

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°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 -6dB
(Adjustable to $\pm 0.4\text{KHz}$ Min)
 $\pm 2.1\text{KHz}$ at -60dB

CW-N

(when optional filter installed)

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

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

AM

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

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

(when optional filter installed)

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

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

Spurious Response Rejection Ratio:

More than 60dB

Audio Output:

More than 2 Watts

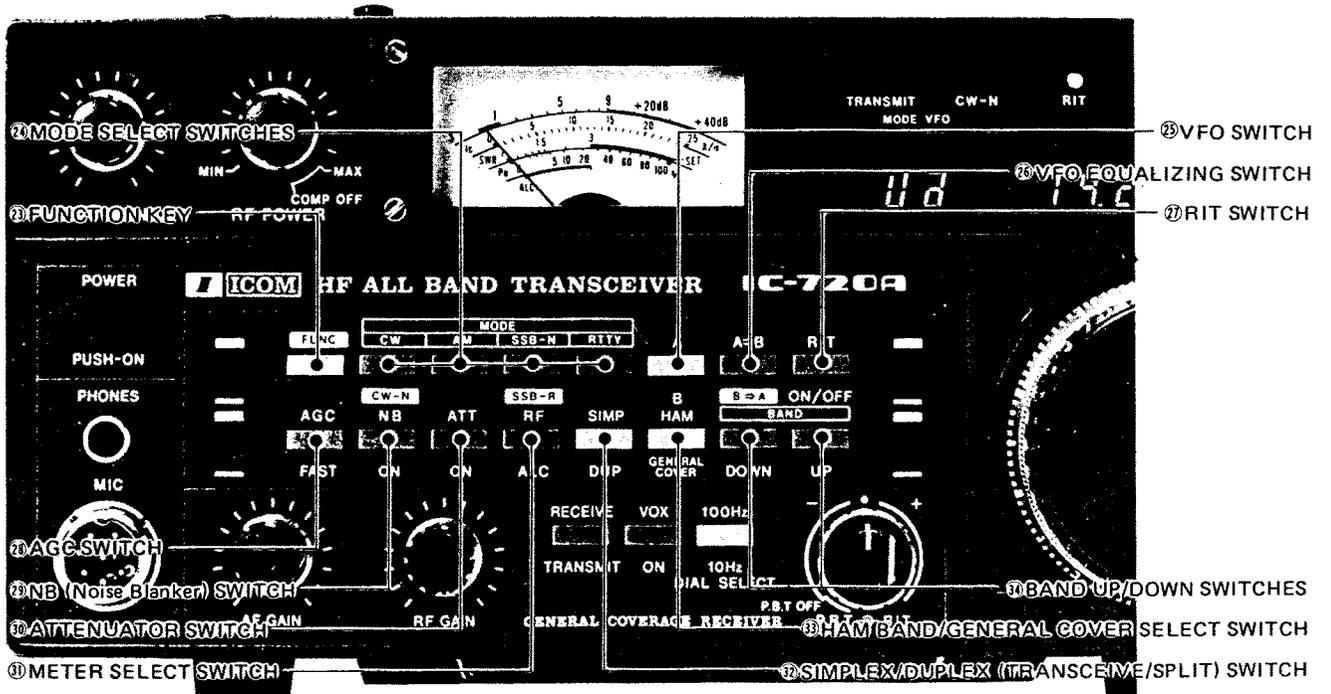
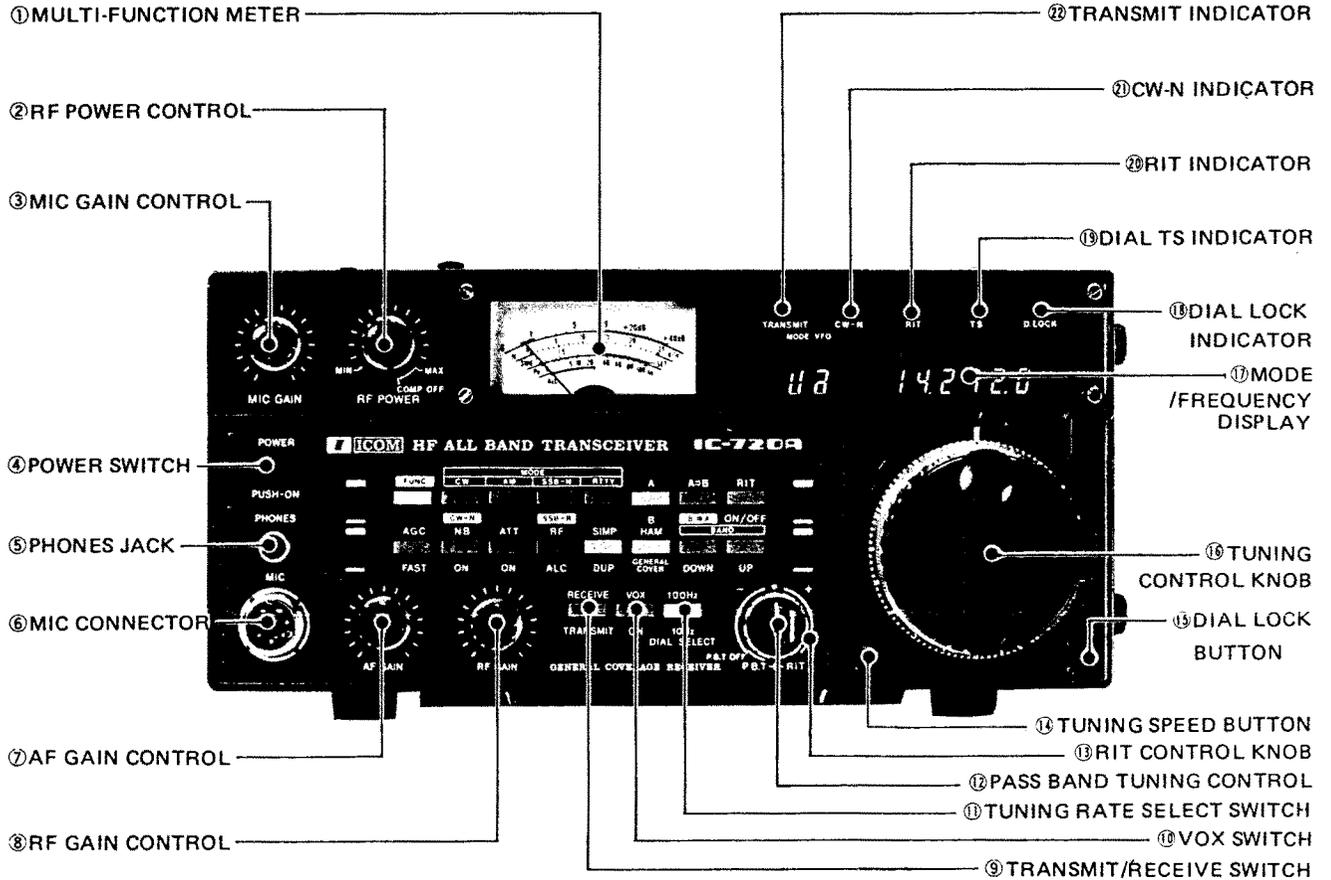
Audio Output Impedance:

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 ± 800 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

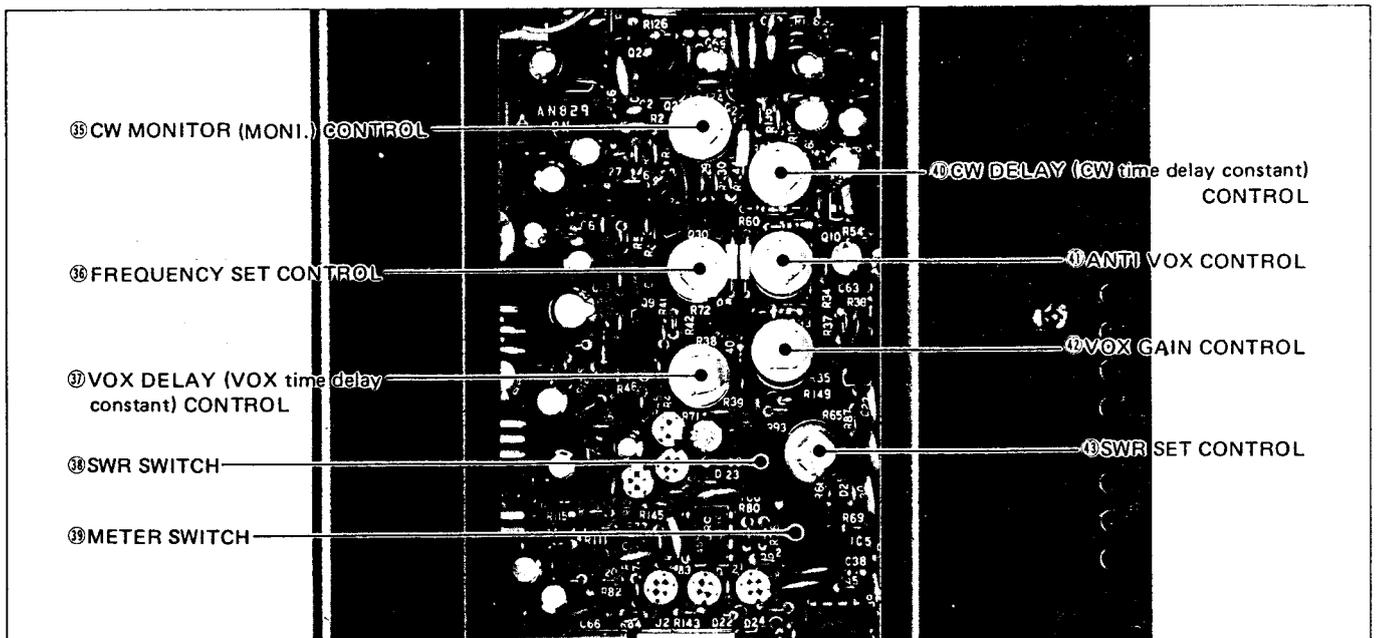
Selects the function of the set. In the HAM (out) position the transceiver functions in any of nine HAM bands between 1.8MHz and 28MHz. In the GENERAL COVER position (in) the set functions as a general coverage receiver between 0.1MHz and 30MHz. (the set will not transmit in this mode.)

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

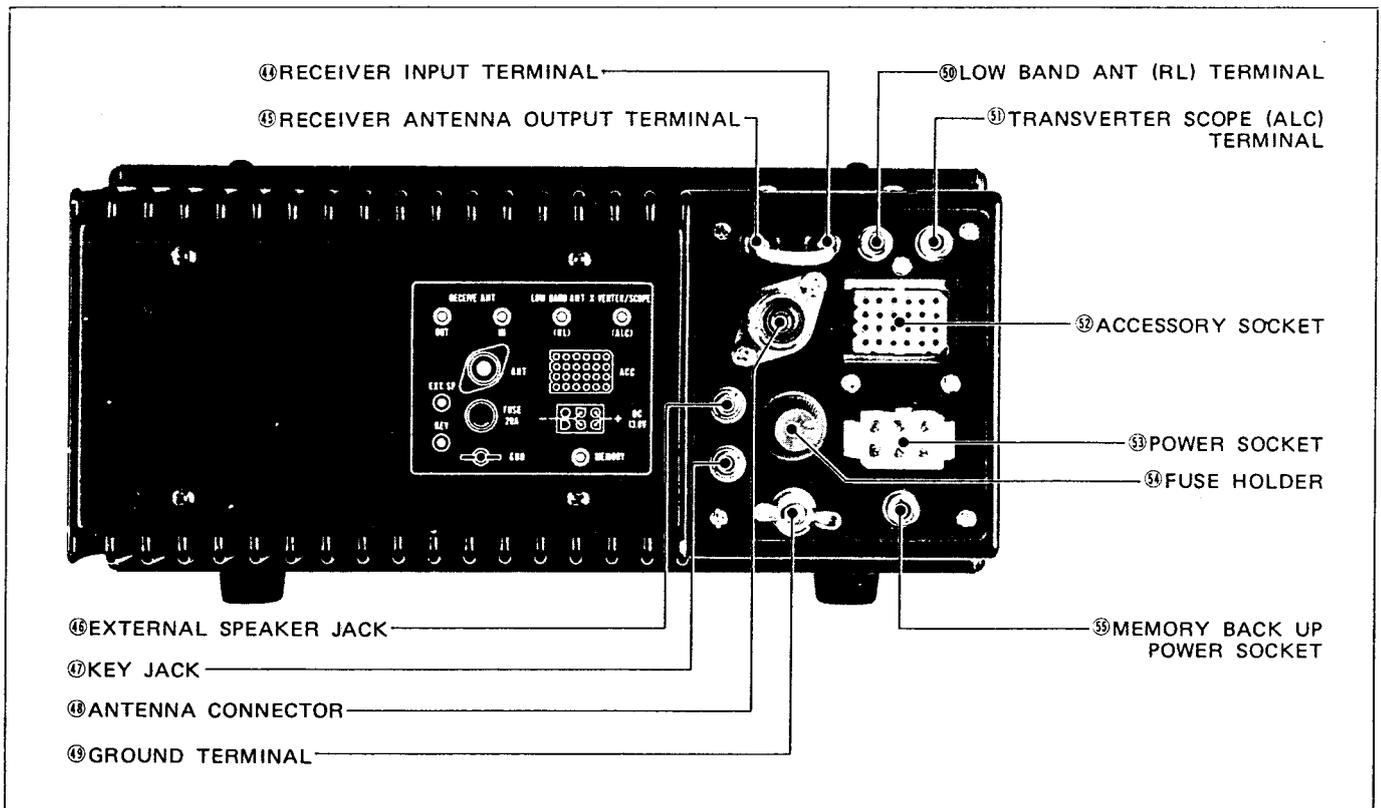
In VOX (SSB and AM) operation, the VOX circuit may be operated by sound from the speaker causing a switch to transmit. This trouble can be prevented by adjusting the input level of the ANTI VOX circuit with this control along with the VOX gain control so that the VOX circuit only operates from the operator's 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.

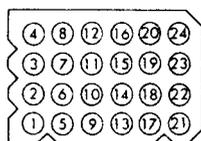
3. EXTERNAL ALC

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 ~ +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 39.7315MHz \pm 7.5KHz, 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 F12 having 2.3KHz (-6 dB) pass-band.

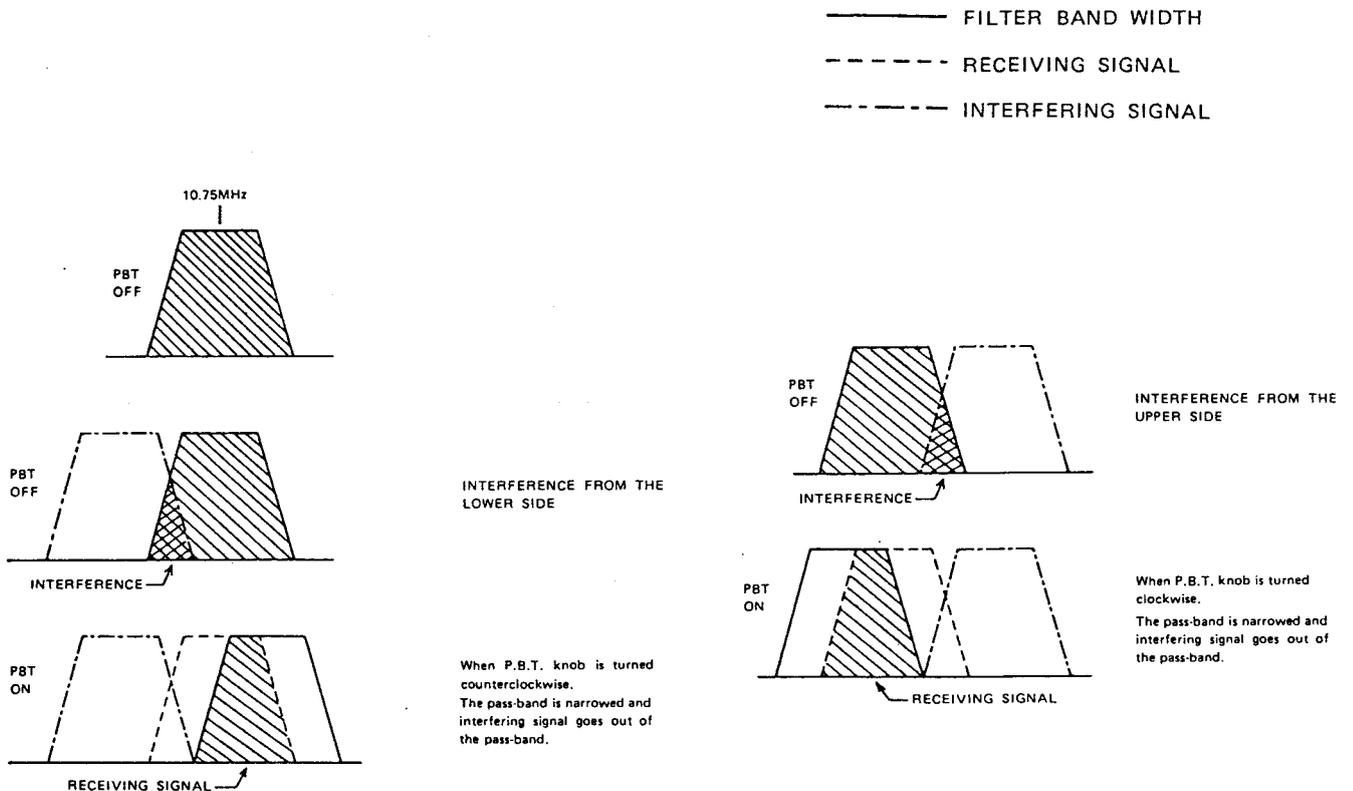
This output also passes D40 which is ON during PBT operation and is supplied to the double balanced mixer IC2. This signal is mixed again with 19.7615MHz local oscillator signal which is the same one as the signal applied to IC1, to convert into 9.0115 MHz IF signal again.

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 F12.

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 ± 1.5 KHz. Thus the pass-band of the 10.75MHz crystal filter is shifted ± 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 ± 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 Ω 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 F12.

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 F11 (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, F11 through D29 which is also turned ON during transmitting. The IF signal passed through F11

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 ± 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 (lower 3 digits)	N1	Oscillation 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 frequency	Dividing ratio (N2)	VCO Output 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.

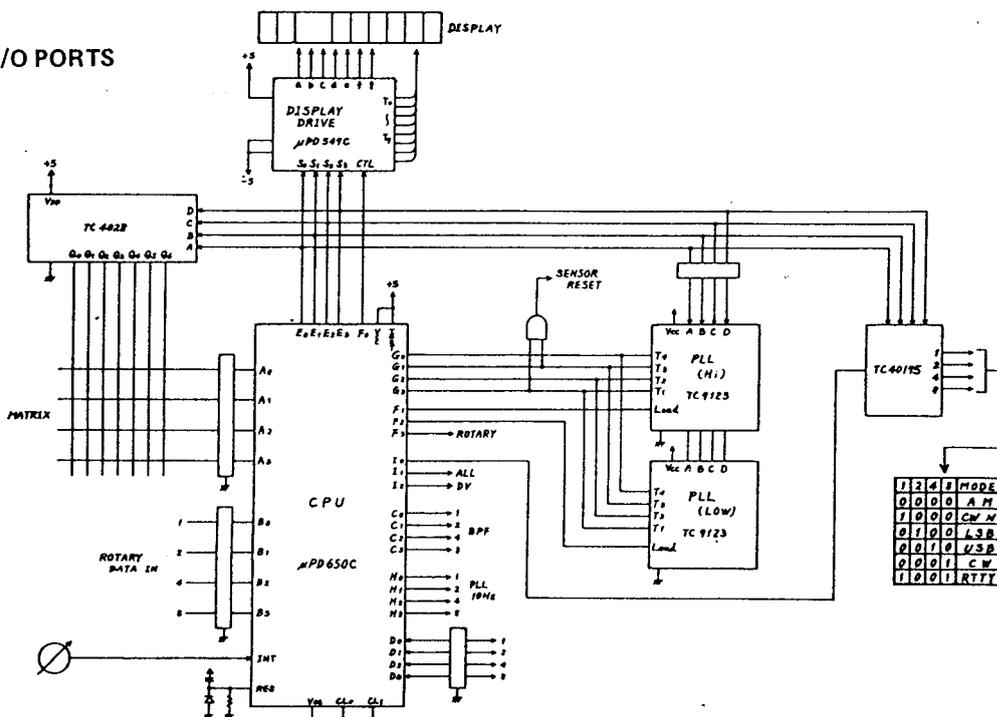
1. CPU

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
I₀ . . . Load signal for mode output.
I₁ . . . Transmitting mute output during general coverage operation.
I₂ . . . 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 G₁ and G₃.

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) Q₀ → A₀ (Count 1)
- 2) Q₀ → A₁ (Count 2)
- 3) Q₀ → A₂ (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) Q₀ → A₃ (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) Q₁ → A₀ (A ⇒ B)

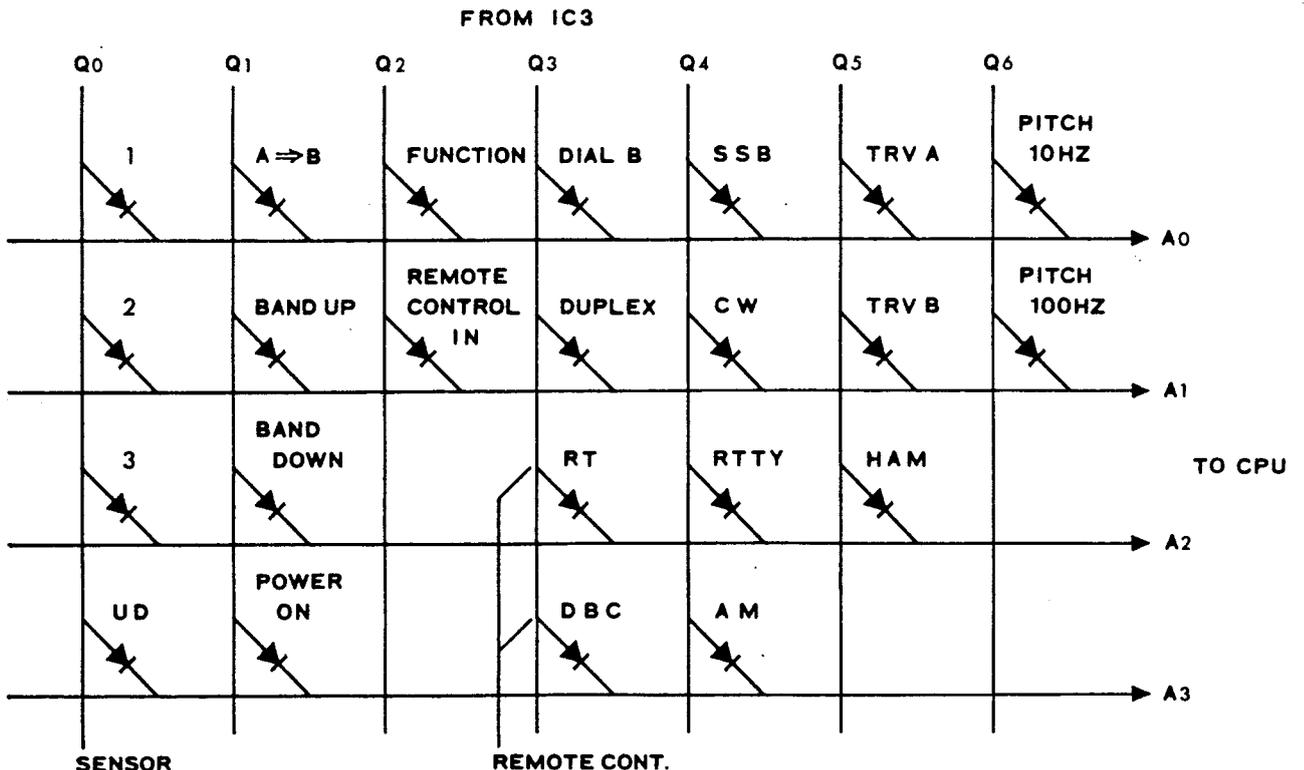
Depressing the A ⇒ B switch, the frequency of the VFO A is transferred to the VFO B. The contents of VFO A is retained. When FUNC switch has been ON (Q₂ → A₀: H-level), operation is in the opposite direction (B ⇒ A).

- 6) Q₁ → A₁ (Band up)

- 7) Q₁ → A₂ (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) $Q_1 \rightarrow A_3$ (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) $Q_2 \rightarrow A_0$ (Function)
When this line is H-level due to operation of the FUNC switch, the CW, SSB and A \Rightarrow 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) $Q_2 \rightarrow A_1$ (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) $Q_3 \rightarrow A_0$ (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) $Q_3 \rightarrow A_1$ (Duplex)
When this line is L-level, the simplex operation is selected.
When this line is H-level, the duplex operation is selected.
- 13) $Q_3 \rightarrow A_2$ (RT)
- 14) $Q_3 \rightarrow A_3$ (DBC)
These lines are used as the status of remote-controller.
- 15) $Q_4 \rightarrow A_0$ (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 $Q_2 \rightarrow A_0$ (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) $Q_4 \rightarrow A_1$ (CW mode)
Designates the CW mode. It provides the CW-N mode when $Q_2 \rightarrow A_0$ (FUNC) is H-level.
- 17) $Q_4 \rightarrow A_2$ (RTTY mode)
Designates the RTTY mode.
- 18) $Q_4 \rightarrow A_3$ (AM mode)
Designates the AM mode.
- 19) $Q_5 \rightarrow A_0$ (TRV A)
 $Q_5 \rightarrow A_1$ (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	\rightarrow 50.100	\rightarrow 0.100
144MHz	\rightarrow 144.150	\rightarrow 4.150
430MHz	\rightarrow 430.000	\rightarrow 0.000

- 20) $Q_5 \rightarrow A_2$ (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) $Q_6 \rightarrow A_0$ (10 Hz Step)
- 22) $Q_6 \rightarrow A_1$ (100 Hz Step)
These lines select frequency resolution. 10 Hz step when " $Q_6 \rightarrow A_0$ " is H-level, 100 Hz step when " $Q_6 \rightarrow A_1$ " 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 F₂ and F₁ 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.

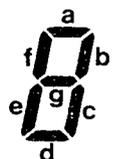
4. Display Circuit

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 T₀ - T₇ signals in sequence by means of the clock oscillator in the IC8. Dynamic lighting display is made by outputting 7-segment data, Sa - Sg, synchronized to T₀ - T₇ signals.

To display a frequency and mode, data are input to S₀ - S₃ 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		b	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 T₇.

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_{SS} (+5V), and V_{GG} (-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

L₁ – L₈ signals from the rotary relay of the FILL unit are fed to B₀ – B₃ input terminals of the CPU. They are compared with the band data programmed in the CPU, and pulses are sent out from F₃ 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 ₃	B ₂	B ₁	B ₀
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 C₀ – C₃ 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 ₃	C ₂	C ₁	C ₀
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 I₀ 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 ₃	E ₂	E ₁	E ₀
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 A₀ and A₁ 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 A₁ 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 I₂ 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 Ic₁ and Ic₂.

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 supply 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.

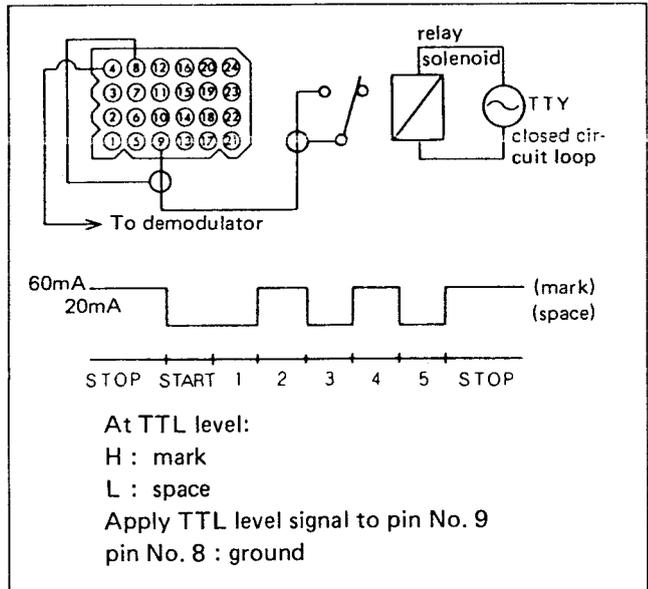
When the SEND line is brought to ground level (transmitting), RL1 is turned ON and the "LINES" line becomes ground level. This line is fed to J13 of the PA unit. By changing connection of P11 to J13, this line is fed to J5 XVERTER terminal on the rear panel and can be used to control TRANSMIT/RECEIVE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

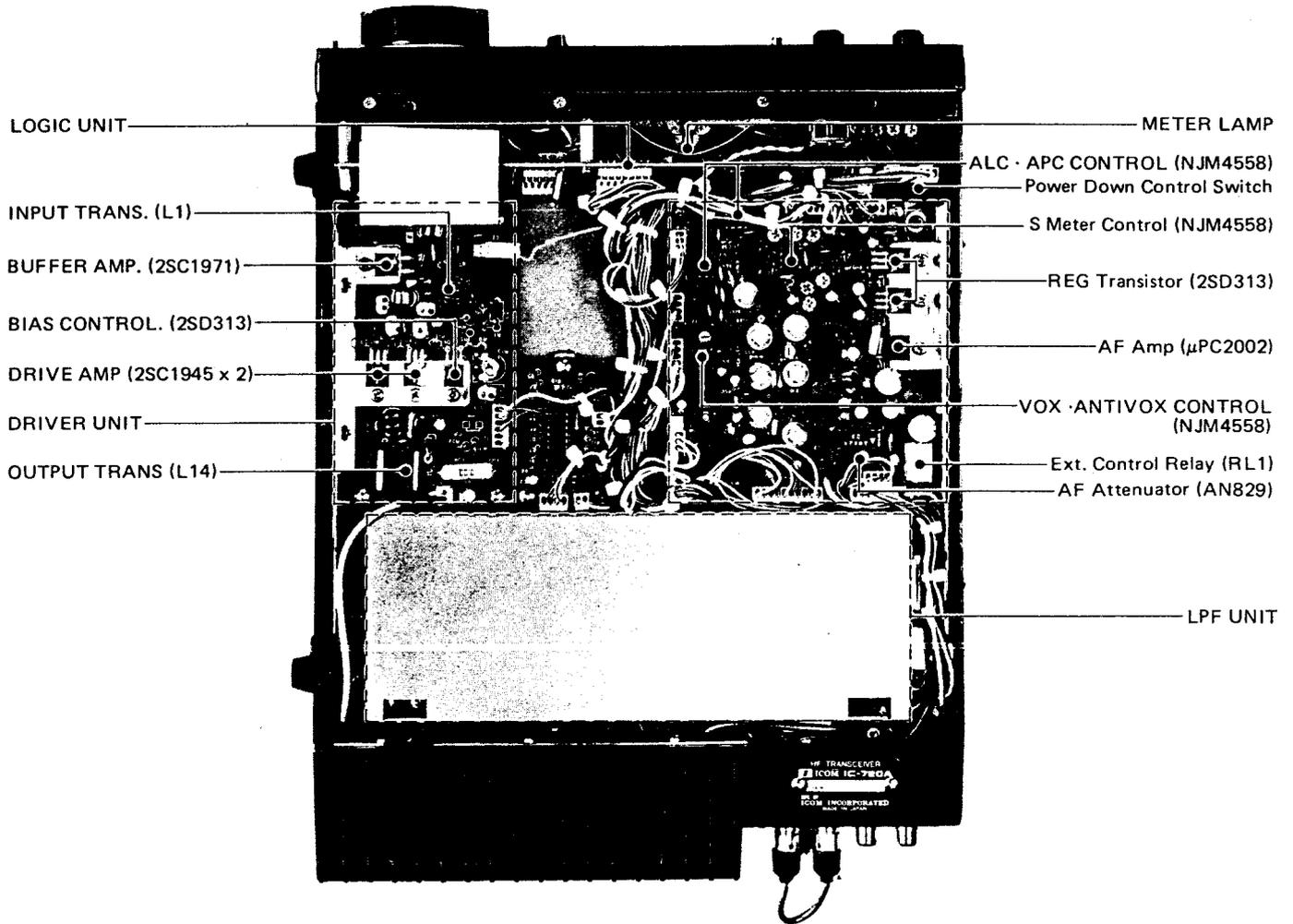
In the RTTY unit, H-level or L-level signal for Mark or Space are fed to J1 through the accessory socket on the rear panel.

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.

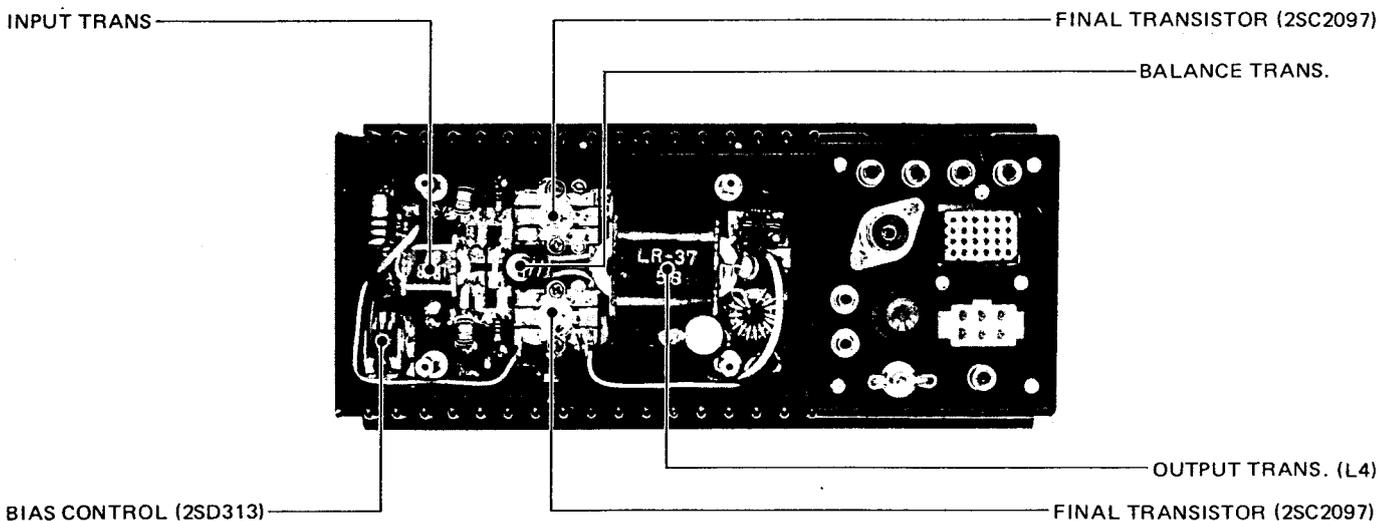


SECTION 5 INSIDE VIEWS

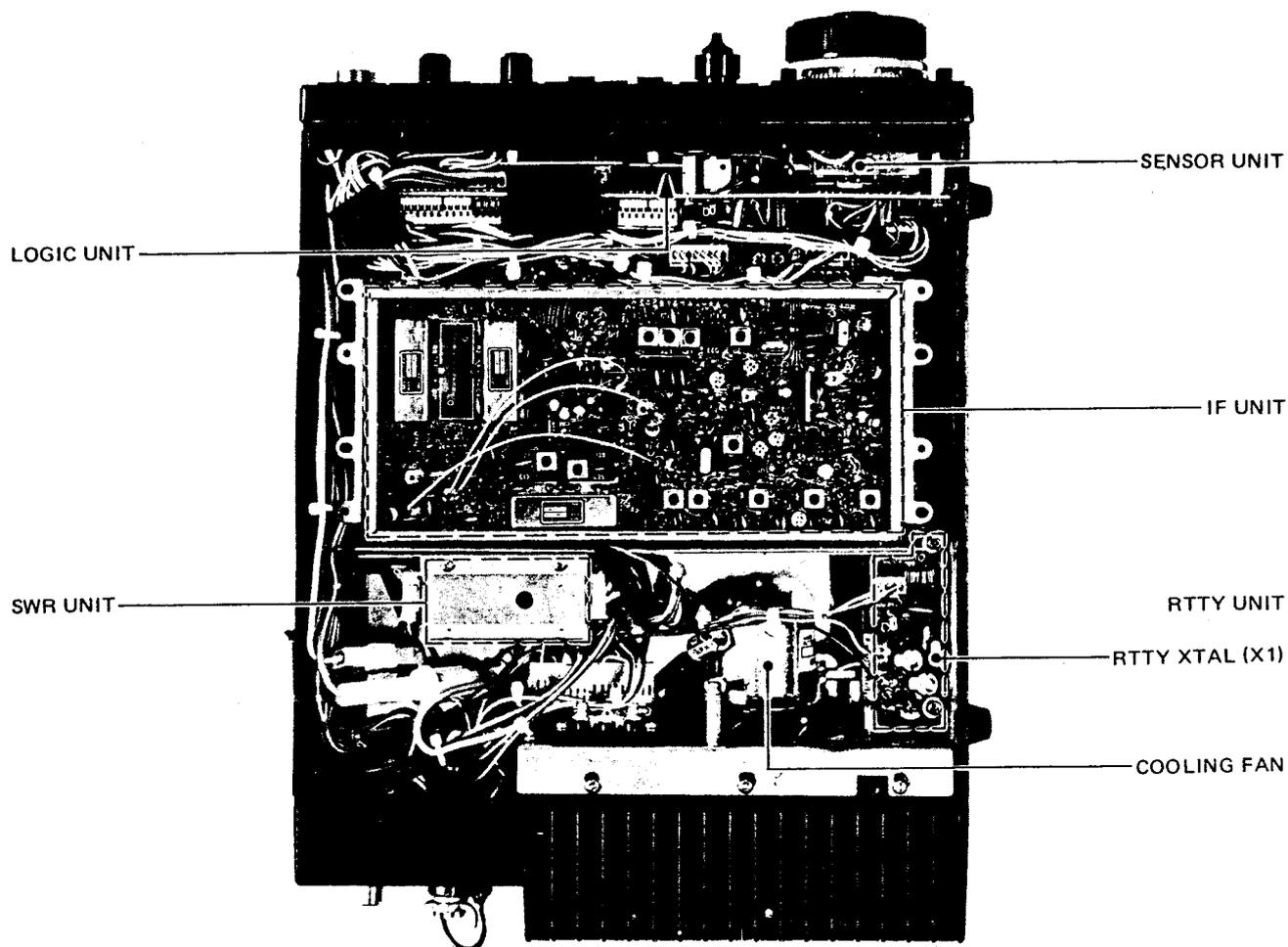
5-1 TOP VIEW



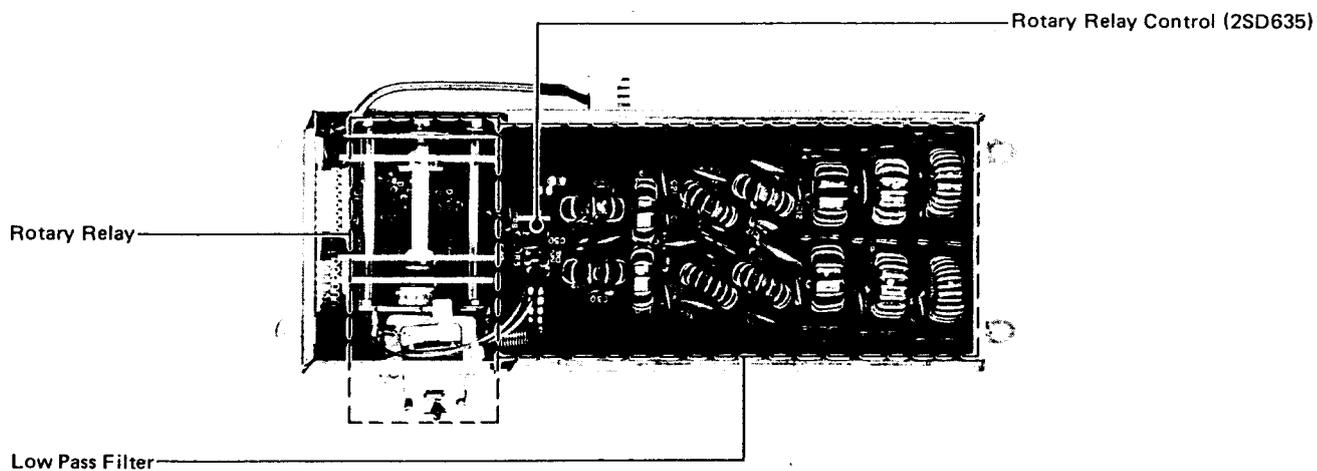
5-2 PA UNIT



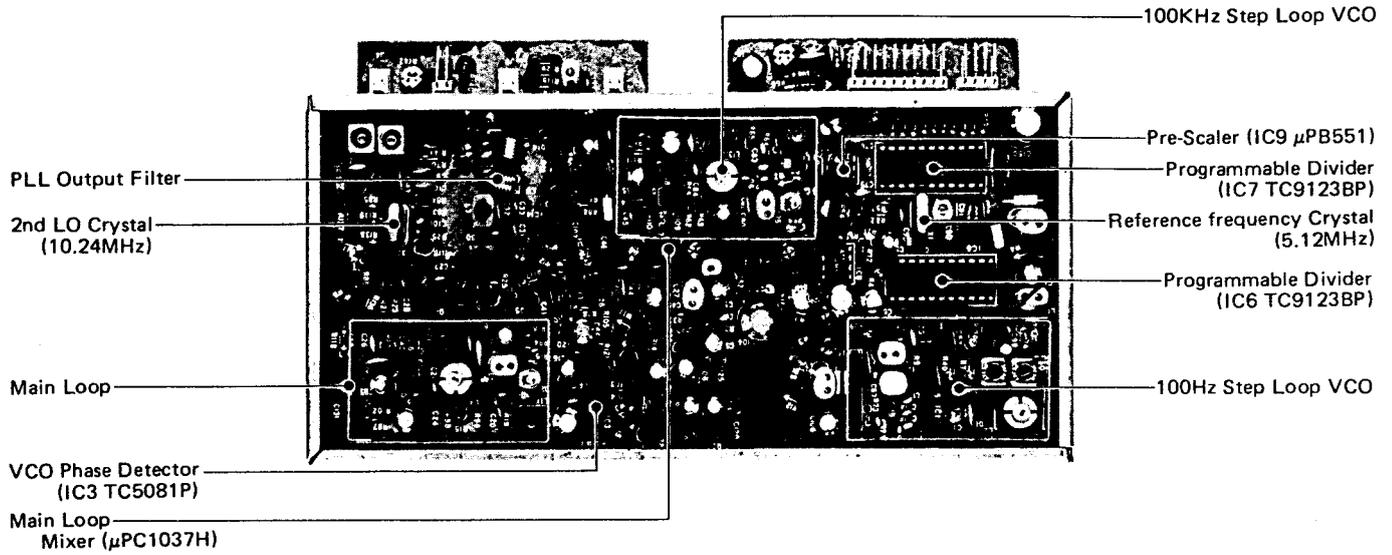
5-3 BOTTOM VIEW



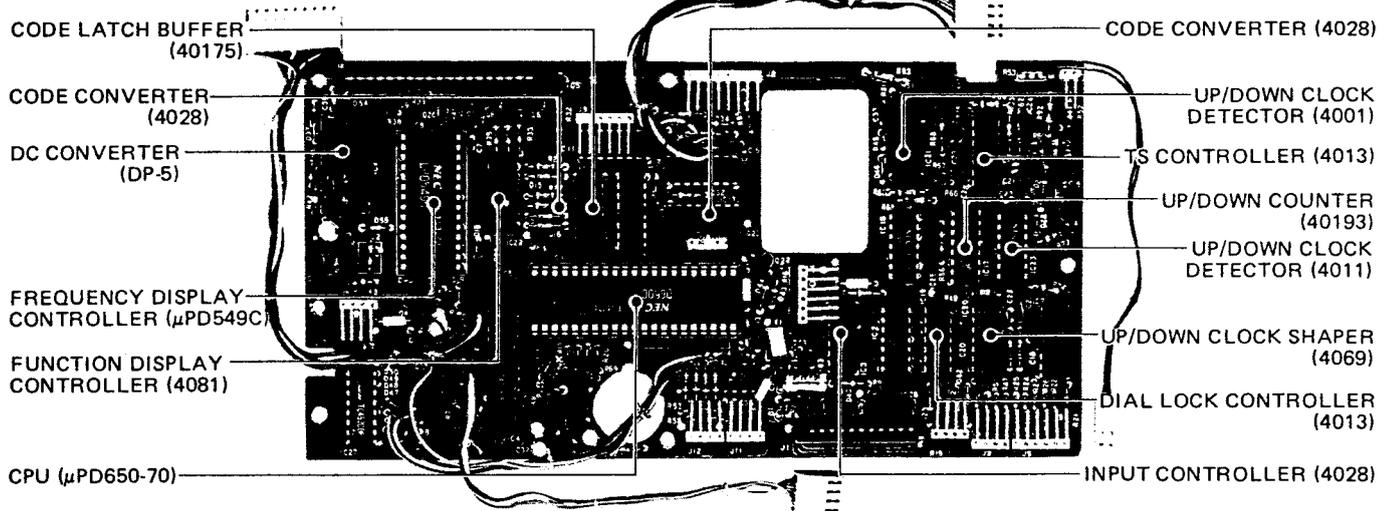
5-4 LPF UNIT



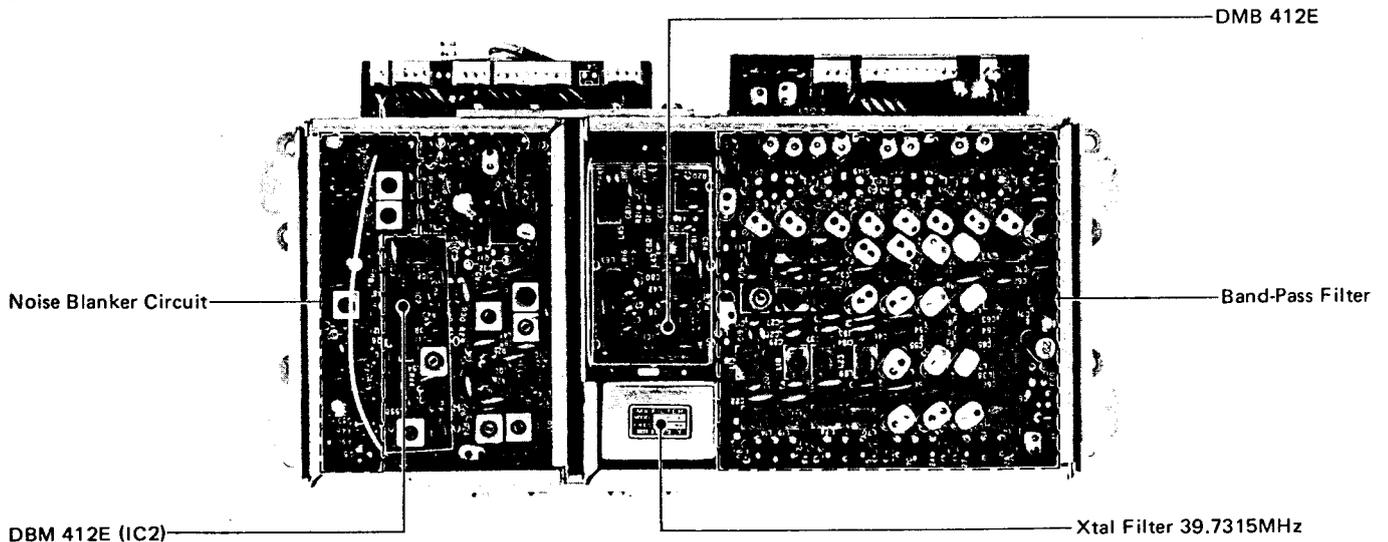
5-5 PLL UNIT



5-6 LOGIC UNIT



5-7 RF UNIT



SECTION 6 OPTIONS INSTALLATION

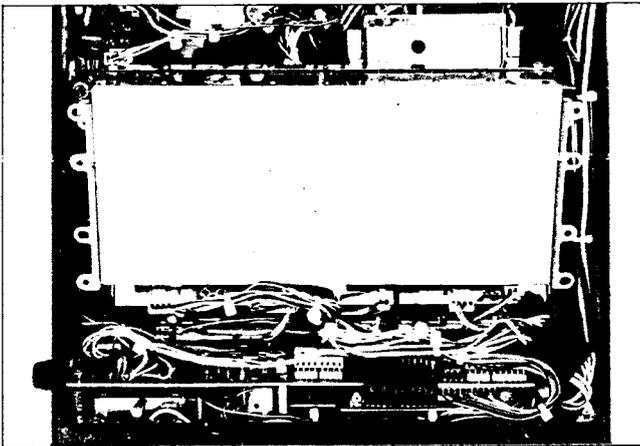
6-1 INSTALLATION OF CW NARROW FILTER

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

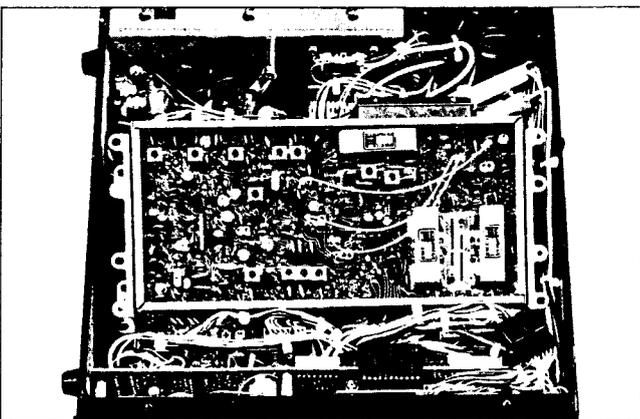
Phillips Screwdriver	Diagonal cutters
Screwdriver	Soldering Iron (40W)
Solder	Soldering tool
De-soldering braid	

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.



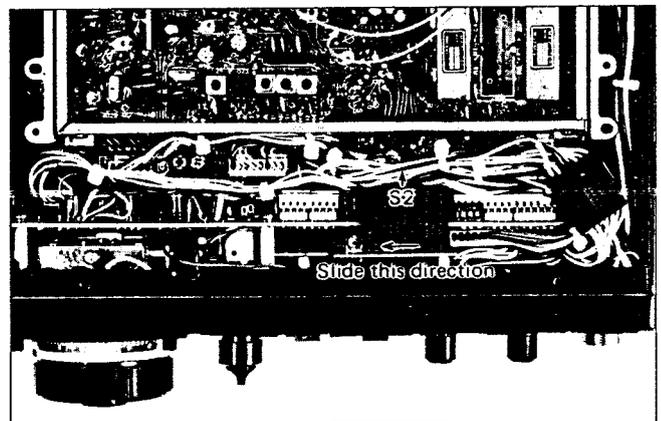
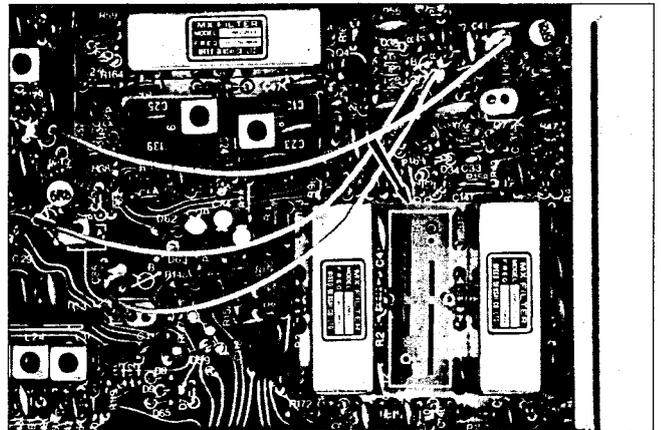
3. Using the screwdriver pry the cover of the IF Unit off, exercise care to prevent bending the shield cover.



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.

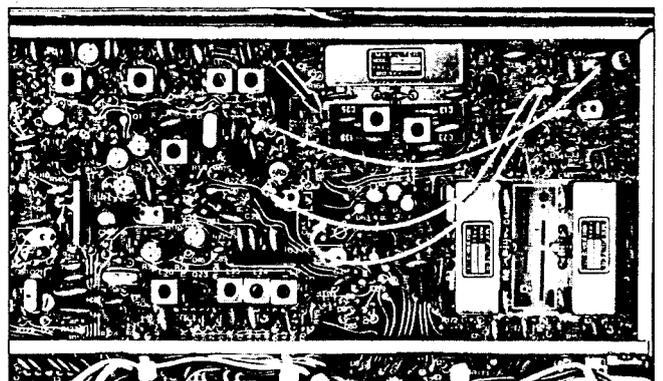
Location of CW Narrow Filter

**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.

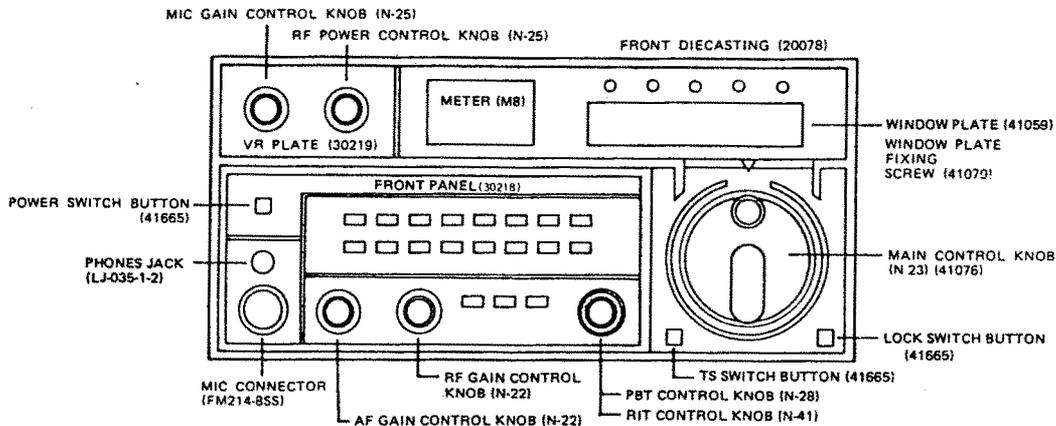
Plug the AM Filter into the board, making sure that it is oriented with the label on the top of the filter matching the label on the adjoining filter. Bend the legs and leads flush with the board, solder them in, and trim the leads flush with the solder points. This completes the installation. Replace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

Location of LC Filter

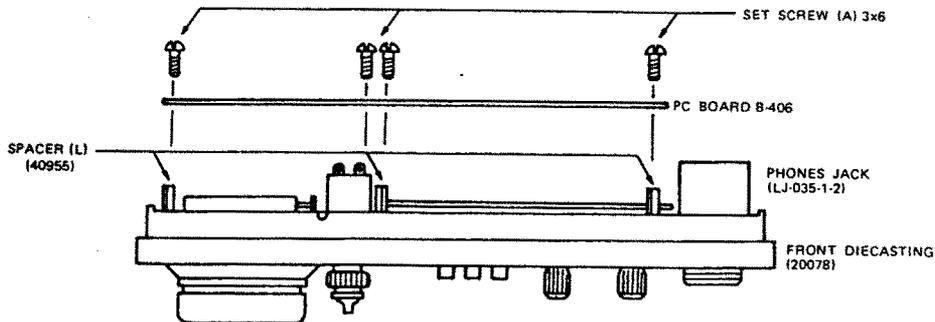
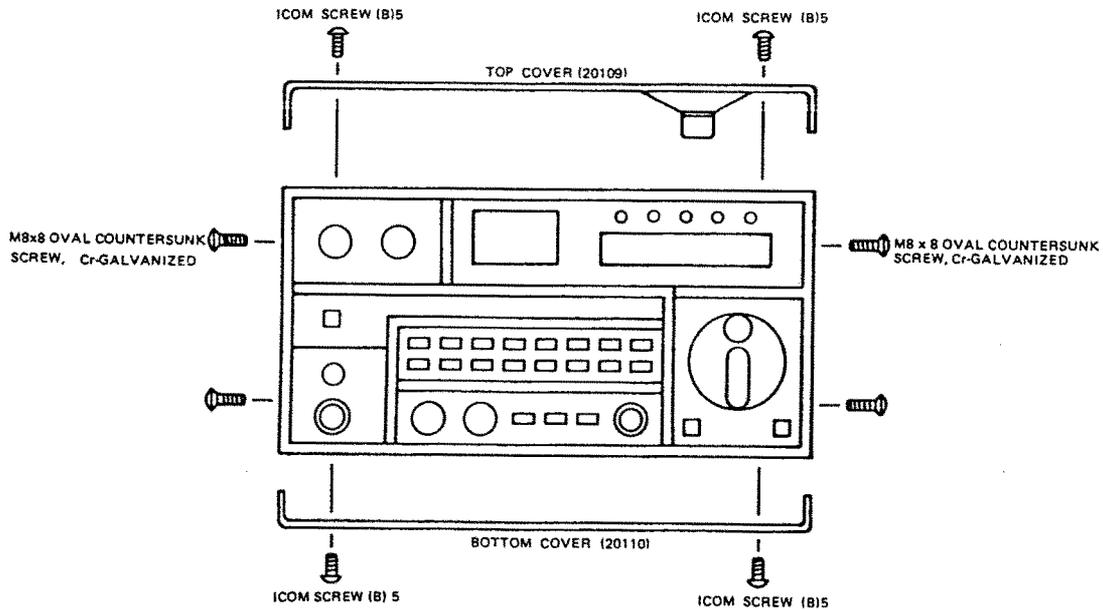


SECTION 7 MECHANICAL PARTS AND DISASSEMBLY

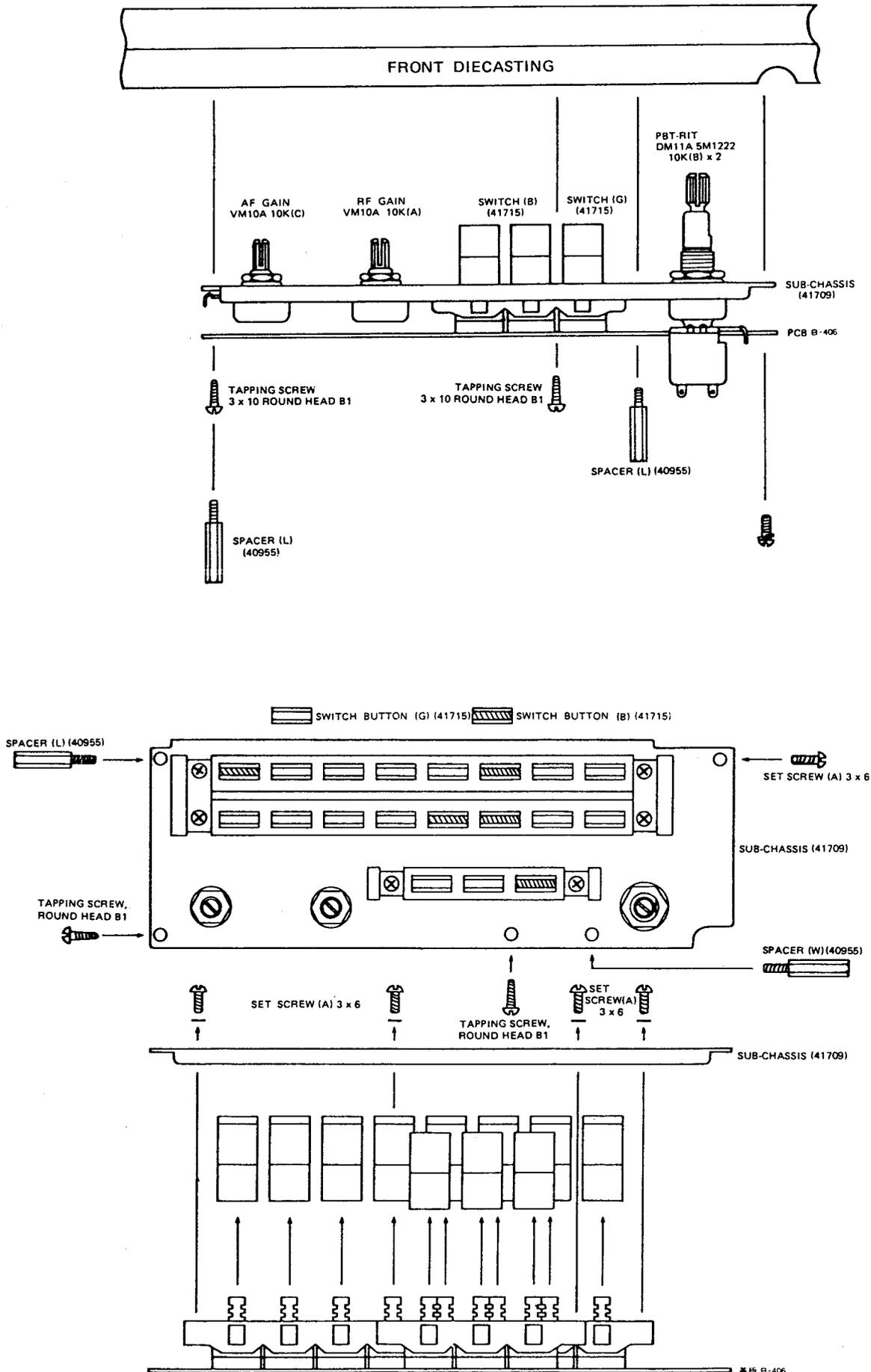
7-1 PARTS ON FRONT PANEL



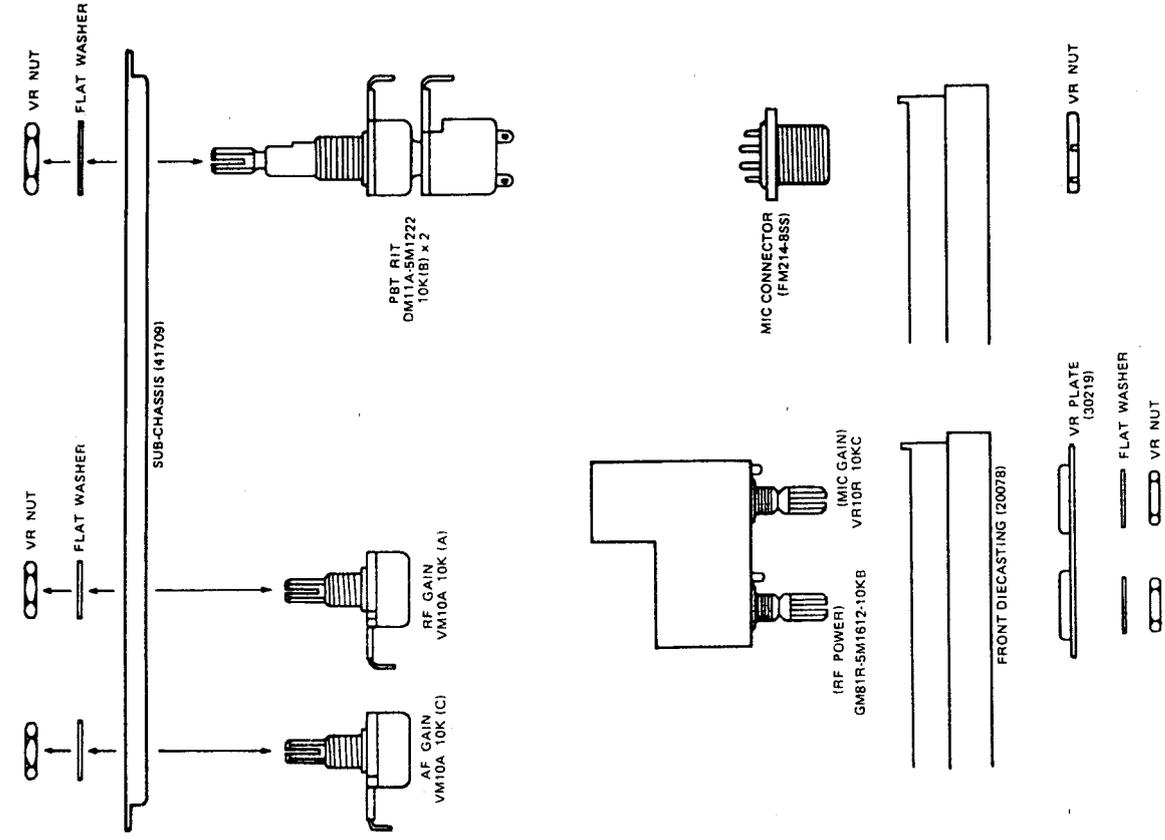
7-2 FRONT PANEL DISASSEMBLY



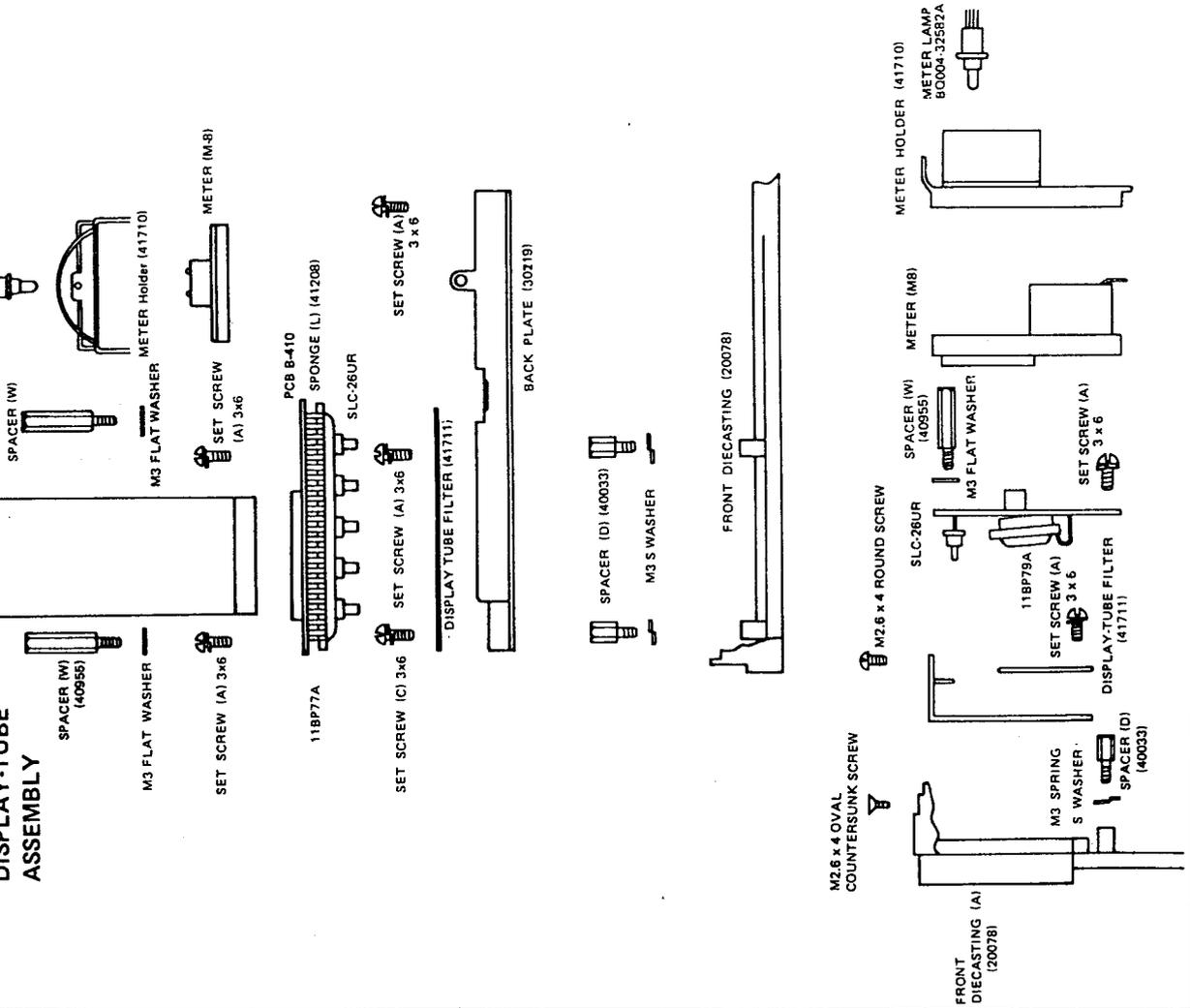
7-3 FRONT PANEL SWITCHES DISASSEMBLY



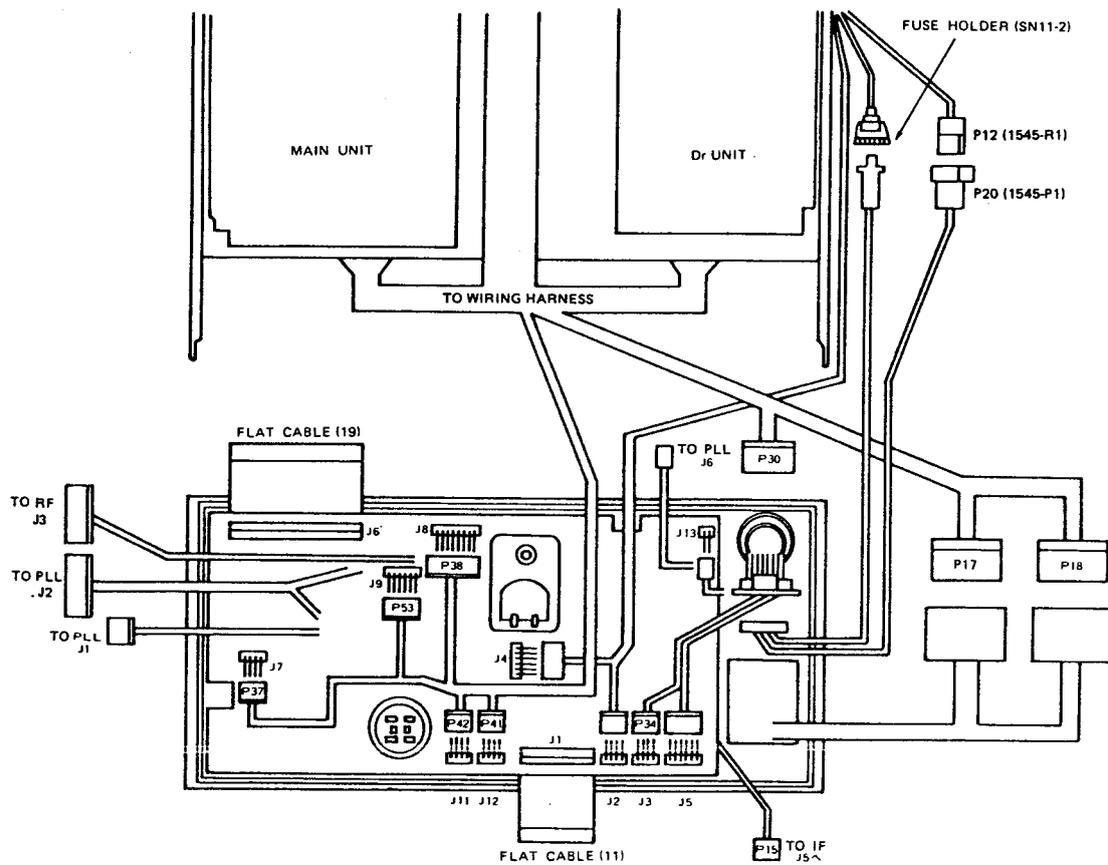
7 - 5 CONTROLS AND CONNECTOR ASSEMBLY



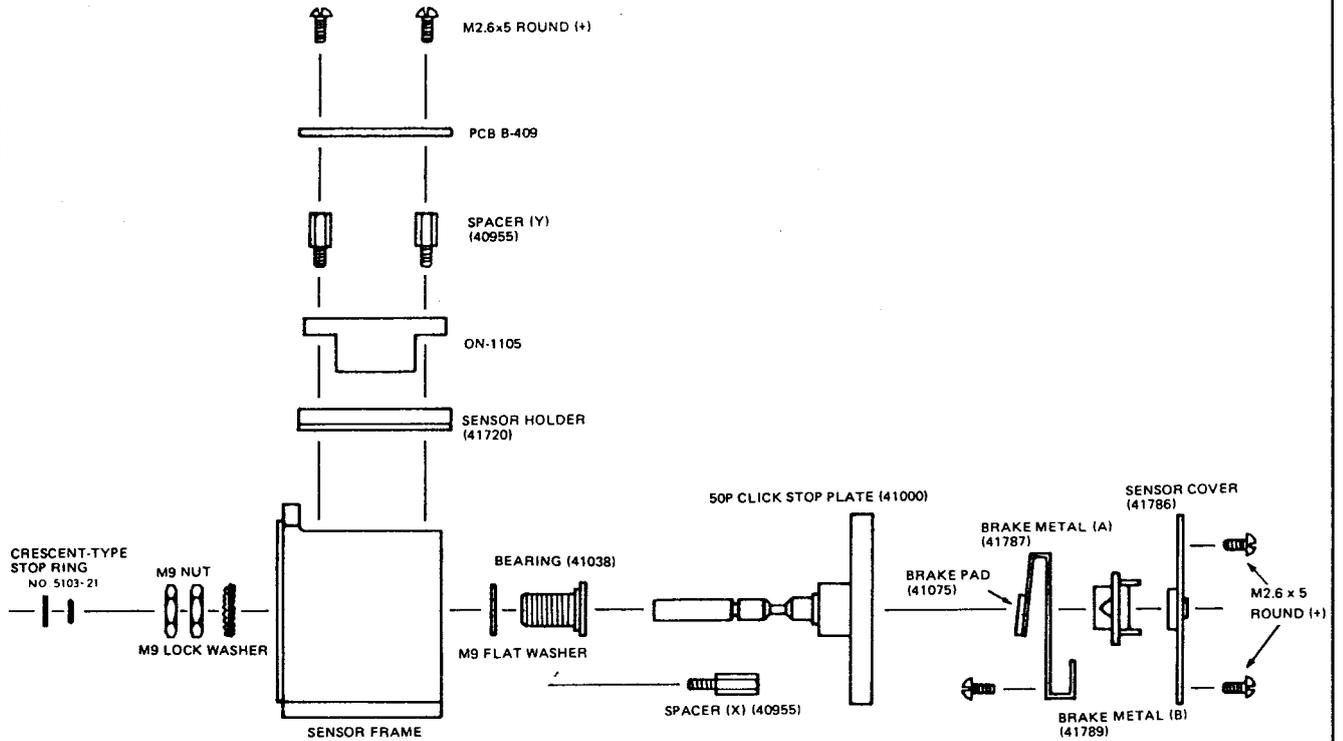
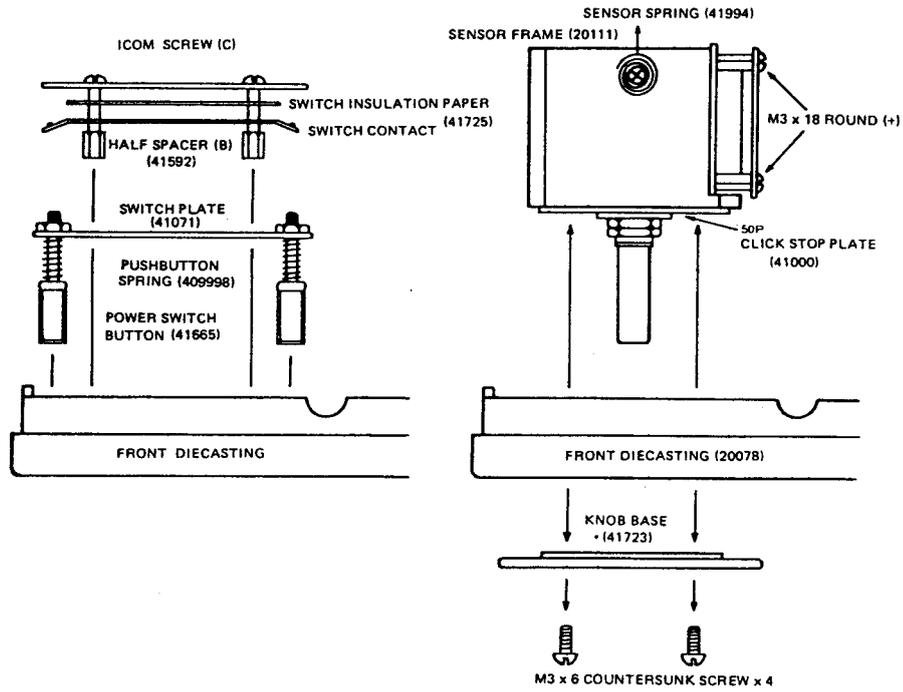
7 - 4 METER AND DISPLAY-TUBE ASSEMBLY



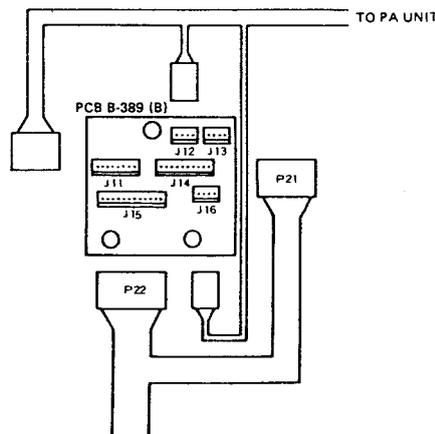
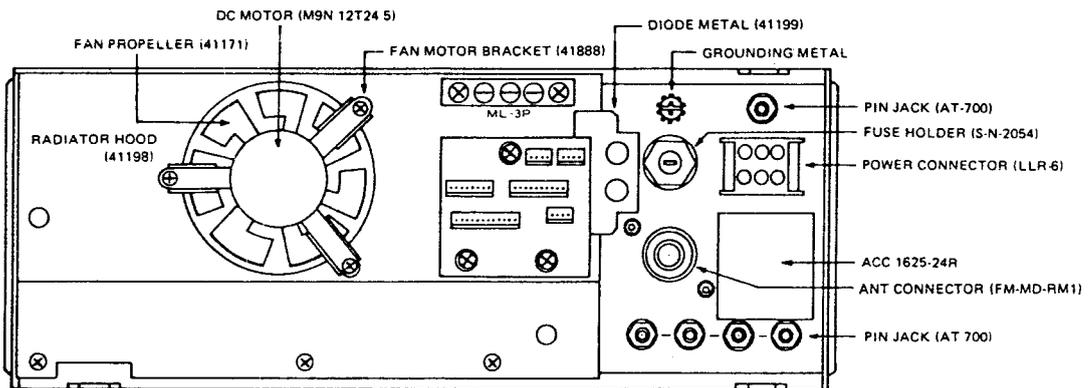
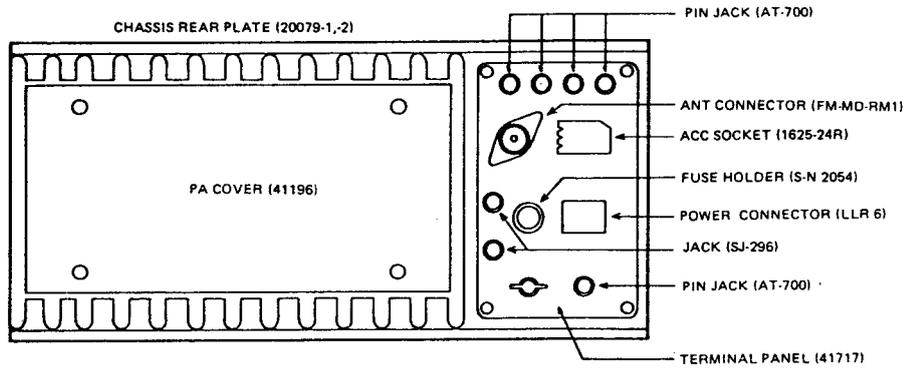
7-6 FRONT PANEL CONNECTORS LOCATION



7-7 SENSOR DISASSEMBLY

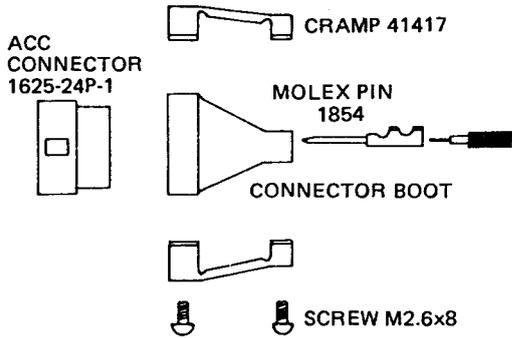


7-8 REAR PANEL DISASSEMBLY

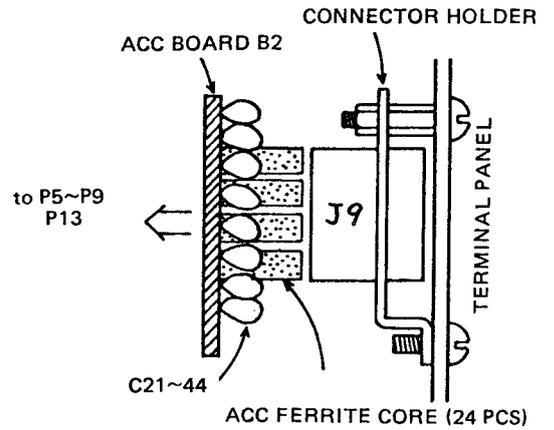


7-9 ACCESSORY SOCKET

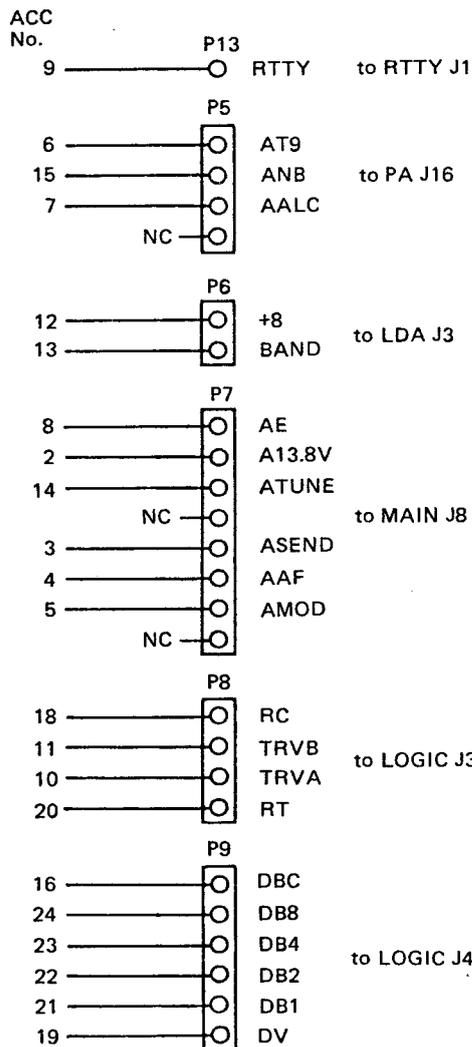
Plug parts for the Accessory Socket



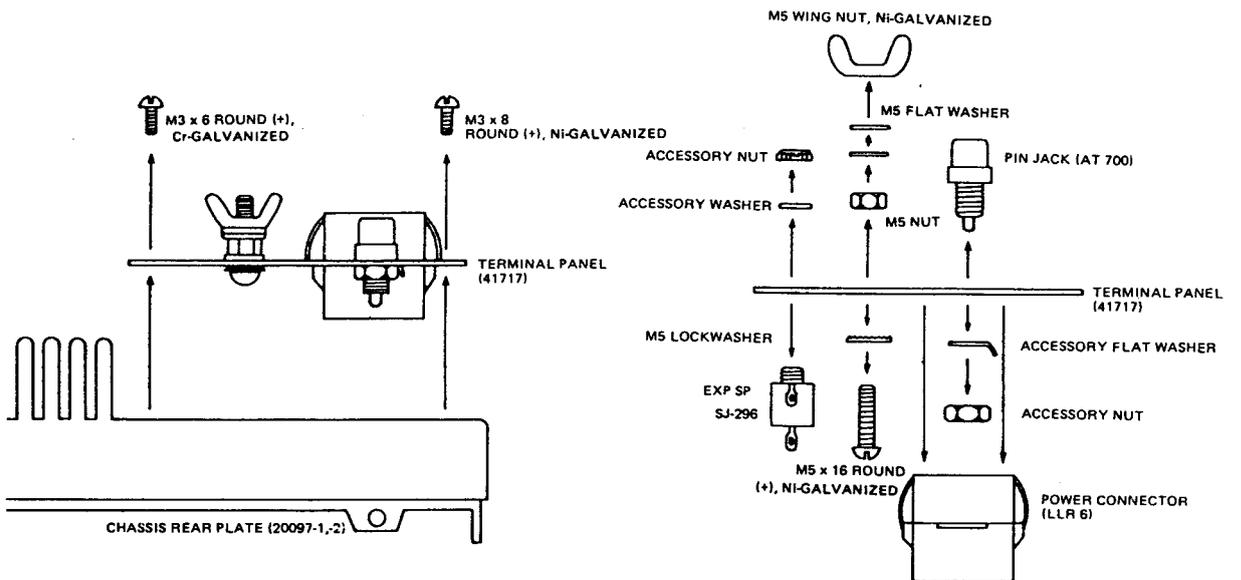
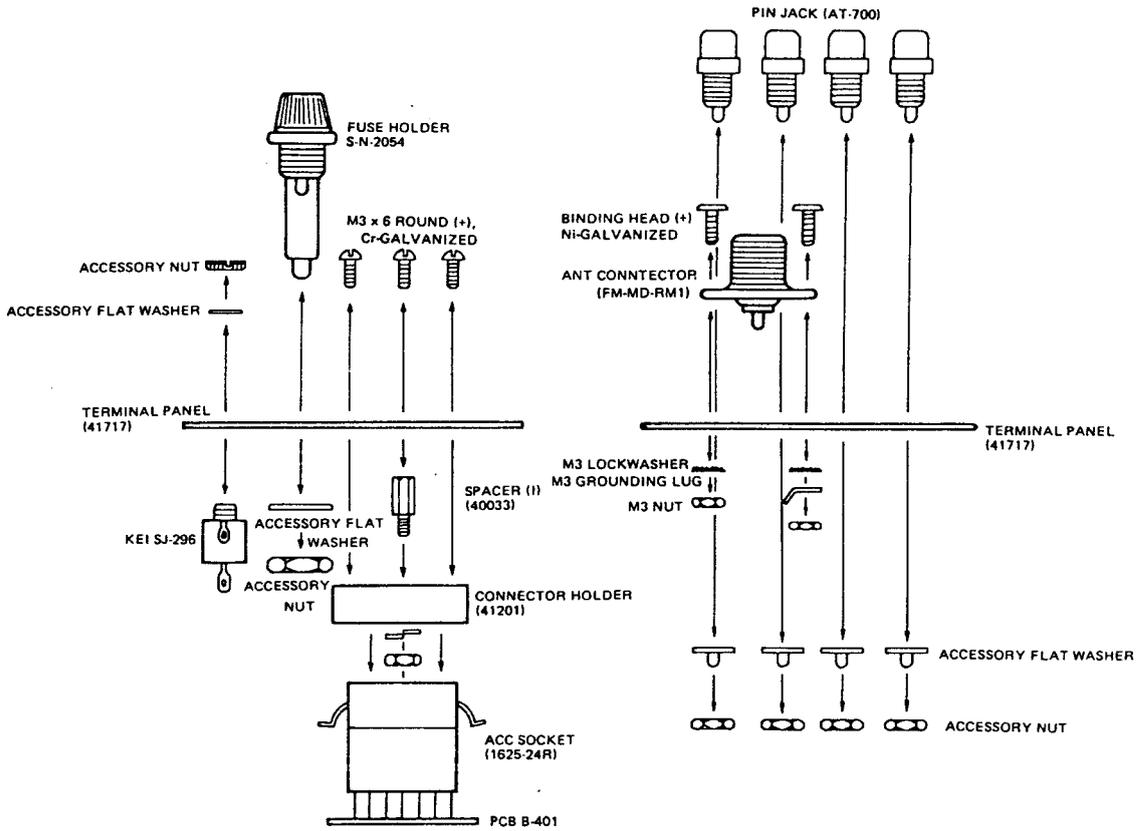
Accessory Socket Assembly



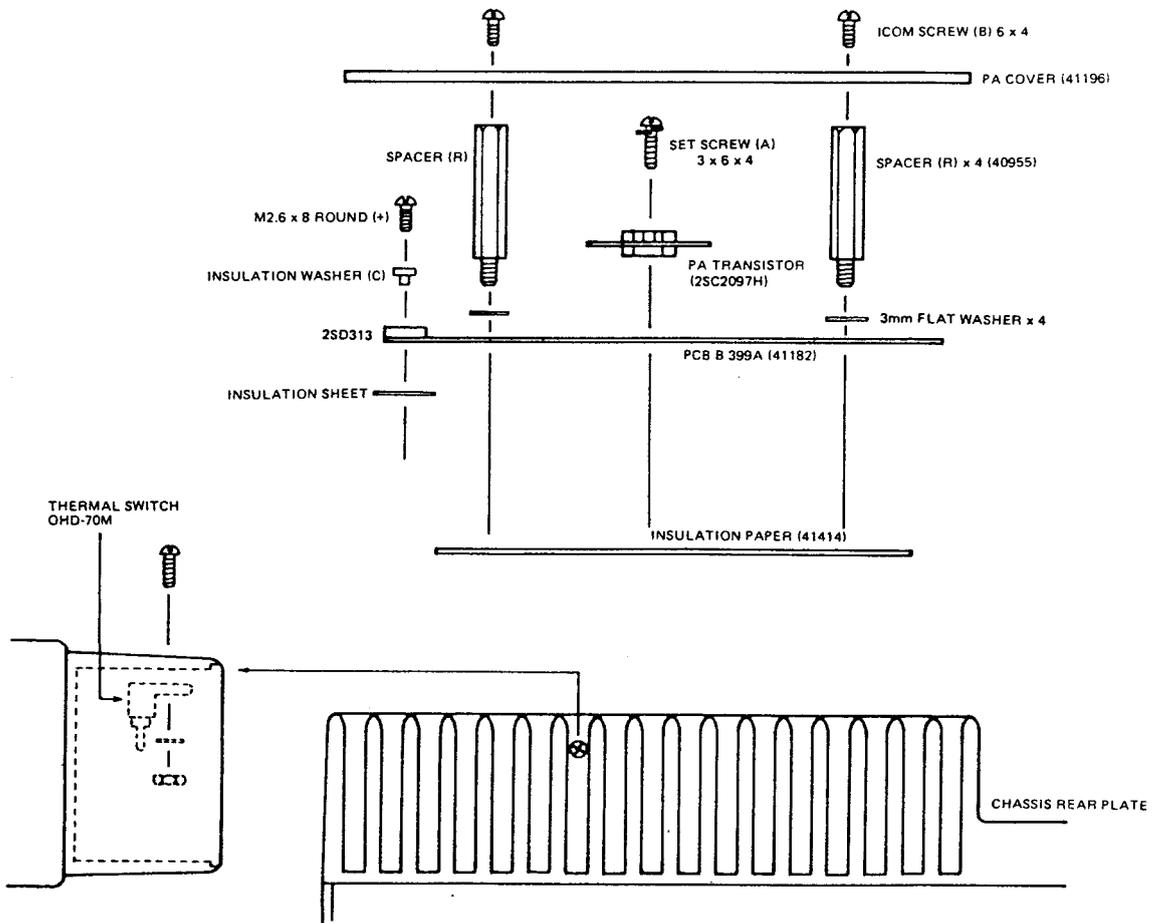
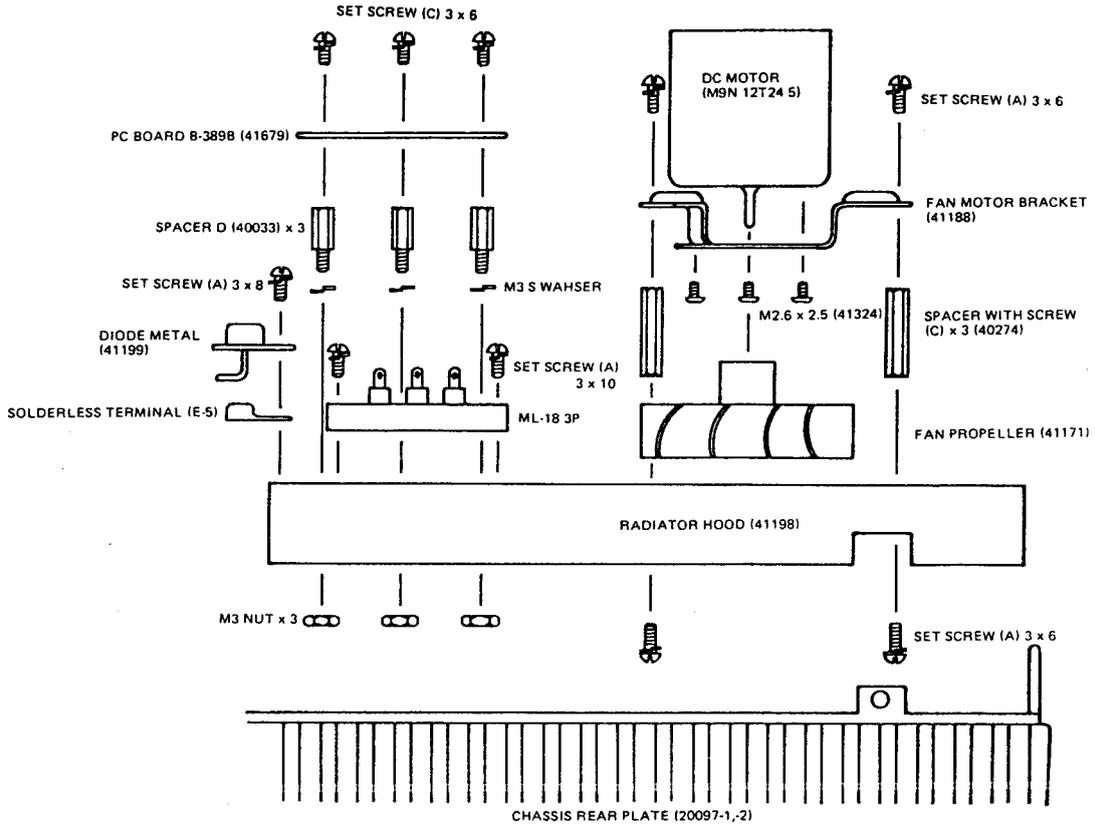
ACC SOCKET WIRING DIAGRAM



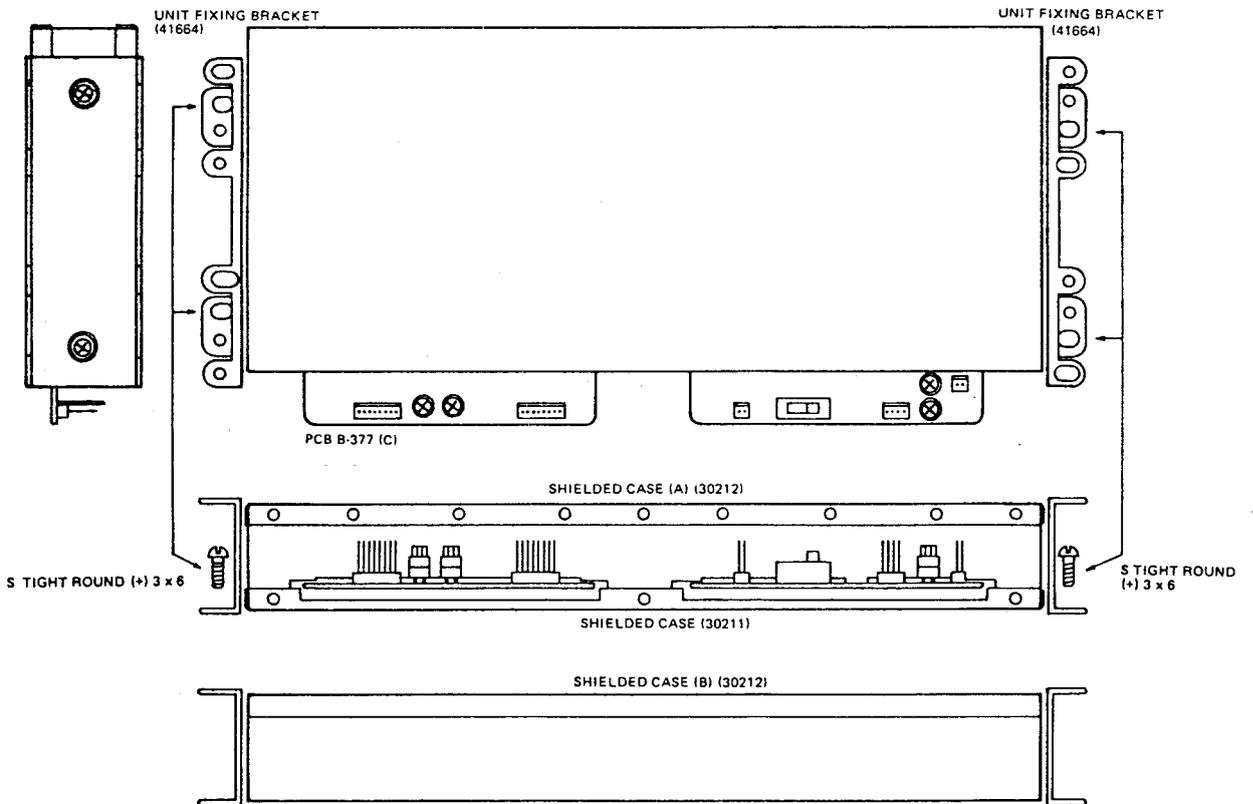
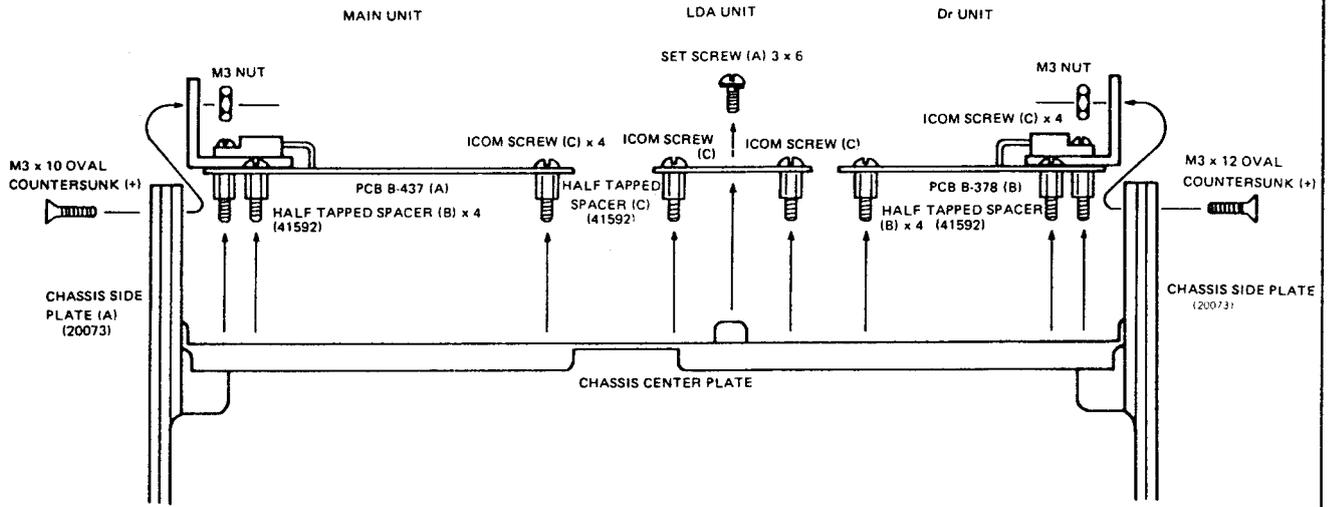
7-10 TERMINAL PANEL DISASSEMBLY



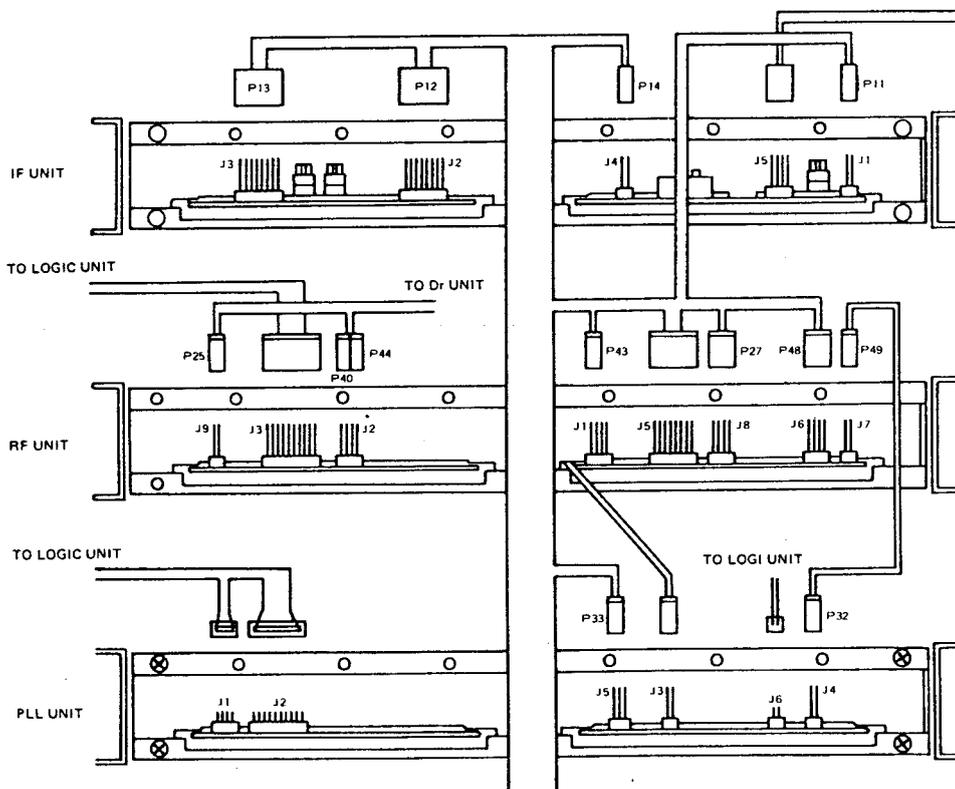
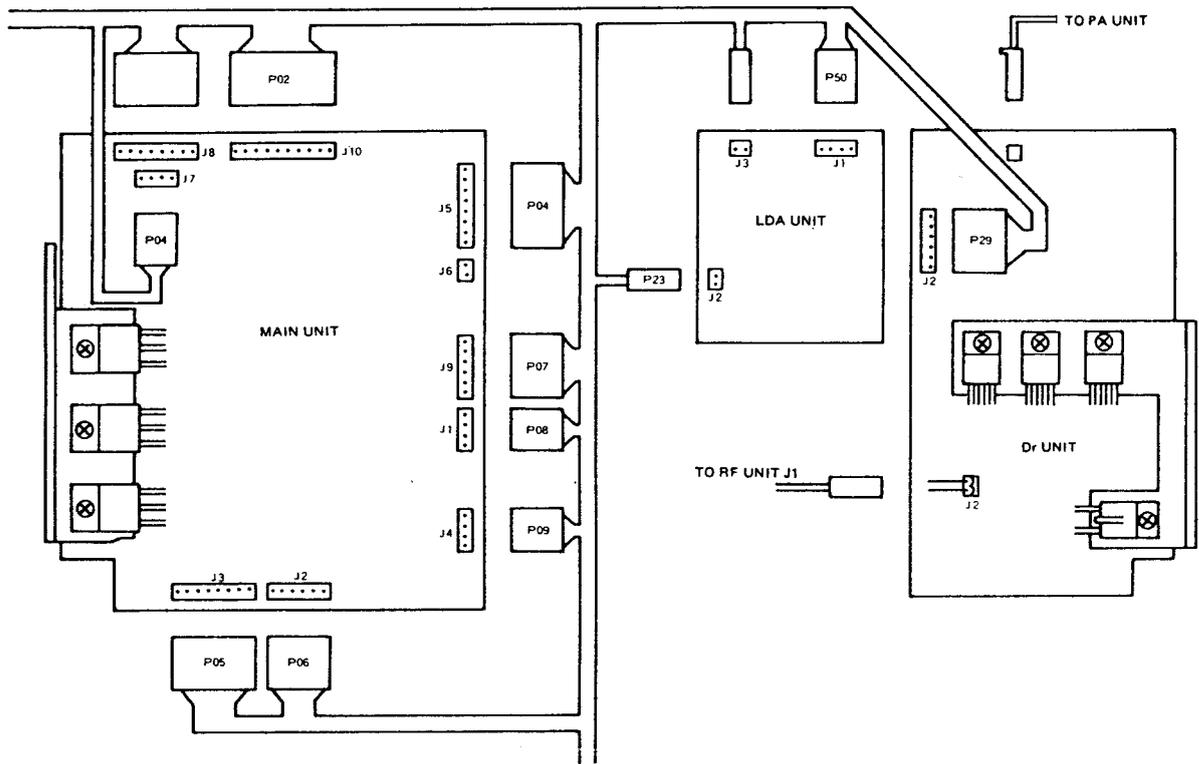
7 - 11 PA UNIT DISASSEMBLY



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 ± 1 ppm
	SENSITIVITY	100mV or BETTER
(2) SIGNAL GENERATOR	FREQUENCY RANGE	0.1MHz - 40MHz
	OUTPUT VOLTAGE	-20 - 90dB (0dB = 1 μ V)
(3) MULTIMETER	50K Ω /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 ~ 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"> Set to general cover Mode: LSB Frequency display: 0,001.5KHz 	Oscilloscope (Measurable up to 20MHz)	PLL	IC6 pin 12	PLL	L20 L21	 <p>Adjust until the above square wave is obtained</p>	101	
Verification	<ul style="list-style-type: none"> Set to general cover Mode: LSB Frequency display: 0,001.5↔0,001.4 KHz 	Frequency counter	PLL	R73	PLL	L2	<p>Shunt R41 ③ to the chassis and adjust L2 until a frequency of 24MHz is obtained</p> <p>1) Make sure that the lock does not fail while alternating the frequency on the display between 0,001.5 and 0,001.4.</p> <p>2) Verify that the lock does not fail while increasing the frequency from 0,001.5KHz to 0,101.4MHz</p> <p>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</p>	24MHz±10KHz	102
Tracking adjustment	<p>*Make adjustment while not removing the back cover and the VCO cover.</p> <p>*Keep the trimmers of C7 ④ and C63 ⑤ in the position where capacitance is minimum.</p> <p>1) Remove the lead wire of R143 ⑥.</p> <p>Mode: USB.</p> <p>Frequency display: 11,160.1KHz</p> <p>Resistor</p>  <p>PCB</p> <p>It is easier cutting the lead wires and soldering than removing and connecting them.</p>		[for reference] Correction for adjustment's 1) - 4)						
			PLL	R53	PLL	L13	Adjust the voltage at R53 to +2V.	+2V	104
					⑦		*Verify that the voltage at R53 is approximately -4.5V under the following condition: Frequency on display: 1,163.1KHz Mode: USB	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 (Continued)	2) Connect the lead wire of R143. • Mode: USB • Frequency display: 29,998.4KHz 3) Disconnect the lead wire of R143. • Mode: LSB • Frequency display: 1,163.1KHz 4) Connect the lead wire of R143. • Mode: USB • Frequency display: 11,160.1KHz	Oscilloscope	PLL	R53 ⑦	PLL	L19	Adjust the voltage at R53 to be +1.4V. * Verify that it is approximately -7V under the following condition: Frequency display: 11,160.1KHz Mode: USB	+1.4V Verify -7V	104
		Oscilloscope	PLL	R120 ⑧	PLL	L4	Adjust the voltage at R120 to be +2.5V.	+2.5V	105
		Oscilloscope	PLL	R120 ⑧	PLL	L18	Adjust the voltage at R120 to be +2.5V. * Verify that it is about +2.5V when the frequency display is 11,160.1KHz, 21,160.1KHz, and 29,998.4KHz.	+2.5V Verify +2.5V	106
		Oscilloscope	PLL	R120 ⑧			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: LSB • Frequency display: 0,001.5KHz ↓ 1MHz step 9,001.5KHz • Mode: USB • Frequency display: 10,998.5KHz ↓ 1MHz step 29,998.5KHz	Oscilloscope	PLL	R120 ⑧		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		
		Oscilloscope	PLL	R120 ⑧					
Frequency adjustment	• Mode: USB • Frequency display: 10,998.5KHz	Frequency counter	PLL	J3 ⑨	PLL	C90	Adjust the frequency at J3 to be 49,731.5 KHz.	49,731.5KHz ± 1Hz	107
2nd LO adjustment	1) • Mode: USB • Frequency display: 15,998.50KHz • RIT: OFF 2) • Mode: USB • Frequency display: 15,998.49KHz • RIT: OFF • STEP: 10Hz	RF Voltmeter	PLL	J4 ⑩	PLL	L14 L15	Adjust alternately until a maximum voltage is obtained.	10mV R.M.S. or more	108
		Frequency counter	PLL	J4 ⑩	PLL	R142	Adjust the frequency at J4 to be 30,720.00 KHz.	30,720.000KHz ± 1Hz	110
		Frequency Counter	PLL	J4 ⑩	PLL	R69	Adjust the frequency at J4 to be 30,719.91 KHz.	30,719.910KHz ± 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"> • Mode: USB • Frequency display: 15,998.50KHz • RIT: ON • RIT control: center 	Frequency counter	PLL	J4	FSW	R25	Adjust the frequency at J4 to be 30,720.00 KHz.	30,720.00KHz ± 10Hz	111

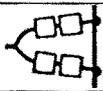
8 - 3 IF UNIT ADJUSTMENT (Continued)

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. VXO frequency adjustment. (Continued)	<ul style="list-style-type: none"> * Verify • Mode: AM • P.B.T. control: center 	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 ± 500Hz	
	<ul style="list-style-type: none"> • Mode: SSB (USB or LSB) • Comp: ON • T/R switch: transmit 	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"> • Mode: AM • P.B.T. control: OFF • T/R switch: transmit 	Frequency counter	IF	R24	⑫	R14	Adjust the frequency to be 19,760.0KHz at R14.	19,760.0KHz	210

[for reference]

- 1) Connect 2PF(CH/ in parallel to C149(5PF) ⑭ of IF unit if 19,763.3KHz is not obtained with P.B.T. control turned fully clockwise after P.B.T. adjustment.
- 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"> • Mode: SSB • MIC-G control: MIN • T/R switch: transmit 	DC ammeter (connect it in series with the jumper wire putting 4 bead cores disconnected.	Driver	Jumper  ¹⁵	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 ¹⁶	PA	R12	Adjust the current to be 600mA at R12	600mA	302	
ALC adjustment	¹⁾ <ul style="list-style-type: none"> • Band: 14MHz • Mode: RTTY or CW • Comp: MAX 	Power meter		Antenna Connector	MIC -G	R9	Adjust the output to be 100 – 110W at R9	100 – 110W	303	
		Power meter		Antenna Connector	MIC -G	R6	Adjust the output to be 5 – 10W at R6	5 – 10W	304	
		Power meter		Antenna Connector	MIC -G			Adjust the output to be 35 – 40W at R13	35 – 40W	305
		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"> • Mode: SSB • Comp: OFF • MIC GAIN: MIN 	Spectrum analyzer or RF volt-meter			IF	R-101 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) <ul style="list-style-type: none"> • Mode: USB • Comp: OFF • MIC terminal: Connect an AF generator (300mV/2.7KHz, 270Hz). • MIC GAIN: Set to transmitting output to be 20W 2) <ul style="list-style-type: none"> • Mode: LSB • Comp: OFF • MIC terminal: Connect an AF generator (300mV/2.7KHz, 270Hz). • MIC GAIN: Set to transmitting output 20W 	Power meter		An-tenna 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
COMP VXO frequency adjustment	<ul style="list-style-type: none"> • Mode: USB, LSB • Comp: MAX • MIC terminal: Connect an AF generator (100mV/270Hz) • MIC GAIN: Set to transmitting output 20W 	Power meter		An-tenna Connector	IF	L30	Same as above	20W	309
COMP Gain adjustment	<ul style="list-style-type: none"> • Mode: SSB • Comp: OFF or MAX • MIC terminal: Connect an AF generator (100mV, 10mV/1.5KHz). • MIC GAIN: Set to transmitting output 20W 	Power meter		An-tenna 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	<ul style="list-style-type: none"> • Mode: AM • Comp: OFF • MIC terminal: Connect an AF generator (100mV/1.5KHz) • MIC GAIN: MAX 	Power meter Monitor scope		An-tenna Connector Couple to the Power meter	IF	R98	Adjust R98 to obtain 100% modulation.	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"> • Meter select: Ic • Mode: SSB • Meter select: Ic • Mode: CW or RTTY 				MAIN	R76	Adjust meter zero setting		313
APC adjustment by current	<ul style="list-style-type: none"> • Adjust after Ic meter adjustment • Mode: CW or RTTY • Comp: OFF 				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"> • Meter select: Po and SWR • Mode: CW or RTTY • Band: 14MHz Band 	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

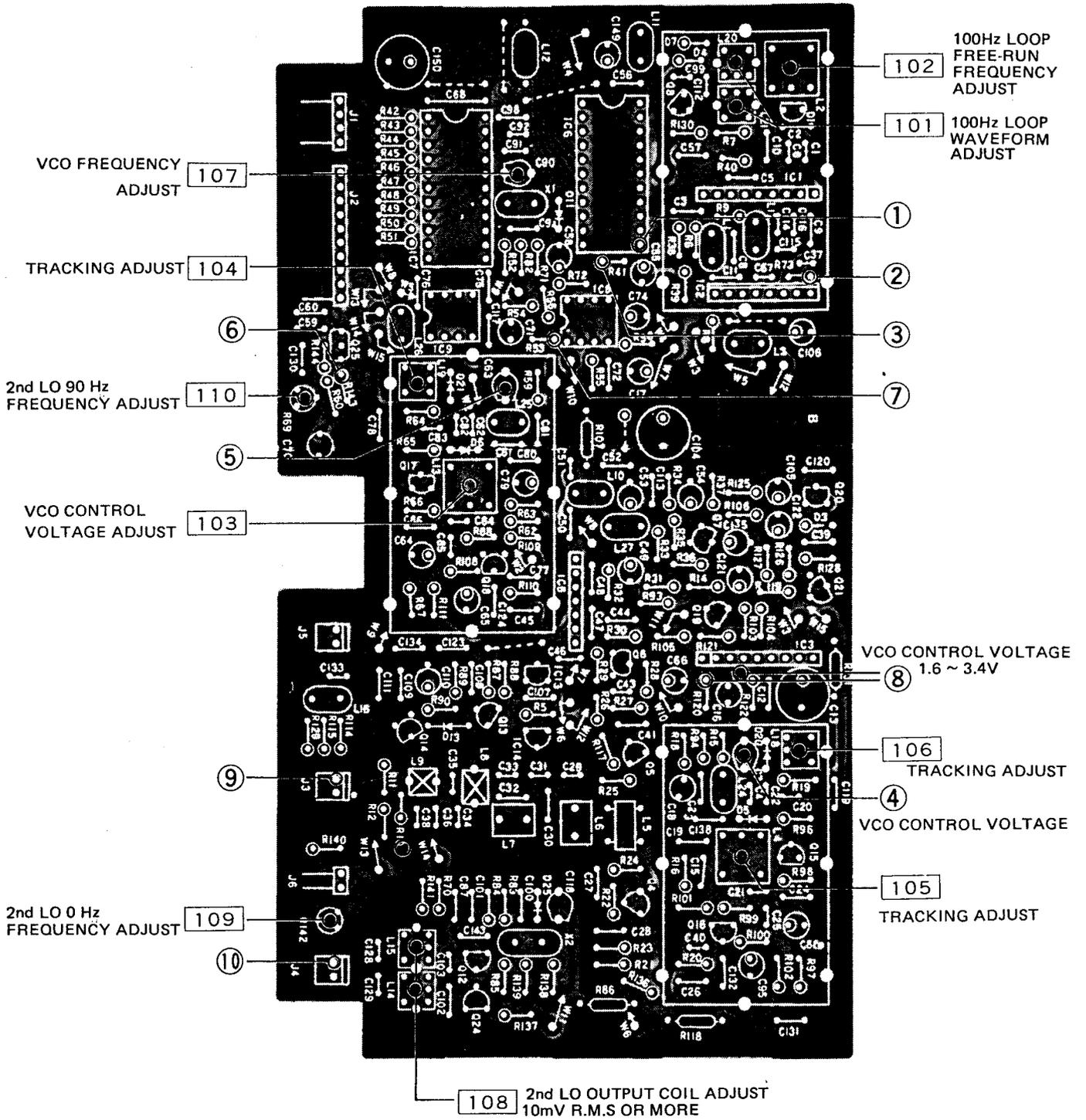
8 - 5 RECEIVER ADJUSTMENT

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		
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"> Band: 14MHz Mode: SSB P.B.T. control: center AGC: FAST ATT: OFF 	SSG AC M.M. 8Ω speaker			IF	R76	-30dB	401
S meter zero setting adjustment	<ul style="list-style-type: none"> Band: 14MHz Mode: SSB P.B.T. control: center AGC: Fast ATT: OFF 				MAIN	R83	Pointed value: 0	402
S meter full scale adjustment	<ul style="list-style-type: none"> Band: 14MHz Mode: SSB P.B.T. control: center AGC: Fast ATT: OFF 	SSG			MAIN	R79	Pointed value: +40dB	403
S meter (S-8) adjustment	<ul style="list-style-type: none"> Band: 14MHz Mode: SSB P.B.T. control: center AGC: Fast ATT: OFF 	SSG			MAIN	R81	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"> Mode: SSB 				F5W	R17		405

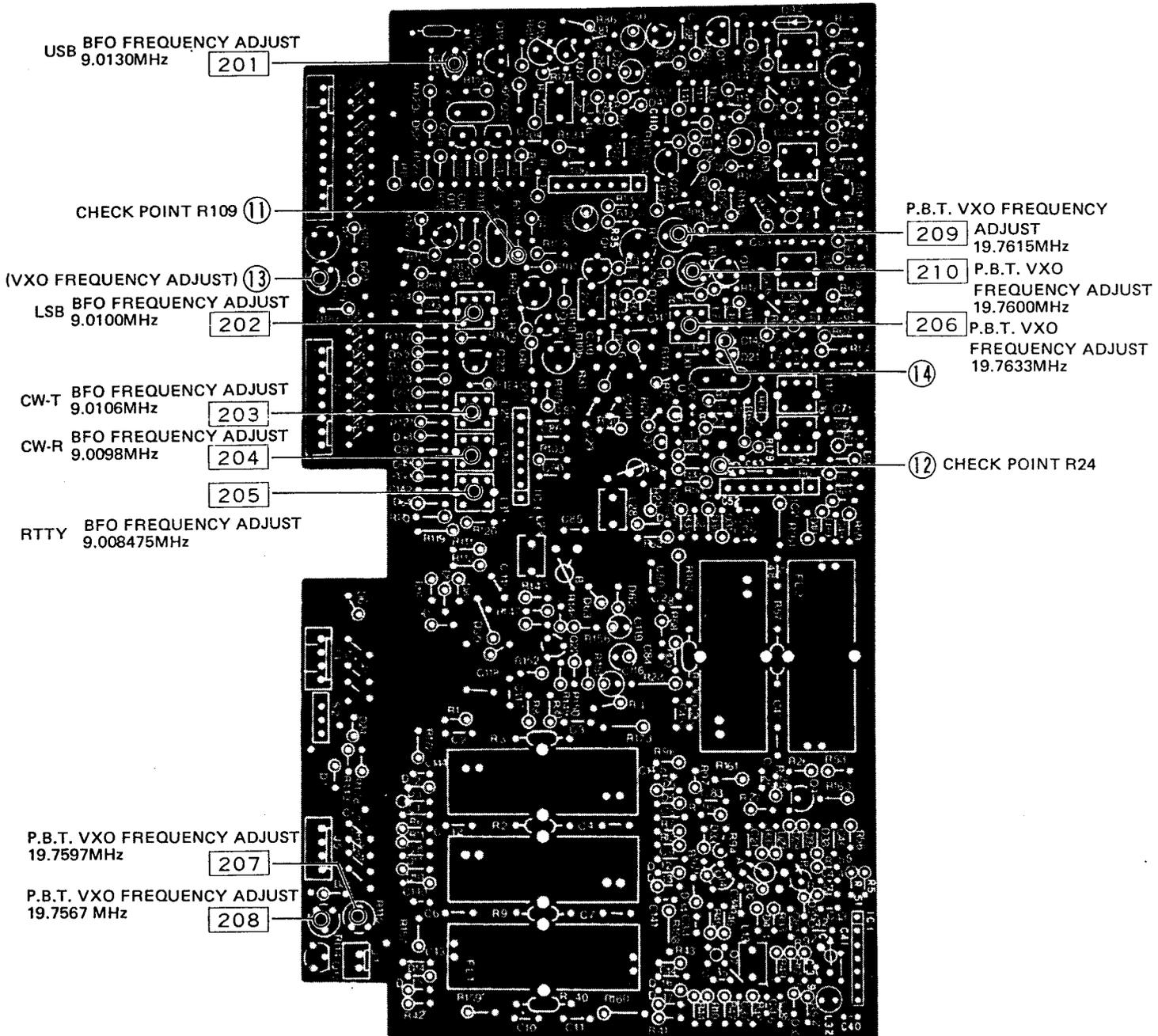
8 - 5 RECEIVER ADJUSTMENT (Continued)

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"> Mode: SSB N.B. Switch: OFF 	Noise generator 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"> Mode: RTTY Ground J1 of RTTY unit when space frequency adjustment. 	Frequency counter	RTTY	Q3 (19)	RTTY	C3 C2	Adjust to obtain: Mark frequency: 9,010.77KHz at C3 Space frequency: 9,010.60KHz at C2	Mark: 9,010.770KHz Space: 9,010.600KHz 407 408	

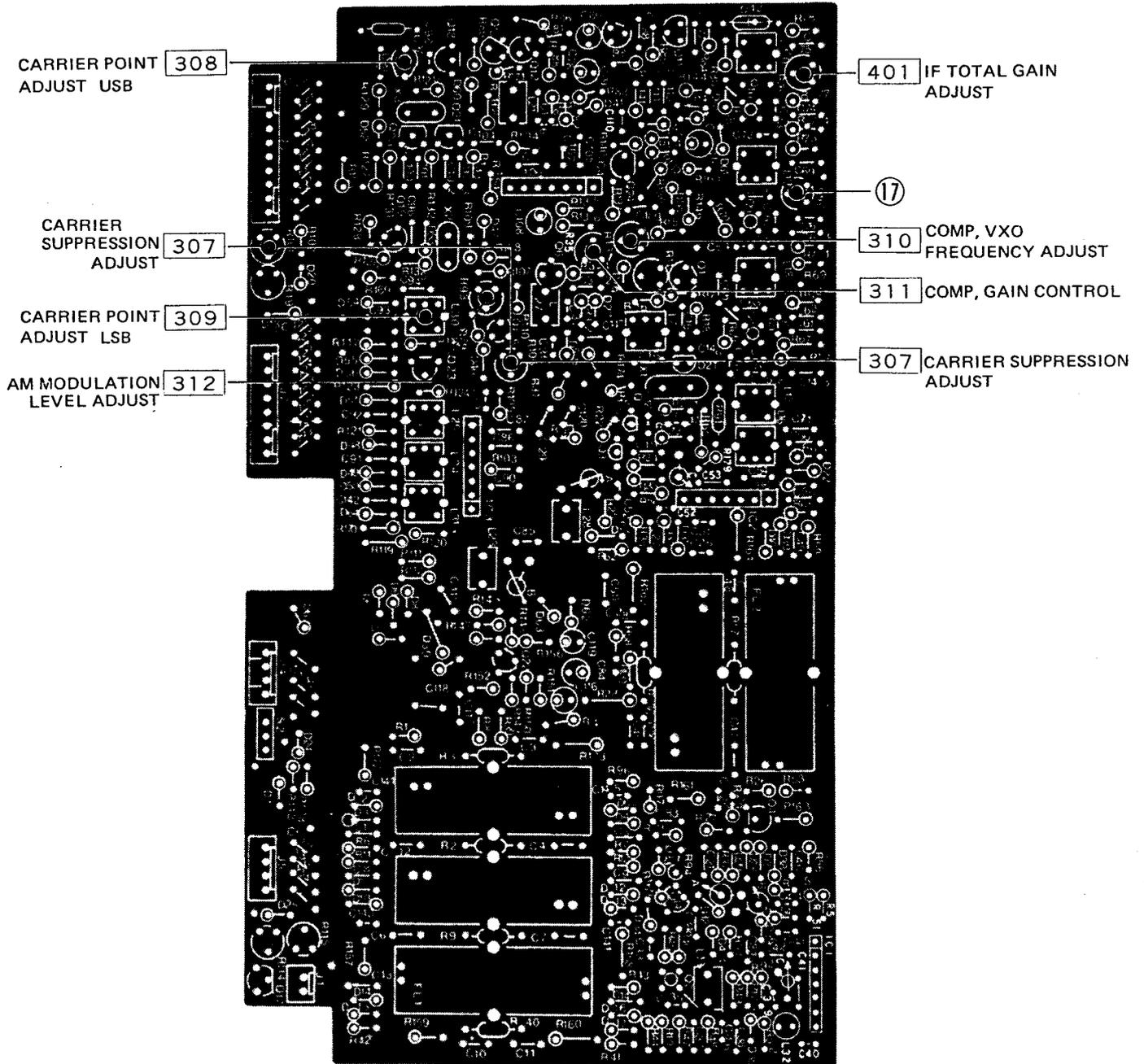
8-6 PLL UNIT PARTS LOCATION



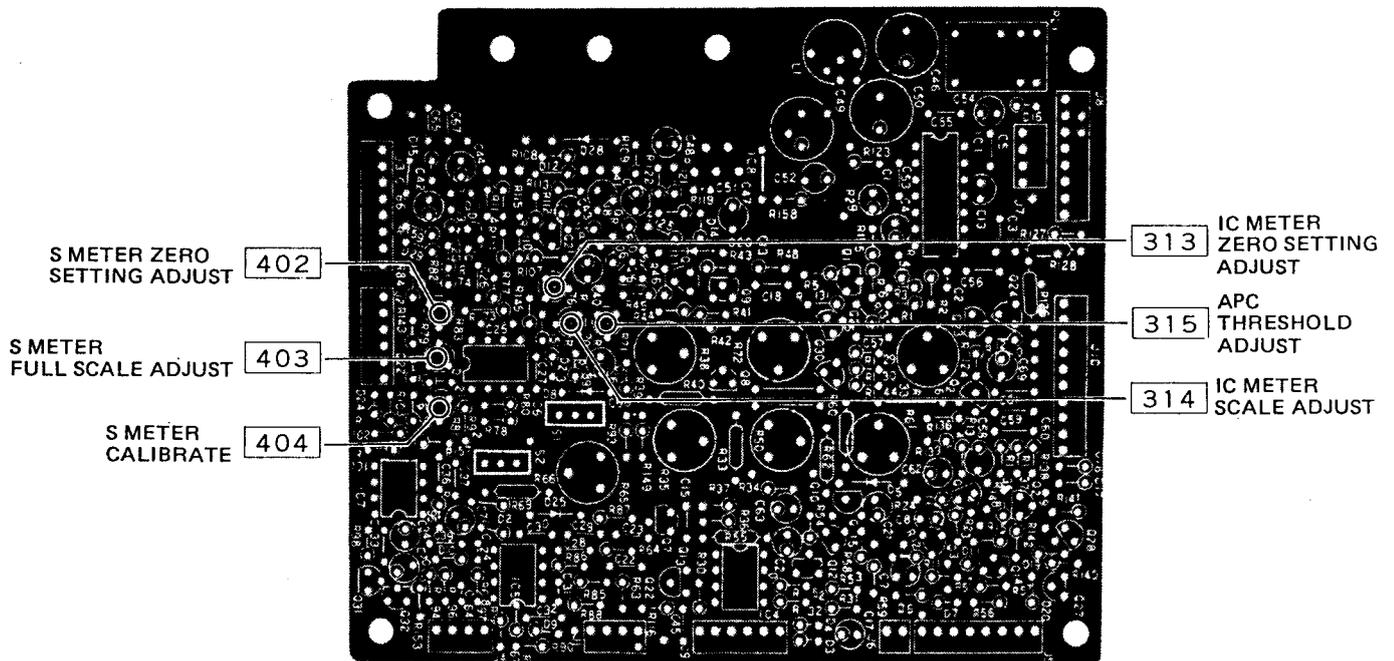
8 - 7 IF UNIT PARTS LOCATION (FREQUENCY ADJUSTMENT)



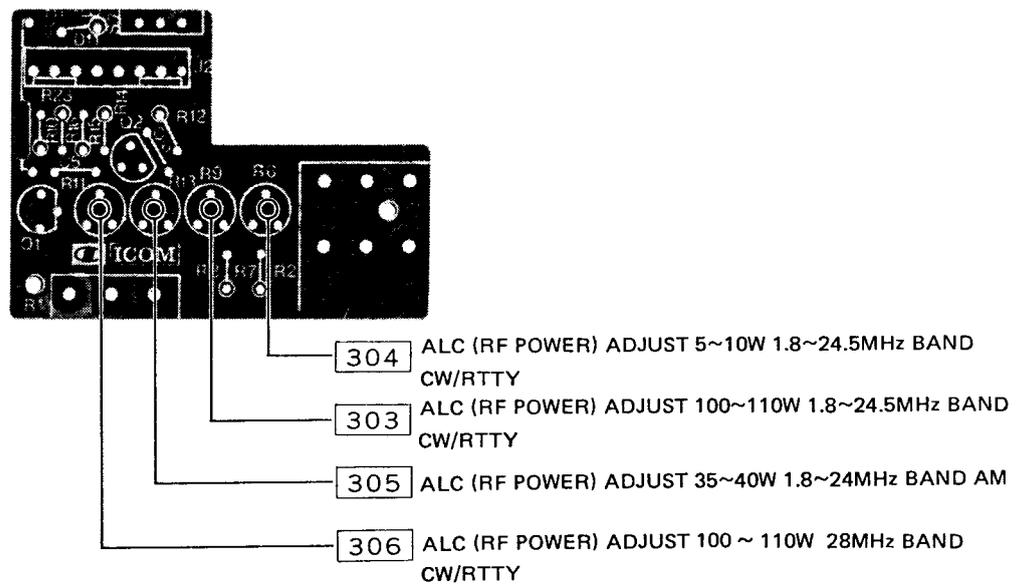
8 - 8 IF UNIT PARTS LOCATION



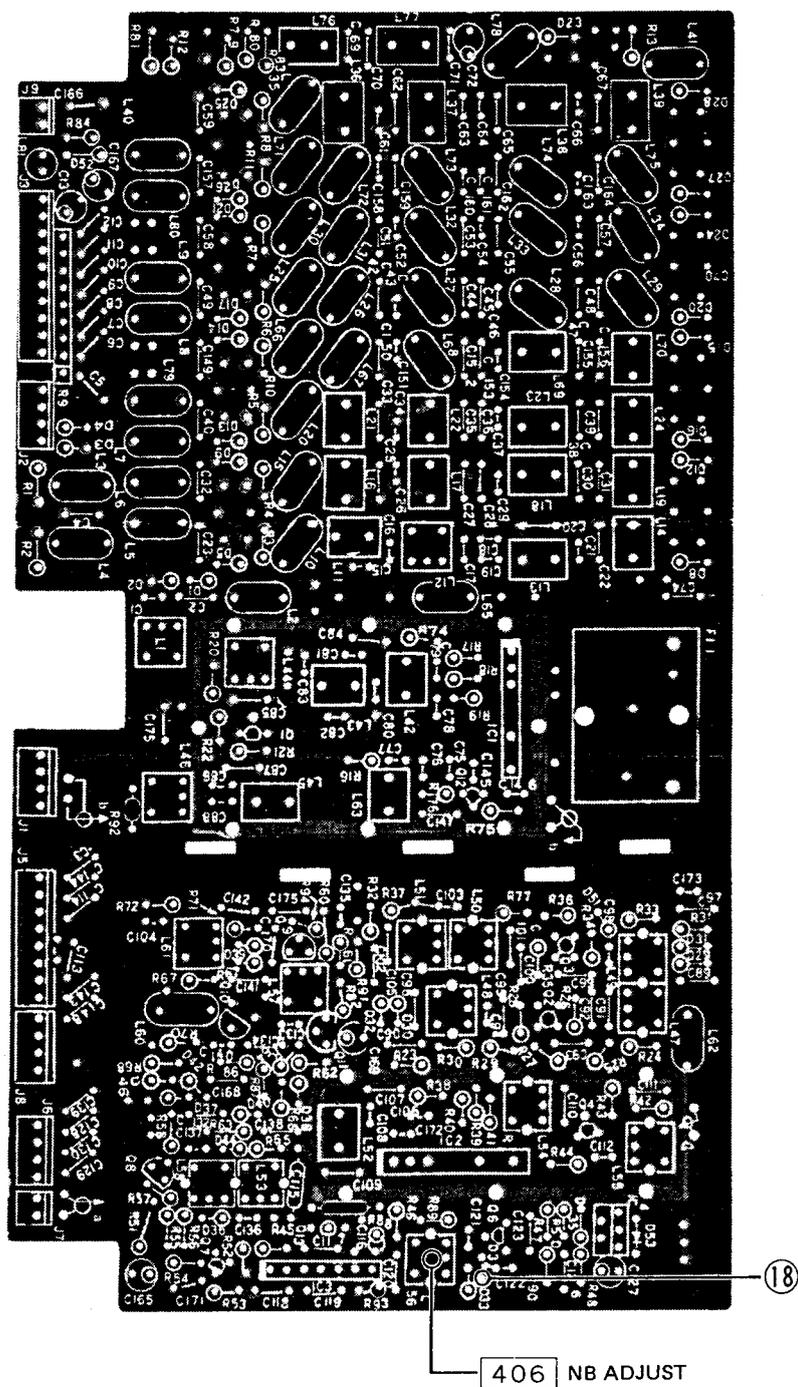
8 - 9 MAIN UNIT PARTS LOCATION



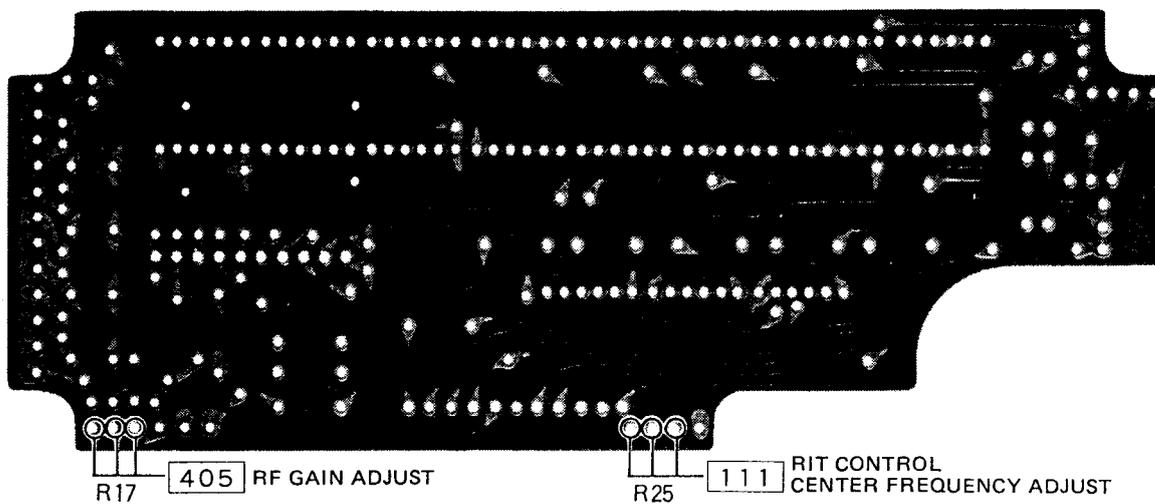
8 - 10 MIC-G UNIT PARTS LOCATION



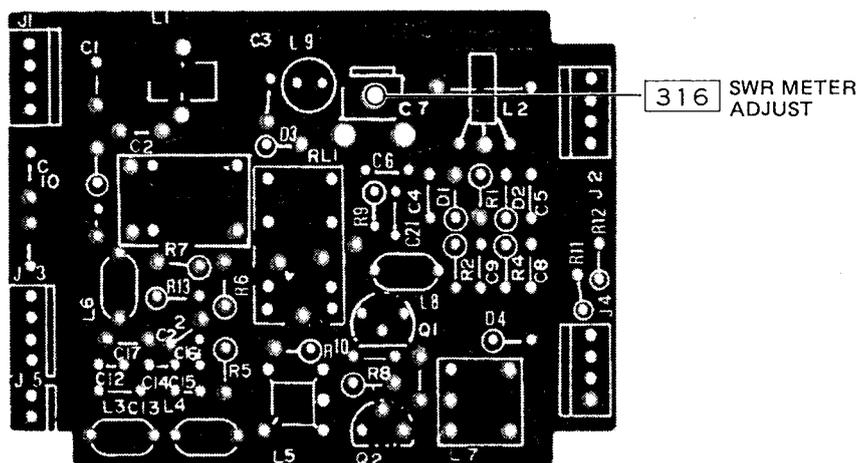
8 - 11 RF UNIT PARTS LOCATION



8 - 12 FSW UNIT

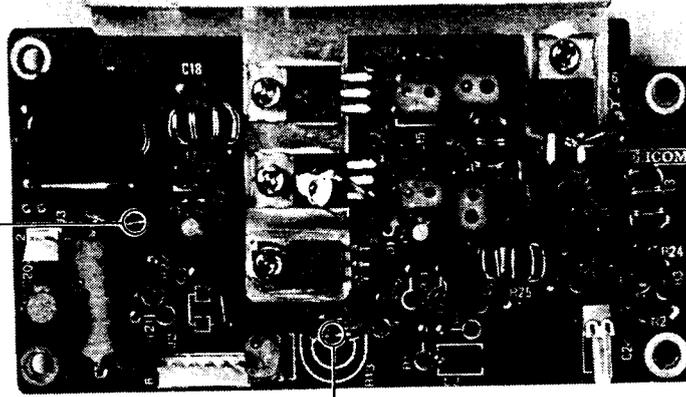


8 - 13 SWR UNIT



8 - 14 DRIVER UNIT
IDLING CURRENT ADJUSTMENT

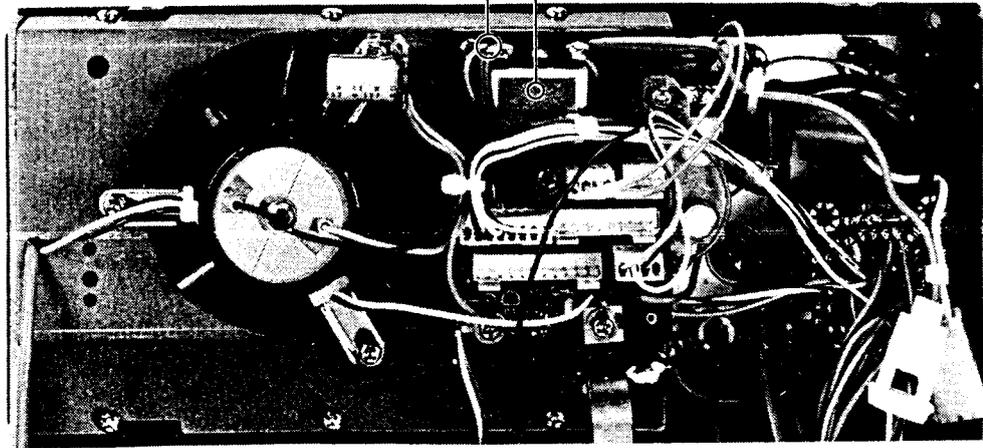
CUT JUMPER AND CONNECT
AMMETER IN SERIES (15)



301 DRIVER IDLING CURRENT ADJUST
100mA

8 - 15 PA UNIT (CONNECTOR PART)

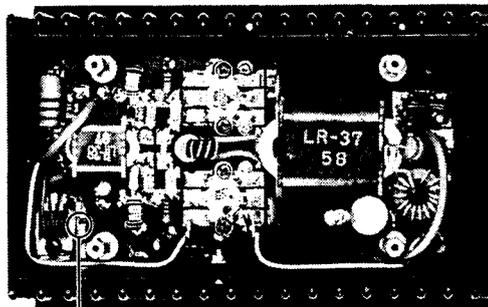
(16) REMOVE THICK WIRE ONLY AND
CONNECTED AMMETER IN SERIES



8 - 16 PA UNIT

8 - 17 RTTY UNIT

RTTY BFO FREQUENCY ADJUST



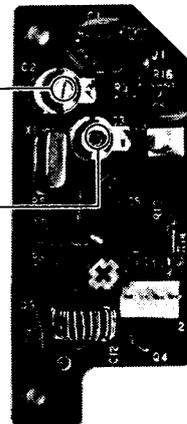
302 PA IDLING CURRENT ADJUST 600mA

MARK FREQUENCY ADJUST
9.010.60MHz

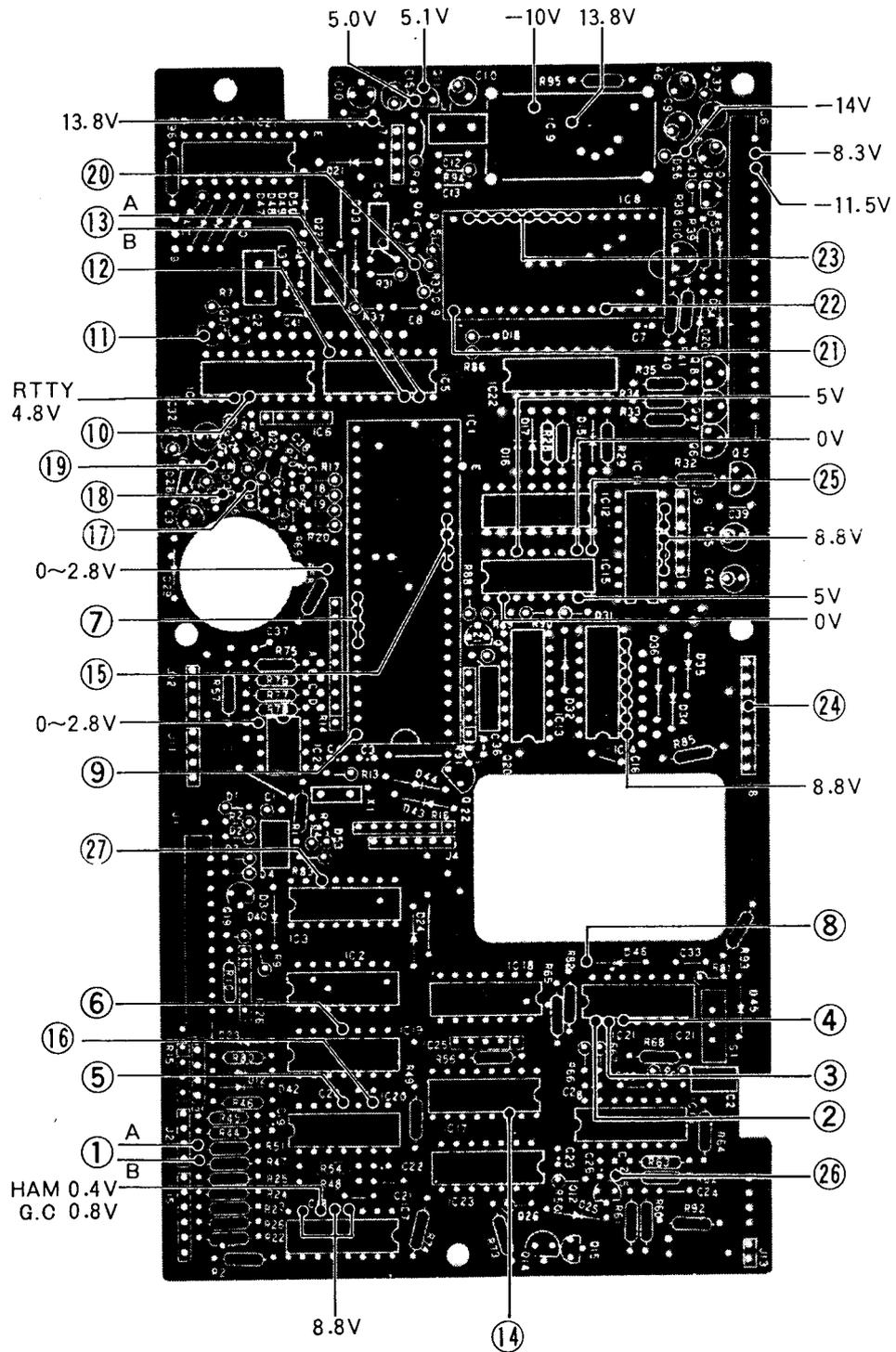
408

SPACE FREQUENCY ADJUST
9.010.77MHz

407

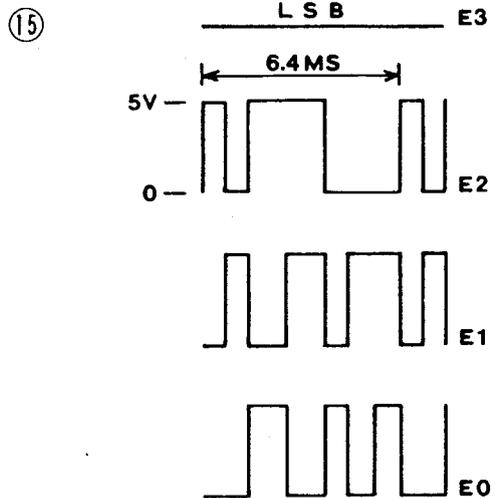
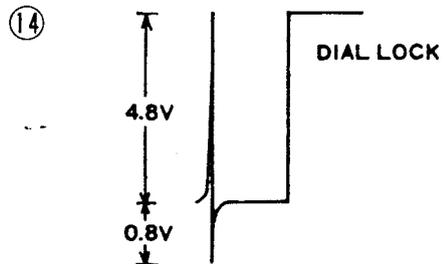
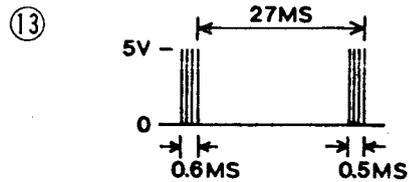
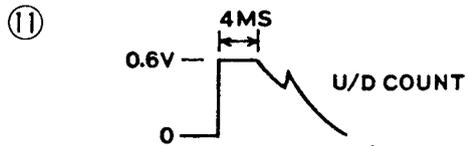
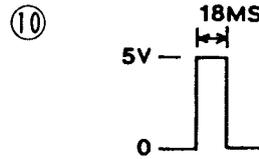
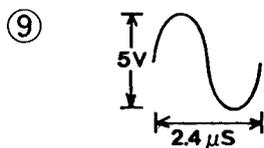
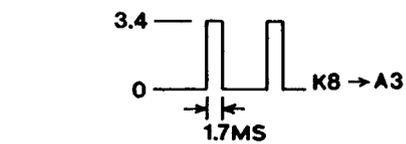
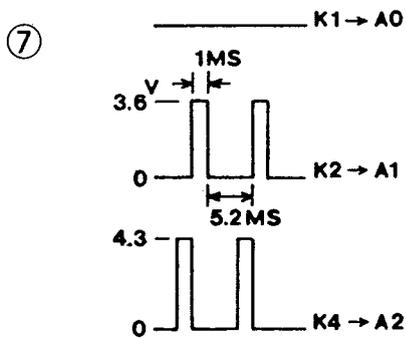
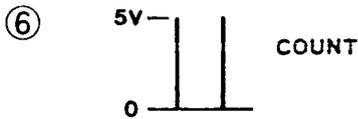
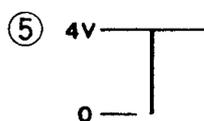
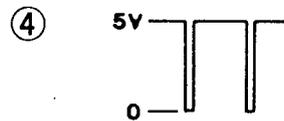
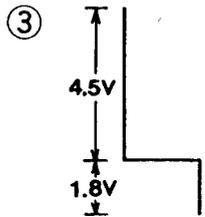
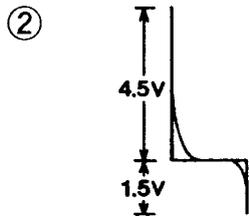
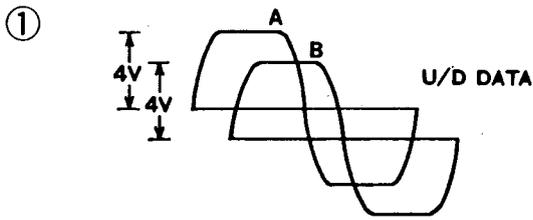


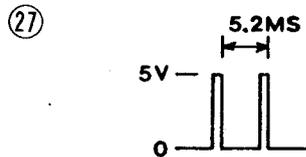
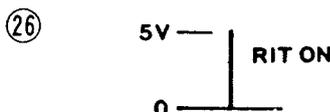
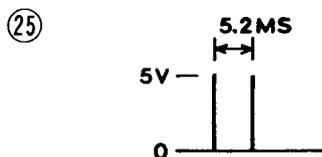
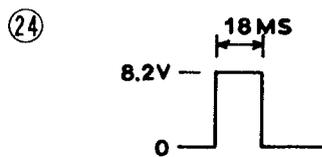
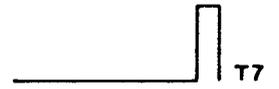
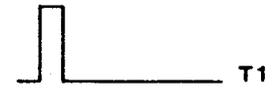
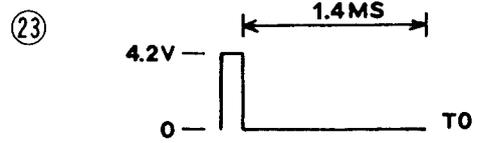
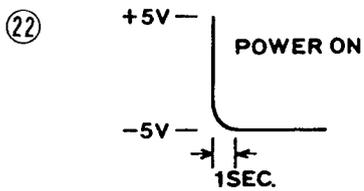
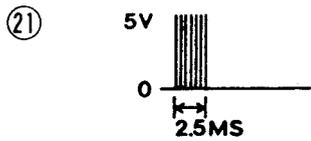
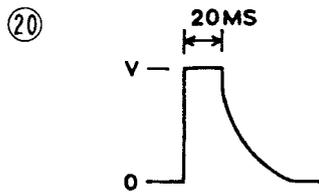
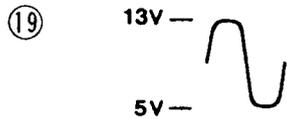
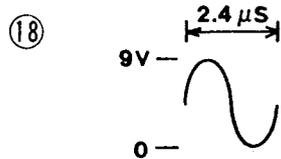
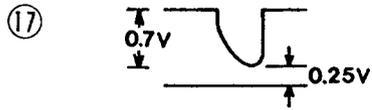
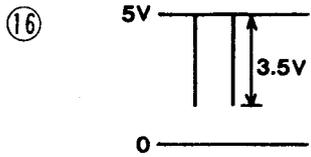
8 - 19 LOGIC UNIT VOLTAGE CHECK



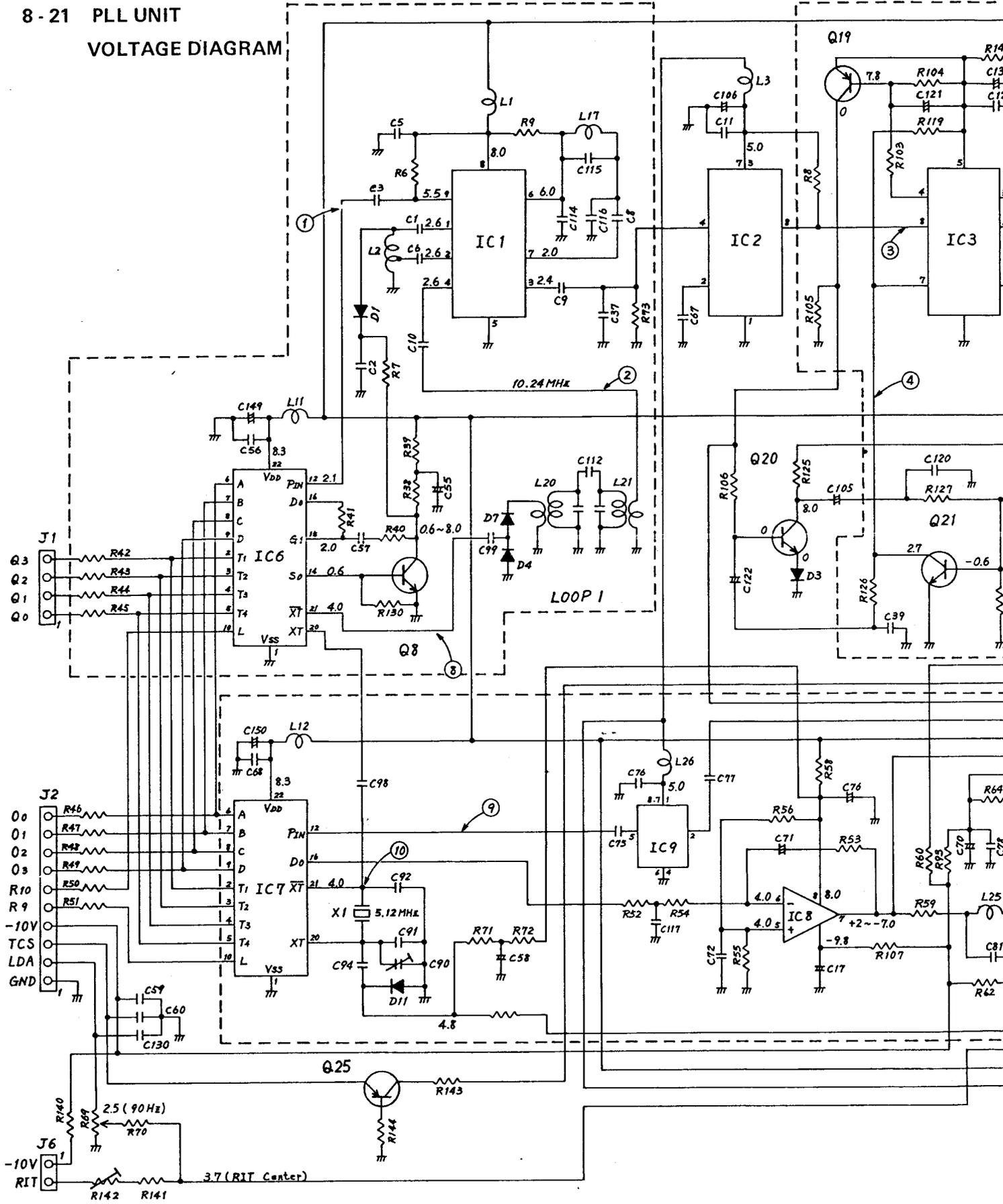
• REFER TO:
 PAGE 8 - 26 FOR CIRCUIT DIAGRAM
 AND PAGE 8 - 20 FOR VOLTAGE WAVEFORMS

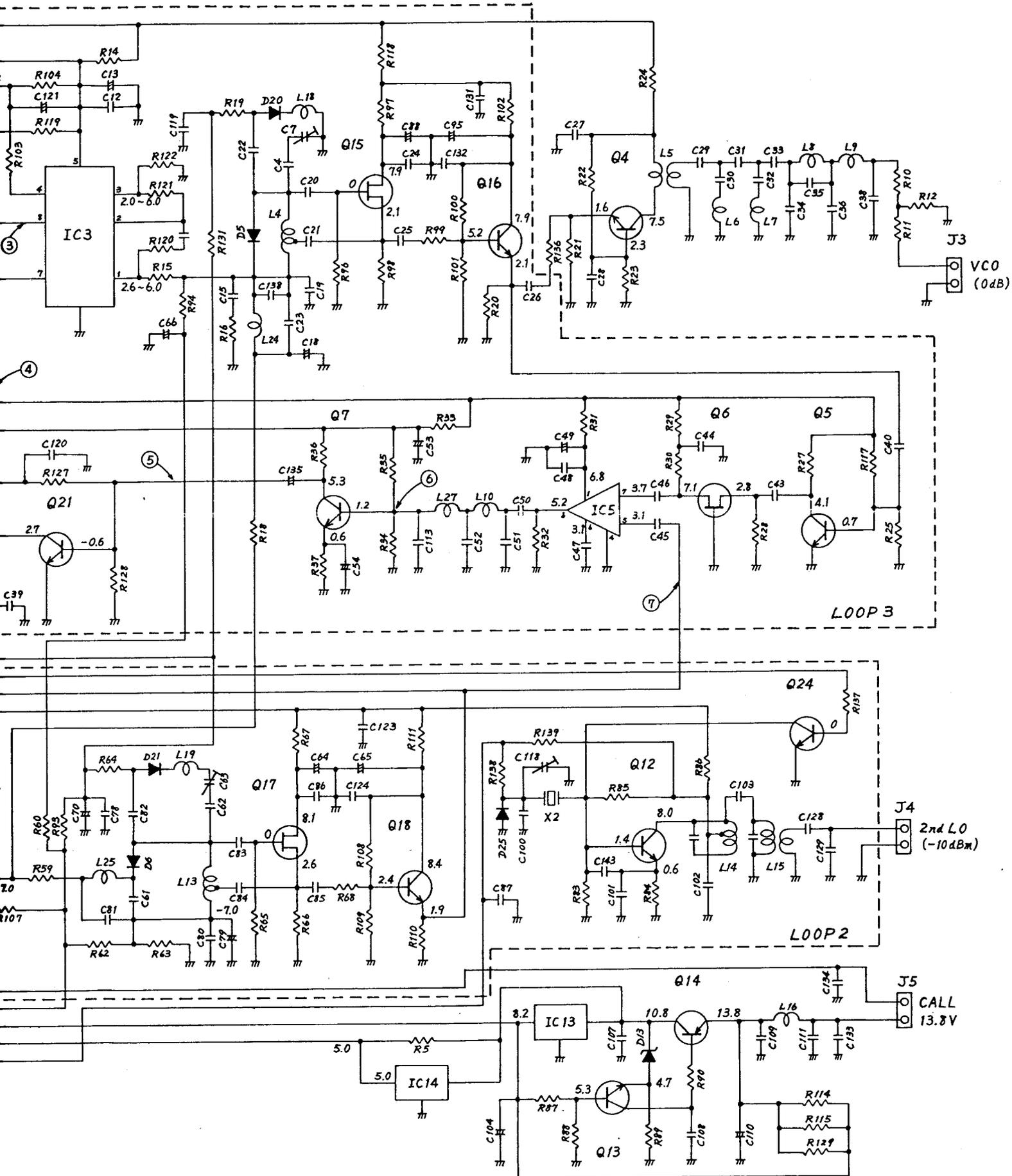
8 - 20 LOGIC UNIT VOLTAGE WAVEFORMS



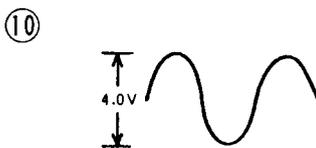
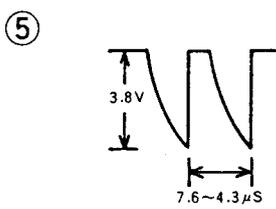
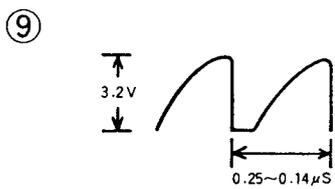
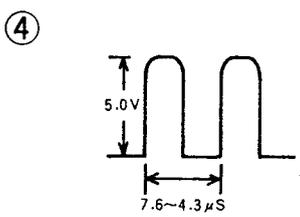
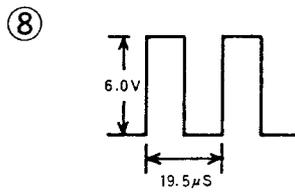
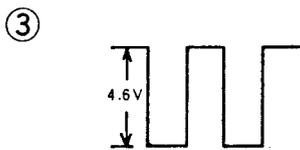
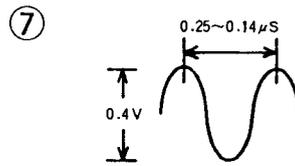
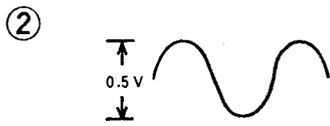
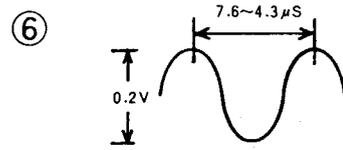
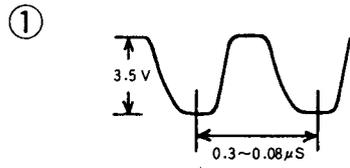


8-21 PLL UNIT
VOLTAGE DIAGRAM

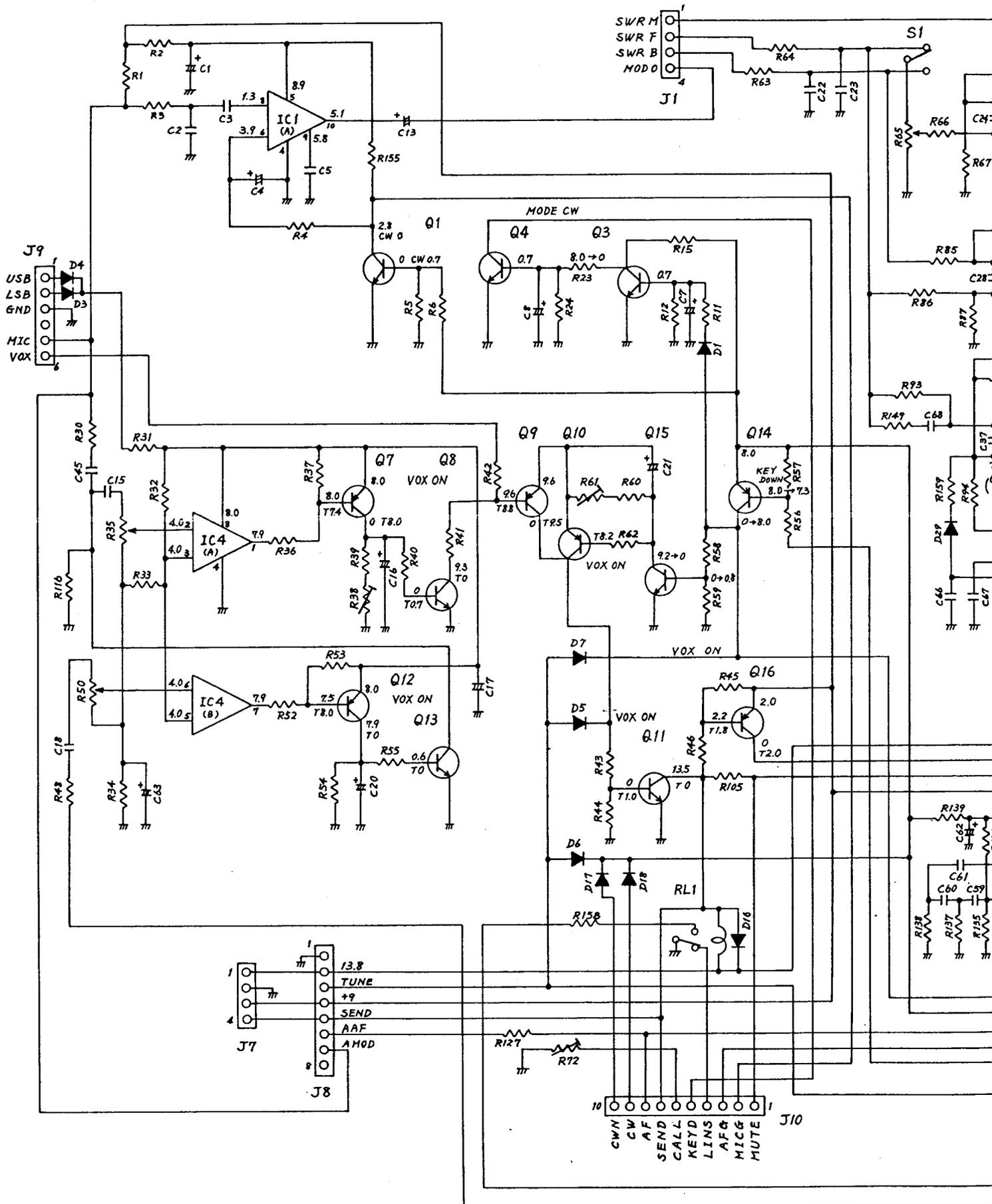


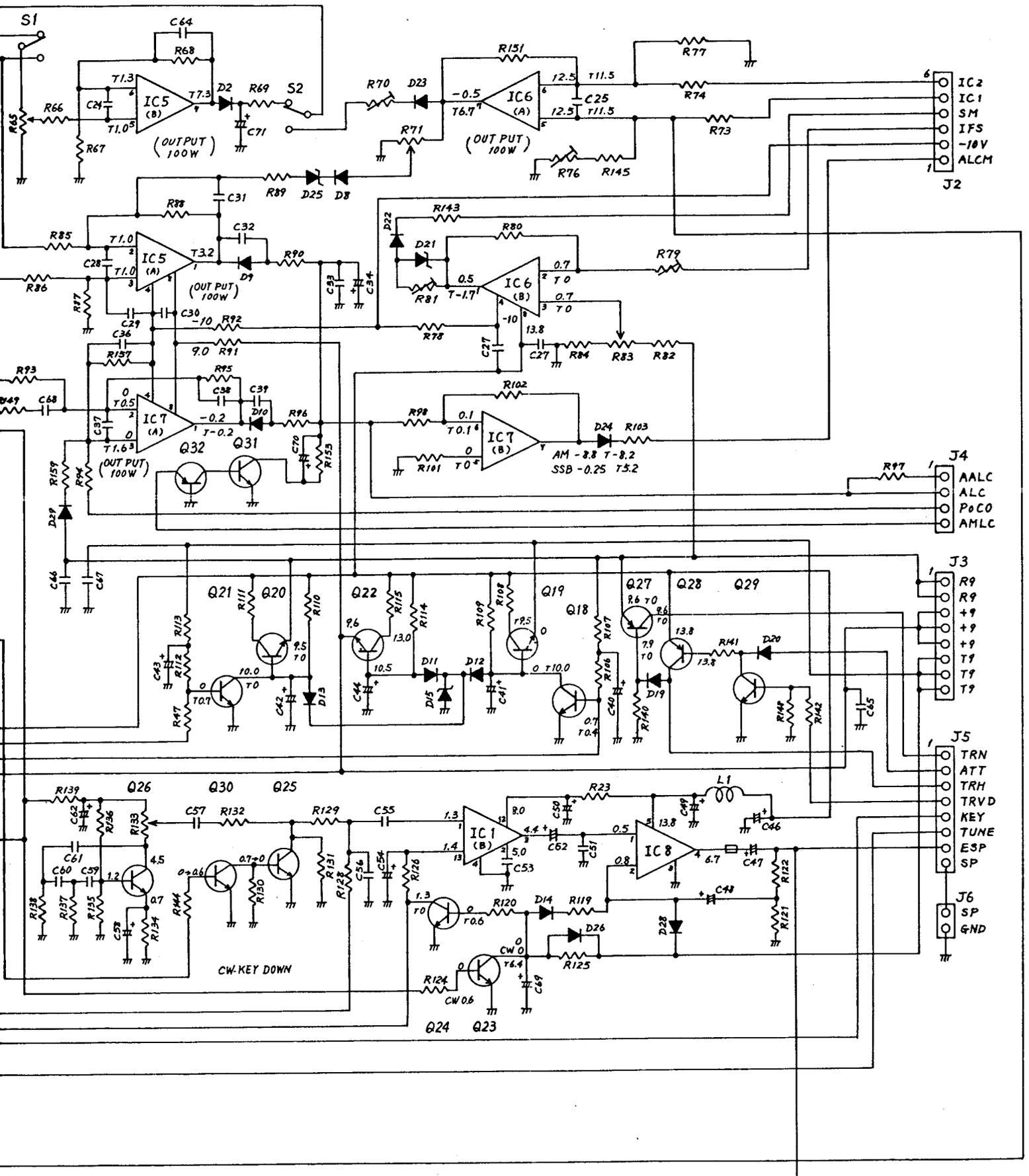


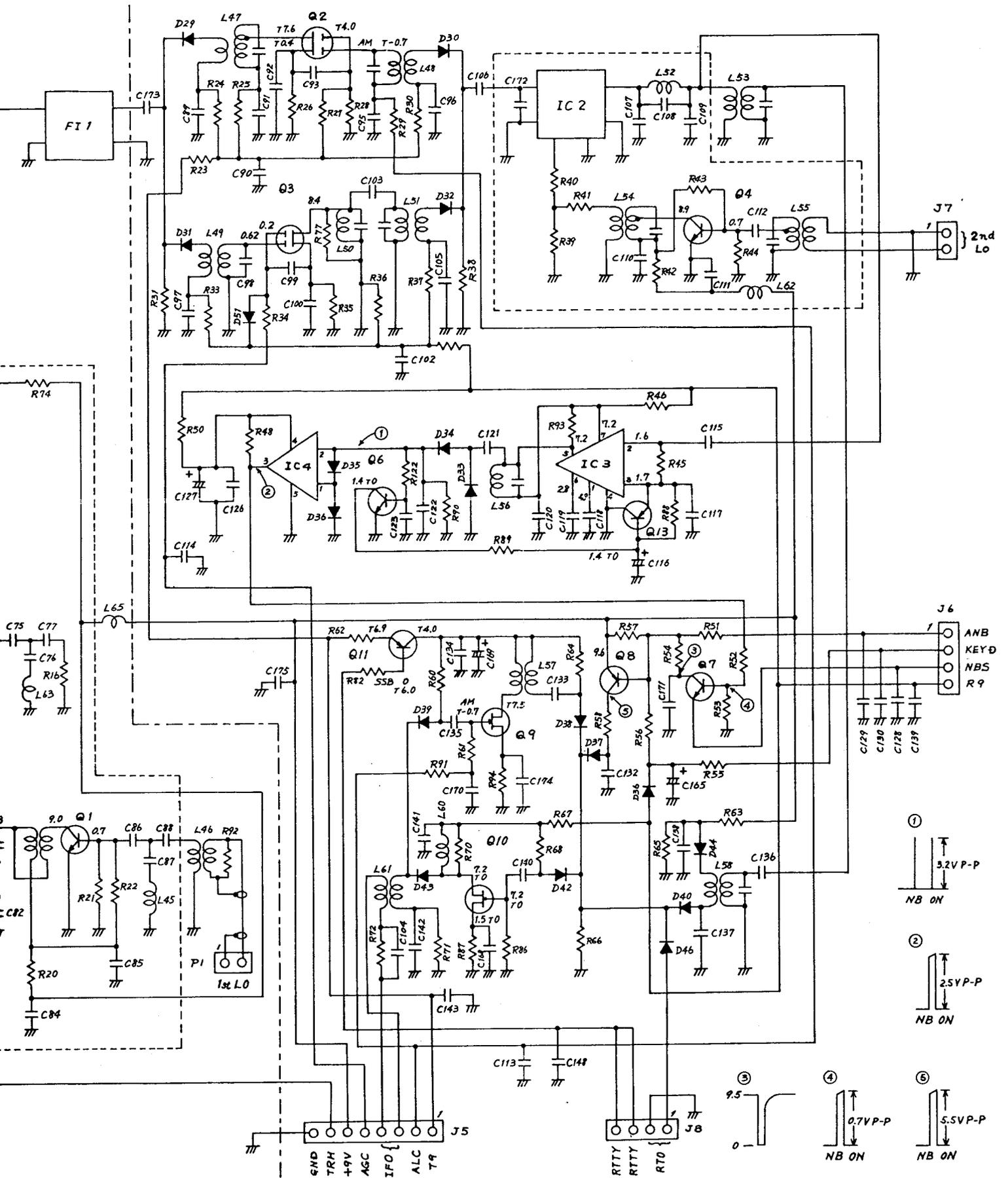
8 - 22 PLL UNIT VOLTAGE WAVEFORMS



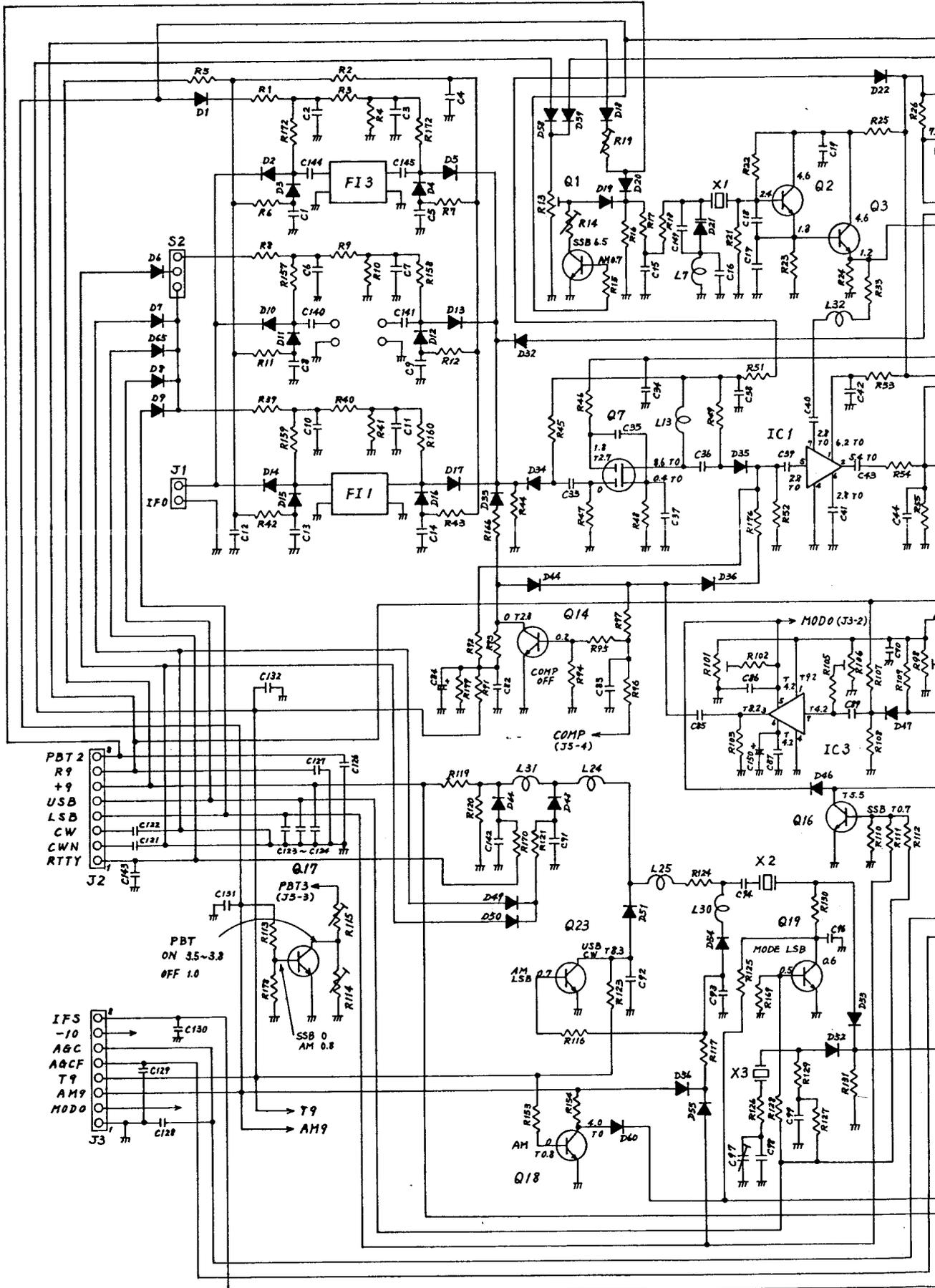
8-23 MAIN UNIT VOLTAGE DIAGRAM

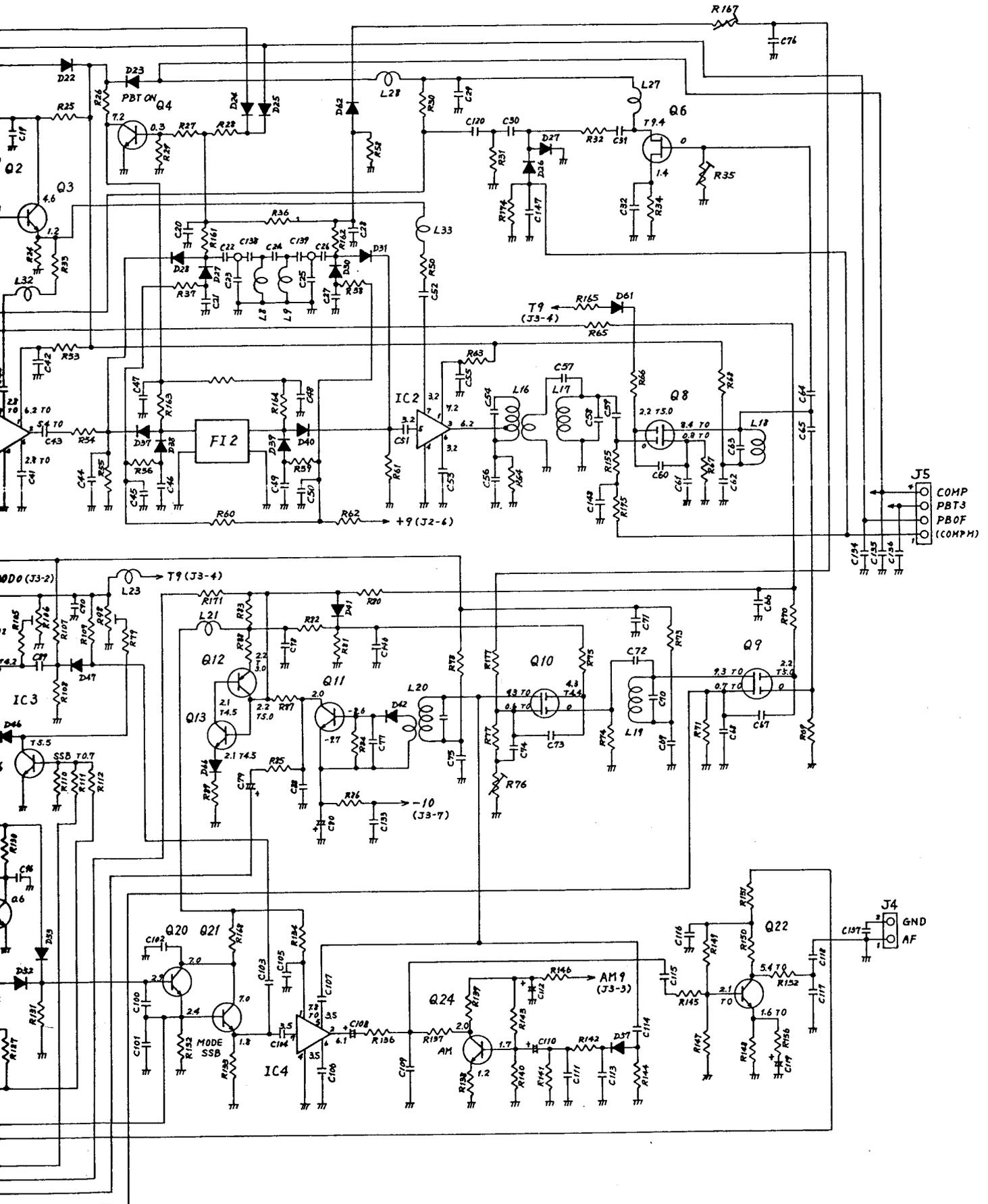




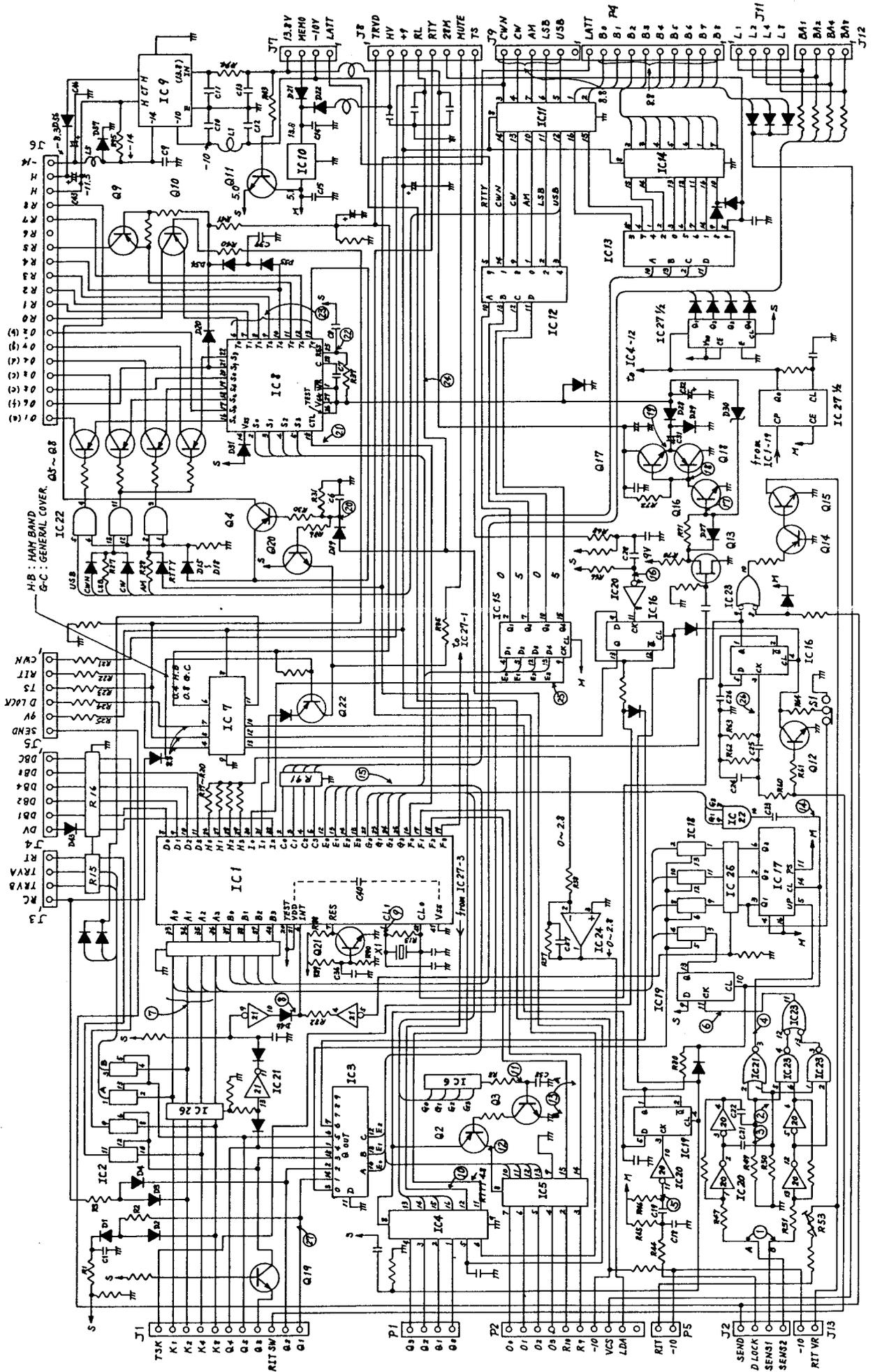


8-25 IF UNIT VOLTAGE DIAGRAM

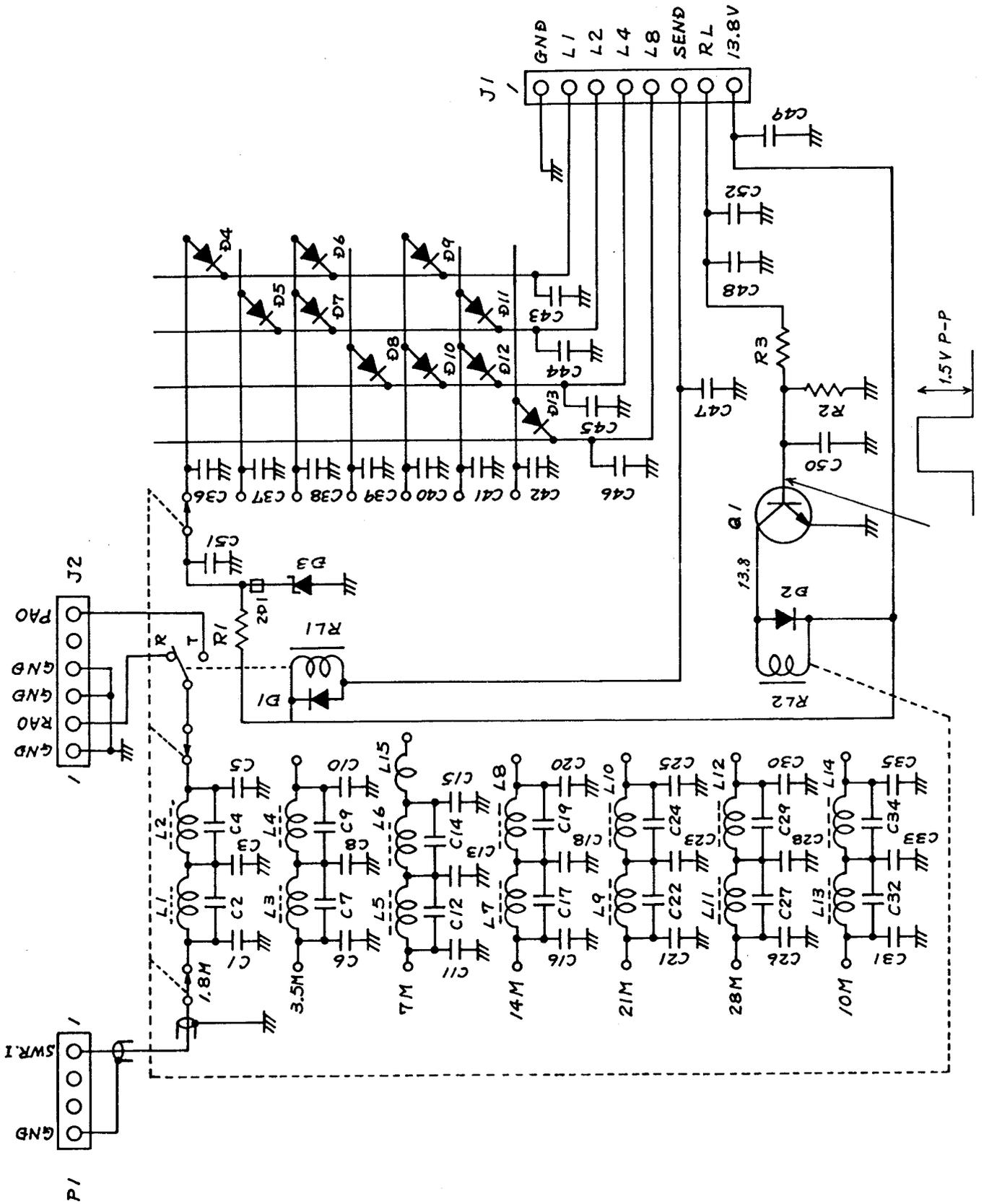




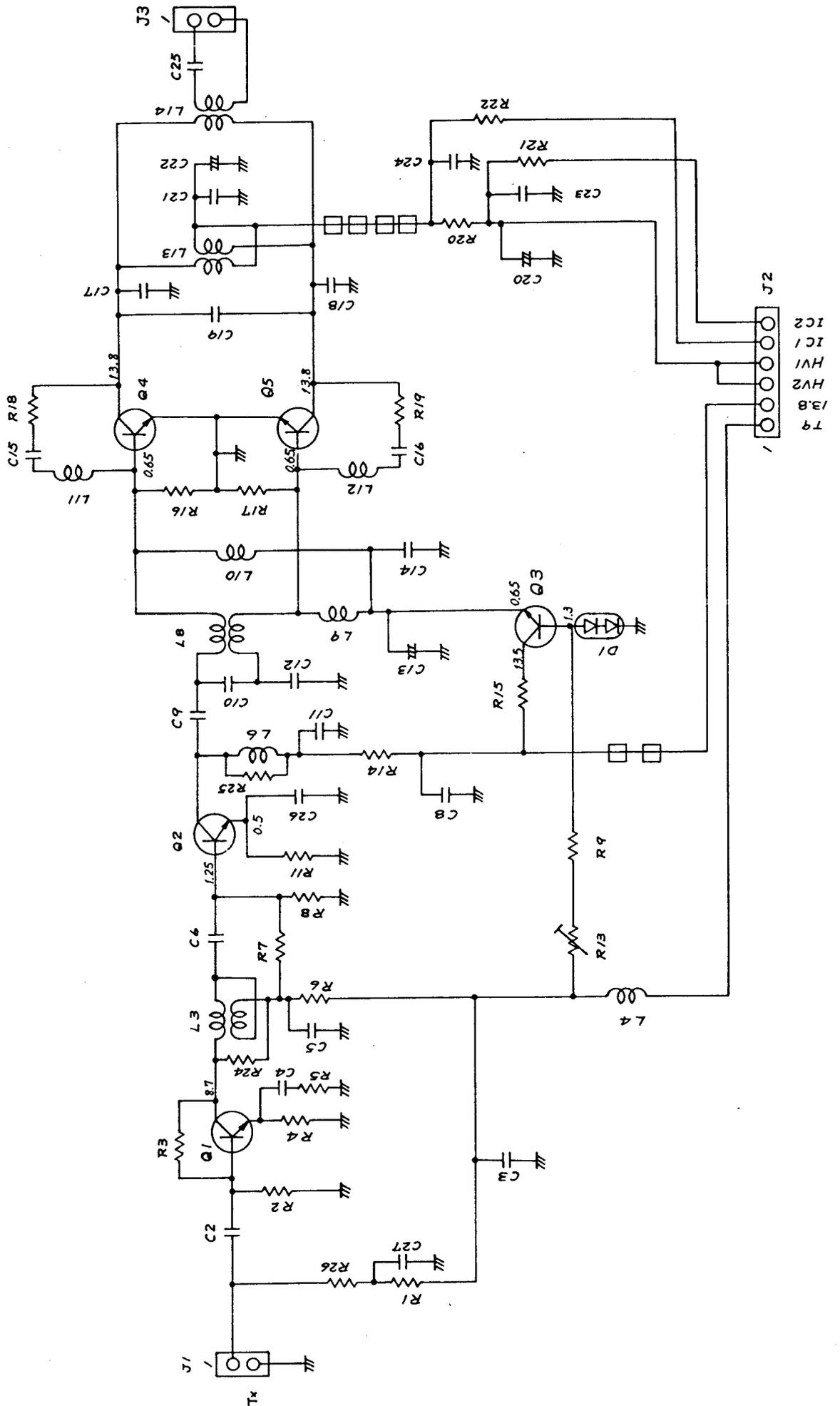
8-26 LOGIC UNIT VOLTAGE DIAGRAM



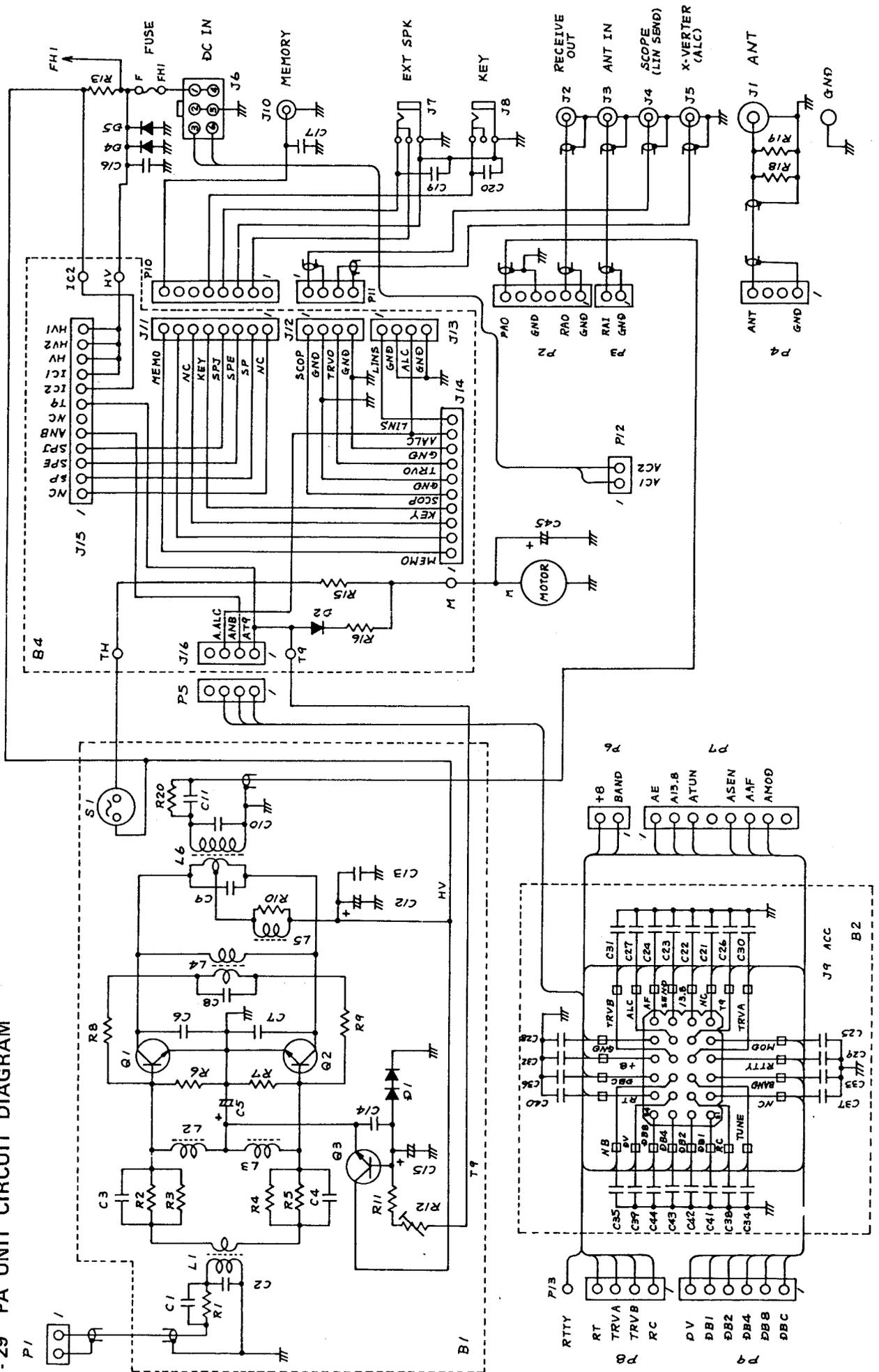
8-27 FILTER UNIT VOLTAGE DIAGRAM



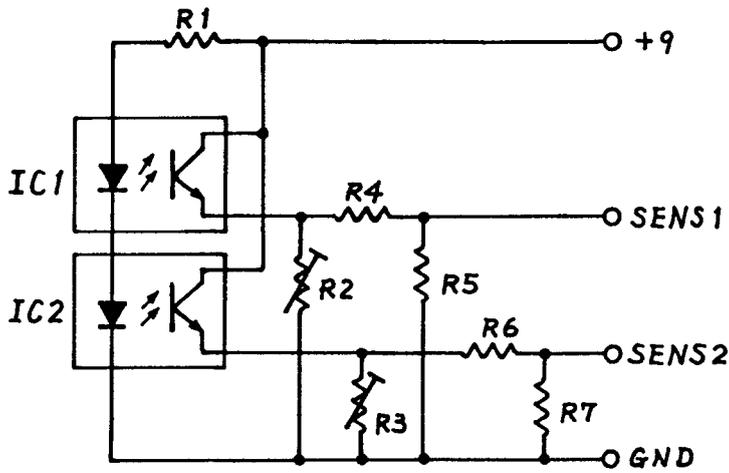
8-28 DRIVER UNIT VOLTAGE DIAGRAM



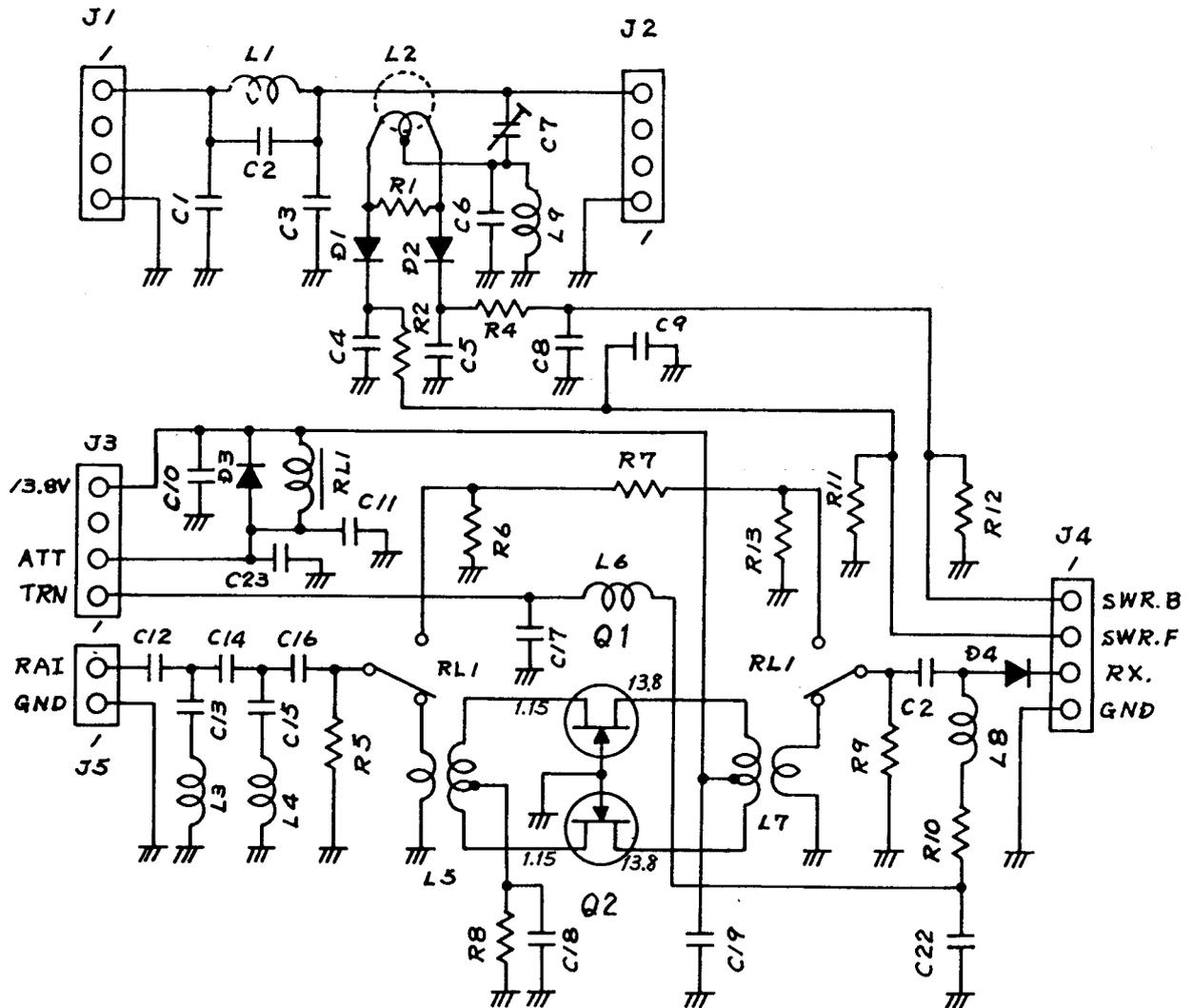
8-29 PA UNIT CIRCUIT DIAGRAM



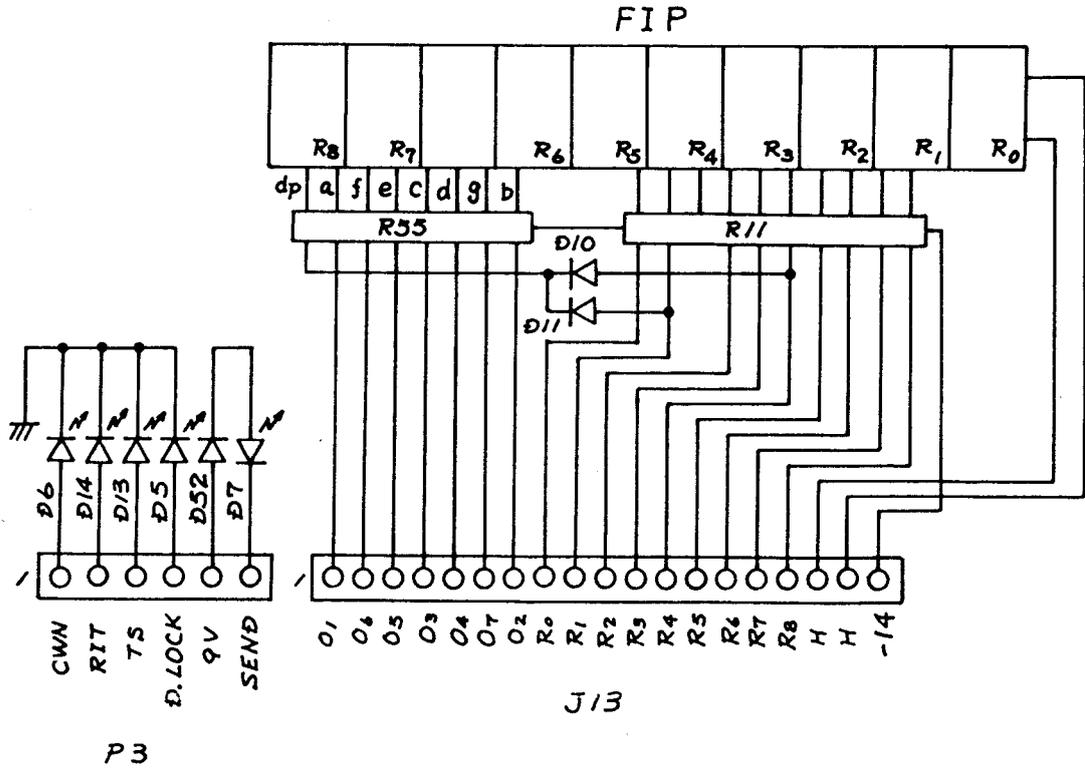
8-30 SENSOR UNIT CIRCUIT DIAGRAM



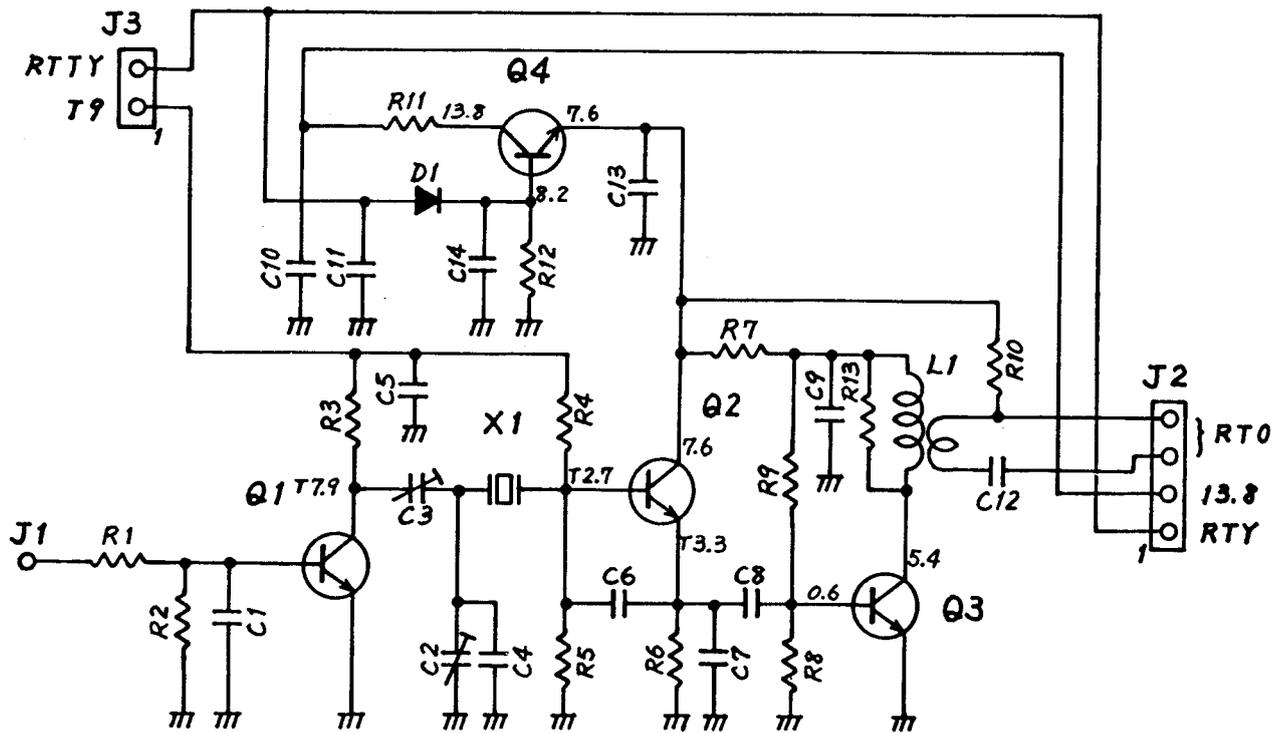
8-31 SWR UNIT CIRCUIT DIAGRAM



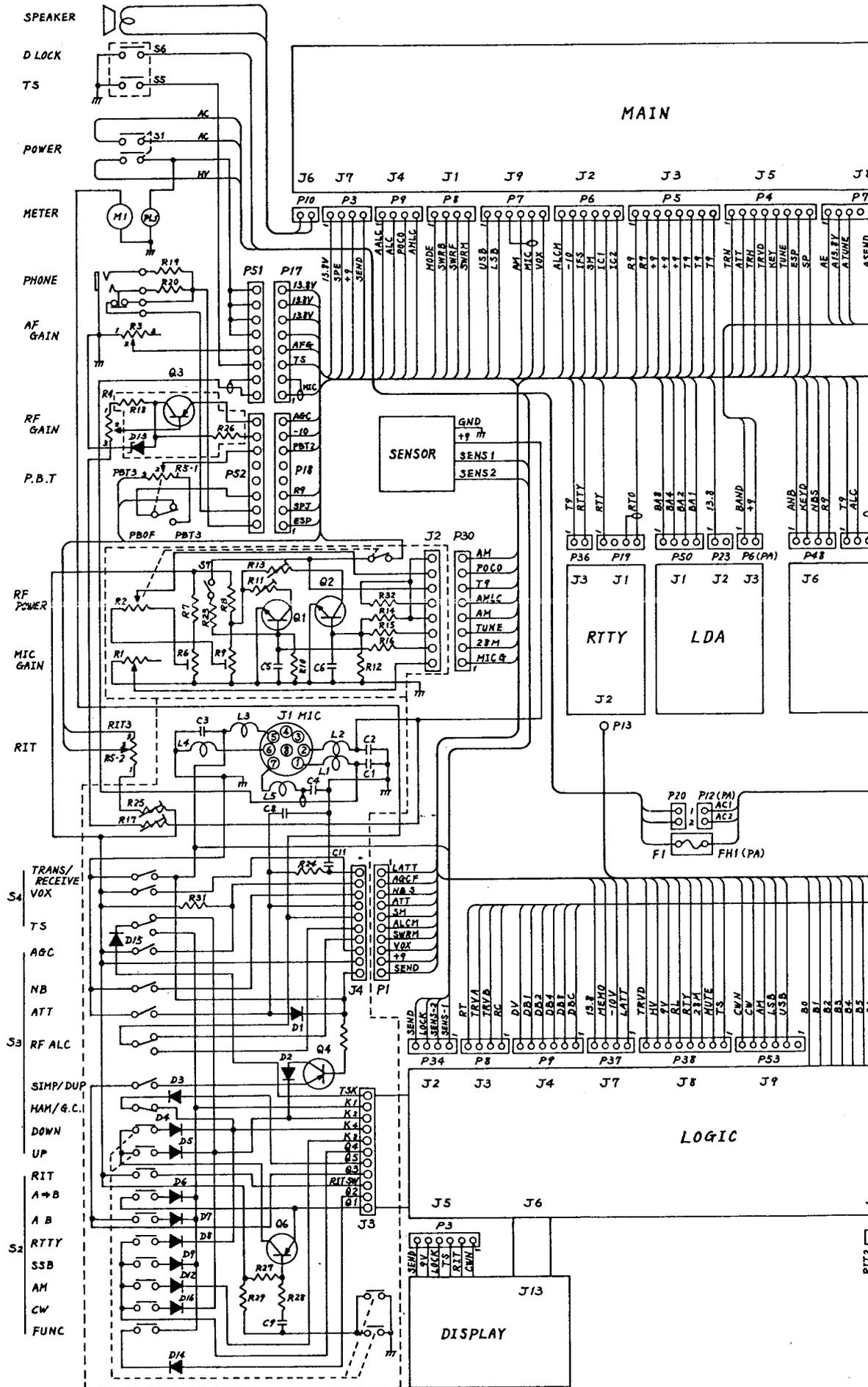
8-31 DISPLAY UNIT CIRCUIT DIAGRAM

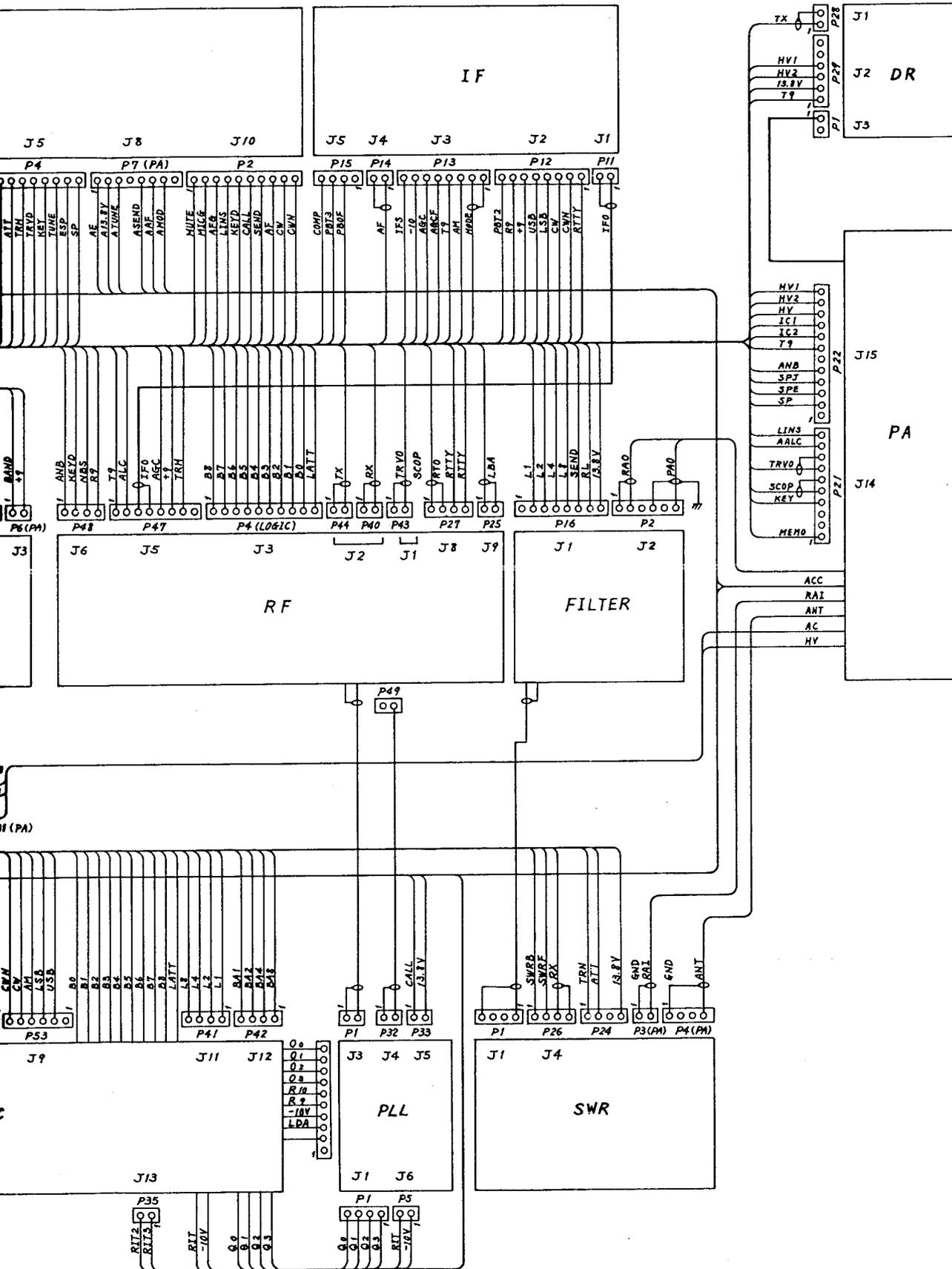


8-32 RTTY UNIT VOLTAGE DIAGRAM

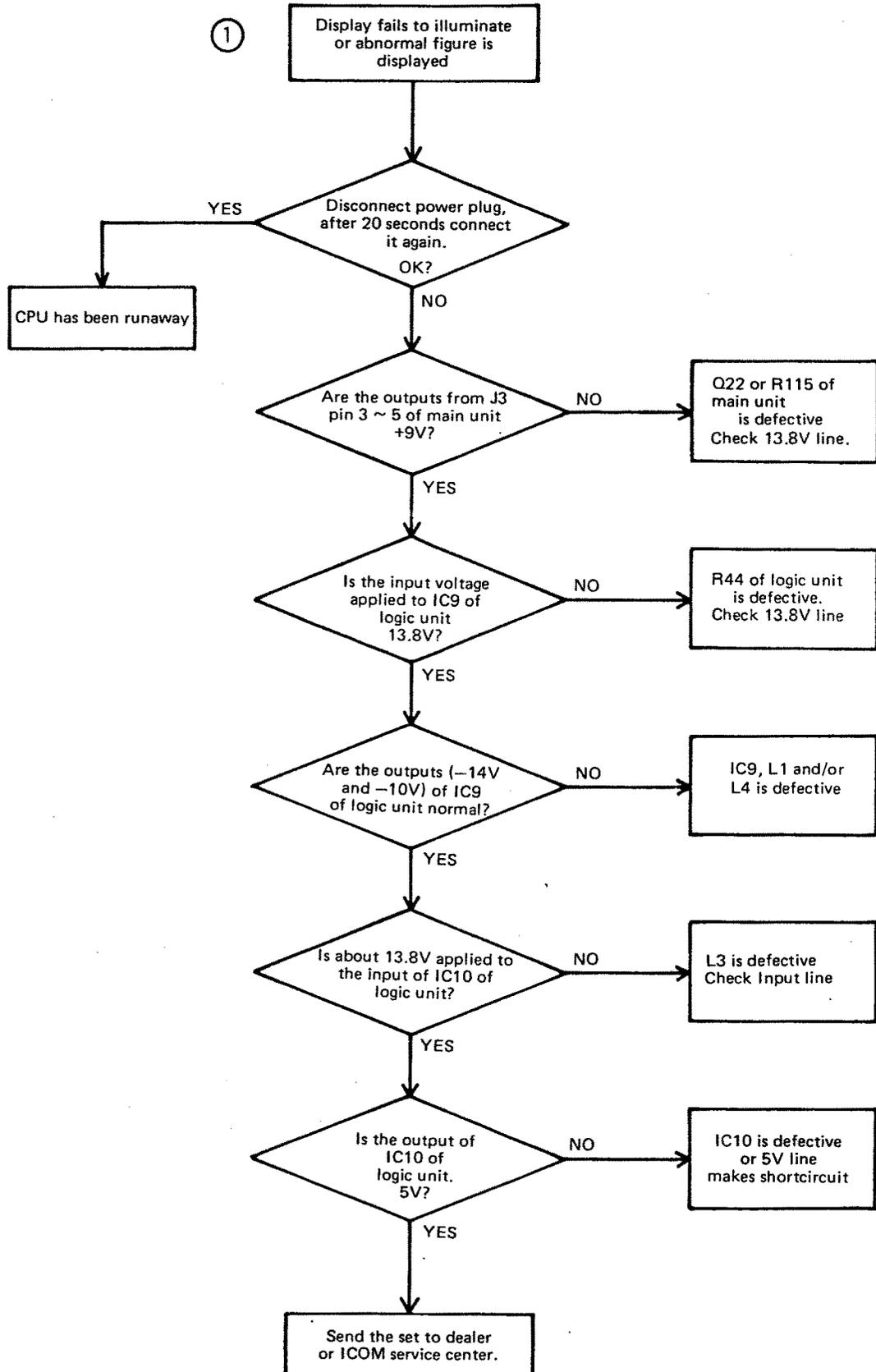


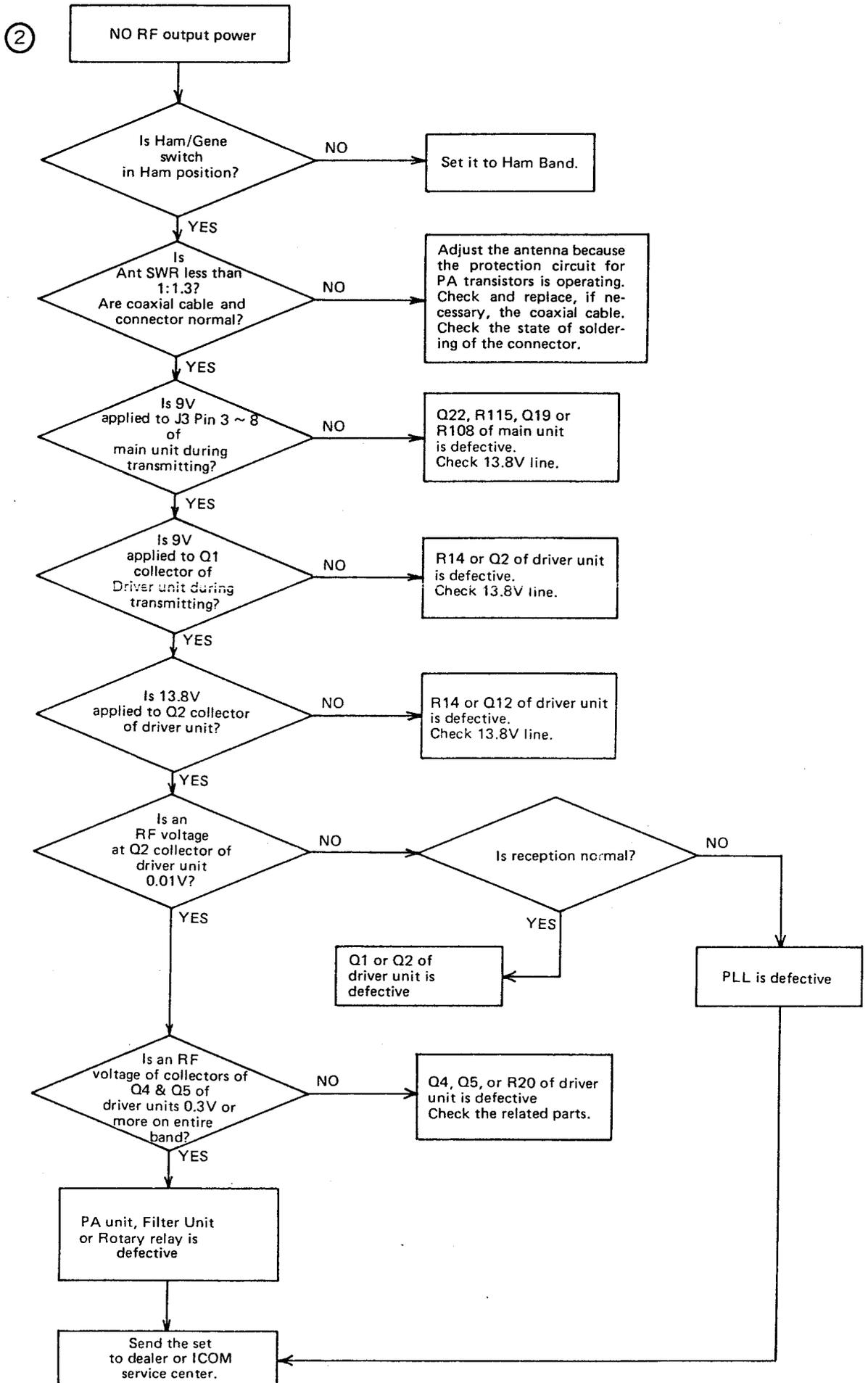
8-33 EF UNIT CIRCUIT

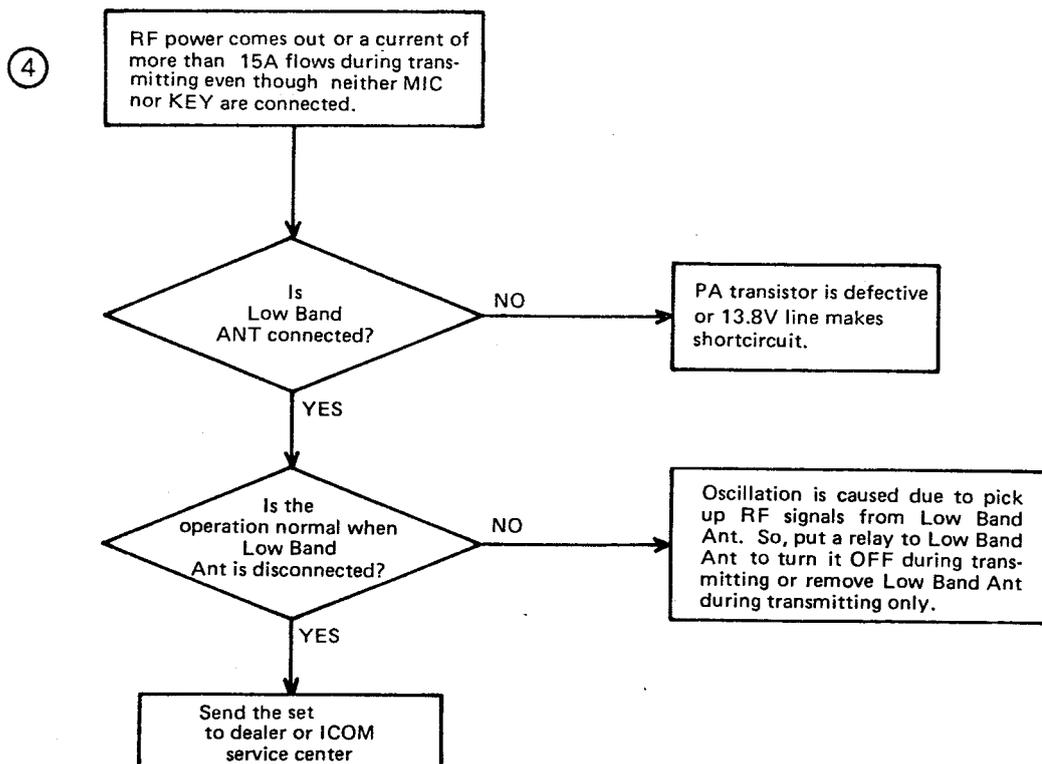
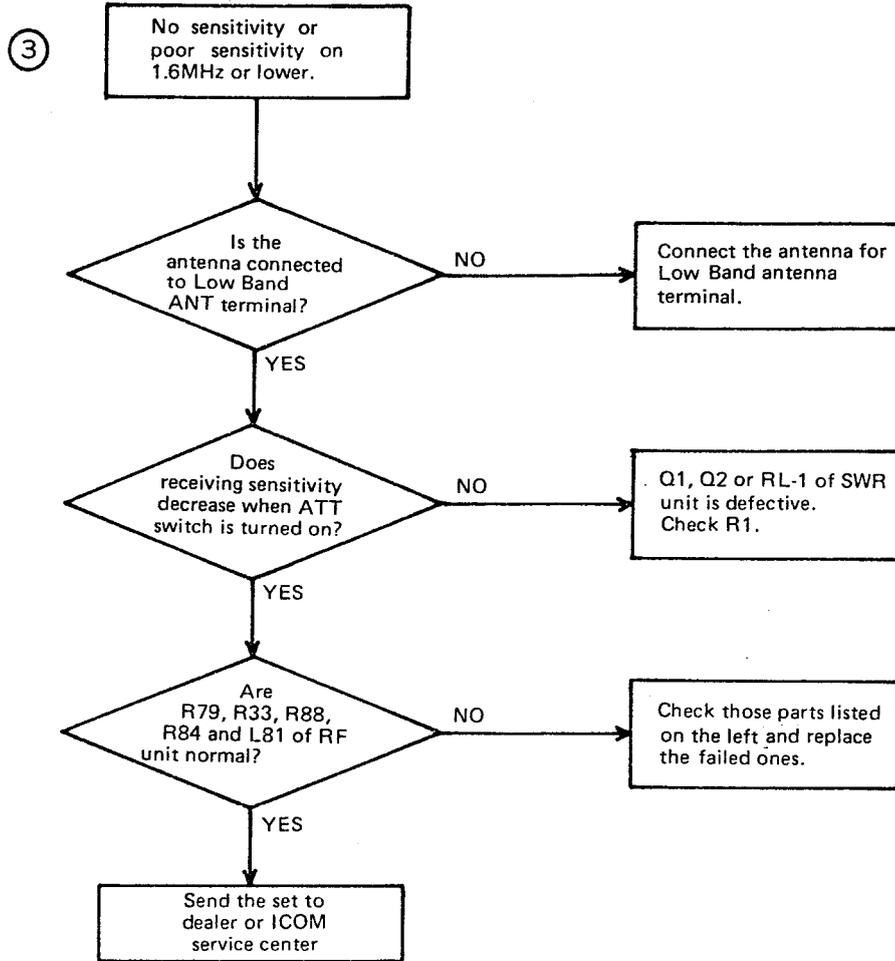




SECTION 9 TROUBLESHOOTING







[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 μ	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 μ	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 μ	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 μ	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 μ	16V
C70	Electroly	2.2 μ	50V
C71	Electroly	10 μ	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	μ PC1037H
IC2	IC	μ PC1037H
IC3	IC	μ PC1037H
IC4	IC	μ 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 μ	50V
C109	Mylar	0.01	50V
C110	Mylar	0.0047	50V
C111	Ceramic	0.0047	50V
C112	Electroly	100 μ	10V
C113	Ceramic	0.0047	50V
C114	Ceramic	100P	50V
C115	Mylar	0.01	50V
C116	Electroly	22 μ	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 μ	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	2D1	
	PC Board	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 μ	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 μ	16V
C13	Monolythic	0.68 μ	25V
C14	Barrier L.	0.047 μ	25V
C15	Electroly	10 μ	10V
C16	Ceramic	0.0047 μ	50V
C17	Ceramic	0.0047 μ	50V
C18	Ceramic	0.0047 μ	50V
C19	Ceramic	0.0047 μ	50V
C20	Ceramic	0.0047 μ	50V
C21	Ceramic	0.0047 μ	50V
C22	Ceramic	0.0047 μ	50V
C23	Ceramic	0.0047 μ	50V
C24	Ceramic	0.0047 μ	50V
C25	Ceramic	0.0047 μ	50V
C26	Ceramic	0.0047 μ	50V
C27	Ceramic	0.0047 μ	50V
C28	Ceramic	0.0047 μ	50V
C29	Ceramic	0.0047 μ	50V

[PA] UNIT

REF. NO.	DESCRIPTION	PART NO.	
C30	Ceramic	0.0047 μ	50V
C31	Ceramic	0.0047 μ	50V
C32	Ceramic	0.0047 μ	50V
C33	Ceramic	0.0047 μ	50V
C34	Ceramic	0.0047 μ	50V
C35	Ceramic	0.0047 μ	50V
C36	Ceramic	470P SL	50V
C37	Ceramic	0.0047 μ	50V
C38	Ceramic	0.0047 μ	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 μ	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 μ	16V
C21	Mylar	0.1	50V
C22	Electroly	33 μ	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	μ PC1037H
IC6	IC	TC9123BP
IC7	IC	TC9123BP
IC8	IC	NJM4558D
IC9	IC	μ PB551
IC13	IC	μ A78L82AWC
IC14	IC	μ 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	220 μ	10V
C15	Barrier L.	0.1	16V
C16	Electroly	1 μ BP	50V
C17	Electroly	220 μ	10V
C18	Electroly	1 μ 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	10 μ	16V
C50	Barrier L.	0.1	12V
C51	Ceramic	47P	50V
C52	Ceramic	100P	50V
C53	Electroly	4.7 μ	25V
C54	Electroly	4.7 μ	25V
C55	Electroly	100 μ	10V
C56	Barrier L.	0.1	12V
C57	Barrier L.	0.1	12V
C58	Electroly	47 μ	10V
C59	Ceramic	0.0047	50V
C60	Ceramic	0.0047	50V
C61	Ceramic	470P	50V
C62	Ceramic	2P	50V
C63	Trimmer	CV05A0601	
C64	Electroly	100 μ	10V
C65	Electroly	47 μ	10V
C66	Electroly	47 μ	50V
C67	Ceramic	0.001	50V
C68	Barrier L.	0.1	12V
*C70	Electroly	100 μ	10V
C71	Electroly	1 μ BP	50V
C72	Barrier L.	0.1	12V

[PLL] UNIT

REF. NO.	DESCRIPTION	PART NO.	
C74	Electroly	220 μ	10V
C75	Cramic	0.0047	50V
C76	Ceramic	0.0047	50V
C77	Ceramic	0.0047	50V
C78	Ceramic	0.0047	50V
C79	Electroly	47 μ	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 μ	10V
C90	Trimmer	CV05D2001	
C92	Dipmica	33P	50V
C94	Ceramic	0.0047	50V
C95	Electroly	47 μ	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 μ	10V
C105	Electroiy	0.47 μ	50V
C106	Electroly	100 μ	10V
C107	Barrier L.	0.1	12V
C108	Barrier L.	0.047	25V
C109	Ceramic	0.0047	50V
C110	Electroly	10 μ	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 μ	16V
C122	Electroly	10 μ	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 μ	50V
C138	Ceramic	470P	50V
C143	Ceramic	330P	50V
C149	Electroly	47 μ	10V
C150	Electroly	470 μ	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	μ PD650-70
IC2	IC	4066/4016
IC3	IC	4028
IC4	IC	BA618
IC5	IC	BA618
IC6	Diode Array	DAN401
IC7	IC	BA618
IC8	IC	μ 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	47 μ	10V
C2	Electroly	1	50V
C3	Ceramic	100P	50V
C4	Ceramic	100P	50V
C6	Electroly	2.2 μ MS	35V
C7	Ceramic	0.001	50V
C8	Barrier L.	0.1	12V
C9	Electroly	47	16V RE
C10	Electroly	47 μ	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	10 μ	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	10 μ	16V
C31	Electroly	2.2 μ	50V
C32	Electroly	2.2 μ	50V
C33	Barrier L.	0.1	12V
C34	Ceramic	0.001	50V
C36	Electroly	22 μ	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	10 μ	10V
C44	Electroly	0.47	50V
C45	Electroly	100 μ	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 μ	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 μ	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	

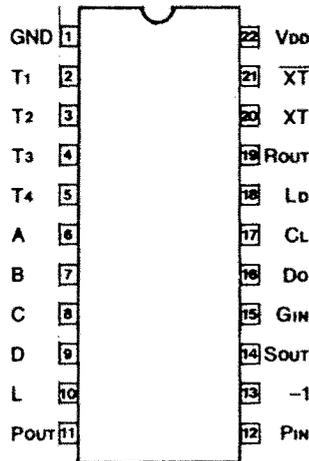
[RTTY] UNIT

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	

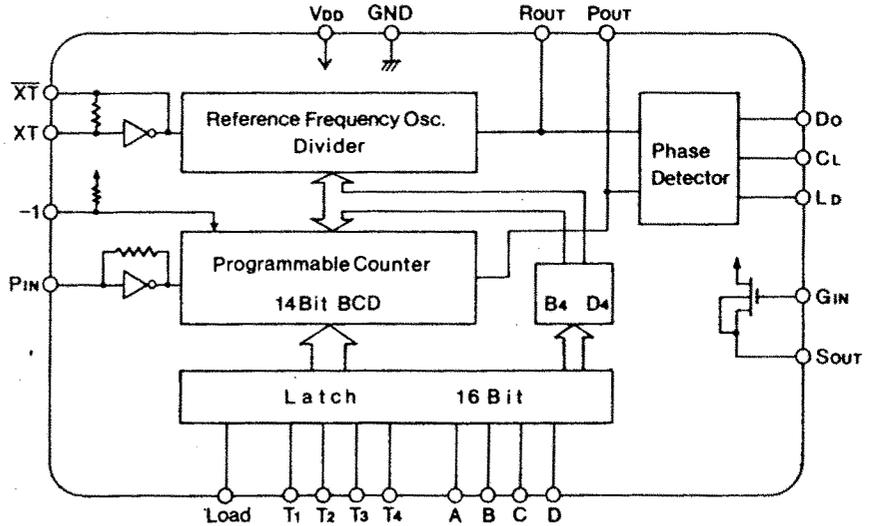
SECTION 11 IC SPECIFICATIONS

TC-9123P (FM/AM SYNTHESIZER TUNER PLL)

PIN CONNECTION



BLOCK DIAGRAM

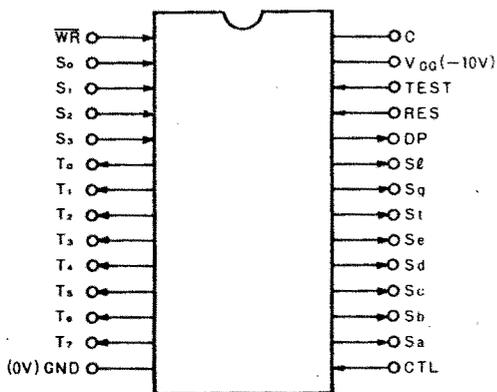


MAXIMUM RATING

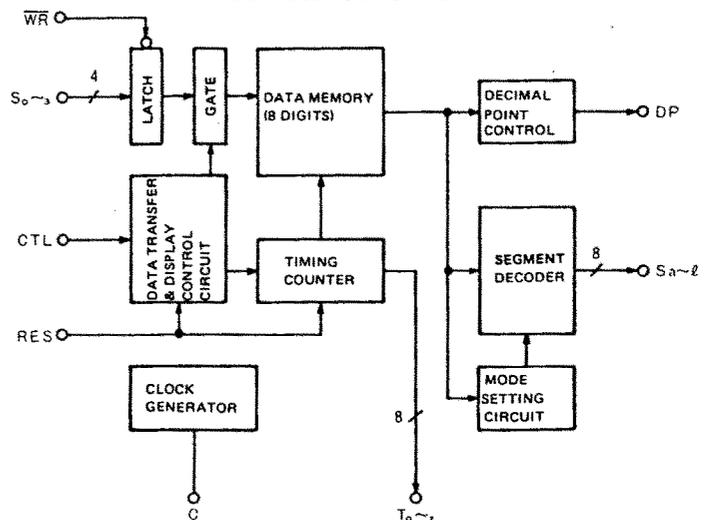
ITEM	SYMBOL	RATING	UNIT
SUPPLY VOLTAGE	VDD	-0.3 ~ 9.0	V
INPUT VOLTAGE	VIN	-0.3 ~ VDD + 0.3	V
OPERATING TEMPERATURE	TOPR	-30 ~ +70	°C
STORAGE TEMPERATURE	TSTG	-55 ~ +125	°C

μPD549C (PROGRAMMABLE DISPLAY CONTROLLER)

PIN CONNECTION



BLOCK DIAGRAM

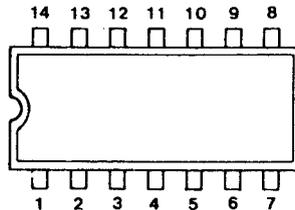


MAXIMUM RATING

ITEM	SYMBOL	RATING	UNIT
SUPPLY VOLTAGE	VGG	-15 ~ +0.3	V
INPUT VOLTAGE	V1	-20 ~ +0.3	V
OUTPUT VOLTAGE	V0	-42 ~ +0.3	V
OPERATING TEMPERATURE	TOPT	-10 ~ +70	°C
STORAGE TEMPERATURE	TSTG	-40 ~ +125	°C

- 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)

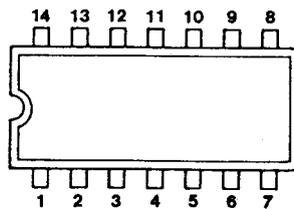
PIN CONNECTION



MAXIMUM RATING

ITEM	SYMBOL	RATING	UNIT
SUPPLY VOLTAGE	VDD	VSS -0.5 ~ VSS +20	V
INPUT VOLTAGE	VIN	VSS -0.5 ~ VDD +0.5	V
OUTPUT VOLTAGE	VOUT	VSS -0.5 ~ VDD +0.5	V
INPUT CURRENT	I IN	±10	mA
POWER DISSIPATION	P D	300	mW
STORAGE TEMPERATURE	TSTG	-65 ~ 150	°C
LEAD TEMPERATURE · TIME	TSOL	260°C · 10Sec.	

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

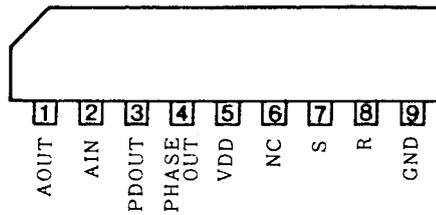


MAXIMUM RATING

ITEM	SYMBOL	RATING	UNIT
SUPPLY VOLTAGE	VDD	VSS -0.5 ~ VSS +20	V
CONTROL INPUT VOLTAGE	VC IN	VSS -0.5 ~ VDD +0.5	V
SWITCH INPUT/OUTPUT VOLTAGE	V I/O	VSS -0.5 ~ VDD +0.5	V
CONTROL INPUT CURRENT	I C IN	±10	mA
POWER DISSIPATION	PD	300	mW
STORAGE TEMPERATURE	TSTG	-65 ~ 150	°C
LEAD TEMPERATURE · TIME	TSOL	260°C · 10 Sec.	

TC5081 (PHASE COMPARATOR)

PIN CONNECTION

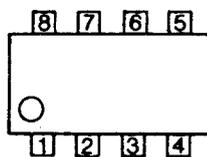


MAXIMUM RATING

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

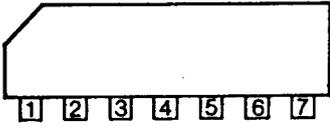
ITEM	SYMBOL	RATING	UNIT
SUPPLY VOLTAGE	VCC	18	V
CONTROL INPUT VOLTAGE	VC	0 ~ 6	V
POWER DISSIPATION	PD	450	mW
OPERATING TEMPERATURE	TOPR	-20 ~ +75	°C
STORAGE TEMPERATURE	TSTG	-55 ~ +150	°C

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

μ PC1037H (DOUBLE BALANCED MODULATOR CIRCUIT)

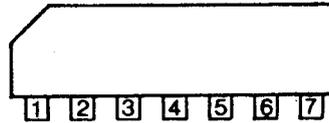
PIN CONNECTION	PIN NUMBER	CONNECTION
	1	V _{CC}
	2	Out Put1
	3	Out Put2
	4	G _{ND}
	5	Signal Input
	6	Bypass
	7	Carrier Input

MAXIMUM RATING

ITEM	SYMBOL	RATING	UNIT
SUPPLY VOLTAGE	V _{CC}	9	V
PACKAGE POWER DISSIPATION	P _D	270	mW
OPERATING TEMPERATURE	T _{OPT}	-30 ~ +65	°C
STORAGE TEMPERATURE	T _{STG}	-40 ~ +125	°C

μ PC577H (FM-IF AMPLIFIER)

PIN CONNECTION

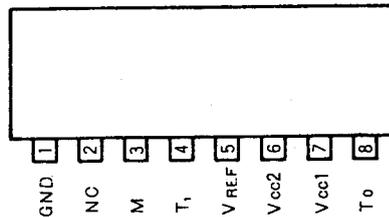


MAXIMUM RATING

ITEM	SYMBOL	RATING	UNIT
SUPPLY VOLTAGE	V _{CC}	15	V
INPUT TERMINAL VOLTAGE	V _{IN}	±3.0	V
POWER DISSIPATION	P _D	300	mW
OPERATING TEMPERATURE	T _{OPT}	-20 ~ +75	°C
STORAGE TEMPERATURE	T _{STG}	-40 ~ +125	°C

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

PIN CONNECTION

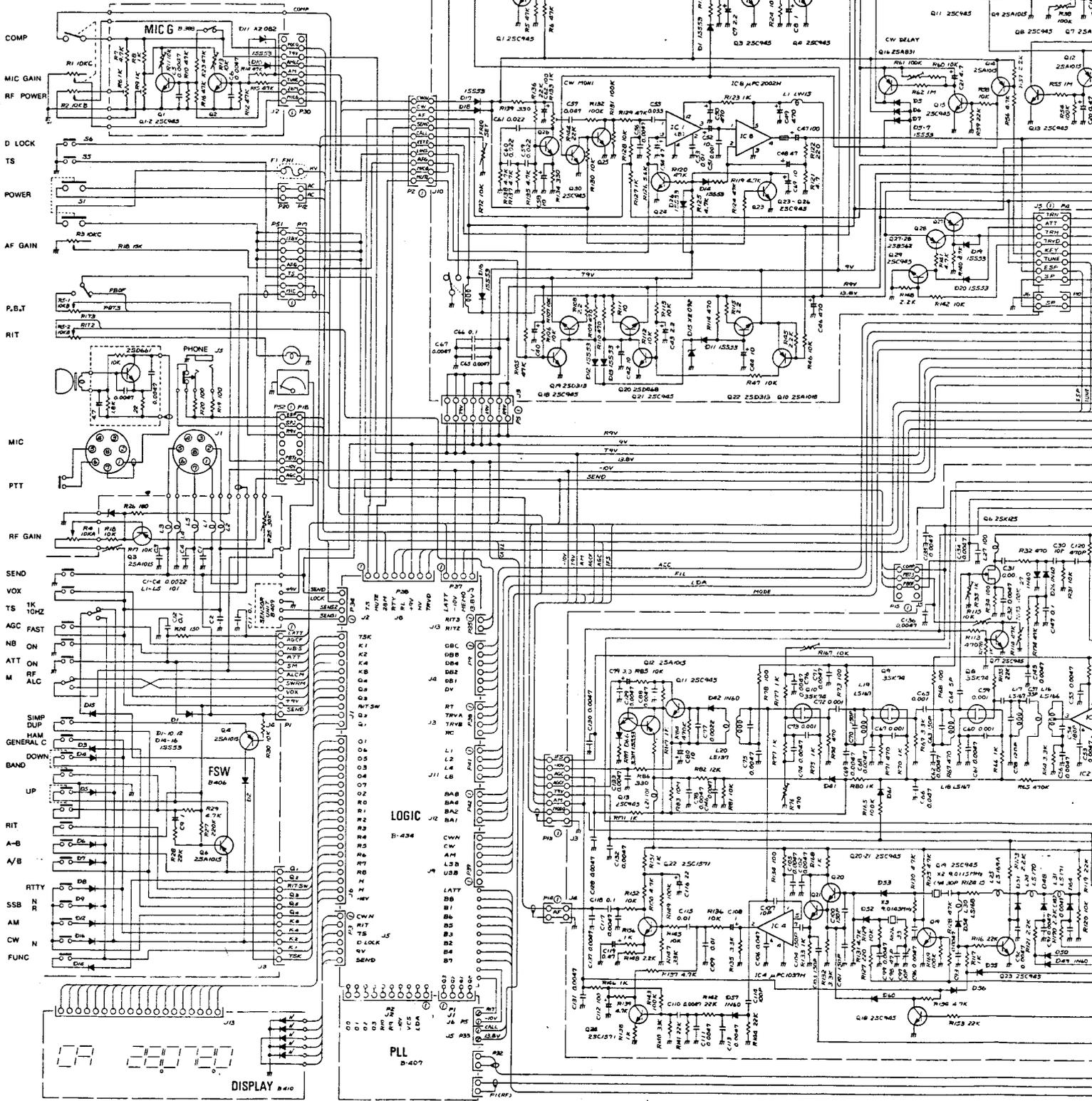


MAXIMUM RATING

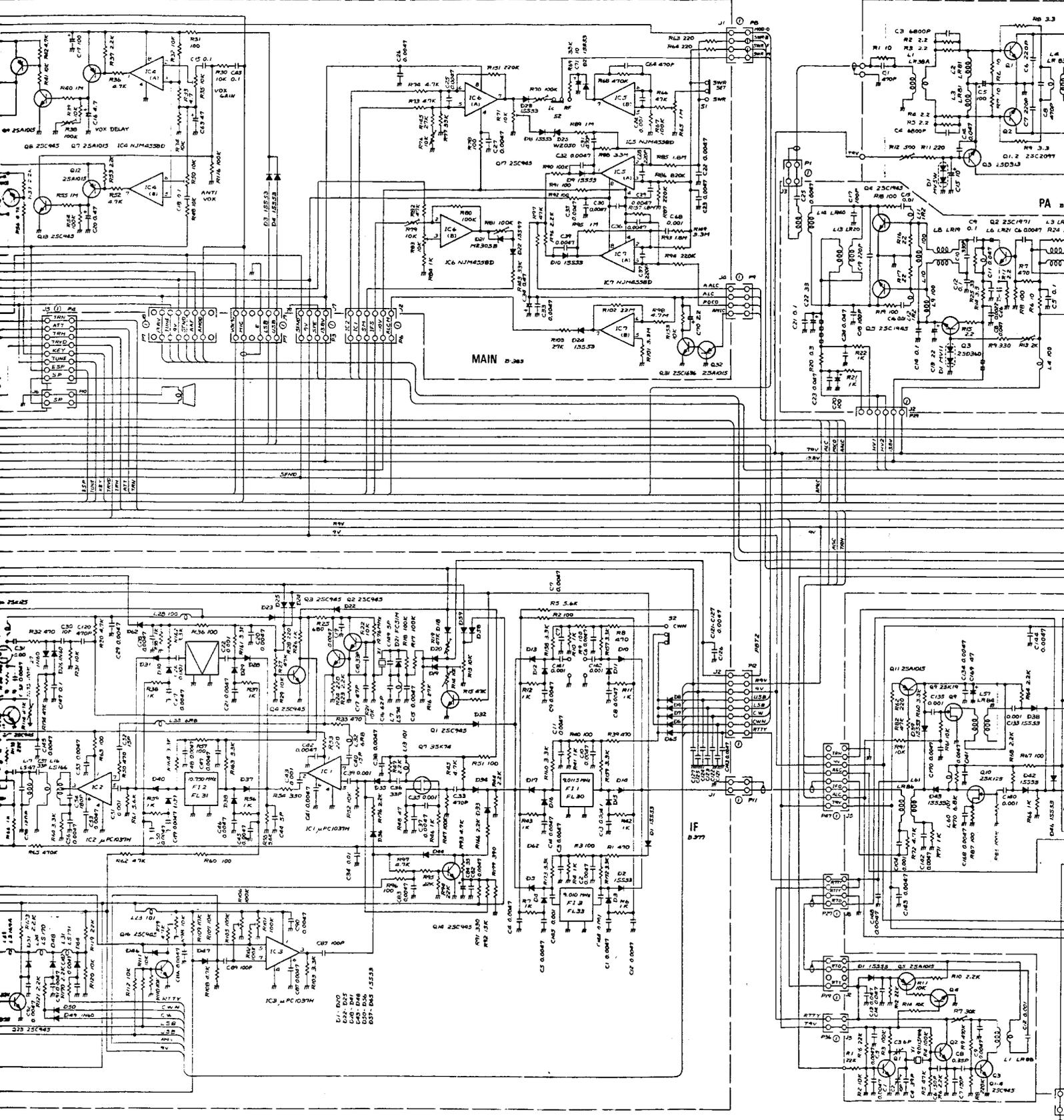
ITEM	SYMBOL	RATING	UNIT
SUPPLY VOLTAGE	V _{CC}	9	V
INPUT VOLTAGE	V _I	1.5	V
OPERATING TEMPERATURE	T _{OPR}	-10 ~ +75	°C
STORAGE TEMPERATURE	T _{STG}	-55 ~ +125	°C

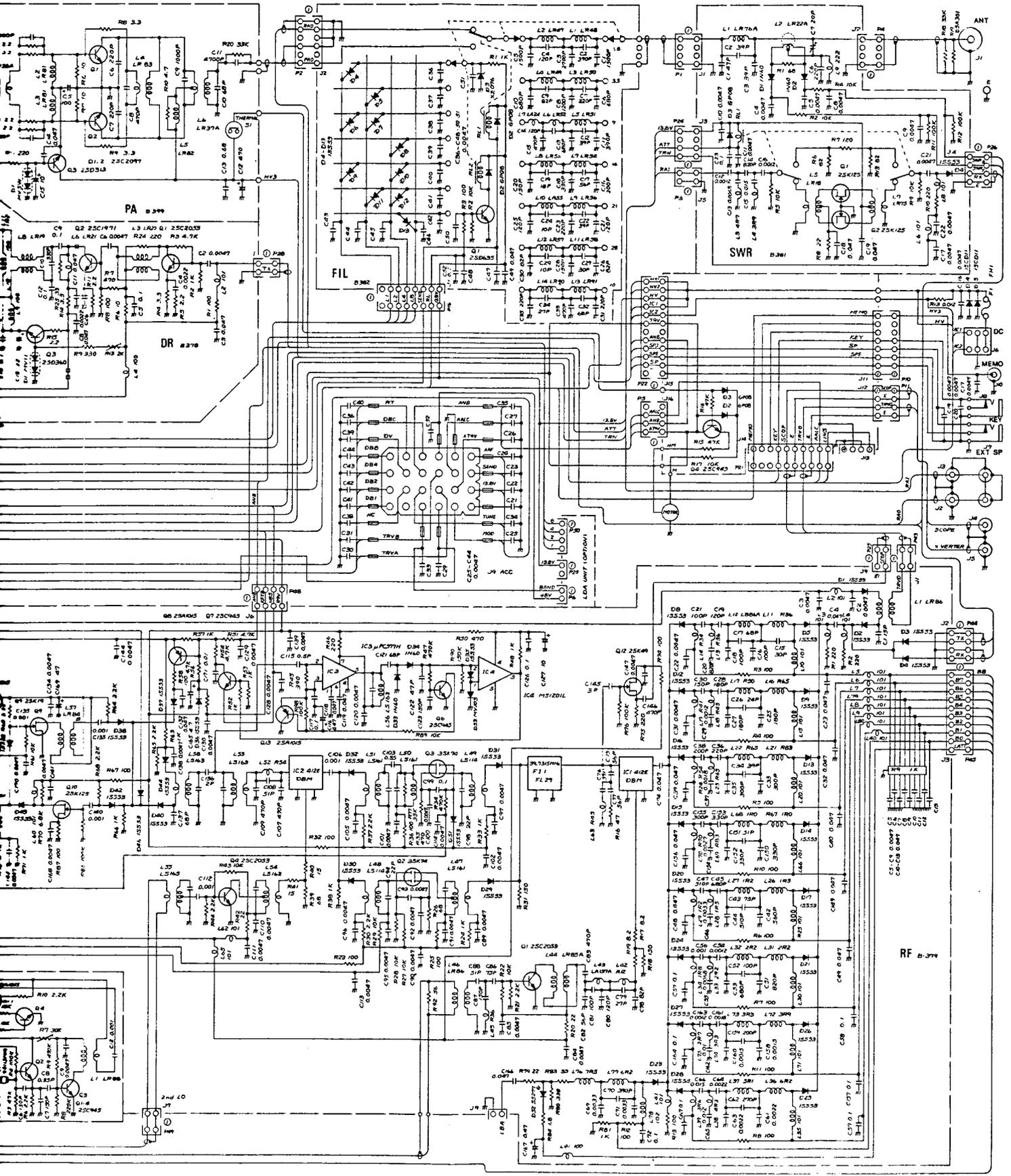
IC-720A

SCHEMATIC DIAGRAM



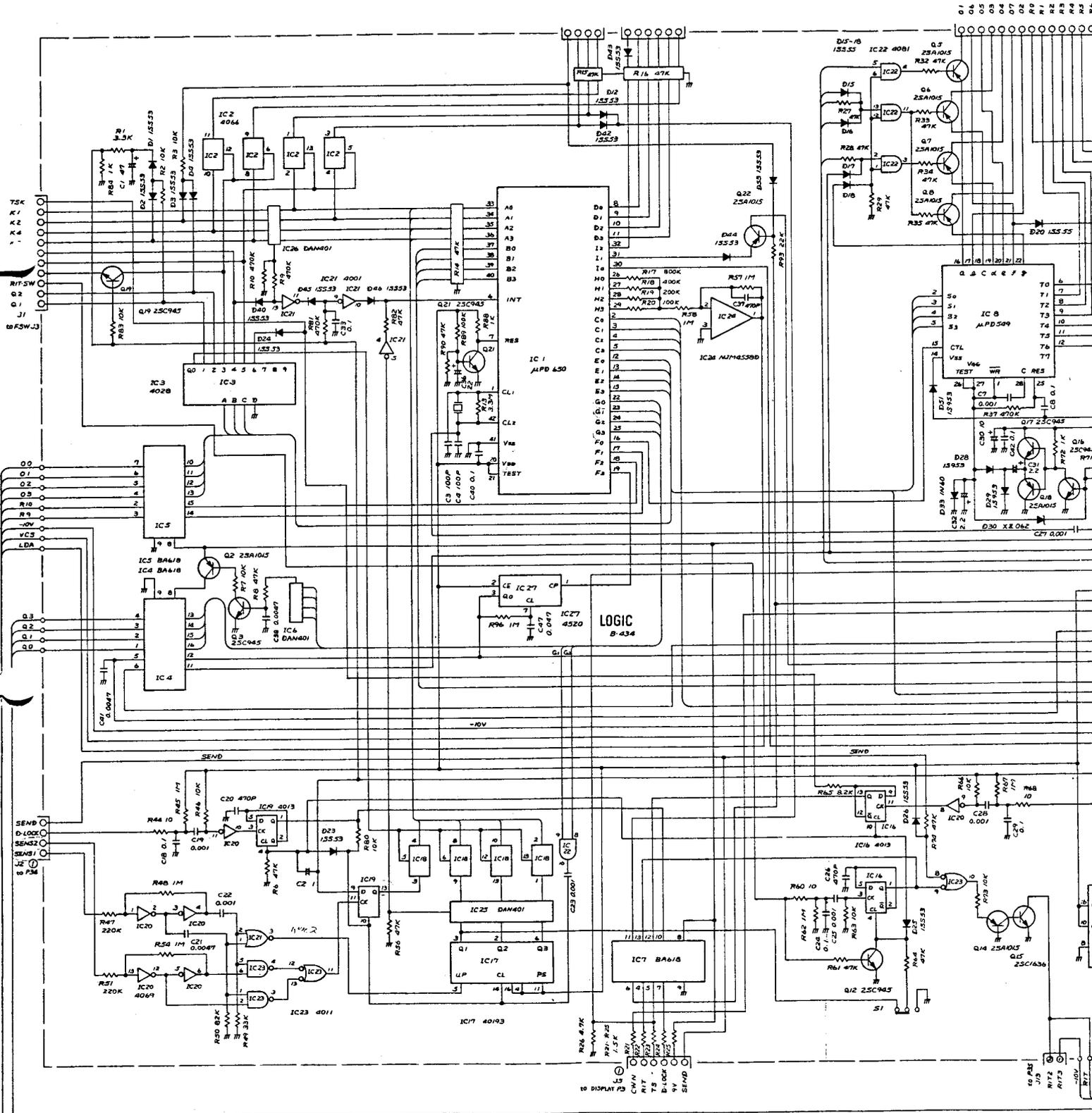
DISPLAY B-410

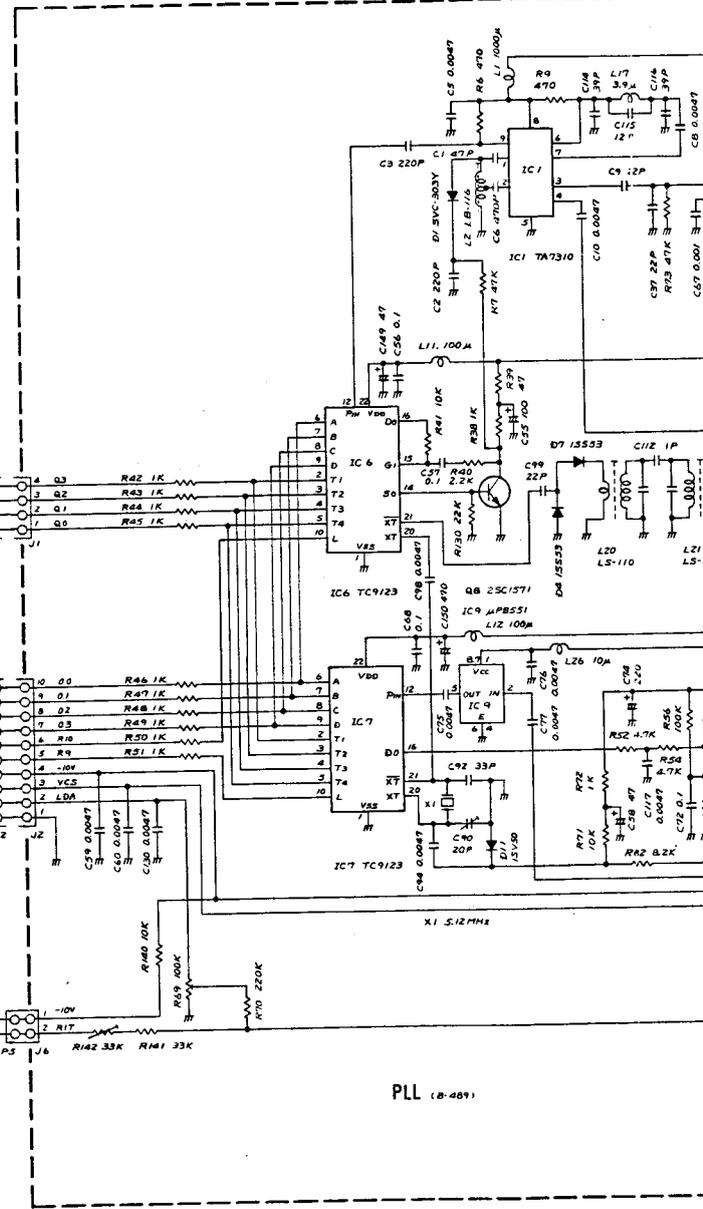
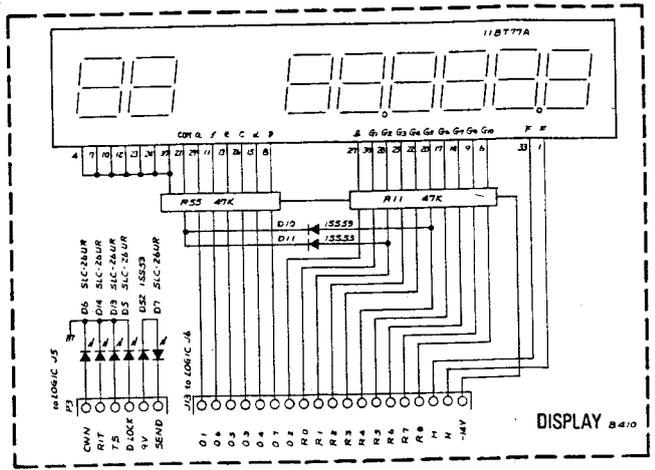
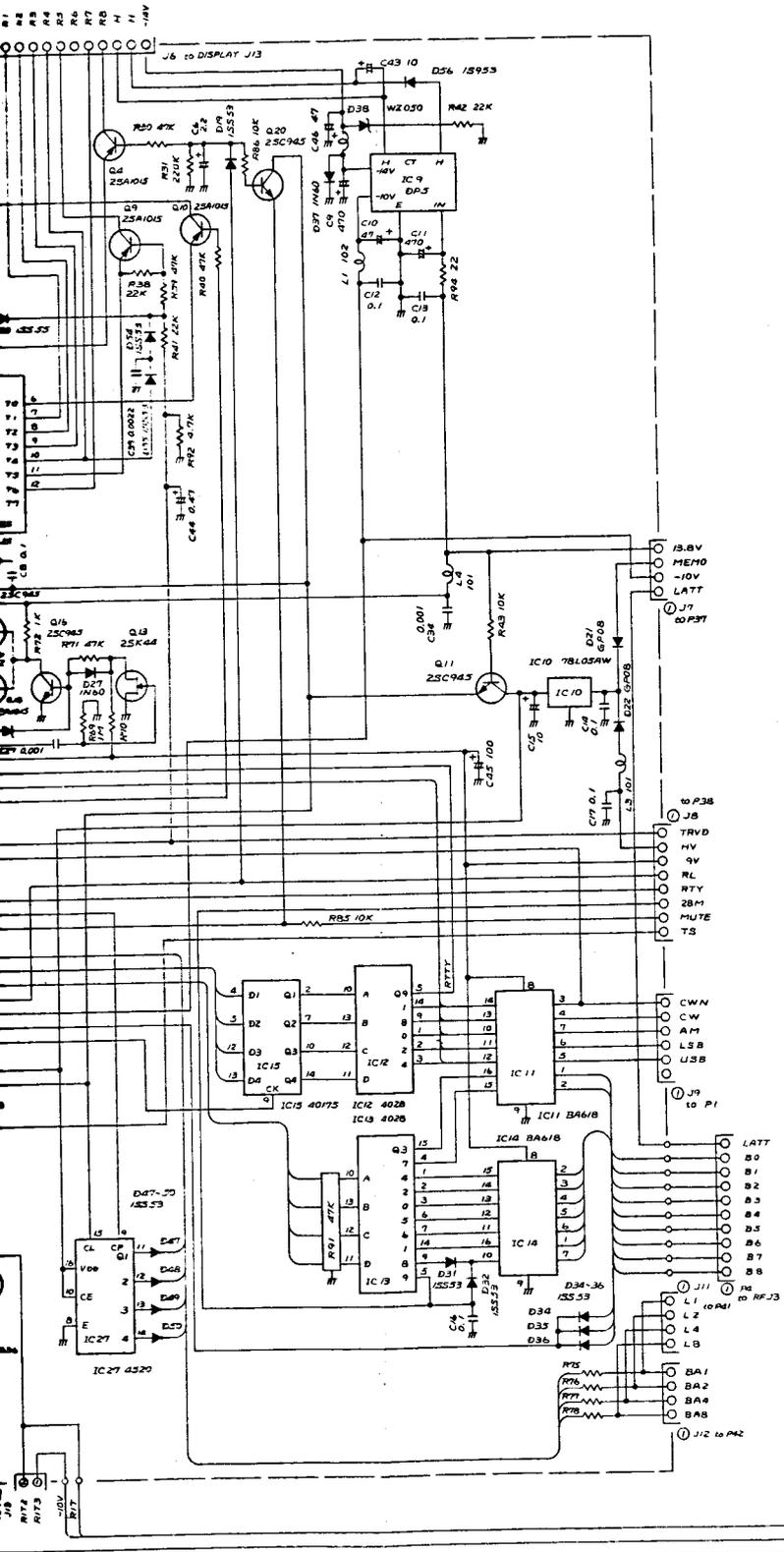


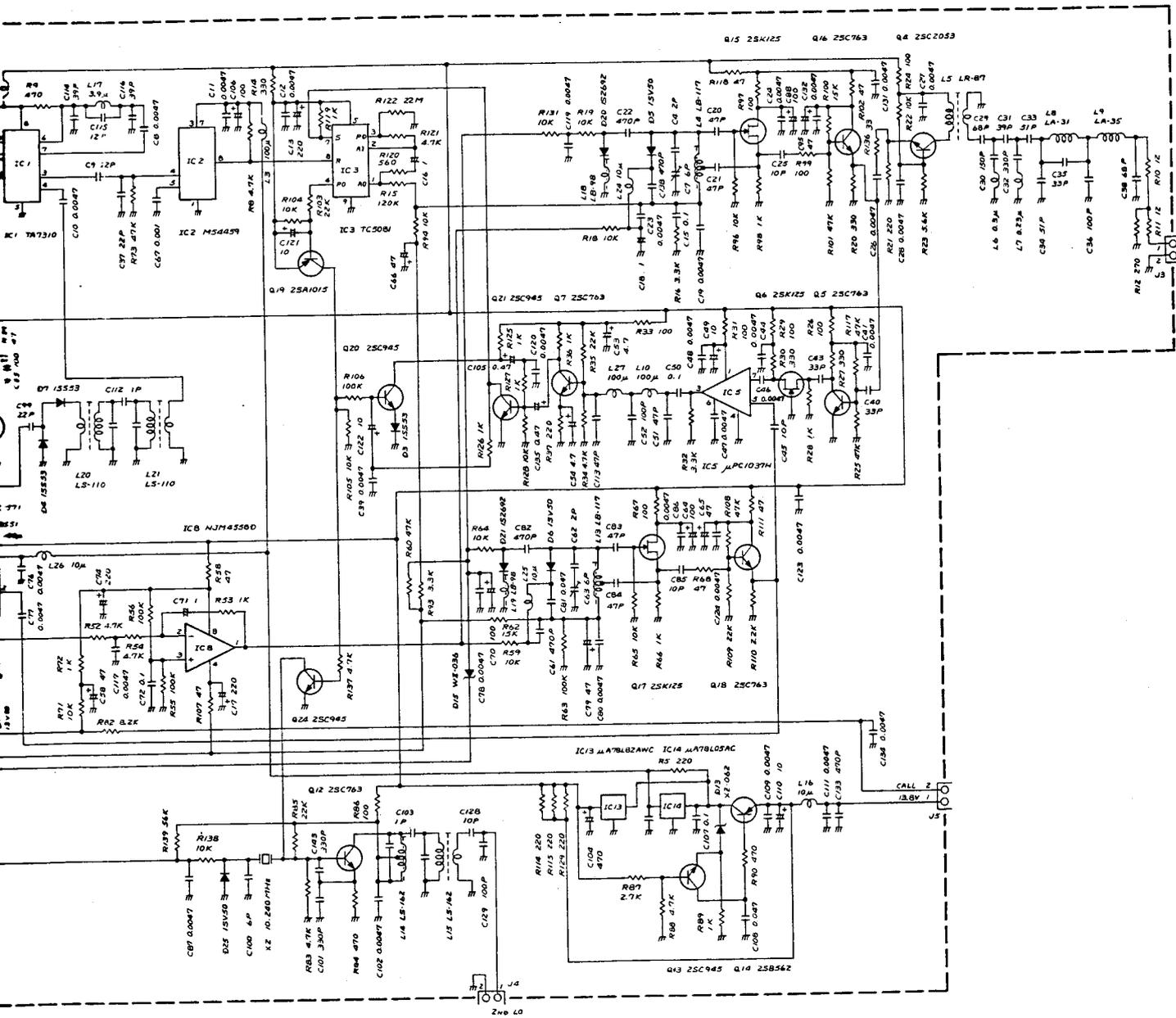
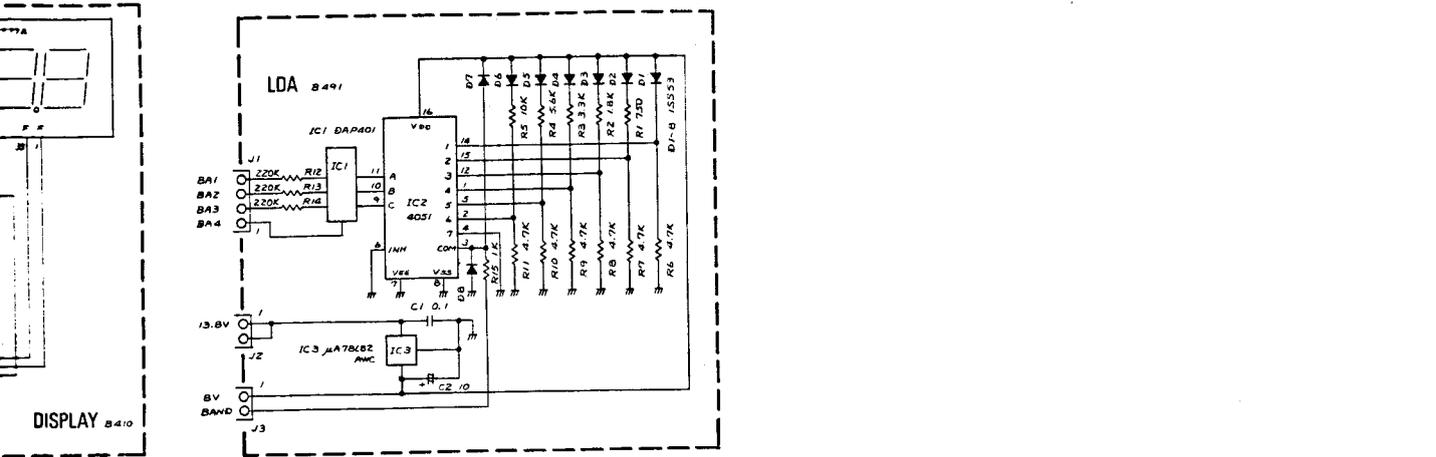


ICOM INCORPORATED

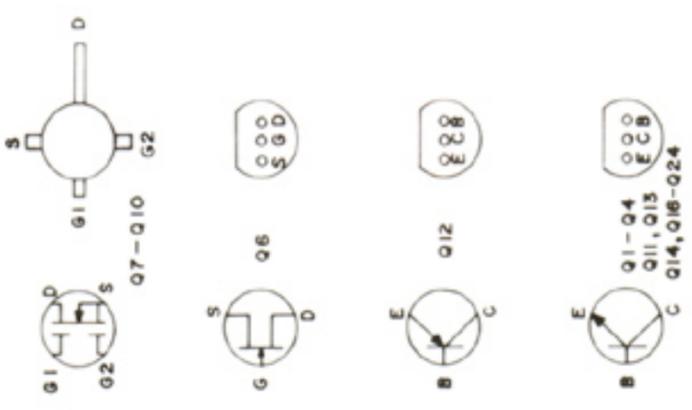
Some components subject to change for an improvement without notice.







A | B | C | D | E | F | G | H



IF UNIT

4 | 3 | 2 | 1

UNIT LAYOUT

EF UNIT
(MIC GAIN BOARD)

EF UNIT
(DISPLAY BOARD)

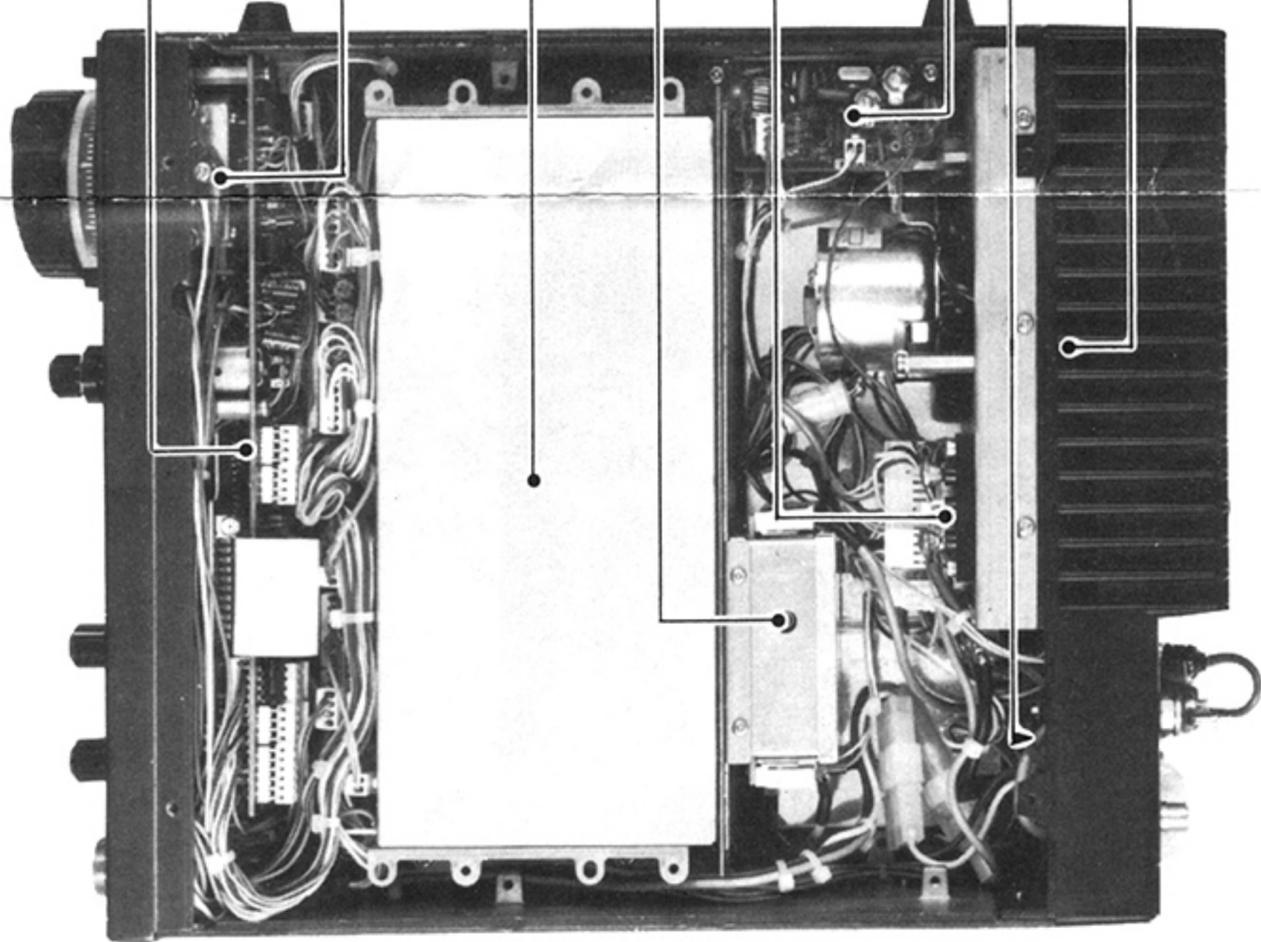
PLL UNIT

MAIN UNIT

DRIVER UNIT

LDA UNIT

FILTER UNIT



LOGIC UNIT

EF UNIT
(SENSOR BOARD)

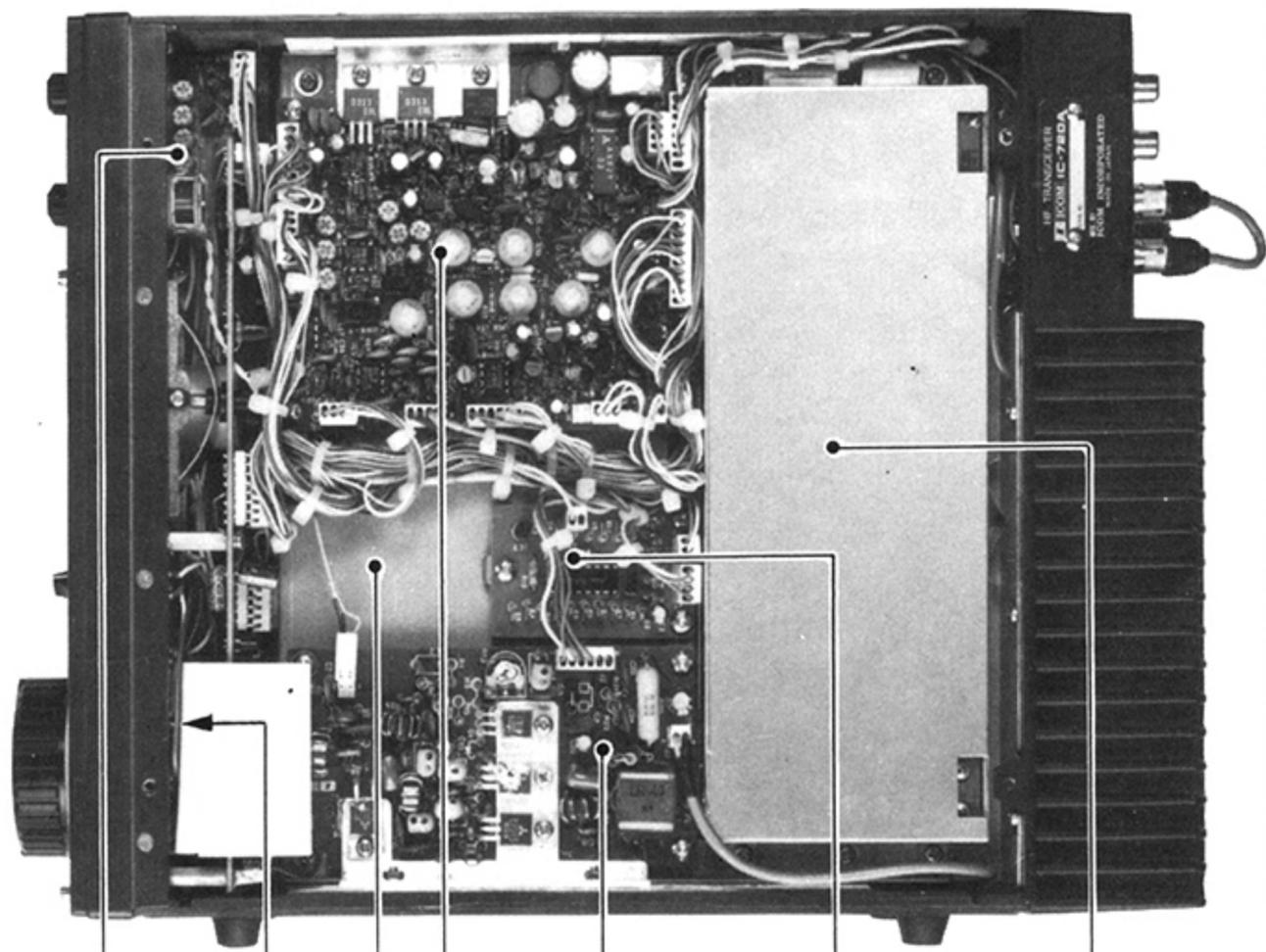
IF UNIT

SWR UNIT

PA CONNECTOR UNIT

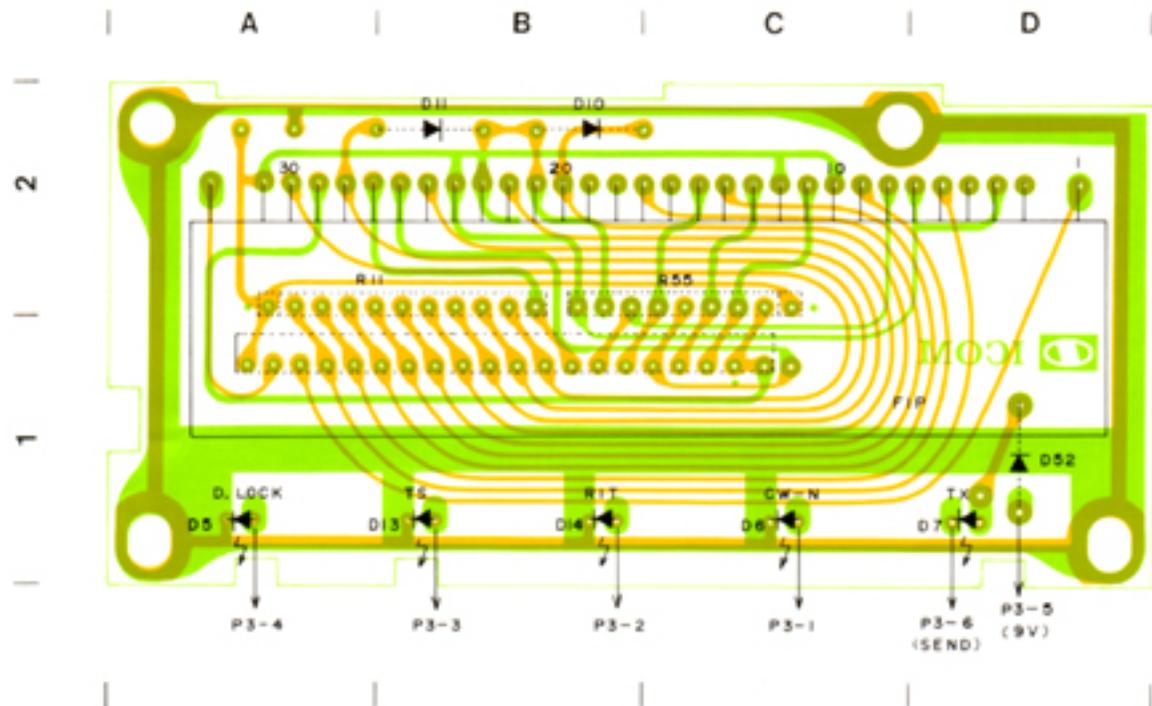
RTTY UNIT
ACC UNIT

POWER AMPLIFIER UNIT

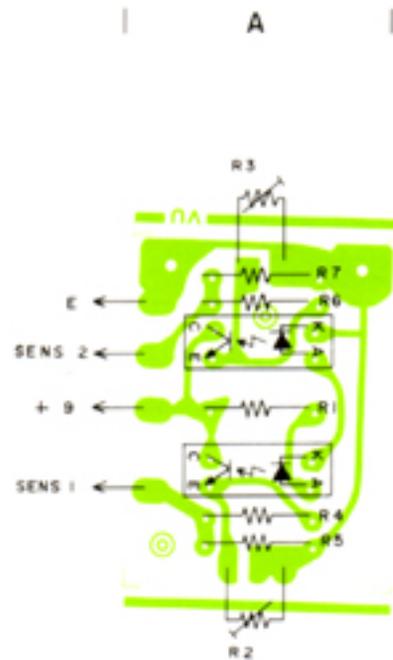


EF UNIT

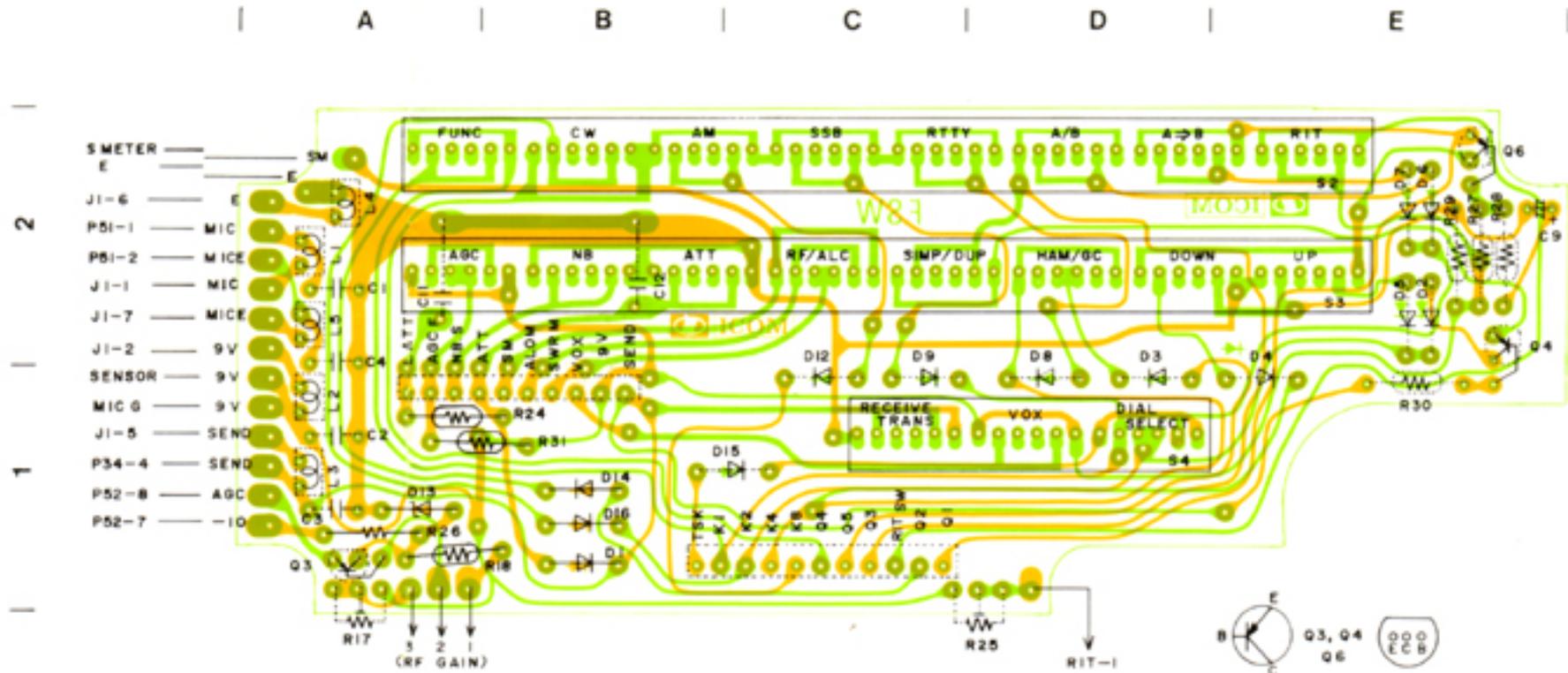
■ DISPLAY BOARD

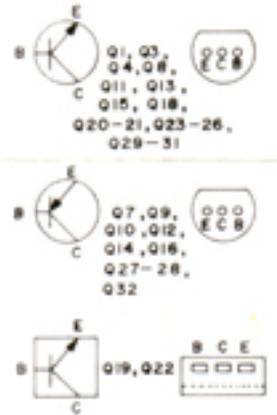
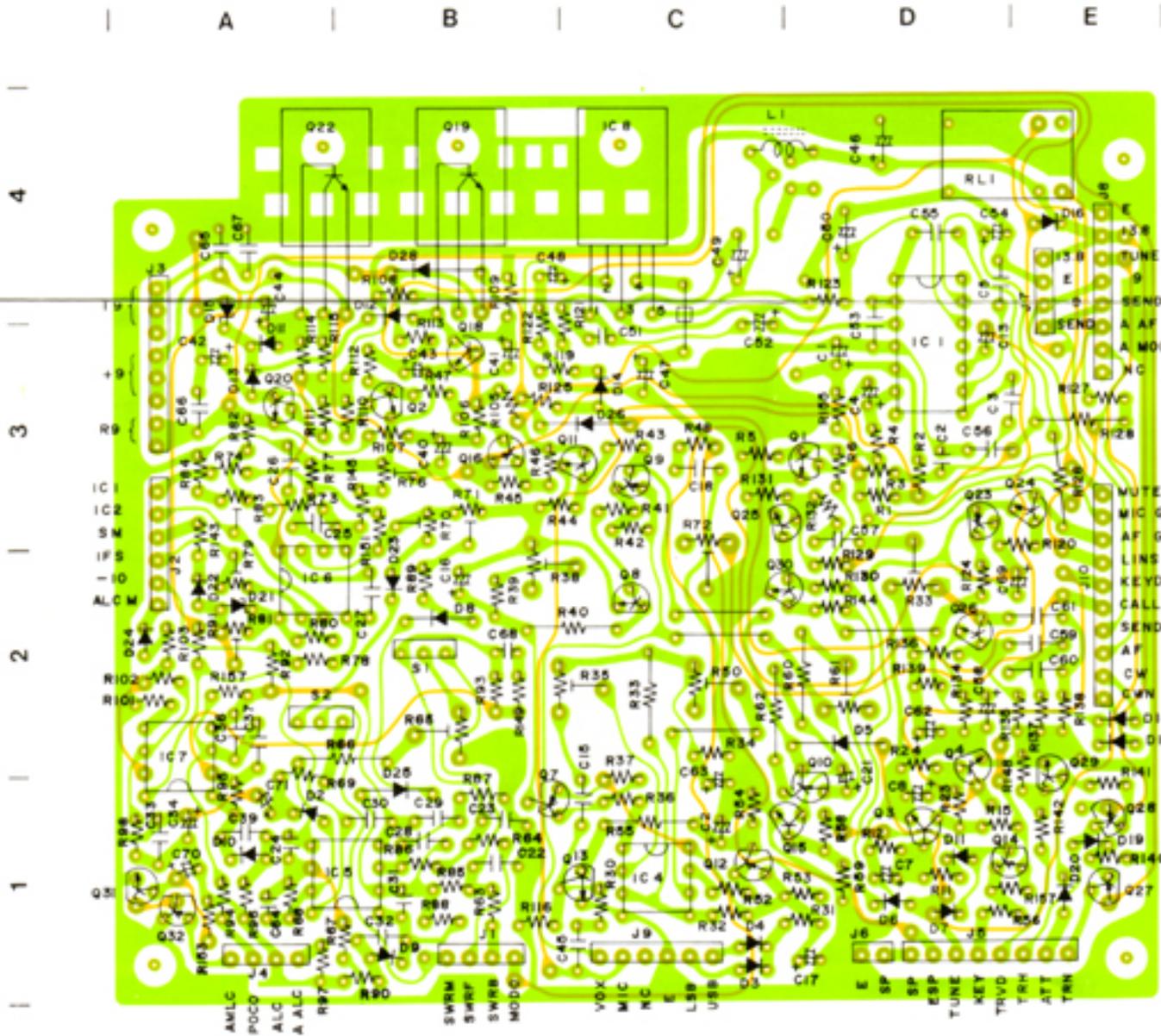


■ SENSOR BOARD

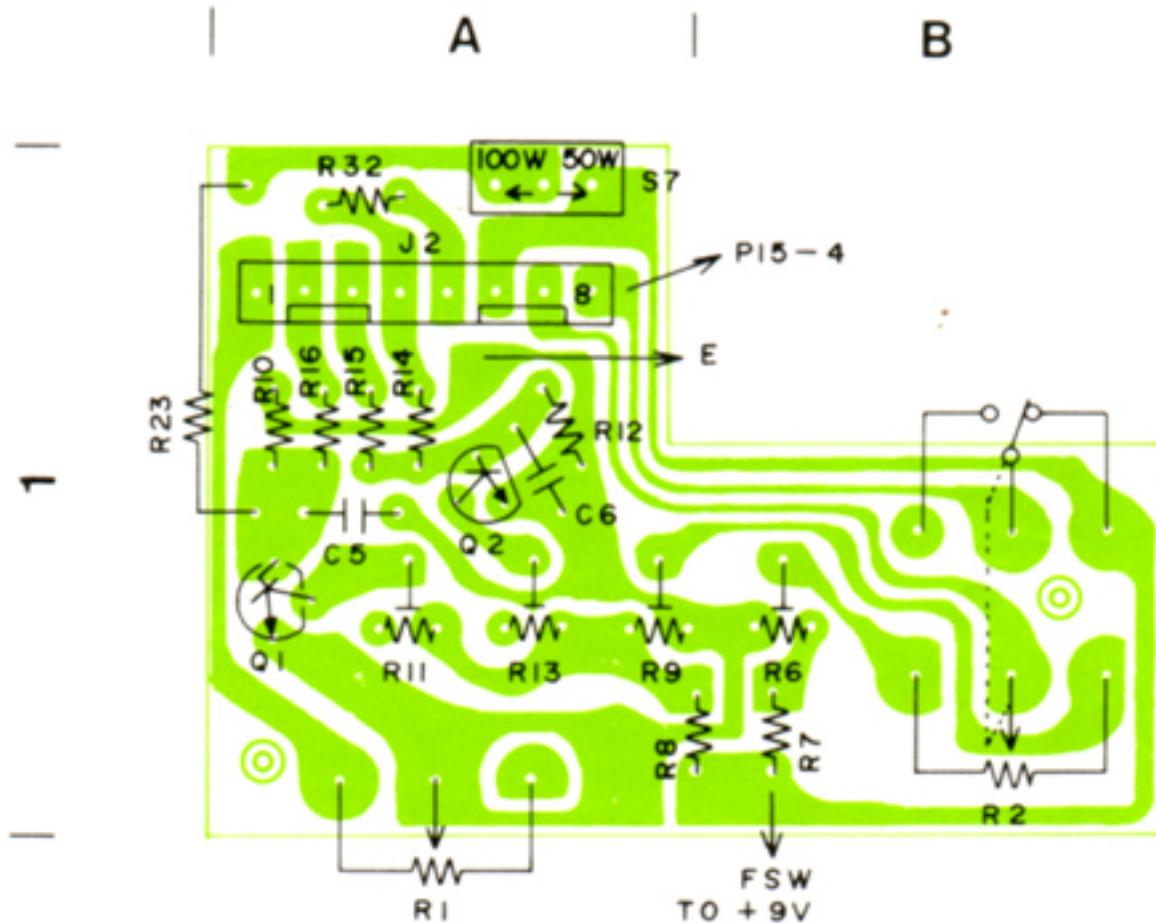


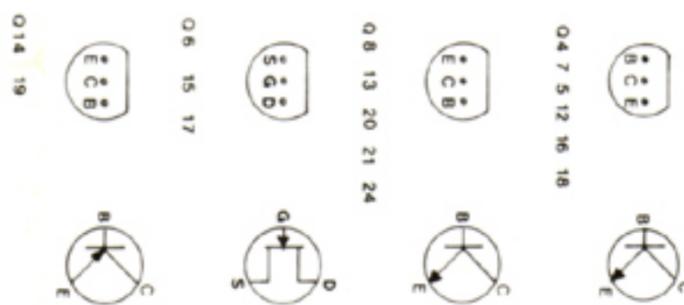
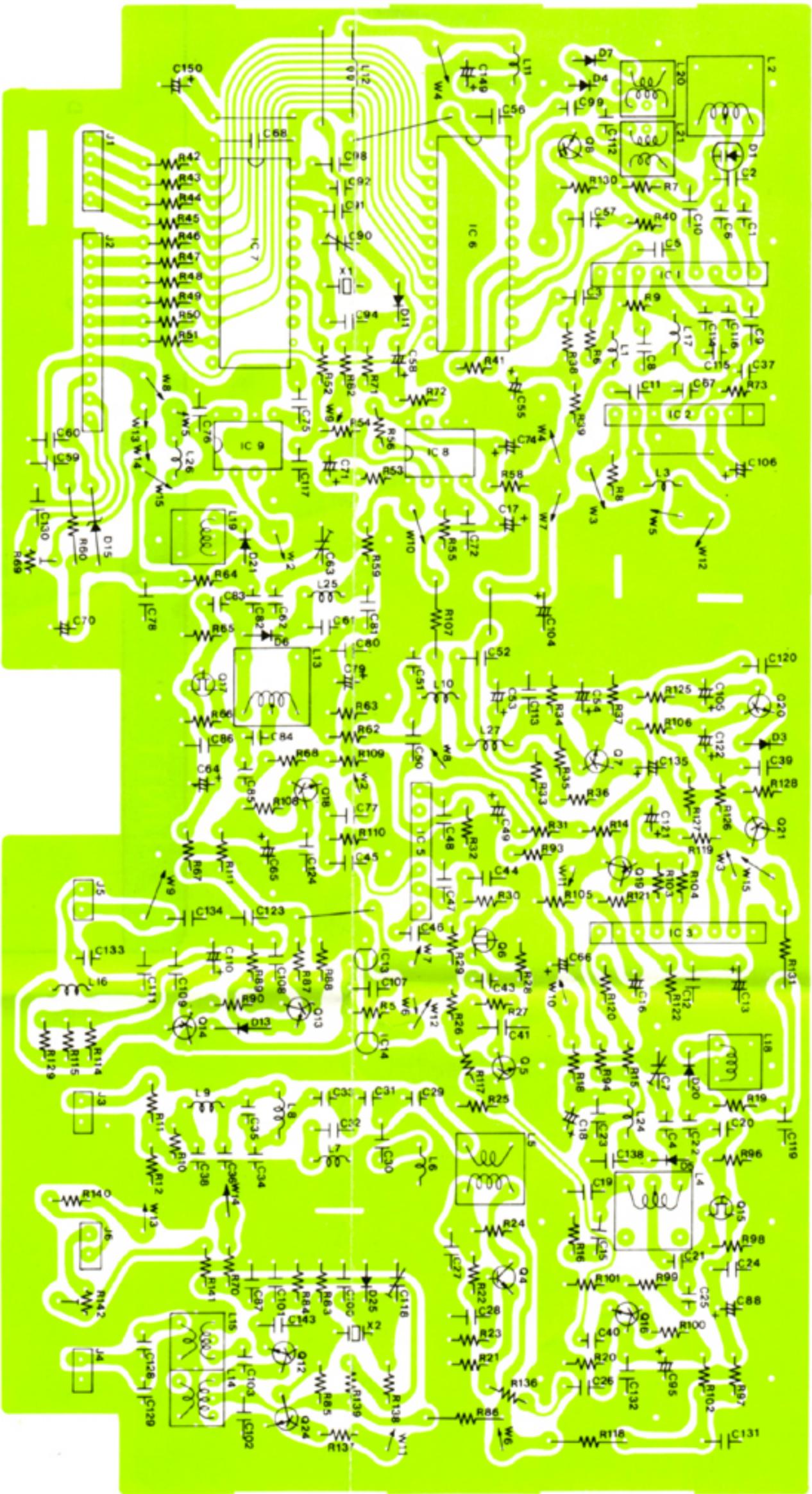
FRONT SWITCH BOARD

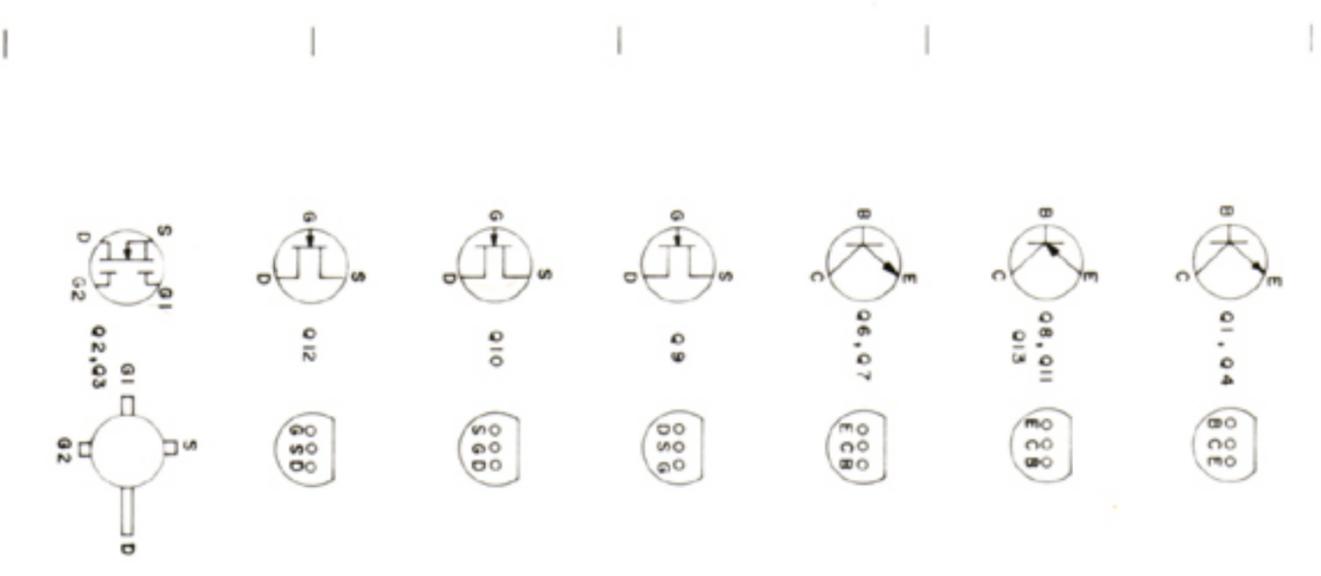
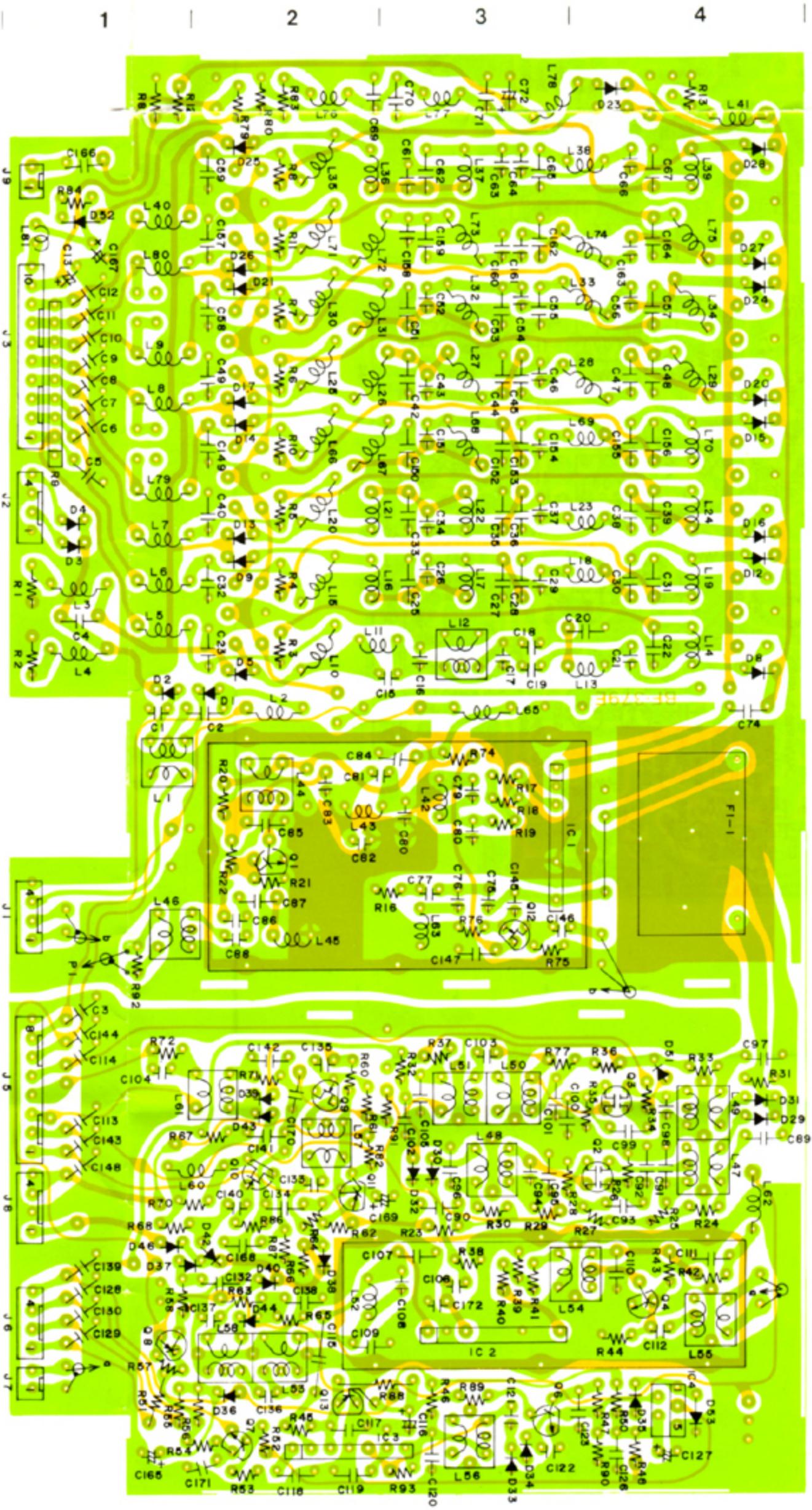




■ MIC GAIN BOARD



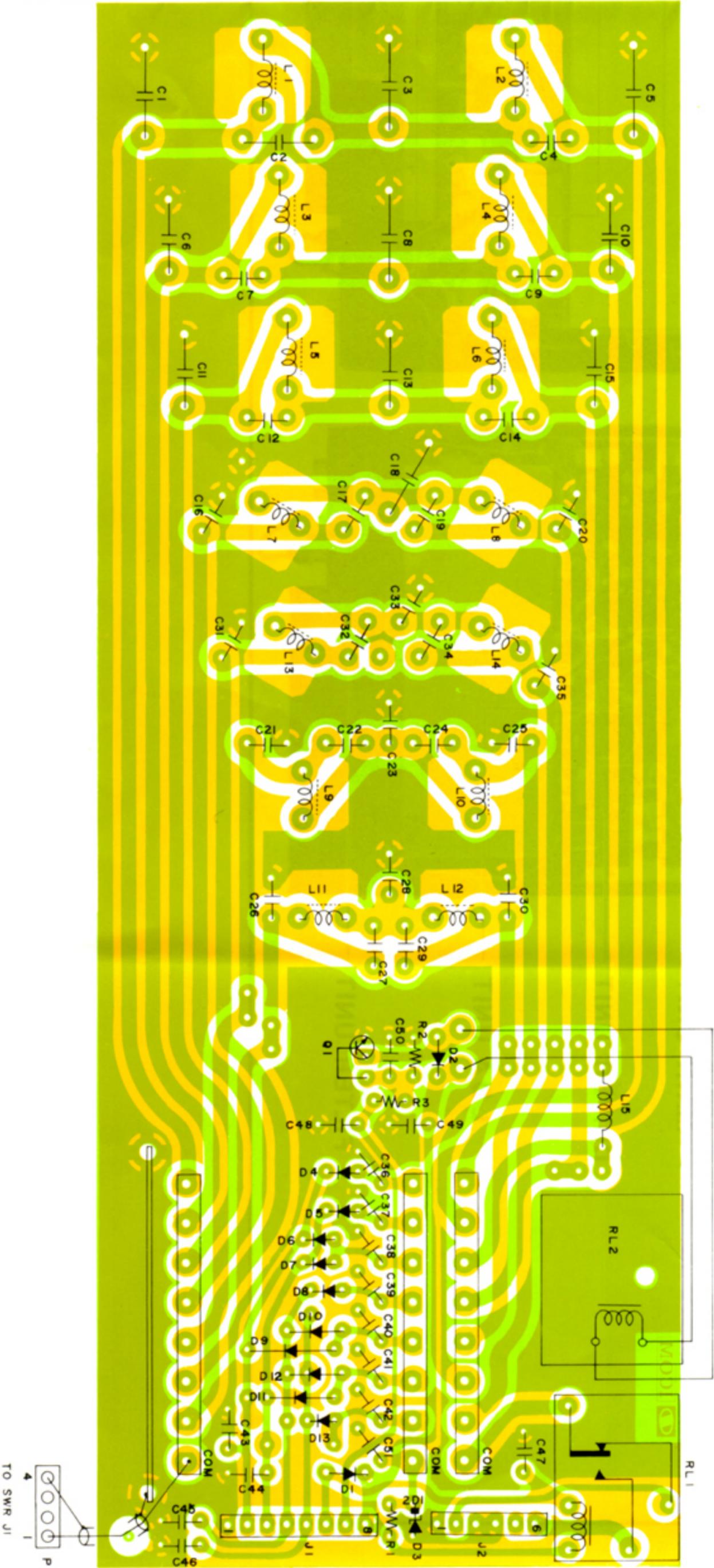




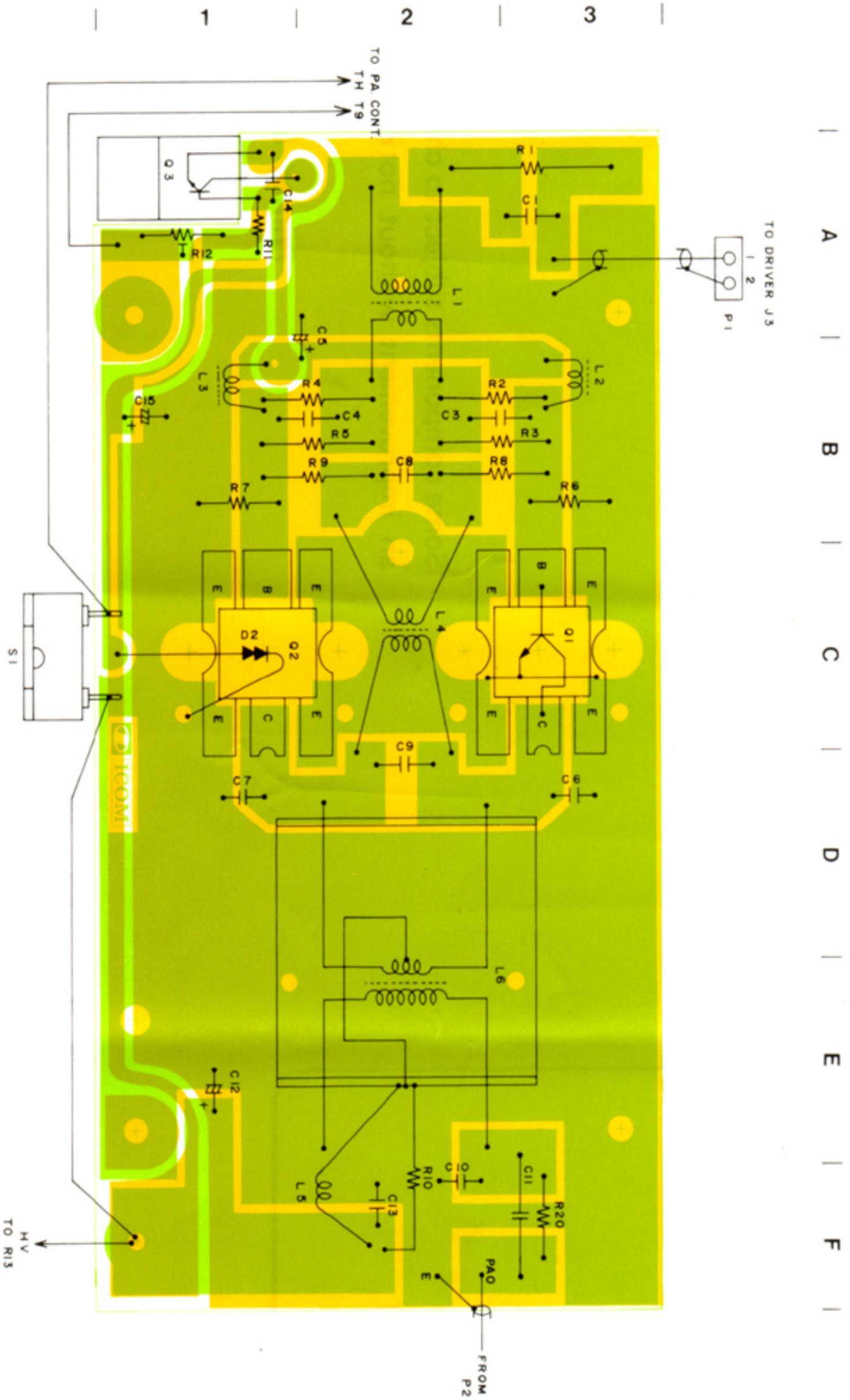
FILTER UNIT

A | B | C | D | E | F | G | H

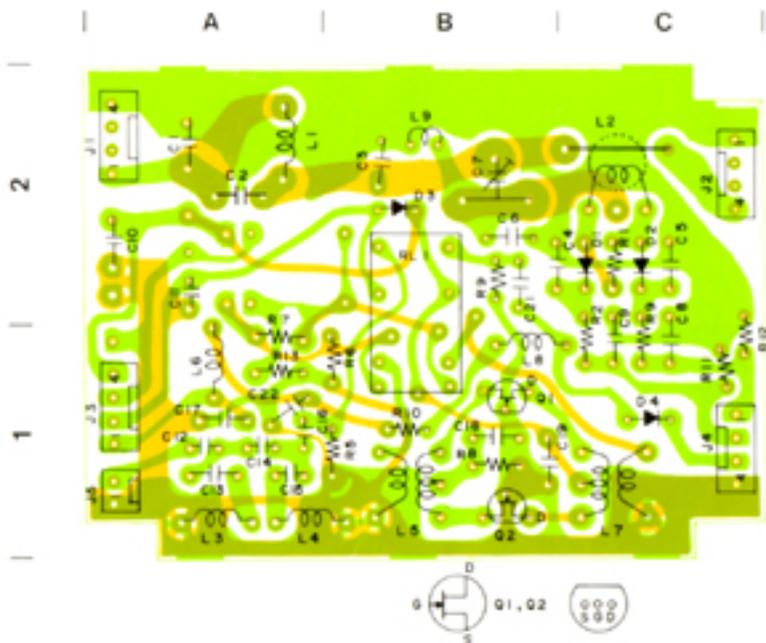
1 | 2 | 3



POWER AMPLIFIER UNIT

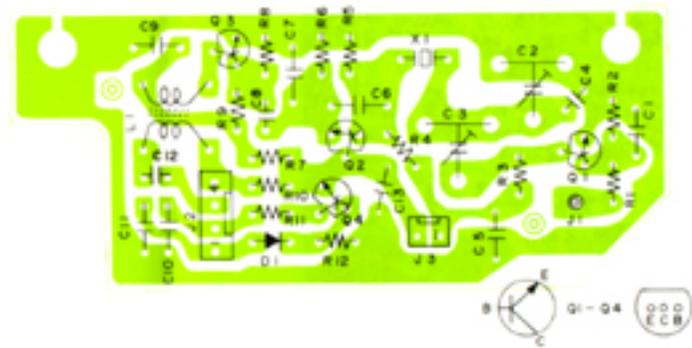


SWR UNIT

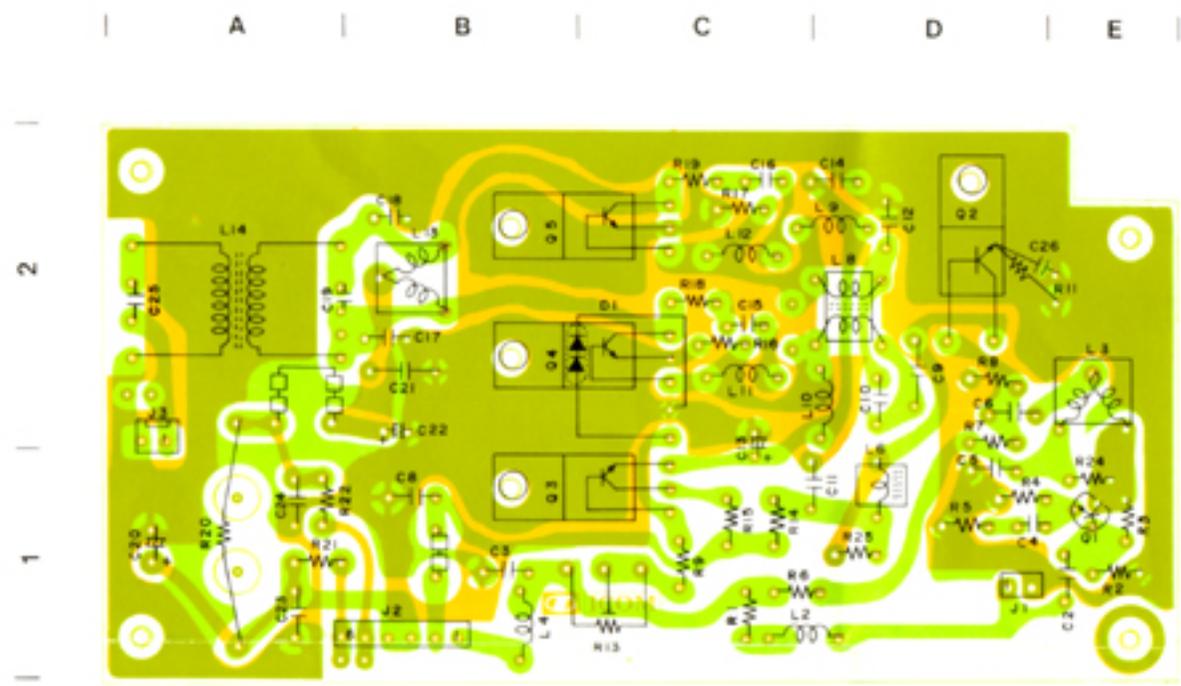


RTTY UNIT

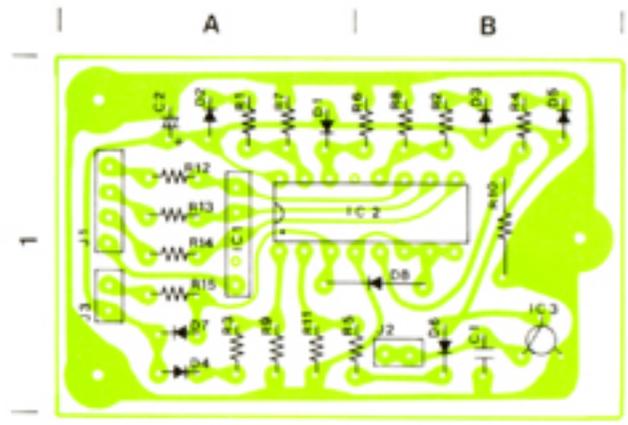
ManualsPlus.com



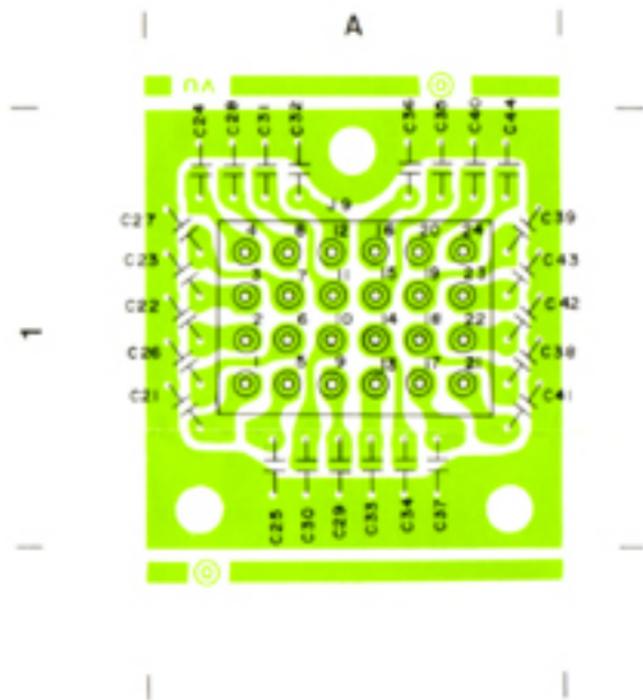
DRIVER UNIT



LDA UNIT



ACC UNIT



PA CONNECTOR BOARD

ManualsPlus.com

