



ICOM

SERVICE MANUAL

IC-751

ICOM INCORPORATED

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SECTION 1 SPECIFICATIONS

GENERAL

Number of Semiconductors:

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

Frequency Coverage:

Ham Band	1.8 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 $\pm 9.9\text{KHz}$

Frequency Control:

CPU based 10Hz step Digital PLL synthesizer.

Independent Transmit-Receive Frequency Available on same band.

Frequency Readout:

6 digit 100Hz readout.

Frequency Stability:

Less than $\pm 200\text{Hz}$ after switch on 1 min to 60 mins, and less than $\pm 30\text{Hz}$ after 1 hour. Less than $\pm 500\text{Hz}$ in the range of $0^\circ\text{C} \sim +50^\circ\text{C}$.

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:

8.5Kg

Dimensions:

115mm(H) x 306mm(W) x 355mm(D)

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
AM (A_3)	40 Watts output

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)
A_3	AM
F_3	FM

Harmonic Output:

More than 40dB below peak power output

Spurious Output:

More than 60dB below peak power output

Carrier Suppression:

More than 40dB below peak power output

Unwanted Sideband:

More than 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

Quadruple 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 , F_3

Intermediate Frequencies:

1st	70.4515MHz
2nd	9.0115MHz (SSB), 9.0106MHz (CW, RTTY) 9.0100MHz (AM, FM)
3rd	455KHz
4th	350KHz (except FM) with continuous Bandwidth Control

Sensitivity:

SSB, CW, RTTY

0.1 ~ 0.5MHz Less than $0.5\mu\text{V}$ for 10dB S/N

0.5 ~ 1.6MHz Less than $1.0\mu\text{V}$ for 10dB S/N

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

AM 0.1 ~ 0.5MHz Less than $3\mu\text{V}$ for 10dB S/N

0.5 ~ 1.6MHz Less than $6\mu\text{V}$ for 10dB S/N

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

FM 1.6 ~ 30MHz Less than $3\mu\text{V}$ for 12dB SINAD.

Squelch Sensitivity:

1.6 ~ 30MHz Less than $0.3\mu\text{V}$

Selectivity:

SSB, CW, RTTY

2.3KHz (Adjustable to 0.8KHz Min)
at -6dB

4.0KHz at -60dB

AM 2.4KHz at -6dB, 4.2KHz at -60dB
(When Filter switch ON)

4.0KHz at -6dB, 15KHz at -50dB

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

Notch Filter Attenuation:

More than 45dB

Spurious Response Rejection Ratio:

More than 60dB

Audio Output:

More than 3 Watts

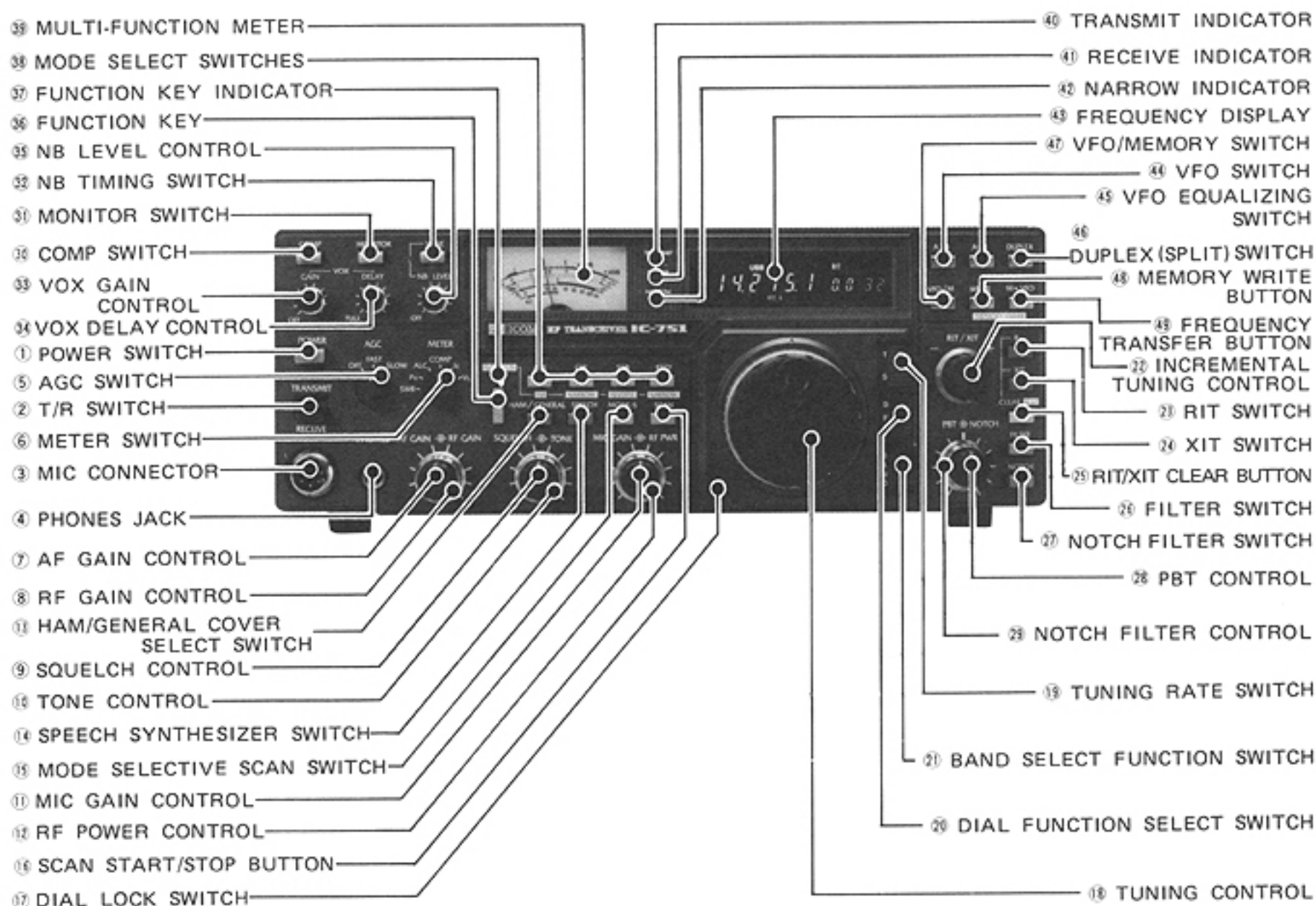
Audio Output Impedance:

8 ohms

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

SECTION 2 OPERATING CONTROLS

2-1 FRONT PANEL



1. POWER SWITCH

The POWER SWITCH is a push-lock type switch which controls the input DC power to the IC-751. When the external AC power supply (IC-PS15) 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).

2. 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-751 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.

3. MIC CONNECTOR

Connect a suitable microphone to this jack. The supplied hand microphone IC-HM12 or optional desk mic IC-SM6

can be used. If you wish to use a different microphone, refer to the drawings on page 4.

4. PHONES JACK

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

5. AGC (AUTOMATIC GAIN CONTROL) SWITCH

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

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 been received. (The AGC does not actuate in the FM mode.)

6. METER SWITCH

In the transmit mode, the meter has six functions.

1. Vc Indicates the collector voltage of the final transistors.
2. Ic Indicates the collector current of the final transistors.
3. COMP Indicates the compression level when the speech processor is in use.
4. ALC Indicates the ALC level. The meter begins to function when the RF output power reaches a certain level.
5. Po Indicates an approximate RF output power.
6. SWR SWR can be measured by setting this switch to the Po position and calibrating the meter needle to the "SET" position with the RF POWER control, then setting this switch to the SWR position.

7. AF GAIN CONTROL

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

8. RF GAIN CONTROL

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

9. 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.

10. TONE CONTROL

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

11. MIC GAIN CONTROL

Adjusts the level of modulation according to the input of the microphone. Clockwise rotation increases the microphone gain. As the input will vary with different microphone 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.

12. RF POWER CONTROL

Controls the RF output power 10 Watts to maximum (SSB: 100 Watts PEP, CW, RTTY, FM: 100 Watts, AM: 40 Watts). Clockwise rotation increases the output power.

13. 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.)

14. SPEECH SYNTHESIZER SWITCH

When the optional speech synthesizer unit is installed, this switch turns on the unit which announces the displayed frequency in English.

15. MODE SELECTIVE SCAN SWITCH

When this switch is pushed, only memory channels stored with the operating mode which is displayed on the frequency display just prior to pushing this switch, are selected by turning the tuning control or scanning.

16. 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 other memory scans.

17. DIAL LOCK SWITCH

After the IC-751 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, the dial lock must first be disengaged by pushing and releasing this switch again.

18. 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.

19. 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.

20. DIAL FUNCTION SELECT SWITCH

In the VFO operation, by pushing in this switch, the operating frequency (displayed VFO frequency) is locked and the memory channel number (displayed on the frequency display) can be changed by turning the tuning control.

In the MEMORY CHANNEL mode, by pushing in this

switch, the memory channel is locked and the operating frequency (displayed frequency) can be changed by turning the tuning control.

21. 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.

22. INCREMENTAL TUNING CONTROL

Shifts the receive frequency 9.9KHz (maximum) 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 this control clockwise (+ side) raises the receive or transmit frequency and counterclockwise (— side) lowers the frequency with 10Hz steps, and 1KHz and 100Hz digits of the frequency shifted are displayed 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.

23. RIT SWITCH

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

To turn ON the RIT, push this button once. At this time, the letters "RIT" and shifted frequency are displayed on the frequency display. If you desire to turn OFF the RIT, push the button again. The letters "RIT" and shifted frequency are no longer displayed, however, the shifted frequency is stored in the memory and if you turn ON the RIT again, the shifted frequency appears on the display again.

24. XIT SWITCH

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

To turn ON the XIT, push this button once. At this time, the letters "XIT" and shifted frequency are displayed on the frequency display. The other functions are in like manners.

25. RIT/XIT CLEAR BUTTON

By pushing this button, a frequency shifted by turning the INCREMENTAL TUNING control is cleared to "0.0".

When pushing the FUNCTION KEY first, then this button, the shifted frequency is added to the displayed one, and the shifted frequency is cleared to "0.0".

26. FILTER SWITCH

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

27. NOTCH FILTER SWITCH

Switches the notch filter function ON and OFF.

28. P.B. TUNE (PASS BAND TUNING) CONTROL

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

29. NOTCH FILTER CONTROL

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

30. COMP (SPEECH PROCESSOR) SWITCH

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

31. 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.

This switch also turns the CW side-tone circuit ON and OFF in the CW mode.

32. NB TIMING SWITCH

The noise blanker blanking time can be selected NORMAL and WIDE by this switch. It will be effective against any types of noises.

33. VOX GAIN CONTROL

When the control is turned completely counterclockwise, the VOX circuit is OFF. By turning the control clockwise beyond the "click", the VOX circuit is turned ON and the VOX gain increases by further rotating it clockwise.

When the VOX is turned ON, in SSB, AM or FM, T/R switching is accomplished by means of a voice signal. In CW operation, semi-break-in or full-break-in switching by means of keying possible.

For VOX operation in SSB, AM or FM, adjust the control so that the VOX circuit will operate with normal speech.

34. 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.

In the CW operation, adjust this control to suit your keying speed. If the control is set at the "FULL" (completely counterclockwise) position, it will reach full-break-in CW.

35. NB LEVEL CONTROL

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

36. FUNCTION KEY

Increases the function of the MODE SELECT switches, MEMORY WRITE button, FREQUENCY TRANSFER button and RIT/XIT CLEAR button by pushing this key switch first.

37. FUNCTION KEY INDICATOR

This indicator is lit by pushing the FUNCTION KEY to indicate the second function will be selected, and turned off by pushing one of the dual function switches or buttons.

38. MODE SELECT SWITCHES

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

1. AM For AM operation.

FM Pushing the FUNCTION KEY first, then the AM switch, the FM mode is selected.
2. CW For normal CW operation.

NARROW Pushing the FUNCTION KEY first, then the CW switch when the optional 455KHz narrow CW filter is installed. (No sound can be heard when the optional filter is not installed.)
3. SSB Upper sideband (USB) for 10MHz band and above, and lower sideband (LSB) for 7MHz (in the GENERAL COVERAGE operation: 9MHz) band and below (normal SSB operation) will be selected.

REVERSE Lower sideband (LSB) for 10MHz band and above, and upper sideband (USB) for 7MHz (in the GENERAL COVERAGE operation: 9MHz) band and below will be selected.
4. RTTY For normal RTTY operation.

NARROW Pushing the FUNCTION KEY first, then the RTTY switch, filter is switched to the narrow CW filter when the optional 455KHz narrow CW filter is installed. (No sound can be heard when the optional narrow CW filter is not installed.)

39. MULTI-FUNCTION METER

When in the receive mode the meter acts as an S-meter regardless of the position of the meter switch. Signal strength is indicated on a scale of S1-S9, and S9 to S9+60dB.

In the transmit mode the meter has six functions which are selected by the Meter Switch (6).

40. TRANSMIT INDICATOR

Illuminates when the transceiver is in the transmit mode.

41. RECEIVE INDICATOR

Illuminates when the squelch is opened in the receive mode.

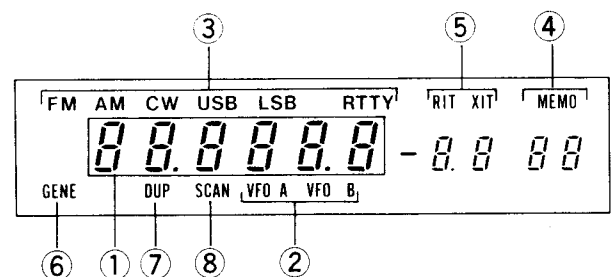
42. NARROW INDICATOR

Illuminates when the set is on CW-Narrow or RTTY-Narrow mode. This indicator illuminates not only when the optional CW filter is installed, but also if it is not installed.

43. FREQUENCY DISPLAY

The frequency of the IC-751 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.

The FREQUENCY DISPLAY shows not only the operating frequency but also mode, duplex (split frequency) mode, selected VFO or memory channel, RIT/XIT functions and their shifted frequency, and the set is in SCAN mode and in HAM band or GENERAL COVERAGE 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 FM, AM, CW, USB, LSB, and RTTY.
- ④ Shows that the set is in the MEMORY CHANNEL MODE or not, and the selected memory channel number. When the set is in the MEMORY CHANNEL MODE, the letters "MEMO" are displayed here.
- ⑤ Shows that the RIT and XIT are ON or OFF, and their shifted frequency.

When the RIT and/or XIT are ON, the letters "RIT" and/or "XIT" are displayed here.

When both the RIT and XIT are OFF, any letters and shifted frequency are no longer displayed.

- ⑥ Shows that the set is in the HAM BAND mode or GENERAL COVERAGE mode.

When the set is in the GENERAL COVERAGE mode, the letters "GENE" are shown here.

- ⑦ Shows that the set is in the DUPLEX (SPLIT FREQUENCY) mode or not. When the set is in the DUPLEX mode, the letters "DUP" are displayed here.
- ⑧ Shows that the set is in the SCAN mode or not. When the set is in the SCAN mode, the letters "SCAN" are displayed here.

44. VFO SWITCH

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

45. VFO EQUALIZING SWITCH

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

46. 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.

47. VFO/MEMORY SWITCH

Switches the VFO operation and MEMORY CHANNEL operation.

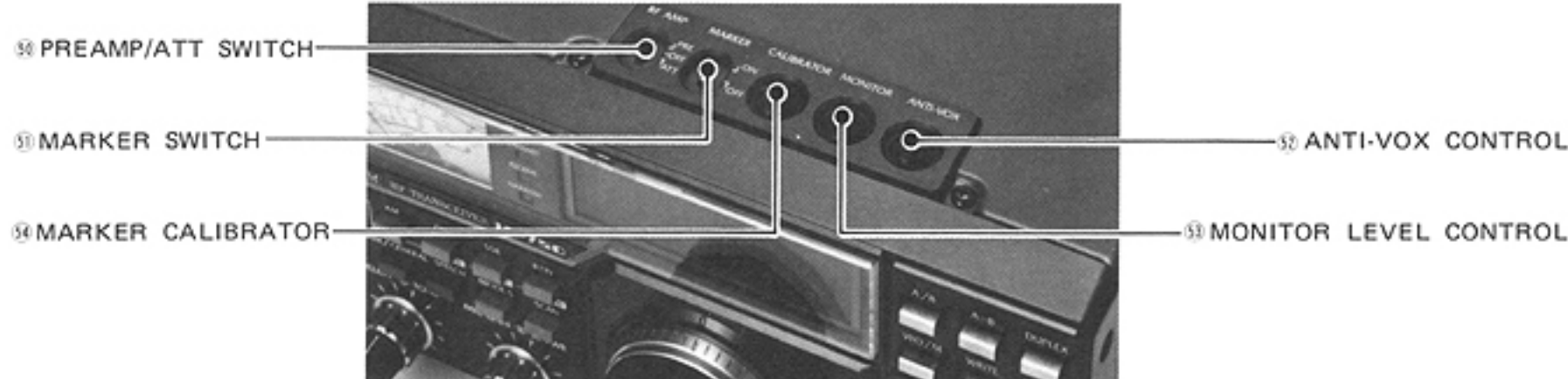
48. MEMORY WRITE BUTTON

By pushing this button, a displayed frequency, mode and HAM/GENE operation are stored into a memory channel displayed on the frequency display.

49. FREQUENCY TRANSFER BUTTON

In the VFO operation, the frequency, mode and HAM/GENE operation stored in a memory channel (displayed its channel number on the frequency display), are transfer to the selected VFO.

2-2 TOP COVER



50. PREAMP/ATT (Attenuator) SWITCH

Switches RF preamplifier and attenuator in the RF circuit.

When the switch is in the OFF position, both preamplifier and attenuator are removed from the circuit, and incoming signals will be fed to the receiver directly.

When using a small antenna or receiving a weak signal, set the switch in the "PRE" position, and the preamplifier is put in the RF circuit and provides higher sensitivity.

When nearby signals interfere with reception, or receiving a very strong signal, set this switch in the "ATT" position. This removes the preamplifier from the circuit and inserts the attenuator into the circuit. This gives about 20dB attenuation.

For normal operation leave this switch in the "OFF" position.

51. MARKER SWITCH

Turns the marker circuit ON or OFF. The marker frequency is available on every 10KHz.

52. ANTI-VOX CONTROL

In VOX 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.

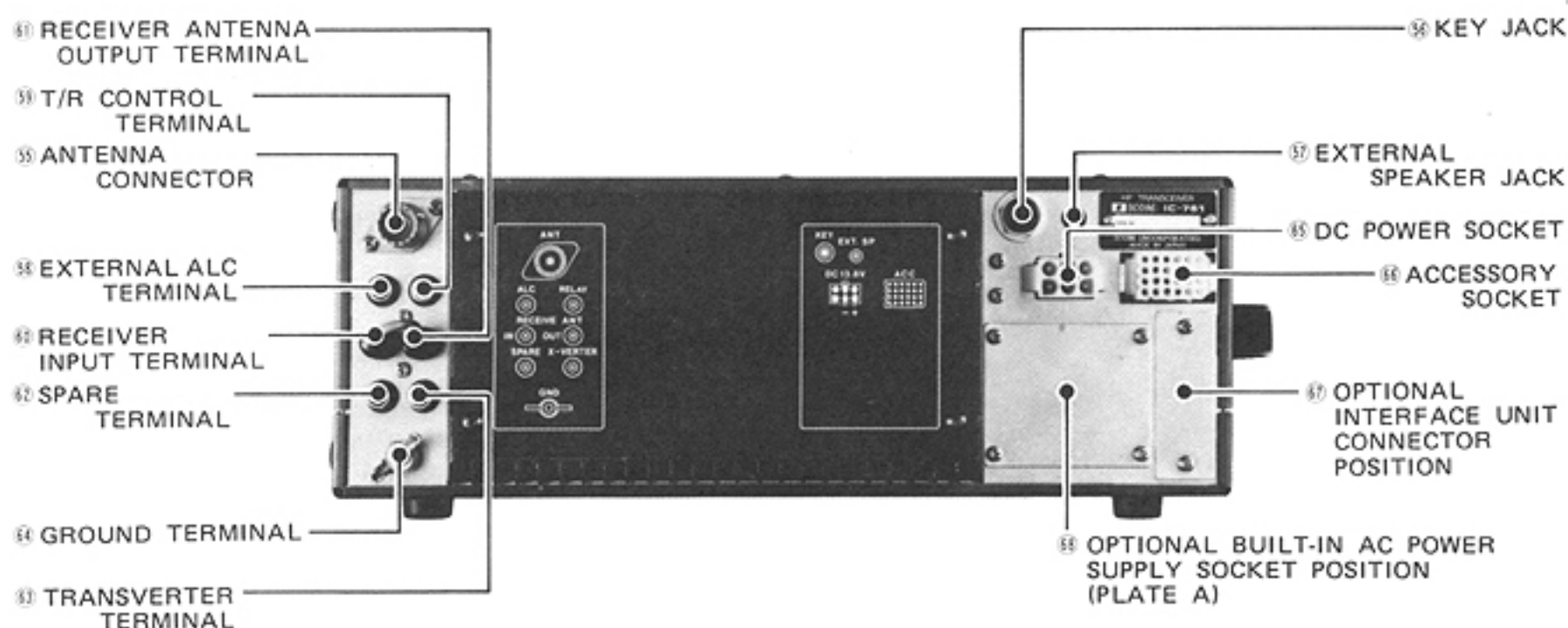
53. MONITOR LEVEL CONTROL

Controls the audio level of the monitoring SSB or CW side-tone when the MONITOR switch on the front panel is turned ON. Adjust the control for comfortable monitoring.

54. MARKER CALIBRATOR

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

2-3 REAR PANEL CONNECTIONS



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 plug. For electronic keying the terminal voltage must be less than 0.4V DC.

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-751.

62. SPARE TERMINAL

This terminal is available for your personal use, such as for adding accessory circuit, etc., if desired.

63. TRANSVERTER TERMINAL

VHF and UHF operation using a suitable transverter with the IC-751 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. 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 CONNECTION on page 3-17.

67. OPTIONAL INTERFACE UNIT CONNECTOR POSITION

This is provided to install the DP-25 connector of the optional interface unit.

68. 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

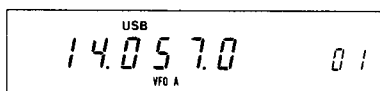
3-1 HOW TO TUNE

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, letters "VFO A" and "01" representing memory channel 1, 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.

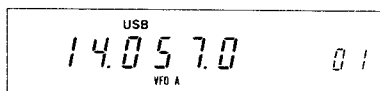
In the GENERAL COVERAGE MODE, the set operates as a receiver in the range of 0.1MHz to 30MHz continuously.

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

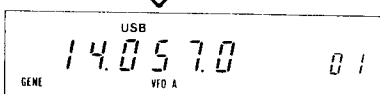
When you change the mode from the GENERAL COVERAGE to HAM BAND, if previous frequency was that of a HAM BAND, the set maintains that frequency.

FOR EXAMPLE:

In the HAM BAND mode

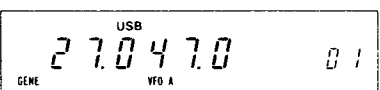


In the GENERAL COVERAGE mode



If the previous frequency was not of any HAM BAND, the frequency is initialized to "1.900.0MHz".

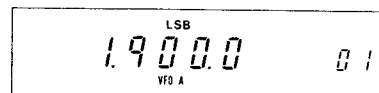
In the GENERAL COVERAGE mode



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)		
	LSB • AM • FM	CW • RTTY	USB
1.8MHz	1.900.0	1.899.4	1.897.0
3.5	3.550.0	3.549.4	3.547.0
7	7.050.0	7.049.4	7.047.0
10	10.050.0	10.049.4	10.047.0
14	14.050.0	14.049.4	14.047.0
18	18.050.0	18.049.4	18.047.0
21	21.050.0	21.049.4	21.047.0
24.5	24.550.0	24.549.4	24.547.0
28	28.050.0	28.049.4	28.047.0

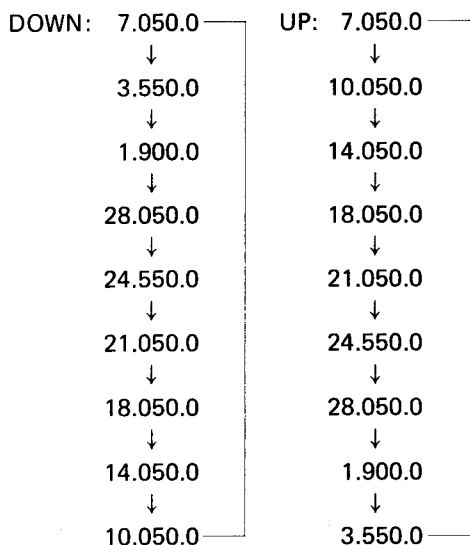
In the GENERAL COVERAGE mode, by turning the TUNING CONTROL clockwise the operating frequency changes to a frequency that is added 1MHz to the previous one. (100KHz and lower digits of the frequency will remain as it had in the previous one.) By turning the TUNING CONTROL counterclockwise, the operating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

DOWN: 15.123.4	UP: 15.123.4
↓	↓
14.123.4	16.123.4
⋮	⋮
1.123.4	29.123.4
↓	↓
0.123.4	0.123.4
↓	↓
29.123.4	1.123.4
⋮	⋮
00.123.4	29.123.4

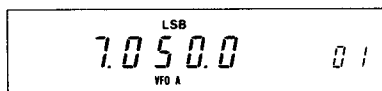
In the HAM BAND mode



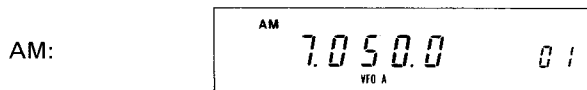
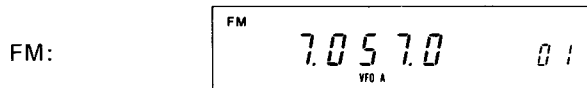
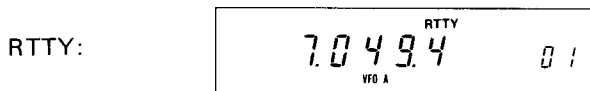
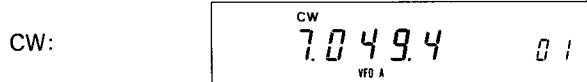
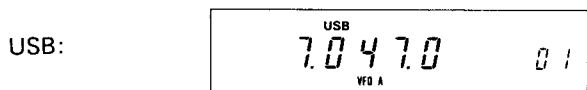
However, in the GENERAL COVERAGE mode, when the operating frequency reaches the highest or lowest edge, of that MHz range by turning the TUNING CONTROL continuously (at this time the BAND SELECT FUNCTION switch is not pushed in), the operating frequency will go to the next MHz range.

3 - 1 - 4 FREQUENCY DISPLAY ON EACH MODE

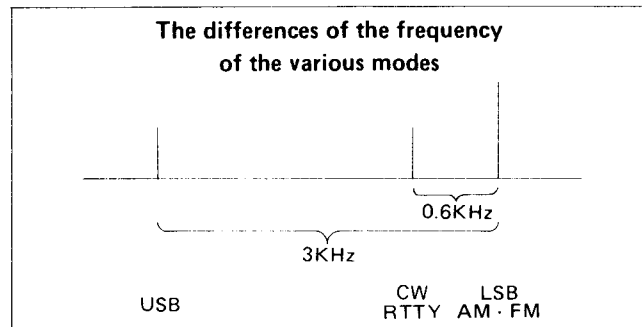
When the 7MHz band and LSB are selected, the display will be as follow:



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



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.



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 FUNCTION key first, then push the SSB switch.

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

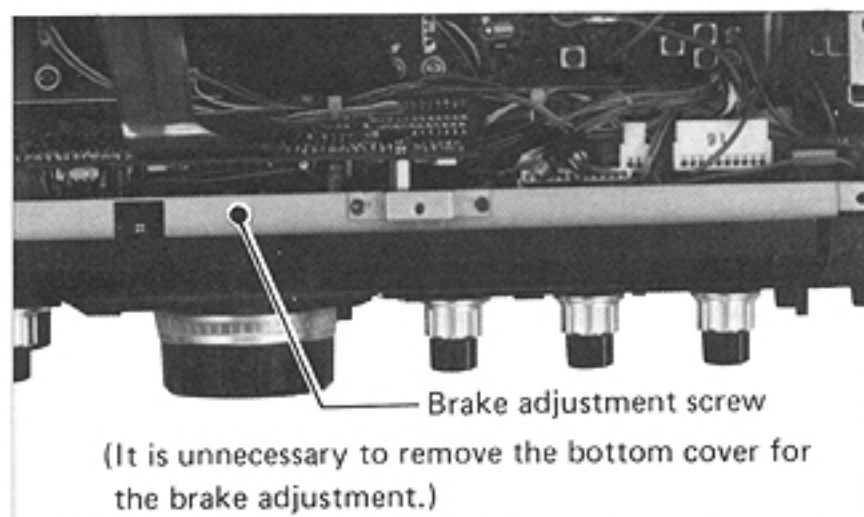
In the HAM BAND mode, by turning the TUNING CONTROL clockwise, the operating frequency reaches to the high edge of the band (for example; 14.499.9MHz), and further turning of the control brings the frequency to the low edge of the band (13.950.0MHz) then continues up the frequency from there. Likewise, 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 letters "VFO A" or "VFO B" are displayed on the frequency display, we call this condition as "VFO MODE", when the letters "MEMO" are displayed above the memory channel number, we call as "MEMORY CHANNEL MODE".

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

3-1-6 DIAL LOCK SWITCH

After the IC-751 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-751 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-751 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.

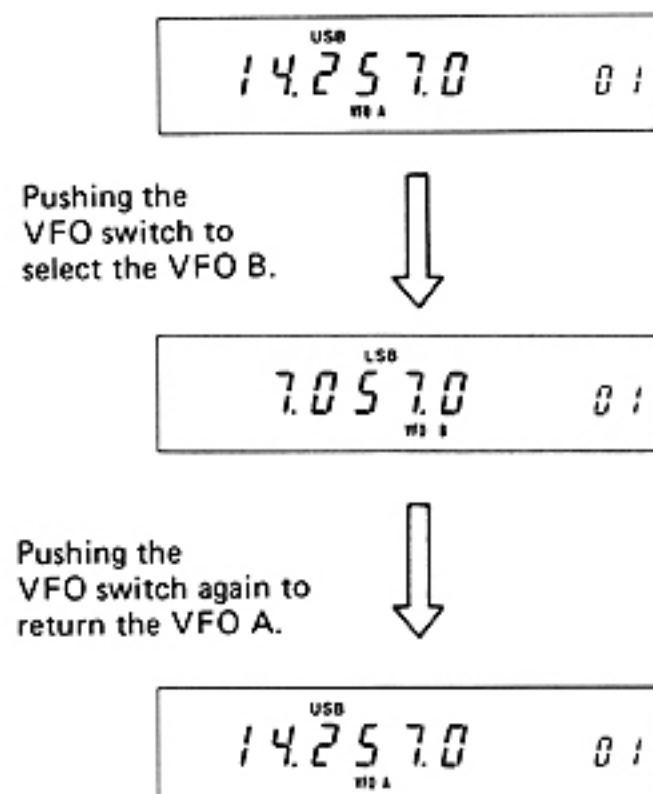
Switching from one VFO to the other VFO does not clear the first VFO. The frequency, operating mode and HAM/GENE mode are retained in the VFO's memory.

FOR EXAMPLE:

If 14.252MHz 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 be 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.



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!

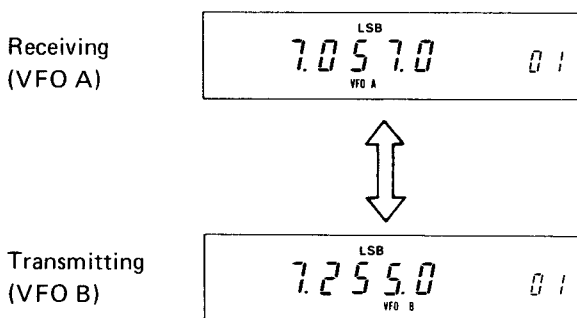
3-1-8 DUPLEX (SPLIT) SWITCH

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

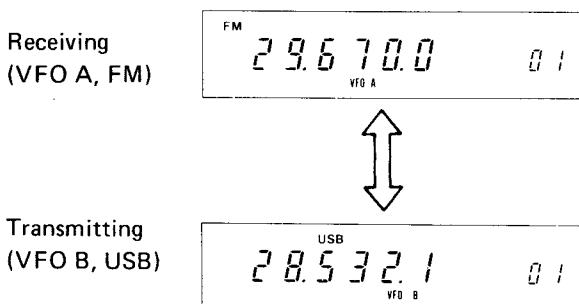
When the function is OFF, one VFO is for both receive and transmit. When the function is ON, the letters "DUP" are displayed on the frequency display, and one VFO is for receive and the other VFO is for transmit. So that this will allow you to operate on split receive/transmit frequencies.

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.



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



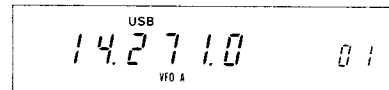
3-1-9 TRANSFERRING VFO FREQUENCY

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.

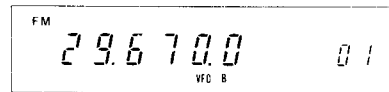
FOR EXAMPLE:

When VFO A is 14.271MHz 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 (14.271MHz 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 (14.271MHz), 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)



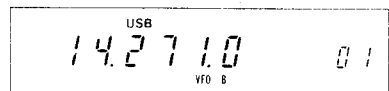
VFO B
(hidden)



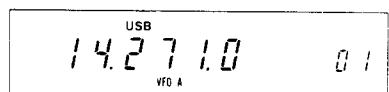
Pushing the VFO
EQUALIZING switch



VFO A
(displayed)



VFO B
(hidden)



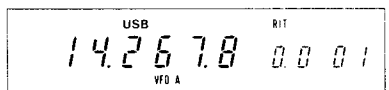
3-1-10 RIT (RECEIVE INCREMENTAL TUNING)

By using the RIT circuit, you can shift the receive frequency 9.9KHz (maximum) 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 letters "RIT" and shifted frequency are displayed on the frequency display.

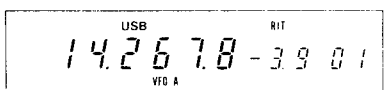
The receive frequency can be shifted 10Hz steps by turning the INCREMENTAL TUNING CONTROL.

First pushing
the RIT switch
to turn ON the
RIT.



(Receiving and transmitting on
14.267.8MHz.)

Turning the
RIT control
counter-
clockwise.

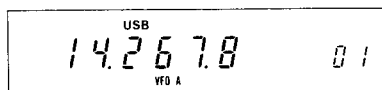


(Receiving on 14.263.9MHz and
transmitting on 14.267.8MHz)

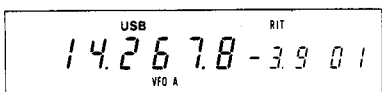
Rotating the control to the (+) direction raises the receiving frequency, and to the (–) direction lowers one.

To turn OFF the RIT function, push again the RIT switch and the letters “RIT” and shifted frequency displayed on the frequency display are no longer displayed. When the RIT circuit is OFF, the transmit and receive frequencies are the same regardless of the shifted frequency. However, the shifted frequency is stored in the memory and it will reappear when the RIT switch is pushed again.

Pushing the RIT switch to turn OFF the RIT.

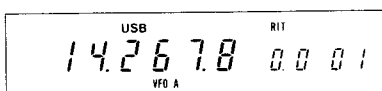


Pushing the RIT switch again to turn ON the RIT.

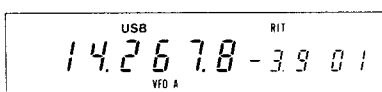


To clear the shifted frequency, push the RIT/XIT CLEAR button and the shifted frequency becomes “0.0” (The receive and transmit frequencies become the same.), regardless the RIT circuit is turned ON or OFF.

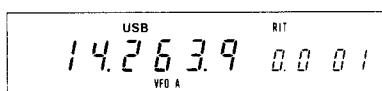
Pushing the RIT/XIT CLEAR button.



If you want to change the operating frequency (displayed frequency) to the receive frequency which is shifted by the RIT function, push the FUNCTION KEY first then the RIT/XIT CLEAR button, and the shifted frequency is added to the previous displayed frequency and the operating frequency is changed to the previous receive frequency. At the same time the shifted frequency is cleared to “0.0” and the set operates on the new displayed frequency for both the transmitting and receiving.



Pushing the RIT/XIT CLEAR button.



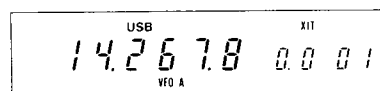
NOTE: The RIT circuit is operational when the frequency has been locked with the DIAL LOCK button as well as in the MEMORY CHANNEL MODE. When the transmitting and receiving frequencies differ by more than 10KHz, use VFO A and B in the DUPLEX (SPLIT) mode.

3 - 1 - 11 XIT (TRANSMIT INCREMENTAL TUNING)

By using the XIT circuit, you can shift the transmit frequency 9.9KHz (maximum) either side of the receive frequency without moving the receive frequency itself in like manner as the RIT function.

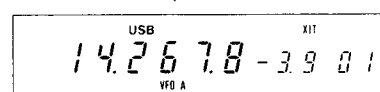
By pushing the XIT switch, the XIT circuit is turned ON and the letters “XIT” and shifted frequency are displayed on the frequency display. The transmit frequency can be shifted 10Hz steps by turning the INCREMENTAL TUNING CONTROL.

First pushing the XIT switch to turn ON the XIT.



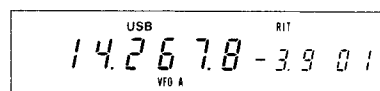
(Receiving and transmitting on 14.267.8MHz.)

Turning the INCREMENTAL TUNING control counterclockwise.



(Receiving on 14.267.8MHz and transmitting on 14.263.9MHz)

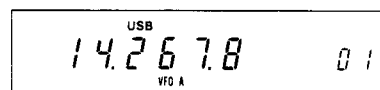
If the RIT has been turned ON before and the shifted frequency is stored in its memory (now the RIT is OFF), then the XIT is turned ON, the shifted frequency stored in the RIT memory is reappeared on the display and it becomes the shifted frequency of the XIT.



The RIT has been turned ON.

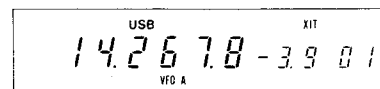
(Receiving on 14.263.9MHz and transmitting on 14.267.8MHz.)

Pushing the RIT switch to turn OFF the RIT.



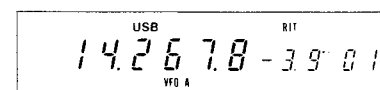
(Receiving and transmitting on 14.267.8MHz.)

Pushing the XIT switch to turn ON the XIT.



(Receiving on 14.267.8MHz and transmitting on 14.263.9MHz.)

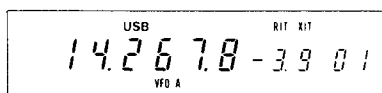
If you push the XIT switch to turn the XIT ON when the RIT has been turned ON already, the XIT is also turned ON, however, its shifted frequency will be the same as that of the RIT. So the set will operate on the same frequency which is shifted from the displayed frequency and it can be changed by turning the INCREMENTAL TUNING CONTROL, in both the transmitting and receiving.



The RIT has been turned ON already.

(Receiving on 14.263.9MHz and transmitting on 14.267.8MHz.)

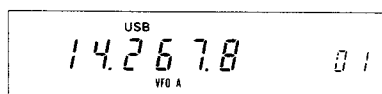
Pushing the XIT switch to turn ON the XIT.



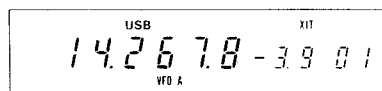
(Receiving and transmitting on 14.263.9MHz.)

To turn OFF the XIT function, push again the XIT switch and the letters "XIT" and shifted frequency displayed on the frequency display are no longer displayed. (If the RIT is ON the shifted frequency will remain.) When the XIT circuit is OFF, the transmit and receive frequencies are the same regardless of the shifted frequency. However, the shifted frequency is stored in the memory and it will be reappear when the XIT switch is pushed again.

Pushing the XIT switch to turn OFF the XIT.



Pushing the XIT switch again to turn ON the XIT.



To clear the shifted frequency or to add the shifted frequency to the displayed one, you can make it in like manner as the RIT.

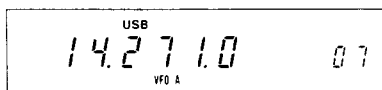
3 - 1 - 12 DIAL FUNCTION SELECT SWITCH (IN VFO MODE)

In the VFO mode, by pushing the DFS (DIAL FUNCTION SELECT) switch in, the operating frequency locked on the displayed frequency and by turning the TUNING CONTROL, the MEMORY CHANNEL NUMBER displayed on the frequency display can be changed. This is very convenient to memorize the operating frequency and modes into a memory channel, or to change the operating frequency and modes to ones in a memory channel.

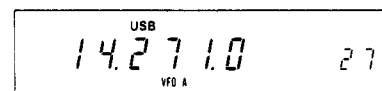
FOR EXAMPLE:

Now you are operating on 14.271MHz and USB, and memory channel number "7" is displayed. If you want to memorize these into the memory channel 27, push the DFS switch in and you can change the displayed memory channel number by turning the tuning control. Turn the tuning control to obtain the desired memory channel number (at this time "27"), then push the MEMORY WRITE button, and the operating frequency "14.271MHz" and mode "USB" are memorized into the memory channel 27. To change the operating frequency again, push and release the DFS switch.

On the display



Pushing the DFS switch and turning the TUNING CONTROL.

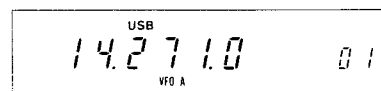


By pushing the MEMORY WRITE button, the frequency and mode are memorized into the MEMORY CHANNEL 27.

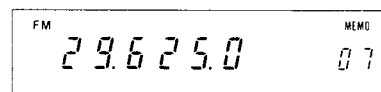
FOR EXAMPLE:

Now you are operating on 14.271MHz USB and memory channel 7 memorizes "29.625MHz" and "FM". If you wish to operate with the frequency and modes which are memorized in the memory channel 7, push the DFS switch in and turn the tuning control to be displayed memory channel number "7". Then push the FREQUENCY TRANSFER button, and "29.625.0" and "FM" are appeared on the frequency display. Now you can operate on these frequency and mode, and by pushing and releasing the DFS switch, the displayed frequency can be changed by turning the tuning control.

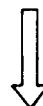
On the display



Contents of the memory channel 7 (hidden)



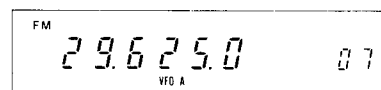
Pushing the DFS switch and turning the TUNING CONTROL.



Pushing the FREQUENCY TRANSFER button.



The contents of the channel 7 are transferred to the VFO A.



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 and memory channel number "01" is displayed. By pushing the VFO/MEMORY switch, the set is switched into the MEMORY CHANNEL MODE and frequency, mode and HAM/GENE mode which have been stored in the "MEMORY CHANNEL 1" are displayed

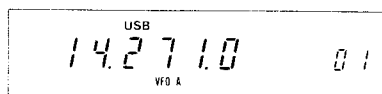
on the frequency display. In addition, the letters "MEMO" are also displayed above the memory channel number to indicate the set is in the MEMORY CHANNEL MODE.

FOR EXAMPLE:

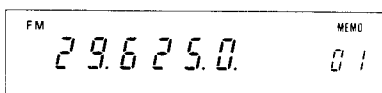
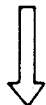
When "14.271MHz" and USB are memorized in VFO A, and "29.625MHz" and "FM" are in MEMORY CHANNEL 1, by pushing the power switch ON, the frequency display shows "14.271.0", "USB", "VFO A" and memory channel number "01".

By pushing the VFO/MEMORY switch, the display will show "29.625.0" and "FM", memory channel number "01", and the letters "MEMO" above the channel number.

When the power is turned ON.



Pushing the VFO/MEMORY switch



By turning the TUNING CONTROL, memory channels can be selected. Turning clockwise increases the channel number and counterclockwise decreases the number, 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, but MHz and KHz decimals. However, the set works with the frequency and mode of the memory channel (or VFO), which was previously displayed.

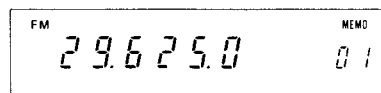
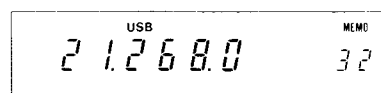
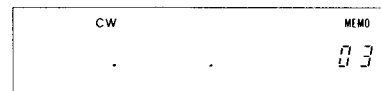
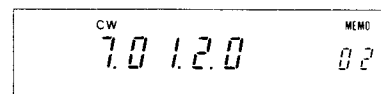
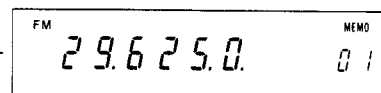
FOR EXAMPLE:

When "7.012MHz" and "CW" are memorized in memory channel 2, and no frequency is in channel 3, by turning the TUNING CONTROL clockwise, the frequency display will show "7.012.0" "CW", "MEMO" and memory channel number "02".

By turning the TUNING CONTROL clockwise furthermore, the memory channel number will change to "03", but the channel has never memorized any frequency, thus the display shows "CW" and only the MHz and KHz decimals. However, the set works with the frequency and mode of channel 2, i.e., "7.012MHz" and "CW".

When memory channel limits are reached (i.e., "01" or "32"), the next memory channel entered will be the opposite limit (i.e., "32" or "01").

Turning the TUNING CONTROL clockwise.



3-2-2 DIAL FUNCTION SELECT SWITCH (IN MEMORY CHANNEL MODE)

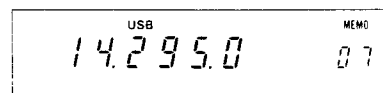
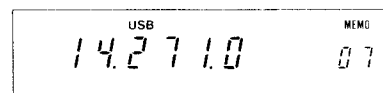
In the MEMORY CHANNEL MODE, by pushing the DFS (DIAL FUNCTION SELECT) switch in, the operating memory channel is locked on the displayed one and by turning the TUNING CONTROL, the OPERATING FREQUENCY displayed on the frequency display can be changed. This is very convenient for tuning a slightly off 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, push the DFS switch in, now you can change the displayed frequency. By turning the TUNING CONTROL clockwise increases the frequency and counterclockwise decreases 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.

Pushing the DFS switch in, and turning the TUNING CONTROL.



If you wish to transfer this operating frequency (14.295 MHz) and mode (USB) into a VFO, push the FREQUENCY TRANSFER button, and the operating frequency "14.295 MHz" and mode "USB" are transferred into the VFO previously selected.

NOTE: Don't push the VFO/MEMORY switch before pushing the FREQUENCY TRANSFER button to transfer the operating frequency (at this time, 14.295MHz), or the operating frequency is erased and the original memorized frequency (14.271 MHz) will be transferred into the VFO.

If you wish to rewrite the memorized frequency in the selected channel (at this time, "07") 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.

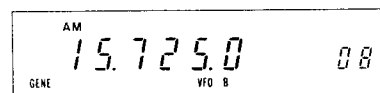
To change the operating memory channel again, push and release the DFS switch, then turn the TUNING CONTROL.

3 - 2 - 3 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. Push the DFS switch in, then select a memory channel to be memorized by turning the TUNING CONTROL. 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, only the MHz and KHz decimals are 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 and so on 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."

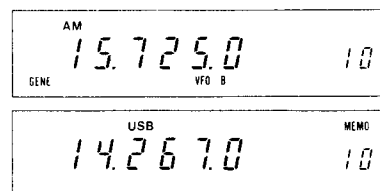
Frequency, mode and HAM/GENE mode to be memorized.



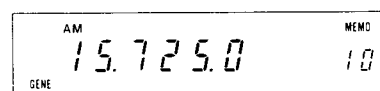
Pushing the DFS switch in, and turning the TUNING CONTROL.



Pushing the VFO/MEMORY switch to check contents of the channel.



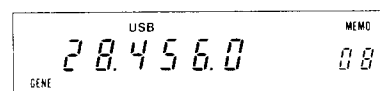
Pushing the VFO/MEMORY switch to return to the VFO, then pushing the MEMORY WRITE button.



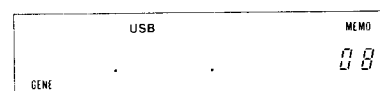
(This is displayed after pushing the VFO/MEMORY switch.)

3 - 2 - 4 MEMORY CLEARING

If you want to clear contents of a memory channel, the first, select the channel to be cleared, the second, push the FUNCTION KEY then the MEMORY WRITE or FREQUENCY TRANSFER button. The contents of the channel will be cleared.



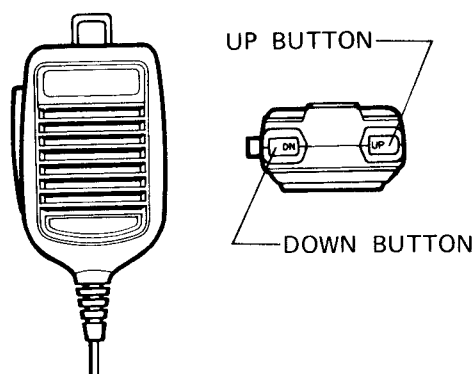
Pushing the FUNCTION KEY first, then the MEMORY WRITE or FREQUENCY TRANSFER button.



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, 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 in the VFO mode and when the DFS switch is pushed in to change the operating frequency in the MEMORY CHANNEL mode.

3-3-2 MEMORY CHANNEL SELECTING

In the MEMORY CHANNEL mode or when the DFS switch is pushed in to change the displayed memory channel number in the VFO mode, by depressing the UP or DN (down) button on the microphone continuously, the operating MEMORY CHANNEL or displayed channel number is changed up or down respectively every two seconds.

3-4 SCANNING OPERATION

The IC-751 provides various scanning operations. Please read the following instructions carefully to fully enjoy the IC-751'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 MODE SELECTIVE SCAN

In the memory scan mode, by pushing the MODE SELECTIVE SCAN switch in, the scan scans only on channels having the desired operating mode.

To be in this scan mode, first, select a channel that has your desired mode, second, push the MODE SELECTIVE switch in, then the SCAN START/STOP button.

When the set is scanning in the normal memory scan mode, push the MODE SELECTIVE switch in at the moment that your desired mode is displayed on the display.

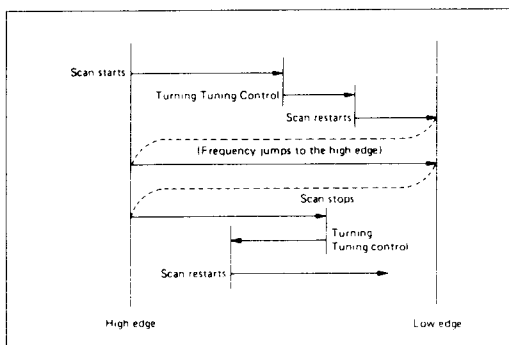
3-4-3 PROGRAMMED SCAN

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

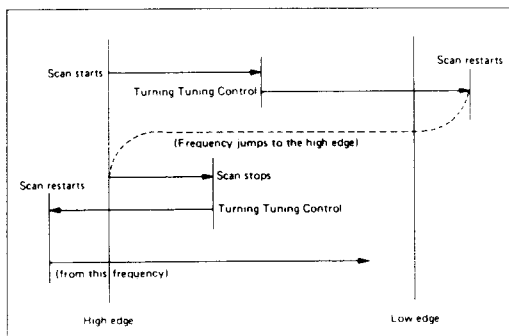
CAUTION The programmed scan does not start when the contents of memory channels 1 and 2, and frequency display differ from which are described below.

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 SELECT 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, RIT or XIT switch, VFO/MEMORY switch, or one of the MODE SELECT switches the scan stops and clears.



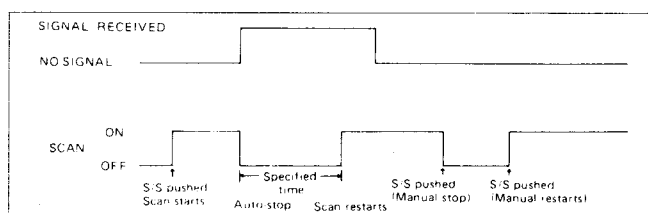
7. When the operating frequency is higher than the high edge (14.300MHz) and the SCAN START/STOP button is pushed, the scan starts from the operating frequency and scan down to the low edge, but it will return to the memorized high edge frequency (14.300MHz) and continue the scanning to the low edge. 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 - 4 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).



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 GAIN CONTROL	Completely Counterclockwise (OFF position)
NB LEVEL CONTROL	Completely Counterclockwise (OFF position)
AGC SWITCH	SLOW
AF GAIN CONTROL	Completely Counterclockwise
RF GAIN CONTROL	Completely Clockwise
SQUELCH CONTROL	Completely Counterclockwise
TONE CONTROL	Center (12 o'clock) Position
TUNING RATE SWITCH	OFF (OUT)
DFS SWITCH	OFF (OUT)
BAND SELECT FUNCTION SWITCH	OFF (OUT)
DIAL LOCK SWITCH	OFF (OUT)
FILTER SWITCH	OFF (OUT)
PBT CONTROL	Center (12 o'clock) Position
NOTCH FILTER SWITCH	OFF (OUT)
NOTCH FILTER CONTROL	Center (12 o'clock) Position
DUPLEX (SPLIT) SWITCH	OFF (OUT)
PREAMP/ATT SWITCH	OFF

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, and memory channel number "01" 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-751 selects the normally used sideband according to the band in which you are operating.

If you wish to operate with the opposite sideband, first push the FUNCTION KEY then the SSB switch and the opposite sideband will 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 letters "GENE" are displayed.), 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)

When there is pulse type noise, such as ignition noise from automobile motors, turn the NB LEVEL control clockwise further click ON, so that noise will be suppressed and even weak signals will be received comfortably.

When the NB switch is set in the WIDE (locked in) 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 out position, or turn the NB LEVEL control completely counterclockwise (OFF position).

3 - 5 - 3 AGC (AUTOMATIC GAIN CONTROL)

The IC-751 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 counterclockwise 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/ATT SWITCH

Place the PREAMP/ATT Switch on the TOP to the PRE position when receiving weak signals. In the PRE position, an RF preamplifier is inserted into the receiving antenna circuit, increasing sensitivity and giving easy reception.

Place the PREAMP/ATT switch to the ATT position when strong nearby signals disturb signal reception or make "S" reading difficult. In the ATT position, the RF amplifier is removed from the circuit and a 20dB attenuator is inserted

into the receiving antenna circuit, reducing interfering signals and giving more stable reception. In normal operation the PREAMP/ATT switch is left in the OFF position.

3 - 5 - 5 P.B. (PASS-BAND) TUNING

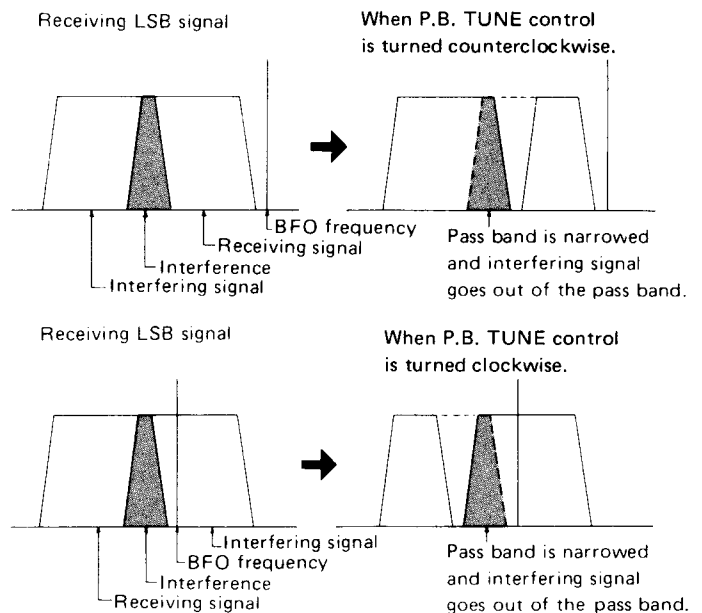
Pass-Band Tuning is a system to narrow the bandwidth (selectivity) of the frequencies that will pass through the crystal filter electronically from either the upper or lower side continuously by up to 800Hz. This is very effective in reducing interference from nearby signals.

The PBT control has a click-stop at the center (12 o'clock) position. This is the widest pass band position and use the set at this position usually.

While receiving in the LSB mode, if you get interference from a lower frequency (interfering signals are high-pitched tones), narrow the band width by turning the P.B. tuning control counterclockwise. When the interfering signals are low-pitched tones, they are from a higher frequency, and you should narrow the bandwidth by turning the P.B. tuning control clockwise.

When receiving in the USB mode, the bandwidth is narrowed in the opposite manner. Interference from a higher frequency will be high-pitched tones, and the P.B. tuning control should be turned clockwise. Interference from a lower frequency will be low-pitched tones and the P.B. tuning control is turned counterclockwise.

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



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). Refer to 7 - 1 OPTIONAL FILTERS.

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 turn 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-751 has a low distortion RF 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	COMP

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).

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-751 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 (OFF position)

VOX DELAY CONTROL

FULLY CLOCKWISE

ANTI VOX CONTROL (on the top)

FULLY COUNTERCLOCKWISE

Turn the VOX GAIN CONTROL on the front panel to click ON. Leaving the T/R switch in the RECEIVE position and without pushing the PTT switch, turn the VOX GAIN control further 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 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 on the top 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, push the MONITOR switch in on the front panel and adjust the MONITOR LEVEL control on the top 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, push the MODE SELECT Switch for CW mode, or CW-N mode (first the FUNCTION key, then the CW switch when an optional CW narrow filter is installed). Other switches and knobs are set the same as for SSB reception.

In addition to the crystal band pass filter, CW Narrow filters are optional for this unit. Refer to 7-1 OPTIONAL FILTERS.

Switch is set at the CW-N mode, this filter is activated and

the total selectivity of CW reception is improved (250Hz or 500Hz/−6dB). Also, with this filter, internal noise is reduced for comfortable CW reception and an improved signal to noise (S/N) ratio.

If the optional CW filter is not installed the set does not work in the CW-N mode.

The Pass Band Tuning system can be used to narrow the bandwidth up to 800Hz, the same as in the SSB mode.

Also, use the Noise Blanker, AGC switch and/or PREAMP/ATT 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	Po
VOX GAIN CONTROL	OFF (Completely Counterclockwise)

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.

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

When the MONITOR switch is pushed in, by keying the key, the side-tone oscillator is activated and an 800Hz tone will be heard. The loudness of the tone is controlled by the MONITOR LEVEL Control located on the top. Rotating the control clockwise will increase the loudness.

3-6-4 BREAK-IN OPERATION

The IC-751 has 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 turn the VOX GAIN control clockwise to click ON.

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.

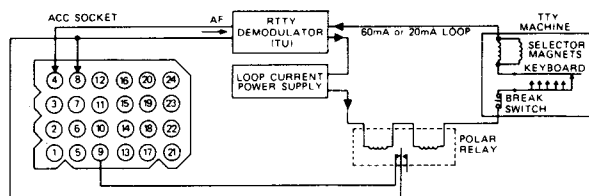
By turning the VOX DELAY control fully counterclockwise and click OFF to the "FULL" position, the break-in

function reaches "FULL-BREAK-IN". So you can watch on the receiving frequency in the interval of each dot or dash.

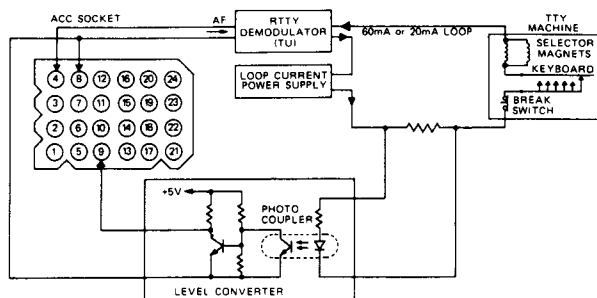
3-7 RTTY OPERATION

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-751.

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 "RTTY". The other controls are the same as those for SSB reception. When tuning a RTTY signal, set the TUNING RATE SELECT 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 set in the RTTY NARROW mode (By pushing the FUNCTION KEY first then the RTTY switch.), 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.

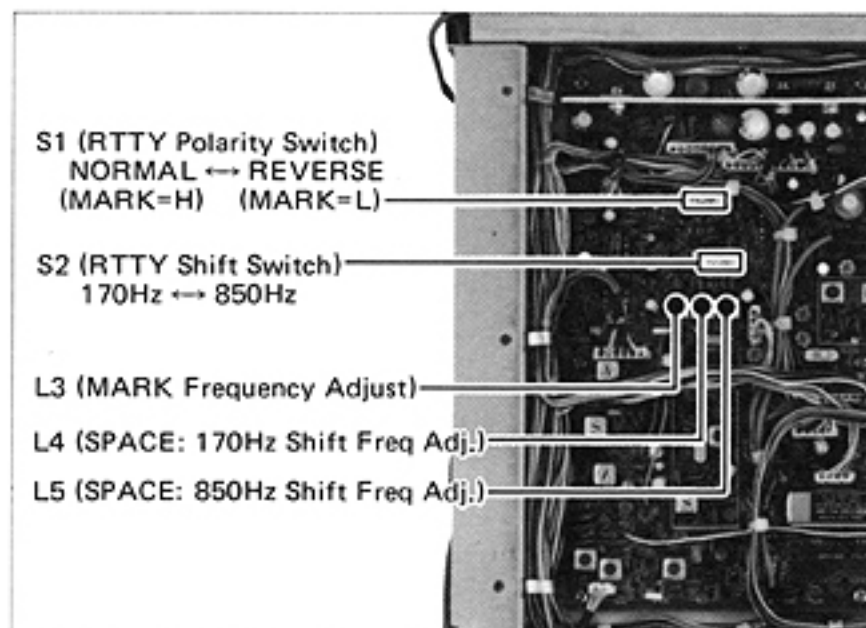
If you wish to receive RTTY signals which have wider shift such as 425Hz and 850Hz shifts, prepare a demodulator suits for the shift and use normal RTTY mode.

3-7-2 TRANSMITTING

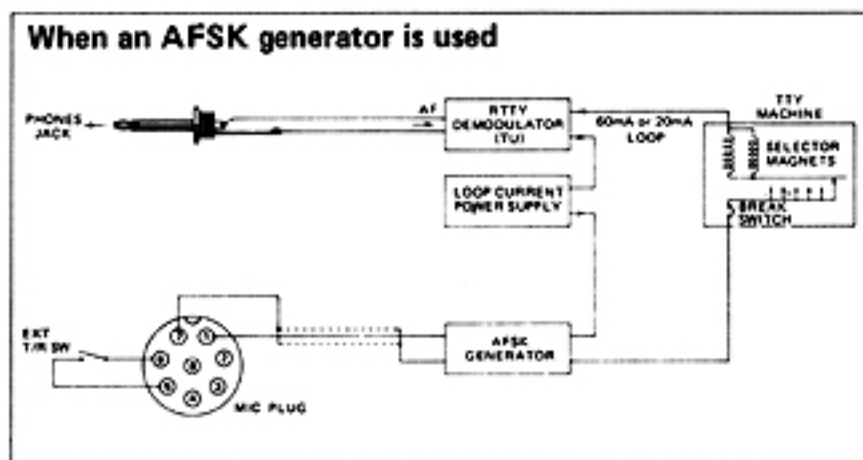
For keying of the Frequency Shift Keying (FSK) circuit insert a high speed relay's coil into the loop current circuit of the teletypewriter, and connect the relay contacts to Pins, 8 and 9 of the ACC Socket on the rear panel. The relay contacts make during the Space and break during the Mark, as shown 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.

If your teletype machine puts out signals which are reverse polarity (LOW level; 0V, is for MARK and HIGH level; 5V, is for SPACE), slide S1 on the MAIN unit board to arrow direction as shown in the photo below.



When using an AFSK generator that has 2125Hz for Mark and 2295MHz 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.



3-8 AM OPERATION

3-8-1 RECEIVING

Set the operating mode for AM, by pushing the MODE SELECT switch "AM". 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. The optional crystal filter FL-33 will provide good selectivity for AM reception. Refer to the installation instructions SECTION 7 OPTION INSTALLATION.

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

3-8-2 TRANSMITTING

Transmitting AM signals is essentially the same as SSB transmission.

Set knobs and switches the same as for SSB operation. The RF output power can be adjusted between 10 Watts and 40 Watts by the RF POWER control. Also the speech processor can be used on this mode.

When transmitting the AM signals, the meter (in Po position) will indicate the carrier power, and the meter needle will move slightly according to your voice.

3-9 FM OPERATION

3-9-1 RECEIVING

Set the operating mode for FM, by pushing the FUNCTION KEY first, then the MODE SELECT switch "AM". The other controls are the same as those for SSB reception, however, the Pass Band Tuning control, Notch Filter, Noise Blanker, AGC circuits and FILTER SWITCH 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 Po 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 bands 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 GAIN CONTROL	Completely Counterclockwise (OFF position)

NB LEVEL CONTROL	Completely Counterclockwise (OFF position)
AGC SWITCH	SLOW
AF GAIN CONTROL	Completely Counterclockwise
RF GAIN CONTROL	Completely Clockwise
SQUELCH CONTROL	Completely Counterclockwise
TONE CONTROL	Center (12 o'clock) Position
TUNING RATE SWITCH	OFF (OUT)
DFS SWITCH	OFF (OUT)
BAND SELECT FUNCTION SWITCH	OFF (OUT)
DIAL LOCK SWITCH	OFF (OUT)
FILTER SWITCH	OFF (OUT)
PBT CONTROL	Center (12 o'clock) Position
NOTCH FILTER SWITCH	OFF (OUT)
NOTCH FILTER CONTROL	Center (12 o'clock) Position
DUPLEX (SPLIT) SWITCH	OFF (OUT)
PREAMP/ATT SWITCH	OFF

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 and memory channel number "01" will be shown on the frequency display.

If the operation mode is in the HAM band mode (The letters "GENE" are not displayed.), push the HAM/GENERAL COVER SELECT switch, and the letters "GENE" will be displayed on the frequency display 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). USB is selected on the 10MHz band and above, and LSB on the 9MHz band and below, by pushing the MODE SELECT switch SSB. When you wish to operate on the opposite sideband, push the FUNCTION KEY first, then the SSB switch.

However, 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 other than the initialized band, push the BAND SELECT FUNCTION switch, then turn the TUNING CONTROL to select the band 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 multi-function 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 - 1 for AM reception and 3 - 9 - 1 for FM reception.

3 - 11 OTHER OPERATIONS

3 - 11 - 1 VSWR READING

The IC-751 has a built-in VSWR meter for checking antenna matching in order to avoid problems caused by VSWR. Set the METER switch to the Po position. Set the operating mode to RTTY, and place the TRANSMIT/RECEIVE switch to TRANSMIT.

Adjust the RF POWER control located on the front panel so that the meter needle points to "SET" on the meter scale. Set the METER 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 METER switch to the Po 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-751 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.

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 mode or GENERAL COVERAGE mode, and the MODE to any mode. Tune to 10.000.0MHz on the frequency display.

Since the IC-751 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.

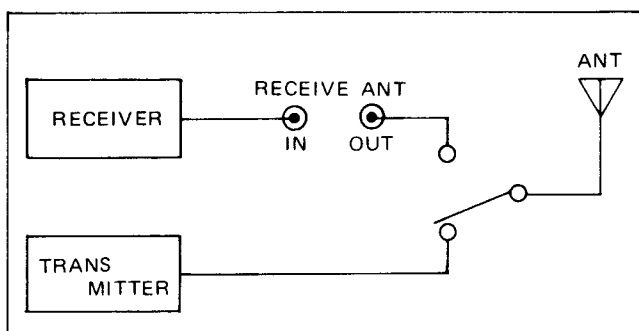
3 - 11 - 3 SIMPLE FREQUENCY ALIGNMENT

A very accurate frequency counter is necessary to align the frequency of the IC-751. However, the frequency can be aligned simply by receiving the WWV signal.

1. Set the frequency display to 10.000.0MHz (or other standard frequency you can receive clearly) in the GENERAL COVERAGE mode and the operating mode to AM, then make sure that you are receiving the WWV signal.
2. Turn ON the MARKER switch on the top.
3. Since a beat tone will be heard, adjust the MARKER CALIBRATOR on the top so that the beat tone becomes zero beat (When the standard frequency signal is modulated with a single audio tone, it makes more easily.).
4. This calibrates the reference oscillator frequency, so it is not necessary to calibrate on any other frequency, even if the operating band is different.
5. Turn OFF the MARKER switch.

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

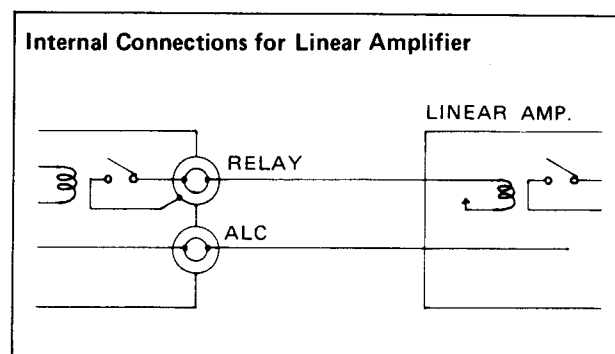
When a transverter control signal (+8V) is applied to Pin 11 of the ACCESSORY socket, the TRANSVERTER terminal can be used for a VHF/UHF transverter INPUT/OUTPUT terminal.

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. 30mV across a 50 ohm load
Receive (Input) : 1μV for S/N 10dB

3 - 11 - 6 LINEAR AMPLIFIER CONNECTION

The jacks on the rear panel marked "RELAY" and "ALC" are a relay built-in for keying a linear amplifier and the input for ALC from the linear amplifier. For linear amplifier hookup the RELAY jack is for an internal relay and the ALC jack is for ALC input. The capacity of the relay is DC 24V 1A. Do not exceed this limit.



The optional linear amplifier IC-2KL and automatic antenna tuner IC-AT100/AT500 can be connected to the IC-751 with their accessory cables as same as other ICOM HF transceivers. Refer to their instruction manuals for detail.

The IC-751 puts out the band control voltage to change operating band automatically for external equipment such as a 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 ~ 3.5V
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:

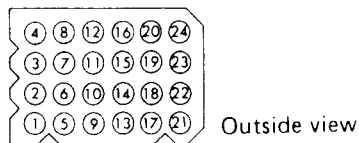
1. The fan does not operate both in the receive and transmit modes.

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. 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 ET

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 squelch control stage. (+8V when the squelch is ON)
2.	13.8 Volts DC in conjunction with the power switch operation.
3.	Connected to Push-to-talk, T/R change-over switch. When grounded, the set operates in the transmit mode.
4.	Output from the 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 Volts DC available when transmitting. (relay can not be directly actuated. Max. 5mA).
7.	Input for external ALC voltage.
8.	Ground
9.	Input for RTTY keying (MARK: HIGH level, SPACE: LOW level: This can be reversed by the internal switch.).
10.	NC (No Connection)
11.	Input for TRANSVERTER control. When 8 Volts 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 CIRCUITS(CONNECTOR/RF UNITS)

Receiving signal from the antenna connector is fed to J10 of the RF unit in the receiver circuit when D4 is turned off and RL1 is turned on.

For full break-in operation, a reed relay is used for RL1 to provide less than 1 millisecond T/R switching time, compared to more than 12 milliseconds with a regular relay.

The incoming signal to the RF unit passes through an L-type attenuator, consisting of R92 and R93, for 20dB attenuation, when the PREAMP/ATT switch is set at the ATT position.

Depending on the receiving frequency range, the incoming signal is fed to one of three different circuits.

- (1) 100 ~ 500KHz : Signal is fed to a low-pass filter by D44.
- (2) 500 ~ 1600KHz : To attenuate strong signals from AM broadcasting stations, signal is fed to a 10dB attenuator, and then to a low-pass filter.
- (3) Above 1.6MHz : signal is fed by D47 to a high-pass filter, consisting of L101, L102, and C180-C182, which attenuate strong radio signals on the BC band, and then to one of the nine band pass filters for various frequency ranges.

The filtered signal is fed to an L-type attenuator, consisting of R28 and PIN diodes D10 and D11, controlled by AGC bias voltage from Q3-Q5. When the AGC functions according to the receiving signals, the emitter voltage of Q4 is lowered accordingly, and then the decrease in the current flow of D11 makes the resistance higher. This turns on Q3 to let a current flow through D10 for lower resistance. This operation provides variable attenuation up to 40dB.

When the PREAMP/ATT switch is at the PRE position, the signal from the attenuator is fed to a broad-band amplifier consisting of Q6 and Q7, of which the gain is approximately 8 to 10dB and the intercept point is about +22dBm. If the PREAMP/ATT switch is at OFF or ATT, the signal bypasses the amplifier.

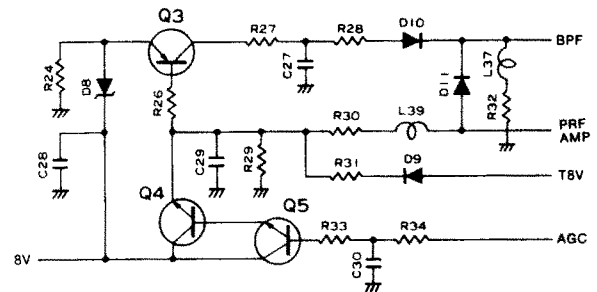
Signal is fed through one of the two filters depending on if the frequency is above or below 1.6MHz, and to a low-pass filter, which improves the image rejection characteristics of the receiver and reduces the spurious emission of the local oscillator from the antenna connector.

The signal is then fed to the receiver first mixer through the T/R switching diode D20.

The BPF switching voltage is obtained with IC1 and IC2 by decoding the band signals B1-B11 from the LOGIC unit.

The on/off switching voltage is provided by IC2. R13V is provided from the OR gate consisting of D5 and D6. The attack time of this control voltage is determined by R9, C8,

L-type Attenuator Circuit



R10 and C9. The immediate release is provided by D1 and D2 when switching to the transmit mode.

4-1-2 IF CIRCUITS

1. RF UNIT

Q9 and Q10 comprise a double-balanced mixer, using low-noise transistor 2SK125's and driven with 13.8V to provide an excellent noise figure, and convert the incoming signal to the 70.4515MHz first IF signal.

The first LO output signal from the PLL unit is fed through a high-pass filter, amplified by Q2, filtered by a low-pass filter, and then applied to the first mixer as its local oscillator signal (70.5515~100.4515MHz). R18, L13, and C14 are for feedback to improve the frequency characteristics of Q2.

The first IF signal is filtered by a monolithic crystal filter F11 ($\pm 7.5\text{KHz}/-3\text{dB}$) and then amplified by a dual-gate FET Q8, of which the second gate is controlled by the AGC voltage.

The signal is fed through T/R switching diode D19 and a high-pass filter to the second IF mixer of IC3 double balanced mixer, where the signal is converted to the 9.0115 MHz second IF signal. Then signal is filtered to remove the local oscillation components by a low-pass filter, and then fed to the MAIN unit through P3.

The second LO signal (61.44MHz) from the PLL unit is fed to IC3 as the local oscillator signal for the second mixer.

2. MAIN UNIT

The 9.0115MHz 2nd IF signal from J13 passes through noise blanker gates D42-D45 and an amplifier Q14, after which it is fed through a filter select switching circuit to the 9MHz IF filter.

The filtered signal through D60 is amplified by Q19 and fed to 3rd mixer Q24 by D61.

A 9.4665MHz ($\pm\text{SHIFT}$ frequency) signal is supplied as the local oscillator signal from Q26 to the 2nd gate of Q24 to obtain the 455kHz 3rd IF signal. In FM mode, the signal is fed to the FM unit through C43 by D33, and in other

modes, the signal is fed to balanced mixer IC1.

One of the two different frequency signals is supplied to IC1 as its local oscillator depending on whether in the transmit or receive mode. An 805kHz signal is supplied to obtain a 350kHz 4th IF signal in the receive mode. The signal through a tuning circuit of L14, C103 and L15 is fed to the notch filter circuit.

The T-type notch filter, consisting of X6, C107, C108, R222 and R390, provides as much as 60dB rejection by adjusting R222. To turn off the notch filter, X6 is shunted by Q34. The filtered signal is amplified by Q35 and Q36, and fed to a detector through L17.

(a) NOISE BLANKER CIRCUIT

To provide both high sensitivity and wide dynamic range, a dual-gate MOS FET is used for the noise amplifier (Q7) and a dual-transistor for a differential amplifier (Q8).

Both Q7 and Q8 are AGC-controlled to provide stable noise-blanking operation for an extremely wide level of noise. To cope with pulse-type noise in particular, the attack time and release time for the noise blanker AGC are longer than conventional, and the noise amplifier operates for a wide dynamic range of more than 100dB without saturation.

The noise signal from Q9 is rectified by D17 and D18, and fed to Q11 to control the noise blanker AGC line to make the mean level of the noise amplifier output constant for sufficient time constant to deal with "woodpecker noise."

The rectified noise signal from D17 and D18 is fed also to the base of Q10. When a pulse-type noise with a higher voltage than the voltage of VBE+VE of Q10 comes in, Q10 is turned on and 8V appears at the collector of Q12. The blanking level is determined by setting the NB LEVEL control on the front panel, thus changing the emitter voltage of Q10 and adjusting the comparative voltage for Q10. Q13 controls the blanking time. The NB timing switch is set at the NARROW position, the maximum blanking time is set at about 1 millisecond, and at the WIDE position, it is set at 5 milliseconds. Thus, minimizing the amount of received signal to be blanked and reducing the distortion of the received audio when the noise blanker is used. Furthermore, the noise blanking gate uses a balanced gate with very high isolation performance.

(b) FILTER SELECT CIRCUIT

Transistors Q15, Q16, Q17 and Q18 constitute circuits

to provide switching voltages for the 9MHz and 455kHz filters, corresponding to the mode selection and the filter switch selection on the front panel.

The 9MHz filters are not changed by the filter switch for AM and FM. For other modes, either the FL-30 or the FL-32 (or a user's optional filter) is selected.

For the 455kHz filter in the AM mode, the filter switch selects either CFW4551T dedicated to AM or the narrow band filter. Since the narrow band filter uses a filter designed for SSB, excellent selectivity performance is obtained.

For the narrow mode of CW and RTTY, the optional CW filter (FL-52A or FL-53A) is selected regardless of the selection by the filter switch, and the PBT control operates as the IF shift control. For the FM mode, the filter switch does not function.

Note that, for the position of 9MHz FL-32, a user can install a wideband filter for SSB (FL-70, 2.8kHz/−6dB), a filter for AM (FL-33, 6kHz/−6dB), or a narrow band filter for CW (FL-63, 250Hz/−6dB) if desired. In the case of FL-33, the jumper wire next to Q18 on the main board has to be cut so that the filter switch can function. Moreover, in the case of FL-32 or FL-63, there may be a case, depending on the position of the PBT control, where pass band does not exist for the narrow mode of CW or RTTY if the filter is selected, so that the available range of the PBT control on the front panel is restricted to the central part.

When the high performance 455kHz filter (FL-44A) is to be used, resistors R203 and R189 have to be cut; otherwise, two filters would be connected in parallel and normal operation would not be possible. Figure 1 shows the signal flow paths of this transceiver for each mode.

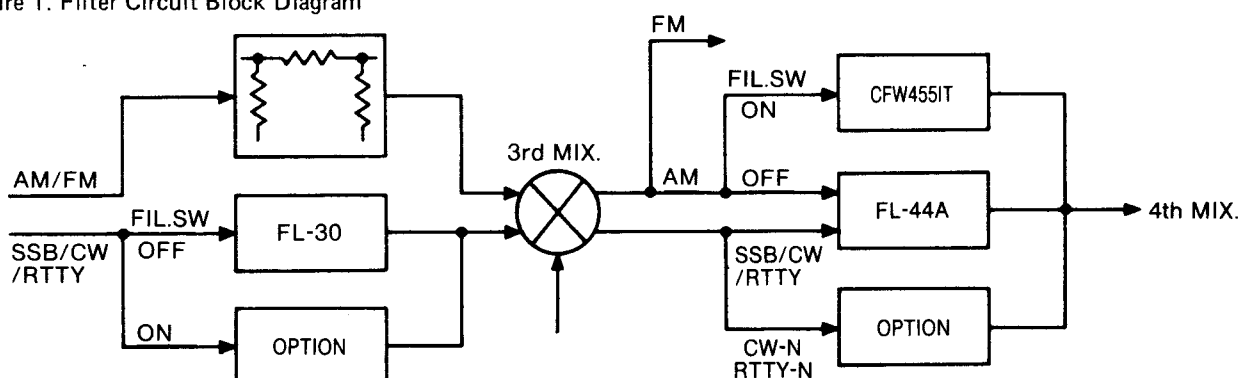
3. FM UNIT

The received FM signal of 455kHz coming through Pin 1 and Pin 2 of P2 is passed through the ceramic filter F11 to enhance the selectivity. The signal is then amplified about 50 to 60 dB in the IF amplifiers of Q4-Q6, and about 20dB more by Q3. The signal is then input to the limiter IC3.

The limited signal is detected by the discriminator composed of X2, D3, D4, R31 and R32, and is passed through the de-emphasis filter consisting of R27 and C19. The signal is amplified by the low noise amplifier Q2 and output to the AF attenuator, IC6 of the MAIN unit through P3.

Diodes D5-D8 are provided for the S-meter circuit around Q3. When the rectified output appears at D5 and

Figure 1. Filter Circuit Block Diagram



	Type	Description	Center Frequency	Band width		Insertion Loss
				at -6dB	at -60dB	
Standard	FL-30	SSB Filter	9.0115MHz	2.3KHz	4.2KHz	6dB
	FL-44A	High grade SSB Filter	455KHz	2.4KHz	4.0KHz	6dB
	CFW4551T	AM Ceramic Filter	455KHz	6KHz	15KHz (-50dB)	7dB
Option	FL-52A	CW Narrow Filter	455KHz	500Hz	1.0KHz	6dB
	FL-53A	CW Narrow Filter	455KHz	250Hz	0.48KHz	6dB
	FL-32	CW Narrow Filter	9.0106MHz	500Hz	1.6KHz	8dB
	FL-63	CW Narrow Filter	9.0106MHz	250Hz	1.1KHz	12dB
	FL-33	AM Wide Filter	9.0100MHz	6KHz	20KHz	6dB
	FL-70	SSB Wide Filter	9.0115MHz	2.8KHz	5KHz	6dB

D6, the S-meter starts moving. This threshold is upon the gain of Q3 adjusted by R40. The output of D7 and D8 is detected for the reception of strong signals to provide a wider dynamic range.

Q10 is provided so that the AGC is not applied in the FM mode by creating a shunt for the AGC circuit.

The detected signal is passed through the SQUELCH control and led to this unit. Only the noise components of the incoming signal whose frequency is higher than voice frequency is amplified by Q7, and rectified by D9 and D10. The rectified signal switches Q9 which then turns on/off the squelch control circuit on the MAIN unit.

4-1-3 AF CIRCUITS (MAIN UNIT)

The 4th IF signal is fed to the AM detector circuit through C235, to the SSB/CW detector circuit through C217, and to the AGC detector circuit through the secondary coil of L17.

The SSB, CW, or RTTY signal is fed through C217 to IC5, in which the signal is mixed with BFO signal for detection.

The AM signal is fed through C235 to D105 for detection, and then amplified by Q49. Detected signal from IC5 or D105/Q49 is fed to IC6A. The detected signal from FM unit is also fed to IC6A through J15. IC5 functions in all modes but AM; however no signal is output in the FM mode due to no input signal from the IF circuit.

A portion of these detector outputs, after being picked up by C228 and amplified by Q50, appears at the accessory connector on the rear panel.

IC6A is an electronic controlled volume control which is DC controlled by Q51 and allows about 80dB audio volume control by changing the applied voltage from 0V to 4V. Audio tone control is provided using the frequency compensation terminal of this IC. The output from IC6A is fed to the AF power amplifier IC9 through the squelch gate explained below to provide sufficient power to drive a speaker.

1. AGC and SQUELCH CIRCUITS

The IF signal passed through L17 is rectified by D78 and

the output drives Q37, which draws down its collector voltage to a negative level according to the incoming signal level. Since the cathode of D79 is normally given an 8V bias voltage through D77, the transistor Q40 is turned off. The cathode voltage of D79 drops due to the signal through R125. If the cathode voltage becomes lower than 4V, the emitter voltage of Q40 is reduced, i.e., the AGC line voltage is reduced, so that the gain of each amplifier applied the AGC voltage is decreased to maintain a constant output level. Capacitors C52, C53 and C54 are provided to hold the AGC voltage, each amplifier of which has a serial resistor to get an optimum attacking time. The AGC is turned off by applying 8V through D76 and turning off the AGC buffer Q40. At this time, the time constant circuit is removed from the AGC control circuit.

To prevent time delay due to the time constant of the AGC when the RF GAIN control is rotated, Q41 is provided in parallel with Q40 to allow the RF gain to be set immediately.

The AGC voltage is discharged through R234 while receiving. While transmitting in the full break-in mode, in addition, D77 is provided to hold the AGC voltage of the receiving mode.

A voltage of about 8 volts stabilized by D38 is applied through R116 to the AGC line when no signal is received.

The variation of the AGC voltage is DC amplified by IC10A to drive the S-meter. A portion of the voltage to drive the S-meter is compared with the squelch voltage by IC10B and amplified to drive Q42 and turn on/off the gate of IC7D.

A bipolar digital IC is used for the squelch gate. Since the resistance of this IC when turned on is negligibly small, i.e., the forward resistance is negligible, and the resistance when turned off is greater than 10 meg ohms, this squelch circuit is free from signal leakage, and high performance is guaranteed.

4-2 TRANSMITTER CIRCUITS

4-2-1 AF CIRCUITS

1. MAIN UNIT

AF signal from the mic connector is fed through the MIC GAIN control and J7 to Q47 on the MAIN unit, where the signal is amplified about 30dB by Q47. After the current is amplified by Q65, this signal is fed to IC4 through R371 for modulation. C165 and R267 connected to the base of Q65 are for controlling the transmitting audio tone, and allow the treble portion of the voice to be varied by about 15dB.

IC4 is a double balanced mixer which provides more than 60dB of carrier suppression by adjusting both R270 and R273. It operates as a sufficiently balanced mixer for SSB. However, an offset voltage is given to the modulating AF line for the AM mode so that the carrier level is controlled by adjusting the offset voltage.

(a) VOX CIRCUIT

Mic input level is adjusted by the VOX GAIN control and fed through J3 to IC11B, where signal is amplified about 60dB, and the output is rectified by D95 and charges C195.

A portion of output signal from the AF power amplifier through the ANTI VOX GAIN control is amplified by VOX amplifier IC11A and R284, C188 and R292 allow the anti-VOX level to vary with respect to the mean level.

IC12 is a comparator to compare the output voltages of VOX and ANTI VOX amplifiers. At no signal, the ANTI VOX output voltage becomes higher than the other and the level of the IC12 Pin 1 becomes low. While both of the signals from the mic and AF amplifier vary, when the voltage at Pin 3 (VOX) of IC12 becomes higher than that of Pin 2 (ANTI VOX), Pin 1 becomes high level to turn Q54 on. When the VOX switch is on, the SEND line becomes grounded for transmit mode.

For CW transmission, keying signals pass through the buffer Q53 and D97 to key the carrier, passing through D98 and charging C196 and C197 to enter the same comparator as the VOX voltages. In the full break-in operation, C197 is opened to respond to high-speed keying. In this case, there is only C196 which is to prevent chattering for high speed keying.

2. FM UNIT

The audio signal input from J1 is filtered by the differentiating circuit composed of R56 and C39 for pre-emphasis (6dB/oct). The signal is then applied to the limiter amplifier IC1 which reduces splatter by limiting the frequency deviation.

The output from this IDC circuit is applied to the anode of D1 and the signal oscillated by Q1 is frequency modulated.

The frequency modulated output from Q1 is passed through the limiter amplifier IC2 to eliminate the residual AM components. Then, the FM signal is selected by RL1 with the signals of CW, SSB, and RTTY coming from the

MAIN unit, and is output to the MAIN unit through J4.

4-2-2 IF CIRCUITS

1. MAIN UNIT

The DSB signal output from balanced modulator IC4 passes through a 9MHz filter, to remove a side band for SSB signal, and fed to an amplifier Q20 through D106.

Q20 operates also as a compressor amplifier. When the COMP switch is at off, the 2nd gate of Q20 is about 1V to set the gain of the amplifier at 0dB to keep the level below the clipping level of the diode clipper D63 and D64.

When the COMP switch is at on, T8V is applied through D108 and the 2nd gate voltage becomes about 4V to increase the gain of Q20 to 20-25dB for efficient clipping by D63 and D64. Meanwhile, C92 is grounded by Q23 to reduce the output level, and the signal is output to Q24 through D62.

A portion of the SSB signal led by D106 is amplified by Q21, rectified by D65 and D66, and DC amplified by Q24 to drive the compressor meter.

The output signal of Q20 is mixed with the 9.4665MHz local oscillator signal at Q24 to convert to a 455kHz signal, and fed to the double balanced mixer IC1 through F14 crystal filter.

The signal is converted back to 9.0115MHz by mixing with 9.4665MHz local oscillator and fed through D71 and D3 to the crystal filter F11.

In CW or RTTY mode, the carrier signal is applied through D2. In FM mode, the FM signal is fed from J4 of the FM unit through D1.

F11 removes unwanted signals and feeds its output signal to the transmit amplifier Q1, where the ALC signal is also applied. A portion of the drain output signal is sampled through C4 for the monitor operation. The output signal passes through the impedance transformer L1 and is fed through J13 to the RF unit.

(a) CW and RTTY CARRIER OSCILLATOR CIRCUIT

Q2 and Q3 are provided for oscillating the transmitting carrier. For CW and the mark signal of RTTY, a frequency which is adjusted by L3 (9.0106MHz) is oscillated. For the space signal of RTTY, the wide shift, 850Hz, or the narrow shift, 170Hz, space carrier which is adjusted by L4 or L5, respectively, is oscillated. The wide or narrow shift is selected by S2. In addition, by tuning the coil, it is possible to oscillate a 425Hz shift which is sometimes used. Note that switching S1 allows this transceiver to accommodate correct reception by an RTTY terminal unit which outputs marks and spaces reversed.

(b) TRANSMIT MONITOR CIRCUIT

The transmission monitor circuit, on the other hand, is not simply a modulation monitor but a monitor which gets the signal from the stage where ALC is applied, allowing accurate monitoring. After a portion of the transmitting signal is amplified by Q64, it is detected by IC8 and fed to pin 8 of the volume control IC6B, of which pin 6 is controlled by the MONITOR control, for controlling the monitor gain.

IC7C provides four switching circuits, two are used for the squelch and monitor circuits and two for the meter switching circuit. The MONITOR switch turns IC7C on/off to drive the output signal of IC6B to IC9 AF power amplifier so that no load variation occurs at the transmit output line.

(c) ALC and METERING CIRCUITS

The forward (FOR) and reflect (REF) voltages detected by the filter unit are amplified by IC13 and drive the multi-function meter as Po voltage and SWR voltage, respectively. A portion of the FOR voltage is input to IC14B and compared with the voltage of Pin 3 to generate the ALC voltage. Since the voltage of Pin 3 can be adjusted by rotating the RF POWER control on the front panel, the power can be easily controlled.

For the Ic meter, the voltage across R20 (0.012 ohms), of the PA unit is detected using the differential amplifier IC15B.

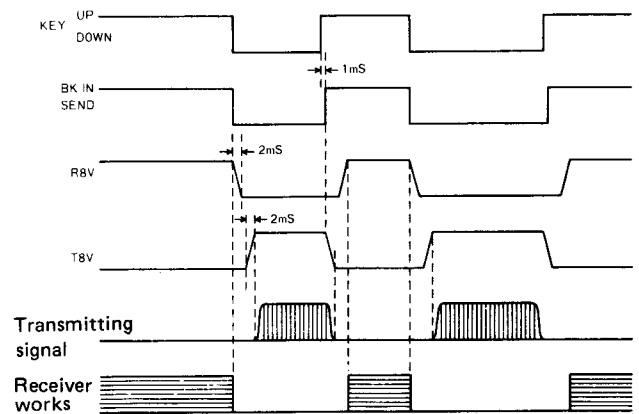
IC14A is provided for detecting signals for the automatic power control (APC), which detects a high SWR state from the output of IC13B and excessive collector current of the PA from the output of IC15B so as to output an appropriate negative voltage to the ALC line for reducing output RF power. The APC for high SWR starts to function when VSWR is about 2 or more. It is noted, however, that within the allowable rating of the transistors corresponding to the cases where output power is reduced, etc, the APC need not function even for a high SWR level and so the APC is designed not to operate for these cases.

The ALC voltage is obtained through R31 and amplified by the inverted amplifier to drive the meter.

(d) POWER SUPPLY CIRCUIT

To respond to break-in operation, accurate transmit/receive change-over timing is required for this transceiver. Transistors Q55 through Q61 form the conventional clamping-type voltage regulator where the timing control circuit is added and operate according to the timing chart shown in Fig. 2. As for the control of the SEND terminal, a voltage lower than 0.8V applied to the terminal sets the transceiver in the transmit mode and a voltage higher than 2V in the receive mode. The short circuit current of the SEND terminal is less than 2mA, allowing a TTL directly connected to the terminal to control the transceiver. Since all the circuits must start operation only after the transmitting and the receiving circuits have been switched, it is necessary to set all the rise times and the fall times of voltage sufficiently short and, moreover, to make them less sensitive to the variations of the load. This transceiver is designed so that sufficient current flows through the bases of Q61 and Q59, and D101 and D103 are provided for voltage clamping as well as temperature compensation to supply a constant voltage for the three-terminal regulator IC16. Transistors Q60 and Q58 are provided for switching. When transmitting, Q60 reduces the base voltage of Q61 and immediately discharges the line voltage of R8V to be less than 0.6V through D100 at the same time. When receiving, on the other hand, Q58 and D102 do the same operation.

Fig. 2 Timing chart for full break-in operation



2. RF UNIT

The 9.0115MHz IF signal from the MAIN unit is passed through the LPF and converted to the 70.4515MHz IF signal by the diode double balanced mixer IC3.

The output from the mixer is passed through the HPF to eliminate the 9.0115MHz component. The serial resonant circuit composed of L30 and C67 also eliminates the 61.44MHz second LO component from the output. The signal is then passed through the T/R switching diode D22 and amplified by the dual-gate FET Q11. The ALC voltage is applied to the first gate of Q11.

The amplified signal is fed through a double-tuned filter composed of L32, C77 and L33, to eliminate spurious components, and then fed to a transmit mixer of Q12 and Q13. This mixer is a balanced mixer with superior low spurious performance. In order to improve the spurious performance, the local oscillator signal is injected to the second gates with a DC bias voltage. The frequency of the local oscillator ranges from 70.5515 to 100.4515MHz which converts the IF signal to the desired frequency of 0.1-30MHz.

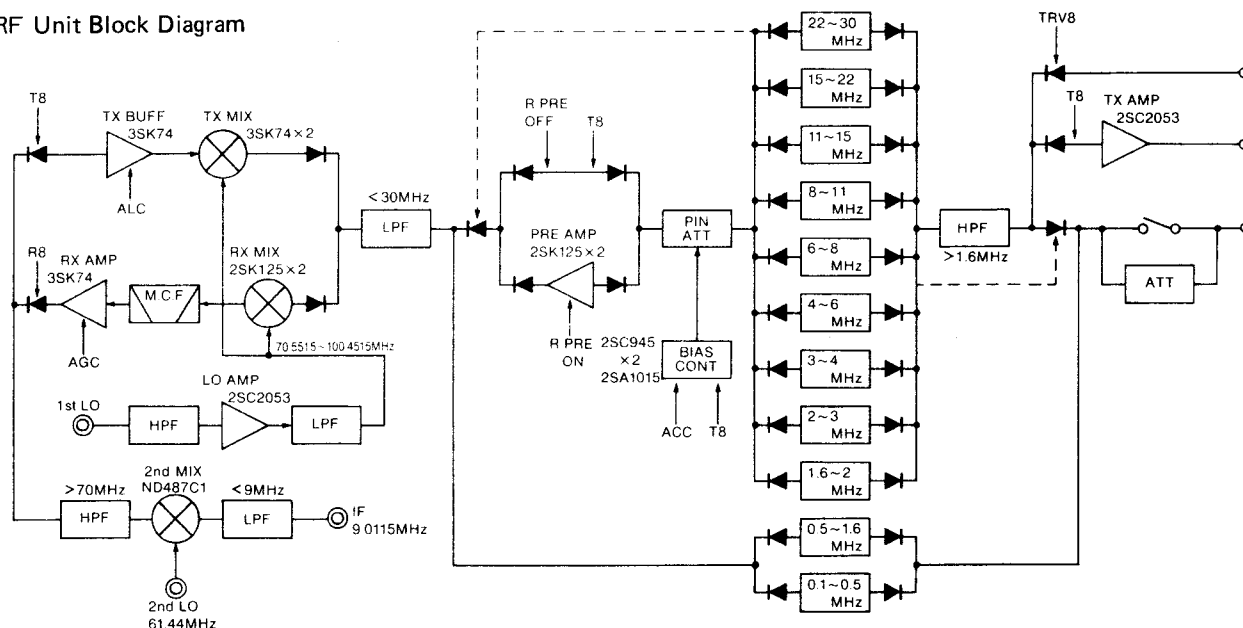
The converted signal is passed through the LPF to eliminate the local oscillator component and fed to the attenuator circuit composed of pin diodes through the receiver preamplifier bypassing circuit composed of D12 and D13. This circuit is given a bias voltage by D9 in the transmit mode so that it passes the signal. Then, the signal is passed through one of the nine BPFs which are selected by a voltage from the LOGIC unit to eliminate spurious components and then passed through the HPF.

Diode D47 is turned on in the receive mode, but it is turned off in the transmit mode since Q16 is turned on and Q18 is turned off to reversally bias the diode. Transistors Q16 and Q18 are the BPF switching transistors which also control diodes D26, D28, D30, D32, D34, D36, D38 and D40. Note that a current flows through L99 and L100.

In the transmit mode, D45 is turned on and the signal is wideband-amplified about 20dB by Q14 and output to the PA unit through J8. C171 and R86 are provided to compensate the frequency characteristics.

When a transverter is used, D46 is turned on to allow

RF Unit Block Diagram



input a converted receive signal to the transceiver, or output a low level transmit signal from the transceiver through the TRANSVERTER terminal.

Transistors Q15 and Q17 prevent the transmitted signal from re-entering through J9 and J10. Transistors with a low saturation voltage between the collector and emitter are used for this circuit.

4-2-3 RF CIRCUITS

1. 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 circuits inserted between the collector and the base of Q2 and Q3 provides wide frequency characteristics. The idling current of Q2 and Q3 is controlled by the junction voltage of D1. The current is set at about 100mA by R27. R30 is to prevent the adjusting point from deviating due to variations of D1 characteristics.

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 output power.

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 provide stability and broadband characteristics over the frequency range from 1.8MHz to 30MHz. R23 is provided to adjust the idling current and set so that the current is 600mA.

The output from Q4 and Q5 is then led 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 in the transmit mode, S2 is turned on around 50 deg. C and the cooling fan starts 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. But the rotation during this receiving period is a little slower than that of the transmitting period.

Switch S1 is turned on if the temperature becomes more than about 90 deg. C due to the air temperature rise or the increase of I_c arising from antenna mismatching, etc. The fan rotation speed increases if S1 is turned on. At the same time, this switch sends a signal to the MAIN unit through R26 to reduce the transmit power to 50 watts. This power reduction prevents Q4 and Q5 from heat breakdown due to the excessive temperature rise.

temperature (°C)		~ 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

2. FILTER/CONNECTOR UNIT

The RF output of the PA unit is fed to J1 of the FILTER unit to eliminate harmonic components. The filtered output signal passes through the SWR detecting transformer L18 to the connector unit through P2.

The forward wave component detected by L18 is rectified by D1, filtered by C38, divided by R2 and R4, and fed to J7 of the MAIN unit. The reflected wave component also detected by L18 is rectified by D2, processed by C39, R3 and R5 in the same way, and sent also to the MAIN unit.

The RF output fed to the connector unit passes through diode switch D4 to the antenna connector J11.

4.3 PLL UNIT

The PLL unit outputs two oscillator signals for the RF unit, i.e., the variable first local oscillator output (1st LO) of 70.55-100.45MHz necessary for the first mixer, and the fixed local oscillator output (2nd LO) of 61.44MHz necessary for the second mixer. In addition, the marker signal is also generated in this unit and sent to the RF unit.

All the signals generated in the PLL unit are produced from a single oscillator output. Therefore, the frequencies of all the signals generated in the PLL unit can be calibrated simply by adjusting the reference frequency oscillator.

4-3-1 REFERENCE FREQUENCY OSCILLATOR AND MARKER CIRCUITS

The frequency of the reference frequency oscillator Q10

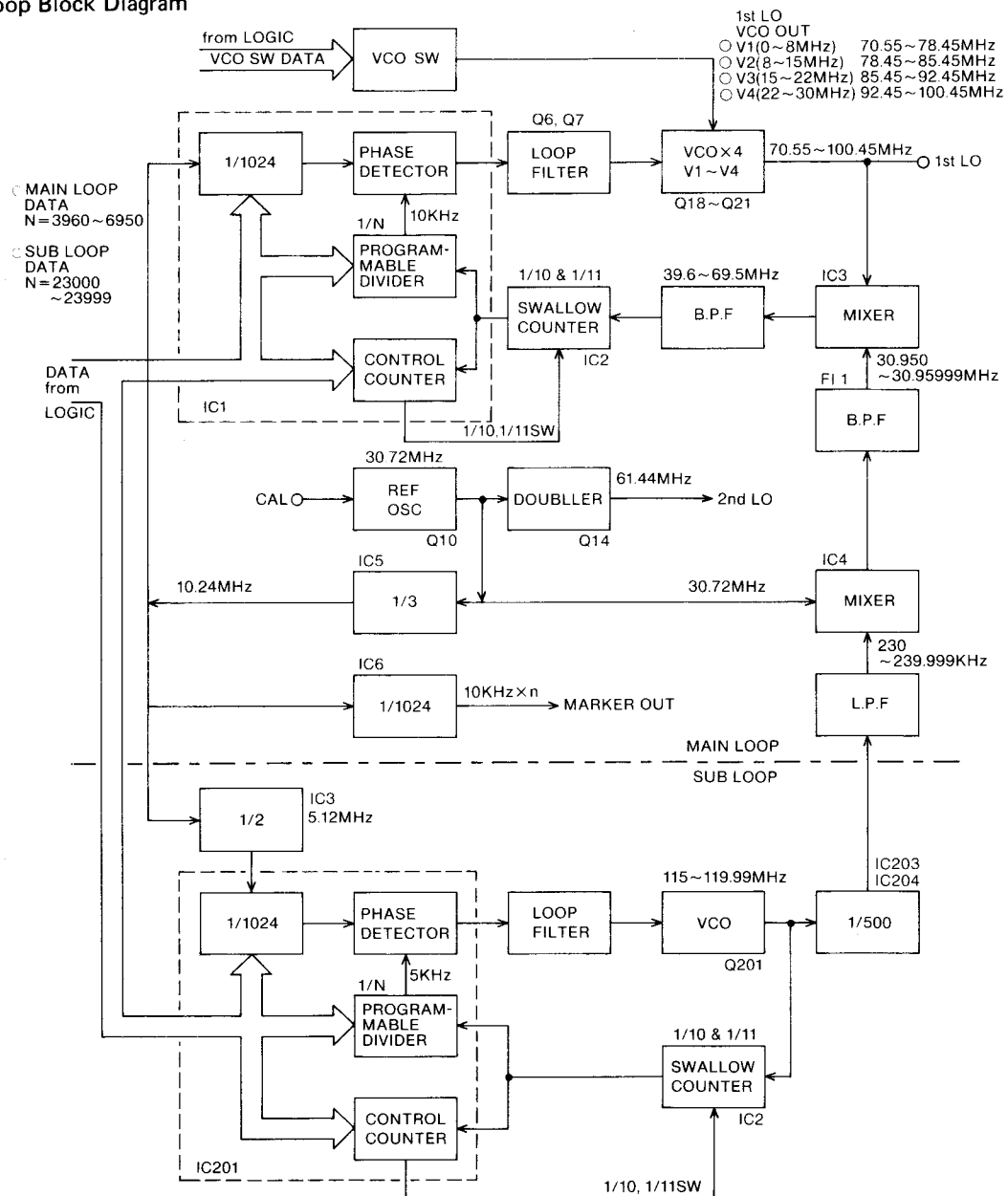
is the base of all the frequencies of the signals in the PLL unit so that it must be sufficiently stabilized. Therefore, C3, C6 and C8 are provided for temperature compensation, and the regulator output voltage of 8 volts is further stabilized by the 5V Zener diode.

The frequency of the reference frequency oscillator is 30.72MHz, which is used for the 2nd LO circuit, the reference frequency signals for the main and sub loops, the in-loop LO oscillator, etc.

In order to provide the 2nd LO output, the reference frequency oscillator output is doubled and amplified by Q14, and the spurious is sufficiently reduced by L3, L4 and L5. The output signal (about 3dBm/50ohms) is fed to the RF unit from J5. In addition, the mute signal is applied to this stage when the PLL is unlocked.

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

PLL Sub-loop Block Diagram



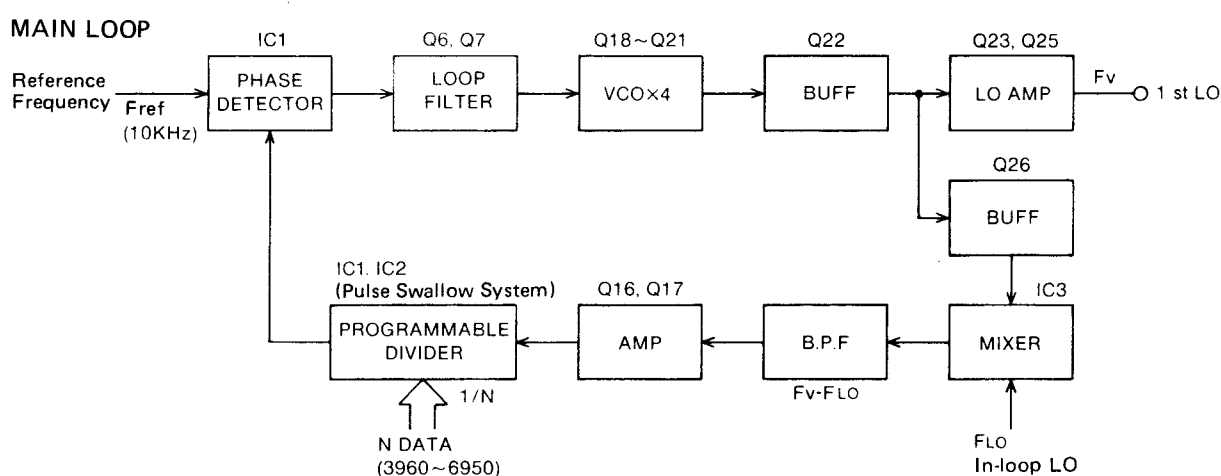
the sub-loop reference signal (5kHz), IC203 divides the output signal of IC5 by two and applies a 5.12MHz signal to IC201.

For the marker signal, a 10kHz signal generated by dividing the IC5 output signal (10.24MHz) by 1024 in IC6, and its harmonics are fed through buffer amplifier Q12 and fed to the RF unit through P1. Since the marker signal is derived from the reference frequency common to all the frequencies in the PLL unit, all the frequencies are adjusted simultaneously when the marker frequency is calibrated with a standard frequency signal such as JJY or WWV.

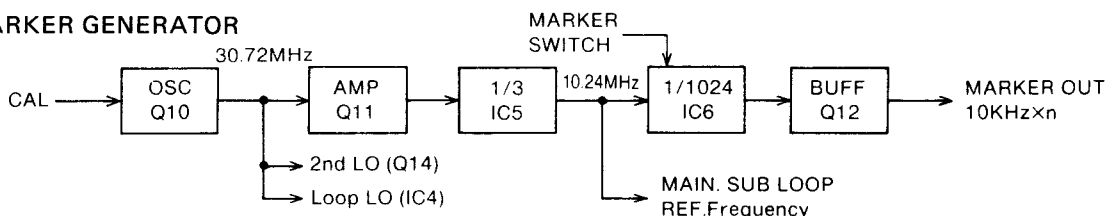
4-3-2 MAIN LOOP CIRCUITS

The main loop forms the PLL loop to provide the 1st

MAIN LOOP



MARKER GENERATOR



(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 swallow counter controller. By using this IC 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 range. Compared to conventional ones, 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 (C/N) ratio 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

LO output, consisting of the combination of a mixed down and divided systems.

The VCO output frequency F_v is given as;

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

Frequency changes are made by changing the F_{LO} and N .

The reference frequency (F_{ref}) is 10kHz, and the VCO is controlled in 10-kHz steps by changing the dividing ratio N of the programmable divider. A frequency between this step (less than 10 kHz) is obtained by F_{LO} which controls the VCO output frequency. Note that F_{LO} can be changed in 10Hz steps over the 9.99kHz range, and in this way, the 30 MHz entire range of the PLL can be varied in 10 Hz steps.

reduces the burden of 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 oscillation 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 circuit board and allocation of components, and utilization of the stout shielding case give a high C/N ratio.

(c) LOOP SYSTEM

The output of the VCO is separated into two parts after passing through the buffer amplifier Q22.

One part 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 part 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 leaking 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 mixed down. The output from the mixer is passed through the bandpass filter with a bandwidth about 35-75 MHz 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

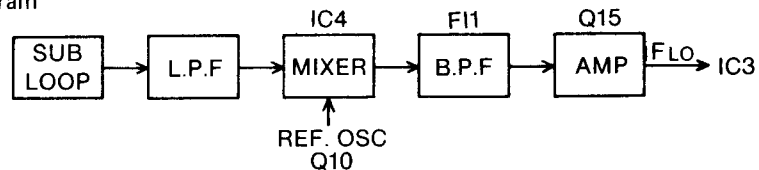
to limit excessive input voltages.

(d) IN-LOOP LOCAL OSCILLATOR CIRCUIT

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

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

In-loop Local Oscillator Block Diagram



(e) LOOP FILTER AND MUTE CIRCUITS

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(Carrier/Noise) 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 subloop 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 subloop 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.

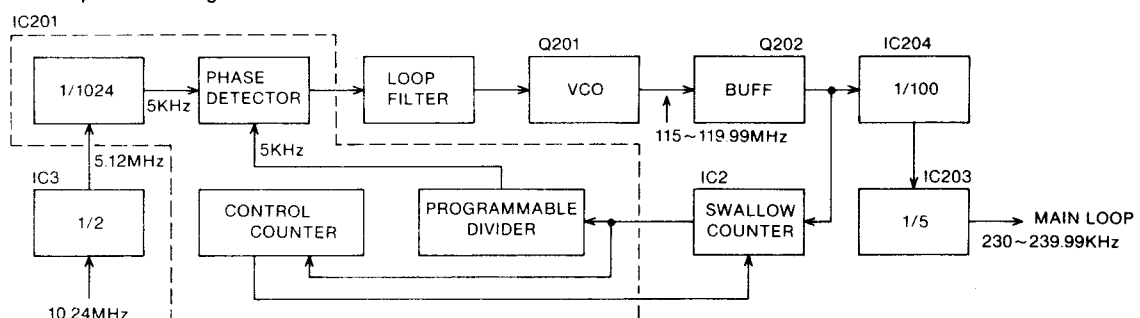
4-3-3 SUB-LOOP

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 115.00~119.995 MHz. The output signal of the 4.995MHz bandwidth with a 5kHz resolution is divided in 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, passed 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, like 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 10.24 MHz is divided by 2 by IC203 and then divided to be 5kHz by the built-in divider of IC201.

Sub-loop Block Diagram



4-3-4 PLL DATA

The data for setting the dividing ratio N of the programmable divider is sent from the logic unit. The control data to switch the VCOs 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 the dividing ratio of the reference frequency divider of IC1 can be changed, the data (1/1024 constant) is also sent at the same time.

(a) HOW TO DERIVE THE N -DATA

Since there are two locked loops, two kinds of N -data are necessary. 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 displayed are the frequencies 1.5kHz higher for LSB, and 1.5kHz lower for USB.

The method to derive the N -DATA for all the modes but 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 F_1 , then

$$N = F_1 \times 100 + 3950$$

where F_1 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 F_2 , then

$$N = F_2 \times 100 + 23000$$

where F_2 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 for USB and subtract 1.5kHz for LSB to and from the displayed frequency, and then follow the steps shown above.

For the value of N as derive in the above way, the dividing ratio of the programmable divider is $1/N$.

4-4 LOGIC UNIT

The functions of this unit include the control of frequency, the processing of 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 Fig. 1 and Fig. 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)

- (a) An external L and C are connected to Pin 18 and Pin 19 to give about a 100kHz clock signal.
- (b) 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.
- (c) M1 and M2 at Pin 38 and Pin 37 are used to switch the multiplication factors of the input pulses from the tuning control. 200 pulses per one rotation are obtained by 50 pulses x 4 (quadri-speed mode). For RIT/XIT control, the multiplication factor is fixed to be a double to give 50 pulses x 2 = 100 pulses per one rotation.

Fig. 1 CPU Pin Connection

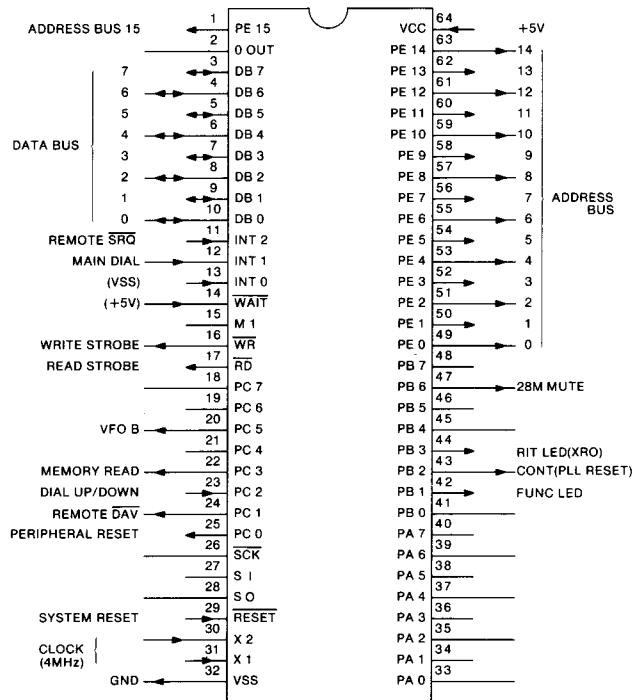
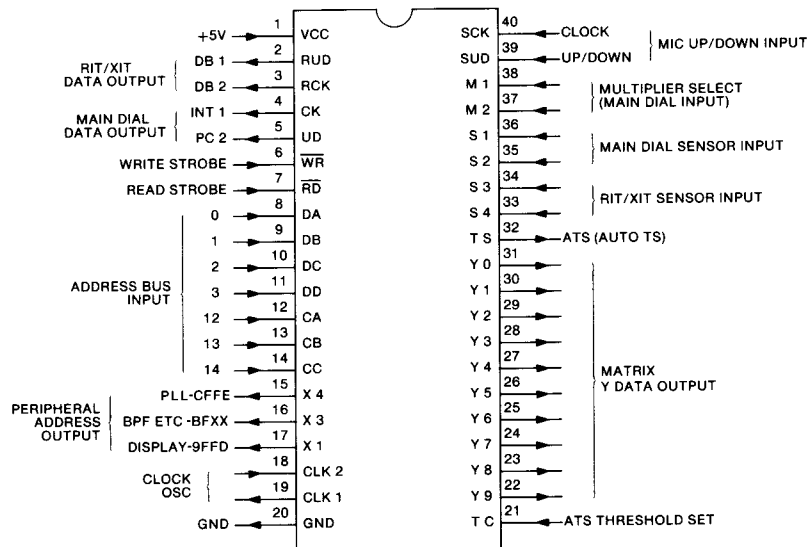


Fig. 2 CPU Memory Map

0 0 0 0	CPU INTERNAL ROM
0 F F F	8bit x 4096W
7 F F F	REMOTE CONTROL
8 F F 0	
1	
2	
3	
4	Input
5	Matrix
6	
7	
8	
8 F F 9	
9 F F D	Display Data Out(μ PD549c x2)
B F F 9	BPF(High)
A	BPF(Mid.)
B	BPF(Low)
C	MODE(High)
D	MODE(Low)
E	ALL F
B F F F	MS. PS
C F F E	PLL Data Out(M54929 x2)
F 8 0 0	EXTERNAL RAM
F B F F	4bit x 1024W(μ PD444C)
F F 8 0	CPU INTERNAL RAM
F F F F	8bit x 128W

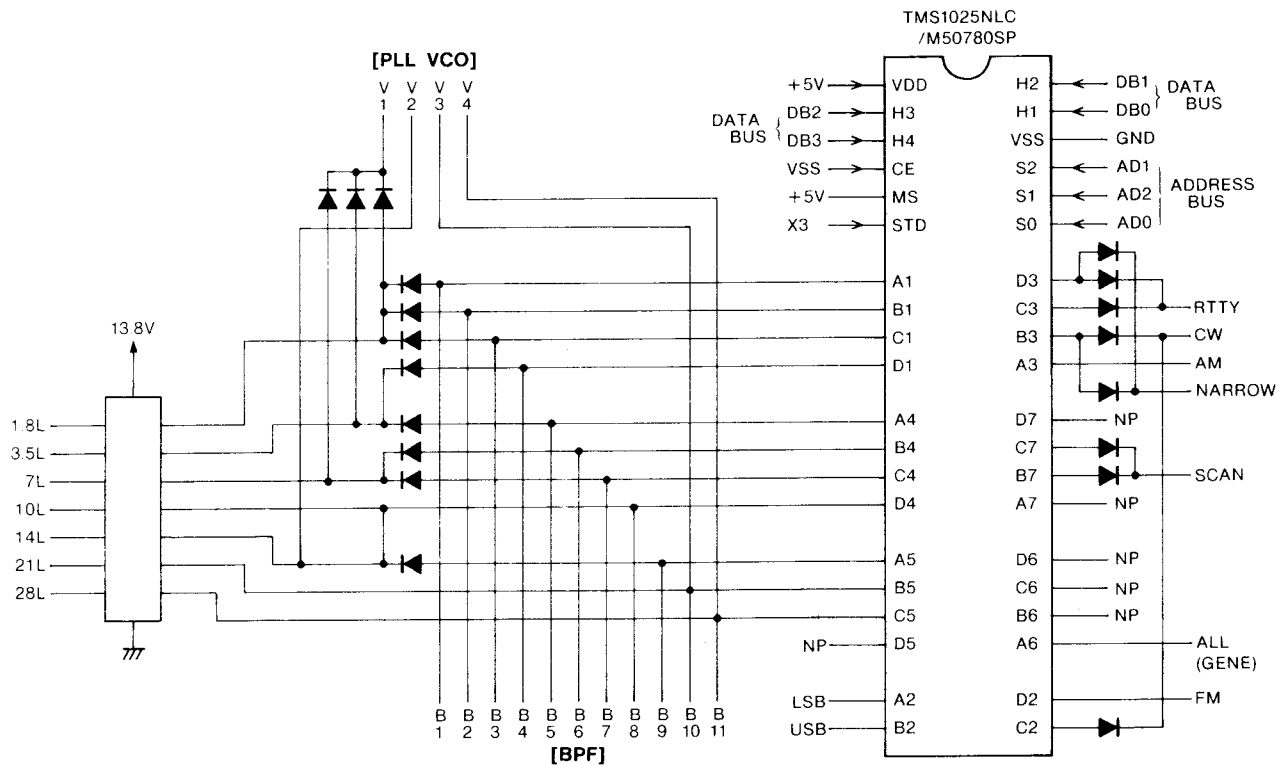
Fig. 3 Custom IC Pin Connection



4-4-3 I/O EXPANDER CIRCUIT

This circuit controls data outputs for BPF, PLL, VCO and MODE, etc.

Fig. 4 I/O Expander Circuit

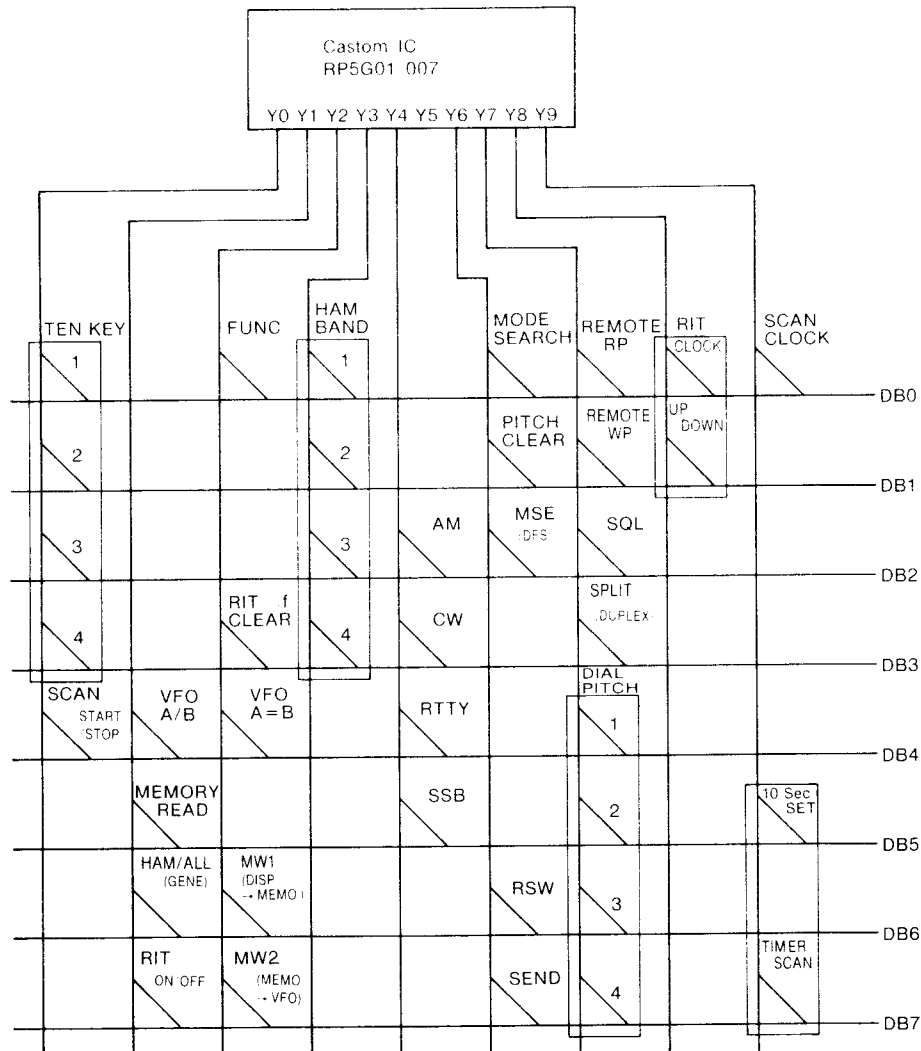


4-4-5 MATRIX UNIT

switch board, and the mode switch board. It processes the front panel matrix input and the data of RIT/XIT.

This unit is composed of the matrix board, the matrix

MATRIX TABLE



(1) Y0 → DB0-DB3 (TEN KEY)

Matrix for operating frequency setting/band changing by an optional ten key unit RC-10 externally.

Y0 → KEY	DB0	DB1	DB2	DB3	BAND	Hex Code
1	1	0	0	0	1.9	1
2	0	1	0	0	3.5	2
3	1	1	0	0	7	3
4	0	0	1	0	10	4
5	1	0	1	0	14	5
6	0	1	1	0	18	6
7	1	1	1	0	21	7
8	0	0	0	1	24	8
9	1	0	0	1	28	9
0	0	1	0	1	---	A
CE	1	1	0	1	---	B
ENT	0	0	1	1	---	C

(2) Y0 → DB4 (SCAN START/STOP)

Matrix to start and stop the scan, which is controlled not only by the SCAN switch but also by squelch and the dial lock switch through IC2b and Q3. When the SCAN switch is pushed, one pulse signal is input to this matrix to start and stop the scan operation repeatedly.

Three types of scanning operations, Memory Scan, Programmed Scan, and Mode Selected Scan, are available. During the VFO operation, Programmed Scan is automatically selected, and during the memory channel operation, Memory Scan is selected. S10 is to select if the scan is completely stopped or started 10 seconds after the scan is interrupted when the squelch is opened. R14 in the LOGIC unit is to adjust the scanning speed.

(3) Y1 → DB4 (VFO A/B)

Matrix to select VFO A or VFO B by the VFO switch. When VFO B is selected, pin 20 of the CPU becomes high

level. To each of VFO A and VFO B, the operation mode, frequency, and the HAM/GENERAL selection are stored independently.

(4) Y1 → DB5 (MEMORY READ)

Matrix to select the VFO mode or the Memory Channel mode switched by the VFO/MEMORY switch. Pin 22 of the CPU is high when the Memory Channel mode is selected. There are 32 memory channels available to store the mode, frequency, and HAM/GENERAL in each of them.

(5) Y1 → DB6 (HAM/GENERAL)

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

(6) Y1 → DB7 (RIT ON/OFF)

Matrix to turn on/off RIT (XIT) by the RIT (XIT) switch. The binary counter IC1b (IC1a) outputs RIT (XIT) signal from pin 13 (pin 1) by turning the RIT (XIT) switch on.

The output signal passes through the OR gate of R13 and D15 and is fed to the one-shot circuit consisting of IC4b, R14 and C5, which outputs a pulse signal to control Q8 to turn on the RIT matrix (Y1 → DB7), and the XRO output (pin 44) becomes high to turn on RIT (XIT). When no RIT input signal is applied, XRO outputs no signal to turn on the reset circuit, consisting of IC3c, IC4c, D14, R3 and C1. Thus RIT (XIT) is turned off by IC1b (IC1a).

The digital transistors Q4 and Q5 turn on/off the RIT and XIT indicators on the display unit. When both pin 1 (XIT) and pin 13 (RIT) of IC1 are off but the RIT setting of the CPU is on, the matrix reset circuit, consisting of IC3c, IC3d, IC5c, IC3a, IC3b, etc., drives IC4b to switch the CPU RIT matrix on/off to match the condition of the CPU and the front panel display. The RIT matrix is turned

on/off by the multi-vibrator of IC3a and IC3b, instead of being left on, to provide other matrix entries can be possible.

(7) Y2 → DB0 (FUNCTION)

Matrix to select a function by combining with the switches as shown in the following table.

Combination	Function
FUNC + A M	Selects FM mode.
FUNC + C W	Selects CW-NARROW mode.
FUNC + RTTY	Selects RTTY-NARROW mode.
FUNC + SSB	Selects reverse side band. (LSB or USB).
FUNC + A = B	Selects VFO transfer direction. (A → B or B → A)
FUNC + CLEAR	Adds RIT/XIT Δf to display frequency.
FUNC + WRITE	Clears (blanks) the displayed memory channel frequency.
FUNC + M ► VFO	

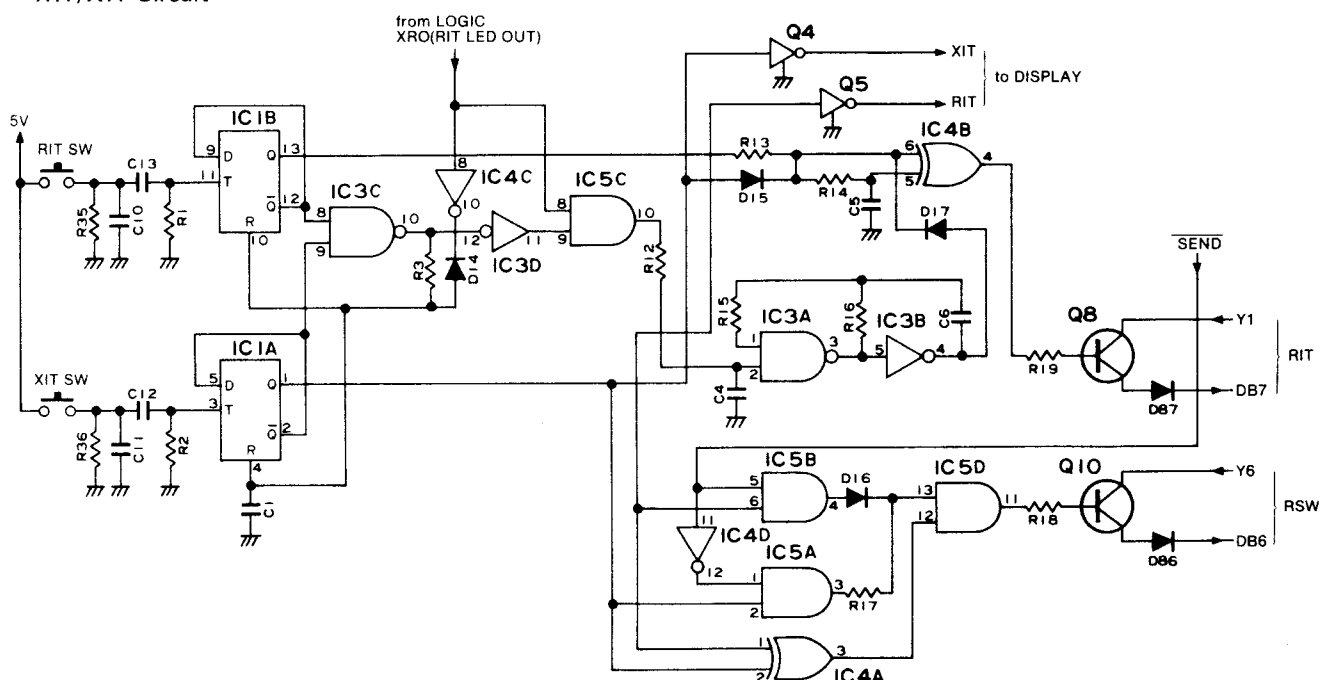
(8) Y2 → DB3 (RIT/XIT CLEAR)

Matrix to clear the RIT/XIT shift frequency. When combined with the FUNC switch, the shift frequency is added to/subtracted from the displayed frequency.

(9) Y2 → DB4 (VFO A = B)

Matrix to transfer the frequency of VFO A/B to the

RIT/XIT Circuit



other VFO. When combined with the FUNC switch, the original VFO is reversed.

Pushing Switch	A = B
VFO A is in use.	VFO A → VFO B
VFO B is in use.	VFO B → VFO A

(10) Y2 → DB6-DB7

(DISPLAY → MEMORY/MEMORY → VFO)

Matrix for the memory write and the memory data transfer by the MEMORY WRITE and FREQUENCY TRANSFER switches. When combined with the FUNC switch, the data in the displayed memory channel is cleared and the channel is blanked.

Condition	Pushing Switch	Function
VFO A or VFO B is in use	WRITE	Transfers the VFO frequency to the selected memory channel.
	M ► VFO	Transfers the selected memory channel frequency to the VFO.
Memory channel mode	WRITE	Transfers the displayed frequency to the selected memory channel.
	M ► VFO	Transfers the displayed frequency to the VFO previously used.

(11) Y3 → DB0-DB3 (HAM BAND)

Matrix to switch the tuning control to a band selector by the BAND switch. When the HAM/GENERAL switch is at GENERAL, the frequency is changed in 1MHz increments.

Matrix to select the operation mode when combined with the MODE switch or FUNC switch. The display frequency is shifted depending on the selected operation mode as shown in the below figure.

Band (MHz)	Initialized Frequency	DB0	DB1	DB2	DB3
1.9	1,900.0	1	0	0	0
3.5	3,550.0	0	1	0	0
7	7,050.0	1	1	0	0
10	10,050.0	0	0	1	0
14	14,050.0	1	0	1	0
18	18,050.0	0	1	1	0
21	21,050.0	1	1	1	0
24	24,550.0	0	0	0	1
28	28,050.0	1	0	0	1

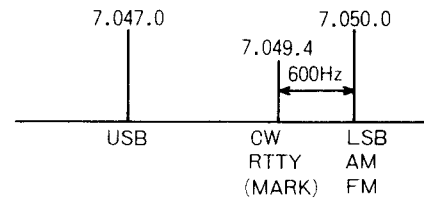
(12) Y4 → DB2 (AM)

(13) Y4 → DB3 (CW)

(14) Y4 → DB4 (RTTY)

(15) Y4 → DB5 (SSB)

The differences of the frequency on various modes



(16) Y6 → DB0 (MODE SEARCH)

Matrix for the mode selected scan by the MODE-S switch. Only the memory channels with the desired operation mode are selected in the memory scan mode or by the tuning control.

(17) Y6 → DB1 (PITCH CLEAR)

Matrix to set the frequency increment to 1kHz in all modes by the TS(TUNING RATE) switch. When the TS switch is on, also the matrix at Y7→DB4 is turned on.

(18) Y6 → DB2 (DFS)

Matrix for the dial function select by the DFS switch as shown in the following table.

DFS switch	OFF	ON
Condition		
VFO A or VFO B is in use	Changes displayed frequency	Changes displayed memory channel number
Memory channel mode	Selects a memory channel (its frequency is displayed)	Changes displayed frequency

(19) Y6 → DB6 (RSW)

Matrix to reset RIT data or to output N-data. IC4a, IC4b, IC5a, IC5b, IC5d, R17 and D16 are for the RSW input circuit.

RIT SW	XIT SW	T/R	RSW MATRIX	Remarks
OFF	OFF	RX	OFF	○ When RSW MATRIX is OFF, the operating frequency becomes the displayed frequency plus RIT/XIT Δf frequency. ○ When RSW MATRIX is ON, the operating frequency is the displayed one.
		TX	OFF	
ON	OFF	RX	OFF	
		TX	ON	
OFF	ON	RX	ON	
		TX	OFF	
ON	ON	RX	OFF	
		TX	OFF	

(20) Y6 → DB7 (SEND)

Matrix for the transmit mode recognition to stop the scanning.

(21) Y7 → DB0 (REMOTE RP)

Matrix for remote-control read pulse.

(22) Y7 → DB1 (REMOTE WP)

Matrix for remote-control write pulse.

(23) Y7 → DB2 (SQL)

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

(24) Y7 → DB3 (SPLIT/DUPLEX)

Matrix for split or duplex operation using VFO A and B by the DUPLEX switch.

(25) Y7 → DB4-DB7 (DIAL PITCH 1-4)

Matrix to set the frequency step(tuning rate). The frequency step and the increments per rotation of the tuning control in each setting are as follows.

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 rotation

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

(26) Y8 → DB0-DB1 (RIT:CLOCK, UP/DOWN)

Data matrix for RIT, which is processed by IC2 in the LOGIC unit.

(27) Y9 → DB0 (SCAN CLOCK)

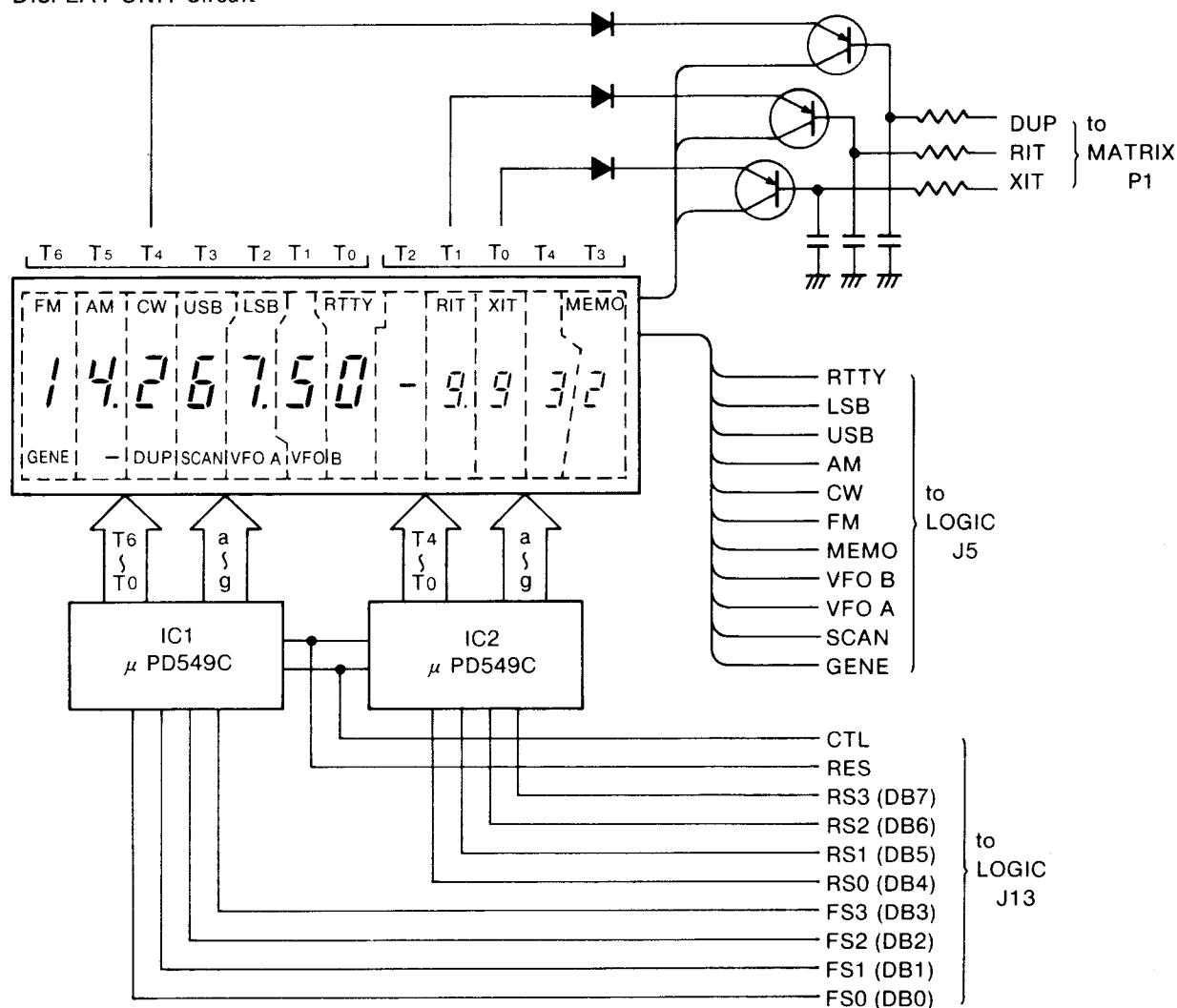
Matrix for the scan control clock form the circuit of Q4, IC7b and R14 in the logic unit.

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

Matrix for 10-second timer to resume scanning after a stop. The matrix Y9 → DB7 is on while the timer scan is operating.

4-5 DISPLAY UNIT

DISPLAY UNIT Circuit



This unit consists of the display tube and its drivers, and a DC-DC convertor section.

The display tube uses a newly developed luminescent display tube. It displays centralized information of frequency, mode, RIT/XIT condition, memory channel, operating mode (VFO A/B, GENE, DUP, SCAN), etc. The operating conditions of the transceiver can be easily understood because of this centralized display. In addition, the display is shown in two colors, red and white, using color filters. Furthermore, LEDs to show transmit/receive and the narrow mode in the CW or RTTY operation are also a part of this unit.

(a) DISPLAY SECTION

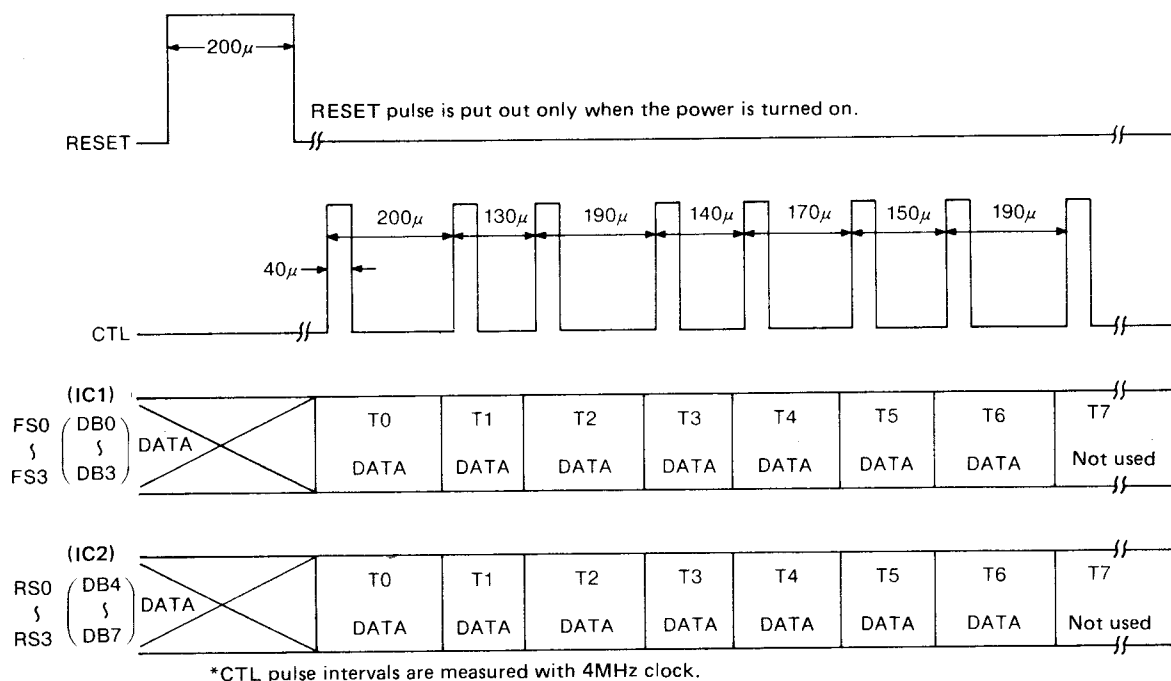
The luminescent display tube (DS1) is driven by the

drivers IC1 and IC2, and lights dynamically. These ICs contain such functions as input data latch, clock oscillator, timing counters, segment decoders, etc. The clock frequency is set by C2 and C6.

Displays for the RIT/XIT shift frequency and memory channel are driven by IC2, and other displays are driven by IC1.

The signals for the display of RTTY through GENE are sent from the LOGIC unit to each segment. These are switched by the digit signals, T0 to T6 from IC1 and T3 from IC2, and lighted dynamically. The words of RIT, XIT, “—” and DUP are connected to the same digit in the tube, thus, the necessary word is selected by T4, T1, and T0 digit signals and dynamically lighted.

DISPLAY DATA Timing Chart



(b) DC-DC CONVERTOR SECTION

The +5 volts voltage source is produced from 13.8 volts by the voltage regulator IC3.

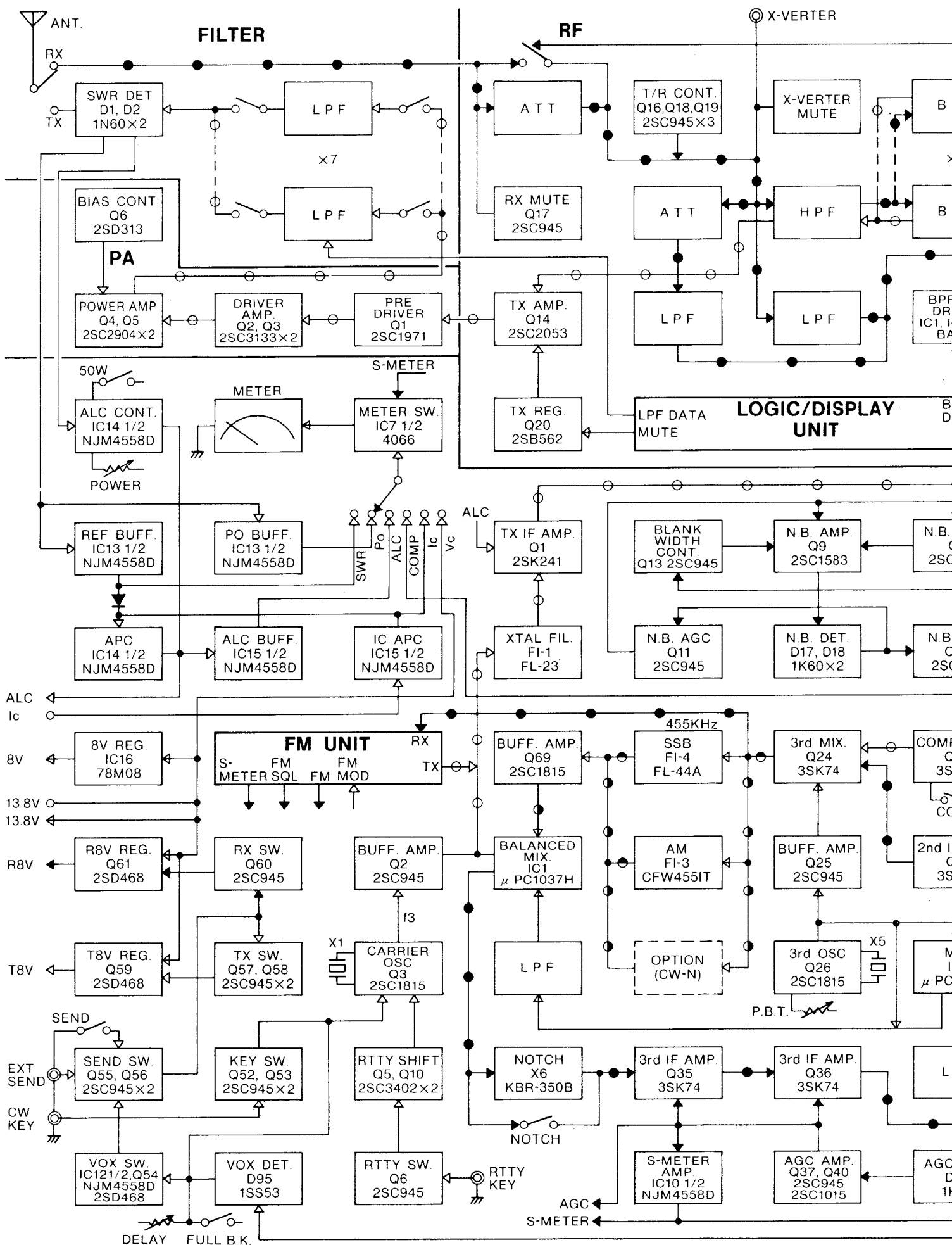
The DC-DC convertor is composed of Q4, Q5 and T1 to generate rectangular pulses of about 15kHz. The pulses are applied to T1 to obtain -5V, -35V, 3.5V AC from the corresponding coils.

Except for the 3.5V AC which is provided for the filament of the display tube, all the voltages are rectified for DC voltages. As for -5 volts, the rectified DC-DC convertor output is regulated by R43 and D22, and supplied to IC1, IC2, and the MAIN unit.

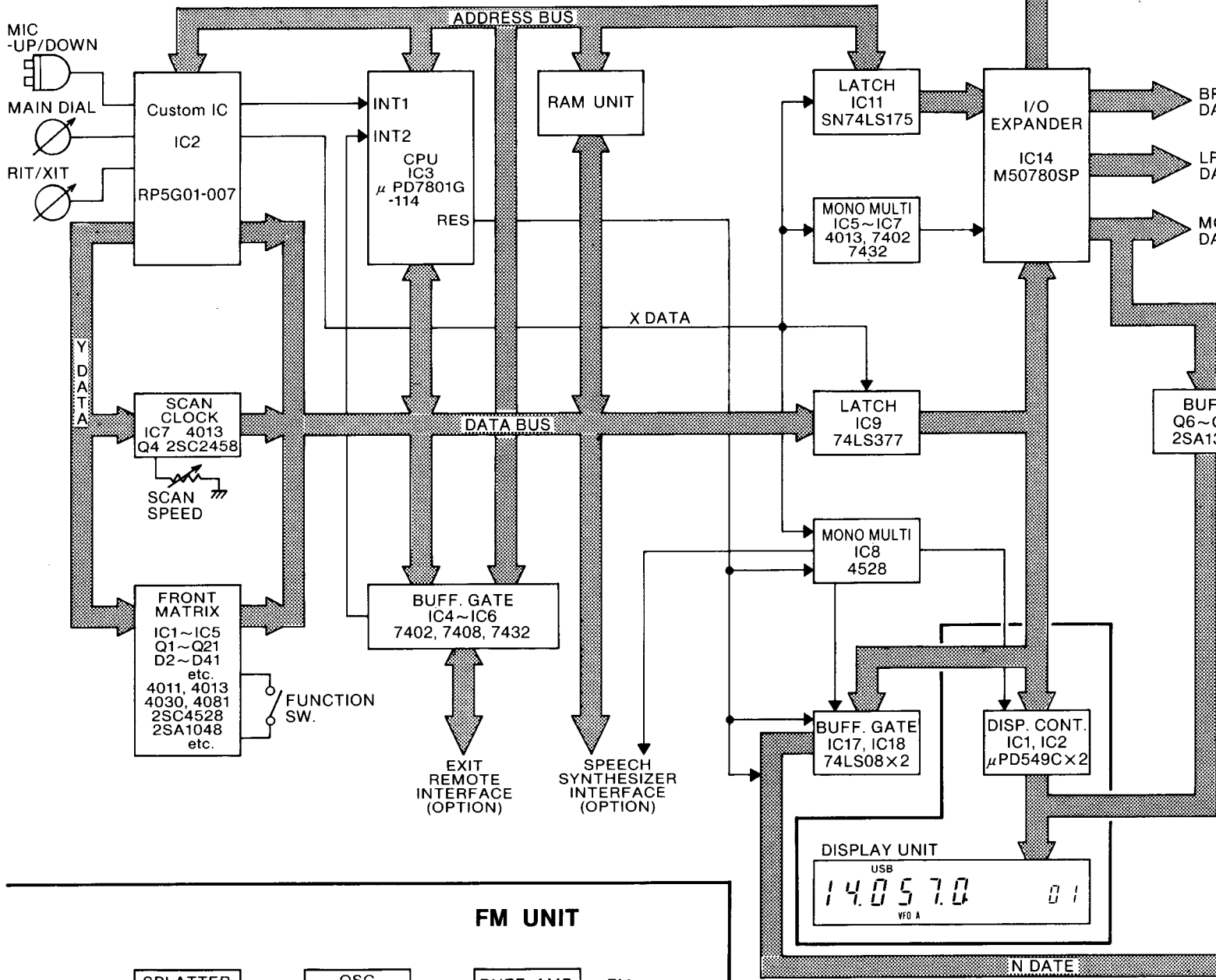
Q6-Q8 comprise a circuit to keep the display off for about 2 seconds before the initial reset is completed when the power is turned on. Immediately after the power is turned on, Q6 through Q8 are off and -35V is not output. When the data (CTL) are supplied from the LOGIC unit when the reset is completed, Q8 is turned on, and then Q6 and Q7 are turned on for -35V output for the display.

The components Q6, Q7, R19 and R41 form a latch circuit, so that once the circuit is turned on it holds the state to keep providing -35 volts. Note that R42, C21 and C22 are provided to prevent erroneous operation.

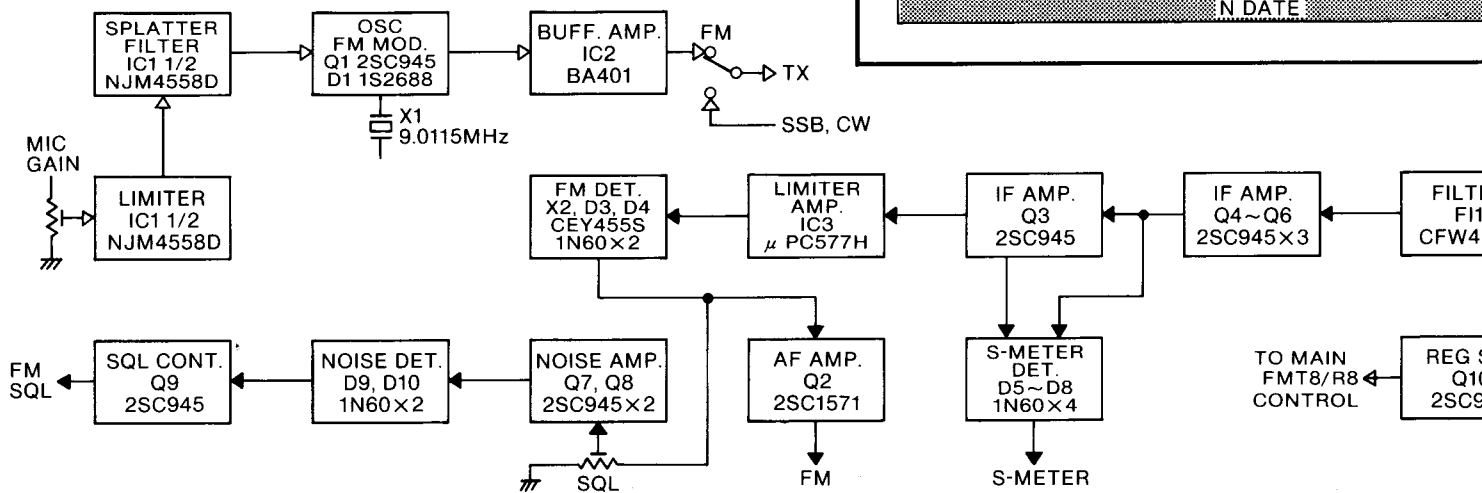
SECTION 5 BLOCK DIAGRAM



LOGIC UNIT

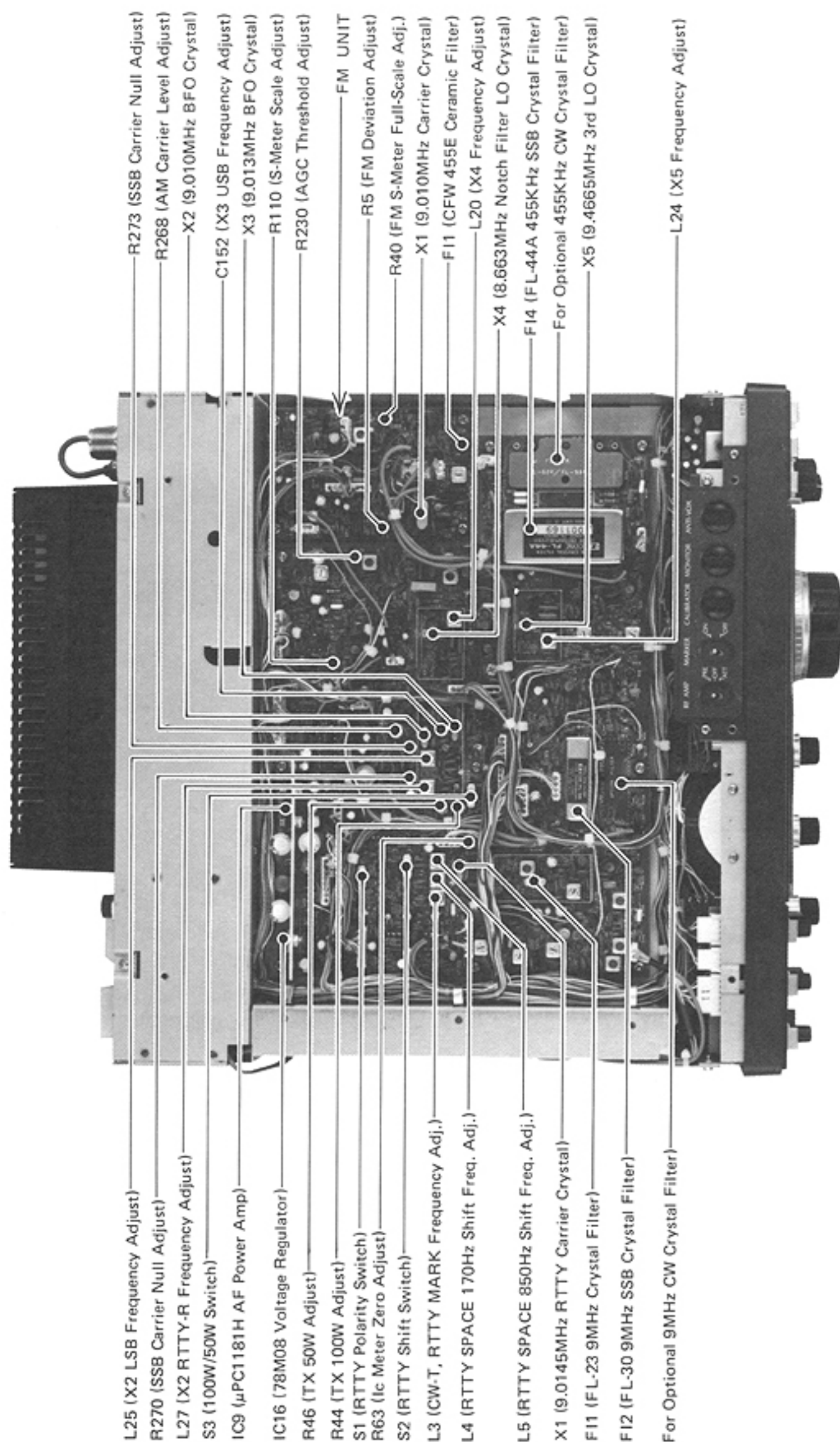


FM UNIT

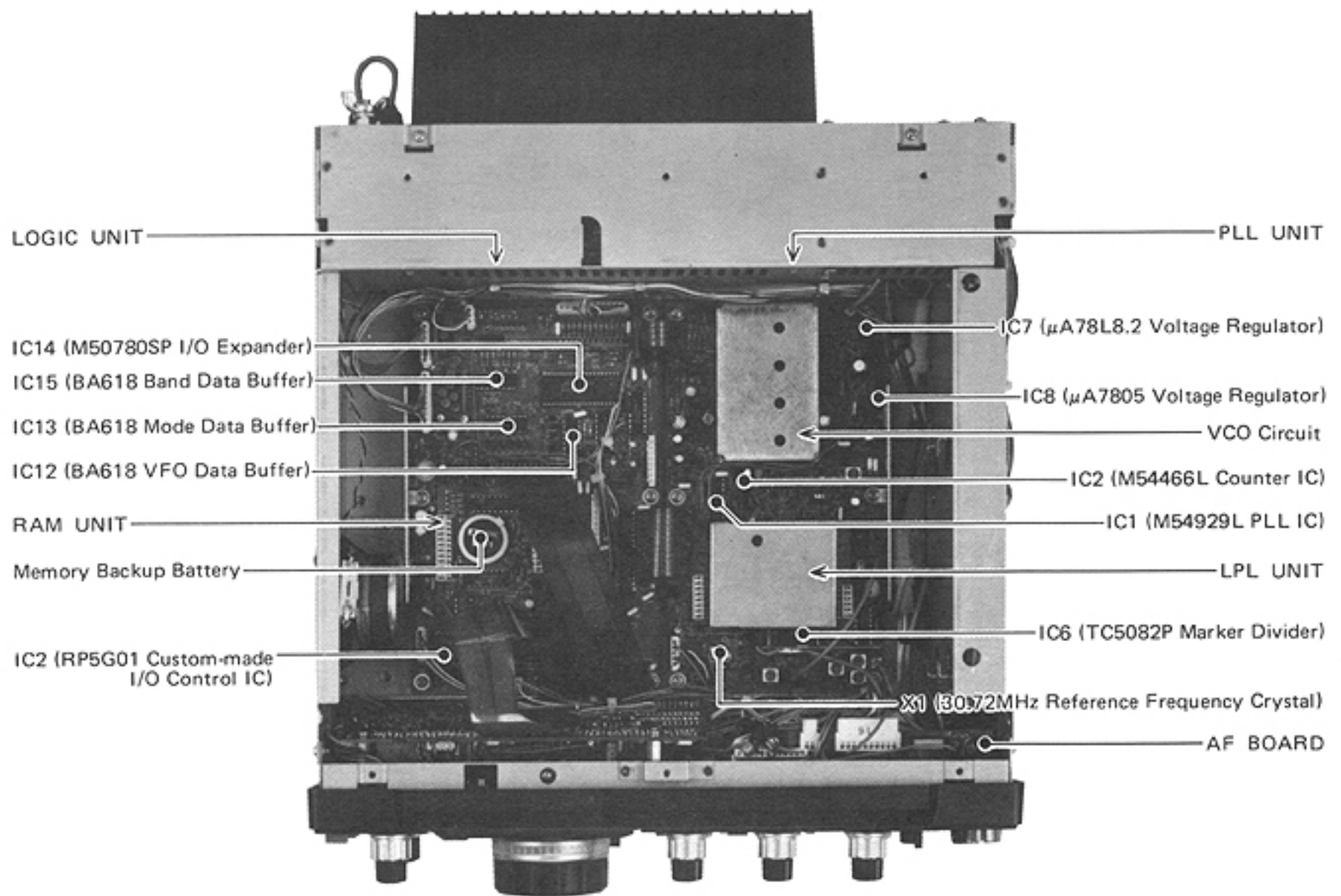


SECTION 6 INSIDE VIEWS

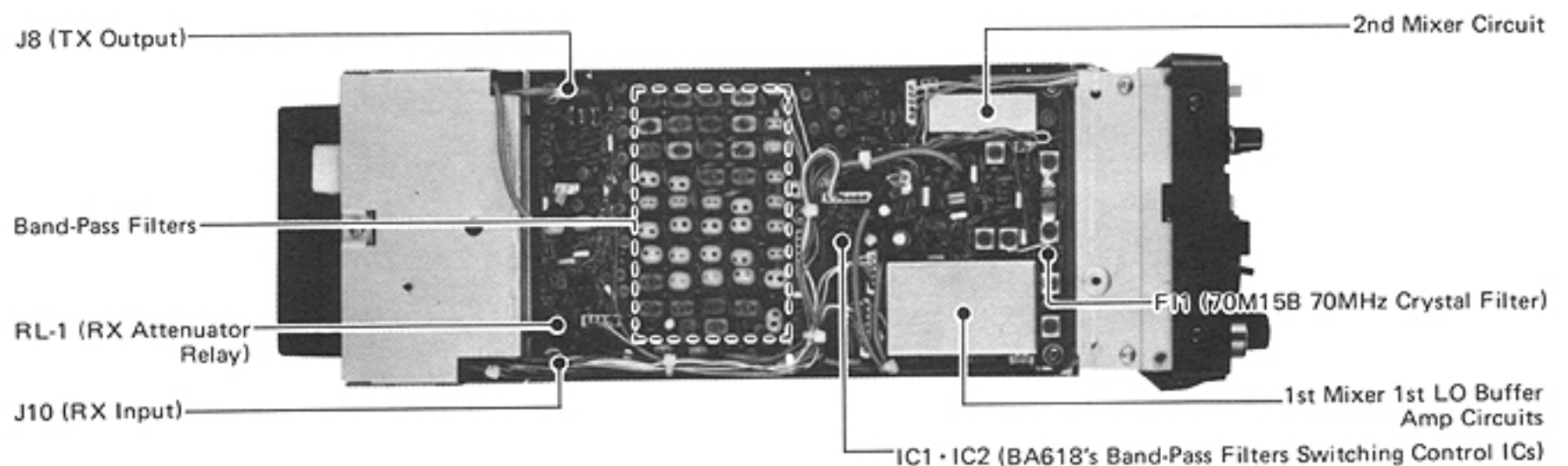
6-1 TOP VIEW



6-2 BOTTOM VIEW



6-3 RF UNIT



SECTION 7 OPTION INSTALLATIONS

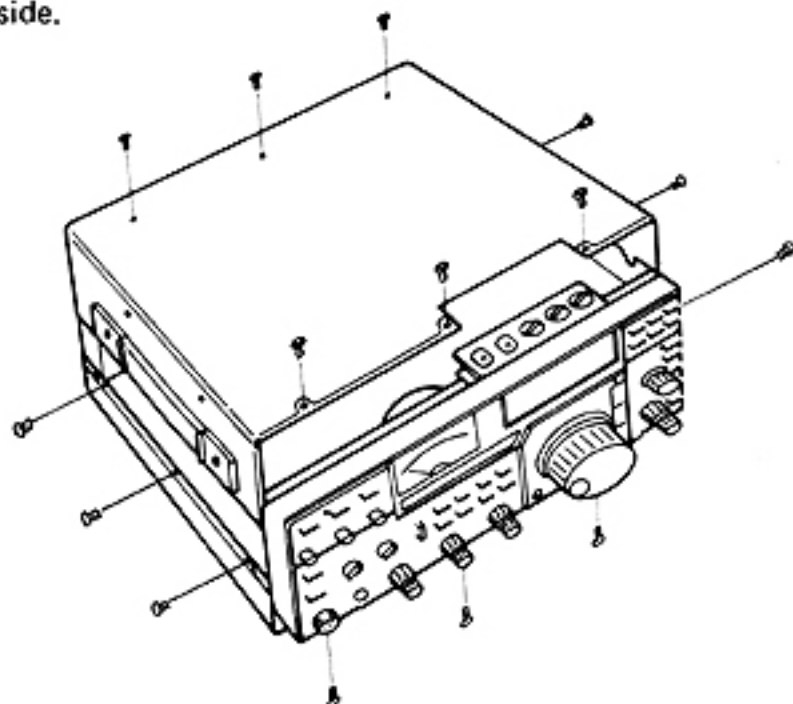
The following tools are needed for the installation of the options:

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.



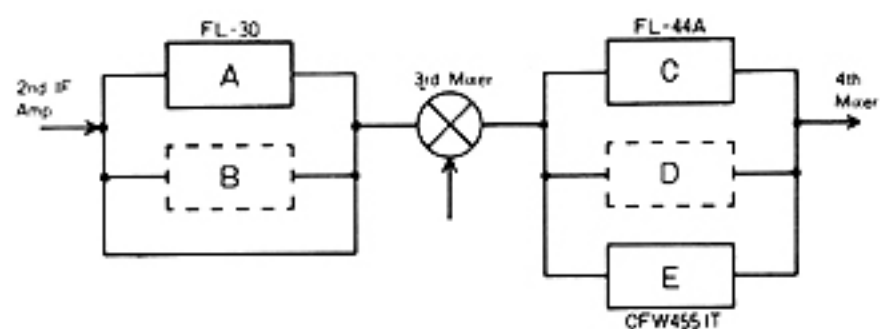
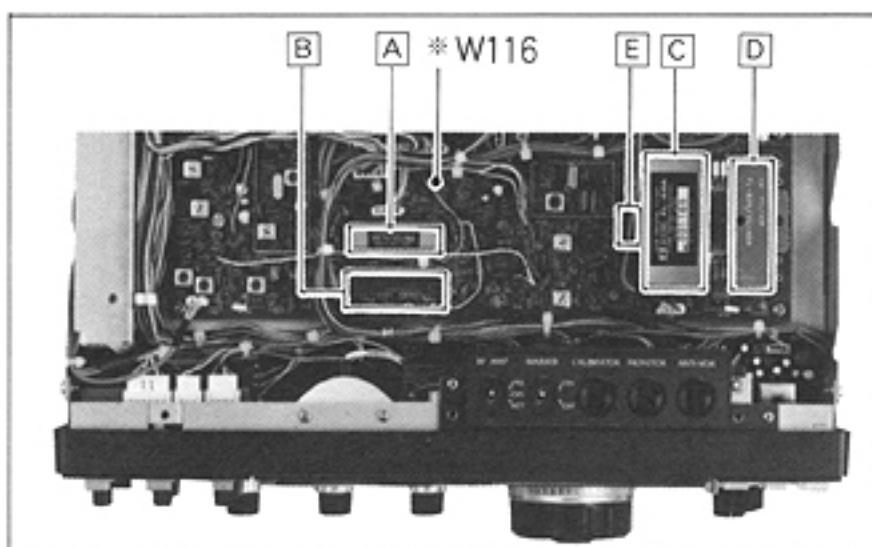
7-1 INSTALLATION OF OPTIONAL FILTER

7-1-1 OPTIONAL FILTERS PREPARED

We have prepared various optional filters as follows.

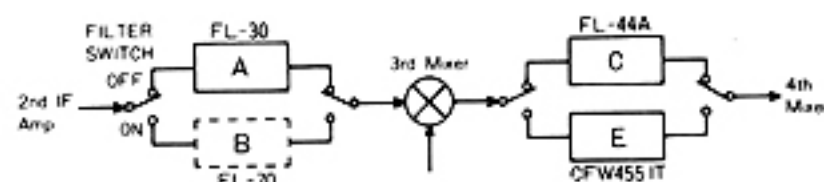
	CENTER FREQUENCY	CHARACTERISTICS	USABLE MODE
FL-32	9.0106MHz	500Hz/-6dB, 1.6KHz/-60dB	CW-RTTY
FL-63	9.0106MHz	250Hz/-6dB, 1.1KHz/-60dB	CW-RTTY
FL-33	9.0100MHz	6KHz/-6dB, 20KHz/-60dB	AM
FL-70	9.0115MHz	2.8KHz/-6dB, 5.0KHz/-60dB	SSB (Wide)
FL-52A	455.0KHz	500Hz/-6dB, 1.0KHz/-60dB	CW-RTTY
FL-53A	455.0KHz	250Hz/-6dB, 480Hz/-60dB	CW-RTTY

The IC-751 has two positions for installing optional filters. The "B" position is for a 9MHz filter, one of the FL-32, FL-33, FL-63 and FL-70, and the "D" position is for a 455KHz filter, one of the FL-52A and FL-53A.



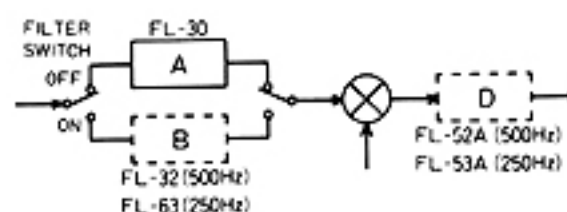
After optional filters are installed, the FILTER switch and PBT control function as follows:

1. When the FL-70 SSB wide filter is installed.



FILTER SWITCH	BANDWIDTH	PBT CONTROL
OFF	NARROW	EFFECTIVE
ON	WIDE	NO WORK

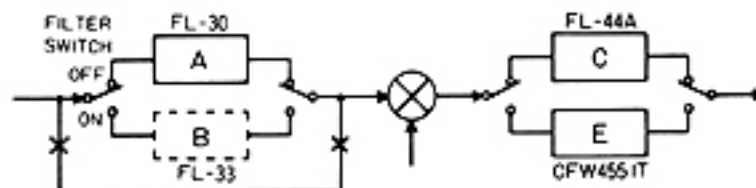
2. When CW narrow filter is installed.



FILTER SWITCH	BANDWIDTH	PBT CONTROL
OFF	WIDE	EFFECTIVE*
ON	NARROW	EFFECTIVE

* The control works as IF SHIFT function and tone pitch can be adjusted.

3. When FL-33 AM filter is installed.



* When installing FL-33, cut the lead of W116 on the MAIN unit board. (Refer the photo.)

FILTER SWITCH	BANDWIDTH	PBT CONTROL
OFF	NARROW	NO WORK
ON	WIDE	NO WORK

Please choose an optional filter which is suitable to your needs.

7-1-2 ASSEMBLY PROCEDURE

When installing FL-52A or FL-53A, simply plug it into the specified position.

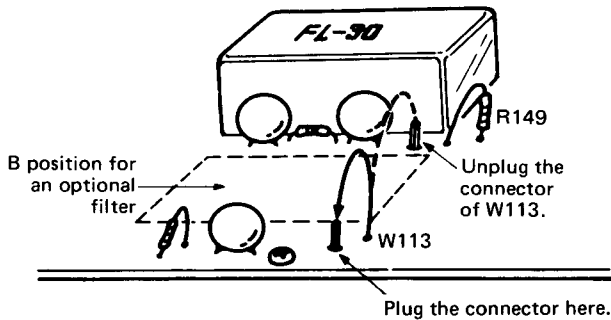
When installing a 9MHz filter;

1. Remove nine screws at each edge and the center of the MAIN unit board, and four screws at each corner of the FM unit board.

2. Tilt the units back toward left, being careful not to damage the sockets and plugs that are installed on the units.

3. The position for the filter is shown as "OPTION FILTER" on the MAIN unit board. The holes for mounting the legs and the leads of the filter are pre-drilled. Be sure to orient the filter so that the label on the top of the filter is facing the same direction as the other filter already mounted. 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.

4. Change the connecting position of the jumper wire W113 as shown in the illustration. This completes the installation. Replace the units with the screws removed before, and top and bottom covers.



7 - 2 BUILT-IN POWER SUPPLY UNIT IC-PS35

7 - 2 - 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 Fuse	2
Installation Screws	6
Insulation Washers	6

7 - 2 - 2 PREPARATION

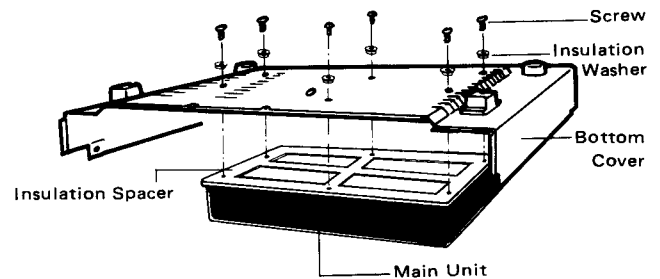
Before performing any work on the set, make sure that the power cord is unplugged from the transceiver.

Remove the top and bottom covers by unscrewing the six screws each on the top and bottom, and the three screws on each side.

7 - 2 - 3 ASSEMBLY PROCEDURE

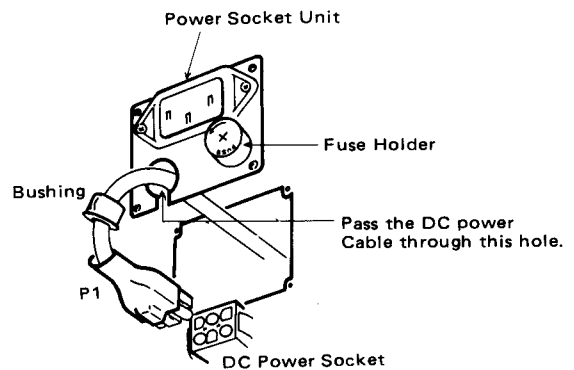
① Turn the transceiver upside down. Remove the "PLATE (A)" attached to the rear panel by unscrewing four screws. These screws will be used later.

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.

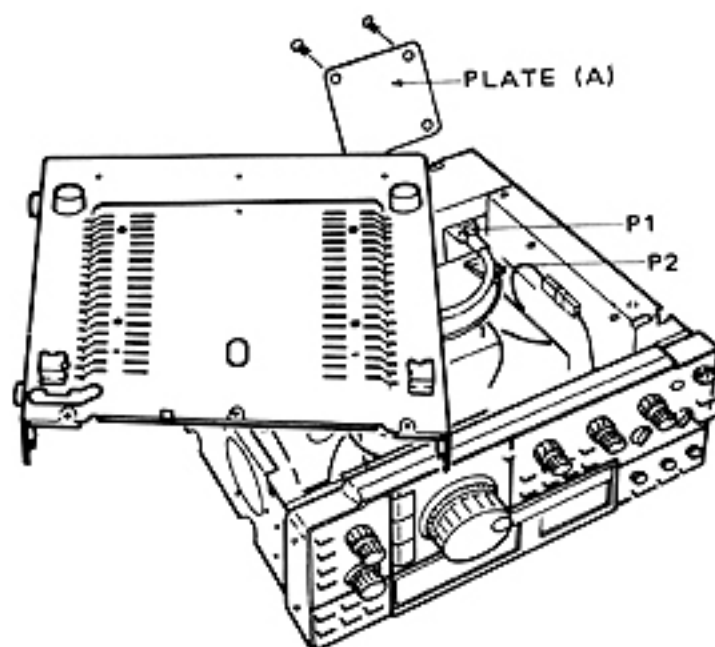


③ Pass the DC power cable attached to P1 through the hole of the AC power socket plate as shown in the illustration, then insert the bushing into the hole.

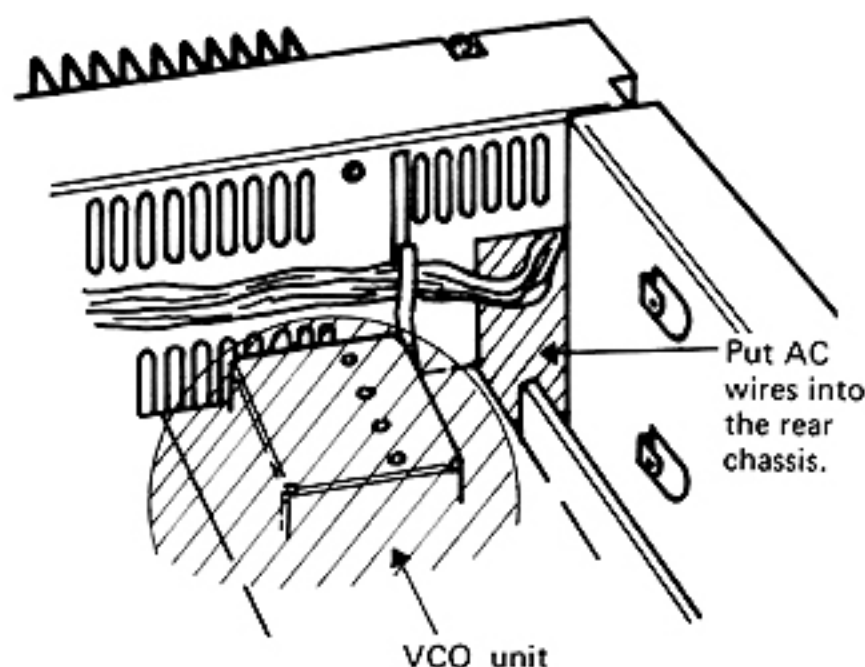
Attach the AC power socket plate to the position which was attached the PLATE (A) before, by using the screws described in ①, so that the AC power socket is toward the bottom of the set.



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.



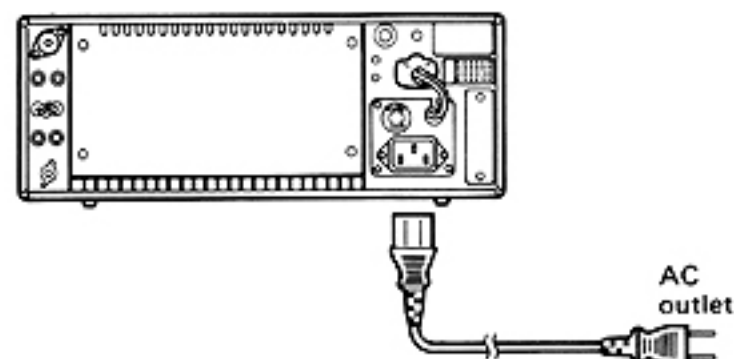
- ⑤ Put these AC wires into the rear chassis as long as possible as shown in the illustration. This will prevent to cause magnetic coupling between the AC wires and the VCO coil cores.



- ⑥ Replace the bottom and top covers of the set.
Plug P1 of the power supply unit to the DC Power Socket of the set.

7-2-4 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.

7-2-5 CAUTION

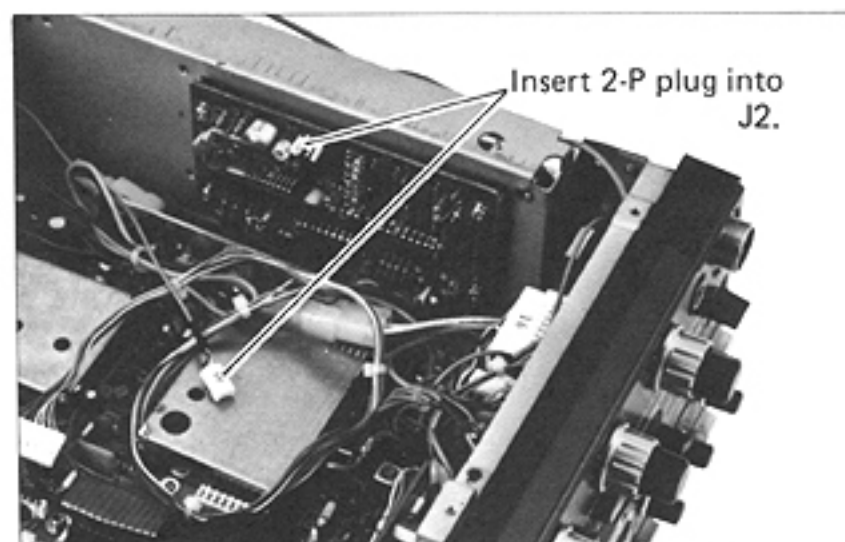
1. Ground the GROUND TERMINAL of the set with as short a wire as possible to prevent electrical shock, TVI, BCI and other problems.
2. This unit stops the output voltage with a protection circuit, when output voltage is shorted or consumed load current exceeds 25A. When the output voltage is stopped, 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.

7-3 VOICE SYNTHESIZER UNIT IC-EX310

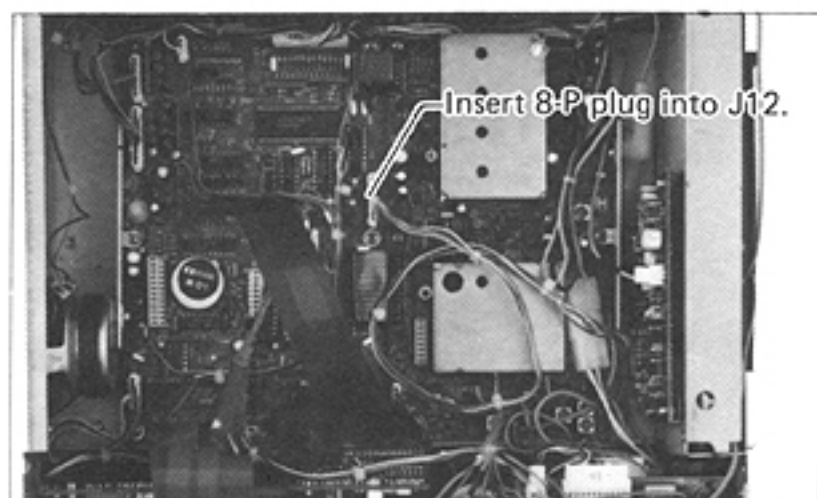
When this unit is installed, the set announces the displayed frequency by pushing the SPEECH switch on the front panel.

7-3-1 ASSEMBLY PROCEDURE

1. Turn the transceiver upside down.
2. Insert 2-P plug shown in the photo into J2 of this unit, then install the unit with the supplied four screws as shown in the photo.



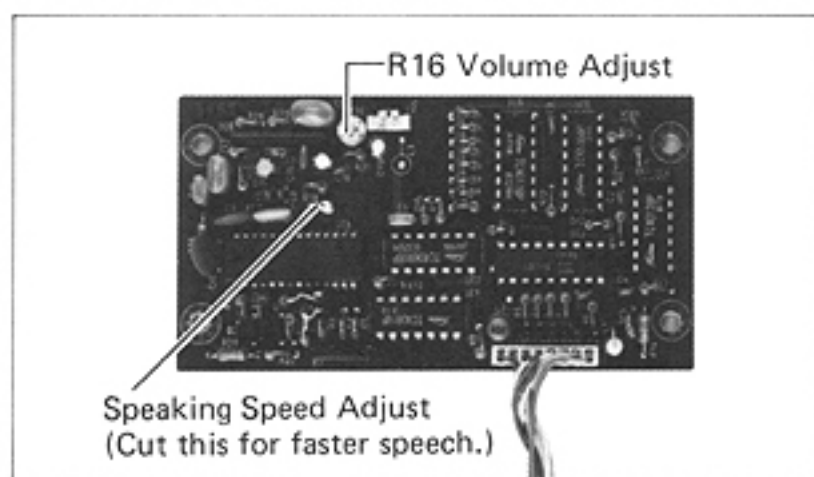
3. Plug 8-P plug of this unit into J12 of the LOGIC unit.



4. Adjust its volume and speaking speed if necessary. (Described later.)
5. Replace the top and bottom covers of the set.

7 - 3 - 2 ADJUSTMENT

1. Adjust the volume of the speech and speaking speed before the top and bottom covers are replaced, if necessary.
2. Connect a power source and turn on the power switch.
3. By pushing the SPEECH switch, the unit is actuated and announces the displayed frequency in English.
4. The volume of the announce is adjustable with R16 in the unit. Adjust it for comfortable level.
5. By cutting W1 jumper wire, the speaking speed becomes faster.
6. When finished the adjustment, replace the top and bottom covers of the set.



7 - 3 - 3 HOW THE VOICE SYNTHESIZER UNIT WORKS

1. When "14.231.5MHz" is displayed, by pushing the SPEECH switch. "ONE FOUR POINT TWO THREE ONE FIVE MHZ", will be heard.
2. When a blanked memory channel is selected; "POINT MHZ", will be heard.

7 - 4 HIGH-STABILITY CRYSTAL UNIT CR-64

7 - 4 - 1 FEATURES

This high-stability crystal unit is consisted of a temperature-compensating oven heater and a crystal unit. By replacing the original crystal unit with this unit, the total frequency stability of the set will be improved.

The specifications of the unit itself are as follows:

Oscillation frequency: 30.72MHz $\pm$ 10ppm

Stability: $\pm$ 0.5ppm in the range of $-30^{\circ}\text{C} \sim +60^{\circ}\text{C}$

7 - 4 - 2 ASSEMBLY PROCEDURE

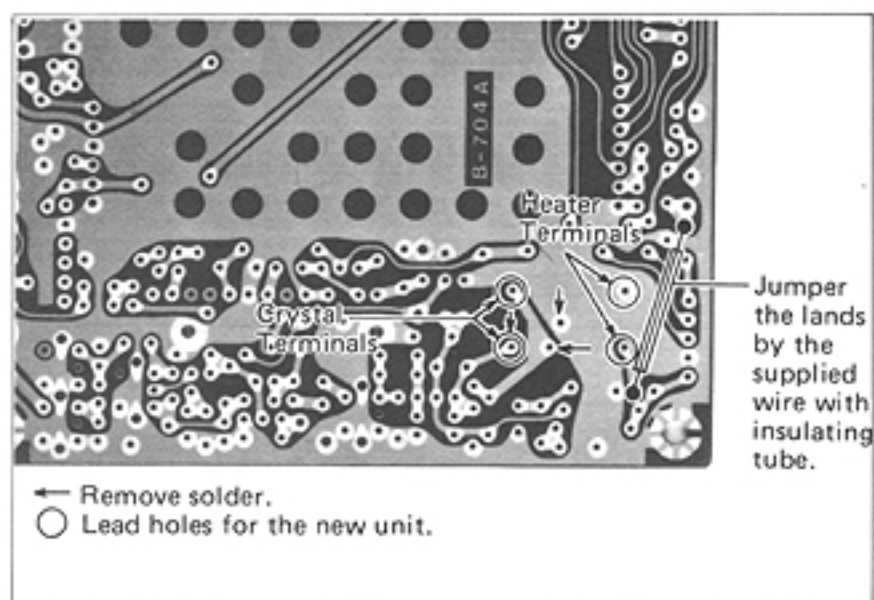
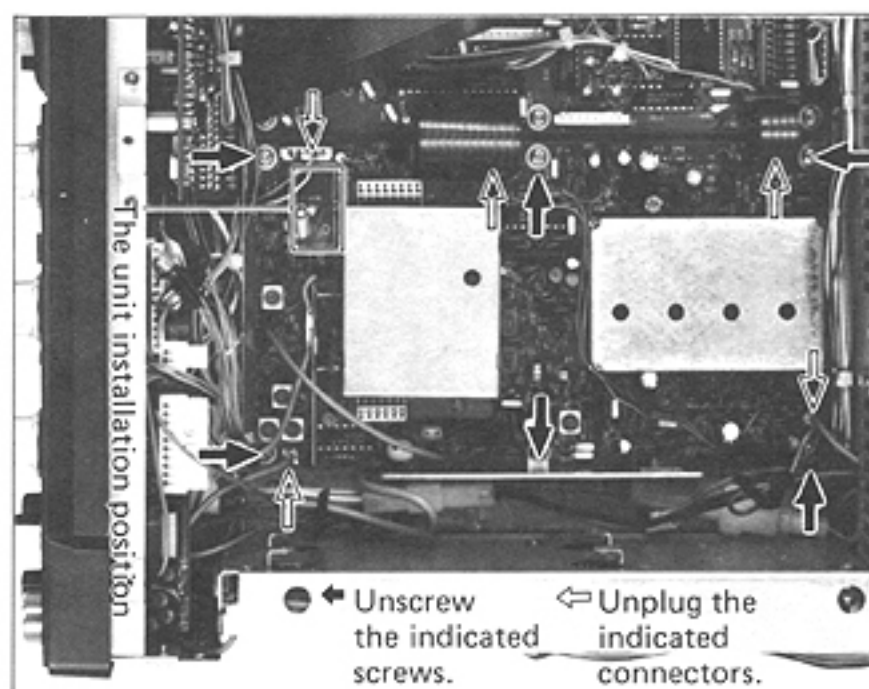
1. Turn the transceiver upside down.
2. Unscrew the six screws retaining the PLL board and unplug the connectors and flat cables indicated in the photo, then turn the board over so that foil side can be seen.
3. Remove the solder of the original crystal unit terminal pins and grounding lead on the foil of the PLL board, by a de-soldering braid, then take off the crystal unit and grounding lead.
4. The location for the high-stability crystal unit is shown in the photo. The holes for the terminal leads of the unit are predrilled. If the holes are filled with solder, remove the solder with a de-soldering braid.

Be sure to orient the unit so that the crystal and heater terminal leads (indicated on the bottom of the unit) are the same direction as shown on the photo.

Insert the unit flush with the board, bend the leads flush with foil side of the board and solder them in.

5. Trim the leads even with the solder points.

6. Jumper the lands of the foil indicated in the photo by using supplied wire with insulating tube. At this time, take care to don't make short circuits with other lands of the foil.
7. This completes the installation. Replace the PLL board and plug the connectors and flat cables unplugged before. Then replace the top and bottom covers.



7-4-3 OPERATION

No adjustment is required and the unit improves the frequency stability of the set as follows:

Frequency Stability:

Less than $\pm 50\text{Hz}$ after switch on 1min to 60mins, and less than $\pm 10\text{Hz}$ after 1hour at normal room temperature. Less than $\pm 100\text{Hz}$ in the range of $-10^{\circ}\text{C} \sim +60^{\circ}\text{C}$.

7-5 OTHER OPTIONS



IC-PS15
AC POWER SUPPLY



IC-SP3
EXTERNAL SPEAKER



IC-SM6
ELECTRET CONDENSER TYPE
DESK MICROPHONE



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



IC-HP1
HEADPHONES



RC-10
FREQUENCY
CONTROLLER



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

IC-2KL
500W SOLID-STATE
LINEAR AMPLIFIER



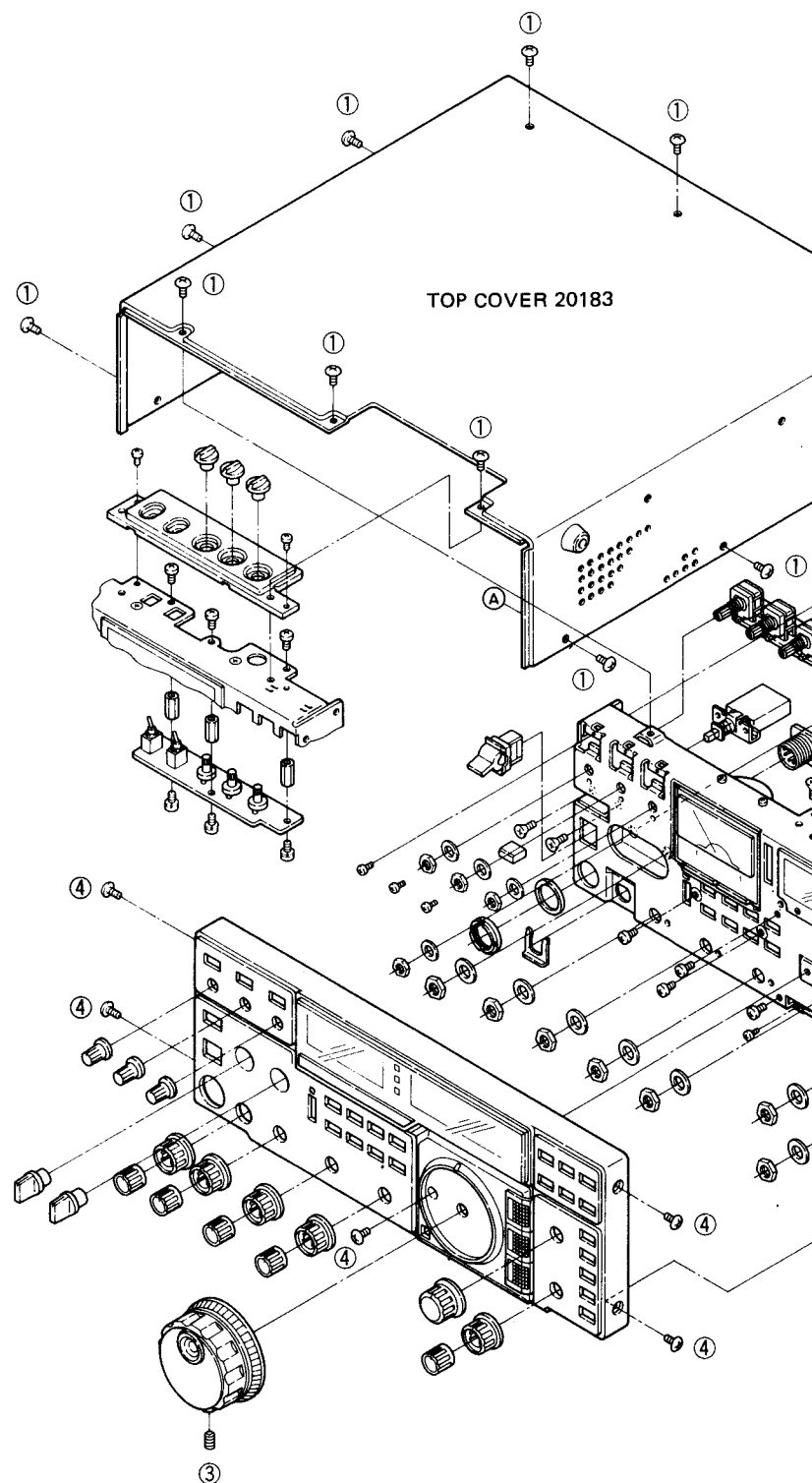
IC-PS30
AC SYSTEM POWER SUPPLY
13.8V 25A



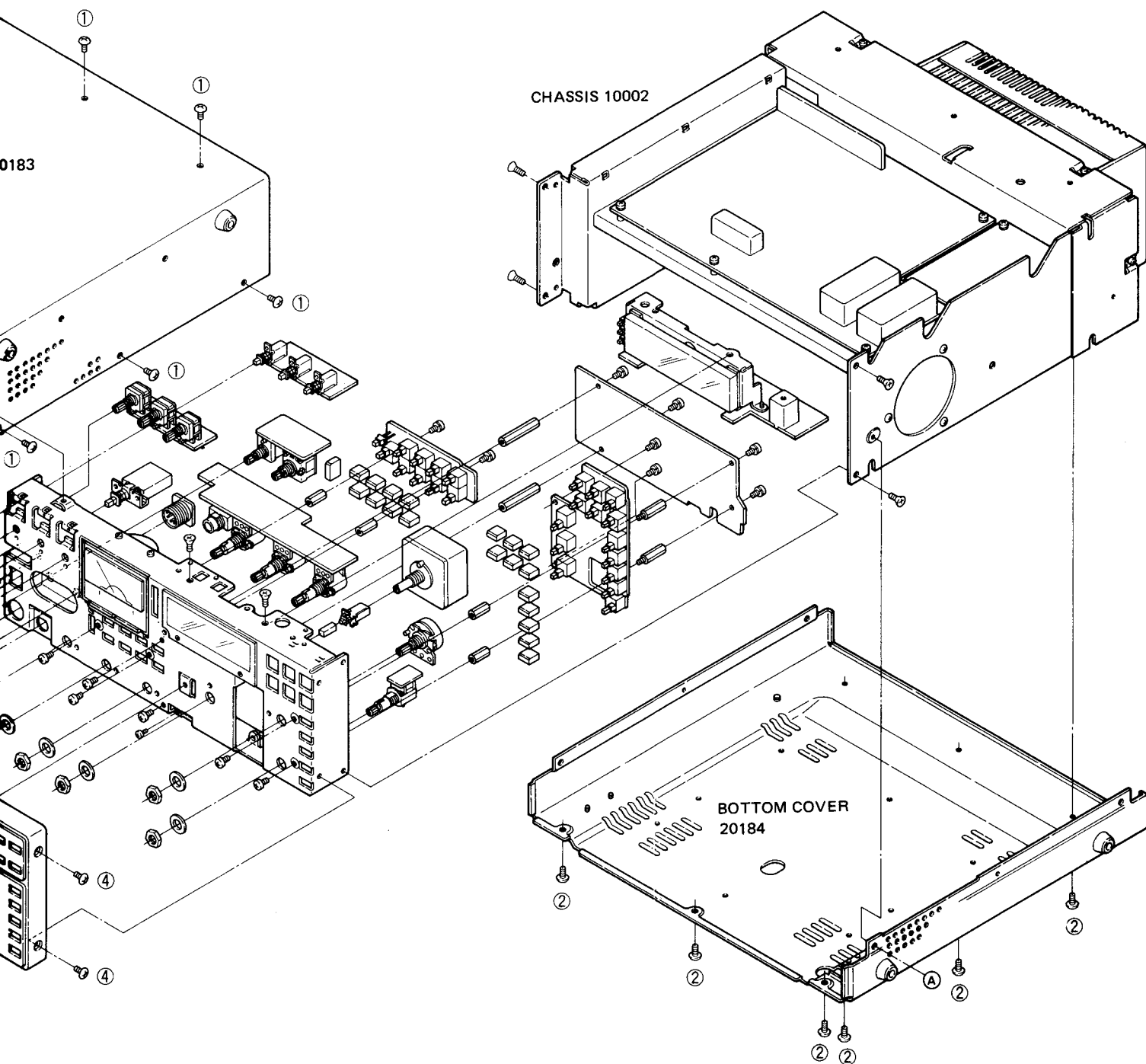
IC-AT100
(100W)
IC-AT500
(500W)
AUTOMATIC
ANTENNA TUNER

SECTION 8 MECHANICAL PARTS AND DISASSEMBLY

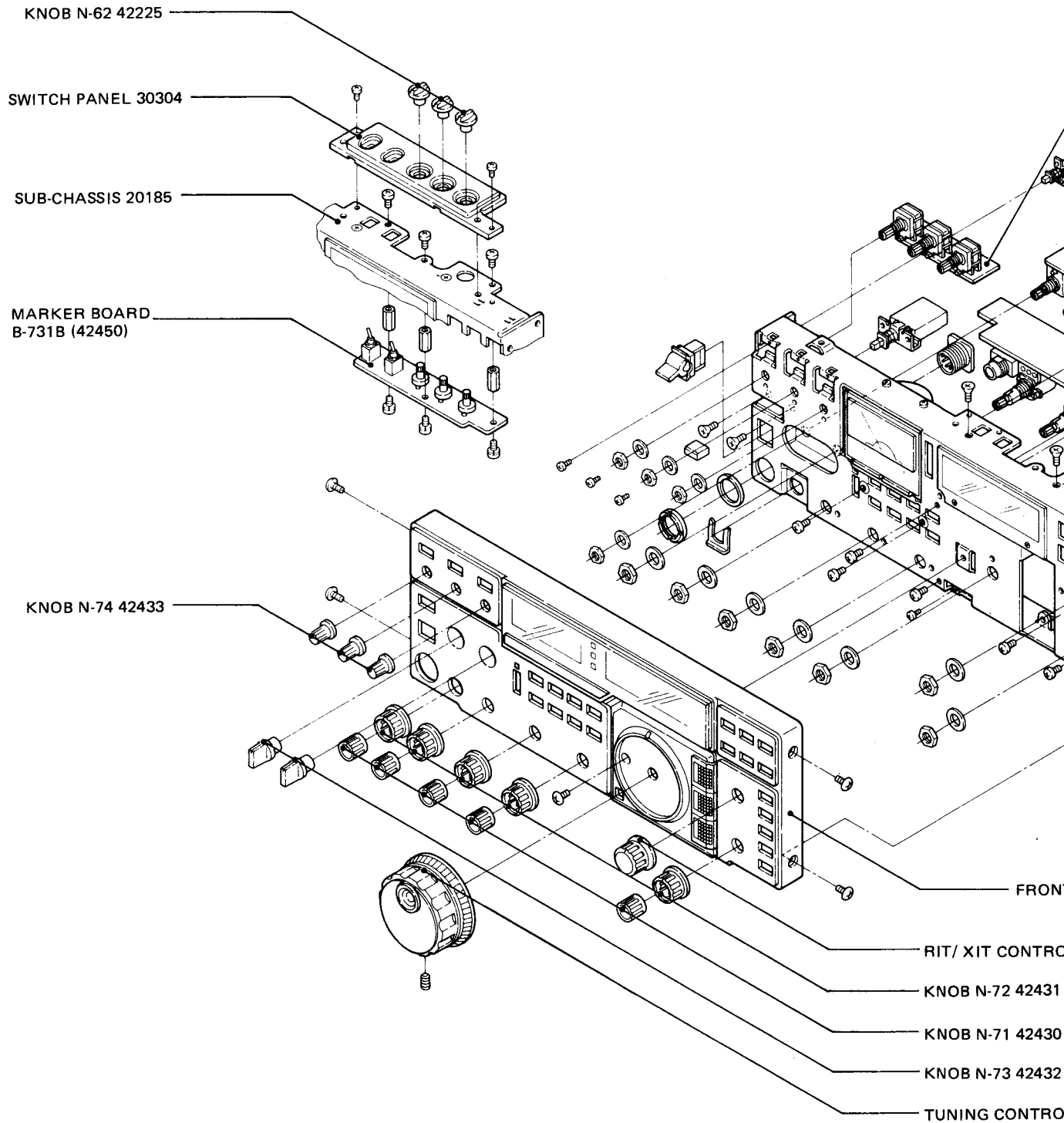
1. Remove the top cover. (12 set screws (1)).
2. Remove the bottom cover. (6 set screws (2)).
3. Remove the front panel control knobs, etc.
(Use a hexagonal wrench to remove the four knob screws (3).)
4. Remove the four frame-holding screws (4), and then remove the front panel frame by pulling it forward.

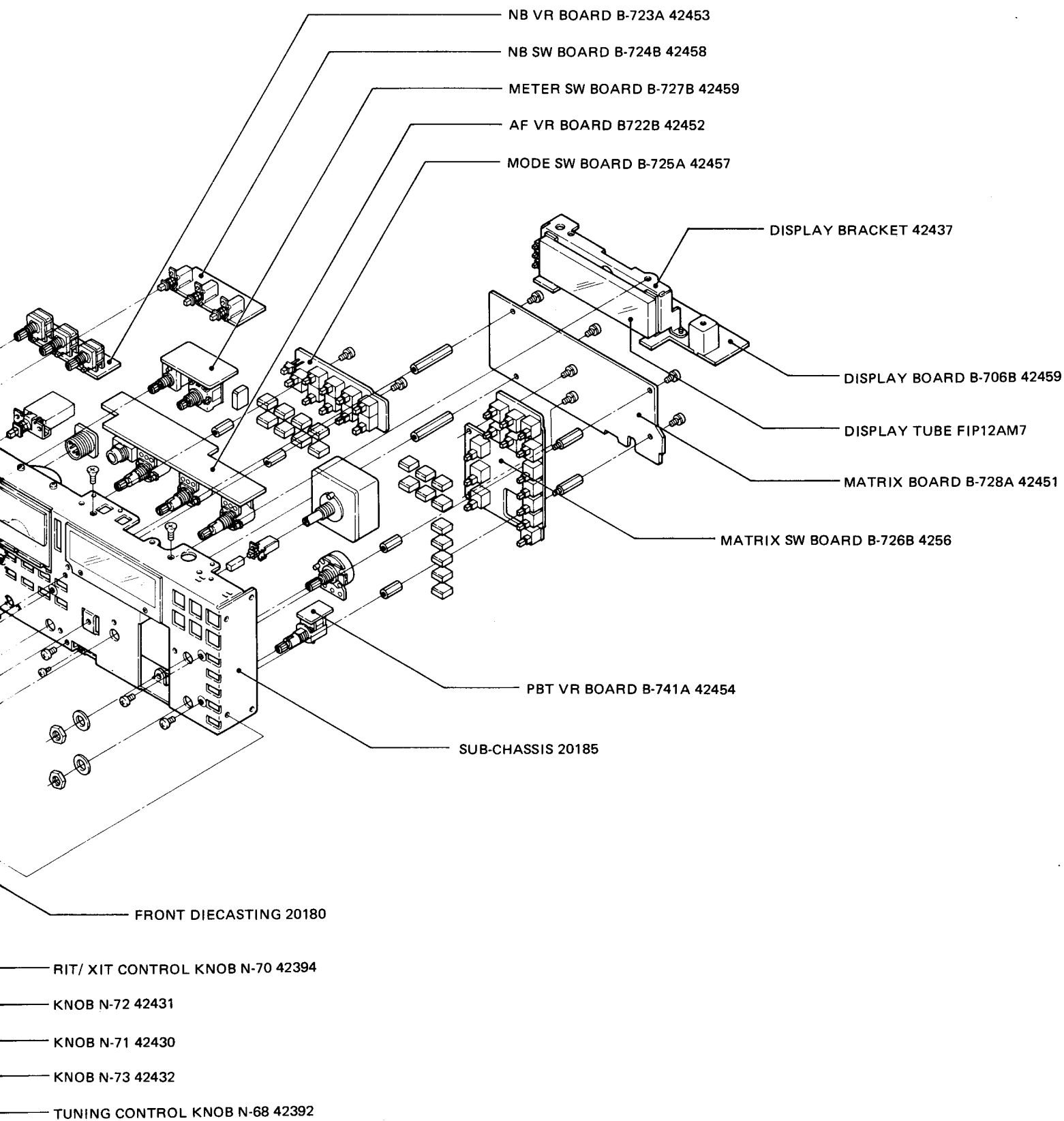


0183

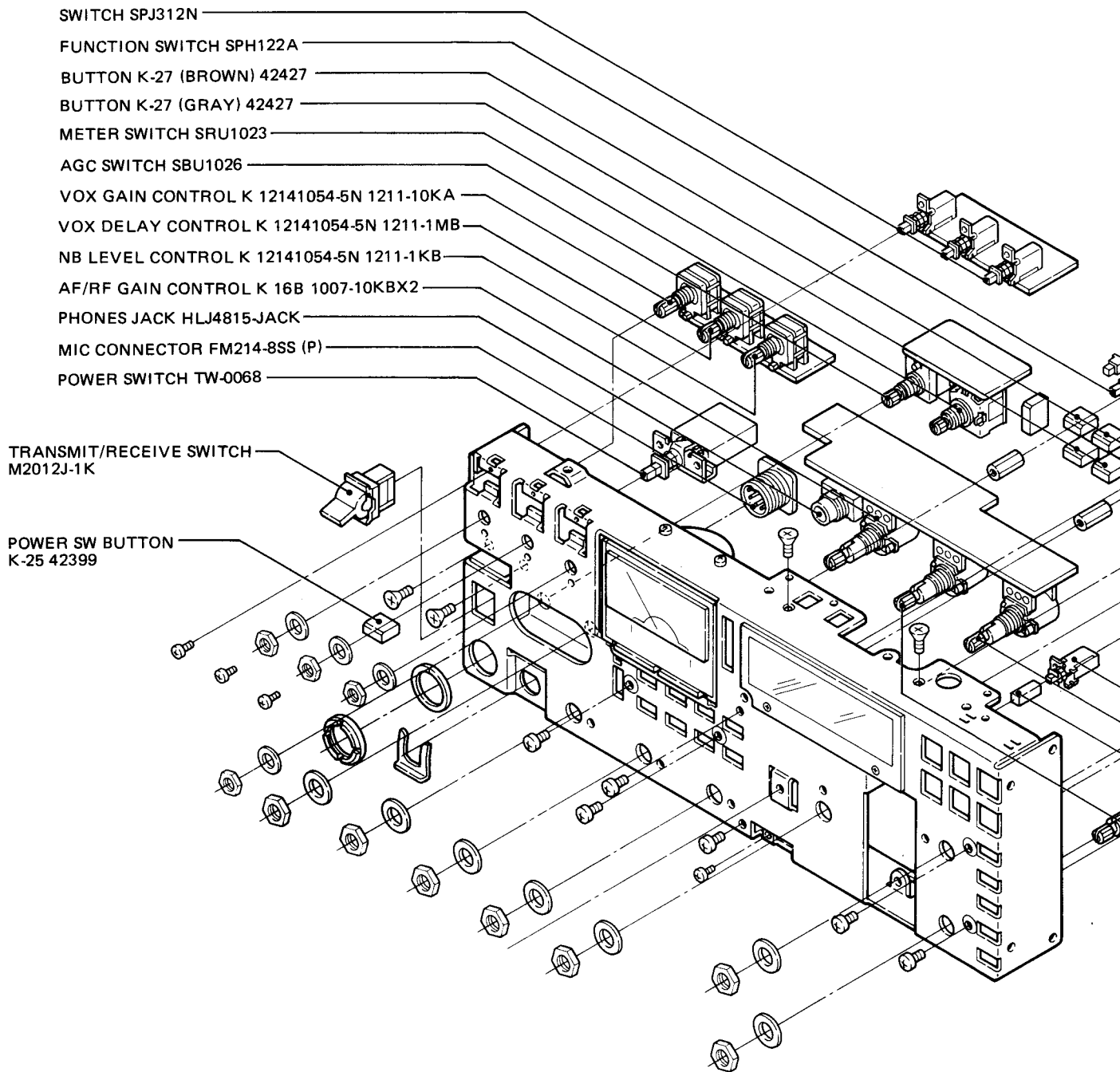


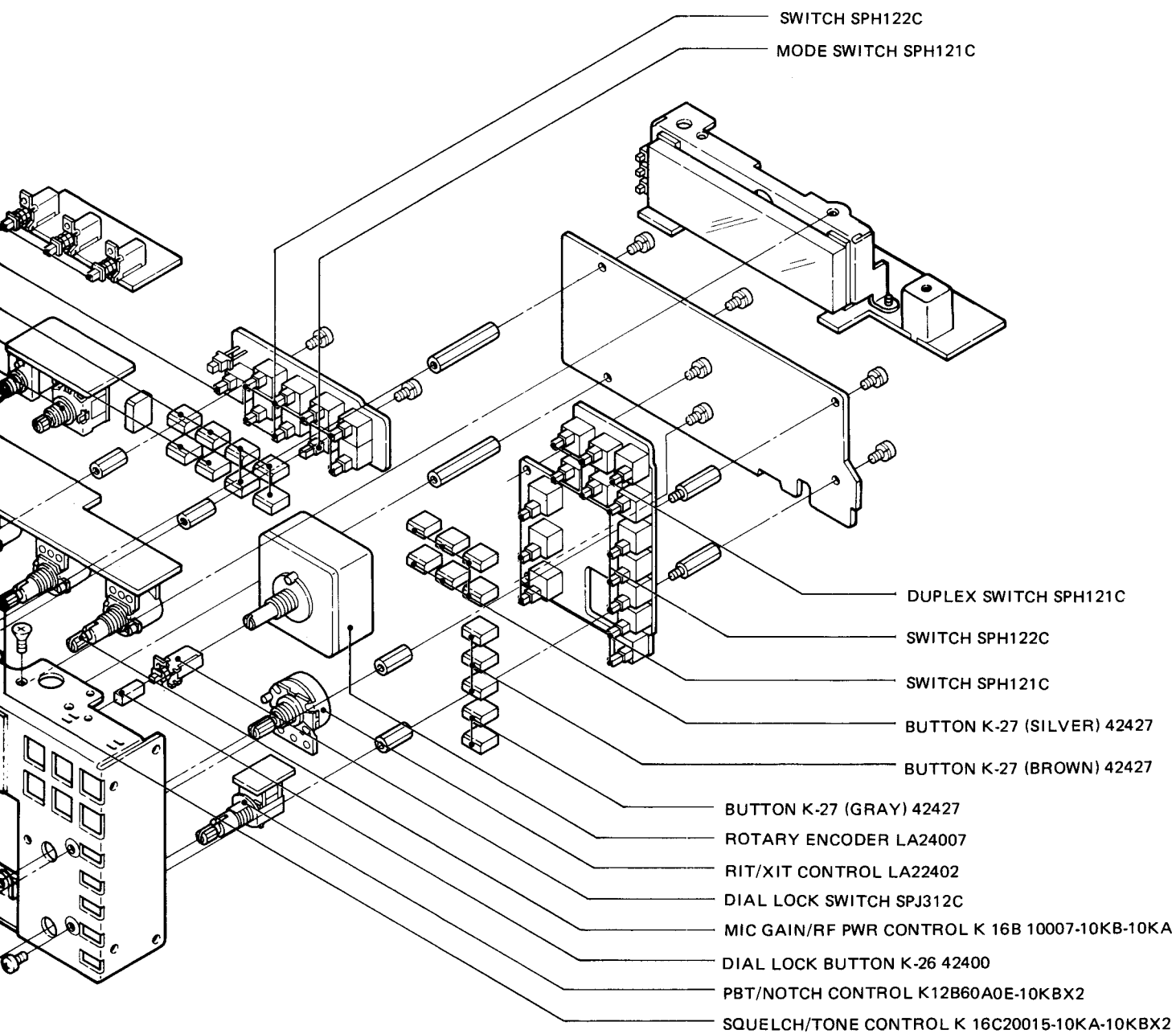
FRONT PANEL PARTS 1



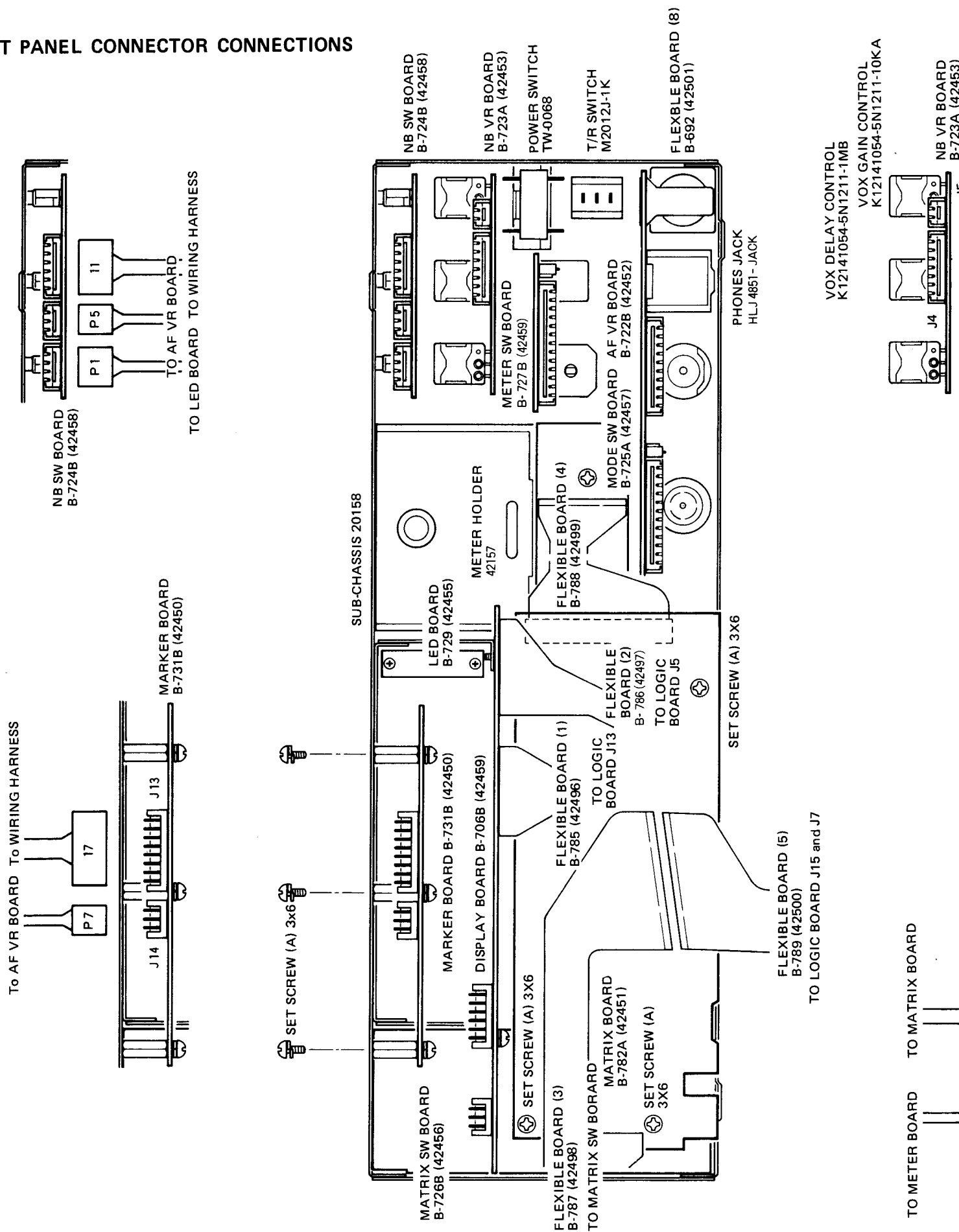


FRONT PANEL PARTS 2





FRONT PANEL CONNECTOR CONNECTIONS



FLEXIBLE BOARD (5)
B-789 (42500)

TO LOGIC BOARD J15 and J7

TO METER BOARD

P2

TO MATRIX BOARD

P1

DISPLAY BOARD
B-706B (42459)

J1

J2

FLEXIBLE BOARD (1)
B-785 (42496)
TO LOGIC BOARD J13
FLEXIBLE BOARD (2)
B-786 (42497)
TO LOGIC BOARD J5

SUB-CHASSIS 20158

MATRIX SW BOARD
B-726B (42456)

STUD (C)
40033

SET SCREW (A)
3x6

ROTARY
ENCODER
LA 24007

SPACER (E)
40274

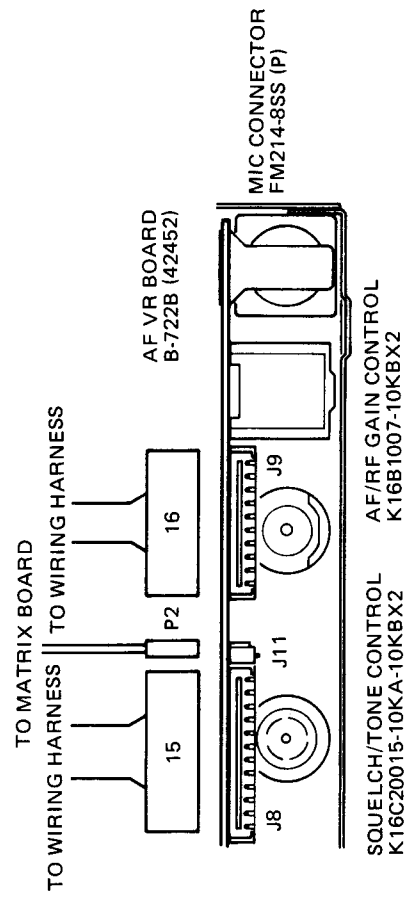
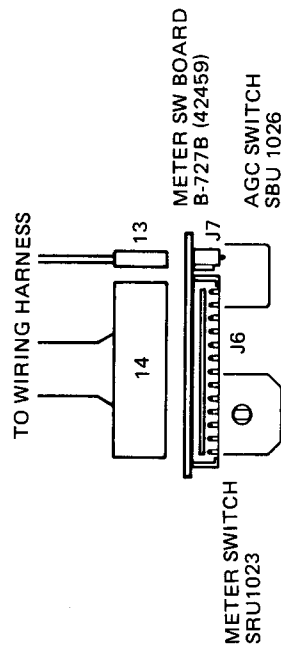
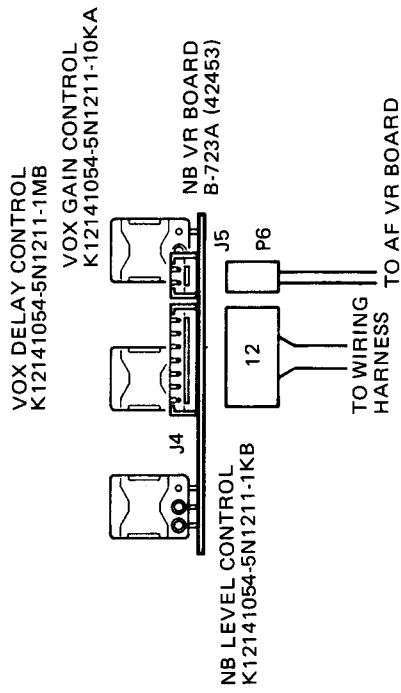
FLEXIBLE BOARD (3)
B-787 (42498)

PBT VR BOARD TO MATRIX BOARD
B-741A (42454)

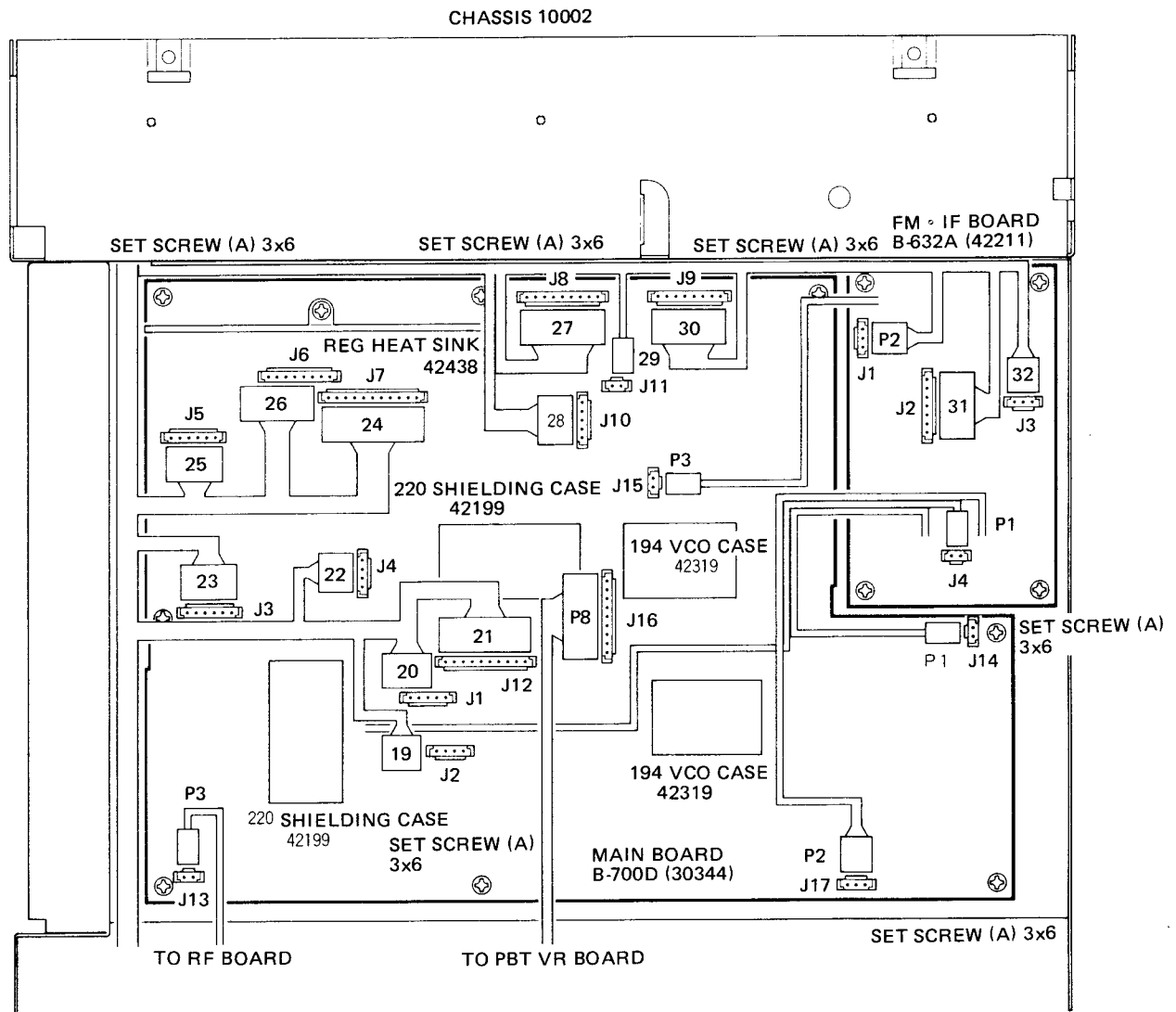
SET SCREW (A)
3x6

SPACER (E)
40274

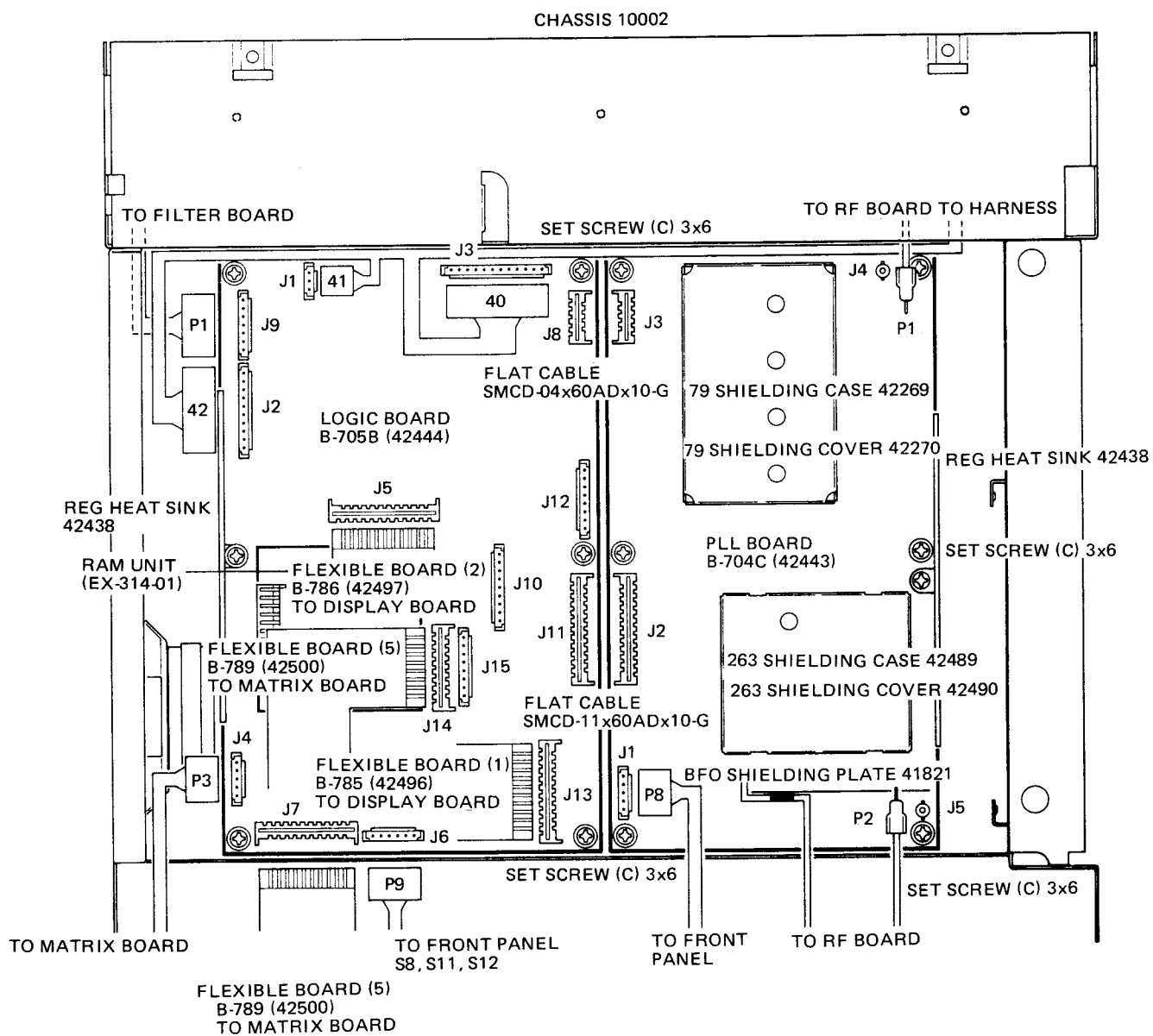
TO MAIN BOARD J16



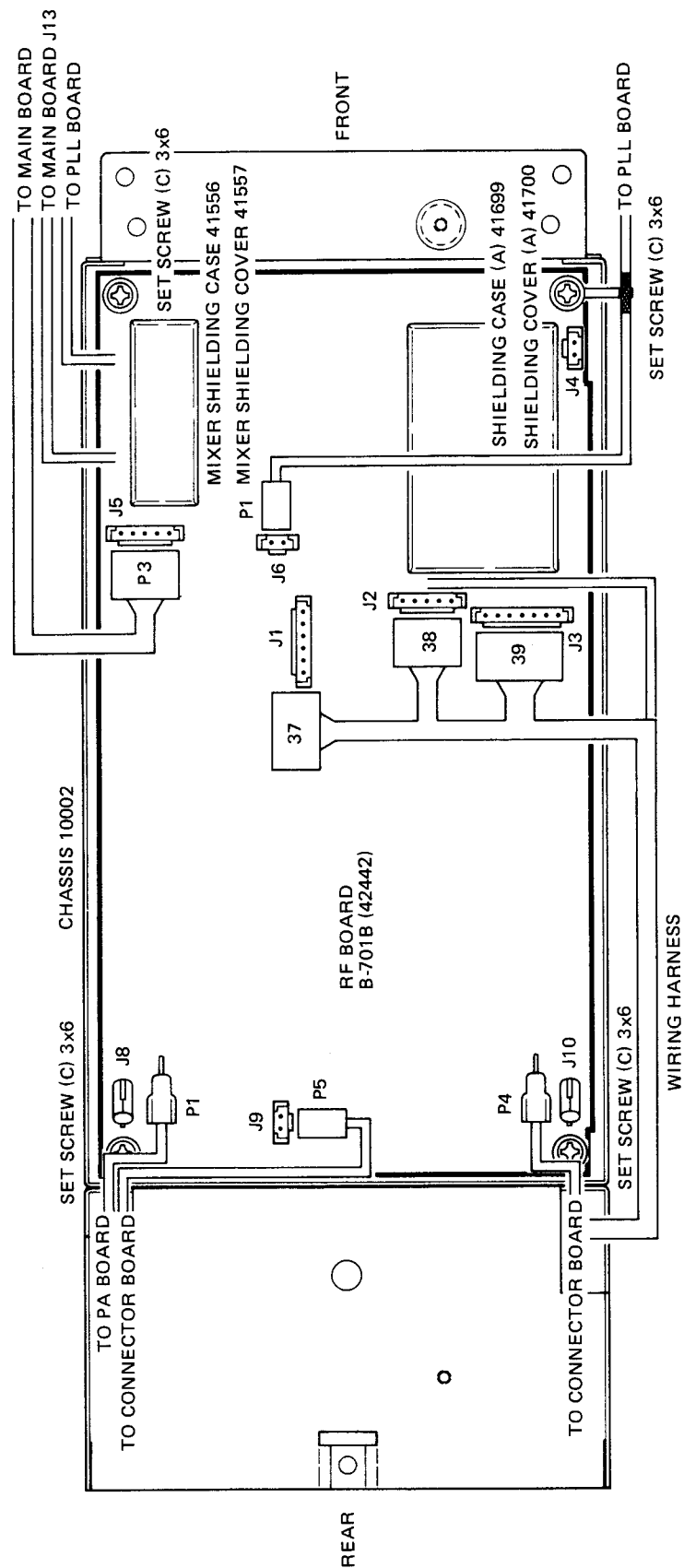
MAIN UNIT SIDE CONNECTOR CONNECTIONS



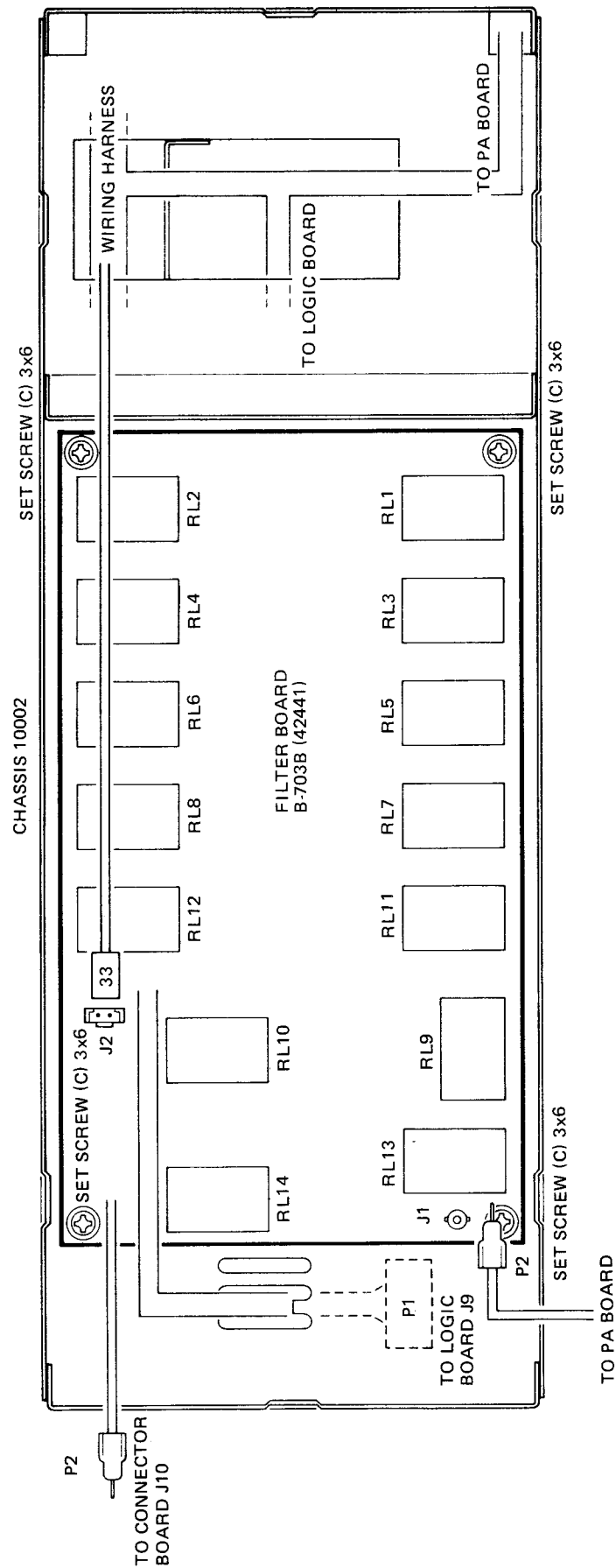
LOGIC · PLL UNIT SIDE CONNECTOR CONNECTIONS



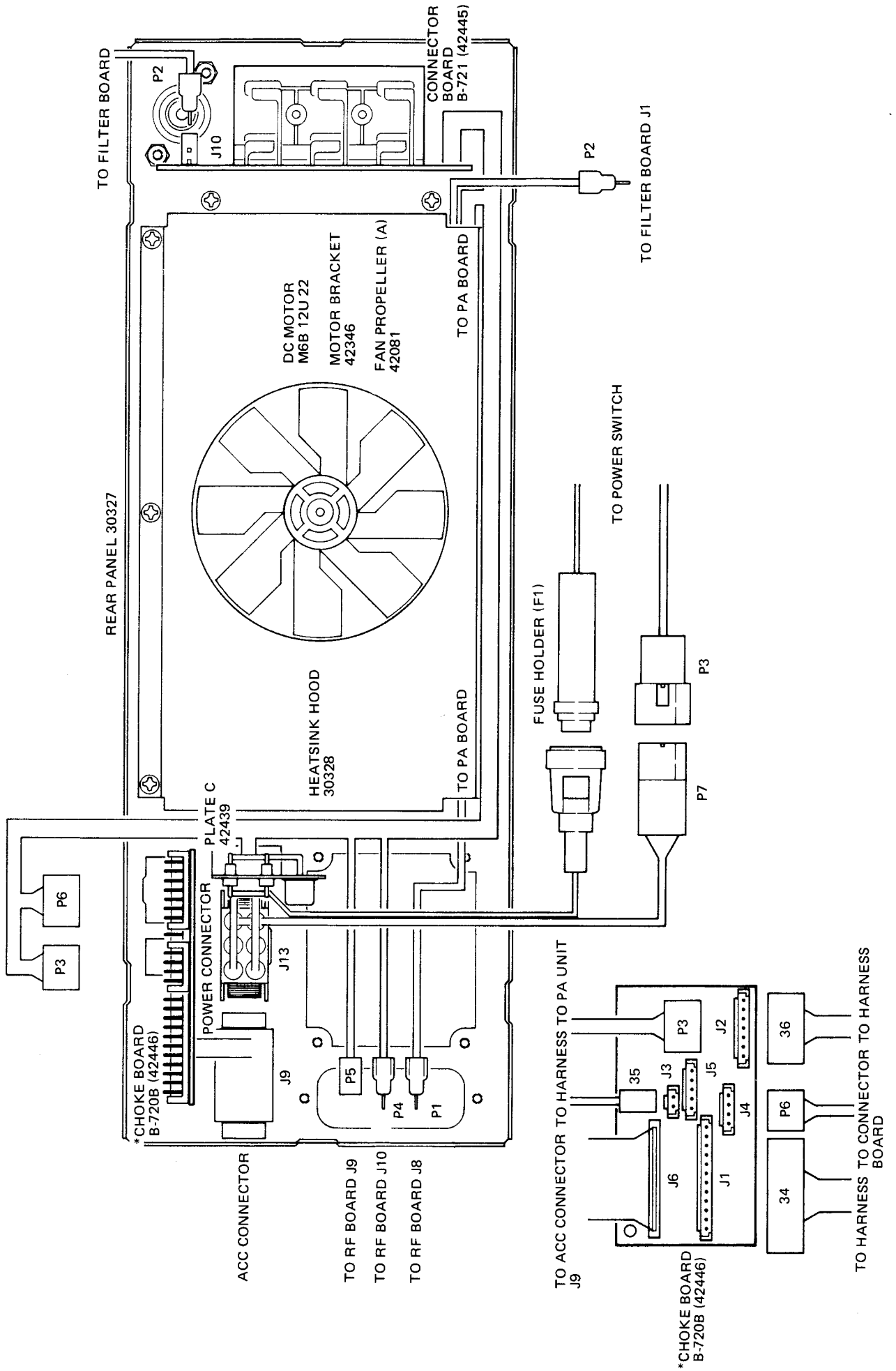
RF UNIT SIDE CONNECTOR CONNECTIONS



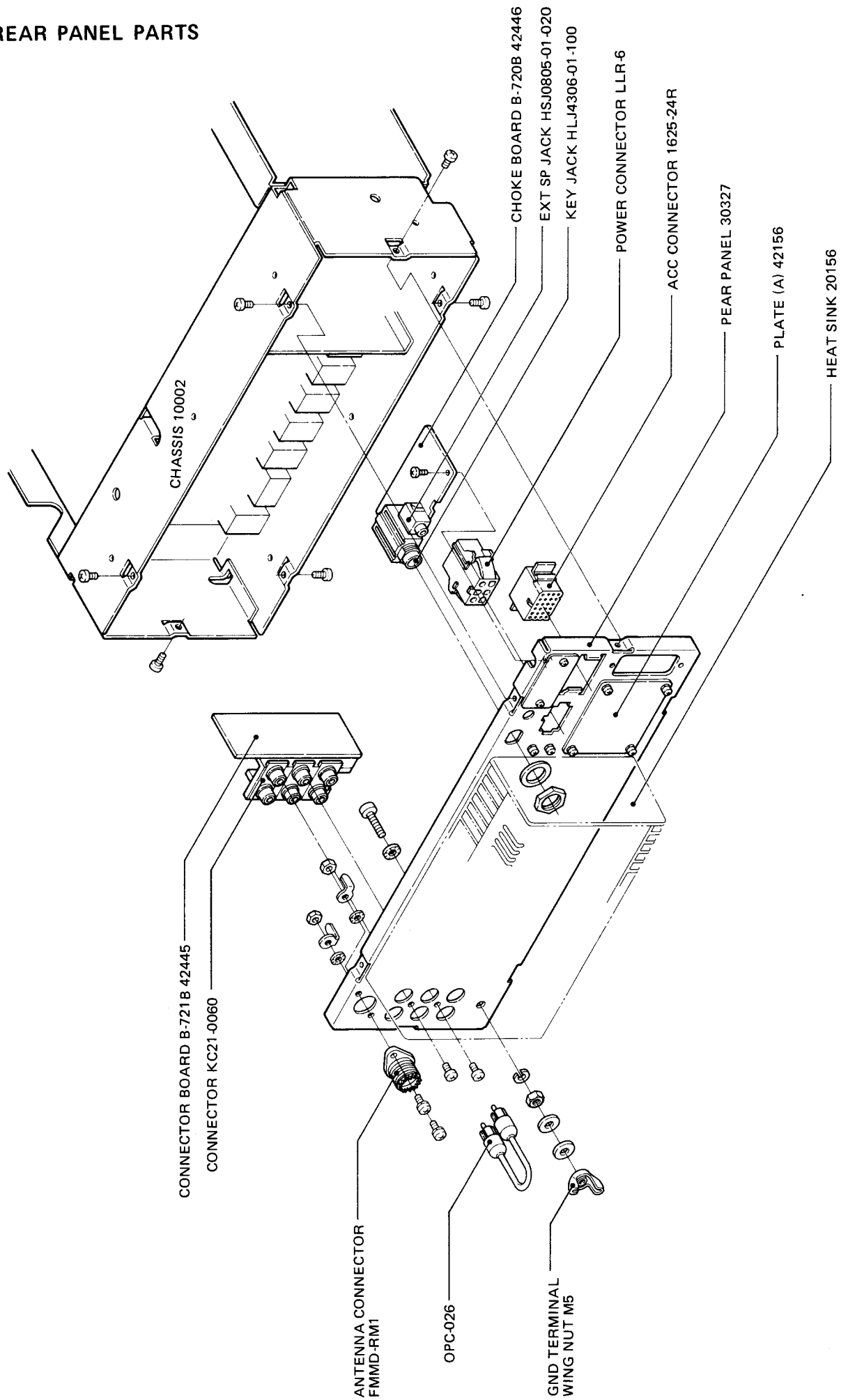
FILTER UNIT SIDE CONNECTOR CONNECTIONS



REAR PANEL CONNECTOR CONNECTIONS



REAR PANEL PARTS



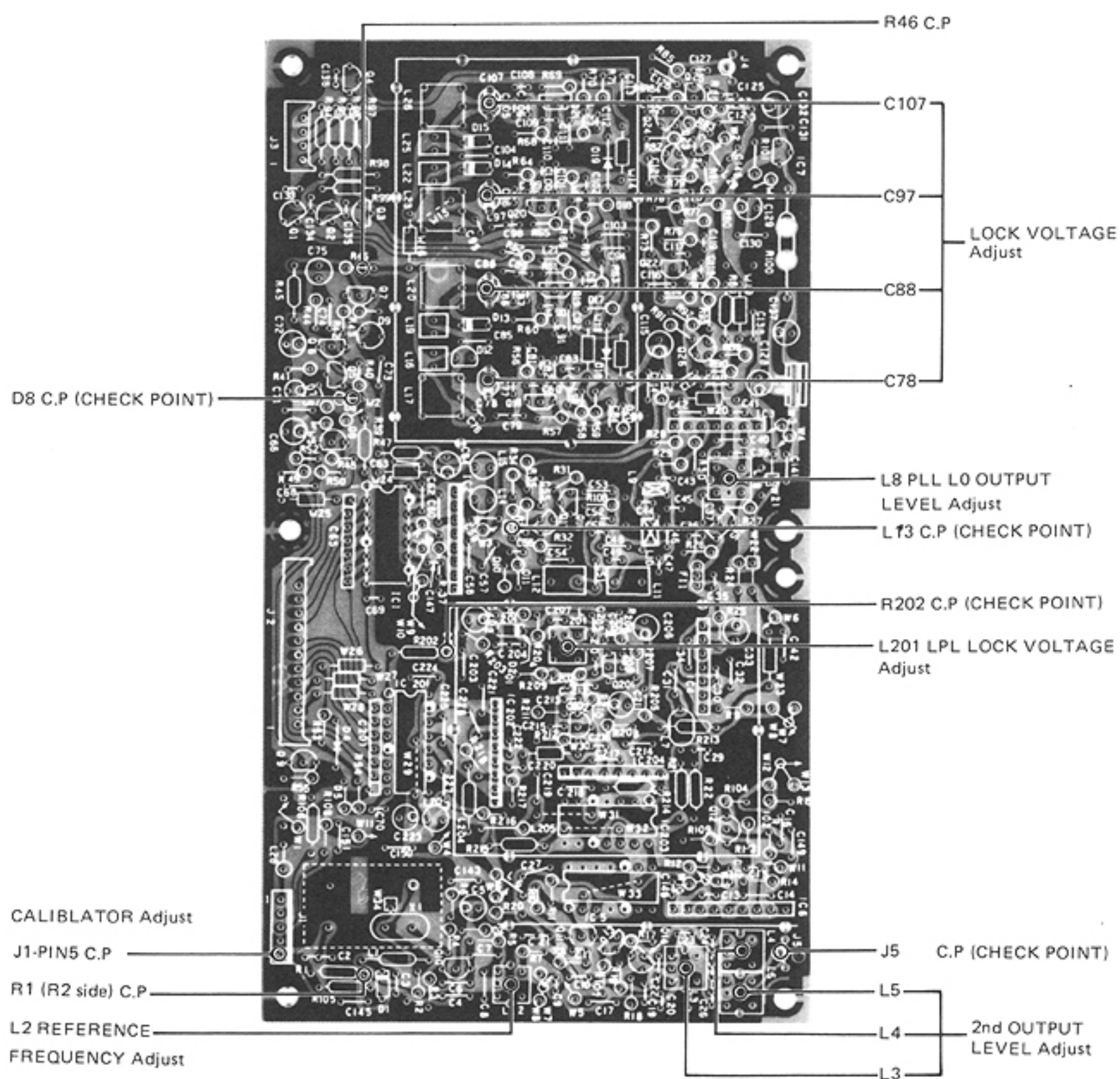
SECTION 9 MAINTENANCE AND ADJUSTMENT

9 - 1 PLL ADJUSTMENT

INSTRUMENTS REQUIRED			CONNECTIONS			
(1) VOLTAGE REGULATED POWER SUPPLY OR ATTENDANT POWER SUPPLY : OUTPUT VOLTAGE : CURRENT CAPACITY	DC 13.8V 20A or more		(3) FREQUENCY COUNTER To PLL UNIT R1 (R2 side) To PLL UNIT J5 L13 (4) RF VOLTMMETER To PLL UNIT J1-PIN5 R202 (R3) R46 D8-CATHODE (2) OSCILLOSCOPE To DC POWER SOCKET (1) VOLTAGE REGULATED POWER SUPPLY PLL UNIT			
(2) OSCILLOSCOPE : FREQUENCY RANGE : MEASURING RANGE	DC ~ 20MHz 0.01 ~ 10V					
(3) FREQUENCY COUNTER : FREQUENCY RANGE : ACCURACY : SENSITIVITY	0.1 ~ 90MHz ± 1ppm or better 100mV or better					
(4) RF VOLTMMETER : FREQUENCY RANGE : MEASURING RANGE	0.1 ~ 80MHz 0.01 ~ 10V					

Adjustment	Adjustment conditions	Unit	Measurement location	Adjustment value	Unit	Adjustment point
CALIBLATOR	1. ● Display frequency: 8.0000MHz ● MODE: LSB-GENERAL	PLL	Connect the oscilloscope to J1 pin 5.	3V	Top panel	CALIB. control
REFERENCE FREQUENCY	1. ● Display frequency: 8.0000MHz ● MODE: LSB-GENERAL	PLL	Connect the frequency counter to R1 (R2 side).	30.7200MHz	PLL	L2
PLL LO OUT-PUT LEVEL	1. ● Display frequency: 8.0000MHz ● MODE: LSB-GENERAL	PLL	Connect the RF voltmeter to L13.	Adjust to maximum output: 400mV ~ 1Vp-p	PLL	L8
LOCK VOLTAGE	1. ● Display frequency: 8.0000MHz ● MODE: LSB-GENERAL	PLL(LPL)	Connect the oscilloscope to R202 (R3).	3V	PLL(LPL)	L201(L1)
	2. ● Display frequency: 7.9999MHz			1.5 ~ 2V		Confirming
HPL LOCK VOLTAGE	1. ● Display frequency: 7.9999MHz ● MODE: LSB-GENERAL	PLL	Connect the oscilloscope to R46.	6.5V	PLL	C78
	2. ● Display frequency: 14.9999MHz ● MODE: USB-GENERAL					C88
	3. ● Display frequency: 21.9999MHz					C97
	4. ● Display frequency: 29.9999MHz					C107
	5. ● Display frequency: 8.0000MHz		Approx. 3V	Confirming		
	6. ● Display frequency: 15.0000MHz					
	7. ● Display frequency: 22.0000MHz					
	8. ● Display frequency: 7.9999MHz ● MODE: LSB-GENERAL					Connect the oscilloscope to D8 cathode.
2nd LO OUT-PUT LEVEL	1. ● Display frequency: 8.0000MHz ● MODE: LSB-GENERAL	PLL	Terminate J5 with a 50Ω resistor and connect the RF voltmeter there.	Adjust to maximum output: 250 ~ 400mVrms	PLL	L3 ~ L5
Note: After completed the adjustment, make J5 in original condition.						

PLL UNIT

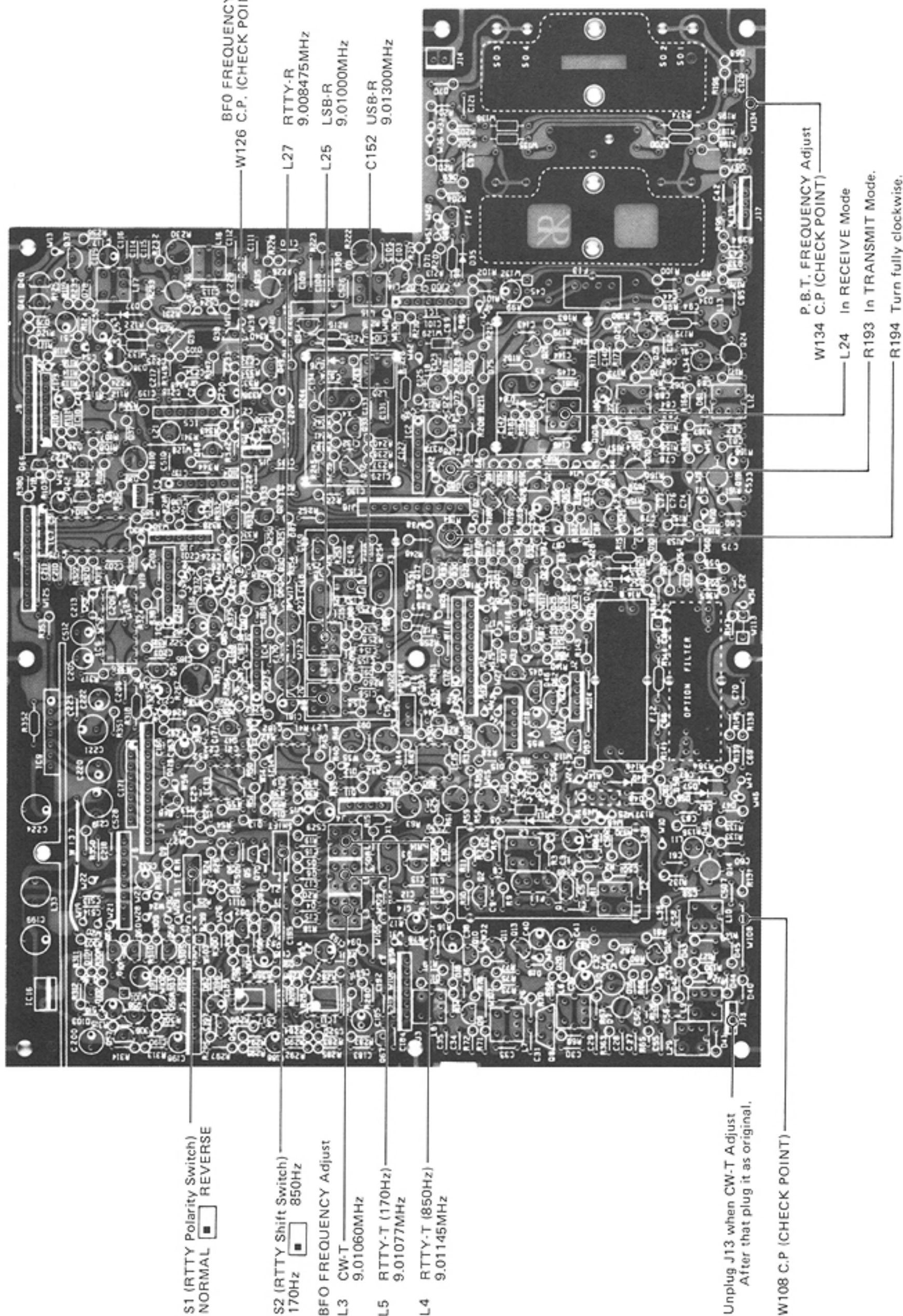


9-2 MAIN UNIT (COMMON CIRCUITS) ADJUSTMENT

INSTRUMENTS		CONNECTIONS	
(1) VOLTAGE REGULATED POWER SUPPLY OR ATTENDANT POWER SUPPLY : OUTPUT VOLTAGE DC 13.8V : CURRENT CAPACITY 20A or more (2) FREQUENCY COUNTER : FREQUENCY RANGE 0.1 ~ 90MHz : ACCURACY ± 1 ppm or better : SENSITIVITY 100mV or better (3) RF POWER METER (TERMINATED TYPE) : MEASURING RANGE 20 ~ 200W : FREQUENCY RANGE 1.8 ~ 30MHz : IMPEDANCE 50 Ω : SWR 1.1 or less			

Adjustment	Adjustment conditions	Unit	Measurement location	Adjustment value	Unit	Adjustment point
BFO FREQUENCY	1. ● Display frequency: 14MHz ● MODE: USB Set in RECEIVE mode	MAIN	Connect the frequency counter to W126.	9.01300MHz	MAIN	C152
	2. ● MODE: LSB			9.01000MHz		L25
	3. ● MODE: CW			9.00980MHz ± 100Hz		Confirming
	4. ● MODE: RTTY			9.008475MHz		L27
	5. ● MODE: AM			No output		Confirming
	6. After confirming the RF POWER METER is connected to the ANT connector, set in TRANSMIT mode.			9.01000MHz ± 100Hz		
	7. ● MODE: CW Unplug the connector inserted to J13, then make key down.		Connect the frequency counter to W108.	9.01060MHz		L3
	8. ● MODE: RTTY ● S1: Right (REVERSE side) ● S2: Left (170Hz side)			9.01077MHz		L5
	9. ● S2: Right (850Hz side)			9.01145MHz		L4
	Note: Repeat adjustments of 6 ~ 9 several times.					
10. ● S1: Left (NORMAL side) ● S2: Left/Right	MAIN	Connect the frequency counter to W108.	Switch S2 the left side and right side alternately, and confirm the frequency is 9.01060 MHz in any side.		Confirming	
Note: After adjustment of 7, plug the connector of J13 in original condition.						
P.B.T. FREQUENCY	1. ● Display frequency: 14MHz ● MODE: USB ● FILTER: ON ● P.B.T. CONTROL: Center Turn R194 fully clockwise and set in RECEIVE mode.	MAIN	Connect the frequency counter to W134.	9.46650MHz	MAIN	L24
	2. ● P.B.T. CONTROL: Fully clockwise			9.46800MHz or higher		Confirming
	3. ● P.B.T. CONTROL: Fully counterclockwise			9.46500MHz or lower		
	4. ● P.B.T. CONTROL: Center Set in TRANSMIT mode.			9.46650MHz		R193

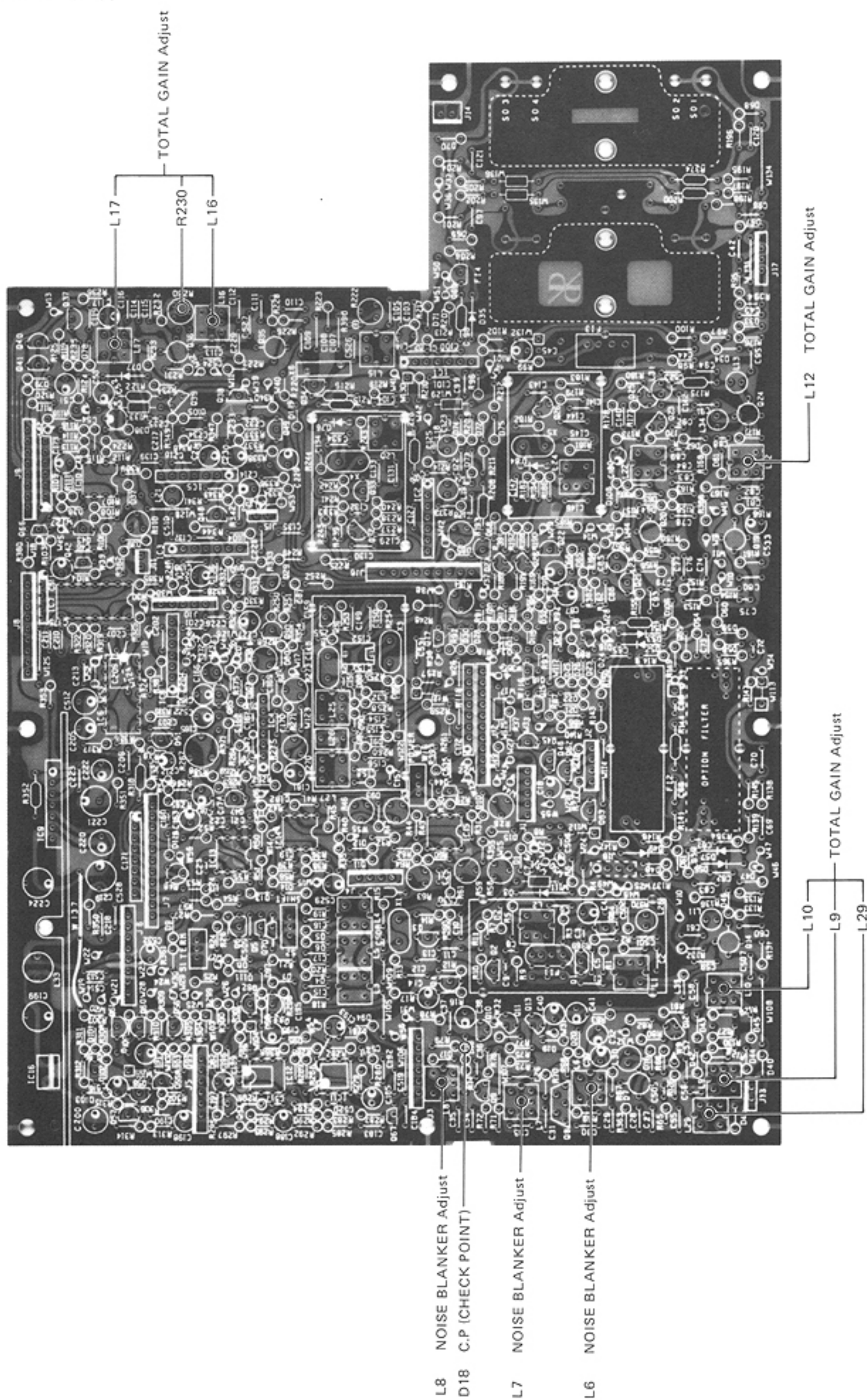
MAIN UNIT



9 - 3 RECEIVER ADJUSTMENT

INSTRUMENTS REQUIRED				CONNECTIONS		
(1) VOLTAGE REGULATED POWER SUPPLY OR ATTENDANT POWER SUPPLY : OUTPUT VOLTAGE DC 13.8V : CURRENT CAPACITY 20A or more (2) STANDARD SIGNAL GENERATOR (SSG) : FREQUENCY RANGE 0.1 ~ 40MHz : OUTPUT LEVEL (Loaded value) -20 ~ +90dB (0dB = 1μV) (3) AC MILLIVOLTMETER : MEASURING RANGE 10mV ~ 3V (4) EXTERNAL SPEAKER : IMPEDANCE 8Ω (5) OSCILLOSCOPE : FREQUENCY RANGE DC ~ 20MHz : MEASURING RANGE 0.01 ~ 10V				(4) EXTERNAL SPEAKER → To MAIN UNIT D18 (5) OSCILLOSCOPE AC MILLI-VOLTMETER To EXT SP JACK To DC POWER SOCKET To ANT CONNECTOR (1) VOLTAGE REGULATED POWER SUPPLY MAIN UNIT STANDARD SIGNAL GENERATOR (SSG)		
Adjustment	Adjustment conditions	Unit	Measurement location	Adjustment value	Unit	Adjustment point
TOTAL GAIN	1. ● Display frequency: 14MHz ● MODE: USB ● RF GAIN: Fully clockwise ● RF AMP: OFF ● FILTER: OFF ● NOTCH: OFF ● P.B.T.: Center ● TONE: Center ● SQL: Fully counterclockwise ● AGC: FAST ● RIT: OFF ● NB: OFF Set the output level of the SSG to -10dBμ.		Connect the AC millivoltmeter to the EXT SP jack.	Adjust to maximum AF output.	MAIN	L9, L10, L12, L16, L17, L29
	2. 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. Turn off the output of the SSG.			Adjust R230 so that the noise level is 30dB down (about 80mV) from 2.5V.	MAIN	R230
NOISE BLANKER	1. ● Display frequency: 14MHz ● MODE: USB ● RF AMP: OFF ● NB TIMING SW: ON ● NB: ON Apply pulse noise to the ANT connector.	MAIN	Connect the oscilloscope to D18.	Adjust to maximum noise waveform on the scope.	MAIN	L6 ~ L8
	Note: When the NB TIMING SWITCH is turned off, the noise blanker should not function for wide noises (pulse width: about 5 milli seconds). When receiving narrow noises (pulse width: 0.4 ~ 0.5 milliseconds), the noise blanker should function regardless of the NB TIMING SWITCH position (turned ON or OFF).					

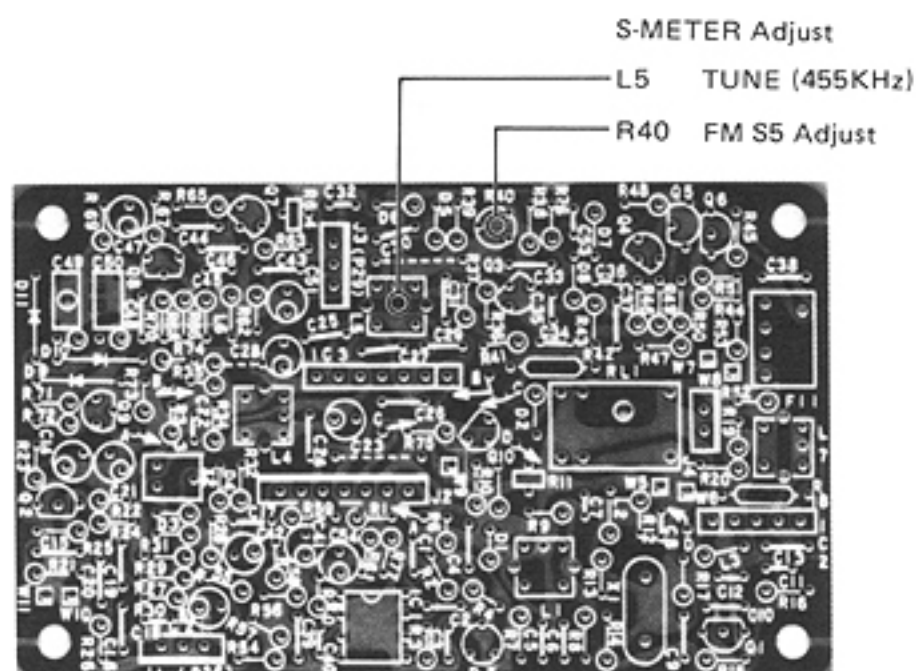
MAIN UNIT



9 - 3 RECEIVER ADJUSTMENT (Continued)

Adjustment	Adjustment conditions	Unit	Measurement location	Adjustment value	Unit	Adjustment point
S-METER	1. ● Display frequency: 14MHz ● MODE: USB ● RF GAIN: Fully clockwise ● RF AMP: OFF ● FILTER: OFF ● NOTCH: OFF ● P.B.T.: Center ● TONE: Center ● SQL: Fully counterclockwise ● AGC: FAST Confirm that the S-meter points zero-point when power is off and no signal is received. Then apply +74dBμ signal from the SSG.	FRONT PANEL	S-METER	S9 + 40dB	MAIN	R110
	2. Set the output level of the SSG to +34dBμ.			S8 ~ S9		Confirming
	3. Set the output level of the SSG to +14dBμ.			S2 ~ S3		
	4. ● Display frequency: 29.6250MHz ● RF AMP: ON Set the output level of the SSG to +6dBμ.			Adjust to get maximum meter deflection.	FM	L5
	5.			S5		R40
	Note: Repeat the adjustments of 4. and 5. several times.					
NOTCH FILTER	1. ● Display frequency: 14.0485MHz ● MODE: USB ● RF GAIN: Fully clockwise ● RF AMP: OFF ● FILTER: OFF ● MARKER: ON ● NOTCH: ON Center ● SQL: Fully counterclockwise ● AGC: FAST Receive the marker's signal.	FRONT PANEL	S-METER	Adjust to get maximum meter deflection.	MAIN	L20 R222
	2. ● NOTCH: Fully clockwise and counterclockwise.			Turn the NOTCH control fully clockwise and counterclockwise alternately, and adjust to get the same meter deflection.		L15

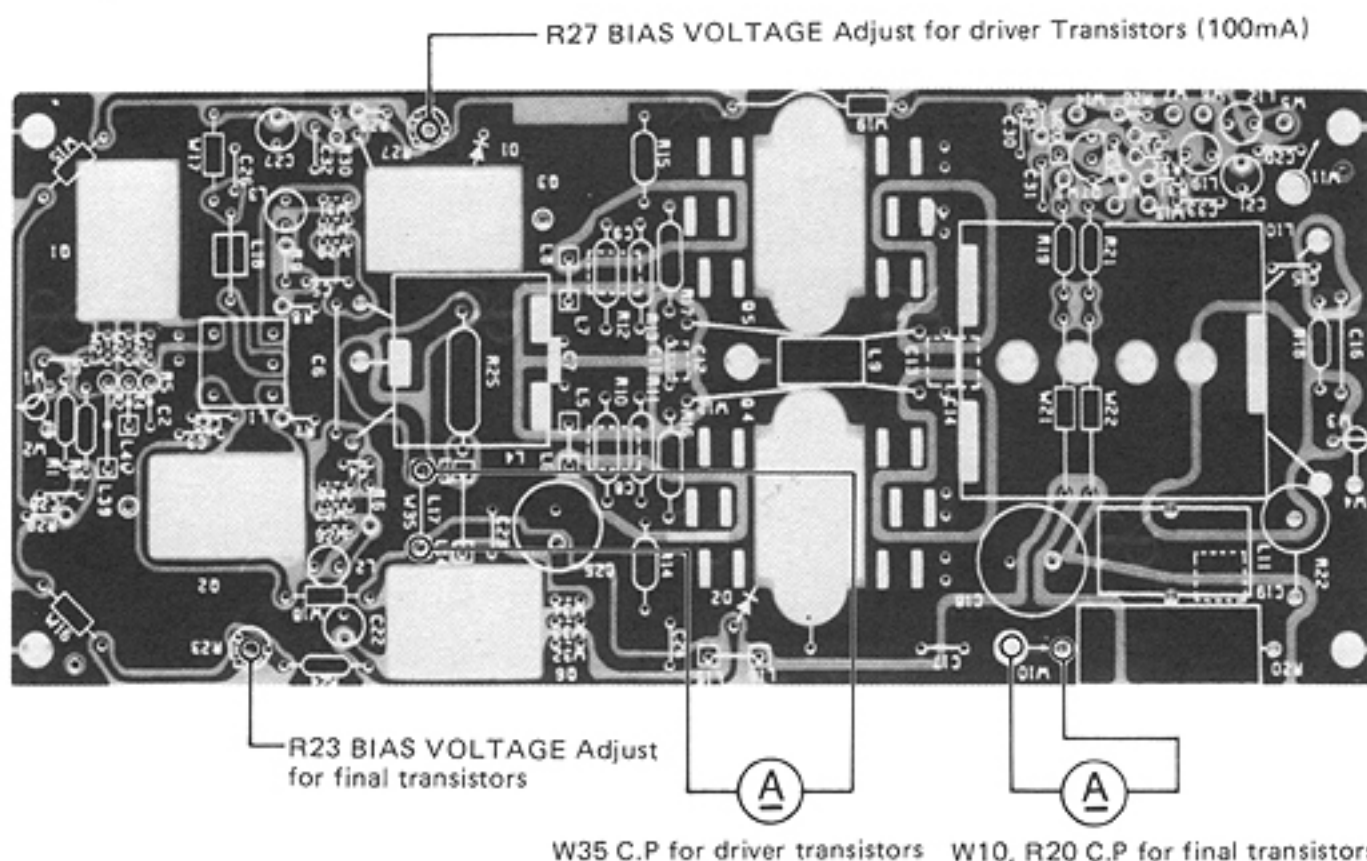
FM UNIT



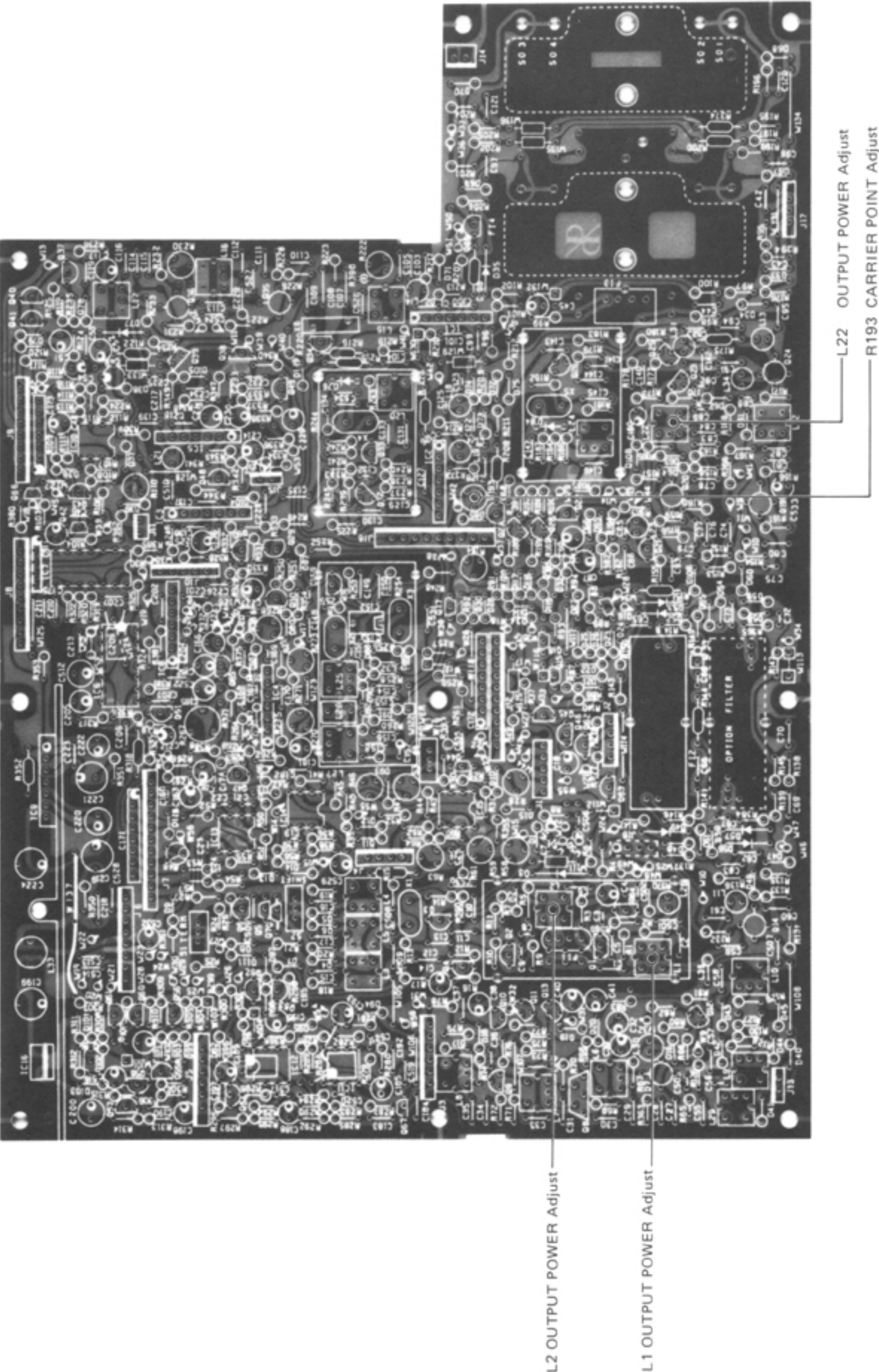
9 - 4 TRANSMITTER ADJUSTMENT

INSTRUMENT REQUIRED			CONNECTIONS			
(1) VOLTAGE REGULATED POWER SUPPLY OR ATTENDANT POWER SUPPLY : OUTPUT VOLTAGE DC 13.8V : CURRENT CAPACITY 20A or more (2) RF POWER METER (TERMINATED TYPE) : MEASURING RANGE 20 ~ 200W : FREQUENCY RANGE 1.8 ~ 30MHz : IMPEDANCE 50Ω : SWR 1.1 (3) AF GENERATOR (AG) : FREQUENCY RANGE 200 ~ 3000Hz : OUTPUT LEVEL 0 ~ 300mV (4) AC MILLIVOLTMETER : MEASURING RANGE 10mV ~ 3V			To DC POWER SOCKET To ANT CONNECTOR (1) VOLTAGE REGULATED POWER SUPPLY (2) RF POWER METER (3) AF GENERATOR (AG) (4) AC MILLIVOLT-METER To MIC CONNECTOR (MIC CONNECTOR CONNECTION) AC MILLIVOLTMETER Pin 1 AG input Pin 7 Ground Pin 5 Jumper Pin 6 Jumper AF GENERATOR Jumper			
Adjustment	Adjustment conditions	Unit	Measurement location	Adjustment value	Unit	Adjustment point
BIAS VOLTAGE (a) For driver transistors (b) For final transistor	1. ● Display frequency: 14MHz ● MODE: SSB ● MIC GAIN: Fully counterclockwise	PA	Desolder at the center at W35 (jumper wire with 6 bead cores), and connect a DC ammeter there in series.	100mA	PA	R27
	2. After confirming no MIC input, set in TRANSMIT mode.		Desolder W10, and connect a DC ammeter between W10 and R20.	600mA		R23
	Note: After adjustments of 1. and 2., solder W35 and W10 as original conditions.					
OUTPUT POWER	1. ● Display frequency: 14MHz ● MODE: USB ● COMP: OFF Apply 1.5KHz/3mV signal from the AG, then adjust the MIC GAIN control to get 30W output power.		Connect the RF POWER METER to the ANT connector.	Adjust to get maximum output power.	MAIN	L1, L2
	2. ● COMP: ON					L22
CARRIER POINT	1. ● Display frequency: 14MHz ● MODE: USB/LSB ● COMP: OFF Apply 270Hz/3mV signal from the AG, then adjust the MIC GAIN control to get 30W output power.		Connect the RF POWER METER to the ANT connector.	Change the operating mode for USB and LSB alternately, and adjust R193 to get same output power in the both modes.	MAIN	R193

PA UNIT



MAIN UNIT



L2 OUTPUT POWER Adjust

L1 OUTPUT POWER Adjust

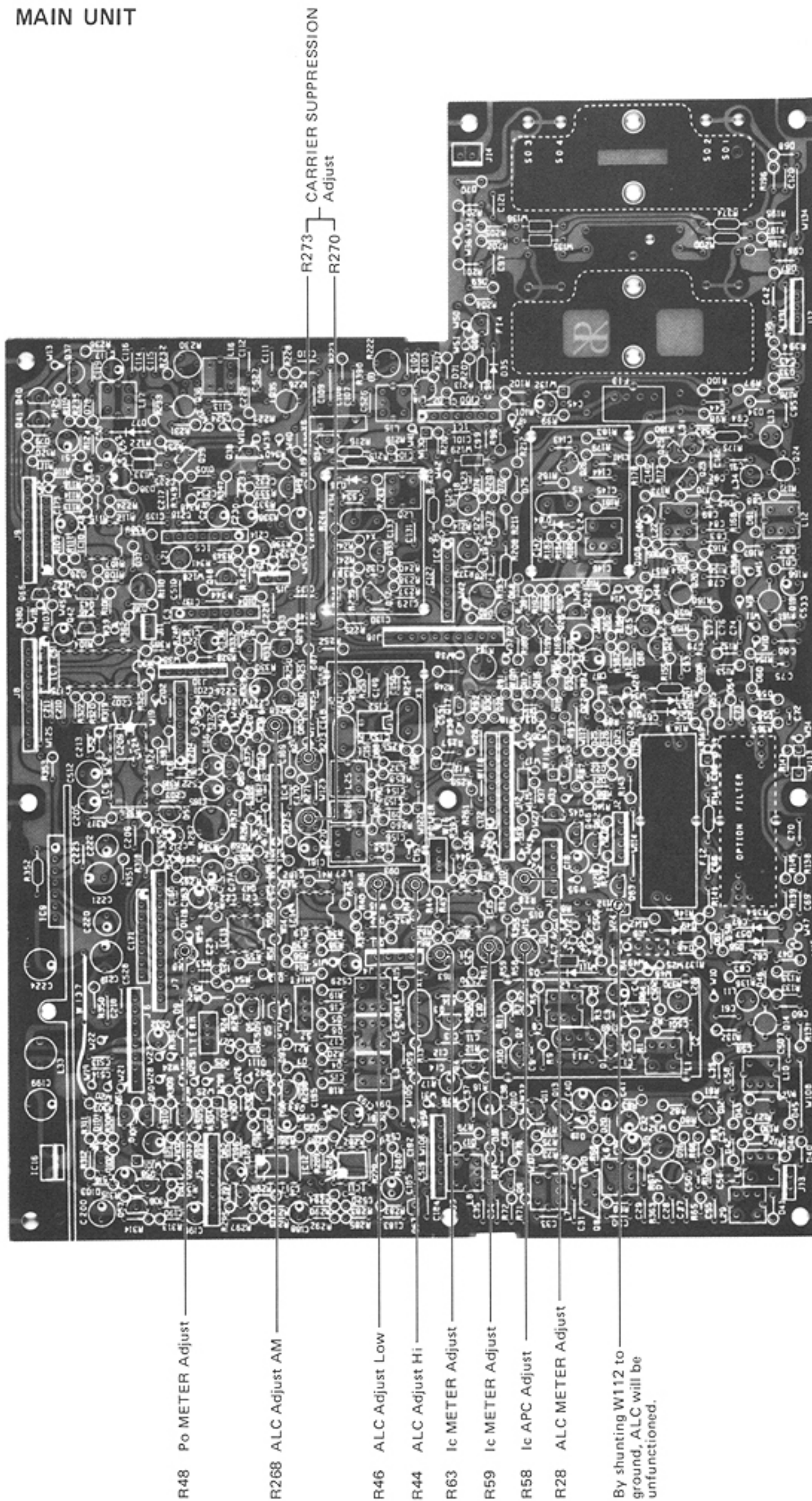
L22 OUTPUT POWER Adjust

R193 CARRIER POINT Adjust

9 - 4 TRANSMITTER ADJUSTMENT (Continued)

Adjustment	Adjustment conditions	Unit	Measurement location	Adjustment value	Unit	Adjustment point	
Ic · APC	1. ● Display frequency: 14MHz ● MODE: CW ● R44 (MAIN UNIT): Fully counterclockwise ● R46 (MAIN UNIT): Fully clockwise Set in TRANSMIT mode and key down.		Read the ammeter provided in the power supply, or connect an ammeter to the power cable in series.	22A	MAIN	R58	
ALC	1. ● Display frequency: 14MHz ● MODE: CW ● RF POWER: Fully counterclockwise Set in TRANSMIT mode and key down.		Connect the RF POWER METER to the ANT connector.	10W	MAIN	R46	
	2. ● RF POWER: Fully clockwise			100W		R44	
	Note: Check RF OUTPUT POWER on each band (90 ~ 100W), and current drain (less than 20A).						
	3. ● MODE: AM Make ALC unfunction by shunting W112 to ground.		Connect the RF POWER METER to the ANT connector.	100W	MAIN	R268	
	Note: After adjustment, remove shunting jumper of W112. Set in TRANSMIT mode with no MIC input, the OUTPUT power should be 40 ~ 60W.						
CARRIER SUPPRESSION	1. ● Display frequency: 14MHz ● MODE: USB/LSB ● COMP: OFF ● MIC GAIN: Fully counterclockwise Set in TRANSMIT mode.		Connect the RF voltmeter or spectrum analyzer to the ANT connector.	Change the operating mode for USB and LSB alternately, and adjust R270 and R273 to get minimum output (less than -50dB).	MAIN	R270 R273	
	2. ● COMP: ON			Less than -50dB.		Confirming	
METER (a) Ic METER	1. ● Display frequency: 14MHz ● MODE: RTTY ● RF POWER: Fully clockwise ● METER SWITCH: Ic Set in TRANSMIT mode.		Read the ammeter provided in the power supply, or connect an ammeter to the power cable in series.	Adjust to total current minus 3A.	MAIN	R59	
	2. ● MODE: CW TRANSMIT mode and key up.		Ic METER	0.6A		R63	
	(b) COMP METER		3. ● MODE: SSB ● COMP: OFF ● METER SWITCH: COMP Apply 270Hz/3mV signal from the AG, then adjust the MIC GAIN control to get 30W output power.	COMP METER		By turning COMP switch ON, the meter deflection and output power will be increased slightly.	Confirming
			(c) Po METER	4. ● MODE: RTTY ● COMP: OFF ● METER SWITCH: Po Set in TRANSMIT mode.		Po METER	100%
	(d) ALC METER		5. ● MODE: USB ● MIC GAIN: Fully clockwise ● RF POWER: Fully counterclockwise ● METER SWITCH: ALC Apply 1.5KHz/100 ~ 300 mV signal from the AG.	ALC METER		ALC ZONE Full level: (Center of meter scale)	R28

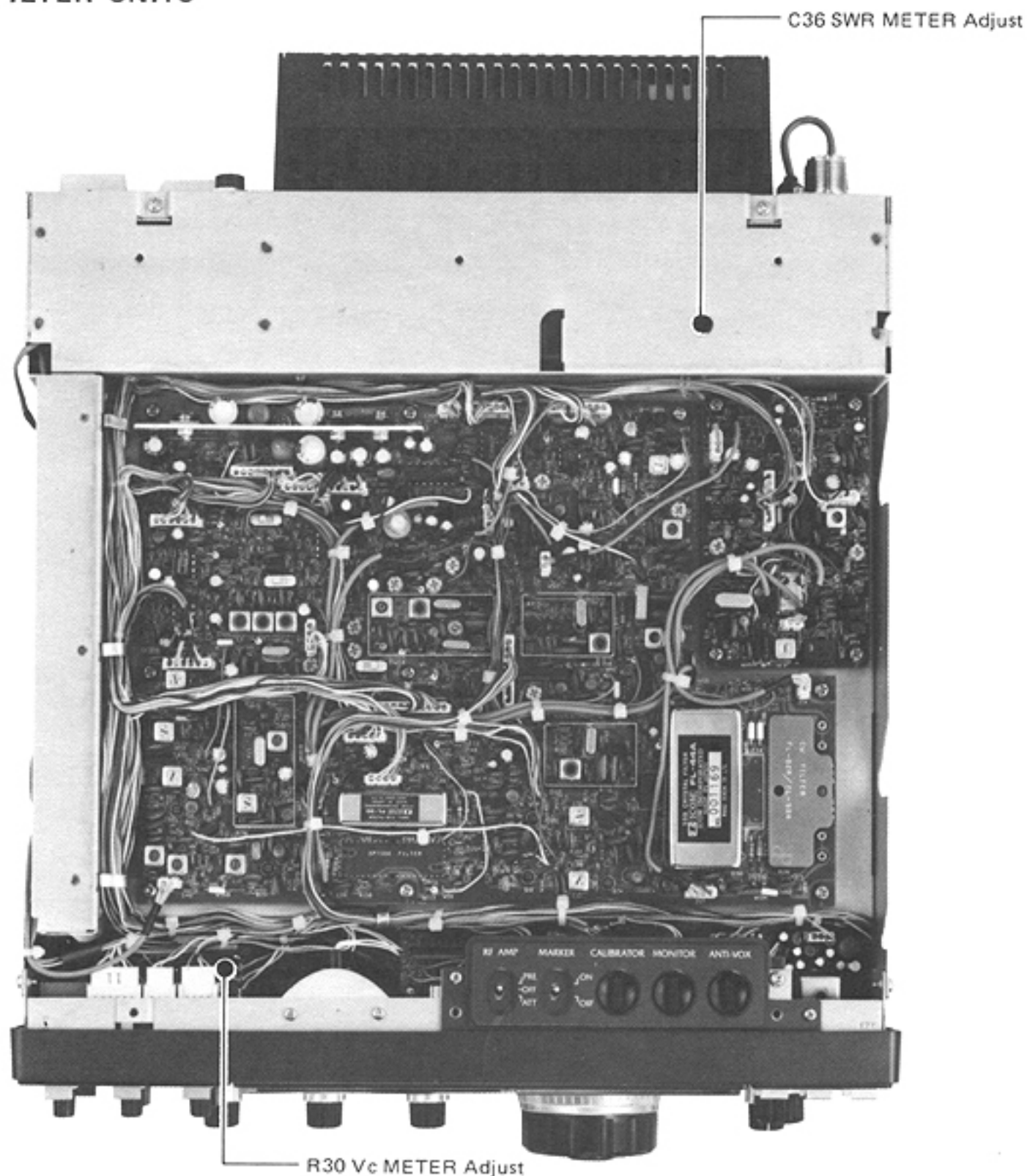
MAIN UNIT



9 - 4 TRANSMITTER ADJUSTMENT (Continued)

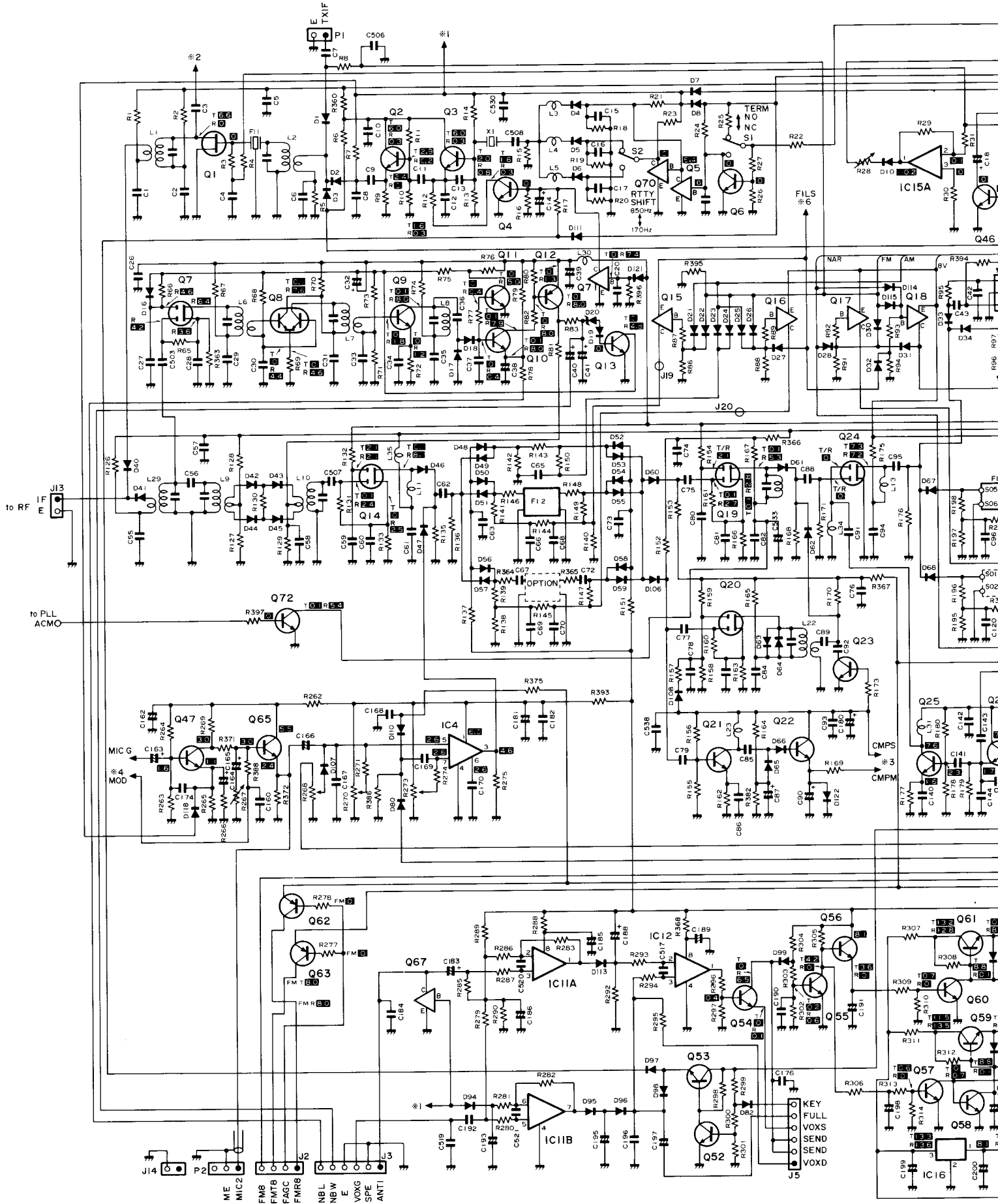
Adjustment	Adjustment conditions	Unit	Measurement location	Adjustment value	Unit	Adjustment point
(e) SWR METER	6. • Display frequency: 14MHz • MODE: RTTY • METER SWITCH: Po Set in TRANSMIT mode.		Po METER	Adjust RF POWER to point the meter needle to "SWR SET".	FRONT PANEL	RF POWER control
	7. • METER SWITCH: SWR Set in TRANSMIT mode.		SWR METER	Adjust to minimum SWR (less than 1.2).	FILTER	C36
	Note: Confirm SWR is less than 1.2 on any band.					
(f) Vc METER	8. • MODE: SSB • MIC GAIN: Fully counterclockwise • METER SWITCH: Vc Set in TRANSMIT mode with no MIC input.		Vc METER	13.8V	METER-SWITCH	R30
SWR APC	1. • Display frequency: 14MHz • MODE: RTTY • RF POWER: Fully clockwise Set in TRANSMIT mode with full output power, and do not connect anything to the ANT connector.		Read the ammeter provided in the power supply, or connect an ammeter to the power cable in series.	Less than 12A		Confirming

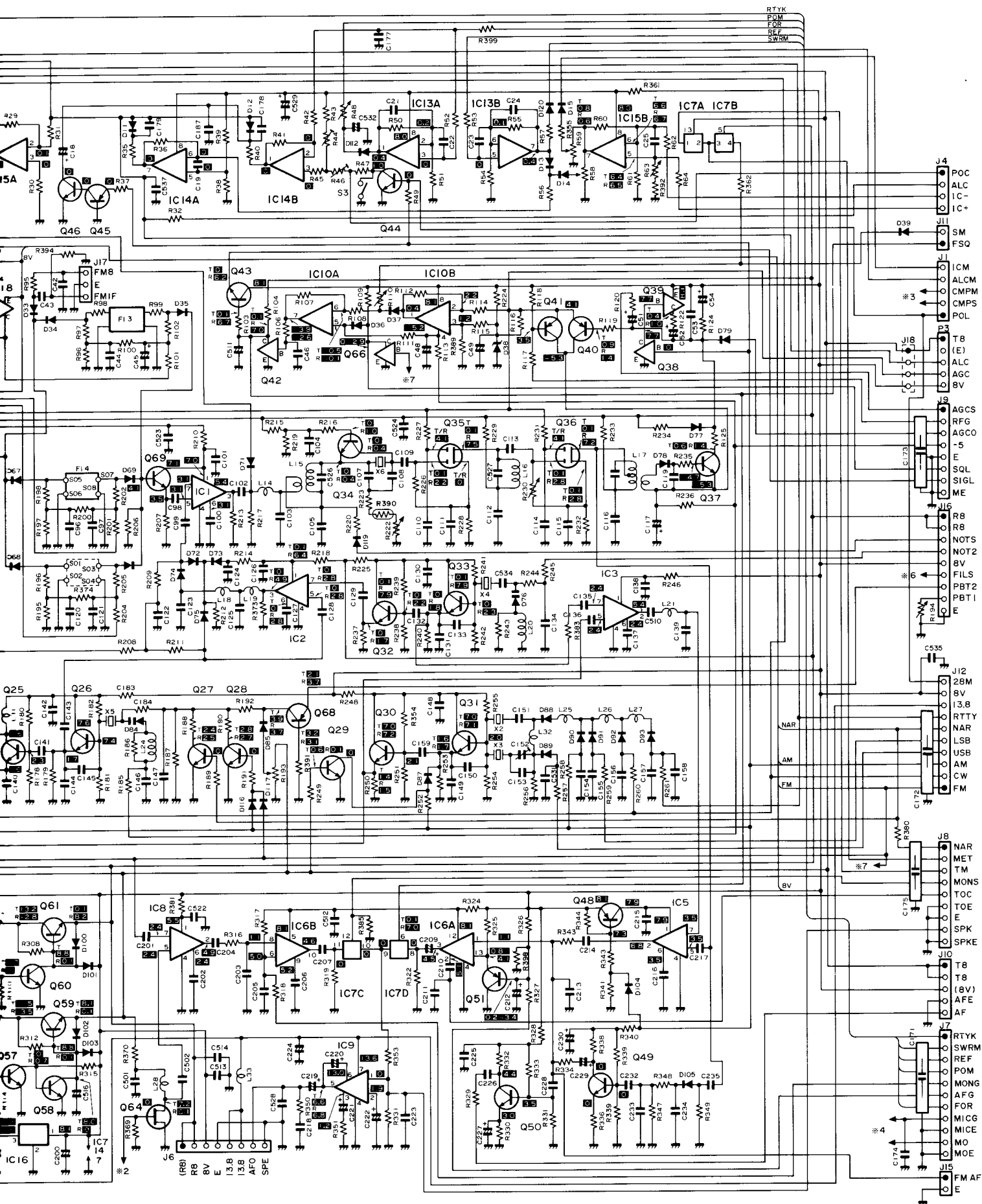
METER SWITCH/FILTER UNITS



SECTION 10 VOLTAGE (CIRCUIT) DIAGRAMS

MAIN UNIT CIRCUIT AND VOLTAGE DIAGRAM





VOLTAGE CHART FOR MODE VS FILTER SWITCH

• When shipping

MODE	FIL SW	Q15 (C)	Q16 (C)	Q17 (C)	Q18 (C)
USB	ON	6.4	6.4	0.0	8.0
	OFF	8.0	8.0	8.0	0.0
LSB	ON	6.4	6.4	0.0	8.0
	OFF	8.0	8.0	8.0	0.0
CW	ON	6.4	6.4	0.0	8.0
	OFF	8.0	8.0	8.0	0.0
CW-N	ON	6.4	6.4	0.1	0.0
	OFF	8.0	8.0	0.1	0.0
RTTY	ON	6.4	6.4	0.0	8.0
	OFF	8.0	8.0	8.0	0.0
RTTY-N	ON	6.4	6.4	0.1	0.0
	OFF	8.0	8.0	0.1	0.0
AM	ON	1.2	1.2	0.0	8.0
	OFF	1.2	1.2	8.0	0.0
FM	ON	1.2	1.2	0.1	0.0
	OFF	1.2	1.2	0.1	0.0

• When optional filter installed

MODE	FIL SW	Q15 (C)	Q16 (C)	Q17 (C)	Q18 (C)
USB	ON	1.1	8.0	0.0	8.0
	OFF	8.0	1.2	8.0	0.0
LSB	ON	1.1	8.0	0.0	8.0
	OFF	8.0	1.2	8.0	0.0
CW	ON	1.1	8.0	0.0	8.0
	OFF	8.0	1.2	8.0	0.0
CW-N	ON	1.1	8.0	0.1	0.0
	OFF	8.0	1.2	0.1	0.0
RTTY	ON	1.1	8.0	0.0	8.0
	OFF	8.0	1.2	8.0	0.0
RTTY-N	ON	1.1	8.0	0.1	0.0
	OFF	8.0	1.2	0.1	0.0
AM	ON	1.2	1.2	0.0	8.0
	OFF	1.2	1.2	8.0	0.0
FM	ON	1.2	1.2	0.1	0.0
	OFF	1.2	1.2	0.1	0.0

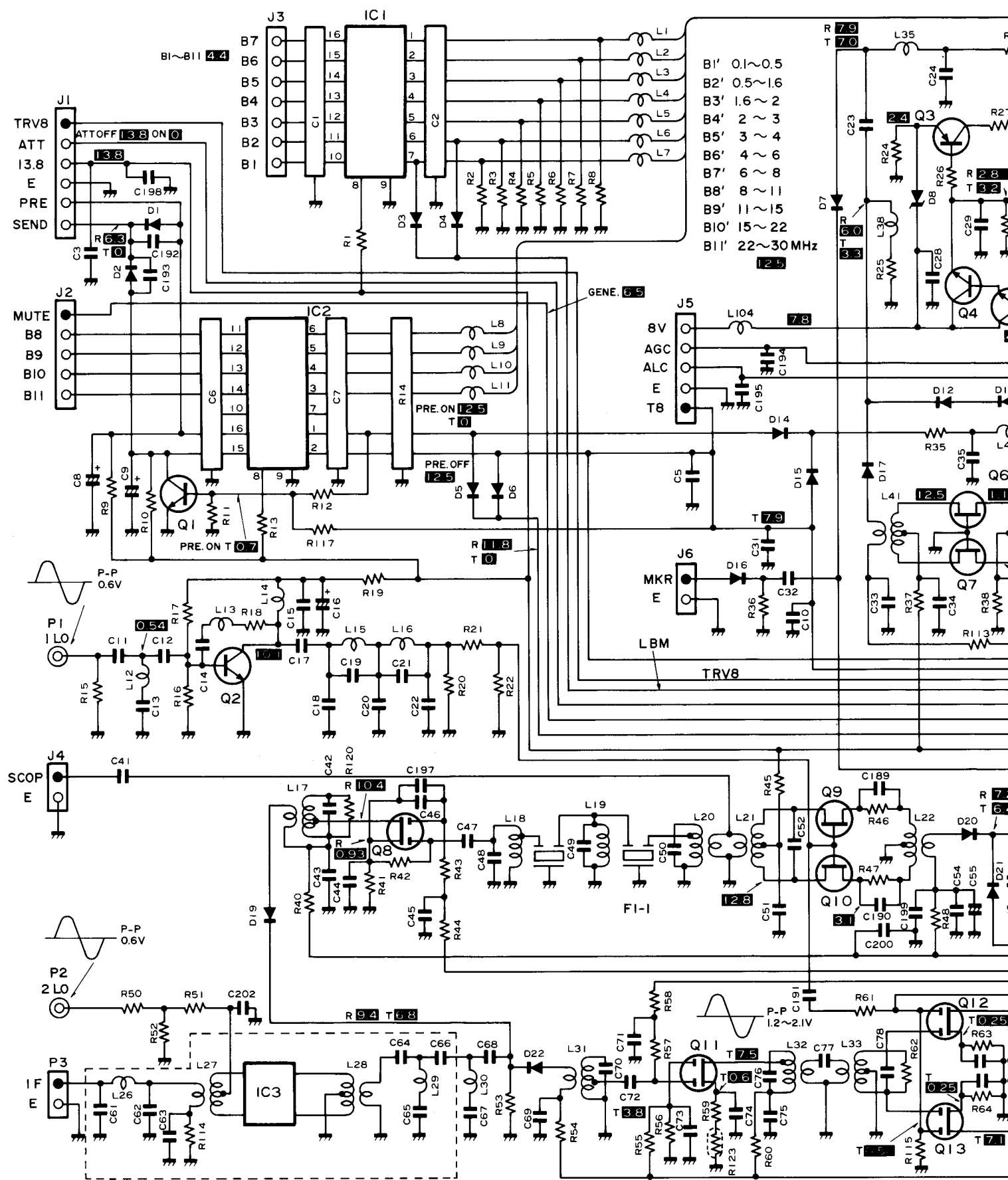
No.	TRANSMIT				RECEIVE				REMARKS
	BASE or GATE 1	GATE 2	COLLECTOR or DRAIN	EMITTER or SOURCE	BASE or GATE 1	GATE 2	COLLECTOR or DRAIN	EMITTER or SOURCE	
Q20	0.4	0.3	7.5	0.5	—	—	—	—	COMP OFF
	1.5	3.8	5.8	2.2	—	—	—	—	ON
Q21	0.0	—	0.0	0.0	—	—	—	—	OFF
	1.8	—	8.1	1.6	—	—	—	—	ON
Q22	0.0	—	0.0	0.1	—	—	—	—	OFF
	0.4	—	8.1	0.1	—	—	—	—	ON
Q23	0.0	—	0.0	E	—	—	—	—	OFF
	0.6	—	0.0	E	—	—	—	—	ON
Q51	—	—	—	—	0.2 ~ 3.4	—	E	0.8 ~ 4.1	AF VOLUME
Q52	0.6	—	0.1	E	—	—	—	—	KEY OPEN
	0.2	—	7.1	E	—	—	—	—	KEY DOWN
Q53	0.1	—	7.3	0.0	—	—	—	—	KEY OPEN
	7.1	—	7.3	6.7	—	—	—	—	KEY DOWN
NOTE:	• Measure with Multimeter 50K Ω /V 0.3, 3, 12, 60V Range								
	• E shows the terminal is grounded.								

LOCAL OSCILLATOR OSCILLATING LEVEL

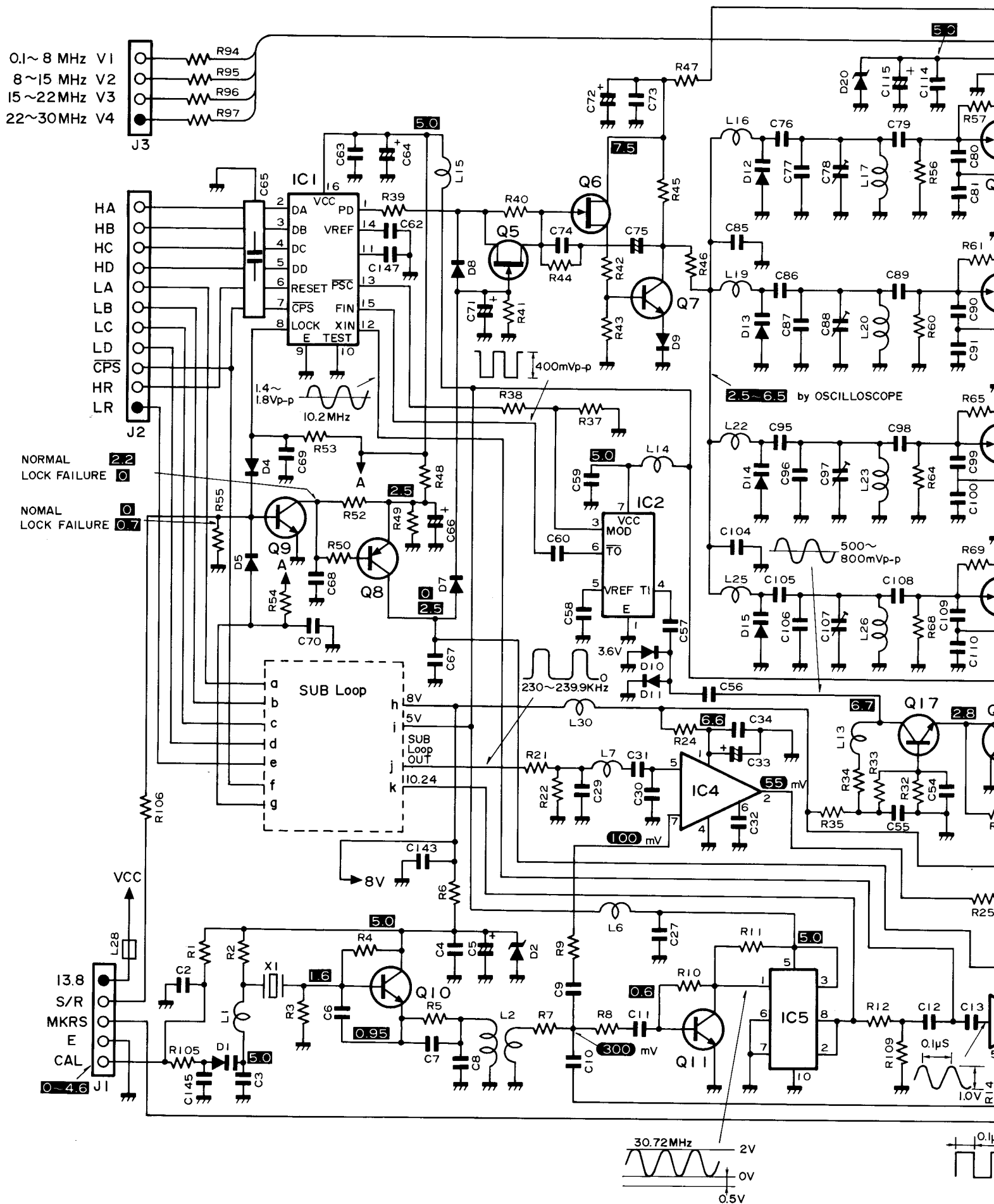
(Measured with an oscilloscope 20MHz 1M Ω probe)

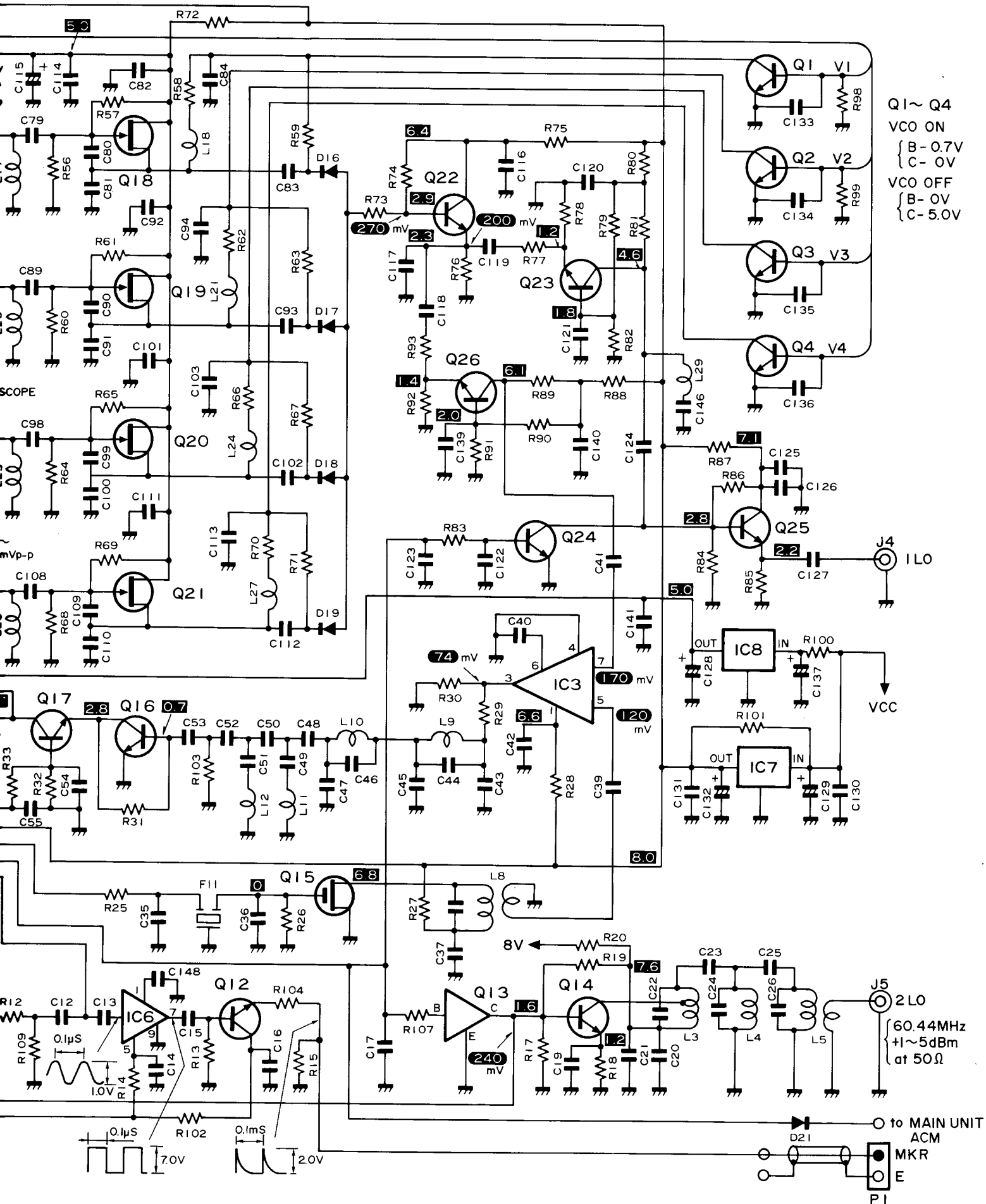
MEASURING POINT	MODE	LEVEL (mVp-p)
D40 ANODE	AM	26.5
	RTTY, CW	60
	FM	250
Q25 COLLECTOR	USB (TX)	2400
Q32 EMITTER	USB	230
Q30 EMITTER		250 ~ 450
IC5 PIN 7	RTTY	170
	USB	300

RF UNIT CIRCUIT AND VOLTAGE DIAGRAM

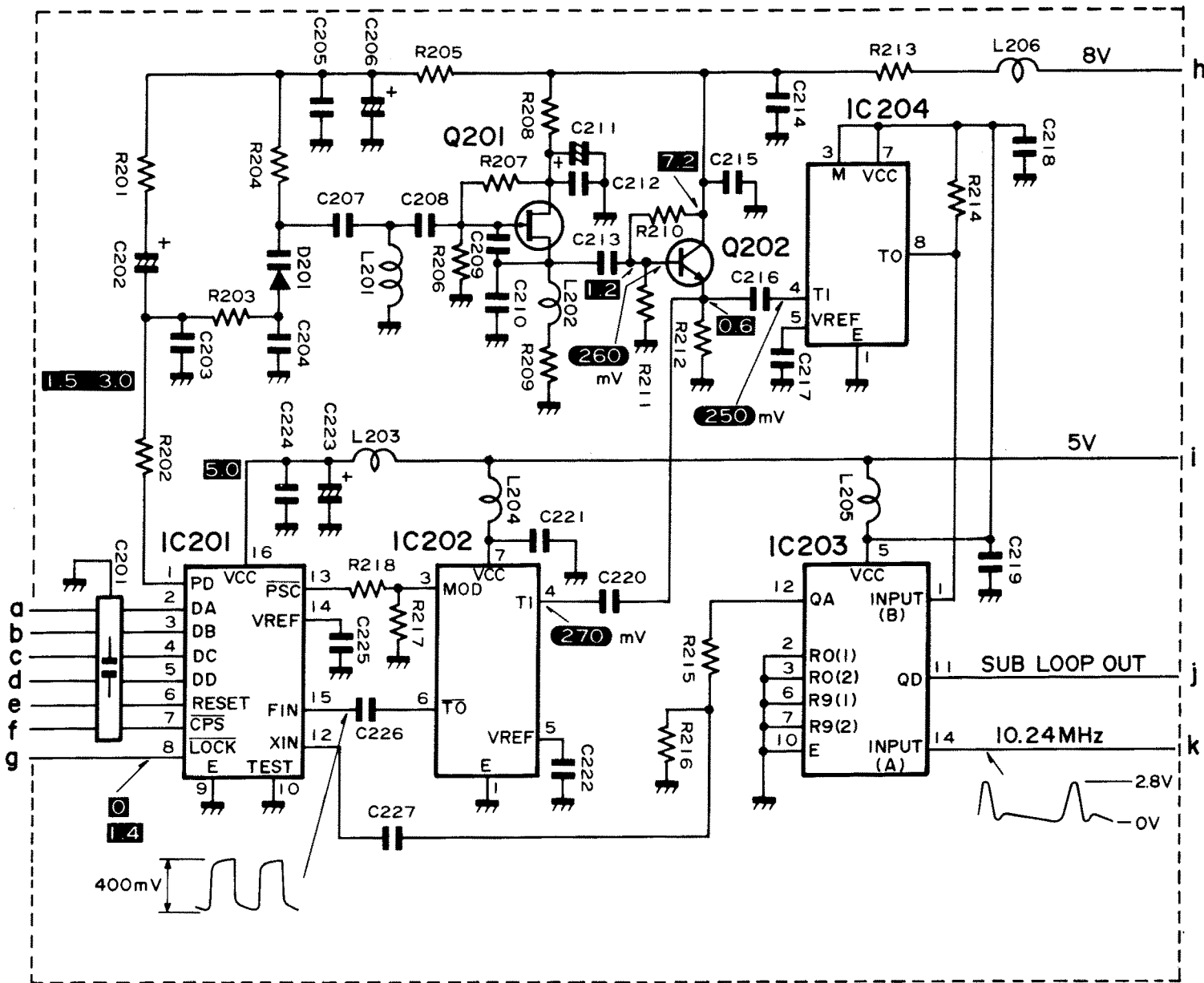


PLL UNIT CIRCUIT AND VOLTAGE DIAGRAM

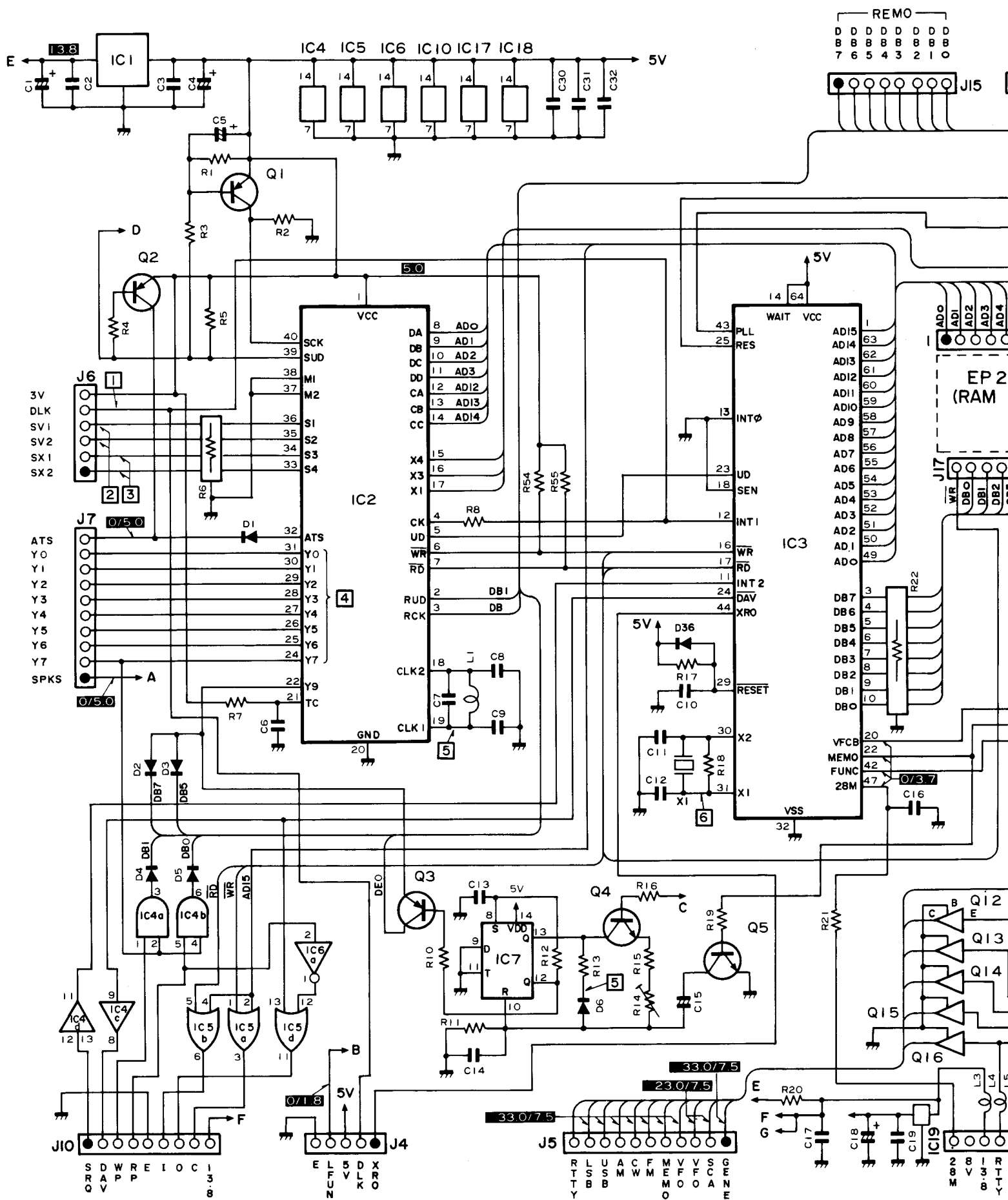




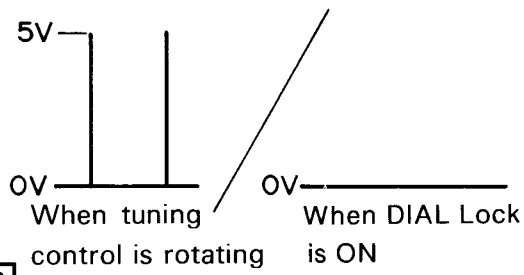
PLL SUB-LOOP CIRCUIT AND VOLTAGE DIAGRAM



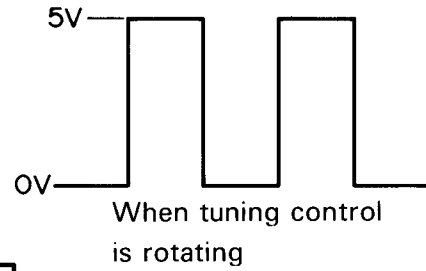
LOGIC UNIT CIRCUIT AND VOLTAGE DIAGRAM



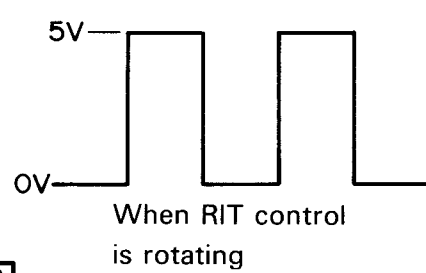
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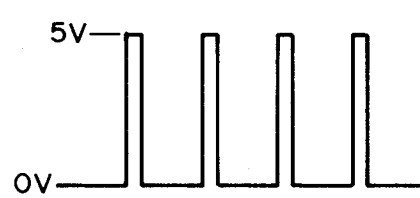
2



3

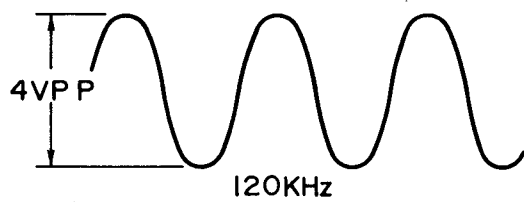


4



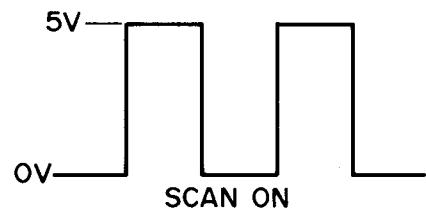
5

(IC 2 PIN19)



5

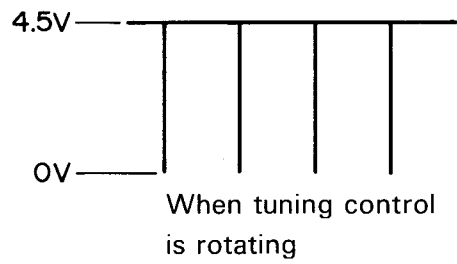
(D6 Cathode side)



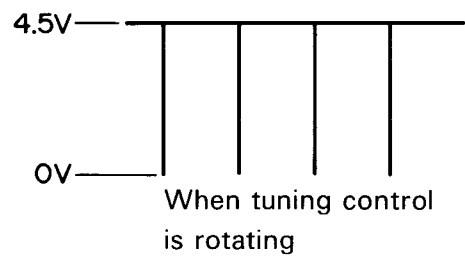
6



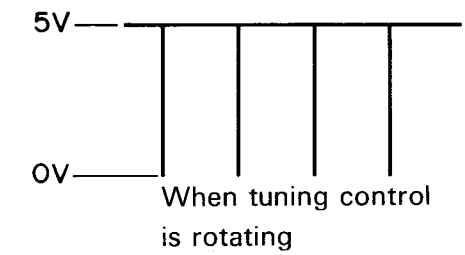
7



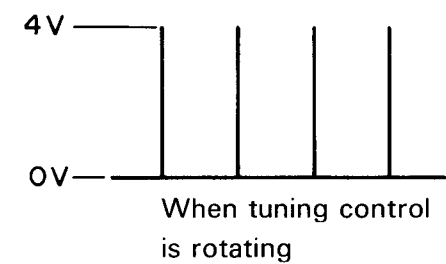
8



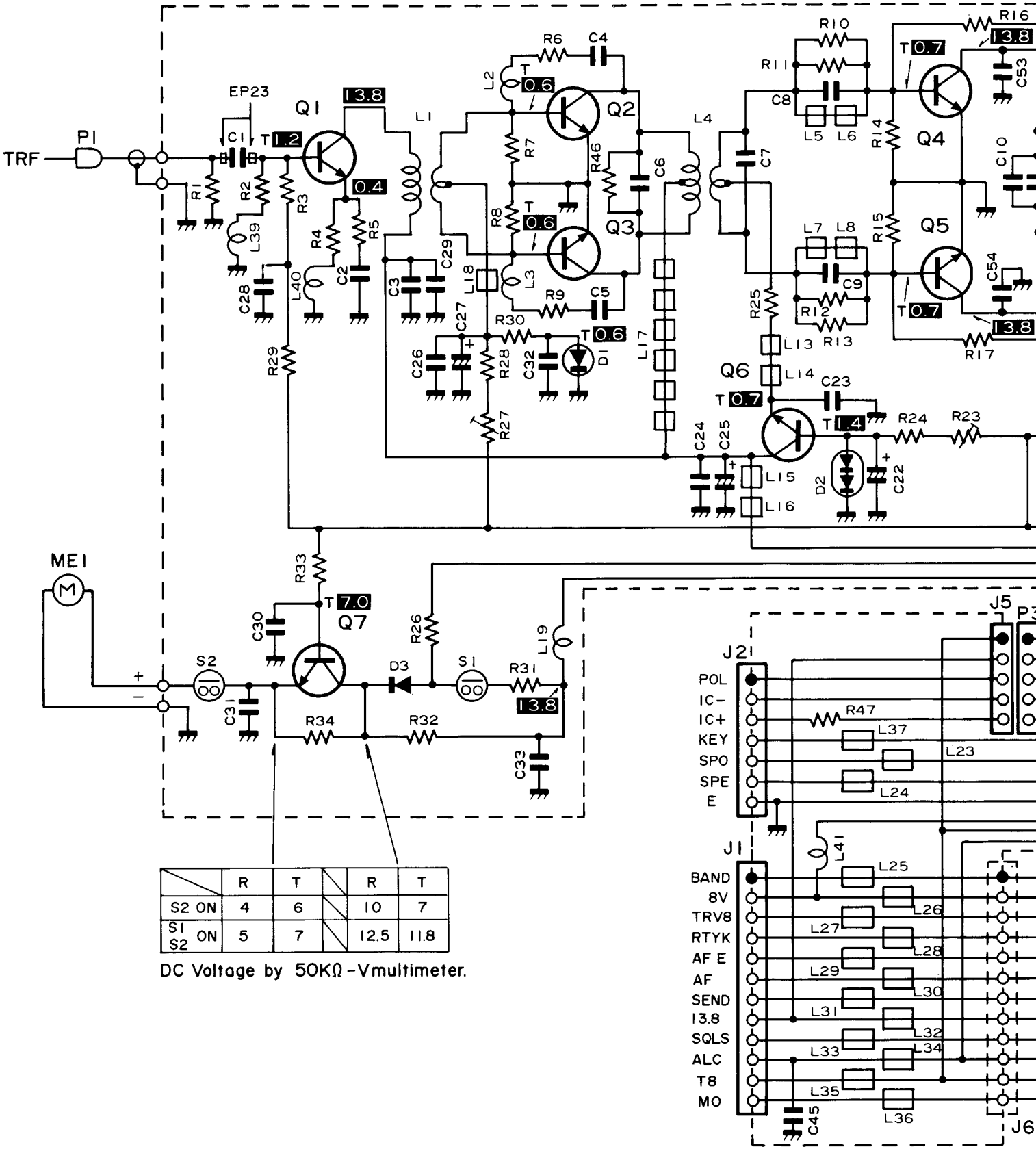
9



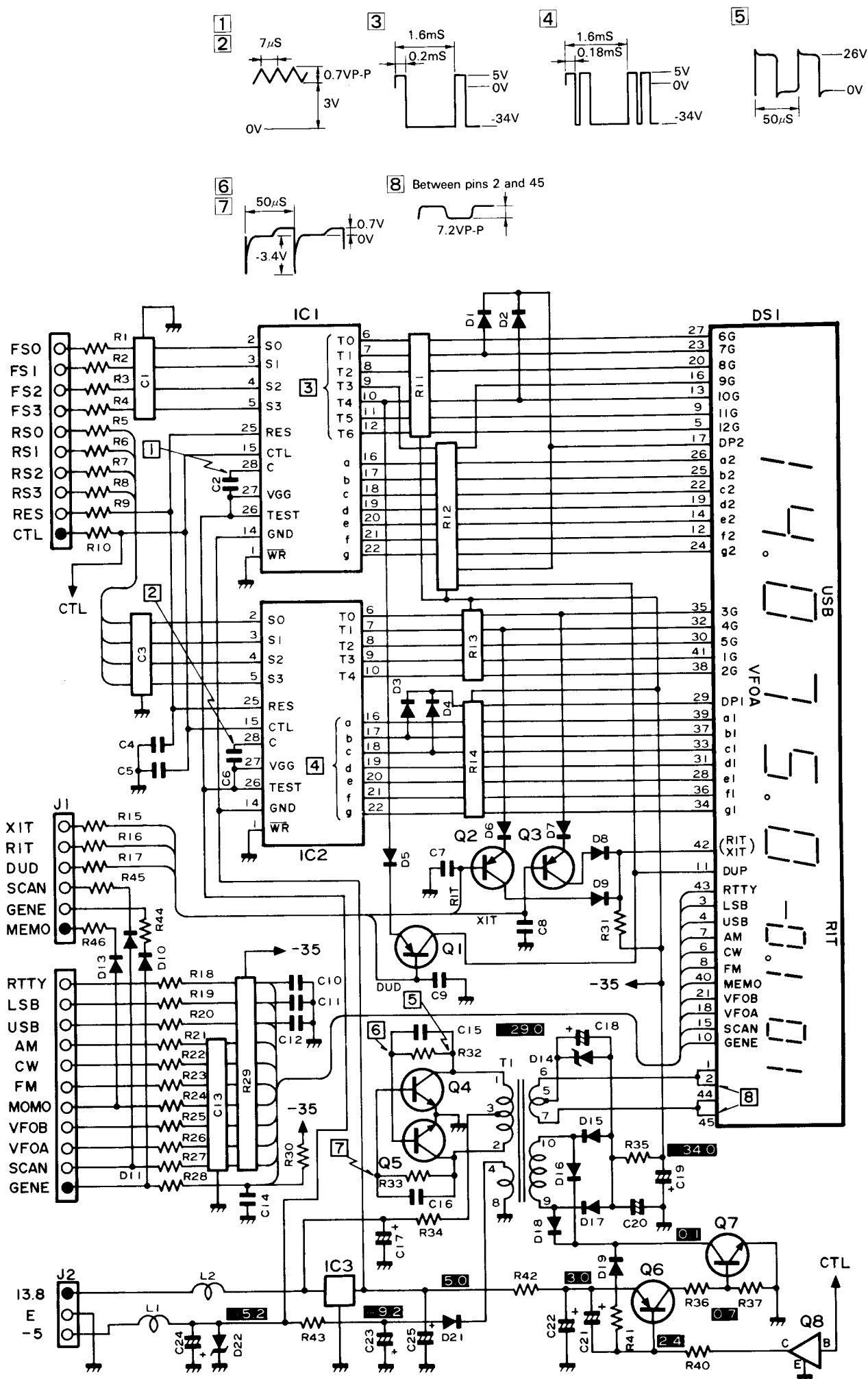
10



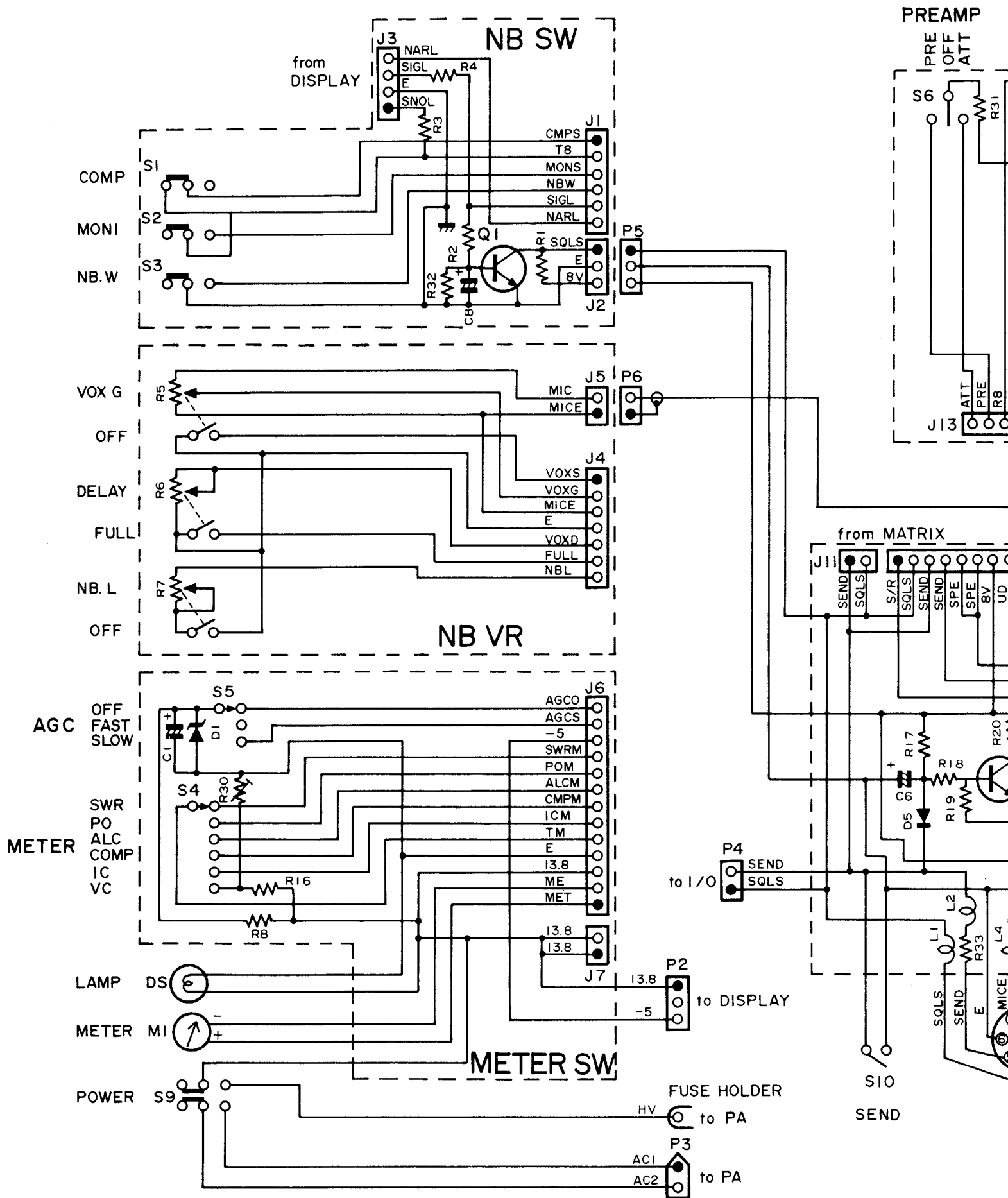
PA UNIT CIRCUIT AND VOLTAGE DIAGRAM

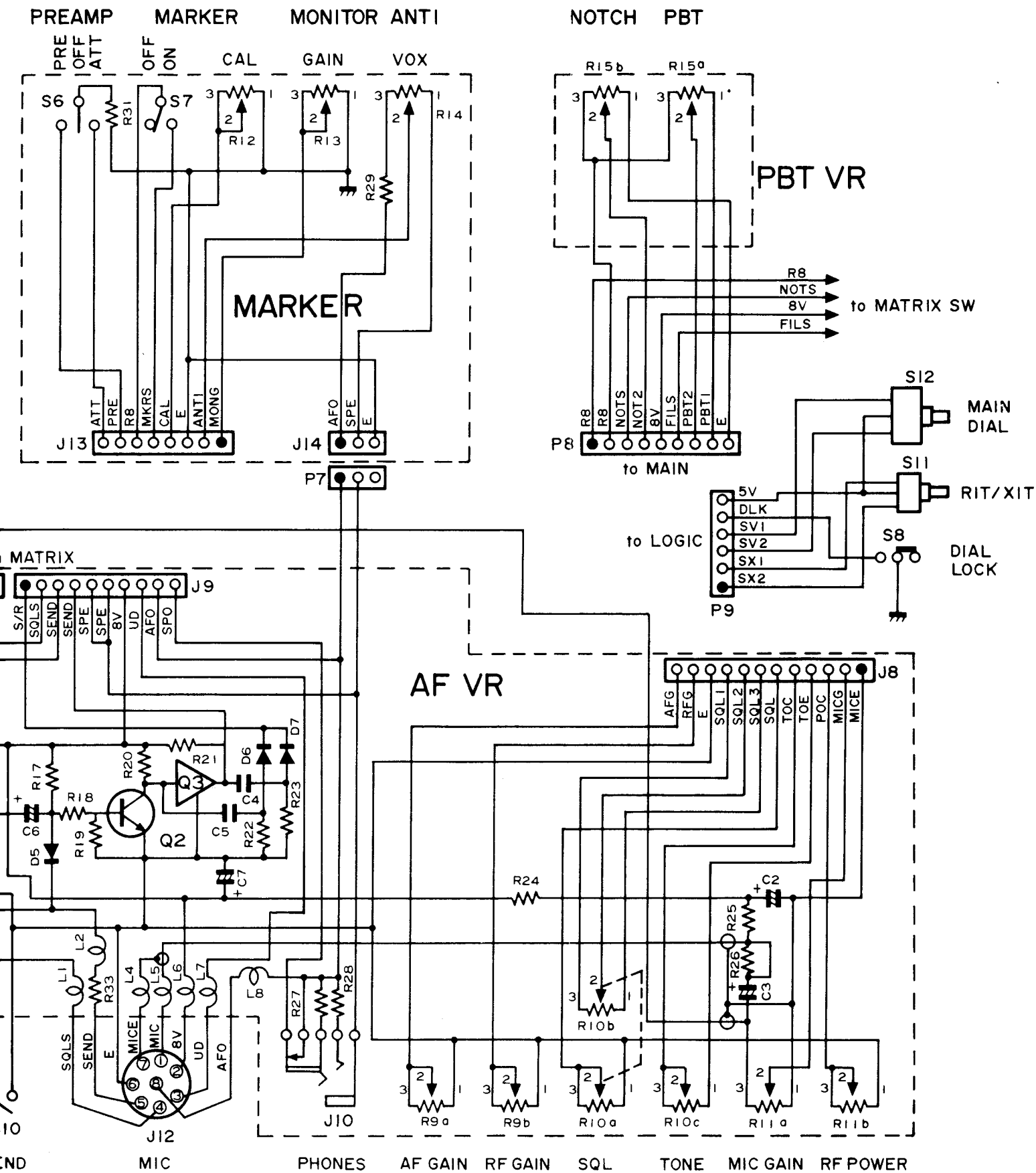


DISPLAY UNIT CIRCUIT AND VOLTAGE DIAGRAM



FRONT UNIT CIRCUIT DIAGRAM

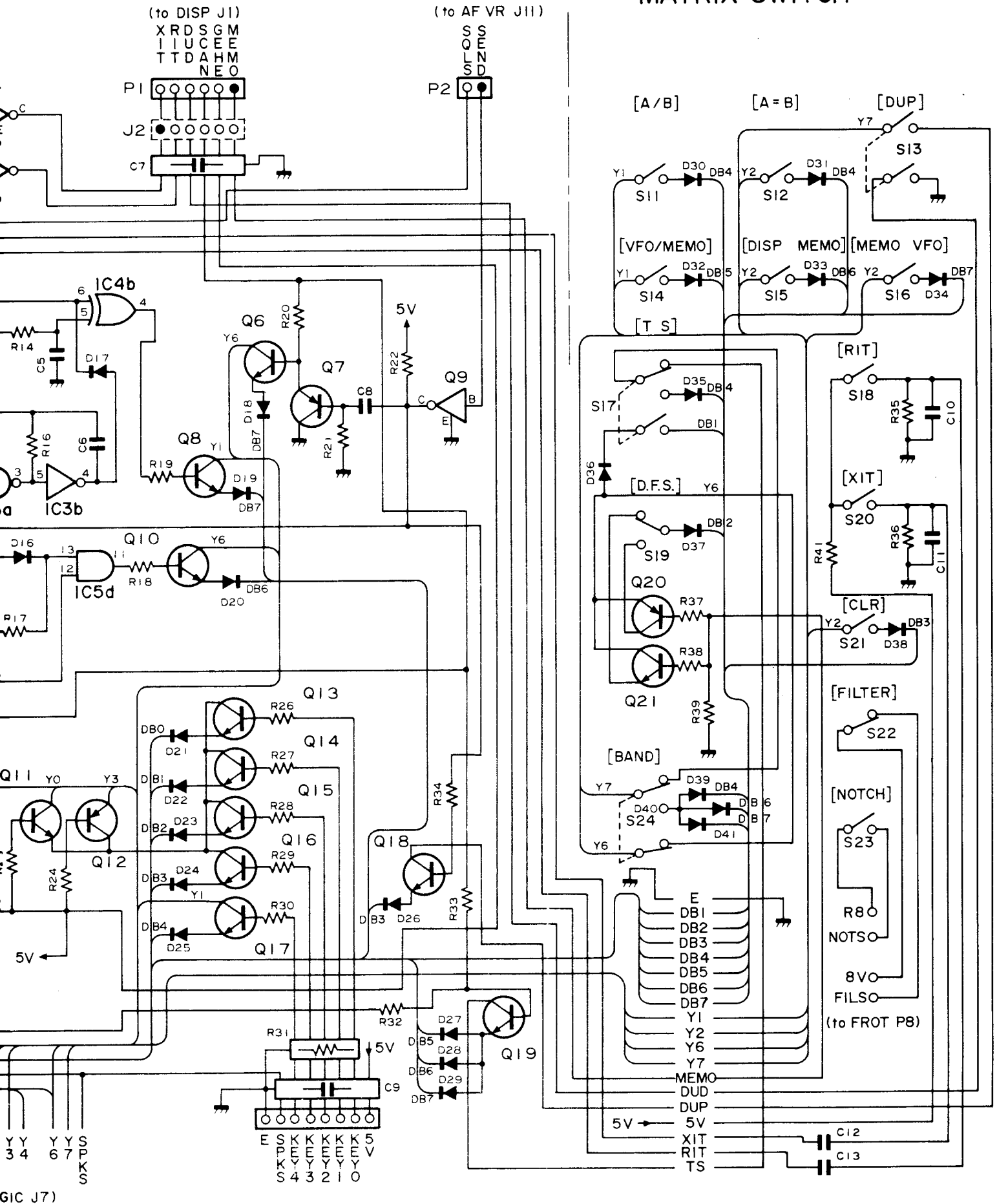




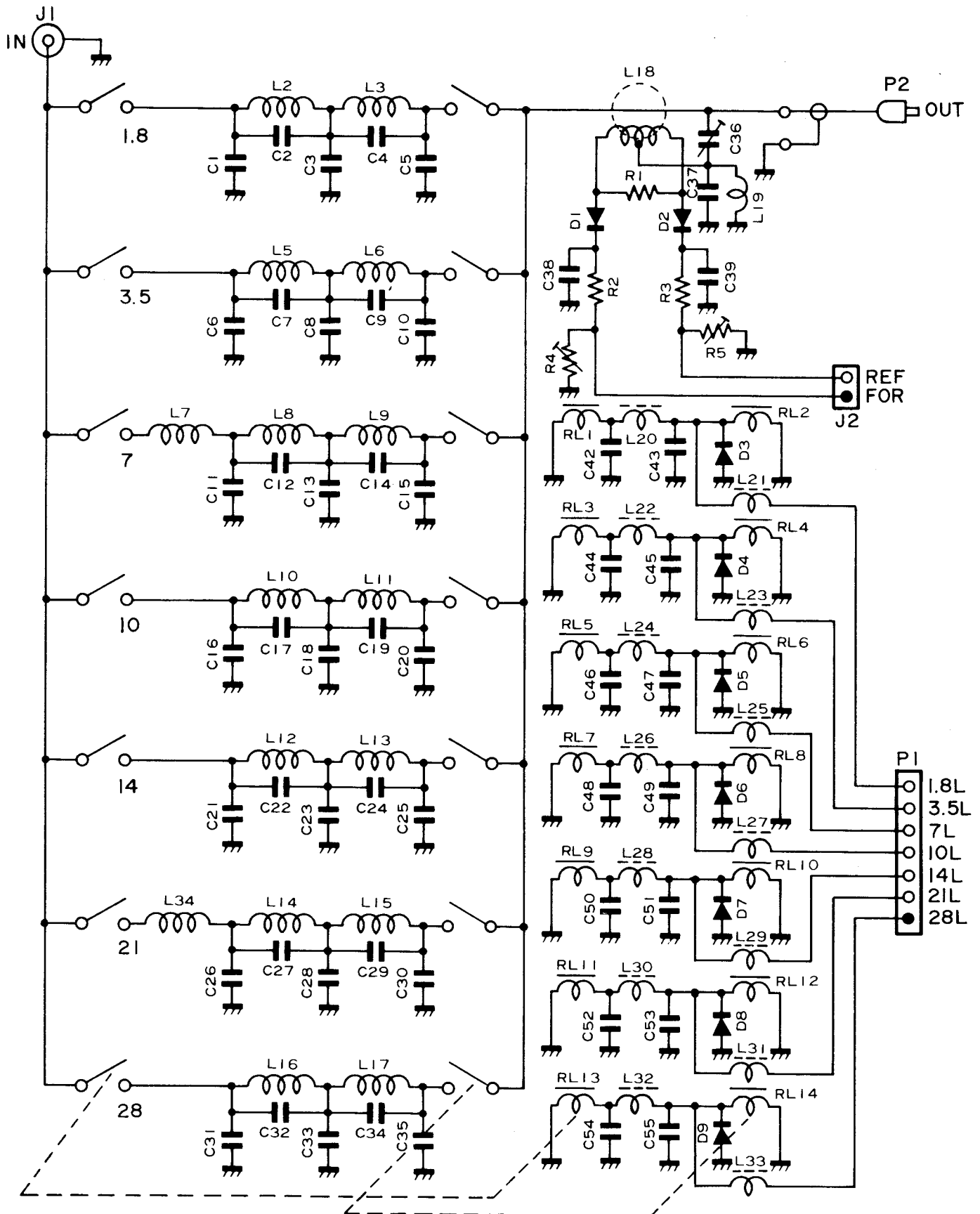
MODE SWITCH

[illegible]

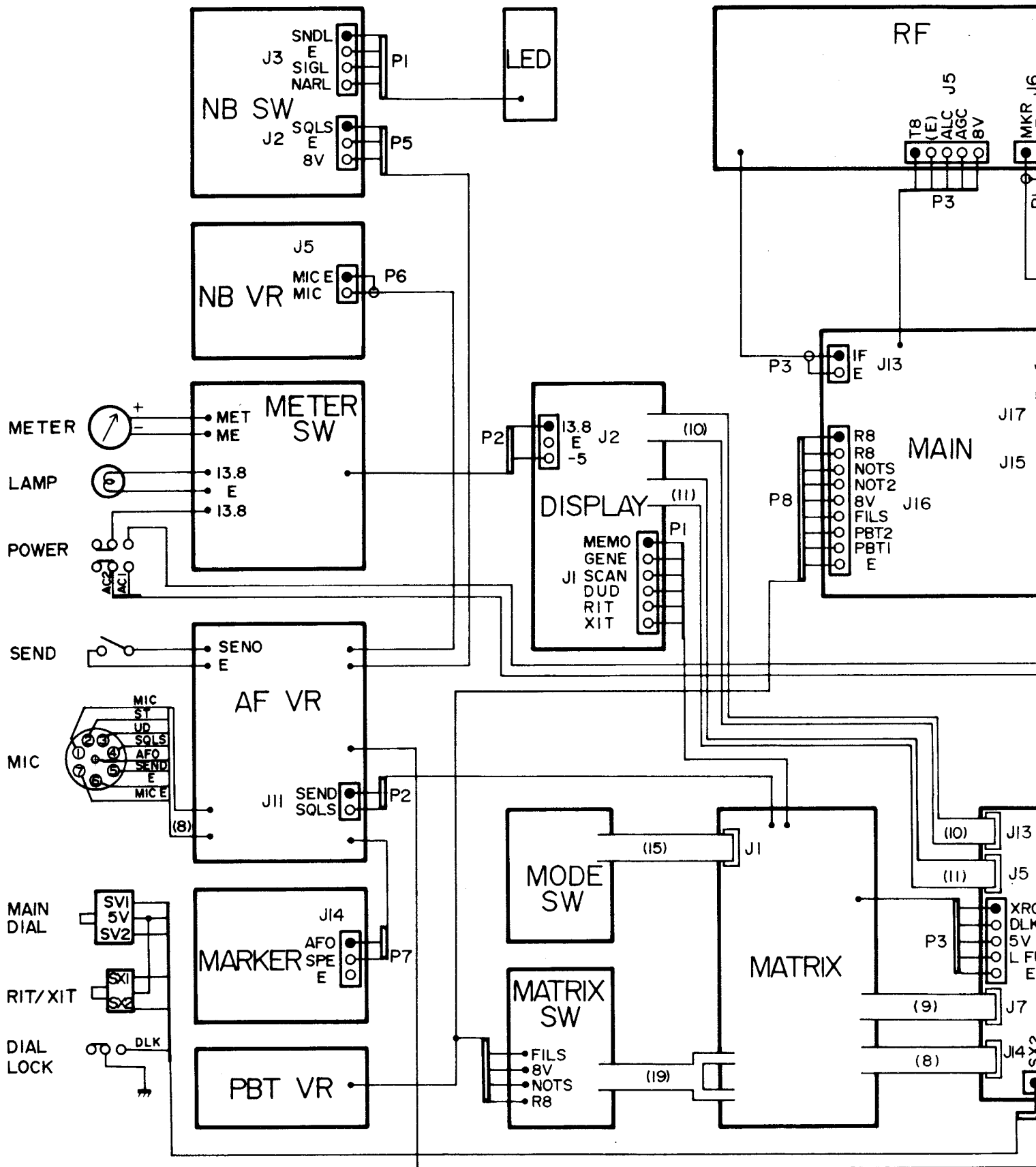
MATRIX SWITCH

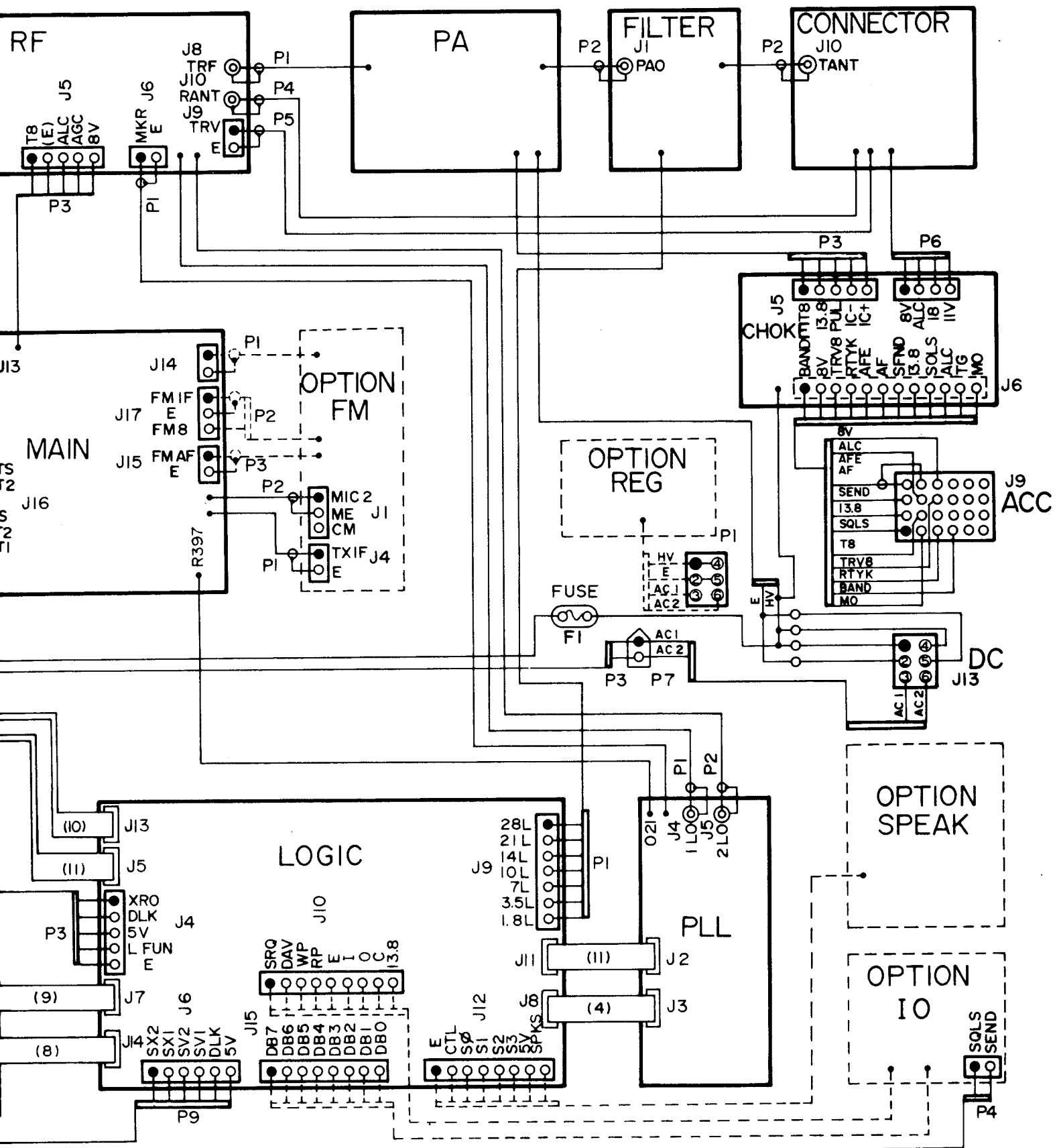


FILTER UNIT CIRCUIT DIAGRAM

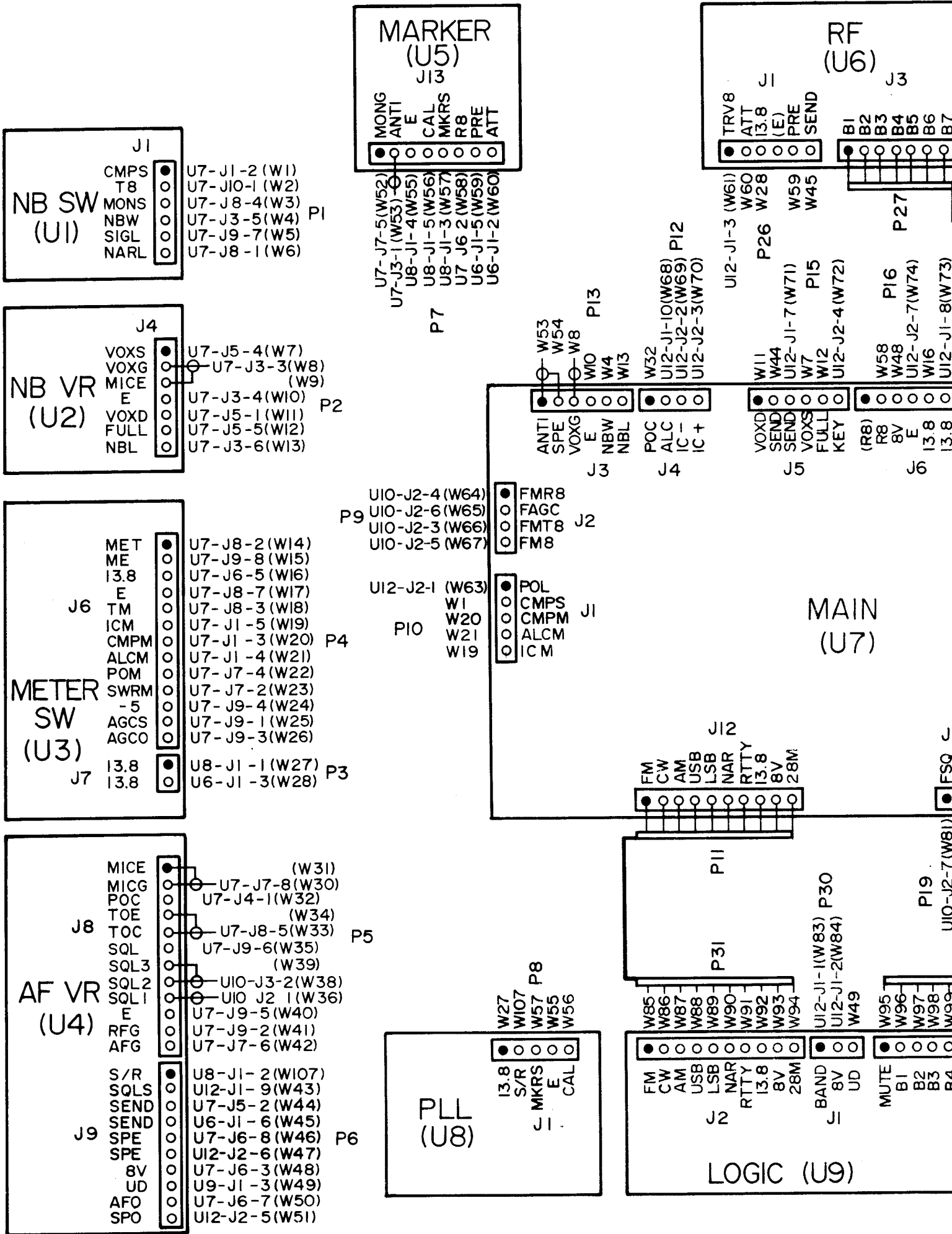


UNIT WIRING DIAGRAM (1)





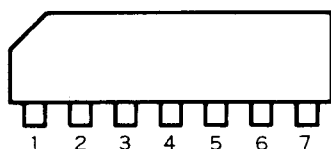
UNIT WIRING DIAGRAM (2)



SECTION 11 IC RATINGS

μPC1037H (DOUBLE BALANCED MODULATOR)

PIN CONNECTION



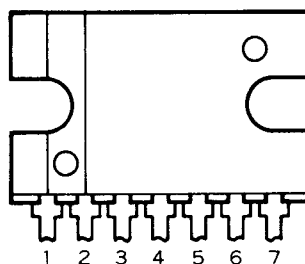
Terminal no.	Connection
1	V _{CC}
2	Output 1
3	Output 2
4	GND
5	Signal input
6	Bypass
7	Carrier input

Maximum Ratings

Item	Symbol	Rating	Unit
Power supply voltage	V _{CC}	9	V
Package allowable loss	P _D	270	mW
Operation temperature	T _{OPT}	−30 ~ +65	°C
Storage temperature	T _{STG}	−40 ~ +125	°C

μPC1181H (AUDIO POWER AMPLIFIER)

PIN CONNECTIONS



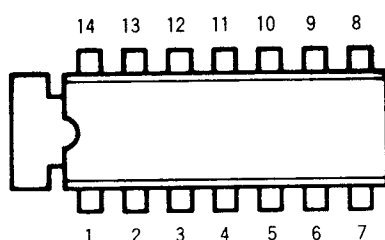
Maximum Ratings

Item	Symbol	Rating	Unit
Peak power supply voltage (200 mS)	V _{CC} (SURGE)	40	V
Power supply voltage (at no signal)	V _{CC1}	25	V
Power supply voltage (during operation) *1	V _{CC2}	18	V
Circuit current	I _{CC} (PEAK)	4.5	A
Package allowable loss	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 × 100 × 1 mm)

LA2600 (DUAL ATTENUATOR)

PIN CONNECTION



- | | |
|---------------------|---------------------|
| 1. CH1 INPUT | 8. CH2 INPUT |
| 2. CH1 COMPENSATION | 9. CH2 COMPENSATION |
| 3. CH1 OUTPUT | 10. CH3 OUTPUT |
| 4. GND | 11. — |
| 5. CH2 Vcc | 12. CH1 Vcc |
| 6. CH2 CONTROL | 13. CH1 CONTROL |
| 7. — | 14. — |

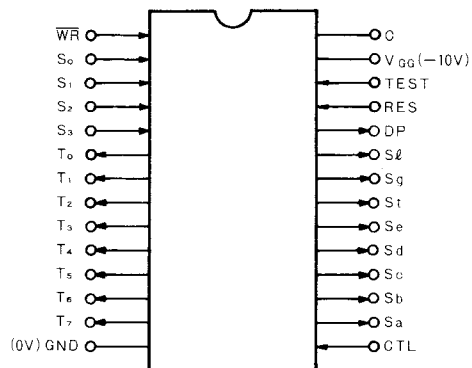
Maximum Ratings ($T_a = 25^\circ\text{C}$)

Item	Symbol	Rating	Unit
Power supply voltage	V_{CC}	16	V
Control input voltage	V_C	0 ~ 6	V
Power dissipation	P_D	*1 500	mW
Operating temperature	T_{OPR}	$-30 \sim +75$	$^\circ\text{C}$
Storage temperature	T_{STG}	$-55 \sim +125$	$^\circ\text{C}$

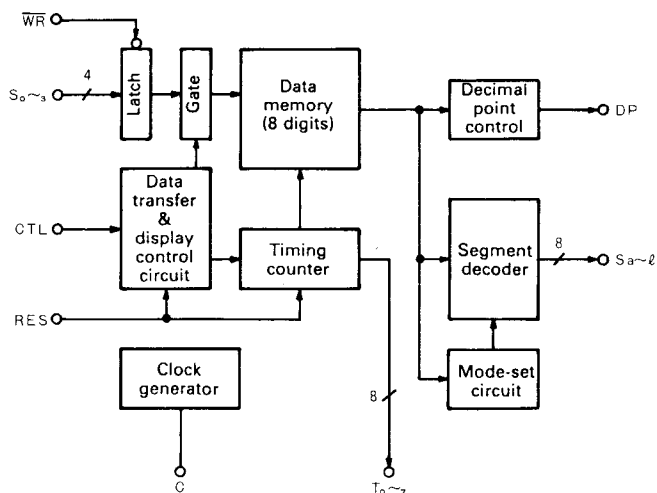
*1 $T_a \leq 75^\circ\text{C}$

μPD549C (PROGRAMMABLE DISPLAY CONTROLLER)

PIN CONNECTION



BLOCK DIAGRAM



Maximum Ratings

Item	Symbol	Rating	Unit
Power supply voltage	V_{GG}	$-15 \sim +0.3$	V
Input voltage	V_I	$-20 \sim +0.3$	V
Output voltage	V_O	$-42 \sim +0.3$	V
Operation temperature	T_{OPT}	$-10 \sim +70$	$^\circ\text{C}$
Storage temperature	T_{STG}	$-40 \sim +125$	$^\circ\text{C}$

TC4011 (QUAD 2-INPUT POSITIVE NOR GATE)

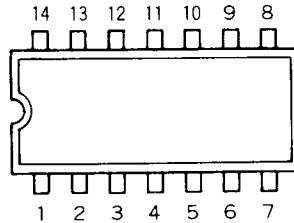
TC4013 (DUAL D-TYPE FLIP FLOP)

TC4030 (QUAD EXCLUSIVE-OR GATE)

TC4081 (QUAD 2-INPUT POSITIVE AND GATE)

TC4066 (QUAD BILATERAL SWITCH)

PIN CONNECTION

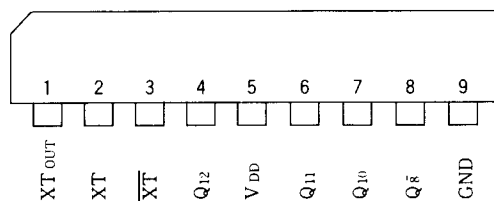


Maximum Ratings

Item	Symbol	Rating	Unit
Power supply voltage	V_{DD}	$V_{SS} - 0.5 \sim V_{SS} + 20$	V
Input voltage	V_{IN}	$V_{SS} - 0.5 \sim V_{DD} + 0.5$	V
Output voltage	V_{OUT}	$V_{SS} - 0.5 \sim V_{DD} + 0.5$	V
Input current	I_{IN}	± 10	mA
Allowable loss	P_D	300	mW
Storage temperature	T_{STG}	$-65 \sim 150$	$^{\circ}\text{C}$
Read temperature and time	T_{SOL}	$260^{\circ}\text{C} \cdot 10 \text{ sec.}$	

TC-5082P-GL (OSCILLATOR AND 12 STAGE DIVIDER)

PIN CONNECTION

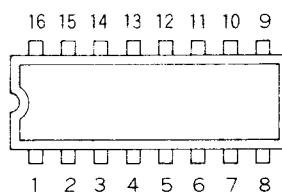


Maximum Ratings ($T_a = 25^{\circ}\text{C}$)

Item	Symbol	Rating	Unit
Supply voltage	V_{DD}	10	V
Input voltage	V_{IN}	$-0.3 \sim V_{DD} + 0.3$	V
Operating temperature	T_{OPR}	$-30 \sim 75$	$^{\circ}\text{C}$
Storage temperature	T_{STG}	$-55 \sim 125$	$^{\circ}\text{C}$

TC4528BP (DUAL MONOSTABLE MULTIVIBRATOR)

PIN CONNECTION



Maximum Ratings

Item	Symbol	Rating	Unit
Power supply voltage	V_{DD}	$V_{SS} - 0.5 \sim V_{SS} + 20$	V
Input voltage	V_{IN}	$V_{SS} - 0.5 \sim V_{DD} + 0.5$	V
Output voltage	V_{OUT}	$V_{SS} - 0.5 \sim V_{DD} + 0.5$	V
Input current	I_{IN}	± 10	mA
Allowable loss	P_D	300	mW
Storage temperature	T_{STG}	$-65 \sim 150$	$^{\circ}\text{C}$
Read temperature and time	T_{SOL}	$260^{\circ}\text{C} \cdot 10 \text{ sec.}$	

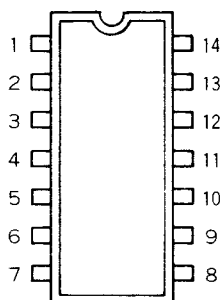
SN74LS02N (QUADRUPL 2-INPUT POSITIVE NOR GATE)

SN74LS08N (QUADRUPL 2-INPUT POSITIVE AND GATE)

SN74LS11N (TRIPLE 3-INPUT POSITIVE AND GATE)

SN74LS32N (QUADRUPL 2-INPUT POSITIVE OR GATE)

PIN CONNECTION



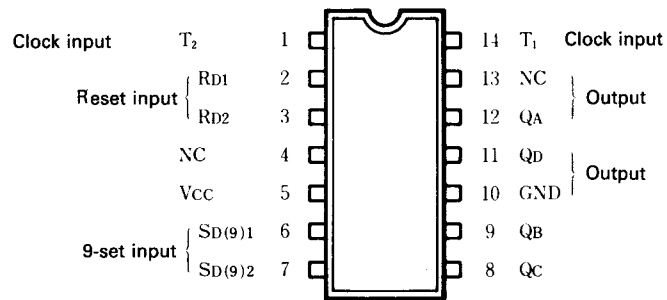
Maximum Ratings

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}	$-20 \sim +75$	$^{\circ}\text{C}$
Storage temperature	T_{STG}	$-65 \sim +150$	$^{\circ}\text{C}$

*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} ^{*2}	V_I	$-0.5 \sim +5.5$	V
	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

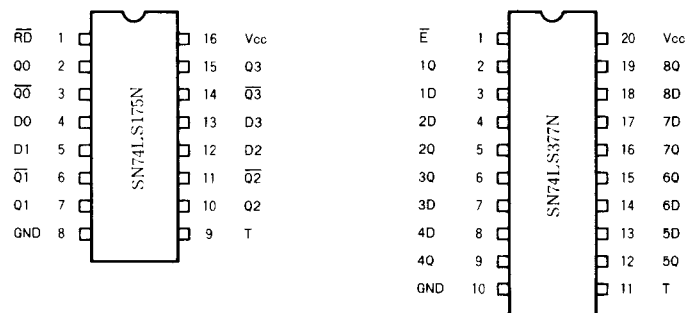
^{*1} Inputs T_1 and T_2

^{*2} Inputs R_{D1} , R_{D2} , $S_{D(9)1}$ and $S_{D(9)2}$

SN74LS175N (QUADRUPLE D-TYPE FLIP FLOP WITH RESET)

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

PIN CONNECTION



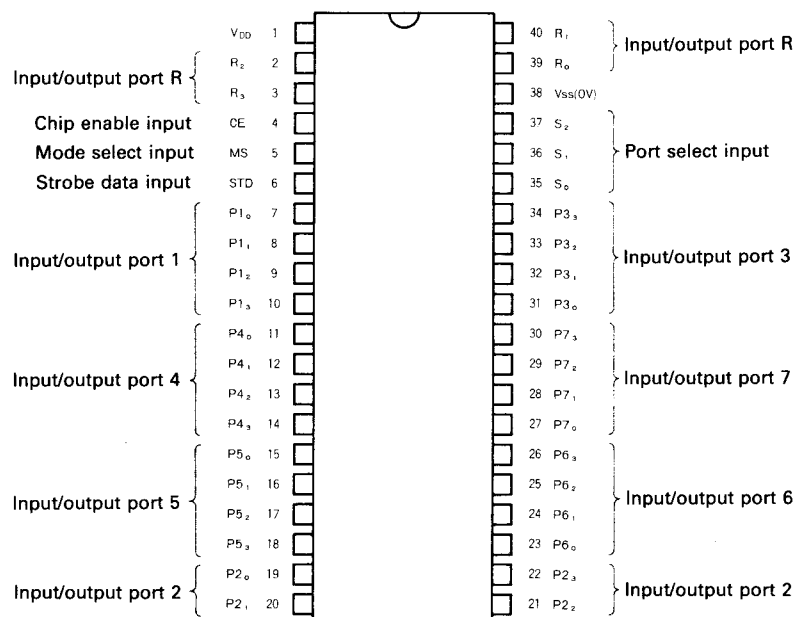
Maximum Ratings

Item	Symbol	Rating	Unit
Power supply voltage	V_{CC}	$-0.5 \sim +7$	V
Input voltage ^{*1}	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

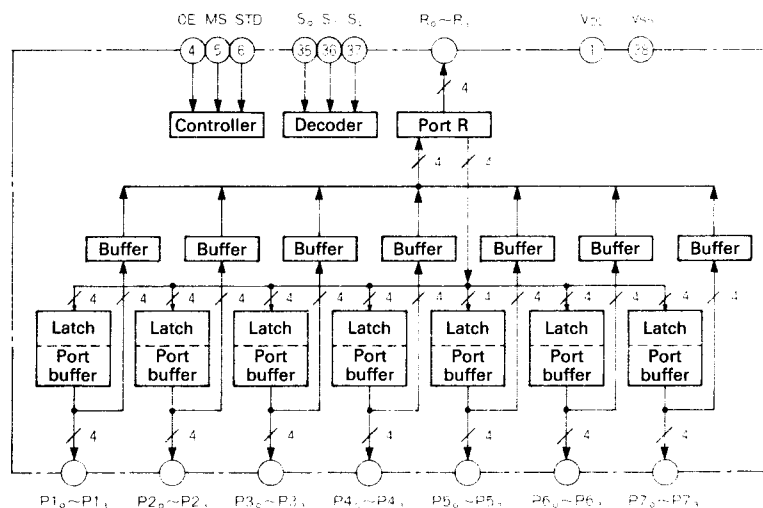
^{*1} When output is H

M50780SP (INPUT/OUTPUT EXPANDER)

PIN CONNECTION



BLOCK DIAGRAM



Maximum Ratings

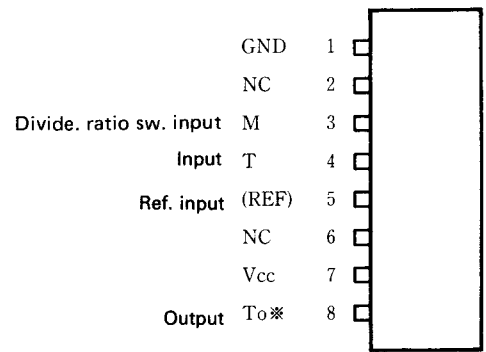
Item	Symbol	Rating	Unit
Power supply voltage	V_{DD}	$-0.3 \sim 15$	V
Input voltage	V_I	$V_{SS} - 0.3 \sim V_{DD} + 0.3$	V
Output voltage *1	V_O	$V_{SS} - 0.3 \sim V_{DD} + 0.3$	V
Maximum power consumption *2	P_D	600	mW
Operation ambient temperature	T_{OPR}	$-10 \sim +70$	°C
Storage temperature	T_{STG}	$-40 \sim +125$	°C

*1 If V_{SS} terminal is standard

*2 Ta-25°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

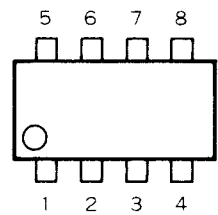
M	L	H
Freq.-div'n. ratio	1/20	1/100

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 consumption	P_D	1.33	W
Operation ambient temperature	T_{OPR}	-10 ~ +75	°C
Storage temperature	T_{STG}	-55 ~ +125	°C

NJM4558D (DUAL LOW NOISE AMP.)

PIN CONNECTION



Maximum Ratings

Item	Symbol	Rating	Unit
Power supply voltage	V_{DD}	18	V
Input voltage	V_{IN}	15	V
Operation temperature	T_{OPT}	-20 ~ +75	°C
Storage temperature	T_{STG}	-40 ~ +125	°C

SECTION 12 PARTS LIST

[EF] UNIT

REF. NO.	DESCRIPTION	PART NO.
P1	Connector	TL25H-06-B1
P2	Connector	TL25H-07-B1
P3	Connector	TL25H-02-B1
P4	Connector	TL25H-13-B1
P5	Connector	TL25H-12-B1
P6	Connector	TL25H-10-B1
P7	Connector	TL25H-08-B1
P8	Connector	TL25H-05-B1
P9	Connector	TL25H-04-B1
P10	Connector	TL25H-05-B1
P11	Connector	TL25H-10-B1
P12	Connector	TL25H-04-B1
P13	Connector	TL25H-06-B1
P14	Connector	TL25H-11-B1
P15	Connector	TL25H-06-B1
P16	Connector	TL25H-08-B1
P17	Connector	TL25H-09-B1
P18	Connector	TL25H-05-B1
P19	Connector	TL25H-01-B1
P20	Connector	TL25H-08-B1
P21	Connector	TL25H-07-B1
P22	Connector	TL25H-03-B1
P23	Connector	TL25H-02-B1
P24	Connector	TL25H-12-B1
P25	Connector	TL25H-07-B1
P26	Connector	TL25H-06-B1
P27	Connector	TL25H-07-B1
P28	Connector	TL25H-05-B1
P29	Connector	TL25H-12-B1
P30	Connector	TL25H-03-B1
P31	Connector	TL25H-10-B1
P32	Connector	TL25H-02-B1
P33	Connector	TL25H-02-B1
SP1	Speaker	C065KX669108
F1	Fuse	3A
EP1	Bead Core	FSQ H070RN

[FRONT] UNIT

REF. NO.	DESCRIPTION	PART NO.
L1	Coil	101 FL5H
L2	Coil	101K LAL04NA
L4	Coil	101 FL5H
L5	Coil	102 FL5H
L6	Coil	101 FL5H
L7	Coil	101 FL5H
L8	Coil	101 FL5H
R1	Resistor	4.7K R25
R2	Resistor	27K ELR25
R3	Resistor	1.2K R25
R4	Resistor	680 R25
R5	Variable	K12141054-5N1211-10KA
R6	Variable	K12141054-5N1211-1MB
R7	Variable	K12141054-5N1211-1KB
R8	Resistor	1K ELR25
R9	Variable	K16B1007-10KB×2
R10	Variable	K16C20015-10KA, 10KB×2
R11	Variable	K16B10007-10KB, 10KA
R12	Trimmer	10K H1051C(SR19D)
R13	Trimmer	10K H1051C(SR19D)
R14	Trimmer	10K H1051C(SR19D)
R15	Variable	K12B60AOE-10KB×2
R16	Resistor	47K R25
R17	Resistor	4.7K ELR25
R18	Resistor	47K ELR25
R19	Resistor	15K ELR25
R20	Resistor	15K ELR25
R21	Resistor	15K ELR25
R22	Resistor	100K ELR25
R23	Resistor	100K ELR25
R24	Resistor	220 R25
R25	Resistor	1K ELR25
R26	Resistor	22K ELR25
R27	Resistor	100 ELR25
R28	Resistor	100 ELR25
R29	Resistor	2.2K R25
R30	Trimmer	1K RGP05
R31	Resistor	47 R25
R32	Resistor	10K ELR25
R33	Resistor	4.7 R25

[FRONT] UNIT

REF. NO.	DESCRIPTION	PART NO.
Q1	Transistor	2SC945P
Q2	Transistor	2SC945P
Q3	Transistor	2SC3399
D1	Zener	XZ082
D5	Diode	1SS53
D6	Diode	1SS53
D7	Diode	1SS53

C1	Electrolytic	10 16V
C2	Electrolytic	47 10V
C3	Electrolytic	1 50V
C4	Ceramic	0.001 50V
C5	Ceramic	0.001 50V
C6	Tantalum	1.5 16V
C7	Electrolytic	47 10V
C8	Electrolytic	22 10V
S1	Push-SW	SPJ312N
S2	Push-SW	SPJ312N
S3	Push-SW	SPJ312N
S4	Rotary-SW	SRU1023
S5	Rotary-SW	SBU1026
S6	Lever-SW	MS-621C

[FRONT] UNIT

REF. NO.	DESCRIPTION	PART NO.
S7	Lever-SW	MS-611A
S8	Push-SW	SPJ312C
S9	Push-SW	TW-0068
S10	Lever-SW	M2012J-1K
S11	Rotary encoder	LA22402
S12	Rotary encoder	LA24007
J1	Connector	TL25P-06-L1
J2	Connector	TL25P-03-L1
J3	Connector	TL25P-04-L1
J4	Connector	TL25P-07-L1
J5	Connector	TL25P-02-L1
J6	Connector	TL25P-13-L1
J7	Connector	TL25P-02-V1
J8	Connector	TL25P-12-V1
J9	Connector	TL25P-10-L1
J10	Connector	HLJ4815-JACK
J11	Connector	TL25P-02-V1
J12	Connector	FM214-8SS(P)
J13	Connector	TL25P-08-V1
J14	Connector	TL25P-03-V1
M1	Meter	M263
DS1	Lamp	BQ044-32582A
P2	Connector	TL-25H-03-B1
P3	Connector	1545P-1
P4	Connector	TL-25H-02-B1
P5	Connector	TL-25H-03-B1
P6	Connector	TL-25H-02-B1
P7	Connector	TL-25H-03-B1
P8	Connector	TL-25H-09-B1
P9	Connector	TL-25H-06-B1
B1	P.C. Board	B-722A (42452)
B2	P.C. Board	B-723A (42453)
B3	P.C. Board	B-724A (42458)
B4	P.C. Board	B-727A (42459)
B5	P.C. Board	B-792A (42501)
B6	P.C. Board	B-731A (42450)
B7	P.C. Board	B-741A (42454)
W1	Jumper	JPW-02H
W43	Jumper	JPW-02A
W44	Jumper	JPW-02A

[DISPLAY] UNIT

REF. NO.	DESCRIPTION	PART NO.
IC1	IC	μ PD549C
IC2	IC	μ PD549C
IC3	IC	μ A78L05

[DISPLAY] UNIT

REF. NO.	DESCRIPTION	PART NO.
Q1	Transistor	2SA1015Y
Q2	Transistor	2SA1015Y
Q3	Transistor	2SA1015Y
Q4	Transistor	2SC1214
Q5	Transistor	2SC1214
Q6	Transistor	2SA1015Y
Q7	Transistor	2SC945P
Q8	Transistor	2SC3402
D1	Diode	1SS55
D2	Diode	1SS55
D3	Diode	1SS55
D4	Diode	1SS55
D5	Diode	1SS55
D6	Diode	1SS55
D7	Diode	1SS55
D8	Diode	1SS55
D9	Diode	1SS55
D10	Diode	1SS55
D11	Diode	1SS55
D13	Diode	1SS55
D14	Zener	XZ-062
D15	Diode	1SS55
D16	Diode	1SS55
D17	Diode	1SS55
D18	Diode	1SS55
D19	Diode	1SS55
D21	Diode	1SS53
D22	Zener	XZ-051
DS1	FLD	FIP12AM7
DS2	LED	SLB-22UR
DS3	LED	SLB-22GG
DS4	LED	SLB-22YY
R1	Resistor	1K ELR25
R2	Resistor	1K ELR25
R3	Resistor	1K ELR25
R4	Resistor	1K R25
R5	Resistor	1K ELR25
R6	Resistor	1K E LR25
R7	Resistor	1K ELR25
R8	Resistor	1K ELR25
R9	Resistor	1K ELR25
R10	Resistor	1K SELR25
R11	Array	473 RM-6
R12	Array	473 RM-10
R13	Array	473 RM-6
R14	Array	473 RM-8
R15	Resistor	47K ELR25
R16	Resistor	47K ELR25
R17	Resistor	47K ELR25
R18	Resistor	2.7K ELR25
R19	Resistor	2.7K ELR25
R20	Resistor	2.7K ELR25
R21	Resistor	2.7K ELR25
R22	Resistor	2.7K ELR25
R23	Resistor	2.7K ELR25
R24	Resistor	2.7K ELR25
R25	Resistor	2.7K ELR25
R26	Resistor	2.7K ELR25
R27	Resistor	2.7K ELR25
R28	Resistor	2.7K ELR25

[DISPLAY] UNIT

REF. NO.	DESCRIPTION	PART NO.
R29	Array	473 RM-10
R30	Resistor	47K ELR25
R31	Resistor	47K R25
R32	Resistor	3.3K ELR25
R33	Resistor	3.3K ELR25
R34	Resistor	2.2 ELR25
R35	Resistor	47 ELR25
R36	Resistor	2.2K ELR25
R37	Resistor	2.2K ELR25
R40	Resistor	1K ELR25
R41	Resistor	100K ELR25
R42	Resistor	2.2K ELR25
R43	Resistor	39 ELR25
R44	Resistor	220 R25
R45	Resistor	220 R25
R46	Resistor	220 R25
C1	Array	B5RC0124-32N
C2	Ceramic	0.001 50V
C3	Array	B5RC0124-32N
C4	Ceramic	0.001 50V
C5	Ceramic	0.001 50V
C6	Ceramic	0.001 50V
C7	Ceramic	0.001 50V
C8	Ceramic	0.001 50V
C9	Ceramic	0.001 50V
C10	Ceramic	0.0047 50V
C11	Ceramic	0.0047 50V
C12	Ceramic	0.0047 50V
C13	Array	B8ZC0111-32N
C14	Ceramic	0.0047 50V
C15	Ceramic	330P 50V
C16	Ceramic	330P 50V
C17	Electrolytic	33 16V
C18	Electrolytic	4.7 25V RC2
C19	Electrolytic	3.3 50V RC2
C20	Electrolytic	3.3 50V RC2
C21	Electrolytic	0.1 50V RC2
C22	Electrolytic	10 16V RC2
C23	Electrolytic	10 16V RC2
C24	Electrolytic	10 16V RC2
C25	Electrolytic	10 16V RC2

L1	Coil	101K FL5H
L2	Coil	471K FL9H
T1	Transformer	TO-9
J1	Connector	TL25P-06-V1
J2	Connector	TL25P-03-V1
P1	Connector	TL25H-04-B1
B1	P.C. Board	B-706A (42449)
B2	P.C. Board	B-729 (42455)
B3	P.C. Board	B-785 (42496)
B4	P.C. Board	B-786 (42497)

[DISPLAY] UNIT

REF. NO.	DESCRIPTION	PART NO.
W13	Jumper	JPW-02A
W14	Jumper	JPW-02A
W15	Jumper	JPW-02A
W16	Jumper	IPS-1041-4
W17	Jumper	JPW-02A
W18	Jumper	IPS-1041-4
W19	Jumper	IPS-1041-4
W20	Jumper	JPW-02H
W21	Jumper	JPW-02H
W22	Jumper	JPW-02H
W23	Jumper	JPW-02H
W24	Jumper	JPW-02H
W25	Jumper	JPW-02H
W26	Jumper	IPS-1041-4
W27	Jumper	IPS-1041-4
W28	Jumper	IPS-1041-4
W29	Jumper	IPS-1041-4
W30	Jumper	IPS-1041-4
W31	Jumper	JPW-02H
W32	Jumper	JPW-02H
W33	Jumper	JPW-02H
W34	Jumper	JPW-02H
W35	Jumper	IPS-1041-4
W36	Jumper	JPW-02H
W37	Jumper	IPS-1041-4
W38	Jumper	JPW-02A
W39	Jumper	JPW-02H
W40	Jumper	IPS-1041-4
W41	Jumper	IPS-1041-4
W42	Jumper	IPS-1041-4
W43	Jumper	JPW-02A
W44	Jumper	IPS-1041-4
W45	Jumper	IPS-1041-4
W46	Jumper	JPW-02A
W47	Jumper	JPW-02A
W48	Jumper	JPW-02A
W49	Jumper	JPW-02H

[LOGIC] UNIT

REF. NO.	DESCRIPTION	PART NO.
IC1	IC	μA78M05
IC2	IC	RP5G01 007
IC3	IC	μPD7801G 114
IC4	IC	SN74LS08N
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
IC19	IC	μA78L82AWC

[LOGIC] UNIT

REF. NO.	DESCRIPTION	PART NO.
Q1	Transistor	2SA1048Y
Q2	Transistor	2SA1048Y
Q3	Transistor	2SA1048Y
Q4	Transistor	2SC2458GR
Q5	Transistor	2SC2458GR
Q6	Transistor	2SA1348
Q7	Transistor	2SA1348
Q8	Transistor	2SA1348
Q9	Transistor	2SA1348
Q10	Transistor	2SA1348
Q11	Transistor	2SA1348
Q12	Transistor	2SA1348
Q13	Transistor	2SA1348
Q14	Transistor	2SA1348
Q15	Transistor	2SA1348
Q16	Transistor	2SA1348
Q17	Transistor	2SC3399
Q18	Transistor	2SC2458GR
D1	Diode	1SS53
D2	Diode	1SS53
D3	Diode	1SS53
D4	Diode	1SS53
D5	Diode	1SS53
D6	Diode	1SS53
D7	Diode	1SS53
D8	Diode	1SS53
D9	Diode	1SS53
D10	Diode	1SS53
D11	Diode	1SS53
D12	Diode	1SS53
D13	Diode	1SS53
D14	Diode	1SS53
D15	Diode	1SS53
D16	Diode	1SS53
D17	Diode	1SS53
D18	Diode	1SS53
D19	Diode	1SS53
D20	Diode	1SS53
D21	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
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

[LOGIC] UNIT

REF. NO.	DESCRIPTION	PART NO.
R6	Array	104 RM-4
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	472 RM-8
R23	Resistor	68K ELR25
R24	Resistor	4.7K ELR25
R25	Resistor	10K R25
R26	Resistor	1K ELR25
R27	Array	472 RM-4
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
R51	Resistor	1K R25
R53	Resistor	1.2K ELR25
R54	Resistor	10K R25
R55	Resistor	10K R25
R58	Resistor	47K R10
R59	Resistor	10K R10
R60	Resistor	10K R10
R61	Resistor	100K R10
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

[LOGIC] UNIT

REF. NO.	DESCRIPTION	PART NO.
C13	Barrier Lay	0.1 16V
C14	Barrier Lay	0.047 25V
C15	Electrolytic	1 50V BP
C16	Ceramic	0.0047 50V
C17	Barrier Lay	0.1 16V
C18	Electrolytic	47 10V
C19	Barrier Lay	0.1 16V
C20	Array	B8ZC0111-32N
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
C27	Array	B5RC0124-32N
C28	Array	B7ZC0711-32N
C29	Array	B7ZC0711-32N
C30	Barrier Lay	0.1 16V
C31	Barrier Lay	0.1 16V
C32	Barrier Lay	0.1 16V
C33	Ceramic	0.0047 50V
C34	Ceramic	0.0047 50V
C35	Ceramic	0.0047 50V
L1	Coil	102K FL5H
L3	Coil	BT01RN1-A61
L4	Coil	102K FL5H
L5	Coil	102K FL5H
L6	Coil	102K FL5H
L7	Coil	102K FL5H
L8	Coil	102K FL5H
L9	Coil	102K FL5H
L10	Coil	102K FL5H
L11	Coil	101K FL5H
L12	Coil	101K FL5H
L13	Coil	101K FL5H
L14	Coil	101K FL5H
L15	Coil	101K FL5H
L16	Coil	101K FL5H
L17	Coil	101K FL5H
L18	Coil	EL0810SK1-102
J1	Connector	TL-25P-03-V1
J2	Connector	TL-25P-10-V1
J3	Connector	TL-25P-12-V1
J4	Connector	TL-25P-05-V1
J5	Connector	5138-11CPB
J6	Connector	TL-25P-06-V1
J7	Connector	5138-10CPB
J8	Connector	5138-04CPB
J9	Connector	TL-25P-07-V1
J10	Connector	TL-25P-09-V1
J11	Connector	5138-11CPB
J12	Connector	TL-25P-08-V1
J13	Connector	5138-10CPB
J14	Connector	5138-08CPB
J15	Connector	TL-25P-08-V1
J16	Connector	3022-12B
J17	Connector	3022-08B
W15	Jumper	IPS-1041-4
W16	Jumper	JPW-02A
W17	Jumper	JPW-02H

[LOGIC] UNIT

REF. NO.	DESCRIPTION	PART NO.
W18	Jumper	JPW-02A
W19	Jumper	JPW-02H
W20	Jumper	JPW-02A
W21	Jumper	IPS-1041-4
W22	Jumper	IPW-1041-4
W23	Jumper	JPW-02H
W24	Jumper	JPW-02A
W25	Jumper	JPW-02A
W26	Jumper	IPS-1041-4
W27	Jumper	IPS-1041-4
W28	Jumper	IPS-1041-4
W29	Jumper	IPS-1041-4
W30	Jumper	IPS-1041-4
W31	Jumper	JPW-02H
W32	Jumper	IPS-1041-4
W33	Jumper	IPS-1041-4
W34	Jumper	JPW-02H
W35	Jumper	JPW-02A
W36	Jumper	JPW-02H
W37	Jumper	JPW-02A
W38	Jumper	JPW-02A
W39	Jumper	JPW-02H
W40	Jumper	JPW-02A
W41	Jumper	JPW-02A
W42	Jumper	JPW-02H
W43	Jumper	IPS-1041-4
W44	Jumper	JPW-02A
W45	Jumper	JPW-02H
W46	Jumper	JPW-02H
W47	Jumper	IPS-1041-4
W48	Jumper	IPS-1041-4
W49	Jumper	JPW-02A
W50	Jumper	JPW-02A
W51	Jumper	JPW-02H
W52	Jumper	JPW-02H
W53	Jumper	JPW-02H
W54	Jumper	JPW-02A
W55	Jumper	JPW-02A
W56	Jumper	JPW-02A
W57	Jumper	JPW-02A
W58	Jumper	IPS-1041-4
W59	Jumper	IPS-1041-4
W60	Jumper	IPS-1041-4
W61	Jumper	JPW-02H
W62	Jumper	JPW-02A
W63	Jumper	JPW-02A
W64	Jumper	IPS-1041-4
W65	Jumper	IPS-1041-4
W66	Jumper	IPS-1041-4
W67	Jumper	IPS-1041-4
W68	Jumper	IPS-1041-4
W69	Jumper	IPS-1041-4
W70	Jumper	IPS-1041-4
W71	Jumper	JPW-02A
W72	Jumper	JPW-02A
W73	Jumper	JPW-02A
W74	Jumper	JPW-02A
W75	Jumper	JPW-02A
W76	Jumper	JPW-02A
W77	Jumper	IPS-1041-4
W78	Jumper	JPW-02H
W79	Jumper	JPW-02H
W80	Jumper	JPW-02H
W81	Jumper	IPS-1041-4
W82	Jumper	IPS-1041-4
W83	Jumper	IPS-1041-4

[LOGIC] UNIT

REF. NO.	DESCRIPTION	PART NO.
W84	Jumper	JPW-02A
W85	Jumper	JPW-02A
W86	Jumper	JPW-02A
W87	Jumper	IPS-1041-4
W88	Jumper	JPW-02A
W89	Jumper	IPS-1041-4
W90	Jumper	IPS-1041-4
W91	Jumper	IPS-1041-4
W92	Jumper	IPS-1041-4
W93	Jumper	JPW-02A
W94	Jumper	JPW-02A
W95	Jumper	JPW-02H
W96	Jumper	IPS-1041-4
B1	P.C. Board	B-705B (42444)
B2	RAM Unit	EX-314-01

[MATRIX] UNIT

REF. NO.	DESCRIPTION	PART NO.
IC1	IC	4013B
IC2	IC	4013B
IC3	IC	4011B
IC4	IC	4030B
IC5	IC	4081B
Q1	Transistor	2SA1048Y
Q2	Transistor	2SC2458GR
Q3	Transistor	2SC2458GR
Q4	Transistor	2SC3399
Q5	Transistor	2SC3399
Q6	Transistor	2SC2458GR
Q7	Transistor	2SA1048Y
Q8	Transistor	2SC2458GR
Q9	Transistor	2SC3399
Q10	Transistor	2SC2458GR
Q11	Transistor	2SC2458GR
Q12	Transistor	2SA1048Y
Q13	Transistor	2SC2458GR
Q14	Transistor	2SC2458GR
Q15	Transistor	2SC2458GR
Q16	Transistor	2SC2458GR
Q17	Transistor	2SC2458GR
Q18	Transistor	2SC2458GR
Q19	Transistor	2SC2458GR
Q20	Transistor	2SA1048Y
Q21	Transistor	2SC2458GR
DS1	LED	SLB-22UR
D2	Diode	1SS53
D3	Diode	1SS53
D4	Diode	1SS53
D5	Diode	1SS53
D6	Diode	1SS53
D7	Diode	1SS53
D8	Diode	1SS53

[MATRIX] UNIT

REF. NO.	DESCRIPTION	PART NO.
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	Diode	1SS53
D38	Diode	1SS53
D39	Diode	1SS53
D40	Diode	1SS53
D41	Diode	1SS53
R1	Resistor	10K ELR25
R2	Resistor	10K ELR25
R3	Resistor	680K ELR25
R4	Resistor	47K R25
R5	Resistor	1M ELR25
R6	Resistor	47K ELR25
R7	Resistor	47K ELR25
R8	Resistor	22K R25
R9	Resistor	47K ELR25
R10	Resistor	47K R25
R11	Resistor	1M ELR25
R12	Resistor	1M ELR25
R13	Resistor	47K ELR25
R14	Resistor	1M ELR25
R15	Resistor	3.3M ELR25
R16	Resistor	330K ELR25
R17	Resistor	47K ELR25
R18	Resistor	47K R25
R19	Resistor	47K R25
R20	Resistor	47K ELR25
R21	Resistor	470K ELR25
R22	Resistor	10K ELR25
R23	Resistor	47K R25
R24	Resistor	47K R25
R25	Resistor	6.8K R25
R26	Resistor	47K ELR25
R27	Resistor	47K ELR25
R28	Resistor	47K ELR25
R29	Resistor	47K ELR25
R30	Resistor	47K ELR25
R31	Array	103 RM-6

[MATRIX] UNIT

REF. NO.	DESCRIPTION	PART NO.
R32	Resistor	47K ELR25
R33	Resistor	47K R25
R34	Resistor	47K ELR25
R35	Resistor	1M ELR25
R36	Resistor	1M ELR25
R37	Resistor	47K R25
R38	Resistor	47K R25
R39	Resistor	6.8K R25
R40	Resistor	47K ELR25
R41	Resistor	4.7 ELR25
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	Electrolytic	0.47 50V BP
C7	Array	B7ZC0711-32N
C8	Barrier Lay	0.1 16V
C9	Array	B8ZC0111-32N
C10	Barrier Lay	0.1 16V
C11	Barrier Lay	0.1 16V
C12	Ceramic	0.001 50V
C13	Ceramic	0.001 50V
J1	Connector	5138-15APB
J2	Connector	TLB-P06H-B1
P1	Connector	TL-25H-06-B1
P2	Connector	TL-25H-02-B1
P3	Connector	TL-25H-05-B1
B1	P.C. Board	B728A (42450)
B2	P.C. Board	B726B (42456)
B3	P.C. Board	B725A (42457)
B4	P.C. Board	B787 (42498)
B5	P.C. Board	B788 (42499)
B6	P.C. Board	B789 (42500)
S1	Switch	SPH122C
S2	Switch	SPH122C
S3	Switch	SPH121C
S4	Switch	SPH122C
S5	Switch	SPH122C
S6	Switch	SPH122C
S7	Switch	SPH122C
S8	Switch	SPH122C
S9	Switch	SPH122A
S10	Switch	SSS212167 TYPE B
S11	Switch	SPH122C
S12	Switch	SPH122C
S13	Switch	SPH121C
S14	Switch	SPH122C
S15	Switch	SPH122C
S16	Switch	SPH122C
S17	Switch	SPH121C
S18	Switch	SPH122C
S19	Switch	SPH121C
S20	Switch	SPH122C
S21	Switch	SPH122C
S22	Switch	SPH121C

[MATRIX] UNIT

REF. NO.	DESCRIPTION	PART NO.
S23	Switch	SPH121C
S24	Switch	SPH121C
W4	Jumper	JPW-02A
W5	Jumper	JPW-02A
W6	Jumper	IPS-1041-4
W7	Jumper	JPW-02A
W8	Jumper	JPW-02A
W9	Jumper	JPW-02A
W10	Jumper	IPS-1041-4
W11	Jumper	JPW-02A
W12	Jumper	JPW-02H
W13	Jumper	JPW-02A
W14	Jumper	JPW-02A
W15	Jumper	JPW-02A
W16	Jumper	JPW-02A
W17	Jumper	JPW-02A
W18	Jumper	JPW-02H
W19	Jumper	IPS-1041-4
W20	Jumper	IPS-1041-4
W21	Jumper	JPW-02A
W22	Jumper	JPW-02H
W23	Jumper	JPW-02H
W24	Jumper	JPW-02H
W25	Jumper	JPW-02A
W26	Jumper	JPW-02A
W27	Jumper	JPW-02A
W28	Jumper	JPW-02A
W29	Jumper	JPW-02H
W30	Jumper	JPW-02A
W31	Jumper	JPW-02A
W32	Jumper	JPW-02H
W33	Jumper	IPS-1041-4
W34	Jumper	IPS-1041-4
W35	Jumper	JPW-02H
W36	Jumper	JPW-02A
W37	Jumper	JPW-02H
W38	Jumper	JPW-02A
W39	Jumper	JPW-02A
W40	Jumper	JPW-02A
W41	Jumper	JPW-02A
W42	Jumper	JPW-02H
W43	Jumper	JPW-02A
W45	Jumper	JPW-02A
W59	Jumper	JPW-02A

[PLL] UNIT

REF. NO.	DESCRIPTION	PART NO.
IC1	IC	M54929P
IC2	IC	M54466L
IC3	IC	μPC1037H
IC4	IC	μPC1037H
IC5	IC	SN74LS90N
IC6	IC	TC5082P-GL
IC7	IC	TA78L008AP
IC8	IC	7805
IC201	IC	M54929P
IC202	IC	M54466L
IC203	IC	SN74LS90N

[PLL] UNIT

REF. NO.	DESCRIPTION	PART NO.
IC204	IC	M54459L
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
Q12	Transistor	2SC945P
Q13	Transistor	2SC3399
Q14	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
Q201	FET	2SK192A-GR
Q202	Transistor	2SC763C
D1	Varactor Diode	1SV50-E
D2	Zener	XZ-051
D4	Diode	1SS53
D5	Diode	1SS53
D7	Diode	1SS53
D8	Diode	1SS53
D9	Diode	1SS53
D10	Diode	1SS53
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	XZ051
D21	Diode	1SS53
D201	Varactor Diode	1SV50-E
L1	Coil	LW-19
L2	Coil	LS-94
L3	Coil	LS-114
L4	Coil	LS-114
L5	Coil	LS-114
L6	Coil	102K LAL04NA
L7	Coil	EL0810SKI-101
L8	Coil	LS-162
L9	Coil	LA-244
L10	Coil	LA-254
L11	Coil	LB4 R36

[PLL] UNIT

REF. NO.	DESCRIPTION	PAPT NO.
L12	Coil	LB4 R23
L13	Coil	LW-17
L14	Coil	101K FL5H
L15	Coil	101K FL5H
L16	Coil	LR-79
L17	Coil	LB-135
L18	Coil	LW-19
L19	Coil	LR-79
L20	Coil	LB-135
L21	Coil	LW-19
L22	Coil	LR-79
L23	Coil	LB-135
L24	Coil	LW-19
L25	Coil	LR-79
L26	Coil	LB-135
L27	Coil	LW-19
L28	Coil	BT01RN1-A61
L29	Coil	LAL03 NAR56M
L30	Coil	101K LAL04NA
L201	Coil	LB-113
L202	Coil	LW-19
L203	Coil	101K FL5H
L204	Coil	101K LAL04NA
L205	Coil	101K LAL04NA
L206	Coil	101K LAL04NA
R1	Resistor	1K R25
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
R13	Resistor	1.2K ELR25
R14	Resistor	220 ELR25
R15	Resistor	47K ELR25
R17	Resistor	10K ELR25
R18	Resistor	220 ELR25
R19	Resistor	22K ELR25
R20	Resistor	100 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
R38	Resistor	390 ELR25
R39	Resistor	1K R25
R40	Resistor	4.7K ELR25
R41	Resistor	1.8M ELR25
R42	Resistor	1K ELR25

[PLL] UNIT

REF. NO.	DESCRIPTION	PART NO.
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	1 0K R25
R96	Resistor	10K R25
R97	Resistor	10K R25
R98	Resistor	47K R25
R99	Resistor	47K R25
R100	Resistor	10 SRW 1P
R101	Resistor	120 R50
R102	Resistor	220 ELR25
R103	Resistor	47 ELR25
R104	Resistor	22 ELR25
R105	Resistor	1K R25
R106	Resistor	15K R25
R107	Resistor	47K ELR25
R108	Resistor	47 ELR25
R109	Resistor	3.3K ELR25

[PLL] UNIT

REF. NO.	DESCRIPTION	PART NO.
R201	Resistor	10K ELR25
R202	Resistor	1K R25
R203	Resistor	2.7K ELR25
R204	Resistor	33K ELR25
R205	Resistor	10K E LR25
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 E LR25
R217	Resistor	2.7K ELR25
R218	Resistor	390 ELR25
C2	Ceramic	0.0047 50V
C3	Ceramic	10P 50V CH
C4	Ceramic	0.0047 50V
C5	Electrolytic	10 16V
C6	Ceramic	82P 50V TH
C7	Ceramic	0.0047 50V
C8	Ceramic	82P 50V TH
C9	Ceramic	10P 50V
C10	Ceramic	68P 50V
C11	Ceramic	47P 50V
C12	Ceramic	100P 50V
C13	Ceramic	100P 50V
C14	Barrier Lay	0.047 25V
C15	Ceramic	15P 50V
C16	Barrier Lay	0.047 25V
C17	Ceramic	0.0047 50V
C19	Ceramic	0.001 50V
C20	Ceramic	0.001 50V
C21	Ceramic	0.0047 50V
C22	Ceramic	8P 50V
C23	Ceramic	1P 50V
C24	Ceramic	8P 50V
C25	Ceramic	1P 50V
C26	Ceramic	8P 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

[PLL] UNIT

REF. NO.	DESCRIPTION	PART NO.
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
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 BP
C76	Ceramic	56P 50V
C77	Ceramic	24P 50V
C78	Trimmer	CT51C
C79	Ceramic	56P 50V CH
C80	Ceramic	12P 50V CH
C81	Ceramic	12P 50V CH
C82	Ceramic	0.0047 50V
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 50V CH
C90	Ceramic	12P 50V CH
C91	Ceramic	12P 50V CH
C92	Ceramic	0.0047 50V
C93	Ceramic	1 P 50V
C94	Ceramic	0.0047 50V
C95	Ceramic	47P 50V
C96	Ceramic	10P 50V
C97	Trimmer	CTZ51A
C98	Ceramic	47P 50V CH
C99	Ceramic	12P 50V CH
C100	Ceramic	8P 50V CH
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 50V CH
C109	Ceramic	12P 50V CH
C110	Ceramic	5P 50V CH
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

[PLL] UNIT

REF. NO.	DESCRIPTION	PART NO.
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
C143	Ceramic	0.0047 50V
C145	Ceramic	0.0047 50V
C146	Ceramic	100P 50V
C147	Ceramic	5P 50V
C148	Ceramic	15P 50V
C151	Ceramic	0.0047 50V
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
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
J1	Connector	TL25P-05-V1
J2	Connector	5138-11CPB
J3	Connector	5138-04CPB
J4	Connector	TMP-J01X-V1
J5	Connector	TMP-J01X-V1
P1	Connector	TL25H-02-B1

[PLL] UNIT

REF. NO.	DESCRIPTION	PART NO.
X1	Crystal	CR-21 (30.720MHz)
FI1	Crystal Filter	FL-69 (30M15A)
B1	P.C. Board	B-704C (42443)
W14	Jumper	JPW-02A
W15	Jumper	IPS-1041-4
W16	Jumper	JPW-02A
W17	Jumper	JPW-02A
W18	Jumper	JPW-02A
W19	Jumper	JPW-02A
W20	Jumper	JPW-02A
W21	Jumper	JPW-02H
W24	Jumper	JPW-02A
W25	Jumper	JPW-02A
W26	Jumper	JPW-02A
W27	Jumper	JPW-02A
W28	Jumper	JPW-02A
W29	Jumper	IPS-1041-4
W30	Jumper	JPW-02A
W31	Jumper	IPS-1041-4
W32	Jumper	IPS-1041-4
W33	Jumper	IPS-1041-4
W34	Jumper	JPW-02A

[MAIN] UNIT

REF. NO.	DESCRIPTION	PART NO.
IC1	IC	μ PC1037H
IC2	IC	μ PC1037H
IC3	IC	μ PC1037H
IC4	IC	μ PC1037H
IC5	IC	μ PC1037H
IC6	IC	LA2600
IC7	IC	4066B
IC8	IC	μ PC1037H
IC9	IC	μ PC1181H
IC10	IC	NJM4558D
IC11	IC	NJM4558D
IC12	IC	NJM4558D
IC13	IC	NJM4558D
IC14	IC	NJM4558D
IC15	IC	NJM4558D
IC16	IC	78M08
Q1	FET	2SK241Y
Q2	Transistor	2SC945P
Q3	Transistor	2SC1815Y
Q4	Transistor	2SC945P
Q5	Transistor	2SC3402
Q6	Transistor	2SC945P
Q7	FET	3SK74M
Q8	Transistor	2SC1583G
Q9	Transistor	2SC945P
Q10	Transistor	2SC945P
Q11	Transistor	2SC945P

[MAIN] UNIT

REF. NO.	DESCRIPTION	PART NO.
Q12	Transistor	2SA1015Y
Q13	Transistor	2SC945P
Q14	FET	3SK74M
Q15	Transistor	2SA1348
Q16	Transistor	2SA1348
Q17	Transistor	2SA1348
Q18	Transistor	2SA1348
Q19	FET	3SK74M
Q20	FET	3SK74M
Q21	Transistor	2SC945P
Q22	Transistor	2SC945P
Q23	Transistor	2SC945P
Q24	FET	3SK74M
Q25	Transistor	2SC945P
Q26	Transistor	2SC1815Y
Q27	Transistor	2SC945P
Q28	Transistor	2SC945P
Q29	Transistor	2SC945P
Q30	Transistor	2SC945P
Q31	Transistor	2SC1815Y
Q32	Transistor	2SC945P
Q33	Transistor	2SC1815Y
Q34	Transistor	2SC945P
Q35	FET	3SK74M
Q36	FET	3SK74M
Q37	Transistor	2SC945P
Q38	Transistor	2SC3399
Q39	Transistor	2SA1348
Q40	Transistor	2SA1015Y
Q41	Transistor	2SA1015Y
Q42	Transistor	2SC3402
Q43	Transistor	2SC945P
Q44	Transistor	2SC2458
Q45	Transistor	2SC1015Y
Q46	Transistor	2SC945P
Q47	Transistor	2SC1571G
Q48	Transistor	2SC1015Y
Q49	Transistor	2SC1571G
Q50	Transistor	2SC1571G
Q51	Transistor	2SA1015Y
Q52	Transistor	2SC945P
Q53	Transistor	2SC945P
Q54	Transistor	2SD468C
Q55	Transistor	2SC945P
Q56	Transistor	2SC945P
Q57	Transistor	2SC945P
Q58	Transistor	2SC945P
Q59	Transistor	2SD468C
Q60	Transistor	2SC945P
Q61	Transistor	2SD468C
Q62	Transistor	2SA1015Y
Q63	Transistor	2SA1015Y
Q64	FET	2SK241Y
Q65	Transistor	2SC945P
Q66	Transistor	2SC3399
Q67	Transistor	2SC3402
Q68	Transistor	2SA1048Y
Q69	Transistor	2SC1815Y
Q70	Transistor	2SC3402
Q71	Transistor	2SC3399
Q72	Transistor	2SC945P
D1	Diode	1SS53
D2	Diode	1SS53
D3	Diode	1SS53

[MAIN] UNIT

REF. NO.	DESCRIPTION	PART NO.
D4	Diode	1SS53
D5	Diode	1SS53
D6	Diode	1SS53
D7	Diode	1SS53
D8	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	1K60
D18	Diode	1K60
D19	Diode	1SS53
D20	Zener	MZ304B
D21	Diode	1SS53
D22	Diode	1SS53
D23	Diode	1SS53
D24	Diode	1SS53
D25	Diode	1SS53
D26	Diode	1SS53
D27	Diode	1SS53
D28	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	1S953
D38	Zener	WZ046
D39	Diode	1SS53
D40	Diode	1SS53
D41	Diode	1SS53
D42	Diode	1SS53
D43	Diode	1SS53
D44	Diode	1SS53
D45	Diode	1SS53
D46	Diode	1SS53
D47	Diode	1SS53
D48	Diode	1SS53
D49	Diode	1SS53
D50	Diode	1SS53
D51	Diode	1SS53
D52	Diode	1SS53
D53	Diode	1SS53
D54	Diode	1SS53
D55	Diode	1SS53
D56	Diode	1SS53
D57	Diode	1SS53
D58	Diode	1SS53
D59	Diode	1SS53
D60	Diode	1SS53
D61	Diode	1SS53
D62	Diode	1SS53
D63	Diode	1SS211
D64	Diode	1SS211
D65	Diode	1K60
D66	Diode	1K60
D67	Diode	1SS53
D68	Diode	1SS53
D69	Diode	1SS53
D70	Diode	1SS53
D71	Diode	1SS53

[MAIN] UNIT

REF. NO.	DESCRIPTION	PART NO.
D72	Diode	1SS53
D73	Diode	1SS53
D74	Diode	1SS53
D75	Diode	1SS53
D76	Varactor Diode	1SV50
D77	Diode	1SS53
D78	Diode	1K60
D79	Diode	1SS53
D80	Diode	1SS53
D82	Diode	1SS53
D84	Varactor Diode	1SV50
D85	Diode	1SS53
D87	Diode	1SS53
D88	Diode	1SS53
D89	Diode	1SS53
D90	Diode	1SS53
D91	Diode	1SS53
D92	Diode	1SS53
D93	Diode	1SS53
D94	Diode	1SS53
D95	Diode	1SS53
D96	Diode	1SS53
D97	Diode	1SS53
D98	Diode	1SS53
D99	Diode	1SS53
D100	Diode	1SS53
D101	Diode	1SS53
D102	Diode	1SS53
D103	Diode	1SS53
D104	Diode	1SS53
D105	Diode	1K60
D106	Diode	1SS53
D107	Diode	1SS53
D108	Diode	1SS53
D110	Diode	1SS53
D111	Diode	1SS53
D112	Diode	1SS53
D113	Diode	1SS53
D114	Diode	1SS53
D115	Diode	1SS53
D116	Diode	1SS53
D117	Diode	1SS53
D118	Diode	1SS53
D119	Diode	1SS53
D120	Diode	1SS53
D121	Diode	1SS53
D122	Diode	1SS53
FI1	Crystal Filter	FL-23 (9M15A)
FI2	Crystal Filter	FL-30 (9M22D2)
FI3	Ceramic Filter	CFW455IT
FI4	Crystal Filter	FL-44A (X00F24A)
X1	Crystal	9.0145MHz (CR-49)
X2	Crystal	9.0115MHz (CR-48)
X3	Crystal	9.0145MHz (CR-49)
X4	Crystal	8.6630MHz (CR-20)
X5	Crystal	9.4665MHz (CR-1)
X6	Ceramic Unit	KBR-350B
L1	Coil	LS-175
L2	Coil	LS-163
L3	Coil	LS-133A

[MAIN] UNIT

REF. NO.	DESCRIPTION	PART NO.
L4	Coil	LS-133A
L5	Coil	LS-133A
L6	Coil	LS-175
L7	Coil	LS-175
L8	Coil	LS-175
L9	Coil	LS-90A
L10	Coil	LS-90A
L11	Coil	101 FL5H
L12	Coil	LS-175
L13	Coil	102 FL5H
L14	Coil	101 FL5H
L15	Coil	LS-238
L16	Coil	LS-239
L17	Coil	LS-240
L18	Coil	100 FL5H
L19	Coil	100 FL5H
L20	Coil	LS-133A
L21	Coil	100 FL5H
L22	Coil	LS-175
L23	Coil	101 FL5H
L24	Coil	LS-133A
L25	Coil	LS-168
L26	Coil	LB4 R70
L27	Coil	LS-260
L28	Coil	101 FL5H
L29	Coil	LS-163
L30	Coil	101 FL5H
L31	Coil	101 FL5H
L32	Coil	101M LAL04SK
L33	Coil	LW-15
L34	Coil	101 FL5H
L35	Coil	101M LAL04SK
R1	Resistor	4.7K ELR25
R2	Resistor	220 ELR25
R3	Resistor	3.9K ELR25
R4	Resistor	220 ELR25
R5	Resistor	4.7K ELR25
R6	Resistor	4.7K ELR25
R7	Resistor	220 ELR25
R8	Resistor	47 ELR25
R9	Resistor	6.8K ELR25
R10	Resistor	47K ELR25
R11	Resistor	47K ELR25
R12	Resistor	3.3K ELR25
R13	Resistor	47K ELR25
R14	Resistor	100K ELR25
R15	Resistor	10K ELR25
R16	Resistor	22K ELR25
R17	Resistor	10K ELR25
R18	Resistor	100K ELR25
R19	Resistor	100K ELR25
R20	Resistor	100K ELR25
R21	Resistor	1K ELR25
R22	Resistor	1K ELR25
R23	Resistor	1K R10
R24	Resistor	15K ELR25
R25	Resistor	15K ELR25
R26	Resistor	10K ELR25
R27	Resistor	22K ELR25
R28	Trimmer	47K H0651A
R29	Resistor	3.3M ELR25
R30	Resistor	1M ELR25
R31	Resistor	1M ELR25
R32	Resistor	1K ELR25

[MAIN] UNIT

REF. NO.	DESCRIPTION	PART NO.
R35	Resistor	2.2K ELR25
R36	Resistor	3.3M ELR25
R37	Resistor	47K ELR25
R38	Resistor	22K ELR25
R39	Resistor	47K ELR25
R40	Resistor	470 ELR25
R41	Resistor	3.3M ELR25
R42	Resistor	220K ELR25
R43	Resistor	56K ELR25
R44	Trimmer	47K H0651A
R45	Resistor	470K ELR25
R46	Trimmer	4.7K H0651A
R47	Resistor	15K ELR25
R48	Trimmer	47K H0651A
R49	Resistor	100K ELR25
R50	Resistor	3.3M ELR25
R51	Resistor	1M ELR25
R52	Resistor	1.8M ELR25
R53	Resistor	1M ELR25
R54	Resistor	470K ELR25
R55	Resistor	3.3M ELR25
R56	Resistor	10K ELR25
R57	Resistor	22K ELR25
R58	Trimmer	10K H0651A
R59	Trimmer	10K H0651A
R60	Resistor	1M ELR25
R61	Resistor	47K ELR25
R62	Resistor	47K ELR25
R63	Trimmer	3.3K H0651A
R64	Resistor	47K ELR25
R65	Resistor	100K ELR25
R66	Resistor	1M ELR25
R67	Resistor	220 ELR25
R68	Resistor	22K ELR25
R69	Resistor	1K ELR25
R70	Resistor	100 ELR25
R71	Resistor	100K ELR25
R72	Resistor	1K ELR25
R73	Resistor	150K ELR25
R74	Resistor	100 ELR25
R75	Resistor	6.8K ELR25
R76	Resistor	68K ELR25
R77	Resistor	47K ELR25
R78	Resistor	100 ELR25
R79	Resistor	8.2K ELR25
R80	Resistor	4.7K ELR25
R81	Resistor	100 ELR25
R82	Resistor	10K ELR25
R83	Resistor	10K ELR25
R86	Resistor	10K ELR25
R87	Resistor	10K ELR25
R88	Resistor	10K ELR25
R89	Resistor	10K ELR25
R91	Resistor	10K ELR25
R92	Resistor	10K ELR25
R93	Resistor	10K ELR25
R94	Resistor	10K ELR25
R95	Resistor	2.2K ELR25
R96	Resistor	10K ELR25
R97	Resistor	1.5K ELR25
R98	Resistor	470 ELR25
R99	Resistor	470 ELR25
R100	Resistor	1K ELR25
R101	Resistor	220 ELR25
R102	Resistor	10K ELR25
R103	Resistor	10K ELR25

[MAIN] UNIT

REF. NO.	DESCRIPTION	PART NO.
R104	Resistor	1K ELR25
R106	Resistor	10K ELR25
R107	Resistor	3.3M ELR25
R108	Resistor	100K ELR25
R109	Resistor	15K ELR25
R110	Trimmer	33K H0651A
R111	Resistor	220K ELR25
R112	Resistor	1.8M ELR25
R113	Resistor	10 ELR25
R114	Resistor	1M ELR25
R115	Resistor	1M ELR25
R116	Resistor	10K ELR25
R117	Resistor	22 ELR25
R118	Resistor	12K ELR25
R119	Resistor	1M ELR25
R120	Resistor	2.2K ELR25
R122	Resistor	1K R25
R124	Resistor	22K ELR25
R125	Resistor	10K ELR25
R126	Resistor	4.7K ELR25
R127	Resistor	2.2K ELR25
R128	Resistor	2.2K ELR25
R129	Resistor	1K ELR25
R130	Resistor	220 ELR25
R131	Resistor	4.7K ELR25
R132	Resistor	470K ELR25
R133	Resistor	330 ELR25
R135	Resistor	10K ELR25
R136	Resistor	10K ELR25
R137	Resistor	10K ELR25
R138	Resistor	2.2K ELR25
R139	Resistor	1.5K ELR25
R140	Resistor	2.2K ELR25
R141	Resistor	1.5K ELR25
R142	Resistor	2.2K ELR25
R143	Resistor	470 ELR25
R144	Resistor	100 R25
R145	Resistor	100 ELR25
R146	Resistor	150 ELR25
R147	Resistor	1.5K ELR25
R148	Resistor	150 ELR25
R149	Resistor	1.5K ELR25
R150	Resistor	2.2K ELR25
R151	Resistor	10K R25
R152	Resistor	10K ELR25
R153	Resistor	10K ELR25
R154	Resistor	470K ELR25
R155	Resistor	220K ELR25
R156	Resistor	470K ELR25
R157	Resistor	4.7K ELR25
R158	Resistor	4.7K ELR25
R159	Resistor	100K ELR25
R160	Resistor	47K ELR25
R161	Resistor	1K ELR25
R162	Resistor	470 ELR25
R163	Resistor	330 ELR25
R164	Resistor	10K ELR25
R165	Resistor	100 ELR25
R166	Resistor	330 ELR25
R167	Resistor	100 ELR25
R168	Resistor	10K ELR25
R169	Resistor	2.7K ELR25
R170	Resistor	4.7K ELR25
R171	Resistor	1K ELR25
R173	Resistor	47K ELR25
R175	Resistor	220 R25

[MAIN] UNIT

REF. NO.	DESCRIPTION	PART NO.
R176	Resistor	10K ELR25
R177	Resistor	2.2K ELR25
R178	Resistor	10K ELR25
R179	Resistor	2.2K ELR25
R180	Resistor	22K ELR25
R181	Resistor	47K ELR25
R182	Resistor	100K ELR25
R183	Resistor	100 ELR25
R184	Resistor	100K ELR25
R185	Resistor	100K ELR25
R186	Resistor	10K ELR25
R187	Resistor	1M ELR25
R188	Resistor	100K ELR25
R189	Resistor	47K ELR25
R190	Resistor	22K ELR25
R191	Resistor	47K ELR25
R192	Resistor	100K ELR25
R193	Resistor	10K H0651A
R194	Resistor	4.7K H0651A
R195	Resistor	10K ELR25
R196	Resistor	1.5K ELR25
R197	Resistor	10K ELR25
R198	Resistor	1.5K ELR25
R200	Resistor	1K R25
R201	Resistor	220 ELR25
R202	Resistor	10K ELR25
R204	Resistor	220 ELR25
R205	Resistor	10K ELR25
R206	Resistor	15K ELR25
R207	Resistor	1K ELR25
R208	Resistor	220 R25
R209	Resistor	3.3K ELR25
R210	Resistor	47 ELR25
R211	Resistor	3.3K ELR25
R212	Resistor	3.3K ELR25
R213	Resistor	2.2K ELR25
R214	Resistor	3.3K ELR25
R215	Resistor	10K R25
R216	Resistor	22K R25
R217	Resistor	3.3K ELR25
R218	Resistor	100 R25
R219	Resistor	10K ELR25
R220	Resistor	1K R25
R222	Trimmer	22K H0651A
R223	Resistor	4.7K ELR25
R224	Resistor	1K ELR25
R225	Resistor	100 R10
R226	Resistor	1K ELR25
R227	Resistor	220 ELR25
R228	Resistor	330 ELR25
R229	Resistor	100 ELR25
R230	Trimmer	10K H0651A
R231	Resistor	220 ELR25
R232	Resistor	330 ELR25
R233	Resistor	100 ELR25
R234	Resistor	3.3M ELR25
R235	Resistor	10K ELR25
R236	Resistor	100 ELR25
R237	Resistor	1K ELR25
R238	Resistor	47K ELR25
R239	Resistor	100K ELR25
R240	Resistor	2.2K ELR25
R241	Resistor	100K ELR25
R242	Resistor	47K ELR25
R243	Resistor	10K ELR25
R244	Resistor	100K ELR25

[MAIN] UNIT

REF. NO.	DESCRIPTION	PART NO.
R245	Resistor	100K ELR25
R246	Resistor	220 ELR25
R248	Resistor	220 ELR25
R249	Resistor	100K ELR25
R250	Resistor	470 ELR25
R251	Resistor	10K ELR25
R252	Resistor	1K ELR25
R253	Resistor	2.2K ELR25
R254	Resistor	47K ELR25
R255	Resistor	100K ELR25
R256	Resistor	10K ELR25
R257	Resistor	2.2K ELR25
R258	Resistor	2.2K ELR25
R259	Resistor	2.2K ELR25
R260	Resistor	2.2K ELR25
R261	Resistor	2.2K ELR25
R262	Resistor	220 ELR25
R263	Resistor	47K ELR25
R264	Resistor	100K ELR25
R265	Resistor	2.2K ELR25
R266	Resistor	220 ELR25
R267	Trimmer	10K H1051C
R268	Trimmer	10K H0651A
R269	Resistor	4.7K ELR25
R270	Trimmer	10K H0651A
R271	Resistor	100K ELR25
R273	Trimmer	10K H0651A
R274	Resistor	100K ELR25
R275	Resistor	3.3K ELR25
R277	Resistor	10K ELR25
R278	Resistor	10K ELR25
R279	Resistor	22K ELR25
R280	Resistor	10K ELR25
R281	Resistor	1K ELR25
R282	Resistor	3.3M ELR25
R283	Resistor	100K ELR25
R285	Resistor	47K ELR25
R286	Resistor	100K ELR25
R287	Resistor	100K ELR25
R288	Resistor	10 ELR25
R289	Resistor	1K ELR25
R290	Resistor	470 ELR25
R292	Resistor	1.8M ELR25
R293	Resistor	1M ELR25
R294	Resistor	1M ELR25
R295	Resistor	100K ELR25
R296	Resistor	4.7K ELR25
R297	Resistor	2.2K ELR25
R298	Resistor	1 0K ELR25
R299	Resistor	4.7K ELR25
R300	Resistor	47K ELR25
R301	Resistor	15K ELR25
R302	Resistor	15K ELR25
R303	Resistor	47K ELR25
R304	Resistor	4.7K ELR25
R305	Resistor	4.7K ELR25
R306	Resistor	3.3K ELR25
R307	Resistor	10 ELR25
R308	Resistor	1K ELR25
R309	Resistor	1K ELR25
R310	Resistor	10K ELR25
R311	Resistor	10 ELR25
R312	Resistor	1K ELR25
R313	Resistor	1K ELR25
R314	Resistor	1K ELR25
R315	Resistor	4.7K ELR25

[MAIN] UNIT

REF. NO.	DESCRIPTION	PART NO.
R316	Resistor	2.2K ELR25
R317	Resistor	10K R25
R318	Resistor	220 R25
R319	Resistor	1K ELR25
R322	Resistor	1K ELR25
R324	Resistor	47 ELR25
R325	Resistor	1K ELR25
R326	Resistor	6.8K ELR25
R327	Resistor	100 ELR25
R328	Resistor	470 R10
R329	Resistor	10K ELR25
R330	Resistor	2.2K ELR
R331	Resistor	47K ELR25
R332	Resistor	2.2K ELR25
R333	Resistor	47K ELR25
R334	Resistor	4.7K ELR25
R336	Resistor	220 ELR25
R337	Resistor	47K ELR25
R338	Resistor	4.7K ELR25
R339	Resistor	330K ELR25
R340	Resistor	220 ELR25
R341	Resistor	10K ELR25
R342	Resistor	10K ELR25
R343	Resistor	4.7K ELR25
R344	Resistor	4.7K ELR25
R347	Resistor	10K ELR25
R348	Resistor	10K R25
R349	Resistor	2.2K ELR25
R350	Resistor	2.2K ELR25
R351	Resistor	68 ELR25
R352	Resistor	3.3K R25
R353	Resistor	470 ELR25
R354	Resistor	22K ELR25
R355	Resistor	22K ELR25
R360	Resistor	4.7K ELR25
R361	Resistor	10 ELR25
R362	Resistor	3.9K ELR25
R363	Resistor	470 ELR25
R364	Resistor	150 ELR25
R365	Resistor	150 ELR25
R366	Resistor	220 ELR25
R367	Resistor	220 ELR25
R368	Resistor	100 ELR25
R369	Resistor	100K ELR25
R370	Resistor	220 ELR25
R371	Resistor	470 ELR25
R372	Resistor	1K ELR25
R373	Resistor	4.7K ELR25
R374	Resistor	1K R25
R375	Resistor	1K R25
R380	Resistor	680 ELR25
R381	Resistor	220 ELR25
R382	Resistor	470 ELR25
R383	Resistor	1K ELR25
R385	Resistor	47K ELR25
R386	Resistor	1K ELR25
R388	Resistor	470 ELR25
R389	Resistor	1.8M ELR25
R390	Thermistor	33D28
R391	Resistor	22K ELR25
R392	Resistor	47K R25
R392	Resistor	100 ELR25
R394	Resistor	1K ELR25
R395	Resistor	4.7K ELR25
R396	Resistor	10K R10
R397	Resistor	470 R10

[MAIN] UNIT

REF. NO.	DESCRIPTION	PART NO.
R398	Resistor	10K ELR25
R399	Resistor	1K R10
C1	Ceramic	0.0047 50V
C2	Ceramic	0.0047 50V
C3	Ceramic	0.5P 50V
C4	Electrolytic	0.47 50V
C5	Ceramic	0.0047 50V
C6	Ceramic	0.0047 50V
C7	Ceramic	100P 50V
C8	Ceramic	200P 50V YL
C9	Ceramic	22P 50V CH
C10	Ceramic	0.0047 50V
C11	Ceramic	47P 50V CH
C12	Dip Mica	120P 50V
C13	Dip Mica	120P 50V
C14	Electrolytic	4.7 50V
C15	Ceramic	0.0047 50V
C16	Ceramic	0.0047 50V
C17	Ceramic	0.0047 50V
C18	Electrolytic	4.7 50V BP
C19	Ceramic	470P 50V
C20	Electrolytic	1 50V RC2
C21	Ceramic	470P 50V
C22	Ceramic	470P 50V
C23	Ceramic	470P 50V
C24	Ceramic	470P 50V
C25	Ceramic	0.001 50V
C26	Ceramic	0.0047 50V
C27	Barrier Lay	0.1 16V
C28	Ceramic	0.0047 50V
C29	Ceramic	0.0047 50V
C30	Ceramic	0.0047 50V
C31	Ceramic	0.0047 50V
C32	Electrolytic	3.3 50V RC2
C33	Ceramic	0.0047 50V
C34	Ceramic	0.0047 50V
C35	Ceramic	0.0047 50V
C36	Ceramic	0.001 50V
C37	Ceramic	330P 50V
C38	Electrolytic	10 16V
C39	Electrolytic	47 10V
C40	Electrolytic	2.2 50V
C41	Tantulum	0.1 35V
C42	Barrier Lay	0.047 25V
C43	Ceramic	47P 50V
C44	Barrier Lay	0.1 16V
C45	Electrolytic	3.3 50V RC2
C46	Barrier Lay	0.1 16V
C48	Electrolytic	10 16V
C49	Electrolytic	47 10V
C51	Electrolytic	2.2 50V
C52	Electrolytic	0.47 50V
C53	Mylar	0.033 50V
C54	Electrolytic	0.47 50V RC2
C55	Ceramic	0.0047 50V
C56	Ceramic	1P 50V
C57	Ceramic	0.0047 50V
C58	Ceramic	0.0047 50V
C59	Mylar	0.033 50V
C60	Ceramic	0.0047 50V
C61	Ceramic	0.0047 50V
C62	Ceramic	0.0047 50V
C63	Ceramic	0.0047 50V
C65	Ceramic	0.0047 50V

[MAIN] UNIT

REF. NO.	DESCRIPTION	PART NO.
C66	Barrier Lay	0.0047 25V
C67	Ceramic	0.001 50V
C68	Barrier Lay	0.0047 50V
C69	Barrier Lay	0.047 25V
C70	Barrier Lay	0.047 25V
C72	Ceramic	0.001 50V
C73	Ceramic	0.0047 50V
C74	Ceramic	0.0047 50V
C75	Ceramic	22P 50V
C76	Ceramic	0.0047 50V
C77	Ceramic	0.0047 50V
C78	Ceramic	0.0047 50V
C79	Ceramic	100P 50V
C80	Mylar	0.01 50V
C81	Ceramic	0.0047 50V
C82	Ceramic	0.0047 50V
C83	Ceramic	0.0047 50V
C84	Ceramic	0.0047 50V
C85	Ceramic	0.001 50V
C86	Ceramic	0.0047 50V
C87	Electrolytic	2.2 50V RC2
C88	Ceramic	470P 50V
C89	Ceramic	15P 50V
C90	Electrolytic	47 16V
C91	Ceramic	0.0047 50V
C92	Ceramic	100P 50V
C93	Ceramic	0.0047 50V
C94	Barrier Lay	0.047 25V
C95	Ceramic	0.0047 50V
C96	Barrier Lay	0.1 16V
C97	Barrier Lay	0.1 16V
C98	Silinder	0.0047 50V
C99	Ceramic	0.0047 50V
C100	Barrier Lay	0.047 25V
C101	Barrier Lay	0.047 25V
C102	Ceramic	0.0047 50V
C103	Barrier Lay	0.047 25V
C104	Barrier Lay	0.047 25V
C105	Barrier Lay	0.047 25V
C107	Dip Mica	330P 50V
C108	Dip Mica	330P 50V
C109	Ceramic	0.0047 50V
C110	Mylar	0.01 50V
C111	Barrier Lay	0.047 25V
C112	Barrier Lay	0.047 25V
C113	Ceramic	0.0047 50V
C114	Barrier Lay	0.047 25V
C115	Barrier Lay	0.047 25V
C116	Barrier Lay	0.047 25V
C117	Electrolytic	100 10V
C119	Ceramic	330P 50V
C120	Barrier Lay	0.1 16V
C121	Barrier Lay	0.1 16V
C122	Barrier Lay	0.1 16V
C123	Ceramic	470P 50V
C124	Ceramic	0.001 50V
C125	Ceramic	470P 50V
C126	Barrier Lay	0.047 25V
C127	Barrier Lay	0.047 25V
C128	Ceramic	150P 50V
C129	Ceramic	150P 50V
C130	Ceramic	0.0047 50V
C131	Dip Mica	200P 50V
C132	Ceramic	22P 50V
C133	Dip Mica	200P 50V
C134	Ceramic	0.0047 50V

[MAIN] UNIT

REF. NO.	DESCRIPTION	PART NO.
C135	Ceramic	330P 50V
C136	Ceramic	330P 50V
C137	Barrier Lay	0.047 25V
C138	Barrier Lay	0.047 25V
C139	Ceramic	330P 50V
C140	Ceramic	0.0047 50V
C141	Ceramic	150P 50V
C142	Ceramic	0.1 16V
C143	Ceramic	150P 50V
C144	Dip Mica	150P 50V
C145	Dip Mica	150P 50V
C146	Ceramic	0.0047 50V
C147	Ceramic	0.0047 50V
C148	Barrier Lay	0.047 25V
C149	Dip Mica	200P 50V
C150	Dip Mica	200P 50V
C151	Dip Mica	33P 50V
C152	Trimmer	CTZ51F
C153	Dip Mica	39P 50V
C154	Ceramic	0.0047 50V
C156	Ceramic	0.0047 50V
C157	Ceramic	0.0047 50V
C158	Cylinder	472 UP125
C159	Ceramic	220P 50V
C160	Ceramic	15P 50V
C162	Ceramic	472K UAT05X
C163	Electrolytic	33 16V
C164	Electrolytic	1 50V
C165	Electrolytic	10 16V
C165	Electrolytic	0.1 50V RC2
C166	Electrolytic	4.7 25V BP
C167	Ceramic	0.001 50V
C168	Barrier Lay	0.047 25V
C169	Ceramic	120P 50V
C170	Ceramic	0.0047 50V
C171	Ceramic	B8ZC0111-32N
C172	Ceramic	B8ZC0111-32N
C173	Ceramic	B7ZC0711-32N
C174	Ceramic	UAT05X472K
C175	Array	B5RC0124-32N
C176	Ceramic	0.0047 50V
C177	Ceramic	220P 50V
C178	Ceramic	0.001 50V
C179	Ceramic	0.001 50V
C180	Electrolytic	10 16V RC2
C181	Electrolytic	100 10V
C182	Ceramic	0.0047 50V
C183	Barrier Lay	0.1 16V
C184	Ceramic	0.0047 50V
C185	Electrolytic	47 10V
C186	Electrolytic	100 10V
C187	Barrier Lay	0.1 16V
C188	Electrolytic	2.2 50V RC2
C189	Electrolytic	100 10V
C190	Barrier Lay	0.047 25V
C191	Tantalum	1 16V
C192	Barrier Lay	0.1 16V
C193	Electrolytic	1 50V
C195	Electrolytic	1 50V
C196	Mylar	0.022 50V
C197	Electrolytic	1 50V
C198	Tantalum	2.2 16V
C199	Electrolytic	1000 16V MS16
C200	Electrolytic	220 10V
C201	Ceramic	150P 50V
C202	Ceramic	0.0047 50V

[MAIN] UNIT

REF. NO.	DESCRIPTION	PART NO.
C203	Barrier Lay	0.047 25V
C204	Barrier Lay	0.1 16V
C205	Electrolytic	4.7 50V
C206	Mylar	0.033 50V
C207	Barrier Lay	0.1 16V
C209	Electrolytic	0.22 50V RC2
C210	Barrier Lay	0.1 16V
C211	Mylar	0.01 50V
C212	Electrolytic	10 16V
C213	Mylar	0.022 50V
C214	Electrolytic	3.3 50V
C215	Electrolytic	47 10V
C216	Barrier Lay	0.047 25V
C217	Ceramic	150P 50V
C218	Mylar	0.1 50V
C219	Electrolytic	470 16V
C220	Electrolytic	47 16V
C221	Electrolytic	220 10V
C222	Electrolytic	47 16V
C223	Barrier Lay	0.1 16V
C224	Electrolytic	1000 16V MS16
C225	Electrolytic	10 16V
C226	Barrier Lay	0.1 16V
C227	Electrolytic	0.22 50V RC2
C228	Barrier Lay	0.1 16V
C229	Electrolytic	3.3 50V
C230	Electrolytic	10 16V
C232	Barrier Lay	0.1 16V
C233	Ceramic	0.0047 50V
C234	Ceramic	0.0047 50V
C235	Ceramic	68P 50V
C501	Ceramic	0.0047 50V
C502	Ceramic	0.001 50V
C503	Ceramic	3P 50V
C506	Ceramic	0.001 50V
C507	Ceramic	0.0047 50V
C508	Ceramic	30P 50V
C509	Barrier Lay	0.047 25V
C510	Barrier Lay	0.047 25V
C511	Electrolytic	10 16V
C512	Electrolytic	100 10V
C513	Ceramic	0.0047 50V
C514	Ceramic	0.0047 50V
C516	Electrolytic	3.3 50V
C517	Ceramic	470P 50V
C519	Ceramic	0.0047 50V
C520	Ceramic	470P 50V
C521	Ceramic	470P 50V
C522	Ceramic	0.0047 50V
C523	Barrier Lay	0.047 25V
C524	Barrier Lay	0.047 25V
C526	Ceramic	150P 50V
C527	Ceramic	150P 50V
C528	Ceramic	0.0047 50V
C529	Electrolytic	47 10V
C530	Barrier Lay	0.1 16V
C531	Ceramic	0.0047 50V
C532	Electrolytic	4.7 50V
C534	Electrolytic	22 10V
C535	Dip Mica	51P 50V
C537	Ceramic	0.0047 50V
C538	Ceramic	0.0047 50V
C538	Ceramic	0.0047 50V

[MAIN] UNIT

REF. NO.	DESCRIPTION	PART NO.
J1	Connector	TL-25P-05-V1
J2	Connector	TL-25P-04-V1
J3	Connector	TL-25P-06-V1
J4	Connector	TL-25P-04-V1
J5	Connector	TL-25P-06-V1
J6	Connector	TL-25P-08-V1
J7	Connector	TL-25P-11-V1
J8	Connector	TL-25P-09-V1
J9	Connector	TL-25P-08-V1
J10	Connector	TL-25P-05-V1
J11	Connector	TL-25P-02-V1
J12	Connector	TL-25P-10-V1
J13	Connector	TL-25P-02-V1
J14	Connector	TL-25P-02-V1
J15	Connector	TL-25P-02-V1
J16	Connector	TL-25P-09-V1
J17	Connector	TL-25P-03-V1
J18	Connector	TLB-P04H-B1
J19	Connector	RT-01T-1.0B
J20	Connector	RT-01 T-1.0B
P1	Connector	TL-25H-02-B1
P2	Connector	TL-25H-03-B1
P3	Connector	TL-25H-05-B1
S1	Switch	SSS312
S2	Switch	SSS312
S3	Switch	SSS312
SO1	Socket	380598-2
SO2	Socket	380598-2
SO3	Socket	380598-2
SO4	Socket	380598-2
SO5	Socket	380598-2
SO6	Socket	380598-2
SO7	Socket	380598-2
SO8	Socket	380598-2
B1	P.C. Board	B-700D (30344)
W101	Jumper	JPW-02H
W102	Jumper	JPW-02H
W103	Jumper	JPW-02H
W104	Jumper	JPW-02H
W105	Jumper	JPW-02A
W106	Jumper	IPS-4041-4
W107	Jumper	IPS-4041-4
W108	Jumper	JPW-02A
W109	Jumper	JPW-02H
W111	Jumper	JPW-02A
W112	Jumper	JPW-02H
W115	Jumper	JPW-02A
W116	Jumper	JPW-02H
W120	Jumper	JPW-02H
W121	Jumper	JPW-02H
W122	Jumper	JPW-02H
W123	Jumper	JPW-02H
W124	Jumper	IPS-4041-4
W125	Jumper	IPS-4041-4
W126	Jumper	JPW-02H
W127	Jumper	JPW-02H

[MAIN] UNIT

REF. NO.	DESCRIPTION	PART NO.
W129	Jumper	JPW-02A
W130	Jumper	JPW-02H
W131	Jumper	IPS-4041-4
W132	Jumper	JPW-02H
W133	Jumper	JPW-02A
W134	Jumper	JPW-02A
W135	Jumper	JPW-02A
W136	Jumper	JPW-02A
W137	Jumper	JPW-02A
W138	Jumper	JPW-02A
W139	Jumper	JPW-02A
W140	Jumper	JPW-02A
W141	Jumper	JPW-02A
EP2	Bead Core	FSQH070RN
EP3	Bead Core	FSQH070RN

[RF] UNIT

REF. NO.	DESCRIPTION	PART NO.
IC1	IC	BA618
IC2	IC	BA618
IC3	IC	ND487C1-3R
Q1	Transistor	2SC945
Q2	Transistor	2SC2053
Q3	Transistor	2SA1015Y
Q4	Transistor	2SC945K
Q5	Transistor	2SC945K
Q6	FET	2SK125
Q7	FET	2SK125
Q8	FET	3SK74M
Q9	FET	2SK125
Q10	FET	2SK125
Q11	FET	3SK74M
Q12	FET	3SK74K
Q13	FET	3SK74K
Q14	Transistor	2SC2053
Q15	Transistor	2SC1636
Q16	Transistor	2SC945
Q17	Transistor	2SC945P
Q18	Transistor	2SC945
Q19	Transistor	2SC945
Q20	Transistor	2SB562C
D1	Diode	1S953
D2	Diode	1S953
D3	Diode	1SS53
D4	Diode	1SS53
D5	Diode	1N4002
D6	Diode	1N4002
D7	Diode	1SS53
D8	Zener	XZ055
D9	Diode	1SS53
D10	Diode	MI204
D11	Diode	MI204
D12	Diode	1SS53
D13	Diode	1SS53

[RF] UNIT

REF. NO.	DESCRIPTION	PART NO.
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	Diode	1SS53
D38	Diode	1SS53
D39	Diode	1SS53
D40	Diode	1SS53
D41	Diode	MI204
D42	Diode	MI204
D43	Diode	MI204
D44	Diode	MI204
D45	Diode	1SS53
D46	Diode	1SS53
D47	Diode	MI204
D48	Diode	1SS53
D49	Diode	1SS53
D50	Diode	1SS53
D51	Zener	XZ096
D52	Diode	1SS53
D53	Diode	1SS53
D54	Diode	1SS53
D55	Diode	1SS53
FI1	Crystal Filter	70M15B
L1	Coil	EL0810SKI-101K
L2	Coil	EL0810SKI-101K
L3	Coil	EL0810SKI-101K
L4	Coil	EL0810SKI-102K
L4	Coil	EL0810SKI-102K
L5	Coil	102K FL5H
L6	Coil	102K FL5H
L8	Coil	EL0810SKI-101K
L9	Coil	EL0810SKI-101K
L10	Coil	EL0810SKI-101K
L11	Coil	EL0810SKI-101K
L12	Coil	LB4 R15
L13	Coil	LB4 R50
L14	Coil	101K FL5H
L15	Coil	LA-267
L16	Coil	LB4 R30
L17	Coil	LS-114
L18	Coil	LS-254
L19	Coil	LS-254

[RF] UNIT

REF. NO.	DESCRIPTION	PART NO.
L20	Coil	LS-254
L21	Coil	LS-198
L22	Coil	LR-129
L23	Coil	LA-258
L24	Coil	LA-257
L25	Coil	102K FL5H
L26	Coil	LB4 R83
L27	Coil	LR-116
L28	Coil	LR-116
L29	Coil	LA-96
L30	Coil	LB-86A
L31	Coil	LS-114
L32	Coil	LS-114
L33	Coil	LS-198
L34	Coil	LR-75A
L35	Coil	102K FL5H
L36	Coil	EL0810SKI-102K
L37	Coil	102K FL5H
L38	Coil	102K FL5H
L39	Coil	102K FL5H
L40	Coil	102K FL5H
L41	Coil	LR-130
L42	Coil	LR-129
L43	Coil	102K FL5H
L44	Coil	LB4 R34
L45	Coil	LB4 R36
L46	Coil	LB4 R30
L47	Coil	LB4 R36
L48	Coil	101K FL5H
L49	Coil	LB4 R45
L50	Coil	LB4 R50
L51	Coil	LB4 R50
L52	Coil	LB4 R54
L53	Coil	101K FL5H
L54	Coil	LB4 R54
L55	Coil	LB4 R65
L56	Coil	LB4 R65
L57	Coil	LB4 R83
L58	Coil	101K FL5H
L59	Coil	LB4 R70
L60	Coil	LB4 R83
L61	Coil	EL0810SKI-1R0K
L62	Coil	EL0810SKI-1R0K
L63	Coil	101K FL5H
L64	Coil	EL0810SKI-1R0K
L65	Coil	EL0810SKI-1R2K
L66	Coil	EL0810SKI-1R2K
L67	Coil	EL0810SKI-1R2K
L68	Coil	101K FL5H
L69	Coil	EL0810SKI-1R5K
L70	Coil	EL0810SKI-1R5K
L71	Coil	EL0810SKI-1R8K
L72	Coil	EL0810SKI-1R8K
L73	Coil	101K FL5H
L74	Coil	EL0810SKI-1R8K
L75	Coil	EL0810SKI-1R8K
L76	Coil	EL0810SKI-2R2K
L77	Coil	EL0810SKI-2R7K
L78	Coil	101K FL5H
L79	Coil	EL0810SKI-2R7K
L80	Coil	EL0810SKI-3R3K
L81	Coil	EL0810SKI-3R3K
L82	Coil	LB4 4R3
L83	Coil	102K FL5H
L84	Coil	LB4 3R6
L85	Coil	LB4 4R3

[RF] UNIT

REF. NO.	DESCRIPTION	PART NO.
L86	Coil	LB4 5R1
L87	Coil	LB4 6R2
L88	Coil	102K FL5H
L89	Coil	102K FL5H
L90	Coil	LB4 6R2
L91	Coil	LB4 5R1
L92	Coil	102K FL5H
L93	Coil	EL0810SKI-220K
L94	Coil	EL0810SKI-220K
L95	Coil	102K FL5H
L96	Coil	LR-20
L97	Coil	102K FL5H
L98	Coil	101K FL5H
L99	Coil	102K FL5H
L100	Coil	102K FL5H
L101	Coil	EL0810SKI-4R7K
L102	Coil	EL0810SKI-3R3K
L103	Coil	102K FL5H
L104	Coil	BT01RN1-A61
R1	Resistor	2.2 ELR10
R2	Resistor	10K ELR25
R3	Resistor	10K ELR25
R4	Resistor	10K ELR25
R5	Resistor	10K ELR25
R6	Resistor	10K ELR25
R7	Resistor	10K ELR25
R8	Resistor	10K R25
R9	Resistor	33K ELR25
R10	Resistor	33K ELR25
R11	Resistor	10K ELR25
R12	Resistor	10K R25
R13	Resistor	2.2 ELR10
R14	Array	10K RM6
R15	Resistor	470 ELR25
R16	Resistor	680 ELR25
R17	Resistor	8.2K ELR25
R18	Resistor	560 ELR25
R19	Resistor	100 ELR25
R20	Resistor	1K ELR25
R21	Resistor	33 ELR25
R22	Resistor	220 ELR25
R23	Resistor	100 ELR25
R24	Resistor	3.3K ELR25
R25	Resistor	330 ELR25
R26	Resistor	22K ELR25
R27	Resistor	47 ELR25
R28	Resistor	47 ELR25
R29	Resistor	10K ELR25
R30	Resistor	100 ELR25
R31	Resistor	390 ELR25
R32	Resistor	47 ELR25
R33	Resistor	10K ELR25
R34	Resistor	1M ELR25
R35	Resistor	220 ELR25
R36	Resistor	2.2K ELR25
R37	Resistor	22 ELR25
R38	Resistor	22 ELR25
R39	Resistor	100 R25
R40	Resistor	100 ELR25
R41	Resistor	100 ELR25
R42	Resistor	3.9K ELR25
R43	Resistor	10K ELR25

[RF] UNIT

REF. NO.	DESCRIPTION	PART NO.
R44	Resistor	470K ELR25
R45	Resistor	47 R25
R46	Resistor	470 ELR25
R47	Resistor	470 ELR25
R48	Resistor	220 R25
R49	Resistor	150 ELR25
R50	Resistor	8.2 ELR25
R51	Resistor	8.2 R25
R52	Resistor	150 R25
R53	Resistor	2.2K ELR25
R54	Resistor	100 ELR25
R55	Resistor	100K ELR25
R56	Resistor	10K ELR25
R57	Resistor	820 ELR25
R58	Resistor	100 ELR25
R59	Resistor	56 R25
R60	Resistor	100 ELR25
R61	Resistor	150 ELR25
R62	Resistor	10K ELR25
R63	Resistor	100 ELR25
R64	Resistor	100 ELR25
R65	Resistor	47 ELR25
R66	Resistor	100 ELR25
R67	Resistor	100 ELR25
R68	Resistor	100 ELR25
R69	Resistor	100 R25
R70	Resistor	100 R25
R71	Resistor	100 R25
R72	Resistor	100 R25
R73	Resistor	100 R25
R74	Resistor	100 R25
R75	Resistor	100 R25
R76	Resistor	100 R25
R77	Resistor	100 R25
R78	Resistor	100 R25
R79	Resistor	470 ELR25
R80	Resistor	82 ELR25
R81	Resistor	680 ELR25
R82	Resistor	8.2K ELR25
R83	Resistor	100 ELR25
R84	Resistor	220 R10
R85	Resistor	4.7 ELR25
R86	Resistor	1 ELR25
R87	Resistor	10K ELR25
R88	Resistor	220 ELR25
R89	Resistor	2.2K ELR25
R90	Resistor	4.7K ELR25
R91	Resistor	470 ELR25
R92	Resistor	56 ELR25
R93	Resistor	470 ELR10
R94	Resistor	8.2K R20
R95	Resistor	2.2K ELR25
R96	Resistor	4.7K ELR25
R97	Resistor	470 ELR25
R98	Resistor	4.7K ELR25
R99	Resistor	4.7K ELR25
R100	Resistor	390 ELR25
R101	Resistor	4.7K ELR25
R102	Resistor	4.7K R25
R103	Resistor	4.7K ELR25
R104	Resistor	22K ELR25
R105	Resistor	22K ELR25
R106	Resistor	3.3K ELR25
R107	Resistor	1K ELR25
R108	Resistor	27 R25
R109	Resistor	33 ELR25

[RF] UNIT

REF. NO.	DESCRIPTION	PART NO.
R110	Resistor	27 ELR25
R111	Resistor	820 ELR25
R112	Resistor	1K ELR25
R113	Resistor	100 R25
R114	Resistor	2.2K ELR25
R115	Resistor	47K ELR25
R116	Resistor	680K ELR25
R117	Resistor	10K R25
R118	Resistor	15K ELR10
R119	Resistor	15K ELR25
R120	Resistor	2.2K R10
R121	Resistor	1.8K R25
R122	Resistor	1K R25
R123	Thermistor	23D29
C1	Array	B8ZC0111N-32N
C2	Array	B8ZC0111-32N
C3	Barrier Lay	0.047 25V
C5	Barrier Lay	0.047 25V
C6	Array	B8ZC0111N-32N
C7	Array	B8ZC0111-32N
C8	Electrolytic	1 50V
C9	Electrolytic	0.47 50V
C10	Barrier Lay	0.047 25V
C11	Ceramic	39P 50V
C12	Ceramic	39P 50V
C13	Ceramic	220P 50V
C14	Ceramic	0.001 50V
C15	Barrier Lay	0.047 25V
C16	Electrolytic	2.2 50V
C17	Ceramic	0.001 50V
C18	Ceramic	8P 50V
C19	Ceramic	5P 50V
C20	Ceramic	15P 50V
C21	Ceramic	1.5P 50V
C22	Ceramic	10P 50V
C23	Barrier Lay	0.047 25V
C24	Barrier Lay	0.1 16V
C25	Barrier Lay	0.1 16V
C26	Barrier Lay	0.047 25V
C27	Barrier Lay	0.047 25V
C28	Barrier Lay	0.047 25V
C29	Barrier Lay	0.047 25V
C30	Mylar	0.022 50V
C31	Barrier Lay	0.047 25V
C32	Ceramic	220P 50V
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	Barrier Lay	0.047 25V
C38	Barrier Lay	0.047 25V
C39	Barrier Lay	0.047 25V
C40	Barrier Lay	0.047 25V
C41	Ceramic	2P 50V
C42	Ceramic	6P 50V
C43	Ceramic	0.0047 50V
C44	Ceramic	0.0047 50V
C45	Mylar	0.022 50V
C46	Ceramic	0.001 50V
C47	Ceramic	0.001 50V
C48	Ceramic	3P 50V
C49	Ceramic	10P 50V
C50	Ceramic	8P 50V
C51	Barrier Lay	0.1 16V

[RF] UNIT

REF. NO.	DESCRIPTION	PART NO.
C52	Barrier Lay	8P 50V
C54	Electrolytic	0.047 25V
C55	Ceramic	1 50V
C56	Ceramic	120P 50V
C57	Ceramic	150P 50V
C58	Ceramic	10P 50V
C59	Ceramic	30P 50V
C60	Barrier Lay	120P 50V
C61	Barrier Lay	UFD08SA681K-L2A
C62	Ceramic	UFD08SA681K-L2A
C63	Ceramic	0.0047 50V
C64	Ceramic	27P 50V
C65	Ceramic	82P 50V
C66	Ceramic	24P 50V
C67	Ceramic	24P 50V
C68	Ceramic	39P 50V
C69	Ceramic	0.0047 50V
C70	Barrier Lay	6P 50V
C71	Ceramic	0.1 16V
C72	Ceramic	0.001 50V
C73	Ceramic	0.0047 50V
C74	Ceramic	0.0047 50V
C75	Ceramic	0.0047 50V
C76	Ceramic	8P 50V
C77	Ceramic	15P 50V
C78	Ceramic	3P 50V
C79	Barrier Lay	0.047 25V
C80	Barrier Lay	0.047 25V
C81	Barrier Lay	0.047 25V
C82	Barrier Lay	0.047 25V
C84	Barrier Lay	0.047 25V
C85	Ceramic	100P 50V
C86	Barrier Lay	UFD08SA821K-L2A
C87	Ceramic	120P 50V
C88	Ceramic	100P 50V
C89	Ceramic	68P 50V
C90	Ceramic	100P 50V
C91	Ceramic	30P 50V
C92	Barrier Lay	0.047 25V
C93	Barrier Lay	0.047 25V
C94	Ceramic	150P 50V
C95	Barrier Lay	TBD04V122K-LOB
C96	Ceramic	220P 50V
C97	Ceramic	180P 50V
C98	Ceramic	24P 50V
C99	Ceramic	180P 50V
C100	Barrier Lay	0.047 25V
C101	Barrier Lay	0.047 25V
C102	Ceramic	200P 50V
C103	Barrier Lay	TBD04V182K-LOB
C104	Ceramic	220P 50V
C105	Ceramic	300P 50V
C106	Ceramic	39P 50V
C107	Ceramic	300P 50V
C108	Barrier Lay	0.047 25V
C109	Barrier Lay	0.047 25V
C110	Ceramic	300P 50V
C111	Barrier Lay	TBD04V222K-LOB
C112	Ceramic	330P 50V
C113	Ceramic	330P 50V
C114	Ceramic	51P 50V
C115	Ceramic	330P 50V
C116	Barrier Lay	0.047 25V
C117	Barrier Lay	0.047 25V
C118	Ceramic	390P 50V
C119	Barrier Lay	TBD05V272K-LOB

[RF] UNIT

REF. NO.	DESCRIPTION	PART NO.
C120	Ceramic	DD109SL471J50V02
C121	Ceramic	DD109SL511J50V02
C122	Ceramic	75P 50V
C123	Barrier Lay	UFD08SA561K-L2A
C124	Barrier Lay	0.047 25V
C125	Barrier Lay	0.047 25V
C126	Barrier Lay	UFD08SA561K-L2A
C127	Barrier Lay	TBD06V562K-L2A
C128	Barrier Lay	TBD04V102K-LOB
C129	Barrier Lay	UFD08SA681K-L2A
C130	Ceramic	82P 50V
C131	Barrier Lay	UFD08SA681K-L2A
C132	Barrier Lay	0.047 25V
C133	Barrier Lay	0.047 25V
C134	Barrier Lay	TBD04V102K-LOB
C135	Barrier Lay	TBD06V682K-L2A
C136	Barrier Lay	TBD04V122K-LOB
C137	Barrier Lay	TBD04V102K-LOB
C138	Ceramic	150P 50V
C139	Barrier Lay	TBD04V152K-LOB
C140	Barrier Lay	0.047 25V
C141	Barrier Lay	0.047 25V
C142	Barrier Lay	TBD04V122K-LOB
C143	Barrier Lay	TBD06V103K-L2A
C144	Barrier Lay	TBD04V182K-LOB
C145	Barrier Lay	TBD04V152K-LOB
C146	Ceramic	200P 50V
C147	Barrier Lay	TBD04V152K-LOB
C148	Barrier Lay	0.047 25V
C149	Barrier Lay	0.047 25V
C150	Barrier Lay	TBD04V152K-LOB
C151	Barrier Lay	TBD08V123K-L2A
C152	Barrier Lay	TBD04V222K-LOB
C153	Barrier Lay	TBD04V222K-LOB
C154	Ceramic	270P 50V
C155	Barrier Lay	TBD04V222K-LOB
C156	Barrier Lay	0.047 25V
C157	Barrier Lay	0.1 16V
C158	Barrier Lay	0.047 25V
C159	Barrier Lay	TBD05V332K-LOB
C160	Ceramic	390P 50V
C161	Barrier Lay	TBD05V332K-LOB
C162	Electrolytic	1 50V BP
C163	Barrier Lay	0.1 16V
C164	Barrier Lay	TBD06V682K-L2A
C165	Barrier Lay	TBD04V102K-LOB
C166	Barrier Lay	TBD06V822K-L2A
C167	Barrier Lay	0.1 16V
C168	Electrolytic	10 16V
C169	Barrier Lay	0.047 25V
C170	Barrier Lay	0.047 25V
C171	Barrier Lay	TBD04V152K-LOB
C172	Barrier Lay	0.1 16V
C173	Barrier Lay	0.047 25V
C174	Barrier Lay	0.047 25V
C175	Barrier Lay	0.047 25V
C176	Barrier Lay	0.047 25V
C177	Barrier Lay	0.047 25V
C178	Barrier Lay	0.1 16V
C179	Barrier Lay	0.1 16V
C180	Barrier Lay	TBD04V182K-LOB
C181	Barrier Lay	TBD04V152K-LOB
C182	Barrier Lay	TBD06V472K-L2A
C183	Barrier Lay	0.1 16V
C184	Barrier Lay	0.1 16V
C185	Barrier Lay	0.047 25V

[RF] UNIT

REF. NO.	DESCRIPTION	PART NO.
C186	Barrier Lay	0.047 25V
C187	Tantalum	3.3 10V
C188	Barrier Lay	0.047 25V
C189	Barrier Lay	0.1 16V
C190	Barrier Lay	0.1 16V
C191	Ceramic	0.001 50V
C192	Ceramic	0.0047 50V
C193	Ceramic	0.0047 50V
C194	Ceramic	0.0047 50V
C196	Ceramic	0.0047 50V
C197	Barrier Lay	0.1 16V
C198	Ceramic	0.0047 50V
C199	Ceramic	0.001 50V
C200	Ceramic	0.001 50V
C202	Ceramic	0.001 50V
C203	Ceramic	5P 50V
C203	Ceramic	0.0047 50V
P1	Pin Plug	TMP-P01X-A1
P2	Pin Plug	TMP-P01X-A1
P3	Connector	TL-25H-02-B1
J1	Connector	TL-25P-06-V1
J2	Connector	TL-25P-05-V1
J3	Connector	TL-25P-07-V1
J4	Connector	TL-25P-02-V1
J5	Connector	TL-25P-05-V1
J6	Connector	TL-25P-02-V1
J8	Pin Jack	TMP-J01X-A1
J9	Connector	TL-25P-02-V1
J10	Pin Jack	TMP-J01X-A1
J11	Connector	TLB-P06H-B1
J12	Connector	TLB-P05H-B1
J13	Connector	TLB-P02H-B1
J14	Connector	TLB-P02H-B1
RL1	Relay	FBR21 D12
B1	P.C.Board	B-701B (42442)
W24	Jumper	JPW-02H
W25	Jumper	JPW-02H
W26	Jumper	JPW-02H
W27	Jumper	JPW-02H
W28	Jumper	JPW-02A
W29	Jumper	JPW-02A
W30	Jumper	JPW-02A
W31	Jumper	JPW-02A
W32	Jumper	JPW-02A
W33	Jumper	JPW-02A
W34	Jumper	JPW-02A
W35	Jumper	JPW-02A
W36	Jumper	JPW-02A
W37	Jumper	JPW-02A
W38	Jumper	JPW-02A
W39	Jumper	JPW-02A
W40	Jumper	JPW-02A
W41	Jumper	JPW-02A
W42	Jumper	JPW-02A
W43	Jumper	JPW-02A
W44	Jumper	JPW-02A

[RF] UNIT

REF. NO.	DESCRIPTION	PART NO.
W45	Jumper	JPW-02A
W46	Jumper	IPS1041-4
W47	Jumper	IPS1041-4
W50	Jumper	JPW-02A

[FILTER] UNIT

REF. NO.	DESCRIPTION	PART NO.
D1	Diode	1K60
D2	Diode	1K60
D3	Diode	1N4002
D4	Diode	1N4002
D5	Diode	1N4002
D6	Diode	1N4002
D7	Diode	1N4002
D8	Diode	1N4002
D9	Diode	1N4002
L2	Coil	LR-136
L3	Coil	LR-137
L5	Coil	LR-138
L6	Coil	LR-139
L7	Coil	LR-140
L8	Coil	LR-141
L9	Coil	LR-141
L10	Coil	LR-90
L11	Coil	LR-91
L12	Coil	LR-53
L13	Coil	LR-54
L14	Coil	LA-166
L15	Coil	LA-165
L16	Coil	LA-168
L17	Coil	LA-167
L18	Coil	LR-22A
L19	Coil	222 L6
L20	Coil	101 FL5H
L21	Coil	101 FL5H
L22	Coil	101 FL5H
L23	Coil	101 FL5H
L24	Coil	101 FL5H
L25	Coil	101 FL5H
L26	Coil	101 FL5H
L27	Coil	101 FL5H
L28	Coil	100 FL5H
L29	Coil	100 FL5H
L30	Coil	100 FL5H
L31	Coil	100 FL5H
L32	Coil	100 FL5H
L33	Coil	100 FL5H
L34	Coil	LA-24

R1	Resistor	68 R50X (10W TYPE:120 R25)
R2	Resistor	47K R25
R3	Resistor	47K R25
R4	Resistor	47K H0651A
R5	Resistor	47K H0651A

[FILTER] UNIT

REF. NO.	DESCRIPTION	PART NO.
C1	Dip Mica	1000P 500V DM20 1CR
C2	Dip Mica	390P 500V DM19 1CR
C3	Dip Mica	2200P 500V DM20 1CR
C4	Ceramic	120P 500V SL
C5	Dip Mica	1200P 500V DM20 1CR
C6	Dip Mica	560P 500V DM19 1CR
C7	Ceramic	220P 500V SL
C8	Dip Mica	1200P 500V DM20 1CR
C9	Ceramic	68P 500V SL
C10	Dip Mica	680P 500V DM19 1CR
C11	Dip Mica	470P 500V DM19 1CR
C12	Ceramic	120P 500V SL
C13	Dip Mica	560P 500V DM19 1CR
C14	Ceramic	68P 500V
C15	Ceramic	270P 500V SL
C16	Ceramic	220P 500V SL
C17	Ceramic	27P 500V
C18	Dip Mica	470P 500V DM19 1CR
C19	Ceramic	68P 500V
C20	Ceramic	220P 500V SL
C21	Ceramic	150P 500V SL
C22	Ceramic	18P 500V
C23	Ceramic	330P 500V SL
C24	Ceramic	56P 500V
C25	Ceramic	200P 500V SL
C26	Ceramic	120P 500V SL
C27	Ceramic	10P 500V
C28	Ceramic	220P 500V SL
C29	Ceramic	33P 500V
C30	Ceramic	100P 500V SL
C31	Ceramic	82P 500V
C32	Ceramic	10P 500V
C33	Ceramic	180P 500V SL
C34	Ceramic	27P 500V
C35	Ceramic	68P 500V
C36	Trimmer	ECV-1ZW20×40
C37	Ceramic	220P 50V
C38	Ceramic	100P 50V
C39	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	FBR313D012-22
RL2	Relay	FBR313D012-22
RL3	Relay	FBR313D012-22
RL4	Relay	FBR313D012-22
RL5	Relay	FBR313D012-22
RL6	Relay	FBR313D012-22
RL7	Relay	FBR313D012-22
RL8	Relay	FBR313D012-22
RL9	Relay	FBR313D012-22
RL10	Relay	FBR313D012-22
RL11	Relay	FBR313D012-22

[FILTER] UNIT

REF. NO.	DESCRIPTION	PART NO.
RL12	Relay	FBR313D012-22
RL13	Relay	FBR313D012-22
RL14	Relay	FBR313D012-22
J1	Connector	TMP-J01X-V1
J2	Connector	TL-25P-02-V1
P1	Connector	TL-25H-07-B1
P2	Connector	TMP-P01X-A1
B1	P.C. Board	B-703B (42441)
W10	Jumper	JPW-02A
W11	Jumper	JPW-02A
W12	Jumper	JPW-02A
W13	Jumper	JPW-02A
W14	Jumper	JPW-02A
W15	Jumper	JPW-02A
W16	Jumper	JPW-02A
W17	Jumper	JPW-02A
W18	Jumper	JPW-02A
W19	Jumper	JPW-02A
W20	Jumper	JPW-02A
W21	Jumper	JPW-02A
W22	Jumper	JPW-02A
W23	Jumper	JPW-02A
W24	Jumper	JPW-02A
W25	Jumper	JPW-02A
W26	Jumper	JPW-02A
W27	Jumper	JPW-02A
W28	Jumper	JPW-02A
W29	Jumper	JPW-02A
W30	Jumper	JPW-02A
W31	Jumper	JPW-02A
W32	Jumper	JPW-02A
W34	Jumper	JPW-02A
W35	Jumper	JPW-02A
W36	Jumper	JPW-02A
W39	Jumper	JPW-02A

[PA] UNIT

REF. NO. DESCRIPTION PART NO.

Q1	Transistor	2SC1971
Q2	Transistor	2SC3133
Q3	Transistor	2SC3133
Q4	Transistor	2SC2904
Q5	Transistor	2SC2904
Q6	Transistor	2SD313
Q7	Transistor	2SC2120
Q8	Transistor	2SD468
Q9	Transistor	2SB562
Q10	Transistor	2SC945P
Q11	Transistor	2SC3402

[PA] UNIT

REF. NO.	DESCRIPTION	PART NO.
D1	Varistor	MV5
D2	Varistor	MV5W
D3	Diode	1N4002
D4	Diode	U05G
D5	Diode	1SS53
D7	Diode	1SS53
D8	Diode	15CD11
L1	Coil	LR-142
L2	Coil	1R2 FL5H
L3	Coil	1R2 FL5H
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	101 FL5H
L13	Coil	FSQH050RN
L14	Coil	BT01RN1-A61
L15	Coil	FSQH050RN
L16	Coil	BT01RN1-A61
L17	Coil	FSQH050RN
L18	Coil	BT01RN1-A61
L19	Coil	101 FL5H
L20	Coil	102 FL9H
L21	Coil	102 FL9H
L22	Coil	LR-151
L23	Coil	BT01RN1-A61
L24	Coil	BT01RN1-A61
L25	Coil	BT01RN1-A61
L26	Coil	BT01RN1-A61
L27	Coil	BT01RN1-A61
L28	Coil	BT01RN1-A61
L29	Coil	BT01RN1-A61
L30	Coil	BT01RN1-A61
L31	Coil	BT01RN1-A61
L32	Coil	BT01RN1-A61
L33	Coil	BT01RN1-A61
L34	Coil	BT01RN1-A61
L35	Coil	BT01RN1-A61
L36	Coil	BT01RN1-A61
L37	Coil	BT01RN1-A61
L38	Coil	102K LAL04NA
L39	Coil	101K LAL04NA
L40	Coil	LW-22
L41	Coil	101K LAL04NA

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

[PA] UNIT

REF. NO.	DESCRIPTION	PART NO.
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 SQ5L
R21	Resistor	1K R25
R22	Resistor	4.7 2W R2J
R23	Trimmer	470 H0651A
R24	Resistor	150 R25
R25	Resistor	0.1 1W SRW1P
R26	Resistor	10K ELR25
R27	Trimmer	100 H0651A
R28	Resistor	68 R50X
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	Resistor	60 3W SRW3P
R36	Resistor	4.7K ELR25
R37	Resistor	10K ELR25
R38	Resistor	1K ELR25
R39	Resistor	1K ELR25
R40	Resistor	4.7 ELR25
R41	Resistor	10K ELR25
R43	Resistor	47 ELR25
R45	Serge Absorber	DSA301
R46	Resistor	220 R50
R47	Resistor	3.3K ELR25
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 DM20 1CR
C17	Barrier Lay	0.047 25V
C18	Electrolytic	470 16V
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	Electrolytic	10 16V

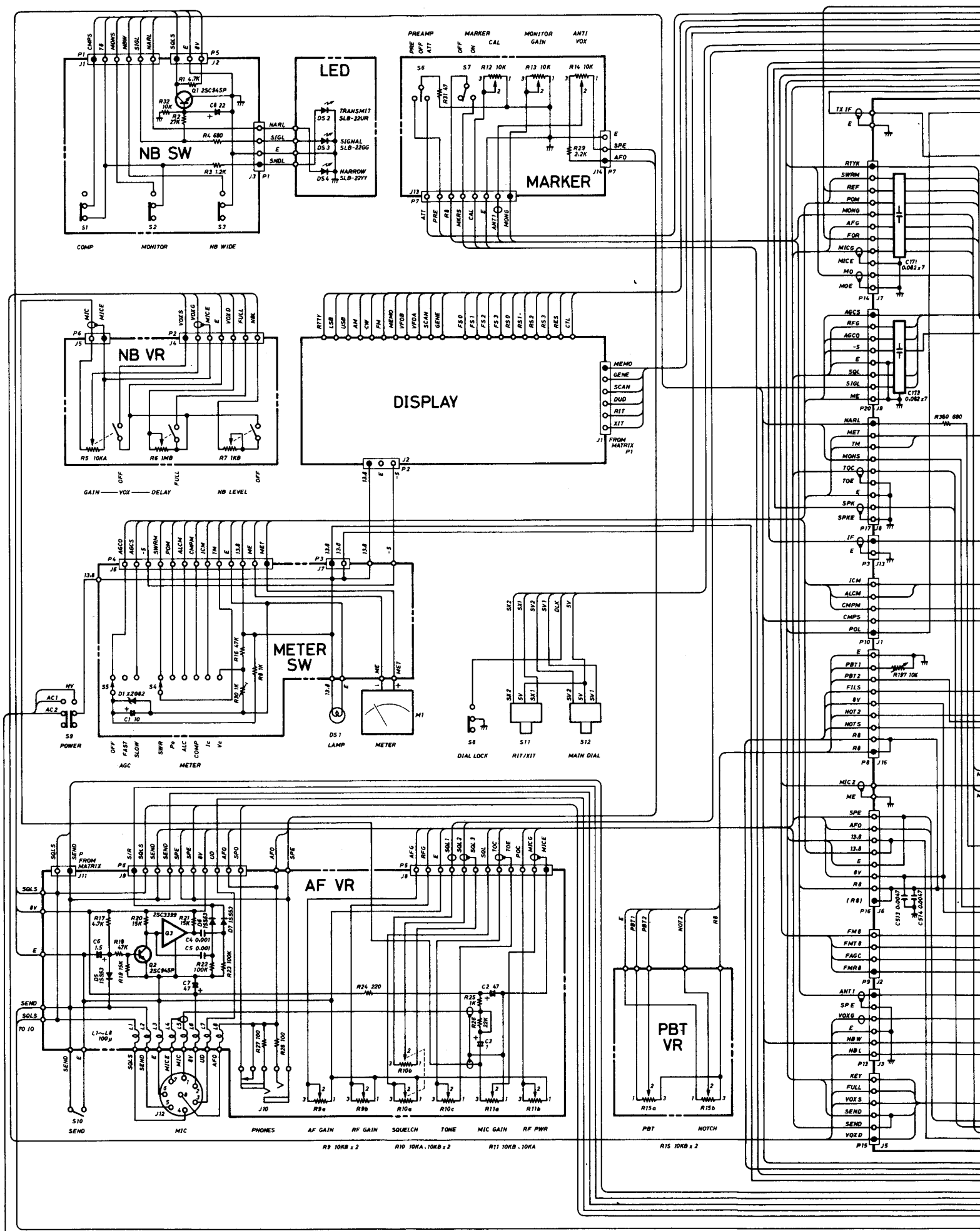
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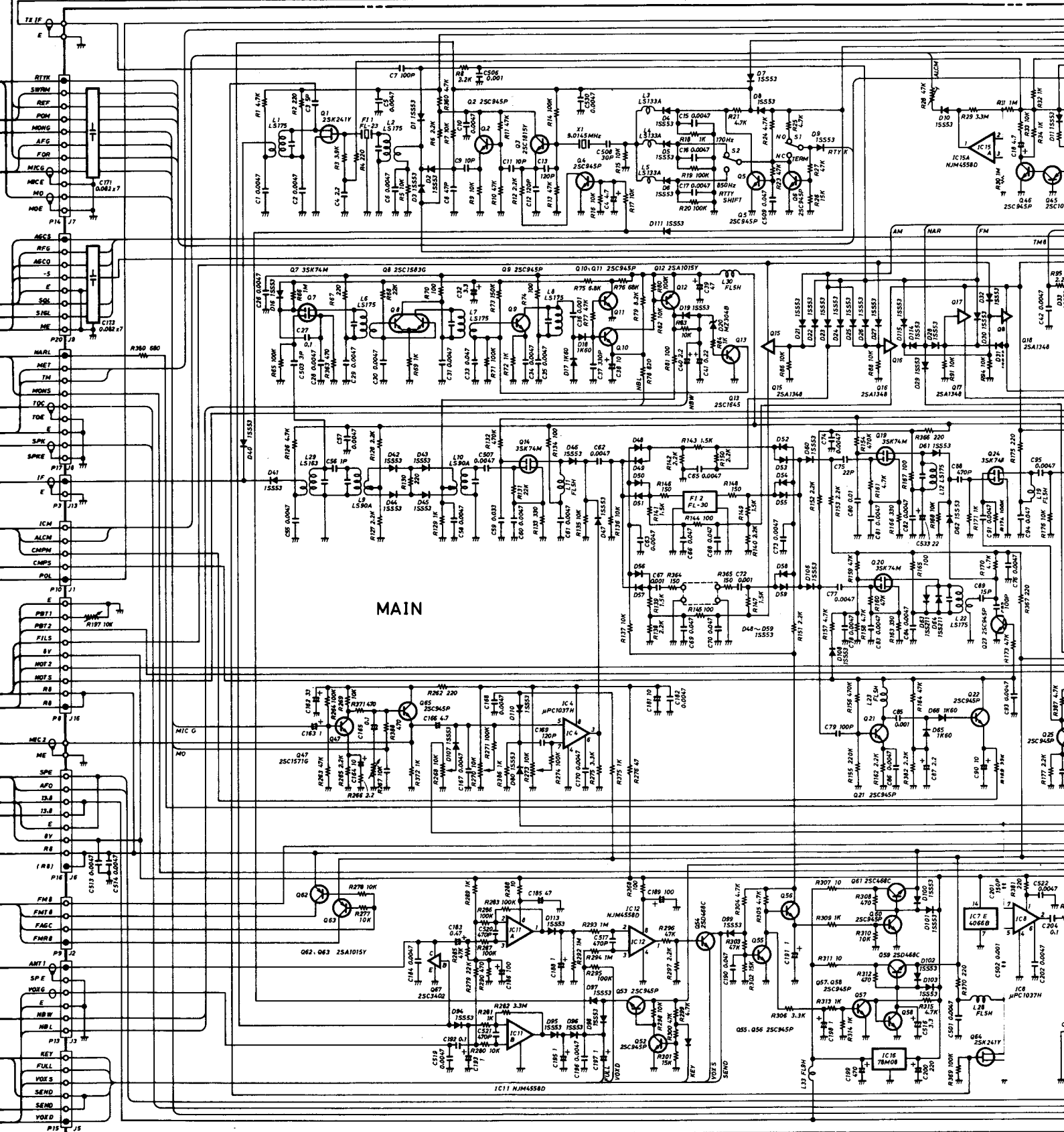
REF. NO.	DESCRIPTION	PART NO.
C35	Barrier Lay	0.047 25V
C36	Ceramic	0.047 50V
C37	Barrier Lay	0.047 25V
C38	Barrier Lay	0.047 25V
C39	Barrier Lay	0.047 25V
C40	Barrier Lay	0.1 16V
C41	Ceramic	120P 50V
C42	Ceramic	20P 50V
C43	Ceramic	120P 50V
C44	Barrier Lay	0.047 25V
C45	Ceramic	220P 50V
C46	Feed Through	TF318-452E102GMV
C47	Feed Through	TF318-452E102GMV
C48	Feed Through	TF318-452E102GMV
C49	Feed Through	TF318-452E102GMV
C50	Barrier Lay	0.047 25V
C51	Barrier Lay	0.047 25V
C52	Barrier Lay	0.1 16V
C53	Ceramic	180P 500V SL
C54	Ceramic	180P 500V SL
RL1	Relay	FRL-764D06/1AS-T
RL2	Relay	FBR211BD012-M
J1	Connector	TL25P-12-V1
J2	Connector	TL25P-07-V1
J3	Connector	TL25P-02-V1
J4	Connector	TL25P-04-V1
J5	Connector	TL25P-05-V1
J6	Connector	TLB-P12H-B1
J7	Connector	HLJ4306-01-100
J8	Connector	HSJ0805-01-020
J9	Connector	1625-24R
J10	Connector	TMP-J01X-V1
J11	Connector	FMMD-RM1
J12	Connector	KC21-0060
J13	Connector	LLR-6
P1	Connector	TMP-P01X-A1
P2	Connector	TMP-P01X-A1
P3	Connector	TL25H-05-B1
P4	Connector	TMP-P01X-A1
P5	Connector	TL25H-02-B1
P6	Connector	TL25H-04-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	P.C. Board	B-702B (42447)
B2	P.C. Board	B-720B (42446)
B3	P.C. Board	B-721B (42445)

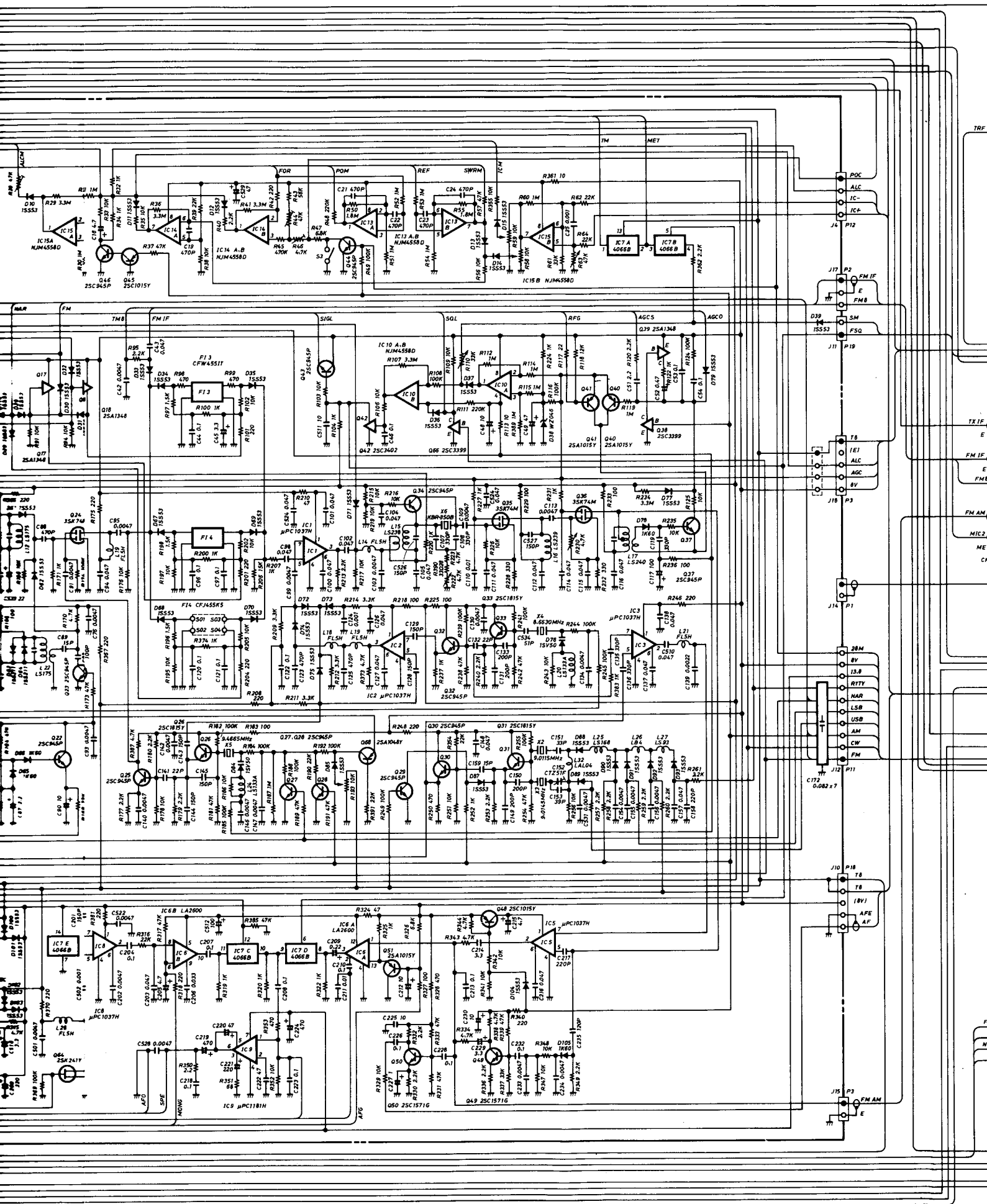
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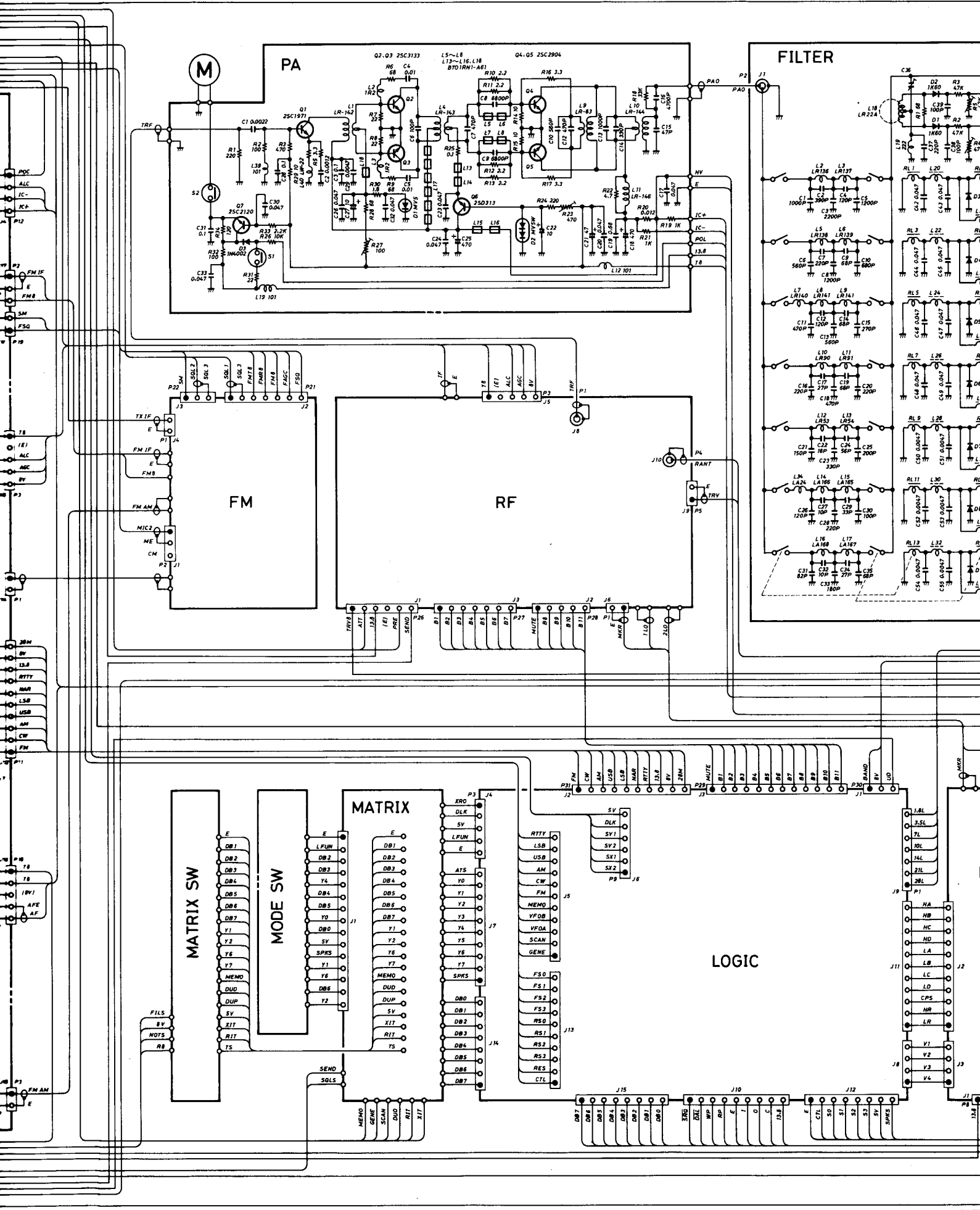
REF. NO.	DESCRIPTION	PART NO.
EP20	Bead Core	FSQH090RN
EP21	Bead Core	FSQH090RN
EP23	Bead Core	DL20P2.6-3-1.2
EP24	Bead Core	FSQ070RN
W15	Jumper	JPW-02A
W16	Jumper	JPW-02A
W17	Jumper	JPW-02A
W18	Jumper	JPW-02A
W19	Jumper	JPW-02A
W20	Jumper	JPW-02A
W21	Jumper	JPW-02A
W22	Jumper	JPW-02A
W44	Jumper	JPW-02A
W45	Jumper	JPW-02A
W46	Jumper	JPW-02A
W47	Jumper	JPW-02A
W62	Jumper	JPW-02A
W63	Jumper	JPW-02H
W64	Jumper	JPW-02H

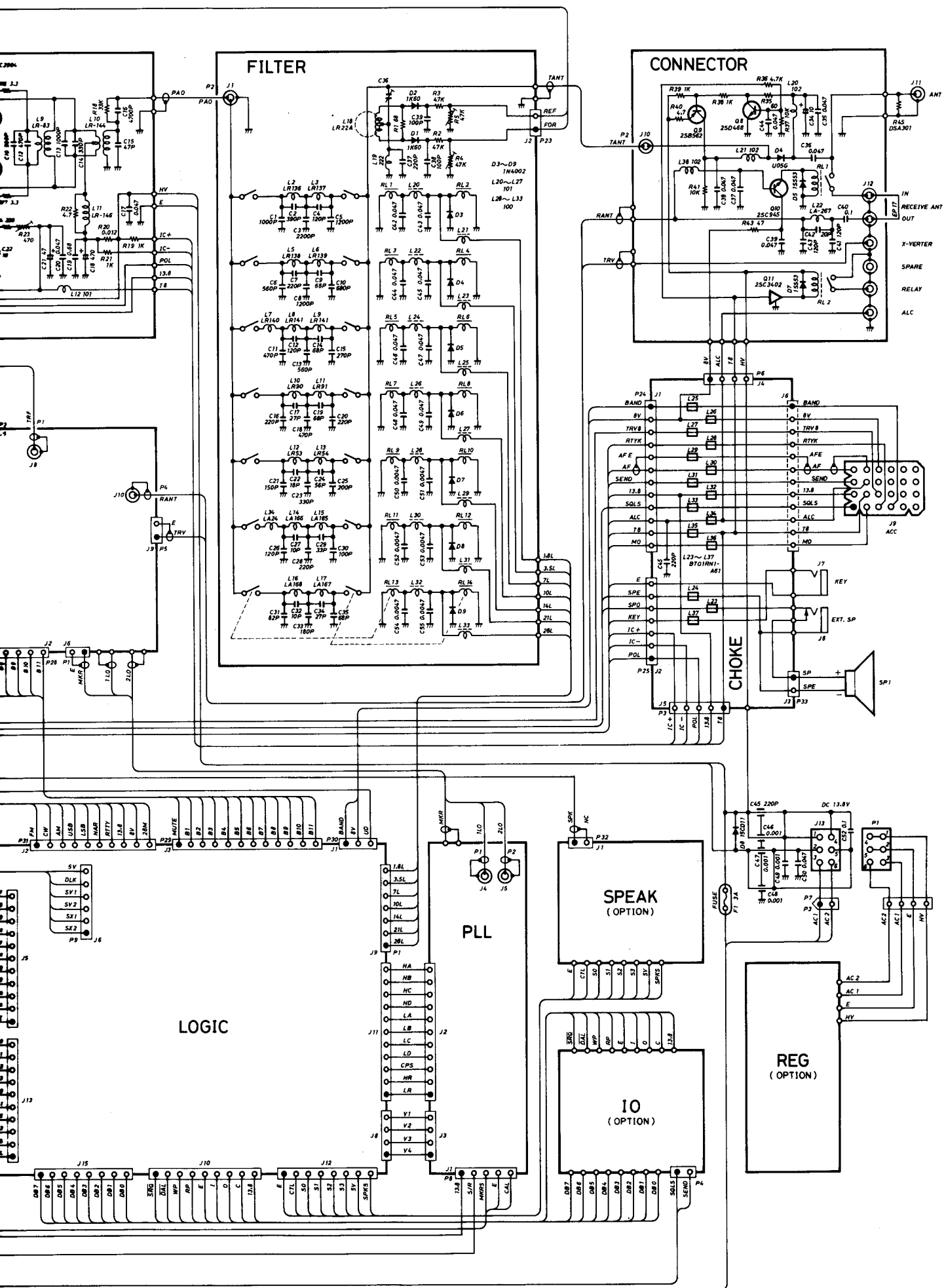
SCHEMATIC DIAGRAM

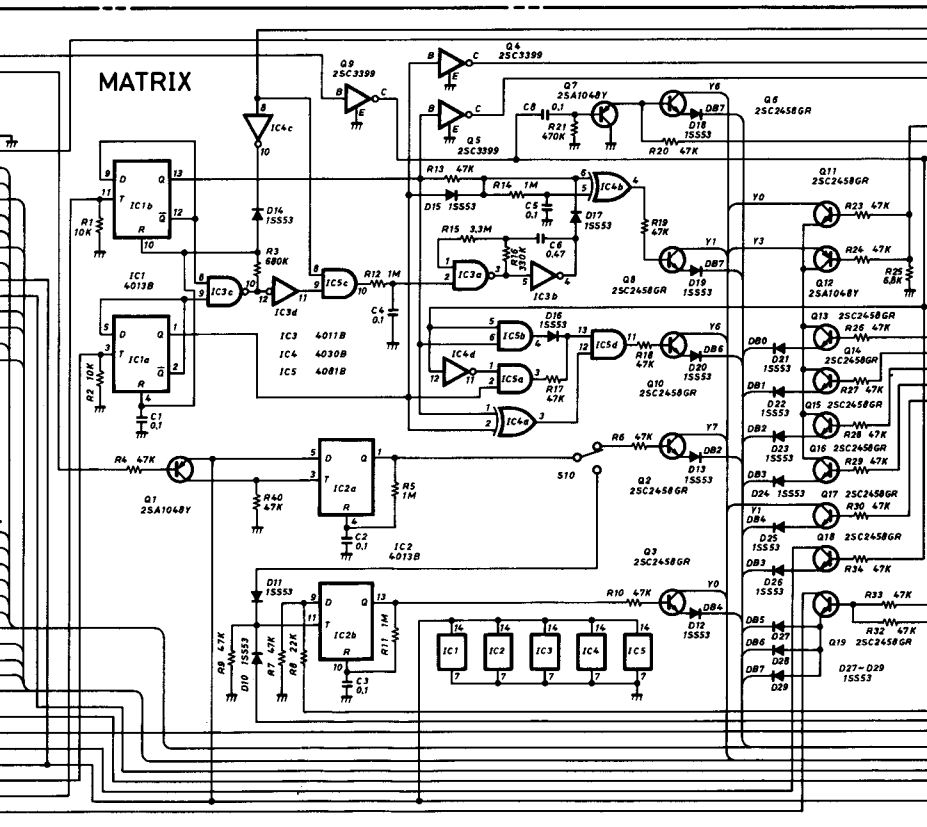
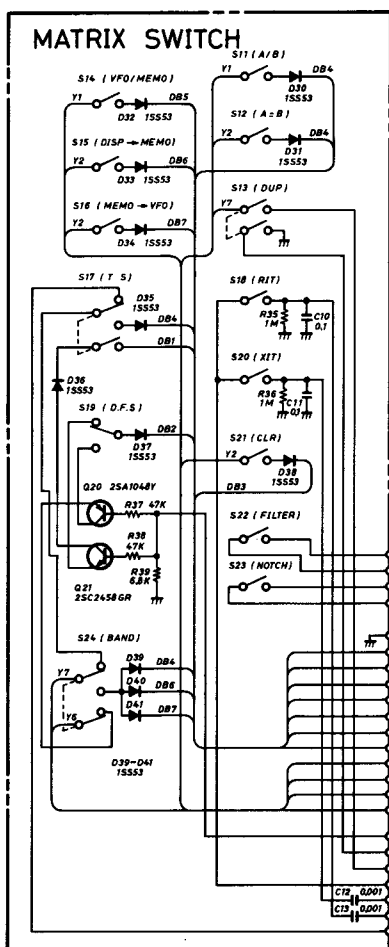


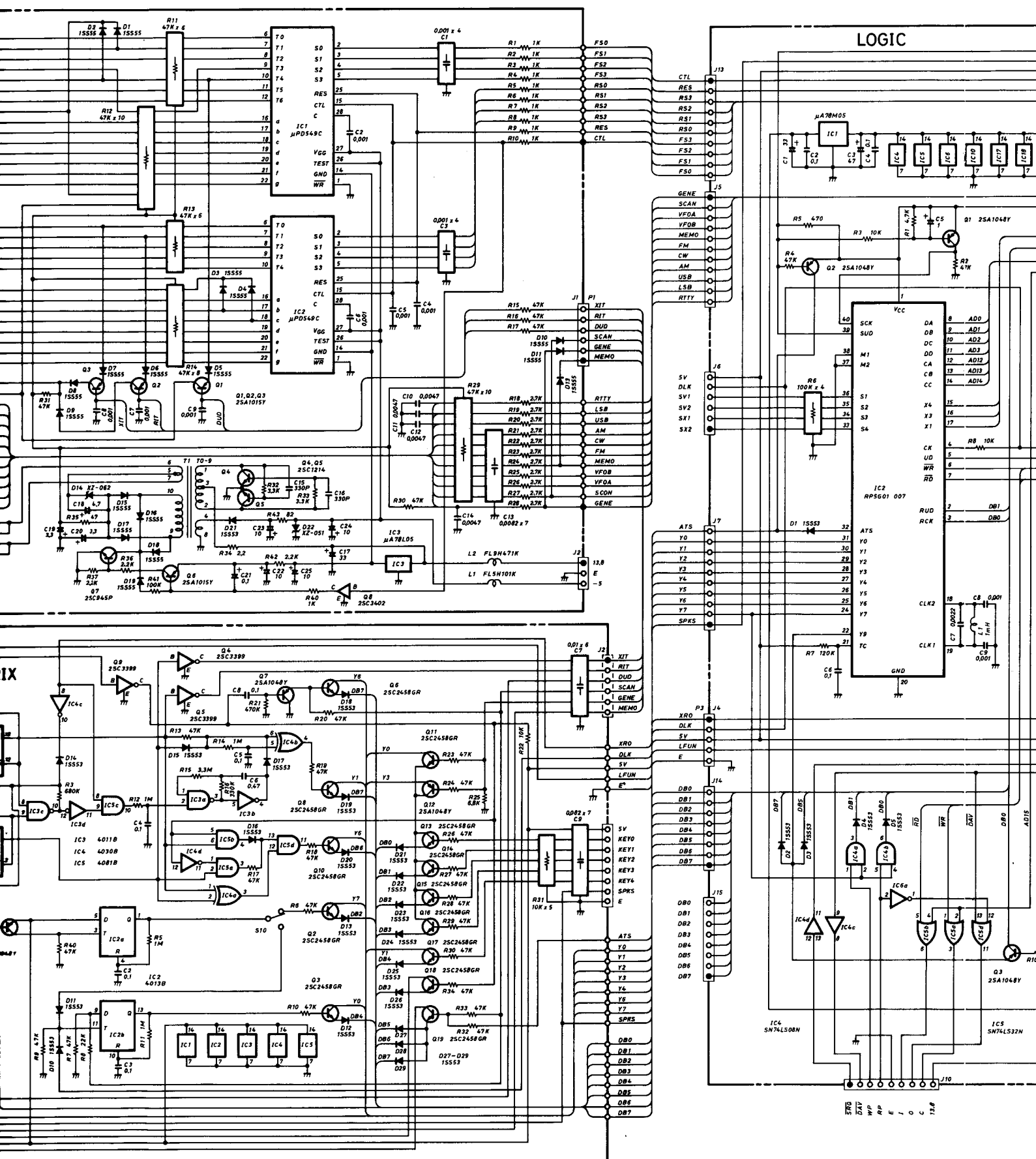




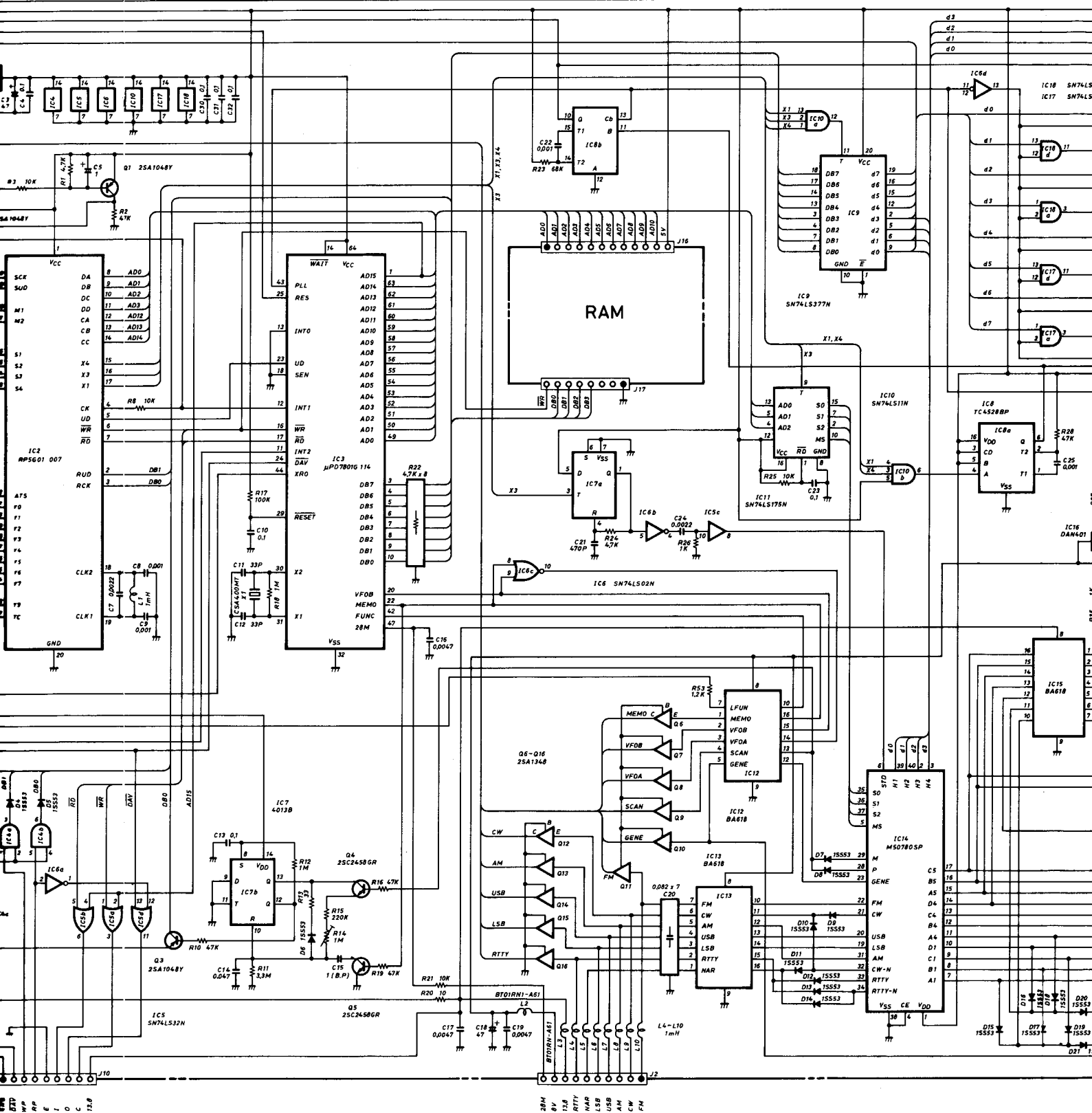


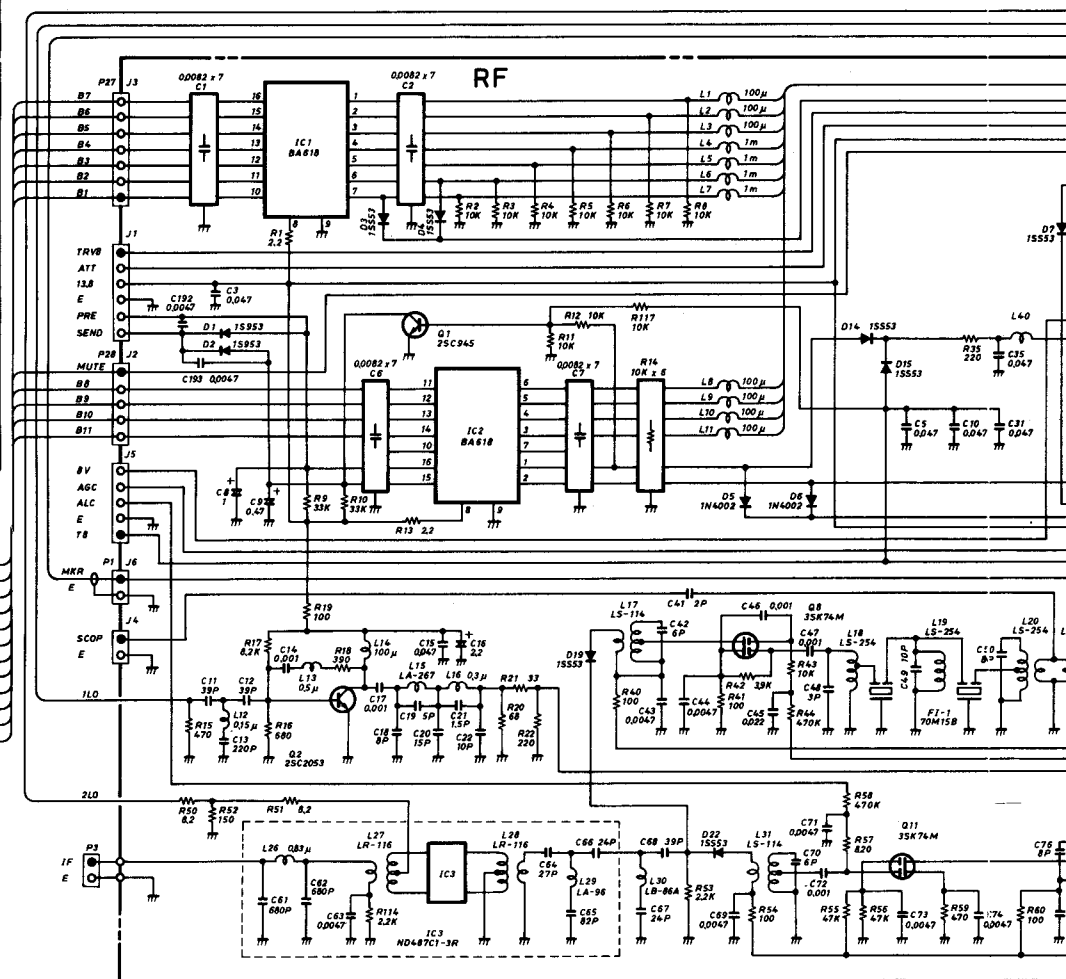


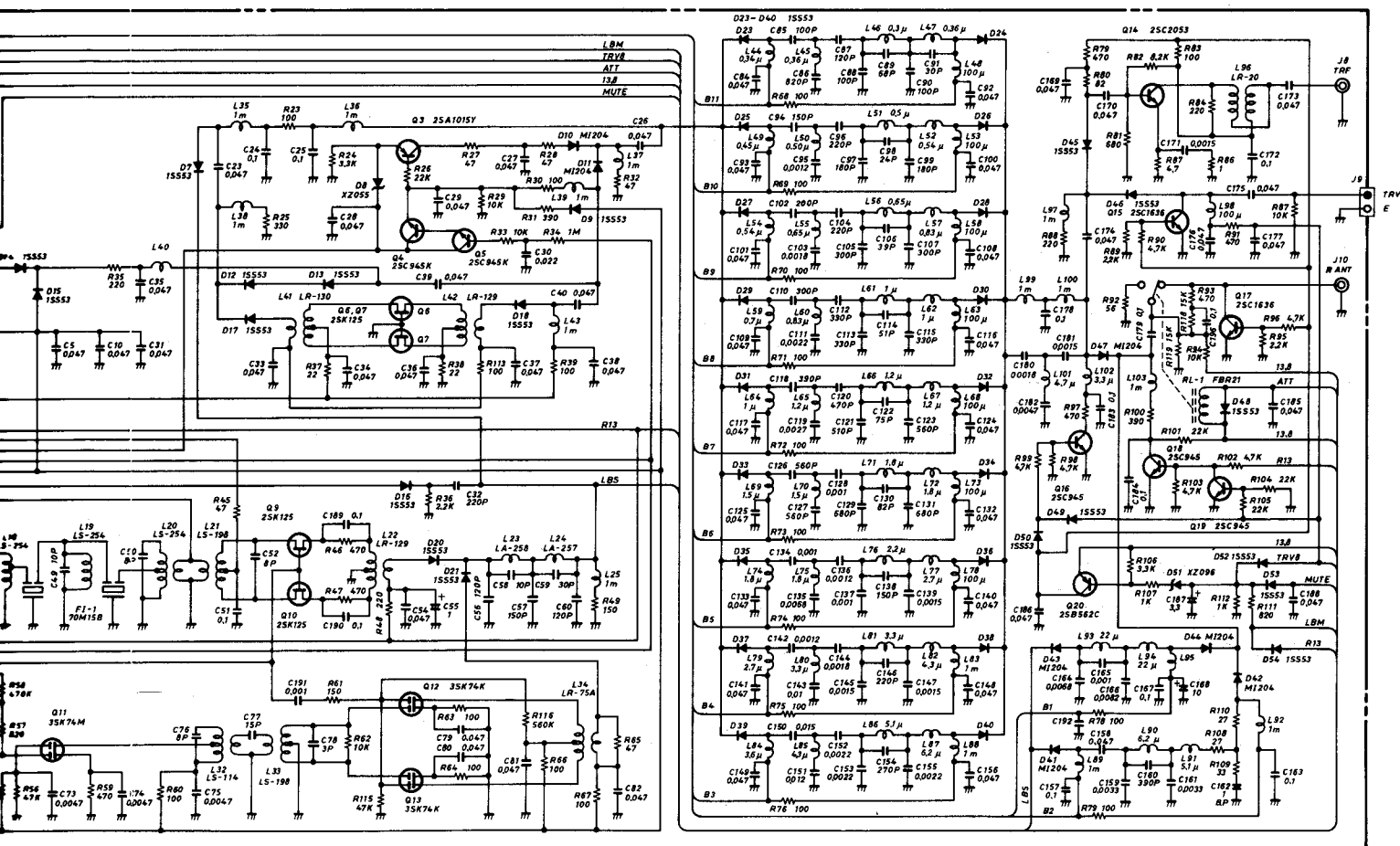




LOGIC









ICOM

IC-751

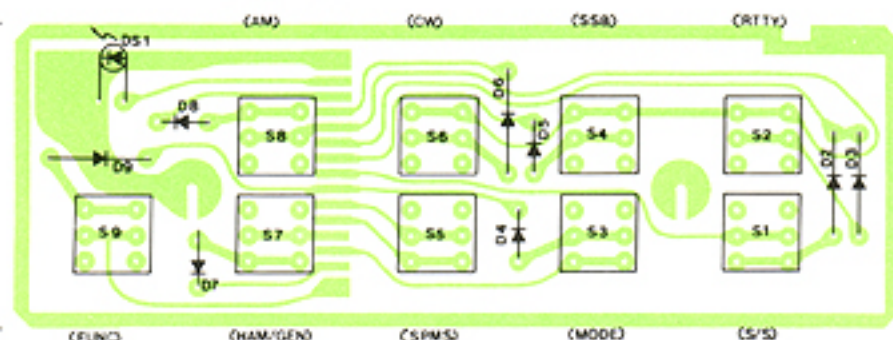
FRONT UNIT

■ MODE SWITCH BOARD

A B C

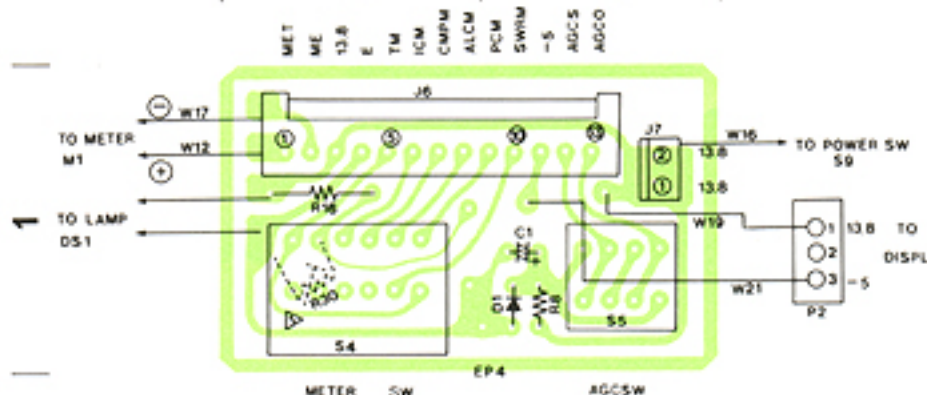
MODE SWITCH

EP3

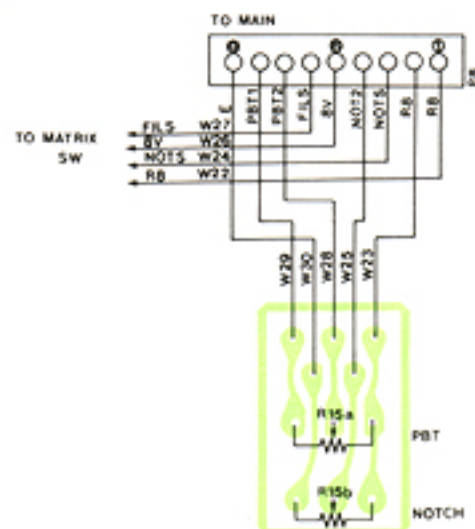


■ METER SWITCH BOARD

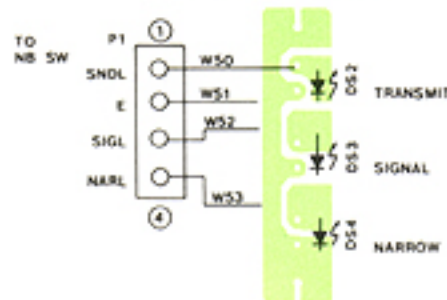
A B



■ PBT VR BOARD



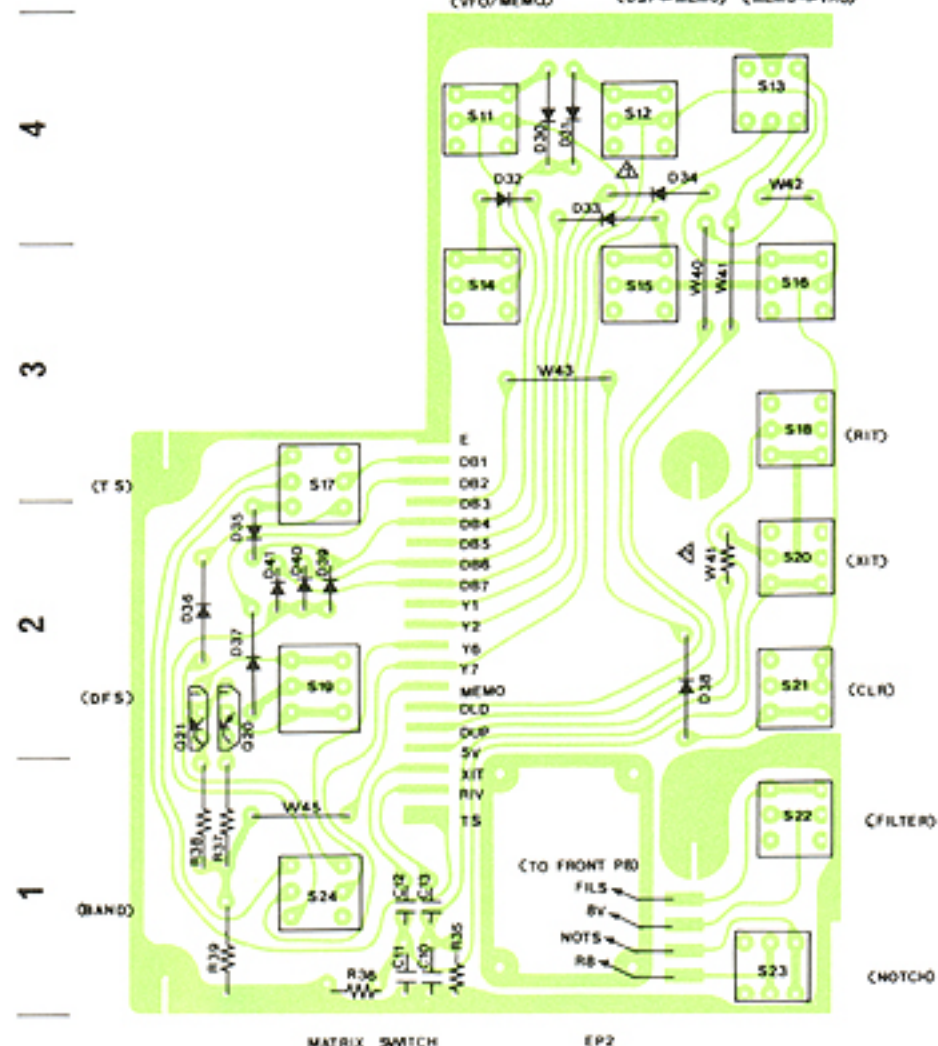
■ LED BOARD



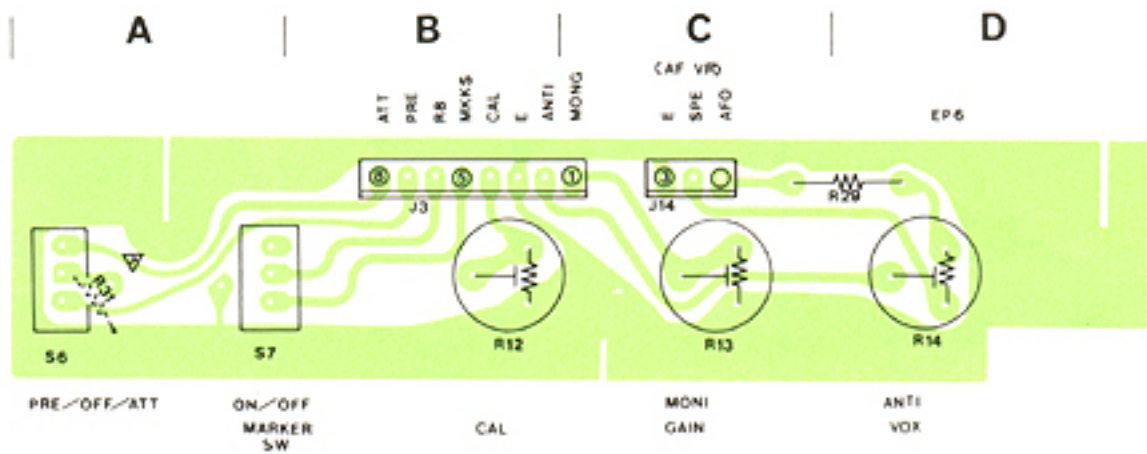
■ MATRIX SWITCH BOARD

A B C

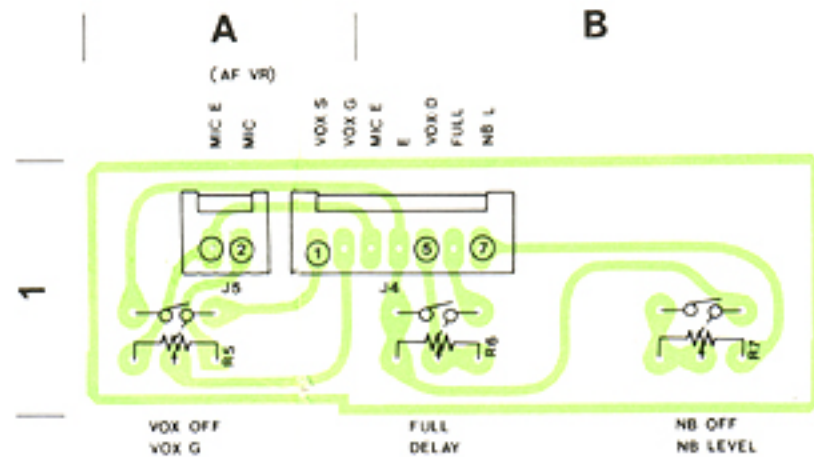
(A/B) (A=B) (COUP)
(VFO/MEMO) (DSP=MEMO) (MEMO=VFO)



■ MARKER BOARD



■ NB SWITCH BOARD



■ DISPLAY BOARD

A

B

C

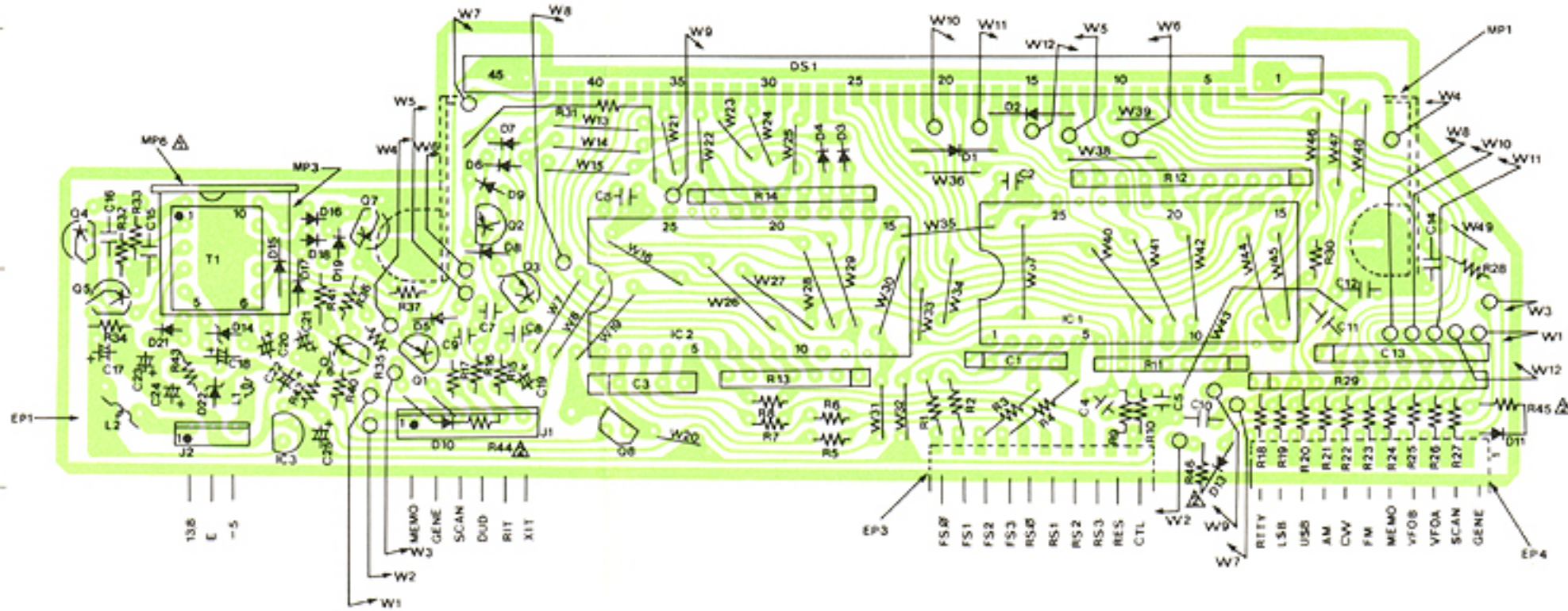
D

E

F

2

1



■ AF BOARD

A

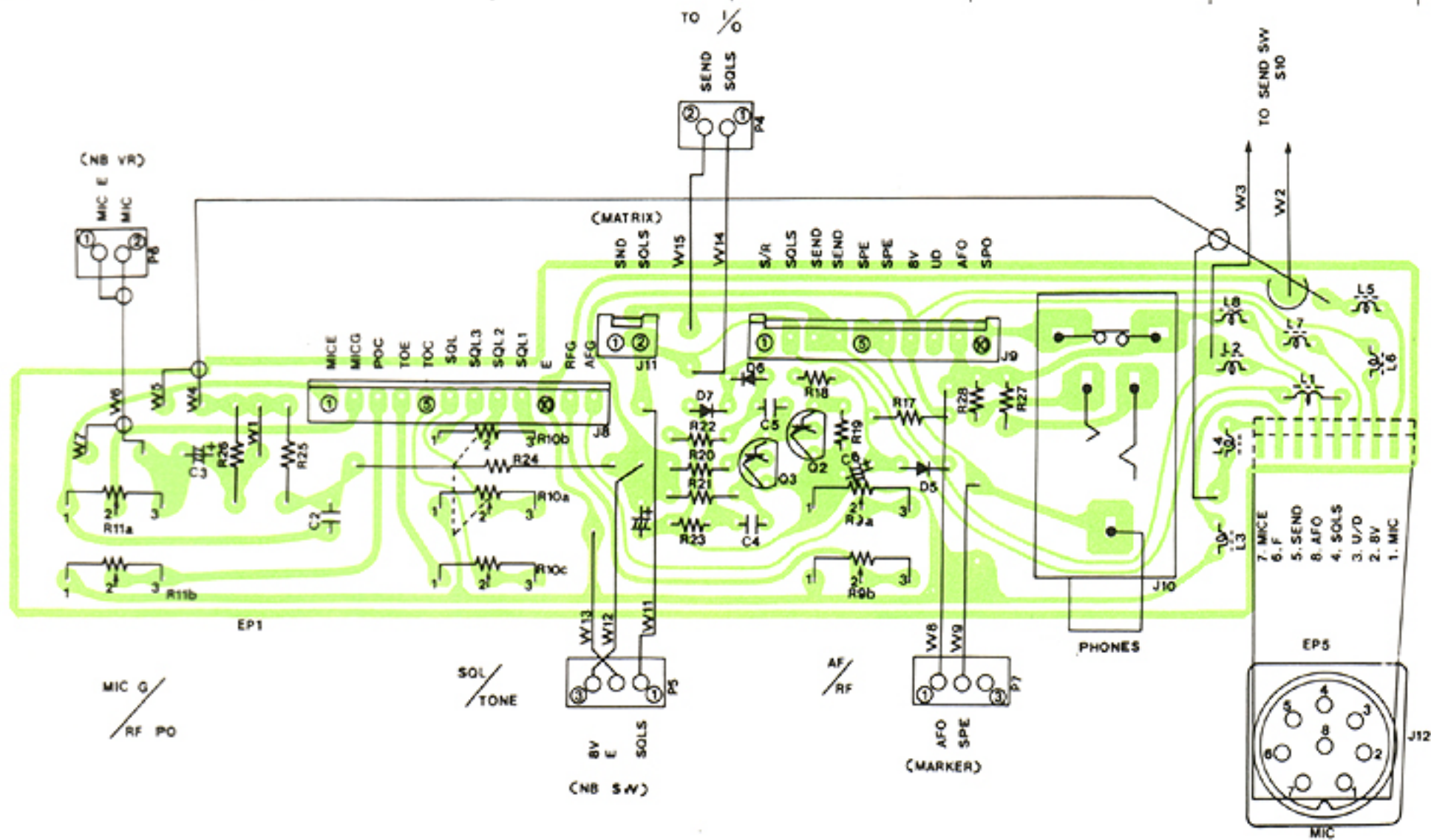
B

C

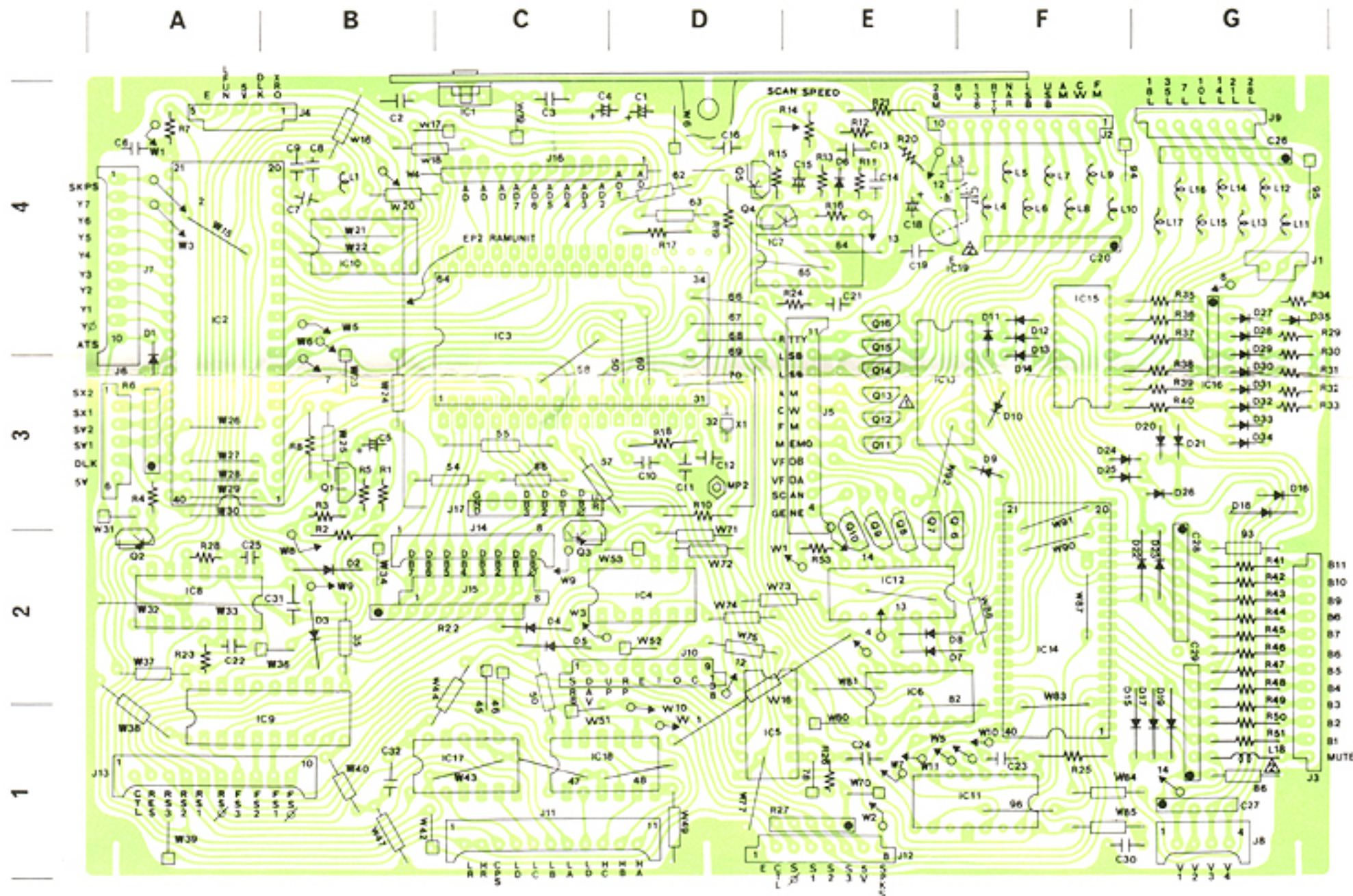
D

E

F



LOGIC UNIT



A

2

1

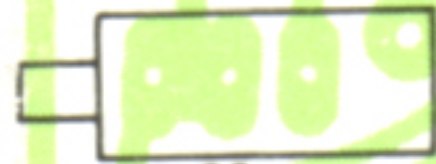
COMP

MONI

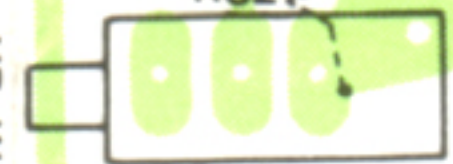
NB-W



S1



S2

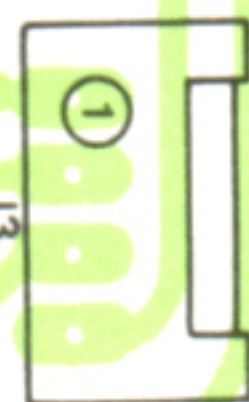
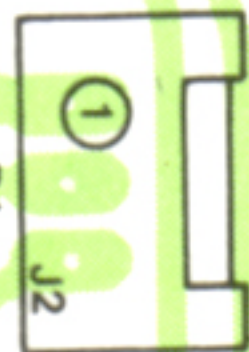
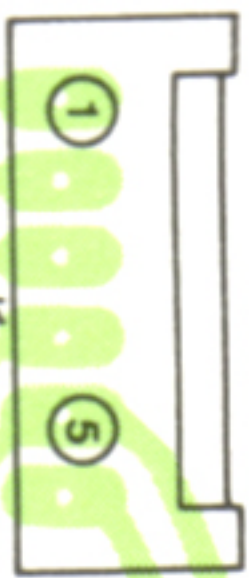


S3



J1

J3



CMPS
T8
MON S
NBW
SIGL
NAR L

SQL S
E
8V

SNDL
E
SIG L
NAR L

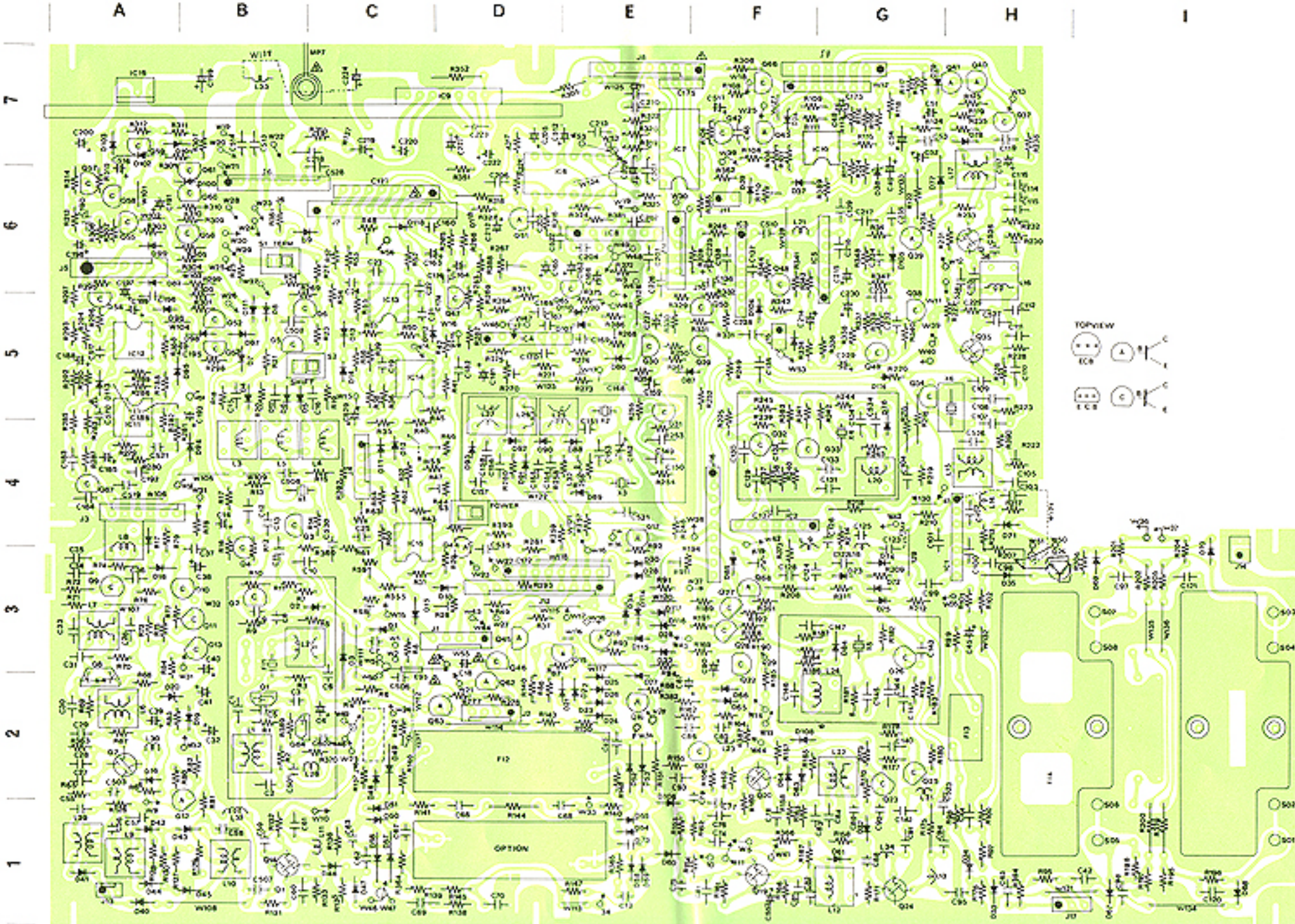
(CAF VR)

(LE D)

FROM
DISPLAY

EP 3

MAIN UNIT



PLL UNIT

A

B

C

D

E

F

G

4

3

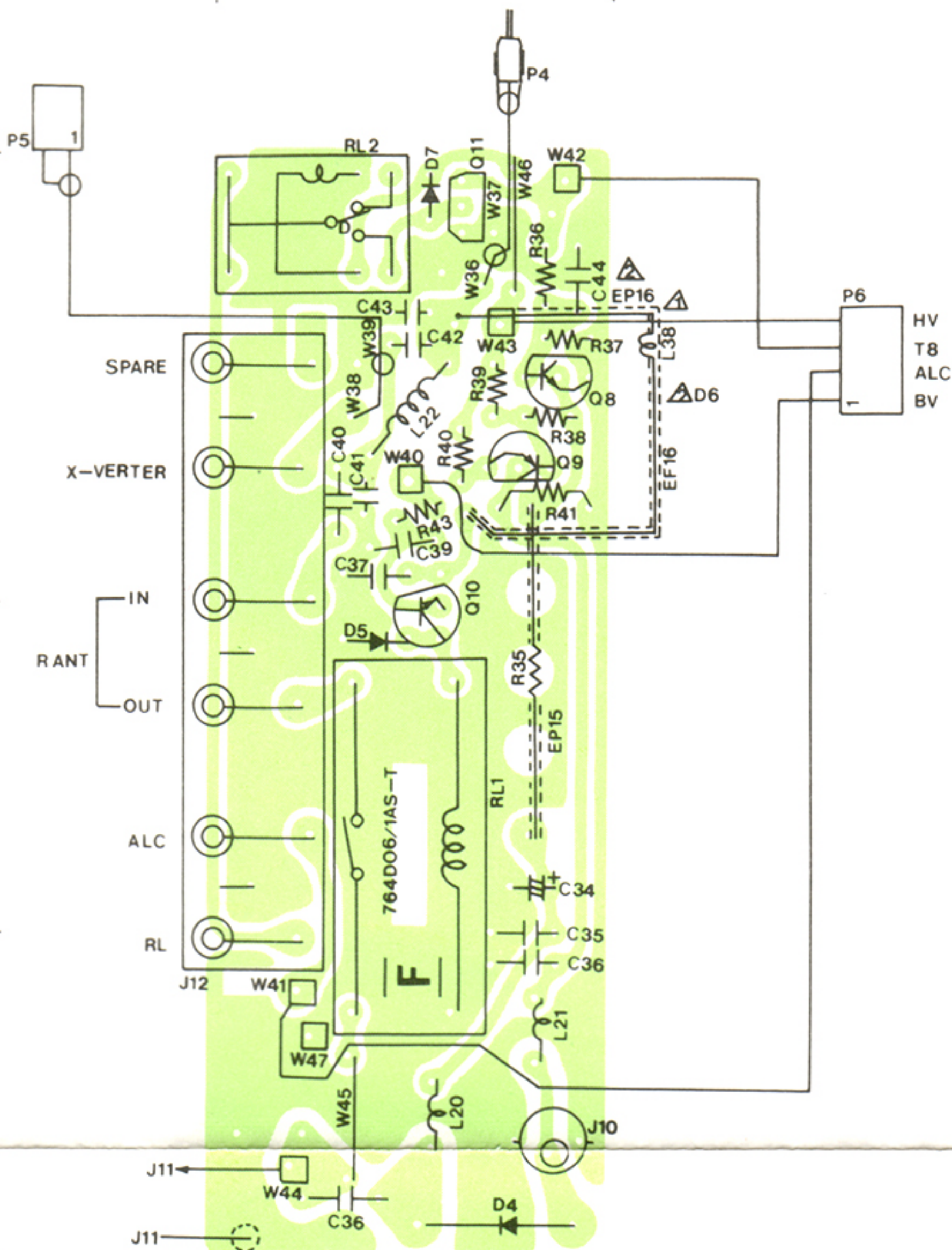
2

1

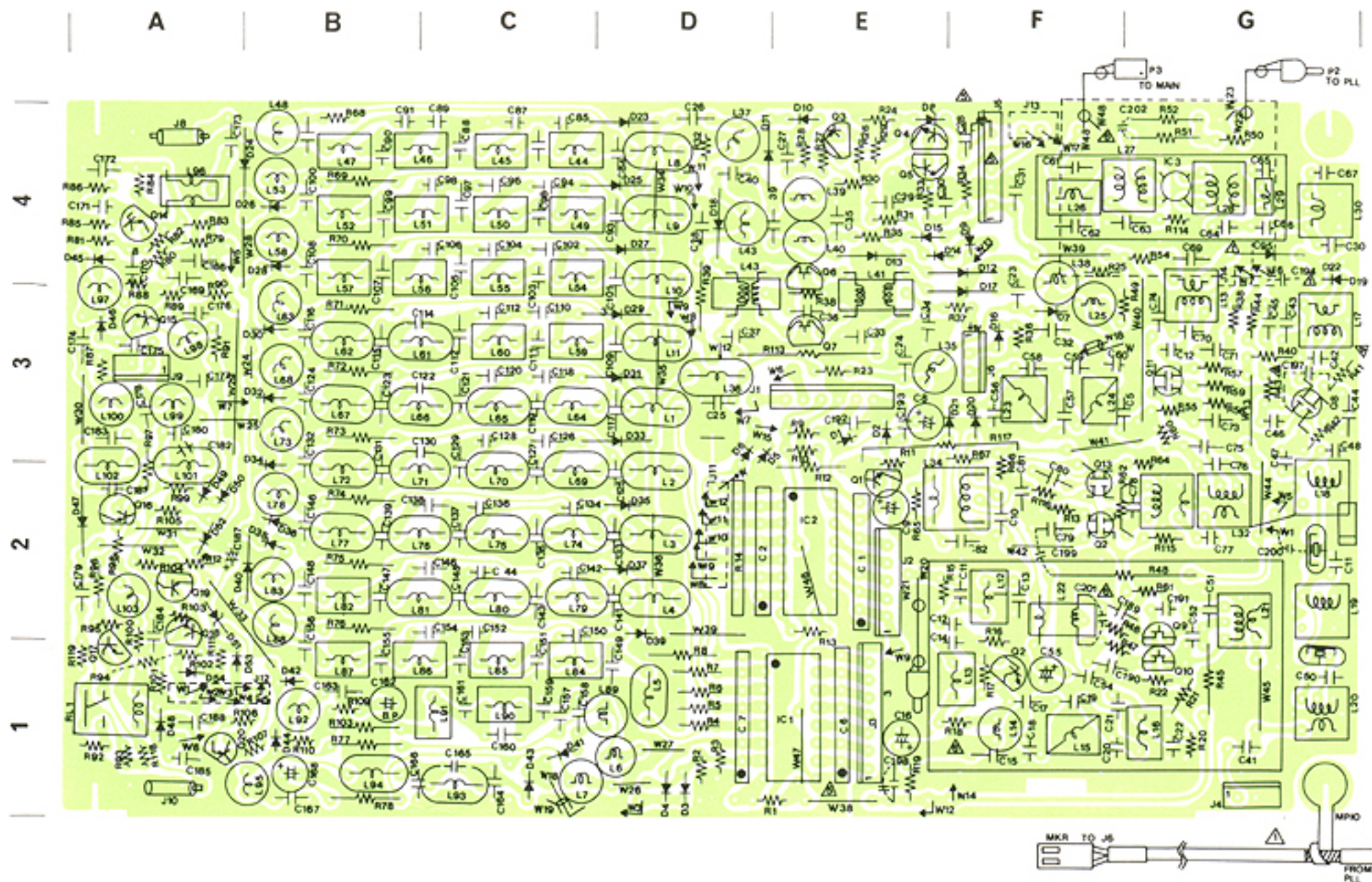


CONNECTOR UNIT

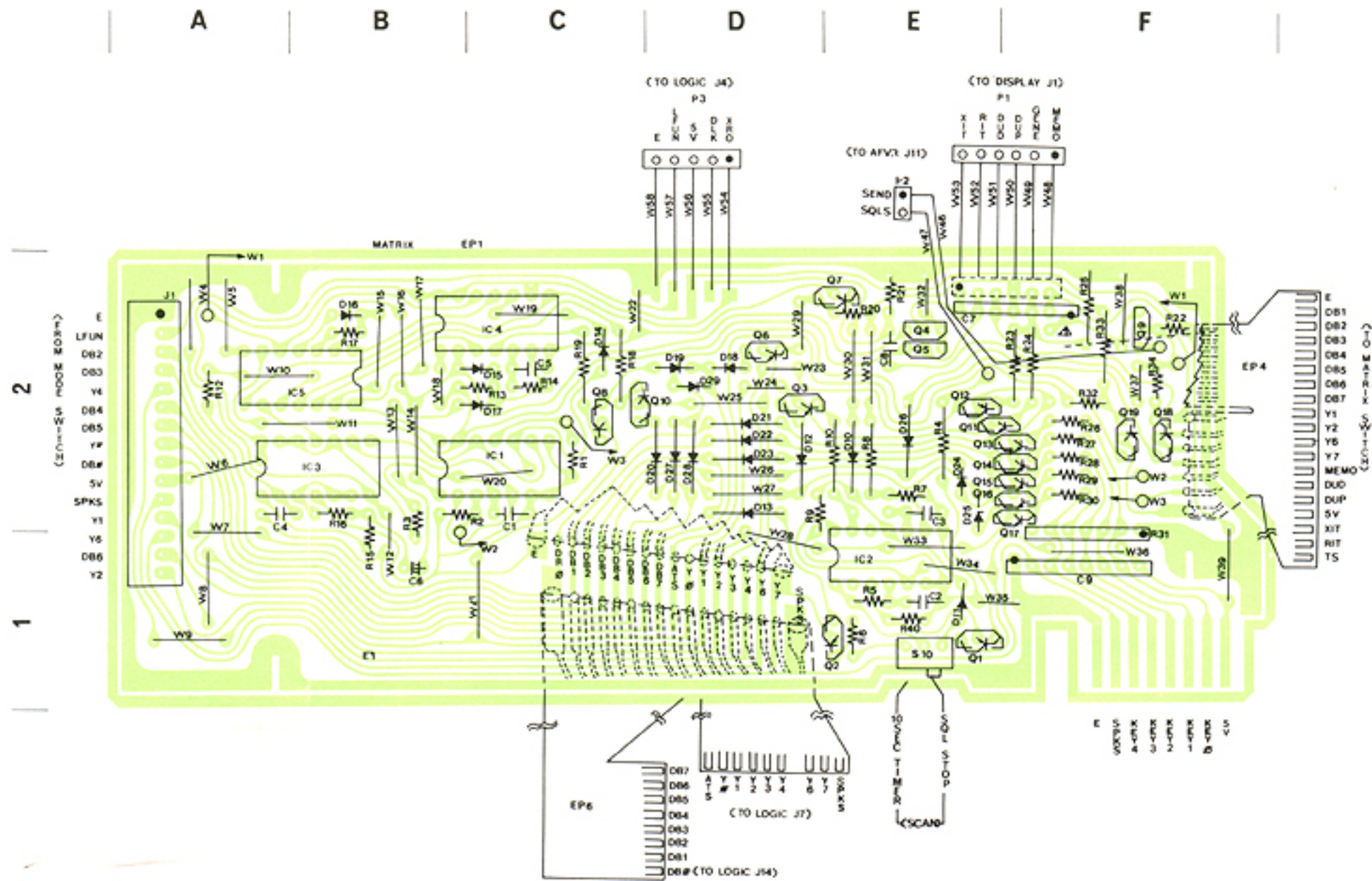
A



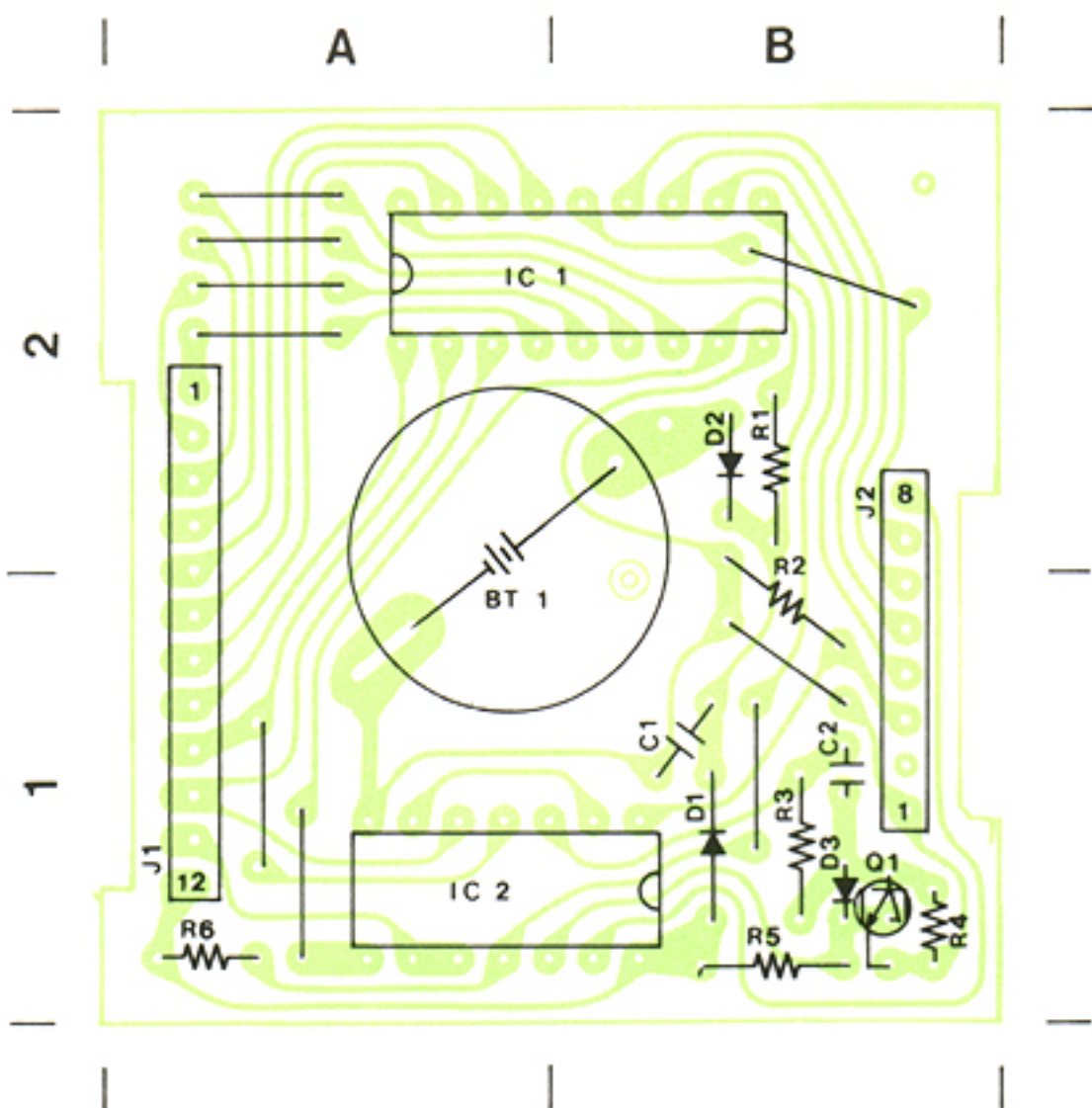
RF UNIT



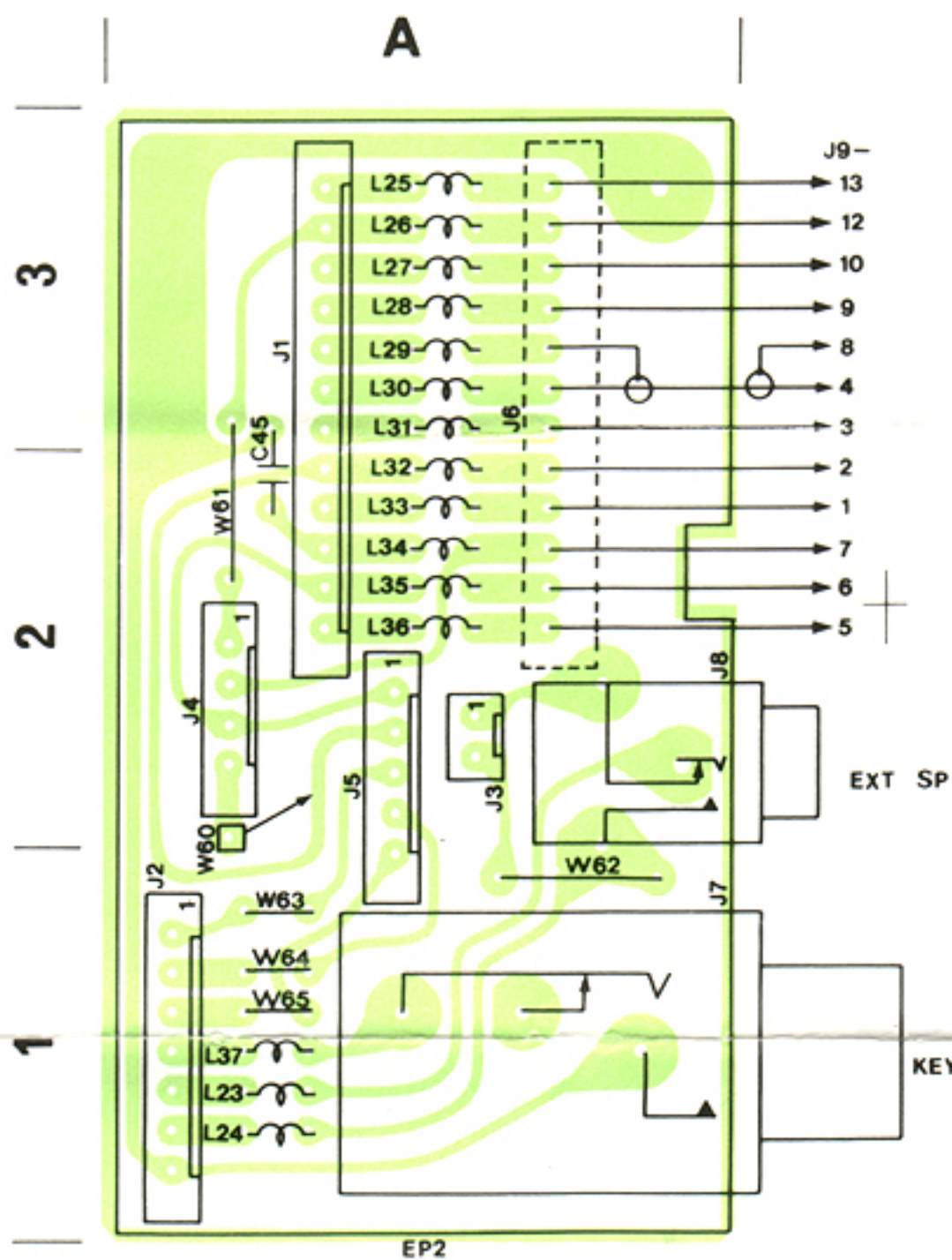
MATRIX UNIT



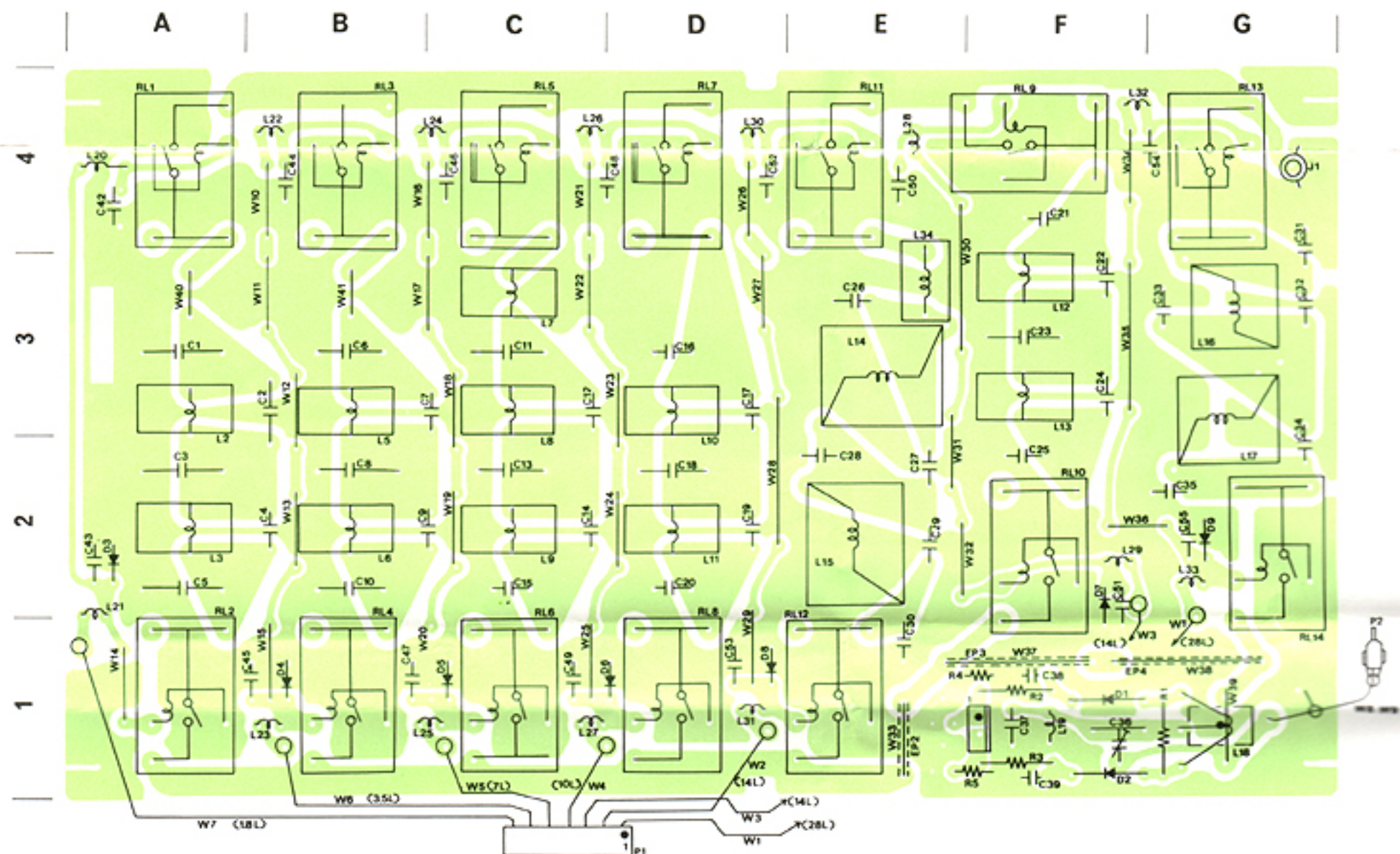
RAM UNIT



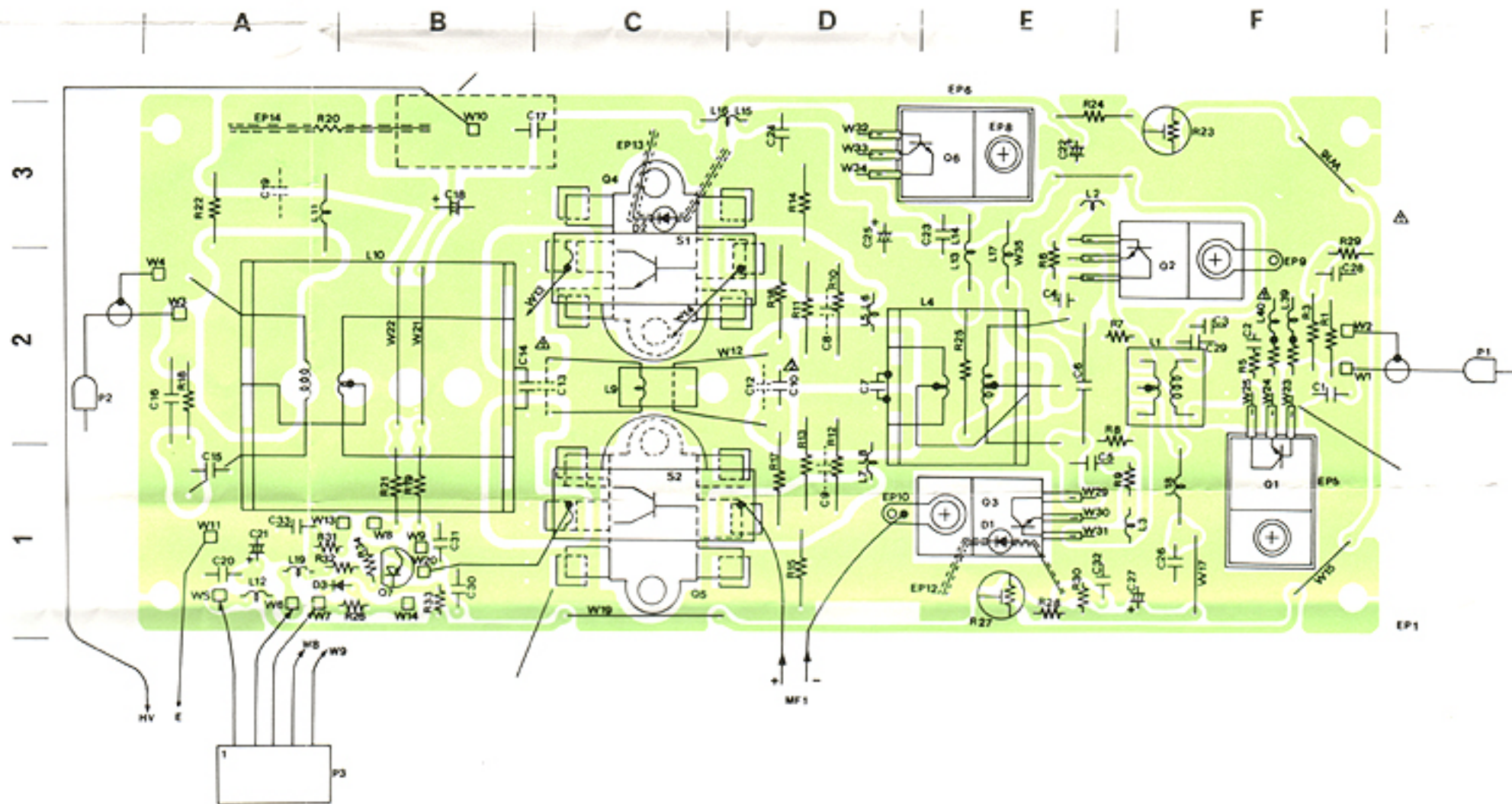
CHOKE UNIT



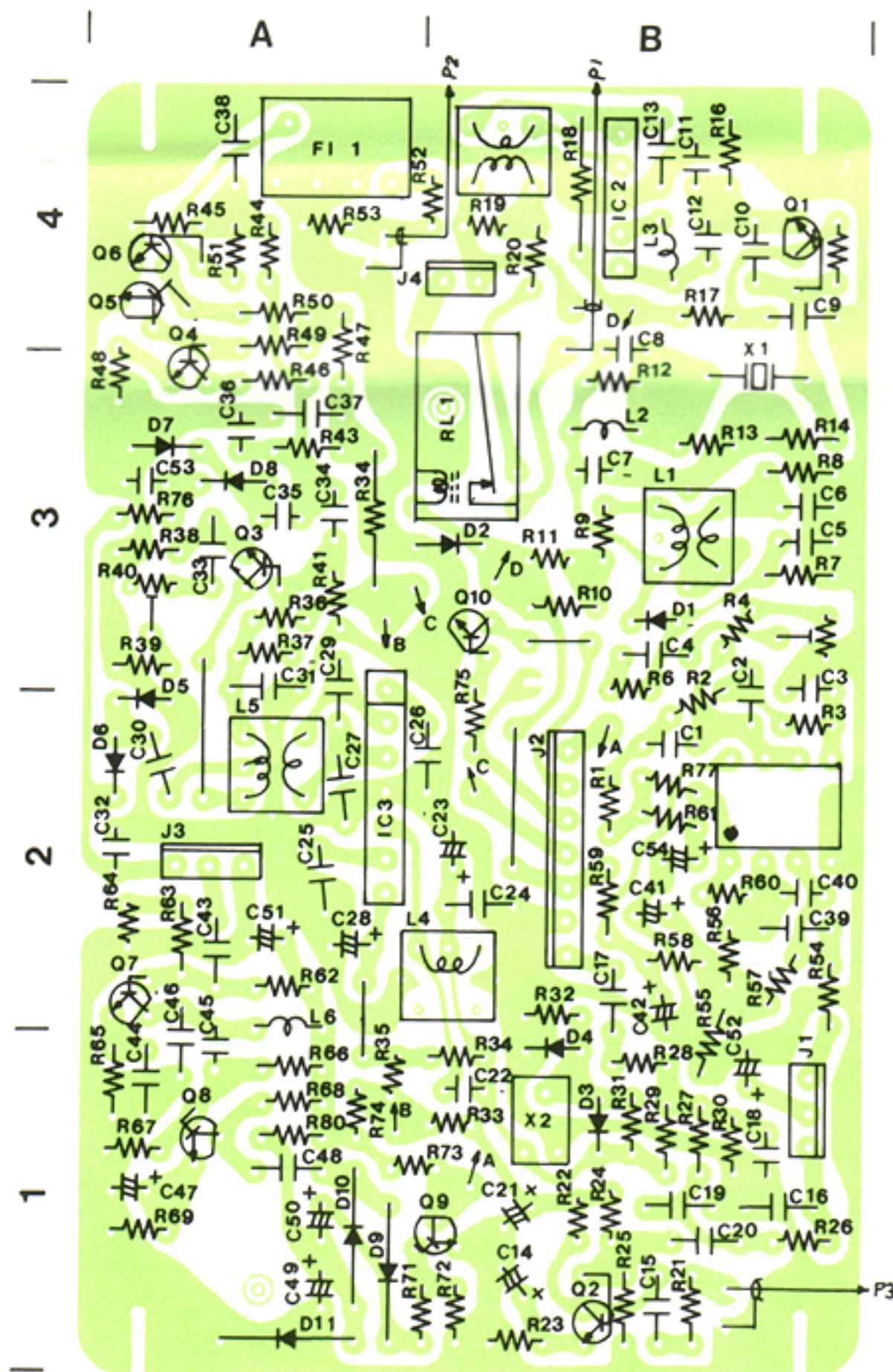
FILTER UNIT



PA UNIT	
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FM UNIT



UNIT LAYOUT

FRONT UNIT

MAIN UNIT

RF UNIT

CHOKE UNIT

FM UNIT

MATRIX UNIT

PLL UNIT

RAM UNIT

LOGIC UNIT

PA UNIT

FILTER UNIT

