144MHz ALL MODE TRANSCEIVER

IC-251A/E

MAINTENANCE MANUAL

TABLE OF CONTENTS

GENERAL

Number of semiconductors	:	Transistor	99
		FET	12
		IC	36 (IC-251A : 35)
		Diode	133 (IC-251A : 132)
Frequency coverage	:	144.0000 ~ 145.9999MHz	
		(IC-251A : 143.8000 ~ 148.1999MHz)	
Frequency resolution	:	SSB 100Hz steps FM 5KHz steps	
		1KHz steps with TS button depressed	
Frequency control	:	Microcomputer based 100Hz step digital PLL synthesizer	
		Independent Transmit-Receive frequency capability	
Frequency readout	:	7 digit luminescent display 100Hz readout	
Frequency stability	:	Within ±1.5KHz	
Memory channels	:	3 channels, any inband frequency programmable	
Usable conditions	:	Temperature : −10°C ~ 60°C (14°F ~ 140°F)	
		Operational time : Continuous	
Antenna impedance	:	50 ohms unbalanced	
Power supply requirement	:	13.8V DC ±15% (negative ground) 3A Max. or 117V/240V AC ±10%	
Current drain (at 13.8V DC)	:	Transmitting	
		SSB (PEP 10W)	Approx. 2.3A
		CW, FM (10W)	Approx. 2.3A
		FM (1W)	Approx. 1.0A
		Receiving	
		At max. audio output	Approx. 0.6A
		Squelched	Approx. 0.4A
Dimensions	:	111mm (H) x 241mm (W) x 264mm (D)	
Weight	:	Approx. 5.0 Kg	

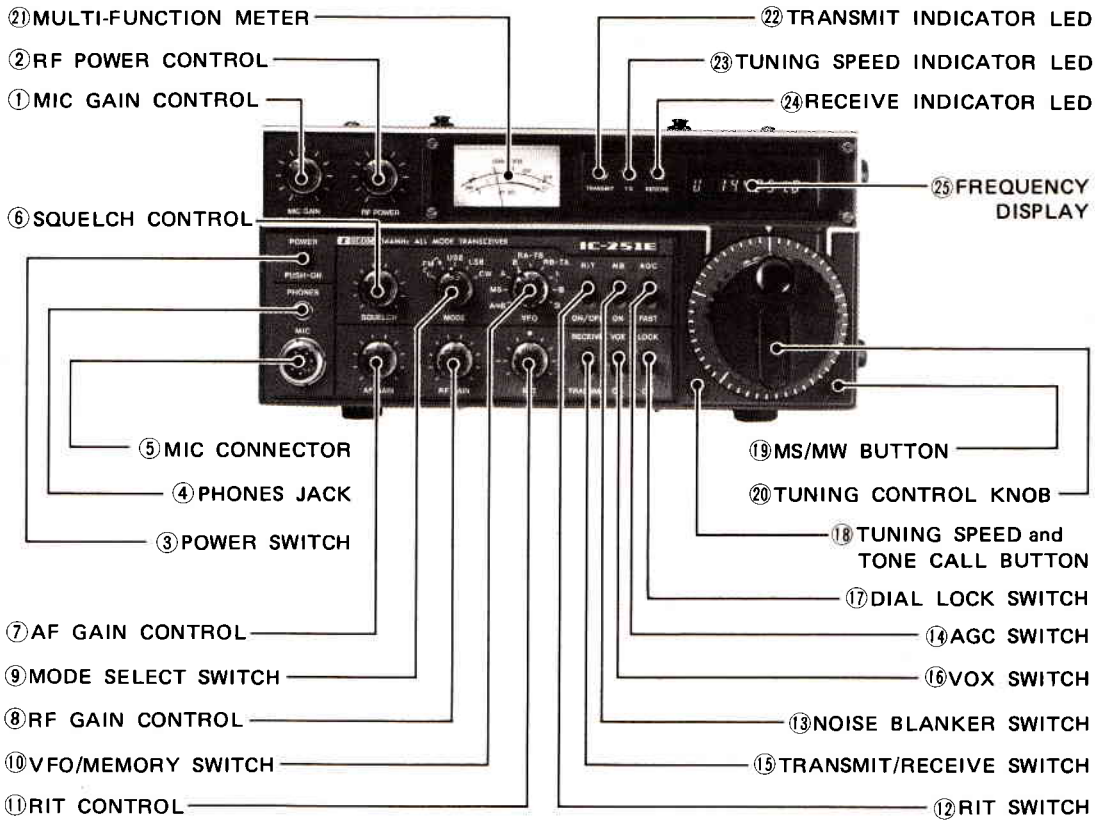
TRANSMITTER

Output power	:	SSB	10W(PEP)
		CW	10W
		FM	1 ~ 10W (Adjustable)
Emission mode	:	SSB (A3J, USB/LSB), CW (A1), FM (F3)	
Modulation system	:	SSB	Balanced modulation
		FM	Variable reactance frequency modulation
Max. frequency deviation	:	±5KHz	
Spurious emission	:	More than 60dB below peak power output	
Carrier Suppression	:	More than 40dB below peak power output	
Unwanted Sideband	:	More than 40dB down at 1000Hz AF input	
Microphone	:	1.3K ohm dynamic mircophone with built-in preamplifier and push-to-talk switch	
Operating mode	:	Simplex, Duplex (Any inband frequency separation programmable)	
Tone Burst	:	1750Hz ±0.1Hz (IC-251A : Not installed)	

RECEIVER

Receiving system	:	SSB, CW	Single conversion superheterodyne
		FM	Double conversion superheterodyne
Receiving Mode	:	SSB (A3J, USB/LSB), CW (A1), FM (F3)	
Intermediate Frequency	:	SSB, CW	10.7MHz
		FM	10.7MHz, 455KHz
Sensitivity	:	SSB, CW	Less than 0.5 microvolts for 10dB S+N/N
		FM	More than 30dB S+N+D/N+D at 1 microvolt
			Less than 0.6 microvolts for 20dB Noise quieting
Squelch sensitivity	:	SSB, CW	Less than 0.6 microvolts
		FM	Less than 0.4 mircovolts
Spurious response rejection ratio	:	More than 60dB	
Selectivity	:	SSB, CW	More than ±1.2KHz at −6dB point
			Less than ±2.4KHz at −60dB point
		FM	More than ±7.5KHz at −6dB point
			Less than ±15KHz at −60dB point
Audio output power	:	More than 1.5W	
Audio output impedance	:	8 ohms	

2-1 FRONT PANEL



1. MIC GAIN CONTROL

Adjusts the level of modulation according to the input of the microphone. As the input will vary with different microphones and different voices, adjust for the proper modulation accordingly. Clockwise rotation increases mic gain.

2. RF POWER CONTROL

The IC-251A/E has an output power of 1 ~ 10watts which can be varied by the RF Power control. Turning the control clockwise will increase power, while turning counterclockwise will decrease it. (FM only)

3. POWER SWITCH

A push lock type ON/OFF switch controls the supplied power, either AC or DC, to the set. Push the switch IN (locked position) to apply power to the set. Push again to unlock the switch to remove power from the set. (In the unlocked position, power for the memory circuit will remain if the memory switch (33) is in the ON (up) position.

4. PHONES JACK

Accepts a standard 1/4-inch headphone plug for a 4 ~ 16 ohm headphone set. Stereo headphones can be used without modification.

5. MIC CONNECTOR

Connect the supplied microphone or optional microphone to this jack. The IC-SM5 stand-type Electret microphone can also be used.

6. 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. The squelch function operates in all modes.

7. AF GAIN CONTROL

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

8. RF GAIN CONTROL

Controls the gain of the RF and IF sections in the receive mode. Clockwise rotation gives maximum gain with no signal present. As the control is rotated counterclockwise, the needle of the Multi-Function meter rises, and only signals stronger than indicated on the meter will be heard. This will eliminate noise during the absence of signals.

9. MODE SELECT SWITCH

This switch selects the mode of operation for both transmit and receive. The initial letter of each mode is displayed on the frequency display unit according to the switch setting.

FM-c	Frequency modulation, and the Multi-Function Meter functions as a discriminator meter in the receive mode.
FM-s	Frequency modulation, and the Multi-Function Meter functions as a signal strength meter in the receive mode.
USB	Upper Sideband
LSB	Lower Sideband
CW	Continuous Wave, for CW operation

10. VFO/MEMORY SWITCH

Selects an operating VFO from "A" VFO and "B" VFO, and selects the other various operations.

A → B	Instantly sets the frequency of "B" VFO to the same as that of "A" VFO.
MS	Sets the MEMORY SCAN function. Push the MS/MW Button to start scanning the three programmed frequencies in Memory Channels 1, [2] and [3].
A	Selects "A" VFO for both transmit and receive. Programmed Scan "A" is started by pushing the MS/MW Button while at this setting.
B	Selects "B" VFO for both transmit and receive. Programmed Scan "B" is started by pushing the MS/MW Button while at this setting.
RA-TB	Selects "A" VFO for receive and "B" VFO for transmit.
RB-TA	Selects "B" VFO for receive and "A" VFO for transmit.
1, [2], [3]	Selects the three Memory Channels. [2] and [3] are also used for Programmed Scan operation.

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

11. RIT CONTROL

Shifts the receiver frequency ±800Hz to either side of the transmit frequency. When the RIT is ON, the RIT LED is illuminated. The LED also represents the "0" position. Rotating the control to the (+) side raises the receiver frequency, and rotating to the (–) side lowers the receiver frequency. With the RIT ON, if the Tuning Control Knob (20) is moved one increment, the RIT circuit is automatically pulsed OFF. Therefore it is not necessary to manually turn OFF the RIT when changing operating frequency. The frequency shifted by turning the RIT Control is not indicated on the frequency display.

12. RIT SWITCH

This is a spring-loaded switch for the RIT Control. To turn ON the RIT, push down once. If the OFF position is desired, push down again. When the RIT is ON, the LED above the RIT control knob is lit. This LED also indicates the center position of the RIT control. When the RIT circuit is OFF, the LED is also OFF. Also, if the RIT is ON, rotating the Tuning Control Knob by one increment will pulse the RIT OFF. The RIT remains ON even after the power is turned OFF.

13. NOISE BLANKER SWITCH

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

14. AGC (AUTOMATIC GAIN CONTROL) SWITCH

With this switch you can select the time constant of the AGC circuit. With the switch in the AGC (up) position, the AGC voltage is released slowly, and thus is suitable for SSB reception. With the switch in the FAST (down) 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.

15. TRANSMIT/RECEIVE (T/R) SWITCH

This switch is for manually switching from transmit to receive and vice versa. Set the switch to RECEIVE (up) and the IC-251A/E is in the receive mode. Set the switch to TRANSMIT (down) 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.

16. VOX SWITCH

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

17. DIAL LOCK SWITCH

After the IC-251A/E is set to a certain frequency for rag chewing, mobile operation, etc., by switching the DIAL LOCK Switch to the ON position (down), the VFO is electronically locked at the displayed frequency, and this inactivates the operation of the Tuning Control Knob. To cnahge frequency, the Dial Lock must first be disengaged by setting the DIAL LOCK Switch to OFF (up) position.

18. TUNING SPEED (TS) and TONE CALL BUTTON

Pushing the TUNING SPEED Button will illuminate the TS indicator LED, and the small vernier marks on the Tuning Control Knob are changed to correspond to 1KHz increments in any mode. At the same time, the 100Hz digits are cleared on the display to show "0" in the last digit.

When the Tuning Speed Button is depressed again, the TS indicator LED goes OFF and the small vernier marks will again correspond to 5KHz steps in the FM mode and 100Hz correspond to 5KHz steps in the FM mode and 100Hz steps in all other modes. This button will allow you to quickly QSY over a great frequency range in SSB and CW, and to tune in FM signals which are off from 5KHz-step frequencies.

When the DIAL LOCK Switch is set in the ON position, this button operates as the TONE CALL Switch. (IC-251E only)

Most repeaters require a 1750Hz Tone-burst for initial access. In the transmitting mode, by depressing the Tone Call Switch for the required period for a repeater, the tone burst generator actuates and you can access the repeater.

19. MEMORY SCAN START/STOP & MEMORY WRITE (MS/MW) BUTTON

The following three functions are provided by pushing the MS/MW Button.

MEMORY WRITE	Writing a frequency into Memory Channel 1, [2], or [3].
SCAN START	Starting the "A" and "B" scans and Memory Scan.
SCAN STOP	Stopping any of the scan functions.

20. TUNING CONTROL KNOB

Rotating the Tuning Control Knob clockwise increases the frequency, while rotating it counterclockwise decreases it. The frequency is changed in 100Hz steps (all modes except FM) and 5KHz steps (FM mode) which correspond to the smaller vernier marks on the knob. When the TUNING SPEED Button is pushed and the TS indicator LED is illuminated, the frequency is changed in 1KHz steps, which correspond to the smaller vernier marks on the knob, in all modes including FM.

By rotating the Tuning Control knob clockwise beyond the highest edge of the band the operating frequency is automatically reverted to the lowest edge of the band, and vice versa. This system prevents you from operating out of the amateur radio band.

When QSYing over a large freqeuncy range is required in the SSB or CW mode, use the TUNING SPEED Button.

When the operating frequency needs to be locked, use the DIAL LOCK Switch.

21. MULTI-FUNCTION METER

This meter functions as a relative RF output meter in transmit mode and as an S-meter (signal strength meter) in receive mode unless the MODE Select Switch is set at the FM-c position, in which case the meter functions as a discriminator meter in the receive mode.

22. TRANSMIT INDICATOR LED

When your set is in the transmit mode, this LED is lit.

23. TUNING SPEED (TS) INDICATOR LED

Illuminates when the TUNING SPEED Button is pressed to set the dial to 1KHz-step tuning.

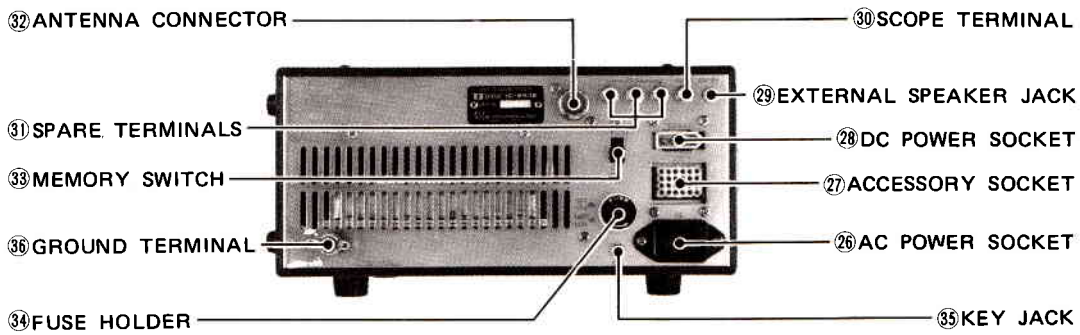
24. RECEIVE INDICATOR LED

Illuminates when the squelch is opened in the receive mode.

25. FREQUENCY DISPLAY

The frequency of the IC-251A/E is displayed on a luminescent display tube. Since the 1MHz and 1KHz decimal points are displayed, the frequency can be easily read. The frequency indicated is the carrier frequency of each mode. The frequency which is changed by use of the RIT is not changed on the frequency display. The letter shown to the left of the frequency indication is the initial letter of the operating mode set by the MODE Select Switch.

2-2 REAR PANEL



26. AC POWER SOCKET

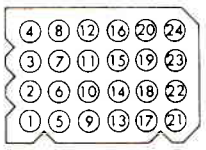
Connect the included AC power cable to this connector and the included jumper plug to the DC power connector for AC operation.

27. ACCESSORY (ACC) SOCKET

The table below shown terminal connections of this connector.

NOTE:IC-RM2/3 does not function with the IC-251A/E.

ACC SOCKET CONNECTIONS



Outside views

PIN No.	FUNCTION
1.	Output from squelch control stage. (+7V when squelch is ON)
2.	13.8 Volts DC in conjunction with the power switch operation. (0.3A Max.)
3.	Connected to Push-to-talk, T/R change-over switch. When grounded, the set operates in the transmit mode.
4.	Output from the receiver detector stage. Fixed output regardless of AF level of AF GAIN Control.
5.	Output from Transmitter MIC amplifier stage.
6.	8 Volts DC available when transmitting. (Relay can not be directly actuated. 5mA Max.)
7.	Input for external ALC voltage.
8.	Ground.
9. ~ 15.	NC (no connection.)
16.	Control signal (DBC) input terminal for external control.
17.	NC (no connection).
18.	NC (no connection).
19.	Control signal (DV) output terminal for external control.
20.	Control signal (RT) input terminal for external control.
21.	Data signal (DB1) input/output terminal for external control.
22.	Data signal (DB2) input/output terminal for external control.
23.	Data signal (DB4) input/output terminal for external control.
24.	Data signal (DB8) input/output terminal for external control.

28. DC POWER SOCKET

Connect the included DC power cable when DC operation is required. Connect the included jumper plug to this socket when AC operation is required.

29. 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.

30. SCOPE TERMINAL

This terminal brings out the 10.7MHz IF signal from the mixer in the receiver. Observation of not only the received signal, but also of signals of the selected band width are possible by using a panadaptor or panascope.

31. SPARE TERMINALS

These terminals are available for your personal use, such as for adding accessory circuits, etc., if desired.

32. ANT (ANTENNA) CONNECTOR

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

33. MEMORY SWITCH

When this switch is in the ON (up) position, the power to the CPU of the IC-251A/E is supplied continuously, even when the POWER Switch on the front panel is turned OFF, to retain all the programmed frequencies in the Memory Channels, the operating frequencies of the two VFO's etc. When this switch is set at the OFF (down) position, all the power, including that to the CPU, is turned OFF by turning OFF the POWER Switch, so that all the programmed frequencies in the Memory Channels, the operating frequencies of the two VFO's, etc., are erased.

34. FUSE HOLDER

This holds the fuse for the AC power circuit. If the fuse is blown, replace it with a new fuse (2 Amp for 117V/1 Amp for 240V) after checking the cause. Open the fuse holder with a Phillips head screwdriver.

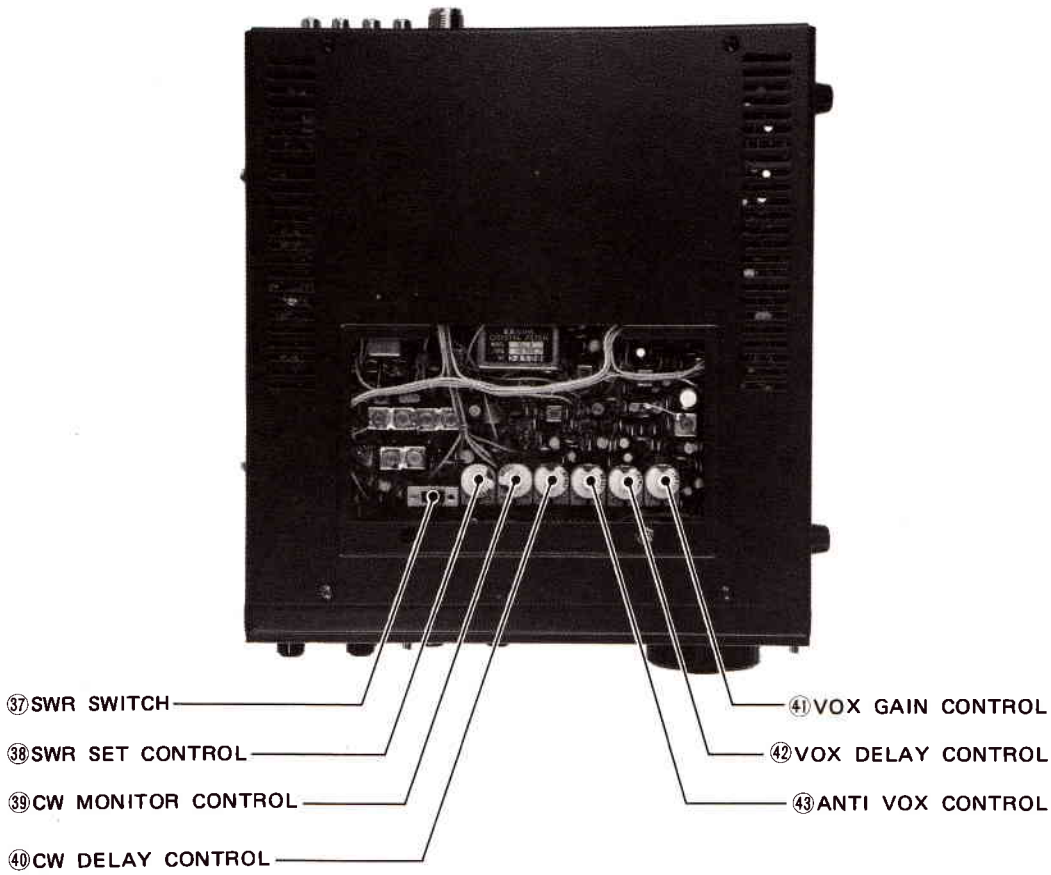
35. KEY JACK

For CW operation, connect a key here using the included key plug.

36. 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.

2-3 CONTROLS UNDER ACCESS COVER



37. SWR SWITCH
When measuring SWR, the calibration SET and SWR reading functions are selected with this switch. Remember, at the factory, the switch is in the SET position and fixed in place with a plastic screw to prevent it from switching to SWR. Remove the screw before attempting to read SWR!

38. SWR SET CONTROL
This control calibrates the meter needle to the SET position when you want to determine the value of SWR. The set must be transmitting a carrier, then adjust the control until the meter needle reaches the SET point.

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

40. CW DELAY (CW time delay constant) CONTROL
In semi-break-in CW operation, this controls the TX/RX switchover time delay. Adjust it to suit your keying speed.

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

42. VOX DELAY (VOX time constant) CONTROL
This controls the TX to RX switching time. Adjust it so TX to RX switching will not occur during short pauses in normal speech.

43. ANTI VOX CONTROL
In VOX (SSB) operation, the VOX circuit may operate 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 will only operate from the operator's voice and not by sound from the speaker.

3-1 OUTLINE

This equipment adopts a digital phase-locked loop (PLL) circuit for local oscillator and performs frequency control and various other controls using a 4-bit microcomputer.

The receiving unit employs a double-conversion superheterodyne system with the first intermediate frequency of 10.7MHz and the second intermediate frequency of 455 kHz in FM mode, and a single-conversion superheterodyne system with the intermediate frequnecy of 10.7MHz in SSB and CW modes.

The transmitting unit employs a doubly balanced modulator IC optimum for SSB modulation and demodulation.

The PLL unit is a mixed down type which locks at every 10kHz and controls up to 9.9kHz with the local oscillator in the loop used as VXO (Variable Crystal Oscillator).

3-2 RECEIVER

3-2-1 ANTENNA SWITCHING CIRCUIT

D21, D22 and D60 connected between the antenna coil, L52, and the low-pass filter are switching diodes, which, during receiving, are made very low-resistance due to storage effects by causing forward current to flow through these diodes. Receiving signals from the antenna pass these diodes at a low loss and are fed to the RF amplifier circuit which continues to the next stage.

During transmission, these diodes are biased by their self-rectification and leakage of the transmitting signal through the diodes is extremely small because only junction capacity of the diodes connected in series will remain. Q48 is for control of the above-mentioned diodes and is turned ON as a result of R +9V being applied to the emitter during receiving. So Q48's collector becomes +9V and cause forward current to flow to D21, D22 and D60 through R194.

During transmission, emitter voltage becomes 0 and Q48 is turned OFF, causing no current to flow to D21, D22 and D60. Q48 employs a high voltage transistor of V_{CER} = 180V (R_{BE} = 30KΩ) because self-rectification voltage of diodes will rise when SWR is high.

3-2-2 RF CIRCUIT

Signals from the antenna, after stepped up at L52, are amplified by Q47, then fed to the first gate of the first mixer Q46 of the next stage through L47 – L51, the five-stage helical cavity band-pass filter. To the second gate of Q46, the local oscillator output from the PLL unit is fed through the bifilar transformer, L46 and D43.

10.7MHz IF signals are put out from the drain of Q46, and a part of the IF signals is fed through Q45 source follower to the scope terminal provided on the rear panel.

The RF circuit employs Q47, a dual-gate MOS FET and means of the five-stage helical cavity band-pass filter to reduce interference caused by near-by signals.

The first mixer also employs a dual-gate MOS FET which has a wide dynamic range and low noise characteristics, thus producing excellent characteristics.

3-2-3 INTERMEDIATE FREQUENCY CIRCUIT

The 10.7MHz intermediate frequency signals put out from the drain of Q46 are fed to the crystal filter FL2 which has a 20kHz band width through the L45 matching transformer and they are then fed to the signal switching circuit.

In the signal switching circuit, D42 is turned ON in SSB and CW modes and the 10.7MHz IF signals are fed to SSB crystal filter FL1 through matching transformer L5.

In FM mode, D40 is turned ON and the 10.7MHz signals are fed to the FM second mixer through matching transformer L44.

During transmission, T9V is supplied through D41, thus both D40 and D42 are turned OFF in any modes. So, no switching operation is performed.

(1) FM Second Mixer, Second IF Circuits

Signals from the above-mentioned signal switching circuit and 10.245MHz signals generated at Q44 are applied to the gate of Q43, converted into 455kHz second IF signals and put out from the drain. The resistive drain load facilitates matching of the ceramic filter continuing to the next stage.

455kHz second IF signals are given sufficient selectivity at narrow-band ceramic filters FL3 and FL4, and amplified at Q42, Q41 and Q40. A portion of the amplified signals is rectified at D38 and causes the S-meter to swing. D39 which is connected to the collector of Q42 is for maintaining stability when a strong signal is input. R167 in the emitter circuit is a trimmer to adjust swing of the S-meter during FM reception.

Q39 is a DC-amplifier to control RF gain during FM reception. The gain control DC voltage is superimposed on the FM S-meter control line, thus S-meter indication is provided when the RF gain control is adjusted.

The signals output from Q40 are fed to IC3 and the signals are further amplified. This IC, with its three-stage direct-coupled differential amplifier circuit provides excellent limiter characteristics.

(2) FM Demodulation Circuit

The 455kHz signals limiter-amplified at IC3 are demodulated by the discriminator composed of DS1, D20, D35, etc. A DC voltage from the discriminator is picked out as a discriminator meter signal through R165.

(3) Integrating, AF, LPF Circuits

AF signals from the discriminator are amplified at Q49 after passing the integrating circuit composed of R196 and C206. At this stage, squelch control is performed by grounding the base of Q49 through R199, thus to minimize abnormal noise caused at the time of squelch ON and OFF. Furthermore, the active low-pass filter of Q50 improves S/N so as to cut off 3kHz and higher which are unnecessary for communication.

(4) Squelch Circuit

A noise squelch system, in which noise is suppressed by input signals, is employed.

To avoid influence of voice signals, a part around 25kHz of noise signal is selectively amplified. The squelch control is provided before the noise amplifier stage to get wide dynamic range.

Q54 is for noise amplification. The voltage of AF signals from the discriminator is divided by the squelch control and fed to the base of Q54. Here, temperature compensation is provided at R224 and only the noise components (about 25kHz) of the load are selected by L56 and C224.

These noise components are further amplified at Q53 and double-voltage-rectified at D44 and D46 while superimposed on the bias voltage of D45 which also serves for temperature compensation. The DC voltage rectified is given appropriate leading edge and trailing edge at C218, C219, R217 and R216, and drives the Q52 squelch switch.

In the absence of receiving signals, Q52 is turned ON by noise rectifying voltage and turns off the AF amplifier Q49. Upon receiving signals, noise rectifying voltage becomes lower and Q52 is turned OFF. So, Q49 is supplied with normal base bias voltage at R197, R199 and R198, resulting the voice signals are amplified.

To the base of Q52 , T9V is supplied through R215, thus noise caused by opened squelch at the time of switching from transmitting to the receiving, is eliminated.

(5) SSB, CW Intermediate Frequency Circuit

The 10.7MHz first IF signals fed from the signal switching circuit through D42, are fed to L5 matching transformer, cutting off pulse type noise at the noise blanker gate composed of D5 and D6, then fed to SSB crystal filter FL1 to obtain a selectivity of ±2.4kHz (–60dB).

The filtered IF signals fed through D8 are amplified at Q7, Q8 and Q10. As this stage requires specially stabilized amplification and high gain as well as a wide AGC range, the Q7 and Q8 employs dual-gate MOS FET's and a Q10 which is composed of a differential amplifier circuit.

AGC voltage is supplied to the second gates of Q7 and Q8 to obtain wider AGC range. The source voltage drop of Q8 caused by applying AGC voltage is used as S-meter function during SSB-CW reception. The source voltage of Q8 is DC-amplified at Q9, then fed to the S-meter. R26 is for adjustment of meter swing and R132 is for zero point adjustment.

(6) SSB, CW Demodulation Circuit

Output of the IF amplifier circuit converted into balanced output at L10, is supplied to IC1 and product-detected with the BFO signal input to pin 2.

This IC1 is composed of a constant current source and differential amplifier circuit, and BFO signals are input to the constant current source. The AF signals detected at IC1 is amplified at Q11 and supplied to the above-mentioned Q50 active low-pass filter, while a part of the AF signal is supplied to the AGC control circuit.

(7) AGC Control Circuit

The AF signals detected at IC1 are amplified at Q27 and supplied to the AGC detector circuit continuing to the next stage. R106 is for gain adjustment of Q27, by which applicable AGC level is set. Output of Q27 is divided at R105 and R314 and fed to Q23 peak detector circuit. By this operation, Q23 functions as an emitter follower when voice signals are at positive peak and capacitors of the time constant circuit C75 and C81 are charged while letting them have leading edge dynamic characteristics. After positive peak, Q23 is biased and cut off by the charged voltage of the above-mentioned time constant circuit. Discharge control of the circuit is made by Q24, Q25 and Q26.

Q26 is a peak detector circuit similar to Q23, but its input level is set higher than that for Q23 and charges C77 more quickly. This voltage is divided at R101, D14 (for temperature compensation) and R100, causing Q25 to be turned ON and Q24 OFF, thus holding the charged voltage of the time constant circuit is held.

When there are no more input signals, C77 is discharged through R101 and R100, and Q25 is cut off causing Q24 to be turned ON, thus the charged voltage of the time constant circuit is discharged through R95.

When the AGC switch is in the FAST position, the base of Q25 is connected to –9V, causing Q25 to be turned OFF and Q26 ON, and the time constant circuit does not work any longer nor any holding effect be caused.

The voltage of the time constant circuit is fed to high input impedance FET, Q21, amplified at Q20 and used as AGC voltage. This AGC voltage is supplied to the second gates of IF amplifiers Q7 and Q8, and to the second gate of RF amplifier Q47. The R92 provided at the source of Q21 is a level control to be used in setting bias when there are no signals.

Q19 superimposes a voltage of RF gain control onto the AGC line using the emitter follower and thus forms a threshold type RF gain control.

To avoid possible charging of the time constant circuit caused by a transmitting signal etc., the leading edge of R9V is differentiated by C74 and R93 and the time constant circuit is discharged by temporarily turning Q22 ON, thus the AGC line is reset to no signal bias.

During FM operation, the AGC circuit becomes inoperative and Q19 DC-amplifies a voltage from the RF gain control, thus the voltage of the above-mentioned AGC line is controlled. By this, gain of Q47 is controlled and, at the same time, Q39 controls the S-meter.

(8) Noise Blanker Circuit

The noise blanker blocks the signal line when pulse type noise is received during SSB-CW reception. 10.7MHz signals containing those noise components which have passed through crystal filter FL2 are fed to the high input impedance junction FET, Q1, through D42, and amplified at Q2 and Q3.

This output is double-voltage-rectified at D1 and D2, then fed to the integrating circuit of R11 and C13 and amplified at Q4. Bias voltages of Q2 and Q3 are changed for AGC. This maintains constant noise amplification level and prevents abnormal operation of the noise blanker in case of strong signal input.

Peak value of noise pulse is picked out at Q5, the re-trigger type monostable multivibrator of IC8 is triggered and pin 4 becomes ground level during a time decided by C332 and R333.

By this, Q6 is turned ON, 9V is applied to the cathode of D5 through L4 and D6, thus receiving signals are blocked, to pass D5 while noise is present. IC7 is a three-terminal voltage regulator to supply source voltage (5V) for TTL of IC8.

3-2-4 AF CIRCUIT

The Q50 active low-pass filter cuts off components of 3KHz or more of detected FM, SSB or CW signals. This output is fed to IC5 through the volume control, and amplified to such a level that can drive the speaker.

The gain of IC5 is reduced by series resistance R286 provided on external NFB control terminal (pin 8), thus residual noise and distortion characteristics are improved.

During SSB-FM transmitting, muting is performed by applying a bias voltage to this terminal (pin 8) through D54.

During CW transmitting, CW monitoring can be made by applying a single tone of 800Hz to this terminal.

3-3 TRANSMITTER

3-3-1 AF AMPLIFIER, LIMITER, LOW-PASS FILTER CIRCUITS

Voice signals from the microphone are fed to Q14 – Q16 limiter amplifier circuit through microphone gain control. This circuit employs a three-stage direct-coupled amplifier and improves limiter characteristics as well as low distortion and overdrive characteristics.

R67 adjusts the bias point of Q14 and its clipping level symmetrically. D12 and D13 are for temperature compensation.

As output from the limiter takes a form like square wave and contains higher harmonic components, Q13 active low-pass filter removes components of 3kHz or higher. This output is temperature-compensated by R60 thermistor to prevent change in frequency deviation caused by temperature fluctuation.

After that, the output is supplied to the FM modulation circuit after its level is adjusted at R59 in FM operation.

In SSB operation, the output is supplied through the emitter follower of Q66 to the balanced modulator after integrated at R274 and C248. The R274 provided on the emitter of Q66 is a level control to set microphone gain in SSB operation.

3-3-2 MODULATION CIRCUIT

(1) FM Modulation, 10.7MHz Oscillator, Limiter Circuits

Q12 is a Colpitts Type VXO Oscillator Circuit. Signals from the above-metioned low-pass filter is applied to the anode of D11 varactor diode, thus its capacitance is varied accordingly by the voice signal and FM-modulates the oscillating frequency 10.7MHz of X1. A thermistor R56 is composed in the bias circuit of the cathode side of D11 for temperature compensation.

These modulated signals are limiter-amplified at IC6 and fed to the transmitting mixer trhough a switching diode D10.

The oscillating frequency is adjusted at L12.

(2) Balanced Modulation Circuit

IC4 is a doubly balanced modulator composed of a differential amplifier. Carrier suppression is about 65dB and carrier null is adjusted at R270.

In SSB mode, BFO signal – USB: 10.6985MHz or LSB: 10.7015MHz – is supplied to pin 10 and amplified voice signals are supplied to pin 1, and modulated DSB (double-sideband) signals are put out from pin 6.

In CW mode, the BFO frequency shifted about 800Hz from 10.6985MHz is applied to pin 4 through D49 to unbalance the balanced modulator and the BFO signal is put out from pin 6 as a CW signal.

3-3-3 ALC AND CW CONTROL CIRCUITS

DSB or CW signal from IC4 is amplified at Q63 and its output level is controlled by the ALC signal which is negative voltage and applied to the gate of Q63.

The signals amplified at Q63 are fed to crystal filter FL1. Spurious generation cuased by overdriving is suppressed by applying ALC at the stage preceding to the crystal filter.

Q62 connected to the drain of Q63 shunts the BFO signal to ground when key is up in CW transmitting, and in SSB/CW receiving, to prevent leakage of the BFO signal into the receiving circuit.

When key is up. Q62 is turned ON by a voltage applied to its base through R241 and R236, and grounds the drain of Q63. This shunts the BFO signals from the balanced modulator.

When key is down, the base of Q62 is grounded by the key and Q62 is turned OFF. Thus Q63 works normally and CW signals are obtained.

3-3-4 BFO CIRCUIT

The BFO signal is oscillated by Q68 with X3 or X4, and fed to the receiving demodulator IC1 and the transmitting modulator IC4, through buffer amplifier Q67.

During LSB operation, a 9V is supplied to D53 through R280, turns D53 ON and X4 is connected to the base of Q68, and Q68 oscillates at 10.7015MHz. This frequency can be adjusted by C259.

During USB operation and CW receiving, a 9V is supplied to D52 through R278 and to D51 through R279, and turns D52 and D51 ON. Thus X3 is connected to the base of Q68, and C255 and C256 are grounded through C251, and Q68 oscillates at 10.6985MHz.

During CW transmitting, a 9V is applied to the cathode of D51 through D50, and D51 is turned OFF. Thus C252 and C253 are inserted between C255 and C256, and the ground in series, and the oscillating frequency is shifted to about 800Hz to 10.6993MHz.

3-3-5 TRANSMITTING MIXER CIRCUIT

In the SSB or CW mode, modulated signals from IC4 balanced modulator, are amplified by Q63 and fed to the crystal filter FL1 through D7 and removed unwanted sideband, then fed to the transmitting mixer IC2 through D57 and L14.

In the FM mode, modulated signals from IC6 are fed to IC2 through D10 and L14.

L14 is a unbalanced-balanced transformer and balanced signals are applied to each input terminal of differential amplifier portion of IC2.

To the constant current portion of IC2, the local oscillator signal from the PLL unit is supplied through D3 which is turned ON in the transmit mode.

IC2 mixes these signals and their added frequency signal and subtracted frequency signal are put out from its output terminals. (The local oscillator signal and 10.7MHz modulated signal are cancelled at IC2 and L16.)

These signals are fed to the band-pass filter composed of L17 – L21 to filter out only local oscillator frequency plus 10.7MHz signal i.e., 144MHz signal.

3-3-6 DRIVER STAGE CIRCUIT

The 144MHz signal passed through the band-pass filter is amplified by Q28 up to 2mW PEP. The gain of this stage is controlled by the APC and ALC signals to control the driving level to the power amplifier.

The amplified signal is fed to Q30, then Q31 amplified up to about 1.6W PEP. D16 is employed for temperature compensation of the bias voltage of Q31; This bias voltage can be adjusted by R127.

3-3-7 POWER AMPLIFIER CIRCUIT

The amplified signal from Q31 is fed to Q32 and amplified up to 10W PEP. Q32 (2SC2094) is developed for SSB linear amplifier and has a superior power gain and linearity characteristics.

This stage handles higher power and generates much heat, so a L-shaped 3mm aluminum heatsink is employed to conduct the heat to the side panel efficiently. D17 is a temperature compensated bias network and the bias voltage can be adjusted by R130.

3-3-8 LOW-PASS FILTER AND SWR DETECTOR

Output of the power amplifier, containing harmonics, is fed to the antenna terminal through the low-pass filter consisting of Chebyshev and constant K sections. This filter reduces the harmonics to –60dB or less. The cut-off frequency of this filter is designed at about 180MHz and the insertion loss is minimized on the operating frequency band.

An SWR circuit should be located at antenna terminal, however, harmonics will be generated by diodes of the SWR detecting circuit. In this set, to resolve this problem, the SWR detecting circuit is located between low-pass filter sections.

D24 detects travelling-wave, and D25 detects reflected-wave, and the detected signals are fed to the SWR switch to select which signal is fed to the meter. The signal level fed to the meter is adjusted by R134.

A portion of the detected reflected-wave signal is fed to the APC amplifier circuit.

3-3-9 APC CIRCUIT

The detected reflected-wave signal from the SWR detecting circuit is fed to the base of Q33 through R136 level adjust trimmer, then to Q29, and DC-amplified. When the SWR is

high, the collector voltage of Q29 will be increased. The collector of Q29 is connected to the source of Q28, and the gain of Q28 is reduced, thus the driving level to the power amplifier Q32 is reduced, and DC input power of Q32 is reduced. This protects Q32 from a problem.

3-3-10 ALC AND POWER CONTROL CIRCUITS

Drive level of SSB or CW signal is detected at threshold-type double-voltage rectifier circuit D18 and D19. (R129 is for bias setting.) This rectified current is fed to the gate of Q63 through R320 and R255, controls the gain of Q63 and the drive level to the PA stage to provide ALC function.

This ALC voltage is applied to the gate of Q64 through R257 in the FM mode. Gain of Q64 is set by the power control connected to the source. The drain voltage of Q64 is DC-amplified at Q65 and this output varies drain voltage of intermediate amplifier Q28 to control driving level for the PA stage.

In SSB-CW mode, no voltage is supplied to the source of Q64 from the power control, and source voltage is lowered by R13 and R6 which are connected to this line. As a result, Q65 is turned ON and drain voltage of Q28 is made constant at 9V by the 9V for transmitting from the emitter.

3-3-11 VOX, ANTI-VOX CIRCUITS

Modulation signals from the microphone are level-set at R310 (VOX GAIN Control), amplified at Q75 and then rectified at Q74. The Receiving AF output is level-set at R291 (ANTI-VOX GAIN Control) and then amplified at Q69. This signal is rectified with only small release time given at Q70 peak value rectifier circuit and DC-amplified at Q71 and Q72. This DC voltage is given to the emitter of VOX rectifier Q74 to suppress VOX rectification.

Rectified voltage obtained from VOX rectifier charges C281 of the DELAY circuit. VOX DELAY TIME is set at R302. DC voltage from the DELAY circuit is given hysteresis at the Schmitt trigger circuit composed of Q57 and Q56, and fed through D47 and turns ON Q55 which is for T/R switching to provide transmitting status.

3-3-12 CW BREAK-IN, MONITOR CIRCUITS

At the KEY DOWN condition, Q59 turns OFF and Q58 turns ON. C299 of the DELAY circuit is charged and the voltage is supplied to the above-mentioned Schmitt trigger circuit Q57, Q56 via D48, thus to provide transmitting status. The phase-shifting type oscillator circuit composed of Q61 is caused to operate (oscillating frequency about 800Hz) by turning Q60 ON making use of Q59 having been turned OFF and by adding emitter bypass capacitor C230 of Q61. This output is fed to IC5 after level-adjusted at R249, thus to cause a monitor sound of about 800Hz to be output from the speaker during CW transmitting. R235 adjusts DELAY TIME.

3-4 OTHERS (MAIN UNIT)

3-4-1 POWER CIRCUIT

The 9V for continuous operation is obtained at the emitter follower of Q37 as regulated voltage generated at the anode of D33 in the clamping circuit in which voltage was supplied to Zener diode D32 through R144 and D33. R145 is an overcurrent protection resistor.

The 9V for receiving operation is obtained at the emitter follower of Q34 as regulated voltage generated at the anode of D26 in the clamping circuit composed of R138, D26 and D32. R139 is an overcurrent protection resistor.

The 9V for transmitting operation is obtained at the emitter follower of Q35 as regulated voltage generated at the anode of D31 in the clamping circuit composed of R143, D31 and D32. R141 is an overcurrent protection resistor.

The cathode sides of D27, D28 and D29 are connected PTT, SEND switch and T/R switching transistor Q55. The line is grounded when the set is brought into transmitting state. The above-mentioned line having been grounded, the base voltage of Q34 is lowered via D27, causing the 9V for receiving to become 0. The 9V for transmitting operation comes out as a result of Q36 being turned OFF through D29.

When this line is opened, D27 is turned OFF and the 9V for receiving operation comes out. At the same time D29 is turned OFF, causing Q36 to be turned ON, and base voltage of Q35 is lowered via D30.

D28 is to quickly discharge capacitors connected to the receiving 9V line.

3-5 PLL (PHASE LOCKED LOOP) UNIT

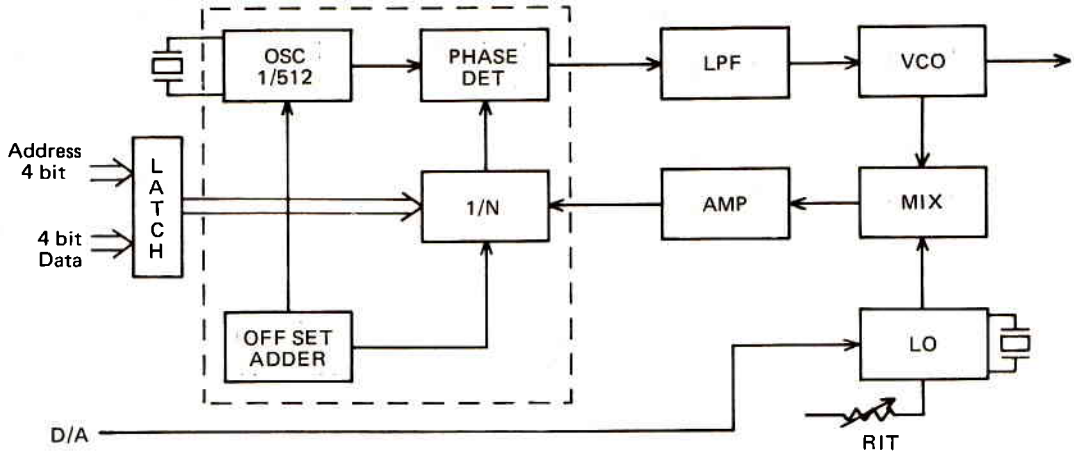
The PLL of this equipment employs a mixed down type, and is locked in 10kHz steps. Between 0 and 9.9kHz, the D/A-converted DC voltage from the LOGIC unit controls the oscillating frequency of the local oscillator circuit (LO).
This unit has also RIT function to change receiving frequency only.

3-5-1 LOCAL OSCILLATOR CIRCUIT

LOCAL OSCILLATOR CIRCUIT

This circuit is for the oscillation, in 100Hz steps, of the lowest two digits (0.0 ~ 9.9KHz) of the VCO output frequency of the PLL circuit. It consists of Q3 oscillator, and Q4, Q5 frequency triplers.

The crystal unit X1, a special VXO (Variable Xtal Oscillator) crystal, is connected to Q3's base and oscillates at about 14.143 MHz. The oscillating frequency is altered



in 100Hz steps by the voltage supplied to the anodes of D2 and D3 from the D/A (Digital to Analog) converter through inverted DC amplifier IC1 (A). The 14MHz signal is tripled at Q4 and Q5, thus the local oscillator output between 127.240MHz and 127.2499MHz is obtained.

The positive input terminal of IC1 (A) is connected to the RIT switch control Q13 and Q14 through the bias network R6 and R102.

When the set is in the transmit mode or the RIT is turned OFF, both Q13 and Q14 are turned ON and R6 is connected to ground. Thus ground level voltage is applied to the positive input terminal and without RIT function.

When the set is in the receive mode and the RIT is turned ON, both Q13 and Q14 are turned OFF, and R6 is connected to the RIT control. A DC voltage from the RIT control is applied to the positive input terminal of IC1 (A), then amplified DC voltage is applied to D2 and D3, and the oscillating frequency will be shifted approximately ±900Hz.

3-5-2 MIXER, LOW PASS FILTER, AND AMPLIFIER CIRCUITS

The output signals from the local oscillator circuit and the VCO signals are mixed by a doubly balanced mixer IC2. The output signals are amplified to the proper drive level (more than 3Vp-p) of the programmable divider IC4 by IC3 and Q6. The output signals are fed to the low-pass filters to filter out only the signals below 15 MHz. Then the signals are fed to Pin 12 of IC4 through C55.

3-5-3 PROGRAMMABLE DIVIDER CIRCUIT

The input signals at Pin 12 of the PLL IC, IC4, consists of the programmable divider, reference frequency generator and phase detector, and these are divided by the BCD input signals at Pins 6 ~ 9 and its digit signals at Pins 2 ~ 5.

The programmable divider is also called the 1/N counter and the BCD input is N. The relationship between the display frequency and the divide number N are as follows:

DISPLAY FREQUENCY	CPU OUTPUT	DIVIDE NUMBER (N)
144.000MHz	494	601
144.010MHz	495	602
≀	≀	≀
145.000MHz	594	701
≀	≀	≀
146.000MHz	694	801
≀	≀	≀
147.000MHz	794	901
≀	≀	≀
148.000MHz	894	1001

3-5-4 REFERENCE FREQUENCY GENERATOR CIRCUIT

Reference frequency generator consists of a crystal oscillator and a high speed divider. X2 oscillates at 5.12MHz, which is divided by 512. The 10KHz reference frequency is fed to phase detector. This 10KHz reference frequency decides the variation step of the PLL output frequency and the divide number N decides the PLL output frequency.

PLL output freq. = local oscillator freq. (MHz)
+ 0.01MHz (the reference freq.)
x N (divide number of programmable divider)

When the last two digits of the display frequency are changed from 0 to 9.9KHz, the local oscillator frequency is changed from 127.240 to 127.2499MHz. When the display frequency reaches 10.0KHz, the local oscillator frequency is set back to 127.240 and 1 is added to N. Thus the frequency change by 10KHz steps is set by the divide number N and the frequency change below 10KHz steps are set by the 100Hz-step variation of the local oscillator (VXO) frequency.

3-5-5 PHASE DETECTOR AND LOOP FILTER CIRCUITS

Digital phase detector detects the phase difference of the pulse signals of the 10KHz reference frequency, and the output signal of the programmable divider, and proportionately puts out positive/negative pulse signals at Pin 16. Pin 18 is for detecting the lock failures and changes to ground level according to the phase difference of the two pulse signals.

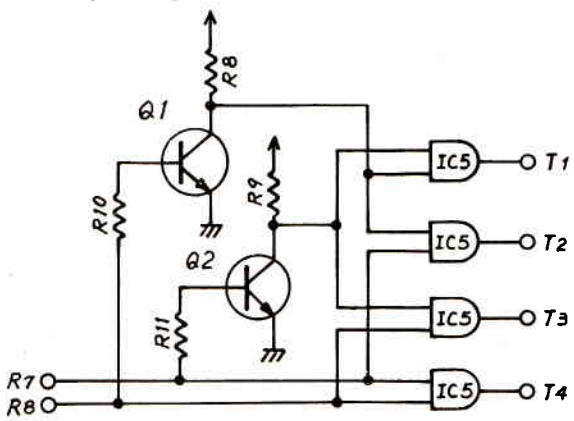
The loop filter, consisting of active filter IC1 (B), converts the pulse signal from Pin 16 into a DC voltage and decides the response time of the whole loop and removes harmonic and noise components. The output signals are fed to tuning diode D6 of the VCO unit as the control voltage for the VCO frequency set.

D5 and D8 are diodes to speed up response in the case of large change in PLL loop such as taking place between upper and lower band edges, and they are in opposite polarity so that they can respond to positive and negative pulses from the phase detector accordingly. In the case of small change, it is fed to IC1 through R67 and R68 and Miller-integrated there.

3-5-6 DIGIT DESIGNATING TIMING INPUT CIRCUIT

Digit designating signals T_1 – T_4 for the programmable divider are designated using the two bits from CPU, R_7 and R_8:

R_8	R_7	T input
L	L	T_1
L	H	T_2
H	L	T_3
H	H	T_4



3-5-7 BUFFER AMPLIFIER CIRCUIT

The VCO output signals are fed to buffer amplifier Q9. They are then fed to Pin 11 of the mixer IC2 through isolation buffer amplifier Q7, and to the transmit and receive mixer in the RF · YGR unit through Q17.

3-5-8 VCO UNIT

The VCO (Voltage-Controlled Oscillator) is a Clapp circuit, using Q8, and oscillates in the 133MHz range. The oscillation frequency is controlled by a DC voltage which is supplied from the loop filter in the PLL unit to varactor diode D6, inserted in series with the oscillation coil.

The oscillator output is taken from the source of Q8, and fed to buffer amplifiers Q9, and Q12 and Q17 in the PLL unit to become the local oscillator signal for the transmitter and receiver, and to get a DC-voltage to control the frequency of the VCO.

3-5-9 TRANSMITTING MUTE CIRCUIT

When the PLL is lock failure, Pin 18 of IC4 becomes ground level. Thus, Q10 is turned ON and Q11 also ON. The collector of Q11 is connected to the base of Q35 voltage regulator in the MAIN unit which produces a 9V for transmitting operation. Thus the base of Q35 is grounded when the lock fails and this stops the supply of 9V for transmitting and prevents radiation of unwanted signals.

3-5-10 DISCRIMINATOR METER AMPLIFIER CIRCUIT

Discriminator meter signals from the MAIN Unit (in FM mode) are DC-amplified at IC6 (B) to swing the discriminator meter. The meter employed in this set is functioning as S/RF meter too. So it is necessary to set its indicator to the center position by applying a bias voltage in use it as a discriminator meter. This is performed by the voltage to be applied to Pin 5 (+ input terminal) of IC6 (B), which is produced by dividing the 9V for receiving operation at R81, R84 and R85.

As IC6 is powered with +9V only, its output Pin 7 will not drop down to ground level, resulting in a voltage of about 1.5V remaining the above the level. To cancel this, a Zener diode D11 is employed and the anode side is dropped to 0V. R92 is a trimmer to set amplitude of the meter and R85 is for center position.

3-5-11 SSB SQUELCH CIRCUIT

This set provides squelch function not only in FM mode but also in SSB-CW mode using IC6 (A), OP amplifier working as a comparator.

Functioning as reference is a voltage applied to the positive input terminal, which is varied by the squelch control for SSB ganged with the squelch control for FM.

An S-meter signal applied to the negative input terminal is compared with the above-mentioned reference voltage. If it is lower than the positive input terminal voltage, output becomes about 9V, which charges C72 with a time constant together with R74 and R72, and supplys a voltage to the MAIN Unit as a S-SQL signal through R73 and D9.

This voltage turns ON the Q52 squelch switch.

Q52 grounds the base bias voltage of Q11, and turns Q11 OFF. As a result, audio signals from the balanced modulator stops at the AF amplifier Q11 and are not sent to the power amplifier of IC5.

When the negative input terminal voltage is higher than the positive input terminal voltage caused by the S-meter signal, the output of the OP amplifier becomes almost ground level, and the squelch is opened.

D9 is for reverse current protection. In FM operation, FM9V is applied to the negative terminal through D10, thus the output of the OP amplifier becomes ground level. Therefore, Q52 of the MAIN Unit functions only as an FM squelch switch in FM operation.

3-6 DRIVER (LOGIC) UNIT

3-6-1 FREQUENCY UP-DOWN CONTROL CIRCUIT

By rotating the tuning control knob, the operating frequency is controlled as follows:

D1 and D2 light-emitting diodes, emit lights to Q1 and Q2 phototransistors respectively, and signals with a phase difference of 90° are taken out from Q1 and Q2 by chopping the light with slits of the chopping disk coupled to the tuning control knob. These two signals, count data (CK) of frequency increase and decrease and signals to decide whether to let frequency go up or down (UD), and are shaped into short transition waveforms by the Schmitt trigger circuit composed of IC1 and R4 – R7 to take waveforms at Ⓐ and Ⓑ . (Refer to Waveform Timing Chart.)

Ⓒ : Ⓑ pulse integrated by time constant of R110 and C36.
Ⓓ : Both edge pulses of Ⓑ taken out of exclusive OR of Ⓑ and Ⓒ.
Ⓔ : Trailing edge of Ⓑ pulse in up-count and leading edge of Ⓑ pulse in down-count taken out, respectively.
Ⓕ : R2 timing pulse from CPU.
Ⓖ : R7 timing pulse from CPU.
Ⓗ : AND of Ⓕ Ⓖ pulses differentiated by C1 and R8.
Ⓘ : Signals which controls up-down.
Ⓙ Ⓚ : Output of the quadrinary counter composed of IC2 and IC3.

The flip-flop of IC3 (B) makes Q output L-level at the first R2 pulse thus to enable differentiation to produce Ⓗ . Signals shaped by the trigger circuit are temporarily latched to the filp-flop circuit of IC2 and IC3. IC2 and IC3 operate as quadrinary counter and data 0 – 3 are stored according to the rotating speed of the tuning control knob:

IC2	IC3	Data	
L	L	0	
L	H	1	L = 0V
H	L	2	H = 9V
H	H	3	

Even when the front panel power switch is OFF, R2 pulse continues to output because CPU is supplied with power in case memory backup power is on supply. At that time, As the D input terminal of IC3 (B) at that time is almost ground level, Q becomes H-level and each flip-flop is put in a clear state, and stops to count.

Immediately after powering, the counter set by the program in the CPU is preset to 145MHz and it is displayed on the display. Then, R2 and R7 pulses are put out and each flip-flop of IC2 and IC3 (A) are cleared.

When pulses generated by rotating the tuning control knob are stored in each flip-flop as data 0 – 3, the gate of IC4 is opened in synchronizing with R2 pulse and data 0 – 3 are put out to Ⓙ Ⓚ and fed to K1 and K2 terminals of the CPU. At the same time, UD signals to designate Up or Down are fed to K8 terminal of the CPU through IC4 and Ⓘ. Up-count brings H-level (9V) and Down-count, L-level (0V).

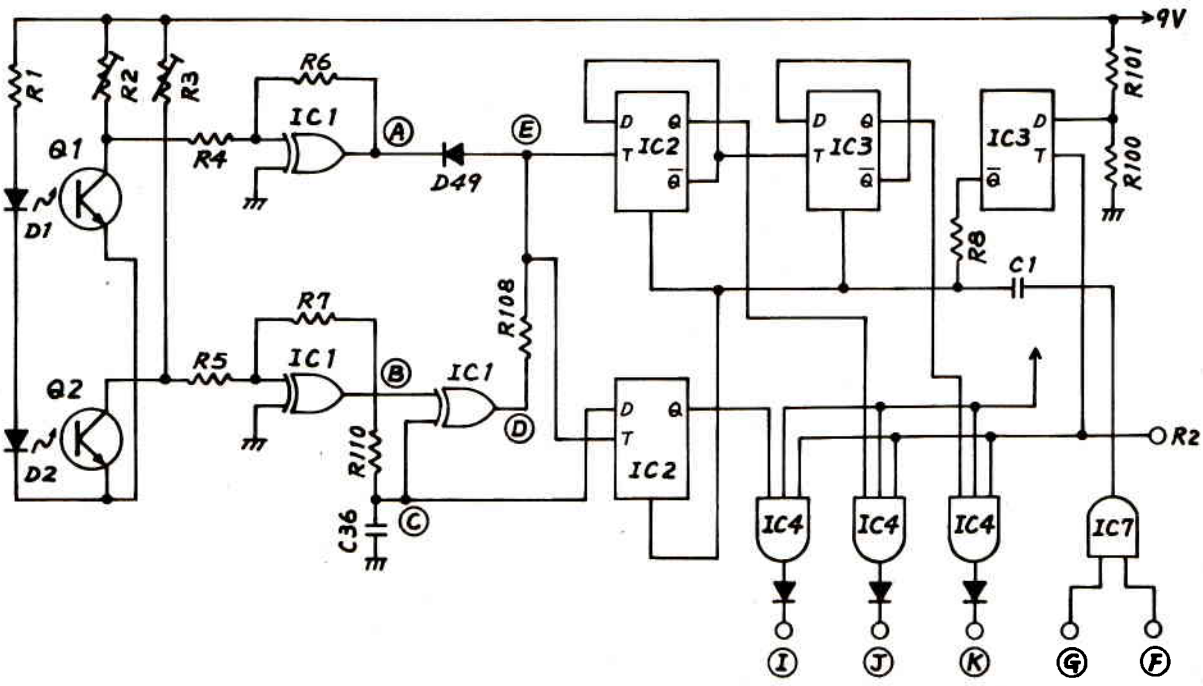
Using these data, addition and subtraction are applied to the frequency preset by the program in the CPU. In other words, the following operations are repeatedly conducted:

(1) R2 pulse from the CPU takes out data 0 – 3 and inputs them to the CPU.

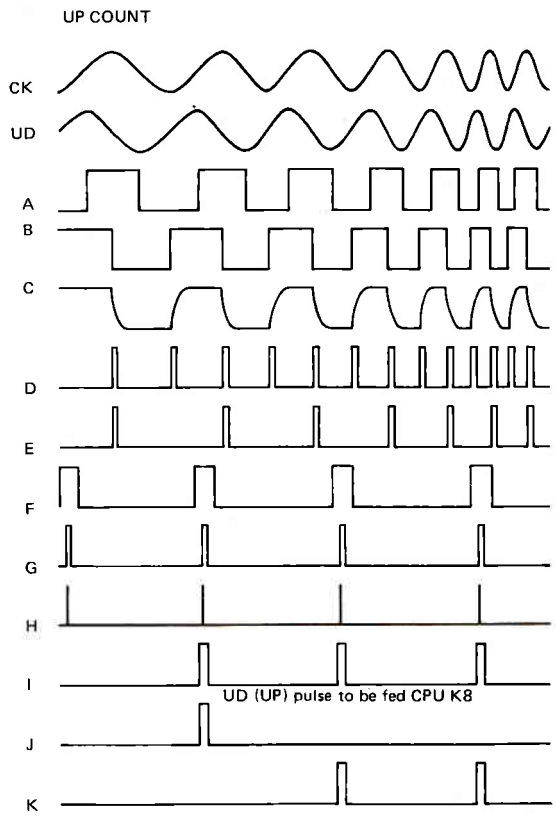
(2) The quadrinary counter is cleared by R7 pulse.

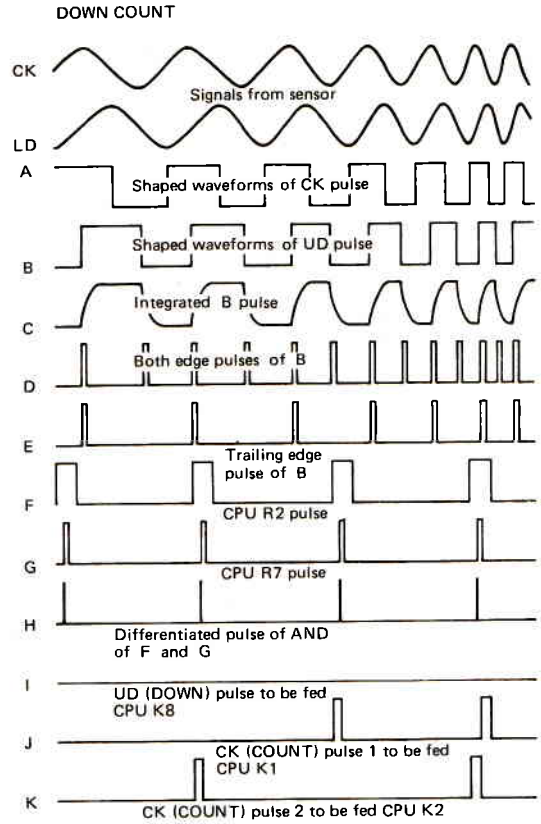
(3) Data are again read by R2 pulse.

Frequency Control Circuit



Frequency Up-Down Control Timing Chart

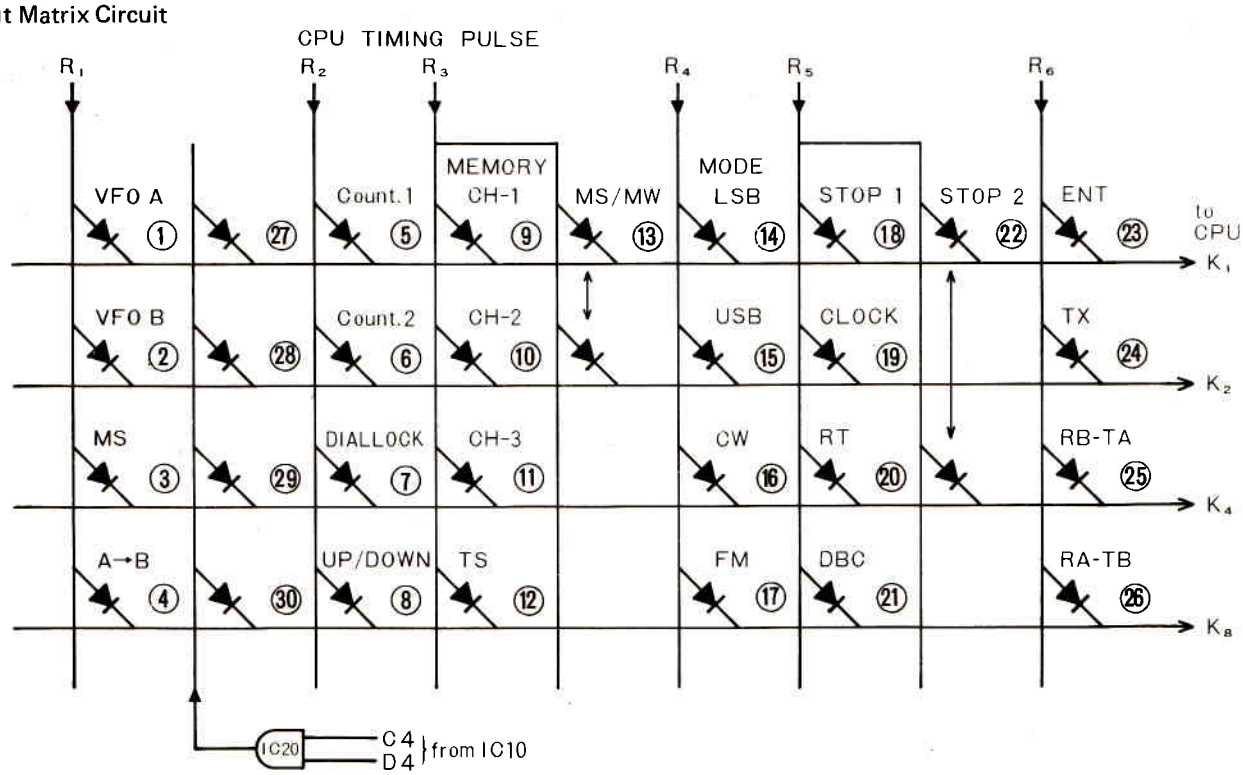




3-6-2 CPU INPUT CONTROL CIRCUIT

As this set employs a 4-bit CPU, it has only four input terminals, K1, K2, K4 and K8, resulting in limitation in its processing capacity. So, to increase its function time sharing scan is performed using R output (R0 – R6 pulse) put out from the CPU. That is, data input to K terminals (K1 – K8) are identified by the timing of R1 – R6. The circuit is composed of a matrix as shown in the following diagram. The flows of function operation made by handling the front panel switches are all fed to the CPU through this matrix circuit.

Input Matrix Circuit



The flow of R1 designates the frequency register to be used.

① R1 → K1 (VFO A)
Designates VFO A. Operates by a frequency set in the A VFO.

② R1 → K2 (VFO B)
Designates VFO B. Operates by a frequency set in the B VFO.

③ R1 → K4 (MS)
Functions scan start/stop operation by pushing the MW/SW switch. Depressing the switch scans memory channels 1, 2 and 3 according to the CLOCK TIMING of R5 → K4.

④ R1 → K8 (A ⇒ B)
Transfers the frequency data of VFO A to VFO B and makes the same ones.

The flow of R2 designates data count and Up-Down of frequency.

⑤ R2 → K1 (COUNT 1)

⑥ R2 → K2 (COUNT 2)
Corresponds to Ⓙ Ⓚ shown in Frequency Up-Down Control Circuit. This signal expresses data of 0 ~ 3 to be added or subtracted.

⑦ R2 → K4 (DIAL LOCK)
Invalidates data input from COUNT 1 and COUNT 2.

⑧ R2 → K8 (UP or DOWN)
Designates Up or Down of frequency data: designates Up when there is an input and Down when there is none.

⑨ R3 → K1 (MEMORY CH1)
Designates memory channel 1.

⑩ R3 → K2 (MEMORY CH2)
Designates memory channel 2.

⑪ R3 → K4 (MEMORY CH3)
Designates memory channel 3.
In the ⑨ , ⑩ or ⑪ state validates the MW switch and enables to write a frequency into a memory channel.

⑫ R3 → K1, K2 (TS)
Makes frequency steps 1kHz.

⑬ R3 → K8 (MS/SS)
Causes program scan to be started when the VFO A or B is selected.
Causes memory scan to be started when the MS button is pushed. Writes a frequency of the VFO A into the designated channel when a memory channel is selected.

⑭ R4 → K1 (MODE LSB)
Designates LSB mode.
At this time, "L" and carrier point frequency are indicated on the display.

⑮ R4 → K2 (MODE USB)
Designates USB mode.
At this time, "U" and carrier point frequency are indicated on the display.

⑯ R4 → K4 (MODE CW)
Designates CW mode.
At this time, "C" and carrier point frequency are indicated on the display.
In the receive mode the BFO frequency is 800Hz lower than the indicated frequency.

⑰ R4 → K8 (MODE FM)
Designates FM mode.
At this time, "F" and carrier frequency are indicated on the display.

The flow of R5 functions as scan control signal and external controller control signal.

⑱ R5 → K1 (STOP 1)
Performs scan stop by pushing the scan start/stop switch.
Restart after this stop is not from the stopped frequency but from the original start frequency.

⑲ R5 →K2 (CLOCK)
Makes sampling pulses of the scan clock control circuit (to be described later) by R5 pulse, inputs them to K2 and performs scanning operation.

⑳ R5 → K4 (RT)

㉑ R5 → K8 (DBC)
Is the flow of signals to be used when an external controller is connected.

㉒ R5 → K1, K4 (STOP 2)
Performs scan stop by a signal in scanning.
Automatic restart by this stop is effected by signals from the scan stop control circuit (to be described later), but from the stopped frequency.

The flow of R6 controls functions of VFO.

㉓ R6 → K1 (ENT)
Causes VFO A and B to perform Up-Down simultaneously.

㉔ R6 → K2 (TX)
Designates transmitting mode.

㉕ R6 → K4 (RB-TA)
Designates RB-TA. Transmits at VFO A frequency and receives at VFO B frequency.

㉖ R6 → K8 (RA-TB)
Designates RA-TB. Transmits at VFO B frequency and receives at VFO A frequency.

Initial frequency and band edge at switched ON, are set by this matrix.

When power is turned ON, hexadecimal data "C" is put out from the CPU (IC9) to I/O (IC10) for out put and latched by IC10, resulting in C4 and D4 terminals becoming H-level.

These outputs are made AND by IC20 and fed to one of K1 ~K8 input terminal according to version of the set.

㉗ C4, D4 – K1
Initially, presets 145MHz to VFO A and 145.6MHz to VFO B.

㉘ C4, D4 – K2 (USA)
Initially, makes band edge 143.8MHz – 148.1999MHz.

㉙ C4, D4 – K4 (EUROPE)
Initially, makes band edge 144MHz – 147.9999MHz. Initially band edge of the set for use in Europe is made 144MHz – 145.9999MHz in the no-input state.

㉚ C4, D4 – K8
Initially, operates in 5kHz steps when the mode switch is in the FM position.

3-6-3 FREQUENCY CONTROL, DISPLAY, I/O CIRCUITS

Time sharing operation is performed for frequency display and dividing number (N) output to the PLL programmable divider.

Display is dynamic lighted and shows operating frequency with 7 digits and an initial letter of operating mode.

7-segment data are put out from the CPU output terminals O_1 – O_7 and digit designating pulses are put out from output terminals R_0 – R_6.

Decimal point (DP) is lighted by the digit signals of 10MHz and 1kHz which are fed through D6 and D7.

Use of O_0 – O_3 and R_0 – R_6 are not limited to display purposes only. By time sharing operation, O_0 – O_3 outputs dividing number to the PLL divider, and R_0 – R_6 are supplied also to the CPU input control (matrix) circuit.

Immediately after powering, CPU is initialized and data of the above-mentioned ㉗ – ㉚ are preset in the built-in RAM area.

Later, in accordance with sequential pulses of R_0 – R_6, information of the above-mentioned ① – ㉖ is fed into the CPU and initial values are preset in the RAM area which stores in memory the display of VFO A, VFO B, frequency steps, memory 1 – 3 and dividing number for the PLL divider.

Then, dividing number and data for VXO control are put out from the CPU output O_0 – O_3 in sequence by BCD codes. Synchronizing with this, the data to designate latch position (digit position) are put out from R_7 – R_9 and latched to I/O (IC10) using AND pulses of R9 and R10 as strobe, thus VXO control data is put out from A4 – D5 terminals of I/O.

Furthermore, 7-segment data are put out from O_1 – O_7 in synchronization with R_0 – R_6 output corresponding to the above-mentioned matrix input, and R_0 – R_6 pulses provide dynamic lighting display of mode indication, 10MHz digit, 1MHz digit, ··· and 100Hz digit.

The 100MHz digit output is synchronized with the R_6 pulse by the 100MHz control circuit of IC21 and Q18.

These operations are repeated in such a manner that work of the above-mentioned matrix comes next.

3-6-4 CPU MALFUNCTION PROTECTIVE CIRCUIT

This is a circuit to prevent possible malfunction of the CPU which may be caused when inserting of the DC power connector.

Such a malfunction is caused when the connector is inserted a second time before C7, once charged, completes discharging. That is because of a chattering when the connector is inserted as a result of the program written in the CPU and has been executed from an in-between position before initialization is completed.

To prevent such problem, this circuit is designed to ground C7 by turning Q4 ON when the power connector is unplugged.

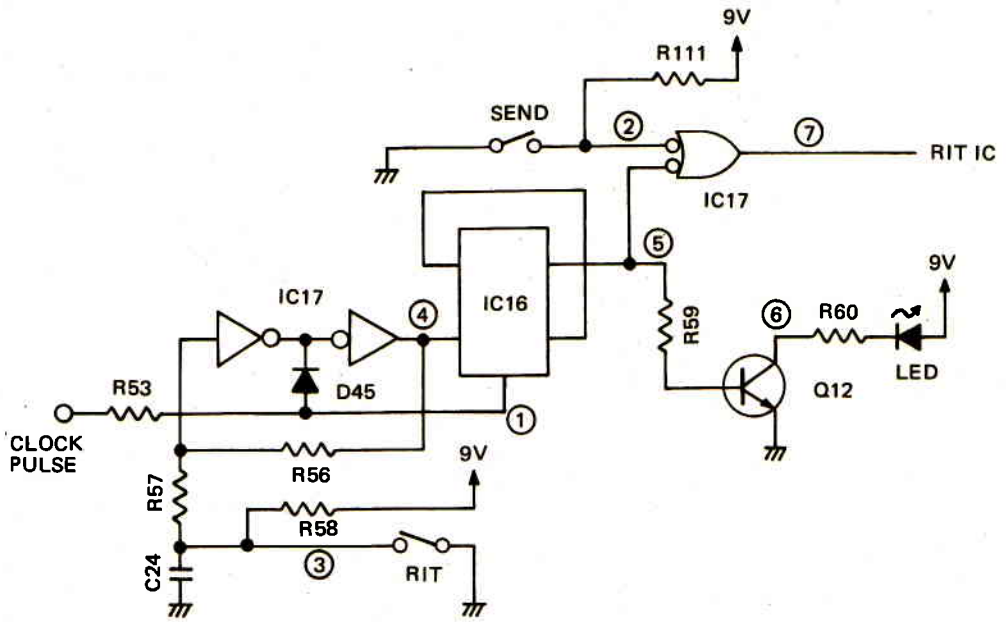
3-6-5 RIT CIRCUIT

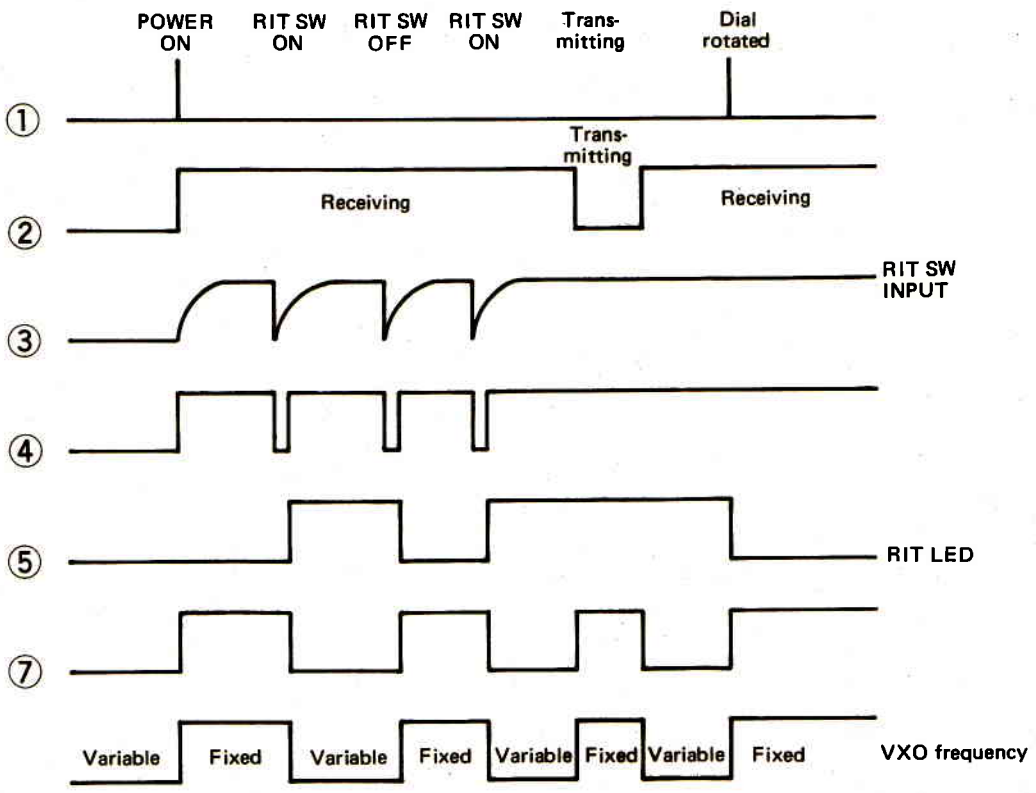
The RIT function is switched by Q13 and Q14 of the PLL unit which are turned ON or OFF by the RIT switch.

During RIT is ON, by turning the tuning control knob, a clock pulse is fed to a flip-flop of IC16 through R53, resets it and also turns RIT OFF.

Similarly, transmitting with RIT ON causes the RIT IC terminal to become H-level while the flip-flop stays in its original state, thus to turn RIT OFF. RIT comes ON when operation is returned to the receive mode.

RIT Control Time Chart





3-6-6 SCAN CLOCK OSCILLATION CONTROL CIRCUIT

By R5 pulse of the CPU output, output ④ of the scan clock oscillation control circuit is sampled and fed to the CPU input terminal K2 as clock for scanning.

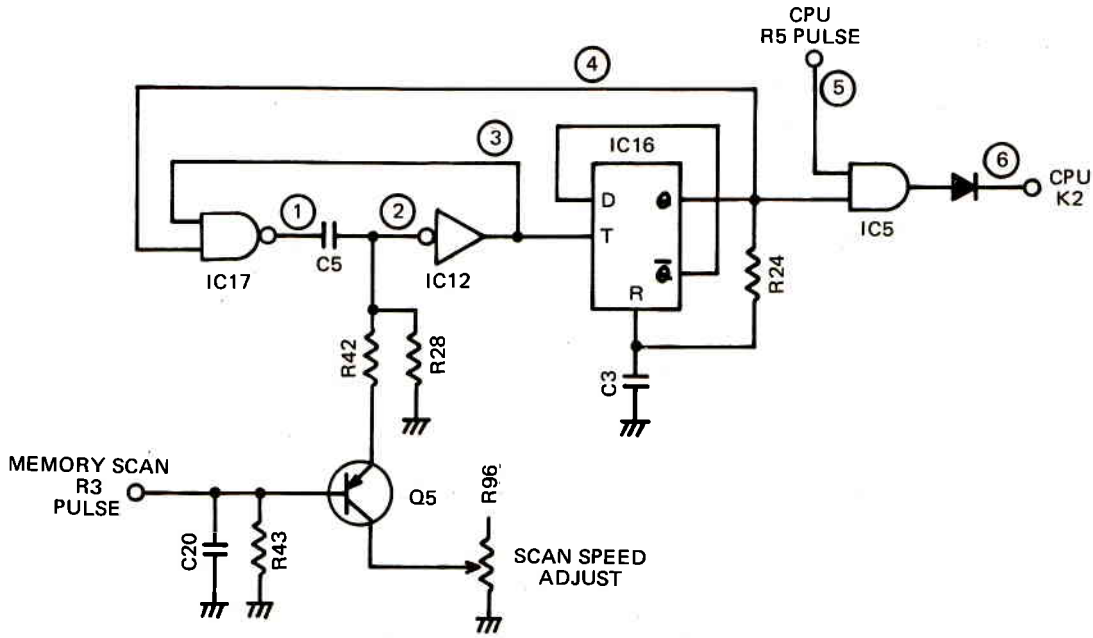
In this oscillator circuit at the time of memory scan, R3 pulse of the CPU output is charged into C20 and turns Q5 OFF.

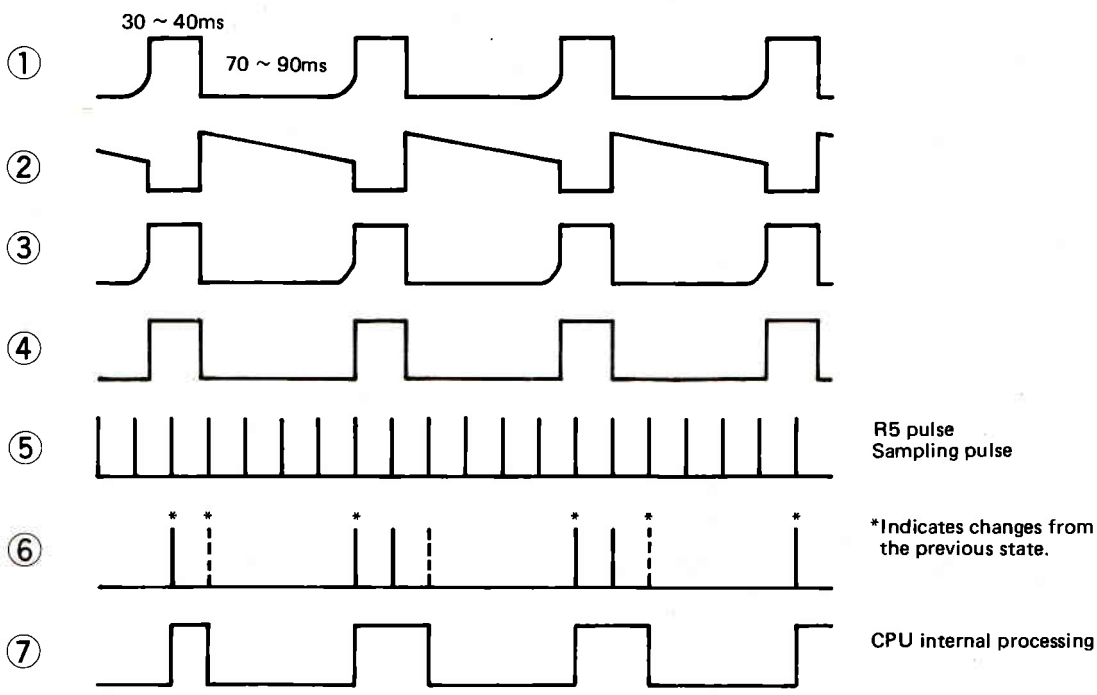
Time constant of the monostable multivibrator composed of IC12 and IC17 is determined by C5 and R28.

In the other scan modes, Q5 is turned ON, R96 on the PLL board are paralleled with R28 and scan speed becomes faster. Scan speed can be adjusted by R96.

In other words, the memory scan scans slowly while the others can faster and their scan speed can be adjusted.

Signals sampled by R5 of the CPU output are fed to the CPU input K2 and are internally processed to detect leading and trailing edges, read the period of scan clock and determine scan speed.





3-6-7 SCAN START STOP CONTROL CIRCUITS

The three circuits – IC11 (A) and IC12 (A), IC13 (B), and IC12 (C) (D) – are monostable multivibrators. These circuits operate in three modes: VFO A, VFO B and Memory Write.

a) VFO A

By pushing the MS/MW switch ON, the monostable multivibrator consisting of IC11 (A) and IC12 (A) is started after processing for chattering absorbed at R30, C32, R31 and C8.

This output is stored in the flip-flop of IC13 (A) and scan is started using the NAND output of this flip-flop output and the above-mentioned monostable multivibrator output as MS/MW signals.

When a signal is received and SQLS becomes H-level, the IC13 (B) monostable multivibrator operates to output signals of STOP 2 mode (described before). At the same time, it inverts the flip-flop of IC13 (A) to return it to the initial state and continues receiving at the scan-stopped frequency until the MS/MW switch is depressed again.

b) VFO B

The same operation with VFO A applies to generation of MS/MW output (⑥).

In VFO B, input of IC11 (D) becomes H-level and its output L-level.

So, output of the IC13 (B) monostable multivibrator can output STOP 2 signals but IC13 (A) is not reset because the signal to reset IC13 (A) becomes L-level with IC11 (D) output.

The IC12 (C) (D) monostable multivibrator is triggered by Q output of IC13 (B) and output ⑩ will rise up in about 16 seconds. The output of this leading edge differentiated by C10, R34 and IC13 (A) output are put out through the IC11 (B) NAND gate as MS/MW signals, thus to cause scan to be restarted.

In VFO B, the flip-flop of IC13 (A) is controlled by the MS/MW switch only.

c) Memory Write

When one of memory channel 1, 2 or 3 is selected, the MC line becomes H-level, resets IC13 (A) and makes Pin 9 of IC11 (B) H-level, thus enabling to memory write at any time when the MS/MW switch is depressed.

- **Explanation on Timing Chart**

Refer to the next pages for explanation on scan start stop time chart and circuit.

② : Removes chattering of the MS/MW switch at R30, C32, C31 and C8.
③ : Oscillates the monostable multivibrator composed of IC11 (A) and IC12 (A) using ② as a trigger.
④ : Operates binary counting of the flip-flop of IC13 (A) using ③ as a trigger.
⑤ : Inverted output pulse of ④ .
⑥ : NAND output of ③ and ④ . The gate of IC7 (PIN8, 9, 10) is controlled by this pulse.
⑦ : AND output of ③and ⑤ .
The gate of IC5 (PIN4, 5, 6) is controlled by this pulse.
⑧ : Differentiated pulse of SQLS.
⑨ : Output which has started the IC13 (B) monostable multivibrator using ⑧ as a trigger pulse. This permits control of IC7 (PIN6) and STOP 2 operation.
⑩ : Starts the IC12 (C) (D) monostable multivibrator using ⑨ as a trigger. This is a pulse to stop operation in STOP 2 mode for about 16 seconds when there is any receiving signal during scanning.
⑪ : Leading edge pulse of ⑩ differentiated by R34 and C10.

⑪ and ④ cause MS/MW to be operated, and restarted in STOP 2 mode after receiving a signal for about 16 seconds, provided that the above-mentioned scan start stop applies to VFO B only.

3-6-8 POWER CIRCUIT

This set employs a special stabilizing circuit to prevent CPU malfunction caused by fluctuations in supply voltage.

When 13.8V is applied to the cathode of D44, this Zener diode (Zener voltage 9V) is turned ON. So, Q11 is turned ON and the bases of Q9 and Q10 respectively becomes grounds level.

As a result, Q9 is turned OFF and Q10 ON, thus the emitter of Q10 becomes ground level.

This is a normal state and current passes D42 and C22 is charged. At the same time, by the diode effect between emitter and base of Q7, a charging current flows to C21 as base current of Q7 and Q7 is turned ON. Current from the collector of Q7 is charged into C18 and potential starts to rise.

When base voltage of Q8 becomes to about 0.6V, Q8 is turned ON, base current of Q7 is switched to flow through R49, colletor and emitter of Q8, and output voltage of Q7 continues to rise.

When this voltage reaches to about 7.6V, Zener diode D4 is turned ON and Zener voltage (7.6V) appears on its anode. This voltage is divided at R44 and R45, and is fed to the base of Q6.

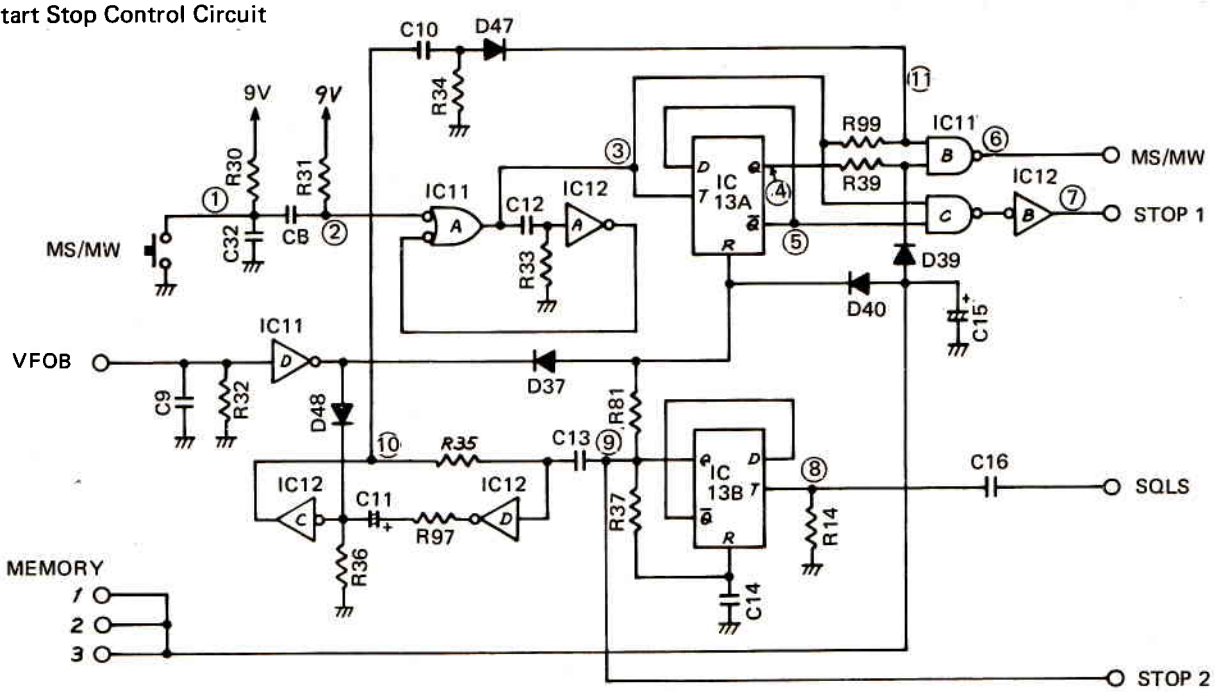
When Q6 starts to turn ON, base voltage of Q8 is controlled by the collector current of Q6.

By this, collector current of Q8 (base current of Q7) is controlled and output voltage of Q7 is stabilized at 9V.

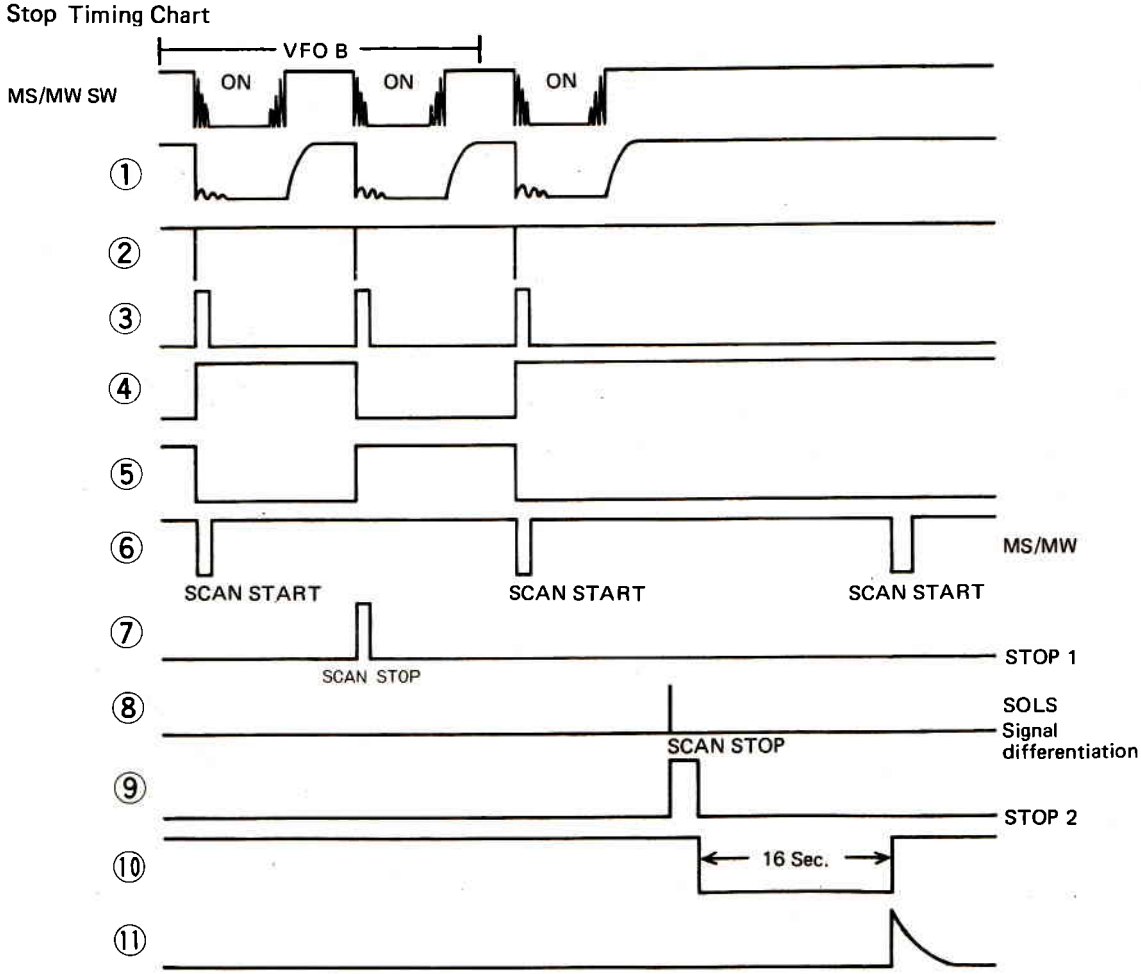
When input voltage of Q7 varies, output voltage fluctuates accordingly. Later, control is established in the order of Q6 – Q8 – Q7 through the above-mentioned operations and regulated voltage is obtained.

If supply voltage rapidly drops to about 10V, D44 is turned OFF and the output in which R3, R5 and R7 pulses from the CPU have been wired-OR'ed at IC19 (diode array) is applied to the base of Q11. (This is canceled when D44 is ON.) Accordingly, Q11 repeats ON-OFF and so does Q9 and Q10, alternately. As a result, C22 is charged through D42 when Q10 is ON. When Q9 is ON, charging voltage of C22 is added to supply voltage. Thus, high voltage is applied to the emitter of Q7 as may be explained by the theory of voltage doubler, resulting in secured regulated voltage.

Scan Start Stop Control Circuit



Scan Start Stop Timing Chart



3-7 AC POWER SUPPLY UNIT

The AC power supply built in the unit is a newly developed switching regulator system, providing light weight and a high level of efficiency.

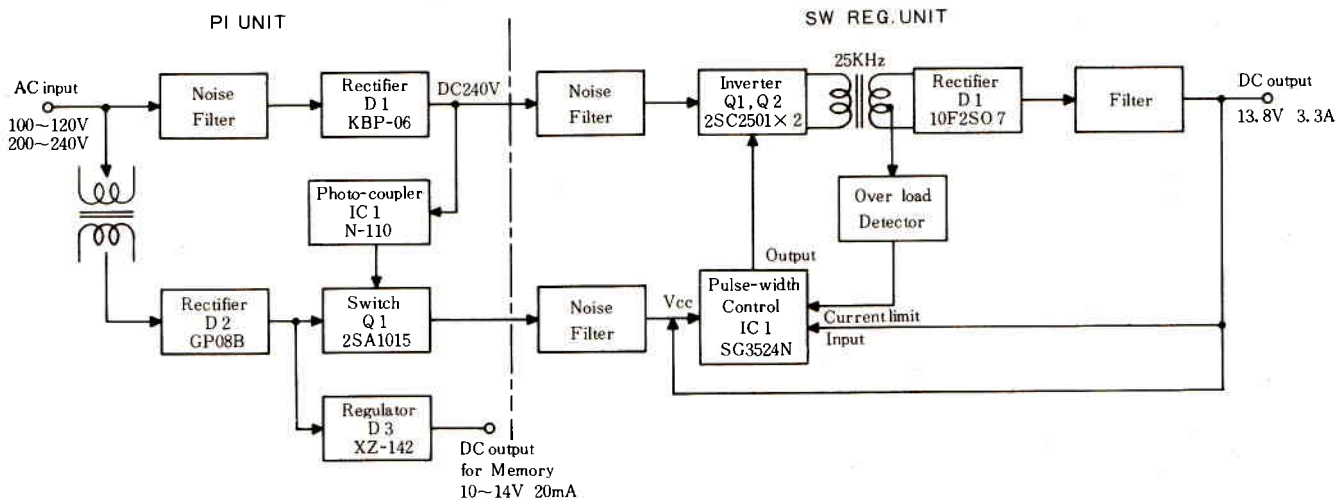
PI UNIT

The AC power supplied from Pins 2 and 3 of P1 is fed to the memory power transformer L2. The output voltage from the secondary of L2 is rectified and filtered by D2 and C7, and switched by Q1 before being fed to the SW REG Unit. The rectified and filtered power is put out also to Pin 4 of P1 as the 10 ~ 14V memory power source. D3 is an overvoltage-protection zener diode, and D4 is a reverse-flow-protection diode. The AC power from Pins 1 and 3 of P1 through line filter L1 is rectified by D1 and supplied through filter C5 and C6 to the SW REG. IC1 is operated by the divided voltage with R5 and R6 to turn ON Q1.

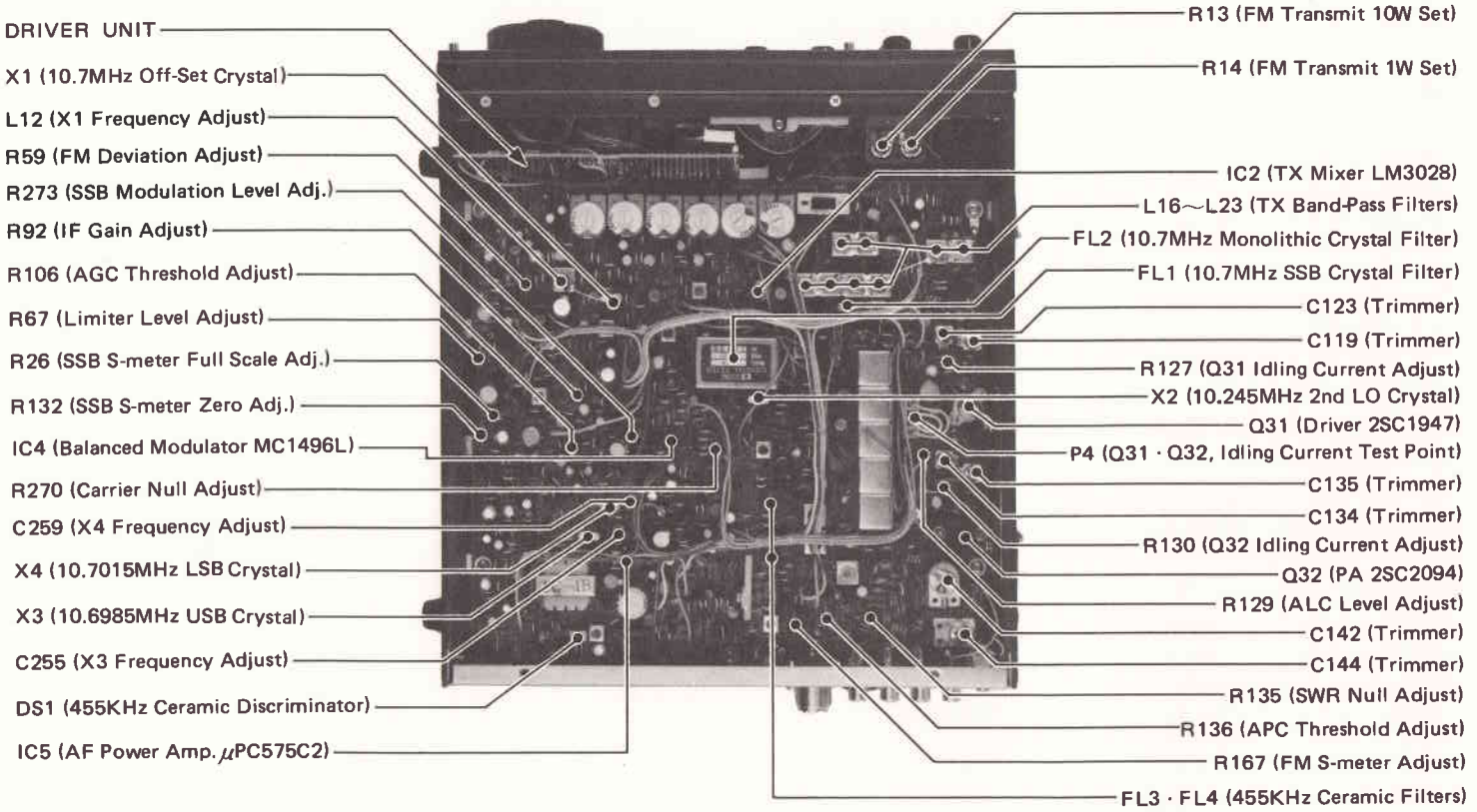
SW REG (Switcing Regulator) UNIT

+120V from H1 and −120V from H2 are fed through various noise filters to the collector of Q1 and the emitter of Q2. IC1 is a switching regulator IC and contains a 5V reference voltage, oscillator circuit, op-amp, comparator, and current limit circuit. The oscillating frequency is set by the time constant circuit of R3 and C6. The pulse signals from Pins 12 and 13 are fed through the pulse transformer L5 to Q1, to switch Q1 and Q2 alternately so that the ±120V is put out at the primary of L6. The output voltage at the secondary is rectified by D1 and filtered by L7, L8, C13, and C14, and then 13.8V DC is put out at Pin 5 of P1.

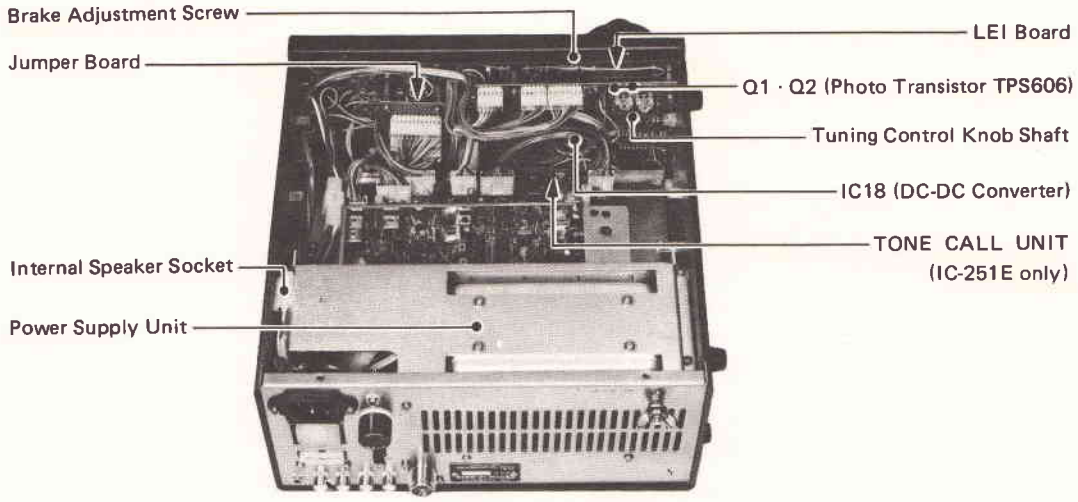
POWER SUPPLY UNIT BLOCK DIAGRAM

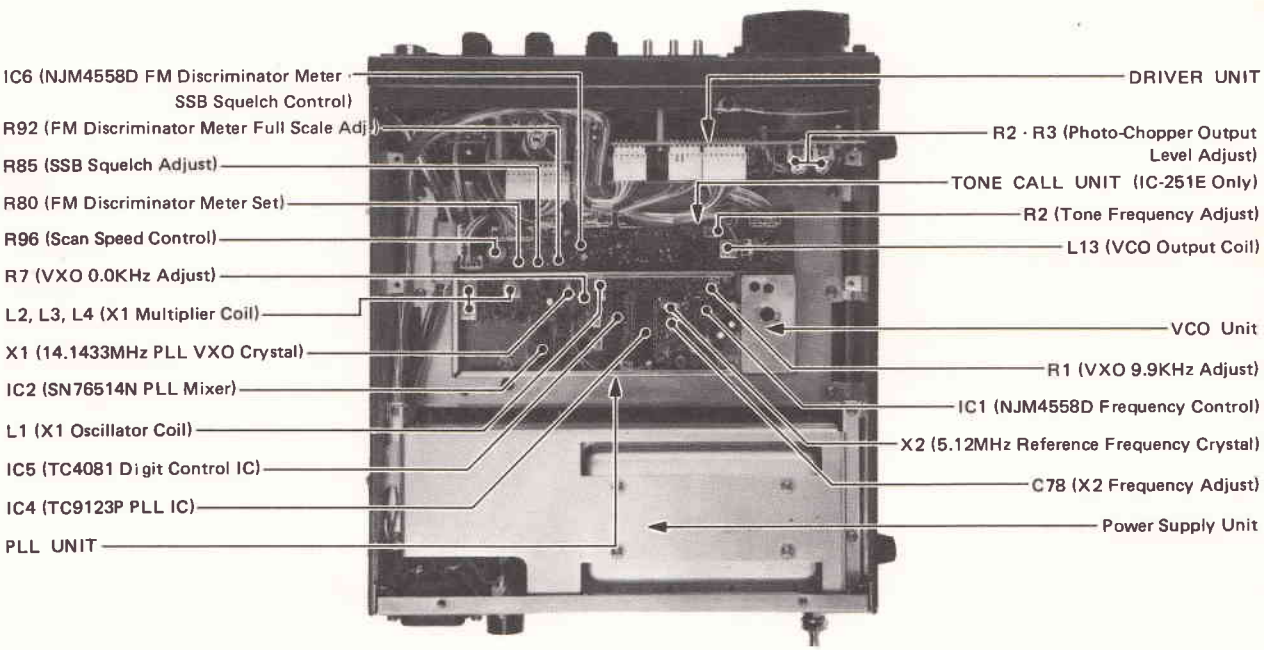


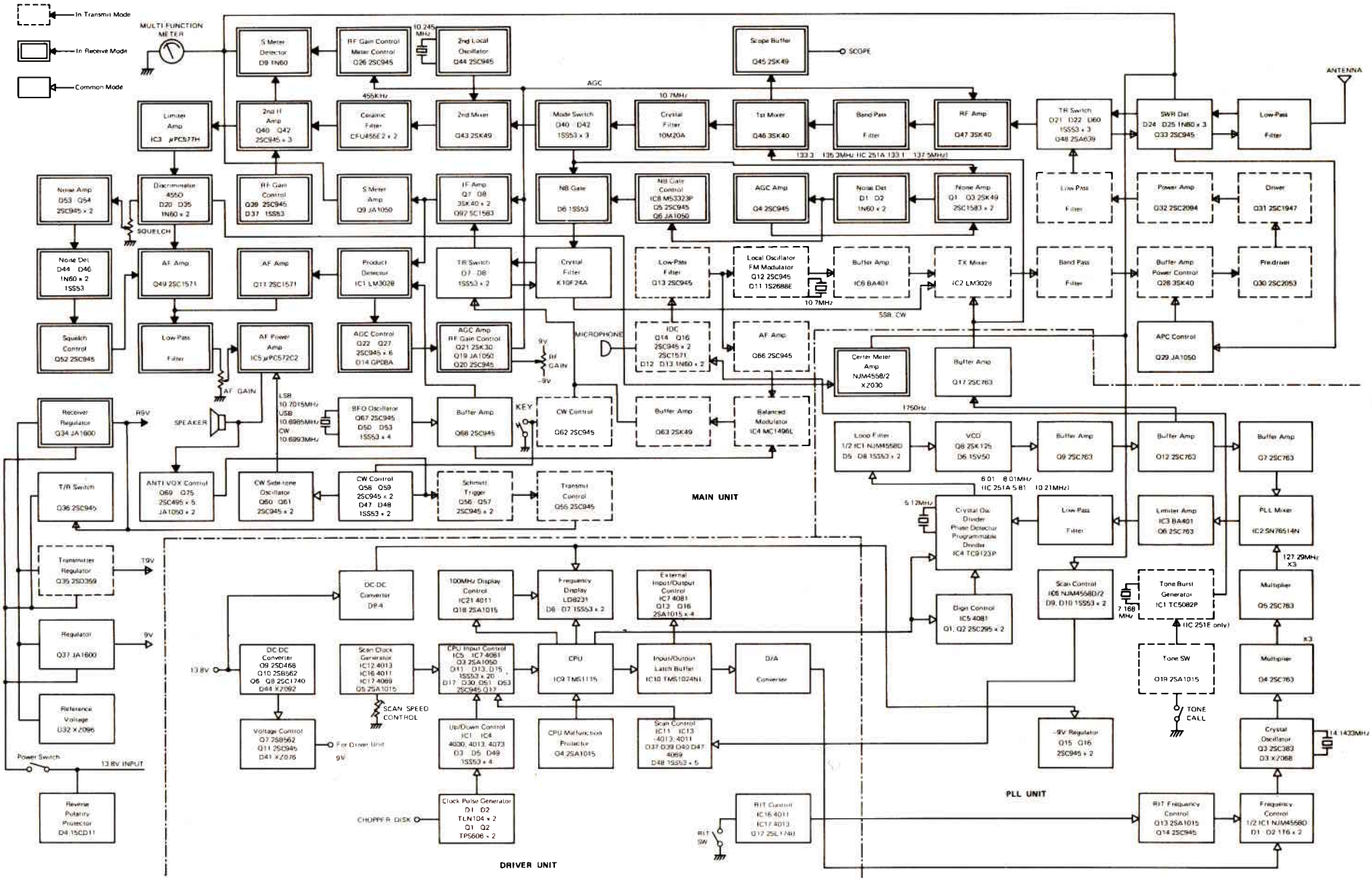
4-1 MAIN UNIT SIDE



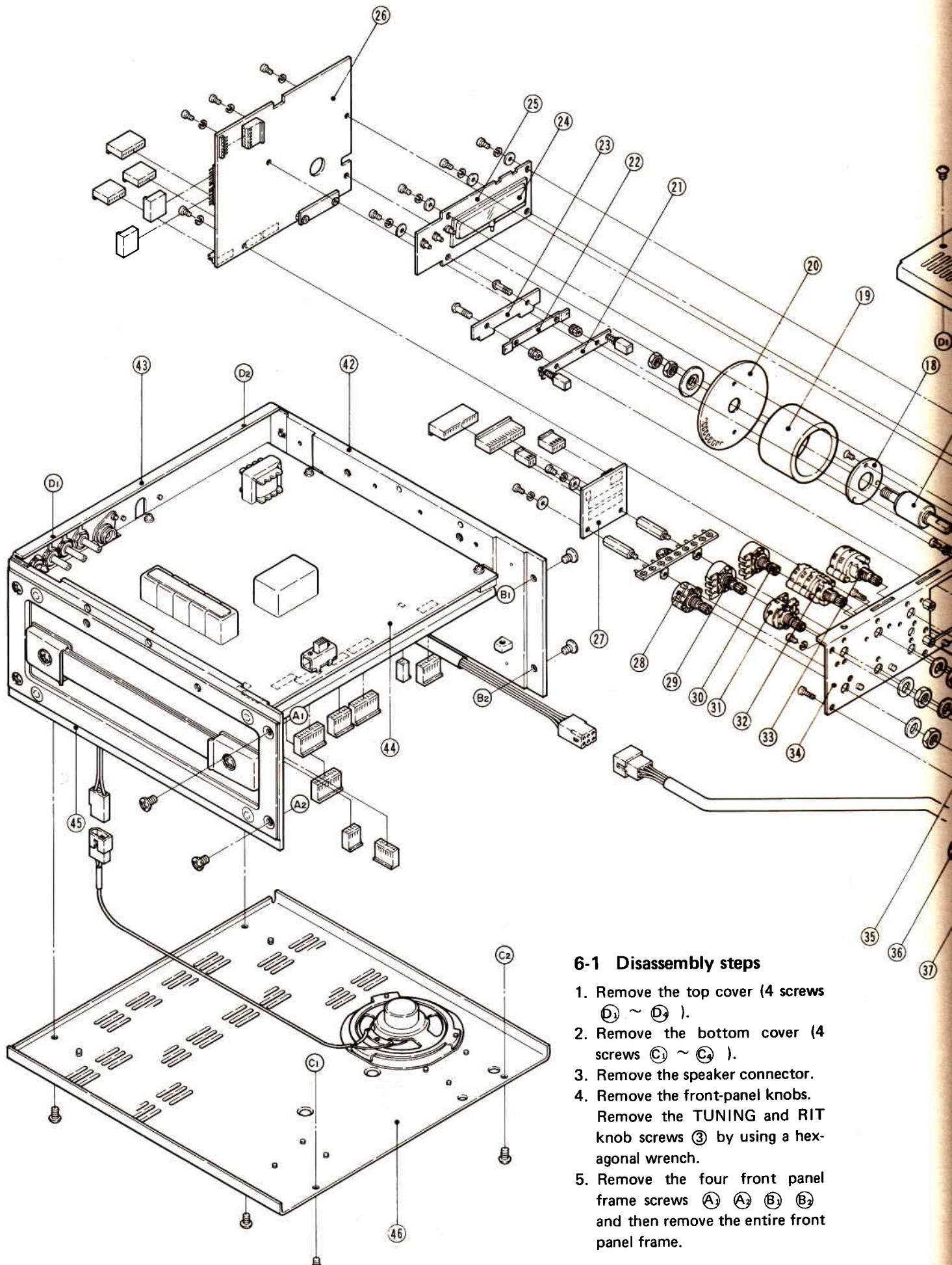
4-2 PLL UNIT SIDE





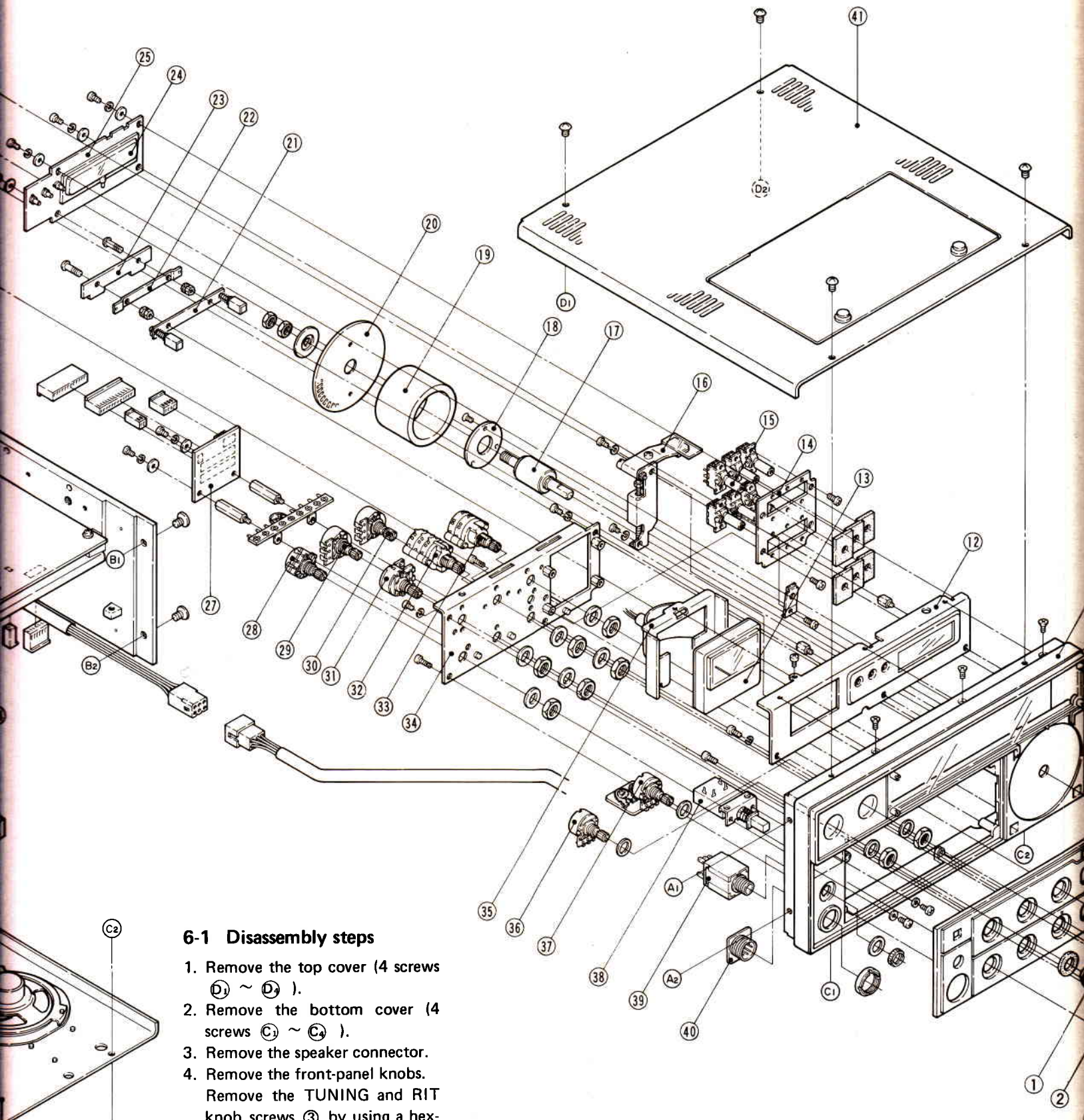

In Transmit Mode
In Receive Mode
Common Mode
MULTI FUNCTION METER
S Meter Detector D8 1N60
RF Gain Control Meter Control Q26 2SC945
10.245 MHz
2nd Local Oscillator Q44 2SC945
Scope Buffer Q45 2SK49
SCOPE
ANTENNA
AGC
455KHz
10.7MHz
Limiter Amp IC3 μPC577H
2nd IF Amp Q40 Q42 2SC945 × 3
Ceramic Filter CFU455E2 × 2
2nd Mixer Q43 2SK49
Mode Switch Q40 Q42 1SS53 × 3
Crystal Filter 10M20A
1st Mixer Q46 3SK40
Band Pass Filter
RF Amp Q47 3SK40
T/R Switch Q21 Q22 D60 1SS53 × 3 Q48 2SA639
SWR Det D24 D25 1N60 × 3 Q33 2SC945
Low-Pass Filter
133.3 135.3MHz (IC 251A 133.1 137.5MHz)
Noise Amp D53 Q54 2SC945 × 2
Discriminator 455D D20 D35 1N60 × 2
SQUELCH
RF Gain Control Q36 2SC945 D37 1SS53
S Meter Amp Q9 2A1050
IF Amp Q7 Q8 3SK40 × 2 Q67 2SC1583
NB Gate D6 1SS53
NB Gate Control IC8 M53323P Q5 2SC945 Q6 2A1050
AGC Amp Q4 2SC945
Noise Det D1 D2 1N60 × 2
Noise Amp Q1 Q3 2SK49 2SC1583 × 2
Low Pass Filter
Power Amp Q32 2SC2094
Driver Q31 2SC1947
Noise Det D44 D46 1N60 × 2 1SS53
AF Amp Q49 2SC1571
AF Amp Q11 2SC1571
Product Detector IC1 LM3028
TR Switch Q7 Q8 1SS53 × 2
Crystal Filter K10F24A
Low-Pass Filter Q13 2SC945
Local Oscillator FM Modulator Q12 2SC945 D11 1S2688E
Buffer Amp IC6 BA401
TX Mixer IC2 LM3028
Band Pass Filter
Buffer Amp Power Control Q28 3SK40
Predriver Q30 2SC2053
10.7MHz
SSB, CW
Squelch Control Q52 2SC945
Low Pass Filter
AF Power Amp IC5 μPC572C2
AGC Control Q22 Q27 2SC945 × 6 D14 GP08A
AGC Amp RF Gain Control Q21 2SK30 Q19 2A1050 Q20 2SC945
9V
RF GAIN
-9V
MICROPHONE
IDC Q14 Q16 2SC945 × 2 2SC1571 D12 D13 1N60 × 2
AF Amp Q66 2SC945
Center Meter Amp NJM4558/2 XZ030
Buffer Amp Q17 2SC763
APC Control Q29 2A1050
AF GAIN
LSB 10.7015MHz USB 10.6985MHz CW 10.6993MHz
Receiver Regulator Q34 2A1600
R9V
SPEAKER
BFO Oscillator Q67 2SC945 D50 D53 1SS53 × 4
Buffer Amp Q68 2SC945
KEY
CW Control Q62 2SC945
Buffer Amp Q63 2SK49
Balanced Modulator IC4 MC1496L
1750Hz
Loop Filter 1/2 IC1 NJM4558D D5 D8 1SS53 × 2
VCO Q8 2SK125 D6 1SV50
Buffer Amp Q9 2SC763
Buffer Amp Q12 2SC763
Buffer Amp Q7 2SC763
T/R Switch Q36 2SC945
ANTI VOX Control Q69 Q75 2SC495 × 5 2A1050 × 2
CW Side-tone Oscillator Q60 Q61 2SC945 × 2
CW Control Q58 Q59 2SC945 × 2 D47 D48 1SS53 × 2
Schmitt Trigger Q56 Q57 2SC945 × 2
Transmit Control Q55 2SC945
MAIN UNIT
6.01 8.01MHz (IC 251A 5.81 10.21MHz)
5.12MHz
Crystal Osc. Divider Phase Detector Programmable Divider IC4 TC9123P
Low Pass Filter
Limiter Amp IC3 BA401 Q6 2SC763
PLL Mixer IC2 SN76514N
127.29MHz X3
Transmitter Regulator Q35 2SD359
T9V
Regulator Q37 2A1600
9V
DC DC Converter DP4
100MHz Display Control IC21 4011 Q18 2SA1015
Frequency Display LD8221 D6 D7 1SS53 × 2
External Input/Output Control IC7 4081 Q13 Q16 2SA1015 × 4
Digit Control IC5 4081 Q1 Q2 2SC295 × 2
Scan Control IC6 NJM4558D/2 D9, D10 1SS53 × 2
7.168 MHz
Tone Burst Generator IC1 TC5082P
(IC 251E only)
Multiplier Q5 2SC763
13.8V
DC DC Converter Q9 2SD468 Q10 2SB562 Q6 Q8 2SC1740 D44 XZ092
Scan Clock Generator IC12 4013 IC16 4011 IC17 4069 Q5 2SA1015
SCAN SPEED CONTROL
CPU Input Control IC5 IC7 4081 Q3 2SA1050 D11 D13, D15 1SS53 × 20 D17 D30 D51 D53 2SC945 Q37
CPU IC9 TMS1115
Input/Output Latch Buffer IC10 TMS1024NL
D/A Converter
Tone SW Q19 2SA1015
TONE CALL
x3
Multiplier Q4 2SC763
Reference Voltage D32 XZ096
Power Switch
13.8V INPUT
Voltage Control Q7 2SB562 Q11 2SC945 D41 XZ076
For Driver Unit
9V
Up/Down Control IC1 IC4 4030, 4013, 4073 D3 D5 D49 1SS53 × 4
CPU Malfunction Protector Q4 2SA1015
Scan Control IC11 IC13 4013, 4011 D37 D39 D40 D47 4069 D48 1SS53 × 5
-9V Regulator Q15 Q16 2SC945 × 2
14.1433MHz
Crystal Oscillator Q3 2SC383 D3 XZ068
Reverse Polarity Protector D4 15CD11
Clock Pulse Generator D1 D2 TLN104 × 2 Q1 Q2 TP5606 × 2
CHOPPER DISK
RIT SW
RIT Control IC16 4011 IC17 4013 Q17 2SK1740
RIT Frequency Control Q13 2SA1015 Q14 2SC945
Frequency Control 1/2 IC1 NJM4558D D1 D2 1T6 × 2
PLL UNIT
DRIVER UNIT

SECTION 6 DISASSEMBLY



6-1 Disassembly steps

1. Remove the top cover (4 screws Ⓓ1 ~ Ⓓ4).
2. Remove the bottom cover (4 screws Ⓒ1 ~ Ⓒ4).
3. Remove the speaker connector.
4. Remove the front-panel knobs. Remove the TUNING and RIT knob screws ③ by using a hexagonal wrench.
5. Remove the four front panel frame screws Ⓐ1 Ⓐ2 Ⓑ1 Ⓑ2 and then remove the entire front panel frame.



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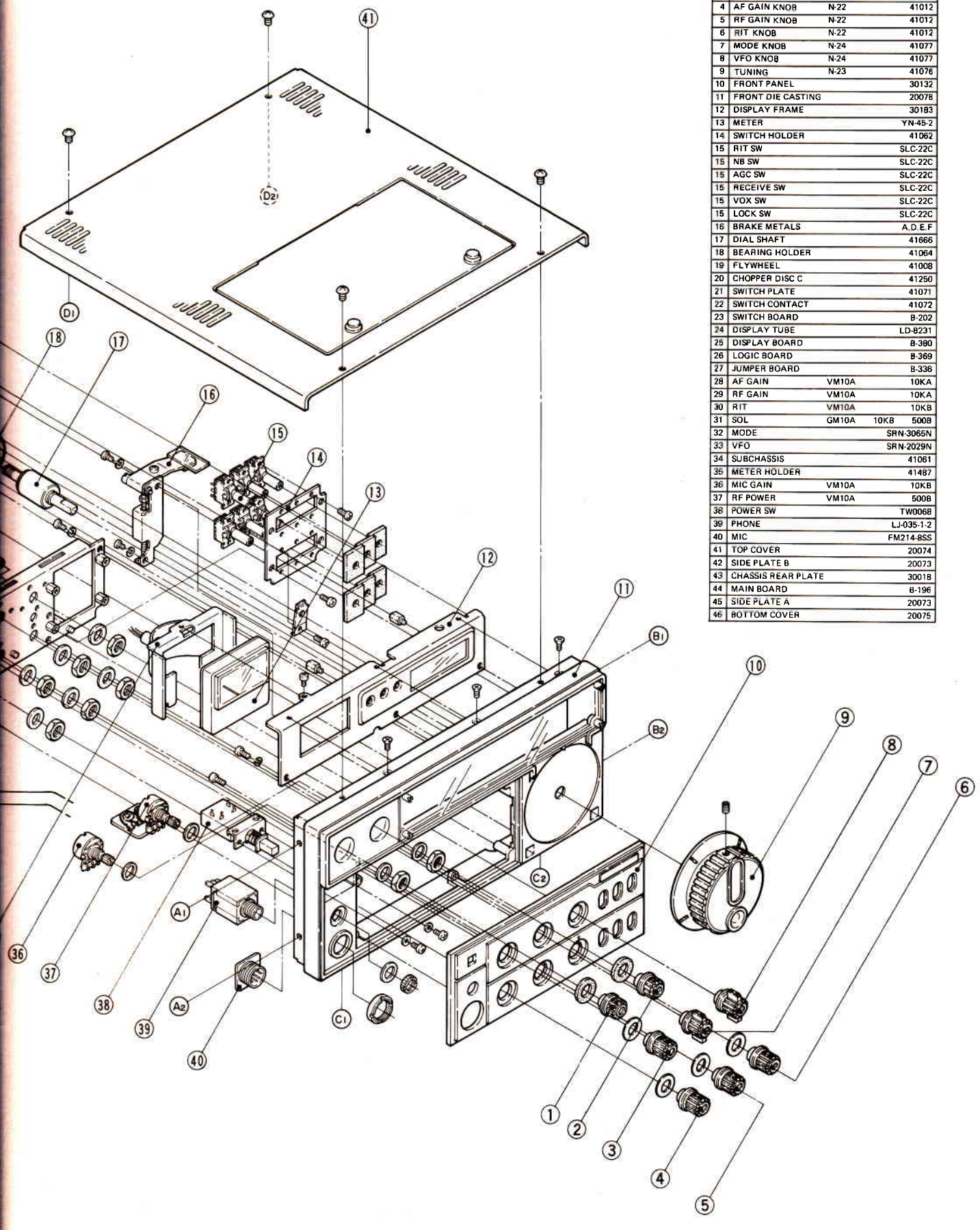
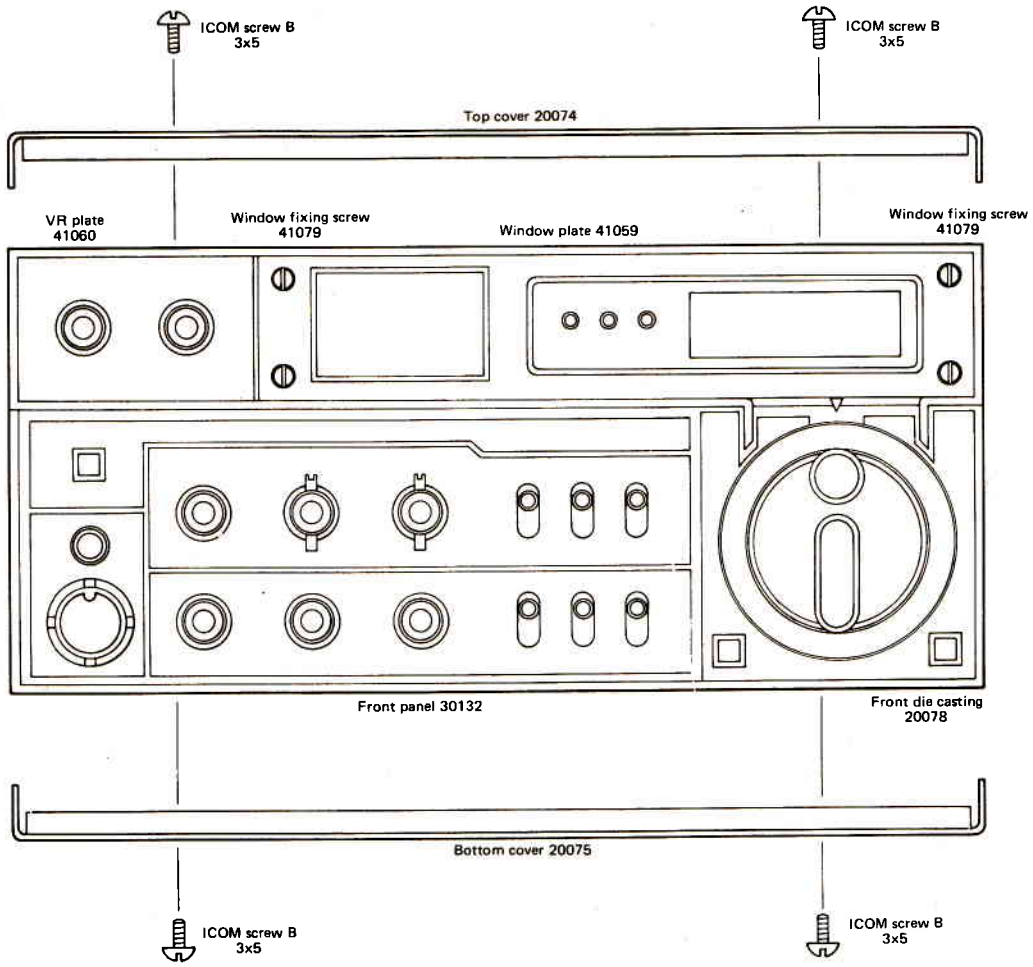
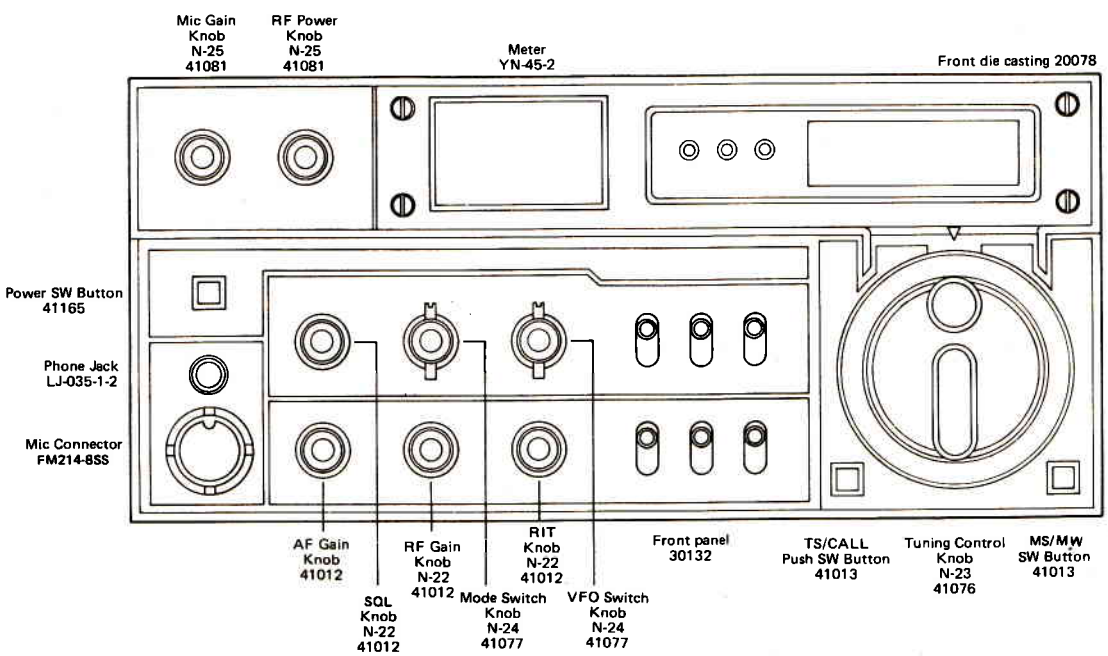
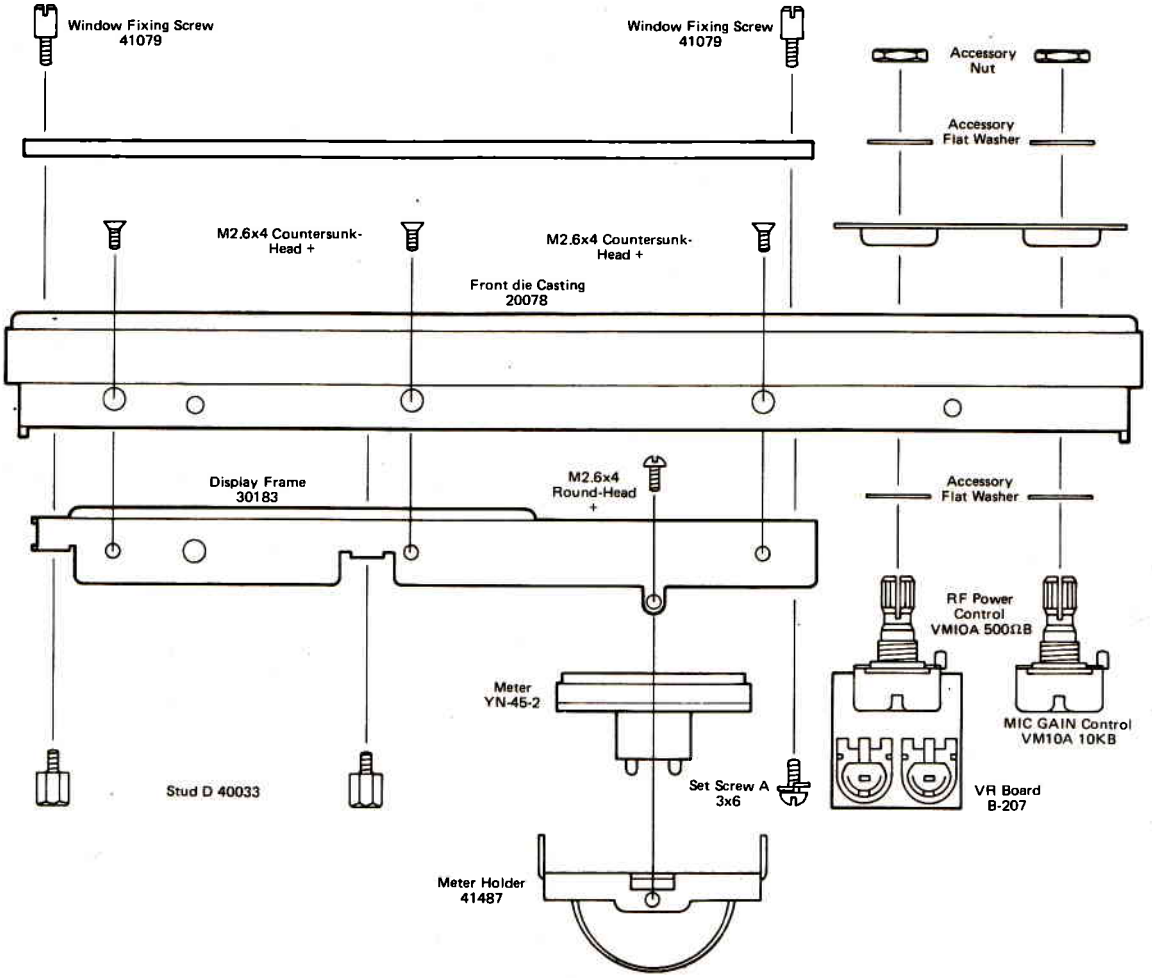


No.	Parts Name		
1	MIC GAIN KNOB	N-25	41081
2	RF POWER KNOB	N-25	41081
3	SQUELCH KNOB	N-22	41012
4	AF GAIN KNOB	N-22	41012
5	RF GAIN KNOB	N-22	41012
6	RIT KNOB	N-22	41012
7	MODE KNOB	N-24	41077
8	VFO KNOB	N-24	41077
9	TUNING	N-23	41076
10	FRONT PANEL		30132
11	FRONT DIE CASTING		20078
12	DISPLAY FRAME		30183
13	METER		YN-45-2
14	SWITCH HOLDER		41062
15	RIT SW		SLC-22C
15	NB SW		SLC-22C
15	AGC SW		SLC-22C
15	RECEIVE SW		SLC-22C
15	VOX SW		SLC-22C
15	LOCK SW		SLC-22C
16	BRAKE METALS		A.D.E.F
17	DIAL SHAFT		41666
18	BEARING HOLDER		41064
19	FLYWHEEL		41008
20	CHOPPER DISC C		41250
21	SWITCH PLATE		41071
22	SWITCH CONTACT		41072
23	SWITCH BOARD		B-202
24	DISPLAY TUBE		LD-8231
25	DISPLAY BOARD		B-380
26	LOGIC BOARD		B-369
27	JUMPER BOARD		B-336
28	AF GAIN	VM10A	10KA
29	RF GAIN	VM10A	10KA
30	RIT	VM10A	10KB
31	SOL	GM10A	10KB 500B
32	MODE		SRN-3065N
33	VFO		SRN-2029N
34	SUBCHASSIS		41061
35	METER HOLDER		41487
36	MIC GAIN	VM10A	10KB
37	RF POWER	VM10A	500B
38	POWER SW		TW0068
39	PHONE		LJ-035-1-2
40	MIC		FM214-8SS
41	TOP COVER		20074
42	SIDE PLATE B		20073
43	CHASSIS REAR PLATE		30018
44	MAIN BOARD		B-196
45	SIDE PLATE A		20073
46	BOTTOM COVER		20075

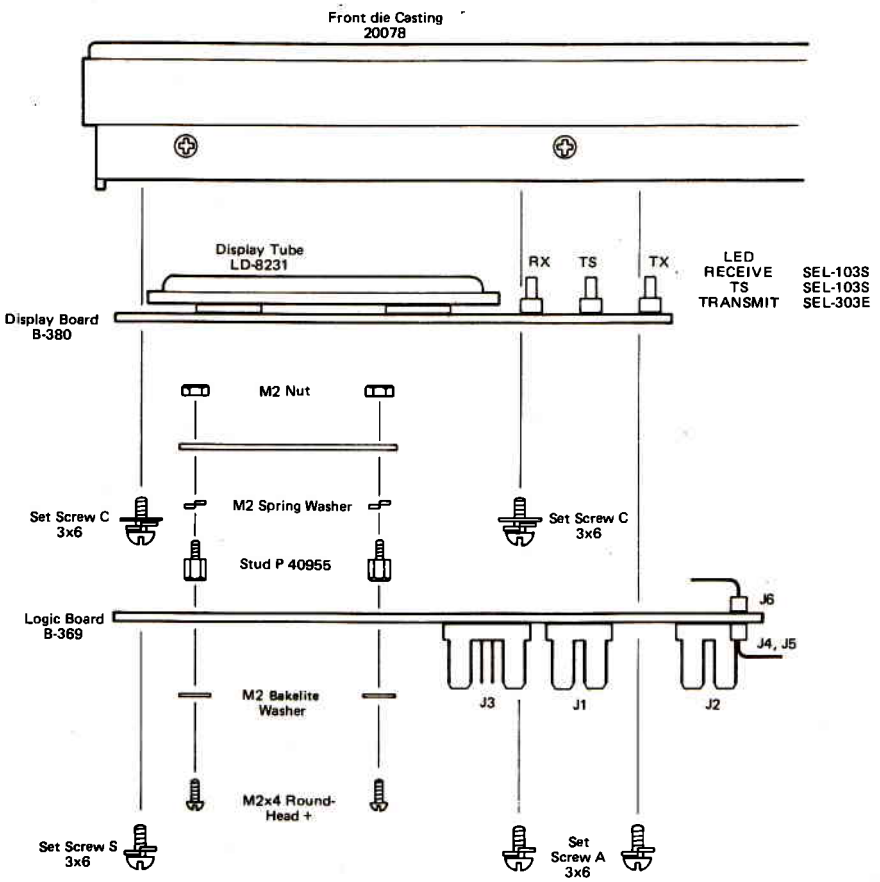
6-2 Front Panel Parts



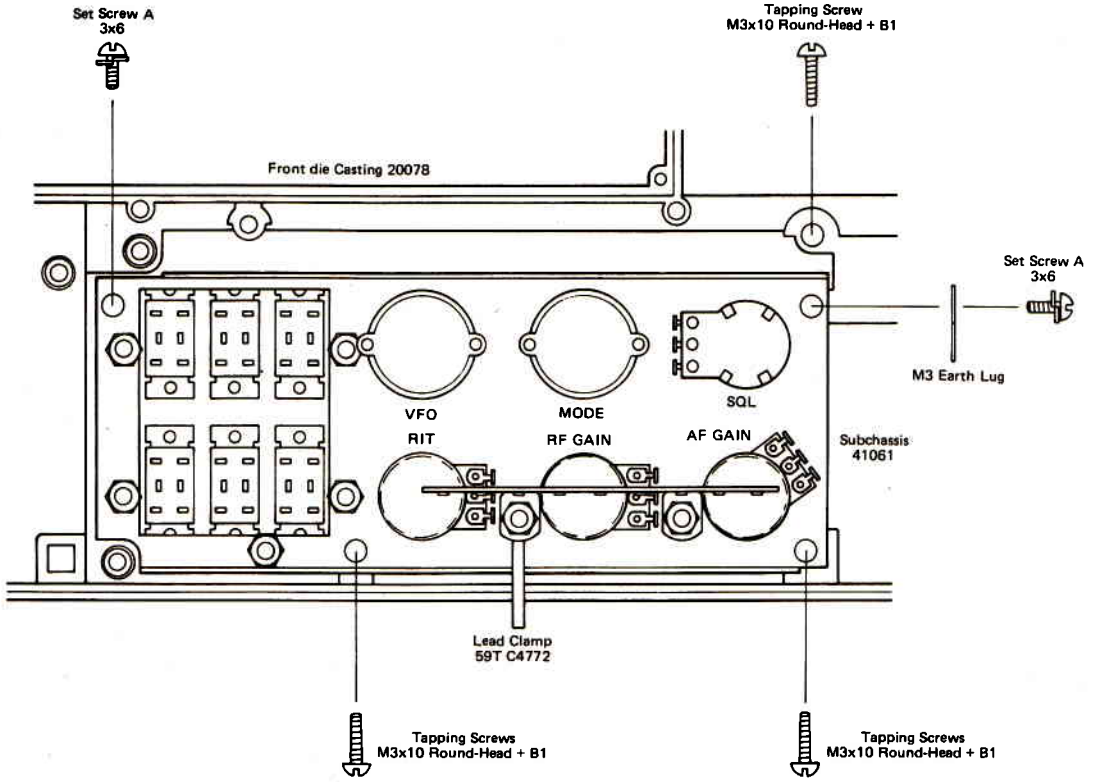


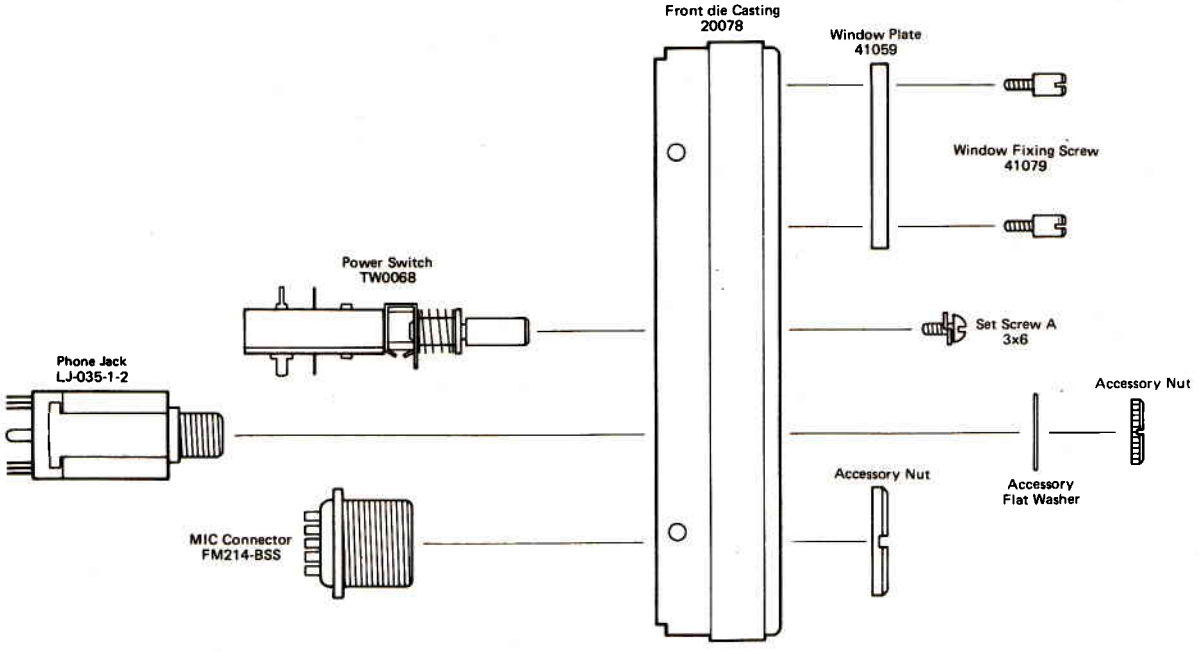


6-4 Display Disassembly

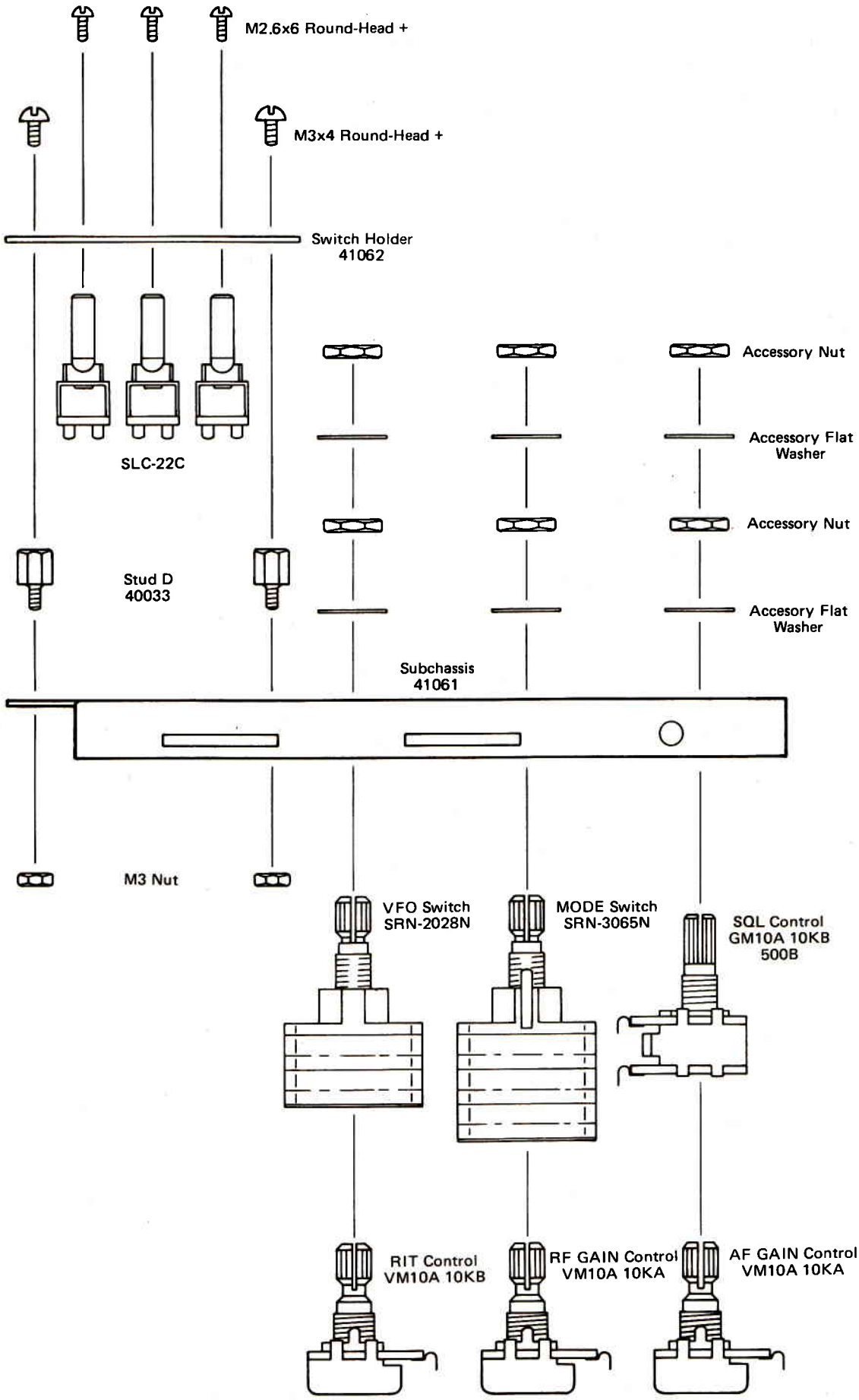


6-5 Front Panel Switches and Jacks Disassembly

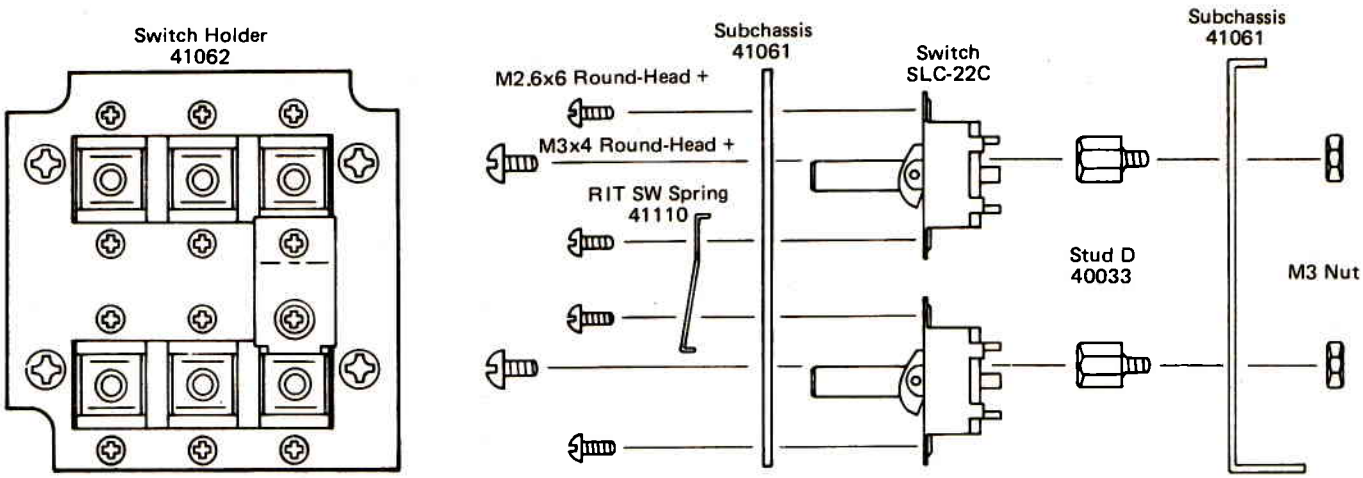


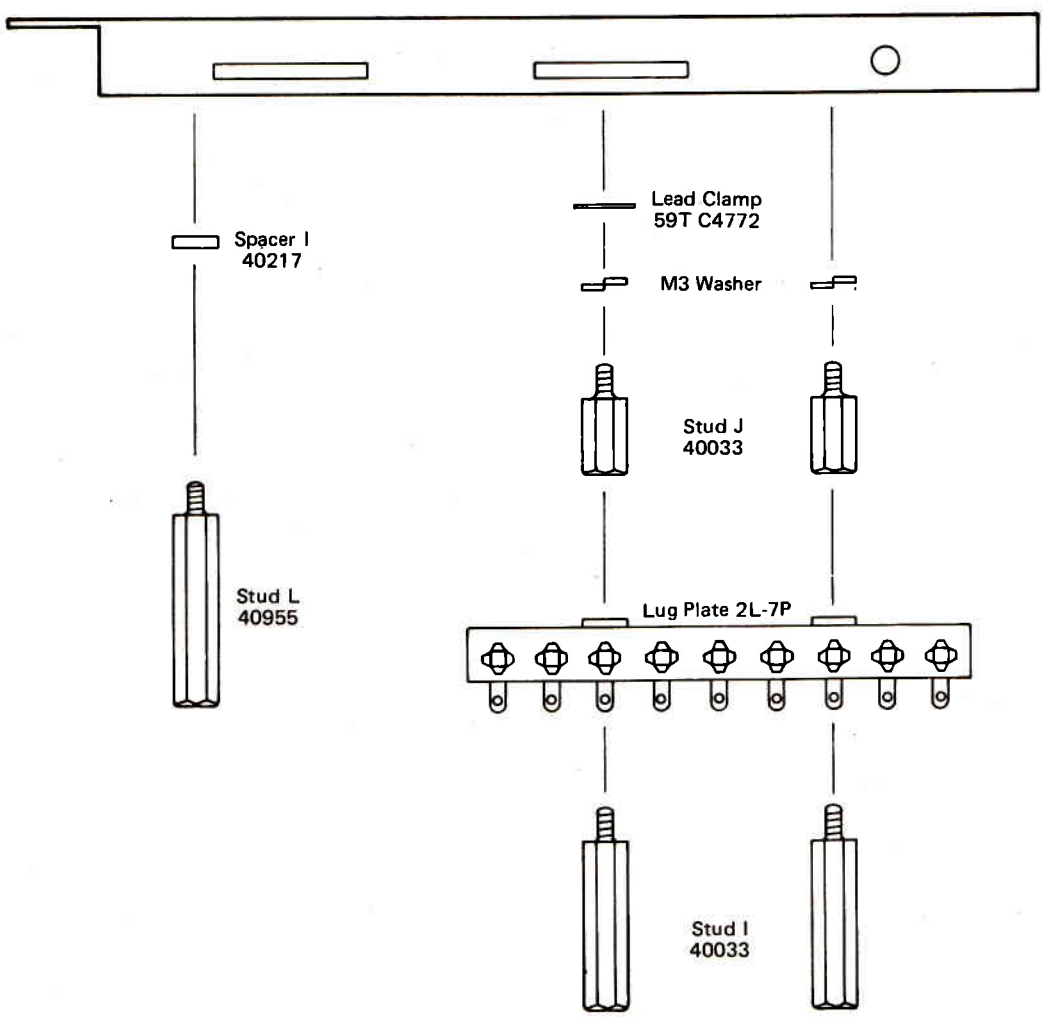


Front Panel Switches and Controls Disassembly

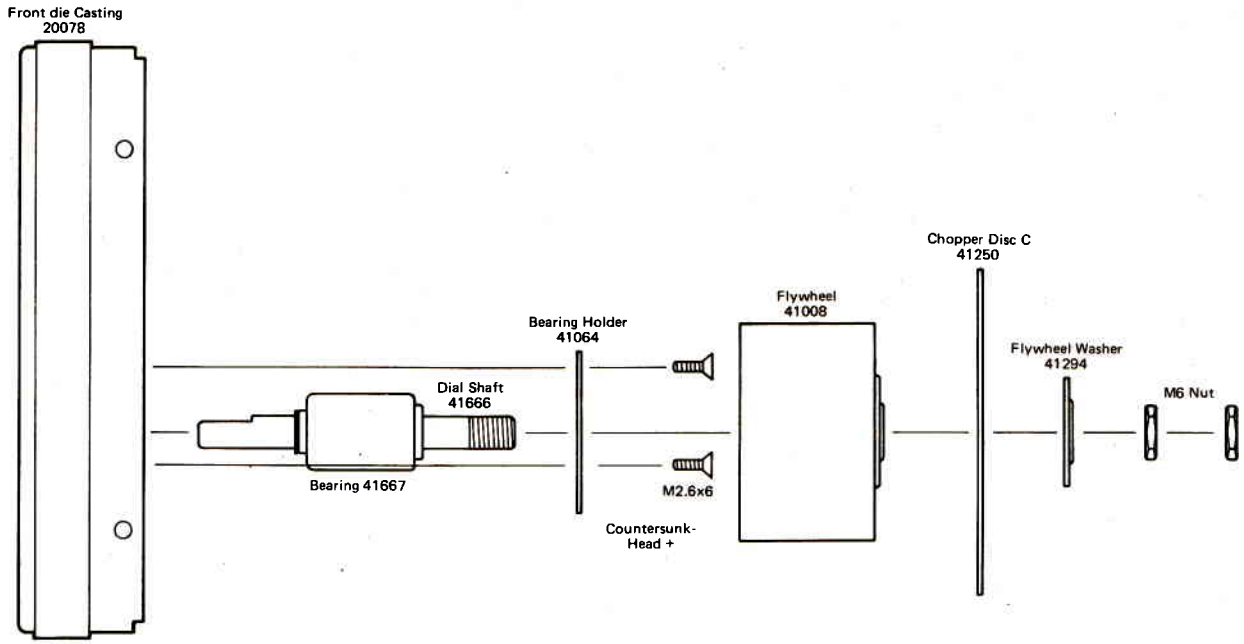


Front Panel Switches Disassembly

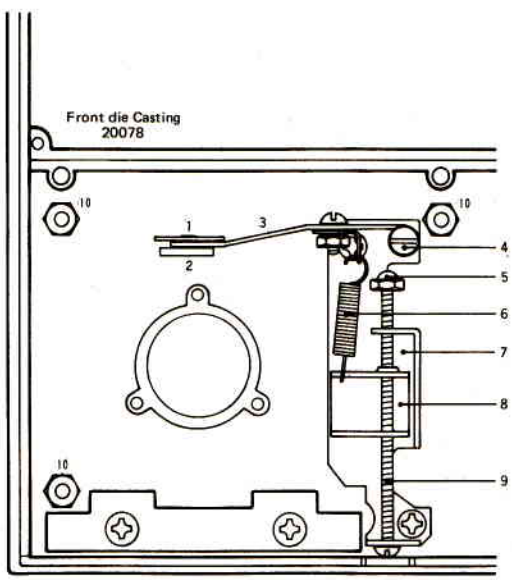




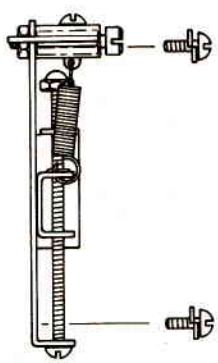
6-6 Tuning Control Disassembly

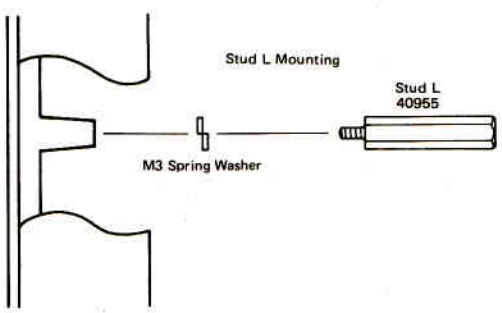


Brake Disassembly

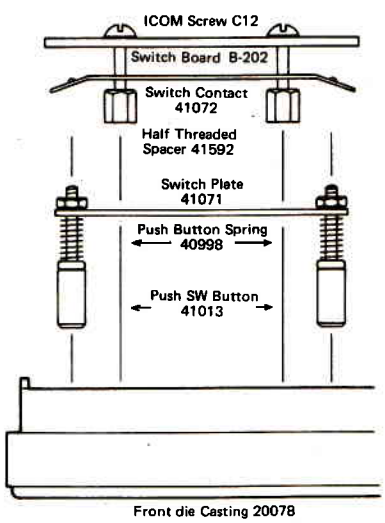


1 Insulator K (40639)
2 Brake pad (41075)
3 Brake metal A (41067)
4 Brake metal D (41070)
5 M3 box nut
6 Gear spring (40554)
7 Brake metal E (41238)
8 Brake metal F (41239)
9 M3x50 round-head +
10 Stud L (40955)

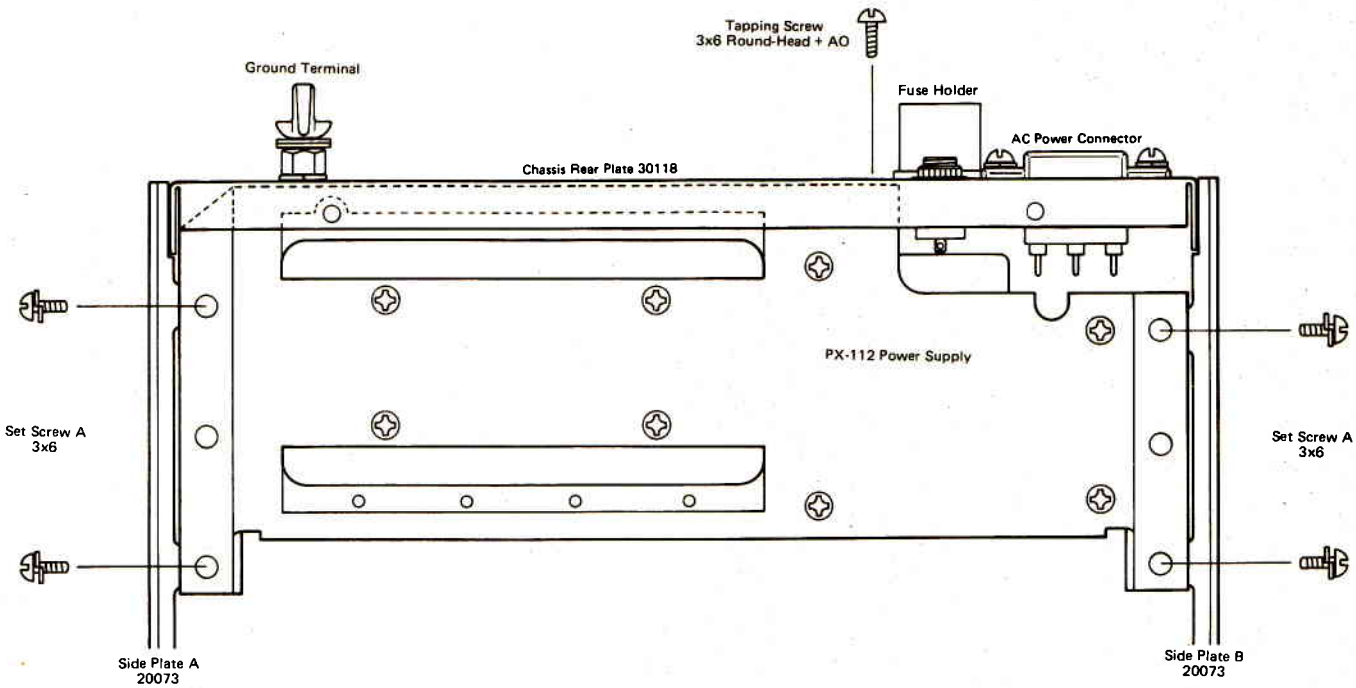




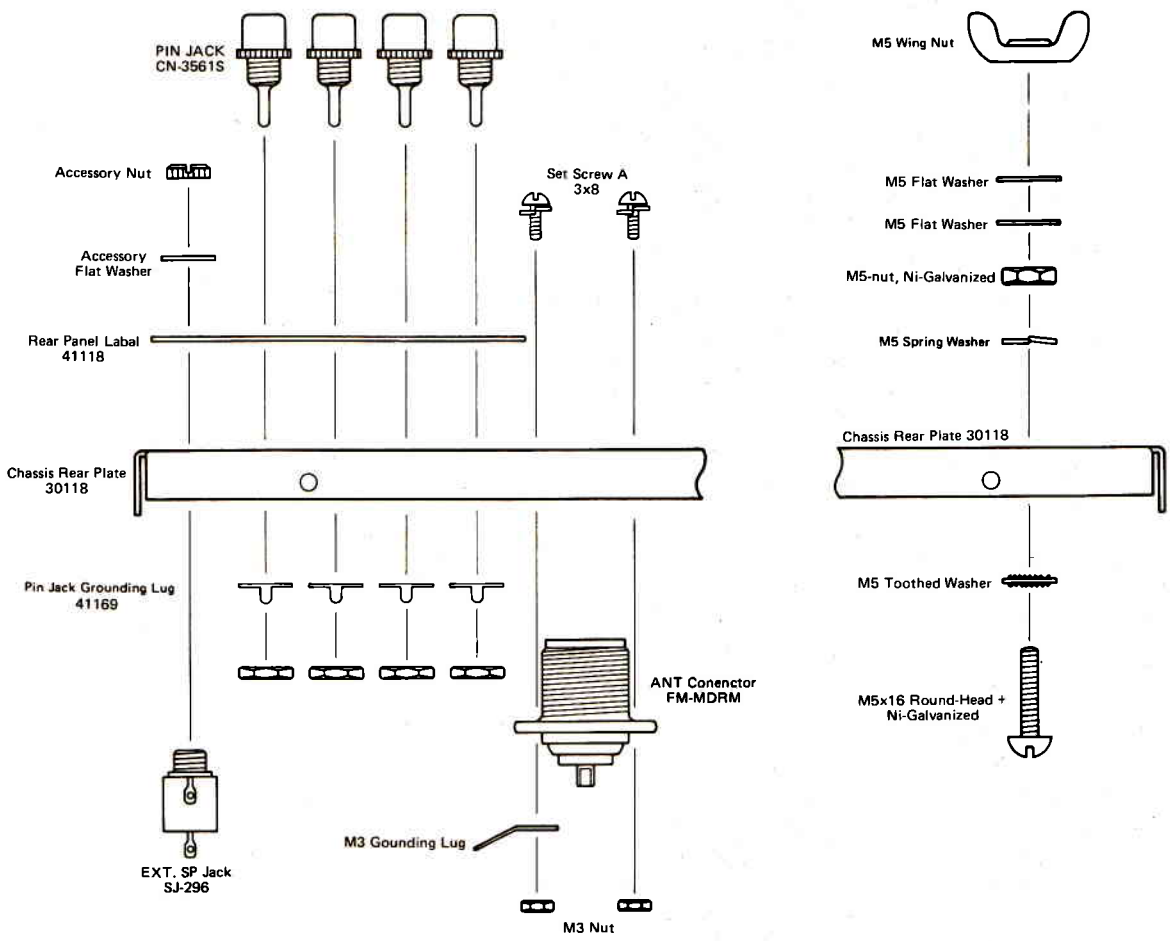
TS, MS Switches Disassembled



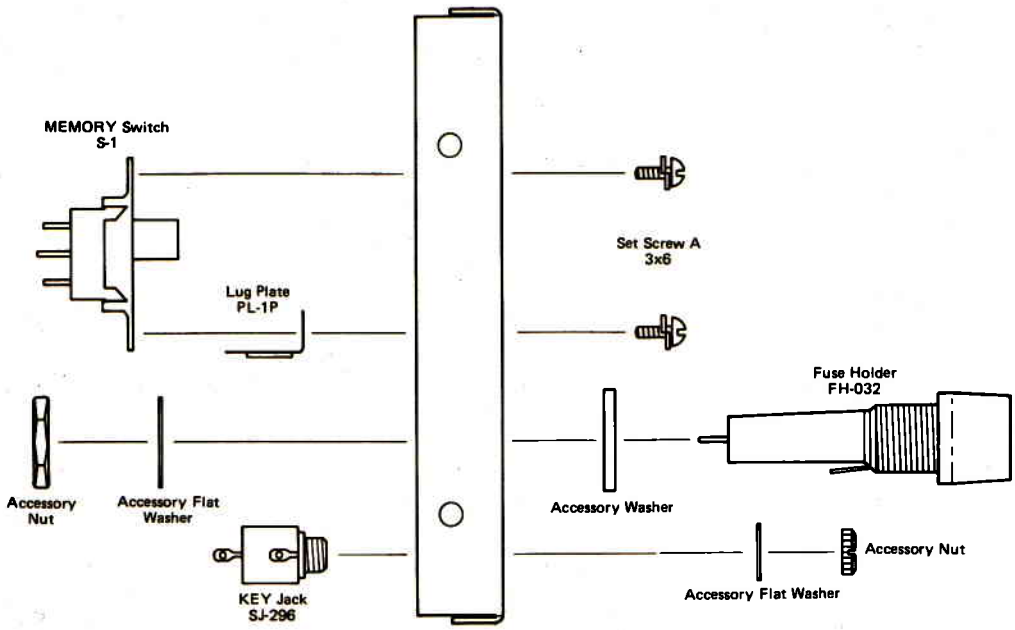
6-7 Rear Panel Disassembly



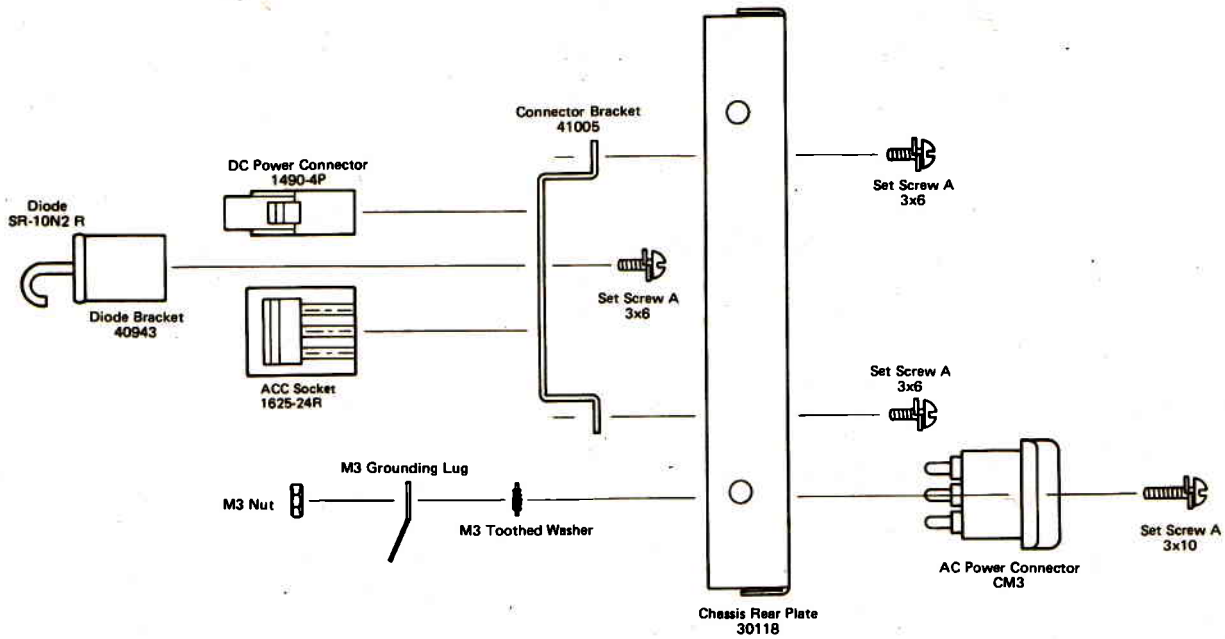
Rear Panel Connectors Disassembly

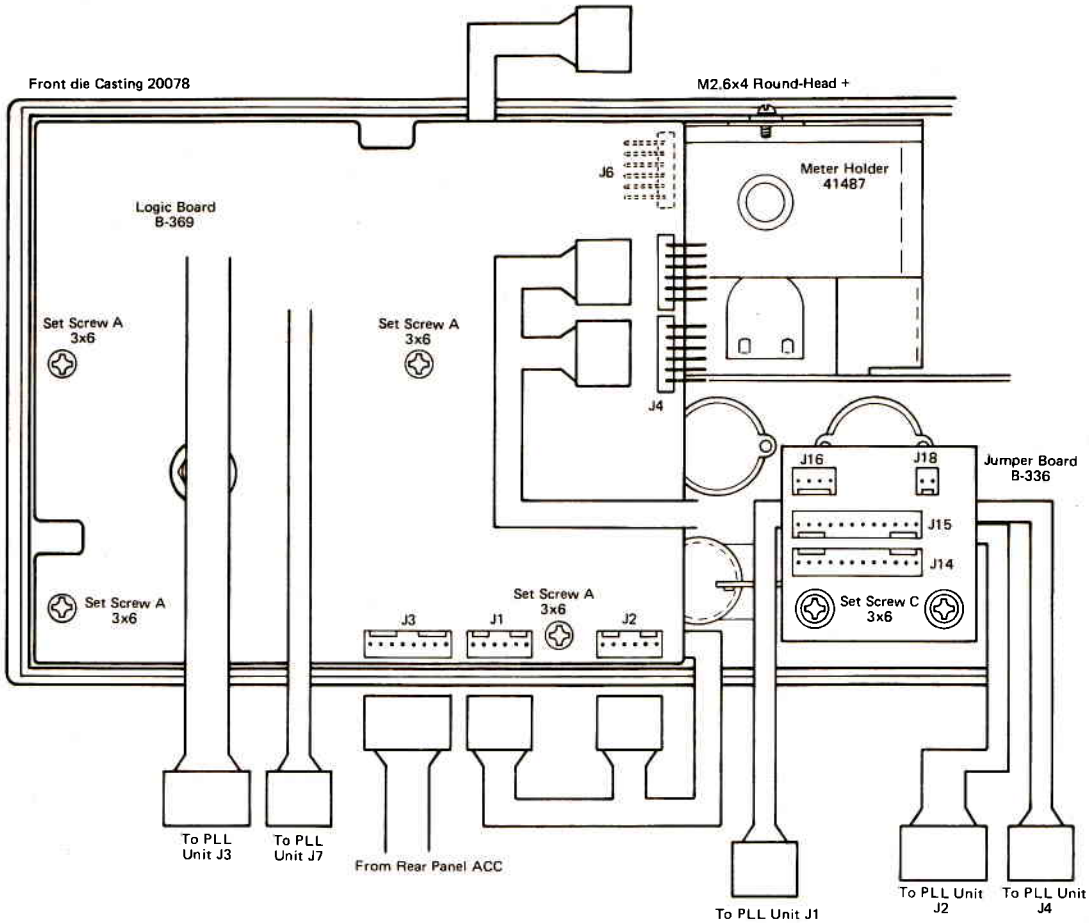


Rear Panel Jack and Fuse Holder Disassembly

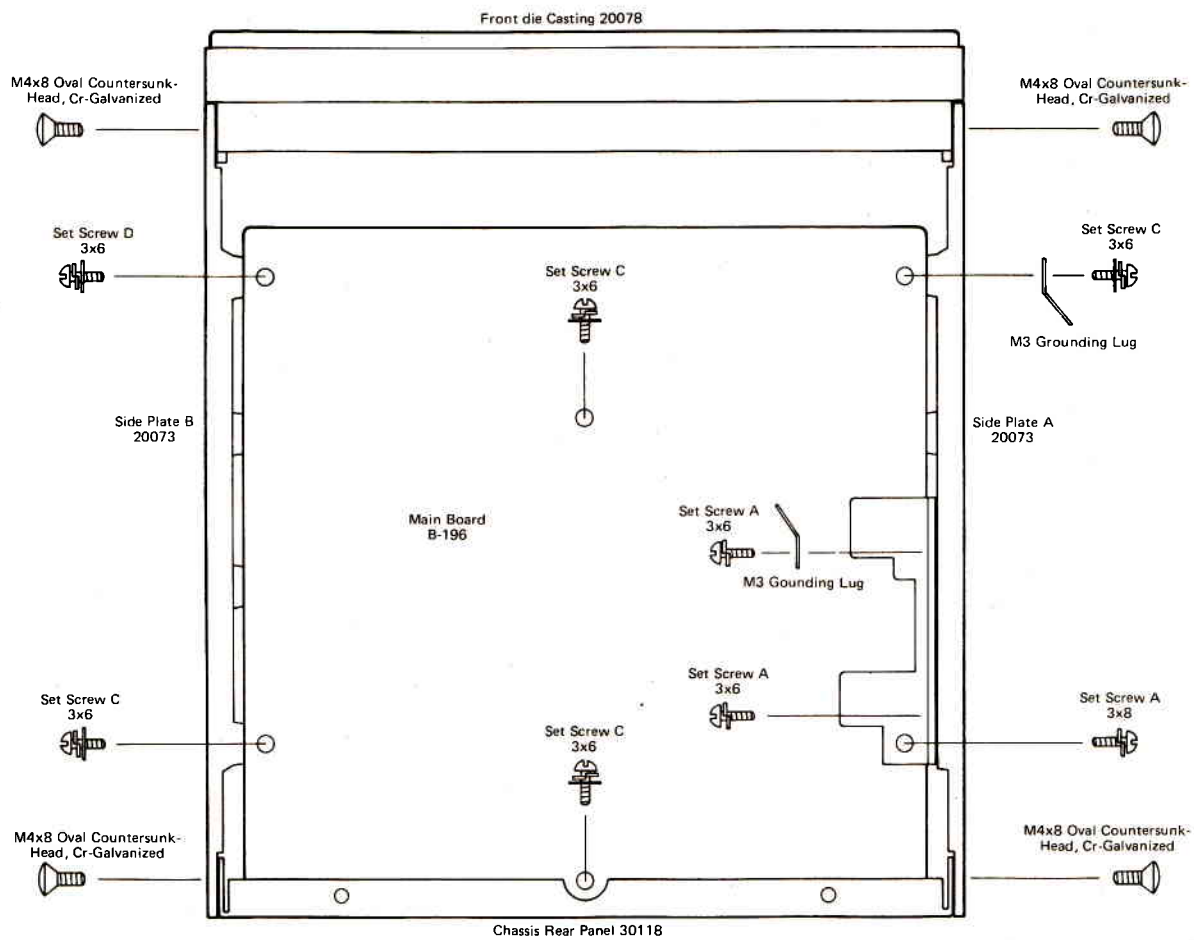


Rear Panel Connector Disassembly

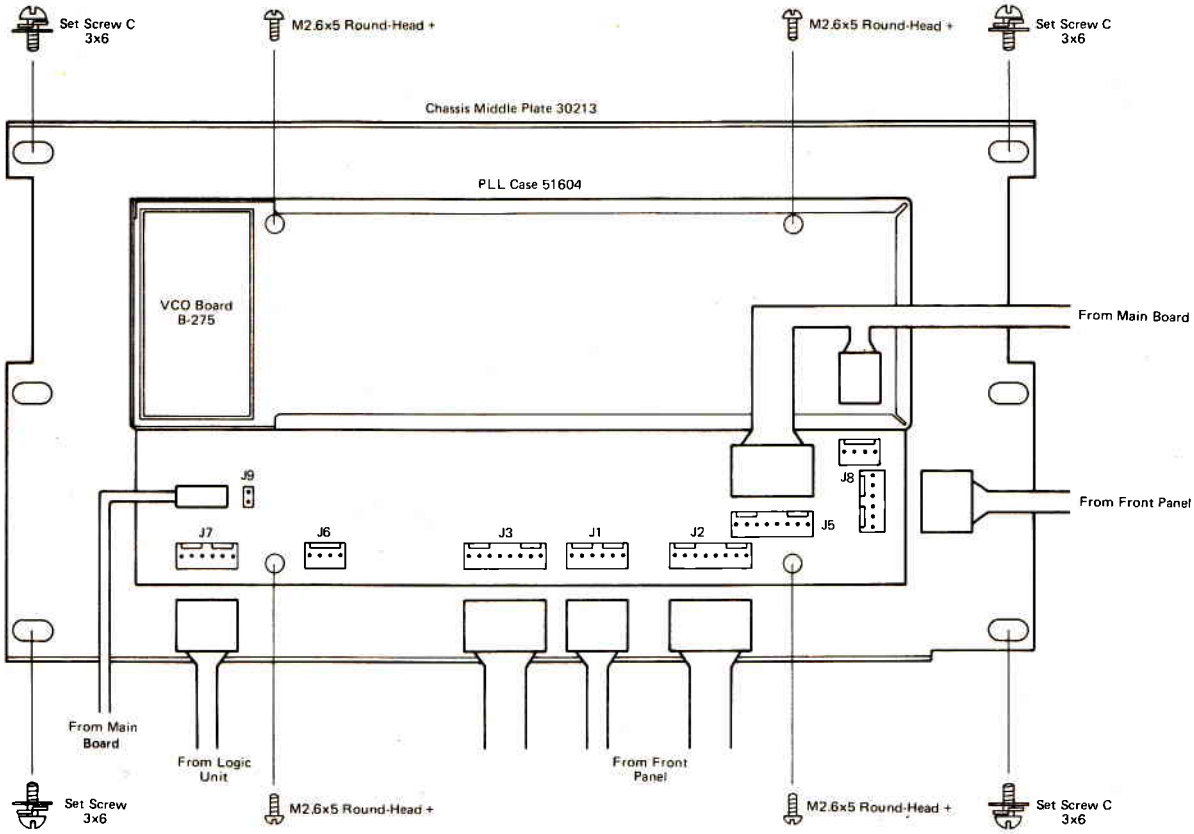


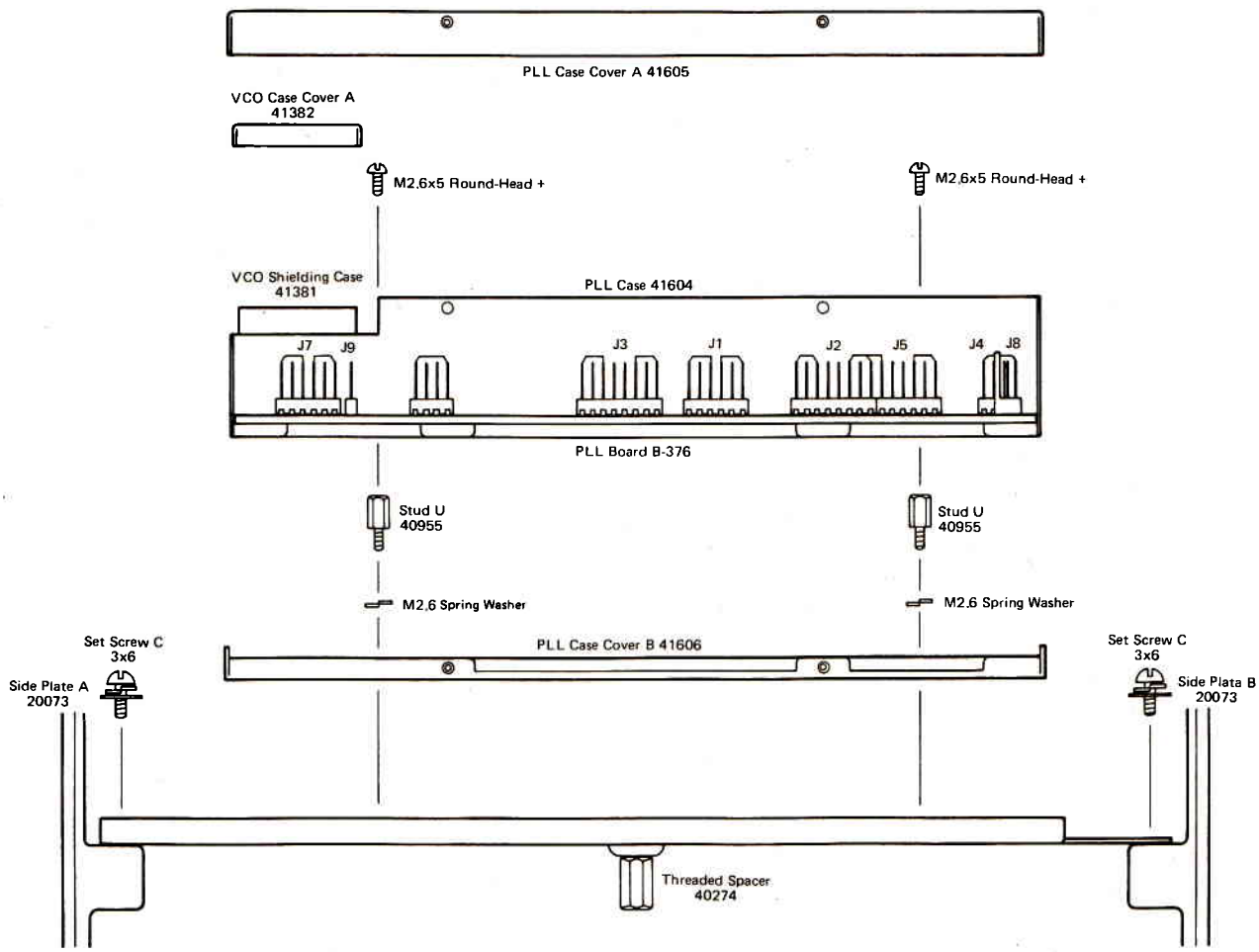


6-9 MAIN Board Disassembly



6-10 PLL Board Disassembly





7-1 MEASURING INSTRUMENTS REQUIRED FOR ADJUSTMENT

(1) FREQUENCY COUNTER	FREQUENCY RANGE	0.1 - 160MHz
	ACCURACY	BETTER THAN ±1 ppm
	SENSITIVITY	100mV or BETTER
(2) SIGNAL GENERATOR	FREQUENCY RANGE	0.1MHz - 160MHz
	OUTPUT VOLTAGE	–20 - 90dB (0dB = 1μV)
(3) MULTIMETER	50KΩ/Volt or better	
(4) AC MILLIVOLTMETER	MEASURING RANGE	10mV - 2V
(5) RF VOLTMETER	FREQUENCY RANGE	0.1 - 160MHz
	MEASURING RANGE	0.01 - 10V
(6) RF WATTMETER (Terminated Type)	MEASURING RANGE	20 Watts
	FREQUENCY RANGE	140 ~ 160MHz
	IMPEDANCE	50 OHMS
	SWR	LESS THAN 1.1
(7) AF OSCILLATOR	OUTPUT FREQUENCY	200 - 3000Hz
	OUTPUT VOLTAGE	0 - 200 mV
	DISTORTION	LESS THAN 0.1%
(8) OSCILLOSCOPE	FREQUENCY RANGE	DC – 10MHz
	MEASURING RANGE	0.01 – 10V
(9) FM DEVIATION METER	FREQUENCY RANGE	140 ~ 160MHz
	MEASURING RANGE	0 ~ ±10KHz
(10) DIRECTIONAL COUPLER	FREQUENCY RANGE	140 ~ 160MHz
(11) DUMMY LOAD OR EXTERNAL SPEAKER	IMPEDANCE	8 OHMS
(12) VARIABLE VOLTAGE REGULATED POWER SUPPLY	OUTPUT VOLTAGE	11.0V ~ 16.5V DC
	CAPACITY	6A OR MORE

Adjusting Points

- Measuring Instruments Required
  Frequency counter (0.1 ~ 160MHz)
  Oscilloscope (DC ~ 10MHz)
  Multimeter

1. VCO Frequency Adjustment

(1) Set the MODE switch in the USB position and tune to 144.998.5MHz.
(2) Connect the frequency counter to pin 3 of J9 connector.

① 101

(3) Adjust R7 for 134.300MHz.
(4) Tune to 144.988.4MHz.
(5) Adjust R1 for 134.2999MHz.

102

(6) Repeat the above-mentioned adjustments two or three times.

2. PLL Reference Frequency Adjustment

(1) Set the MODE switch in the FM position and tune to 145.000.0MHz.
(2) Connect the frequency counter to IC4 (TC9123P) pin12.

② 103

(3) Adjust C78 for 7.010MHz.

3. LO Level Adjustment

(1) Set the MODE switch in the FM position and tune to 145.000.0MHz.
(2) Connect the oscilloscope to IC4 pin12.

② 104

(3) Adjust L2, L3, L4 and L7 to obtain maximum level (3VP-P or more)

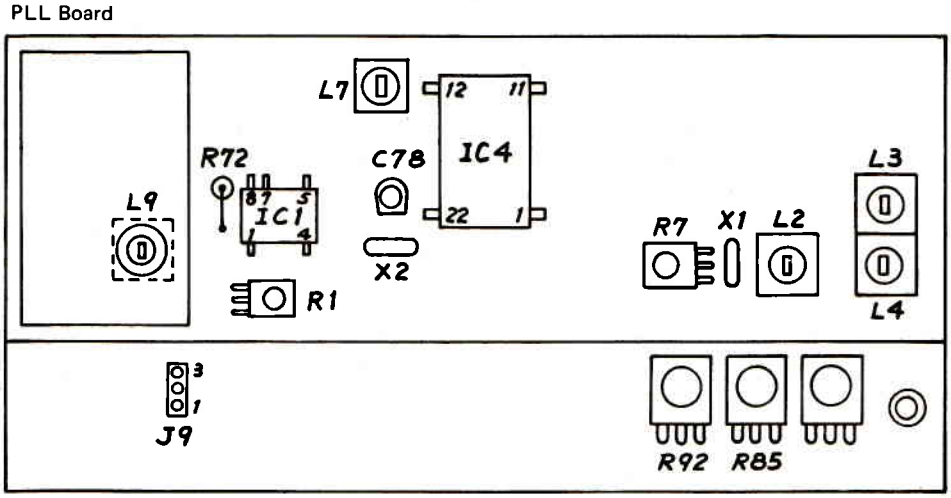
4. VCO Free-Running Frequency Adjustment

(1) Connect the multimeter (DC5 ~ 10V range) to IC1 (NJM4558D) pin7 (or R72).

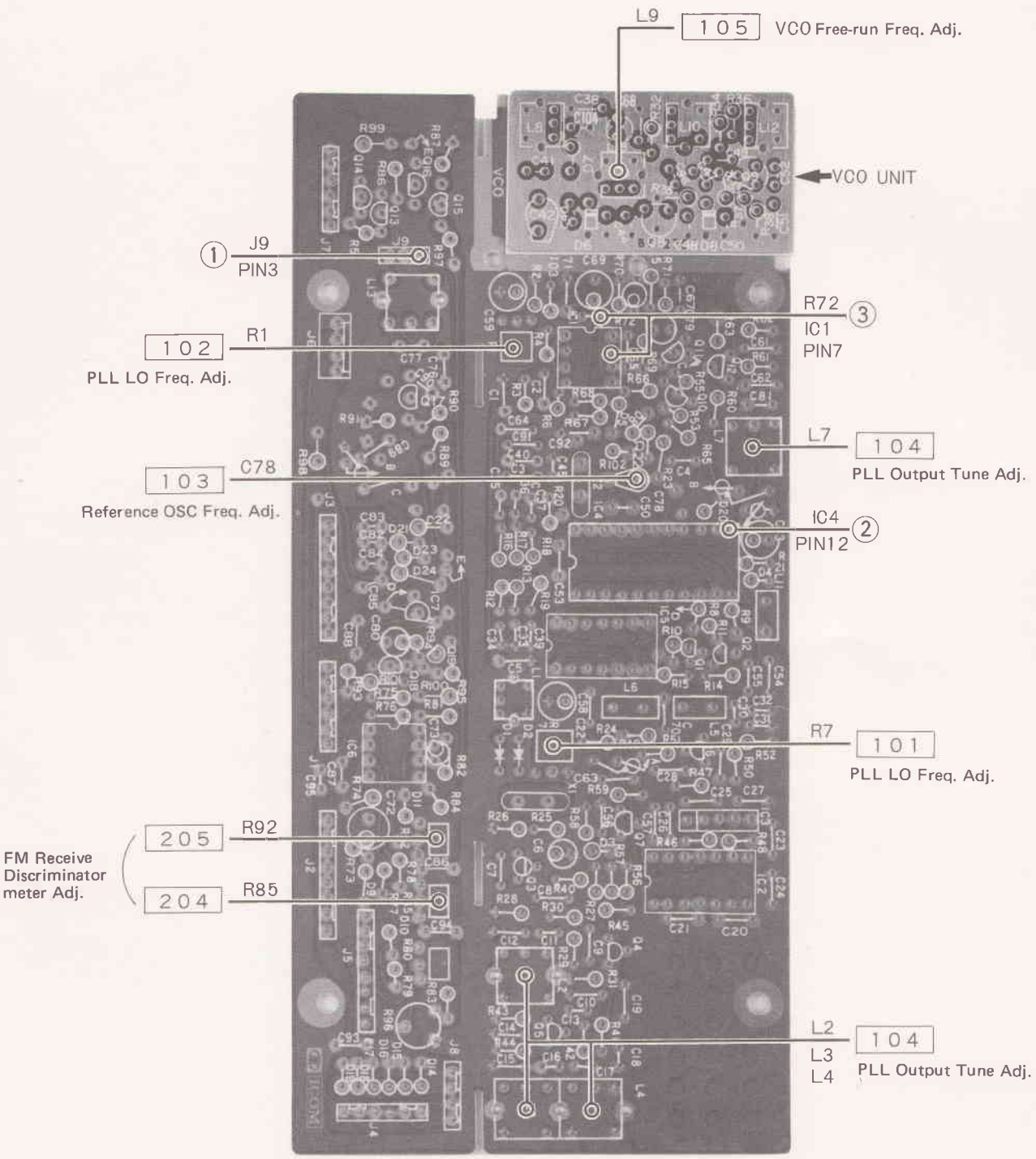
③ 105

(2) Turn the core of VCO UNIT L9 for 3V.

PLL Board



PLL unit parts layout
(PLL adjustments)



Points

- Measuring Instruments Required
  RF Signal generator (0.1MHz ~ 160MHz)
  AC-millivoltmeter (10mV ~ 2V)

1. Receiving Adjustment

(1) Set the MODE switch in the FM position and tune to 145.000.0MHz.

(2) Set the signal generator output (modulated with 1KHz AF 7.5KHz deviation) to cause the S-meter to swing S5–9.

(3) Adjust L52, L45, L44 and L43 to obtain maximum S-meter reading: 201
  SQ: 20dB
  Input: –6dB or less
  Note: L47 – L51 are helical cavity coils precisely adjusted by the factory. In case of need to adjust them, please contact our service center.

2. S-Meter Adjustment
  Adjust R169 to obtain a meter swing of S5 at a SG output of 8dBμ ±3db (at load end). 202

3. Discriminator Adjustment

(1) Adjust L40 to obtain maximum AF output voltage at tuned frequency. 203

4. Discriminator Meter Adjustment

(1) Tune the SG to 145.000 MHz

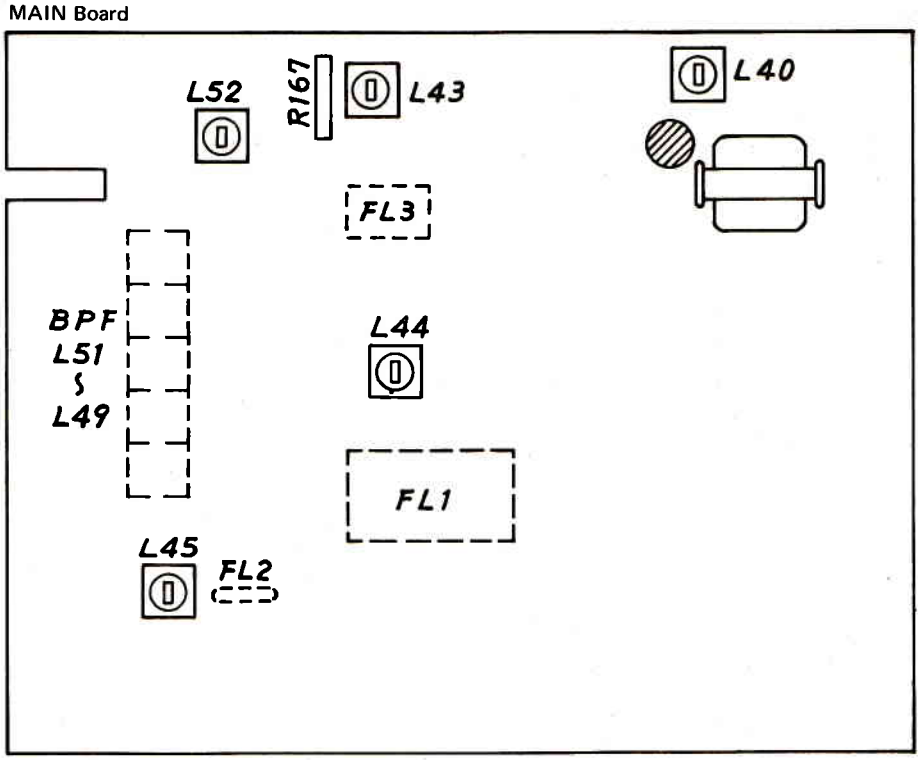
(2) Set the meter switch to the FM-C position. 204

(3) Adjust R85 of PLL UNIT to cause the meter to point to the center. 205

(4) Adjust L43 so that the meter points to the center in the no-signal state. 206

(5) Adjust R92 of PLL UNIT for proper meter swing while varying frequency (TS – 1KHz) using the tuning control.

MAIN Board



Points

- Measuring Instruments Required
  Frequency counter (0.1 ~ 160MHz)
  RF signal generator (0.1 ~ 160MHz)
  AC-millivoltmeter

1. Sensitivity Adjustment

(1) Turn the RF GAIN control on the front panel fully clockwise.
(2) Connect a speaker and the AC millivoltmeter to the external speaker terminal.
(3) Connect the signal generator to the antenna connector and adjust its output to obtain a S-meter swing of about S9.
(4) Adjust L52, L45, L5, L6 and L7 to obtain maximum S-Meter reading: 207
S/N: 14dB or more at −10dB input

2. S-Meter Adjustment

(1) Adjust R132 so that the meter points 0 in the no-signal state. 208
(2) Adjust R26 so that the meter points full scale at 70dBμ input. 209
(3) Adjust L7 so that the meter points S5 at 0dBμ input. 210
(4) Repeat the above adjustments two or three times.

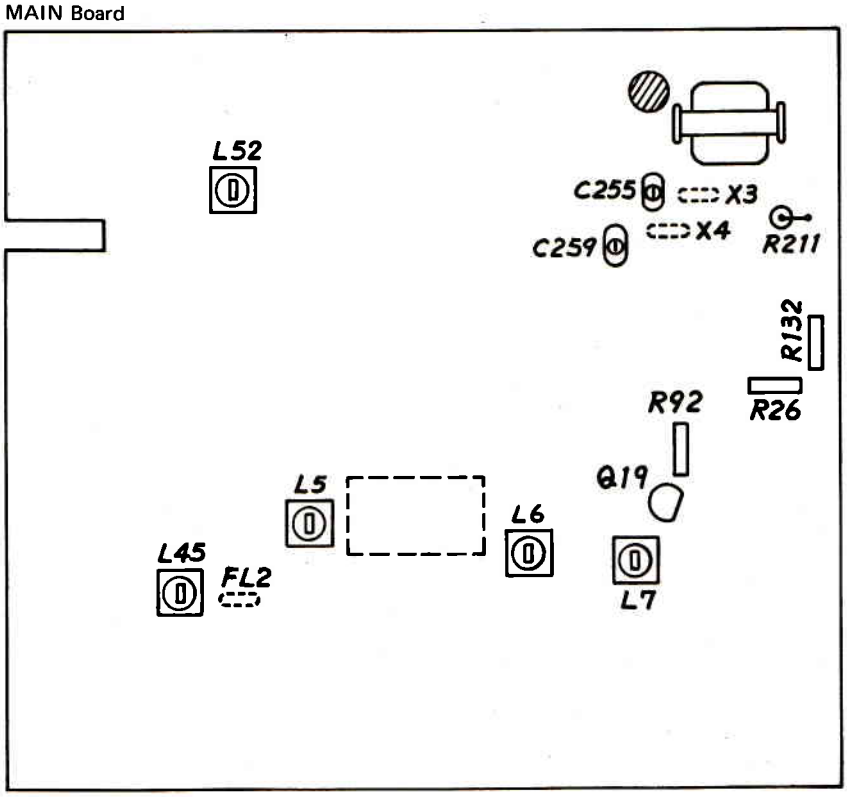
3. AGC Adjustment

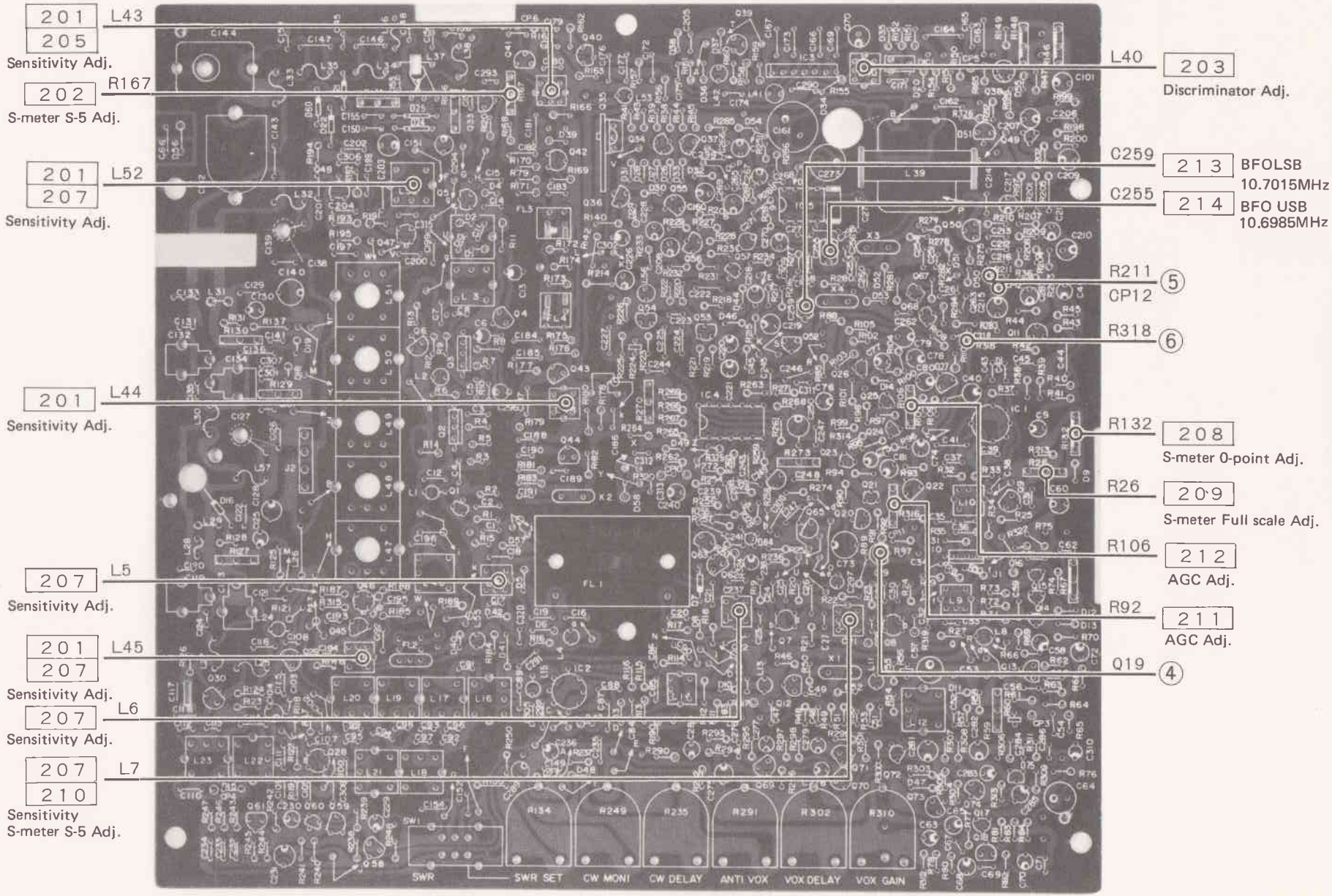
(1) Set AGC SW on the front panel to FAST.
(2) Adjust R92 so that the emitter voltage of Q19 becomes 4V in the no-signal state. 211 ④
(3) Set the signal generator output 30dBμ and its frequency to make about 1KHz beat tone.
(4) Adjust R106 so that AF voltage of CP12 (R211) becomes 0.2V. 212 ⑤

4. BFO Adjustment

(1) Connect the frequency counter to CP9 (R318). ⑥
(2) Set the MODE switch to LSB position and adjust trimmer C259 for 10.7015MHz. 213
(3) Change the MODE switch to USB and adjust trimmer C255 for 10.6985MHz. 214

MAIN Board



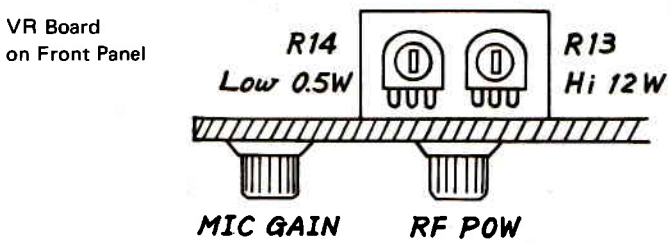

201
205
L43
Sensitivity Adj.
202
R167
S-meter S-5 Adj.
201
207
L52
Sensitivity Adj.
201
L44
Sensitivity Adj.
207
L5
Sensitivity Adj.
201
207
L45
Sensitivity Adj.
207
L6
Sensitivity Adj.
207
210
L7
Sensitivity
S-meter S-5 Adj.
L40
203
Discriminator Adj.
C259
213
BFOLSB
10.7015MHz
C255
214
BFO USB
10.6985MHz
R211
CP12
5
R318
6
R132
208
S-meter 0-point Adj.
R26
209
S-meter Full scale Adj.
R106
212
AGC Adj.
R92
211
AGC Adj.
Q19
4
SWR
SWR SET
CW MONI
CW DELAY
ANTI VOX
VOX DELAY
VOX GAIN

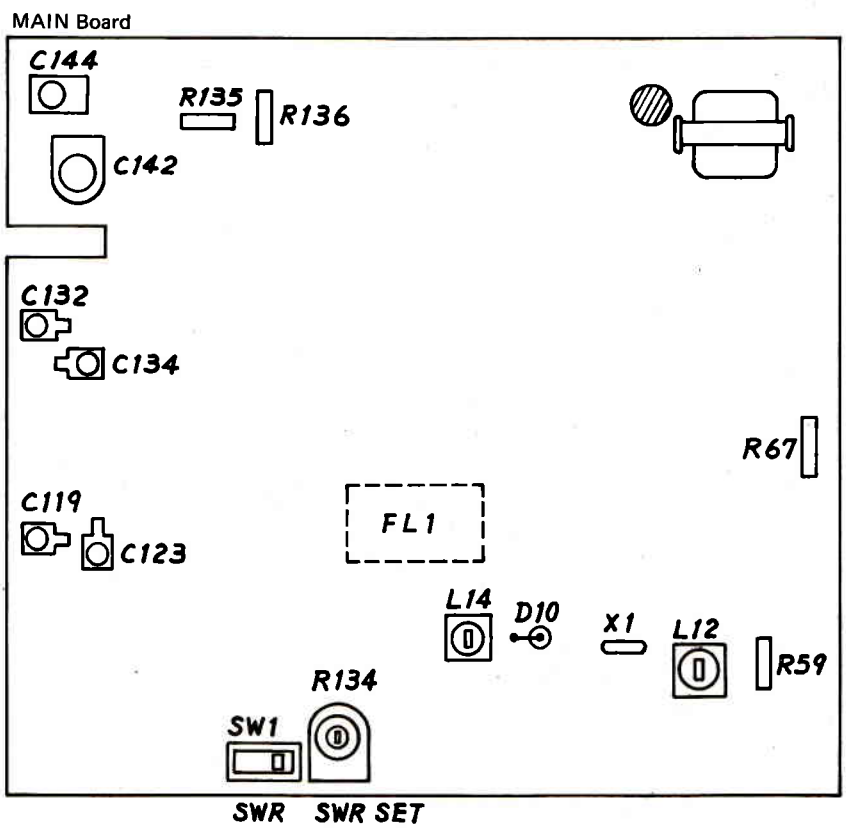
- Measuring Instruments Required
  Frequency counter (0.1 ~ 160MHz)
  Oscilloscope (DC ~ 10MHz)
  RF Power meter (20W 140 ~ 160MHz)
  AF oscillator (AG)
  AC-millivoltmeter
  Deviation meter
  Directional coupler

1. Output Adjustment

(1) Connect the RF Power meter to the antenna connector.
(2) Set the MODE switch in the FM position and tune to 145.000.0MHz.
(3) Turn RF POWER control on the front panel fully clockwise to set it to maximum.
(4) Turn R13 (refer to the figure below) on the VR board fully clockwise.
(5) Turn the set into transmitting state using T/R switch and adjust L14, C119, C123, C132, C142 and C144 so that the power meter reading becomes maximum.
(Note: DO NOT adjust L16 – L23, which are BPFs.)
(6) Repeat adjustments mentioned in (4) above to obtain 15W or more.
(7) Adjust R13 on the VR board so that RF output becomes 12W.
(8) Adjust R14 on the VR board so that RF output becomes 0.5W – 1W.

301





Points

2. Local Oscillator Adjustment

(1) Turn the set into transmitting state, connect the frequency counter to D10 through a capacitor. ⑦

(2) Adjust L12 for 10.700MHz ±200Hz. 302

3. SWR Adjustment

(1) Turn the set into transmitting state.

(2) Set the meter to full scale using SWR SET control (R134). 303

(3) Loosen the plastic screw of SWR SW (SW1) to turn it to the SWR position. ⑧

(4) Adjust R135 so that the meter points to minimum. (SWR 1.2 or less) 304

(5) Turn SWR switch back to the SWR SET position.

4. APC Adjustment

(1) Turn the set into high power transmitting status.

(2) Ground the antenna connector.

(3) Adjust R136 so that total current to the set becomes 2.5A or less. 305

5. Modulation Adjustment

(1) Make output of the AF oscillator 1KHz, 600mV and connect it across pin 1 microphone input terminal and pin 7 ground.

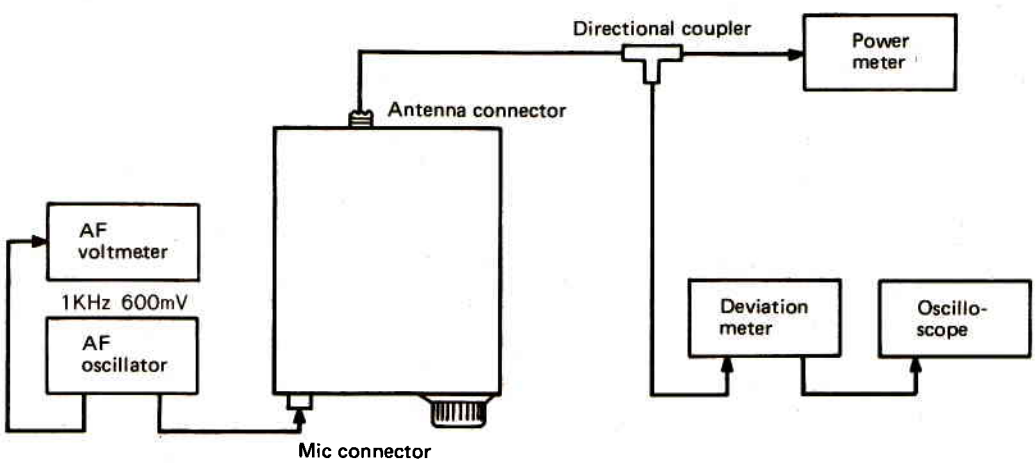
(2) Turn MIC GAIN control on the front panel fully clockwise.

(3) Turn the set into transmitting state.

(4) Adjust R67 so that oscilloscope waveform becomes vertically symmetrical. 306

(5) Adjust R59 for 4.8KHz ±200Hz (P-P/2) deviation. 307

(How to connect measuring instruments)



Adjusting Points

- Measuring Instruments Required
  RF voltmeter
  RF Power meter
  AF oscillator (AG)
  Multimeter

1. Idling Current Adjusment

(1) Turn MIC GAIN control on the front panel fully counterclockwise and turn the set into transmitting state.

(2) Driver stage idling current
Connect the multimeter (DC 50mA) across terminals No.2 and No.3 of J2 and adjust R127 for 25mA

308 (9)

(3) Final stage idling current
Connect the multimeter (DC 100mA) across terminals No. 1 and No. 4 of J2 and adjust R130 for 50mA.

309

2. ALC Adjustment

(1) Set the MODE switch in the CW position and adjust R129 for 12W.

310

3. Carrier Point Adjustment

(1) Turn the set into transmitting state in USB mode and turn MIC GAIN control fully clockwise.
(2) Set the AF oscillator output to 30mV and connect it across the microphone connector pins 1 and 7.
(3) Switch the AF oscillator output frequency to 300Hz and to 3KHz alternately and adjust trimmer C255 for the same RF power meter reading.
(4) Adjust trimmer C259 for LSB in the same manner mentioned above.

312

4. Carrier Null Adjustment

(1) Turn MIC GAIN control on the front panel fully counterclockwise and turn the set into transmitting state.
(2) Connect the RF voltmeter to the antenna connector.
(3) Switch between USB and LSB alternately and adjust R270 to obtain minimum voltmeter reading.

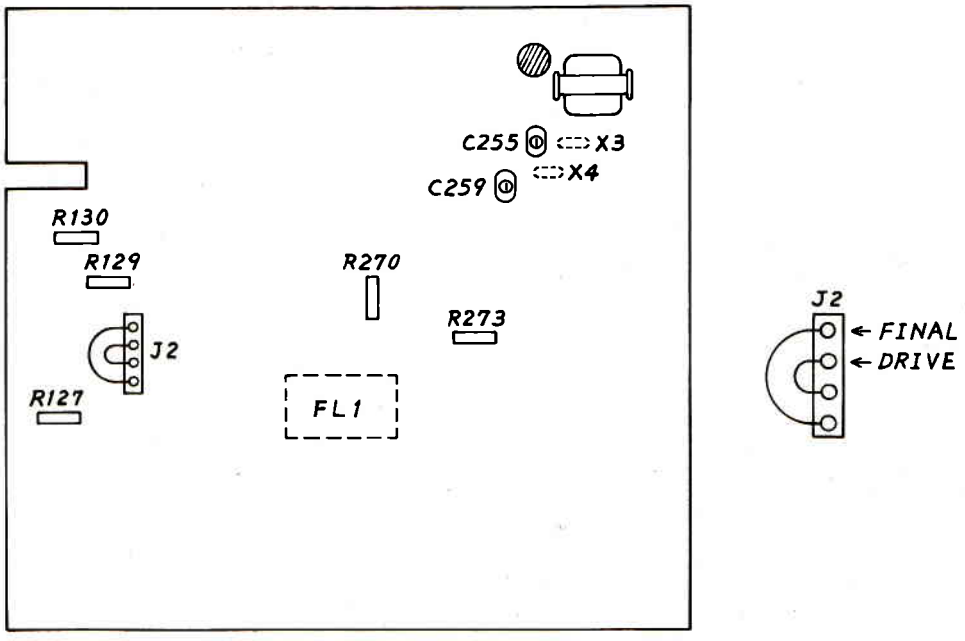
313

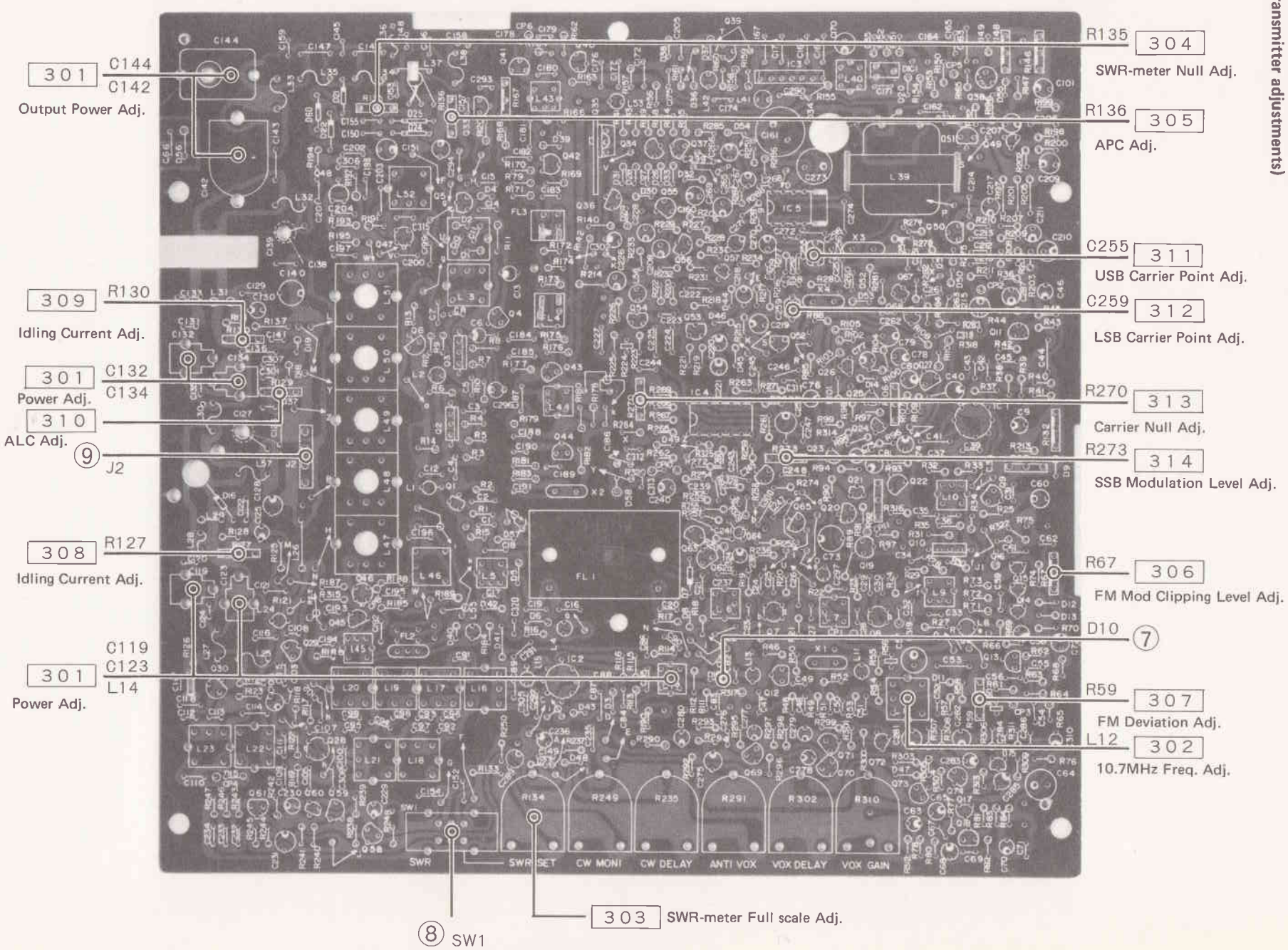
5. Modulation Adjustment

(1) Turn the set into transmitting state in USB or LSB.
(2) Adjust the AF oscillator output to 1KHz, 600mV and connect it to the microphone connector.
(3) Adjust R273 for 12W output power (the same as in the case of CW).

314

MAIN Board




301 C144 C142
Output Power Adj.
309 R130
Idling Current Adj.
301 C132 C134
Power Adj.
310
ALC Adj.
⑨ J2
308 R127
Idling Current Adj.
301 C119 C123 L14
Power Adj.
R135 304
SWR-meter Null Adj.
R136 305
APC Adj.
C255 311
USB Carrier Point Adj.
C259 312
LSB Carrier Point Adj.
R270 313
Carrier Null Adj.
R273 314
SSB Modulation Level Adj.
R67 306
FM Mod Clipping Level Adj.
D10 ⑦
R59 307
FM Deviation Adj.
L12 302
10.7MHz Freq. Adj.
303 SWR-meter Full scale Adj.
⑧ SW1
SWR
SWR SET
CW MONI
CW DELAY
ANTI VOX
VOX DELAY
VOX GAIN

TRANSISTOR VOLTAGE CHART

UNIT	Q 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	
MAIN	Q1					0		8.5	0.2	NB-SW-ON
MAIN	Q2 (1)					1.0		8.0	1.0	NB-SW-ON
MAIN	Q2 (2)					1.7		8.0	1.0	NB-SW-ON
MAIN	Q3 (1)					1.6		9.2	1.0	NB-SW-ON
MAIN	Q3 (2)					1.6		9.2	1.0	NB-SW-ON
MAIN	Q4					0		1.7	GND	NB-SW-ON
MAIN	Q5					0		7.4	0	NB-SW-ON
MAIN	Q6					7.4		0	8.0	NB-SW-ON
MAIN	Q7					0	4.0	8.6	0.4	NB-SW-ON
MAIN	Q8					0	3.9	8.2	0.8	SSB.IF
MAIN	Q9					1.3		0	0.8	SSB.IF
MAIN	Q10 (1)					3.7		9.0	3.0	SSB.IF
MAIN	Q10 (2)					3.5		9.0	3.0	SSB.IF
MAIN	Q11					1.6		3.6	1.0	SSB.IF
MAIN	Q12	4.5		9.0	3.8					FM MOD.
MAIN	Q13	5.4		9.1	5.0					IDC
MAIN	Q14	0.6		1.6	0					IDC
MAIN	Q15	0.5		0.6	0					IDC
MAIN	Q16	0.5		0.5	0					IDC
MAIN	Q19					5.8		−8.8	4.0	AGC
MAIN	Q20					−7.0		3.9	−7.8	AGC
MAIN	Q21					−7.6		9.2	−7.0	AGC
MAIN	Q22					−8.6		−7.6	−8.8	AGC
MAIN	Q23					−8.5		9.1	−7.6	AGC
MAIN	Q24					−8.2		−8.8	−8.8	AGC
MAIN	Q25					−8.2		3.4	−8.8	AGC
MAIN	Q26					−8.4		8.9	−7.8	AGC
MAIN	Q27					−4.6		1.2	−5.2	AGC
MAIN	Q28	0	4.2	8.0	0.2					PA
MAIN	Q29	9.2		0.2	9.2					PA
MAIN	Q30	1.2		13.5	0.5					PA
MAIN	Q31	0.4		13.5	GND					PA
MAIN	Q32	0.4		13.5	GND					PA
MAIN	Q33	0		9.0	GND					PA
MAIN	Q34					10.0		13.5	9.2	R9V
MAIN	Q35	10.0		13.5	9.2					T9V
MAIN	Q36	10.0		10.0	0.2					
MAIN	Q37	10.0		13.5	9.2	10.0		13.5	9.2	9V
MAIN	Q39					0.6		0.6	0	
MAIN	Q40					4.4		6.2	4.0	
MAIN	Q41					0.5		2.0	0	
MAIN	Q42					2.0		9.0	1.4	
MAIN	Q43					0		7.0	0.8	
MAIN	Q44					2.5		7.5	2.3	
MAIN	Q45					0		9.0	0.3	
MAIN	Q46					0	0	8.8	GND	
MAIN	Q47					0	3.8	9.0	0	
MAIN	Q48					8.4		9.0	9.0	
MAIN	Q49					1.4		5.0	0.8	
MAIN	Q50					5.0		9.2	4.6	
MAIN	Q51					0.2		7.4	GND	

UNIT	Q 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	
MAIN	Q53					1.3		4.2	0.9	
MAIN	Q54					1.3		8.8	0.7	
MAIN	Q55	0.6		0	GND	0		9.2	GND	
MAIN	Q56	0.1		8.4	0.2	0.1		0	0.1	VOX-SW-ON
MAIN	Q57	0.8		0.2	0.2	0.7		0.1	0.1	
MAIN	Q58	6.4		7.0	6.4	6.4		7.0	6.0	
MAIN	Q59	0		6.4	GND	0		6.4	GND	
MAIN	Q60	0.6		0	GND	0.6		0	GND	
MAIN	Q61	1.2		3.1	0.6	1.2		3.1	0.6	
MAIN	Q62	0.1		7.4	GND	0.7		0	GND	
MAIN	Q63	−0.7		7.4	GND	0		0	GND	
MAIN	Q64	−4.2		8.4	−5.0					
MAIN	Q65	8.4		9.0	9.1					
MAIN	Q66	4.3		7.9	3.7					
MAIN	Q67	2.0		2.8	1.4	2.0		2.8	1.4	
MAIN	Q68	1.4		2.8	1.2	1.4		2.8	1.2	
MAIN	Q69	1.9		5.6	1.3					
MAIN	Q70	0		8.5	0					
MAIN	Q71	0		8.2	0					
MAIN	Q72	8.2		0	8.6					
MAIN	Q73	8.2		0	8.2					
MAIN	Q74	0		8.2	0					
MAIN	Q75	2.0		5.7	1.4	2.0		5.7	1.4	SSB
PLL	Q3	1.75		6.5	1.25	1.75		6.5	1.25	
PLL	Q4	1.25		7.4	0.8	1.25		7.4	0.8	
PLL	Q5	1.25		7.4	0.9	1.25		7.4	0.9	
PLL	Q6	1.1		4.2	0.4	1.1		4.2	0.4	
PLL	Q7	1.25		5.8	0.8	1.25		5.8	0.8	
PLL	Q10	7.2		0	7.8	7.2		0	7.8	
PLL	Q11	0		9.8	GND	0		0.8	GND	
PLL	Q12	1.1		7.0	0.4	1.1		7.0	0.4	
PLL	Q13	GND		0.6	0.6	GND		0.6	0.6	RIT ON
PLL	Q14	0.6		0	GND	0.6		0	GND	RIT ON
PLL	Q15	−8.5		GND	−9.2	−8.5		GND	−9.2	
PLL	Q16	−9.2		−8.5	−9.6	−9.2		−8.5	−9.6	
PLL	Q17	1.95		7.2	1.4	1.95		7.2	1.4	
PLL	Q18	0		7.6	0	4.0		7.6	3.5	SQL OFF
PLL	Q19	13.8		13.8	13.8	13.8		13.8	13.8	TONE ON
DRIVER	Q4					9.2		0	8.4	
DRIVER	Q5					6.3		0	5.0	
DRIVER	Q6					0.65		0.65	0	
DRIVER	Q7					13.8		8.6	13.8	
DRIVER	Q8					0.65		13.8	0	
DRIVER	Q9					0		13.8	0	
DRIVER	Q10					0		0	0	
DRIVER	Q11					0.75		0	0	
DRIVER	Q12					0.7		0	0	RIT ON
DRIVER	Q12					0		7.0	0	RIT OFF

IC VOLTAGE CHART

UNIT	IC No	MODE	PIN NO.																Remarks
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	
PLL	IC1	Transmit	0	0	0	–9.7	3.0	3.0	3.0	6.2									FM 145MHz
		Receive	0	0	0	–9.7	3.0	3.0	3.0	6.2									FM 145MHz
	IC2	Transmit	0	7.2	6.5	3.6	2.3	GND	0	0	2.3	3.6	3.6	3.6	6.5	0			
		Receive	0	7.2	6.5	3.6	2.3	GND	0	0	2.3	3.6	3.6	3.6	6.5	0			
	IC3	Transmit	1.3	1.3	GND	6.6	7.1												
		Receive	1.3	1.3	GND	6.6	7.1												
	IC4	Transmit	GND	2 ~ 22 PIN = 6.8															
		Receive	GND	2 ~ 22 PIN = 6.8															
	IC6	Transmit	0	0.6	0	GND	0	0	0	0									
		Receive	1.25	1.1	0.6	GND	2.4	2.8	3.0	9.1									
MAIN	IC1	Receive	2.6	2.0	0	1.0	2.6	3.6	3.2	3.6									SSB DET.
	IC2	Transmit	5.1	2.6	GND	2.0	5.1	7.6	8.0	7.8									
	IC3	Receive	5.0	1.6	1.6	GND	6.9	2.8	6.9										FM IF
	IC4	Transmit	2.0	1.4	1.4	2.0	1.4	7.0	0	4.0	0	4.0	0	7.0	0	GND			BALANCED MOD.
	IC5	Receive	1.9	0	13.5	6.6	7.8	13.5	13.5	1.8									AF
	IC6	Transmit	1.3	1.3	0	4.5	4.5												FM
	IC8	Receive	4.7	5.0	5.0	5.2	NC	NC	NC	GND	1.4	NC	NC	NC	NC	1.6	1.4	5.0	

ON DRIVER CIRCUIT

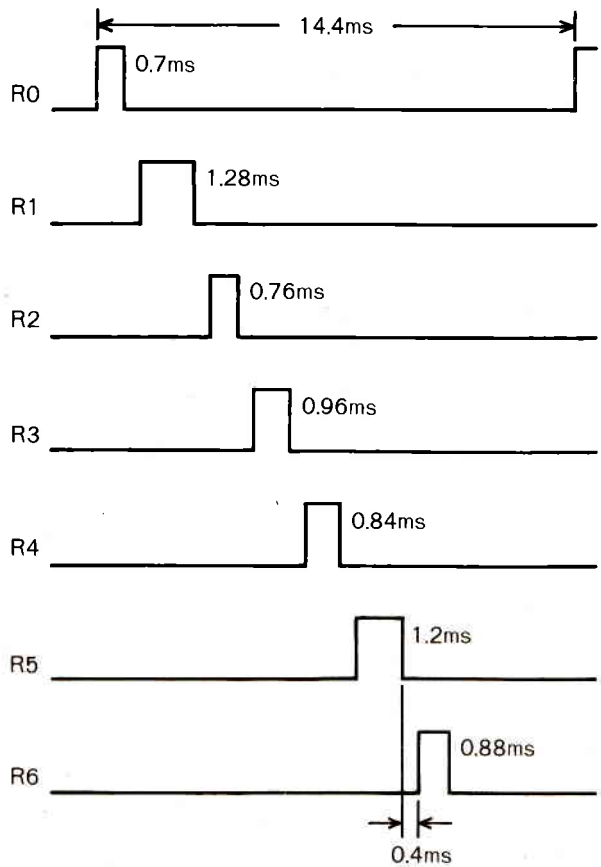
Those parts digitally operating cannot be checked by a multimeter because they involve pulse signals.

Input of CPU are 4 bits, K1 – K8 and their signals are identified by the relationship with output signals of R0 – R6.

By checking while referring to the R0 – R6 timing chart, it can be decided which signals are input as K1 ~ K8.

Check each signal as to whether its level is high enough as well as its timing.

R Output Time Chart



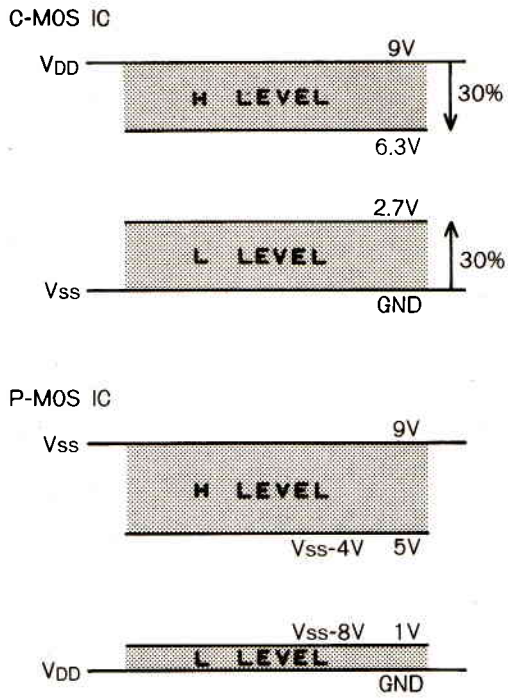
For operation checking, confirm that "R" signals are fed to "K" inputs in accordance with the matrix circuit.

In case DIAL LOCK does not operate, for instance, check whether "R2" signals are input to "K4" input. At that time, take it into consideration that each R input adapted to each states of MS, MEMORY3, CW, RT and RB-TA is also input to K4 input terminal.

THRESHOLD LEVEL

The controller employs C-MOS and P-MOS IC.
Refer to the figures below for each threshold level:

THRESHOLD LEVEL CHART

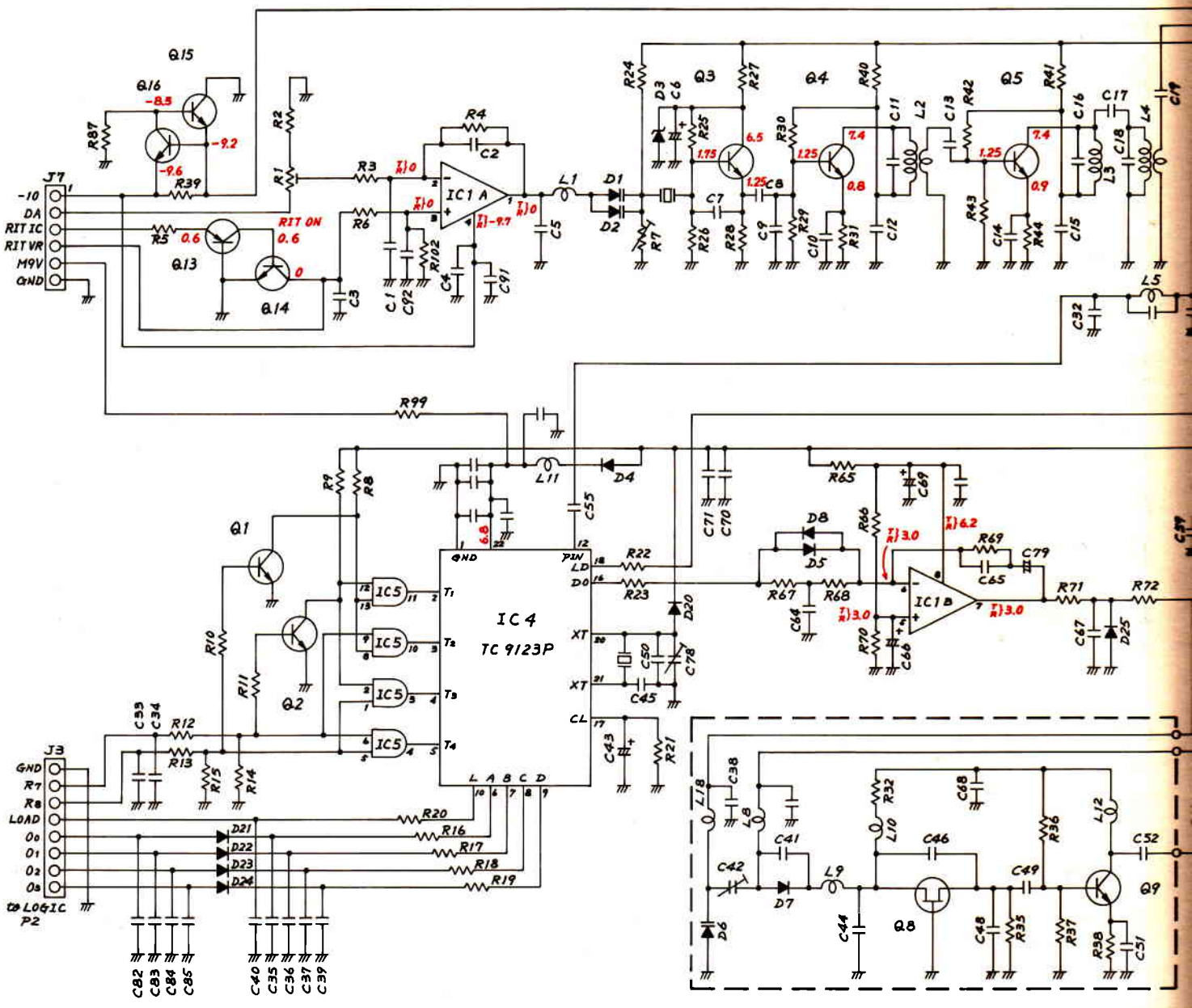


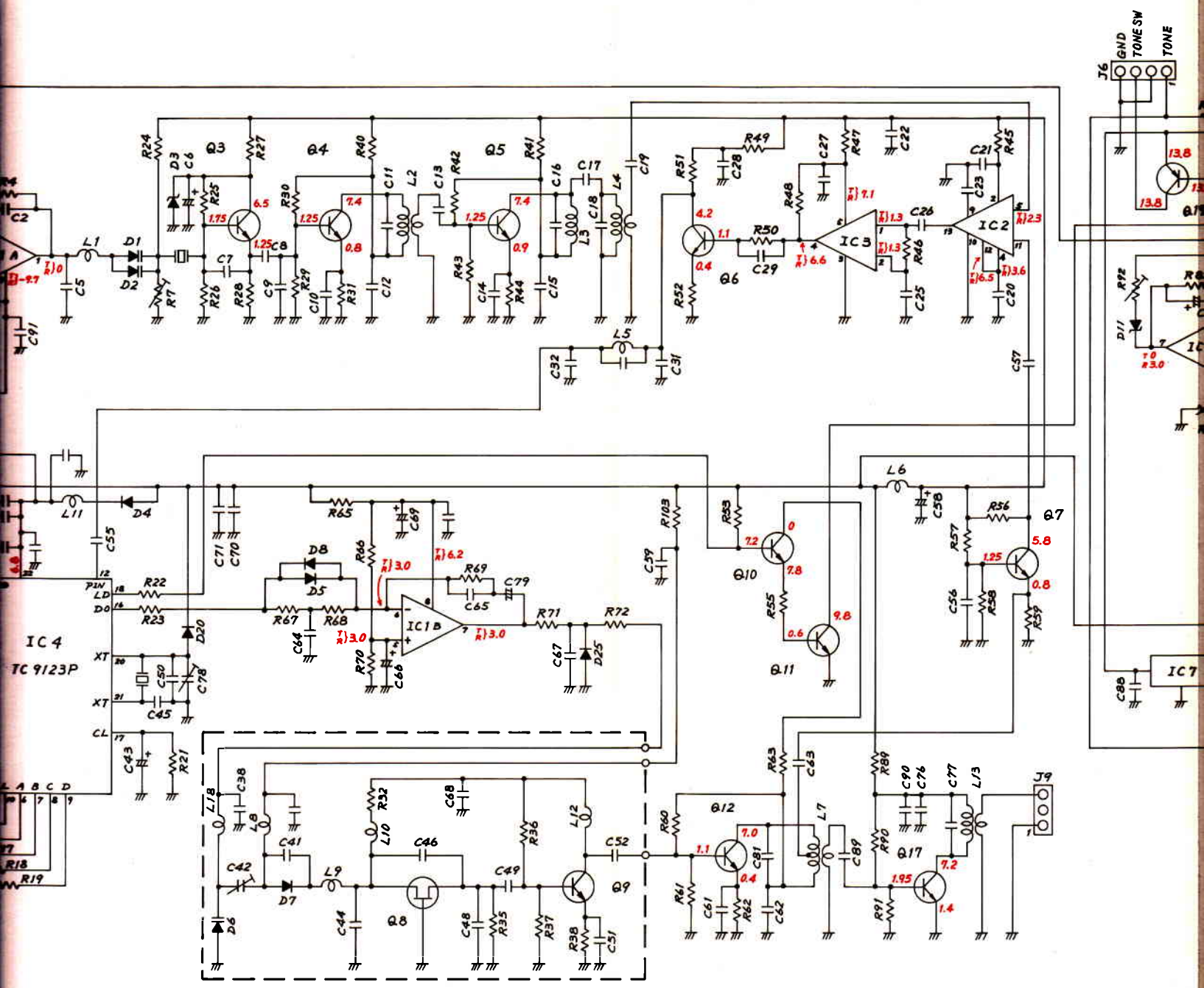
Take care that threshold level is determined by level difference between Vss-4V and Vss-8V in C-MOS.

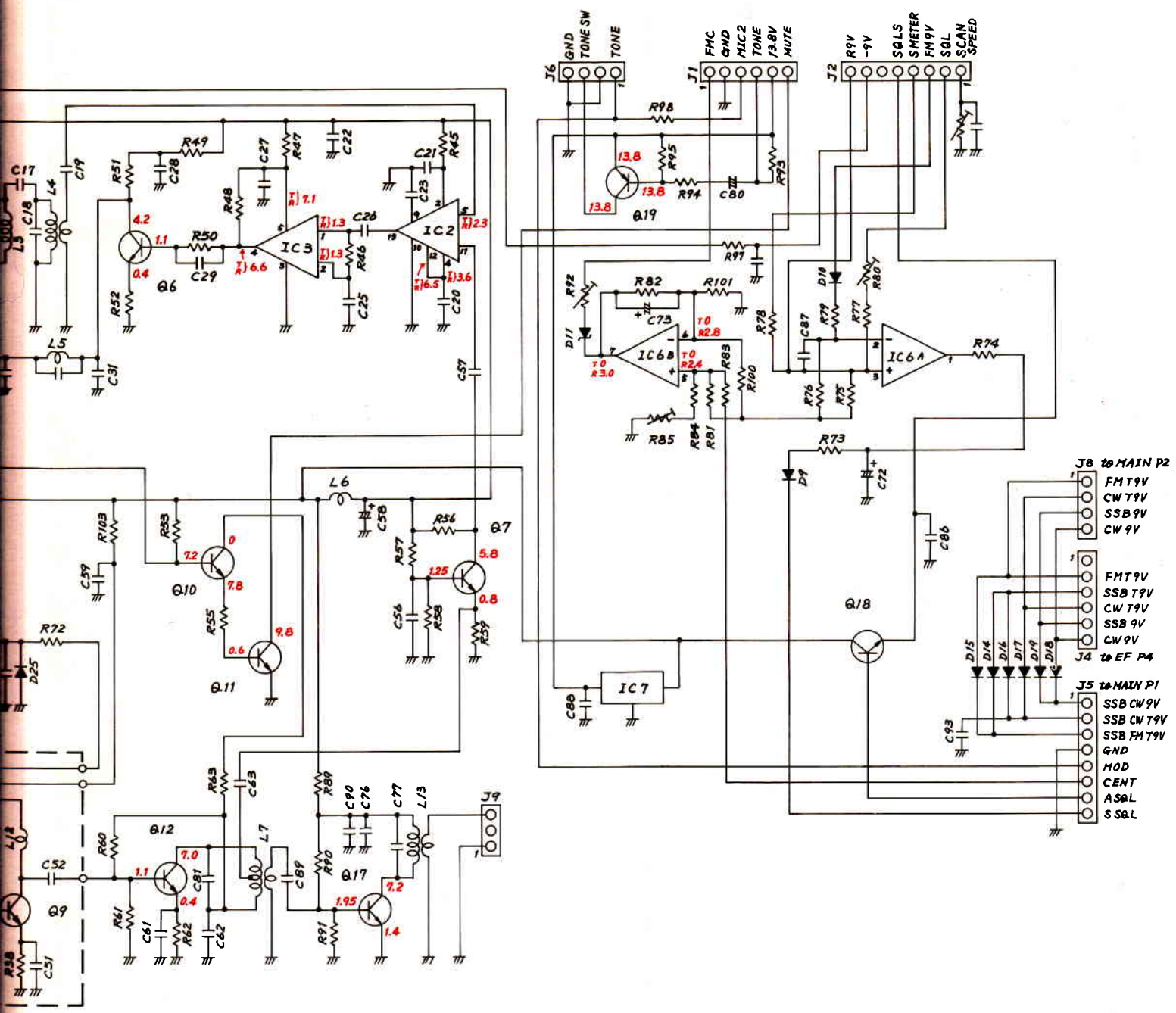
P-MOS employed are TMS1115 for CPU and TMS1024 for I/O.

Other ICs employ C-MOS.

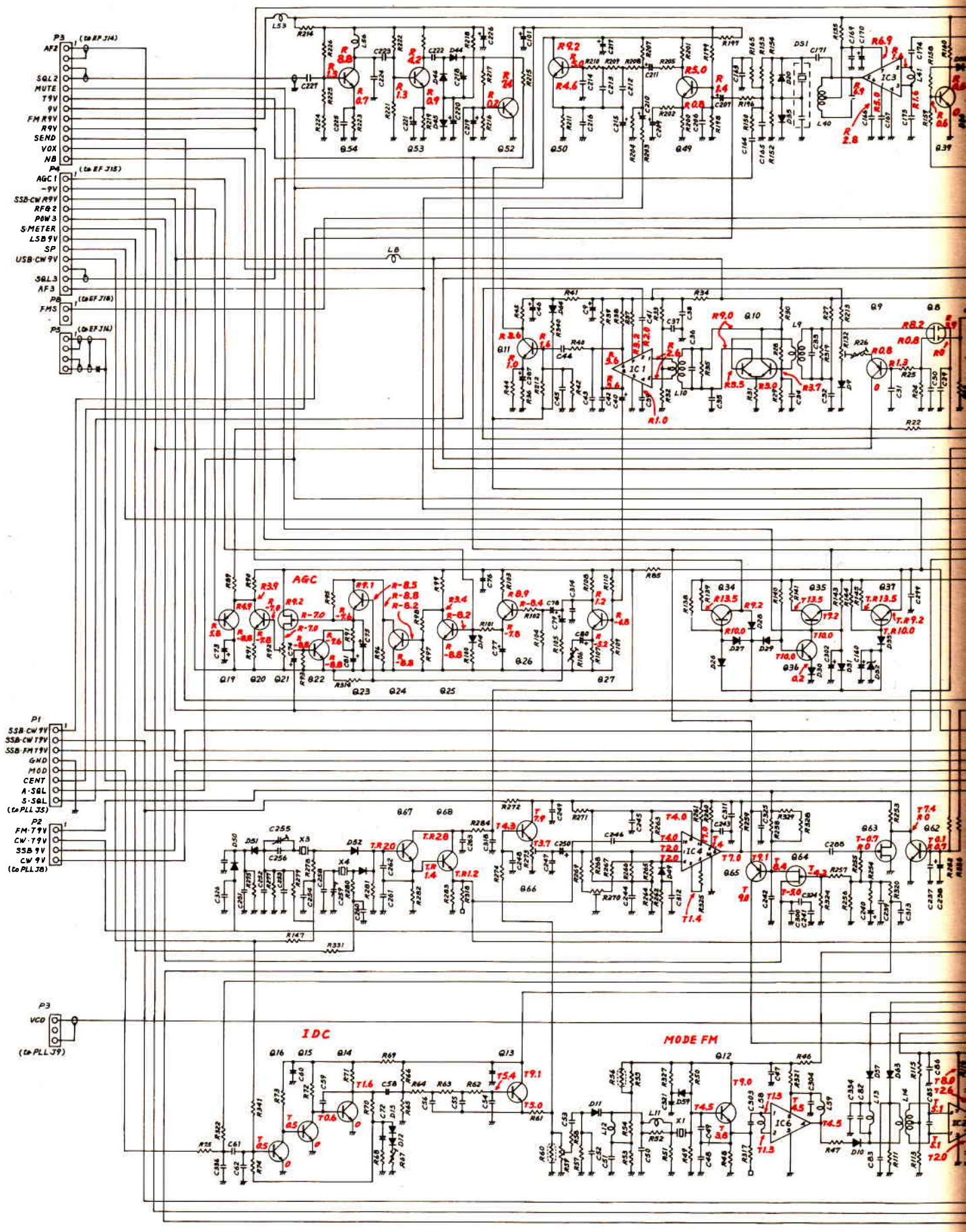
PLL UNIT CHART

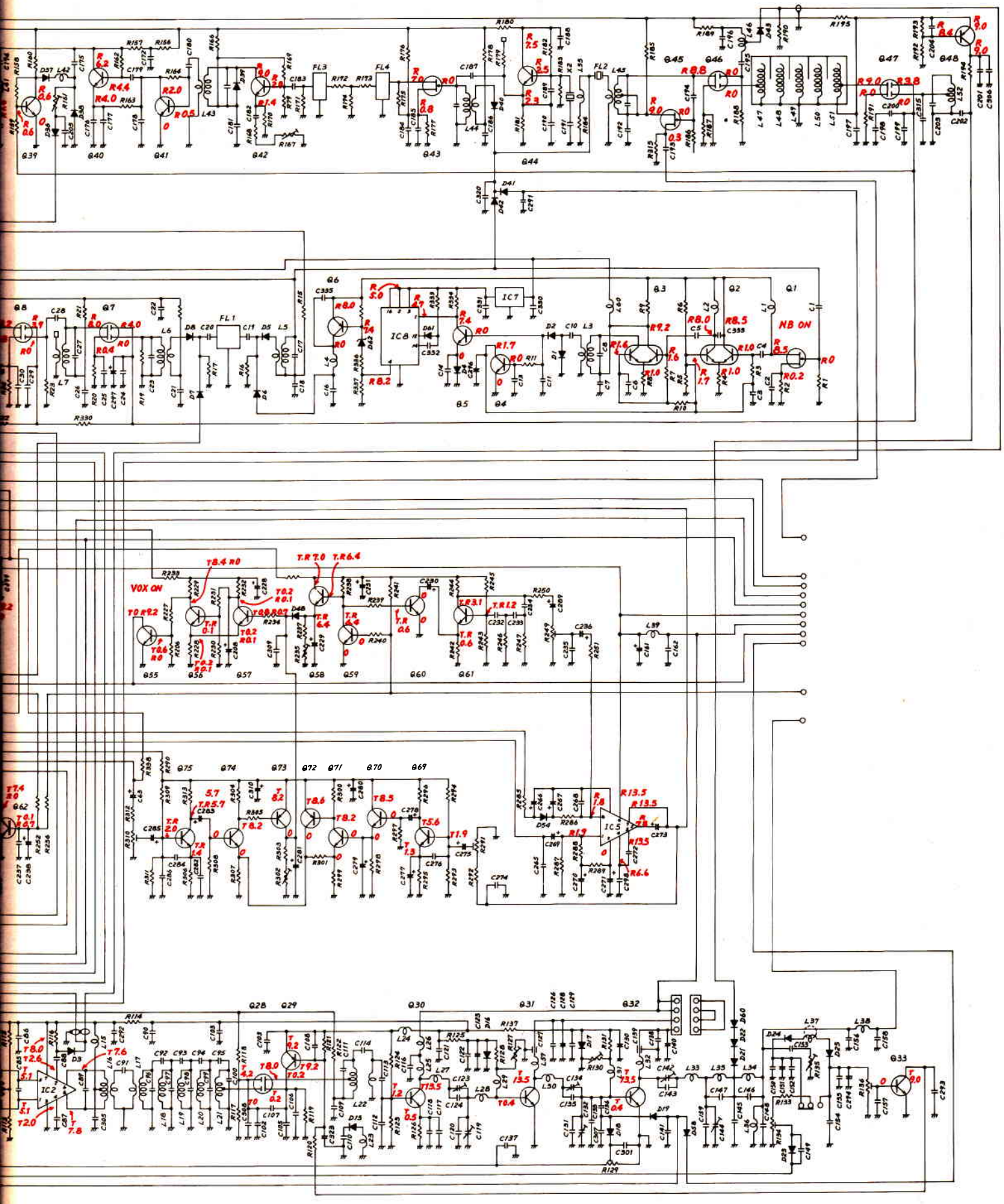


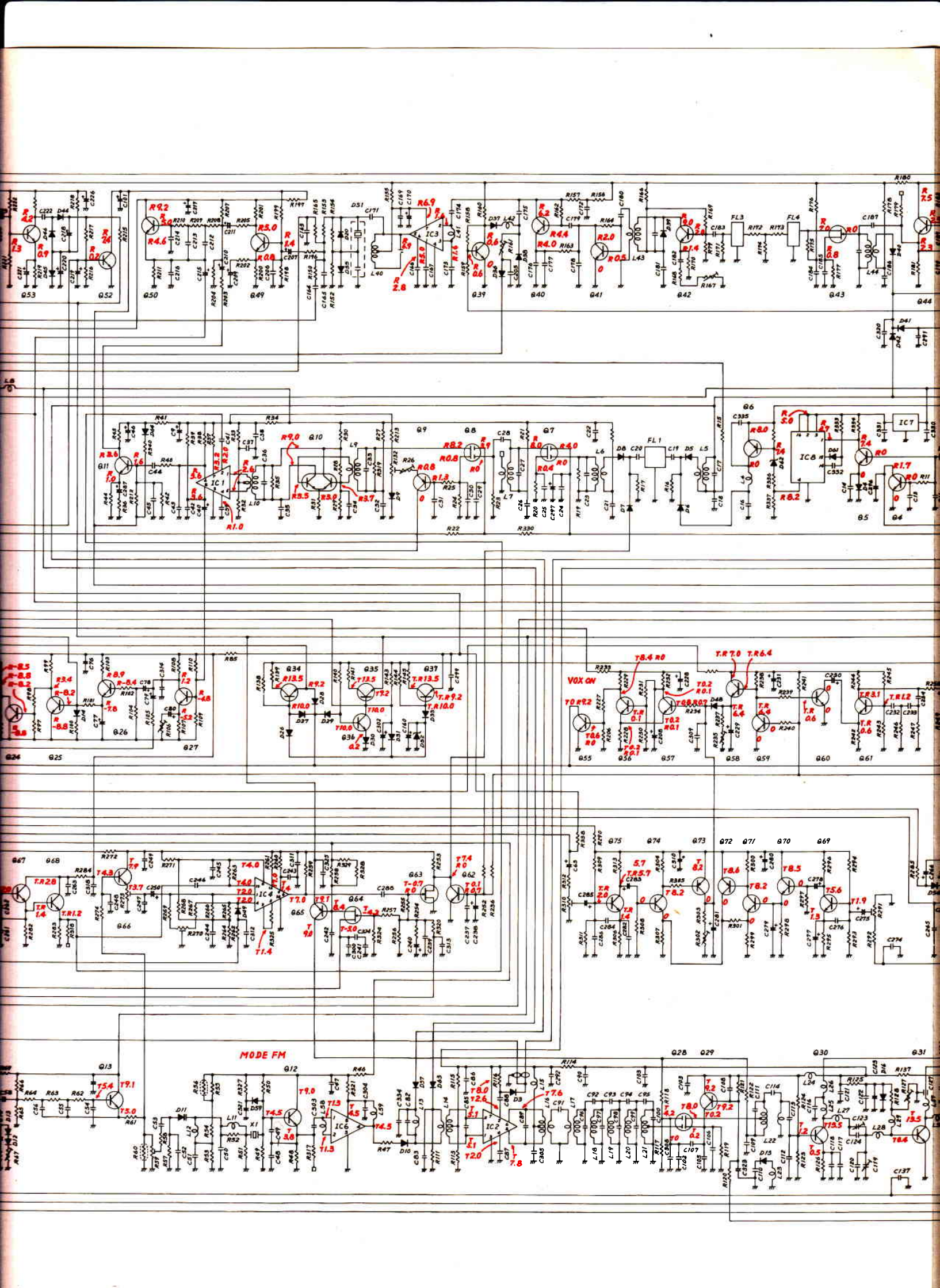

J6
GND
TONE SW
TONE
IC 4
TC 9123P
IC 2
IC 3
IC 1B
IC 7
Q3
Q4
Q5
Q6
Q7
Q8
Q9
Q10
Q11
Q12
Q17
J9


J6
GND
TONE SW
TONE
J1
FMC
GND
MIC2
TONE
13.8V
MUTE
J2
R9V
-9V
SQLS
SMETER
FM9V
SQL
SCAN
SPEED
IC3
IC2
IC6B
IC6A
IC7
Q6
Q7
Q9
Q10
Q11
Q12
Q17
Q18
Q19
J8 to MAIN P2
FMT9V
CWT9V
SSB9V
CW9V
J4 to EF P4
FMT9V
SSBT9V
CWT9V
SSB9V
CW9V
J5 to MAIN P1
SSB CW9V
SSB CWT9V
SSB FMT9V
GND
MOD
CENT
ASQL
SSQL

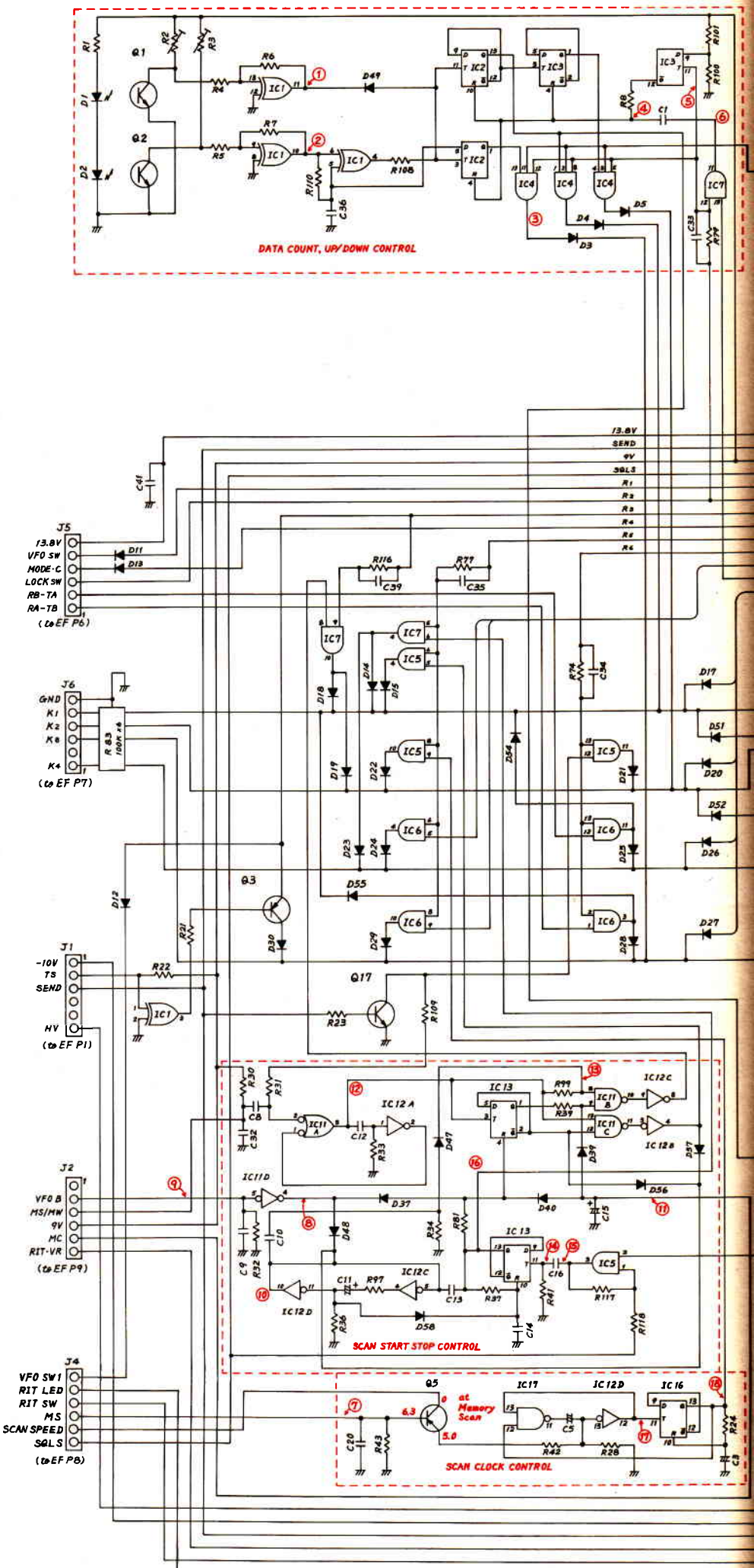
MAIN UNIT VOLTAGE CHART

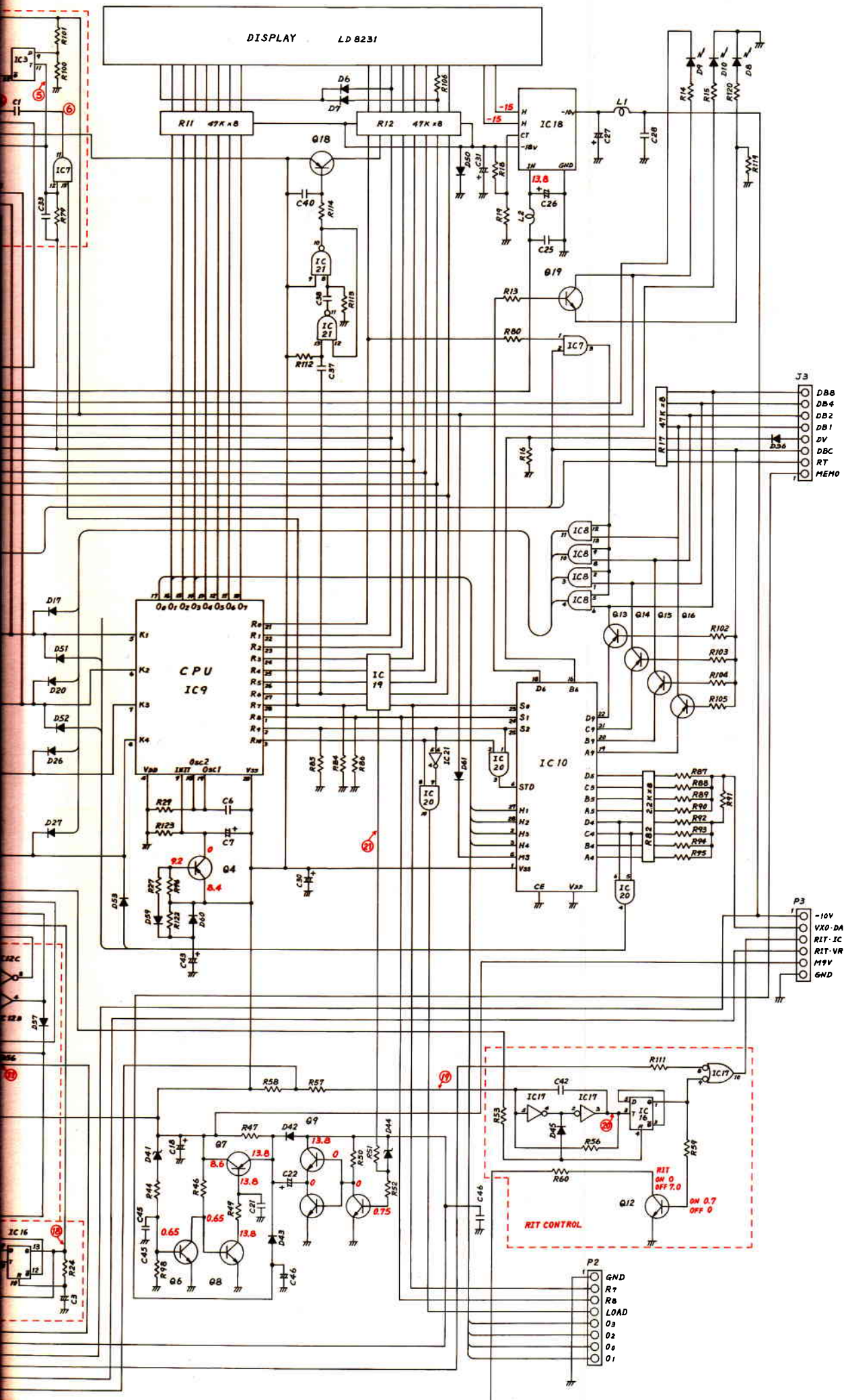


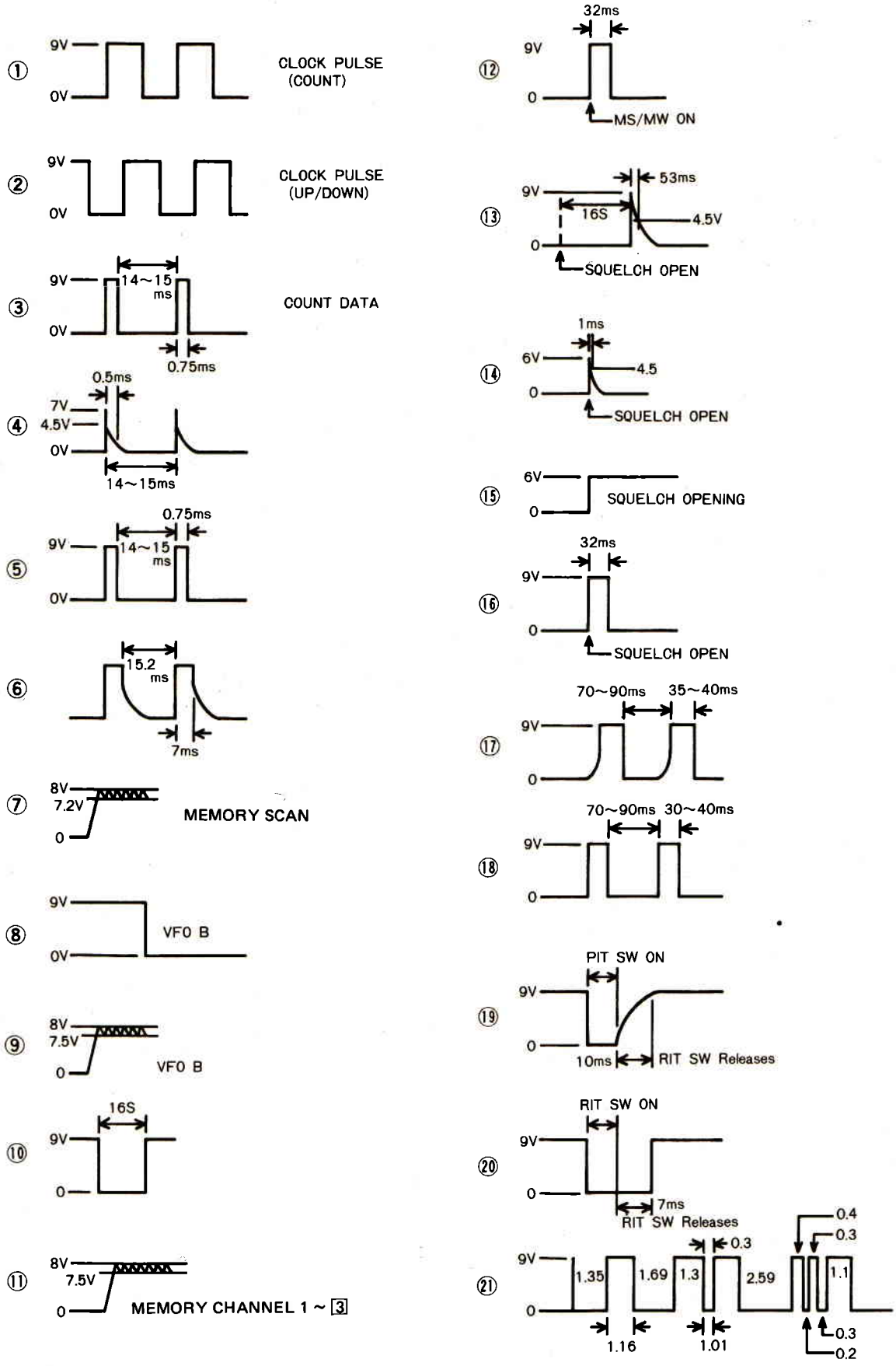

VOX ON
NB ON
IC1
IC2
IC3
IC4
IC5
IC6
IC7
ICB

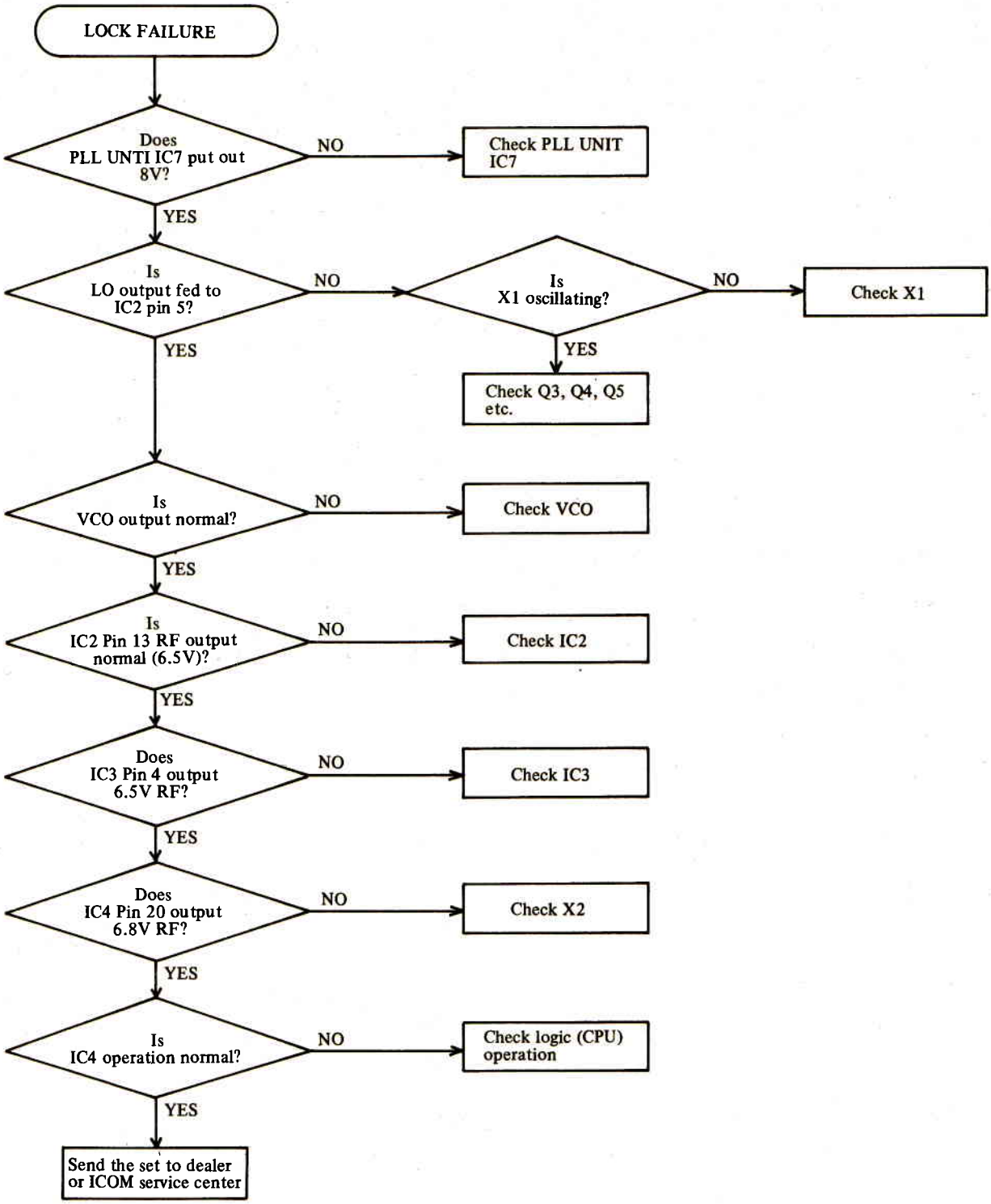

MODE FM
VOX ON
IC1
IC2
IC3
IC4
IC5
IC6
IC7
IC8
FL1
FL3
FL4
X1

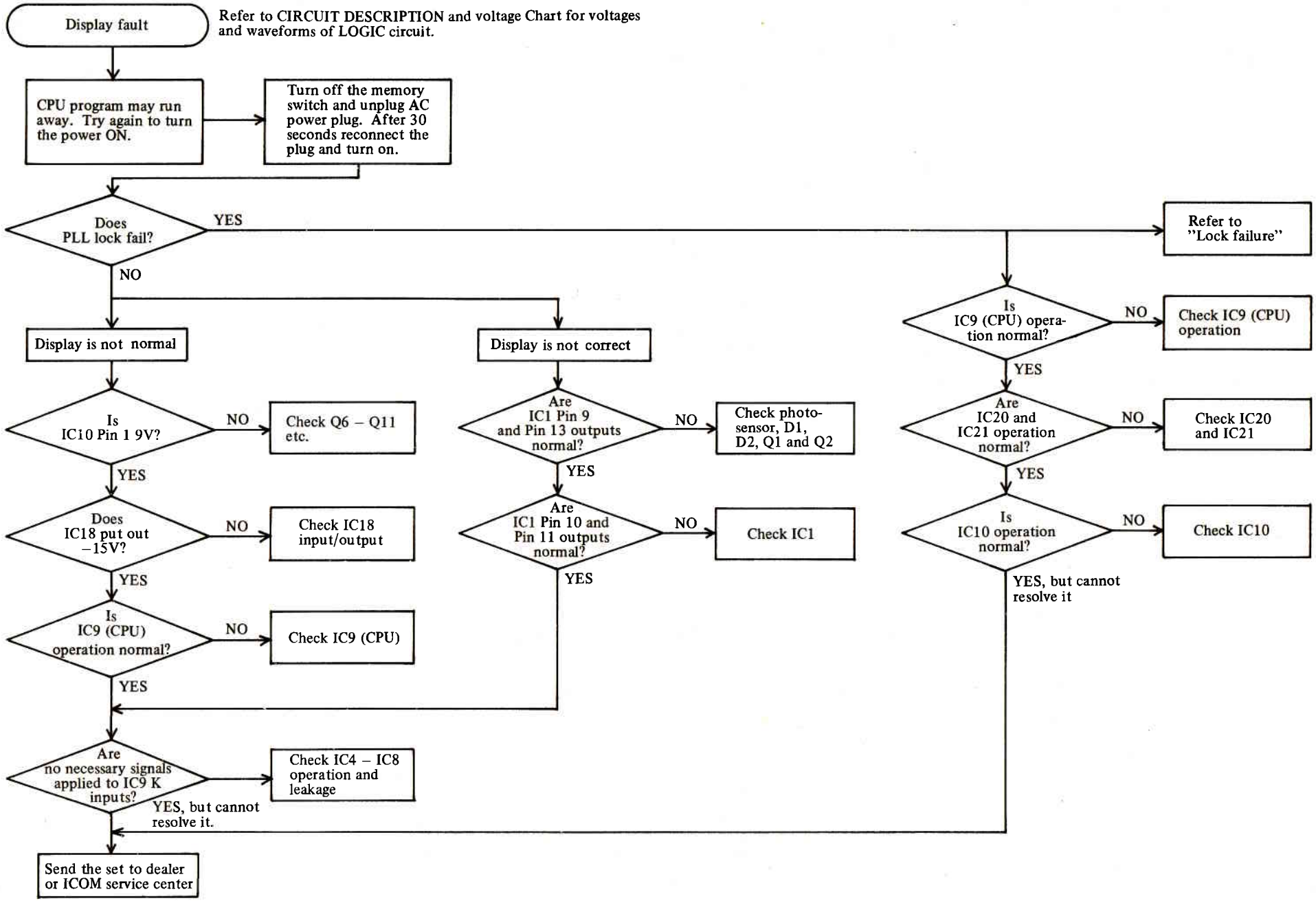
LOGIC UNIT VOLTAGE CHART

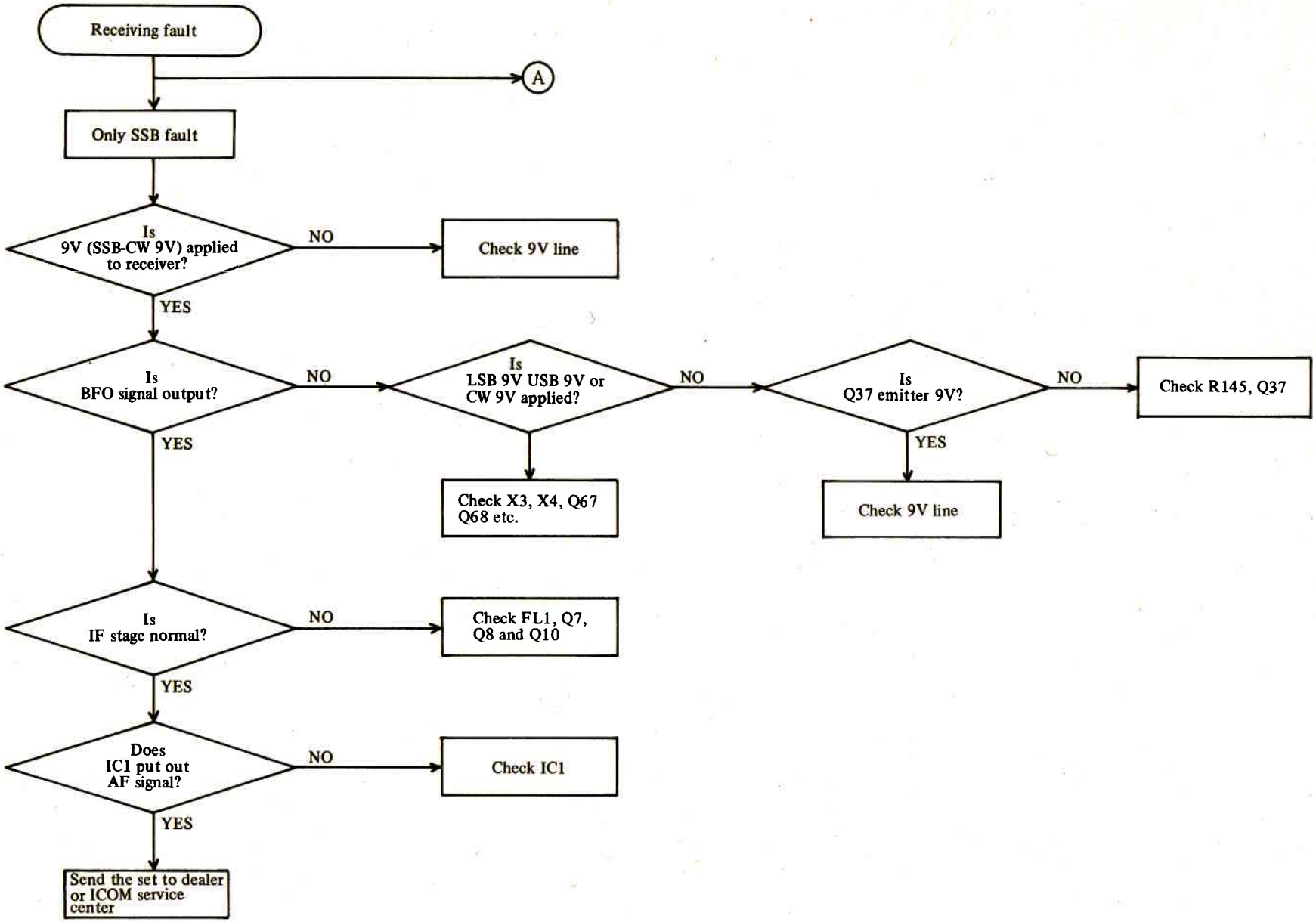


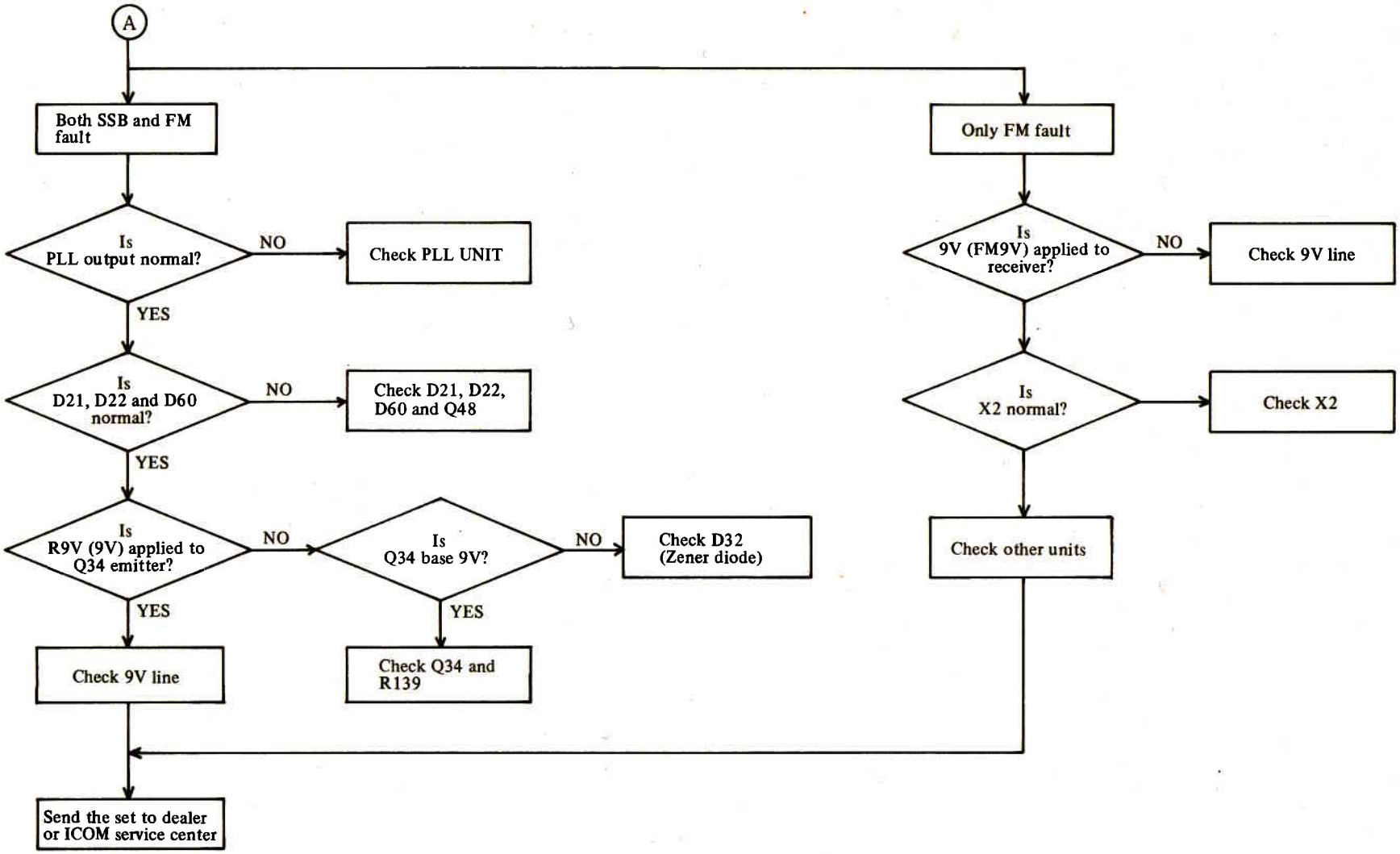

DISPLAY LD 8231
R11 47K x 8
R12 47K x 8
IC18
Q18
Q19
IC 21
IC 19
CPU IC9
IC 10
IC 20
IC 21
R17 47K x 8
R82 2.2K x 8
J3
DB8
DB4
DB2
DB1
DV
DBC
RT
MEM0
P3
-10V
VXO-DA
RIT-IC
RIT-VR
M9V
GND
P2
GND
R7
R8
LOAD
03
02
06
01
RIT CONTROL
RIT ON 0 OFF 7.0
ON 0.7 OFF 0
Q12
Q4
Q6
Q7
Q8
Q9
IC17
IC16

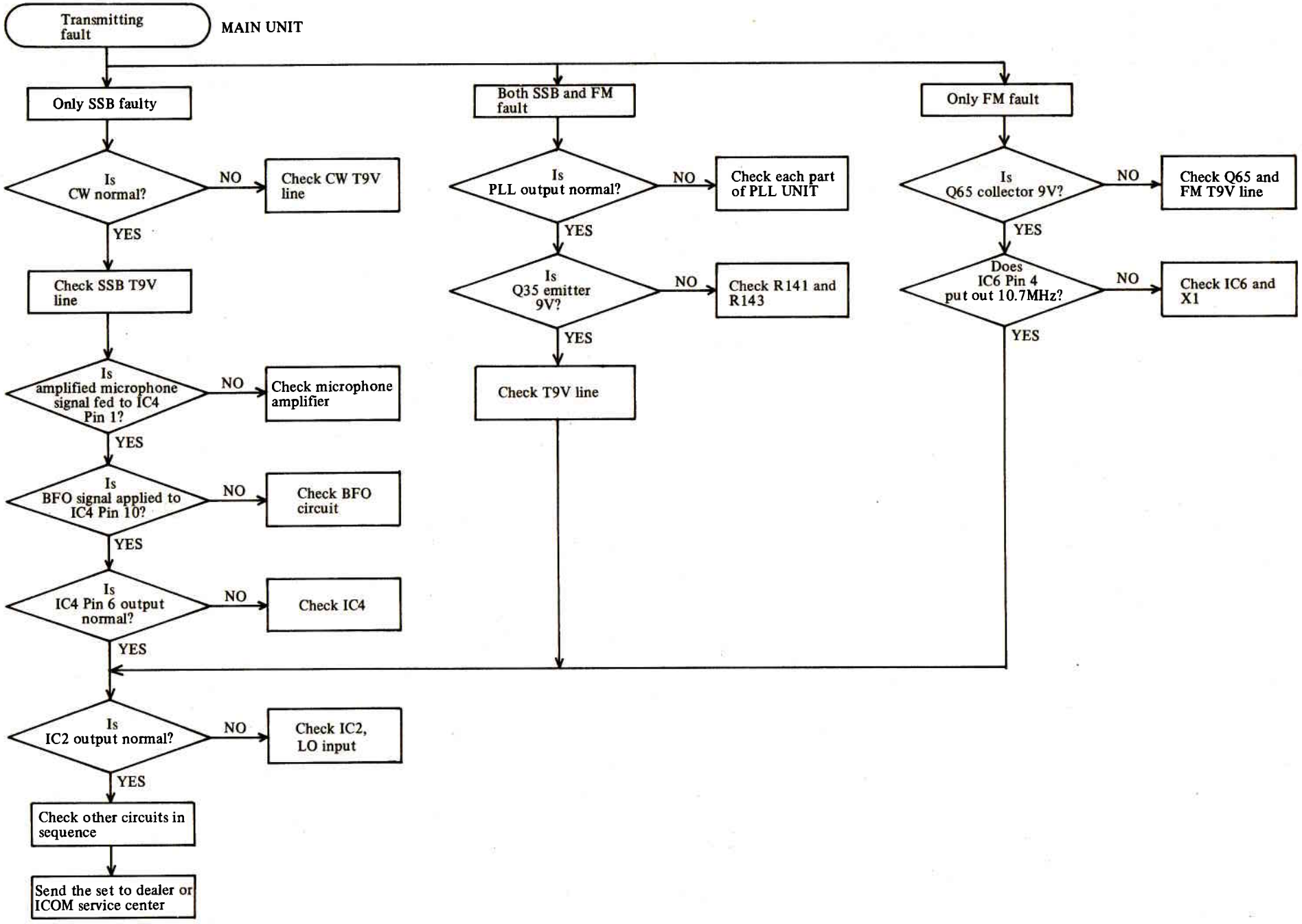

①
9V
0V
CLOCK PULSE (COUNT)
②
9V
0V
CLOCK PULSE (UP/DOWN)
③
9V
0V
14~15 ms
0.75ms
COUNT DATA
④
0.5ms
7V
4.5V
0V
14~15ms
⑤
0.75ms
9V
0V
14~15 ms
⑥
15.2 ms
7ms
⑦
8V
7.2V
0
MEMORY SCAN
⑧
9V
0V
VFO B
⑨
8V
7.5V
0
VFO B
⑩
16S
9V
0
⑪
8V
7.5V
0
MEMORY CHANNEL 1 ~ 3
⑫
32ms
9V
0
MS/MW ON
⑬
53ms
9V
16S
4.5V
0
SQUELCH OPEN
⑭
1ms
6V
4.5
0
SQUELCH OPEN
⑮
6V
0
SQUELCH OPENING
⑯
32ms
9V
0
SQUELCH OPEN
⑰
70~90ms
35~40ms
9V
0
⑱
70~90ms
30~40ms
9V
0
⑲
PIT SW ON
9V
0
10ms
RIT SW Releases
⑳
RIT SW ON
9V
0
7ms
RIT SW Releases
㉑
0.4
0.3
9V
0.3
1.35
1.69
1.3
2.59
1.1
0
1.16
1.01
0.3
0.2

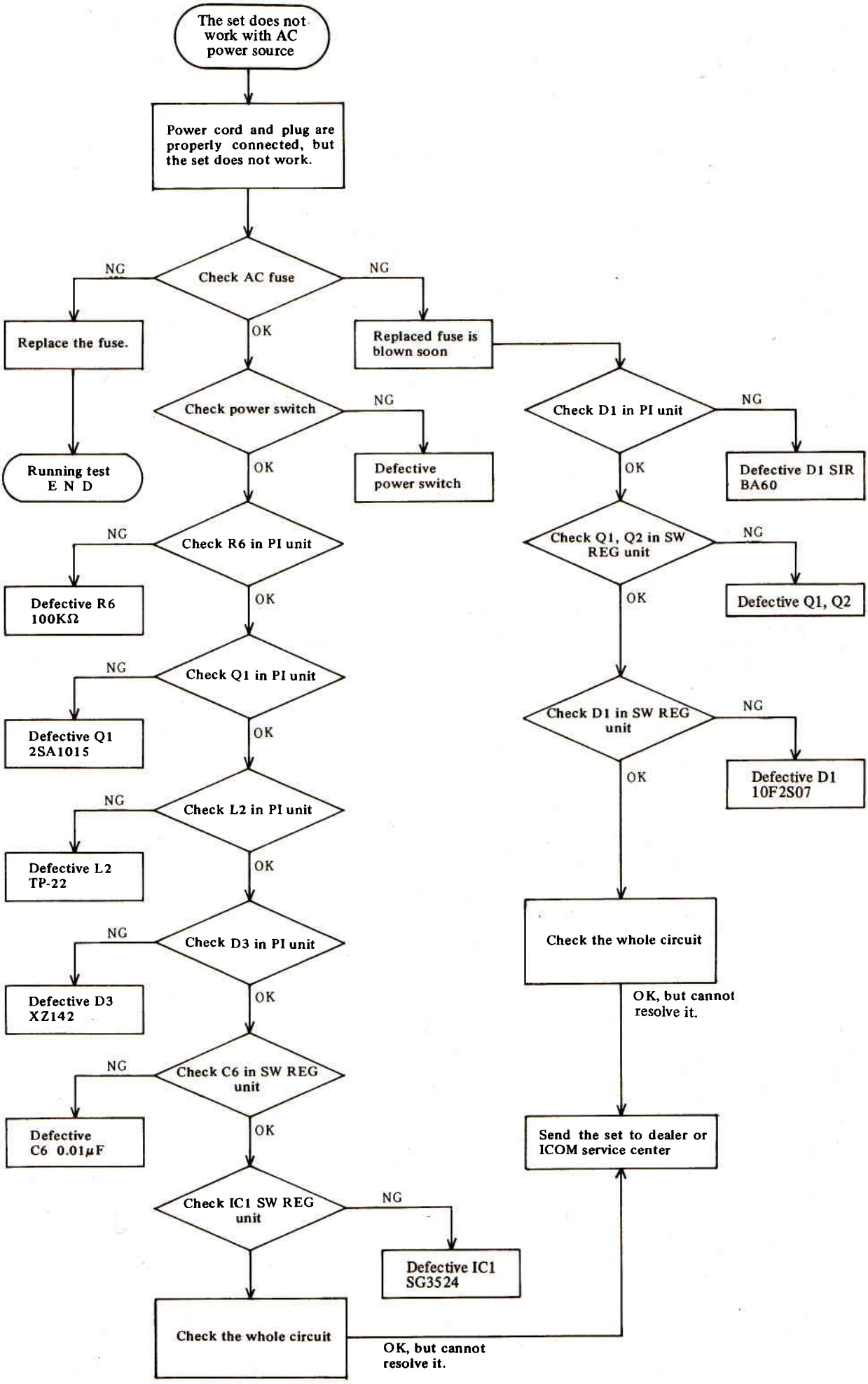

LOCK FAILURE
Does PLL UNTI IC7 put out 8V?
NO
Check PLL UNIT IC7
YES
Is LO output fed to IC2 pin 5?
NO
Is X1 oscillating?
NO
Check X1
YES
Check Q3, Q4, Q5 etc.
YES
Is VCO output normal?
NO
Check VCO
YES
Is IC2 Pin 13 RF output normal (6.5V)?
NO
Check IC2
YES
Does IC3 Pin 4 output 6.5V RF?
NO
Check IC3
YES
Does IC4 Pin 20 output 6.8V RF?
NO
Check X2
YES
Is IC4 operation normal?
NO
Check logic (CPU) operation
YES
Send the set to dealer or ICOM service center

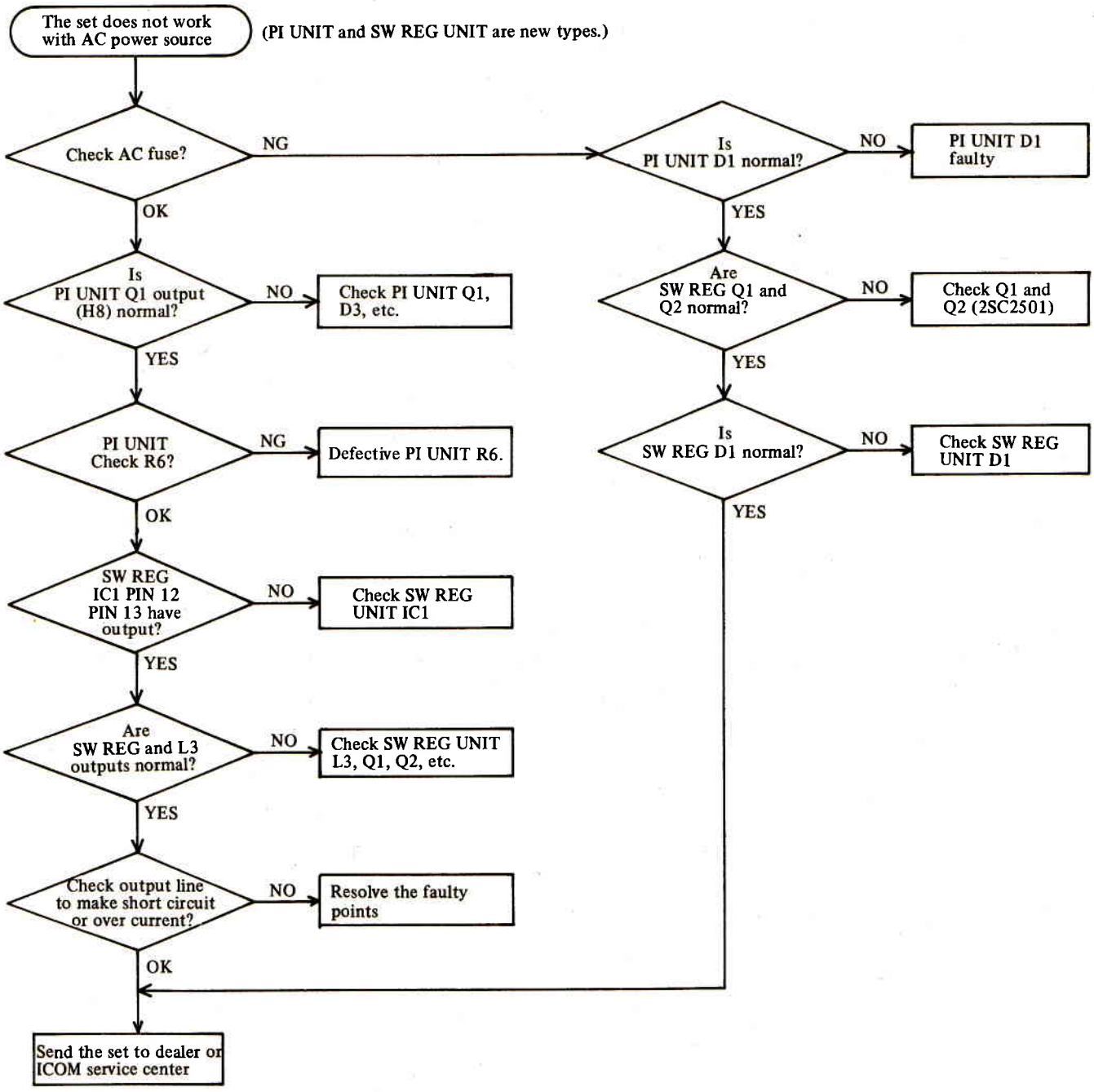

Display fault
Refer to CIRCUIT DESCRIPTION and voltage Chart for voltages and waveforms of LOGIC circuit.
CPU program may run away. Try again to turn the power ON.
Turn off the memory switch and unplug AC power plug. After 30 seconds reconnect the plug and turn on.
Does PLL lock fail?
YES
Refer to "Lock failure"
NO
Display is not normal
Display is not correct
Is IC9 (CPU) operation normal?
NO
Check IC9 (CPU) operation
YES
Is IC10 Pin 1 9V?
NO
Check Q6 – Q11 etc.
Are IC1 Pin 9 and Pin 13 outputs normal?
NO
Check photo-sensor, D1, D2, Q1 and Q2
Are IC20 and IC21 operation normal?
NO
Check IC20 and IC21
YES
YES
YES
Does IC18 put out –15V?
NO
Check IC18 input/output
Are IC1 Pin 10 and Pin 11 outputs normal?
NO
Check IC1
Is IC10 operation normal?
NO
Check IC10
YES
YES
YES, but cannot resolve it
Is IC9 (CPU) operation normal?
NO
Check IC9 (CPU)
YES
Are no necessary signals applied to IC9 K inputs?
Check IC4 – IC8 operation and leakage
YES, but cannot resolve it.
Send the set to dealer or ICOM service center


Receiving fault
A
Only SSB fault
Is 9V (SSB-CW 9V) applied to receiver?
NO
Check 9V line
YES
Is BFO signal output?
NO
Is LSB 9V USB 9V or CW 9V applied?
NO
Is Q37 emitter 9V?
NO
Check R145, Q37
YES
Check X3, X4, Q67 Q68 etc.
YES
Check 9V line
Is IF stage normal?
NO
Check FL1, Q7, Q8 and Q10
YES
Does IC1 put out AF signal?
NO
Check IC1
YES
Send the set to dealer or ICOM service center


A
Both SSB and FM fault
Is PLL output normal?
NO
Check PLL UNIT
YES
Is D21, D22 and D60 normal?
NO
Check D21, D22, D60 and Q48
YES
Is R9V (9V) applied to Q34 emitter?
NO
Is Q34 base 9V?
NO
Check D32 (Zener diode)
YES
YES
Check 9V line
Check Q34 and R139
Send the set to dealer or ICOM service center
Only FM fault
Is 9V (FM9V) applied to receiver?
NO
Check 9V line
Is X2 normal?
Check X2
Check other units

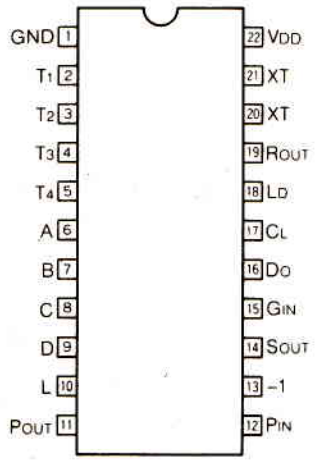

Transmitting fault
MAIN UNIT
Only SSB faulty
Is CW normal?
NO
Check CW T9V line
YES
Check SSB T9V line
Is amplified microphone signal fed to IC4 Pin 1?
NO
Check microphone amplifier
YES
Is BFO signal applied to IC4 Pin 10?
NO
Check BFO circuit
YES
Is IC4 Pin 6 output normal?
NO
Check IC4
YES
Is IC2 output normal?
NO
Check IC2, LO input
YES
Check other circuits in sequence
Send the set to dealer or ICOM service center
Both SSB and FM fault
Is PLL output normal?
NO
Check each part of PLL UNIT
YES
Is Q35 emitter 9V?
NO
Check R141 and R143
YES
Check T9V line
Only FM fault
Is Q65 collector 9V?
NO
Check Q65 and FM T9V line
YES
Does IC6 Pin 4 put out 10.7MHz?
NO
Check IC6 and X1
YES


The set does not work with AC power source
Power cord and plug are properly connected, but the set does not work.
Check AC fuse
NG
NG
OK
Replace the fuse.
Replaced fuse is blown soon
Check power switch
NG
OK
Running test
E N D
Defective power switch
Check D1 in PI unit
NG
OK
Defective D1 SIR BA60
Check R6 in PI unit
NG
OK
Defective R6 100KΩ
Check Q1, Q2 in SW REG unit
NG
OK
Defective Q1, Q2
Check Q1 in PI unit
NG
OK
Defective Q1 2SA1015
Check D1 in SW REG unit
NG
OK
Defective D1 10F2S07
Check L2 in PI unit
NG
OK
Defective L2 TP-22
Check D3 in PI unit
NG
OK
Defective D3 XZ142
Check the whole circuit
OK, but cannot resolve it.
Check C6 in SW REG unit
NG
OK
Defective C6 0.01μF
Send the set to dealer or ICOM service center
Check IC1 SW REG unit
NG
Defective IC1 SG3524
Check the whole circuit
OK, but cannot resolve it.

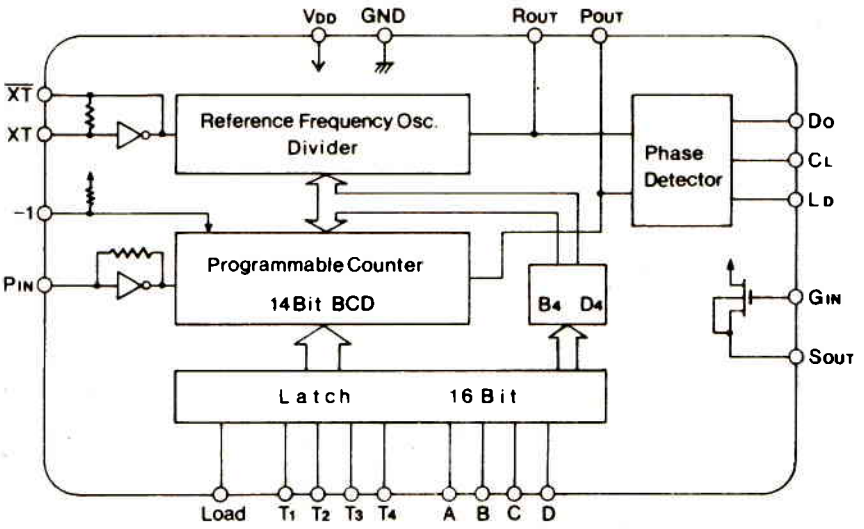

The set does not work with AC power source
(PI UNIT and SW REG UNIT are new types.)
Check AC fuse?
NG
OK
Is PI UNIT Q1 output (H8) normal?
NO
Check PI UNIT Q1, D3, etc.
YES
PI UNIT Check R6?
NG
Defective PI UNIT R6.
OK
SW REG IC1 PIN 12 PIN 13 have output?
NO
Check SW REG UNIT IC1
YES
Are SW REG and L3 outputs normal?
NO
Check SW REG UNIT L3, Q1, Q2, etc.
YES
Check output line to make short circuit or over current?
NO
Resolve the faulty points
OK
Send the set to dealer or ICOM service center
Is PI UNIT D1 normal?
NO
PI UNIT D1 faulty
YES
Are SW REG Q1 and Q2 normal?
NO
Check Q1 and Q2 (2SC2501)
YES
Is SW REG D1 normal?
NO
Check SW REG UNIT D1
YES

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

PIN CONNECTION



BLOCK DIAGRAM

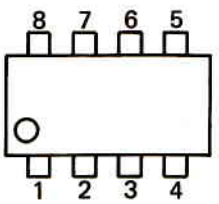


Maximum Ratings

Item	Symbol	Rating	Unit
Power supply voltage	V_{DD}	−0.3 ~9.0	V
Input voltage	V_{IN}	−0.3 ~ V_{DD} +0.3	V
Operation temperature	T_{OPR}	−30 ~ +70	°C
Storage temperature	T_{STG}	−55 ~ +125	°C

NJM4558D (DUAL LOW NOISE AMP.)

PIN CONNECTION

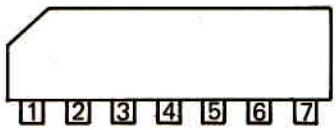


Maximum Ratings

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

μPC577H (FM-IF AMPLIFIER)

PIN CONNECTION

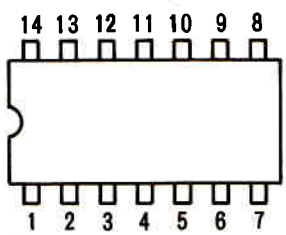


Maximum Ratings

Item	Symbol	Rating	Unit
Power supply voltage	V_{CC}	15	V
Voltage between input terminals	V_{IN}	±3.0	V
Power dissipation	P_D	300	mW
Operation temperature	T_{OPT}	−20 ~ +75	°C
Storage temperature	T_{STG}	−40 ~ +125	°C

TC4001 (QUAD 2-INPUT POSITIVE NOR GATE)
TC4011 (QUAD 2-INPUT POSITIVE NAND GATE)
TC4013 (DUAL D-TYPE FLIP FLOP)
TC4030 (QUAD EXCLUSIVE-OR GATE)
TC4069 (HEX INVERTER)
TC4073 (TRIPLE 3-INPUT POSITIVE AND GATE)
TC4081 (QUAD 2-INPUT POSITIVE AND GATE)

PIN CONNECTION



Maximum Ratings

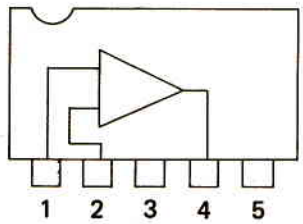
Item	Symbol	Rating	Unit
Power supply voltage	V_{DD}	V_{SS} −0.5 ~ V_{SS} +20	V
Input voltage	V_{IN}	V_{SS} −0.5 ~ V_{DD} +0.5	V
Output voltage	V_{OUT}	V_{SS}0.5 ~ V_{DD} +0.5	V
Input current	I_{IN}	±10	mA
Power dissipation	P_D	300	mW
Storage temperature	T_{STG}	−65 ~ +150	°C
Lead temperature/time	T_{SOL}	260°C · 10sec.	

BA401 (FM/IF LIMITER)

Maximum Ratings

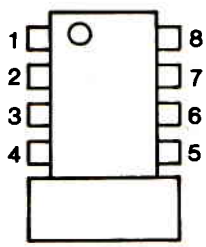
Item	Symbol	Rating	Unit
Power supply voltage	V_{CC}	15	V
Output voltage	V_{OUT}	24	V
Input voltage	V_{IN}	±3	V
Operation temperature	T_{OPR}	−25 ~ +75	°C
Storage temperature	T_{STG}	−55 ~ +125	°C

BLOCK DIAGRAM



μPC575C2 (2.0W AF POWER AMP.)

PIN CONNECTION



Maximum Ratings

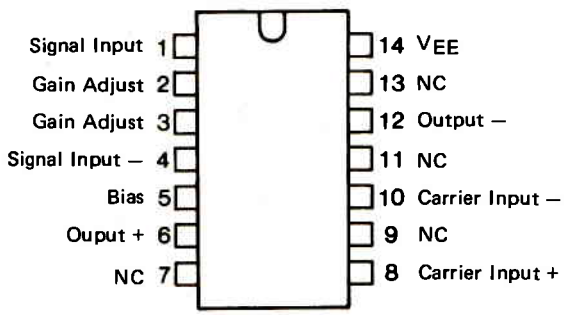
Item	Symbol	Rating	Unit
Power supply voltage (No signal)	V_{CC1}	20	V
Power supply voltage (In operation)	V_{CC2}	17	V
Circuit Current	$I_{CC(Peak)}$	1	A
Package power dissipation	P_D	1.9	W
Operation temperature	T_{OPT}	−20 ~ +75	°C
Storage temperature	T_{STG}	−40 ~ +150	°C

MC1496L (BALANCED MODULATOR-DEMODULATOR)

Maximum Ratings (T_A = +25°C unless otherwise noted)

Rating	Symbol	Value	Unit
Applied Voltage (V_6-V_7, V_8-V_1, V_9-V_7, V_9-V_8, V_7-V_4, V_7-V_1, V_8-V_4, V_6-V_8, V_2-V_5, V_3-V_5)	ΔV	30	Vdc
Differential Input Signal	V_7-V_8 V_4-V_1	+5.0 ±(5 + I_5 Re)	Vdc
Maximum Bias Current	Ib	10	mA
Power Dissipation (Package Limitation)	P_D	575	mW
Operating Temperature Range MC1496	T_A	0 ~ +70	°C
Storage Temperature Range	T_{stg}	−65 ~ +150	°C

PIN CONNECTION

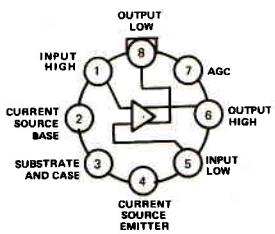


LM3028A (DIFFERENTIAL RF AMPLIFIER)

Maximum Ratings

Item	Symbol	Rating	Unit
Supply Operating Voltage	Vcc	±15	V
Differential Input Voltage	VIN	±5	V
Voltage Between 1 and 8		0 ~ +20	V
Voltage Between 5 and 6		0 ~ +20	V
Voltage Between 2 and 3		+5 ~ −11	V
Voltage Between 2 and 4		±5 ~ −1	V
Power Dissipation	P_D	450	mW
Operating Temperature	TOPR	−55 ~ +125	°C
Storage Temperature	TSTG	−65 ~ +200	°C
Lead Temperature (soldering 10 sec)	TSOL	300	°C

PIN CONNECTION

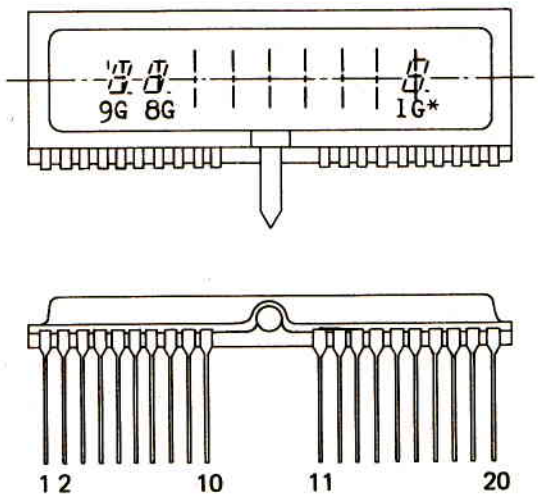


LD8231 (FLUORESCENT INDICATOR PANEL)

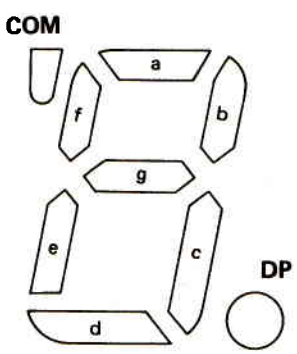
MAXIMUM ABSOLUTE RATINGS

SYMBOL	DESCRIPTION	MIN.	NOM.	MAX.	UNIT
Ef	Filament Voltage	2.97	3.3	3.63	Vac
eb	Anode Voltage	20	24	36	Vp-p
ec	Grid Voltage	20	24	36	Vp-p

OUTLINE DRAWING



PATTERN



TERMINAL CONNECTION

Terminal No.	1	2	3	4	5	6	7	8	9	10
Electrode	F	P(COM)	P(a)	P(b)	P(g)	P(f)	P(c)	P(e)	P(d)	P(DP)
Terminal No.	11	12	13	14	15	16	17	18	19	20
Electrode	9G	8G	7G	6G	5G	4G	3G	2G	1G	F

[EF] UNIT

REF. NO.	DESCRIPTION	PART NO.
Q1	Transistor	2SC2636 (IC-251E only)
D1	Diode	1SS53
D2	Diode	1N60 (IC-251E only)
D3	LED	SLP-119B
D4	Diode	SR-10N2 R
D5	Diode	1N4002
R1	Variable	VM10A 10KA (AF GAIN)
R2	Variable	VM10A 10KB (RIT)
R3	Variable	VM10A 10KB (MIC GAIN)
R4	Variable	VM10A 500B (RF POWER)
R5	Variable	VM10A 10KA (RF GAIN)
R6	Resistor	5.6K R25
R7	Variable	GM10A 10KB 500B (SQL)
R8	Trimmer	50K FR10
R9	Resistor	10K R25
R10	Resistor	6.8K R25
R11	Resistor	22K R25
R12	Resistor	10K R25
R13	Resistor	1.8M R25
R14	Resistor	1.8M R25
R15	Trimmer	1K FR10
R16	Resistor	47 R25
R17	Trimmer	10K FR10
R18	Resistor	100 R25
R19	Resistor	100 R25
R20	Resistor	10K R25
R21	Resistor	1K R25
R22	Resistor	1K R25
R23	Resistor	100K R25 (IC-251E only)
C1	Ceramic	0.001 50V
C2	Ceramic	0.001 50V
C3	Ceramic	0.001 50V
C4	Ceramic	0.0047 50V
C5	Ceramic	0.0047 50V
C6	Ceramic	PME410M102P
C7	Ceramic	PME410M102P
C8	Barrier Lay	0.1 12V
C9	Barrier Lay	0.1 12V
C10	Ceramic	0.001 50V
C11	Ceramic	0.001 16V
C12	Barrier Lay	0.1 12V
S1	Snap Switch	SLC-22C (T/R)
S2	Snap Switch	SLC-22C (AGC)
S3	Snap Switch	SLC-22C (VOX)
S4	Snap Switch	SLC-22C (NB)
S5	Snap Switch	SLC-22C (DIAL LOCK)
S6	TS Switch	
S7	MS/MW Switch	
S8	Push Switch	TW0068 (POWER)
S9	Rotary Switch	SRN3065N (MODE)
S10	Slide Switch	S-1 (MEMORY)
S11	Rotary Switch	SRN2029N (VFO)
S12	Snap Switch	SLC-22C (RIT)
F1	Fuse	2A (IC-251A)
		1A (IC-251E)
FH1	Fuse Holder	FH-032

[EF] UNIT

REF. NO.	DESCRIPTION	PART NO.
B1	PC Board	B-207B
B2	PC Board	B-202
B3	PC Board	B-169
B4	PC Board	B-336A
P1	Connector	5250-06
P2	Connector	5250-08
P3	Connector	5250-06
P4	Connector	5250-06
P6	Connector	5250-06
P7	Connector	5250-06
P8	Connector	5250-06
P9	Connector	5250-06
P10	Connector	1625-03P-1
P11	Connector	1625-03R-1
P12	Connector	1653-05R-1
P13	Connector	1625-06P-1
P14	Connector	1625-06R-1
P15	Connector	5250-08
J1	Connector	FM214-8SS
J3	Phones Jack	LJ-035-1-2
J4	Speaker Jack	SJ-296
J5	Key Jack	SJ-296
J6	Ground Terminal	
J7	AC Power Socket	CM3
J8	DC Power Socket	1490-4P
J9	RCA Jack	CN-3561S
J10	RCA Jack	CN-3561S
J11	RCA Jack	CN-3561S
J12	RCA Jack	CN-3561S
J13	ANT Connector	FM-MDRMI
J14	Connector	5045-12A
J15	Connector	5045-12A
J16	Connector	5045-04A
J17	Connector	1625-24R
J18	Connector	5045-02A
M1	Meter	YN-45-2
PL1	Lamp	BQ044-32582C
SP1	Speaker	65S-03
L1	Coil	LA-37

[MAIN] UNIT

REF. NO.	DESCRIPTION	PART NO.
IC1	IC	LM3028
IC2	IC	LM3028
IC3	IC	μPC577H
IC4	IC	MC1496L
IC5	IC	μPC575-C2
IC6	IC	BA-401
IC7	IC	78L05
IC8	IC	M53323P

[MAIN] UNIT

REF. NO.	DESCRIPTION	PART NO.
Q1	FET	2SK49-H2
Q2	Transistor	2SC1583-G
Q3	Transistor	2SC1583-G
Q4	Transistor	2SC945-P
Q5	Transistor	2SC945-P
Q6	Transistor	JA1050-G/W
Q7	FET	3SK40-M
Q8	FET	3SK74-K
Q9	Transistor	JA1050-G/W
Q10	Transistor	2SC1583-G
Q11	Transistor	2SC1571-G
Q12	Transistor	2SC945-P
Q13	Transistor	2SC945-P
Q14	Transistor	2SC945-P
Q15	Transistor	2SC945-P
Q16	Transistor	2SC1571-G
Q19	Transistor	JA1050-G
Q20	Transistor	2SC945-P
Q21	FET	2SK30A-GR
Q22	Transistor	2SC945-P
Q23	Transistor	2SC945-P
Q24	Transistor	2SC945-P
Q25	Transistor	2SC945-P
Q26	Transistor	2SC945-P
Q27	Transistor	2SC945-P
Q28	FET	3SK40-M
Q29	Transistor	JA1050-G/W
Q30	Transistor	2SC2053
Q31	Transistor	2SC1947
Q32	Transistor	2SC2094
Q33	Transistor	2SC945-P
Q34	Transistor	JA1600-G
Q35	Transistor	2SD359-D
Q36	Transistor	2SC945-P
Q37	Transistor	JA1600-G
Q39	Transistor	2SC945-P
Q40	Transistor	2SC945-P
Q41	Transistor	2SC945-P
Q42	Transistor	2SC945-P
Q43	FET	2SK49-H2
Q44	Transistor	2SC945-P
Q45	FET	2SK49-H2
Q46	FET	3SK74M
Q47	FET	3SK48
Q48	Transistor	2SA639
Q49	Transistor	2SC1571-G
Q50	Transistor	2SC945-R
Q52	Transistor	2SC945-P
Q53	Transistor	2SC945-P
Q54	Transistor	2SC945-P
Q55	Transistor	2SC945-P
Q56	Transistor	2SC945-P
Q57	Transistor	2SC945-P
Q58	Transistor	2SC945-P
Q59	Transistor	2SC945-P
Q60	Transistor	2SC945-P
Q61	Transistor	2SC945-P
Q62	Transistor	2SC945-P
Q63	FET	2SK49-H2
Q64	FET	2SK-30A-Y
Q65	Transistor	JA1050-G/W

[MAIN] UNIT

REF. NO.	DESCRIPTION	PART NO.
Q66	Transistor	2SC945-P
Q67	Transistor	2SC945-P
Q68	Transistor	2SC945-P
Q69	Transistor	2SC945-P
Q70	Transistor	2SC945-P
Q71	Transistor	2SC945-P
Q72	Transistor	JA1050-G/W
Q73	Transistor	JA1050-G/W
Q74	Transistor	2SC945-P
Q75	Transistor	2SC945-P
D1	Diode	1N60
D2	Diode	1N60
D3	Diode	1SS53
D4	Diode	GP08A
D5	Diode	1SS53
D6	Diode	1SS53
D7	Diode	1SS53
D8	Diode	1SS53
D9	Diode	1N60
D10	Diode	1SS53
D11	Varactor Diode	1S2688E
D12	Diode	1N60
D13	Diode	1N60
D14	Diode	GP08A
D16	Diode	1SS53
D17	Diode	GP08A
D18	Diode	1S953
D19	Diode	1N60
D20	Diode	1N60
D21	Diode	1SS55
D22	Diode	1SS55
D23	Diode	1N60
D24	Diode	1N60
D25	Diode	1N60
D26	Diode	1SS53
D27	Diode	1SS53
D28	Diode	GP08A
D29	Diode	1SS53
D30	Diode	1SS53
D31	Diode	1SS53
D32	Zener Diode	XZ096
D33	Diode	1SS53
D35	Diode	1N60
D36	Diode	1SS53
D37	Diode	1SS53
D38	Diode	1N60
D39	Diode	1SS53
D40	Diode	1SS53
D41	Diode	1SS53
D42	Diode	1SS53
D43	Diode	1SS53
D44	Diode	1N60
D45	Diode	1SS53
D46	Diode	1N60
D47	Diode	1SS53
D48	Diode	1SS53
D49	Diode	1SS53
D50	Diode	1SS53
D51	Diode	1SS53
D52	Diode	1SS53

[MAIN] UNIT

REF. NO.	DESCRIPTION	PART NO.
D53	Diode	1SS53
D54	Diode	1SS53
D57	Diode	1SS53
D58	Diode	1SS53
D60	Diode	1SS55
D61	Diode	1SS53
D62	Zener Diode	WZ036
D63	Diode	1SS53
D64	Diode	1SS53
D65	Diode	1SS53
L1	Choke Coil	100
L2	Choke Coil	100
L3	Coil	LS-55
L4	Choke Coil	102
L5	Coil	LS-66
L6	Coil	LS-66
L7	Coil	LS-66
L8	Choke Coil	102
L9	Coil	LS-66
L10	Coil	LS-67
L11	Choke Coil	100
L12	Coil	LS-80
L13	Choke Coil	101
L14	Coil	LS-66
L15	Choke Coil	101
L16	Coil	LS-222
L17	Coil	LS-73
L18	Coil	LS-222
L19	Coil	LS-222
L20	Coil	LS-73
L21	Coil	LS-73
L22	Coil	LS-222
L23	Coil	LS-73
L24	Choke Coil	101
L25	Coil	LA-71
L26	Coil	LW-1
L27	Coil	LA-97
L28	Coil	LA-109
L29	Coil	LW-1
L30	Coil	LA-2
L31	Coil	LW-1
L32	Coil	LA-71
L33	Coil	LA-73
L34	Coil	LA-71
L35	Coil	LA-71
L36	Coil	LA-11
L37	Coil	LR-10
L38	Coil	LA-85
L39	Choke Coil	TC-1B
L40	Coil	LS-16
L41	Choke Coil	102
L42	Choke Coil	102
L43	Coil	LS-20
L44	Coil	LS-110A
L45	Coil	LS-110
L46	Coil	LR-17
L47	Coil	LB-1-3B
L48	Coil	LB-1-1A
L49	Coil	LB-1-1A
L50	Coil	LB-1-1A

[MAIN] UNIT

REF. NO.	DESCRIPTION	PART NO.
L51	Coil	LB-34A
L52	Coil	LS-4
L53	Choke Coil	101
L55	Choke Coil	101
L56	Choke Coil	102
L57	Coil	LA-96
L58	Choke Coil	101
L59	Choke Coil	100
L60	Choke Coil	101
FL1	Crystal Filter	K10F-24A
FL2	Crystal Filter	10M15B
FL3	Ceramic Filter	CFU-455E2
FL4	Ceramic Filter	CFU-455E2
DS1	Ceramic Discriminator	455D
S1	Slide Switch	SJ-0237
J1	AMP Pin	171255-1
J2	Connector	2402-4A
X1	Crystal	HC-18/U 10.700MHz
X2	Crystal	HC-18/U 10.245MHz
X3	Crystal	HC-18/U 10.6985MHz
X4	Crystal	HC-18/U 10.7015MHz
C1	Ceramic	470P 50V
C2	Ceramic	0.01 50V
C3	Ceramic	0.01 50V
C4	Ceramic	50P 50V
C5	Ceramic	50P 50V
C6	Ceramic	0.0047 50V
C7	Ceramic	0.01 50V
C8	Ceramic	47P 50V
C9	Electrolytic	47 16V
C10	Ceramic	100P 50V
C11	Ceramic	100P 50V
C12	Mylar	0.039 50V
C13	Ceramic	0.0047 50V
C14	Ceramic	0.01 50V
C16	Mylar	0.0022 50V
C17	Ceramic	68P 50V
C18	Ceramic	0.01 50V
C19	Ceramic	0.01 50V
C20	Ceramic	0.01 50V
C21	Ceramic	0.01 50V
C22	Ceramic	0.04 50V
C23	Ceramic	120P 50V
C24	Ceramic	0.01 50V
C25	Ceramic	0.01 50V
C26	Ceramic	0.01 50V
C27	Ceramic	120P 50V
C28	Ceramic	0.01 50V
C29	Ceramic	0.01 50V
C30	Ceramic	0.01 50V
C31	Ceramic	0.01 50V
C32	Ceramic	0.01 50V
C33	Ceramic	120P 50V
C34	Ceramic	0.01 50V
C35	Ceramic	0.01 50V

[MAIN] UNIT

REF. NO.	DESCRIPTION	PART NO.
C36	Ceramic	40P 50V
C37	Ceramic	0.01 50V
C38	Mylar	0.022 50V
C39	Ceramic	0.01 50V
C40	Electrolytic	4.7 25V
C41	Dipped Mica	15P 50V
C42	Mylar	0.01 50V
C43	Mylar	0.01 50V
C44	Mylar	0.1 50V
C45	Ceramic	0.01 50V
C46	Electrolytic	47 10V
C47	Ceramic	0.01 50V
C48	Ceramic	200P N2200 50V
C49	Ceramic	100P N2200 50V
C50	Ceramic	10P NPO 50V
C51	Mylar	0.01 50V
C52	Mylar	0.047 50V
C53	Mylar	0.1 50V
C54	Mylar	0.0033 50V
C55	Mylar	0.01 50V
C56	Mylar	0.01 50V
C57	Electrolytic	100 16V
C58	Electrolytic	4.7 25V
C59	Mylar	0.0047 50V
C60	Electrolytic	100 16V
C61	Ceramic	0.01 50V
C62	Ceramic	220P 50V
C63	Electrolytic	4.7 25V
C65	Electrolytic	4.7 25V
C72	Electrolytic	33 10V
C73	Electrolytic	220 16V
C74	Electrolytic	10 16V
C75	Electrolytic	0.47 50V
C76	Electrolytic	220 16V
C77	Electrolytic	10 16V
C78	Electrolytic	3.3 25V
C79	Electrolytic	3.3 25V
C80	Electrolytic	10 16V
C81	Electrolytic	10 16V
C82	Ceramic	10P 50V
C83	Ceramic	0.01 50V
C85	Ceramic	120P 50V
C86	Ceramic	0.01 50V
C87	Ceramic	0.01 50V
C88	Ceramic	0.01 50V
C89	Ceramic	7P NPO 50V
C90	Barrier Lay	0.047 50V
C91	Ceramic	6P NPO 50V
C92	Ceramic	0.35P 50V
C93	Ceramic	0.35P 50V
C94	Ceramic	0.35P 50V
C95	Ceramic	0.5P 50V
C96	Ceramic	8P NPO 50V
C97	Ceramic	6P NPO 50V
C98	Ceramic	6P NPO 50V
C99	Ceramic	8P NPO 50V
C100	Ceramic	6P NPO 50V
C101	Electrolytic	1 50V
C102	Ceramic	0.01 50V
C103	Ceramic	0.01 50V
C104	Barrier Lay	0.1 12V

[MAIN] UNIT

REF. NO.	DESCRIPTION	PART NO.
C105	Ceramic	0.001 50V
C106	Ceramic	0.01 50V
C107	Ceramic	0.01 50V
C108	Ceramic	0.01 50V
C109	Ceramic	0.01 50V
C111	Ceramic	6P 50V
C112	Ceramic	25P 50V
C113	Ceramic	7P 50V
C114	Ceramic	0.5P 50V
C115	Ceramic	0.01 50V
C116	Ceramic	0.01 50V
C117	Ceramic Chip	0.001
C118	Ceramic	0.01 50V
C119	Trimmer	CVC20-11
C120	Ceramic	45P 50V
C121	Ceramic	0.01 50V
C122	Ceramic	0.01 50V
C123	Trimmer	CVC20-11
C124	Ceramic	30P 50V
C125	Electrolytic	10 16V
C126	Ceramic	0.01 50V
C127	Ceramic Feed Thru	0.001 DFT-5
C128	Electrolytic	47 25V
C129	Ceramic	0.01 50V
C130	Electrolytic	10 16V
C131	Ceramic	50P 50V
C132	Trimmer	CVC20-11
C133	Ceramic	100P 50V
C134	Trimmer	CVC20-11
C135	Ceramic	15P 50V
C136	Ceramic	15P 50V
C137	Ceramic	0.01 50V
C138	Ceramic	0.01 50V
C139	Ceramic Feed Thru	0.001 DFT-5
C140	Electrolytic	47 16V
C141	Ceramic	0.01 50V
C142	Trimmer	CV01B150
C143	Ceramic	25P 50V
C144	Trimmer	TYPE C 70P
C145	Ceramic	30P 50V
C146	Ceramic	2P 50V
C147	Ceramic	3P 50V
C148	Ceramic	20P 50V
C149	Ceramic	0.01 50V
C150	Ceramic	0.01 50V
C151	Electrolytic	22 16V
C152	Ceramic	0.01 50V
C153	Ceramic	2P 50V
C154	Ceramic	0.01 50V
C155	Ceramic	0.01 50V
C156	Ceramic	15P 50V
C157	Ceramic	0.001 50V
C158	Ceramic	15P 50V
C159	Ceramic	15P 50V
C160	Electrolytic	100 16V
C161	Electrolytic	470 16V
C162	Ceramic	0.04 50V
C163	Mylar	0.1 50V
C164	Mylar	0.1 50V
C165	Mylar	0.001 50V
C166	Mylar	0.056 50V

[MAIN] UNIT

REF. NO.	DESCRIPTION	PART NO.		
C167	Mylar	0.056	50V	
C169	Mylar	0.056	50V	
C170	Electrolytic	47	10V	
C171	Mylar	0.0022	50V	
C172	Mylar	0.039	50V	
C173	Mylar	0.056	50V	
C174	Mylar	0.0047	50V	
C175	Ceramic	0.01	50V	
C176	Mylar	0.056	50V	
C177	Mylar	0.056	50V	
C178	Mylar	0.001	50V	
C179	Ceramic	0.01	50V	
C180	Ceramic	0.01	50V	
C181	Mylar	0.039	50V	
C182	Mylar	0.039	50V	
C183	Ceramic	0.01	50V	
C184	Mylar	0.039	50V	
C185	Mylar	0.039	50V	
C186	Ceramic	0.01	50V	
C187	Ceramic	1P	50V	
C188	Ceramic	0.01	50V	
C189	Polystyrene	200P	50V	
C190	Polystyrene	100P	50V	
C191	Ceramic	30P	NPO	50V
C192	Ceramic	0.01	50V	
C193	Ceramic	0.001	50V	
C194	Ceramic	2P	50V	
C195	Ceramic	0.01	50V	
C196	Ceramic	0.01	50V	
C197	Ceramic	0.01	50V	
C198	Ceramic	0.01	50V	
C199	Ceramic	0.01	50V	
C200	Ceramic	0.001	50V	
C201	Ceramic	0.002	500V	
C202	Ceramic	15P	500V	
C203	Dipped Mica	10P	50V	
C204	Ceramic	0.001	50V	
C205	Ceramic	0.01	50V	
C206	Mylar	0.056	50V	
C207	Mylar	0.022	50V	
C208	Electrolytic	1	50V	
C209	Electrolytic	4.7	50V	
C210	Electrolytic	0.47	50V	
C211	Electrolytic	0.47	50V	
C212	Mylar	0.01	50V	
C213	Mylar	0.0047	50V	
C214	Mylar	0.0033	50V	
C215	Electrolytic	0.47	50V	
C216	Ceramic	100P	50V	
C217	Electrolytic	10	16V	
C218	Electrolytic	3.3	25V	
C219	Electrolytic	3.3	25V	
C220	Electrolytic	10	16V	
C221	Electrolytic	4.7	25V	
C222	Mylar	0.039	50V	
C223	Mylar	0.0022	50V	
C224	Mylar	0.039	50V	
C225	Mylar	0.1	50V	
C226	Electrolytic	10	16V	
C227	Mylar	0.039	50V	
C228	Electrolytic	10	16V	

[MAIN] UNIT

REF. NO.	DESCRIPTION	PART NO.	
C229	Electrolytic	10	16V
C230	Electrolytic	4.7	25V
C231	Electrolytic	33	16V
C232	Mylar	0.022	50V
C233	Mylar	0.022	50V
C234	Mylar	0.022	50V
C235	Ceramic	0.01	50V
C236	Electrolytic	3.3	10V
C237	Mylar	0.01	50V
C238	Electrolytic	33	6.3V
C239	Ceramic	0.01	50V
C240	Electrolytic	3.3	25V
C241	Ceramic	0.001	50V
C242	Ceramic	0.01	50V
C243	Ceramic	0.01	50V
C244	Ceramic	0.01	50V
C245	Ceramic	0.01	50V
C246	Ceramic	40P	50V
C247	Ceramic	0.01	50V
C248	Mylar	0.033	50V
C249	Ceramic	0.01	50V
C250	Electrolytic	0.47	50V
C251	Ceramic	0.01	50V
C252	Dipped Mica	47P	50V
C253	Dipped Mica	30P	50V
C254	Ceramic	0.01	50V
C255	Trimmer	CV05E300	
C256	Polystyrene	30P	50V
C258	Dipped Mica	15P	50V
C259	Trimmer	CV05D180	
C260	Ceramic	0.01	50V
C261	Polystyrene	200P	50V
C262	Polystyrene	100P	50V
C263	Ceramic	0.01	50V
C265	Ceramic	0.001	50V
C266	Electrolytic	33	6.3V
C267	Electrolytic	4.7	25V
C268	Ceramic	470P	50V
C269	Electrolytic	0.47	50V
C270	Electrolytic	1	50V
C271	Electrolytic	100	16V
C272	Mylar	0.0033	50V
C273	Electrolytic	220	16V
C274	Mylar	0.1	50V
C275	Electrolytic	0.47	50V
C276	Ceramic	0.01	50V
C277	Electrolytic	10	16V
C278	Electrolytic	4.7	25V
C279	Electrolytic	1	50V
C280	Electrolytic	33	16V
C281	Electrolytic	10	16V
C282	Electrolytic	47	10V
C283	Electrolytic	4.7	25V
C284	Ceramic	0.01	50V
C285	Electrolytic	4.7	25V
C286	Ceramic	0.01	50V
C287	Electrolytic	47	10V
C288	Ceramic	0.01	50V
C289	Electrolytic	47	10V
C290	Mylar	0.056	50V
C291	Ceramic	0.01	50V

[MAIN] UNIT

REF. NO.	DESCRIPTION	PART NO.
C292	Ceramic	0.01 50V
C293	Ceramic	0.001 50V
C294	Electrolytic	10 10V
C296	Electrolytic	4.7 20V
C297	Electrolytic	1 50V
C298	Ceramic	0.001 50V
C299	Ceramic	0.01 50V
C300	Ceramic	0.01 50V
C301	Ceramic	0.01 50V
C302	Electrolytic	10 16V
C303	Ceramic	0.01 50V
C304	Ceramic	0.02 50V
C305	Ceramic	0.01 50V
C306	Ceramic	0.001 500V
C307	Ceramic	20P 50V
C308	Ceramic	0.01 50V
C309	Ceramic	0.01 50V
C310	Electrolytic	22 16V
C311	Ceramic	0.01 50V
C312	Ceramic	0.01 50V
C313	Ceramic	0.01 50V
C314	Mylar	0.039 50V
C315	Ceramic	5P 50V
C318	Barrier Lay	0.047 50V
C319	Ceramic	220P 50V
C320	Ceramic	22P 50V
C321	Electrolytic	47 10V
C322	Ceramic	0.35P 50V (IC-251E)
		0.5P 50V (IC-251A)
C323	Electrolytic	10 16V
C324	Ceramic	DD108B472K 50V
C325	Ceramic	DD108B472K 50V
C326	Ceramic	220P 50V
C327	Ceramic	39P 50V
C330	Barrier Lay	0.1 12V
C331	Barrier Lay	0.1 12V
C332	Mylar	0.022 50V
C333	Ceramic	10P 50V
C334	Ceramic	10P 50V
C335	Barrier Lay	0.047 12V
C336	Ceramic	220P 50V
C337	Ceramic	220P 50V
C338	Ceramic	220P 50V
C339	Barrier Lay	0.1 12V
R1	Resistor	100K ELR25
R2	Resistor	220 ELR25
R3	Resistor	4.7K ELR25
R4	Resistor	470 ELR25
R5	Resistor	100K ELR25
R6	Resistor	100K ELR25
R7	Resistor	4.7K ELR25
R8	Resistor	470 ELR25
R9	Resistor	100 ELR25
R10	Resistor	4.7K ELR25
R11	Resistor	47K ELR25
R12	Resistor	4.7K ELR25
R15	Resistor	1K ELR25
R16	Resistor	1K ELR25
R17	Resistor	2.2K ELR25
R18	Resistor	1K ELR25

[MAIN] UNIT

REF. NO.	DESCRIPTION	PART NO.
R19	Resistor	10K ELR25
R20	Resistor	220 ELR25
R21	Resistor	220 ELR25
R22	Resistor	1K ELR25
R23	Resistor	2.2K ELR25
R24	Resistor	220 ELR25
R25	Resistor	47 ELR25
R26	Trimmer	3K FR-10
R27	Resistor	220 ELR-25
R28	Resistor	22K ELR25
R29	Resistor	15K ELR25
R30	Resistor	220 ELR25
R31	Resistor	470 ELR25
R32	Resistor	10K ELR25
R33	Resistor	10K ELR25
R34	Resistor	220 LER25
R35	Resistor	2.2K ELR25
R36	Resistor	1.5K ELR25
R37	Resistor	5.6K ELR25
R38	Resistor	2.2K ELR25
R39	Resistor	2.2K ELR25
R40	Resistor	33K ELR25
R41	Resistor	220 ELR25
R42	Resistor	3.9K ELR25
R44	Resistor	1.5K ELR25
R45	Resistor	2.2K ELR25
R46	Resistor	10 ELR25
R47	Resistor	1.5K R25
R48	Resistor	1.2K R25
R49	Resistor	22K ELR25
R50	Resistor	22K ELR25
R51	Resistor	12K ELR25
R52	Resistor	3.3K ELR25
R53	Resistor	4.7K ELR25
R54	Resistor	33K ELR25
R55	Resistor	47K ELR25
R56	Thermistor	23D29
R57	Resistor	220K ELR25
R58	Resistor	15K ELR25
R59	Trimmer	1K FR-10
R60	Thermistor	33D28
R61	Resistor	100 ELR25
R62	Resistor	5.6K ELR25
R63	Resistor	5.6K ELR25
R64	Resistor	5.6K ELR25
R65	Resistor	47K ELR25
R66	Resistor	22K ELR25
R67	Trimmer	3K FR-10
R68	Resistor	4.7 ELR10
R69	Resistor	1K ELR25
R70	Resistor	5.6K ELR25
R71	Resistor	470 ELR25
R72	Resistor	2.2K ELR25
R73	Resistor	22K ELR25
R74	Resistor	1K ELR25
R79	Resistor	47K ELR25
R85	Resistor	10 ELR25
R89	Resistor	1K R25
R90	Resistor	4.7K R25
R91	Resistor	470 ELR25
R92	Trimmer	100K FR-10

[MAIN] UNIT

REF. NO.	DESCRIPTION	PART NO.	
R93	Resistor	10K	ELR25
R94	Resistor	470	ELR25
R95	Resistor	220K	ELR25
R96	Resistor	3.3M	ELR25
R97	Resistor	47K	ELR25
R98	Resistor	47K	ELR25
R99	Resistor	22K	ELR25
R100	Resistor	33K	ELR25
R101	Resistor	33K	ELR25
R102	Resistor	22K	ELR25
R103	Resistor	4.7	ELR25
R104	Resistor	10K	ELR25
R105	Resistor	4.7K	ELR25
R106	Trimmer	1K	FR-10
R107	Resistor	1K	ELR25
R108	Resistor	2.2K	ELR25
R109	Resistor	4.7K	ELR25
R110	Resistor	15K	ELR25
R111	Resistor	1K	ELR25
R113	Resistor	10K	ELR25
R114	Resistor	100	ELR25
R115	Resistor	4.7K	ELR25
R116	Resistor	2.2K	ELR25
R117	Resistor	100K	ELR25
R118	Resistor	100K	ELR25
R119	Resistor	47	ELR25
R120	Resistor	4.7K	ELR25
R121	Resistor	4.7K	ELR25
R122	Resistor	220	ELR25
R123	Resistor	1K	ELR25
R124	Resistor	4.7K	ELR25
R125	Resistor	470	ELR25
R126	Resistor	10	ELR25
R127	Trimmer	1K	FR-10
R128	Resistor	47	ELR25
R129	Trimmer	1K	FR-10
R130	Trimmer	100	FR-10
R131	Resistor	2.2	ELR25
R132	Trimmer	300	FR-10
R133	Resistor	1K	ELR25
R134	Trimmer	10K	EVT-81AS05 B14
R135	Trimmer	100	FR-10
R136	Trimmer	100K	FR-10
R137	Resistor	150	ELR25
R138	Resistor	2.2K	ELR25
R139	Resistor	15	ELR25
R140	Resistor	10K	ELR25
R141	Resistor	10	ELR25
R142	Resistor	470	ELR25
R143	Resistor	470	ELR25
R144	Resistor	2.2K	ELR25
R145	Resistor	15	ELR25
R147	Resistor	1K	ELR25
R150	Resistor	10K	ELR25
R151	Resistor	100	ELR25
R152	Resistor	10K	ELR25
R153	Resistor	3.3K	ELR25
R154	Resistor	10K	ELR25
R155	Resistor	220	ELR25
R156	Resistor	47	ELR25
R157	Resistor	470	ELR25

[MAIN] UNIT

REF. NO.	DESCRIPTION	PART NO.	
R158	Resistor	220K	ELR25
R159	Resistor	220K	ELR25
R160	Resistor	4.7K	ELR25
R161	Trimmer	5K	FR-10
R162	Resistor	100K	ELR25
R163	Resistor	470	ELR25
R164	Resistor	100K	ELR25
R165	Resistor	22K	ELR25
R166	Resistor	220	ELR25
R167	Trimmer	3K	FR-10
R168	Resistor	47	ELR25
R169	Resistor	150K	ELR25
R170	Resistor	10K	ELR25
R171	Resistor	3.3K	ELR25
R172	Resistor	470	ELR25
R173	Resistor	470	ELR25
R174	Resistor	2.2K	ELR25
R175	Resistor	1.5K	ELR25
R176	Resistor	470	ELR25
R177	Resistor	470	ELR25
R178	Resistor	2.2K	ELR25
R180	Resistor	1K	ELR25
R181	Resistor	2.2K	R25
R182	Resistor	100K	ELR25
R183	Resistor	47K	ELR25
R184	Resistor	2.2K	ELR25
R185	Resistor	220	ELR25
R186	Resistor	100K	ELR25
R187	Resistor	220	ELR25
R188	Resistor	1K	ELR25
R189	Resistor	2.2K	ELR25
R190	Resistor	47	ELR25
R191	Resistor	47	ELR25
R192	Resistor	4.7K	ELR25
R193	Resistor	1K	ELR25
R194	Resistor	220	R25
R195	Resistor	22	ELR25
R196	Resistor	33K	ELR25
R197	Resistor	4.7K	ELR25
R198	Resistor	39K	ELR25
R199	Resistor	150K	ELR25
R200	Resistor	1K	ELR25
R201	Resistor	4.7K	ELR25
R202	Resistor	56	ELR25
R203	Resistor	2.2K	ELR25
R204	Resistor	47K	ELR25
R205	Resistor	2.2K	ELR25
R206	Resistor	2.2K	ELR25
R207	Resistor	22K	ELR25
R208	Resistor	5.6K	ELR25
R209	Resistor	5.6K	ELR25
R210	Resistor	15K	ELR25
R211	Resistor	1K	R25
R212	Resistor	150K	ELR25
R213	Resistor	820	ELR25
R214	Resistor	100	ELR25
R215	Resistor	47K	ELR25
R216	Resistor	22K	ELR25
R217	Resistor	15K	ELR25
R218	Resistor	10K	ELR25
R219	Resistor	1K	ELR25

[MAIN] UNIT

REF. NO.	DESCRIPTION	PART NO.	
R220	Resistor	4.7K	ELR25
R221	Resistor	4.7K	ELR25
R222	Resistor	22K	ELR25
R223	Resistor	1K	ELR25
R224	Thermistor	33D28	
R225	Resistor	2.7K	ELR25
R226	Resistor	27K	ELR25
R227	Resistor	10K	ELR25
R228	Resistor	220	ELR25
R229	Resistor	1K	ELR25
R230	Resistor	22K	ELR25
R231	Resistor	4.7K	ELR25
R232	Resistor	22K	ELR25
R233	Resistor	100	ELR25
R234	Resistor	10K	ELR25
R235	Trimmer	100K	EVT-81AS05 B15
R236	Resistor	2.2K	ELR25
R237	Resistor	3.3K	ELR25
R238	Resistor	2.2K	ELR25
R239	Resistor	22K	ELR25
R240	Resistor	4.7K	ELR25
R241	Resistor	1K	ELR25
R242	Resistor	330	ELR25
R243	Resistor	4.7K	ELR25
R244	Resistor	2.2K	ELR25
R245	Resistor	22K	ELR25
R246	Resistor	4.7K	ELR25
R247	Resistor	4.7K	ELR25
R248	Resistor	220	ELR25
R249	Trimmer	10K	EVT-81AS05 B14
R250	Resistor	10K	ELR25
R251	Resistor	1K	ELR25
R252	Resistor	1K	ELR25
R253	Resistor	220	ELR25
R254	Resistor	1.5K	ELR25
R255	Resistor	100K	ELR25
R256	Resistor	47K	ELR25
R257	Resistor	10M	ELR25
R258	Resistor	12K	ELR25
R259	Resistor	1K	ELR25
R260	Resistor	5.6K	ELR25
R261	Resistor	1K	ELR25
R262	Resistor	100K	ELR25
R263	Resistor	2.2K	ELR25
R264	Resistor	1K	ELR25
R265	Resistor	470	ELR25
R266	Resistor	470	ELR25
R267	Resistor	27K	ELR25
R268	Resistor	820	ELR25
R269	Resistor	27K	ELR25
R270	Trimmer	30K	FR-10
R271	Resistor	1.8K	ELR25
R272	Resistor	4.7	ELR25
R273	Trimmer	3K	FR-10
R274	Resistor	15K	ELR25
R275	Resistor	2.2K	ELR25
R277	Resistor	22K	ELR25
R278	Resistor	15K	ELR25
R279	Resistor	22K	ELR25
R280	Resistor	15K	ELR25
R281	Resistor	4.7K	ELR25

[MAIN] UNIT

REF. NO.	DESCRIPTION	PART NO.	
R282	Resistor	1.2K	ELR25
R283	Resistor	1K	R25
R284	Resistor	2.2K	ELR25
R285	Resistor	4.7K	ELR25
R286	Resistor	220	ELR25
R287	Resistor	47K	ELR25
R288	Resistor	150K	ELR25
R289	Resistor	120K	ELR25
R290	Resistor	100	ELR25
R291	Trimmer	10K	EVT-81AS05 B14
R292	Resistor	10K	ELR25
R293	Resistor	4.7K	ELR25
R294	Resistor	15K	ELR25
R295	Resistor	470	ELR25
R296	Resistor	1K	ELR25
R297	Resistor	10K	ELR25
R298	Resistor	10K	ELR25
R299	Resistor	2.2K	ELR25
R300	Resistor	22K	ELR25
R301	Resistor	10K	ELR25
R302	Trimmer	100K	EVT-81AS05 B15
R303	Resistor	1K	ELR25
R304	Resistor	22K	ELR25
R305	Resistor	1K	ELR25
R306	Resistor	470	ELR25
R307	Resistor	2.2K	ELR25
R308	Resistor	10K	ELR25
R309	Resistor	15K	ELR25
R310	Trimmer	10K	EVT-81AS05 B14
R311	Resistor	4.7K	ELR25
R312	Resistor	100	ELR25
R313	Resistor	1K	ELR25
R314	Resistor	4.7K	ELR25
R315	Resistor	220	ELR25
R319	Resistor	3.3K	ELR25
R320	Resistor	10K	ELR25
R321	Resistor	2.2K	R25
R322	Resistor	2.2K	ELR25
R324	Resistor	680K	ELR25
R325	Resistor	150	ELR25
R327	Resistor	1K	ELR25
R328	Resistor	10K	ELR25
R329	Thermistor	33D28	
R330	Resistor	1K	R25
R331	Resistor	1K	ELR25
R333	Resistor	22K	ELR25
R334	Resistor	10K	ELR25
R336	Resistor	4.7K	R25
R337	Resistor	100K	R25
R338	Resistor	1K	ELR25
R340	Resistor	4.7K	R25
R341	Resistor	10K	ELR25
R342	Resistor	47K	ELR25 (IC-251E)
		10K	ELR25 (IC-251A)
R343	Resistor	10K	R25
R344	Resistor	2.2K	R25
B1	PC Board	B-196E	
B2	PC Board	B-220A	
B3	PC Board	B-350A	

[MAIN] UNIT

REF. NO.	DESCRIPTION	PART NO.
	PA Heat Sink REG Heat Sink CORE IC Heat Sink	2D1
P1	Connector	5250-08
P2	Connector	5250-04
P3	Connector	5250-12
P4	Connector	5250-12
P5	Connector	5250-04
P6	Connector	2139-04
P7	Connector	5250-03
P8	Connector	5250-02

[PLL] UNIT

REF. NO.	DESCRIPTION	PART NO.
IC1	IC	NJM4558D
IC2	IC	SN76514N
IC3	IC	BA401
IC4	IC	TC9123P
IC5	IC	4081
IC6	IC	NJM4558D
IC7	IC	UA78L82AWV
Q1	Transistor	2SC945P
Q2	Transistor	2SC945P
Q3	Transistor	2SC383TM
Q4	Transistor	2SC763C
Q5	Transistor	2SC763C
Q6	Transistor	2SC763C
Q7	Transistor	2SC763C
Q8	FET	2SK125
Q9	Transistor	2SC763C
Q10	Transistor	2SA1015Y
Q11	Transistor	2SC945P
Q12	Transistor	2SC763C
Q13	Transistor	2SA1015Y
Q14	Transistor	2SC1636
Q15	Transistor	2SC945P
Q16	Transistor	2SC945P
Q17	Transistor	2SC763C
Q18	Transistor	2SC945P
Q19	Transistor	2SA1015Y
D1	Varactor Diode	1T6
D2	Varactor Diode	1T6
D3	Zener Diode	XZ068
D4	Diode	1SS53
D5	Diode	1SS53
D6	Varactor Diode	1SV50H-N
D7	Diode	1SS53
D8	Diode	1SS53
D9	Diode	1SS53
D10	Diode	1SS53
D11	Zener Diode	YZ030
D14	Diode	1SS53
D15	Diode	1SS53

[PLL] UNIT

REF. NO.	DESCRIPTION	PART NO.
D16	Diode	1SS53
D17	Diode	1SS53
D18	Diode	1SS53
D19	Diode	1SS53
D20	Diode	1SS53
D21	Diode	1SS55
D22	Diode	1SS55
D23	Diode	1SS55
D24	Diode	1SS55
L1	Coil	LS-109
L2	Coil	LS-2
L3	Coil	LS-3A
L4	Coil	LS-3A
L5	Choke Coil	5R6 (LB4)
L6	Choke Coil	100 (LB4)
L7	Coil	LB-84
L8	Coil	LS-118
L9	Coil	LB-73
L10	Coil	LS-118
L11	Choke Coil	100 (LB4)
L12	Coil	LS-119
L13	Coil	LS-3A
L18	Choke Coil	LR2
R1	Trimmer	20K RGP053
R2	Resistor	18K ELR25
R3	Resistor	680K ELR25
R4	Resistor	820K ELR25
R5	Resistor	10K ELR25
R6	Resistor	3.3M ELR25
R7	Trimmer	30K RGP053
R8	Resistor	22K LER25
R9	Resistor	22K ELR25
R10	Resistor	22K ELR25
R11	Resistor	22K ELR25
R12	Resistor	4.7K ELR25
R13	Resistor	4.7K ELR25
R14	Resistor	22K ELR25
R15	Resistor	22K ELR25
R16	Resistor	2.2K ELR25
R17	Resistor	2.2K ELR25
R18	Resistor	2.2K ELR25
R19	Resistor	2.2K ELR25
R20	Resistor	2.2K ELR25
R21	Resistor	1K ELR25
R22	Resistor	22K ELR25
R23	Resistor	4.7K ELR25
R24	Resistor	5.6K ELR25
R25	Resistor	22K ELR25
R26	Resistor	10K ELR25
R27	Resistor	220 ELR25
R28	Resistor	1K ELR25
R29	Resistor	4.7K ELR25
R30	Resistor	22K ELR25
R31	Resistor	2.2K ELR25
R32	Resistor	220 ELR25
R35	Resistor	330 ELR25
R36	Resistor	5.6K ELR25
R37	Resistor	1.2K ELR25
R38	Resistor	100 ELR25

[PLL] UNIT

REF. NO.	DESCRIPTION	PART NO.
R40	Resistor	220 ELR25
R41	Resistor	220 ELR25
R42	Resistor	22K ELR25
R43	Resistor	4.7K ELR25
R44	Resistor	1K ELR25
R45	Resistor	100 ELR25
R46	Resistor	470 ELR25
R47	Resistor	100 ELR25
R48	Resistor	470 ELR25
R49	Resistor	100 ELR25
R50	Resistor	68K ELR25
R51	Resistor	470 R25
R52	Resistor	68 ELR25
R53	Resistor	10K ELR25
R55	Resistor	10K ELR25
R56	Resistor	470 R25
R57	Resistor	22K ELR25
R58	Resistor	5.6K ELR25
R59	Resistor	220 ELR25
R60	Resistor	5.6K ELR25
R61	Resistor	1.2K ELR25
R62	Resistor	33 ELR25
R63	Resistor	47 ELR25
R65	Resistor	100 ELR25
R66	Resistor	10K ELR25
R67	Resistor	4.7K ELR25
R68	Resistor	4.7K ELR25
R69	Resistor	470 ELR25
R70	Resistor	10K ELR25
R71	Resistor	4.7K R25
R72	Resistor	10K ELR25
R73	Resistor	10K ELR25
R74	Resistor	22K ELR25
R75	Resistor	1.8M ELR25
R76	Resistor	1.8M ELR25
R77	Resistor	390K ELR25
R78	Resistor	470K ELR25
R79	Resistor	1.8M ELR25
R80	Trimmer	100K RGP053
R81	Resistor	100K ELR25
R82	Resistor	470K ELR25
R83	Resistor	100K ELR25
R84	Resistor	68K ELR25
R85	Trimmer	30K RGP053
R86	Resistor	39 ELR25
R87	Resistor	22K ELR25
R89	Resistor	47 ELR25
R90	Resistor	4.7K ELR25
R91	Resistor	1K ELR25
R92	Trimmer	20K RGP053
R93	Resistor	22K ELR25
R94	Resistor	22K ELR25
R95	Resistor	10K ELR25
R96	Trimmer	1MB SR19D
R97	Resistor	10 ELR25
R98	Resistor	4.7K ELR25
R99	Resistor	1K ELR25
R100	Resistor	100K ELR25
R101	Resistor	47K ELR25
R102	Resistor	180K ELR25
R103	Resistor	100 ELR25

[PLL] UNIT

REF. NO.	DESCRIPTION	PART NO.
C1	Ceramic	0.0047 50V
C2	Ceramic	0.0022 50V
C3	Ceramic	0.0047 50V
C4	Ceramic	0.0047 50V
C5	Ceramic	0.0047 50V
C6	Electrolytic	10 16V
C7	Ceramic	220P 50V
C8	Ceramic	220P 50V
C9	Ceramic	220P 50V
C10	Ceramic	0.0047 50V
C11	Ceramic	39P 50V
C12	Ceramic	0.0047 50V
C13	Ceramic	10P 50V
C14	Ceramic	0.0047 50V
C15	Ceramic	0.0047 50V
C16	Ceramic	8P 50V
C17	Ceramic	0.5P 50V
C18	Ceramic	10P 50V
C19	Ceramic	0.0047 50V
C20	Ceramic	0.0047 50V
C21	Ceramic	0.0047 50V
C22	Ceramic	0.0047 50V
C23	Ceramic	0.0047 50V
C24	Ceramic	0.0047 50V
C25	Ceramic	0.0047 50V
C26	Ceramic	0.0047 50V
C27	Ceramic	0.0047 50V
C28	Ceramic	0.0047 50V
C29	Ceramic	0.0047 50V
C31	Ceramic	33P 50V
C32	Ceramic	33P 50V
C33	Ceramic	470P 50V
C34	Ceramic	470P 50V
C35	Ceramic	470P 50V
C36	Ceramic	470P 50V
C37	Ceramic	470P 50V
C38	Mylar	0.022 50V
C39	Ceramic	470P 50V
C40	Ceramic	150P 50V
C41	Ceramic	47P 50V
C42	Ceramic	30P N2200 50V
C43	Electrolytic	47 10V
C44	Ceramic	3P 50V
C45	Dipped Mica	30P 50V
C46	Ceramic	15P 50V
C48	Ceramic	8P 50V
C49	Ceramic	1P 50V
C50	Dipped Mica	22P 50V
C51	Ceramic	220P 50V
C52	Ceramic	47P 50V
C53	Barrier Lay	0.1 12V
C54	Ceramic	0.0047 50V
C55	Barrier Lay	0.1 50V
C56	Ceramic	220P 50V
C57	Ceramic	10P 50V
C58	Electrolytic	100 10V
C59	Electrolytic	100 10V
C61	Ceramic	0.0047 50V
C62	Ceramic	220P 50V
C63	Ceramic	10P 50V
C64	Ceramic	0.0047 50V

[PLL] UNIT

REF. NO.	DESCRIPTION	PART NO.
C65	Ceramic	0.0022 50V
C66	Electrolytic	4.7 25V
C67	Ceramic	0.0047 50V
C68	Ceramic	220P 50V
C69	Electrolytic	220 10V
C70	Barrier Lay	0.1 12V
C71	Barrier Lay	0.1 12V
C72	Electrolytic	2.2 50V
C73	Electrolytic	0.47 50V
C76	Ceramic	220P 50V
C77	Ceramic	8P 50V
C78	Trimmer	CV05D-3001
C79	Elecyrolytic	4.7 25V
C81	Ceramic	8P 50V
C82	Ceramic	470P 50V
C83	Ceramic	470P 50V
C84	Ceramic	470P 50V
C85	Ceramic	470P 50V
C86	Ceramic	0.0047 50V
C87	Mylar	0.01 50V
C88	Barrier Lay	0.1 12V
C89	Ceramic	220P 50V
C90	Ceramic	220P 50V
C91	Barrier Lay	0.1 12V
C92	Ceramic	220P 50V
C93	Ceramic	220P 50V
C94	Barrier Lay	0.1 12V
C95	Ceramic	0.001 50V
C96	Barrier Lay	0.1 12V
C97	Ceramic	0.0047 50V
C98	Barrier Lay	0.1 12V
C104	Ceramic	470P 50V
X1	Crystal	HC-43/U 14.1433MHz
X2	Crystal	HC-43/U 5.12MHz
J1	Connector	5045-06A
J2	Connector	5045-08A
J3	Connector	5045-08A
J4	Connector	5045-06A
J5	Connector	5045-08A
J6	Connector	5045-04A
J7	Connector	5045-06A
J8	Connector	5045-04A
J9	Connector	3022-03A
	PC Board	B-376B (PLL)
	PC Board	B-275C (VCO)

[DRIVER] UNIT

REF. NO.	DESCRIPTION	PART NO.
IC1	IC	4030
IC2	IC	4013
IC3	IC	4013
IC4	IC	4073
IC5	IC	4081
IC6	IC	4081

[DRIVER] UNIT

REF. NO.	DESCRIPTION	PART NO.
IC7	IC	4081
IC8	IC	4081
IC9	IC	TMS1115
IC10	IC	TMS1024NL
IC11	IC	4011
IC12	IC	4069
IC13	IC	4013
IC16	IC	4013
IC17	IC	4011
IC18	DC-DC Connector	DP-4
IC19	Diode Array	DNA401
IC20	IC	4081
IC21	IC	TC4011BP
Q1	Photo Transistor	TPS606Y
Q2	Photo Transistor	TPS606Y
Q3	Transistor	2SA1015
Q4	Transistor	2SA1015
Q5	Transistor	2SA1015
Q6	Transistor	2SC1740
Q7	Transistor	2SB562
Q8	Transistor	2SC1740
Q9	Transistor	2SD468
Q10	Transistor	2SB562
Q11	Transistor	2SC1740
Q12	Transistor	2SC1740
Q13	Transistor	2SA1015
Q14	Transistor	2SA1015
Q15	Transistor	2SA1015
Q16	Transistor	2SA1015
Q17	Transistor	2SC945P
Q18	Transistor	2SA1015
Q19	Transistor	2SC945
D1	LED	TLN104
D2	LED	TLN104
D3	Diode	1SS53
D4	Diode	1SS53
D5	Diode	1SS53
D6	Diode	1SS55
D7	Diode	1SS55
D8	LED	SEL-103S
D9	LED	SEL-103S
D10	LED	SEL-303E
D11	Diode	1S953
D12	Diode	1S953
D13	Diode	1S953
D14	Diode	1SS53
D15	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	1S953
D26	Diode	1SS53
D27	Diode	1SS53
D28	Diode	1SS53

[DRIVER] UNIT

REF. NO.	DESCRIPTION	PART NO.
D29	Diode	1SS53
D30	Diode	1N60
D36	Diode	1SS53
D37	Diode	1SS53
D39	Diode	1SS53
D40	Diode	1SS53
D41	Zener Diode	XZ076
D42	Diode	GP08A
D43	Diode	GP08A
D44	Zener Diode	XZ092
D45	Diode	1SS53
D47	Diode	1SS53
D48	Diode	1SS53
D49	Diode	1SS53
D50	Diode	1N60
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
L1	Choke Coil	101J (LB4)
L2	Choke Coil	102J (LB4)
R1	Resistor	680 ELR25
R2	Trimmer	50K FR-10
R3	Trimmer	50K FR-10
R4	Resistor	220K R25
R5	Resistor	220K R25
R6	Resistor	1M R25
R7	Resistor	1M R25
R8	Resistor	10K R25
R11	Resistor Array	47K RM8
R12	Resistor Array	47K RM8
R13	Resistor	100K R25
R14	Resistor	1K R25
R15	Resistor	1K R25
R16	Resistor	4.7K ELR25
R18	Resistor	470 ELR25
R19	Resistor	2.2K ELR25
R21	Resistor	470K ELR25
R22	Resistor	22K ELR25
R23	Resistor	100K ELR25
R24	Resistor	47K ELR25
R27	Resistor	100 ELR25
R28	Resistor	1M ELR25
R29	Resistor	47K ELR25
R30	Resistor	1M ELR25
R31	Resistor	10K ELR25
R32	Resistor	1.8M ELR25
R33	Resistor	470K ELR25
R34	Resistor	3.3M ELR25
R35	Resistor	100K ELR25
R36	Resistor	1M ELR25
R37	Resistor	470K ELR25

[DRIVER] UNIT

REF. NO.	DESCRIPTION	PART NO.
R39	Resistor	1M ELR25
R41	Resistor	1M ELR25
R42	Resistor	47K ELR25
R43	Resistor	1M ELR25
R44	Resistor	470 ELR25
R45	Resistor	470 ELR25
R46	Resistor	4.7K ELR25
R47	Resistor	4.7K ELR25
R49	Resistor	3.3K ELR25
R50	Resistor	3.3K ELR25
R51	Resistor	10K R25
R52	Resistor	2.2K ELR25
R53	Resistor	1M R25
R56	Resistor	470K ELR25
R57	Resistor	100K ELR25
R58	Resistor	100K ELR25
R59	Resistor	22K ELR25
R60	Resistor	1K ELR25
R77	Resistor	470K ELR25
R78	Resistor	470K ELR25
R79	Resistor	470K ELR25
R80	Resistor	470K ELR25
R81	Resistor	1M ELR25
R82	Resistor Array	2.2K RM8
R83	Resistor Array	100K RM6
R84	Resistor	470K ELR25
R85	Resistor	470K ELR25
R86	Resistor	470K ELR25
R87	Resistor	100K CRA1/8
R88	Resistor	200K CRA1/8
R89	Resistor	400K CRA1/8
R90	Resistor	800K CRB1/4FX
R91	Resistor	480K CRA1/8
R92	Resistor	100K CRA1/8
R93	Resistor	200K CRA1/8
R94	Resistor	400K CRA1/8
R95	Resistor	800K CRB1/4FX
R96	Resistor	10K ELR25
R97	Resistor	1K ELR25
R99	Resistor	1M ELR25
R100	Resistor	82K ELR25
R101	Resistor	22K ELR25
R102	Resistor	470K ELR25
R103	Resistor	470K ELR25
R104	Resistor	470K ELR25
R105	Resistor	470K ELR25
R106	Resistor	10K R25
R108	Resistor	22K ELR25
R109	Resistor	10K ELR25
R110	Resistor	47K ELR25
R111	Resistor	47K ELR25
R112	Resistor	47K ELR25
R113	Resistor	100K ELR25
R114	Resistor	47K ELR25
R116	Resistor	470K ELR25
R117	Resistor	1M ELR25
R118	Resistor	220K ELR25
R119	Resistor	10K ELR25
R120	Resistor	1K ELR25
R122	Resistor	100K ELR25
R123	Resistor	47K ELR25

[DRIVER] UNIT

REF. NO.	DESCRIPTION	PART NO.	
R124	Resistor	100K	ELR25
R125	Resistor	1M	R25
C1	Ceramic	100P	50V
C3	Electrolytic	1	50V
C5	Electrolytic	1	50V
C6	Ceramic	22P	50V
C8	Ceramic	0.001	50V
C9	Barrier Lay	0.1	12V
C10	Barrier Lay	0.1	12V
C11	Electrolytic	47	16V
C12	Barrier Lay	0.1	12V
C13	Barrier Lay	0.1	12V
C14	Barrier Lay	0.1	12V
C15	Electrolytic	0.47	25V
C16	Barrier Lay	0.1	12V
C18	Electrolytic	220	10V
C20	Barrier Lay	0.1	12V
C21	Barrier Lay	0.1	12V
C22	Electrolytic	220	16V
C24	Barrier Lay	0.1	12V
C25	Barrier Lay	0.1	12V
C26	Electrolytic	47	16V
C27	Electrolytic	47	16V
C28	Barrier Lay	0.047	25V
C30	Electrolytic	220	10V
C31	Electrolytic	10	25V
C32	Barrier Lay	0.1	12V
C33	Ceramic	47P	50V
C34	Ceramic	47P	50V
C35	Ceramic	47P	50V
C36	Ceramic	0.001	50V
C37	Ceramic	0.0022	50V
C38	Mylar	0.01	50V
C39	Ceramic	47P	50V
C40	Barrier Lay	0.1	12V
C41	Barrier Lay	0.047	12V
C42	Ceramic	470P	50V
C43	Electrolytic	10	25V
C44	Electrolytic	47	25V
C45	Ceramic	0.001	50V
C46	Electrolytic	47	16V
C47	Electrolytic	22	10V
	Display Tube	LD8231	
J1	Connector	5045-6A	
J2	Connector	5045-6A	
J3	Connector	5045-08A	
J4	Connector	3094-6A	
J5	Connector	3094-6A	
J6	Connector	3094-6A	
P2	Connector	5250-08	
P3	Connector	5250-06	
B1	PC Board	B-369B	
B2	PC Board	B-203C	
B3	PC Board	B-380A	

PARTS LIST

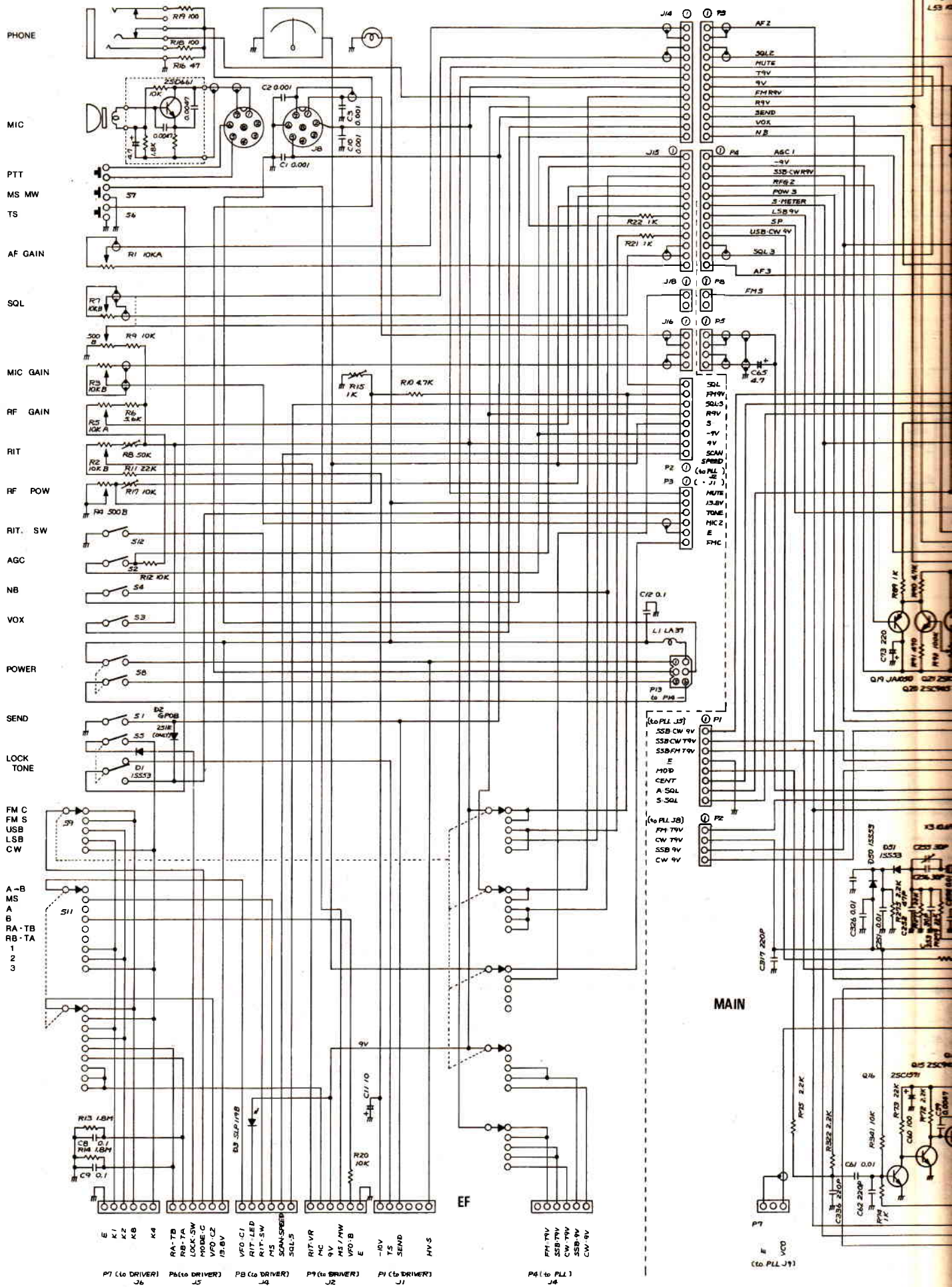
PI UNIT

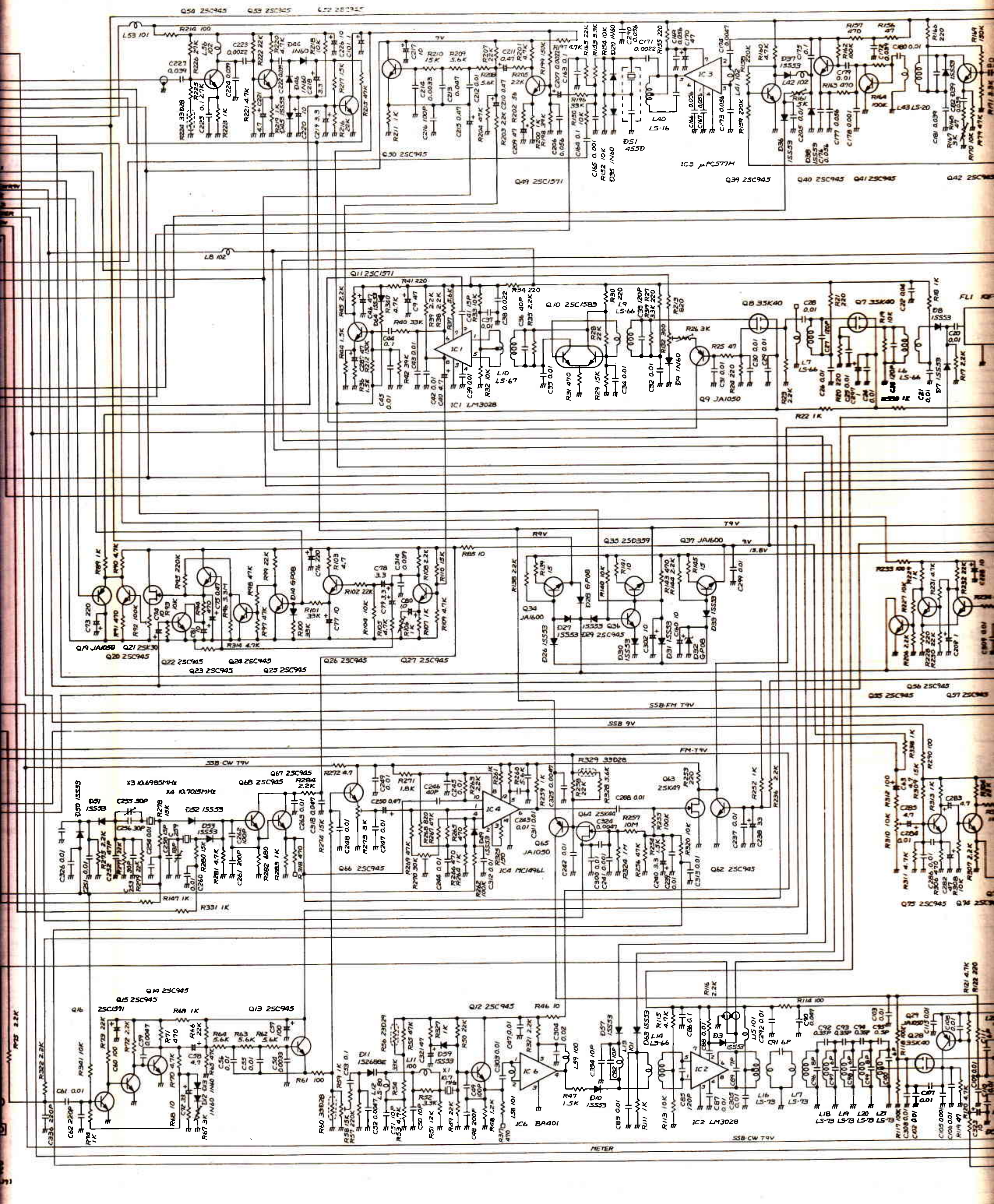
REF. NO.	DESCRIPTION	PART NO.			
		NEW		OLD	
Q 1	TRANSISTOR	2SA1015		2SA1015	
D 1	DIODE	KBP-06		S1RBA60	
D 2	DIODE	GP-08B		GP-08B	
D 3	ZENER DIODE	XZ142		XZ142	
D 4	DIODE	GP-08B		GP-08B	
IC 1	PHOTO COUPLER	N-110		MCN-721A	
C 1	CERAMIC	0.0022	500V	0.001	500V
C 2	CERAMIC	0.0022	500V	0.001	500V
C 3	CERAMIC	0.0022	500V	0.001	500V
C 4	CERAMIC	0.0022	500V	0.001	500V
C 5	ELECTROLYTIC	220	200V	220	200V
C 6	ELECTROLYTIC	220	200V	220	200V
C 7	ELECTROLYTIC	470	25V	470	25V
C 8	CERAMIC	0.0047	50V	0.01	50V
C 9	BARRIER LAY	0.047	25V	CERAMIC 0.0047	50V
C10	CERAMIC	0.001	50V	—	
C11	ELECTROLYTIC	10	25V	—	
C12	CHIP	0.68	25V	—	
R 1	RESISTOR	2.2	2W	3	2W
R 2	RESISTOR	2.2	2W	3	2W
R 3	RESISTOR	120K	ELR25	120K	ELR25
R 4	RESISTOR	120K	ELR25	120K	ELR25
R 5	RESISTOR	68K	ELR25	56K	ELR25
R 6	RESISTOR	150K	R50	100K	1W
R 7	RESISTOR	10K	ELR25	470	ELR25
R 8	RESISTOR	2.2K	ELR25	470	ELR25
R 9	RESISTOR	4.7K	ELR25	220	ELR25
R10	RESISTOR	220	ELR25	—	
R11	SURGE ABSORBER	ERZ-C07DK431		—	
L 1	CHOKE COIL	LR-92		LR-59A	
L 2	TRANSFORMER	TP-22		TP-22	
P 1	CONNECTOR	1653-5P1		1653-5P1	
B 1	PC BOARD	B-422A		B-303A	

SW REG. UNIT

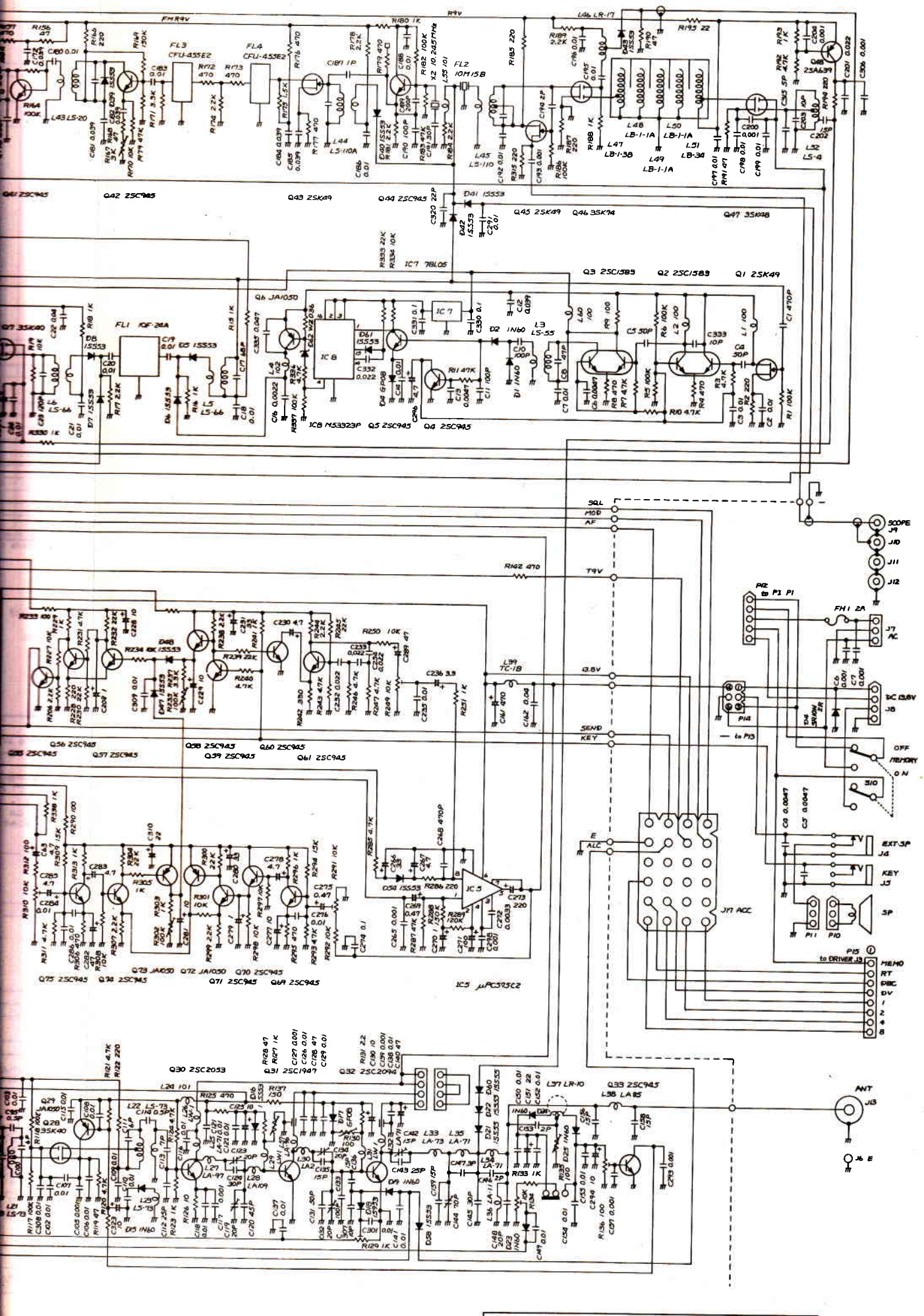
REF. NO.	DESCRIPTION	PART NO.			
		NEW		OLD	
Q 1	TRANSISTOR	2SC2501		MJE13003	
Q 2	TRANSISTOR	2SC2501		MJE13003	
D 1	DIODE	10F2S07		10F2S07	
D 2	DIODE	V19B		—	
D 3	DIODE	V19B		—	
D 4	DIODE	GP-08B		—	
IC 1	IC	SG3524N (HA17524P)		SG3524	
C 1	MP	0.001	250V	0.001	250V
C 2	MP	0.001	250V	0.001	250V
C 3	CERAMIC	0.022	500V	0.0022	500V
C 4	ELECTROLYTIC	3.3	200V	4.7	250V
C 5	ELECTROLYTIC	3.3	200V	4.7	250V
C 6	MYLAR	0.01	50V	0.01	50V
C 7	MYLAR	0.01	50V	0.0047	50V
C 8	ELECTROLYTIC	0.047	50V	0.47	50V
C 9	ELECTROLYTIC	10	25V	10	25V
C10	METALLIZED	0.47	400V	0.47	400V
C11	CERAMIC	470P	500V	0.001	500V
C12	CERAMIC	0.0047	50V	—	
C13	ELECTROLYTIC	680	16V	470	16V
C14	ELECTROLYTIC	680	16V	470	16V
C15	ELECTROLYTIC	47	10V	47	10V
C16	CHIP	0.68	25V	0.68	25V
C17	MP	0.0022	250V	0.001	250V
C18	CERAMIC	0.001	50V	0.0047	50V
C19	ELECTROLYTIC	10	16V	10	16V
C20	CERAMIC	0.0047	50V	MYLAR 0.0022	50V
C21	MYLAR	0.001	50V	—	
R 1	RESISTOR	120K	ELR25	120K	ELR25
R 2	RESISTOR	120K	ELR25	120K	ELR25
R 3	RESISTOR	2.2K	ELR25	2.2K	ELR25
R 4	RESISTOR	33K	ELR25	33K	ELR25
R 5	RESISTOR	4.7K	ELR25	4.7K	ELR25
R 6	RESISTOR	4.7K	ELR25	4.7K	ELR25
R 7	RESISTOR	4.7K	ELR25	4.7K	ELR25
R 8	TRIMMER	10K	RGP053	10K	RGP053
R 9	RESISTOR	15K	ELR25	15K	ELR25
R10	RESISTOR	10	ELR25	10	ELR25
R11	RESISTOR	22	ELR25	22	ELR25
R12	RESISTOR	10	ELR25	10	ELR25
R13	RESISTOR	22	ELR25	22	ELR25
R14	RESISTOR	390	ELR25	220	ELR25
R15	RESISTOR	0.04	1W	0.054	1W
R16	RESISTOR	33	ELR25	33	ELR25
L 1	CHOKE COIL	LR-59A		102J	L8
L 2	CHOKE COIL	102J	LB4	102J	L8
L 3	TRANSFORMER	TI-5		CHOKE	LR-59A
L 4	TRANSFORMER	TO-5		CHOKE	102J LB4
L 5	CHOKE COIL	LR-93		TRANSFORMER	TI-5
L 6		—		TRANSFORMER	TO-5
L 7		—		CHOKE	SN-10-500
L 8				CHOKE	SN-10-500
B 1	PC BOARD	B-423A		B-304A	

IC-251A/E SCHEMATIC DIAGRAM




Q54 2SC945
Q53 2SC945
Q52 2SC945
L53 101
R214 100
Q50 2SC945
Q49 2SC1571
IC3 μPC577H
Q39 2SC945
Q40 2SC945
Q41 2SC945
Q42 2SC945
DS1 455D
L40 LS-16
L43 LS-20
L8 102
Q11 2SC1571
IC1 LM3028
L10 LS-67
Q10 2SC1583
L9 LS-66
Q8 3SK40
Q7 3SK40
Q9 JA1050
FL1
R22 1K
R85 10
T9V
R9V
9V
13.8V
Q35 2SD359
Q37 JA1600
Q34 JA1600
Q36 2SC945
D29 2SC945
Q19 JA1050
Q20 2SC945
Q21 2SK30
Q22 2SC945
Q23 2SC945
Q24 2SC945
Q25 2SC945
Q26 2SC945
Q27 2SC945
Q55 2SC945
Q56 2SC945
Q57 2SC945
SSB·FM T9V
SSB 9V
SSB·CW T9V
FM·T9V
X3 10.6985MHz
X4 10.7015MHz
Q67 2SC945
Q68 2SC945
Q66 2SC945
IC4 MC1496L
Q65 JA1050
Q64 2SK40
Q63 2SK49
Q62 2SC945
R329 33D28
R147 1K
R331 1K
Q75 2SC945
Q74 2SC945
Q16 2SC1571
Q15 2SC945
Q14 2SC945
Q13 2SC945
Q12 2SC945
IC6 BA401
IC2 LM3028
Q28 3SK40
METER
SSB·CW T9V

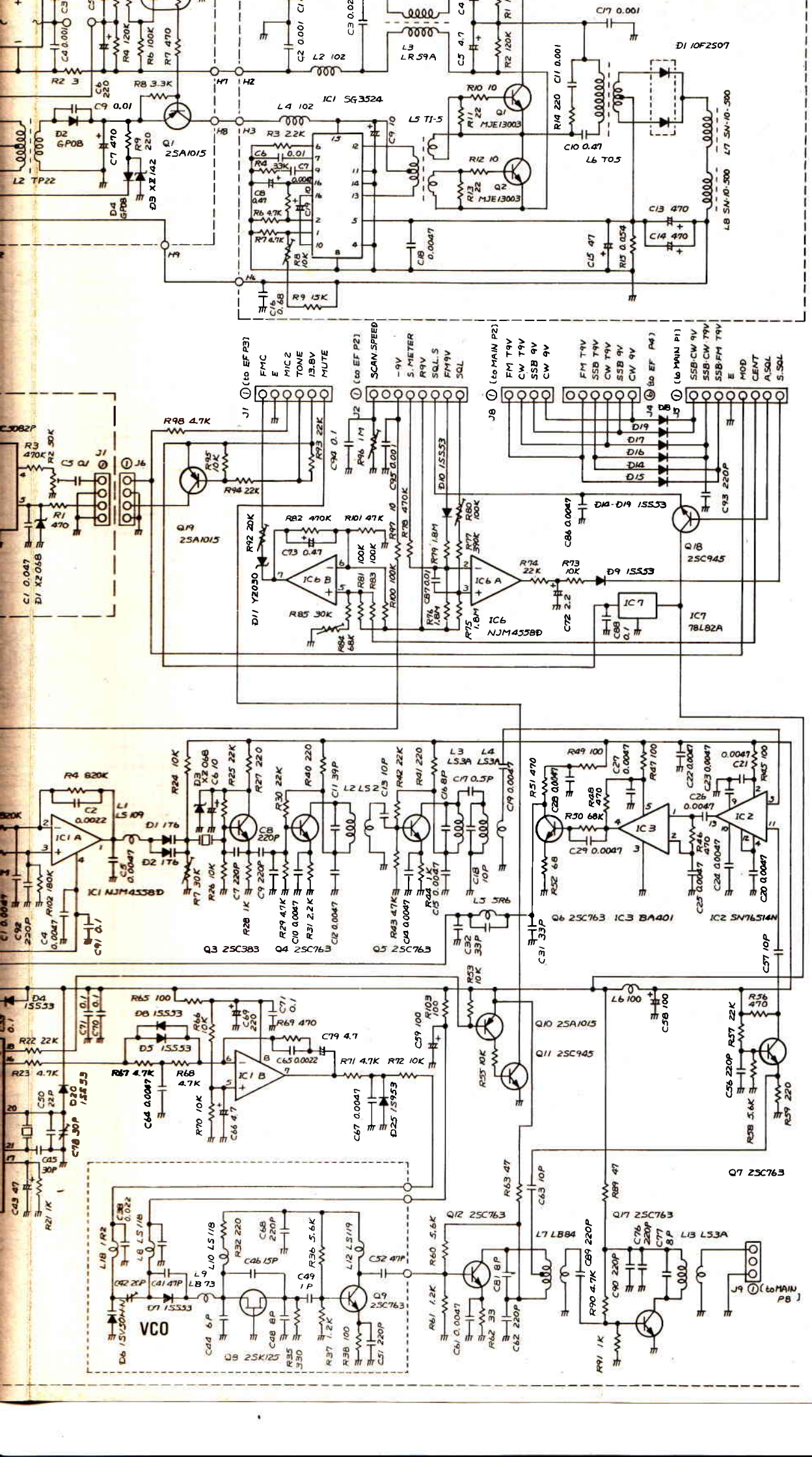
ICOM ICOM



ICOM INCORPORATED

Some components subject to change for an improvement without notice.

A-6242


IC1 SG3524
IC1 NJM4558D
IC6 NJM4558D
IC7 78L82A
IC2 SN76514N
IC3 BA401
VCO
Q1 2SA1015
Q2 MJE13003
Q3 2SC383
Q4 2SC763
Q5 2SC763
Q6 2SC763
Q7 2SC763
Q8 2SK125
Q9 2SC763
Q10 2SA1015
Q11 2SC945
Q12 2SC763
Q17 2SC763
Q18 2SC945
Q19 2SA1015
D1 10F2S07
D11 Y2030
D14-D19 1SS53
J1
J2
J4
J5
J8
J9
(to EF P3)
(to EF P2)
(to MAIN P2)
(to MAIN P1)
(to EF P4)
(to MAIN P8)
FMC
MIC 2
TONE
13.8V
MUTE
SCAN SPEED
-9V
S. METER
R9V
SQL.S
FM9V
SQL
FM T9V
CW T9V
SSB 9V
CW 9V
SSB T9V
SSB:CW 9V
SSB:CW T9V
SSB:FM T9V
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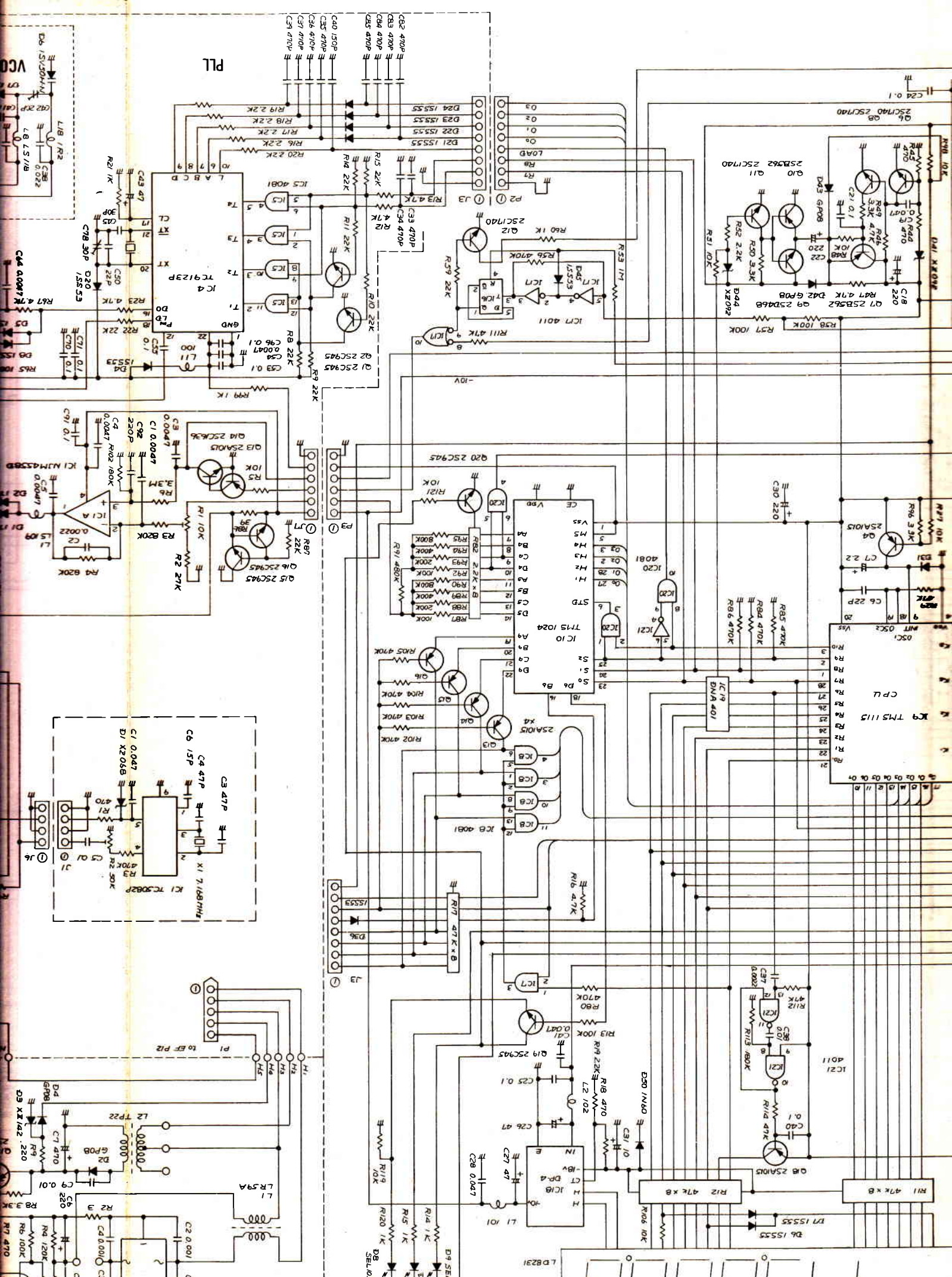
CENT
A.SQL
S.SQL


PLL
IC4 TC9123P
IC5 4081
IC7 4011
IC10 TM13 1024
IC20 4081
IC21 4011
IC9 TMS 1113 CPU
IC8 4081
IC18 DP-4
IC19 ENA 401
IC1 NJM4558D
IC2 TC5082P
X1 7.168MHz
Q1 2SC945
Q2 2SC945
Q3 2SC1740
Q4 2SA1015
Q5 2SC945
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Q7 2SB562
Q8 2SC1740
Q9 2SD468
Q10 2SB562
Q11 2SC1740
Q12 2SC1740
Q13 2SA1015
Q14 2SA1015
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Q16 2SC945
Q17 2SA1015
Q18 2SA1015
Q19 2SC945
Q20 2SC945
Q21 2SA1015
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D2 GP08
D3 XZ142
D4 GP08
D5 1SS53
D20 1SS53
D24 1SS55
D36 1SS53
D43 GP08
D44 2SZ02
D50 1N60
D51 XZ050
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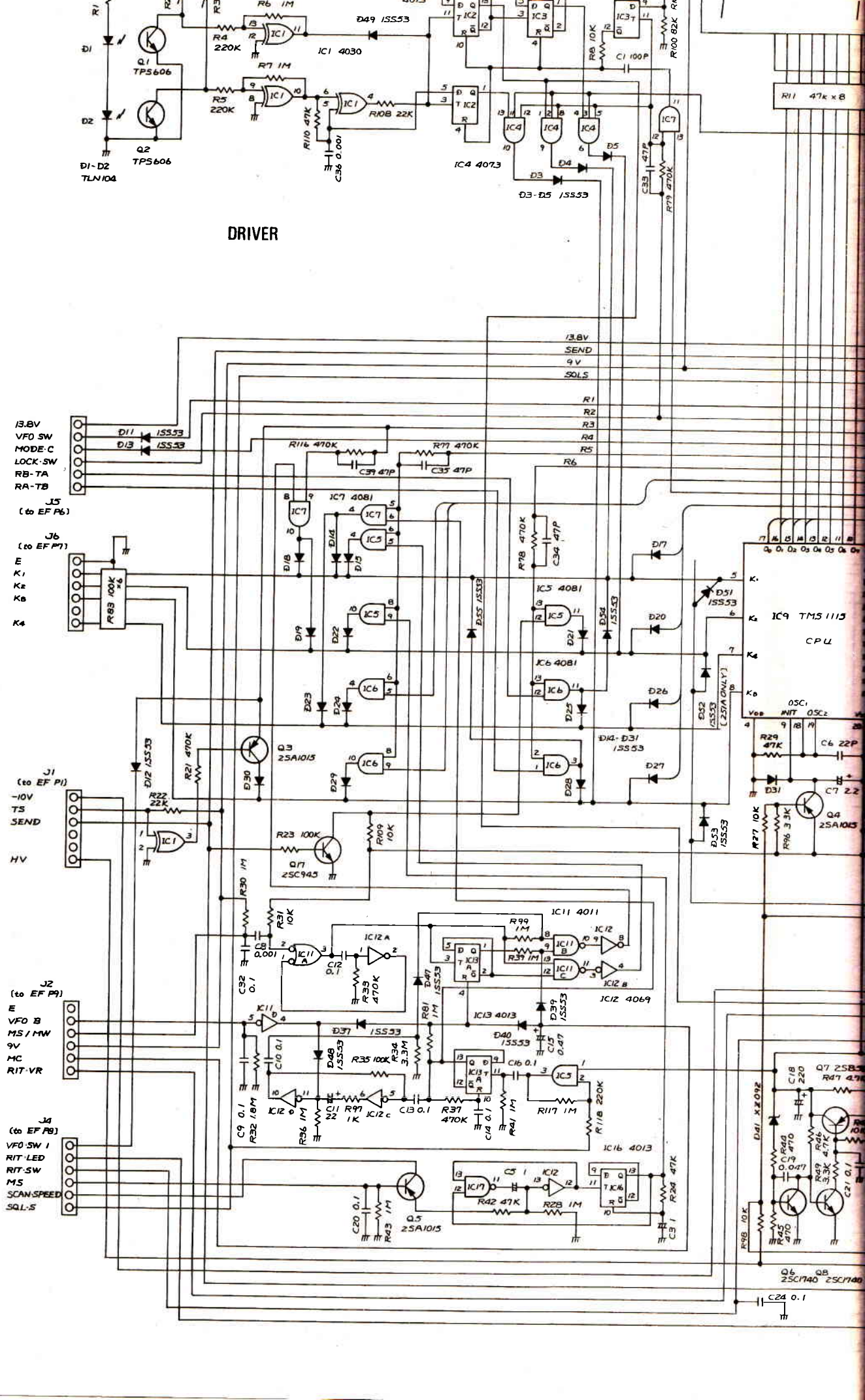
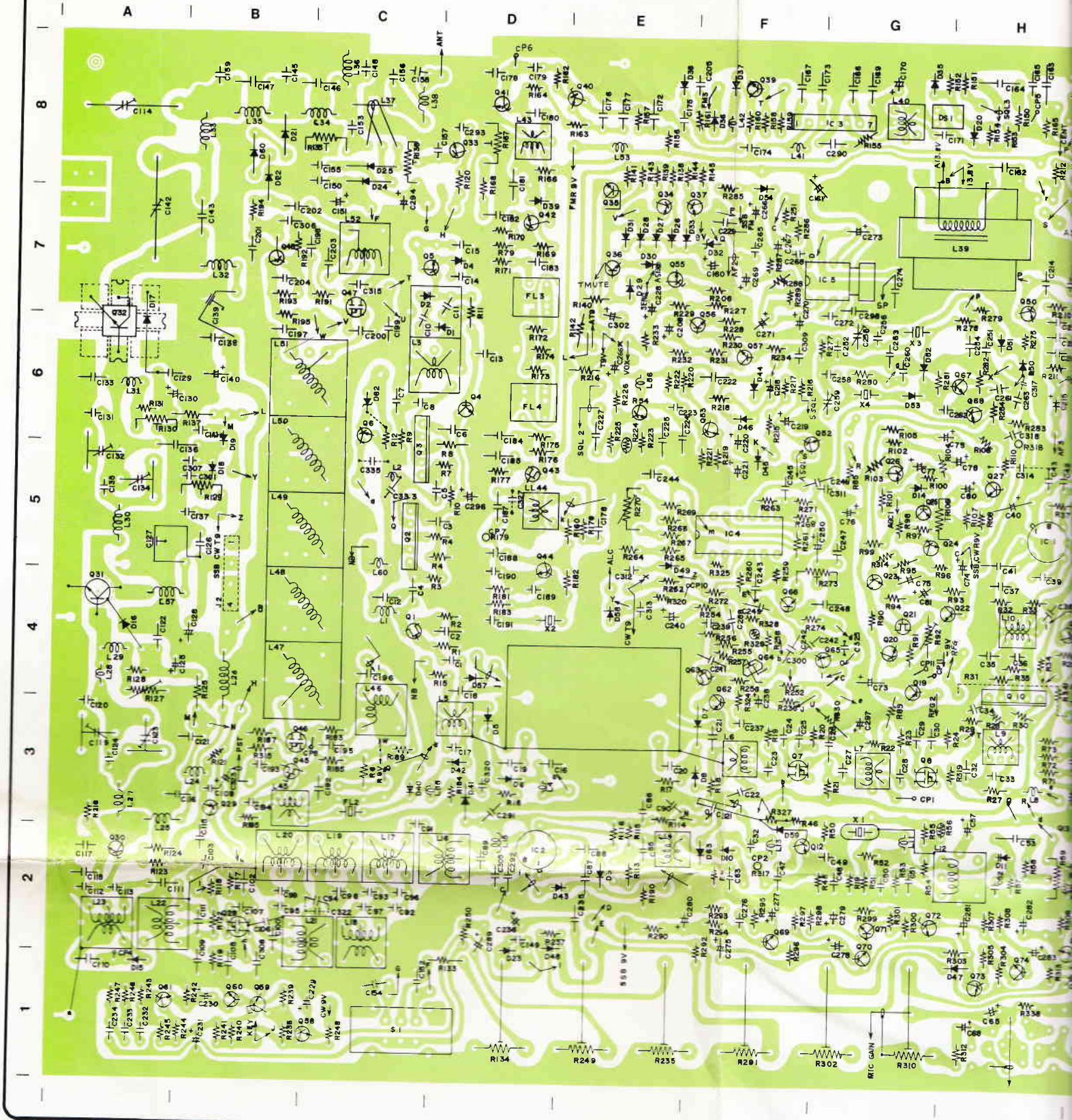

DRIVER
13.8V
SEND
9V
SQLS
R1
R2
R3
R4
R5
R6
J5
(to EF P6)
J6
(to EF P7)
J1
(to EF P1)
J2
(to EF P9)
J4
(to EF P8)
IC1 4030
IC4 4073
IC5 4081
IC6 4081
IC7 4081
IC9 TMS 1113
CPU
IC11 4011
IC12 4069
IC13 4013
IC16 4013
Q1 TPS606
Q2 TPS606
Q3 2SA1015
Q4 2SA1015
Q5 2SA1015
Q7 2SC945
D1-D2 TLN104
D3-D5 1SS53
D14-D31 1SS53
R11 47K x 8
R83 100K x6
R93 100K x6
OSC1
OSC2
INIT

ICOM

IC-251A/E

MAIN UNIT



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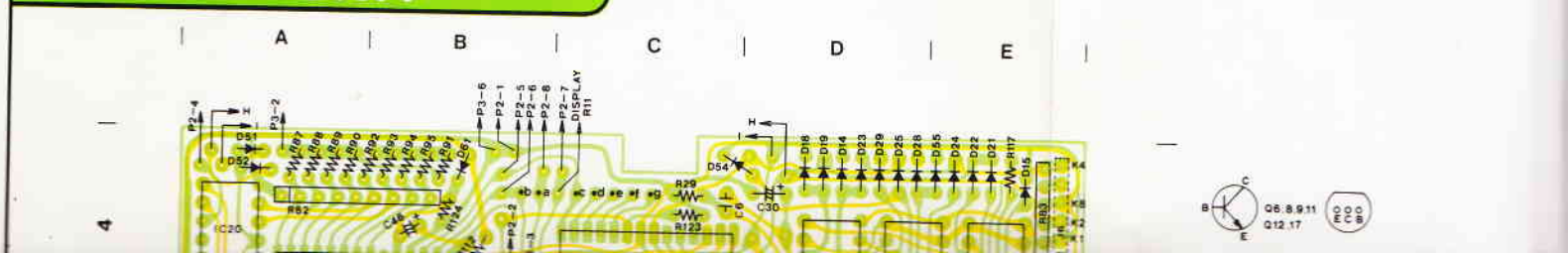
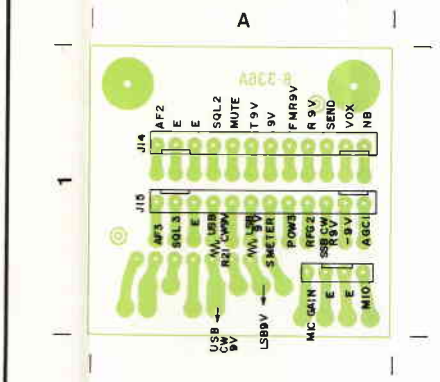
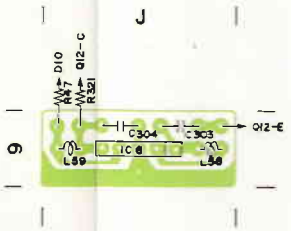


251A/E BOARD LAYOUT

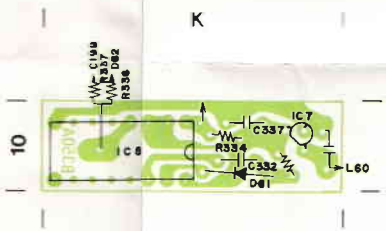
EF UNIT



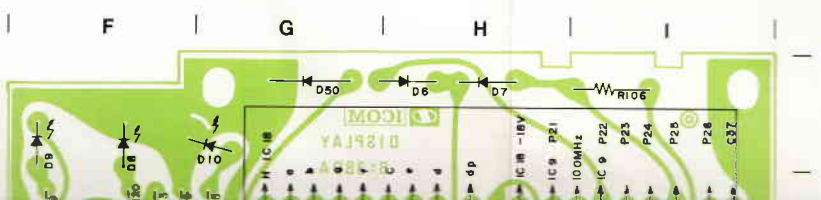
■ LIMITTER BOARD



■ NOISE BLANKER BOARD

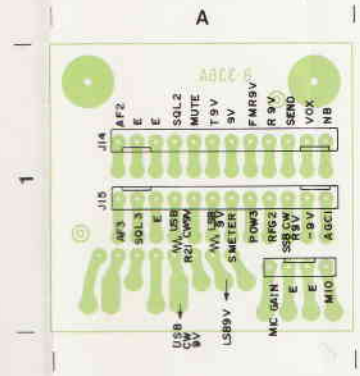


■ DISPLAY BOARD

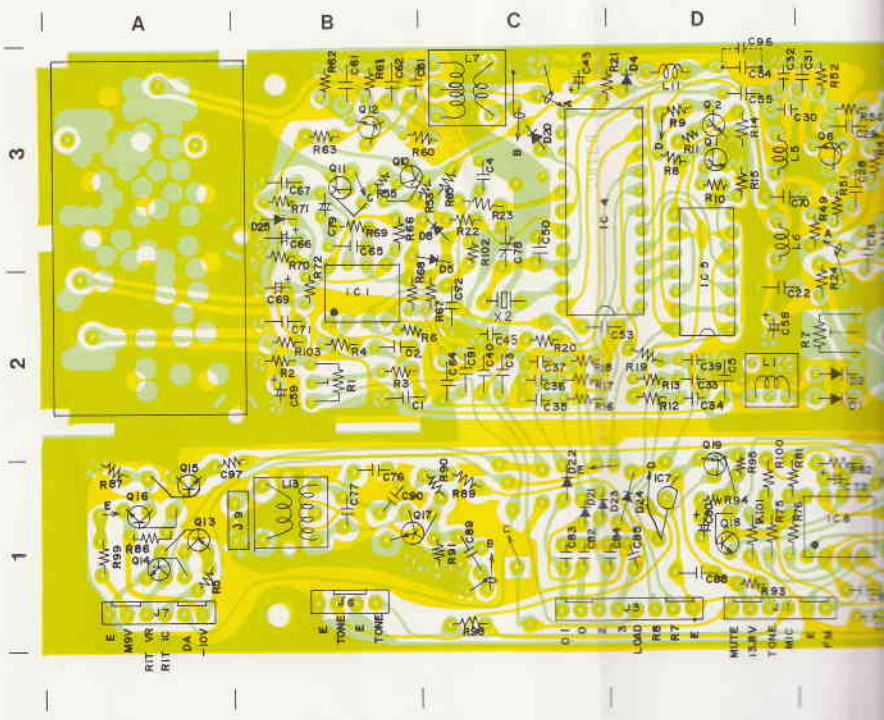


LAYOUT

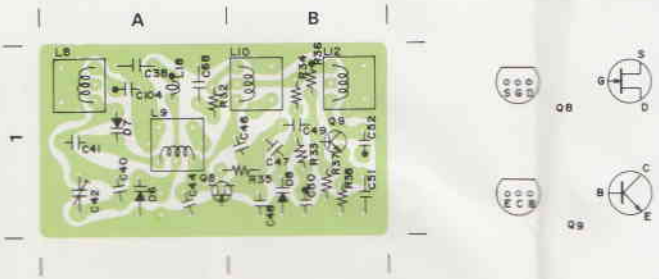
EF UNIT



PLL UNIT

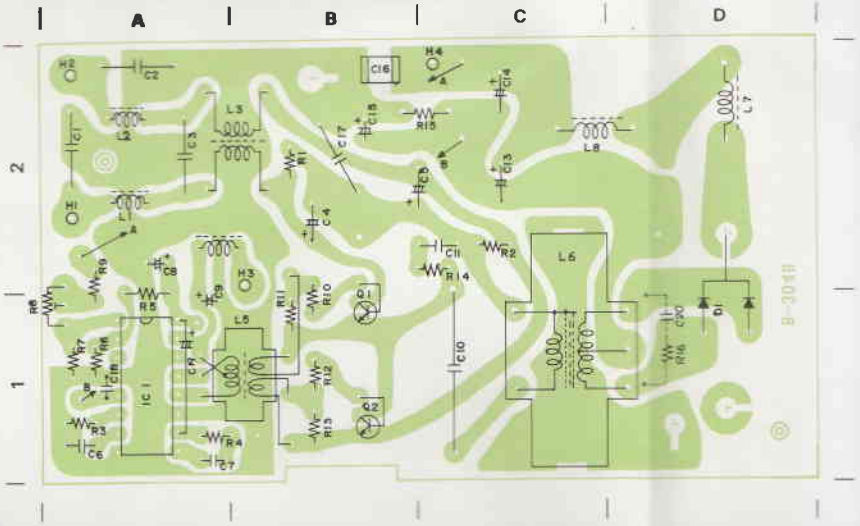


VCO UNIT



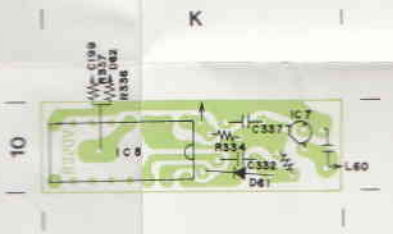
POWER SUPPLY UNIT

■ **SWITCHING REGULATOR BOARD**



■ LIMITTER BOARD

■ NOISE BLANKER BOARD



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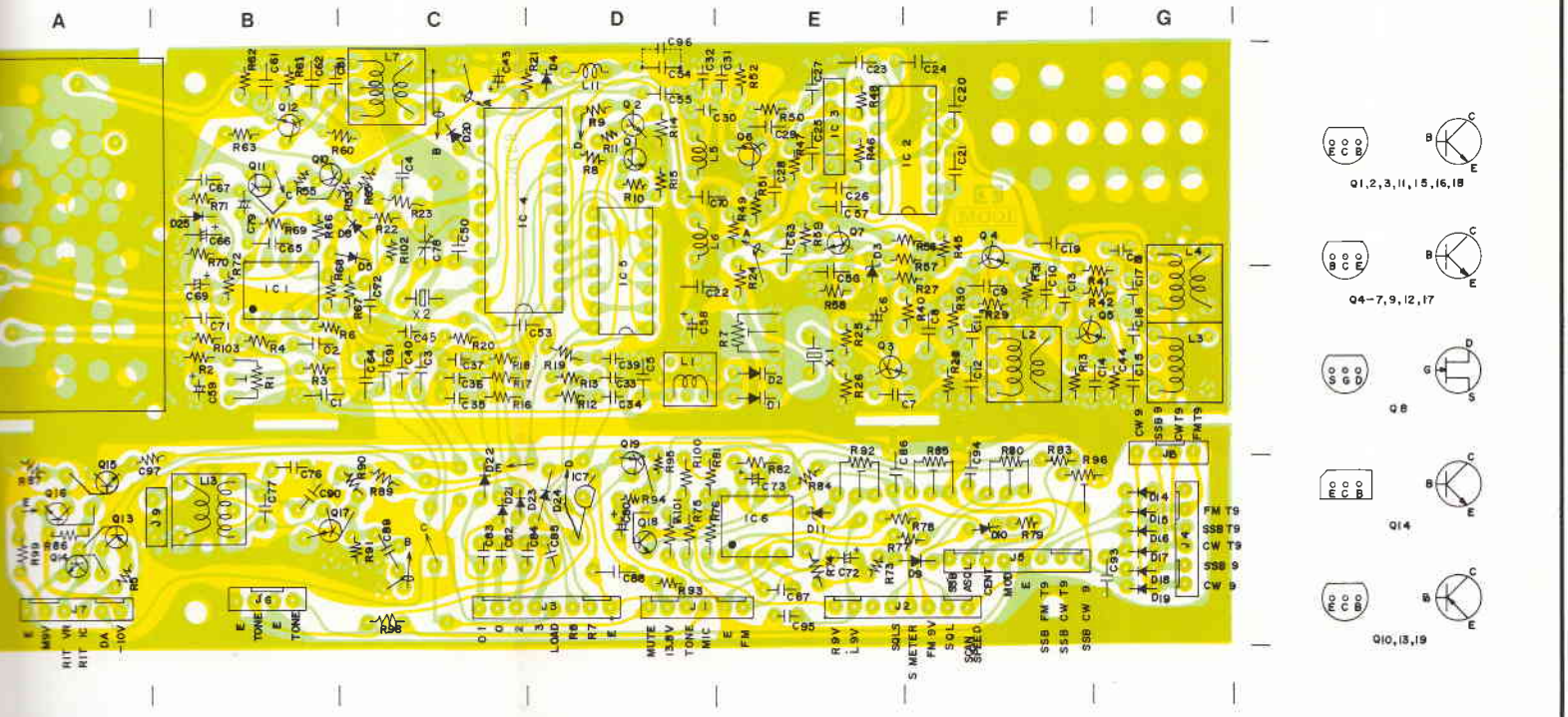
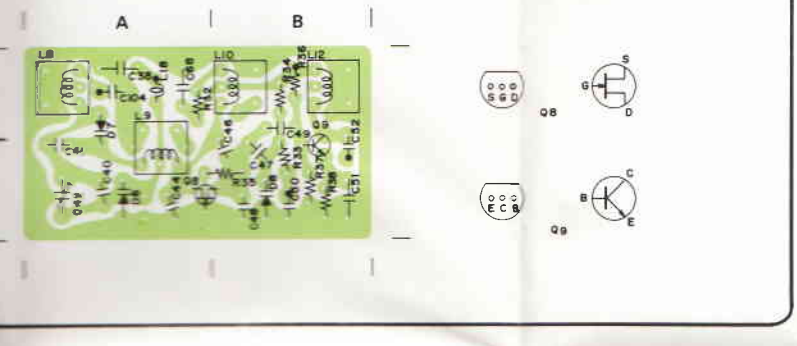
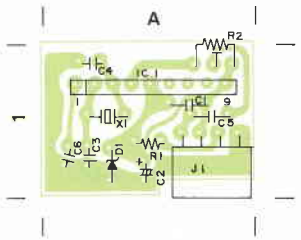


UNIT



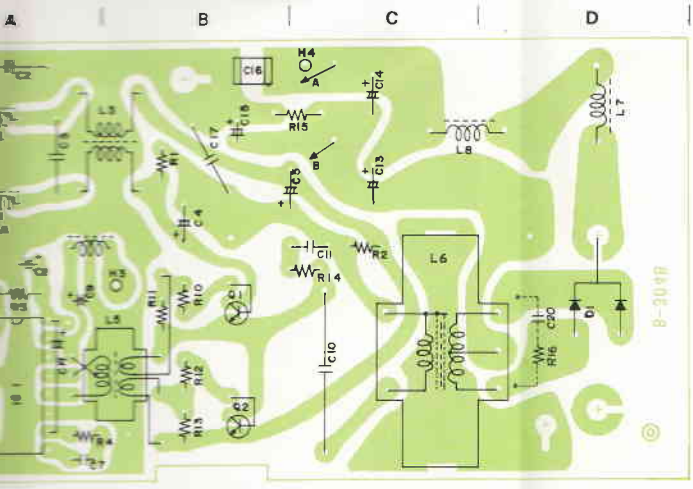
TONE CALL UNIT

(IC-251E ONLY)

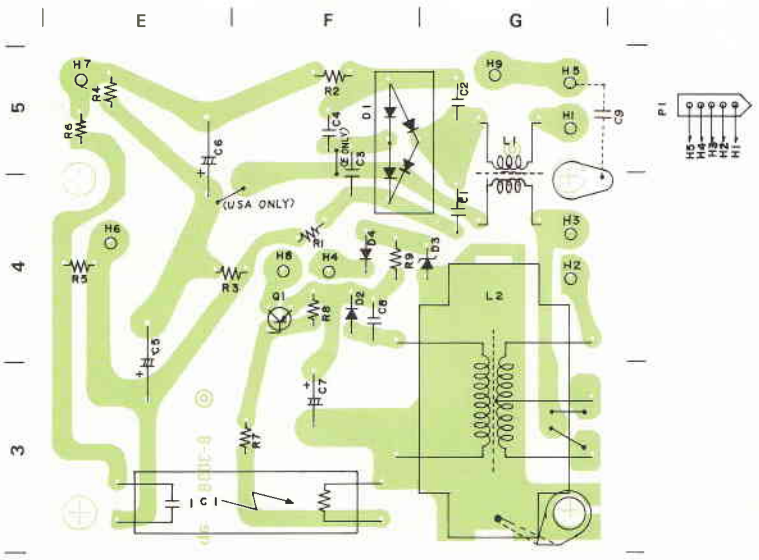


ER SUPPLY UNIT

TCHING REGULATOR BOARD

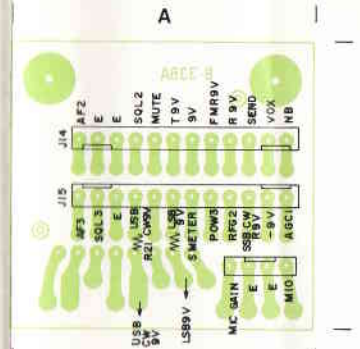


■ PI BOARD

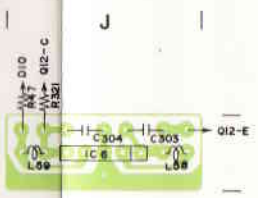


OUT

EF UNIT

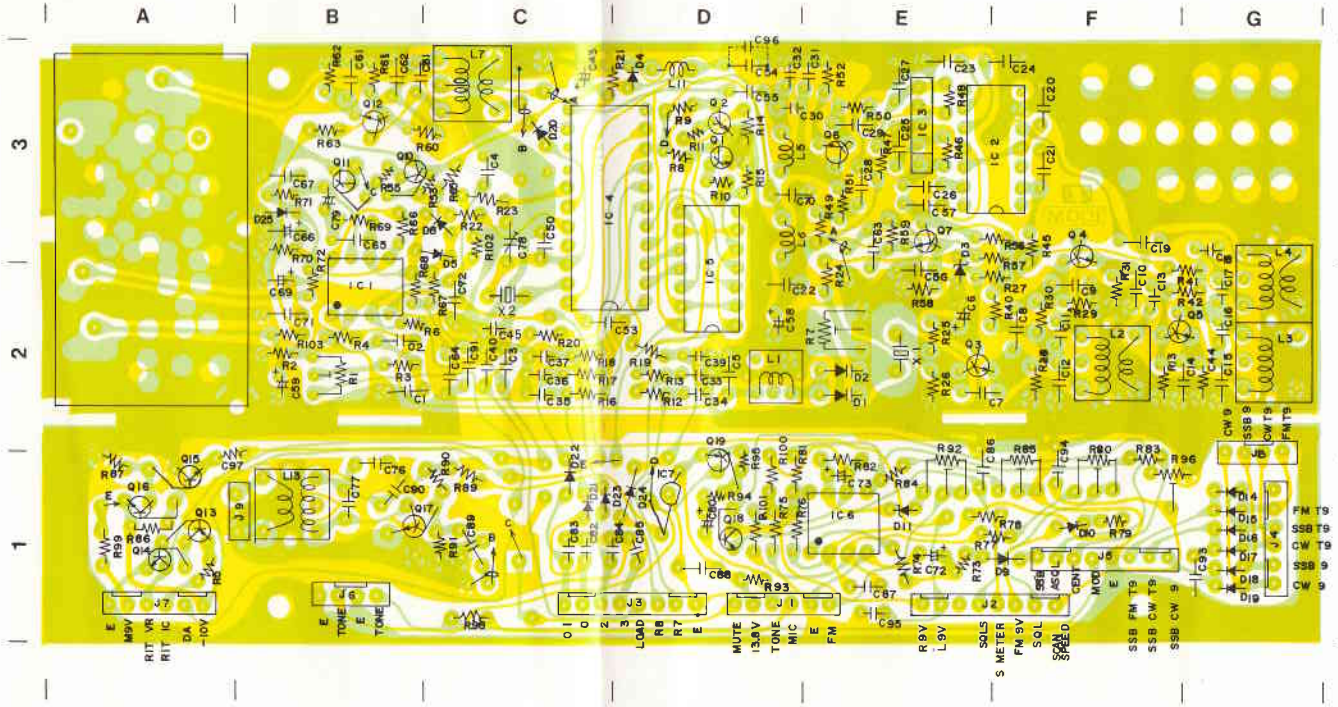


LIMITTER BOARD

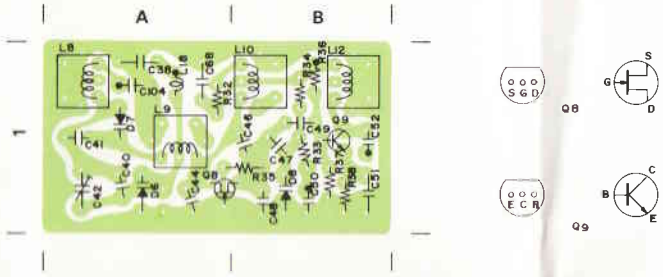


ISE BLANKER BOARD

PLL UNIT

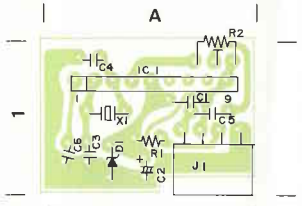


VCO UNIT



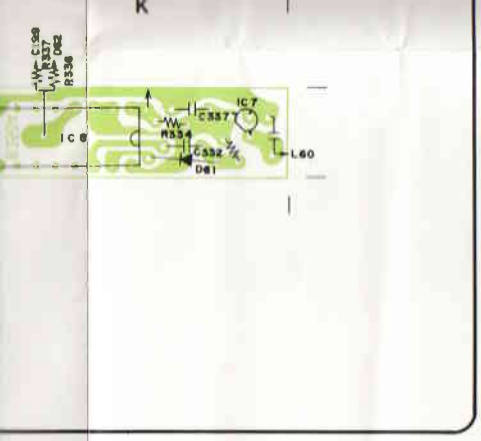
TONE CALL UNIT

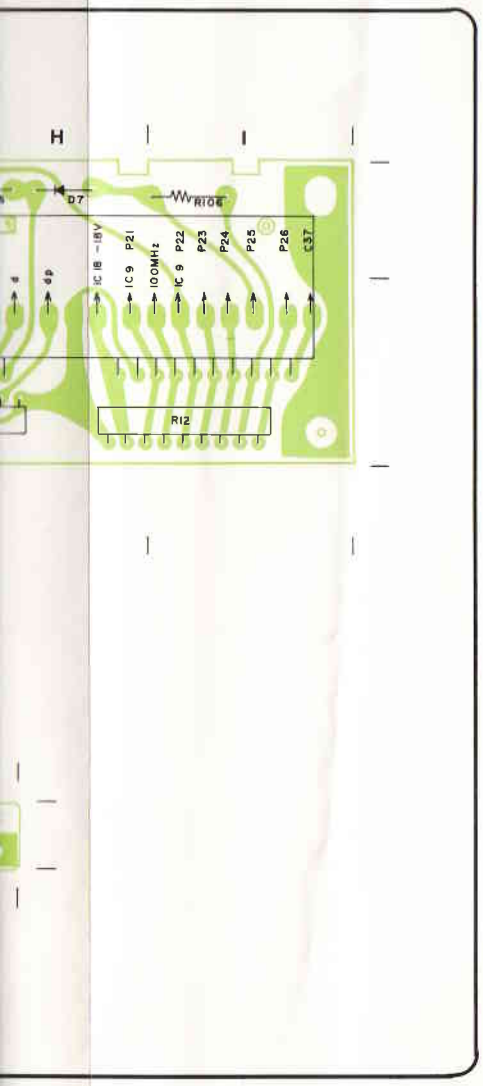
(IC-251E ONLY)



POWER SUPPLY UNIT

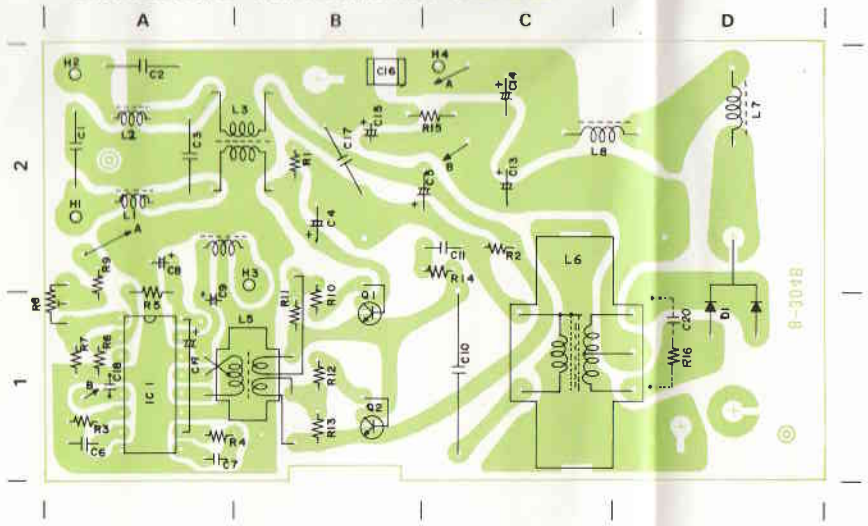
■ PI BOARD



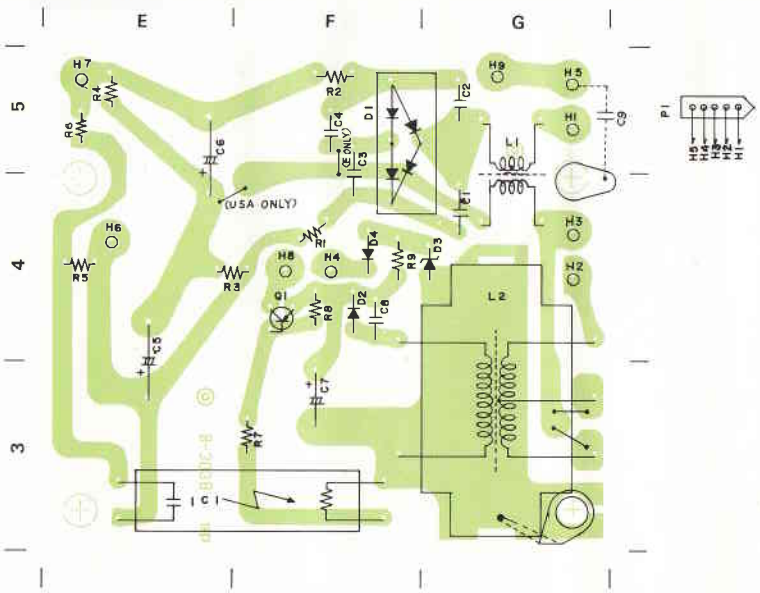


POWER SUPPLY UNIT

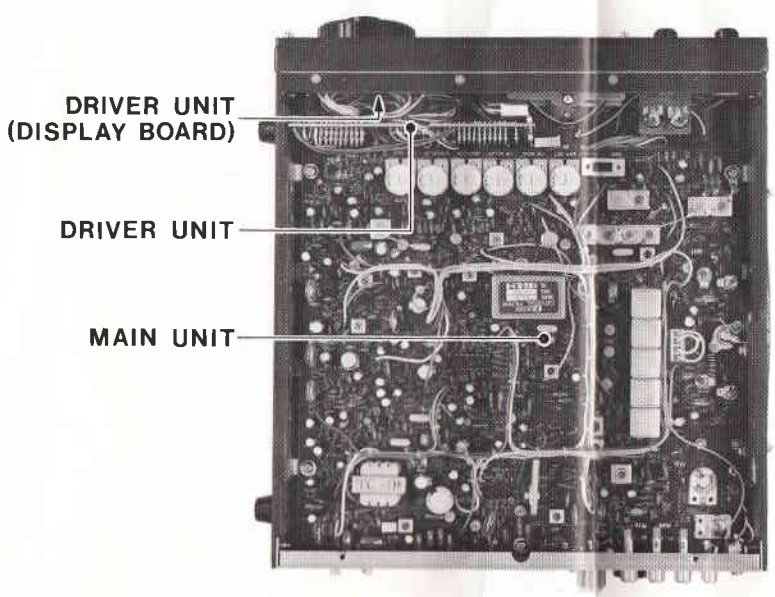
■ SWITCHING REGULATOR BOARD

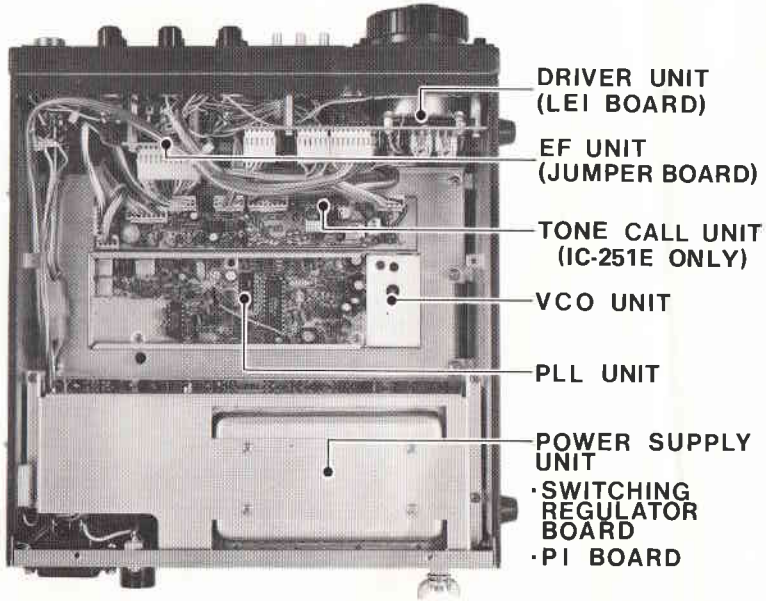


■ PI BOARD



BOARD LAYOUT





ICOM INCORPORATED

Some components subject to change for an improvement without notice.

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