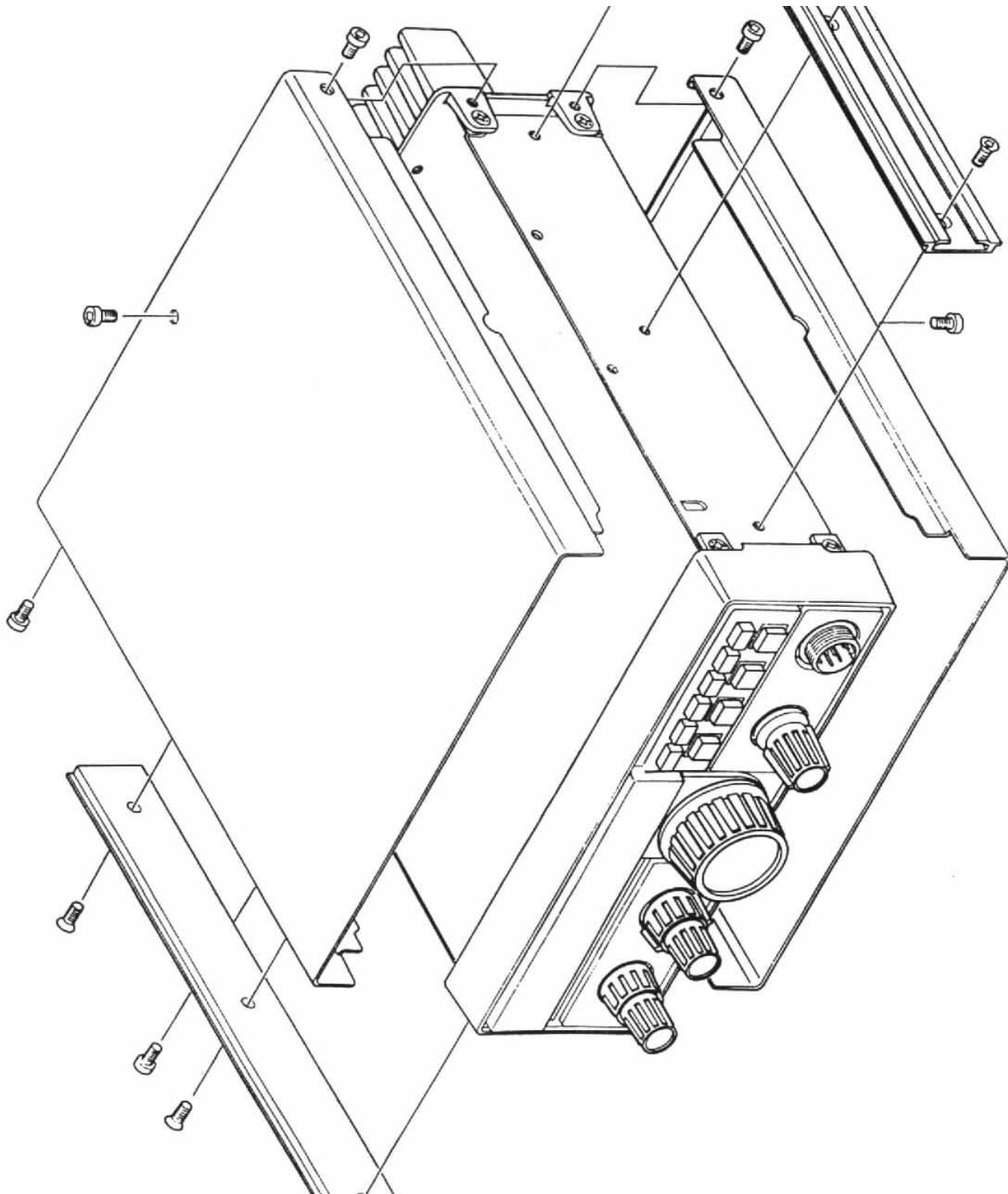
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**SERVICING**



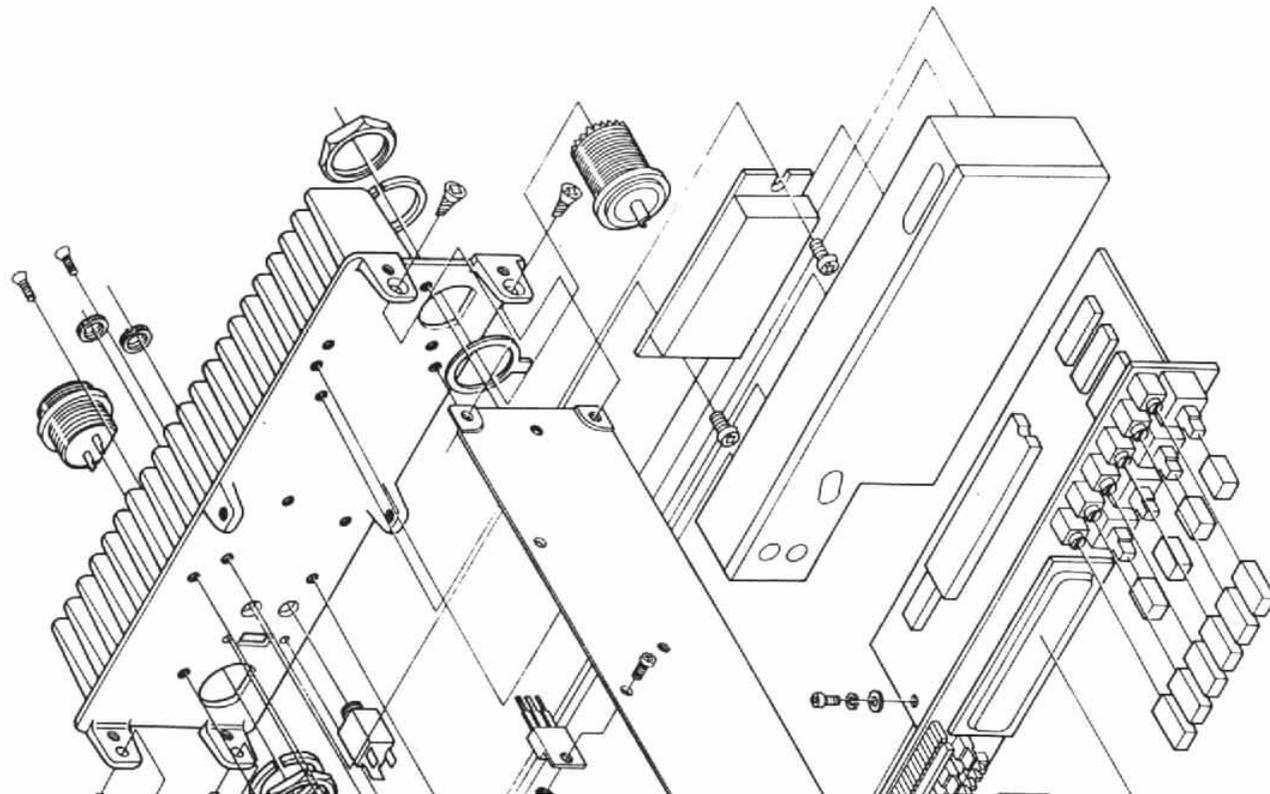
# OUTER COVER REMOVAL



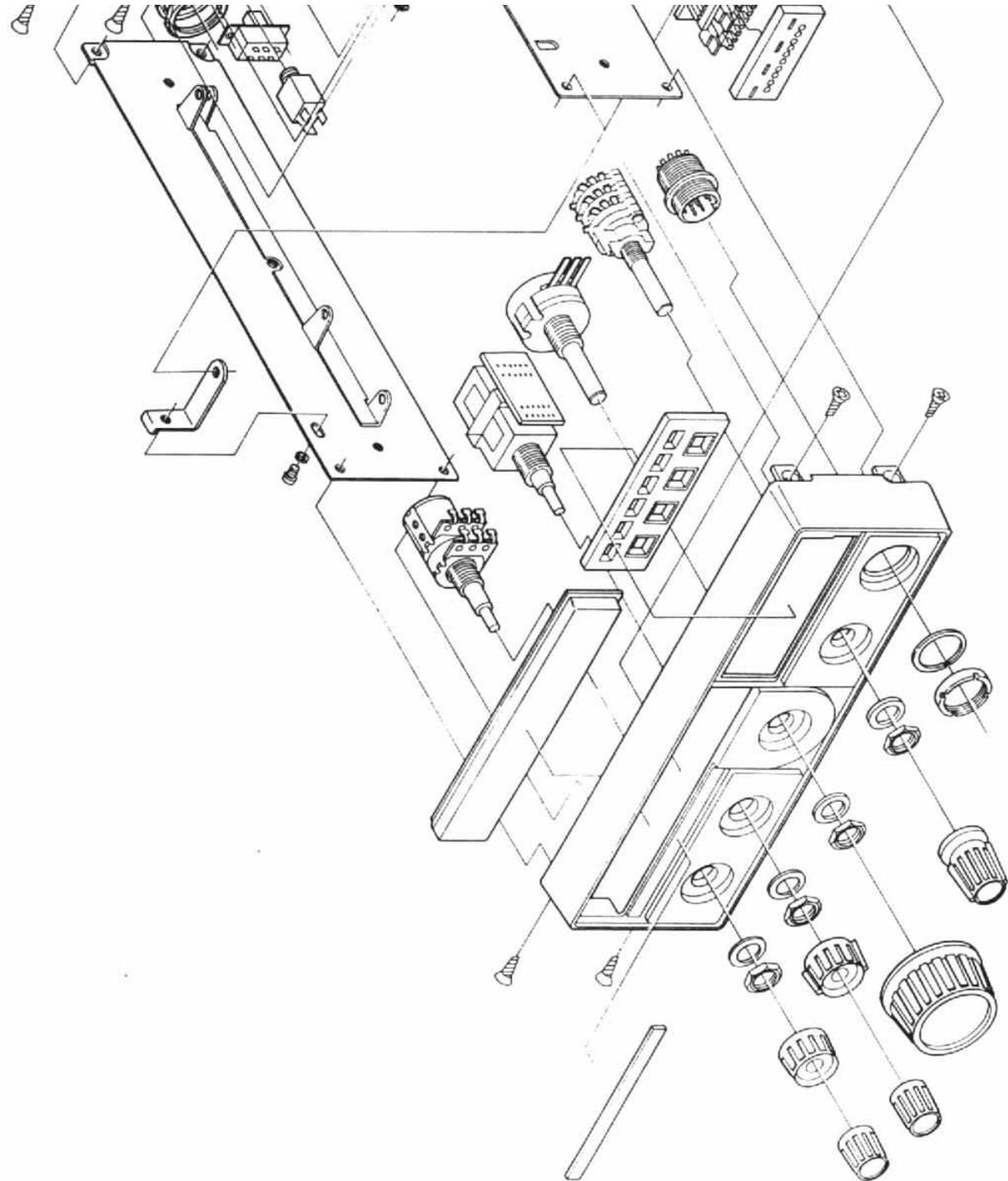


3-1

## SERVICING

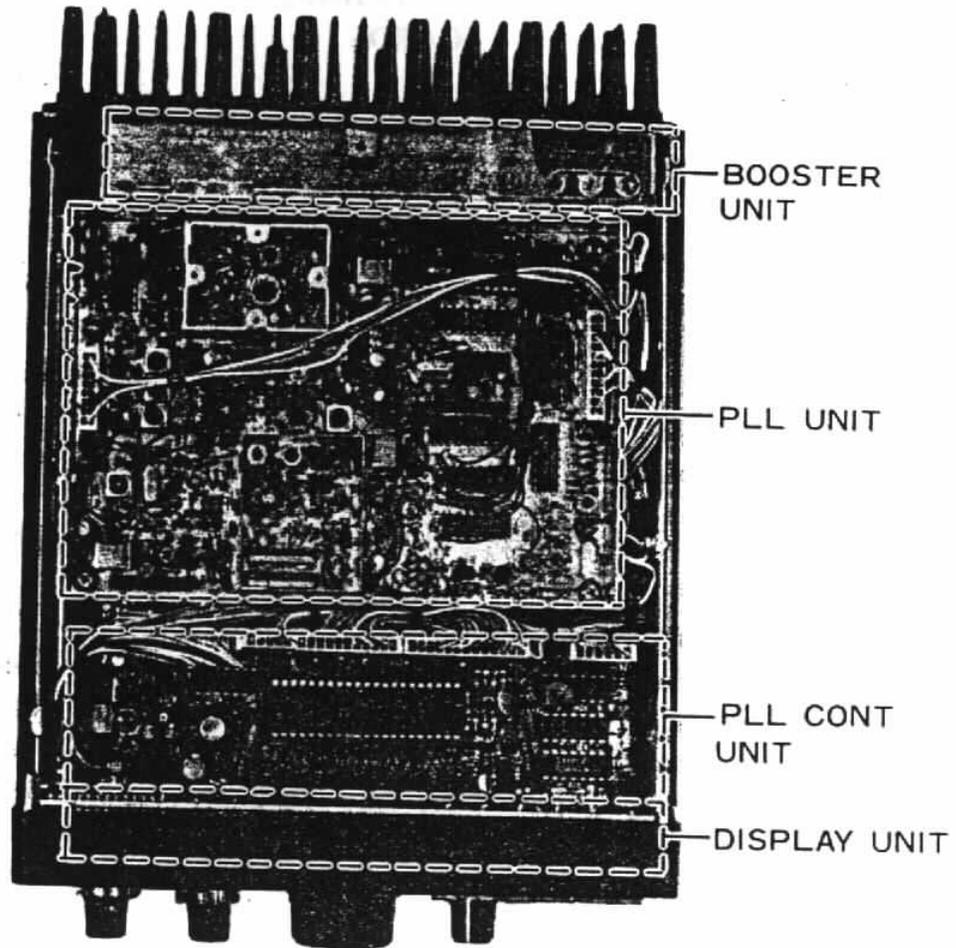


**EXPLODED VIEW**



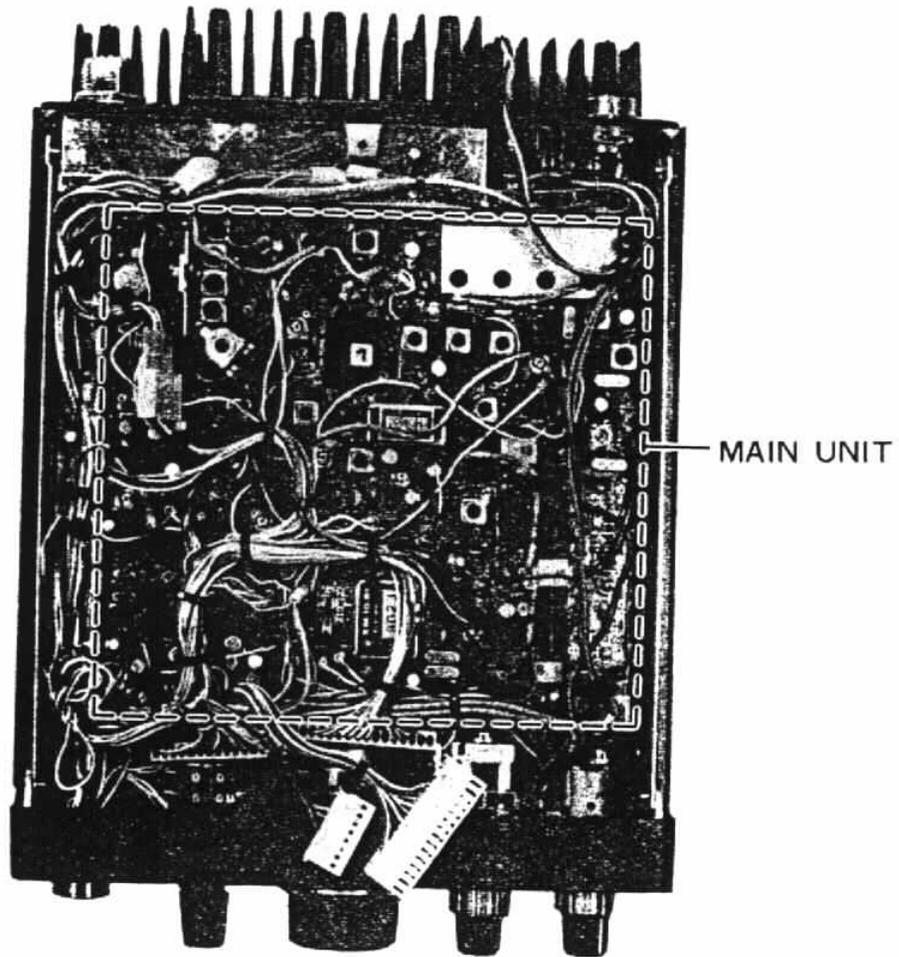
# BOARD LAYOUT

## SERVICING



Top View

Top View



Bottom View

## SERVICING

## SOLDERING TECHNIQUE

SOLDERING AND DESOLDERING TECHNIQUE  
ON PRINTED CIRCUIT BOARDS

The FT-480R circuit boards are tough, but mishandling during soldering can cause circuit traces to "lift." While this does no permanent damage to the board, much servicing trouble can result, because of the tendency for this lifted trace to break. A few simple precautions will keep your circuit boards in A-1 condition.

1. Use only a 12 to 30 watt chisel-tip soldering iron. Yes, some "repairmen" have been known to use small blowtorches on cards.
2. Use only a soldering iron equipped with a three-wire cord, with the tip grounded. Also acceptable is a soldering iron isolated through a transformer. An old soldering iron or gun may have 117 volts on the tip, and will certainly cause more damage than it repairs!
3. **USE ONLY 60/40 ROSIN CORE SOLDER.** Acid core solder should be thrown away if you find it in your radio shop!
4. Use a solder sucker and solder tape to ensure a professional repair job.
5. If you do lift a trace, don't worry! Read on to find out how to repair traces like a pro.

## NOTES ON USE OF CMOS IC's:

As CMOS devices are extremely sensitive to damage from static electricity, special precautions must be observed.

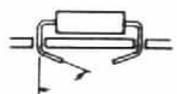
In storage, use only a non-inductive sponge.

When installing a CMOS IC in a socket, or on a circuit board, be certain that the power is off. In addition, the technician should rest his hand on the chassis as the component is inserted, so as to place his hand at the same level as the chassis (better to discharge small amounts of static electricity through your fingers than through a \$5 IC!).

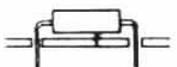
When soldering a CMOS IC onto a circuit board, use a low wattage iron, and be sure to ground the tip with a clip lead, if the tip is not grounded through a three-wire power cord.

## INSERTION OF PARTS ON CIRCUIT BOARDS

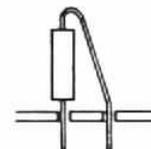
All of the below are acceptable ways of inserting components into circuit board mounting holes.



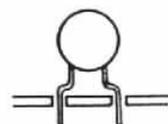
(a) Bend leads slightly



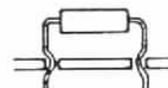
(b) Straight-in mounting



(c) Vertical mounting



(d) Preformed disc ceramic capacitor



(e) Preformed resistor, diode, etc.

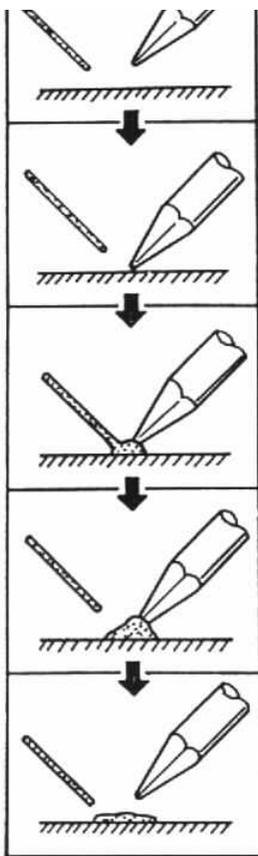
## SERVICING

### BASIC SOLDERING PRACTICE



### EXAMPLES OF POOR SOLDERING PRACTICE

Solder bridge (caused by use of too much solder)



(1) Prepare soldering iron and solder.

(2) Apply soldering iron to surface to be soldered.

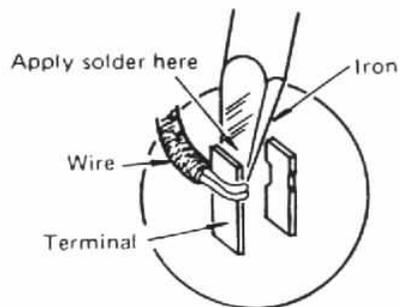
(3) Apply solder to heated surface.

(4) When enough solder is applied, remove solder. Continue to apply heat until solder flows cleanly.

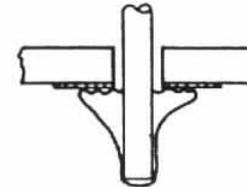
(5) Remove iron from work. Do not apply more heat than necessary for good solder flow.

**Soldering to terminal posts:**

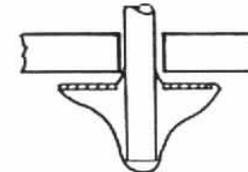
(Be certain to apply heat to both post and wire.)



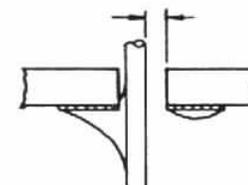
“Cold joint” (caused by insufficient heat to part of work, resulting in poor solder flow)

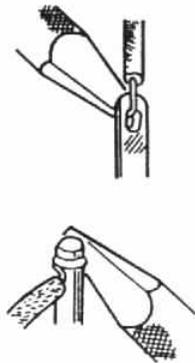


Lifted trace (caused by too much heat on circuit board foil)



Unstable joint (caused by insufficient heat or solder)



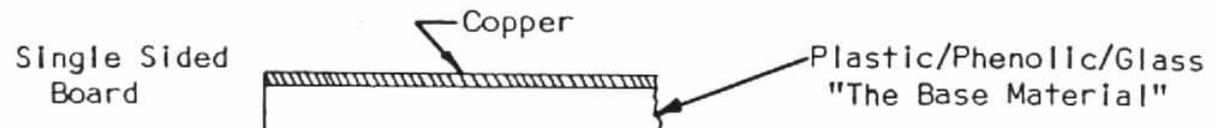


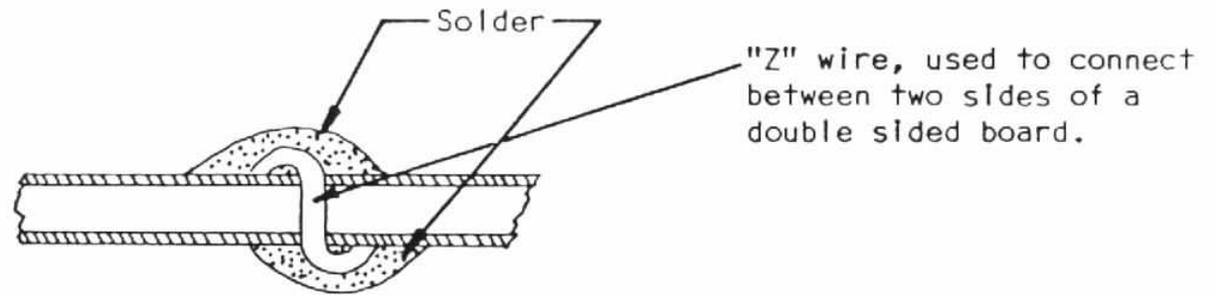
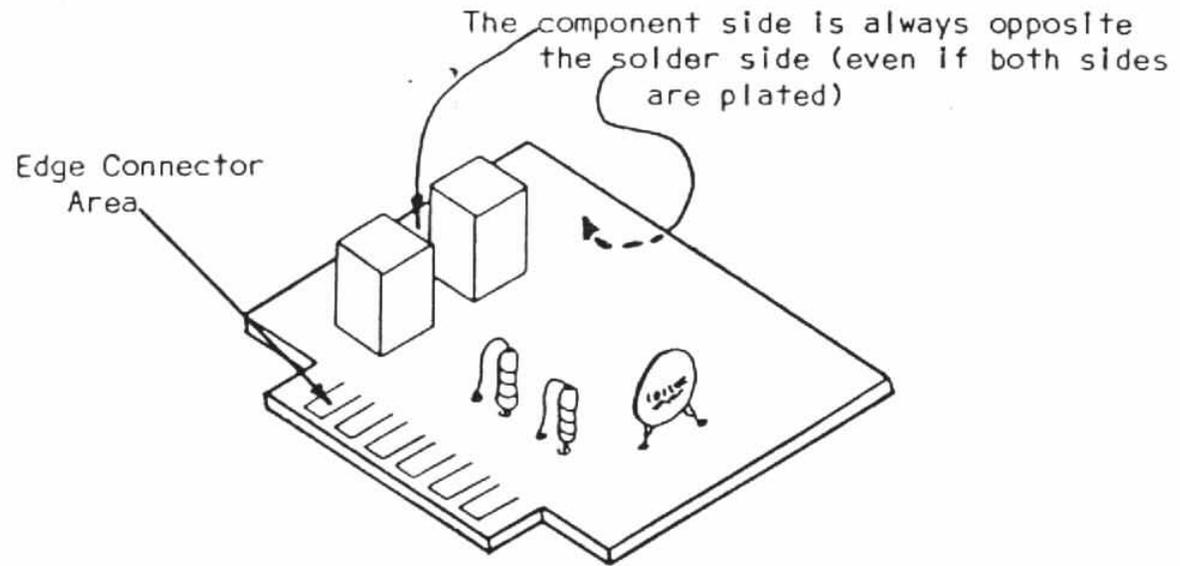
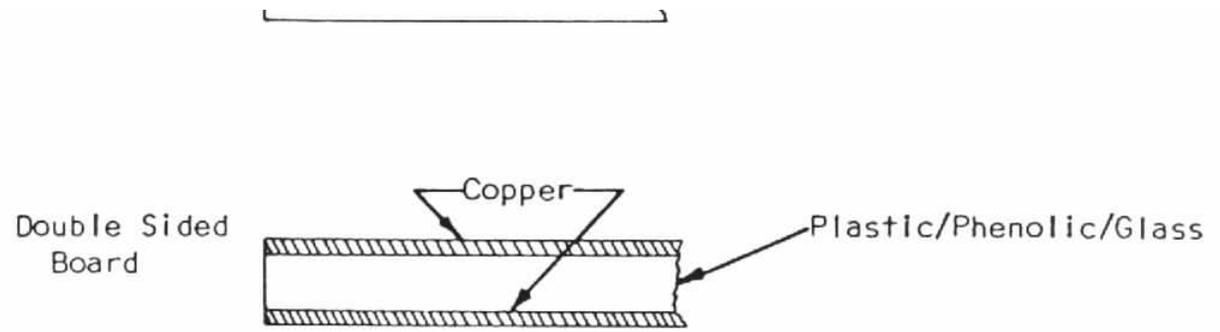
3-5

## SERVICING

## CIRCUIT TRACE REPAIR

Most of the printed circuit boards used in the FT-480R are single sided boards. However, occasionally a double-sided board is used in situations where high shielding is required. A comparison of the two types is shown below.

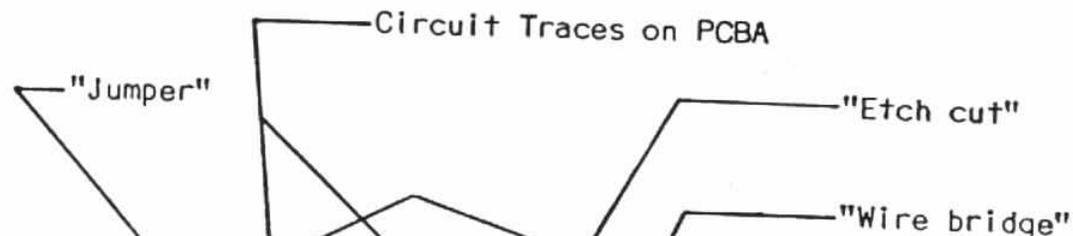


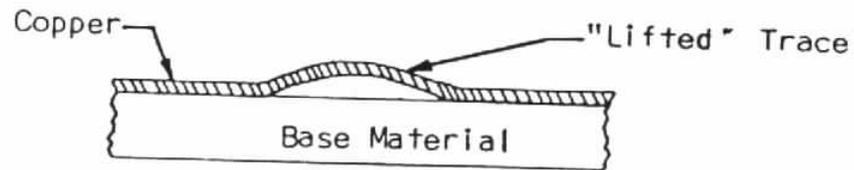
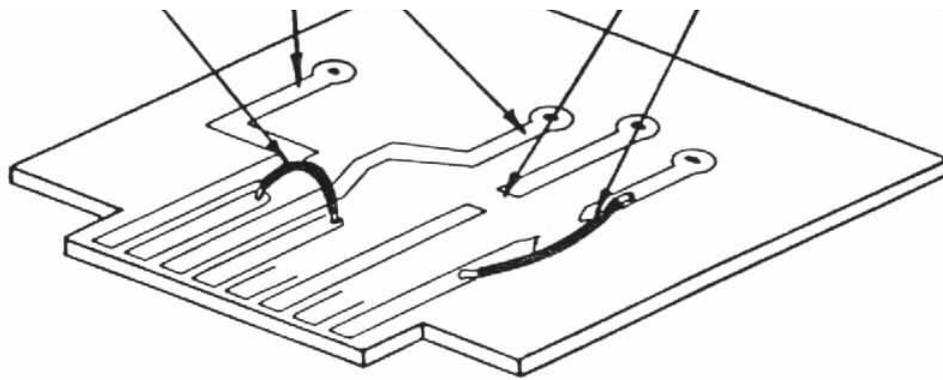


## SERVICING

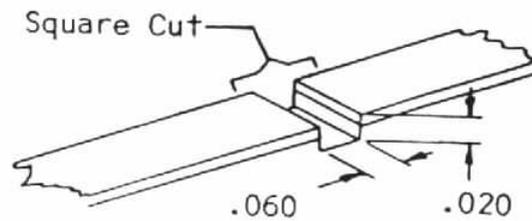
Sometimes, after the design and drafting of a board are completed, a board is produced with an error in it. Though non-technical managers sometimes suffer a stroke at hearing of this situation, it is not unheard of in engineering circles. Thus, should you encounter etch cuts and jumpers on a board, be assured that the modifications were made in the interest of securing optimum performance. Unless you consider your expertise to be superior to that of the design engineer, please leave these mods in place.

However, in service work the occasion does arise when a trace must be cut. Proceed as follows.





If you have previously lifted a trace, make an etch cut on each side of the lifted trace, and install a wire bridge as shown in the drawing.



Coat Cut Area With Eastman 910

## SERVICING

## MODIFICATIONS

## FREQUENCY RANGE MODIFICATION

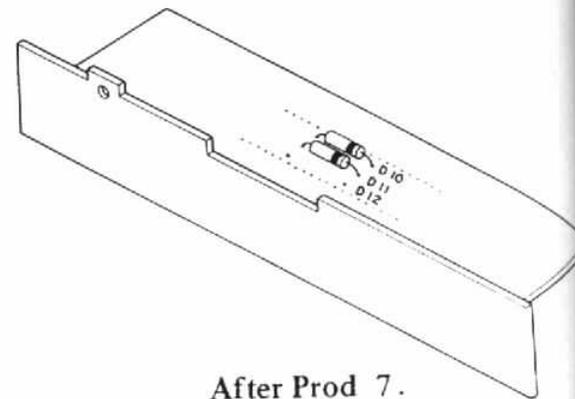
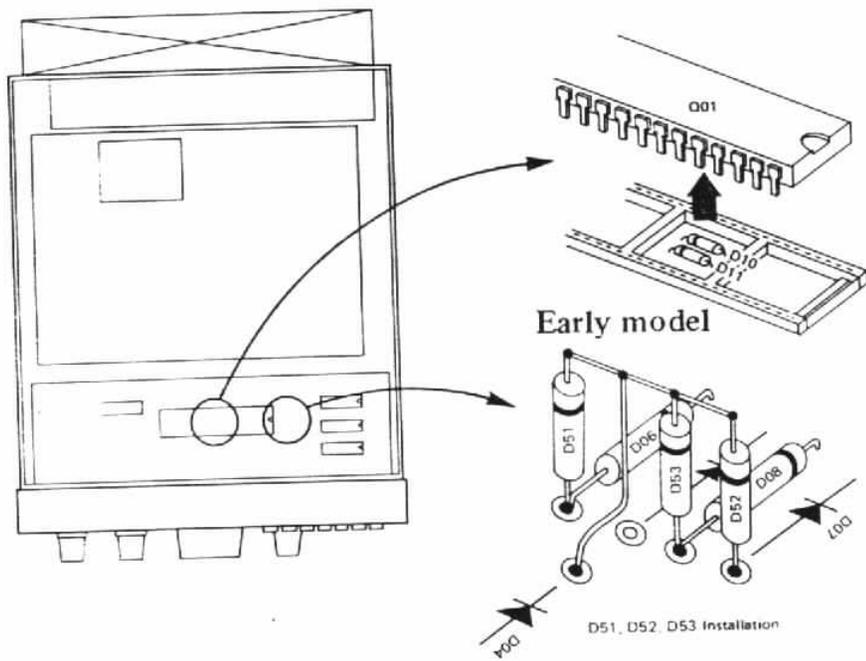
The following modification will allow you to change the frequency coverage and channel space, as per your local regulations. Please refer to the Diode Installation Chart and the parts layout for details.

DIODE INSTALLATION CHART FOR PLL CONTROL UNIT

Frequency Coverage	TYPE A			TYPE B			TYPE C			TYPE D			TYPE E		
	143.5-148.5 MHz			144.0-146.0 MHz			143.5-148.5 MHz			144.0-146.0 MHz			143.5-148.5 MHz		
Channel Separation for FM Mode	S 1kHz	M 20kHz	F 100kHz	S 1kHz	M 25kHz	F 100kHz	S 1kHz	M 25kHz	F 100kHz	S 1kHz	M 12.5kHz	F 25kHz	S 1kHz	M 12.5kHz	F 25kHz
D4004		X			X			X							X
D4006					X			X			X				
D4007		X			X			X							X
D4011		X						X							X
D4051											X				X
D4052											X				X
D4053											X				X

X = install a diode (1SS53)

Blank = vacant

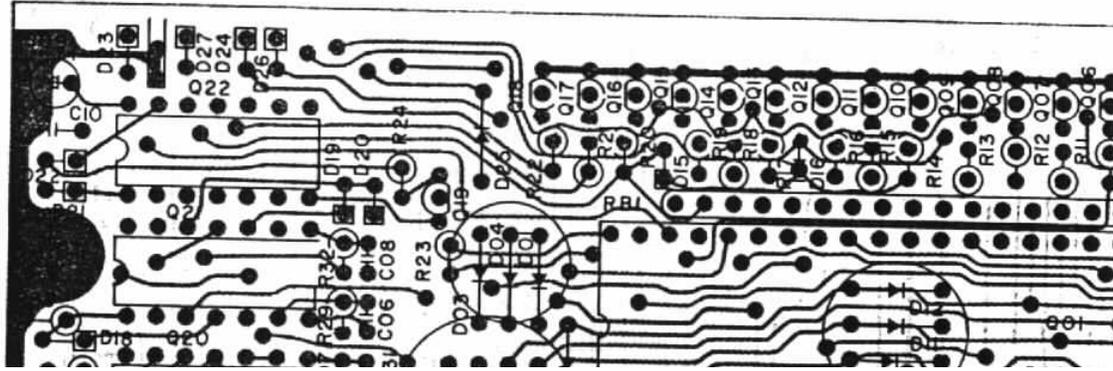


After Prod 7.

**INSTALLATION CHART FOR PLL CONTROL UNIT**

	<b>TYPE B</b>	<b>TYPE C</b>	<b>TYPE D</b>	<b>TYPE E</b>
	144.0-146.0 MHz	143.5-148.5 MHz	144.0-146.0 MHz	143.5-148.5 MHz
	S 1kHz M 25kHz F 100kHz	S 1kHz M 25kHz F 100kHz	S 1kHz M 12.5kHz F 25kHz	S 1kHz M 12.5kHz F 25kHz
z	X	X		
	X	X	X	X
	X	X		
		X		X
			X	X
			X	X
			X	X



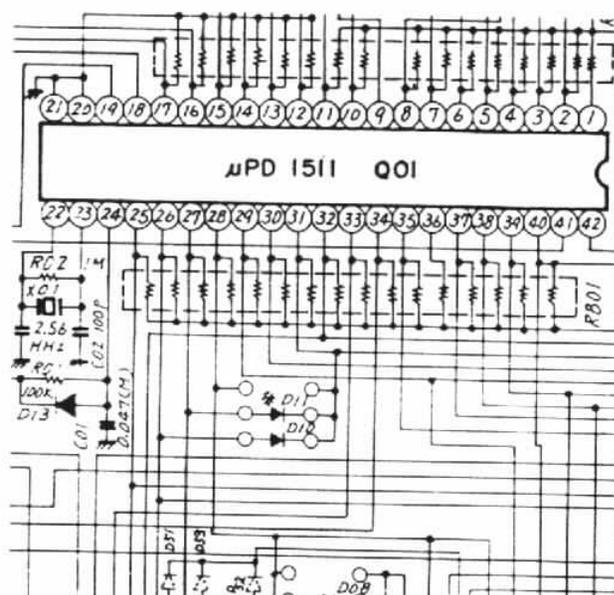
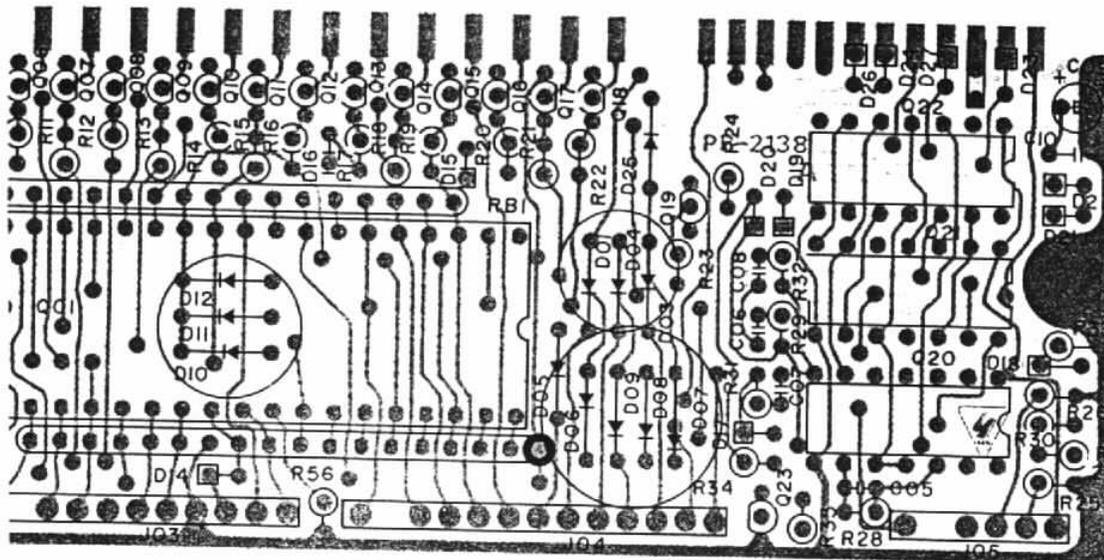
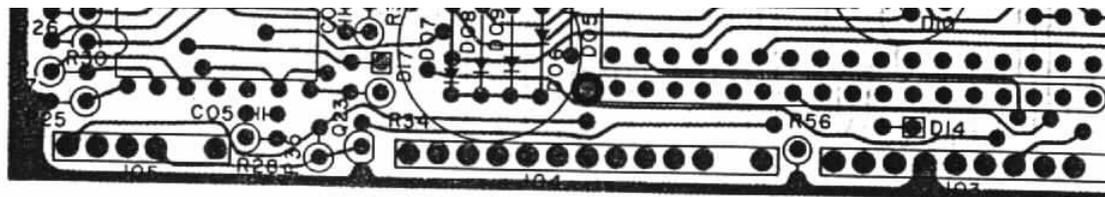


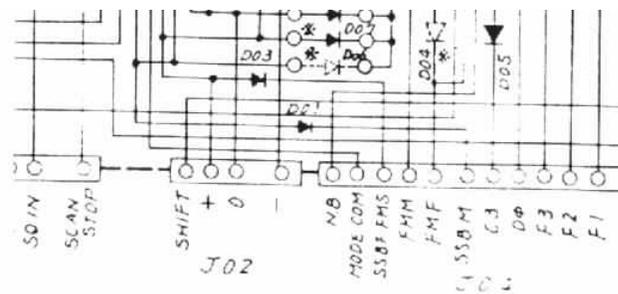
# SERVICING

## DIODE

	TYPE A		
Frequency Coverage	143.5-148.5 MHz		
Channel Separation for F'M Mode	S	M	F
	1kHz	20kHz	100kHz
D4004		X	
D4006			
D4007		X	
D4011			X
D4051			
D4052			
D4053			

X = install a diode (1SS53)  
 Blank = vacant





3-9

## SERVICING

### MODIFICATION TO ALLOW 5 kHz STEPS ON FT-480R ON FM, SLOW SPEED

The FT-480R, as shipped, steps in 1 kHz increments in the SLOW position on FM, 20 kHz per step in the MEDIUM position, and 100 kHz per step in the FAST position. Should you desire to change the scanning and tuning step in the SLOW position to 5 kHz per step, proceed as follows:

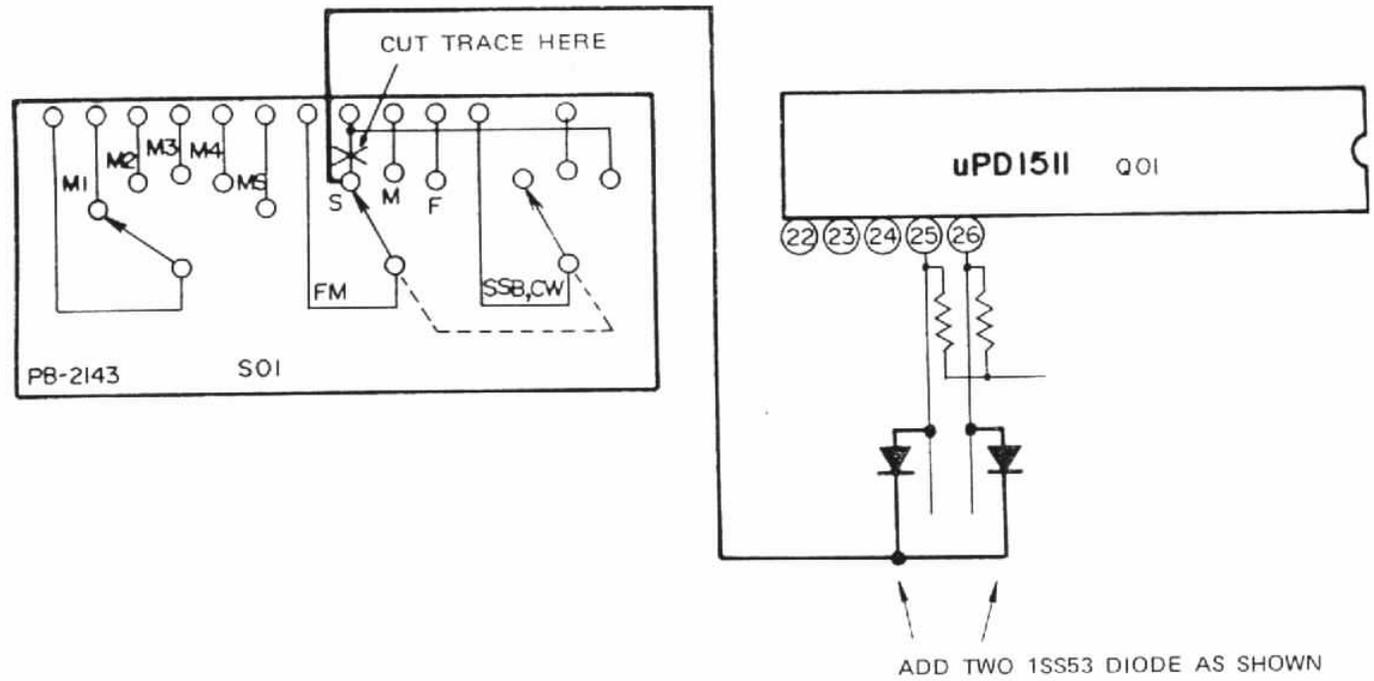
PARTS NEEDED: 1SS53 or equiv. diode 2 ea.  
Hookup wire

#### MODIFICATION PROCEDURE:

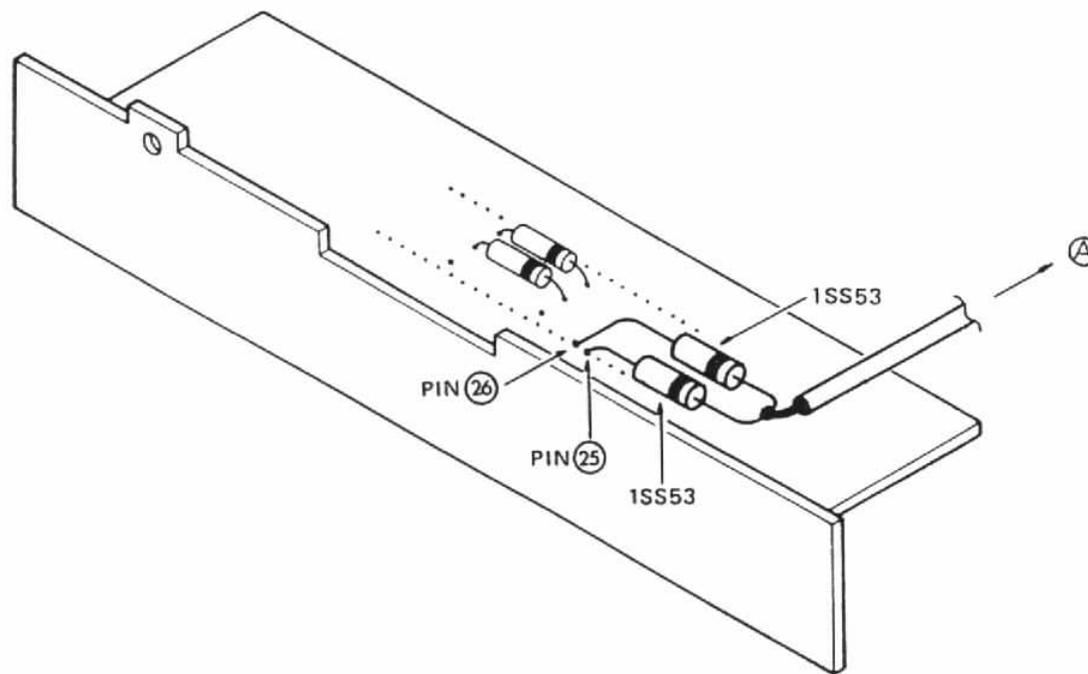
(1) Refer to Figure 1, and make an etch cut on

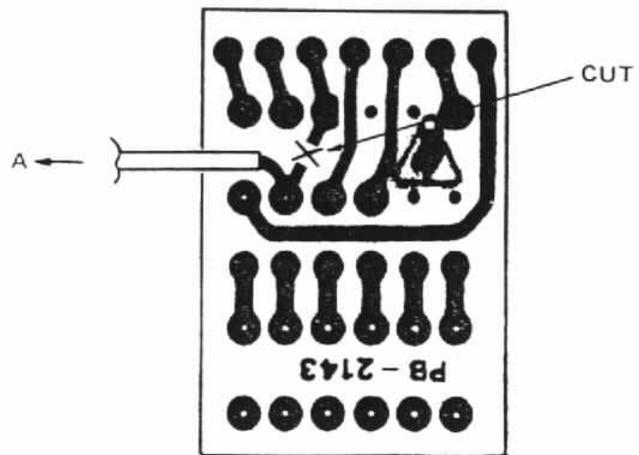
- (2) Connect a wire to the "S" terminal as shown, and run it over to the PLL Control Unit, PB-2138.
- (3) On the PLL Control Unit, locate the  $\mu$ PD1511 IC (Q<sub>4001</sub>), and identify pins 25 and 26. Connect the two diodes to those pins as shown, tie the cathodes together, and connect the cathodes to the wire installed in step (2). Be certain that the FT-480R is completely unplugged from power supplies, etc., and be sure to use a low-wattage soldering iron with a grounded tip. Modification is now complete.

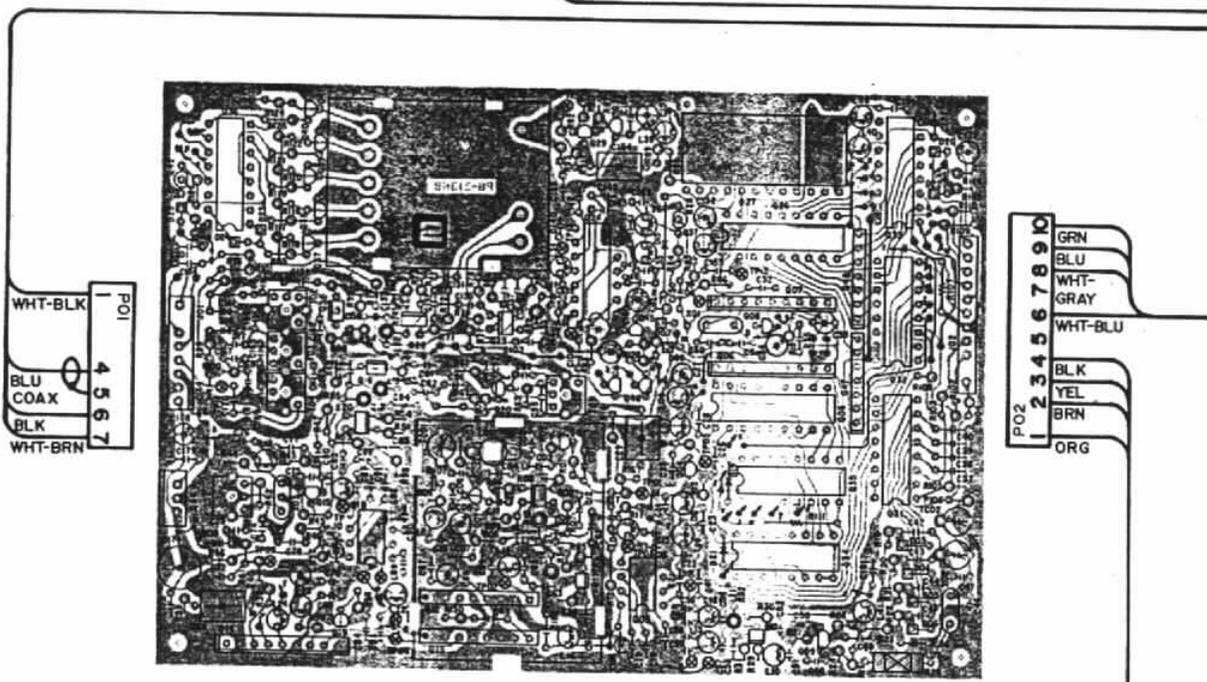
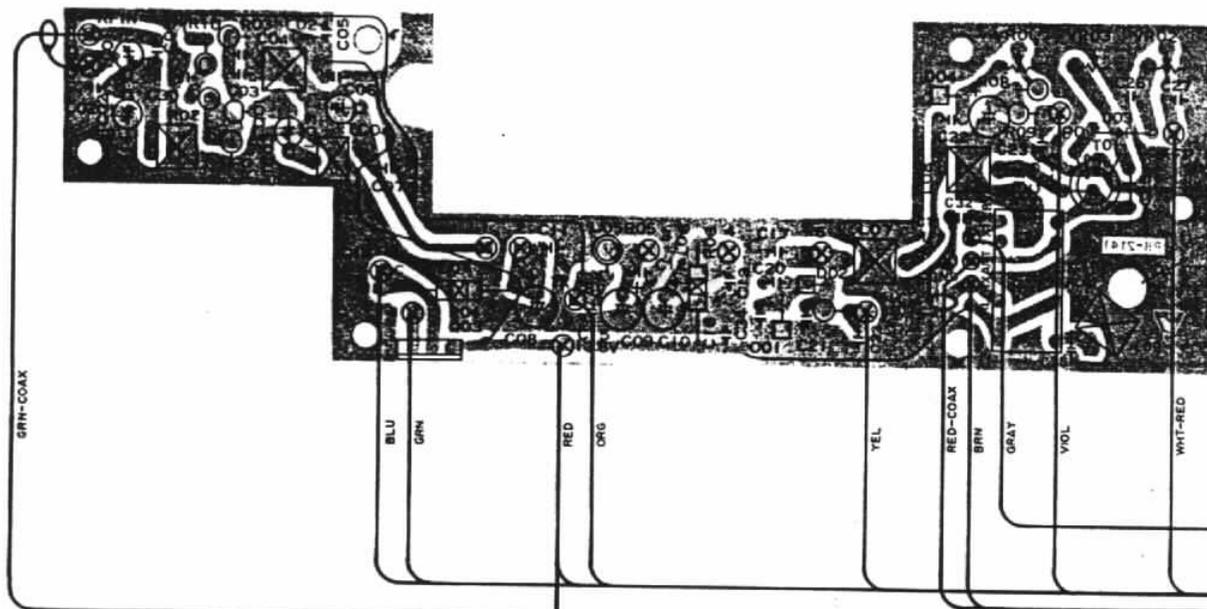
the trace from the "S" (SLOW) terminal line from S<sub>01</sub> on PB-2143. Be sure to cut the trace in use on the FM mode.

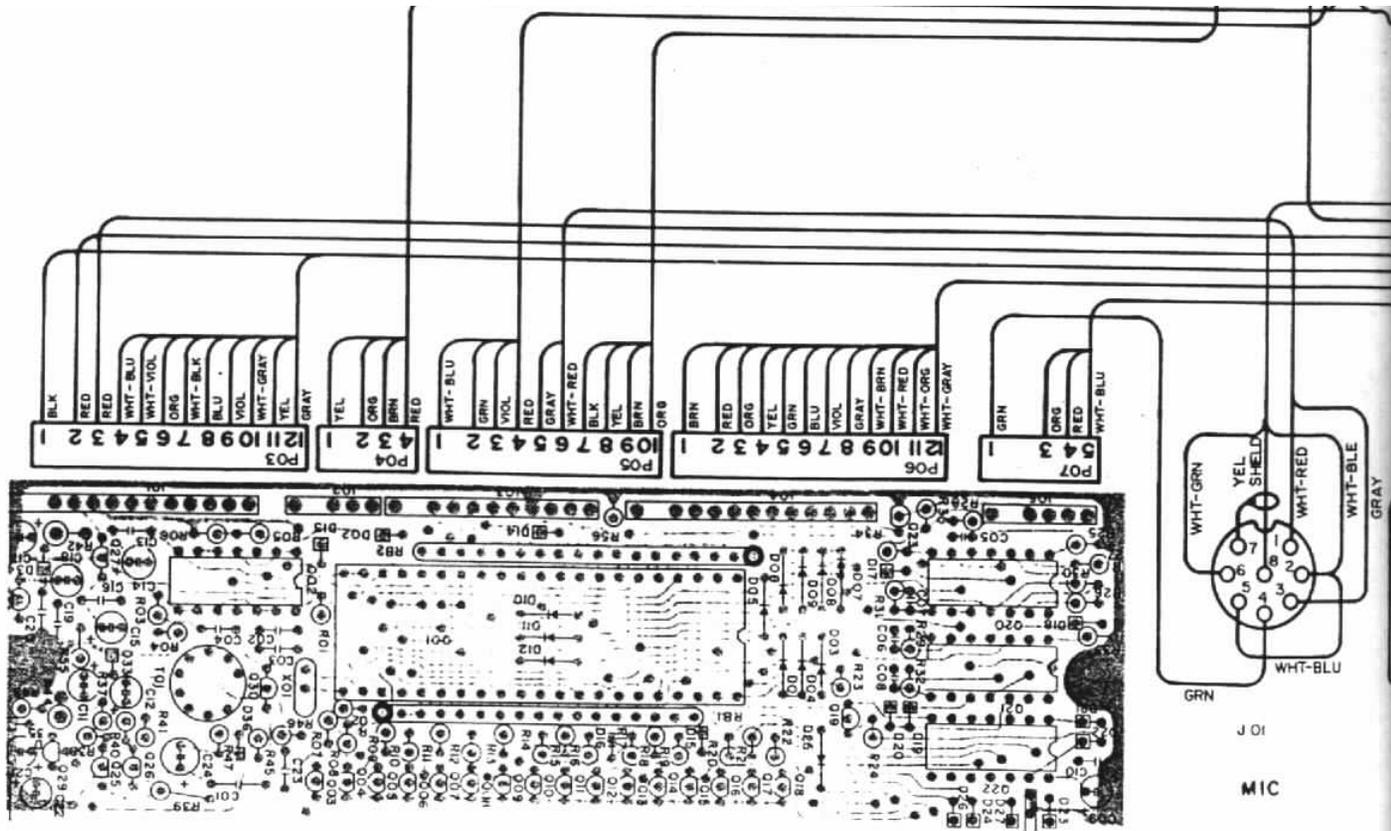


# SERVICING







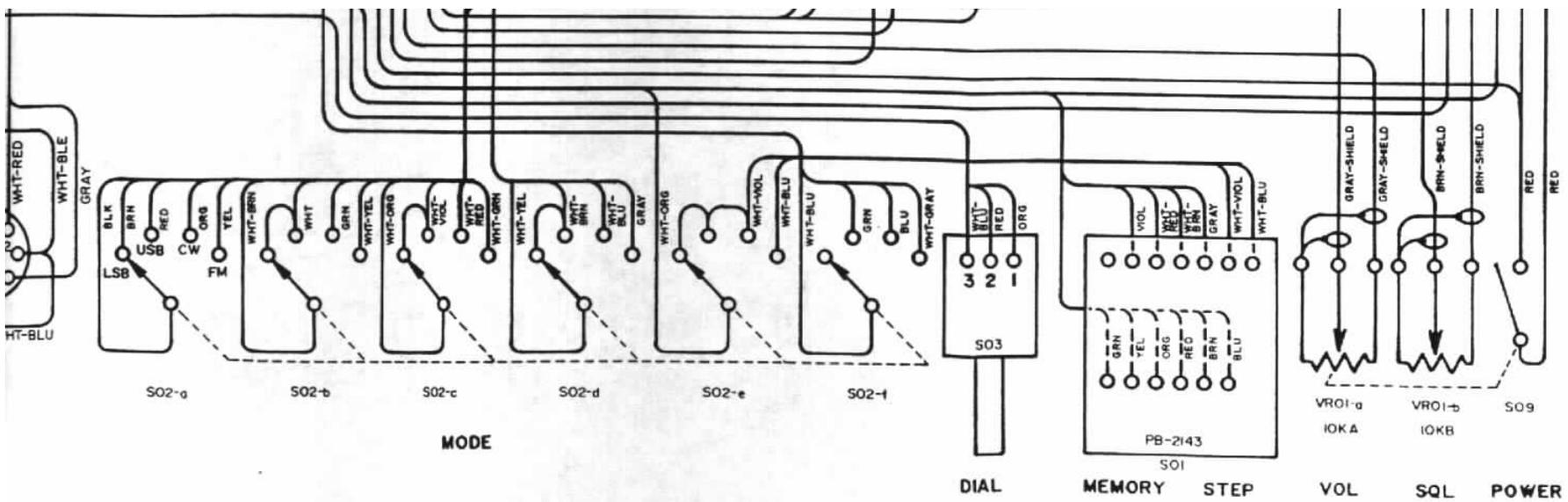


# WIRING DIAGRAM

# SERVICING

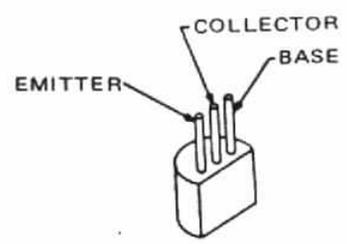
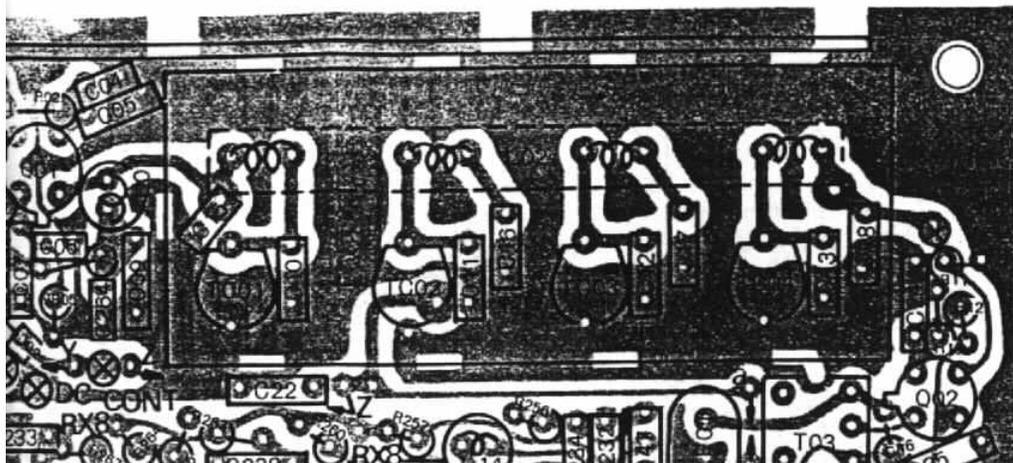




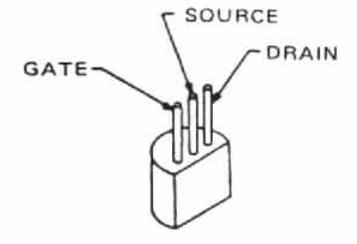


3-13

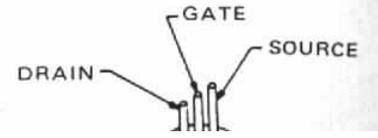
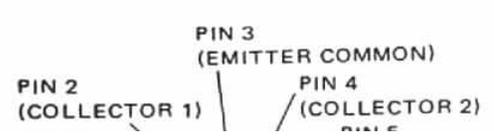
**PARTS LAYOUT MAIN UNIT (PB-2135)**

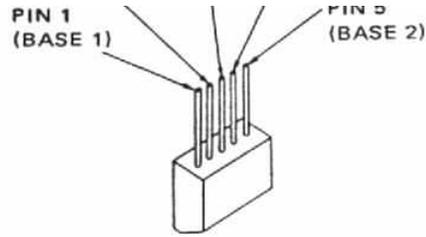
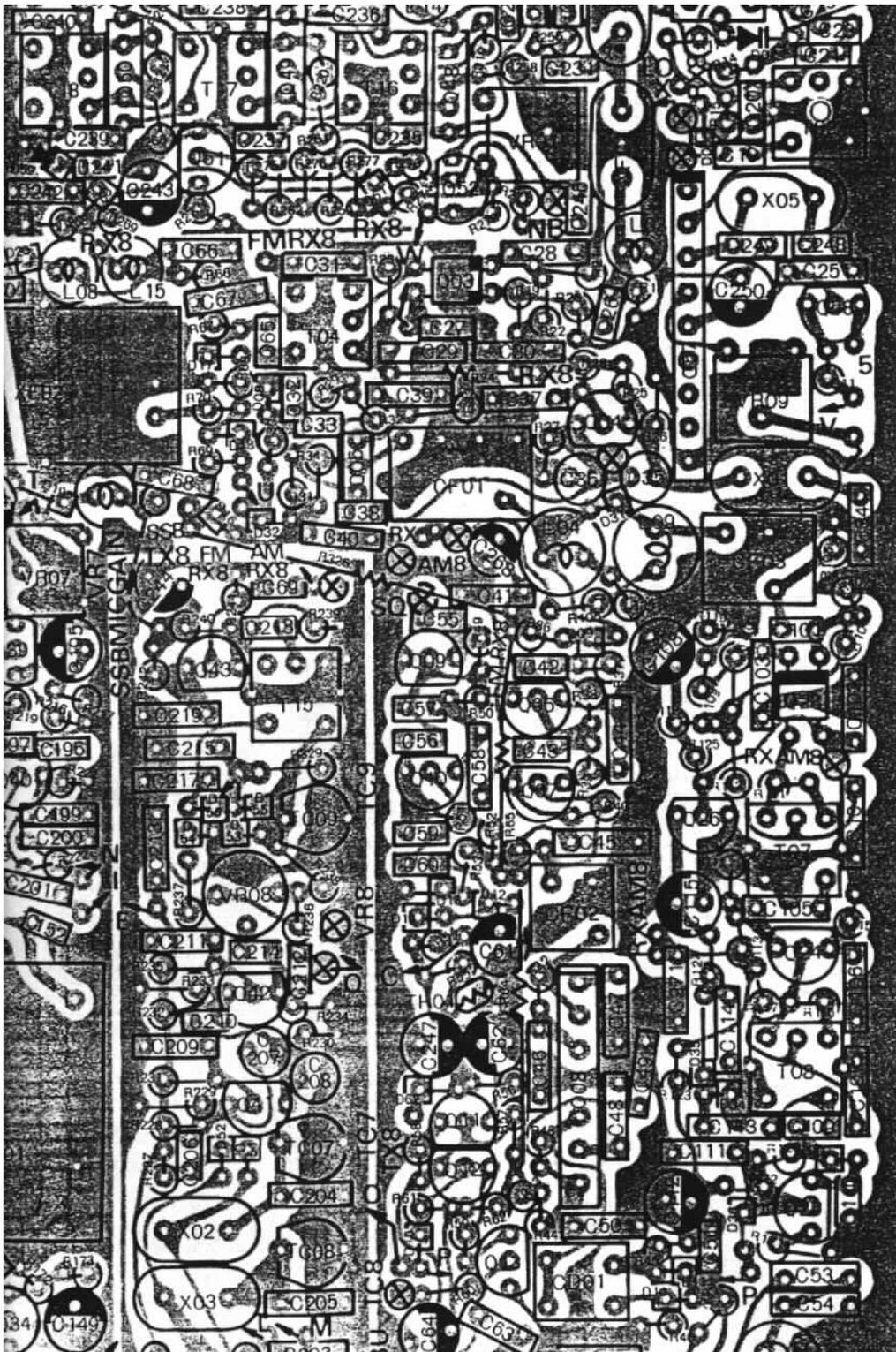


2SC2053

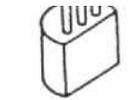


2SK19TM-Y/GR

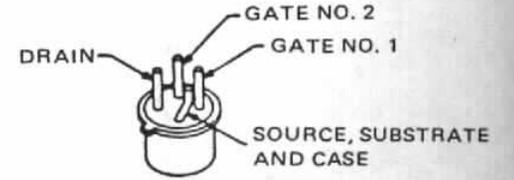




2SC1583



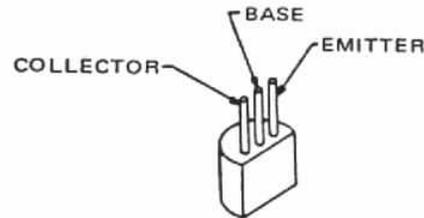
2SK30A-Y



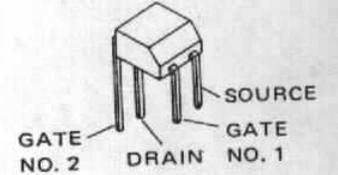
3SK51-03

3SK59

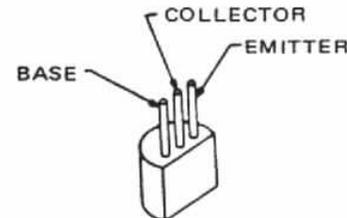
3SK70



MPSA13



3SK73

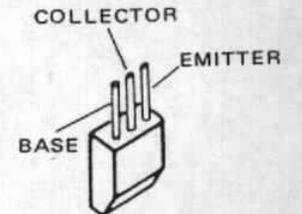


2SA733(A)P/Q

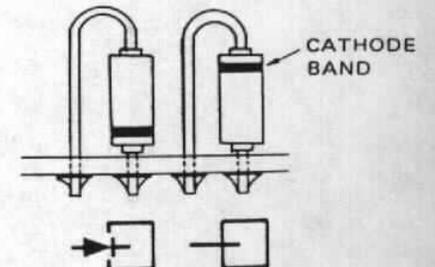
2SC945P/Q

2SC1383R

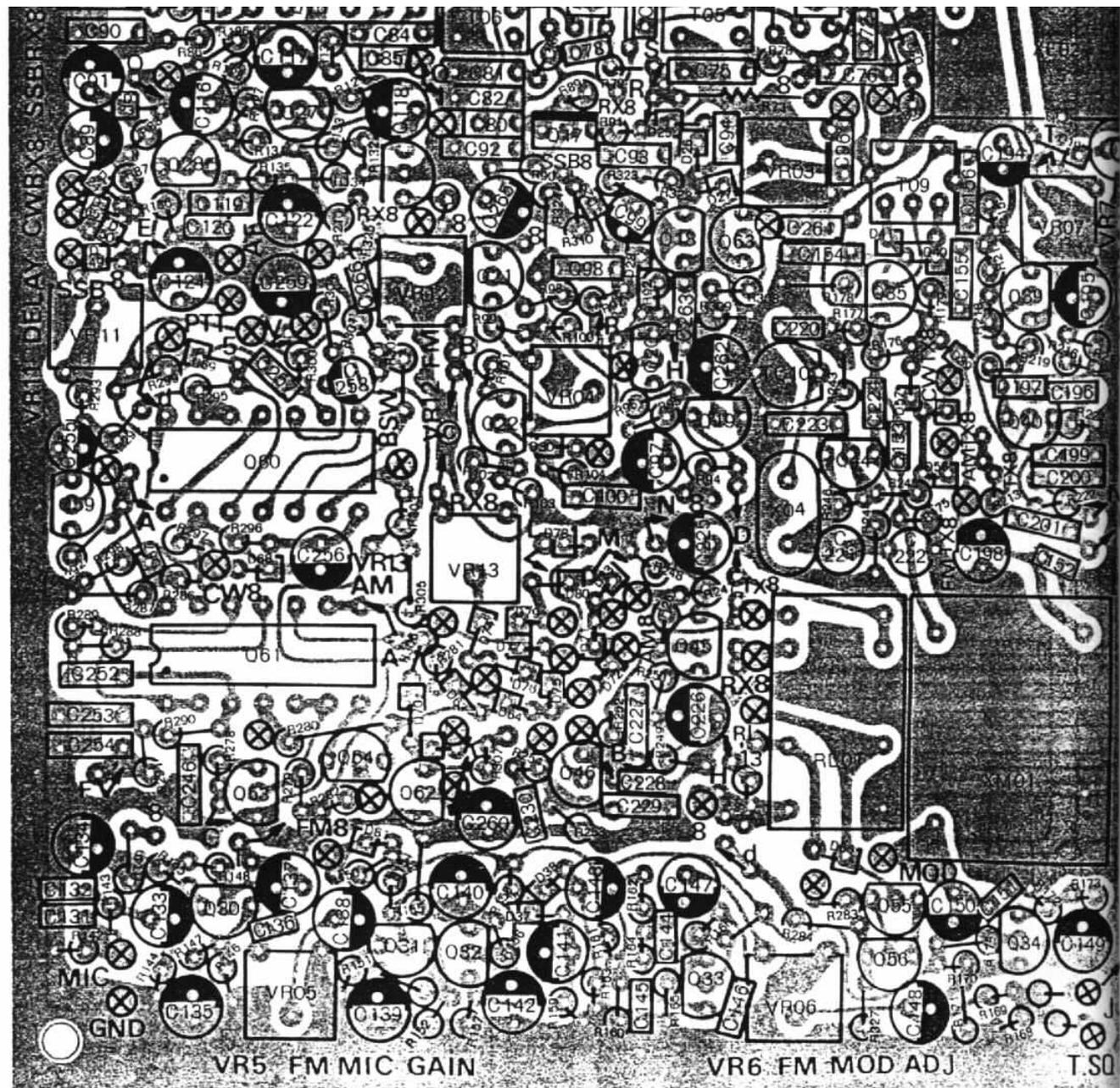
2SC1815GR/Y



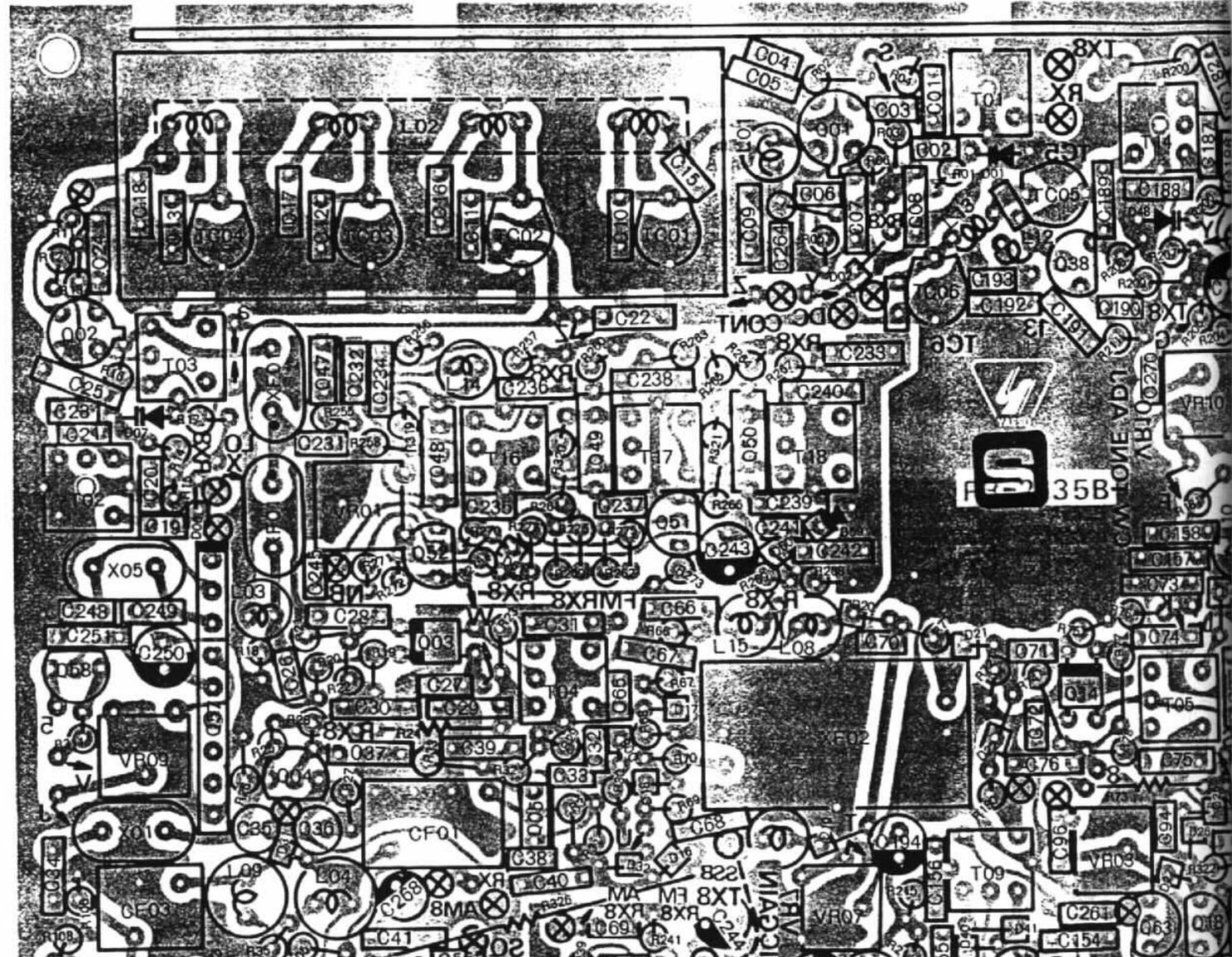
2SC535A/B

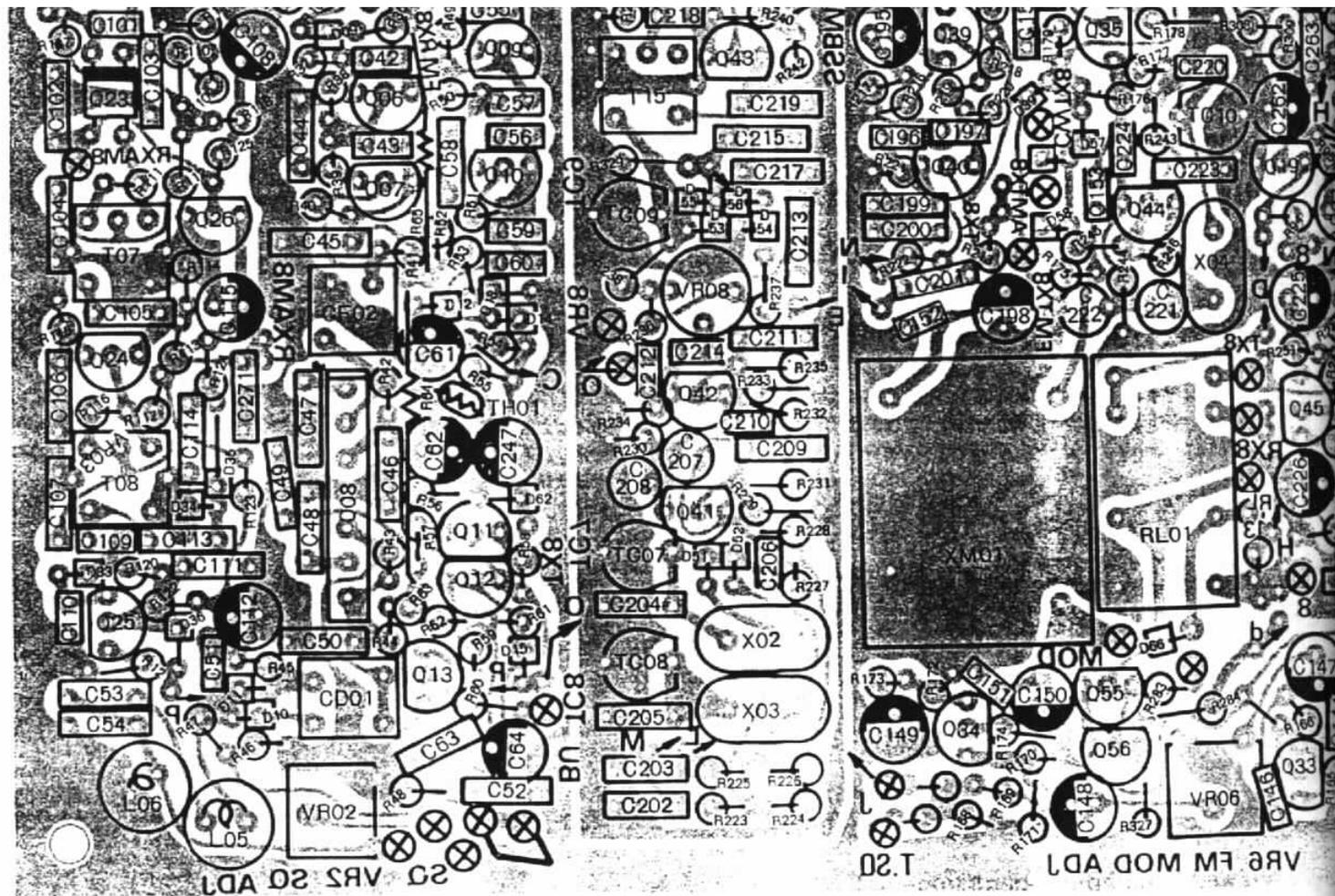






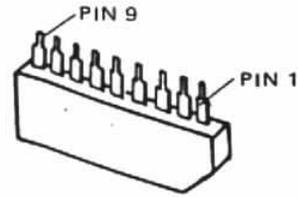
# PARTS LAYOUT



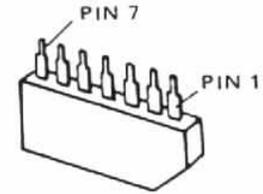


# LAYOUT MAIN UNIT(PB-2135)

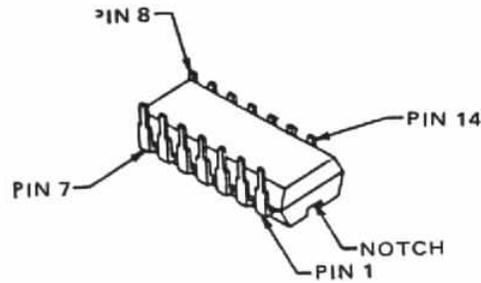
SERVICING



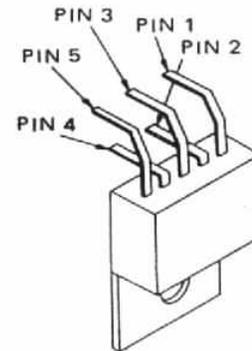
TC5082P



μPC577H

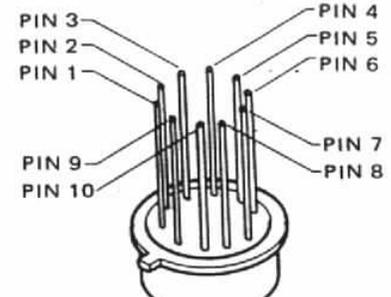
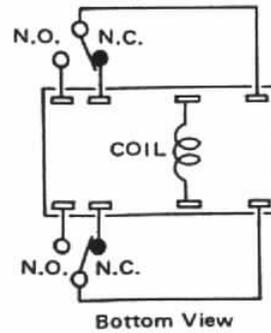


MC14011B



μPC2002H

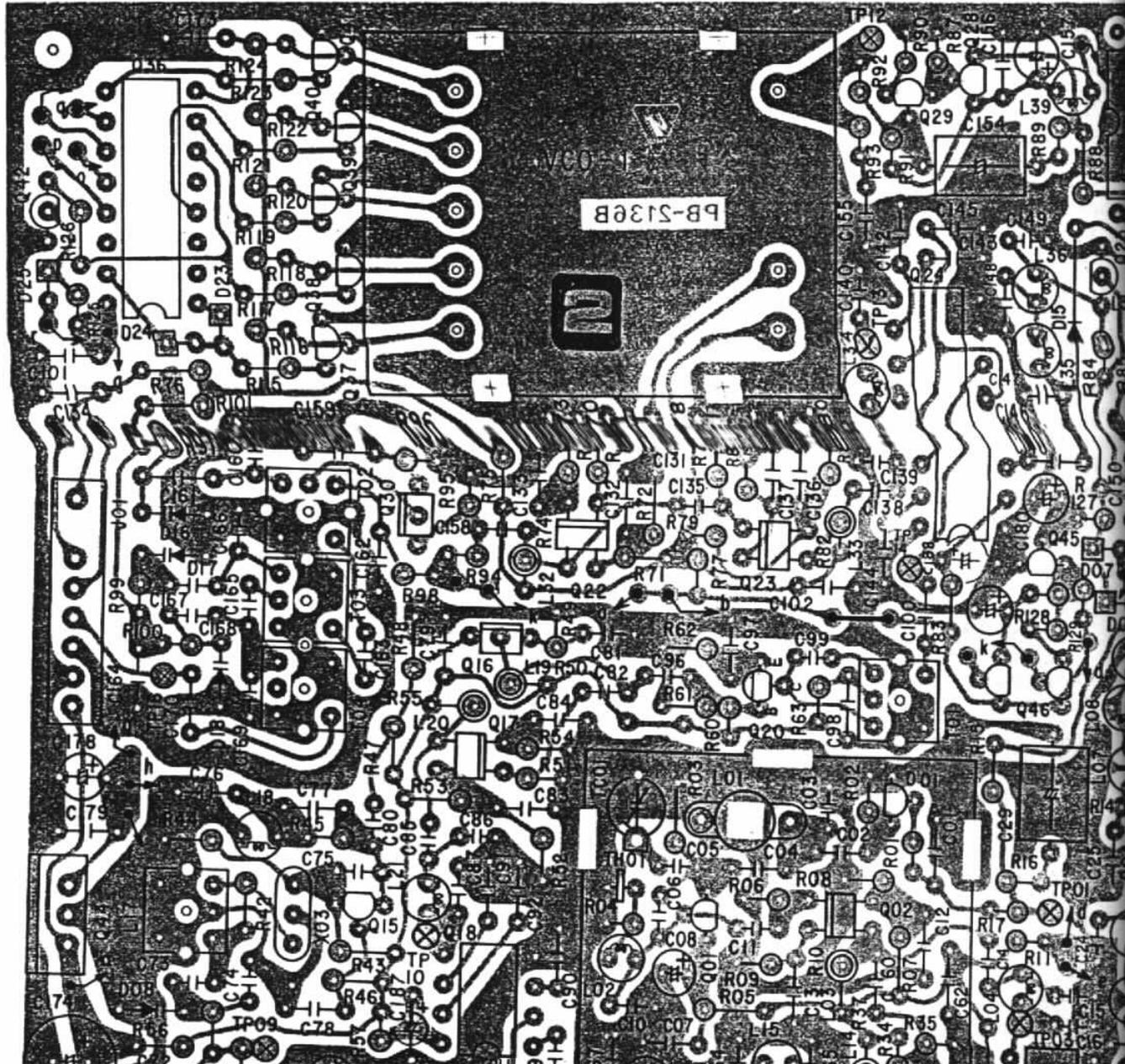
RELAY CONNECTIONS  
RL1001

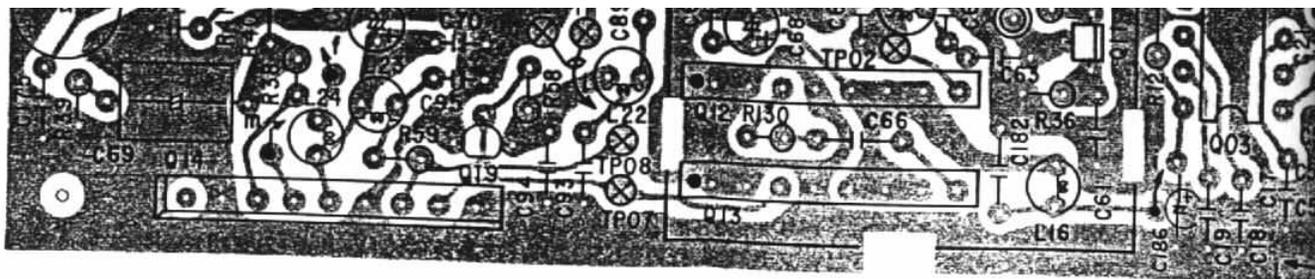




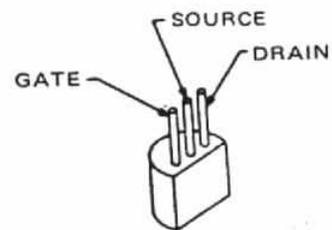


Viewed from component side

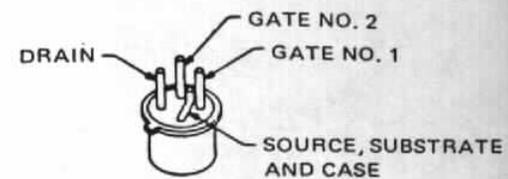




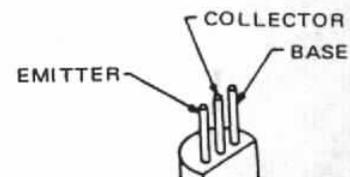
## ARTS LAYOUT PLL UNIT(PB-2136), VCO 1 UNIT(PB-2137A)

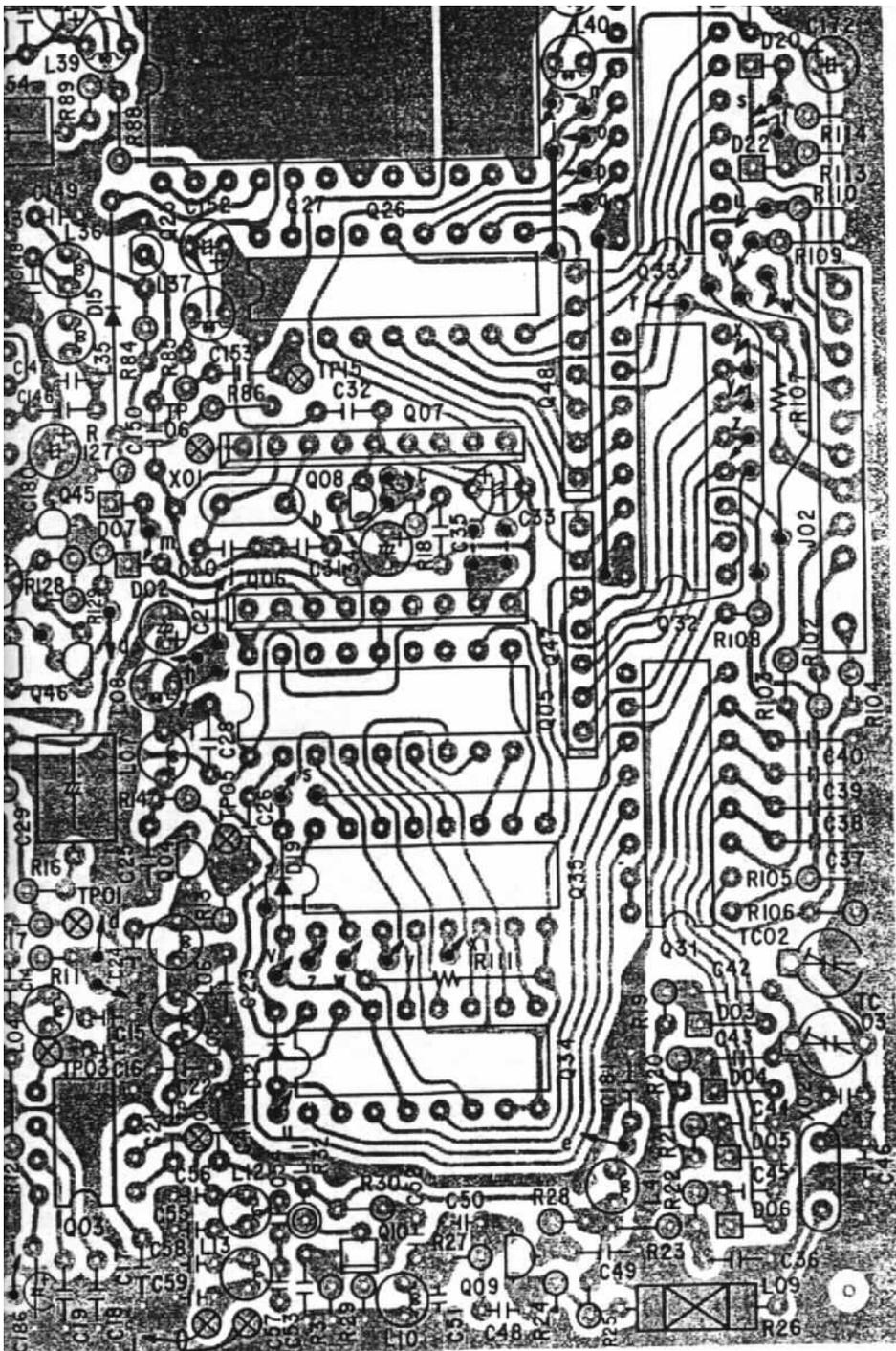


2SK19TM-Y  
2SK19TM GR

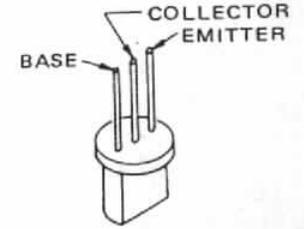
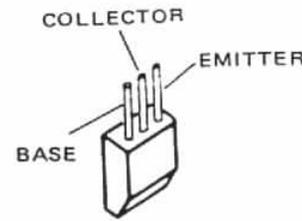
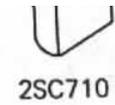


3SK51-03



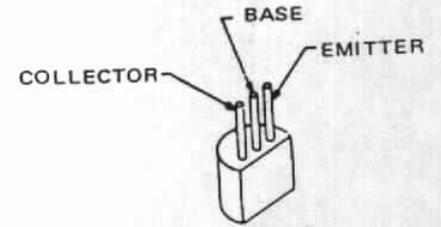
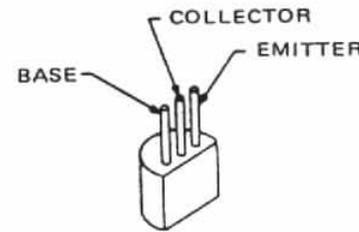


Viewed from component side



2SC535A/B

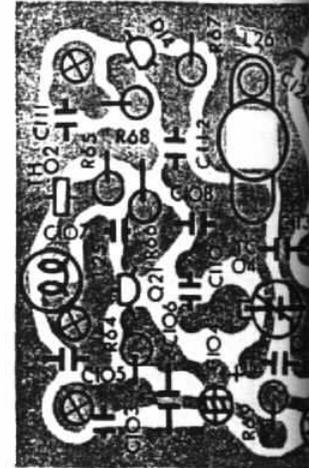
2SC732TMBL



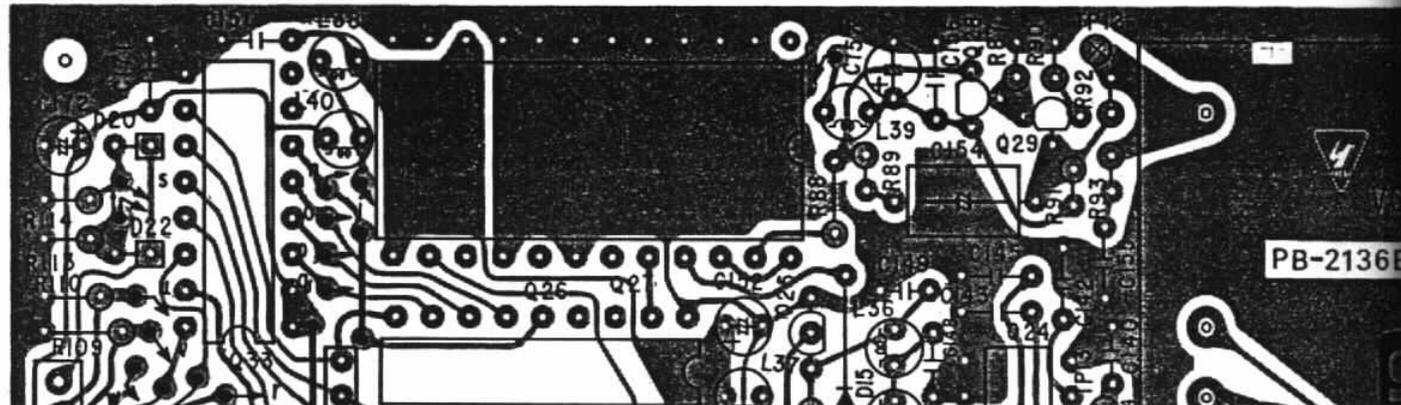
2SA733(A)P/Q  
2SC945Q  
2SC1674

MPSA13

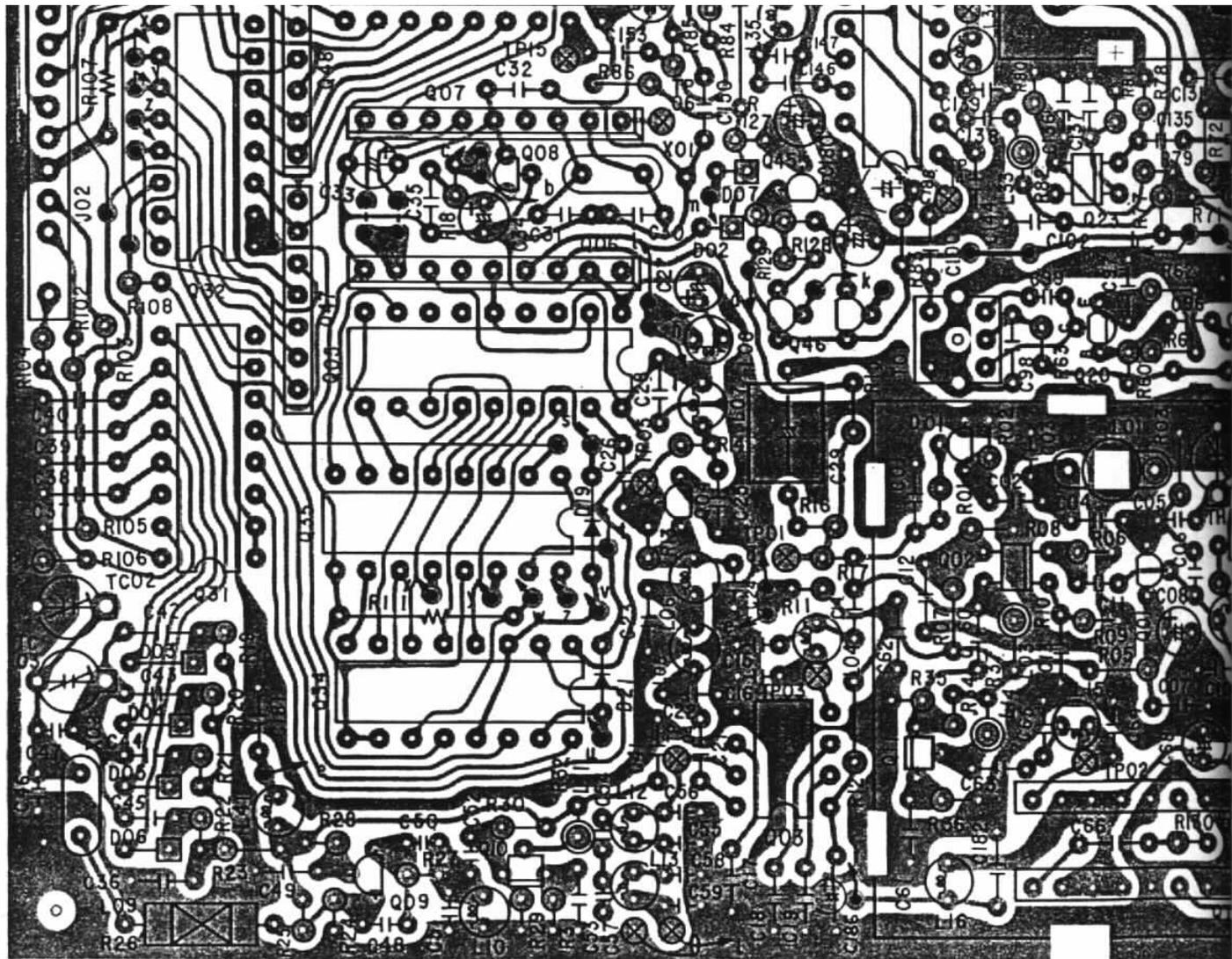
# PARTS LAYOUT PLL UN



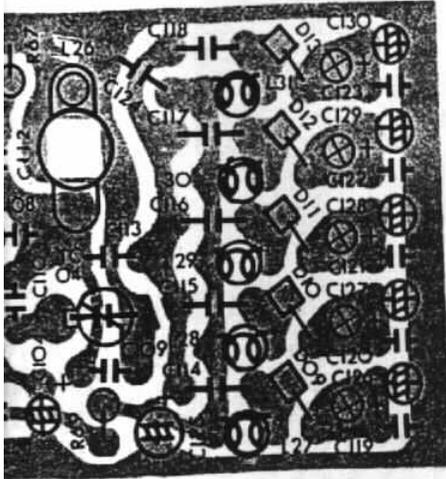
Viewed



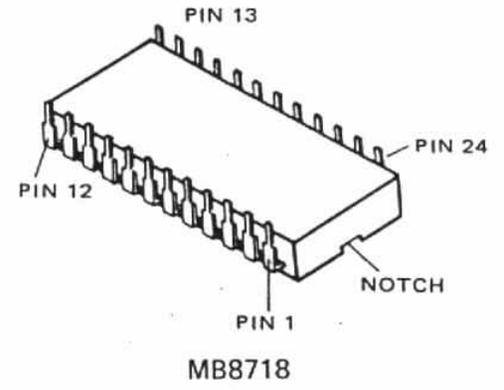
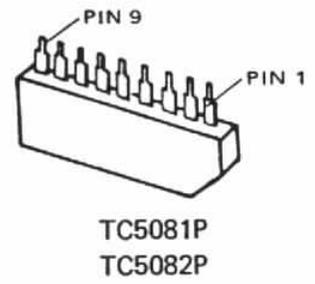
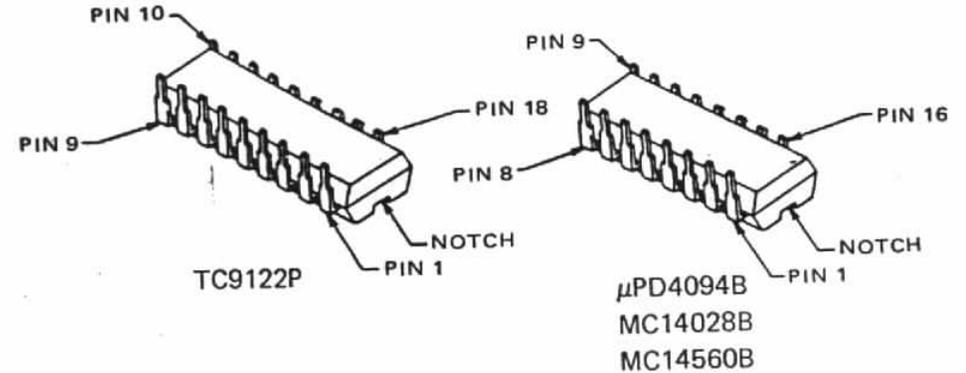
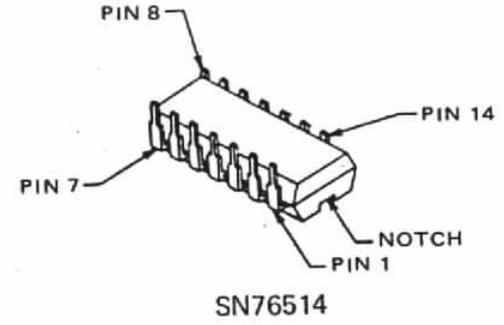
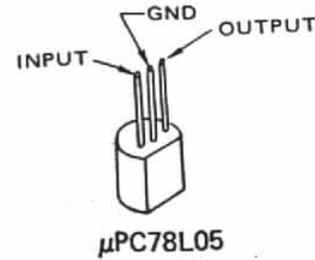
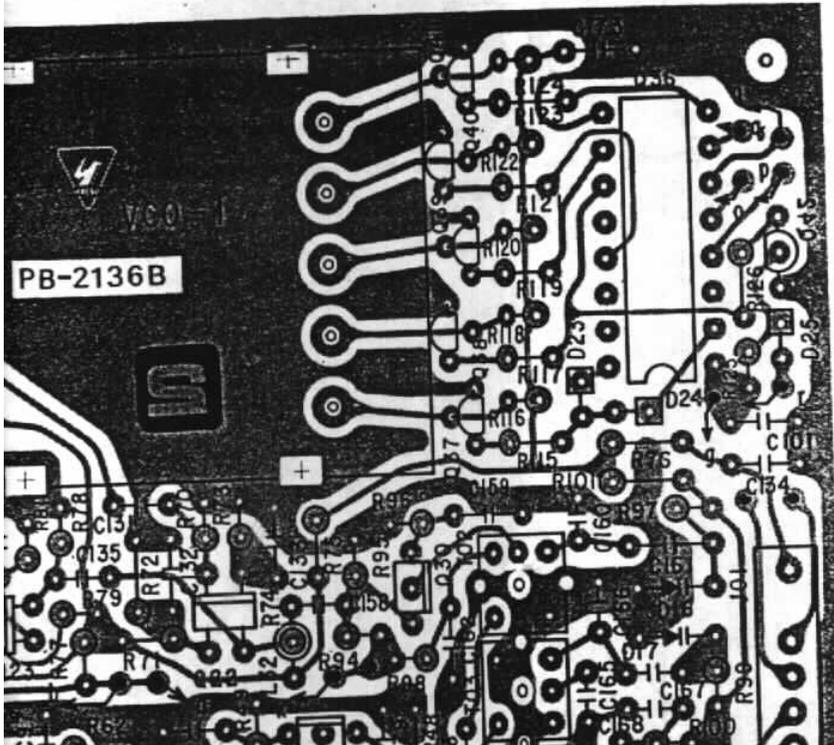
PB-2136E



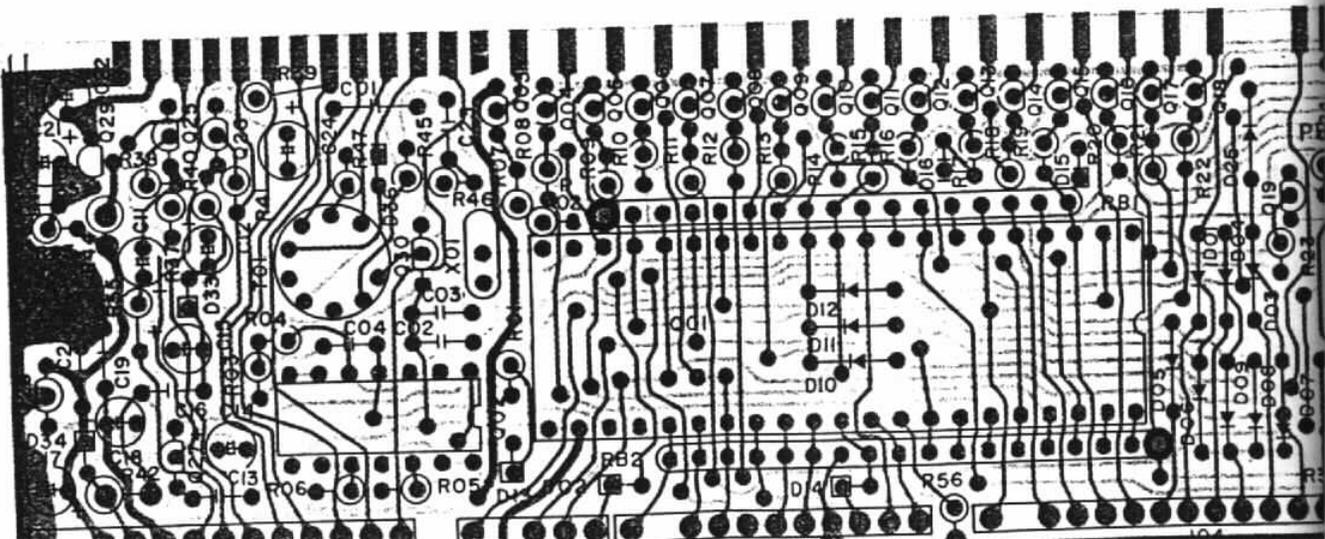
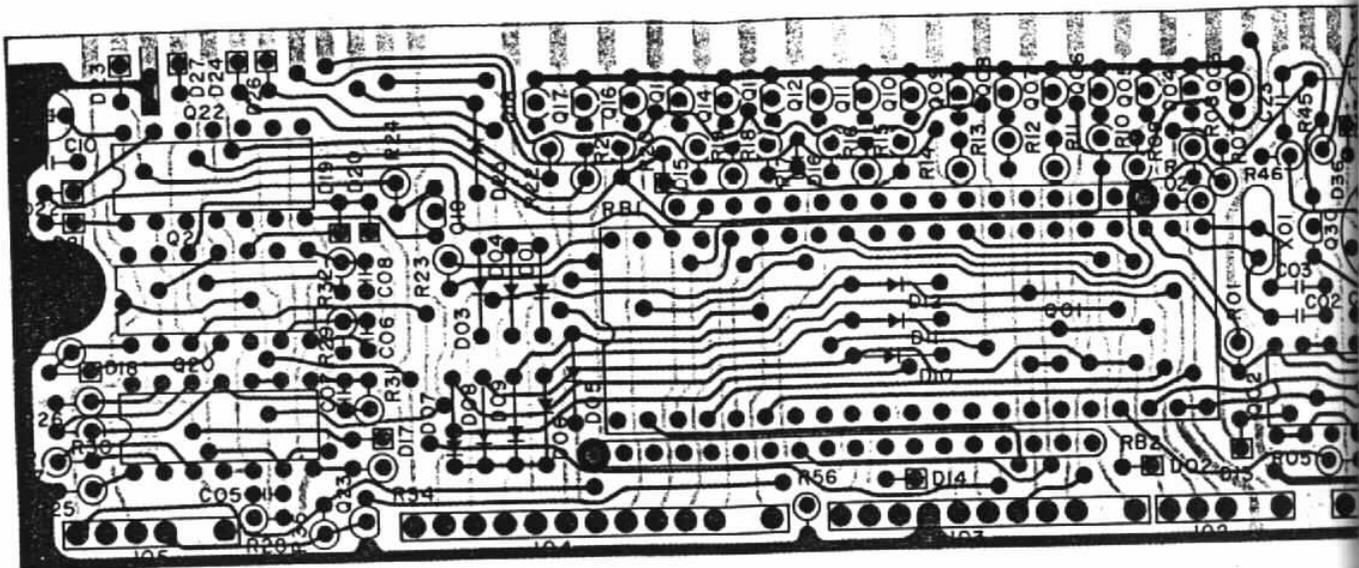
# LL UNIT(PB-2136), VC0 1 UNIT(PB-2137A)



Viewed from component side

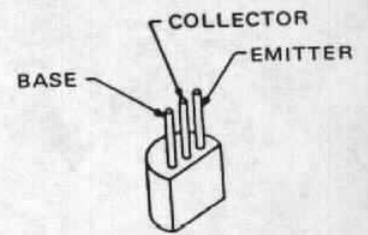




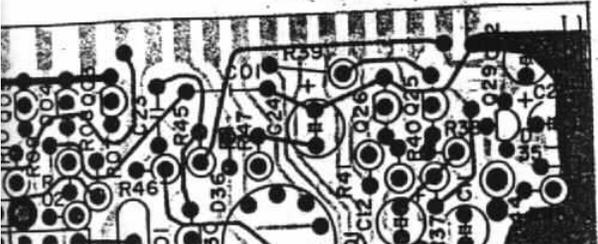


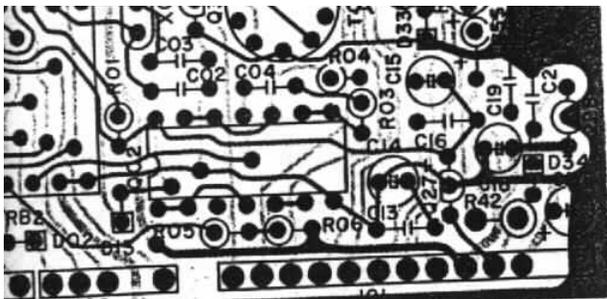


RTS LAYOUT PLL CONTROL UNIT(PB-2138)

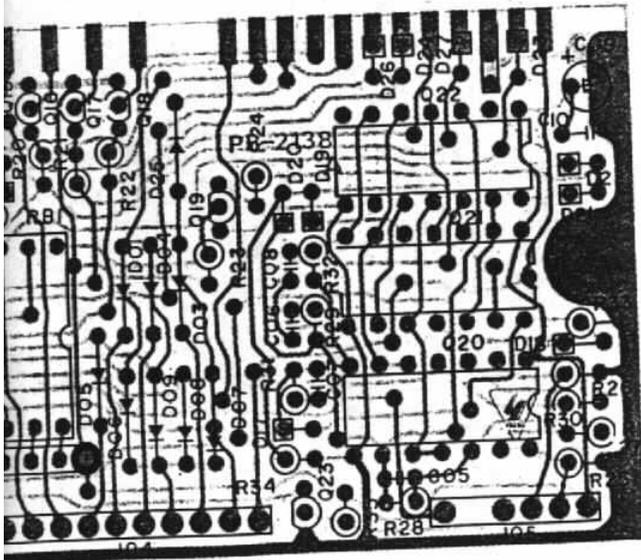


- 2SA733P/Q
- 2SC945Q/K/P
- 2SC1383R
- 2SC2002L

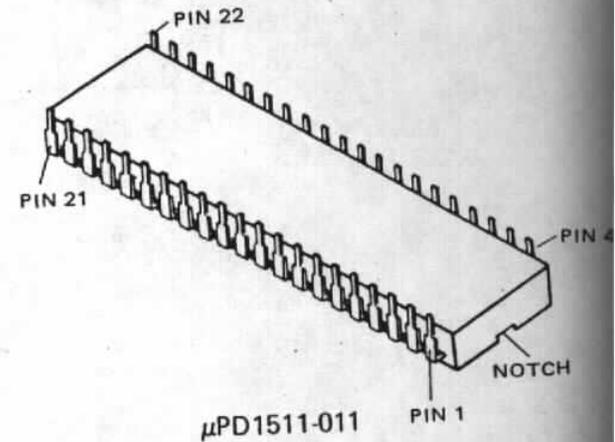
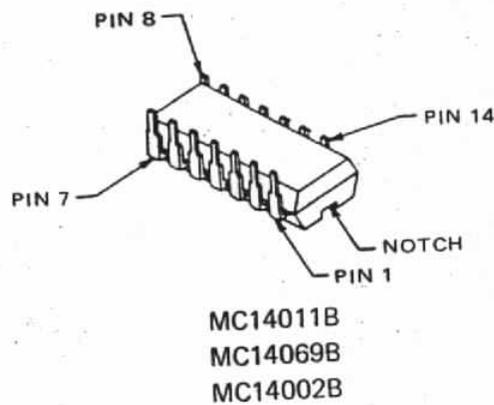
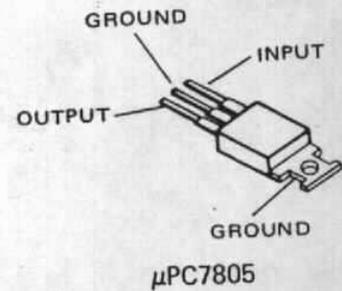
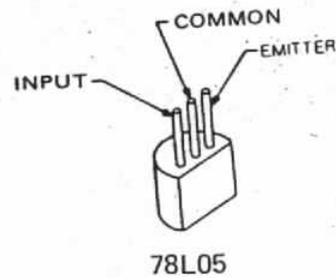




Viewed from component side

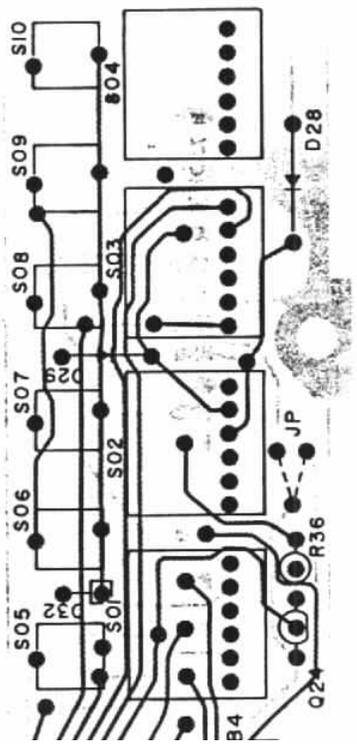


Viewed from solder side

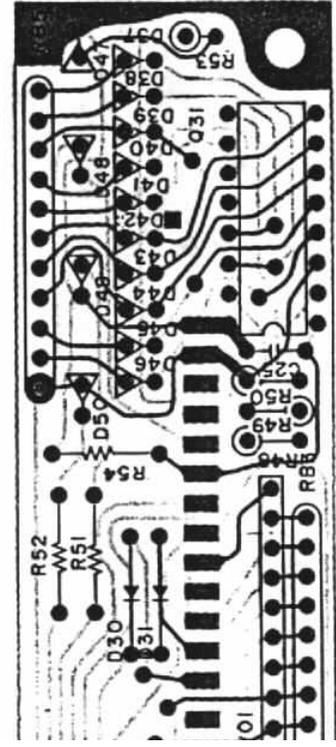


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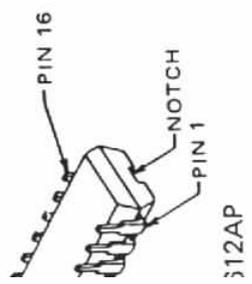
(PB-2139)



Viewed from component side

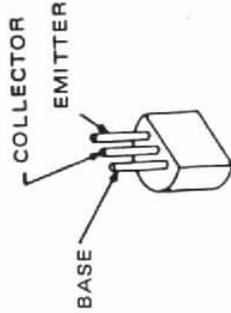
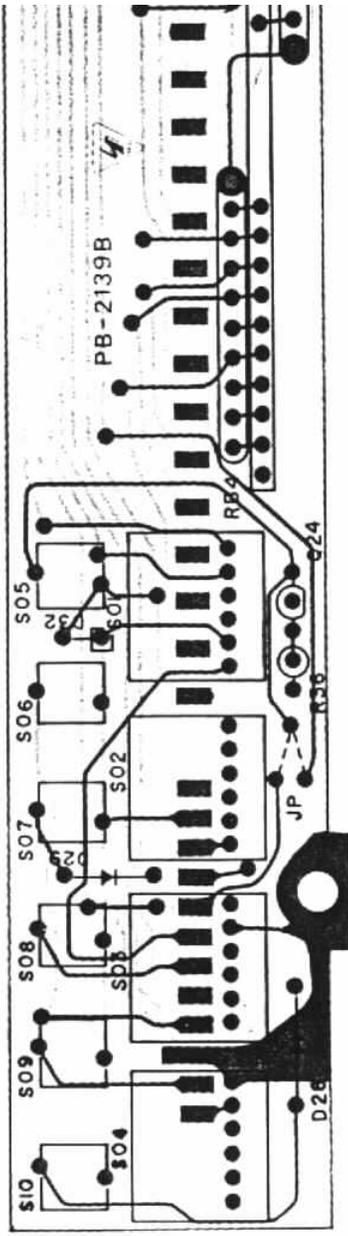
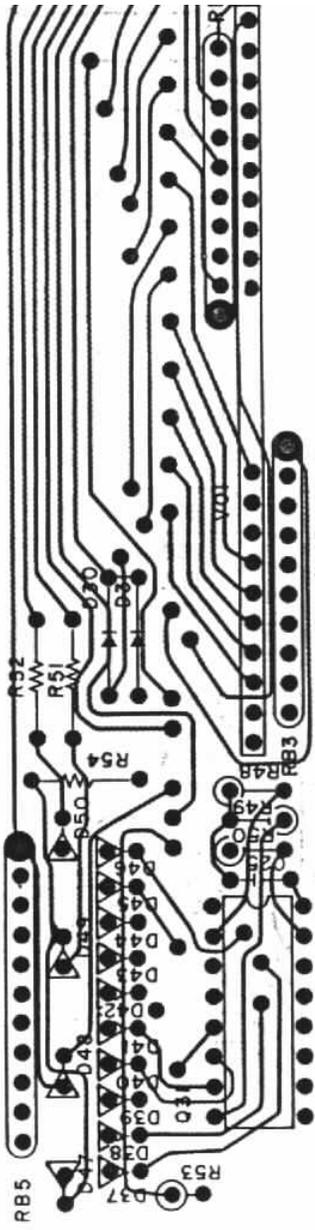


Viewed from solder side

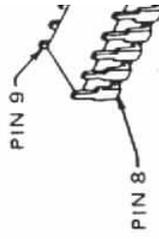


SERVICING

# PARTS LAYOUT DISPLAY UNIT



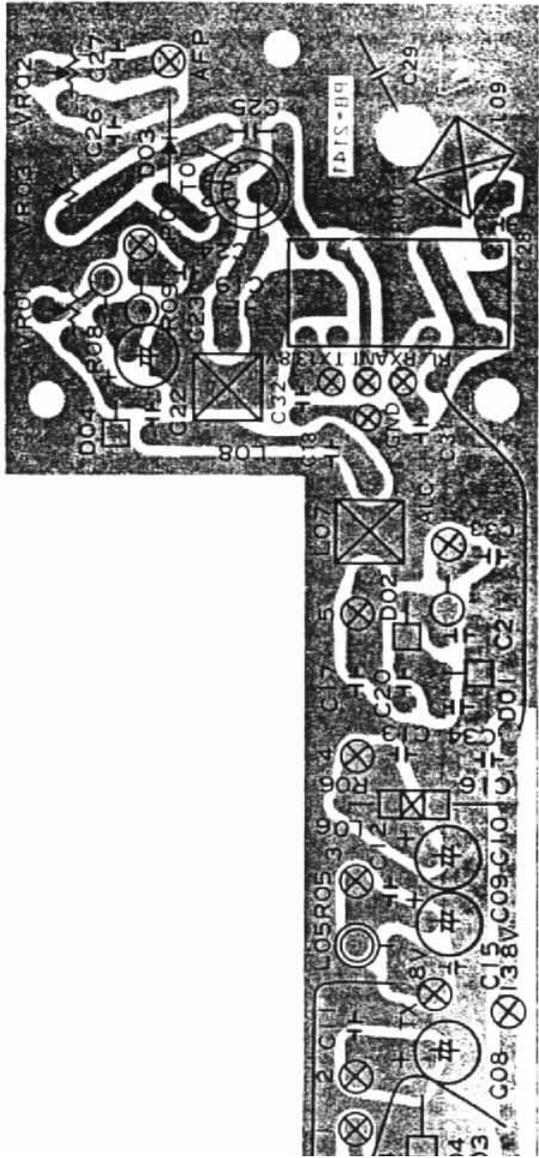
2SC945P/Q



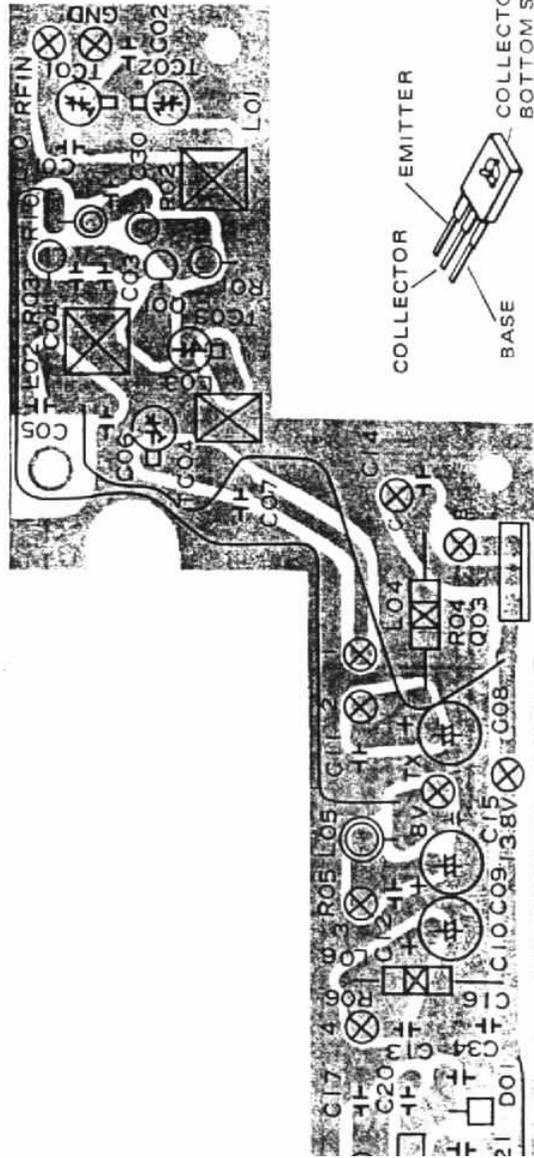
TA7E

# SERVICING

## S LAYOUT P UNIT(PB-2141)



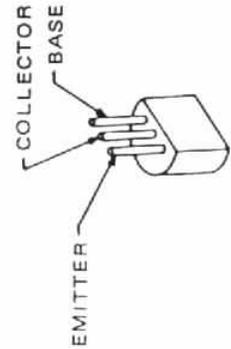
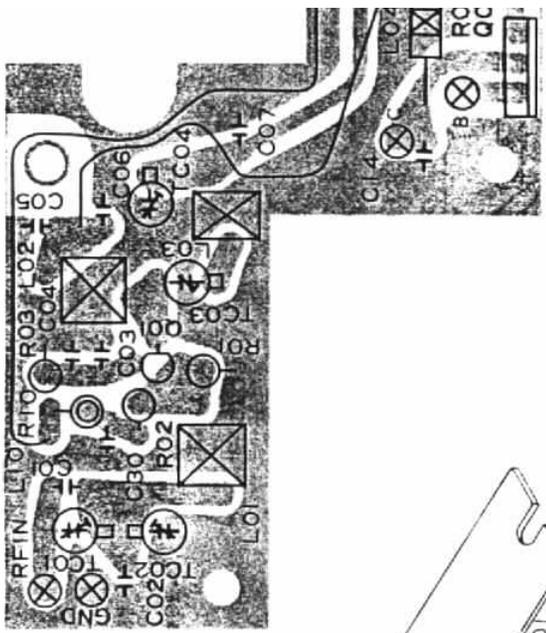
Viewed from component side



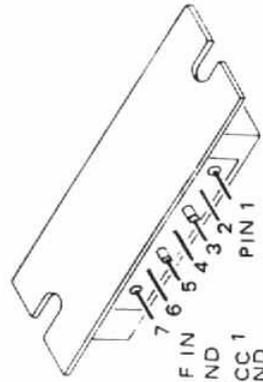
Viewed from solder side

2SA715C

**PART  
POWER AM**

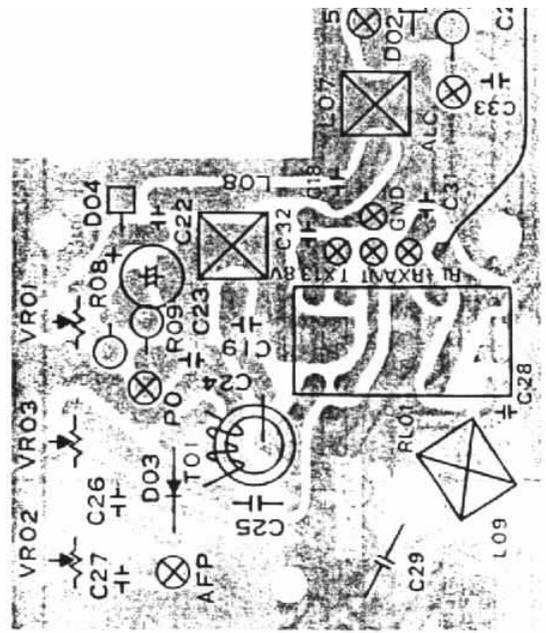


2SC2053

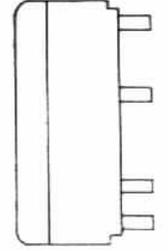
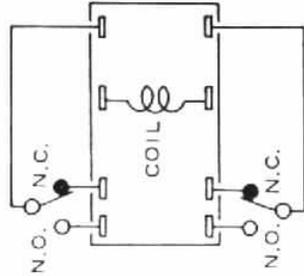


- PIN 1. RF IN
- 2. GND
- 3. V<sub>CC</sub> 1
- 4. GND
- 5. V<sub>CC</sub> 2
- 6. GND
- 7. RF OUT

M57713



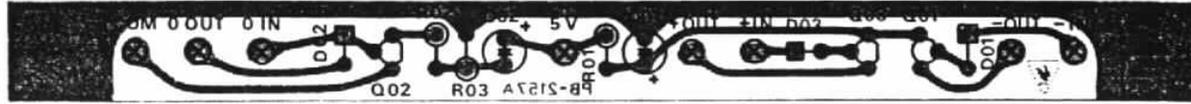
RELAY CONNECTIONS



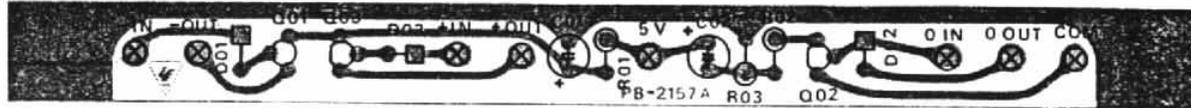
RL2001

**PARTS LAYOUT**

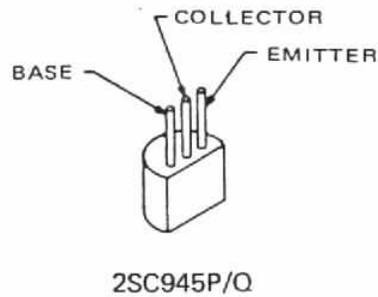
### REPEATER SHIFT UNIT (PB-2157)



Viewed from component side

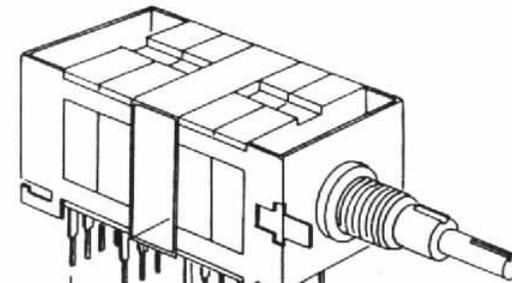
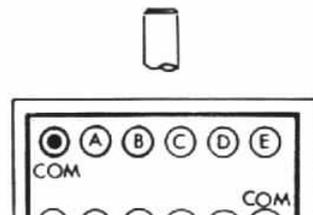


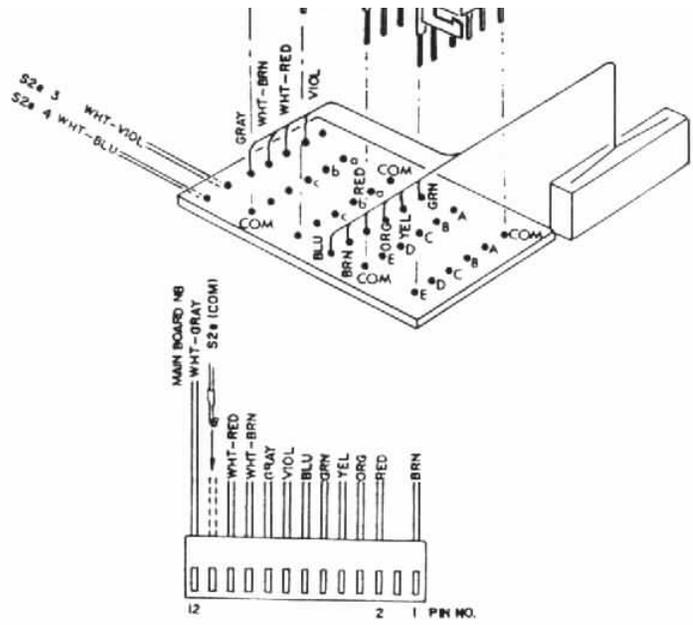
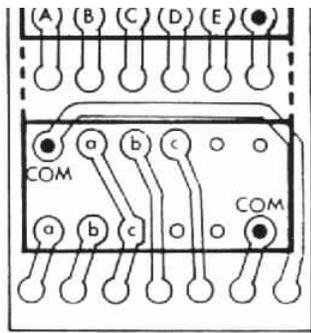
Viewed from solder side



2SC945P/Q

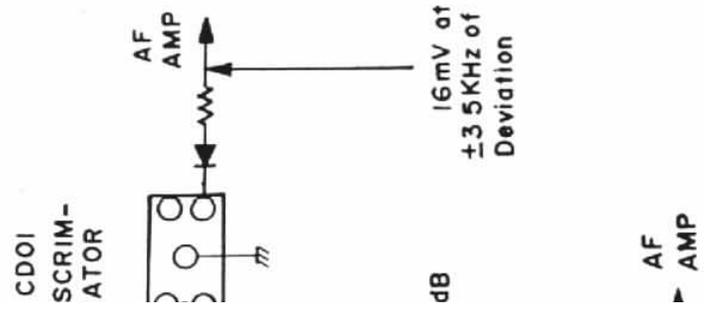
### MEMORY STEP UNIT (PB-2143)



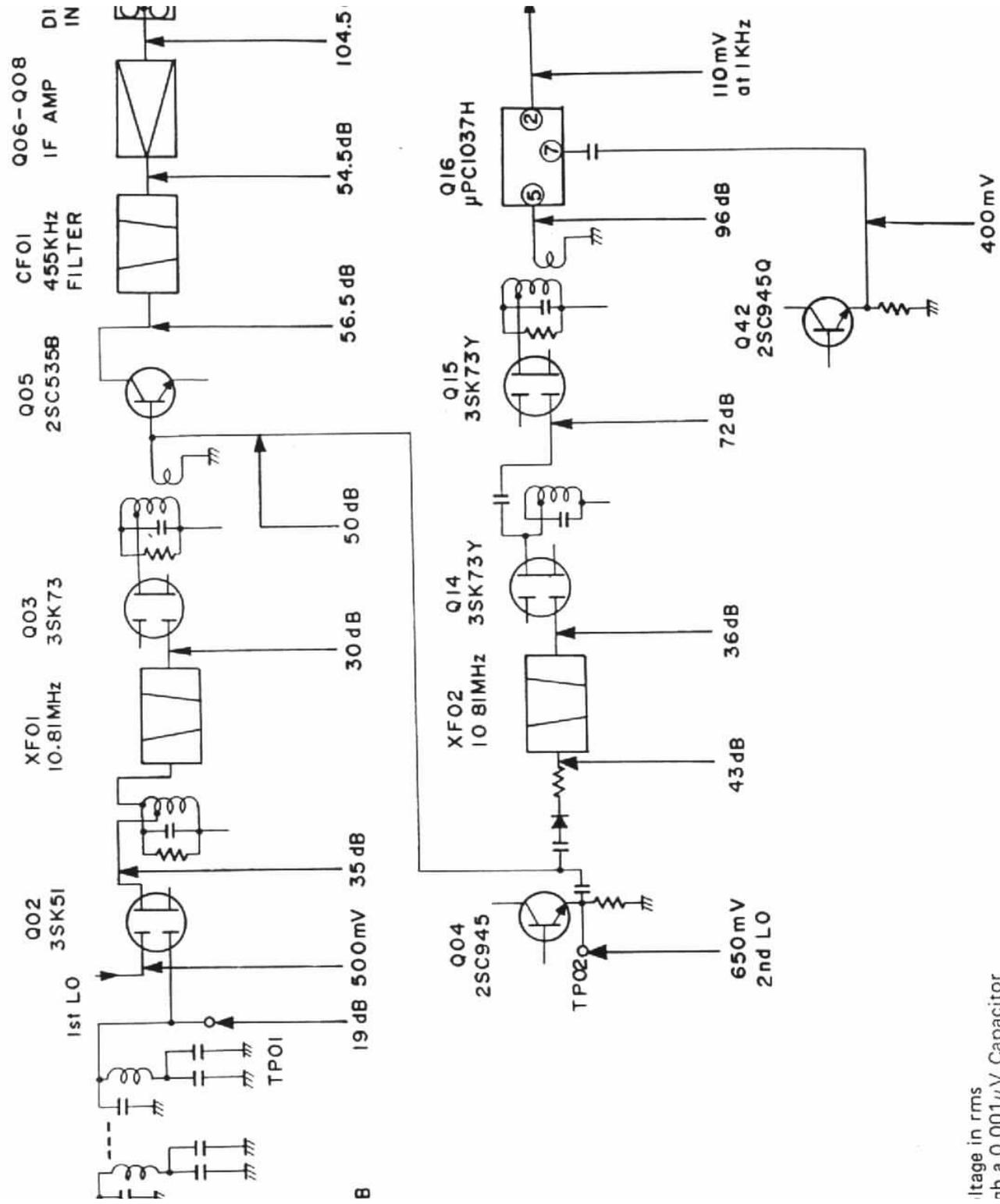


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SERVICING



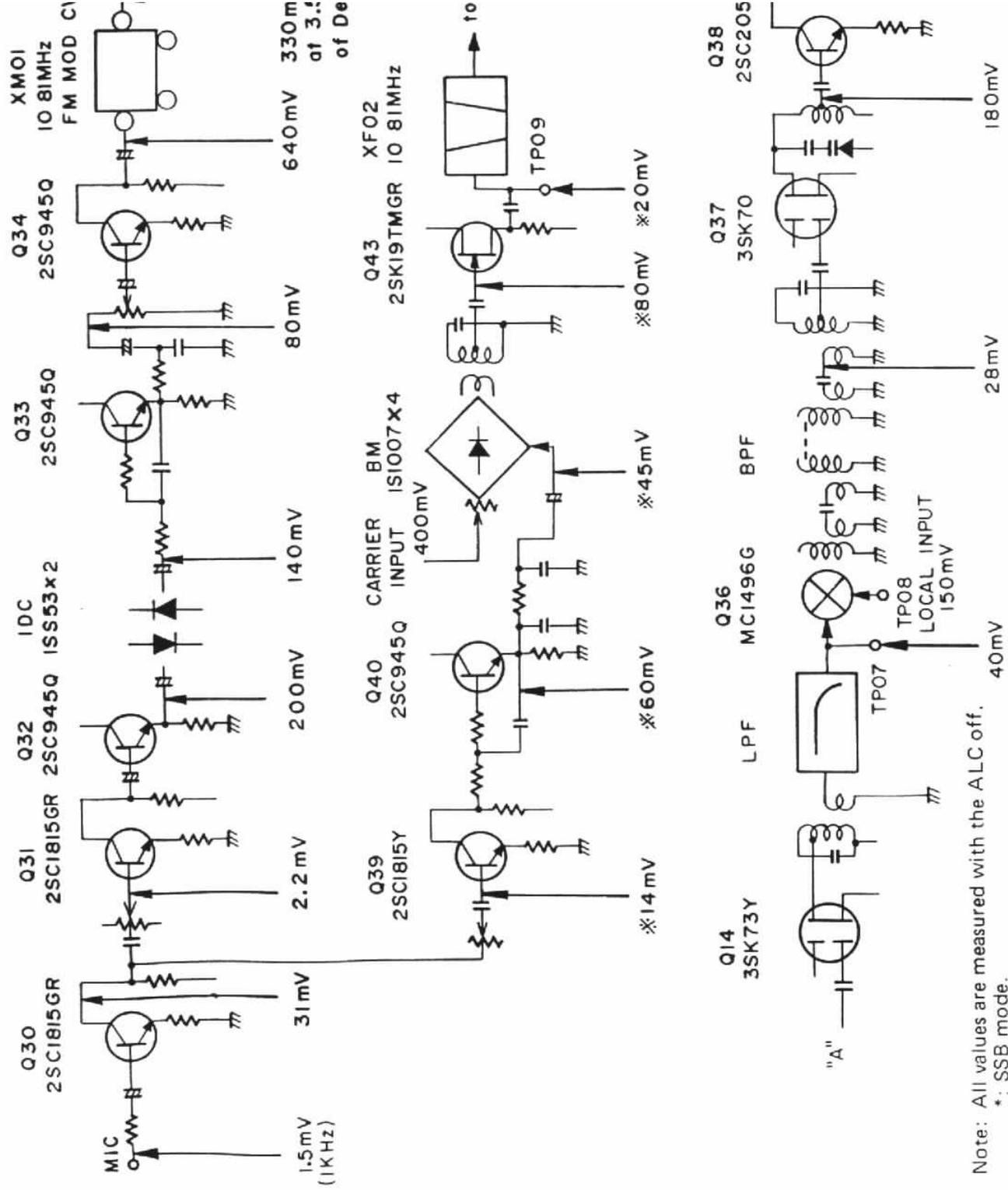
## LEVEL DIAGRAM:RECEIVER SECTION



Voltage in rms  
with a 0.001 $\mu$ V Capacitor



# LEVEL DIAGRAM: TRANSMITTER SECTION



Note: All values are measured with the ALC off.  
 \*: SSB mode.

## SERVICING

## VOLTAGE CHART

(DC VOLTS)

	RX				TX				MODE
	E E(S)	C C(D)	B B(G)	(G2)	E(S)	C(D)	B(G) S	(G2)	
Q1001	2.1	7.5	2.2	4					FM
Q1002	0.2	7.8	0	0.2					FM
Q1003	1.9	7.3	2.2	2.9					FM
Q1004	1.4	7.9	0.9	-					FM
Q1005	0.5	5.6	1.2	-					FM
Q1006	0	1.2	0.6	-					FM
Q1007	3.4	4.6	3.9	-					FM
Q1009	0	1.0	0.6	-					FM
Q1010	3.3	4.5	3.9	-					FM
Q1011	0	1.8	0.4	-					FM
Q1012	1.2	3.1	1.8	-					FM
Q1013	0	0	0.8	-					FM
Q1014	2.1	7.6	2.2	4.8					FM
Q1015	2.1	7.5	2.2	4.8					FM
Q1017	2.6	6.2	1.9	-					FM
Q1018	0	4.8	0.1	-					FM
Q1019	0	7.9	0	-					FM
Q1020	5.5	4.8	7.9	-					FM
Q1021 *	8.0	5.3	4.4	-					FM
Q1022	4.0	0.1	3.4	-					FM
Q1027	1.7	3.4	2.3	-					FM
O1028	2.5	5.9	3.1	-					FM

Q1030					1.5	5.0	2.0	—	FM
Q1031					1.7	7.2	3.3	—	FM
Q1032					2.7	7.2	3.3	—	FM
Q1033					2.7	7.2	3.3	—	FM
Q1034					0.5	5.0	1.2	—	FM
Q1035					1.0	7.1	1.6	—	FM
Q1037					0.7	7.7	0.9	3.0	FM
Q1038					0.3	13.8	1.0	—	FM
Q1039					1.6	4.1	2.2	—	SSB
Q1040					3.2	6.1	3.8	—	SSB
Q1041	1.8	7.1	2.2	—					SSB
Q1042	2.9	5.8	3.6	—					SSB
Q1043					2.9	5.0	2.2	—	SSB
Q1044					2.6	7.7	2.3	—	CW
Q1046					5.5	12.8	6.2	—	FM
Q1047	2.6	7.7	3.3	—					FM
Q1051	0	6.7	0.2	—					FM
Q1052	0	2.9	0	(NB ON)					FM
Q1053	0	4.9	0.4	—					FM
Q1054	0	4.9	0.1	—					FM
Q1055	0	13.8	0	(SAT OFF)					FM
Q1056	0	0	0.6	(SAT OFF)					FM
Q1058	4.9	0.8	4.9	—					FM
Q1059	0	0	0.6	—	0	0	0.6	—	CW
Q1062	0	0.1	0.7	—					FM
Q1063	0	5.5	0	—					FM

Measured with VTVM.

## SERVICING

(DC VOLTS)

	RX				TX				MODE
	E G1	C G2	B S	D	E G1	C G2	B S	D	
Q2001	0.9	13.8	0.1						FM
Q2003	13.8	0	13.3		13.8	11.1	9.5		(High)
(Input PWR = 0)	13.8	1.9	13.2		13.8	2.8	11.1		(Low)
Q3001	0	—	0.9	7.3					FM
Q3002	0	3.9	0.2	7.8					FM
Q3004	0	2.5	0.6						FM
Q3009	1.6	7.8	2.3						FM
Q3010	0.7	8.0	1.5						FM
Q3011	0.7	7.8	1.5						FM
Q3015	1.5	7.4	2.2						FM
Q3016	0.7	7.8	1.4						FM
Q3017	0	3.8	0.3	7.8					FM
Q3019	0	2.8	0.6						FM
Q3020	0.5	7.3	0.8						FM
Q3021	0	—	0.6	7.7					FM
Q3022	0	3.8	0.4	7.7					FM
Q3023	0	3.8	0.5	7.7					FM
Q3025	0	2.6	0.6						FM
Q3028	0.9	—	0.8	7.9					FM
Q3029	0.1	4.8	0.8						FM
Q3030	0.8	7.6	1.5						FM
Q3037	0	3.9	0.2						FM
Q3038	0	0.1	0.7						FM
Q3039	0	3.9	0						FM
Q3040	0	3.9	0						FM
Q3041	0	3.9	0						FM
Q3045	0	0.7	1.3						FM
Q3046	8.0	8.0	7.3						FM
Q4025					0.6	1.8	1.2		FM
Q4026	0	8.6	0						FM
Q3029	10.0	13.5	10.6		10.0	12.5	10.6		FM

(DC VOLTS)

	RX/TX	1 (*B)	2 (*C)	3 (*E)	4 (*C)	5 (*B)	6	7	8	9	10	11	12	13	14	MODE
Q1008	RX	5.1	1.7	1.8	0	2.6	2.3	5.6								FM
Q1016	RX	6.7	5.9	5.4	0	3.0	3.0	3.0								FM
Q1029	RX	0.7	0.7	0	6.6	13.7										FM
Q1036	TX	2.3	1.6	1.6	2.3	2.3	8	4.3	4.3	8	0					FM
*Q1048	RX	3.4	7.6	3.8	7.6	4.5										FM
*Q1049	RX	4.5	7.6	3.8	7.6	4.5										FM
*Q1050	RX	2.4	7.6	2.8	7.6	2.4										FM
Q1060	RX	4.9	0	4.9	4.9	0	0	0	4.9	4.4	0	4.9	1.2	1.2	4.9	CW
	TX	4.9	4.6	0.2	4.9	0	0	0	4.9	4.4	0	4.9	0.1	0.1	4.9	CW
Q1061	RX	4.9	4.9	0	0	4.9	4.9	0	0.7	0.7	4.7	4.9	4.6	0	4.9	CW
	TX	2.6	2.6	2.3	0	3.8	3.8	0	0	0	4.8	2.6	2.4	4.8	4.9	CW
Q2002	TX	0	13.7	8.0	13.8	0	(RF INPUT = 0, HI/LOW switch in "HI" position)									FM
Q3003	RX	5.8	3.5	2.5	0	2.5	3.5	3.5	7.0							FM
Q3018	RX	5.8	3.4	2.5	0	2.5	3.4	3.4	6.9							FM
Q3024	RX	0	7.7	6.9	3.9	2.5	0	0	0	2.5	3.8	3.8	3.9	7.0	0	FM

	IN	COM	OUT
Q3008	7.4	0	5.0
Q3044	8	0	5.0

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SERVICING

PLL UNIT LOGIC CHART

OPERATING FREQUENCY (MHz)	PLL LOCAL FREQUENCY (MHz)	Q3033 (μPD4094B)				Q3032 (μPD4094B)				Q3031 (μPD4094B)							
		11	12	13	14	7	6	5	4	11	12	13	14	7	6	5	4





DISPLAY FREQUENCY	Q3026 DIVIDING RATIO	Q3026 (TC9122P)											
		14	13	12	11	10	9	8	7	6	5	4	3
144.00	1/400	0	1	0	0	0	0	0	0	0	0	0	0
.01	1/401	0	1	0	0	0	0	0	0	0	0	0	1
.02	1/402	0	1	0	0	0	0	0	0	0	0	1	0
.03	1/403	0	1	0	0	0	0	0	0	0	0	1	1
.04	1/404	0	1	0	0	0	0	0	0	0	0	1	0
.05	1/405	0	1	0	0	0	0	0	0	0	1	0	1
.06	1/406	0	1	0	0	0	0	0	0	0	1	1	0
.07	1/407	0	1	0	0	0	0	0	0	0	1	1	1
.08	1/408	0	1	0	0	0	0	0	0	1	0	0	0
.09	1/409	0	1	0	0	0	0	0	0	1	0	0	1
144.10	1/410	0	1	0	0	0	0	0	1	0	0	0	0
.20	1/420	0	1	0	0	0	0	1	0	0	0	0	0
.30	1/430	0	1	0	0	0	0	1	1	0	0	0	0
.40	1/440	0	1	0	0	0	1	0	0	0	0	0	0
.50	1/450	0	1	0	0	0	1	0	1	0	0	0	0
.60	1/460	0	1	0	0	0	1	1	0	0	0	0	0
.70	1/470	0	1	0	0	0	1	1	1	0	0	0	0
.80	1/480	0	1	0	0	1	0	0	0	0	0	0	0
.90	1/490	0	1	0	0	1	0	0	1	0	0	0	0
145.00	1/500	0	1	0	1	0	0	0	0	0	0	0	0
146.00	1/600	0	1	1	0	0	0	0	0	0	0	0	0
147.00	1/700	0	1	1	1	0	0	0	0	0	0	0	0
148.00	1/800	1	0	0	0	0	0	0	0	0	0	0	0

1 - HI LEVEL  
0 - LOW LEVEL

SERVICING

DISPLAY FREQUENCY	Q3035 (MC14560B)									Q3034 (MC14560B)							
	IN				OUT					IN				OUT			
	5	3	1	15	9	10	11	12	13	5	3	1	15	10	11	12	13
144.000.0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	1
.1	0	0	0	0	0	0	0	0	1	0	0	0	1	0	1	1	0
.2	0	0	0	0	0	0	0	0	1	0	0	1	0	0	1	1	1
.3	0	0	0	0	0	0	0	0	1	0	0	1	1	1	0	0	0
.4	0	0	0	0	0	0	0	0	1	0	1	0	0	1	0	0	1
.5	0	0	0	0	0	0	0	1	0	0	1	0	1	0	0	0	0
.6	0	0	0	0	0	0	0	1	0	0	1	1	0	0	0	0	1
.7	0	0	0	0	0	0	0	1	0	0	1	1	1	0	0	1	0
.8	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	1	1
.9	0	0	0	0	0	0	0	1	0	1	0	0	1	0	1	0	0
144.001.0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	1	0	1
2.0	0	0	1	0	0	0	0	1	1	0	0	0	0	0	1	0	1
3.0	0	0	1	1	0	0	1	0	0	0	0	0	0	0	1	0	1
4.0	0	1	0	0	0	0	1	0	1	0	0	0	0	0	1	0	1
5.0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
6.0	0	1	1	0	0	0	1	1	1	0	0	0	0	0	1	0	1
7.0	0	1	1	1	0	1	0	0	0	0	0	0	0	0	1	0	1
8.0	1	0	0	0	0	1	0	0	1	0	0	0	0	0	1	0	1

9.0	1	0	0	1	1	0	0	0	0	0	0	0	0	0	0	1	0	1
144.010.0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	1

1 - HI LEVEL  
0 - LOW LEVEL

DISPLAY FREQUENCY	Q3035 (MC14560B)													Q3034 (MC14560B)												
	IN						OUT							IN						OUT						
	5	1	3	15	6	4	2	14	9	10	11	12	13	5	1	3	15	6	4	2	14	10	11	12	13	
144.005.0 (FM)	0	1	0	1	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	1	0	1	
144.005.0 (CW)	0	1	0	1	0	0	0	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0	1	0	
144.005.0 (USB)	0	1	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
144.005.0 (LSB)	0	1	0	1	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	

1 - HI LEVEL  
0 - LOW LEVEL

## SERVICING

DISPLAY FREQUENCY	Q3005 DIVIDING RATIO	Q3005 (TC9122P)									
		14	11	10	9	8	7	6	5	4	3
144.000.0	1/815	1	0	0	0	0	1	0	1	0	1
.1	1/816	1	0	0	0	0	1	0	1	1	0
.2	1/817	1	0	0	0	0	1	0	1	1	1
.3	1/818	1	0	0	0	0	1	1	0	0	0
.4	1/819	1	0	0	0	0	1	1	0	0	1
.5	1/820	1	0	0	0	1	0	0	0	0	0
.6	1/821	1	0	0	0	1	0	0	0	0	1
.7	1/822	1	0	0	0	1	0	0	0	1	0
.8	1/823	1	0	0	0	1	0	0	0	1	1
.9	1/824	1	0	0	0	1	0	0	1	0	0
144.001.0	1/825	1	0	0	0	1	0	0	1	0	1
2.0	1/835	1	0	0	0	1	1	0	1	0	1
3.0	1/845	1	0	0	1	0	0	0	1	0	1
4.0	1/855	1	0	0	1	0	1	0	1	0	1
5.0	1/865	1	0	0	1	1	0	0	1	0	1
6.0	1/875	1	0	0	1	1	1	0	1	0	1
7.0	1/885	1	0	1	0	0	0	0	1	0	1
8.0	1/895	1	0	1	0	0	1	0	1	0	1
9.0	1/905	1	1	0	0	0	0	0	1	0	1
144.010.0	1/815	1	0	0	0	0	1	0	1	0	1

The BCD output signal from adder Q3035/Q3034 is applied to a programmable divider to select its dividing ratio. The data at pins 7, 8, 9 and 10 of Q3005 represents the 1 kHz digit of the dividing ratio, and the data at pins 3, 4, 5 and 6, represents the 100 Hz digit.

1 - HI LEVEL  
0 - LOW LEVEL

OPERATING FREQUENCY	Q3031( $\mu$ PD4094B)				Q3009 VXO				
	7	6	5	4	D3007	D3006	D3005	D3004	D3003
144.000.00	0	0	0	0	ON	ON	ON	ON	ON
.01	0	0	0	1	ON	ON	ON	ON	OFF
.02	0	0	1	0	ON	ON	ON	OFF	ON
.03	0	0	1	1	ON	ON	ON	OFF	OFF
.04	0	1	0	0	ON	ON	OFF	ON	ON
.05	0	1	0	1	ON	ON	OFF	ON	OFF
.06	0	1	1	0	ON	ON	OFF	OFF	ON
.07	0	1	1	1	ON	ON	OFF	OFF	OFF
.08	1	0	0	0	ON	OFF	ON	ON	ON
.09	1	0	0	1	ON	OFF	ON	ON	OFF
144.000.10	0	0	0	0	ON	ON	ON	ON	ON

The BCD code at pins 4, 5, 6 and 7 of Q3031 represents the 10 Hz digit of the dividing ratio. Selection of the required diode switch, D3003–D3006, is provided by Q3031, according to the dividing ratio selected per the above discussion.

1 – HI LEVEL  
0 – LOW LEVEL

## SERVICING

OPERATING FREQUENCY (MHz)	PLL LOCAL FREQUENCY (MHz)	LOOP-2 OUT FREQUENCY (MHz)	LOOP-2 VCXO FREQUENCY (MHz)	LOOP-3 OUT FREQUENCY (kHz)	Q3009 VXO FREQUENCY (MHz)
144.000.00	133.190.00	129.190.00	64.595.000	677.900.099	63.915.099
.01	.01	.01	.005	.104	.104
.02	.02	.02	.010	.109	.109
.03	.03	.03	.015	.114	.114
.04	.04	.04	.020	.119	.119
.05	.05	.05	.025	.124	.124
.06	.06	.06	.030	.129	.129
.07	.07	.07	.035	.134	.134
.08	.08	.08	.040	.139	.139
.09	.09	.09	.045	.144	.144
144.000.10	.10	.10	.050	.099	.099

2-30

## MAINTENANCE AND ALIGNMENT

### SERVICING

This equipment has been carefully aligned and tested at the factory prior to shipment. If the instrument is not abused, it should not require other than the usual attention given to electronic equipment.

Service or replacement of a major component may

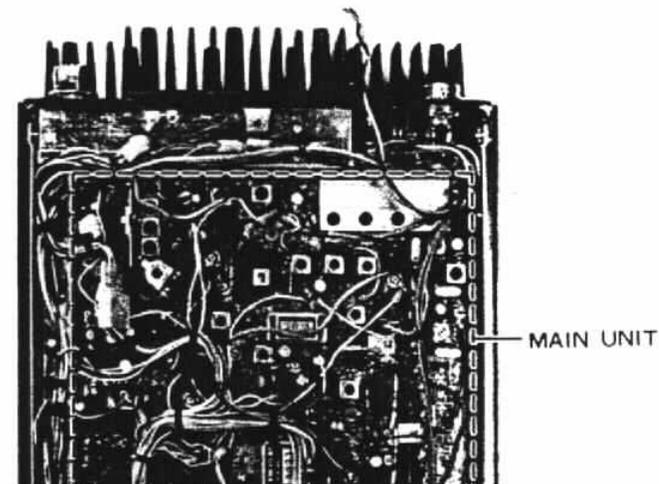
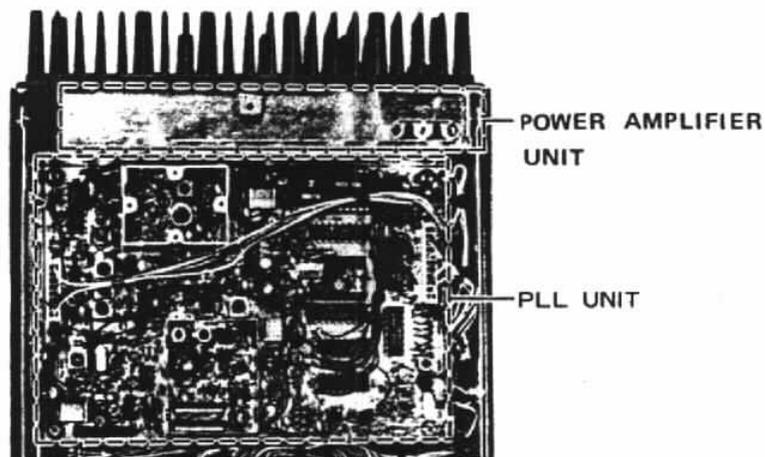
### EQUIPMENT REQUIRED

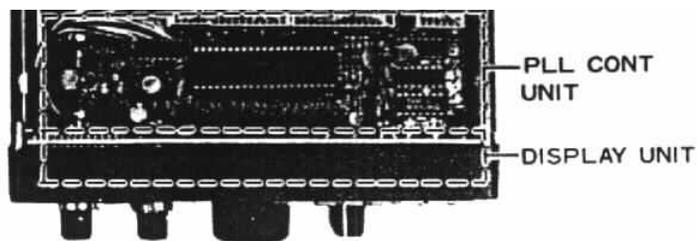
- (1) RF Signal Generator: Hewlett-Packard Model 8640B or equivalent, with one volt output at 50 ohms, and frequency coverage to 150 MHz.

require considerable realignment. Under no circumstances, though, should realignment be attempted unless the operation of the transceiver is fully understood, the malfunction has been carefully analyzed, and the fault has definitely been traced to misalignment rather than part failure. Service work must only be performed by experienced personnel using the proper test equipment.

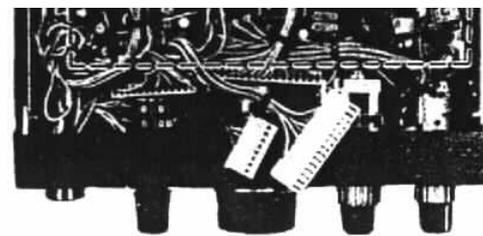
Never align this transceiver without having a 50 ohm dummy load connected to the antenna jack, unless otherwise noted. Troubleshooting using an antenna can result in misleading indications on test equipment.

- (2) Vacuum Tube Voltmeter (VTVM): Hewlett-Packard Model 410B or equivalent, with an RF probe good to 150 MHz.
- (3) Dummy Load/Wattmeter: Yaesu Model YP-150Z or equivalent.
- (4) AF Signal Generator: Hewlett-Packard Model 200AB or equivalent.
- (5) IF Sweep Generator: capable of output at 10.81 MHz.
- (6) RF Sweep Generator: capable of output at 143–149 MHz.
- (7) Oscilloscope: Hewlett-Packard Model 1740A or equivalent.
- (8) FM Deviation Meter
- (9) Precision Frequency Counter: Yaesu Model YC-500 or equivalent, with resolution to 0.01 kHz and frequency coverage to 150 MHz.





Top View



Bottom View

## UNIT LOCATIONS

3-31

## SERVICING

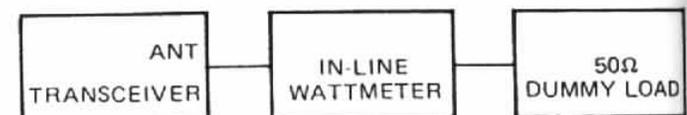
## PERFORMANCE CHECKS

Make all performance checks at 13.8 VDC under load.

Check the transmitter power output as follows:

- (a) Connect a suitable dummy load/wattmeter to the antenna jack.
- (b) Set the MODE switch to the FM position, and key the transceiver while observing the power output, which should be approximately 10 watts. At full power output, 8–9 LED's

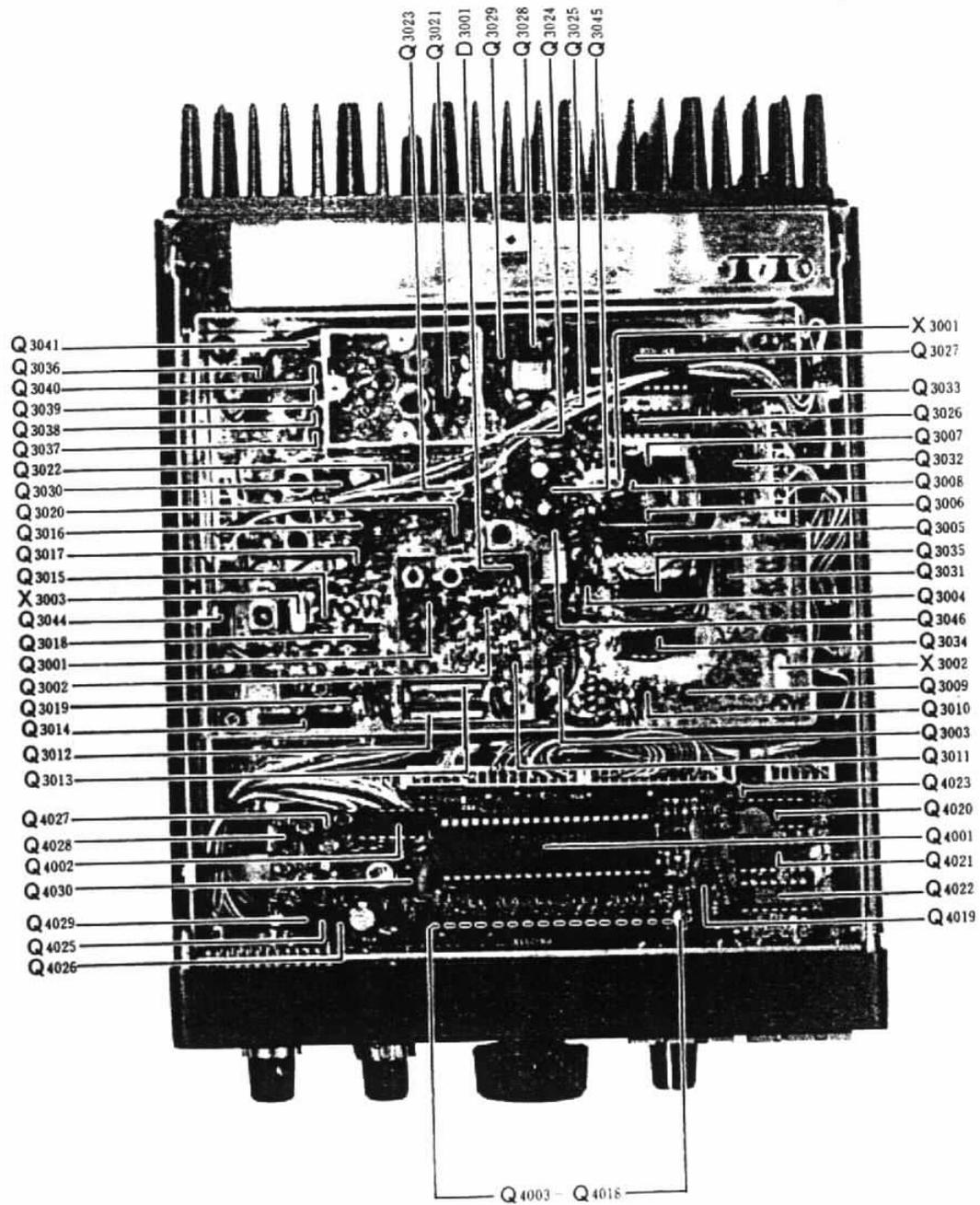
- (c) Set the MODE switch to SSB, and key the transmitter. Speak in a normal voice into the microphone; 8–9 LED's should light up.



Bird Model 43 or equiv.

## PO TEST SETUP

will light up on the S.PO indicator.



## SERVICING

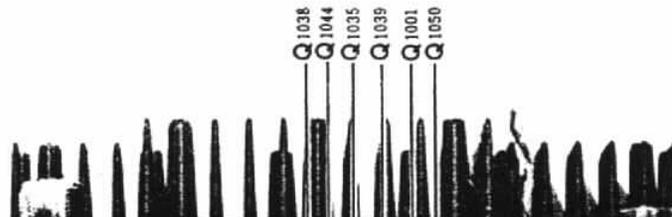
Check the receiver sensitivity as follows:

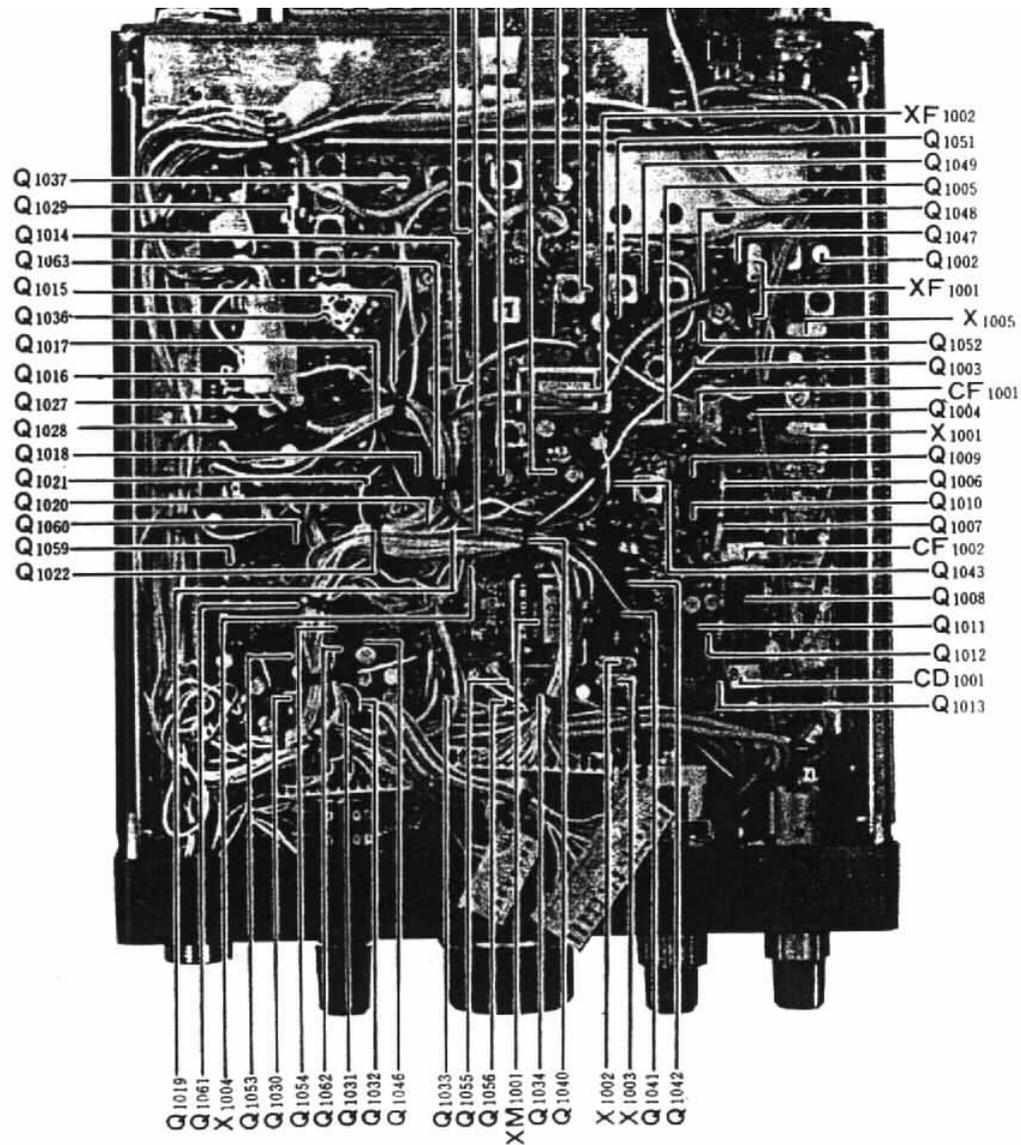
- (a) Connect an AC VTVM to the SP jack. Set the MODE switch to the FM position and rotate the SQUELCH control fully counterclockwise.
- (b) Connect the RF output of a precision VHF signal generator to the antenna jack and note the VTVM reading with no signal input. Adjust the AF GAIN control and the VTVM range, as required, to obtain a full scale VTVM reading. DO NOT change the setting of the AF GAIN control after this calibration has been made.



RX SENSITIVITY TEST SETUP

- (c) Set the signal generator to the receiver frequency of the transceiver, and adjust the output amplitude of the signal generator until the VTVM reads 20 dB (1/10 voltage) below the reading in step (b). The signal generator output voltage at this point is the 20 dB quieting sensitivity, and it should be approximately 0.35  $\mu$ V.





PART LOCATIONS (Bottom View)

## SERVICING

- (d) Set the MODE switch to SSB and connect the AC VTVM to the speaker output. Apply an unmodulated  $0.5 \mu\text{V}$  signal from the signal generator, and tune the transceiver main dial for a maximum VTVM reading.
- (e) Adjust the AF GAIN control for a reading of 450 mV on the VTVM.
- (f) Reduce the signal generator output and read the VTVM: the VTVM reading should be 45 mV for a 20 dB S/N ratio.

If the above check indicates a need for realignment, it is recommended that the unit be returned to the dealer for servicing. The sophisticated CPU and control circuitry, in particular, are so critical that they should not be touched by other than an experienced technician. Attempts to realign the transceiver tuned circuits without the proper equipment may result in degraded transceiver performance.

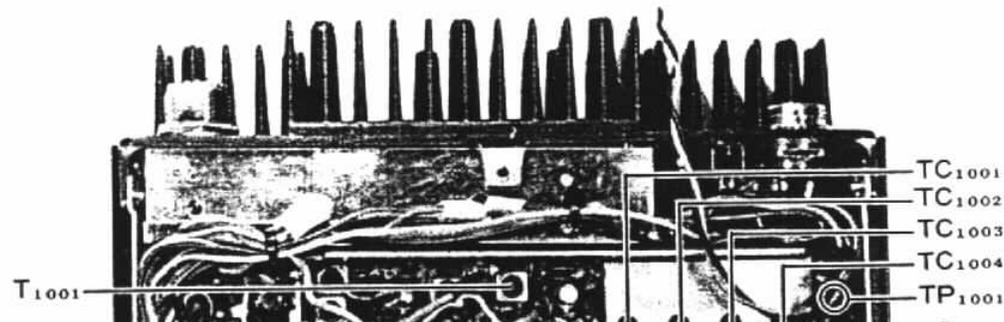
## RECEIVER SECTION

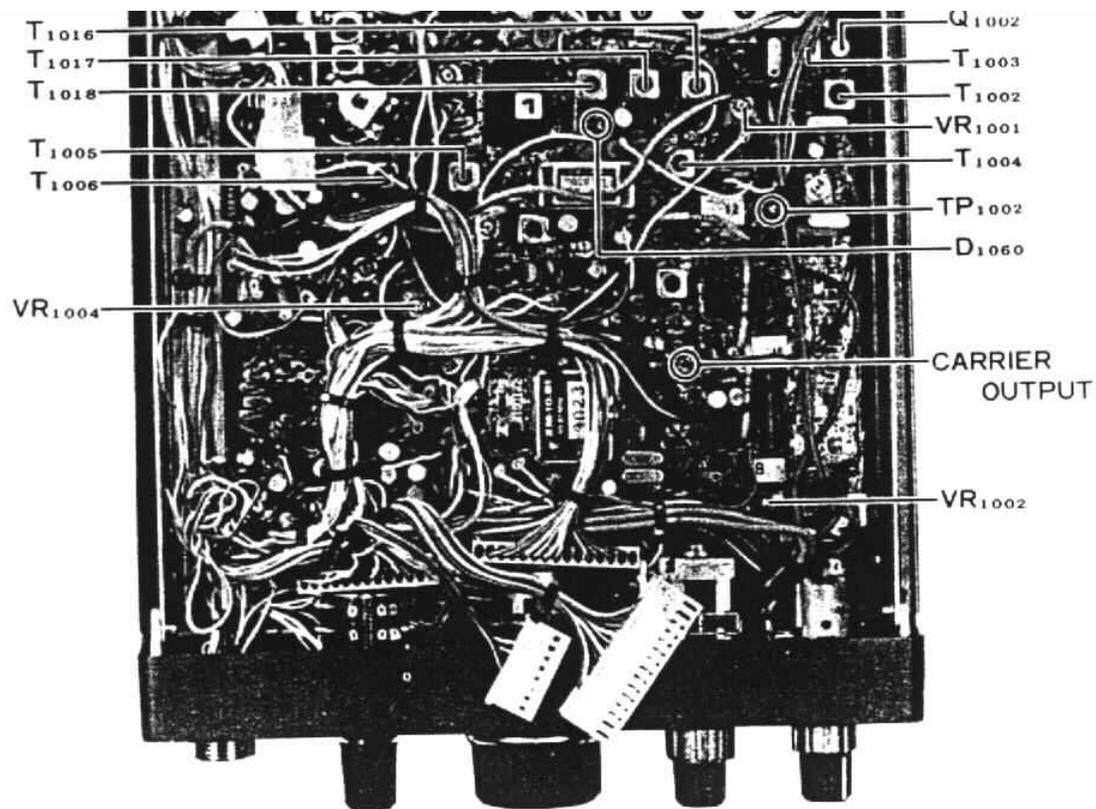
### (1) 2nd Local Oscillator

- a) Set the MODE switch to FM, and connect the RF probe of a VTVM to TP<sub>1002</sub>.
- b) Measure the RF injection voltage. A nominal value is 0.5 V – 0.7 VRMS.
- c) Connect a frequency counter to TP<sub>1002</sub> and check to see that the oscillation frequency is correct: 11.265 MHz.

### (2) 1st IF Amplifier

- a) Set the MODE switch to FM, and adjust VR<sub>1001</sub> to the fully counterclockwise position.





ALIGNMENT AND TEST POINTS FOR RECEIVER

3-34

SERVICING

b) Connect a sweep generator to gate 1 of Q<sub>1002</sub> (TP<sub>1001</sub>). Connect an oscilloscope, through a

(6) S-Meter Full Scale Setting

detector, to the secondary winding of  $T_{1004}$ .

- c) Set the frequency of the sweep generator to 10.81 MHz, and apply output from the generator.
- d) Adjust  $T_{1003}$  and  $T_{1004}$  until the scope pattern illustrated in Fig. 2 is obtained.

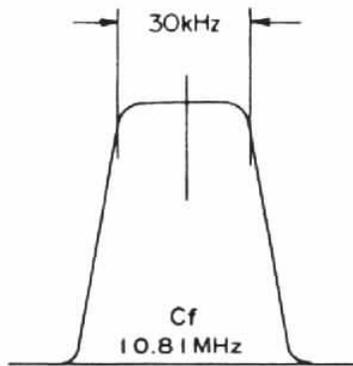


Figure 2

### (3) SSB Carrier Oscillator

- a) Set the MODE switch to LSB.
- b) Connect the RF probe of the VTVM to the CARRIER OUTPUT terminal on the Main Unit (where  $C_{1212}$  and a shielded cable are connected), and measure the oscillation level. A nominal value is 170–230 mV RMS.
- c) Set the MODE switch to USB. Measure the oscillation level in the same way as in the step (b). A nominal value is 170–230 mV RMS.

### (4) SSB IF Circuit

- a) Set the mode switch to USB or LSB.

- a) Rotate  $VR_{1004}$  fully clockwise to make sure that all the LED's on the S-meter scale are illuminated.
- b) Set  $VR_{1004}$  to the point where all the LED's go off.
- c) Apply a 4 dB $\mu$  (1.584  $\mu$ V) signal from the signal generator and adjust  $VR_{1001}$  so that only one LED is illuminated.

### (7) Noise-Blanker Adjustment

- a) Set the MODE switch to USB or LSB.
- b) Set the receiver frequency to 146 MHz.
- c) Adjust the output level and frequency of the signal generator to 5–10 dB $\mu$  (1.78  $\mu$ V–3.16  $\mu$ V) at 146 MHz. Temporarily connect  $TP_{1002}$  to ground with a clip lead, in order to disable the 2nd local oscillator.
- d) Connect a voltmeter (full scale: 2.5V) to the cathode of  $D_{1060}$  and ground. Adjust  $T_{1016}$ ,  $T_{1017}$ , and  $T_{1018}$  for a maximum reading on the voltmeter scale.

### (8) Squelch Adjustment

- a) Set the MODE switch to FM.
- b) Set the front panel SQL control to the 9 o'clock position.
- c) Adjust  $VR_{1002}$  so that the receiver is just muted. Now apply a signal from the signal generator. A signal of approximately -13 dB $\mu$  (0.224  $\mu$ V) with  $\pm 3.5$  kHz deviation at 1 kHz should be required to trip the squelch.

- b) Connect a signal generator to  $TP_{1001}$ , and set its output level to  $15 \text{ dB}\mu$  ( $5.62 \mu\text{V}$ ) at  $10.81 \text{ MHz}$ .
- c) Peak  $T_{1004}$ ,  $T_{1005}$ , and  $T_{1006}$  for a maximum S.PO indication.

#### (5) RF Amplifier

- a) Set the output level and frequency of the generator to  $10 \text{ dB}\mu$  ( $3.16 \mu\text{V}$ ) at  $146 \text{ MHz}$ .
- b) Set the receiver frequency to  $146 \text{ MHz}$ , and adjust  $T_{1001}$ ,  $T_{1002}$ ,  $TC_{1001} - TC_{1004}$  for a maximum S.PO indication.

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## SERVICING

### TRANSMITTER SECTION

Unless otherwise indicated, always perform transmitter alignment with a dummy load connected to the antenna jack. If the AFP circuits are being aligned, an improper load impedance at a critical time could result in the destruction of the final transistors.

\* In order to adjust these trimmers, remove the two screws marked "A", and loosen the two screws marked "B" on the side panels. Then tilt the Final Unit as shown below.

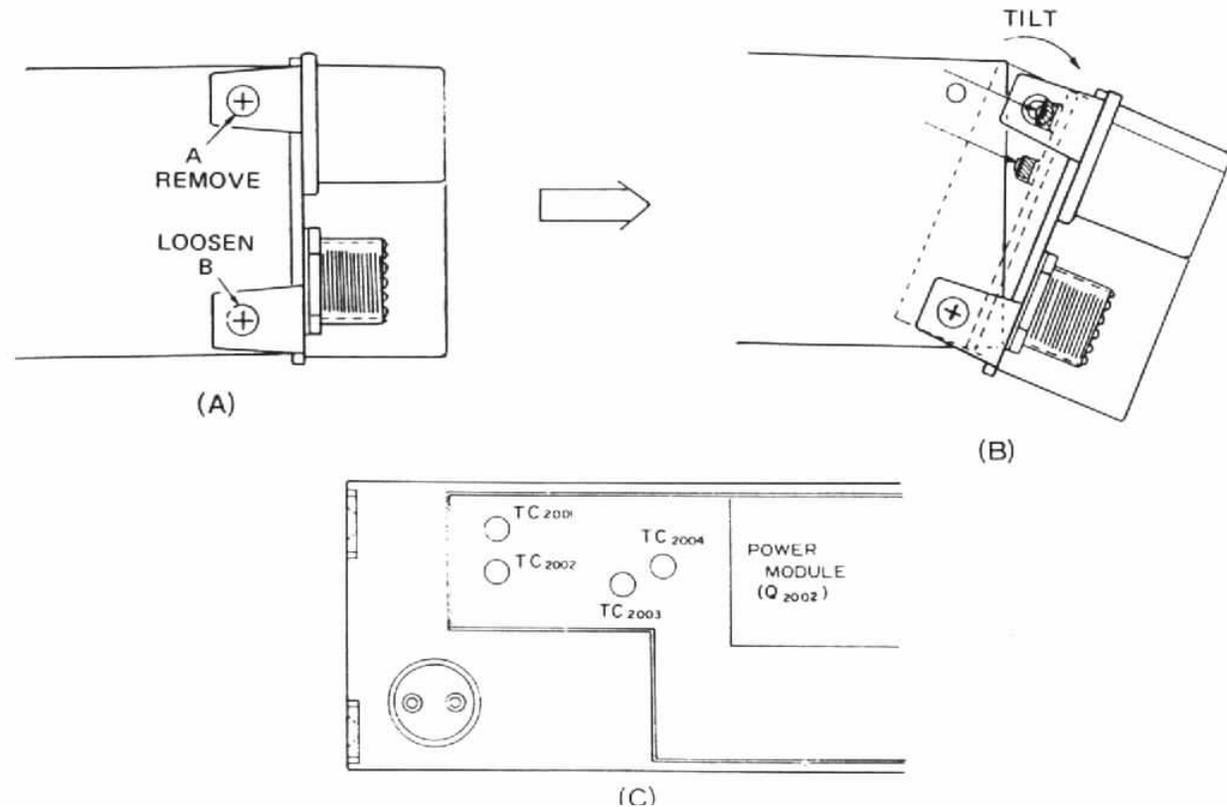
\*\*  $TC_{2001} - TC_{2004}$  require no realignment unless final transistors are replaced.

#### (2) Mixer/Interstage Alignment

**(1) TX Strip Trimmer Adjustment**

- a) Set the MODE switch to FM, and the transmitter frequency to 146.00 MHz.
- b) With a dummy load/wattmeter connected to the antenna jack, advance VR<sub>2002</sub> and VR<sub>1003</sub> fully counterclockwise.
- c) Squeeze the microphone PTT switch, and adjust TC<sub>2001</sub>–TC<sub>2004</sub> \* for maximum power output as indicated on the wattmeter.

- a) Temporarily disconnect the RF OUT cable from the Main Unit.
- b) Terminate the RF OUT terminals with a 50 ohm resistor, and connect the RF probe of VTVM to the RF OUT terminals.
- c) Set the transmitter frequency to 145.5 MHz, MODE to FM, and key the transceiver.
- d) Adjust T<sub>1010</sub>–T<sub>1014</sub>, TC<sub>1005</sub>, and TC<sub>1006</sub> for maximum reading on the VTVM.



## POWER AMPLIFIER UNIT

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## SERVICING

**(3) CW Carrier Oscillator**

- a) Set the MODE switch to CW.
- b) Connect the RF probe of a VTVM to TP<sub>1006</sub> and key the transceiver.
- c) Adjust T<sub>1009</sub> for a reading of 100 mV RMS on the VTVM.
- d) Connect a frequency counter to TP<sub>1006</sub>, and adjust TC<sub>1010</sub> for a reading of exactly 10.8093 MHz on the counter.

**(4) ALC/PO Adjustment**

- a) Set the MODE switch to FM.
- b) With a dummy load/wattmeter connected to

- d) Adjust VR<sub>2001</sub> so as to illuminate 9 LED's on the S.PO indicator.

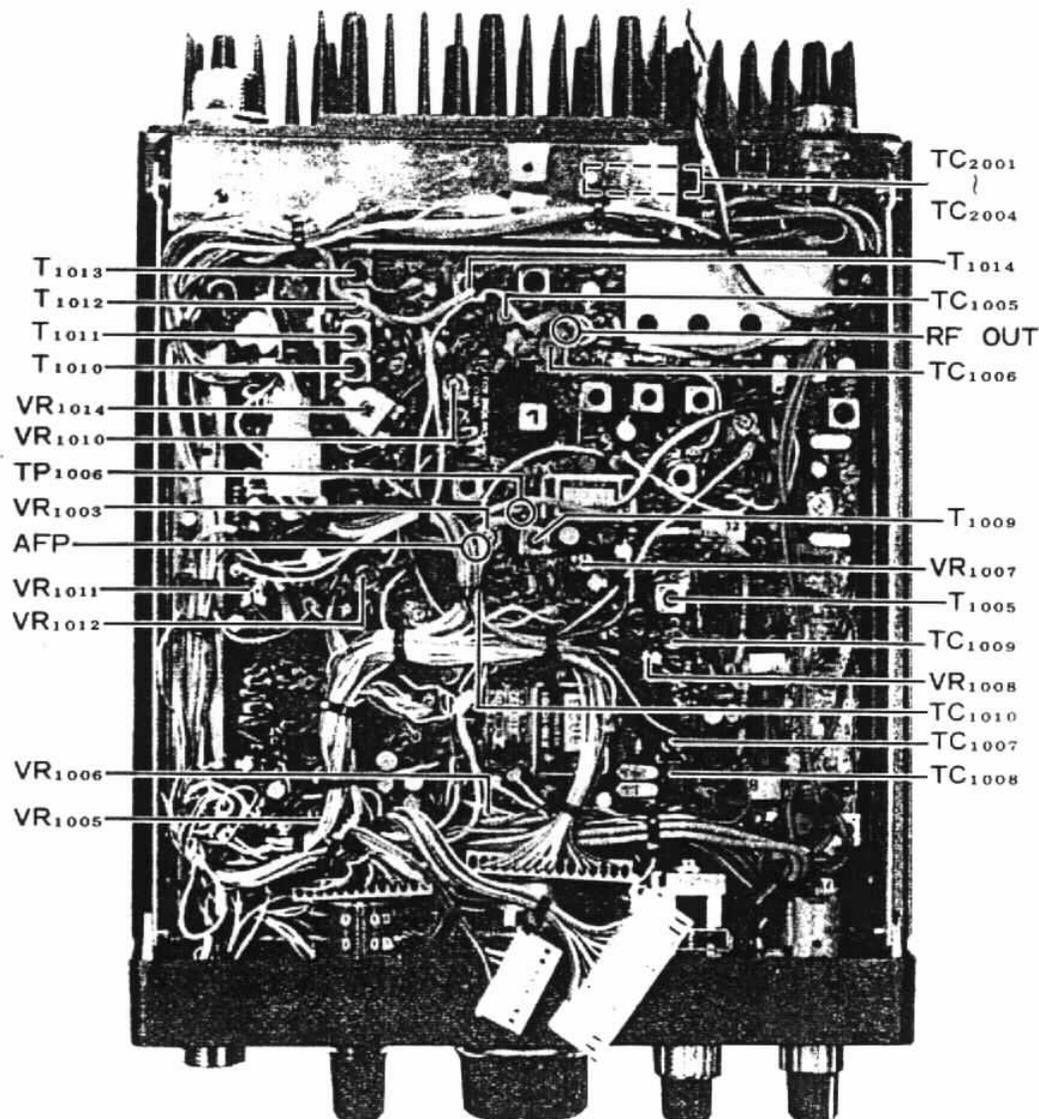
**(5) AFP Adjustment**

- a) Connect a DC voltmeter to the AFP terminal on the Main Unit and ground.
- b) Rotate VR<sub>2002</sub> fully counterclockwise.
- c) Set the MODE switch to FM.
- d) Adjust VR<sub>2003</sub> for minimum indication on the DC voltmeter.
- e) Disconnect the 50 ohm dummy load, and connect a 165 ohm, 10 watt dummy load to the antenna jack. Key the transceiver.
- f) Adjust VR<sub>2002</sub> so as to illuminate 8 LED's on the S.PO indicators. Now return to RX.

the antenna jack. Key the transceiver.

- c) Adjust VR<sub>1003</sub> for an output of 10 watts on the wattmeter.

- g) Remove the dummy load from the antenna jack. Close the PTT switch, and check to see that the current consumption is less than 2 amps.



ALIGNMENT AND TEST POINTS FOR TRANSMITTER

## SERVICING

### (6) Low Power Output Setting

- a) Set the HI/LOW switch to the LOW position, and key the transmitter in the FM mode.
- b) Adjust VR<sub>1012</sub> for an output of 1 watt on the wattmeter.

### (7) FM Modulator Adjustment

- a) Refer to Fig. 3, and set up the transceiver and test equipment as shown.
- b) Set VR<sub>1005</sub>, located on the Main Unit, to the center of its range, and apply a 1 kHz, 15 mV signal from the audio generator to the mic jack.
- c) Adjust VR<sub>1006</sub> for a deviation of  $\pm 4.5$  kHz while observing the signal waveform on the scope.
- d) Now reduce the audio generator output level to 1.5 mV, and adjust VR<sub>1005</sub> for a deviation of  $\pm 3.5$  kHz. Check to see that the waveform on the scope is not distorted.
- e) Turning the audio generator on and off, make sure that the BUSY/MOD indicator illuminates along with the changing audio input.

### (8) SSB Modulator Adjustment

#### (A) Balanced Modulator Output Transformer Adjustment

- a) With a dummy load/wattmeter connected to the antenna jack, set the MODE switch to USB or LSB.
- b) Set VR<sub>1007</sub> to the center of its range, and apply a 1 kHz, 1 mV signal from the audio generator to the mic jack.
- c) Adjust T<sub>1015</sub> for maximum power output.

#### (B) SSB Carrier Point Adjustment

- a) Apply a 1 kHz, 1.2 mV signal from the audio generator to the mic jack, and adjust VR<sub>1007</sub> for an output of 8 watts.
- b) Set the MODE switch to USB and the frequency of the audio generator to 300 Hz. Adjust TC<sub>1008</sub> for an output of 2 watts.
- c) Set the MODE switch to LSB, and the frequency of the audio generator to 300 Hz. Adjust TC<sub>1007</sub> for an output of 2 watts.

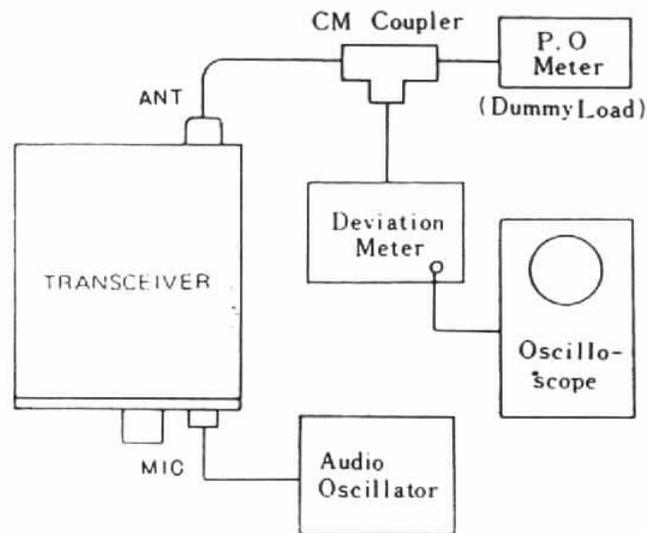


Figure 3

**(C) Carrier Balance Adjustment**

- a) Temporarily short the mic input terminal of the mic jack (pin 8) to ground with a clip lead. Set the MODE switch to USB.
- b) While monitoring the carrier on a monitor receiver, adjust  $VR_{1008}$  and  $TC_{1009}$  for a minimum S-Meter reading (or minimum signal level if no S-Meter reading occurs).
- c) Switch between USB and LSB, and compare the output levels with no modulation. Adjustment of  $VR_{1008}$ ,  $TC_{1009}$  may be necessary to achieve good carrier nulling on both modes.

**(9) CW Side Tone Frequency/Semi-break-in Delay Adjustment**

- a) Adjust  $VR_{1010}$  for the desired monitoring level on CW operation.
- b) Adjust  $VR_{1011}$  for the desired CW VOX relay hang time.

## PLL SECTION

**NOTE:** The PLL circuit is very critical in its adjustment. Alignment must only be performed by an experienced technician. All alignment should be performed at a temperature within the range 15°–30°C, preferably near the center of this range.

### (1) VCV Line Adjustment

#### (A) PLL 1 Adjustment

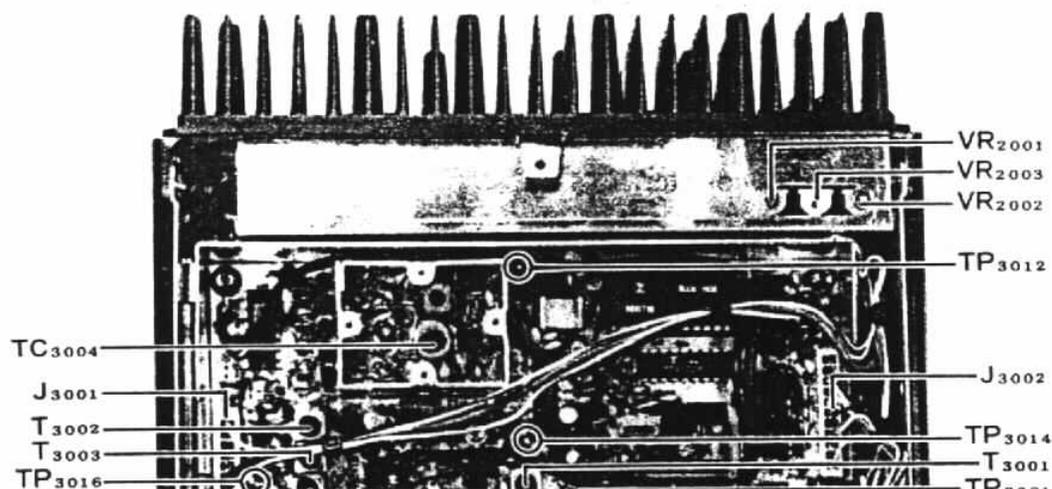
- a) Set the STEP switch to "M," the MODE switch to FM, and tune the transceiver to 145.9900 MHz.
- b) Connect the DC probe of the VTVM to TP<sub>3012</sub>, and adjust TC<sub>3004</sub> for a reading of exactly 6.5 V.

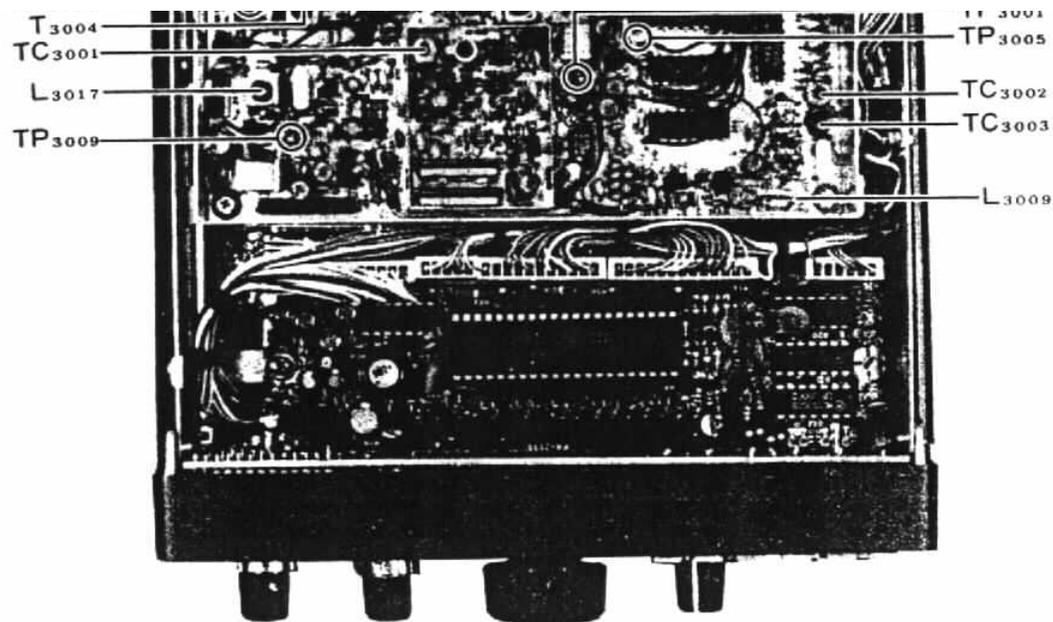
#### (B) PLL 2 Adjustment

- a) Set the STEP switch to "M," the MODE switch to USB, and tune the transceiver to 145.0099 MHz.
- b) Connect the DC probe of the VTVM to TP<sub>3009</sub>, and adjust L<sub>3017</sub> to secure a reading of 3.5 V.

#### (C) PLL 3 Adjustment

- a) Set the STEP switch to "M," MODE switch to USB, and tune the transceiver to 145.0099 MHz.
- b) Connect the DC probe of the VTVM to TP<sub>3001</sub>, and adjust TC<sub>3001</sub> to secure a reading of 3.5 V.





ALIGNMENT AND TEST POINTS FOR PLL

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## SERVICING

### (2) Multiplier Stage Adjustment

- a) Set the STEP switch to "M," the MODE switch to USB, and tune the transceiver to 145.0099 MHz.

NOTE: In order to achieve the specified frequencies for the above alignment steps, some presetting of the display will be required (because the 10 Hz digit is not displayed). Push the F.SET button, switch to USB, then set the STEP switch to "S"

- b) Connect the RF probe of the VTVM to TP<sub>3014</sub>, and adjust T<sub>3001</sub> for a maximum reading on the VTVM.

### (3) PLL Output Bandpass Filter Adjustment

- a) Set the STEP switch to "F," the MODE switch to FM, and tune the transceiver to 145.4000 MHz.
- b) Connect the RF probe of the VTVM to TP<sub>3016</sub>, and peak T<sub>3002</sub>, T<sub>3003</sub>, and T<sub>3004</sub> for a maximum meter reading.

### (4) PLL Local Frequency

- a. Connect a frequency counter to TP<sub>3016</sub>.
- b) Set the STEP switch to "S," the MODE switch to USB, and tune the transceiver to 144.00000 MHz.
- c) Adjust TC<sub>3002</sub> for a reading of exactly 133.19150 MHz on the frequency counter.
- d) Change the transceiver display frequency to 144.00009 MHz, using the Main Dial.
- e) Adjust TC<sub>3003</sub> for a reading of exactly 133.19159 MHz on the frequency counter.
- f) Repeat steps (b), (c), (d) and (e) several times to ensure complete frequency adjustment.

to USB, then set the STEP SWITCH to S .  
The precise frequency may then be set  
using the main dial.

## TROUBLESHOOTING

### SERVICING

#### A FUNDAMENTAL ANALYSIS OF THE TROUBLE

The failure may be caused by one of the following:

- 1) Mechanical defect
- 2) Electrical defect
- 3) Others (Murphy's Law, etc.)

#### 1. MECHANICAL DEFECTS

Typical mechanical defects encountered by the technician are:

- a) Damage from shock during transportation (remember the unit was probably subjected both to sea and truck shipment).
- b) Damage caused by vibration in service.
- c) Damage caused by forcing stubborn knobs or switches. This difficulty is usually preceded by one of

the above two defects.

## 2. ELECTRICAL DEFECTS

Typical electrical defects encountered are:

- a) Part(s) failure(s) caused by aging.
- b) Failures caused by improper application of supply voltage, or by voltage spikes. An improper fuse in use could cause extensive damage to be sustained.
- c) Improper operation (e.g. transistors without load – this usually points to failure elsewhere, in addition to the damaged transistor or IC).
- d) Loose connections at the power connector or elsewhere caused by cold solder joints, etc.

## 3. OTHERS

Among the miscellaneous types of failures or difficulties encountered are:

- a) Antenna troubles – poor connectors, use of cheap coax not made to withstand weather, and sabotage by neighbors (nail driven through coax, etc.).
- b) “Cockpit error:” including mislabeled coax lines to coax switch, or attempt to use transceiver on frequencies other than those it was designed for.
- c) Murphy’s Law: use of a non-Yaesu microphone with different connections, for example (See page 1-10 )

## SERVICING

## TYPICAL PART FAILURES, CAUSES, AND SYMPTOMS

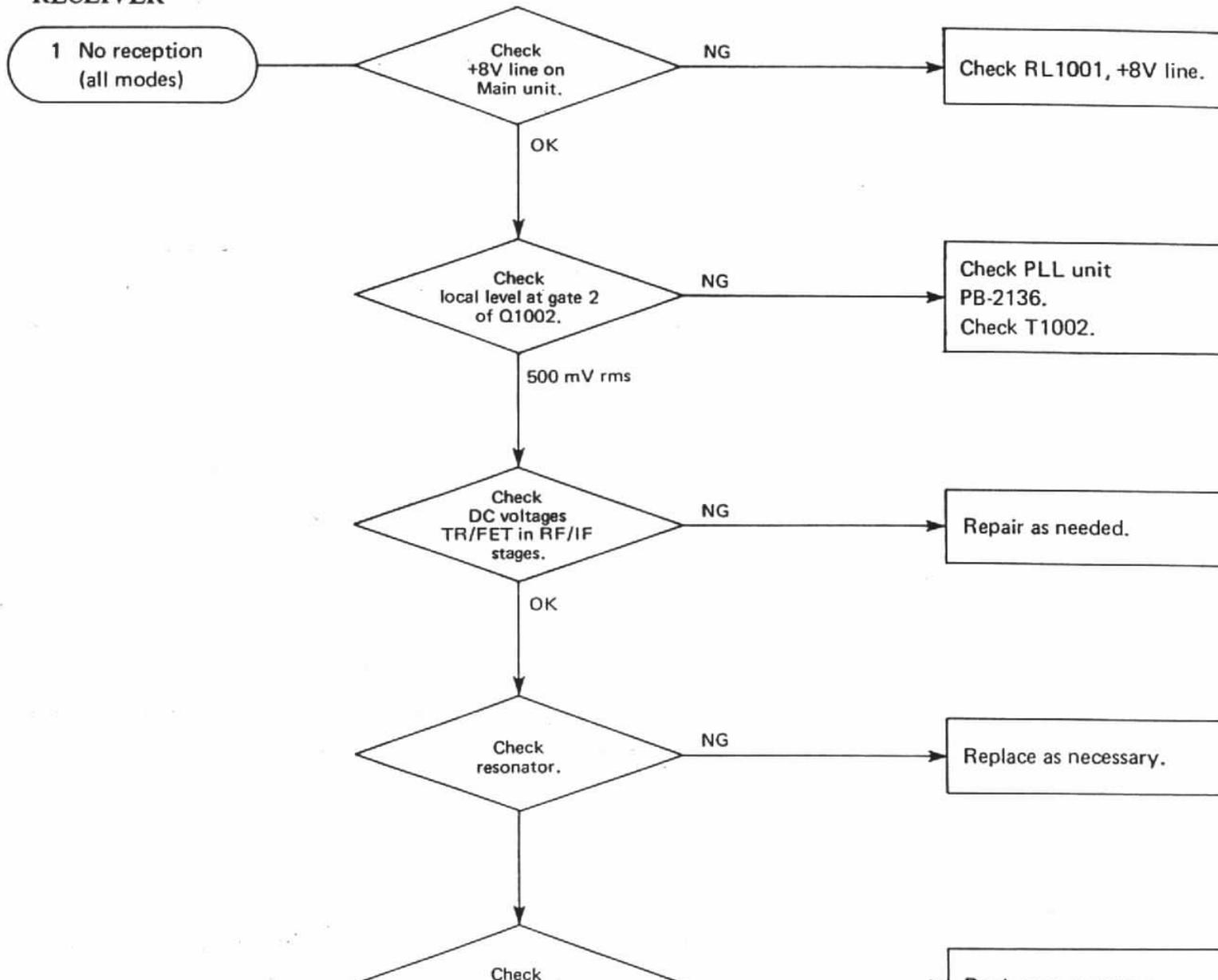
PARTS	CAUSE OF TROUBLE	SYMPTOMS
Semiconductors (IC, FET, TR)	High supply voltage Open circuit Excessive drive High temperature	Short or open circuit Output decreases to 1/2 at 80°C Internal noise Instability
MOS FET MOS IC	Static electricity	Total failure
Crystal Crystal filter	Shock High temperature	Crystal destroyed Frequency drift Filter bandpass change
Resistor	Excessive power Aging High temperature	Component burned Value changed Open circuit
Potentiometer	Excessive power Shock	Component burned Open circuit Noise Unsmooth rotation
Capacitor	Excess voltage	Shorted

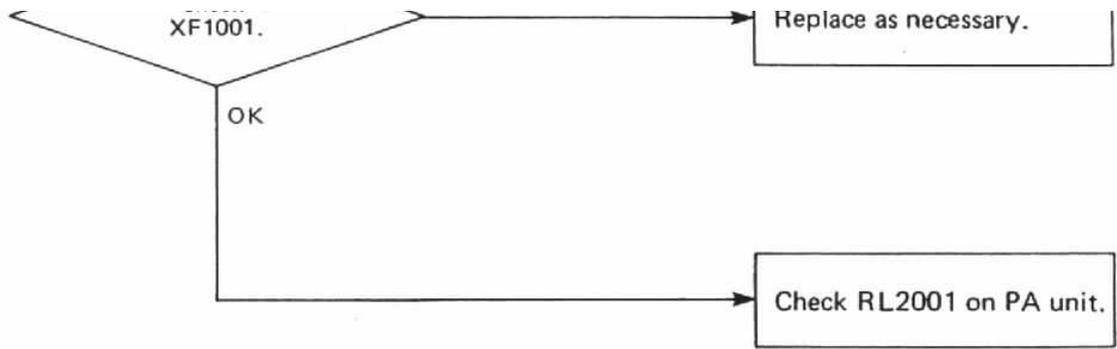
Capacitor	Excess voltage High temperature Excess power	Leakage Open/decreased capacitance
Variable capacitor Trimmer capacitor	Ratings exceeded Dust between plates Shock, forced rotation	Shorted Leakage Unsmooth rotation
Coils	Ratings exceeded Variation	Open or short circuit Leakage or shorted turns Detuned
Switch	Ratings exceeded Aging	Poor contact Unsmooth operation Open circuit
Relay	Ratings exceeded Humidity	Poor contact Noise Coil open

# FAULT TREE

## SERVICING

### RECEIVER

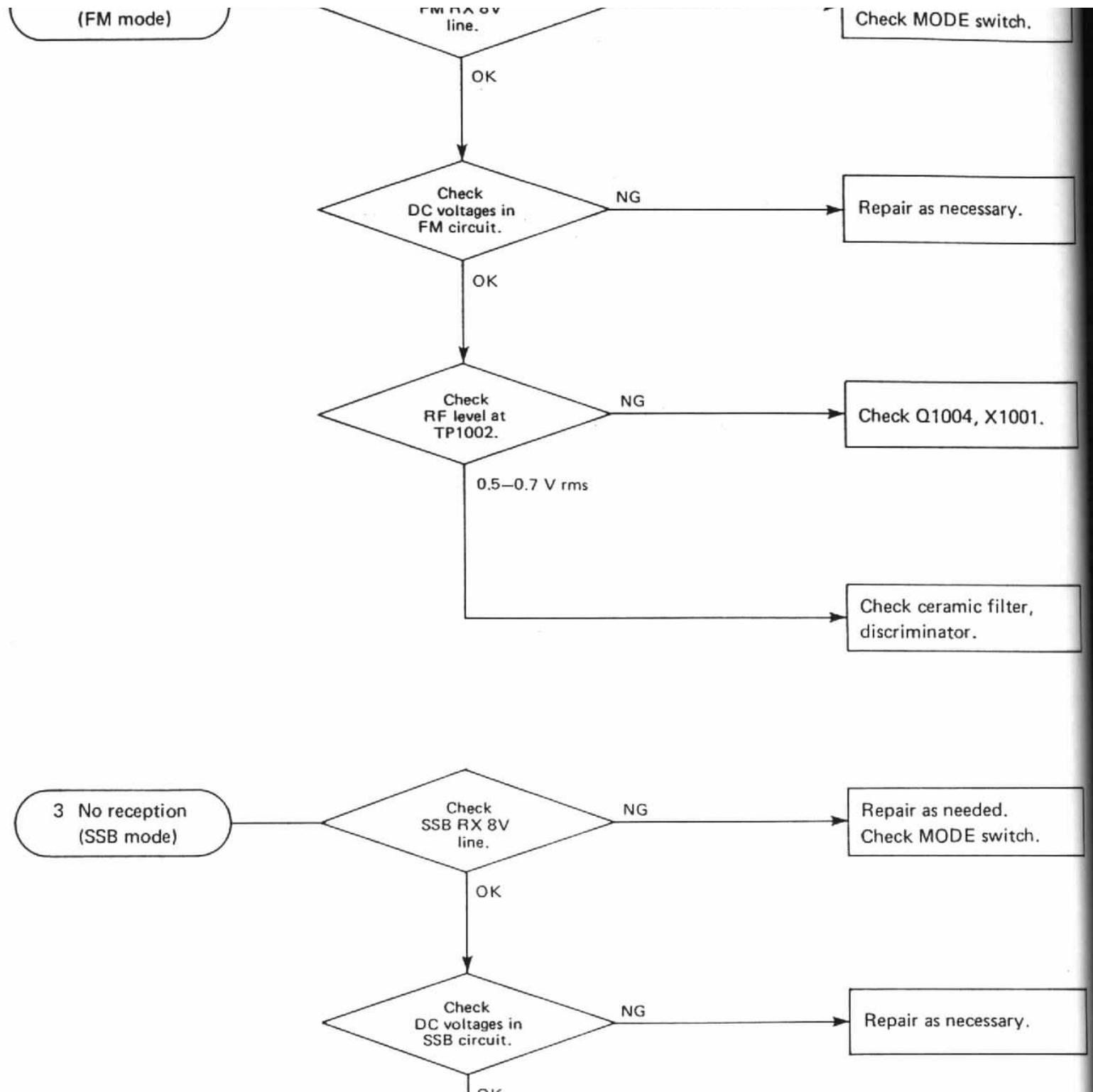


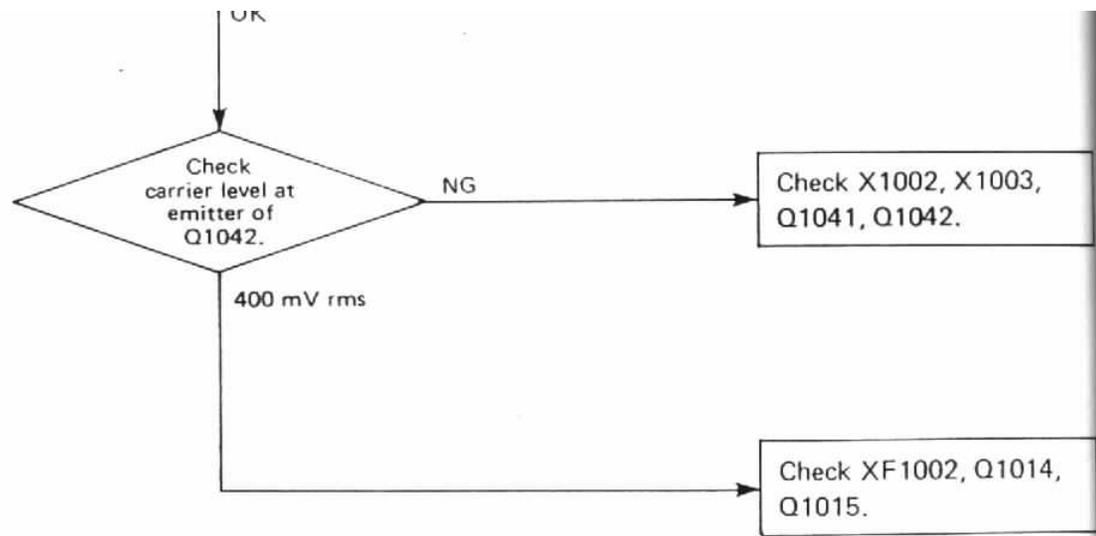


3-43

### SERVICING

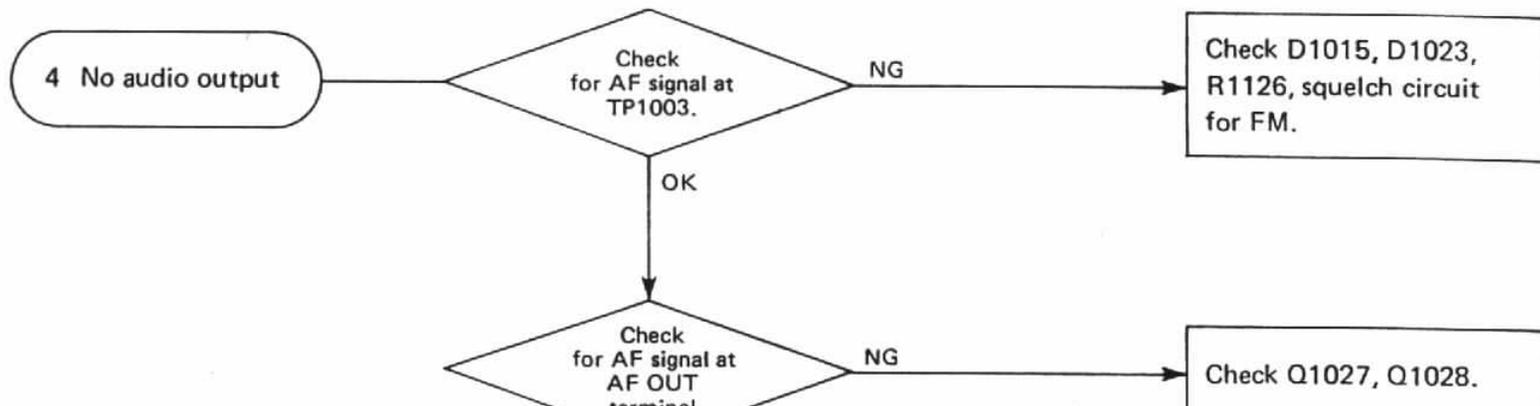


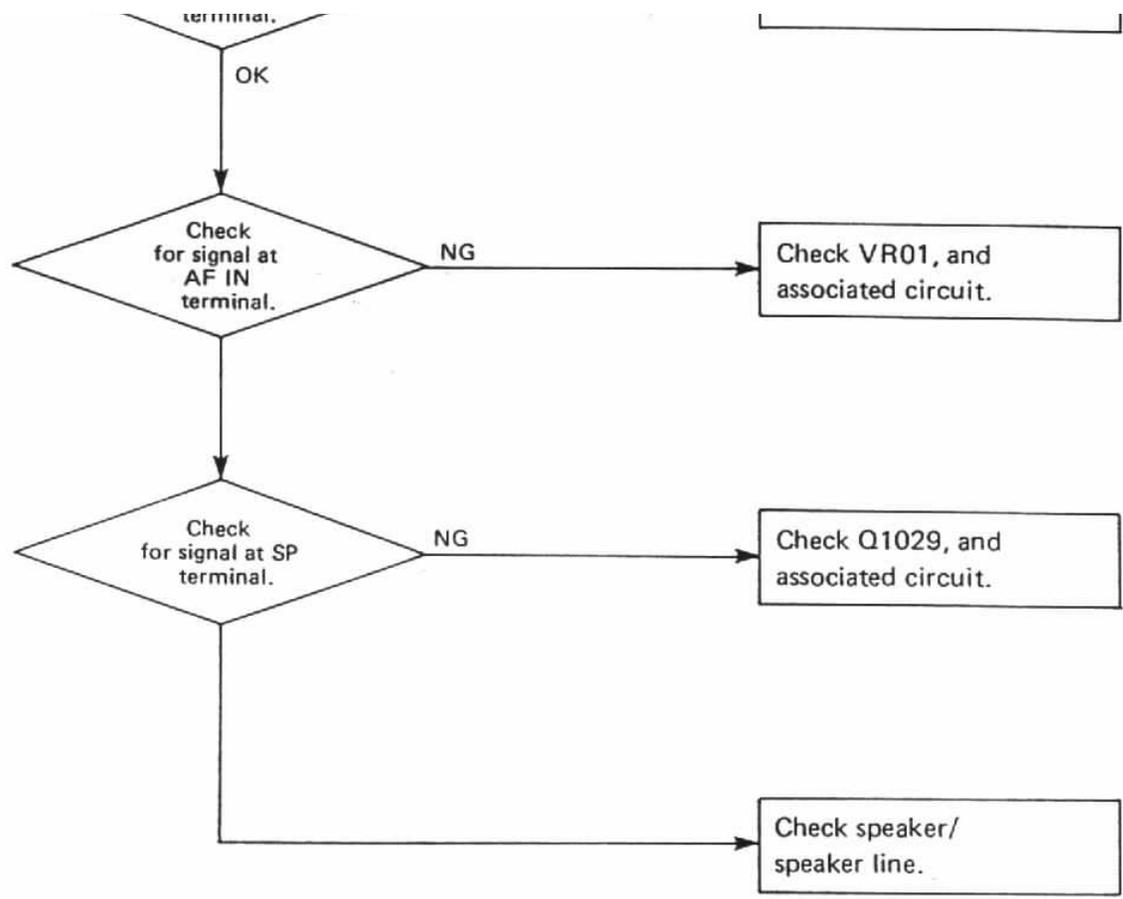




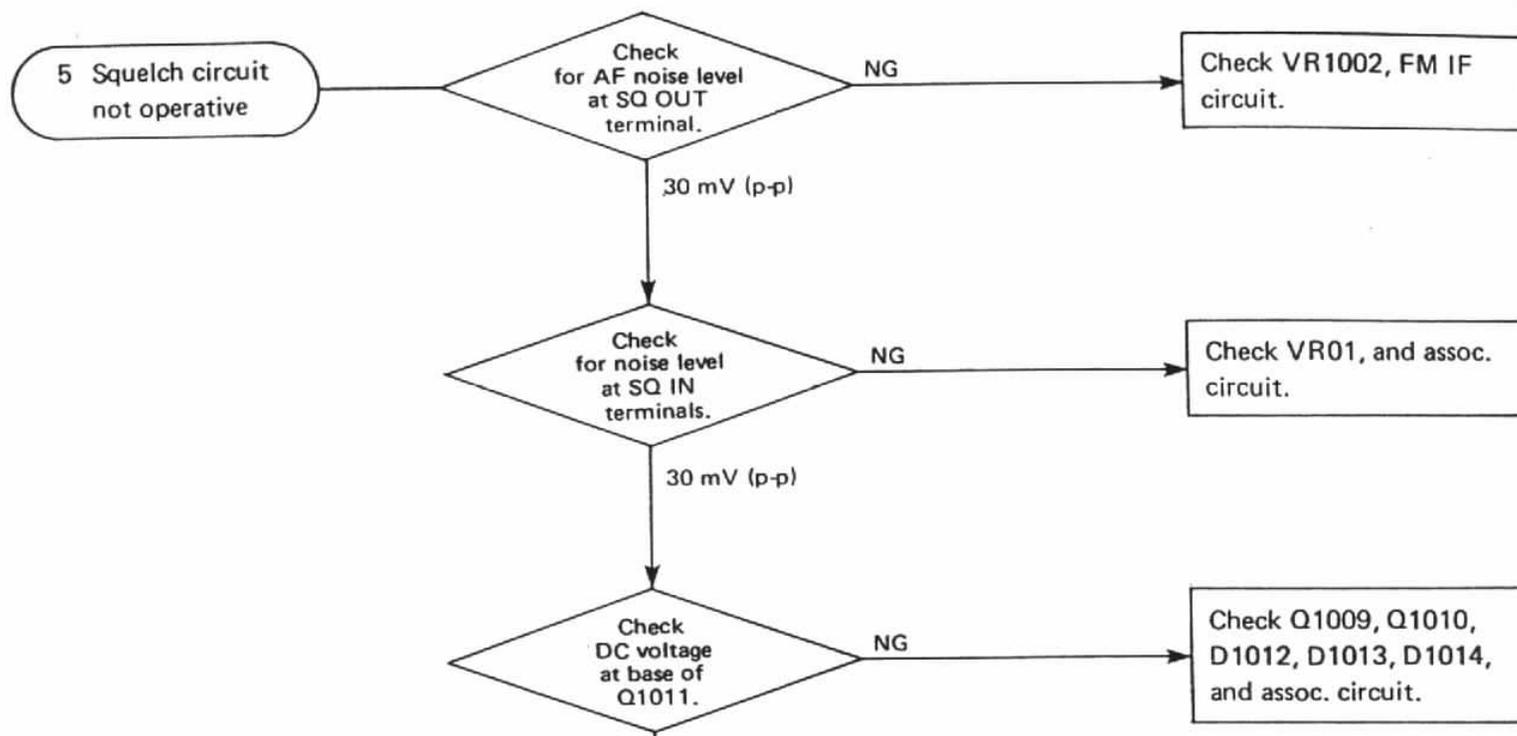
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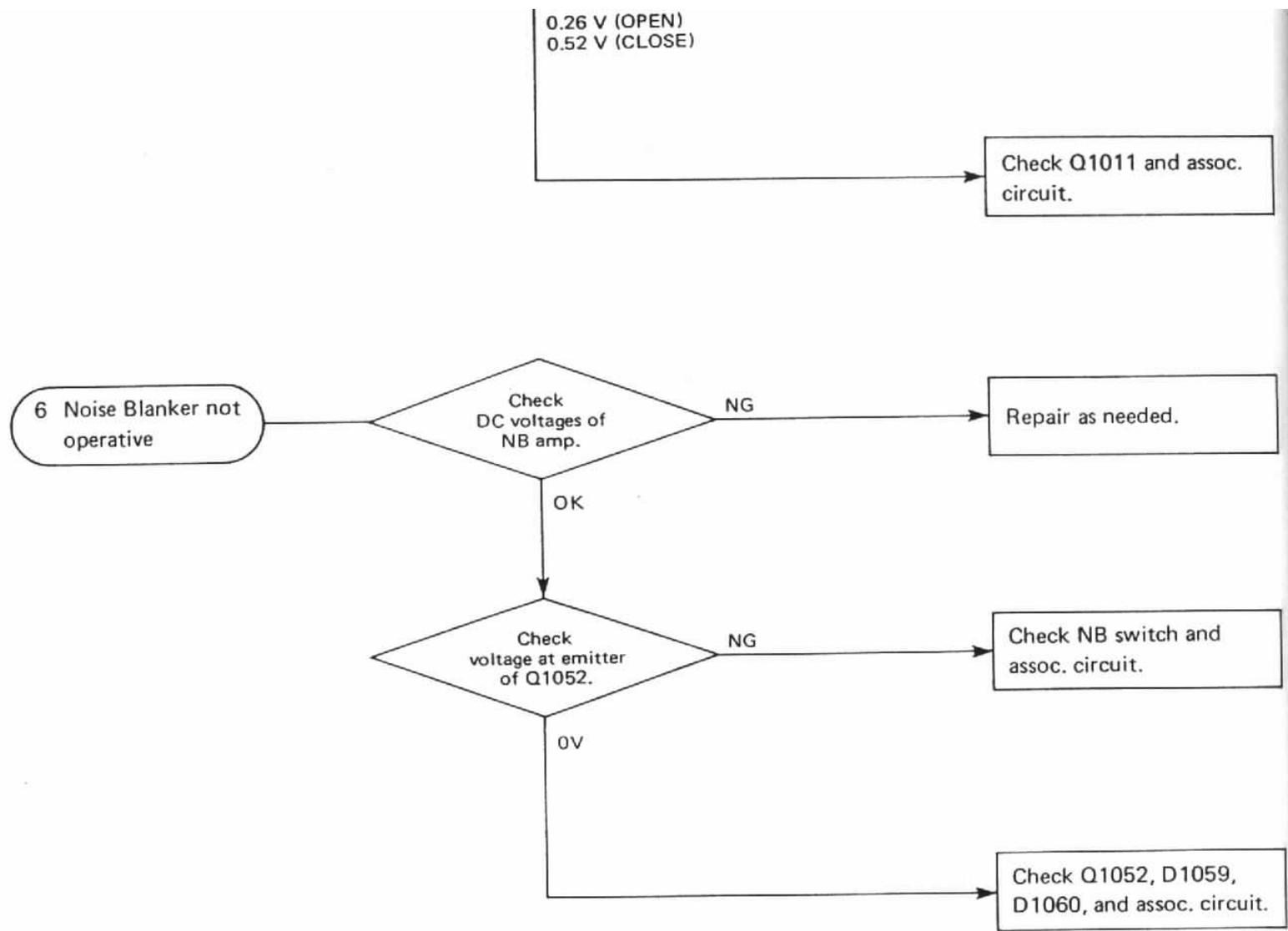
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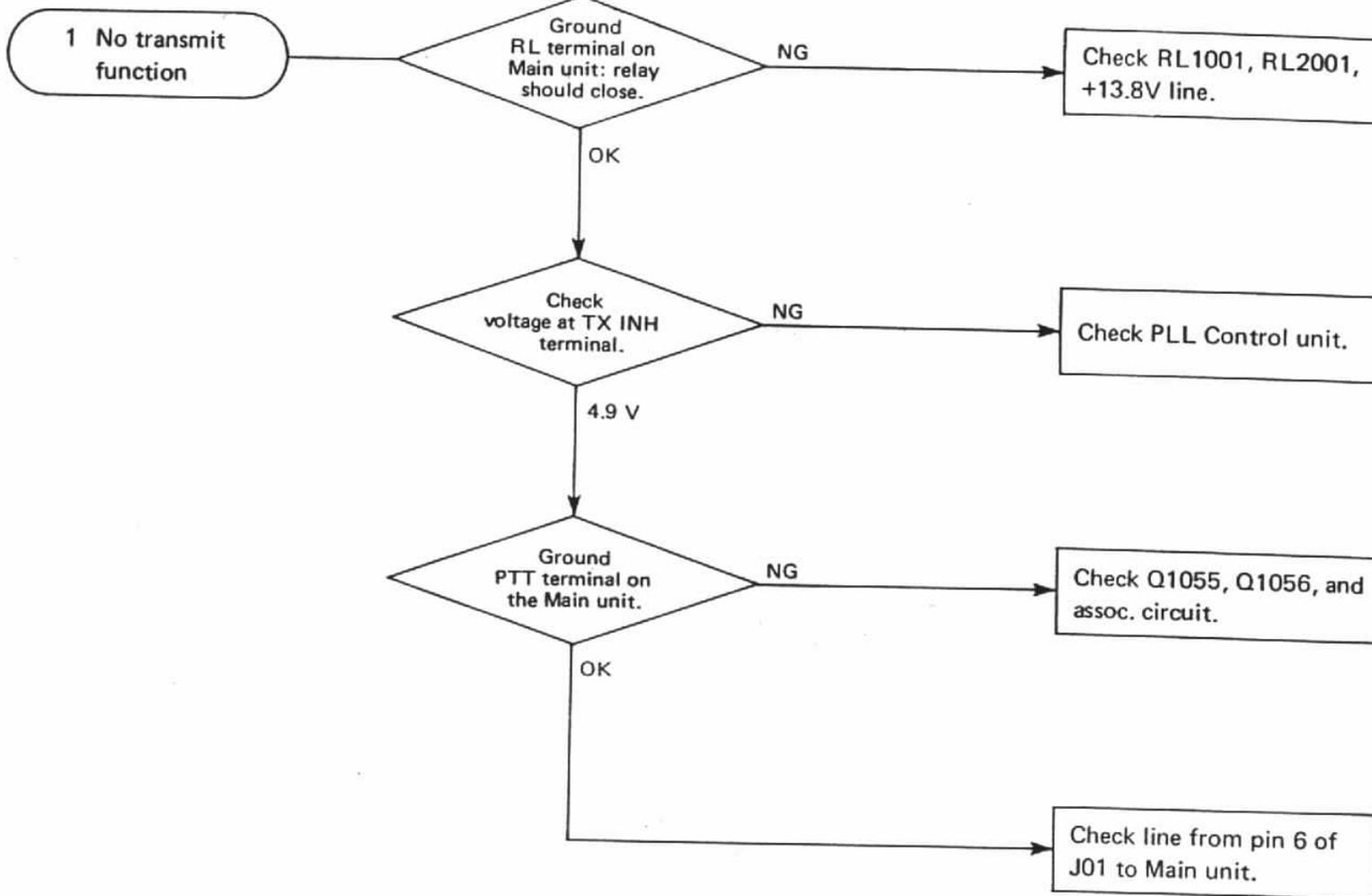
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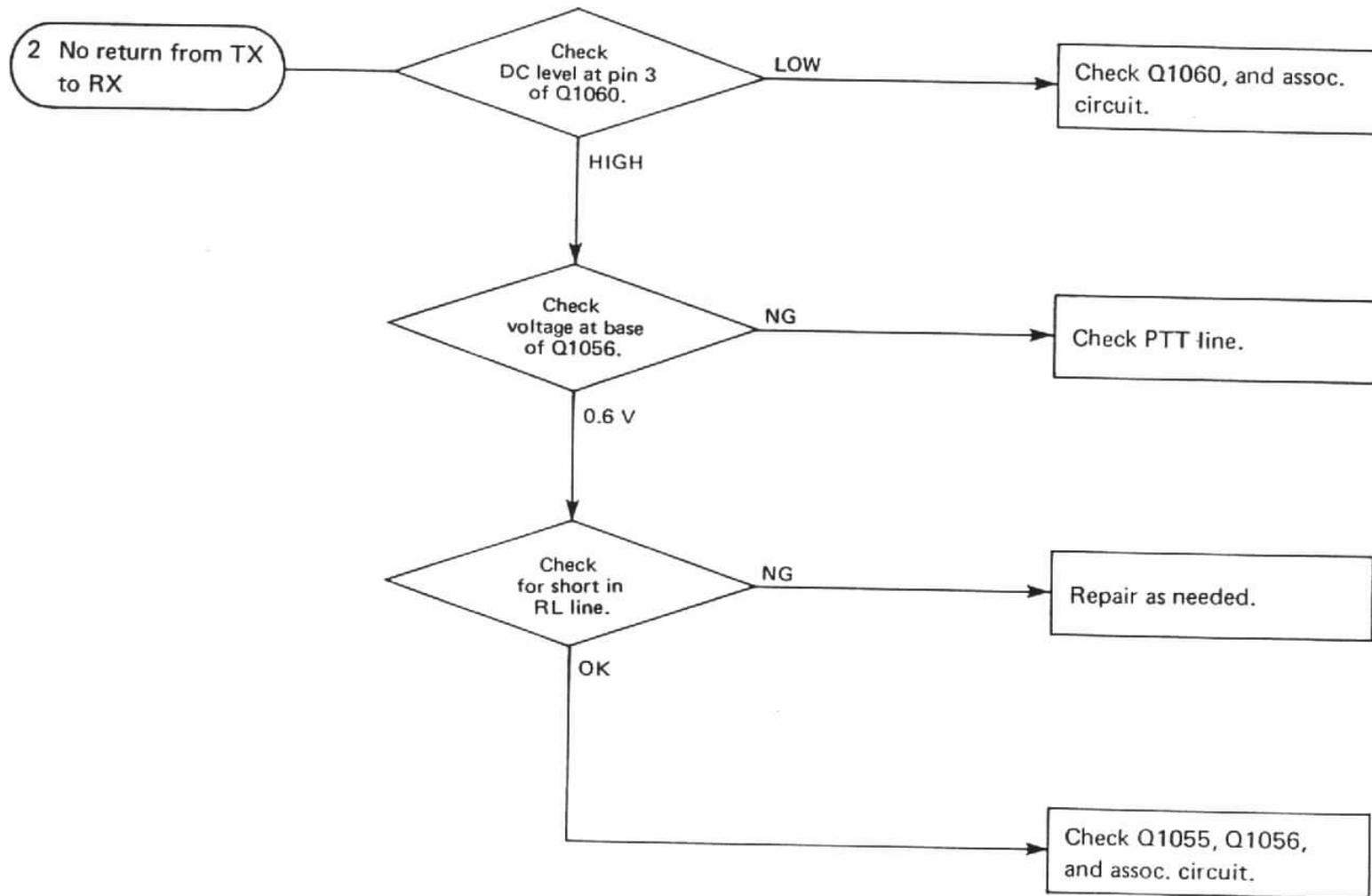




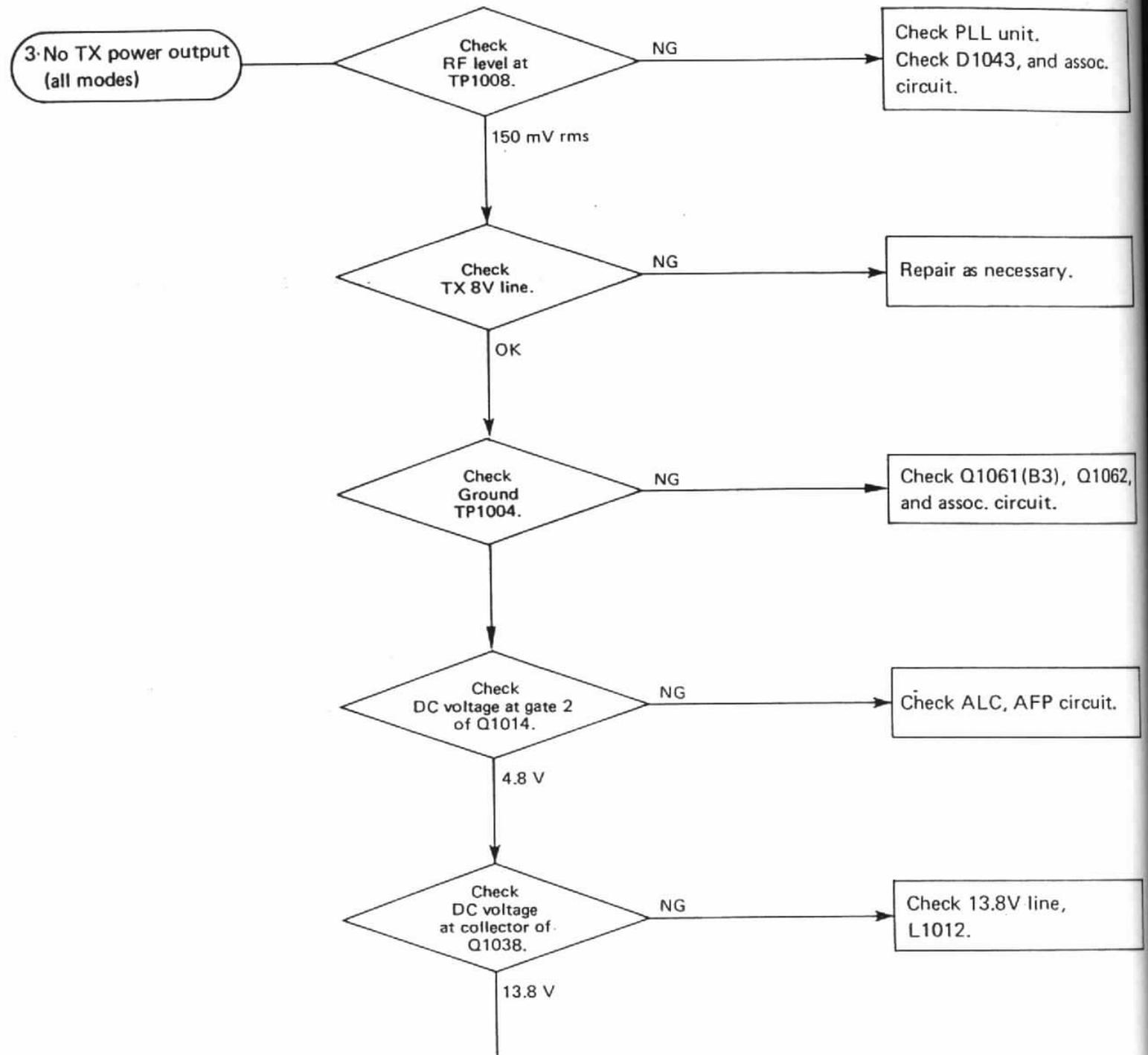
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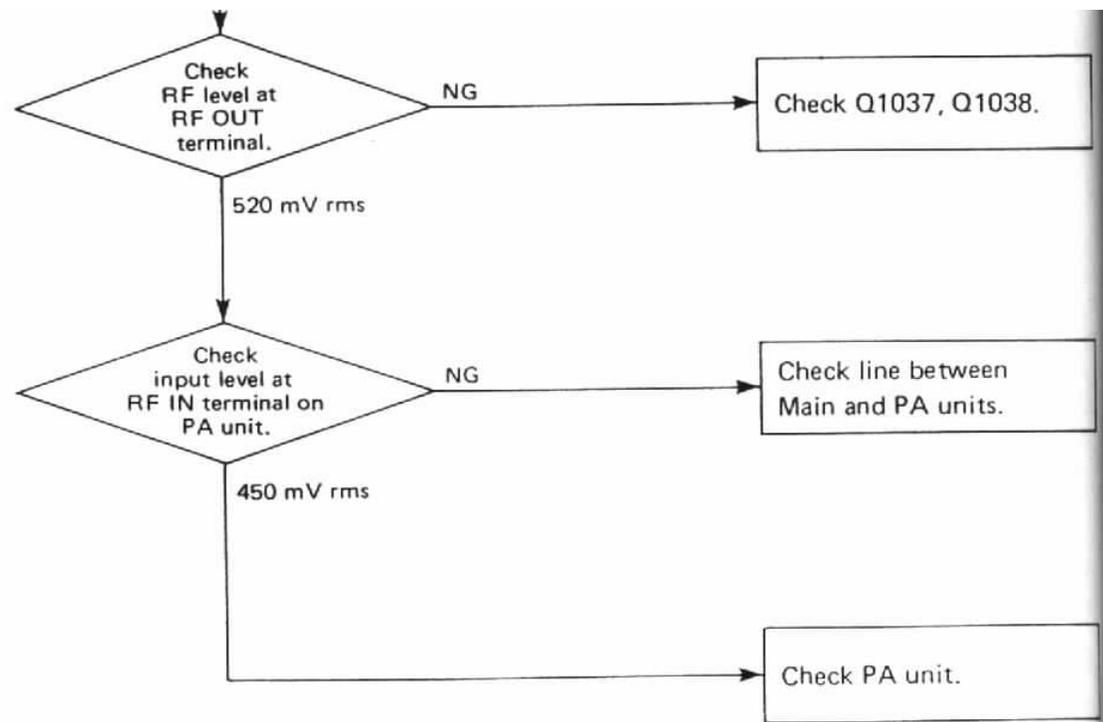
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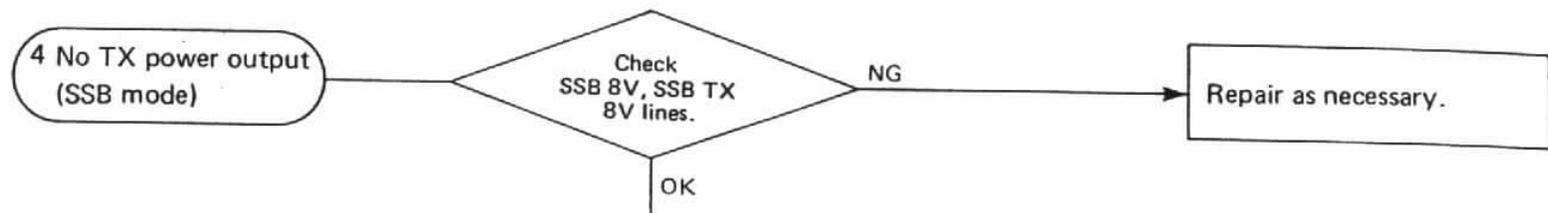
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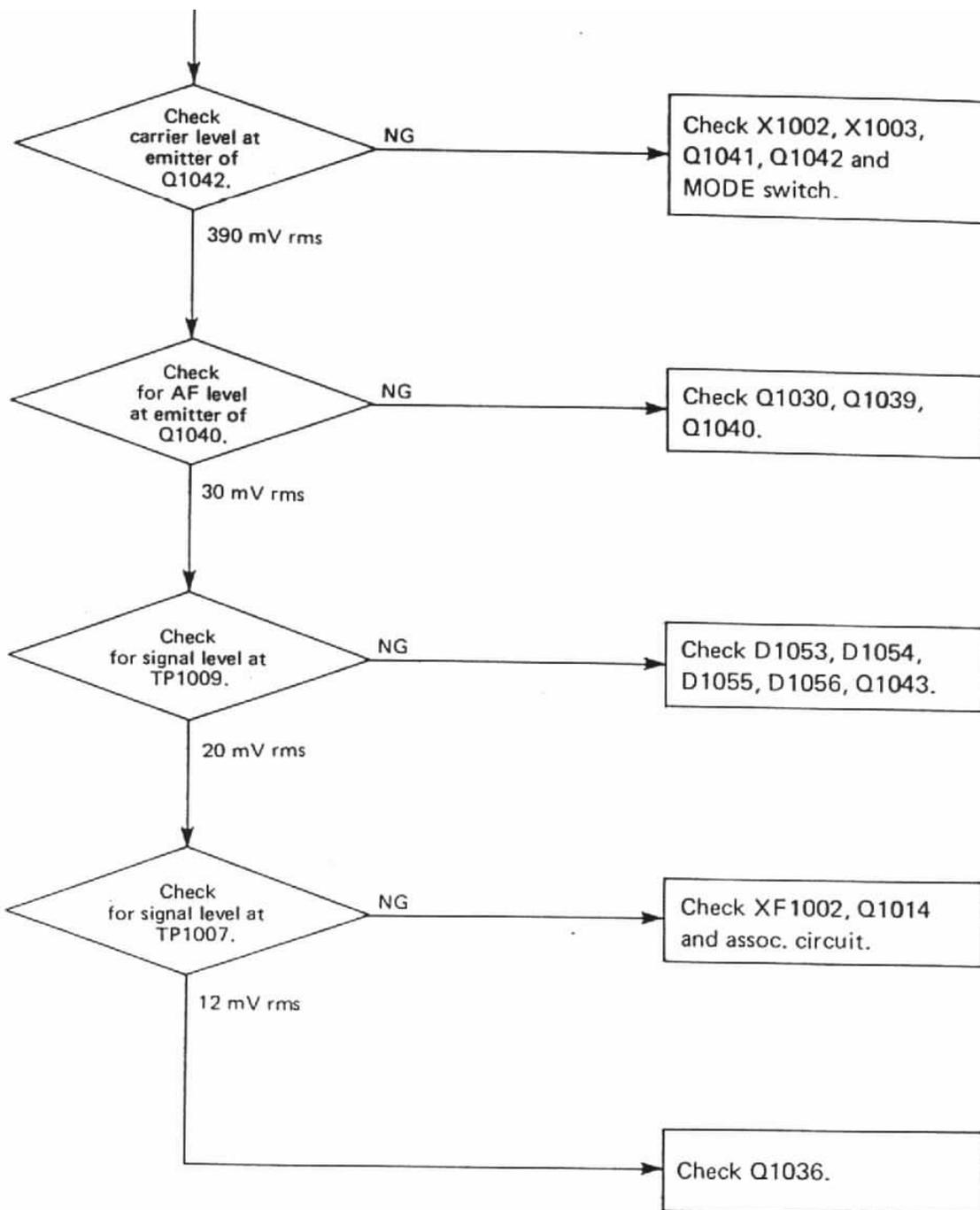


3-48

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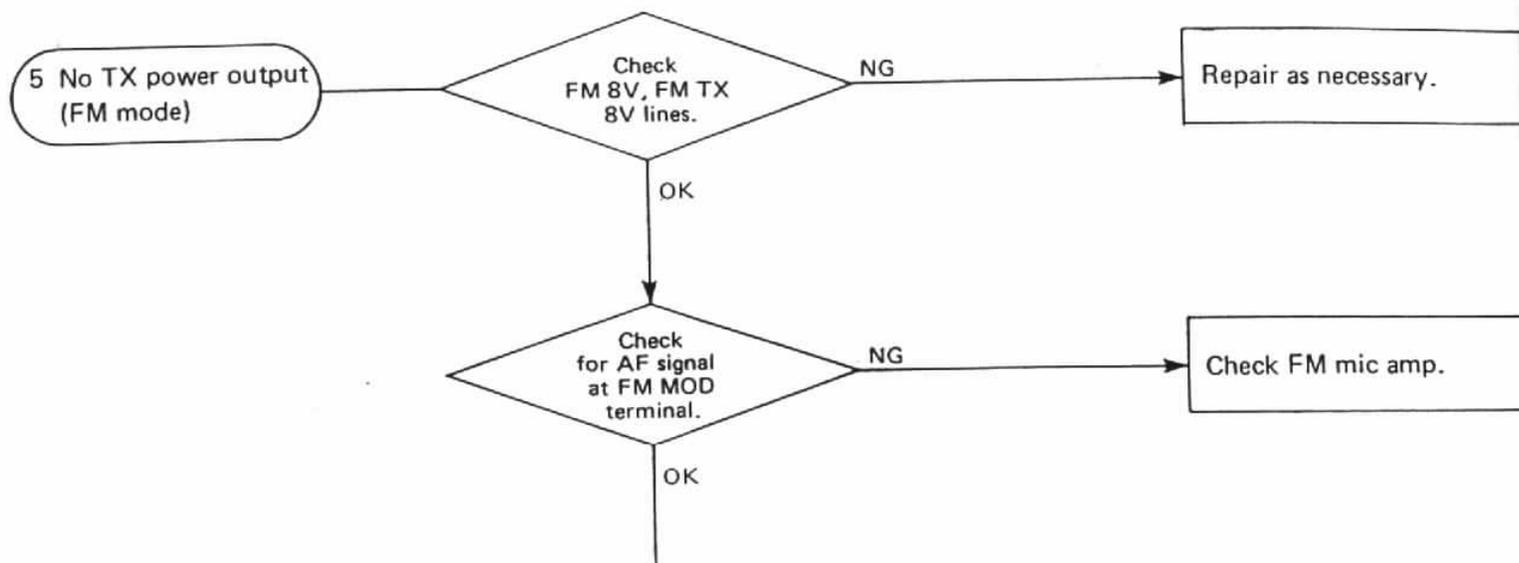


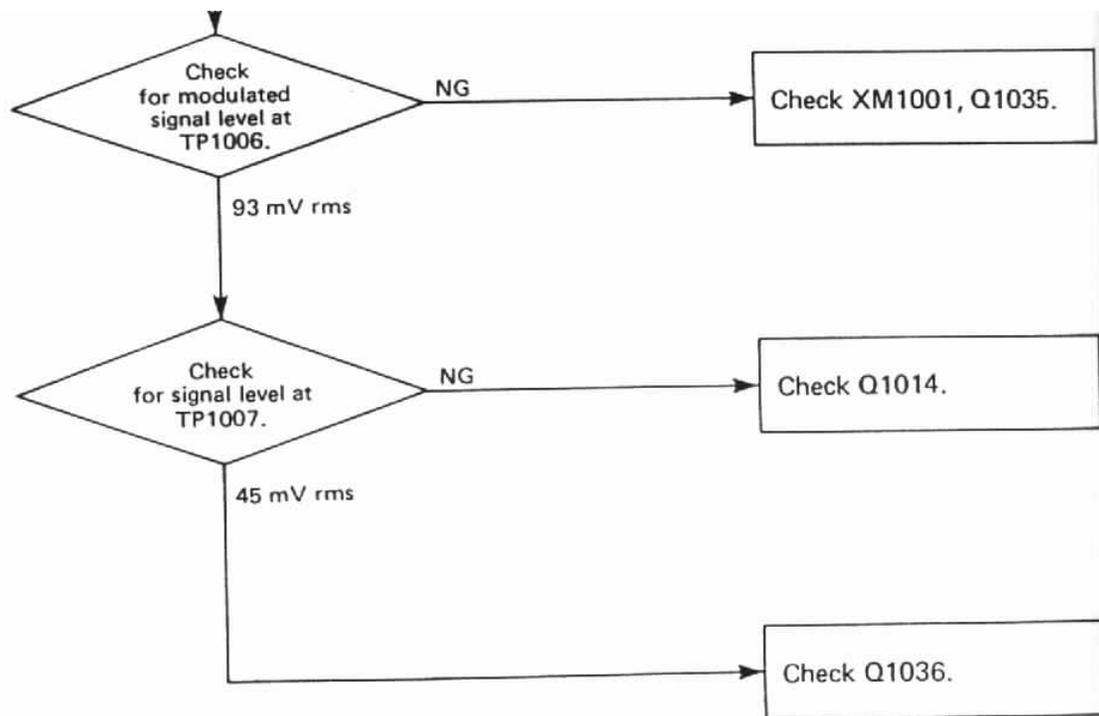
AF IN:  
1 kHz 1.2 mV



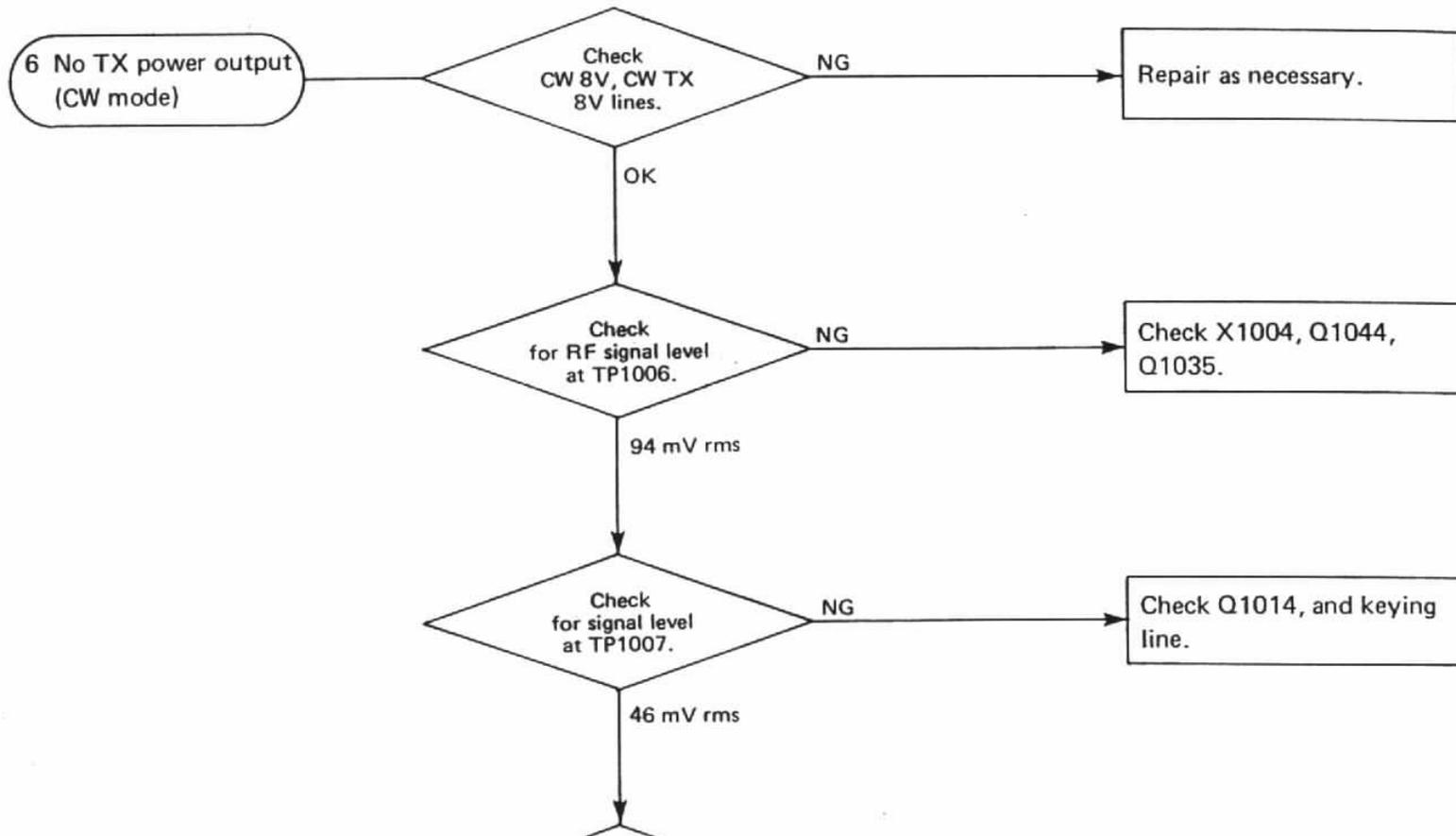
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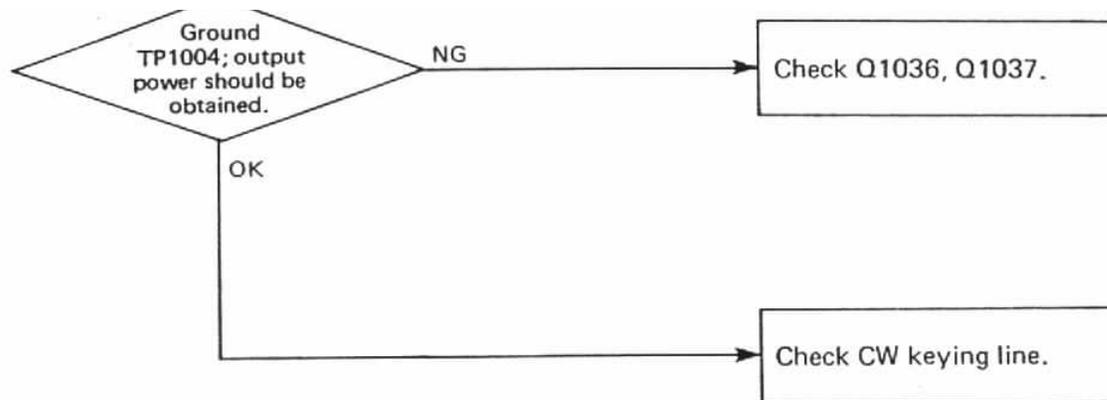
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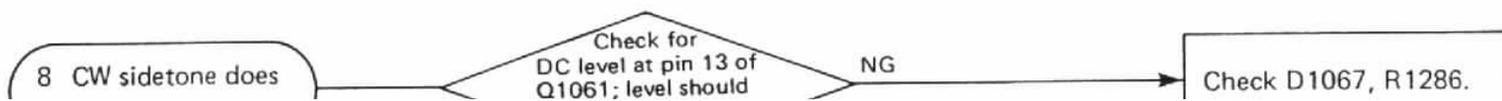
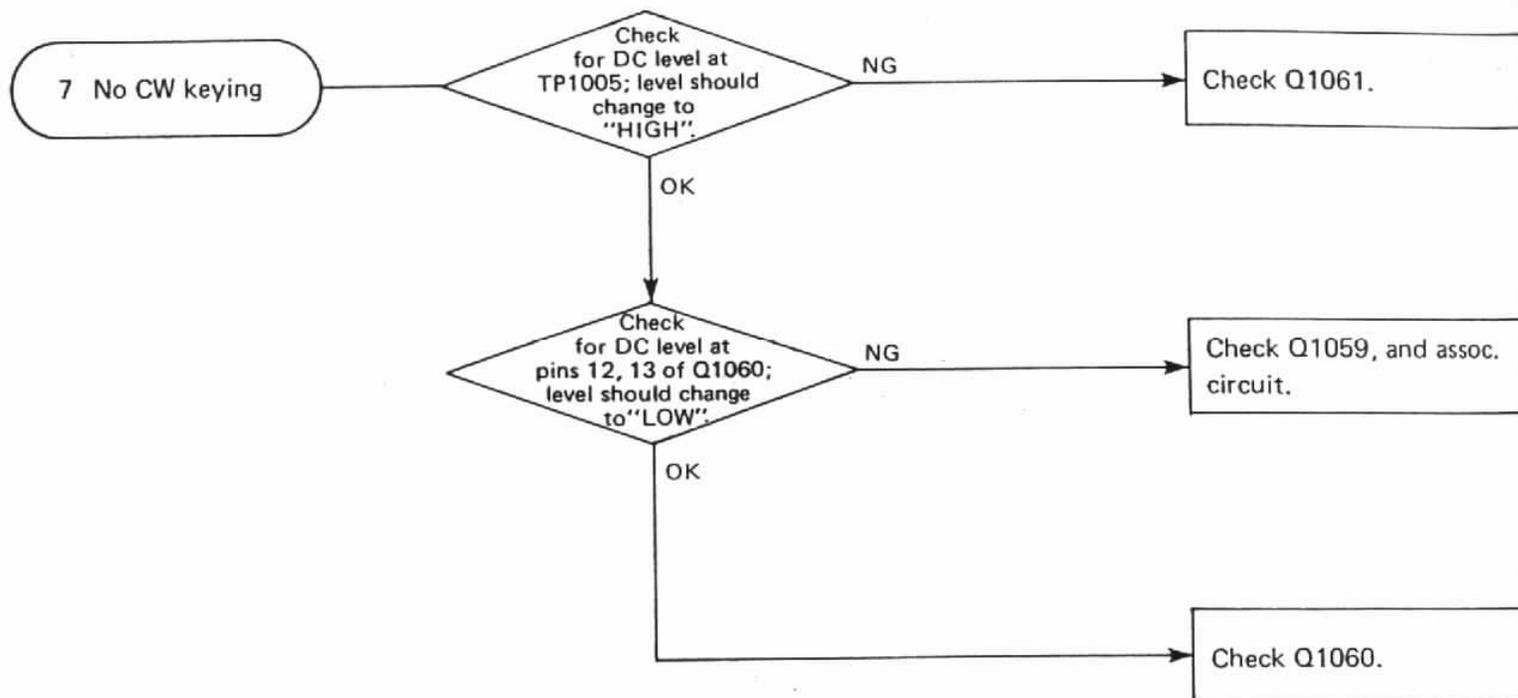


SERVICING

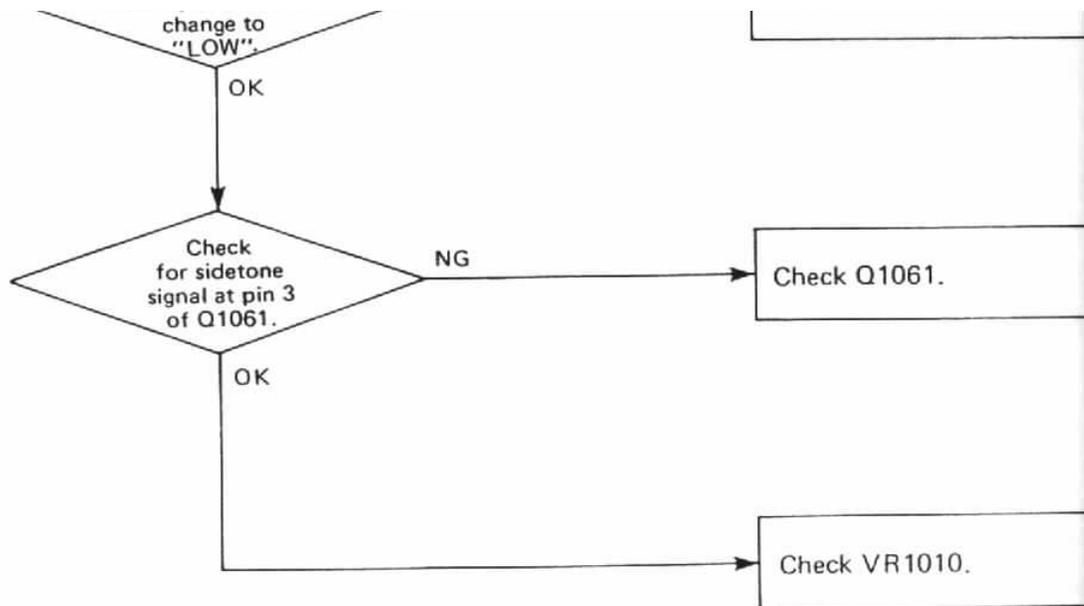




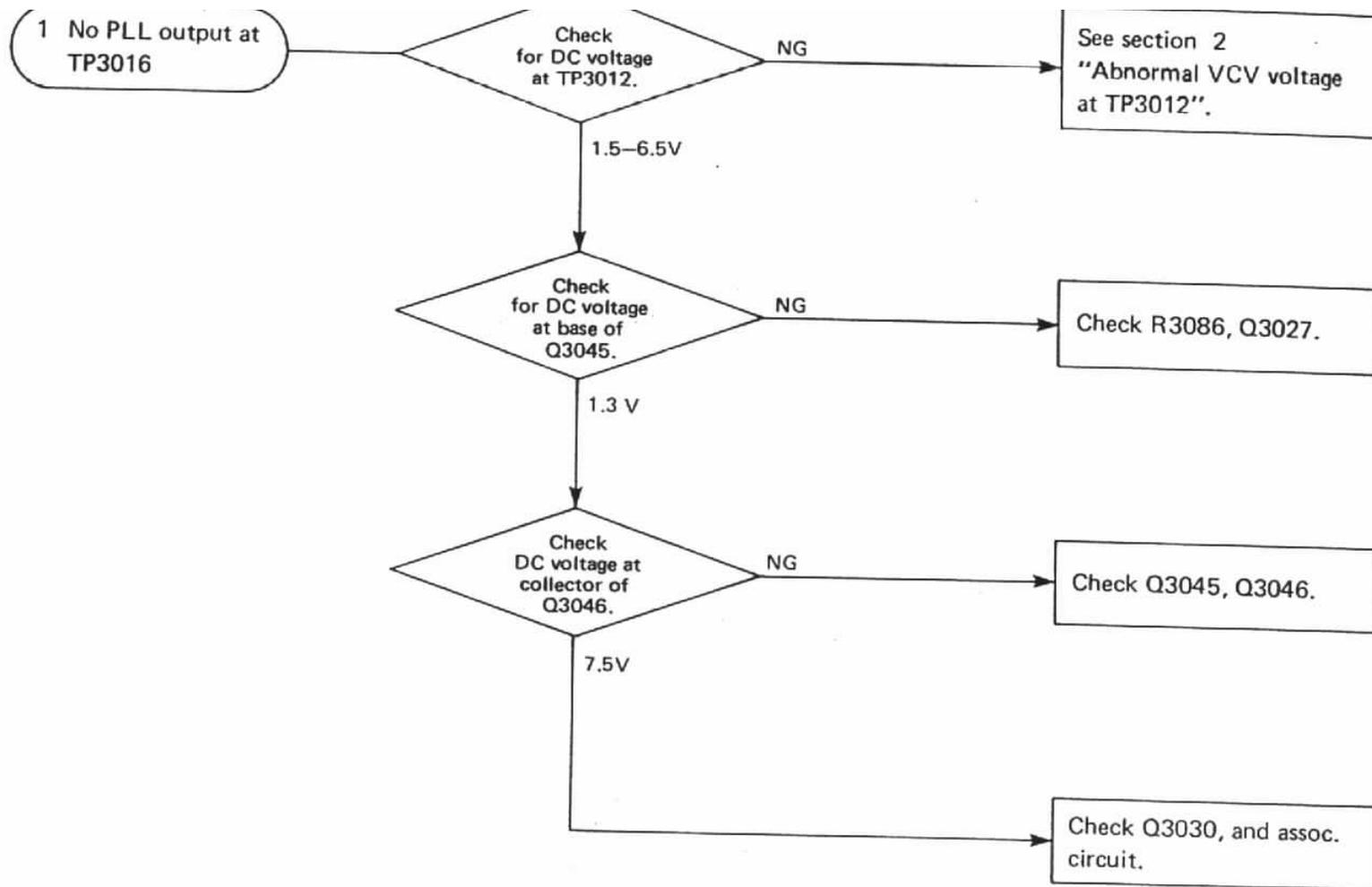
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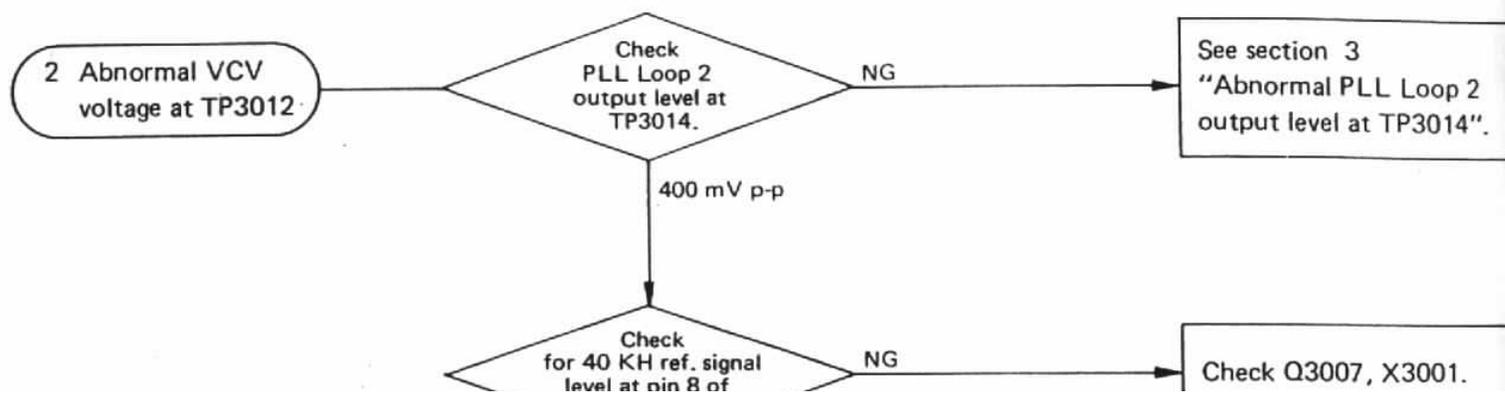
not work.

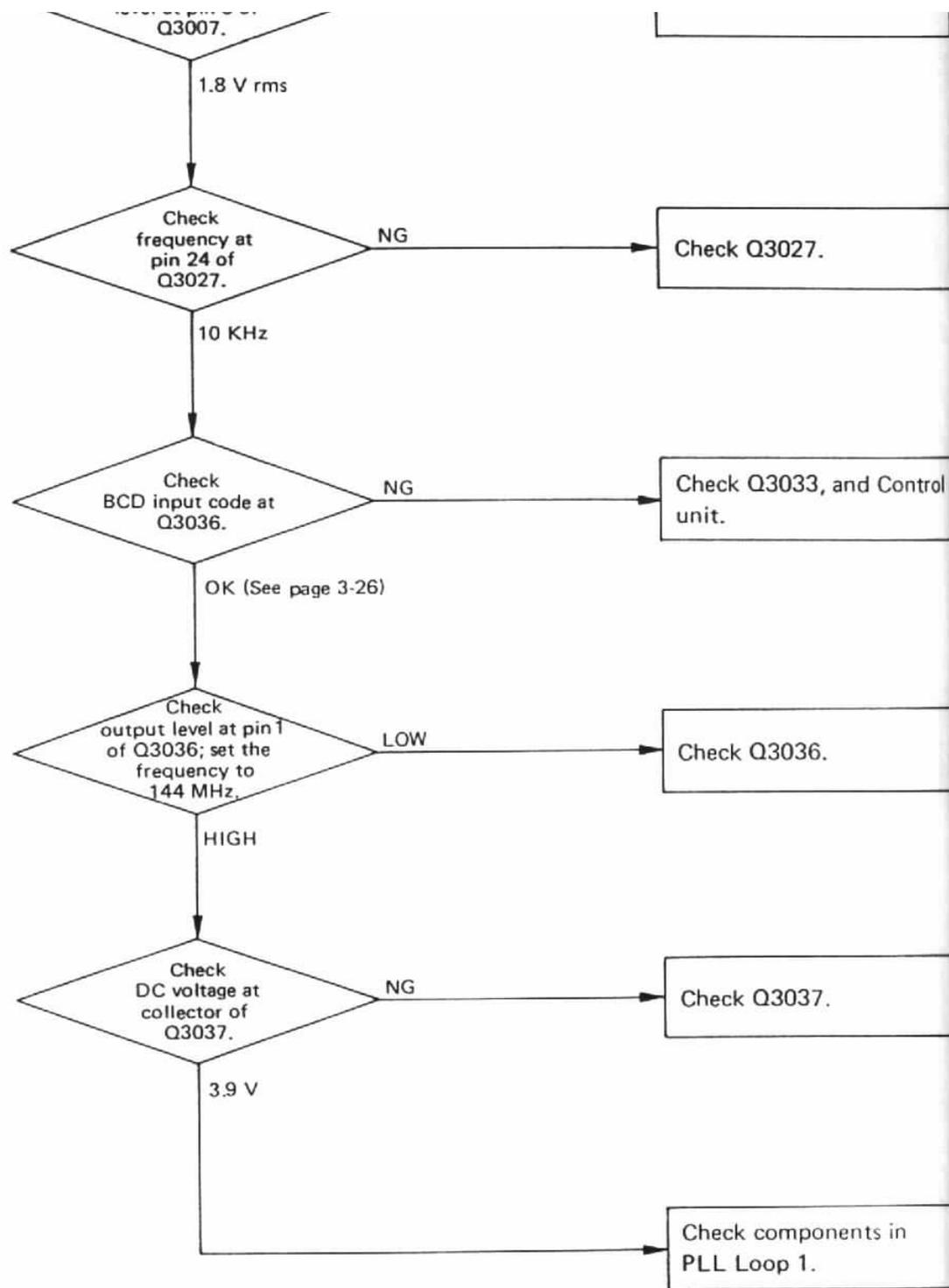


3-52

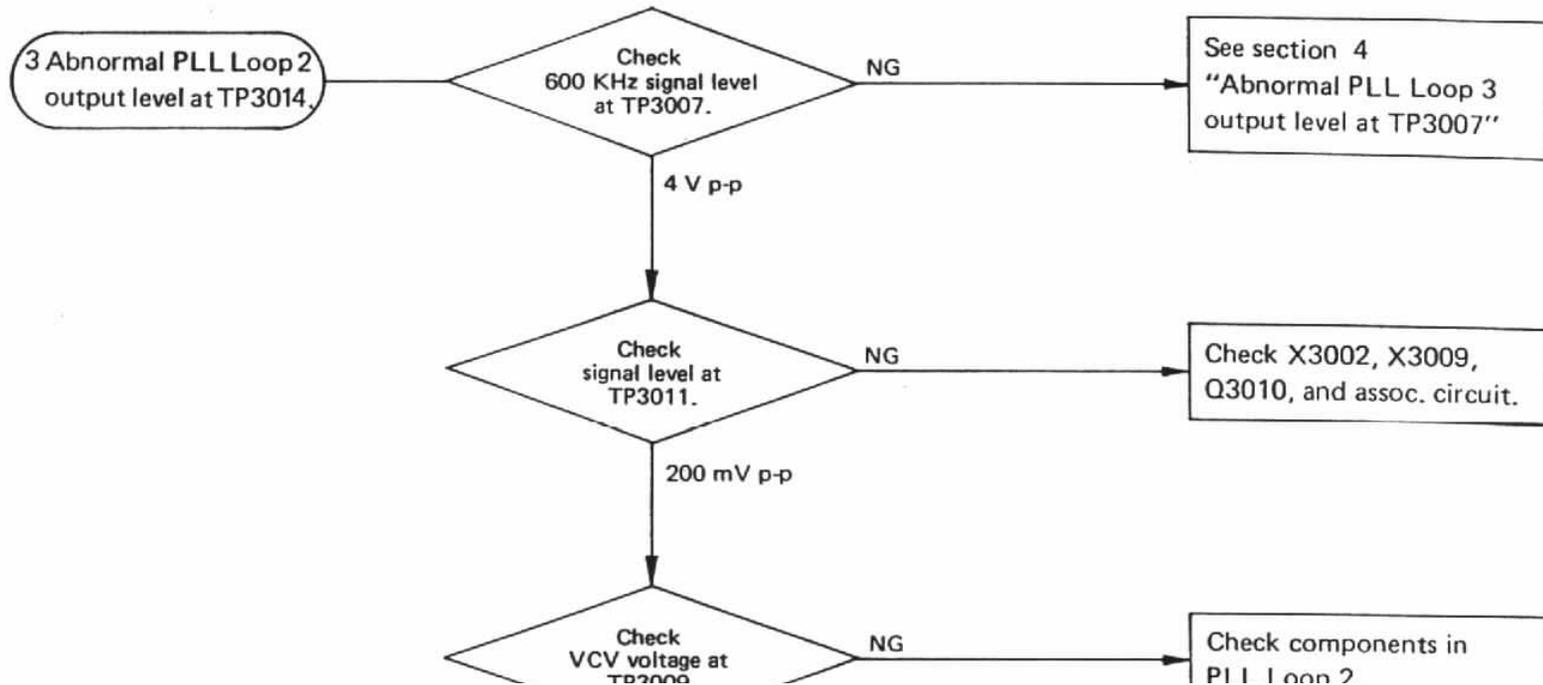


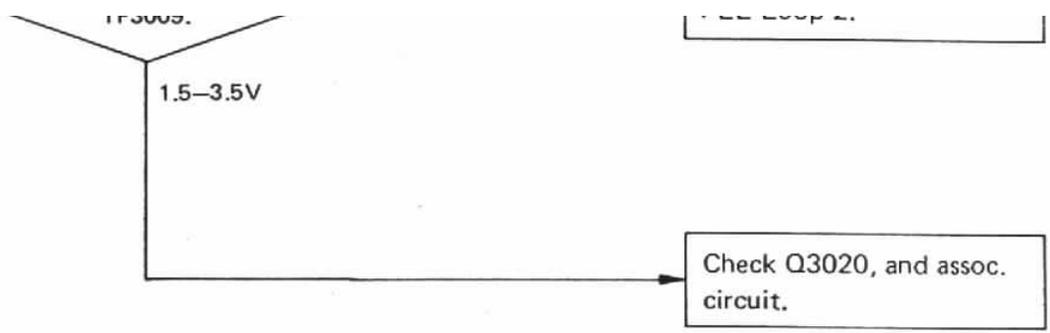
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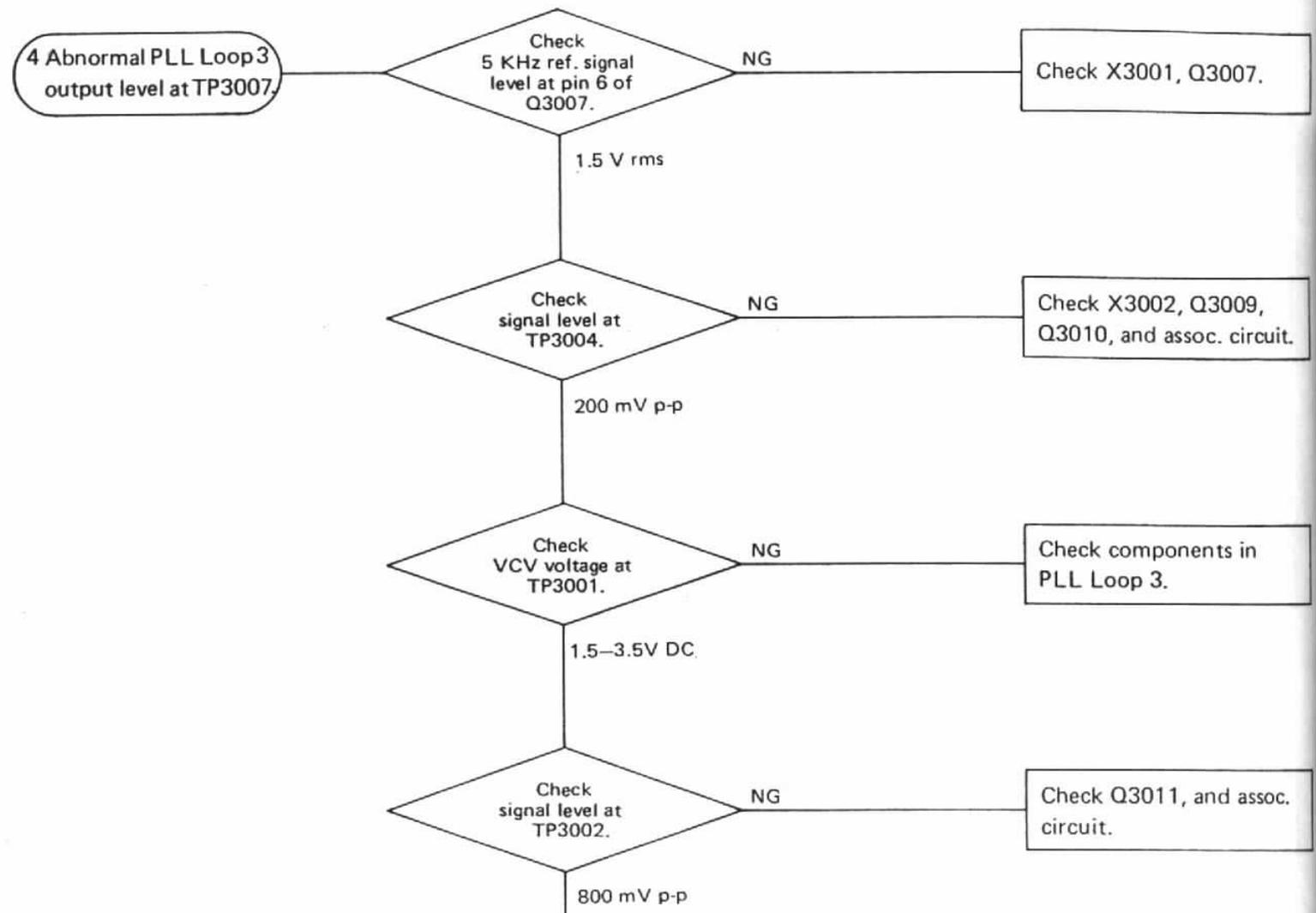


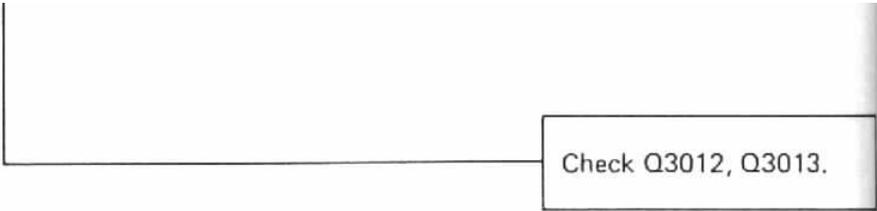
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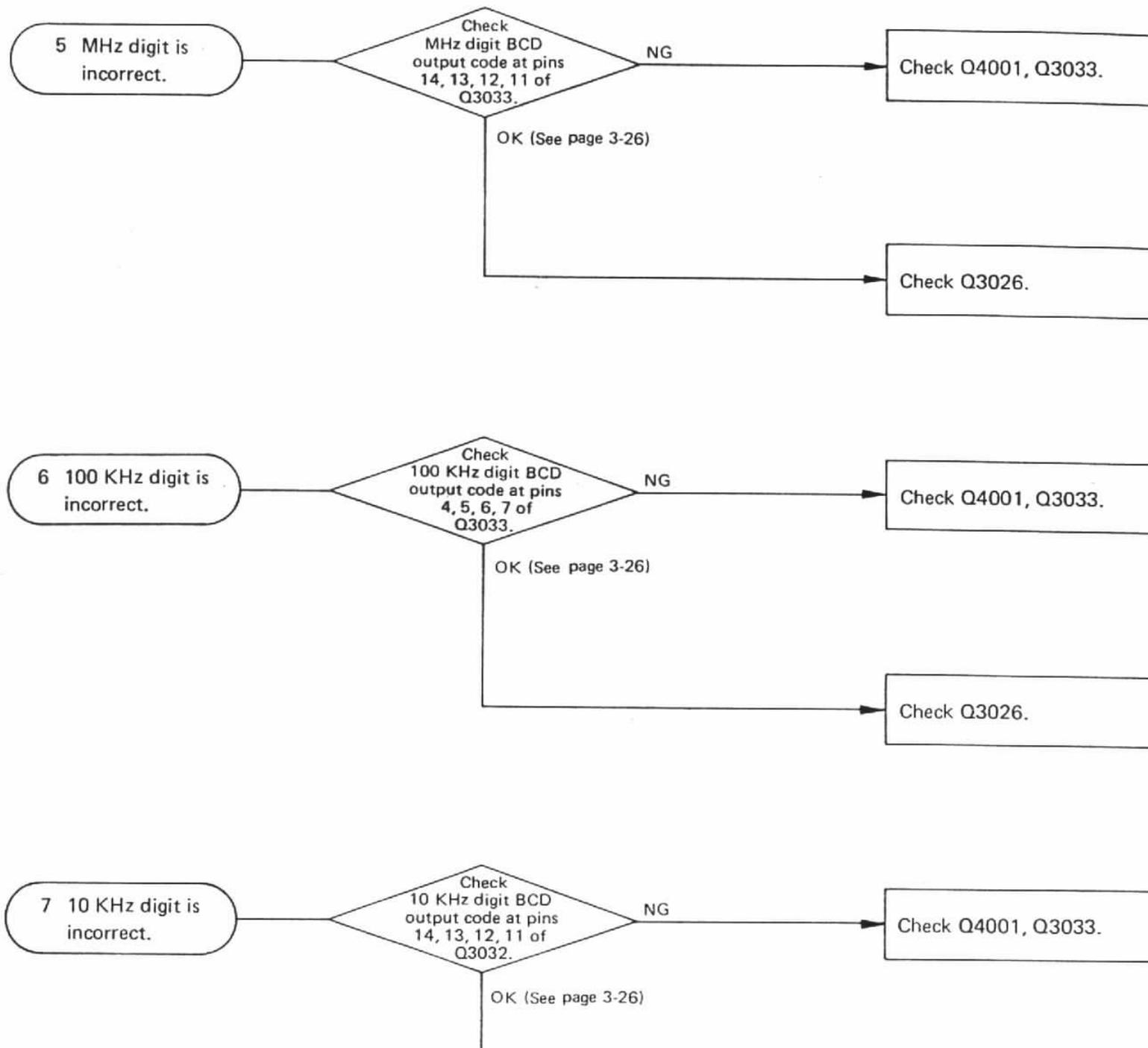


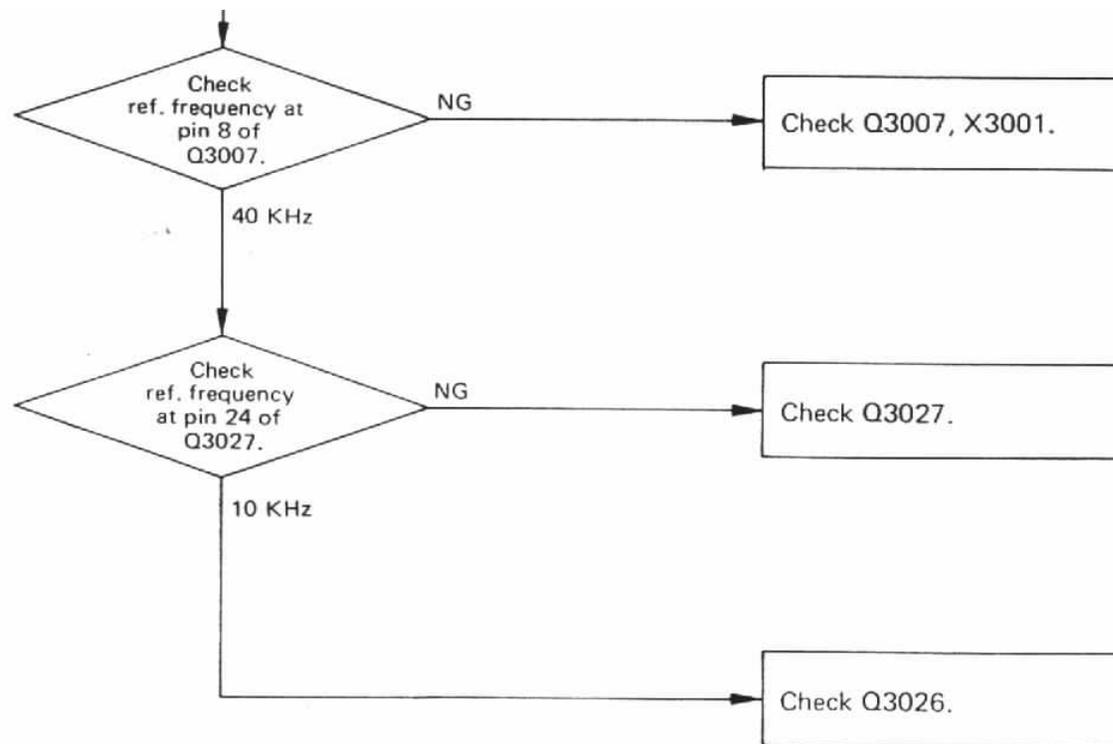
## SERVICING





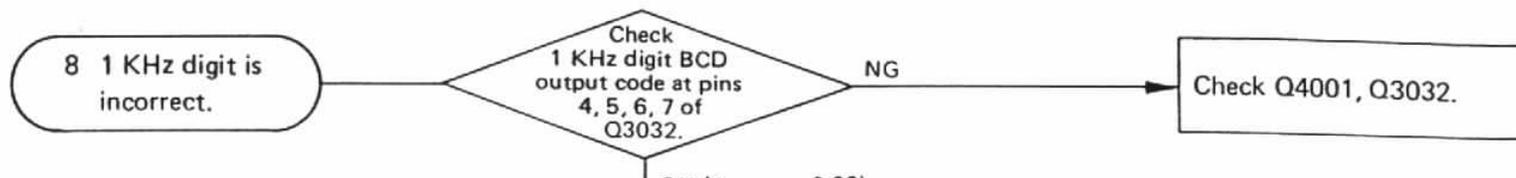
Check Q3012, Q3013.

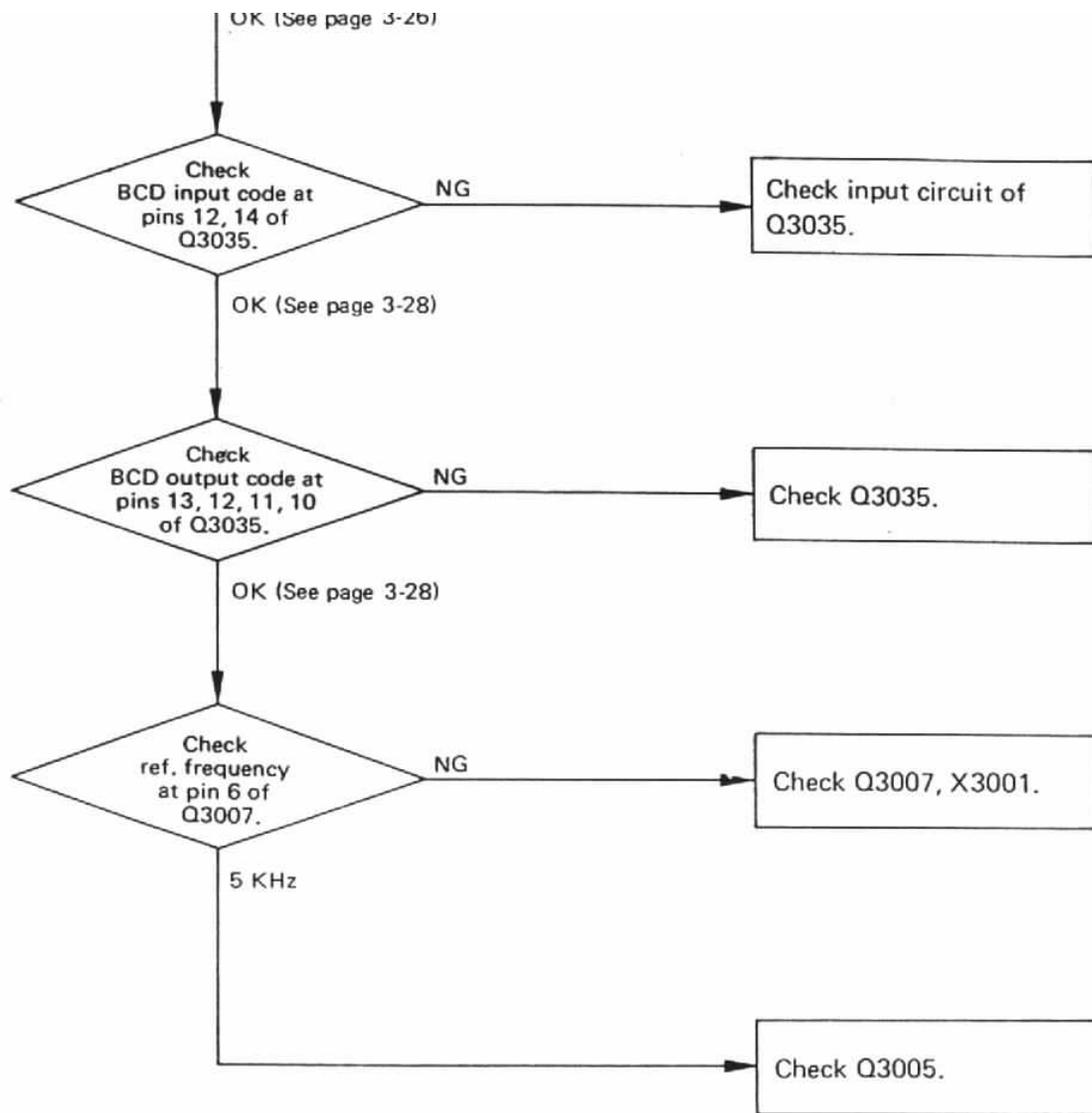




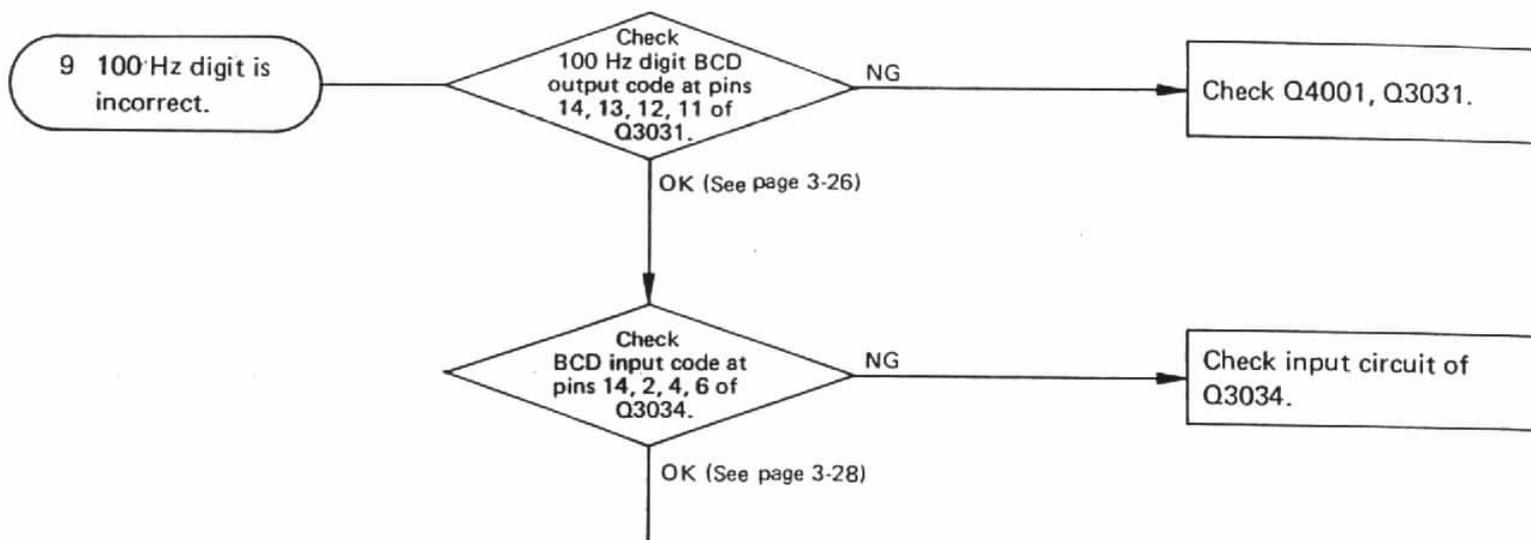
3-57

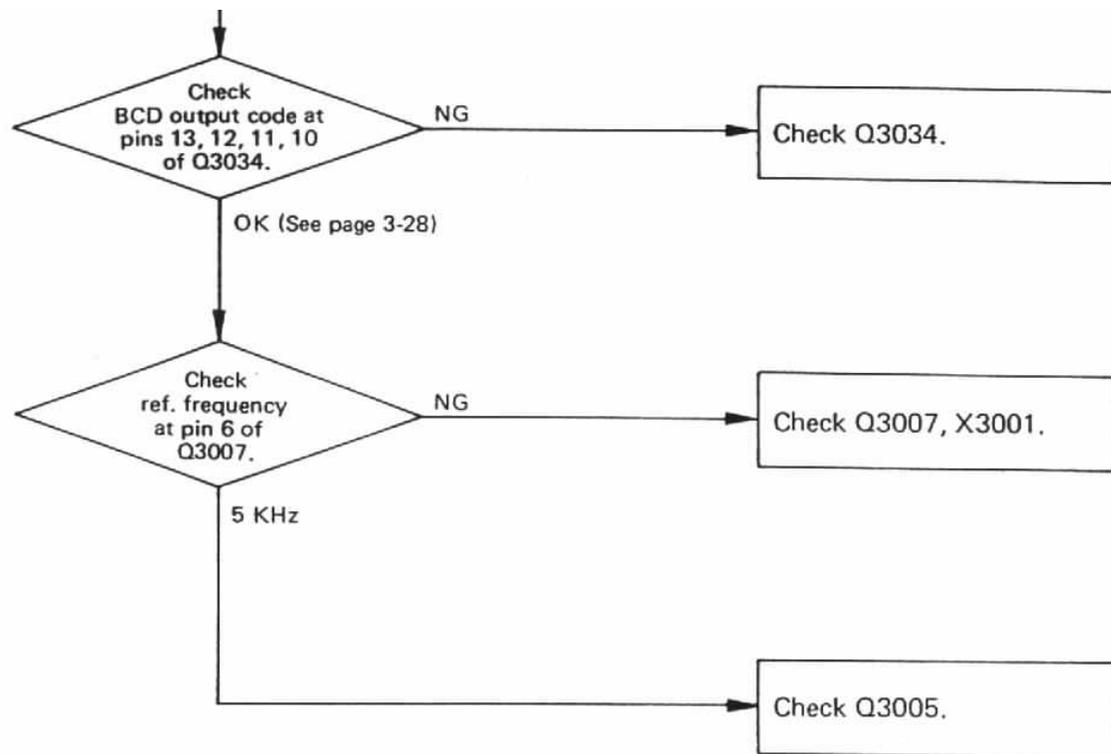
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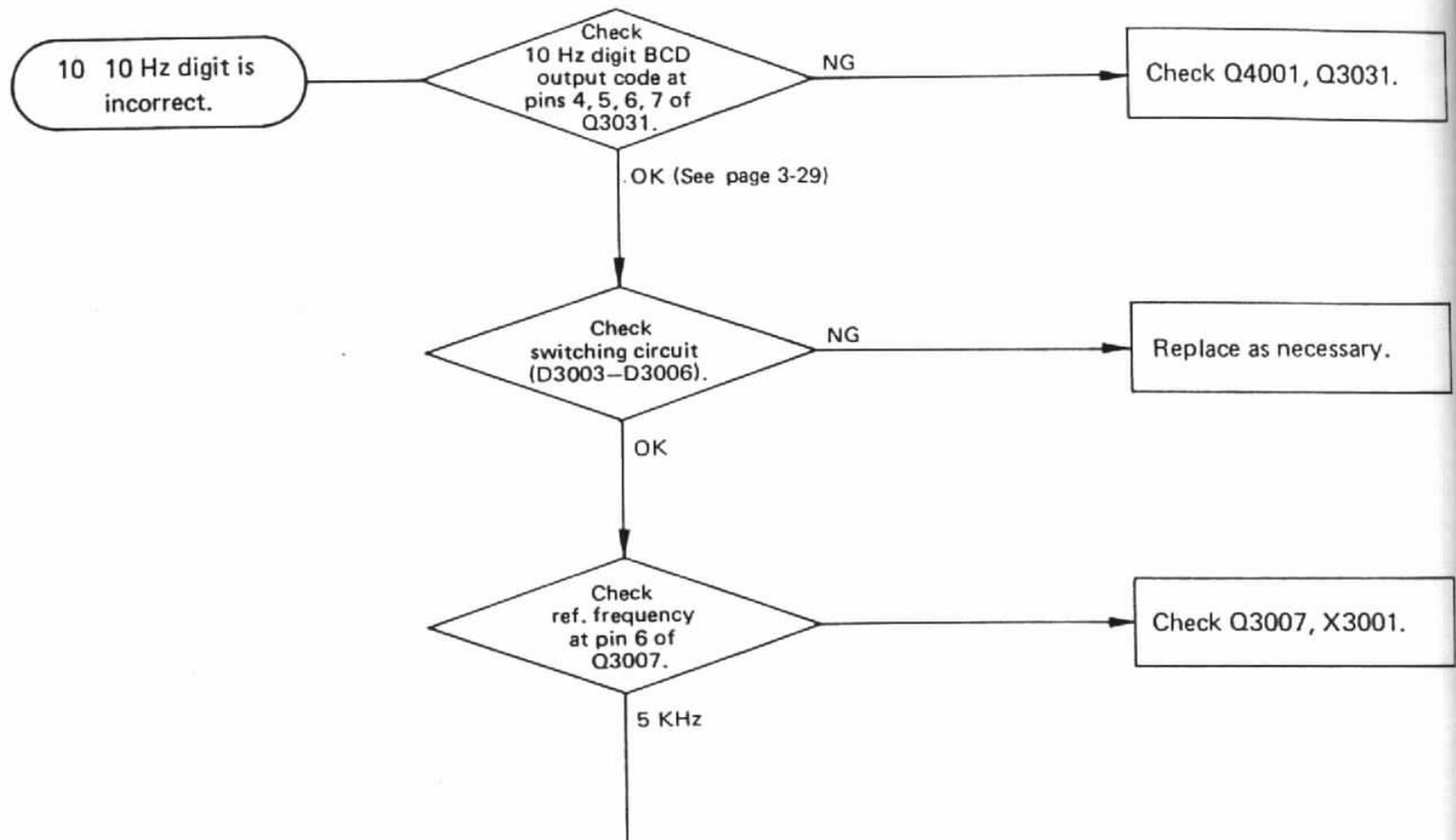


SERVICING





### SERVICING





Check TC3002,  
TC3003, X3002.

## SECTION 4 — REPAIR PARTS

PARTS ORDERING INFORMATION .....	4-1
PARTS LIST .....	4-5

REPAIR PARTS

## PARTS LIST AND ORDERING DATA

If you live in the United States, you may order parts from Yaesu Electronics Corporation. In other countries, you should order parts from the Yaesu agent for your country. In countries where Yaesu is not currently represented, you may order spare parts directly from Yaesu Musen Company, Ltd. in Tokyo.

When ordering, please specify the exact model number of the transceiver that the part is for. Many parts are standard, such as resistors and disc ceramic capacitors, but you should use particular care when ordering such items as electrolytics, tantalum capacitors, and the like.

The parts list to follow identifies the board that the parts belong to, as well as the circuit designation and part description. A "Part Number" is also specified, and this number will allow immediate identification by our parts department of the item you require. (\*See note below.)

Shipment of parts from Yaesu USA is usually made by UPS, COD. Allow at least a week for the parts department to process your order. You will receive prompt notification that your order has been received, and if parts are back ordered, or if additional information is required, you will be so informed.

## PARTS ORDER EXAMPLE

QUANTITY	TRANSCEIVER IDENTIFICATION	LOCATION	* PART NUMBER	CIRCUIT DESIGNATION
1	FT-480R	PB-2135	G4800590Y	Q <sub>1001</sub> 3SK59Y

.....  
(cut here)

YAESU MUSEN COMPANY, LTD.

– C.P.O. BOX 1500, TOKYO, JAPAN

YAESU ELECTRONICS CORPORATION – 6851 Walthall Way, Paramount, CA 90723

YAESU ELECTRONICS CORPORATION – 9812 Princeton-Glendale Rd., Cincinnati, OH 45246

ORDER BLANK

ORDER BLANK

QUANTITY	TRANSCEIVER IDENTIFICATION	LOCATION	PART NUMBER	CIRCUIT DESIGNATION

I authorize shipment via:  Best Way       Parcel Post  
 UPS                       Other

Ship To:  
(Print or Type)

Name: \_\_\_\_\_  
Address: \_\_\_\_\_  
City: \_\_\_\_\_ State: \_\_\_\_\_ Zip: \_\_\_\_\_  
Country: \_\_\_\_\_

4-1

REPAIR PARTS

YAESU MUSEN COMPANY, LTD.      – C.P.O. BOX 1500, TOKYO, JAPAN  
YAESU ELECTRONICS CORPORATION – 6851 Walthall Way, Paramount, CA 90723  
YAESU ELECTRONICS CORPORATION – 9812 Princeton-Glendale Rd., Cincinnati, OH 45246

ORDER BLANK

QUANTITY	TRANSCEIVER IDENTIFICATION	LOCATION	PART NUMBER	CIRCUIT DESIGNATION


I authorize shipment via:  Best Way  Parcel Post  
 UPS  Other

Ship To: (Print or Type) Name: \_\_\_\_\_  
Address: \_\_\_\_\_  
City: \_\_\_\_\_ State: \_\_\_\_\_ Zip: \_\_\_\_\_  
Country: \_\_\_\_\_

.....  
(cut here)

YAESU MUSEN COMPANY, LTD. - C.P.O. BOX 1500, TOKYO, JAPAN  
YAESU ELECTRONICS CORPORATION - 6851 Walthall Way, Paramount, CA 90723  
YAESU ELECTRONICS CORPORATION - 9812 Princeton-Glendale Rd., Cincinnati, OH 45246

**ORDER BLANK**

QUANTITY	TRANSCEIVER IDENTIFICATION	LOCATION	PART NUMBER	CIRCUIT DESIGNATION

I authorize shipment via:  Best Way  Parcel Post  
 UPS  Other

Ship To:  
(Print or Type)

Name: \_\_\_\_\_  
 Address: \_\_\_\_\_  
 City: \_\_\_\_\_ State: \_\_\_\_\_ Zip: \_\_\_\_\_  
 Country: \_\_\_\_\_

4-3

## REPAIR PARTS

## PARTS LIST

MAIN CHASSIS			MAIN UNIT		
Symbol No.	Part No.	Description	Symbol No.	Part No.	Description
PB-2143	F0002143	Printed Circuit Board (for S03)	PB-2135C	F0002135C	Printed Circuit Board
				C0021350	PCB with Components
PB-2132	F0002132	Printed Circuit Board (for J08)			
					IC
		IC	Q1008	G1090072	$\mu$ PC577H
Q01	G1090294	$\mu$ PC7808H	Q1016	G1090101	$\mu$ PC1037H
			Q1029	G1090284	$\mu$ PC2002V
		DIODE	Q1036	G1090061	MC1496G
D01	G2090034	U05B	Q1060,1061	G1090068	MC14011B
			Q1057	G1090239	TC5082P
		POTENTIOMETER			
VR01 (with S09)	J62800048	DM11A825A5M1112			FET
			Q1001	G4800590Y	3SK59Y
		RESISTOR	Q1002	G4800510C	3SK51
R01	J02245103	Carbon film 1/4W SJ 10k $\Omega$	Q1003,1014,1015	G4800730Y	3SK73Y
R02	J02245104	" " " " 100k $\Omega$	Q1021	G3800301Y	3SK30AY
			Q1037	G4800700	3SK70

		CAPACITOR	Q1043	G3090035	2SK19TMGR
C01,02	K40170105	Electrolytic 50WV 1 $\mu$ F (50RL1)			
C03	K40129006	" 16WV 470 $\mu$ F (16RE470)	Q1004,1006,1007, 1009,1010,1013, 1019,1027,1028, 1032-1035, 1040-1042,1044, 1046,1054,1056, 1059,1062	G3309450Q	TRANSISTOR 2SC945Q
		SPEAKER			
SP01	M4090047	SS-77KYH			
		SWITCH	Q1051	G3309450P	2SC945P
S01	N0190066	SBU-2045	Q1005,1017 1047	G3305350B	2SC535B
S02	N0190079	SRN-4086N	Q1011,1018,1039, 1053,1063	G3318150Y	2SC1815Y
S03	Q9000083A	EWT-XD2 S3550B			
S03 (with board)	C0021430		Q1012,1030,1031	G3318150G	2SC1815GR
S04,08,06	N6090004	SSF-22-08B	Q1020,1022,1058	G3107331P	2SA733 P or Q
S07	N6090002	SSH-23-08	Q1038	G3320530	2SC2053
			Q1048,1049,1050	G3315830	2SC1583
		RECEPTACLE	Q1055	G3313830R	2SC1383R/S
J01	P0090158	FM-214-8SS	Q1052	G3090005	MPSA13
J02	P0090010	FM-142S			
J03	P1090028	MBR06D			DIODE
J04,05	P1090005	SG8050	D1006,1015, 1017-1024, 1027-1029, 1037-1043, 1049-1052, 1057,1061-1065, 1067-1073,1075, 1077-1081	G2090027	1SS53
J06,11	P0090054	5048-07A			
J07	P0090036	5048-14A			
J08	P0090173	EMCS0450M			
J08 (with board)	C0021320				
		PLUG			
P01	T9203770A	5208-07	D1010-1012,1014, 1025,1026,1030, 1059,1060	G2001880F	1S188FM
P02	T9203140B	5208-10			
P03	T9203150A	5208-12			
P04	T9203800	5208-04	D1013	G2015550	1S1555
P06	T9203170	5208-12	D1044-1048	G2022090	1S2209
P07	T9203180	5208-5	D1053-1056	G2010070	1S1007
P09	T9203230C	5208-14	D1066	G2090001	10D1
P12	T9203280A				
					CRYSTAL
			X1001	H0101100A	11.265 MHz
			X1002	H0100992	10.8115 MHz
			X1003	H0100991	10.8085 MHz
			X1004	H0102288	10.8093 MHz
			X1005	H0101983	7.3728 MHz
			X1005	H0101982	7.168 MHz (EUROPE MODEL)

## REPAIR PARTS

		<b>CRYSTAL FILTER</b>	R1216	J02245392	Carbon film 1/4W SJ 3.9k $\Omega$
XF1001	H1102021	108M30B	R1018,1136,1146,	J02245472	" " " " 4.7k $\Omega$
XF1002	H1102022	10F-2D	1218,1305,1329		
		<b>CERAMIC FILTER</b>	R1045,1046,1053,	J02245562	" " " " 5.6k $\Omega$
CF1001	H3900220	LF-H12S	1100,1152,1159,		
CF1002	H3900030	LF-B15	1163,1181,1209,		
			1277,1283,1310,		
			1327		
			R1016,1088	J02245682	" " " " 6.8k $\Omega$
		<b>CERAMIC DISCRIMINATOR</b>	R1148	J02245822	" " " " 8.2k $\Omega$
CD1001	H7900040	455-DW-8	R1023,1026,1055,	J02245103	" " " " 10k $\Omega$
			1079,1093,1094,		
			1096,1104,1134,		
			1135,1137,1154,		
			1177,1180,1224,		
			1226,1229,1232,		
			1243,1265,1269,		
			1275,1279,1282,		
			1284,1293,1298,		
			1303,1304,1306,		
			1307,1311,1322		
		<b>RESISTOR</b>			
R1141	J02245010	Carbon film 1/4W SJ 1 $\Omega$			
R1140	J02245229	" " " " 2.2 $\Omega$			
R1211	J02245220	" " " " 22 $\Omega$			
R1007,1013,1017, 1078,1084,1204, 1207	J02245560	" " " " 56 $\Omega$		J10216103	Carbon composition 1/8W GK 10k $\Omega$
R1063	J01245560	" " " TJ 56 $\Omega$	R1126,1219,1233	J02245123	Carbon film 1/4W SJ 12k $\Omega$
R1173	J02245680	" " " SJ 68 $\Omega$	R1286,1290	J02245153	" " " " 15k $\Omega$
R1188	J02245820	" " " " 82 $\Omega$	R1169	J02245183	" " " " 18k $\Omega$
R1028,1044,1085, 1175,1179,1190, 1231,1235,1236, 1242,1245,1257, 1260,1263,1267, 1333	J02245101	" " " " 100 $\Omega$	R1031,1047,1048, 1171,1220,1228, 1246,1264,1272, 1276,1278,1287, 1309	J02245223	" " " " 22k $\Omega$
			R1144,1162,1164	J02245273	" " " " 27k $\Omega$
			R1176,1268,1291	J02245333	" " " " 33k $\Omega$

R1024,1064,1065, 1182,1183,1326	J01245101	"	"	"	TJ	100Ω	R1004,1020 1075,1080,1202, 1324	J02245393 J02245393	"	"	"	"	39kΩ
R1005,1021,1076, 1083,1147	J02245151	"	"	"	SJ	150Ω	R1011,1012,1025, 1058,1151,1280, 1281	J02245473	"	"	"	"	47kΩ
R1139,1172,1234, 1237,1238	J02245221	"	"	"	"	220Ω	R1056,1168,1252	J02245563	"	"	"	"	56kΩ
R1060	J02245331	"	"	"	"	330Ω	R1128,1145,1158	J02245683	"	"	"	"	68kΩ
R1059	J02245391	"	"	"	"	390Ω	R1133	J02245823	"	"	"	"	82kΩ
R1066,1193,1222, 1253,1266,1330	J02245471	"	"	"	"	470Ω	R1003,1019,1074, 1081,1095,1127, 1132,1138,1150, 1156,1161,1170, 194-1199,1201, 1206,1212,1270, 1273,1292	J02245104	"	"	"	"	100kΩ
R1070,1178,1323	J02245561	"	"	"	SJ	560Ω	R1057,1155,1160, 1215	J02245124	"	"	"	"	120kΩ
R1142	J02245681	"	"	"	"	680Ω	R1038,1040,1049, 1051	J02245154	"	"	"	"	150kΩ
R1185	J02245821	"	"	"	"	820Ω	R1089,1214,1255	J02245184	"	"	"	"	180kΩ
R1006,1022,1027, 1033,1062,1071, 1072,1077,1082, 1087,1090,1091, 1097,1130,1149, 1157,1174,1184, 1192,1208,1213, 1241,1244,1256, 1258,1259,1261, 1262,1274,1325, 1328,1331	J02245102	"	"	"	"	1kΩ	R1200	J02245224	"	"	"	"	220kΩ
R1073	J01245103	"	"	"	TJ	1kΩ	R1239,1294	J02245334	"	"	"	"	330kΩ
R1054,1102,1103, 1191,1205,1210, 1217,1230	J02245152	"	"	"	SJ	1.5kΩ	R1240	J02245474	"	"	"	"	470kΩ
R1061	J02245182	"	"	"	"	1.8kΩ	R1271,1297	J02245564	"	"	"	"	560kΩ
R1015,1034,1037, 1039,1041-1043, 1067-1069,1099, 1129,1165,1187, 1221,1254,1308	J02245222	"	"	"	"	2.2kΩ	R1288	J02245684	"	"	"	"	680kΩ
R1299	J02245272	"	"	"	"	2.7kΩ	R1285,1296	J02245824	"	"	"	"	820kΩ
R1050,1052,1086, 1131,1143,1166, 1186,1223,1225, 1227,1289,1302	J02245332	"	"	"	"	3.3kΩ	R1098,1101,1295, 1300	J02245105	"	"	"	"	1MΩ
							R1092,1301	J02245155	"	"	"	"	1.5MΩ
							R1002	J02245225	"	"	"	"	2.2MΩ
									<b>THERMISTOR</b>				
							TH1001	G9090001	SDT-250				

## REPAIR PARTS

		POTENTIOMETER		C1003,1004,1006, 1019,1023,1026, 1033,1065,1071, 1085,1124,1131, 1132,1151,1183, 1190,1193,1218, 1228,1230,1245, 1261,1264,1266, 1272-1274,1277, 1281	K13170102	Ceramic 50WV 0.001 $\mu$ F (DB200YF102Z75L2)		
VR1001	J51730222	P6-S3NA	2.2k $\Omega$					
VR1002-1006, 1009,1010	J51730103	P6-S3NA	10k $\Omega$					
VR1011	J51730104	P6-S3NA	100k $\Omega$					
VR1007,1012	J51730223	P6-S3NA	22k $\Omega$					
VR1008	J51737201	3321P	200 $\Omega$					
VR1014	J51729503	RV8-F AN50k $\Omega$						
		CAPACITOR		C1005,1007,1008, 1009,1024,1025, 1030,1037, 1066-1068,1073, 1076,1082-1084, 1086-1088,1090, 1092,1098,1100, 1127,1152,1154, 1155,1156,1169, 1160-1165,1171, 1182,1185,1188, 1191,1192,1199, 1200,1202,1203, 1206,1209,1211, 1213,1214,1215, 1219,1223,1229, 1251,1263	K13170103	" " 0.01 $\mu$ F (DB201YF103Z5L5)		
C1175	K00179001	Ceramic 50WV SL 0.5pF (DD104SL0R5C50V02)						
C1267	K00172010	" " " 1pF (DD104SL010C50V02)						
	K00172020	" " " 2pF (DD104SL020C50V02)						
C1020,1173,1177	K02179003	" " CH 2pF (DD104CK020C50V02)						
C1224	K00172030	" " SL 3pF (DD104SL030C50V02)						
	K00172040	" " " 4pF (DD104SL040C50V02)						
C1011-1013,1001	K02172050	" " CH 5pF (DD104CH050C50V02)	C1027,1042,1043, 1051,1072, 1145,1197,1252				K19149026	(UAT04V102K-L05AE) " 25WV 0.001 $\mu$ F
C1174,1176,1180, 1186	K06173060	" " UJ 6pF (ECC-D1H060DV)	C1257				K19149001	(UTA04X102K-L05AE) " 25WV 0.001 $\mu$ F
C1280	K00173060	" " SL 6pF (DD104SL060D50V02)	C1078,1120,1270				K19149005	(UAT04X222K-L05AE) 25WV 0.0022 $\mu$ F
C1269	K00173070	" " SL 7pF (DD104SL070D50V02)	C1136,1144,1196				K19149007	(UAT05X332K-L05AE) 25WV 0.0033 $\mu$ F
C1167,1168	K06173080	" " UJ 8pF (DD104UJ080D50V02)	C1055,1056,1060, 1070,1096,1119, 1232,1235,1237, 1239				K19149013	(UAT05X103K-L05AE) 25WV 0.01 $\mu$ F
C1069	K02173080	" " SL 8pF (DD104SL080D50V02)	C1146				K19149015	(UAT08X153K-L45AE) 25WV 0.015 $\mu$ F
C1080,1172,1178	K00173100	" " " 10pF (DD104SL100D50V02)	C1052-1054,1246				K19149017	(UAT04X223K-L05AE) 25WV 0.022 $\mu$ F
C1015,1018,1216	K02173100	" " CH 10pF (DD104CH100D50V02)	C1028,1029, 1039-1041, 1044-1050,1074, 1075,1079,1081.				K19149021	(UAT08X473K-L45AE) 25WV 0.047 $\mu$ F
C1038,1153,1276	K00175150	" " SL 15pF (DD104SL150J50V02)						
C1010	K02175150	" " CH 15pF						

C1016,1017	K02175180	(DD104CH150J50V02) " " " 18pF	1233,1236,1238, 1240,1253,1254		
C1181,1210,1212	K00175220	(DD104CH180J50V02) " " " SL 22pF	C1058,1063,1129	K19149025	(UAT13X104K-L46AE) 25WV 0.1μF
C1220	K00175270	(DD104SL220J50V02) " " " 27pF			Electrolytic
C1204,1205	K02179011	(DD104SL270J50V02) " " " CH 27pF	C1258	K40179005	50WV 0.47μF (50RC2-R47)
C1241,1248,1249	K00175330	(DD104CH270J50V02) " " " SL 33pF	C1091,1097, 1116-1118,1121, 1123,1133,1137, 1138,1140,1141, 1143,1147,1148, 1150,1194,1243, 1247,1256,1260	K40170105	" 1μF (50RL1)
C1034	K00175390	(DD104SL330J50V02) " " " 39pF			
C1059	K00175470	(DD104SL390J50V02) " " " 47pF	C1268	K40179001	" 1μF (50RC2-1)
C1217	K02175470	(DD104SL470J50V02) " " " CH 47pF	C1255	K40149001	25WV 4.7μF (25RE4R7)
C1077,1093,1094, 1234,1271	K00175101	(DD106CH470J50V02) " " " SL 100pF	C1061,1062	K40149011	" 4.7μF (25RC2-4R7)
C1157,1159	K00175221	(DD105SL101J50V02) " " " 220pF	C1250,1262,1265	K40120106	16WV 10μF (16RL10)
C1242	K00175331	(DD107SL221J50V02) " " " 330pF	C1184	K40120226	" 22μF (16RL22)
C1158	K00175471	(DD107SL331J50V02) " " " 470pF	C1064,1089,1134, 1135,1139,1142, 1149,1195,1198, 1244,1259	K40109002	10WV 47μF (10RE47)
		(DD109SL471J50V02)			
			C1122	K40109001	" 100μF (10RE100)
			C1125	K40109007	" 220μF (10RE220)
			C1128	K40129001	16WV 330μF (16RE330)
			C1130	K40129003	" 1000μF (16RL1000 KOHO)

### REPAIR PARTS

		Tantalum	R2007	J02245222	Carbon film	1/4W	2.2kΩ
C1201	K70167474	35WV 0.47μF (CS15E1VR47)	R2008	J02245103	" "	"	10kΩ
C1099	K70127225	16WV 2.2μF (CS15E1C2R2M)	R2009	J02245104	" "	"	100kΩ
		Styrol					

C1036,1208,1222	K51176101	100pF (S0SU101K)				<b>POTENTIOMETER</b>
C1035,1207,1221	K51176221	220pF (S0SU221K)	VR2003	J50716201	RV8FAS	200Ω
			VR2001	J50716103	"	10kΩ
		<b>TRIMMER CAPACITOR</b>	VR2002	J50716503	"	50kΩ
TC1001-1004	K91000074	10pF (TZ03T110A)				
TC1005-1010	K91000075	20pF (TZ03R200A)				<b>CAPACITOR</b>
			C2020	K00179001	Ceramic 50WV SL 0.5pF (DD104SL0R5C50V02)	
L1016	L1190004	(FL4HR68M0.68μH) 0.68μH	C2022,2025	K00172010	" " " 1pF (DD104SL010C50V02)	
L1010,1011	L1190006	(FL4HR2M 1.2μH) 1.2μH				
L1001	L1190116	(FL4HR33M) 0.33μH	C2034	K00173060	" " " 6pF (DD104SL060D50V02)	
L1003	L1190117	(S-4 15μH) 15μH				
L1007,1008,1014, 1015,1017	L1190016	(FL5H101K) 100μH	C2017	K00173070	" " " 7pF (DD104SL070D50V02)	
L1005,1006	L1190040	(S-4 1mH) 1mH	C2001	K00173100	" " " 10pF (DD104SL100D50V02)	
L1012	L0020829					
L1013	L0020725		C2019,2028,2029	K00175150	" " " 15pF (DD104SL150J50V02)	
L1002	L0020302					
			C2002,2007	K00175220	" " " 22pF (DD104SL220J50V02)	
		<b>TRANSFORMER</b>				
T1001,1002 1010-1014	L0020345		C2018	K00175270	" " " 27pF (DD104SL270J50V02)	
T1003,1005,1006, 1015	L0020187		C2035	K00175330	" " " 33pF (DD104SL330J50V02)	
T1004,1009, 1016-1018	L0190001		C2033	K00175390	" " " 39pF (DD104SL390J50V02)	
			C2003,2005, 2011-2016,2024, 2026,2027,2030, 2031,2032	K13170102	" " " 0.001μF (DB200YF102Z5L2)	
CH1001	L2030067	FR14/7/5-2001F				
		<b>RELAY</b>				
RL1001	M1190006	FBR221D012	C2004,2006 2021	K14179002	" " " 0.01μF (RD204YM103Z50V)	
	L9190001	Ferrite Beads R1 3x3-1	C2023	K70167105	Tantalum 35WV 1μF (CS15E1V010M)	
	Q5000026	Terminal TP-E	C2008-2010	K40129004	" 16WV 10μF (16RE10)	
						<b>INDUCTOR</b>
			TC2001-2004	K91000075	20pF (TZ03R200A)	
			L2001,2003	L0020193		
			L2002	L0020195		
			L2004-2006,2010	L1020469		
			L2007	L0020190		
			L2008,2009	L0020430		
			L2011	L0020334		
		<b>TRANSISTOR</b>				<b>TRANSFORMER</b>
<b>PA UNIT</b>						
Symbol No.	Part No.	Description				
PB-2141	F0002141	Printed Circuit Board				
	C002141	PCB with Components				

Q2001	G3320530	2SC2053	T2001	L0020069	
Q2003	Q3107150	2SA715C			
					RELAY
		POWER MODULE	RL2001	M1190006	FBR221-D012
Q2002	Q1090295	M57713		Q5000016	Terminal TP-E
		DIODE			
D2001-2003	G2001880F	Germanium 1S188FM			
D2004	G2015550	Silicon 1S1555			
		RESISTOR			
R2003	J02245479	Carbon film 1/4W 4.7Ω			
R2001	J02245101	" " " 100Ω			
R2002	J02245821	" " " 820Ω			

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REPAIR PARTS

PLL UNIT			R3089,3122	J02245182	Carbon film 1/4W SJ 1.8kΩ
Symbol No.	Part No.	Description	R3091	J02245222	" " " " 2.2kΩ
PB-2136D	F0002136B	Printed Circuit Board	R3124	J02245392	" " " " 3.9kΩ
	C0021360	PCB with Components	R3017,3042	J02245472	" " " " 4.7kΩ
			R3093	J02245562	" " " " 5.6kΩ
		IC, FET and TRANSISTOR	R3092	J02245822	" " " " 8.2kΩ
Q3003,3018	G1090012	IC SN16913P	R3019-3022,3024,3029,3035,3040,3044,3048,3060,3076,3095,3101,3128	J02245103	" " " " 10kΩ
Q3005,3026	G1090247	" TC9122P			
Q3006,3014	G1090048	" TC5081P			
Q3007	G1090239	" TC5082P			
Q3008	G1090084	" μPC78L05	R3023,3025,3043,3086,3105,3106,3108,3115,3117,3119,3121,3123,3127	J02245223	" " " " 22kΩ
Q3012,3013	G1090296	" HD10551			
Q3024	G1090062	" SN76514N			
Q3027	G1090153	" MB8718			

Q3031-3033	G1090297	"	μPD4094B				
Q3034	G1090298	"	MC14560B				
Q3036	G1090088	"	MC14028B	R3030,3034,3047, 3094	J02245333	" " " SJ	33kΩ
Q3044	G1090299	"	μPC7805H				
Q3001	G3090035	FET	2SK19TMGR	R3001-3003, 3006-3008,3041, 3051-3053, 3070-3072, 3078-3080,3097, 3099,3100	J02245104	" " " "	100kΩ
Q3002,3017	G4800730Y	"	3SK73Y				
Q3022,3023	G4800510C	"	3SK51				
Q3028	G3090034	"	2SK19TMY				
Q3004,3019,3025, 3037-3041	G3309450Q	Tr	2SC945Q	R3013,3058,3084	J02245184	" " " "	180kΩ
Q3009,3015	G3316740L	"	2SC1674L				
Q3010,3011,3016, 3030	G3305350A	"	2SC535A				<b>THERMISTOR</b>
				TH3001	G9090008		31D26
Q3020	G3307100	"	2SC710				
Q3029	G3307320G	"	2SC732TML				<b>CAPACITOR</b>
Q3046	G3107331P /Q	"	2SA733 P or Q	C3165	K00179001	Ceramic	50WV SL 0.5pF (ED06J0.5PSL)
Q3045	G3090005	"	MPS-A13	C3160,3166,3169	K02179003	"	" CH 2pF (DD104CK020C50V02)
			<b>IC SOCKET</b>	C3052,3082	K00172020	"	" SL 2pF (DD104SL020C50V02)
QS3001	P3090034		116-24-30-114				
				C3085	K00172030	"	" SL 3pF (DD104SL030D50V02)
			<b>DIODE</b>				
D3002-3007, 3023,3024,3015	G2090027	Silicon	1SS53	C3047	K02172030	"	" CH 3pF (DD104CH030D50V02)
D3001	G2090043	Varactor	MV104	C3003,3011,3131	K02172050	"	" CH 5pF (DD104CH050C50V02)
D3016-3018,3008	G2022090	"	1S2209				
				C3024,3054,3057, 3149	K00172050	"	" SL 5pF (DD104SL050C50V02)
			<b>CRYSTAL</b>				
X3001	H0102367		10.240 MHz	C3046,3074	K06172050	"	" UJ 5pF (DD104UJ050C50V02)
X3002	H0102291		63.9151 MHz				
X3003	H0102289		64.595 MHz	C3006	K06173060	"	" UJ 6pF (DD104UJ060D50V02)
			<b>RESISTOR</b>				
R3011,3056,3077	J02245100	Carbon film	1/4W SJ 10Ω	C3005,3161,3167, 3168	K06173070	"	" UJ 7pF (DD104UJ070D50V02)
R3005,3009,3012, 3018,3028,3046, 3054,3057,3062, 3063,3073,3081, 3083,3090,3098	J02245101	" "	" " 100Ω	C3002,3099	K02173080	"	" CH 8pF (DD104CH080D50V02)
R3087	J02245151	" "	" " 150Ω	C3138	K00173080	"	" SL 8pF (DD108SL080D50V02)
R3031,3036,3049, 3088,3096	J02245221	" "	" " 220Ω	C3042	K02173100	"	" CH 10pF (DD104CH100D50V02)
R3004	J02245331	" "	" " 330Ω	C3014,3060,3063, 3096,3135	K00173100	"	" SL 10pF (DD104SL100D50V02)
R3045	J02245471	" "	" " 470Ω				
R3016,3116	J02245681	" "	" " 680Ω	C3163	K00175120	"	" SL 12pF (DD104SL120J50V02)
R3075,3118	J02245821	" "	" " 820Ω				
R3014,3015,3027, 3039,3059,3061, 3085,3102,3104	J02245102	" "	" " 1kΩ	C3064,3065,3158, 3190,3015,3016	K00175150	"	" SL 15pF (DD104SL150C50V02)

	3083,3104-3104, 3129,3130				C3043,3080	K02175150	" " CH 15pF (DD104CH150J50V02)
R3120	J02245122	" " " " 1.2k $\Omega$			C3022,3147,3184	K00175180	" " SL 18pF (DD104SL180J50V02)
R3038	J02245152	" " " " 1.5k $\Omega$					

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## REPAIR PARTS

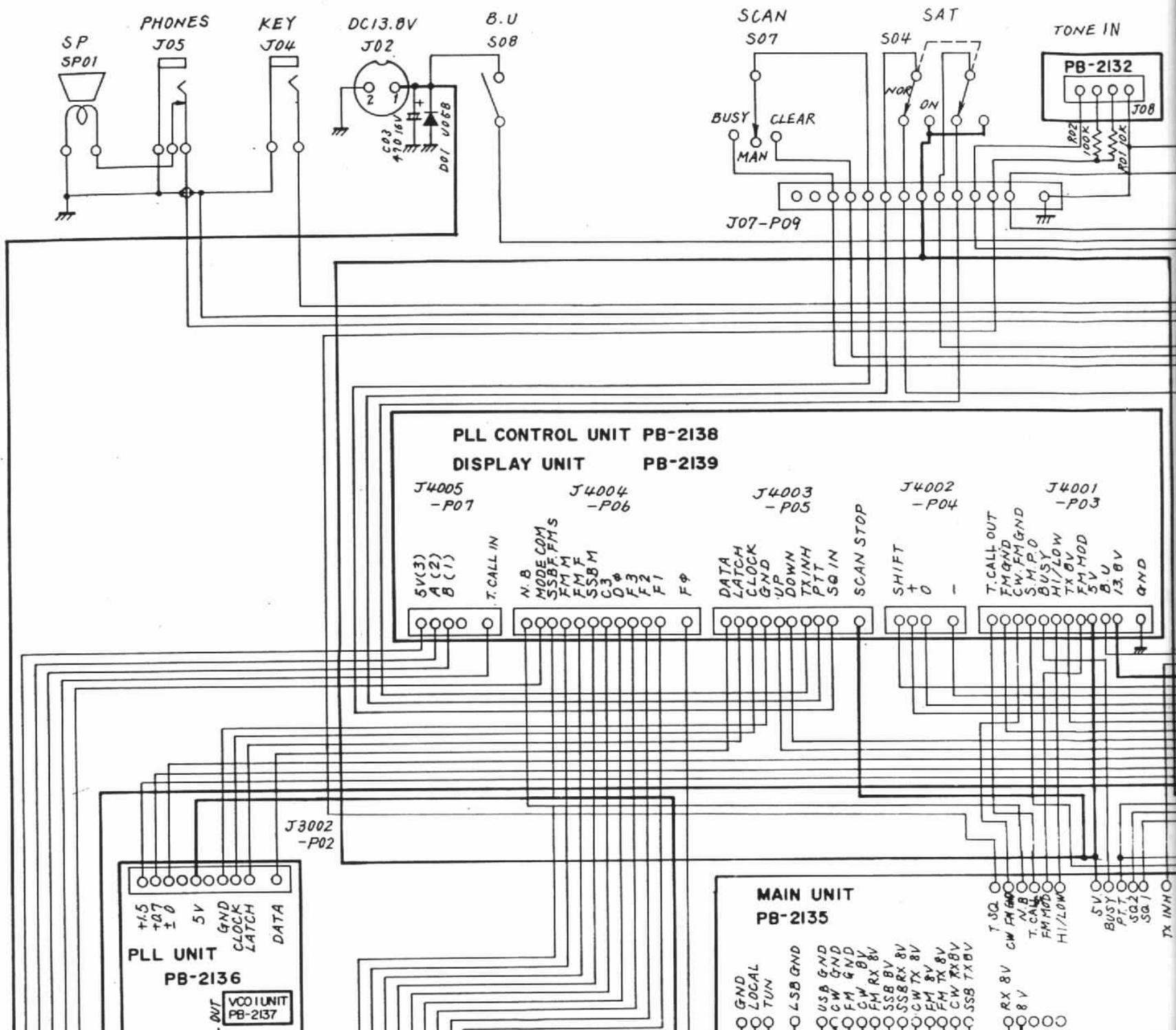
C3004,3044	K02179009	" " CH 22pF (DD104CH220J50V02)				<b>INDUCTOR</b>
			L3012,3013,3021	L1190113	(FL3HR22M)	0.22 $\mu$ H
C3048	K06175220	" " UJ 22pF (ECC-D1H220-JU)	L3004,3015 L3002,3010,3011, 3018	L1190109 L1190004	(FL3HR33M) (FL4HR68M)	0.33 $\mu$ H 0.68 $\mu$ H
	K00175220	" " SL 22pF (DD104SL220J50V02)	L3005,3006,3035, 3036	L1190015	(FL3HR120K)	12 $\mu$ H
C3170	K00175330	" " SL 33pF (DD104SL330J50V02)	L3041	L1190016	(FL5H101K)	100 $\mu$ H
C3010,3073,3075, 3076	K06175330	" " UJ 33pF (DD104UJ330J50V02)	L3022	L1190038	(FL5H271K)	270 $\mu$ H
	K02179013	" " CH 33pF (DD105CH330J50V02)	L3007,3008,3016, 3023,3037-3040, 3024	L1190017	(FL5H102K)	1mH
C3023,3148	K00175390	" " SL 39pF (DD104SL390J50V02)	L3003,3009,3014, 3019,3020,3032, 3033	L0020774		
C3045	K02175390	" " CH 39pF (DD105-257CH390J50V02)	L3017	L0020821		
C3030,3031	K02175470	" " CH 47pF (DD106CH470J50V02)	L3001	L0020793		
C3055,3056,3058, 3059,3086,3087, 3192	K00175470	" " SL 47pF (DD104SL470J50V02)				<b>TRANSFORMER</b>
			T3001-3004	L0020345		
C3051	K06175470	" " UJ 47pF (ECC-D1H470JU2)				<b>CONNECTOR</b>
			J3001	P0090054	5048-07A	
C3185	K00175101	" " SL 100pF (DD105SL101J50V02)	J3002	P0090052	5048-10A	
C3093,3094	K00175391	" " SL 390pF				

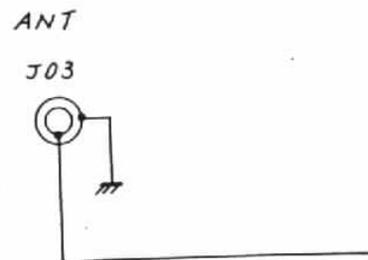
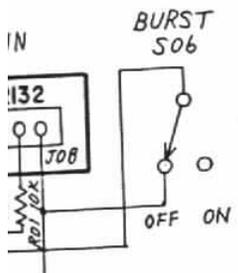
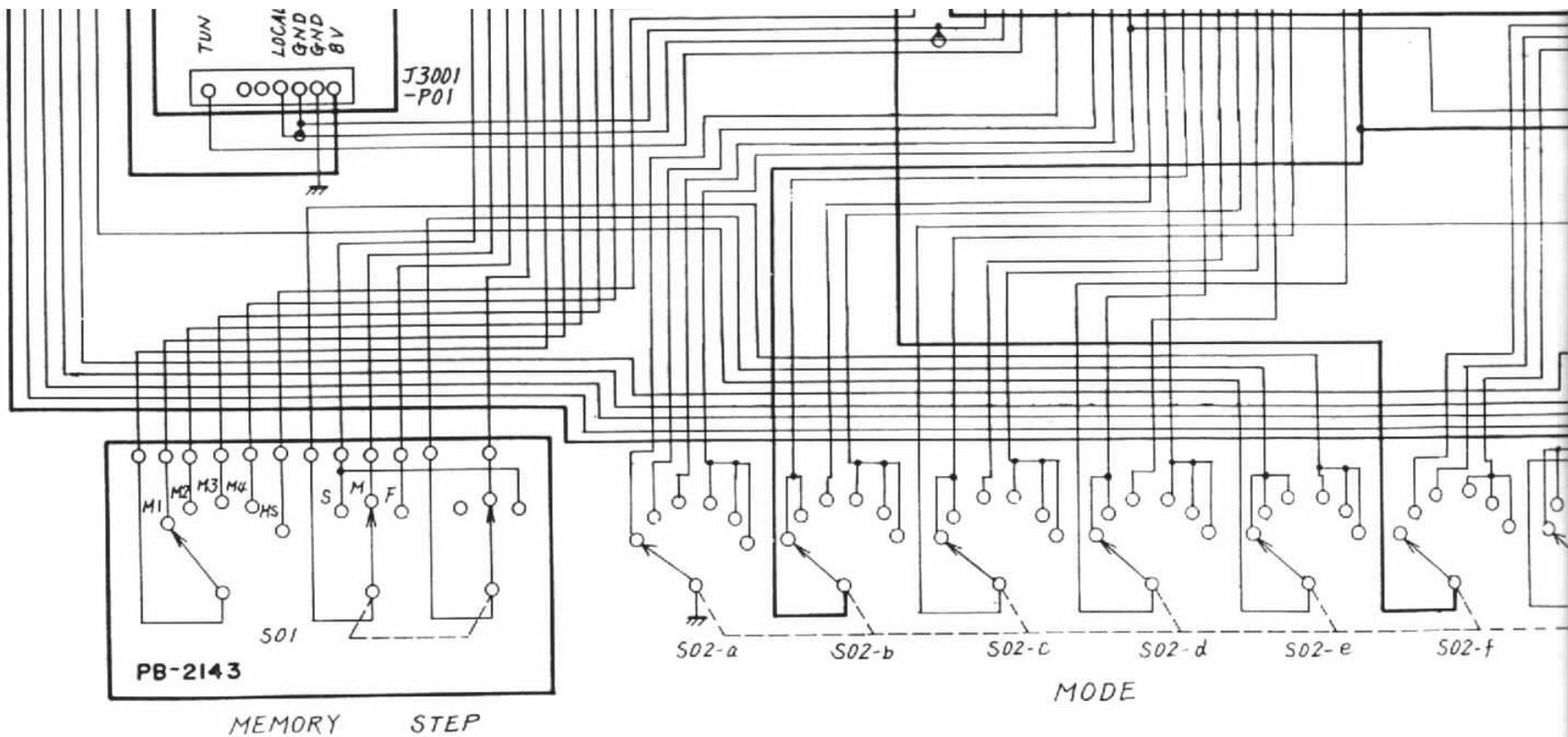
			<b>VCO 1 UNIT</b>		
		(DD104SL391J50V02)	Symbol No.	Part No.	Description
C3050	K12171102	" " 0.001 $\mu$ F (DD105E102P50V02)	PB-2137A	F0002137A	Printed Circuit Board
C3066,3077,3097, 3100,3102,3136, 3132-3134,3137, 3159,3141-3145, 3162,3164, 3183,	K10179016	" " 0.001 $\mu$ F (DD201YB102K5L5)		C0021370	PCB with Components
					FET
			Q3021	G3090035	2SK19TMGR
					DIODE
			D3009-3013	G2090027	1SS53
			D3014	G2090043	MV104
					RESISTOR
			R3064	J00245101	Carbon film 1/4W VJ 100 $\Omega$
			R3065	J00245150	" " " " 150 $\Omega$
			R3069	J00245102	" " " " 1k $\Omega$
			R3066-3068	J00245104	" " " " 100k $\Omega$
					THERMISTOR
C3070,3072,3089, 3095	K19149013	" " 0.01 $\mu$ F (UTA05X103M-L05AE)			
C3155,3175,3182, 3189	K19149021	" " 0.047 $\mu$ F (UAT08X473M-245AE)	TH3002	G9090008	31D26
					CAPACITOR
C3029,3069,3154	K54200001	Polyester film 100V 1 $\mu$ F (B32561-A-1105J)	C3103,3111, 3119-3123	K12171102	Ceramic 50WV 2.5m/m 0.001 $\mu$ F (DD105E102P50V02)
C3027,3033,3068, 3071,3152, 3157,3172	K70127106	Tantalum 16V 10 $\mu$ F (CS15E1C100M)	C3106,3124	K10179016	" " 5m/m 0.001 $\mu$ F (DD201YB102K5L5)
C3180	K40170105	Electrolytic 50V 1 $\mu$ F (50RL105)	C3107,3110	K06172030	" " UJ 3pF (DD104UJ030C50V02)
C3008,3034,(3178) 3186-3188	K40120106	" 16V 10 $\mu$ F (16RL106)	C3113,3116	K02172040	" " CH 4pF (DD104CM040C50V02)
C3174	K40120476	" 16V 47 $\mu$ F (16RL476)	C3112	K02173080	" " CH 8pF (DD104UJ080D50V02)
			C3108	K02173090	" " CH 9pF (DD104CH090D50V02)
					TRIMMER CAPACITOR
TC3003	K91000056	TZ03Z070A6 7pF	C3105	K06175120	" " UJ 12pF (DD104UJ120J50V02)
TC3001	K91000074	TZ03T110A 10pF			
TC3002	K91000030	ECV1ZW40X53N 40pF	C3115	K02179009	" " CH 22pF (DD104CH220J50V02)

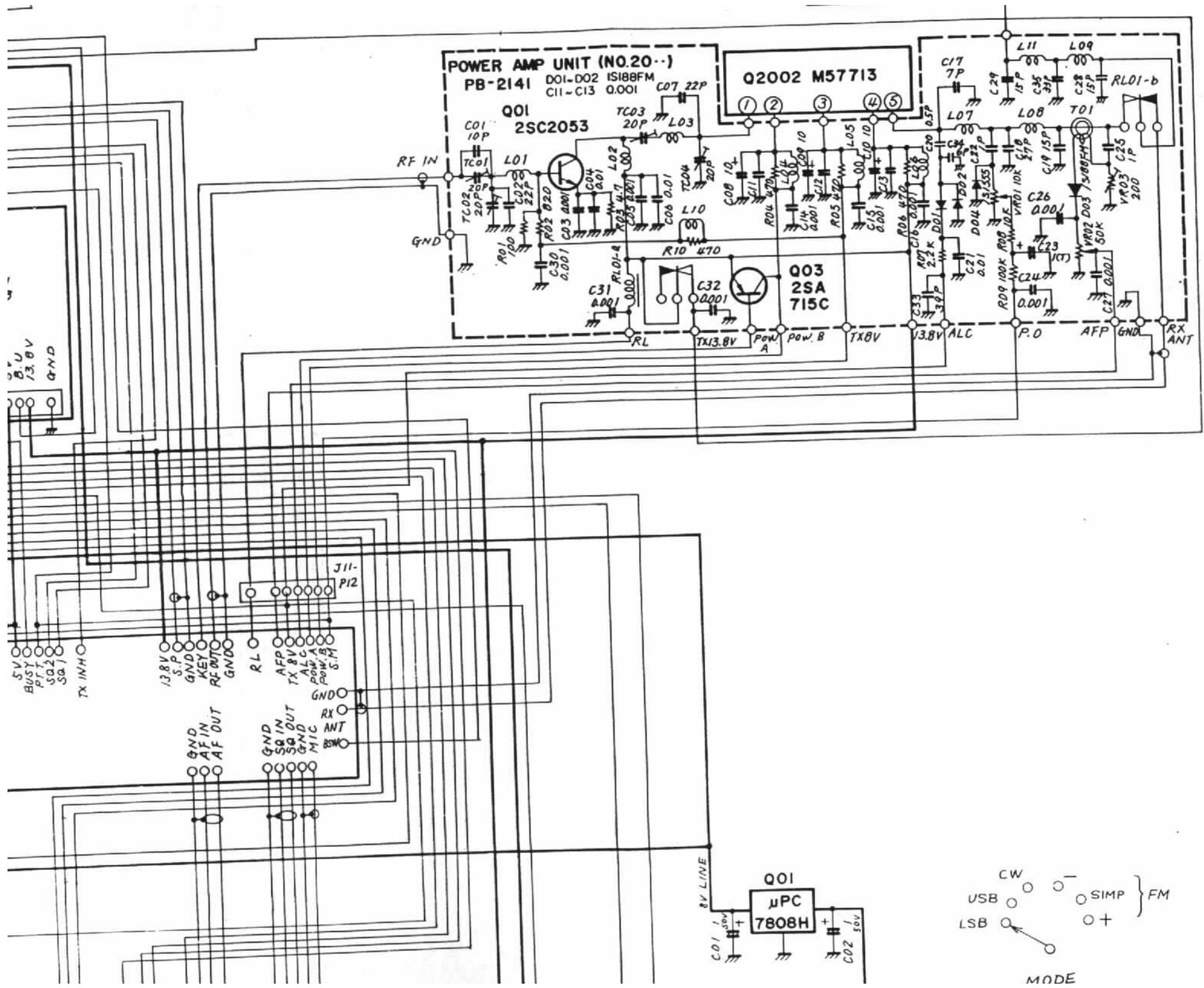
## REPAIR PARTS

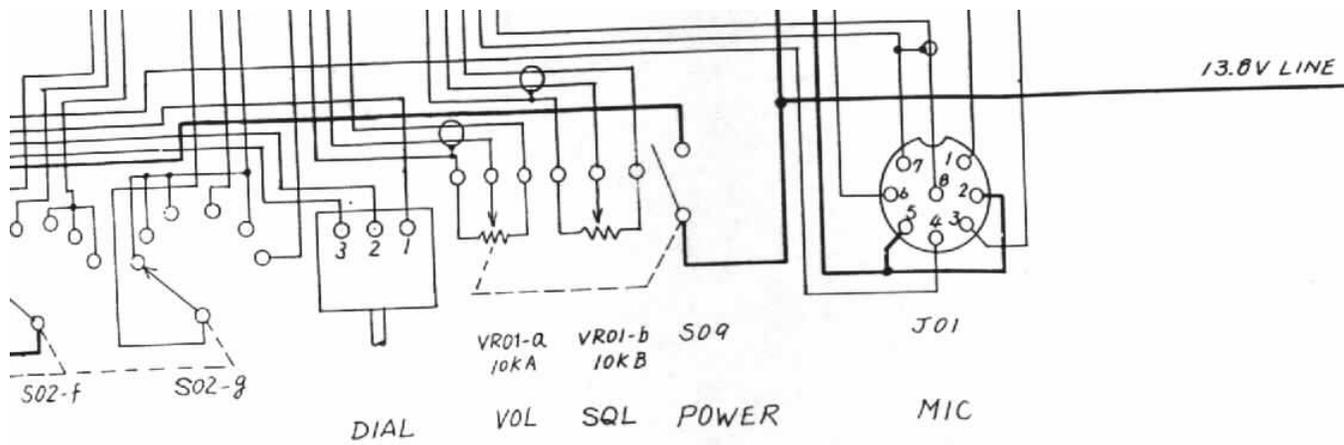
C3126-3130	K70147105	Tantalum 25WV 1μF (CS15E1E010M)	R4057	J02245333	Carbon film 1/4W 33kΩ
			R4029,4032	J02245393	" " " 39kΩ
C3125	K70127106	" 16WV 10μF (CS15E1C100M)	R4007-4022	J02245473	" " " 47kΩ
			R4045,4059	J02245563	" " " 56kΩ
C3104	K40120106	Electrolytic 16WV 10μF (16RL106)	R4001,4005,4033, 4034,4038,4060	J02245104	" " " 100kΩ
			R4025,4026,4027, 4030	J02245334	" " " 330kΩ
		<b>TRIMMER CAPACITOR</b>			
TC3004	K91000056	TZ03Z070A 7pF	R4028,4031	J02245684	" " " 680kΩ
			R4002	J02245105	" " " 1MΩ
		<b>INDUCTOR</b>			
L3025	L1190004	(FL4H R68M) 0.68μH			<b>BLOCK RESISTOR</b>
L3028,3029	L1190110	(FL3H 4R7K) 4.7μH	RB4001	Q80000006	22kX13/5.6kX3
L3026	L0020359A		RB4002	Q80000007	22kX10/10kX6
					<b>CAPACITOR</b>
<b>PLL CONTROL UNIT</b>			C4010,4013,4016, 4019,4020,4026	K13170103	Ceramic 50WV 5m/m 0.01μF (DB201YF103Z5L5)
<b>Symbol No.</b>	<b>Part No.</b>	<b>Description</b>			
PB-2213	F0002213	Printed Circuit Board	C4002,4003	K00175101	" " SL 100pF (DD105SL101J50V02)
	C0022130	PCB with Components			
			C4005-4008	K10176471	" " 470pF (DD104B471K50V02)
		<b>IC</b>			
Q4001	G1090300	μPD1511-011	C4023	K50177152	Mylar " 0.0015μF (50F2U152M)
Q4002,4021	G1090068	MC14011B			
Q4020	G1090126	MC14069B	C4004	K50177103	" " 0.01μF (50F2U103M)
Q4022	G1090174	MC14002B			
Q4027,4028	G1090084	78L05	C4001	K50177473	" " 0.047μF (50F2U473M)
		<b>TRANSISTOR</b>			
Q4003-4018, 4033	G30107331P /Q	2SA733 P or Q	C4011,4012	K40170105	Electrolytic 50WV 1μF (50RL1)
Q4019, 4025	G3309450Q	2SC945Q	C4009,4014,4015, 4017,4018,4021, 4022,4024	K40120106	" 16WV 10μF (16RL10)
Q4026	G3309450K	2SC945K			
Q4029	G3313830R	2SC1383R			
Q4030	G3320020L	2SC2002L			
Q4032	G3327850E	2SC2785E	T4001	L3030078	<b>DC-DC CONVERTER</b> 0392-1030-063

		IC SOCKET					
QS4001	P3090037	116-42-30-144				CONNECTOR	
				J4001,4004	P0090038	5048-12A	
		DIODE			J4003	P0090052	5048-10A
D4001-4008, 4010-4027,4034, 4036,4054,4055	G2090027	Si	1SS53	J4005	P0090042	5048-05A	
				J4002	P0090050	5048-04A	
D4033	G2001880F	Ge	1S188FM		Q5000007	F Terminal	
D4035	G2090143	Zener	HZ11B-1				
		CERAMIC					
X4001	H7900080	CSA2.56M	2.56 MHz				
		RESISTOR			DISPLAY UNIT		
R4044	J10276829	Carbon composition		Symbol No.	Part No.	Description	
		1/2W	8.2Ω	PB-2139B	F0002139B	Printed Circuit Board	
R4042	J10276221	" "	220Ω		C0021390	PCB with Components	
R4043	J02245271	Carbon film	1/4W				
R4041	J02245331	" "	"			DISPLAY TUBE	
R4039	J02245471	" "	"	V4001	G6090008	LD8231/F1P9C5	
R4046	J02245122	" "	"				
R4047	J02245152	" "	"			IC	
R4023	J02245222	" "	"	Q4031	G1090241	TA7612AP	
R4037,4040	J02245472	" "	"				
R4058	J02245562	" "	"			TRANSISTOR	
R4004,4006,4056, 4061	J02245103	" "	"	Q4024	G3309450Q	2SC945Q	
R4024,2055	J02245223	" "	"			DIODE	
R4003	J02245273	" "	"	D4028-4032	G2090027	1SS53	

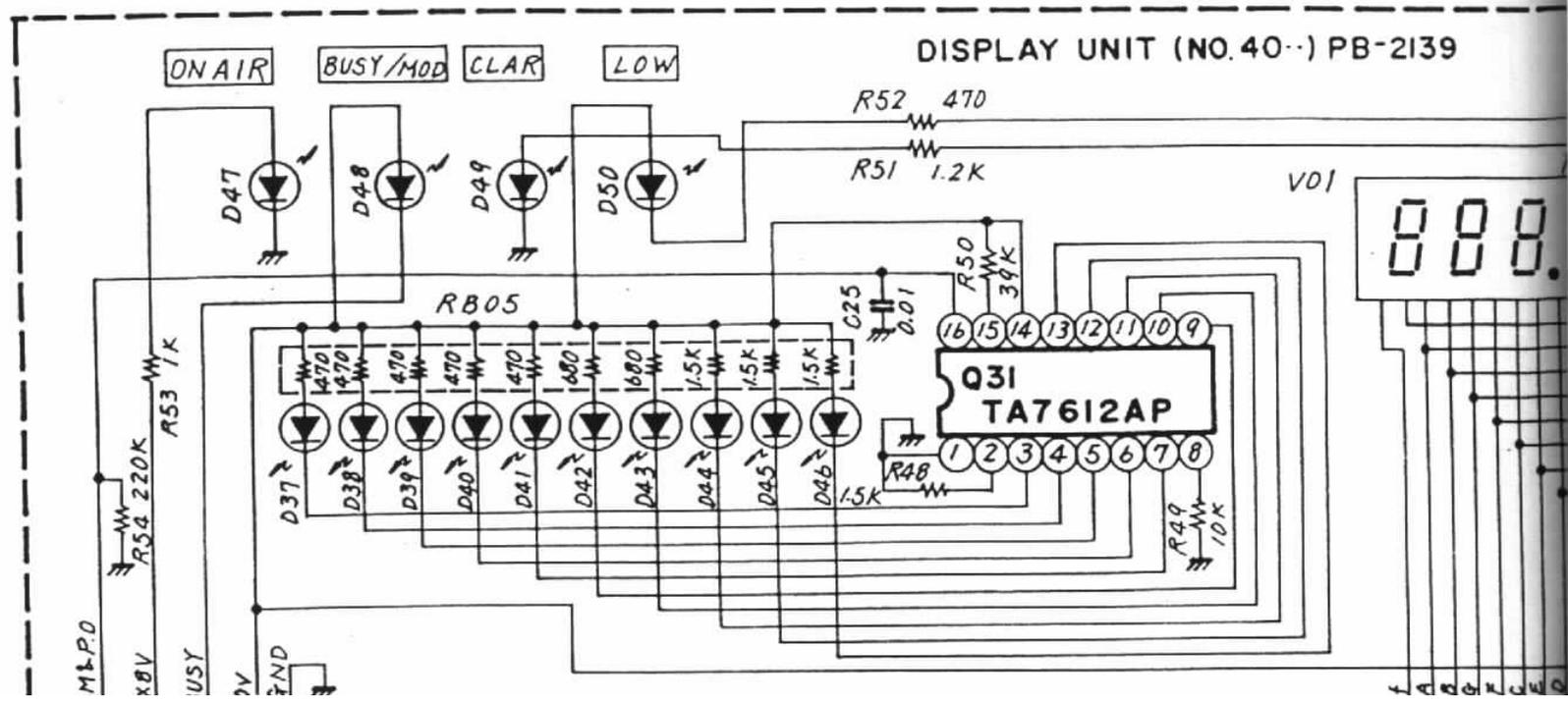


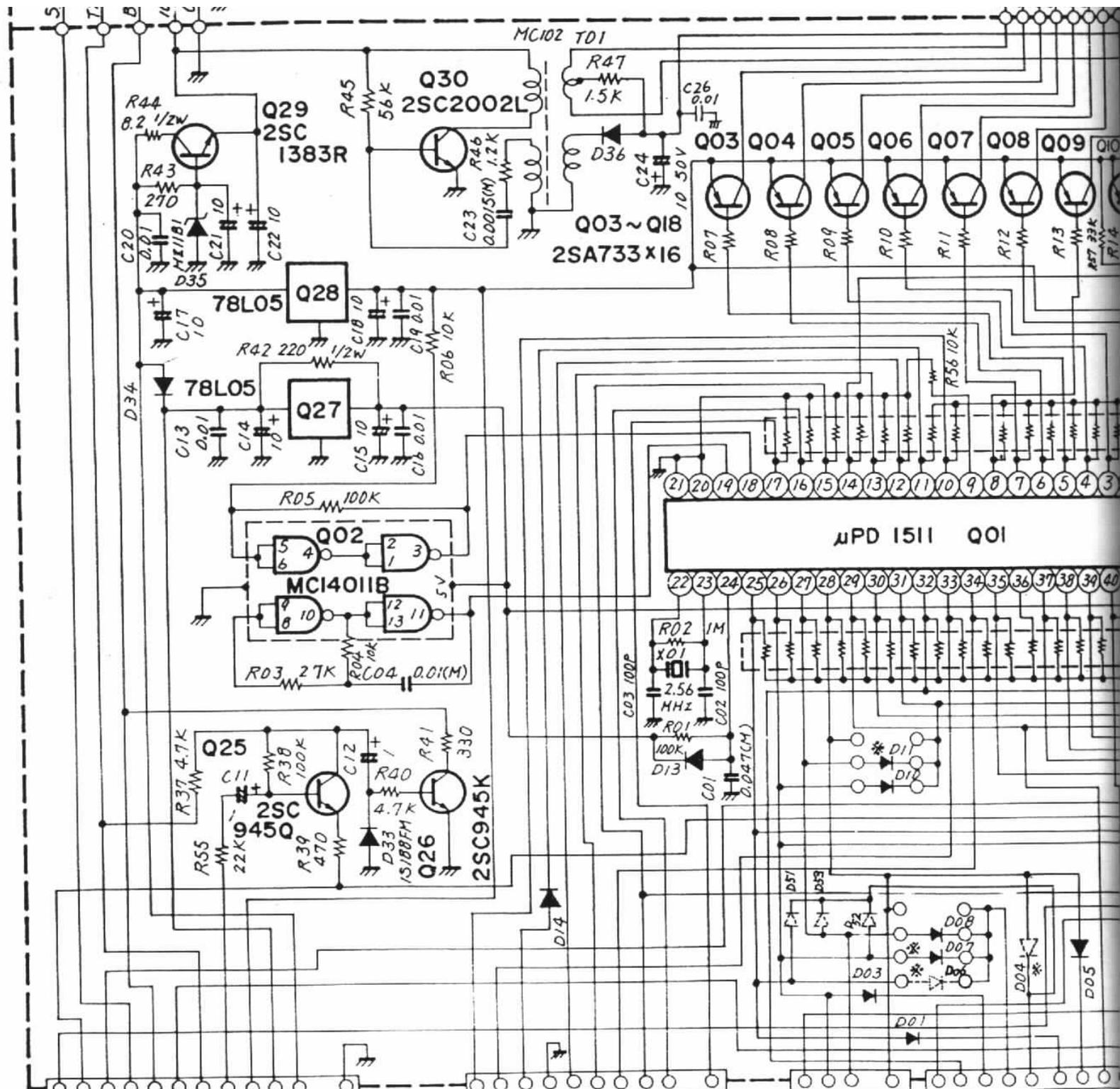






**FT-480R**  
**CONNECTION DIAGRAM**





T.CALL  
OUT  
FM GND  
CW FM GND  
SM/PO  
BUSY  
HI/LOW  
TX 8V  
FM MOD  
5V  
BU  
13.8V  
GND

J01

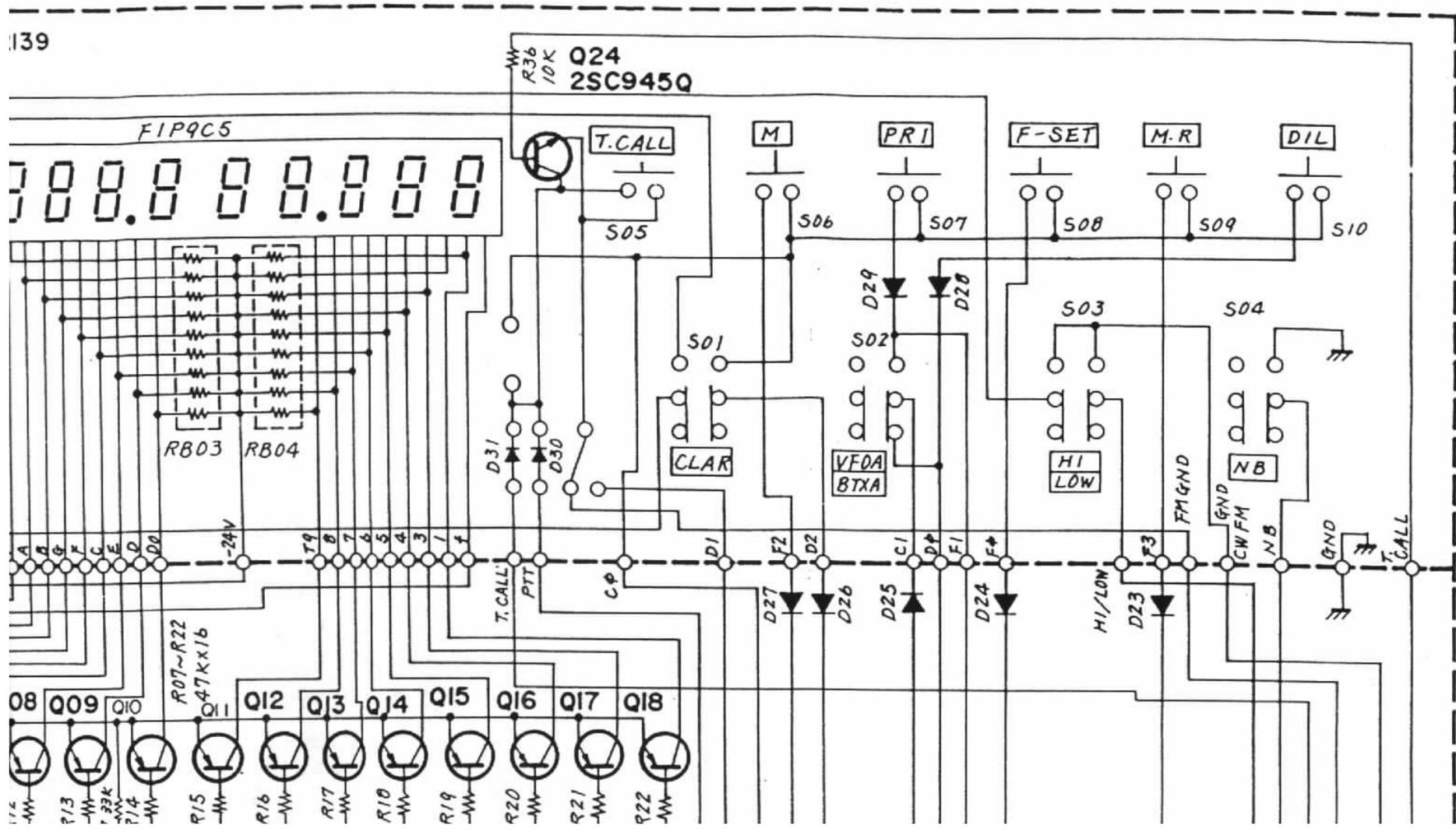
DATA  
LATCH  
CLOCK  
GND  
UP  
DOWN  
TX INH  
PTT  
SO IN  
SCAN  
STOP

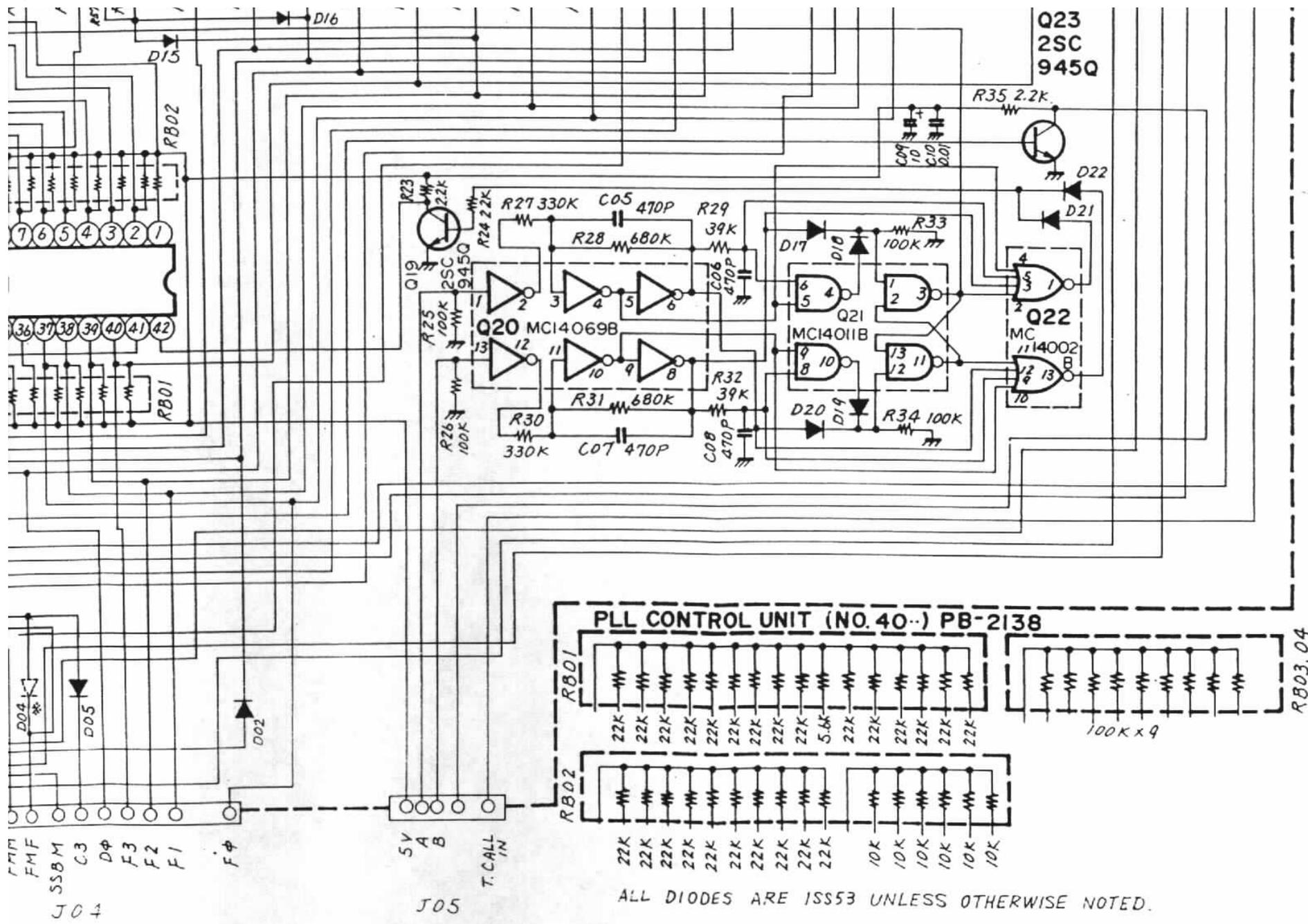
J03

SHIFT  
+ 0 -  
J02

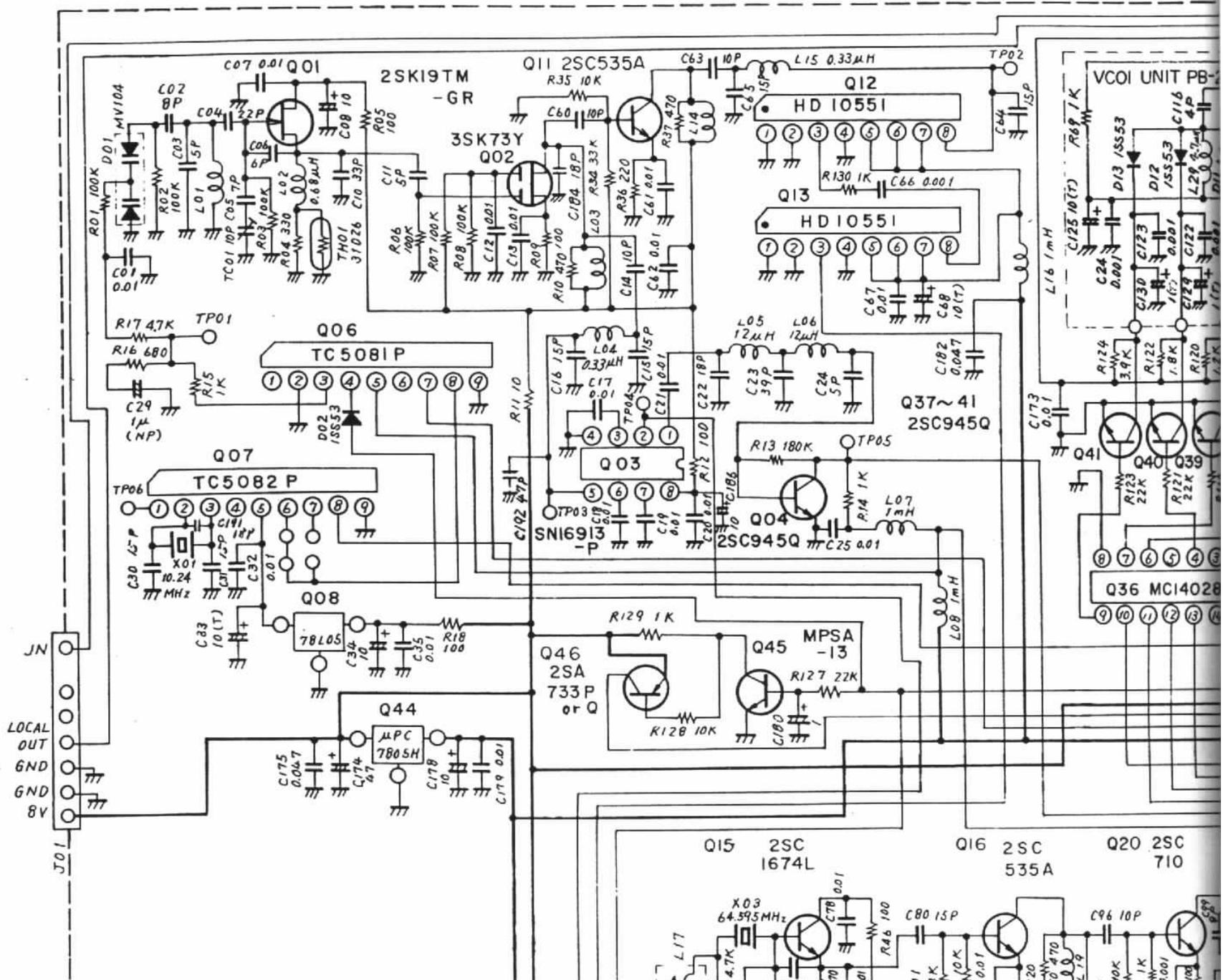
N.B  
MODE COM  
SSBF FMS  
FMM  
FMF  
SSBM  
C3  
DΦ

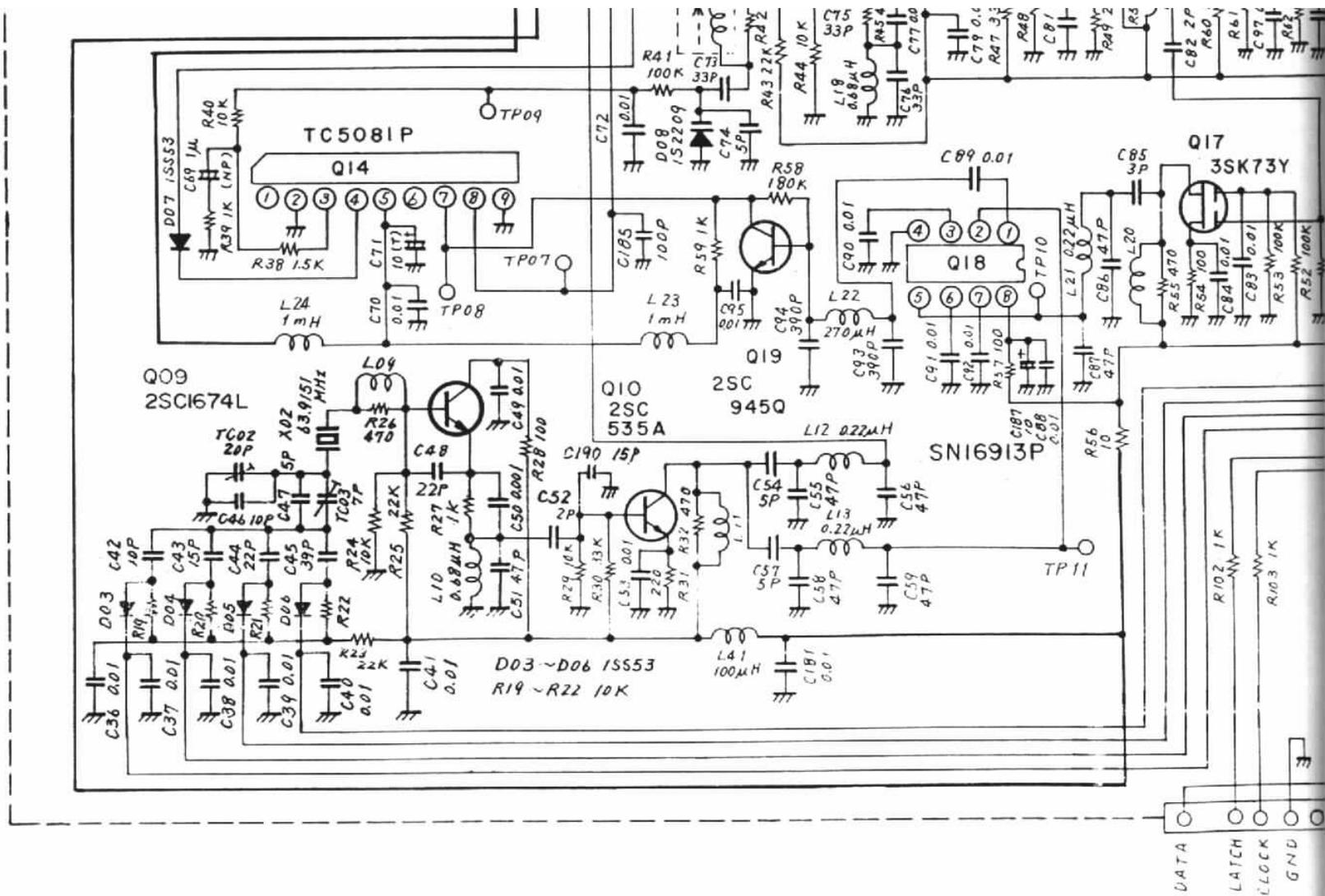
J04



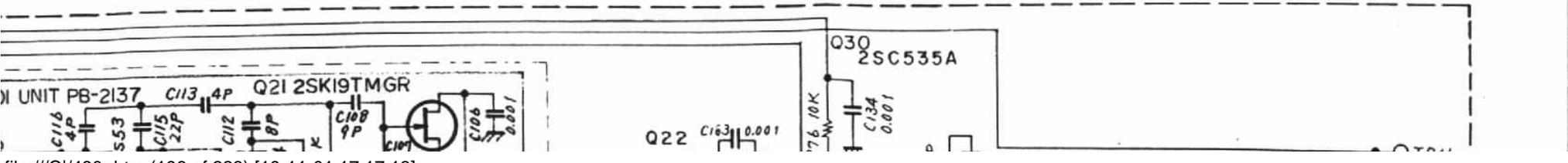


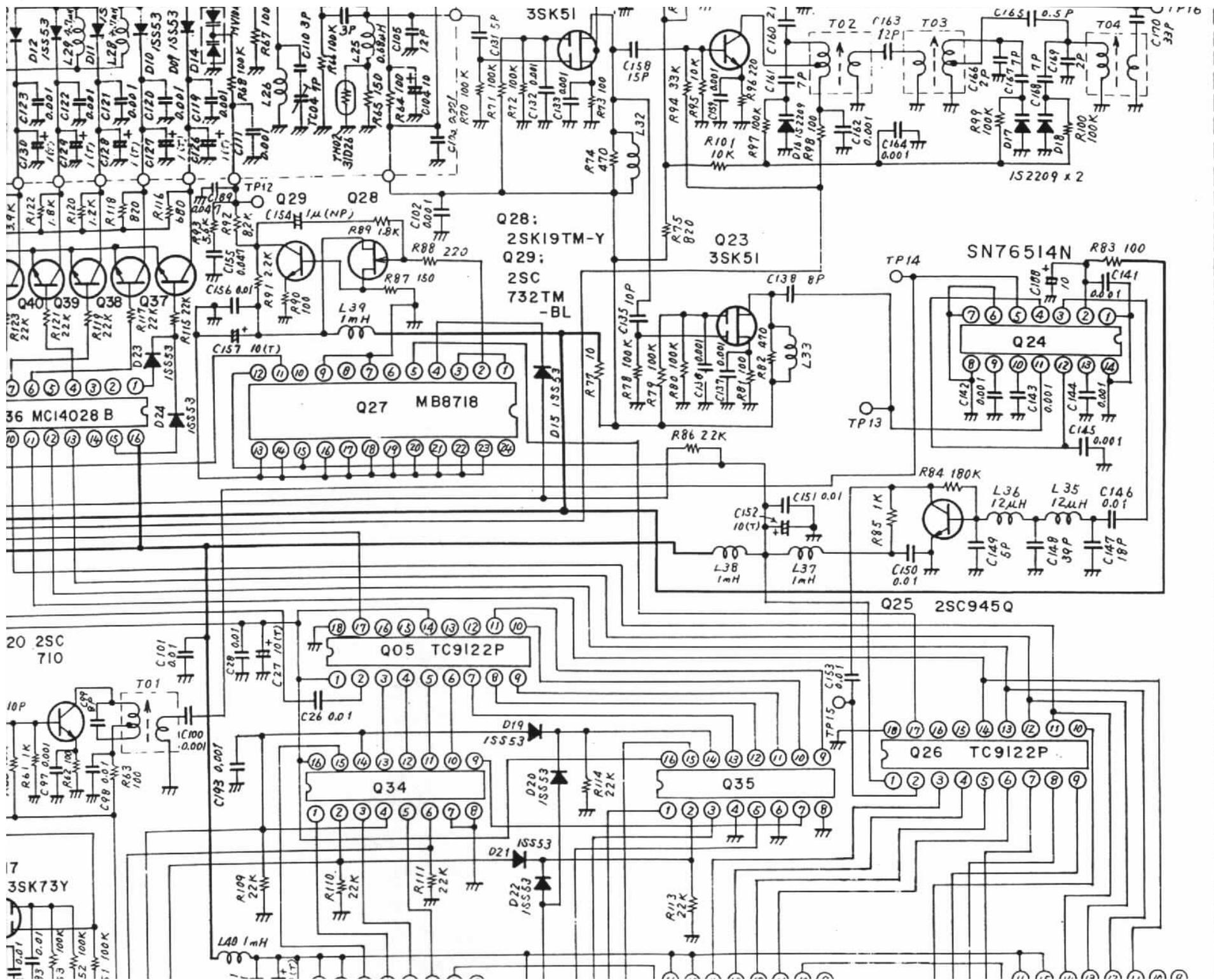
ALL DIODES ARE 1SS53 UNLESS OTHERWISE NOTED.

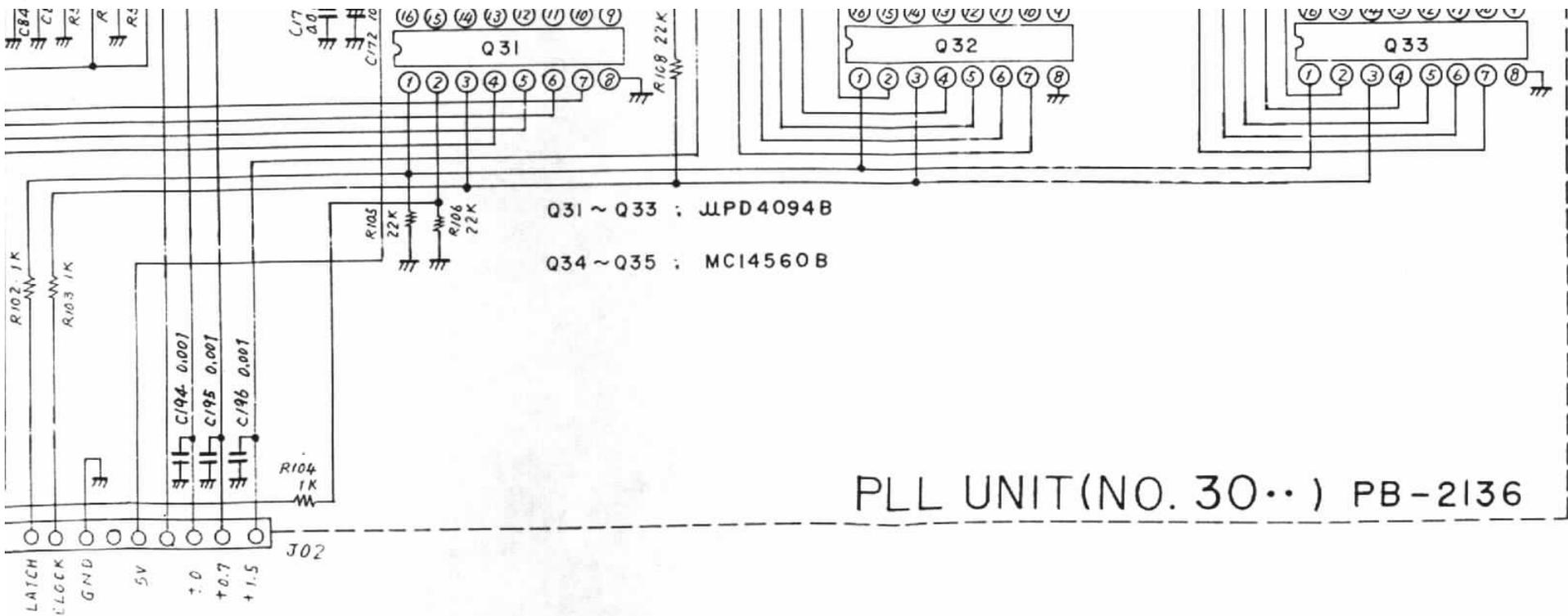




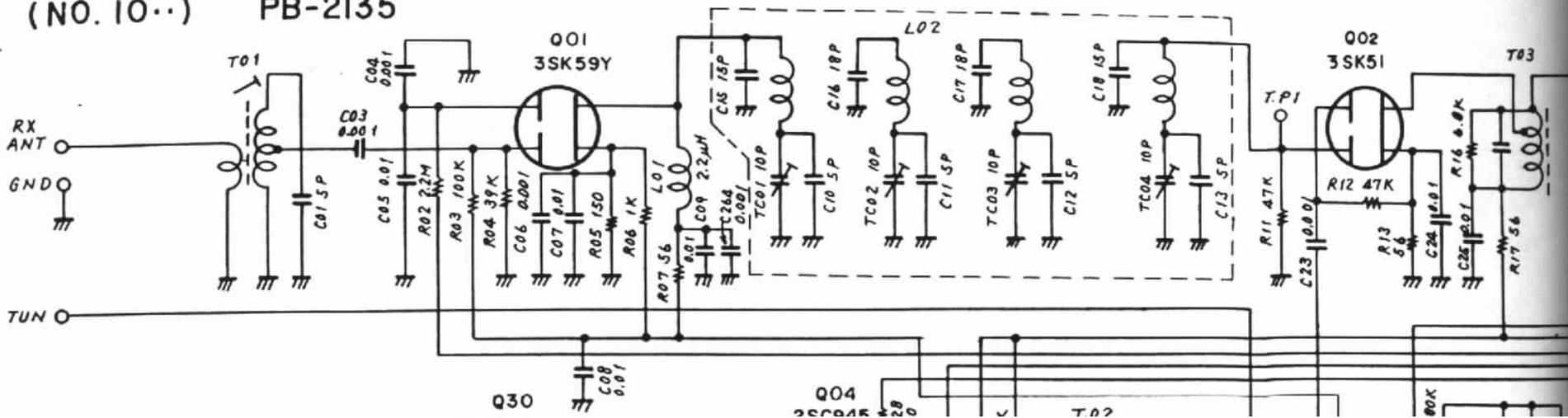
DATA  
LATCH  
CLOCK  
GND

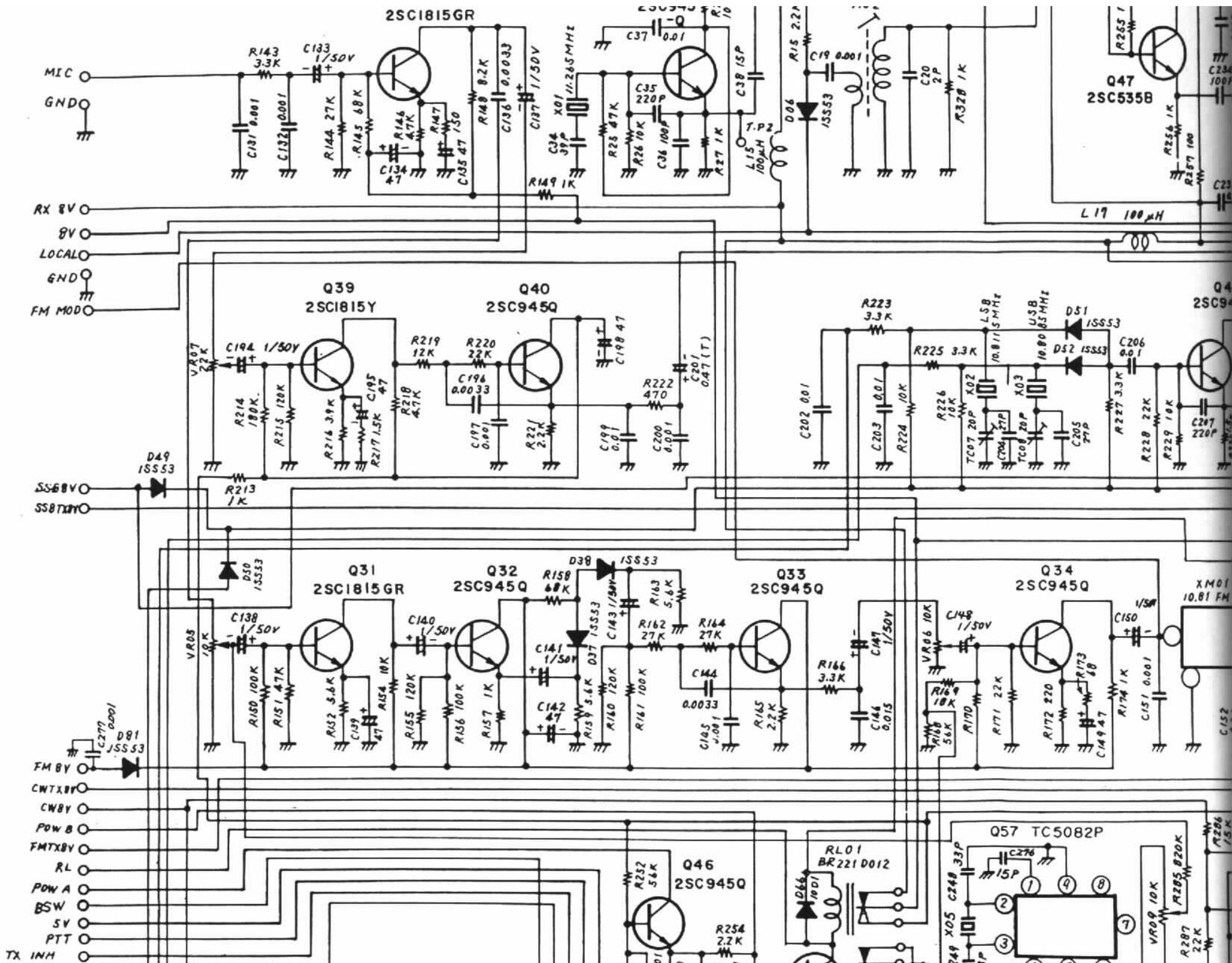






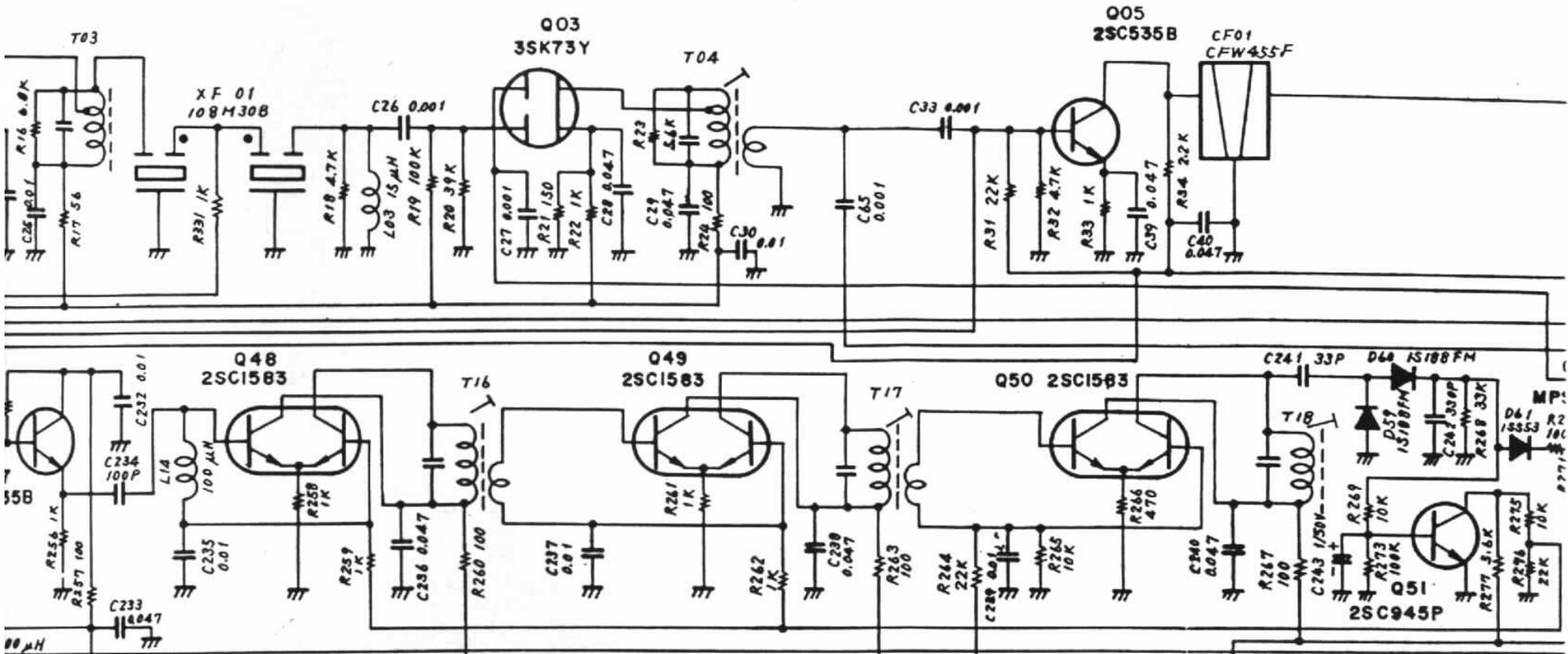
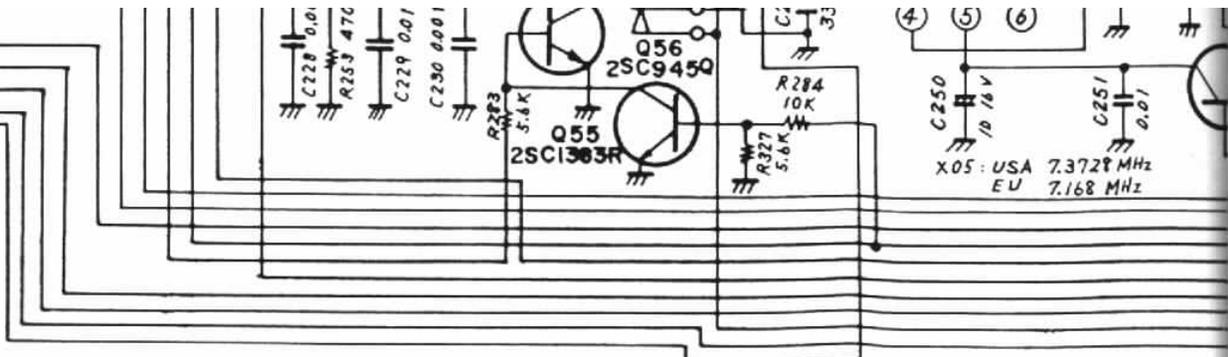
(NO. 10..) PB-2135

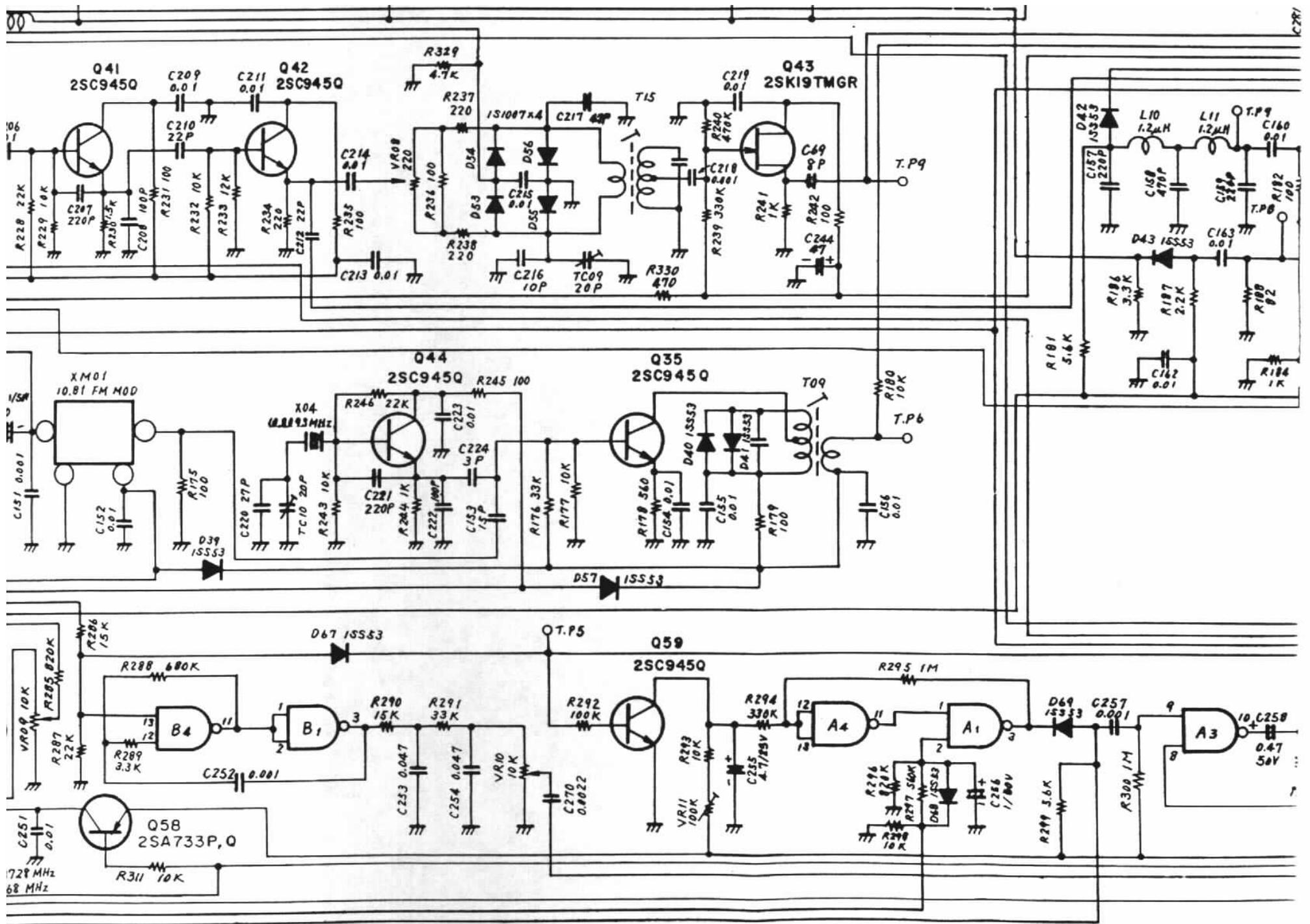


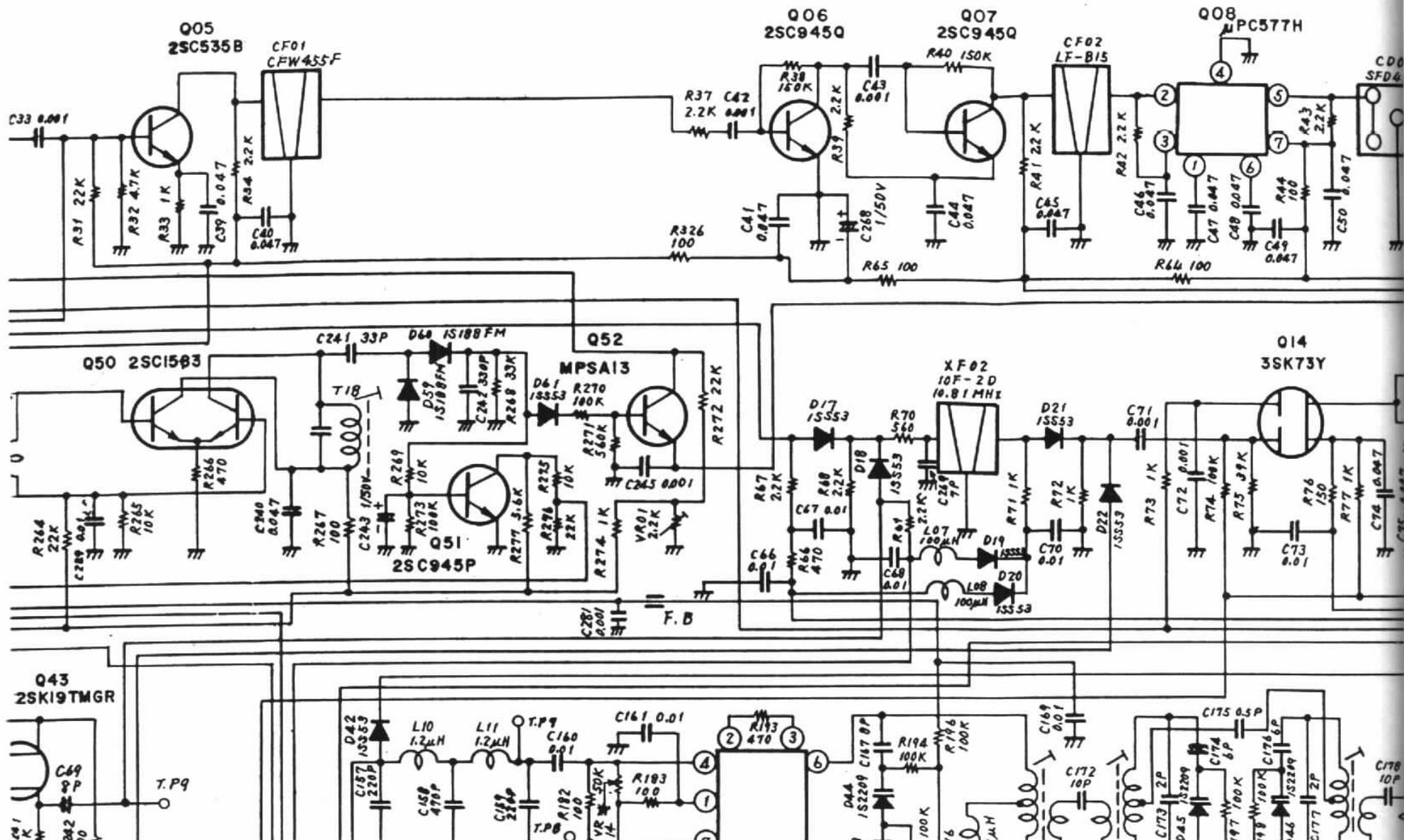


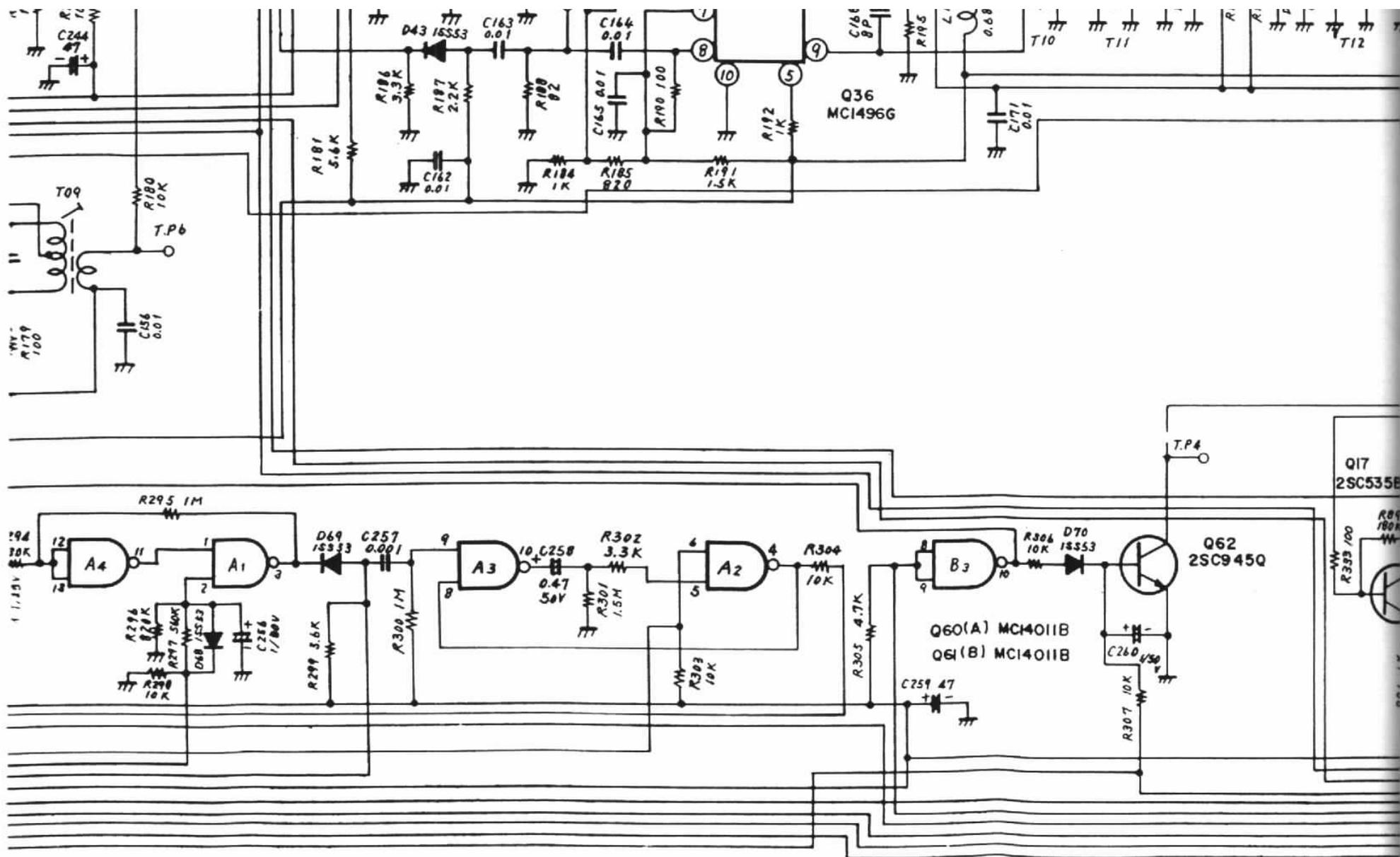
T. CALL  
T. SQ

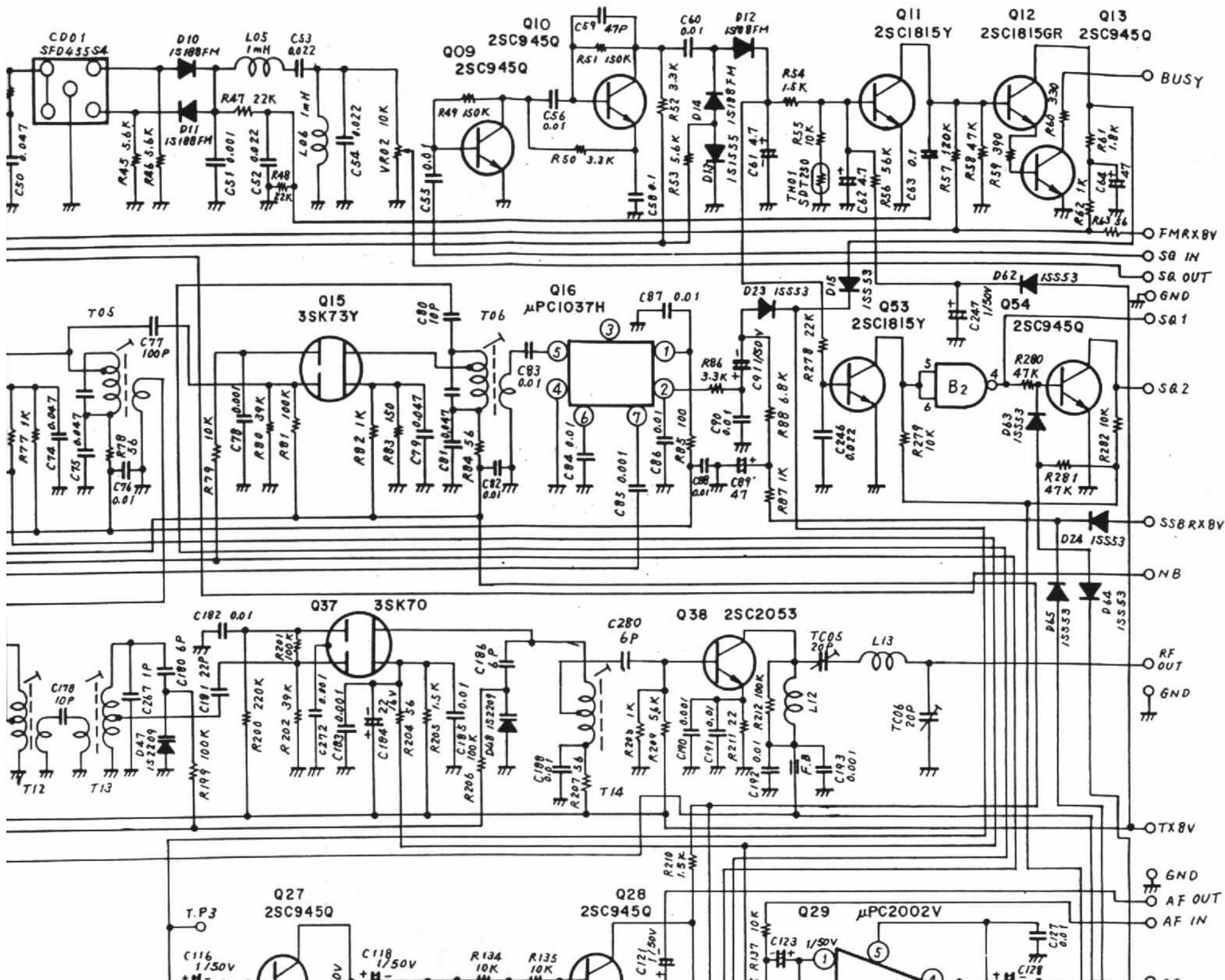
# MAIN UNIT CIRCUIT DIAGRAM

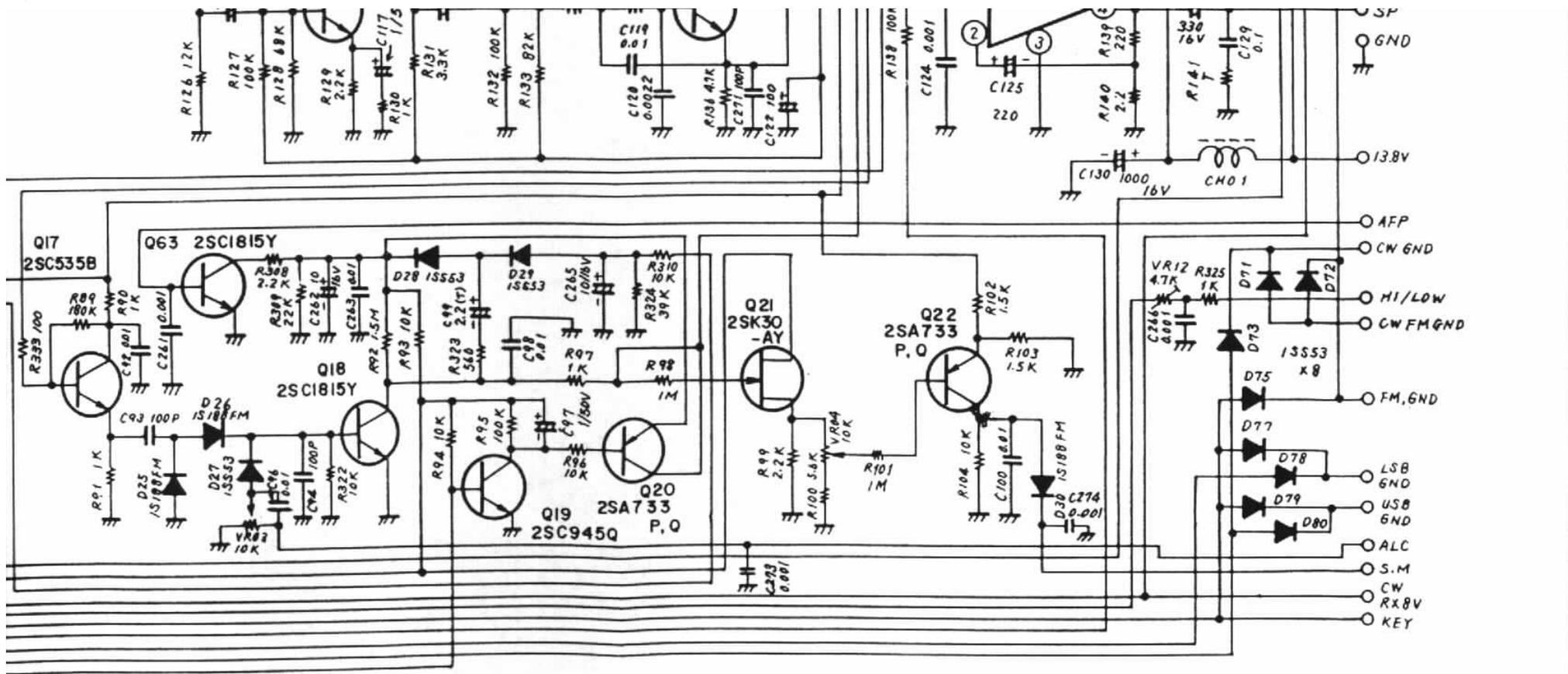


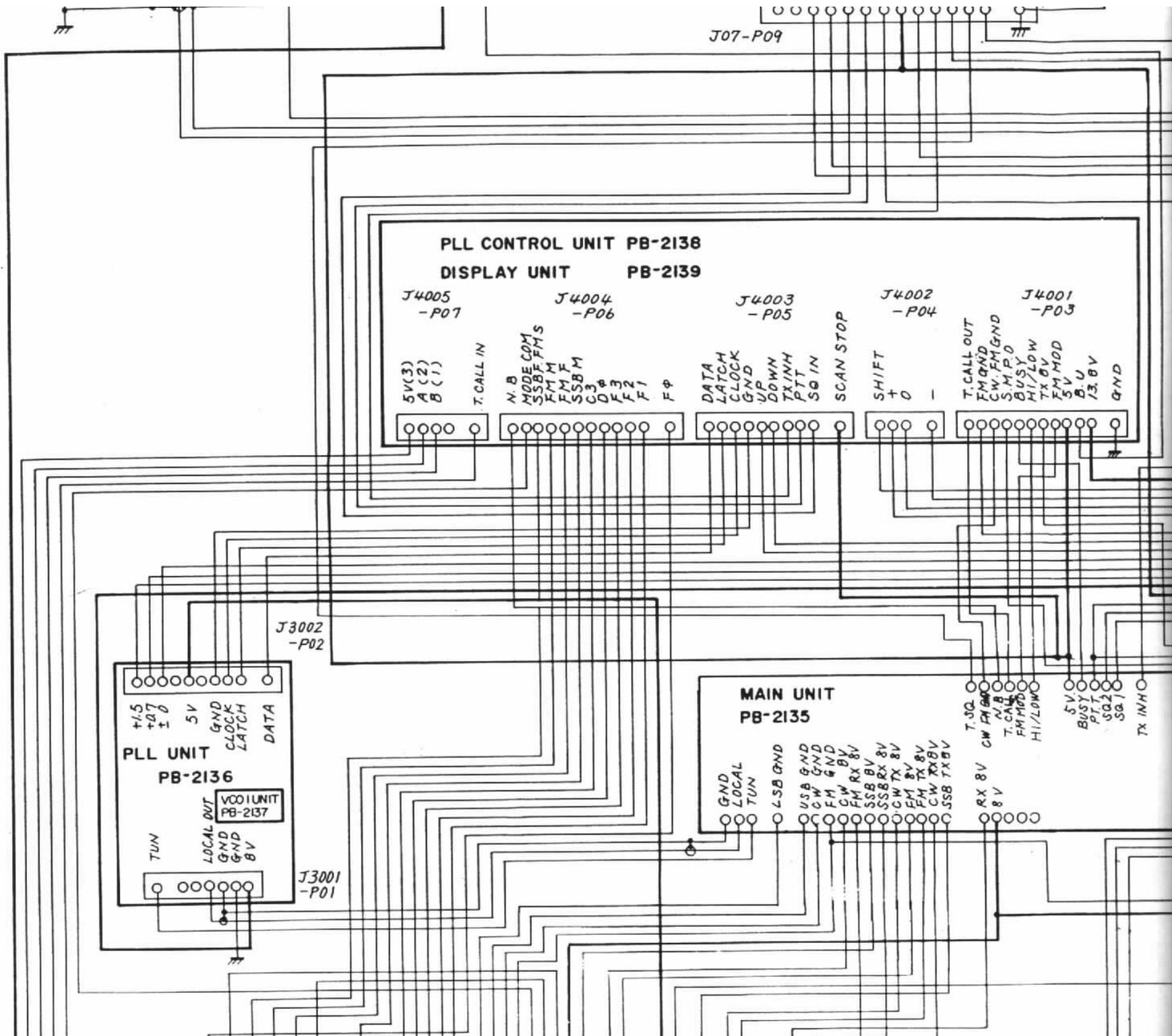


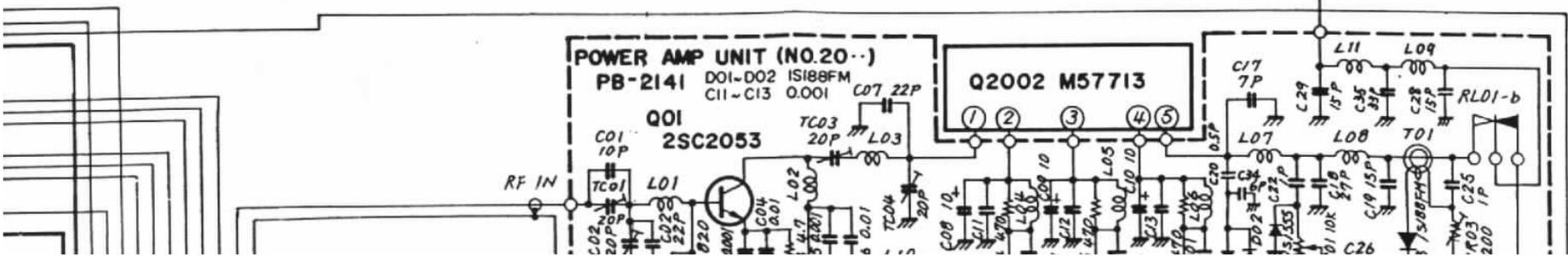
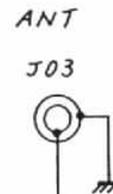
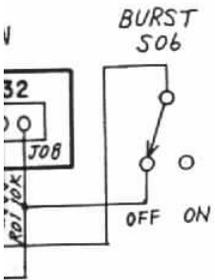
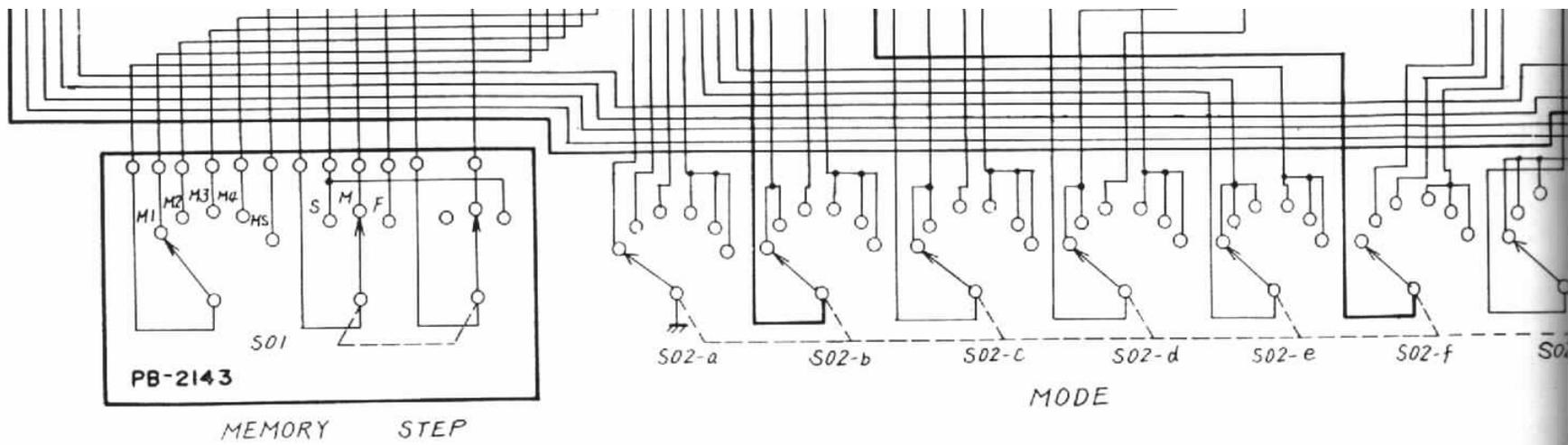


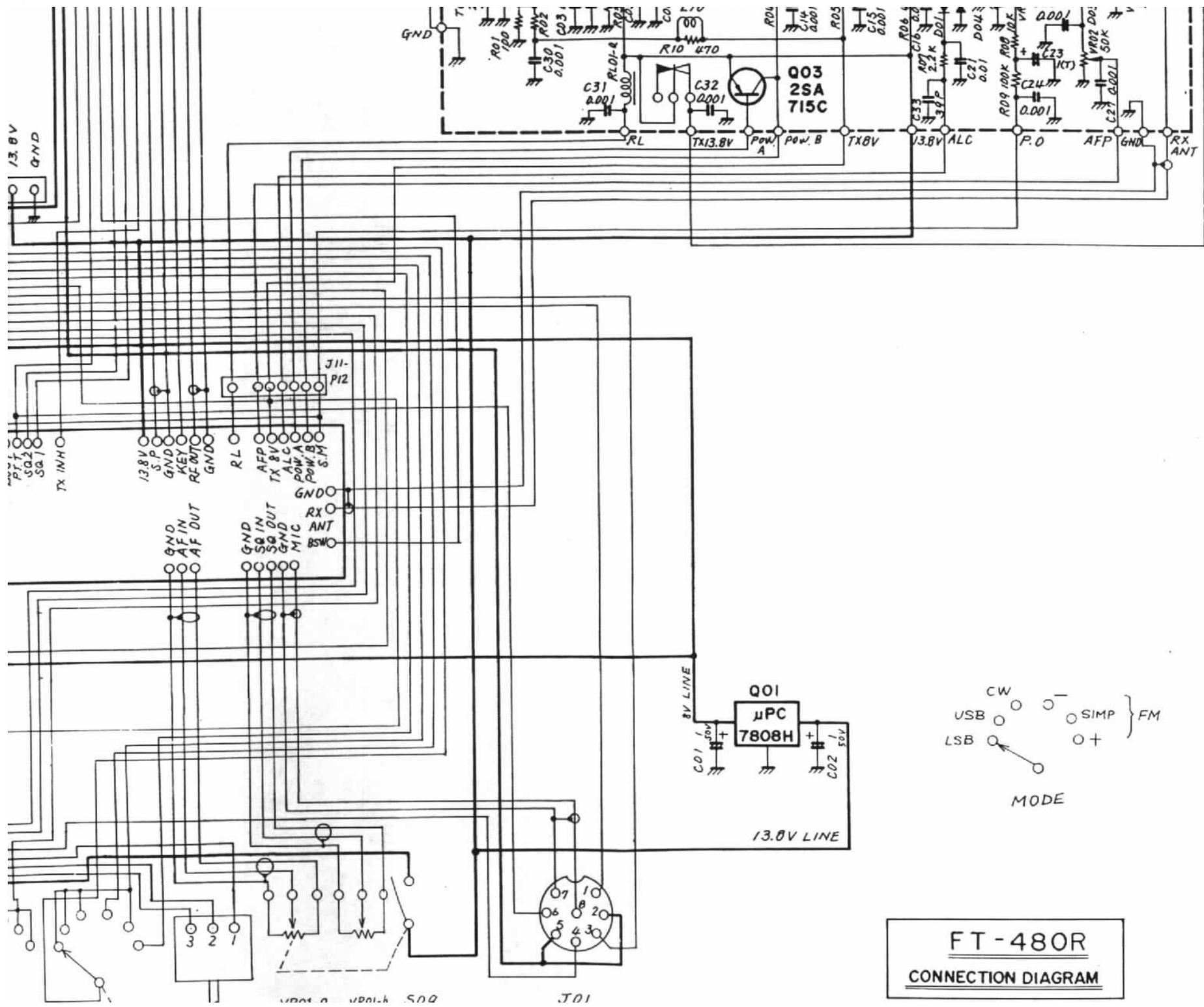










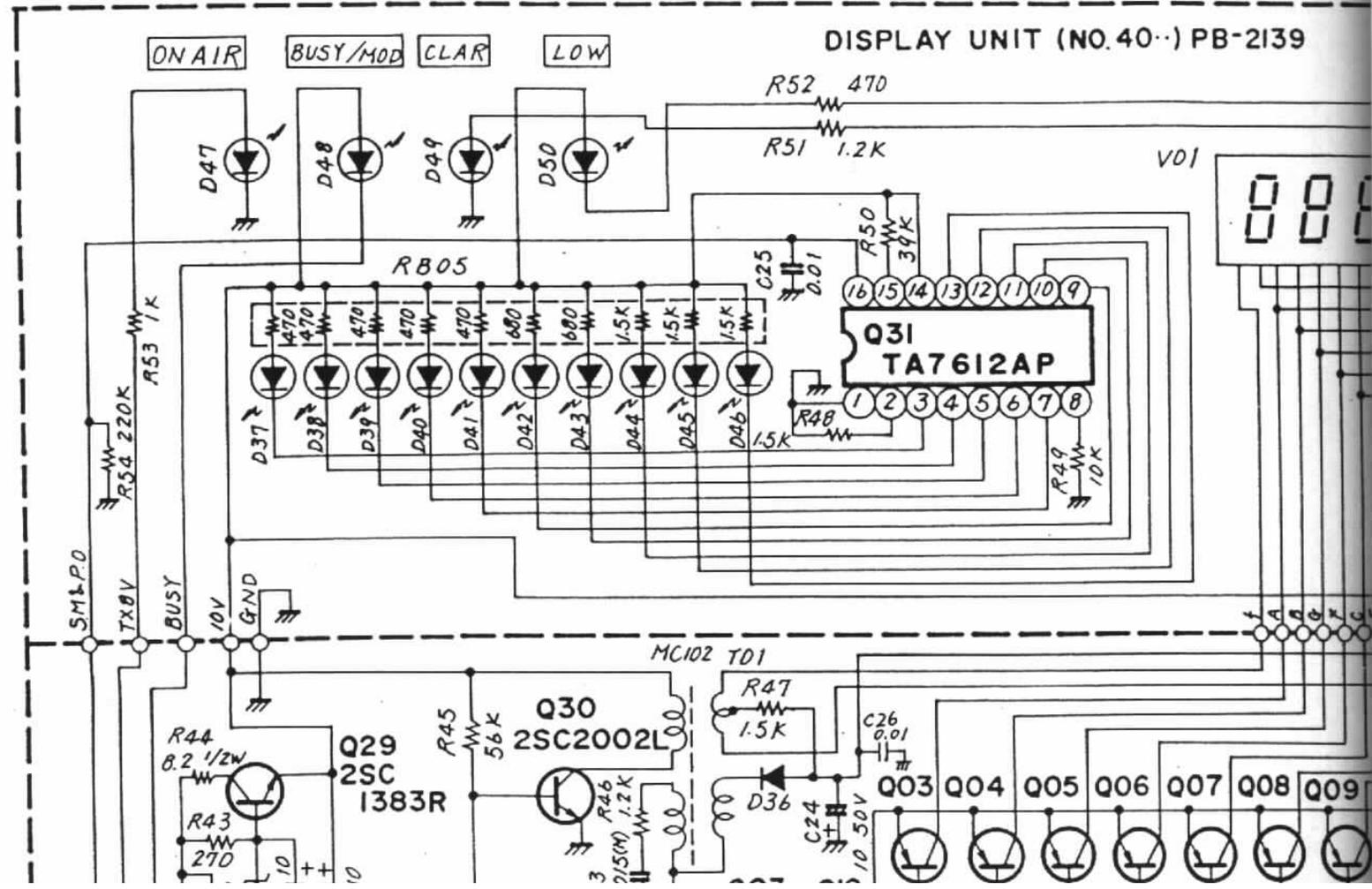


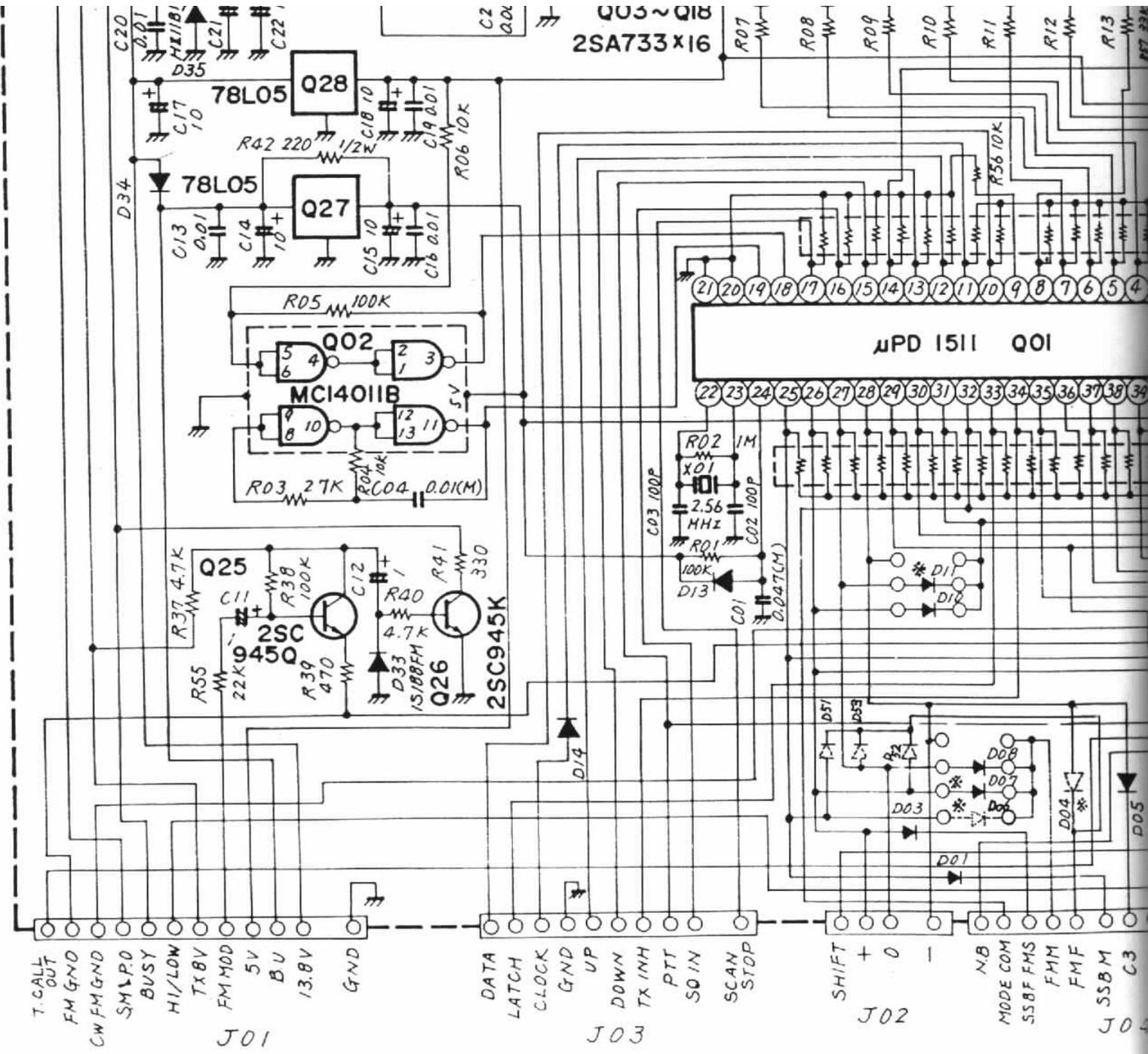
**FT-480R**  
**CONNECTION DIAGRAM**

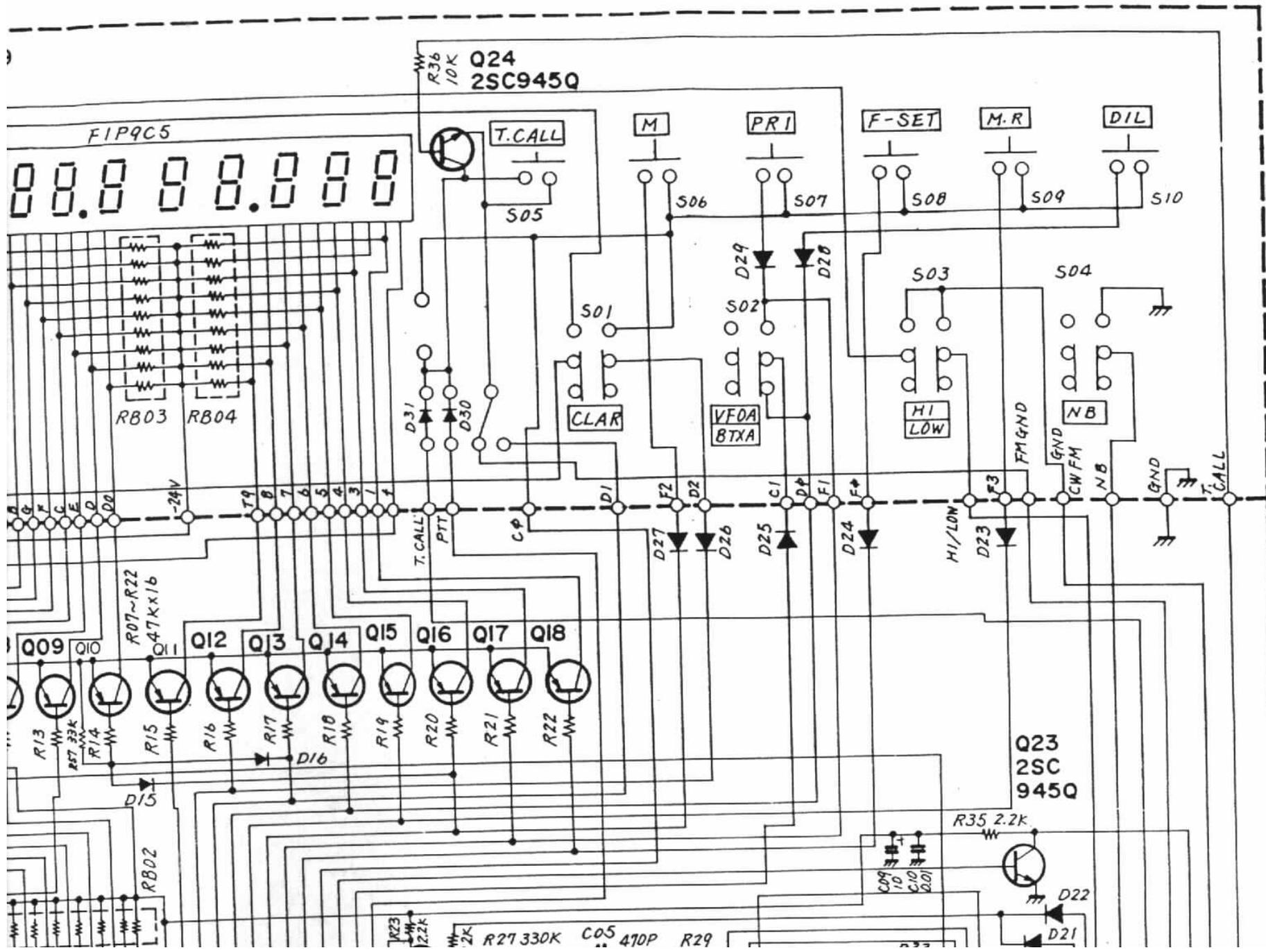
S02-8

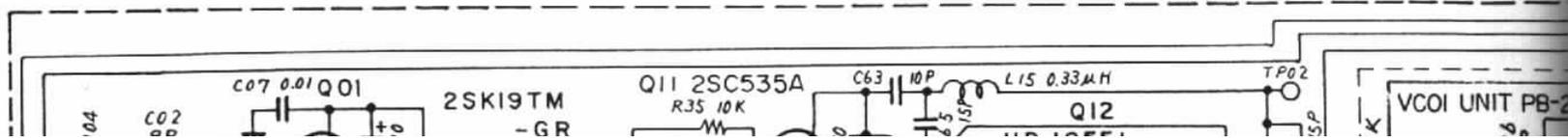
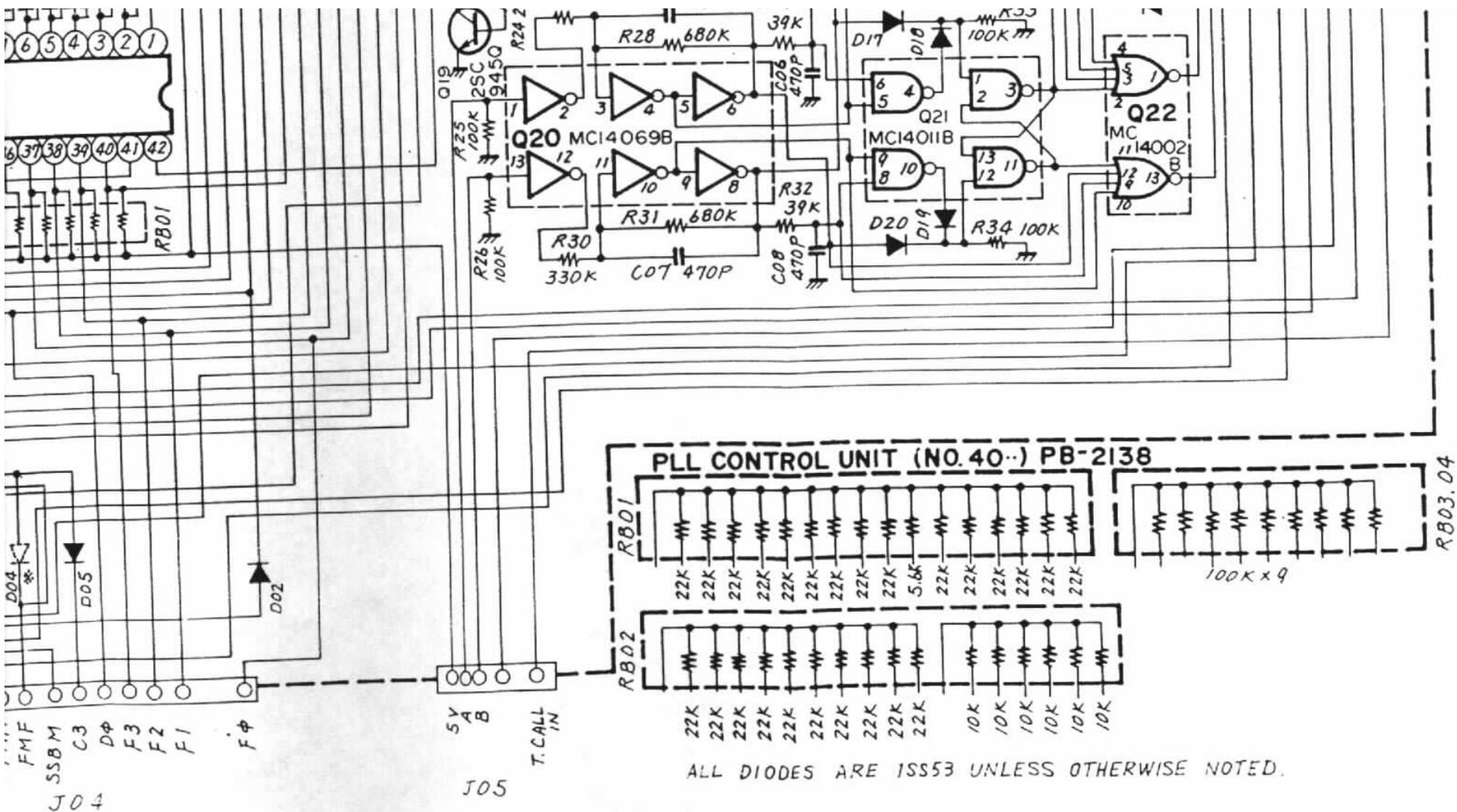
10kA 10kB

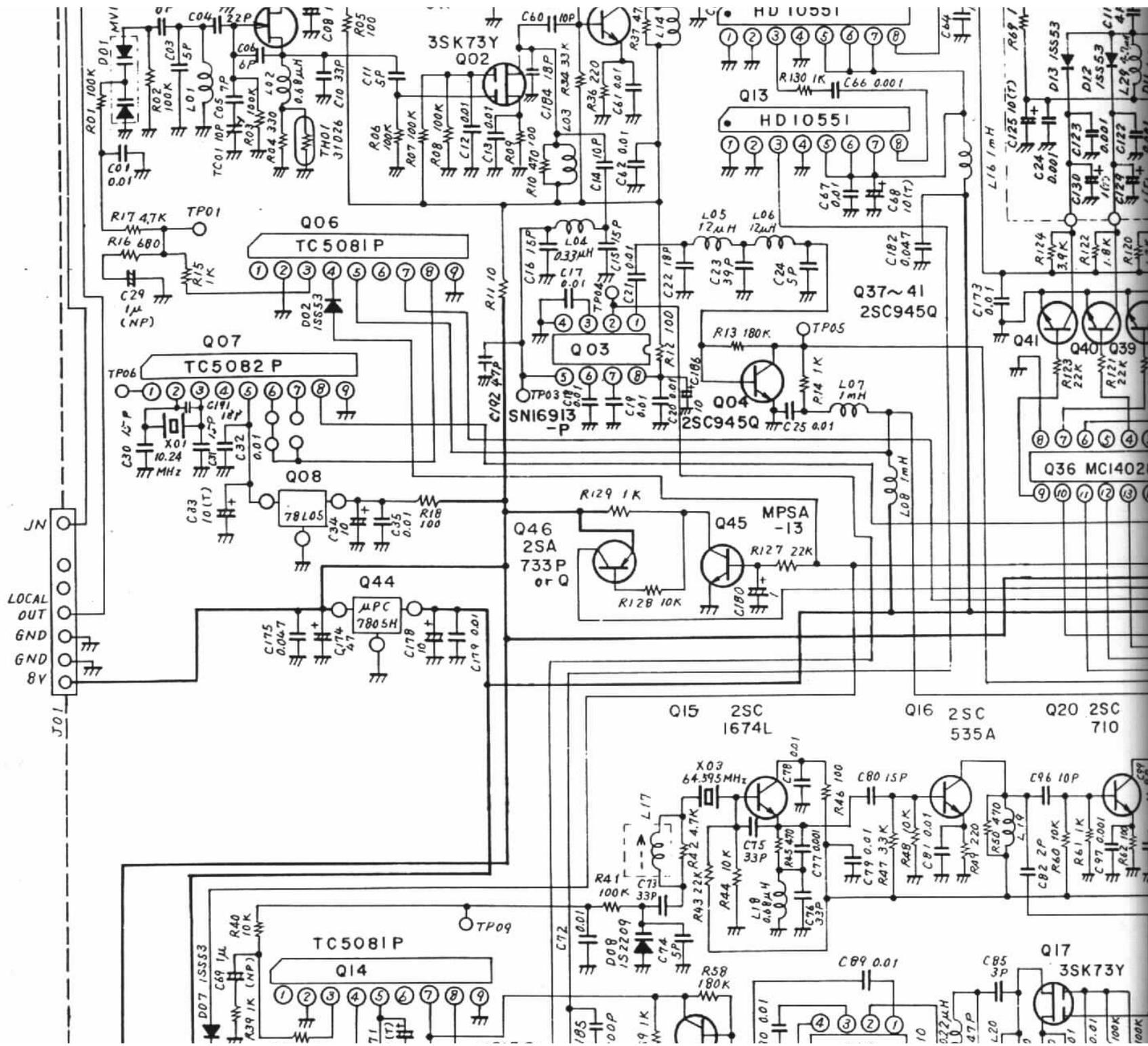
DIAL VOL SQL POWER MIC

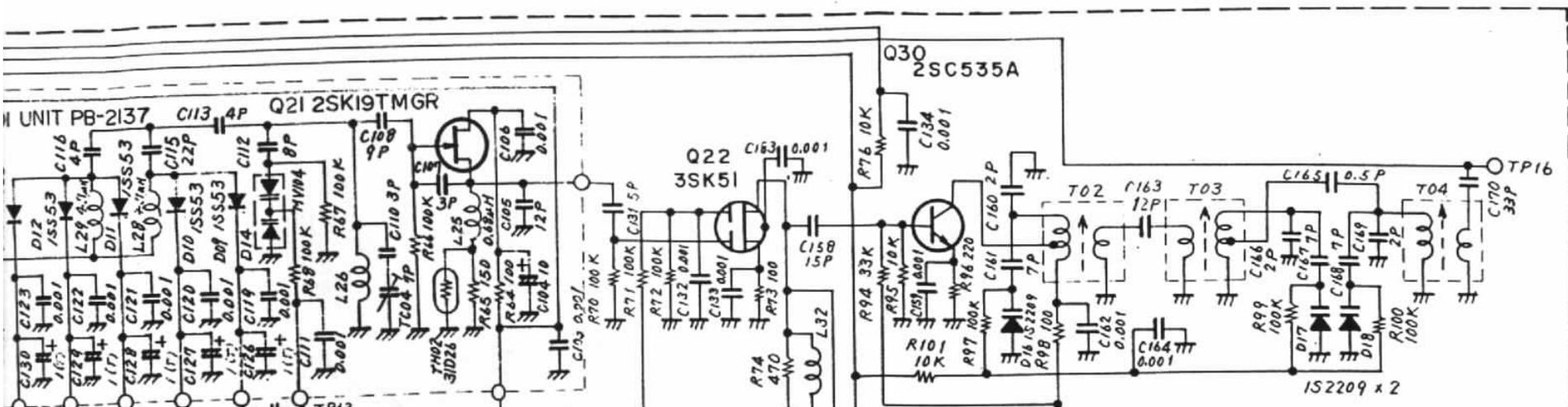
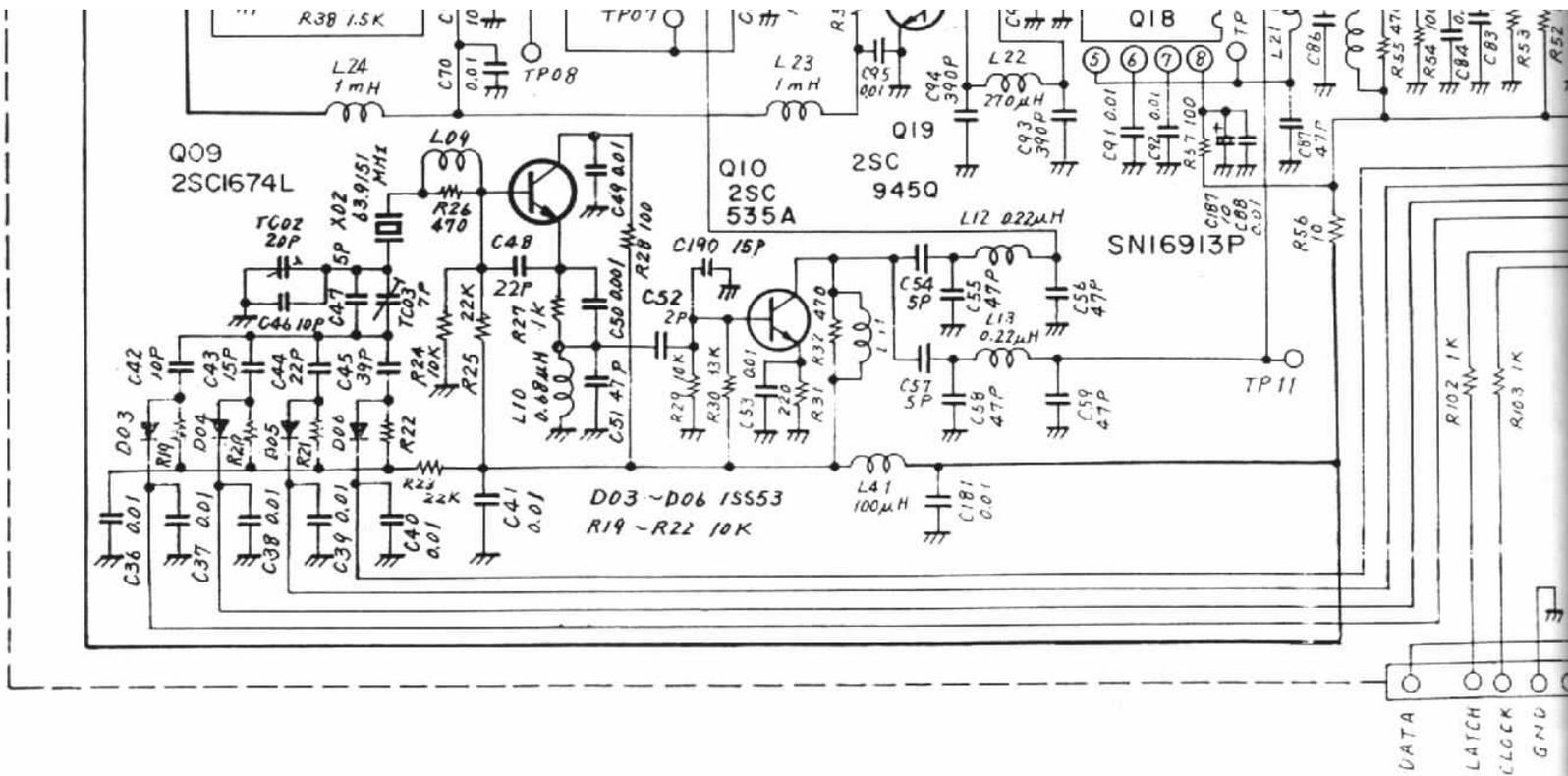


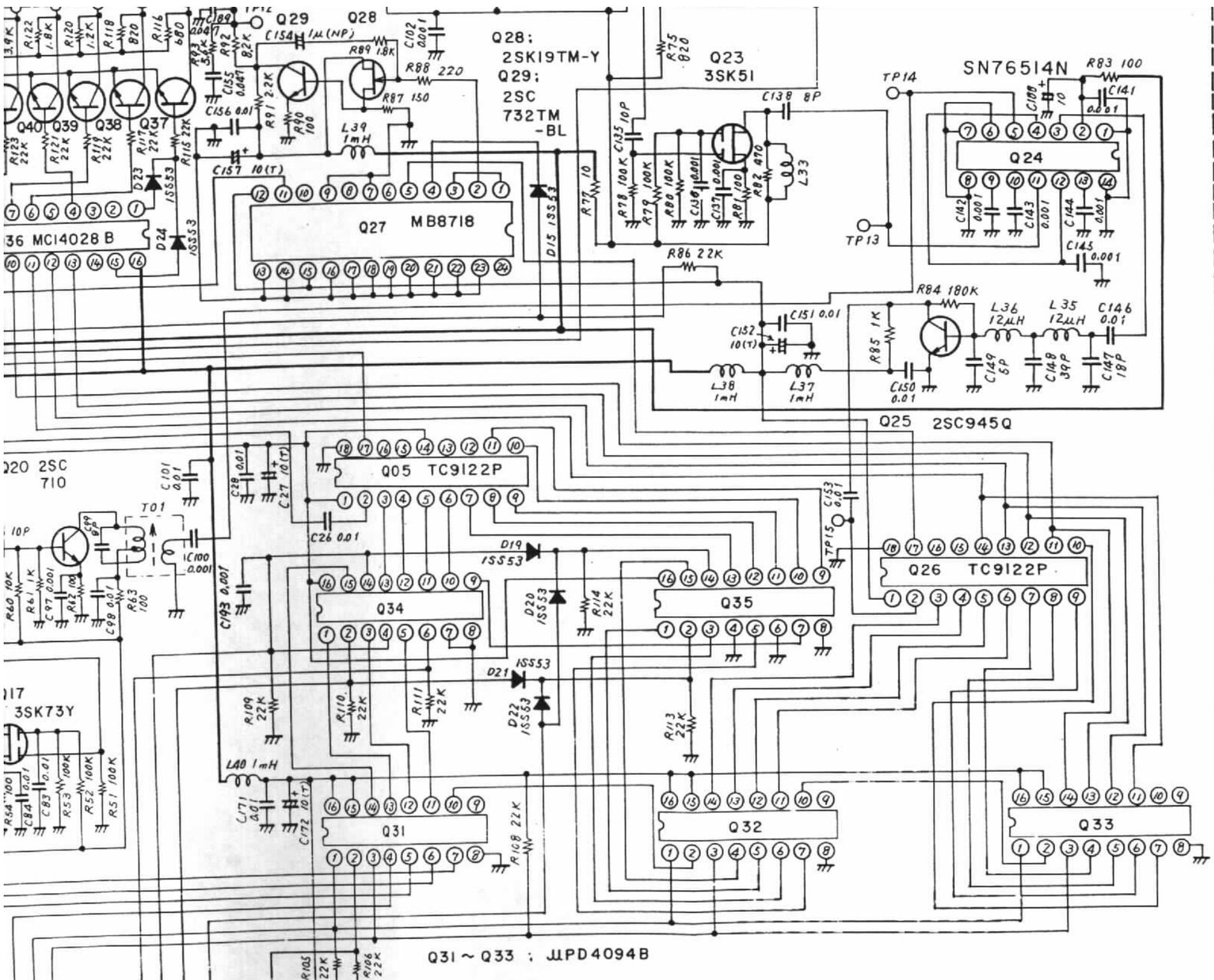




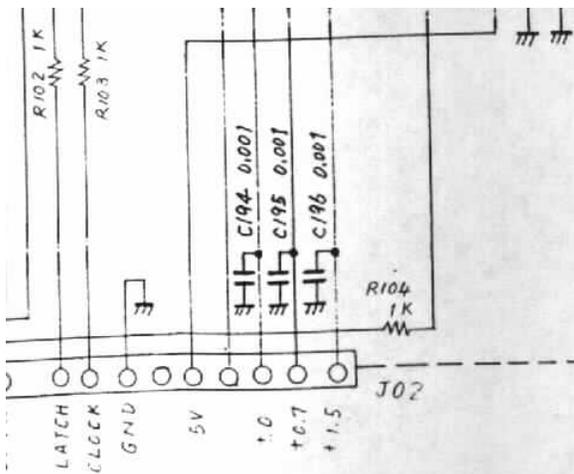








Q31 ~ Q33 : JPD4094B



Q34 ~ Q35 ; MCI4560B

PLL UNIT(NO. 30..) PB-2136

(NO. 10..) PB-2135

