



**ICOM**

# **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.

## TABLE OF CONTENTS

|                  |   |                  |
|------------------|---|------------------|
| <b>SECTION 1</b> | <b>SPECIFICATIONS</b> .....                   | <b>1 – 1</b>     |
| <b>SECTION 2</b> | <b>OUTSIDE AND INSIDE VIEWS</b> .....         | <b>2 – 1 ~ 2</b> |
| <b>SECTION 3</b> | <b>BLOCK DIAGRAM</b> .....                    | <b>3 – 1</b>     |
| <b>SECTION 4</b> | <b>CIRCUIT DESCRIPTION</b> .....              | <b>4 – 1 ~ 8</b> |
| 4 - 1            | RECEIVER CIRCUITS .....                       | 4 – 1            |
| 4 - 2            | TRANSMITTER CIRCUITS .....                    | 4 – 2            |
| 4 - 3            | PLL CIRCUITS .....                            | 4 – 3            |
| 4 - 4            | LOGIC CIRCUITS .....                          | 4 – 5            |
| 4 - 5            | POWER SUPPLY CIRCUITS .....                   | 4 – 6            |
| 4 - 6            | OTHER CIRCUITS .....                          | 4 – 6            |
| <b>SECTION 5</b> | <b>MECHANICAL PARTS AND DISASSEMBLY</b> ..... | <b>5 – 1 ~ 5</b> |
| 5 - 1            | CASE DISASSEMBLY .....                        | 5 – 1            |
| 5 - 2            | TOP PANEL DISASSEMBLY .....                   | 5 – 3            |
| 5 - 3            | HEATSINK DISASSEMBLY .....                    | 5 – 3            |
| 5 - 4            | SPEAKER/MICROPHONE DISASSEMBLY .....          | 5 – 4            |
| 5 - 5            | PTT SPRING DISASSEMBLY .....                  | 5 – 4            |
| 5 - 6            | UNIT BOTTOM DISASSEMBLY .....                 | 5 – 5            |
| <b>SECTION 6</b> | <b>ADJUSTMENT PROCEDURES</b> .....            | <b>6 – 1 ~ 7</b> |
| 6 - 1            | PLL ADJUSTMENT .....                          | 6 – 1            |
| 6 - 2            | RECEIVER ADJUSTMENT .....                     | 6 – 3            |
| 6 - 3            | TRANSMITTER ADJUSTMENT .....                  | 6 – 5            |
| 6 - 4            | SUBAUDIBLE TONE AND DTMF ADJUSTMENT .....     | 6 – 7            |
| <b>SECTION 7</b> | <b>VOLTAGE DIAGRAMS</b> .....                 | <b>7 – 1 ~ 4</b> |
| 7 - 1            | MAIN UNIT .....                               | 7 – 1            |
| 7 - 2            | PLL, VCO UNITS .....                          | 7 – 2            |
| 7 - 3            | LOGIC UNIT .....                              | 7 – 3            |
| 7 - 4            | TONE UNIT .....                               | 7 – 4            |
| <b>SECTION 8</b> | <b>BOARD LAYOUTS</b> .....                    | <b>8 – 1 ~ 9</b> |
| 8 - 1            | MAIN UNIT .....                               | 8 – 1            |
| 8 - 2            | PLL UNIT .....                                | 8 – 3            |
| 8 - 3            | LOGIC UNIT .....                              | 8 – 5            |
| 8 - 4            | TONE UNIT .....                               | 8 – 7            |
| 8 - 5            | VCO UNIT .....                                | 8 – 9            |
| <b>SECTION 9</b> | <b>PARTS LIST</b> .....                       | <b>9 – 1 ~ 5</b> |

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

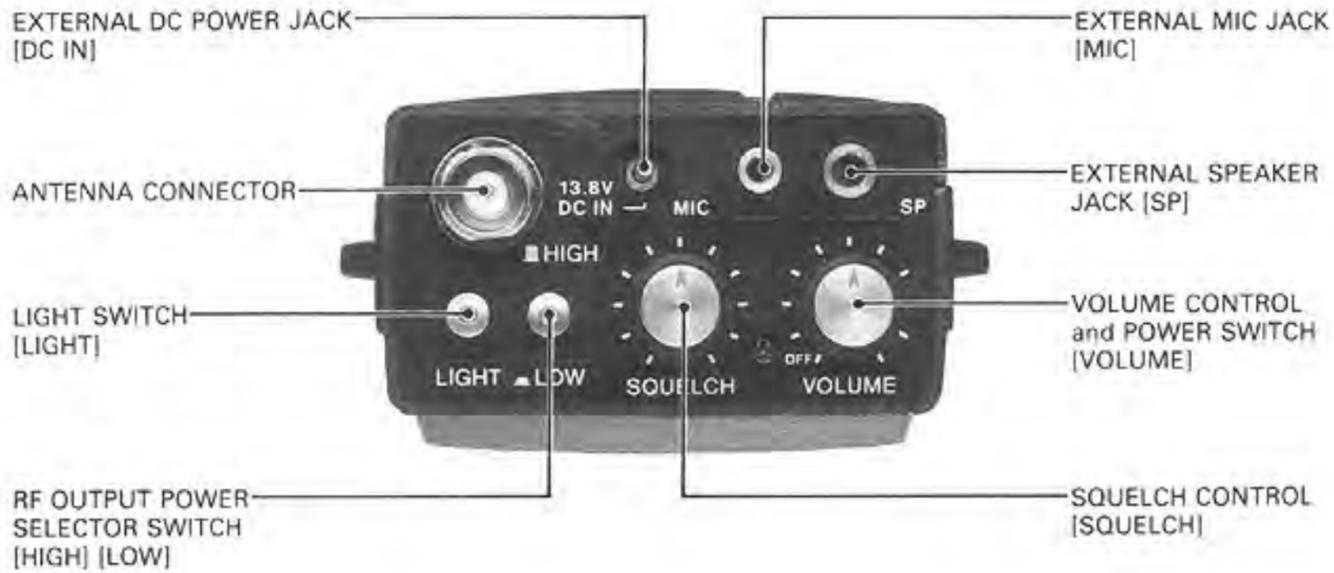
### ■ RECEIVER

- 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)

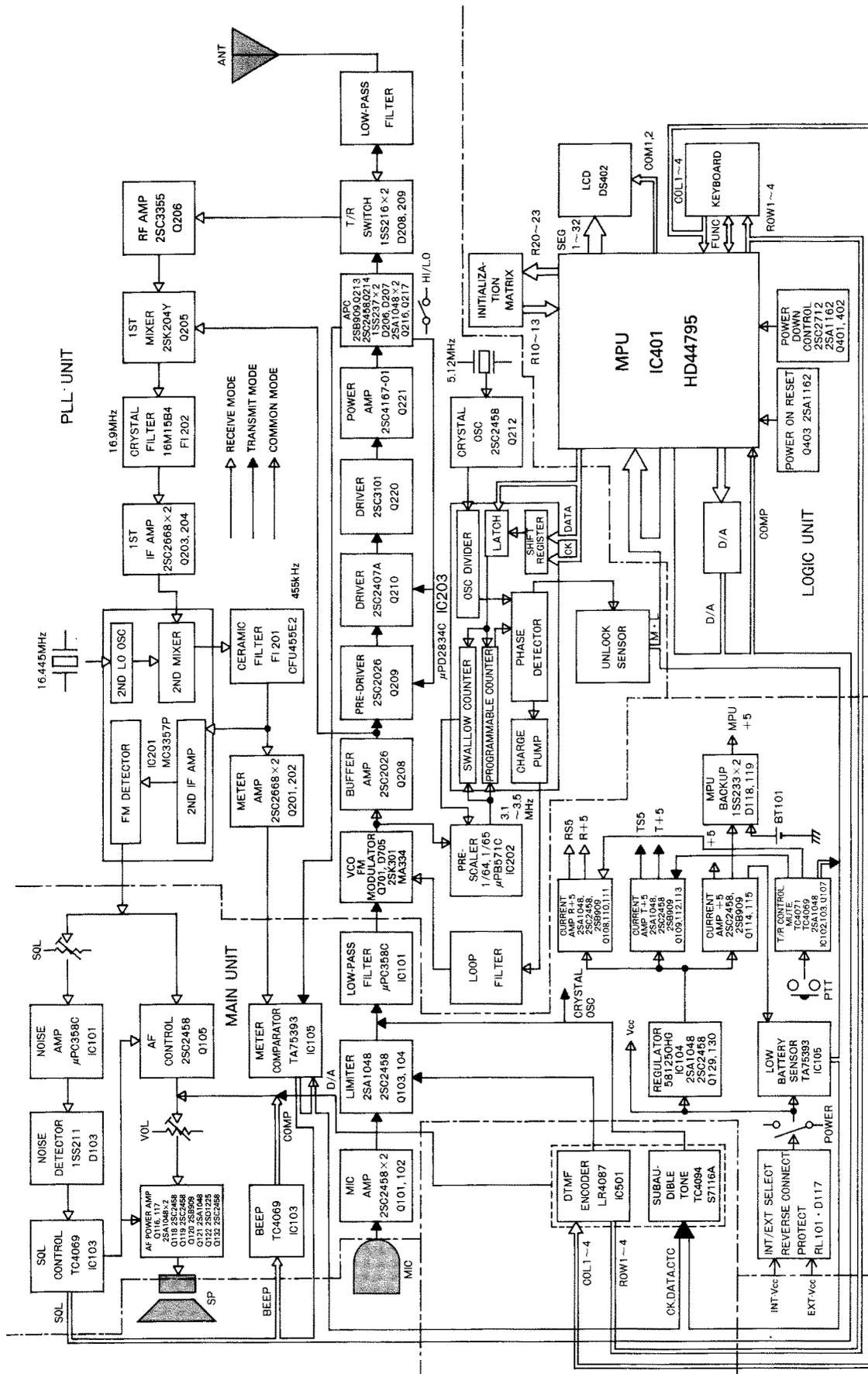
X501 (CSA3.58  
MG18 Ceralock)

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.

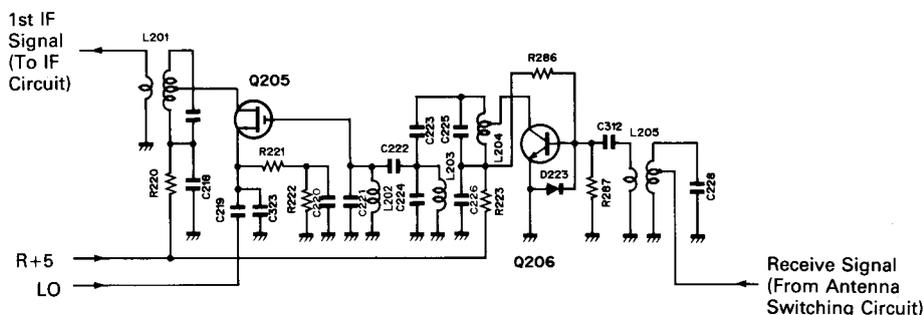


Fig. 4-1 RF Circuit

#### 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).

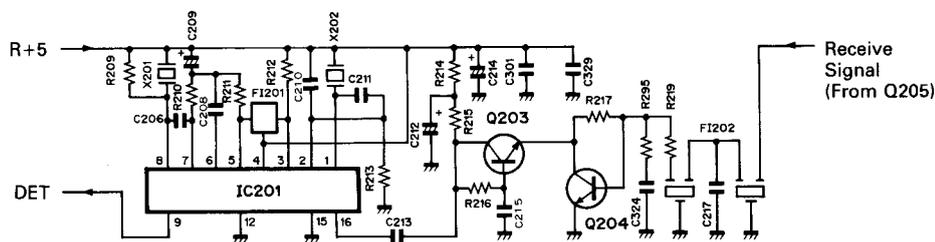
IC201 contains the 2nd LO circuit, 2nd mixer circuit, limiter amplifier circuit and quadrature detector circuit. The 2nd LO circuit located in IC201 and X202 generate 16.445MHz 2nd LO signals which are fed to the 2nd mixer section of IC201.

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.



#### 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.

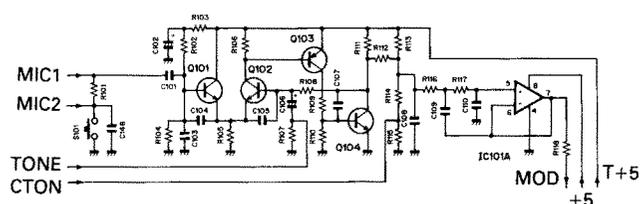


Fig. 4-3 Microphone Amplifier Circuit

#### 4 - 2 - 2 DRIVE AMPLIFIER CIRCUIT (PLL UNIT)

220MHz band signals output from Q701 in the VCO UNIT are buffer amplified by Q208 and pass through transmit/receive switching circuit D204. They are then preamplified at Q209.

Output signals from Q209 are further amplified by drive amplifiers Q210 and Q220.

### 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.

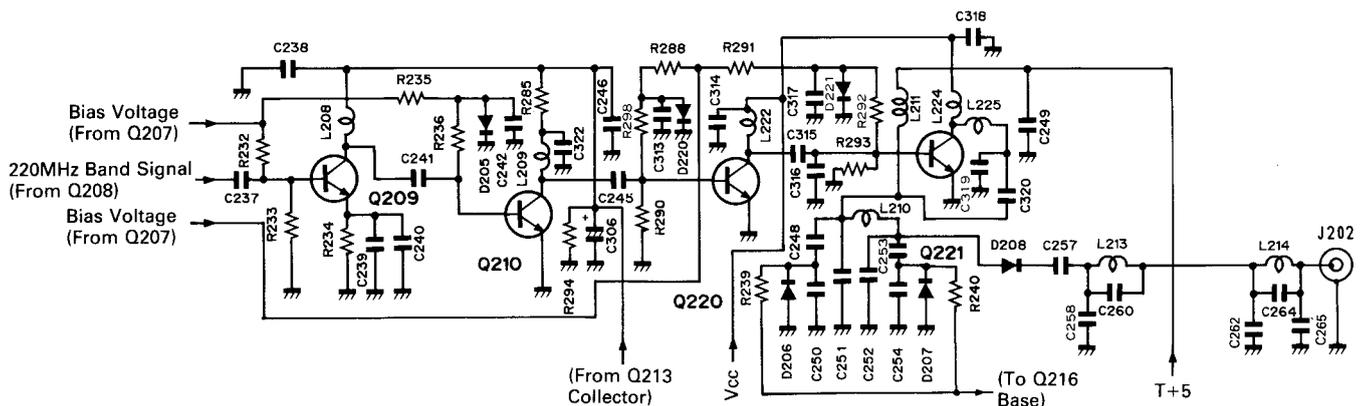


Fig. 4-4 Driver Amplifier and RF Power Amplifier Circuits

### 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.

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).

### 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.

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

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.

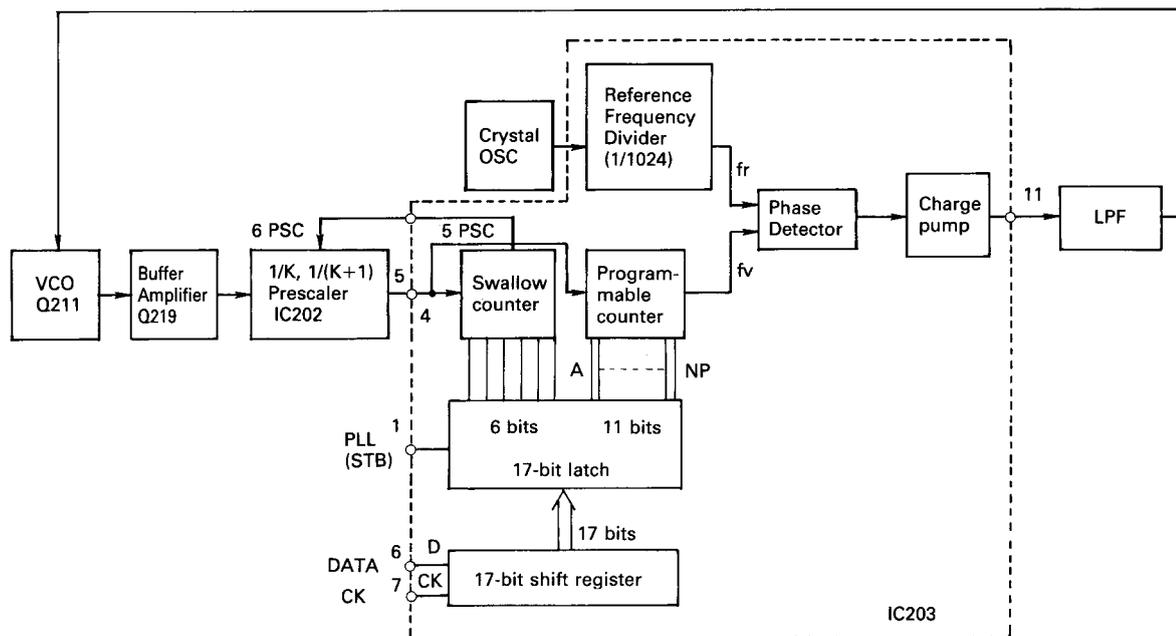


Fig. 4-5 Dual Modulus Prescaler System

### 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<br>[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<br>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<br>[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<br>[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.

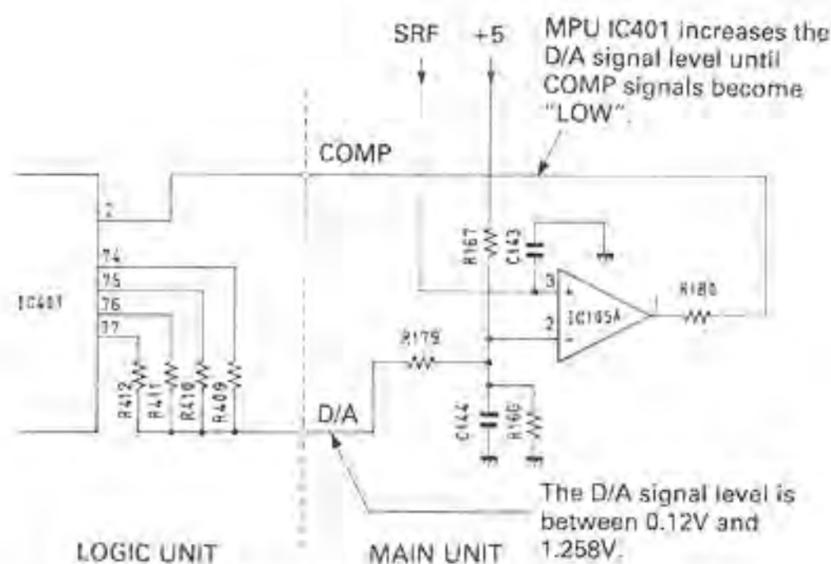


Fig. 4-6 Comparator Circuit

#### 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.

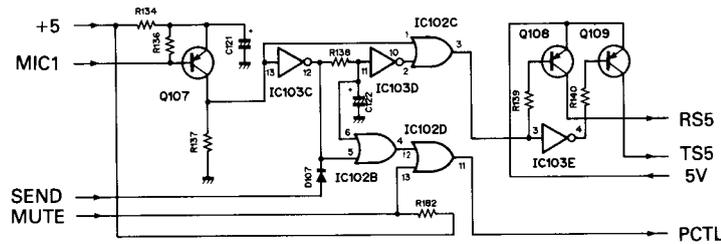


Fig. 4-7 Transmit/Receive Switching Circuit

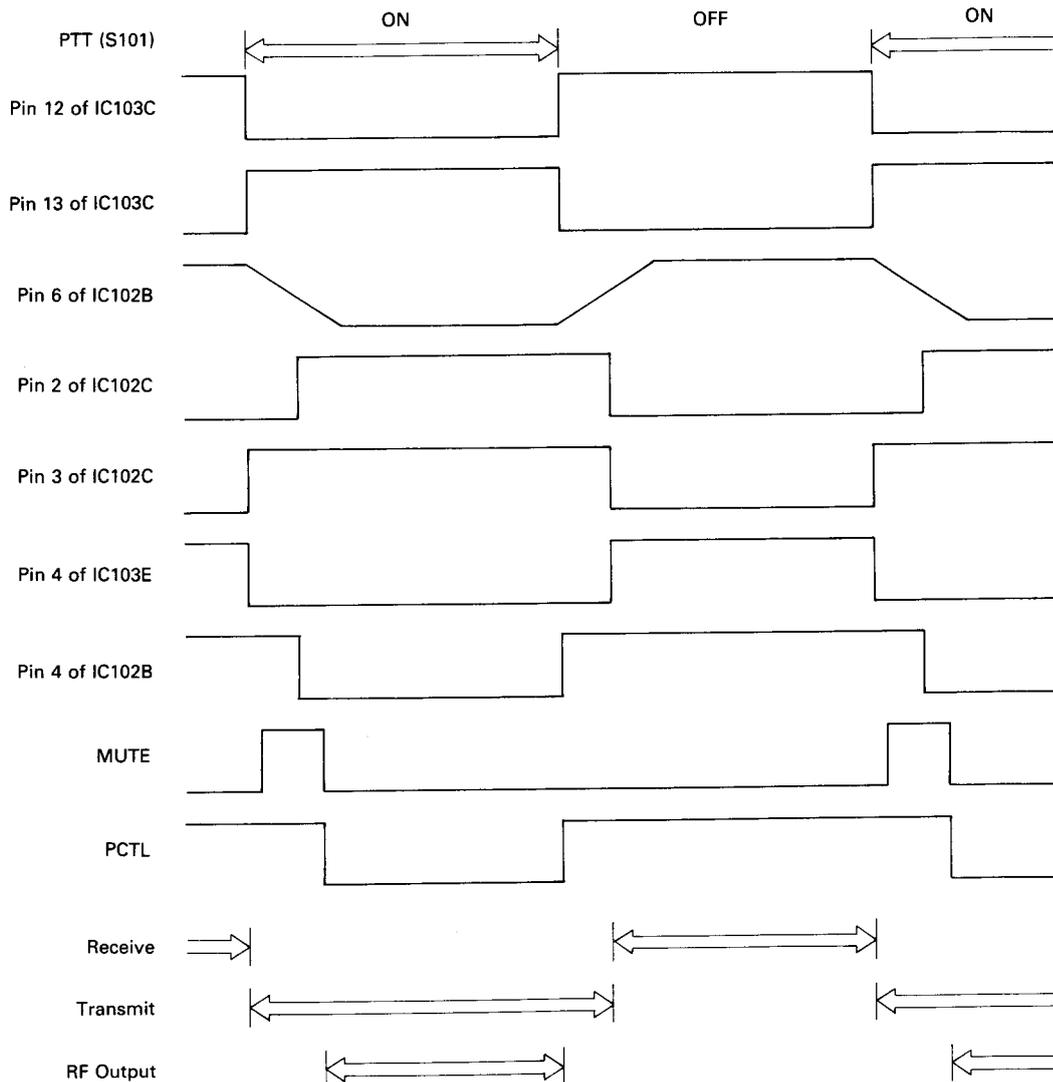


Fig. 4-8 Timing Diagram of Transmit/Receive Switching

## 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.

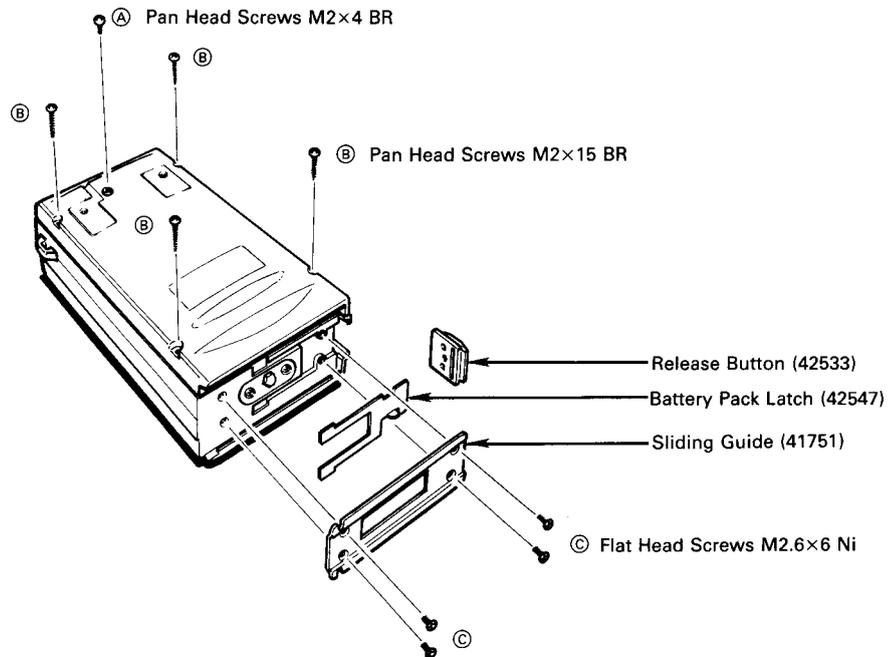


Fig. 5-1-1

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

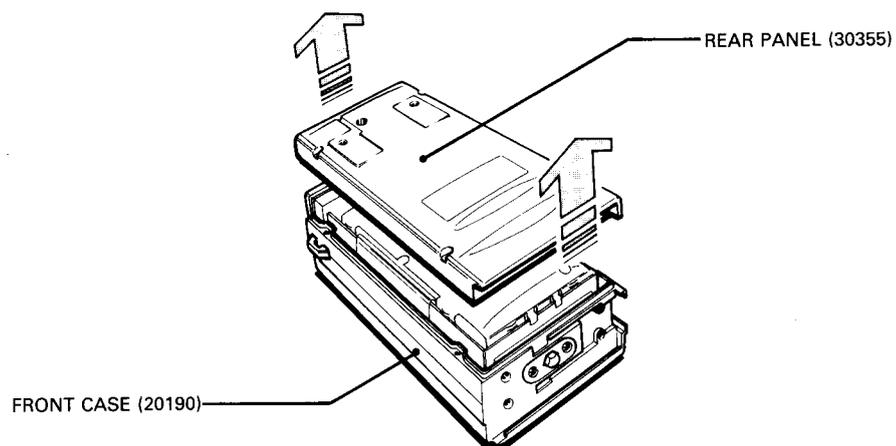


Fig. 5-1-2

- 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.

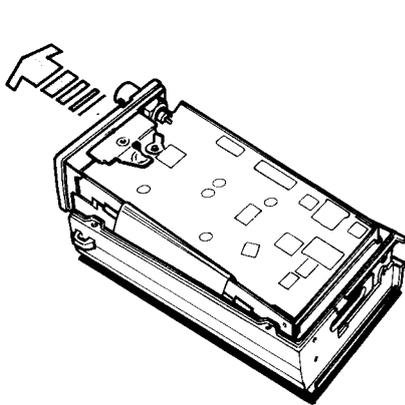


Fig. 5-1-3

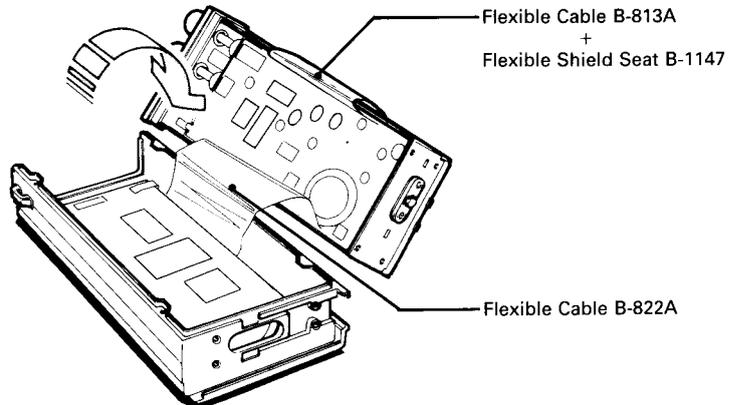


Fig. 5-1-4

- 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.

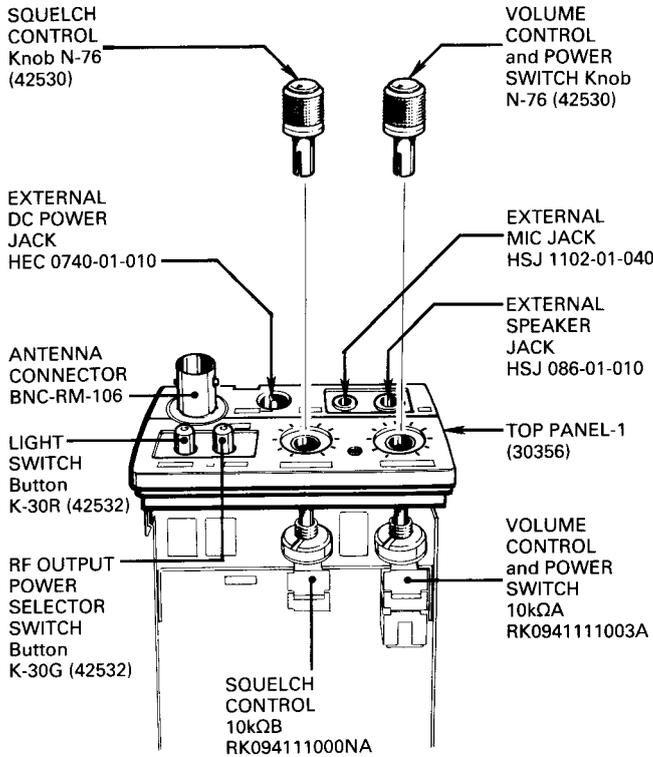


Fig. 5-1-5

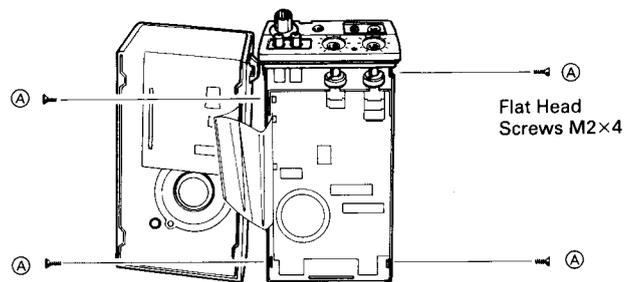


Fig. 5-1-6

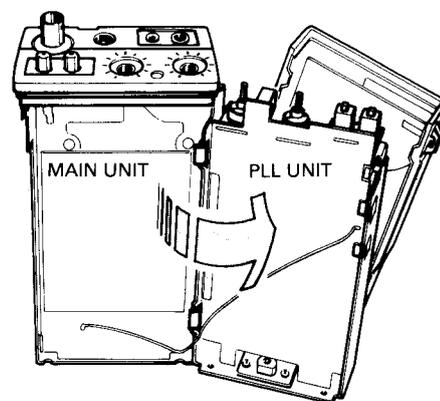
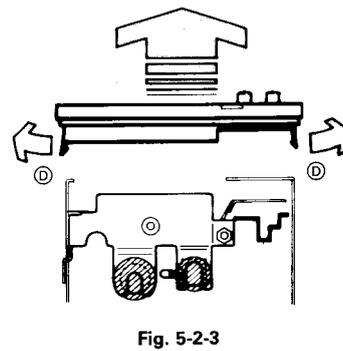
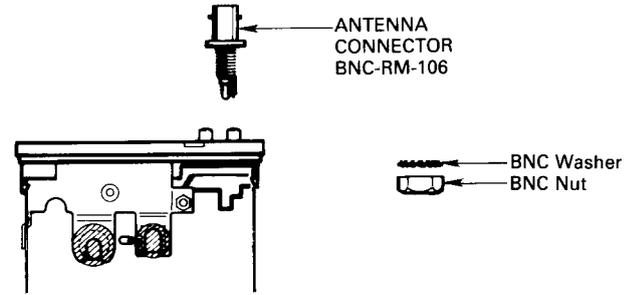
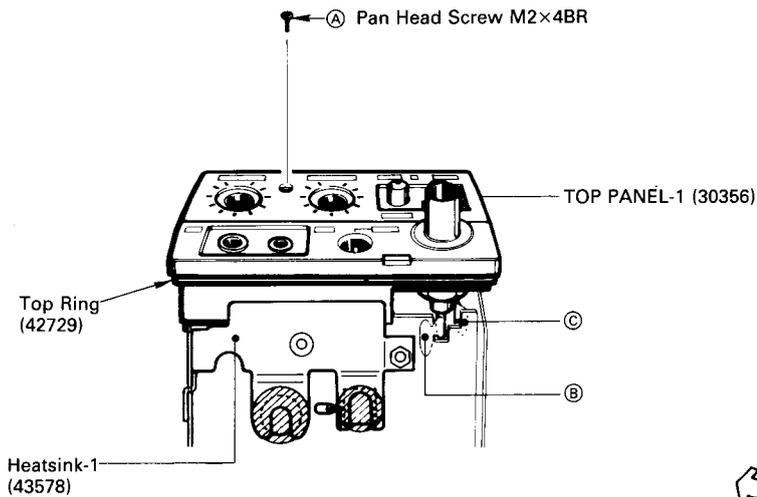


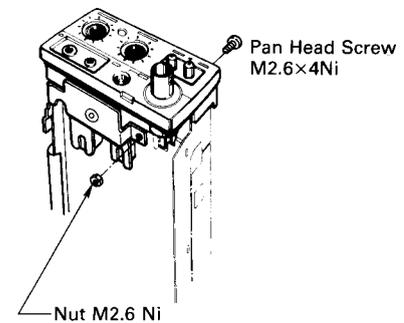
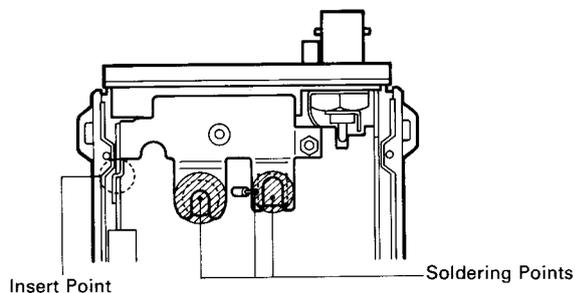
Fig. 5-1-7

## 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.



## 5 - 3 HEATSINK DISASSEMBLY



## 5 - 4 SPEAKER/MICROPHONE DISASSEMBLY

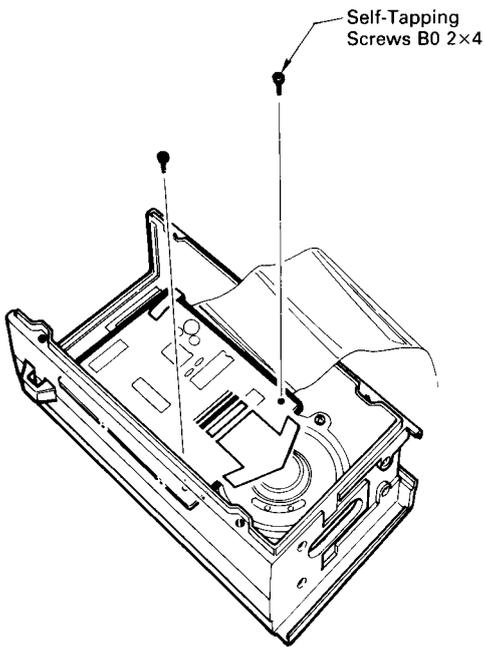


Fig. 5-4-1

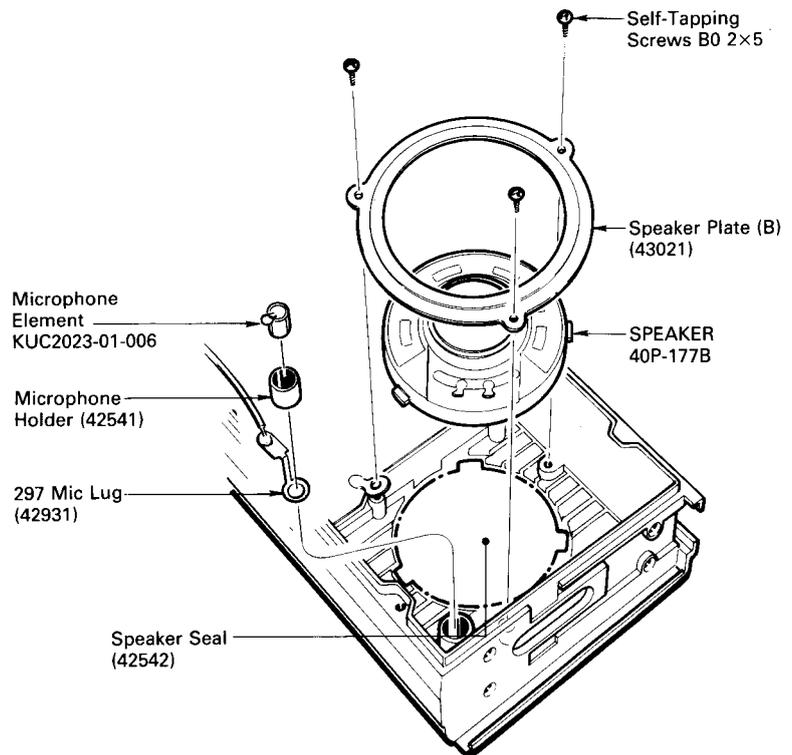


Fig. 5-4-2

## 5 - 5 PTT SPRING DISASSEMBLY

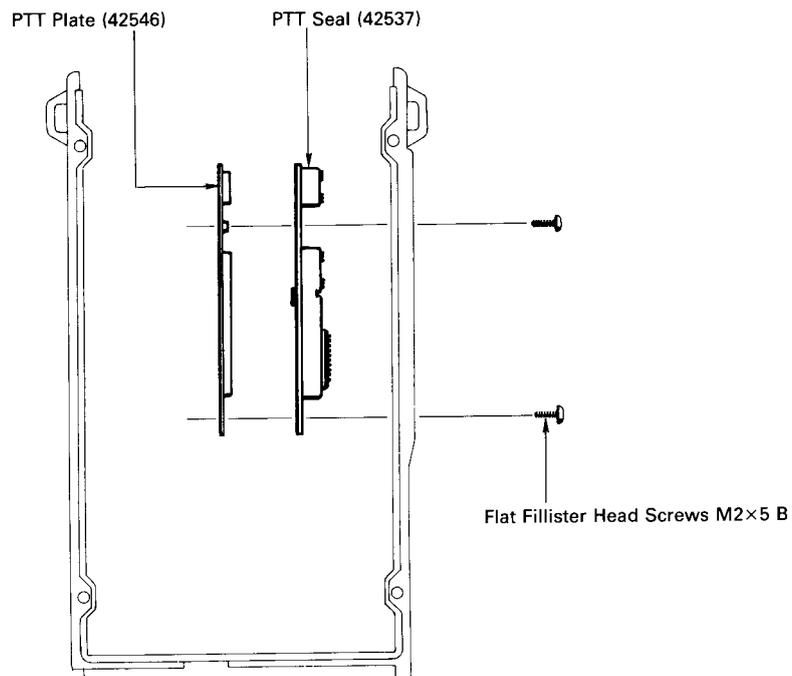


Fig. 5-5-1

## 5 - 6 UNIT BOTTOM DISASSEMBLY

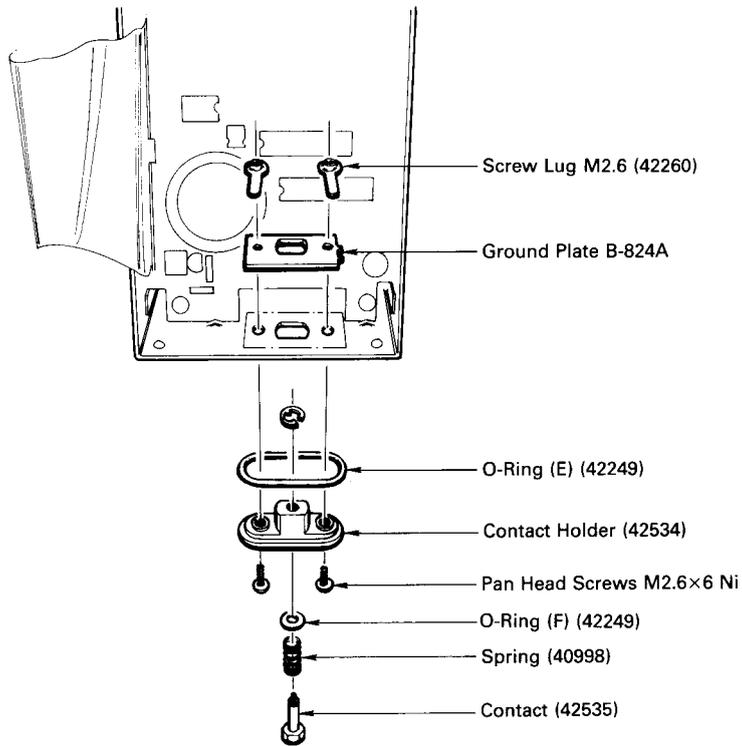


Fig. 5-6-1



Fig. 5-6-2

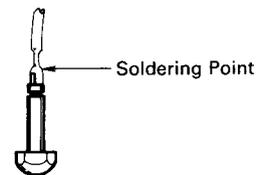


Fig. 5-6-3

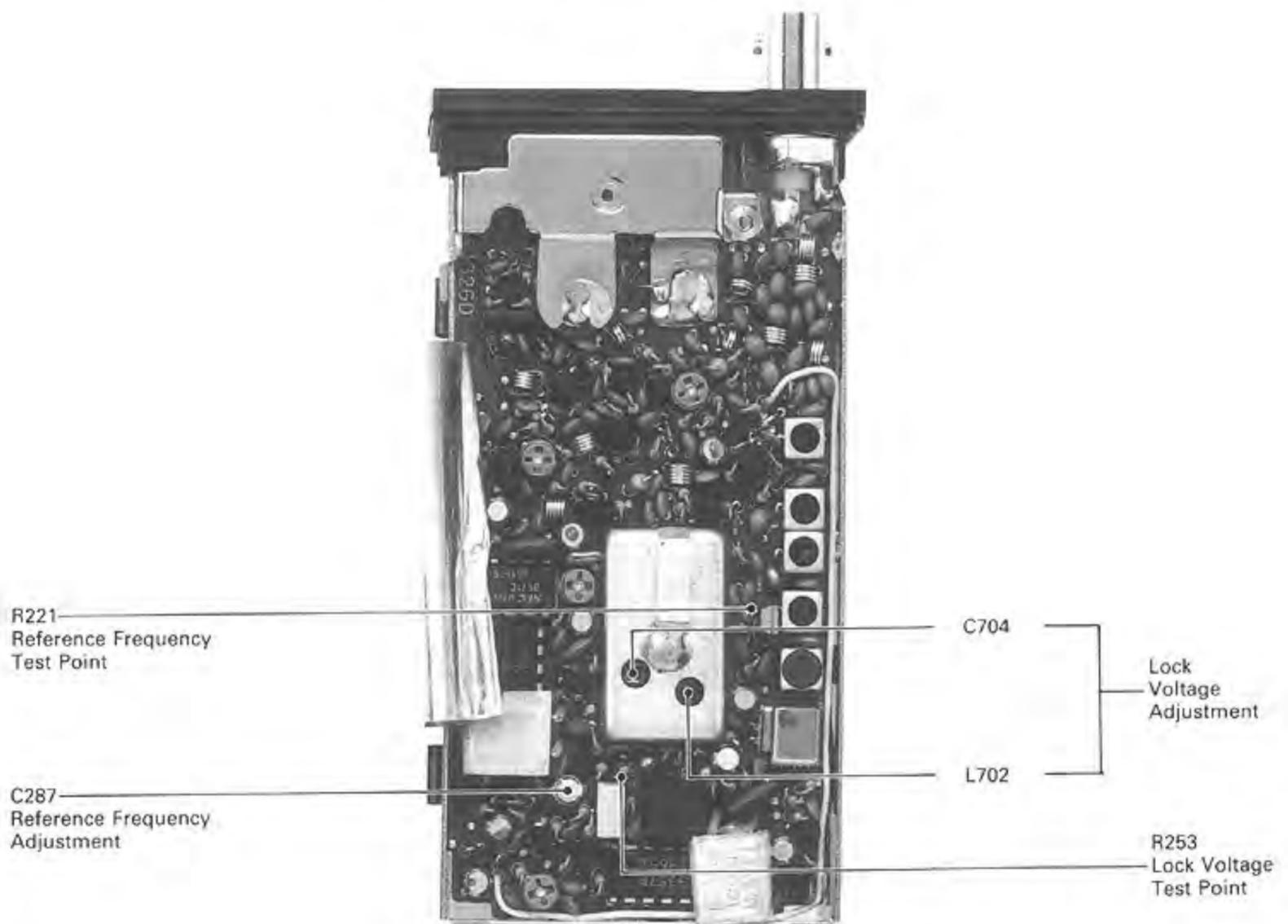
# SECTION 6 ADJUSTMENT PROCEDURES

## 6 - 1 PLL ADJUSTMENT

| TEST INSTRUMENTS REQUIRED  | MEASUREMENT CONNECTION LOCATION |
|--|---------------------------------|
| <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) FREQUENCY COUNTER</p> <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> <p>(3) VOLTMETER</p> <ul style="list-style-type: none"> <li>• Input impedance : 50kΩ DC or better</li> </ul> <p>(4) 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 |
| LOCK VOLTAGE        | 1 • Operating frequency: 220.000MHz<br>• Receive mode                   | PLL         | Connect a voltmeter to R253.         | 1.0V              | VCO              | L702   |
|                     | 2 • Transmit mode<br>• Simplex mode                                     |             |                                      | 1.0V              |                  | C704   |
|                     | 3 • Operating frequency: 224.995MHz<br>• Receive mode                   |             |                                      | More than 2.0V    |                  | Verify |
| REFERENCE FREQUENCY | 1 • Operating frequency: 224.000MHz<br>• Simplex mode<br>• Receive mode | PLL         | Connect a frequency counter to R221. | 207.100MHz        | PLL              | C287   |
|                     | 2 • RF OUTPUT POWER SELECTOR SWITCH: LOW<br>• Transmit mode             |             |                                      | 224.000MHz ±300Hz |                  | Verify |

## PLL UNIT

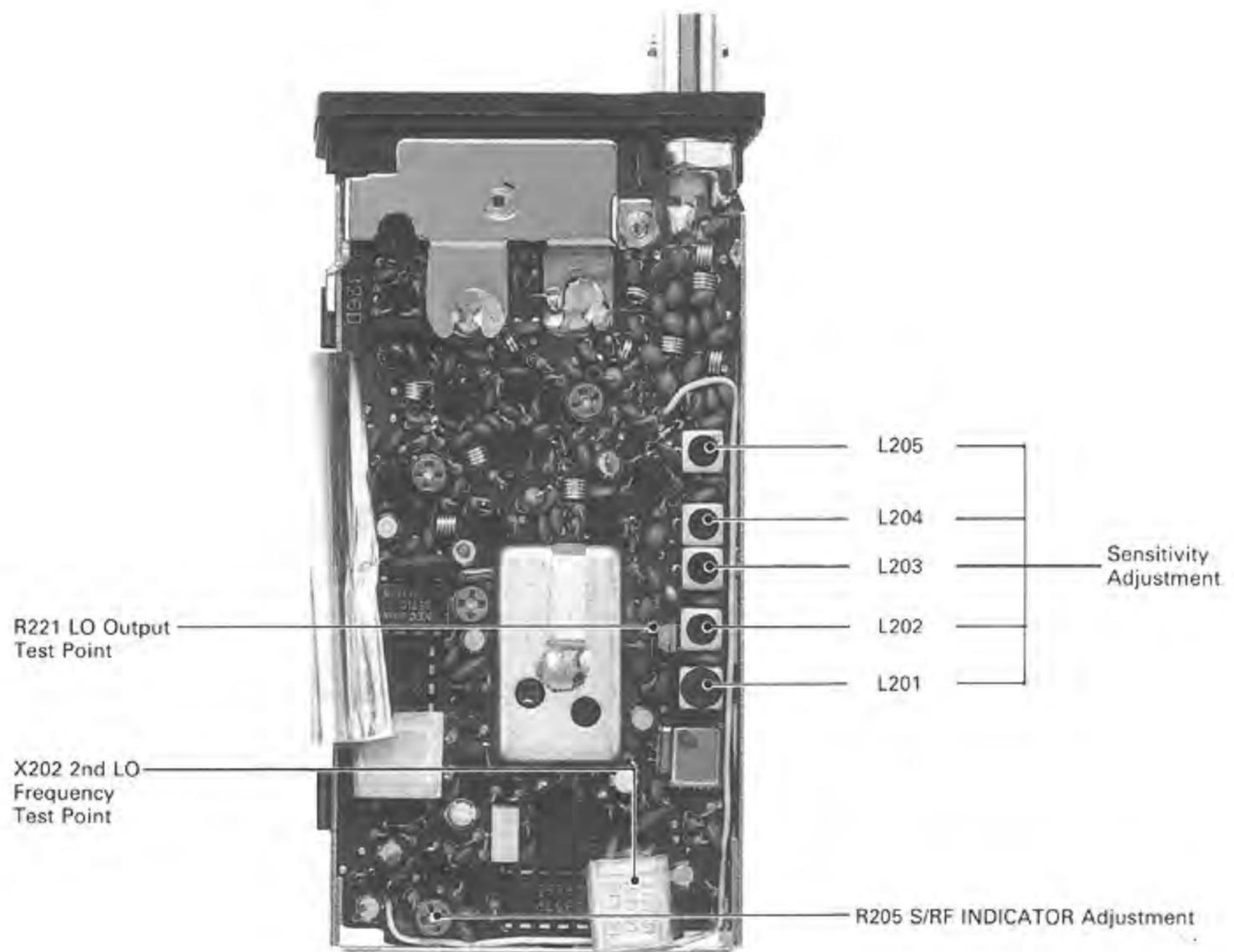


## 6 - 2 RECEIVER ADJUSTMENT

| 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  | <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   | <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  | <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 |
|  |   |             |   | Maximum level                        |                  |             |
| <b>Note:</b> Repeat steps 1 and 2 several times, until the measured value is at maximum. |   |             |   |                                      |                  |             |
| AF OUTPUT  | <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   | <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  | <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

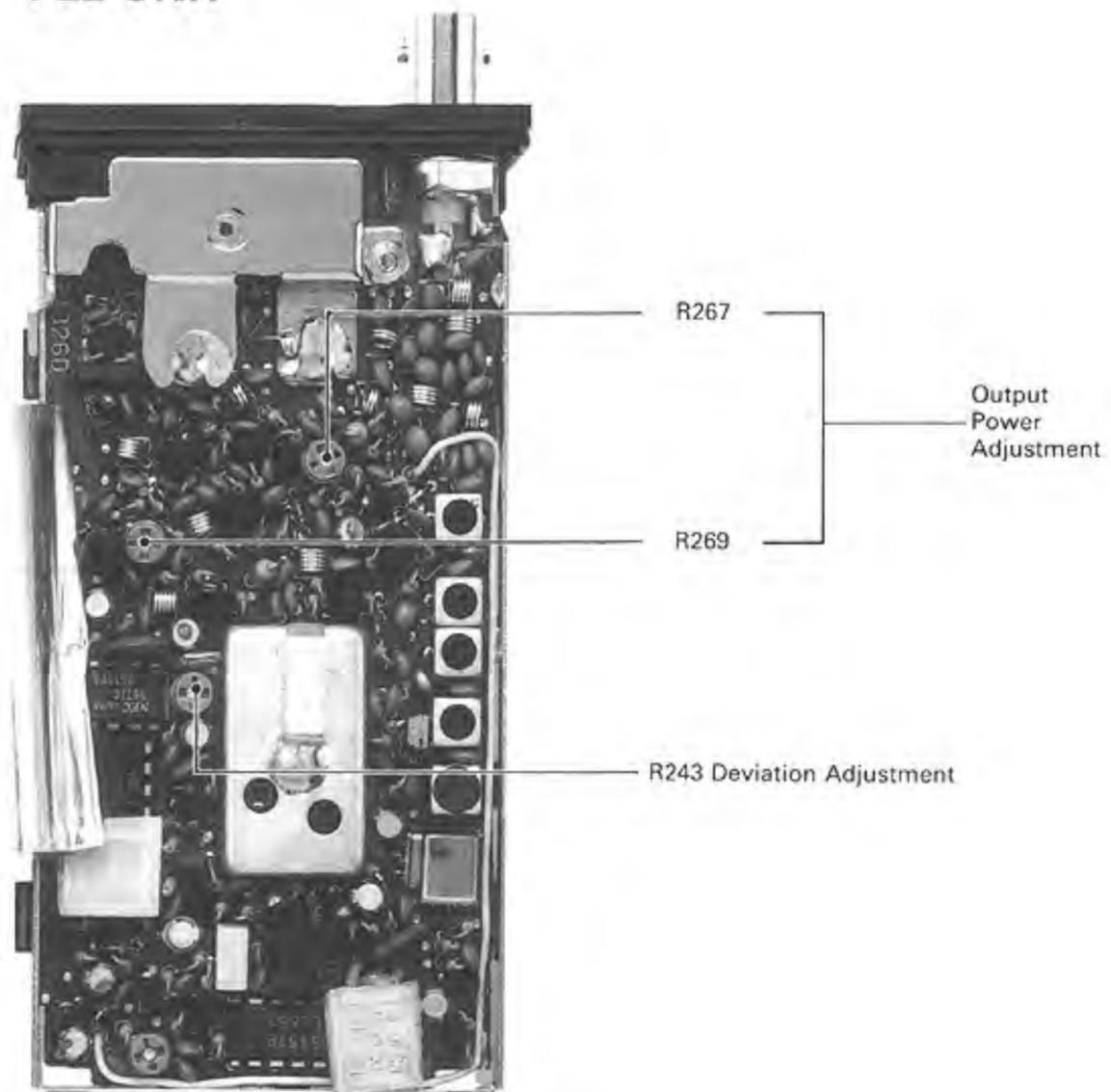


## 6 - 3 TRANSMITTER ADJUSTMENT

| 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

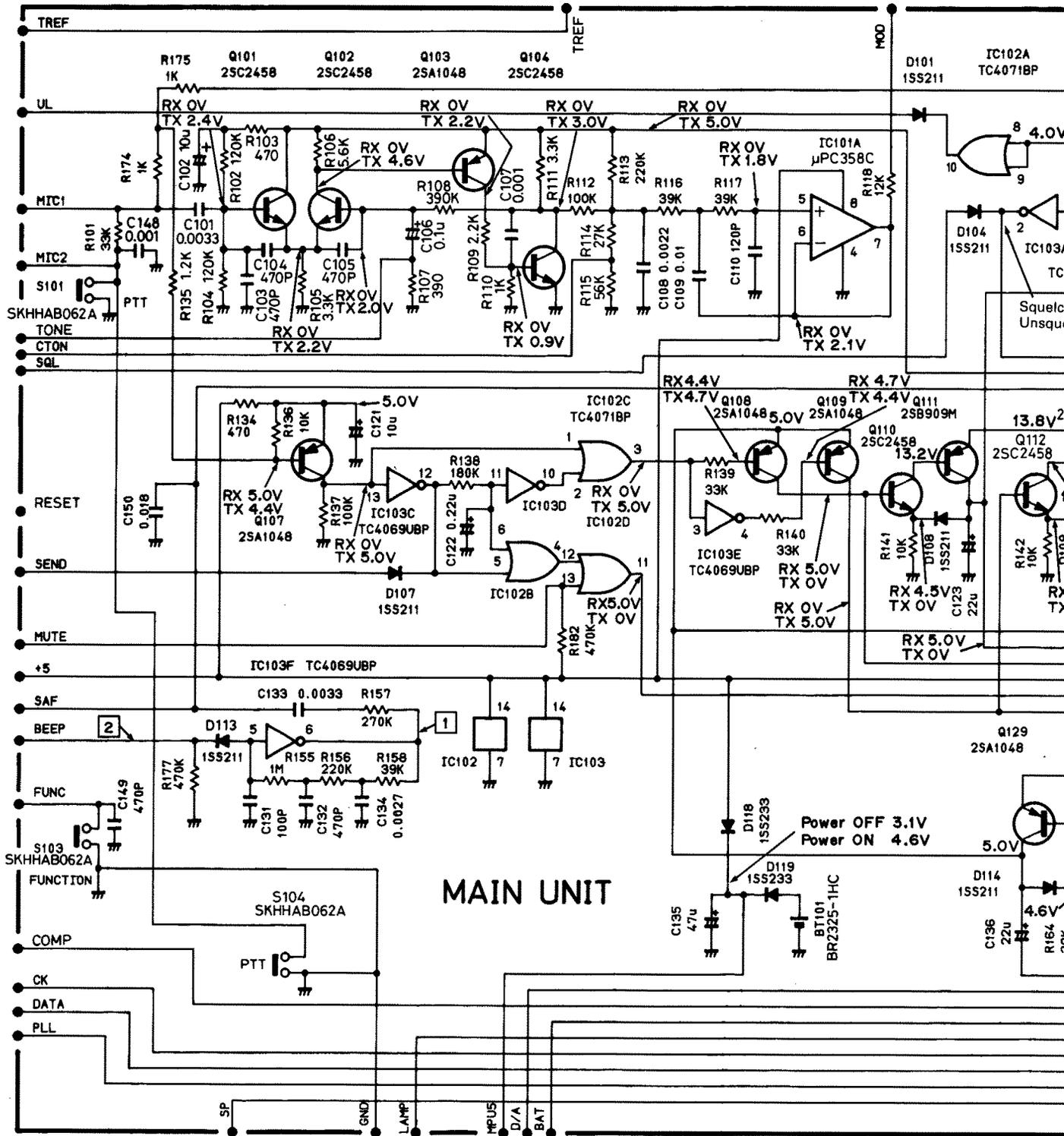
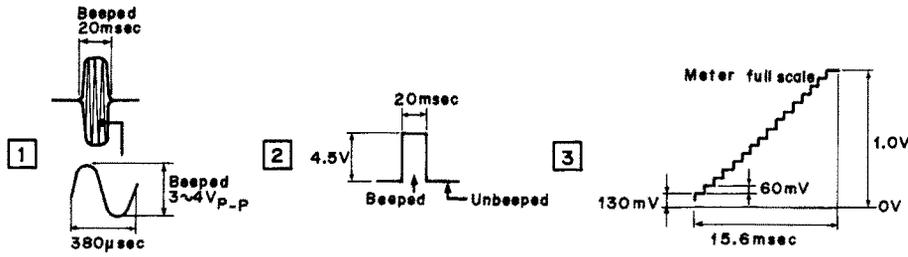
| TEST INSTRUMENTS REQUIRED   |   | MEASUREMENT CONNECTION LOCATION |   |         |                  |        |
|---|---|---------------------------------|---|---------|------------------|--------|
| <p>(1) RF POWER METER (TERMINATED TYPE)</p> <ul style="list-style-type: none"> <li>• Measuring range : 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) ATTENUATOR</p> <ul style="list-style-type: none"> <li>• Input power : At least 5W</li> <li>• Attenuation : 20dB or 30dB</li> </ul> <p>(4) 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 |
| 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   |

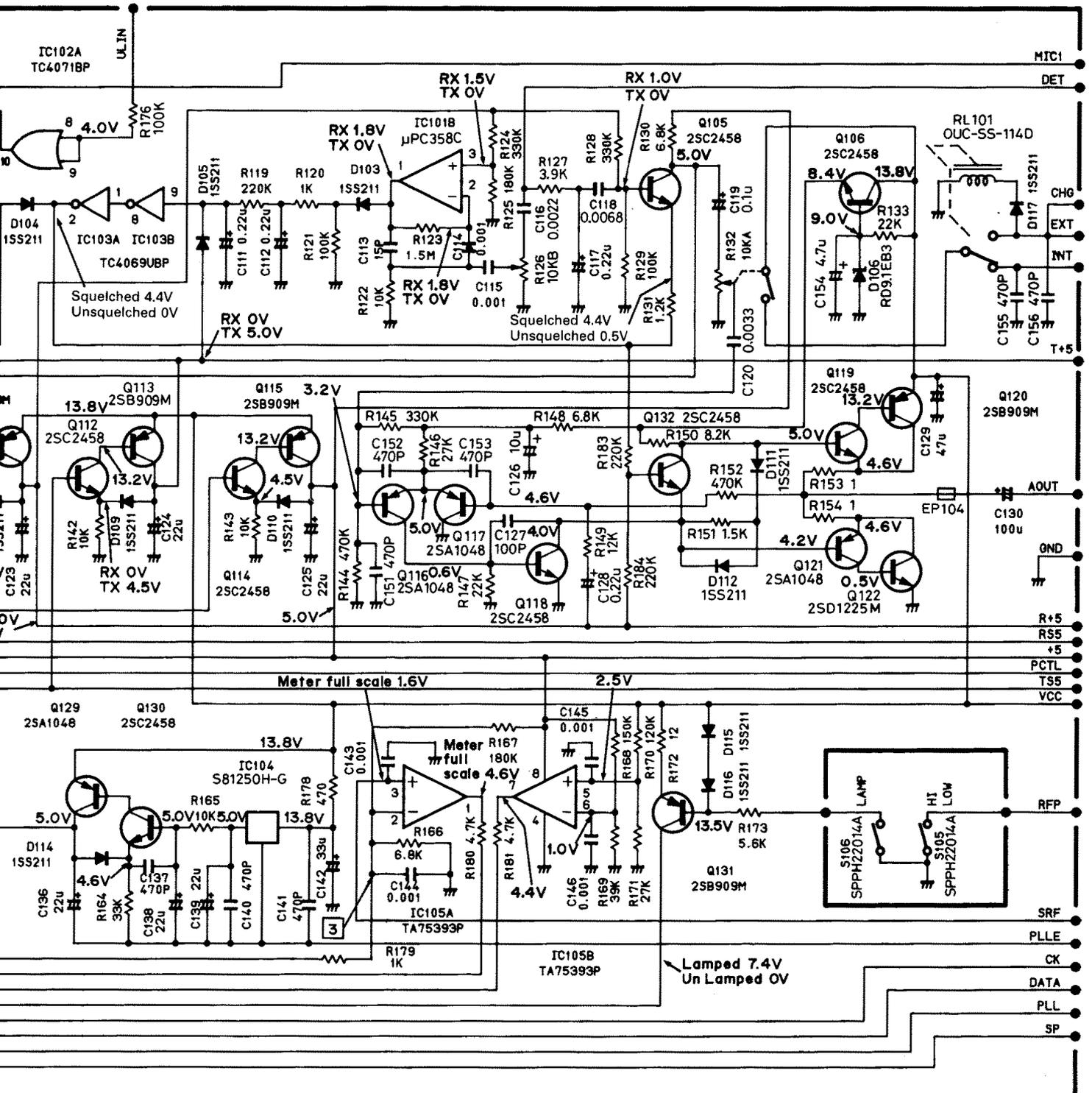
### TONE UNIT



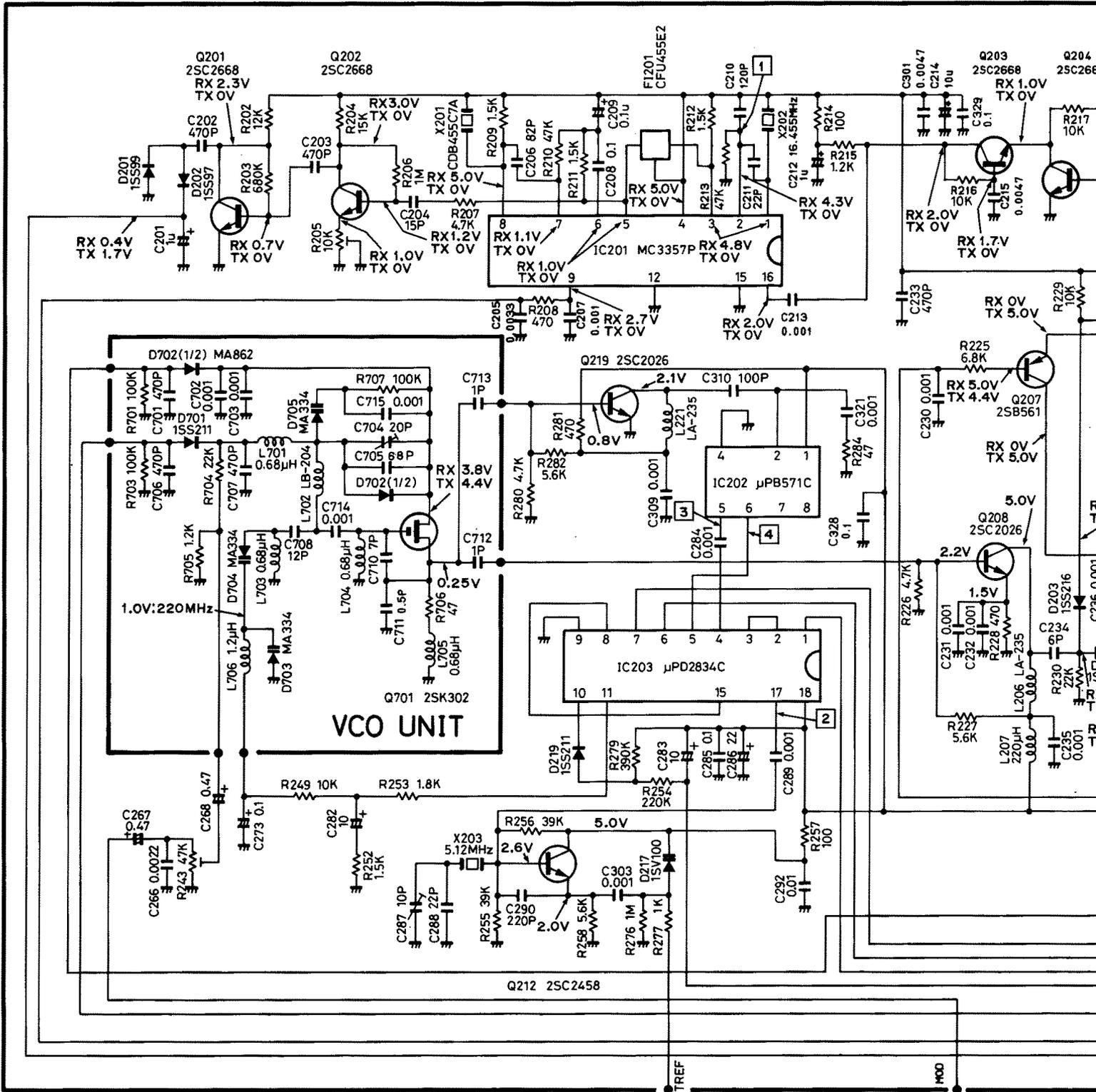
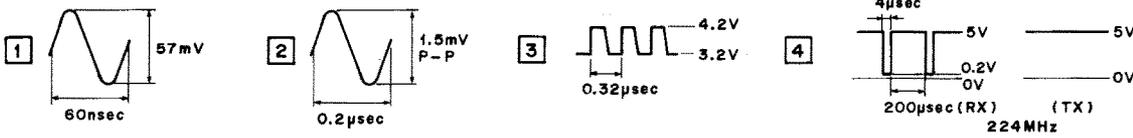
# SECTION 7 VOLTAGE DIAGRAMS

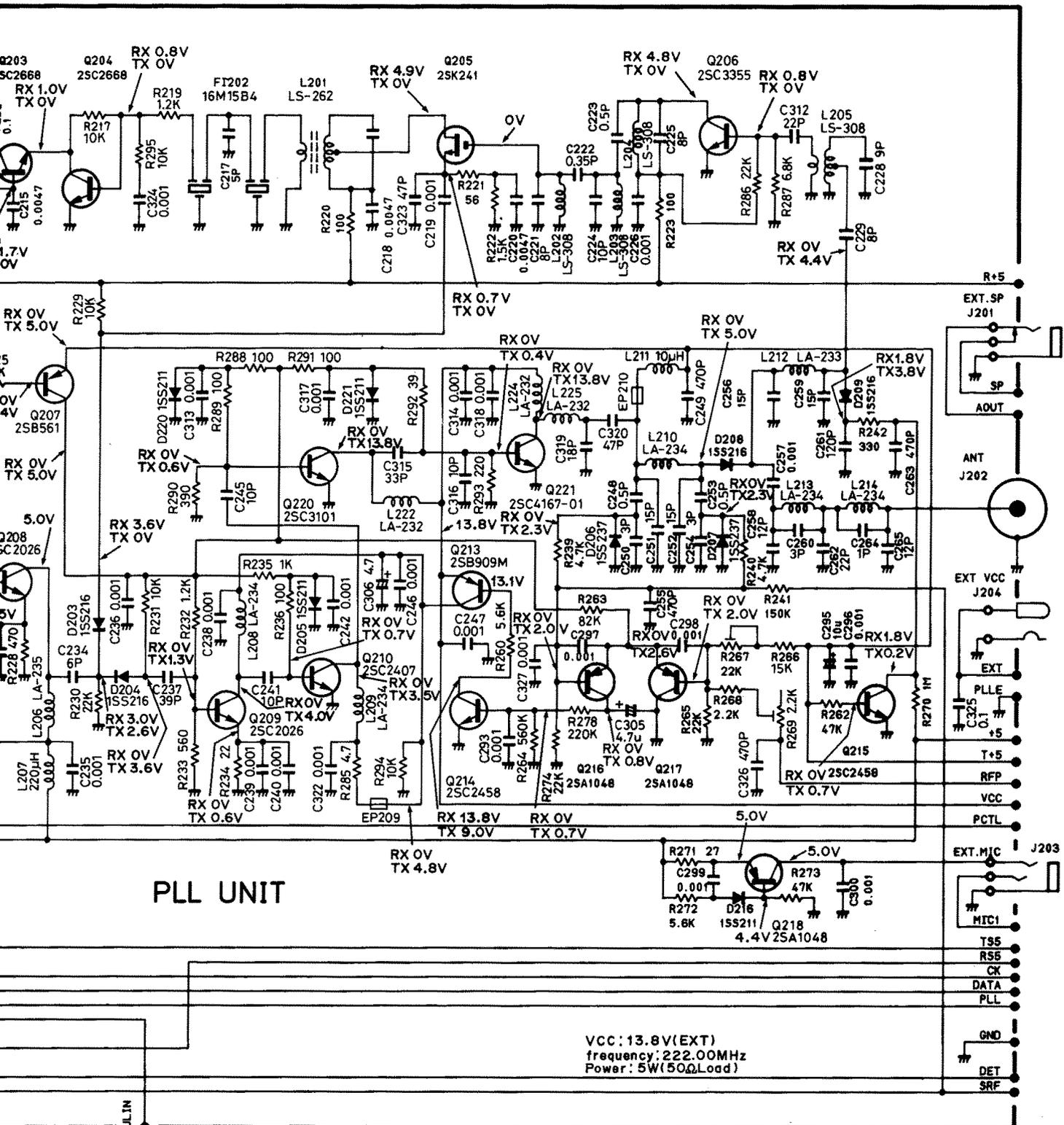
## 7 - 1 MAIN UNIT





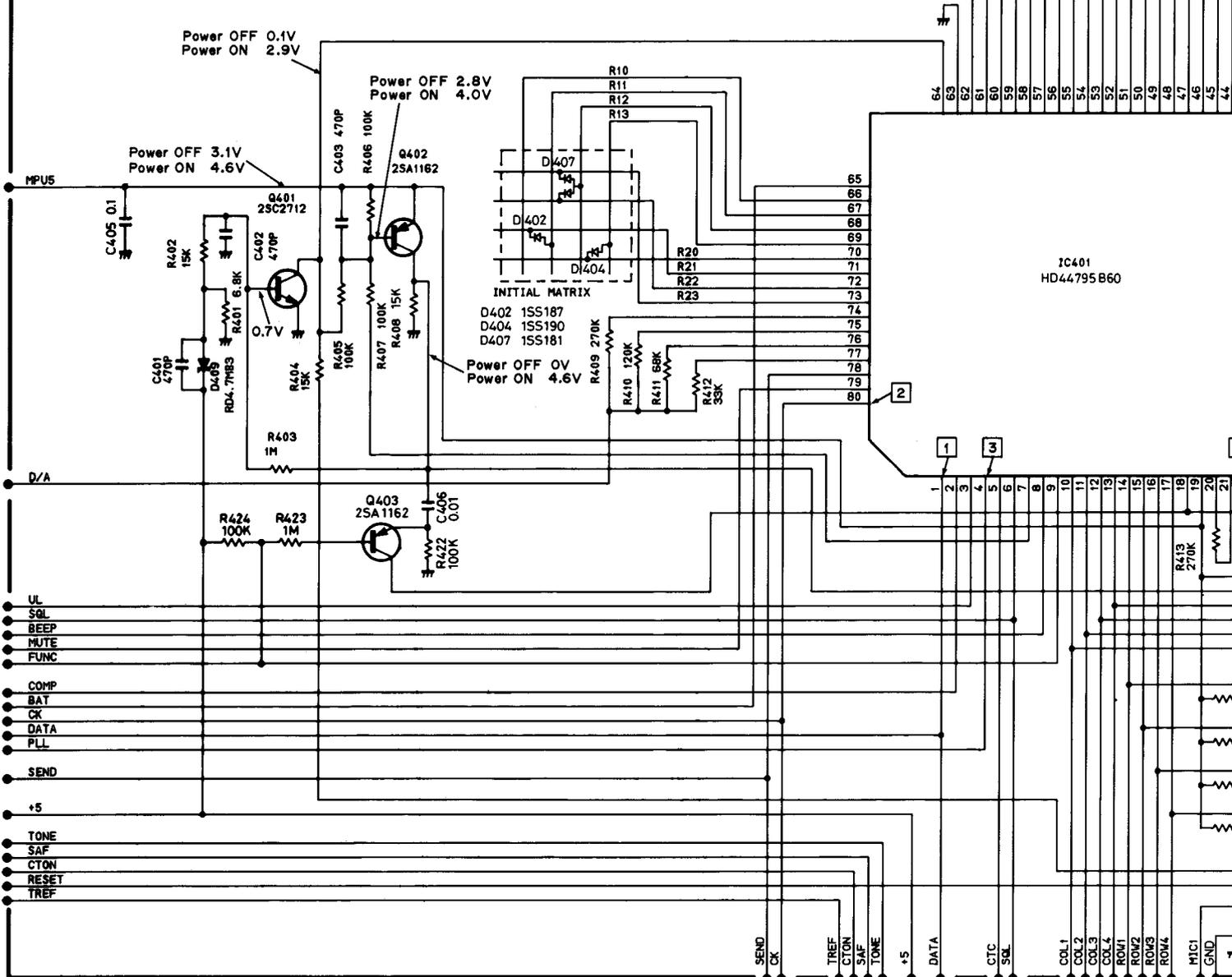
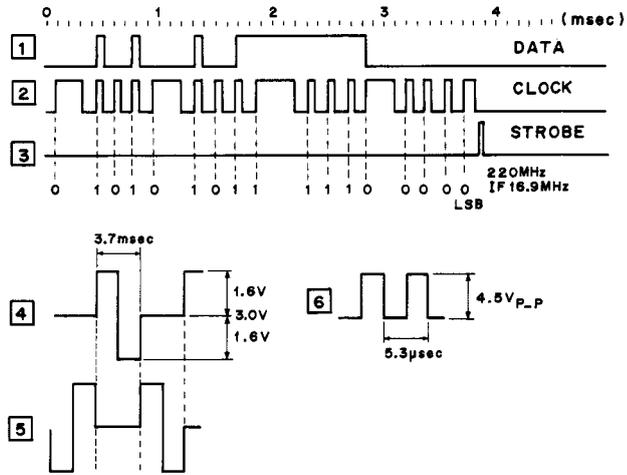
# 7 - 2 PLL, VCO UNITS

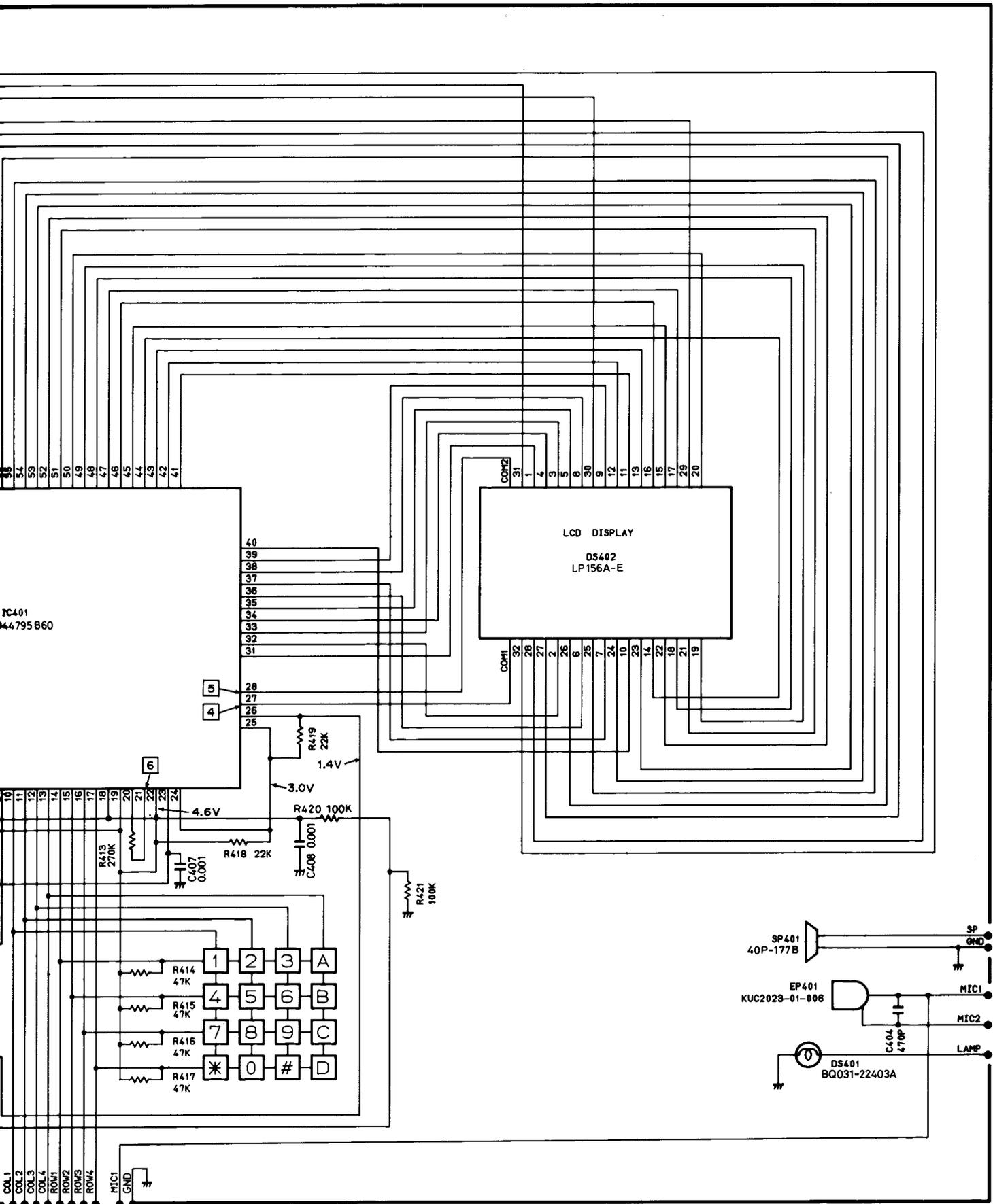




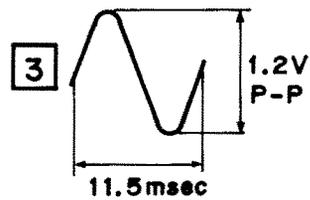
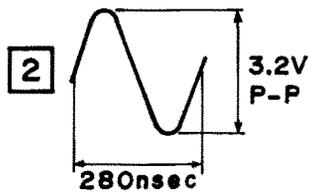
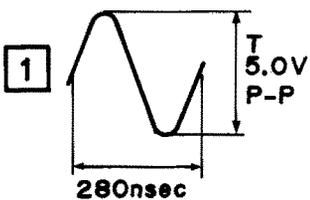
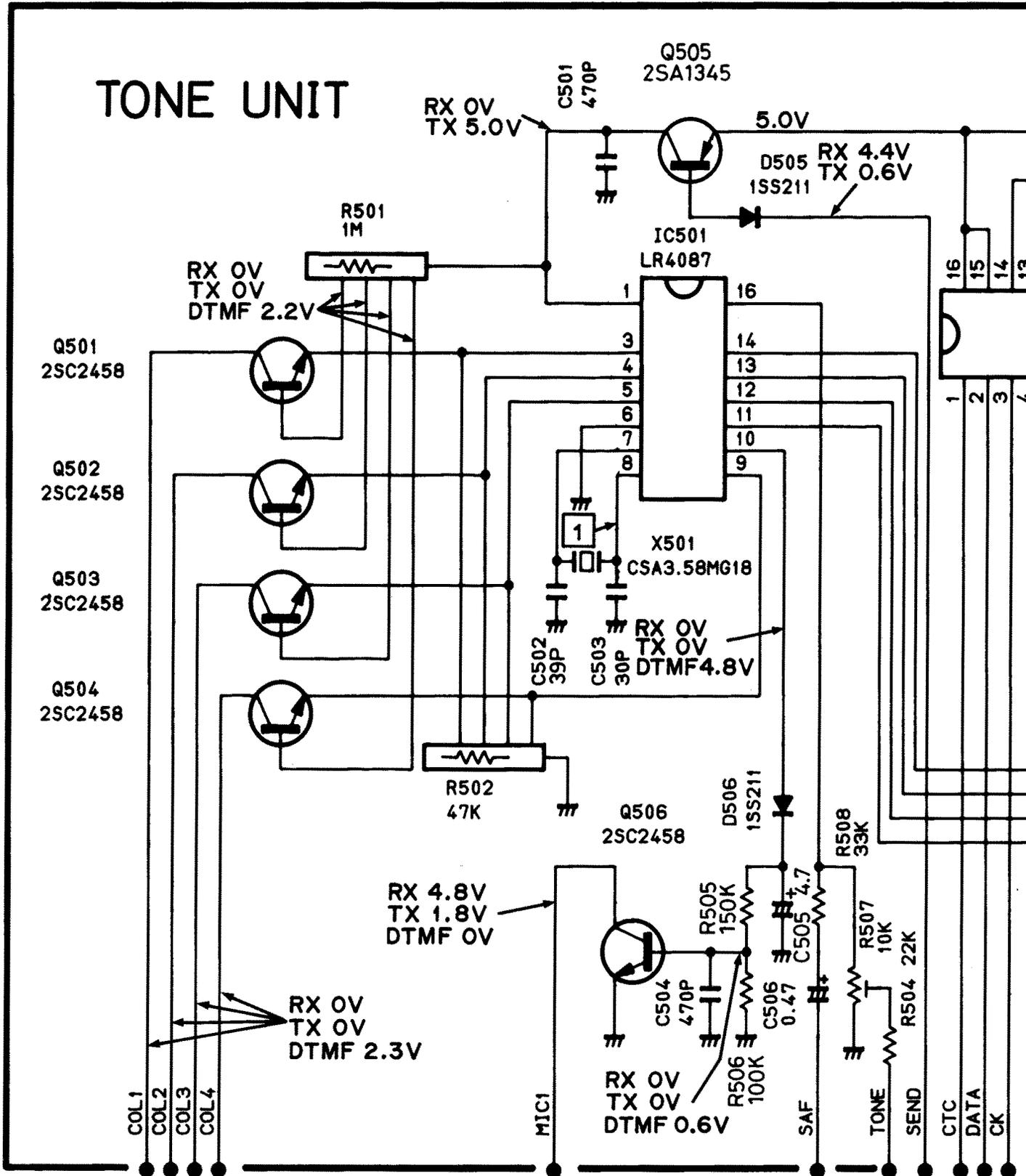
# 7 - 3 LOGIC UNIT

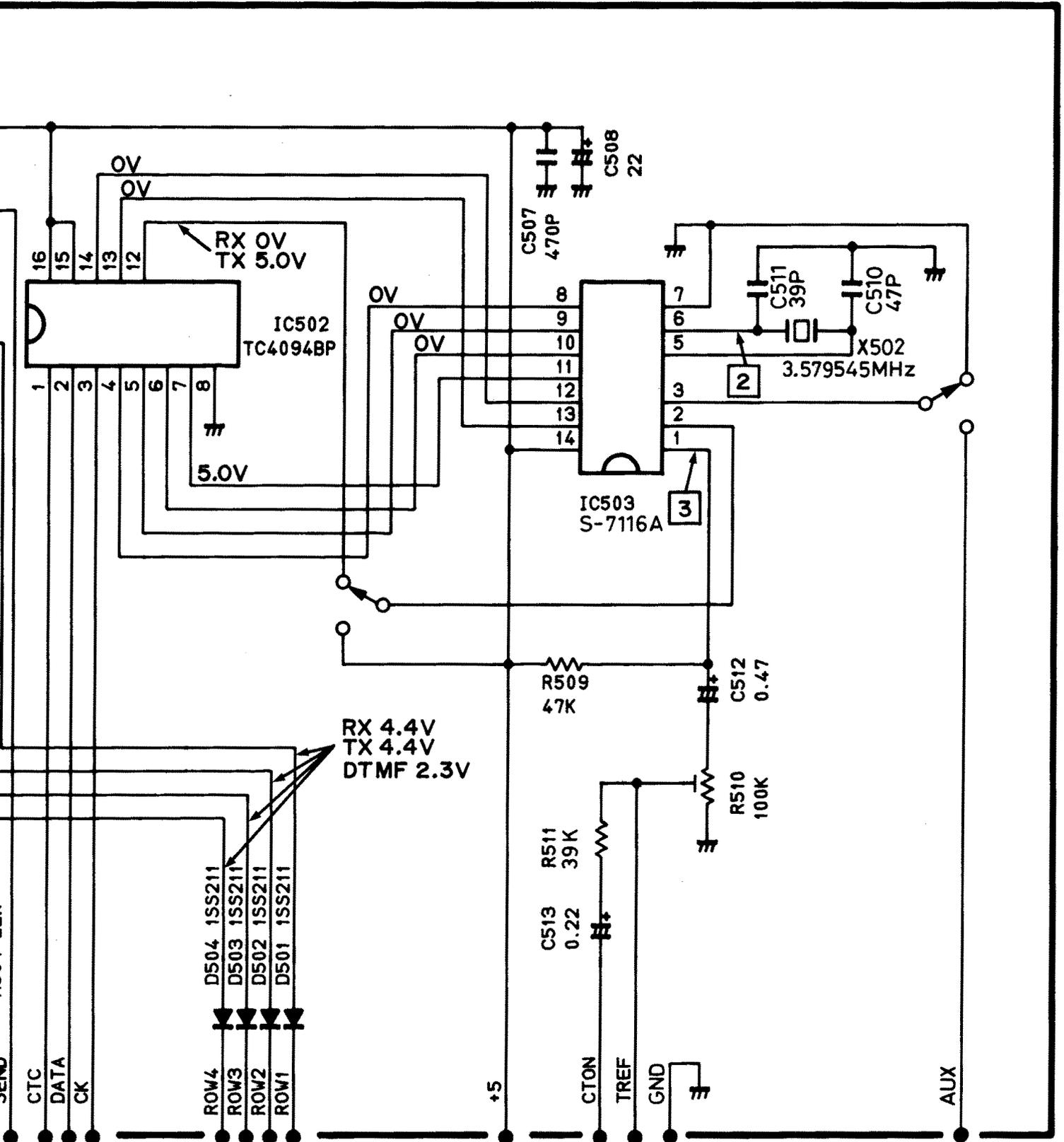
## LOGIC UNIT





7 - 4 TONE UNIT





NOTE: TONE NO. 08 88.5Hz

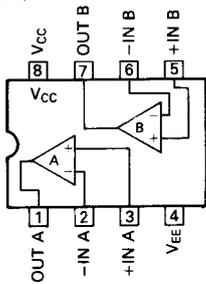
# SECTION 8 BOARD LAYOUTS

## 8 - 1 MAIN UNIT

### • ICs

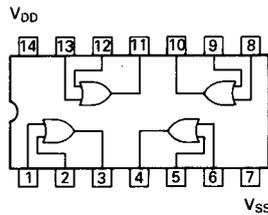
#### μPC358C (Dual Driver)

IC101



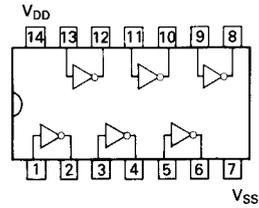
#### TC4071BP (Quad 2-Input OR Gate)

IC102



#### TC4069UBP (Hex Inverter)

IC103



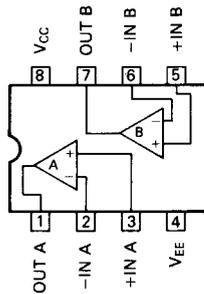
#### S81250H-G (3-Terminal Voltage Regulator)

IC104



#### TA75393P (Dual Comparator)

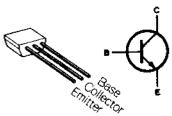
IC105



### • Transistors

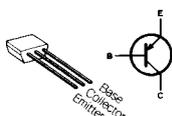
#### 2SC2458 GR

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



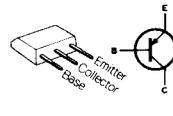
#### 2SA1048 GR

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



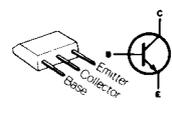
#### 2SB909M R

Q111, Q113, Q115, Q120  
Q131

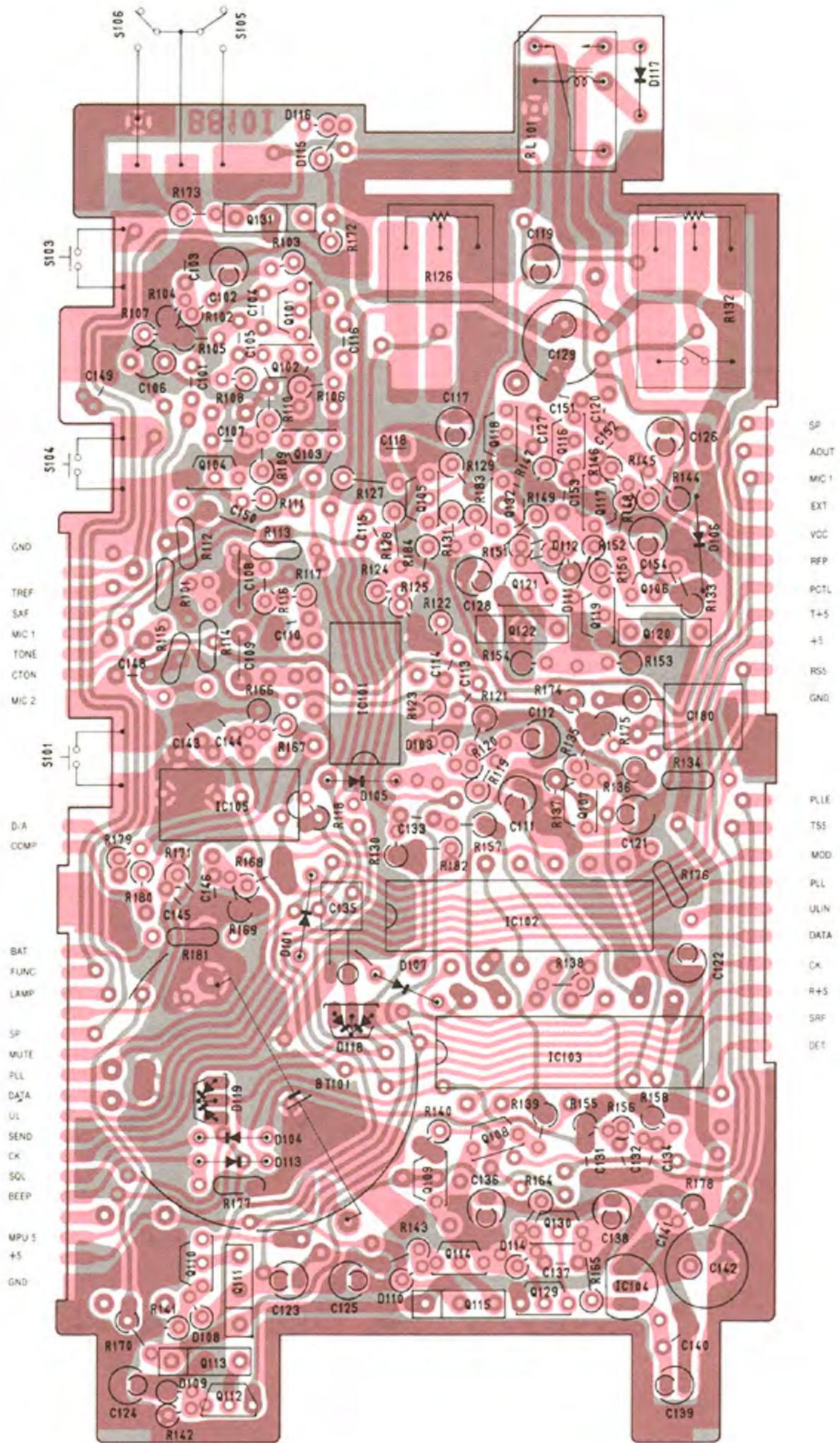


#### 2SD1225M R

Q122



# MAIN UNIT

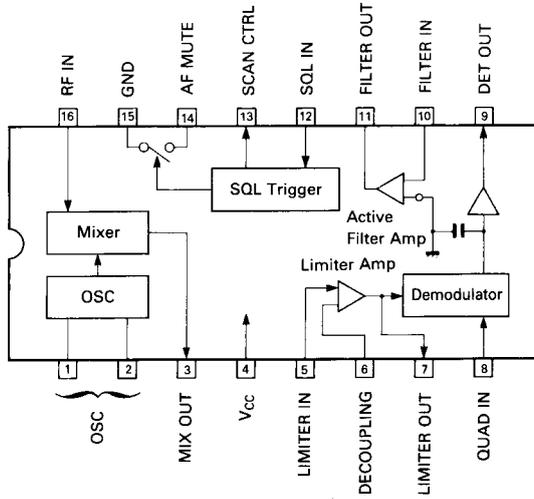


## 8 - 2 PLL UNIT

### • ICs

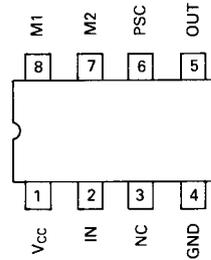
#### MC3357P (Low Power FM IF)

IC201



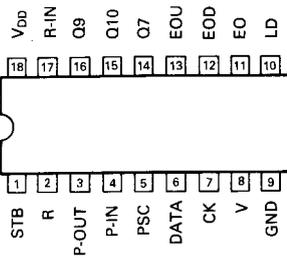
#### μPB571C (Low Power Prescaler)

IC202



#### μPD2834C (PLL Frequency Synthesizer)

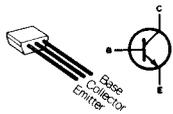
IC203



### • Transistors

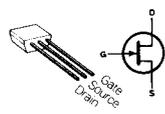
#### 2SC2668 O

Q201, Q202, Q203, Q204



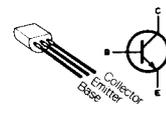
#### 2SK241 Y

Q205



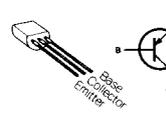
#### 2SC3355

Q206



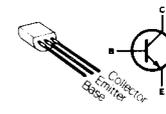
#### 2SB561 C

Q207



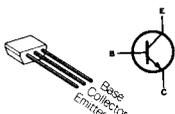
#### 2SC2407 A

Q210



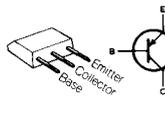
#### 2SC2458 GR

Q212, Q214, Q215



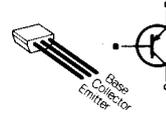
#### 2SB909M R

Q213



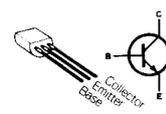
#### 2SA1048 GR

Q216, Q217, Q218



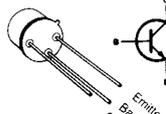
#### 2SC2026

Q219



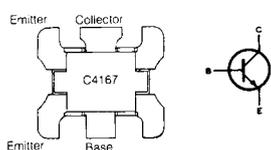
#### 2SC3101

Q220

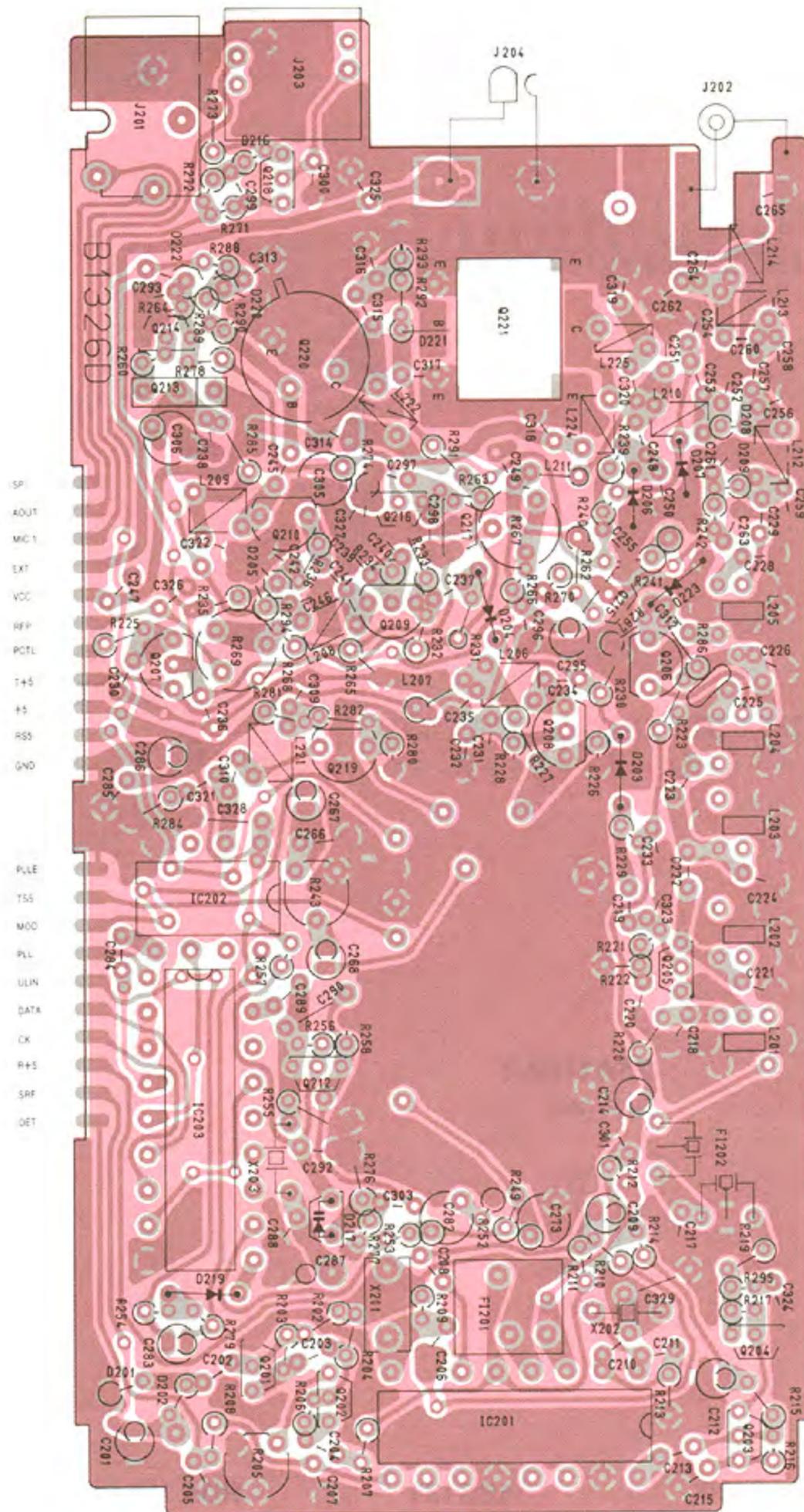


#### 2SC4167-01

Q221



# PLL UNIT

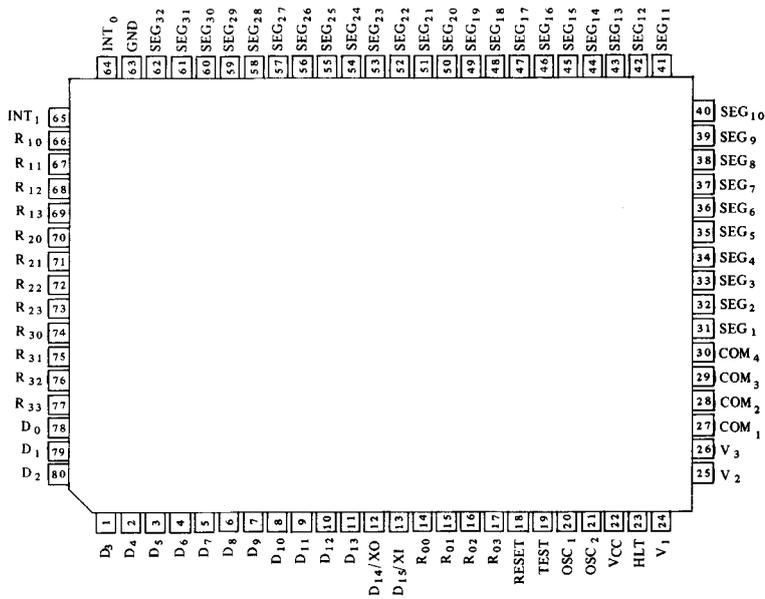


## 8 - 3 LOGIC UNIT

- IC

### HD44795B60 (MPU)

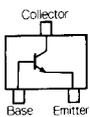
IC401



- Transistors

#### 2SC2712 Y

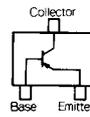
Q401



Symbol: LY

#### 2SA1162 Y

Q402, Q403



Symbol: SY

- Diodes

#### 1SS187

D402



Symbol: D3

#### 1SS190

D404



Symbol: E3

#### 1SS181

D407



Symbol: A3

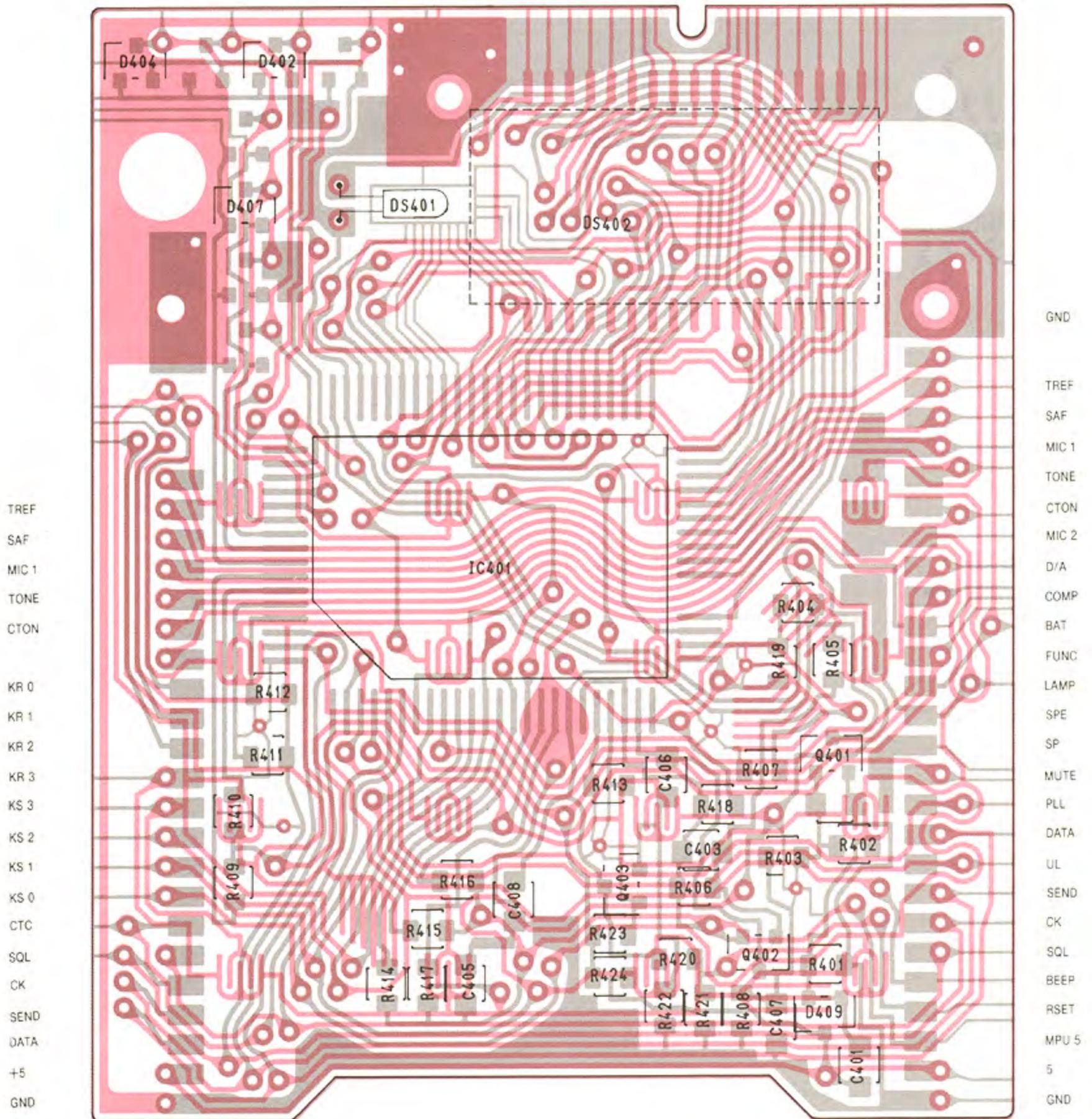
#### RD4.7M B3

D409



Symbol: 473

# LOGIC UNIT

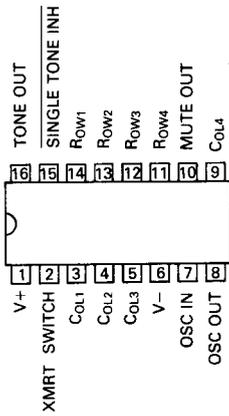


## 8 - 4 TONE UNIT

- ICs

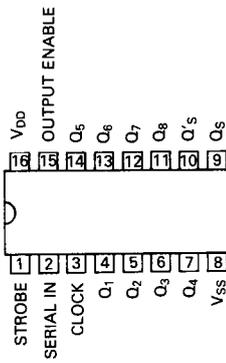
### LR4087 (DTMF Encoder)

IC501



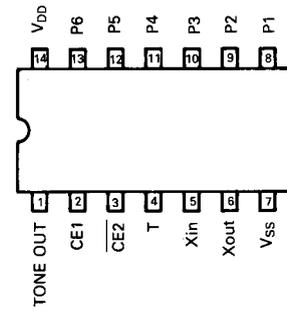
### TC4094BP (8-Stage Shift-and-Store Bus Register)

IC502



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

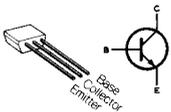
IC503



- Transistors

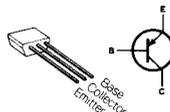
### 2SC2458 GR

Q501, Q502, Q503, Q504  
Q506

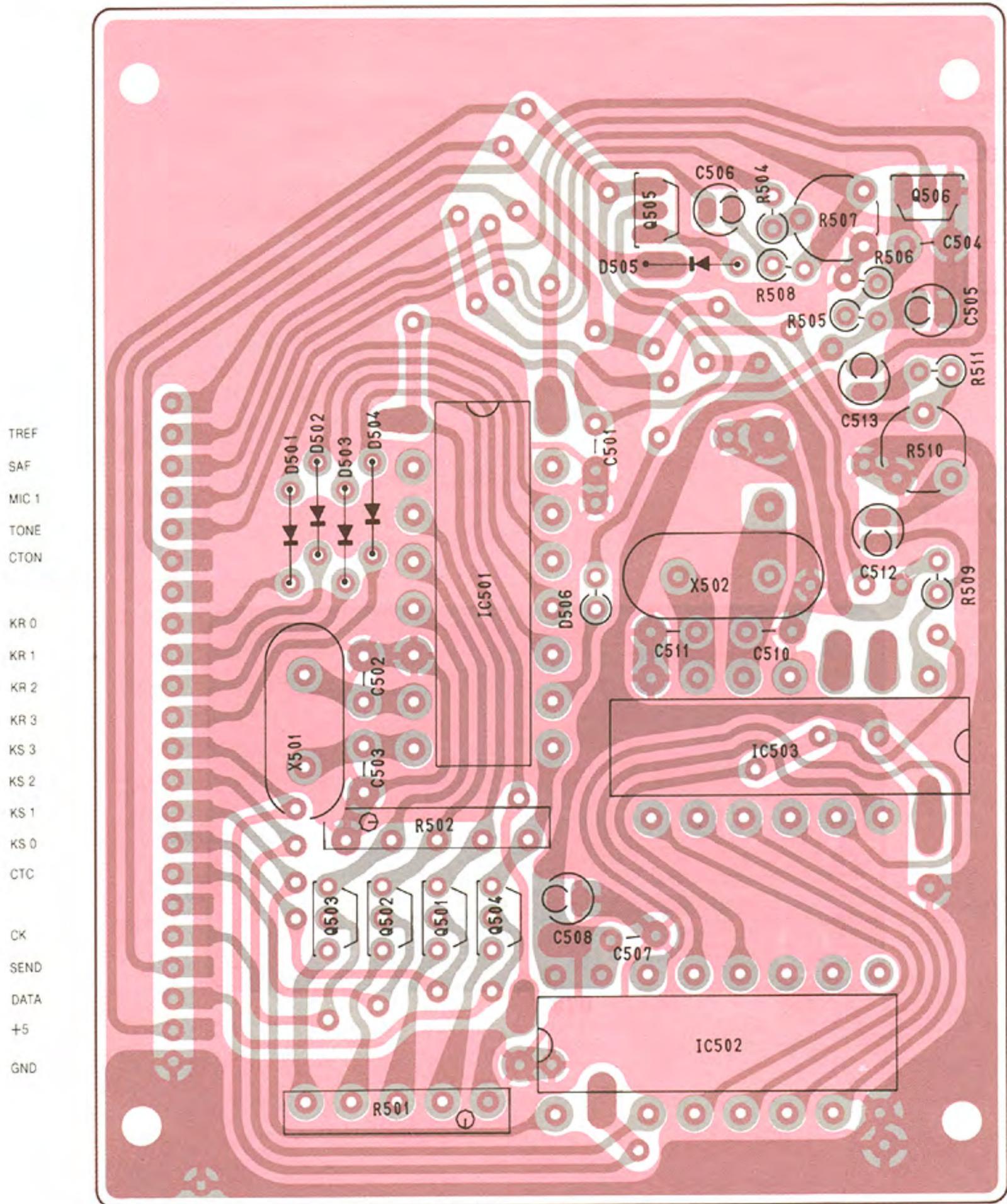


### 2SA1345

Q505



# TONE UNIT

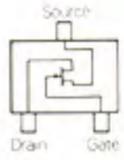


## 8 - 5 VCO UNIT

- Transistor

### 2SK302 Y

Q701

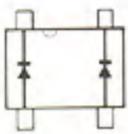


Symbol: TY

- Diode

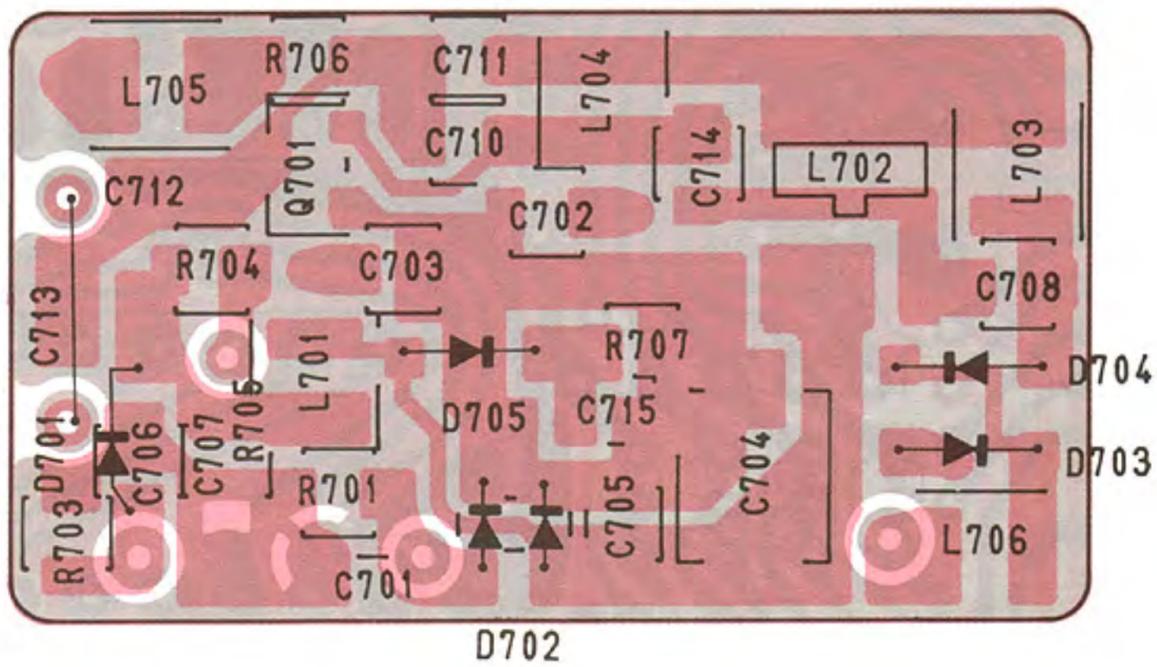
### MA862

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

## PLL UNIT

| REF. NO. | DESCRIPTION     | PART NO.         |      | REF. NO. | DESCRIPTION   | PART NO.          |               |
|----------|-----------------|------------------|------|----------|---------------|-------------------|---------------|
| C113     | Ceramic         | 15pF             | 50V  | IC201    | IC            | MC3357P           |               |
| C114     | Ceramic         | 0.001μF          | 50V  | IC202    | IC            | μPB571C           |               |
| C115     | Ceramic         | 0.001μF          | 50V  | IC203    | IC            | μPD2834C          |               |
| C116     | Barrier Layer   | 0.0022μF         | 25V  |          |               |                   |               |
| C117     | Electrolytic    | 0.22μF           | 50V  | RC3      | Q201          | Transistor        | 2SC2668 O     |
| C118     | Barrier Layer   | 0.0068μF         | 25V  |          | Q202          | Transistor        | 2SC2668 O     |
| C119     | Electrolytic    | 0.1μF            | 50V  | RC3      | Q203          | Transistor        | 2SC2668 O     |
| C120     | Barrier Layer   | 0.0033μF         | 25V  |          | Q204          | Transistor        | 2SC2668 O     |
| C121     | Electrolytic    | 10μF             | 16V  | RC3      | Q205          | FET               | 2SK241 Y      |
| C122     | Electrolytic    | 0.22μF           | 50V  | RC3      | Q206          | Transistor        | 2SC3355       |
| C123     | Electrolytic    | 22μF             | 6.3V | RC3      | Q207          | Transistor        | 2SB561 C      |
| C124     | Electrolytic    | 22μF             | 6.3V | RC3      | Q208          | Transistor        | 2SC2026       |
| C125     | Electrolytic    | 22μF             | 6.3V | RC3      | Q209          | Transistor        | 2SC2026       |
| C126     | Electrolytic    | 10μF             | 16V  | RC3      | Q210          | Transistor        | 2SC2407 A     |
| C127     | Ceramic         | 100pF            | 50V  |          | Q212          | Transistor        | 2SC2458 GR    |
| C128     | Electrolytic    | 0.22μF           | 50V  | RC3      | Q213          | Transistor        | 2SB909M R     |
| C129     | Electrolytic    | 47μF             | 25V  | MS7      | Q214          | Transistor        | 2SC2458 GR    |
| C130     | Electrolytic    | 100μF            | 10V  | MS7      | Q215          | Transistor        | 2SC2458 GR    |
| C131     | Ceramic         | 100pF            | 50V  |          | Q216          | Transistor        | 2SA1048 GR    |
| C132     | Ceramic         | 470pF            | 50V  |          | Q217          | Transistor        | 2SA1048 GR    |
| C133     | Barrier Layer   | 0.0033μF         | 25V  |          | Q218          | Transistor        | 2SA1048 GR    |
| C134     | Barrier Layer   | 0.0027μF         | 25V  |          | Q219          | Transistor        | 2SC2026       |
| C135     | Electrolytic    | 47μF             | 6.3V | RC3      | Q220          | Transistor        | 2SC3101       |
| C136     | Electrolytic    | 22μF             | 6.3V | RC3      | Q221          | Transistor        | 2SC4167-01    |
| C137     | Ceramic         | 470pF            | 50V  |          |               |                   |               |
| C138     | Electrolytic    | 22μF             | 6.3V | RC3      | D201          | Diode             | 1SS99         |
| C139     | Electrolytic    | 22μF             | 6.3V | RC3      | D202          | Diode             | 1SS97         |
| C140     | Ceramic         | 470pF            | 50V  |          | D203          | Diode             | 1SS216        |
| C141     | Ceramic         | 470pF            | 50V  |          | D204          | Diode             | 1SS216        |
| C142     | Electrolytic    | 33μF             | 25V  | RC3      | D205          | Diode             | 1SS211        |
| C143     | Ceramic         | 0.001μF          | 50V  |          | D206          | Diode             | 1SS237        |
| C144     | Ceramic         | 0.001μF          | 50V  |          | D207          | Diode             | 1SS237        |
| C145     | Ceramic         | 0.001μF          | 50V  |          | D208          | Diode             | 1SS216        |
| C146     | Ceramic         | 0.001μF          | 50V  |          | D209          | Diode             | 1SS216        |
| C148     | Ceramic         | 0.001μF          | 50V  |          | D216          | Diode             | 1SS211        |
| C149     | Ceramic         | 470pF            | 50V  |          | D217          | Varicap           | 1SV100        |
| C150     | Barrier Layer   | 0.018μF          | 25V  |          | D219          | Diode             | 1SS211        |
| C151     | Ceramic         | 470pF            | 50V  |          | D220          | Diode             | 1SS211        |
| C152     | Ceramic         | 470pF            | 50V  |          | D221          | Diode             | 1SS211        |
| C153     | Ceramic         | 470pF            | 50V  |          | D222          | Diode             | 1SS237        |
| C154     | Electrolytic    | 4.7μF            | 25V  | RC3      | D223          | Diode             | 1SS211        |
| C155     | Ceramic         | 470pF            | 50V  |          |               |                   |               |
| C156     | Ceramic         | 470pF            | 50V  |          | FI201         | Ceramic           | CFU455 E2     |
|          |                 |                  |      |          | FI202         | Monolithic        | UM-1/16M15B4  |
| RL101    | Relay           | OUC-SS-114D      |      |          |               |                   |               |
| S101     | Switch          | SKHHAB062A       |      | X201     | Discriminator | CDB455 C7A        |               |
| S103     | Switch          | SKHHAB062A       |      | X202     | Crystal       | HC-18/T 16.445MHz |               |
| S104     | Switch          | SKHHAB062A       |      | X203     | Crystal       | HC-18/T 5.12MHz   |               |
| S105     | Switch          | SPPH22014A       |      |          |               |                   |               |
| S106     | Switch          | SPPH22014A       |      | L201     | Coil          | LS-262            |               |
|          |                 |                  |      | L202     | Coil          | LS-308            |               |
|          |                 |                  |      | L203     | Coil          | LS-308            |               |
| BT101    | Lithium Battery | BR2325-1HC       |      | L204     | Coil          | LS-308            |               |
|          |                 |                  |      | L205     | Coil          | LS-308            |               |
| EP101    | P.C. Board      | B-810I           |      | L206     | Coil          | LA-235            |               |
| EP102    | P.C. Board      | B-824A           |      | L207     | Choke         | LAL03NA           | 221K          |
| EP103    | F.P.C. Board    | B-812            |      | L208     | Coil          | LA-234            |               |
| EP104    | Bead Core       | DL2-OP2.6-3-1.2H |      | 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

PLL UNIT

| REF. NO. | DESCRIPTION   | PART NO. | REF. NO.       | DESCRIPTION | PART NO.      |          |                |     |
|----------|---------------|----------|----------------|-------------|---------------|----------|----------------|-----|
| R212     | Resistor      | 1.5kΩ    | R10            | C209        | Electrolytic  | 0.1μF    | 50V            | RC3 |
| R213     | Resistor      | 47kΩ     | ELR10          | C210        | Ceramic       | 120pF    | 50V            |     |
| R214     | Resistor      | 100Ω     | ELR10          | C211        | Ceramic       | 22pF     | 50V            |     |
| R215     | Resistor      | 1.2kΩ    | ELR10          | C212        | Electrolytic  | 1μF      | 50V            | RC3 |
| R216     | Resistor      | 10kΩ     | ELR10          | C213        | Ceramic       | 0.001μF  | 50V            |     |
| R217     | Resistor      | 10kΩ     | ELR10          | C214        | Electrolytic  | 10μF     | 16V            | RC3 |
| R219     | Resistor      | 1.2kΩ    | ELR10          | C215        | Barrier Layer | 0.0047μF | 25V            |     |
| R220     | Resistor      | 100Ω     | ELR10          | C217        | Ceramic       | 5pF      | 50V            |     |
| R221     | Resistor      | 56Ω      | R10            | C218        | Barrier Layer | 0.0047μF | 25V            |     |
| R222     | Resistor      | 1.5kΩ    | ELR10          | C219        | Ceramic       | 0.001μF  | 50V            |     |
| R223     | Resistor      | 100Ω     | ELR10          | C220        | Barrier Layer | 0.0047μF | 25V            |     |
| R225     | Resistor      | 6.8kΩ    | ELR10          | C221        | Ceramic       | 8pF      | 50V            |     |
| R226     | Resistor      | 4.7kΩ    | ELR10          | C222        | Ceramic       | 0.35pF   | 50V            |     |
| R227     | Resistor      | 5.6kΩ    | ELR10          | C223        | Ceramic       | 0.5pF    | 50V            |     |
| R228     | Resistor      | 470Ω     | ELR10          | C224        | Ceramic       | 10pF     | 50V            |     |
| R229     | Resistor      | 10kΩ     | ELR10          | C225        | Ceramic       | 8pF      | 50V            |     |
| R230     | Resistor      | 22kΩ     | ELR10          | C226        | Ceramic       | 0.001μF  | 50V            |     |
| R231     | Resistor      | 10kΩ     | ELR10          | C228        | Ceramic       | 9pF      | 50V            |     |
| R232     | Resistor      | 1.2kΩ    | ELR10          | C229        | Ceramic       | 8pF      | 50V            |     |
| R233     | Resistor      | 560Ω     | ELR10          | C230        | Ceramic       | 0.001μF  | 50V            |     |
| R234     | Resistor      | 22Ω      | ELR10          | C231        | Ceramic       | 0.001μF  | 50V            |     |
| R235     | Resistor      | 1kΩ      | ELR10          | C232        | Ceramic       | 0.001μF  | 50V            |     |
| R236     | Resistor      | 100Ω     | ELR10          | C233        | Ceramic       | 470pF    | 50V            |     |
| R239     | Resistor      | 4.7kΩ    | ELR10          | C234        | Ceramic       | 6pF      | 50V            |     |
| R240     | Resistor      | 4.7kΩ    | ELR10          | C235        | Ceramic       | 0.001μF  | 50V            |     |
| R241     | Resistor      | 150kΩ    | ELR10          | C236        | Ceramic       | 0.001μF  | 50V            |     |
| R242     | Resistor      | 330Ω     | ELR10          | C237        | Ceramic       | 39pF     | 50V            |     |
| R243     | Trimmer       | 47kΩ     | RH0521CS4J0DA  | C238        | Ceramic       | 0.001μF  | 50V            |     |
| R249     | Resistor      | 10kΩ     | ELR10          | C239        | Ceramic       | 0.001μF  | 50V            |     |
| R252     | Resistor      | 1.5kΩ    | ELR10          | C240        | Ceramic       | 0.001μF  | 50V            |     |
| R253     | Resistor      | 1.8kΩ    | R10            | C241        | Ceramic       | 10pF     | 50V            |     |
| R254     | Resistor      | 220kΩ    | ELR10          | C242        | Ceramic       | 0.001μF  | 50V            |     |
| R255     | Resistor      | 39kΩ     | ELR10          | C245        | Ceramic       | 10pF     | 50V            |     |
| R256     | Resistor      | 39kΩ     | ELR10          | C246        | Ceramic       | 0.001μF  | 50V            |     |
| R257     | Resistor      | 100Ω     | ELR10          | C247        | Ceramic       | 0.001μF  | 50V            |     |
| R258     | Resistor      | 5.6kΩ    | ELR10          | C248        | Ceramic       | 0.5pF    | 50V            |     |
| R260     | Resistor      | 8.2kΩ    | ELR10          | C249        | Ceramic       | 470pF    | 50V            |     |
| R262     | Resistor      | 47kΩ     | ELR10          | C250        | Ceramic       | 3pF      | 50V            |     |
| R263     | Resistor      | 82kΩ     | ELR10          | C251        | Ceramic       | 15pF     | 50V            |     |
| R264     | Resistor      | 560kΩ    | ELR10          | C252        | Ceramic       | 15pF     | 50V            |     |
| R265     | Resistor      | 22kΩ     | ELR10          | C253        | Ceramic       | 0.5pF    | 50V            |     |
| R266     | Resistor      | 15kΩ     | ELR10          | C254        | Ceramic       | 3pF      | 50V            |     |
| R267     | Trimmer       | 22kΩ     | RH0521CJ4J06A  | C255        | Ceramic       | 470pF    | 50V            |     |
| R268     | Resistor      | 2.2kΩ    | ELR10          | C256        | Ceramic       | 15pF     | 50V            |     |
| R269     | Trimmer       | 2.2kΩ    | RH0521CJ3J05A  | C257        | Ceramic       | 0.001μF  | 50V            |     |
| R270     | Resistor      | 1MΩ      | ELR10          | C258        | Ceramic       | 12pF     | 50V            |     |
| R271     | Resistor      | 27Ω      | ELR10          | C259        | Ceramic       | 15pF     | 50V            |     |
| R272     | Resistor      | 5.6kΩ    | ELR10          | C260        | Ceramic       | 3pF      | 50V            |     |
| R273     | Resistor      | 47kΩ     | ELR10          | C261        | Ceramic       | 120pF    | 50V            |     |
| R274     | Resistor      | 22kΩ     | ELR10          | C262        | Ceramic       | 22pF     | 50V            |     |
| R276     | Resistor      | 1MΩ      | ELR10          | C263        | Ceramic       | 470pF    | 50V            |     |
| R277     | Resistor      | 1kΩ      | ELR10          | C264        | Ceramic       | 1pF      | 50V            |     |
| R278     | Resistor      | 220kΩ    | ELR10          | C265        | Ceramic       | 12pF     | 50V            |     |
| R279     | Resistor      | 390kΩ    | ELR10          | C266        | Mylar         | 0.0022μF | 50V            |     |
| R280     | Resistor      | 4.7kΩ    | ELR10          | C267        | Electrolytic  | 0.47μF   | 50V            | RC3 |
| R281     | Resistor      | 470Ω     | ELR10          | C268        | Electrolytic  | 0.47μF   | 50V            | RC3 |
| R282     | Resistor      | 5.6kΩ    | ELR10          | C273        | Tantalum      | 0.1μF    | 35V            | DN  |
| R284     | Resistor      | 47Ω      | ELR10          | C282        | Tantalum      | 10μF     | 16V            | DN  |
| R285     | Resistor      | 4.7Ω     | ELR10          | C283        | Electrolytic  | 10μF     | 16V            | RC3 |
| R286     | Resistor      | 22kΩ     | ELR10          | C284        | Ceramic       | 0.001μF  | 50V            |     |
| R287     | Resistor      | 6.8kΩ    | ELR10          | C285        | Monolithic    | 0.1μF    | D33Y5V1E104Z21 |     |
| R288     | Resistor      | 100Ω     | ELR10          | C286        | Electrolytic  | 22μF     | 6.3V           | RC3 |
| R289     | Resistor      | 100Ω     | ELR10          | C287        | Trimmer       | 10pF     | ECRGA010D30    |     |
| R290     | Resistor      | 390Ω     | ELR10          | C288        | Ceramic       | 22pF     | 50V            |     |
| R291     | Resistor      | 100Ω     | ELR10          | C289        | Ceramic       | 0.001μF  | 50V            |     |
| R292     | Resistor      | 39Ω      | ELR10          | C290        | Ceramic       | 220pF    | 50V            |     |
| R293     | Resistor      | 220Ω     | ELR10          | C292        | Barrier Layer | 0.01μF   | 25V            |     |
| R294     | Resistor      | 10kΩ     | ELR10          | C293        | Ceramic       | 0.001μF  | 50V            |     |
| R295     | Resistor      | 10kΩ     | ELR10          | C295        | Electrolytic  | 10μF     | 16V            | RC3 |
| C201     | Electrolytic  | 1μF      | 50V            | RC3         | C296          | Ceramic  | 0.001μF        | 50V |
| C202     | Ceramic       | 470pF    | 50V            | C297        | Ceramic       | 0.001μF  | 50V            |     |
| C203     | Ceramic       | 470pF    | 50V            | C298        | Ceramic       | 0.001μF  | 50V            |     |
| C204     | Ceramic       | 15pF     | 50V            | C299        | Ceramic       | 0.001μF  | 50V            |     |
| C205     | Barrier Layer | 0.0033μF | 25V            | C300        | Ceramic       | 0.001μF  | 50V            |     |
| C206     | Ceramic       | 82pF     | 50V            | C301        | Barrier Layer | 0.0047μF | 25V            |     |
| C207     | Ceramic       | 0.001μF  | 50V            | C303        | Ceramic       | 0.001μF  | 50V            |     |
| C208     | Monolithic    | 0.1μF    | D33Y5V1E104Z21 | C305        | Tantalum      | 4.7μF    | 16V            | DN  |
|          |               |          |                | C306        | Tantalum      | 4.7μF    | 16V            | DN  |

### PLL UNIT

| REF. NO. | DESCRIPTION   | PART NO.             |
|----------|---------------|----------------------|
| C309     | Ceramic       | 0.001µF 50V          |
| C310     | Ceramic       | 100pF 50V            |
| C312     | Ceramic       | 22pF 50V             |
| C313     | Ceramic       | 0.001µF 50V          |
| C314     | Ceramic       | 0.001µF 50V          |
| C315     | Ceramic       | 33pF 50V             |
| C316     | Ceramic       | 10pF 50V             |
| C317     | Ceramic       | 0.001µF 50V          |
| C318     | Ceramic       | 0.001µF 50V          |
| C319     | Ceramic       | 18pF 50V             |
| C320     | Ceramic       | 47pF 50V             |
| C321     | Ceramic       | 0.001µF 50V          |
| C322     | Ceramic       | 0.001µF 50V          |
| C323     | Ceramic       | 47pF 50V             |
| C324     | Ceramic       | 0.001µF 50V          |
| C325     | Monolithic    | 0.1µF D33Y5V1E104Z21 |
| C326     | Ceramic       | 470pF 50V            |
| C327     | Ceramic       | 0.001µF 50V          |
| C328     | Barrier Layer | 0.1µF 16V            |
| C329     | Barrier Layer | 0.1µF 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             | 6.8kΩ MCR10    |
| R402     | Chip             | 15kΩ MCR10     |
| R403     | Chip             | 1MΩ MCR10      |
| R404     | Chip             | 15kΩ MCR10     |
| R405     | Chip             | 100kΩ MCR10    |
| R406     | Chip             | 100kΩ MCR10    |
| R407     | Chip             | 100kΩ MCR10    |
| R408     | Chip             | 15kΩ MCR10     |
| R409     | Chip             | 270kΩ MCR10    |
| R410     | Chip             | 120kΩ MCR10    |
| R411     | Chip             | 68kΩ MCR10     |
| R412     | Chip             | 33kΩ MCR10     |
| R413     | Chip             | 270kΩ MCR10    |
| R414     | Chip             | 47kΩ MCR10     |
| R415     | Chip             | 47kΩ MCR10     |
| R416     | Chip             | 47kΩ MCR10     |
| R417     | Chip             | 47kΩ MCR10     |
| R418     | Chip             | 22kΩ MCR10     |
| R419     | Chip             | 22kΩ MCR10     |
| R420     | Chip             | 100kΩ MCR10    |
| R421     | Chip             | 100kΩ MCR10    |
| R422     | Chip             | 100kΩ MCR10    |
| R423     | Chip             | 1MΩ MCR10      |
| R424     | Chip             | 100kΩ MCR10    |
| C401     | Monolithic       | 470pF GRM40    |
| C402     | Monolithic       | 470pF GRM40    |
| C403     | Monolithic       | 470pF GRM40    |
| C404     | Ceramic          | 470pF 50V      |
| C405     | Monolithic       | 0.1µF GRM40 F  |
| C406     | Monolithic       | 0.01µF GRM40 F |
| C407     | Monolithic       | 0.001µF GRM40  |
| C408     | Monolithic       | 0.001µF 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

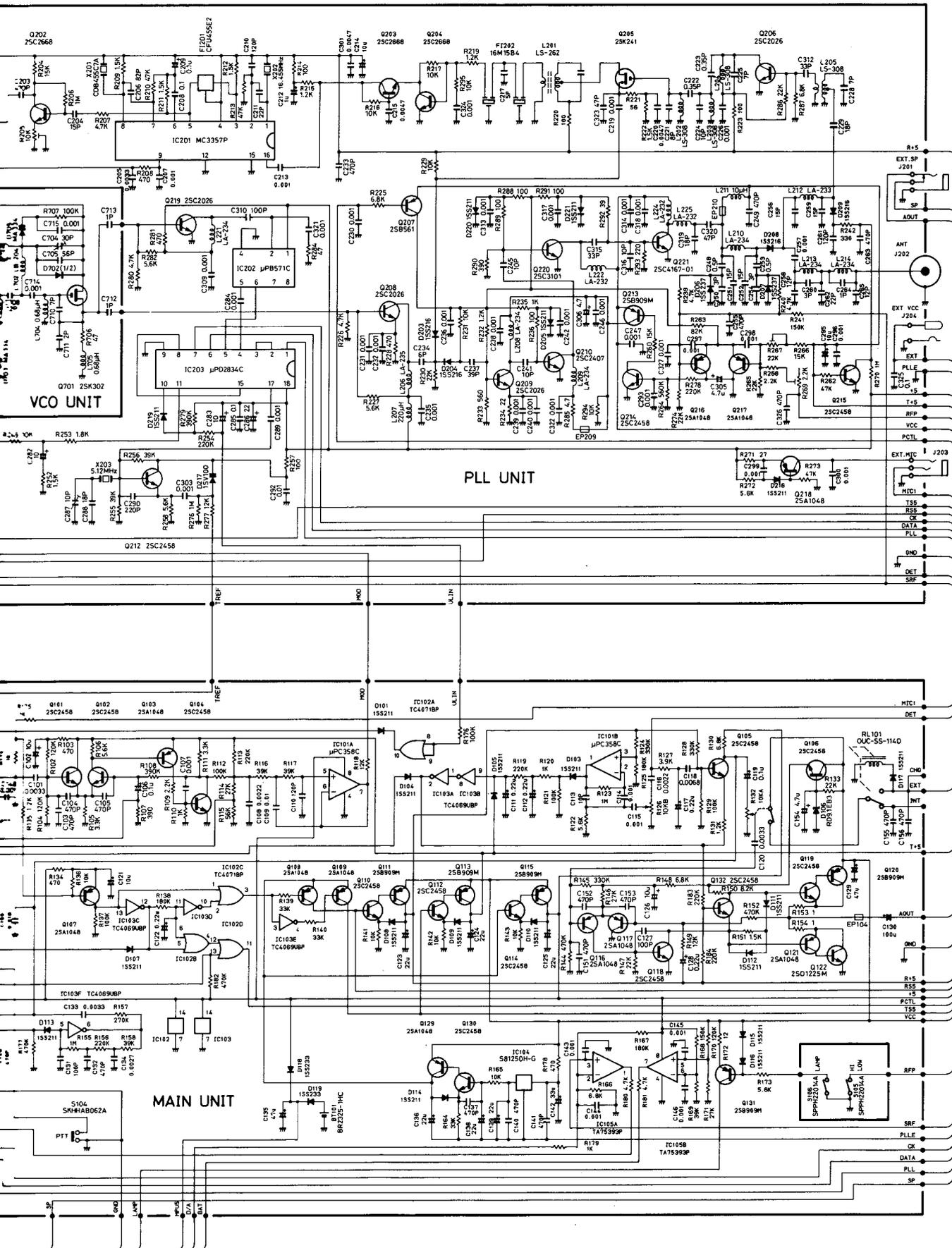
| REF. NO. | DESCRIPTION  | PART NO.   |               |
|----------|--------------|------------|---------------|
| IC501    | IC           | LR4087     |               |
| IC502    | IC           | TC4094BP   |               |
| IC503    | IC           | S-7116A    |               |
| Q501     | Transistor   | 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     | 22kΩ       | ELR10         |
| R505     | Resistor     | 150kΩ      | ELR10         |
| R506     | Resistor     | 100kΩ      | ELR10         |
| R507     | Trimmer      | 10kΩ       | RH0521C14J08A |
| R508     | Resistor     | 33kΩ       | ELR10         |
| R509     | Resistor     | 47kΩ       | ELR10         |
| R510     | Trimmer      | 100kΩ      | RH0521C15J05A |
| R511     | Resistor     | 39kΩ       | ELR10         |
| C501     | Ceramic      | 470pF      | 50V           |
| C502     | Ceramic      | 39pF       | 50V           |
| C503     | Ceramic      | 30pF       | 50V           |
| C504     | Ceramic      | 470pF      | 50V           |
| C505     | Electrolytic | 4.7μF      | 16V RC3       |
| C506     | Electrolytic | 0.47μF     | 50V RC3       |
| C507     | Ceramic      | 470pF      | 50V           |
| C508     | Electrolytic | 22pF       | 6.3V RC3      |
| C510     | Ceramic      | 47pF       | 50V           |
| C511     | Ceramic      | 39pF       | 50V           |
| C512     | Electrolytic | 0.47μF     | 50V RC3       |
| C513     | Electrolytic | 0.22μF     | 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        | 100kΩ    | MCR10       |
| R703     | Chip        | 100kΩ    | MCR10       |
| R704     | Chip        | 22kΩ     | MCR10       |
| R705     | Resistor    | 1.2kΩ    | R10         |
| R706     | Chip        | 47Ω      | MCR10       |
| R707     | Chip        | 100kΩ    | MCR10       |
| C701     | Ceramic     | 470pF    | 50V         |
| C702     | Monolithic  | 0.001μF  | GRM40       |
| C703     | Monolithic  | 0.001μF  | 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  | 0.001μF  | GRM40       |
| C715     | Monolithic  | 0.001μF  | GRM40       |
| EP701    | P.C. Board  | B-1321B  |             |









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