

UHF FM TRANSCEIVER

IC-U400

SERVICE MANUAL



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FOREWORD

Thank you for purchasing the **ICOM IC-U400**, one of the most technologically advanced and sophisticated UHF mobiles on the Land Mobile market today.

Utilizing sophisticated computer based technology and ICOM's precision UHF engineering, the **IC-U400** incorporates state-of-the-art design concepts to meet the demanding needs and requirements of the Land Mobile user.



ASSISTANCE

There are six different versions of the **IC-U400**, including the U.S.A., and GENERAL models. This service manual is designed to cover every version. Each model is assigned a particular code number as follows:

CODE NO.	VERSION	FREQUENCY RANGE
#01	U.S.A.	450 ~ 480MHz
#02	GENERAL	450 ~ 480MHz
#03	U.S.A.	400 ~ 430MHz
#04	GENERAL	400 ~ 430MHz
#05	U.S.A.	480 ~ 520MHz
#06	GENERAL	480 ~ 520MHz

Please contact your nearest ICOM Service Center if you require assistance or information regarding the operation and capabilities of the **IC-U400**. Addresses are provided on the title page of this manual.

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SECTION 1 SPECIFICATIONS

GENERAL

Frequency range	: 450 ~ 480MHz (#01, #02) 400 ~ 430MHz (#03, #04) 480 ~ 520MHz (#05, #06)
Number of channels	: 16 channels
Usable temperature	: -30°C ~ +60°C
Voltage polarity	: Negative ground
Quantity of semiconductors	: ICs: 23 Transistors: 31 FETs: 6 Diodes: 62
Channel spacing	: 25kHz
Frequency stability	: ±5ppm (-30°C ~ +60°C)
Antenna impedance	: 50 ohms
Power supply requirement	: 13.8V DC (±15%)
Current drain	: Transmit : 9.0A Receive Standby: 0.5A AF max. : 1.2A
Dimensions	: 170mm(W) × 50mm(H) × 260mm(D)
Weight	: 2.6kg

RECEIVER

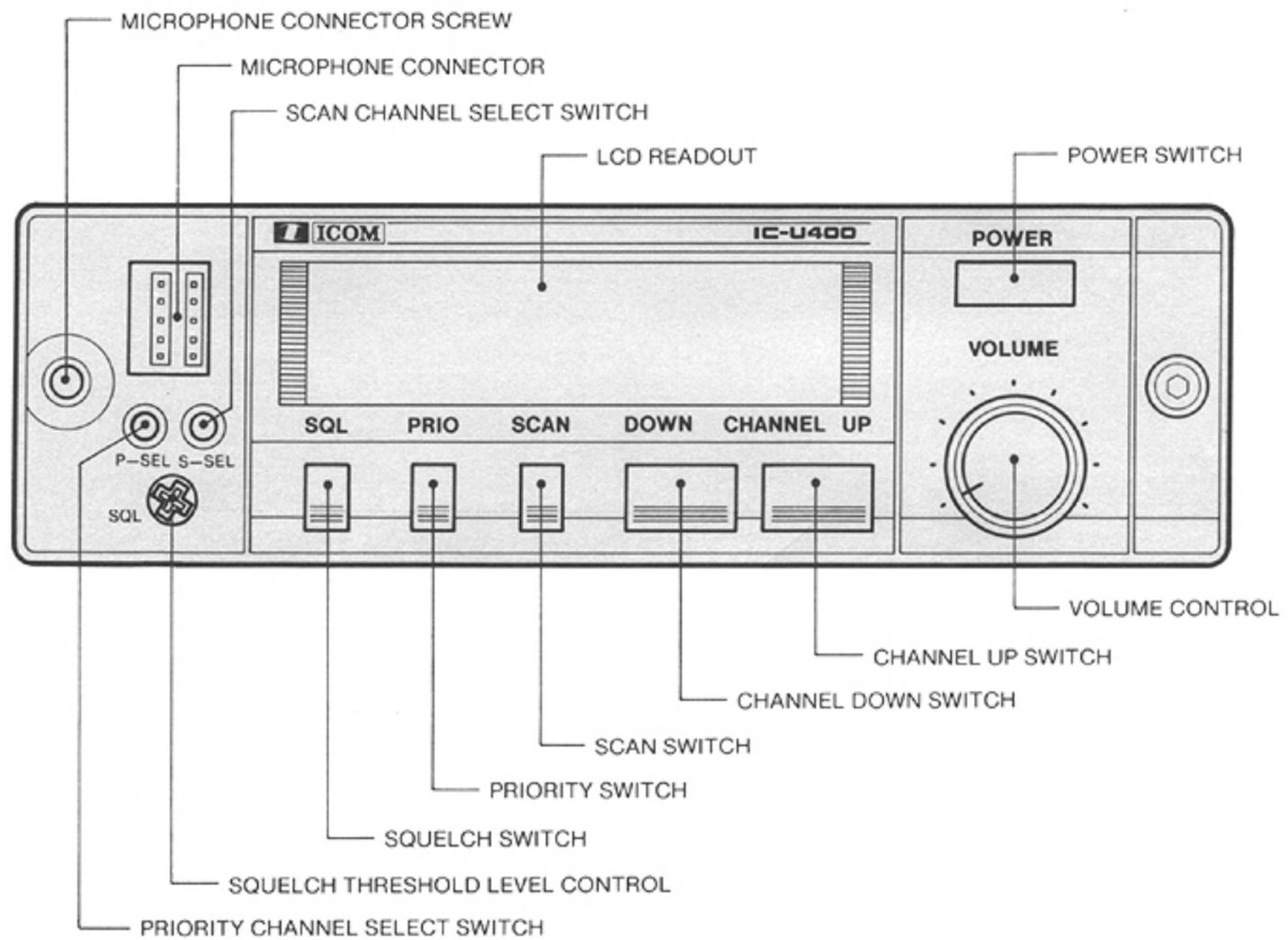
Receiving system	: Double-conversion superheterodyne
Modulation acceptance	: 16K0F3E
Intermediate frequency	: 1st: 21.8MHz 2nd: 455kHz
Sensitivity	: Less than 0.35μV for 12dB SINAD
Threshold squelch sensitivity	: Less than 0.3μV
Spurious & image rejection	: 70dB
Selectivity	: 70dB minimum at adjacent channel
Intermodulation rejection	: 70dB
Audio output power	: More than 5W at 10% distortion
Audio output impedance	: 4 ohms

TRANSMITTER

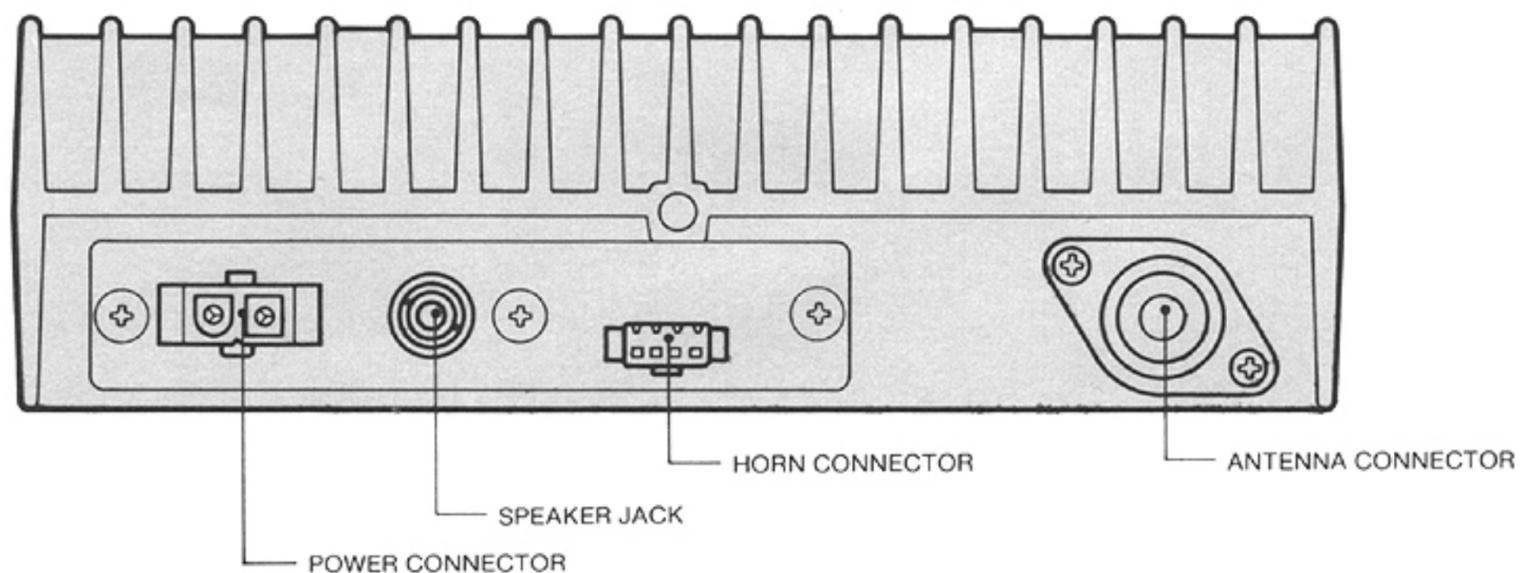
Output power	: 35W
Emission mode	: 16K0F3E
Modulation system	: Variable reactance frequency modulation
Max. frequency deviation	: ±5kHz
Spurious & harmonic emissions	: More than 70dB below peak power output

SECTION 2 OPERATING CONTROLS

FRONT PANEL

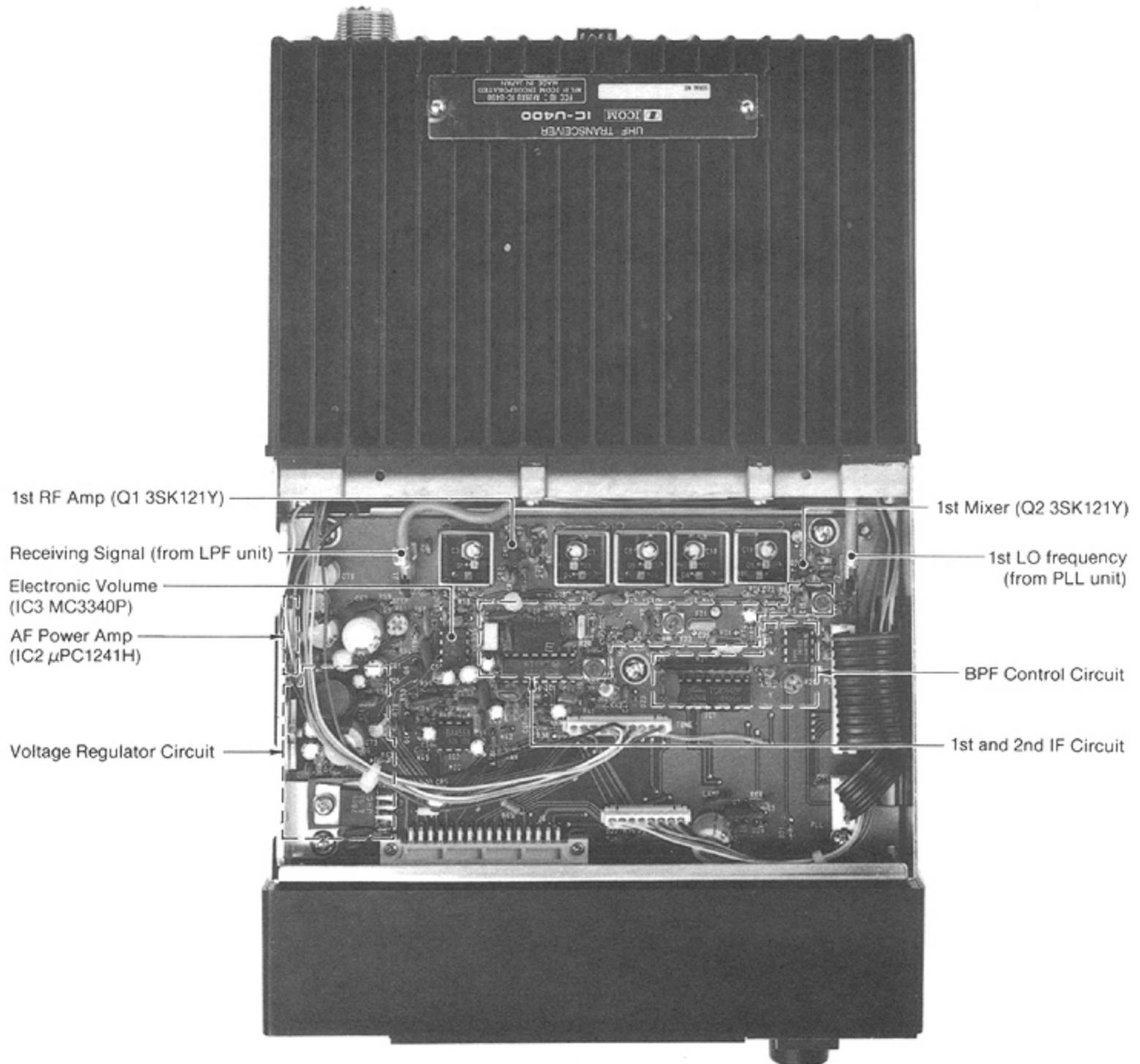


REAR PANEL

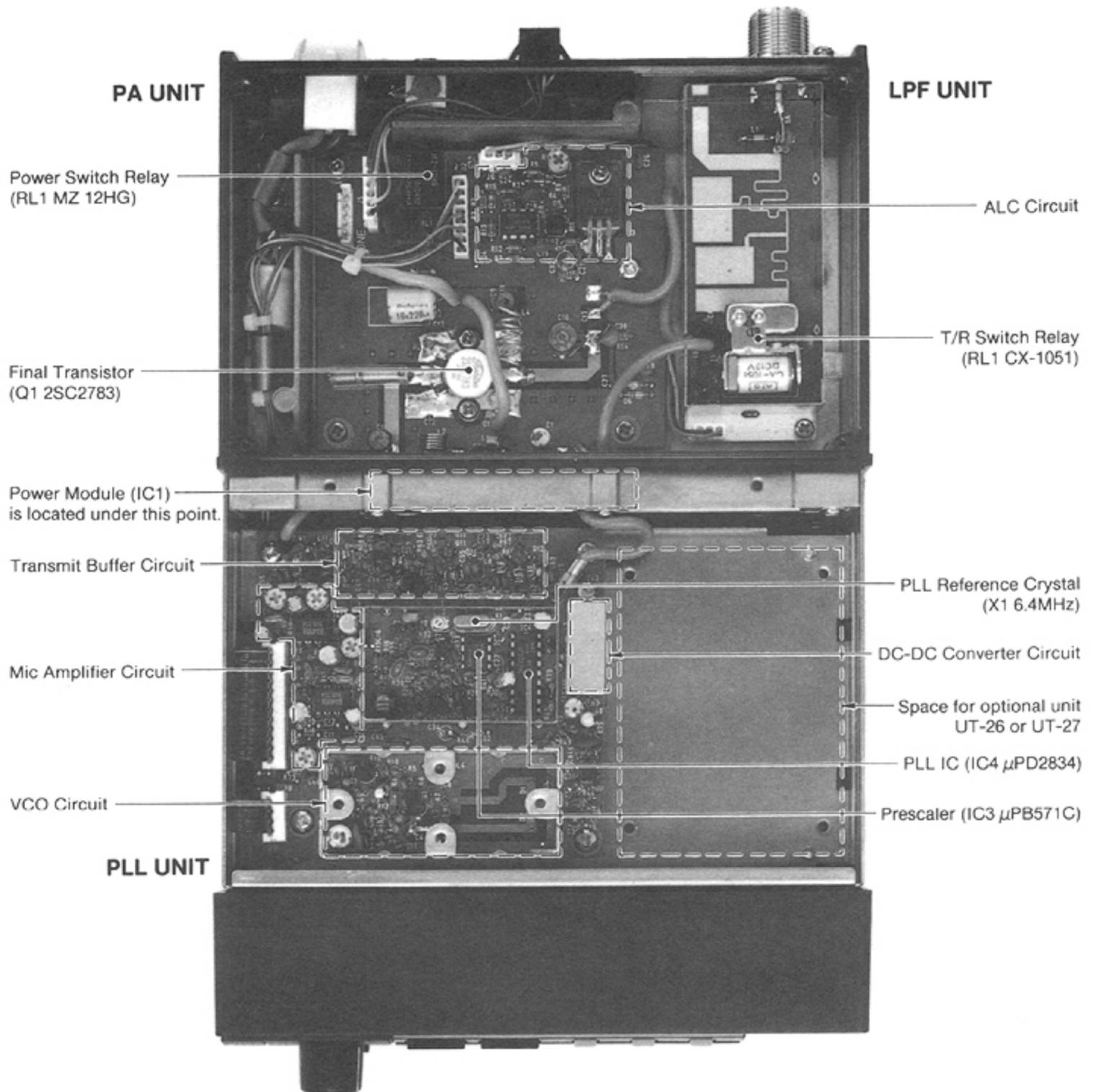


SECTION 3 INSIDE VIEWS

3 - 1 MAIN UNIT

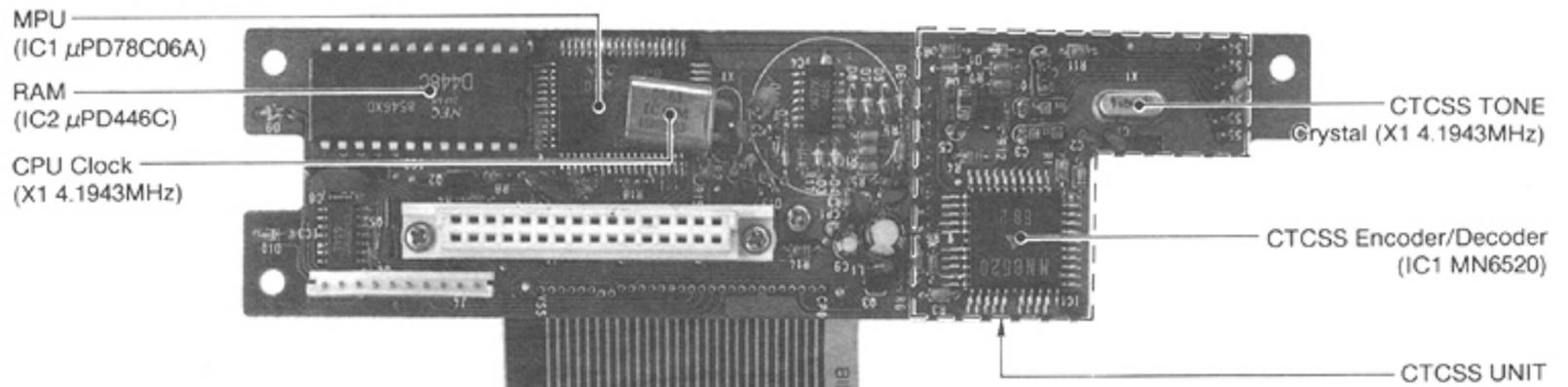


3 - 2 PLL, PA AND LPF UNITS

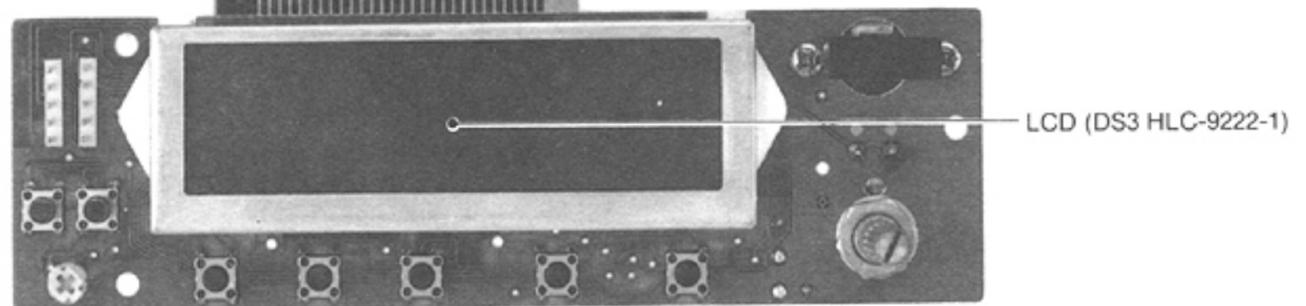


3 - 3 DISPLAY AND LOGIC UNITS

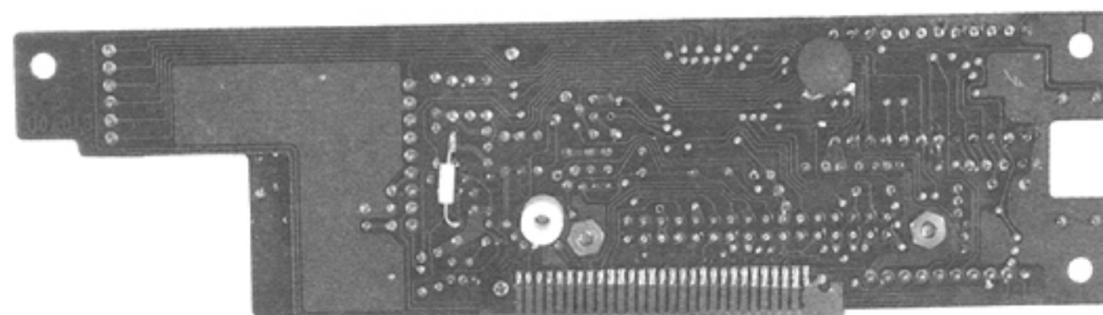
LOGIC UNIT (PARTS SIDE)



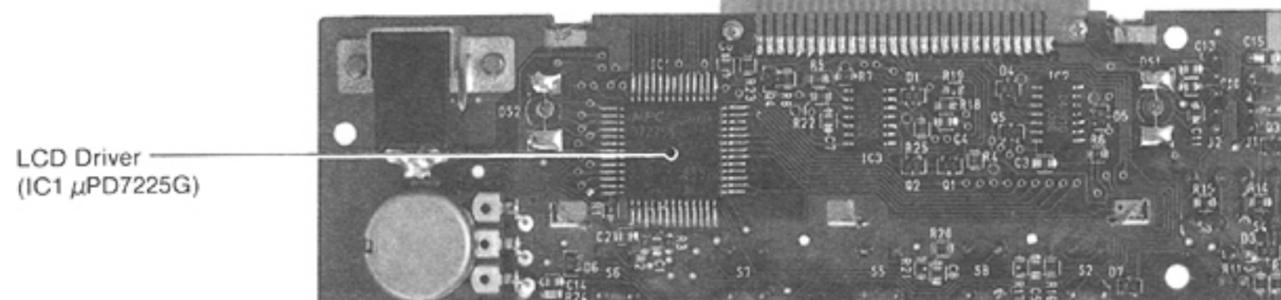
DISPLAY UNIT (PARTS SIDE)



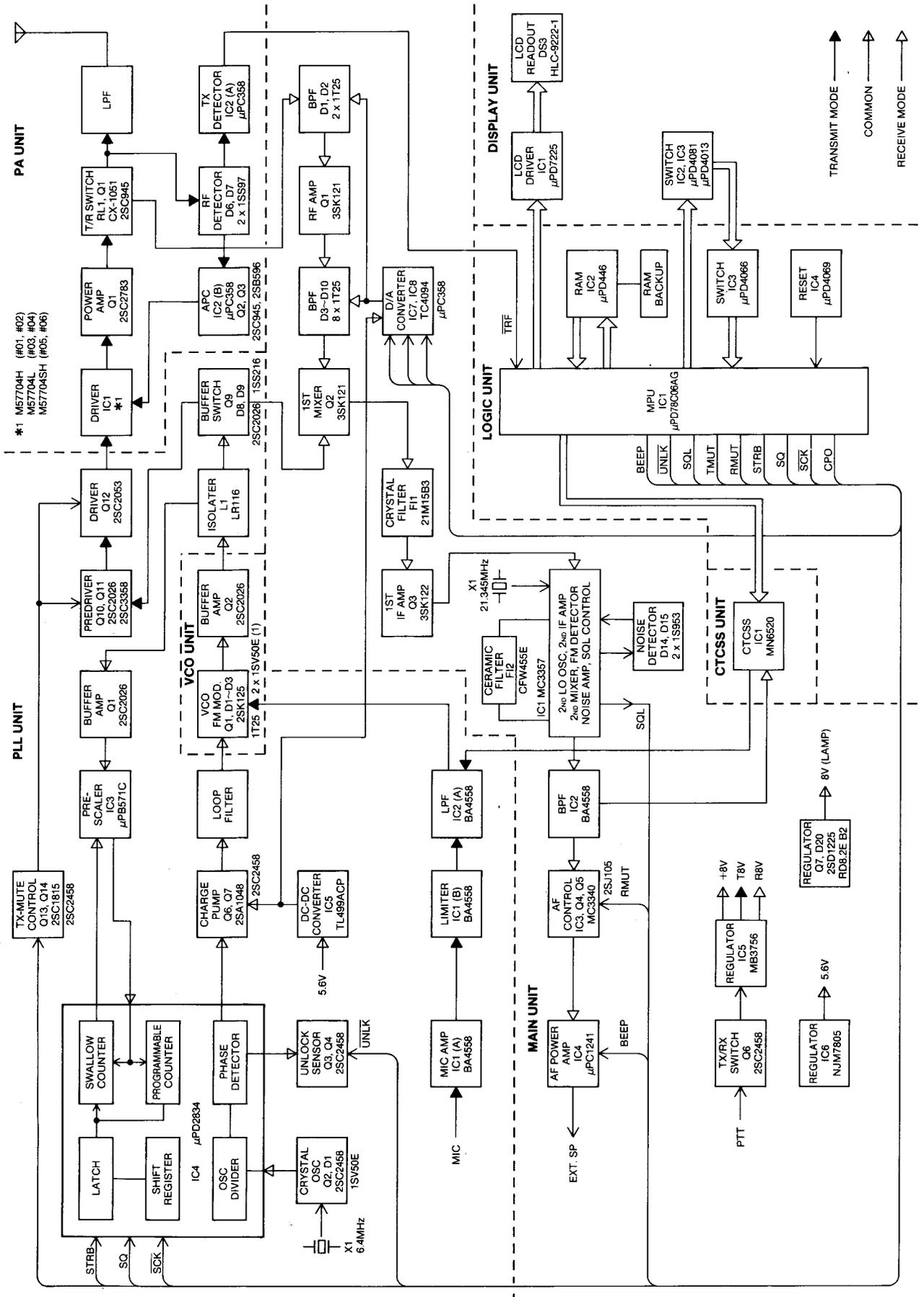
LOGIC UNIT (SOLDER SIDE)



DISPLAY UNIT (SOLDER SIDE)



SECTION 4 BLOCK DIAGRAM



SECTION 5 CIRCUIT DESCRIPTION

5 - 1 RECEIVER CIRCUITS

5 - 1 - 1 ANTENNA SWITCHING CIRCUIT (LPF UNIT)

Input signals from the antenna connector are fed into the antenna switching circuit through a low-pass filter which consists of a strip line. Input signals switched by the transmit/receive switching relay and are fed into the MAIN UNIT through P1 on the LPF UNIT.

5 - 1 - 2 RF AMPLIFIER CIRCUIT (MAIN UNIT)

Signals from the LPF UNIT pass through a bandpass filter which consists of D1, D2, C3, and a strip line, and are then fed into gate 1 of Q1, the 1st RF amplifier, where signals are amplified.

Output signals from Q1 are again passed through bandpass filters consisting of D3~D10, C7~C11, and strip lines. These bandpass filters reduce interference from out-of-band signals. Signals passed through the bandpass filters are fed into gate 1 of Q2, the 1st mixer.

Diodes D1~D10 are varactor diodes that track the bandpass filters and are controlled by the output voltage from IC7 and IC8. These diodes tune the center frequency of the bandpass filters for wide bandwidth reception and a good image response rejection ratio.

Signals from the bandpass filters are fed into gate 1 of Q2. A local oscillator signal from J2 is fed into gate 2 of Q2. Q2 converts RF signals into the 21.8MHz 1st intermediate frequency and outputs them at L4.

5 - 1 - 3 INTERMEDIATE FREQUENCY CIRCUIT (MAIN UNIT)

The 1st intermediate frequency from L4 is filtered further from out-of-band interference through a matched pair of monolithic crystal filters (F11) and is then amplified at Q3.

The intermediate frequency amplified at Q3 is fed into IC1 through the limiter circuit, D11 and D12, and matching transformer, L6.

IC1 incorporates in one package a 2nd local oscillator circuit, a 2nd mixer, a limiter amplifier, an active filter, and a quadrature detector circuit.

The 1st intermediate frequency enters IC1 (pin 16) and mixes with a 2nd local oscillator frequency (21.345MHz) generated by X1. The 455KHz 2nd intermediate frequency is then output from pin 3. This signal passes through a high-performance ceramic filter (F12), and is amplified by a limiter amplifier inside IC1.

Output signals from the limiter amplifier are separated. One of the signals enters a quadrature detector circuit, and the other exits from pin 7. The signal output from pin 7 enters pin 8 through the phase delay element, X2, and then both signals are detected at a quadrature detector circuit inside IC1. The resulting audio signal is output from pin 9. X2, a ceramic resonator, is used for improving temperature characteristics.

5 - 1 - 4 AUDIO FREQUENCY CIRCUIT (MAIN UNIT/CTCSS UNIT)

The audio signal from IC1 passes through the deemphasis circuit, R36 and C50, and enters the low frequency amplifier, IC2(A), and is then amplified. The output signal from IC2(A) is applied to the CTCSS UNIT through the LOGIC UNIT.

IC1 on the CTCSS UNIT incorporates a CTCSS encoder/decoder, an AF amplifier, and a dual AF filter circuit.

The signal amplified at IC1 passes through an AF filter and then exits from pin 18. An audio signal from pin 18 crosses the LOGIC UNIT, the DISPLAY UNIT, and the MIC CONNECTOR and then re-enters the MAIN UNIT.

An audio signal from the CTCSS UNIT is passed through the low-pass filter, IC2(B), and the electronic volume control, IC3. IC3 attenuates the audio signal which determines the voltage level of pin 2. The audio signal attenuated at IC3 is then applied to the AF power amplifier, IC4, through the audio switch circuit, Q5. IC4 drives the speaker at more than 5W.

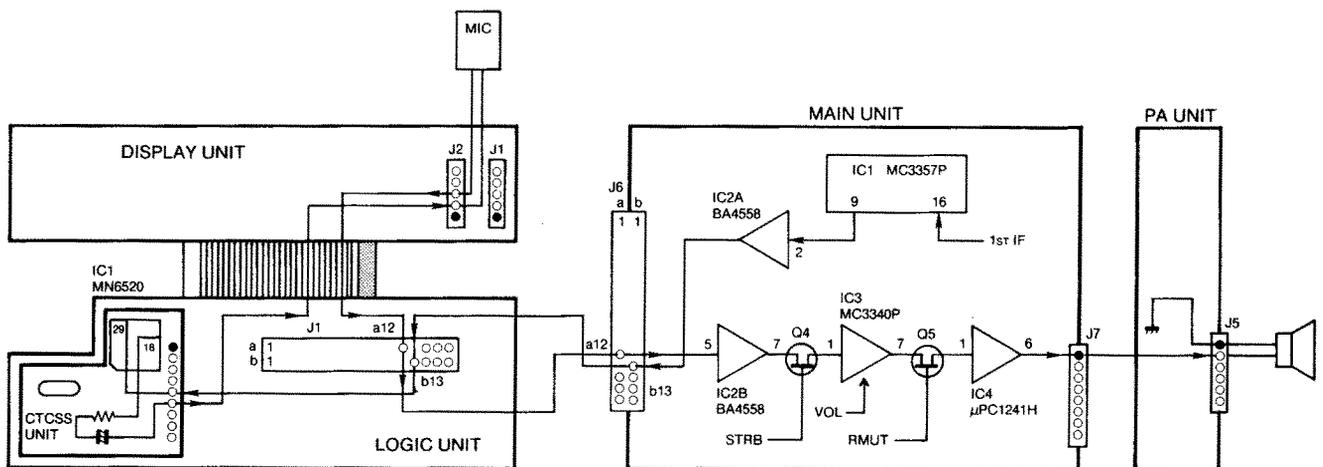


Fig. 5 - 1 AF CIRCUIT BLOCK DIAGRAM

5 - 1 - 5 SQUELCH CIRCUIT (MAIN UNIT)

A portion of signals output from IC1 (pin 9) passes through R37 and R78 (which are in parallel connection), and is then input to an active filter inside IC1 (pin 10) where the noise signal is selected at approximately 20kHz then output from pin 11.

The noise signal is detected by D14 and D15 and is then converted to DC voltage and used as squelch control signals. This voltage level is input to IC1 (pin 12). When pin 12 of IC1 is higher than the threshold level, the squelch trigger circuit inside IC1 is activated, informing the MPU that the squelch is closed. The SQL SET volume, R11, on the DISPLAY UNIT controls the input voltage level of IC1.

When the MPU on the LOGIC UNIT receives the squelch information from IC1, the MPU transfers the RMUT signal to the gate of Q5 and switches the AF output.

The RMUT signal is emitted from the MPU only if the MPU receives the DOUT from the CTCSS UNIT and the squelch control signal at the same time.

Q4 removes the channel switching noise generated during scanning. When changing the channel the strobe signal is emitted from pin 1 on IC4 on the PLL UNIT and is current amplified at Q8. An amplified signal at Q8 is then applied to Q4 to prevent channel switching noise.

5 - 2 TRANSMITTER CIRCUITS

5 - 2 - 1 MIC AMPLIFIER CIRCUIT (PLL UNIT)

The audio signal from the microphone, after preemphasis of 6dB/oct at 300Hz~3000Hz by C1 and R1, is amplified at IC1(A) and is limiter amplified at IC1(B).

The output signal from the limiter amplifier is like a square wave and includes many RF signals which are fed back from the transmitter's final stage. The output signal, therefore, is fed to splatter filter circuit IC2(A) which reduces signals more than 3kHz, and then applies the signal to the VCO circuit for FM modulation.

5 - 2 - 2 BUFFER AMPLIFIER CIRCUIT (PLL UNIT)

The 400MHz band is generated by the VCO and is buffer amplified at Q2 and Q9. The output signal from Q9 passes through diode switch circuit, D8 and D9, and is then applied to the wide-band amplifier circuit, Q10, Q11 and Q12, and enters the PA UNIT through J3.

5 - 2 - 3 POWER AMPLIFIER CIRCUIT (PA UNIT)

The transmitter output signal from the PLL UNIT enters IC1 (pin 1). IC1 is an RF power module which can attain 15W with an input of 200mW and can obtain stable output over a broad band. The output from the power module drives the power transistor (Q1) in the final stage to attain an output of 35W. An impedance conversion circuit is incorporated inside Q1, and by combining this with the use of the strip line, the output becomes broad-band.

5 - 2 - 4 LOW-PASS FILTER CIRCUIT (LPF UNIT)

The output signal from the PA UNIT passes through the transmit/receive switching relay, RL1, and is fed into a low-pass filter consisting of a strip line where harmonic signals are removed. The signal is then applied to the ANTENNA CONNECTOR, J3.

Q1 on the LPF UNIT switches RL1 using T8V.

5 - 2 - 5 ALC CIRCUIT (PA UNIT)

The antenna mismatching detection circuit consists of C16, C30, R14, C27, D6 and D7. Output voltage of the detector is a minimum value when the antenna impedance is matched at 50 ohms. However, when the antenna impedance is in a mismatched condition, the detector voltage becomes higher than it would be if the antenna were matched.

Output voltage is fed into Inverting Amplifier Circuit IC2(B) and then controls the bias voltage of Q2 and Q3. This controls output of IC1.

5 - 2 - 6 TRANSMITTER INDICATOR CIRCUIT (PA UNIT)

IC2(A) is an open loop and is used as a comparator. When the detector voltage of SWR enters IC2(A), the output becomes "LOW". This output enters pin 13 of the MPU and serves as the control signal of the LCD READOUT [TX] indicator.

Even with the transceiver in the transmit mode, the [TX] indicator is not illuminated when the SWR detector voltage is too small.

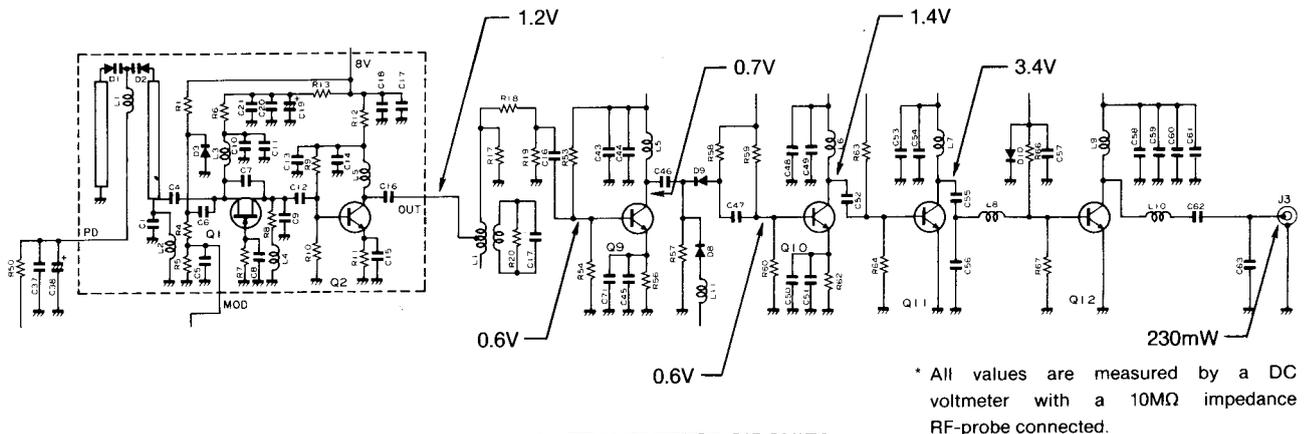


Fig. 5 - 2 TRANSMITTER CIRCUITS RF LEVEL DIAGRAM

5 - 3 PLL CIRCUITS

The PLL is designed in a way that allows the desired frequency to be generated directly by the VCO, adopting a dual modulus prescaler system. The PLL consists of a prescaler (IC3) and PLL IC (IC4). It is fed "divided by N-data" from the MPU which determines the operating frequency.

N-data is determined by dividing the desired frequency by the reference frequency. Desired frequency is the transmit frequency in the transmit mode and the 1st local oscillator frequency in the receive mode.

$$N = \frac{\text{Desired frequency}}{\text{Reference frequency}}$$

The reference frequency oscillator circuit consists of X1, Q2, the thermistors R28 and R30, and the varicap diode D1. The thermistors and varicap are used to obtain high stability within a wide temperature range. The reference oscillator is divided inside IC4 to attain 12.5kHz.

A signal from the VCO is buffer amplified at Q2 and fed into IC3 through the isolation circuit which consists of L1, R17, R18 and R21~R23. The signal from the isolation circuit is divided N times at IC3 and fed into pin 4 on IC4. A signal inside IC4 is phase detected and is converted to lock voltages that are output from pins 12 and 13.

Output voltages are applied to the charge pump, Q6 and Q7, which receives high power source voltage (approximately 20V) and are applied to varactor diodes D1 and D2 in the VCO UNIT through a loop filter. Due to a no-multiplying mixing circuitry, the circuit constitution is simple and reduces spuriousness.

IC5 is a switching regulator which makes 20V with a 5V input voltage.

5 - 3 - 1 VCO CIRCUIT (VCO UNIT)

The VCO circuit employs a Colpitts Oscillator Circuit. The VCO generates a wide-band frequency range with a stable oscillation using a junction-type FET and a strip line.

The oscillation output is passed through the buffer amplifier of Q2 to improve the C/N (Carrier-to-Noise ratio) characteristics through C12.

5 - 3 - 2 UNLOCK DETECTOR CIRCUIT (PLL UNIT)

When the PLL is unlocked, pin 10 of IC4 is at a LOW voltage level. This voltage is fed into an unlocked detection circuit (Q3 and Q4) and is then sent to the MPU on the LOGIC UNIT.

5 - 3 - 3 LOOP FILTER CIRCUIT (PLL UNIT)

Output from pins 12 and 13 of IC4 are fed into a charge pump consisting of Q6 and Q7 and is then applied to a lag lead-type loop filter that consists of R44, R45, C36, D5, D6, R50, C37, and C38. D5 and D6 shortens the time for lock up when changing from receive to transmit mode and vice versa. This circuit determines the characteristics of the PLL. Output voltage from a loop filter controls varactor diodes D1 and D2 on the VCO UNIT.

5 - 4 DISPLAY CIRCUITS

5 - 4 - 1 DISPLAY CIRCUIT

The LCD driver is used to drive the LCD by 1/2 duty and 1/2 bias. The bias voltages are generated by 5V and a resistor divider consisting of R2 and R3. The divided bias voltages are supplied to each terminal of VLC1, VLC2 and VLC3, and the LCD segments are displayed by COM0, COM1, S0~S31.

5 - 4 - 2 OPERATION CIRCUIT

The SCAN (S5), UP (S6) and DOWN (S7) SWITCHES each control the MPU directly.

PRIORITY SWITCH (S8) displays PRIORITY INDICATOR "O", causing the MPU to take the PRIORITY function by turning Q1 and Q2 ON and OFF through the flip-flop of IC3(A).

As for ON/OFF of the squelch circuit SQUELCH SWITCH (S2) is connected by the flip-flop of IC3(B), and the voltage of SQLV line is lowered by this IC3(A) output to open the squelch circuit. At the same time the monitor terminal (PIN 42) of MPU is turned to LOW level and tone squelch is also turned OFF.

SCAN CHANNEL SELECT SWITCH [S-SEL] and PRIORITY CHANNEL SELECT SWITCH [P-SEL] which are located underneath the mic connector cover are secondary functions of the MPU, and required that FUNC terminal of the MPU becomes LOW level by Q3 on the DISPLAY UNIT.

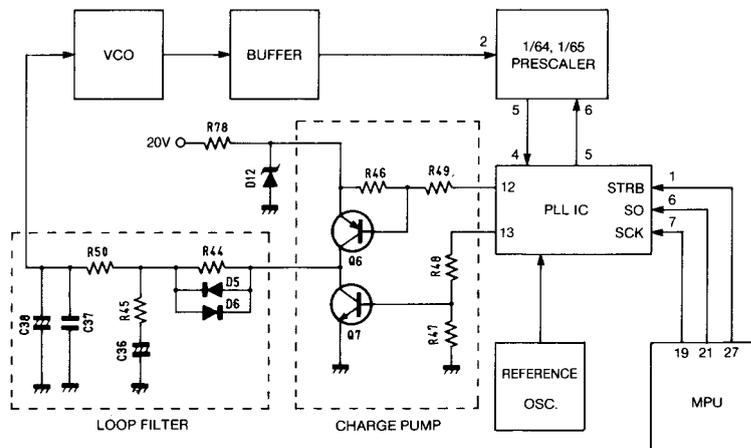


Fig. 5 - 3 PLL BLOCK DIAGRAM

5 - 5 LOGIC CIRCUITS

This unit consists of an 8-bit CMOS-type MPU (μ PD78C06AG) and CMOS-type RAM (μ PD446C), and mainly displays frequency and tone frequency.

5 - 5 - 1 MPU

The MPU (μ PD78C06AG) mainly performs control functions and incorporates a 4K-byte ROM and a 128-byte RAM.

The ports are distributed as follows.

(1) DATA BUS (DB0~DB7)

This is an 8-bit data bus which performs data exchange with a

2K-byte RAM. DB0~DB3 are also used for matrix input.

(2) ADDRESS BUS

(a) PORTS E (PE0~PE15)

There are 16 bit ports which have address ports and output ports that are switched by the program. PE15 is used for the RAM ENABLE signal and PE0~PE10 for ADDRESS signals. Also, PE14 and PE0~PE3 are used for output signals for the MATRIX, whereas PE0 is used for the COMMAND/DATA switching signal of the LCD driver.

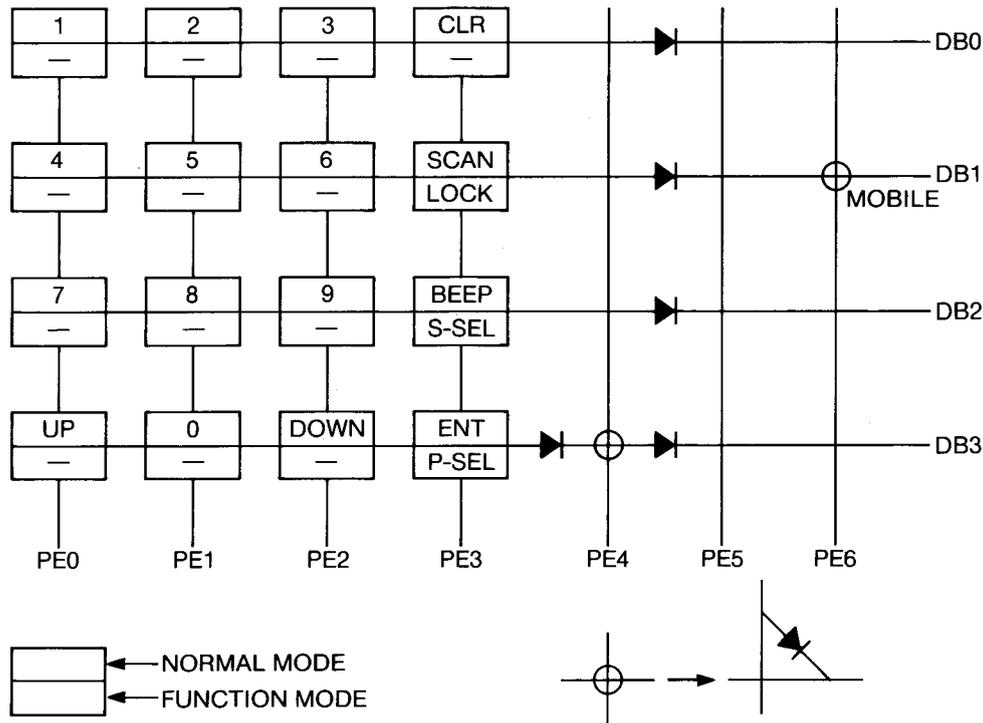


Fig. 5 - 4 THE MATRIX OF THE DATA BUS AND THE ADDRESS BUS

(b) PORTS A (PA0~PA7)

There are 8-bit output ports with a latch.

• PA7 (CS)

This is an ENABLE signal, which becomes LOW when COMMAND/DATA is given.

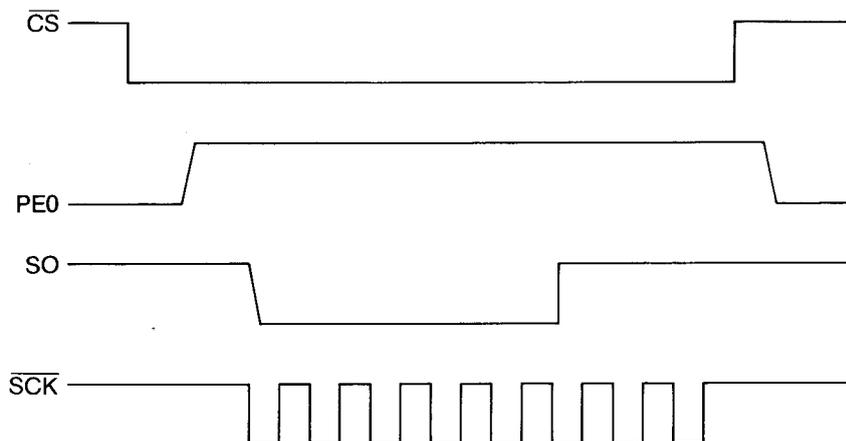


Fig. 5 - 5(a) TIMING CHART OF THE ADDRESS BUS AT COMMAND TRANSMITTING (CODE 0E, 0H BLINKING ON)

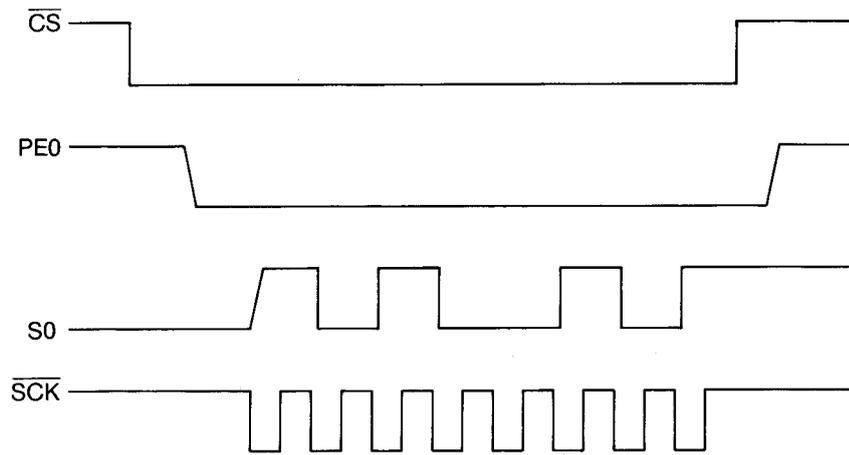


Fig. 5 - 5(b) TIMING CHART OF THE ADDRESS BUS AT DATA TRANSMITTING (DATA 0A, 5H)

- PA4 (TMUT)

When switching from receive to transmit, this terminal becomes HIGH for approximately 60 milliseconds.

When unlocking in the transmit mode, a HIGH level is attained.

- PA3 (RMUT)

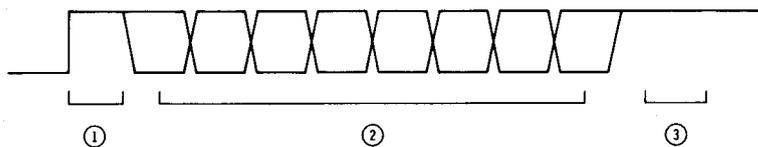
When the reception is muted, this port becomes HIGH.

- PA2 (COPY)

This port outputs a switching signal for data cloning.

- PA1 (CPO)

This port outputs cloning data.



- ① START bit
- ② DATA bits
- ③ STOP bit

Fig. 5 - 6 CLONING DATA CONSTRUCTION

- PA0 (STRB)

This port outputs latch signals for PLL data.

(c) PORTS B (PB0~PB7)

These ports are 8 bit bi-directional ports that change in 1 bit steps.

- PB7 ($\overline{\text{MONI}}$)

This is the monitor switch input port.

- PB6 ($\overline{\text{T/R}}$)

This port emits the CTCSS transmit/receive switching signal. It becomes LOW during transmission and HIGH during reception. When the tone number is 0, these levels are reversed.

- PB0~PB5 (S0~S5)

These ports generate CTCSS data.

(d) PORTS C (PC0~PC5)

These are 6-bit input ports.

- PC5 ($\overline{\text{BUSY}}$)

This is an input port for BUSY signals from the LCD driver.

- PC4 ($\overline{\text{FUNC}}$)

This is the function switch input port. If this port's level is LOW when the power is ON, it serves as the receive input of cloning.

- PC3 ($\overline{\text{TRF}}$)

This is the input port for the transmit output indicator.

"TX" INDICATOR appears on the LCD when this port is HIGH.

- PC2 (SEND)

This is a T/R switching signal input port. When this port is in the HIGH position the MPU is in transmit mode. The port is also used to input cloning signals.

- PC1 (SQL)

This is an input port for squelch signals. When the squelch is open, this port is in the HIGH level position.

- PC0 (UNLK)

This is an input port for unlocked signals. When the PLL is unlocked, this port is at a LOW level position.

(e) OTHER PORTS

• INT0

This is the detector signal input port of the CTCSS decoder.

When this port is HIGH, "CALL" appears on the LCD DISPLAY.

• INT1

This is the reset signal input port. When the power is turned OFF this port becomes HIGH, cancels the LCD, initializes each port and enters the standby mode.

• S0

This is the output port of the shift register inside the MPU, and outputs N-data and LCD COMMAND/DATA.

• \overline{SCK}

This port outputs timing signals of data for transfer to the S0 port. S0 is altered by the trailing edge of the \overline{SCK} signal.

• \overline{RD}

This port outputs timing signals when reading the external memory.

• \overline{WR}

This port outputs timing signals when writing in the external memory.

5 - 5 - 2 RAM

μ PD446C is a CMOS 2048-word 8-bit RAM.

This RAM memorizes the channel, priority channel, transmit/receive N-data, tone number, shift frequency, tone data table, etc., in current use.

Reading and writing data are performed by the timing signal of \overline{RD} or \overline{WR} according to the address specified by PE0~PE10 of MPU.

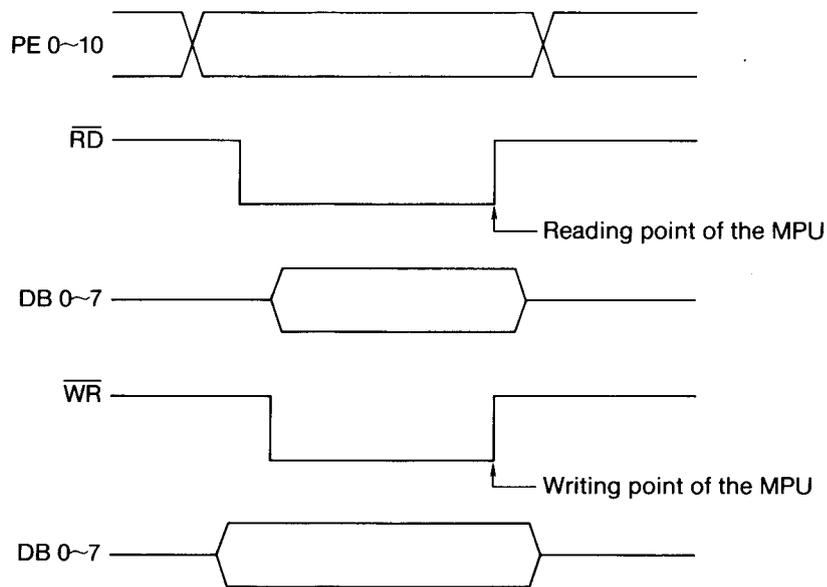


Fig. 5 - 7 TIMING CHART OF THE MEMORY READ AND WRITE

5 - 5 - 3 RESET CIRCUIT

If the voltage of the +5V line rises when the power is ON, Q1 is switched ON and the collector becomes HIGH. When the collector is HIGH IC4(E) output becomes LOW. The IC4(D) output level then turns from LOW to HIGH and resets the MPU and LCD driver. When the power is OFF, Q1 is OFF and the IC4(E) output becomes HIGH and makes the MPU stand by.

5 - 6 CTCSS CIRCUITS

IC1 is a programmable CTCSS encoder/decoder. By using a crystal for the reference oscillator, high frequency stability is attained and 37 kinds of tones are generated.

To determine the tone frequency, the code corresponding to the tone number is given to S0~S5 and sent out by the MPU.

The T/R terminal transmits at LOW and receives at HIGH via the transmit/receive switching of IC1.

When the unit is transmitting, if the tone number is 0, the level becomes HIGH and no tone is output; if the tone number is any other number, the level becomes LOW.

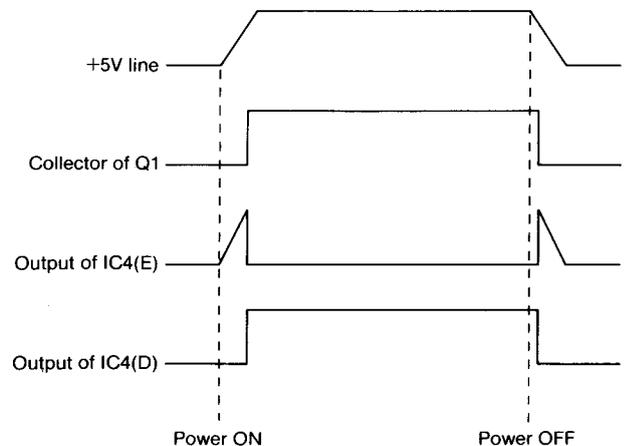
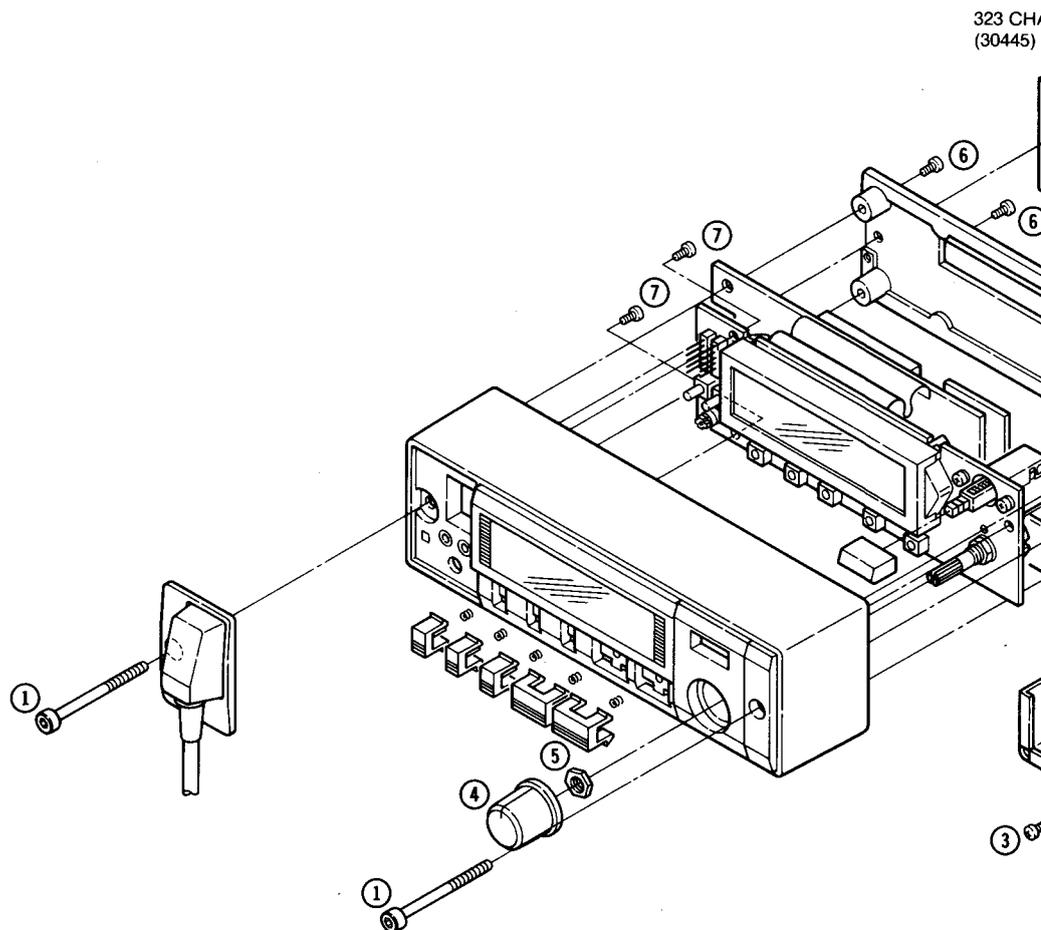


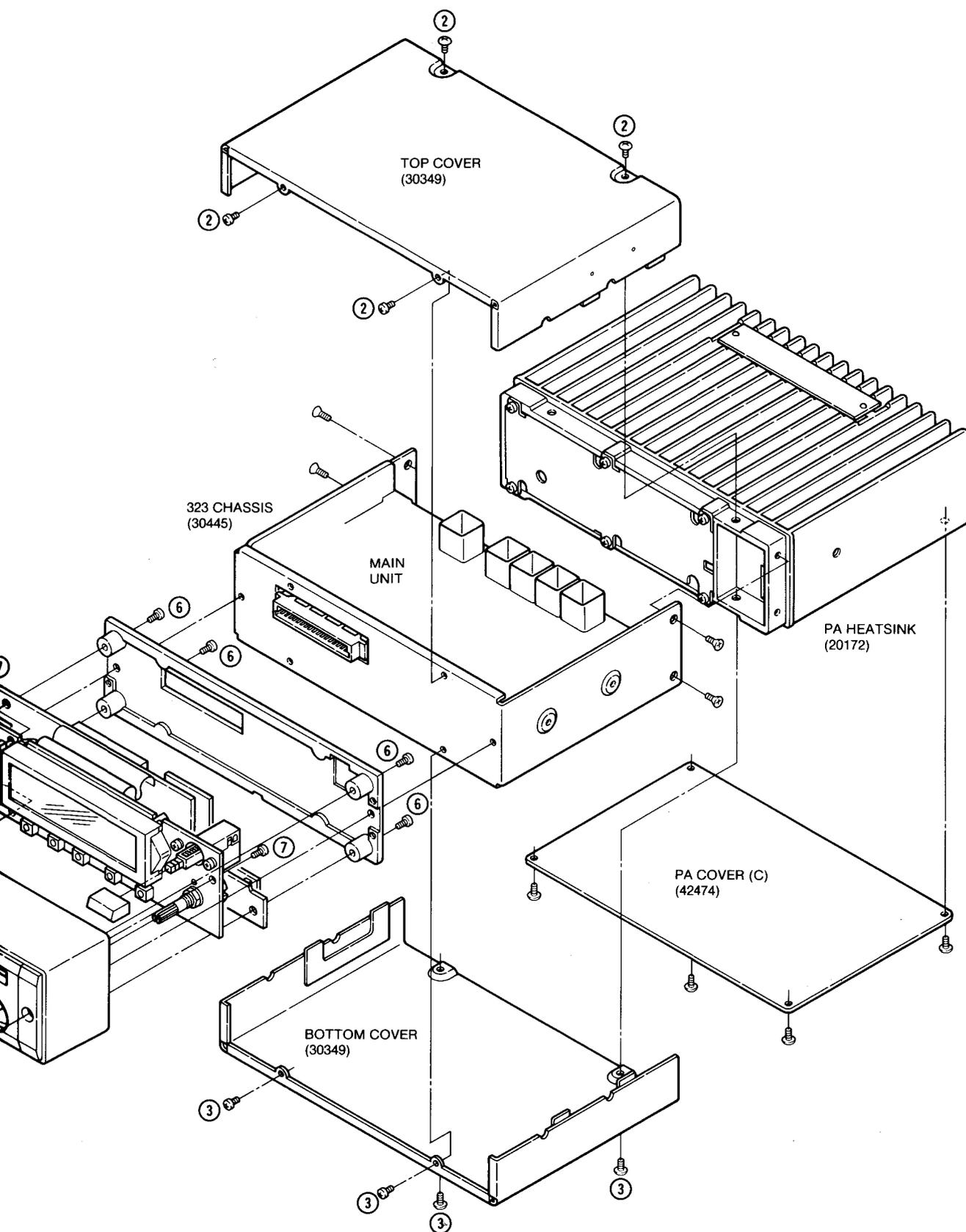
Fig. 5 - 8 RESET TIMING CHART

SECTION 6 MECHANICAL PARTS AND DISASSEMBLY

6 - 1 CHASSIS DISASSEMBLY

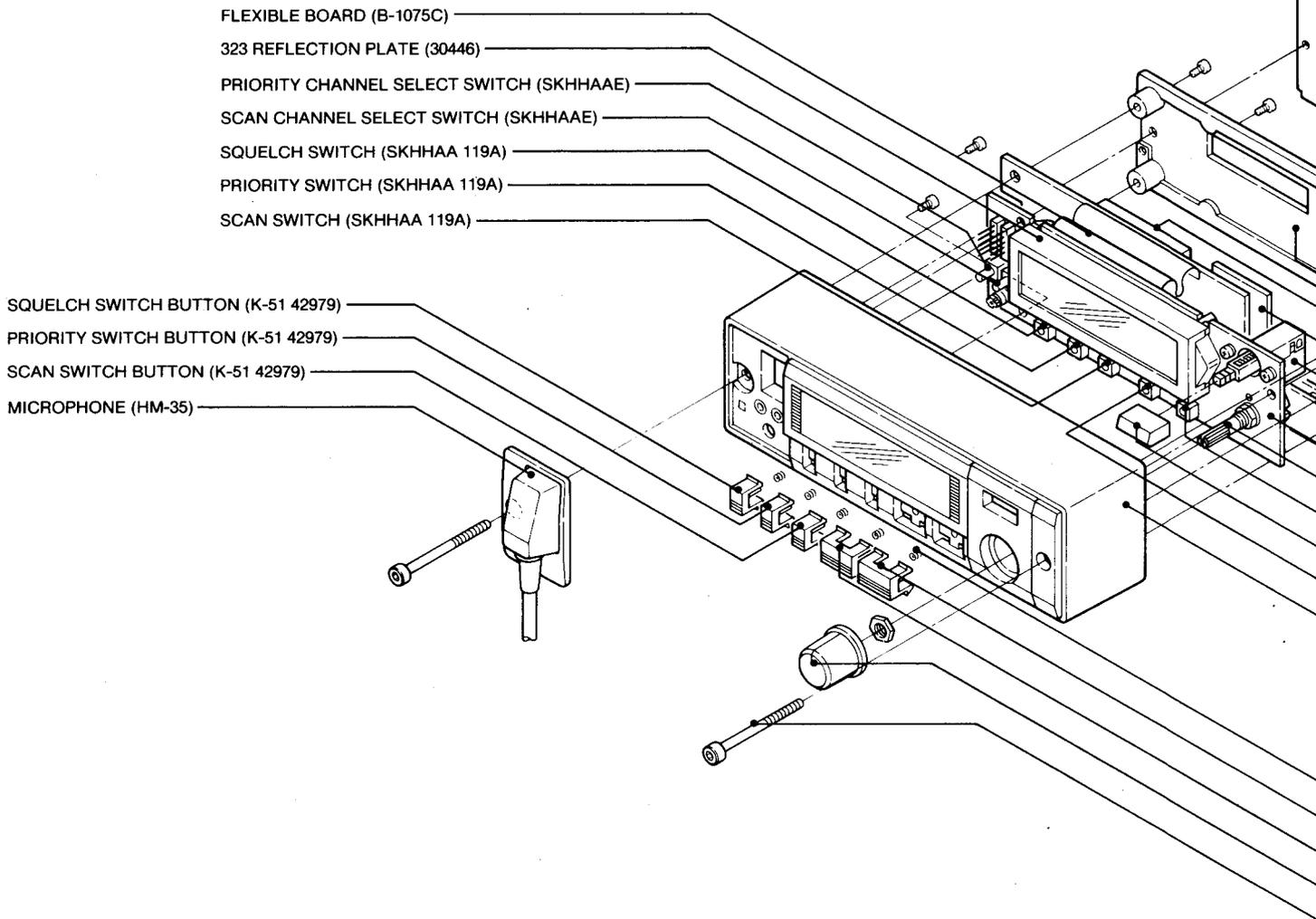
1. Unscrew and remove the 2 hex socket screws ① from the front panel using the supplied accessory hex wrench. Remove the CONTROL HEAD.
2. Unscrew and remove the 4 screws ② from the top cover and the 4 screws ③ from the bottom cover. Remove the top and bottom cover.
3. Remove the volume control knob ④ and the hex nut ⑤.
4. Unscrew and remove the 4 screws ⑥ from the front cover and the 3 screws ⑦ from the DISPLAY UNIT. Remove the front panel.

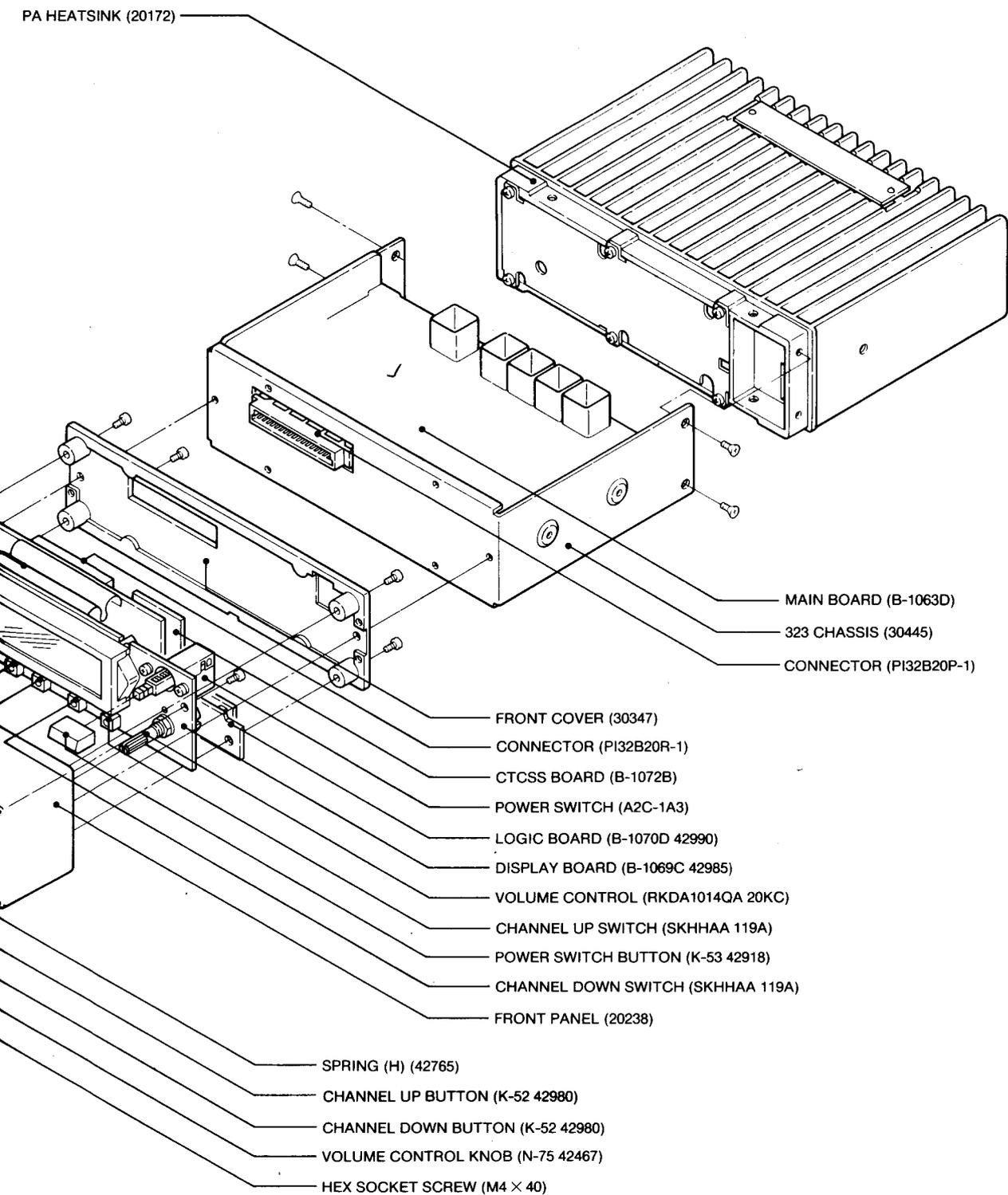




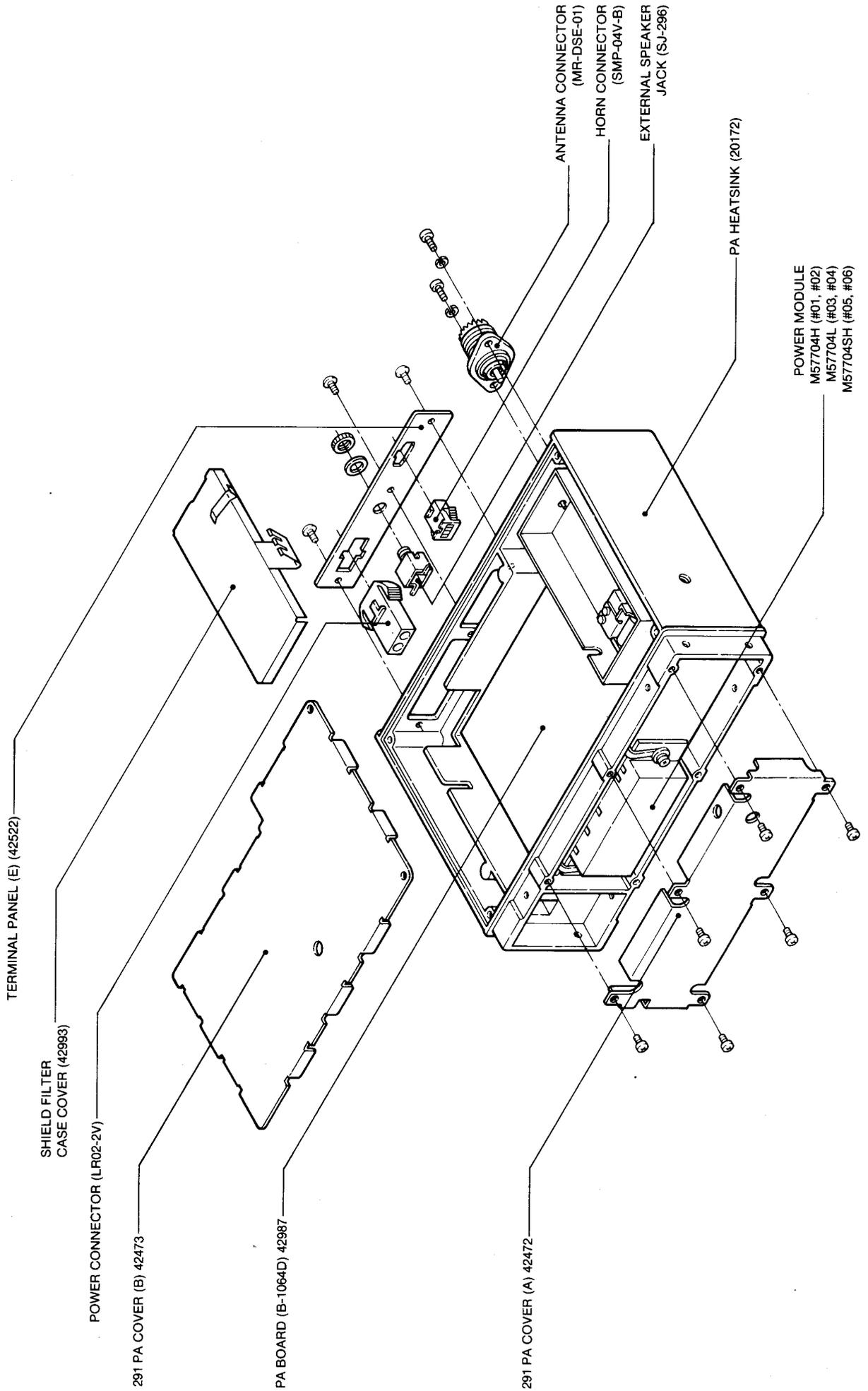
6 - 2 CONTROL HEAD DISASSEMBLY

PA HEATSINK (20172)

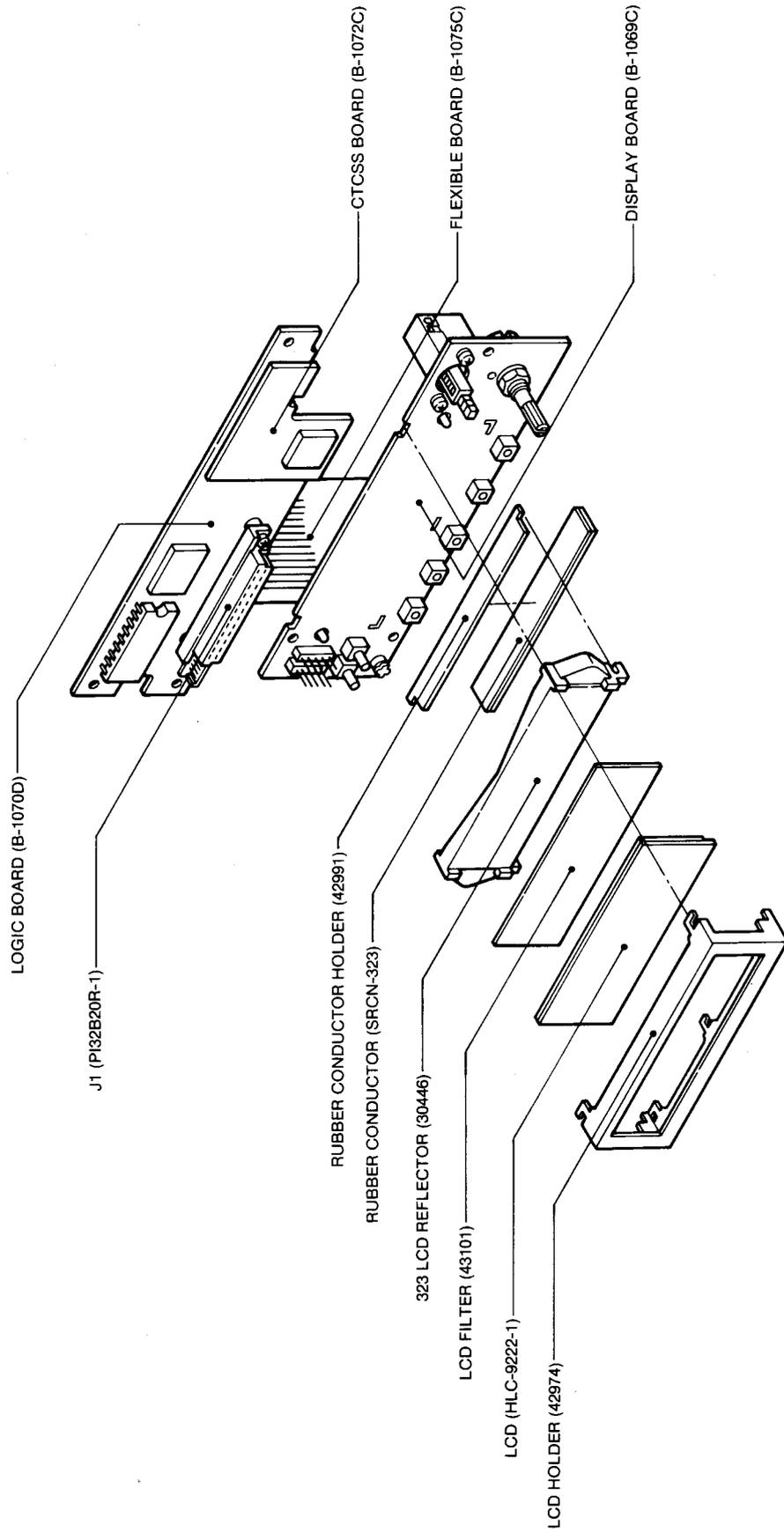




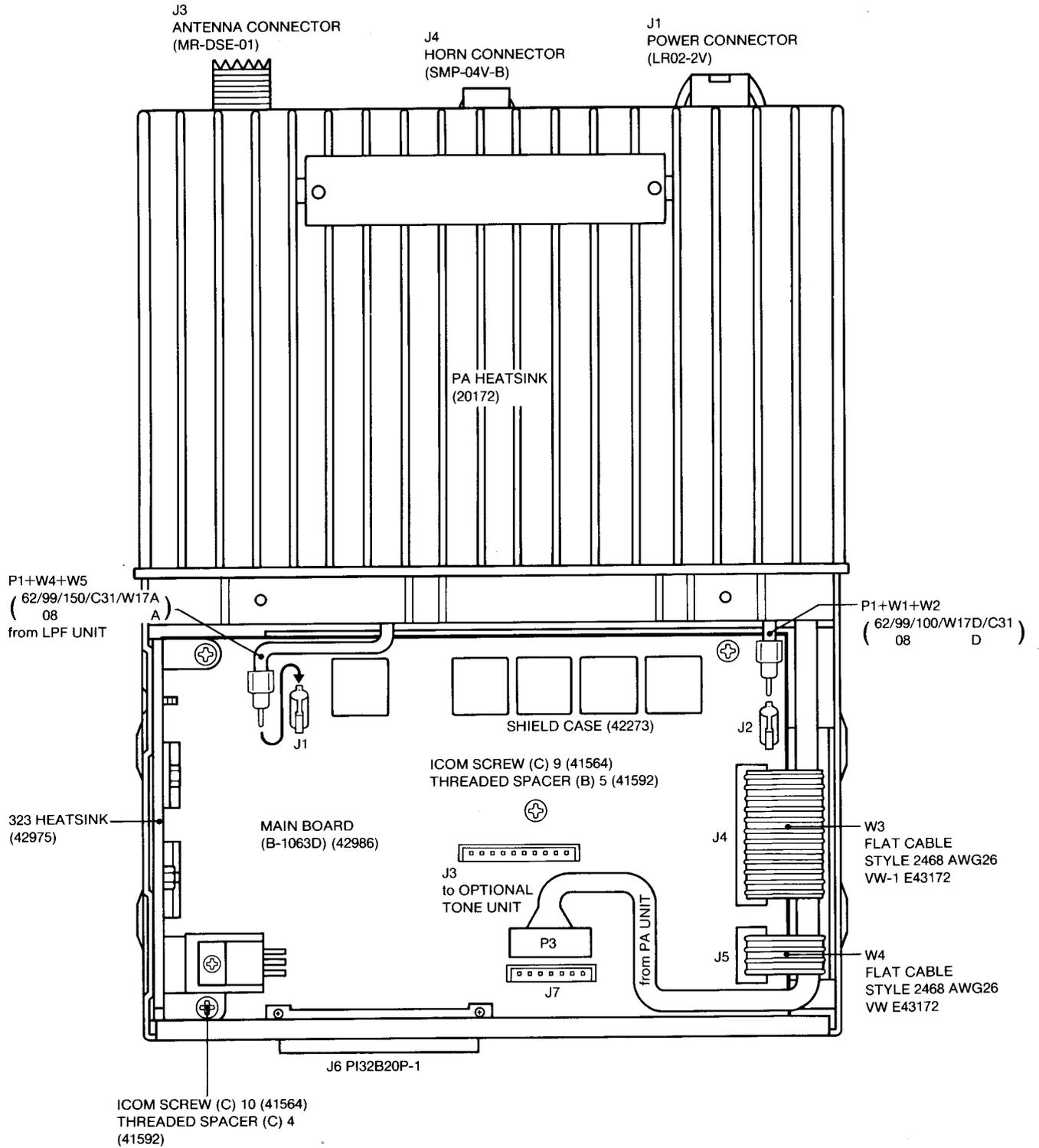
6 - 3 PA UNIT DISASSEMBLY



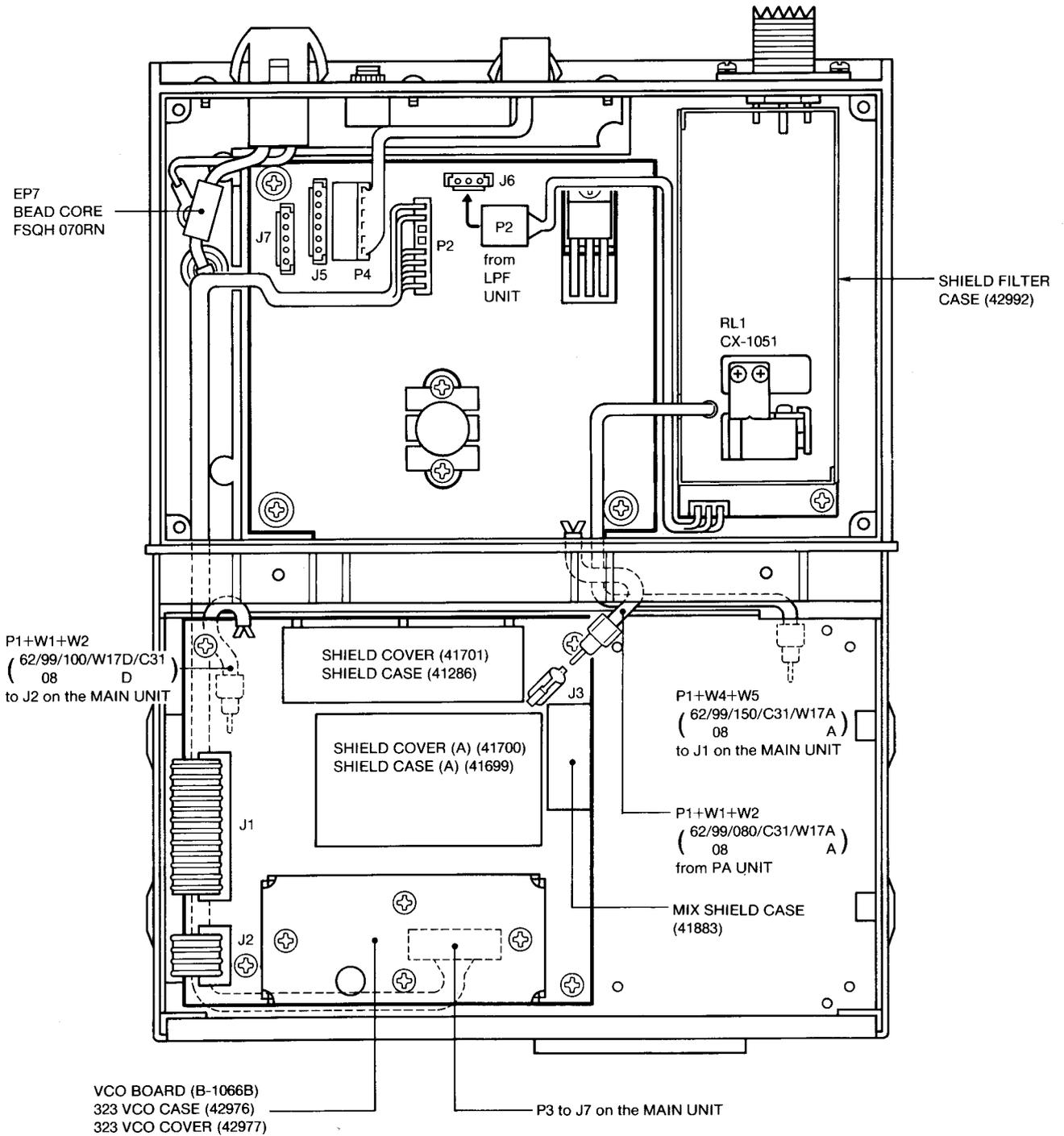
6 - 4 LCD DISASSEMBLY



6 - 5 MAIN UNIT CONNECTOR ASSEMBLY



6 - 6 PLL AND PA UNITS CONNECTOR ASSEMBLY



SECTION 7 MAINTENANCE AND ADJUSTMENT

7 - 1 PREPARATION BEFORE SERVICING

1. Detach the power cable and turn OFF the POWER SWITCH before performing any work on the transceiver.
2. **DO NOT** short circuit components while making adjustments.
3. Use an insulated tuning tool for all adjustments.
4. **DO NOT** force any of the variable components. Tune them slowly and smoothly.
5. Follow the instructions exactly. If an indicated result is not obtained, repeat the instruction until the correct result is obtained.
6. Check the condition of connectors, solder joints and screws when adjustments are complete. Confirm that components do not touch each other.
7. There are different versions of this transceiver. Adjustment procedures and results may differ for each version. Be certain to follow the correct procedure for the transceiver you adjust.
8. Confirm defective operation of the transceiver first when checking an out-of-service unit. Verify that external sources do not cause the problem.
9. Use the correct tools and test equipment.
10. To remove the transceiver covers, refer to SECTION 6-1.
11. Connect a 13.8V DC external power source to the POWER CONNECTOR. Make sure to check the voltage polarity.
12. For transmission problems, connect a 50 Ω dummy load to the ANTENNA CONNECTOR. For reception problems, attach an antenna or signal generator to the ANTENNA CONNECTOR. **DO NOT transmit** into the signal generator.
13. Re-check for the suspected malfunction with the POWER SWITCH ON.
14. Check the defective circuit. Measure the DC voltages of the collector, base and emitter of each transistor.

7 - 2 OPERATING FREQUENCY AND TONE NUMBER SET

■ EXTERNAL KEYBOARD CONNECTION

When the transceiver is placed in programming mode while changing the operating frequency, tone number, etc., connect an EX-494 EXTERNAL KEYBOARD.

- (1) Remove the 2 hex socket screws from the front panel. Remove the CONTROL HEAD.
- (2) Remove the 4 screws from the back of the CONTROL HEAD. Remove the front cover. (Fig 1.)
- (3) Plug the connector from an EX-494 EXTERNAL KEYBOARD into J4. (Fig 2.)
- (4) Re-attach the CONTROL HEAD to the main body.

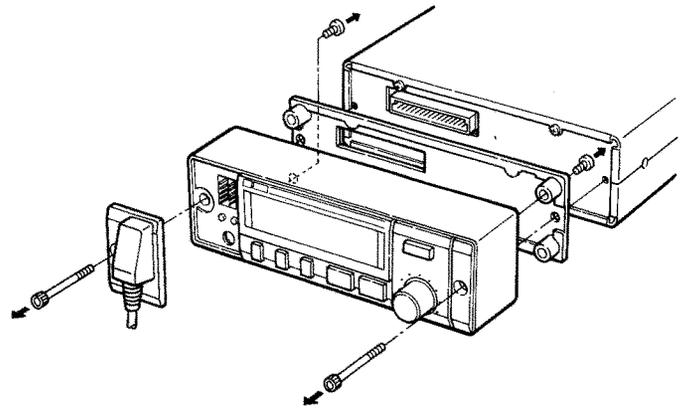
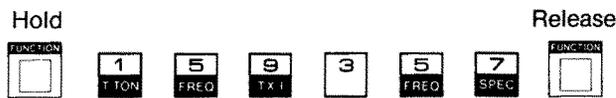


Fig. 1

■ PROGRAMMING

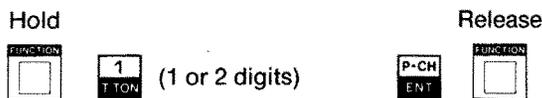
- (1) Programming mode



- (2) Operating frequency



- (3) Transmit CTCSS tone number



NOTE: Please consult PROGRAMMING MANUAL for more detailed programming information.

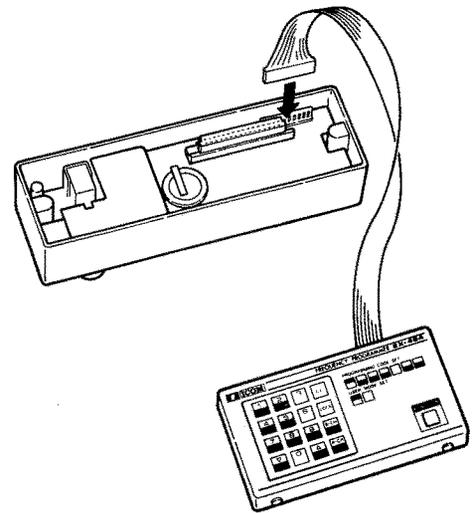


Fig. 2

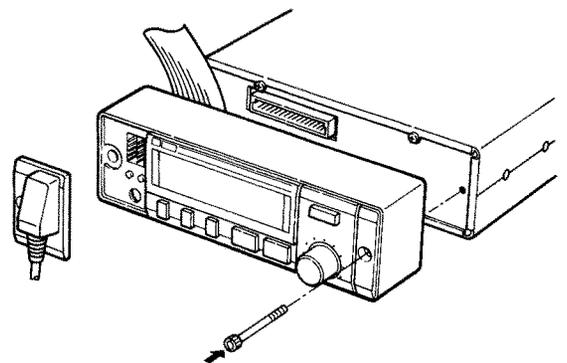


Fig. 3

7 - 3 PLL ADJUSTMENT

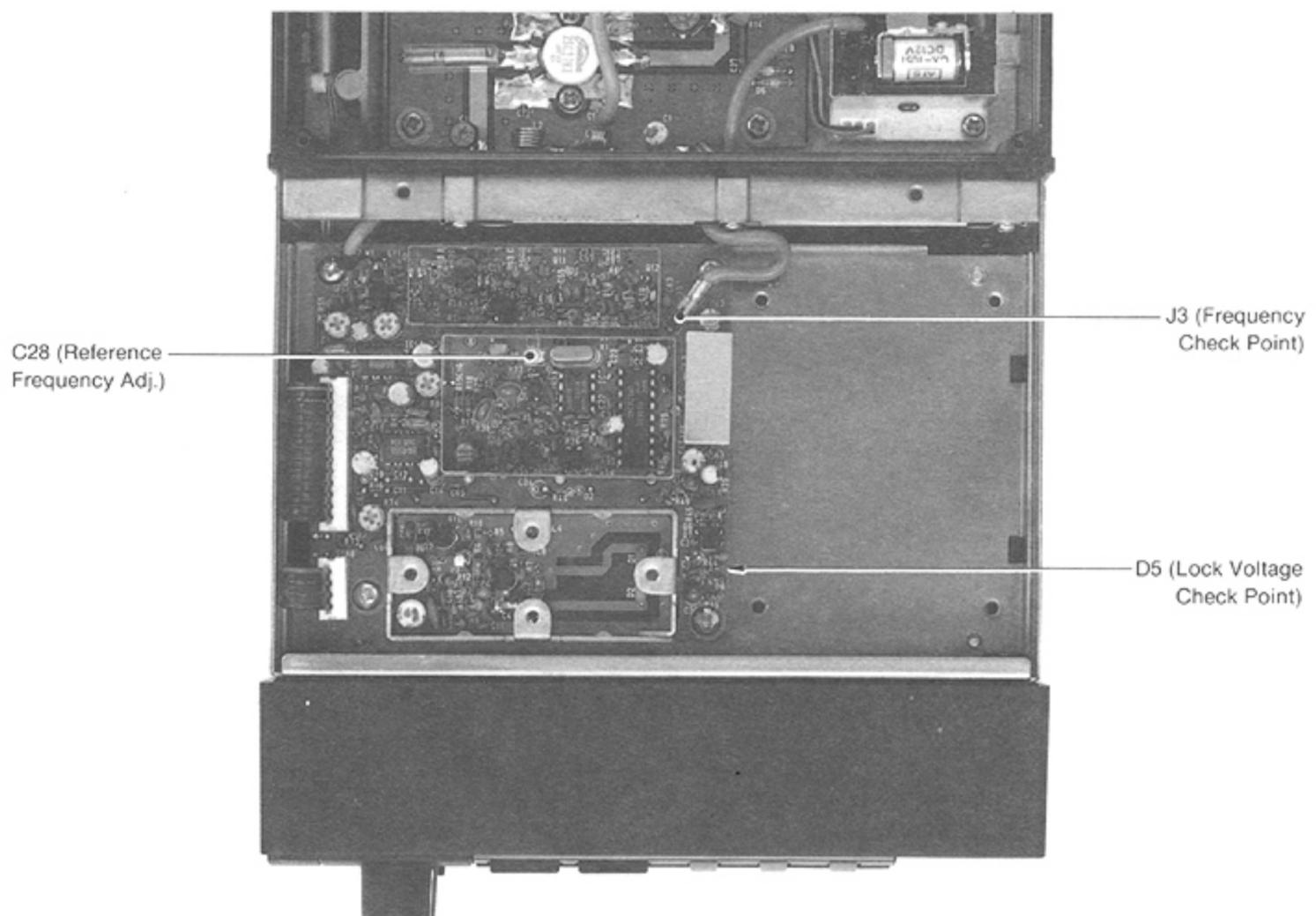
INSTRUMENTS REQUIRED	CONNECTIONS
(1) VOLTAGE REGULATED POWER SUPPLY <ul style="list-style-type: none"> • Output voltage : 13.8V DC \pm15% • Current capacity : 20A 	
(2) VOLTMETER <ul style="list-style-type: none"> • Input impedance : 50kΩ/V DC or better 	
(3) FREQUENCY COUNTER <ul style="list-style-type: none"> • Frequency minimum : At least 520MHz • Accuracy : Better than \pm1ppm • Sensitivity : 100mV or better 	

#01, #02, #03, #04 VERSIONS

ADJUSTMENT	ADJUSTMENT CONDITIONS	MEASUREMENT		VALUE	ADJUSTMENT POINT	
		UNIT	LOCATION		UNIT	ADJUST
LOCK VOLTAGE	1 <ul style="list-style-type: none"> • Operating frequency: 450.00MHz (#01, #02) 400.00MHz (#03, #04) • Receive mode 	PLL	Connect a voltmeter to the cathode of D5.	$5.5 \pm 1V1.5$ (#01, #02) More than 1V (#03, #04)		Verify
REFERENCE FREQUENCY	1 <ul style="list-style-type: none"> • Operating frequency: 450.00MHz (#01, #02) 400.00MHz (#03, #04) • Transmit mode 	PLL	Connect a frequency counter to J3.	450.000MHz (#01, #02) 400.000MHz (#03, #04)	PLL	C28

#05, #06 VERSIONS

ADJUSTMENT	ADJUSTMENT CONDITIONS	MEASUREMENT		VALUE	ADJUSTMENT POINT	
		UNIT	LOCATION		UNIT	ADJUST
LOCK VOLTAGE	1 <ul style="list-style-type: none"> • Operating frequency: 512.00MHz • Transmit mode 	PLL	Connect a voltmeter to the cathode of D5.	$11.0 \pm 1V$		Verify
REFERENCE FREQUENCY	1 <ul style="list-style-type: none"> • Operating frequency: 512.00MHz • Transmit mode 	PLL	Connect a frequency counter to J3.	512.0000MHz	PLL	C28

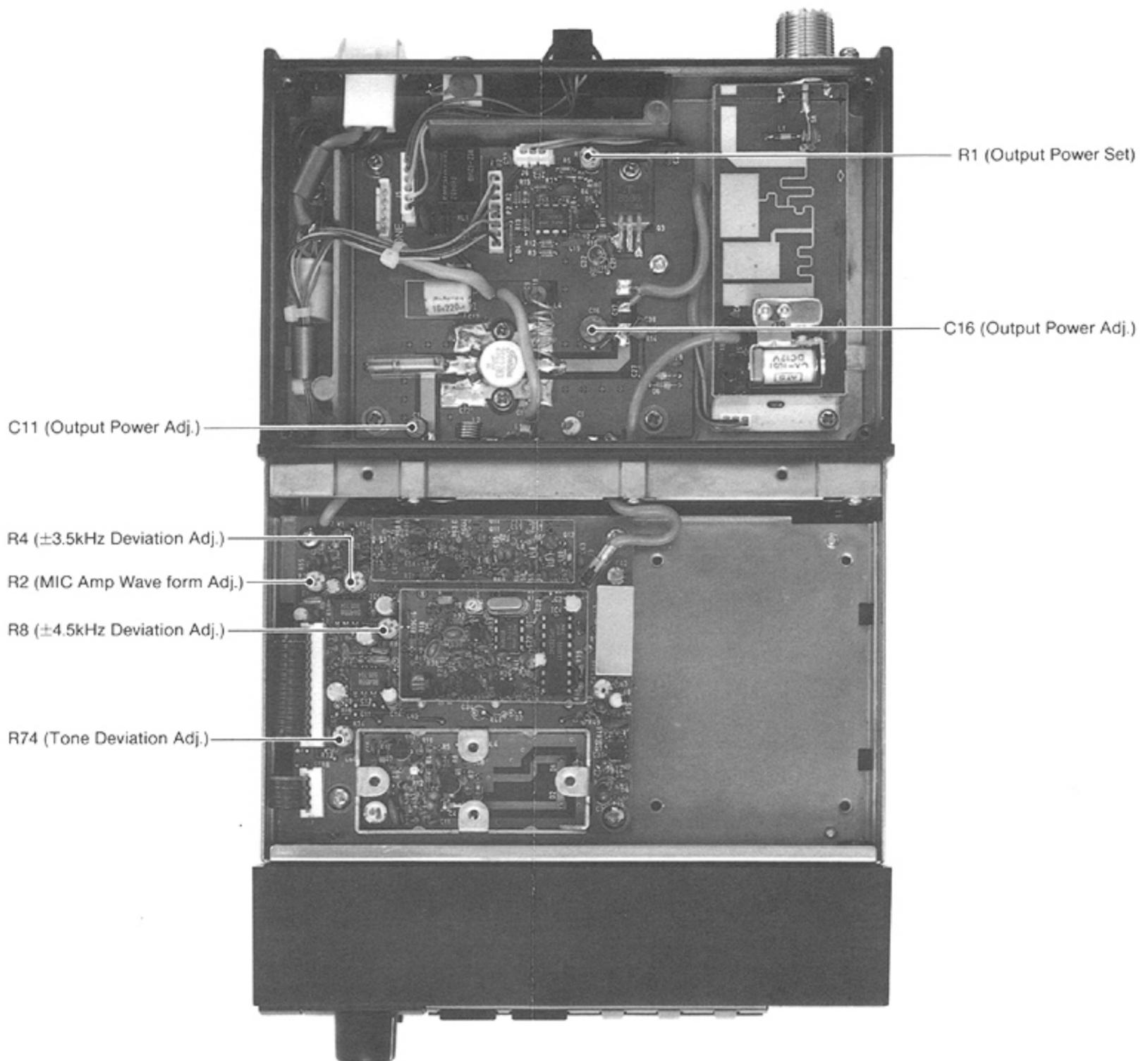


7 - 4 TRANSMITTER ADJUSTMENT

INSTRUMENTS REQUIRED	CONNECTIONS
<p>(1) VOLTAGE REGULATED POWER SUPPLY</p> <ul style="list-style-type: none"> • Output voltage : 13.8V DC \pm15% • Current capacity : 20A <p>(2) RF POWER METER (TERMINATED TYPE)</p> <ul style="list-style-type: none"> • Measuring minimum : At least 50W • Frequency minimum : At least 520MHz • Impedance : 50Ω • SWR : Less than 1:1.2 <p>(3) AUDIO GENERATOR</p> <ul style="list-style-type: none"> • Output frequency : At least 3000Hz • Output level : 0 ~ 200mV <p>(4) AC MILLIVOLTMETER</p> <ul style="list-style-type: none"> • Measuring range : 10mV ~ 3V <p>(5) FM DEVIATION METER</p> <ul style="list-style-type: none"> • Frequency minimum : At least 520MHz • Measuring range : 0 ~ \pm10kHz <p>(6) DIRECTIONAL COUPLER</p> <ul style="list-style-type: none"> • Frequency minimum : At least 520MHz <p>(7) OSCILLOSCOPE</p> <ul style="list-style-type: none"> • Frequency range : DC ~ 5MHz • Measuring range : 0.01 ~ 10V 	<p style="text-align: center;">AF FILTER LPF 50Hz HPL 20kHz DEVIATION 10kHz DEEMPHASIS OFF DEV SENS P-P/2</p>

ADJUSTMENT	ADJUSTMENT CONDITIONS	MEASUREMENT			ADJUSTMENT POINT	
		UNIT	LOCATION	VALUE	UNIT	ADJUST
OUTPUT POWER	<ul style="list-style-type: none"> • Operating frequency: 480.00MHz (#01, #02) 430.00MHz (#03, #04) 510.00MHz (#05, #06) • Turn R1 max. CW • Transmit mode 	Rear panel	Connect an RF power meter to ANTENNA CONNECTOR.	Maximum value (more than 38W)	PA	C11, C16
				35W (less than 9.5A)	PA	R1
POWER BALANCE	<ul style="list-style-type: none"> • Operating frequency: 450.00MHz and 480.00MHz (#01, #02) 400.00MHz and 430.00MHz (#03, #04) 480.00MHz and 512.00MHz (#05, #06) • Transmit mode 	Rear panel	Connect an RF power meter to ANTENNA CONNECTOR.	33 ~ 37W		Verify
DEVIATION	<ul style="list-style-type: none"> • Operating frequency: 480.00MHz (#01, #02) 430.00MHz (#03, #04) 510.00MHz (#05, #06) • Apply AF signal 1kHz/5mV to MIC CONNECTOR. • Transmit mode 	Rear panel	Connect an oscilloscope to output terminal of the deviation meter.	Make the symmetrical wave form.	PLL	R2
				Connect deviation meter to ANTENNA CONNECTOR through the attenuator.	\pm 4.5kHz	PLL
	<ul style="list-style-type: none"> • Apply AF signal 1kHz/50mV (20dB up) to MIC CONNECTOR. • Transmit mode 		\pm 3.5kHz		R4	
	<ul style="list-style-type: none"> • Apply AF signal 1kHz/5mV (20dB down) to MIC CONNECTOR. • Transmit mode 		Record the reading.			
	<ul style="list-style-type: none"> • Apply AF signal 1kHz/5mV to MIC CONNECTOR. • Transmit mode 		Record the reading.			
	<ul style="list-style-type: none"> • Apply no signal to MIC CONNECTOR. 					
<p>NOTE: Verify that the recorded ratio (see STEP 4 and STEP 5) must be greater than 40dB.</p>						

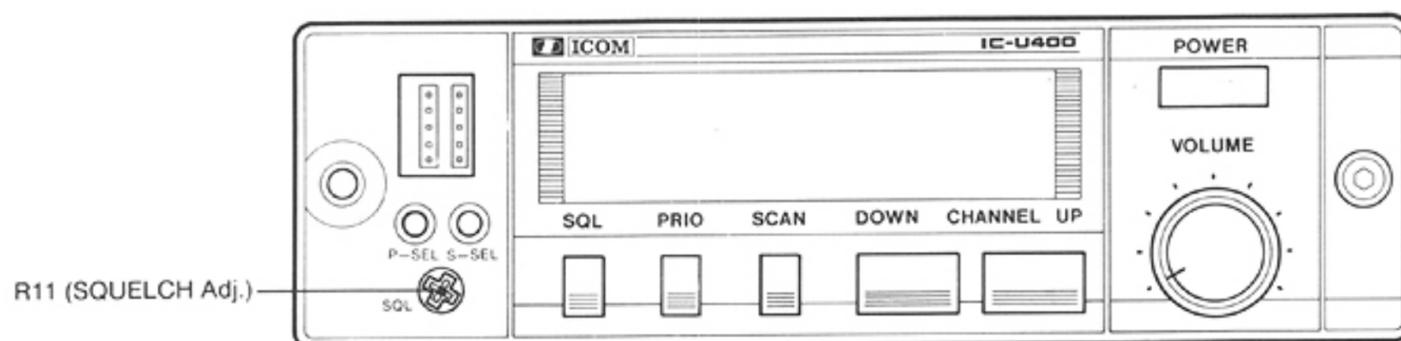
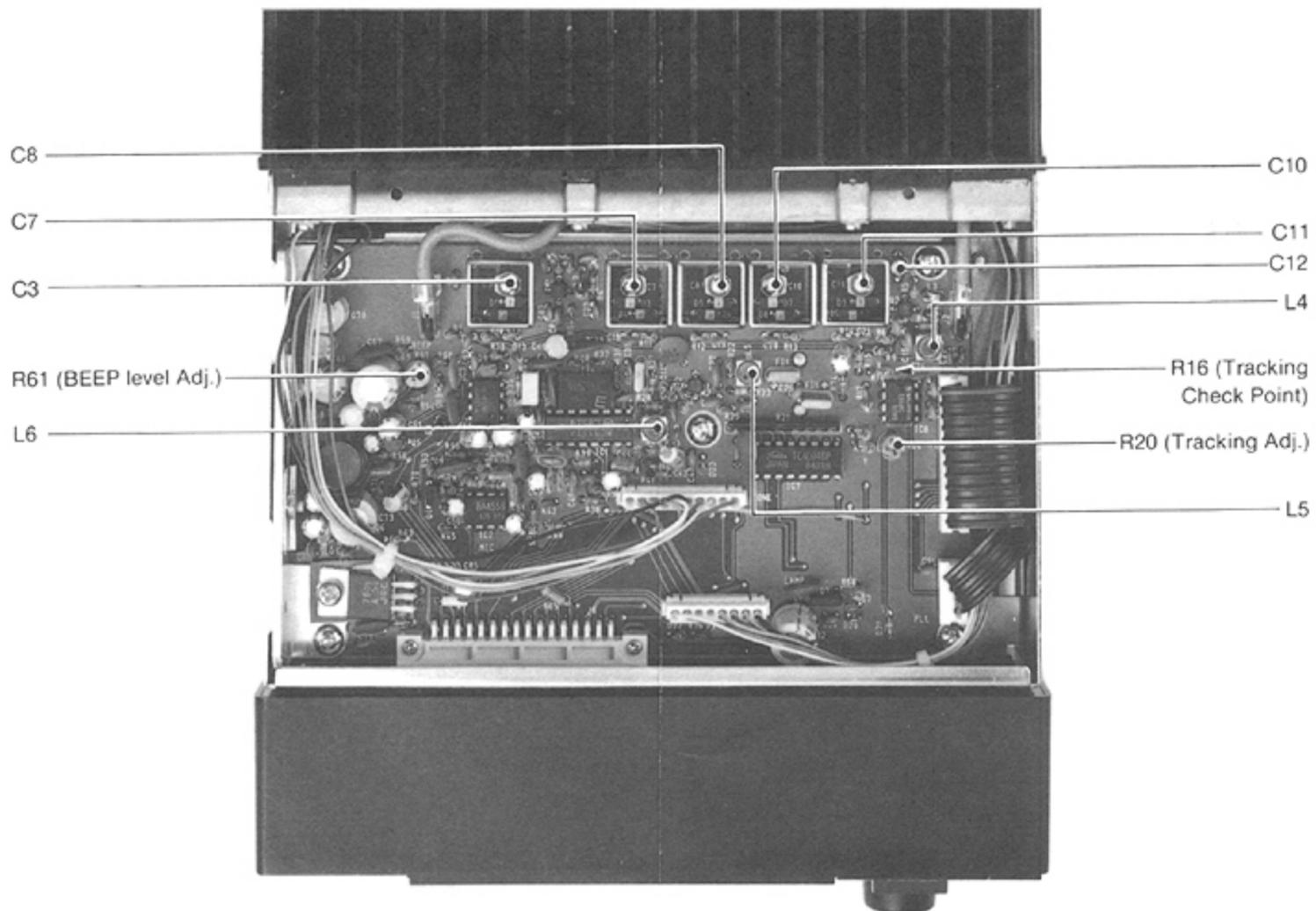
ADJUSTMENT	ADJUSTMENT CONDITIONS	MEASUREMENT		VALUE	ADJUSTMENT POINT	
		UNIT	LOCATION		UNIT	ADJUST
TONE DEVIATION	1 <ul style="list-style-type: none"> • Operating frequency: 480.00MHz (#01, #02) 430.00MHz (#03, #04) 510.00MHz (#05, #06) • TONE No.: 01 • Apply no signal to MIC CONNECTOR. • Transmit mode 	Rear panel	Connect a deviation meter to ANTENNA CONNECTOR through the directional coupler.	$\pm 0.5\text{kHz}$	PLL	R74



7 - 5 RECEIVER ADJUSTMENT

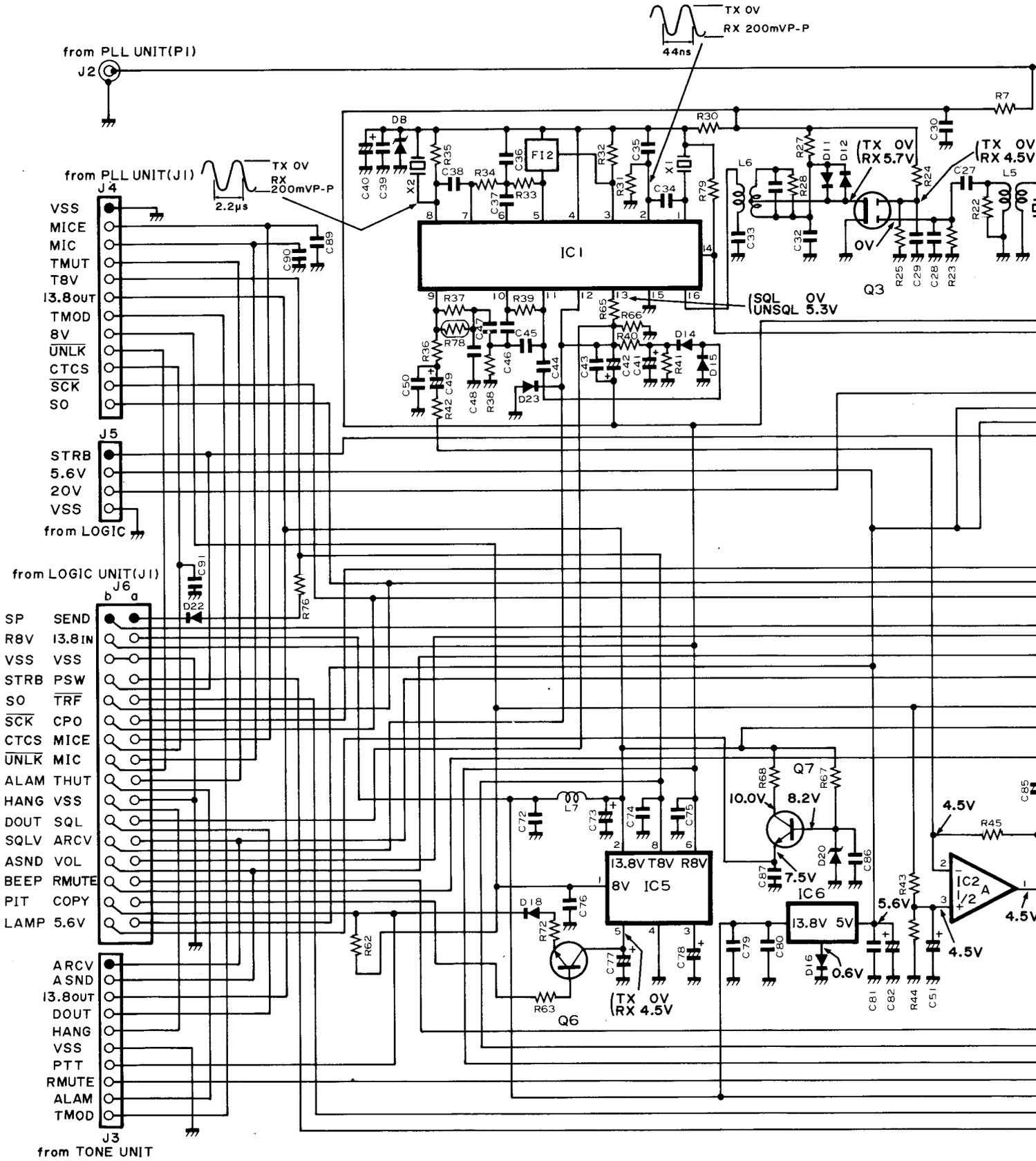
INSTRUMENTS REQUIRED	CONNECTIONS
(1) VOLTAGE REGULATED POWER SUPPLY • Output voltage : 13.8V DC \pm 15% • Current capacity : 20A (2) OSCILLOSCOPE • Frequency range : DC ~ 5MHz • Measuring range : 0.01 ~ 10V (3) AC MILLIVOLTMETER • Measuring range : 10mV ~ 50V (4) SIGNAL GENERATOR • Frequency minimum : At least 520MHz • Output level : 0.1 μ V ~ 32mV (-127dBm ~ -17dBm) (5) DISTORTION METER • Frequency range : 1kHz \pm 10Hz • Measuring range : 1% ~ 100% (6) EXTERNAL SPEAKER • Impedance : 4 Ω (7) VOLTMETER • Input impedance : 50k Ω /V DC or better	<p style="text-align: center;">MIC CONNECTOR</p> <p style="text-align: center;">To emit the audio signal connect the jumper at left or connect the microphone.</p>

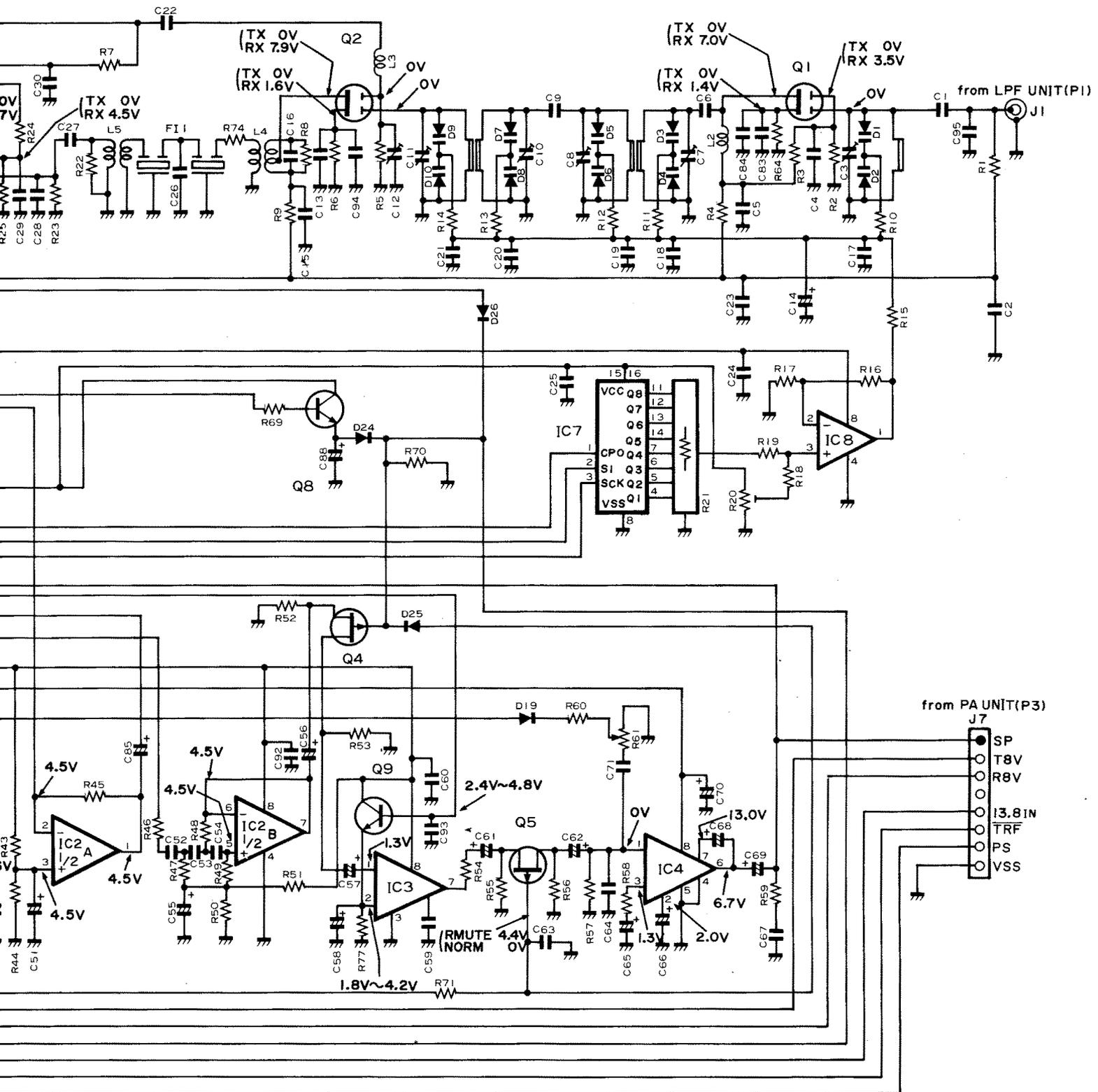
ADJUSTMENT	ADJUSTMENT CONDITIONS	MEASUREMENT			ADJUSTMENT POINT	
		UNIT	LOCATION	VALUE	UNIT	ADJUST
TRACKING	1	• Operating frequency: 450.00MHz (#01, #02) 400.00MHz (#03, #04) 480.00MHz (#05, #06)	MAIN	Connect a voltmeter to R16.	6.5V (#01, #02, #03, #04) 9.4V (#05, #06)	MAIN R20
SENSITIVITY	1	• Operating frequency: 450.00MHz (#01, #02) 400.00MHz (#03, #04) 480.00MHz (#05, #06) • Squelch: OFF (open) • Apply RF signal to ANTENNA CONNECTOR. Level : 0.32 μ V (-117dBm) Dev. : \pm 3.5kHz Mod. : 1kHz	Rear panel	Connect a distortion meter to the EXTERNAL SPEAKER JACK with 4 Ω load.	Minimum distortion level (Less than 0.35 μ V for 12dB SINAD)	MAIN C3, C7 C8, C10, C11, C12 L4, L5 L6
	NOTE: Adjust coils as above 2 or 3 times.					
BEEP LEVEL	1	• AF VOLUME: minimum • Push and hold the CHANNEL UP/DOWN switch.	Rear panel	Connect an oscilloscope to the EXTERNAL SPEAKER JACK with 4 Ω load.	1Vp-p	MAIN R61
SQUELCH	1	• Operating frequency: 450.00MHz (#01, #02) 400.00MHz (#03, #04) 480.00MHz (#05, #06) • Apply RF signal to ANTENNA CONNECTOR. Level : 0.28 μ V (-118dBm) Dev. : \pm 3.5kHz Mod. : 1kHz • Squelch: ON (closed)	Rear panel	Connect a speaker to the EXTERNAL SPEAKER JACK.	Verify squelch is closed when turning R11 CW on the DISPLAY UNIT.	
	2				Starting point of reception	DISPLAY R11
	3	• Apply no signal to ANTENNA CONNECTOR.			Squelch is closed.	
AF OUTPUT	1	• Apply RF signal to ANTENNA CONNECTOR. Level : 32 μ V (-77dBm) Dev. : \pm 3.5kHz Mod. : 1kHz	Rear panel	Connect an AC millivoltmeter to the EXTERNAL SPEAKER JACK with 4 Ω load.	Greater than 4.5V at 10% distortion	Verify

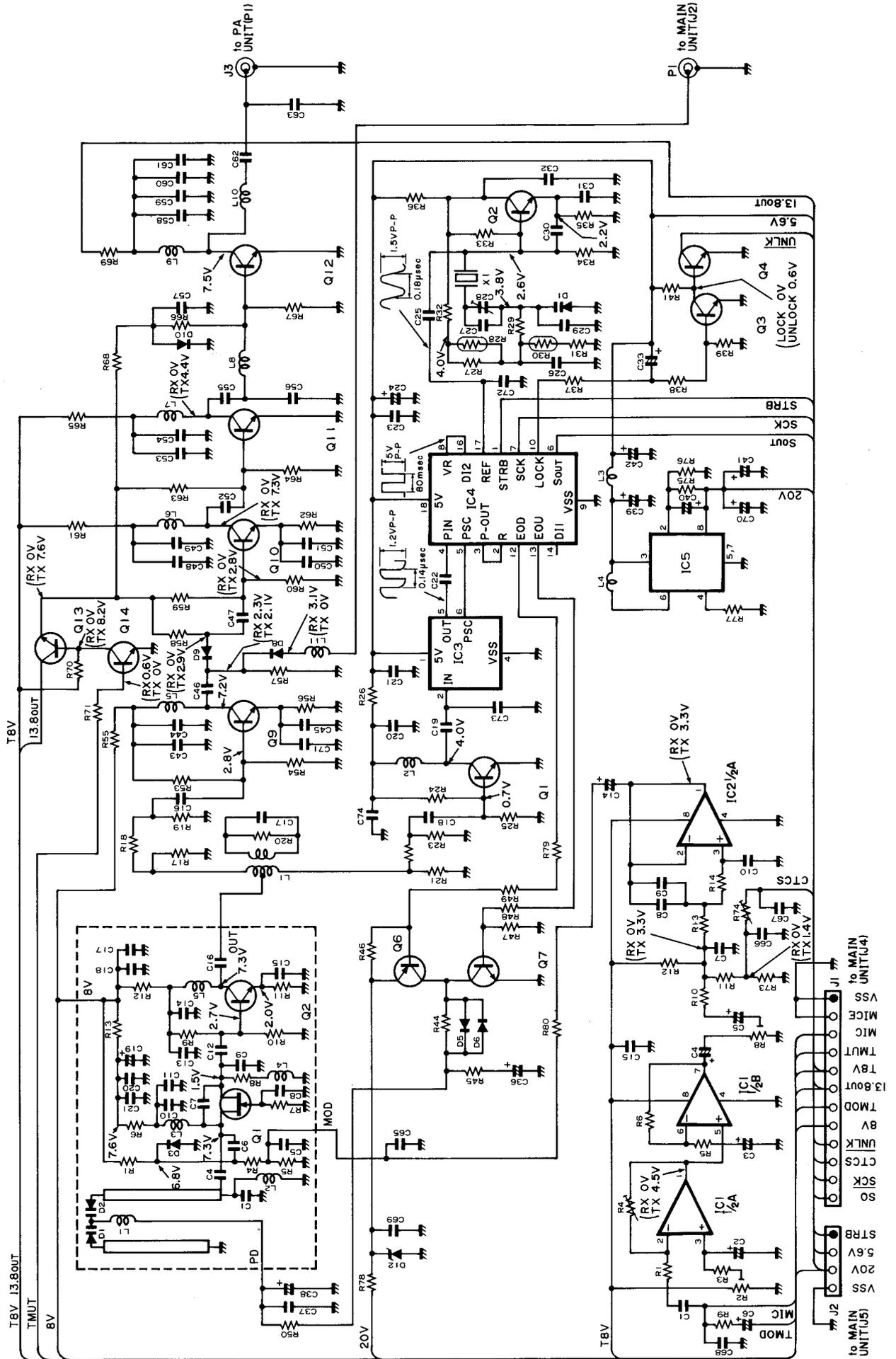


SECTION 8 VOLTAGE DIAGRAMS

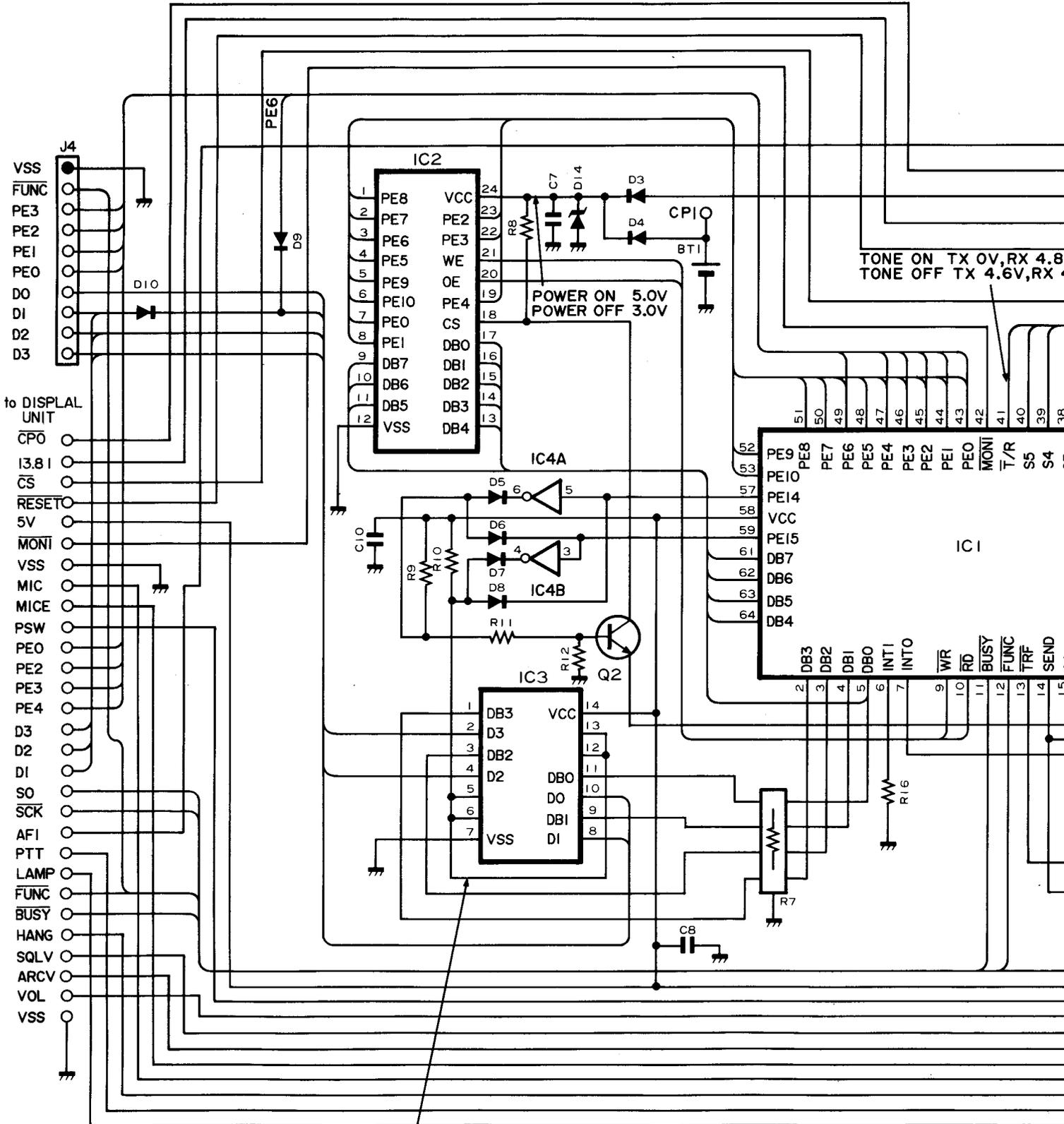
8-1 MAIN UNIT







8 - 3 LOGIC UNIT



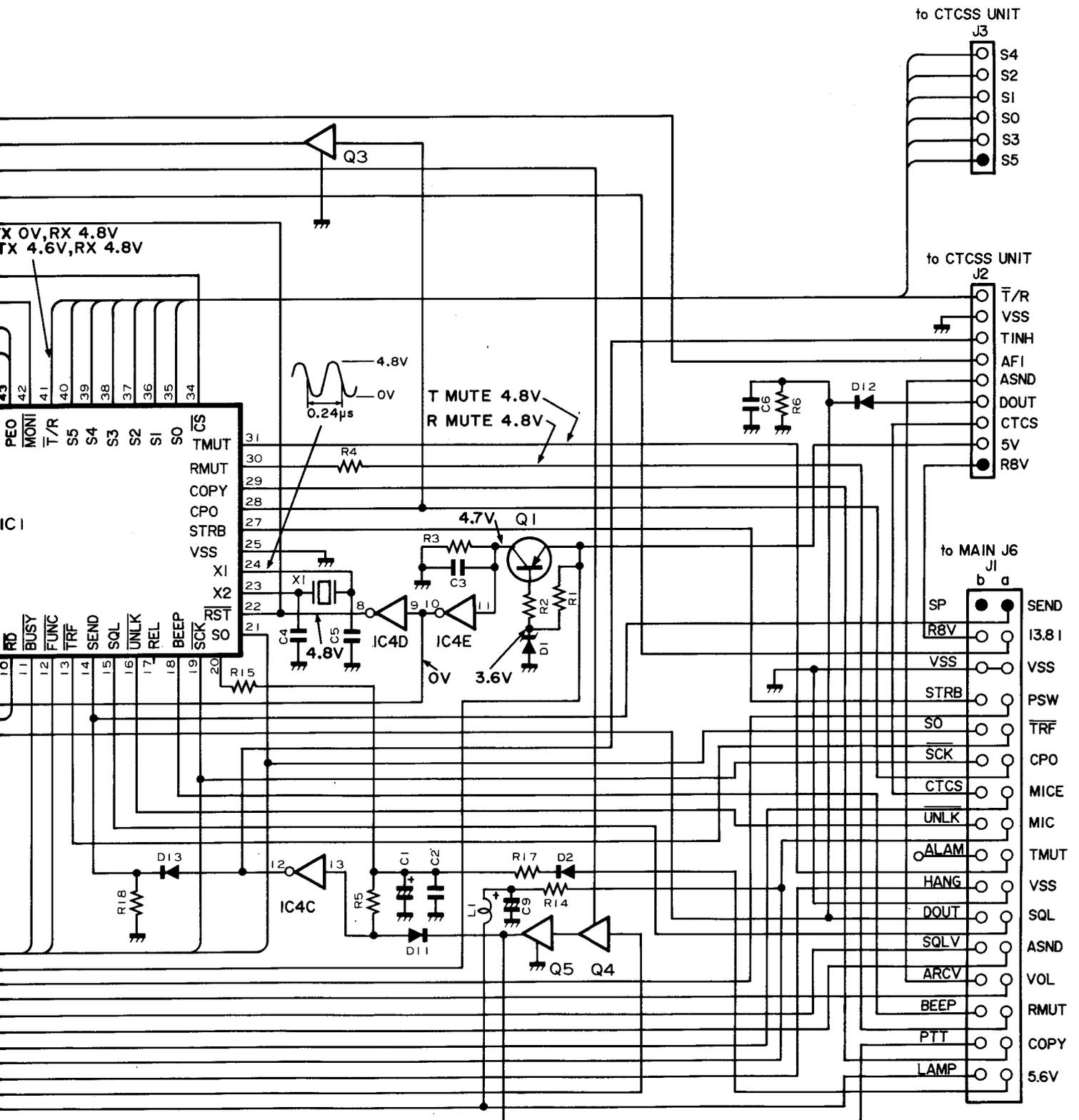
- VSS
- FUNC
- PE3
- PE2
- PE1
- PE0
- DO
- DI
- D2
- D3

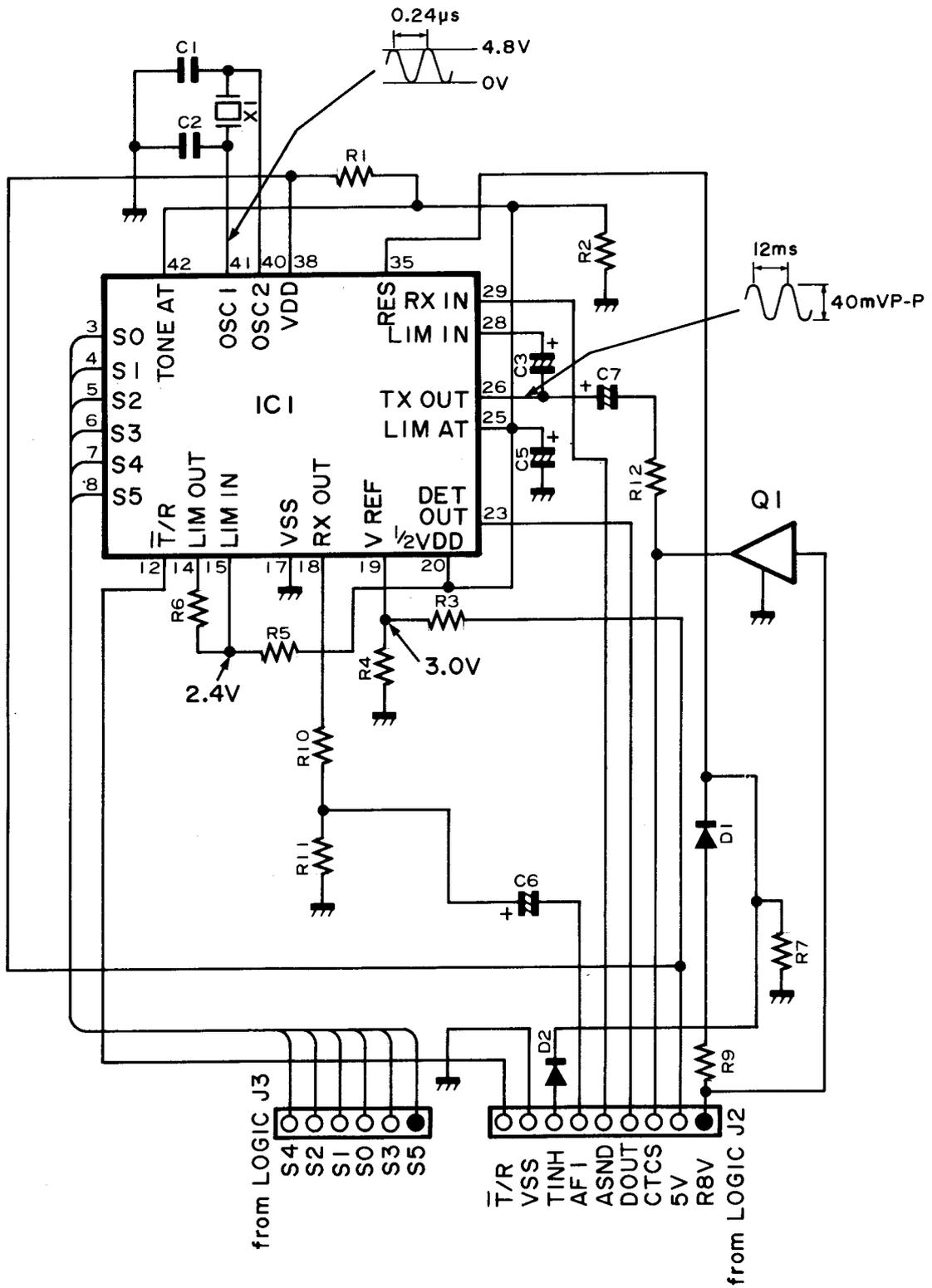
to DISPLAL UNIT

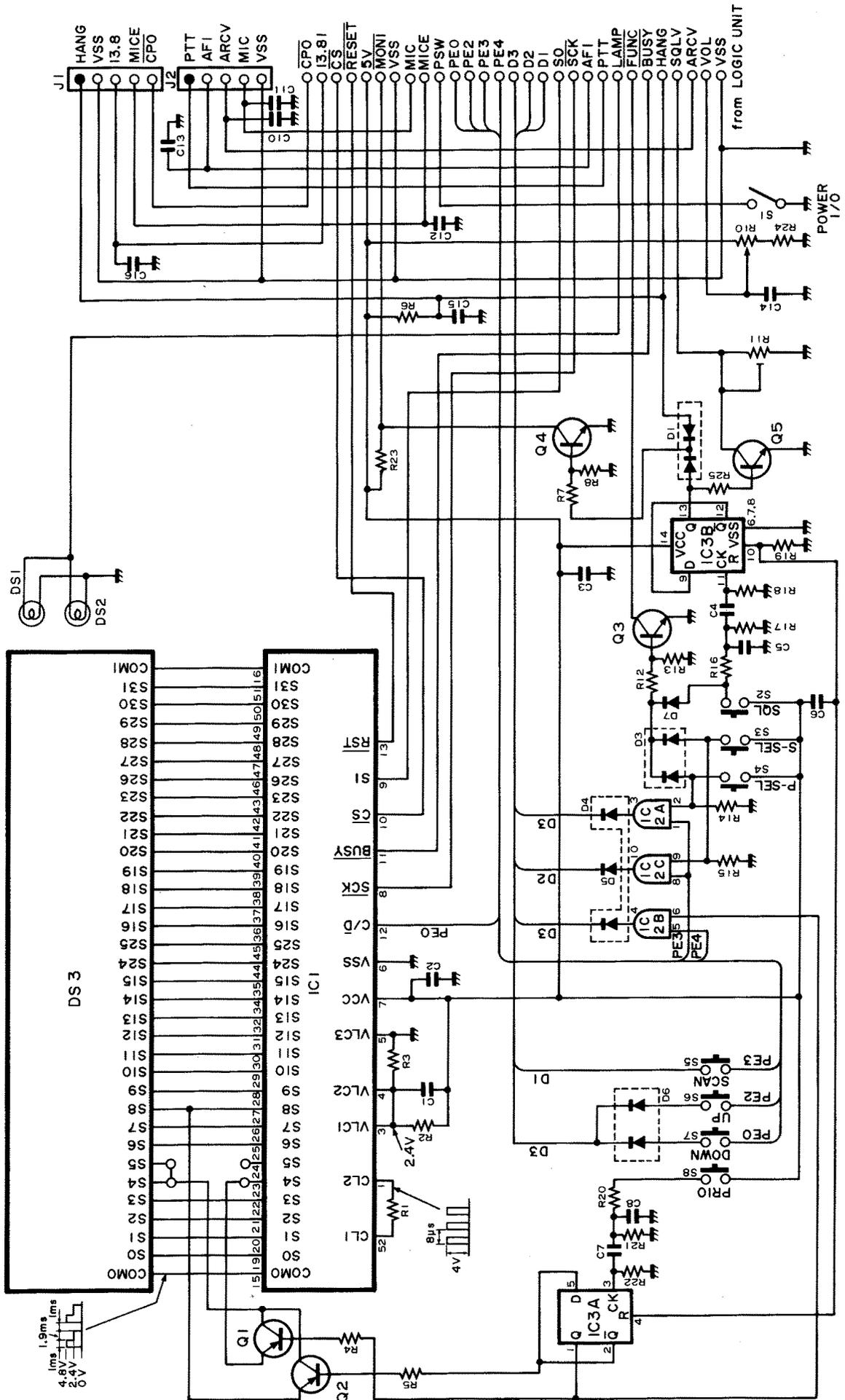
- CP0
- I3.8 I
- CS
- RESET
- 5V
- MONI
- VSS
- MIC
- MICE
- PSW
- PE0
- PE2
- PE3
- PE4
- D3
- D2
- DI
- SO
- SCK
- AF1
- PTT
- LAMP
- FUNC
- BUSY
- HANG
- SQLV
- ARCV
- VOL
- VSS

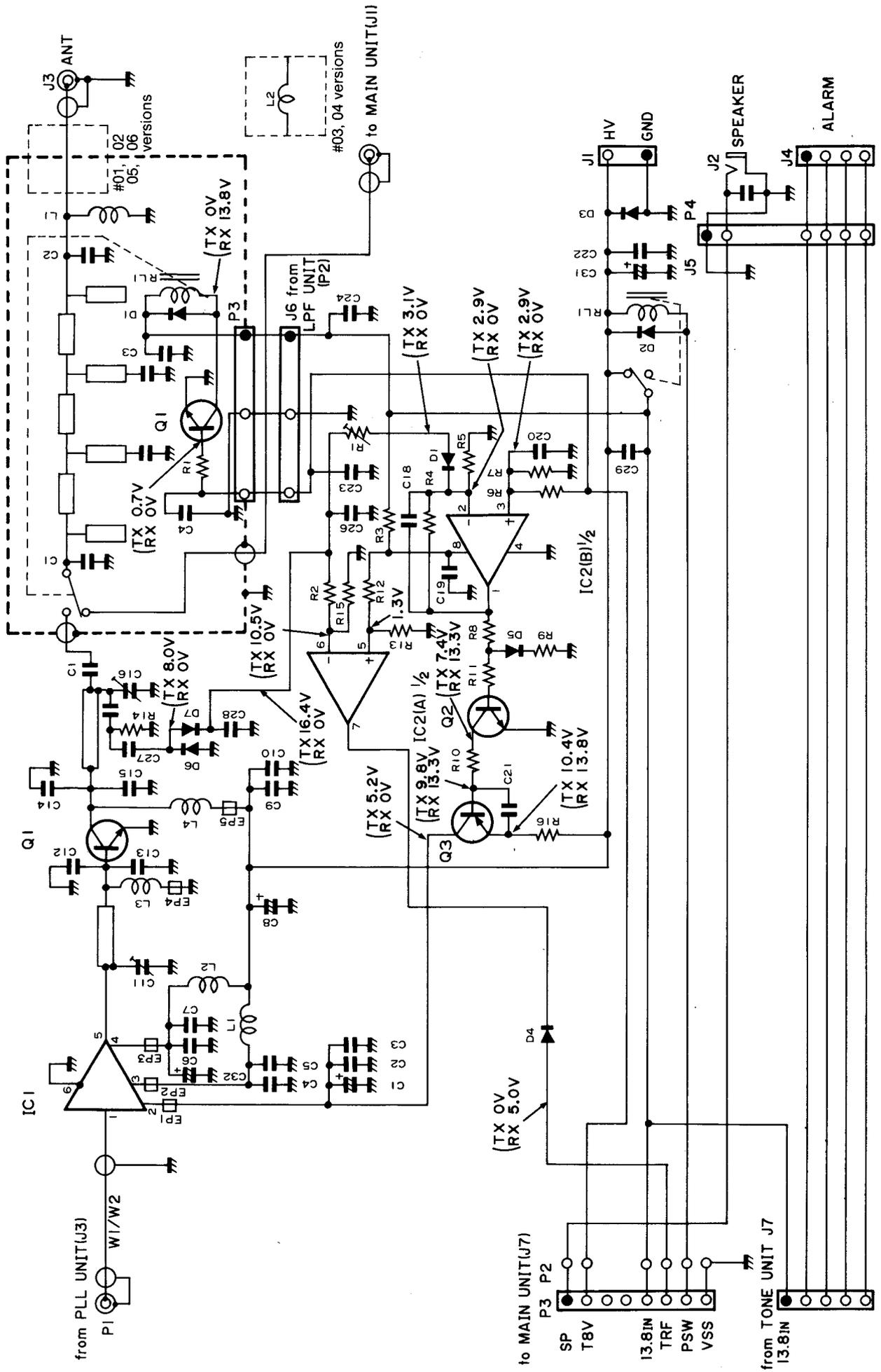
TONE ON TX 0V, RX 4.8
TONE OFF TX 4.6V, RX 4.6

- 51
- 50
- 49
- 48
- 47
- 46
- 45
- 44
- 43
- 42
- 41
- 40
- 39
- 38
- 52
- 53
- 57
- 58
- 59
- 61
- 62
- 63
- 64
- DB3
- DB2
- DB1
- DB0
- INT1
- INT0
- WR
- RD
- BUSY
- FUNC
- TRF
- SEND

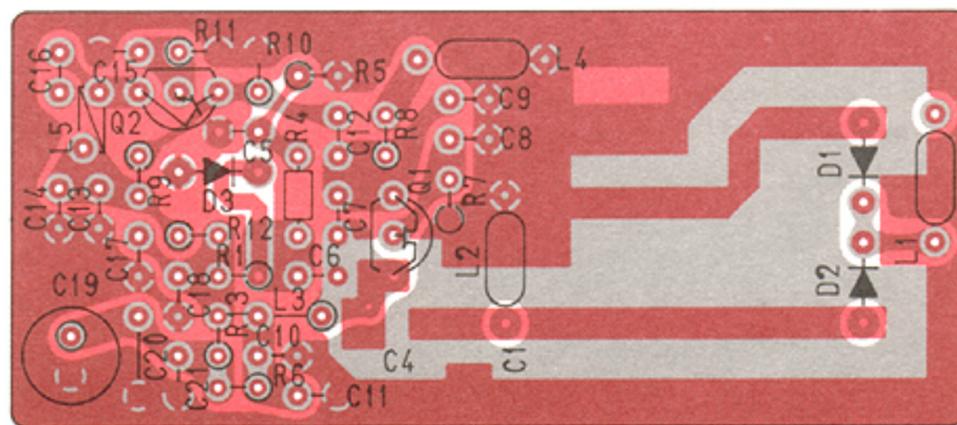
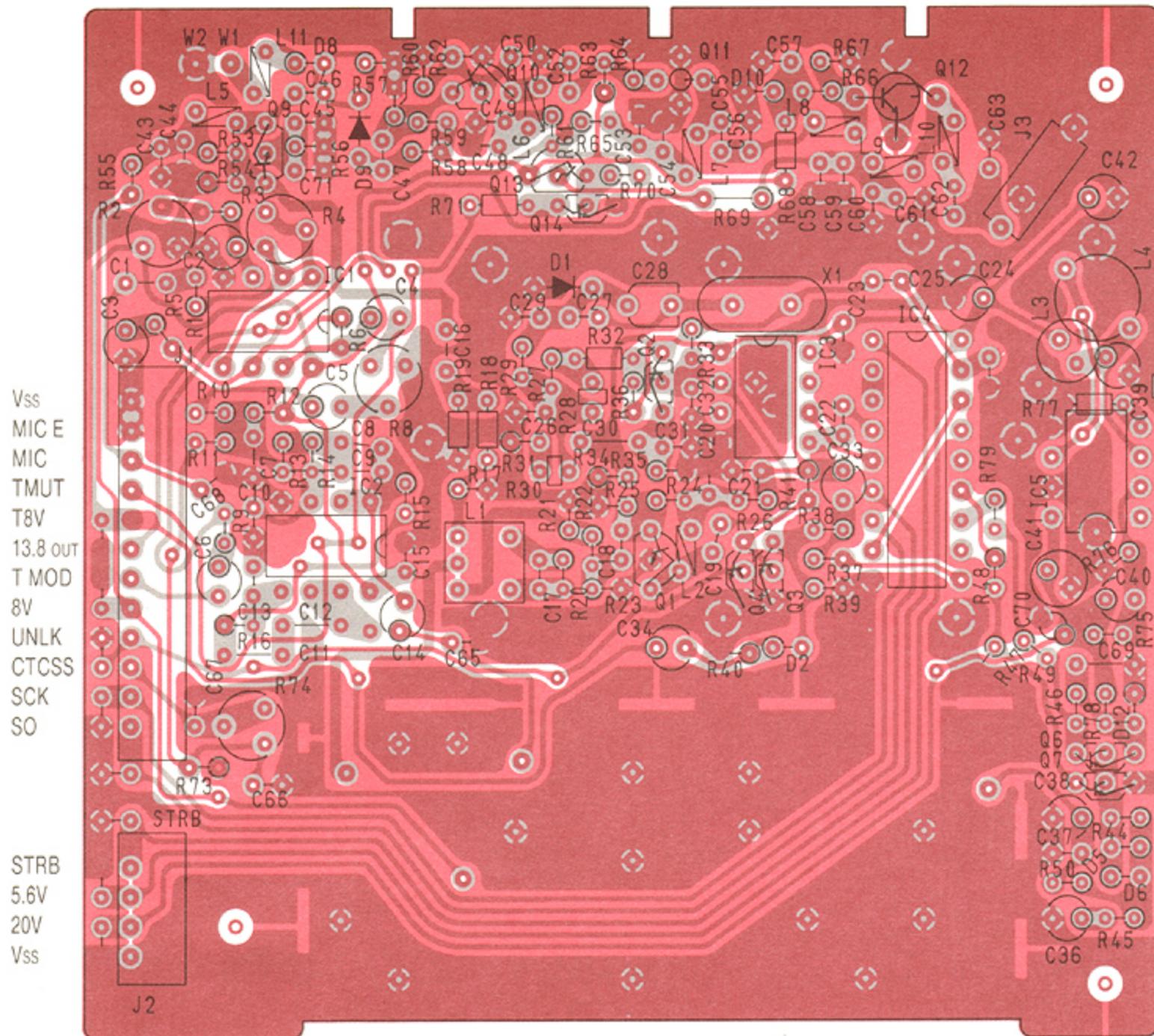




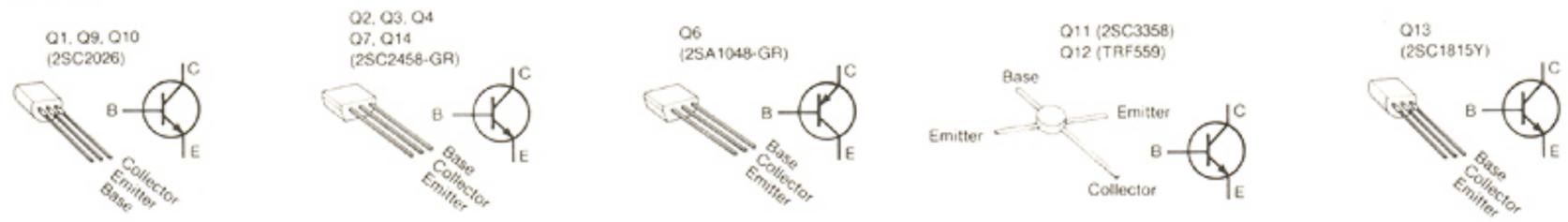




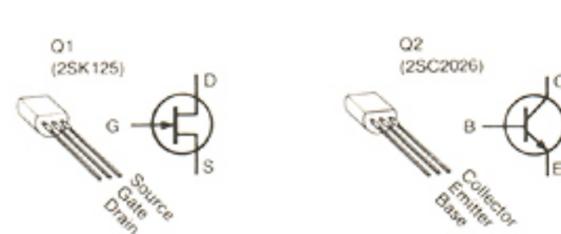
9 - 2 PLL AND VCO UNITS



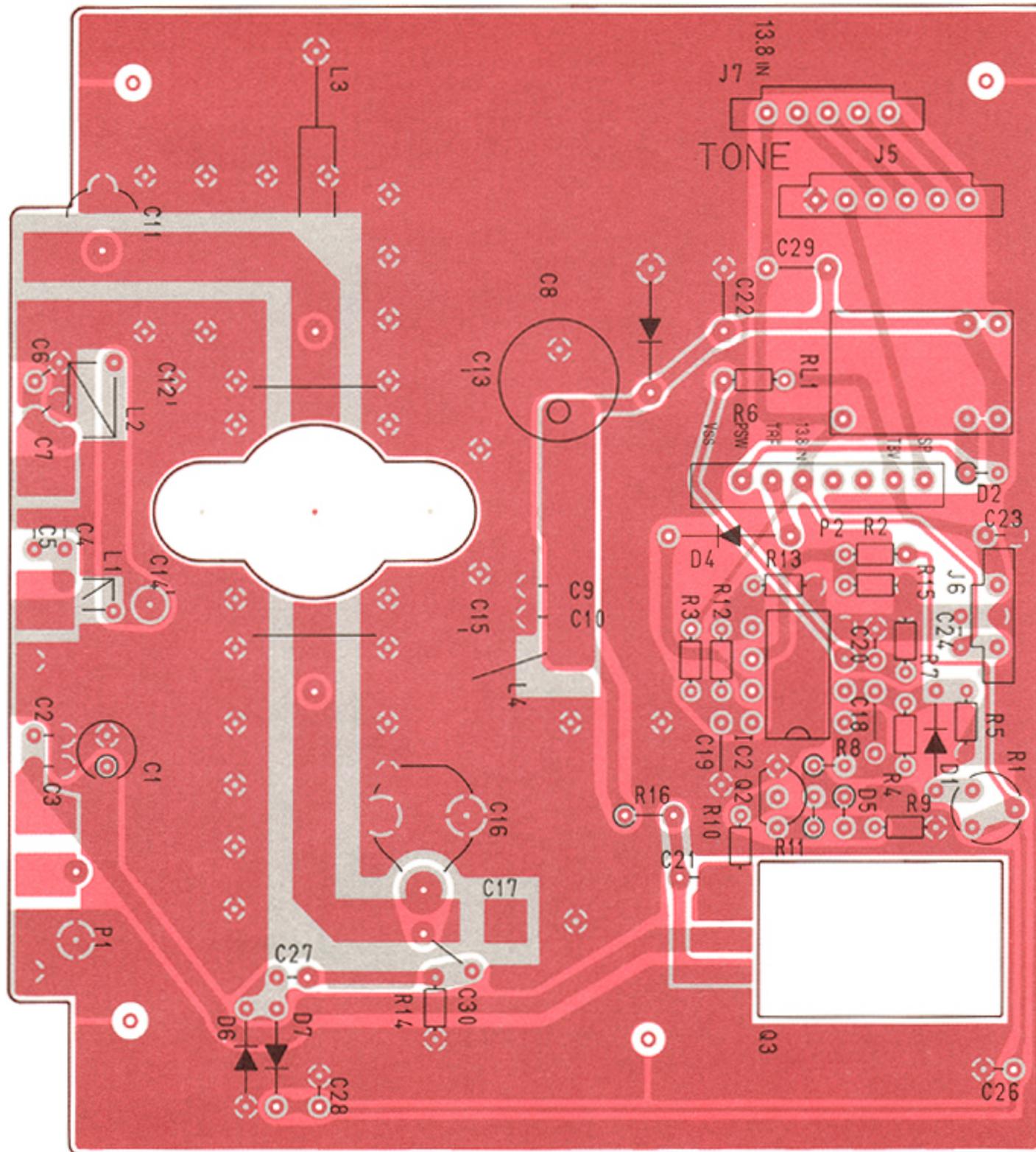
PLL UNIT



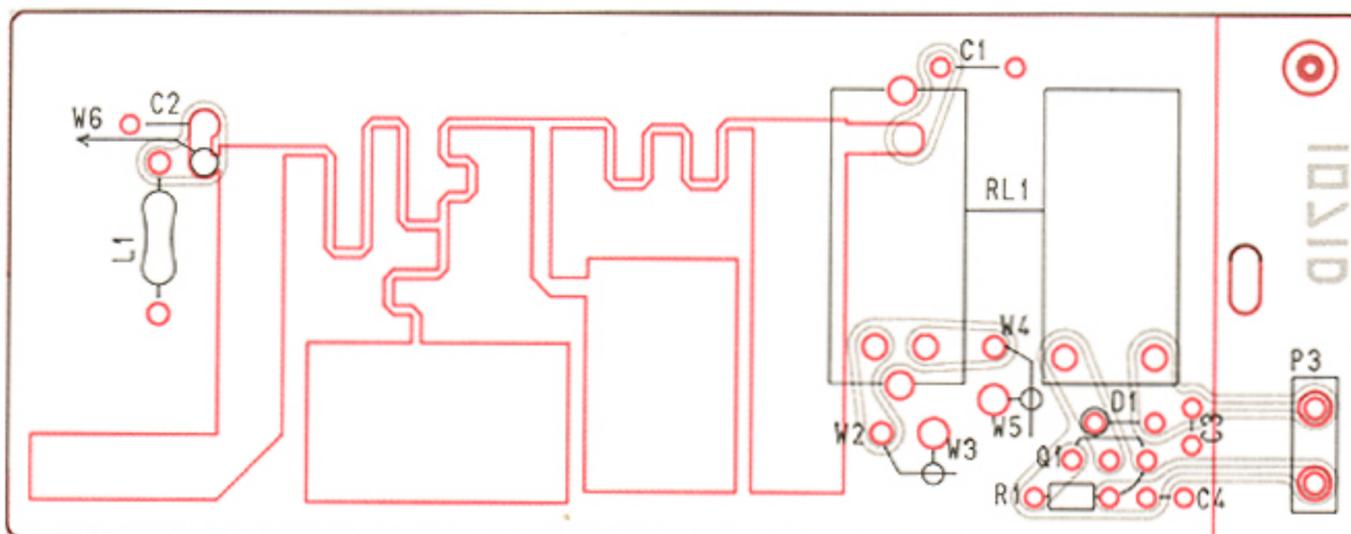
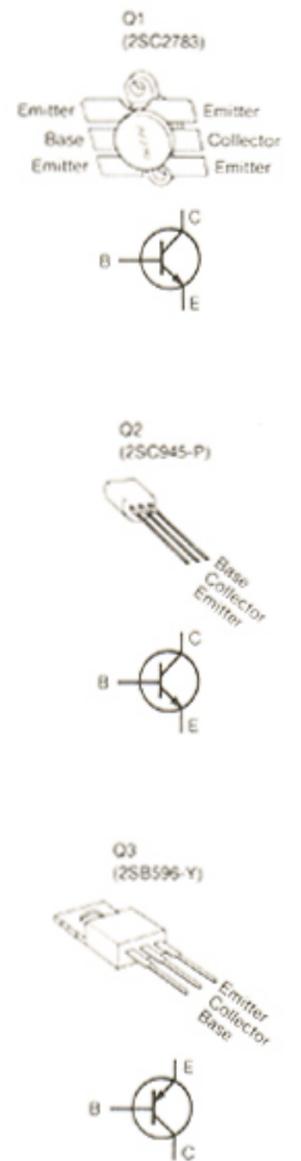
VCO UNIT



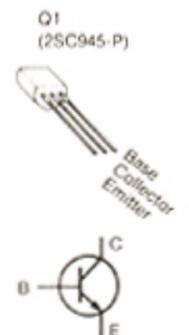
9 - 5 PA AND LPF UNITS



PA UNIT



LPF UNIT



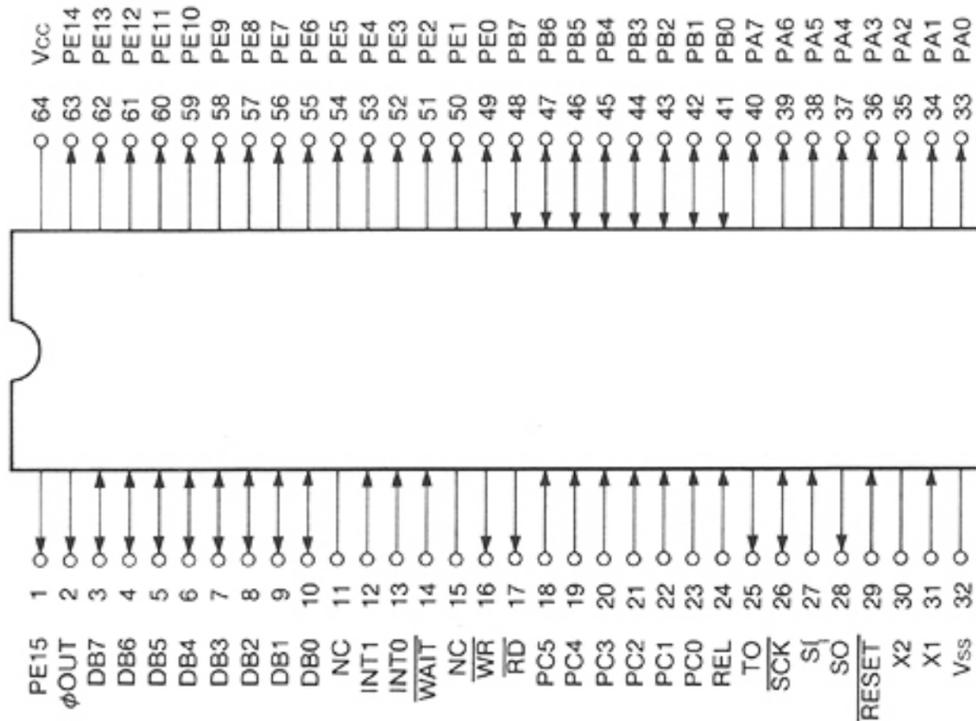
SECTION 10 IC SPECIFICATIONS

μPD78C06AG (MPU)

MAXIMUM RATINGS (Ta = 25°C)

DESCRIPTION	SYMBOL	RATINGS	UNIT
Supply Voltage	V _{CC}	-0.3~7.0	V
Input And Output Voltage	V _T	-0.3~V _{CC} +0.3	V
Output Current (High level)	I _{OH}	-5	mA
Output Current (Low level)	I _{OL}	43.5	mA
Operating Temperature	T _{OPR}	-40~+85	°C
Storage Temperature	T _{STG}	-65~+150	°C

PIN CONNECTION

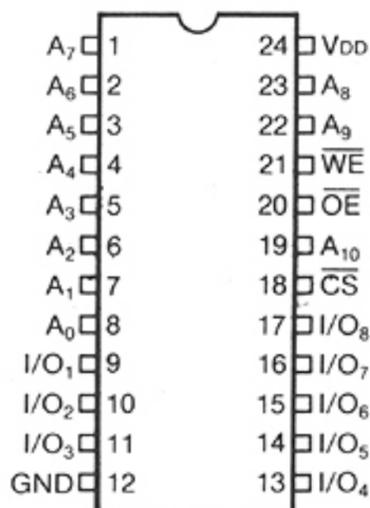


μPD446 (16384 BIT STATIC CMOS RAM)

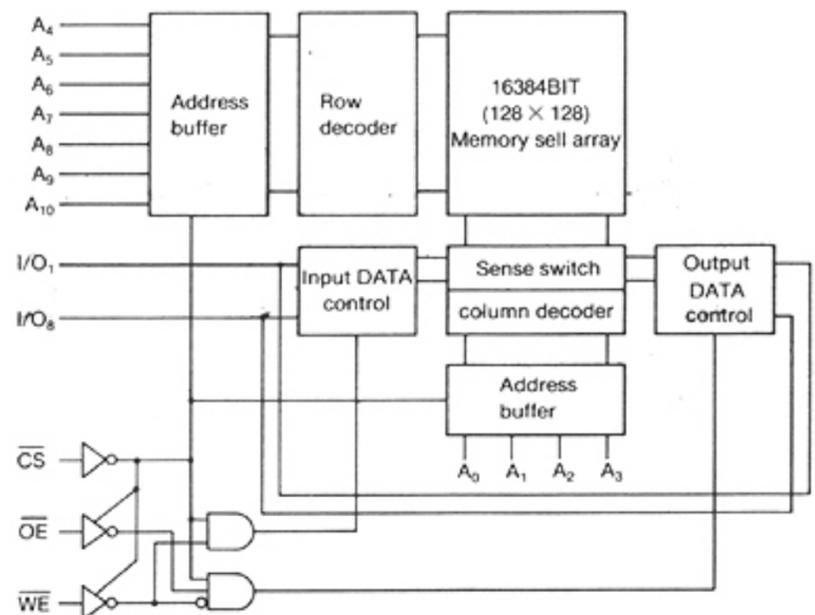
MAXIMUM RATINGS (Ta = 25°C)

DESCRIPTION	SYMBOL	RATINGS	UNIT
Supply Voltage	V _{DD}	7.0	V
Input And Output Voltage	V _T	-0.3~V _{CC} +0.3	V
Operating Temperature	T _{OPR}	-40~+85	°C
Storage Temperature	T _{STG}	-55~+125	°C

PIN CONNECTION



BLOCK DIAGRAM

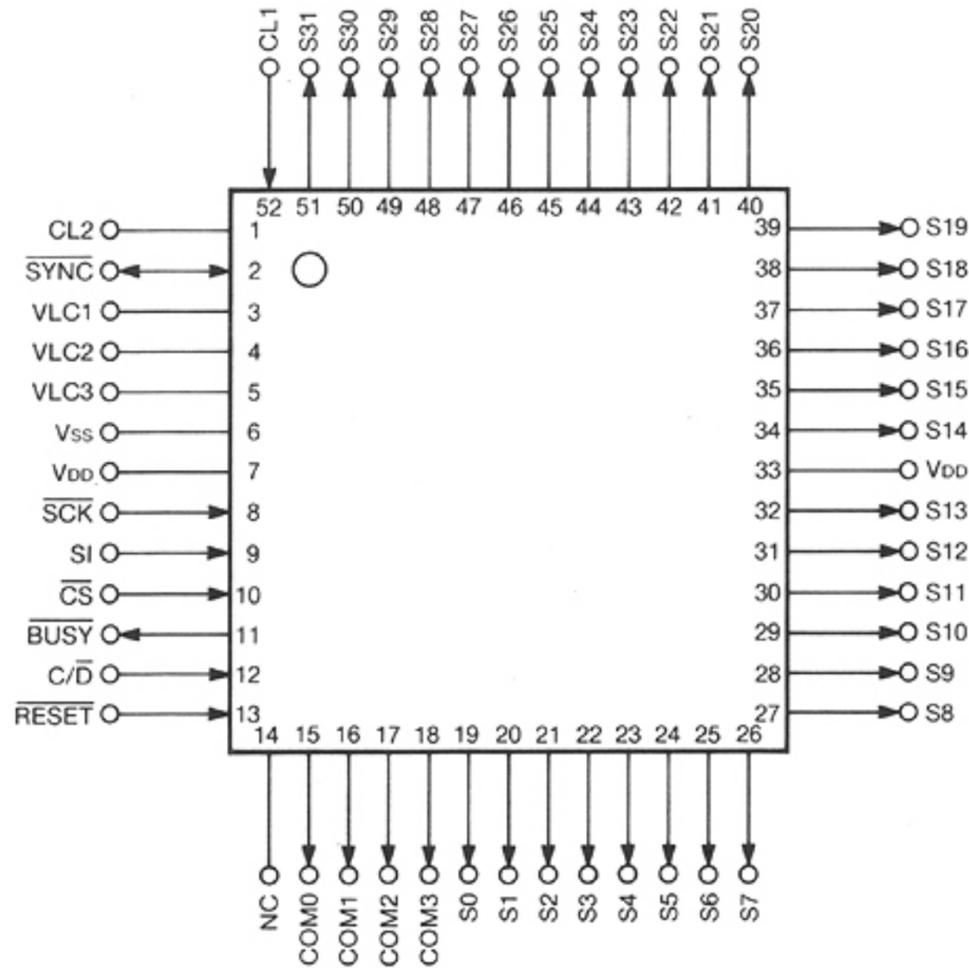


μPD7225G (PROGRAMMABLE LCD DRIVER)

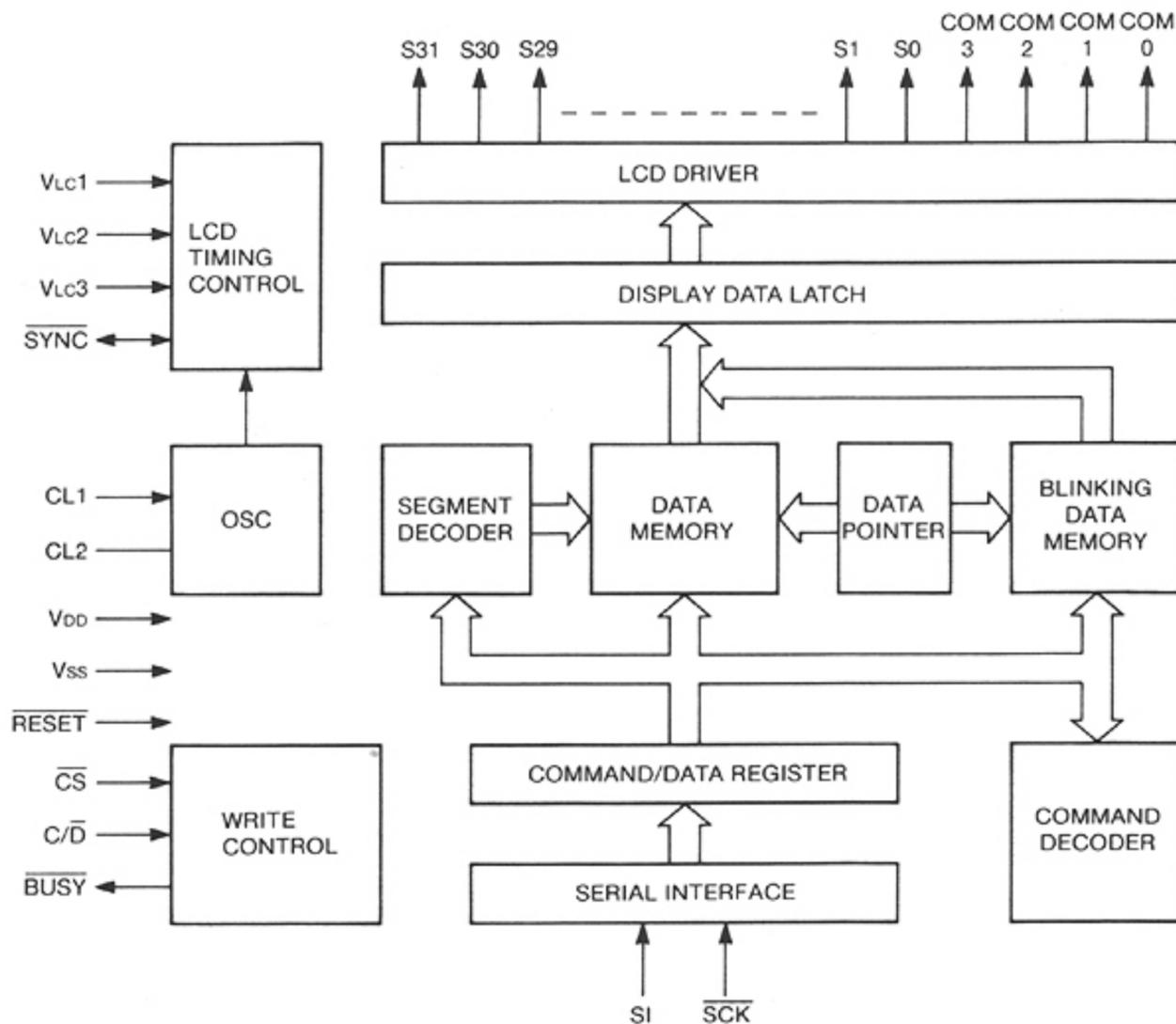
MAXIMUM RATINGS (Ta = 25°C)

DESCRIPTION	SYMBOL	RATINGS	UNIT
Supply Voltage	V _{DD}	-0.3~7.0	V
Input Voltage	V _{IN}	-0.3~V _{DD} +0.3	V
Output Voltage	V _{OUT}	-0.3~V _{DD} +0.3	V
Operating Temperature	T _{OPR}	-10~+70	°C
Storage Temperature	T _{STG}	-65~+150	°C

PIN CONNECTION



BLOCK DIAGRAM

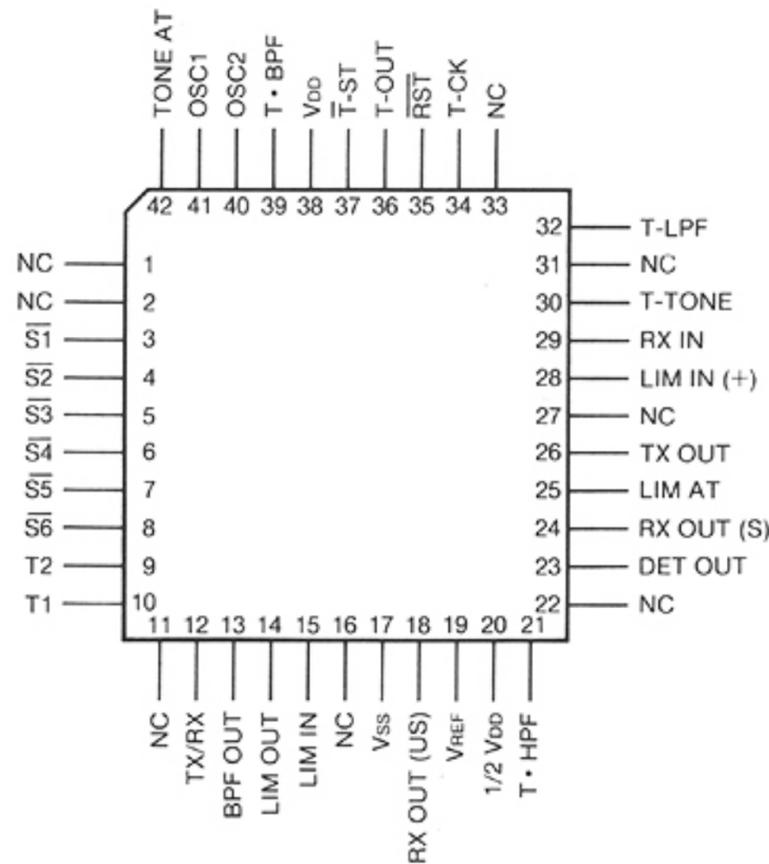


MN6520 (CTCSS ENCODER/DECODER)

MAXIMUM RATINGS (Ta = 25°C)

DESCRIPTION	SYMBOL	RATINGS	UNIT
Supply Voltage	V _{DD}	-0.2~7.0	V
Input And Output Voltage	V _T	-0.2~V _{DD} +0.2	V
Power Dissipation	P _D	100	mW
Operating Temperature	T _{OPR}	-20~+70	°C
Storage Temperature	T _{STG}	-55~+100	°C

PIN CONNECTION

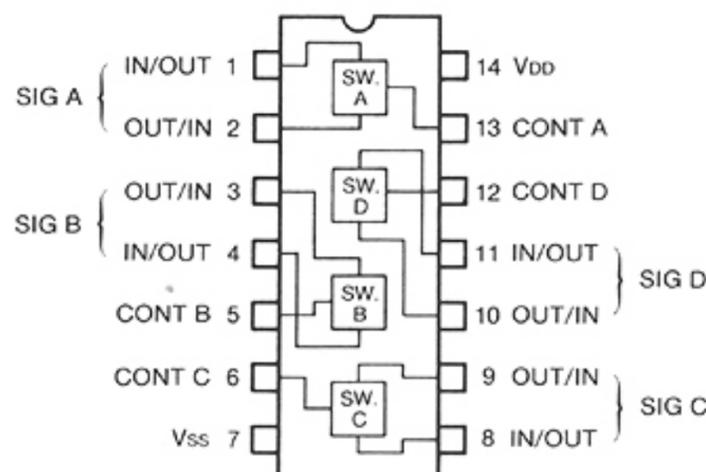


μPD4066BG (QUAD BILATERAL SWITCH)

MAXIMUM RATINGS (Ta = 25°C)

DESCRIPTION	SYMBOL	RATINGS	UNIT
Supply Voltage	V _{DD}	-0.5~20	V
Input Voltage	V _{IN}	-0.5~V _{DD} +0.5	V
Input Current	I _{IN}	10	mA
Permissible Dissipation	P _D	200	mW
Operating Temperature	T _{OPR}	-40~+85	°C
Storage Temperature	T _{STR}	-65~+125	°C

PIN CONNECTION

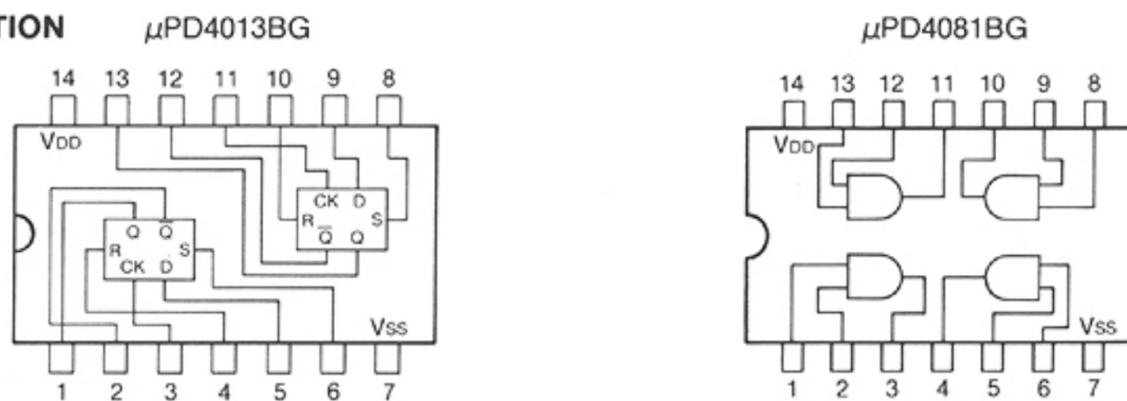


μPD4013BG (DUAL D-TYPE FLIP-FLOP)
μPD4081BG (QUAD 2-INPUT AND GATE)

MAXIMUM RATINGS (Ta = 25°C)

DESCRIPTION	SYMBOL	RATINGS	UNIT
Supply Voltage	V _{DD}	-0.5~20	V
Input Voltage	V _{IN}	-0.5~V _{DD} +0.5	V
Input Current	I _{IN}	10	mA
Power Dissipation	P _D	200	mW
Operating Temperature	T _{OPR}	-40~+85	°C
Storage Temperature	T _{STG}	-65~+125	°C

PIN CONNECTION

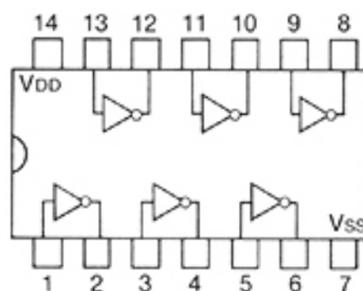


μPD4069UBG (HEX INVERTER)

MAXIMUM RATINGS (Ta = 25°C)

DESCRIPTION	SYMBOL	RATINGS	UNIT
Supply Voltage	V _{DD}	V _{SS} -0.5~V _{SS} +20	V
Input And Output Voltage	V _I	V _{SS} -0.5~V _{CC} +0.5	V
Input Current	I _{IN}	±10	mA
Permissible Dissipation	P _D	300	mW
Storage Temperature	T _{STG}	-65~+150	°C

PIN CONNECTION

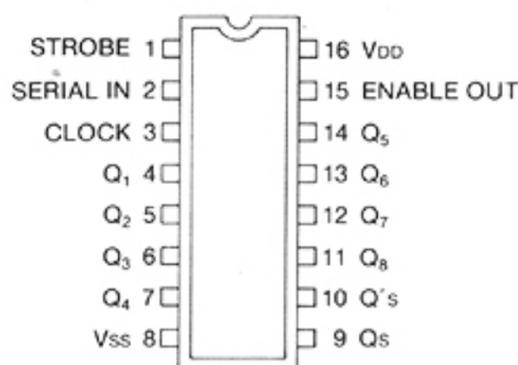


TC4094BP (8-STAGE AND STORE BUS RESISTER)

MAXIMUM RATINGS (Ta = 25°C)

DESCRIPTION	SYMBOL	RATINGS	UNIT
Supply Voltage	V _{DD}	V _{SS} -0.5~V _{SS} +20	V
Input And Output Voltage	V _I	V _{SS} -0.5~V _{DD} +0.5	V
Input Current	I _{IN}	±10	mA
Power Dissipation	P _D	300	mW
Operating Temperature	T _{OPR}	-40~+85	°C
Storage Temperature	T _{STG}	-65~+150	°C

PIN CONNECTION

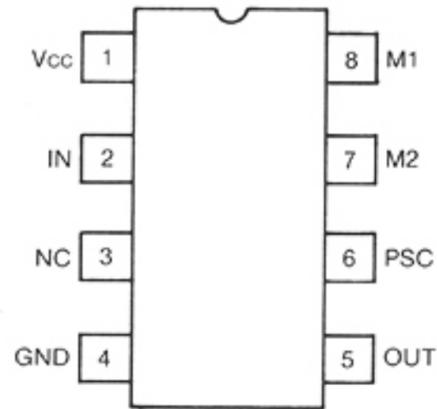


μPB571C (LOW POWER PRESCALER)

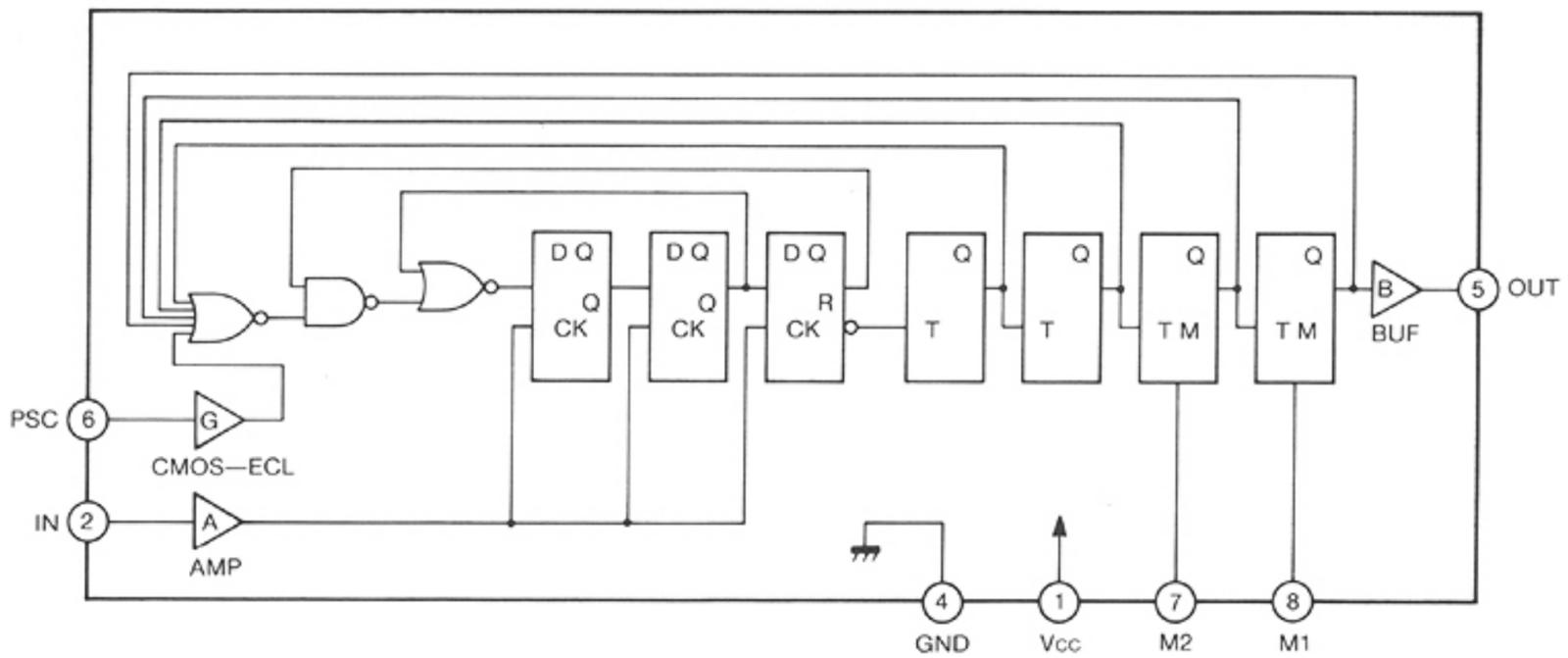
MAXIMUM RATINGS (Ta = 25°C)

DESCRIPTION	SYMBOL	RATINGS	UNIT
Supply Voltage	V _{CC}	-0.5~+6.0	V
Input Voltage	V _{IN}	-0.5~+V _{CC} +0.5	V
Output Current	I _O	-10	mA
Storage Temperature	T _{STG}	-55~+125	°C

PIN CONNECTION



BLOCK DIAGRAM



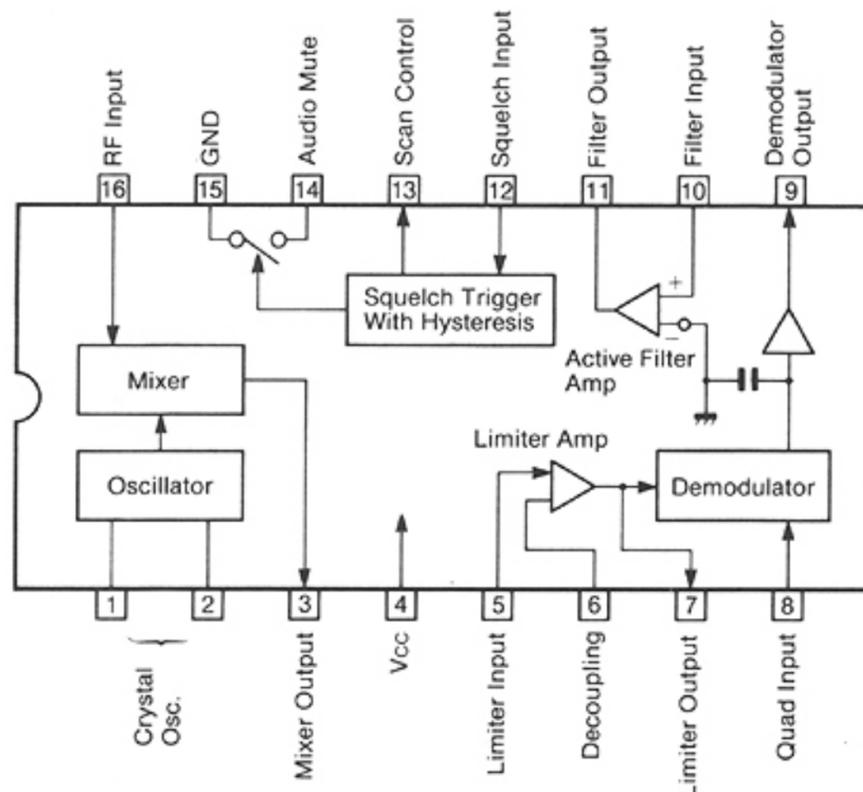
when M1 and M2 are Hi (V_{CC}), FF is equal to buffer.

MC3357 (LOW POWER FM IF)

MAXIMUM RATINGS (Ta = 25°C)

DESCRIPTION	SYMBOL	RATINGS	UNIT
Supply Voltage	V _{CC} (max)	12	V
Operating Supply Voltage	V _{CC}	4 or 8	V
Detector Input Voltage	—	1.0	V
Input Voltage (V _{CC} ≥ 6.0 Volts)	V _{IN}	1.0	V
Mute Function	V _{OM}	-0.5 5.0	V
Junction Temperature	T _J	150	°C
Operating Ambient Temperature Range	T _A	-30 +70	°C
Storage Temperature Range	T _{STG}	-65 +150	°C

PIN CONNECTION



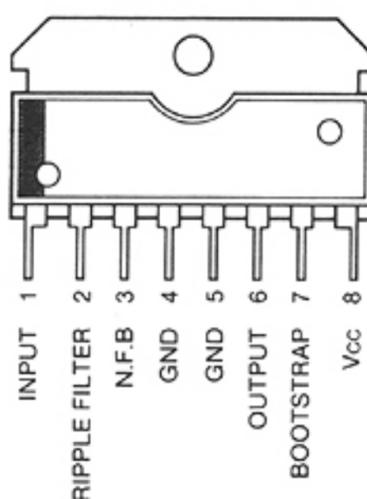
μPC1241H (AUDIO POWER AMPLIFIER)

MAXIMUM RATINGS

DESCRIPTION	SYMBOL	RATINGS	UNIT
Supply Voltage (Surge)	V _{CC} 1 (200mS)	50	V
Power Supply Voltage (No Signal)	V _{CC} 2	25	V
Power Supply Voltage (Operation)	V _{CC} 3	18*	V
Circuitry Current	I _{CC} (peak)	4.5	A
Operating Temperature	T _{OPR}	-30 ~ +75*	°C
Storage Temperature	T _{STG}	-55 ~ +150	°C

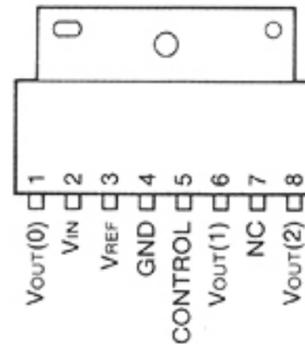
*With 100mm × 100mm × 1mm aluminum heat sink.

PIN CONNECTION

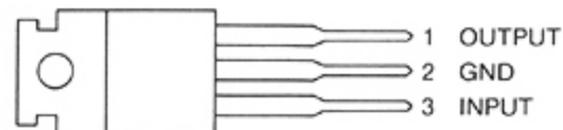


MB3756 (VOLTAGE REGULATOR)**MAXIMUM RATINGS (Ta = 25°C)**

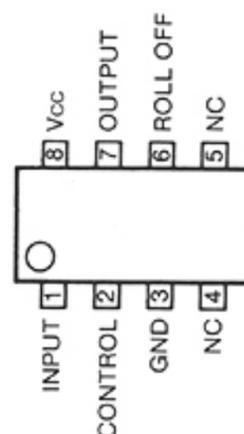
DESCRIPTION	SYMBOL	RATINGS	UNIT
Input Voltage	V _{IN}	18	V
Power Dissipation	P _D	1 *1	W
		4 *2	W
Operating Temperature	T _{OPR}	-30 ~ +80	°C
Storage Temperature	T _{STG}	-55 ~ +150	°C

*1 : No Heat Sink T_A ≤ 70°C*2 : Infinite Heat Sink T_C ≤ 70°C**PIN CONNECTION****NJM7805 (3-TERMINAL 5V REGULATOR)****MAXIMUM RATINGS**

DESCRIPTION	SYMBOL	RATINGS	UNIT
Input Voltage	V _{IN}	35	V
Power Dissipation	P _D	16 (T _C ≤ 45°C)	W
Operating Temperature	T _{OPR}	-30 ~ +75	°C
Storage Temperature	T _{STG}	-40 ~ +125	°C

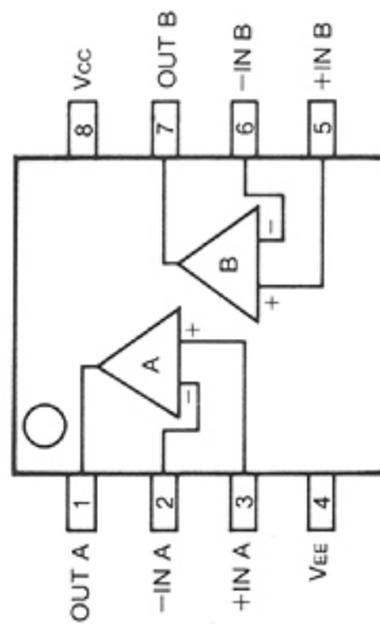
PIN CONNECTION**MC3340 (ELECTRONIC ATTENUATOR)****MAXIMUM RATINGS (Ta = 25°C)**

DESCRIPTION	SYMBOL	RATINGS	UNIT
Supply Voltage	V _{CC}	20	V
Power Dissipation	P _D	1.2	W
Operating Temperature	T _{OPR}	0 ~ +75	°C

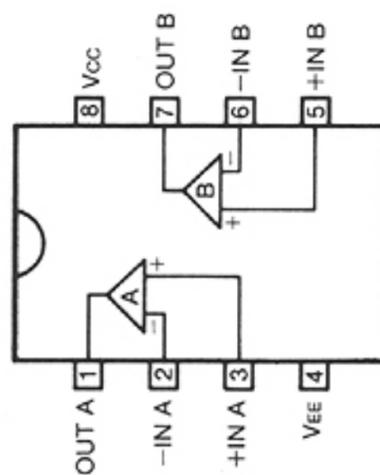
PIN CONNECTION

NJM4558D (DUAL LOW NOISE AMPLIFIER)**MAXIMUM RATINGS (Ta = 25°C)**

DESCRIPTION	SYMBOL	RATINGS	UNIT
Supply Voltage	V _{CC}	±18	V
Input Voltage	V _{IN}	±15	V
Operating Temperature	T _{OPR}	-20 ~ +75	°C
Storage Temperature	T _{STG}	-40 ~ +125	°C

PIN CONNECTION**μPC358C (DUAL DRIVER)****MAXIMUM RATINGS (Ta = 25°C)**

DESCRIPTION	SYMBOL	RATINGS	UNIT
Supply Voltage	V _{CC}	32	V
Drive Input Voltage	DV _{IN}	±36	V
Input Voltage	V _{IN}	-0.3 ~ +32	V
Permissible Dissipation	P _D	350	mW
Operating Temperature	T _{OPR}	0 ~ +70	°C
Storage Temperature	T _{STG}	-55 ~ +125	°C

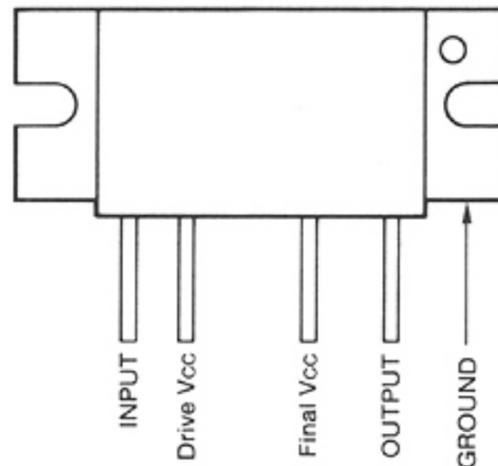
PIN CONNECTION

M57704L (400~430MHz POWER MODULE)
M57704H (450~480MHz POWER MODULE)
M57704SH (480~520MHz POWER MODULE)

MAXIMUM RATINGS

DESCRIPTION	SYMBOL	RATINGS	UNIT
Supply Voltage	V _{CC}	17	V
Input Power	P _{IN}	1.2	W
Output Power	P _{OUT}	20	W
Operating Temperature	T _{OPR}	-30~+110	°C
Storage Temperature	T _{STG}	-40~+110	°C

PIN CONNECTION

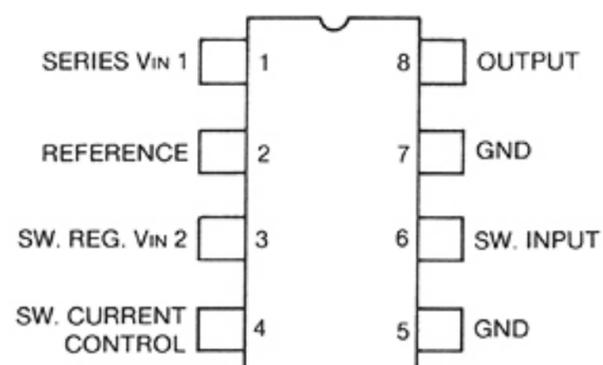


TL499ACP (WIDE RANGE POWER SUPPLY CONTROLLER)

MAXIMUM RATINGS (T_a = 25°C)

DESCRIPTION	SYMBOL	RATINGS	UNIT
Input Voltage	V _{IN}	1.1~25.0	V
Output Voltage	V _{OUT}	2.9~30	V
Output Current	I _{OUT}	1.0	A
Operating Temperature	T _{OPR}	-20~+85	°C
Storage Temperature	T _{STG}	-65~+150	°C

PIN CONNECTION



SECTION 11 PARTS LIST

11 - 1 MAIN UNIT

REF. NO.	DESCRIPTION	PART NO.
IC1	IC	MC3357P
IC2	IC	BA4558
IC3	IC	MC3340P
IC4	IC	μPC1241H
IC5	IC	MB3756
IC6	IC	NJM7805
IC7	IC	TC4094BP
IC8	IC	μPC358C
Q1	FET	3SK121-Y
Q2	FET	3SK121-Y
Q3	FET	3SK122-K
Q4	FET	2SJ105-Y
Q5	FET	2SJ105-Y
Q6	TRANSISTOR	2SC2458-GR
Q7	TRANSISTOR	2SD1225M-R
Q8	TRANSISTOR	2SC2458-GR
Q9	TRANSISTOR	2SC2458-GR
D1	VARICAP	1T25
D2	VARICAP	1T25
D3	VARICAP	1T25
D4	VARICAP	1T25
D5	VARICAP	1T25
D6	VARICAP	1T25
D7	VARICAP	1T25
D8	VARICAP	1T25
D9	VARICAP	1T25
D10	VARICAP	1T25
D11	DIODE	1SS99
D12	DIODE	1SS99
D13	ZENER	RD6.2E B2
D14	DIODE	1S953
D15	DIODE	1S953
D16	DIODE	1SS133
D18	DIODE	1SS133
D19	DIODE	1SS133
D20	ZENER	RD6.8E B2
D21	DIODE	1SS133
D22	DIODE	1SS133
D23	DIODE	1SS133
D24	DIODE	1SS133
D25	DIODE	1SS133
D26	DIODE	1SS133
FI1	CRYSTAL FILTER	21M15B3
FI2	CERAMIC FILTER	CFW455E
X1	CRYSTAL	CR70
X2	DISCRIMINATOR	CDB455C7A
L2	COIL	LW-25
L3	COIL	LA233 (#01,#02,#05,#06) LA234 (#03,#04)

MAIN UNIT

REF. NO.	DESCRIPTION	PART NO.
L4	COIL	LS-264
L5	COIL	LS-264
L6	COIL	LS-263
L7	COIL	LW-15
R1	RESISTOR	4.7k ELR20
R2	RESISTOR	100k ELR20
R3	RESISTOR	100k ELR20
R4	RESISTOR	100 R20
R5	RESISTOR	47k ELR20
R6	RESISTOR	470 ELR20
R7	RESISTOR	2.2k ELR20
R8	RESISTOR	3.3k R20 (#01,#02,#05,#06) 2.2k R20 (#03,#04)
R9	RESISTOR	100 ELR20
R10	RESISTOR	100k ELR20
R11	RESISTOR	100k ELR20
R12	RESISTOR	100k ELR20
R13	RESISTOR	100k ELR20
R14	RESISTOR	100k ELR20
R15	RESISTOR	10k R20
R16	RESISTOR	300k CRB25FX
R17	RESISTOR	100k CRB25FX
R18	RESISTOR	480k CRB25FX
R19	RESISTOR	480k CRB25FX
R20	TRIMMER	RHMOA1408A 10k
R21	ARRAY	RKM10L103FX
R22	RESISTOR	6.8k ELR20
R23	RESISTOR	470k R20
R24	RESISTOR	100k ELR20
R25	RESISTOR	120k ELR20
R27	RESISTOR	100 R20
R28	RESISTOR	10k R20
R30	RESISTOR	220 ELR20
R31	RESISTOR	47k R20
R32	RESISTOR	1.5k ELR20
R33	RESISTOR	1.5k ELR20
R34	RESISTOR	47k R20
R35	RESISTOR	1.5k R20
R36	RESISTOR	15k ELR20
R37	RESISTOR	2.2k ELR20
R38	RESISTOR	2.2k R20
R39	RESISTOR	330k R20
R40	RESISTOR	2.2k R20
R41	RESISTOR	22k R20
R42	RESISTOR	10k ELR20
R43	RESISTOR	8.2k ELR20
R44	RESISTOR	10k ELR20
R45	RESISTOR	33k ELR20
R46	RESISTOR	6.8k R20
R47	RESISTOR	33k ELR20
R48	RESISTOR	8.2k ELR20
R49	RESISTOR	560k ELR20
R50	RESISTOR	10k R20

MAIN UNIT

REF. NO.	DESCRIPTION	PART NO.
R51	RESISTOR	8.2k ELR20
R52	RESISTOR	1M ELR20
R53	RESISTOR	1M ELR20
R54	RESISTOR	18k R20
R55	RESISTOR	1M ELR20
R56	RESISTOR	1M ELR20
R57	RESISTOR	4.7k ELR20
R58	RESISTOR	100 ELR20
R59	RESISTOR	1 ELR20
R60	RESISTOR	1M ELR20
R61	TRIMMER	RHB0CS42BA 47k
R62	RESISTOR	47k ELR20
R63	RESISTOR	47k ELR20
R64	RESISTOR	100 ELR20
R65	RESISTOR	1k ELR20
R66	RESISTOR	10k R20
R67	RESISTOR	1k ELR20
R68	RESISTOR	33 R50X
R69	RESISTOR	22k R25
R70	RESISTOR	470k ELR20
R71	RESISTOR	1M ELR20
R72	RESISTOR	470 ELR20
R74	RESISTOR	560 R20
R76	RESISTOR	12k ELR20
R77	RESISTOR	2.2k ELR20
R78	THERMISTOR	33D28
R79	RESISTOR	470k R20
C1	CERAMIC	4P 50V (#01,#02,#03,#04) 2P 50V (#05,#06)
C2	CERAMIC	0.001 50V
C3	TRIMMER	CV05C1201 12P
C4	CERAMIC	0.001 50V
C5	CERAMIC	0.001 50V
C6	CERAMIC	470P 50V
C7	TRIMMER	CV05C1201 12P
C8	TRIMMER	CV05C1201 12P
C9	CERAMIC	0.35P 50V
C10	TRIMMER	CV05C1201 12P
C11	TRIMMER	CV05C1201 12P
C12	TRIMMER	CV38A0601 6P
C13	CERAMIC	0.001 50V
C14	ELECTROLYTIC	0.1 50V RC2
C15	CERAMIC	0.001 50V
C16	CERAMIC	47P 50V
C17	CERAMIC	47P 50V
C18	CERAMIC	47P 50V
C19	CERAMIC	47P 50V
C20	CERAMIC	47P 50V
C21	CERAMIC	47P 50V
C22	CERAMIC	47P 50V
C23	CERAMIC	0.001 50V
C24	BARRIER LAYER	0.01 25V
C25	BARRIER LAYER	0.1 16V
C26	CERAMIC	7P 50V
C27	CERAMIC	180P 50V
C28	CERAMIC	62P 50V
C29	CERAMIC	0.001 50V
C30	BARRIER LAYER	0.1 16V
C32	CERAMIC	0.001 50V
C33	CERAMIC	0.001 50V

MAIN UNIT

REF. NO.	DESCRIPTION	PART NO.
C34	CERAMIC	120P 50V
C35	CERAMIC	68P 50V
C36	BARRIER LAYER	0.1 16V
C37	BARRIER LAYER	0.1 16V
C38	CERAMIC	82P 50V
C39	BARRIER LAYER	0.1 16V
C40	ELECTROLYTIC	10 16V
C41	ELECTROLYTIC	0.47 50V RC2
C42	ELECTROLYTIC	2.2 50V RC2
C43	CERAMIC	0.001 50V
C44	MYLAR	0.01 50V
C45	CERAMIC	33P 50V
C46	MYLAR	0.001 50V
C47	MYLAR	0.001 50V
C48	MYLAR	0.001 50V
C49	ELECTROLYTIC	0.1 50V RC2
C50	BARRIER LAYER	0.1 16V
C51	ELECTROLYTIC	0.22 50V RC2
C52	MYLAR	0.01 50V
C53	MYLAR	0.01 50V
C54	MYLAR	0.01 50V
C55	ELECTROLYTIC	0.22 50V RC2
C56	ELECTROLYTIC	0.1 50V RC2
C57	ELECTROLYTIC	1 50V
C58	ELECTROLYTIC	2.2 50V RC2
C59	CERAMIC	0.0047 50V
C60	BARRIER LAYER	0.1 16V
C61	ELECTROLYTIC	0.47 50V
C62	ELECTROLYTIC	0.47 50V RC2
C63	MYLAR	0.01 50V
C64	MYLAR	0.01 50V
C65	ELECTROLYTIC	220 10V
C66	ELECTROLYTIC	47 16V
C67	BARRIER LAYER	0.1 16V
C68	ELECTROLYTIC	47 16V
C69	ELECTROLYTIC	470 16V
C70	ELECTROLYTIC	100 16V
C71	BARRIER LAYER	0.01 25V
C72	CERAMIC	0.001 50V
C73	ELECTROLYTIC	470 16V
C74	CERAMIC	0.001 50V
C75	CERAMIC	0.001 50V
C76	CERAMIC	0.001 50V
C77	ELECTROLYTIC	47 10V
C78	ELECTROLYTIC	4.7 25V
C79	CERAMIC	0.001 50V
C80	BARRIER LAYER	0.1 16V
C81	CERAMIC	0.001 50V
C82	ELECTROLYTIC	470 6.3V
C83	CERAMIC	0.001 50V
C84	CERAMIC	0.001 50V
C85	ELECTROLYTIC	1 50V
C86	CERAMIC	0.001 50V
C87	BARRIER LAYER	0.1 16V
C88	ELECTROLYTIC	0.1 50V RC2
C89	CERAMIC	0.001 50V
C90	CERAMIC	0.001 50V
C91	CERAMIC	0.001 50V
C92	BARRIER LAYER	0.1 16V
C93	CERAMIC	0.001 50V
C94	CERAMIC	47P 50V
C95	CERAMIC	2P 50V

MAIN UNIT/PLL UNIT

REF. NO.	DESCRIPTION	PART NO.
J1	CONNECTOR	TMP-J01X-A1
J2	CONNECTOR	TMP-J01X-A1
J3	CONNECTOR	TL25P-10-V1
J4	CONNECTOR	5494-12C
J5	CONNECTOR	5494-04C
J6	CONNECTOR	PI32B20P-1
J7	CONNECTOR	TL25P-08-V1
EP1	P.C.B.	B-1063D

11 - 2 PLL UNIT

REF. NO.	DESCRIPTION	PART NO.
IC1	IC	BA4558
IC2	IC	BA4558
IC3	IC	μ PB571C
IC4	IC	μ PD2834C
IC5	IC	TL499ACP
Q1	TRANSISTOR	2SC2026
Q2	TRANSISTOR	2SC2458-GR
Q3	TRANSISTOR	2SC2458-GR
Q4	TRANSISTOR	2SC2458-GR
Q6	TRANSISTOR	2SA1048-GR
Q7	TRANSISTOR	2SC2458-GR
Q9	TRANSISTOR	2SC2026
Q10	TRANSISTOR	2SC2026
Q11	TRANSISTOR	2SC3358
Q12	TRANSISTOR	TRF559
Q13	TRANSISTOR	2SC1815-Y
Q14	TRANSISTOR	2SC2458-GR
D1	VARICAP	1SV50E(1)
D5	DIODE	1SS133
D6	DIODE	1SS133
D8	DIODE	1SS216
D9	DIODE	1SS216
D10	DIODE	1SS211
D12	ZENER	RD12E B2 (#01,#02,#03,#04)
		RD13E B2 (#05,#06)
X1	CRYSTAL	CR85
L1	COIL	LR-116
L2	COIL	LA-232
L3	COIL	FL5H 101k
L4	COIL	LW-12
L5	COIL	LA-232
L6	COIL	LA-232
L7	COIL	LA-233
L8	COIL	LA-232
L9	COIL	LA-233
L10	COIL	LA-232
L11	COIL	LA-232
R1	RESISTOR	4.7k ELR20
R2	TRIMMER	RHB0C1431A 10k
R3	RESISTOR	1.2k ELR20

PLL UNIT

REF. NO.	DESCRIPTION	PART NO.
R4	TRIMMER	RHB0CJ501A 220k
R5	RESISTOR	4.7k ELR20
R6	RESISTOR	470k ELR20
R8	TRIMMER	RHB0CS32UA 4.7k
R9	RESISTOR	4.7k ELR20
R10	RESISTOR	270k ELR20
R11	RESISTOR	47k ELR20
R12	RESISTOR	120k ELR20
R13	RESISTOR	39k ELR20
R14	RESISTOR	39k ELR20
R17	RESISTOR	330 ELR20
R18	RESISTOR	22 R20
R19	RESISTOR	330 R20
R20	RESISTOR	15 ELR20
R21	RESISTOR	150 ELR20
R22	RESISTOR	33 ELR20
R23	RESISTOR	150 ELR20
R24	RESISTOR	6.8k ELR20
R25	RESISTOR	1.8k ELR20
R26	RESISTOR	330 ELR20
R27	RESISTOR	2.2k ELR20
R28	THERMISTOR	33D28
R29	RESISTOR	10k ELR20
R30	THERMISTOR	33D28
R31	RESISTOR	15k ELR20
R32	RESISTOR	6.8k R20
R33	RESISTOR	100k ELR20
R34	RESISTOR	100k ELR20
R35	RESISTOR	2.2k ELR20
R36	RESISTOR	100 ELR20
R37	RESISTOR	180k ELR20
R38	RESISTOR	33k ELR20
R39	RESISTOR	39k ELR20
R41	RESISTOR	470k ELR20
R44	RESISTOR	1k ELR20
R45	RESISTOR	2.7k ELR20
R46	RESISTOR	4.7k ELR20
R47	RESISTOR	47k ELR20
R48	RESISTOR	47k ELR20
R49	RESISTOR	47k ELR20
R50	RESISTOR	22k ELR20
R53	RESISTOR	3.3k ELR20
R54	RESISTOR	2.2k ELR20
R55	RESISTOR	100 ELR20
R56	RESISTOR	220 ELR20
R57	RESISTOR	1k ELR20
R58	RESISTOR	2.2k ELR20
R59	RESISTOR	3.3k ELR20
R60	RESISTOR	2.2k ELR20
R61	RESISTOR	100 ELR20 (#01,#02,#05,#06) 470 ELR20 (#03,#04)
R62	RESISTOR	220 ELR20
R63	RESISTOR	15k ELR20
R64	RESISTOR	2.2k ELR20
R65	RESISTOR	100 ELR20 (#01,#02,#05,#06) 470 ELR20 (#03,#04)
R66	RESISTOR	100 ELR20
R67	RESISTOR	1k ELR20

PLL UNIT

REF. NO.	DESCRIPTION	PART NO.	
R68	RESISTOR	1k	R20
R69	RESISTOR	15	R50X
R70	RESISTOR	1k	ELR20
R71	RESISTOR	47k	R20
R73	RESISTOR	33k	ELR20
R74	TRIMMER	RHB0CJ501A	220k
R75	RESISTOR	82k	ELR20
R76	RESISTOR	4.7k	ELR20
R77	RESISTOR	1.2k	R20
R78	RESISTOR	1.5k	ELR20
R79	RESISTOR	27k	ELR20
R80	RESISTOR	2.2k	R20
C1	MYLAR	0.01	50V
C2	ELECTROLYTIC	10	16V RC2
C3	ELECTROLYTIC	0.1	50V RC2
C4	ELECTROLYTIC	2.2	50V
C5	ELECTROLYTIC	4.7	25V
C6	ELECTROLYTIC	4.7	25V
C7	MYLAR	0.0022	50V
C8	MYLAR	0.001	50V
C9	MYLAR	0.01	50V
C10	BARRIER LAYER	RAU04SA	121J 50V 120P
C14	ELECTROLYTIC	1	50V RC2
C15	CERAMIC	0.001	50V
C16	CERAMIC	0.001	50V
C17	CERAMIC	15P	50V
C18	CERAMIC	0.001	50V
C19	CERAMIC	10P	50V
C20	CERAMIC	0.001	50V
C21	CERAMIC	0.001	50V
C22	CERAMIC	0.001	50V
C23	CERAMIC	0.001	50V
C24	ELECTROLYTIC	47	6.3V RC2
C25	CERAMIC	47P	50V
C26	CERAMIC	0.001	50V
C27	CERAMIC	33P	50V CH
C28	TRIMMER	CV38D2001	20P
C29	CERAMIC	4P	50V CH
C30	CERAMIC	220P	50V
C31	CERAMIC	100P	50V
C32	BARRIER LAYER	0.01	25V
C33	ELECTROLYTIC	4.7	25V RC2
C36	TANTALUM	2.2	35V
C37	CERAMIC	47P	50V
C38	TANTALUM	0.1	35V
C39	ELECTROLYTIC	22	6.3V RC2
C40	ELECTROLYTIC	0.1	50V RC2
C41	ELECTROLYTIC	1	50V
C42	ELECTROLYTIC	47	6.3V RC2
C43	CERAMIC	470P	50V
C44	CERAMIC	0.001	50V
C45	CERAMIC	470P	50V
C46	CERAMIC	8P	50V
C47	CERAMIC	4P	50V
C48	CERAMIC	0.001	50V
C49	CERAMIC	470P	50V
C50	CERAMIC	470P	50V
C51	CERAMIC	0.001	50V
C52	CERAMIC	6P	50V
C53	CERAMIC	0.001	50V
C54	CERAMIC	470P	50V

PLL UNIT/VCO UNIT

REF. NO.	DESCRIPTION	PART NO.	
C55	CERAMIC	2P	50V
C56	CERAMIC	2P	50V
C57	CERAMIC	470P	50V
C58	CERAMIC	0.001	50V
C59	CERAMIC	0.001	50V
C60	CERAMIC	470P	50V
C61	CERAMIC	470P	50V
C62	CERAMIC	10P	50V
C63	CERAMIC	2P	50V
C65	CERAMIC	0.001	50V
C66	CERAMIC	0.001	50V
C67	CERAMIC	0.001	50V
C68	CERAMIC	0.001	50V
C69	BARRIER LAYER	0.047	25V
C70	TANTALUM	0.33	35V
C71	CERAMIC	47P	50V
C72	CERAMIC	2P	50V CK
C73	CERAMIC	6P	50V
			(#03,#04 only)
C74	CERAMIC	470P	50V
			(#03,#04 only)
J1	CONNECTOR	5494-12C	
J2	CONNECTOR	5494-04C	
J3	CONNECTOR	TMP-J01X-A1	
P1	CONNECTOR	TMP-P01X-A1	
EP1	P.C.B.	B-1065C	

11 - 3 VCO UNIT

REF. NO.	DESCRIPTION	PART NO.	
Q1	FET	2SK125	
Q2	TRANSISTOR	2SC2026	
D1	VARICAP	1SV50E(1)	
D2	VARICAP	1SV50E(1)	
D3	VARICAP	1T25	
L1	COIL	LAL03NA	R47M
L2	COIL	LAL03NA	1R0M
L3	COIL	LAL03NA	1R0M
L4	COIL	LAL03NA	R47M
L5	COIL	LA-233	
R1	RESISTOR	100k	ELR20
R4	RESISTOR	270	R20
R5	RESISTOR	47k	ELR20
R6	RESISTOR	10	ELR20
R7	RESISTOR	100	ELR20
R8	RESISTOR	33	ELR20
R9	RESISTOR	3.3k	ELR20
R10	RESISTOR	2.2k	ELR20
R11	RESISTOR	220	ELR20
R12	RESISTOR	100	ELR20
R13	RESISTOR	22	ELR20

VCO UNIT/PA UNIT

REF. NO.	DESCRIPTION	PART NO.	
C1	MONOLITHIC	2P GR42-6 CH (#01,#02,#03,#04)	
		0.5P GR42-6 CH (#05,#06)	
C4	MONOLITHIC	15P GR42-6 CH	
C5	CERAMIC	470P 50V	
C6	CERAMIC	0.5P 50V	
C7	CERAMIC	3P 50V	
C8	CERAMIC	120P 50V	
C9	CERAMIC	3P 50V	
C10	CERAMIC	470P 50V	
C11	CERAMIC	47P 50V	
C12	CERAMIC	1P 50V	
C13	CERAMIC	470P 50V	
C14	CERAMIC	0.001 50V	
C15	CERAMIC	470P 50V	
C16	CERAMIC	4P 50V	
C17	CERAMIC	0.001 50V	
C18	CERAMIC	0.001 50V	
C19	ELECTROLYTIC	100 10V RC2	
C20	BARRIER LAYER	0.1 16V	
C21	CERAMIC	470P 50V	
EP1	P.C.B.	B-1066B	

11 - 4 PA UNIT

REF. NO.	DESCRIPTION	PART NO.	
IC1	IC	M57704H (#01,#02) M57704L (#03,#04) M57704SH (#05,#06)	
IC2	IC	μPC358C	
Q1	TRANSISTOR	2SC2783	
Q2	TRANSISTOR	2SC945-P	
Q3	TRANSISTOR	2SB596-Y	
D1	DIODE	1S953	
D2	DIODE	1SS53	
D3	DIODE	15CD11	
D4	DIODE	1S953	
D5	DIODE	1SS133	
D6	DIODE	1SS97	
D7	DIODE	1SS97	
L1	COIL	LA-245	
L2	COIL	LA-255	
L3	COIL	LW-8	
L4	COIL	LA-169	
R1	TRIMMER	RH0651CJ5J01A	220k
R2	RESISTOR	56k	R20
R3	RESISTOR	100	R20
R4	RESISTOR	27k	R20
R5	RESISTOR	27k	R20
R6	RESISTOR	22k	R20
R7	RESISTOR	12k	R20
R8	RESISTOR	12k	ELR20
R9	RESISTOR	100k	R20
R10	RESISTOR	5.6k	R20

PA UNIT

REF. NO.	DESCRIPTION	PART NO.	
R11	RESISTOR	12k	ELR20
R12	RESISTOR	12k	R20
R13	RESISTOR	1.2k	R20
R14	RESISTOR	56	R20
R15	RESISTOR	100k	R20
R16	RESISTOR	10	ELR25
C1	ELECTROLYTIC	10	16V
C2	CERAMIC	470P	50V
C3	CERAMIC	0.001	50V
C4	CERAMIC	470P	50V
C5	CERAMIC	0.001	50V
C6	CERAMIC	470P	50V
C7	CERAMIC	0.001	50V
C8	ELECTROLYTIC	220	16V
C9	CERAMIC	470P	50V
C10	CERAMIC	0.001	50V
C11	TRIMMER	VCT51C	10P
C12	MONOLITHIC	UC23 2H	0270F (#01,#02) UC23 2H 0290F (#03,#04) UC23 2H 0220F (#05,#06)
C13	MONOLITHIC	UC23 2H	0270F (#01,#02) UC23 2H 0290F (#03,#04) UC23 2H 0220F (#05,#06)
C14	MONOLITHIC	UC23 2H	0320F (#01,#02) UC23 2H 0390F (#03,#04) UC23 2H 0290F (#05,#06)
C15	MONOLITHIC	UC23 2H	0320F (#01,#02) UC23 2H 0390F (#03,#04) UC23 2H 0290F (#05,#06)
C16	TRIMMER	VCT81C	10P
C17	MONOLITHIC	UC34 2H	1000F
C18	BARRIER LAYER	0.022	25V
C19	BARRIER LAYER	0.1	16V
C20	CERAMIC	0.001	50V
C21	CERAMIC	470P	50V
C22	BARRIER LAYER	0.1	16V
C23	CERAMIC	0.001	50V
C24	CERAMIC	0.001	50V
C25	CERAMIC	0.0047	50V
C26	CERAMIC	0.001	50V
C27	CERAMIC	0.001	50V
C28	CERAMIC	0.001	50V
C29	BARRIER LAYER	0.1	16V
C30	CERAMIC	0.5P	500V
C31	ELECTROLYTIC	1000	16V
C32	ELECTROLYTIC	220	16V
RL1	RELAY	MZ	12HG

PA UNIT/LPF UNIT

REF. NO.	DESCRIPTION	PART NO.
J1	CONNECTOR	LR02-2V
J2	CONNECTOR	SJ-296
J3	CONNECTOR	MR-DSE-01
J4	CONNECTOR	SMP-04V-B
J5	CONNECTOR	TL25P-06-V1
J6	CONNECTOR	TL25P-03-V1
J7	CONNECTOR	TL25P-05-V1
P1	CONNECTOR	TMP-P01X-A1
P2	CONNECTOR	TLB-P08H-A1
P3	CONNECTOR	TL25H-08-B1
P4	CONNECTOR	TL25H-06-B1
EP1	BEAD CORE	DL2-OP2.6-3-1.2H
EP2	BEAD CORE	DL2-OP2.6-3-1.2H
EP3	BEAD CORE	DL2-OP2.6-3-1.2H
EP4	BEAD CORE	FSQH050RN
EP5	BEAD CORE	FSQH050RN
EP6	P.C.B.	B-1064D
EP7	BEAD CORE	FSQH070RN
EP8	BEAD CORE	FSQH070RN

11 - 5 LPF UNIT

REF. NO.	DESCRIPTION	PART NO.
Q1	TRANSISTOR	2SC945-P
D1	DIODE	1SS53
L1	COIL	LW-19
L2	COIL	LA-242 (#03,#04 only)
R1	RESISTOR	12k R20
C1	CERAMIC	0.5P 500V (#01,#02,#03,#04 only)
C2	CERAMIC	3P 500V (#01,#02,#03,#04) 5P 500V (#05,#06)
C3	CERAMIC	0.001 50V
C4	CERAMIC	0.001 50V
RL1	RELAY	CX-1051
P1	CONNECTOR	TMP-P01X-A1
P2	CONNECTOR	TL25H-03-B1
P3	CONNECTOR	TLB-P03H-A1
EP1	P.C.B	B-1071D

11 - 6 LOGIC UNIT

REF. NO.	DESCRIPTION	PART NO.
IC1	IC	μ PD78C06AG
IC2	IC	μ PD446C
IC3	IC	μ PD4066BG
IC4	IC	μ PD4069UBG
Q1	TRANSISTOR	2SA1048-Y
Q2	TRANSISTOR	2SC2458-GR
Q3	TRANSISTOR	2SC3399
Q4	TRANSISTOR	2SA1345
Q5	TRANSISTOR	2SC3399
D1	ZENER	RD5.1E B2
D2	DIODE	1S953
D3	DIODE	1SS133
D4	DIODE	1SS133
D5	DIODE	1SS133
D6	DIODE	1SS133
D7	DIODE	1SS133
D8	DIODE	1SS133
D9	DIODE	1SS133
D10	DIODE	1SS133
D11	DIODE	1SS133
D12	DIODE	1SS133
D13	DIODE	1SS133
D14	ZENER	RD6.2E B2
X1	CRYSTAL	CR63
L1	COIL	LAL03NA 101k
R1	RESISTOR	15k ELR20
R2	RESISTOR	180k ELR20
R3	RESISTOR	22k R20
R4	RESISTOR	33k R20
R5	RESISTOR	47k R20
R6	RESISTOR	100k R20
R7	ARRAY	RM4 10k
R8	RESISTOR	47k R20
R9	RESISTOR	47k R20
R10	RESISTOR	47k R20
R11	RESISTOR	47k R20
R12	RESISTOR	1M R20
R14	RESISTOR	1k R20
R15	RESISTOR	47k ELR20
R16	RESISTOR	22k ELR20
R17	RESISTOR	10 R20
R18	RESISTOR	18k R20
C1	ELECTROLYTIC	100 10V MS7
C2	BARRIER LAYER	0.01 25V
C3	BARRIER LAYER	0.01 25V
C4	CERAMIC	18P 50V
C5	CERAMIC	18P 50V
C6	CERAMIC	0.001 50V
C7	BARRIER LAYER	0.1 16V
C8	BARRIER LAYER	0.1 16V
C9	ELECTROLYTIC	10 16V MS7
C10	BARRIER LAYER	0.1 16V
CP1	CHECK POINT	RT-01T-1.0B

LOGIC UNIT/DISPLAY UNIT

REF. NO.	DESCRIPTION	PART NO.
J1	CONNECTOR	PI32B20R-1
J2	CONNECTOR	9B-SQ
J3	CONNECTOR	6B-SQ
J4	CONNECTOR	B10B-EH-S
BT1	LITHIUM BATTERY	BR2325-1HC
EP1	P.C.B.	B-1070D

11 - 7 DISPLAY UNIT

REF. NO.	DESCRIPTION	PART NO.
IC1	IC	μ PD7225G
IC2	IC	μ PD4081BG
IC3	IC	μ PD4013BG
Q1	TRANSISTOR	2SA1162-Y
Q2	TRANSISTOR	2SA1162-Y
Q3	TRANSISTOR	2SC2712-Y
Q4	TRANSISTOR	2SC2712-Y
Q5	TRANSISTOR	2SC2712-Y
D1	DIODE	1SS184
D3	DIODE	1SS184
D4	DIODE	1SS184
D5	DIODE	1SS184
D6	DIODE	1SS184
D7	DIODE	1SS184
R1	CHIP	180k MCR10
R2	CHIP	15k MCR10
R3	CHIP	15k MCR10
R4	CHIP	100k MCR10
R5	CHIP	100k MCR10
R6	CHIP	47k MCR10
R7	CHIP	47k MCR10
R8	CHIP	47k MCR10
R10	VARIABLE	RKDA1014QA 20kC
R11	TRIMMER	RHB0CS42BA 47k
R12	CHIP	47k MCR10
R13	CHIP	47k MCR10
R14	CHIP	47k MCR10
R15	CHIP	47k MCR10
R16	CHIP	150 MCR10
R17	CHIP	1M MCR10
R18	CHIP	10k MCR10
R19	CHIP	1M MCR10
R20	CHIP	150 MCR10
R21	CHIP	1M MCR10
R22	CHIP	10k MCR10
R23	CHIP	47k MCR10
R24	CHIP	18k MCR10
R25	CHIP	47k MCR10
C1	MONOLITHIC	0.001 GRM40
C2	MONOLITHIC	0.001 GRM40
C3	MONOLITHIC	0.01 GRM40 F
C4	MONOLITHIC	0.001 GRM40
C5	MONOLITHIC	0.01 GRM40 F
C6	MONOLITHIC	0.01 GRM40 F
C7	MONOLITHIC	0.001 GRM40
C8	MONOLITHIC	0.01 GRM40 F

DISPLAY UNIT/CTCSS UNIT

REF. NO.	DESCRIPTION	PART NO.
C10	MONOLITHIC	0.001 GRM40
C11	MONOLITHIC	0.001 GRM40
C12	MONOLITHIC	0.001 GRM40
C13	MONOLITHIC	0.001 GRM40
C14	MONOLITHIC	0.001 GRM40
C15	MONOLITHIC	0.1 GRM40 F
C16	CERAMIC	0.001 50V
J1	CONNECTOR	SB-5P-HVQ-CA
J2	CONNECTOR	SB-5P-HVQ-CA
DS1	LAMP	BQ031-22403A
DS2	LAMP	BQ031-22403A
DS3	LCD	HLC-9222-1
S1	SWITCH	A2C-1A3
S2	SWITCH	SKHHAA
S3	SWITCH	SKHHA
S4	SWITCH	SKHHA
S5	SWITCH	SKHHA
S6	SWITCH	SKHHA
S7	SWITCH	SKHHA
S8	SWITCH	SKHHA
EP1	P.C.B.	B-1069C
EP2	P.C.B.	B-1075C
EP3	RUBBER CONDUCTOR	SRCN-323

11 - 8 CTCSS UNIT

REF. NO.	DESCRIPTION	PART NO.
IC1	IC	MN6520
Q1	TRANSISTOR	2SC3399
D1	DIODE	1SS133
D2	DIODE	1SS133
X1	CRYSTAL	FACNKD
R1	RESISTOR	10k R20
R2	RESISTOR	10k R20
R3	RESISTOR	15k R20
R4	RESISTOR	10k R20
R5	RESISTOR	2.2k R20
R6	RESISTOR	150k R20
R7	RESISTOR	18k R20
R9	RESISTOR	12k R20
R10	RESISTOR	10k R20
R11	RESISTOR	18k R20
R12	RESISTOR	1k R20
C1	CERAMIC	18P 50V
C2	CERAMIC	18P 50V
C3	ELECTROLYTIC	0.1 50V MS5
C5	ELECTROLYTIC	47 6.3V MS5
C6	ELECTROLYTIC	10 16V MS5
C7	ELECTROLYTIC	0.1 50V MS5
EP1	P.C.B.	B-1072C

SECTION 12 OPTIONAL UNITS

12 - 1 UT-26, UT-27 INSTALLATION

1. Orient the circuit board correctly as shown in Fig. 12-1 and tighten the four screws.

2. Connect the 5-pin plug (J6) on the PA unit.

Pass the plug through the PA assembly rectangular opening as shown.

3. Connect the 10-pin plug to J3 on the MAIN unit. The cable harness must be passed through the gap between the PA assembly and the MAIN chassis as shown.

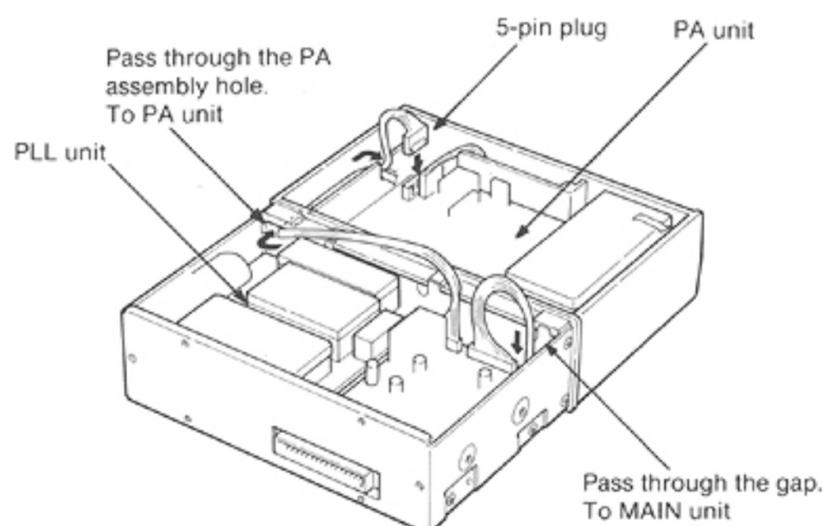


Fig. 12 - 1 UNIT INSTALLATION

12 - 2 UT-26 2-TONE DECODER UNIT PROGRAMMING

12 - 2 - 1 SETTING THE FIRST DIGIT OF THE CODE NUMBER

1. Locate jumper connector J3 on the UT-26 unit and change the connection as follows.

Jumper connector	Position
J3	A•B→C•D

2. Connect a 100mV rms or greater signal from the audio generator across pin B on jumper connector J3 (Fig. 12-2) and ground using alligator clips. Adjust the generator using the frequency counter to the frequency of the first digit of the desired code number according to the frequency chart.

3. Connect the oscilloscope to CP1 on the UT-26 unit.

4. Adjust R2 (active filter) for the maximum output level on the oscilloscope. The output level should be more than 1Vp-p.

12 - 2 - 2 SETTING THE SECOND DIGIT OF THE CODE NUMBER

1. Locate jumper connector J4 on the UT-26 unit and change the connection as follows.

Jumper connector	Position
J4	G•H→E•F

2. Connect the audio generator as THE FIRST DIGIT with the same output level and adjust the generator to the frequency of the second digit of the desired code number.
3. Connect the oscilloscope as above.
4. Adjust R1 to the maximum output level on the oscilloscope. The output level should be more than 1Vp-p.
5. Return the J3 and J4 jumper connectors to the A•B and G•H positions respectively.

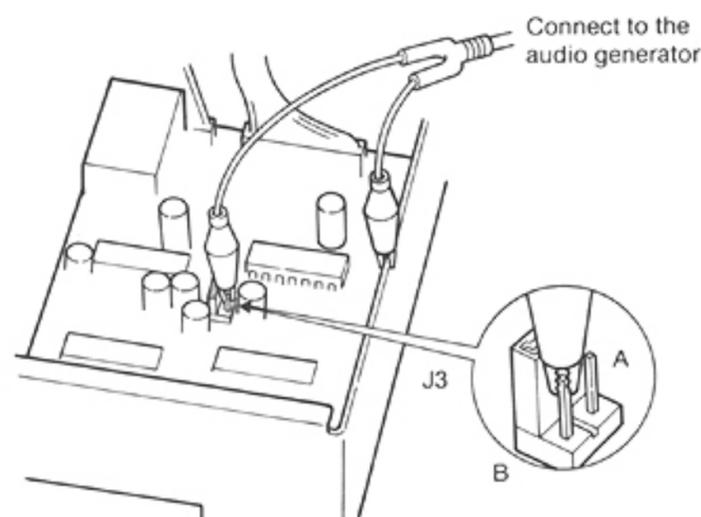


Fig. 12 - 2 AUDIO SIGNAL INPUT

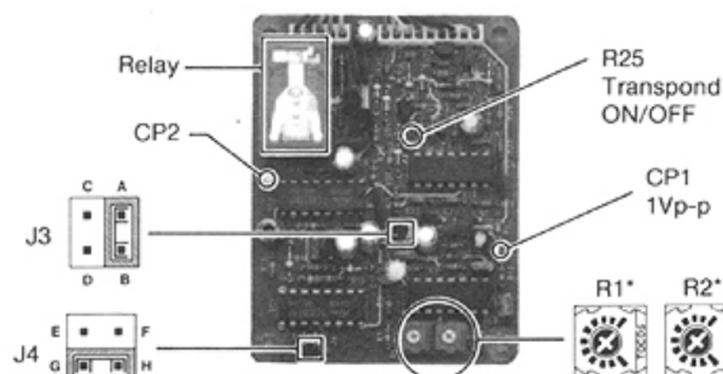


Fig. 12 - 3 UNIT'S CHECK POINT

12 - 2 - 3 STANDARD GROUPS FOR 2-TONE SEQUENTIAL SIGNALLING

CODE NO.	Group 1	Group 2	Group 3	Group 4	Group 5
0	330.5	569.1	1092.4	321.7	553.9
1	349.0	600.9	288.5	339.6	584.8
2	368.5	634.5	296.5	358.6	617.4
3	389.0	669.9	304.7	378.6	651.9
4	410.8	707.3	313.0	399.8	688.3
5	433.7	746.8	953.7	422.1	726.8
6	457.9	788.5	979.9	445.7	767.4
7	483.5	832.5	1006.9	470.5	810.2
8	510.5	879.0	1034.7	496.8	855.5
9	539.0	928.1	1063.2	524.6	903.2
DG	569.1	979.9	569.1	569.1	979.9

(Unit: Hz)

12 - 2 - 4 FUNCTION CHECKS WITH ANOTHER TRANSCEIVER

NOTE: The function checks require another transceiver with a 2-Tone encoder installed. Check the following functions thoroughly before re-assembly.

1. The "CALL" indicator lights up while decoding is in progress.
2. The relay and transpond function work after decoding is completed. The transpond function works for about 2 seconds.
3. The transpond signal is modulated by a single tone.
4. The "CALL" indicator goes OFF after pushing the PTT switch.

12 - 2 - 5 TRANSCEIVER PROGRAMMING

1. After installation of the UT-26 and when all of the previous programming is completed, the IC-U400 must have the 2-Tone decoder function programmed on a particular channel.
2. Transceiver programming requires the optional EX-494 External Keyboard. See the PROGRAMMING MANUAL SECTIONS 1-5 and 1-6 for further instructions.

12 - 3 UT-27 2805Hz DECODER UNIT PROGRAMMING

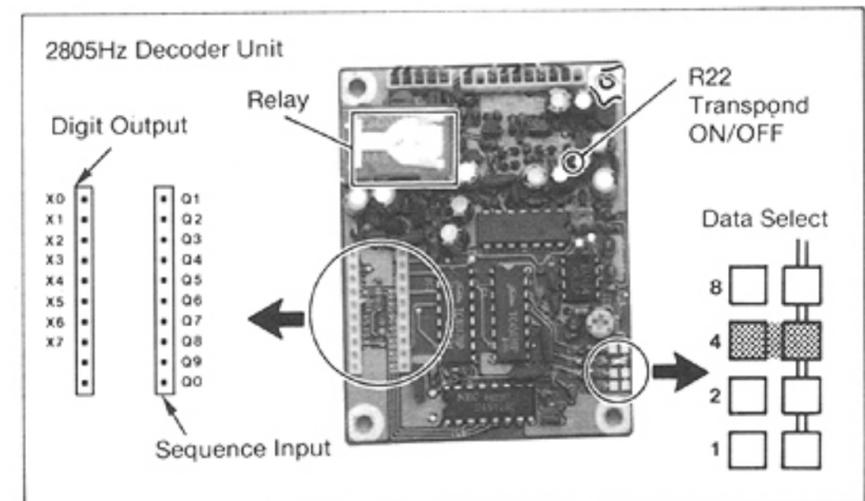
12 - 3 - 1 CODE NUMBER PROGRAMMING

1. Use supplied wire jumpers to connect the Digit output (J3) terminals to the Sequence input (J4) terminals to program the desired code number. The code number may be up to 8 digits in length. Solder the connections.

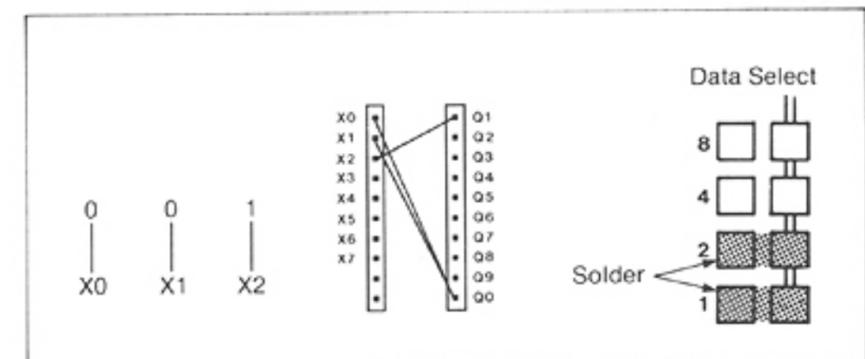
2. The first digit of the code number is allocated to X0, the second digit to X1, the third digit to X2, etc. on the Digit output jack (J3). The pins on the Sequence input jack (J4) refer to the numerical value of each digit; Q1 is "1", Q2 is "2", Q3 is "3", etc. See the diagrams for sample programming.

12 - 3 - 2 DATA SELECT PROGRAMMING

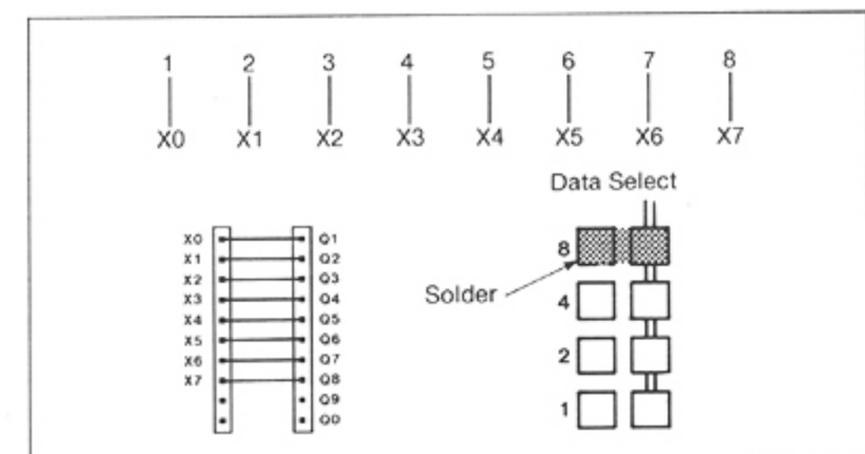
1. Programming is performed by soldering the appropriate printed circuit board traces adjacent to diodes D5 through D8. Solder quickly to avoid damaging the diodes by excessive heat.
2. The data select programming is the total number of digits in the code number. The four traces represent "1", "2", "4" and "8". For example, if the code number desired has 3 digits, solder both traces "1" and "2" (i.e., 1 + 2 = 3).



[EXAMPLE 1] Programming the code number "001".



[EXAMPLE 2] Programming the code number "12345678".



12 - 3 - 3 TRANSCEIVER PROGRAMMING

1. After installation of the UT-27 and when all of the previous programming is completed, the IC-U400 must have the 2805Hz decoder function programmed on a particular channel.
2. Transceiver programming requires the optional EX-494 External Keyboard. See your transceiver PROGRAMMING MANUAL SECTIONS 1-5 and 1-6 for further instructions.

12 - 4 OTHER FUNCTIONS

12 - 4 - 1 TRANSPOND FUNCTION

The transpond function for confirmation of a communication link between the calling and called station is available and may be activated or deactivated.

1. The UT-26 and UT-27 are shipped from the factory with the transpond function activated. Signals received with the correct code number will cause the IC-U400 to transmit a 2 second tone back to the calling station if an operator does not reply to the incoming call.

2. To deactivate this function, cut the lead of R25 (47k ohms) on the UT-26 and R22 (47k ohms) on UT-27. Now, no transpond tone will be transmitted. To reactivate the function at a later date, solder the two ends of the cut lead together.

HORN-HONK FUNCTION

When a signal with a correct code number is decoded by the UT-26 or UT-27, the transceiver alerts the operator through a signalling device, such as an automobile horn. This is useful when the operator is away from the operating position.

1. Connect the supplied cable to the HORN CONNECTOR on the rear panel of the transceiver. Connect this cable to your chosen signalling device.

2. Refer to the sample connection as shown in the Fig. 12-4.

• HORN-HONK SAMPLE CONNECTION

NOTE: Maximum ratings of the UT-26 and UT-27 relays are 28V and 3A. **DO NOT** connect any device with a voltage or current requirement that exceeds these ratings. If the vehicle does not have a horn relay, an intermediate relay must be installed.

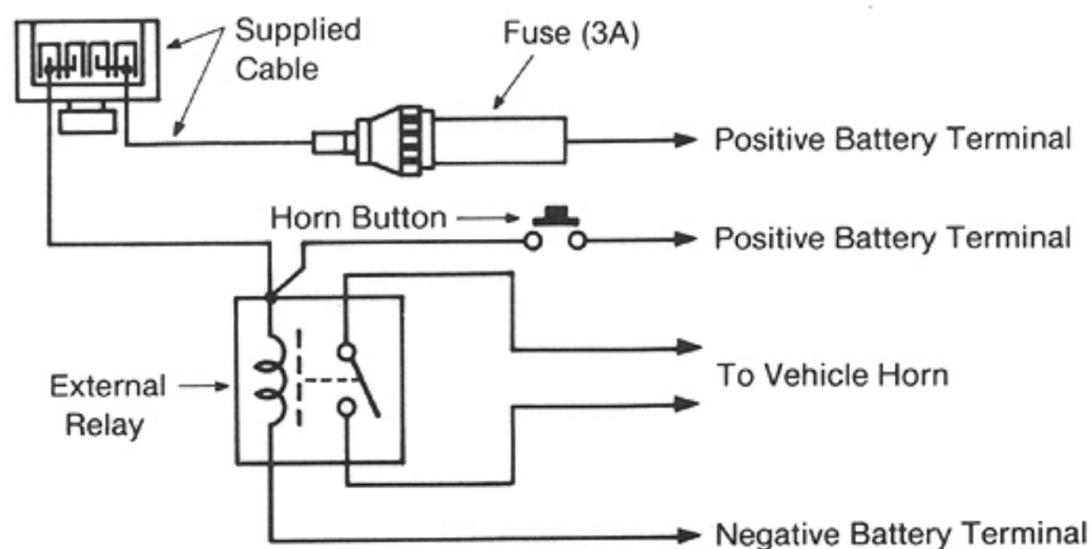
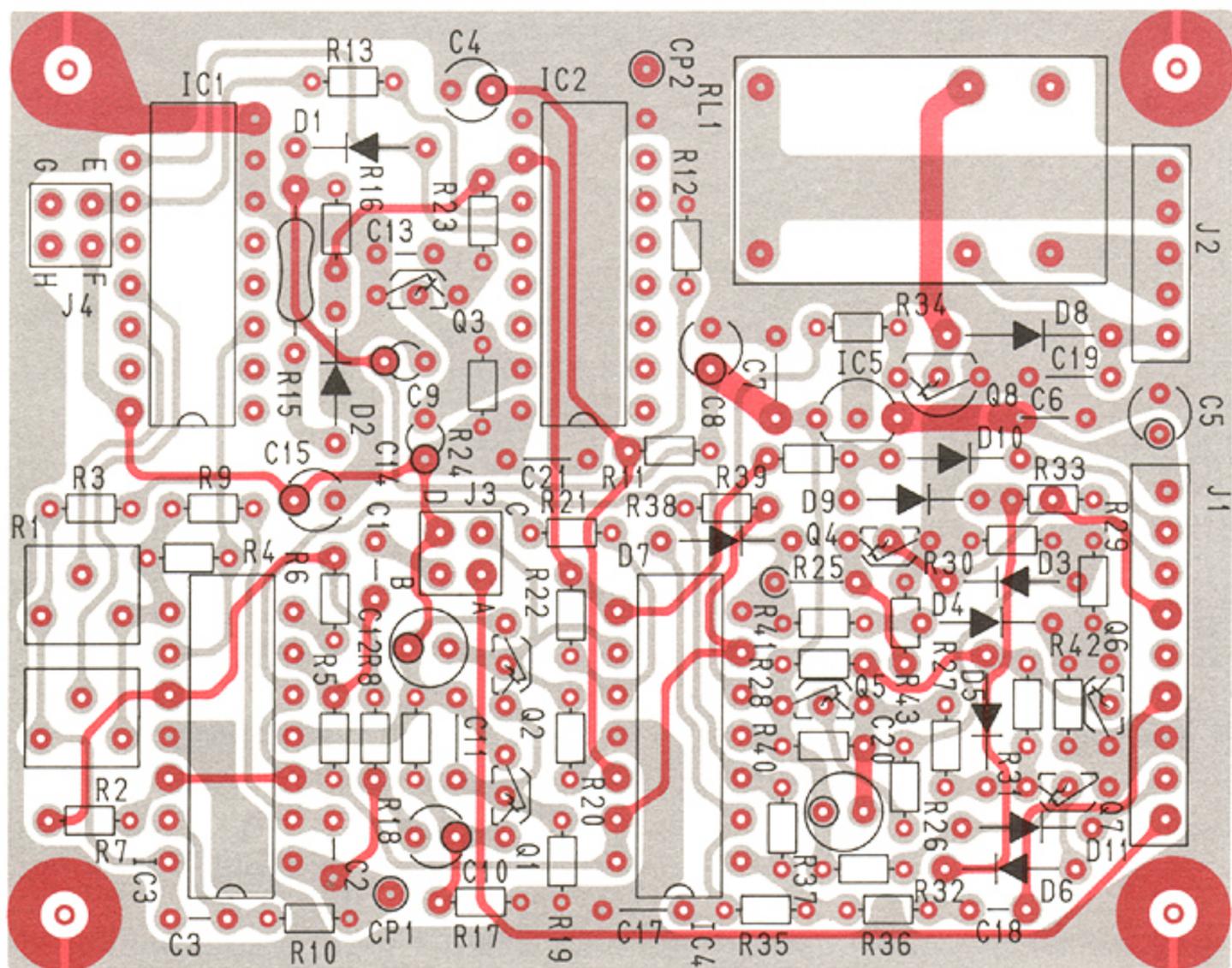
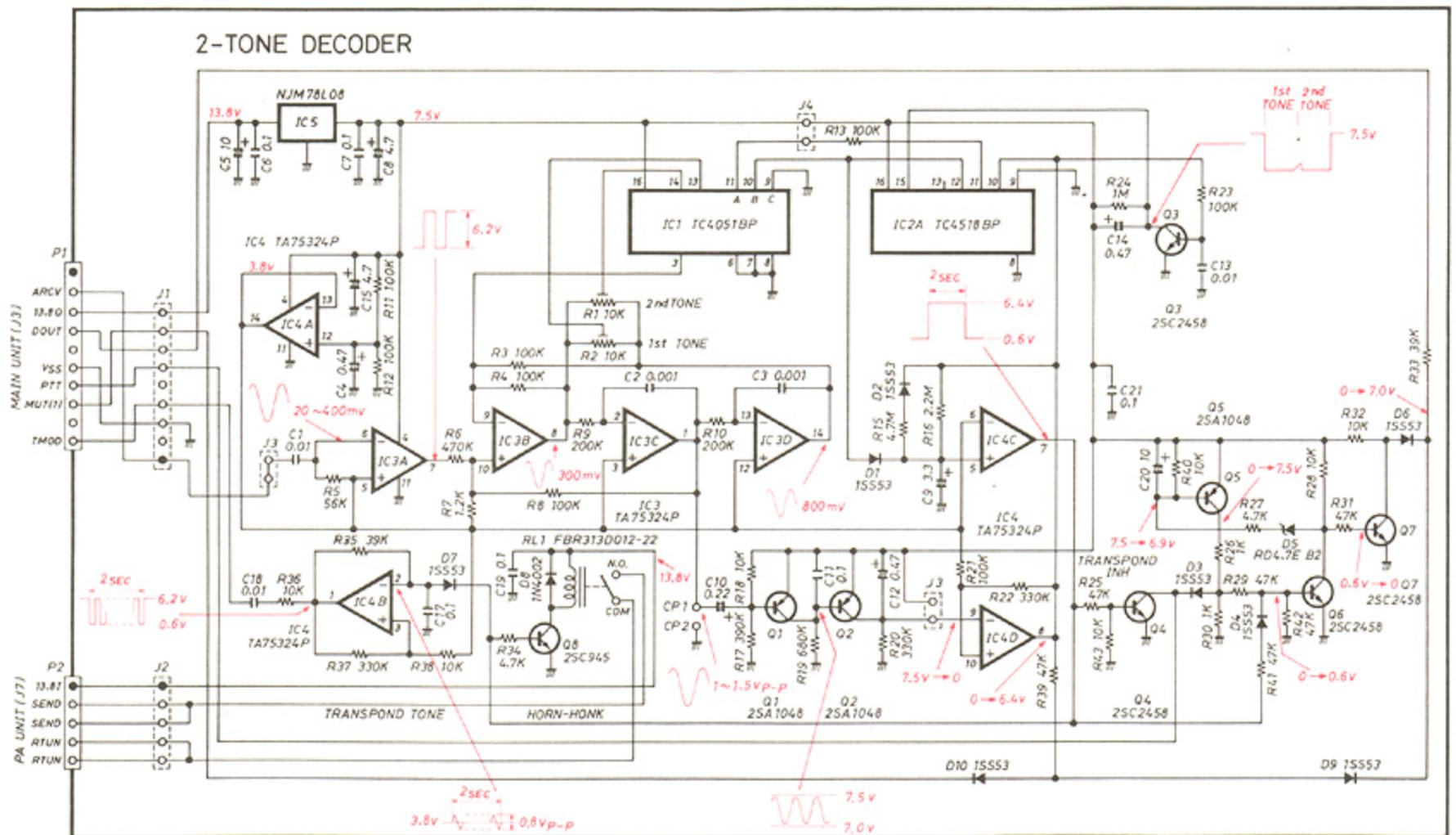
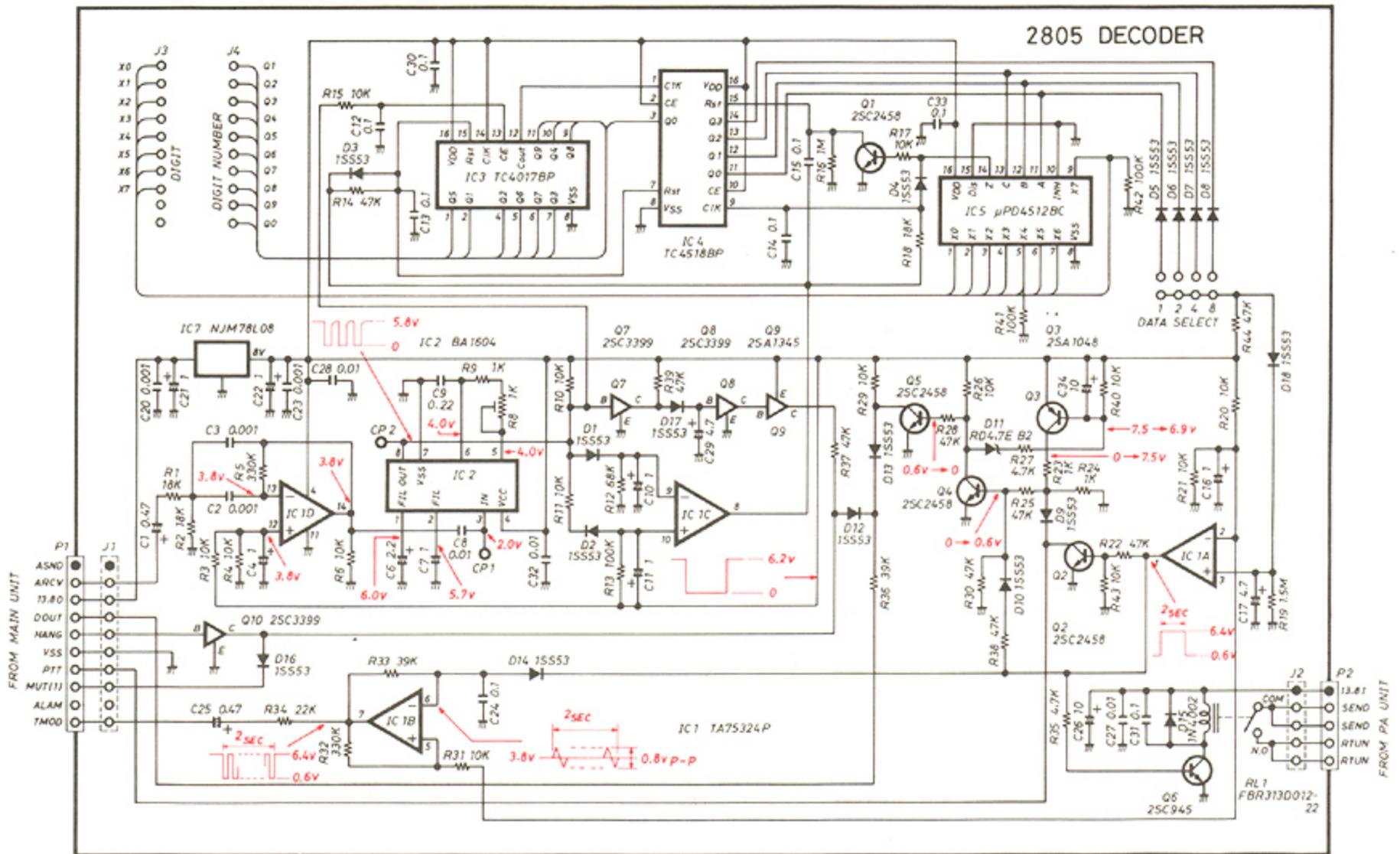


Fig. 12 - 4 HORN-HONK SAMPLE CONNECTION

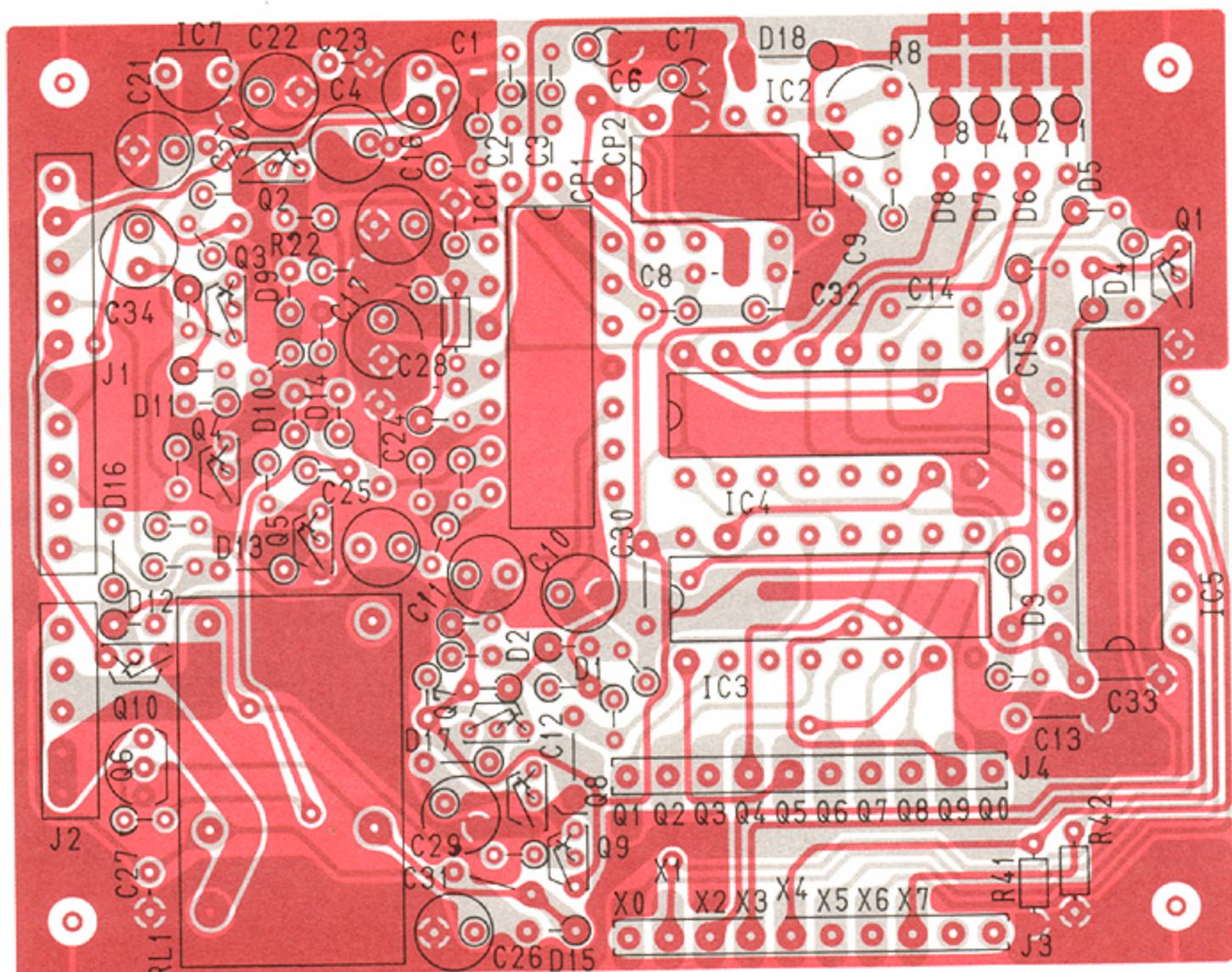
12 - 5 UT-26, UT-27 VOLTAGE DIAGRAMMS AND BOARD LAYOUTS

12 - 5 - 1 UT-26





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12 - 6 UT-26, UT-27 PARTS LIST

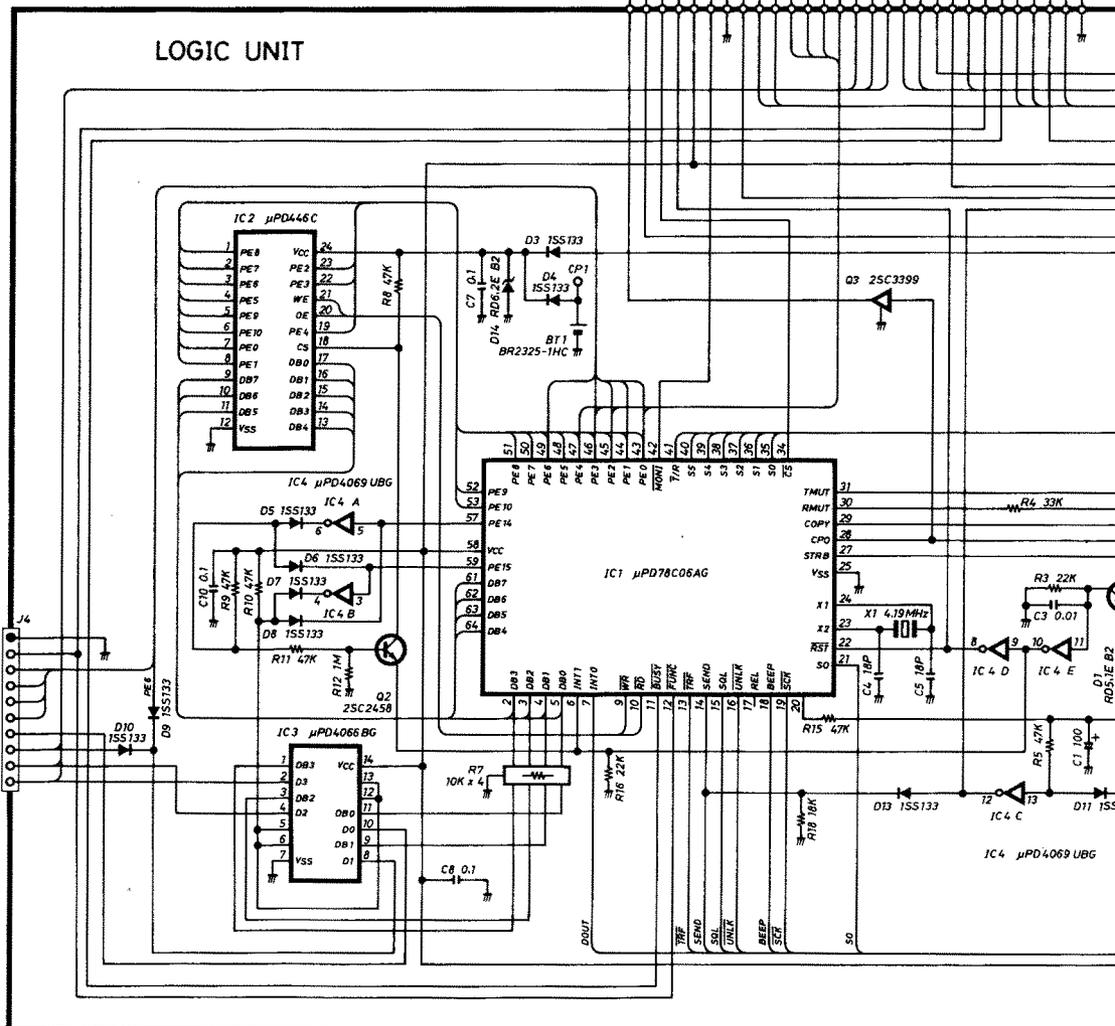
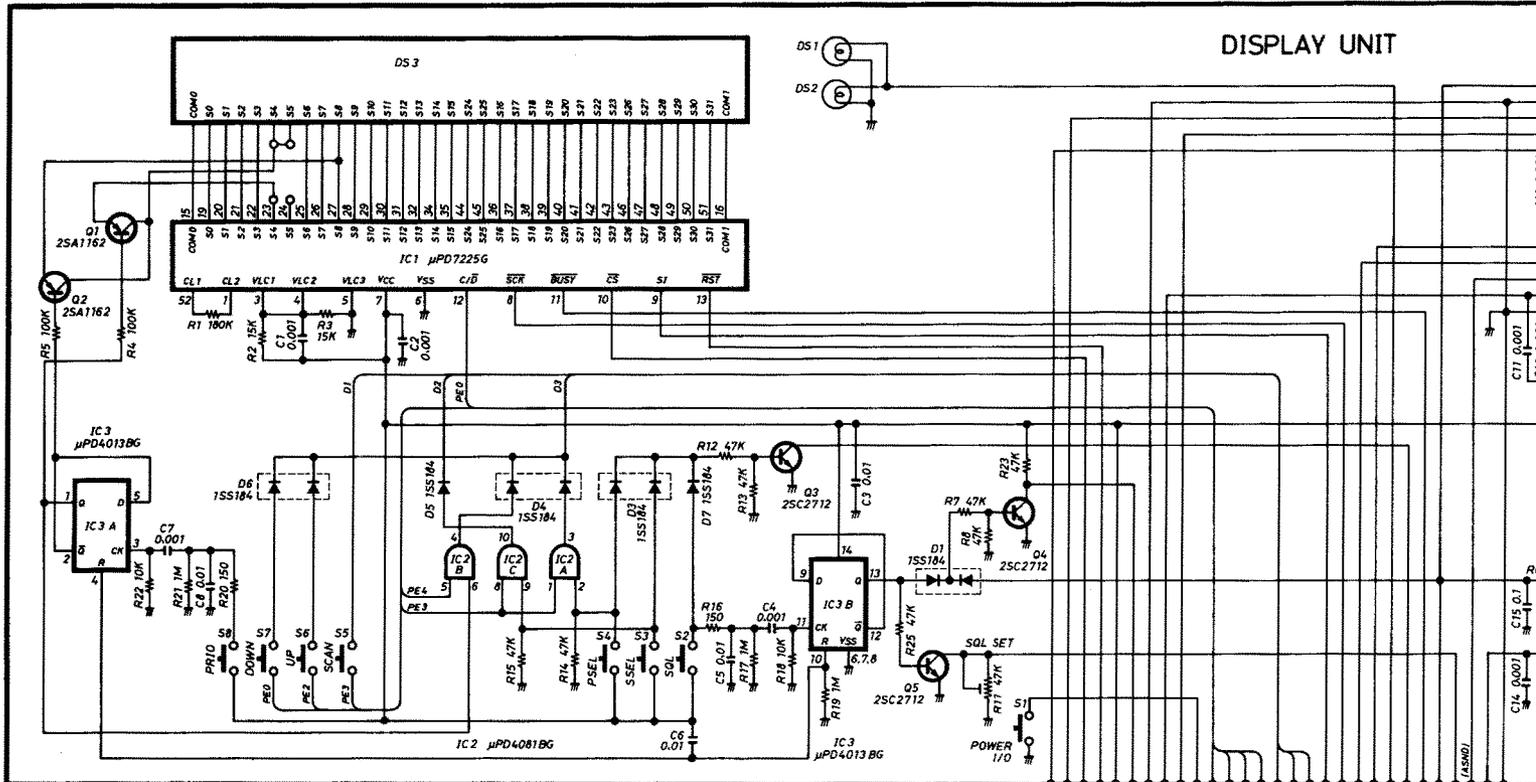
12 - 6 - 1 UT-26

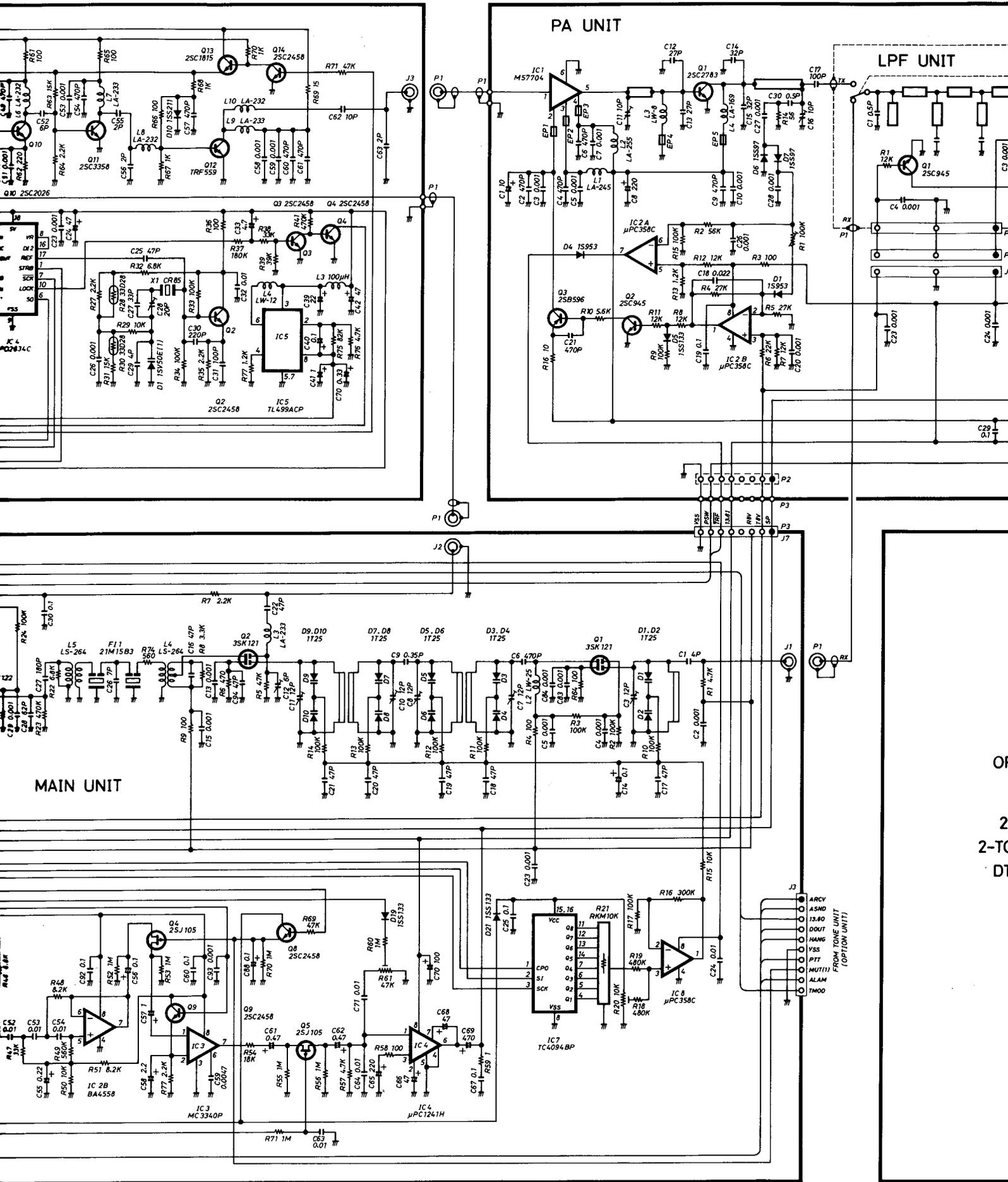
REF. NO.	DESCRIPTION	PART NO.	REF. NO.	DESCRIPTION	PART NO.
IC1	IC	TC4051BP	R33	RESISTOR	39k R20
IC2	IC	TC4518BP	R34	RESISTOR	4.7k R20
IC3	IC	TA75324P	R35	RESISTOR	39k R20
IC4	IC	TA75324P	R36	RESISTOR	10k R20
IC5	IC	NJM78L08	R37	RESISTOR	330k R20
			R38	RESISTOR	10k R20
Q1	TRANSISTOR	2SA1048-Y	R39	RESISTOR	47k R20
Q2	TRANSISTOR	2SA1048-Y	R40	RESISTOR	10k R20
Q3	TRANSISTOR	2SC2458-GR	R41	RESISTOR	47k R20
Q4	TRANSISTOR	2SC2458-GR	R42	RESISTOR	47k R20
Q5	TRANSISTOR	2SA1048-Y	R43	RESISTOR	10k R20
Q6	TRANSISTOR	2SC2458-GR			
Q7	TRANSISTOR	2SC2458-GR	C1	MYLAR	0.01 50V
Q8	TRANSISTOR	2SC945-P	C2	MYLAR	0.001 50V
			C3	MYLAR	0.001 50V
D1	DIODE	1SS53	C4	ELECTROLYTIC	0.47 50V
D2	DIODE	1SS53	C5	ELECTROLYTIC	10 16V
D3	DIODE	1SS53	C6	BARRIER LAYER	0.1 16V
D4	DIODE	1SS53	C7	BARRIER LAYER	0.1 16V
D5	ZENER	RD4.7E B2	C8	ELECTROLYTIC	4.7 50V
D6	DIODE	1SS53	C9	ELECTROLYTIC	3.3 50V
D7	DIODE	1SS53	C10	ELECTROLYTIC	0.22 50V MS7
D8	DIODE	1N4002	C11	BARRIER LAYER	0.1 16V
D9	DIODE	1SS53	C12	ELECTROLYTIC	0.47 50V
D10	DIODE	1SS53	C13	MYLAR	0.01 50V
			C14	ELECTROLYTIC	0.47 50V
R1	TRIMMER	RG06P 103 10k	C15	ELECTROLYTIC	4.7 50V
R2	TRIMMER	RG06P 103 10k	C17	BARRIER LAYER	0.1 16V
R3	RESISTOR	100k R20	C18	MYLAR	0.01 50V
R4	RESISTOR	100k R20	C19	BARRIER LAYER	0.1 16V
R5	RESISTOR	56k R20	C20	ELECTROLYTIC	10 16V
R6	RESISTOR	470k R20	C21	BARRIER LAYER	0.1 16V
R7	RESISTOR	1.2k R20			
R8	RESISTOR	100k R20	RL1	RELAY	FBR313D012-22
R9	RESISTOR	200k R20			
R10	RESISTOR	200k R20	CP1	CHECK POINT	IPS-1136
R11	RESISTOR	100k R20	CP2	CHECK POINT	IPS-1136
R12	RESISTOR	100k R20			
R13	RESISTOR	100k R20	J1	CONNECTOR	TLB-P09-A1
R15	RESISTOR	4.7M ERC14GJ	J2	CONNECTOR	TLB-P05-A1
R16	RESISTOR	2.2M R20	J3	CONNECTOR	IMSA-9201B-2-04-T
R17	RESISTOR	390k R20	J4	CONNECTOR	IMSA-9201B-2-04-T
R18	RESISTOR	10k R20			
R19	RESISTOR	680k R20	P1	CONNECTOR	TL25H-10-B1
R20	RESISTOR	330k R20	P2	CONNECTOR	TL25H-05-B1
R21	RESISTOR	100k R20	P3	CONNECTOR	IMSA-9201-HT
R22	RESISTOR	330k R20	P4	CONNECTOR	IMSA-9201-HT
R23	RESISTOR	100k R20			
R24	RESISTOR	1M R20	EP1	P.C.B.	B-1153B
R25	RESISTOR	47k ELR25			
R26	RESISTOR	1k R20			
R27	RESISTOR	4.7k R20			
R28	RESISTOR	10k R20			
R29	RESISTOR	47k R20			
R30	RESISTOR	1k R20			
R31	RESISTOR	47k R20			
R32	RESISTOR	10k R20			

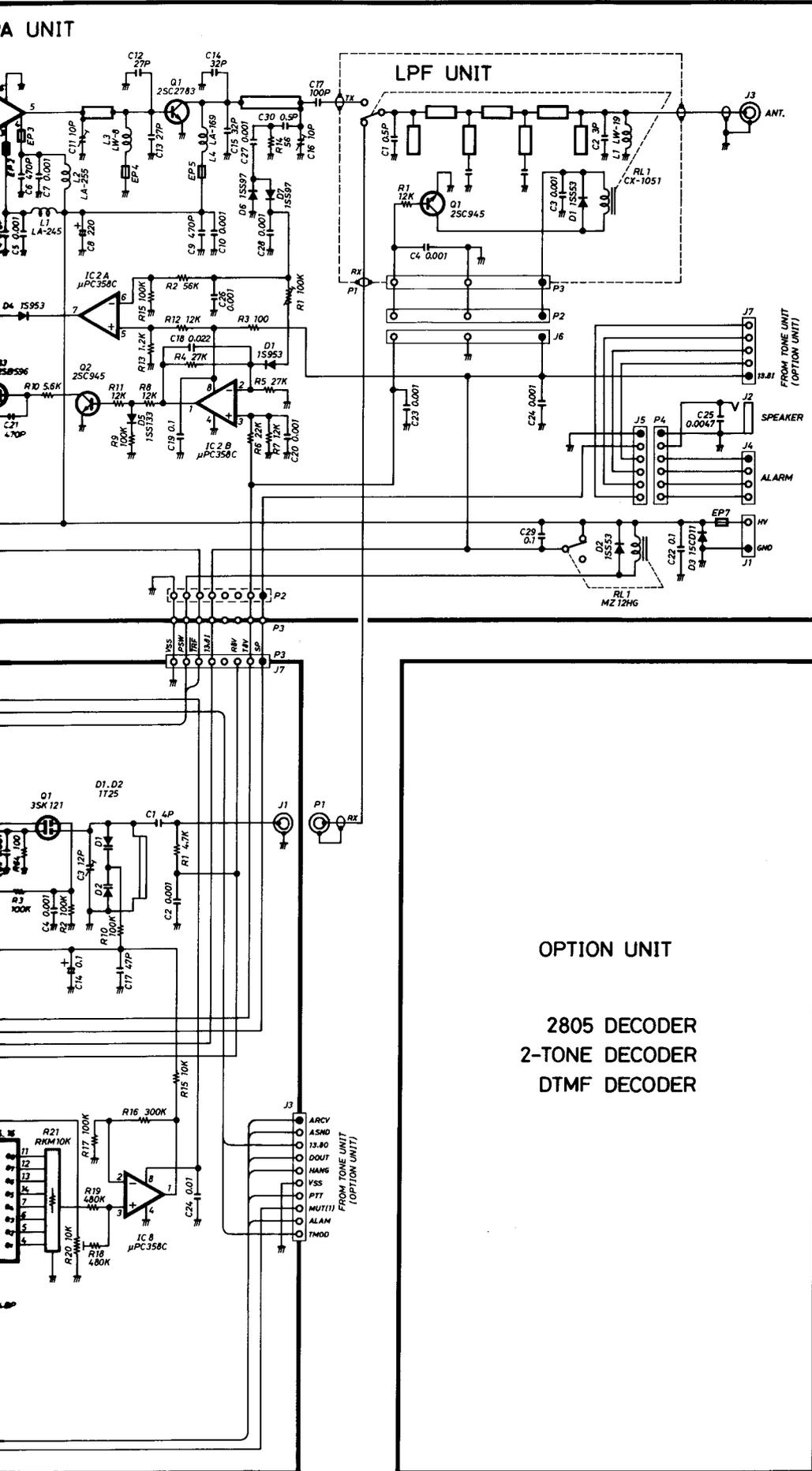
12 - 6 - 2 UT-27

REF. NO.	DESCRIPTION	PART NO.	REF. NO.	DESCRIPTION	PART NO.
IC1	IC	TA75324P	R28	RESISTOR	47k ELR20
IC2	IC	BA1604	R29	RESISTOR	10k ELR20
IC3	IC	TC4017BP	R30	RESISTOR	47k ELR20
IC4	IC	TC4518BP	R31	RESISTOR	10k ELR20
IC5	IC	μPD4512BC	R32	RESISTOR	330k ELR20
IC7	IC	NJM78L08	R33	RESISTOR	39k ELR20
Q1	TRANSISTOR	2SC2458-GR	R34	RESISTOR	22k ELR20
Q2	TRANSISTOR	2SC2458-GR	R35	RESISTOR	4.7k ELR20
Q3	TRANSISTOR	2SA1048-GR	R36	RESISTOR	39k ELR20
Q4	TRANSISTOR	2SC2458-GR	R37	RESISTOR	47k ELR20
Q5	TRANSISTOR	2SC2458-GR	R38	RESISTOR	47k ELR20
Q6	TRANSISTOR	2SC945-P	R39	RESISTOR	47k ELR20
Q7	TRANSISTOR	2SC3399	R40	RESISTOR	10k ELR20
Q8	TRANSISTOR	2SC3399	R41	RESISTOR	100k R20
Q9	TRANSISTOR	2SA1345	R42	RESISTOR	100k R20
Q10	TRANSISTOR	2SC3399	R43	RESISTOR	10k ELR20
			R44	RESISTOR	47k R20
D1	DIODE	1SS53	C1	ELECTROLYTIC	0.47 50V
D2	DIODE	1SS53	C2	MYLAR	0.001 50V
D3	DIODE	1SS53	C3	MYLAR	0.001 50V
D4	DIODE	1SS53	C4	ELECTROLYTIC	1 50V
D5	DIODE	1SS53	C6	TANTALUM	2.2 16V
D6	DIODE	1SS53	C7	TANTALUM	1 35V
D7	DIODE	1SS53	C8	BARRIER LAYER	0.01 25V
D8	DIODE	1SS53	C9	TANTALUM	0.22 35V
D9	DIODE	1SS53	C10	ELECTROLYTIC	1 50V
D10	DIODE	1SS53	C11	ELECTROLYTIC	1 50V
D11	ZENER	RD4.7E B2	C12	BARRIER LAYER	0.1 16V
D12	DIODE	1SS53	C13	BARRIER LAYER	0.1 16V
D13	DIODE	1SS53	C14	BARRIER LAYER	0.1 16V
D14	DIODE	1SS53	C15	BARRIER LAYER	0.1 16V
D15	DIODE	1N4002	C16	ELECTROLYTIC	1 50V
D16	DIODE	1SS53	C17	ELECTROLYTIC	4.7 25V
D17	DIODE	1SS53	C20	CERAMIC	0.001 50V
D18	DIODE	1SS53	C21	ELECTROLYTIC	1 50V
R1	RESISTOR	18k ELR20	C22	ELECTROLYTIC	1 50V
R2	RESISTOR	18k ELR20	C23	CERAMIC	0.001 50V
R3	RESISTOR	10k ELR20	C24	BARRIER LAYER	0.1 16V
R4	RESISTOR	10k ELR20	C25	ELECTROLYTIC	0.47 50V
R5	RESISTOR	330k ELR20	C26	ELECTROLYTIC	10 16V
R6	RESISTOR	10k ELR20	C27	BARRIER LAYER	0.01 25V
R8	TRIMMER	RHB0C1324A 1k	C28	BARRIER LAYER	0.01 25V
R9	RESISTOR	1k ELR20	C29	ELECTROLYTIC	4.7 25V
R10	RESISTOR	10k ELR20	C30	BARRIER LAYER	0.1 16V
R11	RESISTOR	10k ELR20	C31	BARRIER LAYER	0.1 16V
R12	RESISTOR	68k ELR20	C32	BARRIER LAYER	0.01 25V
R13	RESISTOR	100k ELR20	C33	BARRIER LAYER	0.1 16V
R14	RESISTOR	47k ELR20	C34	ELECTROLYTIC	10 16V
R15	RESISTOR	10k ELR20	RL1	RELAY	FBR313D012-22
R16	RESISTOR	1M ELR20	CP1	CHECK POINT	IPS-1136
R17	RESISTOR	10k ELR20	CP2	CHECK POINT	IPS-1136
R18	RESISTOR	18k ELR20	J1	CONNECTOR	TLB-P10-A1
R19	RESISTOR	1.5M ELR20	J2	CONNECTOR	TLB-P05-A1
R20	RESISTOR	10k R20	J3	CONNECTOR	10B-SQ
R21	RESISTOR	10k ELR20	J4	CONNECTOR	10B-SQ
R22	RESISTOR	47k R25	P1	CONNECTOR	TL25H-10-B1
R23	RESISTOR	1k ELR20	P2	CONNECTOR	TL25H-05-B1
R24	RESISTOR	1k ELR20	EP1	P.C.B.	B-1144B
R25	RESISTOR	47k ELR20			
R26	RESISTOR	10k ELR20			
R27	RESISTOR	4.7k ELR20			

IC-U 400 SCHEMATIC DIAGRAM







To upgrade quality, some components may be subject to change without notice.