



# SERVICE MANUAL

UHF FM TRANSCEIVER

# IC-U16T

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## INTRODUCTION

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This service manual describes the latest service information for the **IC-U16T** UHF FM TRANSCEIVER at the time of going to press.

Four versions of the **IC-U16T** have been designed. This service manual covers following versions.

VERSION	FREQUENCY RANGE (MHz)	CHANNEL SPACING (kHz)	5-TONE SYSTEM	IF BAND WIDTH
#01	460 ~ 470	12.5	CCIR	Narrow
#02	460 ~ 470	25	CCIR	Wide
#03	450 ~ 460	12.5	CCIR	Narrow
#04	450 ~ 460	25	CCIR	Wide

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## DANGER

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**NEVER** connect the transceiver to an AC outlet or to a DC power supply that uses more than 16 V. This will ruin the transceiver.

**DO NOT** expose the transceiver to rain, snow or any liquids.

**DO NOT** reverse the polarities of the power supply when connecting the transceiver.

**DO NOT** apply an RF signal of more than 20 dBm (100 mW) to the antenna connector. This could damage the transceiver's front end.

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## ORDERING PARTS

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Be sure to include the following four points when ordering replacement parts:

1. Component part number and name
2. Equipment model name and unit name
3. 10-digit order numbers for mechanical parts
4. Quantity required

### <SAMPLE ORDER>

IC	NJM4560DD	IC-U16T MAIN UNIT	5 pieces
Screw	PH A02×15 ZK	IC-U16T Rear panel	8810000740 10 pieces

Addresses are provided on the inside back cover for your convenience.

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## REPAIR NOTE

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1. Make sure a problem is internal before disassembling the transceiver.
2. **DO NOT** open the transceiver until the transceiver is disconnected from a power source.
3. **DO NOT** force any of the variable components. Turn them slowly and smoothly.
4. **DO NOT** short any circuits or electronic parts. An insulated tuning tool **MUST** be used for all adjustments.
5. **DO NOT** keep power ON for a long time when the transceiver is defective.
6. **DO NOT** transmit power into a signal generator or a sweep generator.
7. **ALWAYS** connect a 30 dB ~ 40 dB 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 equipment to the transceiver.



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To program the operating frequency, tone frequency, etc., see the separately available PROGRAMMING MANUAL (A-0876).

## SECTION 1 SPECIFICATIONS

### ■ GENERAL

Frequency coverage	: 450 MHz~470 MHz
Antenna impedance	: 50 $\Omega$ unbalanced
Audio output impedance	: 8 $\Omega$
Usable temperature range	: $-25^{\circ}\text{C} \sim +60^{\circ}\text{C}$ ( $-13^{\circ}\text{F} \sim +140^{\circ}\text{F}$ )
Frequency tolerance	: $\pm 0.0005\%$ ( $-25^{\circ}\text{C} \sim +60^{\circ}\text{C}$ , $-13^{\circ}\text{F} \sim +140^{\circ}\text{F}$ ) $\pm 0.0003\%$ ( $-10^{\circ}\text{C} \sim +55^{\circ}\text{C}$ , $+14^{\circ}\text{F} \sim +131^{\circ}\text{F}$ )
Current drain (at 8.4 V)	: Receive standby 105 mA Receive Max. audio 260 mA Transmit High 1.9 A (at 13.2 V) Low 1 A

Power supply requirement :

BATTERY PACK	VOLTAGE
CM-7	13.2 V
CM-8	8.4 V

(negative ground)

Dimensions	: 65(W) $\times$ 196(H) $\times$ 38(D) mm, 2.6(W) $\times$ 7.7(H) $\times$ 1.5(D) in. (Projections not included)
Weight	: 390 g (without battery pack)
5-Tone specification	: CCIR

### ■ TRANSMITTER

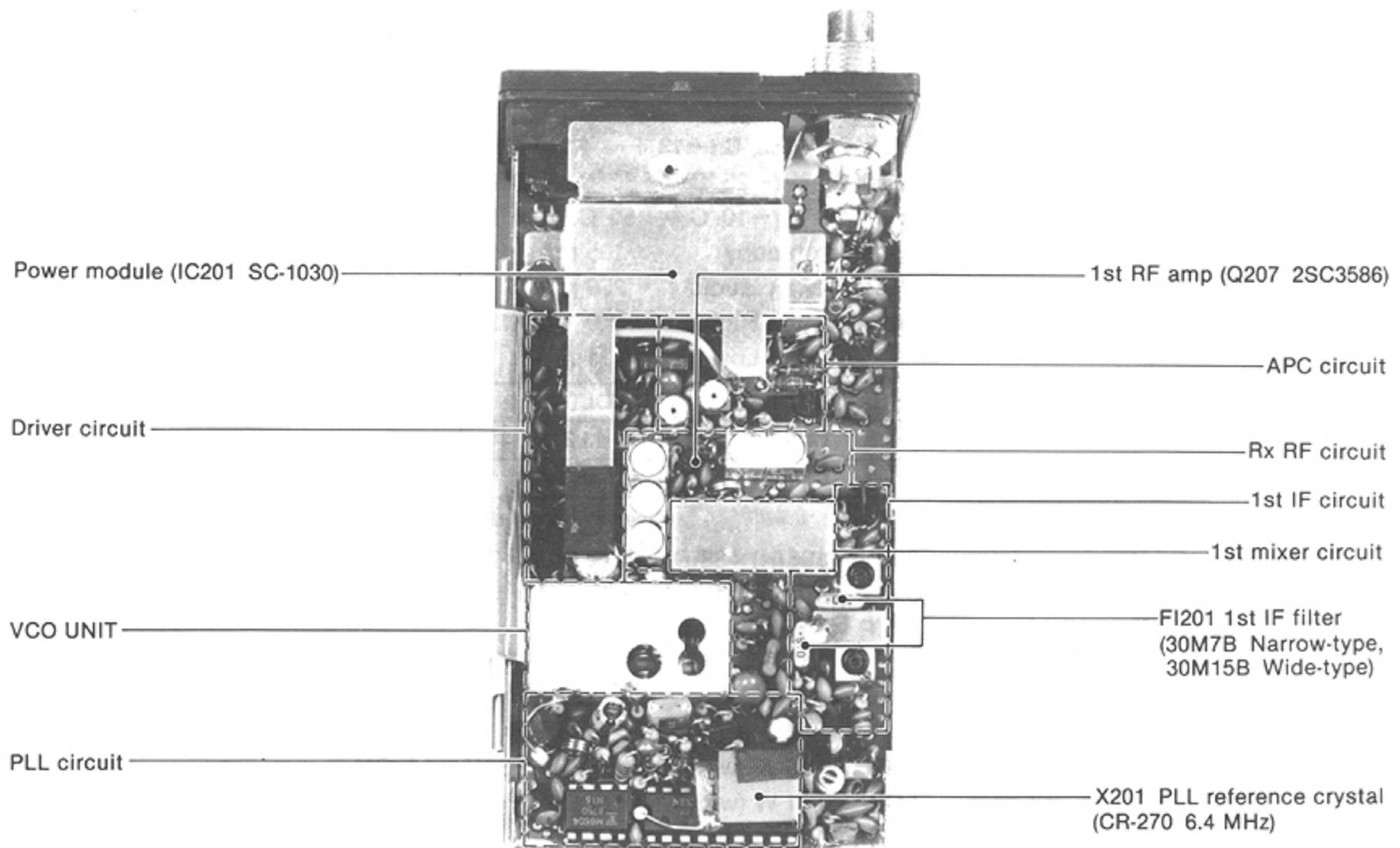
Output power	: HIGH 5 W (with CM-7) 2.5 W (with CM-8) LOW 1 W (with CM-7 or CM-8)
Emission mode	: 16K0F3E (Wide-type) 8K50F3E (Narrow-type)
Limiting of modulator	: 70 % ~ 100 % of max. deviation
Max. frequency deviation	: $\pm 5$ kHz (Wide-type) $\pm 2.5$ kHz (Narrow-type)
Audio frequency response	: +1 dB ~ -3 dB with 6 dB/octave between 300 Hz ~ 3000 Hz (Wide-type) between 300 Hz ~ 2550 Hz (Narrow-type)
Audio harmonic distortion	: 10 % max.
Noise and hum ratio	: 40 dB
Adjacent channel power	: 70 dB (Wide-type) 60 dB (Narrow-type)

### ■ RECEIVER

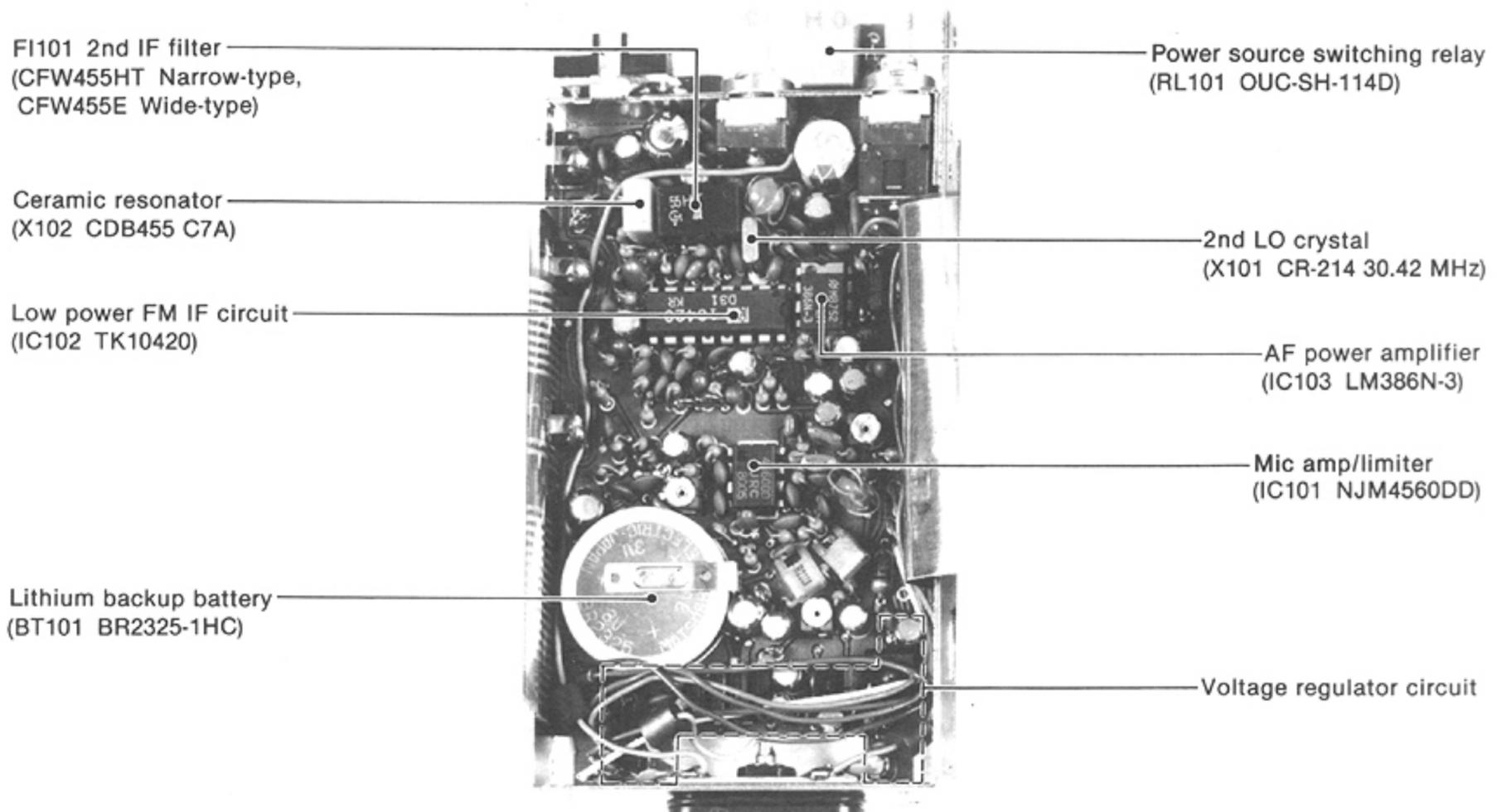
Receiving system	: Double-conversion superheterodyne
Intermediate frequencies	: 1st 30.875 MHz 2nd 455 kHz
Intermodulation	: 70 dB
Sensitivity	: 0.35 $\mu\text{V}$ for 12 dB SINAD
Squelch sensitivity (threshold)	: 0.3 $\mu\text{V}$
Audio output power	: 0.5 W at 10 % distortion with an 8 $\Omega$ load
Adjacent channel selectivity	: 70 dB (Wide-type) 60 dB (Narrow-type)
Spurious response rejection	: 70 dB
Blocking and desensitization	: 90 dB $\mu$
Audio frequency response	: +1 dB ~ -3 dB with -6 dB/octave between 300 Hz ~ 3000 Hz (Wide-type) between 300 Hz ~ 2550 Hz (Narrow-type)
Noise and hum ratio	: 40 dB

## SECTION 2 INSIDE VIEWS

### 2-1 PLL UNIT

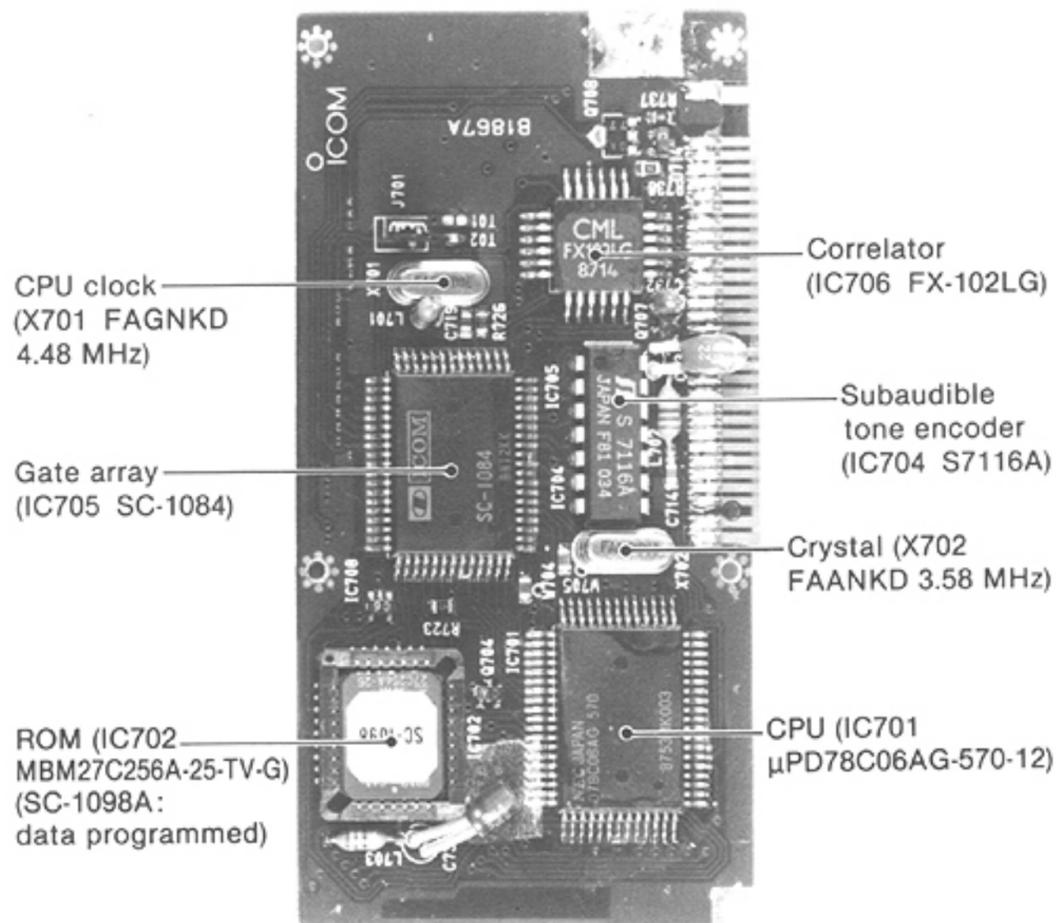


### 2-2 MAIN UNIT

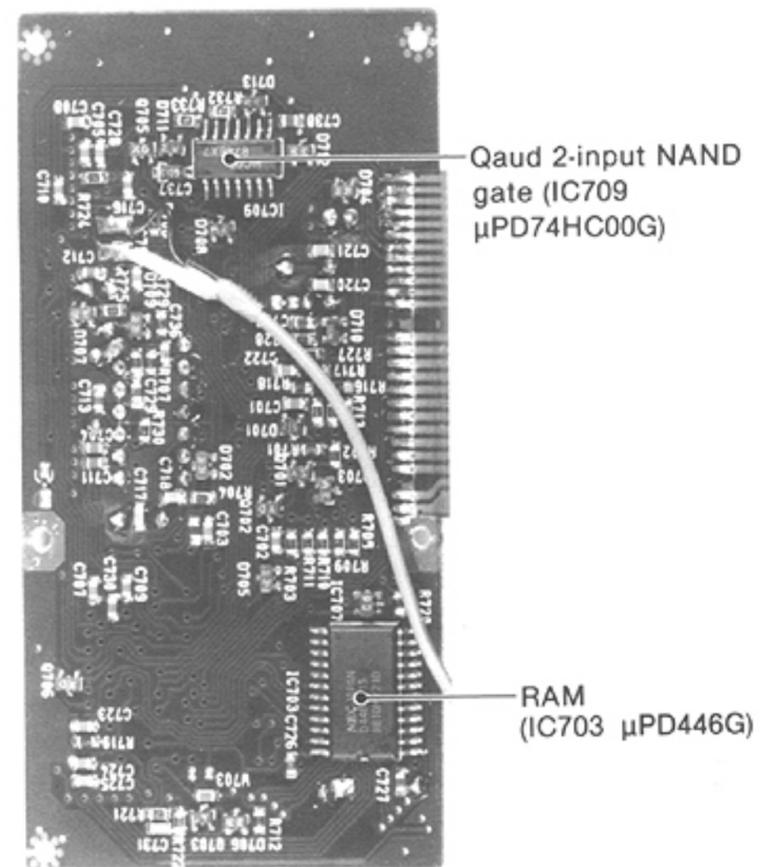


## 2-3 LOGIC UNIT

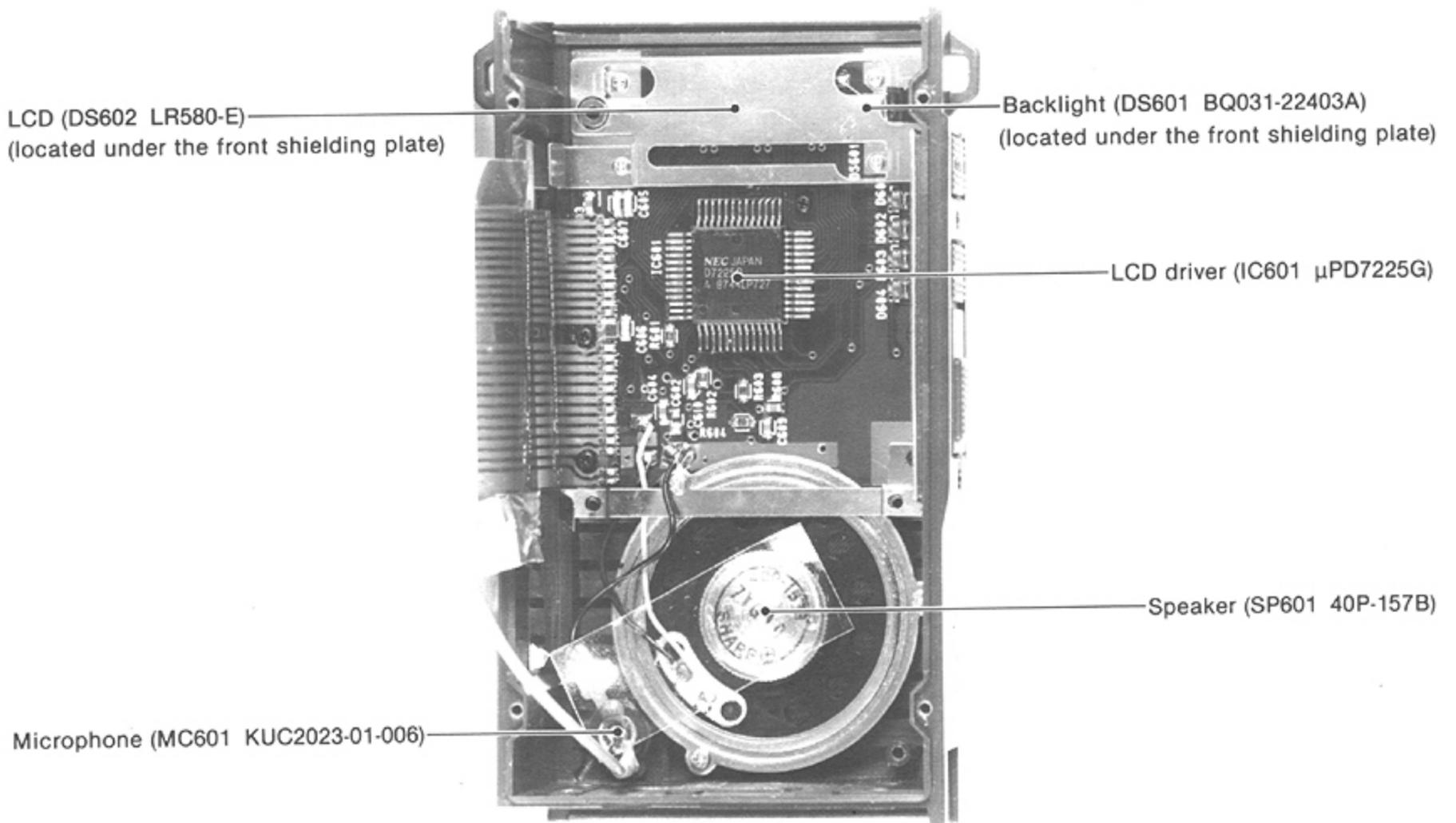
### • COMPONENT SIDE



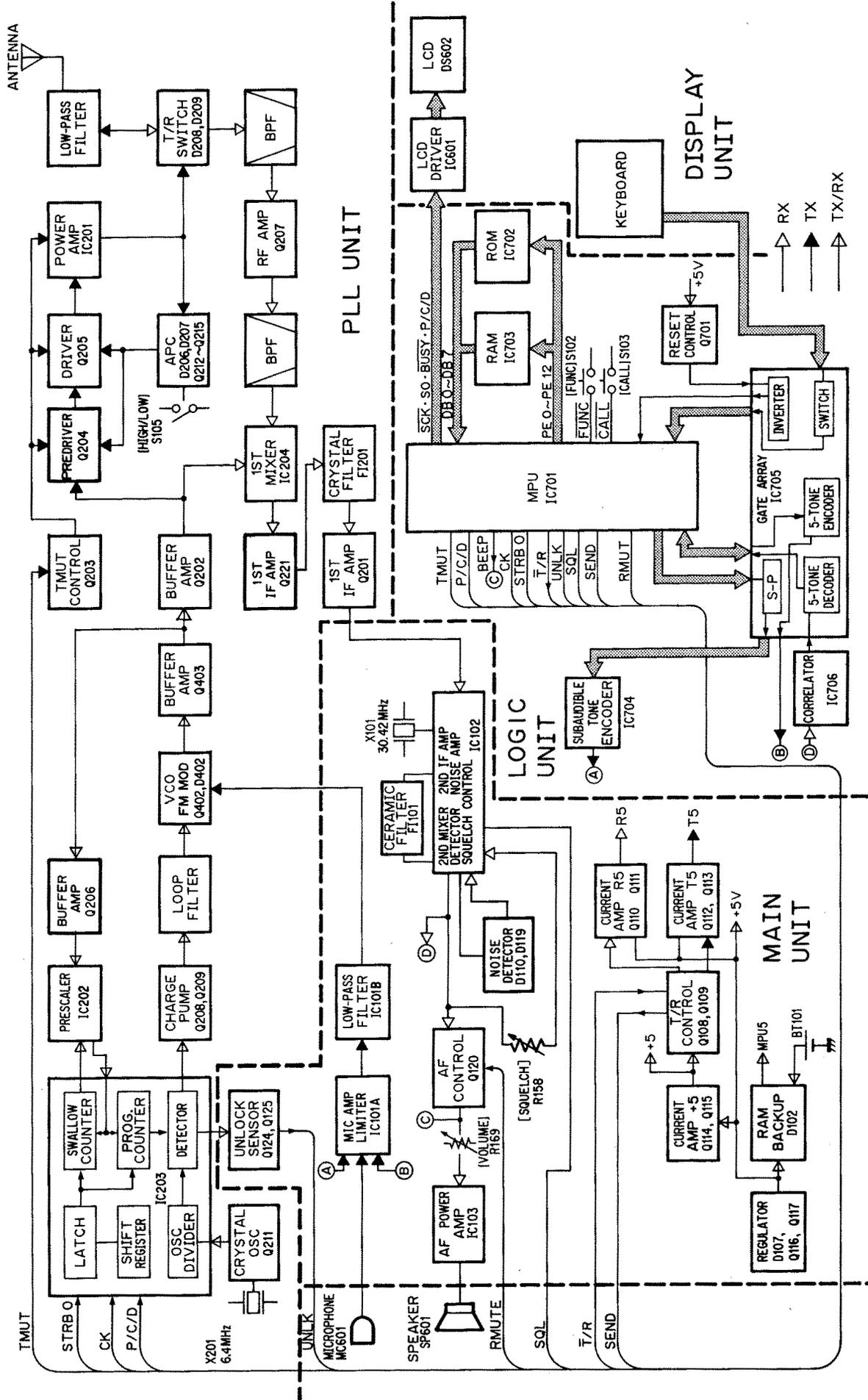
### • FOIL SIDE



## 2-4 DISPLAY UNIT



**SECTION 3 BLOCK DIAGRAM**



## SECTION 4 CIRCUIT DESCRIPTION

### 4-1 RECEIVER CIRCUITS

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

Receive signals enter from the antenna connector and pass through a Chebyshev low-pass filter consisting of L211, L212 and C243~C245. The antenna switching circuit (D208, D209, L209, C309 and C246) employs a  $\lambda/4$ -type diode switching system.

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

The receive signal from the antenna switching circuit passes through helical bandpass filter L217 and is then amplified at the RF amplifier (Q207). Amplified signals pass through the helical bandpass filter (L219). These bandpass filters remove out-of-band signals.

The filtered signals are mixed with the 1st LO signal at the 1st mixer (IC204) to convert to a 30.875 MHz 1st IF signal. The 1st LO signal is the generating signal in the PLL circuit. Refer to Section 4-3 PLL CIRCUITS.

#### 4-1-3 IF CIRCUIT (PLL AND MAIN UNITS)

The 1st IF signal from the 1st mixer is amplified at Q221, passed through crystal filter FI201 and amplified again at Q201. The amplified signal is then applied to the FM IF IC chip (IC102) in the MAIN UNIT.

IC102 contains the oscillator, mixer, limiter amplifier, quadrature detector and trigger circuits. The 1st IF signal from the PLL UNIT enters IC102 pin 16. The signal is mixed with the 2nd LO signal at the mixer section to convert to a 455 kHz 2nd IF signal.

The 2nd IF signal is output from pin 3 and passes through FI101 to remove unwanted heterodyne signals. The filtered signal re-enters at pin 5 and is then amplified at the limiter amplifier section. The amplified signal is detected at the quadrature detector section using ceramic resonator X102 to convert to an audio signal.

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

The audio signals output from IC102 pin 9 de-emphasize audio high frequency components at the de-emphasis circuit (R157, C151). The de-emphasis circuit has  $-6$  dB/octave frequency characteristics.

The de-emphasized signals are amplified at Q118, pass through the audio switch (Q120) and volume control (R169) and are then applied to the audio power amplifier (IC103). IC103 drives the speaker to an AF output of more than 500 mW with an  $8 \Omega$  load.

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

The squelch circuit mutes the audio noise when no RF signal is received.

A portion of the audio signals output from IC102 pin 9 is picked up through C152. The signals pass through the squelch control (R158) and are applied to the operational amplifier section in IC102 (pin 10). The operational amplifier is activated as an active filter that amplifies noise components of higher than approximately 20 kHz.

The amplified noise signals output from pin 11 are detected at D110 and D119 to convert to a DC signal. When the RF signal is not received, noise components increase and then a detected DC signal also increases. This DC voltage drives the squelch trigger circuit in IC102. After being output from pin 13, the "SQL" signal ("HIGH" when the squelch is closed) is input to the CPU (IC701) at pin 15.

When the CPU receives a "HIGH" signal, the "RMUT" signal is output from pin 30, cutting off the audio switch (Q120). CPU pin 30 is also controlled by 5-Tone signals. Refer to Section 4-1-6.

#### IF CIRCUIT

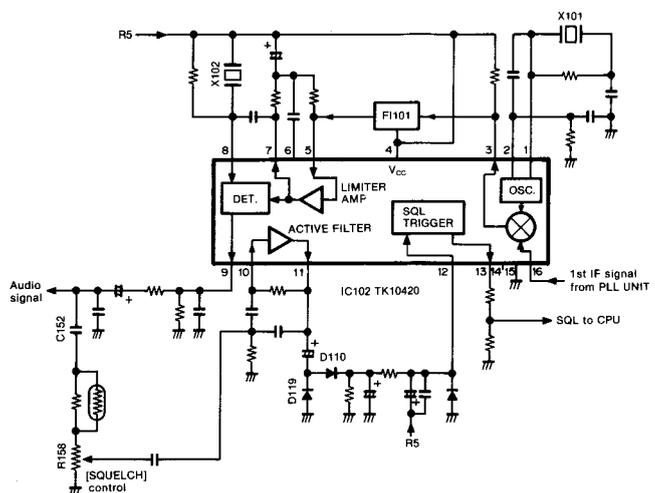


Fig. 1

#### 4-1-6 5-TONE DECODER (LOGIC UNIT)

The 5-tone decoder circuit detects whether the received 5-tone code is the same as the programmed code or not, and controls the squelch circuit using the "RMUT" line.

A portion of the detected signals output from pin 9 of IC102 is applied to the auto-correlator (IC706) in the LOGIC UNIT. IC706 picks up only 5-Tone signals and eliminates noise components.

The picked up 5-Tone signals are applied to the 5-Tone Gate Array IC chip (IC705) pin 21. IC705 converts the 5-Tone signal to a hexadecimal code and sends the code to the CPU (IC701). IC701 compares the received code and programmed code. If these are same number, the "RMUT" terminal (pin 30) becomes "LOW" and opens the squelch circuit.

## 4-2 TRANSMITTER CIRCUITS

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

Microphone signals are amplified at IC101A. C109 and R112 are connected to IC101A pin 2 and pre-emphasize the microphone signal. The signal passes through a splatter filter consisting of R117, R123, R124, C115, C116 and C118 for removing noise components higher than 3 kHz.

The filtered signals are amplified at the limiter amplifier (IC101B) and are then applied to the VCO circuit in the PLL UNIT.

### 4-2-2 MODULATION CIRCUIT (PLL UNIT)

The amplified microphone signals are applied to the anode of D402. By applying audio signals, the capacitance of D402 is changed. Hence, the oscillating signal in the VCO is modulated.

### RF AMPLIFIER CIRCUIT

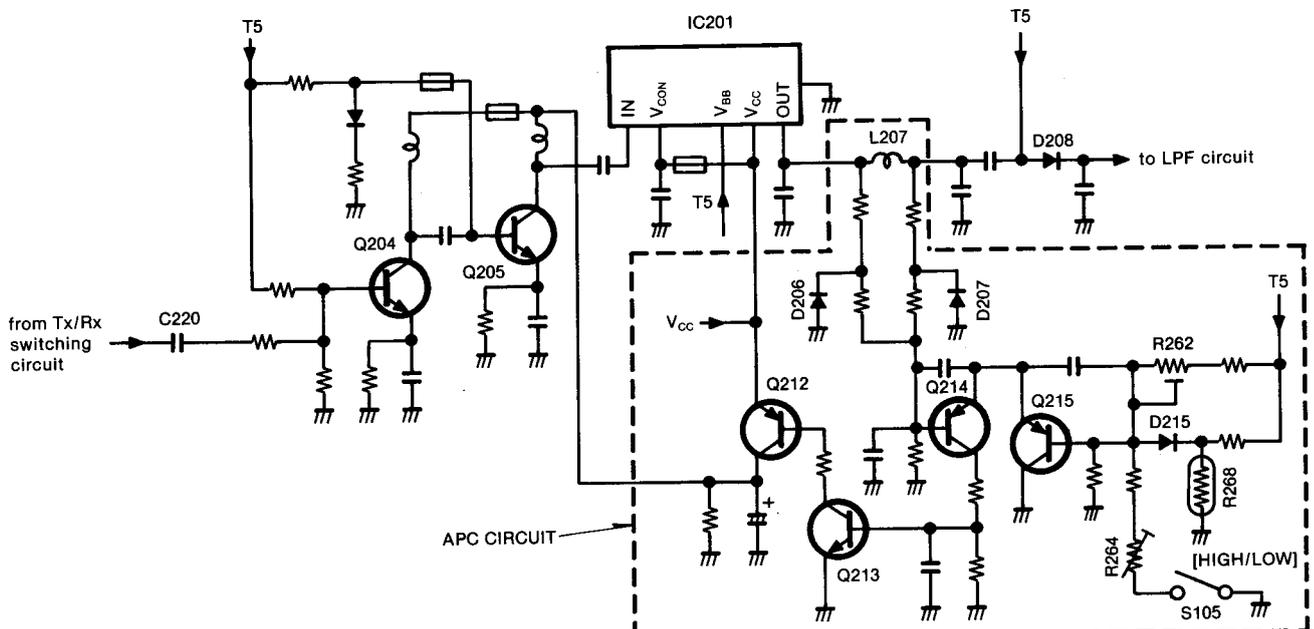


Fig. 2

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

The modulated signal output from the VCO is buffer amplified at Q403 and Q202. The amplified signal then passes through the Tx/Rx switching circuit (D204). The signal is amplified at the predriver (Q204) and the driver (Q205) to obtain drive power of 150 mW.

Drive power is amplified at power module IC201 to obtain 5 W of output power. Power amplified signals pass through the APC detector circuit (L207, D206, D207), antenna switching circuit (D208, D209) and low-pass filter (L211, L212, C243~C245) and are then applied to the antenna connector.

### 4-2-4 APC CIRCUIT (PLL UNIT)

The APC (Auto Power Control) circuit protects the power module from a mismatching output load and selects HIGH or LOW output power.

The output power level from the power module (IC201) is detected at the APC detector circuit (L207, D206, D207). When antenna impedance is matched at 50  $\Omega$ , the detected level is at a minimum. However, when antenna impedance is mismatched, the detected voltage is higher than when matched.

When the antenna impedance is mismatched, the base voltage of Q214 is higher than the base voltage of Q215 (reference voltage). Q214 decreases the collector current of Q212 using Q213. Q212 collector current is used at the predriver (Q204) and the driver (Q205). Hence, when the antenna impedance is mismatched, output power is decreased.

The output power selecting circuit uses the APC circuit. The [HIGH/LOW] switch on the top panel selects the reference voltage, changing output power to HIGH or LOW.

### 4-2-5 TX MUTE CIRCUIT (PLL UNIT)

When the "TMUT" signal from CPU (IC701) pin 31 on the LOGIC UNIT is "HIGH," Q203 turns OFF to cut off the bias voltages of the predriver and driver; transmit power is then suppressed.

## 4-3 PLL CIRCUITS

### 4-3-1 GENERAL

The PLL circuit, using a dual modulus prescaler (IC202, IC203), generates the desired frequency at the VCO circuit. The dual modulus prescaler sets the dividing ratio based on serial data from the CPU (IC701) on the LOGIC UNIT, and compares the phases of the VCO output and the reference oscillator frequency.

The phase detected signal is converted to a lock voltage at a loop filter. The lock voltage controls the VCO oscillating frequency. Thus, a stable oscillation is obtained.

### 4-3-2 REFERENCE OSCILLATOR CIRCUIT (PLL UNIT)

Q211 and X201 oscillates a 6.4 MHz signal. The signal is divided in the divider inside IC203 to obtain a 12.5 kHz reference frequency. R246 and R247 are thermistors designed to compensate for the frequency drift of a temperature.

### 4-3-3 CHARGE PUMP AND LOOP FILTER CIRCUITS (PLL UNIT)

Phase detected signals output from IC203 pins 12 and 13 are pulse signals. These signals are converted to a DC voltage by the charge pump (Q208, Q209) and the loop filter (R241, R282, R284, C267).

### PLL CIRCUIT BLOCK DIAGRAM

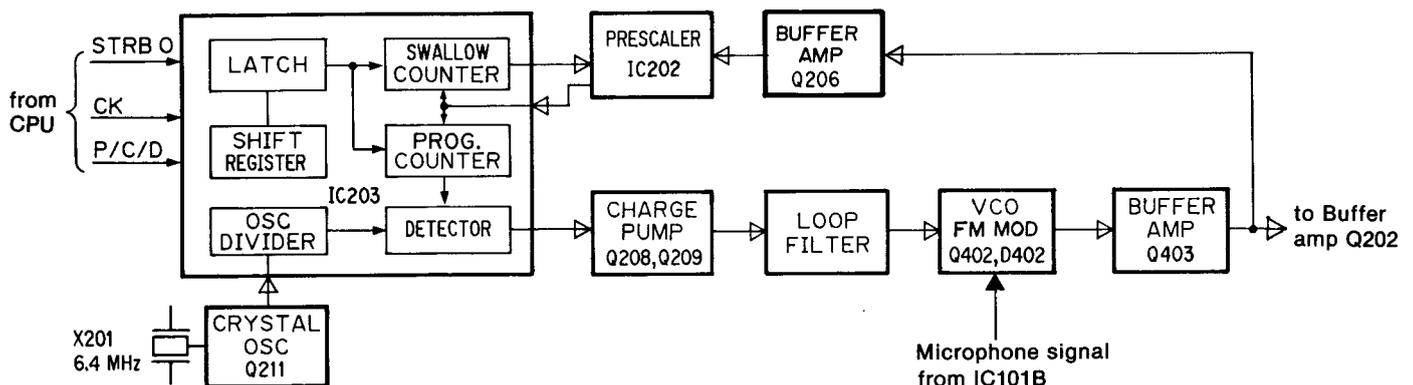


Fig. 3

Q219 and Q220 change loop filter characteristics to obtain a rapid lockup speed when changing frequencies. These transistors obtain stable oscillation when an oscillating frequency does not change.

### 4-3-4 VCO CIRCUIT (VCO UNIT)

The VCO (Variable Control Oscillator) circuit oscillates the 1st LO frequency in receiving and transmit frequency in transmitting.

The VCO free run frequency is shifted by Q401 using an induction reactance of D402. The generated frequency is controlled by D401 using the lock voltage output from the loop filter.

## 4-4 VOLTAGE LINES

LINE	DESCRIPTION
Vcc	The connected battery pack voltage or the external power supply voltage passed through the power switching relay (RL101) and power switch.
+5 V	Common 5 V regulated from Vcc at Q116, Q117, D117 and D107.
5 V	Common 5 V regulated from Vcc at Q114, Q115 and D106. 5 V is separated from the +5 V line to obtain the desired current capacity.
R5	Receive 5 V regulated from Vcc at Q110, Q111 and D104. A reference voltage uses the "+5 V" switched by Q108 and Q109 using the "T/R" line from the CPU.
T5	Transmit 5 V regulated from Vcc at Q112, Q113 and D105. A reference voltage uses the "+5 V" switched by Q108 and Q109 using the "T/R" line from the CPU.

## 4-5 LOGIC CIRCUITS

The logic circuit consists of an 8-bit CMOS CPU, 32k-word ROM, 2k-word RAM, 5-Tone encoder, 5-Tone decoder and subaudible tone encoder. The circuit controls frequency and tone setting and the function display, etc.

### 4-5-1 CPU (LOGIC UNIT)

CPU IC701 is  $\mu$ PD78C06AG. The following are the port allocations of each pin.

#### • CPU PORT ALLOCATIONS

PORT NUMBER	PIN NUMBER	DESCRIPTION	PORT NUMBER	PIN NUMBER	DESCRIPTION
DB0~DB7	5~2 64~61	These are 8-bit data busses for an external ROM and RAM. DB0~DB3 are also used as matrix input ports.	PC3 [FUNC]	13	This is an input port for the [FUNC] switch. The transceiver enters the cloning receive mode when the port is "LOW" at turning the power ON.
PE0~PE15	43~57 59	These are 16-bit data busses. PE0~PE7 are used as matrix output ports. PE13~PE15 are used as select signal ports for the ROM and gate array.	PC2 [SEND]	14	This is an input port for the transmit/receive switching signal. The port is also used as the cloning input.
PA7 [CS]	34	This port becomes "LOW" when IC701 outputs command or data signals to IC601.	PC1 [SQL]	15	This is an input port for the squelch open/close. It becomes "HIGH" when the squelch opens.
PA6 [P/C/D]	33	This port outputs a selector signal for selecting the signal of PLL N-data and IC601 command/data.	PC0 [UNLK]	16	This is an input port for the PLL unlock signal. It becomes "LOW" when the PLL is unlocked.
PA5 [CK]	32	This port outputs a synchronizing clock signal when the PLL N-data is output.	SO	21	This port outputs data for the subaudible tone and IC601.
PA4 [TMUT]	31	This port outputs a transmit mute signal. It becomes "HIGH" when no RF output power is required.	SCK	19	This port outputs a data timing signal of the SO port. The SO signal changes at the leading edge of the SCK output signal.
PA3 [RMUT]	30	This port outputs a receive mute signal. It becomes "HIGH" when no AF output power is required.	INT0	7	This is an input port for controlling the 5-Tone decoder IC. The 5-Tone decoder data are input when the port becomes "HIGH."
PA1 [CPO]	28	This port outputs cloning data.	INT1	6	IC701 enters the standby mode when the port becomes "HIGH." This port becomes "HIGH" and "LOW" when the power is turned OFF and ON respectively.
PA0 [STRB0]	27	This port outputs a strobe signal for PLL data.	TO [BEEP]	18	This port outputs signals for the beep sound.
PB6 [STRB2]	41	This port outputs a strobe signal for the CTCSS data.	WR	9	This port becomes "LOW" when data are stored in the external RAM IC703.
PB5 [STRB1]	40	This port outputs a strobe signal for the 5-Tone encoder.	RD	10	This port becomes "LOW" when data are recalled from the external ROM or RAM.
PB4 [T/R]	39	This port controls the switching of transmit/receive. It becomes "LOW" when transmitting.	$\phi$ out	60	Not used.
PB0~PB3 [S0~S3]	35~38	These are used as ports of the 5-Tone input/output data.			
PC5 [BUSY]	11	This port is an input port for the BUSY signal from IC601.			
PC4 [TRF]	12	This is an input port for the transmit indicator. The indicator lights when the port becomes "LOW."			

### 4-5-2 ROM (LOGIC UNIT)

ROM IC chip IC702 is a 32768-word, 8-bit CMOS ROM IC chip. The program in IC702 controls the IC701 CPU. The data reading is indicated by addresses PE0~PE12 of IC701, and done at the leading edge of the  $\overline{RD}$  port signal.

#### ROM READ TIMING DIAGRAM

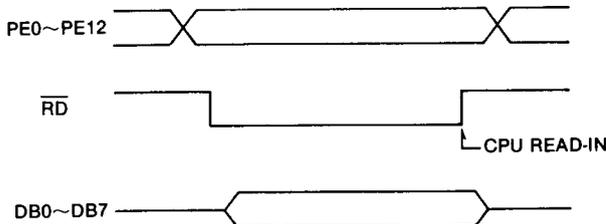


Fig. 4

### 4-5-3 RAM (LOGIC UNIT)

RAM IC chip IC703 is a 2048-word, 8-bit CMOS IC chip. IC703 stores data for channels, PLL N-data, tone numbers to the tone frequencies and shift frequencies, etc. Data reading and writing are indicated by addresses PE0~PE10 of IC701, and done by timing signals RD and WR.

#### RAM READ TIMING DIAGRAM

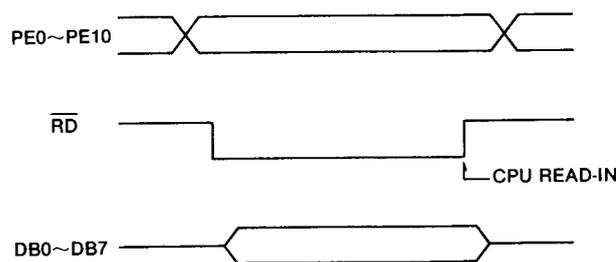


Fig. 5

#### RAM WRITE TIMING DIAGRAM

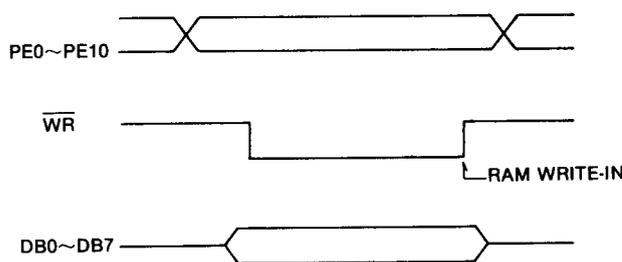


Fig. 6

### 4-5-4 RESET CIRCUIT (LOGIC UNIT)

The voltage of the +5 V line rises up to 5 V after the power is turned ON, and the collector of Q701 becomes 5 V. When the collector of Q701 becomes "HIGH," pin 10 of IC705 becomes "LOW" then pin 12 of IC705 changes from "LOW" to "HIGH." The signal is applied to IC601 in the DISPLAY UNIT for resetting. The signal is also applied to IC701 through a delay circuit consisting of C703 and R704. This action delays the CPU resetting slower than the LCD driver resetting.

When the power is turned OFF, pin 10 of IC705 changes from "LOW" to "HIGH." This voltage change is applied to IC701 for entering the CPU standby mode.

#### RESET TIMING CHART

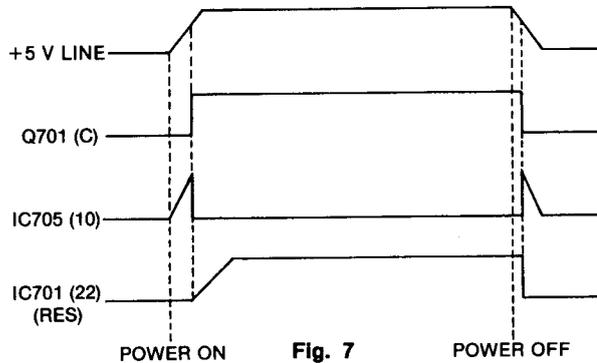


Fig. 7

### 4-5-5 5-TONE ENCODER/DECODER CIRCUIT (LOGIC UNIT)

IC705 is a gate array IC chip and consists of 5-Tone encoder, 5-Tone decoder data selectors for CPU control, serial/parallel converters, dividers and inverters.

PORT NUMBER	PIN NUMBER	DESCRIPTION
IO0~IO3	64~61	These are input/output ports for the 5-Tone encoder/decoder data.
CON1	60	This port is used for selecting either the input or output ports of IO0~IO3. It becomes "LOW" for input ports and "HIGH" for output ports.
RX	59	This port is used for selecting either the encoder or decoder function. It becomes "LOW" for encoding and "HIGH" for decoding.
TO1, TO2	44, 45	These ports select one of the 5-Tone sequential systems: CCIR, ZVEI, EEA or EIA.
ST1	57	This port inputs a strobe signal for the 5-Tone encoder/decoder.
EC, EC0~EC2	40~43	These ports output the 5-Tone encoder data.
DS	21	This port is used as an input port for 5-Tone signals.
ST3	8	This port outputs a strobe signal for the 5-Tone decoder data.
SE1~SE3	2~4	This port is used as a data selector input.
MA0~MA3 DB0~DB3 CE1	39~36 55~52 51	Function of each port CE1 and DB0~DB3 is determined by data from ports SE1~SE3. Ports MA0~MA3 are allocated as data input.
ST2, SCK2, SI2	56, 7, 6	These are serial input ports for converting data from serial to parallel.

PORT NUMBER	PIN NUMBER	DESCRIPTION
P1~P7	13~19	These are used as parallel output ports after data are converted from serial to parallel.
IN1, IN2	9, 11	These ports are connected to internal inverter inputs.
OUT1, OUT2	10, 12	These ports are connected to internal inverter outputs.
KO1	5	This port outputs 4.48 MHz signals.
KO3	22	This port outputs 560 kHz signals.
TEST, T1, SET, RES, CON2, RCE, RT2, RT1, CP1, DATC, KO5, KO4, KO2	23~25 28~33 46~49	These ports are used for checking the IC testing.

#### 4-5-6 SELECTING A 5-TONE SEQUENTIAL (LOGIC UNIT)

One of 4 kinds of 5-Tone sequentials can be selected by the following method:  
(Refer to p. 7-2.)

	TO1	TO2
EIA	L	L
CCIR	H	L
EEA	L	H
ZVEI	H	H

#### 4-5-7 D/A CONVERTER CIRCUIT (LOGIC UNIT)

EC0~EC2 of IC701 outputs 5-Tone signals digitally. R713~R718 convert signal from digital to analog, and then output the signals as 5-Tones to the MAIN UNIT.

#### 4-5-8 SUBAUDIBLE TONE ENCODER CIRCUIT (LOGIC UNIT)

The serial/parallel converter section of IC705 converts serial data from the CPU into tone encoder input data.

IC704 is an IC chip for generating subaudible tone frequency signals from 67 Hz~250.3 Hz. The following table shows the relation between input data and the output frequency of IC704.

#### SUBAUDIBLE TONE ENCODER FREQUENCY TABLE

OUTPUT FREQUENCY [Hz]	IC704 INPUT PIN NUMBER					
	8	9	10	11	12	13
67.0	H	L	L	L	L	L
71.9	L	H	L	L	L	L
74.4	H	H	L	L	L	L
77.0	L	L	H	L	L	L
79.7	H	L	H	L	L	L
82.5	L	H	H	L	L	L
85.4	H	H	H	L	L	L
88.5	L	L	L	H	L	L
91.5	H	L	L	H	L	L
94.8	L	H	L	H	L	L
97.4	H	H	L	H	L	L
100.0	L	L	H	H	L	L
103.5	H	L	H	H	L	L
107.2	L	H	H	H	L	L
110.9	H	H	H	H	L	L
114.8	L	L	L	L	H	L
118.8	H	L	L	L	H	L
123.0	L	H	L	L	H	L
127.3	H	H	L	L	H	L
131.8	L	L	H	L	H	L
136.5	H	L	H	L	H	L
141.3	L	H	H	L	H	L
146.2	H	H	H	L	H	L
151.4	L	L	L	H	H	L
156.7	H	L	L	H	H	L
162.2	L	H	L	H	H	L
167.9	H	H	L	H	H	L
173.8	L	L	H	H	H	L
179.9	H	L	H	H	H	L
186.2	L	H	H	H	H	L
192.8	H	H	H	H	H	L
203.5	L	L	L	L	L	H
210.7	H	L	L	L	L	H
218.1	L	H	L	L	L	H
225.7	H	H	L	L	L	H
233.6	L	L	H	L	L	H
241.8	H	L	H	L	L	H
250.3	L	H	H	L	L	H

H: HIGH L: LOW

#### 4-6 DISPLAY CIRCUIT (DISPLAY UNIT)

IC601 is a programmable LCD controller/driver IC chip. Data from the LOGIC UNIT are applied to IC601 and divided by 3 to be indicated on the function display.

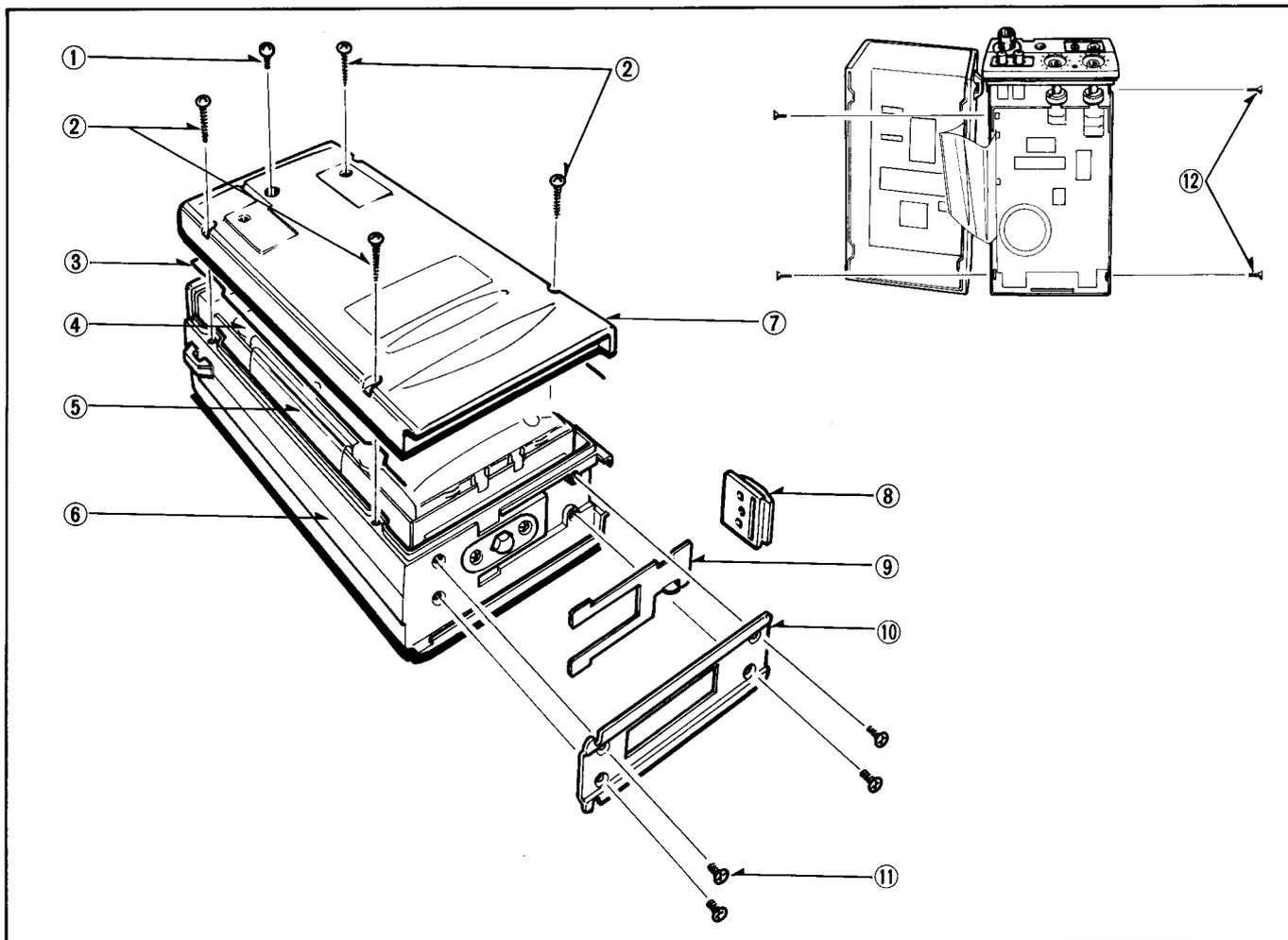
## SECTION 5 MECHANICAL PARTS AND DISASSEMBLY

LABEL NUMBER	DESCRIPTION	ORDERING NUMBER	QTY.	LABEL NUMBER	DESCRIPTION	ORDERING NUMBER	QTY.
①	PH M2×4 ZK*	8810000100	1	③①	297 mic lug	8930007210	1
②	PH A0 2×15 ZK*	8810000740	4	③②	No. 0-1 PH B0 2×5 ZU*	8810004040	3
③	Casing seal-1	8930002950	1	③③	Speaker plate (A)	8930007200	1
④	660 rear shielding plate	8510005490	1	③④	Speaker seal	8930002930	1
⑤	Shielding sheet	8310000010	1	③⑤	No. 0-3 PH B0 1.4×4*	8810001720	4
⑥	Front panel-1	8210001610	1	③⑥	No. 0-3 PH B0 1.4×3.5 ZK*	8810001710	7
⑦	Rear panel-3	8010004731	1	③⑦	461 aluminum sheet	8930008460	1
⑧	Release button	8930005780	1	③⑧	LCD contact strip SRCN-411	8930007790	1
⑨	Battery pack latch-3	8930005612	1	③⑨	Keyboard-1	8010006041	1
⑩	Sliding guide (A)	8010002880	1	④⑩	298 aluminum sheet	8930007270	1
⑪	FH M2.6×6 Ni*	8810002380	4	④⑪	Front shielding plate	8510003310	1
⑫	No. 0-3 FH M2×3*	8810005490	4	④⑫	Ground plate	8930011150	1
⑬	Knobs (Squelch, Volume) N-76	8610000570	2	④⑬	LCD reflector	6910001200	1
⑭	[LIGHT] button K-30R	8610000130	1	④⑭	LCD shielding plate	8510003320	1
⑮	[HIGH/LOW] button K-30G	8610000120	1	④⑮	Push spring (I)	8930002500	1
⑯	Water-resistant cover	8930006050	1	④⑯	PTT plate	8930001090	1
⑰	Chassis (B)	8010007390	1	④⑰	No. 0-1 PH B0 2×5 ZK*	8810000530	2
⑱	Knob grip for N-76 (included with ⑬ above)	—	—	④⑱	PTT seal	8930006040	1
⑲	PH M2×4 ZK*	8810000100	1	④⑲	Shielding sheet (E)	8930005440	1
⑳	Top panel-1	8210001040	1	⑤⑰	Screw lug M2.6	8860000020	2
㉑	Top ring	8930002940	1	⑤⑱	E-ring M2	8860000300	1
㉒	PA heatsink	8410000140	1	⑤⑲	Gasket (E)	8930002780	1
㉓	PA shielding plate	8510002770	1	⑤⑲	Contact holder	8010002740	1
㉔	Water-resistant cover for knob	8310005130	2	⑤⑲	PH M2.6×6 Ni*	8810001840	2
㉕	PH M2.6×6 Ni*	8810001840	2	⑤⑲	Gasket (F)	8930002790	1
㉖	ANT shielding plate	8510003280	1	⑤⑲	Spring (A)-1	8930007220	1
㉗	Chassis (A)	8010007380	1	⑤⑲	Contact	6510000630	1
㉘	No. 0-1 PH B0 2×4*	8810004800	3				
㉙	Ground plate	8930011160	1				
㉚	Microphone holder	8930001630	1				

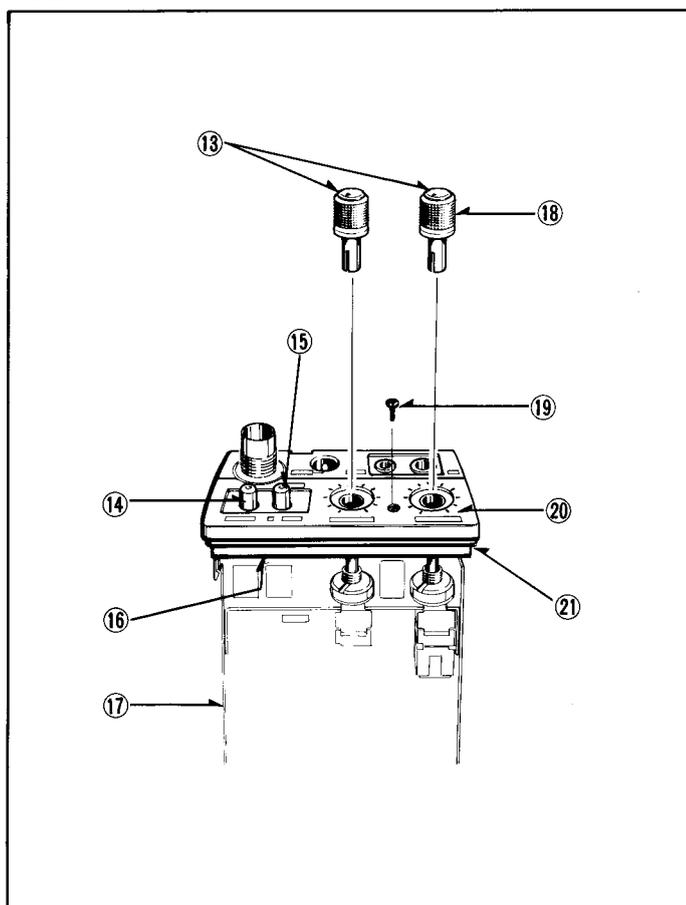
\* **Screw type**      Screw: M2×4, etc.    Self-tapping screw: A0 2×15, etc.    Precision type screw: No. 0-1, etc.

**Screw head style**    PH: Pan head    FH: Flat head

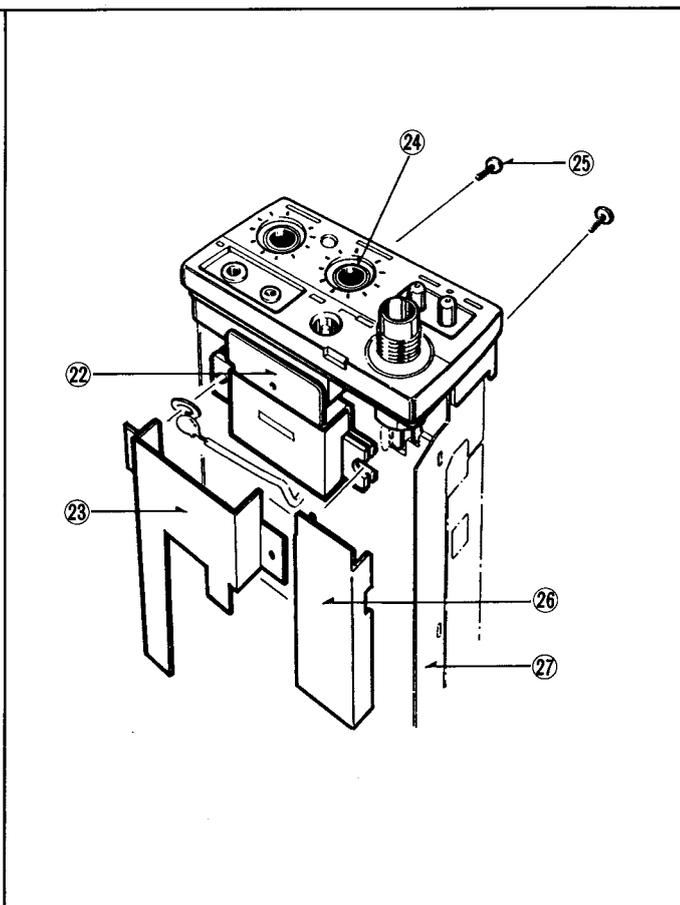
• CASE AND CHASSIS



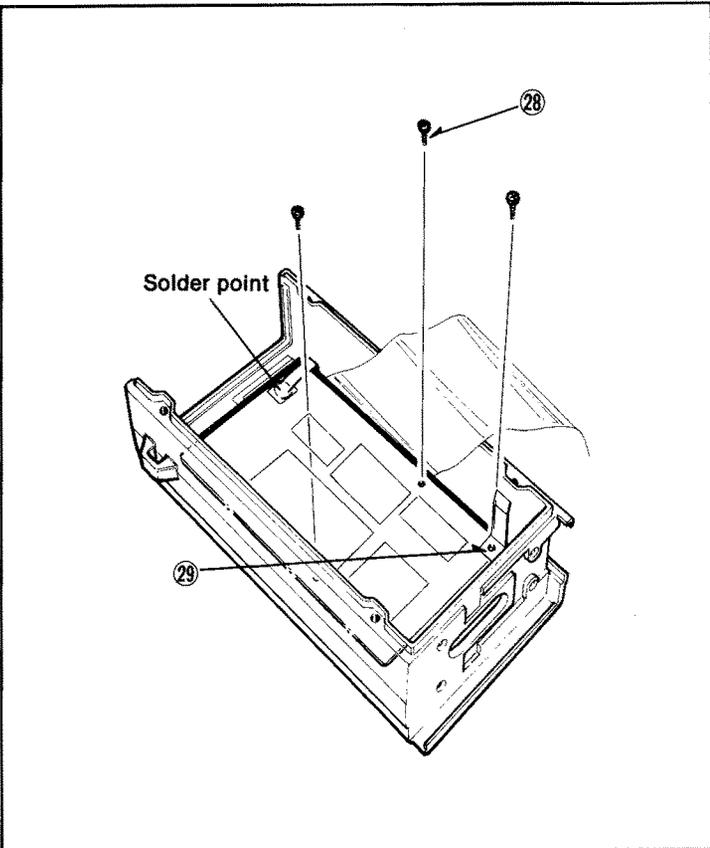
• TOP PANEL



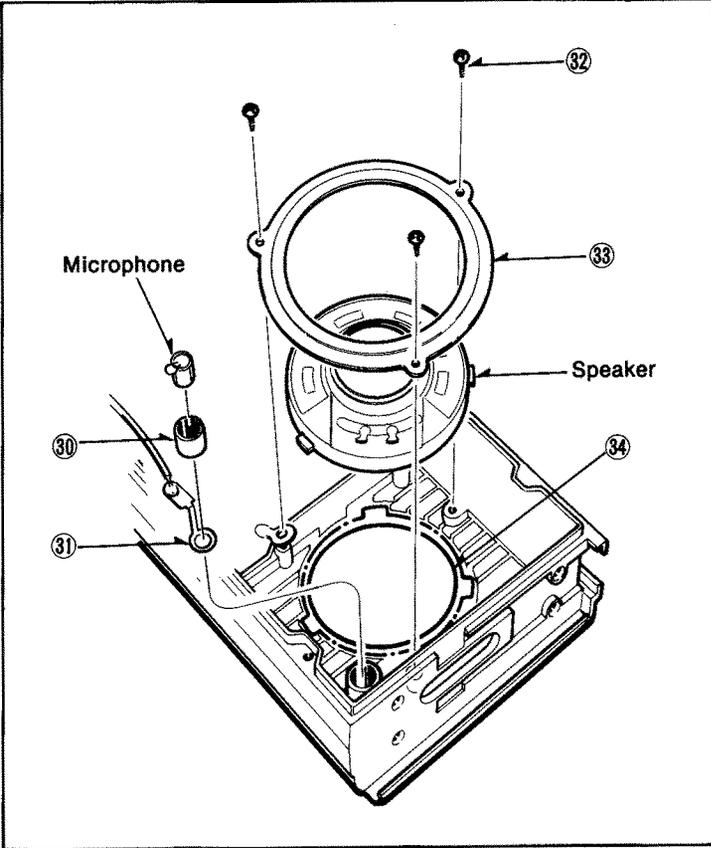
• PA AND SHIELD CASES



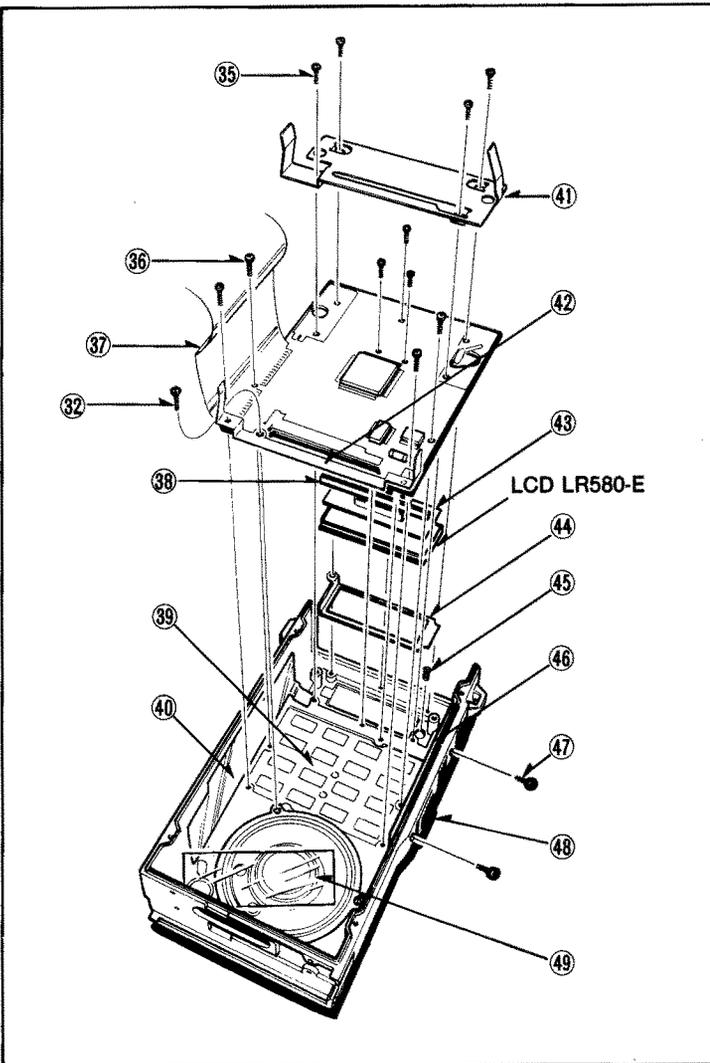
• LOGIC UNIT



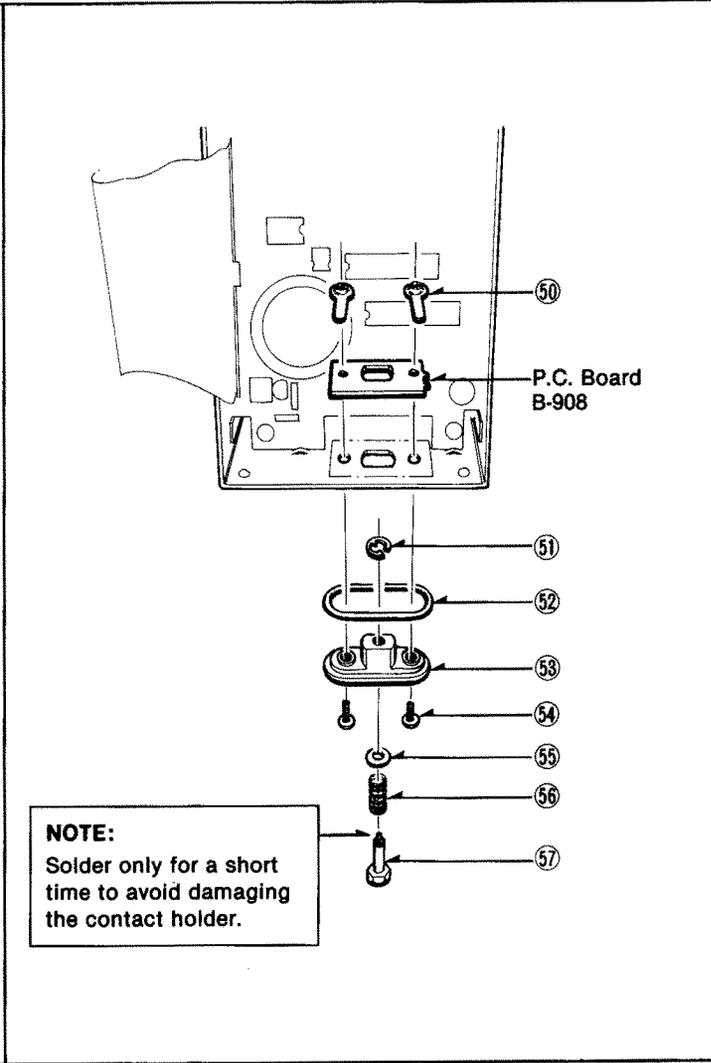
• SPEAKER AND MICROPHONE



• DISPLAY AND LCD



• CONTACT TERMINAL



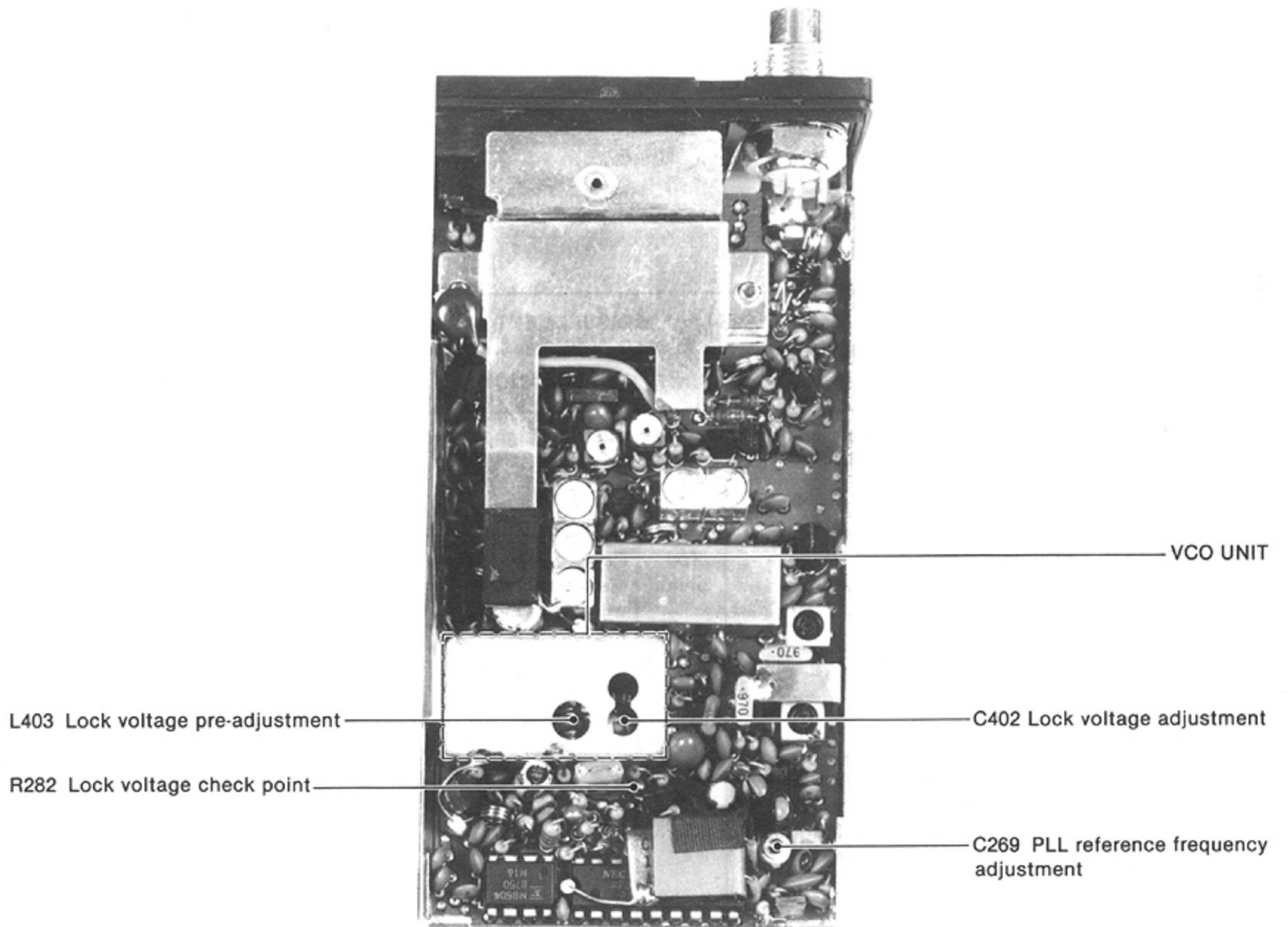
## SECTION 6 ADJUSTMENT PROCEDURES

### 6-1 PLL ADJUSTMENT

TEST INSTRUMENTS REQUIRED	MEASUREMENT CONNECTION LOCATION
<p>(1) AC POWER SUPPLY</p> <ul style="list-style-type: none"> <li>• Output voltage : 13.2 V DC</li> <li>• Current capacity : 3 A or more</li> </ul> <p>(2) FREQUENCY COUNTER</p> <ul style="list-style-type: none"> <li>• Frequency range : 0.1~500 MHz</li> <li>• Frequency accuracy : <math>\pm 1</math> ppm or better</li> <li>• Sensitivity : 100 mV or better</li> </ul> <p>(3) DC VOLTMETER</p> <ul style="list-style-type: none"> <li>• Input impedance : 50 k<math>\Omega</math>/DC or better</li> </ul>	<p>The diagram shows a Frequency Counter connected to the antenna input of the IC-U16T. An AC Power Supply is connected to the [DC IN] jack of the IC-U16T. A DC Voltmeter is connected to R282 on the IC-U16T. A note indicates a loose couple to the antenna.</p>

ADJUSTMENT	ADJUSTMENT CONDITIONS	MEASUREMENT		VALUE	ADJUSTMENT POINT	
		UNIT	LOCATION		UNIT	ADJUST
LOCK VOLTAGE	1 <ul style="list-style-type: none"> <li>• Operating frequency: 470.0000 MHz</li> <li>• Receiving</li> </ul>	PLL	Connect the DC voltmeter to R282.	5.5 V	VCO	C402
	2 <ul style="list-style-type: none"> <li>• Transmitting</li> </ul>			5.2~5.8 V		Verify
<p>NOTE: When replacing L403 (VCO UNIT) the following pre-adjustment is necessary.</p> <ol style="list-style-type: none"> <li>1. Spread the center of L403 to 30°.</li> <li>2. Adjust LOCK VOLTAGE as above from step 1.</li> </ol> <div style="text-align: center;"> <p>L403</p> </div>						
PLL REFERENCE FREQUENCY	1 <ul style="list-style-type: none"> <li>• Select any channel.</li> <li>• Transmitting</li> <li>• Connect a 50 <math>\Omega</math> dummy load.</li> </ul>	Top panel	Loose couple the frequency counter to the antenna connector.	Same frequency as the programmed one.	PLL	C269

## PLL AND VCO UNITS



## 6-2 RECEIVER ADJUSTMENT

TEST INSTRUMENTS REQUIRED	MEASUREMENT CONNECTION LOCATION
<p>(1) AC POWER SUPPLY</p> <ul style="list-style-type: none"> <li>• Output voltage : 13.2 V DC</li> <li>• Current capacity : 3 A or more</li> </ul> <p>(2) STANDARD SIGNAL GENERATOR (SSG)</p> <ul style="list-style-type: none"> <li>• Frequency range : 0.1~500 MHz</li> <li>• Output level : -127~-17 dBm (0.1 μV~32 mV)</li> </ul> <p>(3) DISTORTION METER</p> <ul style="list-style-type: none"> <li>• Frequency range : 1 kHz±10 Hz</li> <li>• Measuring range : 1~100 %</li> </ul> <p>(4) EXTERNAL SPEAKER</p> <ul style="list-style-type: none"> <li>• Impedance : 8 Ω</li> </ul>	

ADJUSTMENT	ADJUSTMENT CONDITIONS	MEASUREMENT		VALUE	ADJUSTMENT POINT	
		UNIT	LOCATION		UNIT	ADJUST

CAUTION: The answer back function must be turned OFF to protect the signal generator while making receiver adjustment. See p. 18 in the PROGRAMMING MANUAL (A-0876) for details.

SENSITIVITY	1	<ul style="list-style-type: none"> <li>• Operating frequency: 455.0000 MHz (#01, #02) 465.0000 MHz (#03, #04)</li> <li>• Receiving</li> <li>• Apply an RF signal to the antenna connector. Level: -116 dBm (0.35 μV) Mod.: 1 kHz Dev.: ±3.5 kHz (Wide-type) ±1.75 kHz (Narrow-type)</li> <li>• [SQUELCH] control: Max. CCW*</li> <li>• Push the [RESET] key to turn ON the monitor function.</li> </ul>	Top panel	Connect the distortion meter with an 8 Ω load to the [SP] jack.	Minimum distortion level	PLL	L217 L219 L201 L202
	2	<ul style="list-style-type: none"> <li>• Adjust SSG output level so that SINAD level becomes 12 dB.</li> </ul>			Applied RF signal level is less than -116 dBm (0.35 μV).		Verify
	NOTE: Each core of the helical coils (L217, L219) should be adjusted uniformly. Repeat above adjustment several times.						

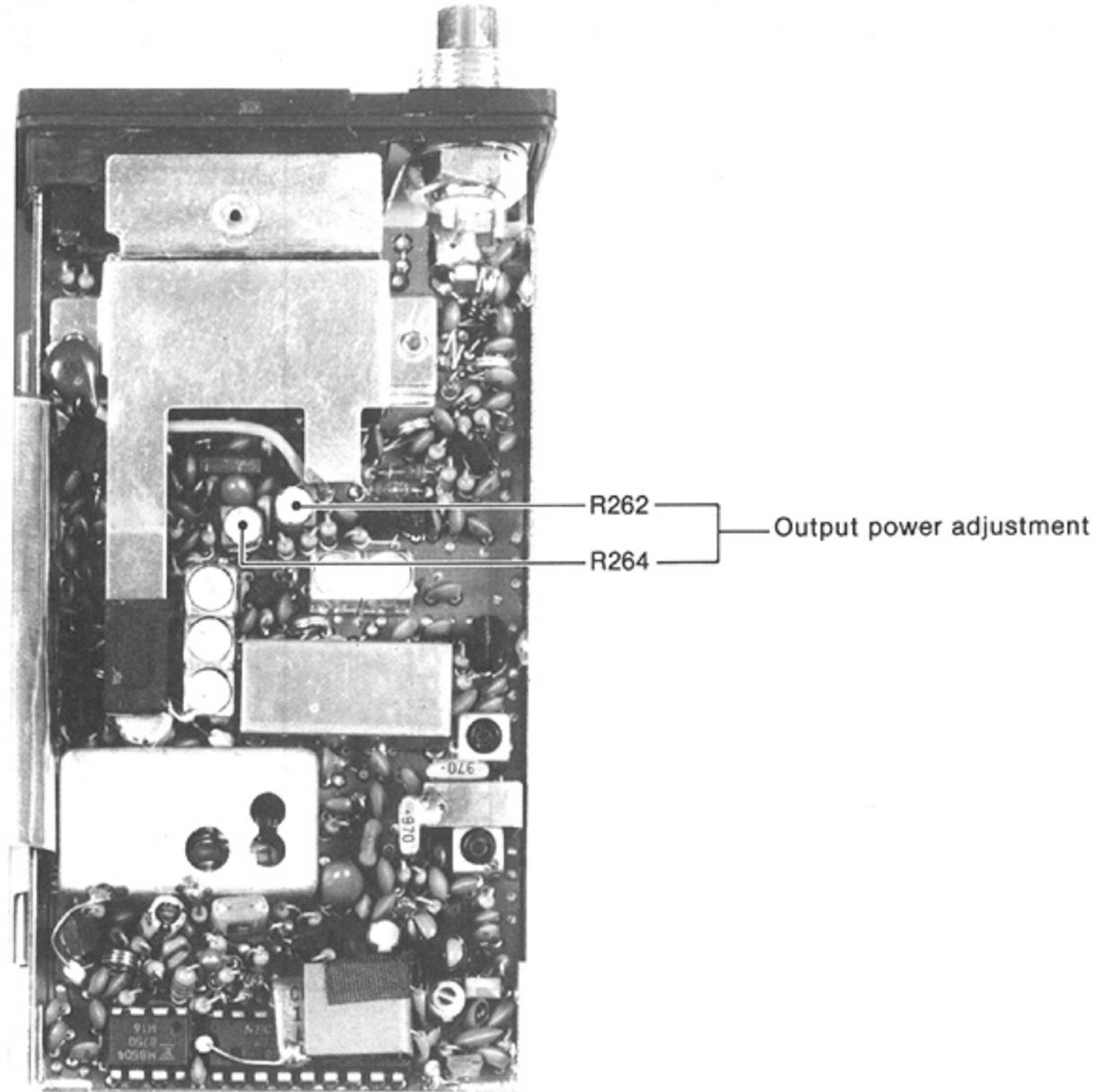
\* CCW: Counterclockwise.



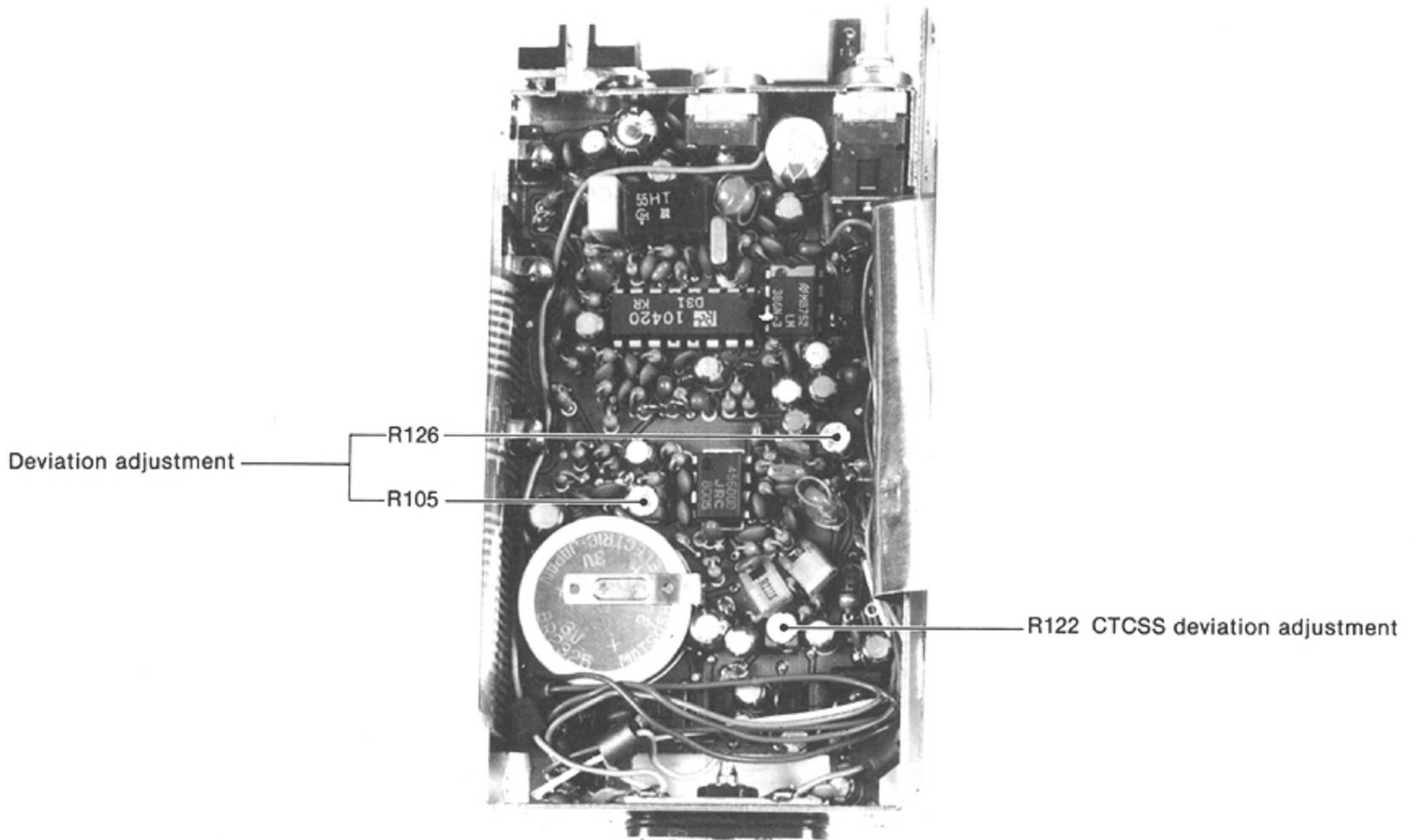
### 6-3 TRANSMITTER ADJUSTMENT

TEST INSTRUMENTS REQUIRED		MEASUREMENT CONNECTION LOCATION					
(1) AC POWER SUPPLY • Output voltage : 13.2 V DC • Current capacity : 3 A or more  (2) RF POWER METER (TERMINATED TYPE) • Measuring range : 1~10 W • Frequency range : 440~480 MHz • Impedance : 50 Ω • SWR : Less than 1.2:1  (3) AF SIGNAL GENERATOR (AG) • Frequency range : 200~2000 Hz • Output level : 0~200 mV  (4) AC MILLI-VOLTMETER • Measuring range : 2~200 mV  (5) FM DEVIATION METER • Frequency minimum : 480 MHz • Measuring range : 0~±5 kHz							
ADJUSTMENT	ADJUSTMENT CONDITIONS	MEASUREMENT		VALUE	ADJUSTMENT POINT		
		UNIT	LOCATION		UNIT	ADJUST	
OUTPUT POWER	1	Top panel	Connect the RF power meter to the antenna connector.	5.0 W	PLL	R262	
	2			1.0 W		R264	
DEVIATION	1	Top panel	Connect the FM deviation meter to the antenna connector via the attenuator.	±4.3 kHz (Wide-type) ±2.1 kHz (Narrow-type)	MAIN	R126	
	2			Same deviation level at +P and -P.		R105	
CTCSS DEVIATION	1	Top panel	Connect the FM deviation meter to the antenna connector via the attenuator.	±0.75 kHz (Wide-type) ±0.35 kHz (Narrow-type)	MAIN	R122	

PLL UNIT



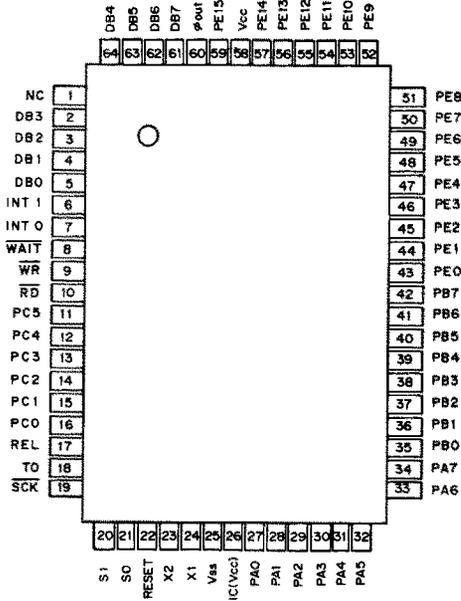
MAIN UNIT



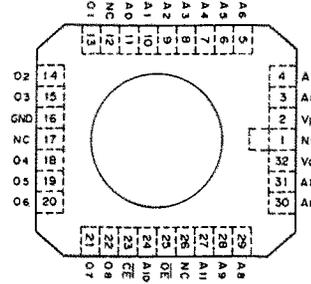
SECTION 7 BOARD LAYOUTS

7-1 LOGIC UNIT

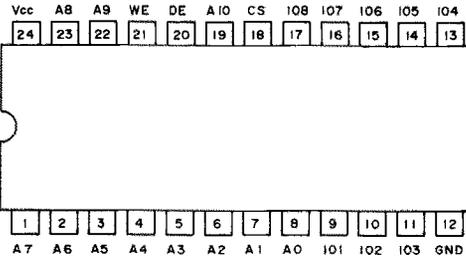
**μPD78C06AG-570-12 IC701**  
(CPU)



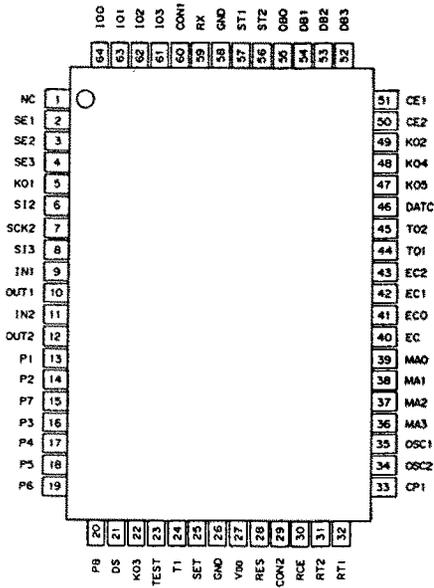
**MBM27C256A-25-TV-G IC702**  
(ROM)



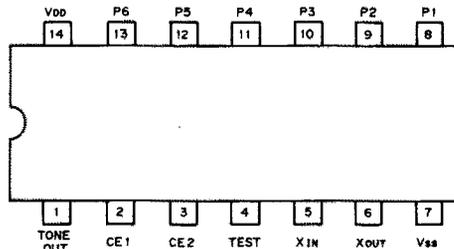
**μPD446G IC703**  
(RAM)



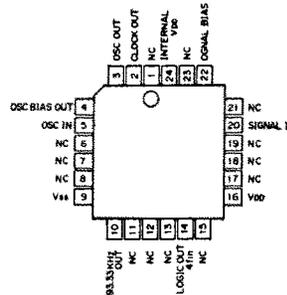
**SC-1084 IC705**  
(GATE ARRAY)



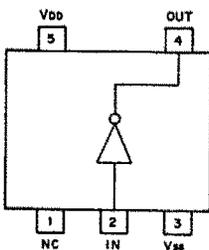
**S7116A IC704**  
(PROGRAMMABLE TONE GENERATOR)



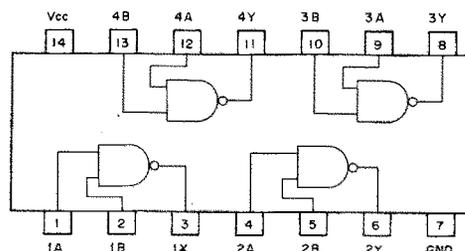
**FX-102LG IC706**  
(AUTO-CORRELATOR)



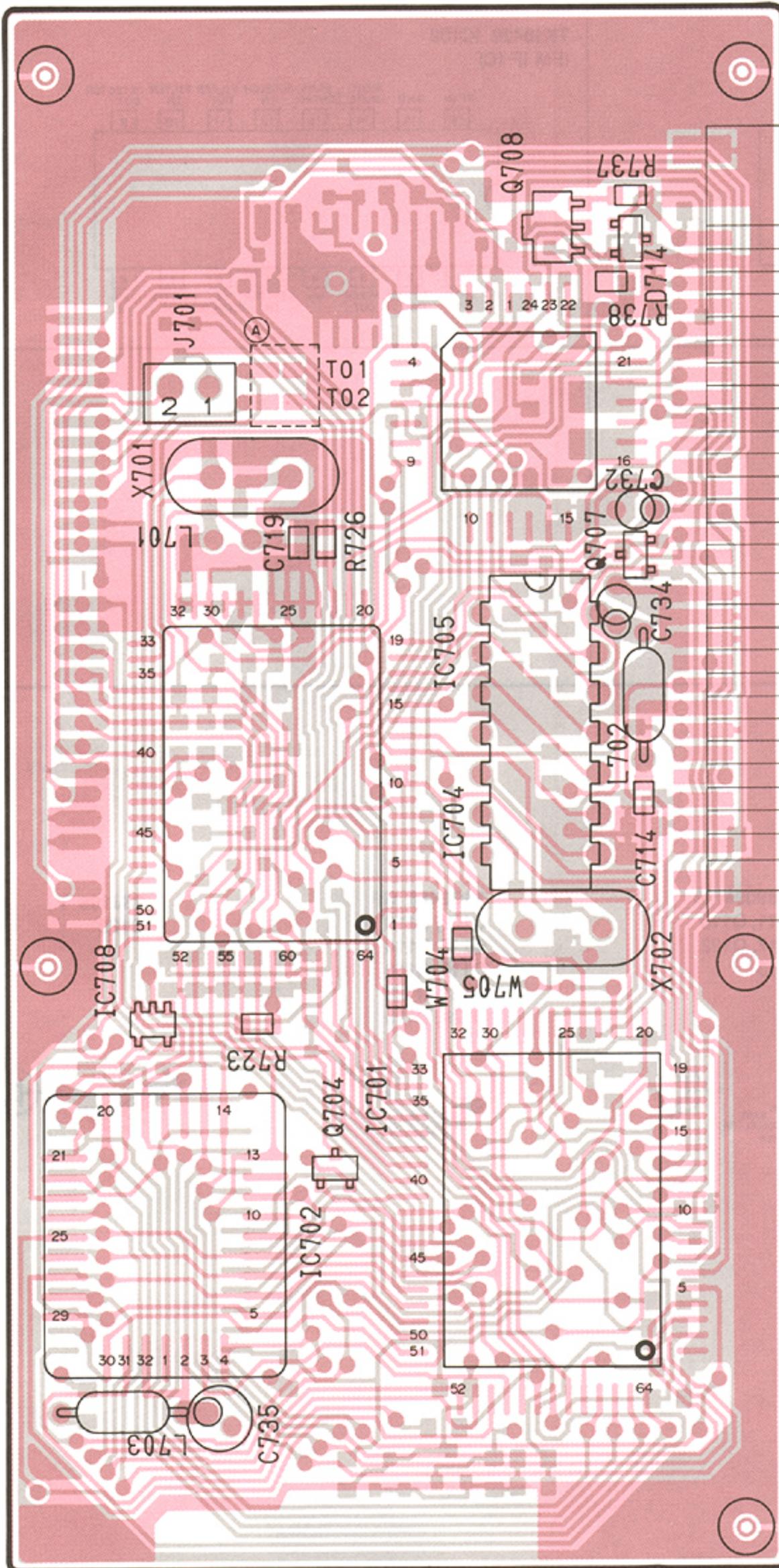
**TC4SU69F IC707, IC708**  
(INVERTER GATE)



**μPD74HC00G IC709**  
(QUAD 2 INPUT NAND GATE)



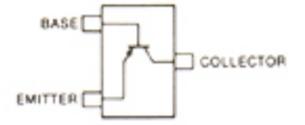
COMPONENT SIDE



GND
LAMP1
GND
RMUT
DET
BEEP
SQL
MIC1
MIC2
SAT
5TONE
SPE
T/R
SEND
CALL
FUNC
GND
GND
GND
UNLK
MPU5
+5V
PSAV
TMUT
SP
STRBO
P/C/D
CK
CPO
GND

TO MAIN UNIT

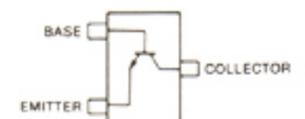
**2SA1162 Y**  
Q701, Q707



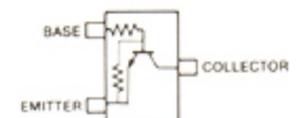
**2SB798 DK**  
Q708



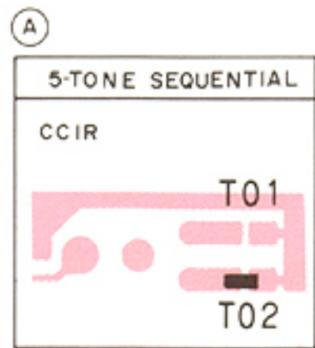
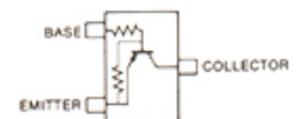
**2SC2712 Y**  
Q703



**RN1404**  
Q705, Q706



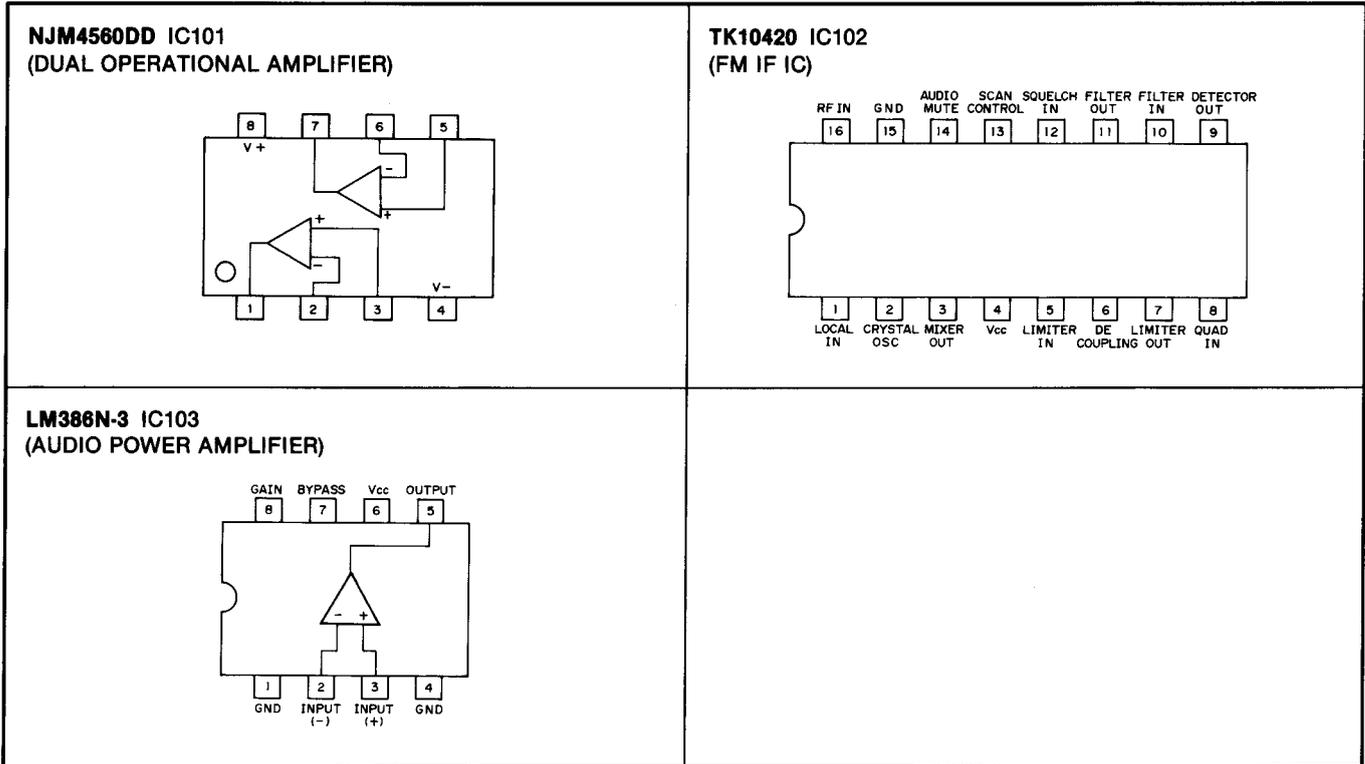
**RN2404**  
Q702, Q704



FOIL SIDE  
COMPONENT SIDE



7-2 MAIN AND DISPLAY UNITS

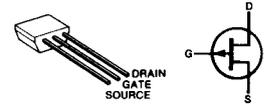
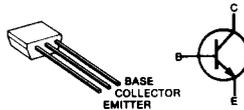
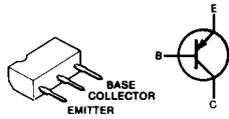


**2SA1048 GR**  
Q105, Q106  
Q108, Q109

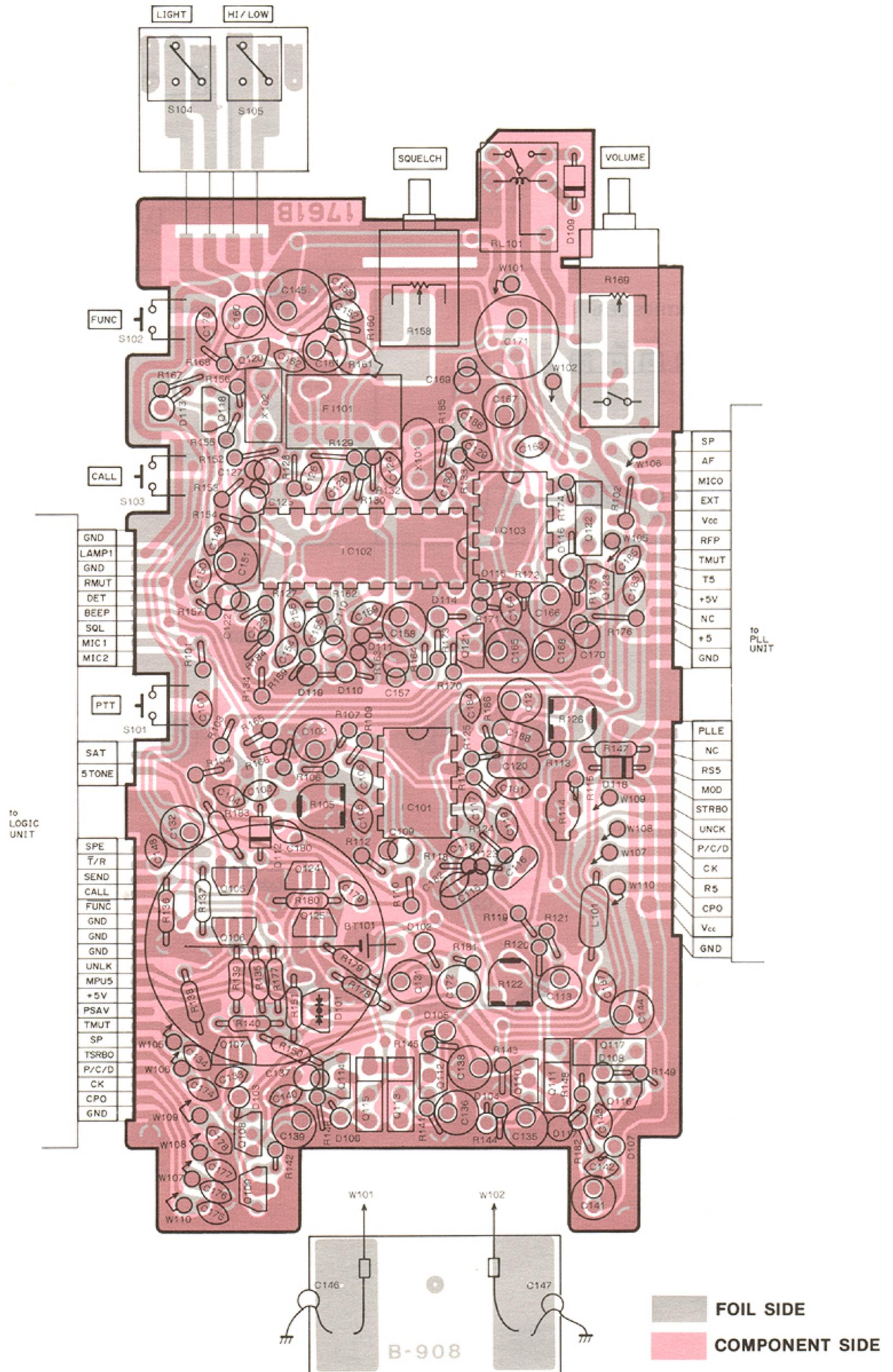
**2SB909M R**  
Q111, Q115  
Q117, Q122  
Q113

**2SC2458 GR**  
Q107, Q110  
Q112, Q114  
Q116, Q118  
Q121, Q123  
Q124, Q125

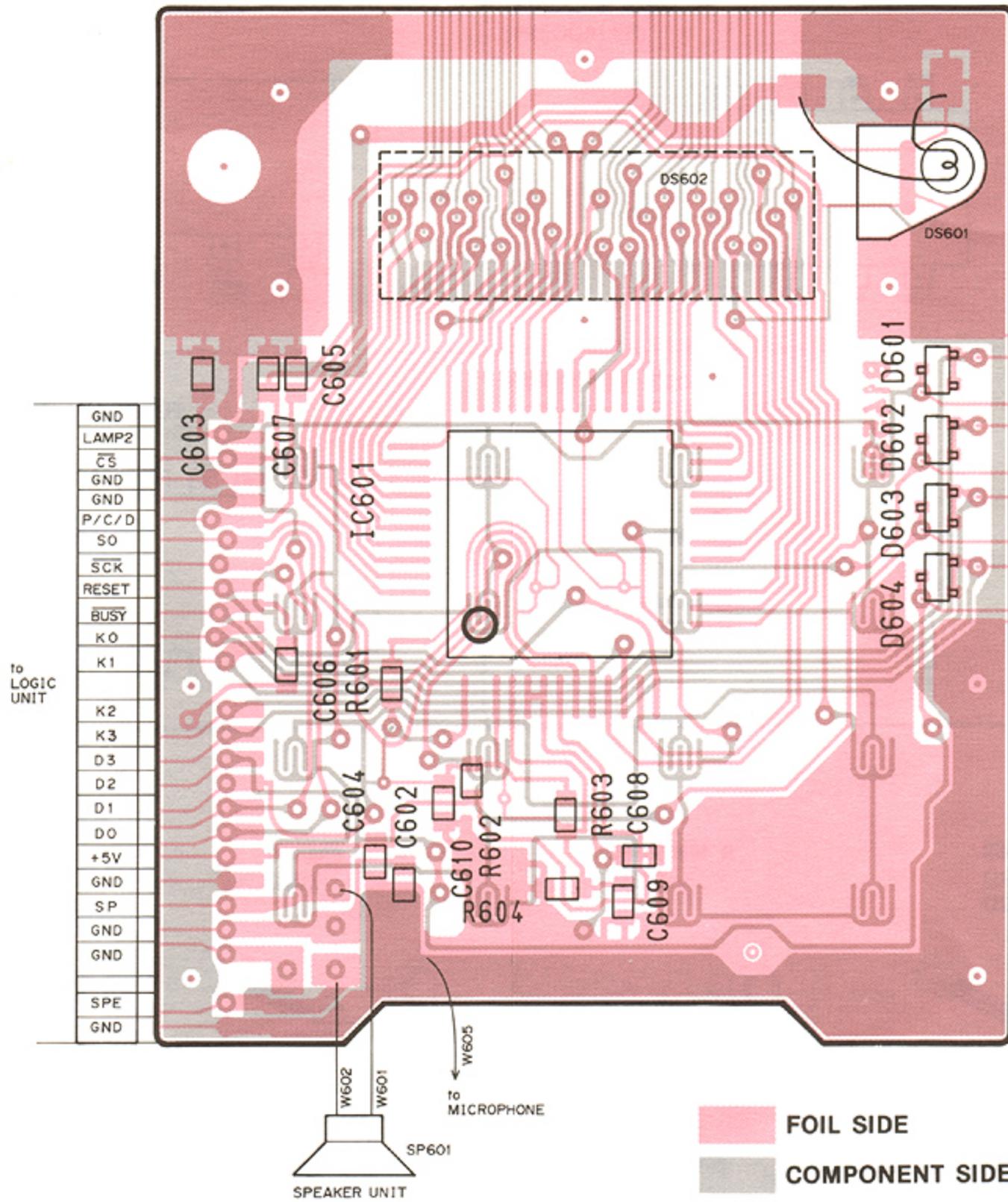
**2SJ105 Y**  
Q120



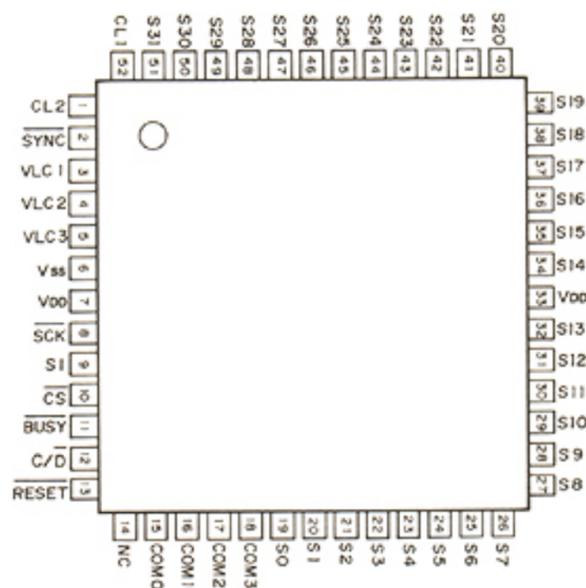
• MAIN UNIT



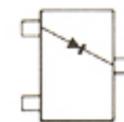
• DISPLAY UNIT



$\mu$ PD7225G IC601  
(PROGRAMMABLE LCD DRIVER)

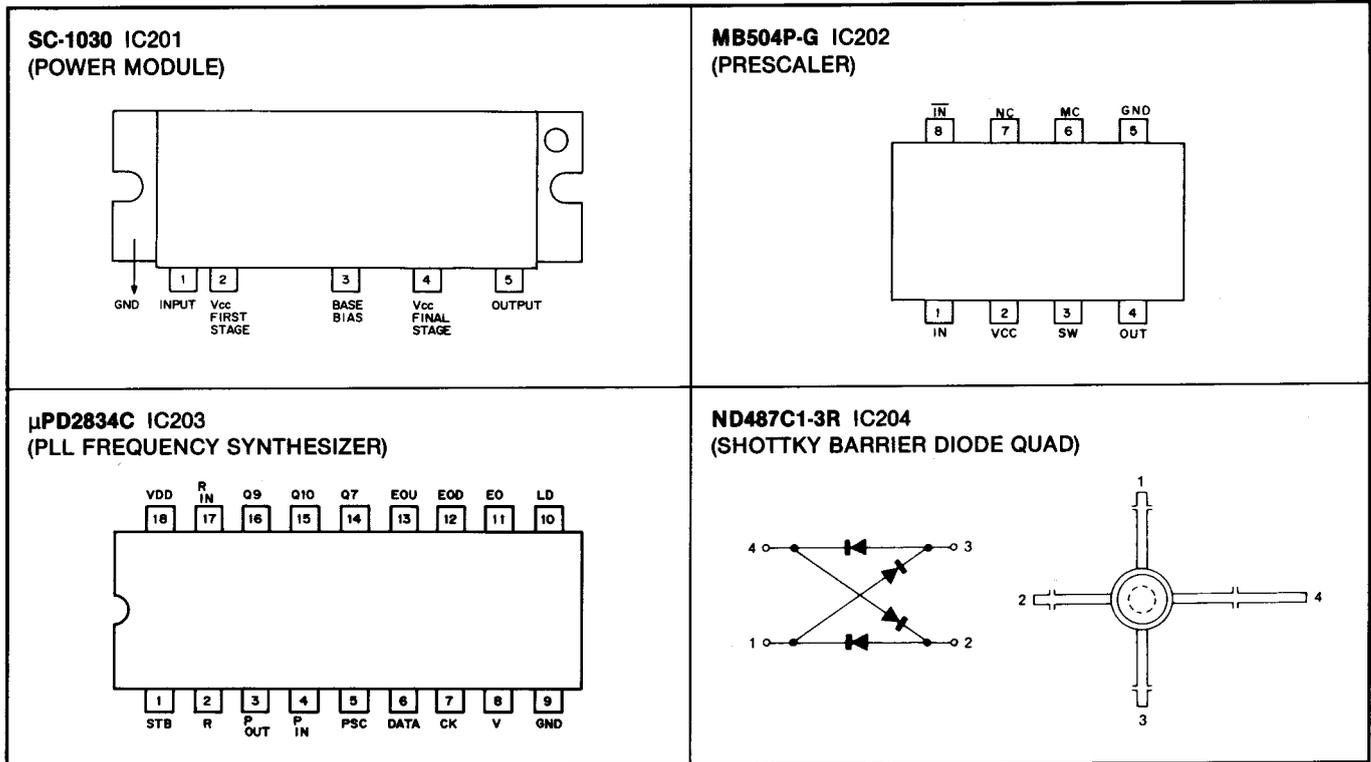


1SS193  
D601, D602  
D603, D604



Symbol: F3

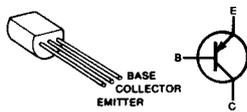
7-3 PLL AND VCO UNITS



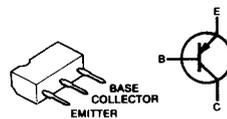
**2SA1048**  
Q208, Q214  
Q215, Q217



**2SB888**  
Q203



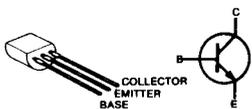
**2SB909M R**  
Q212



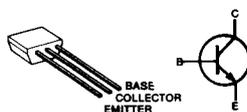
**2SC2026**  
Q202, Q204  
Q206, Q221



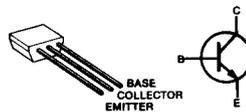
**2SC2407**  
Q205



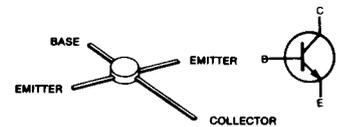
**2SC2458 GR**  
Q209, Q211  
Q213, Q216  
Q220



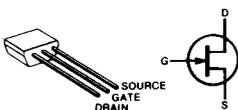
**2SC2668 O**  
Q201



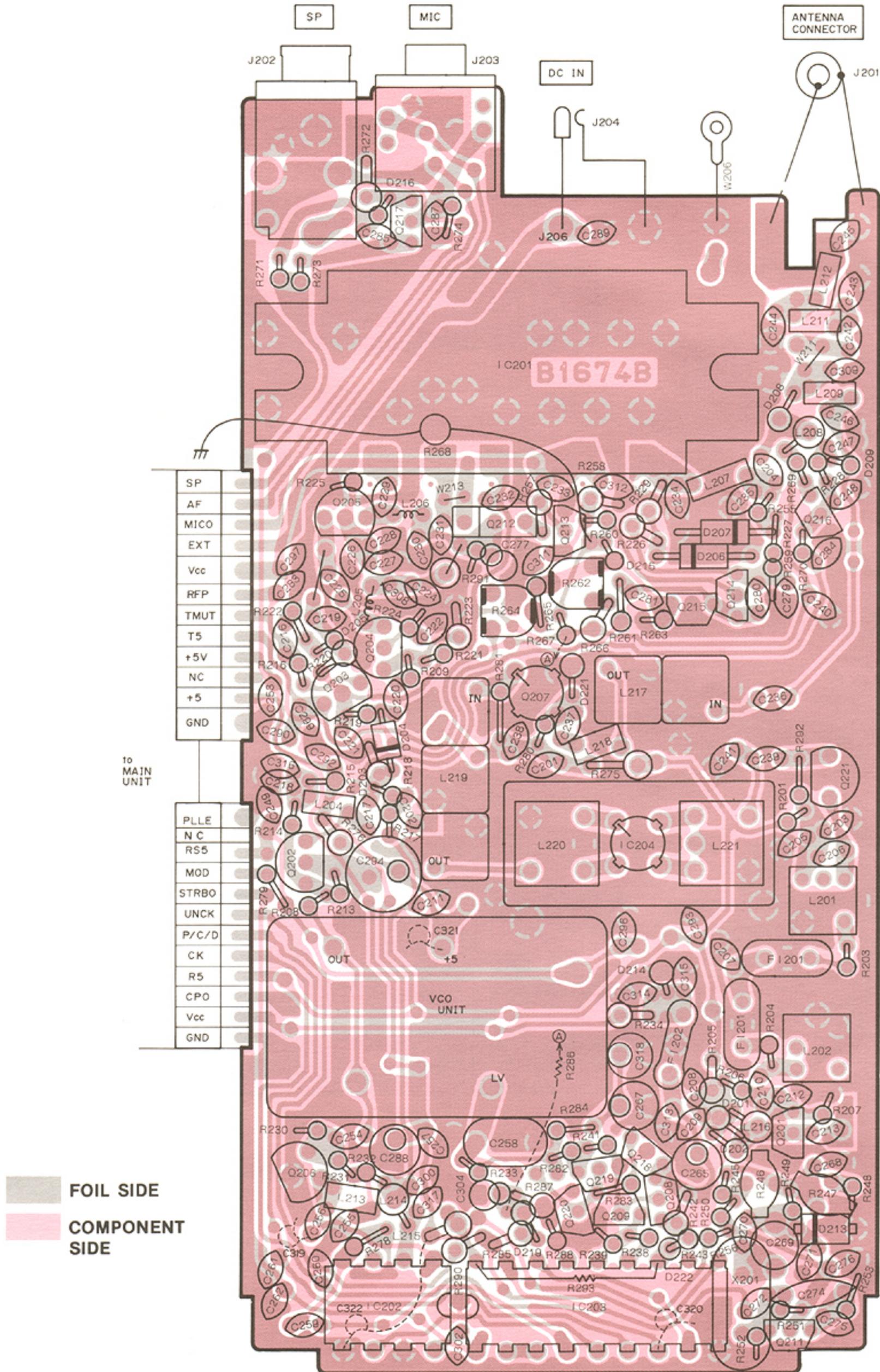
**2SC3586**  
Q207



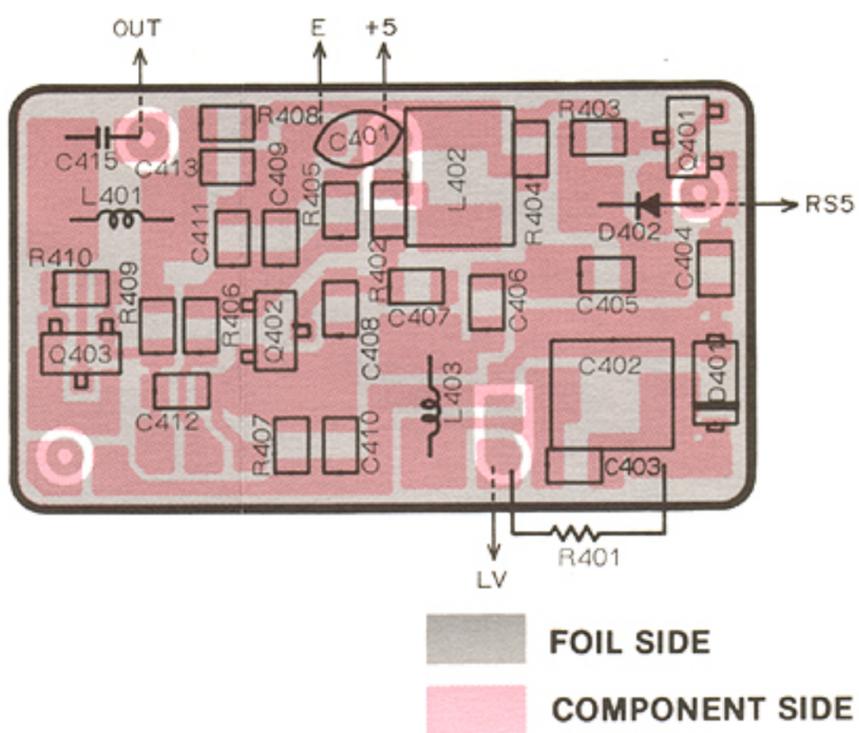
**2SK184 GR/Y**  
Q218, Q219



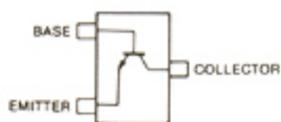
• PLL UNIT



• VCO UNIT

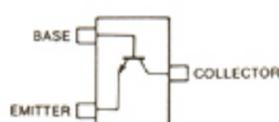


2SC3356  
Q402



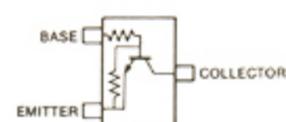
Symbol: R22

2SC3585  
Q403

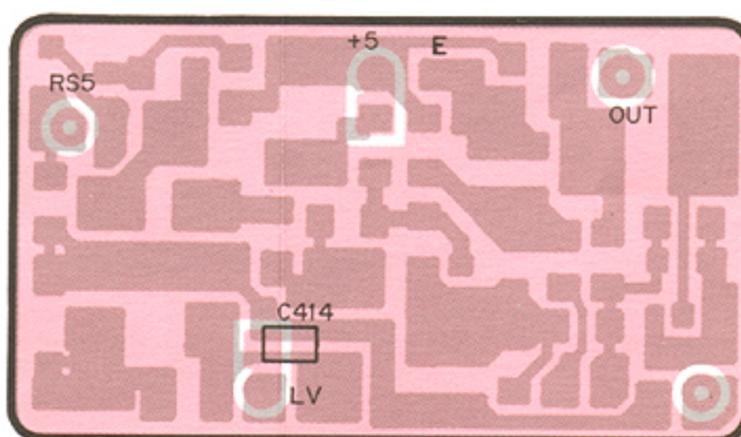


Symbol: R42

DTC124EK  
Q401



Symbol: 25



FOIL SIDE

COMPONENT SIDE

## SECTION 8 PARTS LIST

## [LOGIC UNIT]

REF. NO.	DESCRIPTION	PART NO.
IC701	IC	$\mu$ PD78C06AG-570-12
IC702	IC	MBM27C256A-25-TV-G (SC-1098A: data programmed)
IC703	IC	$\mu$ PD446G
IC704	IC	S7116A
IC705	IC	SC-1084
IC706	IC	FX-102LG
IC707	IC	TC4SU69F
IC708	IC	TC4SU69F
IC709	IC	$\mu$ PD74HC00G
Q701	Transistor	2SA1162 Y
Q702	Transistor	RN2404
Q703	Transistor	2SC2712 Y
Q704	Transistor	RN2404
Q705	Transistor	RN1404
Q706	Transistor	RN1404
Q707	Transistor	2SA1162 Y
Q708	Transistor	2SB798 DK
D701	Zener	RD5.1M B2
D702	Diode	1SS184
D703	Diode	1SS181
D704	Diode	1SS184
D705	Diode	1SS184
D706	Diode	1SS184
D707	Diode	1SS184
D708	Diode	1SS181
D709	Diode	1SS184
D710	Diode	MA862
D711	Diode	1SS181
D712	Diode	1SS184
D713	Diode	1SS184
D714	Diode	1SS226
X701	Crystal	FAGNKD (4.48 MHz)
X702	Crystal	FAANKD (3.58 MHz)
L701	Coil	LAL03NA 331K 330 $\mu$
L702	Coil	LAL03NA 221K 220 $\mu$
L703	Coil	LAL03NA 221K 220 $\mu$
R701	Resistor	27 k $\Omega$ MCR10
R702	Resistor	22 k $\Omega$ MCR10
R703	Resistor	22 k $\Omega$ MCR10
R704	Resistor	270 k $\Omega$ MCR10
R706	Resistor	2.2 M $\Omega$ MCR10
R707	Resistor	47 k $\Omega$ MCR10
R708	Resistor	12 k $\Omega$ MCR10
R709	Resistor	12 k $\Omega$ MCR10
R710	Resistor	12 k $\Omega$ MCR10
R711	Resistor	12 k $\Omega$ MCR10
R712	Resistor	47 k $\Omega$ MCR10
R713	Resistor	100 k $\Omega$ MCR10
R714	Resistor	100 k $\Omega$ MCR10
R715	Resistor	100 k $\Omega$ MCR10
R716	Resistor	47 k $\Omega$ MCR10
R717	Resistor	47 k $\Omega$ MCR10
R718	Resistor	47 k $\Omega$ MCR10
R719	Resistor	47 k $\Omega$ MCR10
R720	Resistor	47 k $\Omega$ MCR10
R721	Resistor	10 k $\Omega$ MCR10
R722	Resistor	4.7 k $\Omega$ MCR10
R723	Resistor	47 k $\Omega$ MCR10
R724	Resistor	15 k $\Omega$ MCR10

## [LOGIC UNIT]

REF. NO.	DESCRIPTION	PART NO.
R725	Resistor	4.7 k $\Omega$ MCR10
R726	Resistor	2.7 k $\Omega$ MCR10
R727	Resistor	10 k $\Omega$ MCR10
R728	Resistor	10 k $\Omega$ MCR10
R729	Resistor	47 k $\Omega$ MCR10
R730	Resistor	220 k $\Omega$ MCR10
R731	Resistor	47 k $\Omega$ MCR10
R732	Resistor	10 k $\Omega$ MCR10
R733	Resistor	1 M $\Omega$ MCR10
R737	Resistor	12 $\Omega$ MCR10
R738	Resistor	5.6 k $\Omega$ MCR10
C701	Ceramic	0.01 $\mu$ F GRM40 F
C702	Ceramic	0.01 $\mu$ F GRM40 F
C703	Ceramic	0.1 $\mu$ F GRM40 F
C704	Ceramic	470 pF GRM40
C705	Ceramic	470 pF GRM40
C707	Ceramic	470 pF GRM40
C708	Ceramic	470 pF GRM40
C709	Ceramic	470 pF GRM40
C710	Ceramic	470 pF GRM40
C711	Ceramic	470 pF GRM40
C712	Ceramic	470 pF GRM40
C713	Ceramic	470 pF GRM40
C714	Ceramic	0.01 $\mu$ F GRM40 F
C715	Ceramic	0.01 $\mu$ F GRM40 F
C716	Ceramic	0.0022 $\mu$ F GRM40
C717	Ceramic	18 pF GRM40
C718	Ceramic	18 pF GRM40
C719	Ceramic	470 pF GRM40
C720	Ceramic	47 pF GRM40
C721	Ceramic	18 pF GRM40
C722	Ceramic	0.01 $\mu$ F GRM40 F
C723	Ceramic	470 pF GRM40
C724	Ceramic	470 pF GRM40
C725	Ceramic	0.01 $\mu$ F GRM40 F
C726	Ceramic	0.01 $\mu$ F GRM40 F
C727	Ceramic	0.01 $\mu$ F GRM40 F
C728	Ceramic	0.01 $\mu$ F GRM40 F
C729	Ceramic	0.01 $\mu$ F GRM40 F
C730	Ceramic	470 pF GRM40
C731	Ceramic	47 pF GRM40
C732	Tantalum	4.7 $\mu$ F 16 V DN
C733	Ceramic	0.01 $\mu$ F GRM40 F
C734	Tantalum	22 $\mu$ F 16 V DN
C735	Electrolytic	22 $\mu$ F 6.3 V RC3
C736	Ceramic	0.1 $\mu$ F GRM40 F
C737	Tantalum	1 $\mu$ F 16 V SV
C738	Ceramic	0.01 $\mu$ F GRM40 F
J701	Connector	IMSA-9201B-2-02T
P701	Connector	IMSA-9201B-HT
SO701	Socket	IC61-0324-017
W701	Shield Cable	51/99/140/W16A/W16A 08 A A
W702	Shield Cable	
W703	Jumper	MCR10-JPW
W704	Jumper	MCR10-JPW
W705	Jumper	MCR10-JPW
EP701	P.C. Board	B-1867A

**[DISPLAY UNIT]**

REF. NO.	DESCRIPTION	PART NO.	
IC601	IC	μPD7225G	
D601	Diode	1SS193	
D602	Diode	1SS193	
D603	Diode	1SS193	
D604	Diode	1SS193	
R601	Resistor	180 kΩ	MCR10
R602	Resistor	10 kΩ	MCR10
R603	Resistor	10 kΩ	MCR10
R604	Resistor	10 kΩ	MCR10
C601	Ceramic	470 pF	50 V
C603	Ceramic	470 pF	GRM40
C604	Ceramic	0.001 μF	GRM40
C605	Ceramic	47 pF	GRM40
C606	Ceramic	47 pF	GRM40
C607	Ceramic	47 pF	GRM40
C608	Ceramic	0.001 μF	GRM40
C609	Ceramic	0.001 μF	GRM40
C610	Ceramic	0.001 μF	GRM40
DS601	Lamp	BQ031-22403A	
DS602	LCD	LR580-E	
MC601	Microphone	KUC2023-01-006	
SP601	Speaker	40P-157B	
W601	Wire	23/04/050/W01/W01	
W602	Wire	23/00/040/W01/W01	
W605	Wire	23/00/040/W01/W01	
EP601	LCD Contact Strip	SRCN-411	
EP603	P.C. Board	B-1453B	
EP604	F.P.C. Board	B-1046A (DISPLAY~LOGIC)	

**[MAIN UNIT]**

REF. NO.	DESCRIPTION	PART NO.	
Q121	Transistor	2SC2458 GR	
Q122	Transistor	2SB909M R	
Q123	Transistor	2SC2458 GR	
Q124	Transistor	2SC2458 GR	
Q125	Transistor	2SC2458 GR	
D101	Diode	1SS233	
D102	Diode	1SS254	
D103	Diode	1SS254	
D104	Diode	1SS254	
D105	Diode	1SS254	
D106	Diode	1SS254	
D107	Zener	RD5.1JS B2	
D108	Diode	1SS254	
D109	Diode	1SS254	
D110	Diode	1S953	
D111	Diode	1SS254	
D112	Diode	1SS254	
D113	Diode	1SS254	
D114	Diode	1SS254	
D115	Diode	1SS254	
D116	Zener	RD4.7E B2	
D117	Zener	RD6.8E B2	
D118	Diode	1SS254	
D119	Diode	1S953	
FI101	Ceramic	CFW455HT (Narrow) CFW455E (Wide)	
X101	Crystal	CR-214	
X102	Discriminator	CDB455 C7A	
L101	Coil	LAL03NA 100K 10μ	
R101	Resistor	33 kΩ	ELR20
R102	Resistor	1 kΩ	ELR20
R103	Resistor	1 kΩ	ELR20
R104	Resistor	1.2 kΩ	ELR20
R105	Trimmer	470 kΩ	RH0421CS5J02A
R106	Resistor	220 kΩ	ELR20
R107	Resistor	470 Ω	ELR20
R109	Resistor	180 kΩ	ELR20
R110	Resistor	10 kΩ	ELR20
R112	Resistor	120 Ω	ELR20
R113	Resistor	10 kΩ	ELR20
R114	Thermistor	33D28	
R115	Resistor	22 kΩ	ELR20
R117	Resistor	220 kΩ	ELR20
R118	Resistor	68 kΩ	ELR20
R119	Resistor	39 kΩ	ELR20
R120	Resistor	33 kΩ	ELR20
R121	Resistor	10 kΩ	ELR20
R122	Trimmer	100 kΩ	RH0421C15J06A
R123	Resistor	39 kΩ	ELR20
R124	Resistor	56 kΩ	ELR20 (Narrow)
		39 kΩ	ELR20 (Wide)
R125	Resistor	12 kΩ	ELR20
R126	Trimmer	100 kΩ	RH0421C15J06A
R127	Resistor	470 Ω	ELR20
R128	Resistor	1.5 kΩ	ELR20
R129	Resistor	47 kΩ	ELR20
R130	Resistor	2.2 kΩ	ELR20 (Narrow)
		1.5 kΩ	ELR20 (Wide)
R132	Resistor	2.2 kΩ	ELR20 (Narrow)
		1.5 kΩ	ELR20 (Wide)
R133	Resistor	4.7 kΩ	ELR20
R134	Resistor	68 kΩ	ELR20 (Narrow)
		180 kΩ	ELR20 (Wide)
R135	Resistor	560 Ω	R20
R136	Resistor	10 kΩ	R20

**[MAIN UNIT]**

REF. NO.	DESCRIPTION	PART NO.	
IC101	IC	NJM4560DD	
IC102	IC	TK10420	
IC103	IC	LM386N-3	
Q105	Transistor	2SA1048 GR	
Q106	Transistor	2SA1048 GR	
Q107	Transistor	2SC2458 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	2SC2458 GR	
Q117	Transistor	2SB909M R	
Q118	Transistor	2SC2458 GR	
Q120	FET	2SJ105 Y	

## [MAIN UNIT]

REF. NO.	DESCRIPTION	PART NO.	
R137	Resistor	100 kΩ	R20
R138	Resistor	100 kΩ	R20
R139	Resistor	220 kΩ	R20
R140	Resistor	33 kΩ	R20
R141	Resistor	10 kΩ	ELR20
R142	Resistor	180 kΩ	ELR20
R143	Resistor	10 kΩ	ELR20
R144	Resistor	10 kΩ	ELR20
R145	Resistor	10 kΩ	ELR20
R146	Resistor	10 kΩ	ELR20
R147	Resistor	18 kΩ	R20
R148	Resistor	2.7 kΩ	ELR20
R149	Resistor	10 kΩ	ELR20
R150	Resistor	10 kΩ	R20
R151	Resistor	100 kΩ	R20
R152	Resistor	6.8 kΩ	ELR20
R153	Resistor	1 MΩ	ELR20
R154	Resistor	470 kΩ	ELR20
R155	Resistor	4.7 kΩ	ELR20
R156	Resistor	820 Ω	ELR20
R157	Resistor	12 kΩ	ELR20
R158	Variable Resistor	10 kΩ B	RK094111000NA
R159	Resistor	2.7 kΩ	ELR20
R160	Resistor	2.2 kΩ	ELR20
R161	Thermistor	33D28	
R162	Resistor	1 MΩ	ELR20
R163	Resistor	100 kΩ	ELR20
R164	Resistor	22 kΩ	ELR20
R165	Resistor	1 kΩ	ELR20
R166	Resistor	10 kΩ	ELR20
R167	Resistor	470 kΩ	ELR20
R168	Resistor	1 MΩ	ELR20
R169	Variable Resistor	10 kΩ A	RK0941111003A
R170	Resistor	220 kΩ	ELR20
R171	Resistor	150 kΩ	ELR20
R172	Resistor	150 kΩ	ELR20
R173	Resistor	33 kΩ	ELR20
R174	Resistor	1.5 kΩ	ELR20 (Narrow)
		1.8 kΩ	ELR20 (Wide)
R175	Resistor	1.2 kΩ	ELR20
R176	Resistor	47 kΩ	ELR20
R177	Resistor	100 kΩ	R20
R178	Resistor	470 kΩ	R20
R179	Resistor	33 kΩ	R20
R180	Resistor	39 kΩ	R20
R181	Resistor	22 kΩ	ELR20
R182	Resistor	3.3 kΩ	ELR20
R183	Resistor	10 kΩ	R20
R184	Resistor	10 kΩ	ELR20
R185	Resistor	1.5 kΩ	ELR20
R186	Resistor	1 kΩ	ELR20
C101	Ceramic	0.001 μF	50 V
C102	Electrolytic	10 μF	16 V RC3
C103	Barrier Layer	0.01 μF	25 V
C104	Ceramic	0.001 μF	50 V
C105	Ceramic	47 pF	50 V
C106	Ceramic	47 pF	50 V
C109	Tantalum	0.1 μF	35 V DN
C110	Tantalum	0.1 μF	35 V DN
C113	Electrolytic	0.22 μF	50 V RC3
C115	Mylar	0.0022 μF	50 V F2D
C116	Mylar	0.01 μF	50 V F2D
C117	Ceramic	470 pF	50 V
C118	Ceramic	120 pF	50 V (Narrow)
		100 pF	50 V (Wide)
C119	Ceramic	470 pF	50 V
C120	Mylar	0.0022 μF	50 V F2D
C121	Electrolytic	1 μF	50 V RC3
C122	Tantalum	0.1 μF	35 V DN
C123	Ceramic	0.001 μF	50 V
C124	Barrier Layer	0.01 μF	25 V
C125	Tantalum	10 μF	16 V DN
C126	Ceramic	82 pF	50 V

## [MAIN UNIT]

REF. NO.	DESCRIPTION	PART NO.		
C127	Tantalum	0.1 μF	35 V	DN
C128	Ceramic	0.1 μF	D33Y5V1E104Z21	
C129	Ceramic	56 pF	50 V	
C130	Ceramic	18 pF	50 V	
C131	Electrolytic	47 μF	6.3 V	RC3
C132	Electrolytic	4.7 μF	50 V RC3	
C133	Ceramic	0.001 μF	50 V	
C134	Ceramic	470 pF	50 V	
C135	Electrolytic	22 μF	6.3 V	RC3
C136	Electrolytic	22 μF	6.3 V RC3	
C137	Tantalum	4.7 μF	16 V DN	
C138	Electrolytic	2.2 μF	50 V RC3	
C139	Electrolytic	22 μF	6.3 V RC3	
C140	Ceramic	0.001 μF	50 V	
C141	Electrolytic	22 μF	6.3 V RC3	
C142	Ceramic	0.001 μF	50 V	
C143	Ceramic	470 pF	50 V	
C144	Electrolytic	22 μF	6.3 V RC3	
C145	Electrolytic	47 μF	25 V MS7	
C146	Ceramic	470 pF	50 V	
C147	Ceramic	470 pF	50 V	
C148	Ceramic	470 pF	50 V	
C149	Barrier Layer	0.01 μF	25 V	
C150	Ceramic	0.1 μF	D33Y5V1E104Z21	
C151	Electrolytic	0.1 μF	50 V RC3	
C152	Ceramic	0.0022 μF	25 V (Narrow)	
		0.001 μF	50 V (Wide)	
C153	Ceramic	47 pF	50 V	
C154	Ceramic	0.001 μF	50 V	
C155	Ceramic	10 pF	50 V	
C156	Ceramic	0.001 μF	50 V	
C157	Tantalum	0.47 μF	35 V DN	
C158	Electrolytic	0.1 μF	50 V RC3	
C159	Ceramic	0.001 μF	50 V	
C160	Electrolytic	1 μF	50 V RC3	
C161	Electrolytic	1 μF	50 V RC3	
C162	Barrier Layer	0.0056 μF	25 V	
C163	Ceramic	0.1 μF	D33Y5V1E104Z21	
C164	Ceramic	470 pF	50 V	
C165	Electrolytic	2.2 μF	50 V RC3	
C166	Electrolytic	10 μF	16 V RC3	
C167	Electrolytic	10 μF	16 V RC3	
C168	Electrolytic	10 μF	16 V RC3	
C169	Tantalum	2.2 μF	16 V DN	
C170	Tantalum	0.68 μF	35 V DN	
C171	Electrolytic	220 μF	10 V MS9	
C172	Electrolytic	4.7 μF	25 V RC3	
C173	Ceramic	470 pF	50 V	
C174	Ceramic	470 pF	50 V	
C175	Ceramic	47 pF	50 V	
C176	Ceramic	47 pF	50 V	
C177	Ceramic	47 pF	50 V	
C178	Ceramic	47 pF	50 V	
C179	Ceramic	0.1 μF	D33Y5V1E104Z21	
C180	Ceramic	0.1 μF	D33Y5V1E104Z21	
C181	Ceramic	120 pF	50 V	
C182	Ceramic	470 pF	50 V	
C183	Ceramic	0.1 μF	D33Y5V1E104Z21	
C184	Ceramic	0.1 μF	D33Y5V1E104Z21	
C185	Ceramic	0.001 μF	50 V	
C186	Ceramic	0.001 μF	50 V	
C187	Ceramic	0.001 μF	50 V	
C188	Mylar	0.0068 μF	50 V F2D	
RL101	Relay	OUC-SH-114D		
S101	Switch	SKHHAK013A [PTT]		
S102	Switch	SKHHAK013A [FUNC]		
S103	Switch	SKHHAK013A [CALL]		
S104	Switch	SPPH22039A [LAMP]		
S105	Switch	SPPH22014A [HI/LOW]		

**[MAIN UNIT]**

REF. NO.	DESCRIPTION	PART NO.
BT101	Lithium Battery	BR2325-1HC
W101	Wire	23/03/145/D21G/W01
W102	Wire	23/02/115/D21/W01
W103	Wire	23/04/040/W02/W02
W104	Wire	72/99/050/X98/X98
W105	Wire	23/01/130/D21/D21
W106	Wire	23/05/135/D21G/D21G
W107	Wire	23/06/090/D21/D21
W108	Wire	23/07/095/D21/D21
W109	Wire	23/08/100/D21/D21
W110	Wire	23/09/085/D21/D21
EP101	P.C. Board	B-1761B (MAIN)
EP102	P.C. Board	B-908 (P.C. Board)
EP103	F.P.C. Board	B-1045 (MAIN~LOGIC)
EP104	Ferrite Bead	DL2-OP2.6-3-1.2H

**[PLL UNIT]**

REF. NO.	DESCRIPTION	PART NO.
IC201	IC	SC-1030
IC202	IC	MB504P-G
IC203	IC	μPD2834C
IC204	IC	ND487C1-3R
Q201	Transistor	2SC2668 O
Q202	Transistor	2SC2026
Q203	Transistor	2SB888
Q204	Transistor	2SC2026
Q205	Transistor	2SC2407
Q206	Transistor	2SC2026
Q207	Transistor	2SC3586
Q208	Transistor	2SA1048 GR
Q209	Transistor	2SC2458 GR
Q211	Transistor	2SC2458 GR
Q212	Transistor	2SB909M R
Q213	Transistor	2SC2458 GR
Q214	Transistor	2SA1048 GR
Q215	Transistor	2SA1048 GR
Q216	Transistor	2SC2458 GR
Q217	Transistor	2SA1048 GR
Q218	FET	2SK184 GR
Q219	FET	2SK184 Y
Q220	Transistor	2SC2458 GR
Q221	Transistor	2SC2026
D201	Diode	1SS254
D202	Diode	1SS254
D203	Diode	1SS265
D204	Diode	1SS265
D205	Diode	1SS254
D206	Diode	1SS97
D207	Diode	1SS97
D208	Diode	1SS265
D209	Diode	1SS265
D213	Varicap	1SV50E
D214	Zener	RD6.8 EB2
D215	Diode	1SS254
D216	Diode	1SS254
D219	Diode	1SS254
D221	Diode	1S953
D222	Diode	SLN-210MC

**[PLL UNIT]**

REF. NO.	DESCRIPTION	PART NO.
FI201	Monolithic	30M7B (Narrow) 30M15B (Wide)
FI202	LC	EXC-EMT103DC
X201	Crystal	CR-270
L201	Coil	LS-319
L202	Coil	LS-320
L204	Coil	LA-233
L205	Coil	LA-126
L206	Coil	LA-126
L207	Coil	LA-232
L208	Coil	LAL02TA R56M 0.56μ
L209	Coil	LA-232
L211	Coil	LA-147
L212	Coil	LA-232
L213	Coil	LA-233
L214	Coil	LAL02TA 100K 10μ
L215	Coil	LAL03NA 4R7 4.7μ
L216	Coil	LAL02TA 100K 10μ
L217	Coil	5HW-44545A
L218	Coil	LA-232
L219	Coil	05M-3075
L220	Coil	LR-145
L221	Coil	LR-145
R201	Resistor	100 Ω ELR20
R203	Resistor	100 Ω ELR20
R204	Resistor	330 Ω ELR20
R205	Resistor	47 Ω ELR20
R206	Resistor	15 kΩ ELR20
R207	Resistor	5.6 kΩ ELR20
R208	Resistor	47 Ω ELR20
R209	Resistor	22 Ω ELR20
R213	Resistor	4.7 kΩ ELR20
R214	Resistor	15 kΩ ELR20
R215	Resistor	100 Ω ELR20
R216	Resistor	6.8 kΩ ELR20
R217	Resistor	10 kΩ ELR20
R218	Resistor	22 kΩ ELR20
R219	Resistor	10 kΩ ELR20
R220	Resistor	1 kΩ ELR20
R221	Resistor	1.2 kΩ ELR20
R222	Resistor	220 Ω ELR20
R223	Resistor	560 Ω ELR20
R224	Resistor	47 Ω ELR20
R225	Resistor	10 Ω ELR20
R226	Resistor	18 kΩ ELR20
R227	Resistor	18 kΩ ELR20
R228	Resistor	100 Ω ELR20
R229	Resistor	100 kΩ ELR20
R230	Resistor	1.8 kΩ ELR20
R231	Resistor	6.8 kΩ ELR20
R232	Resistor	470 Ω ELR20
R233	Resistor	6.8 kΩ ELR20
R234	Resistor	1.5 kΩ ELR20
R238	Resistor	15 kΩ ELR20
R239	Resistor	100 kΩ ELR20
R241	Resistor	4.7 kΩ R20
R242	Resistor	10 kΩ R20
R243	Resistor	18 kΩ ELR20
R245	Resistor	10 kΩ ELR20
R246	Thermistor	33D28
R247	Thermistor	33D28
R248	Resistor	15 kΩ ELR20
R249	Resistor	10 kΩ ELR20
R250	Resistor	6.8 kΩ ELR20
R251	Resistor	100 kΩ ELR20
R252	Resistor	100 kΩ ELR20
R253	Resistor	2.2 kΩ ELR20
R255	Resistor	100 kΩ ELR20
R256	Resistor	100 Ω ELR20

## [PLL UNIT]

REF. NO.	DESCRIPTION	PART NO.	
R257	Resistor	1.8 k $\Omega$	ELR20
R258	Resistor	560 k $\Omega$	ELR20
R259	Resistor	22 k $\Omega$	ELR20
R260	Resistor	150 k $\Omega$	ELR20
R261	Resistor	82 k $\Omega$	ELR20
R262	Trimmer	47 k $\Omega$	RH0421CS4J08A
R263	Resistor	22 k $\Omega$	ELR20
R264	Trimmer	47 k $\Omega$	RH0421CS4J08A
R265	Resistor	2.2 k $\Omega$	ELR20
R266	Resistor	8.2 k $\Omega$	ELR20
R267	Resistor	10 k $\Omega$	ELR20
R268	Thermistor	112503-2AI	
R269	Resistor	47 k $\Omega$	ELR20
R270	Resistor	1 M $\Omega$	ELR20
R271	Resistor	5.6 k $\Omega$	ELR20
R272	Resistor	47 k $\Omega$	ELR20
R273	Resistor	27 $\Omega$	ELR20
R274	Resistor	47 k $\Omega$	ELR20
R275	Resistor	220 $\Omega$	ELR20
R276	Resistor	47 $\Omega$	ELR20
R278	Resistor	1 k $\Omega$	ELR20
R279	Resistor	22 k $\Omega$	ELR20
R280	Resistor	10 k $\Omega$	ELR20
R281	Resistor	4.7 k $\Omega$	ELR20
R282	Resistor	220 $\Omega$	R20
R283	Resistor	2.2 M $\Omega$	ELR20
R284	Resistor	150 $\Omega$	ELR20
R285	Resistor	4.7 k $\Omega$	R20
R286	Resistor	220 k $\Omega$	R20
R287	Resistor	270 k $\Omega$	ELR20
R288	Resistor	100 k $\Omega$	ELR20
R290	Resistor	100 k $\Omega$	ELR20
R291	Resistor	10 k $\Omega$	ELR20
R292	Resistor	22 k $\Omega$	ELR20
R293	Resistor	10 k $\Omega$	R20
C201	Ceramic	470 pF	50 V
C202	Ceramic	10 pF	50 V
C203	Ceramic	0.001 $\mu$ F	50 V
C204	Ceramic	0.001 $\mu$ F	50 V
C205	Barrier Layer	0.01 $\mu$ F	25 V
C206	Ceramic	22 pF	50 V
C207	Ceramic	27 pF	50 V (Narrow)
		12 pF	50 V (Wide)
C208	Barrier Layer	0.01 $\mu$ F	25 V
C209	Barrier Layer	0.0047 $\mu$ F	25 V
C210	Ceramic	120 pF	50 V
C211	Ceramic	47 pF	50 V
C212	Ceramic	68 pF	50 V
C213	Ceramic	0.001 $\mu$ F	50 V
C216	Barrier Layer	0.0015 $\mu$ F	25 V
C217	Ceramic	8 pF	50 V
C218	Ceramic	0.001 $\mu$ F	50 V
C219	Ceramic	0.001 $\mu$ F	50 V
C220	Ceramic	6 pF	50 V
C221	Ceramic	470 pF	50 V
C222	Ceramic	470 pF	50 V
C224	Ceramic	0.001 $\mu$ F	50 V
C225	Ceramic	4 pF	50 V
C226	Ceramic	0.001 $\mu$ F	50 V
C227	Ceramic	0.001 $\mu$ F	50 V
C228	Ceramic	470 pF	50 V
C229	Ceramic	12 pF	50 V
C230	Ceramic	0.001 $\mu$ F	50 V
C231	Ceramic	47 pF	50 V
C232	Ceramic	47 pF	50 V
C233	Ceramic	0.001 $\mu$ F	50 V
C234	Ceramic	6 pF	50 V
C235	Ceramic	10 pF	50 V
C236	Ceramic	47 pF	50 V
C237	Ceramic	47 pF	50 V
C238	Ceramic	0.001 $\mu$ F	50 V
C239	Ceramic	36 pF	50 V

## [PLL UNIT]

REF. NO.	DESCRIPTION	PART NO.	
C240	Ceramic	0.001 $\mu$ F	50 V
C241	Ceramic	82 pF	50 V
C242	Ceramic	18 pF	50 V
C243	Ceramic	10 pF	50 V
C244	Ceramic	12 pF	50 V
C245	Ceramic	6 pF	50 V
C246	Ceramic	6 pF	50 V
C247	Ceramic	33 pF	50 V
C248	Ceramic	47 pF	50 V
C249	Ceramic	47 pF	50 V
C253	Ceramic	470 pF	50 V
C254	Ceramic	2 pF	50 V
C255	Ceramic	0.001 $\mu$ F	50 V
C256	Ceramic	10 pF	50 V
C257	Ceramic	0.1 $\mu$ F	D33Y5V1E104Z21
C258	Tantalum	0.1 $\mu$ F	35 V DN
C259	Ceramic	0.001 $\mu$ F	50 V
C260	Ceramic	47 pF	50 V
C261	Ceramic	47 pF	50 V
C262	Ceramic	47 pF	50 V
C265	Electrolytic	10 $\mu$ F	16 V RC3
C267	Tantalum	22 $\mu$ F	16 V DN
C268	Ceramic	0.001 $\mu$ F	50 V
C269	Trimmer	15 pF	ECRGA015E30
C270	Ceramic	33 pF	50 V CH
C271	Ceramic	4 pF	50 V CH
C272	Ceramic	0.001 $\mu$ F	50 V
C274	Ceramic	220 pF	50 V
C275	Ceramic	100 pF	50 V
C276	Barrier Layer	0.01 $\mu$ F	25 V
C277	Tantalum	10 $\mu$ F	16 V DN
C279	Ceramic	47 pF	50 V
C280	Ceramic	47 pF	50 V
C281	Ceramic	47 pF	50 V
C283	Ceramic	470 pF	50 V
C284	Ceramic	470 pF	50 V
C285	Ceramic	47 pF	50 V
C287	Ceramic	470 pF	50 V
C288	Electrolytic	22 $\mu$ F	6.3 V RC2
C289	Ceramic	470 pF	50 V
C290	Ceramic	470 pF	50 V
C292	Ceramic	470 pF	50 V
C293	Ceramic	0.001 $\mu$ F	50 V
C294	Electrolytic	100 $\mu$ F	6.3 V RC2
C296	Ceramic	47 pF	50 V
C297	Ceramic	47 pF	50 V
C299	Ceramic	47 pF	50 V
C300	Ceramic	0.1 $\mu$ F	D33Y5V1E104Z21
C302	Ceramic	0.001 $\mu$ F	50 V
C304	Tantalum	0.1 $\mu$ F	35 V DN
C308	Ceramic	0.001 $\mu$ F	50 V
C309	Ceramic	7 pF	50 V
C311	Ceramic	47 pF	50 V
C312	Ceramic	0.001 $\mu$ F	50 V
C313	Ceramic	0.001 $\mu$ F	50 V
C314	Ceramic	0.1 $\mu$ F	D33Y5V1E104Z21
C315	Barrier Layer	0.01 $\mu$ F	25 V
C316	Ceramic	470 pF	50 V
C317	Ceramic	0.1 $\mu$ F	D33Y5V1E104Z21
C318	Tantalum	6.8 $\mu$ F	35 V DN
C319	Ceramic	3 pF	50 V
C320	Ceramic	47 pF	50 V
C321	Ceramic	0.1 $\mu$ F	D33Y5V1E104Z21
C322	Tantalum	10 $\mu$ F	6.3 V CS
J201	Connector	TNC-102-N1-W1-L1	
J202	Connector	HSJ0836-01-010	
J203	Connector	HSJ1102-01-040	
J204	Connector	HEC0747-01-010	
J205	Connector	171255-1	
J206	Connector	171255-1	

## [PLL UNIT]

REF. NO.	DESCRIPTION	PART NO.
W201	Shield Cable	66/99/115/W99/W99 08
W202		
W203	Shield Cable	66/99/040/W18/W18 08
W204		
W205	Jumper	JPW-01 R01
W206	Wire	72/98/015/X98/X98
W207	Jumper	JPW-01 R01
W208	Wire	72/98/010/X98/X98
W209	Jumper	JPW-01 R01
W210	Jumper	JPW-01 R01
W211	Wire	72/98/010/X98/X98
W212	Wire	72/98/010/X98/X98
W213	Wire	72/98/010/X98/X98
W214	Wire	23/03/080/W02/W02
W215	Jumper	JPW-01 R01
W216	Jumper	JPW-01 R01
EP201	P.C. Board	B-1674B
EP202	Ferrite Bead	DL2-OP2.6-3-1.2H
EP203	Ferrite Bead	DL2-OP2.6-3-1.2H
EP204	Ferrite Bead	DL2-OP2.6-3-1.2H
EP212	Ferrite Bead	DL2-OP2.6-3-1.2H
EP215	F.P.C. Board	B-1044 (PLL~MAIN)
EP217	F.P.C. Board	B-1147 (PA shield)
EP218	Ferrite Bead	DL2-OP2.6-3-1.2H

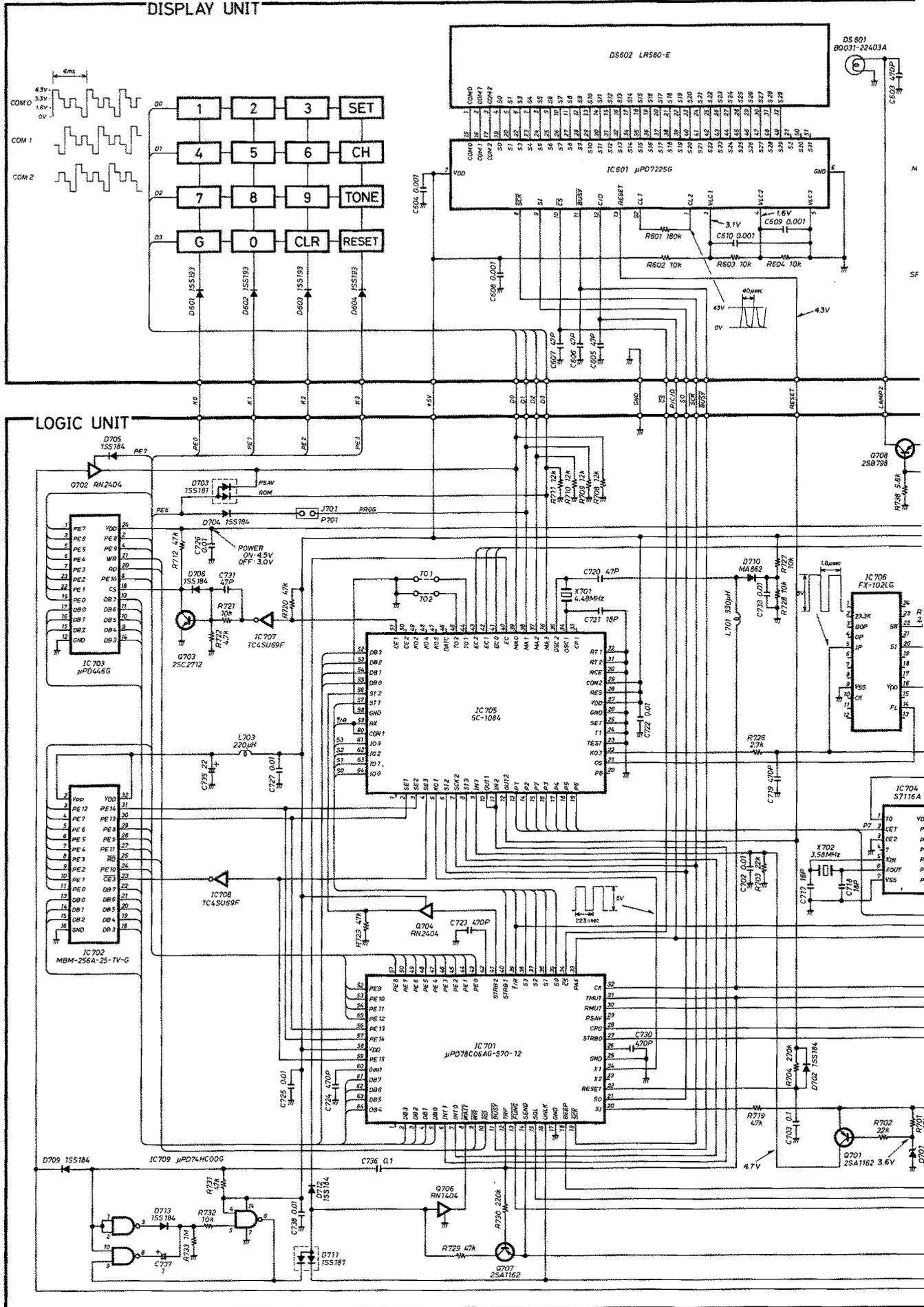
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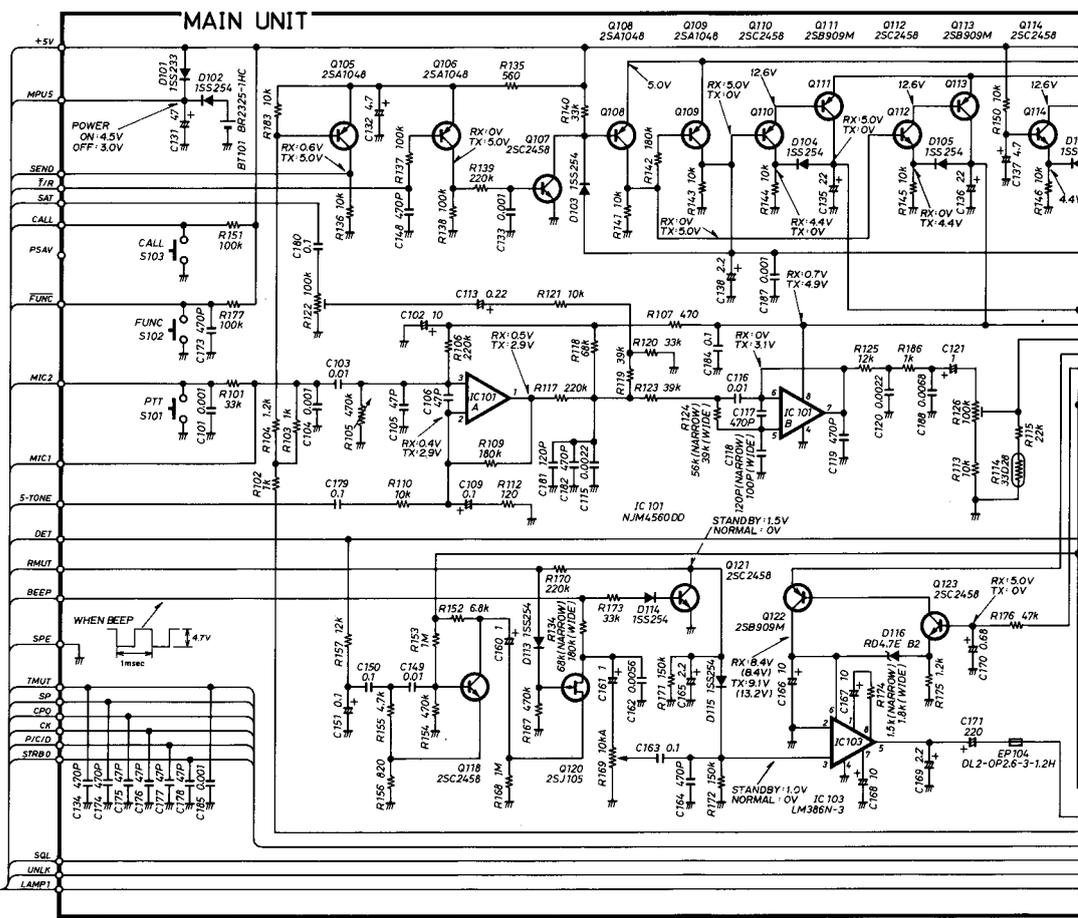
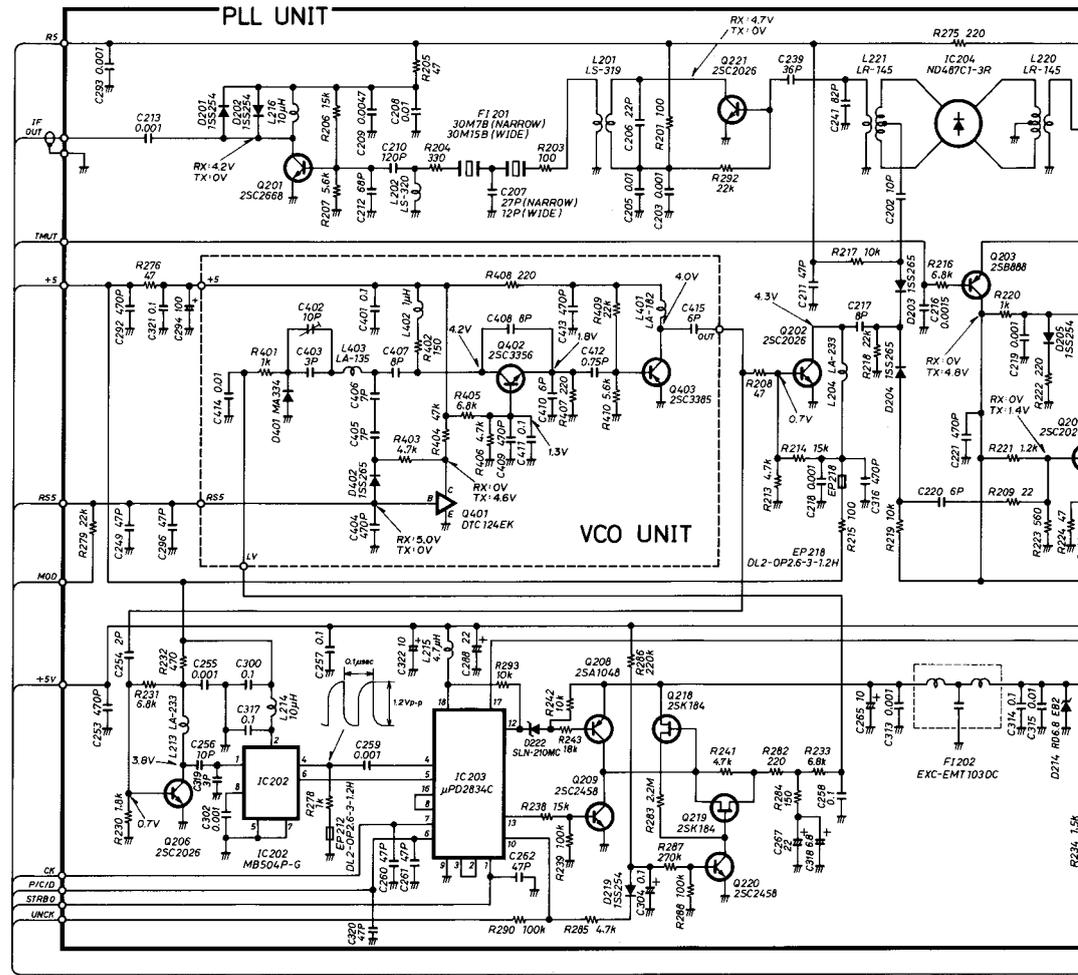
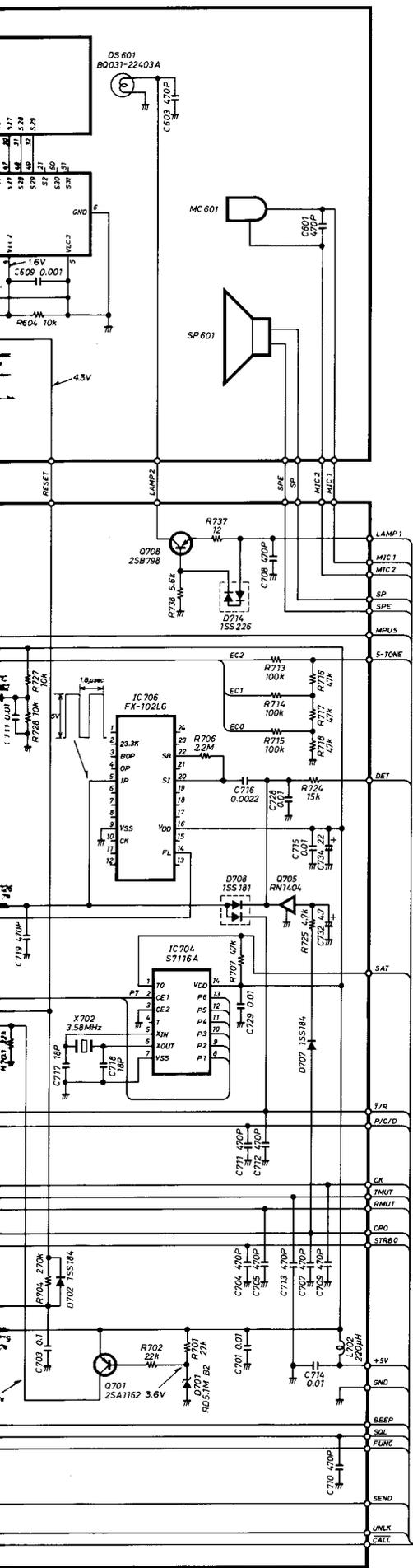
REF. NO.	DESCRIPTION	PART NO.
C412	Ceramic	0.75 pF GRM40
C413	Ceramic	470 pF GRM40
C414	Ceramic	0.01 μF GRM40 F
C415	Ceramic	6 pF 50 V
EP401	P.C. Board	B-1762

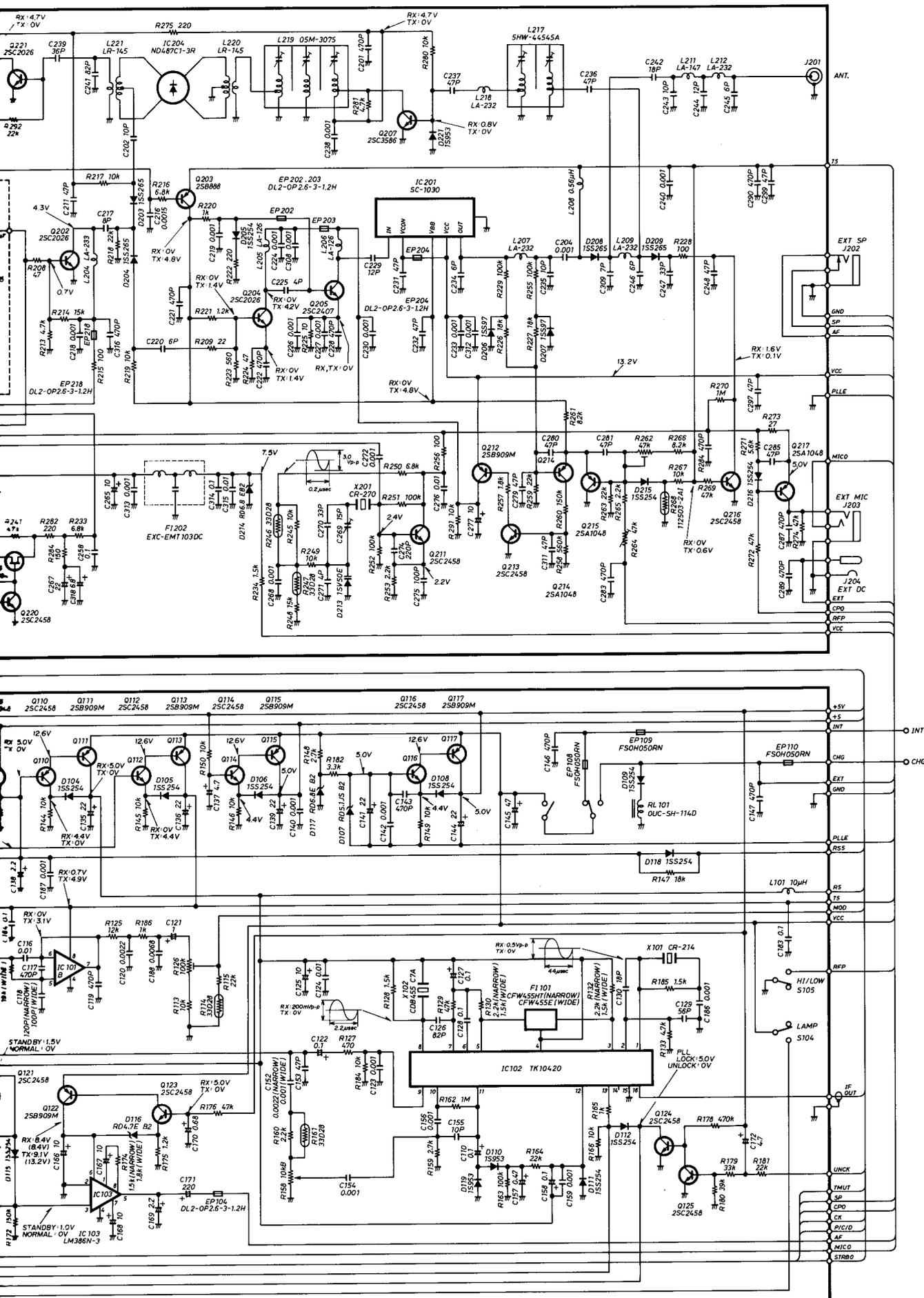
## [VCO UNIT]

REF. NO.	DESCRIPTION	PART NO.
Q401	Transistor	DTC124EK
Q402	Transistor	2SC3356
Q403	Transistor	2SC3585
D401	Varicap	MA334
D402	Diode	1SS265
L401	Coil	LA-182
L402	Coil	LQN5N1R0M 1μ
L403	Coil	LA-135
R401	Resistor	1 kΩ R20
R402	Resistor	150 Ω MCR10
R403	Resistor	4.7 kΩ MCR10
R404	Resistor	47 kΩ MCR10
R405	Resistor	6.8 kΩ MCR10
R406	Resistor	4.7 kΩ MCR10
R407	Resistor	220 Ω MCR10
R408	Resistor	220 Ω MCR10
R409	Resistor	22 kΩ MCR10
R410	Resistor	5.6 kΩ MCR10
C401	Ceramic	0.1 μF D33Y5V1E104Z21
C402	Trimmer	10 pF TZB04N100BA
C403	Ceramic	3 pF GRM40
C404	Ceramic	470 pF GRM40
C405	Ceramic	7 pF GRM40
C406	Ceramic	7 pF GRM40
C407	Ceramic	8 pF GRM40
C408	Ceramic	8 pF GRM40
C409	Ceramic	470 pF GRM40
C410	Ceramic	6 pF GRM40
C411	Ceramic	0.1 μF GRM40 F

# SECTION 9 VOLTAGE DIAGRAM







## Icom Inc.

6-9-16, Kamihigashi, Hirano-ku, Osaka 547, Japan  
Phone: 06 793 5301  
Fax : 06 793 0013  
Telex : 05277822 ICOMTR J

### Icom America Inc.

<Corporate Headquarters>  
2380 116th Avenue N.E., Bellevue, WA 98004, U.S.A.  
Phone : (206) 454-8155  
Fax : (206) 454-1509  
Telex : 152210 ICOM AMER BVUE

<Customer Service>  
Phone : (206) 454-7619

<Regional Customer Service Centers>  
3150 Premier Drive, Suite 126, Irving, TX 75063, U.S.A.  
Phone : (214) 550-7525  
Fax : (214) 550-7423

1777 Phoenix Parkway, Suite 201, Atlanta, GA 30349, U.S.A.  
Phone : (404) 991-6166  
Fax : (404) 991-6327

### Icom Canada

A Division of Icom America Inc.  
3071 #5 Road, Unit 9, Richmond, B.C., V6X 2T4, Canada  
Phone : (604) 273-7400  
Fax : (604) 273-1900

### Icom (Europe) GmbH

Communication Equipment  
Himmelgeister Str. 100, 4000 Düsseldorf 1, W. Germany  
Phone : 0211 346047  
Fax : 0211 333639  
Telex : 8588082 ICOM D

### Icom (Australia) Pty. Ltd.

Incorporated In Victoria  
7 Duke Street, Windsor, Victoria, 3181, Australia  
Phone : 03 529 7582  
Fax : 03 529 8485  
Telex : AA 35521 ICOM AS

### Icom (UK) Ltd.

Unit 9, Sea St., Herne Bay, Kent, U.K.  
Phone : 0227 363859  
Fax : 0227 360155  
Telex : 965179 ICOM G

### Icom France S.a

120 Route de Revel, BP4063, 31029 Toulouse Cedex, France  
Phone : 61. 20. 31. 49  
Fax : 61. 34. 05. 91  
Telex : 521515 ICOM FRA

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