



# SERVICE MANUAL

**IC-03AT**  
220MHz FM TRANSCEIVER

ICOM INCORPORATED

## INTRODUCTION

This service manual contains information relative to the theoretical, physical, mechanical and electrical characteristics of the **IC-03AT** 220MHz FM TRANSCEIVER.

## ASSISTANCE

If you require assistance or further information regarding the operation and capabilities of the **IC-03AT**, please contact your nearest authorized ICOM Dealer or ICOM Service Center.

## ORDERING PARTS

For the fastest service, supply all of the following information when ordering parts from your dealer or ICOM Service Center:

1. Equipment model and serial number
2. Schematic part identifier (e.g., IC301, Q318)
3. Printed circuit board name and number (e.g., MAIN UNIT/B-810I)
4. Part number and name (e.g., 2SC2053 Transistor)
5. Quantity required (e.g., 3pcs.)

## REPAIR NOTE

1. **DO NOT** open transceiver covers until the transceiver is disconnected from a power source.
2. **DO NOT** connect the transceiver to an external power source of more than 16V.
3. **DO NOT** force any of the variable components. Turn them slowly and smoothly.
4. **DO NOT** short any circuits or electronic parts.
5. An insulated tuning tool **MUST BE** used for all adjustments.
6. **DO NOT** keep power ON for a long time when the transceiver is defective.
7. **DO NOT** transmit power into a signal generator or sweep generator. Always connect a 20dB or 30dB attenuator between the transceiver and a deviation meter or spectrum analyzer when using such test equipment.
8. Read the instructions of test equipment thoroughly before connecting the equipment to the transceiver.

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The SCHEMATIC DIAGRAM is attached at the end of this manual.

## SECTION 1 SPECIFICATIONS

### ■ GENERAL

- Frequency coverage : 220.000 ~ 224.995MHz
- Mode : F3 (FM)
- Tuning step increments : 5, 10, 15, 20 or 25kHz (programmable)
- Memory channels : 10
- Antenna impedance : 50Ω unbalanced
- Power supply requirement : 5.5 ~ 16.0V DC (negative ground)
- Current drain (at 8.4V DC) : Receive Squelched 50mA  
Max. audio output 170mA  
Transmit HIGH (2.0W): 1.8A  
LOW (0.5W): 700mA
- Usable temperature range : -10°C ~ +60°C
- Frequency stability : ±20ppm (-10°C ~ +60°C)
- Dimensions : 64(74)W × 160(171)H × 35(41)D mm  
(Bracketed values include projections)
- Weight : 515g

### ■ TRANSMITTER

- Output power : HIGH 2.0W (at 8.4V DC)  
5.0W (at 13.8V DC)  
LOW 0.5W
- Modulation system : Variable reactance frequency modulation
- Maximum frequency deviation : ±5.0kHz
- Spurious emissions : Less than -60dB below peak output power
- Microphone impedance : 600Ω

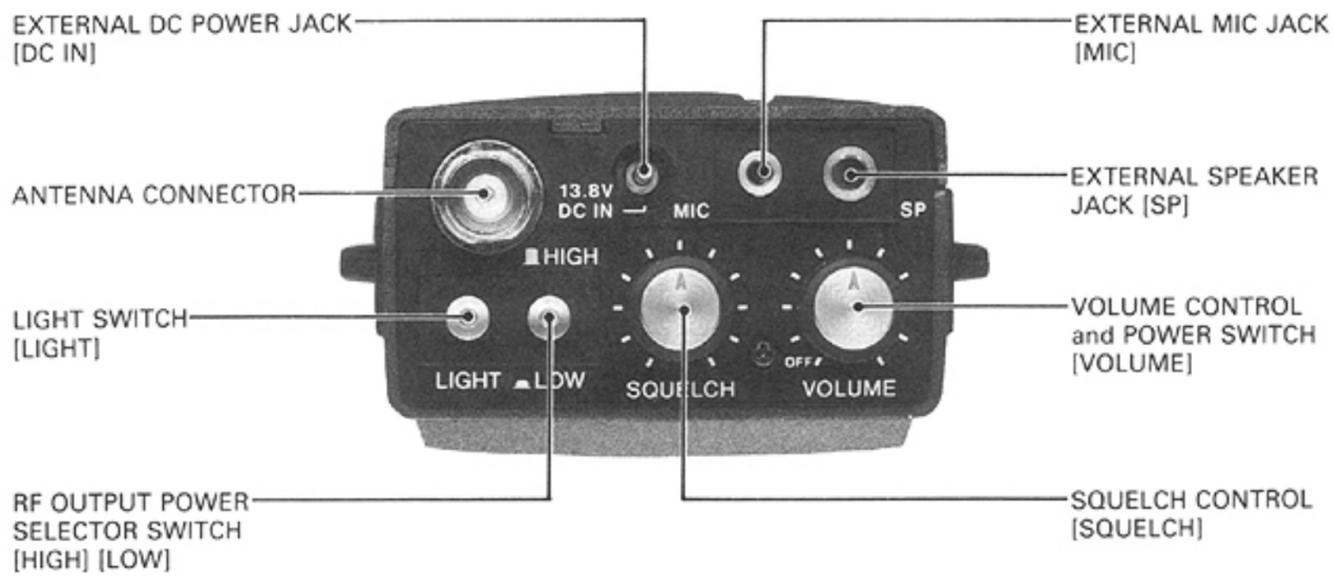
### ■ RECEIVER

- Receive system : Double-conversion superheterodyne
- Intermediate frequencies : 1st 16.9MHz  
2nd 455kHz
- Sensitivity : Less than 0.25μV for 12dB SINAD
- Selectivity : More than 15kHz/-6dB  
Less than 30kHz/-60dB
- Squelch threshold sensitivity : Less than 0.1μV
- Spurious response rejection ratio : More than 60dB
- Audio output power : More than 500mW at 10% distortion with an 8Ω load
- Audio output impedance : 8Ω

All stated specifications are approximate and subject to change without notice or obligation.

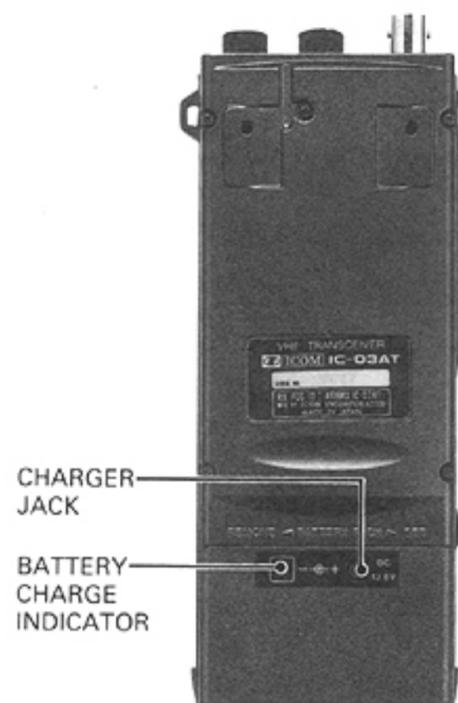
# SECTION 2 OUTSIDE AND INSIDE VIEWS

## TOP PANEL



## FRONT PANEL

## REAR PANEL



**MAIN UNIT**

**PLL UNIT**

AF Power Amp Circuit

IC101 ( $\mu$ PC358C Mic  
Signal Low-pass Filter)

IC105 (TA75393P  
Low Battery Sensor)

BT101 (BR2325-1HC  
Lithium Battery)

Voltage Regulator Circuit

Q220 (2SC3101 Driver)

Q221 (2SC4167-01  
RF Power Amp)

IC202 ( $\mu$ PB571C  
1/64, 1/65 Prescaler)

IC203  
( $\mu$ PD2834C PLL IC)

X203 (HC-18/T  
5.12MHz Reference  
Frequency Crystal)

X202 (HC-18/T  
16.445MHz Receiver  
2nd LO Crystal)

IC201 (MC3357P  
IF Circuit IC)

**TONE UNIT**

**LOGIC UNIT**

X502 (HC-43/U  
3.579545MHz)

IC501 (LR4087  
DTMF Encoder)

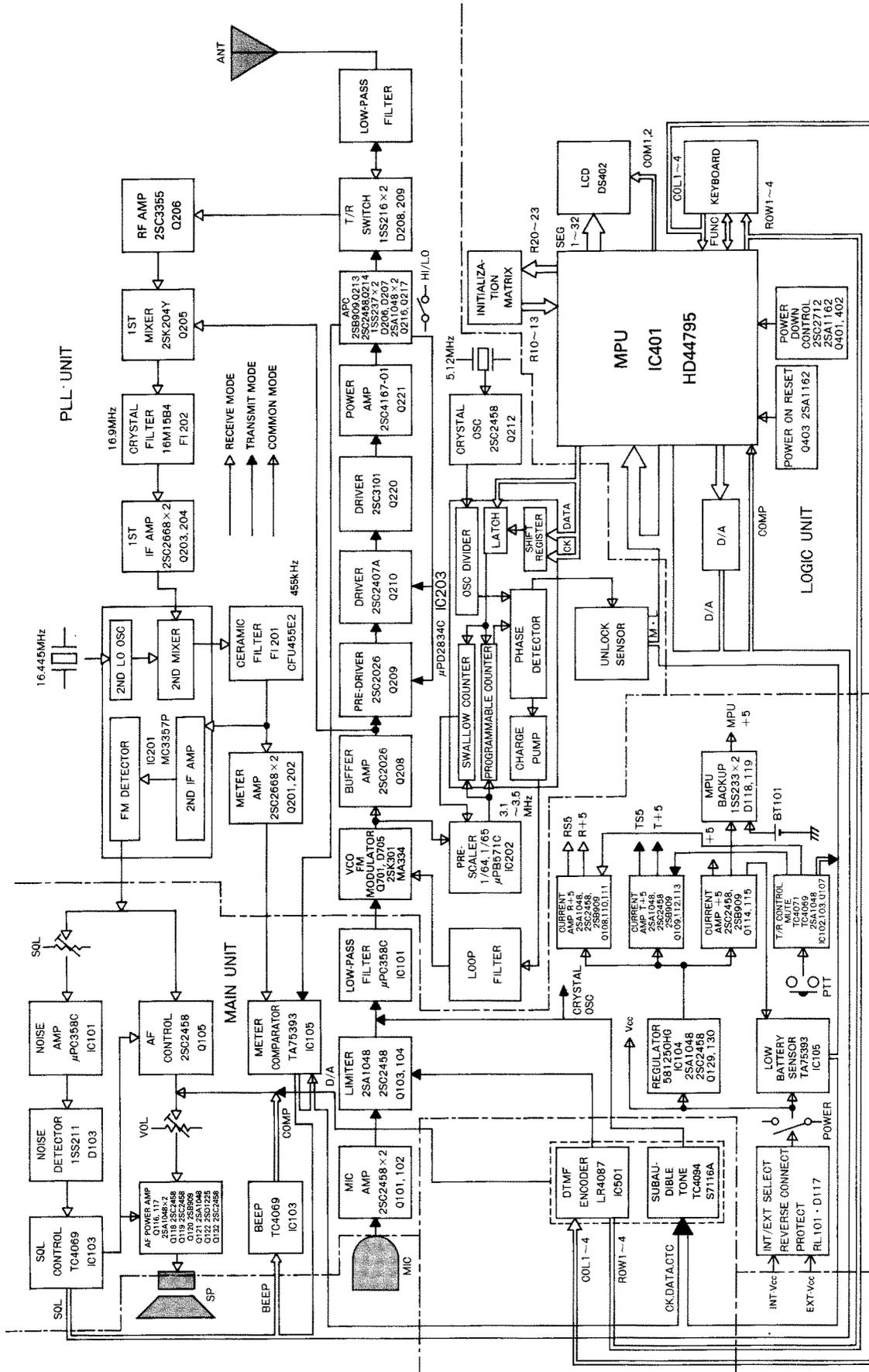
X501 (CSA3.58  
MG18 Ceralock)

IC503 (S-7116A  
Subaudible Tone  
Encoder)

Initial Matrix

IC401  
(HD44795B60 MPU)

SECTION 3 BLOCK DIAGRAM



# SECTION 4 CIRCUIT DESCRIPTION

## 4 - 1 RECEIVER CIRCUITS

### 4 - 1 - 1 ANTENNA SWITCHING CIRCUIT (PLL UNIT)

Receive signals enter the PLL UNIT from ANTENNA CONNECTOR J202, pass through a low-pass filter, and are fed to the antenna switching circuit. The low-pass filter is a Chebyshev low-pass filter consisting of L213, L214, C258, C260, C262, C264 and C265. The antenna switching circuit employs a  $\lambda/4$ -type diode switching system which does not allow current to flow during receive operations.

The antenna switching circuit consists of D208 and D209. D208 and D209 are turned OFF during receive operations and the receive signals are fed to the two-stage  $\lambda/4$  circuit. After passing through the  $\lambda/4$  circuit, the signals are fed to the RF circuit.

### 4 - 1 - 2 RF CIRCUIT (PLL UNIT)

After passing through the antenna switching circuit, signals are amplified at Q206. After amplification at Q206, RF out-of-band signals are further suppressed by passing through a bandpass filter consisting of L202 ~ L204. After passing through the bandpass filter, the signals are fed to the gate of 1st mixer Q205.

203MHz band LO signals fed from Q208 pass through transmit/receive switching circuit D203 and are applied to the source of 1st mixer Q205. Receive signals and 203MHz band LO signals are mixed by 1st mixer Q205, and 16.9MHz 1st IF signals are applied to the IF circuit.

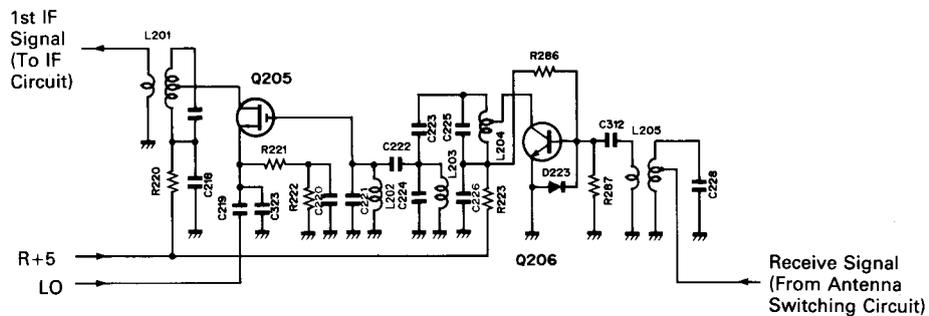


Fig. 4-1 RF Circuit

### 4 - 1 - 3 IF CIRCUIT (PLL UNIT)

The 1st IF signals converted at Q205 pass through FI202, a pair of crystal mechanical filters with matching characteristics. This further suppresses out-of-band signals. After passing through FI202, the signals are amplified at Q204 and Q203, pass through C213 and are applied to IC201 (pin 16).

IC201 contains the 2nd LO circuit, 2nd mixer circuit, limiter amplifier circuit and quadrature detector circuit. The 2nd LO circuit located in IC201 and X202 generate 16.445MHz 2nd LO signals which are fed to the 2nd mixer section of IC201.

The 1st IF signals and 2nd LO signals applied to IC201 (pin 16) are mixed at the 2nd mixer section in IC201. These are converted to 455kHz 2nd IF signals which are output from IC201 (pin 3).

The 2nd IF signals output from pin 3 are applied to IC201 (pin 5) and to the S-meter amplifier circuit which consists of Q202 and Q201. 2nd IF signals input to pin 5 are amplified by the limiter amplifier section of IC201.

The output of the limiter amplifier section is input to the quadrature detection section and simultaneously output from pin 7.

After being output from pin 7, the signals pass through ceramic resonator X201, are input to IC201 (pin 8) and are detected by the quadrature detector section for conversion to AF signals which are output from pin 9.

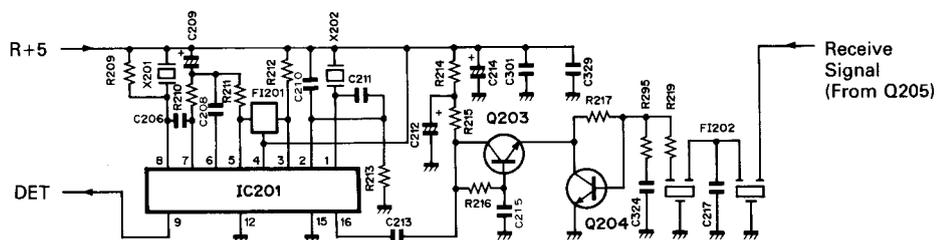


Fig. 4-2 IF Circuit

#### 4 - 1 - 4 S-METER CIRCUIT (PLL UNIT)

Q202 and Q201 are S-meter amplifiers.

A portion of 2nd IF signals from FI201 is amplified at Q202 and Q201. The signals from Q201 pass through C202 and are voltage doubler-detected by D201 and D202.

The output signals from D202 charge C201, and the terminal voltage of C201 is fed to the comparator circuit in the MAIN UNIT.

#### 4 - 1 - 5 AF CIRCUIT (MAIN UNIT)

AF signals output from pin 9 of IC201 pass through a de-emphasis circuit consisting of R127 and C117, and are amplified at AF amplifier Q105. This de-emphasis circuit is an integrator circuit with frequency characteristics of 6dB/oct.

Q116 ~ Q122 are AF power amplifier circuits. The input section functions as a differential amplifier for stable operations, ensuring a suitable frequency response by the negative feedback network, R152 and R149. The AF power amplifier circuit is a complementary SEPP circuit with a Darlington connection of Q119 ~ Q122. This circuit drives SPEAKER SP401.

When the power source voltage is more than 10V, D106 and voltage regulator Q106 limit the output voltage and output power, and stabilize the bias.

#### 4 - 1 - 6 SQUELCH CIRCUIT (MAIN UNIT)

Noise components from pin 9 of IC201 are fed to active filter IC101B through SQUELCH CONTROL R126.

This active filter is a high-pass filter, and amplifies approximately 20kHz noise components. The noise components are then rectified by D103 and converted to DC voltage at R119 ~ R121, C111 and C112. The DC voltage passes through inverters IC103A and IC103B.

AF amplifier Q105 is controlled by voltage from pin 2 of IC103A. The voltage from pin 2 of IC103A is also fed as a SQL signal to MPU IC401 on the LOGIC UNIT through D104.

If no signal is received from the ANTENNA CONNECTOR, the voltage of D103 increases, pin 2 of IC103A becomes "HIGH", Q105 turns OFF and AF output is cut OFF.

In transmit mode, T+5 is applied to pin 9 of IC103B via D105, and pin 2 of IC103A becomes "HIGH", turning Q105 OFF.

#### 4 - 1 - 7 203MHz LO CIRCUIT (VCO, PLL UNITS)

203MHz band LO signals from Q701 in the VCO UNIT are buffer amplified at Q208 and fed to transmit/receive switching circuit D203 in the PLL UNIT. After passing through D203, LO signals are applied to the source of 1st mixer Q205.

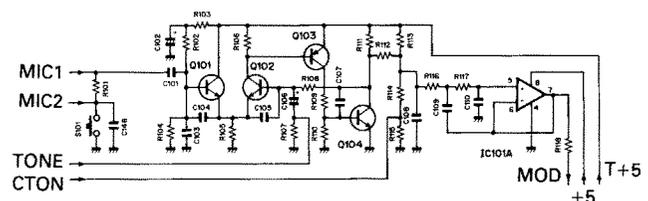
### 4 - 2 TRANSMITTER CIRCUIT

#### 4 - 2 - 1 MICROPHONE AMPLIFIER CIRCUIT (MAIN UNIT)

AF signals from MICROPHONE EP401 or EXTERNAL MIC JACK J203 are amplified at a limiter amplifier consisting of Q101 ~ Q104.

This limiter amplifier has a negative feedback circuit with frequency characteristics set at 6dB/oct. in the 300Hz ~ 3kHz range. This makes the limiter amplifier function as a pre-emphasis circuit. Output from the limiter amplifier is similar to a rectangular waveform and includes harmonic components. Harmonic components higher than 3kHz are attenuated by splatter filter IC101A.

AF signals from IC101A pass through R243 in the PLL UNIT and are then applied to the anode of D705 in the VCO UNIT to perform frequency modulation.



### 4 - 2 - 3 RF POWER AMPLIFIER CIRCUIT (PLL UNIT)

Signals output from Q220 are power amplified at Q221. Q221 outputs stable power at approximately 5W when RF POWER SELECTOR SWITCH S105 is in the "HIGH" position.

In transmit mode, a transmit/receive switching circuit consisting of Q215, D208, and D209 is turned ON, and L212 and C256 become a parallel resonance circuit. Output power from Q221 is fed to ANTENNA CONNECTOR J202 through a low-pass filter consisting of L213, L214, C258, C260, C262, C264 and C265.

Q207 controls the bias voltage of Q209, Q210, Q220 and Q221 to prevent unwanted emissions when switching from receive to transmit mode, or when the PLL circuits are unlocked.

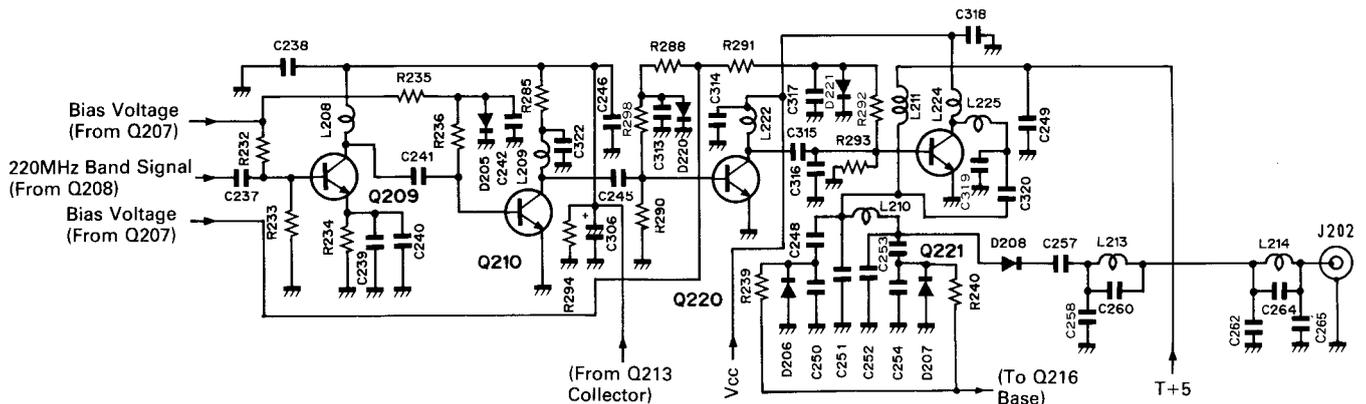


Fig. 4-4 Driver Amplifier and RF Power Amplifier Circuits

### 4 - 2 - 4 APC AND POWER SET CIRCUITS (PLL UNIT)

L210, C248, C250 ~ C254, D206 and D207 form an antenna mismatching detection circuit. When antenna impedance is matched at 50Ω, voltage detected at D206 and D207 has a minimum value. However, when antenna impedance is in a mismatched condition, the detected voltage becomes higher than in the matched condition.

Q216 and Q217 form the differential amplifier circuit. The base bias voltage of Q217 is determined by R265 ~ R267.

The voltage detected at D206 and D207 is combined by R239 and R240, and fed to the base of Q216.

When antenna impedance is mismatched, the base voltage of Q216 will be higher than the base voltage of Q217. The Q216 collector current and Q214 base current are then reduced, decreasing the Q214 collector current. The Q210 collector current from the base of Q213 also decreases. This decreases the output power of Q210 and Q209 until the base voltage of Q216 becomes the same as the base voltage of Q217.

When RF POWER SELECTOR SWITCH S105 is in the "HIGH" position, RF output power can be adjusted by R267.

When S105 is in the "LOW" position, the series combination of R268 and R269 is connected in parallel with R265, and RF output power can be adjusted by R269.

The output voltage detected at D206 and D207 passes through R241 and is applied to the comparator circuit pin 3 of IC105A on the MAIN UNIT. This voltage is used for the RF power output level meter.

## 4 - 3 PLL CIRCUITS

The PLL circuits adopt a dual modulus pre-scaler system. The circuits generate desired frequency directly in the VCO circuit.

The PLL circuits are composed of pre-scaler IC202 and PLL IC IC203.

### 4 - 3 - 1 5kHz REFERENCE FREQUENCY CIRCUIT (PLL UNIT)

IC203 incorporates a swallow counter of 6 binary bits, a programmable counter of 11 binary bits, a phase comparator, a charge pump and a frequency divider for the reference frequency.

A 5.12MHz signal is oscillated by a crystal oscillator consisting of Q212 and X203, and is fed to pin 17 of IC203. IC203 divides the frequency by 1/1024 and a reference frequency of 5kHz is obtained. The 5kHz reference frequency is fed to pin 8 of IC203.

**4 - 3 - 2 DUAL MODULUS PRE-SCALER**

Signals from the VCO circuit are buffer amplified at Q219 and divided N times at IC202 and IC203.

MPU IC401 feeds IC203 N-data for determining the operating frequency. Signals are then phase detected at IC203 and output from pin 11 of IC203.

IC202 is a pre-scaler that divides signals generated by the VCO from 203MHz to 225MHz by either 1/64 or 1/65.

N-data is the number of times the desired frequency is divided by the reference frequency. (The desired frequency is the transmit frequency in transmit mode and the 1st local oscillator frequency in receive mode).

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

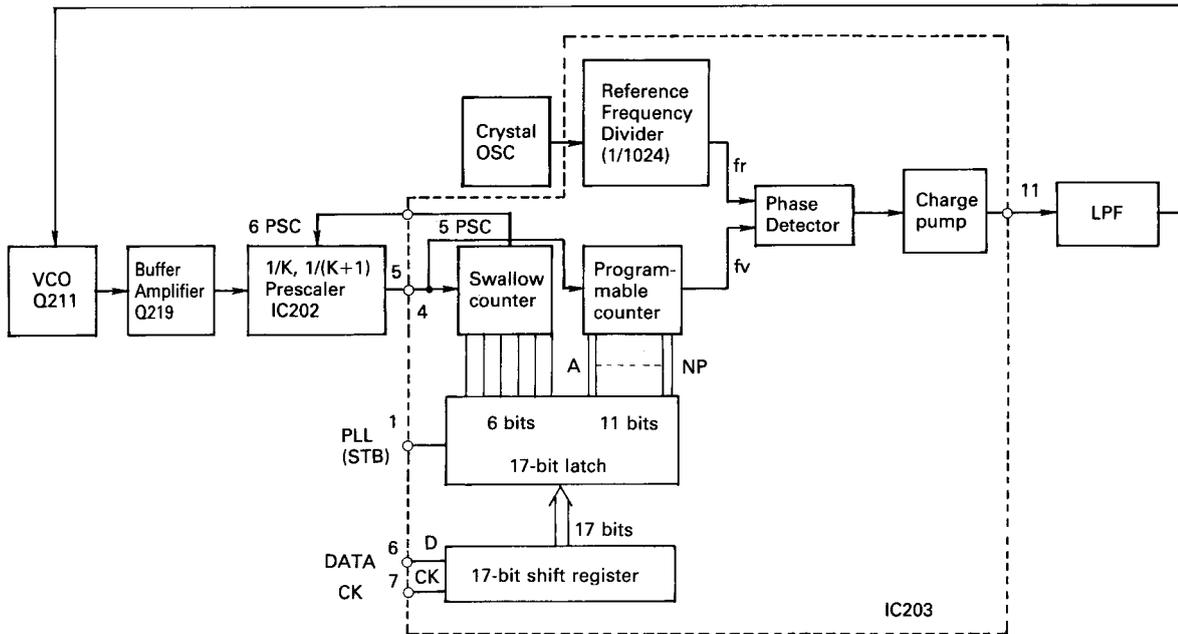


Fig. 4-5 Dual Modulus Prescaler System

**4 - 3 - 3 LOOP FILTER, VCO, MODULATION CIRCUITS (PLL, VCO UNITS)**

Output from pin 11 of IC203 determines the characteristics of the PLL circuits through a lag-lead type loop filter consisting of R253, R252 and C282. This output controls D703 and D704 in the VCO UNIT through an integrator circuit consisting of R249 and C273.

VCO Q701 employs a Clapp oscillator circuit. By shunting C704 and C705 in receive mode, the VCO free-run frequency is shifted lower from the one in transmit mode. In transmit mode, C704, C705, C715, and D705 are connected in parallel. Thus the free-run frequency will be higher than in receive mode and stable oscillation can be achieved over a wide frequency range.

Output signals pass through the loop filter, and then are applied to D703 and D704 in the VCO UNIT to control the VCO oscillation frequency.

When modulation signals are applied to the anode of D705, the capacitance of D705 is changed and performs frequency modulation. Deviation is adjusted by R243.

**4 - 3 - 4 UNLOCK CIRCUIT (PLL UNIT)**

When the PLL circuits are unlocked, pin 10 of IC203 is "LOW" and a "LOW" signal is fed as an unlock signal to pin 8 of IC102A through time constant circuit R254 and C283.

As pin 8 and pin 9 of IC102A are "LOW", pin 10 becomes "LOW". The MPU is then fed information that the PLL circuits are unlocked to prevent unwanted signals from being transmitted.

## 4 - 4 LOGIC CIRCUITS

Following is an explanation of operations and their I/O ports.

The main part of the logic circuits is MPU IC401.

This includes a 2k-word ROM, 128-word pattern ROM, 160-byte RAM, and a circuit to drive FREQUENCY DISPLAY DS401.

I/O Port	Pin no.	Operation
D0 [SEND]	78	This port becomes "LOW" for the SEND line when the transceiver is in transmit mode.
D1 [MUTE]	79	This port becomes "HIGH" for approximately 60msec. when the transceiver is in transmit mode.
D2 [CK]	80	This port outputs serial CK signals for the PLL and subaudible tone encoder circuits.
D3 [DATA]	1	This port outputs serial DATA signals for the PLL and subaudible tone encoder circuits.
D4 [COMP]	2	When this port is "LOW" the number of R3 ports is indicated by the S/RF INDICATOR.
D5 [UNLOCK]	3	This port reads UNLOCK signals from IC102A. When the port reads UNLOCK signals, port D1 becomes "LOW" and a small "U" appears on the FREQUENCY DISPLAY.
D6 [PLL]	4	This port outputs a strobe signal for PLL N-DATA.
D7 [CTCSS]	5	This port outputs strobe signals for the subaudible tone encoder.
D8 [SQL]	6	This port becomes "LOW" when the squelch opens.
D9 [HALT CONT]	7	This is an output port for storing the program execution address of the MPU when the transceiver is turned OFF.
D10 [BEEP]	8	This port becomes "HIGH" when beep sounds are emitted.
D11 [FUNC]	9	This port becomes "LOW" when the FUNCTION SWITCH is pushed.
D12 ~ D15 [KEY SCAN]	10 ~ 13	These are output ports for the KEYBOARD scan.
R0 [KEY RETURN]	14 ~ 17	These are input ports for the keyboard scan. The ports read signals from ports D12 ~ D15 and are connected to the rows of the keyboard matrix.
R1 [INITIAL KEY RETURN]	66 ~ 69	These are input ports for the initial matrix key scan. These ports read signals from the R2 ports to determine frequency ranges, tuning step increments, etc.
R2 [INITIAL KEY SCAN]	70 ~ 73	These are output ports for the initial matrix key scan.
R3 [D/A]	74 ~ 77	These ports output a loop counter number in hexadecimal when the program of the MPU is executed in the main routine.
INT0 [POWER DOWN]	64	This port becomes "LOW" when the transceiver is turned OFF or the power supply voltage goes down.
INT1 [BAT]	65	This port becomes "LOW" when the battery voltage becomes lower than normal.
RESET [RESET]	18	The MPU is reset when this port becomes "HIGH".

Table 4-1 MPU Port Allocations

## 4 - 5 POWER SUPPLY CIRCUITS

### 4 - 5 - 1 INTERNAL/EXTERNAL POWER SWITCHING CIRCUIT (MAIN UNIT)

When using a battery pack, relay RL101 is OFF and POWER SWITCH R132 is connected to the battery pack. When a power source with voltage between 10~16V is connected to EXTERNAL DC POWER JACK J204, RL101 is ON and R132 is connected to the external power source.

In case a wrong connection to J204 is made with reverse polarity, D117 is reversely biased, preventing RL101 from being ON and protecting the transceiver.

### 4 - 5 - 2 VOLTAGE REGULATOR CIRCUITS (MAIN UNIT)

Three-terminal regulator IC104 keeps the output voltage at 5V constantly even with input voltage from 5.1V to 16V.

Noise components are eliminated from the output of IC104 through a filter circuit consisting of R165 and C138. Output from the filter circuit is fed to a current amplifier circuit consisting of Q129 and Q130.

Q129 and Q130 are connected in a complementary circuit for a higher current amplification factor. The base voltage of Q130 is nearly equal to the output voltage of IC104. Also, the collector voltage of Q129 is approximately 5V. As the temperature coefficient of the junction voltage of D114 is nearly equal to the  $V_{BE}$  of Q130, the output voltage is kept constant against any change in temperature.

The regulated 5V from the collector of Q129 is fed to common circuits through current amplifier circuit Q114 and Q115, and is also fed to transmit/receive switching circuit Q108 and Q109.

### 4 - 5 - 3 POWER SOURCE CIRCUIT FOR MPU (MAIN UNIT)

When the battery pack is removed from the transceiver, a voltage is applied to MPU IC401 on the LOGIC UNIT via D119 from BT101 to provide backup for the memory contents.

### 4 - 5 - 4 VOX POWER SOURCE CIRCUITS (PLL UNIT)

This circuit supplies a voltage to an optional HS-10SA VOX UNIT.

With normal load currents, the voltage drop through R271 is small and approximately 5V is fed to the VOX UNIT. The increase of load currents leads to voltage drops at R271. When the voltage obtained by adding the voltage between the emitter and base of Q218 is equal to the voltage between R272 and cathode voltage of D216, the load current is limited.

## 4 - 6 OTHER CIRCUITS

### 4 - 6 - 1 LAMP CIRCUIT (MAIN UNIT)

The lamp circuit consists of Q131, D115, D116, and other components, and drives backlight DS401 at a constant current, ensuring that brightness does not change even with a change of power supply voltage.

When S106 is pushed ON, current flows into R173, resulting in the base voltage of Q131 being approximately  $V_{cc}-1.2V$  as determined by D115 and D116. The emitter voltage of Q131 is then  $V_{cc}-0.6V$  and the voltage at both ends of R172 is kept constant. The result is a constant current even with a change of power supply voltage.

### 4 - 6 - 2 BEEP CIRCUIT (MAIN UNIT)

This is a phase shift oscillator consisting of IC103F, R155, R156, R158, C131, C132, and C134. The circuit oscillates when the cathode of D113 becomes "HIGH". The oscillating frequency is set at approximately 2500Hz.

### 4 - 6 - 3 REDUCED VOLTAGE DETECTING CIRCUIT (MAIN UNIT)

The reduced voltage detecting circuit consists of IC105B, and R168 ~ R171.

A regulated 5V is divided at R168 and R169 and a voltage of approximately 1.03V is applied to pin 6 of IC105B. The voltage of  $V_{cc}$  is divided by R170 and R171, and is applied to pin 5. The voltage division ratio is selected so that the voltage at pin 5 is 1.03V when  $V_{cc}$  is approximately 5.6V.

If the  $V_{cc}$  is greater than 5.6V, the voltage at pin 5 of IC105B is higher than that at pin 6. Pin 7 then becomes "HIGH". If the  $V_{cc}$  voltage decreases to less than 5.6V, the voltage at pin 5 is less than that at pin 6. The output voltage at pin 7 and the output of IC105B is then "LOW". This information is fed to MPU IC401, causing the BATTERY CONDITION INDICATOR to appear on the FREQUENCY DISPLAY.

### 4 - 6 - 4 COMPARATOR CIRCUIT (MAIN UNIT)

The voltage detected in the S-meter circuits and APC circuits is input to pin 3 of IC105A and D/A signals generated in IC401 are fed to pin 2 of IC105A.

The voltage of D/A signals is divided at R166 and R179, and is changed in 16 steps between 0.12V and 1.258V by providing bias at R167.

When the voltage at pin 2 of IC105A is less than that at pin 3, the output at pin 1 is "HIGH". When the voltage at pin 2 is higher and exceeds that of pin 3, pin 1 is "LOW" and the voltage is fed into the MPU.

The MPU counts D/A signals until pin 1 of IC105A is "LOW" and outputs signals for indicating signal strength in receive mode and RF output in transmit mode on the S/RF INDICATOR on FREQUENCY DISPLAY DS402.

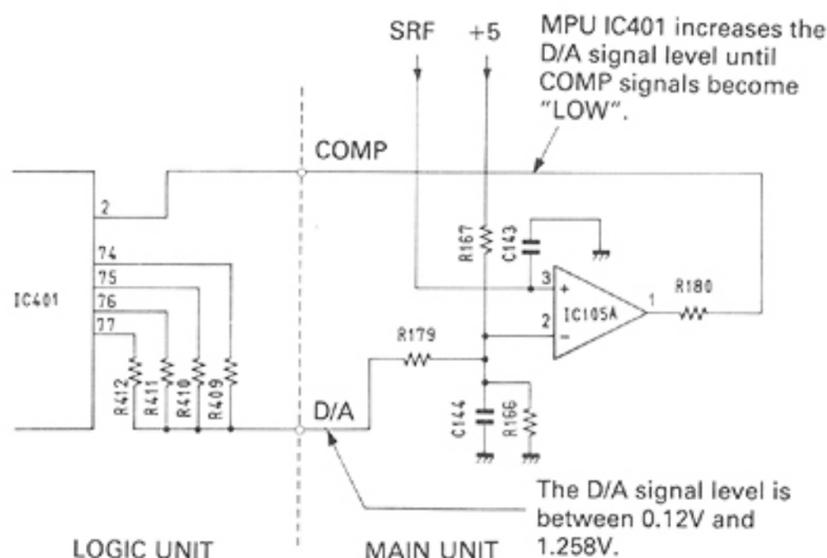


Fig. 4-6 Comparator Circuit

#### 4 - 6 - 5 DTMF ENCODER CIRCUIT (TONE UNIT)

DTMF encoder IC501, generates DTMF telephone dialing tones. While transmitting, Q505 turns ON, applying voltage to IC501.

If there is any input from the KEYBOARD, the proper frequency dividing ratio for the dividing frequency of X501 (3.58MHz) is selected to output one set of audio frequencies corresponding to row input (R<sub>OW</sub>) and column input (C<sub>OL</sub>) from pin 16 of IC501.

Also, a "HIGH" level is applied from pin 10 of IC501 when the KEYBOARD is activated. This level has a time constant of approximately 1msec. for turning Q506 ON. Thus key entries can be made without holding PTT S101 down.

#### 4 - 6 - 6 SUBAUDIBLE TONE ENCODER CIRCUIT (TONE UNIT)

When a tone number is set, data is sent to IC502 from MPU IC401 on the LOGIC UNIT. IC502 converts serial data from IC401 to parallel data, and feeds it to IC503. IC503 divides the frequency of X502 (3.579545MHz) corresponding to data, and outputs a subaudible tone from pin 1.

Tone Number	Freq. (Hz)	IC503						Tone Number	Freq. (Hz)	IC503					
		P1	P2	P3	P4	P5	P6			P1	P2	P3	P4	P5	P6
01	67.0	1	0	0	0	0	0	21	136.5	1	0	1	0	1	0
02	71.9	0	1	0	0	0	0	22	141.3	0	1	1	0	1	0
03	74.4	1	1	0	0	0	0	23	146.2	1	1	1	0	1	0
04	77.0	0	0	1	0	0	0	24	151.4	0	0	0	1	1	0
05	79.7	1	0	1	0	0	0	25	156.7	1	0	0	1	1	0
06	82.5	0	1	1	0	0	0	26	162.2	0	1	0	1	1	0
07	85.4	1	1	1	0	0	0	27	167.9	1	1	0	1	1	0
08	88.5	0	0	0	1	0	0	28	173.8	0	0	1	1	1	0
09	91.5	1	0	0	1	0	0	29	179.9	1	0	1	1	1	0
10	94.8	0	1	0	1	0	0	30	186.2	0	1	1	1	1	0
11	97.4	1	1	0	1	0	0	31	192.8	1	1	1	1	1	0
12	100.0	0	0	1	1	0	0	32	203.5	0	0	0	0	0	1
13	103.5	1	0	1	1	0	0	33	210.7	1	0	0	0	0	1
14	107.2	0	1	1	1	0	0	34	218.1	0	1	0	0	0	1
15	110.9	1	1	1	1	0	0	35	225.7	1	1	0	0	0	1
16	114.8	0	0	0	0	1	0	36	233.6	0	0	1	0	0	1
17	118.8	1	0	0	0	1	0	37	241.8	1	0	1	0	0	1
18	123.0	0	1	0	0	1	0	38	250.3	0	1	1	0	0	1
19	127.3	1	1	0	0	1	0								
20	131.8	0	0	1	0	1	0								

Table 4-2 Subaudible Tone Encoder Frequency Settings

1: ON 0: OFF

### 4 - 6 - 7 TRANSMIT/RECEIVE SWITCHING CIRCUIT (MAIN UNIT)

When PTT S101 is pushed, Q107 turns ON and pin 13 of IC103C and pin 1 of IC102 become "HIGH". Pin 2 of IC102C remains "LOW" for approximately 20msec. via time constant circuit R138 and C122. After 20msec. IC102C becomes "HIGH", thus Q108 is turned OFF and Q109 is turned ON and the T+5 and TS5 lines become 5V. Also, "transmit information" is sent to the MPU from pin 12 of IC103C via D107.

MUTE signals from MPU IC401 remain "HIGH" for approximately 60msec. after S101 is pushed. The signals are applied to pin 13 of IC102D to prevent unstable RF output power transmissions.

When S101 is released, pin 3 of IC102C becomes "LOW" after 20msec. and turns Q108 ON and Q109 OFF.

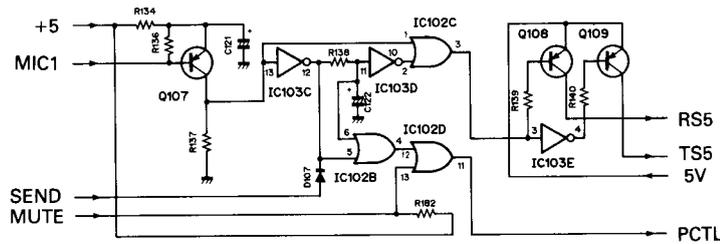


Fig. 4-7 Transmit/Receive Switching Circuit

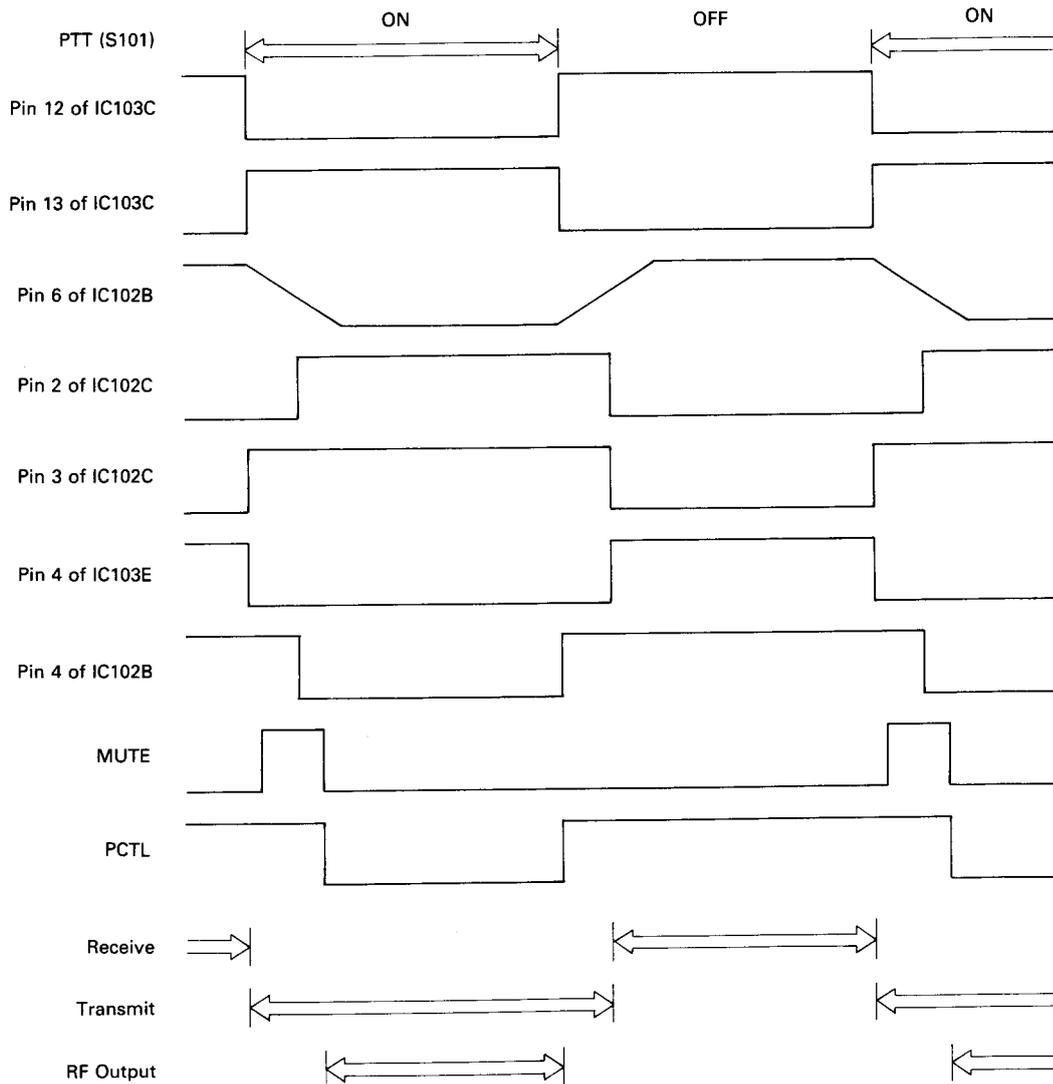


Fig. 4-8 Timing Diagram of Transmit/Receive Switching

## SECTION 5 MECHANICAL PARTS AND DISASSEMBLY

### 5 - 1 CASE DISASSEMBLY

1. Turn power OFF and remove the battery pack.
2. Remove screw (A), four screws (B) on the REAR PANEL and four screws (C) on the bottom as shown in Fig. 5-1-1.

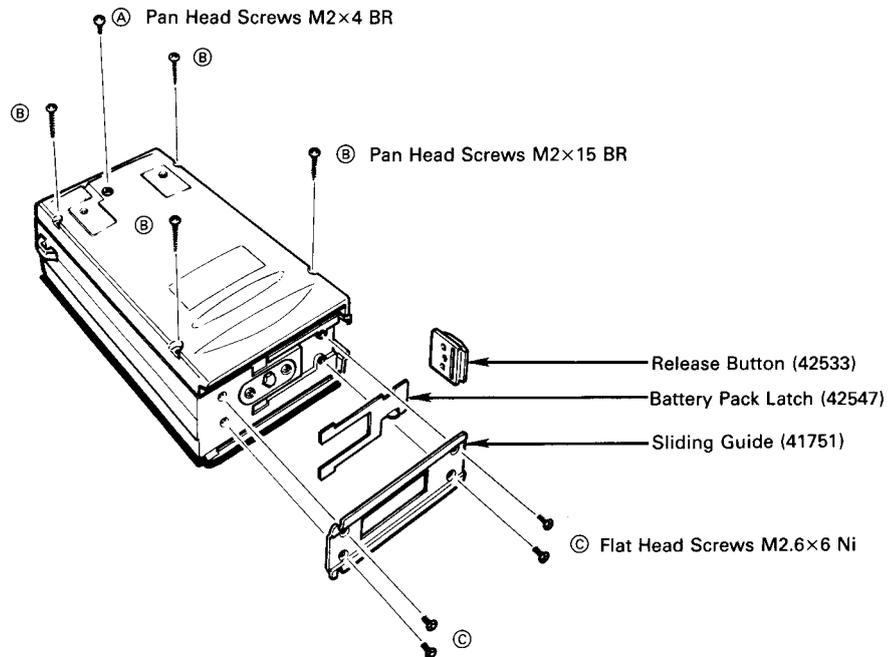


Fig. 5-1-1

3. Remove the REAR PANEL as shown in Fig. 5-1-2.

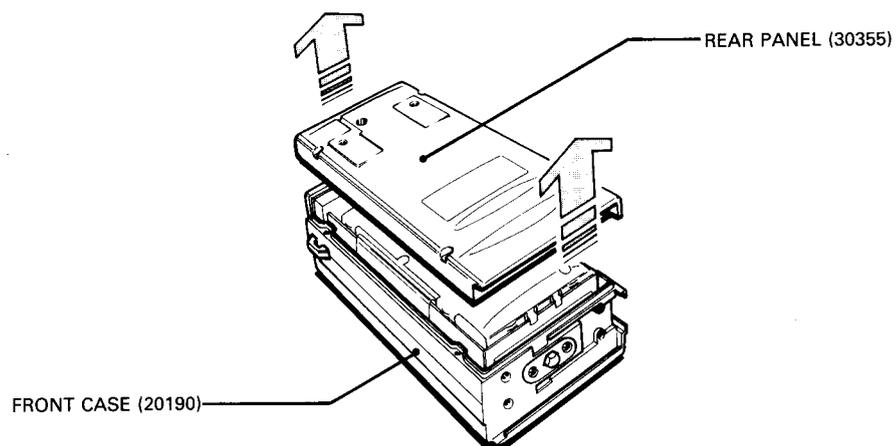


Fig. 5-1-2

- Slide the inner frame upward slightly as shown in Fig. 5-1-3, and lift the frame away from the FRONT CASE. Be sure not to damage the flexible cable while removing the FRONT CASE.

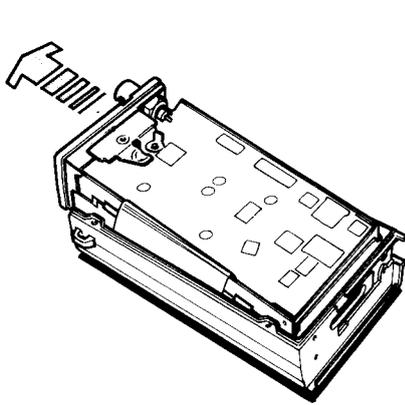


Fig. 5-1-3

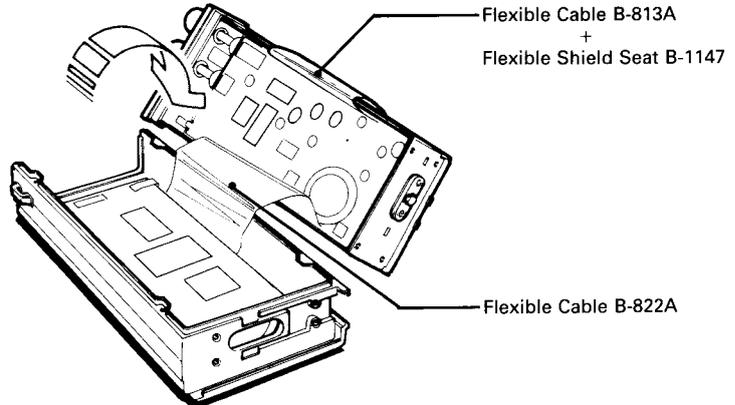


Fig. 5-1-4

- To see the foil sides of the MAIN and PLL UNITS, remove the SQUELCH CONTROL and VOLUME CONTROL and POWER SWITCH knobs as shown in Fig. 5-1-5. Remove the four screws (A) on the sides of the inner frame as shown in Fig. 5-1-6.

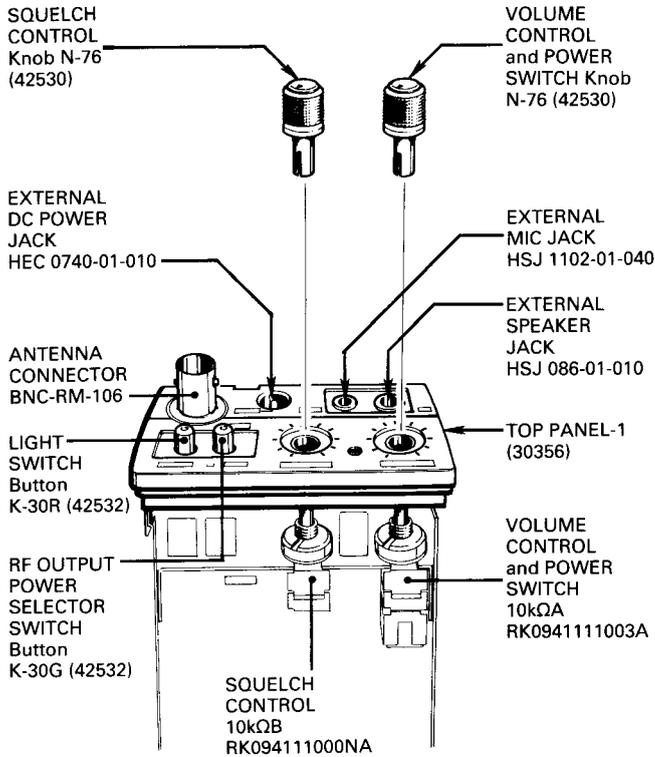


Fig. 5-1-5

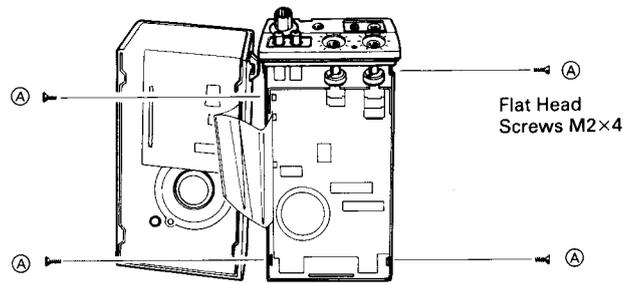


Fig. 5-1-6

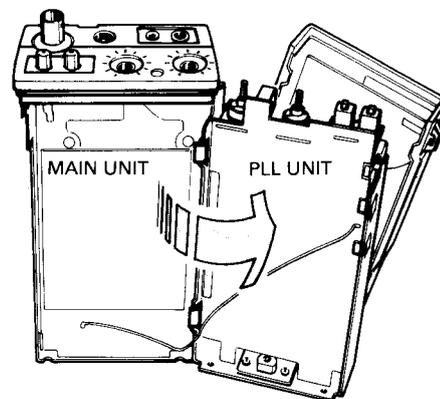


Fig. 5-1-7

## 5 - 2 TOP PANEL DISASSEMBLY

1. Remove screw (A) as shown in Fig. 5-2-1.
2. Remove the BNC Nut and the BNC Washer as shown in Fig. 5-2-2.
3. Remove the ANTENNA CONNECTOR by unsoldering point (B) on the components side and point (C) on the foil side of the PLL UNIT.
4. Remove the TOP PANEL-1 by slightly prying it outward on both sides at points (D) as shown in Fig. 5-2-3. DO NOT break the tabs.

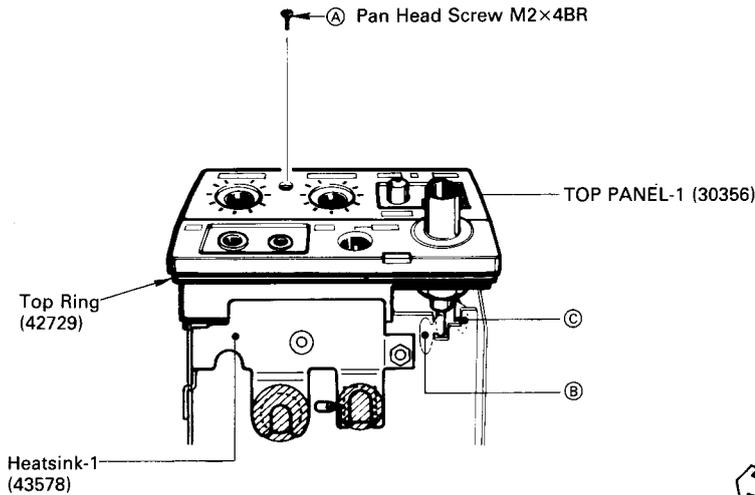


Fig. 5-2-1

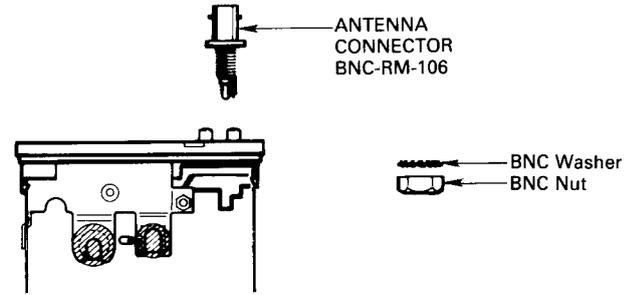


Fig. 5-2-2

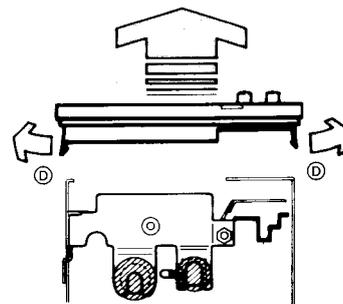


Fig. 5-2-3

## 5 - 3 HEATSINK DISASSEMBLY

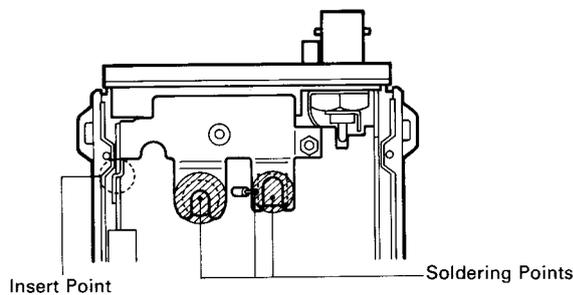


Fig. 5-3-1

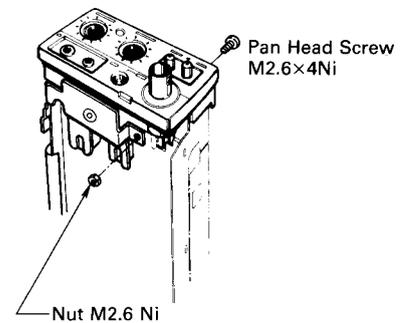


Fig. 5-3-2

### 5 - 4 SPEAKER/MICROPHONE DISASSEMBLY

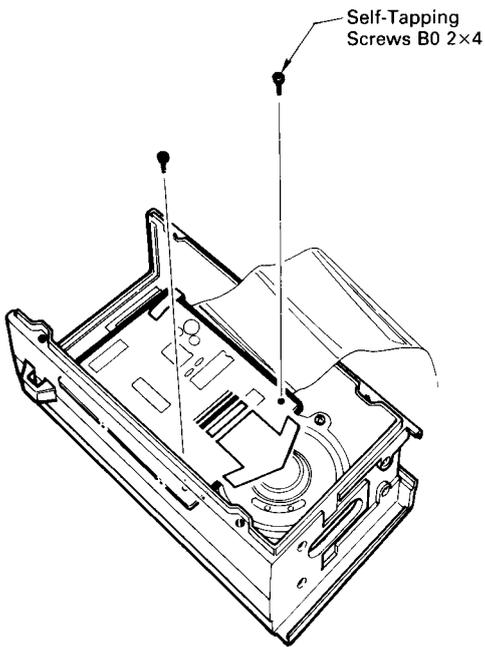


Fig. 5-4-1

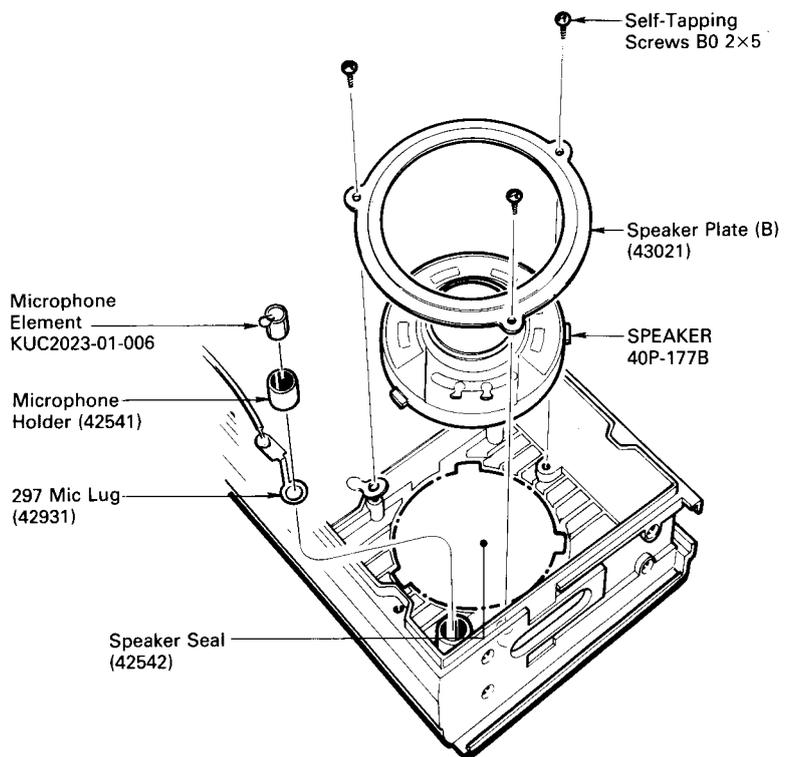


Fig. 5-4-2

### 5 - 5 PTT SPRING DISASSEMBLY

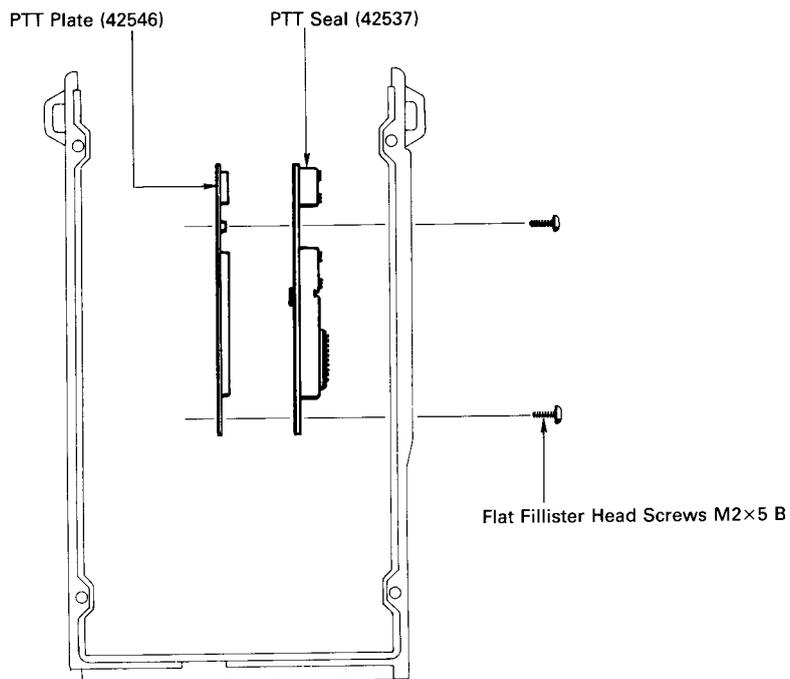


Fig. 5-5-1

### 5 - 6 UNIT BOTTOM DISASSEMBLY

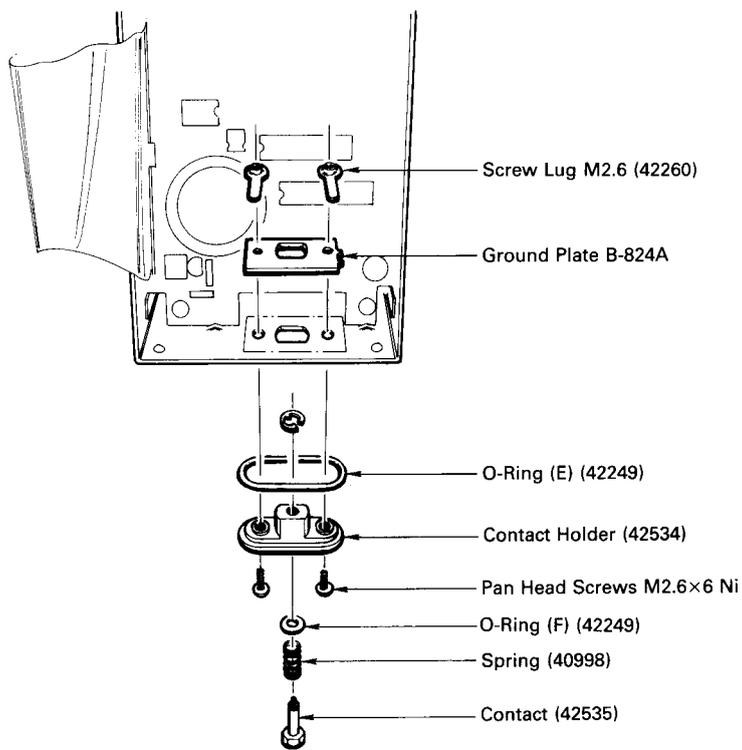


Fig. 5-6-1

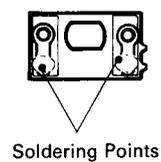


Fig. 5-6-2

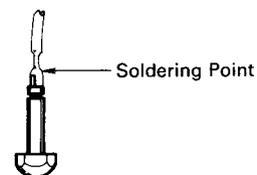


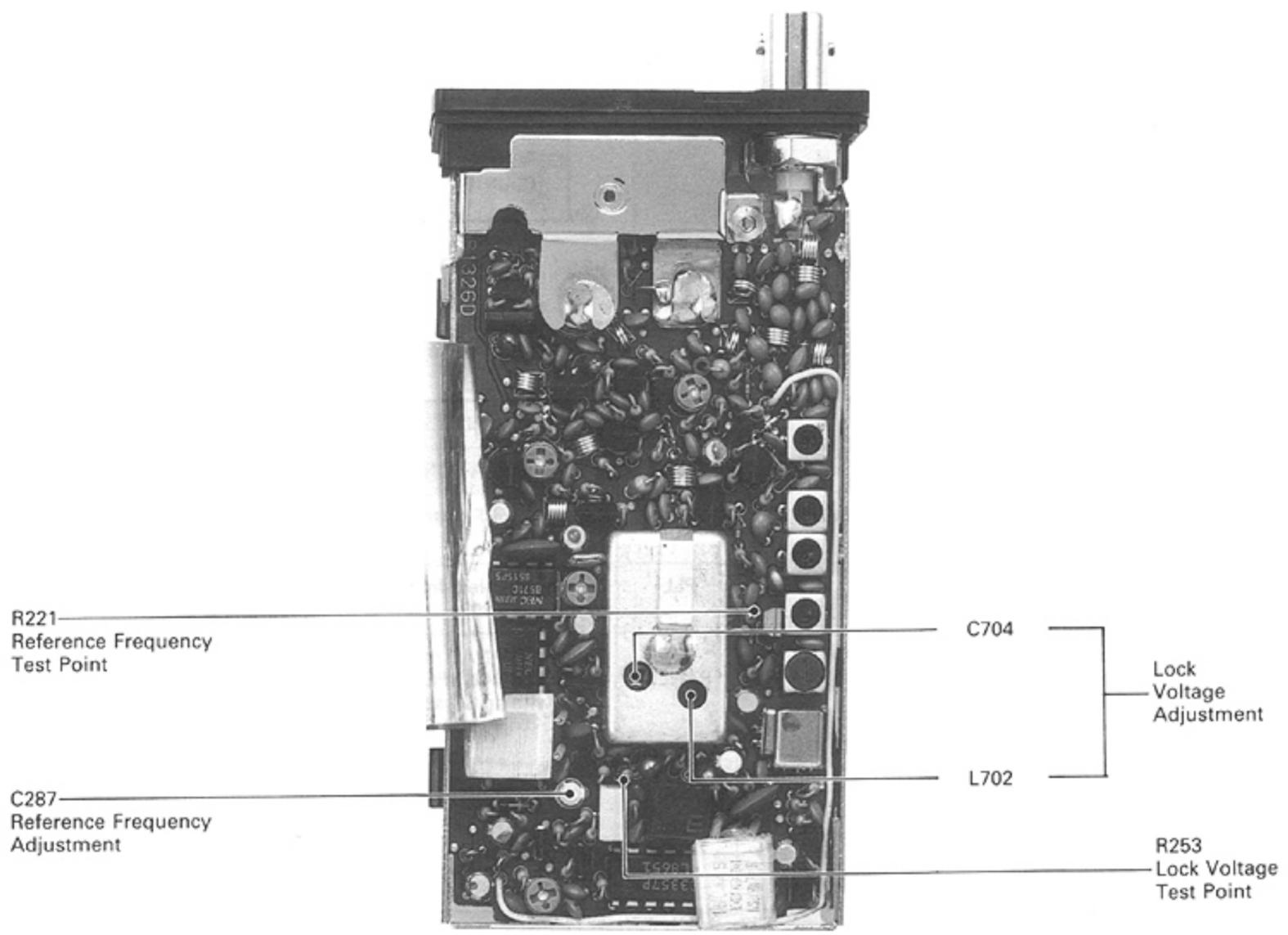
Fig. 5-6-3

## SECTION 6 ADJUSTMENT PROCEDURES

### 6 - 1 PLL ADJUSTMENT

TEST INSTRUMENTS REQUIRED		MEASUREMENT CONNECTION LOCATION				
(1) RF POWER METER (TERMINATED TYPE) <ul style="list-style-type: none"> <li>• Measuring range : 0 ~ 10W</li> <li>• Frequency range : At least 250MHz</li> <li>• Impedance : 50Ω</li> <li>• SWR : Less than 1:1.2</li> </ul> (2) FREQUENCY COUNTER <ul style="list-style-type: none"> <li>• Frequency range : At least 250MHz</li> <li>• Accuracy : Better than ±1ppm</li> <li>• Sensitivity : 100mV or better</li> </ul> (3) VOLTMETER <ul style="list-style-type: none"> <li>• Input impedance : 50kΩ DC or better</li> </ul> (4) VOLTAGE REGULATED POWER SUPPLY <ul style="list-style-type: none"> <li>• Output voltage : 13.2V DC</li> <li>• Current capacity : 2A</li> </ul>						
ADJUSTMENT	ADJUSTMENT CONDITIONS	MEASUREMENT		VALUE	ADJUSTMENT POINT	
		UNIT	LOCATION		UNIT	ADJUST
LOCK VOLTAGE	1 <ul style="list-style-type: none"> <li>• Operating frequency: 220.000MHz</li> <li>• Receive mode</li> </ul>	PLL	Connect a voltmeter to R253.	1.0V	VCO	L702
	2 <ul style="list-style-type: none"> <li>• Transmit mode</li> <li>• Simplex mode</li> </ul>			1.0V		C704
	3 <ul style="list-style-type: none"> <li>• Operating frequency: 224.995MHz</li> <li>• Receive mode</li> </ul>			More than 2.0V		Verify
REFERENCE FREQUENCY	1 <ul style="list-style-type: none"> <li>• Operating frequency: 224.000MHz</li> <li>• Simplex mode</li> <li>• Receive mode</li> </ul>	PLL	Connect a frequency counter to R221.	207.100MHz	PLL	C287
	2 <ul style="list-style-type: none"> <li>• RF OUTPUT POWER SELECTOR SWITCH: LOW</li> <li>• Transmit mode</li> </ul>			224.000MHz ±300Hz		Verify

### PLL UNIT

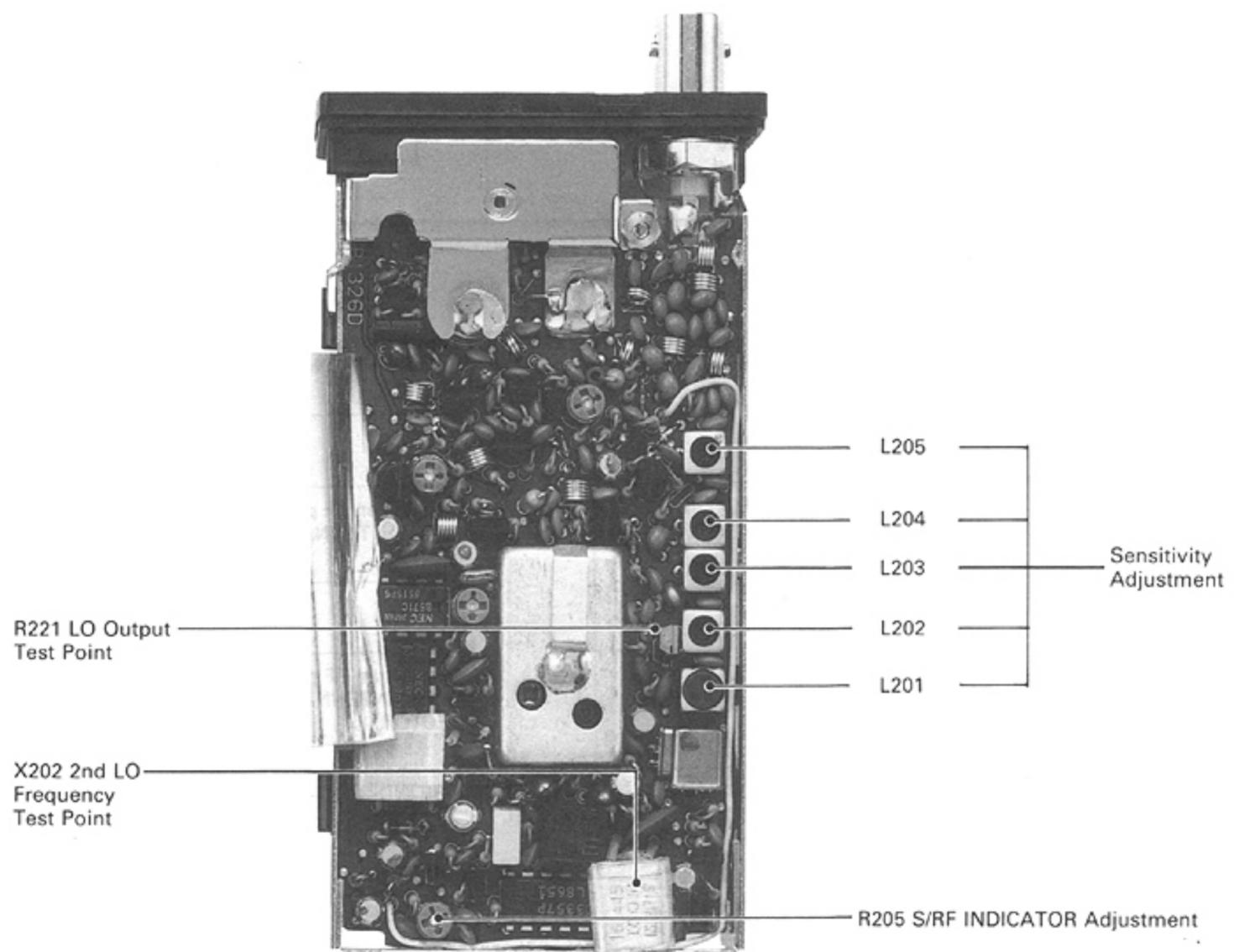


## 6 - 2 RECEIVER ADJUSTMENT

TEST INSTRUMENTS REQUIRED	MEASUREMENT CONNECTION LOCATION
<p>(1) SIGNAL GENERATOR</p> <ul style="list-style-type: none"> <li>• Frequency range : 200 ~ 250MHz</li> <li>• Output level : 0.1<math>\mu</math>V ~ 3.2mV</li> </ul> <p>(2) DISTORTION METER</p> <ul style="list-style-type: none"> <li>• Frequency range : 1kHz <math>\pm</math>10Hz</li> <li>• Measuring range : 1% ~ 100%</li> </ul> <p>(3) FREQUENCY COUNTER</p> <ul style="list-style-type: none"> <li>• Frequency range : At least 250MHz</li> <li>• Accuracy : Better than <math>\pm</math>1ppm</li> <li>• Sensitivity : 100mV or better</li> </ul> <p>(4) SINAD METER</p> <p>(5) RF VOLTMETER</p> <ul style="list-style-type: none"> <li>• Frequency range : At least 50MHz</li> <li>• Measuring range : 0.01 ~ 10V</li> </ul> <p>(6) AC MILLI-VOLTMETER</p> <ul style="list-style-type: none"> <li>• Measuring range : 10mV ~ 10V</li> </ul> <p>(7) VOLTAGE REGULATED POWER SUPPLY</p> <ul style="list-style-type: none"> <li>• Output voltage : 13.2V DC</li> <li>• Current capacity : 2A</li> </ul>	

ADJUSTMENT	ADJUSTMENT CONDITIONS	MEASUREMENT		VALUE	ADJUSTMENT POINT	
		UNIT	LOCATION		UNIT	ADJUST
LO OUTPUT	1 <ul style="list-style-type: none"> <li>• Operating frequency: 224.995MHz</li> <li>• Receive mode</li> </ul>	PLL	Connect an RF voltmeter to R221.	Approx. 100mV		Verify
2nd LO FREQUENCY	1 <ul style="list-style-type: none"> <li>• Operating frequency: Any</li> <li>• Receive mode</li> </ul>	PLL	Loosely couple a frequency counter to X202.	16.445MHz $\pm$ 500Hz		Verify
SENSITIVITY	1 <ul style="list-style-type: none"> <li>• Operating frequency: 224.990MHz</li> <li>• Receive mode</li> <li>• SQUELCH CONTROL: Max. counterclockwise</li> <li>• Apply an RF signal to the ANTENNA CONNECTOR. Level: 0.4<math>\mu</math>V Dev. : <math>\pm</math>3.5kHz Mod. : 1kHz</li> </ul>	TOP PANEL	Connect a SINAD meter to the EXTERNAL SPEAKER JACK with an 8 $\Omega$ speaker.	Maximum level	PLL	L201 ~ L203
	2 <ul style="list-style-type: none"> <li>• Operating frequency: 220.100MHz</li> </ul>			Maximum level		
<b>Note:</b> Repeat steps 1 and 2 several times, until the measured value is at maximum.						
AF OUTPUT	1 <ul style="list-style-type: none"> <li>• Operating frequency: 223.100MHz</li> <li>• Receive mode</li> <li>• Apply an RF signal to the ANTENNA CONNECTOR. Level: 10<math>\mu</math>V Dev. : <math>\pm</math>3.5kHz Mod. : 1kHz</li> </ul>	TOP PANEL	Connect an AC milli-voltmeter and distortion meter to the EXTERNAL SPEAKER JACK with an 8 $\Omega$ speaker.	More than 2.0Vrms at 10% distortion.		Verify
S/RF INDICATOR	1 <ul style="list-style-type: none"> <li>• Operating frequency: 223.100MHz</li> <li>• Receive mode</li> <li>• Apply an RF signal to the ANTENNA CONNECTOR Level: 2.5<math>\mu</math>V</li> </ul>	FRONT PANEL	S/RF INDICATOR.	8 dots	PLL	R205
TIGHT SQUELCH SENSITIVITY	1 <ul style="list-style-type: none"> <li>• Operating frequency: 223.100MHz</li> <li>• Receive mode</li> <li>• SQUELCH CONTROL: Max. clockwise</li> <li>• Apply an RF signal to the ANTENNA CONNECTOR. Level: 0.4<math>\mu</math>V Dev. : <math>\pm</math>3.5kHz Mod. : 1kHz</li> </ul>	TOP PANEL	Connect an 8 $\Omega$ speaker to the EXTERNAL SPEAKER JACK.	Squelch opens.		Verify

### PLL UNIT

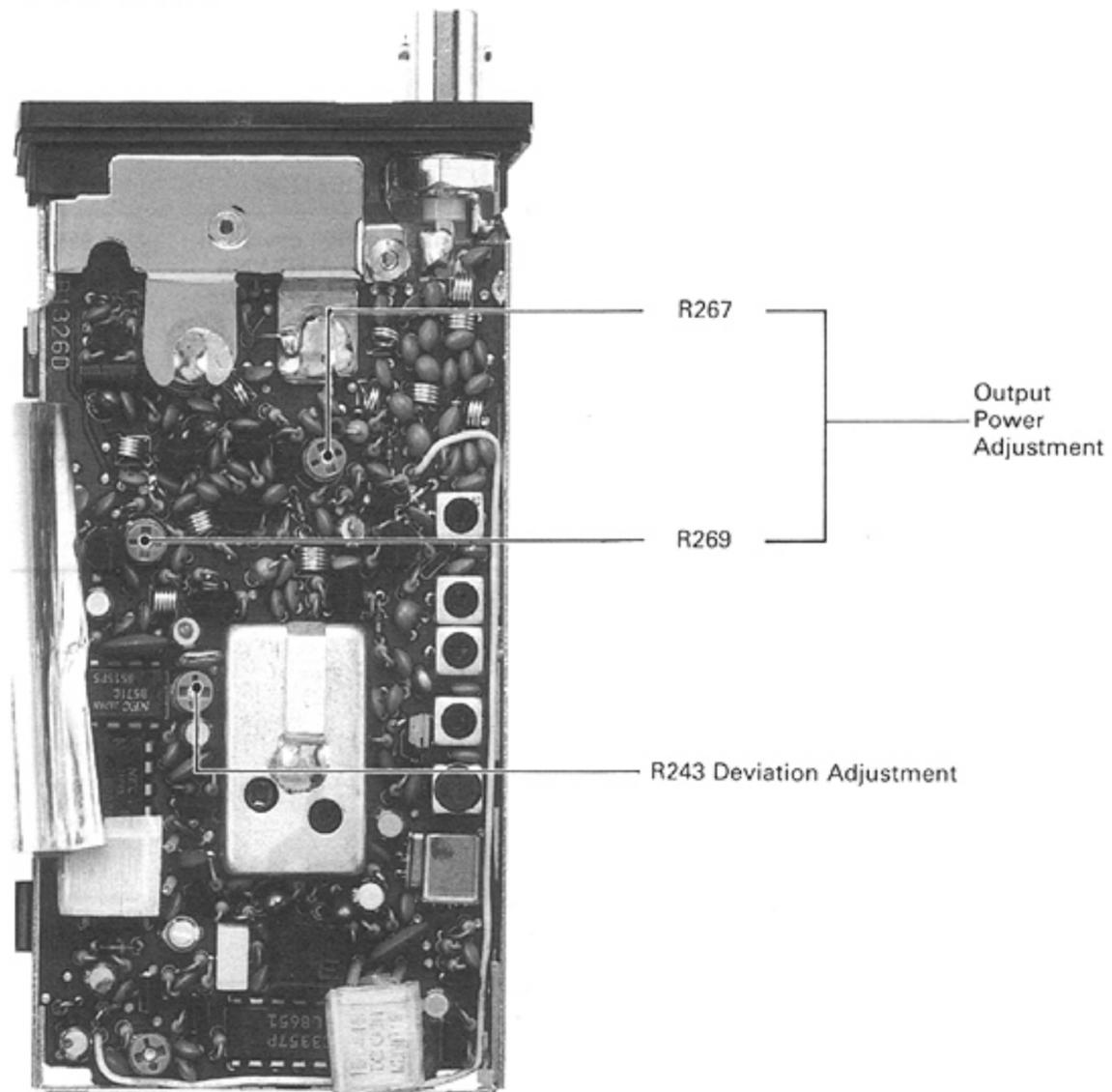


### 6 - 3 TRANSMITTER ADJUSTMENT

TEST INSTRUMENTS REQUIRED	MEASUREMENT CONNECTION LOCATION
<p>(1) RF POWER METER (TERMINATED TYPE)</p> <ul style="list-style-type: none"> <li>• Measuring range : 0 ~ 10W</li> <li>• Frequency range : At least 250MHz</li> <li>• Impedance : 50Ω</li> <li>• SWR : Less than 1:1.2</li> </ul> <p>(2) FM DEVIATION METER</p> <ul style="list-style-type: none"> <li>• Frequency range : At least 250MHz</li> <li>• Measuring range : 0 ~ ±10kHz</li> </ul> <p>(3) AUDIO GENERATOR</p> <ul style="list-style-type: none"> <li>• Output frequency : 50 ~ 3000Hz</li> <li>• Output level : 0 ~ 200mV</li> <li>• Distortion : Less than 0.1%</li> </ul> <p>(4) AC MILLI-VOLTMETER</p> <ul style="list-style-type: none"> <li>• Measuring range : 10mV ~ 2V</li> </ul> <p>(5) ATTENUATOR</p> <ul style="list-style-type: none"> <li>• Input power : At least 5W</li> <li>• Attenuation : 20dB or 30dB</li> </ul> <p>(6) AMMETER</p> <ul style="list-style-type: none"> <li>• Measuring range : 0 ~ 2A</li> </ul> <p>(7) VOLTAGE REGULATED POWER SUPPLY</p> <ul style="list-style-type: none"> <li>• Output voltage : 8.4/13.2V DC selectable</li> <li>• Current capacity : 2A</li> </ul>	

ADJUSTMENT	ADJUSTMENT CONDITIONS	MEASUREMENT		VALUE	ADJUSTMENT POINT	
		UNIT	LOCATION		UNIT	ADJUST
OUTPUT POWER	1	TOP PANEL	Connect an RF power meter to the ANTENNA CONNECTOR.	5.0W	PLL	R267
	2		Ammeter	Less than 1.8A		Verify
	3		Connect an RF power meter to the ANTENNA CONNECTOR.	0.5W		R269
	4		Ammeter	Less than 700mA		Verify
	5		Connect an RF power meter to the ANTENNA CONNECTOR.	More than 2.0W		Verify
S/RF INDICATOR	1	FRONT PANEL	S/RF INDICATOR	Full scale		Verify
	2			10 ~ 18 dots		Verify
DEVIATION	1	TOP PANEL	Connect an FM deviation meter to the ANTENNA CONNECTOR via an attenuator.	±5kHz	PLL	R243
	2			±5kHz ±10%		Verify

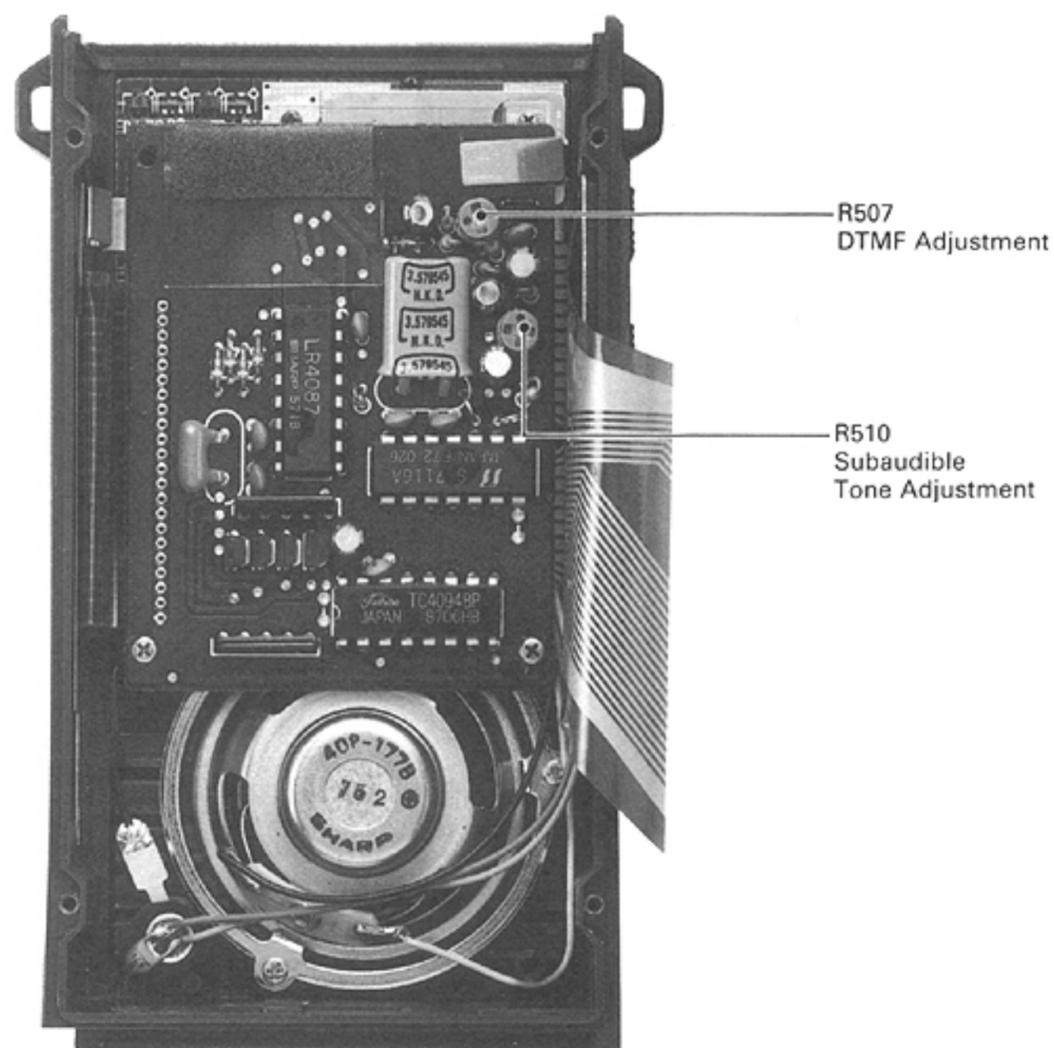
### PLL UNIT



## 6 - 4 SUBAUDIBLE TONE AND DTMF ADJUSTMENTS

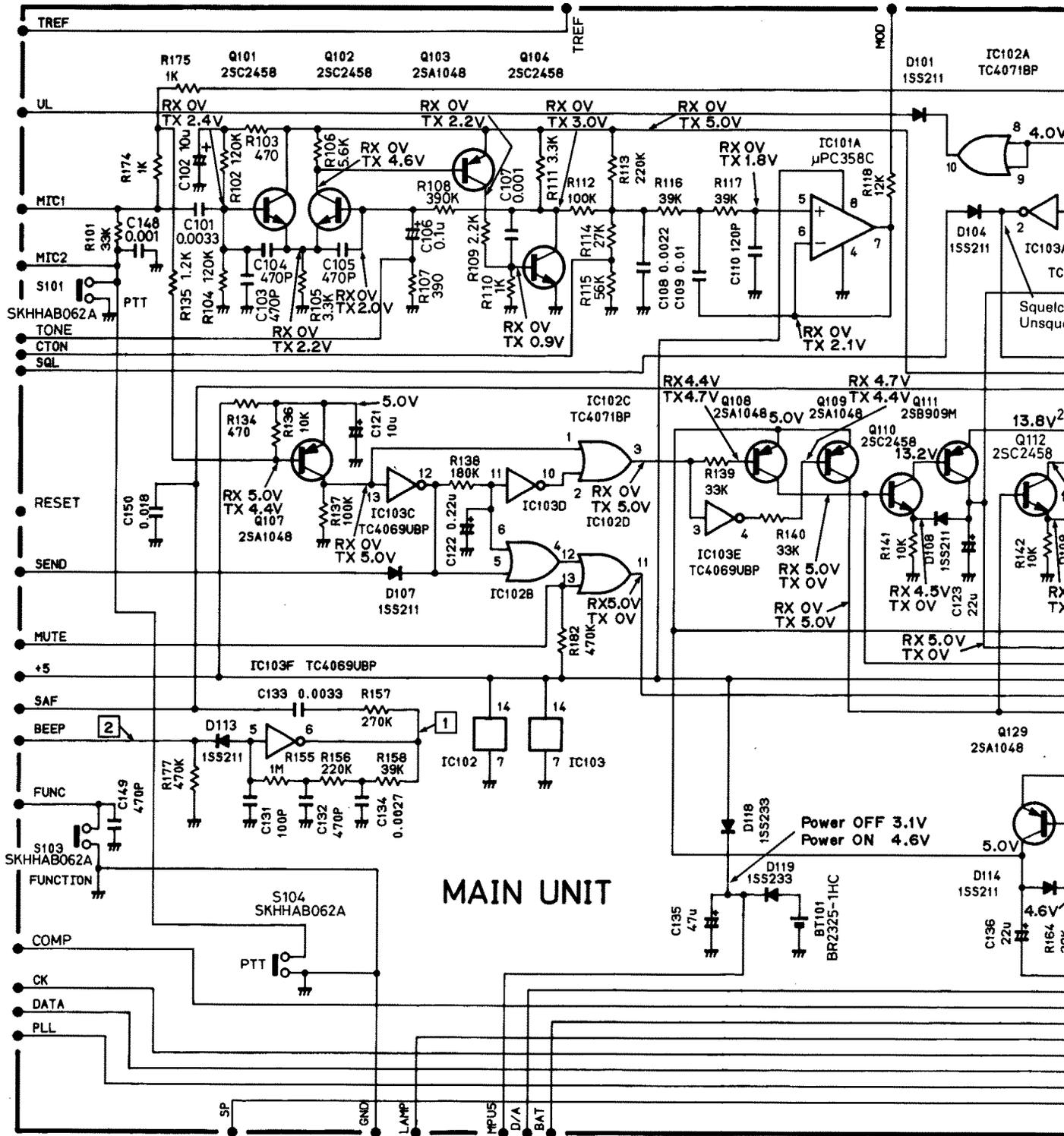
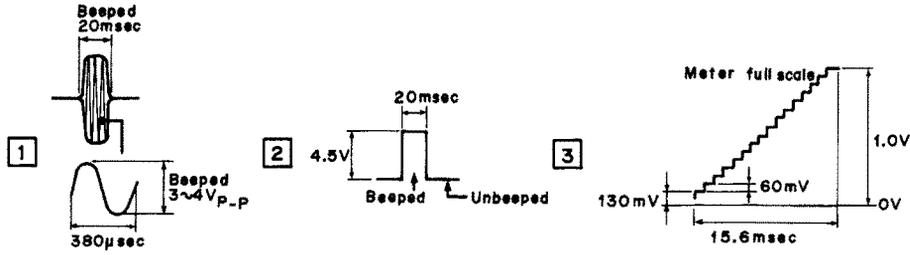
TEST INSTRUMENTS REQUIRED		MEASUREMENT CONNECTION LOCATION				
(1) RF POWER METER (TERMINATED TYPE) <ul style="list-style-type: none"> <li>• Measuring range : 0 ~ 10W</li> <li>• Frequency range : At least 250MHz</li> <li>• Impedance : 50Ω</li> <li>• SWR : Less than 1:1.2</li> </ul> (2) FM DEVIATION METER <ul style="list-style-type: none"> <li>• Frequency range : At least 250MHz</li> <li>• Measuring range : 0 ~ ±10kHz</li> </ul> (3) ATTENUATOR <ul style="list-style-type: none"> <li>• Input power : At least 5W</li> <li>• Attenuation : 20dB or 30dB</li> </ul> (4) VOLTAGE REGULATED POWER SUPPLY <ul style="list-style-type: none"> <li>• Output voltage : 13.2V DC</li> <li>• Current capacity : 2A</li> </ul>						
ADJUSTMENT	ADJUSTMENT CONDITIONS	MEASUREMENT		VALUE	ADJUSTMENT POINT	
		UNIT	LOCATION		UNIT	ADJUST
SUBAUDIBLE TONE	1 <ul style="list-style-type: none"> <li>• Operating frequency: 222.55MHz</li> <li>• Simplex mode</li> <li>• FM deviation meter: HPF (50Hz) OFF, LPF (20Hz) ON</li> <li>• Tone number: 01</li> <li>• Transmit mode</li> </ul>	TOP PANEL	Connect an FM deviation meter to the ANTENNA CONNECTOR via an attenuator.	±0.5kHz	TONE	R510
DTMF	1 <ul style="list-style-type: none"> <li>• Operating frequency: 222.55MHz</li> <li>• Simplex mode</li> <li>• Transmit mode</li> <li>• Push and hold [D] key.</li> </ul>	TOP PANEL	Connect an FM deviation meter to the ANTENNA CONNECTOR via an attenuator.	±3.5kHz	TONE	R507

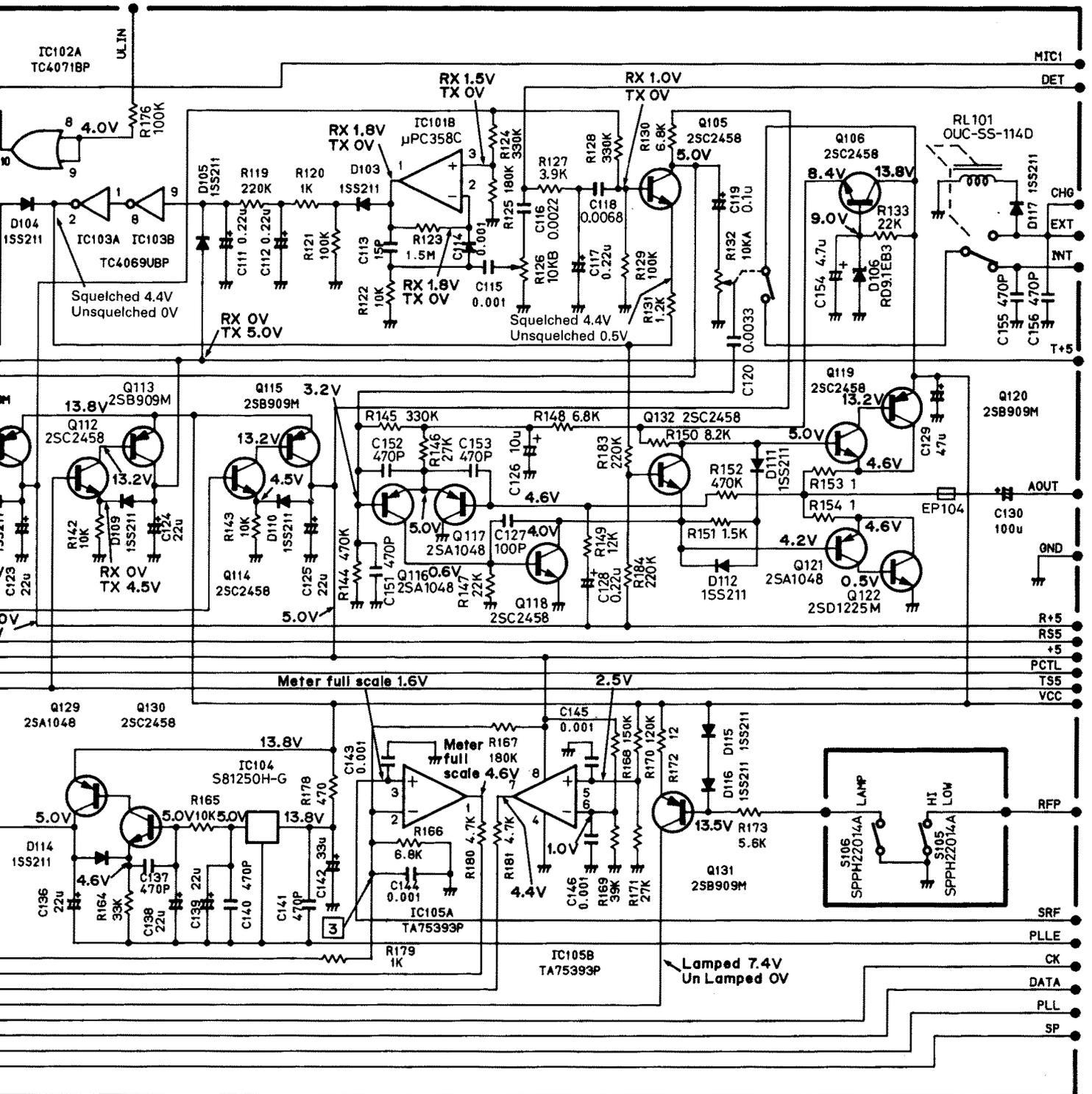
## TONE UNIT



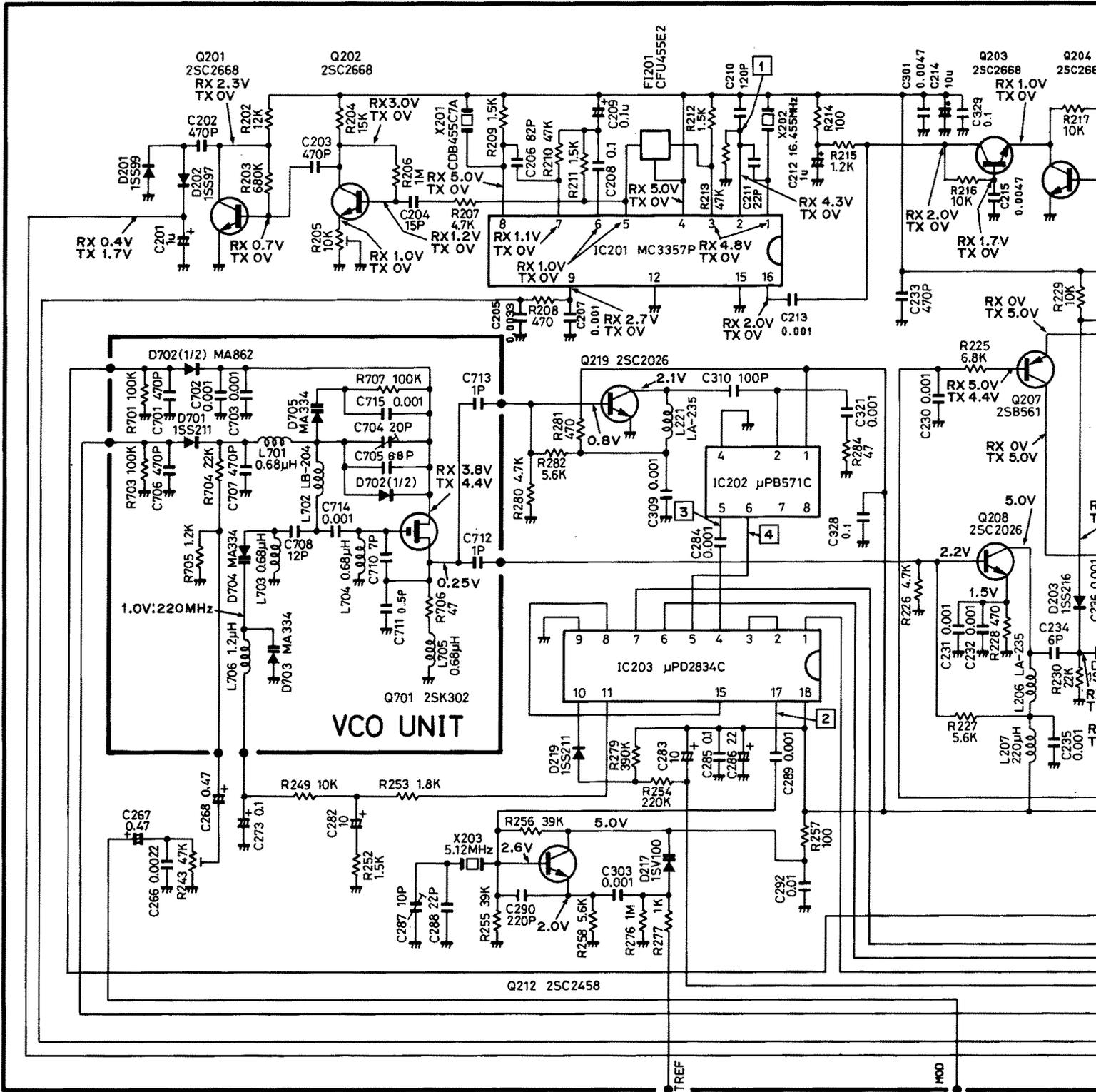
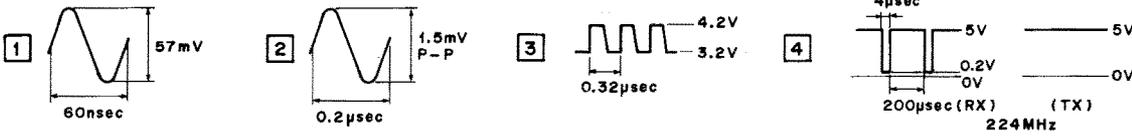
SECTION 7 VOLTAGE DIAGRAMS

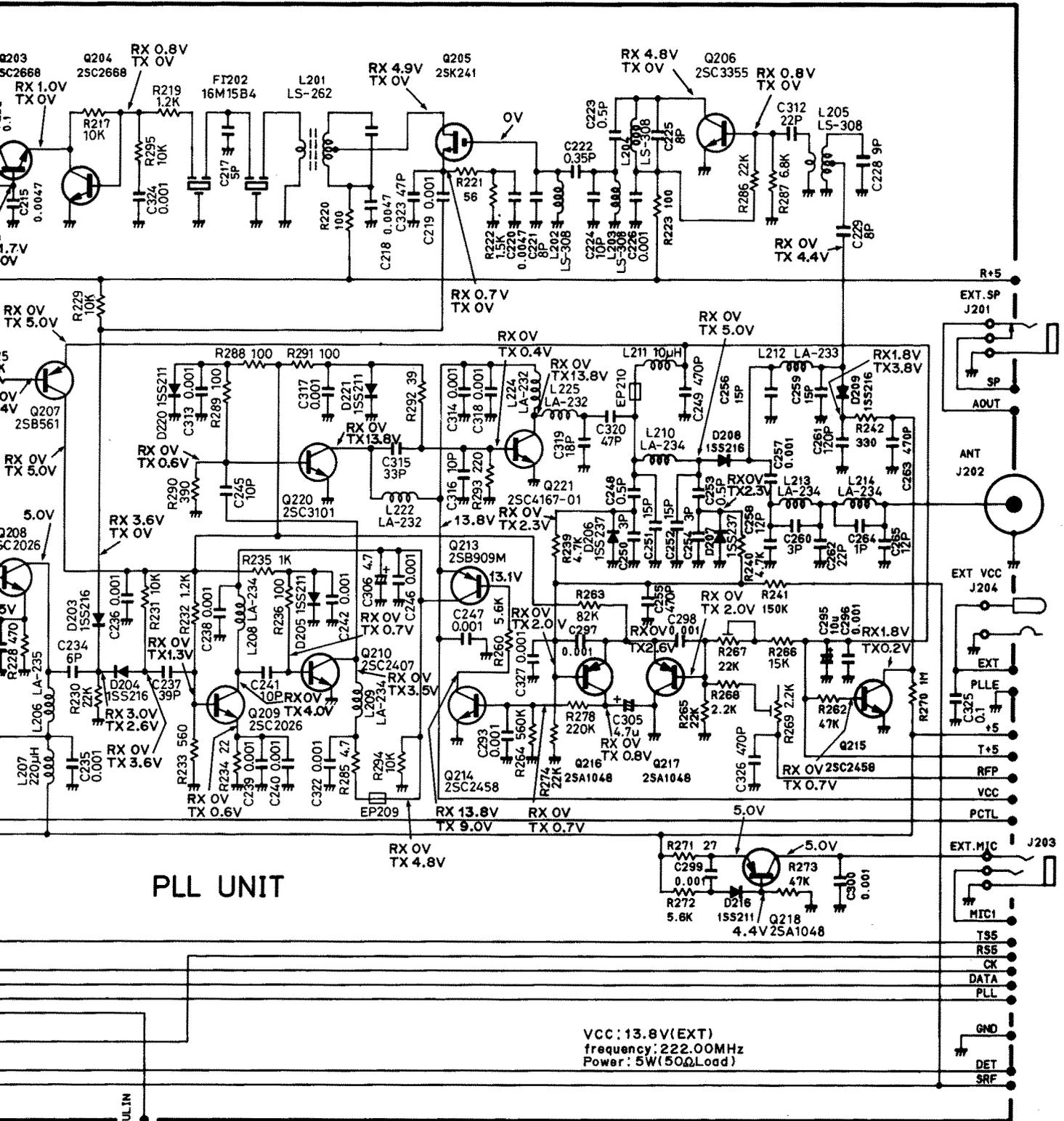
7 - 1 MAIN UNIT





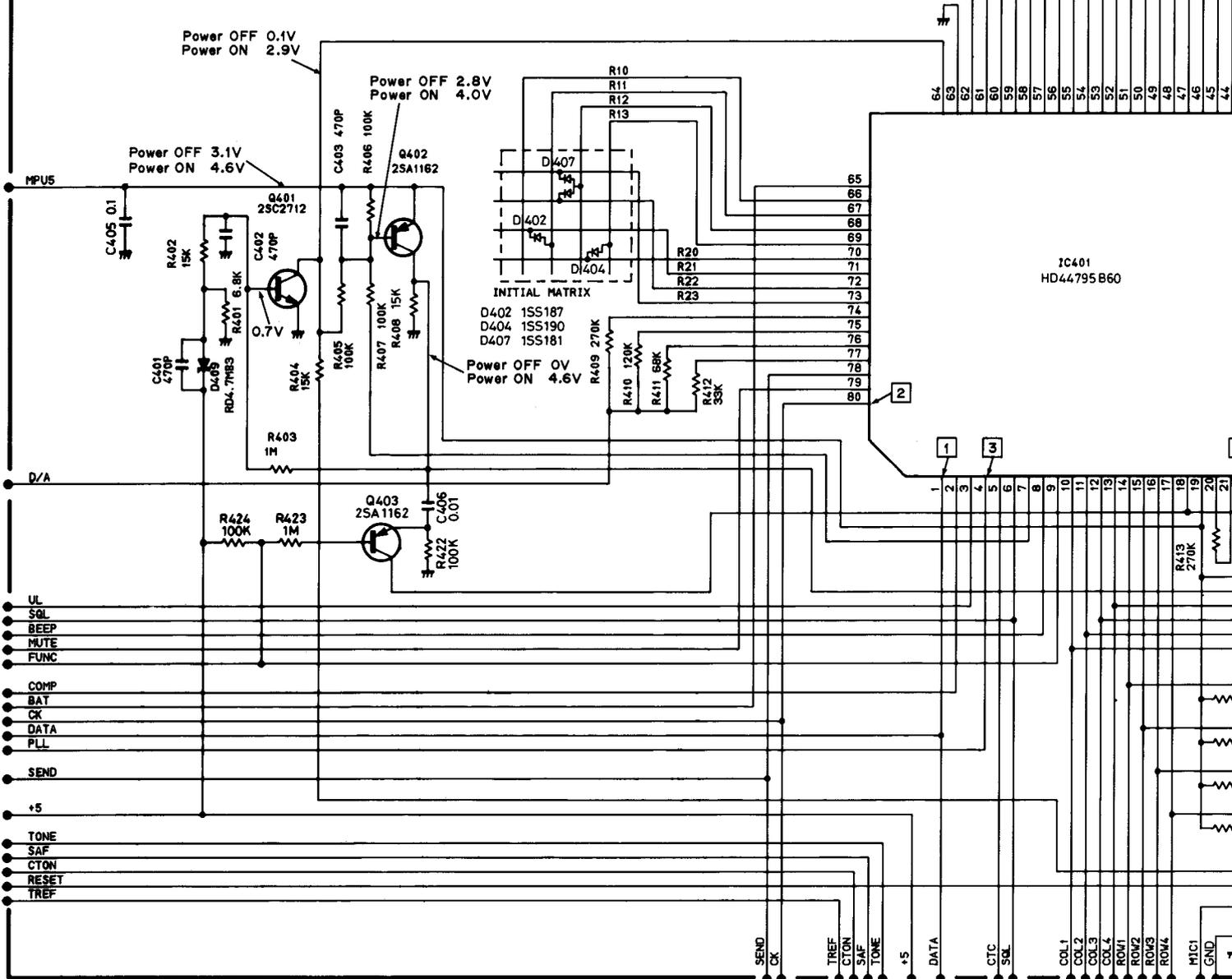
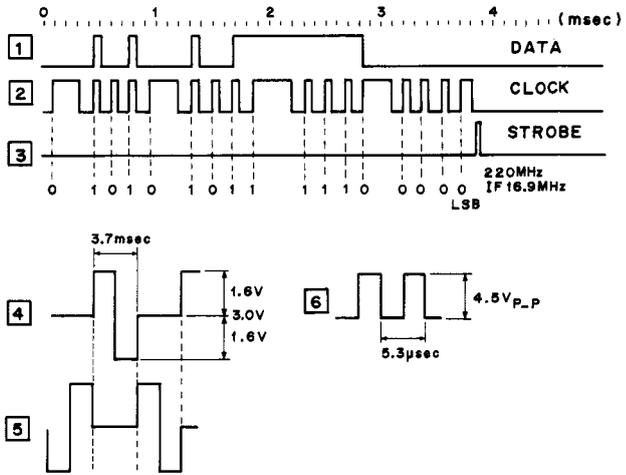
7 - 2 PLL, VCO UNITS





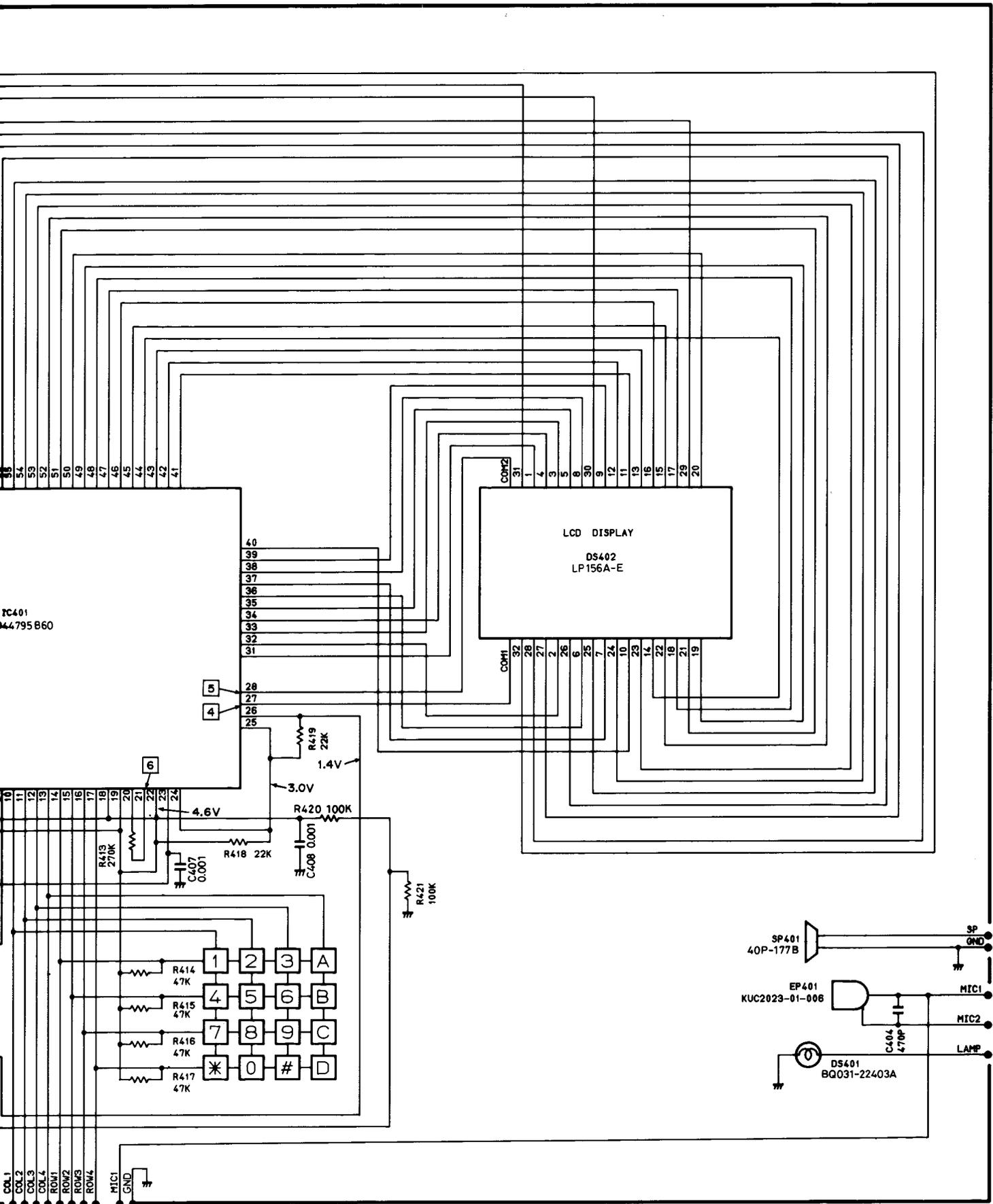
7 - 3 LOGIC UNIT

LOGIC UNIT

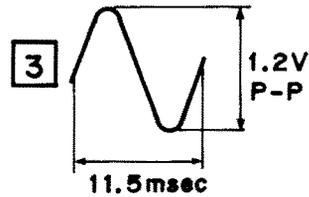
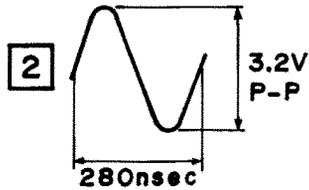
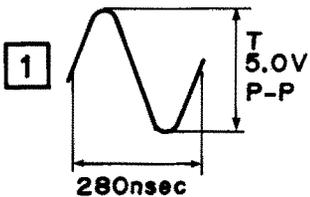
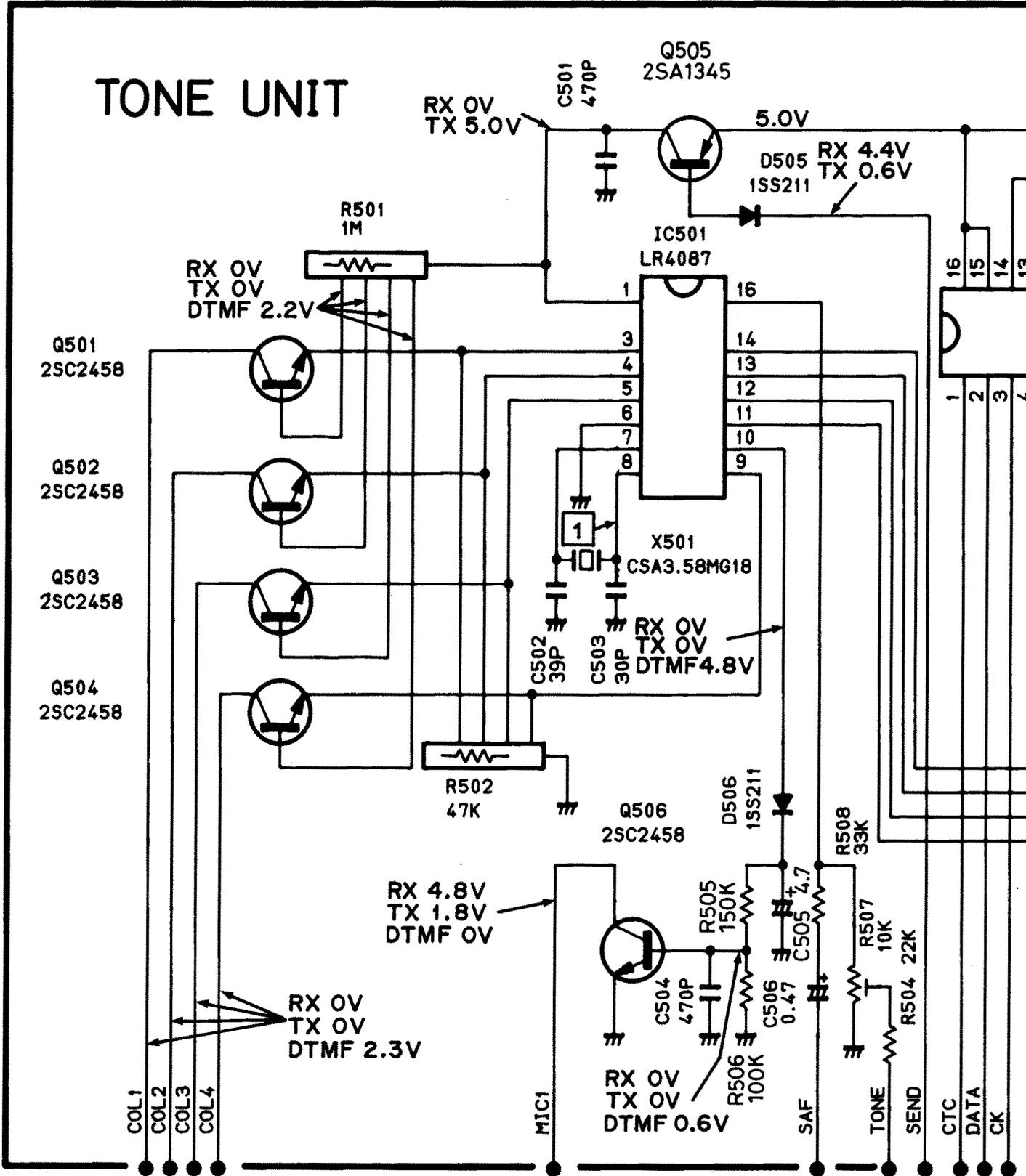


- UL
- SOL
- BEEP
- MUTE
- FUNC
- COMP
- BAT
- CK
- DATA
- PLL
- SEND
- +5
- TONE
- SAF
- CTON
- RESET
- TREF

- SEND
- CK
- TREF
- CTON
- SAF
- TONE
- +5
- DATA
- CTC
- SOL
- COL1
- COL2
- COL3
- COL4
- ROW1
- ROW2
- ROW3
- ROW4
- MIC1
- GND



7 - 4 TONE UNIT





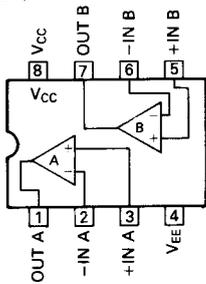
**SECTION 8 BOARD LAYOUTS**

**8 - 1 MAIN UNIT**

• ICs

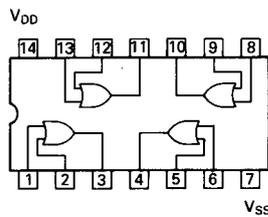
**μPC358C  
(Dual Driver)**

IC101



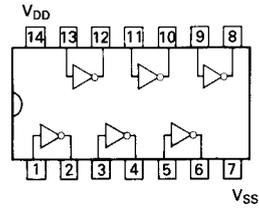
**TC4071BP  
(Quad 2-Input OR Gate)**

IC102



**TC4069UBP  
(Hex Inverter)**

IC103



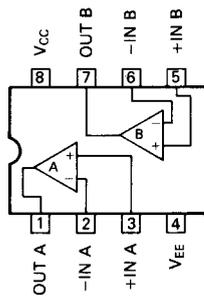
**S81250H-G  
(3-Terminal Voltage Regulator)**

IC104



**TA75393P  
(Dual Comparator)**

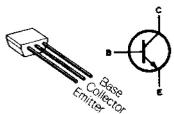
IC105



• Transistors

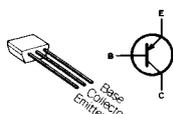
**2SC2458 GR**

Q101, Q102, Q104, Q105  
Q106, Q110, Q112, Q114  
Q118, Q119, Q130, Q132



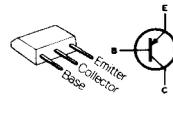
**2SA1048 GR**

Q103, Q107, Q108, Q109  
Q116, Q117, Q121, Q129



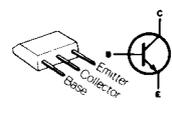
**2SB909M R**

Q111, Q113, Q115, Q120  
Q131

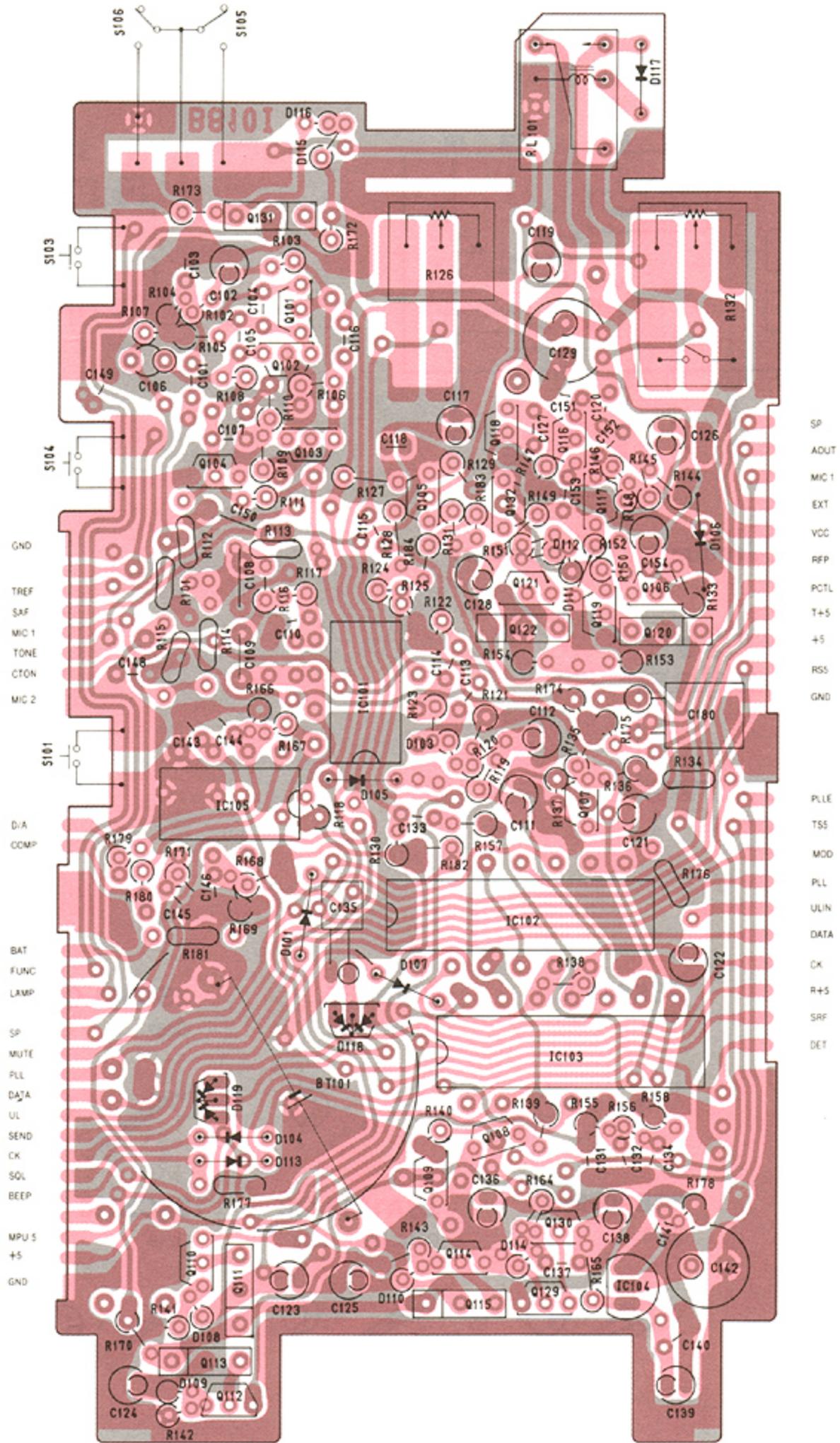


**2SD1225M R**

Q122



MAIN UNIT

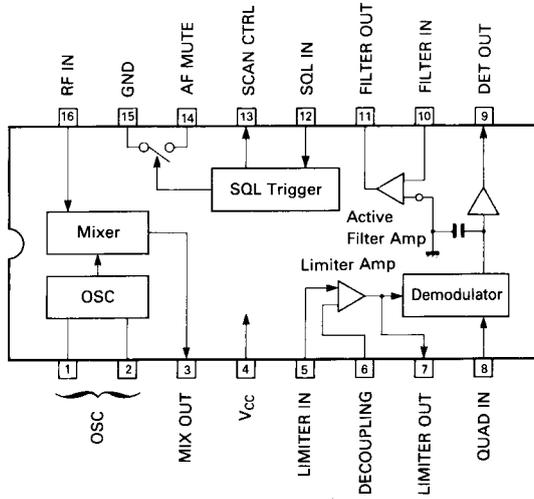


## 8 - 2 PLL UNIT

### • ICs

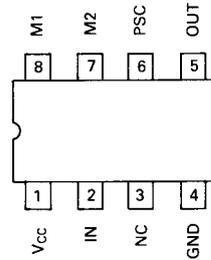
#### MC3357P (Low Power FM IF)

IC201



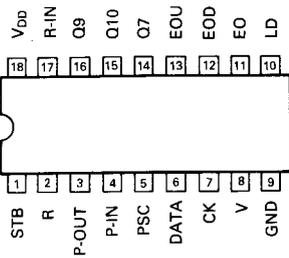
#### μPB571C (Low Power Prescaler)

IC202



#### μPD2834C (PLL Frequency Synthesizer)

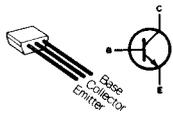
IC203



### • Transistors

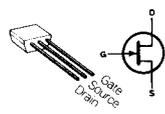
#### 2SC2668 O

Q201, Q202, Q203, Q204



#### 2SK241 Y

Q205



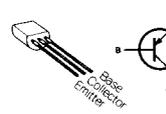
#### 2SC3355

Q206



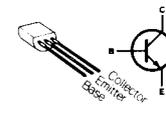
#### 2SB561 C

Q207



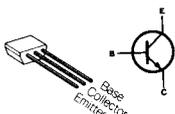
#### 2SC2407 A

Q210



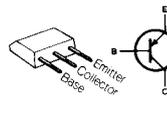
#### 2SC2458 GR

Q212, Q214, Q215



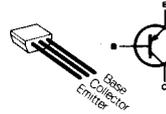
#### 2SB909M R

Q213



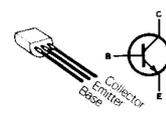
#### 2SA1048 GR

Q216, Q217, Q218



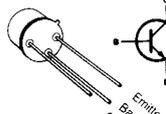
#### 2SC2026

Q219



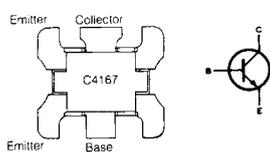
#### 2SC3101

Q220

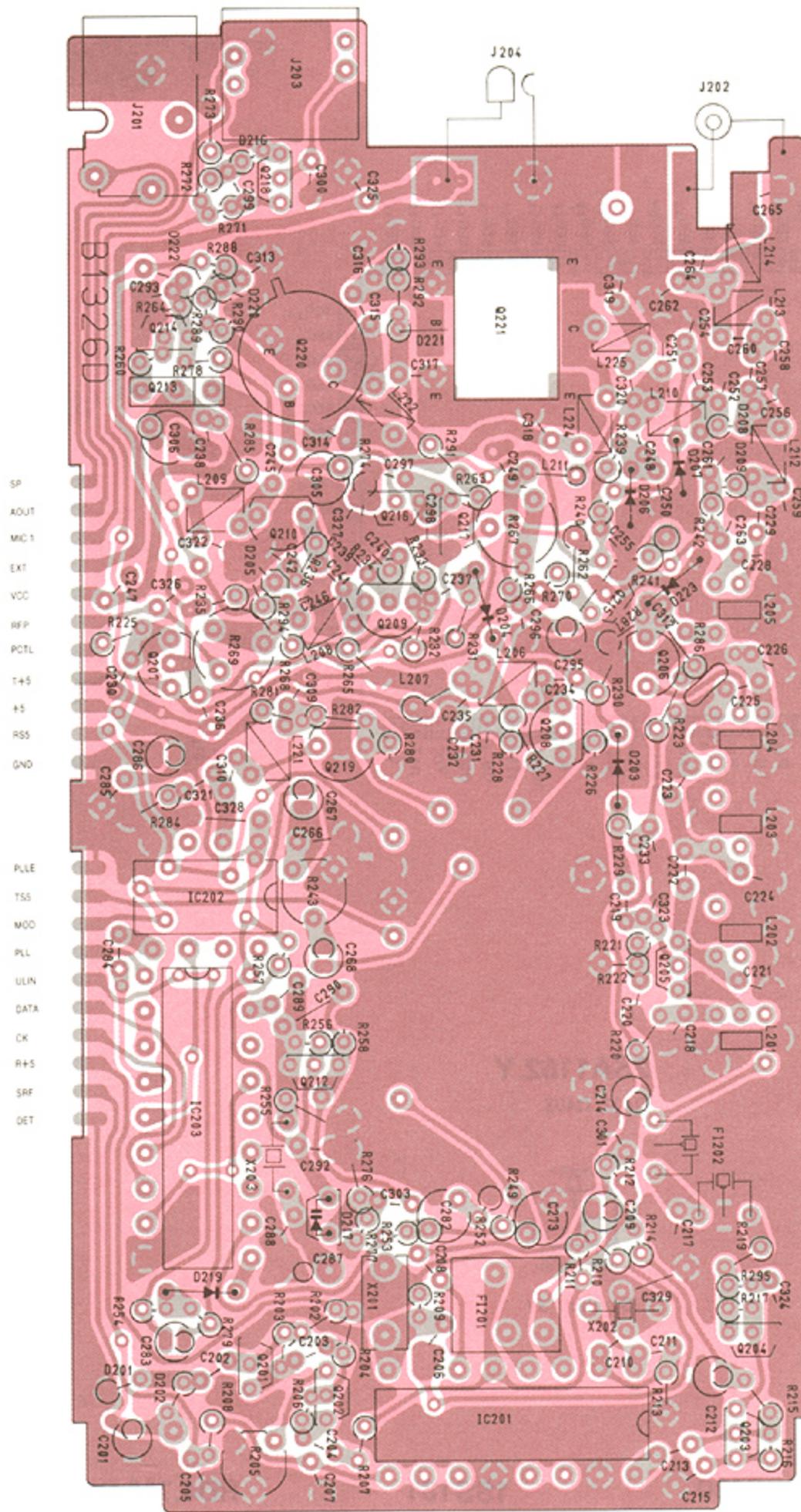


#### 2SC4167-01

Q221



PLL UNIT

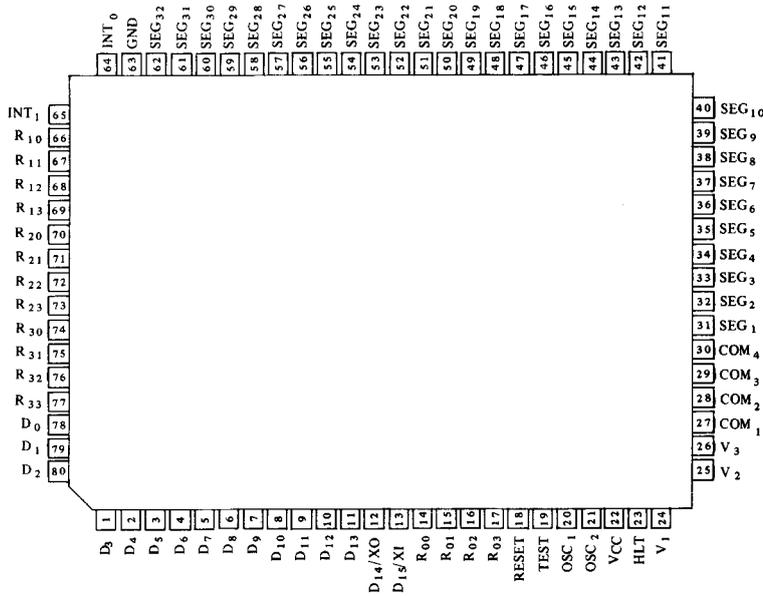


### 8 - 3 LOGIC UNIT

- IC

#### HD44795B60 (MPU)

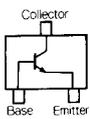
IC401



- Transistors

#### 2SC2712 Y

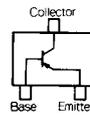
Q401



Symbol: LY

#### 2SA1162 Y

Q402, Q403



Symbol: SY

- Diodes

#### 1SS187

D402



Symbol: D3

#### 1SS190

D404



Symbol: E3

#### 1SS181

D407



Symbol: A3

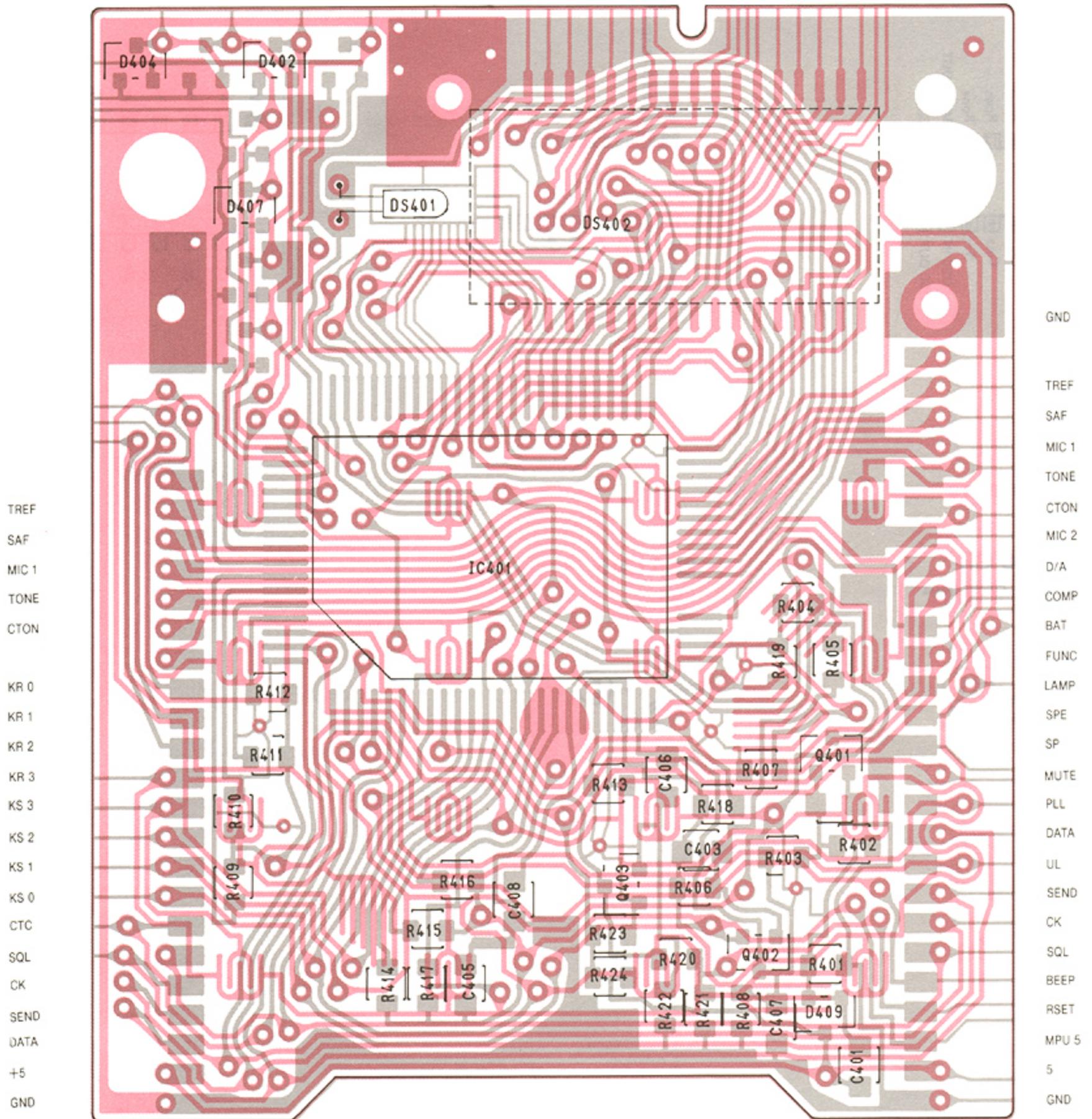
#### RD4.7M B3

D409



Symbol: 473

LOGIC UNIT

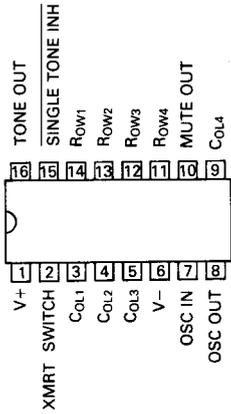


## 8 - 4 TONE UNIT

- ICs

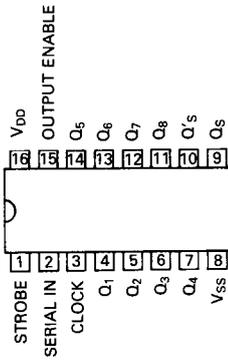
### LR4087 (DTMF Encoder)

IC501



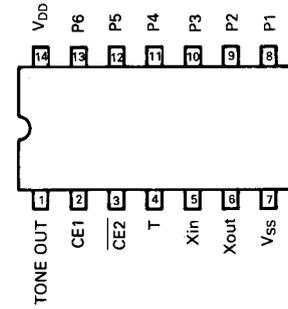
### TC4094BP (8-Stage Shift-and-Store Bus Register)

IC502



### S-7116A (Subaudible Tone Encoder)

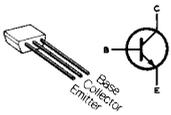
IC503



- Transistors

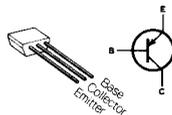
### 2SC2458 GR

Q501, Q502, Q503, Q504  
Q506

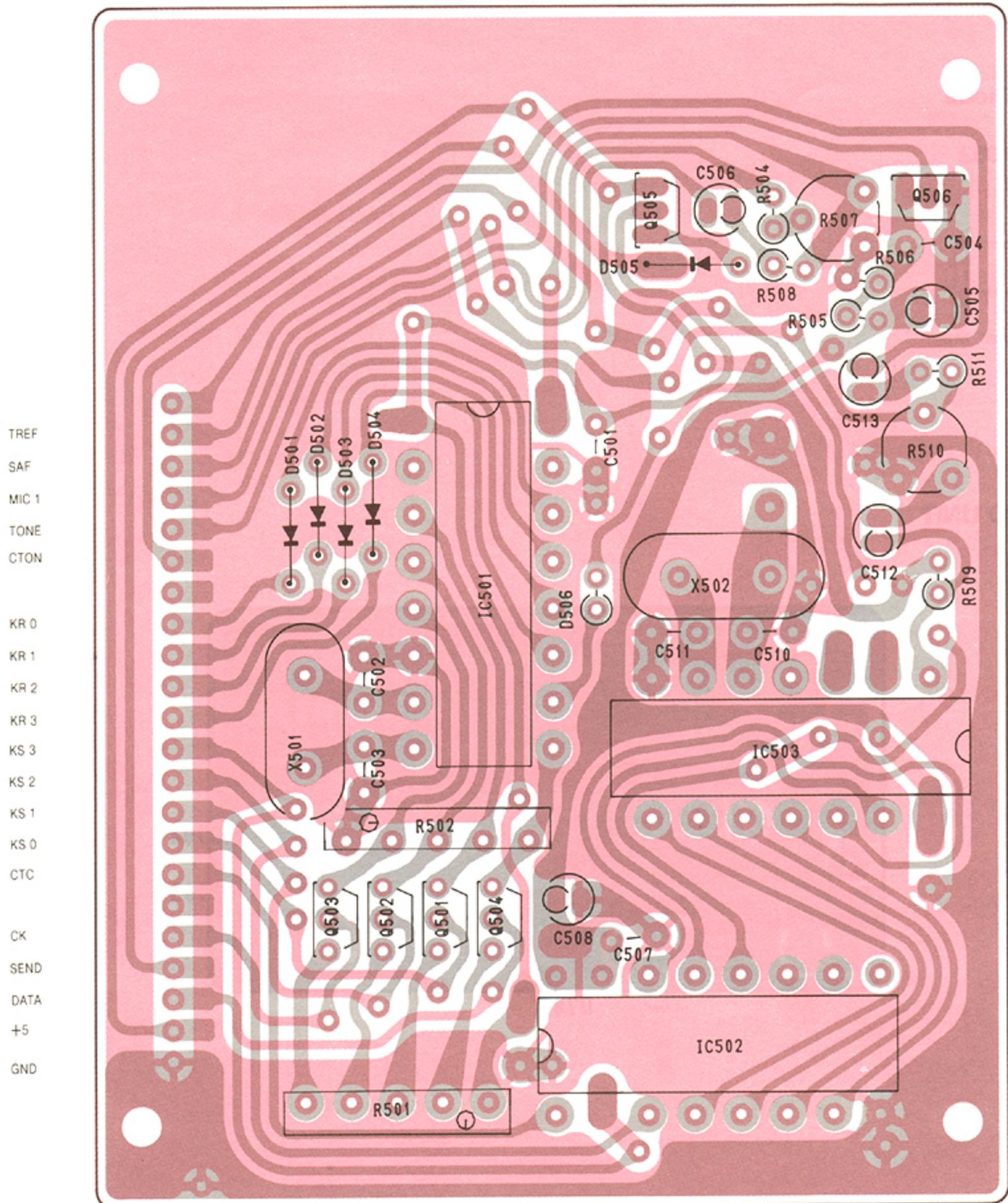


### 2SA1345

Q505



TONE UNIT

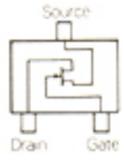


## 8 - 5 VCO UNIT

### • Transistor

#### 2SK302 Y

Q701

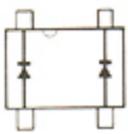


Symbol: TY

### • Diode

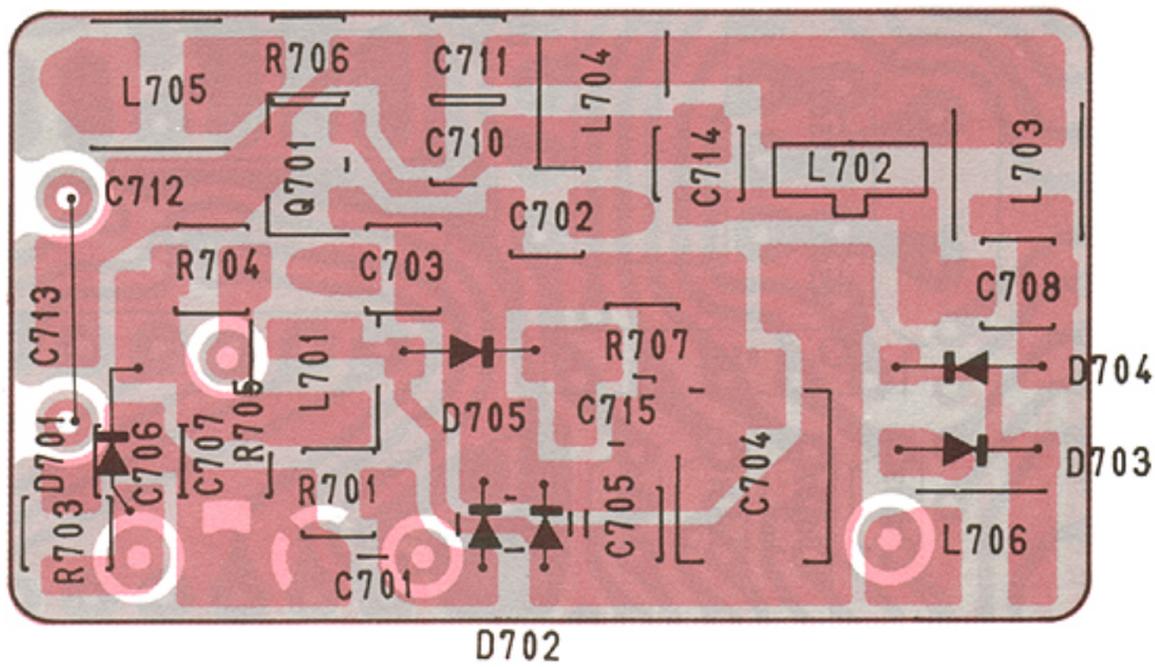
#### MA862

D702



Symbol: M11

## VCO UNIT



## SECTION 9 PARTS LIST

## MAIN UNIT

REF. NO.	DESCRIPTION	PART NO.
IC101	IC	μPC358C
IC102	IC	TC4071BP
IC103	IC	TC4069UBP
IC104	IC	S81250H-G
IC105	IC	TA75393P
Q101	Transistor	2SC2458 GR
Q102	Transistor	2SC2458 GR
Q103	Transistor	2SA1048 GR
Q104	Transistor	2SC2458 GR
Q105	Transistor	2SC2458 GR
Q106	Transistor	2SC2458 GR
Q107	Transistor	2SA1048 GR
Q108	Transistor	2SA1048 GR
Q109	Transistor	2SA1048 GR
Q110	Transistor	2SC2458 GR
Q111	Transistor	2SB909M R
Q112	Transistor	2SC2458 GR
Q113	Transistor	2SB909M R
Q114	Transistor	2SC2458 GR
Q115	Transistor	2SB909M R
Q116	Transistor	2SA1048 GR
Q117	Transistor	2SA1048 GR
Q118	Transistor	2SC2458 GR
Q119	Transistor	2SC2458 GR
Q120	Transistor	2SB909M R
Q121	Transistor	2SA1048 GR
Q122	Transistor	2SD1225M R
Q129	Transistor	2SA1048 GR
Q130	Transistor	2SC2458 GR
Q131	Transistor	2SB909M R
Q132	Transistor	2SC2458 GR
D101	Diode	1SS211
D103	Diode	1SS211
D104	Diode	1SS211
D105	Diode	1SS211
D106	Zener	RD9.1E B3
D107	Diode	1SS211
D108	Diode	1SS211
D109	Diode	1SS211
D110	Diode	1SS211
D111	Diode	1SS211
D112	Diode	1SS211
D113	Diode	1SS211
D114	Diode	1SS211
D115	Diode	1SS211
D116	Diode	1SS211
D117	Diode	1SS211
D118	Diode	1SS233
D119	Diode	1SS233
R101	Resistor	33kΩ R10
R102	Resistor	120kΩ ELR10
R103	Resistor	470Ω ELR10
R104	Resistor	120kΩ ELR10
R105	Resistor	3.3kΩ ELR10
R106	Resistor	5.6kΩ ELR10
R107	Resistor	390Ω ELR10
R108	Resistor	390kΩ ELR10
R109	Resistor	2.2kΩ ELR10
R110	Resistor	1kΩ ELR10
R111	Resistor	3.3kΩ ELR10
R112	Resistor	100kΩ R10
R113	Resistor	220kΩ R10
R114	Resistor	27kΩ R10
R115	Resistor	56kΩ R10
R116	Resistor	39kΩ ELR10
R117	Resistor	39kΩ ELR10
R118	Resistor	12kΩ ELR10
R119	Resistor	220kΩ ELR10
R120	Resistor	1kΩ ELR10

## MAIN UNIT

REF. NO.	DESCRIPTION	PART NO.
R121	Resistor	100kΩ ELR10
R122	Resistor	10kΩ ELR10
R123	Resistor	1.5MΩ ELR20
R124	Resistor	330kΩ ELR10
R125	Resistor	180kΩ ELR10
R126	Variable	10kΩB RK094111000NA
R127	Resistor	3.9kΩ ELR10
R128	Resistor	330kΩ ELR10
R129	Resistor	100kΩ ELR10
R130	Resistor	6.8kΩ ELR10
R131	Resistor	1.2kΩ ELR10
R132	Variable	10kΩA RK094111003A
R133	Resistor	22kΩ ELR10
R134	Resistor	470Ω R10
R135	Resistor	1.2kΩ ELR10
R136	Resistor	10kΩ ELR10
R137	Resistor	100kΩ ELR10
R138	Resistor	180kΩ ELR10
R139	Resistor	33kΩ ELR10
R140	Resistor	33kΩ ELR10
R141	Resistor	10kΩ ELR10
R142	Resistor	10kΩ ELR10
R143	Resistor	10kΩ ELR10
R144	Resistor	470kΩ ELR10
R145	Resistor	330kΩ ELR10
R146	Resistor	27kΩ ELR10
R147	Resistor	22kΩ ELR10
R148	Resistor	6.8kΩ ELR10
R149	Resistor	12kΩ ELR10
R150	Resistor	8.2kΩ ELR10
R151	Resistor	1.5kΩ ELR10
R152	Resistor	470kΩ ELR10
R153	Resistor	1Ω ELR10
R154	Resistor	1Ω ELR10
R155	Resistor	1MΩ ELR10
R156	Resistor	220kΩ ELR10
R157	Resistor	270kΩ ELR10
R158	Resistor	39kΩ ELR10
R164	Resistor	33kΩ ELR10
R165	Resistor	10kΩ ELR10
R166	Resistor	6.8kΩ ELR10
R167	Resistor	180kΩ ELR10
R168	Resistor	150kΩ ELR10
R169	Resistor	39kΩ ELR10
R170	Resistor	120kΩ ELR10
R171	Resistor	27kΩ ELR10
R172	Resistor	12Ω ELR10
R173	Resistor	5.6kΩ ELR10
R174	Resistor	1kΩ ELR10
R175	Resistor	1kΩ ELR10
R176	Resistor	100kΩ R10
R177	Resistor	470kΩ R10
R178	Resistor	470Ω ELR10
R179	Resistor	1kΩ ELR10
R180	Resistor	4.7kΩ ELR10
R181	Resistor	4.7kΩ R10
R182	Resistor	470kΩ ELR10
R183	Resistor	220kΩ ELR10
R184	Resistor	220kΩ ELR10
C101	Barrier Layer	0.0033μF 25V
C102	Electrolytic	10μF 16V RC3
C103	Ceramic	470pF 50V
C104	Ceramic	470pF 50V
C105	Ceramic	470pF 50V
C106	Tantalum	0.1μF 35V DN
C107	Ceramic	0.001μF 50V
C108	Mylar	0.0022μF 50V
C109	Mylar	0.01μF 50V
C110	Ceramic	120pF 50V
C111	Electrolytic	0.22μF 50V RC3
C112	Electrolytic	0.22μF 50V RC3

## MAIN UNIT

REF. NO.	DESCRIPTION	PART NO.	
C113	Ceramic	15pF	50V
C114	Ceramic	0.001μF	50V
C115	Ceramic	0.001μF	50V
C116	Barrier Layer	0.0022μF	25V
C117	Electrolytic	0.22μF	50V RC3
C118	Barrier Layer	0.0068μF	25V
C119	Electrolytic	0.1μF	50V RC3
C120	Barrier Layer	0.0033μF	25V
C121	Electrolytic	10μF	16V RC3
C122	Electrolytic	0.22μF	50V RC3
C123	Electrolytic	22μF	6.3V RC3
C124	Electrolytic	22μF	6.3V RC3
C125	Electrolytic	22μF	6.3V RC3
C126	Electrolytic	10μF	16V RC3
C127	Ceramic	100pF	50V
C128	Electrolytic	0.22μF	50V RC3
C129	Electrolytic	47μF	25V MS7
C130	Electrolytic	100μF	10V MS7
C131	Ceramic	100pF	50V
C132	Ceramic	470pF	50V
C133	Barrier Layer	0.0033μF	25V
C134	Barrier Layer	0.0027μF	25V
C135	Electrolytic	47μF	6.3V RC3
C136	Electrolytic	22μF	6.3V RC3
C137	Ceramic	470pF	50V
C138	Electrolytic	22μF	6.3V RC3
C139	Electrolytic	22μF	6.3V RC3
C140	Ceramic	470pF	50V
C141	Ceramic	470pF	50V
C142	Electrolytic	33μF	25V RC3
C143	Ceramic	0.001μF	50V
C144	Ceramic	0.001μF	50V
C145	Ceramic	0.001μF	50V
C146	Ceramic	0.001μF	50V
C148	Ceramic	0.001μF	50V
C149	Ceramic	470pF	50V
C150	Barrier Layer	0.018μF	25V
C151	Ceramic	470pF	50V
C152	Ceramic	470pF	50V
C153	Ceramic	470pF	50V
C154	Electrolytic	4.7μF	25V RC3
C155	Ceramic	470pF	50V
C156	Ceramic	470pF	50V
RL101	Relay	OUC-SS-114D	
S101	Switch	SKHHAB062A	
S103	Switch	SKHHAB062A	
S104	Switch	SKHHAB062A	
S105	Switch	SPPH22014A	
S106	Switch	SPPH22014A	
BT101	Lithium Battery	BR2325-1HC	
EP101	P.C. Board	B-810I	
EP102	P.C. Board	B-824A	
EP103	F.P.C. Board	B-812	
EP104	Bead Core	DL2-OP2.6-3-1.2H	

## PLL UNIT

REF. NO.	DESCRIPTION	PART NO.	
IC201	IC	MC3357P	
IC202	IC	μPB571C	
IC203	IC	μPD2834C	
Q201	Transistor	2SC2668 O	
Q202	Transistor	2SC2668 O	
Q203	Transistor	2SC2668 O	
Q204	Transistor	2SC2668 O	
Q205	FET	2SK241 Y	
Q206	Transistor	2SC3355	
Q207	Transistor	2SB561 C	
Q208	Transistor	2SC2026	
Q209	Transistor	2SC2026	
Q210	Transistor	2SC2407 A	
Q212	Transistor	2SC2458 GR	
Q213	Transistor	2SB909M R	
Q214	Transistor	2SC2458 GR	
Q215	Transistor	2SC2458 GR	
Q216	Transistor	2SA1048 GR	
Q217	Transistor	2SA1048 GR	
Q218	Transistor	2SA1048 GR	
Q219	Transistor	2SC2026	
Q220	Transistor	2SC3101	
Q221	Transistor	2SC4167-01	
D201	Diode	1SS99	
D202	Diode	1SS97	
D203	Diode	1SS216	
D204	Diode	1SS216	
D205	Diode	1SS211	
D206	Diode	1SS237	
D207	Diode	1SS237	
D208	Diode	1SS216	
D209	Diode	1SS216	
D216	Diode	1SS211	
D217	Varicap	1SV100	
D219	Diode	1SS211	
D220	Diode	1SS211	
D221	Diode	1SS211	
D222	Diode	1SS237	
D223	Diode	1SS211	
FI201	Ceramic	CFU455 E2	
FI202	Monolithic	UM-1/16M15B4	
X201	Discriminator	CDB455 C7A	
X202	Crystal	HC-18/T 16.445MHz	
X203	Crystal	HC-18/T 5.12MHz	
L201	Coil	LS-262	
L202	Coil	LS-308	
L203	Coil	LS-308	
L204	Coil	LS-308	
L205	Coil	LS-308	
L206	Coil	LA-235	
L207	Choke	LAL03NA	221K
L208	Coil	LA-234	
L209	Coil	LA-234	
L210	Coil	LA-234	
L211	Choke	LAL03NA	100K
L212	Coil	LA-233	
L213	Coil	LA-234	
L214	Coil	LA-234	
L221	Coil	LA-235	
L222	Coil	LA-232	
L224	Coil	LA-232	
L225	Coil	LA-232	
R202	Resistor	12kΩ	ELR10
R203	Resistor	680kΩ	ELR10
R204	Resistor	15kΩ	ELR10
R205	Trimmer	10kΩ	RH0521C14J08A
R206	Resistor	1MΩ	ELR10
R207	Resistor	4.7kΩ	ELR10
R208	Resistor	470Ω	ELR10
R209	Resistor	1.5kΩ	ELR10
R210	Resistor	47kΩ	ELR10
R211	Resistor	1.5kΩ	ELR10

## PLL UNIT

REF. NO.	DESCRIPTION	PART NO.		
R212	Resistor	1.5kΩ	R10	
R213	Resistor	47kΩ	ELR10	
R214	Resistor	100Ω	ELR10	
R215	Resistor	1.2kΩ	ELR10	
R216	Resistor	10kΩ	ELR10	
R217	Resistor	10kΩ	ELR10	
R219	Resistor	1.2kΩ	ELR10	
R220	Resistor	100Ω	ELR10	
R221	Resistor	56Ω	R10	
R222	Resistor	1.5kΩ	ELR10	
R223	Resistor	100Ω	ELR10	
R225	Resistor	6.8kΩ	ELR10	
R226	Resistor	4.7kΩ	ELR10	
R227	Resistor	5.6kΩ	ELR10	
R228	Resistor	470Ω	ELR10	
R229	Resistor	10kΩ	ELR10	
R230	Resistor	22kΩ	ELR10	
R231	Resistor	10kΩ	ELR10	
R232	Resistor	1.2kΩ	ELR10	
R233	Resistor	560Ω	ELR10	
R234	Resistor	22Ω	ELR10	
R235	Resistor	1kΩ	ELR10	
R236	Resistor	100Ω	ELR10	
R239	Resistor	4.7kΩ	ELR10	
R240	Resistor	4.7kΩ	ELR10	
R241	Resistor	150kΩ	ELR10	
R242	Resistor	330Ω	ELR10	
R243	Trimmer	47kΩ	RH0521CS4J0DA	
R249	Resistor	10kΩ	ELR10	
R252	Resistor	1.5kΩ	ELR10	
R253	Resistor	1.8kΩ	R10	
R254	Resistor	220kΩ	ELR10	
R255	Resistor	39kΩ	ELR10	
R256	Resistor	39kΩ	ELR10	
R257	Resistor	100Ω	ELR10	
R258	Resistor	5.6kΩ	ELR10	
R260	Resistor	8.2kΩ	ELR10	
R262	Resistor	47kΩ	ELR10	
R263	Resistor	82kΩ	ELR10	
R264	Resistor	560kΩ	ELR10	
R265	Resistor	22kΩ	ELR10	
R266	Resistor	15kΩ	ELR10	
R267	Trimmer	22kΩ	RH0521CJ4J06A	
R268	Resistor	2.2kΩ	ELR10	
R269	Trimmer	2.2kΩ	RH0521CJ3J05A	
R270	Resistor	1MΩ	ELR10	
R271	Resistor	27Ω	ELR10	
R272	Resistor	5.6kΩ	ELR10	
R273	Resistor	47kΩ	ELR10	
R274	Resistor	22kΩ	ELR10	
R276	Resistor	1MΩ	ELR10	
R277	Resistor	1kΩ	ELR10	
R278	Resistor	220kΩ	ELR10	
R279	Resistor	390kΩ	ELR10	
R280	Resistor	4.7kΩ	ELR10	
R281	Resistor	470Ω	ELR10	
R282	Resistor	5.6kΩ	ELR10	
R284	Resistor	47Ω	ELR10	
R285	Resistor	4.7Ω	ELR10	
R286	Resistor	22kΩ	ELR10	
R287	Resistor	6.8kΩ	ELR10	
R288	Resistor	100Ω	ELR10	
R289	Resistor	100Ω	ELR10	
R290	Resistor	390Ω	ELR10	
R291	Resistor	100Ω	ELR10	
R292	Resistor	39Ω	ELR10	
R293	Resistor	220Ω	ELR10	
R294	Resistor	10kΩ	ELR10	
R295	Resistor	10kΩ	ELR10	
C201	Electrolytic	1μF	50V	RC3
C202	Ceramic	470pF	50V	
C203	Ceramic	470pF	50V	
C204	Ceramic	15pF	50V	
C205	Barrier Layer	0.0033μF	25V	
C206	Ceramic	82pF	50V	
C207	Ceramic	0.001μF	50V	
C208	Monolithic	0.1μF	D33Y5V1E104Z21	

## PLL UNIT

REF. NO.	DESCRIPTION	PART NO.		
C209	Electrolytic	0.1μF	50V	RC3
C210	Ceramic	120pF	50V	
C211	Ceramic	22pF	50V	
C212	Electrolytic	1μF	50V	RC3
C213	Ceramic	0.001μF	50V	
C214	Electrolytic	10μF	16V	RC3
C215	Barrier Layer	0.0047μF	25V	
C217	Ceramic	5pF	50V	
C218	Barrier Layer	0.0047μF	25V	
C219	Ceramic	0.001μF	50V	
C220	Barrier Layer	0.0047μF	25V	
C221	Ceramic	8pF	50V	
C222	Ceramic	0.35pF	50V	
C223	Ceramic	0.5pF	50V	
C224	Ceramic	10pF	50V	
C225	Ceramic	8pF	50V	
C226	Ceramic	0.001μF	50V	
C228	Ceramic	9pF	50V	
C229	Ceramic	8pF	50V	
C230	Ceramic	0.001μF	50V	
C231	Ceramic	0.001μF	50V	
C232	Ceramic	0.001μF	50V	
C233	Ceramic	470pF	50V	
C234	Ceramic	6pF	50V	
C235	Ceramic	0.001μF	50V	
C236	Ceramic	0.001μF	50V	
C237	Ceramic	39pF	50V	
C238	Ceramic	0.001μF	50V	
C239	Ceramic	0.001μF	50V	
C240	Ceramic	0.001μF	50V	
C241	Ceramic	10pF	50V	
C242	Ceramic	0.001μF	50V	
C245	Ceramic	10pF	50V	
C246	Ceramic	0.001μF	50V	
C247	Ceramic	0.001μF	50V	
C248	Ceramic	0.5pF	50V	
C249	Ceramic	470pF	50V	
C250	Ceramic	3pF	50V	
C251	Ceramic	15pF	50V	
C252	Ceramic	15pF	50V	
C253	Ceramic	0.5pF	50V	
C254	Ceramic	3pF	50V	
C255	Ceramic	470pF	50V	
C256	Ceramic	15pF	50V	
C257	Ceramic	0.001μF	50V	
C258	Ceramic	12pF	50V	
C259	Ceramic	15pF	50V	
C260	Ceramic	3pF	50V	
C261	Ceramic	120pF	50V	
C262	Ceramic	22pF	50V	
C263	Ceramic	470pF	50V	
C264	Ceramic	1pF	50V	
C265	Ceramic	12pF	50V	
C266	Mylar	0.0022μF	50V	
C267	Electrolytic	0.47μF	50V	RC3
C268	Electrolytic	0.47μF	50V	RC3
C273	Tantalum	0.1μF	35V	DN
C282	Tantalum	10μF	16V	DN
C283	Electrolytic	10μF	16V	RC3
C284	Ceramic	0.001μF	50V	
C285	Monolithic	0.1μF	D33Y5V1E104Z21	
C286	Electrolytic	22μF	6.3V	RC3
C287	Trimmer	10pF	ECRGA010D30	
C288	Ceramic	22pF	50V	
C289	Ceramic	0.001μF	50V	
C290	Ceramic	220pF	50V	
C292	Barrier Layer	0.01μF	25V	
C293	Ceramic	0.001μF	50V	
C295	Electrolytic	10μF	16V	RC3
C296	Ceramic	0.001μF	50V	
C297	Ceramic	0.001μF	50V	
C298	Ceramic	0.001μF	50V	
C299	Ceramic	0.001μF	50V	
C300	Ceramic	0.001μF	50V	
C301	Barrier Layer	0.0047μF	25V	
C303	Ceramic	0.001μF	50V	
C305	Tantalum	4.7μF	16V	DN
C306	Tantalum	4.7μF	16V	DN

## PLL UNIT

REF. NO.	DESCRIPTION	PART NO.
C309	Ceramic	0.001 $\mu$ F 50V
C310	Ceramic	100pF 50V
C312	Ceramic	22pF 50V
C313	Ceramic	0.001 $\mu$ F 50V
C314	Ceramic	0.001 $\mu$ F 50V
C315	Ceramic	33pF 50V
C316	Ceramic	10pF 50V
C317	Ceramic	0.001 $\mu$ F 50V
C318	Ceramic	0.001 $\mu$ F 50V
C319	Ceramic	18pF 50V
C320	Ceramic	47pF 50V
C321	Ceramic	0.001 $\mu$ F 50V
C322	Ceramic	0.001 $\mu$ F 50V
C323	Ceramic	47pF 50V
C324	Ceramic	0.001 $\mu$ F 50V
C325	Monolithic	0.1 $\mu$ F D33Y5V1E104Z21
C326	Ceramic	470pF 50V
C327	Ceramic	0.001 $\mu$ F 50V
C328	Barrier Layer	0.1 $\mu$ F 16V
C329	Barrier Layer	0.1 $\mu$ F 16V
J201	Connector	HSJ0836-01-010
J202	Connector	BNC-RM-106
J203	Connector	HSJ1102-01-040
J204	Connector	HEC0747-01-010
J205	Connector	171255-1
J206	Connector	171255-1
EP201	P.C. Board	B-1326D
EP208	F.P.C. Board	B-1050A
EP209	Bead Core	DL2-OP2.6-3-1.2H
EP210	Bead Core	DL2-OP2.6-3-1.2H

## LOGIC UNIT

REF. NO.	DESCRIPTION	PART NO.
IC401	MPU	HD44795B60
Q401	Transistor	2SC2712 Y
Q402	Transistor	2SA1162 Y
Q403	Transistor	2SA1162 Y
D402	Diode	1SS187
D404	Diode	1SS190
D407	Diode	1SS181
D409	Zener	RD4.7M B3
R401	Chip	6.8k $\Omega$ MCR10
R402	Chip	15k $\Omega$ MCR10
R403	Chip	1M $\Omega$ MCR10
R404	Chip	15k $\Omega$ MCR10
R405	Chip	100k $\Omega$ MCR10
R406	Chip	100k $\Omega$ MCR10
R407	Chip	100k $\Omega$ MCR10
R408	Chip	15k $\Omega$ MCR10
R409	Chip	270k $\Omega$ MCR10
R410	Chip	120k $\Omega$ MCR10
R411	Chip	68k $\Omega$ MCR10
R412	Chip	33k $\Omega$ MCR10
R413	Chip	270k $\Omega$ MCR10
R414	Chip	47k $\Omega$ MCR10
R415	Chip	47k $\Omega$ MCR10
R416	Chip	47k $\Omega$ MCR10
R417	Chip	47k $\Omega$ MCR10
R418	Chip	22k $\Omega$ MCR10
R419	Chip	22k $\Omega$ MCR10
R420	Chip	100k $\Omega$ MCR10
R421	Chip	100k $\Omega$ MCR10
R422	Chip	100k $\Omega$ MCR10
R423	Chip	1M $\Omega$ MCR10
R424	Chip	100k $\Omega$ MCR10
C401	Monolithic	470pF GRM40
C402	Monolithic	470pF GRM40
C403	Monolithic	470pF GRM40
C404	Ceramic	470pF 50V
C405	Monolithic	0.1 $\mu$ F GRM40 F
C406	Monolithic	0.01 $\mu$ F GRM40 F
C407	Monolithic	0.001 $\mu$ F GRM40
C408	Monolithic	0.001 $\mu$ F GRM40
DS401	Lamp	BQ031-22403A
DS402	LCD	LP156A-E
SP401	Speaker	40P-177B
EP401	Microphone	KUC2023-01-006
EP402	Rubber Conductor	SRCN-297B
EP404	P.C. Board	B-811C
EP405	F.P.C. Board	B-813A
EP406	F.P.C. Board	B-822A

## TONE UNIT

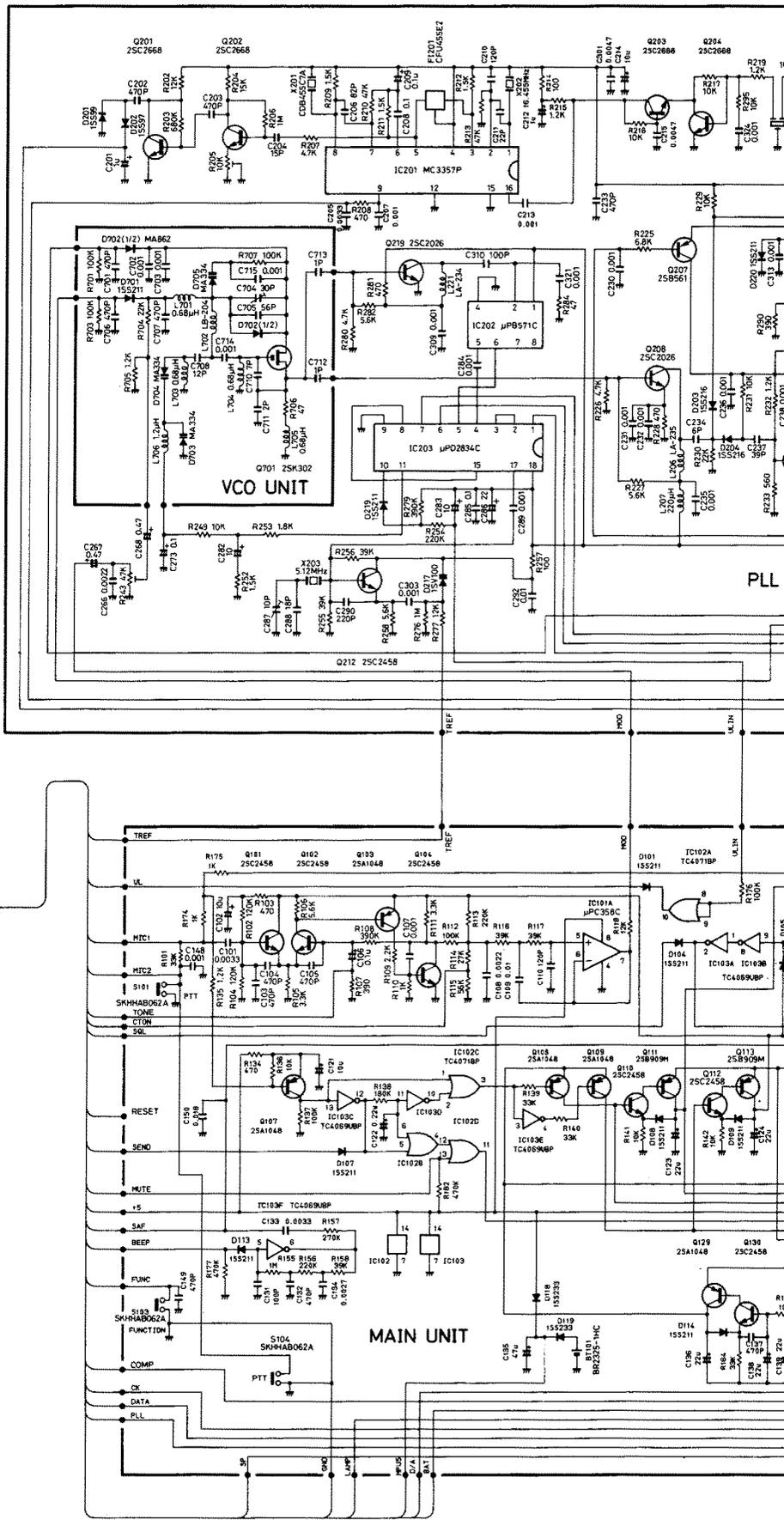
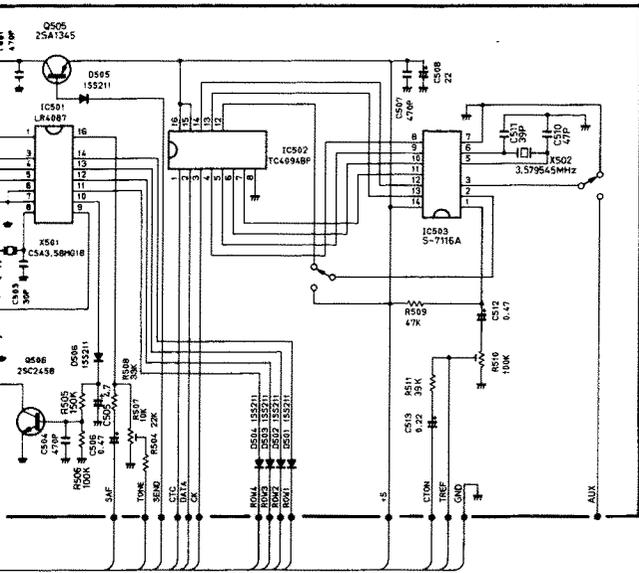
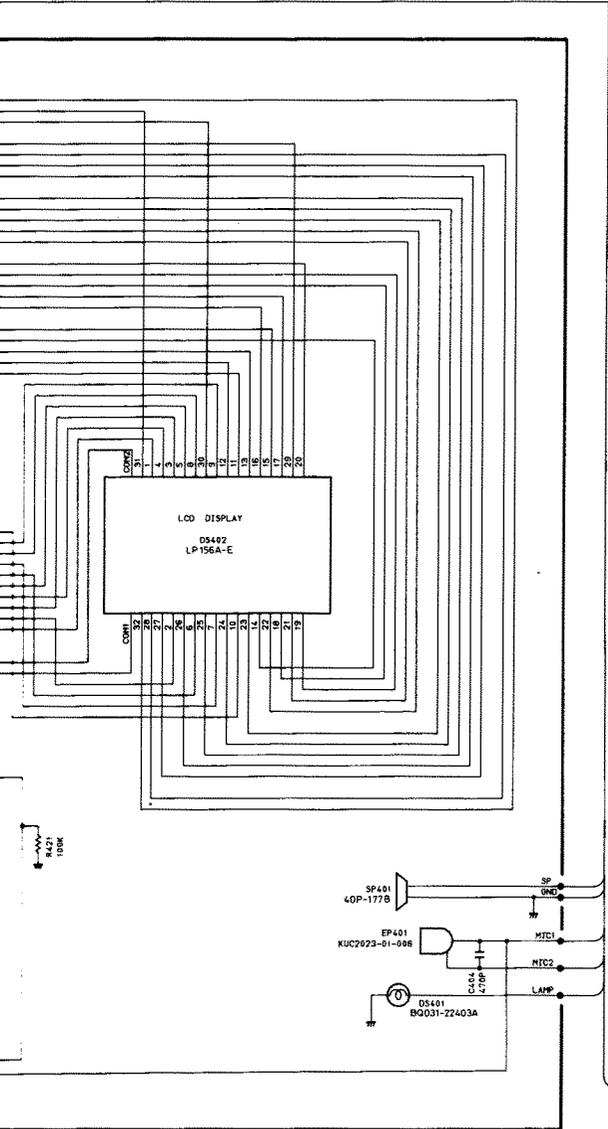
REF. NO.	DESCRIPTION	PART NO.	
IC501	IC	LR4087	
IC502	IC	TC4094BP	
IC503	IC	S-7116A	
Q501	Transistor	2SC2458 GR	
Q502	Transistor	2SC2458 GR	
Q503	Transistor	2SC2458 GR	
Q504	Transistor	2SC2458 GR	
Q505	Transistor	2SA1345	
Q506	Transistor	2SC2458 GR	
D501	Diode	1SS211	
D502	Diode	1SS211	
D503	Diode	1SS211	
D504	Diode	1SS211	
D505	Diode	1SS211	
D506	Diode	1SS211	
X501	Cera lock	CSA3.58	MG18
X502	Crystal	HC-43/u	3579.545kHz
R501	Array	RKL5S	105J
R502	Array	RKL5S	473J
R504	Resistor	22k $\Omega$	ELR10
R505	Resistor	150k $\Omega$	ELR10
R506	Resistor	100k $\Omega$	ELR10
R507	Trimmer	10k $\Omega$	RH0521C14J08A
R508	Resistor	33k $\Omega$	ELR10
R509	Resistor	47k $\Omega$	ELR10
R510	Trimmer	100k $\Omega$	RH0521C15J05A
R511	Resistor	39k $\Omega$	ELR10
C501	Ceramic	470pF	50V
C502	Ceramic	39pF	50V
C503	Ceramic	30pF	50V
C504	Ceramic	470pF	50V
C505	Electrolytic	4.7 $\mu$ F	16V RC3
C506	Electrolytic	0.47 $\mu$ F	50V RC3
C507	Ceramic	470pF	50V
C508	Electrolytic	22pF	6.3V RC3
C510	Ceramic	47pF	50V
C511	Ceramic	39pF	50V
C512	Electrolytic	0.47 $\mu$ F	50V RC3
C513	Electrolytic	0.22 $\mu$ F	50V RC3
EP501	P.C. Board	B-814B	

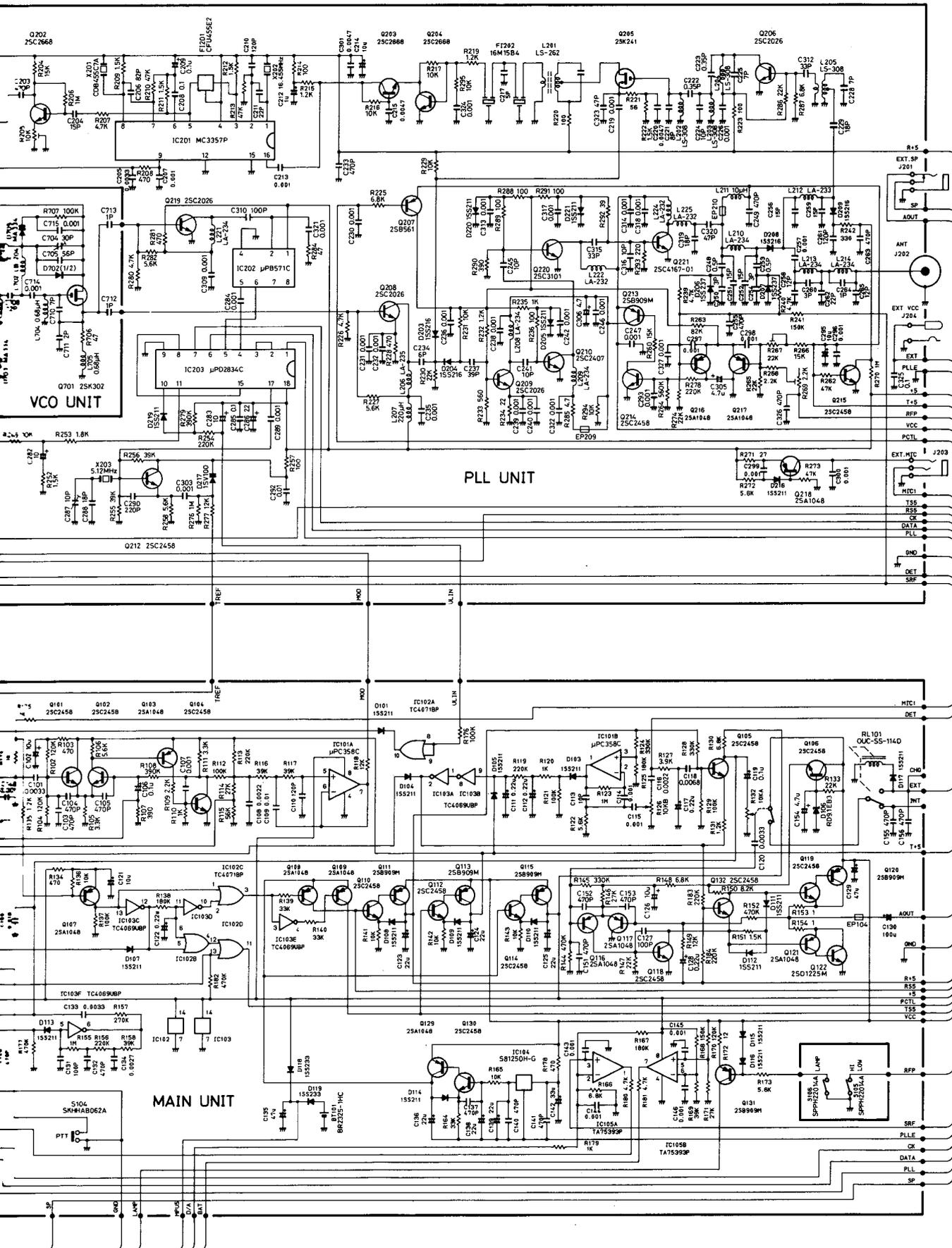
## VCO UNIT

REF. NO.	DESCRIPTION	PART NO.	
Q701	FET	2SK302 Y	
D701	Diode	1SS211	
D702	Diode	MA862	
D703	Varicap	MA334	
D704	Varicap	MA334	
D705	Varicap	MA334	
L701	Choke	LQH3N	R68
L702	Coil	LB-204	
L703	Choke	LQH3N	R68
L704	Choke	LQH3N	R68
L705	Choke	LQH3N	R68
L706	Choke	LQH3N	1R2
R701	Chip	100k $\Omega$	MCR10
R703	Chip	100k $\Omega$	MCR10
R704	Chip	22k $\Omega$	MCR10
R705	Resistor	1.2k $\Omega$	R10
R706	Chip	47 $\Omega$	MCR10
R707	Chip	100k $\Omega$	MCR10
C701	Ceramic	470pF	50V
C702	Monolithic	0.001 $\mu$ F	GRM40
C703	Monolithic	0.001 $\mu$ F	GRM40
C704	Trimmer	20pF	TZB04R200BA
C705	Monolithic	68pF	GRM40
C706	Monolithic	470pF	GRM40
C707	Monolithic	470pF	GRM40
C708	Monolithic	12pF	GRM40
C710	Monolithic	7pF	GRM40
C711	Monolithic	0.5pF	GRM40
C712	Ceramic	1pF	50V
C713	Ceramic	1pF	50V
C714	Monolithic	0.001 $\mu$ F	GRM40
C715	Monolithic	0.001 $\mu$ F	GRM40
EP701	P.C. Board	B-1321B	



# DIAGRAM







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