

HF ALL BAND TRANSCEIVER
GENERAL COVERAGE RECEIVER

IC-745

MAINTENANCE MANUAL



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TABLE OF CONTENTS

SECTION	1	SPECIFICATIONS	1- 1
SECTION	2	OPERATING CONTROLS.....	2- 1 ~ 5
SECTION	3	OPERATING INSTRUCTIONS.....	3- 1 ~ 15
	3- 1	HOW TO TUNE	3- 1
	3- 2	MEMORY CHANNEL OPERATION	3- 5
	3- 3	TUNING BY UP/DOWN BUTTONS ON THE MICROPHONE.	3- 6
	3- 4	SCANNING OPERATION.....	3- 7
	3- 5	SSB OPERATION	3- 8
	3- 6	CW OPERATION.....	3- 11
	3- 7	RTTY OPERATION	3- 11
	3- 8	AM OPERATION.....	3- 12
	3- 9	FM OPERATION (OPTION).....	3- 12
	3- 10	GENERAL COVERAGE RECEIVER.....	3- 13
	3- 11	OTHER OPERATIONS.....	3- 13
SECTION	4	CIRCUIT DESCRIPTION	4- 1 ~ 12
	4- 1	RECEIVER CIRCUITS	4- 1
	4- 2	TRANSMITTER CIRCUITS	4- 3
	4- 3	PLL CIRCUITS	4- 5
	4- 4	LOGIC CIRCUITS.....	4- 8
SECTION	5	BLOCK DIAGRAM	5- 1
SECTION	6	INSIDE VIEWS	6- 1 ~ 2
SECTION	7	OPTIONS INSTALLATION.....	7- 1 ~ 6
SECTION	8	MECHANICAL PARTS AND DISASSEMBLY	8- 1 ~ 11
SECTION	9	MAINTENANCE AND ADJUSTMENT	9- 1 ~ 6
SECTION	10	VOLTAGE (CIRCUIT) DIAGRAMS.....	10- 1 ~ 12
SECTION	11	IC RATINGS	11- 1 ~ 6
SECTION	12	PARTS LIST	12- 1 ~ 21
SECTION	13	SCHEMATIC DIAGRAM.....	13- 1
SECTION	14	BOARD LAYOUT.....	SEPARATE

SECTION 1 SPECIFICATIONS

GENERAL

Frequency Coverage:

Ham Band 1.8 MHz ~ 2.0MHz
3.45MHz ~ 4.1MHz
6.95MHz ~ 7.5MHz
9.95MHz ~ 10.5MHz
13.95MHz ~ 14.5MHz
17.95MHz ~ 18.5MHz
20.95MHz ~ 21.5MHz
24.45MHz ~ 25.1MHz
27.95MHz ~ 30.0MHz

General Cover (Receive Only)

0.1MHz ~ 30.0MHz

Thirty 1MHz Segments (or Continuous)

RIT/XIT Coverage $\pm 1.0\text{KHz}$

Frequency Control:

CPU based 10Hz step Digital PLL synthesizer.

Independent Transmit-Receive Frequency Available

Frequency Readout:

6 digit 100Hz readout.

Frequency Stability:

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

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:

8.0Kg (11Kg; when optional power supply is installed)

Dimensions:

111(123) mm(H) x 280(304) mm(W) x 355(383) mm(D)

*(); including projections

TRANSMITTER

RF Power:

SSB (A_3J) 200 Watts PEP input

CW (A_1), RTTY (F_1) 200 Watts input

FM (F_3)* 200 Watts input

Continuously Adjustable Output power 10 Watts ~ Max.

Emission Mode:

A_3J SSB (Upper sideband and Lower sideband)

A_1 CW

F_1 RTTY (Frequency Shift Keying)

F_3 FM

Harmonic Output:

More than 60dB 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 55dB down at 1000Hz AF input

Microphone:

Impedance 600 ohms

Input Level 12 millivolts typical

Dynamic or Electret Condenser Microphone

(Optional desk mic IC-SM6 and SM-8 can be used.)

RECEIVER

Receiving System:

SSB, CW, RTTY, AM

Triple Conversion Superheterodyne with continuous Bandwidth Control.

FM* Triple Conversion Superheterodyne

Receiving Mode:

A_1 , A_3J (USB, LSB) F_1 (Output FSK audio signal), A_3 (Receive only) F_3 *

IF Frequencies:

1st 70.4515MHz

2nd 9.0115MHz

3rd 455KHz

Sensitivity:

SSB, CW, RTTY

0.1 ~ 1.6MHz Less than $3.2\mu\text{V}$ for 10dB S/N

1.6 ~ 30MHz Less than $0.15\mu\text{V}$ for 10dB S/N

AM 0.1 ~ 1.6MHz Less than $20\mu\text{V}$ for 10dB S/N

1.6 ~ 30MHz Less than $1\mu\text{V}$ for 10dB S/N

FM* 1.6 ~ 30MHz Less than $0.3\mu\text{V}$ for 12dB SINAD

Squelch Sensitivity:

1.6 ~ 30MHz Less than $0.5\mu\text{V}$

Selectivity:

SSB, CW, RTTY

2.2KHz (Adjustable to 0.8KHz Min)
at -6dB

4.2KHz at -60dB

AM 2.4KHz at -6dB, 4.8KHz at -60dB
(When Filter switch ON)

4.0KHz at -6dB, 15KHz at -60dB

FM* 15KHz at -6dB, 30KHz at -60dB

Notch Filter Attenuation:

More than 30dB

Spurious Response Rejection Ratio:

More than 60dB

Audio Output:

More than 2.8 Watts

Audio Output Impedance:

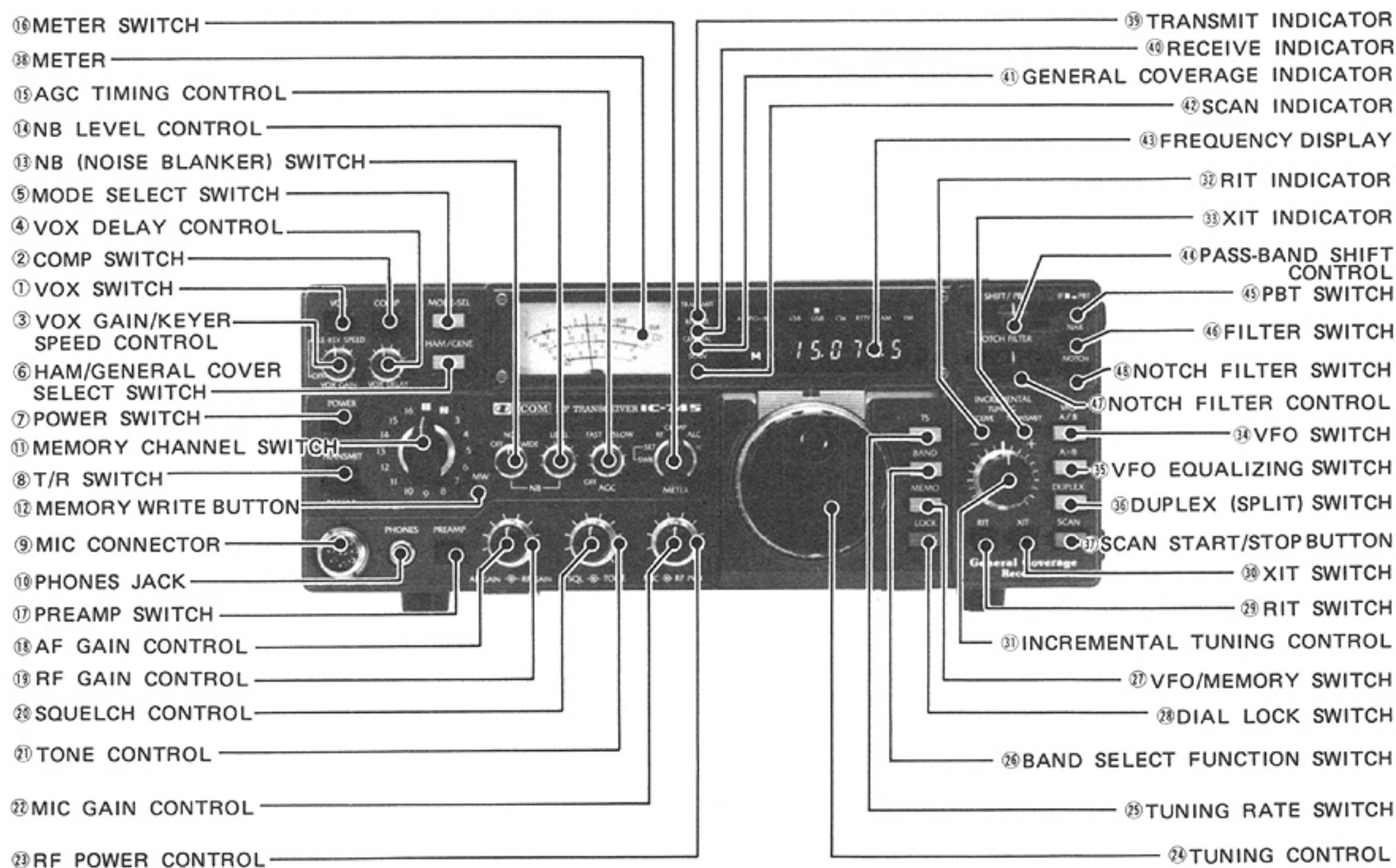
8 Ohms

* When optional FM unit is installed.

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

SECTION 2 OPERATING CONTROLS

2 - 1 FRONT PANEL



1. VOX SWITCH

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

2. COMP (SPEECH PROCESSOR) SWITCH

Switches the speech processor circuit ON and OFF. This circuit enables greater talk power and better results in DX operation.

3. VOX GAIN/KEYER SPEED CONTROL

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

When the optional electronic keyer unit is installed and the set is in CW mode, this control adjusts keying speed of the keyer.

4. 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.

5. MODE SELECT SWITCH

Selects any one of six operating modes. Each push of the switch changes the mode in order of LSB, USB, CW, RTTY, AM (receive only) and FM (option). The selected mode is shown on the FREQUENCY DISPLAY.

6. HAM BAND/GENERAL COVER SELECT SWITCH

Each push selects the function of the set alternately. In the HAM BAND mode, the transceiver functions in any of nine HAM bands between 1.8MHz and 28MHz. In the GENERAL COVERAGE mode the set functions as a general coverage receiver between 0.1MHz and 30MHz. (The set will not transmit in this mode.)

7. POWER SWITCH

The POWER SWITCH is a push-lock type switch which controls the input DC power to the IC-745. When the external AC power supply (IC-PS15 or IC-PS30) or optional built-in AC power supply (IC-PS35) 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 using an external DC power supply).

8. T/R (TRANSMIT/RECEIVE) SWITCH

This switch is for manually switching from transmit to receive and vice versa. Set the switch to RECEIVE (down) and the IC-745 is in the receive mode. Set the switch to TRANSMIT (up) 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.

9. MIC CONNECTOR

Connect a suitable microphone to this jack. The supplied hand microphone IC-HM12 or optional desk mic IC-SM6 or SM-8 can be used.

10. PHONES JACK

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

11. MEMORY CHANNEL SWITCH

Selects any one of sixteen memory channels in the MEMORY CHANNEL operation.

12. MEMORY WRITE BUTTON

By pushing this button, a displayed frequency, mode and HAM/GENE operation are stored into a memory channel which is selected by the MEMORY CHANNEL switch.

13. NB (NOISE BLANKER) SWITCH

When pulse type noise such as automobile ignition noise is present, set this switch to the NOR or WIDE position. The noise will be reduced to provide comfortable reception.

The blanking time can be selected NORMAL and WIDE by this switch. It will be effective against any type noises.

14. NB LEVEL CONTROL

Controls the threshold level of the noise blanker. Adjust the control so that incoming noises will be disappeared.

15. AGC TIMING CONTROL

For changing the time-constant of the AGC (Automatic Gain Control) circuit. By turning the control clockwise, the AGC voltage is released more slowly. Adjust the control to provide comfortable reception.

When the control is in the OFF position, the AGC function is turned OFF and the S-meter does not swing even if a signal has being received. (The AGC does not actuate on the FM mode.)

16. METER SWITCH

In the transmit mode, the meter has five functions.

- | | |
|--------|---|
| 1. Ic | Indicates the collector current of the final transistors. |
| 2. ALC | Indicates the ALC level. The meter begins to function when the RF output power reaches a certain level. |

- | | |
|------------|--|
| 3. COMP | Indicates the compression level when the speech processor is in use. |
| 4. RF | Indicates an approximate RF output power. |
| 5. SET/SWR | SWR can be measured by setting this switch to the SET position and calibrating the meter needle to the "SET" position with the RF POWER control, then setting this switch to the SWR position. |

17. PREAMP SWITCH

Switches the preamplifier for the receiver.

18. AF GAIN CONTROL

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

19. 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 METER rises, and only signals stronger than the level indicated by the needle will be heard. (The needle of the METER does not rise in the FM mode.)

20. SQUELCH CONTROL

Sets the squelch threshold level. To turn OFF the squelch function, rotate this control completely counterclockwise. To set the threshold level higher, rotate the control clockwise.

21. TONE CONTROL

Controls the receiver audio tone. Adjust the control to provide comfortable reception.

22. 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 Meter needle, in the ALC mode, begins to move slightly within the ALC zone. In the SSB mode when the speech processor is in use, the MIC GAIN CONTROL sets a clipping limit, 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.

23. RF POWER CONTROL

Controls the RF output power 10 Watts to maximum (SSB: 100 Watts PEP, CW, RTTY FM (option): 100 Watts). Clockwise rotation increases the output power. (AM is receive only.)

24. TUNING CONTROL

Rotating this control clockwise increases the frequency or the memory channel number, while rotating it counterclockwise decreases it. The frequency changes by 10Hz in any mode. In 10Hz step tuning rate, by turning the tuning control faster, the 50Hz step tuning rate is automatically selected. This makes it very convenient to make a QSY over a wide frequency range.

This control is also used to select the operating band while the BAND SELECT FUNCTION switch is depressed.

25. TUNING RATE SWITCH

By pushing in this switch, the operating frequency is changed to correspond to 1KHz increments in any mode.

At the same time, the 100Hz digit on the display is cleared to show "0". When this switch is pushed again and released, the frequency is changed normally. This switch allows you to quickly QSY over a great frequency range.

26. BAND SELECT FUNCTION SWITCH

By pushing in this switch, the operating band is changed by turning the TUNING CONTROL.

In the HAM BAND mode, each initialized frequency of the band is selected. In the GENERAL COVERAGE mode, the operating frequency is changed in 1MHz steps but the lower digits do not change.

27. VFO/MEMORY SWITCH

Switches the VFO operation and MEMORY CHANNEL operation.

28. DIAL LOCK SWITCH

After the IC-745 is set to a certain frequency for rag chewing, mobile operation, etc., by pushing this switch, the VFO is electronically locked at the display frequency, thus inactivating the operation of the tuning control. To change frequency or band, the dial lock must first be disengaged by pushing and releasing this switch again.

29. RIT SWITCH

Switches the RIT (Receiver Incremental Tuning) circuit ON and OFF.

30. XIT SWITCH

Switches the XIT (Transmitter Incremental Tuning) circuit ON and OFF.

31. INCREMENTAL TUNING CONTROL

Shifts the receive frequency about 1KHz to either side of the transmit frequency when the RIT is ON, and shifts the transmit frequency to either side of the receive frequency when the XIT is ON. Rotating the control to the (+) side raises the receive or transmit frequency, and rotating to the (—) side lowers the receive or transmit frequency. The frequency shifted by turning the control is not indicated on the frequency display.

When both the RIT and XIT switches are ON, the receive and transmit frequencies are the same, and this frequency can be shifted either side from the displayed frequency by the control.

32. RIT INDICATOR

Illuminates when RIT is turned ON.

33. XIT INDICATOR

Illuminates when XIT is turned ON.

34. VFO SWITCH

Selects either VFO, "A" or "B", for tuning. Each push of this button selects VFO A and B alternately.

It also selects the relationship of the two VFO's with the DUPLEX (SPLIT) switch. The switch performs the following operations.

A. (NORMAL) Selects the VFO "A" for both transmit and receive.

A. (SPLIT) Selects VFO "A" for receive and VFO "B" for transmit.

B. (NORMAL) Selects VFO "B" in both transmit and receive.

B. (SPLIT) Selects VFO "B" for receive and VFO "A" for transmit.

35. VFO EQUALIZING SWITCH

Instantly sets the frequency, mode and HAM/GENE operation of a VFO to the same as those of the other VFO.

36. DUPLEX (SPLIT) SWITCH

Selects the relationship of the two VFO's. In the OFF position, one VFO is for both receive and transmit. By pushing in this switch, one VFO is for receive and the other VFO is for transmit.

37. SCAN START/STOP BUTTON

Starts and stops any of the scan functions. When depressing it again to restart the scan, it will start from the stopped frequency in the programmed scan, or from the highest memory channel in the memory scan.

38. 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 to S9+60dB.

In the transmit mode the meter has five functions which are selected by the Meter Switch (16).

39. TRANSMIT INDICATOR

Illuminates when the transceiver is in the transmit mode.

40. RECEIVE INDICATOR

Illuminates when the squelch is opened in the receive mode.

41. GENERAL COVERAGE INDICATOR

Illuminates when the set is in the general coverage receiver operation.

42. SCAN INDICATOR

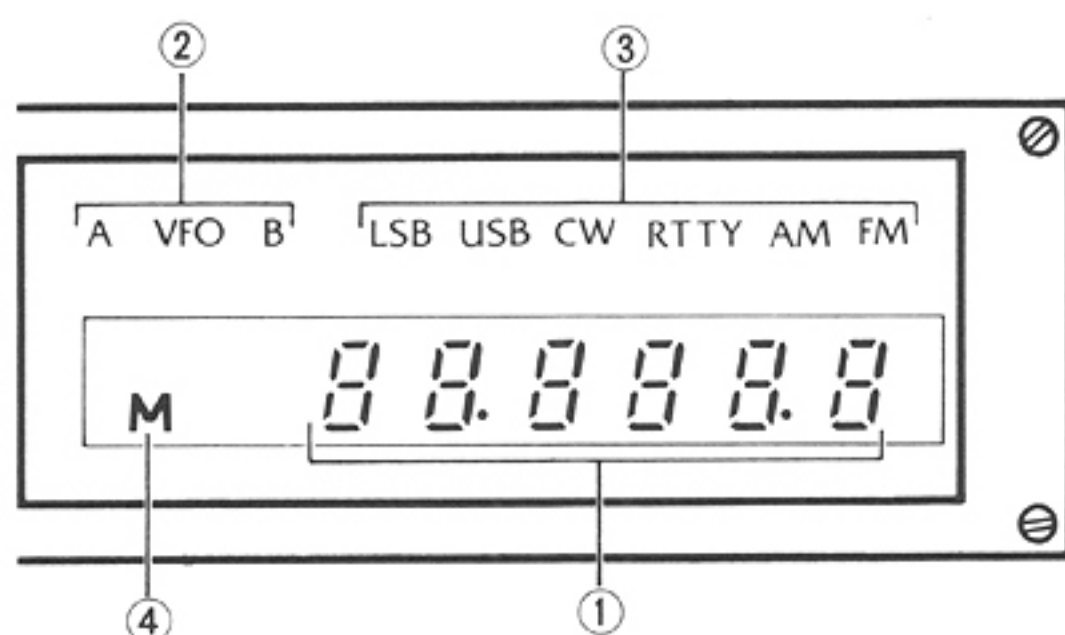
Illuminates when the set is in the scan mode.

43. FREQUENCY DISPLAY

The frequency of the IC-745 is displayed on a luminescent display tube. Since the 1MHz and 1KHz decimal points are displayed, the frequency can easily be read. The frequency indicated is the carrier frequency of each mode in USB, LSB, CW, AM and FM, and the mark frequency in RTTY.

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

The FREQUENCY DISPLAY shows not only the operating frequency but also MODE and selected VFO or in MEMORY CHANNEL mode.



- ① Shows operating frequency in 6 digits between 10MHz and 100Hz.
- ② Shows selected VFO; VFO A or VFO B.
- ③ Shows operating mode; one of LSB, USB, CW, RTTY, AM, and FM.
- ④ Shows whether the set is in the MEMORY CHANNEL MODE or not. When the set is in the MEMORY CHANNEL MODE, the letter "M" is displayed here.

44. PASS-BAND SHIFT (TUNING) CONTROL

Allows continuous shifting of the pass-band from upper or lower side in SSB, CW and RTTY. This will reduce interference by a nearby signal. When the PBT switch is pushed ON, this 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. This not only improves selectivity, but also can improve the audio tone. Normal position is in the center position and is 2.4KHz wide in SSB.

45. PBT SWITCH

Switches the IF SHIFT function and PASS-BAND TUNING function.

46. FILTER SWITCH

Selects the combination of the second IF (9MHz) filter and the third IF (455KHz) filter to improve the selectivity.

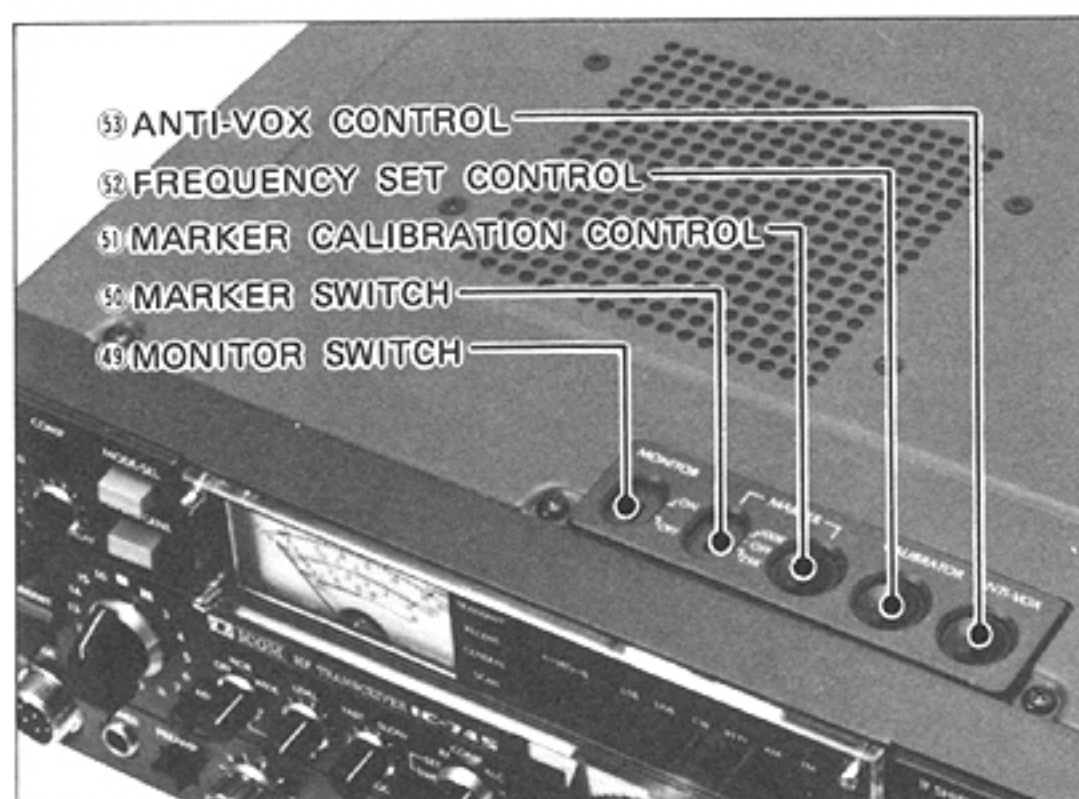
47. NOTCH FILTER CONTROL

Shifts the notch filter frequency. Adjust the control so that the interference is reduced.

48. NOTCH FILTER SWITCH

Switches the notch filter function ON and OFF.

2 - 2 TOP COVER



49. MONITOR SWITCH

In the SSB transmit mode, the transmitting IF signals can be monitored by turning this switch ON. At this time, use headphones or reduce receiver audio volume to prevent howling.

50. MARKER SWITCH

When an optional marker oscillator unit is installed, this switch turns the marker oscillator ON or OFF.

The marker frequency is available on every 25KHz or 100KHz step.

51. MARKER CALIBRATION CONTROL

Calibrates the marker frequency with a standard frequency such as WWV.

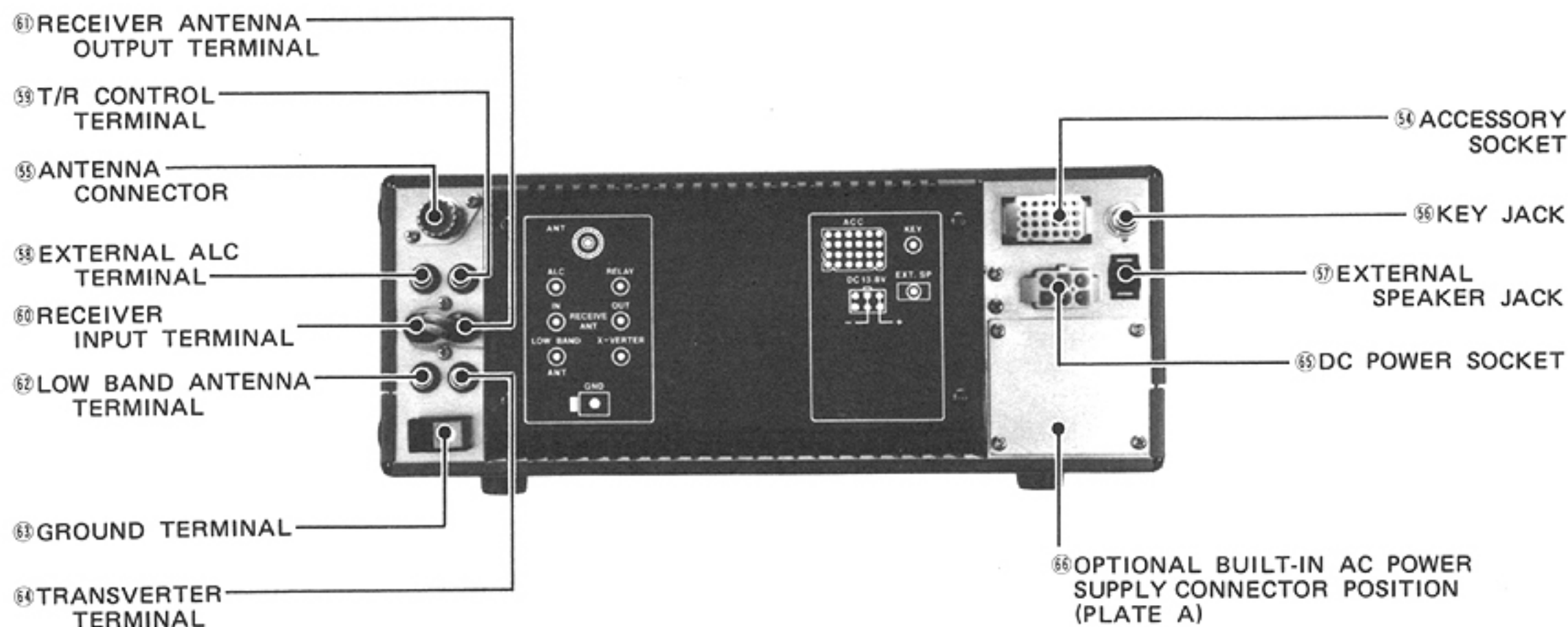
52. FREQUENCY SET CONTROL

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.

53. ANTI-VOX CONTROL

In VOX (SSB) 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 by the operator's voice, not by sound from the speaker.

2-3 REAR PANEL CONNECTIONS



54. ACCESSORY (ACC) SOCKET

Various functions are available through the accessory socket such as modulation output, receiver output, T/R change-over, and so forth.

Refer to the ACCESSORY SOCKET CONNECTIONS on page 3 - 15.

55. ANTENNA (ANT) CONNECTOR

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

56. KEY JACK

For CW operation, connect a key here using a standard 1/4 inch 3-P plug. For electronic keying the terminal voltage must be less than 0.4V DC.

When an optional electronic keyer unit is installed, an iambic keyer paddle can be used with a 1/4 inch 3-P plug.

57. 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.

58. EXTERNAL ALC TERMINAL

This terminal can be used for input terminal of external ALC signal from a linear amplifier or transverter. The ALC voltage should be in 0V ~ -4V.

59. T/R CONTROL TERMINAL

Controls Transmit/Receive for an external linear amplifier or transverter. This terminal can be used to switch 24V 1A DC. Don't exceed this limit.

60. RECEIVER INPUT TERMINAL

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

61. 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-745.

62. LOW BAND ANTENNA 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 the ANTENNA connector to this terminal automatically.

63. TRANSVERTER TERMINAL

VHF and UHF operation using a suitable transverter with the IC-745 is possible. This terminal is for Transverter connection. The output is about 30mV.

64. 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.

65. DC POWER SOCKET

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

66. OPTIONAL BUILT-IN AC POWER SUPPLY SOCKET POSITION

This is provided to install AC power socket plate of the optional built-in AC power supply, IC-PS35.

SECTION 3 OPERATING INSTRUCTIONS

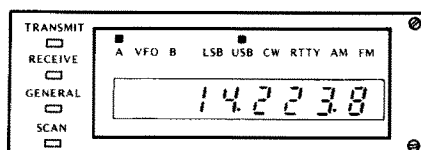
3-1 HOW TO TUNE

The following instructions are for tuning in any mode. Please read carefully and understand fully before turning ON your unit. Proper tuning is necessary for optimum operation.

3-1-1 PRESET

When the power switch is turned ON, the frequency display shows frequency, HAM/GENE (HAM BAND mode or GENERAL COVERAGE mode) mode and mode stored in the VFO A and letters "A VFO", and the set operates with the VFO A and displayed mode, even if the previous operating mode was different. In addition, the RIT/XIT, DUPLEX mode and SCAN are turned OFF.

FOR EXAMPLE:



3-1-2 HAM BAND/GENERAL COVERAGE SELECTION

Each push of the HAM/GENERAL COVER SELECT switch changes the set in the HAM BAND MODE and GENERAL COVERAGE MODE alternately.

In the HAM BAND MODE, the frequencies available are those of the nine amateur bands between 1.8MHz and 28MHz including new three bands for both transmit and receive.

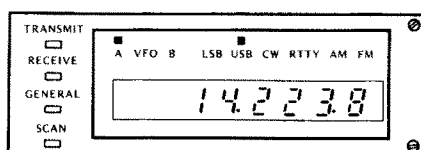
In the GENERAL COVERAGE MODE, the set operates as a receiver in the range of 0.1MHz to 30MHz continuously.

When you change the mode from the HAM BAND to GENERAL COVERAGE, the set maintains the frequency that was in the HAM BAND mode.

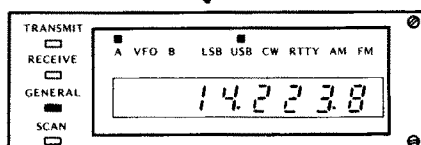
When you change the mode from the GENERAL COVERAGE to HAM BAND, if previous frequency was that of a HAM BAND, the set maintains that frequency.

FOR EXAMPLE:

In the HAM BAND mode

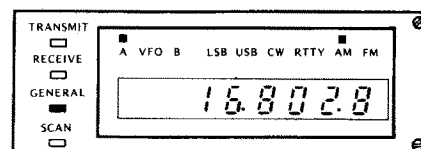


In the GENERAL COVERAGE mode



If the previous frequency was not of any HAM BAND, the frequency is initialized to "1.900.0MHz" or shifted frequency according to the operating mode.

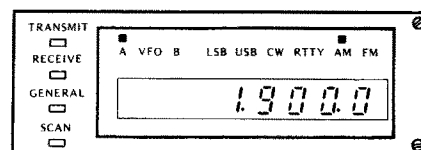
In the GENERAL COVERAGE mode



Pushing the HAM/GENERAL COVER SELECT switch



In the HAM BAND mode



3-1-3 BAND SWITCHING

To change the operating band, push the BAND SELECT FUNCTION switch in and rotate the TUNING CONTROL.

In the HAM BAND mode, by turning the TUNING CONTROL clockwise the operating band changes to the next upper band, and counterclockwise changes to the next lower band, and the operating frequency is initialized as follows.

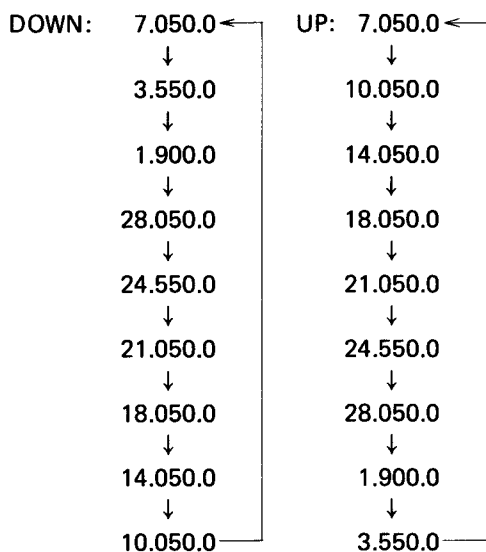
Band	Displayed Frequency (MHz)		
	CW•RTTY•AM•FM	LSB	USB
1.8MHz	1.900.0	* 1.901.5	1.898.5
3.5 "	3.550.0	* 3.551.5	3.548.5
7 "	7.050.0	* 7.051.5	7.048.5
10 "	10.050.0	10.051.5	*10.048.5
14 "	14.050.0	14.051.5	*14.048.5
18 "	18.050.0	18.051.5	*18.048.5
21 "	21.050.0	21.051.5	*21.048.5
24.5 "	24.550.0	24.551.5	*24.548.5
28 "	28.050.0	28.051.5	*28.048.5

* Initialized frequency and mode for each band.

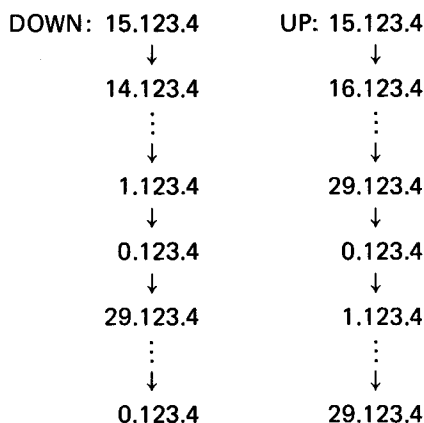
In the GENERAL COVERAGE mode, by turning the TUNING CONTROL clockwise the operating frequency changes to a frequency that is added 1MHz to the previous one. (100KHz and lower digits of the frequency will remain as it had in the previous one.) By turning the TUNING CONTROL counterclockwise, the operating frequency changes to a frequency that is subtracted 1MHz from the previous one.

When the band reaches to the highest one in either mode, it will automatically return to the lowest one, or vice versa, as per the following charts.

In the HAM BAND mode



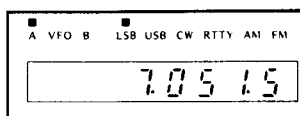
In the GENERAL COVERAGE mode



However, in the GENERAL COVERAGE mode, when the operating frequency reaches the highest or lowest edge, of that MHz range by turning the TUNING CONTROL continuously (at this time the BAND SELECT FUNCTION switch is not pushed in), the operating frequency will go to the next MHz range.

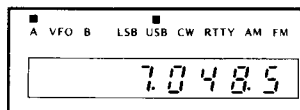
3-1-4 FREQUENCY DISPLAY ON EACH MODE

When the 7MHz band and LSB are selected, the display will be as follow:

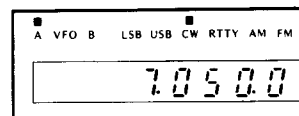


When changing to other modes, the display will be as follows:

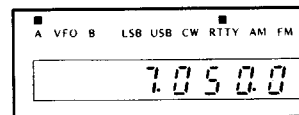
USB:



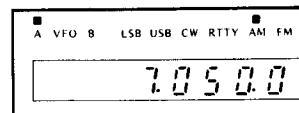
CW:



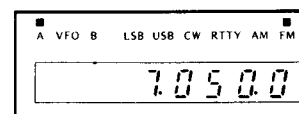
RTTY:



AM
(Receive only):

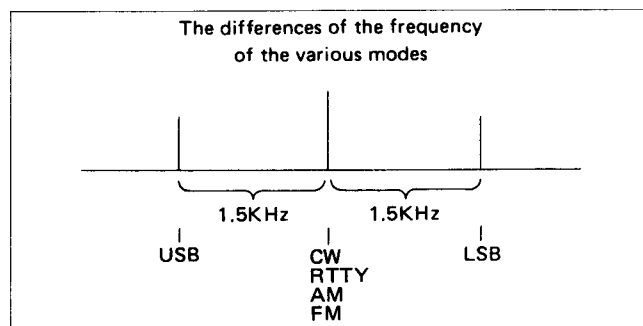


FM
(Option):



The displayed frequency shows the carrier frequency. To avoid the trouble of recalibrating the dial when you change the operating mode, the displayed frequency is set to shift to the carrier frequency of each mode automatically. For the differences of frequency shifts of the various modes, refer to the following figure.

When changing to other bands, 100KHz and lower digits of the frequency display will remain as it had in the previous display in the GENERAL COVERAGE mode.



In the HAM BAND SSB mode, the sideband will be automatically selected to the one usually used on the band, i.e., upper sideband (USB) for the 10MHz band and above, and lower sideband (LSB) for the 7MHz band and below. If reverse sideband is desired, push the MODE SELECT SWITCH so that the desired mode is selected.

3-1-5 TUNING CONTROL

Rotating the TUNING CONTROL clockwise increases the frequency, while turning counterclockwise decreases the frequency in 10Hz steps. By turning the tuning control faster, the 50Hz steps tuning rate is automatically selected.

When the TUNING RATE switch is pushed in, the 1KHz steps tuning rate is selected in any mode. At this time, the 100Hz digit of the frequency display is cleared to "0".

The frequency range of each band in the HAM band mode is shown in the following chart.

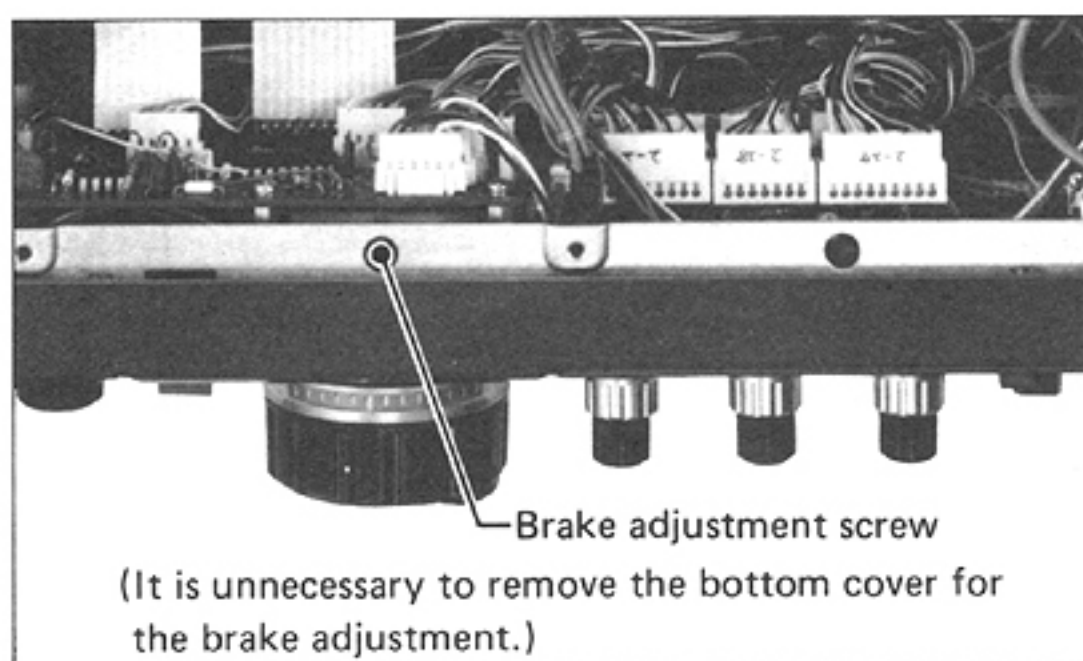
Band	Frequency Range
1.8	1.800.0 ~ 1.999.9
3.5	3.440.0 ~ 4.099.9
7.0	6.950.0 ~ 7.499.9
10.0	9.950.0 ~ 10.499.9
14.0	13.950.0 ~ 14.499.9
18.0	17.950.0 ~ 18.499.9
21.0	20.950.0 ~ 21.499.9
24.0	24.450.0 ~ 25.099.9
28.0	27.950.0 ~ 29.999.9

In the HAM BAND mode, by turning the TUNING CONTROL clockwise, the operating frequency reaches to the high edge of the band (for example; 14.499.9MHz), and further turning of the control brings the frequency to the low edge of the band (13.950.0MHz) then continues up the frequency from there. Likewise, by continuing to turn the TUNING CONTROL counterclockwise beyond the low edge of the band, the frequency jumps up to the high edge and goes down from that frequency.

In the GENERAL COVERAGE mode, by turning the TUNING CONTROL clockwise, the operating frequency reaches the highest one of that MHz range (for example; 14.999.9 MHz), and further turning of the control brings the frequency to the next upper MHz range (15.000.0MHz) and continues up the frequency from there. By turning the control counterclockwise, the operating frequency changes in like manner to the next lower MHz range.

Brake Adjustment

If the control is too loose or too stiff for comfortable use, you can adjust the torque by tightening or loosening the brake adjustment screw accessible from underneath the set.



The following instructions should be used to adjust the tension of the Tuning control.

1. The Tuning control tension will become tighter by turning the brake adjustment screw clockwise, and will become looser by turning the screw counterclockwise.

2. While performing this adjustment, the Tuning control must be turned continuously as the screw is adjusted in order to set the tension for a comfortable touch.

NOTE: When the "VFO A" or "VFO B" LED is illuminated on the frequency display, we call this condition as "VFO MODE", when the letter "M" is displayed on the frequency display, we call this "MEMORY CHANNEL MODE".

These can be changed by pushing the VFO/MEMORY switch alternately.

3 - 1 - 6 DIAL LOCK SWITCH

After the IC-745 is set at a certain frequency for rag chewing, mobile operation, etc., by pushing the Dial Lock switch the VFO is locked at the displayed frequency, thus inactivating the operation of the tuning control. To change the frequency, the Dial Lock must first be disengaged by pushing and releasing the Dial Lock switch again.

3 - 1 - 7 VFO SWITCH

The IC-745 contains two VFO's for both receiving and transmitting. The VFO's are labeled "VFO A" and "VFO B", and are selectable by pushing the VFO switch alternately in the VFO MODE. The dual VFO system gives the IC-745 many very convenient features. Please read this section very carefully and perform the operation several times until you are comfortable with the system. Try the example for practice!

1. "VFO A" is for both receiving and transmitting, and selected by pushing the VFO switch. The receive and transmit frequency will be controlled by the "VFO A", displayed on the frequency display, and stored in the "A" memory.
2. "VFO B" is for both receiving and transmitting, and selected by pushing the VFO switch. The receive and transmit frequency will be controlled by the "VFO B", displayed on the frequency display, and stored in the "B" memory.

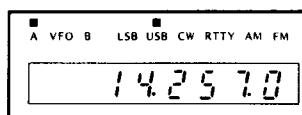
Switching from one VFO to the other VFO does not clear the first VFO. the frequency, operating mode and HAM/GENE mode are retained in the VFO's memory.

FOR EXAMPLE:

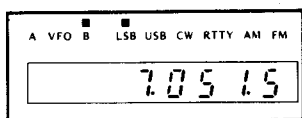
If 14.257MHz and USB are set with the "VFO A", then the VFO switch is pushed to select the "VFO B", the frequency display will show VFO B's frequency and mode, but 14.257MHz and USB are still stored in the VFO A's memory.

Pushing the VFO switch again to return the VFO A, "14.257.0" and "USB" will displayed on the frequency display.

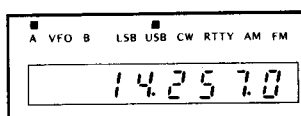
Accordingly, if the VFO switch is pushed again to the VFO B, the frequency and mode that were set with the VFO B will appear.



Pushing the VFO switch to select the VFO B.



Pushing the VFO switch again to return the VFO A.



This allows you to set a certain frequency with one VFO, work up and down the band with the other VFO, and periodically check the set frequency simply by switching between VFO "A" and "B".

It also allows you to search for a clear frequency with one VFO, while keeping your operating frequency on the other VFO. When you have found a clear frequency, switch back to your operating frequency, inform the station you are in contact with of the new frequency, and switch back. It's that simple!

3-1-8 DUPLEX (SPLIT) SWITCH

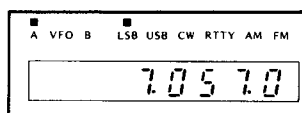
The DUPLEX (SPLIT) switch changes the relationship of the two VFO's. Each push turns the function ON and OFF alternately.

When the function is OFF, one VFO is for both receive and transmit. When the function is ON, and one VFO is for receive and the other VFO is for transmit. So that this will allow you to operate on split receive/transmit frequencies.

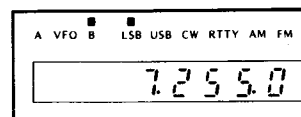
FOR EXAMPLE:

Set VFO A to 7.057MHz and VFO B to 7.255MHz. Push the VFO switch to return VFO A then the DUPLEX (SPLIT) switch to ON. 7.057MHz will be shown on the display during receive (VFO A) and 7.255MHz during transmit (VFO B). You are now receiving on 7.057MHz and transmitting on 7.255MHz. Pushing the VFO switch to reverse the above.

Receiving (VFO A)

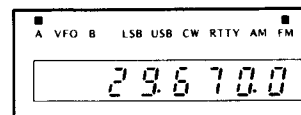


Transmitting (VFO B)

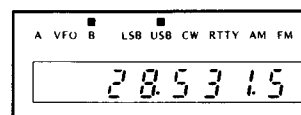


Each VFO stores operating mode too. If different mode is stored in each VFO, a crossmode QSO can be possible as well.

Receiving (VFO A, FM)



Transmitting (VFO B, USB)



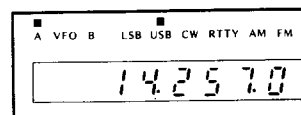
3-1-9 TRANSFERRING VFO FREQUENCY

The VFO EQUALIZING switch allows either VFO's to be brought to the exact frequency of the other VFO without turning the tuning control, and the operating mode.

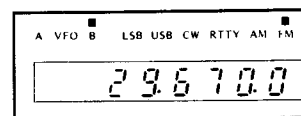
FOR EXAMPLE:

When VFO A is 14.257MHz and USB, and VFO B is 29.670MHz and FM, pushing the VFO switch to select VFO A, then the VFO EQUALIZING switch, VFO B's frequency and operating mode become the same as VFO A's (14.257MHz and USB). Now the VFO A's frequency is memorized in the VFO B, and you can operate anywhere with VFO A or B. When you want to return to the previous frequency (14.257MHz), switch back to the other VFO. To reverse this (A the same as B), select VFO B first, then the VFO EQUALIZING switch.

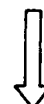
VFO A (displayed)



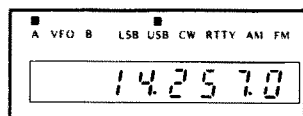
VFO B (hidden)



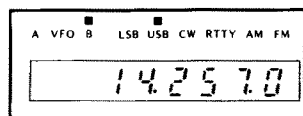
Pushing the VFO EQUALIZING switch



VFO A
(displayed)



VFO B
(hidden)



3 - 1 - 10 RIT (RECEIVE INCREMENTAL TUNING)

By using the RIT circuit, you can shift the receive frequency $\pm 1.0\text{KHz}$ either side of the transmit frequency without moving the transmit frequency itself. Therefore, when you get a call slightly off frequency, or when the other station's frequency has been drifted, you can tune in the frequency without disturbing the transmitting frequency. By pushing the RIT switch the RIT circuit is turned ON and the RIT Indicator is lit.

The receive frequency can be shifted with the INCREMENTAL TUNING Control knob.

When the Control knob is in the "0" position, the transmitting and receiving frequencies are the same.

Rotating the control to the (+) side raises the receiving frequency, and rotating to the (-) side lowers the frequency. To turn OFF the RIT function, again push and release the RIT switch and the RIT Indicator will go OFF. When the RIT circuit is OFF, the transmit and receive frequencies are the same regardless of the setting of the control knob.

NOTE: The RIT circuit is operational when the frequency is locked with the dial lock switch. The frequency shifted by turning the INCREMENTAL TUNING control is not indicated on the frequency display. When the transmitting and receiving frequencies differ by more than 1.0KHz, use "A" and "B" VFOs.

3 - 1 - 11 XIT (XMITTER INCREMENTAL TUNING)

You can shift the transmit frequency $\pm 1.0\text{KHz}$ on either side of the receive frequency without moving the receive frequency the same function as the RIT by using the XIT circuit.

By pushing the XIT switch, the XIT circuit is turned ON and the XIT Indicator is lit.

The transmit frequency can be shifted with the INCREMENTAL TUNING Control.

NOTE: When both the RIT and XIT switches are pushed, the receive frequency and transmit frequency become the same frequency, and it can be shifted to either side from the displayed frequency by the INCREMENTAL TUNING control.

3 - 2 MEMORY CHANNEL OPERATION

3 - 2 - 1 MEMORY CHANNEL SELECTION

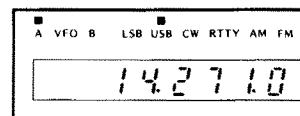
When the power switch is turned ON, the set initially operates with the VFO A. By pushing the VFO/MEMORY switch, the set is switched into the MEMORY CHANNEL MODE and a frequency, mode and HAM/GENE mode which have been stored in a memory channel are displayed on the frequency display. In addition, the letter "M" is also displayed to indicate the set is in the MEMORY CHANNEL MODE. The desired memory channel can be selected by the MEMORY CHANNEL switch.

FOR EXAMPLE:

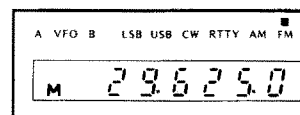
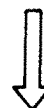
When "14.271MHz" and USB are memorized in VFO A, and "29.625MHz" and "FM" are in MEMORY CHANNEL 1, by pushing the power switch ON, the frequency display shows "14.271.0", "USB" and "VFO A".

By setting the MEMORY CHANNEL switch at "1", then pushing the VFO/MEMORY switch, the display will show "29.625.0" and "FM", and the letter "M" on the frequency display.

When the power is turned ON.



Pushing the VFO/MEMORY switch (Channel 1 has been selected.)



By turning the MEMORY CHANNEL switch, memory channels can be selected, and the respective frequency, mode and HAM/GENE mode are displayed on the display.

When you select a memory channel that has never been stored any frequency, the frequency display does not show any frequency. However, the set works with the frequency and mode of the memory channel (or VFO), which was previously displayed.

FOR EXAMPLE:

When "7.012MHz" and "CW" are memorized in memory channel 2, and no frequency is in channel 3, by setting the MEMORY CHANNEL switch at "2", the frequency display will show "7.012.0" and "CW".

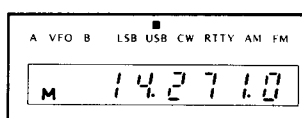
By turning the MEMORY CHANNEL SWITCH clockwise furthermore, the memory channel number will change to "3", but the channel has never memorized any frequency, thus the display shows "CW" only. However, the set works with the frequency and mode of channel 2, i.e., "7.012MHz" and "CW".

In the MEMORY CHANNEL MODE, by turning the TUNING CONTROL, the OPERATING FREQUENCY displayed on the frequency display can be changed. This is very convenient for tuning a slightly off frequency or to change the operating frequency, or to rewrite the memorized frequency in the selected memory channel.

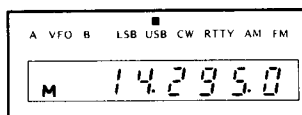
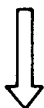
FOR EXAMPLE:

Now you are operating on 14.271MHz and USB with memory channel 7. If you want to change this frequency, turn the TUNING CONTROL clockwise to increase the frequency and counterclockwise to decrease one, the same as a VFO.

To tune to "14.295MHz", turn the TUNING CONTROL clockwise to obtain the desired frequency "14.295.0" on the display.



Turning
the TUNING CONTROL



If you wish to rewrite the memorized frequency in the selected channel (at this time, "7") to this frequency ("14.295.0"), push the MEMORY WRITE button, and the operating frequency "14.295MHz" and mode "USB" are memorized into the memory channel 7.

To change the operating memory channel, turn the MEMORY CHANNEL switch.

3-2-2 MEMORY-WRITE (PROGRAMMING THE MEMORY CHANNELS)

Any operating frequency, mode and HAM/GENE mode can be memorized into a memory channel.

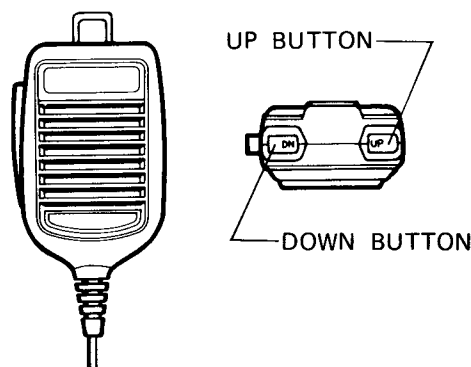
1. Set the operating frequency, mode and HAM/GENE mode to desired ones by a VFO. For example, set them for "15.725MHz", "AM" and "GENE" by using VFO B.

2. Select a memory channel to be memorized by turning the MEMORY CHANNEL switch. For example, select it at memory channel 10.
3. To check the contents in the memory channel, push the VFO/MEMORY switch, and the contents are displayed on the frequency display. If you don't like to rewrite these contents, select another memory channel which has contents erasable or no memorized frequency. (When no frequency has been memorized, no figure is displayed at the frequency position.) After checking, push the VFO/MEMORY switch again to return to the VFO.
4. One push of the MEMORY WRITE button erases the previous memorized contents (if any) and memorizes the displayed frequency, mode and HAM/GENE mode into the selected memory channel (at this time channel 10).
5. Memorize other desired frequencies into memory channels in the same manner. Memory channel 1 and 2 are used also for the PROGRAMMED SCAN. For PROGRAMMED SCAN operation, refer to "SCANNING OPERATION".

3-3 TUNING BY UP/DOWN BUTTONS ON THE MICROPHONE

3-3-1 FREQUENCY CONTROL

With each push of the UP or DN (down) button on the supplied microphone, IC-HM12, the operating frequency is changed one increment up or down respectively. In the same way, by depressing the button continuously, the operating frequency is changed up or down the same as turning the TUNING CONTROL. The tuning rate is according to the setting of the TUNING RATE switch.



This function is effective both in the VFO mode and in the MEMORY CHANNEL mode.

3-3-2 BAND SELECTING

In the VFO mode, when the BAND SELECT FUNCTION switch is pushed in, by depressing the UP or DN (down) button on the microphone continuously, the operating band is changed up or down respectively every one second.

3 - 4 SCANNING OPERATION

The IC-745 provides various scanning operations. Please read the following instructions carefully to fully enjoy the IC-745's many capabilities.

3 - 4 - 1 MEMORY SCAN

This is used to scan all programmed memory channels continuously.

1. Program your desired frequencies into memory channels.
2. Select a memory channel programmed with a frequency.
(The scan cannot start from a blank channel.)
3. Depress the SCAN START/STOP button, and the frequency starts scanning the programmed frequencies in the memory channels from the highest channel to lowest. At this time, the scan skips blank channels, if any.
4. If the SQUELCH is engaged, the scan stops when the squelch is opened and receives a signal. This restarts after passing a specified time.

To stop scanning without opening the squelch, depress the SCAN START/STOP button. Depress it again to restart the scanning.

3 - 4 - 2 PROGRAMMED SCAN

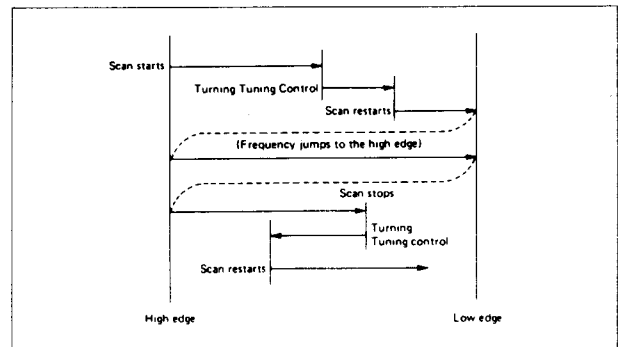
This is to scan between two desired frequencies, which are memorized in the memory channels "1" and "2".

CAUTION The programmed scan does not start when the contents of memory channels 1 and 2, and frequency display differ from which are described below.

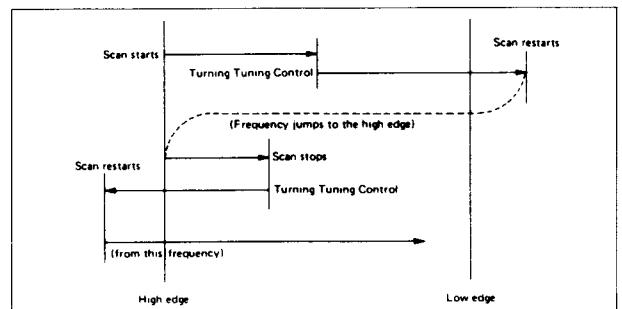
1. The same operation mode (HAM BAND or GENERAL COVERAGE mode) should be stored into memory channels 1 and 2. To start the scan, the set should be in the same operation mode as the memory channels.
 2. Stored frequencies in memory channels 1 and 2 should be in the same band, if the HAM BAND mode is stored in both memory channels 1 and 2. To start the scan, the set should be in the HAM BAND mode and in the same band as the memory channels.
1. Memorize the frequencies of the high and low edges of the desired scanning range into the memory channels 1 and 2. Regardless of which channel the higher frequency is memorized in, the scan starts from the high edge of the range.
For example, 14.200MHz is in the memory channel 1 and 14.300MHz in the channel 2.
 2. Place the unit in the VFO MODE and select operation mode the same as the channels 1 and 2, and a VFO you

desire. Pushing the SCAN START/STOP button starts the scan from the high edge (14.300MHz) to the low edge (14.200MHz). The scanning frequency increments depend on the TUNING RATE switch setting.

3. When the scanning frequency reaches the low edge (14.200MHz), it automatically returns to the high edge (14.300MHz) and continues scanning down to provide endless scanning operation.



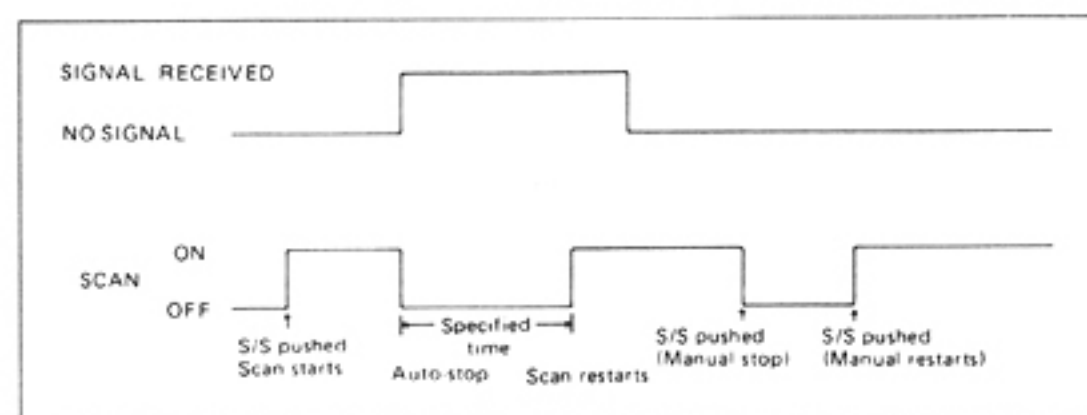
4. While the SQUELCH is engaged, the squelch opens when a signal is received and will stop the scanning automatically on the frequency, and the signal can be monitored. After approximately 10 seconds, the scan restarts from the frequency the scan stopped at, continuing to the low edge. If the RECEIVE indicator is lit because the SQUELCH is not engaged, the scan does not stop at any signals.
5. Depressing the SCAN START/STOP button while the scan is operating or during the 10 seconds of monitoring, clears the scanning operation and the VFO goes back to normal operation.
6. By turning the set into the transmit mode, or rotating the TUNING CONTROL, or pushing the VFO switch, VFO/MEMORY switch, or the MODE SELECT switch the scan stops and clears.
7. When the operating frequency is higher than the high edge (14.300MHz) and the SCAN START/STOP button is pushed, the scan starts from the operating frequency and scan down to the low edge, but it will return to the memorized high edge frequency (14.300MHz) and continue the scanning to the low edge. If the operating frequency is below the low edge frequency (14.200MHz), the scan frequency jumps to the high edge frequency (14.300MHz) and starts from the high edge.



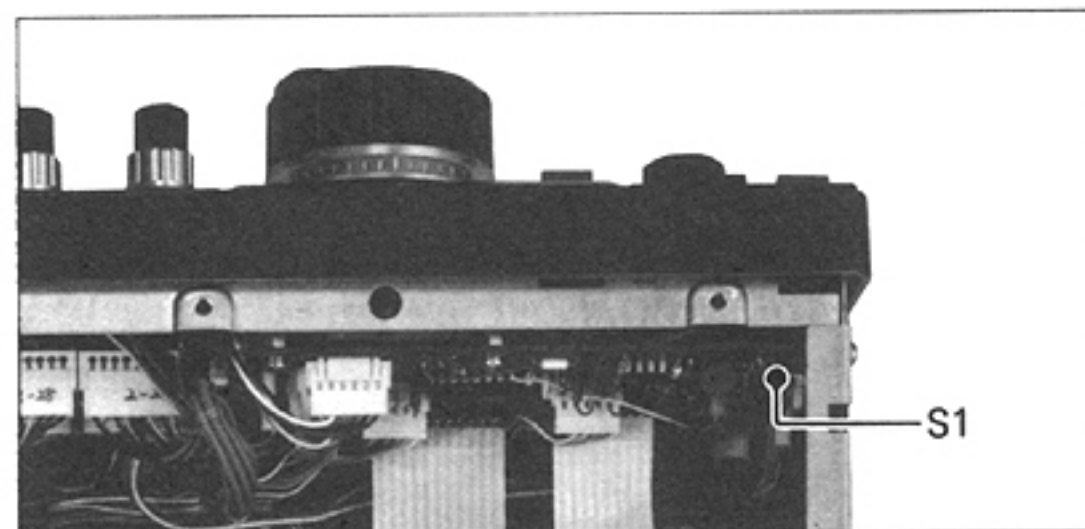
NOTE: The auto-stop functions with SSB or CW signals, but the scan does not always stop at the exact carrier frequency. When the scan stops on a signal, tune into the signal for better reception by pushing a MODE switch for the proper mode (if different) and by rotating the TUNING CONTROL.

3 - 4 - 3 RESUMING SCAN

All scan modes are provided with the resume scan function. When the scan has been stopped by the auto-stop function, the scan will restart after passing a specified time (about 10 seconds).

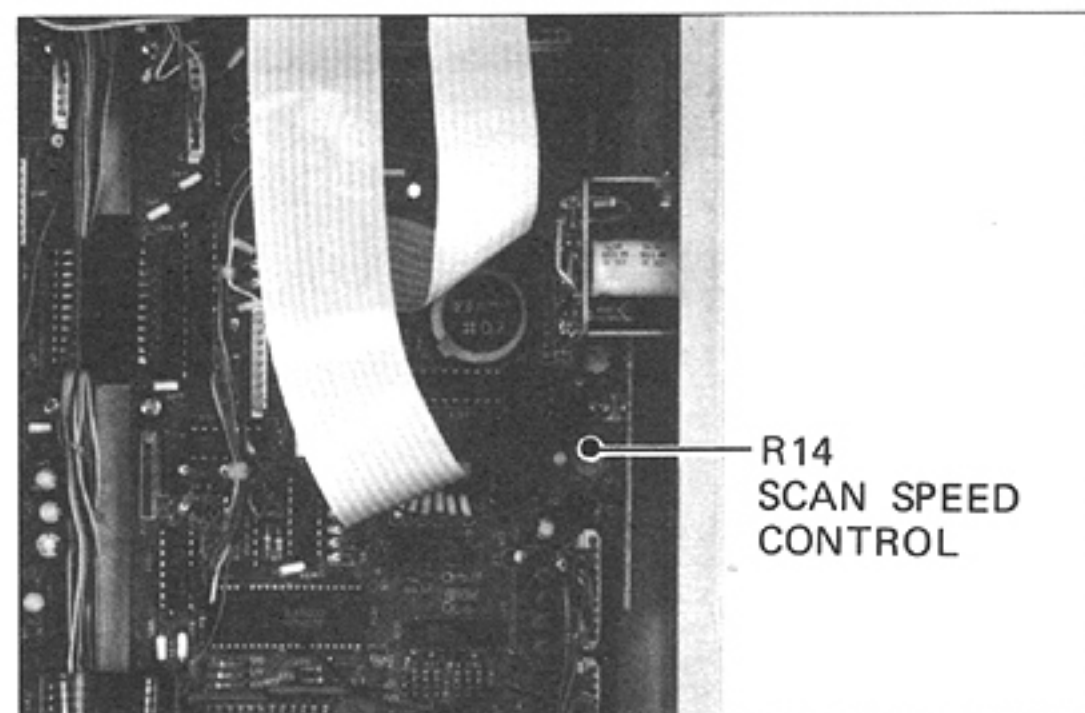


This function can be turned OFF by the switch (S1) in the MATRIX unit shown in the photo below. When this function is turned OFF, the scan function is cleared when a signal is received, and the operating frequency is locked on the frequency.



3 - 4 - 4 SCAN SPEED

The scanning speed of any scan mode can be adjusted by the SCAN SPEED CONTROL (R14) located in the LOGIC unit as shown in the photo. Rotating the control clockwise makes the scanning speed faster.



3 - 5 SSB OPERATION

3 - 5 - 1 RECEIVING

After connecting an antenna, microphone, etc., set knobs and switches as follows.

POWER SWITCH	OFF (OUT)
T/R SWITCH	RECEIVE (DOWN)
VOX SWITCH	OFF (OUT)
NOISE BLANKER (NB) SWITCH	OFF
NB LEVEL CONTROL	Completely Counterclockwise
AGC CONTROL	Center (12 o'clock) position
PREAMP SWITCH	OFF (OUT)
TUNING RATE SWITCH	OFF (OUT)
AF GAIN CONTROL	Completely Counterclockwise
RF GAIN CONTROL	Completely Clockwise
SQUELCH CONTROL	Completely Counterclockwise
TONE CONTROL	Center (12 o'clock) position
P.B. SHIFT CONTROL	Center position
BAND SELECT FUNCTION SWITCH	OFF (OUT)
RIT SWITCH	OFF
XIT SWITCH	OFF
DUPLEX (SPLIT) SWITCH	OFF (OUT)
DIAL LOCK SWITCH	OFF (OUT)
VFO/MEMORY SWITCH	OFF (OUT)
PBT SWITCH	IF SHIFT (OUT)
FILTER SWITCH	OFF (OUT)
NOTCH FILTER SWITCH	OFF (OUT)

The other controls are unrelated to receiving and need not be set at this time.

Now push the POWER switch in. The meter lamp will be illuminated, after a few seconds, a frequency, mode and HAM/GENE mode memorized in the VFO A will be shown on the frequency display.

In SSB operation there is both a USB (upper side band) and an LSB (lower side band). In the HAM bands, LSB is usually used on the 1.8, 3.5 and 7MHz bands, while USB is usually used on the 10MHz band and above. The IC-745 selects the normally used sideband according to the band in which you are operating.

If you wish to operate with the opposite sideband, push the MODE SELECT switch so that the opposite sideband can be selected.

When you wish to operate on another band than the displayed one (if the desired band is not a HAM band, push the HAM/GENERAL switch so that the GENERAL COVERAGE INDICATOR is illuminated.), push the BAND SELECT FUNCTION switch in, then turn the TUNING CONTROL so that the desired band is displayed.

Slowly turn the AF GAIN control clockwise to a comfortable level. Rotate the tuning knob until a signal is received. The meter needle will move according to the signal strength, so tune for the highest possible meter reading and the clearest audio. If you cannot get a clear signal, you may be receiving in the opposite sideband. If so, change the mode to the proper sideband.

Adjust the RF GAIN control and TONE control for comfortable reception.

If squelch operation is required to cut out noise when no signal is received, turn the SQUELCH control clockwise until the noise from the speaker stops and leave it just below this threshold.

For tuning, memory channel operation and scanning operation, please refer to 3 - 1 HOW TO TUNE, 3 - 2 MEMORY CHANNEL OPERATION and 3 - 4 SCANNING OPERATION.

3 - 5 - 2 NB (NOISE BLANKER)

Set the NB (noise blanker) switch in the NOR position when there is pulse type noise, such as ignition noise from automobile motors, and turn the NB LEVEL control clockwise so that noise will be suppressed and even weak signals will be received comfortably.

When the NB switch is set in the WIDE position, the noise blanker will effectively work for "woodpecker's noise", however, if the receiving signal is too strong, the noise blanker may work with the receiving signal itself, and some distortion may cause in the receiving audio or keying form. At this time, set the N.B. Switch in the NOR position, or turn the NB switch OFF.

3 - 5 - 3 AGC (AUTOMATIC GAIN CONTROL)

The IC-745 has a fast attack/slow release AGC system which holds the peak voltage of rectified IF signals from the IF amp circuit for a certain period. Therefore, during the pauses in normal speech of the received signal, uncomfortable noise will not be heard. The meter indicates the peak value for a certain period, facilitating reading of the meter "S" function.

For normal SSB reception, turn the AGC control clockwise to the SLOW position. Turn the AGC control counter-clockwise to the FAST position, when tuning or receiving signals with short interval fading. When in the FAST position, the time constant is shortened.

When this control is set at the OFF position, the AGC circuit is turned OFF, and the S-meter does not work even if a signal is received. However the RF GAIN control is still active and the needle of the meter moves depending on the control position.

3 - 5 - 4 PREAMP SWITCH

Turn the PREAMP Switch ON (in) when receiving weak

signals. In the ON position, an RF preamplifier is inserted into the receiving antenna circuit, increasing sensitivity and giving easy reception.

3 - 5 - 5 PASS-BAND SHIFT CONTROL

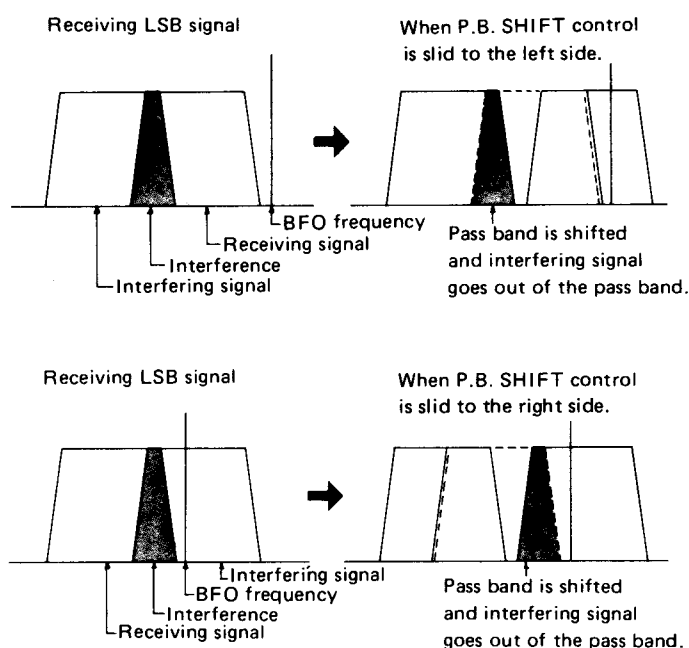
Pass-Band Shift Control is a system in the receive mode to shift the pass-band of the IF upper or lower side continuously. This is very effective in reducing interference from nearby signals.

To use the Pass-Band (IF) Shift system, set the PBT switch in the IF (out) position and slide the control toward right or left side. The center position is the normal pass-band condition.

For example, while receiving in the LSB mode, if you get interference from a lower frequency (interfering signals are high pitched tones), shift the pass-band by sliding the P.B. SHIFT control to the left side. When the interfering signals are low-pitched tones, they are from a high frequency, and you should shift the pass-band by sliding the P.B. SHIFT control to the right side.

When receiving in the USB mode, the pass-band is shifted in the opposite manner. Interference from a higher frequency will be high-pitched tones, and the P.B. SHIFT control should be slid to the right side. Interference from a lower frequency will be low-pitched tones and the P.B. SHIFT control is slid to the left side.

This control can also be used for audio tone adjustment, so it may be set for the most comfortable reception.



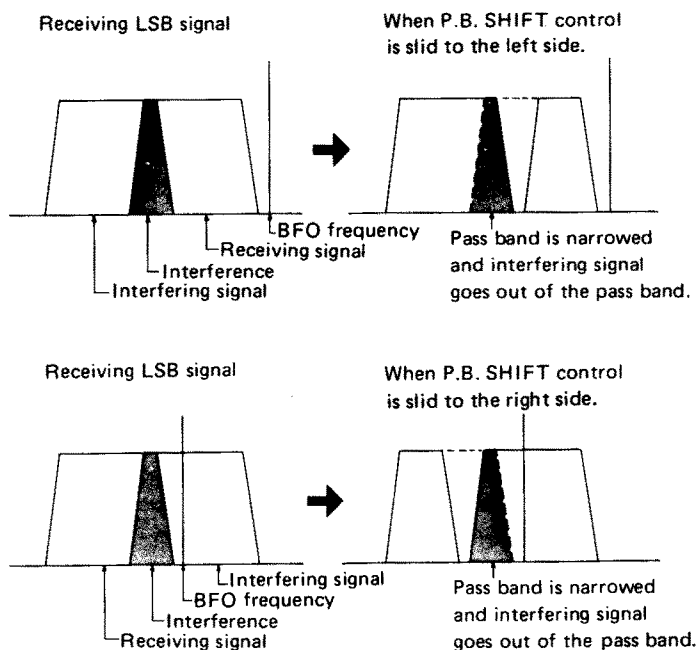
When the PBT switch is set in the PBT (in) position, the Pass-Band Shift system will be changed to the Pass-Band Tuning system.

The Pass-Band Tuning (PBT) is a system in the receive mode

to narrow the bandwidth (selectivity) of the frequencies that will pass through the crystal filter electronically from either the upper or lower side continuously by up to 800Hz. This is very effective in reducing interference from nearby signals.

To use the PBT system, slide the control the same as the Pass-Band Shift system.

The center position is the widest position and is equivalent to the normal SSB band width.



3-5-6 FILTER SWITCH

This switch selects the combination of the internal filters. When an optional filter is installed, this function will be more effective. Select and install the optional filter(s) to suit your favorite mode(s).

3-5-7 NOTCH FILTER

This circuit notches a frequency in the IF pass-band, so this is effective to reduce interference such as a beat-tone signal.

To use this function, push the NOTCH FILTER switch ON and slide the NOTCH FILTER control so that the interference is reduced.

3-5-8 TRANSMITTING

Before transmitting, listen in the receive mode to make sure your transmission will not interfere with other communications. If possible, use a dummy load for adjustment instead of an antenna. Set knobs and switches as follows.

MIC GAIN	CENTER (12 o'clock) position
RF POWER CONTROL	Fully Counterclockwise
METER SWITCH	ALC

Other knobs and switches are left in the same positions as for receiving. When the T/R switch is moved to transmit,

or when the PTT (push to talk) switch on the microphone is depressed, the TRANSMIT Indicator is illuminated. By speaking into the microphone, the meter needle will move according to the strength of your voice and SSB signals will be transmitted. Set the MIC GAIN control so that the meter needle stays well within the ALC zone at voice peaks. If you wish to increase the output power, turn the RF POWER Control clockwise and adjust to obtain the desired RF output power of between 10 watts and 100 watts (approximately).

Change to the receive mode by moving the T/R switch to receive, or release the microphone PTT switch.

3-5-9 HOW TO USE THE SPEECH PROCESSOR

The IC-745 has a low distortion RF stage speech processor which enables greater talk power and better results in DX operation. Follow the steps below for use of the Speech Processor:

MIC GAIN CONTROL CENTER (12 o'clock) position

RF POWER CONTROL Fully Counterclockwise

COMP SWITCH ON

METER SWITCH RF

Switch to transmit and turn the RF POWER CONTROL clockwise while speaking into the microphone until you obtain the desired RF "PEAK" output power of between 10 watts and 100 watts (approximately).

Turn the METER SWITCH at the COMP position, then adjust the MIC GAIN CONTROL to a point where the meter needle swings between 10dB and 20dB on the COMP scale.

The Speech Processor should be turned OFF or MIC GAIN CONTROL carefully set for minimum compression for all communication other than DX operation for a very natural voice quality.

3-5-10 HOW TO USE THE VOX CIRCUIT

The IC-745 has a built-in VOX (voice operated relay) which allows automatic T/R switching by voice signals into the microphone. For VOX use, set the knobs and switch as follows:

VOX GAIN CONTROL	Fully Counterclockwise
VOX DELAY CONTROL	Fully Clockwise
ANTI VOX CONTROL (on the top)	Fully Counterclockwise

Push the VOX switch on the front panel to the ON (in) position. Leaving the T/R switch in the RECEIVE position and without pushing the PTT switch, turn the VOX GAIN

control clockwise while speaking into the microphone. At a certain point, the T/R switching circuit will be activated by your voice. This is the proper position for the VOX GAIN control. Set the VOX GAIN control at a level which provides for T/R switching at your normal voice level.

Transmit-release time (the time delay before the set automatically returns to receive when you stop talking) is controlled by the VOX DELAY control. Turning the control counterclockwise makes the time shorter. Set it at a position which is comfortable and which allows for short pauses in normal speech.

Adjust the ANTI VOX control so that the VOX circuit is not activated by sounds from the speaker by turning the control clockwise while receiving a signal.

3-5-11 MONITOR

The transmitting IF signals can be monitored in the SSB mode. So you can check the quality of the transmitting signals and conditions of the speech processor and so on.

To use this function, turn the MONITOR switch on the top cover ON and adjust the AF GAIN control to a comfortable audio level. At this time, use headphones to prevent howling which will be caused by picking up sounds from the speaker.

3-6 CW OPERATION

3-6-1 RECEIVING

For CW reception, set the operating mode for CW by pushing the MODE SELECT switch.

Other switches and knobs are set the same as for SSB reception.

In addition to the crystal band-pass filter, Narrow filters are optional for this unit. When the FILTER Switch is set at the ON (in) position, this filter is activated and the total selectivity of CW reception is improved. With these filters, internal noise is reduced for comfortable CW reception and an improved signal to noise ratio (S/N).

Also, use the Noise Blanker, AGC switch and/or PREAMP Switch depending on the receiving conditions, the same as SSB reception.

3-6-2 TRANSMITTING

Insert the keyer plug into the KEY Jack on the rear panel of the unit, and set knobs and switches as follows:

RF POWER CONTROL	Fully counterclockwise
METER SWITCH	RF
VOX GAIN/KEYER SPEED CONTROL	OFF

Other knobs and switches are set the same as for CW reception.

By setting the T/R switch to TRANSMIT, the TRANSMIT indicator is lit and shows that you are ready for CW transmission. When you key the keyer, the meter needle moves and your CW signal is transmitted. To increase the transmitting power, turn the RF POWER Control clockwise to adjust while watching the meter needle on the Po scale for the desired output power.

When the optional keyer unit is installed, connect an iambic paddle with the supplied 3-P key plug to the KEY jack on the rear panel.

Then adjust keying speed by turning the VOX GAIN/KEYER SPEED CONTROL clockwise for your favorite keying speed.

The other procedures are the same when using a hand keyer or an external electronic keyer.

3-6-3 CW SIDE-TONE (MONITOR)

When keying the side-tone oscillator is activated and an 800Hz tone will be heard. The loudness of the tone is controlled by the CW MONI Control located under the top cover. Rotating the control clockwise will increase the loudness. This tone is also audible in the receive mode and can be used for code practice, adjustment of the keyer, etc.

3-6-4 SEMI BREAK-IN OPERATION

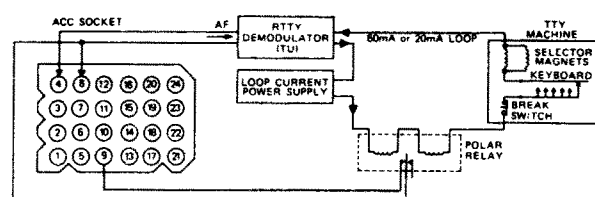
The IC-745 has Semi Break-In CW capability when using the VOX function. When keying, the unit is automatically set in the transmit mode. After keying, it is returned to the receive mode, also automatically, after a given transmit-release delay time constant. Leave the T/R switch in the RECEIVE position, and set the VOX switch in the ON (IN) position.

The transmit release delay time constant is set by adjusting the VOX DELAY Control. Turning the VOX DELAY Control clockwise will make the transmit release time longer. Set it for your own keying speed.

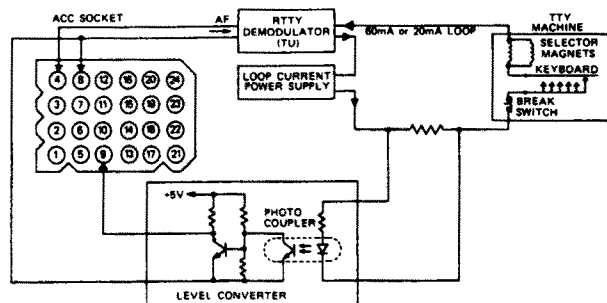
3-7 RTTY OPERATION

For RTTY operation, a teletypewriter (or an equivalent) and a demodulator (terminal unit) which is operational with audio input are required. Any demodulator with 2125/2295Hz filters (narrow, 170Hz shift) can be used with the IC-745.

When a highspeed relay is used.



When a level converter is used.



3-7-1 RECEIVING

Audio signals for the demodulator can be supplied from Pin 4 of the ACC socket on the rear panel, or from the PHONES jack on the front panel. The level of the audio signals from Pin 4 of the ACC socket does not vary by turning the AF GAIN Control, and the level is about 300mVp-p maximum.

Set the operating mode for RTTY, by pushing the MODE SELECT switch. The other controls are the same as those for SSB reception. When tuning a RTTY signal, set the TUNING RATE switch OFF (out) position, and tune to get audio signals of 2125Hz for MARK and 2295Hz for SPACE. (Use the tuning indicator of the terminal unit for easy tuning.) Also adjust the P.B. Tune control for clear reception.

When an optional CW narrow filter is installed, by setting the FILTER switch ON, the narrow filter is activated and the total selectivity of the RTTY reception is improved (250Hz or 500Hz/-6dB) the same as the CW mode.

If you wish to receive RTTY signals which have wider shift such as 425Hz and 850Hz shifts, prepare a demodulator suits for the shift and turn OFF the FILTER switch.

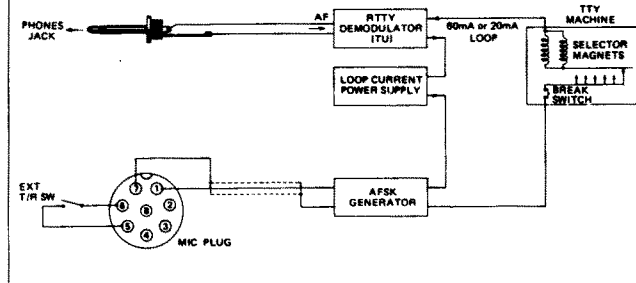
3-7-2 TRANSMITTING

For keying of the Frequency Shift Keying (FSK) circuit insert a high speed relay's coil into the loop current circuit of the teletypewriter, and connect the relay contacts to Pins, 8 and 9 of the ACC Socket on the rear panel. The relay contacts make during the Space and break during the Mark, as shown in the drawing. Fine adjustment of the MARK and SPACE frequencies can be done by adjusting the coil cores in the MAIN unit.

When a level converter for TTL level signals is used, connect the output of the converter to Pins 8 (ground) and 9 of the ACC Socket, apply High level (5V) signals for the Mark, and Low (0V) for the Space.

When using an AFSK generator that has 2125Hz for Mark and 2295Hz for Space, connect the output signals for the AFSK to the Mic connector on the front panel and set the Mode to LSB. (See Other Operations chapter.) Doing this, you can use the VOX operation available in this mode, and receive/transmit changeover is very easy.

When an AFSK generator is used



If you wish to transmit continuously 10 minutes or more, reduce the output power to less than 70% of the full power, by rotating the RF POWER control on the front panel.

3-8 AM OPERATION (RECEIVE ONLY)

Set the operating mode for AM by pushing the MODE SELECT switch. The other controls are the same as those for SSB reception, except the PASS BAND TUNING. The Pass Band Tuning control does not work in this mode.

By pushing the FILTER switch, a better selectivity (the same as for SSB) will be provided.

When tuning an AM signal, tune for maximum signal strength as indicated on the meter.

NOTE: In this mode, the set does not transmit on any band.

3-9 FM OPERATION (OPTION)

3-9-1 RECEIVING

Set the operating mode for FM, by pushing the MODE SELECT switch. The other controls are the same as those for SSB reception, however, the Pass Band Shift (Tune) control, Notch Filter, Noise Blanker and AGC circuits do not work in this mode.

When tuning an FM signal, tune for maximum signal strength as indicated on the meter and the clearest audio.

3-9-2 TRANSMITTING

Transmitting FM signals is essentially the same as SSB transmission.

Set knobs and switches the same as for SSB operation. However the speech processor can not be used on this mode.

When transmitting the FM signals, the meter (in RF position) will indicate the carrier power, but the meter needle does not move according to your voice such as SSB transmitting.

NOTE: Most countries may not allow to use the FM mode on HF HAM band except 28MHz.

3 - 10 GENERAL COVERAGE RECEIVER

In this mode, the set does not transmit on any frequency, even if the frequency is on the HAM band.

Set knobs and switches as follows.

POWER SWITCH	OFF (OUT)
T/R SWITCH	RECEIVE (DOWN)
VOX SWITCH	OFF (OUT)
NOISE BLANKER (NB) SWITCH	OFF
NB LEVEL CONTROL	Completely Counterclockwise
AGC CONTROL	Center (12 o'clock) position
PREAMP SWITCH	OFF (OUT)
TUNING RATE SWITCH	OFF (OUT)
AF GAIN CONTROL	Completely Counterclockwise
RF GAIN CONTROL	Completely Clockwise
SQUELCH CONTROL	Completely Counterclockwise
TONE CONTROL	Center (12 o'clock) position
P.B. SHIFT CONTROL	Center position
BAND SELECT FUNCTION SWITCH	OFF (OUT)
RIT SWITCH	OFF
XIT SWITCH	OFF
DUPLEX (SPLIT) SWITCH	OFF (OUT)
DIAL LOCK SWITCH	OFF (OUT)
VFO/MEMORY SWITCH	OFF (OUT)
PBT SWITCH	IF SHIFT (OUT)
FILTER SWITCH	OFF (OUT)
NOTCH FILTER SWITCH	OFF (OUT)

The other controls are unrelated and need not be set for this operation.

Now push the POWER switch in. The meter lamp will be illuminated and after a few seconds a frequency, mode and HAM/GENERAL mode memorized in the VFO A will be shown on the frequency display.

If the operation mode is in the HAM band mode (The GENERAL COVERAGE indicator is not illuminated.), push the HAM/GENERAL COVER SELECT switch, and the indicator will be illuminated and the set will work in the GENERAL COVERAGE mode.

In SSB operation there are both a USB (upper side band) and an LSB (lower side band). The desired mode can be selected by pushing the MODE SELECT switch.

The selected mode does not change on the entire band. For example, LSB has been selected on 8MHz band then the operating band is changed to 10MHz band or above, the operating mode, "LSB", will be kept.

When you wish to operate on a band (MHz range) other than the initialized band (MHz range), push the BAND

SELECT FUNCTION switch, then turn the TUNING CONTROL to select the band (MHz range) you wish to operate. Slowly turn the AF GAIN control clockwise to a comfortable level. After releasing the BAND SELECT FUNCTION switch, rotate the TUNING CONTROL until a signal is received.

The meter needle will move according to the signal strength, so tune for the highest possible meter reading and the clearest audio.

Refer to 3 - 5 - 2 ~ 7 for other functions, 3 - 6 - 1 for CW reception, 3 - 7 - 1 for RTTY reception, 3 - 8 for AM reception and 3 - 9 - 1 for FM reception.

3 - 11 OTHER OPERATIONS

3 - 11 - 1 VSWR READING

The IC-745 has a built-in VSWR meter for checking antenna matching in order to avoid problems caused by VSWR. Set the METER SELECT switch to the SET position. Set the operating mode to RTTY, and turn the TRANSMIT/RECEIVE switch to TRANSMIT.

Adjust the RF POWER control so that the meter needle points to "SET" on the meter scale. Set the METER SELECT switch to the SWR position. With the switch in the SWR position, SWR reading can be seen on the meter. Although this unit is built to handle VSWR of up to 2:1, it is recommended that the antenna(s) be adjusted for the lowest possible VSWR. After taking the reading, return the switch to the other position. ALSO BE SURE THAT THE ANTENNA IMPEDANCE IS 50 OHMS OR THERE MAY NOT BE ANY OUTPUT. OTHERWISE THERE WILL BE DAMAGE TO THE TRANSCEIVER.

The final transistors used in the IC-745 are of good design and are protected to a reasonable extent by circuits incorporated in the set. These devices can be expected to have an indefinite lifetime since there are no cathodes to burn out. Under some conditions, however, they can be abused beyond tolerance and may have to be replaced.

When in doubt about antenna systems, use the lowest power setting possible to achieve meaningful readings. Use a good tuner or transmatch when necessary. Always use caution and exercise judgement when testing RF power generators.

3 - 11 - 2 WWV RECEPTION

To receive WWV (or other standard frequency station), set the operating band to 10MHz in the HAM band or GENERAL COVER mode, and the MODE to any mode. Tune to 10.000.0MHz on the frequency display.

Since the IC-745 has a General Coverage receiver built-in, any frequency's WWV can be received. Merely set to the

GENERAL COVERAGE mode and tune to the desired frequency.

The WWV signal can be used for alignment of a frequency counter, marker oscillator, or the frequency display.

3 - 11 - 3 SIMPLE FREQUENCY ALIGNMENT

A very accurate frequency counter is necessary to align the frequency of the IC-745. However, the frequency can be aligned simply by receiving the WWV signal.

1. Set the frequency display to 10.000.0MHz and be sure that you are receiving the WWV signal.
2. Set the operating mode to CW. An 800Hz beat can be heard.
3. Short the KEY Jack on the rear panel so that the CW side-tone also becomes audible.
4. Adjust the CALIBRATOR Control, located on the top cover, so that the two tones are of the same pitch (in zero beat). If the tones are difficult to adjust because of a difference in their strengths, adjust the CW side-tone level with the CW MONI control, located on the MAIN unit (under the top cover), until the strengths are the same.

When the optional marker unit, IC-EX241 is installed, operating frequency can be calibrated each 25KHz or 100KHz on the all bands.

WHEN ALIGNING THE FREQUENCY, DO NOT PUT THE UNIT IN THE TRANSMIT MODE.

Be sure the T/R switch is in the RECEIVE position, the VOX switch is OFF, and that you do not touch the PTT switch on the microphone.

3 - 11 - 4 RECEIVE ANTENNA TERMINALS

The RECEIVE ANT IN jack is connected to the input terminal of the receiving section, and the RECEIVE ANT OUT jack is connected to the antenna connector through the internal T/R antenna switching circuit.

These two jacks are normally jumpered with a cable, but can be used for:

1. A receiving preamplifier.
2. A separate receiver.
3. Separate receiver and transmitter antennas.

If you wish to use a receiver preamplifier, connect it between the receiver input and antenna output terminals.

If a separate receiver is used, connect it to the receiver antenna output terminal. For a separate receive antenna connect it to the receiver input terminal.

3 - 11 - 5 TRANSVERTER CONNECTION

When a transverter control signal (+8V) is applied to Pin 11 of the ACCESSORY socket, the TRANSVERTER terminal

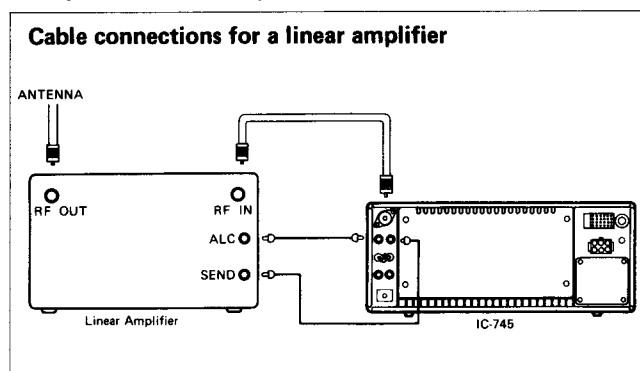
can be used for a VHF/UHF transverter INPUT/OUTPUT terminal.

The transverter's input/output frequency and signal level should be as follows:

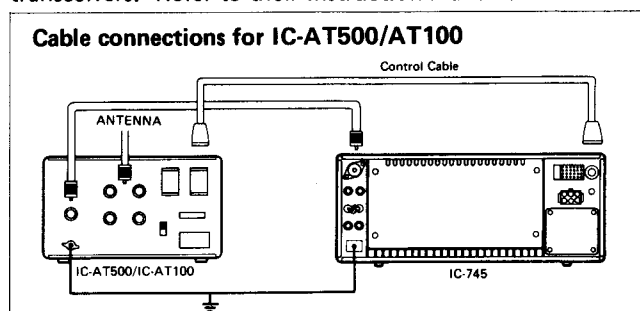
- Transverter INPUT/OUTPUT Frequency
28 ~ 30MHz
- Input/Output Level
Transmit (Output) : Max. 150mV across a 50 ohm load
Receive (Input) : 1 μ V for S/N 10dB

3 - 11 - 6 LINEAR AMPLIFIER CONNECTION

The jacks on the rear panel marked "ALC" and "SEND" are a relay built-in for keying a linear amplifier, and the input for ALC from the linear amplifier. For linear amplifier hookup the SEND jack is for an internal relay and the ALC jack is for ALC input.



The optional linear amplifier IC-2KL and automatic antenna tuner IC-AT100/AT500 can be connected to the IC-745 with their accessory cables as same as other ICOM HF transceivers. Refer to their instruction manuals for detail.



The IC-745 puts out the band control voltage to change operating band automatically for external equipment such as linear amplifier and antenna tuner. The voltage is put out from Pin 13 of the accessory socket.

Band Control Voltage Chart

BAND (MHz)	Band Control Voltage
1.8	7.0 ~ 8.0V
3.5	6.0 ~ 6.5V
7	5.0 ~ 5.5V
14	4.0 ~ 4.5V
18 - 21	3.0 ~ 2.5V
24 - 28	2.0 ~ 2.5V
10	0 ~ 1.2V

3-11-7 COOLING FAN

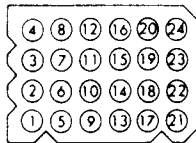
The rear of the PA unit is designed to provide for adequate cooling, but with 200 Watts input the final stage produces quite a bit of heat, and its temperature may rise during prolonged transmissions. The fan is connected to a temperature monitoring circuit which monitors the temperature of the final stage. The fan operates as follows:

1. The fan does not operate both in the receive and transmit modes.
2. When the temperature rises to a point (50°C) detected by the monitor circuit the fan will operate during both transmit and receive to provide additional cooling.
3. If the temperature rises to a danger limit (90°C) the fan will run much more rapidly. At this time the output power is reduced to 50 Watts. Investigate the cause of overheating i.e. antenna mismatch, etc. and correct the cause of the overheating before starting to transmit again.

3-11-8 ACCESSORY (ACC) SOCKET

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

ACC SOCKET CONNECTIONS



PIN No.	FUNCTION
1.	Output from the discriminator circuit. (When optional FM unit is installed).
2.	13.8 Volt 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 receive 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 Volt DC is 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.	NC (No Connection)
11.	Input for TRANSVERTER control. When 8 Volt DC is applied, the set can operate with a transverter.
12.	Output reference voltage for band switching.
13.	Output for external band switching.
14.~24.	NC

3-11-9 CAUTIONS

As the unit has already been closely adjusted with highly sophisticated measuring instruments, never tamper with the turnable resistors, coils, trimmers, etc.

C-MOS is used in the Logic unit as well as the PLL. C-MOS ICs are very susceptible to excessive static charges and over current and care must be used when handling them. Therefore, avoid touching the Logic unit and the nearby circuitry unless absolutely necessary. When it is necessary to check the circuitry, observe the following points.

Ground all measuring instruments, the soldering iron, and other tools. Do not connect or disconnect the C-MOS IC from its socket, or solder it when the power is on. Do not apply voltage of less than -0.5 or more than +5 Volts to the input terminals of the IC. DO NOT MEASURE WITH AN OHMMETER.

SECTION 4 CIRCUIT DESCRIPTION

4 - 1 RECEIVER CIRCUITS

4 - 1 - 1 RF SECTION (RF Unit)

Receiving signals of 100 - 1600KHz and 1.6 - 30MHz from the separated antenna connectors are fed to the RF unit through the connector unit,

Receiving signal of 1.6 - 30MHz passes a high-pass filter, consisting of L87, L88 and C177 - C181, which attenuates strong radio signals on the middle wave BC band, and then goes to one of the nine band-pass filters for various frequency ranges.

When the PREAMP switch on the front panel is on, the emitter of Q14 is grounded to turn on RL1, and an RF preamplifier of Q11 and Q12 is turned on.

When a transverter is in use, TRV8V is supplied to the base of Q15 and the base of Q14 is grounded to turn off RL1.

The gain of this preamplifier is more than 8dB and the intercept point is +26dBm.

D35 is turned on by the bias voltages R8V and TRV8V through D38 and D39. In the transmit mode, Q10 is turned on to improve the isolation from transmit RF output signals.

A signal on 100 - 1600KHz is fed to the 20dB attenuator of DS1, R72, and R73 to attenuate strong signals from AM broadcasting stations.

Signals of both the frequency ranges are fed through a low-pass filter of C34, C35 and L15 - L17, to the first mixer.

4 - 1 - 2 IF SECTION (RF Unit)

The received signal is converted to the 70.4515MHz first IF signal in a double-balanced mixer. The first LO output signal from the PLL unit is amplified by Q1 to more than +10dBm before being applied to the mixer.

The image rejection ratio and spurious response rejection ratio are improved by use of the up-conversion mixer.

Q4 and Q3 comprise a two-stage first IF amplifier with about 20dB gain. The first IF signal is filtered by a monolithic crystal filter F11 and F12 (70M15B) to improve the second image characteristics by removing strong signals in the same band, and then fed to the second mixer.

The second LO signal (61.44MHz) from the PLL unit is fed to the second mixer to convert the receiving signal to the 9.0115MHz second IF signal, which is fed through the noise blanker gate to J5 of the IF unit.

(a) Noise Blanker Circuit (RF Unit)

The output signal from the second mixer through D4 and C48 is amplified by Q9 and IC6, and rectified by D7. When the output voltage exceeds 0.6V RMS, the AGC voltage is supplied to Pin 3 of IC3 through Q7 and Q8. The AGC attack time constant is determined by R34 and C65 when the NB switch on the front panel is at WIDE and by R35 and C65 at NORMAL. The release time constant is determined by R32, R33, R35 and C65.

The output signal from D7 is also supplied to Pin 2 of IC5. When a pulse noise is received, IC5 outputs a high-level signal to drive Q6 to make R71 to the ground level.

The source voltage of Q9 is controlled by the NB LEVEL

control on the front panel to control the gain of the noise amplifier. L20 and L21 at the noise blanking gate comprise a dual-tuned circuit to suppress the spurious output from the second mixer.

Receiving signal without noise components passes through D8 and D9, which are turned on by R23 - R25, and D10 is turned off by a bias voltage. However signal with noises passes through D10, which is turned on by R23, and D8 and D9 are turned off by a bias voltage.

The signal through the noise blanking gate is output from J5 to the IF unit.

(b) PBT, IF SHIFT, NOTCH FILTER (IF Unit)

The second IF signal from J5 of the IF unit passes through D19 and the filter selected by the MODE and the PBT/IF SHIFT switches on the front panel.

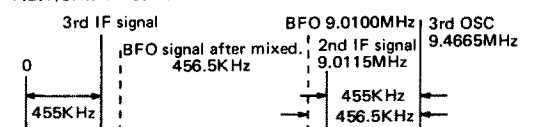
When the IF SHIFT is selected or when in AM or FM mode, the signal passes through FI3 (9M15A $\pm 7.5\text{KHz}/-3\text{dB}$). The filter switching circuit is composed of Q13, Q14, D42 - D45, D47 - D53 and D36. The signal through the filter is amplified by Q12, of which the secondary coil L9 is used for a notch filter circuit. The notch frequency is shifted by the voltage change at the cathode of D30 controlled by the NOTCH FILTER CONTROL on the front panel. The frequency variation is $9.0115\text{MHz} \pm 1.52\text{KHz}$ and the attenuation is more than 30dB.

To obtain stable notch operation, the output impedance of Q12 is held high by use of the source follower Q10, and it is supplied to the third mixer IC2.

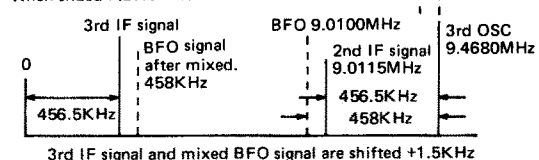
The LO signal from Q8 to Pin 7 of the mixer IC2 can be varied by $\pm 1.5\text{KHz}$ from 9.4665MHz, thus the receiving signal from Q10 is converted to the 455KHz third IF signal. The frequency of the converted signal is varied according to the frequency shift of the LO signal. The signal from Q8 is also applied to the BFO, and when the LO frequency is varied, the IF SHIFT is effected.

For example : LSB 9.0115MHz

P.B.T./SHIFT : Center

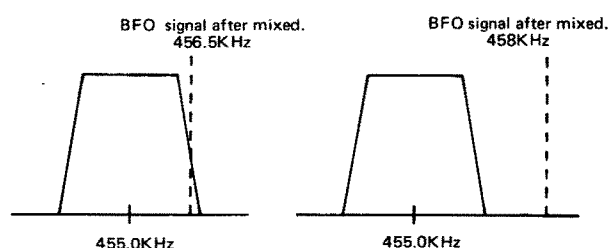


When slid P.B.T. +1.5KHz

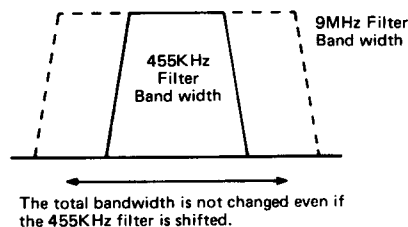


Normal

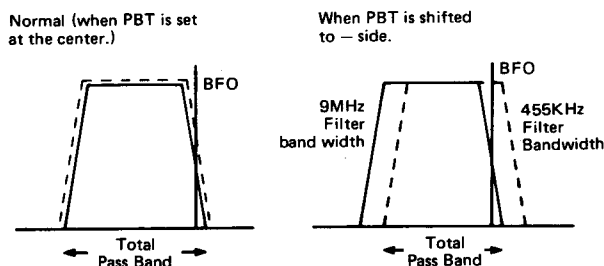
When slid PBT +1.5KHz



When the bandwidth of the 9MHz filter is wide enough for the bandwidth of the 455KHz filter and the SHIFT frequency, this system functions as a IF shift circuit.



When the bandwidth of the 9MHz filter is as wide (narrow) as that of the 455KHz filter, the total bandwidth becomes narrower as the LO frequency is shifted, and the system functions as a pass band tuning circuit.



The receiving signal from IC1 is fed through D28 to a 455KHz filter, which determines the selectivity, and then through an emitter follower Q4, for a low impedance output, to the MAIN unit through J2.

4 - 1 - 3 AF SECTION (MAIN Unit)

The 455KHz IF signal from the IF unit is input to J1 of the MAIN unit, amplified by IF amplifiers Q1 and Q2, and fed to Pin 5 of the double-balanced demodulator IC1.

The SSB, CW or RTTY signal is demodulated by the BFO signal to Pin 7 of IC1. The AM signal is detected by D6 and buffered by Q3.

The detected signal passes through squelch circuit Q10 to the AF GAIN control on the front panel, by which the CW sidetone and SSB monitor audio levels are also controlled.

Q10 is turned on when the gate level is high and off when it is low.

The audio signal controlled by the AF GAIN control is amplified by Q30 in the CW mode and by Q29 in other modes. The output signal from the amplifier is selected by D29 and D30 and fed to Pin 1 of the AF power amplifier IC5 to drive a speaker. Q30 comprising a phase oscillator circuit functions as an active filter with the center frequency of about 800Hz.

Part of the demodulator output signal is amplified by Q6 and output to the ACC connector on the rear panel and is unaffected by the AF GAIN control. (Impedance: approximately 5K ohm, approximately 0.4Vp-p at SSB or AM 30% mod.)

(a) BFO circuit (MAIN Unit)

The BFO signal is generated by Q14 and X1, X2 or X3, buffered by Q15, fed to Pin 5 of IC2, where the signal is mixed with the PBT LO (9.4665MHz) for the 455KHz (\pm SHIFT frequency) BFO signal. L7 and C57 comprises a low-pass filter.

In the USB mode, D11 is turned on by 8V supplied through R69, X2 oscillates at 9.0130MHz with C46, and the output signal is mixed at IC2 for the 453.5KHz \pm PBT SHIFT frequency. At this time, D10 and D12 are inversely biased. In the LSB mode, D12 is turned on by 8V supplied through R73, X3 oscillates at 9.0100MHz with C52, and the output signal is mixed at IC2 for the 456.5KHz \pm PBT SHIFT frequency. At this time, D10 and D11 are inversely biased. In the RTTY mode, for the space signal transmission, Q40 is turned on, Q13 is off, and Q12 is on. Thus C42 is grounded for X1 to oscillate at 9.01167Hz with C42. The output frequency of IC2 is 454.82KHz \pm PBT SHIFT frequency.

For the mark signal in the RTTY mode and for CW-T mode, Q40 is turned on and Q12 is off to turn D9 on by supplying 8V through R60. Thus, L6 is grounded to shift the oscillating frequency of X1 to 9.01150MHz. The output frequency of IC2 is 455.00KHz \pm PBT SHIFT frequency.

In CW-R, Q13 is on and D12 is off to supply 8V to turn on D8 through R59. Thus, L5 is grounded, as well as L6, to shift the X1 frequency to 9.01070MHz. The IC2 output frequency is 455.70KHz \pm PBT SHIFT frequency.

In the RTTY-R mode, Q13 is on and Q12 is off, Q10 is turned on by 8V supplied to its base through R58. Thus, the frequency of X1 is determined by L4, as well as L5 and L6, for 9.009375MHz. At this time D8 and D9 are inversely biased. The output frequency of IC2 is 457.125KHz \pm PBT SHIFT frequency.

The power supply to Q14, Q15, IC1 and IC2 is controlled by Q39 and turned off in the AM or FM mode to turn off the BFO and product detector.

(b) Squelch Circuit (MAIN Unit)

The AGC voltage is supplied to Pin 6 of IC6 and the voltage controlled by the SQUELCH control on the front panel is supplied to Pin 5. IC5 comprises a comparator for the voltages at Pins 5 and 6. The output voltage of IC5 turns on Q22 and Q21, making the gate level of Q10 high to drive the squelch circuit.

(c) AGC Circuit (MAIN Unit)

The output signal from Q2 is buffer-amplified by Q5 and rectified by D4 and D5. The rectified signal passes through the emitter follower Q4 and charges the peak-hold circuit of R35 and C122. The delay time constant can be varied by adjusting the AGC TIMING control on the front panel. In the AM mode, R250 and C123 are connected in parallel to prevent the AGC from following the AM modulation signals when the AGC is set at FAST.

The obtained voltage is compared by Q15 and Q16 with the voltage set by the RF GAIN control, and then output to the MAIN, IF and RF units as the AGC voltage.

(d) S-meter

The AGC voltage is input through R174 to Pin 2 of IC6 for inverting amplification, and its output signal is fed through the SW-C unit to the meter after the level is adjusted by R172 and R171, which are for the S9 level adjustment and for the fullscale adjustment.

4 - 2 TRANSMITTER CIRCUITS

4 - 2 - 1 AF SECTION (MAIN Unit)

AF signal from the mic connector is amplified about 30dB by IC3, and then fed to the VOX GAIN control and the MIC GAIN control.

For use with a microphone with a built-in amplifier, such as the IC-SM5, the gain of the amplifier (IC3) can be reduced to approximately 6dB by removing R83.

The signal through the MIC GAIN control is amplified by Q9 and fed to Pin 5 of the balanced modulator IC1, of which Pin 7 is for the BFO input and Pin 5 is for the DSB output to the IF unit through J4.

The output is muted by Q7 in the receive mode or in the CW or RTTY mode. In CW or RTTY mode, a voltage is supplied to Pin 5 of IC1 through R28 and D6. Thus, the modulator is unbalanced to output the BFO signal as the carrier signal.

(a) VOX Circuit (MAIN Unit)

The signal from IC3 is adjusted by the VOX GAIN control and fed to IC4, from which the output is rectified by D20 and charges C68.

A portion of the output signal from the AF power amplifier through the ANTI VOX GAIN control is amplified by VOX amplifier IC4 (Pins 1, 2 and 3) and rectified by D22 and charges C70. Approximately 4V is applied to C70 by R102 and R105, and 3.3V to C68 when there is no signal.

IC3 is a comparator to compare the output voltages of the VOX and ANTI VOX amplifiers. At no signal, the ANTI VOX output voltage becomes higher than that of the VOX, and the level of IC3 Pin 7 becomes low. While both of the signals from the mic and AF amplifier vary, when the voltage at Pin 5 (VOX) of IC3 becomes higher than that of Pin 6 (ANTI VOX), Pin 7 becomes high to turn Q17 and Q18 on. When the VOX switch is on, the SEND line is grounded for the transmit mode.

The delay time constant is to be adjusted by the VOX DELAY control on the front panel.

(b) Keying Circuit

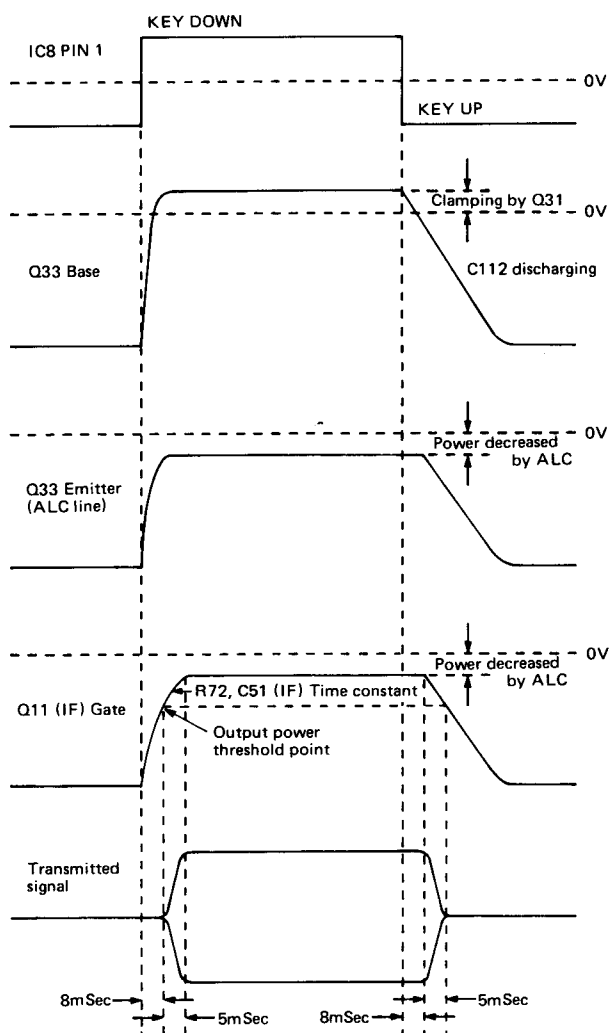
The voltage at Pin 2 of comparater IC8 is higher than that of Pin 3 when the CW key is up, and the output voltage at Pin 1 is negative. The output is input to the base of Q33 to set the ALC voltage negative. This operation suppresses the carrier signal more than 100dB. When the key is down, Pin 2 becomes low and the output from Pin 1 becomes high to drive the side tone circuit, to charge C69 to operate the break-in circuit, and to set the base of Q33 positive. When the base of Q33 is positive, the ALC voltage immediately becomes 0V. However, the delay time constant of the ALC circuit for the IF and RF stages is set by R72 and C51, and

provides a proper attack time for CW transmission.

When the key is up, Pin 1 of IC8 becomes negative to turn off Q42 to stop the oscillation of the side tone and to stop charging C69. The base of Q33 becomes negative with some delay caused by the discharge of C112. In all modes but CW, Q31 turns off the ALC keying and prevents the ALC from excessive delay caused by high voltage at the base of Q33. By use of the base voltage of Q33, the voltage of Pin 3 of IC7 is kept negative to prevent the ALC meter from moving out of the scale when the CW key is up.

C112 and R192 are to set the time constant, and R193 is to determine the carrier suppression.

Keying Timing Chart



(c) Ic Meter

The collector current of the PA transistor Q4 and Q5 flows through R20. A voltage across R20 is fed to pins 5 and 6 of IC7 on the MAIN unit and inverting amplified. The amplified voltage is adjusted its level by R162 and R166, and fed to the meter when the METER switch (S11) is set at the Ic position. R162 is for meter deflection adjustment and R166 is for APC threshold adjustment.

(d) RF, SWR Meter

The forward (FOR) and reflect (REF) voltages detected by

the filter unit are fed to IC9.

For the RF meter and the SWR set, the forward voltage is fed to Pin 2 of IC9 and its output voltage is adjusted by R61 of the SW-C unit and fed through S11 to the meter.

For the SWR, the reflect voltage is input to Pin 5 of IC9 and its output voltage is fed through the SW-C unit and S11 to the meter.

(e) ALC Meter

The ALC voltage is fed to Pin 2 of IC7. The amplified output voltage is adjusted by R201, and supplied to the meter through S11 on the SW-C unit.

(f) ALC Circuit (MAIN Unit)

The forward and reflect voltages detected by L15 in the filter unit are supplied to J15 on the MAIN unit.

The forward voltage is compared with the voltage set by the RF POWER control on the front panel by IC10 (Pins 5, 6 and 7), and then fed to the IF and RF units as ALC voltage. Both of forward and reflect voltages are input to IC10 (Pins 1, 2 and 3) to protect the final transistors by refusing the RF output power when the VSWR of the antenna load exceeds 3 to 1. A portion of the output for the IC meter is adjusted by R164 and input to Pin 2 of IC2 to control the ALC voltage by through the increase of the collector current of the final transistors.

When the temperature of the final transistors rises, Q20 is turned on by D26 - D28 to control the power control voltage. R117 is for HIGH POWER adjustment and R113 is for LOW POWER.

4 - 2 - 2 IF SECTION

(a) IF Unit

The carrier frequency from the MAIN unit varies depending on the mode: DSB for LSB, 456.5KHz; DSB for USB, 453.5KHz; CW, 455KHz; RTTY (mark), 455KHz; and RTTY (space), 454.83KHz.

The DSB signal output from J9 of the IF unit passes through D27 and F11, to remove unwanted side band to make SSB signal.

After going through the emitter follower Q4, when the COMP switch on the front panel is off, the signal passes through D13 to the RF POWER control on the front panel. When the COMP switch is on, D13 turns off and D14 turns on. The signal is fed to an amplifier Q5, then clipped by D11 and D12. To remove the distortion in the clipped signal, a 9MHz filter is provided before the adjustment of the output level by R78 - 1 on the front panel.

The output signal is mixed with the 9.4665MHz local oscillator signal to 9.0115MHz, and fed through D20 to F13 when the COMP switch is off and to F14 when it is on. The signal is amplified by Q11 and fed to the RF unit through J12. At the gate of Q11, the ALC voltage is supplied, and the attack time constant is determined by R72 and C51 in the CW mode.

A receive IF amplifier Q12 functions as a monitor amplifier during the transmit mode, and feeds the signals to the monitor circuit.

(b) RF Unit

The signal from the IF unit is passed through D3 to the

second mixer. Q5 is turned on to prevent the IF signal from being fed back to the noise blanker gate.

The input signal to the double-balanced mixer IC2 is mixed with the 61.44MHz second LO signal for a 70.4515MHz signal, which passes through a switching diode D1 and a dual-tuned filter L2 and L3 to eliminate spurious components, and then fed to a 20dB amplifier Q2.

The output signal from Q2 is fed through D12 to the first mixer, which converts the signal to the desired frequency. The converted signal is fed through a band-pass filter for the operation band and D40 to a 20dB amplifier Q16, from which the approximately +13dBm signal is output to the PA unit through J11.

The ALC voltage is supplied to the gate of Q2, and the ALC attack time constant is determined by R78 and C165.

4 - 2 - 3 RF SECTION (PA Unit)

The RF signal input from the RF unit through P1 is amplified by the class A amplifier Q1. The output from Q1 is converted to a balanced output by L1 and amplified by the class AB push-pull amplifier Q2 and Q3. The negative feedback circuit, consisting of C4, R6, L2, C5, R9 and L3, inserted between the collector and the base of Q2 and Q3, prevents the amplification factor from varying for various frequencies.

The idling current of Q2 and Q3 is controlled by the junction voltage of D1. The current is set at about 100mA by R27. D1 senses the heat of Q3 for temperature compensation by Q2 and Q3.

The output of Q2 and Q3 is fed to the impedance-matching section L4 and amplified by the class AB push-pull amplifier Q4 and Q5 to provide 100 watts of output power.

Q6 comprises the bias circuit for Q4 and Q5 using the regulated voltage. The idling current is set at about 600mA by R23.

A portion of the output power from Q4 and Q5 is applied to the bases of these transistors through the negative feedback transformer L9 to reduce the variations in the factor over the frequency range from 1.9MHz to 30MHz. R23 is provided to adjust the idling current and is set so that the current is 600mA.

The output from Q4 and Q5 is then fed to L10 for impedance conversion and output to the filter unit from P2.

Thermal switches S1 and S2 detect the temperature of the package of Q4 and Q5, and control the cooling fan and the output power reduction.

If the temperature increases, S2 is turned on around 50 deg. C to make the cooling fan start to rotate. The fan continues to rotate even after the mode is switched to the receive mode, until the temperature decreases to below 50 deg. C.

Temperature		- 50	50 - 90	90 -
Thermal Switch	S1	off	off	on
	S2	off	on	on
Cooling fan Speed	receive	off	low	mid
	transmit	off	mid high	high
Transmit power (watts)		100	100	50

When the temperature reaches about 90 deg. C, S1 is turned on and the fan starts high-speed rotation. At the same time, this switch sends a signal to the MAIN unit through R26 to reduce the transmit power to 50 watts.

4-2-4 FILTER UNIT

The RF output of the PA unit is fed to the FILTER unit to eliminate harmonic components. The desired filter is selected by RL1 - RL14, which are controlled by the signal from the LOGIC unit.

The filtered output signal passes through the SWR detecting transformer L15 to the antenna connector on the rear panel.

4-3 PLL UNIT

This unit controls the local oscillator signal with a frequency range of 70.55 - 100.45MHz for the first mixer by use of two locked loops.

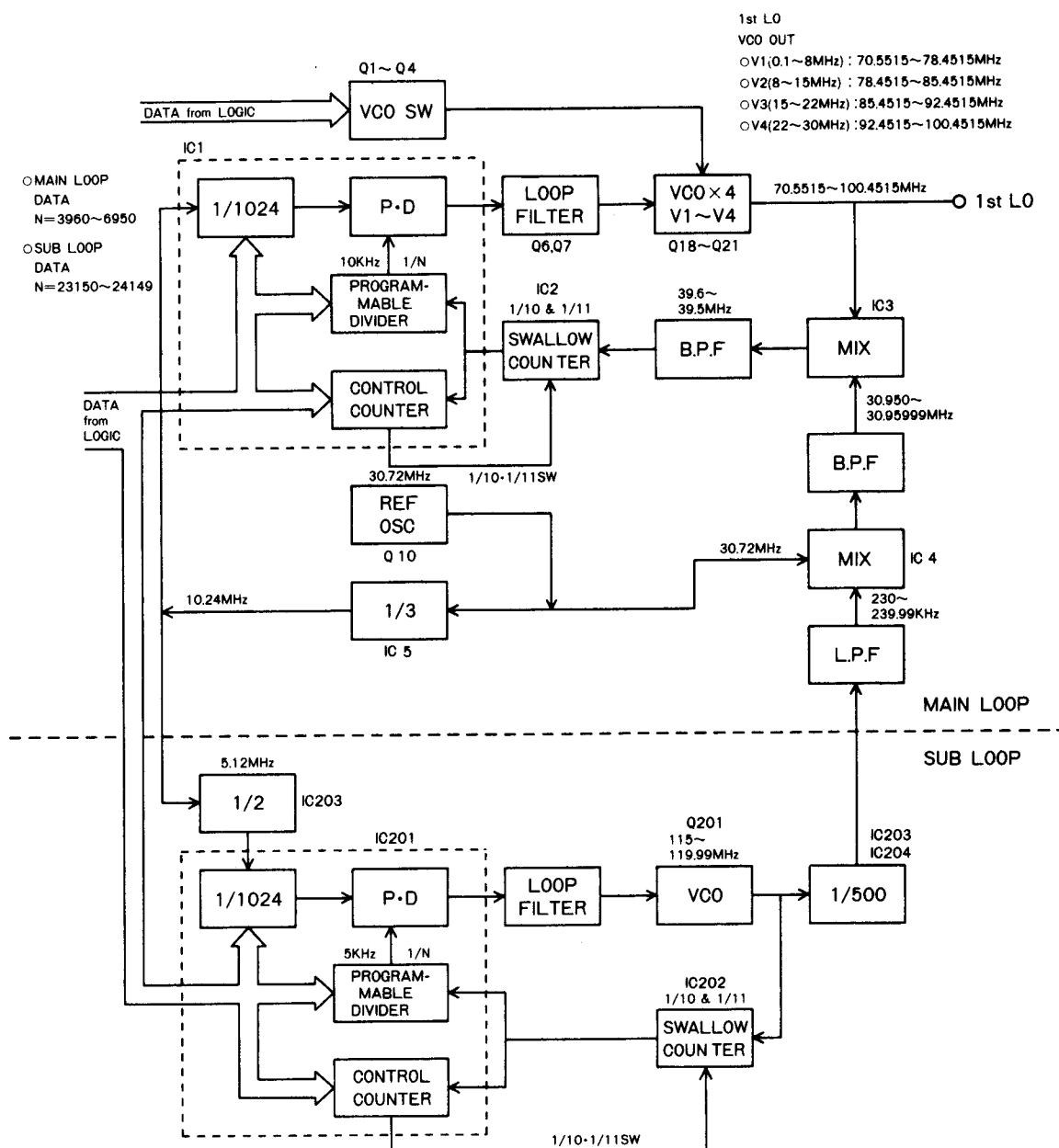
4-3-1 REFERENCE FREQUENCY OSCILLATOR CIRCUIT

The frequency of the reference frequency oscillator is the base of all the frequencies of the signals in the PLL unit so that it must be sufficiently stabilized. Therefore, C3, C6 and C8 are provided for temperature compensation, and the regulator output voltage of 8 volts is further stabilized by the 5V Zener diode.

The frequency of the reference frequency oscillator is 30.72MHz, which is used for the reference signals for the main and sub loops, and for the in-loop local oscillator signal.

The division of the divider IC1 and IC201 is set at 1/1024 so that the signals of 10.24MHz and 5.12MHz are needed for each IC.

In order to obtain the reference signal (10KHz) for the main loop, IC5 divides the reference frequency oscillator signal by three and applies a 10.24MHz signal to IC1. For



the sub-loop reference signal (5KHz), IC203 divides the output signal of IC5 by two and applies a 5.12MHz signal to IC201.

4 - 3 - 2 MAIN LOOP

The main loop forms the PLL loop to provide the 1st LO output, and is comprised of the combination of the mixed down system and the divider system.

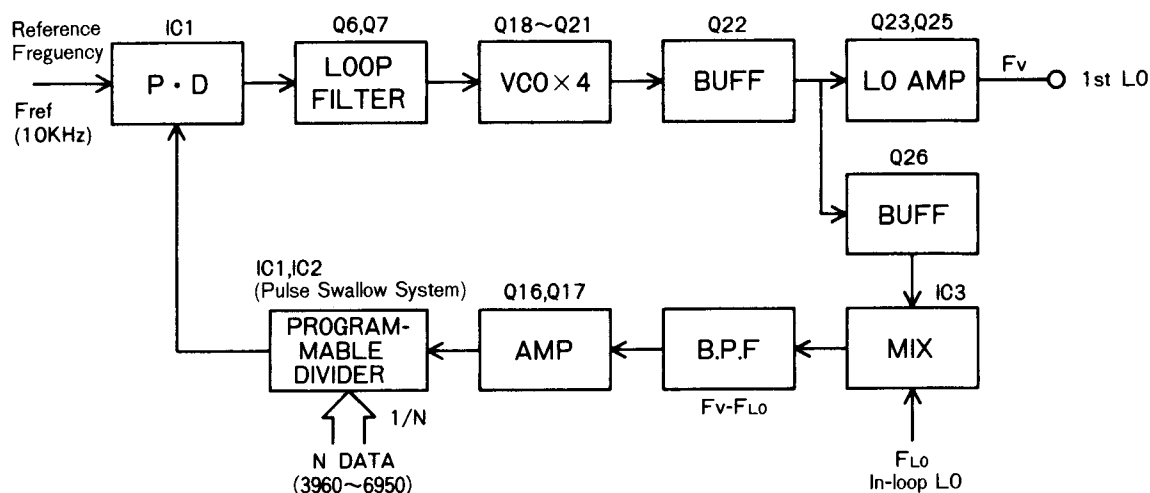
The VCO output frequency F_v is given as;

$$F_v = F_{LO} + N \times F_{ref}$$

The output frequency is changed by varying the F_{LO} and N .

The frequency of the reference frequency (F_{ref}) is 10KHz. By changing the dividing ratio N of the programmable divider, the VCO output frequency is changed in 10KHz steps. If a frequency change of less than 10KHz is desired, F_{LO} can be altered to change the VCO output frequency. F_{LO} can be changed in 10Hz steps over the 9.99KHz bandwidth. Thus, as a whole, the frequency of the PLL can be changed in 10Hz steps over the 30MHz bandwidth.

MAIN LOOP



(a) PLL IC

IC1 (M54929P) is a multi-function IC containing a phase comparator, a programmable divider, a reference frequency oscillator circuit, a divider, and a control counter for the swallow counter. By using IC1 with IC2 (M54466L, a swallow counter), it can perform pulse swallow dividing. This combination forms a programmable divider which features a large dividing ratio and allows operation even in a higher frequency region. Compared to conventional circuits, fewer components are required and the combination allows the PLL to be locked in steps as small as 10Hz.

(b) VCO

The performance of the VCO is very important for PLL operation. In order to obtain a high carrier-to-noise ratio (C/N) and a stable oscillator output in this radio, therefore, four separate VCOs are used, each assigned for a quarter of the whole necessary bandwidth. The division of the VCOs reduces the burden on one VCO that would otherwise provide frequency changes over the entire bandwidth.

The power supply for the VCOs is doubly regulated as that for the reference frequency oscillator. Furthermore, coreless coils are used for the oscillator coils in order to obtain a high Q as well as immunity from external induction.

In addition to these features of the circuit, the care for grounding points on the printed pattern board and allocation of components, and utilization of the stout shielding case allow a high C/N ratio.

(c) Loop System

The output of the VCO is divided into two components after passing through the buffer amplifier Q22.

One component is amplified by Q23, and after impedance-matching by Q25, output to the RF unit as the 1st LO. The output level is about 0dBm/50ohm.

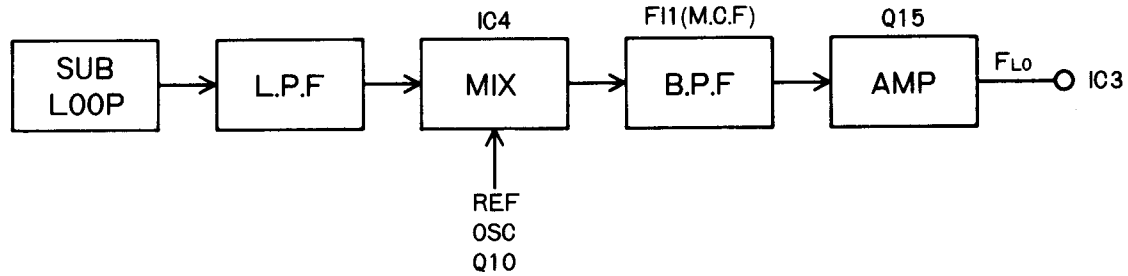
The other component is fed back to the PLL loop through the buffer amplifier Q26. A common base amplifier circuit providing a high isolation performance is used for the buffer amplifier so as to prevent the spurious components from feeding back to the 1st LO; the spurious components arise from various frequency components in the PLL loop. The VCO signal is then mixed with the in-loop LO F_{LO} by IC3 for heterodyning. The output from the mixer is passed through the band-pass filter with a bandwidth about 35 - 75MHz to eliminate the spurious components. The output is then amplified by the cascade amplifier Q16 and Q17, and input to IC2 to form the PLL. It is noted that a pair of diodes D10 and D11 is added to the input of IC2 in order to limit excessive input voltages.

(d) In-Loop LO

The in-loop LO controls the main loop in 10Hz steps in terms of heterodyning the VCO signal.

The output frequency of the sub loop is too low to use (230.00 - 239.99KHz). Therefore, the output is mixed with the reference frequency oscillator output by IC4 and converted to an appropriate frequency by heterodyning to

IN-LOOP LO



give the in-loop LO. The heterodyned output is passed through the monolithic filter FI1 to eliminate the spurious components and fed to IC3 after amplification by Q15.

(e) Loop Filter and Mute Circuit

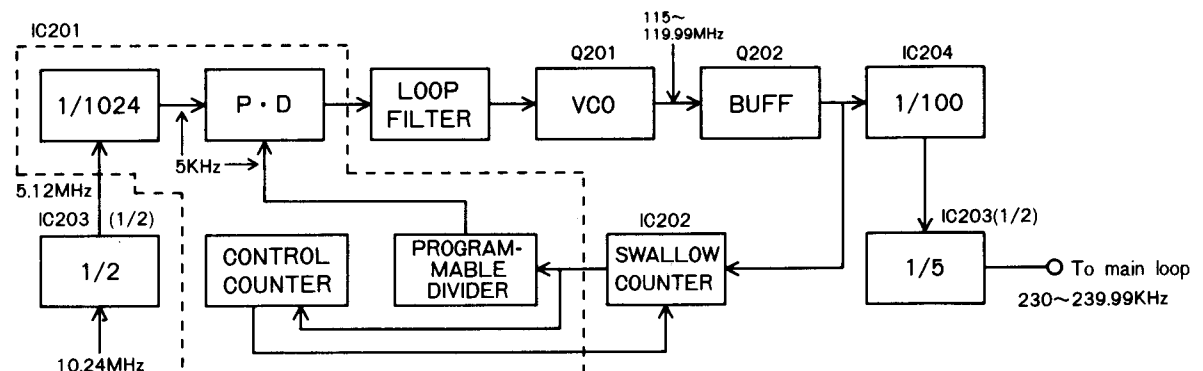
The loop filter of the main loop uses an active filter composed of Q6 and Q7. The loop filter as well as the VCO is important for the performance of the PLL, and it determines the lock-up time and the C/N ratio. The lock-up time and the C/N ratio are a conflicting relation to each other. That is, if the time constant of the loop filter is determined so as to make the lock-up time faster, the C/N ratio will be decreased. In order to solve this problem, a variable resistor composed of an FET is inserted in the loop filter in the PLL. Thus, if the frequency is changed more than a certain level at one time the lock-up time becomes faster by making the time constant of the loop filter smaller, while making the C/N ratio greater by setting the time constant larger for normal operation.

The circuit to change the time constant Q5 is driven by the mute signal. Namely, if the mute signal is generated by the main loop or the sub loop because the loop is unlocked or the frequency is changed more than a certain level at one time, the circuit starts operating.

The mute signal coming from IC1 and IC201 of the main loop and the sub loop is processed by Q8 and Q9 to have an appropriate voltage and a time constant and is fed to Q5, Q13 and Q24. Q13 and Q24 switch the bases of the transistors of the output amplifier for the 1st LO and the 2nd LO, so as to halt the LO outputs, respectively.

Because of this switching operation, even if the PLL is unlocked or the frequency is changed more than a certain level at one time, the system does not transmit/receive a frequency other than the desired one and the locking operation is completed faster.

SUB LOOP



4-3-3 SUBLOOP

This loop forms the locked loop using the divider to provide in-loop LO for the main loop.

The reference frequency is 5KHz and the VCO can be locked within the frequency range of 115.00 - 119.995MHz. The output signal of the 4.995MHz bandwidth with a 5KHz resolution is divided into 1/500 by IC204 and IC203 to provide an output ranging from 230.00 to 239.99KHz (i.e., 9.99KHz bandwidth) in 10Hz steps. This output is led to the main loop.

The VCO output is input to IC202 as well as to IC204, passes through the loop filter composed of IC201, and controls the VCO to form a PLL. The pulse swallow counter composed of the combination of IC201 and IC202, as in the main loop, is used in this loop. Therefore, the frequency can be changed by changing the dividing ratio. The same reference frequency as the main loop of 10.24MHz is divided by 2 by IC203 and then divided to be 5KHz by the divider of IC201.

4-3-4 PLL DATA

The PLL needs data that set the dividing ratio N of the programmable divider. The data is sent from the LOGIC unit. The control data to switch the VCO is also sent from the LOGIC unit. The data to set the dividing ratio, called the N-DATA, is sent dynamically, while the data for the VCO is sent statically.

Since IC1 changes the dividing ratio of the divider, the data (1/1024 constant) is also sent.

(a) How to Derive the N-DATA

Since there are two locked loops, there are two kinds of N-DATA. Even if the output frequencies from the PLL in all the modes are the same, the display frequencies are different depending on the operating mode. Namely, the

same frequency is displayed for CW, RTTY, AM and FM, while the LSB frequency is displayed 1.5KHz higher and the USB frequency 1.5KHz lower.
The method to derive the N-DATA for all modes except SSB is shown below.

Example: 14.0750MHz

Main Loop

Ignore the digits equal to or lower than 1KHz of the displayed frequency and let the obtained frequency be F1, then:

$$N = F1 \times 100 + 3950$$

Where F1 is 14.07 for the case shown above. Thus, we get:

$$N = 14.07 \times 100 + 3950 = 5357$$

Sub loop

Let the frequency shown in the digits equal to or lower than 1KHz of the displayed frequency be F2, then:

$$N = F2 \times 100 + 23000$$

Where F2 is 5.00 in the case shown above. Thus, we get:

$$N = 5.00 \times 100 + 23000 = 23500$$

Note that the digit for 10Hz is not displayed.

To get N for other modes, add 1.5KHz to the displayed frequency for USB and subtract 1.5KHz from the displayed frequency for LSB, and then follow the steps shown above. For the value of N as derived in the above way, the dividing ratio of the programmable divider is 1/N.

4 - 4 LOGIC UNIT

The functions of this unit include controlling the frequency, processing BPF and LPF signals and mode signals, data outputs for the PLL unit and DISPLAY unit, etc. This unit is composed of an 8-bit N-MOS CPU, a 4-bit 1K word C MOS RAM, a multi-purpose custom IC, I/O expander IC's, etc.

4 - 4 - 1 CPU

Functions are assigned to the pins of the CPU as shown below. The interrupt pins are assigned to the tuning control to which the highest priority is given. The pins where no function is assigned are left unconnected.

Addresses are assigned not only to ROM and RAM, but to all the other peripheral devices.

The CPU's port addressing and its memory maps are shown in Figs. 1 and 2.

4 - 4 - 2 CPU INPUT CONTROL CIRCUIT

A multi-function custom IC, 40-pin DIL package C MOS IC, is used. (Refer to Fig. 3.)

- An external L and C are connected to Pin 18 and Pin 19 to give about a 100KHz clock signal.
- ATS of Pin 32 gives a high level if the tuning control is rotated faster than a certain speed, which can be set by the values of C6 and R7 connected to TC of Pin 21. The high level is used as a strobe signal which switches the dial-pitch (tuning rate) of the matrix input.
- M1 and M2 at Pin 38 and Pin 37 are used to switch the multiplication factors of the input pulses from the

Fig. 1 CPU Pin Connection

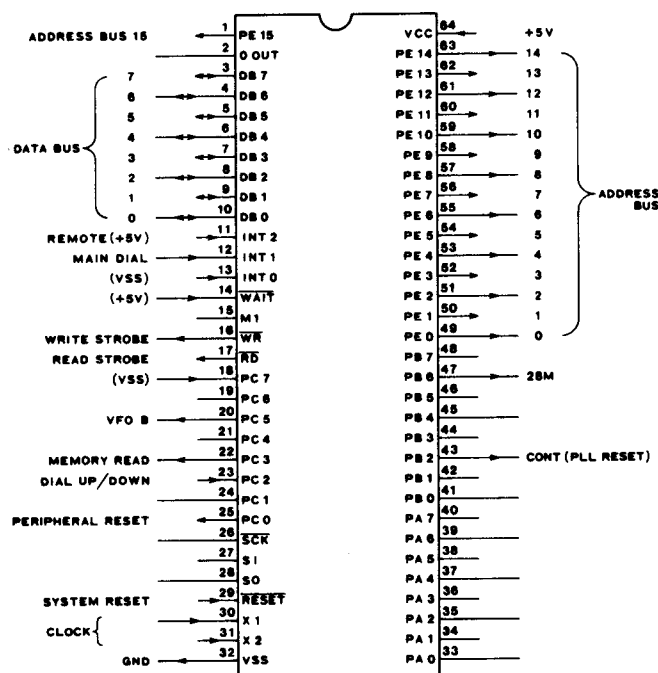
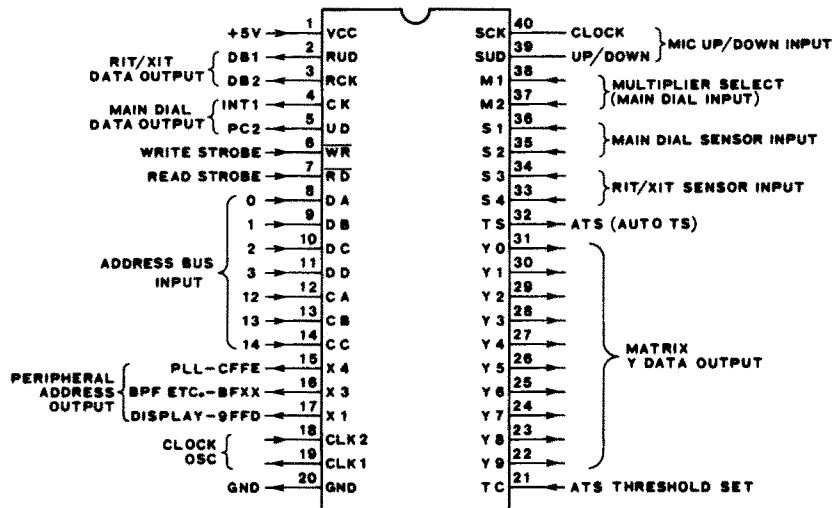


Fig. 2 CPU Memory Map

0000	CPU INTERNAL ROM
0FFF	8bit × 4096W
7FFF	REMOTE CONTROL
8FF0	1
	2
	3
	4 Input
	5 Matrix
	6
	7
	8
8FF9	
9FF0	Display Data Out (μPD549c × 2)
BFF9	BPF (High)
	A BPF (Mid.)
	B BPF (Low)
	C MODE (High)
	D MODE (Low)
	E ALL F
BFFF	MS.PS
CFFF	PLL Data Out (M54929 × 2)
F800	EXTERNAL RAM
FBFF	4bit × 1024W (μPD444C)
FF80	CPU INTERNAL RAM
FFFF	8bit × 128W

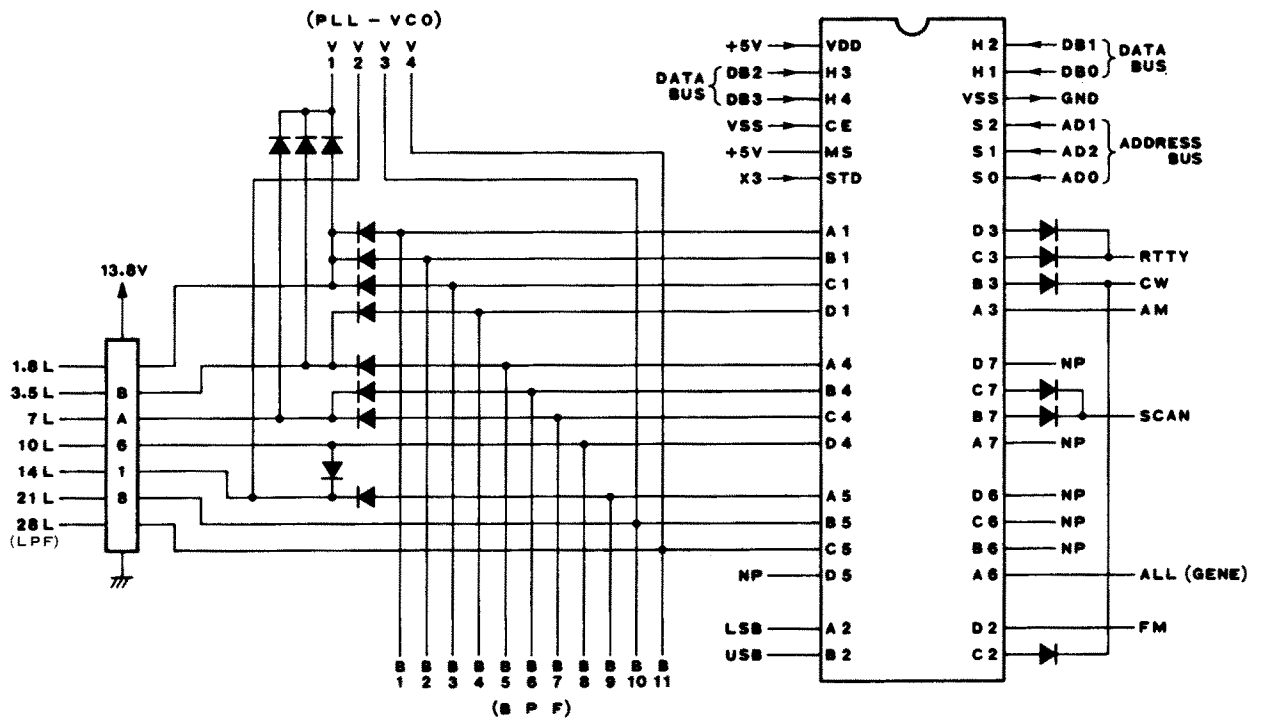
tuning control. Two hundred pulses per one rotation are obtained by 50 pulses x 4 (quadri-speed mode).

Fig. 3 Custom I/O Control IC Pin Connection



4-4-3 I/O EXPANDER CIRCUIT

Decoding of the data outputs of BPF, PLL, VCO and MODE, etc.



OUTPUT DATA TABLE

FREQUENCY	BPF	LPF	PLL VCO
0.1 ~ 0.5MHz	1	1	1
0.5 ~ 1.6MHz	2		
1.6 ~ 2 MHz	3		
2 ~ 3 MHz	4		
3 ~ 4 MHz	5	2	

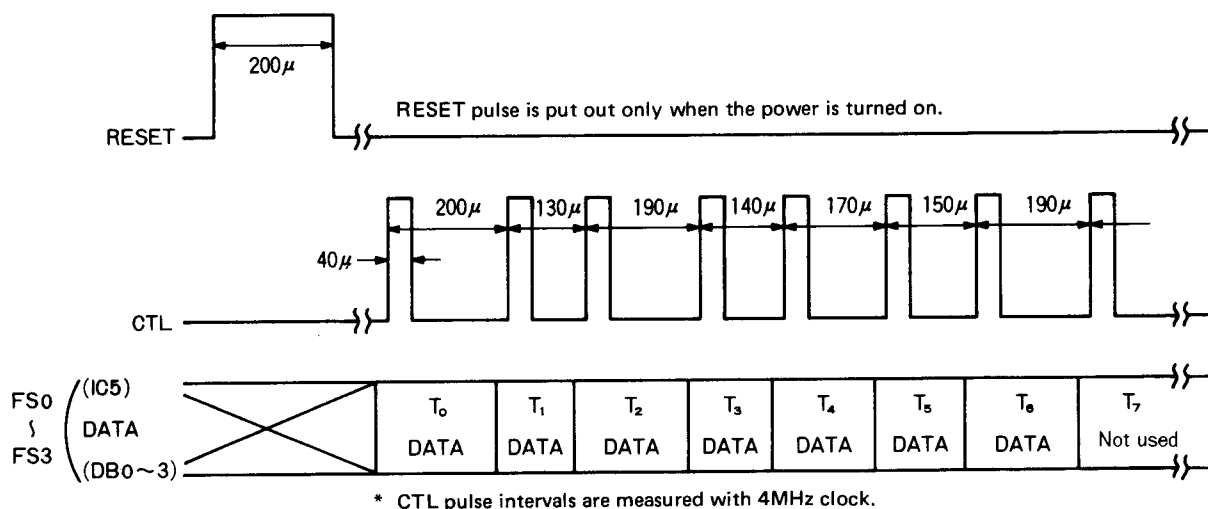
4 ~ 6MHz	6	3	1
6 ~ 8MHz	7	4	2
8 ~ 11MHz	8		
11 ~ 15MHz	9		
15 ~ 22MHz	10	6	3
22 ~ 30MHz	11	7	4

4 - 4 - 4 TIMING OF DISPLAY CIRCUIT

Data for the eight-digit frequency display and CTS pulse signals for the eight indicators are supplied to the display drive IC5 in the DISPLAY unit. T7 of IC5 is not used.

The display data are sent only when the operation frequency or memory channel is changed or when any operation related to the display is performed.

DISPLAY DATA Timing Chart



4 - 4 - 5 THE N-DATA OF PLL

Since the PLL uses the double loop construction, two N-DATA of high and low are sent from the LOGIC unit to the PLL unit.

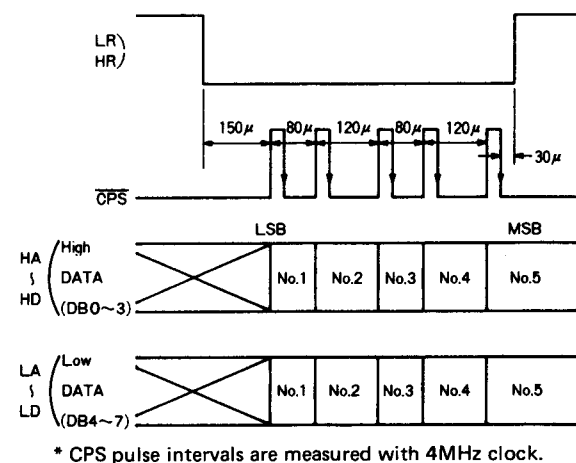
The lines HA-HD, and LA-LD of the data lines are switched by the gates of IC17 and IC18. The lines are shared by signals for the PLL, the DISPLAY, the BPF, etc. Therefore, this switching prevents the VCOs of the PLL unit from introducing noise when the lines are not used for the data of the PLL.

High and Low N-DATA Table

High N-DATA x10M, x1M, x100K, x10K		Low N-DATA x1, x100Hz, x10Hz	
Disp. freq.	N-DATA	Disp. freq.	N-DATA
0.10MHz	3960	0Hz	23150
0.11MHz	3961	10Hz	23151
0.12MHz	3962	20Hz	23152
0.13MHz	3963	50Hz	23155
0.14MHz	3964	100Hz	23160
0.15MHz	3965	1KHz	23250
1MHz	4060	2KHz	23350
10MHz	4950	3KHz	23450
20MHz	5950	4KHz	23550
30MHz	6950	5KHz	23650
		9.99KHz	24149

* Display frequency is shown when mode is AM.

N-DATA Output Timing Chart



4 - 4 - 6 MATRIX UNIT

This unit is composed of the matrix board, the MATRIX SWITCH board, and the MODE SWITCH board. It processes the front panel matrix input and the data of RIT/XIT.

1. Y0 → DB4 (SCAN)

Matrix to start and stop the scan operation. When the SCAN switch (S23) is pushed, one pulse signal is input to this matrix to start and stop the scan operation repeatedly. Two types of scanning operations, Memory Scan and Programmed Scan, are available.

MATRIX TABLE

IC 2 RP5G01 007 OUTPUT

Y 0	Y 1	Y 2	Y 4	Y 5	Y 7	Y 9	
			LSB	MEMORY CH 1		SCAN CLOCK	DB 0
			USB	2			DB 1
			AM	3	SQL		DB 2
			CW	4	SPLIT (DUP)		DB 3
SCAN START/STOP	VFO A/B	VFO A=B	RTTY	5	1		DB 4
	MEMORY READ				2	10SEC SET	DB 5
	HAM/ALL (GENE)	MW1 (DISP → MEMO)	FM		3		DB 6
					4	TIMER SCAN	DB 7
						DIAL PITCH	

C P U · D A T A · B U S

2. Y1 → DB4 (VFO A/B)

Matrix to select VFO A or VFO B by the VFO switch (S22).

3. Y1 → DB5 (MEMORY READ)

Matrix to select VFO or Memory Channel mode by the VFO/MEMORY switch (S26).

4. Y1 → DB6 (HAM/GENERAL)

Matrix to select the HAM band mode or general coverage mode by the HAM/GENERAL COVER SELECT switch (S6).

5. Y2 → DB4 (VFO A=B)

Matrix to equalize the frequencies of VFO A and VFO B by the VFO EQUALIZING switch (S21).
When VFO A is in use, the frequency of VFO A is stored in VFO B, and vice versa.

6. Y2 → DB6 (DISP → MEMO)

Matrix to write the frequency, mode, and HAM/GENE by the MEMORY WRITE button (S5).

7. Y4 → DB0 (LSB)

8. Y4 → DB1 (USB)

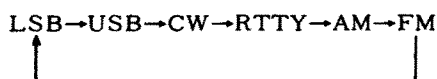
9. Y4 → DB2 (AM)

10. Y4 → DB3 (CW)

11. Y4 → DB4 (RTTY)

12. Y4 → DB6 (FM)

Matrix to select the operation mode by the MODE SELECT switch (S7). The mode is switched in the following order each time the switch is pushed.



The mode is set by IC2, which has six buffers with an INHIBIT input. By pushing S7, Pin 1 (AIN) becomes low and set to high level Pin 2 through Pin 7 (IN1-6) in order. When the Y4 signal is input to Pin 9 (BIN), the same phase signal is output from Pin 15 to 10 (OUT1-6) to drive the mode indicator LED through the matrix of Y4 to DB0-DB6.

In HAM band mode, USB is automatically selected for USB operation above 10MHz, and LSB is selected below 9MHz.

In SSB mode, only the display frequency is shifted higher by 1.5KHz in LSB and lower by 1.5KHz in USB without changing the value of N in the PLL circuit.

13. Y5 → DB0-DB4 (Memory Channel)

Matrix to select a memory channel by the MEMORY CHANNEL switch (S14).

MEMORY CHANNEL SELECT DATA TABLE

MEMORY CHANNEL	D	D	D	D	D	MEMORY CHANNEL	D	D	D	D	D
	B	B	B	B	B		B	B	B	B	B
	0	1	2	3	4		0	1	2	3	4
1	0	0	0	0	0	9	0	0	0	1	0
2	1	0	0	0	0	10	1	0	0	1	0
3	0	1	0	0	0	11	0	1	0	1	0
4	1	1	0	0	0	12	1	1	0	1	0
5	0	0	1	0	0	13	0	0	1	1	0
6	1	0	1	0	0	14	1	0	1	1	0
7	0	1	1	0	0	15	0	1	1	1	0
8	1	1	1	0	0	16	1	1	1	1	0

14. Y7 → DB2 (SQL)

Matrix to input one pulse when the squelch is closed, and to control the scanning operation.

15. Y7 → DB3 (SPLIT/DUPLEX)

Matrix for split or duplex operation using VFO A and B by the DUPLEX (SPLIT) switch. This operation is provided by Q2 and Q3.

16. Y7 → DB4-DB7 (DIAL PITCH 1-4)

Matrix to set the frequency step by the TS and BAND switches. The band switch has priority.

TS	VFO	MEMORY Mode	BAND Switching
OFF	10Hz steps (2kHz/1 rotation) By faster rotation 50Hz steps (10kHz/1 rotation)	8CH /1 rotation	HAM: 8 BAND /1 rotation
ON	1kHz steps (200kHz/1 rotation) 100Hz and lower digits will be cleared as "0".		GENE.: 8MHz /1 rotaion

Y7 → DATA				STEPS and BAND
DB4	DB5	DB6	DB7	
0	0	0	0	10Hz
0	1	1	1	50Hz
1	0	0	0	1kHz
1	0	1	1	BAND

17. Y9 → DB0 (SCAN CLOCK)

Matrix for the scan control, formed by Q4, IC7b, and R14, to control the programmed scan, memory scan, etc.

18. Y9 → DB5 and DB7 (10 sec. SET/TIMER SCAN)

Matrix for the scan stop by the Squelch operation. S1 is to select the complete stop or resume scan after 10-seconds. This function is available both in the Programmed scan and Memory scan.

The scanning speed can be adjusted by R14 in the LOGIC unit.

4 - 5 OTHER CIRCUITS

4 - 5 - 1 SECOND LOCAL OSCILLATOR (2nd LO Unit)

The 2nd LO unit generates the 2nd local oscillator signal for the 2nd mixer in the MAIN unit. The frequency calibration and the RIT/XIT controls are performed by changing the oscillator frequency.

Q1 oscillates at 10.245MHz with X1, tripled by L1 and L2, doubled by Q3, and fed to a band-pass filter of L3 - L15, eliminating spurious signals.

A varactor diode D3 is connected to X1 and the oscillation frequency is controlled by adjusting the voltage across D3 for the calibration and RIT/XIT controls.

The control voltage to D3 is supplied through D1 from the RIT/XIT control on the front panel when the RIT/XIT is on, and through D2 from a voltage divider of R1, R2, and R3.

A mute switch Q2 is turned on, by the mute signal from the PLL unit, to stop the 2nd LO output.

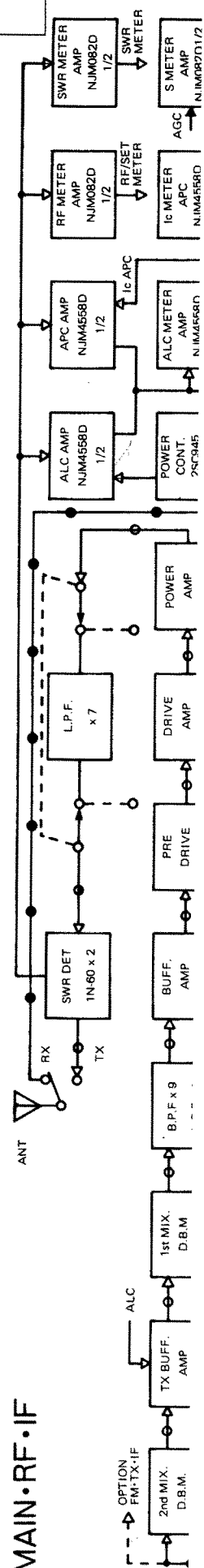
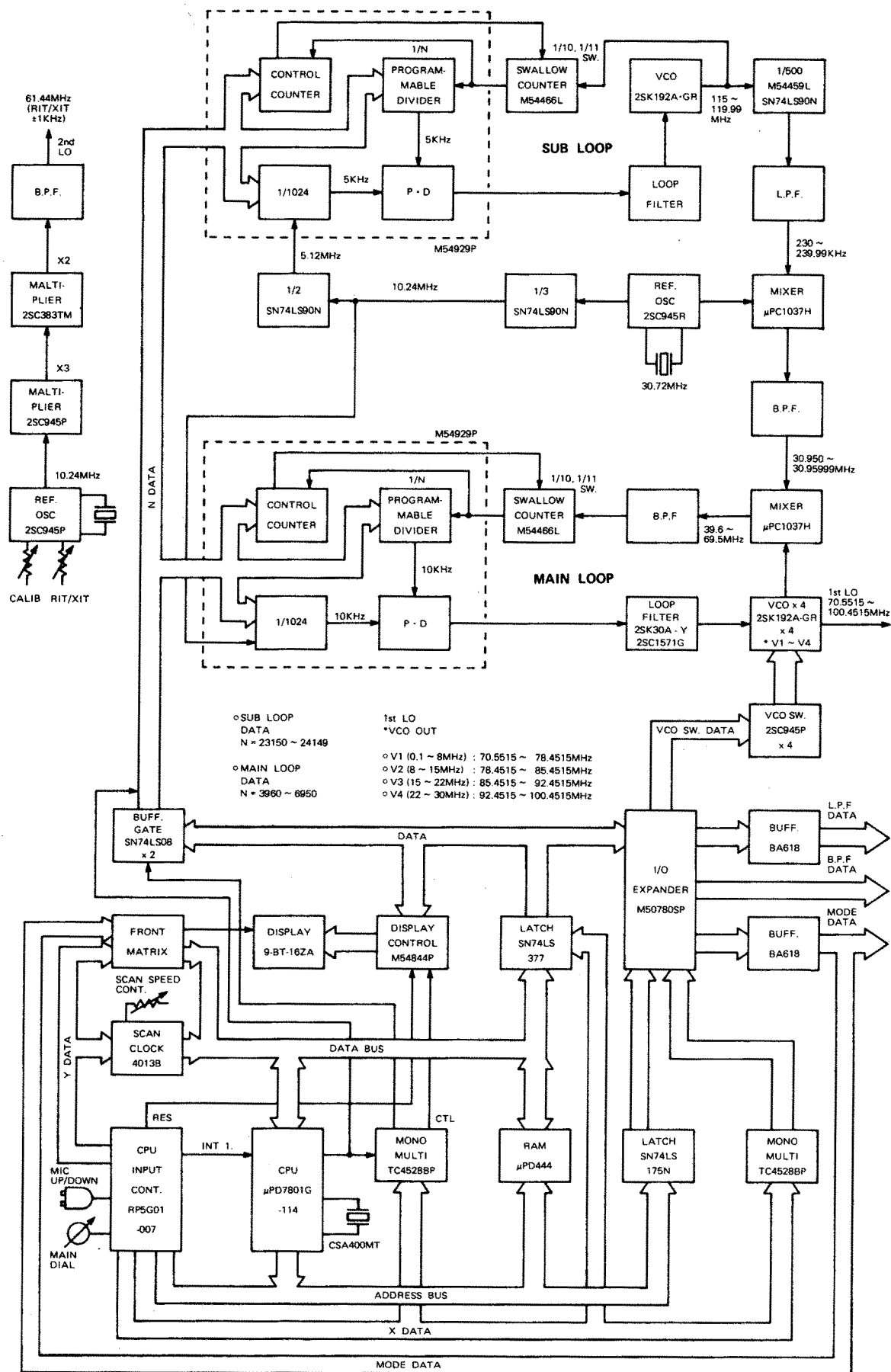
4 - 5 - 2 DISPLAY UNIT

This unit consists of the display tube DS15, drivers of IC5, Q10, and Q11, and a DC-DC converter of T1 and Q9.

The DC-DC converter supplies -14V and heater voltage to the display tube, and -5V for the other circuits.

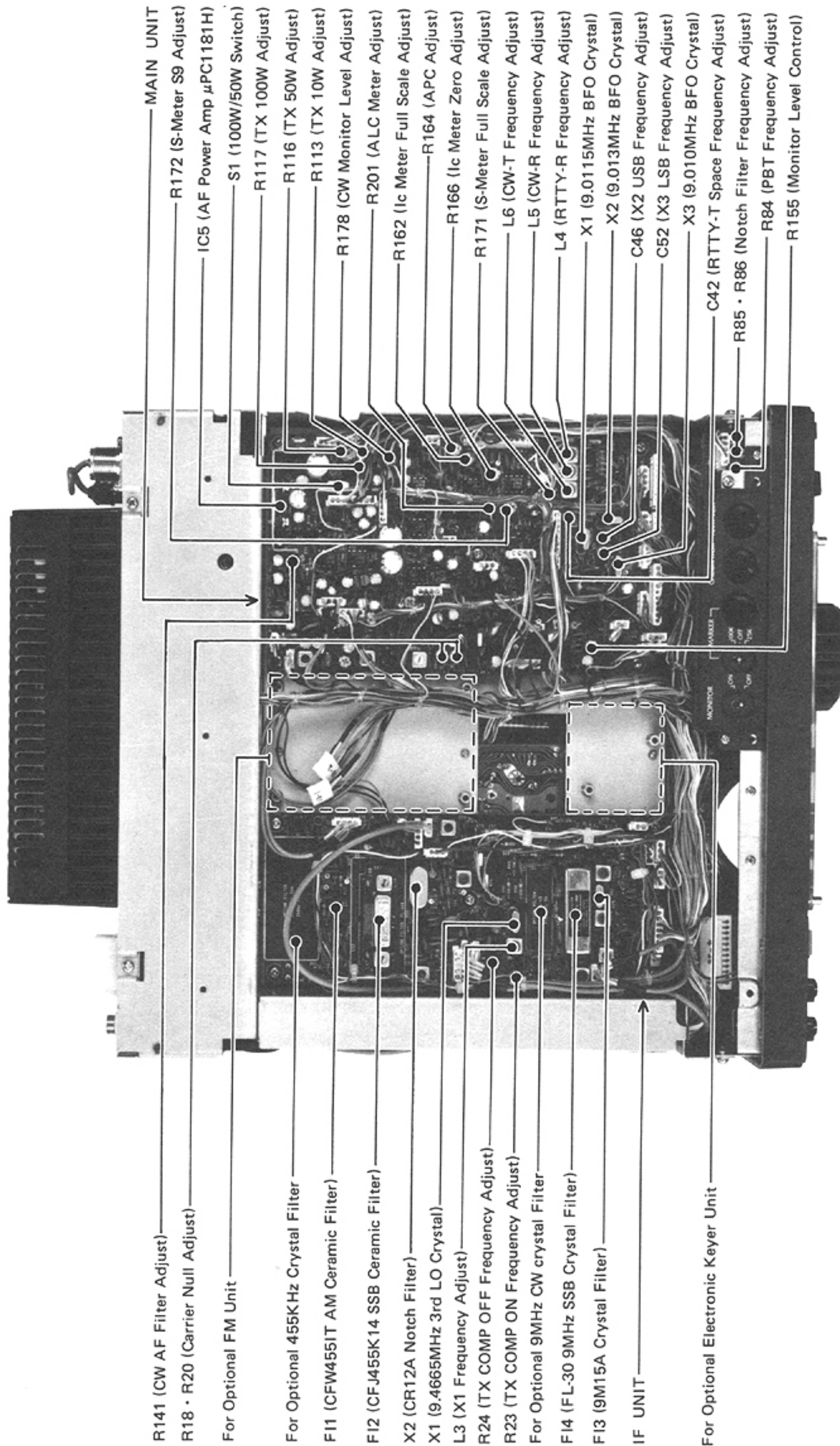
The input signal is fed through J13 of the LOGIC unit to IC5 and drives the display tube to light dynamically. IC5 contains such functions as input data latch, clock oscillator, data memory, segment decoders, etc. Q10 drives the decimal point with the T-signals from IC5 and the segment signals.

PLL • LOGIC

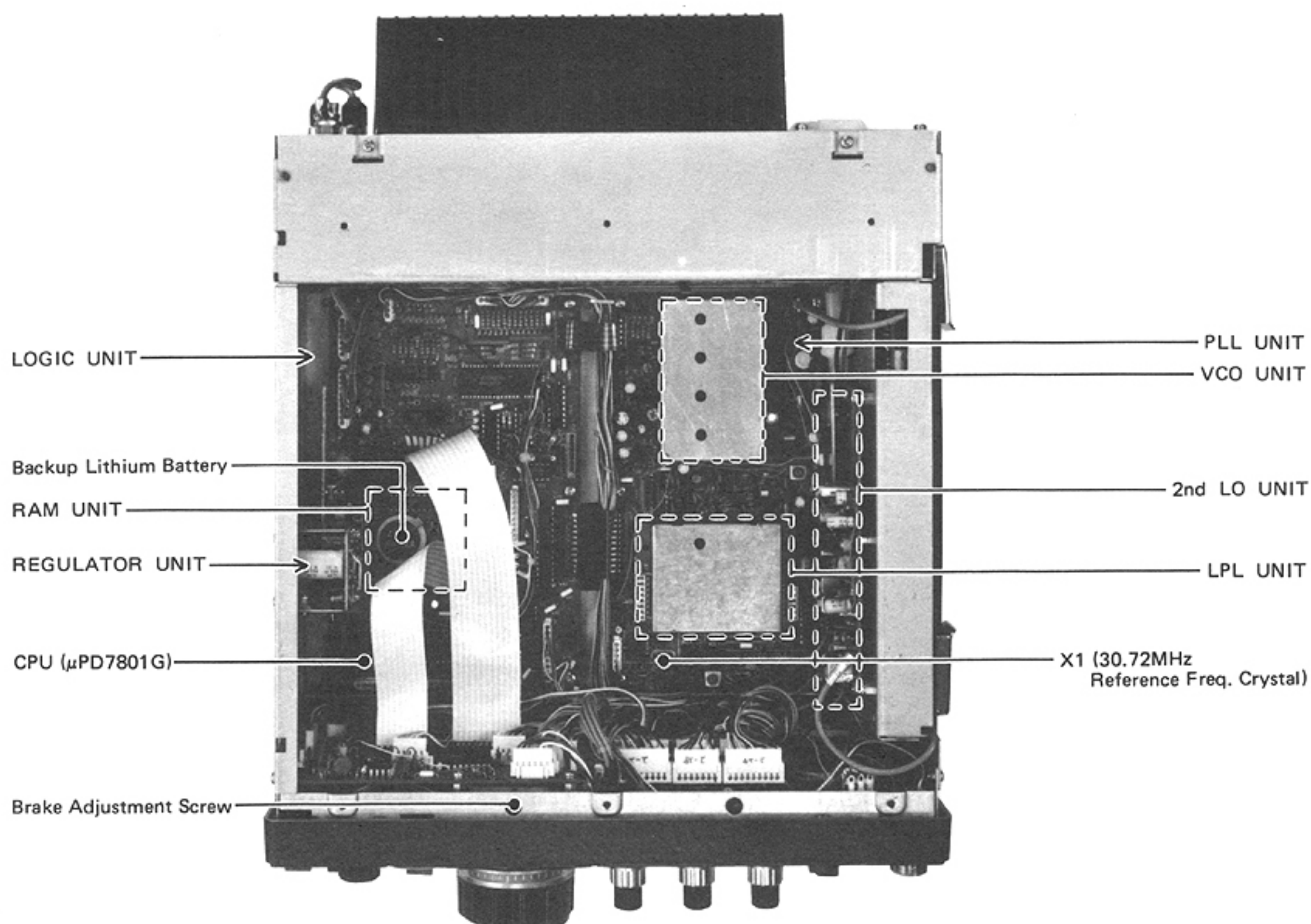


SECTION 6. INSIDE VIEWS

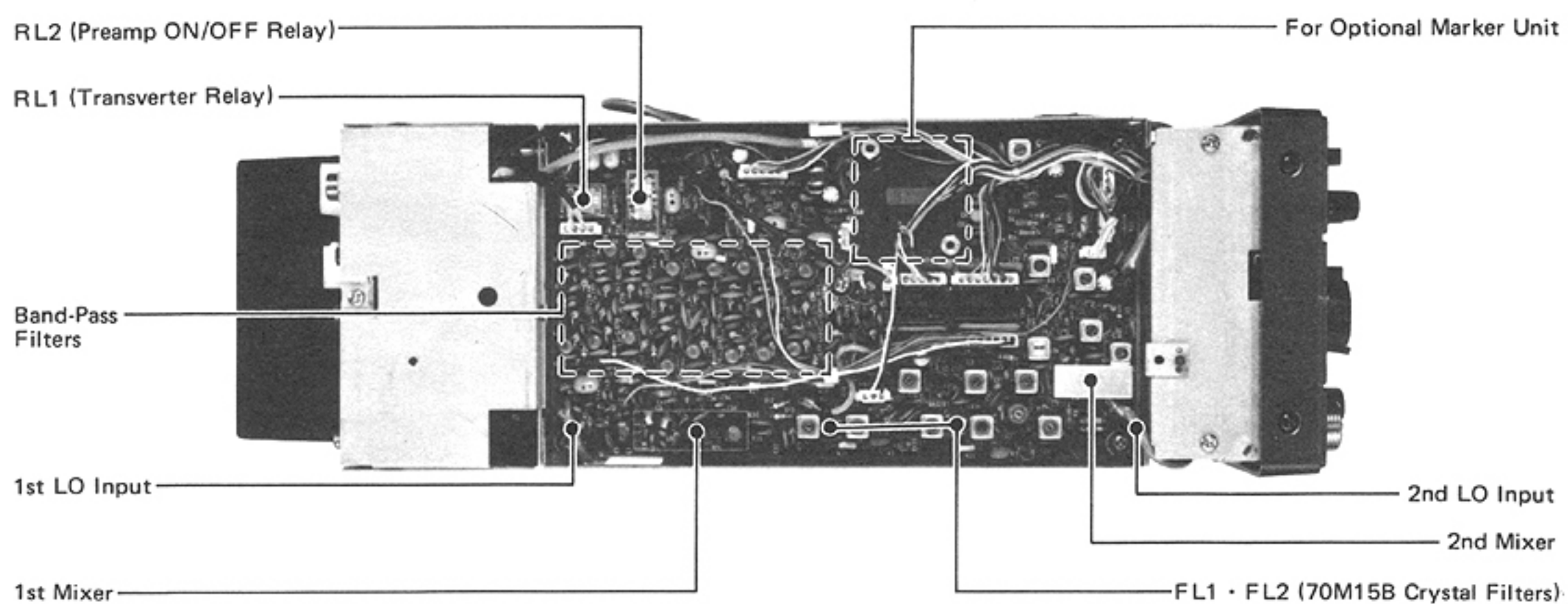
6 - 1 TOP VIEW



6 - 2 BOTTOM VIEW



6 - 3 RF UNIT



SECTION 7 OPTIONS INSTALLATION

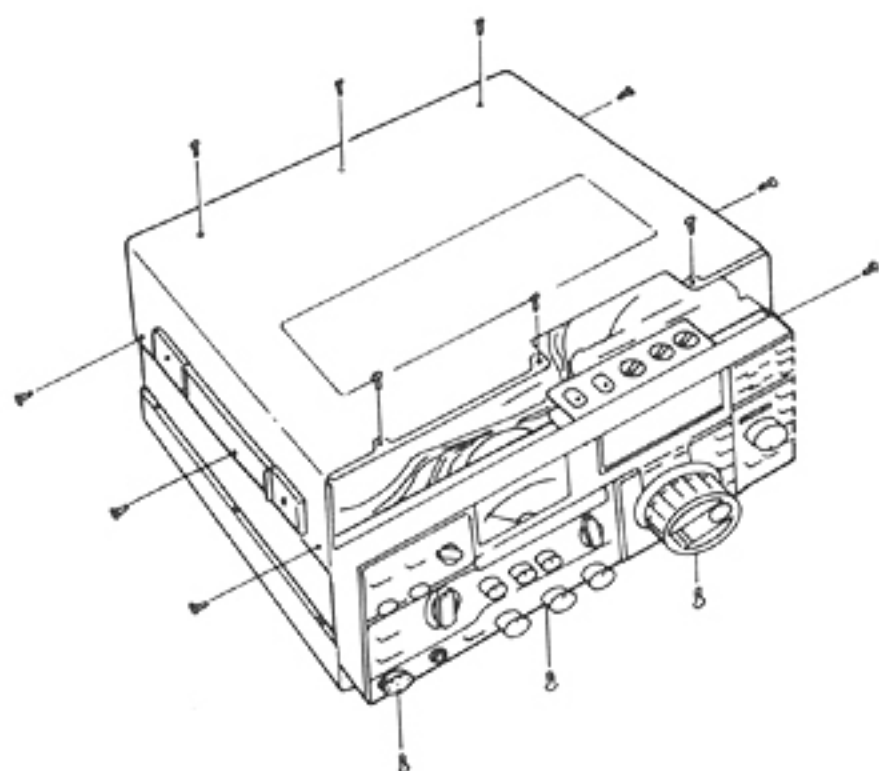
The following tools are needed for the installation of the options:

Philips Screwdriver
Screwdriver
Solder
De-soldering braid

Diagonal cutters
Soldering Iron (40W)
Soldering tool

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

Remove the top and bottom covers by unscrewing the six screws each on the top and bottom, and the three screws on each side, while taking care not to damage the internal speaker, and unplug its connector.



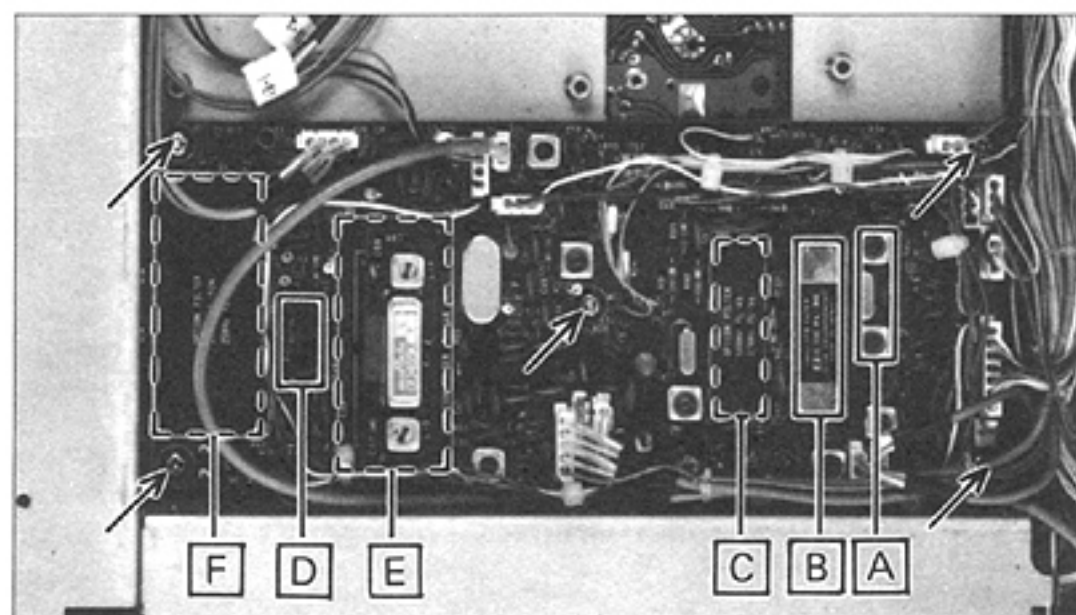
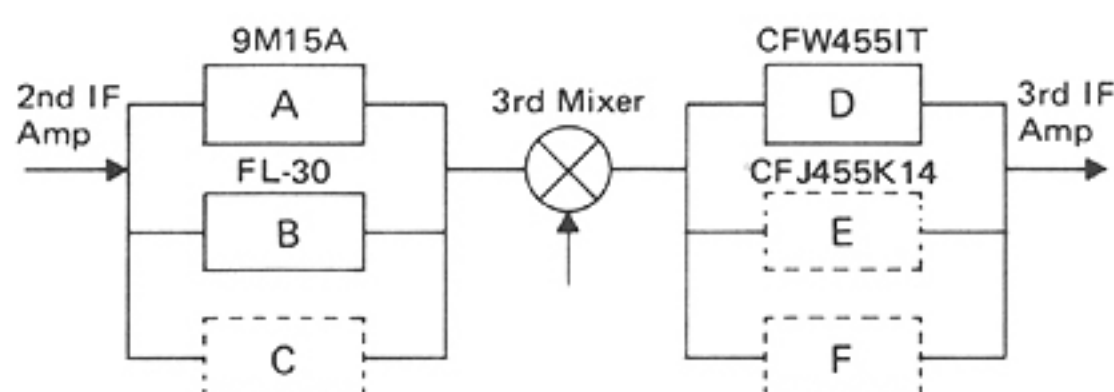
7-1 INSTALLATION OF OPTIONAL FILTER

7-1-1 OPTIONAL FILTERS PREPARED

We have prepared various optional filters as follows.

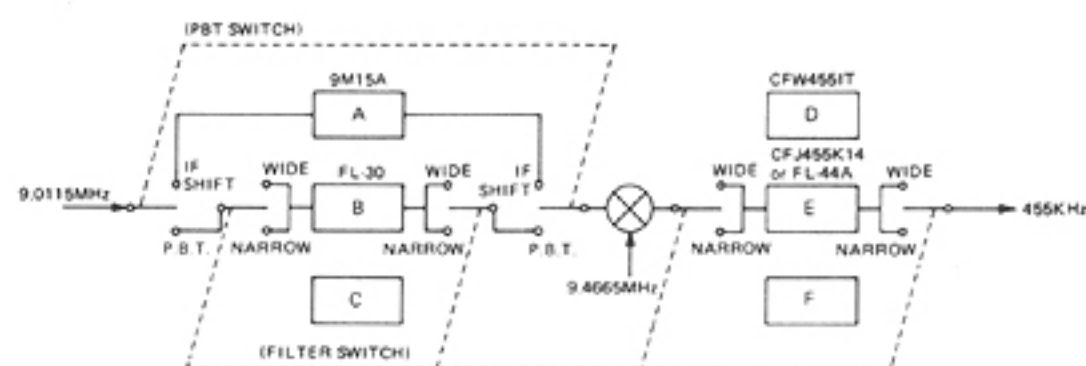
	CENTER FREQUENCY	CHARACTERISTICS	USABLE MODE
FL-45	9.0115MHz	500Hz/-6dB, 1.6KHz/-60dB	CW-RTTY
FL-54	9.0115MHz	270Hz/-6dB, 1.1KHz/-60dB	CW-RTTY
FL-44A	455.0KHz	2.4KHz/-6dB, 4.2KHz/-60dB	SSB
FL-52A	455.0KHz	500Hz/-6dB, 1.0KHz/-60dB	CW-RTTY
FL-53A	455.0KHz	250Hz/-6dB, 480Hz/-60dB	CW-RTTY

The IC-745 has three positions for installing optional filters. The "C" position is for 9MHz filter, one of FL-45 and FL-54, the "E" position for a 455KHz filter, FL-44A (replacing the original ceramic filter with this), and the "F" position for a 455KHz filter, one of FL-52A and FL-53A.



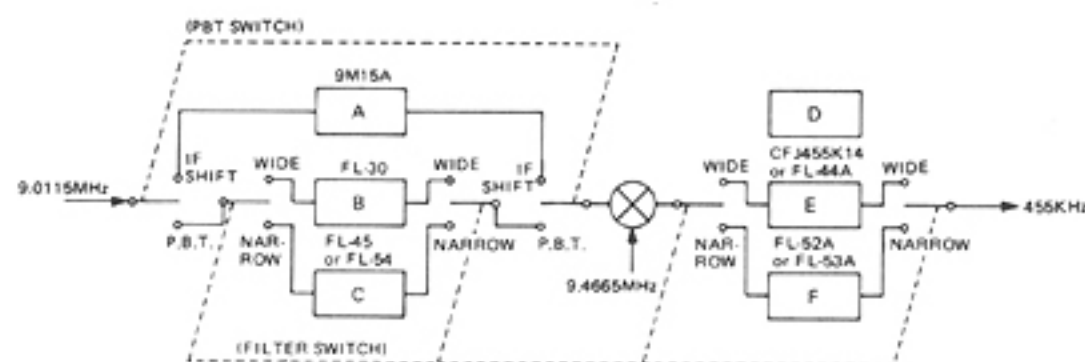
After optional filters are installed, the PBT switch, FILTER switch and PASS-BAND SHIFT control function as follows:

1. When the set is in SSB mode.



PBT SWITCH	FILTER SWITCH	BAND WIDTH	PBT CONTROL
OFF (IF SHIFT)	OFF (WIDE)	2.2KHz/2.4KHz	IF SHIFT
OFF (IF SHIFT)	ON (NARROW)	2.2KHz/2.4KHz	IF SHIFT
ON (PBT)	OFF (WIDE)	2.3KHz ~ 0.8KHz	EFFECTIVE
ON (PBT)	ON (NARROW)	2.3KHz ~ 0.8KHz	EFFECTIVE

2. When a CW narrow filter is installed.
(This can be used in RTTY mode.)

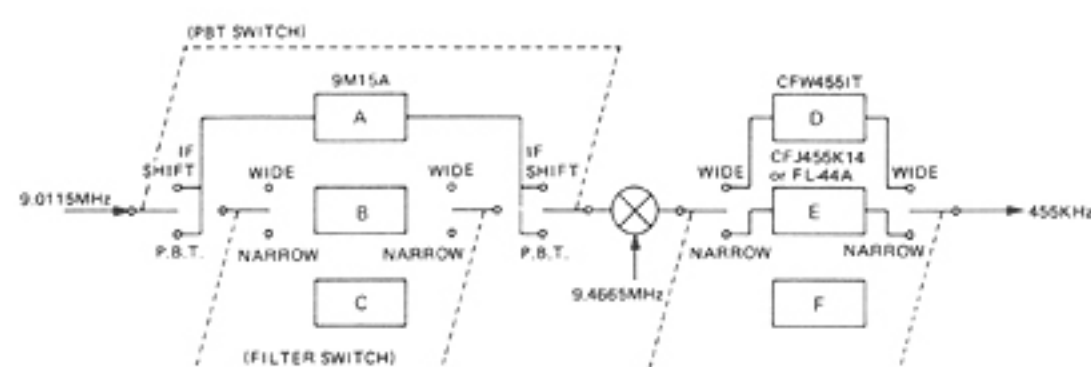


PBT SWITCH	FILTER SWITCH	BAND WIDTH	PBT CONTROL
OFF (IF SHIFT)	OFF (WIDE)	2.2KHz/2.4KHz	IF SHIFT
OFF (IF SHIFT)	ON (NARROW)	*250Hz/500Hz	*IF SHIFT
ON (PBT)	OFF (WIDE)	2.3KHz ~ 0.8KHz	EFFECTIVE
ON (PBT)	ON (NARROW)	**	**

* When FL-52A or FL-53A is installed. If only FL-45 or FL-54 is installed, the set does not work.

** When both 9MHz and 455KHz filters are installed, the PBT is effective and the bandwidth will be varied from 500Hz (or 250Hz) to almost 0. If both filters are not installed, the set does not work.

- When the set is in AM mode.

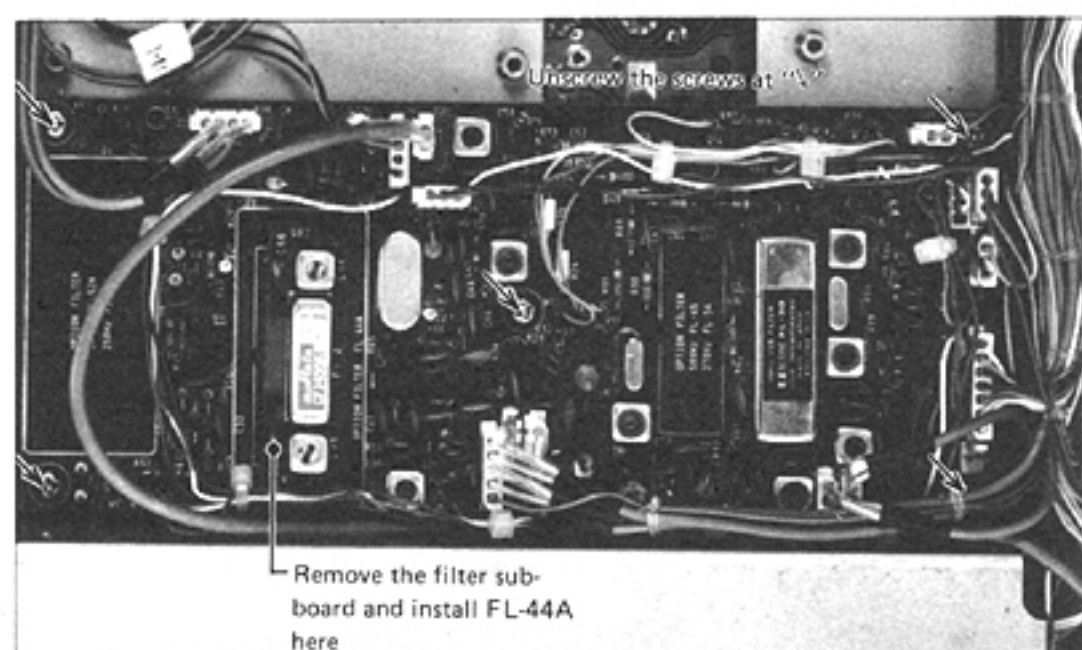


PBT SWITCH	FILTER SWITCH	BAND WIDTH	PBT CONTROL
OFF (IF SHIFT)	OFF (WIDE)	6.0KHz	IF SHIFT
OFF (IF SHIFT)	ON (NARROW)	2.2KHz/2.4KHz	IF SHIFT
ON (PBT)	OFF (WIDE)	6.0KHz	IF SHIFT
ON (PBT)	ON (NARROW)	2.2KHz/2.4KHz	IF SHIFT

7-1-2 INSTALLATION OF FL-44A

(Replacing the original ceramic filter by FL-44A)

- Unscrew the five screws retaining the IF unit board shown in the photo. Then turn the board over to the front side so that the foil side of the board can be seen.
- Remove the solder from the ceramic filter sub-board on the IF unit board shown in the photo below, using a de-soldering braid, then remove the sub-board.
- Insert the FL-44A to the position where the ceramic filter was installed (shown in the photo below) and retain it by using the two supplied nuts, then solder its terminal pins.
- Replace the IF unit board, and top and bottom covers.
- No adjustment is required for operation.



7-1-3 INSTALLATION OF FL-52A/FL-53A

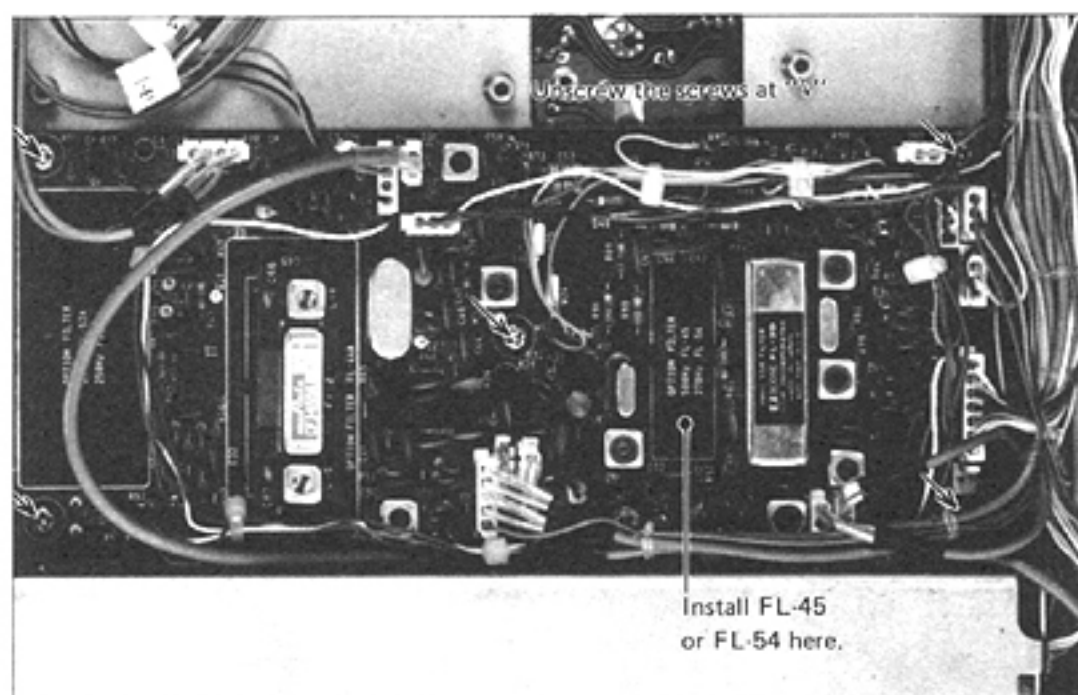
- Unscrew the five screws retaining the IF unit board shown in the photo above. Then turn the board over to the front side so that the foil side of the board can be seen.
- Insert the FL-52A or FL-53A to the position where is shown as "OPTION FILTER" for FL-52A and FL-53A, and retain it by using the two supplied nuts then solder its terminal pins.

- In the CW or RTTY mode, the FL-52A or FL-53A is selected when the FILTER switch on the front panel is pushed in, and the filter gives 500Hz/-6dB or 250Hz/-6dB pass-band for both the CW and RTTY modes.

- When the PBT function is desired, install FL-45 or FL-54. If FL-45 or FL-54 is not installed, the set does not work when the PBT switch and FILTER switch are pushed in.

7-1-4 INSTALLATION OF FL-45/FL-54

- Unscrew the five screws retaining the IF unit board shown in the photo. Then turn the board over to the front side so that the foil side of the board can be seen.
- 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 filter 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.



- The installed filter gives PBT function only when FL-52A or FL-53A is installed. If FL-52A or FL-53A is installed alone, the set does not work when the PBT switch and FILTER switch are pushed in.

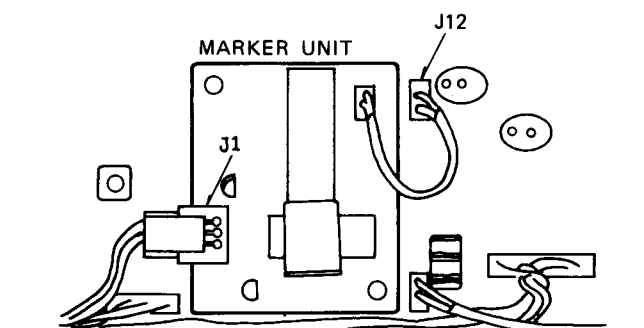
7-2 MARKER UNIT IC-EX241

This unit generates marker signals to calibrate IC-745's operation frequency. The marker generator puts out accurate 100KHz or 25KHz signals on the entire band, and gives easy and accurate frequency calibration.

7-2-1 ASSEMBLY PROCEDURE

- Install this unit in the position as shown in the illustration, using the attached screws.
- Plug P9 (3 pins) of the set to J1 of this unit.

3. Plug P1 (2 pins) of this unit to J12 of the RF unit.
4. Replace the speaker cord connector, and top and bottom covers.



7 - 2 - 2 CALIBRATION OF THE MARKER

1. Set the MODE in the CW and BAND on the 10MHz band.
2. The FREQUENCY DISPLAY will show "10.050.0". Turn the TUNING CONTROL knob to tune to WWV (or other standard frequency station) on 10.000.0MHz, and a 800Hz beat tone will be heard. Set the TUNING RATE switch in OFF position for fine tuning.
3. Set the MARKER Switch on the top cover in the "100K" or "25K" and adjust the MARKER CALIBRATION CONTROL on the top cover, so that the two tones are of the same pitch (in zero beat).

7 - 2 - 3 CALIBRATION OF THE TRANSCEIVER

1. Set the MODE in the CW. Tune to the lower band edge of the band you want to calibrate, as an example, "21.000.0".
2. Ground the KEY jack on the rear panel so that the CW side-tone becomes audible. (Don't transmit.)
3. Set the MARKER switch in the "100K" or "25K", and adjust the FREQUENCY SET CONTROL of the set so that the two tones are of the same pitch (in zero beat).
4. The frequency calibration is sufficient on a frequency on the same band.

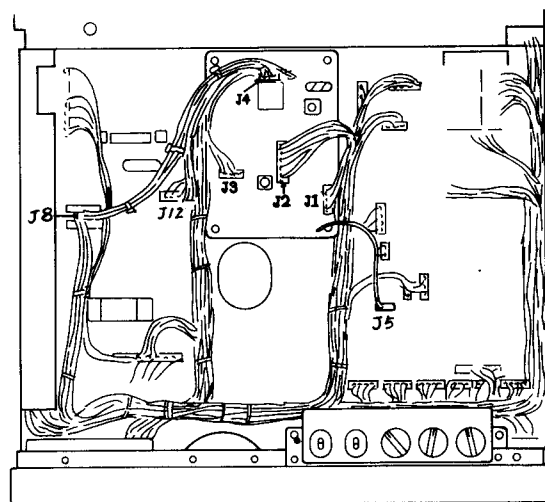
7 - 3 FM UNIT IC-EX242

This unit has a 9.0115MHz FM generator, 3rd IF amplifier, and FM detector circuits that will upgrade the IC-745 to a complete all-mode transceiver. The unit provides a clear, powerful FM signal, and interference-free steady reception for 29MHz FM and/or a VHF/UHF transverter.

7 - 3 - 1 ASSEMBLY PROCEDURE

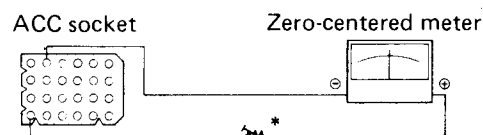
1. Install this unit into the position shown in the illustration, using the attached screws.

2. Unplug P3 (2 pins with a coaxial cable) which is plugged into J12 of the IF unit, and then plug it into J4 of this unit.
3. Plug P33 (3 pins with a shielded wire and red wire) from the IF unit, into J1 of this unit.
4. Plug P34 (7 pins with a shielded wire, red, orange, yellow, green, and purple wires) from the front panel, into J2 of this unit.
5. Plug P37 (3 pins with brown, blue and yellow wires) from the front panel, into J3 of this unit.
6. Plug P1 (2 pins with a coaxial cable) of this unit, into, J12 of the IF unit.
7. Plug P2 (3 pins with a coaxial cable and green wire) of this unit into J8 of the IF unit.
8. Plug P3 (2 pins with a shielded wire) of this unit, into J5 of the MAIN unit.
9. Replace the speaker cord connector, and top and bottom covers.
10. No adjustment is required, and the unit provides a complete FM operation.



7 - 3 - 2 OPERATION

Refer to page 3 - 12 for the FM operations. When you would like to use a discriminator-meter, connect a zero-centered meter ($\pm 50\mu\text{A}$ - $100\mu\text{A}$) across Pin 1 and Pin 8 (ground) of the ACCESSORY socket on the rear panel of the set.



* Insert a trimmer resistor if the meter swings too much.

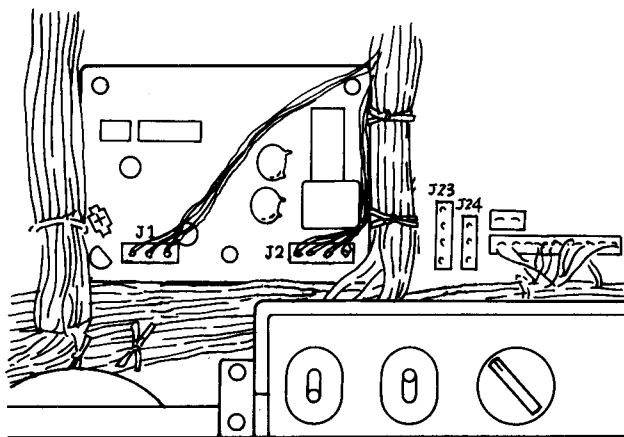
7 - 4 ELECTRONIC KEYER UNIT IC-EX243

This unit provides automatic keying function with an iambic paddle. This unit is built with a single CMOS IC. Features designed into this IC include contact debouncing, RF immunity, self-completing character generation, dot memory and weight control.

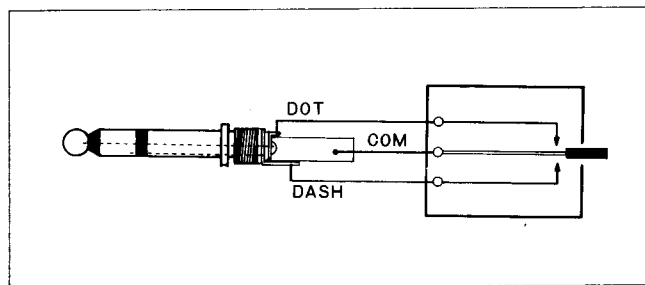
The keying speed can be changed between 5 - 45 wpm by the VOX GAIN/KEYER SPEED CONTROL on the front panel of the set.

7 - 4 - 1 ASSEMBLY PROCEDURE

1. Install this unit into the position shown in the illustration using the attached screws.
2. Plug P30 which is presently inserted to J24 of the MAIN unit, into J1 of this unit.
3. Plug P53 which is presently inserted to J23 of the MAIN unit, into J2 of this unit.



4. Connect an iambic paddle with a 3-p 1/4 inch key plug as shown in the following illustration.



5. Plug the key plug to the KEY JACK on the rear panel.
6. Check the operation of the keyer. If you would like to increase the weight (to alter the dot-space ratio), turn the weight control on this unit clockwise for your favorite position.
7. Replace the speaker cord connector, and top and bottom covers.

7 - 4 - 2 OPERATION

Turn the VOX GAIN/KEYER SPEED CONTROL click on,

and adjust keying speed by turning the control further clockwise for the most comfortable speed for you.

When you don't wish to use the keyer, turn the VOX GAIN/KEYER SPEED CONTROL completely counter-clockwise and click off. Then connect a hand key to the KEY JACK on the rear panel.

7 - 5 BUILT-IN POWER SUPPLY UNIT IC-PS35

7 - 5 - 1 SPECIFICATIONS

Number of Semiconductors

Transistor	5
IC	2
Diode	4

Input Voltage

110/220V AC (50/60Hz)

Allowable Voltage Fluctuation

±10% of input voltage
(suitable line voltage)

Input Capacity

550VA (at 20A load)

Output Voltage

13.8V DC Negative ground

Max. Load Current

20A (10 mins ON/10 mins OFF)

Dimensions

194(W) x 50(H) x 186(D) mm

Weight

Approx. 2.3kg

Kit Included

Main Unit	1
Insulation Spacer	1
Power Socket Unit	1
AC Power Cord	1
Spare Fuses	2
Installation Screws	6
Insulation Washers	6

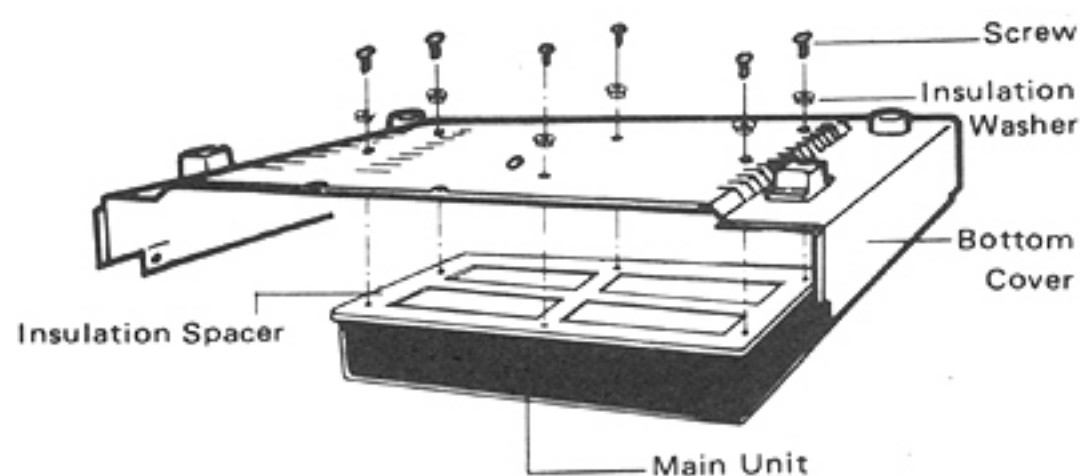
7 - 5 - 2 PREPARATION

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

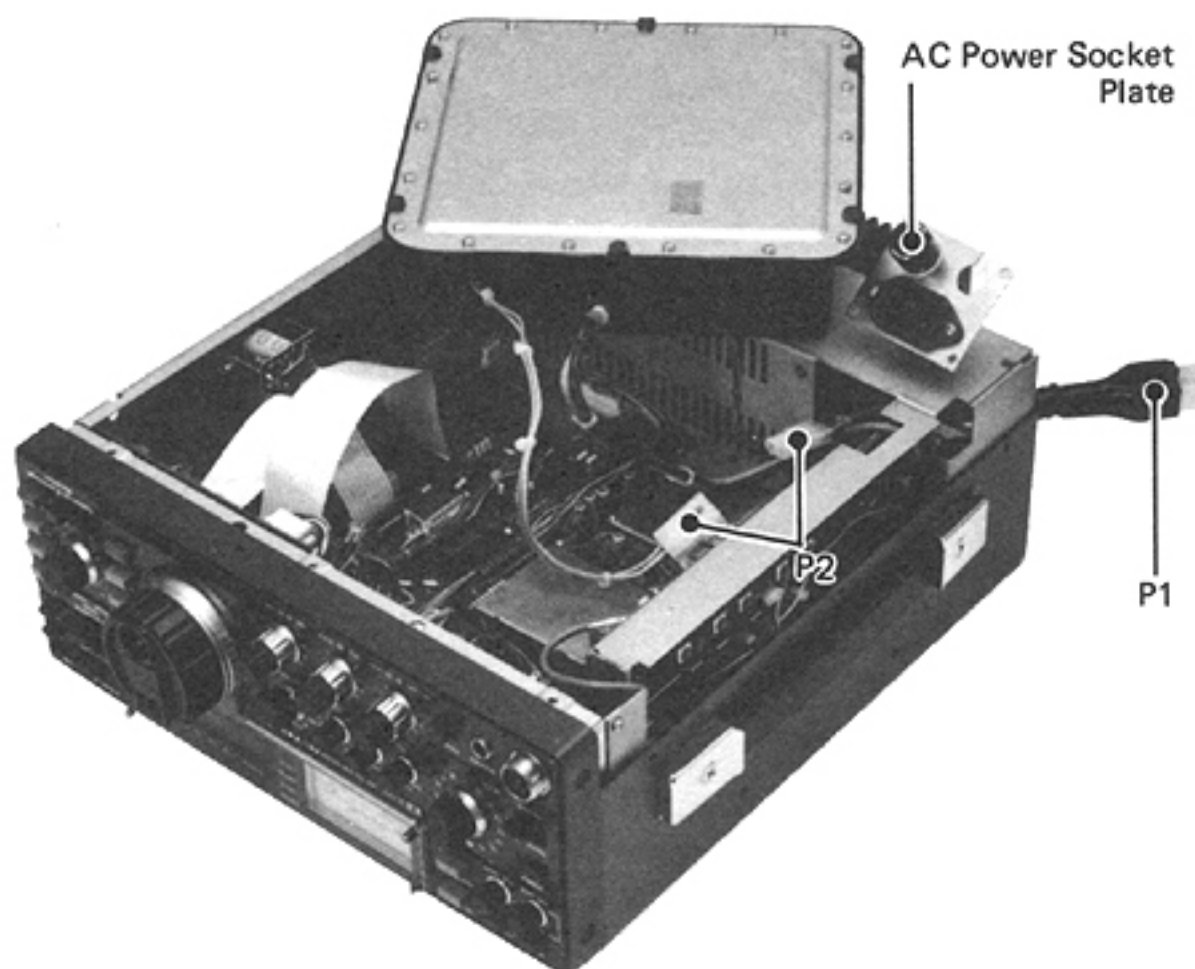
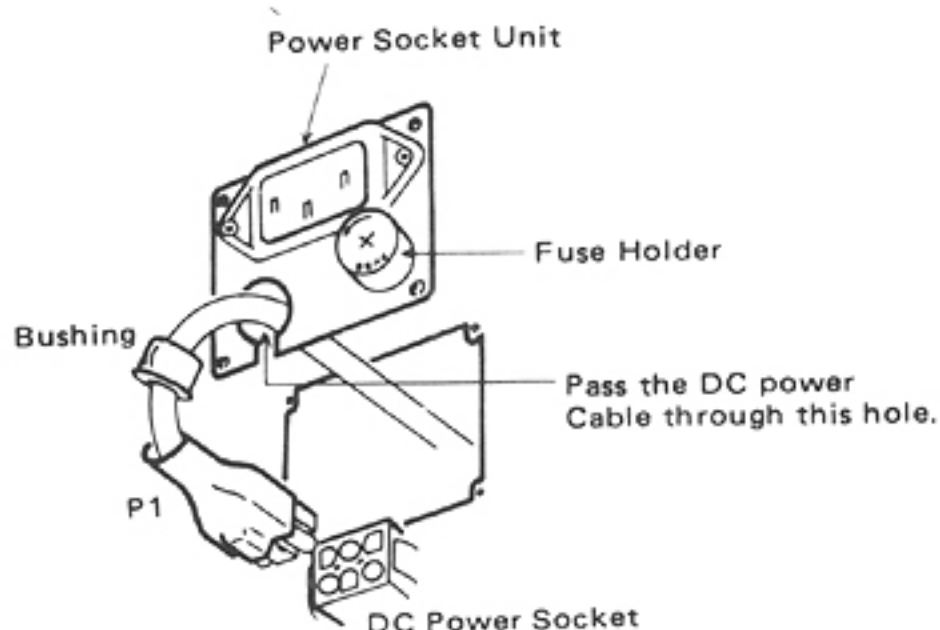
Remove the top and bottom covers by unscrewing the six screws each on the top and bottom, and the three screws on each side, while taking care not to damage the internal speaker, and unplug its connector.

7 - 5 - 3 ASSEMBLY PROCEDURE

- 1 Turn the transceiver upside down. Remove the "PLATE (A)" attached to the rear panel by unscrewing four screws. These screws will be used later.
- 2 Attach the main unit (power supply) to the bottom cover with supplied screws and insulation washers. At this time, insert the insulation spacer between the main unit and the bottom cover.



- 3 Pass the DC power cable attached to P1 through the hole of the AC power socket plate as shown in the illustration, then insert the bushing into the hole. Attach the AC power socket plate to the position which was attached the PLATE (A) before, by using the screws described in 1, so that the AC power socket is toward the bottom of the set.

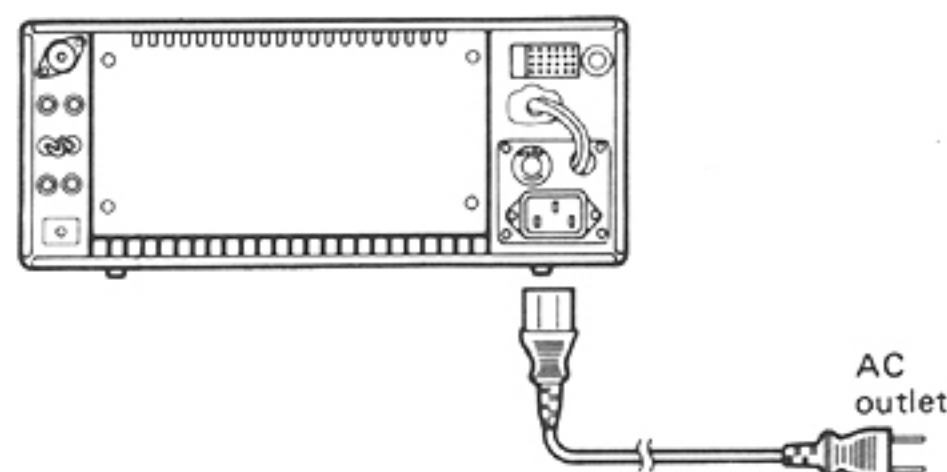


- 4 Pass the connector, P2', from the power socket unit to the inner chassis through the hole of the rear chassis. Then connect it with the connector, P2, from the main unit of the power supply.

- 5 Connect the internal speaker connector and replace the bottom and top covers of the set. Plug P1 of the power supply unit to the DC Power Socket of the set.

7-5-4 OPERATION

1. Connect the DC output plug, P1, of this unit into the transceiver DC power Socket securely. At this time, make sure that:
 - A. The power switch on the transceiver is OFF.
 - B. The T/R switch is in the RECEIVE position.
 - C. The PTT switch on the microphone is not depressed.
 - D. The VOX switch is in the OFF position.
2. Connect the supplied AC power cord into the AC power socket (newly installed) on the rear panel of the transceiver. Then connect the AC power plug into an AC power outlet.



3. By turning the transceiver power switch ON, this unit will be turned ON and supply a DC 13.8V to the transceiver.

7-5-5 CAUTION

1. Ground the GROUND TERMINAL of the set with as short a wire as possible to prevent electrical shock, TVI, BCI and other problems.
2. This unit stops the output voltage with a protection circuit, when output voltage is shorted or consumed load current exceeds 25A. When the output voltage is stopped, turn the power switch of the transceiver OFF and remove the cause of the problem.
3. If the fuse blows, replace it with a 10A (at 117V) or 5A (at 240V) fuse after checking the cause of the problem. Use a Philips (+) screwdriver to open the holder. The outside ring of the holder cannot be rotated.

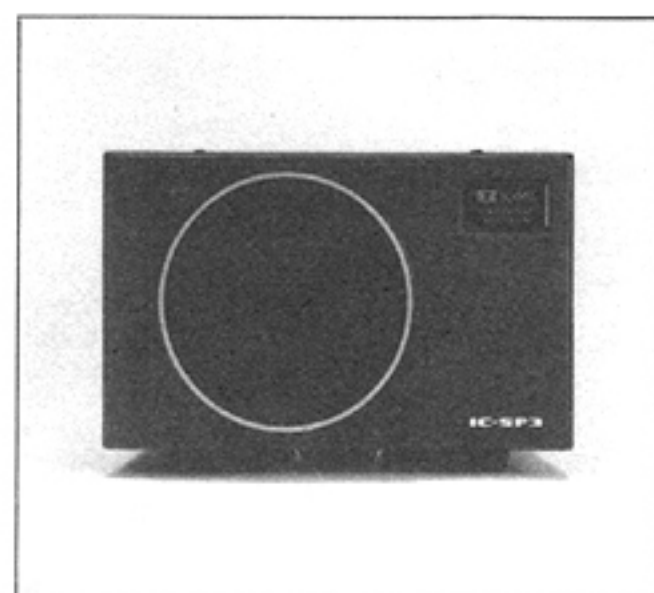
7-6 OTHER OPTIONS



IC-PS15
AC POWER SUPPLY
13.8V 20A



IC-PS30
AC SYSTEM POWER SUPPLY
13.8V 25A



IC-SP3
EXTERNAL SPEAKER



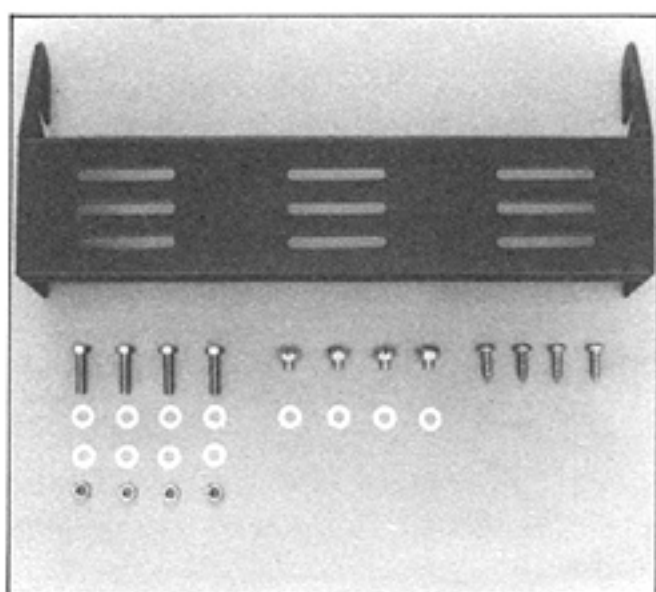
IC-SM6
ELECTRET CONDENSER TYPE
DESK MICROPHONE



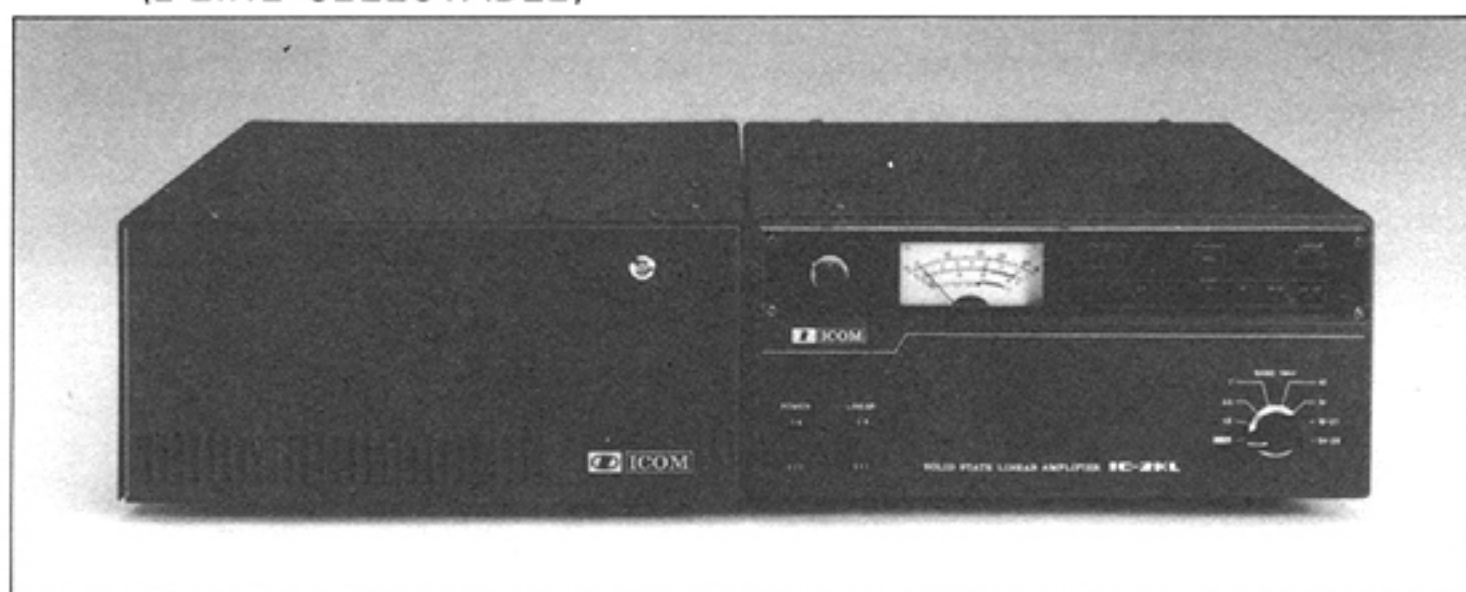
SM-8
ELECTRET CONDENSER TYPE
DESK MICROPHONE
(2-LINE SELECTABLE)



IC-HP1
HEADPHONES



IC-MB12
MOBILE MOUNTING
BRACKET



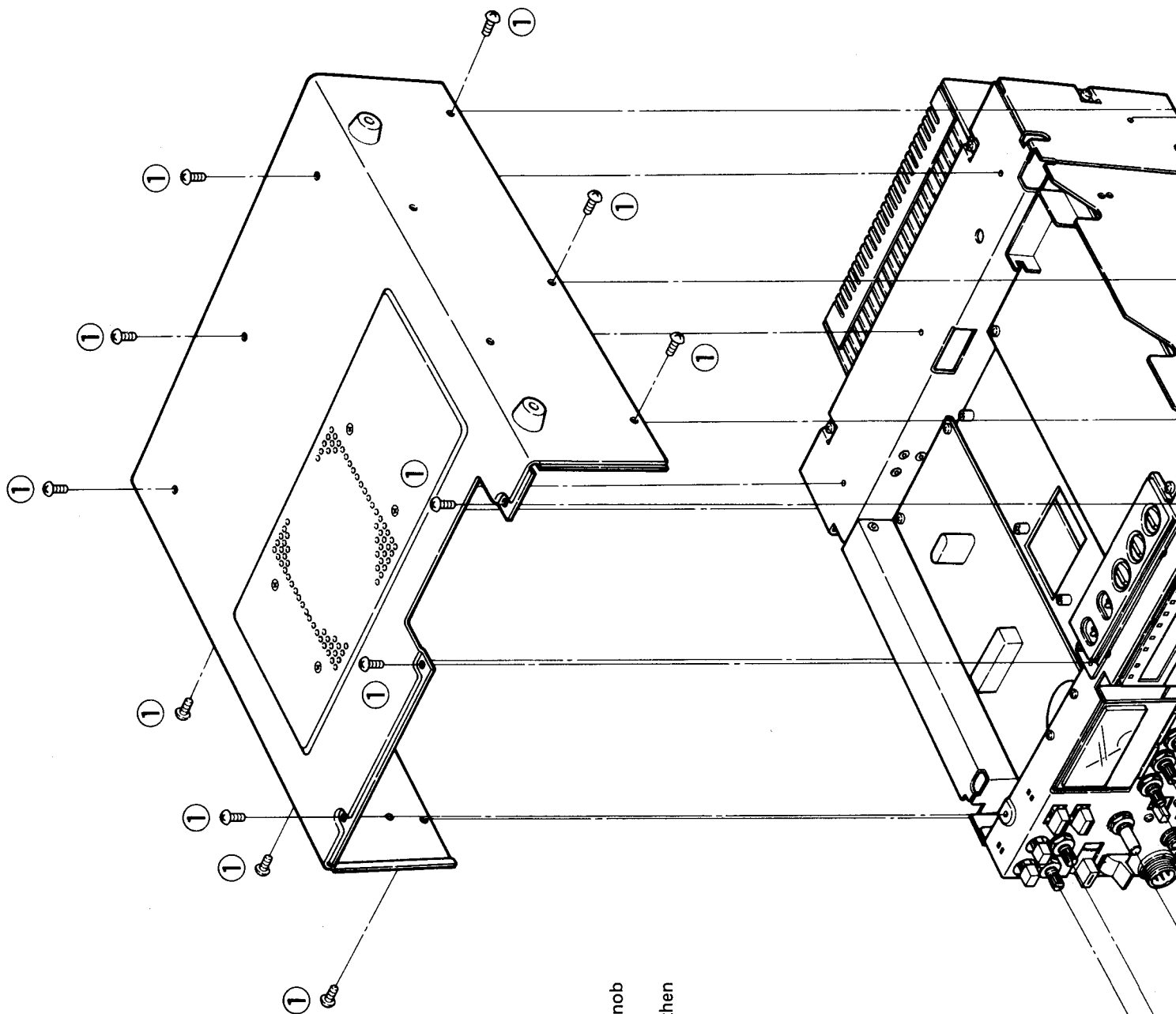
IC-2KLPS
ATTENDANT POWER SUPPLY
FOR IC-2KL

IC-2KL
500W SOLID-STATE
LINEAR AMPLIFIER

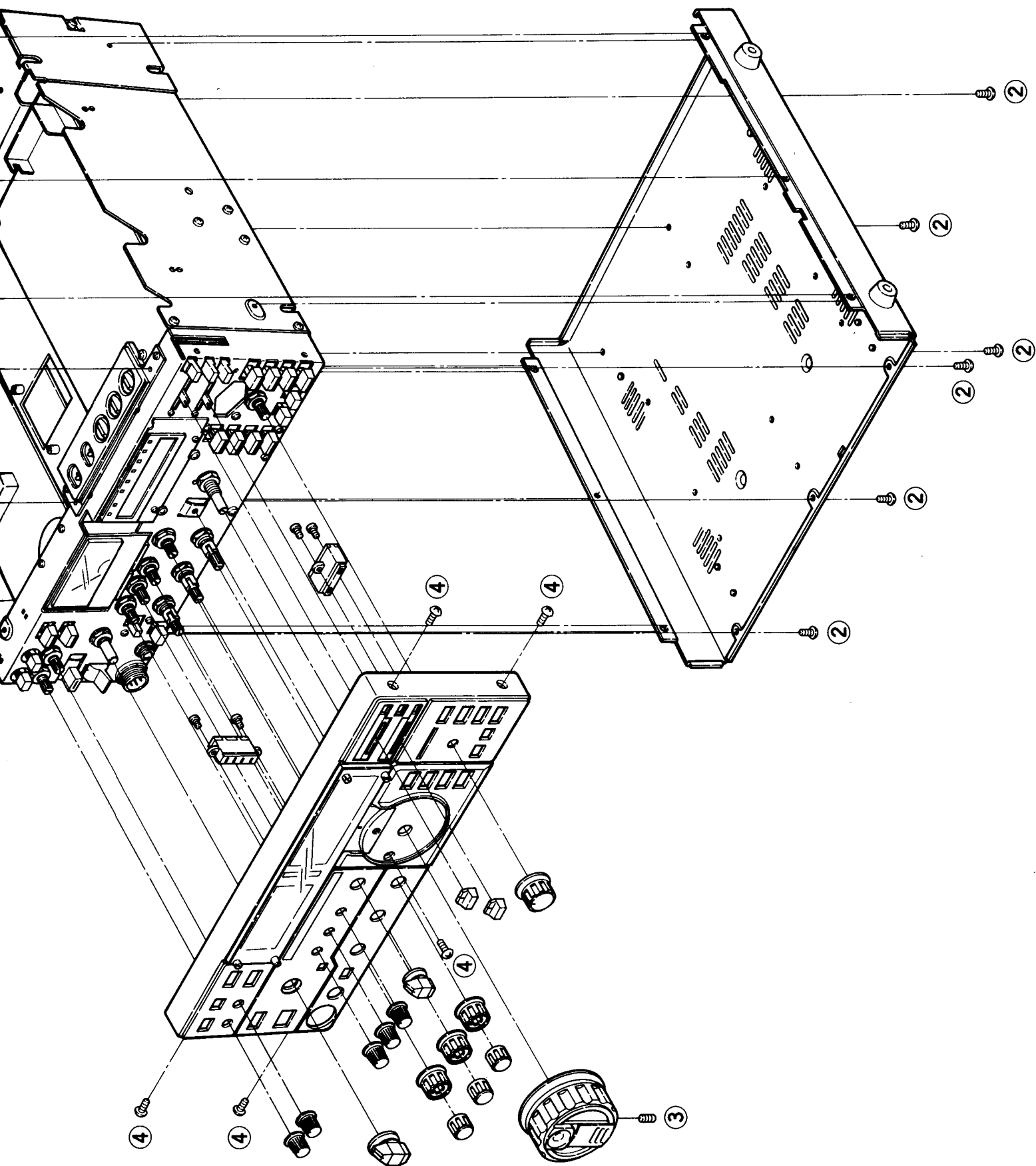


IC-AT100
(100W)
IC-AT500
(500W)

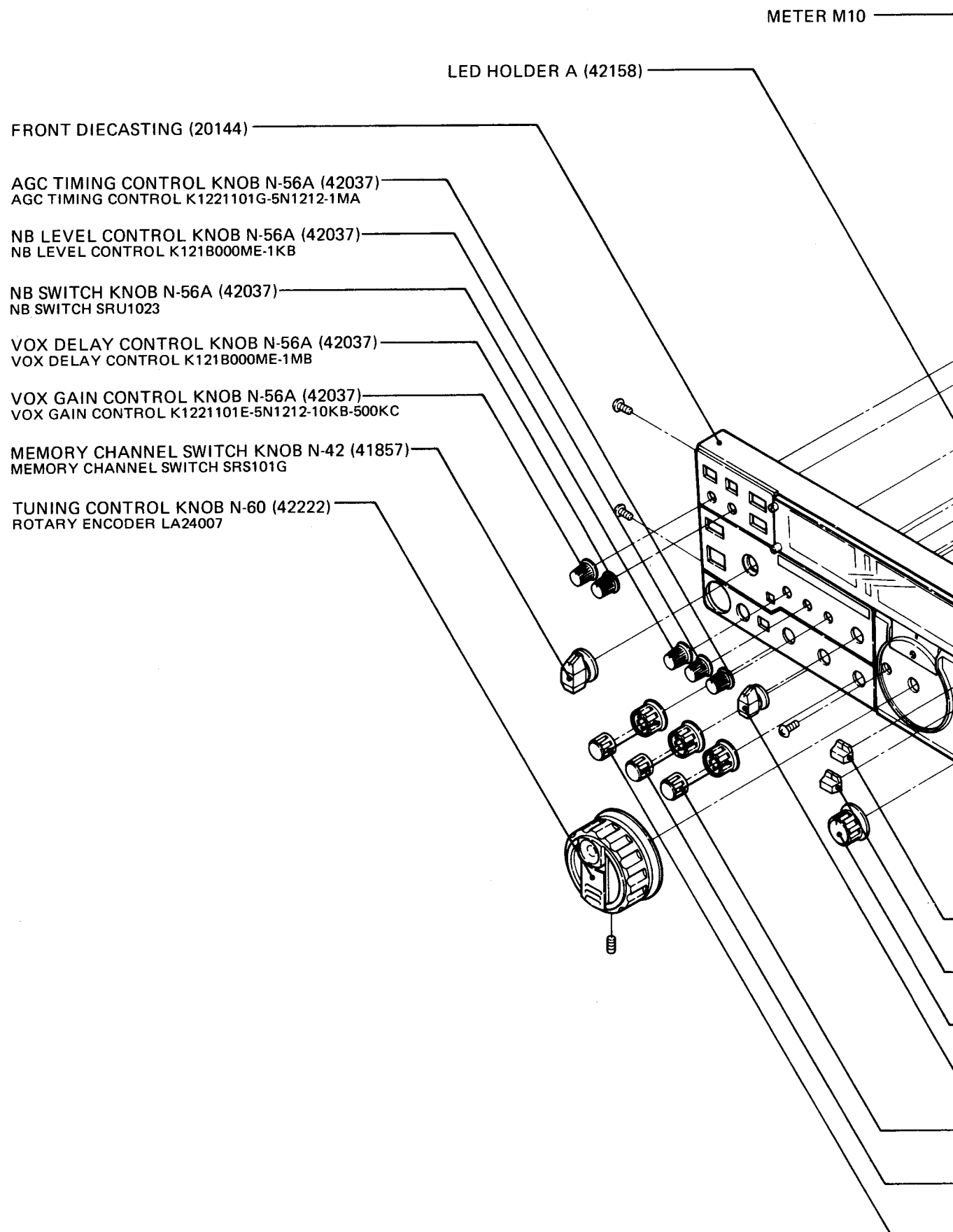
AUTOMATIC
ANTENNA TUNER

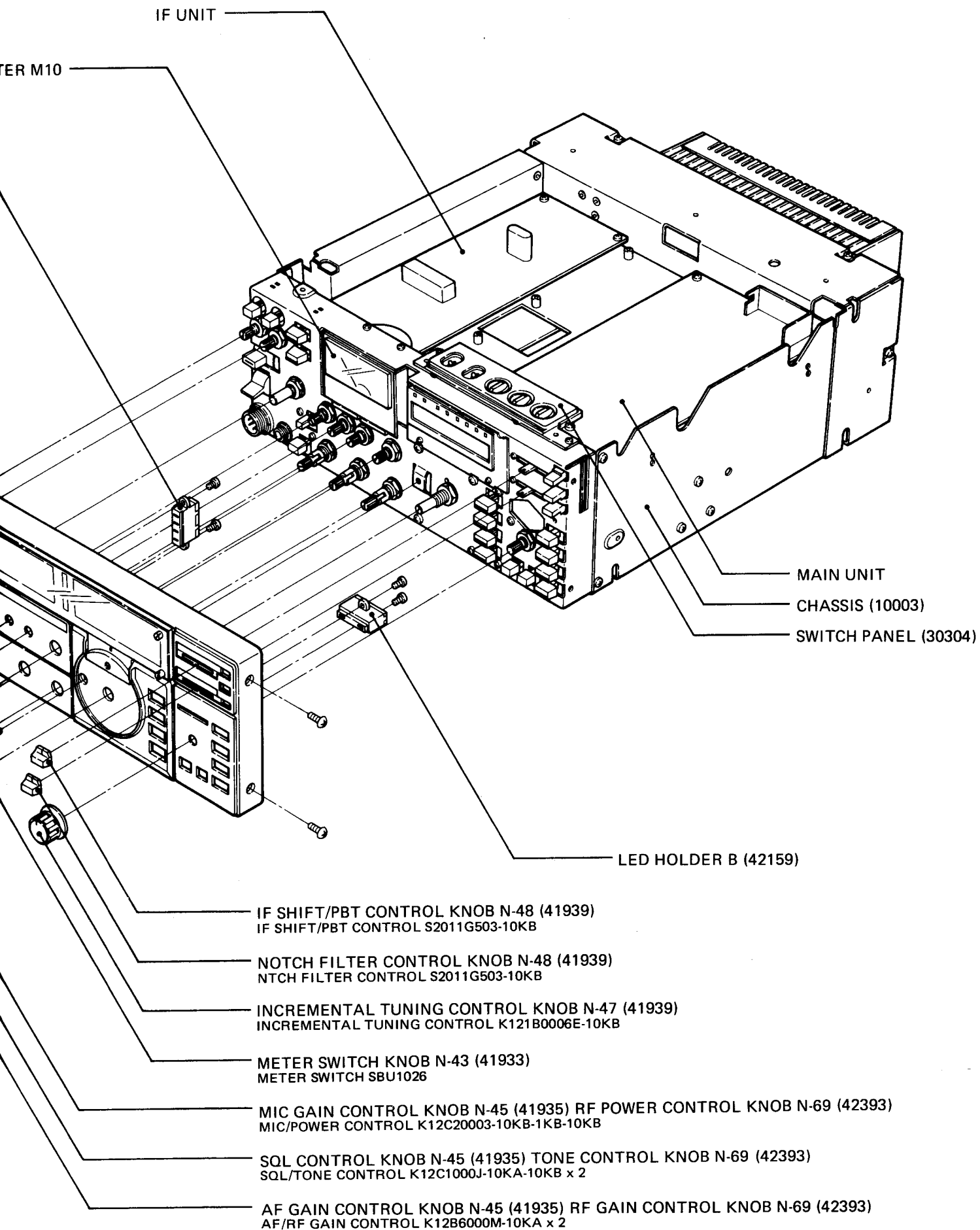


1. Remove the top cover. (12 set screws ①)
2. Remove the bottom cover. (6 set screws ②)
3. Remove the front panel control knobs, etc.
(Use a hexagonal wrench to remove the four knob screws ③.)
4. Remove the four frame-holding screws ④, and then remove the front panel frame by pulling it forward.

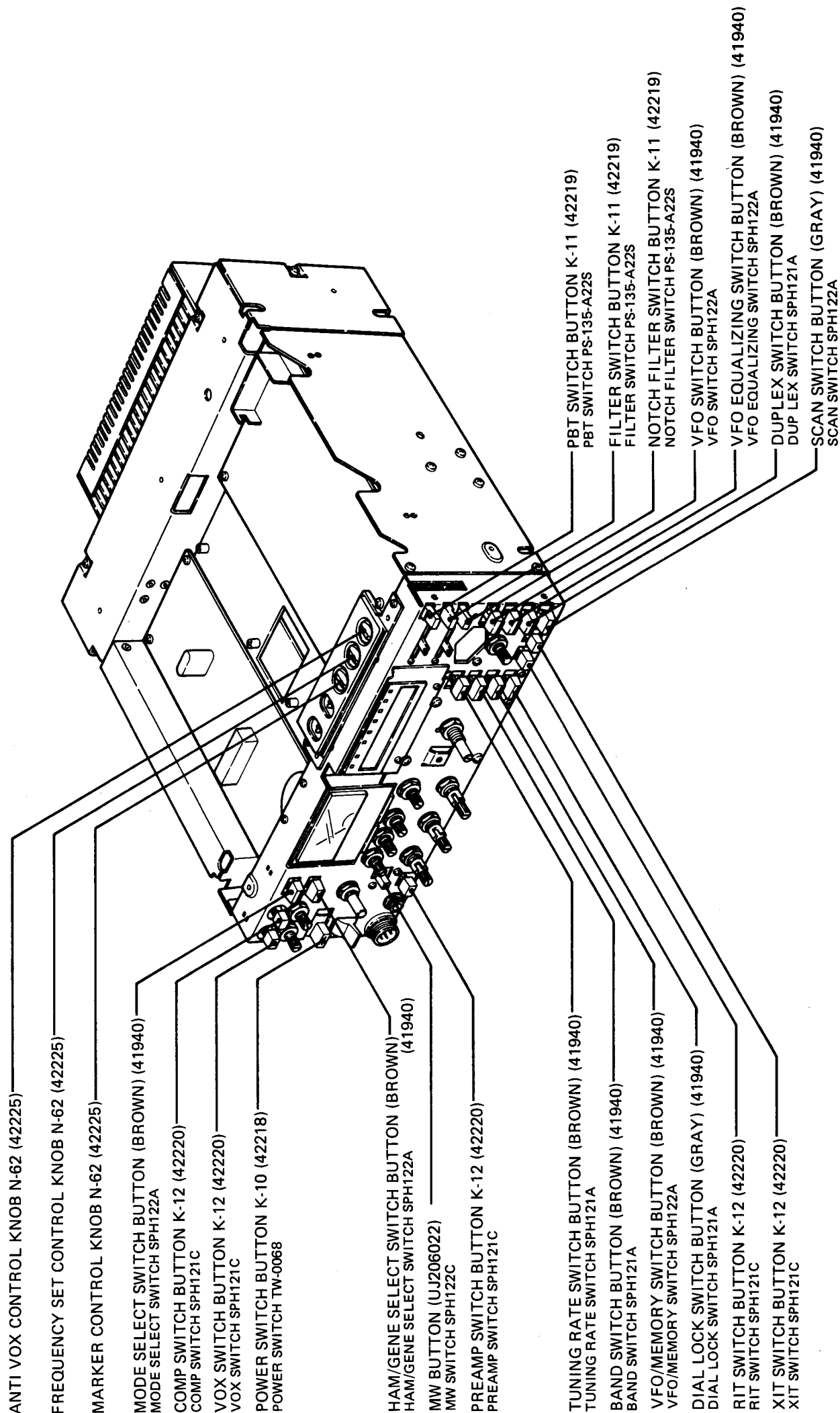


FRONT PANEL PARTS 1

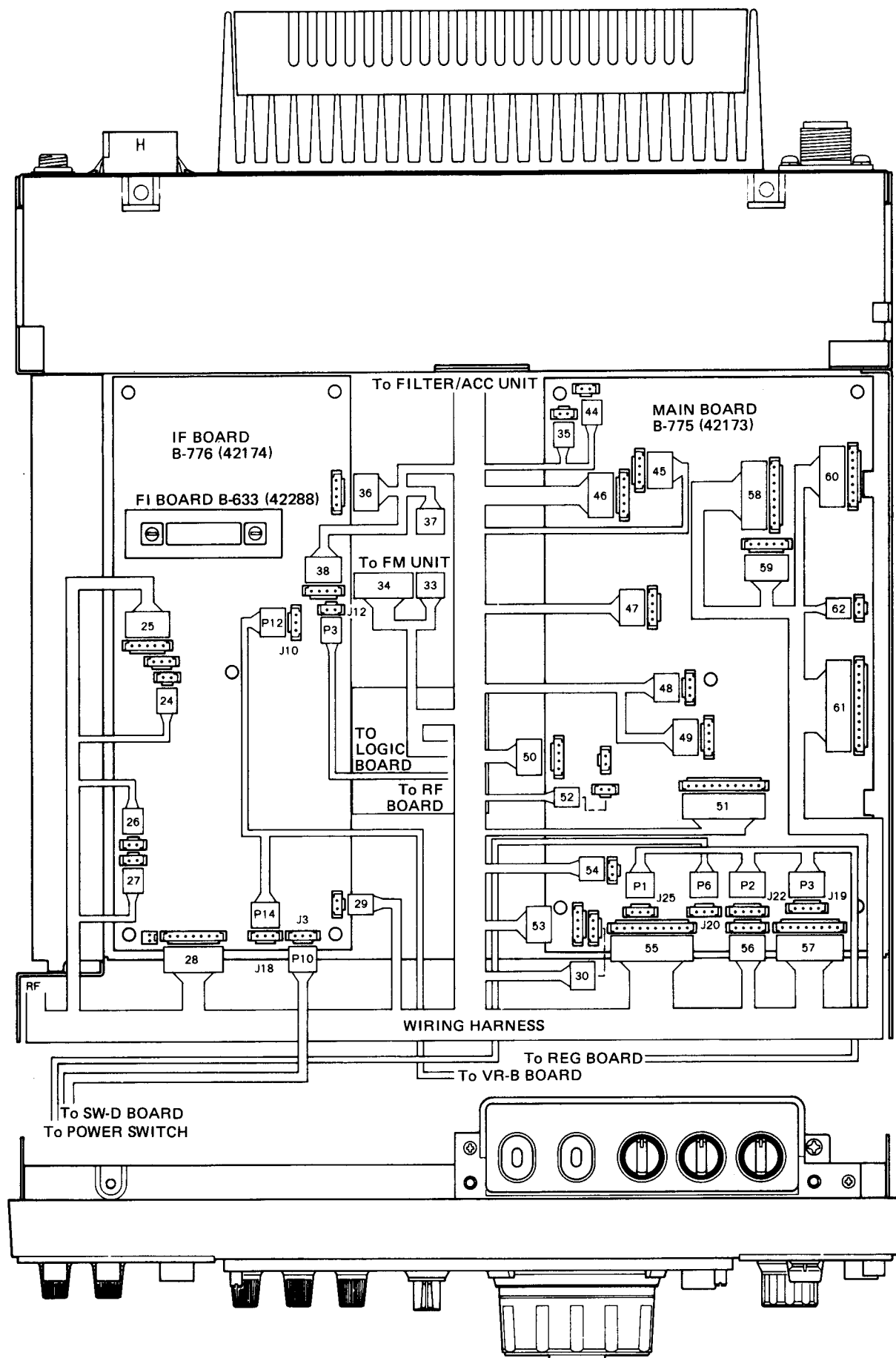




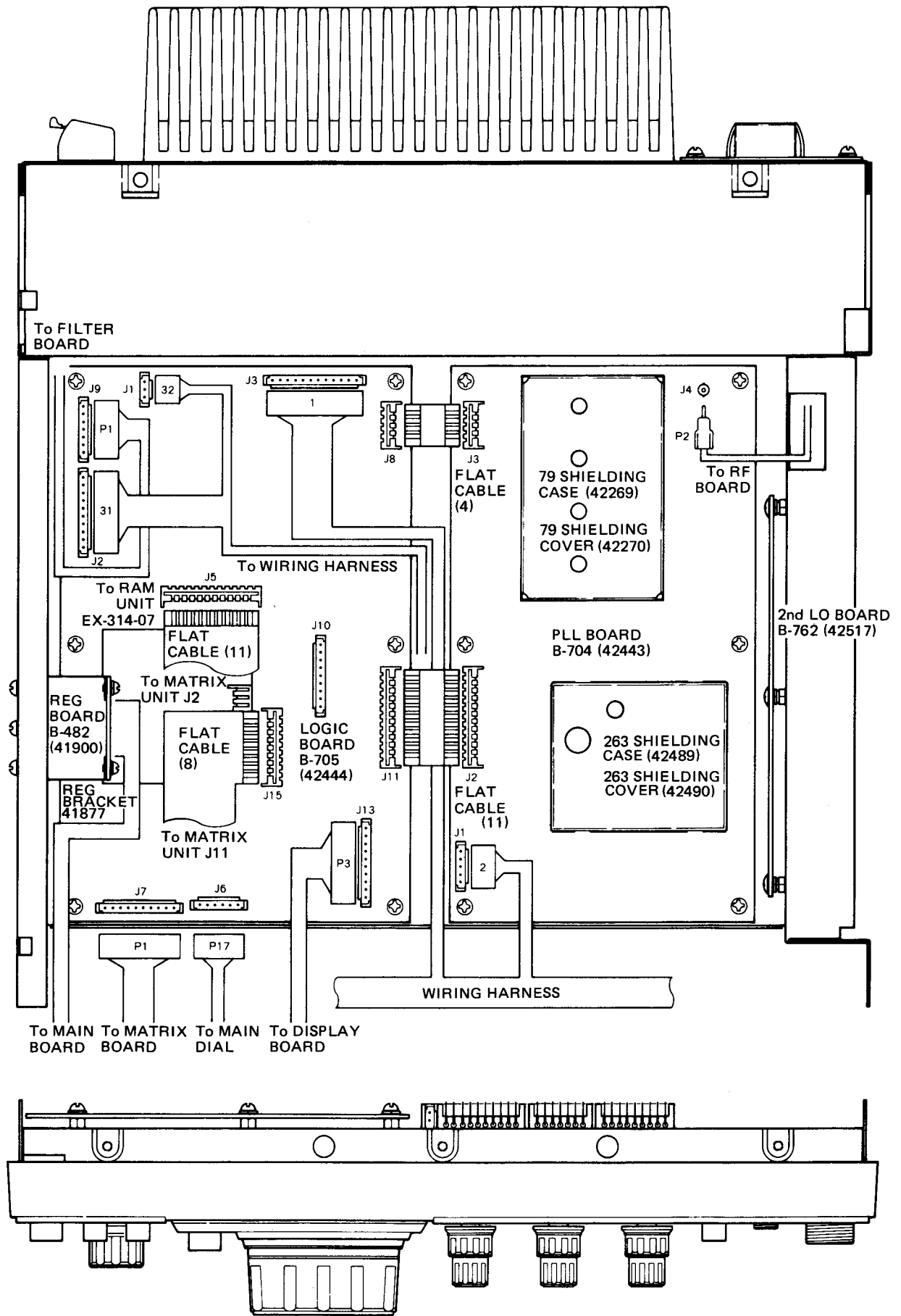
FRONT PANEL PARTS 2



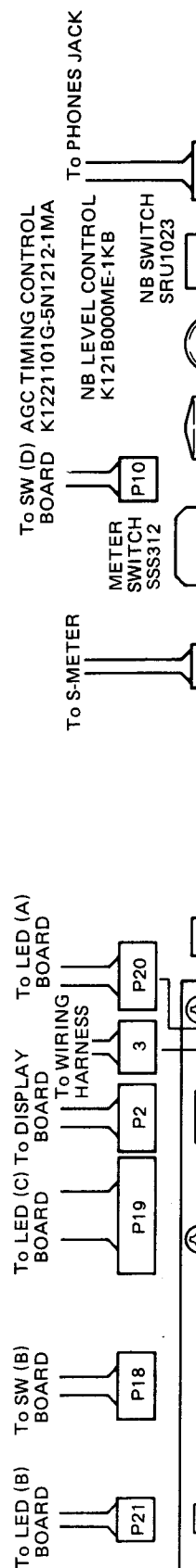
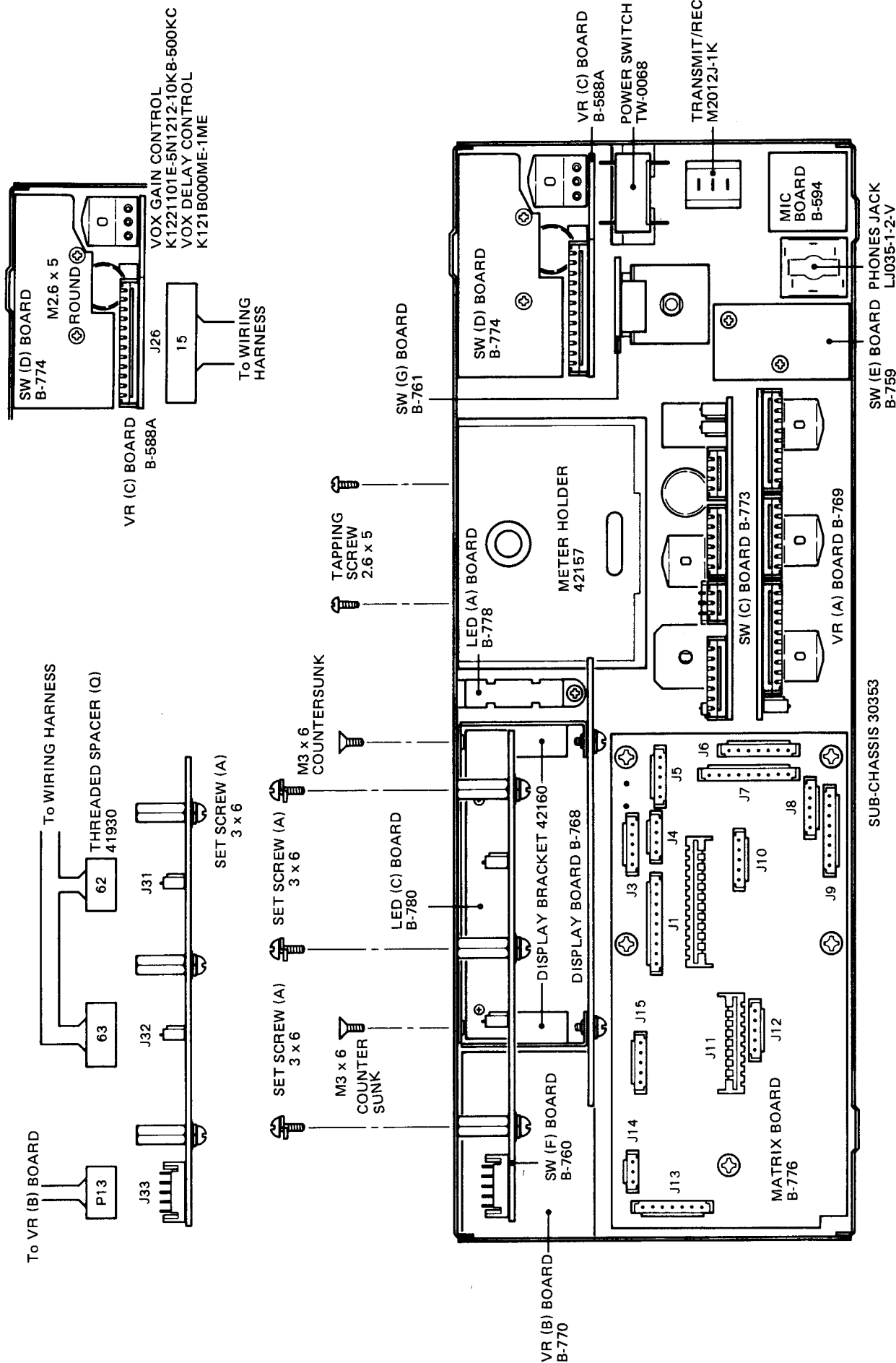
IF/MAIN UNIT SIDE CONNECTOR CONNECTIONS

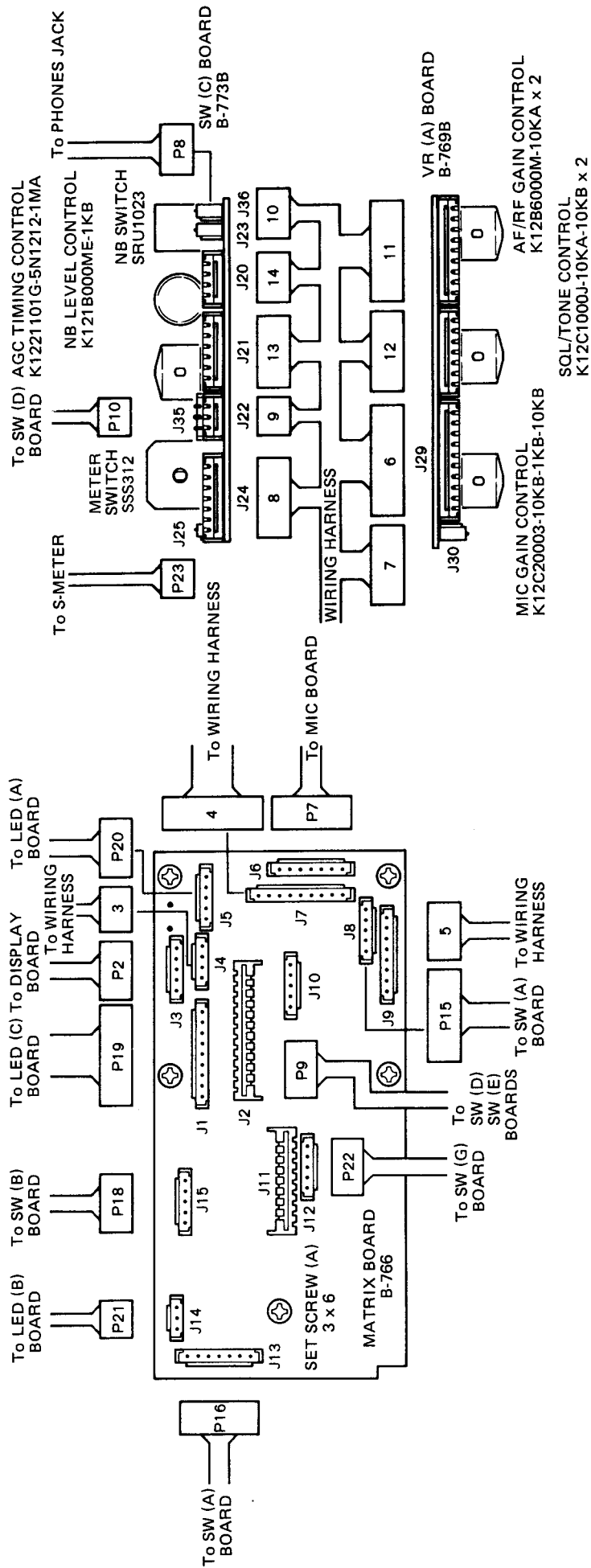


LOGIC/PLL UNIT SIDE CONNECTOR CONNECTIONS



FRONT PANEL CONNECTOR CONNECTIONS





SUB-CHASSIS 30353

REAR SIDE

FRONT SIDE

SET SCREW (A) 3 x 6 41566

To PA UNIT

To CONNECTOR UNIT

To IF UNIT J12 P3

To MARKER UNIT (J1)

To PLL UNIT J4

To 2nd LO UNIT J2

1st MIXER

2nd MIXER

MIXER SHIELDING CASE 41556

MIXER SHIELDING COVER 41557

RF BOARD B-777 (42442)

J1, J2, J3, J4, J5, J6, J7, J8, J9, J10, J11, J12, J13, J14

P1, P2, P3, P4, P5

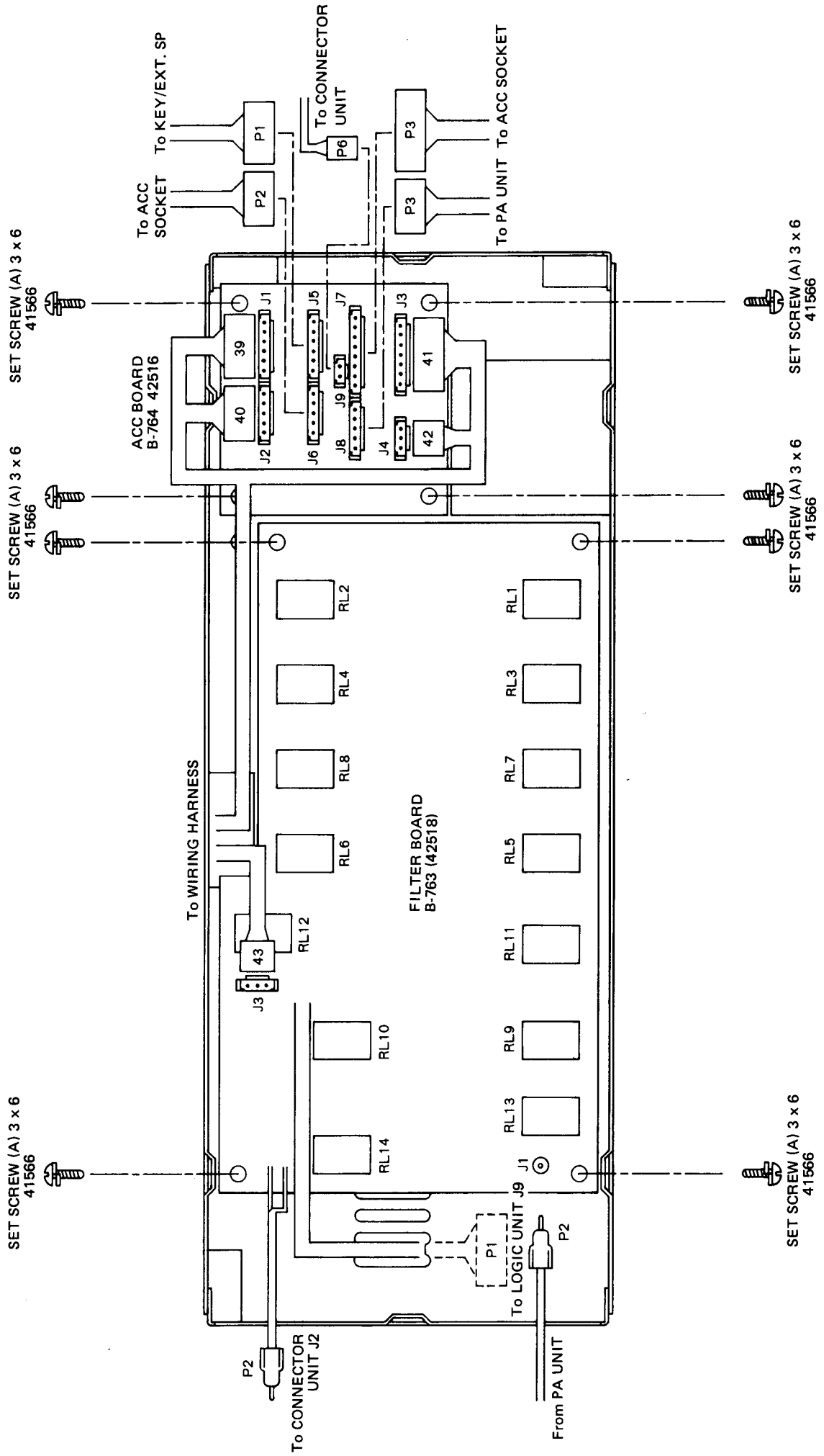
SET SCREW (A) 3 x 6 41566

SET SCREW (A) 3 x 6 41566

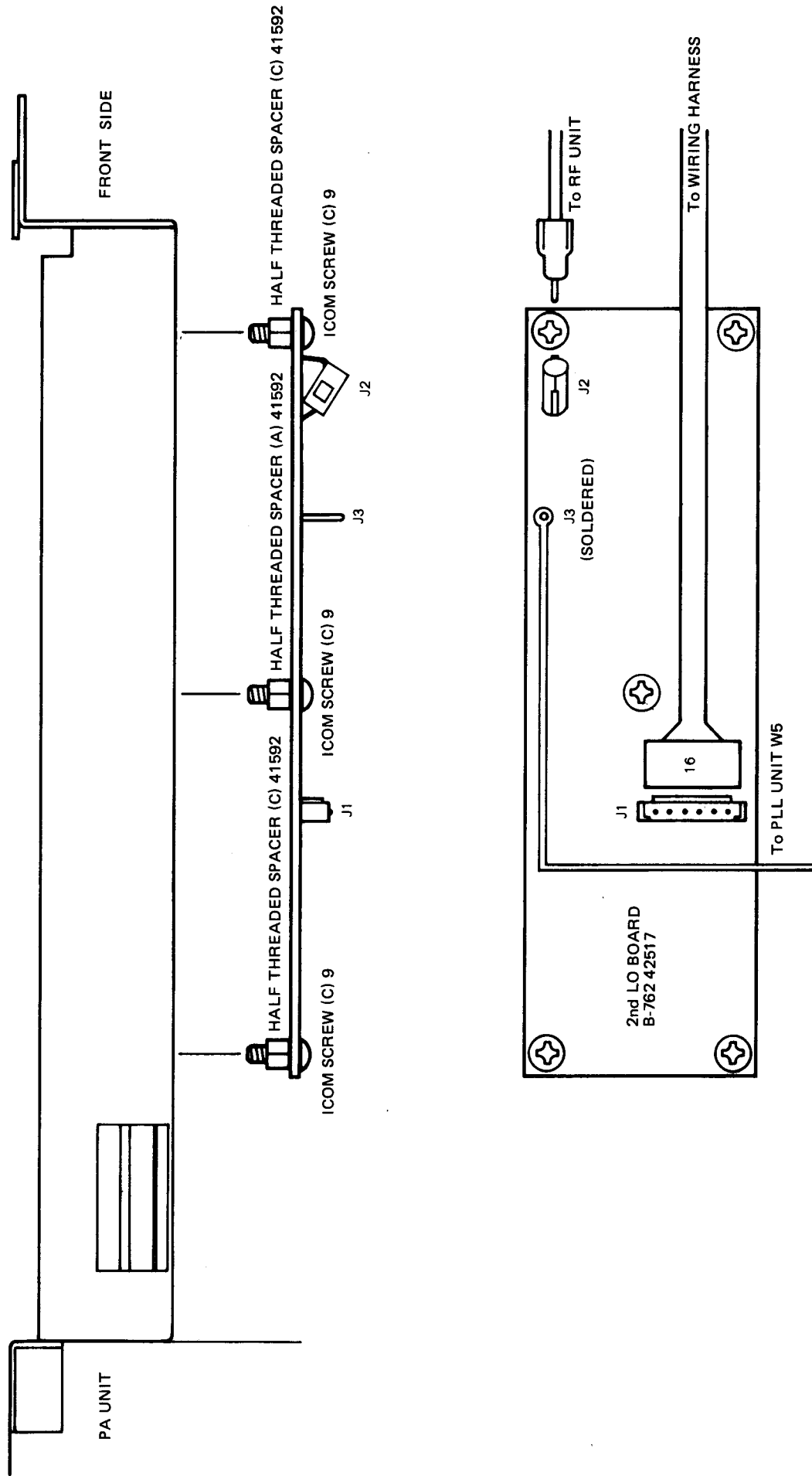
SET SCREW (A) 3 x 6 41566

SET SCREW (A) 3 x 6 41566

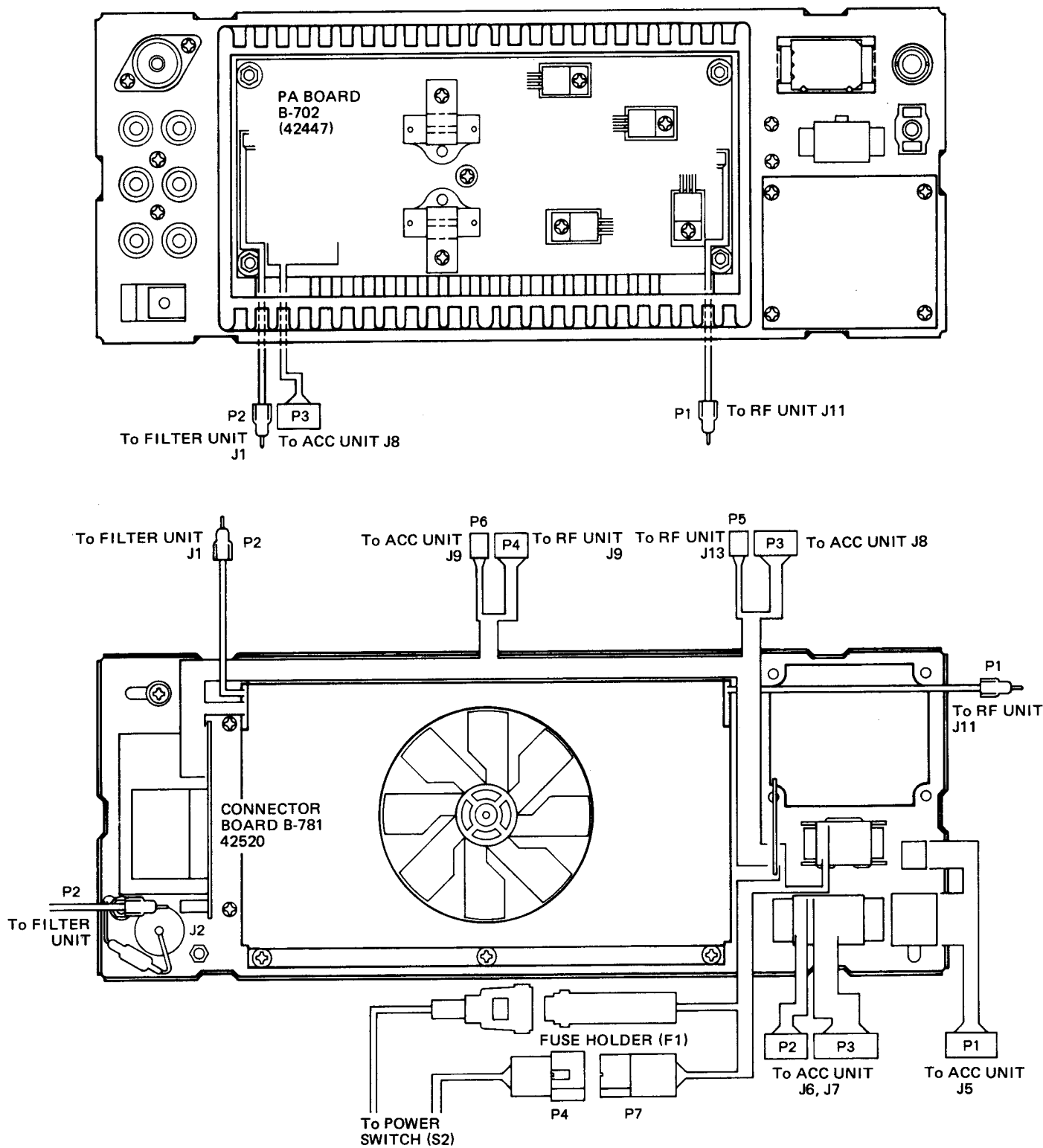
FILTER • ACC UNIT SIDE CONNECTOR CONNECTIONS



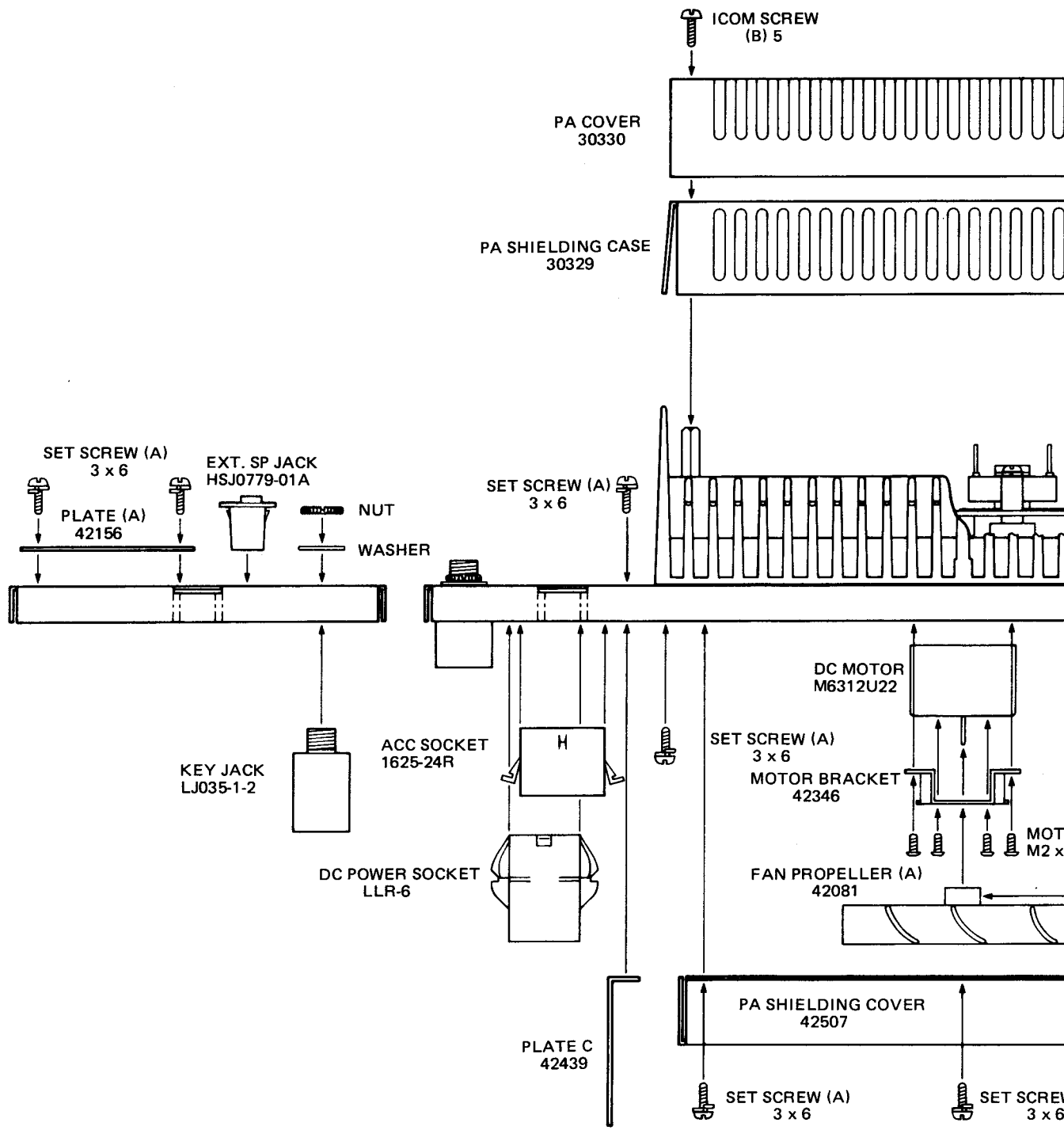
2nd LO UNIT CONNECTOR CONNECTIONS



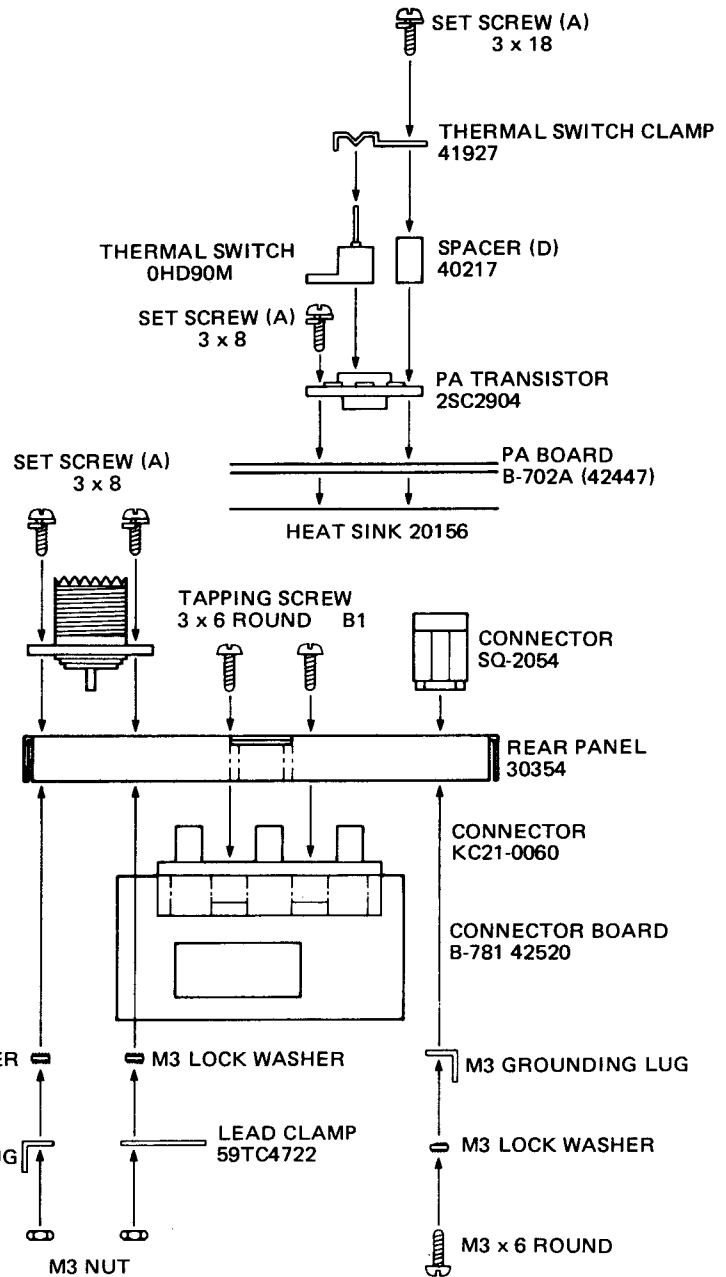
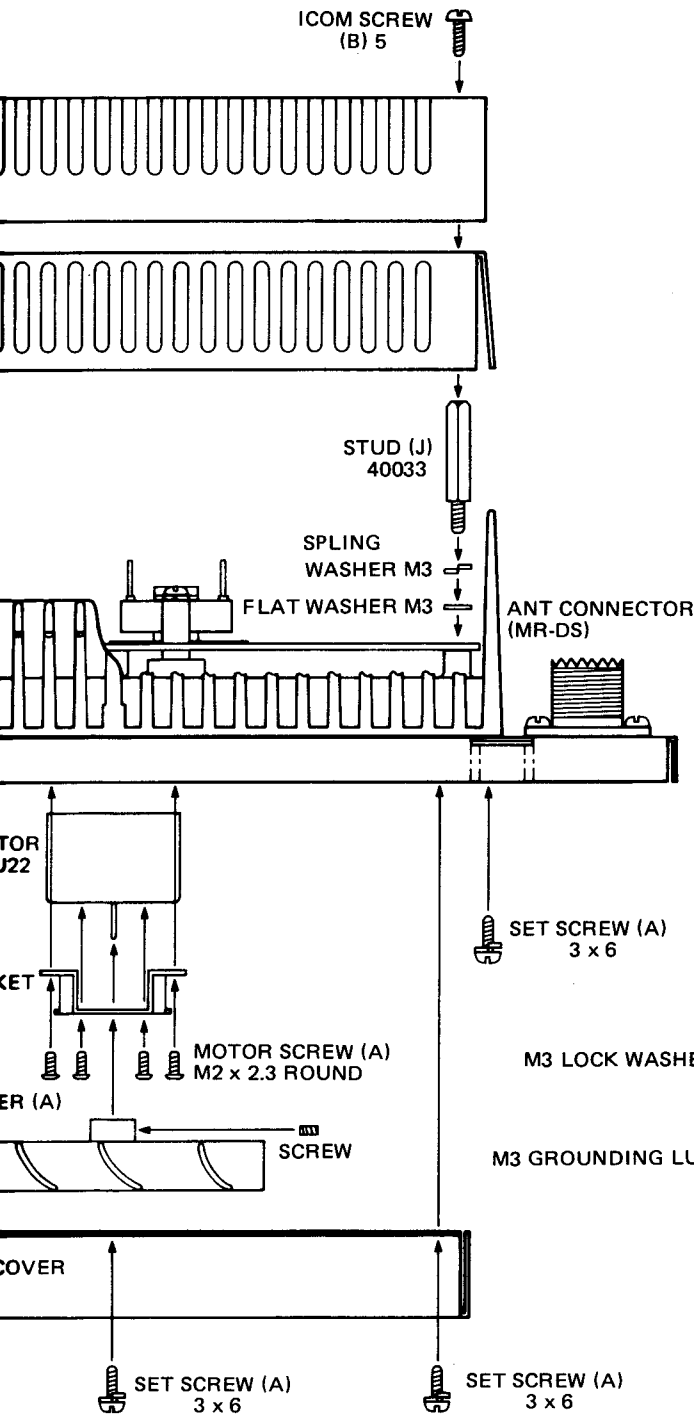
REAR UNIT CONNECTOR CONNECTIONS



REAR UNIT DISASSEMBLY

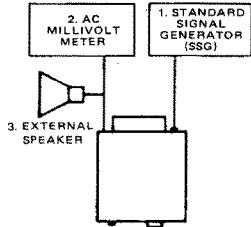


PA TRANSISTOR MOUNTING

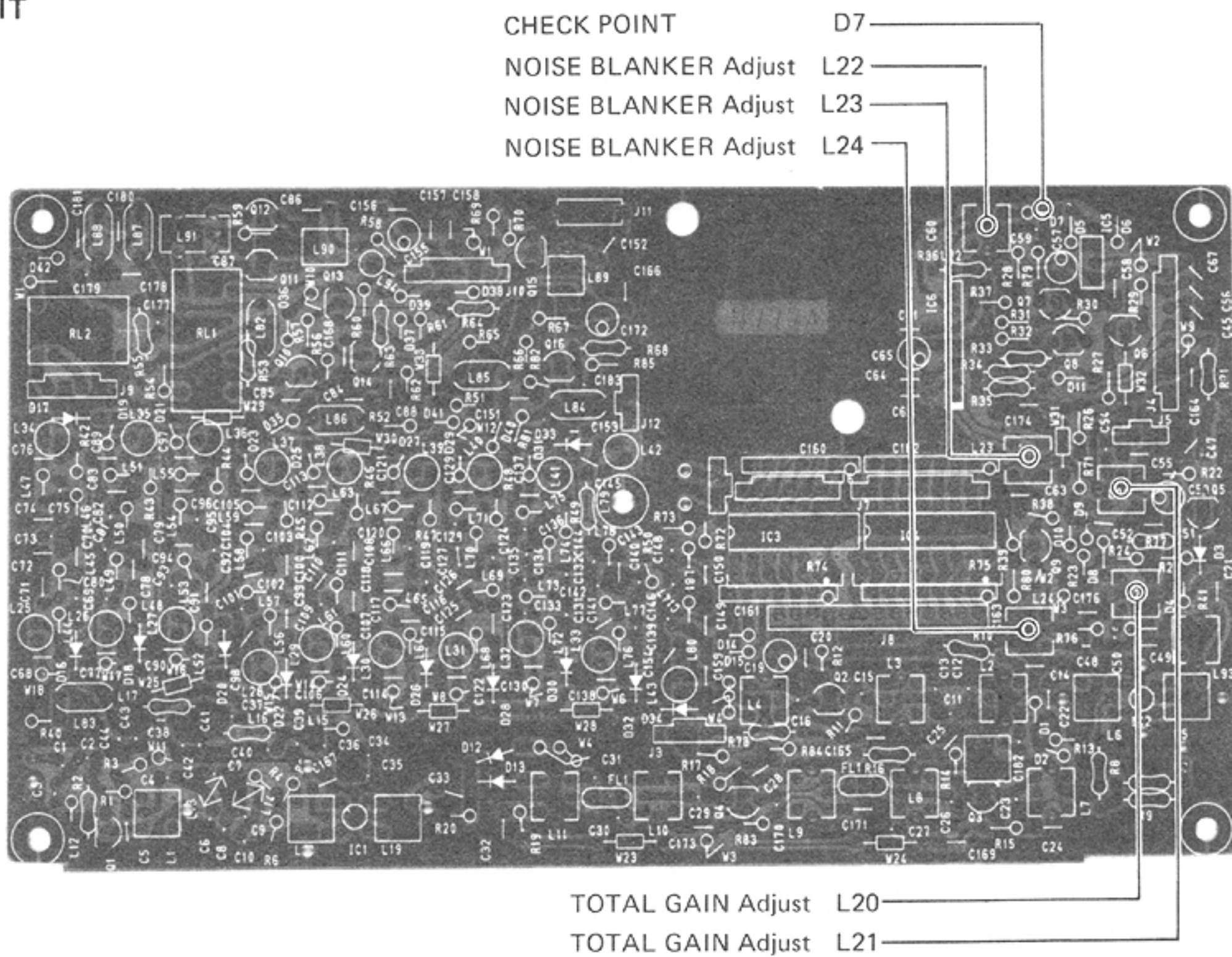


SECTION 9 MAINTENANCE AND ADJUSTMENT

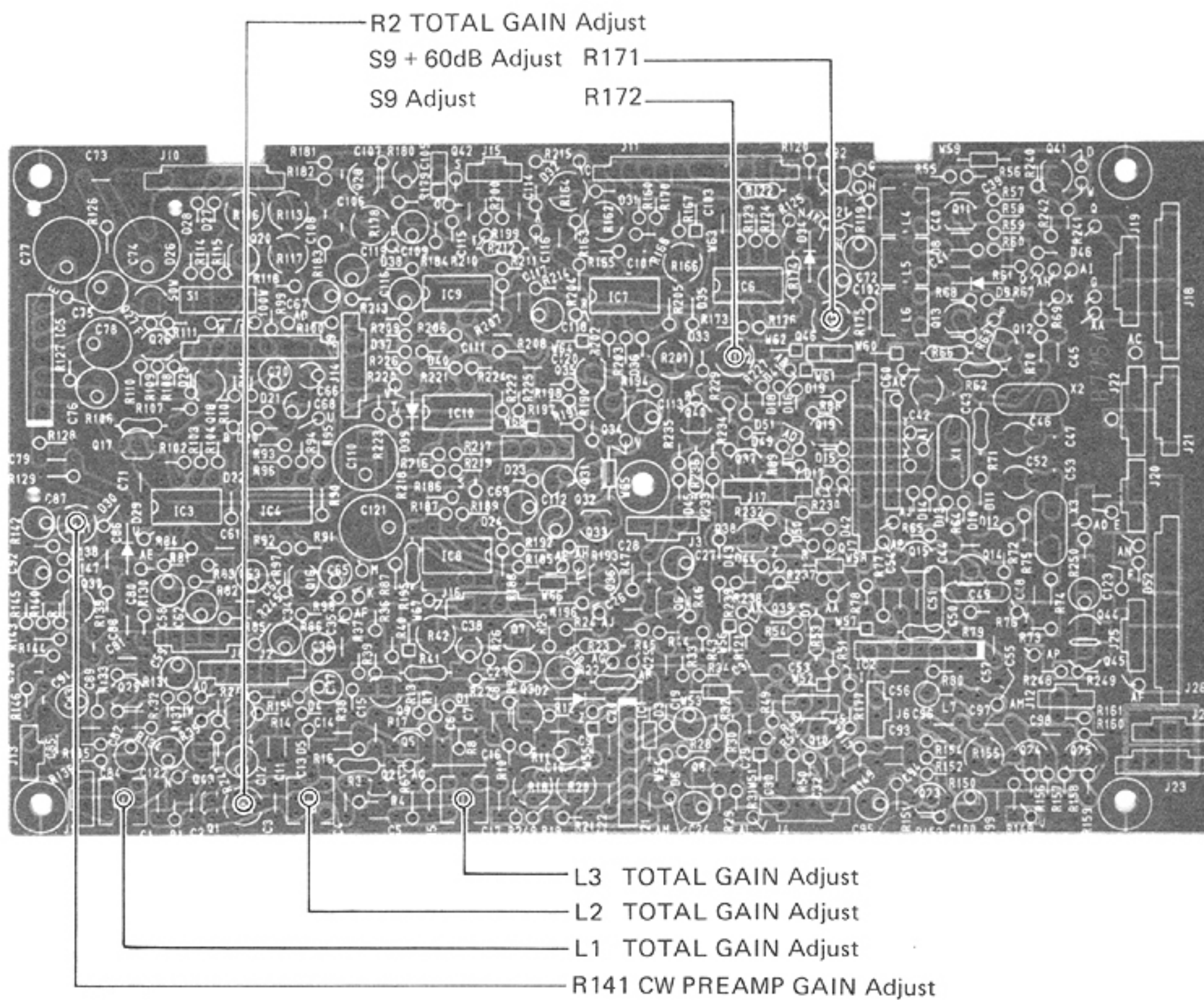
9-1 RECEIVER ADJUSTMENT

Adjustment	Adjustment conditions	Unit	Measurement location	Adjust Value	Unit	Adjust point
INSTRUMENTS REQUIRED	(1) STANDARD SIGNAL GENERATOR (SSG) FREQUENCY RANGE 0.1 ~ 40MHz OUTPUT LEVEL (loaded value) -20 ~ +100dB (0dB=1μV) (2) AC MILLIVOLT METER MEASURING RANGE 10mV ~ 3V (3) EXTERNAL SPEAKER IMPEDANCE 8 ohms					
TOTAL GAIN	1. <ul style="list-style-type: none"> • MODE : SSB • BAND : 14MHz • PRE AMP : OFF • P.B.T : Center • NOTCH : OFF • NB : OFF • SQL : MIN • RF GAIN : MAX • TONE : Fully clockwise • AGC : OFF • Set the output level of the SSG to -10dBμ. 		<ul style="list-style-type: none"> • Connect the SSG to the ANT connector. • Connect the AC millivolt meter and external speaker to the EXT SP jack. 	Adjust to maximum AF output.	RF	L20, L21
	2. <ul style="list-style-type: none"> • AGC : Center • Set the output level of the SSG to +40 ~ 60dBμ. 			Adjust the AF GAIN control to get 2.5V AF output.	FRONT PANEL	AF GAIN
	3. <ul style="list-style-type: none"> • Turn off the output of the SSG. 			Adjust R2 so that the noise level is 30dB down (about 80mV) from 2.5V.	MAIN	R2
CW PREAMP GAIN	1. <ul style="list-style-type: none"> • MODE : USB • Set the output level of the SSG to +40 ~ 60dBμ. 		<ul style="list-style-type: none"> • Connect the SSG to the ANT connector. • Connect the AC millivolt meter and external speaker to the EXT SP jack. 	Tune to get maximum AF output.	FRONT PANEL	Tuning control
	2. Keep the condition of 1., and adjust the AF GAIN control to get 1V AF output.					
	3. <ul style="list-style-type: none"> • MODE : CW • Set the output level of the SSG to +40 ~ 60dBμ. 			Tune to get 800Hz beat tone and maximum AF output.	FRONT PANEL	Tuning Control
	4.			Keep the condition of 3., and adjust R141 to get 1V AF output.	MAIN	R141
S-METER	1. <ul style="list-style-type: none"> • MODE : USB • BAND : 14MHz • PRE AMP : OFF • P.B.T : Center • AGC : Center • Set the output level of the SSG to +30dBμ. 		S-METER of the set.	S9	MAIN	R172
	2. <ul style="list-style-type: none"> • Set the output level of the SSG to +94dBμ. 			S9 + 60dB		R171
	3. Repeat adjustments of 1. and 2. several times. Confirm that the meter is full-scaled when the RF GAIN control is turned fully counterclockwise, and does not deflect in the FM mode.					
NOISE BLANKER	1. <ul style="list-style-type: none"> • MODE : USB • Apply pulse noise to the ANT connector. 	RF	Connect and oscilloscope to D7.	Adjust to get maximum.	RF	L22 ~ L24
	2. When the NB switch is set at the NOR position, the noise blanker should not work for wide noises (pulse width: about 5 milliseconds). When the NB switch is set at the WIDE position, the noise blanker should work for either narrow noises (pulse width: about 0.4 ~ 0.5 milliseconds) or wide noises. Confirm that the NB amplifiers do not oscillate when the NB LEVEL controls is turned fully clockwise.					

RF UNIT



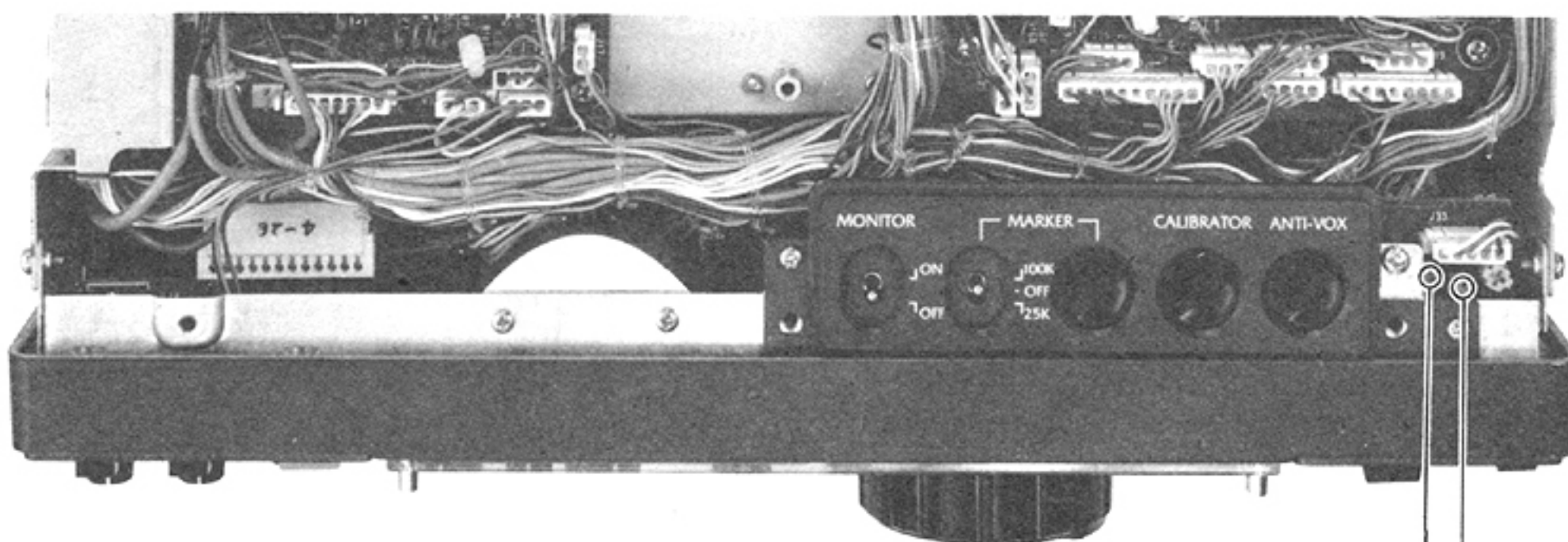
MAIN UNIT



9 - 1 RECEIVER ADJUSTMENT (Continued)

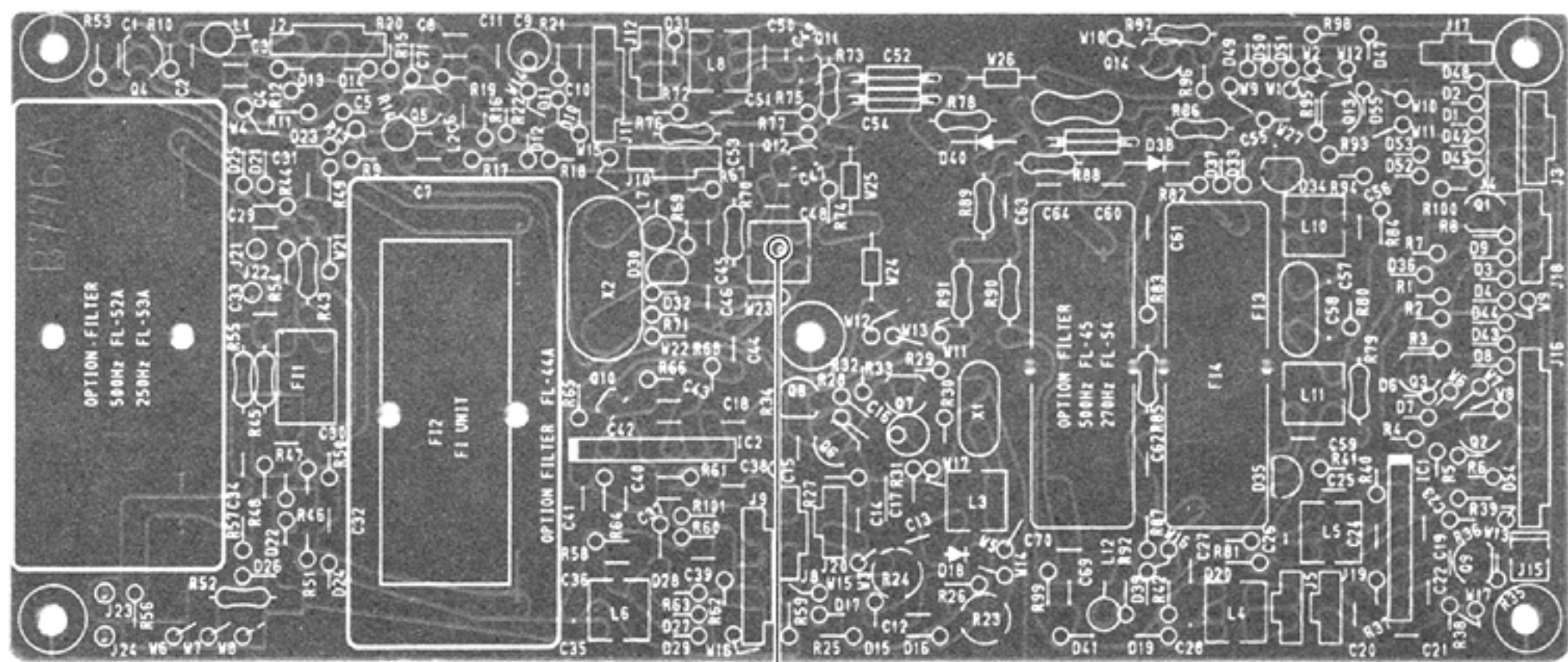
Adjustment	Adjustment conditions	Unit	Measurement location	Adjust value	Unit	Adjust point
NOTCH FILTER	1. <ul style="list-style-type: none"> • MODE : USB • BAND : 14MHz • IF/P.B.T : IF • IF SHIFT/P.B.T CONTROL : Fully Left • NOTCH : OFF • NOTCH FILTER : Fully Left • Set the output level of the SSG to +34dBμ. 			Tune to make zero-beat.	FRONT PANEL	Tuning Control
	2. <ul style="list-style-type: none"> • NOTCH : ON 		S-METER	Adjust R85 to get minimum meter deflection.	SW-F	R85
	3. <ul style="list-style-type: none"> • MODE : LSB • IF SHIFT/P.B.T CONTROL : Fully Right • NOTCH : OFF • NOTCH FILTER : Fully Right • Set the output level of the SSG to +34dBμ. 			Tune to make zero-beat.	FRONT PANEL	Tuning Control
	4. <ul style="list-style-type: none"> • NOTCH : ON 		S-METER	Adjust R86 to get minimum meter deflection.	SW-F	R86
	5. Repeat adjustment of 1. ~ 4. several times. The notch deep will be more than 25dB.					
SQUELCH	1. <ul style="list-style-type: none"> • MODE : SSB • RF GAIN: Fully counterclockwise • AGC : OFF • SQL CONTROL : At 10 o'clock position • Turn off the output of the SSG. 			Adjust R73 to close the squelch.	VR-A	R73
	2. <ul style="list-style-type: none"> • Confirm that the squelch will be opened by turning the RF GAIN control clockwise. • The squelch should be closed by turning the control clockwise when a S9 + 40dB signal is applied or the RF GAIN control is turned counterclockwise to deflect the S-METER. • Confirm that the RECEIVE indicator is lighted when the squelch is opened. 					

SW-F UNIT



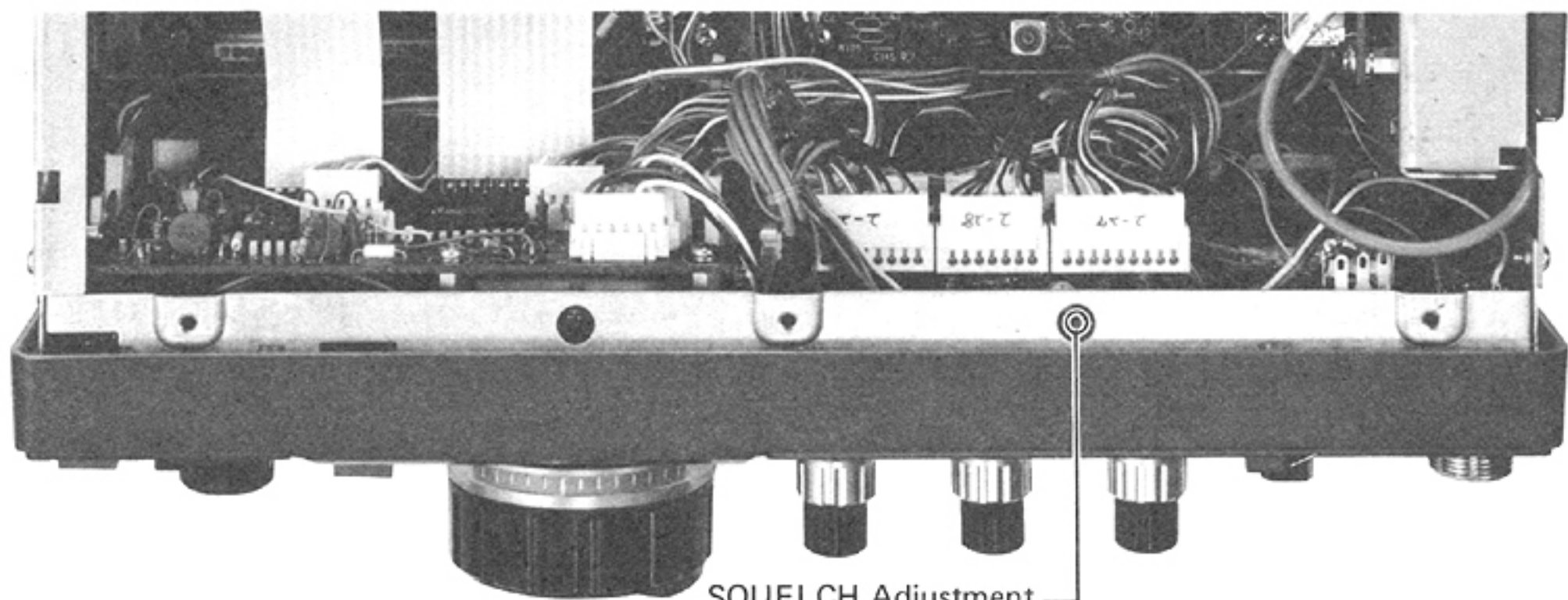
NOTCH FILTER Adjustment R86
NOTCH FILTER Adjustment R85

IF UNIT



L9 TOTAL GAIN Adjustment

VR-A UNIT

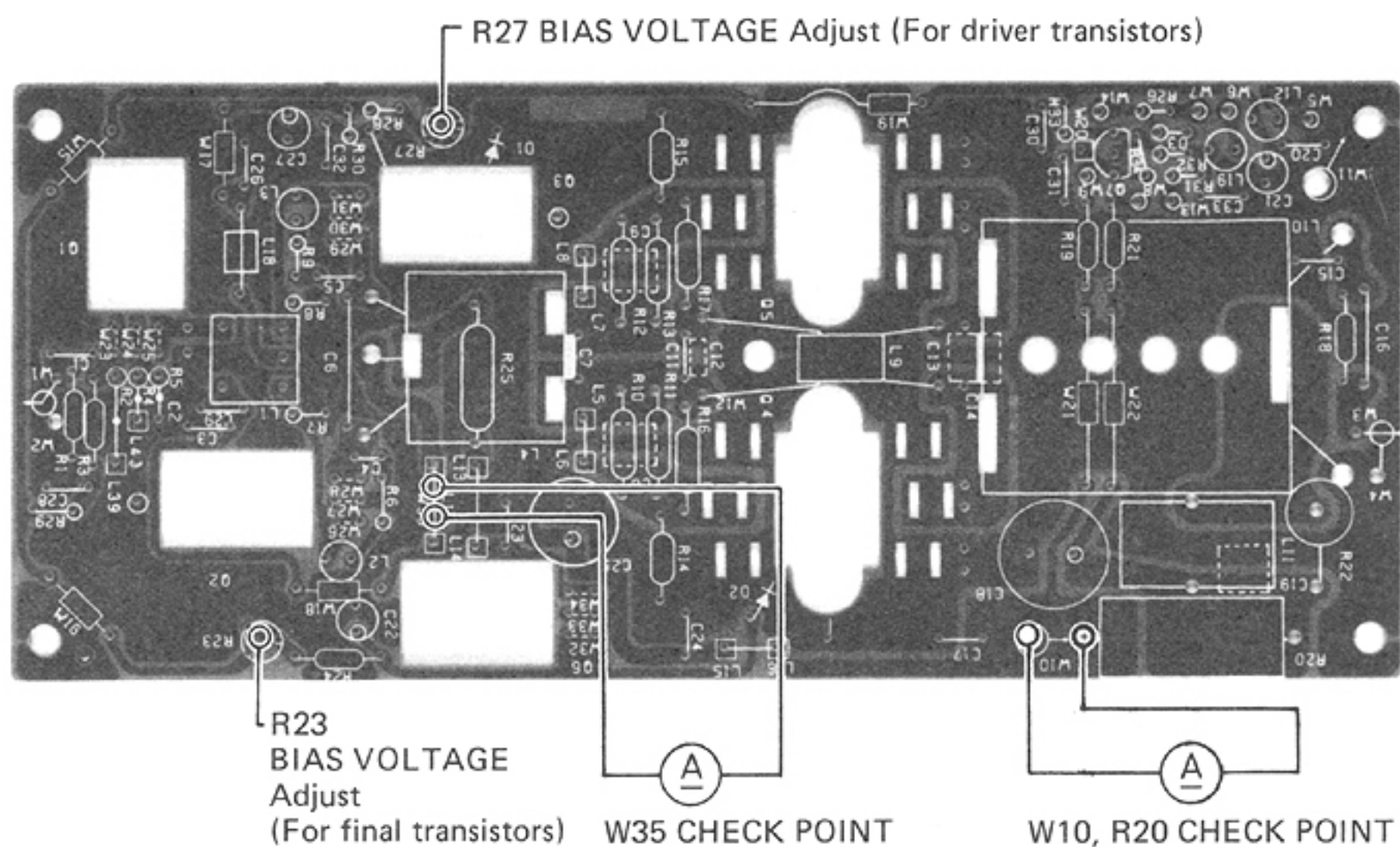


SQUELCH Adjustment
R73

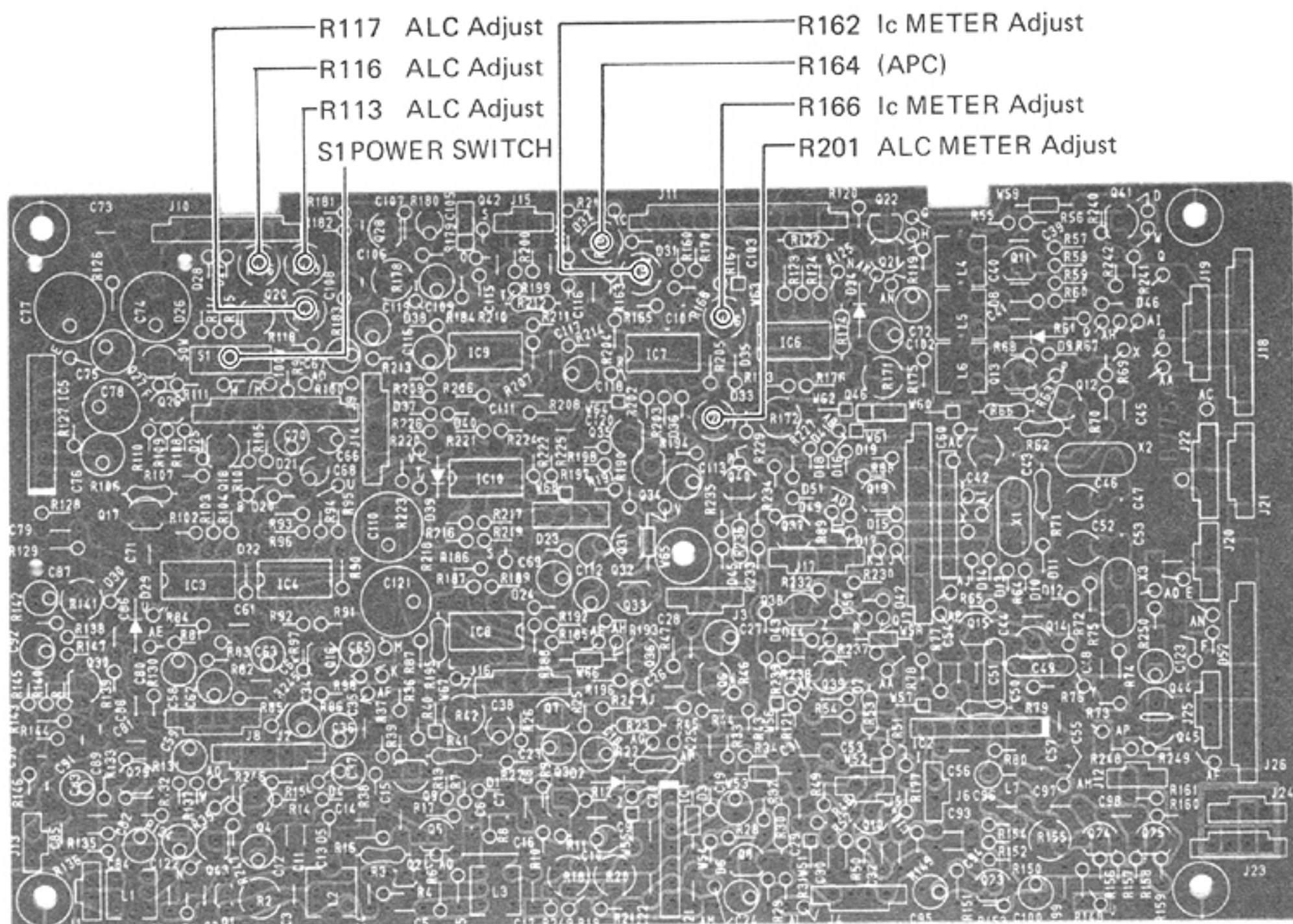
9-2 TRANSMITTER ADJUSTMENT

Adjustment	Adjustment conditions	Unit	Measurement location	Adjust value	Unit	Adjust point
INSTRUMENTS REQUIRED	1. (1) RF POWER METER (TERMINATED TYPE) MEASURING RANGE 20 ~ 200W FREQUENCY RANGE 1.8 ~ 30MHz IMPEDANCE 50 ohms SWR Less than 1.1 (2) AF GENERATOR (AG) FREQUENCY RANGE 200 ~ 3000Hz OUTPUT LEVEL 0 ~ 300mV (3) AC MILLIVOLTMETER MEASURING RANGE 10mV ~ 3V					
BIAS VOLTAGE	1. • MODE : SSB • BAND : 14MHz • MIC GAIN : MIN (Fully counterclockwise)	PA	Desolder at the center of W35 (jumper wire with 6 bead cores), and connect a DC ammeter there in series.	100mA	PA	R27 (For driver transistors)
	2. • T/R SWITCH : TRANSMIT		Desolder W10, and connect a DC ammeter between W10 and R20.	600mA		R23 (For final transistors)
ALC	1. • MODE : RTTY • BAND : 14MHz • COMP : OFF • RF POWER : MAX (Fully clockwise) • Turn R164 on the MAIN unit fully clockwise.		RF POWER METER	100W	MAIN	R117
	2. • RF POWER : MIN (Fully counterclockwise)			5 ~ 10W		R113
	3. • RF POWER : MAX • Set S1 on the MAIN unit to "50W" position.			50W		R116
Ic METER	1. • MODE : CW • METER SWITCH : Ic • Set in TRANSMIT mode and key up.	FRONT PANEL	Ic METER	600mA	MAIN	R166
	2. • MODE : RTTY • METER SWITCH : Ic • RF POWER : Fully clockwise		Connect a DC ammeter to the power cable in series.	Adjust to total current minus 3A.		R162
ALC METER	1. • MODE : USB • BAND : 14MHz • COMP : ON • RF POWER : MAX (Fully clockwise) • MIC GAIN : MAX (Fully clockwise) • METER SWITCH : ALC • Apply 1.5KHz/100 ~ 300mV signal from the AG.	FRONT PANEL	ALC METER	ALC ZONE Full level (Center of the meter scale)	MAIN	R201
	2. • COMP : OFF			Meter deflection will be overscale from the ALC zone.		Confirming

PA UNIT



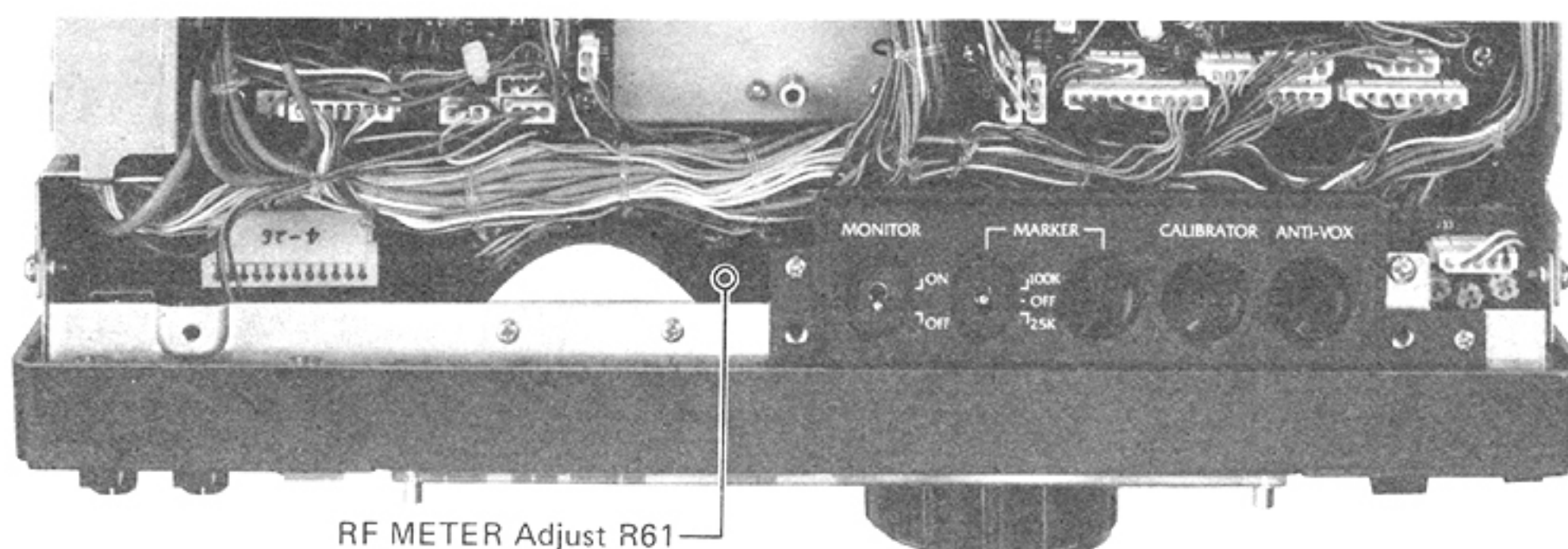
MAIN UNIT



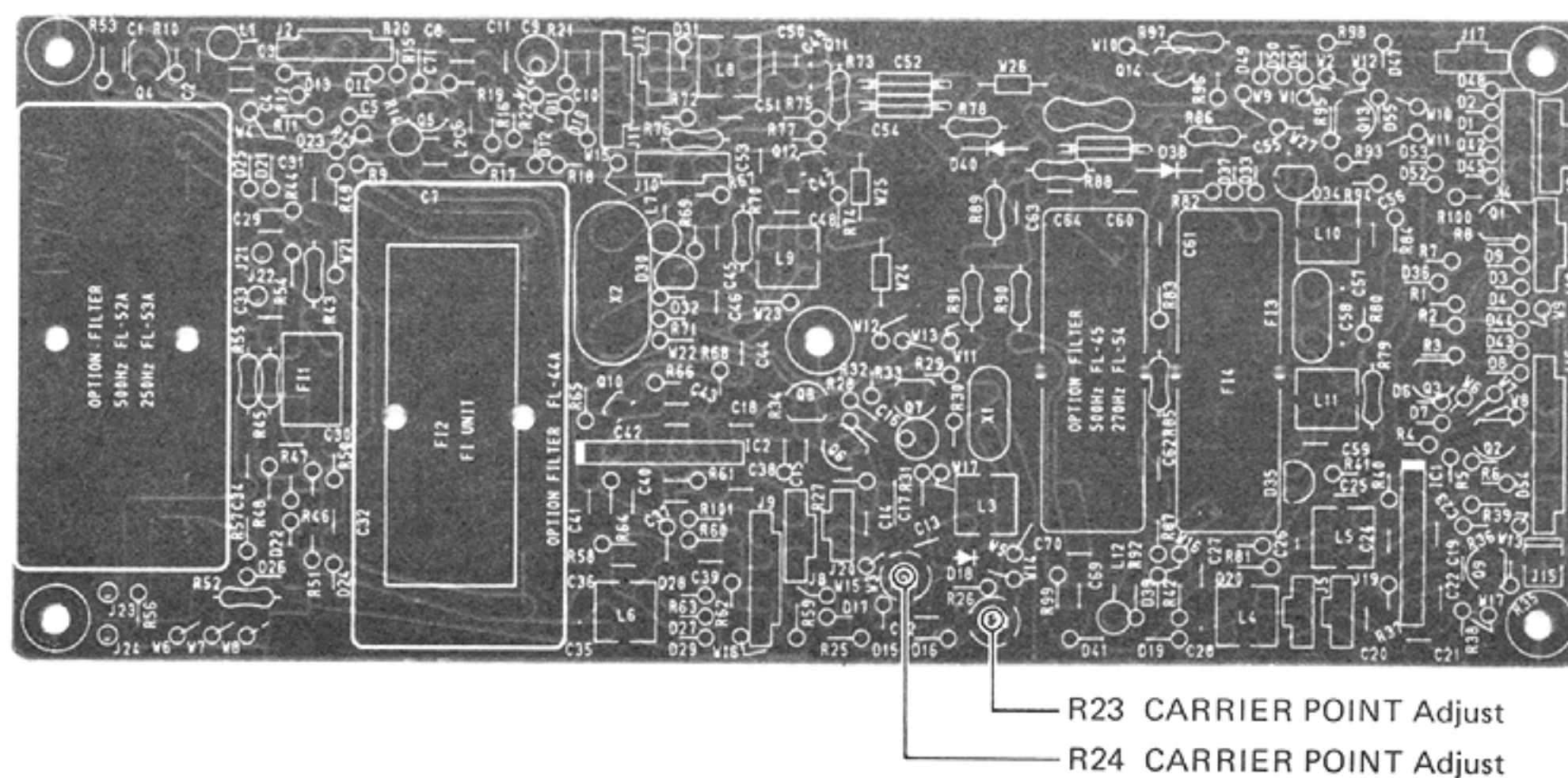
9 - 2 TRANSMITTER ADJUSTMENT (Continued)

Adjustment	Adjustment conditions	Unit	Measurement location	Adjust value	Unit	Adjust point
COMP METER	1. <ul style="list-style-type: none"> • MODE : RTTY • COMP : ON • METER SWITCH : COMP • RF POWER : Fully clockwise 	FRONT PANEL	S-METER	Meter deflection will be about 20dB on the COMP scale.		Confirming
	2. <ul style="list-style-type: none"> • MODE : USB • Apply 1.5KHz/100 ~ 300 mV signal from the AG. 			Meter deflection will be over 20dB on the COMP scale.		
RF METER	1. <ul style="list-style-type: none"> • MODE : RTTY • METER SWITCH : RF 	FRONT PANEL	Po METER	80%	SW-C	R61
SWR METER	1. <ul style="list-style-type: none"> • MODE : RTTY • RF POWER : Set to get 35 ~ 45W output power. • METER SWITCH : SET 	FRONT PANEL	SWR METER	Adjust the RF POWER control so that the meter points "SET" mark.	FRONT PANEL	RF POWER Control
	2. <ul style="list-style-type: none"> • BAND : EACH BAND • METER SWITCH : SWR 			SWR should be less than 1.2 on each band.		Confirming

SW-C UNIT

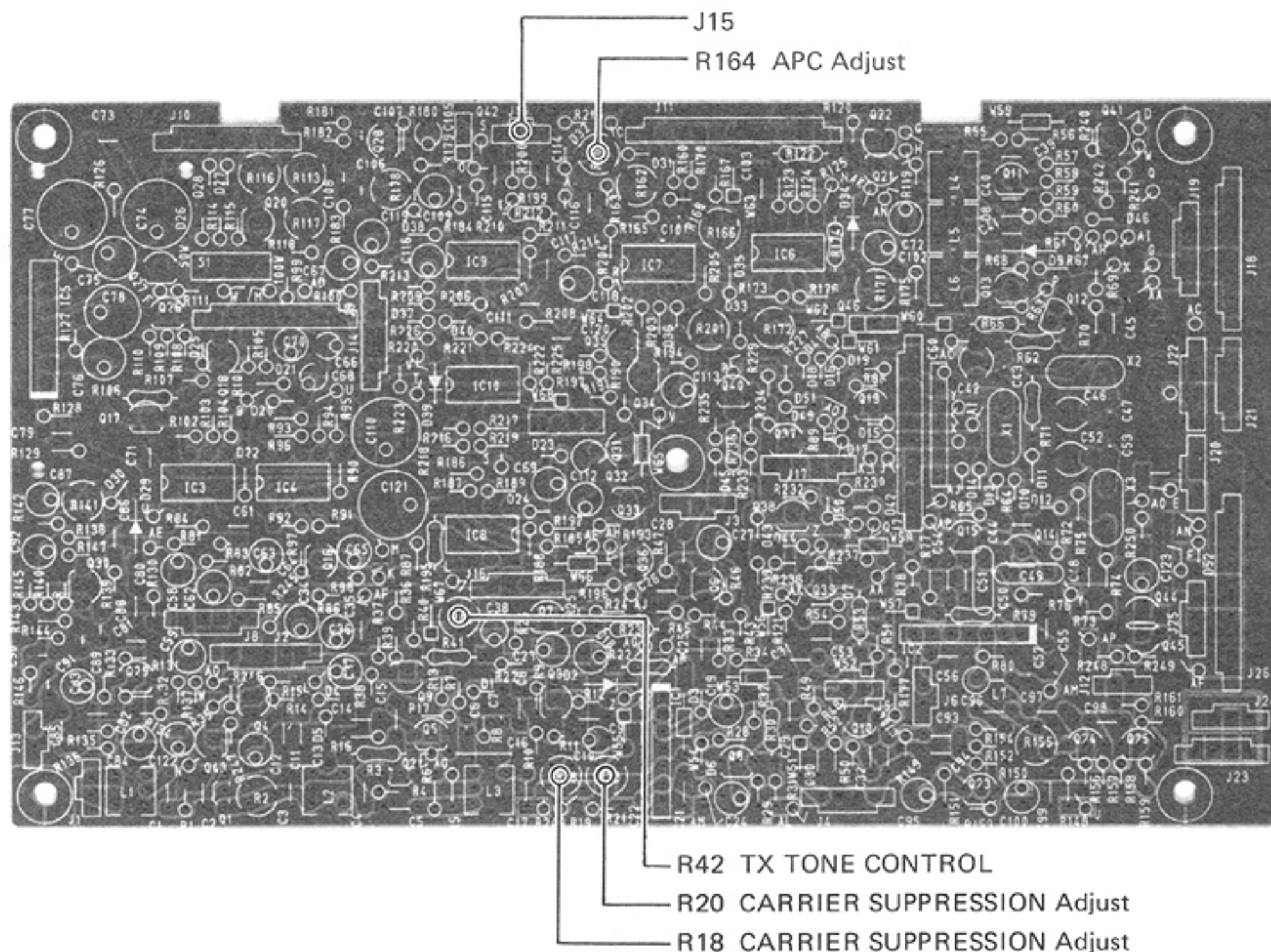


IF UNIT



Adjustment	Adjustment conditions	Unit	Measurement location	Adjust value	Unit	Adjust point
APC	1. <ul style="list-style-type: none"> • MODE : RTTY • BAND : 14MHz • RF POWER : Fully clockwise • Remove the connector inserted to J15 on the MAIN unit. 		Read the ammeter provided in the power supply, or connect an ammeter to the power cable in series.	20A	MAIN	R164
	2. <ul style="list-style-type: none"> • BAND : EACH BAND • Set in TRANSMIT mode with full output power, and do not connect anything to the ANT Connector. 			Less than 12A		Confirming
CARRIER POINT	1. <ul style="list-style-type: none"> • MODE : USB/LSB • BAND : 14MHz • COMP : OFF • TX TONE CONTROL (MAIN/R42) : MAX (Fully clockwise) Apply 2.7KHz/10 ~ 30mV signal from the AG then adjust the MIC GAIN control to get 10 ~ 20W output power.		Connect the RF POWER METER to the ANT connector.	Change the operating mode for USB and LSB alternately, and adjust R24 and R23 to get same output power in either mode.	IF	R24
	2. <ul style="list-style-type: none"> • COMP : ON Apply 2.7KHz/10 ~ 30mV signal from the AG.					R23
CARRIER SUPPRESSION	1. <ul style="list-style-type: none"> • MODE : USB/LSB • BAND : 14MHz • COM : OFF • MIC GAIN : MIN 		Connect an RF voltmeter or spectrum analyzer to the ANT connector.	Change the operating mode for USB and LSB alternately, and adjust R18 and R20 to get minimum output (less than -50dB).	MAIN	R18 R20
	2. <ul style="list-style-type: none"> • COMP : ON 					Confirming

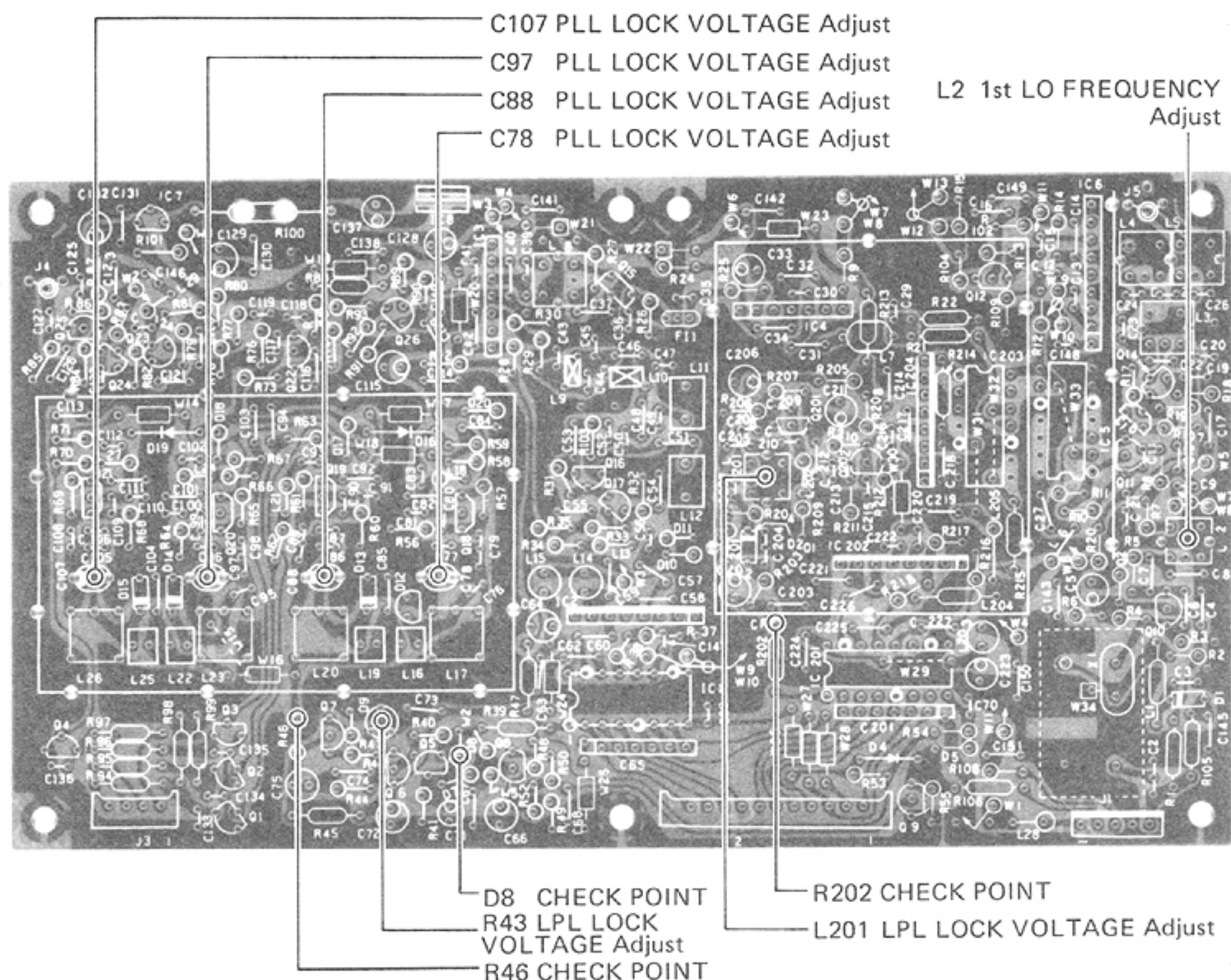
MAIN UNIT



9 - 3 PLL ADJUSTMENT

Adjustment		Adjustment conditions	Unit	Measurement location	Adjust value	Unit	Adjust point
1st-LO	1.	● MODE : RTTY ● Display frequency : 30.0015MHz	RF	Connect a frequency counter to R4 on the RF unit.	100.4530MHz	PLL	L2
	2.	● Display frequency : 0.0985MHz			70.5500MHz		Confirming
LPL LOCK VOLTAGE	1.	● MODE : RTTY ● Display frequency : 8.0000MHz	PLL	Connect an oscilloscope to R202 on the PLL unit.	3V	PLL	L201
	2.	● Display frequency : 7.9999MHz			1.5V ~ 2.0V		Confirming
	3.			Connect the oscilloscope to D8 on the PLL unit.	2.0V ~ 2.5V		
PLL LOCK VOLTAGE	1.	● MODE : RTTY ● Display frequency 7.9999MHz	PLL	Connect the oscilloscope to R46 on the PLL unit.	6.5V	VCO	C78
	2.	● Display frequency : 14.9999MHz					C88
	3.	● Display frequency : 21.9999MHz					C96
	4.	● Display frequency : 30.0015MHz					C107
	5.	● Display frequency : 8.0000MHz			2.0V ~ 3.0V		Confirming
	6.	● Display frequency : 15.0000MHz					
	7.	● Display frequency : 22.0000MHz					

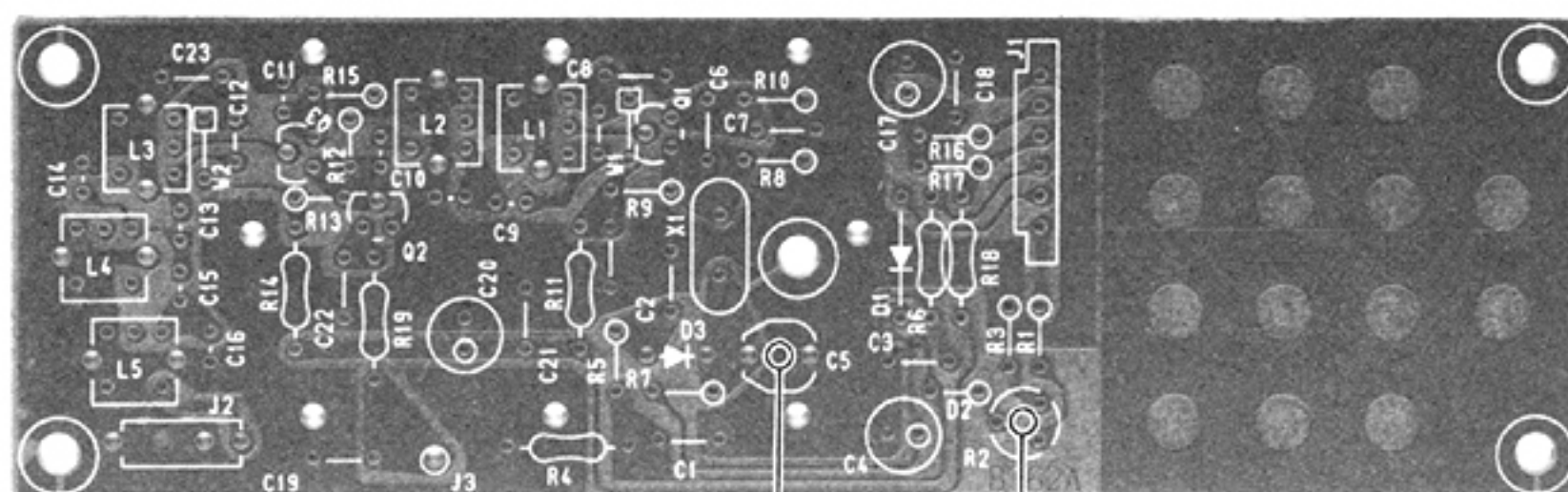
PLL UNIT



9 - 4 COMMON CIRCUITS ADJUSTMENT

Adjustment	Adjustment conditions	Unit	Measurement location	Adjust value	Unit	Adjust point
RIT/XIT FREQUENCY	1. • CALIBRATOR : CENTER • T/R SWITCH : RECEIVE • RIT SWITCH : ON • INCREMENTAL TUNING CONTROL : Center	RF	Connect the frequency counter to R9 on the RF unit through a 470 ohm resistor.	61.4400MHz	2nd-LO	C5
	2. • RIT SWITCH : OFF			61.4400MHz		R2
	3. • RIT SWITCH : ON			Turn the incremental tuning control fully clockwise and counter clockwise alternately, and confirm that the frequency changes more than ± 1 KHz.		Confirming
	4. • T/R SWITCH : TRANSMIT • RIT SWITCH : OFF • XIT SWITCH : ON Make adjustment with the same manner as 1. ~ 3.			The same as 1. ~ 3.		The same as 1. ~ 3.

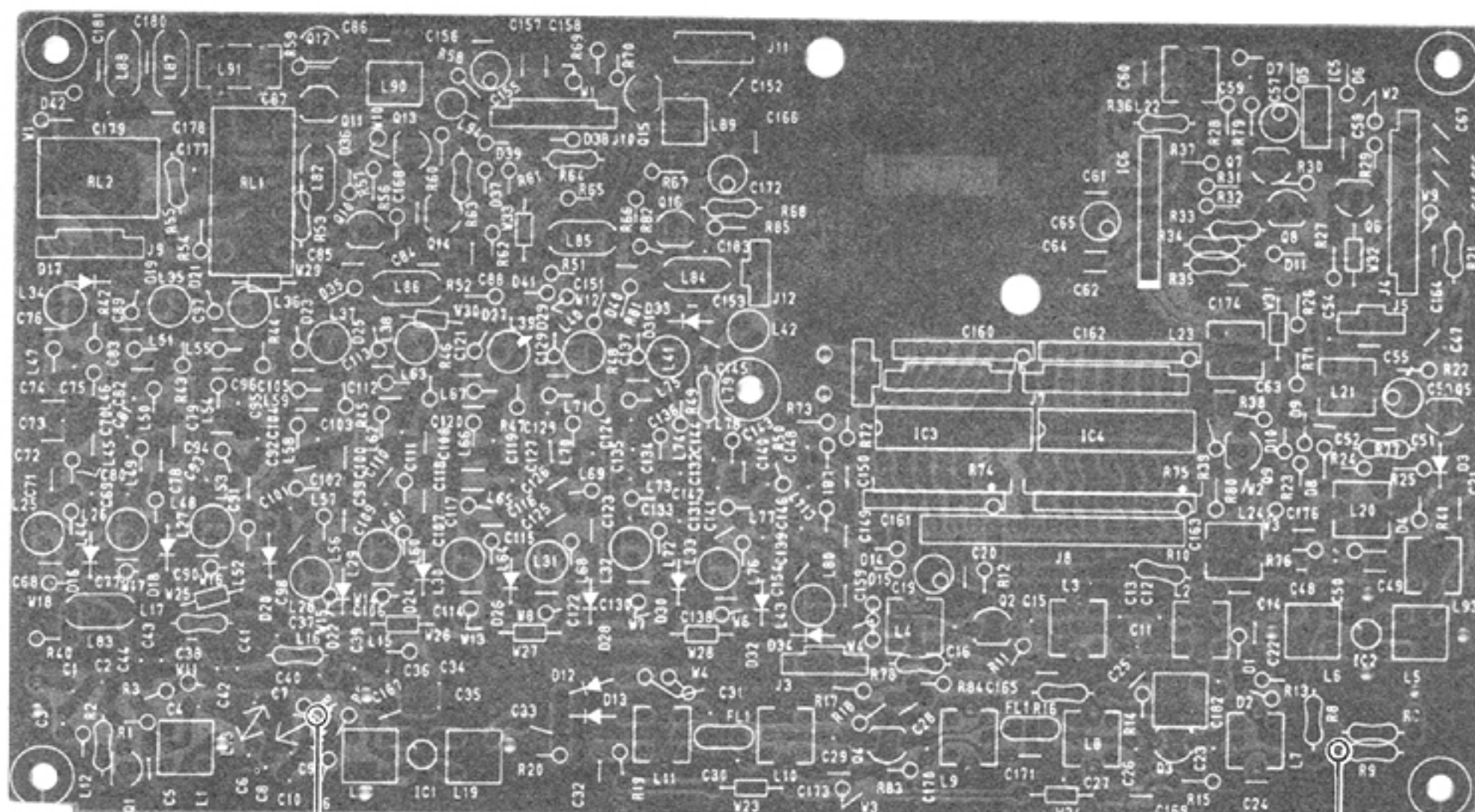
2nd-LO UNIT



RIT/XIT FREQUENCY Adjust C5

R2 RIT/XIT
FREQUENCY Adjust

RF UNIT



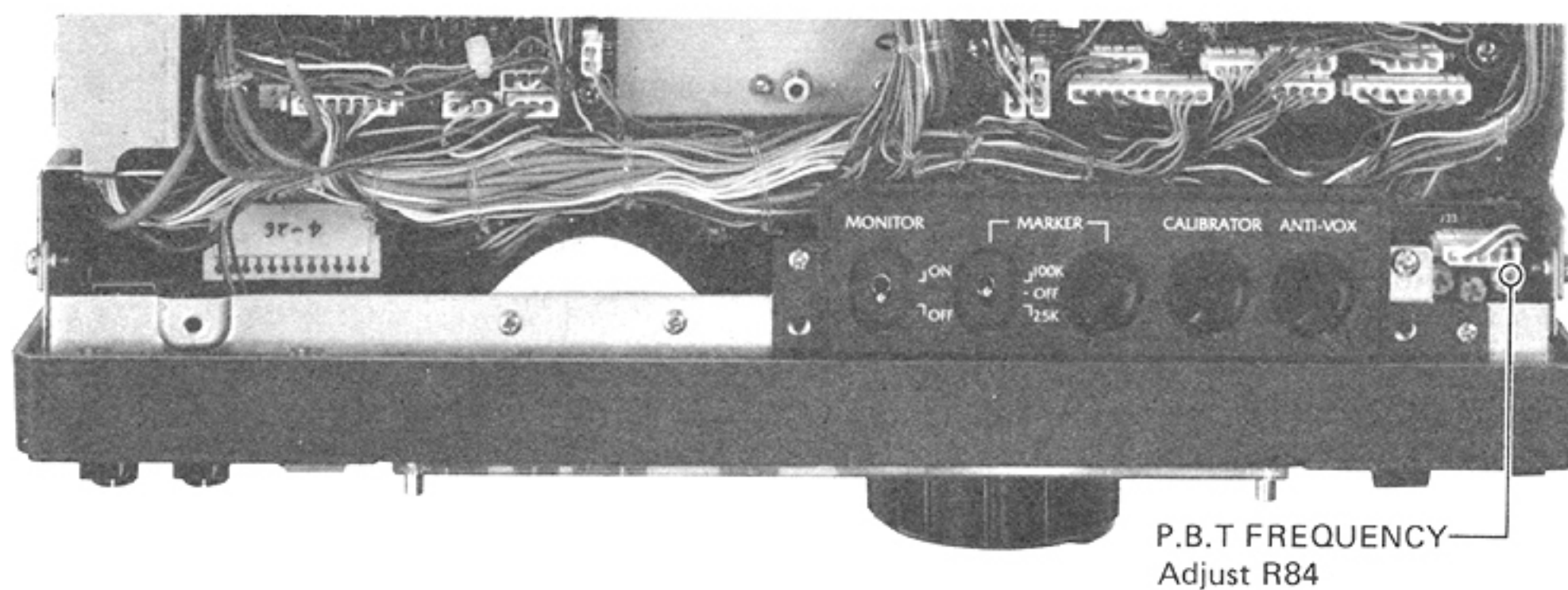
R4 CHECK POINT

CHECK POINT R9

9 - 4 COMMON CIRCUITS ADJUSTMENT (Continued)

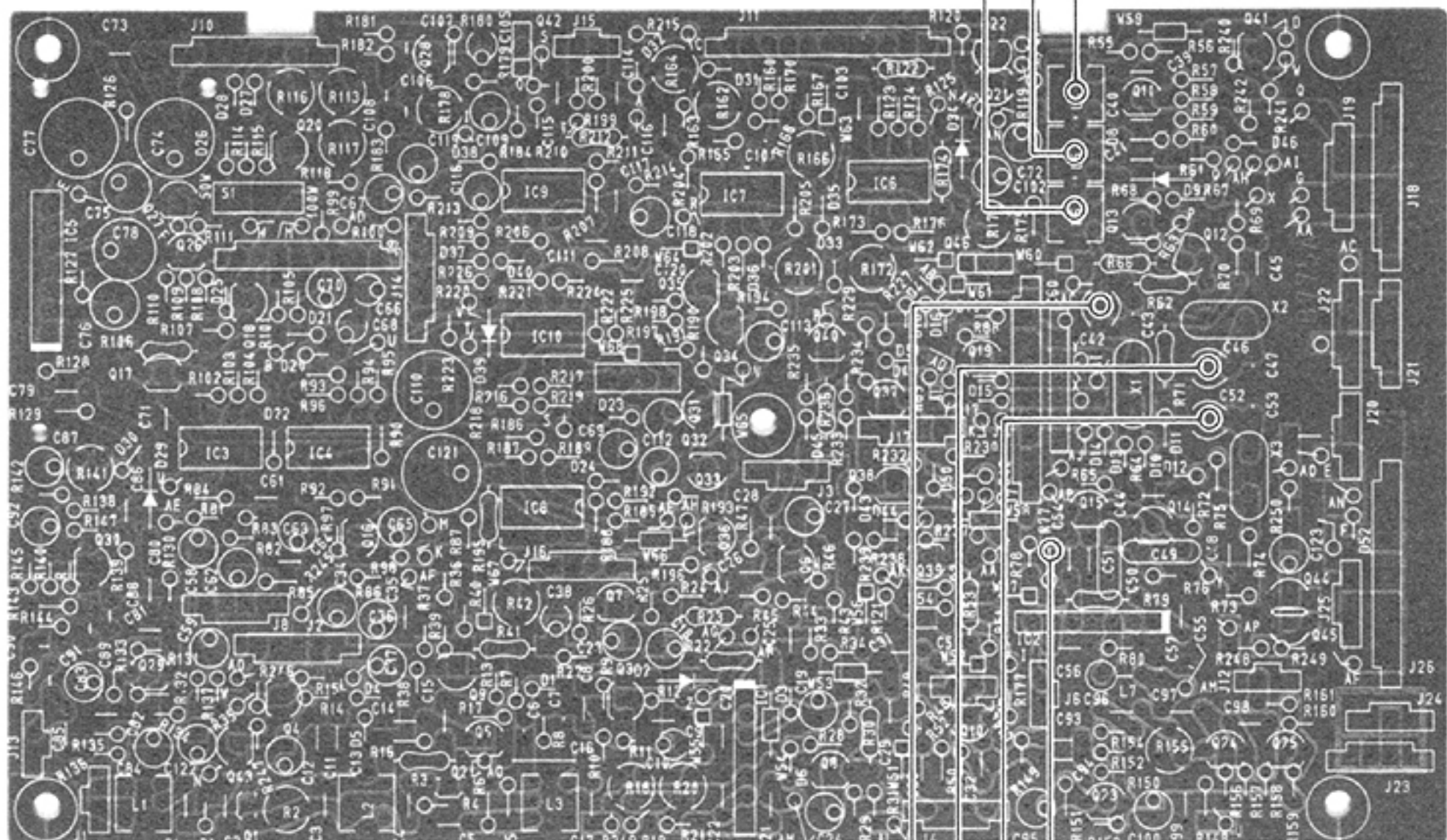
Adjustment		Adjustment conditions	Unit	Measurement location	Adjust value	Unit	Adjust point
BFO FREQUENCY	1.	• MODE : LSB • T/R SWITCH : RECEIVE	MAIN	Connect a frequency counter to R77 on the MAIN unit through a 470 ohm resistor.	9.01000MHz	MAIN	C52
	2.	• MODE : USB			9.01300MHz		C46
	3.	• MODE : RTTY • T/R SWITCH : TRANSMIT Jumper between J3 pin 1 and ground (SPACE).			9.01167MHz		C42
	4.	Remove the jumper between J3 pin 1 and ground (MARK).			9.01150MHz		L6
	5.	• MODE : CW			9.01150MHz		Confirming
	6.	• T/R SWITCH : RECEIVE			9.01070MHz		L5
	7.	• MODE : RTTY			9.009375MHz		L4
P.B.T/COMP FREQUENCY	1.	• IF SHIFT/P.B.T CONTROL : Fully left • T/R SWITCH : RECEIVE	IF	Connect the frequency counter to R34 on the IF unit through a 470 ohm resistor.	9.46830MHz	IF	L3
	2.	• IF SHIFT/P.B.T CONTROL : Center			9.46650MHz	SW-F	R84
	3.	• IF SHIFT/P.B.T CONTROL : Fully right			9.46500MHz or lower		Confirming
	4.	• COMP : OFF • T/R SWITCH : TRANSMIT			9.46650MHz	IF	R24
	5.	• COMP : ON			9.46650MHz		R23

SW-F UNIT



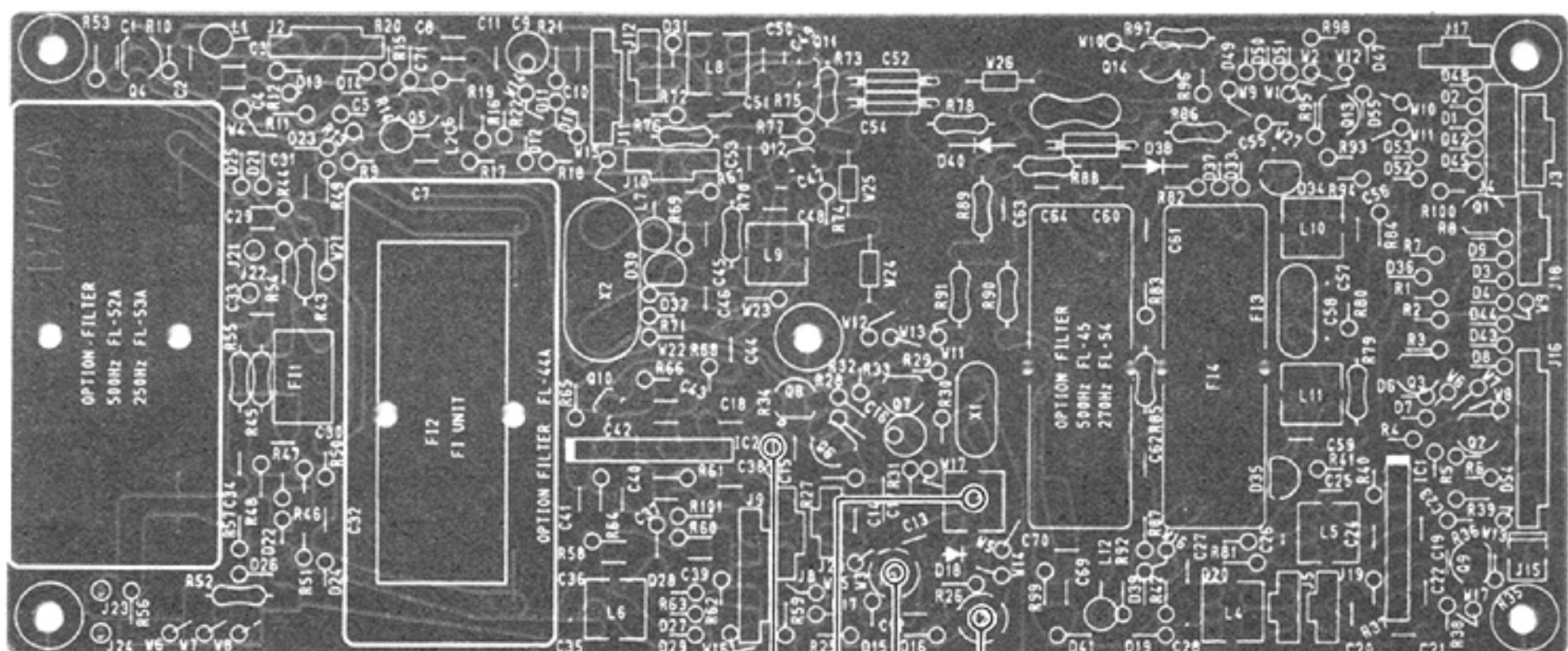
MAIN UNIT

BFO FREQUENCY Adjust RTTY-R 9.009375MHz L4
 BFO FREQUENCY Adjust CW-R 9.01070MHz L5
 BFO FREQUENCY Adjust RTTY-T 9.01150MHz L6



BFO FREQUENCY Adjust RTTY-T 9.01167MHz C42
 BFO FREQUENCY Adjust USB 9.01300MHz C46
 BFO FREQUENCY Adjust LSB 9.01000MHz C52
 CHECK POINT R77

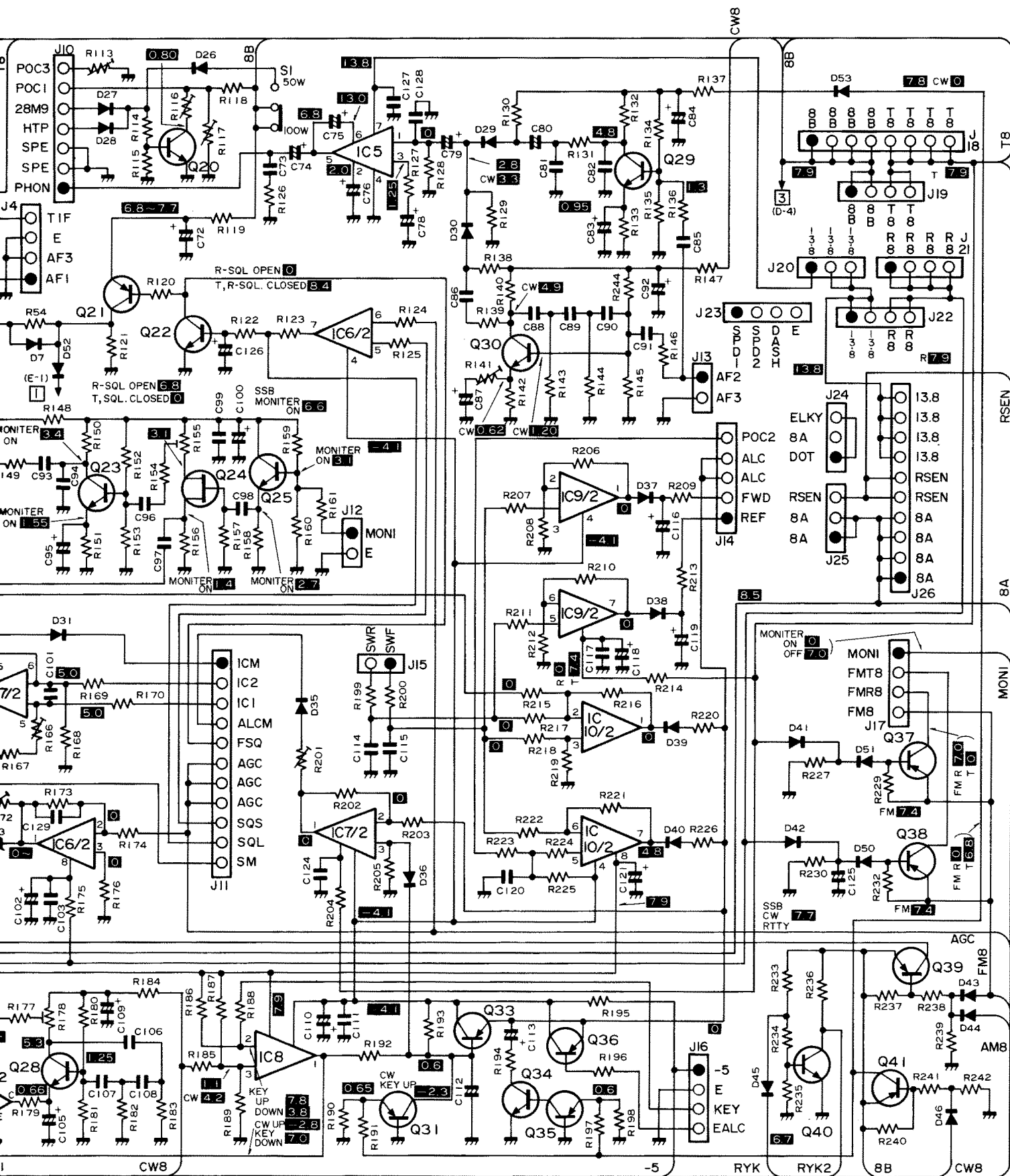
IF UNIT



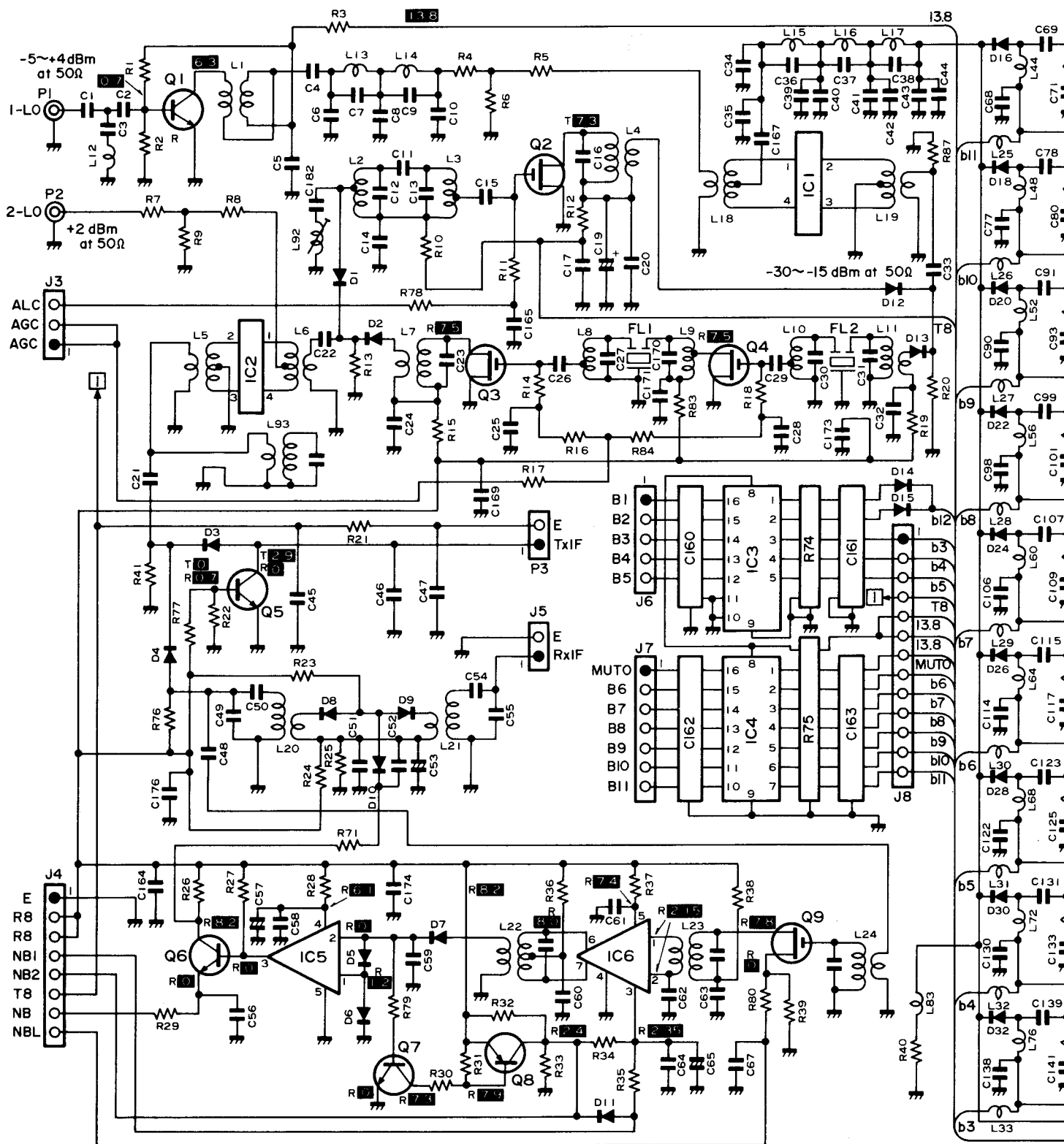
CHECK POINT R34
 P.B.T FREQUENCY Adjust L3
 R23 COMP FREQUENCY Adjust
 R24 COMP FREQUENCY Adjust

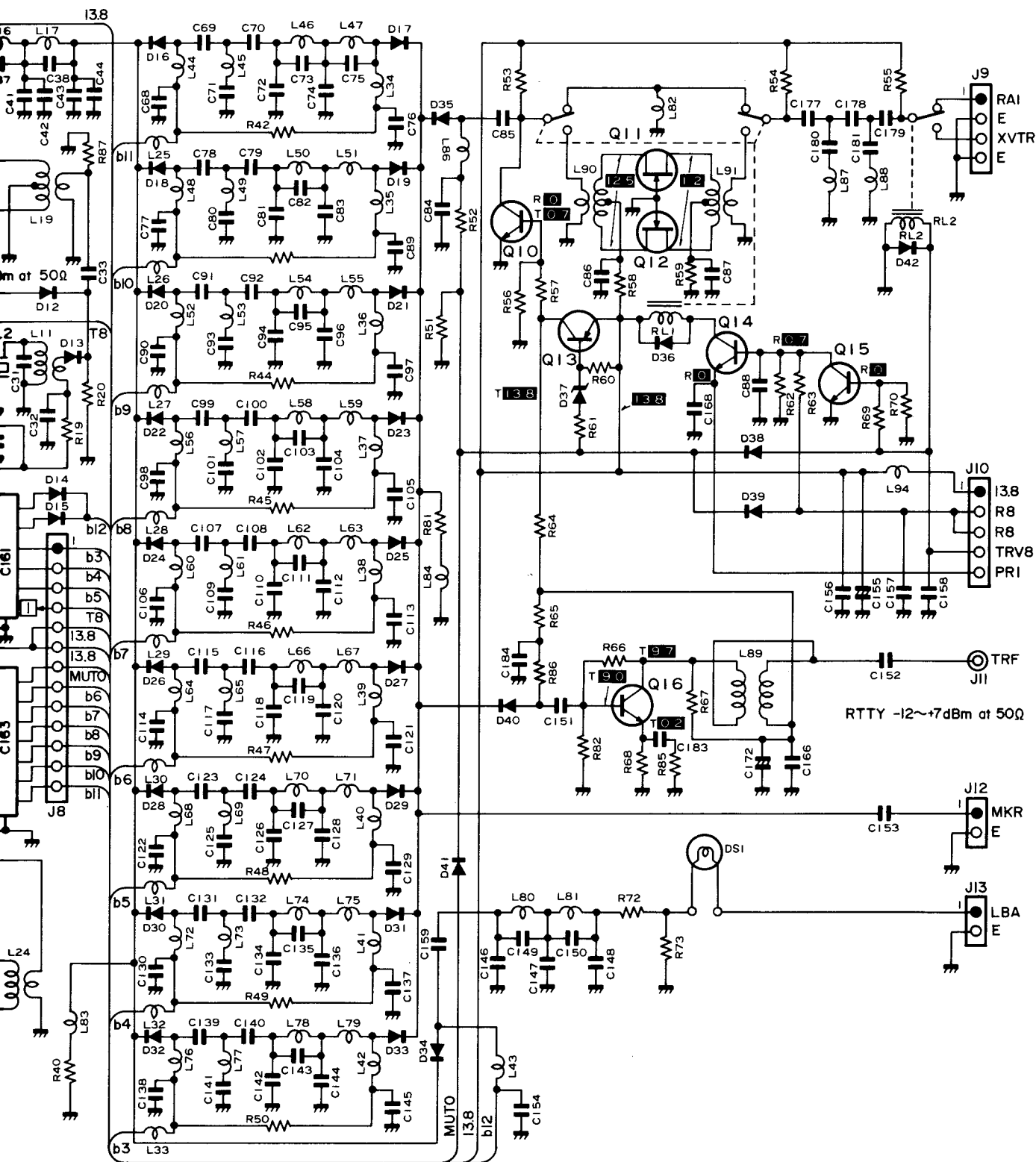
MAIN UNIT CIRCUIT AND VOLTAGE DIAGRAM



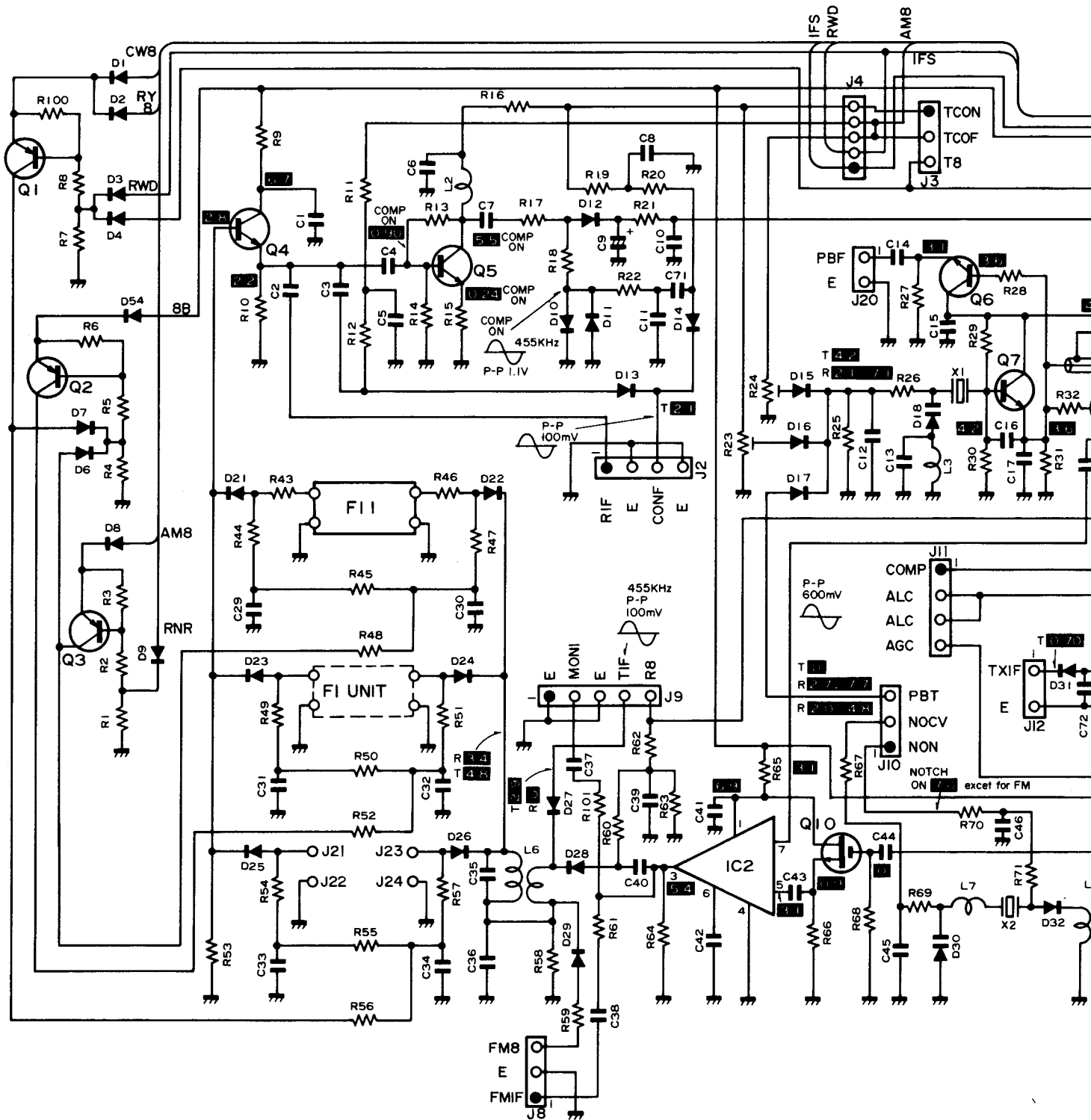


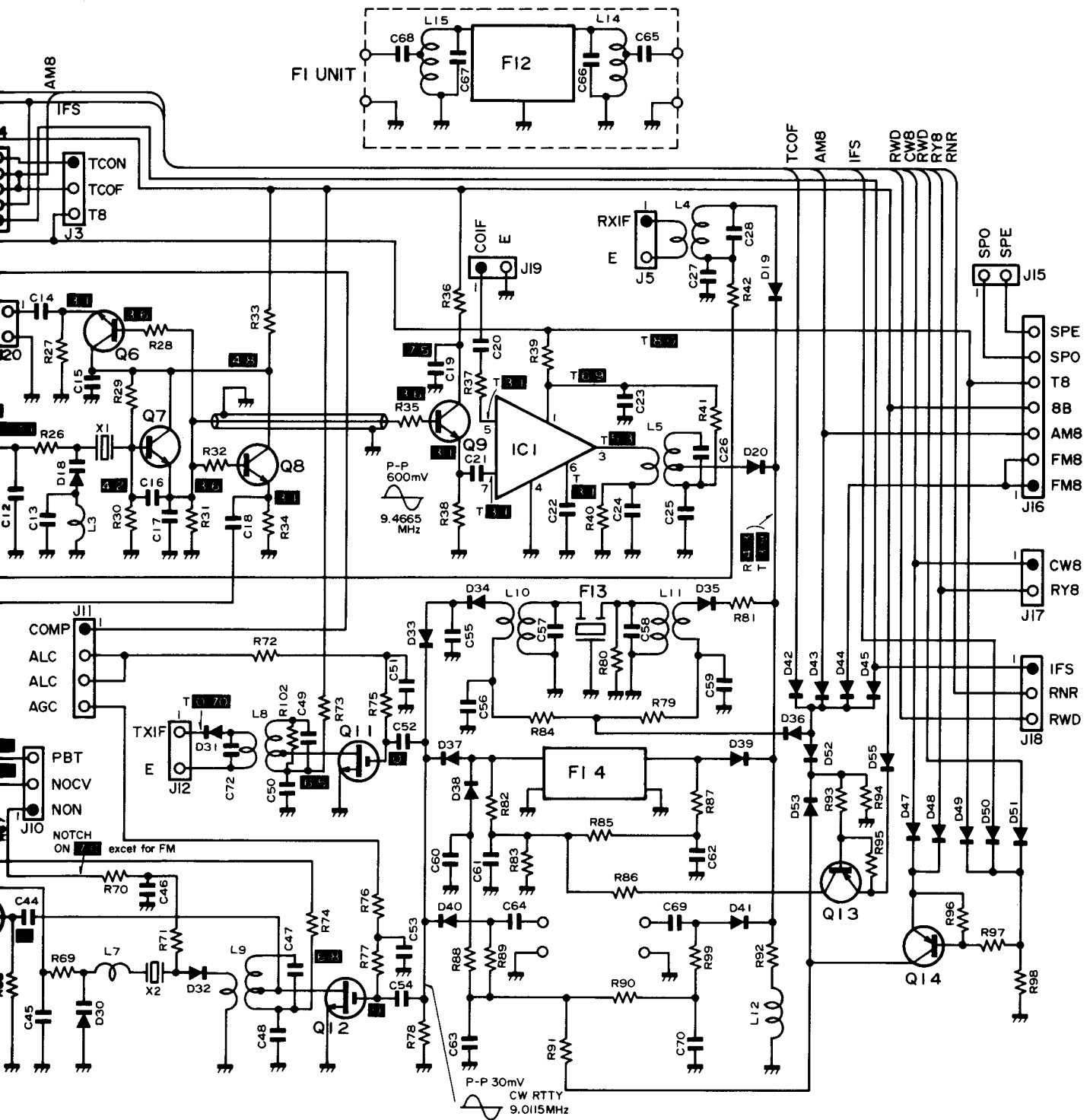
RF UNIT CIRCUIT AND VOLTAGE DIAGRAM



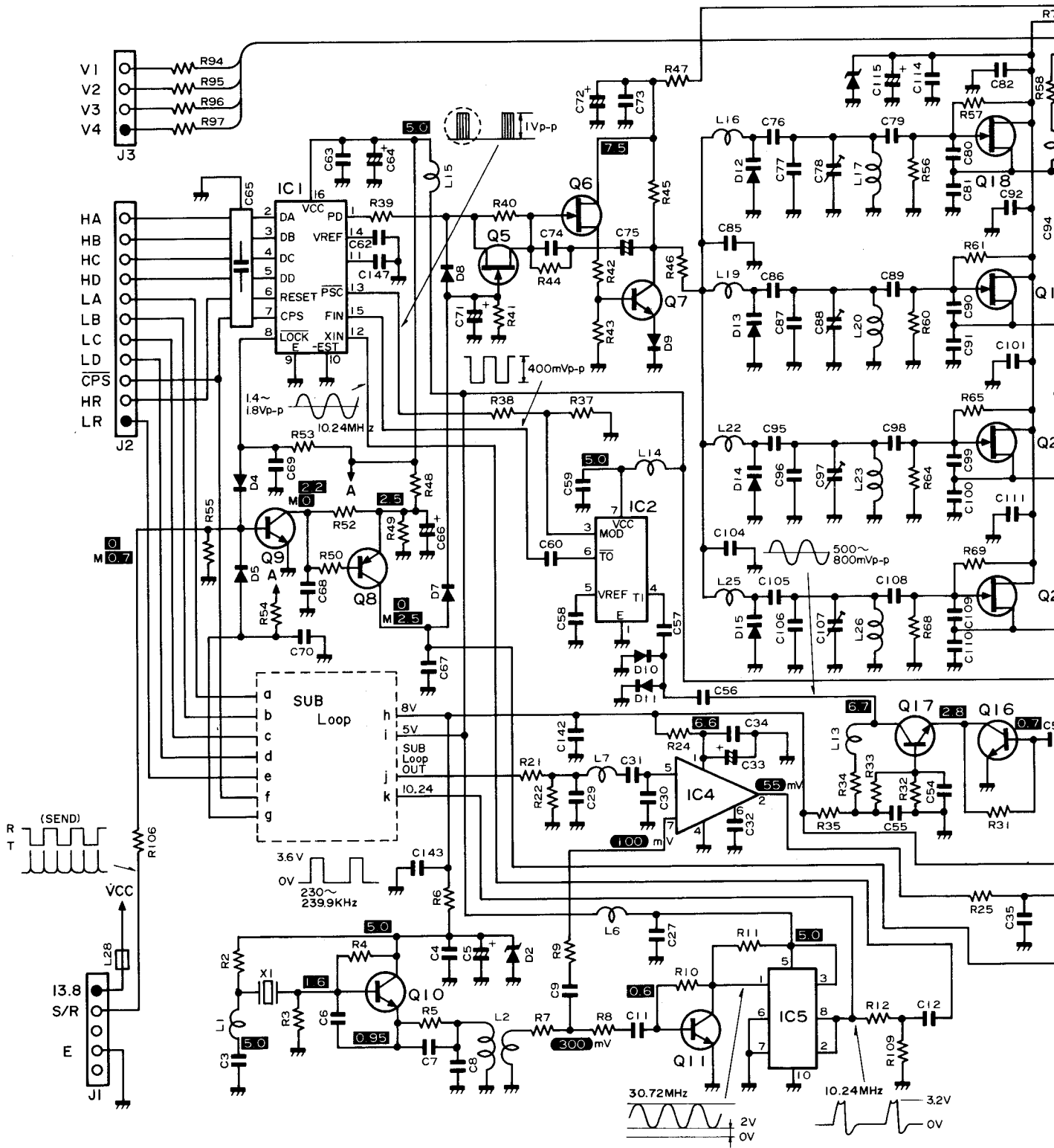


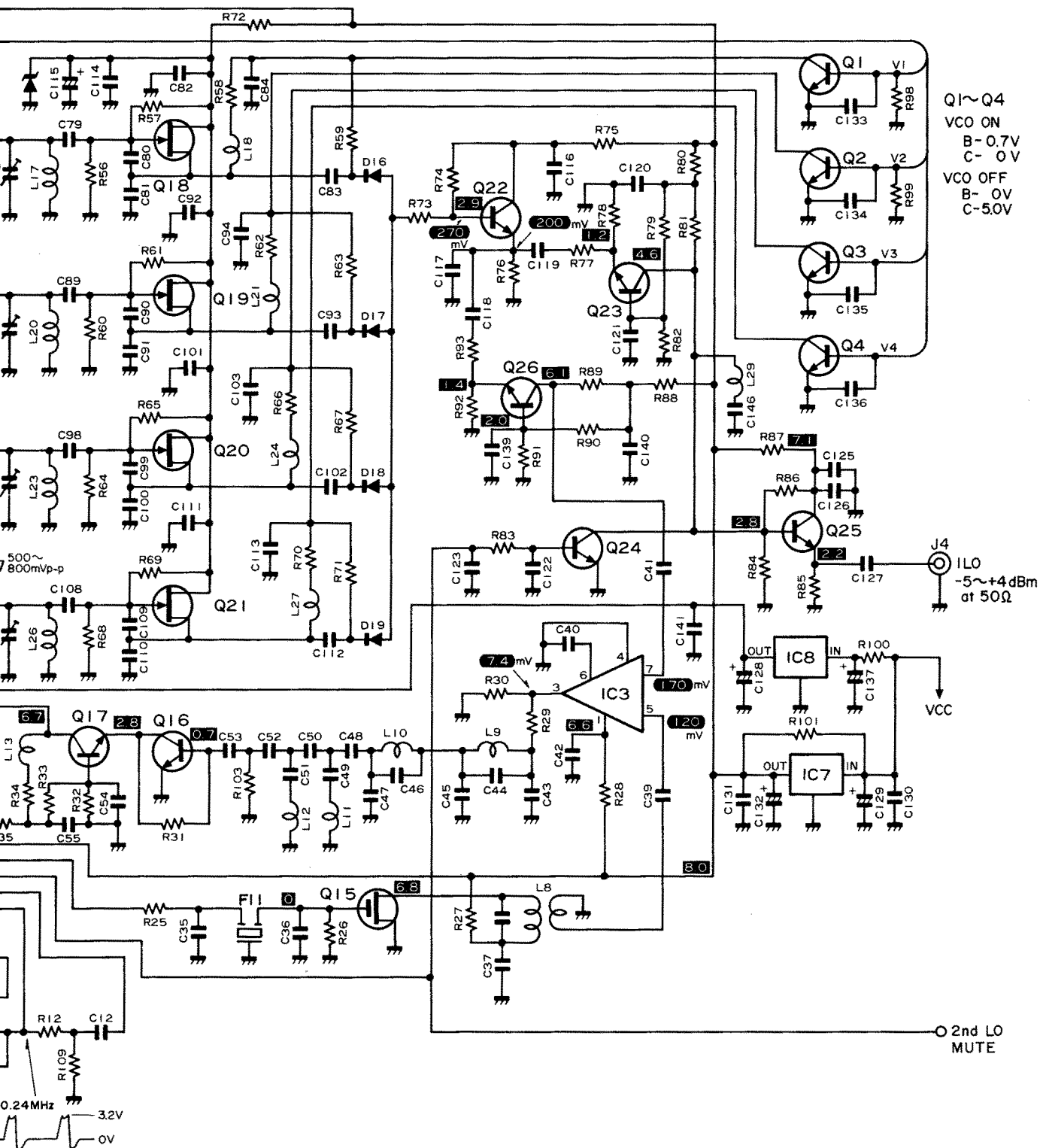
IF UNIT CIRCUIT AND VOLTAGE DIAGRAM



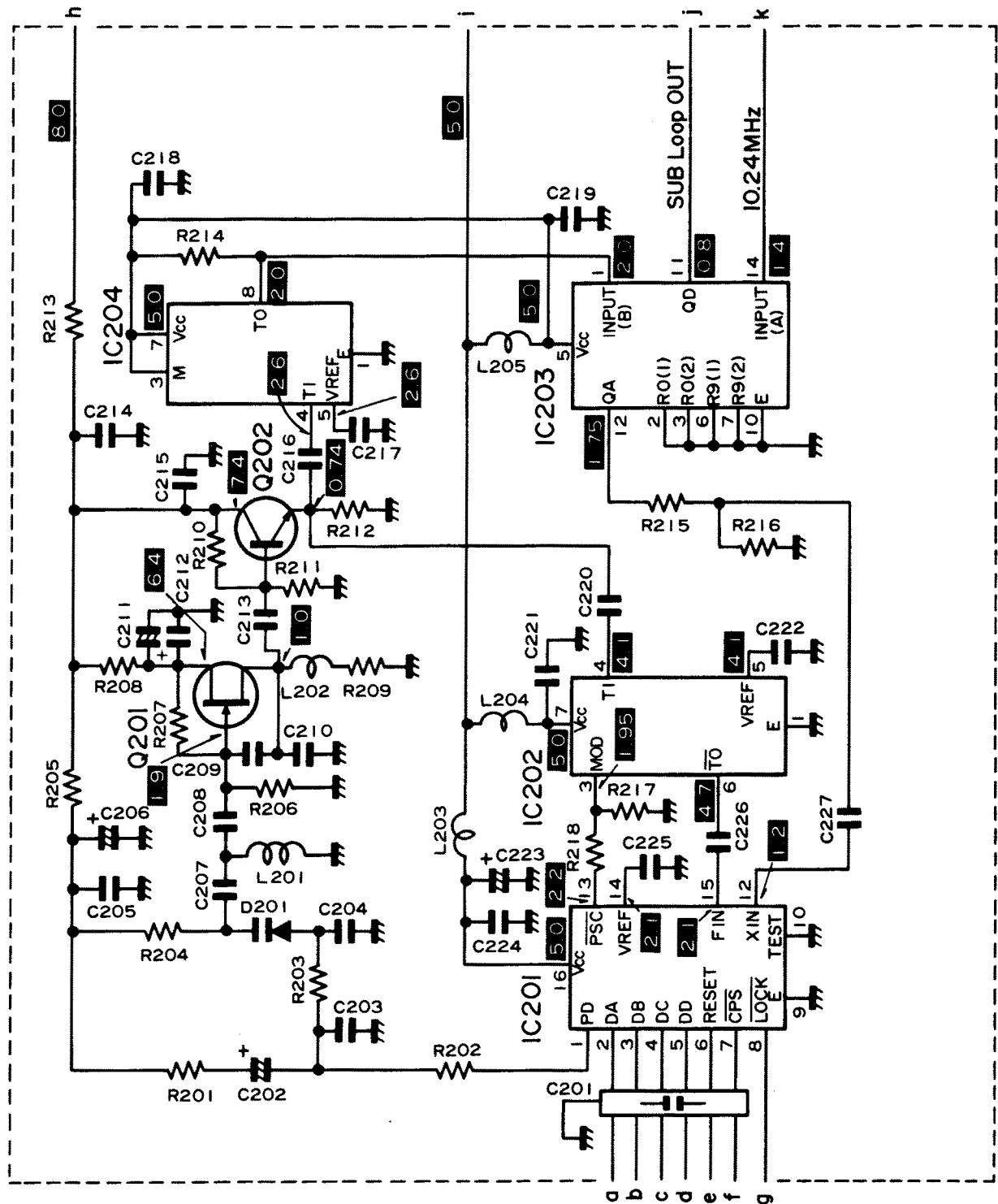


PLL UNIT CIRCUIT AND VOLTAGE DIAGRAM

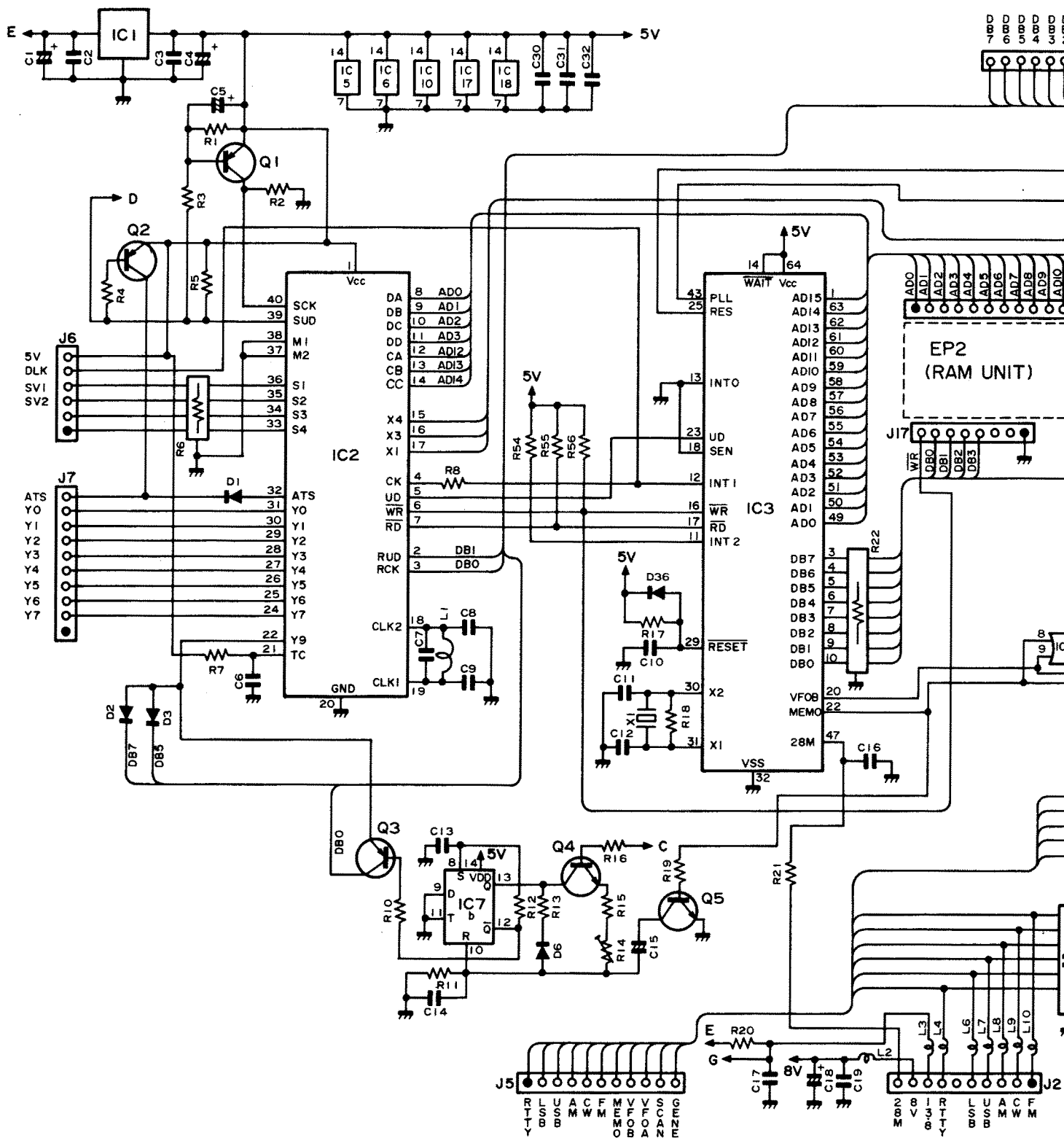


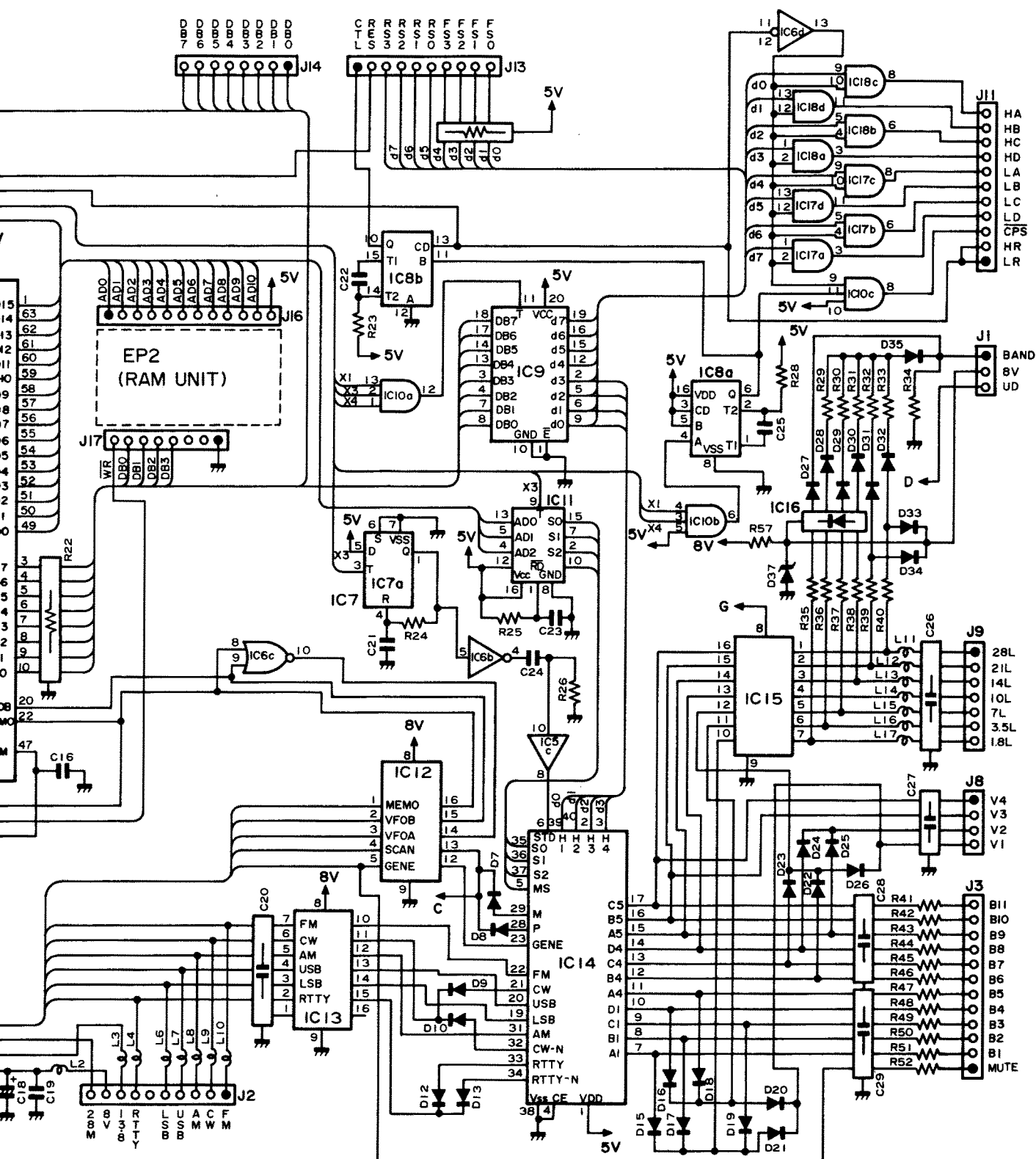


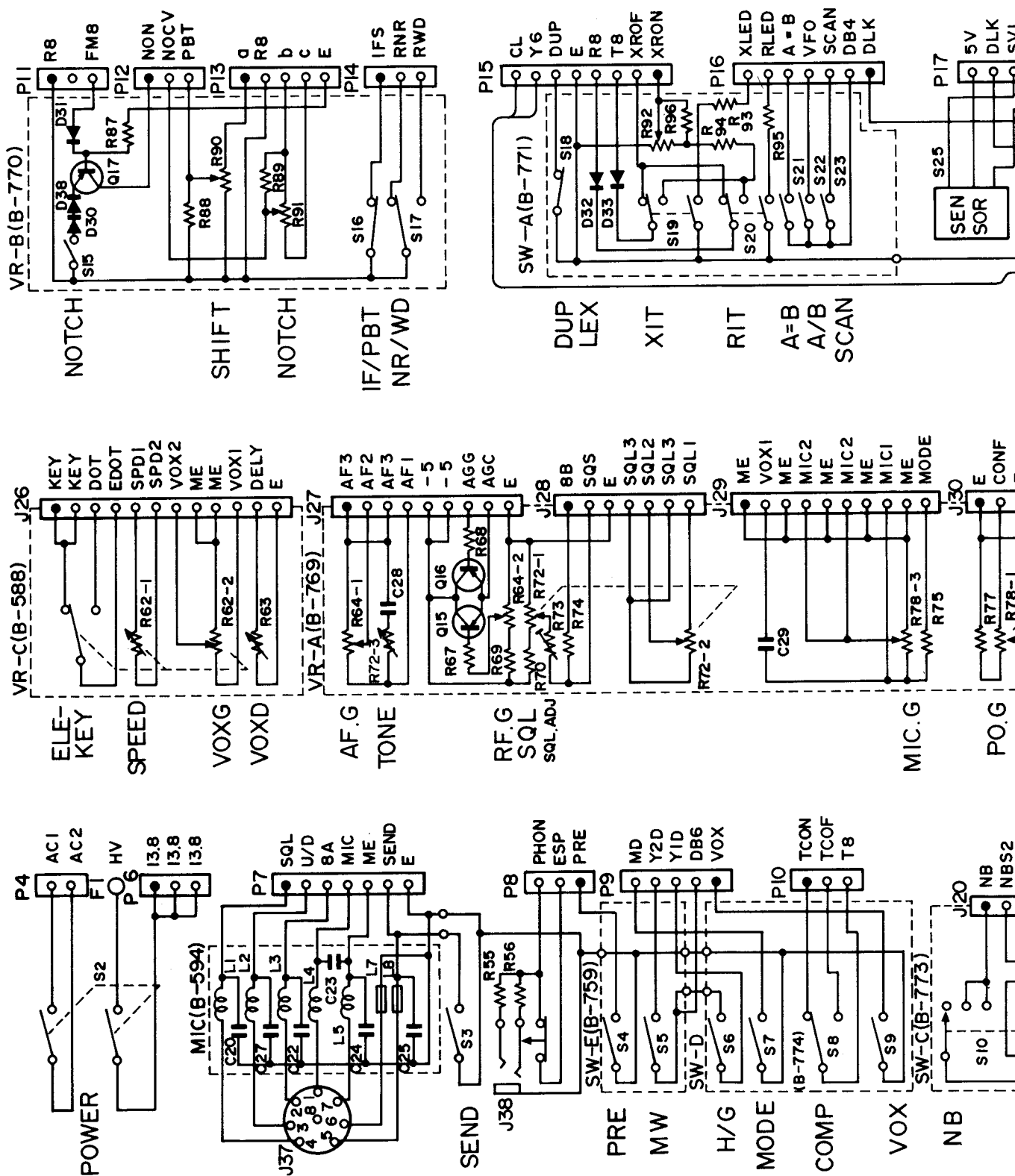
SUB LOOP UNIT CIRCUIT AND VOLTAGE DIAGRAM

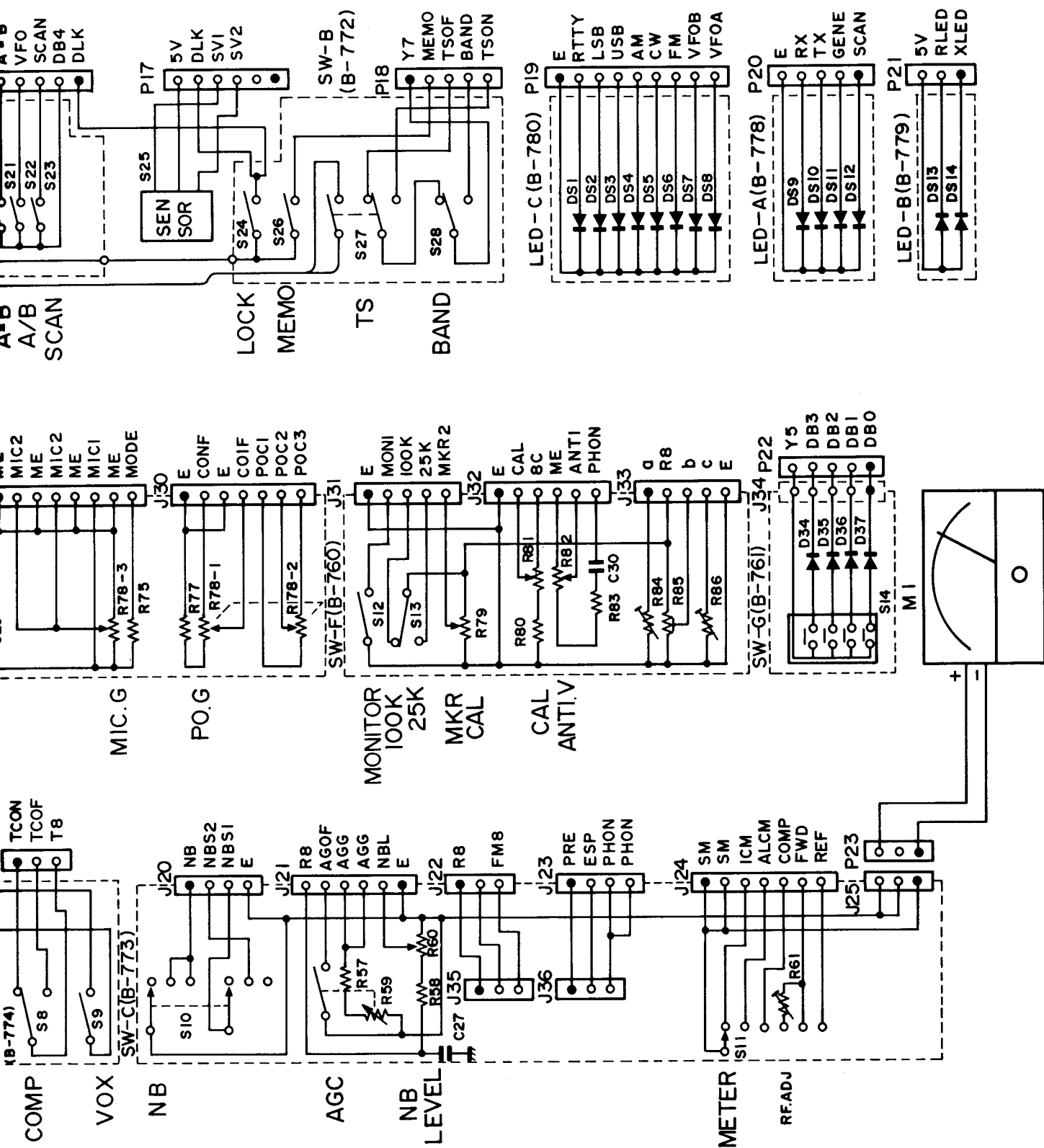


LOGIC UNIT CIRCUIT DIAGRAM

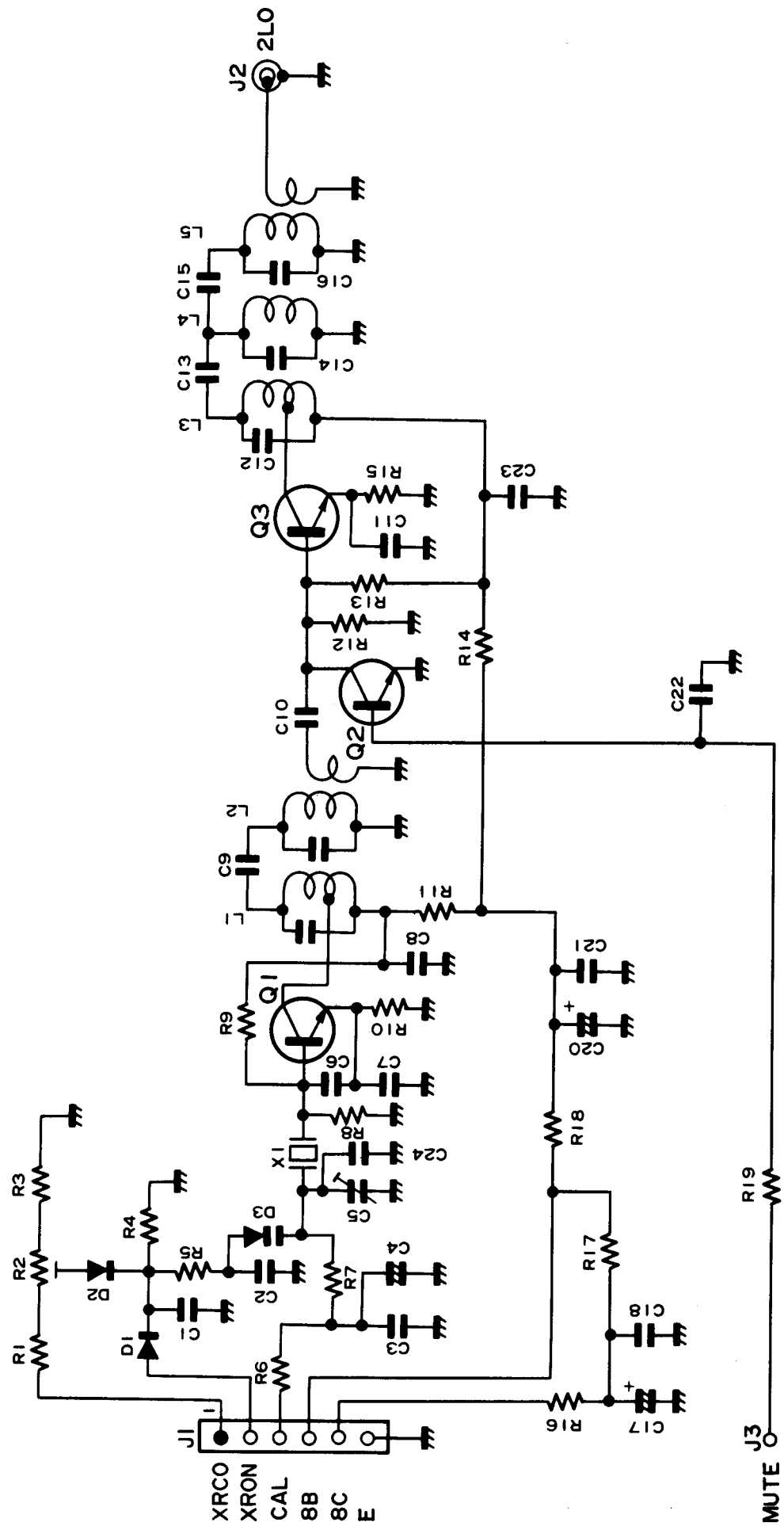




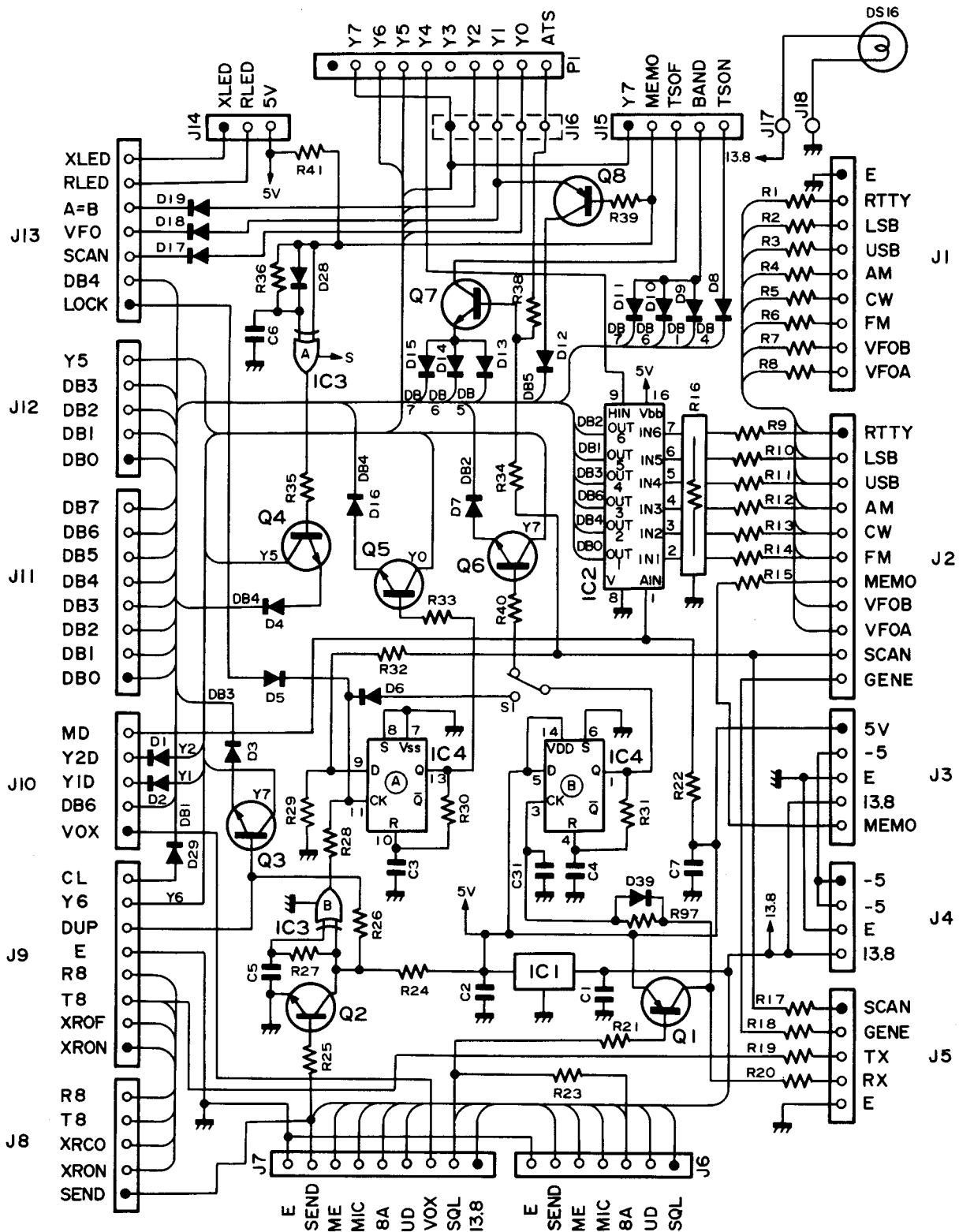




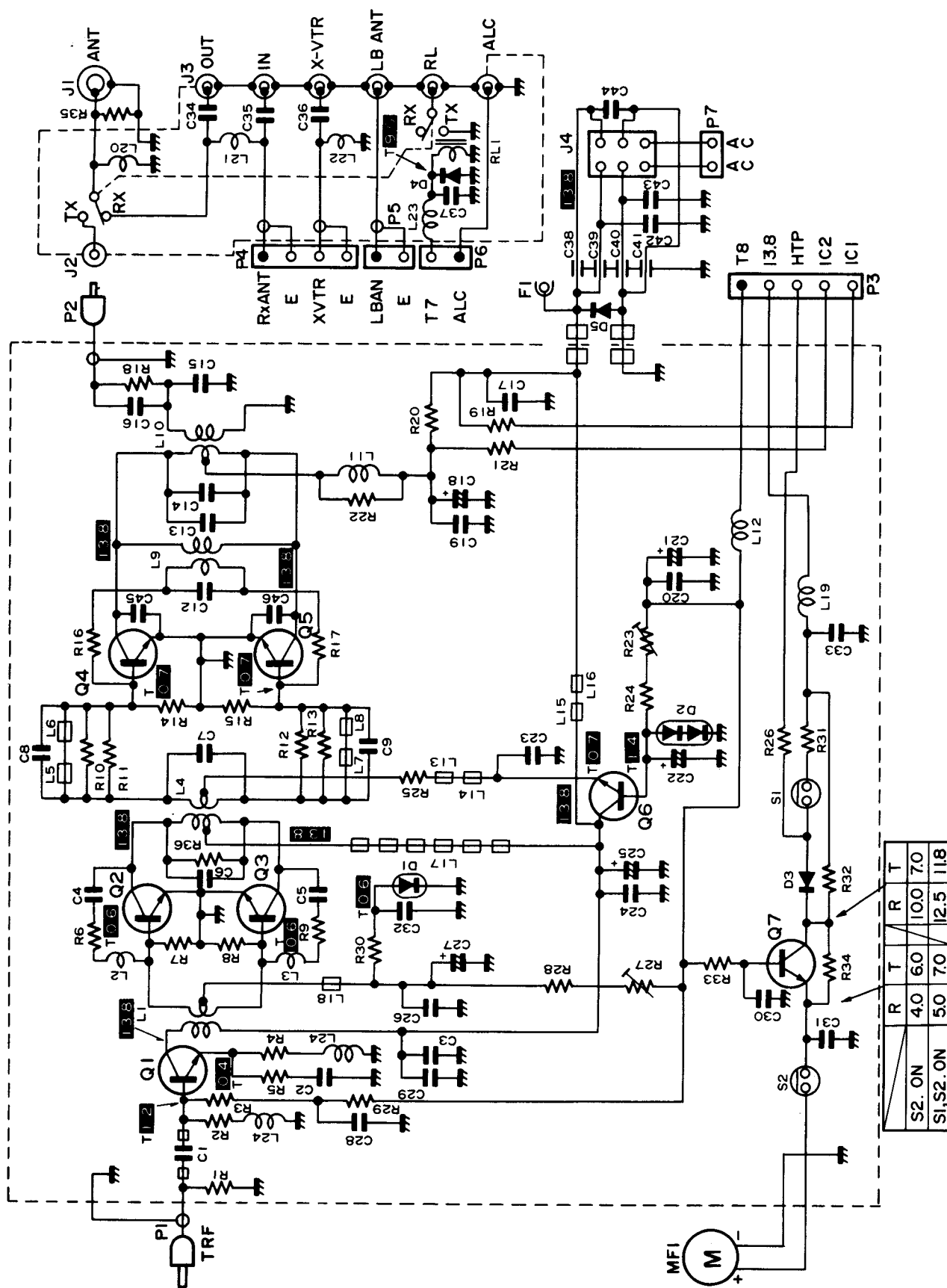
2nd LO UNIT CIRCUIT DIAGRAM



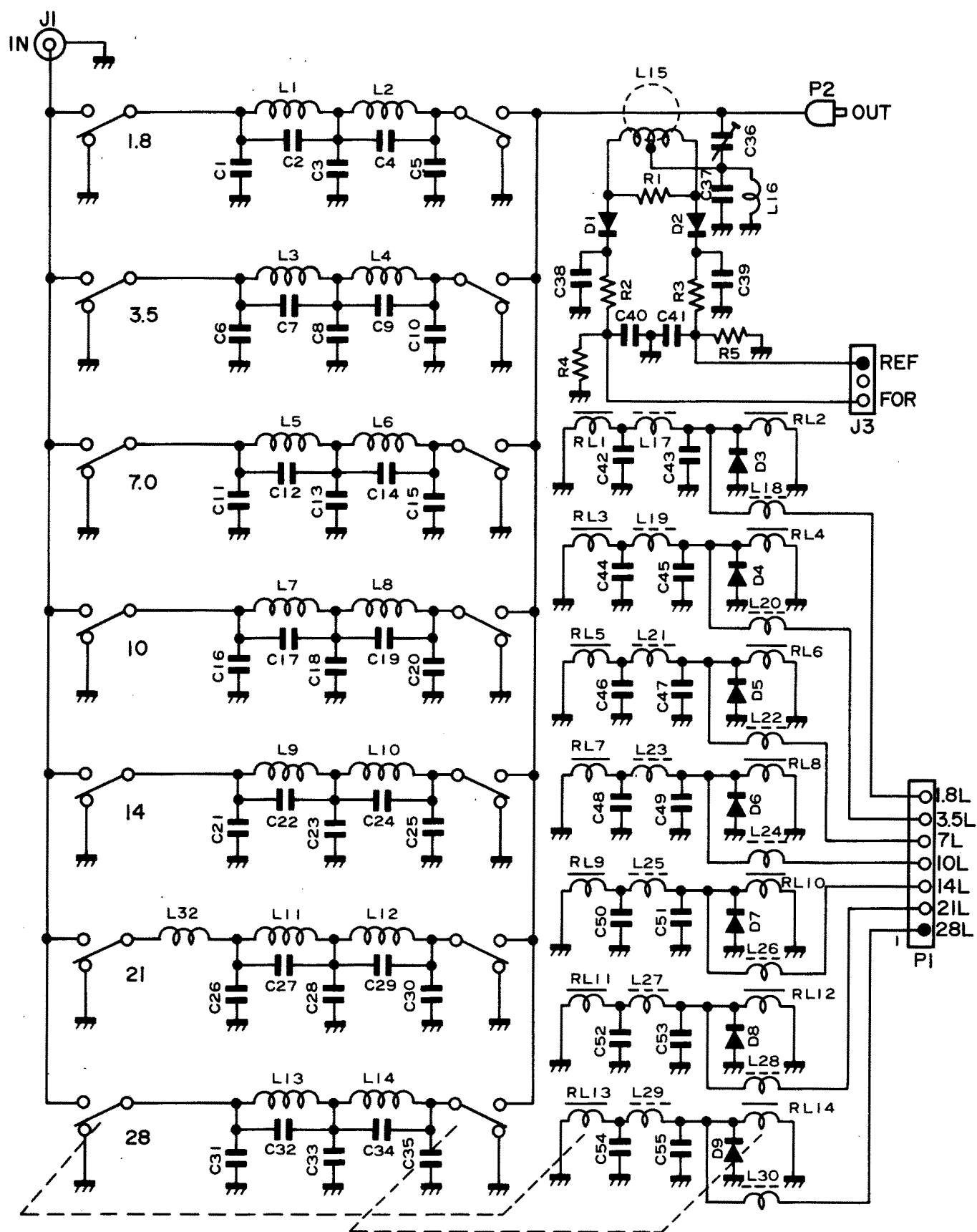
MATRIX UNIT CIRCUIT DIAGRAM



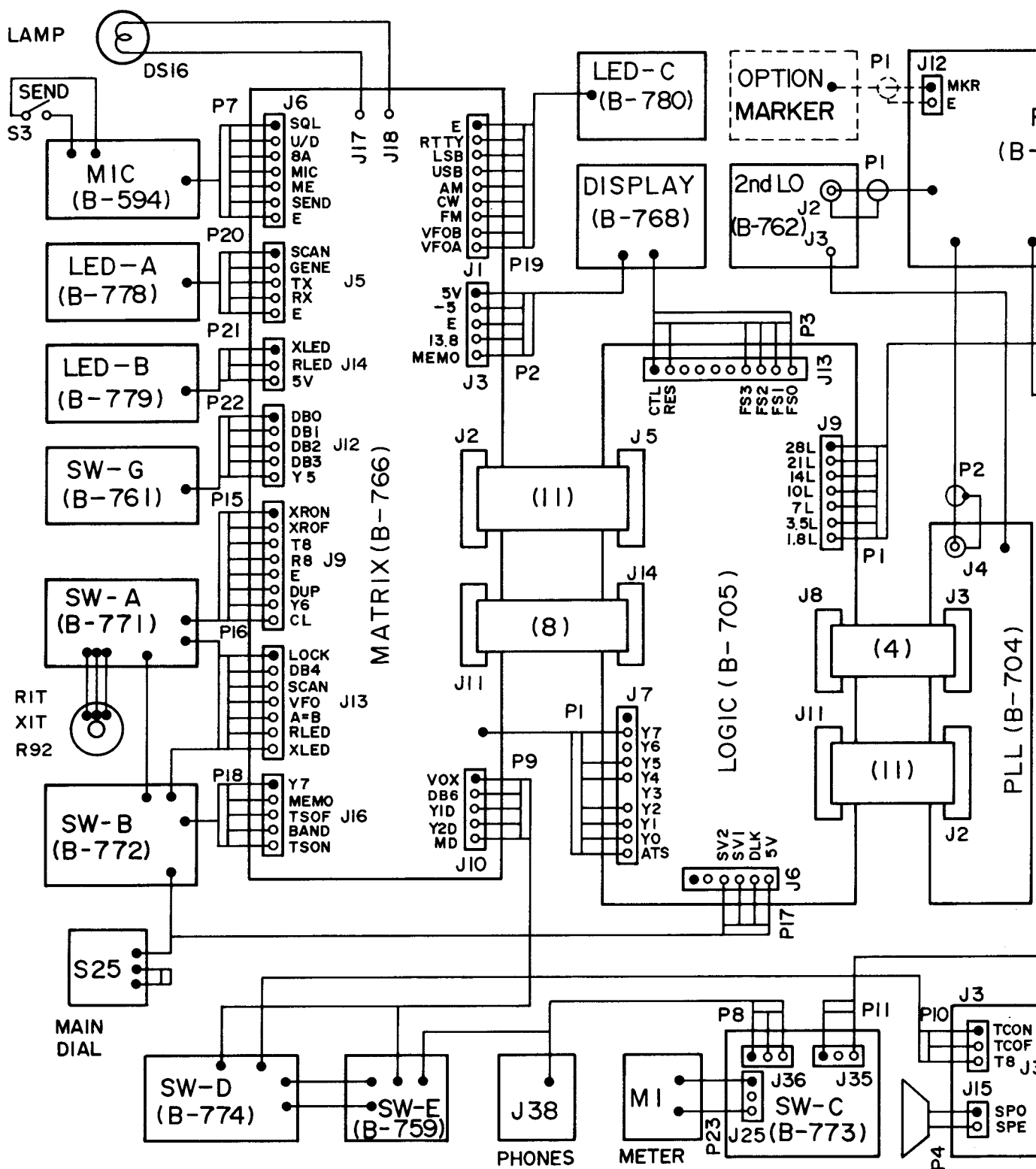
PA UNIT CIRCUIT AND VOLTAGE DIAGRAM

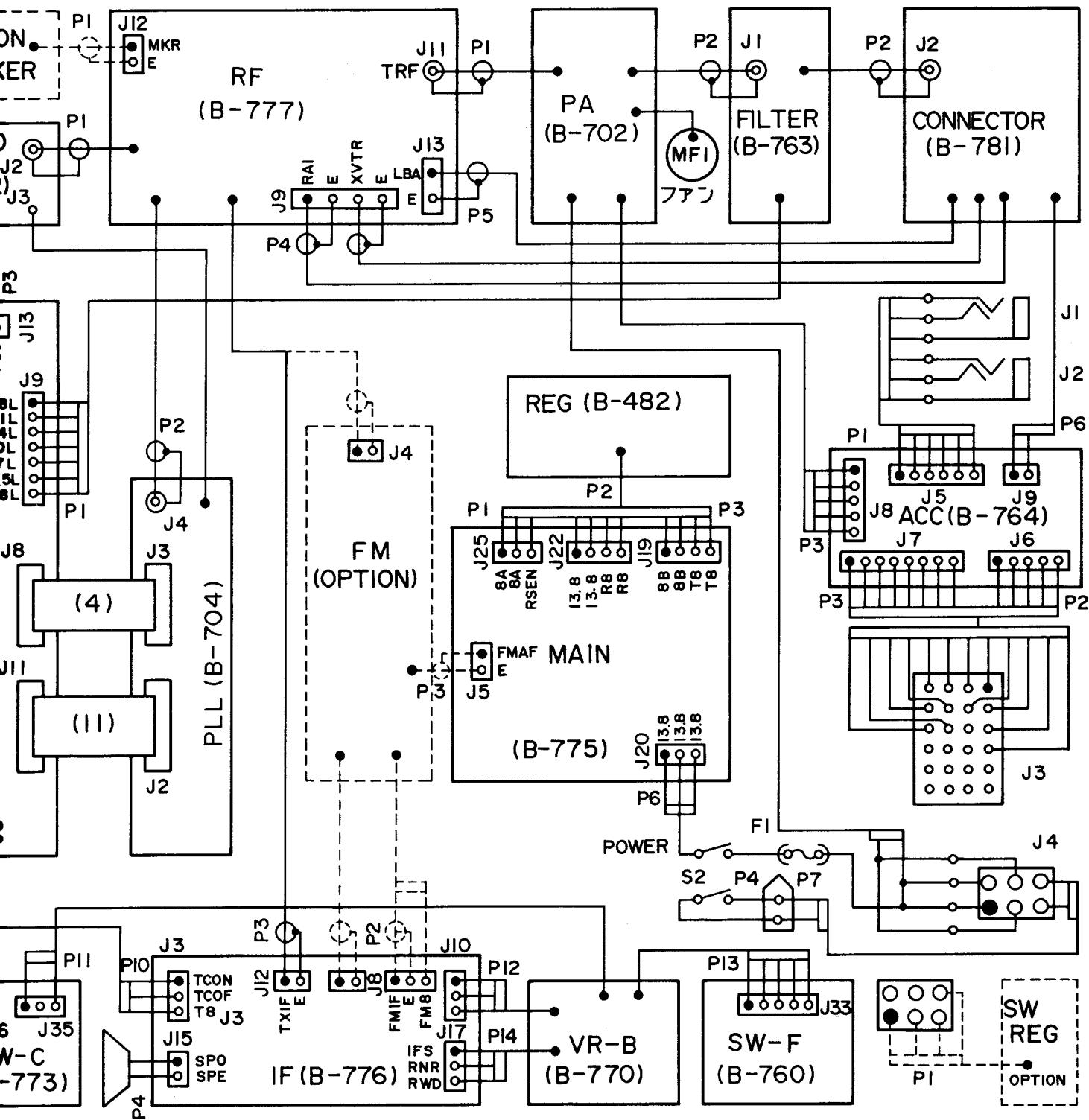


FILTER UNIT CIRCUIT DIAGRAM



UNIT CONNECTION DIAGRAM

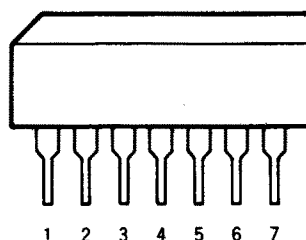




SECTION 11 IC RATINGS

TA7124P (BIPOLAR MONOLITHIC LINEAR INTEGRATED CIRCUIT)

PIN CONNECTION

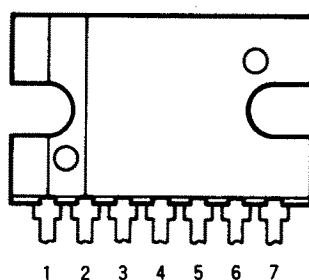


MAXIMUM RATINGS

ITEM	SYMBOL	RATING	UNIT
Power Supply Voltage	V_{cc}	15	V
Output Voltage	$V_6 V_7$	18	V
AGC Input Voltage	V_3	0 ~ V_{cc}	V
Input Voltage	$V_1 V_2$	10	Vp-p
Power Dissipation	P_D	400	mW
Operation Temperature	T_{OPR}	-20 ~ 65	°C
Storage Temperature	T_{STG}	-55 ~ 125	°C

μPC1181H (AUDIO POWER AMPLIFIER)

PIN CONNECTION



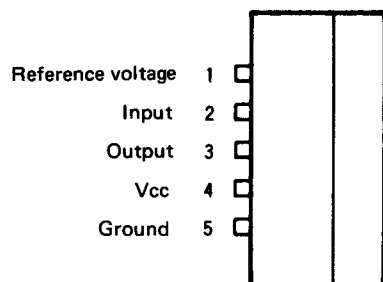
MAXIMUM RATINGS

ITEM	SYMBOL	RATING	UNIT
Peak Power Supply Voltage (200 ms)	$V_{CC(SUNGER)}$	40	V
Power Supply Voltage (when no signal)	V_{CC1}	25	V
Power Supply Voltage (during operation) *1	V_{CC2}	18	V
Circuit Current	$I_{CC(PEAK)}$	4.5	A
Permissive Dissipation	P_D	12	W
Operation Ambient Temperature *2	T_{OPR}	-30 ~ +75	°C
Storage Temperature	T_{STG}	-55 ~ +150	°C

*1 *2 Aluminum heat sink (100 x 100 x 1mm)

M51201L (VOLTAGE COMPARATOR)

PIN CONNECTION

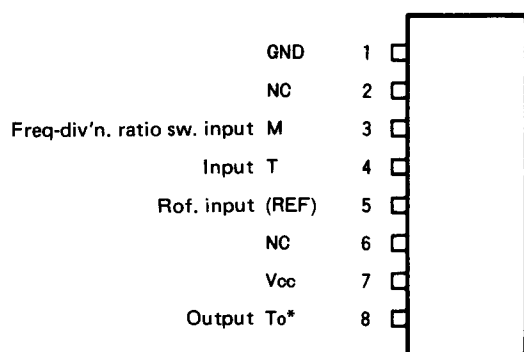


MAXIMUM RATINGS

ITEM	SYMBOL	RATING	UNIT
Supply Voltage	V _{cc}	6.5	V
Output Current	I _{OL}	60	mA
Input Voltage	V _{IN}	V _{cc}	V
Power Dissipation	P _D	180	mW
Operation Temperature	T _{OPR}	-20 ~ +75	°C
Storage Temperature	T _{STG}	-40 ~ +125	°C

M54459L (1/20, 1/100 HIGH SPEED DIVIDER)

PIN CONNECTION



*Open collector output
NC unconnected

Frequency-division ratio switching input (M) and frequency division ratio.

M	L	H
Freq-div'n. ratio	1/20	1/100

MAXIMUM RATINGS

ITEM	SYMBOL	RATING	UNIT
Power Supply Voltage	V _{cc}	7	V
Input Voltage	V _I	2.5	V
Output Voltage	V _O	5.5	V
Power Dissipation	P _D	1.33	W
Operation Ambient temperature	T _{OPR}	-10 ~ +75	°C
Storage Temperature	T _{STG}	-55 ~ +125	°C

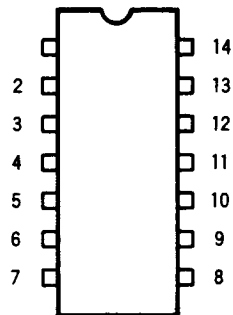
SN74LS02N (QUADRUPLE 2-INPUT POSITIVE NOR GATE)

SN74LS08N (QUADRUPLE 2-INPUT POSITIVE AND GATE)

SN74LS11N (TRIPLE 3-INPUT POSITIVE AND GATE)

SN74LS32N (QUADRUPLE 2-INPUT POSITIVE OR GATE)

PIN CONNECTION



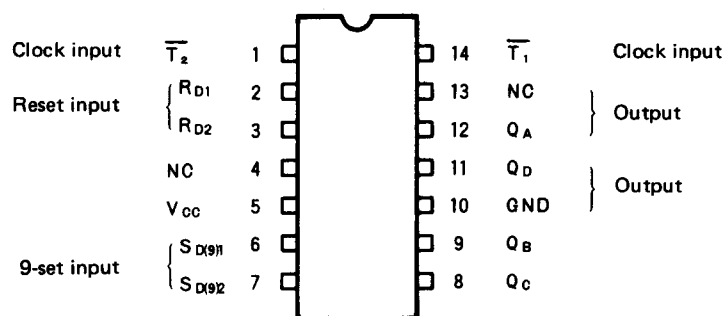
MAXIMUM RATINGS

ITEM	SYMBOL	RATING	UNIT
Power Supply Voltage	V_{cc}	$-0.5 \sim +7$	V
Input Voltage	V_i	$-0.5 \sim +15$	V
Output Voltage *1	V_o	$-0.5 \sim V_{cc}$	V
Operation Ambient Temperature	T_{opr}	$-20 \sim +75$	°C
Storage Temperature	T_{stg}	$-65 \sim +150$	°C

*1 When output is H

SN74LS90N (DECODE COUNTER)

PIN CONNECTION



MAXIMUM RATINGS

ITEM	SYMBOL	RATING	UNIT
Power Supply Voltage	V_{cc}	$-0.5 \sim +7$	V
Input Voltage *1	V_i	$-0.5 \sim +5.5$	V
Input Voltage *2	V_i	$-0.5 \sim +15$	
Output Voltage *1	V_o	$-0.5 \sim V_{cc}$	V
Operation Ambient Temperature	T_{opr}	$-20 \sim +75$	°C
Storage Temperature	T_{stg}	$-65 \sim +150$	°C

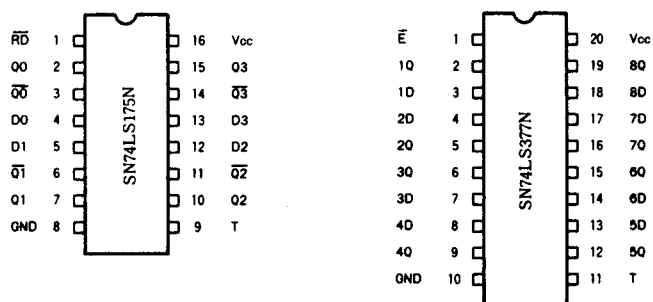
*1 Inputs T1 and T2

*2 Inputs RD1, RD2 SD(9)1 and SD(9)2

SN74LS175N (QUADRUPLE D-TYPE FLIP FLOP WITH RESET)

SN74LS377N (OCTAL POSITIVE EDGE-TRIGGERED D-TYPE FLIP FLOP WITH ENABLE)

PIN CONNECTION



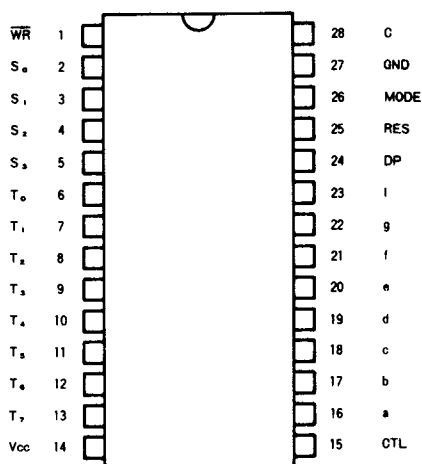
MAXIMUM RATINGS

ITEM	SYMBOL	RATING	UNIT
Power Supply Voltage	V_{cc}	-0.5 ~ +7	V
Input Voltage *1	V_i	-0.5 ~ +15	V
Output Voltage *1	V_o	-0.5 ~ V_{cc}	V
Operation Ambient Temperature	T_{opr}	-20 ~ +75	°C
Storage Temperature	T_{stg}	-65 ~ +150	°C

*1 When output is H

M54844P (PROGRAMMABLE DISPLAY CONTROLLER)

PIN CONNECTION

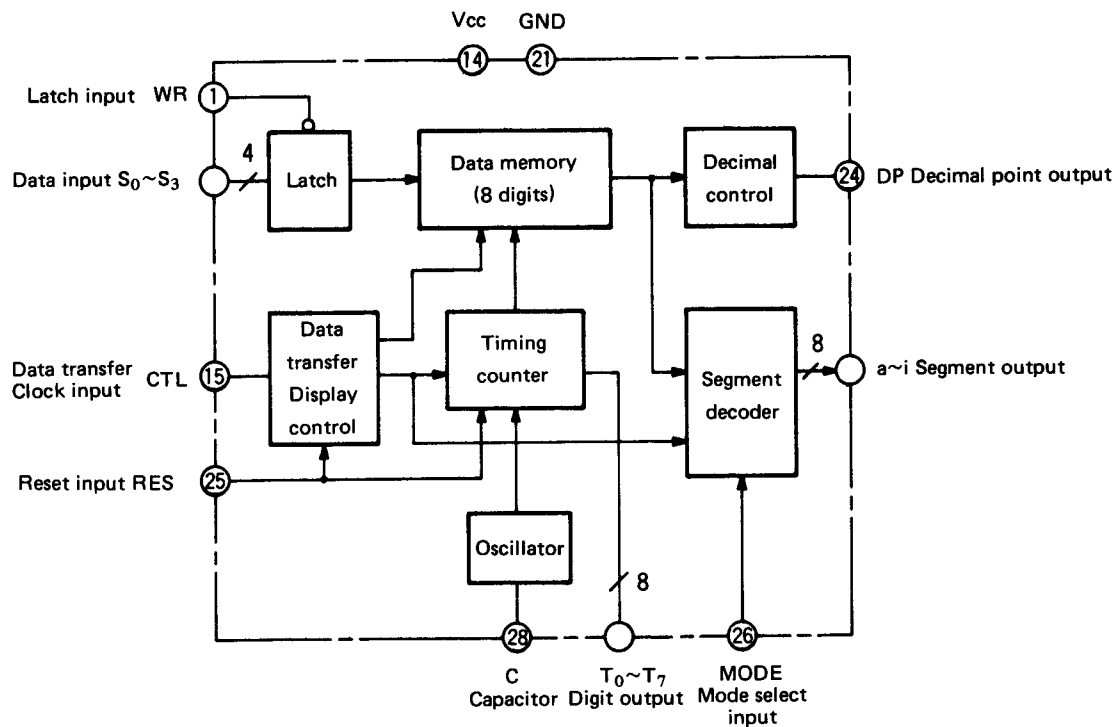


MAXIMUM RATINGS

ITEM	SYMBOL	RATING	UNIT
Supply Voltage	V_{cc}	-0.3 ~ +15	V
Input Voltage	V_i	-0.3 ~ V_{cc}	V
Supply – Output Terminal Voltage *1	$V_{cc}-V_o$	-0.3 ~ +35	V
Operation Temperature	T_{opr}	-30 ~ +85	°C
Storage Temperature	T_{stg}	-55 ~ +125	°C

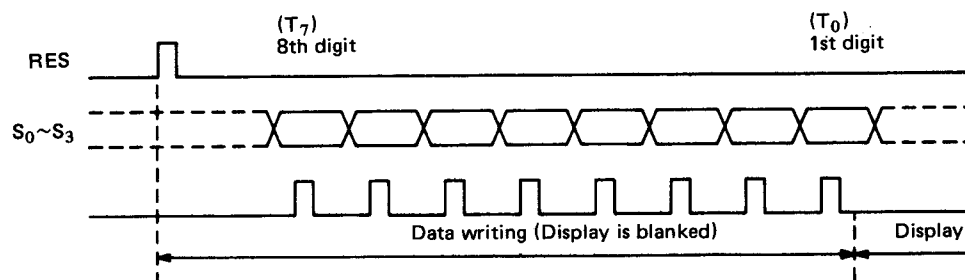
*1 When output is OFF.

M54844P BLOCK DIAGRAM



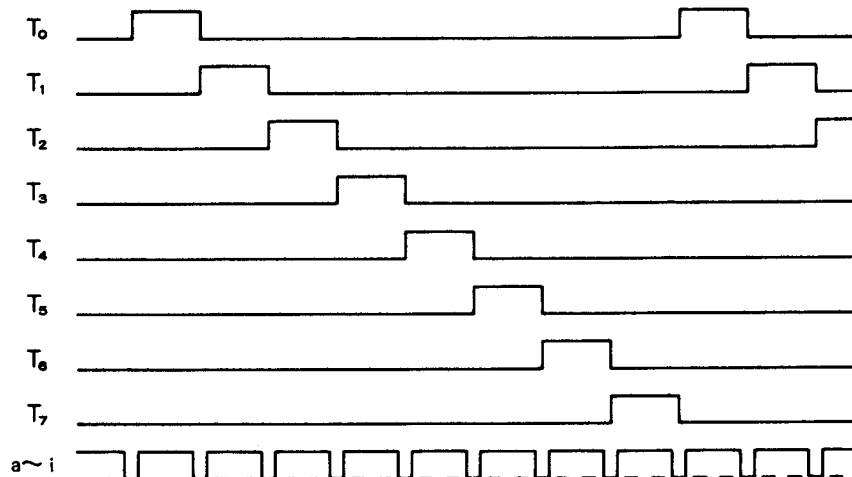
OPERATION TIMING

(1) Data writing



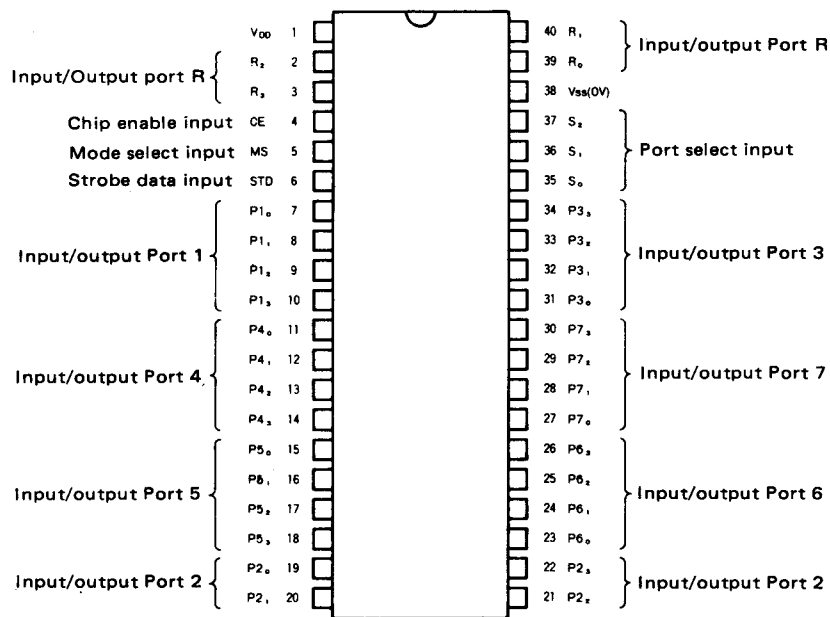
- When power is turned on, first, reset the counter, then accept data writing.
- After 1st data writing, reset is no required. At this time, 1st digit has been input, the display is blanked until 8th digit is input and data writing is completed.

(2) Output timing

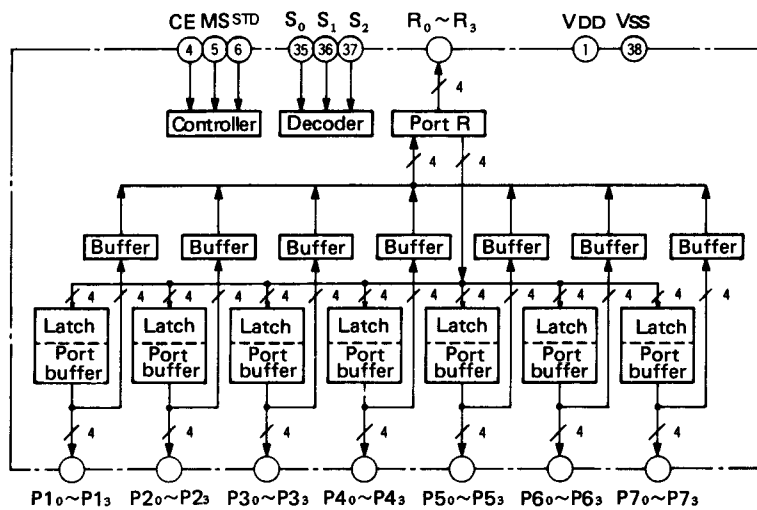


M50780SP (INPUT/OUTPUT EXPANDER)

PIN CONNECTION



BLOCK DIAGRAM



MAXIMUM RATINGS

ITEM	SYMBOL	RATING	UNIT
Power Supply Voltage	V _{DD}	-0.3 ~ 15	V
Input Voltage	V _I	V _{SS} - 0.3 ~ V _{DD} + 0.3	V
Output Voltage *1	V _O	V _{SS} - 0.3 ~ V _{DD} + 0.3	V
Maximum Power Consumption *2	P _D	600	mW
Operation Ambient Temperature	T _{OPR}	-10 ~ +70	°C
Storage Temperature	T _{STG}	-40 ~ +125	°C

*1 If V_{SS} terminal is standard

*2 Ta-25°C

SECTION 12 PARTS LIST

[EF UNIT]

REF. NO.	DESCRIPTION	PART NO.
J1	Connector	HSJ0779-01A
J2	Connector	LJ035-1-2
J3	Connector	1625-24R
J4	Connector	SQ-2054
P1	Connector	TL-25H-06-B1
P2	Connector	TL-25H-05-B1
P3	Connector	TL-25H-08-B1
P4	Connector	5250-2A
F1	Fuse	3A
SP1	Speaker	C090A21A0000

[MAIN UNIT]

IC1	IC	μ PC1037H
IC2	IC	μ PC1037H
IC3	IC	NJM4558D
IC4	IC	NJM4558D
IC5	IC	μ PC1181H
IC6	IC	NJM082D
IC7	IC	NJM4558D
IC8	IC	NJM4558D
IC9	IC	NJM082D
IC10	IC	NJM4558D
Q1	FET	2SK241GR
Q2	FET	2SK241GR
Q3	Transistor	2SC945P
Q4	Transistor	2SA1015GR
Q5	Transistor	2SC945Q
Q6	Transistor	2SC945P
Q7	Transistor	2SC945 (ALL)
Q8	Transistor	2SC945 (ALL)
Q9	Transistor	2SC945P
Q10	FET	2SK30A-Y
Q11	Transistor	2SC945 (ALL)
Q12	Transistor	2SC945 (ALL)
Q13	Transistor	2SC945 (ALL)
Q14	Transistor	2SC945P
Q15	Transistor	2SC945P
Q16	Transistor	2SC945 (ALL)
Q17	Transistor	2SC945 (ALL)
Q18	Transistor	2SC945 (ALL)
Q19	Transistor	2SA1015Y
Q20	Transistor	2SC945 (ALL)
Q21	Transistor	2SA1015Y
Q22	Transistor	2SC945P
Q23	Transistor	2SC1571G
Q24	FET	2SK192A-GR
Q25	Transistor	2SC945 (ALL)
Q26	Transistor	2SC945P
Q27	Transistor	2SC1645
Q28	Transistor	2SC945P
Q29	Transistor	2SC1571G
Q30	Transistor	2SC945P
Q31	Transistor	2SC1015Y
Q33	Transistor	2SA1015Y

[MAIN UNIT]

REF. NO.	DESCRIPTION	PART NO.
Q34	Transistor	2SC945 (ALL)
Q35	Transistor	2SA1015Y
Q36	Transistor	2SA1015Y
Q37	Transistor	2SA1015Y
Q38	Transistor	2SA1015GR
Q39	Transistor	2SA1015GR
Q40	Transistor	2SC945 (ALL)
Q41	Transistor	2SA1015Y
Q42	Transistor	2SC3402
Q43	Transistor	2SA1015Y
Q44	Transistor	2SA1015Y
Q45	Transistor	2SC945 (ALL)
Q46	Transistor	2SC3402
D1	Diode	1K60
D2	Diode	1SS53
D3	Diode	1SS53
D4	Diode	1K60
D5	Diode	1K60
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	Diode	1SS53
D22	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	Zener	MZ304B
D34	Diode	1SS53
D35	Diode	1SS53
D36	Diode	1SS53
D37	Diode	1SS53
D38	Diode	1SS53
D39	Diode	1SS53
D40	Diode	1SS53
D41	Diode	1SS53
D42	Diode	1SS53
D43	Diode	1SS53
D44	Diode	1SS53
D45	Diode	1SS53
D46	Diode	1SS53
D49	Diode	1SS53
D50	Diode	1SS53

[MAIN UNIT]

REF. NO.	DESCRIPTION	PART NO.
D51	Diode	1SS53
D52	Diode	1SS53
D53	Diode	1SS53
D55	Diode	1SS53
X1	Crystal	9.0116MHz HC-43/U
X2	Crystal	CR-49 (9.0145MHz)
X3	Crystal	CR-48 (9.0115MHz)
L1	Coil	LS-238
L2	Coil	LS-239
L3	Coil	LS-240
L4	Coil	LS-171
L5	Coil	LS-171
L6	Coil	LS-243
L7	Coil	LAL04SK820K
R1	Resistor	1.5K ELR25
R2	Trimmer	22K H0651A
R3	Resistor	100 R25
R4	Resistor	100K ELR25
R6	Resistor	100 ELR25
R7	Resistor	10K ELR25
R8	Resistor	56K ELR25
R9	Resistor	100K ELR25
R10	Resistor	100K ELR25
R11	Resistor	100K ELR25
R12	Resistor	330 ELR25
R13	Resistor	220 ELR25
R14	Resistor	100 ELR25
R15	Resistor	47K ELR25
R16	Resistor	2.2K ELR25
R17	Resistor	470K ELR25
R18	Trimmer	100K H0651A
R19	Resistor	100K ELR25
R20	Trimmer	100K H0651A
R21	Resistor	47K ELR25
R22	Resistor	2.2K R25
R23	Resistor	10K R25
R24	Resistor	10K ELR25
R25	Resistor	10K ELR25
R26	Resistor	100K ELR25
R27	Resistor	2.2K ELR25
R28	Resistor	33K ELR25
R29	Resistor	10K ELR25
R30	Resistor	10K R25
R31	Resistor	10K ELR25
R32	Resistor	33K ELR25
R33	Resistor	2.2K ELR25
R34	Resistor	47 ELR25
R35	Resistor	1K ELR25
R36	Resistor	330 ELR25
R37	Resistor	27K ELR25
R38	Resistor	4.7K ELR25
R39	Resistor	3.3K ELR25
R40	Resistor	470 ELR25
R41	Resistor	2.2K R25
R42	Trimmer	10K H0651A
R43	Resistor	330 ELR25
R44	Resistor	47K ELR25
R45	Resistor	15K ELR25
R46	Resistor	3.3K ELR25
R47	Resistor	1K ELR25
R48	Resistor	1K ELR10

[MAIN UNIT]

REF. NO.	DESCRIPTION	PART NO.
R49	Resistor	220 ELR25
R50	Resistor	6.8K ELR25
R51	Resistor	100K ELR25
R52	Resistor	33K ELR25
R53	Resistor	10K R25
R54	Resistor	100K ELR25
R55	Resistor	10K ELR25
R56	Resistor	10K ELR25
R57	Resistor	10K ELR25
R58	Resistor	47K ELR25
R59	Resistor	2.2K ELR25
R60	Resistor	2.2K ELR25
R61	Resistor	3.3 ELR25
R62	Resistor	4.7 R25
R63	Resistor	10K ELR25
R64	Resistor	10K ELR25
R65	Resistor	220 ELR25
R66	Resistor	10K R25
R67	Resistor	10K ELR25
R68	Resistor	10K ELR25
R69	Resistor	220 ELR25
R70	Resistor	10K ELR25
R71	Resistor	15 R25
R72	Resistor	4.7K ELR25
R73	Resistor	220 ELR25
R74	Resistor	10K ELR25
R75	Resistor	15 ELR25
R76	Resistor	3.9K ELR25
R77	Resistor	1K R25
R78	Resistor	220 ELR25
R79	Resistor	47 R25
R80	Resistor	2.2K ELR25
R81	Resistor	180K ELR25
R82	Resistor	180K ELR25
R83	Resistor	4.7K ELR25
R84	Resistor	180K ELR25
R85	Resistor	1K ELR25
R86	Resistor	100 ELR25
R87	Resistor	100 ELR25
R88	Resistor	10K ELR25
R89	Resistor	22K ELR25
R90	Resistor	47K ELR25
R91	Resistor	47K ELR25
R92	Resistor	1M ELR25
R93	Resistor	10K ELR25
R94	Resistor	47K ELR25
R95	Resistor	47K ELR25
R96	Resistor	1.8M ELR25
R97	Resistor	10K ELR25
R98	Resistor	10K ELR25
R99	Resistor	15K ELR25
R100	Resistor	100 ELR25
R101	Resistor	220K ELR25
R102	Resistor	1M ELR25
R103	Resistor	220K ELR25
R104	Resistor	1.8M ELR25
R105	Resistor	820K ELR25
R106	Resistor	10K R25
R107	Resistor	10K ELR25
R108	Resistor	4.7K ELR25
R109	Resistor	47K ELR25
R110	Resistor	15K ELR25
R111	Resistor	4.7K ELR25
R113	Trimmer	33K H0651A

[MAIN UNIT]

REF. NO.	DESCRIPTION	PART NO.	
R114	Resistor	10K	ELR25
R115	Resistor	10K	ELR25
R116	Trimmer	10K	H0651A
R117	Trimmer	10K	H0651A
R118	Resistor	10K	ELR25
R119	Resistor	6.8K	ELR25
R120	Resistor	47K	ELR25
R121	Resistor	470K	ELR25
R122	Resistor	10K	R25
R123	Resistor	10K	ELR25
R124	Resistor	3.3M	ELR25
R125	Resistor	3.3M	ELR25
R126	Resistor	2.2	ELR25
R127	Resistor	100	ELR25
R128	Resistor	1K	ELR25
R129	Resistor	10K	ELR25
R130	Resistor	10K	ELR25
R131	Resistor	10K	ELR25
R132	Resistor	4.7K	ELR25
R133	Resistor	2.2K	ELR25
R134	Resistor	100K	ELR25
R135	Resistor	33K	ELR25
R136	Resistor	10K	ELR25
R137	Resistor	220	ELR25
R138	Resistor	10K	ELR25
R139	Resistor	1K	ELR25
R140	Resistor	1K	ELR25
R141	Trimmer	100	H0651A
R142	Resistor	330	ELR25
R143	Resistor	4.7K	ELR25
R144	Resistor	4.7K	ELR25
R145	Resistor	4.7K	ELR25
R146	Resistor	15K	ELR25
R147	Resistor	220	ELR25
R148	Resistor	100	ELR25
R149	Resistor	33K	ELR25
R150	Resistor	4.7K	ELR25
R151	Resistor	2.2K	ELR25
R152	Resistor	100K	ELR25
R153	Resistor	33K	ELR25
R154	Resistor	4.7K	ELR25
R155	Trimmer	2.2K	H0651A
R156	Resistor	1K	ELR25
R157	Resistor	100K	ELR25
R158	Resistor	4.7K	ELR25
R159	Resistor	47K	ELR25
R160	Resistor	47K	ELR25
R161	Resistor	47K	ELR25
R162	Trimmer	33K	H0651A
R163	Resistor	4.7K	ELR25
R164	Trimmer	10K	H0651A
R165	Resistor	1M	ELR25
R166	Trimmer	10K	H0651A
R167	Resistor	39K	ELR25
R168	Resistor	47K	ELR25
R169	Resistor	68K	ELR25
R170	Resistor	68K	ELR25
R171	Trimmer	4.7K	H0651A
R172	Trimmer	100K	H0651A
R173	Resistor	1.8M	ELR25
R174	Resistor	390K	R25
R175	Resistor	100	ELR25
R176	Resistor	330K	ELR25
R177	Resistor	82K	ELR25

[MAIN UNIT]

REF. NO.	DESCRIPTION	PART NO.	
R178	Trimmer	1K	H0651A
R179	Resistor	330	ELR25
R180	Resistor	22K	ELR25
R181	Resistor	4.7K	ELR25
R182	Resistor	4.7K	ELR25
R183	Resistor	4.7K	ELR25
R184	Resistor	220	ELR25
R185	Resistor	4.7K	ELR25
R186	Resistor	4.7K	ELR25
R187	Resistor	10K	ELR25
R188	Resistor	4.7K	ELR25
R189	Resistor	4.7K	ELR25
R190	Resistor	2.2K	ELR25
R191	Resistor	10K	ELR25
R192	Resistor	22K	ELR25
R193	Resistor	68K	ELR25
R194	Resistor	1K	ELR25
R195	Resistor	47	R25
R196	Resistor	100K	ELR25
R197	Resistor	10K	ELR25
R198	Resistor	2.2K	ELR25
R199	Resistor	220	ELR25
R200	Resistor	220	ELR25
R201	Trimmer	47K	H0651A
R202	Resistor	3.3M	ELR25
R203	Resistor	470K	ELR25
R204	Resistor	330	ELR25
R205	Resistor	470K	ELR25
R206	Resistor	10M	ELR25
R207	Resistor	3.3M	ELR25
R208	Resistor	3.3M	ELR25
R209	Resistor	3.9K	ELR25
R210	Resistor	22M	ELR25
R211	Resistor	3.3M	ELR25
R212	Resistor	3.3M	R25
R213	Resistor	10K	ELR25
R214	Resistor	100	ELR25
R215	Resistor	1M	ELR25
R216	Resistor	3.3M	ELR25
R217	Resistor	820K	ELR25
R218	Resistor	820K	ELR25
R219	Resistor	330K	ELR25
R220	Resistor	47K	ELR25
R221	Resistor	3.3M	ELR25
R222	Resistor	680K	ELR25
R223	Resistor	10K	ELR25
R224	Resistor	560K	ELR25
R225	Resistor	100K	ELR25
R226	Resistor	1K	ELR25
R227	Resistor	4.7K	ELR25
R229	Resistor	10K	ELR25
R230	Resistor	4.7K	ELR25
R232	Resistor	10K	ELR25
R233	Resistor	4.7K	ELR25
R234	Resistor	47K	ELR25
R235	Resistor	15K	ELR25
R236	Resistor	10K	R25
R237	Resistor	10K	ELR25
R238	Resistor	10K	ELR25
R239	Resistor	4.7K	ELR25
R240	Resistor	10K	ELR25
R241	Resistor	22K	ELR25
R242	Resistor	22K	ELR25
R244	Resistor	15K	ELR25

[MAIN UNIT]

REF. NO.	DESCRIPTION	PART NO.	
R245	Resistor	22K	ELR25
R246	Resistor	15K	ELR25
R247	Resistor	22K	ELR25
R248	Resistor	10K	ELR25
R249	Resistor	10K	ELR25
R250	Resistor	1M	ELR25
R251	Resistor	2.2K	ELR25
R252	Resistor	3.3K	ELR25
C1	Barrier Lay	0.047	25V
C2	Mylar	0.022	25V
C3	Barrier Lay	0.047	25V
C4	Barrier Lay	0.047	25V
C5	Barrier Lay	0.047	25V
C6	Ceramic	100P	50V
C7	Ceramic	0.001	50V
C8	Barrier Lay	0.047	25V
C9	Barrier Lay	0.047	25V
C10	Electrolytic	10	16V RC2
C11	Barrier Lay	0.047	25V
C12	Electrolytic	47	10V
C13	Ceramic	330P	50V
C14	Barrier Lay	0.047	25V
C15	Barrier Lay	0.047	25V
C16	Cylinder	0.001	UP125SL50V
C17	Barrier Lay	0.047	25V
C18	Electrolytic	1	50V
C19	Electrolytic	47	10V
C20	Barrier Lay	0.047	25V
C21	Barrier Lay	0.047	25V
C22	Barrier Lay	0.047	25V
C23	Electrolytic	10	16V
C24	Electrolytic	0.47	50V
C25	Barrier Lay	0.047	25V
C26	Barrier Lay	0.047	25V
C27	Electrolytic	22	10V
C28	Barrier Lay	0.1	16V
C29	Barrier Lay	0.047	25V
C30	Barrier Lay	0.047	25V
C31	Electrolytic	1	50V RC2
C32	Barrier Lay	0.1	16V
C33	Barrier Lay	0.047	25V
C34	Electrolytic	47	10V
C35	Ceramic	0.0047	50V
C36	Electrolytic	33	10V
C37	Electrolytic	10	16V
C38	Electrolytic	0.22	50V RC2
C39	Ceramic	0.0047	50V
C40	Ceramic	0.0047	50V
C41	Ceramic	0.0047	50V
C42	Trimmer	CV05E 3001	
C43	Ceramic	82P	50V
C44	Ceramic	0.0047	50V
C45	Ceramic	0.0047	50V
C46	Trimmer	CV05E 3001	
C47	Ceramic	47P	50V
C48	Ceramic	0.0047	50V
C49	Dip Mica	150P	50V
C50	Dip Mica	150P	50V
C51	Ceramic	0.0047	50V
C52	Trimmer	CV05E 3001	
C53	Ceramic	47P	50V
C54	Ceramic	0.0047	50V
C55	Barrier Lay	0.047	25V

[MAIN UNIT]

REF. NO.	DESCRIPTION	PART NO.	
C56	Barrier Lay	0.047	25V
C57	Ceramic	470P	50V
C58	Electrolytic	2.2	50V
C59	Electrolytic	47	10V
C60	Array	B7ZC0711-32N	(0.01x6)
C61	Barrier Lay	0.1	16V
C62	Electrolytic	1 BP	50V
C63	Electrolytic	47	10V
C64	Ceramic	0.0047	50V
C65	Electrolytic	1	50V
C66	Electrolytic	47	10V
C67	Electrolytic	22	10V
C68	Electrolytic	4.7	50V
C69	Electrolytic	1	50V
C70	Electrolytic	10	16V
C71	Barrier Lay	0.047	25V
C72	Electrolytic	47	10V
C73	Mylar	0.1	50V
C74	Electrolytic	470	16V
C75	Electrolytic	47	16V
C76	Electrolytic	47	10V
C78	Electrolytic	220	10V
C79	Electrolytic	0.47	50V RC2
C80	Electrolytic	0.47 BP	50V
C81	Mylar	0.01	50V
C82	Mylar	0.01	50V
C83	Electrolytic	22	10V
C84	Electrolytic	33	10V
C85	Mylar	0.022	50V
C86	Barrier Lay	0.1	16V
C87	Electrolytic	22	10V
C88	Mylar	0.022	50V
C89	Mylar	0.022	50V
C90	Mylar	0.022	50V
C91	Mylar	0.01	50V
C92	Electrolytic	22	10V
C93	Barrier Lay	0.047	25V
C94	Barrier Lay	0.047	25V
C95	Electrolytic	33	10V
C96	Ceramic	0.0047	50V
C97	Barrier Lay	0.047	25V
C98	Barrier Lay	0.047	25V
C99	Barrier Lay	0.047	25V
C100	Electrolytic	33	10V
C101	Ceramic	0.001	50V
C102	Electrolytic	22	10V
C103	Barrier Lay	0.047	25V
C104	Barrier Lay	0.1	16V
C105	Tantalum	10	16V
C106	Mylar	0.022	50V
C107	Mylar	0.022	50V
C108	Mylar	0.022	50V
C109	Electrolytic	100	10V
C110	Electrolytic	470	10V
C111	Barrier Lay	0.047	25V
C112	Electrolytic	0.47 BP	50V
C113	Electrolytic	1	50V
C114	Ceramic	0.0047	50V
C115	Ceramic	0.0047	50V
C116	Electrolytic	4.7	50V
C117	Ceramic	0.0047	50V
C118	Electrolytic	10	16V
C119	Electrolytic	4.7	50V
C120	Ceramic	0.0047	50V

[MAIN UNIT]

REF. NO.	DESCRIPTION	PART NO.	
C121	Electrolytic	470	10V
C122	Electrolytic	10	16V
C123	Electrolytic	10	50V
C124	Barrier Lay	0.047	25V
C125	Electrolytic	10	16V RC2
C127	Barrier Lay	0.1	16V
C128	Ceramic	0.01	50V
C129	Mylar	0.022	50V

J1	Connector	TL-25P-02-V1
J2	Connector	TL-25P-05-V1
J3	Connector	TL-25P-03-V1
J4	Connector	TL-25P-04-V1
J5	Connector	TL-25P-02-V1
J6	Connector	TL-25P-02-V1
J7	Connector	TL-25P-10-V1
J8	Connector	TL-25P-04-V1
J9	Connector	TL-25P-08-V1
J10	Connector	TL-25P-07-V1
J11	Connector	TL-25P-11-V1
J12	Connector	TL-25P-02-V1
J13	Connector	TL-25P-02-V1
J14	Connector	TL-25P-05-V1
J15	Connector	TL-25P-02-V1
J16	Connector	TL-25P-04-V1
J17	Connector	TL-25P-04-V1
J18	Connector	TL-25P-08-V1
J19	Connector	TL-25P-04-V1
J20	Connector	TL-25P-03-V1
J21	Connector	TL-25P-04-V1
J22	Connector	TL-25P-04-V1
J23	Connector	TL-25P-04-V1
J24	Connector	TL-25P-03-V1
J25	Connector	TL-25P-03-V1
J26	Connector	TL-25P-10-V1
J27	Connector	TLB-P04H-B1

S1 Switch SSS312

B1 Main P.C.B. B-775

[RF UNIT]

IC1	Diode Array	ND487C2-3R
IC2	Diode Array	ND487C1-3R
IC3	IC	BA618
IC4	IC	BA618
IC5	IC	M51201L
IC6	IC	TA7124P
FL1	Crystal Filter	70M15B
Q1	Transistor	2SC2053
Q2	FET	2SK241Y
Q3	FET	2SK241GR
Q4	FET	2SK241GR
Q5	Transistor	2SC945 (ALL, RANK)
Q6	Transistor	2SC945P
Q7	Transistor	2SC945P
Q8	Transistor	2SA1015Y
Q9	FET	2SK241Y

[RF UNIT]

REF. NO.	DESCRIPTION	PART NO.
Q10	Transistor	2SC1636
Q11	FET	2SK125
Q12	FET	2SK125
Q13	Transistor	2SB562
Q14	Transistor	2SC945 (ALL, RANK)
Q15	Transistor	2SC945 (ALL, RANK)
Q16	Transistor	2SC2053

D1	Diode	1SS53
D2	Diode	1SS53
D3	Diode	1SS53
D4	Diode	1SS53
D5	Diode	1SS53
D6	Diode	MV-11
D7	Diode	IK60
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	Diode	1SS53
D22	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	1SS53
D34	Diode	1SS53
D35	Diode	1SS53
D36	Diode	1SS53
D37	Zener	RD 8.2 B3
D38	Diode	1SS53
D39	Diode	1SS53
D40	Diode	1SS53
D41	Diode	1SS53
D42	Diode	1SS53

DS1 Lamp RQ031-3043A

L1	Coil	LR-85A
L2	Coil	LS-254
L3	Coil	LS-254
L4	Coil	LS-114
L5	Coil	LR-116
L6	Coil	LR-116
L7	Coil	LS-114
L8	Coil	LS-254
L9	Coil	LS-198
L10	Coil	LS-198
L11	Coil	LS-254

[RF UNIT]		
REF. NO.	DESCRIPTION	PART NO.
L12	Coil	LAL03NAR33M
L13	Coil	LA-235
L14	Coil	LA-236
L15	Coil	LAL03NAR27M
L16	Coil	LAL03NAR33M
L17	Coil	LAL03NAR33M
L18	Coil	LR-116
L19	Coil	LR-116
L20	Coil	LS-232
L21	Coil	LS-232
L22	Coil	LS-266
L23	Coil	LS-136
L24	Coil	LS-226
L25	Coil	FL5H101K
L26	Coil	FL5H101K
L27	Coil	FL5H101K
L28	Coil	FL5H101K
L29	Coil	FL5H101K
L30	Coil	FL5H101K
L31	Coil	FL5H101K
L32	Coil	FL5H101K
L33	Coil	FL5H101K
L34	Coil	FL5H101K
L35	Coil	FL5H101K
L36	Coil	FL5H101K
L37	Coil	FL5H101K
L38	Coil	FL5H101K
L39	Coil	FL5H101K
L40	Coil	FL5H101K
L41	Coil	FL5H101K
L42	Coil	FL5H101K
L43	Coil	FL5H102K
L44	Coil	LAL03NAR33M
L45	Coil	LAL03NAR33M
L46	Coil	LAL03NAR27M
L47	Coil	LAL03NAR33M
L48	Coil	LAL03NAR39M
L49	Coil	LAL03NAR47M
L50	Coil	LAL03NAR47M
L51	Coil	LAL03NAR68M
L52	Coil	LAL03NAR56M
L53	Coil	LAL03NAR68M
L54	Coil	LAL03NAR68M
L55	Coil	LAL03NAR82M
L56	Coil	LAL03NAR68M
L57	Coil	LAL03NAR82M
L58	Coil	LAL03NAR82M
L59	Coil	LAL03NA1R0M
L60	Coil	LAL03NA1R0M
L61	Coil	LAL03NA1R2M
L62	Coil	LAL03NA1R2M
L63	Coil	LAL03NA1R2M
L64	Coil	LAL03NA1R5M
L65	Coil	LAL03NA1R8M
L66	Coil	LAL03NA1R8M
L67	Coil	LAL03NA1R8M
L68	Coil	LAL03NA2R2M
L69	Coil	LAL03NA2R2M
L70	Coil	LAL03NA2R2M
L71	Coil	LAL03NA2R7M
L72	Coil	LAL03NA3R3K
L73	Coil	LAL03NA3R9K
L74	Coil	LAL03NA3R3K
L75	Coil	LAL03NA3R9K

[RF UNIT]		
REF. NO.	DESCRIPTION	PART NO.
L76	Coil	LAL03NA4R7K
L77	Coil	LAL03NA5R6K
L78	Coil	LAL03NA4R7K
L79	Coil	LAL03NA5R6K
L80	Coil	LAL03NA3R9K
L81	Coil	LAL03NA4R7K
L82	Coil	EL0810SK1-101K
L83	Coil	EL0810SK1-101K
L84	Coil	EL0810SK1-101K
L86	Coil	EL0810SK1-101K
L87	Coil	EL0810SK1-3R9K
L88	Coil	EL0810SK1-4R7K
L89	Coil	LR-20
L90	Coil	LR-130
L91	Coil	LR-129
L92	Coil	LB-86A
L93	Coil	LS-163
L94	Coil	LAL04SK101K
R1	Resistor	10K ELR25
R2	Resistor	2.2K R25
R3	Resistor	220 ELR25
R4	Resistor	8.2 ELR25
R5	Resistor	8.2 ELR25
R6	Resistor	150 ELR25
R7	Resistor	15 R25
R8	Resistor	15 R25
R9	Resistor	68 R25
R10	Resistor	1K R25
R11	Resistor	2.2K ELR25
R12	Resistor	100 ELR25
R13	Resistor	2.2K ELR25
R14	Resistor	1.8K ELR25
R15	Resistor	100 ELR25
R16	Resistor	1K R25
R17	Resistor	1.8M ELR25
R18	Resistor	1.8K ELR25
R19	Resistor	1K ELR25
R20	Resistor	2.2K ELR25
R21	Resistor	4.7K R25
R22	Resistor	10K ELR25
R23	Resistor	1K ELR25
R24	Resistor	2.2K ELR25
R25	Resistor	1K ELR25
R26	Resistor	1K ELR25
R27	Resistor	4.7K ELR25
R28	Resistor	470 ELR25
R29	Resistor	100 ELR25
R30	Resistor	47K ELR25
R31	Resistor	10K ELR25
R32	Resistor	22K ELR25
R33	Resistor	10K R25
R34	Resistor	47K ELR25
R35	Resistor	4.7K R25
R36	Resistor	100 R25
R37	Resistor	100 ELR25
R38	Resistor	100 ELR25
R39	Resistor	150 ELR25
R40	Resistor	390 ELR25
R41	Resistor	2.2K ELR25
R42	Resistor	220 ELR25
R43	Resistor	220 ELR25
R44	Resistor	220 ELR25
R45	Resistor	220 ELR25

[RF UNIT]

REF. NO.	DESCRIPTION	PART NO.
R46	Resistor	220 ELR25
R47	Resistor	220 ELR25
R48	Resistor	220 ELR25
R49	Resistor	220 ELR25
R50	Resistor	220 ELR25
R51	Resistor	1K ELR25
R52	Resistor	100 ELR25
R53	Resistor	10K R25
R54	Resistor	10K ELR25
R55	Resistor	10K R25
R56	Resistor	2.2K ELR25
R57	Resistor	4.7K ELR25
R58	Resistor	22 ELR25
R59	Resistor	22 ELR25
R60	Resistor	4.7K ELR25
R61	Resistor	1K ELR25
R62	Resistor	10K ELR25
R63	Resistor	22K R25
R64	Resistor	56 R25
R65	Resistor	47 ELR25
R66	Resistor	5.6K ELR25
R67	Resistor	220 ELR25
R68	Resistor	4.7 R25
R69	Resistor	22K ELR25
R70	Resistor	10K ELR25
R71	Resistor	220 ELR25
R72	Resistor	47 ELR25
R73	Resistor	10 ELR25
R74	Array	RM6-473K
R75	Array	RM8-473K
R76	Resistor	1K ELR25
R77	Resistor	10K R25
R78	Resistor	1K R25
R79	Resistor	100K ELR25
R80	Resistor	680 ELR25
R81	Resistor	100 ELR25
R82	Resistor	680 ELR25
R83	Resistor	100 ELR25
R84	Resistor	1K ELR25
R85	Resistor	1 ELR25
R86	Resistor	68 ELR25
R87	Resistor	220 R10
C1	Ceramic	47P 50V
C2	Ceramic	22P 50V
C3	Ceramic	DD104SL200J50V02 (20P)
C4	Ceramic	470P 50V
C5	Barrier Lay	0.047 25V
C6	Ceramic	DD104SL390J50V02 (39P)
C7	Ceramic	DD104SL070J50V02 (7P)
C8	Ceramic	DD104SL620J50V02 (62P)
C9	Ceramic	DD104SL030J50V02 (3P)
C10	Ceramic	DD104SL390J50V02 (39P)
C11	Ceramic	0.5P 50V
C12	Ceramic	DD104SL080J50V02 (8P)
C13	Ceramic	5P 50V
C14	Ceramic	0.0047 50V
C15	Ceramic	0.001 50V
C16	Ceramic	DD104SL040J50V02 (4P)
C17	Ceramic	0.0047 50V
C19	Electrolytic	2.2 50V
C20	Ceramic	0.0047 50V
C21	Ceramic	0.0047 50V
C22	Ceramic	0.0047 50V

[RF UNIT]

REF. NO.	DESCRIPTION	PART NO.
C23	Ceramic	5P 50V
C24	Ceramic	0.0047 50V
C25	Ceramic	0.0047 50V
C26	Ceramic	0.001 50V
C27	Ceramic	5P 50V
C28	Ceramic	0.0047 50V
C29	Ceramic	0.001 50V
C30	Ceramic	DD104SL020J50V02 (2P)
C31	Ceramic	DD104SL080J50V02 (8P)
C32	Ceramic	0.0047 50V
C33	Ceramic	0.0047 50V
C34	Ceramic	DD104SL200J50V02 (20P)
C35	Ceramic	68P 50V
C36	Ceramic	DD104SL180J50V02 (18P)
C37	Ceramic	10P 50V
C38	Ceramic	DD104SL030J50V02 (3P)
C39	Ceramic	DD104SL390J50V02 (39P)
C40	Ceramic	DD105SL121J50V02 (120P)
C41	Ceramic	100P 50V
C42	Ceramic	68P 50V
C43	Ceramic	47P 50V
C44	Ceramic	DD104SL430J50V02 (43P)
C45	Ceramic	0.0047 50V
C47	Ceramic	0.0047 50V
C48	Ceramic	68P 50V
C49	Ceramic	330P 50V
C50	Ceramic	DD104SL560J50V02 (56P)
C51	Ceramic	0.0047 50V
C52	Ceramic	0.01 50V
C53	Electrolytic	10 16V
C54	Ceramic	DD104SL560J50V02 (56P)
C55	Ceramic	330P 50V
C56	Ceramic	0.0047 50V
C57	Electrolytic	10 16V
C58	Ceramic	0.0047 50V
C59	Ceramic	100P 50V
C60	Ceramic	0.0047 50V
C61	Ceramic	0.0047 50V
C62	Ceramic	0.0047 50V
C63	Ceramic	0.0047 50V
C64	Ceramic	0.0047 50V
C65	Electrolytic	0.47 50V
C67	Ceramic	0.0047 50V
C68	Ceramic	0.0047 50V
C69	Ceramic	100P 50V
C70	Ceramic	220P 50V
C71	Barrier Lay	RAU08SA821K (820P)
C72	Ceramic	DD104SL240J50V02 (24P)
C73	Ceramic	47P 50V
C74	Ceramic	100P 50V
C75	Ceramic	33P 50V
C76	Ceramic	0.0047 50V
C77	Ceramic	0.0047 50V
C78	Ceramic	DD106SL181J50V02 (180P)
C79	Ceramic	DD108SL391J50V02 (390P)
C80	Barrier Lay	UAT05X103K (0.01)
C81	Ceramic	DD104SL121J50V02 (120P)
C82	Ceramic	33P 50V
C83	Ceramic	DD106SL181J50V02 (180P)
C84	Barrier Lay	0.047 25V
C85	Barrier Lay	0.047 25V
C86	Barrier Lay	0.047 25V
C87	Barrier Lay	0.047 25V
C88	Ceramic	0.0047 50V

[RF UNIT]

REF. NO.	DESCRIPTION	PART NO.
C89	Ceramic	0.0047 50V
C90	Ceramic	0.0047 50V
C91	Ceramic	220P 50V
C92	Barrier Lay	UAT04X102K (0.001)
C93	Barrier Lay	UAT04X222K (0.0022)
C94	Ceramic	220P 50V
C95	Ceramic	DD104SL240J50V02 (24P)
C96	Ceramic	DD107SL271J50V02 (270P)
C97	Ceramic	0.0047 50V
C98	Barrier Lay	0.047 25V
C99	Ceramic	330P 50V
C100	Ceramic	DD109SL471J50V02 (470P)
C101	Barrier Lay	UAT05X272K (0.0027)
C102	Ceramic	DD107SL301J50V02 (300P)
C103	Ceramic	DD104SL390J50V02 (39P)
C104	Ceramic	DD109SL471J50V02 (470P)
C105	Barrier Lay	0.047 25V
C106	Barrier Lay	0.047 25V
C107	Ceramic	DD107SL301J50V02 (300P)
C108	Ceramic	DD109SL511J50V02 (510P)
C109	Barrier Lay	UAT05X332K (0.0033)
C110	Ceramic	DD109SL511J50V02 (510P)
C111	Ceramic	47P 50V
C112	Barrier Lay	RAU06SA561K (560P)
C113	Barrier Lay	0.047 25V
C114	Barrier Lay	0.047 25V
C115	Barrier Lay	RAU06SA561K (560P)
C116	Barrier Lay	UAT04X122K (0.0012)
C117	Barrier Lay	UAT06X562K (0.0056)
C118	Ceramic	DD108SL391J50V02 (390P)
C119	Ceramic	100P 50V
C120	Ceramic	DD109SL511J50V02 (510P)
C121	Barrier Lay	0.047 25V
C122	Barrier Lay	0.1 16V
C123	Barrier Lay	RAU08SA821K (820P)
C124	Barrier Lay	UAT04X182K (0.0018)
C125	Barrier Lay	UAT05X682K (0.0068)
C126	Barrier Lay	RAU08SA821K (820P)
C127	Ceramic	150P 50V
C128	Ceramic	DD108SL391J50V02 (390P)
C129	Barrier Lay	0.1 16V
C130	Barrier Lay	0.1 16V
C131	Barrier Lay	UAT04X122K (0.0012)
C132	Barrier Lay	UAT05X272K (0.0027)
C133	Barrier Lay	UAT05X103K (0.01)
C134	Barrier Lay	UAT04X152K (0.0015)
C135	Ceramic	DD105SL121J50V02 (120P)
C136	Barrier Lay	UAT04X152K (0.0015)
C137	Barrier Lay	0.1 16V
C138	Barrier Lay	0.1 16V
C139	Barrier Lay	UAT04X152K (0.0015)
C140	Barrier Lay	UAT04X182K (0.0018)
C141	Barrier Lay	UAT08X123K (0.012)
C142	Barrier Lay	UAT04X122K (0.0012)
C143	Ceramic	220P 50V
C144	Barrier Lay	UAT05X272K (0.0027)
C145	Barrier Lay	0.1 16V
C146	Barrier Lay	UAT04X222K (0.0022)
C147	Barrier Lay	UAT05X332K (0.0033)
C148	Barrier Lay	UAT04X222K (0.0022)
C149	Ceramic	DD109SL471J50V02 (470P)
C150	Ceramic	DD106SL181J50V02 (180P)
C151	Barrier Lay	0.047 25V
C152	Barrier Lay	0.047 25V

[RF UNIT]

REF. NO.	DESCRIPTION	PART NO.
C153	Ceramic	DD104SL030J50V02 (3P)
C154	Barrier Lay	0.1 16V
C155	Electrolytic	10 16V
C156	Barrier Lay	0.047 25V
C157	Ceramic	0.0047 50V
C158	Ceramic	0.0047 50V
C159	Barrier Lay	0.1 16V
C160	Array	B7ZC0711-32N (0.01x6)
C161	Array	B7ZC0711-32N (0.01x6)
C162	Array	B8ZC0111-32N (0.0082x7)
C163	Array	B8ZC0111-32N (0.0082x7)
C164	Ceramic	0.0047 50V
C165	Ceramic	0.0047 50V
C166	Barrier Lay	0.1 16V
C167	Barrier Lay	6.1 16V
C168	Barrier Lay	0.047 25V
C169	Ceramic	0.0047 50V
C170	Ceramic	5P 50V
C171	Ceramic	0.0047 50V
C172	Electrolytic	2.2 50V
C173	Ceramic	0.0047 50V
C174	Ceramic	0.0047 50V
C176	Ceramic	0.0047 50V
C177	Barrier Lay	UAT04X102K (0.001)
C178	Barrier Lay	RAU08SA821K (820P)
C179	Barrier Lay	UAT04X102K (0.001)
C180	Barrier Lay	UAT08X153K (0.015)
C181	Barrier Lay	UAT05X682K (0.0068)
C182	Ceramic	DD104SL270J50V02 (27P)
C183	Barrier Lay	UAT04X152K (0.0015)
C184	Barrier Lay	0.047 25V

RL1	Relay	FBR221D012
RL2	Relay	FBR211BD009-M

J1	Connector	RT-0.1T-1.3B
J2	Connector	RT-0.1T-1.3B
J3	Connector	TL-25P-03-V1
J4	Connector	TL-25P-08-V1
J5	Connector	TL-25P-02-V1
J6	Connector	TL-25P-05-V1
J7	Connector	TL-25P-07-V1
J8	Connector	TLB-P13H-B1
J9	Connector	TL-25P-04-V1
J10	Connector	TL-25P-05-V1
J11	Connector	TMP-J01X-A1
J12	Connector	TL-25P-02-V1
J13	Connector	TL-25P-02-V1

B1	RF P.C.B	B-777
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P1	Connector	TMP-P01X-A1
P2	Connector	TMP-P01X-A1
P3	Connector	TL-25H-02-B1

[PA UNIT]

Q1	Transistor	2SC1971
Q2	Transistor	2SC3133
Q3	Transistor	2SC3133
Q4	Transistor	2SC2904

[PA UNIT]

REF NO.	DESCRIPTION	PART NO.	
Q5	Transistor	2SC2904	
Q6	Transistor	2SD313	
Q7	Transistor	2SC2120	
D1	Varistor	MV5	
D2	Varistor	MV5W	
D3	Diode	1N4002	
D4	Diode	1N4002	
D5	Diode	15CD11	
L1	Coil	LR-142	
L2	Coil	FL5H 1R2	
L3	Coil	FL5H 1R2	
L4	Coil	LR-143	
L5	Coil	FSQH050RN	
L6	Coil	BT01RN1-A61	
L7	Coil	FSQH050RN	
L8	Coil	BT01RN1-A61	
L9	Coil	LR-83	
L10	Coil	LR-144	
L11	Coil	LR-146	
L12	Coil	FL5H101	
L13	Coil	FSQH050RN	
L14	Coil	BT01RN1-A61	
L15	Coil	FSQH050RN	
L16	Coil	BT01RN1-A61	
L17	Coil	FSQH050RN	
L18	Coil	BT01RN1-A61	
L19	Coil	FL5H 101	
L20	Coil	FL7H 222J	
L21	Coil	FL5H 221K	
L22	Coil	FL5H 102K	
L23	Coil	FL5H 101K	
L24	Coil	LAL04NA101K	
L25	Coil	LW-22	
R1	Resistor	220	R25
R2	Resistor	100	R25
R3	Resistor	470	R25
R4	Resistor	2.2	R25
R5	Resistor	4.7	R25
R6	Resistor	68	ELR25
R7	Resistor	22	ELR25
R8	Resistor	22	ELR25
R9	Resistor	68	ELR25
R10	Resistor	2.2	1W
R11	Resistor	2.2	1W
R12	Resistor	2.2	1W
R13	Resistor	2.2	1W
R14	Resistor	10	R50X
R15	Resistor	10	R50X
R16	Resistor	3.3	1W
R17	Resistor	3.3	1W
R18	Resistor	33K	R25
R19	Resistor	1K	R25
R20	Resistor	0.012	5W SQ SL
R21	Resistor	1K	R25
R22	Resistor	4.7	2W R2J
R23	Resistor	470	H0651A
R24	Resistor	150	R25
R25	Resistor	0.1	1W SRW1P
R26	Resistor	10K	ELR25
R27	Resistor	100	H0651A
R28	Resistor	68	R50X

[PA UNIT]

REF NO.	DESCRIPTION	PART NO.	
R29	Resistor	10	ELR25
R30	Resistor	1.8	ELR25
R31	Resistor	22	ELR25
R32	Resistor	100	R50X
R33	Resistor	2.2K	ELR25
R34	Resistor	120	R50X
R35	Serge Absorber	DSA301	
R36	Resistor	220	R50X
C1	Ceramic	0.0022	50V
C2	Barrier Lay	0.0012	50V
C3	Barrier Lay	0.1	16V
C4	Mylar	0.01	50V
C5	Mylar	0.01	50V
C6	Cylinder	100P	50V
C7	Monolithic	470P	50V
C8	Monolithic	6800P	50V
C9	Monolithic	6800P	50V
C10	Barrier Lay	560P	50V
C12	Monolithic	470P	50V
C13	Monolithic	1000P	50V
C14	Dip Mica	DM19 560P 500V	1CR
C15	Ceramic	47P	500V
C16	Dip Mica	4700P	500V
C17	Barrier Lay	0.047	25V
C18	Electrolytic	ECEA16Z470	
C19	Monolythic	0.68	25V
C20	Barrier Lay	0.047	25V
C21	Electrolytic	47	10V
C22	Electrolytic	10	16V
C23	Barrier Lay	0.047	25V
C24	Barrier Lay	0.047	25V
C25	Electrolytic	470	16V
C26	Barrier Lay	0.047	25V
C27	Electrolytic	10	16V
C28	Barrier Lay	0.1	16V
C29	Ceramic	0.0047	50V
C30	Barrier Lay	0.047	25V
C31	Barrier Lay	0.1	16V
C32	Barrier Lay	0.047	25V
C33	Barrier Lay	0.047	25V
C34	Barrier Lay	0.047	25V
C35	Barrier Lay	0.047	25V
C36	Barrier Lay	0.047	25V
C37	Ceramic	0.0047	50V
C38	Feed Through	TF318-452E102GMV(0.001)	
C39	Feed Through	TF318-452E102GMV(0.001)	
C40	Feed Through	TF318-452E102GMV(0.001)	
C41	Feed Through	TF318-452E102GMV(0.001)	
C42	Barrier Lay	0.047	25V
C43	Barrier Lay	0.047	25V
C44	Barrier Lay	0.1	25V
C45	Ceramic	DD31-0-SL180P 500V 02	
C46	Ceramic	DD31-0-SL180P 500V 02	
RL1	Relay	FBR621D009	
J1	Connector	MR-DS	
J2	Connector	TMP-J01X-V1	
J3	Connector	KC21-0060	
J4	Connector	LLR-6	
P1	Connector	TMP-P01X-A1	
P2	Connector	TMP-P01X-A1	

[PA UNIT]

REF. NO.	DESCRIPTION	PART NO.
P3	Connector	TL25H-05-B1
P4	Connector	TL25H-04-B1
P5	Connector	TL25H-02-B1
P6	Connector	TL25H-02-B1
P7	Connector	1545R-1
F1	Fuse Holder	TFH-S30
S1	Thermal Switch	OHD-90M
S2	Thermal Switch	OHD-50M
MF1	DC Motor	M6B 12U22
B1	PA P.C.B	B-720A
B2	Connector P.C.B	B-781

[FILTER UNIT]

D1	Diode	1K60
D2	Diode	1K60
D3	Diode	1SS53
D4	Diode	1SS53
D5	Diode	1SS53
D6	Diode	1SS53
D7	Diode	1SS53
D8	Diode	1SS53
D9	Diode	1SS53
L1	Coil	LR-47
L2	Coil	LR-48
L3	Coil	LR-49
L4	Coil	LR-50
L5	Coil	LR-52
L6	Coil	LR-51
L7	Coil	LR-90
L8	Coil	LR-91
L9	Coil	LR-53
L10	Coil	LR-54
L11	Coil	LA-166
L12	Coil	LA-165
L13	Coil	LA-168
L14	Coil	LA-167
L15	Coil	LR-22A
L16	Coil	FL7H222J
L17	Coil	FL5H101
L18	Coil	FL5H101
L19	Coil	FL5H101
L20	Coil	FL5H101
L21	Coil	FL5H101
L22	Coil	FL5H101
L23	Coil	FL5H101
L24	Coil	FL5H101
L25	Coil	FL5H100
L26	Coil	FL5H100
L27	Coil	FL5H100
L28	Coil	FL5H100
L29	Coil	FL5H100
L30	Coil	FL5H100
L32	Coil	LA-24
R1	Resistor	68 R25

[FILTER UNIT]

REF. NO.	DESCRIPTION	PART NO.
R2	Resistor	47K R25
R3	Resistor	47K R25
R4	Resistor	12K ELR25
R5	Resistor	12K ELR25
C1	Dip Mica	DM20 1200P 500V 1CR
C2	Ceramic	DD31-0-SL150P 500V 02
C3	Dip Mica	DM20 2200P 500V 1CR
C4	Dip Mica	DM19 390P 500V 1CR
C5	Dip Mica	DM20 1000P 500V 1CR
C6	Dip Mica	DM19 680P 500V 1CR
C7	Ceramic	DD31-0-82P 500V 02
C8	Dip Mica	DM19 1200P 500V 1CR
C9	Ceramic	DD31-2-SL220P 500V 02
C10	Dip Mica	DM19 680P 500V 1CR
C11	Ceramic	DD31-4-SL 300P 500V 02
C12	Ceramic	DD38-0-SL 100P 500V 02
C13	Dip Mica	DM19 680P 500V 1CR
C14	Ceramic	DD35-0-SL39P 500V 02
C15	Ceramic	DD31-4-SL330P 500V 02
C16	Ceramic	DD31-2-SL220P 500V 02
C17	Ceramic	DD38-0-SL47P 500V 02
C18	Dip Mica	DM19 470P 500V 1CR
C19	Ceramic	DD38-0-SL82P 500V 02
C20	Ceramic	DD31-2-SL220P 500V 02
C21	Ceramic	DD31-2-SL150P 500V 02
C22	Ceramic	DD35-0-SL24P 500V 02
C23	Ceramic	DD31-4-SL330P 500V 02
C24	Ceramic	DD36-0-SL56P 500V 02
C25	Ceramic	DD31-2-SL150P 500V 02
C26	Ceramic	DD31-2-SL150P 500V 02
C27	Ceramic	DD35-0-SL10P 500V 02
C28	Ceramic	DD31-2-SL220P 500V 02
C29	Ceramic	DD35-0-SL33P 500V 02
C30	Ceramic	DD38-0-SL100P 500V 02
C31	Ceramic	DD38-0-SL82P 500V 02
C32	Ceramic	DD35-0-SL10P 500V 02
C33	Ceramic	DD31-0-SL180P 500V 02
C34	Ceramic	DD35-0-SL27P 500V 02
C35	Ceramic	DD38-0-SL68P 500V 02
C36	Trimmer	ECV-1ZW 20 x 40
C37	Ceramic	220P 50V
C38	Ceramic	100P 50V
C39	Ceramic	100P 50V
C40	Ceramic	100P 50V
C41	Ceramic	100P 50V
C42	Barrier Lay	0.047 25V
C43	Barrier Lay	0.047 25V
C44	Barrier Lay	0.047 25V
C45	Barrier Lay	0.047 25V
C46	Barrier Lay	0.047 25V
C47	Barrier Lay	0.047 25V
C48	Barrier Lay	0.047 25V
C49	Barrier Lay	0.047 25V
C50	Ceramic	0.0047 50V
C51	Ceramic	0.0047 50V
C52	Ceramic	0.0047 50V
C53	Ceramic	0.0047 50V
C54	Ceramic	0.0047 50V
C55	Ceramic	0.0047 50V
RL1	Relay	FBR211BD012-M
RL2	Relay	FBR211BD012-M
RL3	Relay	FBR211BD012-M

[FILTER UNIT]

REF. NO.	DESCRIPTION	PART NO.
RL4	Relay	FBR211BD012-M
RL5	Relay	FBR211BD012-M
RL6	Relay	FBR211BD012-M
RL7	Relay	FBR211BD012-M
RL8	Relay	FBR211BD012-M
RL9	Relay	FBR211BD012-M
RL10	Relay	FBR211BD012-M
RL11	Relay	FBR211BD012-M
RL12	Relay	FBR211BD012-M
RL13	Relay	FBR211BD012-M
RL14	Relay	FBR211BD012-M
B1	Filter P.C.B	B-763
J1	Connector	TMP-J01X-V1
J3	Connector	TL-25P-03-V1
P1	Connector	TL-25H-07-A1
P2	Connector	TMP-J01X-A1

[PLL UNIT]

IC1	IC	M54929P
IC2	IC	M54466L
IC3	IC	μPC1037H
IC4	IC	μPC1037H
IC5	IC	SN74LS90N
IC7	IC	TA78L008AP
IC8	IC	7805
Q1	Transistor	2SC945P
Q2	Transistor	2SC945P
Q3	Transistor	2SC945P
Q4	Transistor	2SC945P
Q5	FET	2SK30A-Y
Q6	FET	2SK30A-Y
Q7	Transistor	2SC1571G
Q8	Transistor	2SA1015Y
Q9	Transistor	2SC945P
Q10	Transistor	2SC945R
Q11	Transistor	2SC383TM
Q15	FET	2SK241-Y
Q16	Transistor	2SC383TM
Q17	Transistor	2SC383TM
Q18	FET	2SK192A-GR
Q19	FET	2SK192A-GR
Q20	FET	2SK192A-GR
Q21	FET	2SK192A-GR
Q22	Transistor	2SC383TM
Q23	Transistor	2SC383TM
Q24	Transistor	2SC945P
Q25	Transistor	2SC383TM
Q26	Transistor	2SC383TM
D2	Zener	RD 5.1E B2
Q4	Diode	1SS53
D5	Diode	1SS53
D7	Diode	1SS53
D8	Diode	1SS53
D9	Diode	1SS53
D10	Diode	1SS53

[PLL UNIT]

REF. NO.	DESCRIPTION	PART NO.
D11	Diode	1SS53
D12	Varactor Diode	FC52M
D13	Varactor Diode	1SV50-E
D14	Varactor Diode	1SV50-E
D15	Varactor Diode	1SV50-E
D16	Diode	1SS53
D17	Diode	1SS53
D18	Diode	1SS53
D19	Diode	1SS53
D20	Zener	RD 5.1 B2
L1	Choke	LW-19
L2	Coil	LS-94
L6	Choke	LAL04NA102K
L7	Choke	EL0810SKI-101
L8	Coil	LS-162
L9	Coil	LA-244
L10	Coil	LA-254
L11	Choke	LB4 R36
L12	Choke	LB4 R23
L13	Choke	LW-17
L14	Choke	FL5H101K
L15	Choke	FL5H101K
L16	Choke	LR-79
L17	Coil	LB-135
L18	Choke	LW-19
L19	Choke	LR-79
L20	Coil	LB-135
L21	Choke	LW-19
L22	Choke	LR-79
L23	Coil	LB-135
L24	Choke	LW-19
L25	Choke	LR-79
L26	Coil	LB-135
L27	Choke	LW-19
L28	Choke	BT01RN1-A61
L29	Choke	LAL03NAR56M
R2	Resistor	2.2K ELR25
R3	Resistor	4.7K ELR25
R4	Resistor	10K ELR25
R5	Resistor	470 ELR25
R6	Resistor	220 ELR25
R7	Resistor	47 R25
R8	Resistor	47 ELR25
R9	Resistor	100 ELR25
R10	Resistor	15K ELR25
R11	Resistor	1K R25
R12	Resistor	470 ELR25
R21	Resistor	8.2K R25
R22	Resistor	1K R25
R24	Resistor	100 ELR25
R25	Resistor	100 ELR25
R26	Resistor	470 ELR25
R27	Resistor	220 ELR25
R28	Resistor	100 ELR25
R29	Resistor	47 ELR25
R30	Resistor	3.3K ELR25
R31	Resistor	47K ELR25
R32	Resistor	10K ELR25
R33	Resistor	10K ELR25
R34	Resistor	220 ELR25
R35	Resistor	220 ELR25
R37	Resistor	2.7K ELR25

[PLL UNIT]

REF. NO.	DESCRIPTION	PART NO.
R38	Resistor	390 ELR25
R39	Resistor	1K R25
R40	Resistor	4.7K ELR25
R41	Resistor	1.8M ELR25
R42	Resistor	1K ELR25
R43	Resistor	1.2K ELR25
R44	Resistor	4.7K ELR25
R45	Resistor	1K R25
R46	Resistor	4.7K R25
R47	Resistor	100 R25
R48	Resistor	2.2K ELR25
R49	Resistor	2.2K ELR25
R50	Resistor	10K ELR25
R52	Resistor	27K ELR25
R53	Resistor	22K ELR25
R54	Resistor	22K ELR25
R55	Resistor	47K ELR25
R56	Resistor	100K ELR25
R57	Resistor	100K ELR25
R58	Resistor	150 ELR25
R59	Resistor	3.3K ELR25
R60	Resistor	100K ELR25
R61	Resistor	100K ELR25
R62	Resistor	150 ELR25
R63	Resistor	3.3K ELR25
R64	Resistor	100K ELR25
R65	Resistor	100K ELR25
R66	Resistor	150 ELR25
R67	Resistor	3.3K ELR25
R68	Resistor	100K ELR25
R69	Resistor	100K ELR25
R70	Resistor	150 ELR25
R71	Resistor	3.3K ELR25
R72	Resistor	180 ELR25
R73	Resistor	33 ELR25
R74	Resistor	4.7K ELR25
R75	Resistor	220 ELR25
R76	Resistor	330 ELR25
R77	Resistor	22 ELR25
R78	Resistor	220 ELR25
R79	Resistor	22K ELR25
R80	Resistor	100 ELR25
R81	Resistor	560 ELR25
R82	Resistor	10K ELR25
R83	Resistor	47K ELR25
R84	Resistor	10K ELR25
R85	Resistor	220 ELR25
R86	Resistor	10K ELR25
R87	Resistor	100 ELR25
R88	Resistor	100 R25
R89	Resistor	220 ELR25
R90	Resistor	22K ELR25
R91	Resistor	10K ELR25
R92	Resistor	470 ELR25
R93	Resistor	47 ELR25
R94	Resistor	10K R25
R95	Resistor	10K R25
R96	Resistor	10K R25
R97	Resistor	10K R25
R98	Resistor	47K R25
R99	Resistor	47K R25
R100	Resistor	SRW 1P 10
R101	Resistor	120 R50
R103	Resistor	47 ELR25

[PLL UNIT]

REF. NO.	DESCRIPTION	PART NO.
R109	Resistor	3.3K ELR25
C3	Ceramic	47P CH 50V
C4	Ceramic	0.0047 50V
C5	Electrolytic	10 16V
C6	Ceramic	82P TH 50V
C7	Ceramic	0.0047 50V
C8	Ceramic	82P TH 50V
C9	Ceramic	10P 50V
C11	Ceramic	47P 50V
C12	Ceramic	100P 50V
C27	Barrier Lay	0.047 25V
C29	Ceramic	470P 50V
C30	Ceramic	470P 50V
C31	Barrier Lay	0.1 16V
C32	Ceramic	0.0047 50V
C33	Electrolytic	47 10V
C34	Ceramic	0.0047 50V
C35	Ceramic	6P 50V
C36	Ceramic	6P 50V
C37	Ceramic	0.0047 50V
C39	Ceramic	47P 50V
C40	Ceramic	0.0047 50V
C41	Ceramic	0.001 50V
C42	Ceramic	0.0047 50V
C43	Ceramic	43P 50V
C44	Ceramic	51P 50V
C45	Ceramic	82P 50V
C46	Ceramic	15P 50V
C47	Ceramic	62P 50V
C48	Ceramic	150P 50V
C49	Ceramic	120P 50V
C50	Ceramic	56P 50V
C51	Ceramic	330P 50V
C52	Ceramic	68P 50V
C53	Ceramic	150P 50V
C54	Ceramic	0.0047 50V
C55	Ceramic	0.0047 50V
C56	Ceramic	0.001 50V
C57	Ceramic	0.0047 50V
C58	Ceramic	0.0022 50V
C59	Ceramic	0.0047 50V
C60	Ceramic	0.0047 50V
C62	Ceramic	0.0047 50V
C63	Ceramic	0.0047 50V
C64	Electrolytic	47 10V
C65	Array	B7ZC0717-32N (470Px6)
C66	Electrolytic	47 10V
C67	Barrier Lay	0.047 25V
C68	Barrier Lay	0.1 16V
C69	Ceramic	0.001 50V
C70	Ceramic	0.001 50V
C71	Electrolytic	1 50V
C72	Electrolytic	100 10V
C73	Ceramic	0.0047 50V
C74	Barrier Lay	0.047 25V
C75	Electrolytic	0.47 50V B.P
C76	Ceramic	56P 50V
C77	Ceramic	24P 50V
C78	Trimmer	CTZ51C
C79	Ceramic	56P CH 50V
C80	Ceramic	12P CH 50V
C81	Ceramic	12P CH 50V
C82	Ceramic	0.0047 50V

[PLL UNIT]

REF. NO.	DESCRIPTION	PART NO.	
C83	Ceramic	1P	50V
C84	Ceramic	0.0047	50V
C85	Barrier Lay	0.047	25V
C86	Ceramic	56P	50V
C87	Ceramic	15P	50V
C88	Trimmer	CTZ51C	
C89	Ceramic	47P CH	50V
C90	Ceramic	12P CH	50V
C91	Ceramic	12P CH	50V
C92	Ceramic	0.0047	50V
C93	Ceramic	1P	50V
C94	Ceramic	0.0047	50V
C95	Ceramic	47P	50V
C96	Ceramic	10P	50V
C97	Trimmer	CTZ51A	
C98	Ceramic	47P CH	50V
C99	Ceramic	12P CH	50V
C100	Ceramic	8P CH	50V
C101	Ceramic	0.0047	50V
C102	Ceramic	1P	50V
C103	Ceramic	0.0047	50V
C104	Barrier Lay	0.047	25V
C105	Ceramic	39P	50V
C106	Ceramic	7P	50V
C107	Trimmer	CTZ51A	
C108	Ceramic	33P CH	50V
C109	Ceramic	12P CH	50V
C110	Ceramic	5P CH	50V
C111	Ceramic	0.0047	50V
C112	Ceramic	1P	50V
C113	Ceramic	0.0047	50V
C114	Barrier Lay	0.047	25V
C115	Electrolytic	100	10V
C116	Ceramic	0.0047	50V
C117	Ceramic	22P	50V
C118	Ceramic	22P	50V
C119	Ceramic	47P	50V
C120	Ceramic	0.0047	50V
C121	Ceramic	0.0047	50V
C122	Ceramic	0.001	50V
C123	Ceramic	0.0047	50V
C124	Ceramic	5P	50V
C125	Ceramic	0.001	50V
C126	Ceramic	0.0047	50V
C127	Ceramic	47P	50V
C128	Electrolytic	47	10V
C129	Electrolytic	100	16V
C130	Ceramic	0.0047	50V
C131	Ceramic	0.0047	50V
C132	Electrolytic	47	10V
C133	Ceramic	0.001	50V
C134	Ceramic	0.001	50V
C135	Ceramic	0.001	50V
C136	Ceramic	0.001	50V
C137	Electrolytic	10	16V
C139	Ceramic	0.0047	50V
C140	Ceramic	0.0047	50V
C141	Ceramic	0.0047	50V
C142	Ceramic	0.0047	50V
C143	Ceramic	0.0047	50V
C146	Ceramic	100P	50V
C147	Ceramic	5P	50V
J1	Connector	TL25P-05-V1	

[PLL UNIT]

REF. NO.	DESCRIPTION	PART NO.	
J2	Connector	5138-11CPB	
J3	Connector	5138-04CPB	
J4	Connector	TMP-J01X-V1	
X1	Crystal	CR-21 (30.72MHz)	
F11	Crystal Filter	FL-69 (30M15A)	
B1	PLL P.C.B	B-704C	
[PLL SUB LOOP]			
IC201	IC	M54929P	
IC202	IC	M54466L	
IC203	IC	SN74LS90N	
IC204	IC	M54459L	
Q201	FET	2SK192A-GR	
Q202	Transistor	2SC763C	
D201	Varactor Diode	1SV50-E	
L201	Coil	LB-133	
L202	Choke	LW-19	
L203	Choke	FL5H 101K	
L204	Choke	LAL04NA 101K	
L205	Choke	LAL04NA 101K	
R201	Resistor	10K	ELR25
R202	Resistor	1K	R25
R203	Resistor	2.7K	ELR25
R204	Resistor	33K	ELR25
R205	Resistor	10K	ELR25
R206	Resistor	470K	ELR25
R207	Resistor	470K	ELR25
R208	Resistor	180	ELR25
R209	Resistor	150	ELR25
R210	Resistor	5.6K	ELR25
R211	Resistor	1.2K	ELR25
R212	Resistor	330	ELR25
R213	Resistor	150	R25
R214	Resistor	4.7K	R25
R215	Resistor	2.2K	R25
R216	Resistor	2.7K	ELR25
R217	Resistor	2.7K	ELR25
R218	Resistor	390	ELR25
C201	Array	B7ZC0717-32N	
C202	Electrolytic	0.22	50V RC2
C203	Barrier Lay	0.047	25V
C204	Ceramic	0.0022	50V
C205	Ceramic	0.001	50V
C206	Electrolytic	47	10V
C207	Ceramic	39P	50V (UJ)
C208	Ceramic	22P	50V
C209	Ceramic	4P	50V
C210	Ceramic	4P	50V
C211	Electrolytic	47	10V
C212	Ceramic	0.0022	50V
C213	Ceramic	1P	50V
C214	Ceramic	0.0047	50V

[PLL SUB LOOP]

REF. NO.	DESCRIPTION	PART NO.
C215	Ceramic	0.001 50V
C216	Ceramic	47P 50V
C217	Ceramic	0.0022 50V
C218	Ceramic	0.0047 50V
C219	Barrier Lay	0.047 25V
C220	Ceramic	470P 50V
C221	Ceramic	0.0047 50V
C222	Ceramic	0.001 50V
C223	Electrolytic	47 10V
C224	Ceramic	0.0047 50V
C225	Ceramic	0.0047 50V
C226	Ceramic	0.0047 50V
C227	Ceramic	0.0047 50V

[LOGIC UNIT]

IC1	IC	μA78M05
IC2	IC	RP5G01 007
IC3	IC	μPD7801G 114
IC5	IC	SN74LS32N
IC6	IC	SN74LS02N
IC7	IC	4013B
IC8	IC	TC4528BP
IC9	IC	SN74LS377N
IC10	IC	SN74LS11N
IC11	IC	SN74LS175N
IC12	IC	BA618
IC13	IC	BA618
IC14	IC	M50780SP
IC15	IC	BA618
IC16	IC	DAN401
IC17	IC	SN74LS08N
IC18	IC	SN74LS08N
Q1	Transistor	2SA1048Y
Q2	Transistor	2SA1048Y
Q3	Transistor	2SA1048Y
Q4	Transistor	2SC2458GR
Q5	Transistor	2SC2458GR
D1	Diode	1SS53
D2	Diode	1SS53
D3	Diode	1SS53
D6	Diode	1SS53
D7	Diode	1SS53
D8	Diode	1SS53
D9	Diode	1SS53
D10	Diode	1SS53
D12	Diode	1SS53
D13	Diode	1SS53
D15	Diode	1SS53
D16	Diode	1SS53
D17	Diode	1SS53
D18	Diode	1SS53
D19	Diode	1SS53
D20	Diode	1SS53
D21	Diode	1SS53
D22	Diode	1SS53
D23	Diode	1SS53
D24	Diode	1SS53
D25	Diode	1SS53

[LOGIC UNIT]

REF. NO.	DESCRIPTION	PART NO.
D26	Diode	1SS53
D27	Diode	1SS53
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
D37	Zener	RD8.2 EBI
X1	Ceramic Unit	CSA400MT
R1	Resistor	4.7K ELR25
R2	Resistor	47K R25
R3	Resistor	10K ELR25
R4	Resistor	47K ELR25
R5	Resistor	470 ELR25
R6	Array	RM-4 104
R7	Resistor	120K ELR25
R8	Resistor	10K R25
R10	Resistor	47K R25
R11	Resistor	3.3M ELR25
R12	Resistor	1M ELR25
R13	Resistor	33 ELR25
R14	Trimmer	1M H1051C
R15	Resistor	220K ELR25
R16	Resistor	47K ELR25
R17	Resistor	1M R25
R18	Resistor	1M R25
R19	Resistor	47K R25
R20	Resistor	10 R50
R21	Resistor	10K R25
R22	Array	RM-8 472
R23	Resistor	68K ELR25
R24	Resistor	4.7K ELR25
R25	Resistor	10K R25
R26	Resistor	1K ELR25
R27	Array	RM-4 472
R28	Resistor	47K ELR25
R29	Resistor	750 CRB25FX
R30	Resistor	1.8K CRB25FX
R31	Resistor	3.3K CRB25FX
R32	Resistor	5.6K CRB25FX
R33	Resistor	10K CRB25FX
R34	Resistor	4.7K CRB25FX
R35	Resistor	1K R25
R36	Resistor	1K R25
R37	Resistor	1K R25
R38	Resistor	1K R25
R39	Resistor	1K R25
R40	Resistor	1K R25
R41	Resistor	1K R25
R42	Resistor	1K R25
R43	Resistor	1K R25
R44	Resistor	1K R25
R45	Resistor	1K R25
R46	Resistor	1K R25
R47	Resistor	1K R25
R48	Resistor	1K R25
R49	Resistor	1K R25
R50	Resistor	1K R25

[LOGIC UNIT]

REF. NO.	DESCRIPTION	PART NO.	
R51	Resistor	1K	R25
R52	Resistor	100	R25
R54	Resistor	1.2K	R25
R55	Resistor	10K	R25
R56	Resistor	10K	R25
R57	Resistor	220	ELR25
C1	Electrolytic	33	16V
C2	Barrier Lay	0.1	16V
C3	Barrier Lay	0.1	16V
C4	Electrolytic	47	10V
C5	Electrolytic	1	50V
C6	Barrier Lay	0.1	16V
C7	Mylar	0.0022	50V
C8	Mylar	0.001	50V
C9	Mylar	0.001	50V
C10	Barrier Lay	0.1	16V
C11	Ceramic	33P	50V
C12	Ceramic	33P	50V
C13	Barrier Lay	0.1	16V
C14	Barrier Lay	0.047	25V
C15	Electrolytic	1 B.P	50V
C16	Ceramic	0.0047	50V
C17	Ceramic	0.0047	50V
C18	Electrolytic	47	10V
C19	Ceramic	0.0047	50V
C20	Array	B8ZC0111-32N (0.0082x7)	
C21	Ceramic	470P	50V
C22	Ceramic	0.001	50V
C23	Barrier Lay	0.1	16V
C24	Ceramic	0.0022	50V
C25	Ceramic	0.001	50V
C26	Array	B8ZC0111-32N (0.0082x7)	
C27	Array	B5RC0124-32N(0.001x4)	
C28	Array	B7ZC0711-32N (0.01x6)	
C29	Array	B7ZC0711-32N (0.01x6)	
C30	Barrier Lay	0.1	16V
C31	Barrier Lay	0.1	16V
C32	Barrier Lay	0.1	16V
L1	Choke	FL5H 102K	
L2	Choke	BT01RN1-A61	
L3	Choke	BT01RN1-A61	
L4	Choke	FL5H 102K	
L6	Choke	FL5H 102K	
L7	Choke	FL5H 102K	
L8	Choke	FL5H 102K	
L9	Choke	FL5H 102K	
L10	Choke	FL5H 102K	
L11	Choke	FL5H 101K	
L12	Choke	FL5H 101K	
L13	Choke	FL5H 101K	
L14	Choke	FL5H 101K	
L15	Choke	FL5H 101K	
L16	Choke	FL5H 101K	
L17	Choke	FL5H 101K	
J1	Connector	TL-25P-03-V1	
J2	Connector	TL-25P-10-V1	
J3	Connector	TL-25P-12-V1	
J5	Connector	5138-11CPB	
J6	Connector	TL-25P-06-V1	
J7	Connector	TL-25P-10-V1	
J8	Connector	5138-04C	

[LOGIC UNIT]

REF. NO.	DESCRIPTION	PART NO.
J9	Connector	TL-25P-07-V1
J10	Connector	TL-25P-09-V1
J11	Connector	5138-11C
J13	Connector	TL-25P-10-V1
J14	Connector	5138-08C
J16	Connector	3022-12B
J17	Connector	3022-08B
B1	Logic P.C.B	B705A
[IF UNIT]		
IC1	IC	μPC1037H
IC2	IC	μPC1037H
Q1	Transistor	2SA1015Y
Q2	Transistor	2SA1015Y
Q3	Transistor	2SA1015Y
Q4	Transistor	2SC945P
Q5	Transistor	2SC945P
Q6	Transistor	2SC945P
Q7	Transistor	2SC763C
Q8	Transistor	2SC945P
Q9	Transistor	2SC945P
Q10	FET	2SK241GR
Q11	FET	2SK241Y
Q12	FET	2SK241GR
Q13	Transistor	2SA1015Y
Q14	Transistor	2SA1015Y
D1	Diode	1SS53
D2	Diode	1SS53
D3	Diode	1SS53
D4	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	Varactor Diode	1T25
D19	Diode	1SS53
D20	Diode	1SS53
D21	Diode	1SS53
D22	Diode	1SS53
D23	Diode	1SS53
D24	Diode	1SS53
D25	Diode	1SS53
D26	Diode	1SS53
D27	Diode	1SS53
D28	Diode	1SS53
D29	Diode	1SS53
D30	Varactor Diode	FC51M
D31	Diode	1SS53
D32	Diode	1SS53

[IF UNIT]

REF. NO.	DESCRIPTION	PART NO.
D33	Diode	1S1555
D34	Diode	1SV99
D35	Diode	1SV99
D36	Diode	1SS53
D37	Diode	1S1555
D38	Diode	1SS53
D39	Diode	1S1555
D40	Diode	1SS53
D41	Diode	1SS53
D42	Diode	1SS53
D43	Diode	1SS53
D44	Diode	1SS53
D45	Diode	1SS53
D47	Diode	1SS53
D48	Diode	1SS53
D49	Diode	1SS53
D50	Diode	1SS53
D51	Diode	1SS53
D52	Diode	1SS53
D53	Diode	1SS53
D54	Diode	1SS53
D55	Diode	1SS53
F11	Ceramic Filter	CFW-455IT
F12	Ceramic Filter	CFJ-455K14
F13	Crystal Filter	FL-23 (9M15A)
F14	Crystal Filter	FL-30 (9M22D2)
X1	Crystal	9.4665MHz HC-43/U
X2	Crystal	CR-12A (9.0115MHz)
L2	Coil	LAL04NA102K
L3	Coil	LS-141A
L4	Coil	LS-187
L5	Coil	LS-246
L6	Coil	LS-251A
L7	Coil	LAL04NA2R2K
L8	Coil	LS-245
L9	Coil	LS-253
L10	Coil	LS-188
L11	Coil	LS-188
L12	Coil	LAL04NA101K
L14	Coil	LS-255
L15	Coil	LS-255
R1	Resistor	22K ELR25
R2	Resistor	10K ELR25
R3	Resistor	10K ELR25
R4	Resistor	4.7K ELR25
R5	Resistor	33K ELR25
R6	Resistor	10K ELR25
R7	Resistor	22K ELR25
R8	Resistor	10K ELR25
R9	Resistor	220 ELR25
R10	Resistor	470 ELR25
R11	Resistor	220 ELR25
R12	Resistor	3.3K ELR10
R13	Resistor	10K ELR10
R14	Resistor	2.2K ELR25
R15	Resistor	12 ELR25
R16	Resistor	100 ELR25
R17	Resistor	47 ELR25
R18	Resistor	27 ELR25
R19	Resistor	220 ELR25

[IF UNIT]

REF. NO.	DESCRIPTION	PART NO.
R20	Resistor	3.3K ELR25
R21	Resistor	27 ELR25
R22	Resistor	6.8K ELR25
R23	Trimmer	10K H0651A
R24	Trimmer	10K H0651A
R25	Resistor	47K ELR25
R26	Resistor	100K ELR25
R27	Resistor	4.7K ELR25
R28	Resistor	1.5K ELR25
R29	Resistor	33K ELR25
R30	Resistor	100K R25
R31	Resistor	2.7K ELR25
R32	Resistor	1.5K ELR25
R33	Resistor	1.5K ELR25
R34	Resistor	4.7K R25
R35	Resistor	1.5K ELR25
R36	Resistor	330 ELR25
R37	Resistor	1K ELR25
R38	Resistor	4.7K ELR25
R39	Resistor	47 ELR25
R40	Resistor	2.2K ELR25
R41	Resistor	2.2K ELR25
R42	Resistor	2.2K ELR25
R43	Resistor	470 R25
R44	Resistor	3.3K ELR25
R45	Resistor	220 R25
R46	Resistor	470 ELR25
R47	Resistor	3.3K ELR25
R48	Resistor	220 ELR25
R49	Resistor	3.3K ELR25
R50	Resistor	220 ELR25
R51	Resistor	3.3K ELR25
R52	Resistor	220 R25
R53	Resistor	3.3K ELR25
R54	Resistor	3.3K ELR25
R55	Resistor	220 R25
R56	Resistor	220 ELR25
R57	Resistor	3.3K ELR25
R58	Resistor	2.2K ELR25
R59	Resistor	220 ELR25
R60	Resistor	3.3K ELR25
R61	Resistor	1K ELR25
R62	Resistor	330 ELR25
R63	Resistor	3.3K ELR25
R64	Resistor	3.3K ELR25
R65	Resistor	47 ELR25
R66	Resistor	1K ELR25
R67	Resistor	47K ELR25
R68	Resistor	1M ELR25
R69	Resistor	1M ELR25
R70	Resistor	220 R25
R71	Resistor	4.7K ELR25
R72	Resistor	100K ELR25
R73	Resistor	220 R25
R74	Resistor	100 ELR25
R75	Resistor	100K ELR25
R76	Resistor	1M R25
R77	Resistor	100K ELR25
R78	Resistor	2.7K R25
R79	Resistor	1.5K R25
R80	Resistor	12K ELR25
R81	Resistor	560 ELR25
R82	Resistor	1K ELR25
R83	Resistor	4.7K ELR25

[IF UNIT]

REF. NO.	DESCRIPTION	PART NO.	
R84	Resistor	1.5K	ELR25
R85	Resistor	220	R25
R86	Resistor	220	R25
R87	Resistor	2.2K	ELR25
R88	Resistor	10K	R25
R89	Resistor	1K	R25
R90	Resistor	220	R25
R91	Resistor	220	R25
R92	Resistor	2.2K	ELR25
R93	Resistor	33K	ELR25
R94	Resistor	4.7K	ELR25
R95	Resistor	10K	ELR25
R96	Resistor	10K	ELR25
R97	Resistor	10K	R25
R98	Resistor	22K	ELR25
R99	Resistor	2.2K	R25
R100	Resistor	10K	ELR25
R101	Resistor	1K	ELR25
R102	Resistor	10K	R25
C1	Barrier Lay	0.047	25V
C2	Barrier Lay	0.047	25V
C3	Barrier Lay	0.047	25V
C4	Ceramic	0.0047	50V
C5	Barrier Lay	0.047	25V
C6	Barrier Lay	0.047	25V
C7	Ceramic	0.0047	50V
C8	Barrier Lay	0.047	25V
C9	Electrolytic	47	10V
C10	Barrier Lay	0.1	16V
C11	Ceramic	330P	50V
C12	Ceramic	0.0047	50V
C13	Ceramic	82P UJ	50V
C14	Ceramic	0.0047	50V
C15	Ceramic	0.0047	50V
C16	Stycon	510P	50V
C17	Dip Mica	120P	50V
C18	Ceramic	0.0047	50V
C19	Ceramic	0.0047	50V
C20	Ceramic	0.0047	50V
C21	Ceramic	0.0047	50V
C22	Barrier Lay	0.047	25V
C23	Barrier Lay	0.1	16V
C24	Ceramic	0.0047	50V
C25	Ceramic	0.0047	50V
C26	Ceramic	56P	50V
C27	Ceramic	0.0047	50V
C28	Ceramic	120P	50V
C29	Barrier Lay	0.1	16V
C30	Barrier Lay	0.1	16V
C31	Barrier Lay	0.1	16V
C32	Barrier Lay	0.1	16V
C33	Barrier Lay	0.1	16V
C34	Barrier Lay	0.1	16V
C35	Ceramic	470P	50V
C36	Barrier Lay	0.047	25V
C37	Ceramic	0.0047	50V
C38	Ceramic	0.0047	50V
C39	Barrier Lay	0.047	25V
C40	Barrier Lay	0.047	25V
C41	Barrier Lay	0.047	25V
C42	Barrier Lay	0.047	25V
C43	Ceramic	0.0047	50V
C44	Ceramic	0.0047	50V

[IF UNIT]

REF. NO.	DESCRIPTION	PART NO.	
C45	Ceramic	0.0047	50V
C46	Ceramic	0.0047	50V
C47	Ceramic	47P	50V
C48	Ceramic	0.0047	50V
C49	Ceramic	47P	50V
C50	Ceramic	0.0047	50V
C51	Ceramic	0.0047	50V
C52	Cylinder	0.0047	UP125SL 50V
C53	Ceramic	0.0047	50V
C54	Cylinder	0.0047	UP125SL 50V
C55	Ceramic	22P	50V
C56	Barrier Lay	0.047	25V
C57	Ceramic	22P	50V
C58	Ceramic	33P	50V
C59	Barrier Lay	0.047	25V
C60	Barrier Lay	0.047	25V
C61	Barrier Lay	0.047	25V
C62	Ceramic	0.0047	50V
C63	Ceramic	0.0047	50V
C64	Ceramic	0.0047	50V
C65	Barrier Lay	0.047	25V
C66	Ceramic	470P	50V
C67	Ceramic	470P	50V
C68	Barrier Lay	0.047	25V
C69	Ceramic	0.0047	50V
C70	Ceramic	0.0047	50V
C71	Barrier Lay	0.047	25V
C72	Ceramic	220P	50V
J2	Connector	TL-25P-04-V1	
J3	Connector	TL-25P-03-V1	
J4	Connector	TLB-P05H-B1	
J5	Connector	TL-25P-02-V1	
J8	Connector	TL-25P-03-V1	
J9	Connector	TL-25P-05-V1	
J10	Connector	TL-25P-03-V1	
J11	Connector	TL-25P-04-V1	
J12	Connector	TL-25P-02-V1	
J15	Connector	5045-2A	
J16	Connector	TL-25P-07-V1	
J17	Connector	TL-25P-02-V1	
J18	Connector	TL-25P-03-V1	
J19	Connector	TL-25P-02-V1	
J20	Connector	TL-25P-02-V1	
J21	Connector	RT-01T-1.3B	
J22	Connector	RT-01T-1.3B	
J23	Connector	RT-01T-1.3B	
J24	Connector	RT-01T-1.3B	
B1	IF P.C.B	B-776	
B2	FI P.C.B	B-633	

[2ND LO UNIT]

REF. NO.	DESCRIPTION	PART NO.
Q1	Transistor	2SC945P
Q2	Transistor	2SC945P
Q3	Transistor	2SC383TM
D1	Diode	1SS53
D2	Diode	1SS53
D3	Varactor Diode	1SV50-E

[2nd IF UNIT]

REF. NO.	DESCRIPTION	PART NO.	
L1	Coil	LS-162	
L2	Coil	LS-162	
L3	Coil	LS-114	
L4	Coil	LS-114	
L5	Coil	LS-114	
X1	Crystal	CR22 (10.24MHz)	
R1	Resistor	4.7K	ELR25
R2	Trimmer	H0651A	10K
R3	Resistor	4.7K	ELR25
R4	Resistor	100K	R25
R5	Resistor	10K	ELR25
R6	Resistor	1K	R25
R7	Resistor	10K	ELR25
R8	Resistor	10K	ELR25
R9	Resistor	22K	ELR25
R10	Resistor	1K	ELR25
R11	Resistor	100	R25
R12	Resistor	10K	ELR25
R13	Resistor	10K	R25
R14	Resistor	100	R25
R15	Resistor	390	ELR25
R16	Resistor	100	ELR25
R17	Resistor	47	ELR25
R18	Resistor	100	R25
R19	Resistor	47K	R25
C1	Ceramic	0.0047	50V
C2	Ceramic	0.0047	50V
C3	Ceramic	0.0047	50V
C4	Electrolytic	2.2	50V
C5	Trimmer	CTZ51F	(30P)
C6	Dip Mica	100P	50V
C7	Dip Mica	120P	50V
C8	Ceramic	0.0047	50V
C9	Ceramic	1P	50V
C10	Ceramic	470P	50V
C11	Ceramic	0.001	50V
C12	Ceramic	DD104SL080D 50V (8P)	
C13	Ceramic	0.5P	50V
C14	Ceramic	DD104SL080D 50V (8P)	
C15	Ceramic	1P	50V
C16	Ceramic	DD104SL080D 50V (8P)	
C17	Electrolytic	100	10V
C18	Ceramic	0.0047	50V
C20	Electrolytic	47	16V
C21	Ceramic	0.0047	50V
C22	Ceramic	0.0047	50V
C23	Ceramic	0.0047	50V
C24	Ceramic	6P	(CH) 50V
J1	Connector	TL-25P-06-V1	
J2	Connector	TMP-J01X-A1	
J3	Connector	RT-01T-1.3B	
B1	2nd LO P.C.B	B-762	

[FRONT UNIT]

IC1	IC	78L05
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[FRONT UNIT]

REF. NO.	DESCRIPTION	PART NO.
IC2	IC	TC5064
IC3	IC	TC4030
IC4	IC	TC4013
IC5	IC	M54844P
Q1	Transistor	2SA1048Y
Q2	Transistor	2SC2458GR
Q3	Transistor	2SC2458GR
Q4	Transistor	2SC2458GR
Q5	Transistor	2SC2458GR
Q6	Transistor	2SC2458GR
Q7	Transistor	2SC2458GR
Q8	Transistor	2SA1048Y
Q9	Transistor	2SC1214
Q10	Transistor	2SA1015Y
Q11	Transistor	2SC945 (ALL RANK)
Q15	Transistor	2SA1015Y
Q16	Transistor	2SA1015Y
Q17	Transistor	2SA1015Y
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	Zener	RD3.9E B2
D21	Diode	1S953
D22	Diode	1S953
D23	Zener	RD5.6E B2
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	1SS53
D34	Diode	1SS53
D35	Diode	1SS53
D36	Diode	1SS53
D37	Diode	1SS53
D38	Diode	1SS53
D39	Diode	1SS53
DS1	LED	SLB-22DU
DS2	LED	SLB-22DU
DS3	LED	SLB-22DU
DS4	LED	SLB-22DU

[FRONT UNIT]

REF. NO.	DESCRIPTION	PART NO.
DS5	LED	SLB-22DU
DS6	LED	SLB-22DU
DS7	LED	SLB-22YY
DS8	LED	SCB-22GG
DS9	LED	LN333GP
DS10	LED	LN233RP
DS11	LED	LN433YP
DS12	LED	LN433YP
DS13	LED	LN233RP
DS14	LED	LN233RP
DS15	Display Tube	9-BT-16ZA
DS16	LAMP	BQ044-32582A
L1	Coil	LAL04NA101K
L2	Coil	LAL04NA101K
L3	Coil	LAL04NA101K
L4	Coil	LAL04NA101K
L5	Coil	LAL04NA101K
L7	Coil	BT01RN1-A61
L8	Coil	BT01RN1-A61
T1	Transformer	LB-119
M1	Meter	M-10
R1	Resistor	1K ELR25
R2	Resistor	1K ELR25
R3	Resistor	1K ELR25
R4	Resistor	1K ELR25
R5	Resistor	1K ELR25
R6	Resistor	1K ELR25
R7	Resistor	820 ELR25
R8	Resistor	680 ELR25
R9	Resistor	68K ELR25
R10	Resistor	68K ELR25
R11	Resistor	68K ELR25
R12	Resistor	68K ELR25
R13	Resistor	68K ELR25
R14	Resistor	68K ELR25
R15	Resistor	1K R25
R16	Array	RM-6 104
R17	Resistor	1K R25
R18	Resistor	1K ELR25
R19	Resistor	1.2K R25
R20	Resistor	330 ELR25
R21	Resistor	47K ELR25
R22	Resistor	10K ELR25
R23	Resistor	10K ELR25
R24	Resistor	4.7K R25
R25	Resistor	100K R25
R26	Resistor	47K ELR25
R27	Resistor	100K ELR25
R28	Resistor	47K R25
R29	Resistor	100K ELR25
R30	Resistor	680K ELR25
R31	Resistor	680K ELR25
R32	Resistor	68K R25
R33	Resistor	47K R25
R34	Resistor	100K R25
R35	Resistor	47K ELR25
R36	Resistor	470K ELR25
R38	Resistor	47K R25
R39	Resistor	10K ELR25
R40	Resistor	47K R25

[FRONT UNIT]

REF. NO.	DESCRIPTION	PART NO.
R41	Resistor	1.2K R25
R45	Resistor	10K R10
R46	Resistor	680 ELR25
R47	Resistor	2.7K R10
R48	Resistor	22 ELR25
R49	Resistor	15 ELR25
R50	Resistor	47K ELR25
R51	Resistor	470K R25
R52	Array	RM-10 473
R53	Array	RM-8 473
R54	Resistor	47K ELR25
R55	Resistor	100 R25
R56	Resistor	100 R25
R57	Resistor	47K ELR25
R58	Resistor	47 ELR25
R59	Variable	K1221101G-5N1212-1MA
R60	Variable	K121B000ME-1KB
R61	Trimmer	H0651A 33K
R62	Variable	K1221101E-5N1212-10KB-500KC
R63	Variable	K121B000ME-1MB
R64	Variable	K12B6000M-10KAX2
R67	Resistor	47K R25
R68	Resistor	47K ELR25
R69	Resistor	15K R25
R70	Resistor	18K R25
R72	Variable	K12C1000J-10KA-10KBx2
R73	Trimmer	H0651A 33K
R74	Resistor	470K R25
R75	Resistor	2.2K R25
R77	Resistor	470 R25
R78	Variable	K12C20003-10KB-1KB-10KB
R79	Trimmer	H1051C 10K
R80	Resistor	18K R25
R81	Trimmer	H1051C 10K
R82	Trimmer	H1051C 10K
R83	Resistor	47K R25
R84	Trimmer	H0651A 10K
R85	Trimmer	H0651A 4.7K
R86	Trimmer	H0651A 10K
R87	Resistor	47K R25
R88	Resistor	33K R25
R89	Resistor	22K R25
R90	Variable	S2011G503-10KB
R91	Variable	S2011G503-10KB
R92	Variable	K121B0006E-10KB
R93	Resistor	330 R25
R94	Resistor	5.6K R25
R95	Resistor	330 R25
R96	Resistor	4.7K R25
R97	Resistor	150K R10
C1	Barrier Lay	0.1 16V
C2	Barrier Lay	0.1 16V
C3	Barrier Lay	0.1 16V
C4	Barrier Lay	0.1 16V
C5	Barrier Lay	0.1 16V
C6	Barrier Lay	0.1 16V
C7	Barrier Lay	0.1 16V
C8	Electrolytic	47 16V
C9	Electrolytic	47 16V
C10	Electrolytic	10 16V (MS7)
C11	Ceramic	0.01 50V (Z)
C12	Ceramic	0.0047 50V
C13	Electrolytic	1000 6.3V (MS9)

[FRONT UNIT]

REF. NO.	DESCRIPTION	PART NO.	
C14	Barrier Lay	0.1	16V
C15	Ceramic	0.001	50V
C16	Ceramic	0.0047	50V
C20	Ceramic	0.0022	50V
C21	Ceramic	0.0022	50V
C22	Ceramic	0.0022	50V
C23	Ceramic	0.0022	50V
C24	Ceramic	0.0022	50V
C25	Ceramic	0.0022	50V
C27	Ceramic	0.0047	50V
C28	Mylar	0.1	50V
C29	Barrier Lay	0.1	16V
C30	Ceramic	0.0047	50V
C31	Electrolytic	0.47	50V (RC2)
S1	Switch	SSS312	
S2	Switch	TW-0068	
S3	Switch	M2012J-1K	
S4	Switch	SPH121C	
S5	Switch	SPH122C	
S6	Switch	SPH122A	
S7	Switch	SPH122A	
S8	Switch	SPH121C	
S9	Switch	SPH121C	
S10	Switch	SRU1023	
S11	Switch	SBU1026	
S12	Switch	MS-611A	
S13	Switch	MS-621C	
S14	Switch	SRS101G	
S15	Switch	PS-135-A22S	
S16	Switch	PS-135-A22S	
S17	Switch	PS-135-A22S	
S18	Switch	SPH121A	
S19	Switch	SPH121C	
S20	Switch	SPH121C	
S21	Switch	SPH122A	
S22	Switch	SPH122A	
S23	Switch	SPH122A	
S24	Switch	SPH121A	
S25	Rotary Encoder	LA24007	
S26	Switch	SPH122A	
S27	Switch	SPH121A	
S28	Switch	SPH121A	
J1	Connector	TL-25P-09-V1	
J2	Connector	5138-11CPB	
J3	Connector	TL-25P-05-V1	
J4	Connector	TL-25P-04-V1	
J5	Connector	TL-25P-05-V1	
J6	Connector	TL-25P-07-V1	
J7	Connector	TL-25P-09-V1	
J8	Connector	TL-25P-05-V1	
J9	Connector	TL-25P-08-V1	
J10	Connector	TL-25P-05-V1	
J11	Connector	5138-08CPB	
J12	Connector	TL-25P-05-V1	
J13	Connector	TL-25P-07-V1	
J14	Connector	TL-25P-03-V1	
J15	Connector	TL-25P-05-V1	
J16	Connector	TLB-P05H-B1	
J17	Connector	RT-01T-1.3B	
J18	Connector	RT-01T-1.3B	
J20	Connector	TL-25P-04-L1	
J21	Connector	TL-25P-06-L1	

[FRONT UNIT]

REF. NO.	DESCRIPTION	PART NO.
J22	Connector	TL-25P-03-L1
J23	Connector	TL-25P-04-V1
J24	Connector	TL-25P-07-L1
J25	Connector	TL-25P-03-V1
J26	Connector	TL-25P-12-L1
J27	Connector	TL-25P-09-L1
J28	Connector	TL-25P-07-L1
J29	Connector	TL-25P-10-L1
J30	Connector	TL-25P-07-V1
J31	Connector	TL-25P-05-V1
J32	Connector	TL-25P-06-V1
J33	Connector	TL-25P-05-V1
J34	Connector	TLB-P05H-B1
J35	Connector	TL-25P-03-V1
J36	Connector	TL-25P-03-V1
J37	Connector	FM214-8SS
J38	Connector	LJ035-1-2-V
P1	Connector	TL-25H-10-B1
P2	Connector	TL-25H-05-B1
P3	Connector	TL-25H-10-B1
P4	Connector	1545P-1
P6	Connector	TL-25H-03-B1
P7	Connector	TL-25H-07-B1
P8	Connector	TL-25H-03-B1
P9	Connector	TL-25H-05-B1
P10	Connector	TL-25H-03-B1
P11	Connector	TL-25H-03-B1
P12	Connector	TL-25H-03-B1
P13	Connector	TL-25H-05-B1
P14	Connector	TL-25H-03-B1
P15	Connector	TL-25H-08-B1
P16	Connector	TL-25H-07-B1
P17	Connector	TL-25H-06-B1
P18	Connector	TL-25H-05-B1
P19	Connector	TL-25H-09-B1
P20	Connector	TL-25H-05-B1
P21	Connector	TL-25H-03-B1
P22	Connector	TL-25H-05-B1
P23	Connector	TL-25H-03-B1
B1	Matrix P.C.B	B-766
B2	Display P.C.B	B-768
B3	VR-A P.C.B	B-769
B4	VR-B P.C.B	B-770
B5	VR-C P.C.B	B-588A
B6	SW-A P.C.B	B-771
B7	SW-B P.C.B	B-772
B8	SW-C P.C.B	B-773
B9	SW-D P.C.B	B-774
B10	SW-E P.C.B	B-759
B11	SW-F P.C.B	B-760
B12	SW-G P.C.B	B-761
B13	LED-A P.C.B	B-778
B14	LED-B P.C.B	B-779
B15	LED-C P.C.B	B-780
B16	MIC P.C.B	B-594

[REG UNIT]

IC1	IC	MB3756
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[REG UNIT]

REF. NO.	DESCRIPTION	PART NO.	
Q1	Transistor	2SD313	
D1	Zener	RD-9.1-EB3	
D2	Diode	1N4002	
R1	Resistor	4.7	ELR25
R2	Resistor	220	ELR25
R3	Resistor	22K	ELR25
C1	Electrolytic	1000	16V
C2	Electrolytic	4.7	10V
C3	Electrolytic	22	10V
C4	Electrolytic	47	10V
C5	Electrolytic	10	10V
P1	Connector	TL-25H-03-B1	
P2	Connector	TL-25H-04-B1	
P3	Connector	TL-25H-04-B1	
B1	REG P.C.B	B-482A	

[ACC UNIT]

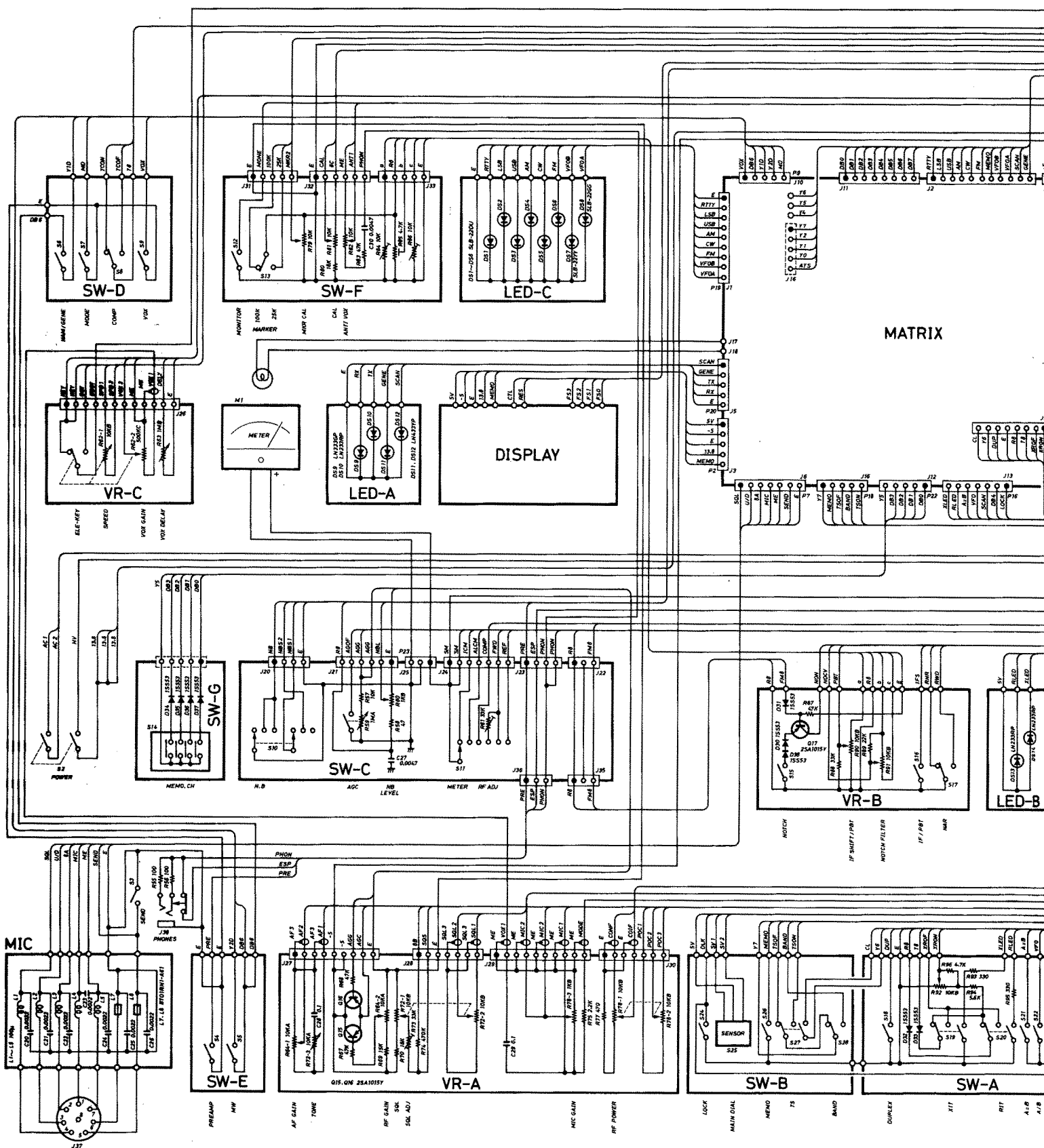
Q1	Transistor	2SA1015Y	
Q2	Transistor	2SC3402	
L1	Coil	BT01RN1-A61	
L2	Coil	BT01RN1-A61	
L3	Coil	BT01RN1-A61	
L4	Coil	BT01RN1-A61	
L5	Coil	BT01RN1-A61	
L6	Coil	BT01RN1-A61	
L7	Coil	BT01RN1-A61	
L8	Coil	BT01RN1-A61	
L9	Coil	BT01RN1-A61	
L10	Coil	BT01RN1-A61	
R1	Resistor	220	ELR25
R2	Resistor	220	ELR25
R3	Resistor	1K	ELR25
R4	Resistor	1K	ELR25
R5	Resistor	1K	ELR25
R6	Resistor	220	ELR25
R7	Resistor	220	ELR25
R8	Resistor	220	ELR25
R9	Resistor	1K	ELR25
R10	Resistor	220	ELR25
R11	Resistor	220	ELR25
R12	Resistor	220	ELR25
R13	Resistor	22K	R25
R14	Resistor	10K	R25
R15	Resistor	33K	R25
R16	Resistor	100	R25
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	470P	50V

[ACC UNIT]

REF. NO.	DESCRIPTION	PART NO.	
C8	Ceramic	470P	50V
C9	Ceramic	470P	50V
C10	Ceramic	0.0047	50V
C11	Ceramic	470P	50V
C12	Ceramic	0.0047	50V
C13	Ceramic	0.0047	50V
C14	Ceramic	0.0047	50V
C15	Ceramic	0.0047	50V
C16	Ceramic	0.0047	50V
C19	Ceramic	0.0047	50V
C20	Ceramic	0.0047	50V
C21	Ceramic	0.0047	50V
C23	Ceramic	0.0047	50V
J1	Connector	TL-25P-06-V1	
J2	Connector	TL-25P-05-V1	
J3	Connector	TL-25P-07-V1	
J4	Connector	TL-25P-03-V1	
J5	Connector	TL-25P-06-V1	
J6	Connector	TL-25P-05-V1	
J7	Connector	TL-25P-08-V1	
J8	Connector	TL-25P-05-V1	
J9	Connector	TL-25P-02-V1	
B1	ACC P.C.B	B-764	

IC-745

SCHEMATIC DIAGRAM



GRAM

