

HF ALL BAND TRANSCEIVER  
GENERAL COVERAGE RECEIVER

# **IC-720A**

## **MAINTENANCE MANUAL**

This is the service manual for IC-720A. In IC-720A, improved PLL and other units are employed as compared with IC-720. Use of this manual for IC-720 shall be limited for information only, because a considerable number of modifications have been made in IC-720A, although units other than PLL are the same for both models. In case of questions on repairs and adjustments of IC-720A, please contact your dealer or ICOM service center.

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## SECTION 1 SPECIFICATIONS

### GENERAL

#### Number of Semiconductors:

|                   |     |
|-------------------|-----|
| Transistors       | 105 |
| FET               | 16  |
| IC (Includes CPU) | 51  |
| Diodes            | 219 |

#### Frequency Coverage:

|          |                   |
|----------|-------------------|
| Ham Band | 1.8MHz ~ 2.0MHz   |
|          | 3.5MHz ~ 4.1MHz   |
|          | 6.9MHz ~ 7.5MHz   |
|          | 9.9MHz ~ 10.5MHz  |
|          | 13.9MHz ~ 14.5MHz |
|          | 17.9MHz ~ 18.5MHz |
|          | 20.9MHz ~ 21.5MHz |
|          | 24.5MHz ~ 25.1MHz |
|          | 28.0MHz ~ 30.0MHz |

#### General Cover (Receive Only)

0.1MHz ~ 30.0MHz

Thirty 1MHz Segments

#### Frequency Control:

CPU based 10Hz step Digital PLL synthesizer.

Independent Transmit-Receive Frequency Available on same band.

#### Frequency Readout:

6 digit 100Hz readout.

#### Frequency Stability:

Less than 500Hz after switch on 1 min to 60 mins, and less than 100Hz after 1 hour. Less than 1KHz in the range of  $-10^{\circ}\text{C}$  to  $+60^{\circ}\text{C}$ .

#### Power Supply Requirements:

DC 13.8V  $\pm 15\%$  Negative ground Current drain 20A max. (at 200W input)

AC power supply is available for AC operation.

#### Antenna Impedance:

50 ohms Unbalanced

#### Weight:

7.5Kg

#### Dimensions:

111mm(H) x 241mm(W) x 311mm(D)

### TRANSMITTER

#### RF Power:

|                                                      |                     |
|------------------------------------------------------|---------------------|
| SSB ( $A_3J$ )                                       | 200 Watts PEP input |
| CW ( $A_1$ ), RTTY ( $F_1$ )                         | 200 Watts input     |
| Continuously Adjustable Output power 10 Watts ~ Max. |                     |
| AM ( $A_3$ )                                         | 40 Watts output     |

#### Emission Mode:

|        |                                         |
|--------|-----------------------------------------|
| $A_3J$ | SSB (Upper sideband and Lower sideband) |
| $A_1$  | CW                                      |
| $F_1$  | RTTY (Frequency Shift Keying)           |
| $A_3$  | AM                                      |

#### Harmonic Output:

More than 40dB below peak power output

#### Spurious Output:

More than 60dB below peak power output

#### Carrier Suppression:

More than 40dB below peak power output

#### Unwanted Sideband:

More than 40dB down at 1000Hz AF input

#### Microphone:

Impedance 1300 ohms

Input Level 120 millivolts typical

Dynamic or Electret Condenser Microphone with Preamplifier

### RECEIVER

#### Receiving System:

Quadruple Conversion Superheterodyne with continuous Bandwidth Control.

#### Receiving Mode:

$A_1$ ,  $A_3J$  (USB, LSB)  $F_1$  (Output FSK audio signal),  $A_3$

#### IF Frequencies:

|     |            |
|-----|------------|
| 1st | 39.7315MHz |
| 2nd | 9.0115MHz  |
| 3rd | 10.75MHz   |
| 4th | 9.0115MHz  |

with continuous Bandwidth Control

#### Sensitivity:

Less than 0.25 microvolts for 10dB S+N/N

#### Selectivity:

SSB, CW, RTTY  $\pm 1.15\text{KHz}$  at  $-6\text{dB}$   
(Adjustable to  $\pm 0.4\text{KHz}$  Min)  
 $\pm 2.1\text{KHz}$  at  $-60\text{dB}$

#### CW-N

(when optional filter installed)

$\pm 250\text{Hz}$  at  $-6\text{dB}$

$\pm 750\text{Hz}$  at  $-60\text{dB}$

#### AM

$\pm 3.0\text{KHz}$  at  $-6\text{dB}$

$\pm 9.0\text{KHz}$  at  $-60\text{dB}$

(when optional filter installed)

$\pm 2.6\text{KHz}$  at  $-6\text{dB}$

$\pm 6.0\text{KHz}$  at  $-60\text{dB}$

#### Spurious Response Rejection Ratio:

More than 60dB

#### Audio Output:

More than 2 Watts

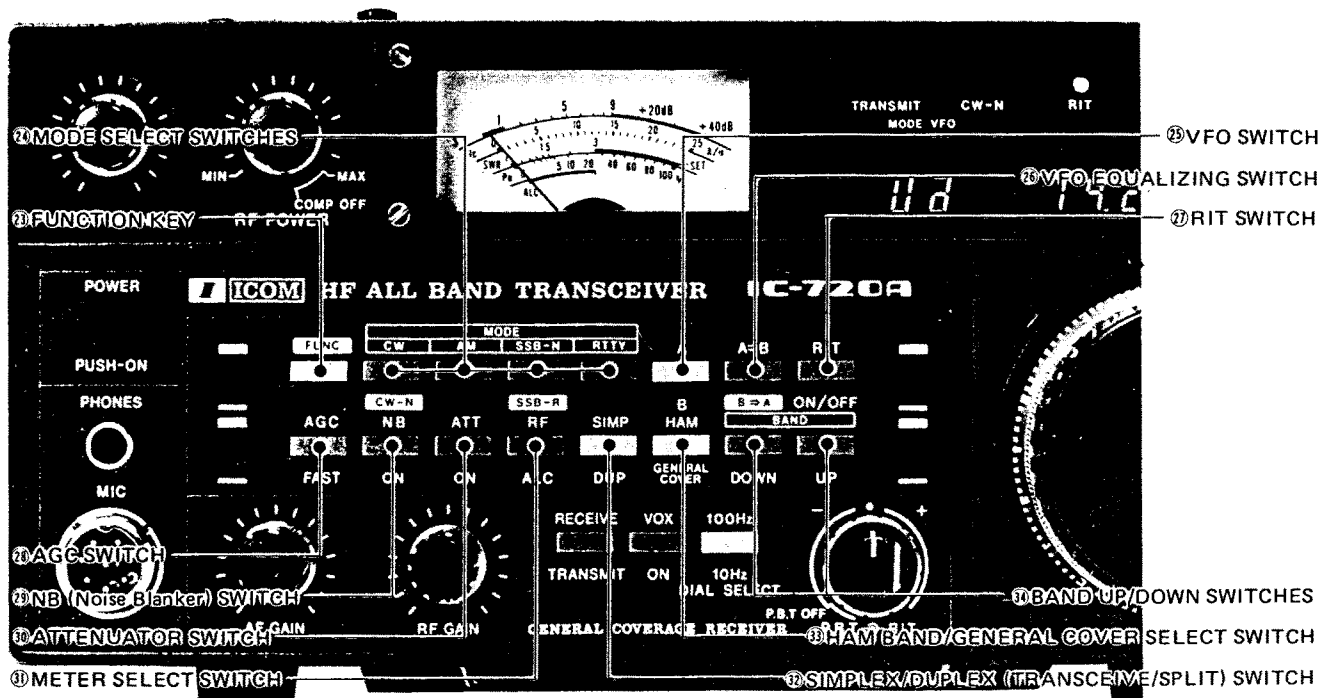
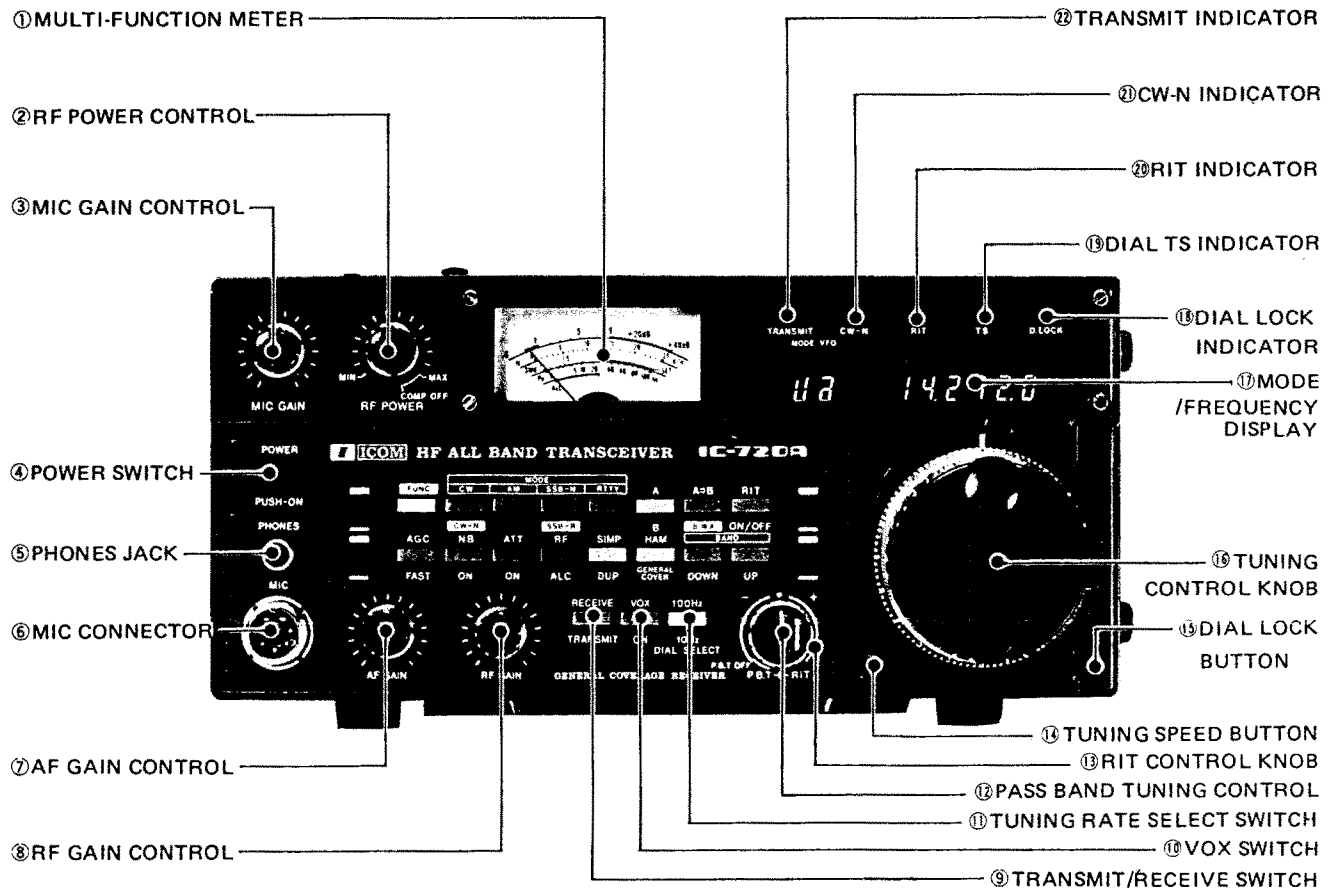
#### Audio Output Impedance:

8 ohms

Specifications are approximate and are subject to change without notice or obligation.

## SECTION 2 OPERATING CONTROLS

### 2-1 FRONT PANEL





## 1. MULTI-FUNCTION METER

When in the receive mode the meter acts as an S meter regardless of the position of the meter select switch. Signal strength is indicated on a scale of S1-S9, and S9+20dB to S9+40dB.

In the transmit mode the meter has three functions which are selected by the Meter Select Switch (31) and the IC Meter Switch inside the top access cover. They are as follows:

Ic; Indicates the collector current of the final transistors.

Po; Indicates the relative output power. SWR can be measured by placing the switch located inside the top cover to the SWR position.

ALC; In this position the meter functions when the RF output reaches a certain level.

| METER FUNCTION          | METER SELECT SWITCH | SWR SWITCH | METER SWITCH |
|-------------------------|---------------------|------------|--------------|
| RF meter                | RF                  | SWR SET    | RF           |
| ALC meter               | ALC                 | —          | —            |
| Ic meter                | RF                  | —          | IC           |
| SWR meter (calibrating) | RF                  | SWR SET    | RF           |
| SWR meter (measuring)   | RF                  | SWR        | RF           |

## 2. RF POWER CONTROL

The IC-720A has a built-in RF speech processor which is turned ON by turning the control counterclockwise, from the COMP OFF position. (a click will be heard.) In the ON position, it functions as the RF drive control, as explained in the MIC GAIN CONTROL paragraph. In CW, SSB and RTTY modes it operates as the output level control of the IC-720A. When this function is not desired the control should be turned completely clockwise until COMP OFF, and a click is heard.

## 3. MIC GAIN CONTROL

Adjusts the level of modulation according to the input of the microphone. Clockwise rotation increases the microphones gain. As the input will vary with different microphones and different voices, the knob should be turned until the Multi-Function Meter needle, in the ALC mode, begins to move slightly within the ALC zone. In SSB and AM modes, when the RF speech processor is in use, the MIC GAIN CONTROL sets the clipping limits, while the RF POWER CONTROL sets the RF drive level to the maximum power level, where ALC starts at the saturation point of the amplifiers.

## 4. POWER SWITCH

The POWER SWITCH is a push-lock type switch which controls the input DC power to the IC-720A. When the external AC power supply (IC-PS15) is used, the switch also acts as the AC power supply switch. When the switch is pushed in and locked, power is supplied to the set. When

the switch is pushed again and released, power is cut to all circuits except the PA unit. (When the BC-10A is used, power will also be supplied to the CPU.)

## 5. PHONES JACK

Accepts a standard 1/4 inch headphone plug for headphones of 4 ~ 16 ohms. Stereo phones can be used without modification.

## 6. MIC CONNECTOR

Connect the supplied microphone or optional microphone IC-SM5 to this jack. If you wish to use a different microphone, refer to the drawing on page 4 of the instruction manual.

## 7. AF GAIN CONTROL

Controls the audio output level in the receive mode. Clockwise rotation increases the level.

## 8. RF GAIN CONTROL

Controls the gain of the RF section in the receive mode. Clockwise rotation gives the maximum gain. As the control is rotated counterclockwise, the needle of the MULTI-FUNCTION METER rises, and only signals stronger than the level indicated by the needle will be heard.

## 9. TRANSMIT/RECEIVE (T/R) SWITCH

This switch is for manually switching from transmit to receive and vice versa. Set the switch to RECEIVE (out) and the IC-720A is in the receive mode. Set the switch to TRANSMIT (in) and it switches to transmit. When switching with the PTT switch on the microphone or with the VOX switch set to ON, the T/R switch must be in the RECEIVE position.

## 10. VOX SWITCH

This switches the VOX circuit ON and OFF. When it is in the ON (in) position, in SSB or AM, T/R switching is accomplished by means of a voice signal. In CW operation, semi-break-in switching by means of keying is possible.

## 11. TUNING RATE SELECT SWITCH

The small vernier marks on the tuning knob are changed to correspond to 10Hz steps or 100Hz steps which is selected by this switch.

## 12. P.B. TUNE (PASS BAND TUNING) CONTROL

Allows continuous tuning of the pass-band selectivity by moving the filter up to 800Hz from the upper or lower side in SSB, CW and RTTY. Not only improves selectivity, but also can improve the audio tone. Normal position is in the center (12 o'clock) position and is 2.3KHz wide in SSB.

## 13. RIT CONTROL

Shifts the receive frequency  $\pm 800\text{Hz}$  either side of the transmit frequency. When the RIT is ON, the RIT INDICATOR is illuminated. Rotating the control to the (+) side raises the receiver frequency, and rotating to the (—) side lowers the receiver frequency. With the RIT ON, if the TUNING CONTROL KNOB is moved one increment, the RIT circuit is automatically pulsed OFF. Therefore it is unnecessary to manually turn OFF the RIT when changing operating fre-

quency. The frequency shift by tuning the RIT Control is not indicated on the frequency display.

#### 14. TUNING SPEED BUTTON

Pushing the TUNING SPEED BUTTON will illuminate the DIAL TS INDICATOR, and the small vernier marks on the tuning knob are changed to correspond to 1KHz steps. At the same time, the 100Hz digit is turned OFF on the display. When the TUNING SPEED BUTTON is depressed again, the DIAL TS INDICATOR goes OFF and the small vernier marks will again correspond to 100Hz steps or 10Hz steps. This button will allow you to quickly QSY over a great frequency range.

#### 15. DIAL LOCK BUTTON

After the IC-720A is set to a certain frequency for rag chewing, mobile operation, etc., pushing the DIAL LOCK BUTTON will illuminate the DIAL LOCK INDICATOR and the VFO is electronically locked at the displayed frequency, thus inactivating the operation of the tuning knob. To change frequency, the dial lock must first be disengaged by pushing the DIAL LOCK BUTTON again. The DIAL LOCK INDICATOR will go OFF and the frequency will change with the direction of the tuning knob rotation. Turning the power OFF will release the dial lock and clear the displayed frequency.

#### 16. TUNING CONTROL KNOB

Rotating the TUNING CONTROL KNOB clockwise increases the frequency, while rotating it counterclockwise decreases the frequency. The frequency is changed in 10Hz, 100Hz or 1KHz steps which is according to the TUNING RATE SELECT switch and the TUNING SPEED BUTTON. One complete rotation of the tuning knob results in a 1KHz frequency increase or decrease in 10Hz steps, 10KHz in 100Hz steps and 100KHz in 1KHz steps.

#### 17. MODE/FREQUENCY DISPLAY

The frequency of the IC-720A is displayed on a luminescent display tube. Since the 1MHz and 1KHz decimal points are displayed, the frequency can easily be read. The frequencies indicated are the carrier frequencies of each mode in AM, USB, LSB and CW. In the RTTY mode, the mark frequency is displayed.

Remember, if you turn the RIT SWITCH ON to change the receive frequency and rotate the RIT CONTROL knob, the frequency displayed will not change.

The letters shown to the left of the frequency indication are the initial letter of the operating mode and the letter of the operating VFO.

#### 18. DIAL LOCK INDICATOR

Illuminates when the DIAL LOCK BUTTON is pressed to lock the dial.

#### 19. DIAL TUNING SPEED (TS) INDICATOR

Illuminates when the TUNING SPEED BUTTON is pressed to set the dial to fast tuning.

#### 20. RIT INDICATOR

Illuminates when RIT is turned ON.

#### 21. CW-N (CW NARROW) INDICATOR

Illuminates when the set is in CW-N mode. This indicator illuminates not only when the optional CW filter is installed, but also if it is not installed.

#### 22. TRANSMIT INDICATOR

Illuminates when the transceiver is in the transmit mode.

#### 23. FUNCTION KEY

Increases the function of the CW and SSB MODE SELECT switches and the VFO EQUALIZING switch by pushing this key switch.

#### 24. MODE SELECT SWITCHES

Selects any one of four operating modes by simply pushing the desired switch. Additionally, the CW and SSB switches have dual functions as follows.

1. CW : For normal CW operation.  
CW-N : Pushing the FUNCTION key first, then the CW button, filter is switched to the Narrow CW filter (when the optional Narrow CW filter is installed).
2. SSB-N : For normal SSB operation, upper sideband (USB) for 10MHz band and above, and lower sideband (LSB) for 9MHz band and below.  
SSB-R : For reverse SSB operation, lower sideband (LSB) for 10MHz band and above, and upper sideband (USB) for 9MHz band and below.

#### 25. VFO SWITCH

You can select either of the built-in two VFO's with this switch. It also selects the relationship of the two VFO's with the SIMPLEX/DUPLEX switch. The switch performs the following operations according to its position.

- A. (SIMPLEX) Selects the "A" VFO for both transmit and receive.
- A. (DUPLEX) Selects "A" VFO for receive and "B" VFO for transmit.
- B. (SIMPLEX) Selects the "B" VFO in both transmit and receive.
- B. (DUPLEX) Selects "B" VFO for receive and "A" VFO for transmit.

**NOTE:** The set will not transmit in the GENERAL COVER mode.

In addition, when the VFO is switched from "A" VFO to "B" VFO, the frequency indicated on the frequency display just prior to switching goes into a memory inside the CPU. Thus even if "B" VFO is being used, switching to "A" again will enable you to operate at the initial frequency. Switching from "B" to "A" results in the same operation.

## 26. VFO EQUALIZING SWITCH

When "A" VFO and "B" VFO have different frequencies, by pushing this switch, "B" VFO will have the same frequency as "A" VFO. This switch has dual functions, by pushing the FUNCTION key first, then this switch, "A" VFO will have the same frequency as "B" VFO.

## 27. RIT SWITCH

Push once for ON; if OFF is desired push the switch again. When the RIT is ON the RIT INDICATOR will light. (Note: The RIT will also pulse OFF when the TUNING CONTROL knob is turned.)

## 28. AGC (AUTOMATIC GAIN CONTROL) SWITCH

For changing the time-constant of the AGC circuit. With the switch in the AGC position (out) the AGC voltage is released slowly, and thus is suitable for SSB reception. With the switch in the FAST (in) position, the AGC voltage is released faster, and the AGC is suitable for stations suffering from fast fading or when operating in the CW mode.

## 29. NB (NOISE BLANKER) SWITCH

When pulse type noise such as automobile ignition noise is present, set this switch to the ON (in) position. The noise will be reduced to provide comfortable reception.

## 30. ATT (ATTENUATOR) SWITCH

When nearby signals interfere with reception, or make "S" readings difficult push the switch in, this removes the RF Amplifier from the receiving circuit, and an attenuator is put into the circuit. For normal operation leave it in the

OFF (out) position.

## 31. METER SELECT SWITCH

Selects meter function in the transmit mode.

## 32. SIMPLEX/DUPLEX (TRANSCIVE/SPLIT) SWITCH

Selects the relationship of the two VFO's. In the SIMPLEX (out) position, one VFO is for both transmit and receive. In the DUPLEX (in) position, one VFO is for transmit and the other is for receive.

## 33. HAM BAND/GENERAL COVER SELECT SWITCH

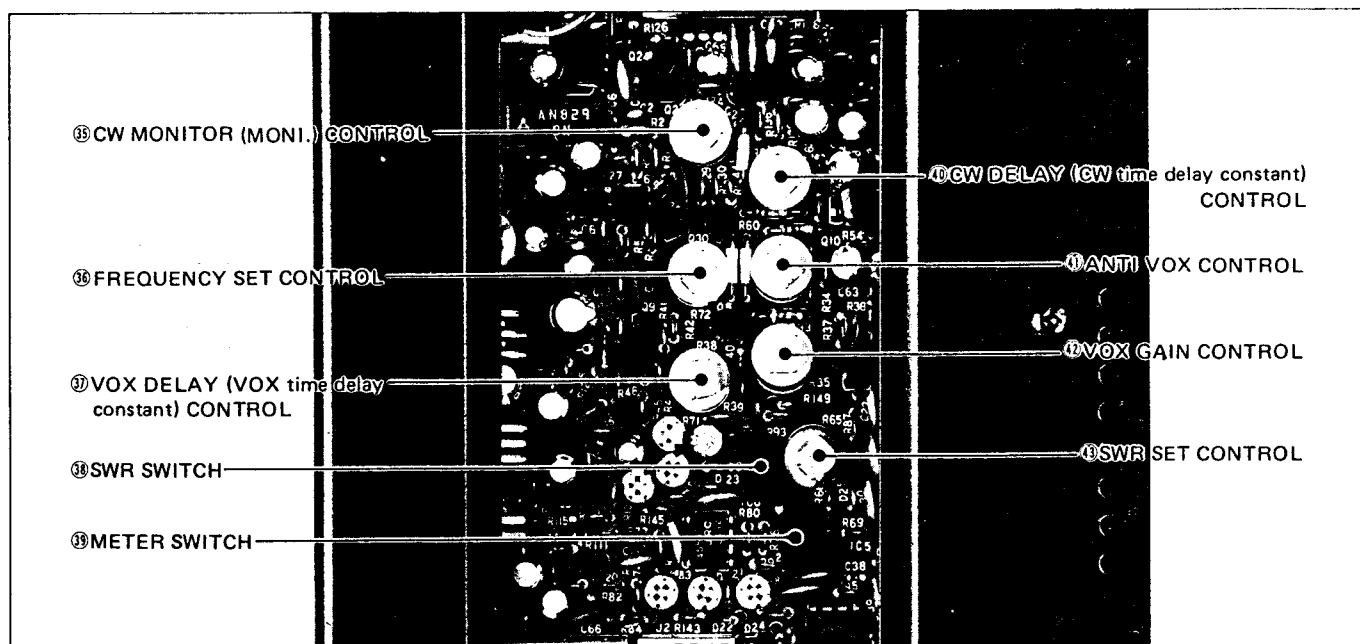
Selects the function of the set. In the HAM (out) position the transceiver functions in any of nine HAM bands between 1.8MHz and 28MHz. In the GENERAL COVER position (in) the set functions as a general coverage receiver between 0.1MHz and 30MHz. (the set will not transmit in this mode.)

## 34. BAND UP/DOWN SWITCHES

Changes the operating band upward or downward. In the HAM BAND operation, the band skips to the next upper or lower band with each push. (28MHz band is divided into two segments of 28-29MHz and 29-30MHz.)

In the GENERAL COVERAGE operation, the band changes to next upper or lower 1MHz segment. When the band reaches the highest band, the next is the lowest band. Also when the band reaches the lowest band, the next is the highest band.

## 2-2 CONTROLS UNDER THE ACCESS COVER



## 35. CW MONITOR (MONI) CONTROL

This control adjusts the audio volume of the side tone (monitor) audio during CW transmit operation. Adjust it to your desired level for easy listening.

## 36. FREQUENCY SET CONTROL

This control is for fine adjustment of the reference frequency of the PLL unit, which is local oscillator frequency. Do not turn it unless you want to change the frequency.

### 37. VOX DELAY (VOX time constant) CONTROL

This controls the transmit to receive switching time. Adjust it so transmit to receive switching will not occur during short pauses in normal speech.

### 38. SWR SWITCH

When measuring SWR, calibration SET and SWR reading functions are selected with this switch. When reading SWR make sure the METER SELECT switch on the front panel is in the RF position.

### 39. METER SWITCH

When the METER SELECT switch on the front panel is in the RF position, this switch is used to select indication of the collector current of the final transistors, or relative output power.

### 40. CW DELAY CONTROL

In semi-break-in operation, this controls the transmit/receive switchover time-delay. Adjust to suit your keying speed.

(Note: If the delay is set to the shortest position, it will reach almost full break-in CW.)

### 41. ANTI-VOX CONTROL

In VOX (SSB and AM) operation, the VOX circuit may be operated by sound from the speaker causing a switch to transmit. This trouble can be prevented by adjusting the input level of the ANTI VOX circuit with this control along with the VOX gain control so that the VOX circuit only operates from the operator's voice, not by sound from the speaker.

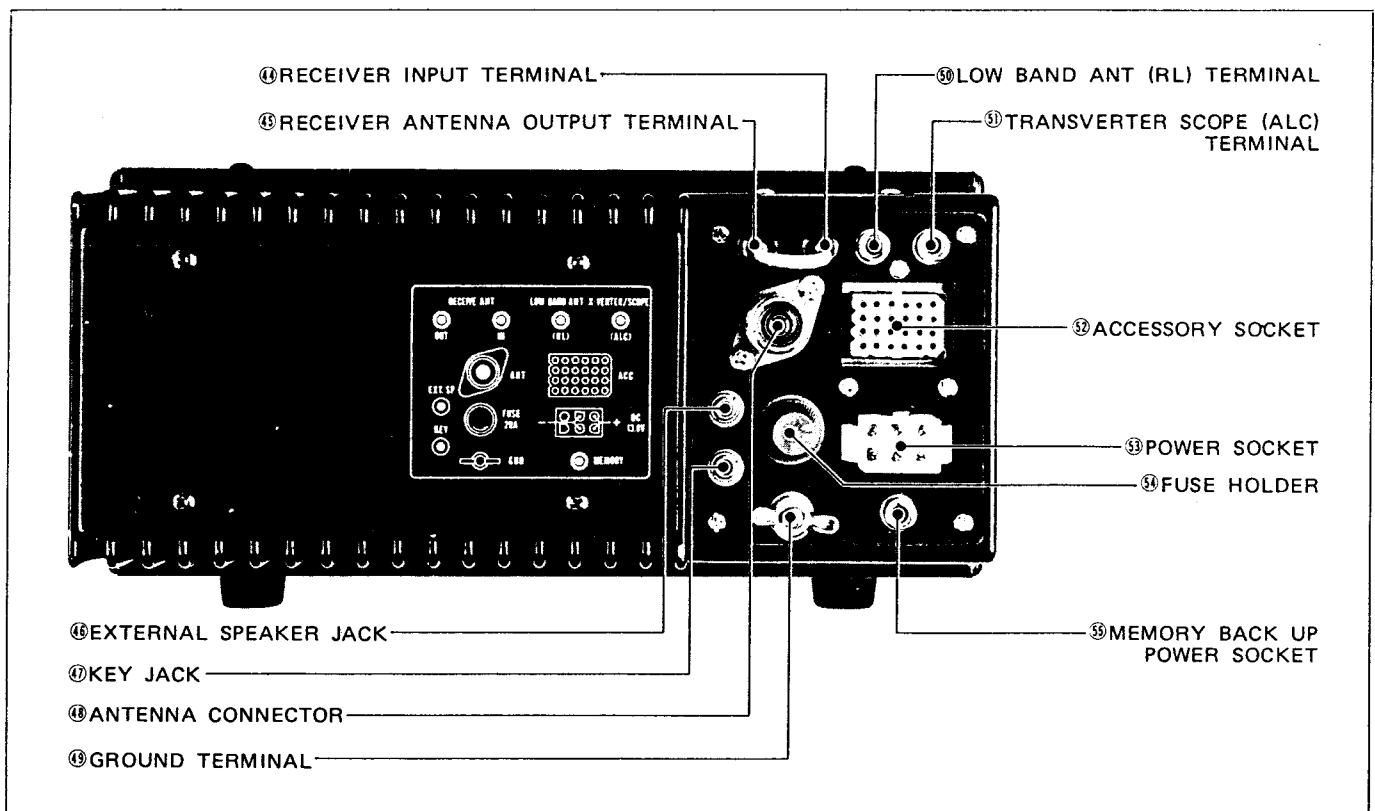
### 42. VOX GAIN CONTROL

This control adjusts input signal level via the microphone to the VOX circuit. For VOX operation in SSB and AM, adjust the control so that the VOX circuit will operate with normal speech.

### 43. SWR SET CONTROL

This control calibrates the meter needle to the Po SET position when you want to determine the value of SWR. The METER SELECT switch must be in the RF position and the set must be transmitting a carrier.

## 2-3 REAR PANEL CONNECTIONS



### 44. RECEIVER INPUT TERMINAL

This is an input terminal which is connected directly to the receiver.

### 45. RECEIVER ANTENNA OUTPUT TERMINAL

This is a terminal to which received signals from the antenna connector are conducted after the signal passes through the transmit/receive antenna switching circuit. Usually the receiver IN and OUT terminals are jumpered. The receiver

antenna output terminal is usually used when another receiver is used or a preamplifier is connected to the IC-720A.

### 46. EXTERNAL SPEAKER JACK

When an external speaker is used, connect it to this jack. Use a speaker with an impedance of 8 ohms. When the external speaker is connected, the built-in speaker does not function.

#### 47. KEY JACK

For CW operation, connect a key here. For electronic keying the terminal voltage must be less than 0.4V DC.

#### 48. ANTENNA (ANT) CONNECTOR

This is used to connect an antenna to the set. Its impedance is 50 ohms and connects with a PL-259 connector.

#### 49. GROUND TERMINAL

To prevent electrical shock, TVI, BCI and other problems, be sure to ground the equipment through the GROUND TERMINAL. For best results use as heavy a gauge wire or strap as possible and make the connection as short as possible, even in mobile installations.

#### 50. LOW BAND ANTENNA (RL) TERMINAL

For connection of a low band antenna to receive 1600KHz and below. When operating frequency goes to 1600KHz and below, the antenna terminal will be changed from (48) ANTENNA connector to this terminal automatically.

By changing an internal connector, this terminal can be used for a Transmit/Receive relay control terminal. This terminal can be used to switch 24V 1A DC. Don't exceed this limit.

#### 51. TRANSVERTER/SCOPE (ALC) TERMINAL

By changing internal connectors, this terminal can be used for a TRANSVERTER terminal, SCOPE terminal, or external ALC signal input terminal.

##### 1. TRANSVERTER

VHF and UHF operation using a suitable transverter with the IC-720A is possible. This terminal is for Transverter connection. The output is a few milliwatts. Refer to the transverters instruction on the instruction manual.

##### 2. SCOPE

This terminal brings out the 39.7MHz IF signal from the mixer in the receiver. Not only observation of the received signal, but also of signals of a selected band width are possible by using a panadaptor or panascope.

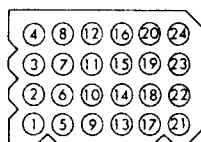
##### 3. EXTERNAL ALC

This terminal can be used for an input terminal of external ALC signal from a linear amplifier or transverter.

#### 52. ACCESSORY (ACC) SOCKET

Various functions are available through the accessory socket such as frequency control, modulation output, receiver output, T/R changeover, and so forth. The table below shows those terminals.

#### ACC SOCKET CONNECTIONS



Outside view

| PIN No. | FUNCTION                                                                                                 |
|---------|----------------------------------------------------------------------------------------------------------|
| 1.      | NC (no connection)                                                                                       |
| 2.      | 13.8 Volts DC in conjunction with the power switch operation.                                            |
| 3.      | Connected to Push-to-talk, T/R change-over switch. When grounded, the set operates in the transmit mode. |
| 4.      | Output from the receiver detector stage. Fixed output regardless of AF output or AF gain.                |
| 5.      | Output from Transmitter MIC amplifier stage. (Input for MIC gain control stage.)                         |
| 6.      | 8 Volts DC available when transmitting. (relay can not be directly actuated. Max. 5mA.)                  |
| 7.      | Input for external ALC voltage.                                                                          |
| 8.      | Ground                                                                                                   |
| 9.      | Input for RTTY keying (MARK: HIGH level, SPACE: LOW level).                                              |
| 10.     | Input for TRVA transverter control signal.                                                               |
| 11.     | Input for TRVB transverter control signal.                                                               |
| 12.     | Output reference voltage for band switching.                                                             |
| 13.     | INPUT/OUTPUT for external band switching.                                                                |
| 14.     | Input for TUNE mode. When +9V is applied, the set operates in the CW transmit mode.                      |
| 15.     | Input for external Noise Blanker control.                                                                |
| * 16.   | Input for external control (DBC signal).                                                                 |
| 17.     | NC No connection.                                                                                        |
| * 18.   | Input for external control (RC signal).                                                                  |
| * 19.   | Output for external control (DV signal).                                                                 |
| * 20.   | Input for external control (RT signal).                                                                  |
| * 21.   | Input/Output for external control (DB1).                                                                 |
| * 22.   | Input/Output for external control (DB2).                                                                 |
| * 23.   | Input/Output for external control (DB4).                                                                 |
| * 24.   | Input/Output for external control (DB8).                                                                 |

CAUTION: Those terminals marked \* are internally connected with logic ICs such as CMOS. Voltage beyond the range of  $-0.5 \sim +5.3V$ , if applied, would damage these ICs.

#### 53. POWER SOCKET

For connection of the IC-PS15's DC power cord, or other suitable power supply.

#### 54. FUSE HOLDER

This holds the fuse for the DC power circuit. If the fuse is blown, replace it with a new 20 Amp fuse after checking the cause. Open the fuse holder with a Phillips head screwdriver.

#### 55. MEMORY BACKUP POWER SOCKET

For connection of a 9 ~ 12V DC power supply. For mobile installation connection to the vehicle's battery can be made as the current drain is low, for fixed installation use of the IC-BC10A is recommended.

## SECTION 3 CIRCUIT DESCRIPTION

### 3-1 OUTLINE

The IC-720A operates as a general coverage receiver for 100KHz — 30.0MHz and as a transceiver for amateur radio bands including those newly accepted by WARC '79. The IC-720A uses a phase-locked-loop (PLL) consisting of three loops for the local oscillator for both transmit and receive. The PLL is controlled by a Microcomputer system. The basic circuit uses an up-conversion with a First IF of 39.7315MHz and a Second IF of 9.0115MHz. Included within the IF unit is the Pass Band Tuning circuit. Altogether there are 11 units in the IC-720A, with overall control exercised by the Logic Unit. The units are:

1. Main Unit : Power supply, AF amplifier, various control circuits, etc.
2. IF Unit : Intermediate frequency (IF) amplifier.
3. RF Unit : Band-Pass filter.
4. Filter Unit : Low-Pass filter.
5. Driver Unit : Transmitting driver stage.
6. PA Unit : Transmitting final stage power amplifier.
7. SWR Unit : SWR detector, RF amplifier, attenuator, etc.
8. LOGIC Unit : Main controls for CPU, etc.
9. PLL Unit : Local oscillator.
10. RTTY Unit : RTTY transmitting signal generator.
11. Other Units

Explanation will be given in the order of signal flow.

### 3-2 RECEIVING CIRCUITS

#### 1. RF CIRCUITS

An incoming signal from Antenna Connector J1 will be fed to SWR Unit, and then to low-pass filter unit through SWR detector line. In this unit, unwanted out-band signals are removed by low-pass filters corresponding to the respective bands. The low-pass filters are automatically selected by Rotary Relay (RL 2) in response to switching control signals coming from the Logic unit.

The matrix circuit composed of D4 — D13 functions to send out the present band status to the band coincidence circuit of the Logic unit, controlling Q1 (Darlington transistor) in response to band switching control signals, thus to drive the Rotary Relay.

The low-pass filters function to remove unwanted harmonic components in transmitting, switching the transmitting/receiving switching relay (RL1) in response to SEND signal coming from pin 6 of J1.

D1 and D2 absorb inductive kickback generated by relay solenoid, and D3 is a voltage regulator Zener diode for matrix.

The incoming signal from the low-pass filter is output to RECEIVE OUT (J2) terminal on the rear panel, jumpered to ANT IN(J3) terminal and again fed to RA1 terminal of the SWR unit.

Jumpering of receiving signal on the rear panel as mentioned above permits the set to be used with another receiving antenna or a preamplifier, etc.

The signal fed to the SWR unit is amplified (10dB) by a wide dynamic range junction FET's Q1 and Q2 in push-pull to ensure durability against strong signal input.

It is also possible to drive RL1 using ATT switch on the front panel and feeds the signal, attenuated by about 10 dB, to the RF unit without passing it through the RF amplifier.

When no transverter is in use, a 9V is applied on TRN line in receive mode and it is fed to D4 through L6, R10 and L8 of the SWR unit, and turns D4 ON.

Then this superimposed DC voltage is fed to D4 of the RF unit and turns D4 ON. Thus the amplified or attenuated receiving signal is fed to band-pass filters of the RF unit. BPF switching control signal from the Logic unit is supplied to J3 of the RF unit and turns ON one of the BPF input switching diodes — D5, D9, D17, D21, D25 and D26 and one of the BPF output switching diodes — D6, D12, D16, D20, D24, D27 and D28 in correspondence with the respective bands. This selects a band-pass filter corresponding to each band, thus the receiving signal is fed to the mixer IC1 through the selected band-pass filter.

#### 2. IF CIRCUITS

The signal which has passed the BPF is supplied to double balanced mixer, IC1 to convert into the first intermediate frequency of 39.7315 MHz.

The first local oscillator signal from the PLL unit is fed to the local oscillator input terminal of IC1 through buffer amplifier Q1.

The first IF signal of 39.7315 MHz mixed at IC1 passes the monolithic crystal filter of F11, which has a pass-band of  $39.7315\text{MHz} \pm 7.5\text{KHz}$ , then sent to the first IF amplifier Q3 through D31 which is turned ON in receive mode.

The amplified first IF signal is fed to the double balanced mixer of IC2 through a band-pass filter consisting of L50, L51 and C103, and turned ON in receive mode.

To the local oscillator input terminal of IC2, 30.72 MHz second local oscillator signal from the PLL unit is fed through buffer amplifier Q4. By mixing this signal with the first IF signal, a second IF signal of 9.0115MHz is obtained from output terminal of IC2.

#### 1) Noise Blanker Circuit

A portion of the second IF signal is fed to the noise blanker circuit through C115. This circuit is to block receiving signal at a moment a pulse type noise is received.

The second IF signal fed through C115 is amplified by IC3 then rectified by D33 and D34. A portion of the rectified signal is amplified by Q6 and fed to pin 3 of IC3 as an AGC voltage to keep the output level of this IC constant. The other part of the rectified signal is supplied to pin 2 of IC4. The output of IC4 is connected to the noise blanker gate and is ground level when the NB switch is turned ON.

When a pulse type noise is received (when the Noise Blanker is ON), IC4 operates to bring the output to a H (High) level. IC4 is a comparator having a hysteresis when its output is turned H-level to L (Low) level, which is used as gate control timing. The level immediately turns H-level upon entrance of noise and turns ON the noise blanker gate controls Q7, Q8 and D37, and turns OFF the noise blanker gates D40, D42 and D44.

Thus the receiving signal (noise) is blocked to feed to the second IF amplifier circuit.

## 2) Crystal Filters

The second IF signal put out from IC2 is fed to a band-pass filter consisting of L53, C136 and L58, then second IF amplifier Q10 through D40 and D42 which are turned ON in receive mode. It is then fed to the IF unit through D13 which is turned ON in receive mode.

The amplified second IF signal, is fed to J1 of the IF unit. In the LSB, USB, CW or RTTY mode D14 and D17 are turned ON and the second IF signal is passed through F11 SSB crystal filter. In AM mode, D2 and D5 are turned ON and the second IF signal is passed through F13 AM crystal filter. When optional CW narrow filter is installed and S2 is set in CWN position, D10 and D13 is turned ON, and the signal is passed through the CW narrow crystal filter in CWN mode.

If S2 is not set in CWN position, the SSB crystal filter F11 is selected even if the mode is in CWN.

Pairs of diodes, D3 and D4, D15 and D16, and D11 and D12 are turned ON when respective filters are not used for the operating mode, and they by-pass leaked signals and isolate respective filters from the selected filter.

The filtered signal is supplied to the receiving IF amplifier Q7 through D34 which is ON during receiving, then fed to PBT (Pass Band Tuning) circuit.

## 3) PBT circuit

The signal amplified by Q7 is supplied to the double balanced mixer IC1 through D35 which is ON during receiving. Then the signal is mixed with 19.7615MHz local oscillator signal applied to pin 7 of IC1, and is converted into 10.75MHz IF signal.

This signal passes diode D37 which is ON during PBT operation, then 10.75MHz crystal filter FI2 having 2.3KHz ( $-6$  dB) pass-band.

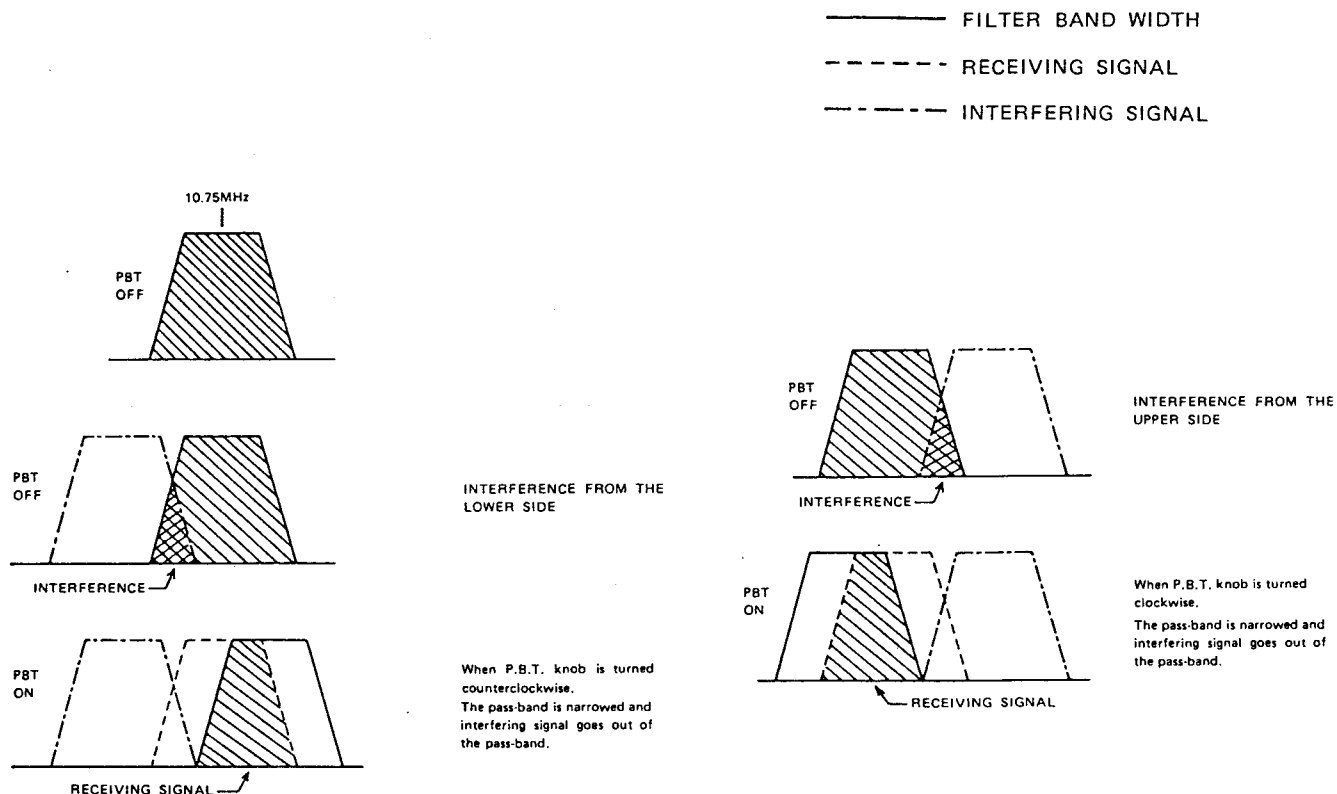
This output also passes D40 which is ON during PBT operation and is supplied to the double balanced mixer IC2. This signal is mixed again with 19.7615MHz local oscillator signal which is the same one as the signal applied to IC1, to convert into 9.0115 MHz IF signal again.

When PBT is OFF or during AM operation, D28 and D31 are turned ON and the signal is fed to a band-pass filter composed of C22 – C26, L8, L9, etc., not FI2.

The diode switches for input and output circuits for the filters also have such bias setting as may turn ON the necessary lines as same as diode switches for 9.0115MHz filters.

When the PBT is ON, 19.7615MHz local oscillator frequency can be varied  $\pm 1.5$ KHz. Thus the pass-band of the 10.75MHz crystal filter is shifted  $\pm 1.5$ KHz against the pass-band of the 9.0115MHz crystal filter relatively, and the total pass-band is varied as shown in figures below.

## OPERATION OF PASS-BAND TUNING



DURING TRANSMITTING, THE PBT CIRCUIT FUNCTIONS AS AN RF SPEECH PROCESSOR CIRCUIT.

#### 4) VXO Circuit for PBT and RF Speech Processor

By turning the PBT control, a voltage applied to D21 varactor diode is varied, and its capacity is also varied.

D21 is in series with X1 and varies the local oscillator frequency when the PBT is turned ON. R9V is applied to R13 trimmer, and divided a voltage which sets the local oscillator frequency at 19.7615MHz and the total pass-band at normal band width.

In the transmit mode T9V is applied to R13 and the local oscillator frequency is set at 19.7615MHz, the same as above. In the transmit mode and the RF POWER control is in COMP OFF position (speech processor is OFF), the 9MHz DSB signals generated at the balanced modulator, IC3, is fed to one of the 9MHz crystal filters depending on the operating mode, through D44 and D37.

When the speech processor is turned ON (the RF POWER control is in any position except COMP OFF position), T9V is applied to the PBT circuit through the COMP switch and D23, and the PBT circuit acts as a speech processor. At this time, the 9MHz DSB signals are fed to the mixer through D36, then FI2 10.75MHz crystal filter, and the unwanted side band of the DSB signals is removed to get 10.75MHz SSB signal.

The 10.75MHz SSB signal is fed to the mixer IC2 to convert 9.0115MHz SSB signal, then to IF amplifier Q8 and Q6. This amplified signal is clipped a portion above the specified level (this level can be adjusted by R35) by D26 and D27, then fed to the 9MHz crystal filter through D32.

In the AM mode, when the PBT is turned ON, Q17 is turned ON, and the local oscillator frequency is set at 19.76MHz and can be shifted  $\pm 3$ KHz by turning the PBT control. When the PBT is turned OFF or in the transmit mode, Q1 is turned ON and the local oscillator frequency is set at 19.76MHz by R14 trimmer.

The 9MHz IF signal which has passed through the PBT circuit is amplified by a three-stage amplifier consisting of Dual-Gate MOS FET's of Q8, Q9 and Q10. As this stage specially requires stable amplification and high gain as well as a wide AGC range, AGC voltage is supplied to the second gates of Q8 and Q9. The IF coils L18, L19 and L20, reject interference from outside the IF pass-band and other wide range noise.

Source voltage of Q9 is decreased when AGC voltage is applied. This voltage is fed to the MAIN unit as the IFS signal. In the Main unit, this IFS signal is fed to IC6 (B), inverting amplifier, and amplified to drive the S-meter. R83 is a trimmer for zero point setting and R79 for full scale setting.

D21 (Zener), R81 and R143 of IC6 (B) output are for linearity compensation of S-meter reading. When output of IC6 (B) is lower than 3V (Zener voltage), D21 is OFF and voltage is fed through R81 and R143. When the output exceeds 3V, D21 is turned ON and voltage is fed through R143 only.

#### 5. AF Circuits

The amplified SSB, CW or RTTY signals which are taken from the drain of Q10, are then fed to pin 5 (signal input) of IC4 (double balanced demodulator), with the BFO signal fed to pin 7 (carrier input), and detected AF signals are put

out from pin 2. The AM signals are fed to D57 and detected.

The SSB, CW or RTTY detected signals from IC4 are fed to an AF amplifier Q22 and then to the Main unit. The AM detected signals from D57 are amplified by Q24, then fed to Q22 the same as the signals from IC4.

In the Main unit, this AF signal is fed to DC-controlled AF attenuator IC1 (B) and then AF power-amplifier to drive the speaker.

IC1 (B) is an attenuator IC, and its attenuation can be varied by a DC voltage applied to pin 13. AF signal and CW side-tone signal (to be explained later) are fed to pin 1 and the DC voltage set by AF GAIN Control on the front panel to pin 13, thus the volume from the speaker is controlled by the AF GAIN control. In the transmit mode, Q24 is turned ON and grounds pin 13. This gives the maximum attenuation and prevent residual noise is being heard from the speaker.

In the CW transmit mode Q23 is turned ON and Q24 OFF and the AF attenuator IC1 (B) works with normal condition, and CW side-tone (to be explained later) may be heard from the speaker when key is down. CW side-tone is about 800 Hz tone and is generated by the phase oscillator, Q26, and its level can be adjusted with R133 trimmer.

The CW side-tone oscillator constantly oscillates during CW operation, however, when key is up, CW 9V is applied to Q25 through R130 and Q25 is turned ON, thus the tone signal is shunted to ground through Q25. When the key is down, Q14 is turned ON and CW 9V is fed to Q30 through R144. This turns Q30 ON and Q25 OFF, thus, the CW side-tone signal is fed to pin 1 of IC1 (B), and can be heard from the speaker according to your keying.

IC8 is an AF power amplifier which provides high output power (2W or more at 8 $\Omega$  load) and low distortion, with various protector circuits built in.

#### 6. AGC Detection Control Circuit

The IF signals put out from Q10 in the IF unit are also fed to AGC Circuit. This IF signal is rectified by D42, then amplified by Q11, DC amplifier. To make a wider AGC range, Q11 gets power from +9V and -10V sources. The amplified voltage from Q11 is integrated by C88 and R87 and determines the attacking time of the AGC. Also, the releasing time is determined by the time constant of C88 and R83.

When the AGC switch is in the FAST (in) position, +9V is supplied from "AGCF" terminal and the attacking time is determined by C79 and R85, and the releasing time is determined by C79 and R88 for a weak signal and by C79 and R83 for a strong signal.

The AGC voltage is fed to 9MHz IF amplifiers in the IF unit and 39MHz first IF amplifier securing stable reception.

#### 7. BFO Circuit

The BFO signal is oscillated by Q20 with X2 or X3 in the IF unit, and fed to the receiving demodulator IC4 and to the transmitting modulator IC3, through buffer amplifier Q21.

During USB operation, 9V is supplied to D52 through



R127, turns D52 ON and X3 is connected to the base of Q20, and Q20 oscillates at 9.013MHz. This frequency can be adjusted by C97. At the same time, Q19 is turned ON and shunts 9V applied D53 and turns it OFF to isolate X2 from Q20. During LSB operation, a 9V is supplied to D54 through D55 and R117, and turns D54 ON. Thus L30 is grounded through D54 and C93. At the same time, 9V is supplied to D53 through R125 and R130, and turns D53 ON, and to Q23 through R116 and turns Q23 ON. Thus, X2 is connected to the base of Q20 and L25 is isolated from the ground, and Q20 oscillates at 9.010MHz. This frequency can be adjusted by L30.

During AM operation a 9V is supplied to D54 through D56 and the BFO works the same as the LSB operation. However, in the receive mode, a 9V is supplied to the emitter of Q20 through R154 and D60 and the BFO stops oscillating. In the transmit mode, T 9V is fed to the base of Q18 through R153, and turns Q18 ON.

Thus the 9V supplied to the emitter of Q20 is shunted to ground through Q18, and the BFO works normally.

During CW, CWN and RTTY transmission, T 9V is supplied to D51 through R123 and turns D51 ON and grounds L25 through D51 and C92. Thus the BFO oscillates at 9.0106 MHz, and this frequency can be adjusted by L25.

In the receive mode, T9V goes zero and D51 is turned OFF, however, in the CW or CWN mode, a 9V is supplied to D48 through D49 or D50 and R121. Thus D48 is turned ON and L24 is inserted between L25 and the ground in series, and the BFO oscillates at 9.0098MHz. This frequency can be adjusted by L24.

In the RTTY receive mode, D64 is turned ON and L31 is added in series, and the BFO oscillates at 9.008475MHz. This frequency can be adjusted by L31.

### 3 - 3 TRANSMITTING CIRCUITS

#### 1. AF Circuits

Audio signal from the microphone is fed to AF attenuator IC1 (A) of the Main unit. A DC voltage set by the MIC gain control on the front panel is applied to pin 6 of this IC, the signal fed to pin 8 is controlled by the MIC gain control and put out from pin 10.

During CW operation, pin 6 is grounded by Q1 which is turned ON in the CW or CWN mode, and the signal is not fed to the modulator.

The signal from IC1 (A) is fed to the double balanced modulator IC of the IF unit as the "MODO" signal to make modulation. In the CW operation, a keying signal is fed to the base of Q14 as the "KEY" signal. When key is down, Q14 is turned ON because it is "L" level and Q14 turns Q3 ON and Q4 OFF. The collector of Q4 is connected to the keying circuit in the RF unit, and keys 9MHz IF signals.

#### 2. IF Circuits

Audio signal from the MAIN unit is fed to pin 5 of the double balanced modulator IC3 in the IF unit. To the pin 7, the BFO signal is fed and mixed with the audio signal, and a modulated DSB (carrier suppressed double side band) signal is put out from the pin 3. D47 is a BFO signal switching diode and feeds the BFO signal to IC3 in the transmit mode. The carrier null point can be adjusted by R106 and R101 trimmers.

During CW, CWN, AM RTTY operation, the voltage set by R98 is supplied to the modulator input terminal, pin 5, through D46. This makes IC3 in unbalanced condition, and the BFO signal is leaked to the output to use as a carrier. During SSB operation, Q16 is turned ON to shunt the unbalancing offset voltage to ground and no BFO signal is output from IC3. The signal output from IC3 is fed to a respective crystal filter according to operating mode, through D44 and D33 which are turned ON during transmitting.

When the Compressor (speech processor) is turned ON, Q14 is turned ON, and turns D33 and D44 OFF, and D36 ON. As a result, the above signal is fed to the double balanced mixer IC1, for compressor (for PBT during receiving) through D36.

The compressor circuit and the PBT circuit are the same circuit and the circuit operates as a compressor during transmitting and as PBT circuit during receiving. The state of signal passing the compressor circuit during transmitting is the same as the state of PBT OFF shown in the figure on page 3 - 2.

The DSB signal having passed the compressor circuit becomes LSB or USB signal by FI2.

The compressor is a diode limiter which detects limiter current and controls the first gate voltage of Dual-Gate MOS FET Q8. The transmitting IF signal from IC2 is amplified by Q8, buffered by Q6 and then fed to a limiter consisting of D26 and D27. Limiter current is detected by D26 and D27 and applied to the first gate of Q8 as an ALC voltage for compressor.

The compression level can be set by R31 and the compressed transmitting IF signal is fed to a respective crystal filter the same as the compressor is turned OFF through D32 which is ON when compressor is in operation.

Crystal filter FI1 (filters for AM and CWN are options) is used for either transmitting or receiving.

The transmitting IF signal which has passed the crystal filter is supplied to buffer amplifier, Q9 in the RF unit through D39 which is ON during transmitting.

Then, it passes D38 which is turned ON during transmitting, D40 which is turned ON by +9V, the double tuned circuits consisting of L58 and L53, and the low-pass filter consisting of L52, C107, C108 and C109, and is fed to the double balanced mixer, IC2.

During CW operation, the "KEYD" signal ("H" level when key is DOWN) from the MAIN unit is fed to the base of Q8 through R55 and R56. When the key is UP, Q8 is turned ON, and a current flows through R58, D37 and R66, and turns D38, D40, D44 and D46 OFF.

Thus the transmitting IF signal which buffered by Q9 during transmission is stopped to feed to IC2 by D38 and its leaked signal is shunted to the ground through D37 and C132.

The transmitting IF signal fed to the double balanced mixer, IC2 is mixed with the second local oscillator signal (30.72 MHz) from PLL unit and converted into an IF signal of 39.7315 MHz.

This signal passed through D30 which is turned ON during transmitting, is amplified by Q2 and then fed to the monolithic filter, FI1 through D29 which is also turned ON during transmitting. The IF signal passed through FI1

is then fed to the double balanced mixer IC1, with the first local oscillator signal from the PLL unit to convert into the desired transmitting frequency signal. After passing the Band-Pass Filter the same as for receiving, this signal is then fed to the driver unit through D3 which is turned ON during transmitting.

### 3. RF Power Amplifier Circuits

The transmitting signal fed to the driver unit is amplified by Q1 and Q2 up to about 1 watt. Both Q1 and Q2 are class A amplifiers and give the highest linearity.

L8 gives the correct phase signals (180 degrees apart) for the push-pull amplifier Q4 and Q5. Q4 and Q5 are class AB amplifiers and amplify the signal up to about 6 watts.

The bases of Q4 and Q5 are biased by emitter voltage of Q3 which is controlled by means of the barrier voltage set by D1. The barrier voltage can be adjusted by R13 slightly, and R13 is set to get 100mA idling current. D1 also functions as temperature compensator for Q4 and Q5 and is attached to the case of Q4. Negative feedback by R, L and C applied across each collector and base of Q4 and Q5, provides stability and broadband characteristics.

L13, a broadband transformer provides balanced DC feed to the collectors of Q4 and Q5. L14 is another broadband transformer which is for matching the collector-to-collector impedance to 50 ohms.

The output signal from L14 is fed to the PA unit.

6 watts transmitting signal fed to the PA unit, is fed to each base of Q1 and Q2 through L1 broadband transformer which is for impedance matching. Q1 and Q2 are class AB push-pull amplifier to get 100 watts output.

The bases of Q1 and Q2 are biased for class AB operation by the emitter voltage of Q3 which is controlled by the barrier voltage of D1 which is set by R12 to make the idling current about 600mA.

D1 also functions as a temperature compensator to prevent runaway caused by heating, and is attached to the case of Q2.

R8 and R9 are resistors to make negative feedback from L4 which picks up a portion of the output, and provide stability and broadband characteristics.

The signal amplified by Q1 and Q2 is fed to the low-pass filter unit through L6 impedance matching transformer.

A thermal switch is mounted in the case of the unit and turned ON when the case temperature exceeds 70°C.

This turns turning speed of the cooling fan from low to high. This cooling fan rotates at low speed during transmitting in normal condition. At this time, 9V is supplied through D2 and R16. When the thermal switch is turned ON, 13.8V is supplied to the fan motor through R15 and the cooling fan rotates at high speed not only in the transmit mode, but also in the receive mode.

The transmitting signal which has passed the low-pass filter is fed to ANT connector on the rear panel through the SWR Detector Coil L2 in the SWR unit.

## 3 - 4 PLL (PHASE LOCKED LOOP) UNIT

This unit is composed of three phase-locked loops and their frequencies are controlled by two crystal oscillators. Since the transceiver circuits employ a double-conversion system, the PLL unit outputs the first and second local oscillator signals. The first local oscillator outputs a locked signal down to the digit of 100Hz.

For frequency resolution down to the digit of 10Hz, the second local oscillator frequency is shifted slightly by the D/A converted signal from the LOGIC unit.

### 1. SECOND LOCAL OSCILLATOR

The second local oscillator circuit composed of X2, Q12, D25, etc., is used for control of frequencies to the digit of 10Hz and for RIT control.

For RIT control, where a frequency shift of  $\pm 1$ KHz or more is required, the 10.24MHz oscillator frequency is multiplied three times (30.72MHz). D25 is a varactor diode for these frequency shifts. The oscillating frequency is controlled by a signal from the DA Converter for 10Hz resolution and a signal from the RIT control on the front panel.

### 2. OSCILLATION OF 5.12MHz AND GENERATION OF 30.72MHz SIGNAL

The reference frequency, 5.12MHz, is oscillated by IC7 with X1 connected across pins 20 and 21.

This frequency can be calibrated with a standard frequency signal, such as WWV by R72 trimmer on the MAIN unit which applies a voltage to varactor diode D11.

A portion of this 5.12MHz signal put out from pin 21 of IC7, is fed to pin 20 of IC6 and used as a reference frequency for another loop controlled by IC6. This 5.12MHz signal is also used as the local oscillator signal of the loop, which is put out from pin 21 through an internal buffer amplifier and doubled by D4 and D7 and fed to pin 4 of IC1 mixer/VCO through 10.24MHz band-pass filter consisting of L20 and L21.

### 3. LOCKED LOOP (1)

This is a mixing-down type PLL, consisting of IC1, IC6, Q8, etc.

IC1 is composed of an oscillator, a double-balanced mixer and an amplifier. The oscillator is used as a VCO with D1 varactor diode, and a portion of its output is fed internally to the double-balanced mixer. The 10.24MHz signal from L21 is supplied to pin 4, the mixer input terminal and mixed with the VCO signal, and its difference is put out from pin 6, then fed to pin 7 amplifier input terminal through low-pass filter consisting of L17 and C114 - C116. The amplified signal is put out from pin 9 and fed to pin 12 programmable divider input terminal of IC6. On the other hand, the VCO signal is put out from pin 3, and fed to IC2, 1/100 divider.

IC6 is a multi-function IC specially developed for PLL, composed of a programmable divider, a fixed divider, a phase comparator, a latch, etc., and applied the signals from the LOGIC unit to each input terminal of A, B, C, D, T1 - T4 and L, to determine internal operations.

The signal fed to pin 12 the programmable divider input terminal, is divided into desired ratio and then internally fed to the phase comparator. The 5.12MHz signal from IC7 fed to pin 20 is divided into 1/512 by the fixed divider

to get a reference signal of 10KHz, and is fed to the phase comparator.

Pulses corresponding to phase difference between the two signals, are put out from pin 16 and converted into a DC voltage by the loop filter. This voltage is applied to varactor diode D1 as a control voltage of VCO to set the frequency. The frequency range of PLL is 13.15 – 23.14MHz.

So, the frequency of 2.91 – 12.9MHz is fed to pin 12 of IC6.

The output (pin 3 of IC1) of the Locked Loop (1) is converted into ECL level by C9 and C37, and is divided into 1/100 by IC2.

Oscillation frequency is obtained from the formula of  $10.24 + 0.01 \times N1$ , where N1 varies from 291 to 1290, by 1 for every 100Hz change in the frequency displayed:

| Display<br>(lower 3 digits) | N1   | Oscillation<br>frequency f1 |
|-----------------------------|------|-----------------------------|
| 00.0 KHz                    | 291  | 13.15 MHz                   |
| 00.1                        | 292  | 13.16                       |
| 00.2                        | 293  | 13.17                       |
| 01.0                        | 301  | 13.25                       |
| 02.0                        | 311  | 13.35                       |
| 10.0                        | 391  | 14.15                       |
| 20.0                        | 491  | 15.15                       |
| 99.9                        | 1290 | 23.14                       |

Even if the reference frequency is 10KHz, it can be made to 100Hz steps by dividing it to 1/100. The output frequency is used as the reference frequency for the Locked Loop (3) with the range of 131.5KHz – 231.4KHz.

#### 4. LOCKED LOOP (2)

This is a pre-scaler type PLL, consisting of IC7 (programmable divider, phase comparator, latch and oscillator circuit), IC8 (low-pass filter), IC9 (pre-scaler) and Q17, Q18, (VCO, Buffer).

Q17 (VCO) is an electron-coupled oscillator circuit and its oscillation frequency is controlled by the PLL control voltage applied to D6 varactor diode. The oscillation frequency range of the VCO is expanded by adding L19 to L13 in parallel. When the operating frequency is 11MHz or higher, the VCS signal from the LOGIC unit becomes high-level and turns D21 ON, and L19 is connected to L13 in parallel. The VCO output (39.6 ~ 69.5MHz) is fed to IC9 (ECL pre-scaler) through a buffer amplifier, Q18, then, divided into 1/10 and supplied to the programmable divider of IC7.

IC9 is a super-high speed ECL pre-scaler, capable of dividing a frequency up to 150MHz, which has been specially developed for the PLL frequency synthesizer. IC7 is an IC for PLL, the same as IC6 for Locked Loop (1), which divides the 5.12MHz signal generated with X1 to 1/512 internally and uses it as the reference frequency for the phase comparator. The signal from this phase comparator is put out from D0 terminal of pin 16, Miller-integrated at IC8 (A) to convert the pulses corresponding to the respective phase differences into a DC voltage, and supplied to the varactor diode D6 of the VCO.

The relationship among operating frequency, dividing ratio and the VCO output frequency is as shown below:

| Operating<br>frequency | Dividing<br>ratio (N2) | VCO Output<br>frequency (f2) |
|------------------------|------------------------|------------------------------|
| 0.0 MHz                | 396                    | 39.6 MHz                     |
| 0.01                   | 397                    | 39.7                         |
| 0.2                    | 398                    | 39.8                         |
| 1.0                    | 406                    | 40.6                         |
| 1.1                    | 407                    | 40.7                         |
| 1.2                    | 408                    | 40.8                         |
| 10.0                   | 496                    | 49.6                         |
| 20.0                   | 596                    | 59.6                         |
| 29.9                   | 695                    | 69.5                         |

$$f2 = 0.01 \times 10 \times N2 = 0.1N2 \text{ (MHz)}$$

where, 0.01: Reference frequency obtained by dividing 5.12MHz to 1/512,

10: Dividing ratio of pre-scaler, and

N2: Dividing ratio of programmable divider.

The number input to the programmable divider from the LOGIC unit is subtracted 107 from the value of N2 above. That is a feature of IC7, where an offset number is input beforehand and the dividing ratio is determined by adding to this offset number thereafter.

The input data for this IC are dynamic-signals and latched into 3 digits.

The data is input to pins 6 – 9 by means of a BCD code, digit designating input to pins 2 – 5 and they are latched by the load input pulse of pin 10.

The above-mentioned offset number 107 is input every time after the CPU has been initialized.

#### 5. LOCKED LOOP (3)

This is a heterodyne type PLL using the output frequency of the Locked Loop (1) as the reference frequency and the frequency of the Locked Loop (2) as the local oscillator. The output of the digital phase comparator of IC3 is used as a DC control voltage of the VCO in the Locked Loop (3).

The output signal is converted into a DC voltage by the loop filter consisting of R120 – R122, C16 and the internal amplifier, etc., then fed to D5 varactor diode through another filter consisting of R15, R16 and C15.

As the frequencies of the Locked Loops (2) and (3) are closely related, the output voltage of IC8 which is the VCO control voltage for the Locked Loop (2), is fed to the Locked Loop (3), too, to make tracking. This VCO output is fed to a buffer amplifier, Q16, then Q5 and a common gate amplifier Q6 for improved isolation, and is fed to the double balanced mixer, IC5.

Here, it is mixed with the output of the Locked Loop (2) and only the subtracted frequency signal is picked out at low-pass filter consisting of L10, C51, C52, L27 and C113. This signal is limiter-amplified at Q7, level-converted at Q21 and fed to IC3.

The output frequency, f3, of the Locked Loop (3) is calculated as:

$$f3 = 0.1 \times N2 + \frac{10.24 + 0.01 \times N1}{100} \text{ [MHz]}$$

This output is amplified at Q4, common base amplifier, where isolation is improved, and output to J3 through two-stage high-pass filter and two-stage low-pass filter, consisting of C29 – C38 and L6 – L9.

The Po output (pin 4) of IC3 becomes "L" level when the lock is failed. Using this signal, Q19 is turned ON and the multi-vibrator, Q20 and Q21, with the time constant determined by C122, C105, R126 and R127 is triggered. Here, Q21 normally functions as a level converter, when Q19 is turned ON by lock failure, Q21 functions as a multi-vibrator and subjects the loop to be brought into the lock range by turning pin 7 of IC3 to "L" level.

## 6. POWER CIRCUIT

The PLL unit employs C-MOS's and TTL's and is required to have high output level. So 5V (three-terminal regulator of IC14) is provided for TTL's and 8.2V (three-terminal regulator of IC13) for C-MOS's and others. Immediately after the power has been turned ON, a base current to charge C108 flows due to the diode effects between emitter and base of Q14, Q14 is turned ON, and as a result, each of the three-terminal regulators output the rated voltage. Here, the output voltage of IC13 is divided by R87 and R88, and turns Q13 ON.

As a result, a voltage lower than the base voltage by junction voltage (0.6V) is applied to the emitter of Q13. Thus the collector voltage of Q14 is stabilized at this voltage plus Zener voltage of D13 (6.8V). At this time, the base current of Q14 flows through R90, Q13 and R89. The emitter voltage of Q13 varies according to the input voltage of each three-terminal regulator, thus being the collector voltage of Q14 is maintained at a constant voltage.

## 3-5 LOGIC UNIT

This unit controls frequency, operating band and mode, PLL and displays, etc., and is designed for low power consumption and high speed operation using a CMOS 4-bit CPU.

### 1. CPU

IC1 is the CPU, a plastic package with 42 pins. CL0 and

CL1 of pins 1 and 2 are the clock terminal for this CPU, oscillating about 400KHz with a ceramic oscillation unit. A portion of this output is used as a power source of minus voltage. The CPU has a total of 9 input and output ports, each sharing its own function:

#### A Port – 4 Bit Input

Decodes E port output as shown in the matrix table to expand input functions with time sharing.

#### B Port – 4 Bit Input

Input port for position information of the rotary relay to switch low-pass filter.

#### C Port – 4 Bit Output

Output port for band-pass filter switching.

#### D Port – 4 Bit Input Output

Used as an input/output terminal for external remote control.

#### E Port – 4 Bit Output

Outputs various data as a general purpose output terminal.

#### F Port – 4 Bit Output

F0 . . . Strobe signal output for display.

F1 . . . Load signal output for PLL above 100KHz digit.

F2 . . . Load signal output for PLL below 100KHz digit.

F3 . . . Rotary relay driving output.

#### G Port – 4 Bit Output

PLL digit designating output.

#### H Port – 4 Bit Output

PLL 10Hz D/A converting output.

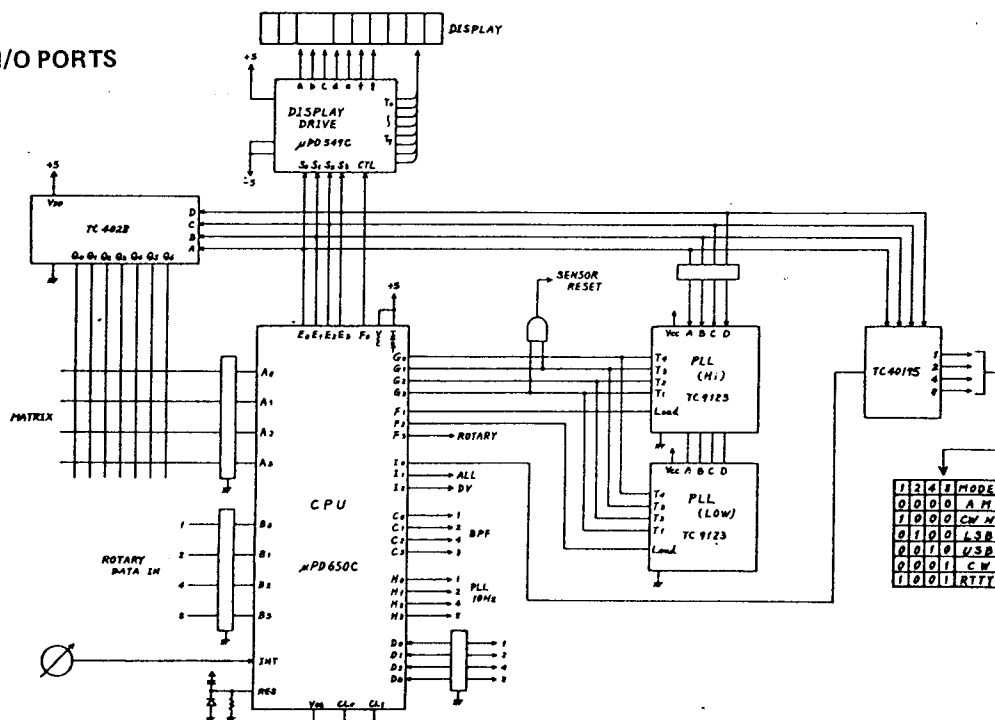
#### I Port – 3 Bit Output

I<sub>0</sub> . . . Load signal for mode output.

I<sub>1</sub> . . . Transmitting mute output during general coverage operation.

I<sub>2</sub> . . . DV output for remote control.

### CPU I/O PORTS



## 2. SENSOR SIGNAL PROCESSING CIRCUIT

The two signals from the rotary encoder are input to SENS1 and SENS2 terminals, waveform-shaped by the respective Schmitt triggers, each consisting of 2 inverters of IC20, differentiated at C21 and R50, and C22 and R49, and then input to pins 1 and 2 of IC21.

The encoder outputs 50 pulses per revolution, while pin 3 of IC21 outputs both leading edge and trailing edge, resulting in an output of 100 pulses per revolution.

IC17 is a counter of 3 Bits, capable of counting a maximum of 7 pulses, and serves as a timing buffer between the encoder and the display in relation to reading by the CPU.

If there is any output at the counter of IC17, the output of the diode array of IC25 becomes H-level, input to pin 5 of IC25 and then input to the INT terminal of IC1 with its level inverted to L-level.

This terminal is a priority terminal which gives priority to sensor processing by stopping other operations. In the priority routine, counter data of IC17 and up-down data from pin 13 of IC19 are read at the switching gate of IC18 with a timing of "digit 0" as shown in the matrix table, performing in this way all operations related to sensor processing.

Immediately after sensor data have been read, pulses are sent to the output terminals of G<sub>1</sub> and G<sub>3</sub>.

After passing the AND gates of pins 8, 9 and 10 of IC22, they are turned into pulses with narrower width, by means of C23 and R80, to clear IC17 and IC19, so that they may be ready for the next encoder input.

The flip-flops of pins 9, 10, 11 and 13 of IC19 holds up-signal only, and no down-signals are input.

IC3 is a decoder for matrix which decodes signals from E output and distributes them into signals of digit 0 – digit 9.

## INPUT MATRIX CIRCUIT

- 1) Q<sub>0</sub> → A<sub>0</sub> (Count 1)
- 2) Q<sub>0</sub> → A<sub>1</sub> (Count 2)
- 3) Q<sub>0</sub> → A<sub>2</sub> (Count 3)

Signals from encoder are input to the CPU through these counters. Data to be added to or subtracted from the preset frequency of CPU can be expressed in the range of 0 – 7:

| Data    | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---------|---|---|---|---|---|---|---|---|
| Count 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 |
| Count 2 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 1 |
| Count 3 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 |

- 4) Q<sub>0</sub> → A<sub>3</sub> (Up or Down)

Decides whether to make addition (UP) or subtraction (DOWN) of frequency depends on the direction of the encoder revolution: Up for H-level (with input) and DOWN for L-level (without input).

- 5) Q<sub>1</sub> → A<sub>0</sub> (A ⇒ B)

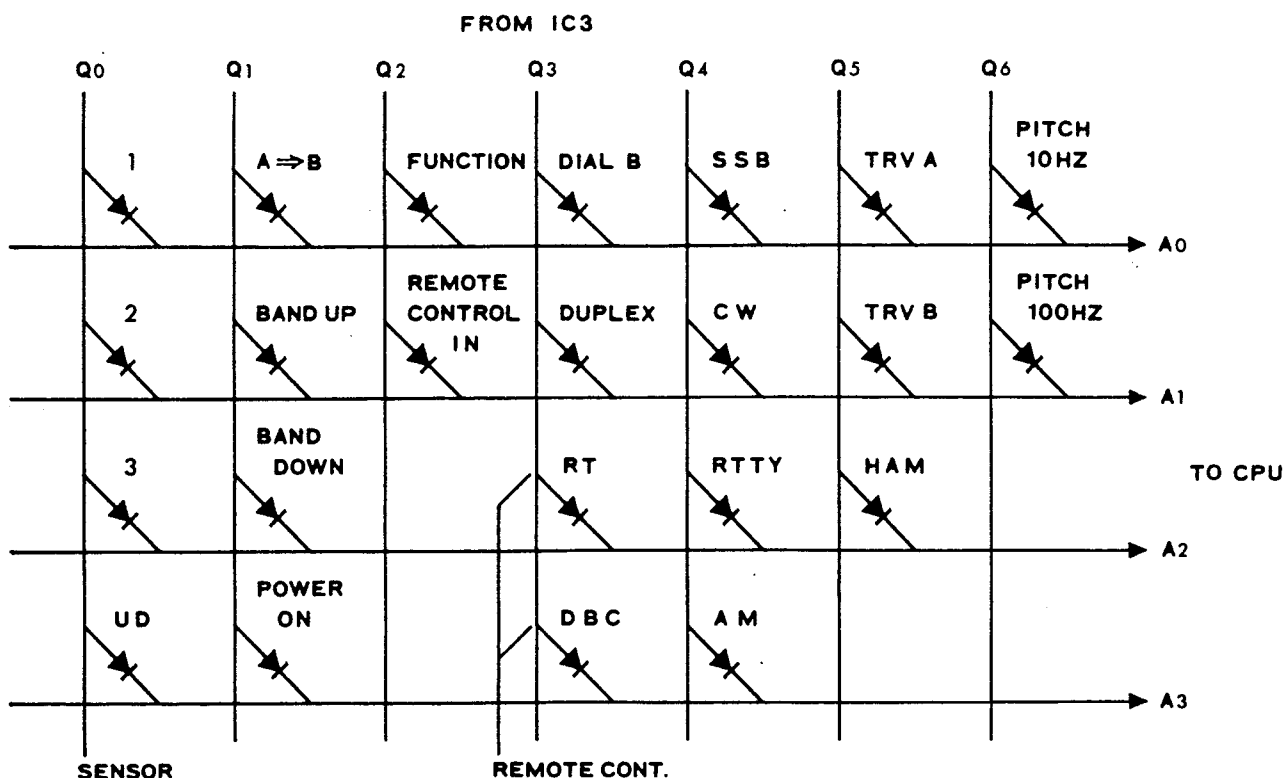
Depressing the A ⇒ B switch, the frequency of the VFO A is transferred to the VFO B. The contents of VFO A is retained. When FUNC switch has been ON (Q<sub>2</sub> → A<sub>0</sub>: H-level), operation is in the opposite direction (B ⇒ A).

- 6) Q<sub>1</sub> → A<sub>1</sub> (Band up)

- 7) Q<sub>1</sub> → A<sub>2</sub> (Band down)

Change-over of one amateur band to another where Ham band operation is designated; Up/Down of every 1MHz where General Coverage operation is designated. This operation takes place only when either 6) or 7) becomes H-level.

## INPUT MATRIX CIRCUIT



### 8) Q<sub>1</sub> → A<sub>3</sub> (Power on)

When the power is turned ON, this line becomes H-level to instruct normal operation. When the power is turned OFF, where backup power is available, it becomes L-level and original data will be remained the same.

### 9) Q<sub>2</sub> → A<sub>0</sub> (Function)

When this line is H-level due to operation of the FUNC switch, the CW, SSB and A → B switches give effect to their second function. When any other switch has been depressed, this function is cleared and this line becomes L-level.

### 10) Q<sub>2</sub> → A<sub>1</sub> (Remote-control input)

This line becomes H-level when an external remote-controller has been connected and makes VFO A, B and HAM/G. C switches inoperative.

### 11) Q<sub>3</sub> → A<sub>0</sub> (VFO A or B)

When this line is L-level, the VFO A is selected. When this line is H-level, the VFO B is selected.

### 12) Q<sub>3</sub> → A<sub>1</sub> (Duplex)

When this line is L-level, the simplex operation is selected.

When this line is H-level, the duplex operation is selected.

### 13) Q<sub>3</sub> → A<sub>2</sub> (RT)

### 14) Q<sub>3</sub> → A<sub>3</sub> (DBC)

These lines are used as the status of remote-controller.

### 15) Q<sub>4</sub> → A<sub>0</sub> (SSB mode)

Designates the SSB mode. USB is usually selected automatically on 10MHz or higher band, and LSB on 9MHz or lower band. However, when Q<sub>2</sub> → A<sub>0</sub> (FUNC) is H-level, USB and LSB are inverted at every input.

This function is cleared when the BAND UP or BAND DOWN signal is input.

### 16) Q<sub>4</sub> → A<sub>1</sub> (CW mode)

Designates the CW mode. It provides the CW-N mode when Q<sub>2</sub> → A<sub>0</sub> (FUNC) is H-level.

### 17) Q<sub>4</sub> → A<sub>2</sub> (RTTY mode)

Designates the RTTY mode.

### 18) Q<sub>4</sub> → A<sub>3</sub> (AM mode)

Designates the AM mode.

### 19) Q<sub>5</sub> → A<sub>0</sub> (TRV A)

### Q<sub>5</sub> → A<sub>1</sub> (TRV B)

When a transverter signal is input through the ACC socket, the set puts out a 20MHz ~ 30MHz RF signal to a transverter in the transmit mode, and receives a converted signal from the transverter in the receive mode. The operating band of transverter is designated as follows:

| TRVA | TRVB |                |
|------|------|----------------|
| 0    | 0    | Normal HF band |
| 1    | 0    | 50MHz          |
| 0    | 1    | 144MHz         |
| 1    | 0    | 430MHz         |

It provides the General Coverage Mode independently of the HAM/G. C. switch on the front panel when TRVA or TRVB signal is input.

In the transverter mode, the display will shown as follows:

|        | Frequency | Display |
|--------|-----------|---------|
| 50MHz  | → 50.100  | → 0.100 |
| 144MHz | → 144.150 | → 4.150 |
| 430MHz | → 430.000 | → 0.000 |

### 20) Q<sub>5</sub> → A<sub>2</sub> (Ham or General Cover)

When this line is L-level, the HAM BAND mode is selected.

When this line is H-level, the GENERAL COVERAGE mode is selected.

### 21) Q<sub>6</sub> → A<sub>0</sub> (10 Hz Step)

### 22) Q<sub>6</sub> → A<sub>1</sub> (100 Hz Step)

These lines select frequency resolution. 10 Hz step when "Q<sub>6</sub> → A<sub>0</sub>" is H-level, 100 Hz step when "Q<sub>6</sub> → A<sub>1</sub>" is H-level. When TS switch is pushed ON, the both lines becomes L-level and 1 KHz step is selected.

## 3. PLL Data Output Circuit

The output data are separated into higher digits than 100 KHz and the lower digits, and fed to each programmable divider of the loop. There are the three kinds of signal output to the PLL-numerical data, digit designation data and load enable signal.

Numerical data are output from the general purpose E port and are buffered by IC5.

IC5 also functions as a gate to feed these data to the PLL only at a moment the digit designation data are put out from the G port of IC1.

One of the digit designation data signals passes through IC6, OR gate, switches Q2, Q3 and the power voltage of IC5, and controls the gate function. Load signals put out from F<sub>2</sub> and F<sub>1</sub> terminals are fed to the PLL as R10 and R9 signals through IC5, buffer/gate. IC4 is the buffer for the digit designation data from G port, and feeds them to the PLL.

## 4. Display Circuit

IC8 is a seven segment display IC capable of showing 8 digits, with latch buffers, to provide dynamic lighting display with these data in sequence. C7 is a clocktiming capacitor, and IC8 outputs T<sub>0</sub> - T<sub>7</sub> signals in sequence by means of the clock oscillator in the IC8. Dynamic lighting display is made by outputting 7-segment data, S<sub>a</sub> - S<sub>g</sub>, synchronized to T<sub>0</sub> - T<sub>7</sub> signals.

To display a frequency and mode, data are input to S<sub>0</sub> - S<sub>3</sub> terminals, the load signal to CTL terminal and these are repeated eight times until inputting in full digits is completed.

The circuit composed of three AND gates of IC22 and Q5 - Q8 is used to display those letters which are not available in the characters prepared in expressing operating modes as follows:

| Mode | Display | Character | Segment to be deleted |
|------|---------|-----------|-----------------------|
| USB  |         | U         | a                     |
| LSB  |         | L         | c, g                  |
| CW   |         | C         | c, g                  |
| RTTY |         | R         | d                     |
| AM   |         | A         | d                     |



The three AND gates of IC22 are controlled by D15 – D18, R27, R28 and timing signal T<sub>7</sub>.

Q9 is controlled by transverter input signal to erase display of 10 MHz digit; Q10 is controlled by TS signal to erase display of 100 Hz digit. IC8, being a PMOS, requires V<sub>ss</sub> (+5V), and V<sub>GG</sub> (–5V). So, it is provided with an exclusive power circuit of –5V. Signal from the clock circuit of the CPU is amplified at Q13 and switches Q16 – Q18. C32 is charged with a negative voltage which is rectified by D29 and D28. When the negative voltage exceeds –5V, D30 Zener diode conducts, feed backs a negative voltage to the base of Q16, and stops its function until D30 is turned off. Thus the output voltage is regulated at –5V.

## 5. Rotary Relay Driving Circuit

L<sub>1</sub> – L<sub>8</sub> signals from the rotary relay of the FILL unit are fed to B<sub>0</sub> – B<sub>3</sub> input terminals of the CPU. They are compared with the band data programmed in the CPU, and pulses are sent out from F<sub>3</sub> terminal until they have the same data. These pulse signals are output to the rotary relay driving transistor through the buffer of IC4. The band data for each frequency are as follows:

| Frequency       | Signal (4 Bit) | B <sub>3</sub> | B <sub>2</sub> | B <sub>1</sub> | B <sub>0</sub> |
|-----------------|----------------|----------------|----------------|----------------|----------------|
| 0 ~ 2.0 MHz     | 1              | 0              | 0              | 0              | 1              |
| 2.0 ~ 4.0 MHz   | 2              | 0              | 0              | 1              | 0              |
| 4.0 ~ 8.0 MHz   | 3              | 0              | 0              | 1              | 1              |
| 8.0 ~ 11.5 MHz  | 8              | 1              | 0              | 0              | 0              |
| 11.0 ~ 15.0 MHz | 4              | 0              | 1              | 0              | 0              |
| 15.0 ~ 22.0 MHz | 5              | 0              | 1              | 0              | 1              |
| 22.0 ~ 30.0 MHz | 6              | 0              | 1              | 1              | 0              |

IC27 is dummy band data generator circuit to return from the rotary relay driving routine in the event of POWER OFF during memory backup operation.

## 6. Switching Signal for Band-Pass Filter

Band-pass filter switching signals corresponding to display output signals from the CPU are output to C<sub>0</sub> – C<sub>3</sub> terminals.

IC13 is the decoder for these 4 Bit signals. These signals are multiplexed into signals 0 – 9 and output to the RF unit through buffers IC14 and IC11, for use as band-pass filter switching signal.

The band-pass filter switching signal for each frequency is as follows:

| Frequency       | Signal (4 Bit) | C <sub>3</sub> | C <sub>2</sub> | C <sub>1</sub> | C <sub>0</sub> |
|-----------------|----------------|----------------|----------------|----------------|----------------|
| 0 ~ 1.6 MHz     | 0              | 0              | 0              | 0              | 0              |
| 1.6 ~ 2.0 MHz   | 1              | 0              | 0              | 0              | 1              |
| 2.0 ~ 3.0 MHz   | 2              | 0              | 0              | 1              | 0              |
| 3.0 ~ 5.0 MHz   | 3              | 0              | 0              | 1              | 1              |
| 5.0 ~ 8.0 MHz   | 4              | 0              | 1              | 0              | 0              |
| 8.0 ~ 11.0 MHz  | 5              | 0              | 1              | 0              | 1              |
| 11.0 ~ 15.0 MHz | 6              | 0              | 1              | 1              | 0              |
| 15.0 ~ 22.0 MHz | 7              | 0              | 1              | 1              | 1              |
| 22.0 ~ 28.0 MHz | 8              | 1              | 0              | 0              | 0              |
| 28.0 ~ 29.0 MHz | 9              | 1              | 0              | 0              | 1              |

Signals 8 and 9 are used as the 22.0 – 30 MHz range signal through an OR circuit consisting of D31 and D32.

## 7. Mode Select Signal Circuit

Mode signals are put out from the E Port and latched to IC15 by a load signal put out from I<sub>0</sub> terminal. IC12 is a decoder for this operation, where the signal is decoded into each mode signal and output through a buffer IC11.

Correspondence of mode signal to each mode is as follows:

| Mode | Signal (4 Bit) | E <sub>3</sub> | E <sub>2</sub> | E <sub>1</sub> | E <sub>0</sub> |
|------|----------------|----------------|----------------|----------------|----------------|
| USB  | 4              | 0              | 1              | 0              | 0              |
| LSB  | 2              | 0              | 0              | 1              | 0              |
| CW   | 8              | 1              | 0              | 0              | 0              |
| AM   | 0              | 0              | 0              | 0              | 0              |
| RTTY | 9              | 1              | 0              | 0              | 1              |
| CWN  | 1              | 0              | 0              | 0              | 1              |

## 8. Dial Lock

The DLOCK signal of J2 is passed through the chattering absorbing circuit consisting of R44 – R46, C18 and C19, and then fed to a flip-flop of IC19 through an inverter of IC20. The Q output of IC19 is fed to pin 10, clear terminal of the other flip-flop, through R80 to clear the flip-flop. This makes unable to feed the encoder signals to the counter. IC19, being a flip-flop, repeats ON-OFF with inversions caused at every input. The signal of the Q output is also fed to the DIAL LOCK indicator LED through a buffer of IC7 and lights it.

## 9. RIT ON-OFF Circuit

The RIT SW signal of J1 is fed to a flip-flop of IC16 through the chattering absorbing circuit consisting of R60, R62, R63, C24 and C26. Its Q output and the SEND signal are fed to an L-level NOR gate of IC23, its output switches Q14 and Q15, and performs RIT ON-OFF function.

The signal from Q1 of IC17 is fed to the CL terminal of the flip-flop through S1 and R64 and performs RIT OFF when the tuning control has been turned. R61 and Q12 function to stop this operation while the RIT switch has been depressed. The Q output is fed to the RIT indicator through a buffer of IC7 and lights the LED.

## 10. TS Circuit

The TS signal of J8 is fed to the other flip-flop of IC16 through the chattering absorbing circuit consisting of R66 – R68, C28 and C29, and further through an inverter of IC20.

The  $\bar{Q}$  output of the flip-flop makes Q6 line to L-level, and selects 1 KHz steps. At the same time, the Q output of the flip-flop is fed to the TS indicator through a buffer of IC7 and lights it.

## 11. D/A Converter

10 Hz digit data output from the H port of IC1 are converted into an Analog value (a DC voltage) by R17 – R20. This voltage is fed to D25, varactor diode in the second local oscillator of the PLL unit through an inverter of IC24, and controls its oscillation frequency.

## 12. Other Circuits

### 1) Transverter Control Input

TTL level signals applied to the TRVA and TRVB terminals are fed to two switching gates of IC2 which are synchronized to the Q5 signal, then their output are fed to A<sub>0</sub> and A<sub>1</sub> lines of the CPU input matrix. The relationship between the input and function is as follows:

| Object Frequency    | TRVA | TRVB | Input/Output Frequency | Display (MHz digit) |
|---------------------|------|------|------------------------|---------------------|
| 50 MHz              | H    | L    | 20 – 24 MHz            | 0 – 3               |
| 144 MHz             | L    | H    | 24 – 28 MHz            | 4 – 7               |
| 430 MHz             | H    | H    | 20 – 30 MHz            | 0 – 9               |
| without transverter | L    | L    | —                      | —                   |

### 2) Remote Control

The signal from RC of J3 is fed to an AND gate consisting of R3, D3 and D4, and the signal is fed to A<sub>1</sub> line when Q2 line is H-level. This provides the remote control function.

The input and output data for the control are fed on a data bus, where is D0 – D3 lines.

RT and DBC control signals are respectively input from the terminals of J4 and fed to the CPU through two switching gates of IC2, which are synchronized to the Q3 signal. The output control signal DV is output from I<sub>2</sub> Port to DV terminal of J4 through D43.

### 3) Power ON

The Power ON input is to recognized the ON-OFF status of power source for other circuits when the CPU is in the memory back-up state. During Power OFF, it functions to turn OFF all unnecessary ports and stops its operation.

### 4) Reset Circuit

Q21, R88 – R90 and C36 are the resetting circuit for the CPU which prevents to runaway the CPU at turning the power ON.

## 13. Power Circuit

This unit has two power supply circuits – one for the display circuit and the other for the logic circuit. The logic circuit power supply is composed of a 5-volt 3-terminal voltage regulator IC. Its input is supplied from not only the main power source, but also the memory back-up batteries, which operates when the main power is turned OFF. Q11 is a switching transistor to stop supplying 5V to other circuits during Power OFF.

IC9 is a DC-DC converter for display and for –10V. The heater voltage for the display tube is put out from the H Output, rectified at D56 and smoothed at C43.

The (–) voltage for display is put out at –14V terminal and supplied to the display PC Board. –10V is put out from J7 to other circuits.

## 3 – 6 OTHER CIRCUITS

### 1. SWR Detector and RF Detector

The traveling wave and reflected wave picked up by L2 of the SWR unit are rectified at D1 and D2 and supplied to the Main unit as SWRF and SWRB signals, respectively. For the RF meter, the SWRF voltage is fed to the meter through the SWR switch, S1, SWR set control R65, non-inverting DC amplifier IC5 (B) and meter switch, S2.

For the SWR meter, the SWRB signal is fed to the meter through the SWR switch S1 set at the SWR position, IC5 (B) and the meter switch S2 the same as for the RF meter. In this way, the ratio of traveling wave versus refelected wave (SWR) can be read on the meter.

### 2. Ic Meter Detector

Collector current of the PA transistors Q1 and Q2 of the PA unit passes through R13, and the resultant voltage across R13 is fed to the MAIN unit as Ic<sub>1</sub> and Ic<sub>2</sub>.

In the main unit, this voltage is amplified by IC6(A) inverting DC amplifier, then the amplified output is fed to the meter through the meter switch set at the Ic position. The output voltage of IC6 (A) is controlled at R70 to calibrate the meter indication value. R76 is a trimmer for the zero point setting of the Ic meter.

### 3. ALC Circuit

The SWRF and SWRB signals are also fed to a comparator IC5(A).

When SWR is 3 or more, the comparator IC5(A) puts out a voltage (ALC voltage) to decrease the driving power to the PA transistors. This protects the PA transistors from breakdown.

A portion of IC6(A) output is fed to the SWRB input terminal of IC5(A) through a level adjust trimmer R71, and the ALC voltage is also put out when the collector current exceeds specified value, and protects the PA transistors.

The SWRF voltage and the voltage set by the RF power control on the front panel are fed to a comparator IC7(A), which also puts out the ALC voltage. This provides to control the RF output power by turning the RF POWER control knob.

The ALC voltage is fed to the first gate of Q2 and the gate of Q9 of the RF unit to control their gain, gets the specified RF output power and protects the PA transistors.

### 4. VOX Control and CW Break-In Circuit

The modulation signal from MIC connector is fed to an AF amplifier IC4(A) of the main unit through R35 (VOX gain control).

The output signal of IC4(A) is rectified by Q7 and charges C16. This charged voltage turns Q8, Q9 and Q11 ON. The collector of Q11 is connected to the SEND line, thus the SEND line is grounded through Q11 and the set becomes in the transmit mode. Even when there are no more modulation signals, Q8, Q9 and Q11 hold ON condition until the charged voltage in C16 is discharged through R38 and R39. This VOX DELAY time constant can be adjusted by R38. A portion of the output (speaker output) of the AF power amplifier, IC8, is fed to an AF amplifier



IC4(B) through R50. The output signal of IC4(B) is rectified by Q12 and turns Q13 ON, thus the modulation signal to IC4(A) is shunted through Q13, and the VOX operation does not function with a voice from the speaker. This threshold level can be adjusted by R50, ANTI-VOX GAIN control. After Q12 is turned OFF, it delays Q13 OFF by means of time constant of C20 and R54.

When the set is in the CW mode and the VOX is in operation, by keying DOWN, Q14, Q15 and Q16 are turned ON, and a 9V is applied to the base of Q11 and turns Q11 ON the same as the VOX operation to bring SEND line to the ground level.

After keying UP, Q16 holds ON condition until the charged voltage in C21 is discharged through R60 and R61. This is the CW semi-break-in operation, where time constant for CW delay is set by R61.

## 5. Power Circuit

In the main unit, a voltage is supplied to the Zener diode, D15, through R114 and D11 to produce a reference voltage of 9.2V. This reference voltage is supplied to the base of Q22.

The power source for Q22 is connected to the collector through the protection resistor, R115, and Q22 continuously outputs a regulated voltage of 9V from the emitter. In the receive mode, a voltage is supplied to the Zener diode, D15, through R110 and D13, and a reference voltage of 9.2V is supplied to the base of Q20. The power source for Q20 is connected to the collector through the protection resistor, R111, and Q20 outputs a regulated voltage of 9V from the emitter.

However, Q10 is turned ON in the transmit mode, and Q21 is also turned ON. Thus the base of Q20 is grounded through Q21, and the regulated voltage (R9V) is supplied in the receive mode only. In the transmit mode, a voltage is supplied to the Zener diode, D15, through R109 and D12, and a reference voltage of 9.2V is supplied to the base of Q19.

The power source for Q19 is connected to the collector through the protection resistor, R108, and Q19 outputs a regulated voltage of 9V from the emitter. However, the R9V is supplied to the base of Q18 through R107 and R106 in the receive mode, and Q18 is turned ON and shunts the base of Q19 to the ground. Thus the regulated voltage (T9V) is not supplied to the transmit circuits in the receive mode.

The mute voltage which is put out from the LOGIC unit when the PLL is unlocked, turns Q18 ON and stops to put out the T9V.

C40 and C43, are connected to each base of the transmitting/receiving control transistors, Q18 and Q21, and they make proper time delay during transmit/receive changing over.

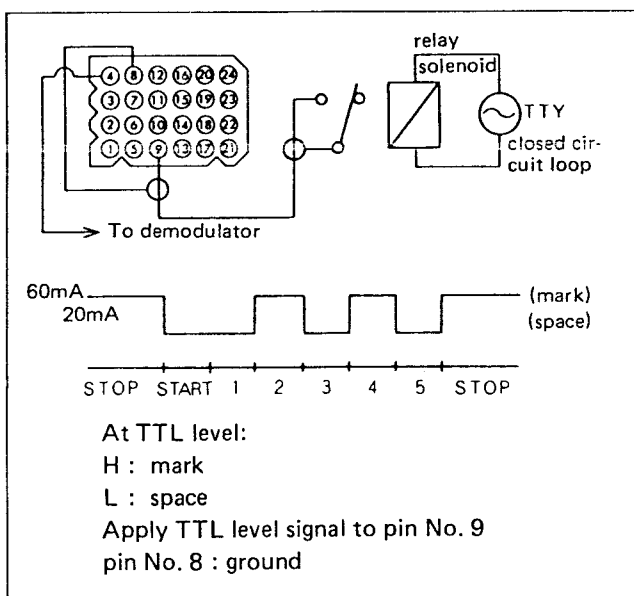
When the SEND line is brought to ground level (transmitting), RL1 is turned ON and the "LINES" line becomes ground level. This line is fed to J13 of the PA unit. By changing connection of P11 to J13, this line is fed to J5 XVERTER terminal on the rear panel and can be used to control TRANSMIT/RECEIVE an external linear amplifier.

## 6. RTTY Transmitting

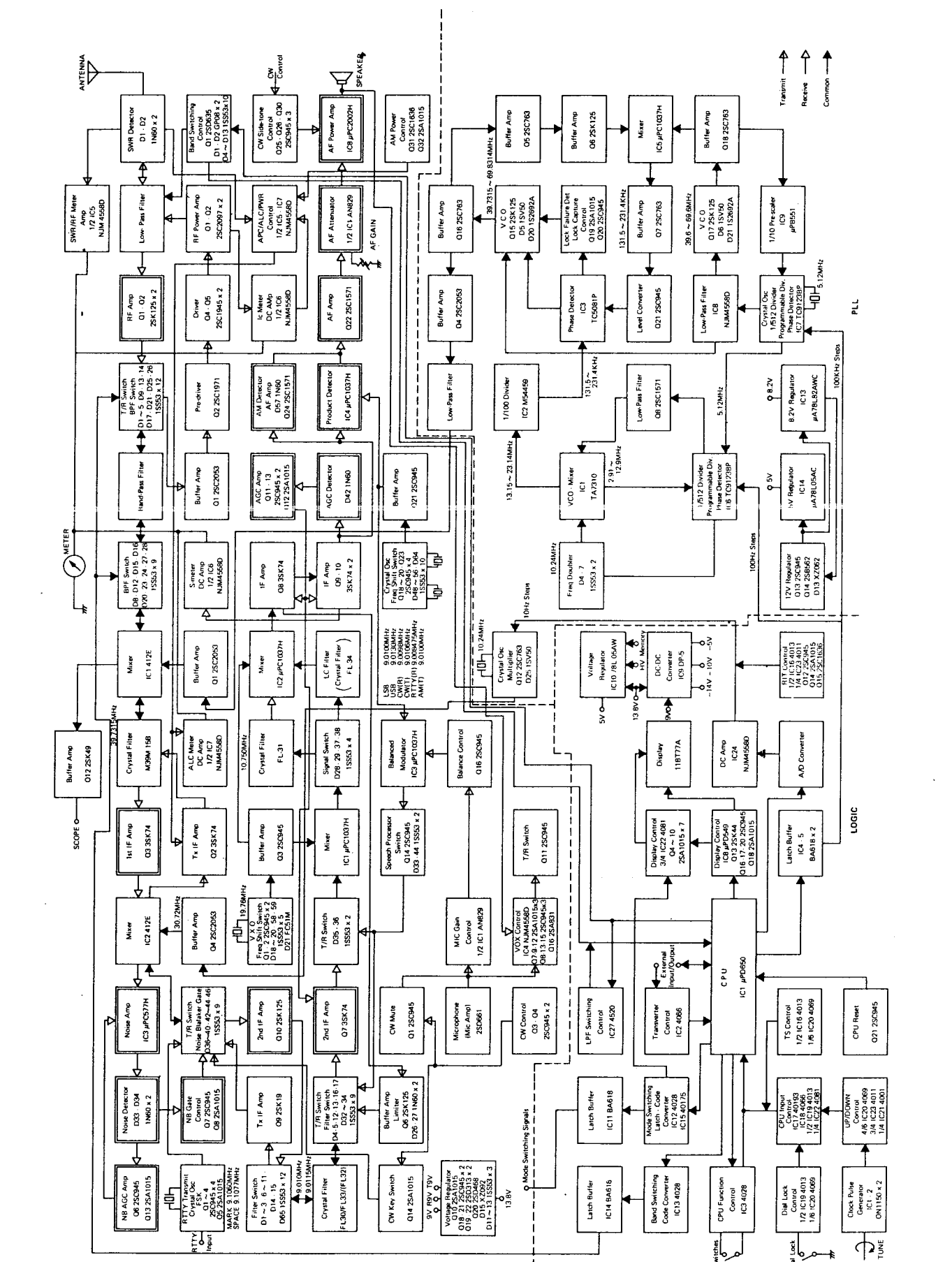
During transmission in the RTTY mode, a 9V is supplied to the base of Q11 through R82 of the RF unit, Q11 is turned OFF and power supply to Q9, D39 and D38 is stopped. At the same time, a 9MHz RTTY transmitting signal from the RTTY unit is supplied through D46, which is ON during RTTY transmission, and supplied to IC2, mixer through the band-pass filter consisting of L58 and L53. RTTY Mark and Space Frequency for transmitting are generated by the RTTY unit.

In the RTTY unit, H-level or L-level signal for Mark or Space are fed to J1 through the accessory socket on the rear panel.

When the signal is H-level (Mark), Q1 is turned ON and grounds C3. Thus C3 is in parallel to C2, and lowers oscillating frequency which is generated by Q2 and X1. This output (9.0106 MHz : at Mark; 9.01077 MHz : at Space) is buffer-amplified at Q3, picked out at L1 and supplied to the RF unit as the RTO signal. As 9V is supplied through D1 during RTTY operation, Q4 turns ON and supplied 9V to Q1 - Q3 during transmission.

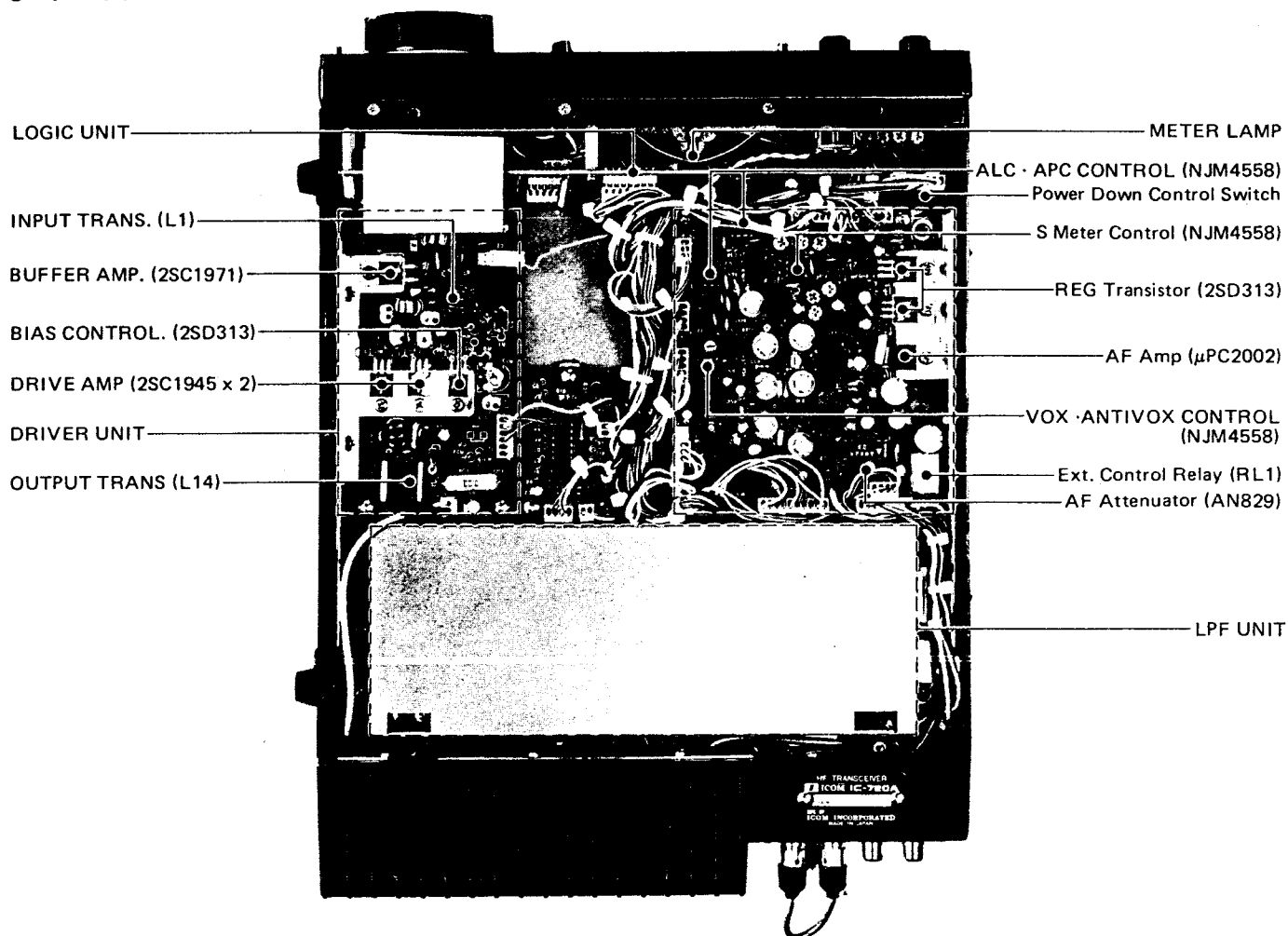


## SECTION 4 BLOCK DIAGRAM

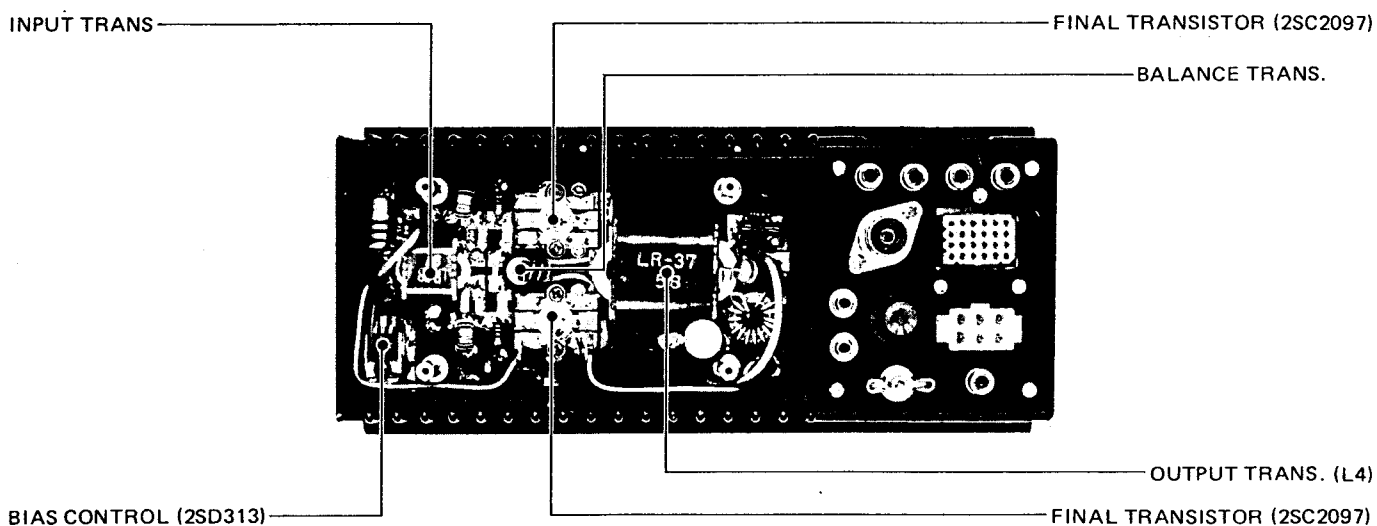


## SECTION 5 INSIDE VIEWS

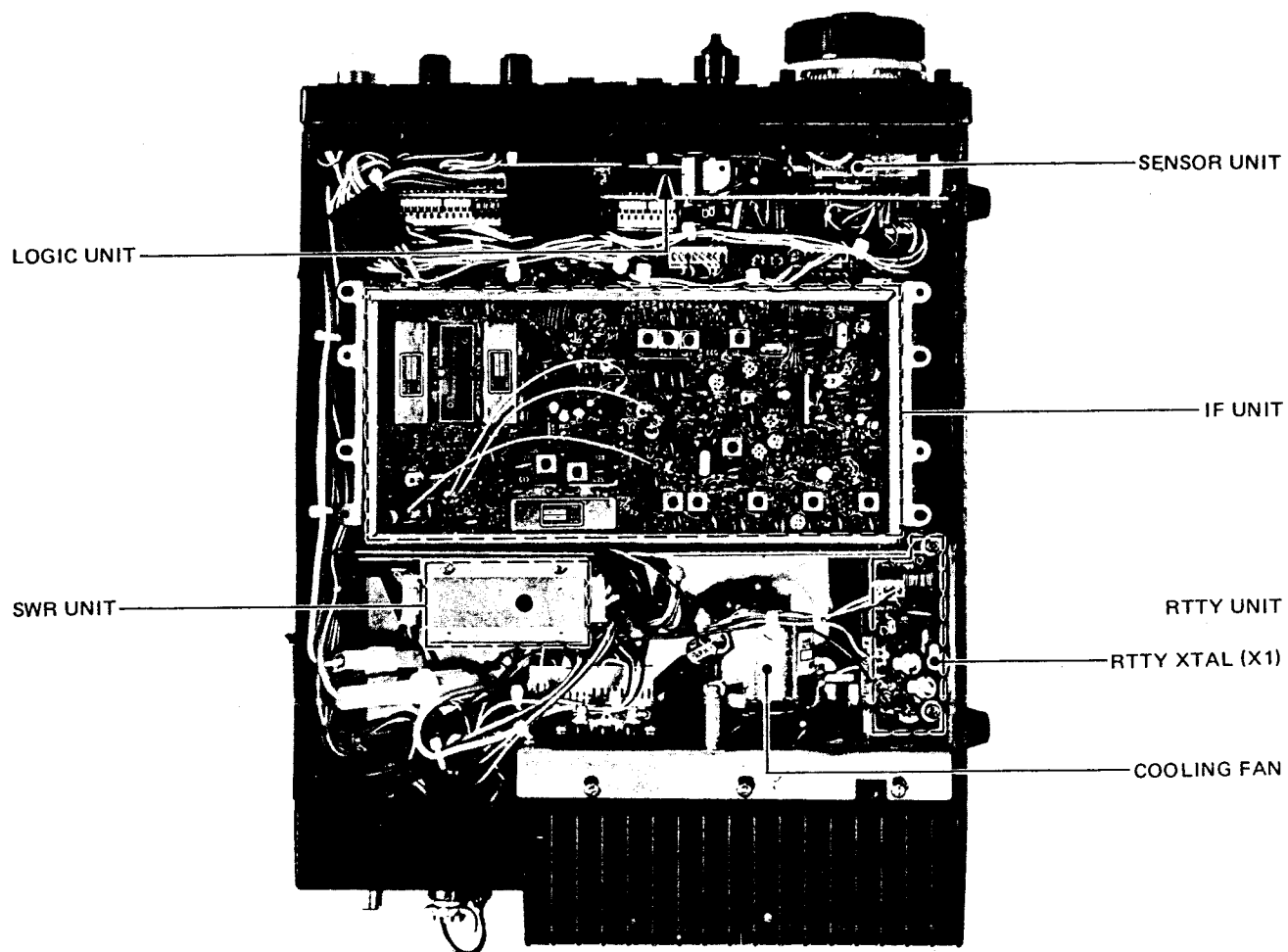
### 5-1 TOP VIEW



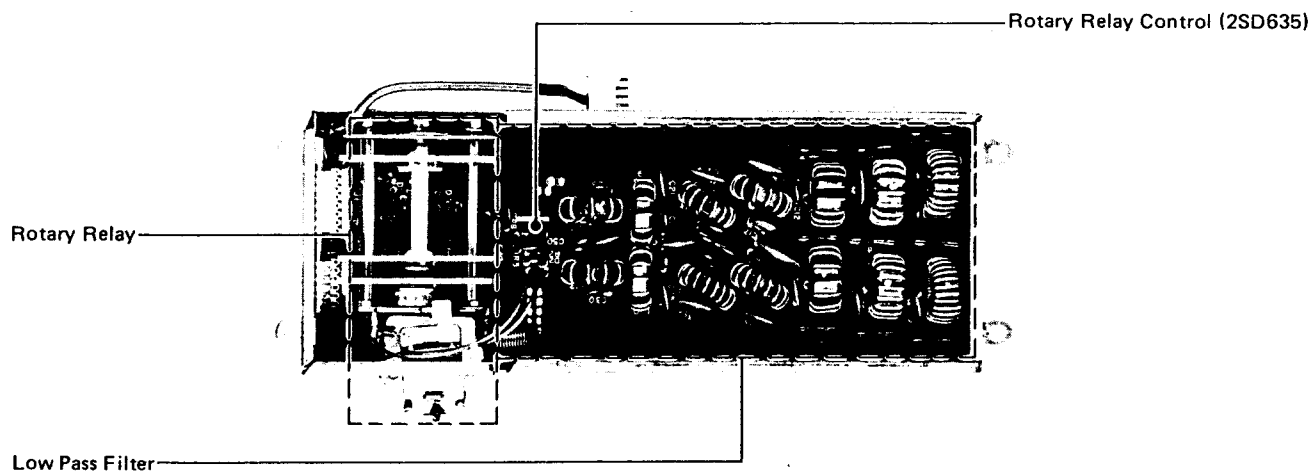
### 5-2 PA UNIT



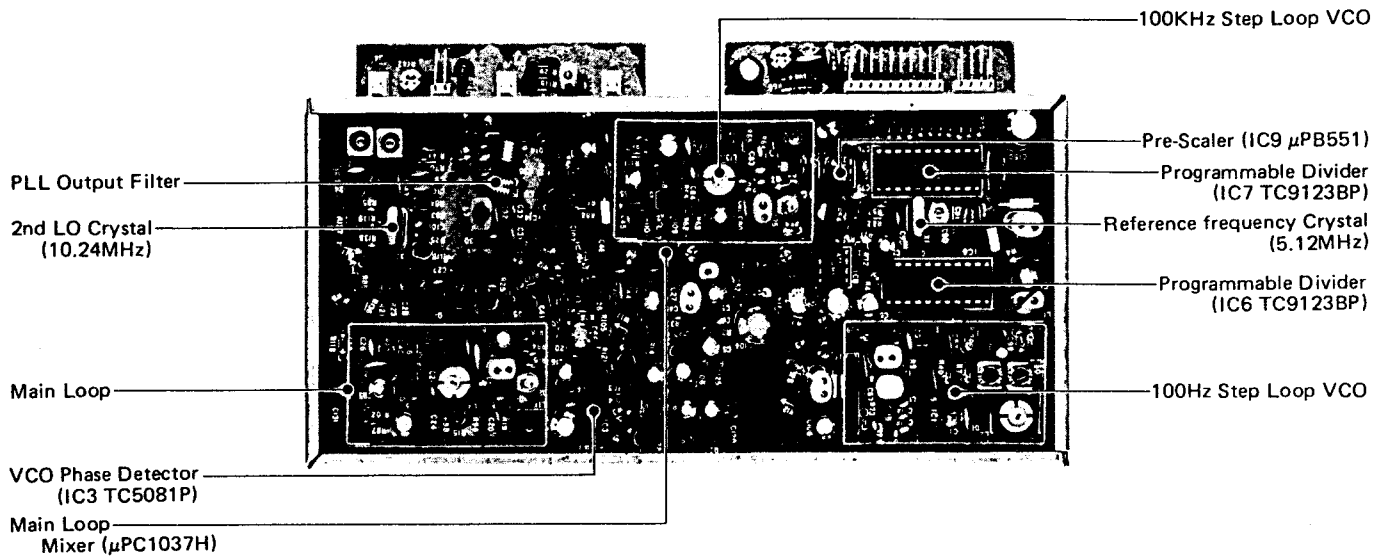
### 5-3 BOTTOM VIEW



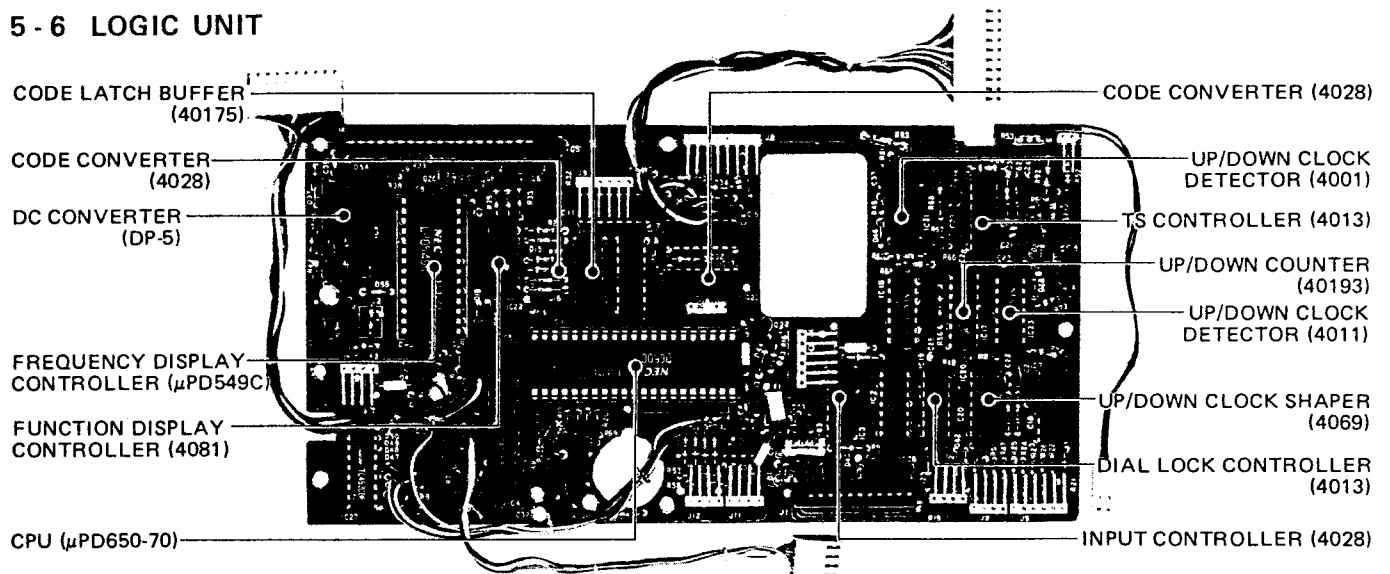
### 5-4 LPF UNIT



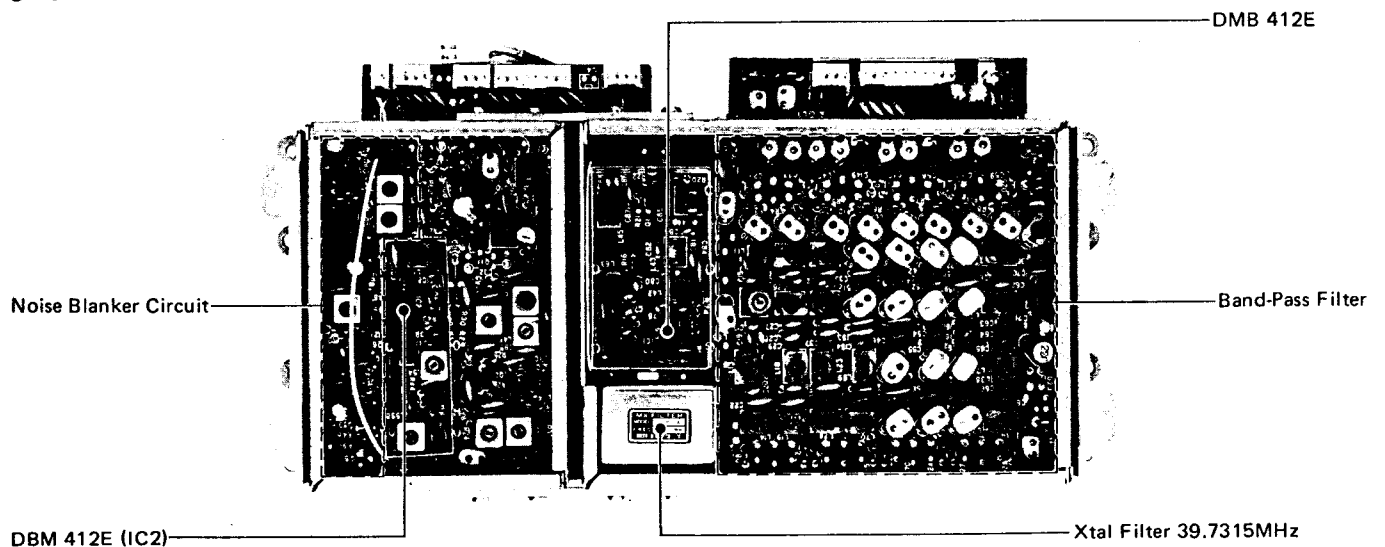
## 5-5 PLL UNIT



## 5-6 LOGIC UNIT



## 5-7 RF UNIT



## SECTION 6 OPTIONS INSTALLATION

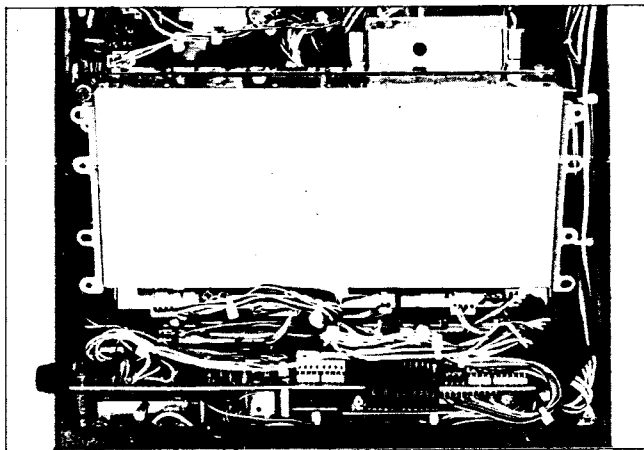
### 6-1 INSTALLATION OF CW NARROW FILTER

The following tools are needed for the installation of the options:

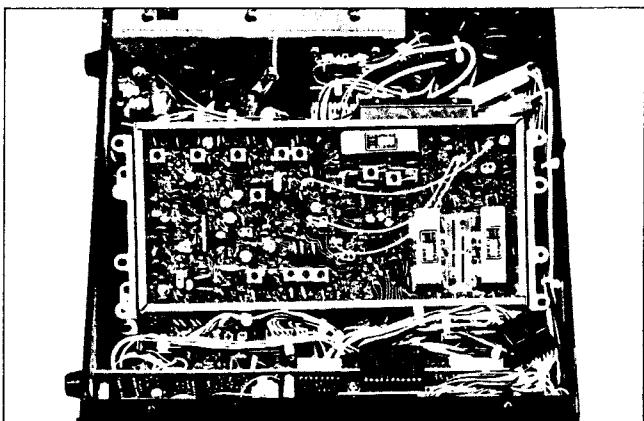
|                      |                      |
|----------------------|----------------------|
| Phillips Screwdriver | Diagonal cutters     |
| Screwdriver          | Soldering Iron (40W) |
| Solder               | Soldering tool       |
| De-soldering braid   |                      |

Before performing any work on the set, make sure that the power cord is detached from the transceiver.

1. Remove the bottom cover.
2. Remove the four screws at each end of the IF Unit (see photo). Tilt the unit back toward you, being careful not to damage the sockets and plugs that are installed on the IF Unit.



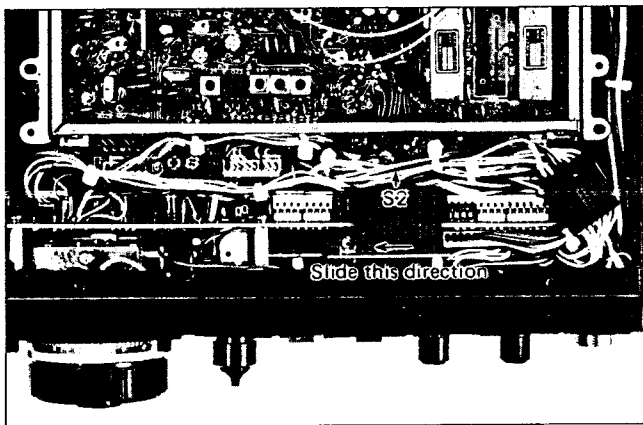
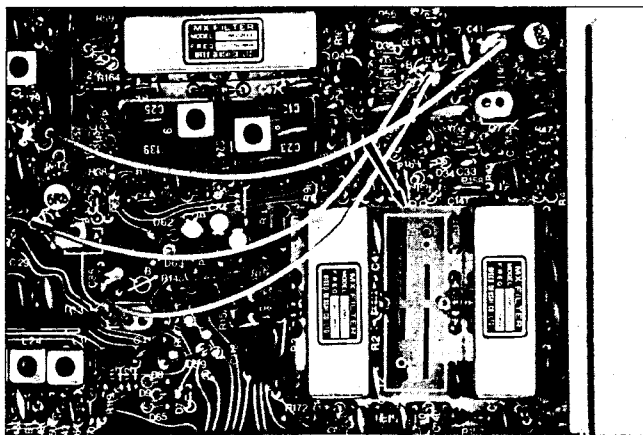
3. Using the screwdriver pry the cover of the IF Unit off, exercise care to prevent bending the shield cover.



4. The location for the filter is shown in the photo. The holes for mounting the legs and the leads of the filter are predrilled. Be sure to orient the filter so that the label on the top of the unit is facing the same direction as the other two filters already mounted in the set. Insert the filter flush with the board, bend the leads and legs flush with the opposite side of the board and solder them in. Trim the leads even with the solder points. This completes the installation. Replace the IF Unit, and the

screws. Move Switch S2 in the direction shown. Replace the bottom cover.

Location of CW Narrow Filter

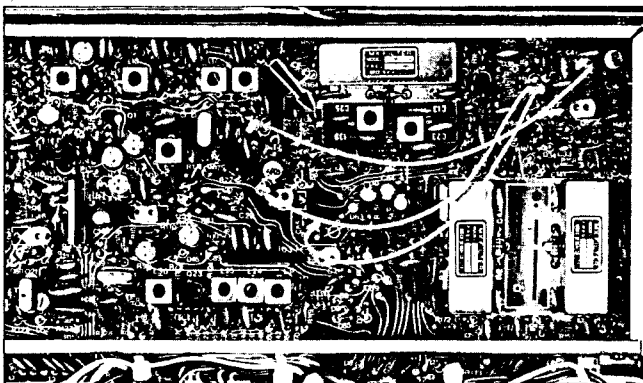


### 6-2 INSTALLATION OF AM FILTER

Follow steps 1 through 3 of the CW Narrow Filter instructions. Remove the LC Filter sub board, taking care not to damage the printed patterns of the board. The holes must be clear of solder when this sub board is removed.

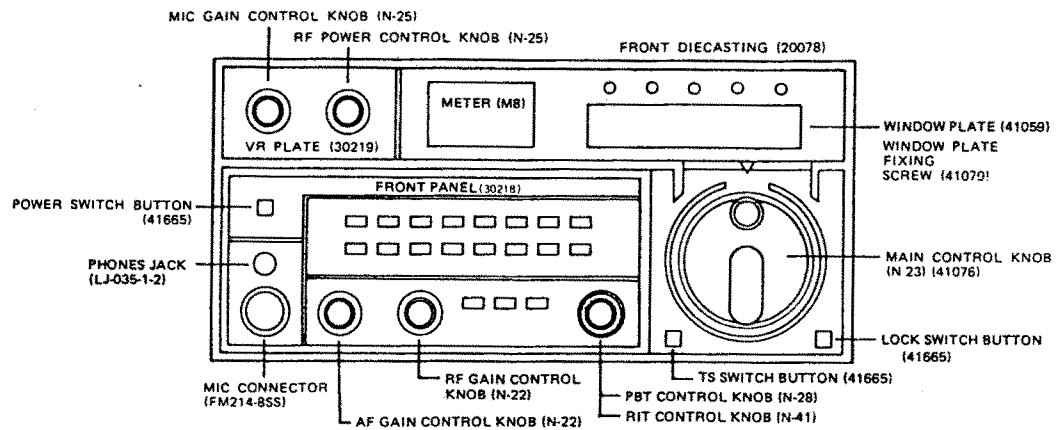
Plug the AM Filter into the board, making sure that it is oriented with the label on the top of the filter matching the label on the adjoining filter. Bend the legs and leads flush with the board, solder them in, and trim the leads flush with the solder points. This completes the installation. Replace the IF Unit, the screws, and the bottom cover.

Location of LC Filter

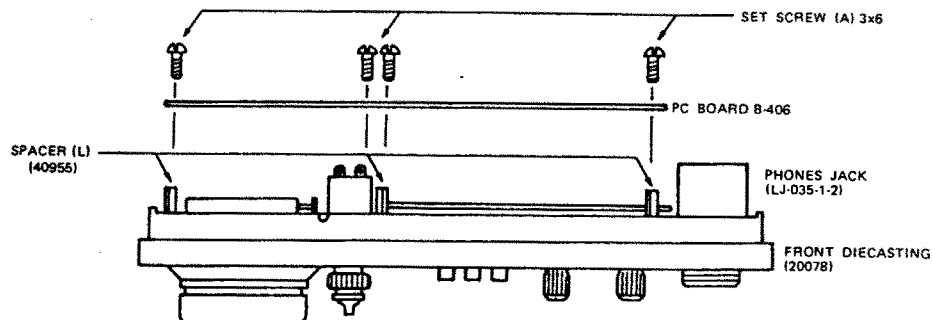
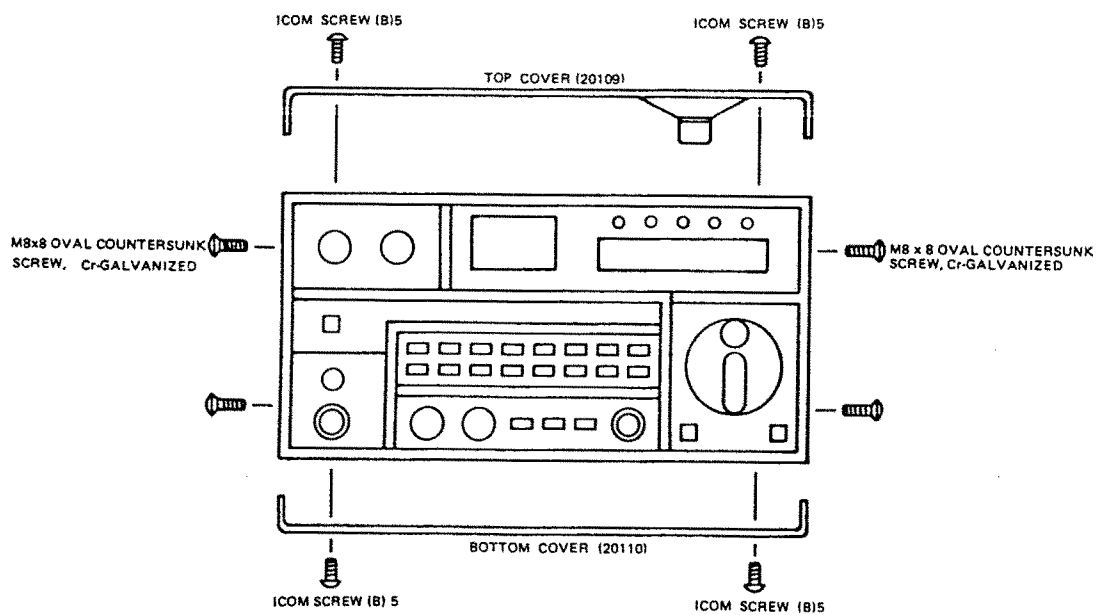


## SECTION 7 MECHANICAL PARTS AND DISASSEMBLY

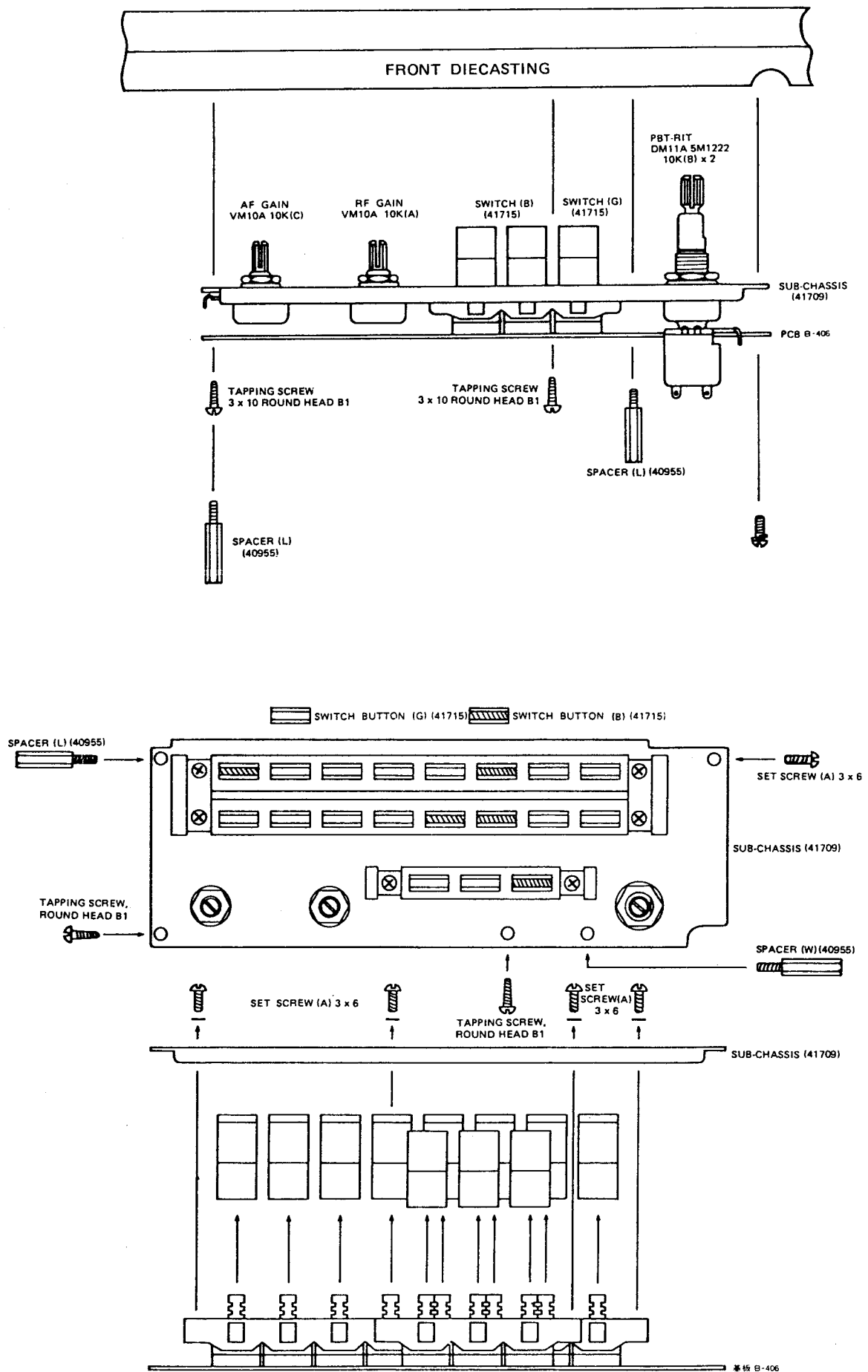
### 7-1 PARTS ON FRONT PANEL



### 7-2 FRONT PANEL DISASSEMBLY

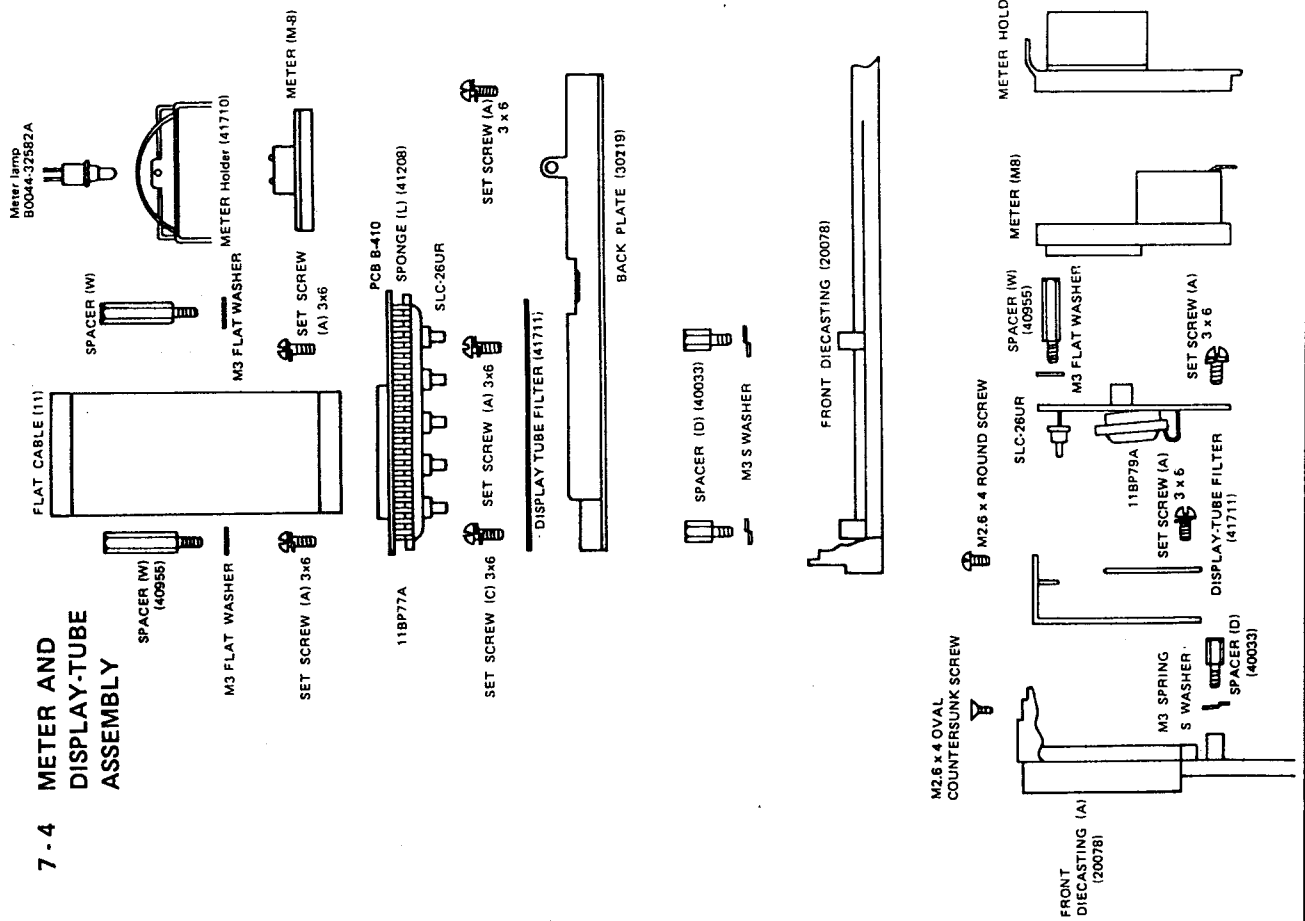


### 7-3 FRONT PANEL SWITCHES DISASSEMBLY

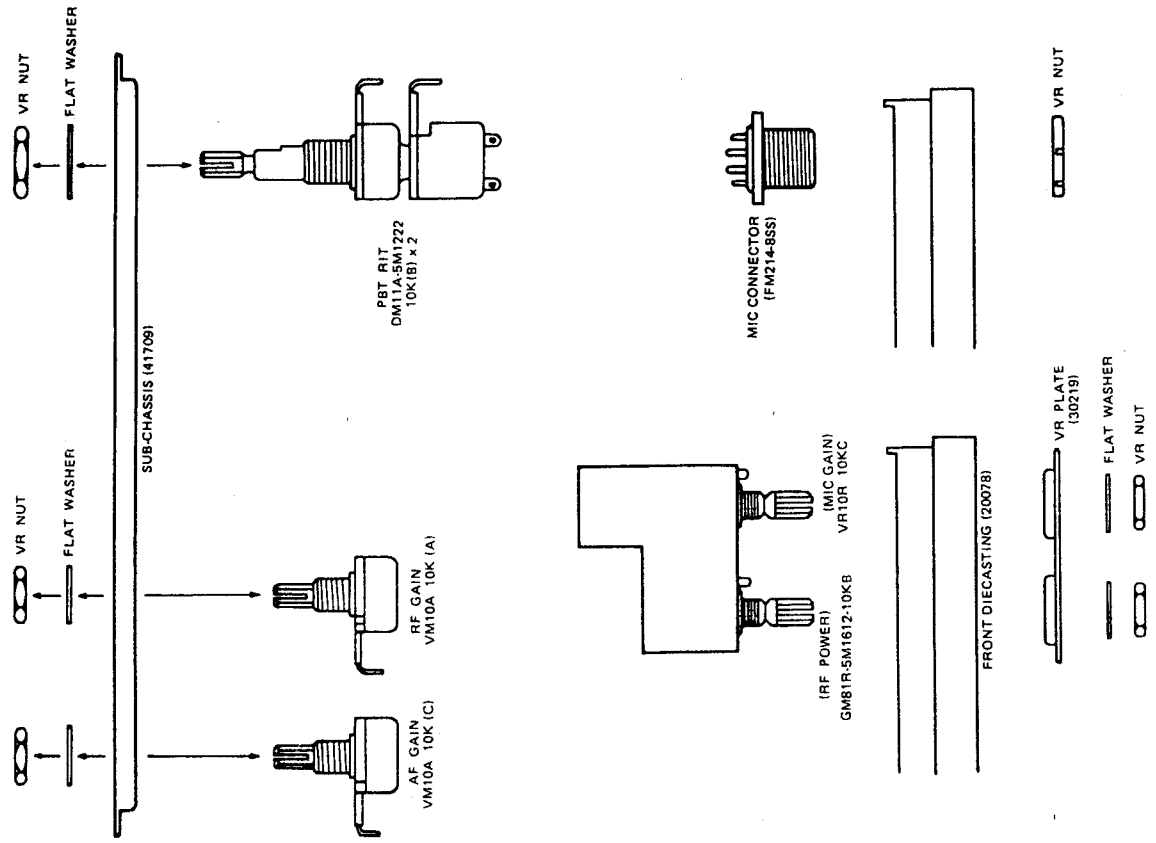




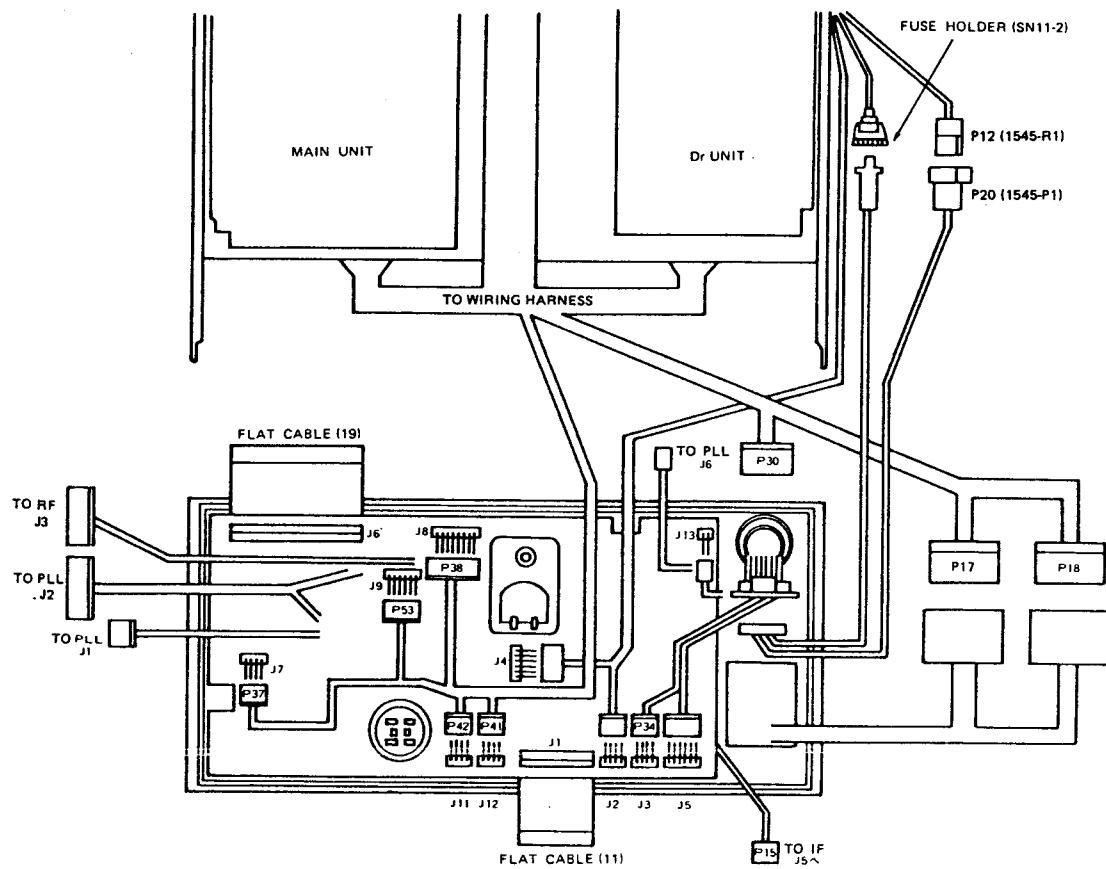
## 7-4 METER AND DISPLAY-TUBE ASSEMBLY



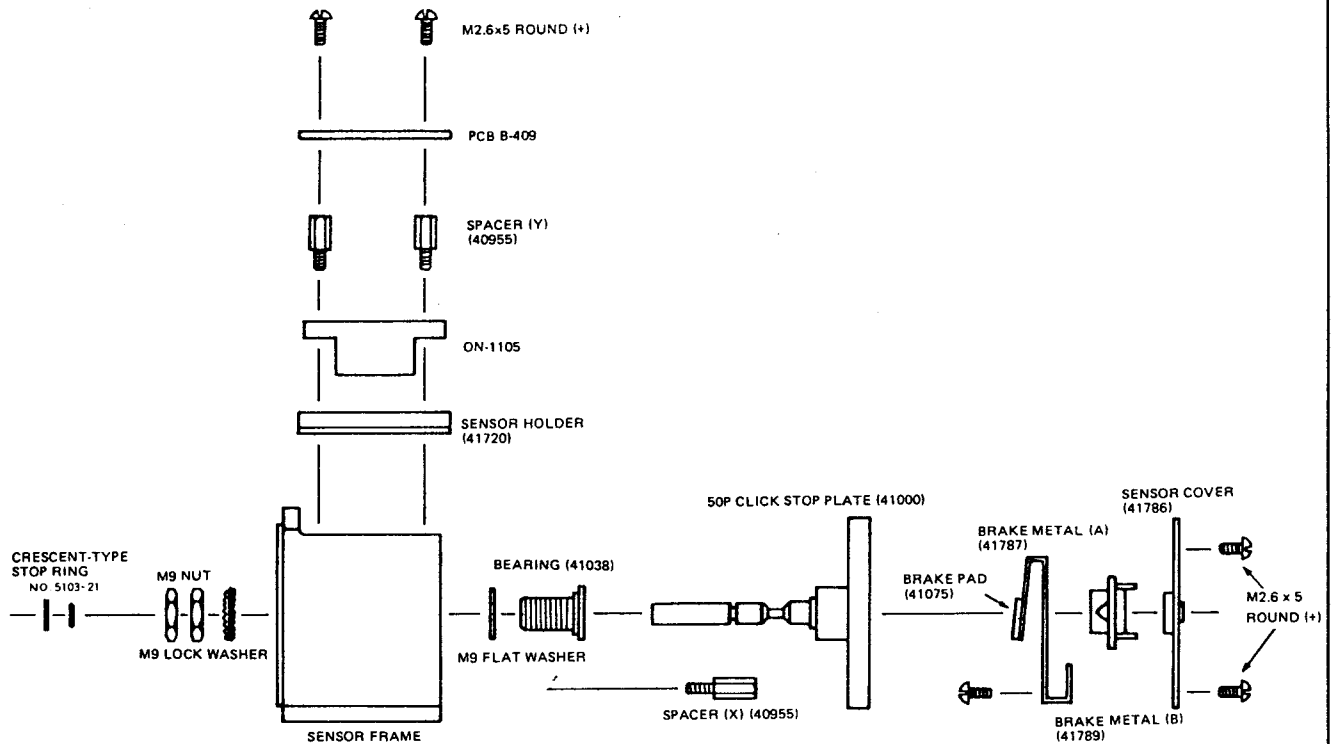
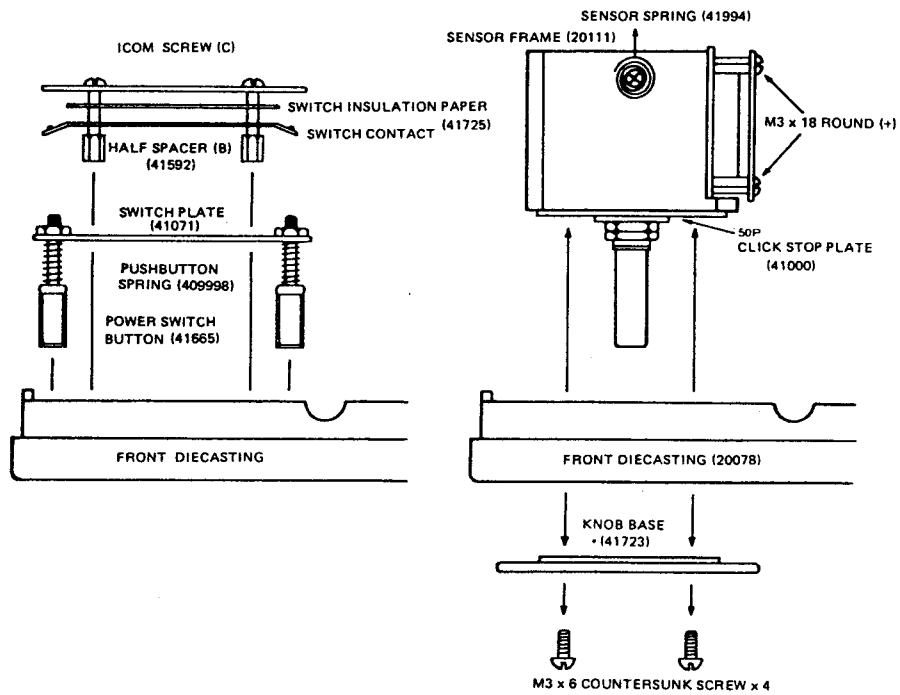
## 7-5 CONTROLS AND CONNECTOR ASSEMBLY



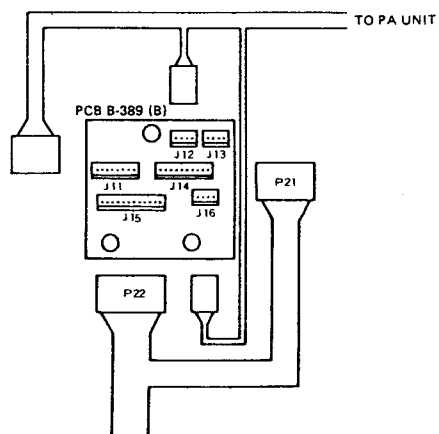
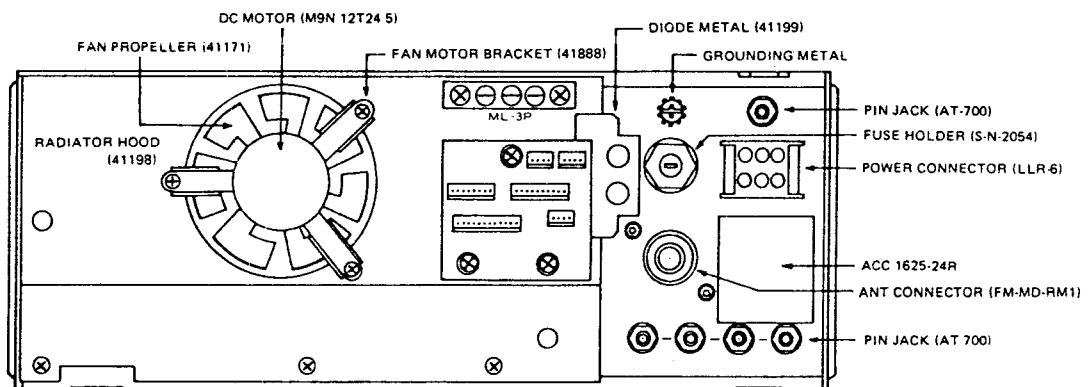
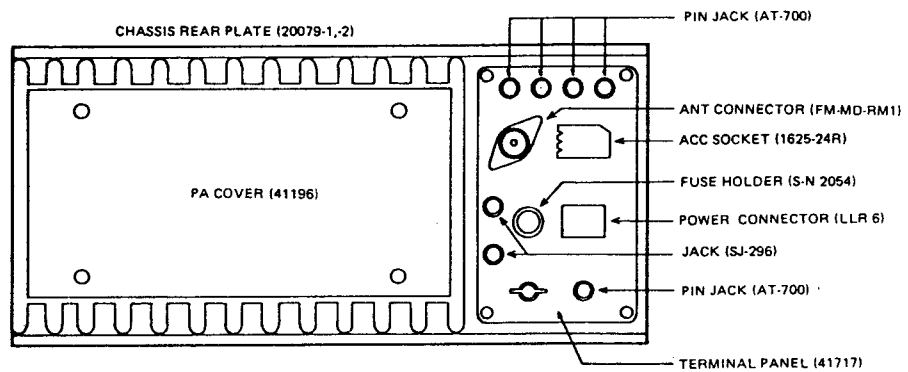
## 7-6 FRONT PANEL CONNECTORS LOCATION



## 7-7 SENSOR DISASSEMBLY

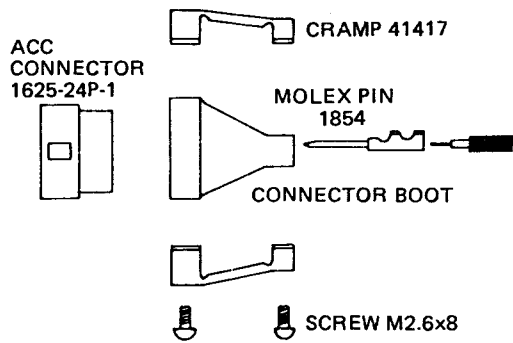


## 7-8 REAR PANEL DISASSEMBLY

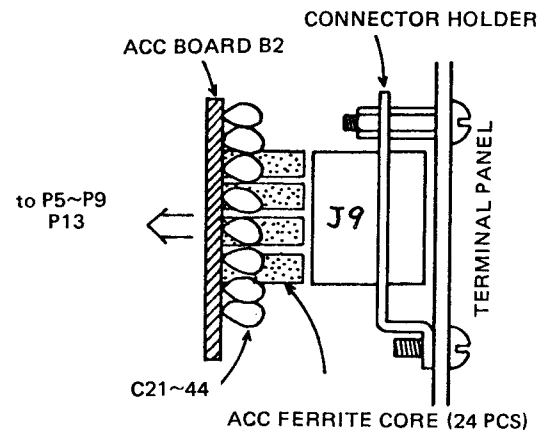


## 7-9 ACCESSORY SOCKET

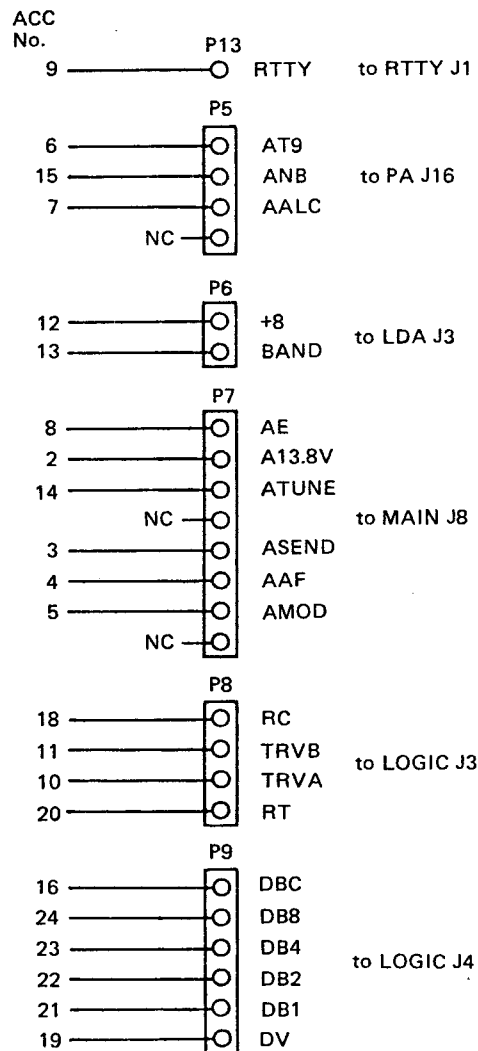
### Plug parts for the Accessory Socket



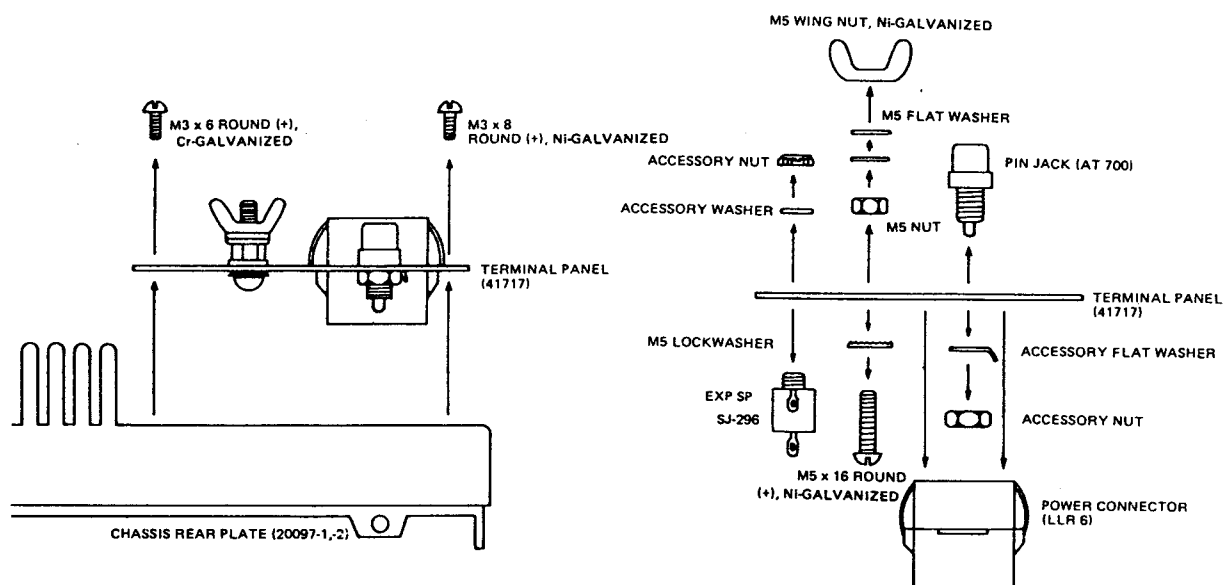
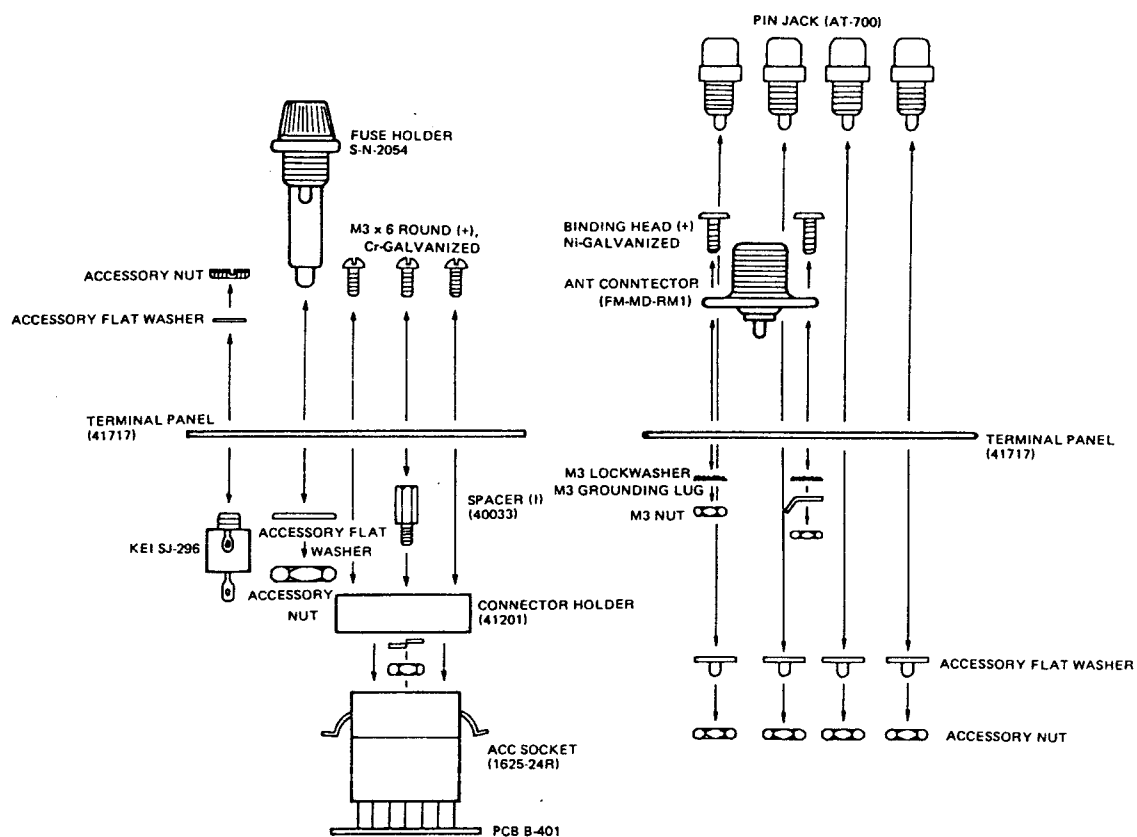
### Accessory Socket Assembly



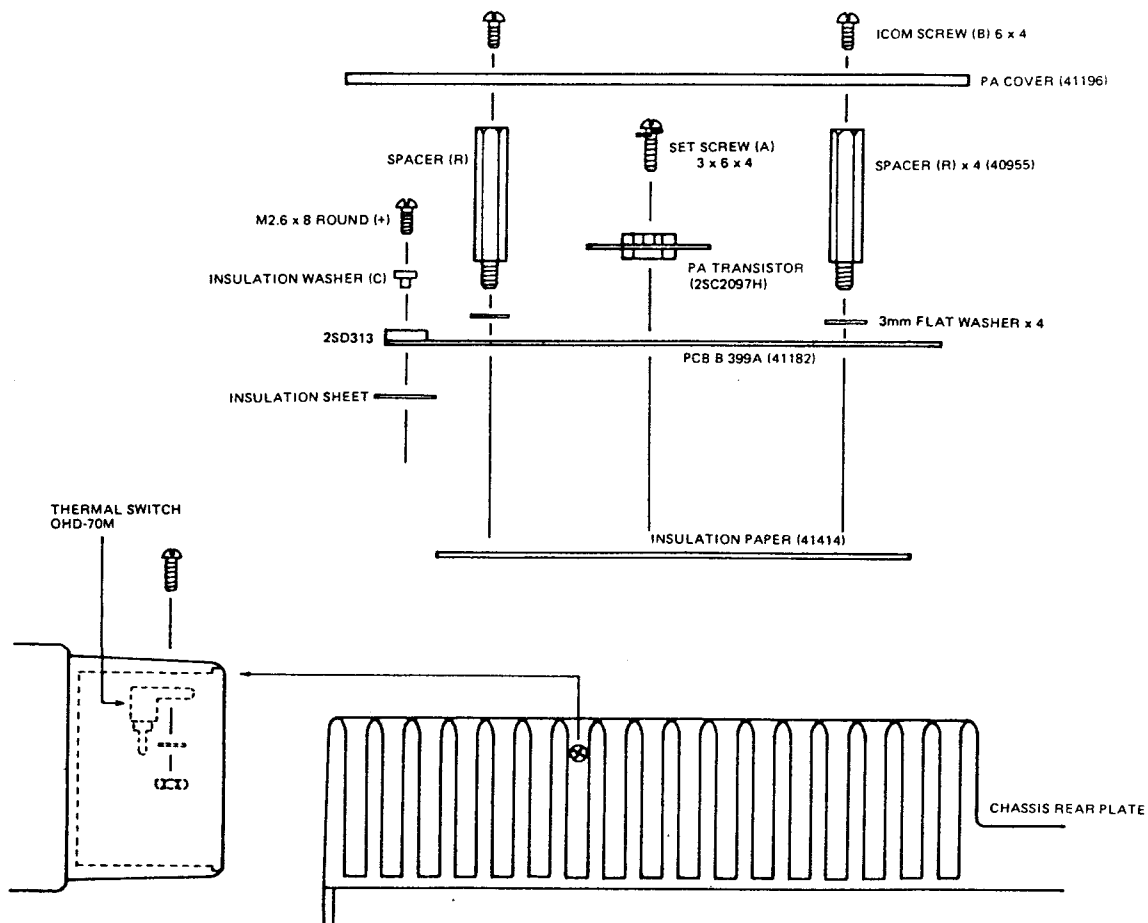
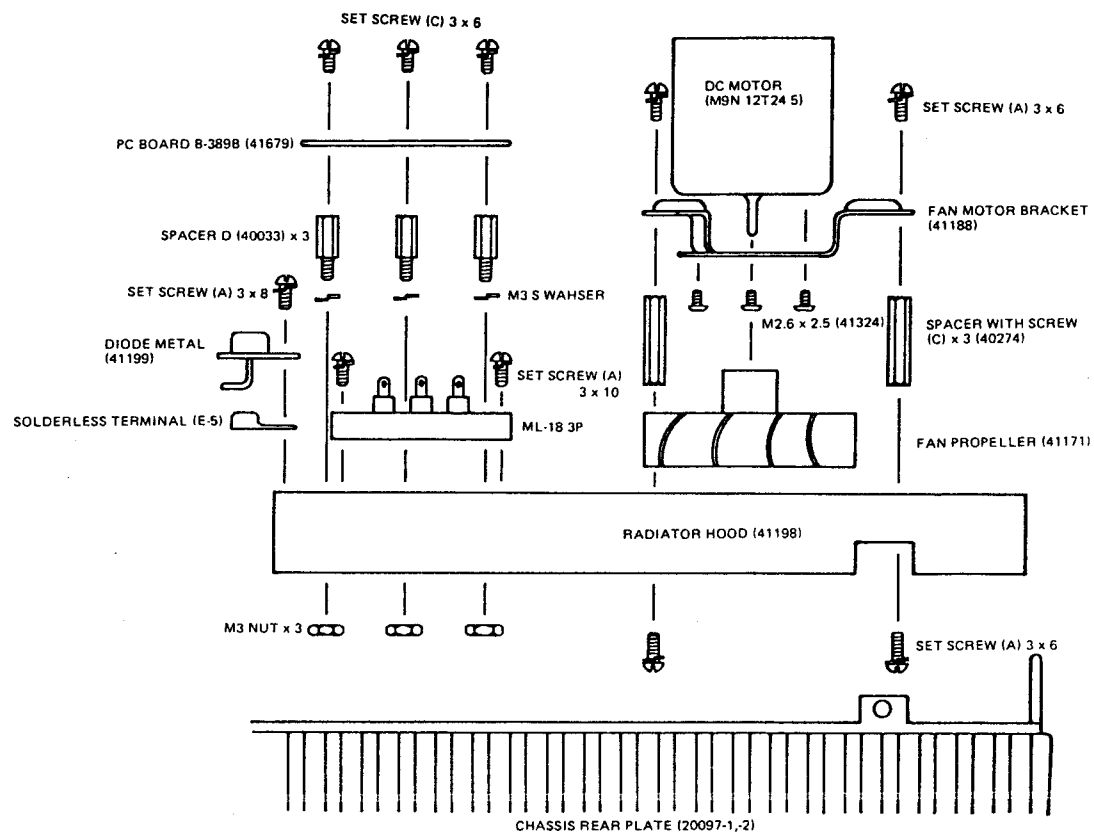
### ACC SOCKET WIRING DIAGRAM



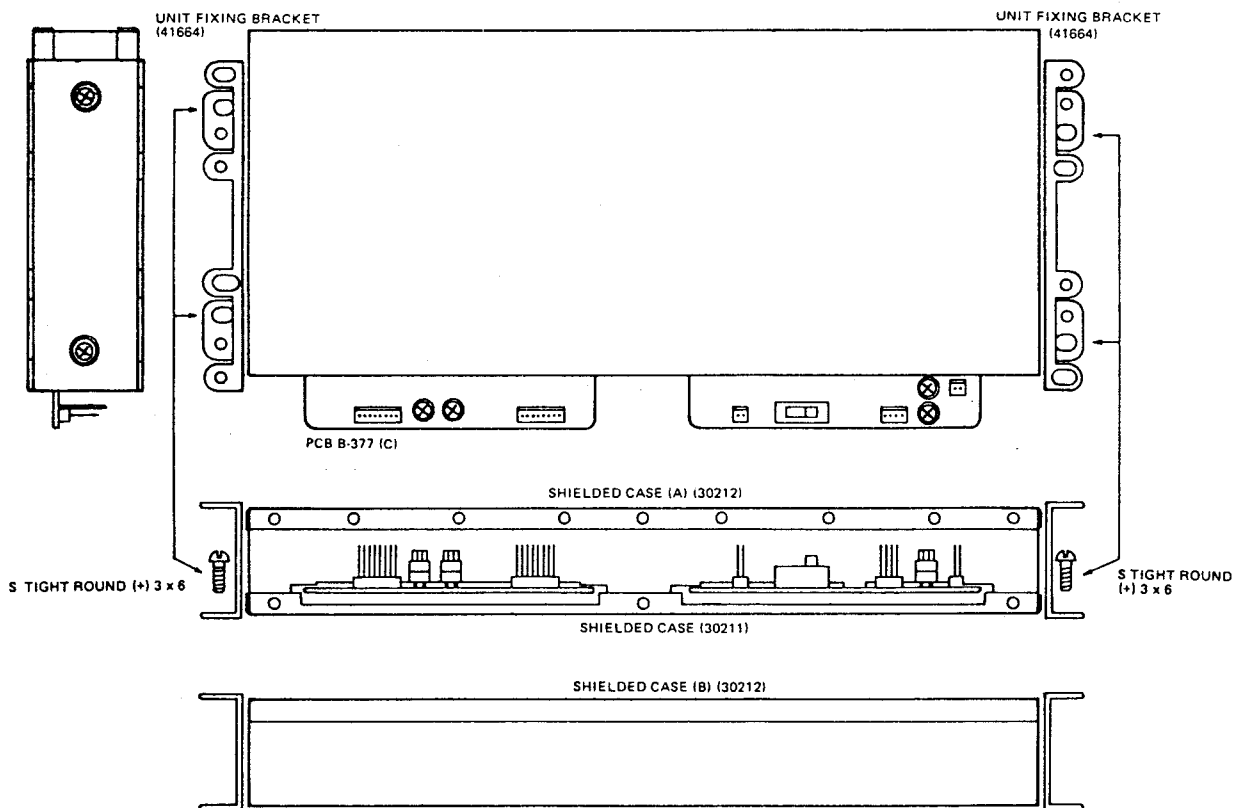
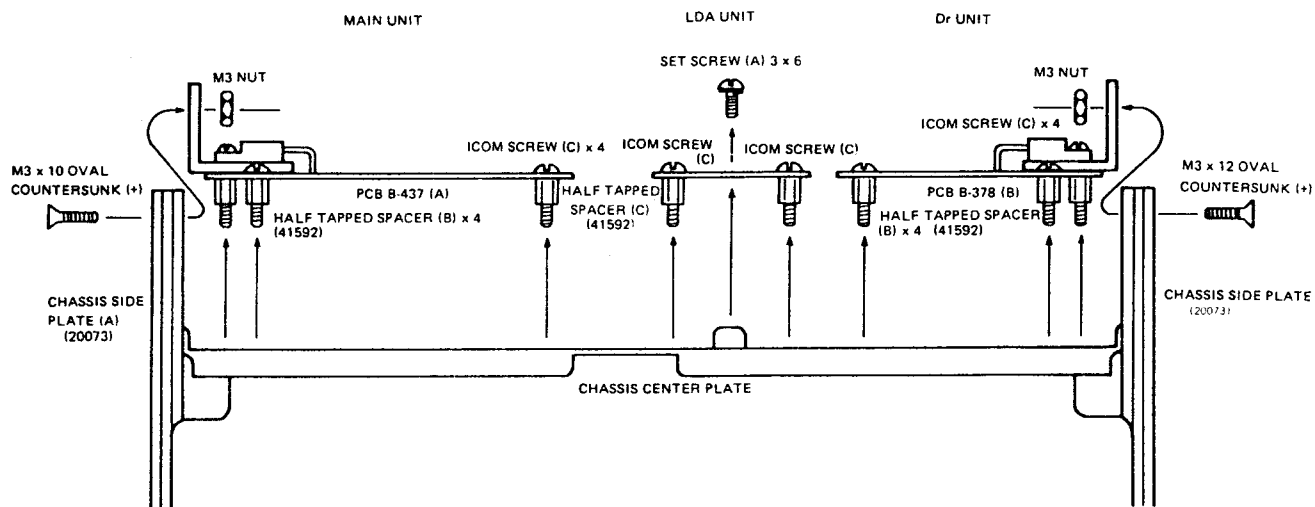
## 7-10 TERMINAL PANEL DISASSEMBLY



## 7 - 11 PA UNIT DISASSEMBLY

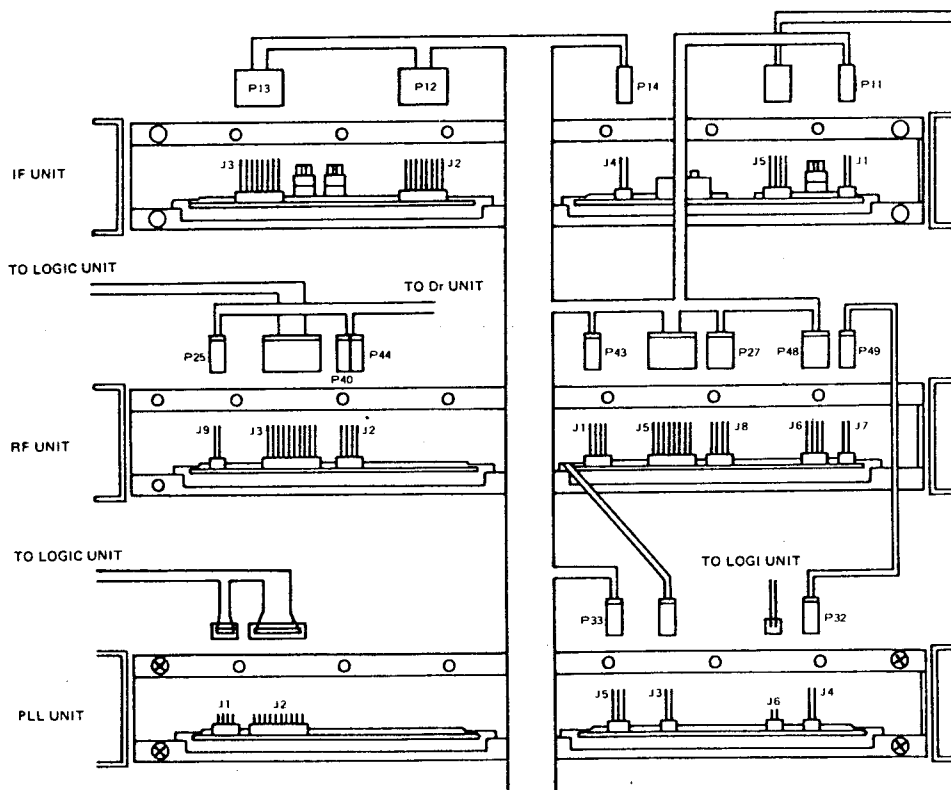
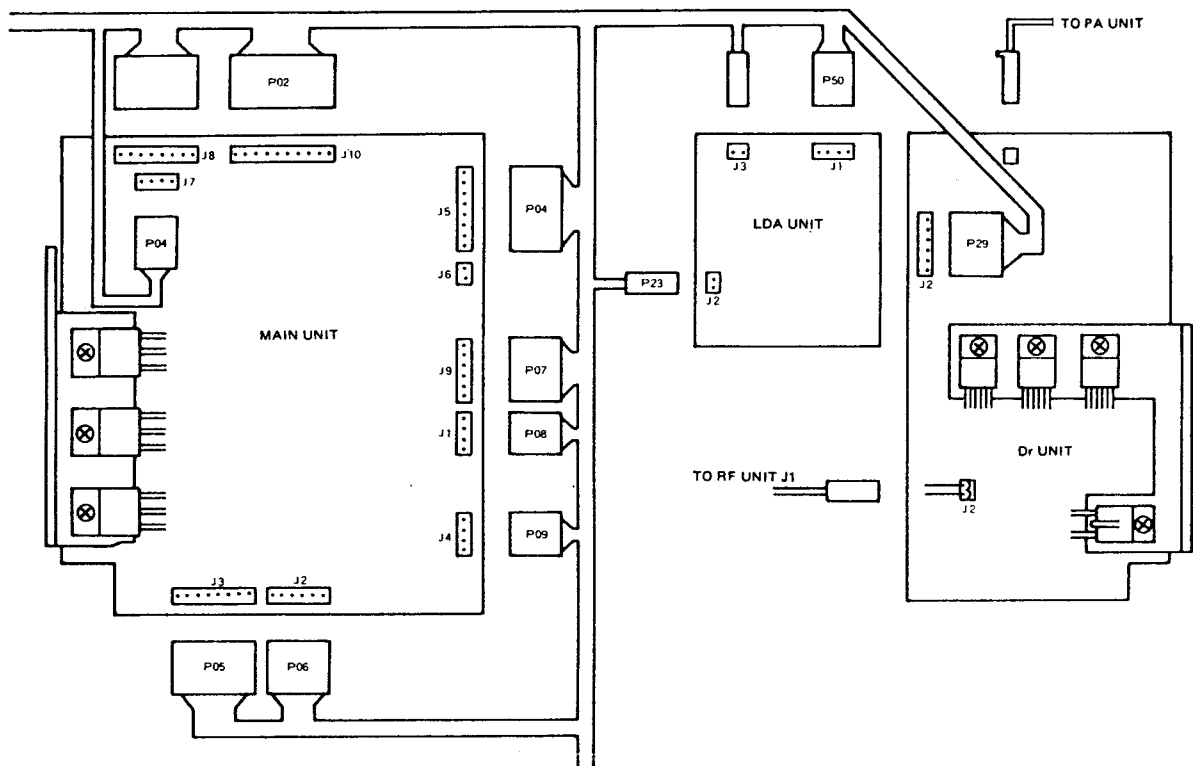


## 7 - 12 UNIT PC BOARD DISASSEMBLY





## 7 - 13 INTERNAL CONNECTORS LOCATION



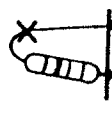
## SECTION 8 MAINTENANCE AND ADJUSTMENT

### 8 - 1 MEASURING INSTRUMENTS REQUIRED FOR ADJUSTMENT

|                                    |                                                                    |                              |
|------------------------------------|--------------------------------------------------------------------|------------------------------|
| (1) FREQUENCY COUNTER              | FREQUENCY RANGE                                                    | 0.1 - 90MHz                  |
|                                    | ACCURACY                                                           | BETTER THAN $\pm 1$ ppm      |
|                                    | SENSITIVITY                                                        | 100mV or BETTER              |
| (2) SIGNAL GENERATOR               | FREQUENCY RANGE                                                    | 0.1MHz - 40MHz               |
|                                    | OUTPUT VOLTAGE                                                     | -20 - 90dB (0dB = 1 $\mu$ V) |
| (3) MULTIMETER                     | 50K $\Omega$ /VOLT OR BETTER                                       |                              |
| (4) AC MILLIVOLTMETER              | MEASURING RANGE                                                    | 10mV - 2V                    |
| (5) RF VOLTMETER                   | FREQUENCY RANGE                                                    | 0.1 - 80MHz                  |
|                                    | MEASURING RANGE                                                    | 0.01 - 10V                   |
| (6) RF WATTMETER (Terminated Type) | MEASURING RANGE                                                    | 20 - 200 Watts               |
|                                    | FREQUENCY RANGE                                                    | 1.8 - 30MHz                  |
|                                    | IMPEDANCE                                                          | 50 OHMS                      |
|                                    | SWR                                                                | LESS THAN 1.1                |
| (7) AF OSCILLATOR                  | OUTPUT FREQUENCY                                                   | 200 - 3000Hz                 |
|                                    | OUTPUT VOLTAGE                                                     | 0 - 100mV                    |
| (8) OSCILLOSCOPE                   | FREQUENCY RANGE                                                    | DC $\sim$ 20MHz              |
|                                    | MEASURING RANGE                                                    | 0.01 - 10V                   |
| (9) NOISE GENERATOR                | (Generates ignition-like noise containing harmonics beyond 30MHz.) |                              |

NOTE: ☐ indicates an adjusting or instrument connecting point.  
○ indicates an instrument connecting point and its readings.  
These also are used in the board layout and schematic diagrams.

## 8-2 PLL ADJUSTMENT

| Item for Adjustment               | Conditions                                                                                                                                                                                                                                                                                                                                     | Points for measurement                                                                                                                      |                   |          | Adjustment location |            | Instruments reading                                                                                                                                                                                                                                                                                                                                               | Number given to the position to be adjusted                                                                                                                                 |                     |
|-----------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------|-------------------|----------|---------------------|------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|
|                                   |                                                                                                                                                                                                                                                                                                                                                | Measuring instruments required                                                                                                              | Unit              | Terminal | Unit                | Parts      |                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                             | How to adjust       |
| 100Hz-loop free-running frequency | <ul style="list-style-type: none"><li>• Set to general cover</li><li>• Mode: LSB</li><li>• Frequency display: 0,001.5KHz</li></ul>                                                                                                                                                                                                             | Oscilloscope (Measurable up to 20MHz                                                                                                        | PLL               | ①        | PLL                 | L20<br>L21 |                                                                                                                                                                                                                                                                                  | 101                                                                                                                                                                         |                     |
|                                   |                                                                                                                                                                                                                                                                                                                                                | Frequency counter                                                                                                                           | PLL               | ②        | PLL                 | L2         | Adjust until the above square wave is obtained                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                             |                     |
|                                   | Verification                                                                                                                                                                                                                                                                                                                                   | <ul style="list-style-type: none"><li>• Set to general cover</li><li>• Mode: LSB</li><li>• Frequency display: 0,001.5↔0,001.4 KHz</li></ul> | Frequency counter | PLL      | ②                   |            |                                                                                                                                                                                                                                                                                                                                                                   | Shunt R41 ③ to the chassis and adjust L2 until a frequency of 24MHz is obtained                                                                                             | 24MHz±10KHz         |
|                                   |                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                             |                   |          |                     |            | 1) Make sure that the lock does not fail while alternating the frequency on the display between 0,001.5 and 0,001.4.                                                                                                                                                                                                                                              |                                                                                                                                                                             |                     |
|                                   |                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                             |                   |          |                     |            | 2) Verify that the lock does not fail while increasing the frequency from 0,001.5KHz to 0,101.4MHz                                                                                                                                                                                                                                                                |                                                                                                                                                                             |                     |
| Tracking adjustment               | <ul style="list-style-type: none"><li>*Make adjustment while not removing the back cover and the VCO cover.</li><li>*Keep the trimmers of C7 ④ and C63 ⑤ in the position where capacitance is minimum.</li></ul>                                                                                                                               |                                                                                                                                             |                   |          |                     |            | 3) Verify that output frequency at R73 is 13.15MHz when the frequency on the display is 0,001.5KHz; and 23.14MHz when it is 0,101.4MHz                                                                                                                                                                                                                            |                                                                                                                                                                             |                     |
|                                   |                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                             |                   |          |                     |            | [for reference] Correction for adjustments 1) — 4) <ul style="list-style-type: none"><li>• Correct with C7 if lock voltage [R120 ⑧] increases at higher frequencies.</li><li>• Correct with C63 if lock voltage [R120 ⑧] decreases at higher frequencies.</li></ul> However, it is desirable either C7 or C63 is in such a position where capacitance is minimum. |                                                                                                                                                                             |                     |
|                                   | <ul style="list-style-type: none"><li>1) Remove the lead wire of R143 ⑥.</li><li>• Mode: USB.</li><li>• Frequency display: 11,160.1KHz</li></ul> Resistor <br>PCB<br>It is easier cutting the lead wires and soldering than removing and connecting them. | Oscilloscope                                                                                                                                | PLL               | R53      | ⑦                   | PLL        | L13                                                                                                                                                                                                                                                                                                                                                               | Adjust the voltage at R53 to +2V.<br>*Verify that the voltage at R53 is approximately -4.5V under the following condition:<br>Frequency on display: 1,163.1KHz<br>Mode: USB | +2V<br>Verify -4.5V |

## 8 - 2 PLL ADJUSTMENT (Continued)

| Item for Adjustment                            | Conditions                                                                                      | Points for measurement         |      |          | Adjustment location |            |                                                                                                                                                               | Instruments reading      | Number given to the position to be adjusted |
|------------------------------------------------|-------------------------------------------------------------------------------------------------|--------------------------------|------|----------|---------------------|------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------|---------------------------------------------|
|                                                |                                                                                                 | Measuring instruments required | Unit | Terminal | Unit                | Parts      | How to adjust                                                                                                                                                 |                          |                                             |
| Tracking adjustment<br>(Continued)             | 2) Connect the lead wire of R143.<br>• Mode: USB<br>• Frequency display: 29,998.4KHz            | Oscilloscope                   | PLL  | R53      | PLL                 | L19        | Adjust the voltage at R53 to be +1.4V.<br>* Verify that it is approximately -7V under the following condition:<br>Frequency display: 11,160.1KHz<br>Mode: USB | +1.4V<br>Verify<br>-7V   | 104                                         |
|                                                | 3) Disconnect the lead wire of R143.<br>• Mode: LSB<br>• Frequency display: 1,163.1KHz          | Oscilloscope                   | PLL  | R120     | PLL                 | L4         | Adjust the voltage at R120 to be +2.5V.                                                                                                                       | +2.5V                    | 105                                         |
|                                                | 4) Connect the lead wire of R143.<br>• Mode: USB<br>• Frequency display: 11,160.1KHz            | Oscilloscope                   | PLL  | R120     | PLL                 | L18        | Adjust the voltage at R120 to be +2.5V.<br>* Verify that it is about +2.5V when the frequency display is 11,160.1KHz, 21,160.1KHz, and 29,998.4KHz.           | +2.5V<br>Verify<br>+2.5V | 106                                         |
|                                                | • Mode: LSB<br>• Frequency display: 0,001.5KHz<br>1,001.5KHz<br>↓<br>1MHz step<br>9,001.5KHz    | Oscilloscope                   | PLL  | R120     |                     |            | Verify that lock voltage is between 1.6 and 3.4V at each frequency when the frequency display is increased from 0,001.5KHz on with 1MHz steps.                | 1.6 – 3.4V               |                                             |
| Voltage verification after tracking adjustment | • Mode: USB<br>• Frequency display: 10,998.5KHz<br>11,998.5KHz<br>↓<br>1MHz step<br>29,998.5KHz | Oscilloscope                   | PLL  | R120     |                     |            | Verify that lock voltage is between 1.6 and 3.4V at each frequency when the frequency display is increased from 10,998.5KHz on with 1MHz steps.               | 1.6 – 3.4V               |                                             |
|                                                | • Mode: USB<br>• Frequency display: 10,998.5KHz                                                 | Frequency counter              | PLL  | J3       | PLL                 | C90        | Adjust the frequency at J3 to be 49,731.5 KHz.                                                                                                                | 49,731.5KHz<br>± 1Hz     | 107                                         |
| 2nd LO adjustment                              |                                                                                                 | RF Voltmeter                   | PLL  | J4       | PLL                 | L14<br>L15 | Adjust alternately until a maximum voltage is obtained.                                                                                                       | 10mV R.M.S.<br>or more   | 108                                         |
|                                                | 1) • Mode: USB<br>• Frequency display: 15,998.50KHz<br>• RIT: OFF                               | Frequency counter              | PLL  | J4       | PLL                 | R142       | Adjust the frequency at J4 to be 30,720.00 KHz.                                                                                                               | 30,720.000KHz<br>± 1Hz   | 110                                         |
|                                                | 2) • Mode: USB<br>• Frequency display: 15,998.49KHz<br>• RIT: OFF<br>• STEP: 10Hz               | Frequency Counter              | PLL  | J4       | PLL                 | R69        | Adjust the frequency at J4 to be 30,719.91 KHz.                                                                                                               | 30,719.910KHz<br>± 1Hz   | 110                                         |

## 8 - 2 PLL ADJUSTMENT (Continued)

| Item for Adjustment           | Conditions                                                                                                                                                 | Points for measurement         |      |          | Adjustment location |       |                                                 | Instruments reading    | Number given to the position to be adjusted |
|-------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------|------|----------|---------------------|-------|-------------------------------------------------|------------------------|---------------------------------------------|
|                               |                                                                                                                                                            | Measuring instruments required | Unit | Terminal | Unit                | Parts | How to adjust                                   |                        |                                             |
| 2nd LO adjustment (Continued) | 3) Adjust 1) and 2) several times.                                                                                                                         |                                |      |          |                     |       |                                                 |                        |                                             |
| RIT adjustment                | <ul style="list-style-type: none"> <li>• Mode: USB</li> <li>• Frequency display: 15,998.50KHz</li> <li>• RIT: ON</li> <li>• RIT control: center</li> </ul> | Frequency counter              | PLL  | J4       | FSW                 | R25   | Adjust the frequency at J4 to be 30,720.00 KHz. | 30,720.00KHz<br>± 10Hz | 111                                         |

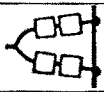
### 8-3 IF UNIT ADJUSTMENT

| Item for Adjustment              | Conditions                                                                                | Points for measurement         |      |          | Adjustment location |       |                                                                                                                 | Instruments reading   | Number given to the position to be adjusted |
|----------------------------------|-------------------------------------------------------------------------------------------|--------------------------------|------|----------|---------------------|-------|-----------------------------------------------------------------------------------------------------------------|-----------------------|---------------------------------------------|
|                                  |                                                                                           | Measuring instruments required | Unit | Terminal | Unit                | Parts | How to adjust                                                                                                   |                       |                                             |
| B.F.O. frequency adjustment      | * Connect a 470Ω resistor in series between the check point and the measuring instrument. |                                |      |          |                     |       | * Make adjustment in the order of 1) to 5).                                                                     |                       |                                             |
|                                  | 1) Mode: USB                                                                              | Frequency counter              | IF   | R109     | (11)                | IF    | C97 Adjust the frequency at R109 to be 9,013.0 KHz.                                                             | 9,013.000KHz          | [201]                                       |
|                                  | 2) Mode: LSB                                                                              | Frequency counter              | IF   | R109     | (11)                | IF    | L30 Adjust the frequency at R109 to be 9,010.0 KHz.                                                             | 9,010.000KHz          | [202]                                       |
|                                  | 3) Mode: CW<br>• T/R switch: transmit                                                     | Frequency counter              | IF   | R109     | (11)                | IF    | L25 Adjust the frequency at R109 to be 9,010.6 KHz.                                                             | 9,010.600KHz          | [203]                                       |
|                                  | 4) Mode: CW<br>• T/R switch: receive                                                      | Frequency counter              | IF   | R109     | (11)                | IF    | L24 Adjust the frequency at R109 to be 9,009.8 KHz.                                                             | 9,009.800KHz          | [204]                                       |
| P.B.T. V XO frequency adjustment | 5) Mode: RTTY                                                                             | Frequency counter              | IF   | R109     | (11)                | IF    | L31 Adjust the frequency at R109 to be 9,008.475 KHz.                                                           | 9,008.475KHz          | [205]                                       |
|                                  | *-Connect a 470Ω resistor in series between the check point and the measuring instrument. |                                |      |          |                     |       |                                                                                                                 |                       |                                             |
|                                  | • Mode: SSB (USB or LSB)<br>• P.B.T. control: Turn fully clockwise                        | Frequency counter              | IF   | R24      | (12)                | IF    | L7 Turn R19 (3) fully counterclockwise. Adjust the frequency to be 19,763.3KHz at L7.                           | 19,763.300KHz         | [206]                                       |
|                                  | • Mode: AM<br>• P.B.T. control: Turn fully counterclockwise                               | Frequency counter              | IF   | R24      | (12)                | IF    | R-115 Adjust the frequency to be 19,756.7KHz at R115.                                                           | 19,759.700KHz         | [207]                                       |
|                                  | • Mode: SSB<br>• P.B.T. control: Turn fully counterclockwise                              | Frequency counter              | IF   | R24      | (12)                | IF    | R-114 Adjust the frequency to be 19,759.7KHz at R114.                                                           | 19,759.700KHz         | [208]                                       |
|                                  | * Verify<br>• Mode: SSB (USB or LSB)<br>• P.B.T. control: center.                         | Frequency counter              | IF   | R24      | (12)                |       | Make adjustments with R19 (13) and position of the control knob if frequencies differ from the specified value. | 19,761.500KHz ± 200Hz |                                             |

### 8 - 3 IF UNIT ADJUSTMENT (Continued)

| Item for Adjustment                              | Conditions                                                                                                                                                                                                                                                                                                                            | Points for measurement         |      |          | Adjustment location |       |                                                                                                                   | Instruments reading    | Number given to the position to be adjusted |
|--------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------|------|----------|---------------------|-------|-------------------------------------------------------------------------------------------------------------------|------------------------|---------------------------------------------|
|                                                  |                                                                                                                                                                                                                                                                                                                                       | Measuring instruments required | Unit | Terminal | Unit                | Parts | How to adjust                                                                                                     |                        |                                             |
| P.B.T. V XO frequency adjustment.<br>(Continued) | <ul style="list-style-type: none"> <li>* Verify</li> <li>• Mode: AM</li> <li>• P.B.T. control: center</li> </ul>                                                                                                                                                                                                                      | Frequency counter              | IF   | R24      | ⑫                   |       | Make adjustment with using R19 ⑬ and position of the control knob if frequencies differ from the specified value. | 19,760.0KHz<br>± 500Hz |                                             |
|                                                  | <ul style="list-style-type: none"> <li>• Mode: SSB (USB or LSB)</li> <li>• Comp: ON</li> <li>• T/R switch: transmit</li> </ul>                                                                                                                                                                                                        | Frequency counter              | IF   | R24      | ⑫                   | R13   | Adjust the frequency to be 19,761.5KHz at R13.                                                                    | 19,761.5KHz            | 209                                         |
|                                                  | <ul style="list-style-type: none"> <li>• Mode: AM</li> <li>• P.B.T. control: OFF</li> <li>• T/R switch: transmit</li> </ul>                                                                                                                                                                                                           | Frequency counter              | IF   | R24      | ⑫                   | R14   | Adjust the frequency to be 19,760.0KHz at R14.                                                                    | 19,760.0KHz            | 210                                         |
|                                                  | [for reference]<br>1) Connect 2PF (CH/ in parallel to C149 (SPF) ⑭ of IF unit if 19,763.3KHz is not obtained with P.B.T. control turned fully clockwise after P.B.T. adjustment.<br>2) Make adjustment using R19 ⑬ of IF unit if frequency is lower than 19,751.5KHz with P.B.T. control in center position during P.B.T. adjustment. |                                |      |          |                     |       |                                                                                                                   |                        |                                             |

## 8 - 4 TRANSMITTER ADJUSTMENT

| Item for Adjustment            | Conditions                                                                                                                  | Points for measurement                                                                                 |        |                                                                                            | Adjustment location |                |                                                        | Instruments reading | Number given to the position to be adjusted |
|--------------------------------|-----------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------|--------|--------------------------------------------------------------------------------------------|---------------------|----------------|--------------------------------------------------------|---------------------|---------------------------------------------|
|                                |                                                                                                                             | Measuring instruments required                                                                         | Unit   | Terminal                                                                                   | Unit                | Parts          | How to adjust                                          |                     |                                             |
| Bias adjustment                | <ul style="list-style-type: none"> <li>• Mode: SSB</li> <li>• MIC-G control: MIN</li> <li>• T/R switch: transmit</li> </ul> | DC ammeter (connect it in series with the jumper wire putting 4 bead cores disconnected.               | Driver | Jumper  | Driver              | R13            | Adjust the current to be 100mA at R13                  | 100mA               | 301                                         |
|                                |                                                                                                                             | DC ammeter (connect it in series with the 1.6 mm wire connected to R13 of the Driver unit disconnected | PA     | R13                                                                                        | PA                  | R12            | Adjust the current to be 600mA at R12                  | 600mA               | 302                                         |
| ALC adjustment                 | 1) • Band: 14MHz<br>• Mode: RTTY or CW<br>• Comp: MAX                                                                       | Power meter                                                                                            |        | Antenna Connector                                                                          | MIC -G              | R9             | Adjust the output to be 100 – 110W at R9               | 100 – 110W          | 303                                         |
|                                | 2) • Band: 14MHz<br>• Mode: RTTY or CW<br>• Comp: MIN                                                                       | Power meter                                                                                            |        | Antenna Connector                                                                          | MIC -G              | R6             | Adjust the output to be 5 – 10W at R6                  | 5 – 10W             | 304                                         |
|                                | 3) • Band: 14MHz<br>• Mode: AM<br>• Comp: MAX                                                                               | Power meter                                                                                            |        | Antenna Connector                                                                          | MIC -G              |                | Adjust the output to be 35 – 40W at R13                | 35 – 40W            | 305                                         |
|                                | 4) • Band: 28MHz<br>• Mode: RTTY or CW<br>• Comp: MAX                                                                       | Power meter                                                                                            |        | Antenna Connector                                                                          | MIC -G              |                | Adjust the output to be 100 – 110W at R13              | 100 – 110W          | 306                                         |
| Carrier suppression adjustment | <ul style="list-style-type: none"> <li>• Mode: SSB</li> <li>• Comp: OFF</li> <li>• MIC GAIN: MIN</li> </ul>                 | Spectrum analyzer or RF volt-meter                                                                     |        |                                                                                            | IF                  | R-101<br>R-106 | Adjust alternately until a minimum carrier is obtained | –40dB or less       | 307                                         |



## 8 - 4 TRANSMITTER ADJUSTMENT (Continued)

| Item for Adjustment           | Conditions                                                                                                                                        | Points for measurement         |      |                                             | Adjustment location |       |                                                                                                                                                                                                                                            | Instruments reading                              | Number given to the position to be adjusted |
|-------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------|------|---------------------------------------------|---------------------|-------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------|---------------------------------------------|
|                               |                                                                                                                                                   | Measuring instruments required | Unit | Terminal                                    | Unit                | Parts | How to adjust                                                                                                                                                                                                                              |                                                  |                                             |
| Carrier point adjustment      | 1) Mode: USB<br>• Comp: OFF<br>• MIC terminal: Connect an AF generator (300mV/2.7KHz, 270Hz).<br>• MIC GAIN: Set to transmitting output to be 20W | Power meter                    |      | Antenna Connector                           | IF                  | C97   | Switch frequency of AF generator alternately between 2.7KHz and 270Hz and adjust C97 until the same output (20W) is obtained.                                                                                                              | 20W                                              | 308                                         |
|                               | 2) Mode: LSB<br>• Comp: OFF<br>• MIC terminal: Connect an AF generator (300mV/2.7KHz, 270Hz).<br>• MIC GAIN: Set to transmitting output 20W       | Power meter                    |      | Antenna Connector                           | IF                  | L30   | Same as above                                                                                                                                                                                                                              | 20W                                              | 309                                         |
| COMP VXO frequency adjustment | • Mode: USB, LSB<br>• Comp: MAX<br>• MIC terminal: Connect an AF generator (100mV/270Hz)<br>• MIC GAIN: Set to transmitting output 20W            | Power meter                    |      |                                             | IF                  | R13   | Switch alternately between USB and LSB and adjust R13 until the same output (20W) is obtained.                                                                                                                                             |                                                  | 310                                         |
| COMP Gain adjustment          | • Mode: SSB<br>• Comp: OFF or MAX<br>• MIC terminal: Connect an AF generator (100mV, 10mV/1.5KHz).<br>• MIC GAIN: Set to transmitting output 20W  | Power meter                    |      | Antenna Connector                           | IF                  | R35   | Set the output of AF generator to 100mV, 1.5KHz at Comp: OFF and to transmitting output 20W at MIC GAIN. Leaving MIC GAIN as it is, bring AF generator output to 10mV, make COMP MAX and adjust R35 to obtain a transmitting output of 20W | Difference between COMP: OFF and Max. to be 20dB | 311                                         |
| AM modulation adjustment      | • Mode: AM<br>• Comp: OFF<br>• MIC terminal: Connect an AF generator (100mV/1.5KHz)<br>• MIC GAIN: MAX                                            | Power meter<br>Monitor scope   |      | Antenna Connector Couple to the Power meter | IF                  | R98   | Adjust R98 to obtain 100% modulation.<br>                                                                                                               | 100% modulation                                  | 312                                         |

## 8-4 TRANSMITTER ADJUSTMENT (Continued)

| Item for Adjustment       | Conditions                                                                                                                                        | Points for measurement         |      |          | Adjustment location |       |                                                                                                                                                                                                                                                    | Instruments reading | Number given to the position to be adjusted |
|---------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------|------|----------|---------------------|-------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|---------------------------------------------|
|                           |                                                                                                                                                   | Measuring instruments required | Unit | Terminal | Unit                | Parts | How to adjust                                                                                                                                                                                                                                      |                     |                                             |
| Ic meter adjustment       | <ul style="list-style-type: none"> <li>• Meter select: Ic</li> <li>• Mode: SSB</li> <li>• Meter select: Ic</li> <li>• Mode: CW or RTTY</li> </ul> |                                |      |          | MAIN                | R76   | Adjust meter zero setting                                                                                                                                                                                                                          |                     | 313                                         |
| APC adjustment by current | <ul style="list-style-type: none"> <li>• Adjust after Ic meter adjustment</li> <li>• Mode: CW or RTTY</li> <li>• Comp: OFF</li> </ul>             |                                |      |          | MAIN                | R70   | Adjust R70 to the total current value less 3.5 A at 100W output with Mode: CW or RTTY.                                                                                                                                                             |                     | 314                                         |
| SWR adjustment            | <ul style="list-style-type: none"> <li>• Meter select: Po and SWR</li> <li>• Mode: CW or RTTY</li> <li>• Band: 14MHz Band</li> </ul>              | Built-in SWR meter             |      |          | SWR                 | C7    | Adjust R71 to a point just before the point where transmitting output starts to decrease on a band with highest current consumption.                                                                                                               | SWR 1.2 or less     | 315                                         |
|                           |                                                                                                                                                   |                                |      |          |                     |       | Let transmitting output to a certain extent and adjust the SWR set control of Main unit until Po meter swings to a full scale. Then set the meter select switch to SWR, and adjust C7 until SWR reflected wave (meter indication) becomes minimum. |                     | 316                                         |

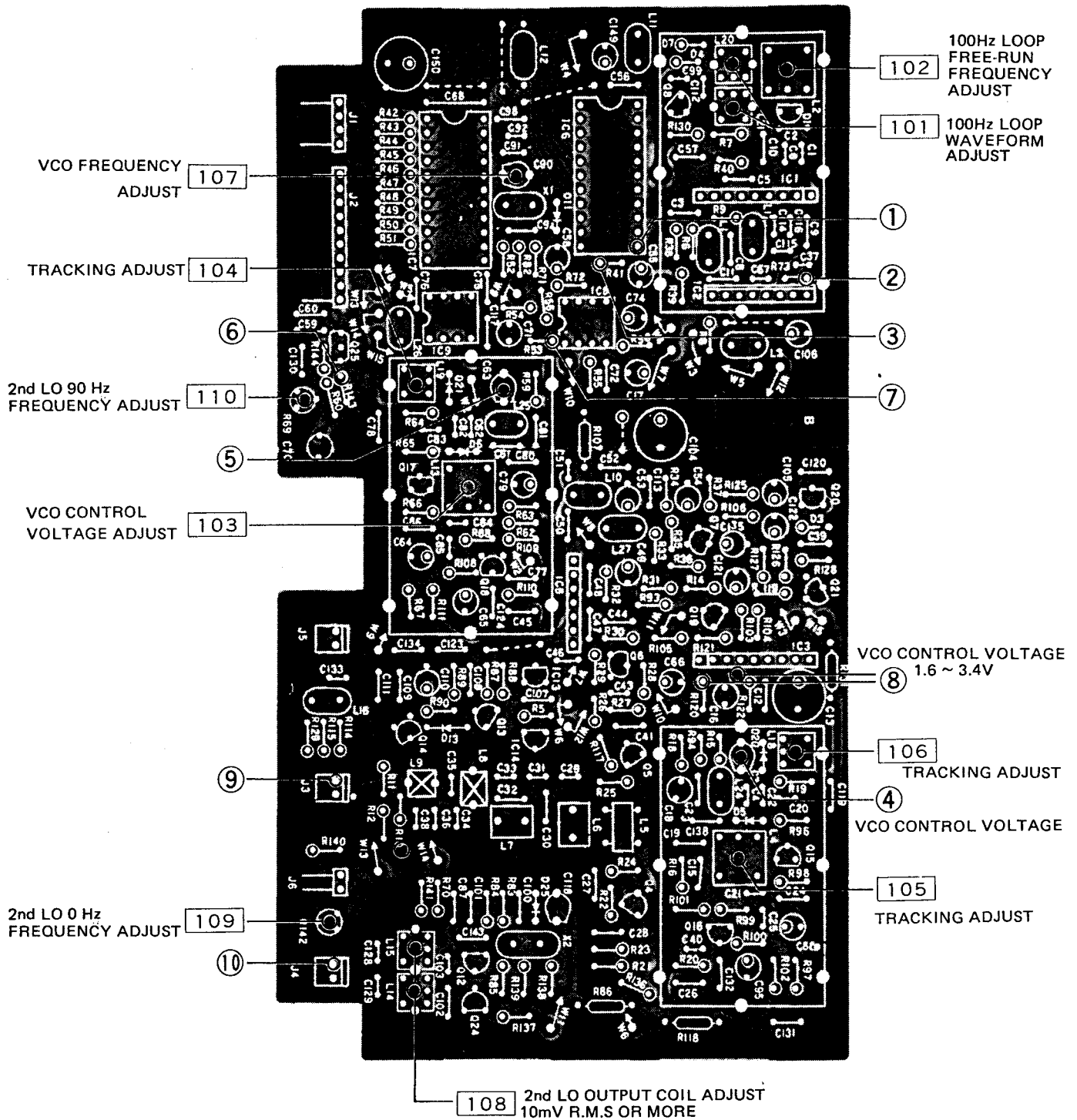
## 8 - 5 RECEIVER ADJUSTMENT

| Item for Adjustment                 | Conditions                                                                                                                                            | Points for measurement         |      |          | Adjustment location |       |                                                                                                                                                                                                             | Instruments reading  | Number given to the position to be adjusted |
|-------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------|------|----------|---------------------|-------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|---------------------------------------------|
|                                     |                                                                                                                                                       | Measuring instruments required | Unit | Terminal | Unit                | Parts | How to adjust                                                                                                                                                                                               |                      |                                             |
| Connection of measuring instruments | Connect signal generator (SSG) to ANT connector on the rear panel, and speaker (8Ω) and AC millivolt meter (ACM, M) to ext SP terminal.               |                                |      |          |                     |       |                                                                                                                                                                                                             |                      |                                             |
| Total gain adjustment               | <ul style="list-style-type: none"> <li>Band: 14MHz</li> <li>Mode: SSB</li> <li>P.B.T. control: center</li> <li>AGC: FAST</li> <li>ATT: OFF</li> </ul> | SSG<br>AC M.M.<br>8Ω speaker   |      |          | IF                  | R76   | Turn R167 ⑰ of IF unit fully clockwise. Then input from SSG such a level of signal as may bring AGC. The output at that time shall be 0dB. Turn off SSG signal and adjust to obtain a noise level of -30dB. | -30dB                | 401                                         |
| S meter zero setting adjustment     | <ul style="list-style-type: none"> <li>Band: 14MHz</li> <li>Mode: SSB</li> <li>P.B.T. control: center</li> <li>AGC: Fast</li> <li>ATT: OFF</li> </ul> |                                |      |          | MAIN                | R83   | Adjust to the point where meter starts to swing at no signal                                                                                                                                                | Pointed value: 0     | 402                                         |
| S meter full scale adjustment       | <ul style="list-style-type: none"> <li>Band: 14MHz</li> <li>Mode: SSB</li> <li>P.B.T. control: center</li> <li>AGC: Fast</li> <li>ATT: OFF</li> </ul> | SSG                            |      |          | MAIN                | R79   | Make SSG output (at open) 68dB and adjust to bring S meter to point to a full scale (+40 dB)                                                                                                                | Pointed value: +40dB | 403                                         |
| S meter (S-8) adjustment            | <ul style="list-style-type: none"> <li>Band: 14MHz</li> <li>Mode: SSB</li> <li>P.B.T. control: center</li> <li>AGC: Fast</li> <li>ATT: OFF</li> </ul> | SSG                            |      |          | MAIN                | R81   | Make SSG output (at open) 28dB and adjust to bring S meter to point to S-8.                                                                                                                                 | Pointed value: 8     | 404                                         |
| S meter readjustment                | Repeat zero setting, full scale and S-8 adjustments several times.                                                                                    |                                |      |          |                     |       |                                                                                                                                                                                                             |                      |                                             |
| RF Gain adjustment                  | <ul style="list-style-type: none"> <li>Mode: SSB</li> </ul>                                                                                           |                                |      |          | FSW                 | R17   | Put RF Gain control to the position of 0830 hours (shorter hand) and adjust to bring S meter to a full scale.                                                                                               |                      | 405                                         |

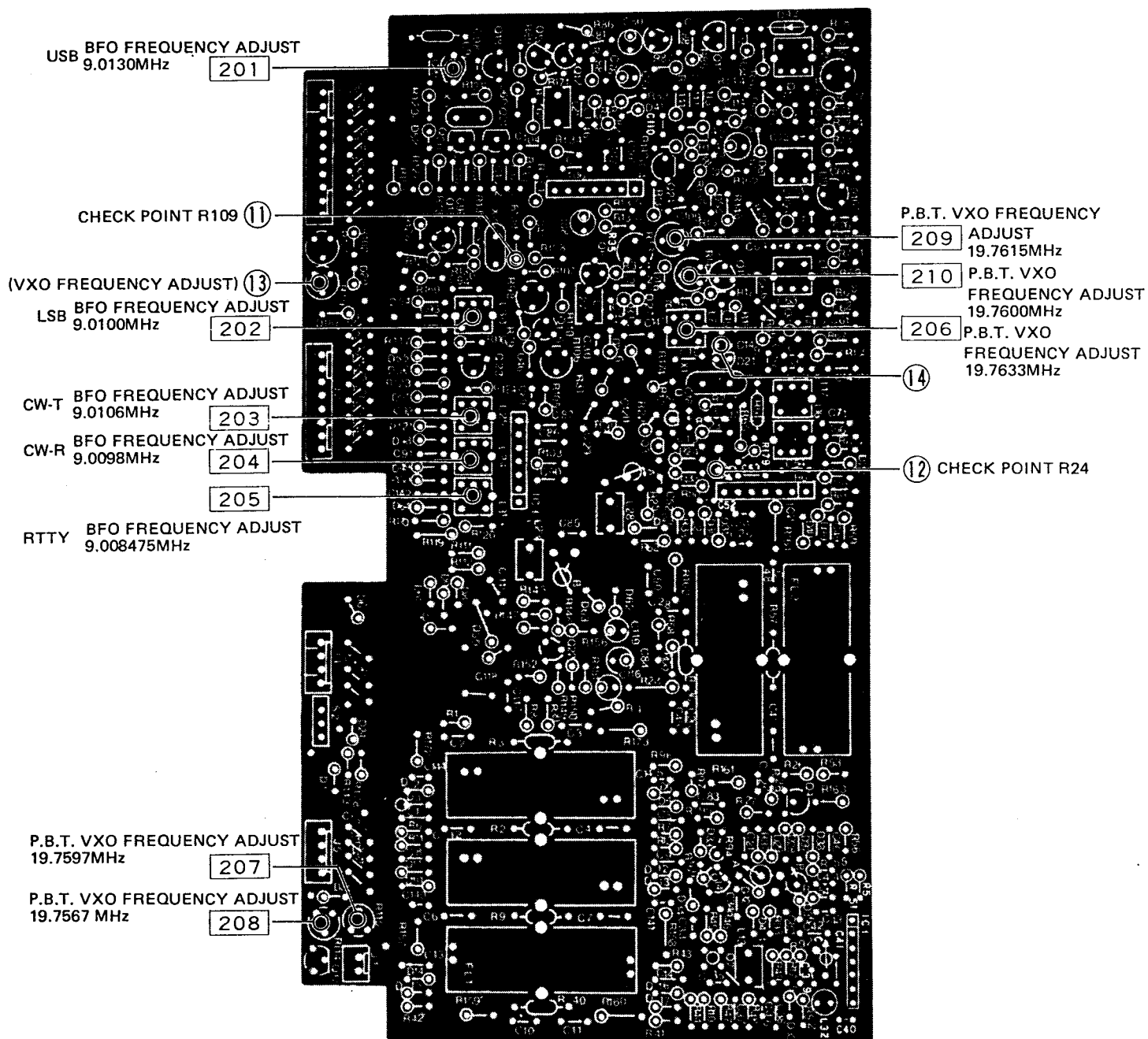
## 8 - 5 RECEIVER ADJUSTMENT (Continued)

| Item for Adjustment           | Conditions                                                                                                                     | Points for measurement          |      |          |      | Adjustment location |               |                                                                                                                                                                    | Instruments reading                             | Number given to the position to be adjusted |
|-------------------------------|--------------------------------------------------------------------------------------------------------------------------------|---------------------------------|------|----------|------|---------------------|---------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------|---------------------------------------------|
|                               |                                                                                                                                | Measuring instruments required  | Unit | Terminal | Unit | Parts               | How to adjust |                                                                                                                                                                    |                                                 |                                             |
| NB adjustment                 | <ul style="list-style-type: none"><li>● Mode: SSB</li><li>● N.B. Switch: OFF</li></ul>                                         | Noise generator<br>Oscilloscope | RF   | D34      | (18) | RF                  | L56           | Input noise from antenna connector and adjust L56 to obtain a maximum peak value of the noise. (It is advisable to adjust noise level to a peak value of about 1V) |                                                 | 406                                         |
| RTTY BFO frequency adjustment | <ul style="list-style-type: none"><li>● Mode: RTTY</li><li>● Ground J1 of RTTY unit when space frequency adjustment.</li></ul> | Frequency counter               | RTTY | Q3       | (19) | RTTY                | C3<br>C2      | Adjust to obtain:<br>Mark frequency: 9,010.77KHz at C3<br>Space frequency: 9,010.60KHz at C2                                                                       | Mark:<br>9,010.770KHz<br>Space:<br>9,010.600KHz | 407<br>408                                  |

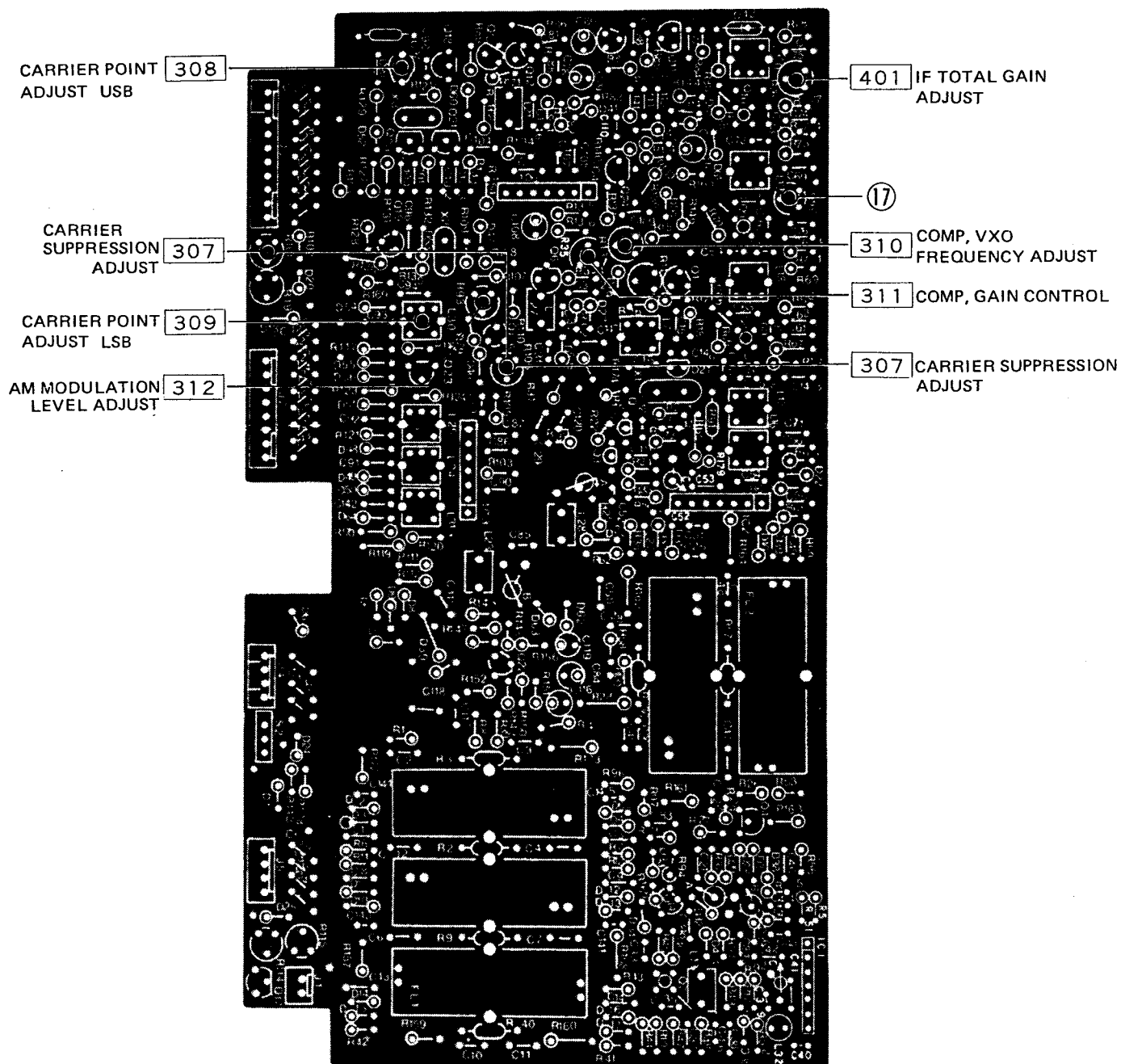
## 8-6 PLL UNIT PARTS LOCATION



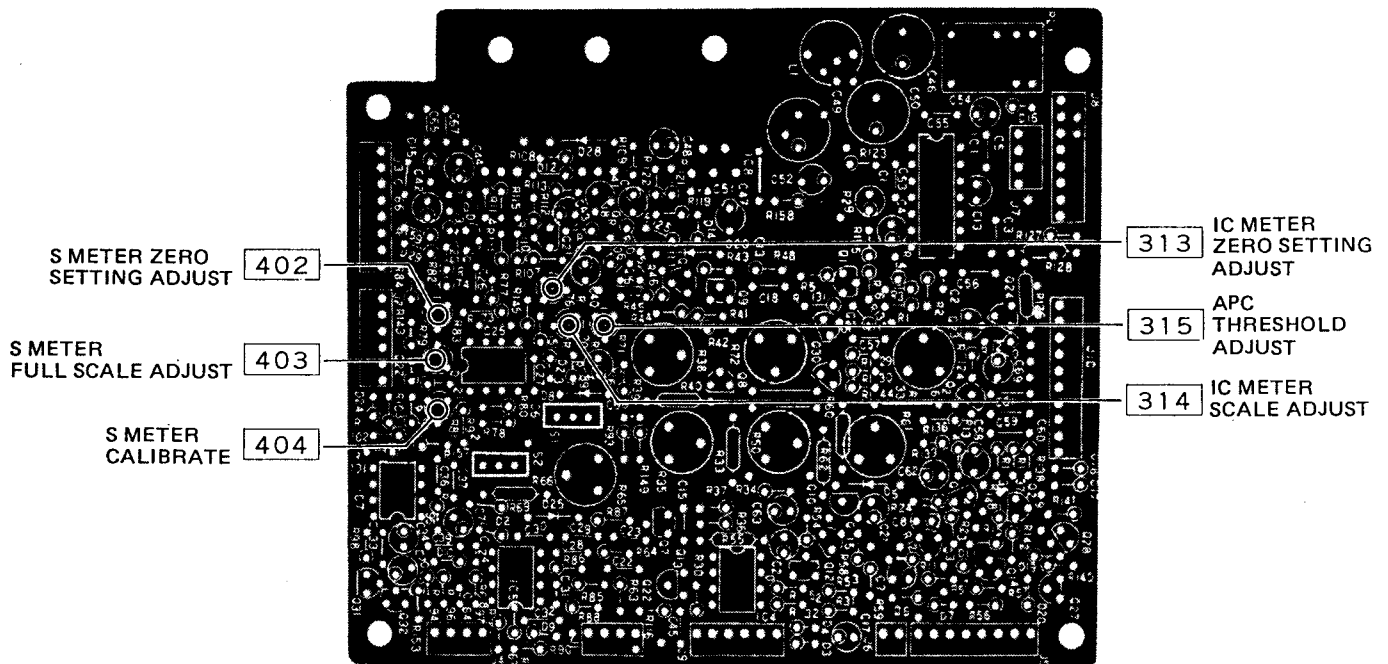
## 8-7 IF UNIT PARTS LOCATION (FREQUENCY ADJUSTMENT)



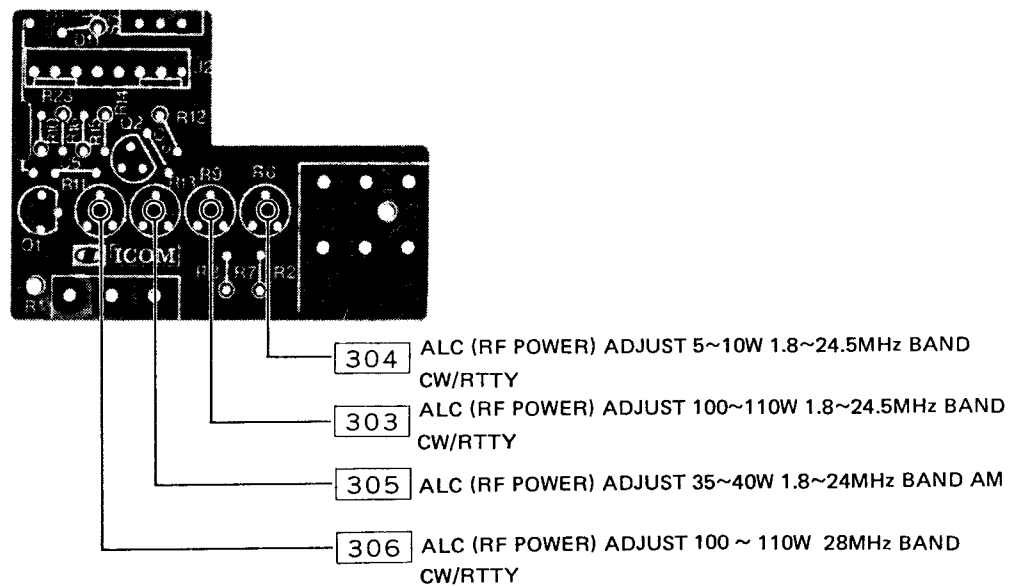
## 8-8 IF UNIT PARTS LOCATION



## 8 - 9 MAIN UNIT PARTS LOCATION

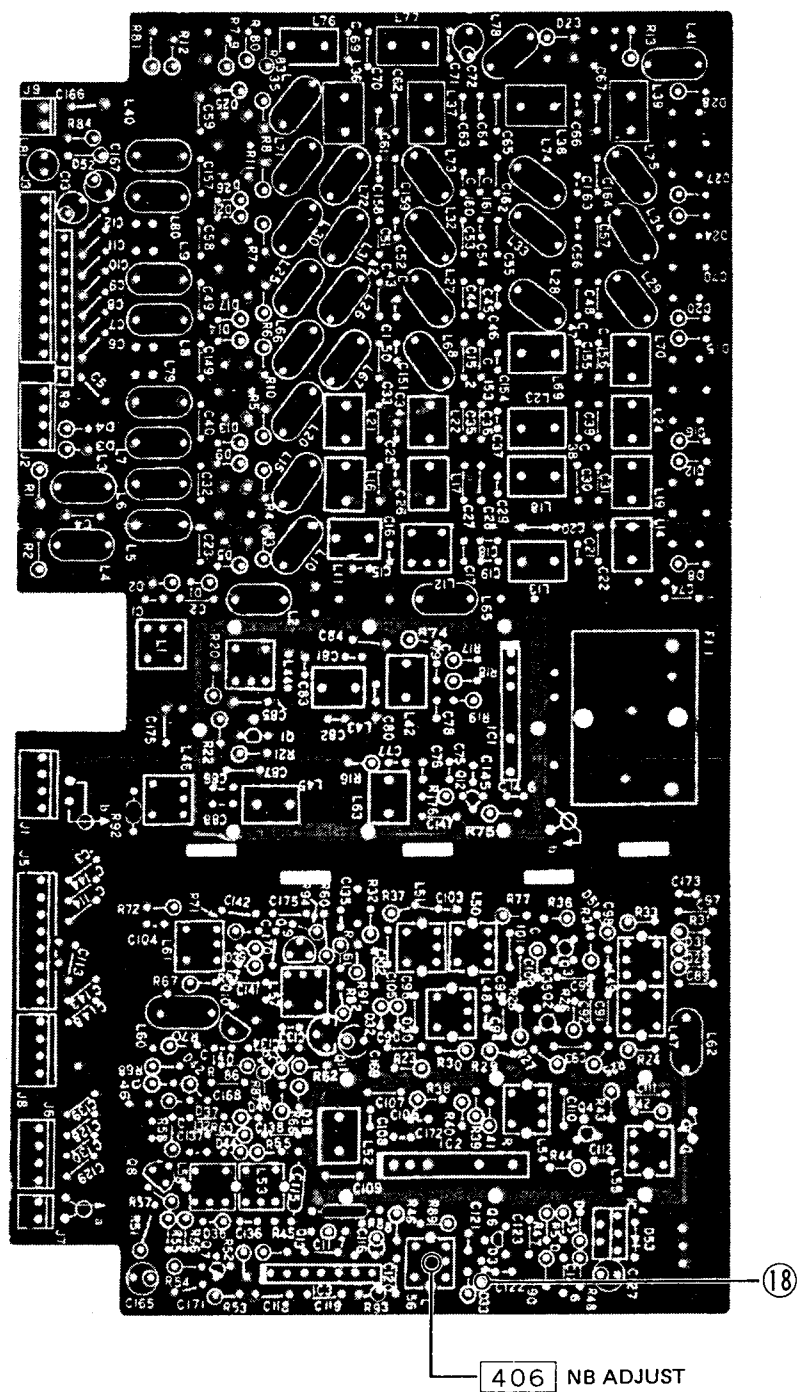


## 8 - 10 MIC-G UNIT PARTS LOCATION

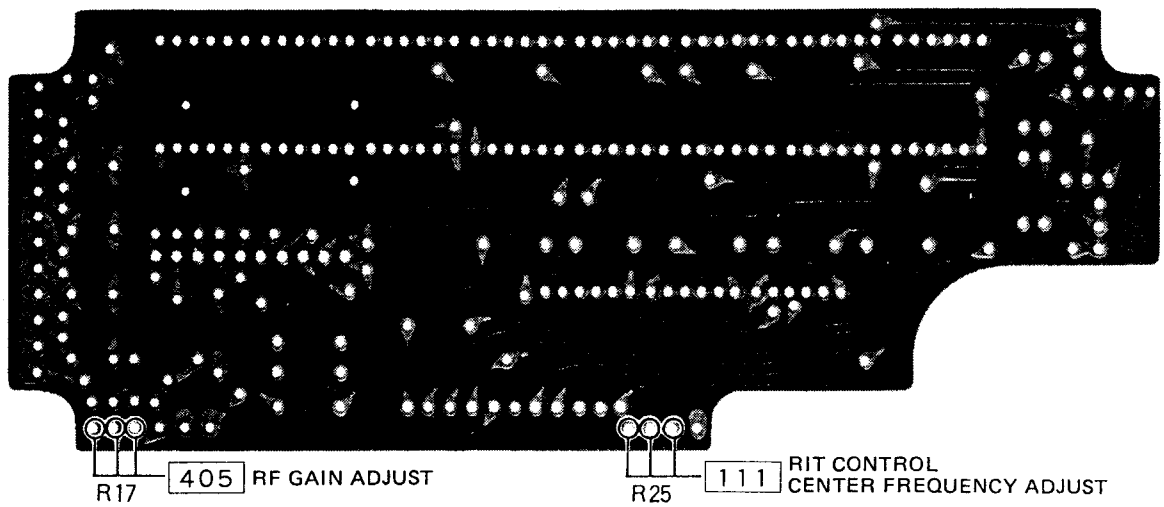




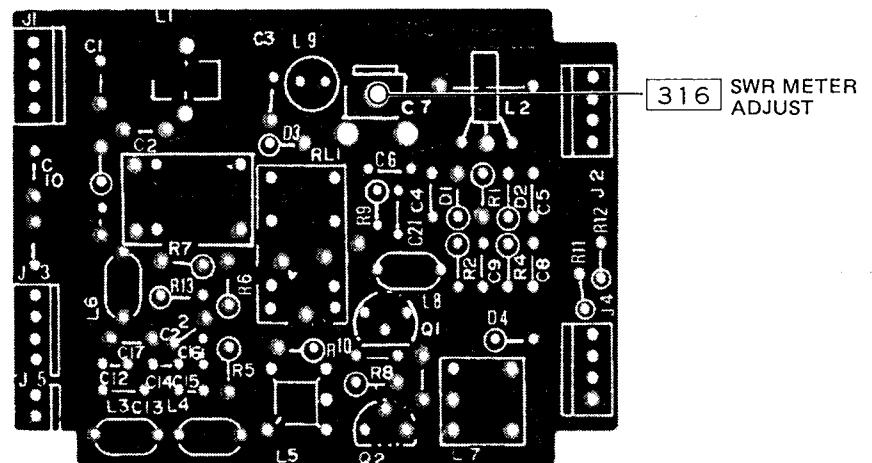
# 8 - 11 RF UNIT PARTS LOCATION



## 8-12 FSW UNIT



## 8-13 SWR UNIT

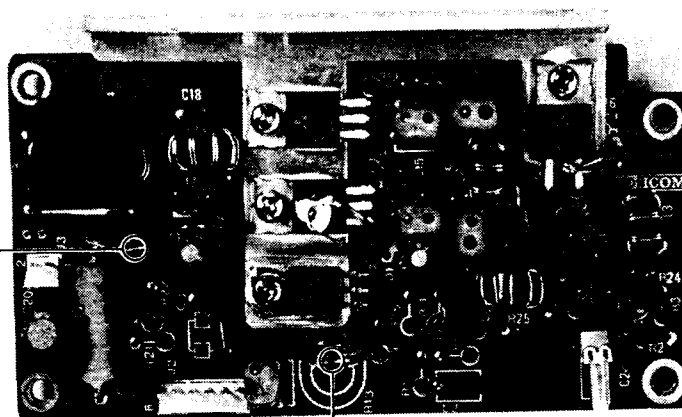


## 8 - 14 DRIVER UNIT

### IDLING CURRENT ADJUSTMENT

CUT JUMPER AND CONNECT  
AMMETER IN SERIES

15

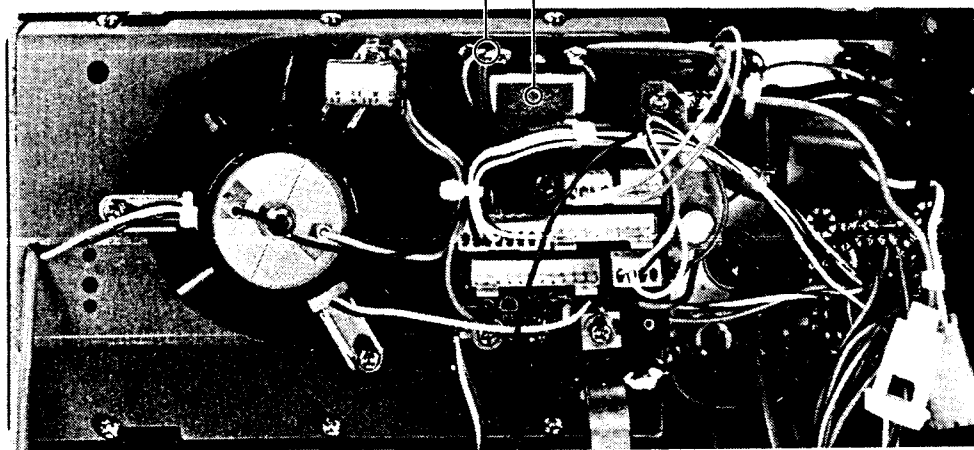


301 DRIVER IDLING CURRENT ADJUST  
100mA

## 8 - 15 PA UNIT (CONNECTOR PART)

16 REMOVE THICK WIRE ONLY AND  
CONNECTED AMMETER IN SERIES

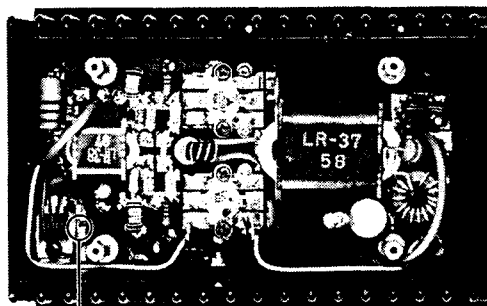
R13



## 8 - 16 PA UNIT

## 8 - 17 RTTY UNIT

### RTTY BFO FREQUENCY ADJUST



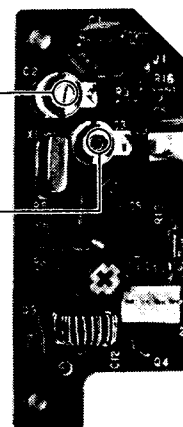
302 PA IDLING CURRENT ADJUST 600mA

MARK FREQUENCY ADJUST  
9.010.60MHz

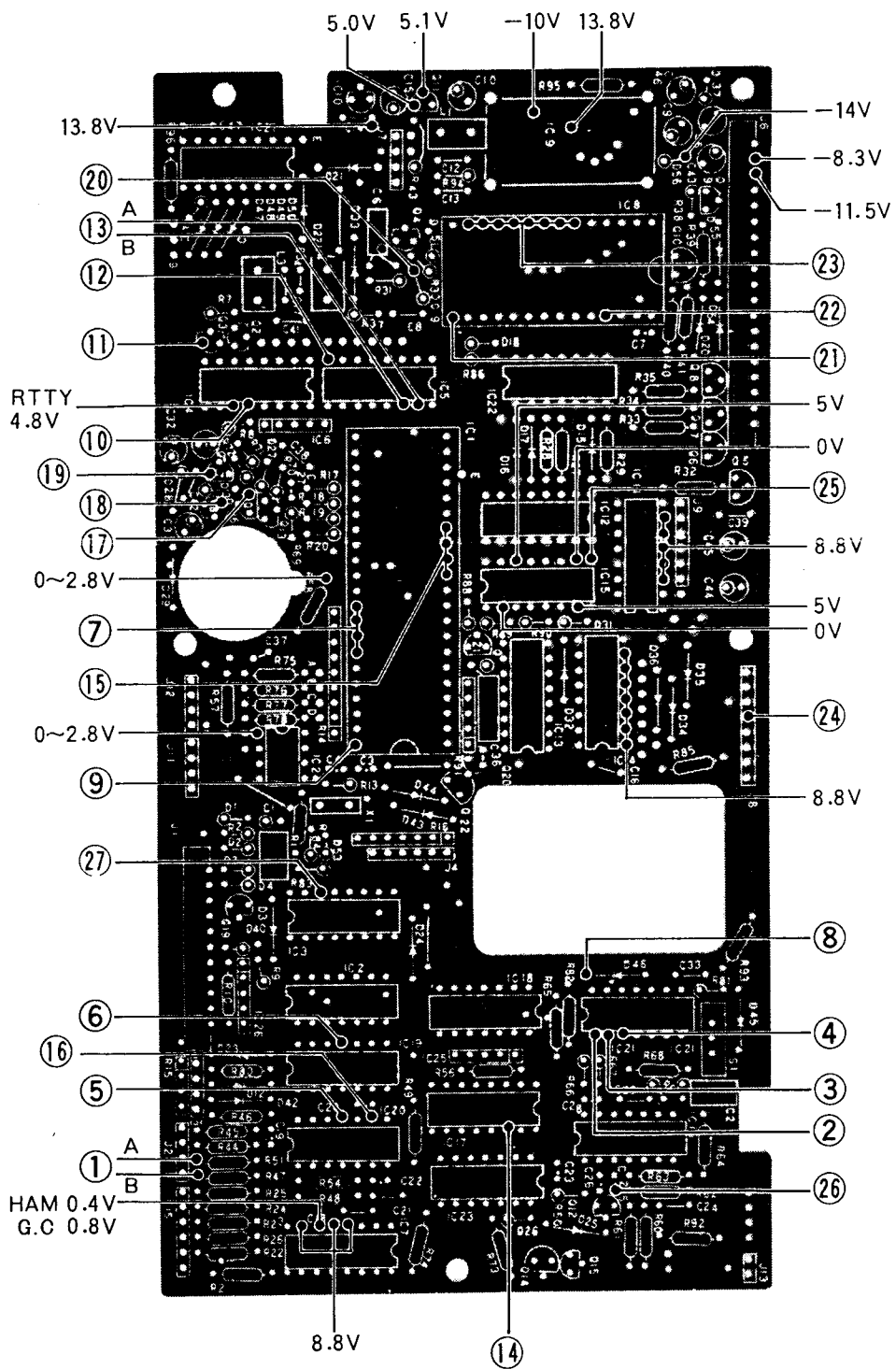
408

SPACE FREQUENCY ADJUST  
9.010.77MHz

407

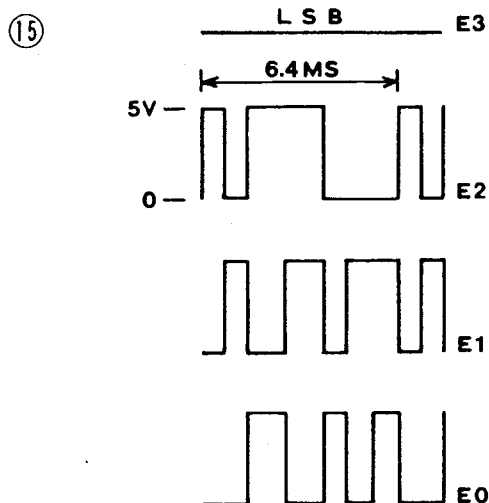
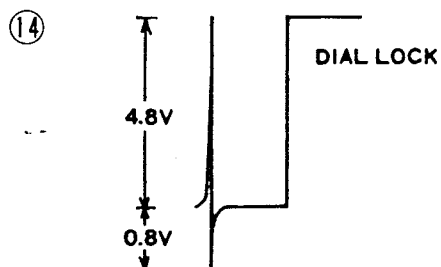
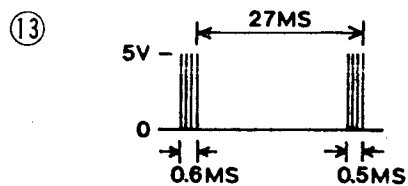
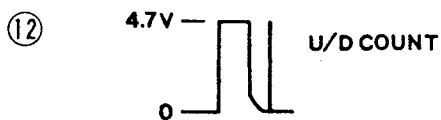
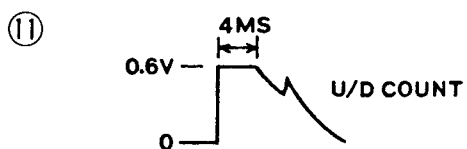
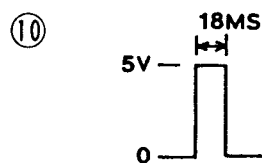
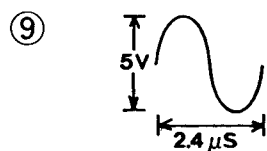
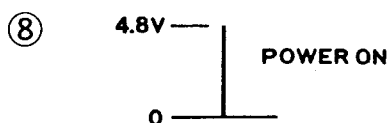
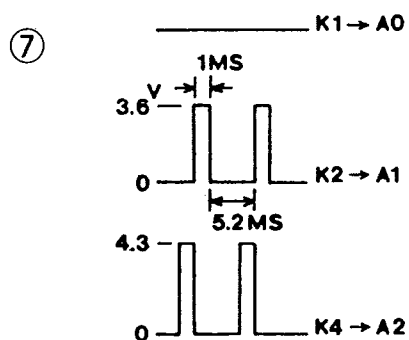
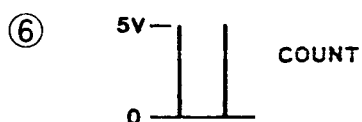
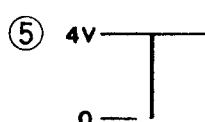
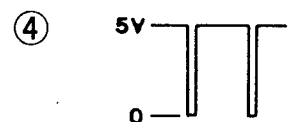
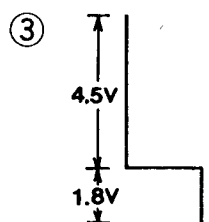
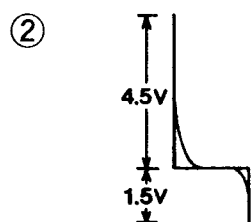
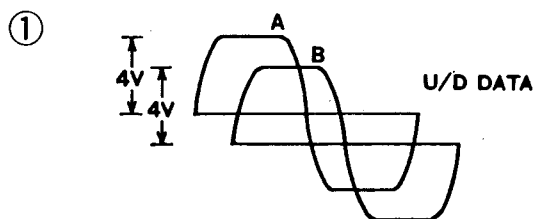


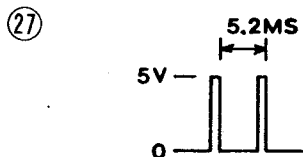
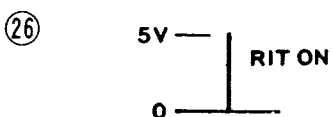
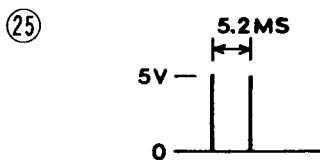
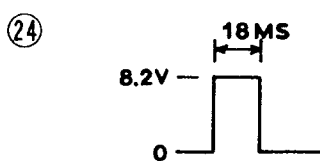
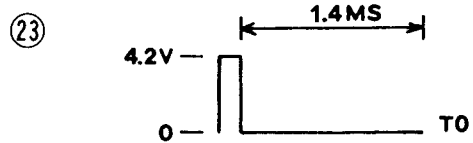
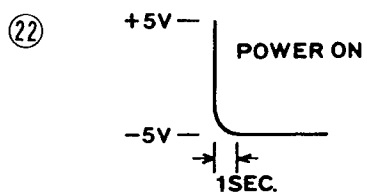
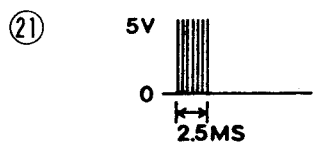
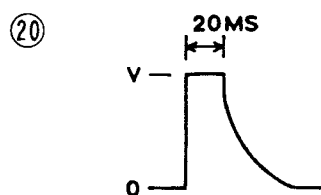
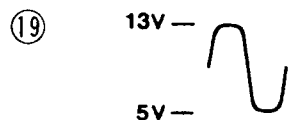
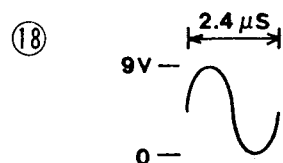
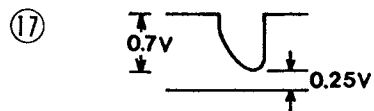
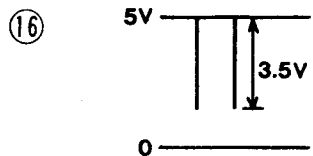
## 8 - 19 LOGIC UNIT VOLTAGE CHECK



\* REFER TO:  
PAGE 8 – 26 FOR CIRCUIT DIAGRAM  
AND PAGE 8 – 20 FOR VOLTAGE WAVEFORMS

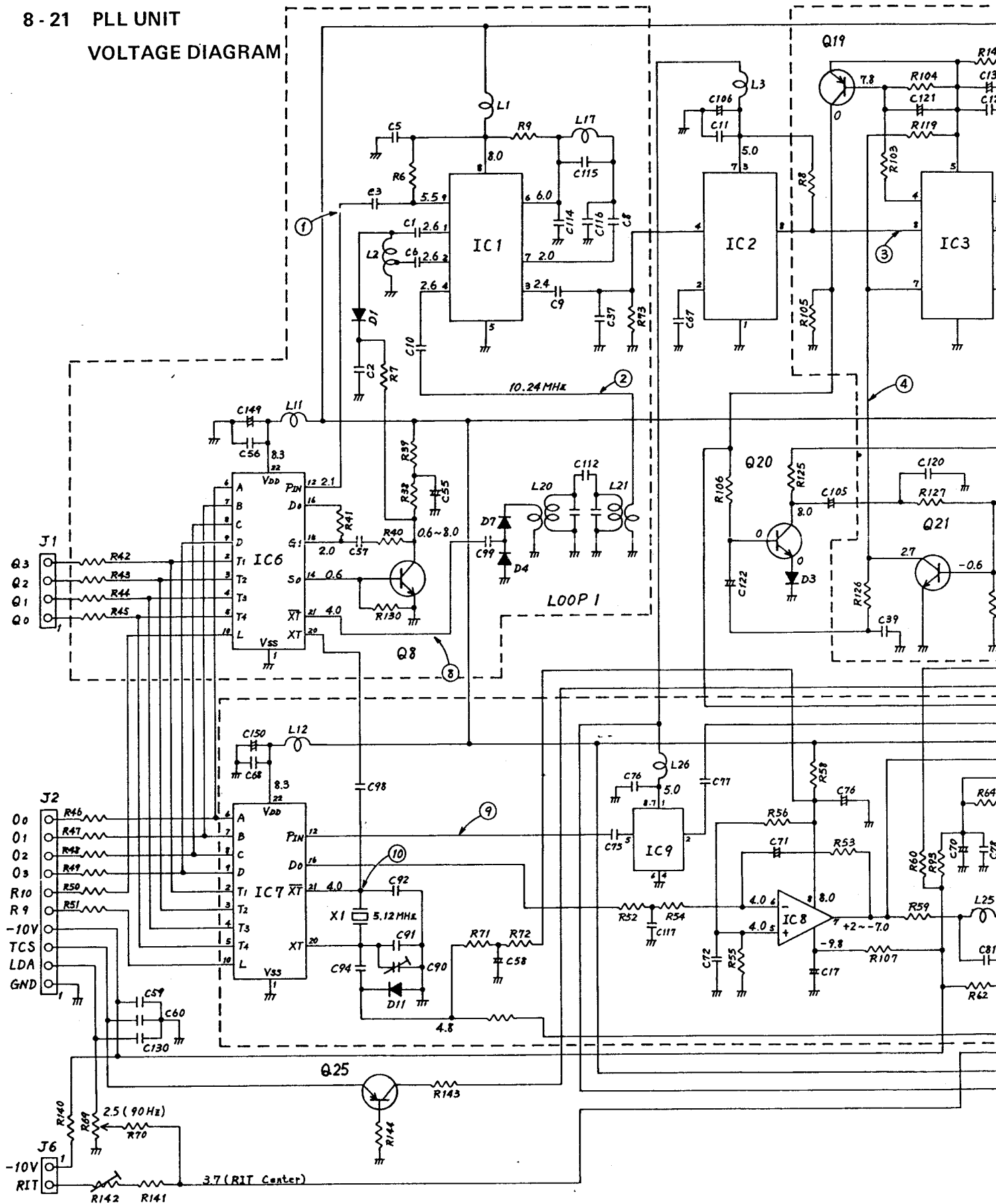
# 8 - 20 LOGIC UNIT VOLTAGE WAVEFORMS





# 8-21 PLL UNIT

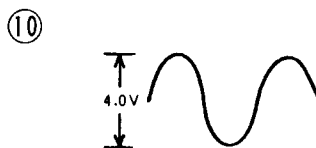
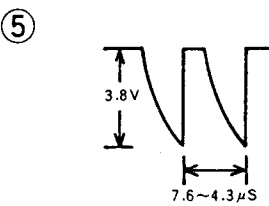
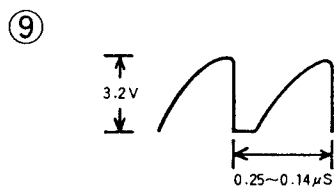
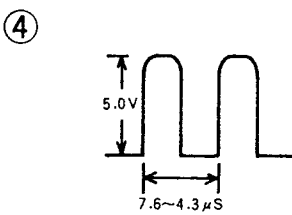
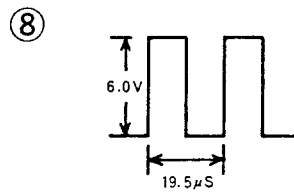
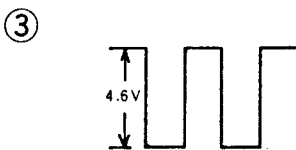
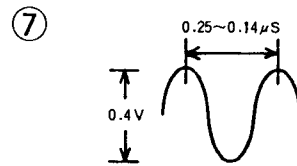
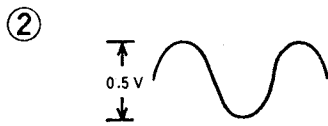
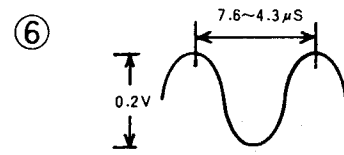
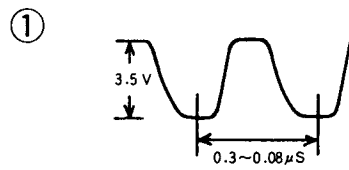
## VOLTAGE DIAGRAM



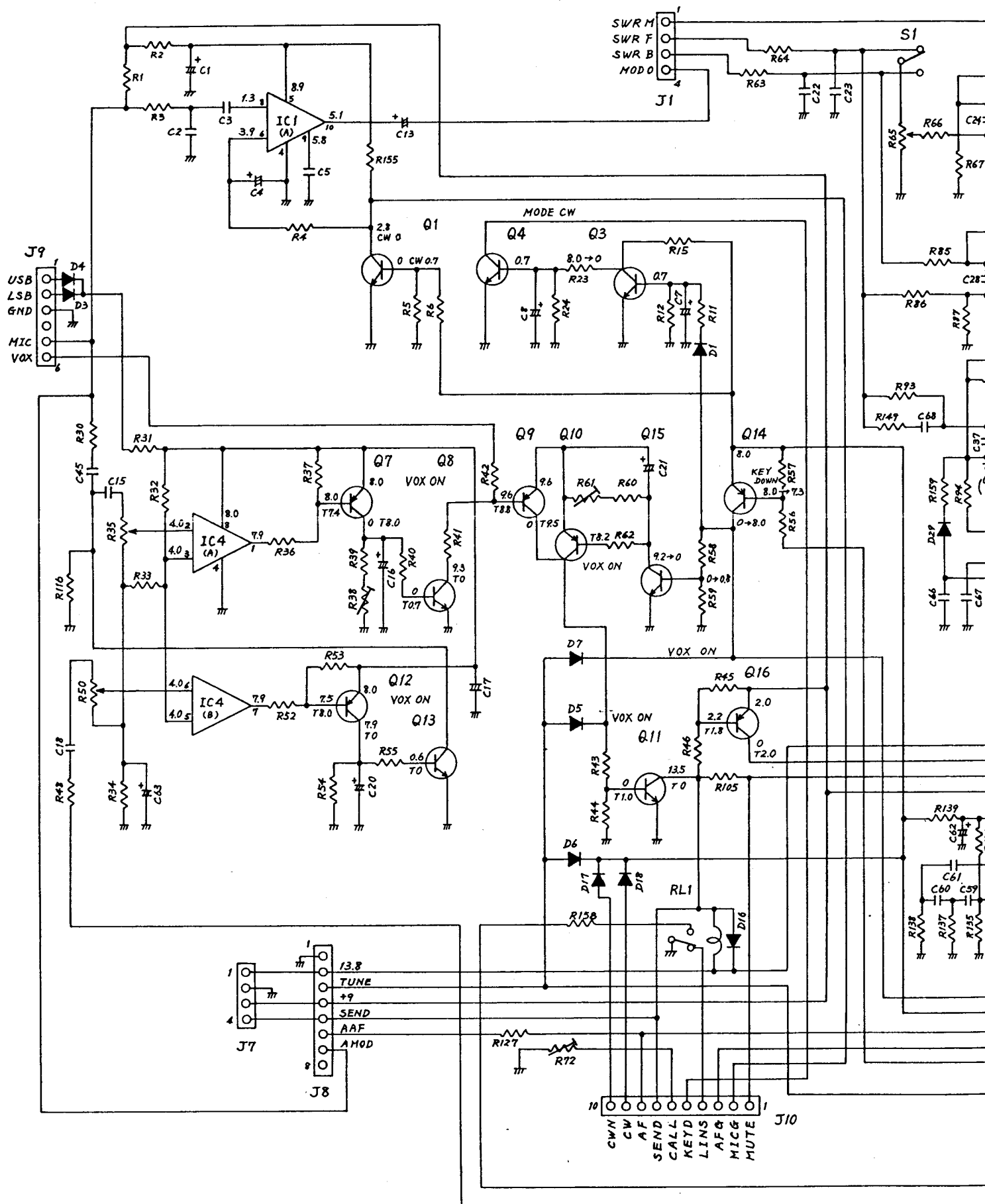




## 8 - 22 PLL UNIT VOLTAGE WAVEFORMS



# 8-23 MAIN UNIT VOLTAGE DIAGRAM

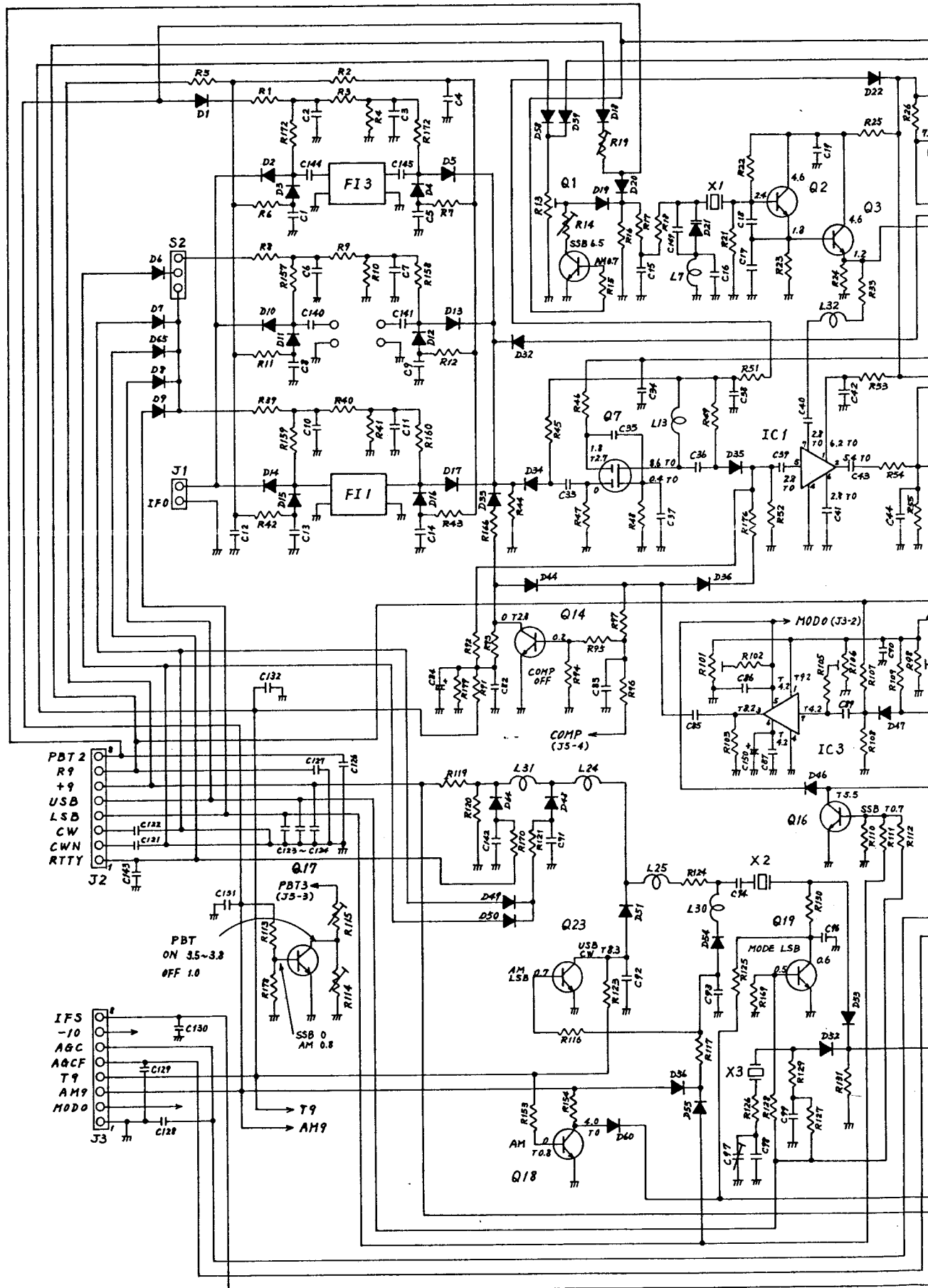


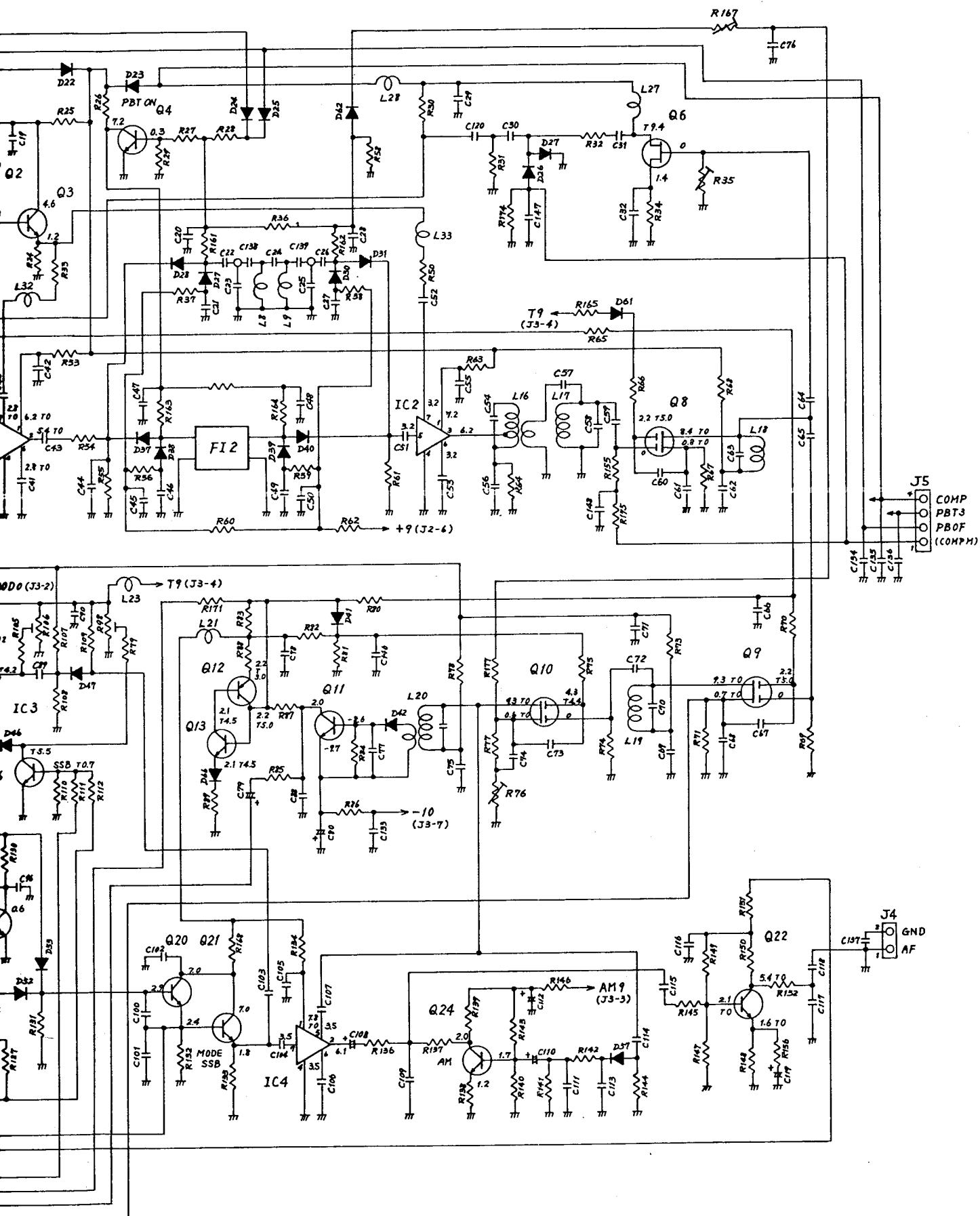


The diagram illustrates a 100-MHz, 100-Watt transmitter circuit. It is a single-page layout with a grid background. The circuit includes several input and output connectors: J1 (SCOP, TRV0, GND, TX, GND, RX), J2 (B8, B7, B6, B5, B4, B3, B2, B1, B0, LATT), J3 (C5, C6, C7, C8, C9, C10, C11, C12, C13, R9), and J9 (LBA, GND). The main circuit consists of a matching network (L1, L2, C1, C2, D1, D2, R1, R2), a driver stage (L3, L4, C3, C4, D3, D4, R3, R4, C5, C6, D5, D6, L5, L6, L7, L8, L9, L10, L11, L12, C7, C8, C9, C10, C11, C12, C13, C14, C15, C16, C17, C18, C19, C20, C21, C22, C23, C24, C25, C26, C27, C28, C29, C30, C31, C32, C33, C34, C35, C36, C37, C38, C39, C40, C41, C42, C43, C44, C45, C46, C47, C48, C49, C50, C51, C52, C53, C54, C55, C56, C57, C58, C59, C60, C61, C62, C63, C64, C65, C66, C67, C68, C69, C70, C71, C72, C73, C74, C75, C76, C77, C78, C79, C80, C81, C82, C83, C84, C85, C86, C87, C88, C89, C90, C91, C92, C93, C94, C95, C96, C97, C98, C99, C100, C101, C102, C103, C104, C105, C106, C107, C108, C109, C110, C111, C112, C113, C114, C115, C116, C117, C118, C119, C120, C121, C122, C123, C124, C125, C126, C127, C128, C129, C130, C131, C132, C133, C134, C135, C136, C137, C138, C139, C140, C141, C142, C143, C144, C145, C146, C147, C148, C149, C150, C151, C152, C153, C154, C155, C156, C157, C158, C159, C160, C161, C162, C163, C164, C165, C166, C167, C168, C169, C170, C171, C172, C173, C174, C175, C176, C177, C178, C179, C180, C181, C182, C183, C184, C185, C186, C187, C188, C189, C190, C191, C192, C193, C194, C195, C196, C197, C198, C199, C200, C201, C202, C203, C204, C205, C206, C207, C208, C209, C210, C211, C212, C213, C214, C215, C216, C217, C218, C219, C220, C221, C222, C223, C224, C225, C226, C227, C228, C229, C230, C231, C232, C233, C234, C235, C236, C237, C238, C239, C240, C241, C242, C243, C244, C245, C246, C247, C248, C249, C250, C251, C252, C253, C254, C255, C256, C257, C258, C259, C260, C261, C262, C263, C264, C265, C266, C267, C268, C269, C270, C271, C272, C273, C274, C275, C276, C277, C278, C279, C280, C281, C282, C283, C284, C285, C286, C287, C288, C289, C290, C291, C292, C293, C294, C295, C296, C297, C298, C299, C300, C301, C302, C303, C304, C305, C306, C307, C308, C309, C310, C311, C312, C313, C314, C315, C316, C317, C318, C319, C320, C321, C322, C323, C324, C325, C326, C327, C328, C329, C330, C331, C332, C333, C334, C335, C336, C337, C338, C339, C340, C341, C342, C343, C344, C345, C346, C347, C348, C349, C350, C351, C352, C353, C354, C355, C356, C357, C358, C359, C360, C361, C362, C363, C364, C365, C366, C367, C368, C369, C370, C371, C372, C373, C374, C375, C376, C377, C378, C379, C380, C381, C382, C383, C384, C385, C386, C387, C388, C389, C390, C391, C392, C393, C394, C395, C396, C397, C398, C399, C400, C401, C402, C403, C404, C405, C406, C407, C408, C409, C410, C411, C412, C413, C414, C415, C416, C417, C418, C419, C420, C421, C422, C423, C424, C425, C426, C427, C428, C429, C430, C431, C432, C433, C434, C435, C436, C437, C438, C439, C440, C441, C442, C443, C444, C445, C446, C447, C448, C449, C450, C451, C452, C453, C454, C455, C456, C457, C458, C459, C460, C461, C462, C463, C464, C465, C466, C467, C468, C469, C470, C471, C472, C473, C474, C475, C476, C477, C478, C479, C480, C481, C482, C483, C484, C485, C486, C487, C488, C489, C490, C491, C492, C493, C494, C495, C496, C497, C498, C499, C500, C501, C502, C503, C504, C505, C506, C507, C508, C509, C510, C511, C512, C513, C514, C515, C516, C517, C518, C519, C520, C521, C522, C523, C524, C525, C526, C527, C528, C529, C530, C531, C532, C533, C534, C535, C536, C537, C538, C539, C540, C541, C542, C543, C544, C545, C546, C547, C548, C549, C550, C551, C552, C553, C554, C555, C556, C557, C558, C559, C560, C561, C562, C563, C564, C565, C566, C567, C568, C569, C570, C571, C572, C573, C574, C575, C576, C577, C578, C579, C580, C581, C582, C583, C584, C585, C586, C587, C588, C589, C590, C591, C592, C593, C594, C595, C596, C597, C598, C599, C600, C601, C602, C603, C604, C605, C606, C607, C608, C609, C610, C611, C612, C613, C614, C615, C616, C617, C618, C619, C620, C621, C622, C623, C624, C625, C626, C627, C628, C629, C630, C631, C632, C633, C634, C635, C636, C637, C638, C639, C640, C641, C642, C643, C644, C645, C646, C647, C648, C649, C650, C651, C652, C653, C654, C655, C656, C657, C658, C659, C660, C661, C662, C663, C664, C665, C666, C667, C668, C669, C670, C671, C672, C673, C674, C675, C676, C677, C678, C679, C680, C681, C682, C683, C684, C685, C686, C687, C688, C689, C690, C691, C692, C693, C694, C695, C696, C697, C698, C699, C700, C701, C702, C703, C704, C705, C706, C707, C708, C709, C710, C711, C712, C713, C714, C715, C716, C717, C718, C719, C720, C721, C722, C723, C724, C725, C726, C727, C728, C729, C730, C731, C732, C733, C734, C735, C736, C737, C738, C739, C740, C741, C742, C743, C744, C745, C746, C747, C748, C749, C750, C751, C752, C753, C754, C755, C756, C757, C758, C759, C760, C761, C762, C763, C764, C765, C766, C767, C768, C769, C770, C771, C772, C773, C774,

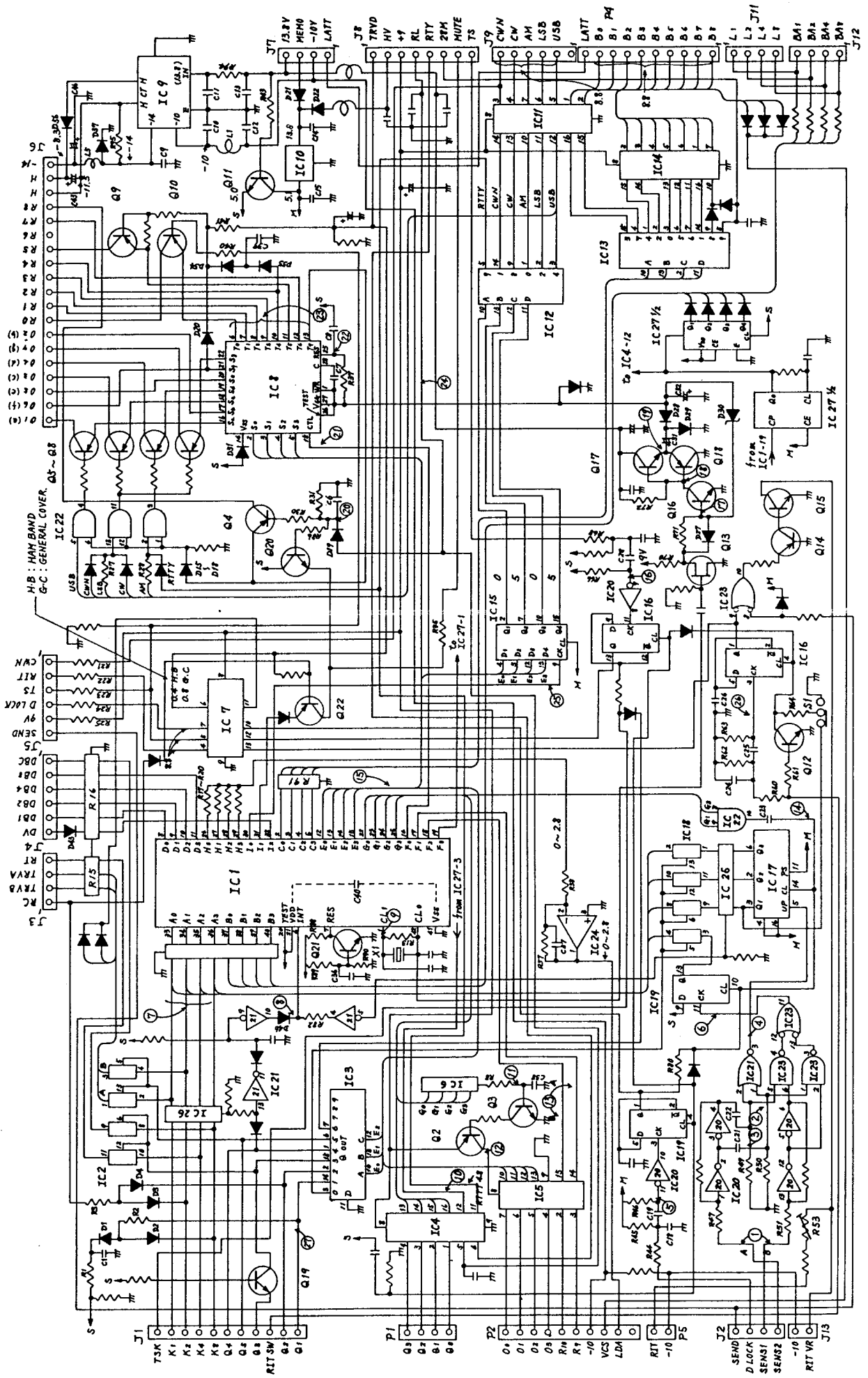


# 8-25 IF UNIT VOLTAGE DIAGRAM



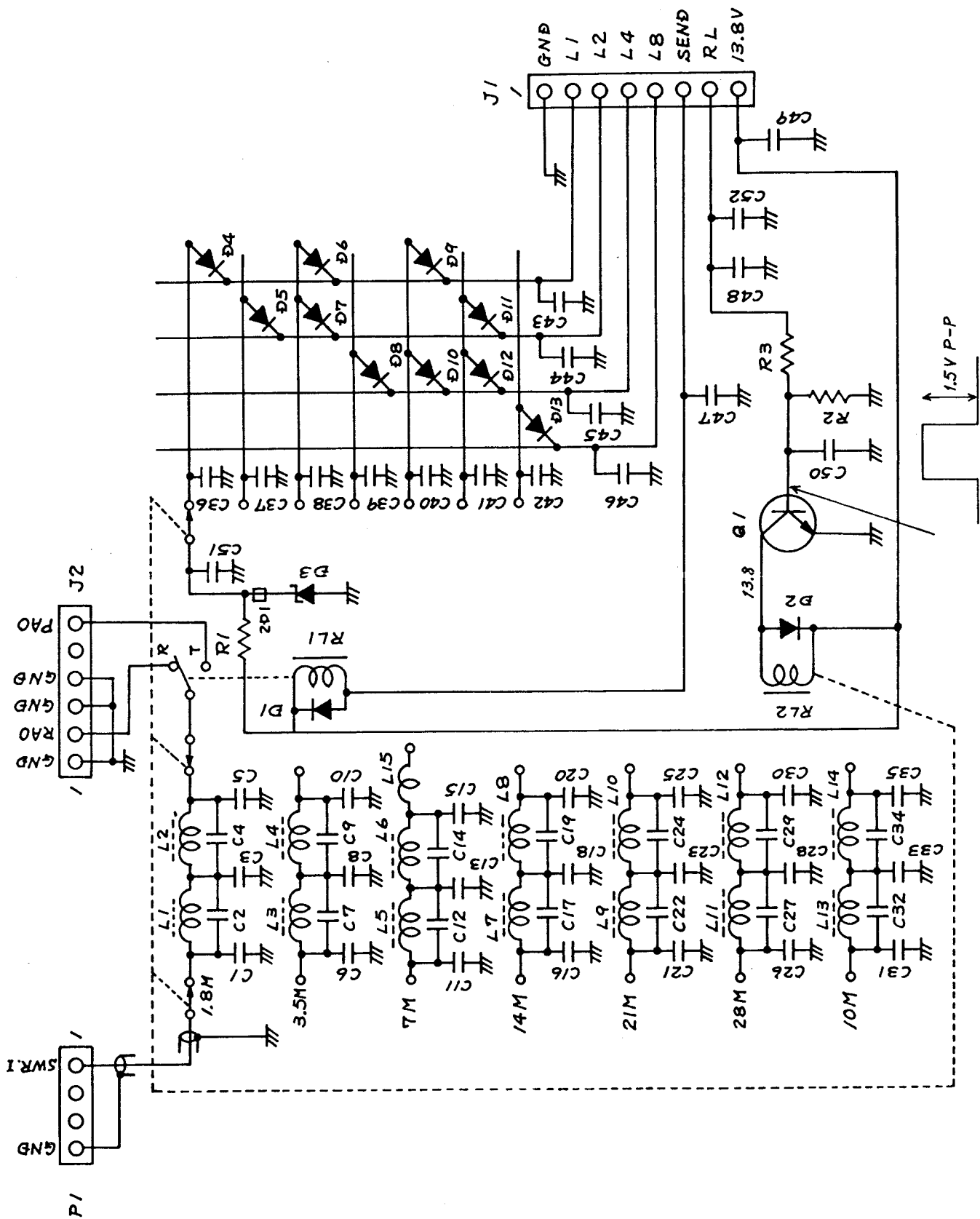


8-26 LOGIC UNIT VOLTAGE DIAGRAM





# 8-27 FILTER UNIT VOLTAGE DIAGRAM



# 8-28 DRIVER UNIT VOLTAGE DIAGRAM

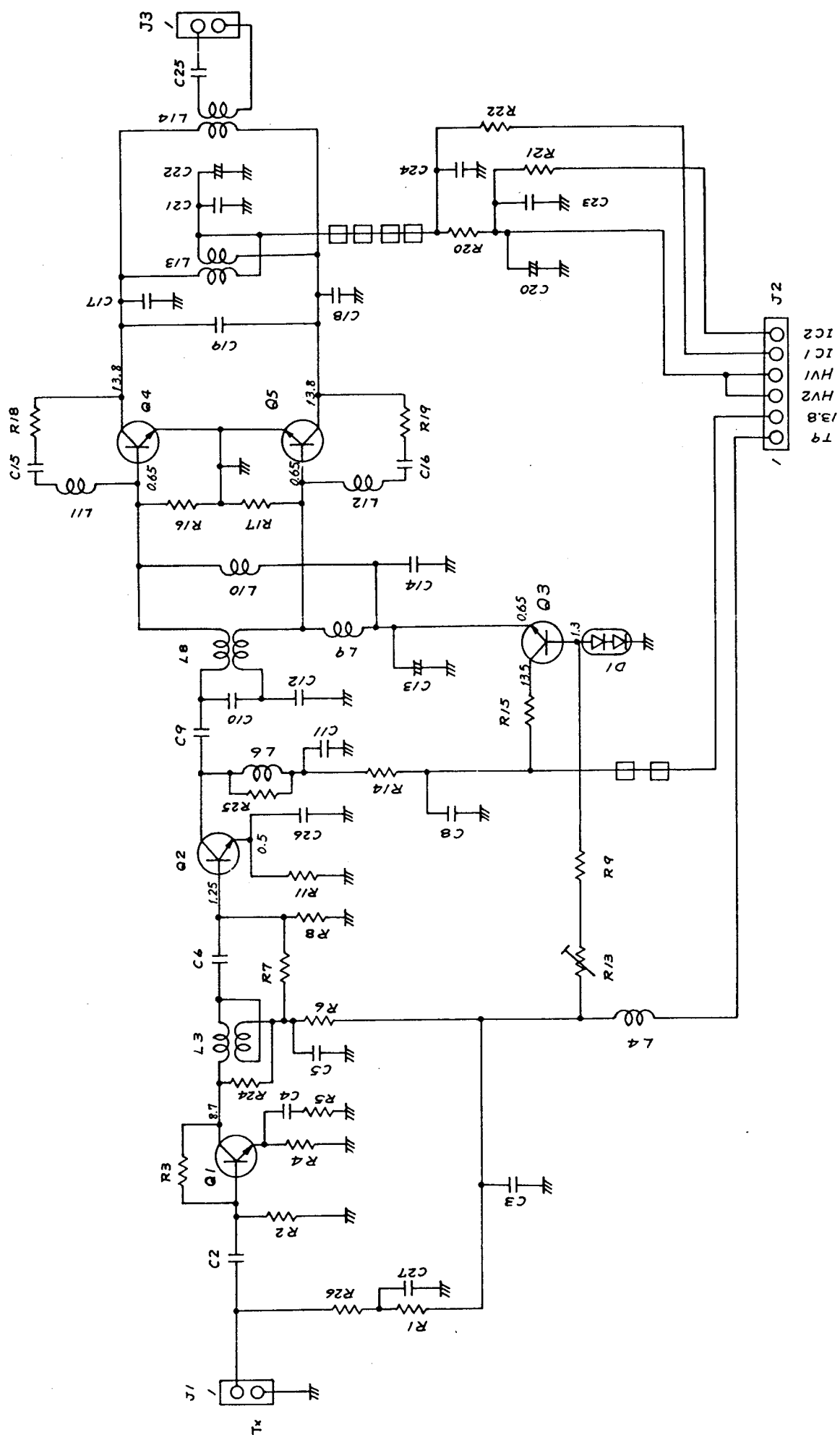
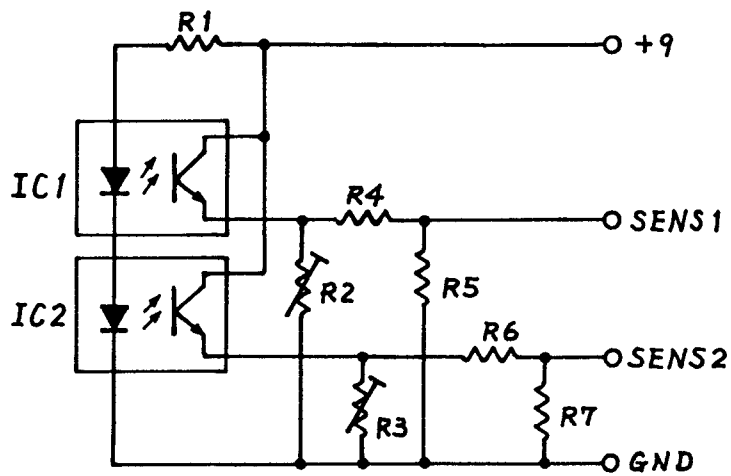
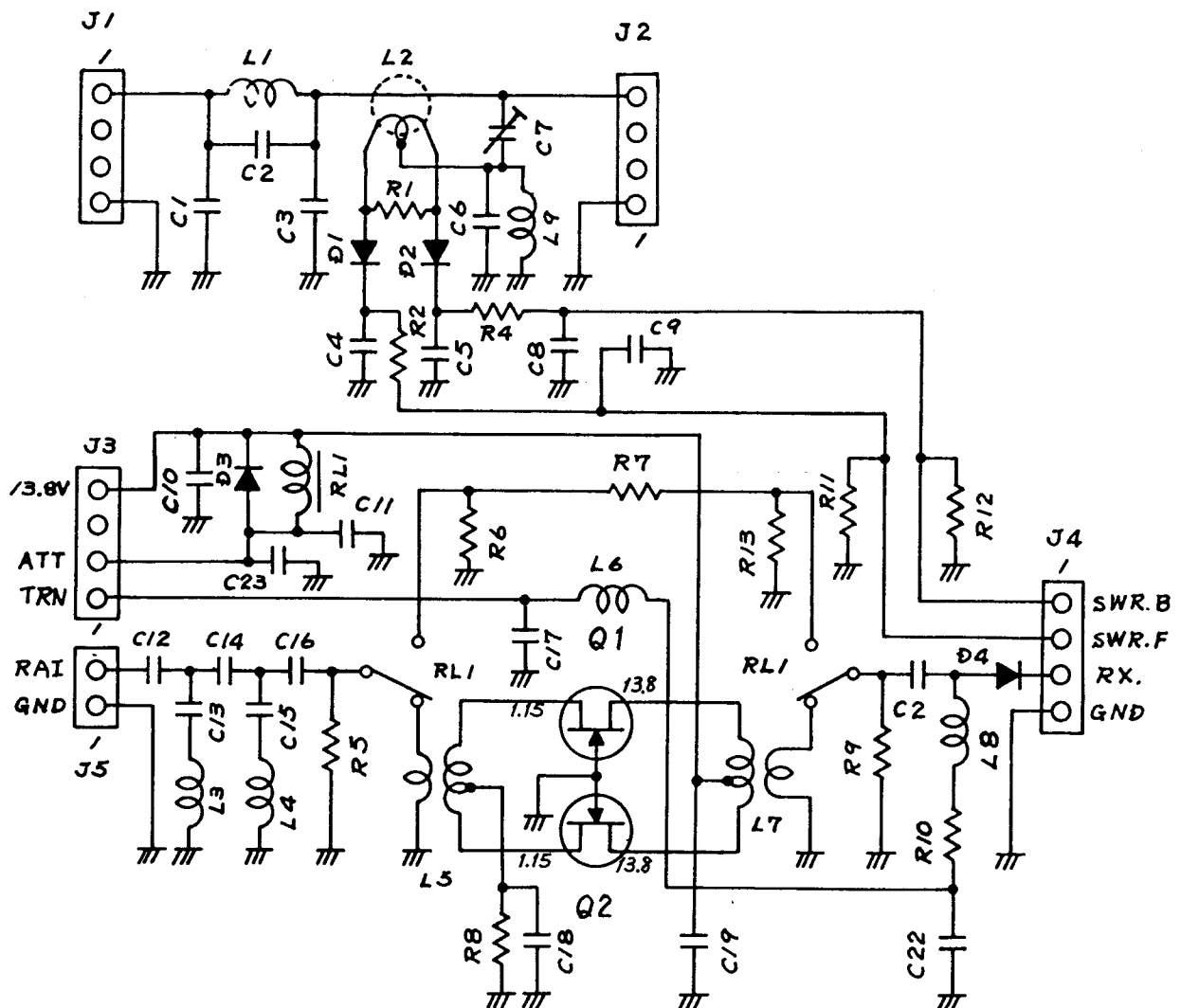


FIG. 1-29 PA UNIT CIRCUIT DIAGRAM

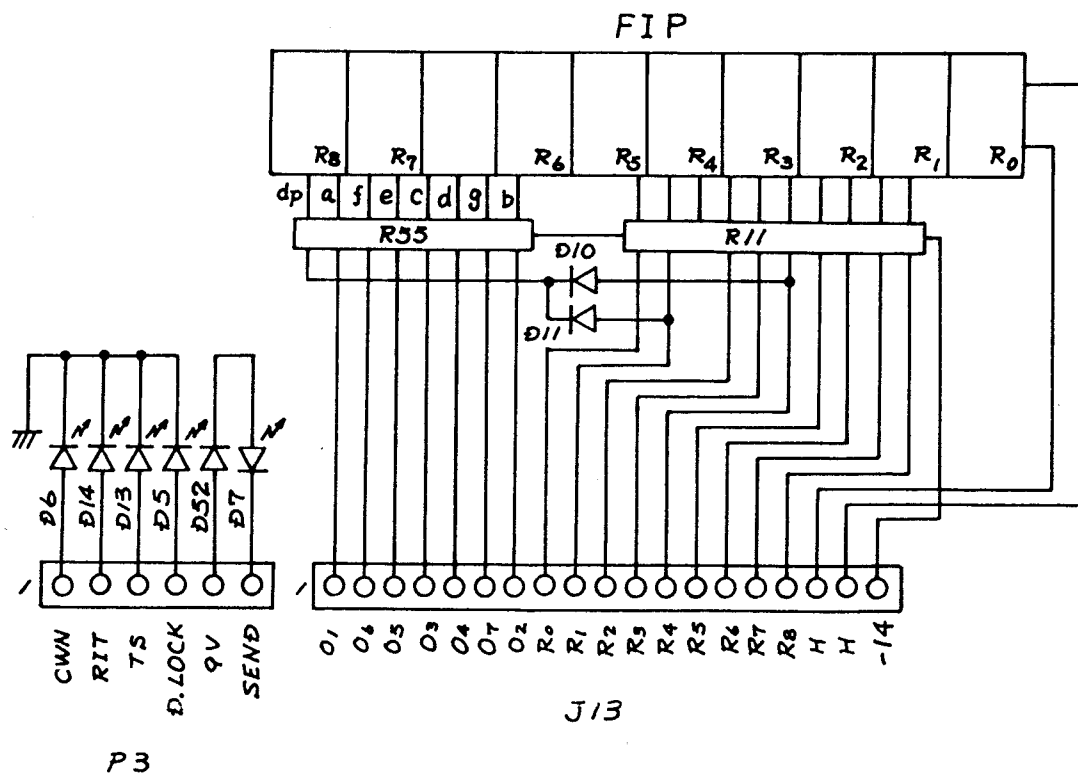
# 8-30 SENSOR UNIT CIRCUIT DIAGRAM



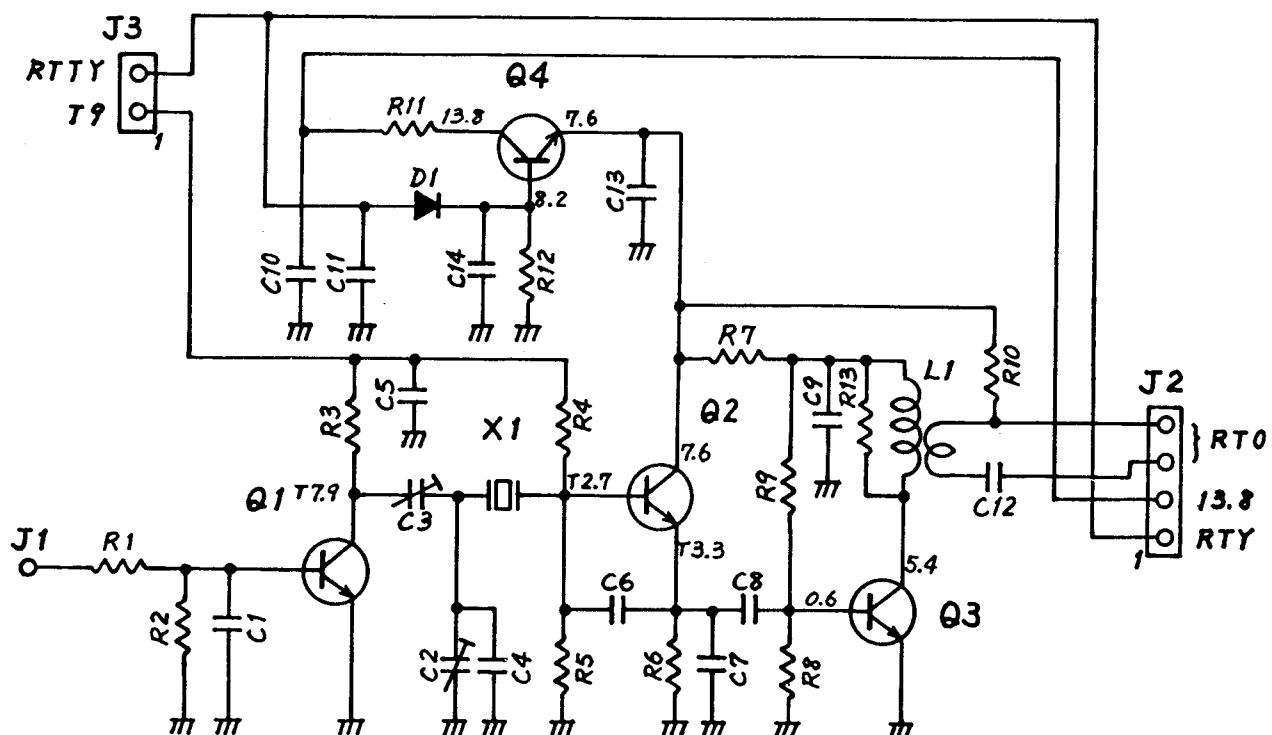
# 8-31 SWR UNIT CIRCUIT DIAGRAM



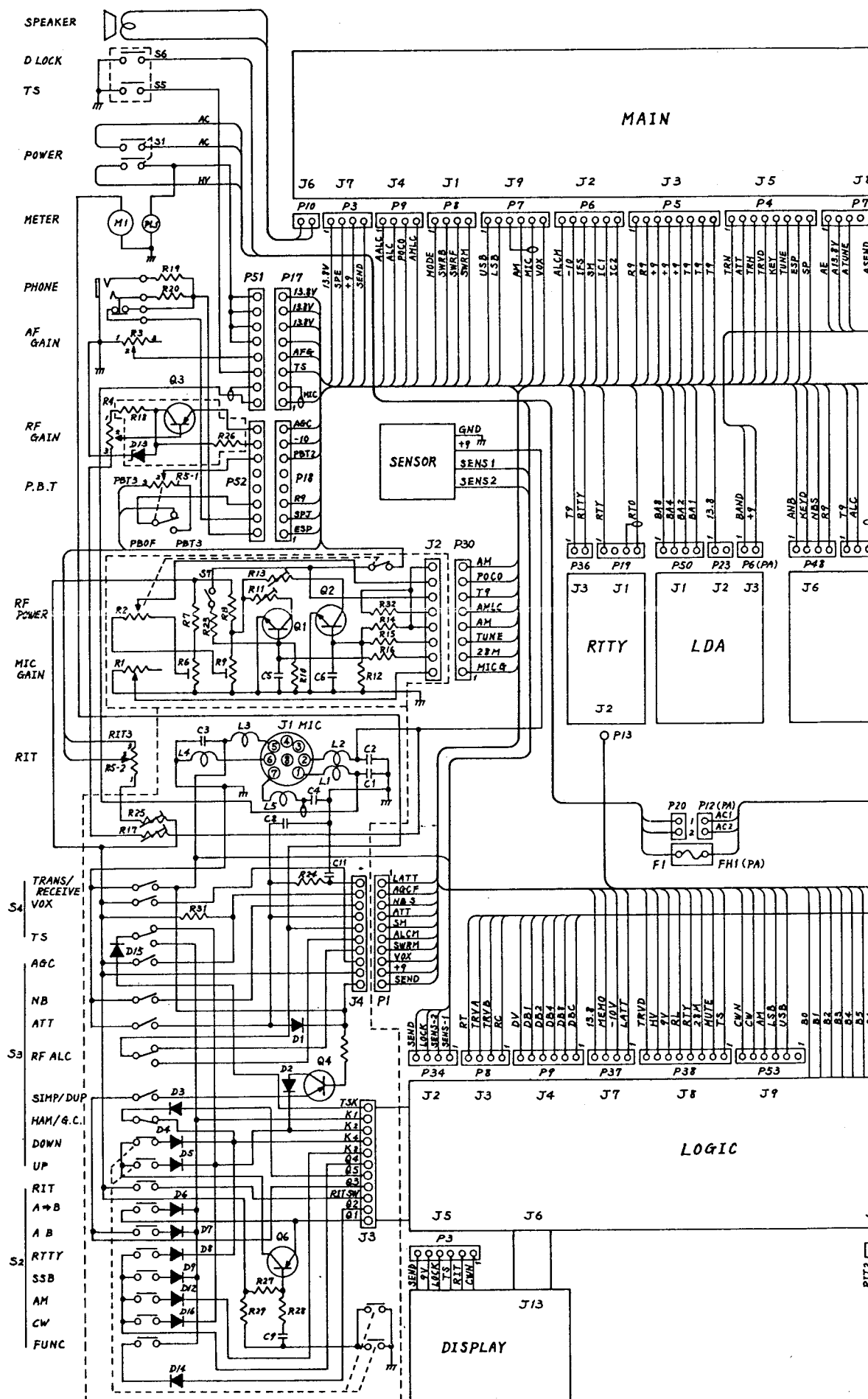
8-31 DISPLAY UNIT CIRCUIT DIAGRAM

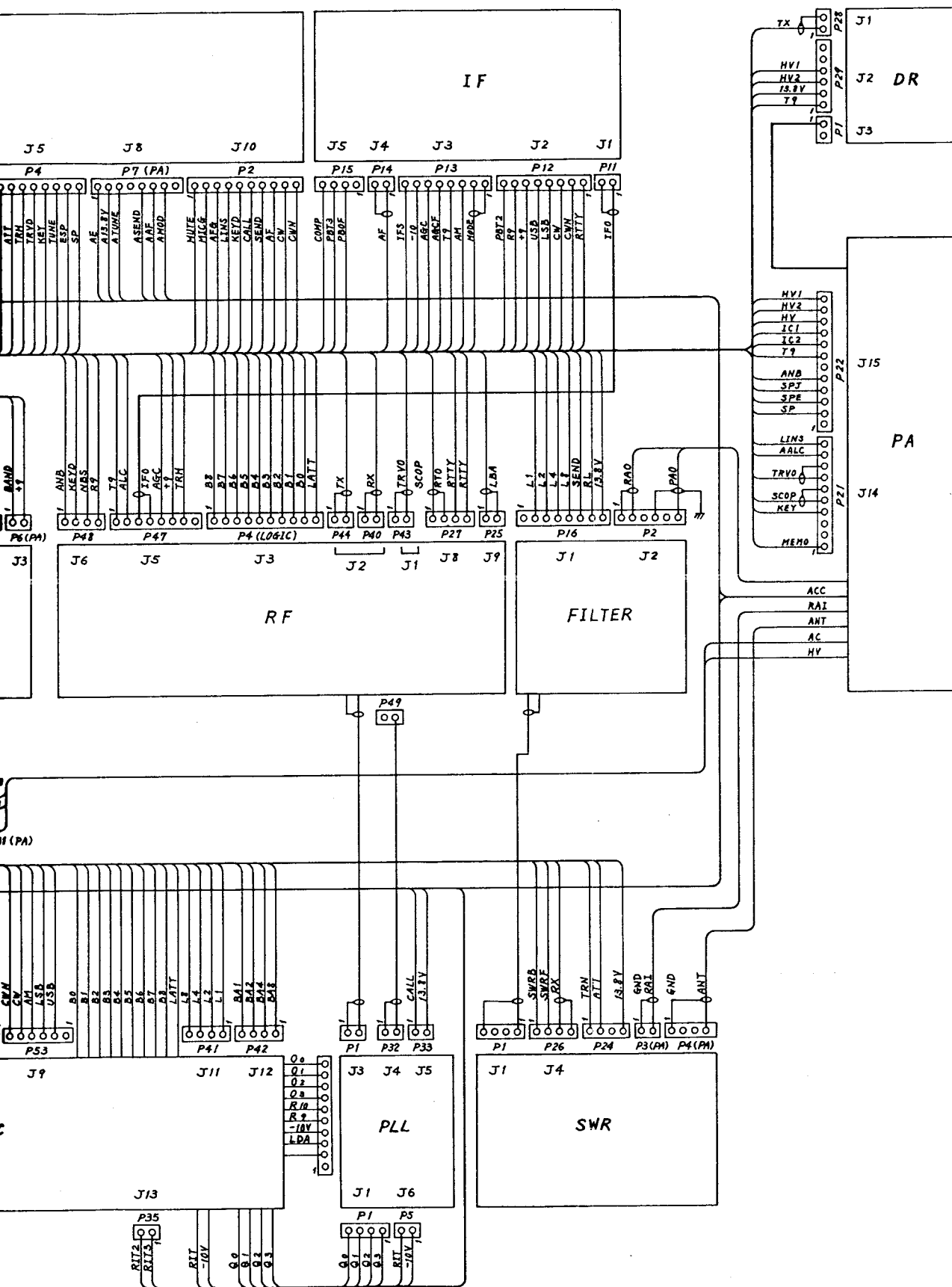


8-32 RTTY UNIT VOLTAGE DIAGRAM

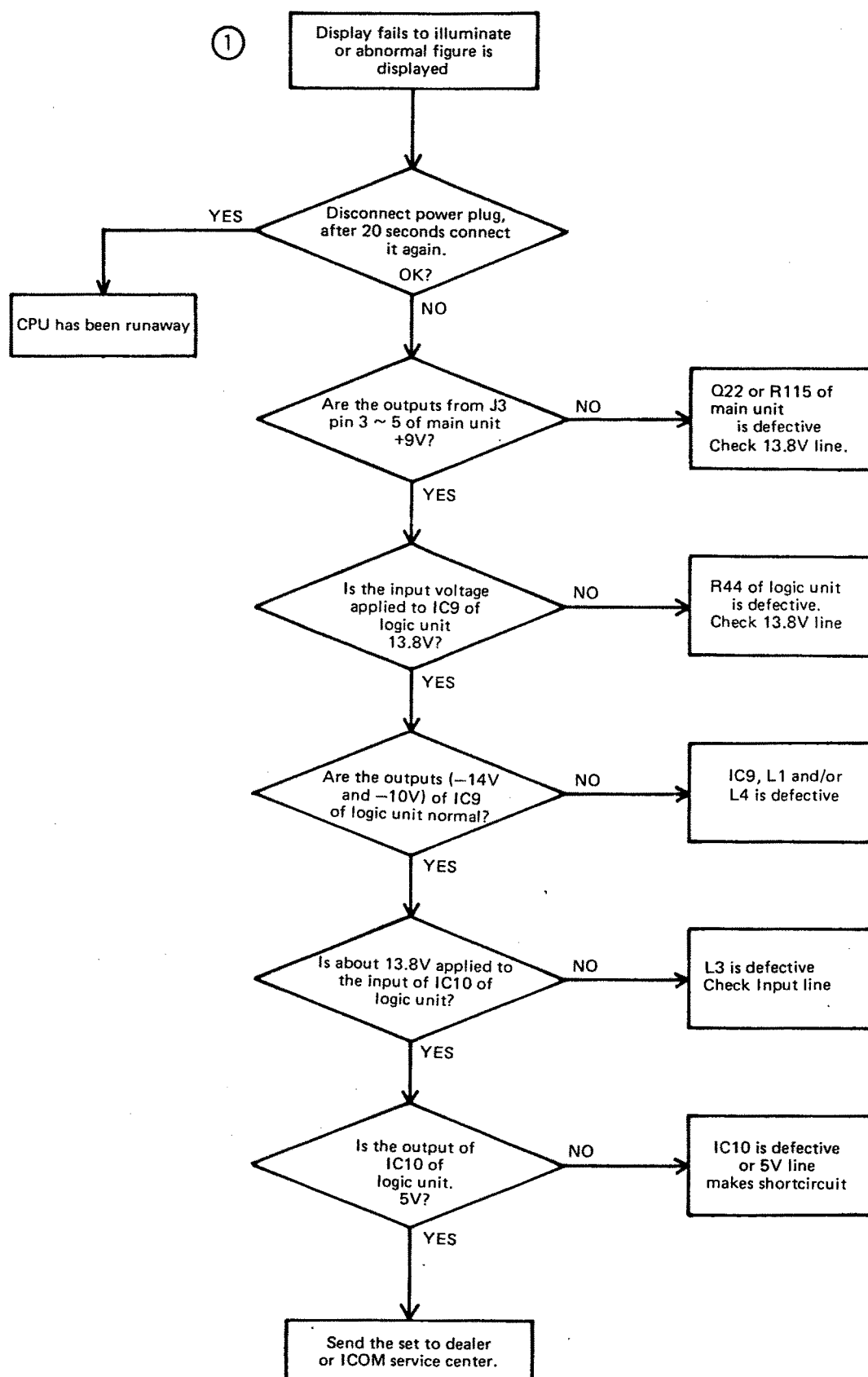


### 8-33 EF UNIT CIRCUIT

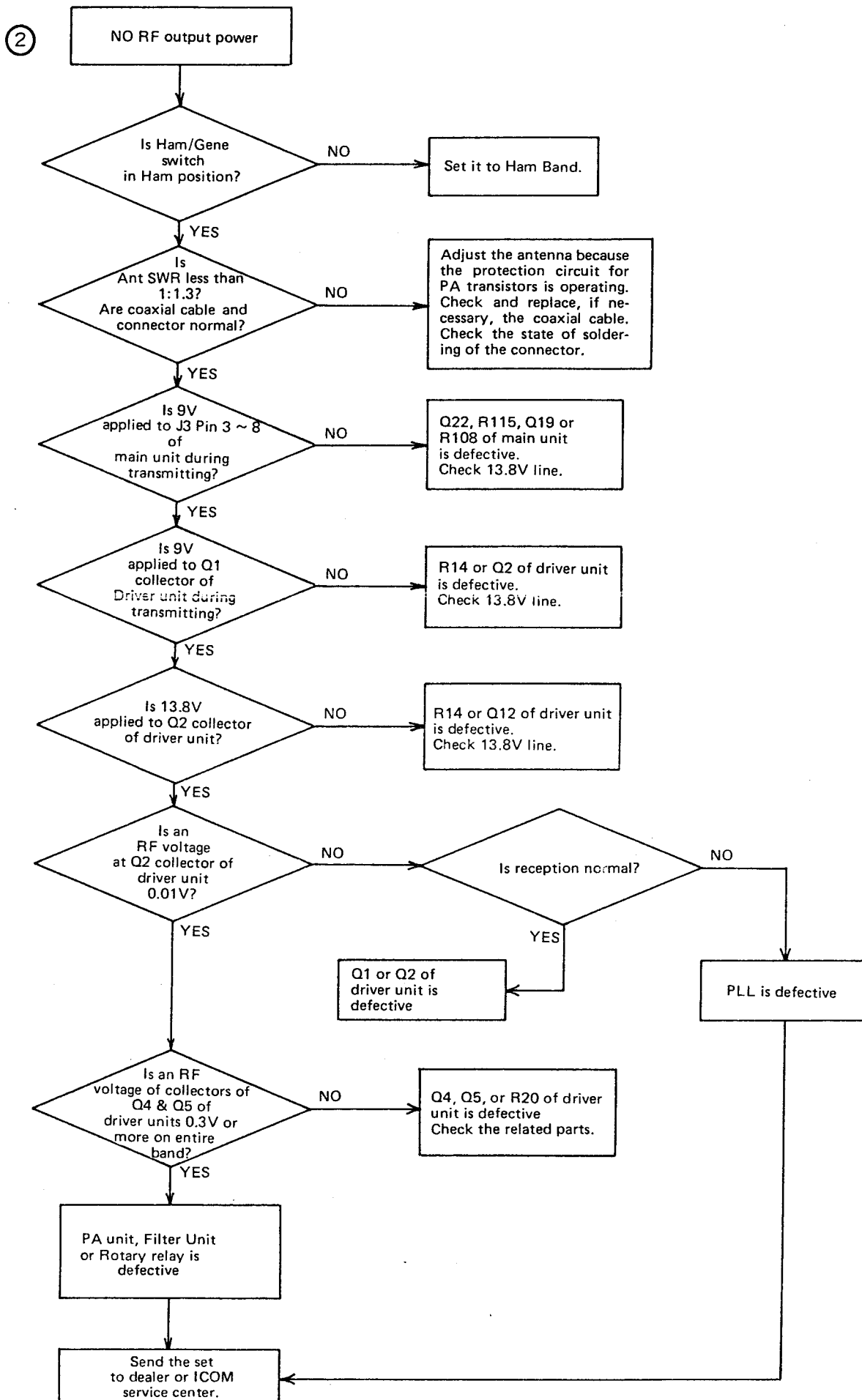


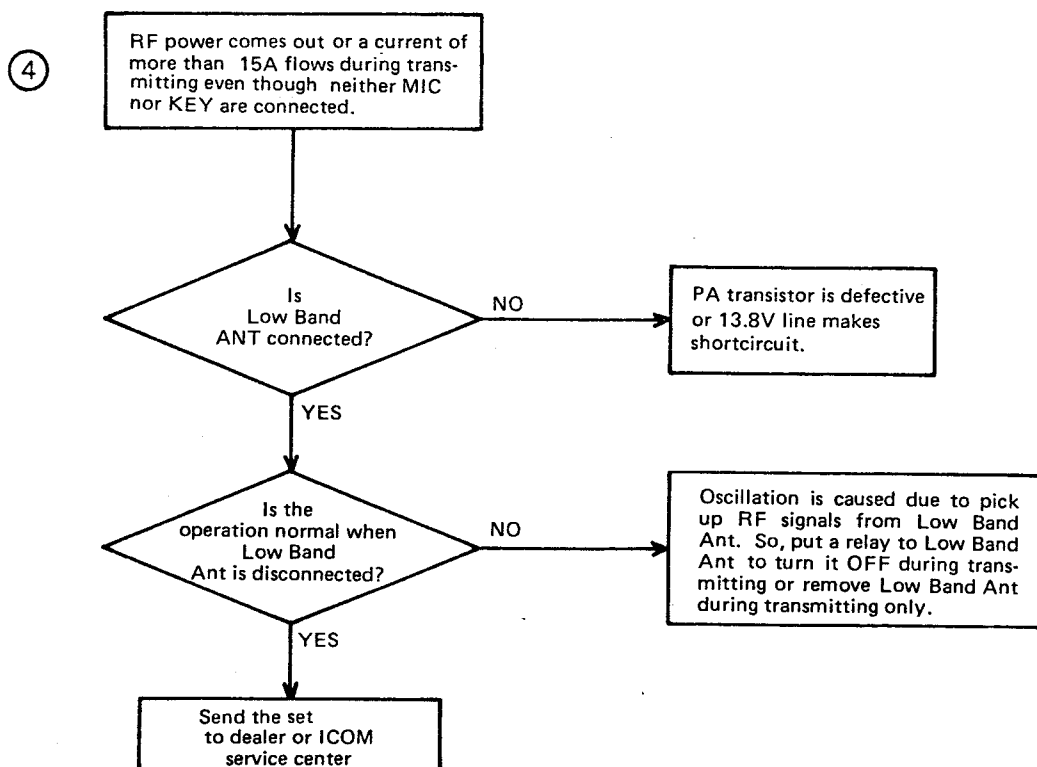
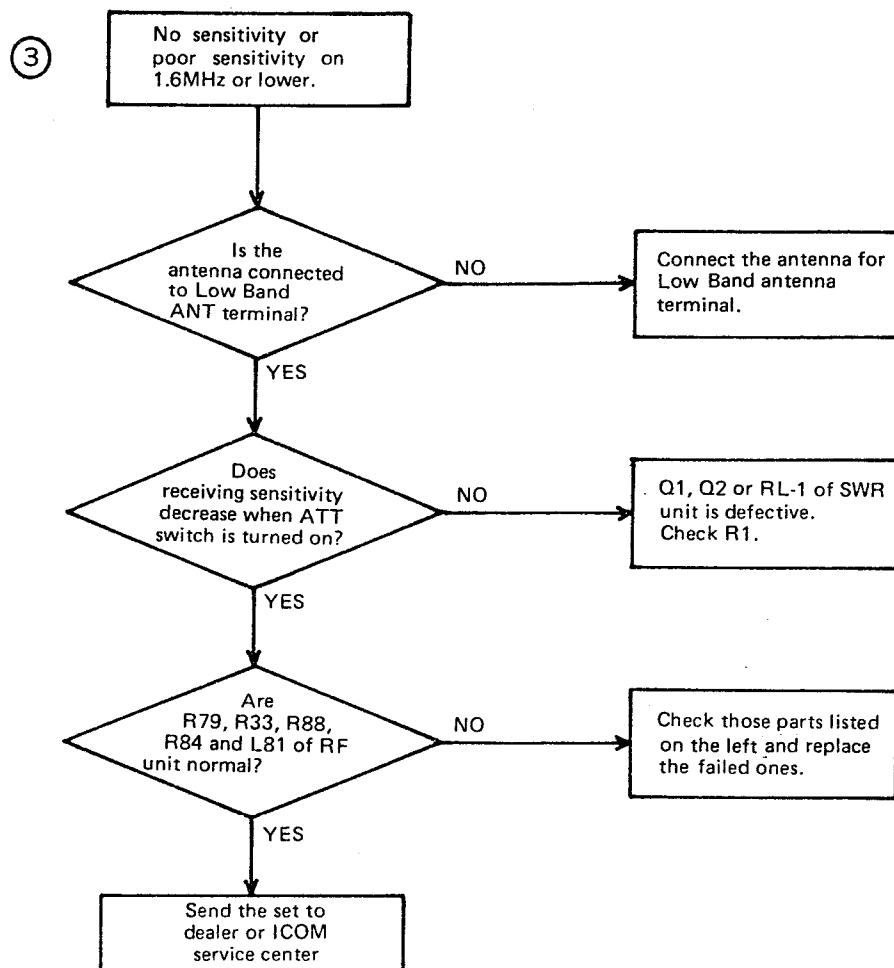


## SECTION 9 TROUBLESHOOTING









## SECTION 10 PARTS LIST

Parts employed in the circuits of this model are listed from the next page on. Some of them (marked \*) have been changed for further improvement of equipment performance.

Those parts are listed below for your reference.

| UNIT | REF No.  | AFTER MODIFICATION | BEFORE MODIFICATION |
|------|----------|--------------------|---------------------|
| EF   | R3       | PR-16 15KC         | VM10A 10KA          |
|      |          |                    |                     |
| MAIN | D29      | 1SS53              | ADDED               |
|      | R97      | 2.2K ELR25         | 47K ELR25           |
|      | R158     | 1M ELR25           | ADDED               |
|      | R159     | 1.8M ELR25         | ADDED               |
|      |          |                    |                     |
|      |          |                    |                     |
| IF   | C150     | 10 $\mu$ 16V       | ADDED               |
|      |          |                    |                     |
|      |          |                    |                     |
| PA   | Q4       | DELETED            | 2SC945              |
|      | D3       | DELETED            | GP-08B              |
|      | R15      | 100 R50            | 3.3K ELR25          |
|      | R16      | 56 R25             | 47K ELR25           |
|      | C2       | 100P 50VB          | 150P 50V            |
|      | DC MOTOR | M9N12T24-5         | M9T 12L20           |
|      |          |                    |                     |
|      |          |                    |                     |
| Dr   | L2       | DELETED            | EL0810SKI-101K      |
|      | R1       | 47 ELR25           | 100 ELR25           |
|      | R9       | 100 ELR25          | 330 ELR25           |
|      | R26      | 68 ELR25           | ADDED               |
|      | C27      | 0.047              | ADDED               |
|      |          |                    |                     |
|      |          |                    |                     |
| PLL  | Q25      | 2SA1048            | ADDED               |
|      | D15      | DELETED            | WZ-036              |
|      | D20      | 1SS85              | 1S2692A             |
|      | D21      | 1SS85              | 1S2692A             |
|      | R65      | 4.7K ELR25         | 10K ELR25           |
|      | R96      | 4.7K ELR25         | 10K ELR25           |
|      | R143     | 470 ELR25          | ADDED               |
|      | R144     | 22K ELR25          | ADDED               |
|      | C70      | 100 $\mu$ BP10V    | 4.7 $\mu$ BP50V     |
|      |          |                    |                     |
|      |          |                    |                     |
|      |          |                    |                     |

[illegible]

## [EF] UNIT

| REF. NO. | DESCRIPTION | PART NO.              |  |
|----------|-------------|-----------------------|--|
| Q1       | Transistor  | 2SC945P               |  |
| Q2       | Transistor  | 2SC945P               |  |
| Q3       | Transistor  | 2SA1015               |  |
| Q4       | Transistor  | 2SA1015               |  |
| Q6       | Transistor  | 2SA1015               |  |
| D1       | Diode       | 1SS53                 |  |
| D2       | Diode       | 1SS53                 |  |
| D3       | Diode       | 1SS53                 |  |
| D4       | Diode       | 1SS53                 |  |
| D5       | Diode       | 1SS53                 |  |
| D6       | Diode       | 1SS53                 |  |
| D7       | Diode       | 1SS53                 |  |
| D8       | Diode       | 1SS53                 |  |
| D9       | Diode       | 1SS53                 |  |
| D12      | Diode       | 1SS53                 |  |
| D13      | Zener       | XZ-092                |  |
| D14      | Diode       | 1SS53                 |  |
| D15      | Diode       | 1SS53                 |  |
| D16      | Diode       | 1SS53                 |  |
| R1       | Variable    | VM10R 10KC            |  |
| R2       | Variable    | GM81R-5M1612-10KB     |  |
| *R3      | Variable    | PR-16 15KC            |  |
| R4       | Variable    | VM10A 10KA            |  |
| R5       | Variable    | DM11A-5H1222-10KB x 2 |  |
| R6       | Trimmer     | WHS512A 1K            |  |
| R7       | Resistor    | 4.7K ELR25            |  |
| R8       | Resistor    | 560 ELR25             |  |
| R9       | Trimmer     | WHS512A 1K            |  |
| R10      | Resistor    | 47K ELR25             |  |
| R11      | Trimmer     | WHS512A 4.7K          |  |
| R12      | Resistor    | 47K ELR25             |  |
| R13      | Trimmer     | WHS512A 2.2K          |  |
| R14      | Resistor    | 47K ELR25             |  |
| R15      | Resistor    | 47K ELR25             |  |
| R16      | Resistor    | 47K ELR25             |  |
| R17      | Trimmer     | RGP053 10K            |  |
| R18      | Resistor    | 10K R25               |  |
| R19      | Resistor    | 100 R25               |  |
| R20      | Resistor    | 100 R25               |  |
| R23      | Resistor    | 47K R25               |  |
| R24      | Resistor    | 150 R25               |  |
| R25      | Trimmer     | RGP053 20K            |  |
| R26      | Resistor    | 180 R25               |  |
| R27      | Resistor    | 220K R25              |  |
| R28      | Resistor    | 22K R25               |  |
| R29      | Resistor    | 4.7K R25              |  |
| R30      | Resistor    | 10K R25               |  |
| R31      | Resistor    | 1M R25                |  |
| R32      | Resistor    | 10K ELR25             |  |
| C1       | Ceramic     | 0.0022 50V            |  |
| C2       | Ceramic     | 0.0022 50V            |  |
| C3       | Ceramic     | 0.0022 50V            |  |
| C4       | Ceramic     | 0.0022 50V            |  |
| C5       | Ceramic     | 0.0047 50V            |  |
| C6       | Ceramic     | 0.0047 50V            |  |
| C9       | Electroly   | 1 $\mu$ 50V           |  |
| C11      | Barrier L.  | 0.1 12V               |  |
| C12      | Barrier L.  | 0.1 12V               |  |
| L1       | Choke       | 101 L4                |  |

## [EF] UNIT

| REF. NO. | DESCRIPTION | PART NO.     |  |
|----------|-------------|--------------|--|
| L2       | Choke       | 101 L4       |  |
| L3       | Choke       | 101 L4       |  |
| L4       | Choke       | 101 L4       |  |
| L5       | Choke       | 101 L4       |  |
|          | Flat cable  | 11 80m/m     |  |
|          | Flat cable  | 19 80m/m     |  |
|          | SP          | 65S-03       |  |
| M1       | Meter       |              |  |
| PL1      | Lamp        | BQ044-32582A |  |
| S1       | Switch      | TW0068       |  |
| S2       | Push switch | SUT (1)      |  |
| S3       | Push switch | SUT (2)      |  |
| S4       | Push switch | SUT (3)      |  |
| S5       | Push switch |              |  |
| S6       | Push switch |              |  |
| S7       | Switch      | SSS012       |  |
| B1       | PC board    | B-388C       |  |
| B2       | PC board    | B-411        |  |
| B3       | PC board    | B-406C       |  |
| J1       | Connector   | FM214-8SS    |  |
| J2       | Connector   | 5045-08A     |  |
| J3       | Connector   | HBLB11R-1J   |  |
| J4       | Connector   | 3094-10A     |  |
| J5       | Connector   | LJ-035-1-2   |  |
| P1       | Connector   | 5250-10A     |  |
| P2       | Connector   | 5250-10A     |  |
| P3       | Connector   | 5250-04A     |  |
| P4       | Connector   | 5250-08A     |  |
| P5       | Connector   | 5250-08A     |  |
| P6       | Connector   | 5250-06A     |  |
| P7       | Connector   | 5250-06A     |  |
| P8       | Connector   | 5250-04A     |  |
| P9       | Connector   | 5250-04A     |  |
| P10      | Connector   | 5250-02A     |  |
| P11      | Connector   | 5250-02A     |  |
| P12      | Connector   | 5250-08A     |  |
| P13      | Connector   | 5250-08A     |  |
| P14      | Connector   | 5250-02A     |  |
| P15      | Connector   | 5250-04A     |  |
| P16      | Connector   | 5250-08A     |  |
| P17      | Connector   | SMP-08V-B    |  |
| P18      | Connector   | SMP-08V-B    |  |
| P19      | Connector   | 5250-04A     |  |
| P20      | Connector   | 1545P-1      |  |
| P21      | Connector   | 5250-10A     |  |
| P22      | Connector   | 5250-12A     |  |
| P23      | Connector   | 5250-02A     |  |
| P24      | Connector   | 5250-04A     |  |
| P25      | Connector   | 5250-02A     |  |
| P26      | Connector   | 5250-04A     |  |
| P27      | Connector   | 5250-04A     |  |
| P28      | Connector   | 5250-02A     |  |
| P29      | Connector   | 5250-06A     |  |
| P30      | Connector   | 5250-08A     |  |
| P32      | Connector   | 5250-02A     |  |
| P33      | Connector   | 5250-02A     |  |

## [EF] UNIT

| REF. NO. | DESCRIPTION | PART NO.  |
|----------|-------------|-----------|
| P34      | Connector   | 5250-04A  |
| P35      | Connector   | 5250-02A  |
| P36      | Connector   | 5250-02A  |
| P37      | Connector   | 5250-04A  |
| P38      | Connector   | 5250-08A  |
| P40      | Connector   | 5250-02A  |
| P41      | Connector   | 5250-04A  |
| P42      | Connector   | 5250-04A  |
| P43      | Connector   | 5250-02A  |
| P44      | Connector   | 5250-02A  |
| P45      | Connector   | 5250-10A  |
| P47      | Connector   | 5250-08A  |
| P48      | Connector   | 5250-04A  |
| P49      | Connector   | 5250-02A  |
| P50      | Connector   | 5250-04A  |
| P51      | Connector   | SMR-08V-B |
| P52      | Connector   | SMR-08V-B |
| P53      | Connector   | 5250-60   |
| FH1      | Fuse holder | SN11-2    |
| F1       | Fuse        | 5A        |
|          | Beads core  | 2D1       |
|          | LDA unit    | EX-182    |

## [MAIN] UNIT

| REF. NO. | DESCRIPTION | PART NO.         |
|----------|-------------|------------------|
| IC1      | IC          | AN829            |
| IC4      | IC          | NJM4558D         |
| IC5      | IC          | NJM4558D         |
| IC6      | IC          | NJM4558D         |
| IC7      | IC          | NJM4558D         |
| IC8      | IC          | μPC2002H         |
| Q1       | Transistor  | 2SC945P          |
| Q3       | Transistor  | 2SC945P          |
| Q4       | Transistor  | 2SC945P          |
| Q7       | Transistor  | 2SA1015          |
| Q8       | Transistor  | 2SC945P          |
| Q9       | Transistor  | 2SA1015          |
| Q10      | Transistor  | 2SA831 or 2SA830 |
| Q11      | Transistor  | 2SC945P          |
| Q12      | Transistor  | 2SA1015          |
| Q13      | Transistor  | 2SC945P          |
| Q14      | Transistor  | 2SA1015          |
| Q15      | Transistor  | 2SC945P          |
| Q16      | Transistor  | 2SA1015          |
| Q18      | Transistor  | 2SC945P          |
| Q19      | Transistor  | 2SD313E          |
| Q20      | Transistor  | 2SD468C          |
| Q21      | Transistor  | 2SC945P          |
| Q22      | Transistor  | 2SD313E          |
| Q23      | Transistor  | 2SC945P          |
| Q24      | Transistor  | 2SC945P          |
| Q25      | Transistor  | 2SC945P          |
| Q26      | Transistor  | 2SC945P          |
| Q27      | Transistor  | 2SB562C          |
| Q28      | Transistor  | 2SB562C          |
| Q29      | Transistor  | 2SC945P          |
| Q30      | Transistor  | 2SC945P          |
| Q31      | Transistor  | 2SC1636          |
| Q32      | Transistor  | 2SA1015          |
| D1       | Diode       | 1SS53            |
| D3       | Diode       | 1SS53            |
| D4       | Diode       | 1SS53            |
| D5       | Diode       | 1SS53            |
| D6       | Diode       | 1SS53            |
| D7       | Diode       | 1SS53            |
| D8       | Diode       | 1SS53            |
| D9       | Diode       | 1SS53            |
| D10      | Diode       | 1SS53            |
| D11      | Diode       | 1SS53            |
| D12      | Diode       | 1SS53            |
| D13      | Diode       | 1SS53            |
| D14      | Diode       | 1SS53            |
| D15      | Zener       | XZ092            |
| D16      | Diode       | 1SS53            |
| D17      | Diode       | 1SS53            |
| D18      | Diode       | 1SS53            |
| D19      | Diode       | 1SS53            |
| D20      | Diode       | 1SS53            |
| D21      | Diode       | MZ303B           |
| D22      | Diode       | 1SS97            |
| D23      | Diode       | 1SS53            |
| D24      | Diode       | 1SS53            |
| D25      | Zener       | WZ050            |
| D26      | Diode       | 1SS53            |
| D28      | Varistor    | MV-11            |
| *D29     | Diode       | 1SS53            |

## [MAIN] UNIT

| REF. NO. | DESCRIPTION | PART NO.     |
|----------|-------------|--------------|
| R1       | Resistor    | 1K ELR25     |
| R2       | Resistor    | 100 ELR25    |
| R3       | Resistor    | 1K ELR25     |
| R4       | Resistor    | 4.7K ELR25   |
| R5       | Resistor    | 47K ELR25    |
| R6       | Resistor    | 47K ELR25    |
| R11      | Resistor    | 100K ELR25   |
| R12      | Resistor    | 47K ELR25    |
| R15      | Resistor    | 47K ELR25    |
| R23      | Resistor    | 10K ELR25    |
| R24      | Resistor    | 10K ELR25    |
| R30      | Resistor    | 10K ELR25    |
| R31      | Resistor    | 100 ELR25    |
| R32      | Resistor    | 10K ELR25    |
| R33      | Resistor    | 4.7 R25      |
| R34      | Resistor    | 10K ELR25    |
| R35      | Trimmer     | SR19D 10K    |
| R36      | Resistor    | 4.7K ELR25   |
| R37      | Resistor    | 2.2K ELR25   |
| R38      | Trimmer     | SR19D 100K   |
| R39      | Resistor    | 10K ELR25    |
| R40      | Resistor    | 1M R25       |
| R41      | Resistor    | 10K ELR25    |
| R42      | Resistor    | 4.7K ELR25   |
| R43      | Resistor    | 1K ELR25     |
| R44      | Resistor    | 2.2K ELR25   |
| R45      | Resistor    | 2.2K ELR25   |
| R46      | Resistor    | 10K ELR25    |
| R47      | Resistor    | 10K ELR25    |
| R48      | Resistor    | 10K ELR25    |
| R50      | Resistor    | SR19D 10K    |
| R52      | Resistor    | 4.7K ELR25   |
| R53      | Resistor    | 2.2K ELR25   |
| R54      | Resistor    | 100K ELR25   |
| R55      | Resistor    | 1M R25       |
| R56      | Resistor    | 4.7K ELR25   |
| R57      | Resistor    | 2.2K ELR25   |
| R58      | Resistor    | 10K ELR25    |
| R59      | Resistor    | 22K ELR25    |
| R60      | Resistor    | 10K ELR25    |
| R61      | Trimmer     | SR19D 100K   |
| R62      | Resistor    | 1M R25       |
| R63      | Resistor    | 220 ELR25    |
| R64      | Resistor    | 220 ELR25    |
| R65      | Trimmer     | SR19D 1M     |
| R66      | Resistor    | 47K R25      |
| R67      | Resistor    | 100K ELR25   |
| R68      | Resistor    | 470K ELR25   |
| R69      | Resistor    | 33K ELR25    |
| R70      | Trimmer     | WHS512A 100K |
| R71      | Trimmer     | WHS512A 10K  |
| R72      | Trimmer     | SR19D 10K    |
| R73      | Resistor    | 4.7K ELR25   |
| R74      | Resistor    | 4.7K ELR25   |
| R76      | Trimmer     | WHS512A 10K  |
| R77      | Resistor    | 33K ELR25    |
| R78      | Resistor    | 100 ELR25    |
| R79      | Trimmer     | WHS512A 10K  |
| R80      | Resistor    | 100K ELR25   |
| R81      | Trimmer     | WHS512A 100K |
| R82      | Resistor    | 47K ELR25    |
| R83      | Trimmer     | WHS512A 10K  |
| R84      | Resistor    | 1K ELR25     |
| R85      | Resistor    | 1.8M ELR25   |

## [MAIN] UNIT

| REF. NO. | DESCRIPTION | PART NO.     |
|----------|-------------|--------------|
| R86      | Resistor    | 820K ELR25   |
| R87      | Resistor    | 220K ELR25   |
| R88      | Resistor    | 3.3M ELR25   |
| R89      | Resistor    | 1M R10       |
| R90      | Resistor    | 100K ELR25   |
| R91      | Resistor    | 100 ELR25    |
| R92      | Resistor    | 100 ELR25    |
| R93      | Resistor    | 1.8M ELR25   |
| R94      | Resistor    | 220K ELR25   |
| R95      | Resistor    | 1M ELR25     |
| R96      | Resistor    | 2.2K ELR25   |
| *R97     | Resistor    | 2.2K ELR25   |
| R98      | Resistor    | 4.7M ERC14GJ |
| R101     | Resistor    | 3.3M ELR25   |
| R102     | Resistor    | 22M ERC14GJ  |
| R103     | Resistor    | 27K ELR25    |
| R105     | Resistor    | 47K ELR25    |
| R106     | Resistor    | 10K ELR25    |
| R107     | Resistor    | 10K ELR25    |
| R108     | Resistor    | 2.2 ELR25    |
| R109     | Resistor    | 470 ELR25    |
| R110     | Resistor    | 470 ELR25    |
| R111     | Resistor    | 10 ELR25     |
| R112     | Resistor    | 10K ELR25    |
| R113     | Resistor    | 10K ELR25    |
| R114     | Resistor    | 470 ELR25    |
| R115     | Resistor    | 2.2 ELR25    |
| R116     | Resistor    | 100K ELR25   |
| R119     | Resistor    | 4.7K ELR25   |
| R120     | Resistor    | 47K ELR25    |
| R121     | Resistor    | 4.7 ELR25    |
| R122     | Resistor    | 220 ELR25    |
| R123     | Resistor    | 1K ELR25     |
| R124     | Resistor    | 47K ELR25    |
| R125     | Resistor    | 4.7K ELR25   |
| R126     | Resistor    | 2.2K R25     |
| R127     | Resistor    | 1K ELR25     |
| R128     | Resistor    | 10K R25      |
| R129     | Resistor    | 47K ELR25    |
| R130     | Resistor    | 10K ELR25    |
| R131     | Resistor    | 100K ELR25   |
| R132     | Resistor    | 100K ELR25   |
| R133     | Trimmer     | SR19D 1K     |
| R134     | Resistor    | 330 ELR25    |
| R135     | Resistor    | 4.7K ELR25   |
| R136     | Resistor    | 22K ELR25    |
| R137     | Resistor    | 4.7K ELR25   |
| R138     | Resistor    | 4.7K ELR25   |
| R139     | Resistor    | 330 ELR25    |
| R140     | Resistor    | 4.7K ELR25   |
| R141     | Resistor    | 4.7K ELR25   |
| R142     | Resistor    | 10K ELR25    |
| R143     | Resistor    | 33K ELR25    |
| R144     | Resistor    | 22K ELR25    |
| R145     | Resistor    | 27K ELR25    |
| R148     | Resistor    | 2.2K ELR25   |
| R149     | Resistor    | 10MJ RD1/4PC |
| R151     | Resistor    | 220K ELR25   |
| R153     | Resistor    | 27K R25      |
| R155     | Resistor    | 47K ELR25    |
| R157     | Resistor    | 1.8M ELR25   |
| *R158    | Resistor    | 1M ELR25     |
| *R159    | Resistor    | 1.8M ELR25   |

## [MAIN] UNIT

| REF. NO. | DESCRIPTION | PART NO.  |     |
|----------|-------------|-----------|-----|
| C1       | Electroly   | 100       | 10V |
| C2       | Ceramic     | 0.001     | 50V |
| C3       | Mylar       | 0.01      | 50V |
| C4       | Electroly   | 0.47      | 50V |
| C5       | Mylar       | 0.01      | 50V |
| C7       | Electroly   | 2.2       | 50V |
| C8       | Electroly   | 1 $\mu$   | 50V |
| C13      | Electroly   | 1 (BP)    | 50V |
| C15      | Barrier L.  | 0.1       | 12V |
| C16      | Electroly   | 4.7       | 50V |
| C17      | Electroly   | 100       | 10V |
| C18      | Barrier L.  | 0.1       | 12V |
| C20      | Electroly   | 0.47      | 50V |
| C21      | Electroly   | 4.7       | 50V |
| C22      | Ceramic     | 0.0047    | 50V |
| C23      | Ceramic     | 0.0047    | 50V |
| C24      | Ceramic     | 0.001     | 50V |
| C25      | Ceramic     | 0.0047    | 50V |
| C26      | Ceramic     | 0.0047    | 50V |
| C27      | Ceramic     | 0.0047    | 50V |
| C28      | Ceramic     | 220P      | 50V |
| C29      | Ceramic     | 0.0047    | 50V |
| C30      | Ceramic     | 0.0047    | 50V |
| C31      | Ceramic     | 470P      | 50V |
| C32      | Ceramic     | 0.0047    | 50V |
| C33      | Ceramic     | 0.0047    | 50V |
| C34      | Electroly   | 0.47      | 50V |
| C35      | Ceramic     | 0.0047    | 50V |
| C37      | Ceramic     | 220P      | 50V |
| C39      | Ceramic     | 0.0047    | 50V |
| C40      | Electroly   | 1         | 50V |
| C42      | Electroly   | 10        | 16V |
| C43      | Electroly   | 2.2       | 35V |
| C44      | Electroly   | 47 $\mu$  | 10V |
| C45      | Barrier L.  | 0.1       | 12V |
| C46      | Electroly   | 16MS470   | 16V |
| C47      | Electroly   | 100       | 16V |
| C48      | Electroly   | 220       | 10V |
| C49      | Electroly   | 16MS470   | 16V |
| C50      | Electroly   | 470       | 10V |
| C51      | Ceramic     | 0.001     | 50V |
| C52      | Electroly   | 1 $\mu$   | 50V |
| C53      | Mylar       | 0.01      | 50V |
| C54      | Electroly   | 4.7       | 25V |
| C55      | Mylar       | 0.033     | 50V |
| C56      | Ceramic     | 0.0047    | 50V |
| C57      | Barrier L.  | 0.047     | 25V |
| C58      | Electroly   | 10        | 16V |
| C59      | Mylar       | 0.022     | 50V |
| C60      | Mylar       | 0.022     | 50V |
| C61      | Mylar       | 0.022     | 50V |
| C62      | Electroly   | 100       | 10V |
| C63      | Electroly   | 47        | 10V |
| C64      | Ceramic     | 470P      | 50V |
| C65      | Ceramic     | 0.0047    | 50V |
| C66      | Barrier L.  | 0.1       | 12V |
| C67      | Ceramic     | 0.0047    | 50V |
| C68      | Ceramic     | 0.001     | 50V |
| C69      | Electroly   | 10 $\mu$  | 16V |
| C70      | Electroly   | 2.2 $\mu$ | 50V |
| C71      | Electroly   | 10 $\mu$  | 16V |
| S1       | Switch      | SSS012    |     |
| S2       | Switch      | SSS012    |     |

## [MAIN] UNIT

| REF. NO. | DESCRIPTION | PART NO.      |
|----------|-------------|---------------|
| L1       | Coil        | LW-15         |
| J1       | Connector   | 5041-04A      |
| J2       | Connector   | 5041-06A      |
| J3       | Connector   | 5041-08A      |
| J4       | Connector   | 5041-04A      |
| J5       | Connector   | 5041-08A      |
| J6       | Connector   | 5041-02A      |
| J7       | Connector   | 5041-04A      |
| J8       | Connector   | 5041-08A      |
| J9       | Connector   | 5041-06A      |
| J10      | Connector   | 5041-10A      |
|          | Beads core  | 2D1           |
| RL1      | Relay       | FBR211AD012-M |
| B1       | PC. board   | B-437A        |
| W1       | Jummpers    | JPW-02A       |

## [IF] UNIT

| REF. NO. | DESCRIPTION | PART NO.      |
|----------|-------------|---------------|
| IC1      | IC          | $\mu$ PC1037H |
| IC2      | IC          | $\mu$ PC1037H |
| IC3      | IC          | $\mu$ PC1037H |
| IC4      | IC          | $\mu$ PC1037H |
| Q1       | Transistor  | 2SC945P       |
| Q2       | Transistor  | 2SC945P       |
| Q3       | Transistor  | 2SC945P       |
| Q4       | Transistor  | 2SC945P or K  |
| Q6       | FET         | 2SK125        |
| Q7       | FET         | 3SK74M        |
| Q8       | FET         | 3SK74M        |
| Q9       | FET         | 3SK74M        |
| Q10      | FET         | 3SK74M        |
| Q11      | Transistor  | 2SC945P       |
| Q12      | Transistor  | 2SA1015       |
| Q13      | Transistor  | 2SC945P       |
| Q14      | Transistor  | 2SC945P       |
| Q16      | Transistor  | 2SC945P       |
| Q17      | Transistor  | 2SC945P       |
| Q18      | Transistor  | 2SC945P       |
| Q19      | Transistor  | 2SC945P       |
| Q20      | Transistor  | 2SC945P       |
| Q21      | Transistor  | 2SC945P       |
| Q22      | Transistor  | 2SC1571G      |
| Q23      | Transistor  | 2SC945P       |
| Q24      | Transistor  | 2SC1571G      |
| D1       | Diode       | 1SS53         |
| D2       | Diode       | 1SS53         |
| D3       | Diode       | 1SS53         |
| D4       | Diode       | 1SS53         |
| D5       | Diode       | 1SS53         |
| D6       | Diode       | 1SS53         |
| D7       | Diode       | 1SS53         |
| D8       | Diode       | 1SS53         |
| D9       | Diode       | 1SS53         |
| D10      | Diode       | 1SS53         |
| D11      | Diode       | 1SS53         |
| D12      | Diode       | 1SS53         |
| D13      | Diode       | 1SS53         |
| D14      | Diode       | 1SS53         |
| D15      | Diode       | 1SS53         |
| D16      | Diode       | 1SS53         |
| D17      | Diode       | 1SS53         |
| D18      | Diode       | 1SS53         |
| D19      | Diode       | 1SS53         |
| D20      | Diode       | 1SS53         |
| D21      | Varicap     | FC51M         |
| D22      | Diode       | 1SS53         |
| D23      | Diode       | 1SS53         |
| D24      | Diode       | 1SS53         |
| D25      | Diode       | 1SS53         |
| D26      | Diode       | 1N60          |
| D27      | Diode       | 1N60          |
| D28      | Diode       | 1SS53         |
| D29      | Diode       | 1SS53         |
| D30      | Diode       | 1SS53         |
| D31      | Diode       | 1SS53         |
| D32      | Diode       | 1SS53         |
| D33      | Diode       | 1SS53         |
| D34      | Diode       | 1SS53         |
| D35      | Diode       | 1SS53         |
| D36      | Diode       | 1SS53         |

## [IF] UNIT

| REF. NO. | DESCRIPTION | PART NO.           |
|----------|-------------|--------------------|
| D37      | Diode       | 1SS53              |
| D38      | Diode       | 1SS53              |
| D39      | Diode       | 1SS53              |
| D40      | Diode       | 1SS53              |
| D41      | Diode       | 1SS53              |
| D42      | Diode       | 1N60               |
| D44      | Diode       | 1SS53              |
| D46      | Diode       | 1SS53              |
| D47      | Diode       | 1SS53              |
| D48      | Diode       | 1SS53              |
| D49      | Diode       | 1N60               |
| D50      | Diode       | 1SS53              |
| D51      | Diode       | 1SS53              |
| D52      | Diode       | 1SS53              |
| D53      | Diode       | 1SS53              |
| D54      | Diode       | 1SS53              |
| D55      | Diode       | 1SS53              |
| D56      | Diode       | 1SS53              |
| D57      | Diode       | 1N60               |
| D58      | Diode       | 1SS53              |
| D59      | Diode       | 1SS53              |
| D60      | Diode       | 1SS53              |
| D61      | Diode       | 1SS53              |
| D62      | Diode       | 1SS53              |
| D64      | Diode       | 1SS53              |
| D65      | Diode       | 1SS53              |
| D66      | Diode       | 1SS53              |
| F11      | MC          | FL-30 9M22D2       |
| F12      | MC          | FL-31 10M22D3      |
| F13      | MC          | FL-33 9M6C         |
| X1       | Xtal        | 19.7699MHz HC-18/u |
| X2       | Xtal        | 9.0115MHz HC-43/u  |
| X3       | Xtal        | 9.0145MHz HC-43/u  |
| L7       | Coil        | LS-74              |
| L8       | Coil        | LS-167             |
| L9       | Coil        | LS-167             |
| L13      | Choke       | EL0810SKI-100K     |
| L16      | Coil        | LS-166             |
| L17      | Coil        | LS-167             |
| L18      | Coil        | LS-167             |
| L19      | Coil        | LS-167             |
| L20      | Coil        | LS-137             |
| L21      | Choke       | EL0810SKI-101K     |
| L23      | Choke       | EL0810SKI-101K     |
| L24      | Coil        | LS-170             |
| L25      | Coil        | LS-169A            |
| L27      | Choke       | EL0810SKI-100K     |
| L28      | Choke       | EL0810SKI-100K     |
| L30      | Coil        | LS-168             |
| L31      | Coil        | LS-171             |
| L32      | Choke       | 6R8 (L4)           |
| L33      | Choke       | 6R8 (L4)           |
| R1       | Resistor    | 470 ELR25          |
| R2       | Resistor    | 100 R25            |
| R3       | Resistor    | 100 R25            |
| R4       | Resistor    | 1K ELR25           |
| R5       | Resistor    | 8.2K R25           |
| R6       | Resistor    | 1K ELR25           |
| R7       | Resistor    | 1K ELR25           |
| R8       | Resistor    | 470 ELR25          |



## [IF] UNIT

| REF. NO. | DESCRIPTION | PART NO.    |
|----------|-------------|-------------|
| R9       | Resistor    | 100 R25     |
| R10      | Resistor    | 1K ELR25    |
| R11      | Resistor    | 1K ELR25    |
| R12      | Resistor    | 1K ELR25    |
| R13      | Trimmer     | WHS512A 10K |
| R14      | Trimmer     | WHS512A 10K |
| R15      | Resistor    | 47K ELR25   |
| R16      | Resistor    | 27K ELR25   |
| R17      | Resistor    | 100K ELR25  |
| R18      | Resistor    | 100K ELR25  |
| R19      | Trimmer     | WHS512A 47K |
| R21      | Resistor    | 10K ELR25   |
| R22      | Resistor    | 10K ELR25   |
| R23      | Resistor    | 2.2K ELR25  |
| R24      | Resistor    | 220 R25     |
| R25      | Resistor    | 680 ELR25   |
| R26      | Resistor    | 1K ELR25    |
| R27      | Resistor    | 47K ELR25   |
| R28      | Resistor    | 220 ELR25   |
| R29      | Resistor    | 10K ELR25   |
| R30      | Resistor    | 4.7K ELR25  |
| R31      | Resistor    | 10K ELR25   |
| R32      | Resistor    | 470 ELR25   |
| R33      | Resistor    | 470 ELR25   |
| R34      | Resistor    | 100 ELR25   |
| R35      | Trimmer     | WHS512A 1K  |
| R36      | Resistor    | 100 R25     |
| R37      | Resistor    | 1K ELR25    |
| R38      | Resistor    | 1K ELR25    |
| R39      | Resistor    | 470 ELR25   |
| R40      | Resistor    | 100 R25     |
| R41      | Resistor    | 1K ELR25    |
| R42      | Resistor    | 1K ELR25    |
| R43      | Resistor    | 1K ELR25    |
| R44      | Resistor    | 2.2K ELR25  |
| R45      | Resistor    | 4.7K ELR25  |
| R46      | Resistor    | 1K ELR25    |
| R47      | Resistor    | 100K ELR25  |
| R48      | Resistor    | 47 ELR25    |
| R49      | Resistor    | 2.2K ELR25  |
| R50      | Resistor    | 470 ELR25   |
| R51      | Resistor    | 100 ELR25   |
| R52      | Resistor    | 10K ELR25   |
| R53      | Resistor    | 220 ELR25   |
| R54      | Resistor    | 330 ELR25   |
| R55      | Resistor    | 5.6K ELR25  |
| R56      | Resistor    | 1K ELR25    |
| R57      | Resistor    | 100 R25     |
| R58      | Resistor    | 1K ELR25    |
| R59      | Resistor    | 1K ELR25    |
| R60      | Resistor    | 100 ELR25   |
| R61      | Resistor    | 5.6K ELR25  |
| R62      | Resistor    | 4.7K ELR25  |
| R63      | Resistor    | 100 ELR25   |
| R64      | Resistor    | 3.3K ELR25  |
| R65      | Resistor    | 470K ELR25  |
| R66      | Resistor    | 1K ELR25    |
| R67      | Resistor    | 470 ELR25   |
| R68      | Resistor    | 100 ELR25   |
| R69      | Resistor    | 3.3K ELR25  |
| R70      | Resistor    | 1K ELR25    |
| R71      | Resistor    | 470 ELR25   |
| R73      | Resistor    | 100 ELR25   |
| R74      | Resistor    | 470 ELR25   |

## [IF] UNIT

| REF. NO. | DESCRIPTION | PART NO.     |
|----------|-------------|--------------|
| R75      | Resistor    | 1K ELR25     |
| R76      | Trimmer     | WHS512A 470  |
| R77      | Resistor    | 100 ELR25    |
| R78      | Resistor    | 100 ELR25    |
| R79      | Resistor    | 4.7K ELR25   |
| R80      | Resistor    | 1K ELR25     |
| R81      | Resistor    | 10K ELR25    |
| R82      | Resistor    | 12K ELR25    |
| R83      | Resistor    | 10MJ RD1/4PC |
| R84      | Resistor    | 470K ELR25   |
| R85      | Resistor    | 2.2K ELR25   |
| R86      | Resistor    | 330 ELR25    |
| R87      | Resistor    | 1K ELR25     |
| R88      | Resistor    | 1.8M ELR25   |
| R89      | Resistor    | 3.3M R25     |
| R91      | Resistor    | 330 R25      |
| R92      | Resistor    | 15K ELR25    |
| R93      | Resistor    | 4.7K ELR25   |
| R94      | Resistor    | 22K ELR25    |
| R95      | Resistor    | 22K ELR25    |
| R96      | Resistor    | 100 ELR25    |
| R97      | Resistor    | 4.7K ELR25   |
| R98      | Trimmer     | WHS512A 10K  |
| R101     | Trimmer     | WHS512A 100K |
| R102     | Resistor    | 100K ELR25   |
| R103     | Resistor    | 3.3K ELR25   |
| R105     | Resistor    | 100K ELR25   |
| R106     | Trimmer     | WHS512A 100K |
| R107     | Resistor    | 10K ELR25    |
| R108     | Resistor    | 4.7K ELR25   |
| R109     | Resistor    | 10K R25      |
| R110     | Resistor    | 10K ELR25    |
| R111     | Resistor    | 10K ELR25    |
| R112     | Resistor    | 10K ELR25    |
| R113     | Resistor    | 470 ELR25    |
| R114     | Trimmer     | WHS512A 47K  |
| R115     | Trimmer     | WHS512A 10K  |
| R116     | Resistor    | 22K ELR25    |
| R117     | Resistor    | 1K ELR25     |
| R119     | Resistor    | 22K ELR25    |
| R120     | Resistor    | 10K ELR25    |
| R121     | Resistor    | 2.2K ELR25   |
| R123     | Resistor    | 2.2K ELR25   |
| R124     | Resistor    | 15 ELR25     |
| R125     | Resistor    | 4.7K ELR25   |
| R126     | Resistor    | 33 ELR25     |
| R127     | Resistor    | 220 ELR25    |
| R128     | Resistor    | 47K ELR25    |
| R129     | Resistor    | 10K ELR25    |
| R130     | Resistor    | 4.7K ELR25   |
| R131     | Resistor    | 4.7K ELR25   |
| R132     | Resistor    | 3.3K ELR25   |
| R133     | Resistor    | 1K ELR25     |
| R134     | Resistor    | 100 ELR25    |
| R135     | Resistor    | 3.3K ELR25   |
| R136     | Resistor    | 10K ELR25    |
| R137     | Resistor    | 4.7K ELR25   |
| R138     | Resistor    | 1K ELR25     |
| R139     | Resistor    | 4.7K ELR25   |
| R140     | Resistor    | 33K ELR25    |
| R141     | Resistor    | 22K ELR25    |
| R142     | Resistor    | 22K ELR25    |
| R143     | Resistor    | 100K ELR25   |
| R144     | Resistor    | 22K ELR25    |

## [IF] UNIT

| REF. NO. | DESCRIPTION | PART NO.       |       |
|----------|-------------|----------------|-------|
| R145     | Resistor    | 10K            | ELR25 |
| R146     | Resistor    | 1K             | ELR25 |
| R147     | Resistor    | 33K            | ELR25 |
| R148     | Resistor    | 2.2K           | ELR25 |
| R149     | Resistor    | 100K           | ELR25 |
| R150     | Resistor    | 4.7K           | ELR25 |
| R151     | Resistor    | 1K             | ELR25 |
| R152     | Resistor    | 10K            | ELR25 |
| R153     | Resistor    | 22K            | ELR25 |
| R154     | Resistor    | 4.7K           | ELR25 |
| R155     | Resistor    | 22K            | ELR25 |
| R156     | Resistor    | 1K             | ELR25 |
| R157     | Resistor    | 3.3K           | ELR25 |
| R158     | Resistor    | 3.3K           | ELR25 |
| R159     | Resistor    | 3.3K           | ELR25 |
| R160     | Resistor    | 3.3K           | ELR25 |
| R161     | Resistor    | 3.3K           | ELR25 |
| R162     | Resistor    | 3.3K           | ELR25 |
| R163     | Resistor    | 3.3K           | ELR25 |
| R164     | Resistor    | 3.3K           | ELR25 |
| R165     | Resistor    | 100K           | ELR25 |
| R166     | Resistor    | 2.2K           | ELR25 |
| R167     | Trimmer     | WHS512A        | 10K   |
| R168     | Resistor    | 1K             | ELR25 |
| R169     | Resistor    | 100K           | ELR25 |
| R170     | Resistor    | 2.2K           | ELR25 |
| R171     | Resistor    | 1K             | ELR25 |
| R172     | Resistor    | 3.3K           | ELR25 |
| R173     | Resistor    | 3.3K           | ELR25 |
| R174     | Resistor    | 47K            | ELR25 |
| R175     | Resistor    | 100K           | ELR25 |
| R176     | Resistor    | 2.2K           | ELR25 |
|          |             |                |       |
| R178     | Resistor    | 1K             | ELR25 |
| R179     | Resistor    | 390            | ELR25 |
|          |             |                |       |
| C1       | Ceramic     | 0.0047         | 50V   |
| C2       | Ceramic     | 0.0047         | 50V   |
| C3       | Ceramic     | 0.0047         | 50V   |
| C4       | Ceramic     | 0.0047         | 50V   |
| C5       | Ceramic     | 0.0047         | 50V   |
| C6       | Ceramic     | 0.0047         | 50V   |
| C7       | Ceramic     | 0.0047         | 50V   |
| C8       | Ceramic     | 0.0047         | 50V   |
| C9       | Ceramic     | 0.0047         | 50V   |
| C10      | Ceramic     | 0.0047         | 50V   |
| C11      | Ceramic     | 0.0047         | 50V   |
| C12      | Ceramic     | 0.0047         | 50V   |
| C13      | Ceramic     | 0.0047         | 50V   |
| C14      | Ceramic     | 0.0047         | 50V   |
| C15      | Ceramic     | 0.0047         | 50V   |
| C16      | Ceramic     | DD106-63CH620J | 50V   |
| C17      | Dip mica    | 47P            | 50V   |
| C18      | Dip mica    | 33P            | 50V   |
| C19      | Ceramic     | 0.0047         | 50V   |
| C20      | Ceramic     | 0.0047         | 50V   |
| C21      | Ceramic     | 0.0047         | 50V   |
| C22      | Ceramic     | 0.001          | 50V   |
| C23      | Ceramic     | DD109SL471J    | 50V   |
| C24      | Ceramic     | 3P             | 50V   |
| C25      | Ceramic     | DD109SL471J    | 50V   |
| C26      | Ceramic     | 0.001          | 50V   |
| C27      | Ceramic     | 0.0047         | 50V   |
| C28      | Ceramic     | 0.0047         | 50V   |

## [IF] UNIT

| REF. NO. | DESCRIPTION | PART NO. |     |
|----------|-------------|----------|-----|
| C29      | Ceramic     | 0.0047   | 50V |
| C30      | Ceramic     | 10P      | 50V |
| C31      | Ceramic     | 0.001    | 50V |
| C32      | Ceramic     | 0.0047   | 50V |
| C33      | Ceramic     | 470P     | 50V |
| C34      | Ceramic     | 0.001    | 50V |
| C35      | Ceramic     | 0.001    | 50V |
| C36      | Ceramic     | 33P      | 50V |
| C37      | Ceramic     | 0.0047   | 50V |
| C38      | Ceramic     | 0.0047   | 50V |
| C39      | Ceramic     | 0.001    | 50V |
| C40      | Ceramic     | 15P      | 50V |
| C41      | Ceramic     | 0.0047   | 50V |
| C42      | Ceramic     | 0.0047   | 50V |
| C43      | Ceramic     | 0.001    | 50V |
| C44      | Ceramic     | 5P       | 50V |
| C45      | Ceramic     | 0.0047   | 50V |
| C46      | Ceramic     | 0.0047   | 50V |
| C47      | Ceramic     | 0.0047   | 50V |
| C48      | Ceramic     | 0.0047   | 50V |
| C49      | Ceramic     | 0.0047   | 50V |
| C50      | Ceramic     | 0.0047   | 50V |
| C51      | Ceramic     | 0.001    | 50V |
| C52      | Ceramic     | 15P      | 50V |
| C53      | Ceramic     | 0.0047   | 50V |
| C54      | Ceramic     | 180P     | 50V |
| C55      | Ceramic     | 0.0047   | 50V |
| C56      | Ceramic     | 0.0047   | 50V |
| C57      | Ceramic     | 33P      | 50V |
| C58      | Ceramic     | 120P     | 50V |
| C59      | Ceramic     | 0.001    | 50V |
| C60      | Ceramic     | 0.001    | 50V |
| C61      | Ceramic     | 0.0047   | 50V |
| C62      | Ceramic     | 0.0047   | 50V |
| C63      | Ceramic     | 150P     | 50V |
| C64      | Ceramic     | 5P       | 50V |
| C65      | Ceramic     | 0.001    | 50V |
| C66      | Barrier L.  | 0.047    | 12V |
| C67      | Ceramic     | 0.001    | 50V |
| C68      | Ceramic     | 0.0047   | 50V |
| C69      | Ceramic     | 0.0047   | 50V |
| C70      | Ceramic     | 150P     | 50V |
| C71      | Ceramic     | 0.0047   | 50V |
| C72      | Ceramic     | 0.001    | 50V |
| C73      | Ceramic     | 0.001    | 50V |
| C74      | Ceramic     | 0.0047   | 50V |
| C75      | Ceramic     | 0.0047   | 50V |
| C76      | Ceramic     | 0.0047   | 50V |
| C77      | Ceramic     | 0.0022   | 50V |
| C78      | Ceramic     | 0.0047   | 50V |
| C79      | Electroly   | 2.2      | 25V |
| C80      | Electroly   | 10       | 16V |
| C82      | Ceramic     | 0.0047   | 50V |
| C83      | Ceramic     | 0.0047   | 50V |
| C84      | Electroly   | 33       | 10V |
| C85      | Electroly   | 100P     | 10V |
| C86      | Electroly   | 0.0047   | 10V |
| C87      | Electroly   | 0.0047   | 10V |
| C88      | Electroly   | 0.0047   | 10V |
| C89      | Electroly   | 100P     | 10V |
| C90      | Electroly   | 0.0047   | 10V |
| C91      | Electroly   | 0.0047   | 10V |
| C92      | Electroly   | 0.0047   | 10V |
| C93      | Electroly   | 0.0047   | 10V |

## [IF] UNIT

| REF. NO. | DESCRIPTION | PART NO.        |
|----------|-------------|-----------------|
| C94      | Electroly   | DD105CH300J 50V |
| C96      | Ceramic     | 0.0047 50V      |
| C97      | Trimmer     | CV05E3001       |
| C98      | Dip mica    | 47P 50V         |
| C99      | Ceramic     | 0.0047 50V      |
| C100     | Dip mica    | 150P 50V        |
| C101     | Dip mica    | 150P 50V        |
| C102     | Ceramic     | 0.0047 50V      |
| C103     | Ceramic     | 150P 50V        |
| C104     | Ceramic     | 150P 50V        |
| C105     | Ceramic     | 0.0047 50V      |
| C106     | Barrier L.  | 0.047 25V       |
| C107     | Ceramic     | 10P 50V         |
| C108     | Electroly   | 1 $\mu$ 50V     |
| C109     | Mylar       | 0.01 50V        |
| C110     | Mylar       | 0.0047 50V      |
| C111     | Ceramic     | 0.0047 50V      |
| C112     | Electroly   | 100 $\mu$ 10V   |
| C113     | Ceramic     | 0.0047 50V      |
| C114     | Ceramic     | 100P 50V        |
| C115     | Mylar       | 0.01 50V        |
| C116     | Electroly   | 22 $\mu$ 10V    |
| C117     | Ceramic     | 0.0047 50V      |
| C118     | Barrier L.  | 0.1 12V         |
| C119     | Electroly   | 0.47 50V        |
| C120     | Ceramic     | 470P 50V        |
| C121     | Ceramic     | 0.0047 50V      |
| C122     | Ceramic     | 0.0047 50V      |
| C123     | Ceramic     | 0.0047 50V      |
| C124     | Ceramic     | 0.0047 50V      |
| C125     | Ceramic     | 0.0047 50V      |
| C126     | Ceramic     | 0.0047 50V      |
| C127     | Ceramic     | 0.0047 50V      |
| C128     | Ceramic     | 0.0047 50V      |
| C129     | Ceramic     | 0.0047 50V      |
| C130     | Ceramic     | 0.0047 50V      |
| C131     | Ceramic     | 0.0047 50V      |
| C132     | Ceramic     | 0.0047 50V      |
| C133     | Ceramic     | 0.0047 50V      |
| C134     | Ceramic     | 0.0047 50V      |
| C135     | Ceramic     | 0.0047 50V      |
| C136     | Ceramic     | 0.0047 50V      |
| C137     | Ceramic     | 0.0047 50V      |
| C138     | Dip mica    | 150P 50V        |
| C139     | Dip mica    | 150P 50V        |
| C140     | Ceramic     | 0.001 50V       |
| C141     | Ceramic     | 0.001 50V       |
| C142     | Ceramic     | 0.0047 50V      |
| C143     | Ceramic     | 0.0047 50V      |
| C144     | Ceramic     | 0.001 50V       |
| C145     | Ceramic     | 0.001 50V       |
| C146     | Ceramic     | 0.0047 50V      |
| C147     | Barrier L.  | 0.1 12V         |
| C148     | Ceramic     | 0.0047 50V      |
| C149     | Ceramic     | 5P CH           |
| *C150    | Electroly   | 10 $\mu$ 16V    |
| J1       | Connector   | 5045-02         |
| J2       | Connector   | 5045-08         |
| J3       | Connector   | 5045-08         |
| J4       | Connector   | 5045-02         |
| J5       | Connector   | 5045-04         |
| P1       | Connector   | 5250-06         |

## [IF] UNIT

| REF. NO. | DESCRIPTION | PART NO.    |
|----------|-------------|-------------|
| S2       | Switch      | SSS 012     |
| B1       | PC Board    | B-377E IF   |
| B2       | PC Board    | B-402A COIL |

## [FILTER] UNIT

| REF. NO. | DESCRIPTION | PART NO.               |
|----------|-------------|------------------------|
| Q1       | Transistor  | 2SD635                 |
| D1       | Diode       | GP08B                  |
| D2       | Diode       | GP08B                  |
| D3       | Zener       | XZ-076                 |
| D4       | Diode       | 1SS53                  |
| D5       | Diode       | 1SS53                  |
| D6       | Diode       | 1SS53                  |
| D7       | Diode       | 1SS53                  |
| D8       | Diode       | 1SS53                  |
| D9       | Diode       | 1SS53                  |
| D10      | Diode       | 1SS53                  |
| D11      | Diode       | 1SS53                  |
| D12      | Diode       | 1SS53                  |
| D13      | Diode       | 1SS53                  |
| L1       | Coil        | LR-48                  |
| L2       | Coil        | LR-47                  |
| L3       | Coil        | LR-50                  |
| L4       | Coil        | LR-49                  |
| L5       | Coil        | LR-51                  |
| L6       | Coil        | LR-52                  |
| L7       | Coil        | LR-54                  |
| L8       | Coil        | LR-53                  |
| L9       | Coil        | LR-56                  |
| L10      | Coil        | LR-55                  |
| L11      | Coil        | LR-58                  |
| L12      | Coil        | LR-57                  |
| L13      | Coil        | LR-91                  |
| L14      | Coil        | LR-90                  |
| L15      | Coil        | LA-24                  |
| R1       | Resistor    | 1K ELR25               |
| R2       | Resistor    | 10K ELR25              |
| R3       | Resistor    | 100 ELR25              |
| C1       | Dip mica    | DM20 1500P 500V 1CR    |
| C2       | Dip mica    | DM19 390P 500V 1CR     |
| C3       | Dip mica    | DM20 2700P 500V 1CR    |
| C4       | Ceramic     | DD31SL121K500V02       |
| C5       | Dip mica    | DM20 1500P 500V 1CR    |
| C6       | Dip mica    | DM19 680P 500V 1CR     |
| C7       | Ceramic     | DD31-2SL221K500V02     |
| C8       | Dip mica    | DM20 1200P 500V 1CR    |
| C9       | Ceramic     | DD38SL820K500V02       |
| C10      | Dip mica    | DM19 680P 500V 1CR     |
| C11      | Dip mica    | DM19 390P 500V 1CR     |
| C12      | Ceramic     | DD35-0-465SL390K500V02 |
| C13      | Dip mica    | DM19 680P 500V 1CR     |
| C14      | Ceramic     | DD31SL121K500V02       |
| C15      | Dip mica    | DM19 470P 500V 1CR     |
| C16      | Ceramic     | DD31-2SL201K500V02     |
| C17      | Ceramic     | DD38SL560K500V02       |
| C18      | Ceramic     | DD31-4SL331K500V02     |
| C19      | Ceramic     | DD35-0-465SL180K500V02 |
| C20      | Ceramic     | DD31SL151K500V02       |
| C21      | Ceramic     | DD31SL121K500V02       |
| C22      | Ceramic     | DD35-0-465SL390K500V02 |
| C23      | Ceramic     | DD31-2SL221K500V02     |
| C24      | Ceramic     | DD35-0-465SL100K500V02 |
| C25      | Ceramic     | DD31SL121K500V02       |
| C26      | Ceramic     | 82P 500V               |
| C27      | Ceramic     | 30P 500V               |
| C28      | Ceramic     | 150P 500V              |

## [FILTER] UNIT

| REF. NO. | DESCRIPTION            | PART NO.       |
|----------|------------------------|----------------|
| C29      | Ceramic                | 10P 500V       |
| C30      | Ceramic                | 82P 500V       |
| C31      | Ceramic                | 220P 500V      |
| C32      | Ceramic                | 68P 500V       |
| C33      | Dip mica               | DM19 470P 500V |
| C34      | Ceramic                | 27P 500V       |
| C35      | Ceramic                | 220P 500V      |
| C36      | Ceramic                | 0.0047 50V     |
| C37      | Ceramic                | 0.0047 50V     |
| C38      | Ceramic                | 0.0047 50V     |
| C39      | Ceramic                | 0.0047 50V     |
| C40      | Ceramic                | 0.0047 50V     |
| C41      | Ceramic                | 0.0047 50V     |
| C42      | Ceramic                | 0.0047 50V     |
| C43      | Ceramic                | 0.0047 50V     |
| C44      | Ceramic                | 0.0047 50V     |
| C45      | Ceramic                | 0.0047 50V     |
| C46      | Ceramic                | 0.0047 50V     |
| C47      | Ceramic                | 0.0047 50V     |
| C48      | Ceramic                | 0.0047 50V     |
| C49      | Barrier L.             | 0.047 50V      |
| C50      | Ceramic                | 0.0047 50V     |
| C51      | Ceramic                | 0.0047 50V     |
| C52      | Barrier L.             | 0.1 12V        |
| RL1      | Relay                  | LZ12H          |
| RL2      | Relay                  | SR-53-44C      |
| J1       | Connector              | 5046-08A       |
| J2       | Connector              | 5046-06A       |
| P1       | Connector              | 5250-04        |
| B1       | Beads core<br>PC Board | 2D1<br>B-382C  |

## [PA] UNIT

| REF. NO. | DESCRIPTION    | PART NO.      |       |
|----------|----------------|---------------|-------|
| Q1       | Transistor     | 2SC2097-HH    |       |
| Q2       | Transistor     | 2SC2097-HH    |       |
| Q3       | Transistor     | 2SD313-E or F |       |
| D1       | Diode          | MV-5W         |       |
| D2       | Diode          | GP-08B        |       |
| D4       | Diode          | 15CD11        |       |
| D5       | Diode          | 15CD11        |       |
| L1       | Transformer    | LR-38A        |       |
| L2       | Choke          | LR-81         |       |
| L3       | Choke          | LR-81         |       |
| L4       | Transformer    | LR-83         |       |
| L5       | Choke          | LR-82         |       |
| L6       | Transformer    | LR-37A        |       |
| R1       | Resistor       | 10            | 2W    |
| R2       | Resistor       | 2.2           | 1W    |
| R3       | Resistor       | 2.2           | 1W    |
| R4       | Resistor       | 2.2           | 1W    |
| R5       | Resistor       | 2.2           | 1W    |
| R6       | Resistor       | 10            | R50   |
| R7       | Resistor       | 10            | R50   |
| R8       | Resistor       | 3.3           | 1W    |
| R9       | Resistor       | 3.3           | 1W    |
| R10      | Resistor       | 4.7           | 2W    |
| R11      | Resistor       | 220           | ELR25 |
| R12      | Trimmer        | 500           | FR-10 |
| R13      | Resistor       | 0.012         | 5W    |
| *R15     | Resistor       | 100           | R50   |
| *R16     | Resistor       | 56            | R25   |
| R18      | Resistor       | 33K           | R25   |
| R19      | Surge Absorber | DSA-301       |       |
| R20      | Resistor       | 33K           | R25   |
| C1       | Ceramic        | 470P          | 50V   |
| *C2      | Ceramic        | 100P          | 50VB  |
| C3       | Monolythic     | 6800P         | 50V   |
| C4       | Monolythic     | 6800P         | 50V   |
| C5       | Electroly      | 100 $\mu$     | 10V   |
| C6       | Ceramic        | 220P          | 500V  |
| C7       | Ceramic        | 220P          | 500V  |
| C8       | Monolythic     | 470P          | 50V   |
| C9       | Monolythic     | 1000P         | 50V   |
| C10      | Ceramic        | 68P           | 500V  |
| C11      | Dip mica       | 4700P         | 500V  |
| C12      | Electroly      | 470 $\mu$     | 16V   |
| C13      | Monolythic     | 0.68 $\mu$    | 25V   |
| C14      | Barrier L.     | 0.047 $\mu$   | 25V   |
| C15      | Electroly      | 10 $\mu$      | 10V   |
| C16      | Ceramic        | 0.0047 $\mu$  | 50V   |
| C17      | Ceramic        | 0.0047 $\mu$  | 50V   |
| C18      | Ceramic        | 0.0047 $\mu$  | 50V   |
| C19      | Ceramic        | 0.0047 $\mu$  | 50V   |
| C20      | Ceramic        | 0.0047 $\mu$  | 50V   |
| C21      | Ceramic        | 0.0047 $\mu$  | 50V   |
| C22      | Ceramic        | 0.0047 $\mu$  | 50V   |
| C23      | Ceramic        | 0.0047 $\mu$  | 50V   |
| C24      | Ceramic        | 0.0047 $\mu$  | 50V   |
| C25      | Ceramic        | 0.0047 $\mu$  | 50V   |
| C26      | Ceramic        | 0.0047 $\mu$  | 50V   |
| C27      | Ceramic        | 0.0047 $\mu$  | 50V   |
| C28      | Ceramic        | 0.0047 $\mu$  | 50V   |
| C29      | Ceramic        | 0.0047 $\mu$  | 50V   |

## [PA] UNIT

| REF. NO. | DESCRIPTION | PART NO.     |     |
|----------|-------------|--------------|-----|
| C30      | Ceramic     | 0.0047 $\mu$ | 50V |
| C31      | Ceramic     | 0.0047 $\mu$ | 50V |
| C32      | Ceramic     | 0.0047 $\mu$ | 50V |
| C33      | Ceramic     | 0.0047 $\mu$ | 50V |
| C34      | Ceramic     | 0.0047 $\mu$ | 50V |
| C35      | Ceramic     | 0.0047 $\mu$ | 50V |
| C36      | Ceramic     | 470P SL      | 50V |
| C37      | Ceramic     | 0.0047 $\mu$ | 50V |
| C38      | Ceramic     | 0.0047 $\mu$ | 50V |
| C39      | Ceramic     | 470P SL      | 50V |
| C40      | Ceramic     | 470P SL      | 50V |
| C41      | Ceramic     | 470P SL      | 50V |
| C42      | Ceramic     | 470P SL      | 50V |
| C43      | Ceramic     | 470P SL      | 50V |
| C44      | Ceramic     | 470P SL      | 50V |
| C45      | Electroly   | 470          | 16V |
| S1       | Thermal     | OHD-70M      |     |
| FH1      | Fuse Holder | S-N-2054     |     |
| F1       | Fuse        | 20A          |     |
| B1       | PC Board    | B-399A       |     |
| B2       | PC Board    | B-401A       |     |
| B4       | PC Board    | B-389B       |     |
| J1       | Connector   | FM-MD-RMI    |     |
| J2       | Pin Jack    | AT-700       |     |
| J3       | Pin Jack    | AT-700       |     |
| J4       | Pin Jack    | AT-700       |     |
| J5       | Pin Jack    | AT-700       |     |
| J6       | Connector   | LLR-6        |     |
| J7       | Jack        | SJ-296       |     |
| J8       | Jack        | SJ-296       |     |
| J9       | Connector   | 1625-24R     |     |
| J10      | Pin Jack    | AT-700       |     |
| J11      | Connector   | 5045-08A     |     |
| J12      | Connector   | 5045-04A     |     |
| J13      | Connector   | 5045-04A     |     |
| J14      | Connector   | 5045-10A     |     |
| J15      | Connector   | 5045-12A     |     |
| J16      | Connector   | 5045-04A     |     |
| P1       | Connector   | 5250-02      |     |
| P2       | Connector   | 5250-06      |     |
| P3       | Connector   | 5250-02      |     |
| P4       | Connector   | 5250-04      |     |
| P5       | Connector   | 5250-04      |     |
| P6       | Connector   | 5250-02      |     |
| P7       | Connector   | 5250-08      |     |
| P8       | Connector   | 5250-04      |     |
| P9       | Connector   | 5250-06      |     |
| P10      | Connector   | 5250-08      |     |
| P11      | Connector   | 5250-04      |     |
| P12      | Connector   | 1545R-1      |     |
| P13      | Connector   | 170136-2     |     |
| *        | DC Motor    | M9N 12T24-5  |     |
| W1       | Jummpers    | JPW-02       |     |

## [SWR] UNIT

| REF. NO. | DESCRIPTION | PART NO.       |       |
|----------|-------------|----------------|-------|
| Q1       | FET         | 2SK125         |       |
| Q2       | FET         | 2SK125         |       |
| D1       | Diode       | 1N60           |       |
| D2       | Diode       | 1N60           |       |
| D3       | Diode       | GP08           |       |
| D4       | Diode       | 1SS53          |       |
| L1       | Coil        | LR-76A         |       |
| L2       | Coil        | LR-22A         |       |
| L3       | Choke       | EL0810SKI-4R7K |       |
| L4       | Choke       | EL0810SKI-3R9K |       |
| L5       | Coil        | LR-18          |       |
| L6       | Choke       | EL0810SKI-101K |       |
| L7       | Coil        | LR-75 (A)      |       |
| L8       | Choke       | EL0810SKI-101K |       |
| L9       | Choke       | 222 (L6)       |       |
| R1       | Resistor    | 68             | ELR25 |
| R2       | Resistor    | 10K            | ELR25 |
| R4       | Resistor    | 10K            | ELR25 |
| R5       | Resistor    | 10K            | ELR25 |
| R6       | Resistor    | 82             | ELR25 |
| R7       | Resistor    | 120            | ELR25 |
| R8       | Resistor    | 22             | ELR25 |
| R9       | Resistor    | 10K            | ELR25 |
| R10      | Resistor    | 220            | ELR25 |
| R11      | Resistor    | 100K           | ELR25 |
| R12      | Resistor    | 100K           | ELR25 |
| R13      | Resistor    | 82             | ELR25 |
| C1       | Ceramic     | 47P            | 500V  |
| C2       | Ceramic     | 39P            | 500V  |
| C3       | Ceramic     | 39P            | 500V  |
| C4       | Ceramic     | 0.0047         | 50V   |
| C5       | Ceramic     | 0.0047         | 50V   |
| C6       | Ceramic     | 220P           | 50V   |
| C7       | Trimmer     | ECV-1ZW20X40   |       |
| C8       | Ceramic     | 0.0047         | 50V   |
| C9       | Ceramic     | 0.0047         | 50V   |
| C10      | Ceramic     | 0.0047         | 50V   |
| C11      | Ceramic     | 0.0047         | 50V   |
| C12      | Barrier L.  | TBD04V122K     |       |
| C13      | Barrier L.  | TBD06V682K     |       |
| C14      | Barrier L.  | UFD08SA821K    |       |
| C15      | Barrier L.  | TBD08V153K     |       |
| C16      | Barrier L.  | TBD04V122K     |       |
| C17      | Ceramic     | 0.0047         | 50V   |
| C18      | Barrier L.  | TBD08X473M     |       |
| C19      | Barrier L.  | TBD08X473M     |       |
| C21      | Ceramic     | 0.0047         | 50V   |
| C22      | Ceramic     | 0.0047         | 50V   |
| C23      | Barrier L.  | 0.1            |       |
| J1       | Connector   | 5045-04A       |       |
| J2       | Connector   | 5045-04A       |       |
| J3       | Connector   | 5045-04A       |       |
| J4       | Connector   | 5045-04A       |       |
| J5       | Connector   | 5045-02A       |       |
| RL1      | Relay       | BR221D012      |       |
| W1       | Jumper      | H98W060W-V-V   |       |

## [SWR] UNIT

| REF. NO. | DESCRIPTION | PART NO. |
|----------|-------------|----------|
| B1       | PC. Board   | B-381B   |

## [Dr] UNIT

| REF. NO. | DESCRIPTION | PART NO.       |       |
|----------|-------------|----------------|-------|
| Q1       | Transistor  | 2SC2053        |       |
| Q2       | Transistor  | 2SC1971        |       |
| Q3       | Transistor  | 2SD360         |       |
| Q4       | Transistor  | 2SC1945        |       |
| Q5       | Transistor  | 2SC1945        |       |
| D1       | Varistor    | MV-11          |       |
| L3       | Coil        | LR-20          |       |
| L4       | Choke       | EL0810SKI-100K |       |
| L6       | Coil        | LR-21          |       |
| L8       | Coil        | LR-19          |       |
| L9       | Choke       | EL0810SKI-100K |       |
| L10      | Choke       | EL0810SKI-100K |       |
| L11      | Choke       | EL0810SKI-1R2K |       |
| L12      | Choke       | EL0810SKI-1R2K |       |
| L13      | Coil        | LR-20          |       |
| L14      | Coil        | LR-40          |       |
| *R1      | Resistor    | 47             | ELR25 |
| R2       | Resistor    | 1K             | ELR25 |
| R3       | Resistor    | 4.7K           | ELR25 |
| R4       | Resistor    | 3.3            | ELR25 |
| R5       | Resistor    | 2.2            | ELR25 |
| R6       | Resistor    | 10             | ELR25 |
| R7       | Resistor    | 470            | ELR25 |
| R8       | Resistor    | 100            | ELR25 |
| *R9      | Resistor    | 100            | ELR25 |
| R11      | Resistor    | 2.2            | R25   |
| R13      | Trimmer     | 1K             | FR-10 |
| R14      | Resistor    | 3.3            | R25   |
| R15      | Resistor    | 2.2            | ELR25 |
| R16      | Resistor    | 22             | ELR25 |
| R17      | Resistor    | 22             | ELR25 |
| R18      | Resistor    | 100            | ELR25 |
| R19      | Resistor    | 100            | ELR25 |
| R20      | Resistor    | 0.3            | 2W    |
| R21      | Resistor    | 1K             | ELR25 |
| R22      | Resistor    | 1K             | ELR25 |
| R24      | Resistor    | 220            | ELR25 |
| R25      | Resistor    | 33             | ELR25 |
| *R26     | Resistor    | 68             | ELR25 |
| C2       | Ceramic     | 0.0047         | 50V   |
| C3       | Barrier L.  | 0.047          | 50V   |
| C4       | Mylar       | 0.001          | 50V   |
| C5       | Barrier L.  | 0.1            | 12V   |
| C6       | Ceramic     | 0.0047         | 50V   |
| C8       | Barrier L.  | 0.047          | 25V   |
| C9       | Mylar       | 0.1            | 50V   |
| C10      | Ceramic     | 150P           | 50V   |
| C11      | Barrier L.  | 0.047          | 25V   |
| C12      | Barrier L.  | 0.1            | 12V   |
| C13      | Electroly   | 22 $\mu$       | 10V   |
| C14      | Barrier L.  | 0.1            | 12V   |
| C15      | Mylar       | 0.01           | 50V   |
| C16      | Mylar       | 0.01           | 50V   |
| C17      | Ceramic     | 100P           | 50V   |
| C18      | Ceramic     | 100P           | 50V   |
| C19      | Ceramic     | 150P           | 50V   |
| C20      | Electroly   | 100 $\mu$      | 16V   |
| C21      | Mylar       | 0.1            | 50V   |
| C22      | Electroly   | 33 $\mu$       | 16V   |
| C23      | Barrier L.  | 0.047          | 25V   |

## [Dr] UNIT

| REF. NO. | DESCRIPTION | PART NO. |     |
|----------|-------------|----------|-----|
| C24      | Barrier L.  | 0.047    | 25V |
| C25      | Mylar       | 0.0047   | 50V |
| C26      | Ceramic     | 0.0022   | 50V |
| *C27     | Barrier L.  | 0.047    | 25V |
|          | Beads Core  | 2D1      |     |
| J1       | Connector   | 5046-02A |     |
| J2       | Connector   | 5041-06A |     |
| J3       | Connector   | 5041-02A |     |
| B1       | PC Board    | B-378B   |     |

## [PLL] UNIT

| REF. NO. | DESCRIPTION | PART NO.         |
|----------|-------------|------------------|
| IC1      | IC          | TA7310           |
| IC2      | IC          | M54459           |
| IC3      | IC          | TC5081P          |
| IC5      | IC          | $\mu$ PC1037H    |
| IC6      | IC          | TC9123BP         |
| IC7      | IC          | TC9123BP         |
| IC8      | IC          | NJM4558D         |
| IC9      | IC          | $\mu$ PB551      |
| IC13     | IC          | $\mu$ A78L82AWC  |
| IC14     | IC          | $\mu$ A78L05AC   |
| Q4       | Transistor  | 2SC2053          |
| Q5       | Transistor  | 2SC763C          |
| Q6       | FET         | 2SK125           |
| Q7       | Transistor  | 2SC763C          |
| Q8       | Transistor  | 2SC1571G         |
| Q12      | Transistor  | 2SC763C          |
| Q13      | Transistor  | 2SC945P          |
| Q14      | Transistor  | 2SB562           |
| Q15      | FET         | 2SK125           |
| Q16      | Transistor  | 2SC763C          |
| Q17      | FET         | 2SK125           |
| Q18      | Transistor  | 2SC763C          |
| Q19      | Transistor  | 2SA1015          |
| Q20      | Transistor  | 2SC945P          |
| Q21      | Transistor  | 2SC945P          |
| Q24      | Transistor  | 2SC945P          |
| *Q25     | Transistor  | 2SA1048          |
| D1       | Varicap     | SVC-303Y         |
| D3       | Diode       | 1SS53            |
| D4       | Diode       | 1SS53            |
| D5       | Varicap     | 1SV50 (1) E      |
| D6       | Varicap     | 1SV50 (1) E      |
| D7       | Diode       | 1SS53            |
| D11      | Varicap     | 1SV50            |
| D13      | Zener       | XZ-062           |
| *D20     | Diode       | 1SS85            |
| *D21     | Diode       | 1SS85            |
| D25      | Varicap     | 1SV50            |
| X1       | Xtal        | HC43/U 5.12MHz   |
| X2       | Xtal        | HC43/U 10.240MHz |
| L1       | Choke       | 102 EL0810SKI    |
| L2       | Coil        | LB-116           |
| L3       | Choke       | 101 EL0810SKI    |
| L4       | Coil        | LB-117           |
| L5       | Coil        | LR-87            |
| L6       | Choke       | R30 LB4          |
| L7       | Choke       | R23 LB4          |
| L8       | Coil        | LA-31            |
| L9       | Coil        | LA-35            |
| L10      | Choke       | 101 EL0810SKI    |
| L11      | Choke       | 101 EL0810SKI    |
| L12      | Choke       | 101 EL0810SKI    |
| L13      | Coil        | LB-117           |
| L14      | Coil        | LS-162           |
| L15      | Coil        | LS-162           |
| L16      | Choke       | 100 EL0810SKI    |
| L17      | Choke       | 3R9 EL0810SKI    |
| L18      | Coil        | LB-98            |
| L19      | Coil        | LB-98            |
| L20      | Coil        | LS-110           |

## [PLL] UNIT

| REF. NO. | DESCRIPTION | PART NO.      |
|----------|-------------|---------------|
| L21      | Coil        | LS-110        |
| L24      | Choke       | 100 EL0810SKI |
| L25      | Choke       | 100 EL0810SKI |
| L26      | Choke       | 100 EL0810SKI |
| L27      | Choke       | 101 EL0810SKI |
| R5       | Resistor    | 220 ELR25     |
| R6       | Resistor    | 470 ELR25     |
| R7       | Resistor    | 47K ELR25     |
| R8       | Resistor    | 4.7K ELR25    |
| R9       | Resistor    | 470 ELR25     |
| R10      | Resistor    | 12 ELR25      |
| R11      | Resistor    | 12 ELR25      |
| R12      | Resistor    | 270 ELR25     |
| R14      | Resistor    | 330 ELR25     |
| R15      | Resistor    | 120K R25      |
| R16      | Resistor    | 3.3K ELR25    |
| R18      | Resistor    | 10K ELR25     |
| R19      | Resistor    | 10K ELR25     |
| R20      | Resistor    | 330 ELR25     |
| R21      | Resistor    | 220 ELR25     |
| R22      | Resistor    | 10K ELR25     |
| R23      | Resistor    | 5.6K ELR25    |
| R24      | Resistor    | 100 ELR25     |
| R25      | Resistor    | 47K ELR25     |
| R26      | Resistor    | 100 ELR25     |
| R27      | Resistor    | 330 ELR25     |
| R28      | Resistor    | 1K ELR25      |
| R29      | Resistor    | 100 ELR25     |
| R30      | Resistor    | 330 ELR25     |
| R31      | Resistor    | 100 ELR25     |
| R32      | Resistor    | 3.3K ELR25    |
| R33      | Resistor    | 100 ELR25     |
| R34      | Resistor    | 4.7K ELR25    |
| R35      | Resistor    | 22K ELR25     |
| R36      | Resistor    | 1K ELR25      |
| R37      | Resistor    | 220 ELR25     |
| R38      | Resistor    | 1K ELR25      |
| R39      | Resistor    | 47 ELR25      |
| R40      | Resistor    | 2.2K ELR25    |
| R41      | Resistor    | 10K R25       |
| R42      | Resistor    | 1K ELR25      |
| R43      | Resistor    | 1K ELR25      |
| R44      | Resistor    | 1K ELR25      |
| R45      | Resistor    | 1K ELR25      |
| R46      | Resistor    | 1K ELR25      |
| R47      | Resistor    | 1K ELR25      |
| R48      | Resistor    | 1K ELR25      |
| R49      | Resistor    | 1K ELR25      |
| R50      | Resistor    | 1K ELR25      |
| R51      | Resistor    | 1K ELR25      |
| R52      | Resistor    | 4.7K ELR25    |
| R53      | Resistor    | 1K R25        |
| R54      | Resistor    | 4.7K ELR25    |
| R55      | Resistor    | 100K ELR25    |
| R56      | Resistor    | 100K ELR25    |
| R58      | Resistor    | 47 ELR25      |
| R59      | Resistor    | 10K ELR25     |
| R60      | Resistor    | 47K ELR25     |
| R62      | Resistor    | 15K ELR25     |
| R63      | Resistor    | 100K ELR25    |
| R64      | Resistor    | 10K ELR25     |
| *R65     | Resistor    | 4.7K ELR25    |
| R66      | Resistor    | 1K ELR25      |



## [PLL] UNIT

| REF. NO. | DESCRIPTION | PART NO. |         |
|----------|-------------|----------|---------|
| R67      | Resistor    | 100      | ELR25   |
| R68      | Resistor    | 47       | ELR25   |
| R69      | Trimmer     | 100K     | WHS512A |
| R70      | Resistor    | 220K     | ELR25   |
| R71      | Resistor    | 10K      | ELR25   |
| R72      | Resistor    | 1K       | ELR25   |
| R73      | Resistor    | 47K      | R25     |
| R82      | Resistor    | 8.2K     | ELR25   |
| R83      | Resistor    | 4.7K     | ELR25   |
| R84      | Resistor    | 470      | ELR25   |
| R85      | Resistor    | 22K      | ELR25   |
| R86      | Resistor    | 100      | R25     |
| R87      | Resistor    | 2.7K     | ELR25   |
| R88      | Resistor    | 4.7K     | ELR25   |
| R89      | Resistor    | 1K       | ELR25   |
| R90      | Resistor    | 470      | ELR25   |
| R93      | Resistor    | 3.3K     | ELR25   |
| R94      | Resistor    | 10K      | ELR25   |
| *R96     | Resistor    | 4.7K     | ELR25   |
| R97      | Resistor    | 100      | ELR25   |
| R98      | Resistor    | 1K       | ELR25   |
| R99      | Resistor    | 47       | ELR25   |
| R100     | Resistor    | 15K      | ELR25   |
| R101     | Resistor    | 47K      | ELR25   |
| R102     | Resistor    | 47       | ELR25   |
| R103     | Resistor    | 22K      | ELR25   |
| R104     | Resistor    | 10K      | ELR25   |
| R105     | Resistor    | 10K      | ELR25   |
| R106     | Resistor    | 100K     | ELR25   |
| R107     | Resistor    | 47       | R25     |
| R108     | Resistor    | 47K      | ELR25   |
| R109     | Resistor    | 22K      | ELR25   |
| R110     | Resistor    | 2.2K     | ELR25   |
| R111     | Resistor    | 47       | ELR25   |
| R114     | Resistor    | 220      | ELR25   |
| R115     | Resistor    | 220      | ELR25   |
| R117     | Resistor    | 47K      | ELR25   |
| R118     | Resistor    | 47       | R25     |
| R119     | Resistor    | 1K       | R25     |
| R120     | Resistor    | 560      | R25     |
| R121     | Resistor    | 4.7K     | R25     |
| R122     | Resistor    | 22M      |         |
| R125     | Resistor    | 1K       | ELR25   |
| R126     | Resistor    | 1K       | ELR25   |
| R127     | Resistor    | 1K       | ELR25   |
| R128     | Resistor    | 10K      | ELR25   |
| R129     | Resistor    | 220      | ELR25   |
| R130     | Resistor    | 22K      | R25     |
| R131     | Resistor    | 1K       | R25     |
| R136     | Resistor    | 33       | ELR25   |
| R137     | Resistor    | 4.7K     | ELR25   |
| R138     | Resistor    | 10K      | ELR25   |
| R139     | Resistor    | 56K      | ELR25   |
| R140     | Resistor    | 10K      | ELR25   |
| R141     | Resistor    | 33K      | ELR25   |
| R142     | Trimmer     | 33K      | WHS512A |
| *R143    | Resistor    | 470      | ELR10   |
| *R144    | Resistor    | 22K      | ELR10   |
| C1       | Ceramic     | 47P      | 50V     |
| C2       | Ceramic     | 220P     | 50V     |
| C3       | Ceramic     | 220P     | 50V     |
| C4       | Ceramic     | 2P       | 50V     |
| C5       | Ceramic     | 0.0047   | 50V     |

## [PLL] UNIT

| REF. NO. | DESCRIPTION | PART NO.  |     |
|----------|-------------|-----------|-----|
| C6       | Ceramic     | 470P      | 50V |
| C7       | Trimmer     | CV05A0601 |     |
| C8       | Ceramic     | 0.0047    | 50V |
| C9       | Ceramic     | 22P       | 50V |
| C10      | Ceramic     | 0.0047    | 50V |
| C11      | Ceramic     | 0.0047    | 50V |
| C12      | Ceramic     | 0.0047    | 50V |
| C13      | Electroly   | 220μ      | 10V |
| C15      | Barrier L.  | 0.1       | 16V |
| C16      | Electroly   | 1μ BP     | 50V |
| C17      | Electroly   | 220μ      | 10V |
| C18      | Electroly   | 1μ BP     | 50V |
| C19      | Ceramic     | 0.0047    | 50V |
| C20      | Ceramic     | 47P       | 50V |
| C21      | Ceramic     | 47P       | 50V |
| C22      | Ceramic     | 470P      | 50V |
| C23      | Ceramic     | 0.0047    | 50V |
| C24      | Ceramic     | 0.0047    | 50V |
| C25      | Ceramic     | 10P       | 50V |
| C26      | Ceramic     | 0.0047    | 50V |
| C27      | Ceramic     | 0.0047    | 50V |
| C28      | Ceramic     | 0.0047    | 50V |
| C29      | Ceramic     | 68P       | 50V |
| C30      | Ceramic     | 150P      | 50V |
| C31      | Ceramic     | 39P       | 50V |
| C32      | Ceramic     | 330P      | 50V |
| C33      | Ceramic     | 51P       | 50V |
| C34      | Ceramic     | 51P       | 50V |
| C35      | Ceramic     | 33P       | 50V |
| C36      | Ceramic     | 100P      | 50V |
| C37      | Ceramic     | 22P       | 50V |
| C38      | Ceramic     | 68P       | 50V |
| C39      | Ceramic     | 0.0047    | 50V |
| C40      | Ceramic     | 33P       | 50V |
| C41      | Ceramic     | 0.0047    | 50V |
| C43      | Ceramic     | 33P       | 50V |
| C44      | Ceramic     | 0.0047    | 50V |
| C45      | Ceramic     | 10P       | 50V |
| C46      | Ceramic     | 0.0047    | 50V |
| C47      | Ceramic     | 0.0047    | 50V |
| C48      | Ceramic     | 0.0047    | 50V |
| C49      | Electroly   | 10μ       | 16V |
| C50      | Barrier L.  | 0.1       | 12V |
| C51      | Ceramic     | 47P       | 50V |
| C52      | Ceramic     | 100P      | 50V |
| C53      | Electroly   | 4.7μ      | 25V |
| C54      | Electroly   | 4.7μ      | 25V |
| C55      | Electroly   | 100μ      | 10V |
| C56      | Barrier L.  | 0.1       | 12V |
| C57      | Barrier L.  | 0.1       | 12V |
| C58      | Electroly   | 47μ       | 10V |
| C59      | Ceramic     | 0.0047    | 50V |
| C60      | Ceramic     | 0.0047    | 50V |
| C61      | Ceramic     | 470P      | 50V |
| C62      | Ceramic     | 2P        | 50V |
| C63      | Trimmer     | CV05A0601 |     |
| C64      | Electroly   | 100μ      | 10V |
| C65      | Electroly   | 47μ       | 10V |
| C66      | Electroly   | 47μ       | 50V |
| C67      | Ceramic     | 0.001     | 50V |
| C68      | Barrier L.  | 0.1       | 12V |
| *C70     | Electroly   | 100μ      | 10V |
| C71      | Electroly   | 1μ BP     | 50V |
| C72      | Barrier L.  | 0.1       | 12V |

## [PLL] UNIT

| REF. NO. | DESCRIPTION | PART NO.   |     |
|----------|-------------|------------|-----|
| C74      | Electroly   | 220 $\mu$  | 10V |
| C75      | Cramic      | 0.0047     | 50V |
| C76      | Ceramic     | 0.0047     | 50V |
| C77      | Ceramic     | 0.0047     | 50V |
| C78      | Ceramic     | 0.0047     | 50V |
| C79      | Electroly   | 47 $\mu$   | 10V |
| C80      | Ceramic     | 0.0047     | 50V |
| C81      | Barrier L.  | 0.047      | 25V |
| C82      | Ceramic     | 470P       | 25V |
| C83      | Ceramic     | 47P        | 25V |
| C84      | Ceramic     | 47P        | 25V |
| C85      | Ceramic     | 10P        | 25V |
| C86      | Ceramic     | 0.0047     | 25V |
| C87      | Ceramic     | 0.0047     | 25V |
| C88      | Electroly   | 100 $\mu$  | 10V |
| C90      | Trimmer     | CV05D2001  |     |
| C92      | Dipmica     | 33P        | 50V |
| C94      | Ceramic     | 0.0047     | 50V |
| C95      | Electroly   | 47 $\mu$   | 10V |
| C98      | Ceramic     | 0.0047     | 50V |
| C99      | Ceramic     | 22P        | 50V |
| C100     | Ceramic     | 6P         | 50V |
| C101     | Ceramic     | 330P       | 50V |
| C102     | Ceramic     | 0.0047     | 50V |
| C103     | Ceramic     | 1P         | 50V |
| C104     | Electroly   | 470 $\mu$  | 10V |
| C105     | Electroly   | 0.47 $\mu$ | 50V |
| C106     | Electroly   | 100 $\mu$  | 10V |
| C107     | Barrier L.  | 0.1        | 12V |
| C108     | Barrier L.  | 0.047      | 25V |
| C109     | Ceramic     | 0.0047     | 50V |
| C110     | Electroly   | 10 $\mu$   | 16V |
| C111     | Ceramic     | 0.0047     | 50V |
| C112     | Ceramic     | 1P         | 50V |
| C113     | Ceramic     | 47P        | 50V |
| C114     | Ceramic     | 39P        | 50V |
| C115     | Ceramic     | 12P        | 50V |
| C116     | Ceramic     | 39P        | 50V |
| C117     | Ceramic     | 0.0047     | 50V |
| C119     | Ceramic     | 0.0047     | 50V |
| C120     | Ceramic     | 0.0047     | 50V |
| C121     | Electroly   | 10 $\mu$   | 16V |
| C122     | Electroly   | 10 $\mu$   | 16V |
| C123     | Ceramic     | 0.0047     | 50V |
| C124     | Ceramic     | 0.0047     | 50V |
| C128     | Ceramic     | 10P        | 50V |
| C129     | Ceramic     | 100P       | 50V |
| C130     | Ceramic     | 0.0047     | 50V |
| C131     | Ceramic     | 0.0047     | 50V |
| C132     | Ceramic     | 0.0047     | 50V |
| C133     | Ceramic     | 470P       | 50V |
| C134     | Ceramic     | 0.0047     | 50V |
| C135     | Electroly   | 0.47 $\mu$ | 50V |
| C138     | Ceramic     | 470P       | 50V |
| C143     | Ceramic     | 330P       | 50V |
| C149     | Electroly   | 47 $\mu$   | 10V |
| C150     | Electroly   | 470 $\mu$  | 10V |
| J1       | Connector   | 3094-4A    |     |
| J2       | Connector   | 3094-10A   |     |
| J3       | Connector   | 5045-2A    |     |
| J4       | Connector   | 5045-2A    |     |
| J5       | Connector   | 5045-2A    |     |

## [PLL] UNIT

| REF. NO. | DESCRIPTION | PART NO. |
|----------|-------------|----------|
| J6       | Connector   | 3094-02A |
| B1       | PC Board    | B-489B   |
| W1       | Jumper      | JPW-02H  |

## [LOGIC] UNIT

| REF. NO. | DESCRIPTION | PART NO.       |
|----------|-------------|----------------|
| IC1      | IC          | $\mu$ PD650-70 |
| IC2      | IC          | 4066/4016      |
| IC3      | IC          | 4028           |
| IC4      | IC          | BA618          |
| IC5      | IC          | BA618          |
| IC6      | Diode Array | DAN401         |
| IC7      | IC          | BA618          |
| IC8      | IC          | $\mu$ PD549C   |
| IC9      | DC Conv.    | DP-5           |
| IC10     | IC          | 78L05AW        |
| IC11     | IC          | BA618          |
| IC12     | IC          | 4028           |
| IC13     | IC          | 4028           |
| IC14     | IC          | BA618          |
| IC15     | IC          | 40175          |
| IC16     | IC          | 4013           |
| IC17     | IC          | 40193          |
| IC18     | IC          | 4066/4016      |
| IC19     | IC          | 4013           |
| IC20     | IC          | 4069           |
| IC21     | IC          | 4001           |
| IC22     | IC          | 4081           |
| IC23     | IC          | 4011           |
| IC24     | IC          | NJM4558        |
| IC25     | Diode Array | DAN401         |
| IC26     | Diode Array | DAN401         |
| IC27     | IC          | 4520           |
|          |             |                |
| Q2       | Transistor  | 2SA1015        |
| Q3       | Transistor  | 2SC945         |
| Q4       | Transistor  | 2SA1015        |
| Q5       | Transistor  | 2SA1015        |
| Q6       | Transistor  | 2SA1015        |
| Q7       | Transistor  | 2SA1015        |
| Q8       | Transistor  | 2SA1015        |
| Q9       | Transistor  | 2SA1015        |
| Q10      | Transistor  | 2SA1015        |
| Q11      | Transistor  | 2SC945         |
| Q12      | Transistor  | 2SC945         |
| Q13      | FET         | 2SK44D         |
| Q14      | Transistor  | 2SA1015        |
| Q15      | Transistor  | 2SC1636        |
| Q16      | Transistor  | 2SC945P        |
| Q17      | Transistor  | 2SC945P        |
| Q18      | Transistor  | 2SA1015        |
| Q19      | Transistor  | 2SC945         |
| Q20      | Transistor  | 2SC945         |
| Q21      | Transistor  | 2SC945         |
| Q22      | Transistor  | 2SA1015        |
|          |             |                |
| D1       | Diode       | 1SS53          |
| D2       | Diode       | 1SS53          |
| D3       | Diode       | 1SS53          |
| D4       | Diode       | 1SS53          |
| D5       | LED         | SLC-26UR       |
| D6       | LED         | SLC-26UR       |
| D7       | LED         | SLC-26UR       |
| D10      | Diode       | 1SS53          |
| D11      | Diode       | 1SS53          |
| D12      | Diode       | 1SS53          |
| D13      | LED         | SLC-26UR       |
| D14      | LED         | SLC-26UR       |
| D15      | Diode       | 1SS55          |
| D16      | Diode       | 1SS55          |

## [LOGIC] UNIT

| REF. NO. | DESCRIPTION  | PART NO.       |
|----------|--------------|----------------|
| D17      | Diode        | 1SS55          |
| D18      | Diode        | 1SS55          |
| D19      | Diode        | 1SS53          |
| D20      | Diode        | 1SS55          |
| D21      | Diode        | GP08B          |
| D22      | Diode        | GP08B          |
| D23      | Diode        | 1SS53          |
| D24      | Diode        | 1SS53          |
| D25      | Diode        | 1SS53          |
| D26      | Diode        | 1SS53          |
| D27      | Diode        | 1N60           |
| D28      | Diode        | 1S953          |
| D29      | Diode        | 1S953          |
| D30      | Zener        | XZ-062         |
| D31      | Diode        | 1SS53          |
| D32      | Diode        | 1SS53          |
| D33      | Diode        | 1N60           |
| D34      | Diode        | 1SS53          |
| D35      | Diode        | 1SS53          |
| D36      | Diode        | 1SS53          |
| D37      | Diode        | 1N60           |
| D40      | Diode        | 1SS53          |
| D42      | Diode        | 1SS53          |
| D43      | Diode        | 1SS53          |
| D44      | Diode        | 1SS53          |
| D45      | Diode        | 1SS53          |
| D46      | Diode        | 1SS53          |
| D47      | Diode        | 1SS53          |
| D48      | Diode        | 1SS53          |
| D49      | Diode        | 1SS53          |
| D50      | Diode        | 1SS53          |
| D51      | Diode        | 1S953          |
| D52      | Diode        | 1SS53          |
| D53      | Diode        | 1SS53          |
| D54      | Diode        | 1S953          |
| D55      | Diode        | 1S953          |
| D56      | Diode        | 1S953          |
|          |              |                |
| L1       | Coil         | 102 LB4        |
| L3       | Coil         | 101 LB4        |
| L4       | Coil         | 101 LB4        |
| *L5      | Coil         | 102 L4         |
|          |              |                |
| X1       | Ceralock     | CSB 430A       |
|          |              |                |
|          | Display-Tube | 11BT77A        |
|          |              |                |
| R1       | Resistor     | 3.3K R25       |
| R2       | Resistor     | 10K ELR25      |
| R3       | Resistor     | 10K ELR25      |
| R6       | Resistor     | 47K ELR25      |
| R7       | Resistor     | 10K ELR25      |
| R8       | Resistor     | 47K ELR25      |
| R9       | Resistor     | 470K ELR25     |
| R10      | Resistor     | 470K R25       |
| R11      | Resistor     | 47K RM10       |
| R13      | Resistor     | 3.3M ELR25     |
| R14      | Resistor     | 47K RM8        |
| R15      | Resistor     | 47K RM3        |
| R16      | Resistor     | 47K RM6        |
| R17      | Resistor     | 800K CRB 1/4FX |
| R18      | Resistor     | 400K CRA 1/8   |
| R19      | Resistor     | 200K CRA 1/8   |
| R20      | Resistor     | 100K CRA 1/8   |

## [LOGIC] UNIT

| REF. NO. | DESCRIPTION   | PART NO. |
|----------|---------------|----------|
| R21      | Resistor 1.5K | R25      |
| R22      | Resistor 1.5K | R25      |
| R23      | Resistor 1.5K | R25      |
| R24      | Resistor 1.5K | R25      |
| R25      | Resistor 1.5K | R25      |
| R26      | Resistor 4.7K | R25      |
| R27      | Resistor 47K  | R25      |
| R28      | Resistor 47K  | R25      |
| R29      | Resistor 47K  | R25      |
| R30      | Resistor 47K  | ELR25    |
| R31      | Resistor 220K | ELR25    |
| R32      | Resistor 47K  | R25      |
| R33      | Resistor 47K  | R25      |
| R34      | Resistor 47K  | R25      |
| R35      | Resistor 47K  | R25      |
| R37      | Resistor 470K | ELR25    |
| R38      | Resistor 22K  | ELR25    |
| R39      | Resistor 47K  | R25      |
| R40      | Resistor 47K  | ELR25    |
| R41      | Resistor 22K  | ELR25    |
| R43      | Resistor 10K  | ELR25    |
| R44      | Resistor 10   | R25      |
| R45      | Resistor 1M   | R25      |
| R46      | Resistor 10K  | R25      |
| R47      | Resistor 220K | R25      |
| R48      | Resistor 1M   | R25      |
| R49      | Resistor 33K  | R25      |
| R50      | Resistor 82K  | ELR25    |
| R51      | Resistor 220K | R25      |
|          |               |          |
| R54      | Resistor 1M   | R25      |
| R55      | Resistor 47K  | RM8      |
| R56      | Resistor 47K  | R25      |
| R57      | Resistor 1M   | R25      |
| R58      | Resistor 1M   | R25      |
| R60      | Resistor 10   | R25      |
| R61      | Resistor 47K  | R25      |
| R62      | Resistor 1M   | R25      |
| R63      | Resistor 10K  | R25      |
| R64      | Resistor 47K  | R25      |
| R65      | Resistor 8.2K | R25      |
| R66      | Resistor 10K  | ELR25    |
| R67      | Resistor 1M   | ELR25    |
| R68      | Resistor 10   | R25      |
| R69      | Resistor 1M   | ELR25    |
| R70      | Resistor 10K  | ELR25    |
| R71      | Resistor 47K  | ELR25    |
| R72      | Resistor 1K   | ELR25    |
| R73      | Resistor 10K  | R25      |
| R74      | Resistor 47K  | R25      |
| R75      | Resistor 47K  | R25      |
| R76      | Resistor 47K  | R25      |
| R77      | Resistor 47K  | R25      |
| R78      | Resistor 47K  | R25      |
| R80      | Resistor 10K  | R25      |
| R81      | Resistor 470K | ELR25    |
| R82      | Resistor 47K  | R25      |
| R83      | Resistor 10K  | ELR25    |
| R84      | Resistor 1K   | ELR25    |
| R85      | Resistor 10K  | R25      |
| R86      | Resistor 10K  | ELR25    |
|          |               |          |
| R88      | Resistor 1K   | ELR25    |

## [LOGIC] UNIT

| REF. NO. | DESCRIPTION       | PART NO.   |
|----------|-------------------|------------|
| R89      | Resistor 100K     | ELR25      |
| R90      | Resistor 47K      | ELR25      |
| R91      | Resistor 47K      | RM4        |
| R92      | Resistor 4.7K     | R25        |
| R93      | Resistor 22K      | R25        |
| R94      | Resistor 22       | ELR25      |
| *R95     | Resistor 1K       | R25        |
| *R96     | Resistor 1M       | R25        |
|          |                   |            |
| C1       | Electroly 47μ     | 10V        |
| C2       | Electroly 1       | 50V        |
| C3       | Ceramic 100P      | 50V        |
| C4       | Ceramic 100P      | 50V        |
| C6       | Electroly 2.2μ MS | 35V        |
| C7       | Ceramic 0.001     | 50V        |
| C8       | Barrier L. 0.1    | 12V        |
| C9       | Electroly 47      | 16V RE     |
| C10      | Electroly 47μ     | 10V        |
| C11      | Electroly 470     | 16V        |
| C12      | Barrier L. 0.1    | 12V        |
| C13      | Barrier L. 0.1    | 12V        |
| C14      | Barrier L. 0.1    | 12V        |
| C15      | Electroly 10μ     | 16V        |
| C16      | Barrier L. 0.1    | 12V        |
| C17      | Barrier L. 0.1    | 12V        |
| C18      | Barrier L. 0.1    | 12V        |
| C19      | Ceramic 0.001     | 50V        |
| C20      | Ceramic 470P      | 50V        |
| C21      | Ceramic 0.0047    | 50V        |
| C22      | Ceramic 0.001     | 50V        |
| C23      | Ceramic 0.001     | 50V        |
| C24      | Barrier L. 0.1    | 12V        |
| C25      | Ceramic 0.001     | 50V        |
| C26      | Ceramic 470P      | 50V        |
| C27      | Ceramic 0.001     | 50V        |
| C28      | Ceramic 0.001     | 50V        |
| C29      | Barrier L. 0.1    | 12V        |
| C30      | Electroly 10μ     | 16V        |
| C31      | Electroly 2.2μ    | 50V        |
| C32      | Electroly 2.2μ    | 50V        |
| C33      | Barrier L. 0.1    | 12V        |
| C34      | Ceramic 0.001     | 50V        |
| C36      | Electroly 22μ     | 16V        |
| C37      | Ceramic 470P      | 50V        |
| C38      | Ceramic 0.0047    | 50V        |
| C39      | Ceramic 0.0022    | 50V        |
| C40      | Barrier L. 0.1    | 12V        |
| C41      | Ceramic 0.0047    | 50V        |
| C42      | Barrier L. 0.1    | 12V        |
| C43      | Electroly 10μ     | 10V        |
| C44      | Electroly 0.47    | 50V        |
| C45      | Electroly 100μ    | 10V        |
| C46      | Electroly 47      | 16V        |
| *C47     | Barrier L. 0.0047 |            |
| *C48     | Barrier L. 0.1    | 12V        |
|          |                   |            |
| J1       | Connector         | HBLB11S-1J |
| J2       | Connector         | 3094-4A    |
| J3       | Connector         | 3094-4A    |
| J4       | Connector         | 3094-6A    |
| J5       | Connector         | 3094-6A    |
| J6       | Connector         | HBLB19S-1J |
| J7       | Connector         | 3094-4A    |
| J8       | Connector         | 3094-8A    |

# [LOGIC] UNIT

| REF. NO. | DESCRIPTION | PART NO.   |
|----------|-------------|------------|
| J9       | Connector   | 3094-6A    |
| J11      | Connector   | 3094-4A    |
| J12      | Connector   | 3094-4A    |
| J13      | Connector   | HBLB19R-1J |
| J14      | Connector   | 3094-2A    |
| P1       | Connector   | 5250-04    |
| P2       | Connector   | 5250-10    |
| P3       | Connector   | 5250-06    |
| P4       | Connector   | 5250-10    |
| P5       | Connector   | 5250-02    |
| B1       | P.C Board   | B-434D     |
| B2       | P.C Board   | B-410A     |
| S1       | Switch      | SSS012     |
| W1       | Jumper      | JPW-02A    |

# [RF] UNIT

| REF. NO. | DESCRIPTION | PART NO.       |
|----------|-------------|----------------|
| IC1      | DBM         | 412E           |
| IC2      | DBM         | 412E           |
| IC3      | IC          | μPC577H        |
| IC4      | IC          | M51201L        |
| Q1       | Transistor  | 2SC2053        |
| Q2       | FET         | 3SK74M         |
| Q3       | FET         | 3SK74M         |
| Q4       | Transistor  | 2SC2053        |
| Q6       | Transistor  | 2SC945P        |
| Q7       | Transistor  | 2SC945P        |
| Q8       | Transistor  | 2SA1015Y       |
| *Q9      | FET         | 2SK206         |
| Q10      | FET         | 2SK125         |
| Q11      | Transistor  | 2SA1015Y       |
| Q12      | FET         | 2SK49H2        |
| Q13      | Transistor  | 2SA1015        |
| D1       | Diode       | 1SS53          |
| D2       | Diode       | 1SS53          |
| D3       | Diode       | 1SS53          |
| D4       | Diode       | 1SS53          |
| D5       | Diode       | 1SS53          |
| D8       | Diode       | 1SS53          |
| D9       | Diode       | 1SS53          |
| D12      | Diode       | 1SS53          |
| D13      | Diode       | 1SS53          |
| D14      | Diode       | 1SS53          |
| D15      | Diode       | 1SS53          |
| D16      | Diode       | 1SS53          |
| D17      | Diode       | 1SS53          |
| D20      | Diode       | 1SS53          |
| D21      | Diode       | 1SS53          |
| D23      | Diode       | 1SS53          |
| D24      | Diode       | 1SS53          |
| D25      | Diode       | 1SS53          |
| D26      | Diode       | 1SS53          |
| D27      | Diode       | 1SS53          |
| D28      | Diode       | 1SS53          |
| D29      | Diode       | 1SS53          |
| D30      | Diode       | 1SS53          |
| D31      | Diode       | 1SS53          |
| D32      | Diode       | 1SS53          |
| D33      | Diode       | 1N60           |
| D34      | Diode       | 1N60           |
| D35      | Diode       | 1SS53          |
| D36      | Diode       | 1SS53          |
| D37      | Diode       | 1SS53          |
| D38      | Diode       | 1SS53          |
| D39      | Diode       | 1SS53          |
| D40      | Diode       | 1SS53          |
| D42      | Diode       | 1SS53          |
| D43      | Diode       | 1SS53          |
| D44      | Diode       | 1SS53          |
| D46      | Diode       | 1SS53          |
| D51      | Diode       | 1SS53          |
| D52      | Diode       | S5277G         |
| D53      | Varistor    | MV103          |
| L1       | Coil        | LR-86          |
| L2       | Choke       | EL0810SKI-101K |
| L3       | Choke       | EL0810SKI-101K |
| L4       | Choke       | EL0810SKI-101K |

## [RF] UNIT

| REF. NO. | DESCRIPTION | PART NO.       |
|----------|-------------|----------------|
| L5       | Choke       | EL0810SKI-101K |
| L6       | Choke       | EL0810SKI-101K |
| L7       | Choke       | EL0810SKI-101K |
| L8       | Choke       | EL0810SKI-101K |
| L9       | Choke       | EL0810SKI-101K |
| L10      | Choke       | EL0810SKI-101K |
| L11      | Choke       | R36 LB4        |
| L12      | Coil        | LB-86A         |
| L13      | Choke       | R36 LB4        |
| L14      | Choke       | R34 LB4        |
| L15      | Choke       | EL0810SKI-101K |
| L16      | Choke       | R65 LB4        |
| L17      | Choke       | R50 LB4        |
| L18      | Choke       | R45 LB4        |
| L19      | Choke       | R41 LB4        |
| L20      | Choke       | EL0810SKI-101K |
| L21      | Choke       | R83 LB4        |
| L22      | Choke       | R65 LB4        |
| L23      | Choke       | R65 LB4        |
| L24      | Choke       | R54 LB4        |
| L25      | Choke       | EL0810SKI-101K |
| L26      | Choke       | EL0810SKI-1R5K |
| L27      | Choke       | EL0810SKI-1R2K |
| L28      | Choke       | EL0810SKI-1R5K |
| L29      | Choke       | EL0810SKI-1R2K |
| L30      | Choke       | EL0810SKI-101K |
| L31      | Choke       | EL0810SKI-2R2K |
| L32      | Choke       | EL0810SKI-2R2K |
| L33      | Choke       | EL0810SKI-2R2K |
| L34      | Choke       | EL0810SKI-1R8K |
| L35      | Choke       | EL0810SKI-101K |
| L36      | Choke       | EL0810SKI-6R2K |
| L37      | Choke       | EL0810SKI-5R1K |
| L38      | Choke       | EL0810SKI-4R3K |
| L39      | Choke       | EL0810SKI-3R6K |
| L40      | Choke       | EL0810SKI-101K |
| L41      | Choke       | EL0810SKI-101K |
| L42      | Choke       | R12 LB4        |
| L43      | Coil        | LA-137A        |
| L44      | Coil        | LR-85A         |
| L45      | Choke       | R36 LB4        |
| L46      | Coil        | LR-86          |
| L47      | Coil        | LS-172         |
| L48      | Coil        | LS-114         |
| L49      | Coil        | LS-114         |
| L50      | Coil        | LS-161         |
| L51      | Coil        | LS-172         |
| L52      | Choke       | R54 LB4        |
| *L53     | Coil        | LS-217         |
| L54      | Coil        | LS-162         |
| L55      | Coil        | LS-165         |
| L56      | Coil        | LS-163         |
| L57      | Coil        | LR-84B         |
| *L58     | Coil        | LS-217         |
| L60      | Choke       | EL0810SKI-101K |
| L61      | Coil        | LR-86          |
| L62      | Choke       | EL0810SKI-101K |
| L63      | Choke       | R45 LB4        |
| L65      | Choke       | EL0810SKI-101K |
| L66      | Choke       | EL0810SKI-101K |
| L67      | Choke       | EL0810SKI-1R0K |
| L68      | Choke       | EL0810SKI-1R0K |
| L69      | Choke       | R83 LB4        |
| L70      | Choke       | R70 LB4        |

## [RF] UNIT

| REF. NO. | DESCRIPTION | PART NO.       |
|----------|-------------|----------------|
| L71      | Choke       | EL0810SKI-101K |
| L72      | Choke       | EL0810SKI-3R9K |
| L73      | Choke       | EL0810SKI-3R3K |
| L74      | Choke       | EL0810SKI-3R3K |
| L75      | Choke       | EL0810SKI-2R7K |
| L76      | Choke       | 7R5 LB4        |
| L77      | Choke       | 6R2 LB4        |
| L78      | Choke       | EL0810SKI-220K |
| L79      | Choke       | EL0810SKI-101K |
| L80      | Choke       | EL0810SKI-101K |
| L81      | Choke       | 100 L4         |
| R1       | Resistor    | 220 R50        |
| R2       | Resistor    | 220 R50        |
| R3       | Resistor    | 100 ELR25      |
| R4       | Resistor    | 100 ELR25      |
| R5       | Resistor    | 100 ELR25      |
| R6       | Resistor    | 100 ELR25      |
| R7       | Resistor    | 100 ELR25      |
| R8       | Resistor    | 100 ELR25      |
| R9       | Array       | RM8-102        |
| R10      | Resistor    | 100 ELR25      |
| R11      | Resistor    | 100 ELR25      |
| R12      | Resistor    | 100 ELR25      |
| R13      | Resistor    | 100 R50        |
| R16      | Resistor    | 47 ELR25       |
| R17      | Resistor    | 8.2 ELR25      |
| R18      | Resistor    | 150 ELR25      |
| R19      | Resistor    | 8.2 R25        |
| R20      | Resistor    | 22 ELR25       |
| R21      | Resistor    | 2.2K ELR25     |
| R22      | Resistor    | 10K ELR25      |
| R23      | Resistor    | 100 ELR25      |
| R24      | Resistor    | 1K ELR25       |
| R25      | Resistor    | 100 ELR25      |
| R26      | Resistor    | 68 ELR25       |
| R27      | Resistor    | 10K ELR25      |
| R28      | Resistor    | 10K ELR25      |
| R29      | Resistor    | 10K ELR25      |
| R30      | Resistor    | 2.2K ELR25     |
| R31      | Resistor    | 150 ELR25      |
| R32      | Resistor    | 100 ELR25      |
| R33      | Resistor    | 1K ELR25       |
| R34      | Resistor    | 470K ELR25     |
| R35      | Resistor    | 470 ELR25      |
| R36      | Resistor    | 100 ELR25      |
| R37      | Resistor    | 2.2K ELR25     |
| R38      | Resistor    | 1K ELR25       |
| R39      | Resistor    | 68 ELR25       |
| R40      | Resistor    | 15 ELR25       |
| R41      | Resistor    | 15 R25         |
| R42      | Resistor    | 22 ELR25       |
| R43      | Resistor    | 10K ELR25      |
| R44      | Resistor    | 2.2K ELR25     |
| R45      | Resistor    | 390 R25        |
| R46      | Resistor    | 220 ELR25      |
| R47      | Resistor    | 470K ELR25     |
| R48      | Resistor    | 10K ELR25      |
| R49      | Resistor    | 22K ELR25      |
| R50      | Resistor    | 470 ELR25      |
| R51      | Resistor    | 4.7K ELR25     |
| R52      | Resistor    | 1K ELR25       |
| R53      | Resistor    | 1K ELR25       |
| R54      | Resistor    | 4.7K ELR25     |

## [RF] UNIT

| REF. NO. | DESCRIPTION | PART NO.         |       |
|----------|-------------|------------------|-------|
| R55      | Resistor    | 5.6K             | R25   |
| R56      | Resistor    | 2.2K             | ELR25 |
| R57      | Resistor    | 1K               | ELR25 |
| R58      | Resistor    | 100              | ELR25 |
| R60      | Resistor    | 3.3K             | ELR25 |
| R61      | Resistor    | 10K              | ELR25 |
| R62      | Resistor    | 220              | ELR25 |
| R63      | Resistor    | 1K               | ELR25 |
| R64      | Resistor    | 2.2K             | ELR25 |
| R65      | Resistor    | 2.2K             | ELR25 |
| R66      | Resistor    | 1K               | ELR25 |
| R67      | Resistor    | 100              | ELR25 |
| R68      | Resistor    | 2.2K             | ELR25 |
| R70      | Resistor    | 6.8K             | ELR25 |
| R71      | Resistor    | 1K               | ELR25 |
| R72      | Resistor    | 4.7K             | ELR25 |
| R74      | Resistor    | 100              | ELR25 |
| R75      | Resistor    | 220              | ELR25 |
| R76      | Resistor    | 100K             | ELR25 |
| R77      | Resistor    | 22K              | ELR25 |
| R79      | Resistor    | 22               | ELR25 |
| R80      | Resistor    | 330              | ELR25 |
| R81      | Resistor    | 1K               | ELR25 |
| R82      | Resistor    | 47K              | ELR25 |
| R83      | Resistor    | 33               | ELR25 |
| R84      | Resistor    | 1.8              | ELR25 |
| R86      | Resistor    | 100K             | ELR25 |
| R87      | Resistor    | 100              | ELR25 |
| R88      | Resistor    | 100K             | ELR25 |
| R89      | Resistor    | 10K              | ELR25 |
| R90      | Resistor    | 150K             | ELR25 |
| R91      | Resistor    | 10K              | ELR25 |
| R92      | Resistor    | 56               | R10   |
| R93      | Resistor    | 10K              | ELR25 |
| *R94     | Resistor    | 100              | ELR25 |
| C1       | Ceramic     | 15P              | 50V   |
| C2       | Ceramic     | 0.0047           | 50V   |
| C3       | Ceramic     | 0.0047           | 50V   |
| C4       | Barrier L.  | 0.047            | 25V   |
| C5       | Ceramic     | 0.0047           | 50V   |
| C6       | Ceramic     | 0.0047           | 50V   |
| C7       | Ceramic     | 0.0047           | 50V   |
| C8       | Ceramic     | 0.0047           | 50V   |
| C9       | Ceramic     | 0.0047           | 50V   |
| C10      | Barrier L.  | 0.047            | 25V   |
| C11      | Barrier L.  | 0.047            | 25V   |
| C12      | Barrier L.  | 0.047            | 25V   |
| C13      | Barrier L.  | 10 RC2           | 16V   |
| C15      | Ceramic     | DD104SL300J50V02 |       |
| C16      | Ceramic     | 100P             | 50V   |
| C17      | Ceramic     | 68P              | 50V   |
| C18      | Ceramic     | 100P             | 50V   |
| C19      | Ceramic     | 120P             | 50V   |
| C20      | Barrier L.  | UFD08SA821K-L2A  |       |
| C21      | Ceramic     | 100P             | 50V   |
| C22      | Ceramic     | 0.0047           | 50V   |
| C23      | Barrier L.  | 0.047            | 25V   |
| C25      | Ceramic     | DD106SL181J50V02 |       |
| C26      | Ceramic     | DD104SL240J50V02 |       |
| C27      | Ceramic     | DD106SL181J50V02 |       |
| C28      | Ceramic     | DD106SL181J50V02 |       |
| C29      | Barrier L.  | TBD04V122K-L0B   |       |
| C30      | Ceramic     | 150P             | 50V   |

## [RF] UNIT

| REF. NO. | DESCRIPTION | PART NO.         |     |
|----------|-------------|------------------|-----|
| C31      | Ceramic     | 0.0047           | 50V |
| C32      | Barrier L.  | 0.047            | 25V |
| C33      | Ceramic     | DD107SL301J50V02 |     |
| C34      | Ceramic     | DD104SL390J50V02 |     |
| C35      | Ceramic     | DD107SL301J50V02 |     |
| C36      | Ceramic     | 220P             | 50V |
| C37      | Barrier L.  | TBD04V182K-L0B   |     |
| C38      | Ceramic     | DD106SL201J50V02 |     |
| C39      | Barrier L.  | 0.047            | 25V |
| C40      | Barrier L.  | 0.047            | 25V |
| C42      | Barrier L.  | UFD08SA561K-L2A  |     |
| C43      | Ceramic     | DD104SL750J50V02 |     |
| C44      | Ceramic     | DD109SL511J50V02 |     |
| C45      | Barrier L.  | UFD08SA681K-L2A  |     |
| C46      | Barrier L.  | TBD05V332K-L0B   |     |
| C47      | Ceramic     | DD109SL511J50V02 |     |
| C48      | Barrier L.  | 0.047            | 25V |
| C49      | Barrier L.  | 0.047            | 25V |
| C51      | Barrier L.  | UFD08SA821K-L2A  |     |
| C52      | Ceramic     | 100P             | 50V |
| C53      | Barrier L.  | UFD08SA681K-L2A  |     |
| C54      | Barrier L.  | TBD04V122K-L0B   |     |
| C55      | Barrier L.  | TBD06V682K-L2A   |     |
| C56      | Barrier L.  | TBD04V102K-L0B   |     |
| C57      | Barrier L.  | 0.1              | 12V |
| C58      | Barrier L.  | 0.1              | 12V |
| C59      | Barrier L.  | 0.1              | 12V |
| C61      | Barrier L.  | TBD04V222K-L0B   |     |
| C62      | Ceramic     | DD107SL271J50V02 |     |
| C63      | Barrier L.  | TBD04V222K-L0B   |     |
| C64      | Barrier L.  | TBD04V222K-L0B   |     |
| C65      | Barrier L.  | TBD08V123K-L2A   |     |
| C66      | Barrier L.  | TBD04V152K-L0B   |     |
| C67      | Barrier L.  | 0.1              | 12V |
| C69      | Barrier L.  | TBD05V332K-L0B   |     |
| C70      | Ceramic     | DD108SL391J50V02 |     |
| C71      | Barrier L.  | TBD05V332K-L0B   |     |
| C72      | Barrier L.  | 10               | 16V |
| C74      | Barrier L.  | 0.0047           | 25V |
| C75      | Ceramic     | DD104SL560J50V02 |     |
| C76      | Ceramic     | DD104SL390J50V02 |     |
| C77      | Ceramic     | DD104SL560J50V02 |     |
| C78      | Ceramic     | DD104SL820J50V02 |     |
| C79      | Ceramic     | DD104SL270J50V02 |     |
| C80      | Ceramic     | 120P             | 50V |
| C81      | Ceramic     | 100P             | 50V |
| C82      | Ceramic     | DD104SL560J50V02 |     |
| C83      | Ceramic     | 470P             | 50V |
| C84      | Ceramic     | 0.0047           | 50V |
| C85      | Ceramic     | 0.0047           | 50V |
| C86      | Ceramic     | DD104SL750J50V02 |     |
| C87      | Ceramic     | 150P             | 50V |
| C88      | Ceramic     | DD104SL510J50V02 |     |
| C89      | Ceramic     | 0.0047           | 50V |
| C90      | Ceramic     | 0.0047           | 50V |
| C91      | Ceramic     | 0.0047           | 50V |
| C92      | Ceramic     | 0.0047           | 50V |
| C93      | Ceramic     | 0.0047           | 50V |
| C94      | Ceramic     | 22P              | 50V |
| C95      | Ceramic     | 0.0047           | 50V |
| C96      | Ceramic     | 0.0047           | 50V |
| C97      | Ceramic     | 0.0047           | 50V |
| C98      | Ceramic     | 22P              | 50V |
| C99      | Barrier L.  | 0.1              | 12V |

## [RF] UNIT

| REF. NO. | DESCRIPTION | PART NO.         |     |
|----------|-------------|------------------|-----|
| C100     | Ceramic     | 0.0047           | 50V |
| C101     | Ceramic     | 0.0047           | 50V |
| C102     | Ceramic     | 0.0047           | 50V |
| C103     | Ceramic     | 0.35P            | 50V |
| C104     | Ceramic     | 0.001            | 50V |
| C105     | Ceramic     | 0.0047           | 50V |
| C106     | Ceramic     | 0.001            | 50V |
| C107     | Ceramic     | DD109SL471J50V02 |     |
| C108     | Ceramic     | DD104SL510J50V02 |     |
| C109     | Ceramic     | DD109SL471J50V02 |     |
| C110     | Ceramic     | 0.0047           | 50V |
| C111     | Ceramic     | 0.0047           | 50V |
| C112     | Ceramic     | 0.001            | 50V |
| C113     | Ceramic     | 0.0047           | 50V |
| C114     | Ceramic     | 0.0047           | 50V |
| C115     | Cylinder    | 100P             | 50V |
| *C116    | Electroly   | 10               | 16V |
| C117     | Barrier L.  | 0.1              | 12V |
| C118     | Barrier L.  | 0.047            | 25V |
| C119     | Barrier L.  | 0.047            | 25V |
| C120     | Ceramic     | 0.0047           | 50V |
| C121     | Ceramic     | 68P              | 50V |
| C122     | Ceramic     | 47P              | 50V |
| C123     | Ceramic     | 150P             | 50V |
|          |             |                  |     |
| C126     | Barrier L.  | 0.1              | 12V |
| C127     | Electroly   | 10 $\mu$         | 16V |
| C128     | Ceramic     | 0.0047           | 50V |
| C129     | Ceramic     | 0.0047           | 50V |
| C130     | Ceramic     | 0.0047           | 50V |
| C132     | Barrier L.  | 0.047            | 25V |
| C133     | Ceramic     | 0.001            | 50V |
| C134     | Ceramic     | 0.0047           | 50V |
| C135     | Ceramic     | 0.001            | 50V |
| C136     | Ceramic     | 2P               | 50V |
| C137     | Ceramic     | 68P              | 50V |
| C138     | Ceramic     | 0.0047           | 50V |
| C139     | Ceramic     | 0.0047           | 50V |
| C140     | Ceramic     | 0.001            | 50V |
| C141     | Ceramic     | 0.0047           | 50V |
| C142     | Ceramic     | 0.0047           | 50V |
| C143     | Ceramic     | 0.0047           | 50V |
| C144     | Ceramic     | 0.0047           | 50V |
| C145     | Ceramic     | 0.5P             | 50V |
| C146     | Ceramic     | 22P              | 50V |
| C147     | Ceramic     | 0.0047           | 50V |
| C148     | Ceramic     | 0.0047           | 50V |
| C149     | Barrier L.  | 0.047            | 25V |
| C150     | Ceramic     | DD108SL331J50V02 |     |
| C151     | Ceramic     | DD104SL510J50V02 |     |
| C152     | Ceramic     | DD108SL331J50V02 |     |
| C153     | Ceramic     | DD108SL331J50V02 |     |
| C154     | Barrier L.  | TBD05V272K-L0B   |     |
| C155     | Ceramic     | DD107SL301J50V02 |     |
| C156     | Barrier L.  | 0.047            | 25V |
| C157     | Barrier L.  | 0.1              | 12V |
| C158     | Barrier L.  | TBD04V152K-L0B   |     |
| C159     | Ceramic     | DD106SL201J50V02 |     |
| C160     | Barrier L.  | TBD04V152K-L0B   |     |
| C161     | Barrier L.  | TBD04V182K-L0B   |     |
| C162     | Barrier L.  | TBD06V103K-L2A   |     |
| C163     | Barrier L.  | TBD04V122K-L0B   |     |
| C164     | Barrier L.  | 0.1              | 12V |
| C165     | Electroly   | 4.7 $\mu$        | 50V |

## [RF] UNIT

| REF. NO. | DESCRIPTION | PART NO.       |      |
|----------|-------------|----------------|------|
| C166     | Barrier L.  | 0.047          | 25V  |
| C167     | Electroly   | 10             | 25V  |
| C168     | Ceramic     | 0.0047         | 50V  |
| C169     | Ceramic     | 47             | 10V  |
| C170     | Ceramic     | 0.0047         | 50V  |
| C171     | Barrier L.  | 0.001          | 50V  |
| C172     | Ceramic     | 22P            | 50V  |
| *C173    | Ceramic     | 0.001          | 50VB |
| *C174    | Ceramic     | 0.0047         | 50VB |
| *C175    | Ceramic     | 0.0047         | 50VB |
|          |             |                |      |
| J1       | Connector   | 5045-04A       |      |
| J2       | Connector   | 5045-04A       |      |
| J3       | Connector   | 5045-10A       |      |
| J5       | Connector   | 5045-08A       |      |
| J6       | Connector   | 5045-04A       |      |
| J7       | Connector   | 5045-02A       |      |
| J8       | Connector   | 5045-04A       |      |
| J9       | Connector   | 5045-02A       |      |
|          |             |                |      |
| P1       | Connector   | 5250-02A       |      |
|          |             |                |      |
| F11      | MC          | FL-29 (39M15B) |      |
|          |             |                |      |
| B1       | PC. Board   | B-379F         |      |
|          |             |                |      |
| W1       | Jumper      | JPW-02A        |      |



# [SENSOR] UNIT

| REF. NO. | DESCRIPTION | PART NO. |     |
|----------|-------------|----------|-----|
| IC1      | Photo. Int. | ON1105   |     |
| IC2      | Photo. Int. | ON1105   |     |
| R1       | Resistor    | 330      | R25 |
| R2       | Resistor    | RGP056   | 30K |
| R3       | Resistor    | RGP056   | 30K |
| R4       | Resistor    | 10K      | R25 |
| R5       | Resistor    | 10K      | R25 |
| R6       | Resistor    | 10K      | R25 |
| R7       | Resistor    | 10K      | R25 |
| B1       | PC Board    | B-409    |     |

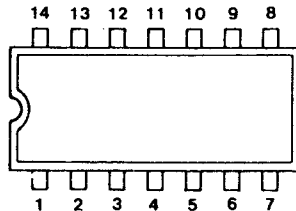
# [RTTY] UNIT

| REF. NO. | DESCRIPTION | PART NO.          |       |
|----------|-------------|-------------------|-------|
| Q1       | Transistor  | 2SC945P           |       |
| Q2       | Transistor  | 2SC945P           |       |
| Q3       | Transistor  | 2SC945P           |       |
| Q4       | Transistor  | 2SC945P           |       |
| Q5       | Transistor  | 2SA1015           |       |
| D1       | Diode       | 1SS53             |       |
| X1       | Xtal        | 9.0115MHz HC-43/u |       |
| L1       | Coil        | LR-88             |       |
| R1       | Resistor    | 22K               | ELR25 |
| R2       | Resistor    | 10K               | ELR25 |
| R3       | Resistor    | 100K              | ELR25 |
| R4       | Resistor    | 100K              | ELR25 |
| R5       | Resistor    | 47K               | ELR25 |
| R6       | Resistor    | 2.2K              | ELR25 |
| R7       | Resistor    | H0651A            | 30K   |
| R8       | Resistor    | 220K              | ELR25 |
| R9       | Resistor    | 470K              | ELR25 |
| R10      | Resistor    | 2.2K              | ELR25 |
| R11      | Resistor    | 10K               | ELR25 |
| R12      | Resistor    | 22K               | ELR25 |
| R14      | Resistor    | 10K               | ELR25 |
| R16      | Resistor    | 22K               | ELR25 |
| C1       | Ceramic     | 0.0047            | 50V   |
| C2       | Trimmer     | CVB10-41          |       |
| C3       | Trimmer     | CVB06-41          |       |
| C4       | Dip mica    | 39P               | 50V   |
| C5       | Ceramic     | 0.0047            | 50V   |
| C6       | Dip mica    | 150P              | 50V   |
| C7       | Dip mica    | 150P              | 50V   |
| C8       | Ceramic     | 0.35P             | 50V   |
| C9       | Ceramic     | 0.0047            | 50V   |
| C12      | Ceramic     | 0.001             | 50V   |
| C13      | Barrier L.  | 0.047             | 25V   |
| C14      | Barrier L.  | 0.047             | 25V   |
| J1       | Connector   | 171255-1          |       |
| J2       | Connector   | 5045-4A           |       |
| J3       | Connector   | 5045-02A          |       |
| B1       | PC Board    | B-413B            |       |



TC4001 (QUAD 2-INPUT POSITIVE NOR GATE)  
 TC4011 (QUAD 2-INPUT POSITIVE NOR GATE)  
 TC4013 (DUAL D-TYPE FLIP FLOP)  
 TC4028 (BCD TO DECIMAL DECODER)  
 TC4069 (HEX INVERTER)  
 TC4081 (QUAD 2-INPUT POSITIVE AND GATE)  
 TC40175 (QUAD TYPE D FLIP FLOP)  
 TC4520 (DUAL BINARY UP COUNTER)

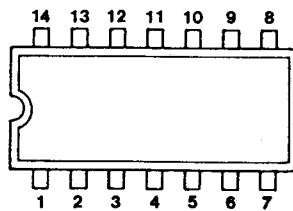
PIN CONNECTION



MAXIMUM RATING

| ITEM                    | SYMBOL           | RATING                                      | UNIT |
|-------------------------|------------------|---------------------------------------------|------|
| SUPPLY VOLTAGE          | V <sub>DD</sub>  | V <sub>SS</sub> -0.5 ~ V <sub>SS</sub> +20  | V    |
| INPUT VOLTAGE           | V <sub>IN</sub>  | V <sub>SS</sub> -0.5 ~ V <sub>DD</sub> +0.5 | V    |
| OUTPUT VOLTAGE          | V <sub>OUT</sub> | V <sub>SS</sub> -0.5 ~ V <sub>DD</sub> +0.5 | V    |
| INPUT CURRENT           | I <sub>IN</sub>  | ±10                                         | mA   |
| POWER DISSIPATION       | P <sub>D</sub>   | 300                                         | mW   |
| STORAGE TEMPERATURE     | T <sub>STG</sub> | -65 ~ 150                                   | °C   |
| LEAD TEMPERATURE · TIME | T <sub>SOL</sub> | 260°C · 10Sec.                              |      |

TC4016 (QUAD BILATERAL SWITCH)  
 TC4066 (QUAD BILATERAL SWITCH)

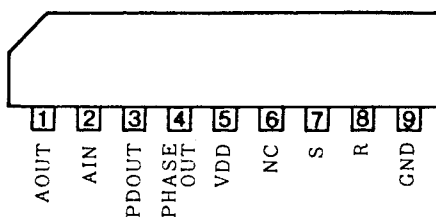


MAXIMUM RATING

| ITEM                        | SYMBOL            | RATING                                      | UNIT |
|-----------------------------|-------------------|---------------------------------------------|------|
| SUPPLY VOLTAGE              | V <sub>DD</sub>   | V <sub>SS</sub> -0.5 ~ V <sub>SS</sub> +20  | V    |
| CONTROL INPUT VOLTAGE       | V <sub>C IN</sub> | V <sub>SS</sub> -0.5 ~ V <sub>DD</sub> +0.5 | V    |
| SWITCH INPUT/OUTPUT VOLTAGE | V <sub>I/O</sub>  | V <sub>SS</sub> -0.5 ~ V <sub>DD</sub> +0.5 | V    |
| CONTROL INPUT CURRENT       | I <sub>C IN</sub> | ±10                                         | mA   |
| POWER DISSIPATION           | P <sub>D</sub>    | 300                                         | mW   |
| STORAGE TEMPERATURE         | T <sub>STG</sub>  | -65 ~ 150                                   | °C   |
| LEAD TEMPERATURE · TIME     | T <sub>SOL</sub>  | 260°C · 10 Sec.                             |      |

## TC5081 (PHASE COMPARATOR)

### PIN CONNECTION

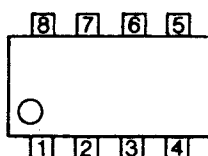


### MAXIMUM RATING

| ITEM                  | SYMBOL | RATING          | UNIT |
|-----------------------|--------|-----------------|------|
| SUPPLY VOLTAGE        | VDD    | 10              | V    |
| INPUT VOLTAGE         | VIN    | -0.3 ~ VDD +0.3 | V    |
| OPERATING TEMPERATURE | TOPR   | -30 ~ +75       | °C   |
| STORAGE TEMPERATURE   | TSTG   | -55 ~ +125      | °C   |

## NJM4558D (DUAL LOW NOISE AMP.)

### PIN CONNECTION



### MAXIMUM RATING

| ITEM                  | SYMBOL | RATING     | UNIT |
|-----------------------|--------|------------|------|
| SUPPLY VOLTAGE        | VDD    | 18         | V    |
| INPUT VOLTAGE         | VIN    | 15         | V    |
| OPERATING TEMPERATURE | TOPT   | -20 ~ +75  | °C   |
| STORAGE TEMPERATURE   | TSTG   | -40 ~ +125 | °C   |

## AN829 (DUAL ATTENUATOR)

### MAXIMUM RATING

| ITEM                  | SYMBOL | RATING     | UNIT |
|-----------------------|--------|------------|------|
| SUPPLY VOLTAGE        | VCC    | 18         | V    |
| CONTROL INPUT VOLTAGE | Vc     | 0 ~ 6      | V    |
| POWER DISSIPATION     | PD     | 450        | mW   |
| OPERATING TEMPERATURE | TOPR   | -20 ~ +75  | °C   |
| STORAGE TEMPERATURE   | TSTG   | -55 ~ +150 | °C   |

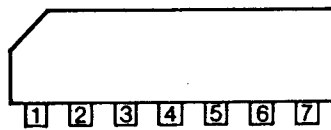
## μPC2002 (5.4W AUDIO POWER AMP.)

### MAXIMUM RATING

| ITEM                               | SYMBOL       | RATING     | UNIT |
|------------------------------------|--------------|------------|------|
| SUPPLY VOLTAGE (SURGE)             | VCC1 (50ms)  | 40         | V    |
| SUPPLY VOLTAGE (NO-LOAD)           | VCC2         | 28         | V    |
| SUPPLY VOLTAGE (OPERATING)         | VCC3         | 18         | V    |
| CIRCUIT CURRENT (CONTINUOUS PULSE) | Icc (PEAK) 1 | 3.5        | A    |
| CIRCUIT CURRENT (CONTINUOUS PULSE) | Icc (PEAK) 2 | 4.5        | A    |
| PACKAGE POWER DISSIPATION          | PD (Tc=90°C) | 75         | W    |
| OPERATING TEMPERATURE              | TOPR         | -30 ~ +75  | °C   |
| STORAGE TEMPERATURE                | TSTG         | -40 ~ +150 | °C   |

### $\mu$ PC1037H (DOUBLE BALANCED MODULATOR CIRCUIT)

PIN CONNECTION



PIN NUMBER

CONNECTION

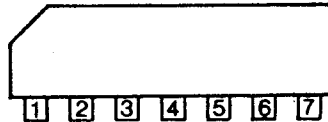
|   |                 |
|---|-----------------|
| 1 | V <sub>CC</sub> |
| 2 | Out Put1        |
| 3 | Out Put2        |
| 4 | G <sub>ND</sub> |
| 5 | Signal Input    |
| 6 | Bypass          |
| 7 | Carrier Input   |

MAXIMUM RATING

| ITEM                      | SYMBOL           | RATING     | UNIT |
|---------------------------|------------------|------------|------|
| SUPPLY VOLTAGE            | V <sub>CC</sub>  | 9          | V    |
| PACKAGE POWER DISSIPATION | P <sub>D</sub>   | 270        | mW   |
| OPERATING TEMPERATURE     | T <sub>OPT</sub> | -30 ~ +65  | °C   |
| STORAGE TEMPERATURE       | T <sub>STG</sub> | -40 ~ +125 | °C   |

### $\mu$ PC577H (FM-IF AMPLIFIER)

PIN CONNECTION

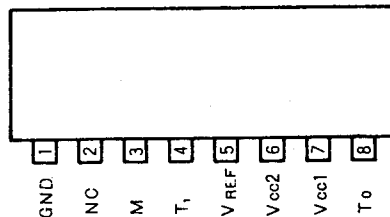


MAXIMUM RATING

| ITEM                   | SYMBOL           | RATING     | UNIT |
|------------------------|------------------|------------|------|
| SUPPLY VOLTAGE         | V <sub>CC</sub>  | 15         | V    |
| INPUT TERMINAL VOLTAGE | V <sub>IN</sub>  | ±3.0       | V    |
| POWER DISSIPATION      | P <sub>D</sub>   | 300        | mW   |
| OPERATING TEMPERATURE  | T <sub>OPT</sub> | -20 ~ +75  | °C   |
| STORAGE TEMPERATURE    | T <sub>STG</sub> | -40 ~ +125 | °C   |

### M54459 ( $\frac{1}{20}$ , $\frac{1}{100}$ HIGH SPEED DIVIDER)

PIN CONNECTION

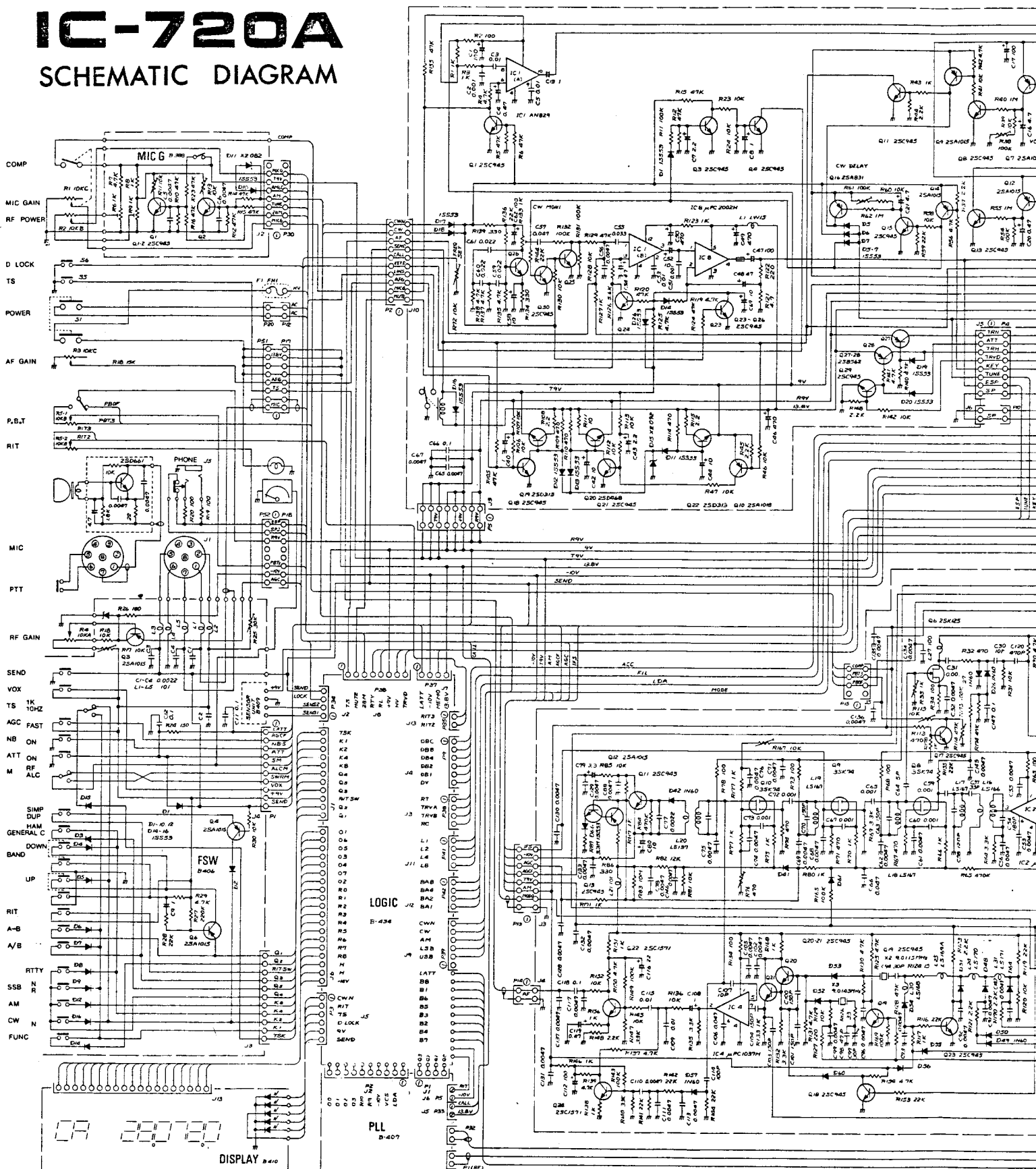


MAXIMUM RATING

| ITEM                  | SYMBOL           | RATING     | UNIT |
|-----------------------|------------------|------------|------|
| SUPPLY VOLTAGE        | V <sub>CC</sub>  | 9          | V    |
| INPUT VOLTAGE         | V <sub>I</sub>   | 1.5        | V    |
| OPERATING TEMPERATURE | T <sub>OPR</sub> | -10 ~ +75  | °C   |
| STORAGE TEMPERATURE   | T <sub>STG</sub> | -55 ~ +125 | °C   |

# IC-720A

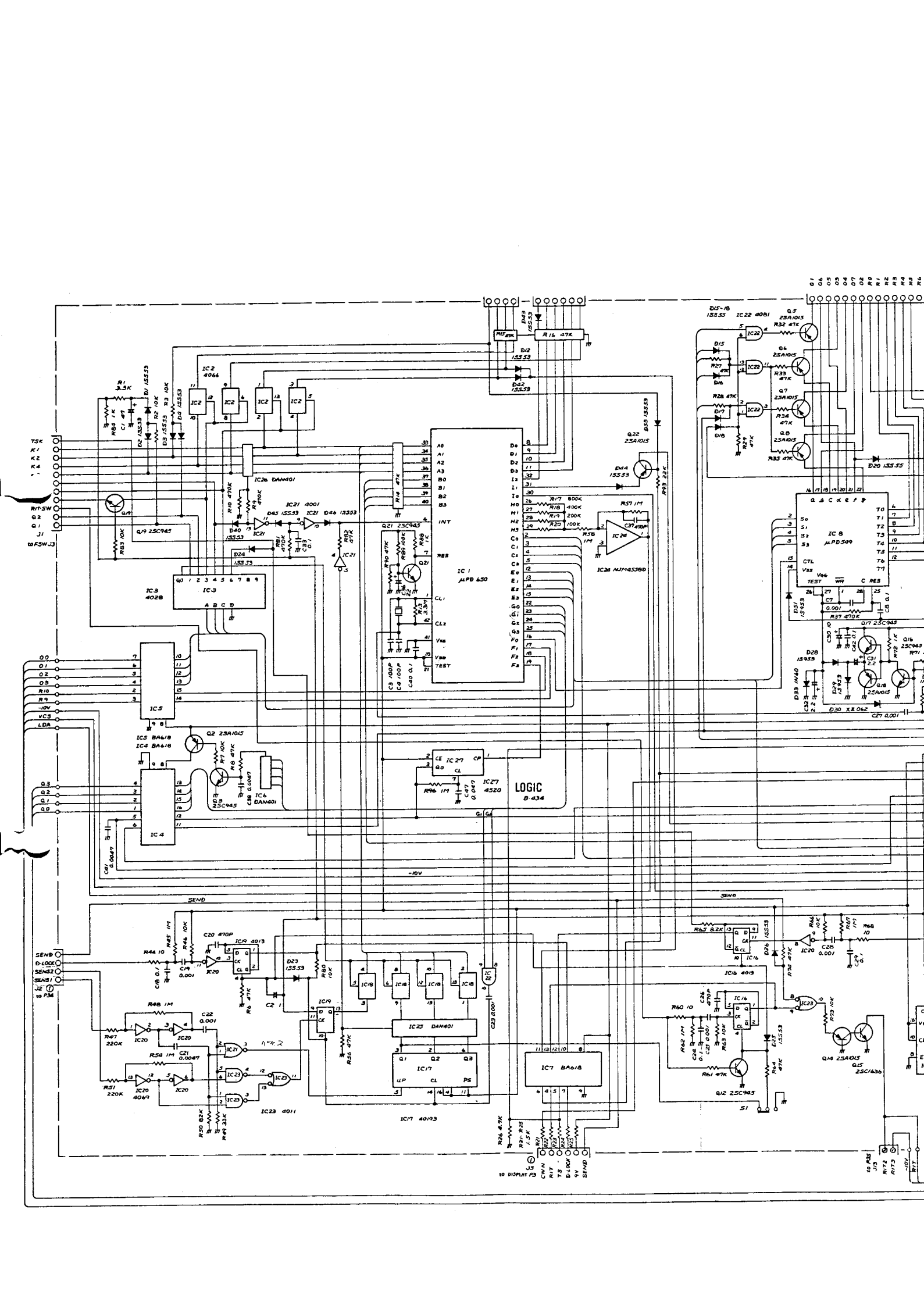
## SCHEMATIC DIAGRAM



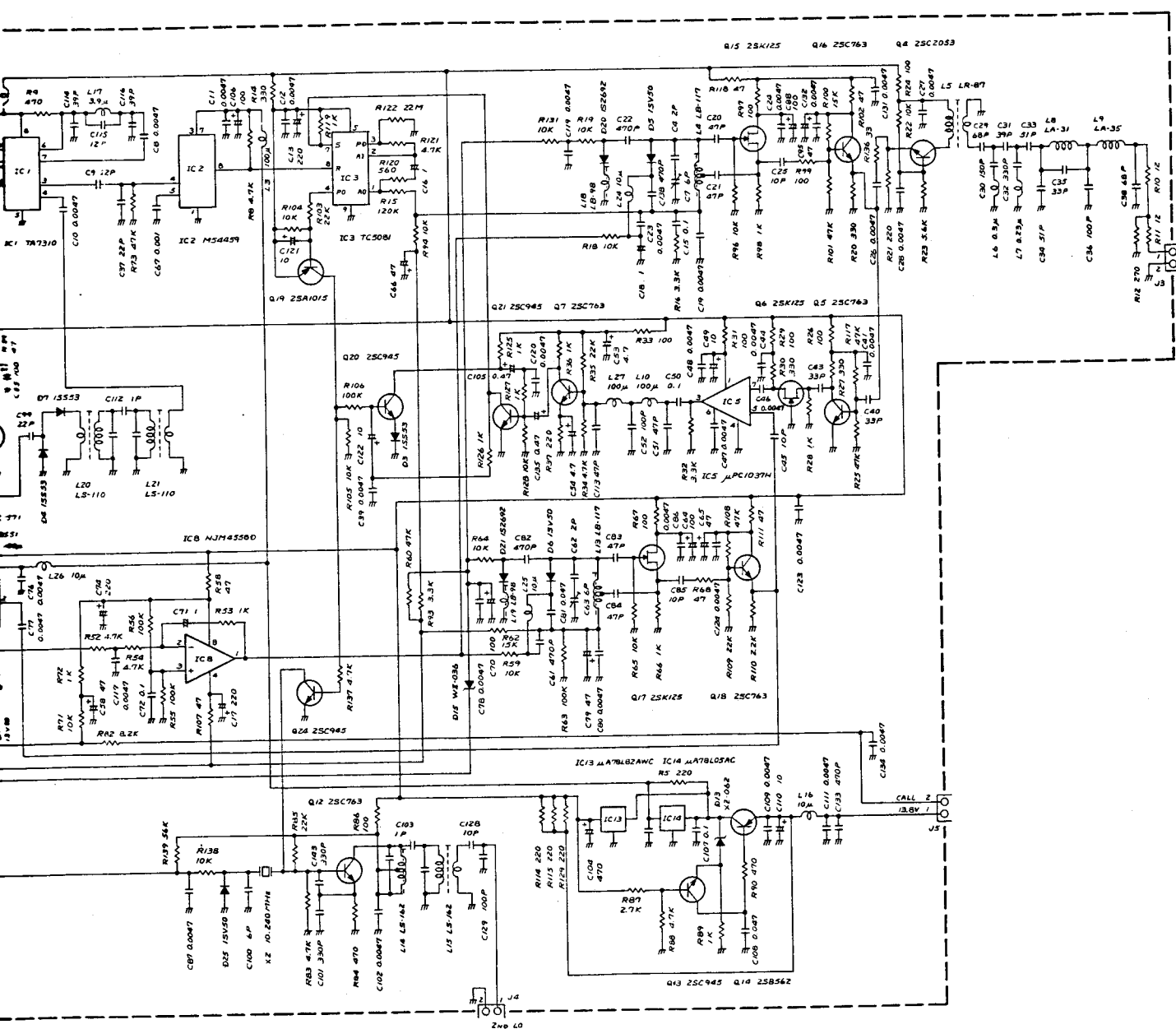




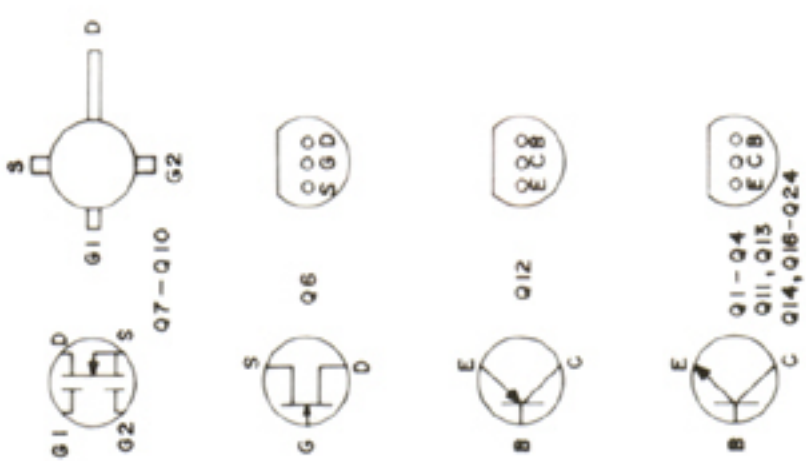














# UNIT LAYOUT

EF UNIT  
(MIC GAIN BOARD)

EF UNIT  
(DISPLAY BOARD)

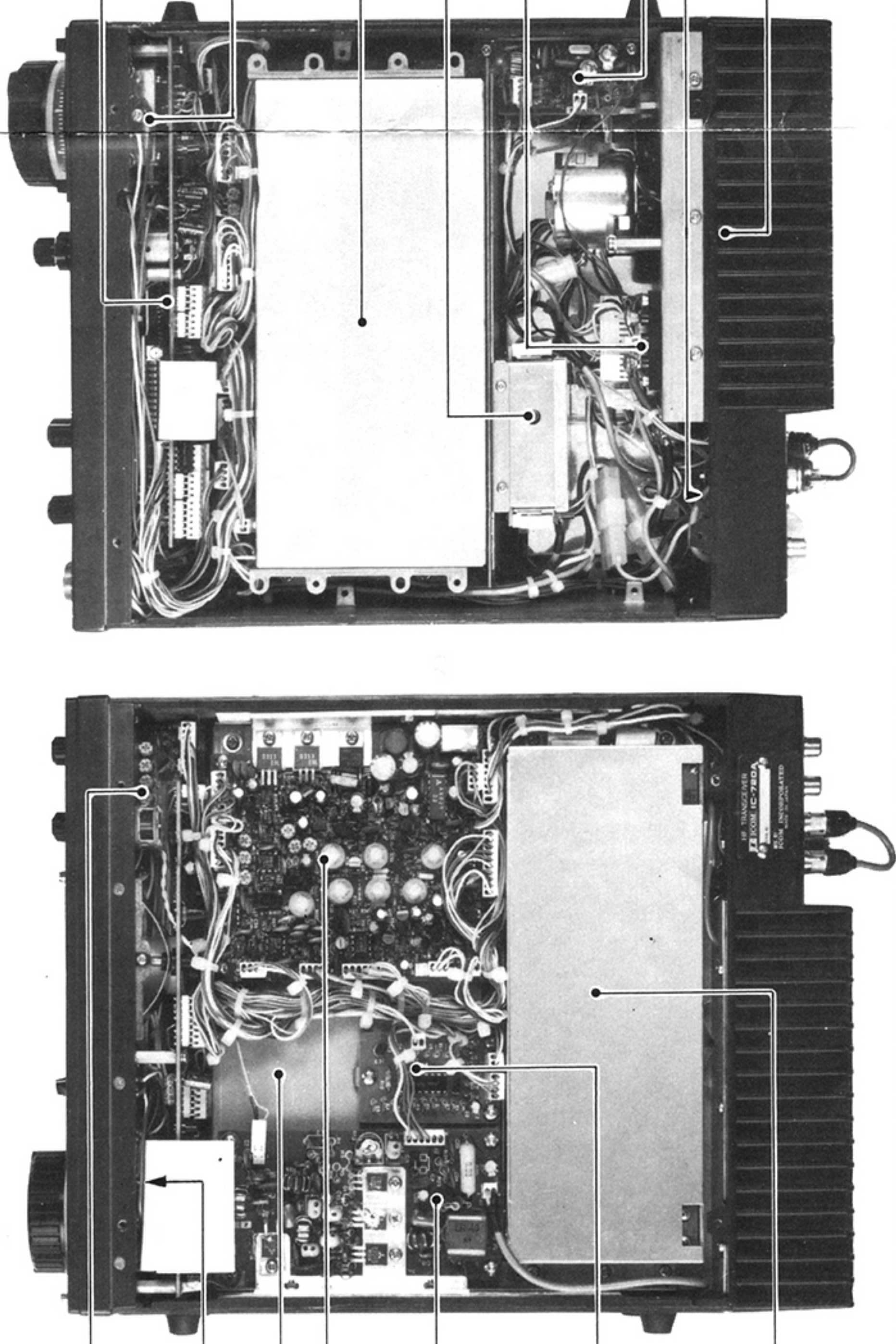
PLL UNIT

MAIN UNIT

DRIVER UNIT

LDA UNIT

FILTER UNIT



LOGIC UNIT

EF UNIT  
(SENSOR BOARD)

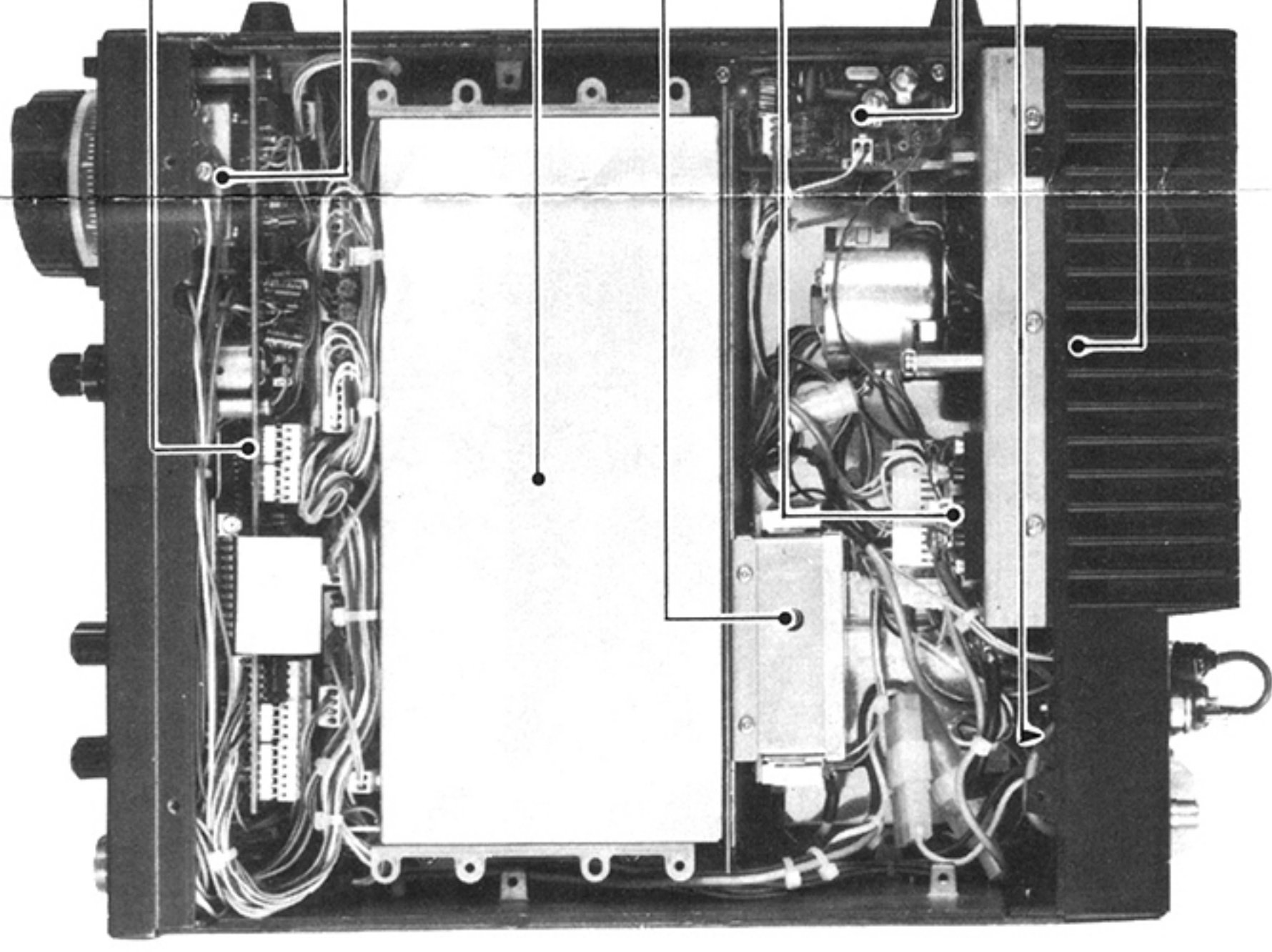
IF UNIT

SWR UNIT

PA CONNECTOR UNIT

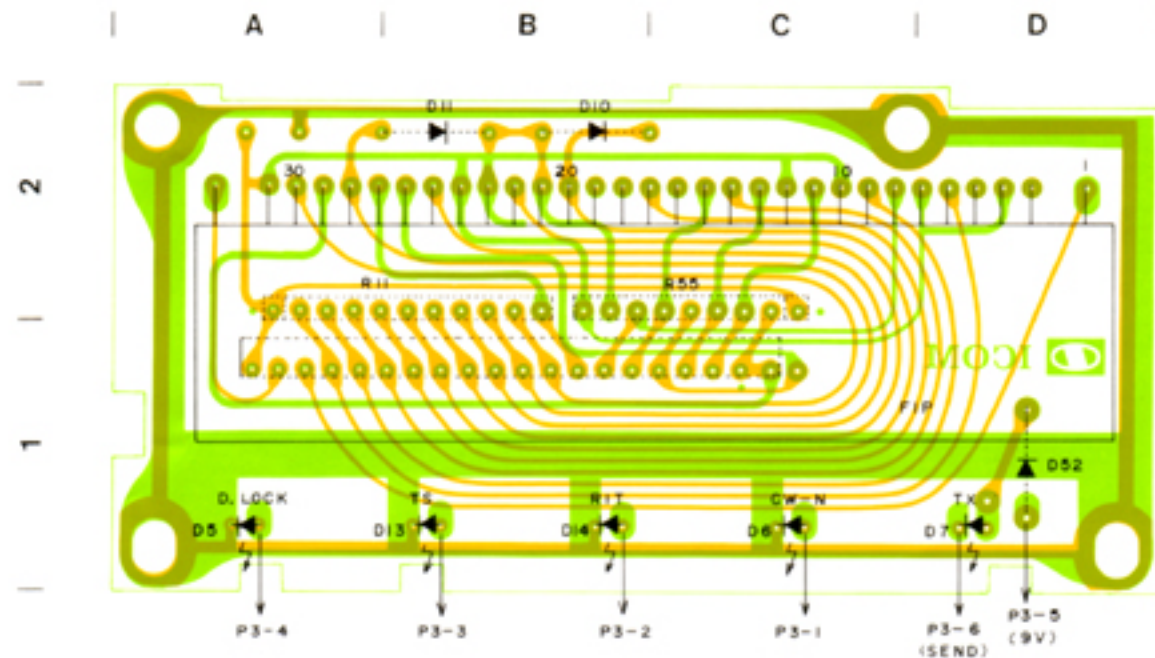
RTTY UNIT  
ACC UNIT

POWER AMPLIFIER UNIT

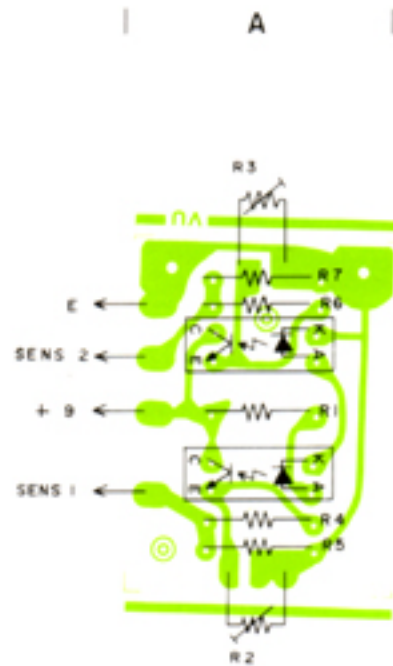


# EF UNIT

## ■ DISPLAY BOARD

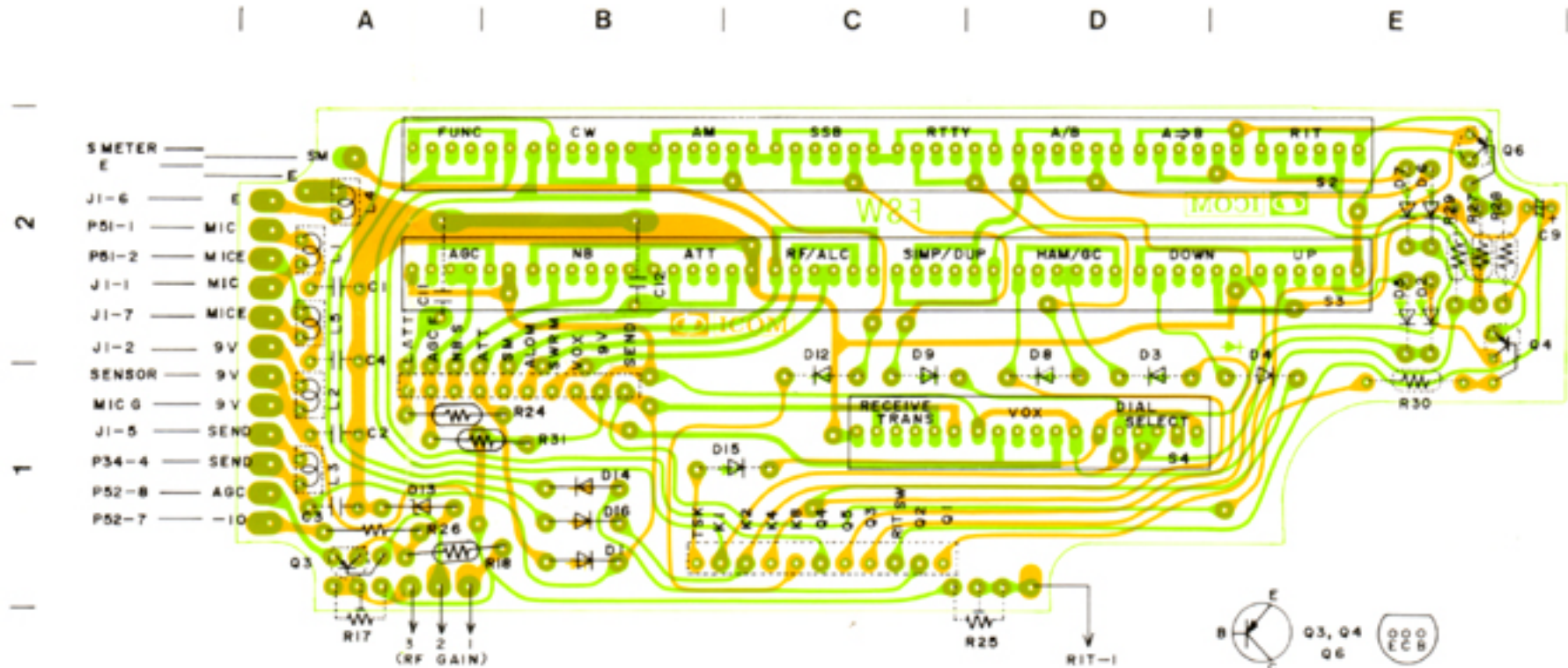


## ■ SENSOR BOARD

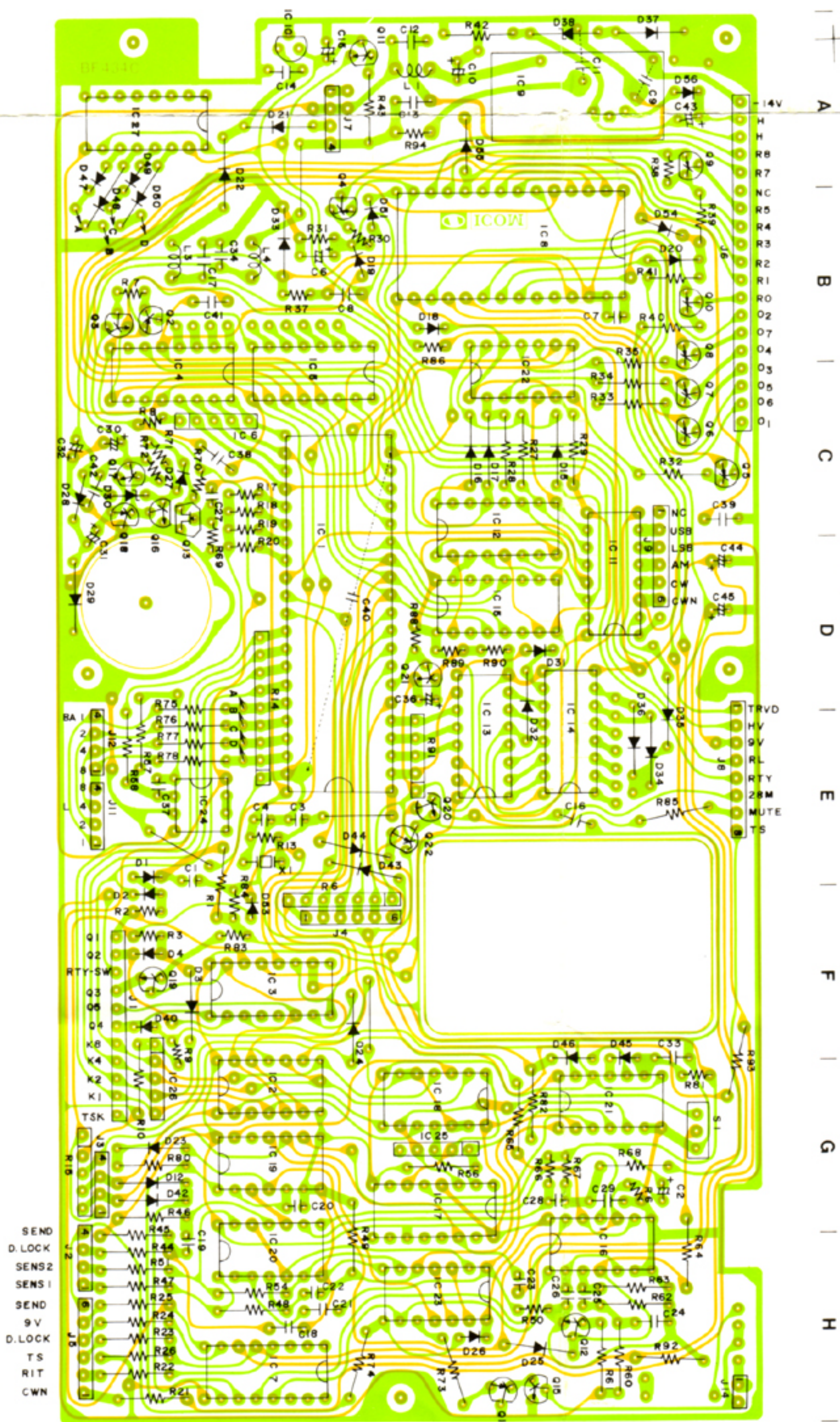




# ■ FRONT SWITCH BOARD

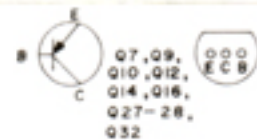
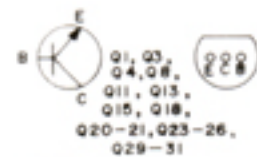
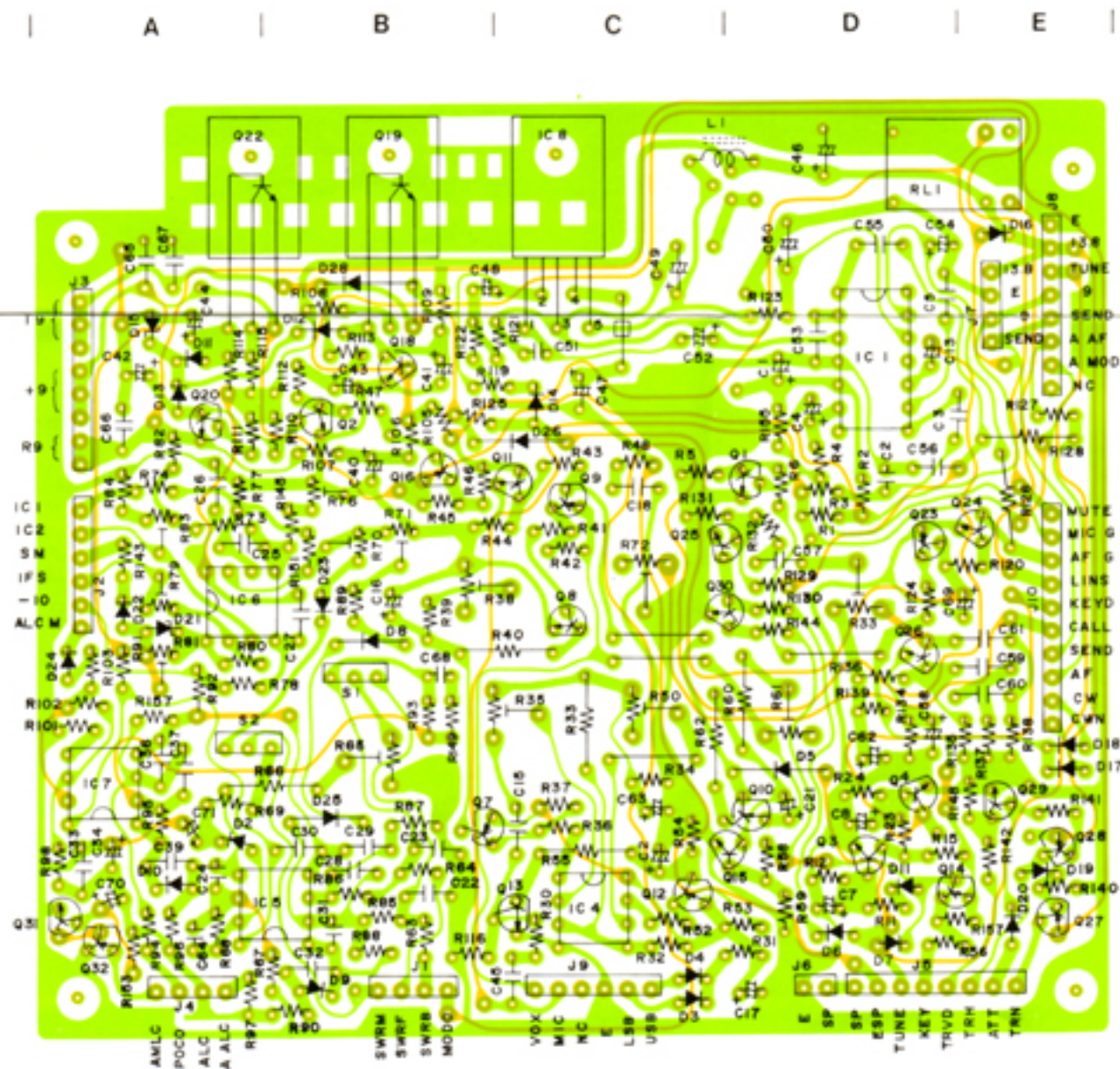




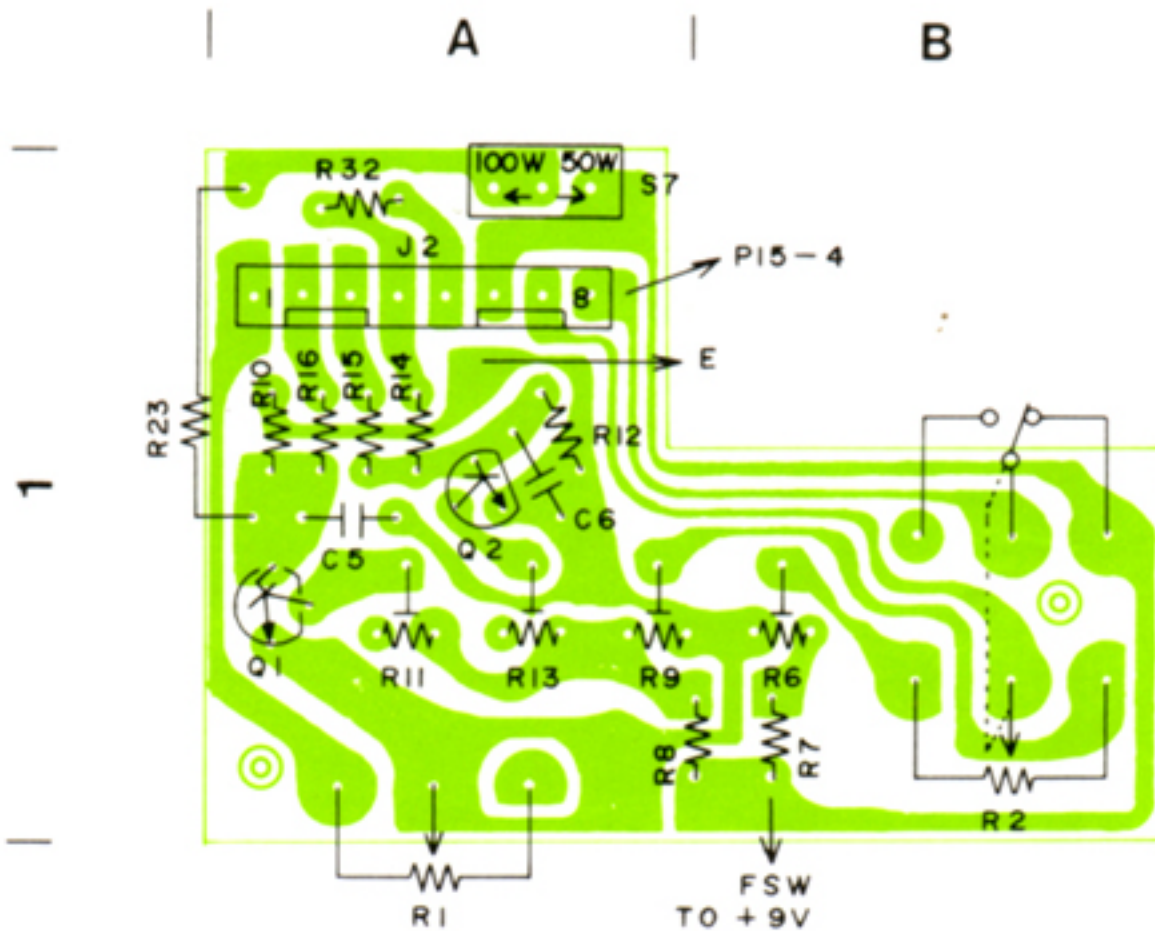




# MAIN UNIT



# ■ MIC GAIN BOARD





# PLL UNIT



Q4 7 5 12 16 18



Q8 13 20 21 24

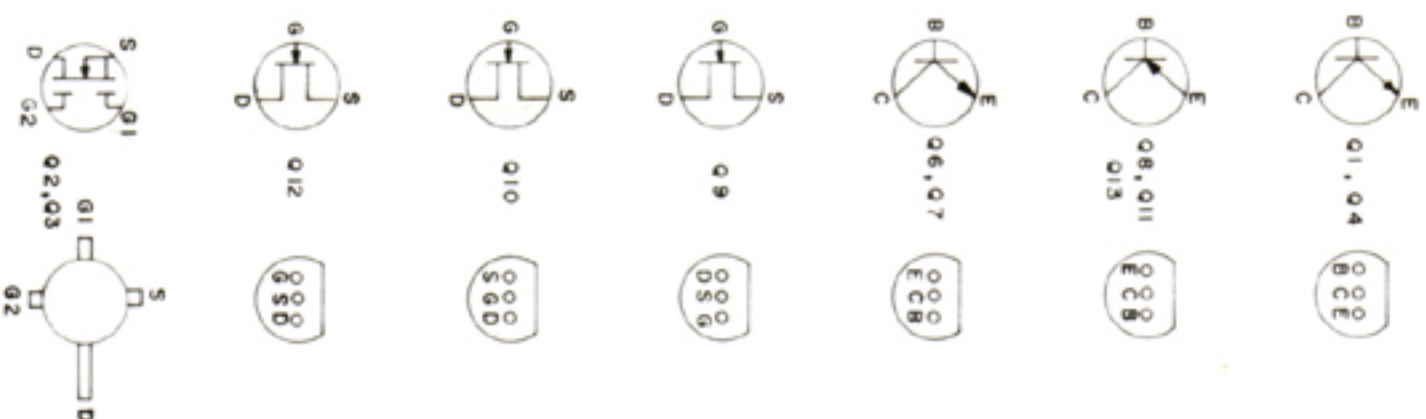
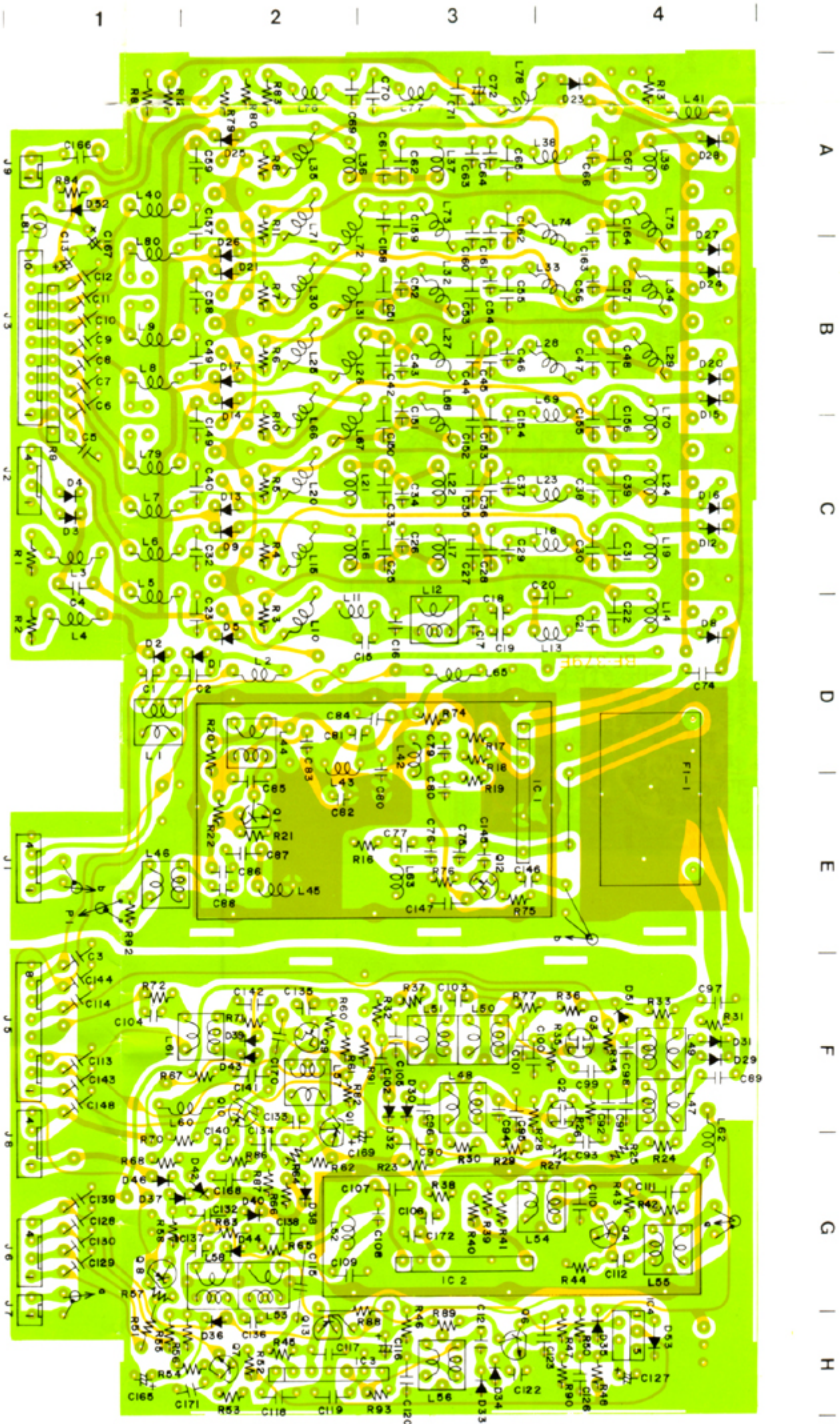


Q6 15 17



Q14 19



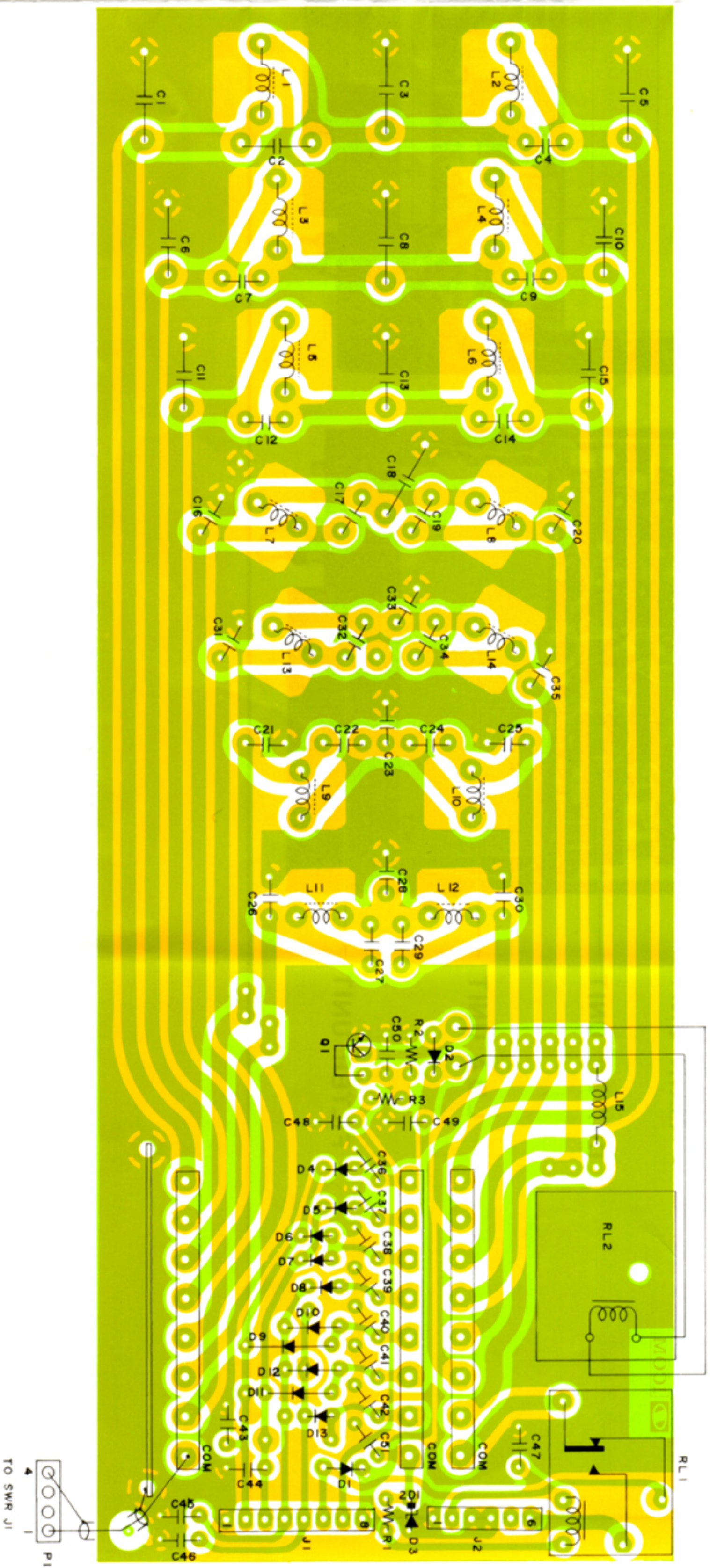




# FILTER UNIT

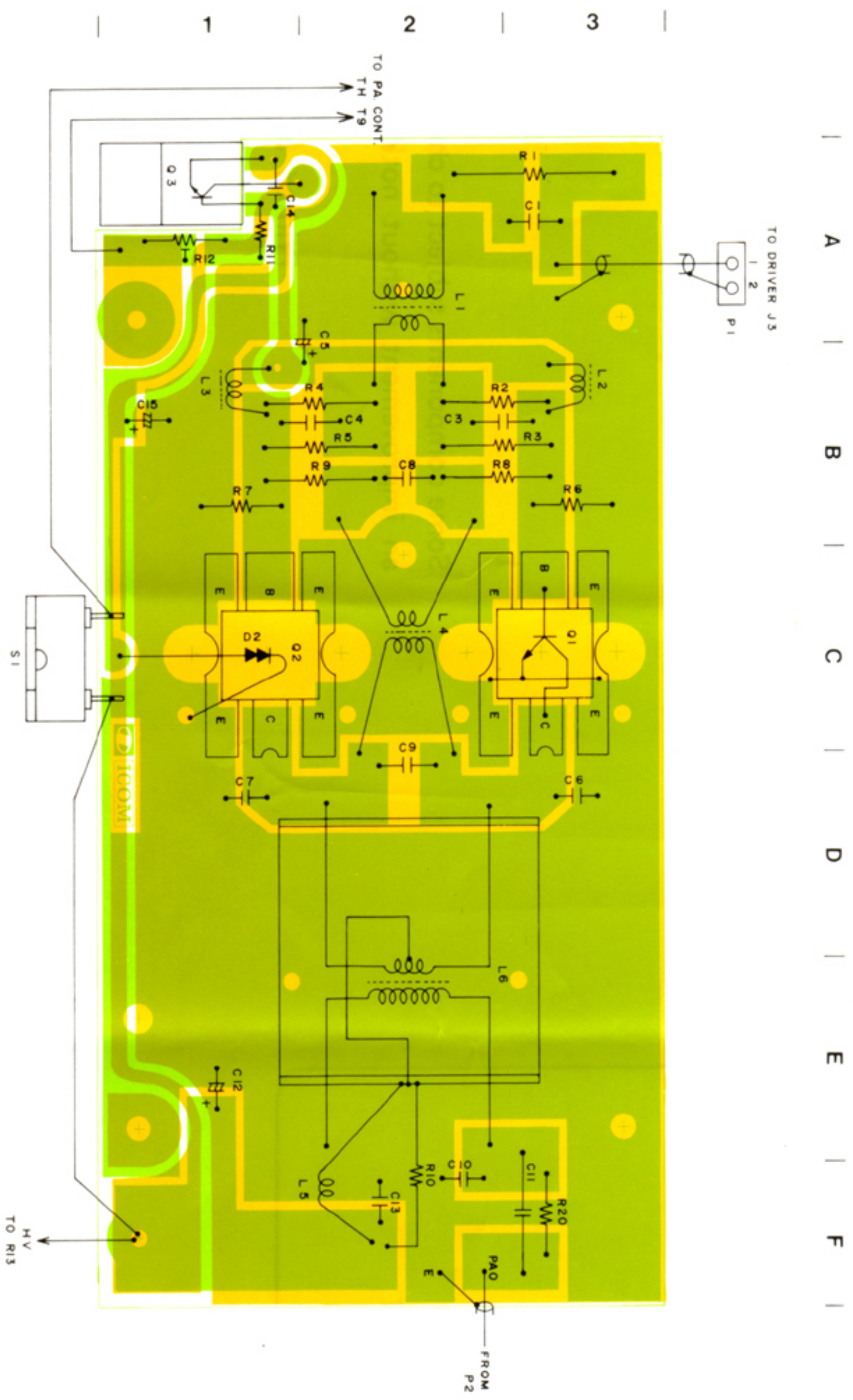
A B C D E F G H

1 2 3

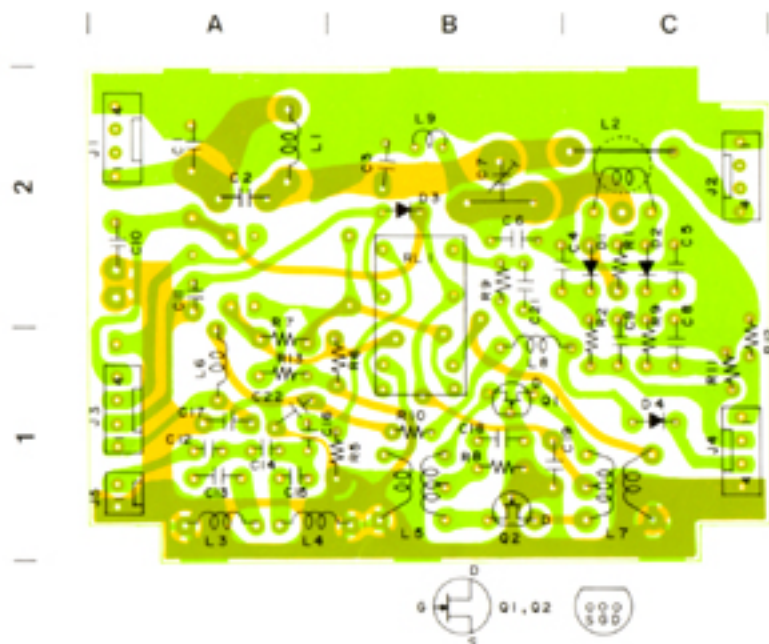




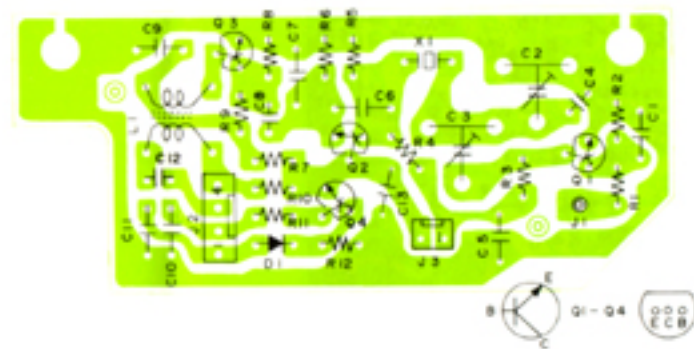
# POWER AMPLIFIER UNIT



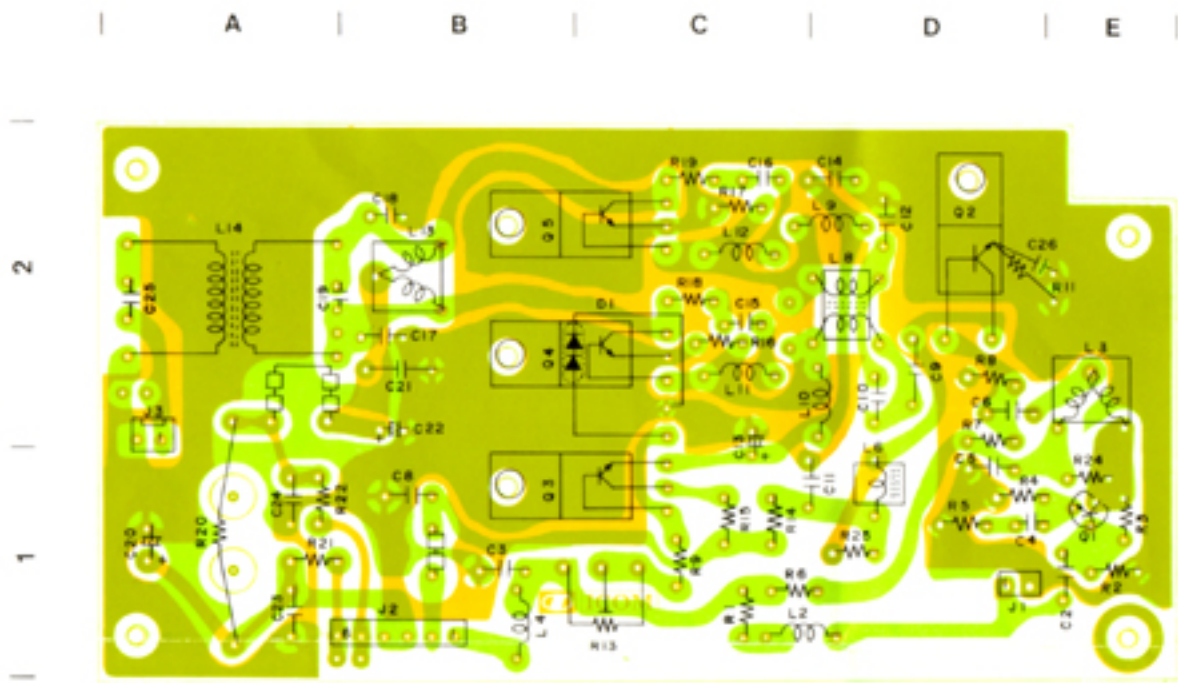
## SWR UNIT



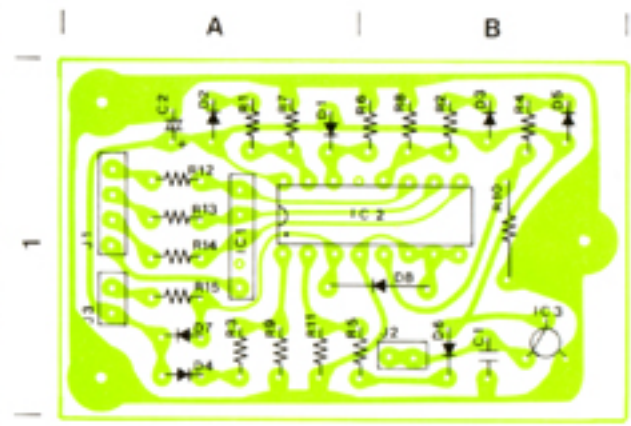
## RTTY UNIT



## DRIVER UNIT

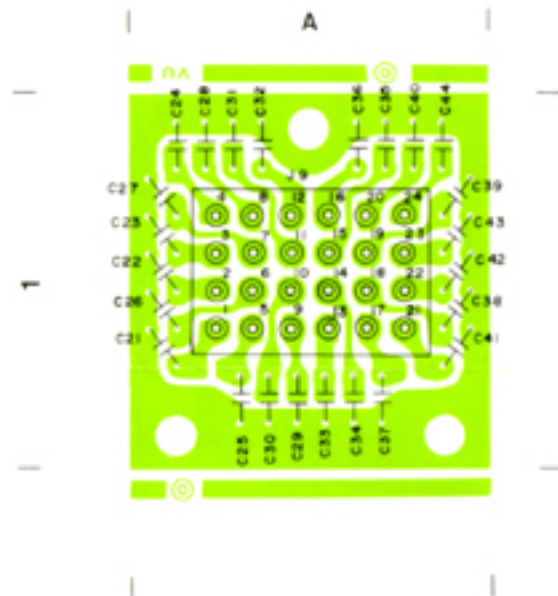


## LDA UNIT





# ACC UNIT



# PA CONNECTOR BOARD

