



# SERVICE MANUAL

VHF TRANSCEIVER (68 ~ 88 MHz)

## **IC-V200T**

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## INTRODUCTION

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This service manual describes the latest information for the **IC-V200T VHF TRANSCEIVER** at the time of publication.

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## VERSIONS

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VERSION NUMBER	DESTINATION	SYMBOL
#61	France	FRA-61
#62	United Kingdom	UK-61
#63	Germany	FRG-61
#64	Spain	ESP-61
#65	Spain	ESP-62
#66	Sweden	SWE-61
#67	Sweden	SWE-62
#68	Holland	HOL-61
#69	Italy	ITA-61

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

### <SAMPLE ORDER>

1110002220 IC  $\mu$ PC358C IC-V200T MAIN UNIT 5 pieces  
8810003840 Screw BiH M3 x 6 ZK SUS IC-V200T Top cover 10 pieces

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

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## REPAIR NOTES

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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 its 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 40 dB ~ 50 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 upgrade quality, all electrical and mechanical parts and internal circuits are subject to change without notice or obligation.

# SECTION 1 SPECIFICATIONS

## ■ GENERAL

- Frequency coverage : 68 ~ 88 MHz
- Type of emission : 16K0F3E (#64, #65, #66, #67, #69)  
14K0F3E (#63)  
8K50F3E (#61, #62, #68)
- Antenna impedance : 50  $\Omega$  unbalanced
- Usable temperature range :  $-25^{\circ}\text{C} \sim +55^{\circ}\text{C}$  ( $-13^{\circ}\text{F} \sim +131^{\circ}\text{F}$ )
- Frequency stability :  $\pm 500$  Hz ( $\pm 0.0005$  %)
- Power supply requirement : 13.2 V DC  $\pm 15$  % (negative ground)
- Current drain (at 13.8 V DC) :

Transmit	10 W versions	4.0 A
	25 W versions	7.0 A
Receive	Squelched	350 mA
	Max. audio output	1.0 A

- Dimensions : 140 (W) x 50 (H) x 191 (D) mm  
5.5 (W) x 2.0 (H) x 7.5 (D) in  
(Projections not included)
- Weight : 1.5 kg
- 5-Tone system : CCIR, ZVEI

## ■ TRANSMITTER

- Output power : 25 W (#61 ~ #68)  
10 W (#69)
- Modulation system : Variable reactance frequency modulation
- Max. frequency deviation :  $\pm 5$  kHz (#64, #65, #66, #67, #69)  
 $\pm 4$  kHz (#63)  
 $\pm 2.5$  kHz (#61, #62, #68)
- Spurious emissions :  $-70$  dB
- Adjacent channel power :  $-60$  dB
- Audio response :  $+1$  dB  $\sim -3$  dB of  $+6$  dB/octave from 300 Hz to 3000 Hz (#63 ~ 67, #69)  
 $+1$  dB  $\sim -3$  dB of  $+6$  dB/octave from 300 Hz to 2550 Hz (#61, #62, #68)
- Noise and hum ratio :  $-40$  dB (#64, #65, #66, #67, #69)  
 $-35$  dB (#61, #62, #68)  
 $-38$  dB (#63)
- Microphone impedance : 600  $\Omega$

## ■ RECEIVER

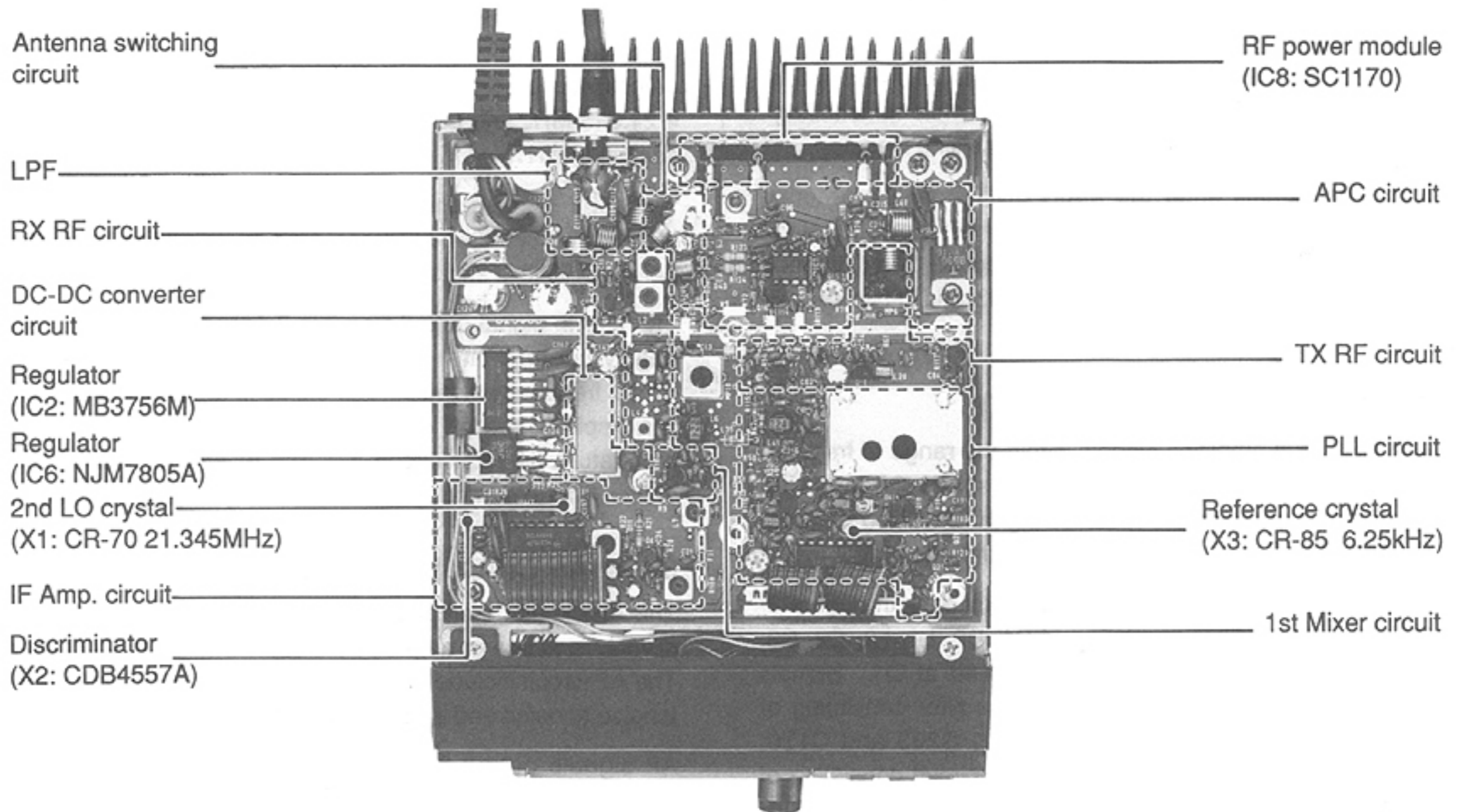
- Sensitivity : 0.55  $\mu\text{V}$  for 12 dB SINAD
- Intermediate frequency : 1st 21.8 MHz  
2nd 455 kHz
- Squelch sensitivity : 0.3  $\mu\text{V}$  (Threshold level)
- Adjacent channel selectivity :  $-70$  dB (#63 ~ 67, #69)  
 $-60$  dB (#61, #62, #68)
- Intermodulation rejection :  $-70$  dB
- Spurious response rejection :  $-70$  dB
- Audio response :  $+1$  dB  $\sim -3$  dB of  $-6$  dB/octave from 300 Hz to 3000 Hz (#63 ~ 67, #69)  
 $+1$  dB  $\sim -3$  dB of  $-6$  dB/octave from 300 Hz to 2550 Hz (#61, #62, #68)
- Audio output impedance : 4  $\Omega$
- Audio output power : 3 W with a 4  $\Omega$  load

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

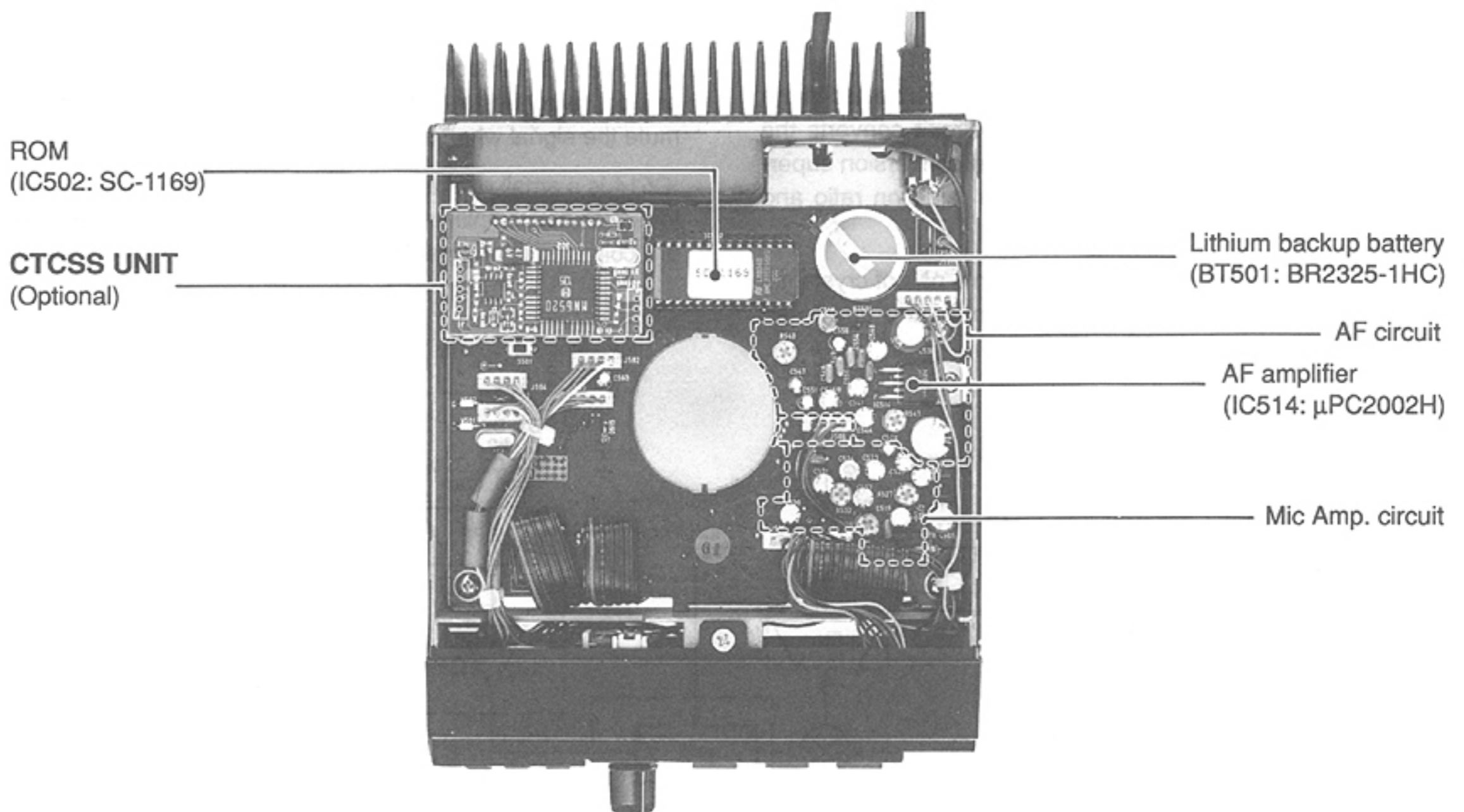


## SECTION 2 INSIDE VIEWS

### • MAIN UNIT



### • LOGIC UNIT



# SECTION 3 CIRCUIT DESCRIPTION

## 3-1 RECEIVER CIRCUITS

### 3-1-1 ANTENNA SWITCHING CIRCUIT (MAIN UNIT)

The antenna switching circuit functions as a low-pass filter while receiving and as a resonator circuit while transmitting. It switches the flow of transmitting or receiving signals.

Received signals enter the MAIN UNIT from the antenna connector through a low-pass filter consisting of L27~L29, C103, C107~C113. They are then applied to an antenna switching circuit consisting of D32, D33 and other components.

### 3-1-2 RF CIRCUIT (MAIN UNIT)

The RF circuit amplifies signals within the range of frequency coverage and filters out out-of-band signals. Then, a 1st mixer circuit converts the received signal to a fixed frequency of the 1st IF signal using a PLL output frequency.

Signals from the antenna switching circuit pass through a 2-stage bandpass filter consisting of D1, D2, L1, L2, C2, C3, C200, C201 and C168 and are amplified at Q1. Signals then pass through a 2-stage bandpass filter consisting of D3, D4, L3, L4, C8, C9, C169, C202, C203 and C170. They are then applied to the 1st mixer circuit consisting of Q2, Q3, L6 and other components for conversion to a 21.8 MHz 1st IF signal.

A local oscillator signal (output from Q6) is buffer amplified at Q7 and Q8, passes through a switching circuit (D23, D24) and a 2-stage bandpass filter consisting of L21, L22 and C161~C163 and is applied to L6.

### 3-1-3 IF CIRCUIT (MAIN UNIT)

The 1st IF circuit amplifies a signal which is converted in the 1st mixer circuit. Then, the 2nd mixer circuit converts the 1st IF signal to a 2nd IF signal. A double-conversion super-heterodyne system improves the image rejection ratio and maintains stable receiver gain.

The 1st IF signal from L7 passes through a pair of crystal filters (F11) to suppress out-of-band signals and unwanted heterodyned frequency signals.

After passing through the filter, the 1st IF signal is amplified at IF amplifier Q4 and is applied to IC1 (pin 16) through L9.

IC1 contains the 2nd LO circuit, 2nd mixer circuit, limiter amplifier circuit, squelch trigger circuit and quadrature detector circuit. The 2nd LO circuit, including X1, generates a 21.345 MHz 2nd LO signal which is used at the 2nd mixer section of IC1.

The 1st IF signal from Q4, which is applied to IC1 (pin 16), is mixed with the 2nd LO signal for converting the 1st IF signal to a 455 kHz 2nd IF signal.

The 2nd IF signal output from pin 3 passes through a high-quality ceramic filter (F12) to suppress unwanted heterodyned frequency signals. The signal is amplified at the limiter amplifier section circuit IC1 (pin 5) and applied to the quadrature detector circuit IC1 (pin 8) and a ceramic resonator (X2) to demodulate the 2nd IF signal to AF signals.

### 3-1-4 AF CIRCUIT (LOGIC UNIT)

The AF circuit de-emphasizes demodulated signals with -6 dB/oct. and power amplifies the signals to drive a speaker. The AF circuit includes a mute circuit to mute the signal with a noise squelch and a tone squelch.

AF signals output from IC1 (pin 9) pass through a de-emphasis circuit (R30, C35) and are amplified at IC515a.

The AF signals from IC515a are also applied to the 5-TONE decoder (IC517).

The AF signal from IC515b is applied to the AF power amplifier (IC514) via analog switch Q511 and the VOLUME CONTROL (R1) on the VR UNIT. The signal amplified by IC514 drives the speaker.

Q511 and Q512 together function as a muting circuit using analog switches to mute the AF signal. Q511 and Q512 mute the signal when an R-MUTE signal appears.

IC514 is a small packaged power amplifier. High-power and low-distortion amplifiers and protection circuits for overload are collected in one package.

### • RF, IF CIRCUIT

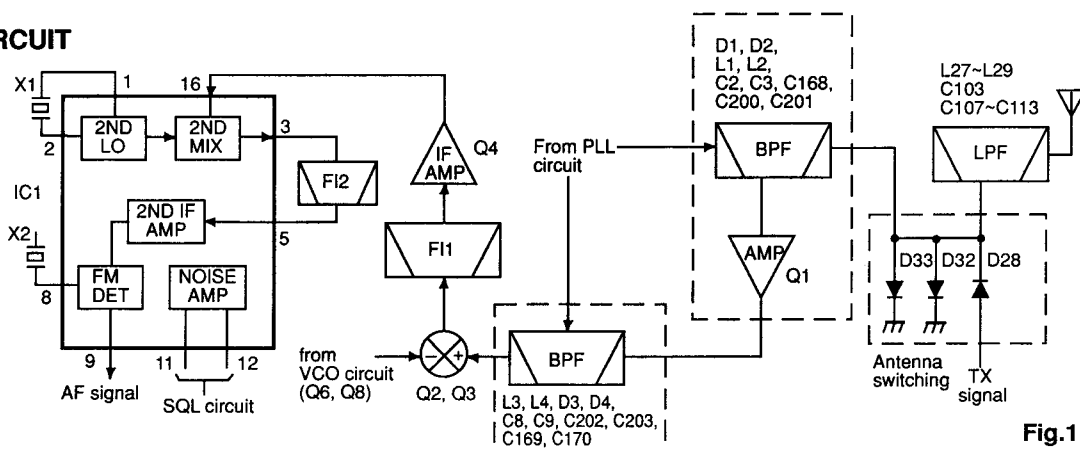


Fig.1

### 3-1-5 SQUELCH CIRCUIT (MAIN UNIT)

The squelch circuit cuts out AF signals when no RF signals are being received. By detecting noise components in the AF signals, the squelch circuit turns the AF power amplifier OFF.

Some signals from IC1 (pin 9) are applied to pin 11, (attached to the active filter of IC1), where noise components of 20 kHz or above are collected.

Audio signals from pin 9 consist of noise components higher than 20 kHz which are amplified by IC1 and then output from pin 11. Amplified noise signals are detected by D15 and D16, and are converted to DC voltage. This voltage is applied to the squelch trigger circuit IC1 (pin 12). The squelch control pot (R543) on the LOGIC UNIT is also connected to pin 12 to adjust converted DC voltage.

A "HIGH" or "LOW" squelch control signal is output from pin 13 and then applied to IC501 (pin 15) on the LOGIC UNIT.

IC501 (Pin 30) becomes "HIGH", while pin 15 is "LOW". The R-MUTE signal is applied to Q511 and Q512 to cut the audio signals.

## 3-2 TRANSMITTER CIRCUITS

### 3-2-1 MICROPHONE AMPLIFIER CIRCUIT (LOGIC UNIT)

The microphone amplifier circuit amplifies audio signals with +6 dB/octave pre-emphasis from the microphone to a level needed at the modulation circuit.

AF signals from the microphone pass through the pre-emphasis circuit consisting of C518 and R525, which has +6 dB/octave frequency characteristics in the 300~3000 Hz frequency range.

After waveform adjustment with R527 and gain adjustment with R529 are made, output signals from IC512a are applied to limiter amplifier IC512b (pin 3).

Output signals from IC512b pass through the splatter filter (IC513) which eliminates components of the signals greater than 3 kHz. The signals are then applied to the VCO circuit Q6 as frequency modulation signals.

### 3-2-2 DRIVER AMPLIFIER CIRCUIT (MAIN UNIT)

The driver amplifier circuit amplifies the VCO oscillating signal to a level needed at the power amplifier.

Signals generated at the VCO circuit are buffer amplified at Q7 and passed through an isolating circuit consisting of L17 and R42. After passing through the isolating circuit, signals are supplied to Q8 and Q9, respectively.

Signals applied to Q9 are used as prescaler signals; signals applied to Q8 are applied to Q10.

The signals are then amplified by Q10 and Q12 to obtain 500 mW of RF output power. To obtain constant output, the APC circuit applies control voltage to the collector of Q12.

A T-MUTE signal prevents unnecessary RF power emissions from occurring at the moment of switching from receive to transmit mode, or when the PLL circuit is unlocked. Q13 controls D23, Q10 and Q12 using the T-MUTE signal.

### 3-2-3 POWER AMPLIFIER CIRCUIT (MAIN UNIT)

The power amplifier circuit amplifies the driver signal to an output power level.

IC8 is an RF power module that can attain 25 W (10 W for #69) with an input of 500mW (68 MHz~88 MHz) as well as obtain stable output over broad bands.

The output power from IC8 (pin 4) passes through an antenna switching circuit and a low-pass filter before being applied to the antenna connector.

Output signals from IC8 pass through a 3-stage low-pass filter consisting of L27~L29, C107~C113 and C103 via D28. This filter suppresses high-frequency spurious signals.

### 3-2-4 APC CIRCUIT (MAIN UNIT)

The APC circuit stabilizes RF output power even when the supplied voltage changes.

The output power from IC8 is detected by D42, D43 and is converted to DC voltage. The voltage is then applied to the inverting amplifier IC7 to control the input current of Q12 and IC8 (pin 2) using Q14 and Q15.

## • DRIVER AMPLIFIER CIRCUIT

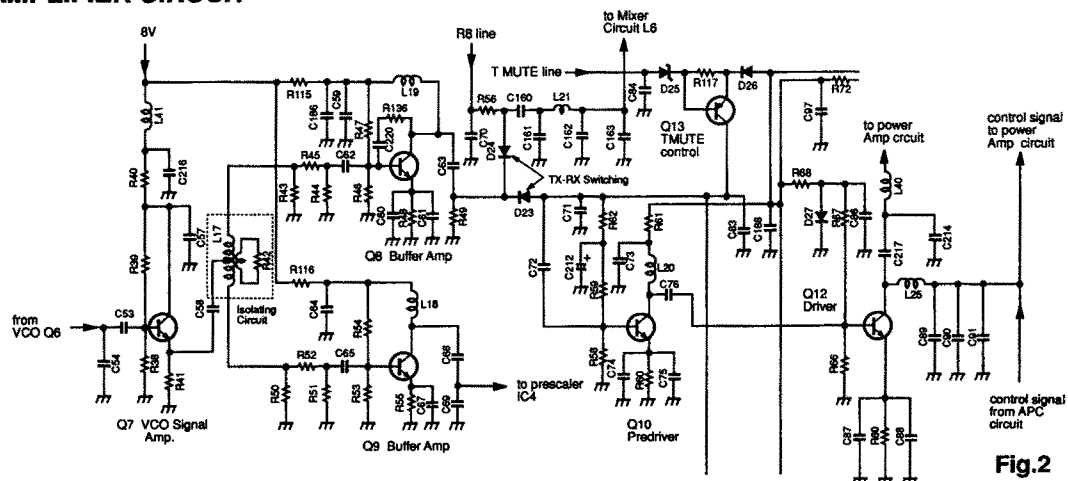


Fig.2

### 3-3 PLL CIRCUITS

#### 3-3-1 GENERAL DESCRIPTION

The PLL is designed in a way that allows the desired frequency to be generated directly by the VCO. The PLL is fed "divided by N-data" from the CPU which determines the operating frequency.

N-data is determined by dividing the desired frequency by the reference frequency. The desired frequency is the transmit frequency in transmit mode and the first local oscillator frequency in receive mode.

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

#### 3-3-2 REFERENCE OSCILLATOR AND VCO CIRCUIT (MAIN UNIT)

A reference frequency of 6.25kHz is acquired by X3, Q17, and the divider inside IC4. A signal from the VCO is buffer amplified at Q9, applied to IC4, and divided N times at IC4. The divided signal is applied to the phase detector in IC4. Phase detection results in lock voltages being output from pins 5 and 12.

#### 3-3-3 LOOP FILTER CIRCUIT (MAIN UNIT)

Output from IC4 (pins 5 and 12) is converted to DC voltage

in a charge pump circuit consisting of Q23, Q18 and Q19, and is then applied to a lag-lead type, loop filter consisting of R104, R105 and C149.

The signal passing through the loop filter is applied to varactor diodes D21 and D22 via the RF choke-coil L12 to control the VCO output frequency.

D37 and D38 shorten the lockup time when changing from receive to transmit mode or vice versa.

#### 3-3-4 DC-DC CONVERTER (MAIN UNIT)

IC5 is a DC-DC converter which converts 5 V DC to 20 V DC to obtain lock voltages for the PLL circuit and a voltage range of 1~20 V DC for the bandpass tuning operation of the RF circuit.

#### 3-3-5 VOLTAGE LINES (MAIN UNIT)

HV	External power from the DC power connector.
13.2 V	13.2 V DC from the [VOL] switch.
5 V	Common 5 V converted from the 13.2 V line at IC6.
8 V	Common 8 V converted from the 13.2 V line at IC2.
T8	Transmit 8 V converted from the 13.2 V line at IC2.
R8	Receive 8 V converted from the 13.2 V line at IC2.

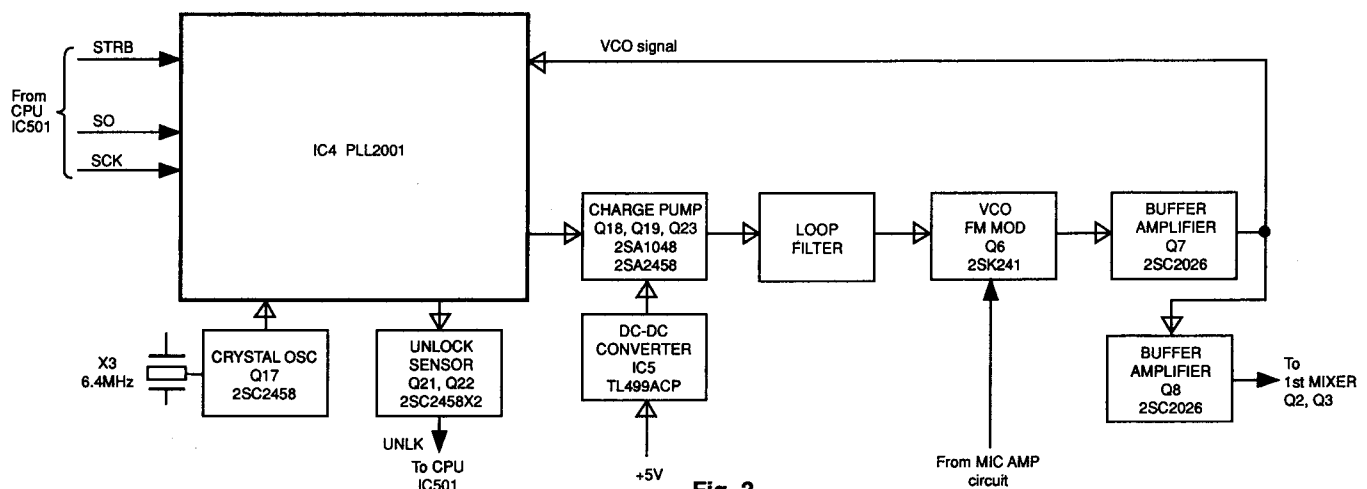


Fig. 3

### 3-4 LOGIC CIRCUITS

The LOGIC circuit section consists of an 8-bit C-MOS type CPU, an 8 K-byte C-MOS ROM, a 2 K-byte C-MOS RAM and a 5-TONE encoder/decoder which mainly displays frequency and tone numbers.

#### 3-4-1 CPU (LOGIC UNIT)

CPU  $\mu$ PD78C06AG's main functions relate to the controls and switches on the FRONT PANEL of the IC-V200T. It incorporates a 4 K-byte ROM and a 128-byte RAM. The ports are distributed as follows:

##### (1) DATA BUS (DB0~DB7)

This is an 8-bit data bus which performs data exchange with the 2 K-byte RAM. DB0~DB3 are also matrix input ports.

##### (2) ADDRESS BUS (PE0~PE15)

This is a 16-bit port which can switch ADDRESS and OUTPUT ports according to the program. PE13~PE15 are used as ENABLE signals for RAM, ROM or MATRIX selection.

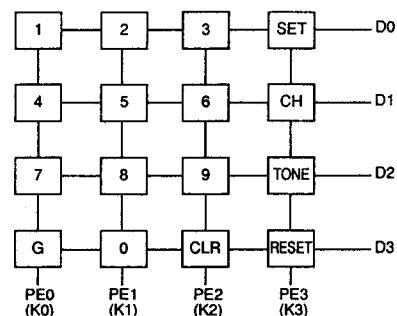


Fig. 4

### 3-4-2 PORT DESCRIPTIONS (LOGIC UNIT)

PIN NO.	NAME	DESCRIPTION
6	INT1	This port is "HIGH" when the CPU is in standby mode or when the POWER SWITCH is in the OFF position. When the POWER SWITCH is in the ON position, this port is "LOW".
7	INT0	This is an input port for 5-TONE decoder data. The 5-TONE data is input when this port is "HIGH".
9	WR	This port outputs the timing signal when writing in the external memory (RAM).
11	PC5 (BUSY)	Input port for the BUSY signal of the LCD driver.
12	PC4 (TRF)	Input port for "TX" INDICATOR. The indicator appears on the LCD when this port is "LOW".
13	PC3 (FUNC)	Input port for the FUNCTION SWITCH. If this port is "LOW" when power is ON, it accepts the received cloning input.
14	PC2 (SEND)	Input port for transmit/ receive switching signals that are ready at a HIGH level. (This terminal is used for cloning input.)
15	PC1 (SQL)	Input port for the squelch open signal; becomes "HIGH" when opened.
16	PC0 (UNLK)	Input port for PLL unlock signals. During unlock conditions, this port is "LOW."
18	BEEP	Output port for the beep tone signal.
19	SCK	Output port for the SO data output timing signal. The data of SO changes the trailing edge of SCK.
21	SO	Output port for the shift register inside the CPU. This terminal outputs CTCSS tone data and LCD command/data.
27	PA0 (STRB0)	Outputs a latch signal for PLL N-data.
28	PA1 (CPO)	Outputs cloning data.
29	PA2 (PSAV)	Not used.
30	PA3 (RMUT)	This port becomes "HIGH" when the speaker sound is muted.
31	PA4 (TMUT)	This port becomes "HIGH" when RF power is turned OFF.

PIN NO.	NAME	DESCRIPTION
32	PA5 (CK)	Outputs a synchronized clock signal when PLL N-data is sent out.
33	PA6 (PLL/C/D)	Outputs a signal for switching between PLL N-data and LCD command/data.
34	PA7 (CS)	Outputs an enable signal of the LCD driver when LCD command/data is sent out. This port becomes "LOW" when command/data is sent out.
35~38	PB0~PB3 (S0~S3)	Input/output port for 5-TONE data. The output port applies the data to the 5-tone encoder when transmitting. The input port receives the data for the 5-tone decoder when receiving.
39	PB4 (T/R)	Output port for the transmit/ receive switching signal. It becomes "LOW" during transmit and "HIGH" during receive.
40	PB5 (STRB1)	Output port for the 5-TONE encoder strobe signal.
41	PB6 (STRB2)	Output port for the CTCSS tone data strobe signal.
42	PB7 (EXC)	When the received 5-TONE code is matched to the desired code, this terminal becomes "HIGH" for about 1msec.

### 3-4-3 ROM

SC-1169 is a CMOS, 32768-word 8-bit ROM.

This ROM memorizes the control program for the CPU. Reading data is performed by the address specified by PE0~PE12 of the CPU.

#### ROM READ TIMING DIAGRAM

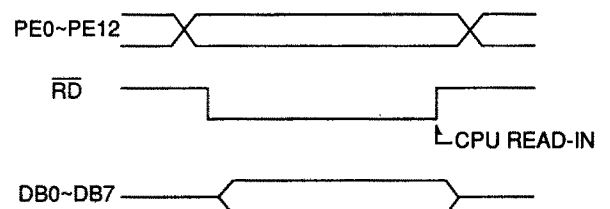


Fig. 5

### 3-4-4 RAM

$\mu$ PD446G is a CMOS, 2048-word 8-bit RAM.

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

Reading or writing data is performed by the address specified by PE0~PE10 of the CPU.

#### RAM READ TIMING DIAGRAM

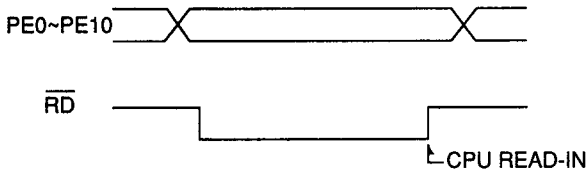


Fig. 6

#### RAM WRITE TIMING DIAGRAM

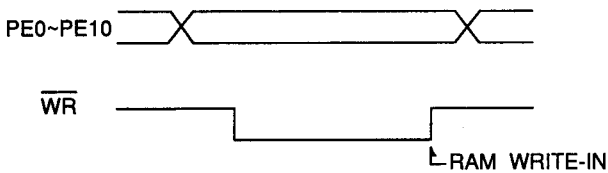


Fig. 7

### 3-4-5 RESET CIRCUIT (LOGIC UNIT)

If the voltage of the +5 V line rises when the power is ON, Q505 is switched ON and the collector becomes "HIGH." When the collector is "HIGH," IC516 (pin 9) output becomes "LOW." The IC516 (pin 12) output switches from "LOW" to "HIGH" and resets the LCD driver and the CPU.

The CPU reset timing is delayed by C510 and R510.

When the power is OFF, Q505 is OFF and the IC516 (pin 12) output becomes "LOW" to make the CPU standby.

#### RESET TIMING CHART

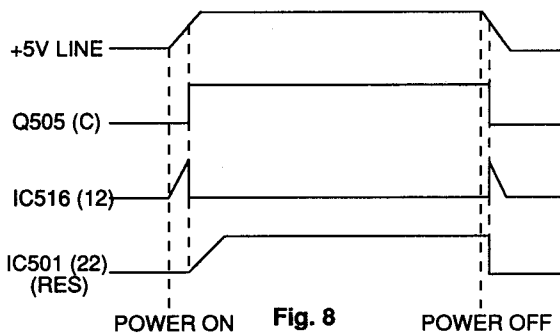


Fig. 8

## 3-5 5-TONE CIRCUITS

### 3-5-1 5-TONE IC

IC516 (SC-1084) is a gate-array IC consisting of a 5-tone encoder/decoder, data selector for controlling the CPU, a serial-parallel converter and a divider and inverter for resetting.

The following I/O ports are equipped:

PORT NAME	PIN NUMBER	DESCRIPTION
IO0~IO3	61~64	I/O ports for the 5-tone encoder/decoder data.
CON1	60	Output/Input control port for the IO0~IO3.
RX	59	Control port which activates either the encoder or decoder.
TO1, TO2	44, 45	Ports which change the 5-tone system. (see below)
ST1	57	Port for a 5-tone encoder strobe signal.
EC, EC0~EC2	40~43	Output ports for the encoder/decoder.
DS	21	Input port for the decoder signal.
ST3	8	Port for a decoder strobe signal.
SE1~SE3	2 ~ 4	Input ports for the selection of data.
MA0~MA3 DB0~DB3 CE1, CE2	39~36 52~55 50, 51	SE1~SE3 select each port.
ST2, SCK2, SI2	56, 7, 6	Series input ports for the S-P converter.
P1~P8	13~20	Parallel input ports for the S-P converter.
IN1, IN2	9, 11	Input ports for an inverter.
OUT1, OUT2	10, 12	Output ports for an inverter.
KO1	5	Output port for 4.48 MHz.
KO3	22	Output port for 560 kHz.
OSC1, OSC2	34, 35	Ports for a crystal oscillator.

TEST, T1, SET, RES, CON2, RCE, RT2, RT1, CP1, DATAC, K05, K04, K02 are test points for the IC516.

The 5-tone system depends on the transceiver version and signals from the CPU, V1 (TO1) and V2 (TO2) as follows:

V1	V2	SC-1084
L	L	EIA
H	L	CCIR
L	H	EEA
H	H	ZVEI

### 3-5-2 5-TONE FREQUENCY TABLE

The programmable 5-TONE encoder/decoder described at bottom, left is included in IC516, (a gate-array type IC chip):

5-TONE CODE	FREQUENCY			
	CCIR (Hz)	EEA (Hz)	ZVEI (Hz)	EIA (Hz)
0	1981	1981	2400	600
1	1124	1124	1060	741
2	1197	1197	1160	882
3	1275	1275	1270	1023
4	1358	1358	1400	1164
5	1446	1446	1530	1305
6	1540	1540	1670	1446
7	1640	1640	1830	1587
8	1747	1747	2000	1728
9	1860	1860	2200	1869
G	2400	1055	2800	2151
R	2110	2110	2600	459

### 3-5-3 SERIAL-PARALLEL CONVERTER (LOGIC UNIT)

Serial CTCSS data from the CPU is converted to paralleled data at IC516 and is applied to the optional CTCSS UNIT.

This circuit is included in IC516, (a gate-array type IC chip):

TONE NO.	FREQUENCY (Hz)	DATA (HEX)	TONE NO.	FREQUENCY (Hz)	DATA (HEX)
1	67.0	3E	20	136.5	2F
2	71.9	3D	21	141.3	2E
3	74.4	1B	22	146.2	2D
4	77.0	3C	23	151.4	2C
5	79.7	19	24	156.7	2B
6	82.5	3B	25	162.2	2A
7	85.4	17	26	167.9	29
8	88.5	3A	27	173.8	28
9	91.5	15	28	179.9	27
10	94.8	39	29	186.2	26
11	100.0	38	30	192.8	25
12	103.5	37	31	203.5	24
13	107.2	36	32	210.7	23
14	110.9	35	33	218.1	22
15	114.8	34	34	225.7	21
16	118.8	33	35	233.6	20
17	123.0	32	36	241.8	1F
18	127.3	31	37	250.3	1E
19	131.8	30	—	—	—

### 3-5-4 HORN DRIVER CIRCUIT (LOGIC UNIT)

The horn driver circuit consists of IC510 and Q513.

If the transceiver acknowledges a 5-TONE signal, CPU (pin 42) outputs one pulse signal to IC510, and then IC510 turns Q513 ON for about 2 seconds.

### 3-5-5 AF MUTE AND 5-TONE CANCELLER CIRCUITS (LOGIC UNIT)

When an optional CTCSS UNIT is installed, the DOUT signal (J512) becomes "LOW" and then Q518 (collector) outputs in a "HIGH" condition.

The output signal from Q518 (collector) is applied to the gates of Q511 and Q512 via D510.

"HIGH" signals from Q518 (collector) turn Q511 and Q512 ON, and then AF signals are muted. Simultaneously, signals are applied to the IC501 (pin 7, INT0) via D510 and Q504. Thus, the interrupt signal from the 5-TONE encoder/decoder circuit is canceled.

While a CTCSS tone signal is received, output signals from Q518 (collector) become "LOW," and AF signal muting is released if the tone number matches the desired number.

When the HANG signal from J505 (pin 7) is "HIGH," Q519 and Q506 turn OFF and the CTCSS UNIT does not function.

### 3-6 DISPLAY CIRCUIT (DISPLAY UNIT)

IC401 is a programmable LCD controller/driver. DS401 is a LCD panel which displays the following indicators:

- 5-TONE code
- Channel number
- Transmit/Receive
- Answer back

A voltage regulator circuit consisting of Q510 and D512 applies 8V to DS402 and DS403 for illuminating the LCD.

# SECTION 4 MECHANICAL PARTS AND DISASSEMBLY

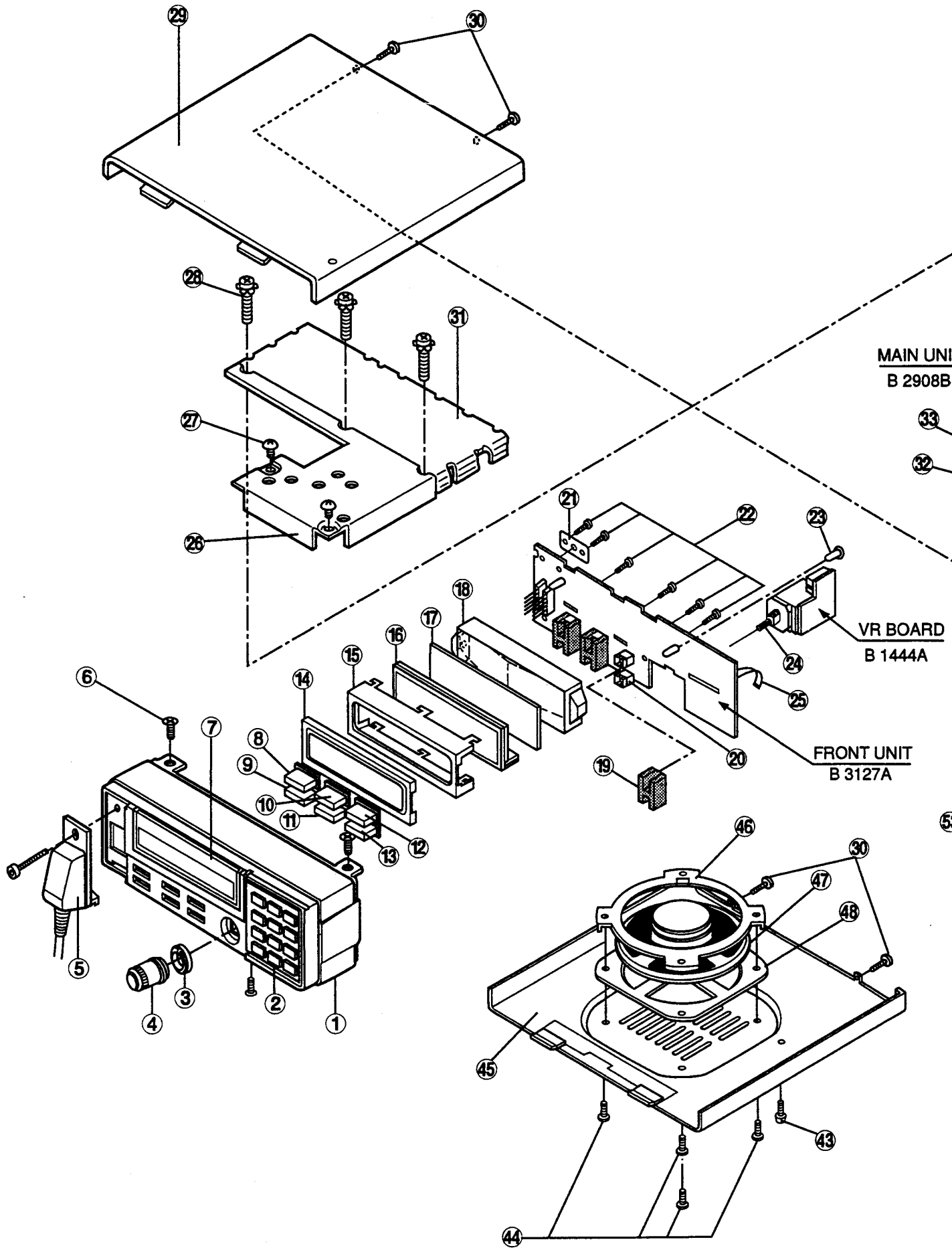
## 4-1 FRONT PANEL AND CHASSIS PARTS LIST

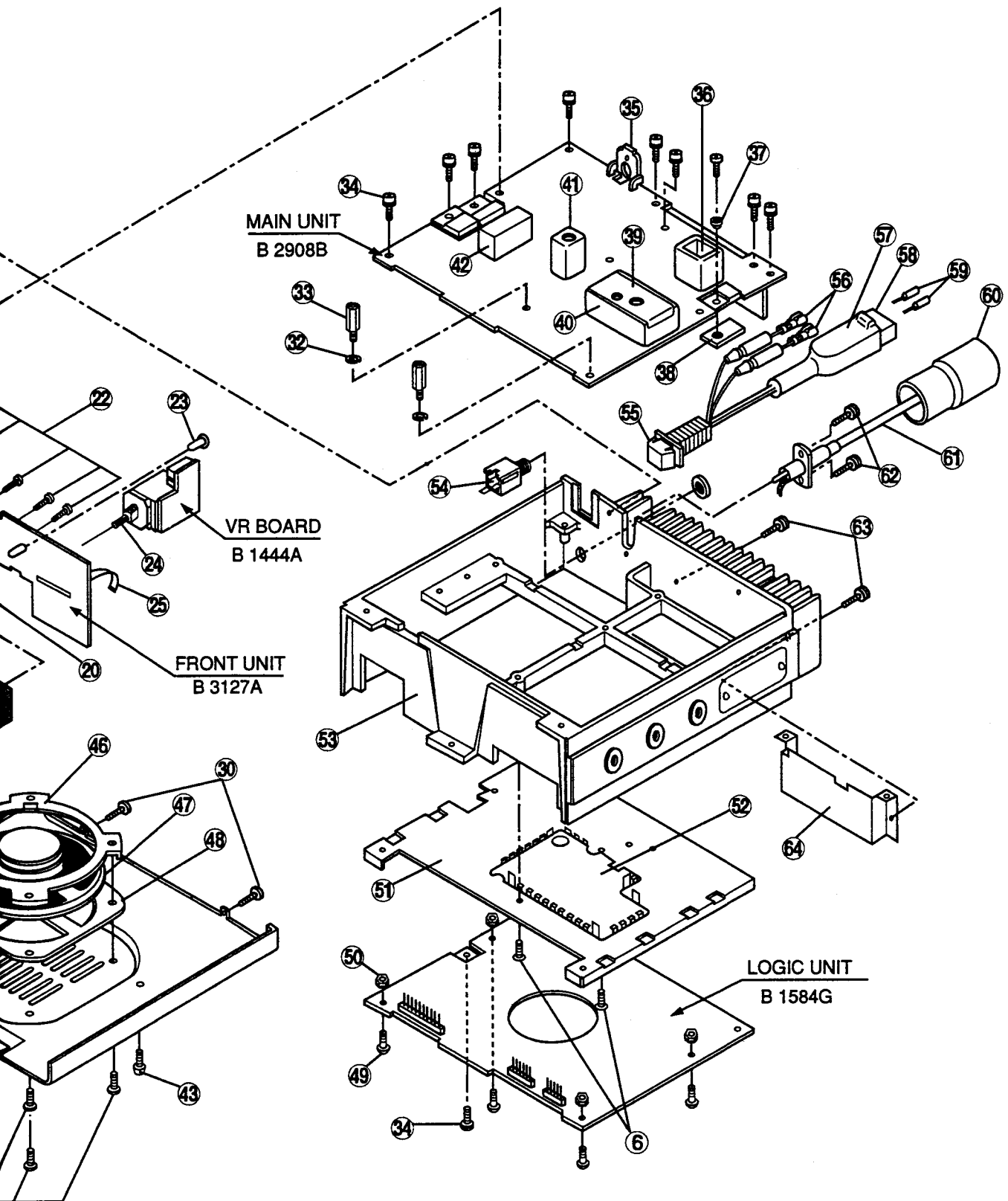
LABEL NO.	ORDER NO.	DESCRIPTION	QTY.
①	8210004700	331 Front Panel	1
②	8010006210	Keyboard (A)	1
③	8830000050	VR Nut (B)	1
④	8610003370	VR knob N115	1
⑤	7700000710	Microphone (HM-45)	1
⑥	8810002170	Screw FH M3 x 6	5
⑦	8310010500	331 Window panel (A)	1
⑧	8610003361	Button K50 (F)-2 [CALL]	1
⑨	8610003351	Button K50 (E)-2 [RESET]	1
⑩	8610003321	Button K50 (B)-2 [SCAN]	1
⑪	8610003341	Button K50 (D)-2 [SET]	1
⑫	8610003311	Button K50 (A)-2 [TONE]	1
⑬	8610003331	Button K50 (C)-2 [CH]	1
⑭	8930010430	331 LCD cover	1
⑮	8930010870	331 LCD holder	1
⑯	5030000260	LCD (LR598-A)	1
⑰	8930010480	331 LCD filter	1
⑱	8010006230	331 LCD reflector	1
⑲	8930010440	331 Switch sheet	3
⑳	2260000680	Switch SKHHBV011A	6
㉑	8930010860	331 Mic. base plate	1
㉒	8810001000	Screw B0 M2 x 6	6
㉓	6910001290	T3 Lump cover (Green)	2
㉔	7210001280	Volume (EVK-QVB315A14) 10KA	1
㉕	8930017190	Grounding spring (F)	1
㉖	8510004341	Main shield case-1	1
㉗	8810000210	Screw PH M3 x 4	2
㉘	8810005000	Setscrew (G) M3 x 17	3
㉙	8110004200	622 Top cover (A)	1
㉚	8810002960	Screw BiH M3 x 6 ZK SUS	4
㉛	8510005271	PA shield plate (B)-1	1
㉜	8850000420	Spring washer M3 NI	2

LABEL NO.	ORDER NO.	DESCRIPTION	QTY.
㉝	8930000100	Standoff (F)	2
㉞	8810003160	Setscrew A M3 x 6	10
㉟	8930017490	Cable stopper	1
㊱	8510000020	194 Shield case	1
㊲	6910000280	B17 insulating bush	1
㊳	8950000230	Insulating sheet TC45A (T = 0.4)	1
㊴	8510006330	855 VCO case (top)	1
㊵	8510006320	855 VCO case	1
㊶	6910001130	10M/M shield case (P10L-A)	1
㊷	8510004150	DC-DC shield case	1
㊸	8810000560	Polyester screw PH M4 x 6	1
㊹	8810003840	Screw BiH M3 x 8 ZK SUS	4
㊺	8110004400	Bottom cover (F)	1
㊻	8930006390	Speaker plate	1
㊼	2510000200	Speaker (4 Ω)	1
㊽	8930004950	57 Speaker spacer (includes net)	1
㊾	8810003760	Icom screw C10	4
㊿	8930006080	Half thread spacer C	4
①	8010003240	Chassis spacer-1	1
②	8510006770	331 Antenna shield plate	1
③	8010010460	452 chassis (C)-1	1
④	6450000420	SPJack (HSJ0780-01-010)	1
⑤	8900002780	DC cable (OPC-274)	1
⑥	6510008830	Pin SGF-41-4	2
⑦	6950000180	Connector cover	1
⑧	6510004780	Connector LR-02-1V	1
⑨	6510005150	Pin SLM61T-2.0	2
⑩	6950000040	M type cap (Black)	1
⑪	8900001050	Antenna cable OPC-103	1
⑫	8810003140	Setscrew M2.6 x 8	2
⑬	8810003180	Setscrew M3 x10	2
⑭	8930006470	Module plate	1

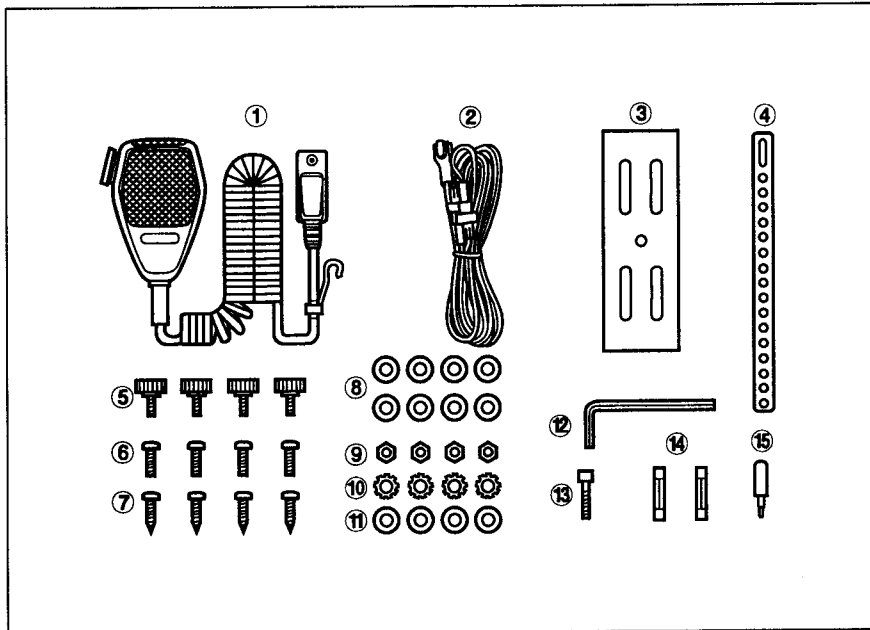
**Screw abbreviations**    FH: Flat head    B0: Self-tapping    PH: Pan head    BiH: Binding head    NI: Nickel    ZK: Black







## 4-2 ACCESSORIES



LABEL NO.	ORDER NO.	DESCRIPTION	QTY.
①	Optional product	Microphone HM-45	1
②	Optional product	DC power cable OPC-044A	1
③	8010004060	Mounting bracket	1
④	8010004050	Mounting support plate (B) ZK	1
⑤	8820000461	Mounting bolt (B)-1 M4 x 8 ZK	4
⑥	8810003870	Screw PH M5 x 20	4
⑦	8810000950	Screw PH A M5 x 16	4
⑧	8850000150	Flat washer M5 NI BS	8
⑨	8830000120	Nut M5	4
⑩	8850000590	Star washer M5	4
⑪	8850000140	Flat washer M4 NI BS	4
⑫	8860000640	Allen key wrench 2.5M/M	1
⑬	8820000510	Allen head screw M3 x 18 ZK	1
⑭	5210000070	Fuse FGB 10A	2
⑮	5610000020	AP313 3.5φ CS plug	1

**Screw abbreviations** BS: Brass NI: Nickel  
PH: Pan head ZK: Black

# SECTION 5 PARTS LIST

## [MAIN UNIT]

REF. NO.	ORDER NO.	DESCRIPTION	
IC1	1110000630	IC	MC3357P
IC2	1110000390	IC	MB3756M-G
IC4	1130003050	IC	PLL2001
IC5	1110000900	IC	TL499ACP
IC6	1180000190	IC	NJM7805A
IC7	1110000070	IC	μPC358C
IC8	1150000990	IC	SC1170
Q1	1560000110	FET	2SK241-GR
Q2	1530001810	Transistor	2SC3355
Q3	1530001810	Transistor	2SC3355
Q4	1560000110	FET	2SK241-GR
Q5	1530000110	Transistor	2SC2458-GR
Q6	1560000110	FET	2SK241-GR
Q7	1530000520	Transistor	2SC2026
Q8	1530000520	Transistor	2SC2026
Q9	1530000520	Transistor	2SC2026
Q10	1530000530	Transistor	2SC2407
Q12	1530000810	Transistor	2SC2053
Q13	1520000070	Transistor	2SB561C
Q14	1520000030	Transistor	2SB596-Y (Z)
Q15	1530000440	Transistor	2SC945 P
Q16	1530000440	Transistor	2SC945 P
Q17	1530000110	Transistor	2SC2458-GR
Q18	1510000080	Transistor	2SA1048-GR
Q19	1530000110	Transistor	2SC2458-GR
Q20	1560000010	FET	2SK184-Y
Q21	1530000110	Transistor	2SC2458-GR
Q22	1530000110	Transistor	2SC2458-GR
Q23	1530000110	Transistor	2SC2458-GR
D1	1720000340	Varicap	1SV211
D2	1720000340	Varicap	1SV211
D3	1720000340	Varicap	1SV211
D4	1720000340	Varicap	1SV211
D11	1790000240	Diode	1SS99
D13	1730000120	Zener	RD6.2E B2
D14	1710000160	Diode	1SS133
D15	1710000040	Diode	1S953
D16	1710000040	Diode	1S953
D17	1710000160	Diode	1SS133
D20	1710000580	Diode	1SS265
D21	1720000060	Varicap	1SV50 (1)E
D22	1720000060	Varicap	1SV50 (1)E
D23	1710000580	Diode	1SS265
D24	1710000580	Diode	1SS265
D25	1730000390	Zener	RD4.7E B3
D26	1710000040	Diode	1S953
D27	1710000600	Diode	1SS254
D28	1710000290	Diode	M1308
D31	1710000160	Diode	1SS133
D32	1710000290	Diode	M1308
D33	1710000290	Diode	M1308
D34	1710000040	Diode	1S953
D35	1710000010	Diode	15CD11
D36	1720000060	Varicap	1SV50 (1)E
D37	1710000160	Diode	1SS133
D38	1710000160	Diode	1SS133
D41	1710000050	Diode	1SS53
D42	1790000070	Diode	1SS237
D43	1790000070	Diode	1SS237
D44	1710000050	Diode	1SS53

## [MAIN UNIT]

REF. NO.	ORDER NO.	DESCRIPTION	
D45	1730000120	Zener	RD6.2E B2
X1	6050002000	Crystal	CR-70
X2	6070000010	Discriminator	CDB455C7A
X3	6050002150	Crystal	CR-85
F11	2010001020	Filter	21M 7B2 (FL-125) (#61,#62,#68)
F11	2010001050	Filter	21M15B3 (FL-141) (#63,#64,#65,#66,#67,#69)
F12	2020000150	Ceramic	CFW455HT (#61,#62,#68)
F12	2020000120	Ceramic	CFW455E (#63,#64,#65,#66,#67,#69)
L1	6150003760	Coil	LS-427
L2	6150003760	Coil	LS-427
L3	6150003770	Coil	LS-428
L4	6150003770	Coil	LS-428
L6	6140002050	Coil	LR-224
L7	6150002950	Coil	LS-304
L8	6150002730	Coil	LS-298
L9	6150002720	Coil	LS-297
L11	6130001050	Coil	LB-141
L12	6140001010	Coil	LR-125
L13	6140001010	Coil	LR-125
L14	6180000850	Coil	LAL 03NA 4R7K
L15	6180000850	Coil	LAL 03NA 4R7K
L17	6140002050	Coil	LR-224
L18	6110001570	Coil	LA-237
L19	6180000740	Coil	LAL 03NA R56M
L20	6110001580	Coil	LA-238
L21	6110001620	Coil	LA-245
L22	6110001620	Coil	LA-245
L25	6110001700	Coil	LA-256
L26	6170000180	Coil	LW-19
L27	6110001690	Coil	LA-255
L28	6110001690	Coil	LA-255
L29	6110001680	Coil	LA-254
L30	6170000150	Coil	LW-16
L31	6180001440	Coil	RFC S4 101K
L32	6180001460	Coil	LAL 03NA 681K
L33	6180000900	Coil	LAL 03NA 101K
L34	6180001120	Coil	FL 5H 101K
L35	6180000900	Coil	LAL 03NA 101K
L37	6110001650	Coil	LA-248
L38	6110001650	Coil	LA-248
L39	6130002470	Coil	LB-274
L40	6110001700	Coil	LA-256
L41	6180000770	Coil	LAL 03NA 1R0M
L42	6140001070	Coil	LR-132
L43	6180000900	Coil	LAL 03NA 101K
L44	6180000690	Coil	LAL 03NA R22M
L45	6180000960	Coil	LAL 03NA 102K
R1	7010003680	Resistor	ELR20J 150 kΩ
R2	7010003680	Resistor	ELR20J 150 kΩ
R4	7010003390	Resistor	ELR20J 820 Ω
R5	7010004070	Resistor	R20J 100 Ω
R6	7010003680	Resistor	ELR20J 150 kΩ

[MAIN UNIT]

REF. NO.	ORDER NO.	DESCRIPTION
R7	7010004470	Resistor R20J 150 kΩ
R9	7010004070	Resistor R20J 100 Ω
R10	7010004330	Resistor R20J 12 kΩ
R11	7010003300	Resistor ELR20J 150 Ω
R12	7010003300	Resistor ELR20J 150 Ω
R13	7010003400	Resistor ELR20J 1 kΩ
R14	7010003250	Resistor ELR20J 56 Ω
R15	7010003250	Resistor ELR20J 56 Ω
R16	7010004320	Resistor R20J 10 kΩ
R18	7010004320	Resistor R20J 10 kΩ
R19	7010003740	Resistor ELR20J 470 kΩ
R20	7010003280	Resistor ELR20J 100 Ω
R21	7010001030	Resistor R25XJ 100 Ω
R22	7010004320	Resistor R20J 10 kΩ
R23	7010003780	Resistor ELR20J 1 MΩ
R24	7010003620	Resistor ELR20J 47 kΩ
R25	7010003440	Resistor ELR20J 2.2 kΩ (#61,#62,#68)
	7010003420	Resistor ELR20J 1.5 kΩ (#63,#64,#65,#66,#67,#69)
R26	7010003440	Resistor ELR20J 2.2 kΩ (#61,#62,#68)
	7010003420	Resistor ELR20J 1.5 kΩ (#63,#64,#65,#66,#67,#69)
R27	7010003620	Resistor ELR20J 47 kΩ
R28	7010003420	Resistor ELR20J 1.5 kΩ
R29	7010003430	Resistor ELR20J 1.8 kΩ
R30	7010003580	Resistor ELR20J 22 kΩ
R31	7510000090	Thermistor ERT-D2FGL202S
R32	7010003740	Resistor ELR20J 470 kΩ (#61,#62,#68)
	7010003720	Resistor ELR20J 330 kΩ (#63,#64,#65,#66,#67,#69)
R33	7010003440	Resistor ELR20J 2.2 kΩ
R34	7010003640	Resistor ELR20J 68 kΩ (#61,#62,#68)
	7010003580	Resistor ELR20J 22 kΩ (#63,#64,#65,#66,#67,#69)
R35	7010003530	Resistor ELR20J 10 kΩ
R36	7310000820	Trimmer RH0651C16J0RA (105)
R37	7010003340	Resistor ELR20J 330 Ω
R38	7010003430	Resistor ELR20J 1.8 kΩ
R39	7010003530	Resistor ELR20J 10 kΩ
R40	7010003320	Resistor ELR20J 220 Ω
R41	7010003280	Resistor ELR20J 100 Ω
R42	7010004030	Resistor R20J 47 Ω
R43	7010003330	Resistor ELR20J 270 Ω
R44	7010003330	Resistor ELR20J 270 Ω
R45	7010003980	Resistor R20J 18 Ω
R46	7010003440	Resistor ELR20J 2.2 kΩ
R47	7010004200	Resistor R20J 1.2 kΩ
R48	7010003320	Resistor ELR20J 220 Ω
R49	7010003400	Resistor ELR20J 1 kΩ
R50	7010003300	Resistor ELR20J 150 Ω
R51	7010004090	Resistor R20J 150 Ω
R52	7010004020	Resistor R20J 39 Ω
R53	7010004250	Resistor R20J 3.3 kΩ
R54	7010004230	Resistor R20J 2.2 kΩ
R55	7010003320	Resistor ELR20J 220 Ω
R56	7010003440	Resistor ELR20J 2.2 kΩ
R57	7010003440	Resistor ELR20J 2.2 kΩ
R58	7010003350	Resistor ELR20J 390 Ω
R59	7010003400	Resistor ELR20J 1 kΩ
R60	7010003160	Resistor ELR20J 10 Ω
R61	7010003280	Resistor ELR20J 100 Ω
R62	7010003440	Resistor ELR20J 2.2 kΩ
R66	7010003360	Resistor ELR20J 470 Ω
R67	7010003280	Resistor ELR20J 100 Ω
R68	7010003360	Resistor ELR20J 470 Ω
R69	7010000130	Resistor ELR25J 10 Ω
R70	7010004660	Resistor R50XJ 15 Ω
R72	7010003280	Resistor ELR20J 100 Ω

[MAIN UNIT]

REF. NO.	ORDER NO.	DESCRIPTION
R74	7010003660	Resistor ELR20J 100 kΩ
R75	7010003590	Resistor ELR20J 27 kΩ
R76	7010003660	Resistor ELR20J 100 kΩ
R77	7010003550	Resistor ELR20J 15 kΩ
R78	7010004390	Resistor R20J 33 kΩ
R79	7310000790	Trimmer RH0651C15J1UA (104)
R80	7010003540	Resistor ELR20J 12 kΩ
R81	7010003550	Resistor ELR20J 15 kΩ
R82	7510000090	Thermistor ERT-D2FGL202S
R83	7010003530	Resistor ELR20J 10 kΩ
R84	7510000090	Thermistor ERT-D2FGL202S
R85	7010003430	Resistor ELR20J 1.8 kΩ
R86	7010003510	Resistor ELR20J 6.8 kΩ
R87	7010003660	Resistor ELR20J 100 kΩ
R88	7010003660	Resistor ELR20J 100 kΩ
R89	7010003440	Resistor ELR20J 2.2 kΩ
R90	7010003280	Resistor ELR20J 100 Ω
R92	7010004170	Resistor R20J 680 Ω
R93	7010003650	Resistor ELR20J 82 kΩ
R94	7010003480	Resistor ELR20J 4.7 kΩ
R95	7010003400	Resistor ELR20J 1 kΩ
R96	7010003610	Resistor ELR20J 39 kΩ
R97	7010003600	Resistor ELR20J 33 kΩ
R98	7010003740	Resistor ELR20J 470 kΩ
R99	7010003630	Resistor ELR20J 56 kΩ
R100	7010003700	Resistor ELR20J 220 kΩ
R101	7010003620	Resistor ELR20J 47 kΩ
R102	7010003660	Resistor ELR20J 100 kΩ
R103	7010003530	Resistor ELR20J 10 kΩ
R104	7010003360	Resistor ELR20J 470 Ω
R105	7010003440	Resistor ELR20J 2.2 kΩ
R106	7010003480	Resistor ELR20J 4.7 kΩ
R107	7010003700	Resistor ELR20J 220 kΩ
R108	7010003620	Resistor ELR20J 47 kΩ
R109	7010004320	Resistor R20J 10 kΩ
R110	7010003440	Resistor ELR20J 2.2 kΩ
R111	7010003540	Resistor ELR20J 12 kΩ
R112	7010003490	Resistor ELR20J 5.6 kΩ
R113	7010004070	Resistor R20J 100 Ω
R114	7010003410	Resistor ELR20J 1.2 kΩ
R115	7010004070	Resistor R20J 100 Ω
R116	7010003280	Resistor ELR20J 100 Ω
R117	7010004320	Resistor R20J 10 kΩ
R118	7010004110	Resistor R20J 220 Ω
R120	7010003400	Resistor ELR20J 1 kΩ
R122	7010003280	Resistor ELR20J 100 Ω
R123	7010001230	Resistor R25XJ 4.7 kΩ
R124	7010001230	Resistor R25XJ 4.7 kΩ
R125	7010003530	Resistor ELR20J 10 kΩ
R126	7010004190	Resistor R20J 1 kΩ
R128	7010003400	Resistor ELR20J 1 kΩ
R129	7010003400	Resistor ELR20J 1 kΩ
R130	7010003400	Resistor ELR20J 1 kΩ
R131	7010003580	Resistor ELR20J 22 kΩ
R132	7010003480	Resistor ELR20J 4.7 kΩ
R133	7010003550	Resistor ELR20J 15 kΩ
R134	7010003530	Resistor ELR20J 10 kΩ
R135	7010003220	Resistor ELR20J 33 Ω
R136	7010004230	Resistor R20J 2.2 kΩ
R137	7010003610	Resistor ELR20J 39 kΩ (#61,#62,#68)
	7010003550	Resistor ELR20J 15 kΩ (#63,#64,#65,#66,#67,#69)
R138	7010004000	Resistor R20J 27 Ω
R139	7010004320	Resistor R20J 10 kΩ
C1	4010000500	Ceramic DD104 B 102K 50V
C2	4010000050	Ceramic DD104 SL 030C 50V
C3	4010000070	Ceramic DD104 SL 050C 50V
C5	4010000500	Ceramic DD104 B 102K 50V
C6	4010000460	Ceramic DD104 B 471K 50V

[MAIN UNIT]

REF. NO.	ORDER NO.	DESCRIPTION
C8	4010000090	Ceramic DD104 SL 070D 50V
C9	4010000020	Ceramic DD104 SL 010C 50V
C11	4010000500	Ceramic DD104 B 102K 50V
C13	4010000500	Ceramic DD104 B 102K 50V
C14	4010000500	Ceramic DD104 B 102K 50V
C15	4010000500	Ceramic DD104 B 102K 50V
C17	4010000500	Ceramic DD104 B 102K 50V
C18	4010000500	Ceramic DD104 B 102K 50V
C19	4010000500	Ceramic DD104 B 102K 50V
C20	4010000520	Ceramic DD108 B 472K 50V
C21	4010000150	Ceramic DD104 SL 150J 50V
C21	4010000100	Ceramic DD104 SL 080D 50V (#63,#64,#65,#66,#67,#69)
C22	4010000320	Ceramic DD104 SL 820J 50V
C23	4010000300	Ceramic DD104 SL 680J 50V
C24	4010000500	Ceramic DD104 B 102K 50V
C25	4040000150	Barrier Layer UAT 05X 472K
C26	4010000500	Ceramic DD104 B 102K 50V
C27	4010000340	Ceramic DD105 SL 121J 50V
C28	4010000300	Ceramic DD104 SL 680J 50V
C29	4040000260	Barrier Layer UZE 08X 104M
C30	4010000320	Ceramic DD104 SL 820J 50V
C31	4550000320	Tantalum DN 1V 0R1M
C32	4010000500	Ceramic DD104 B 102K 50V
C33	4510001100	Electrolytic 16 MS7 10 μF
C34	4510001970	Electrolytic 50 MS7 0R1 μF
C35	4040000260	Barrier Layer UZE 08X 104M
C36	4310000010	Mylar F2D 50V 102K
C37	4310000050	Mylar F2D 50V 222K (#61,#62,#68)
	4310000010	Mylar F2D 50V 102K (#63,#64,#65,#66,#67,#69)
C38	4010000190	Ceramic DD104 SL 240J 50V (#61,#62,#68)
	4010000220	Ceramic DD104 SL 330J 50V (#63,#64,#65,#66,#67,#69)
C39	4310000050	Mylar F2D 50V 222K (#61,#62,#68)
	4310000010	Mylar F2D 50V 102K (#63,#64,#65,#66,#67,#69)
C40	4510001150	Electrolytic 50 MS7 R47 μF
C41	4510001170	Electrolytic 50 MS7 2R2 μF
C42	4310000060	Mylar F2D 50V 223K
C44	4010000460	Ceramic DD104 B 471K 50V
C48	4040000190	Barrier Layer UAT 05X 103K
C50	4010000280	Ceramic DD104 SL 560J 50V
C51	4010000140	Ceramic DD104 SL 120J 50V
C52	40100003270	Ceramic DD104 UJ 030C 50V
C53	4010000020	Ceramic DD104 SL 010C 50V
C54	40100003270	Ceramic DD104 UJ 030C 50V
C57	4040000190	Barrier Layer UAT 05X 103K
C58	4010000500	Ceramic DD104 B 102K 50V
C59	4010000500	Ceramic DD104 B 102K 50V
C60	4010000500	Ceramic DD104 B 102K 50V
C61	4010000460	Ceramic DD104 B 471K 50V
C62	4010000500	Ceramic DD104 B 102K 50V
C63	4010000500	Ceramic DD104 B 102K 50V
C64	4010000500	Ceramic DD104 B 102K 50V
C65	4010000500	Ceramic DD104 B 102K 50V
C66	4010000500	Ceramic DD104 B 102K 50V
C67	4010000500	Ceramic DD104 B 102K 50V
C68	4010000300	Ceramic DD104 SL 680J 50V
C69	4010000300	Ceramic DD104 SL 680J 50V
C70	4010000500	Ceramic DD104 B 102K 50V
C71	4010000500	Ceramic DD104 B 102K 50V
C72	4010000180	Ceramic DD104 SL 220J 50V
C73	4010000500	Ceramic DD104 B 102K 50V
C74	4010000500	Ceramic DD104 B 102K 50V
C75	4010000460	Ceramic DD104 B 471K 50V
C76	4010000310	Ceramic DD104 SL 750J 50V
C83	4010000500	Ceramic DD104 B 102K 50V

[MAIN UNIT]

REF. NO.	ORDER NO.	DESCRIPTION
C84	4010000500	Ceramic DD104 B 102K 50V
C86	4010000460	Ceramic DD104 B 471K 50V
C87	4010000460	Ceramic DD104 B 471K 50V
C88	4010000500	Ceramic DD104 B 102K 50V
C89	4010000460	Ceramic DD104 B 471K 50V
C90	4010000500	Ceramic DD104 B 102K 50V
C91	4010000500	Ceramic DD104 B 102K 50V
C93	4010000460	Ceramic DD104 B 471K 50V
C94	4010000500	Ceramic DD104 B 102K 50V
C95	4010000500	Ceramic DD104 B 102K 50V
C96	4010000460	Ceramic DD104 B 471K 50V
C97	4010000500	Ceramic DD104 B 102K 50V
C98	4010000460	Ceramic DD104 B 471K 50V
C99	4010000500	Ceramic DD104 B 102K 50V
C100	4040000260	Barrier Layer UZE 08X 104M
C103	4010003950	Ceramic DD06 SL 330K 500V
C104	4010004120	Ceramic DD07 B 102K 500V
C105	4010003960	Ceramic DD06 SL 390K 500V
C106	4010003910	Ceramic DD06 SL 220K 500V
C107	4010003800	Ceramic DD06 SL 030C 500V
C108	4010003980	Ceramic DD09 SL 560K 500V
C109	4010003850	Ceramic DD06 SL 080D 500V
C110	4010003970	Ceramic DD07 SL 470K 500V
C111	4010003870	Ceramic DD06 SL 120K 500V
C112	4010003870	Ceramic DD06 SL 120K 500V
C113	4010003800	Ceramic DD06 SL 030C 500V
C114	4010000500	Ceramic DD104 B 102K 50V
C115	4010000500	Ceramic DD104 B 102K 50V
C117	4040000190	Barrier Layer UAT 05X 103K
C118	4040000260	Barrier Layer UZE 08X 104M
C119	4040000260	Barrier Layer UZE 08X 104M
C120	4510002380	Electrolytic 16 SS 470 μF (10X12.5)
C121	4010000520	Ceramic DD108 B 472K 50V
C122	4510002380	Electrolytic 16 SS 470 μF (10X12.5)
C123	4510002380	Electrolytic 16 SS 470 μF (10X12.5)
C124	4010000500	Ceramic DD104 B 102K 50V
C125	4560000010	Ceramic D55X5T 1H 104M
C126	4510001120	Electrolytic 25 MS7 4R7 μF
C128	4040000260	Barrier Layer UZE 08X 104M
C129	4040000260	Barrier Layer UZE 08X 104M
C130	4010000640	Ceramic DD104 CH 040C 50V
C131	4010000500	Ceramic DD104 B 102K 50V
C132	4010000330	Ceramic DD105 SL 101J 50V
C133	4010000380	Ceramic DD107 SL 221J 50V
C134	4010000500	Ceramic DD104 B 102K 50V
C136	4040000190	Barrier Layer UAT 05X 103K
C137	4010000800	Ceramic DD105 CH 270J 50V
C138	4610001470	Trimmer CV38D 2001E
C141	4510001970	Electrolytic 50 MS7 0R1 μF
C142	4510002640	Electrolytic 25 SS 47 μF
C143	4510002850	Electrolytic 25 SS 22 μF
C144	4010000500	Ceramic DD104 B 102K 50V
C145	4510001310	Electrolytic 6R3 MS5 22 μF
C146	4510003040	Electrolytic 16 SS 100 μF
C148	4040000250	Barrier Layer UAT 08X 473M
C149	4550000260	Tantalum DN 1V 100M
C150	4040000190	Barrier Layer UAT 05X 103K
C151	4550000320	Tantalum DN 1V 0R1M
C152	4510001970	Electrolytic 50 MS7 0R1 μF
C153	4510002810	Electrolytic 16 SS 47 μF
C154	4010000500	Ceramic DD104 B 102K 50V
C155	4510001480	Electrolytic 50 MS5 2R2 μF
C156	4010000500	Ceramic DD104 B 102K 50V
C158	4010000500	Ceramic DD104 B 102K 50V
C160	4020000110	Cylinder UP125 SL 330J
C161	4010000220	Ceramic DD104 SL 330J 50V
C162	4010000270	Ceramic DD104 SL 510J 50V
C163	4010000220	Ceramic DD104 SL 330J 50V
C165	4010000500	Ceramic DD104 B 102K 50V
C167	4010000500	Ceramic DD104 B 102K 50V
C168	4010000040	Ceramic DD104 SL 020C 50V
C169	4010000030	Ceramic DD104 SL 1R5C 50V

**[MAIN UNIT]**

REF. NO.	ORDER NO.	DESCRIPTION	
C170	4010000080	Ceramic	DD104 SL 060D 50V
C171	4010000500	Ceramic	DD104 B 102K 50V
C172	4040000260	Barrier Layer	UZE 08X 104M
C173	4510001100	Electrolytic	16 MS7 10 μF
C174	4010003910	Ceramic	DD06 SL 220K 500V
C176	4510001470	Electrolytic	50 MS5 1 μF
C177	4010000500	Ceramic	DD104 B 102K 50V
C178	4560000010	Ceramic	D55X5T 1H 104M
C179	4550000320	Tantalum	DN 1V 0R1M
C180	4010000500	Ceramic	DD104 B 102K 50V
C182	4510002330	Electrolytic	6R3 MS7 22 μF
C183	4040000190	Barrier Layer	UAT 05X 103K
C184	4550000010	Tantalum	DN 1C 4R7M
C185	4310000060	Mylar	F2D 50V 223K
C186	4010000460	Ceramic	DD104 B 471K 50V
C188	4010000500	Ceramic	DD104 B 102K 50V
C189	4010000500	Ceramic	DD104 B 102K 50V
C190	4010000500	Ceramic	DD104 B 102K 50V
C191	4010000500	Ceramic	DD104 B 102K 50V
C193	4040000150	Barrier Layer	UAT 05X 472K
C194	4010000500	Ceramic	DD104 B 102K 50V
C195	4040000150	Barrier Layer	UAT 05X 472K
C196	4010000500	Ceramic	DD104 B 102K 50V
C197	4010000520	Ceramic	DD108 B 472K 50V
C198	4010000500	Ceramic	DD104 B 102K 50V
C200	4010000960	Ceramic	DD109 CH 121J 50V
C201	4010000960	Ceramic	DD109 CH 121J 50V
C202	4010000260	Ceramic	DD104 SL 470J 50V
C203	4010000330	Ceramic	DD105 SL 101J 50V
C205	4610001450	Trimmer	CV38B 0601E
C206	4010000330	Ceramic	DD105 SL 101J 50V
C207	4010000500	Ceramic	DD104 B 102K 50V
C208	4010000500	Ceramic	DD104 B 102K 50V
C209	4010000500	Ceramic	DD104 B 102K 50V
C212	4510002790	Electrolytic	16 SS 22 μF
C213	4510003040	Electrolytic	16 SS 100 μF
C214	4010000200	Ceramic	DD104 SL 270J 50V
C215	4010000210	Ceramic	DD104 SL 300J 50V
C216	4010000500	Ceramic	DD104 B 102K 50V
C217	4010000500	Ceramic	DD104 B 102K 50V
C218	4040000190	Barrier Layer	UAT 05X 103K
C219	4010000020	Ceramic	DD104 SL 010C 50V
C220	4010000500	Ceramic	DD104 B 102K 50V
C221	4010000110	Ceramic	DD104 SL 090D 50V
EP1	0910028652	P.C. Board	B 2908B (MAIN)
EP3	6910000970	Lead Frame	DL 2OP 2.6-3-1.2H
EP4	6910000970	Lead Frame	DL 2OP 2.6-3-1.2H

**[LOGIC UNIT]**

REF. NO.	ORDER NO.	DESCRIPTION	
IC501	1140000540	IC	μPD78C06AG-570-12
IC502	1130006160	IC	SC-1169 (NMC27C256BQ200)
IC503	1130002560	IC	μPD446G
IC510	1110001350	IC	TA7555F
IC512	1110000960	IC	NJM4558M (T1)
IC513	1110000960	IC	NJM4558M (T1)
IC514	1110000210	IC	μPC2002H
IC514	1110000210	IC	μPC2002H
IC515	1110000960	IC	NJM4558M (T1)
IC516	1140000640	IC	SC1084
IC517	1140000620	IC	FX102LG
IC518	1130003610	IC	TC4SU69F (TE85R)
IC519	1130003610	IC	TC4SU69F (TE85R)

**[LOGIC UNIT]**

REF. NO.	ORDER NO.	DESCRIPTION	
Q501	1510000340	Transistor	2SA1341-TA
Q503	1510000340	Transistor	2SA1341-TA
Q504	1530000980	Transistor	2SC3395-TA
Q505	1510000110	Transistor	2SA1162-Y (TE85R)
Q506	1510000340	Transistor	2SA1341-TA
Q507	1530000980	Transistor	2SC3395-TA
Q508	1530000160	Transistor	2SC2712-Y (TE85RTEM)
Q509	1530000980	Transistor	2SC3395-TA
Q510	1540000150	Transistor	2SD1225M R
Q511	1590000380	FET	2SJ106-Y (TE85R)
Q512	1590000380	FET	2SJ106-Y (TE85R)
Q513	1540000300	Transistor	2SD1286 K
Q514	1530000160	Transistor	2SC2712-Y (TE85RTEM)
Q515	1530000980	Transistor	2SC3395-TA
Q516	1530000980	Transistor	2SC3395-TA
Q517	1530000980	Transistor	2SC3395-TA
Q518	1530000980	Transistor	2SC3395-TA
Q519	1530000160	Transistor	2SC2712-Y (TE85RTEM)
Q520	1530000980	Transistor	2SC3395-TA
Q521	1530000980	Transistor	2SC3395-TA
Q522	1530000160	Transistor	2SC2712-Y (TE85RTEM)
Q523	1530000980	Transistor	2SC3395-TA
D501	1750000020	Diode	1SS184 (TE85R)
D502	1730000730	Zener	RD6.2M-T2B2
D504	1750000040	Diode	1SS190 (TE85R)
D505	1750000010	Diode	1SS181 (TE85R)
D506	1750000040	Diode	1SS190 (TE85R)
D508	1750000060	Diode	1SS196 (TE85R)
D510	1750000020	Diode	1SS184 (TE85R)
D511	1730000410	Zener	RD5.1M-T2B2
D512	1730000180	Zener	RD8.2E B2
D513	1750000010	Diode	1SS181 (TE85R)
D514	1750000050	Diode	1SS193 (TE85R)
D515	1710000600	Diode	1SS254
X501	6050003450	Crystal	RF-4A3 FAG NKD (4.480000M)
L501	6180002310	Coil	LAL 02NA 330K
R503	7030000580	Resistor	MCR10EZHZ 47 kΩ (473)
R504	7030000500	Resistor	MCR10EZHZ 10 kΩ (103)
R505	7030000500	Resistor	MCR10EZHZ 10 kΩ (103)
R506	7030000500	Resistor	MCR10EZHZ 10 kΩ (103)
R507	7030000500	Resistor	MCR10EZHZ 10 kΩ (103)
R508	7030000580	Resistor	MCR10EZHZ 47 kΩ (473)
R509	7030000580	Resistor	MCR10EZHZ 47 kΩ (473)
R510	7030000670	Resistor	MCR10EZHZ 270 kΩ (274)
R512	7030000580	Resistor	MCR10EZHZ 47 kΩ (473)
R513	7030000580	Resistor	MCR10EZHZ 47 kΩ (473)
R514	7030000540	Resistor	MCR10EZHZ 22 kΩ (223)
R515	7030000540	Resistor	MCR10EZHZ 22 kΩ (223)
R516	7030000550	Resistor	MCR10EZHZ 27 kΩ (273)
R517	7030000740	Resistor	MCR10EZHZ 1 MΩ (105)
R518	7030000580	Resistor	MCR10EZHZ 47 kΩ (473)
R519	7030000740	Resistor	MCR10EZHZ 1 MΩ (105)
R520	7030000580	Resistor	MCR10EZHZ 47 kΩ (473)
R521	7030000460	Resistor	MCR10EZHZ 4.7 kΩ (472)
R522	7030000580	Resistor	MCR10EZHZ 47 kΩ (473)
R523	7030000580	Resistor	MCR10EZHZ 47 kΩ (473)
R524	7030000580	Resistor	MCR10EZHZ 47 kΩ (473)
R525	7030000460	Resistor	MCR10EZHZ 4.7 kΩ (472)
R526	7030000520	Resistor	MCR10EZHZ 15 kΩ (153)
R527	7310000750	Trimmer	RH0651C14J2WA (103)
R528	7030000390	Resistor	MCR10EZHZ 1.2 kΩ (122)
R529	7310000800	Trimmer	RH0651CJ5J01A (224)
R530	7030000470	Resistor	MCR10EZHZ 5.6 kΩ (562)

[LOGIC UNIT]

REF. NO.	ORDER NO.	DESCRIPTION	
R531	7030000700	Resistor	MCR10EZHZ 470 kΩ (474)
R532	7310000740	Trimmer	RH0651CS3J2KA (472)
R533	7030000670	Resistor	MCR10EZHZ 270 kΩ (274)
R534	7030000630	Resistor	MCR10EZHZ 120 kΩ (124)
R535	7030000580	Resistor	MCR10EZHZ 47 kΩ (473)
R536	7030000570	Resistor	MCR10EZHZ 39 kΩ (393)
R537	7030000560	Resistor	MCR10EZHZ 33 kΩ (333)
R538	7030000570	Resistor	MCR10EZHZ 39 kΩ (393)
R539	7030000260	Resistor	MCR10EZHZ 100 Ω (101)
R540	7310000800	Trimmer	RH0651CJ5J01A (224)
R541	7010004680	Resistor	R50XJ 33 Ω
R542	7030000380	Resistor	MCR10EZHZ 1 kΩ (102)
R543	7310000760	Trimmer	RH0651CJ4J01A (223)
R544	7030000020	Resistor	MCR10EZHZ 1 Ω (010)
R545	7030000330	Resistor	MCR10EZHZ 390 Ω (391)
R546	7030000060	Resistor	MCR10EZHZ 2.2 Ω (2R2)
R547	7310000780	Trimmer	RH0651CS4J25A (473)
R548	7030000740	Resistor	MCR10EZHZ 1 MΩ (105)
R549	7030000500	Resistor	MCR10EZHZ 10 kΩ (103)
R550	7030000740	Resistor	MCR10EZHZ 1 MΩ (105)
R551	7030000260	Resistor	MCR10EZHZ 100 Ω (101)
R552	7030000490	Resistor	MCR10EZHZ 8.2 kΩ (822)
R553	7030000710	Resistor	MCR10EZHZ 560 kΩ (564)
R554	7030000500	Resistor	MCR10EZHZ 10 kΩ (103)
R555	7030000490	Resistor	MCR10EZHZ 8.2 kΩ (822)
R556	7030000550	Resistor	MCR10EZHZ 27 kΩ (273)
R557	7030000560	Resistor	MCR10EZHZ 33 kΩ (333)
R558	7030000590	Resistor	MCR10EZHZ 56 kΩ (563)
R559	7030000500	Resistor	MCR10EZHZ 10 kΩ (103)
R560	7030000500	Resistor	MCR10EZHZ 10 kΩ (103)
R561	7030000490	Resistor	MCR10EZHZ 8.2 kΩ (822)
R562	7030000740	Resistor	MCR10EZHZ 1 MΩ (105)
R563	7030000740	Resistor	MCR10EZHZ 1 MΩ (105)
R564	7030000390	Resistor	MCR10EZHZ 1.2 kΩ (122)
R565	7030000390	Resistor	MCR10EZHZ 1.2 kΩ (122)
R566	7030000390	Resistor	MCR10EZHZ 1.2 kΩ (122)
R568	7030000580	Resistor	MCR10EZHZ 47 kΩ (473)
R569	7030000580	Resistor	MCR10EZHZ 47 kΩ (473)
R570	7030000580	Resistor	MCR10EZHZ 47 kΩ (473)
R571	7030000460	Resistor	MCR10EZHZ 4.7 kΩ (472)
R572	7030000260	Resistor	MCR10EZHZ 100 Ω (101)
R573	7030000380	Resistor	MCR10EZHZ 1 kΩ (102)
R574	7030000500	Resistor	MCR10EZHZ 10 kΩ (103)
R575	7030000620	Resistor	MCR10EZHZ 100 kΩ (104)
R576	7030000620	Resistor	MCR10EZHZ 100 kΩ (104)
R577	7030000730	Resistor	MCR10EZHZ 820 kΩ (824)
R578	7030000460	Resistor	MCR10EZHZ 4.7 kΩ (472)
R579	7030000580	Resistor	MCR10EZHZ 47 kΩ (473)
R580	7030000620	Resistor	MCR10EZHZ 100 kΩ (104)
R581	7030000620	Resistor	MCR10EZHZ 100 kΩ (104)
R582	7030000620	Resistor	MCR10EZHZ 100 kΩ (104)
R583	7030000580	Resistor	MCR10EZHZ 47 kΩ (473)
R584	7030000580	Resistor	MCR10EZHZ 47 kΩ (473)
R585	7030000580	Resistor	MCR10EZHZ 47 kΩ (473)
R586	7030000580	Resistor	MCR10EZHZ 47 kΩ (473)
R587	7030000500	Resistor	MCR10EZHZ 10 kΩ (103)
R588	7030000460	Resistor	MCR10EZHZ 4.7 kΩ (472)
R589	7030000580	Resistor	MCR10EZHZ 47 kΩ (473)
R590	7030000580	Resistor	MCR10EZHZ 47 kΩ (473)
R591	7030000460	Resistor	MCR10EZHZ 4.7 kΩ (472)
R592	7030000430	Resistor	MCR10EZHZ 2.7 kΩ (272)
R593	7030000580	Resistor	MCR10EZHZ 47 kΩ (473)
C503	4030001140	Ceramic	GRM40 F 103Z 50PT
C504	4030001140	Ceramic	GRM40 F 103Z 50PT
C507	4030001140	Ceramic	GRM40 F 103Z 50PT
C508	4030000630	Ceramic	GRM40 SL 100D 50PT
C509	4030003060	Ceramic	GRM40 SL 300J 50PT
C510	4550000320	Tantalum	DN 1V 0R1M
C512	4030001140	Ceramic	GRM40 F 103Z 50PT
C515	4030001110	Ceramic	GRM40 B 222K 50PT

[LOGIC UNIT]

REF. NO.	ORDER NO.	DESCRIPTION	
C516	4550002690	Tantalum	TESVB 1A 335M-12L
C517	4030001150	Ceramic	GRM40 F 104Z 25PT
C518	4310000020	Mylar	F2D 50V 103K
C519	4510002780	Electrolytic	16 SS 10 μF
C520	4510001970	Electrolytic	50 MS7 0R1 μF
C521	4510002940	Electrolytic	50 SS 1 μF
C523	4510002950	Electrolytic	50 SS 2R2 μF
C524	4510002830	Electrolytic	25 SS 4R7 μF
C525	4510002930	Electrolytic	50 SS R47 μF
C526	4030001110	Ceramic	GRM40 B 222K 50PT
C527	4310000020	Mylar	F2D 50V 103K
C528	4310000010	Mylar	F2D 50V 102K
C529	4030000740	Ceramic	GRM40 SL 101J 50PT
C530	4510002940	Electrolytic	50 SS 1 μF
C531	4510002830	Electrolytic	25 SS 4R7 μF
C532	4030001100	Ceramic	GRM40 B 102K 50PT
C533	4030001100	Ceramic	GRM40 B 102K 50PT
C534	4030001150	Ceramic	GRM40 F 104Z 25PT
C535	4030001100	Ceramic	GRM40 B 102K 50PT
C537	4030001150	Ceramic	GRM40 F 104Z 25PT
C538	4510004580	Electrolytic	16 MV 470 AG
C539	4510002380	Electrolytic	16 SS 470 μF (10X12.5)
C540	4510002780	Electrolytic	16 SS 10 μF
C541	4510002830	Electrolytic	25 SS 4R7 μF
C542	4310000020	Mylar	F2D 50V 103K
C543	4030001140	Ceramic	GRM40 F 103Z 50PT
C544	4510002930	Electrolytic	50 SS R47 μF
C545	4030001140	Ceramic	GRM40 F 103Z 50PT
C546	4510002930	Electrolytic	50 SS R47 μF
C547	4510001120	Electrolytic	25 MS7 4R7 μF
C548	4310000020	Mylar	F2D 50V 103K
C549	4310000020	Mylar	F2D 50V 103K
C550	4310000020	Mylar	F2D 50V 103K
C551	4510001140	Electrolytic	50 MS7 R22 μF
C552	4030001140	Ceramic	GRM40 F 103Z 50PT
C553	4510001100	Electrolytic	16 MS7 10 μF
C554	4310000010	Mylar	F2D 50V 102K
C555	4510002940	Electrolytic	50 SS 1 μF
C556	4510001140	Electrolytic	50 MS7 R22 μF
C557	4510002830	Electrolytic	25 SS 4R7 μF
C559	4030001140	Ceramic	GRM40 F 103Z 50PT
C560	4030001140	Ceramic	GRM40 F 103Z 50PT
C561	4030000700	Ceramic	GRM40 SL 470J 50PT
C562	4030000740	Ceramic	GRM40 SL 101J 50PT
C563	4510001120	Electrolytic	25 MS7 4R7 μF
C564	4030000670	Ceramic	GRM40 SL 220J 50PT
C565	4510004170	Electrolytic	10 MS7 220 μF
CP502	6510003080	Check Point	RT01T-1.0B
CP502	6510003080	Check Point	RT01T-1.0B
S501	2260000390	Switch	SKHLAB064A
BT501	3020000040	Lithium Battery	BR2325-1HC
EP501	0910016827	P.C. Board	B 1584G (LOGIC)



**[FRONT UNIT]**

REF. NO.	ORDER NO.	DESCRIPTION	
IC401	1130000790	IC	μPD7225G
Q401	1510000110	Transistor	2SA1162-Y (TE85R)
D401	1750000050	Diode	1SS193 (TE85R)
D402	1750000050	Diode	1SS193 (TE85R)
D403	1750000050	Diode	1SS193 (TE85R)
D404	1750000050	Diode	1SS193 (TE85R)
D405	1750000050	Diode	1SS193 (TE85R)
D406	1750000050	Diode	1SS193 (TE85R)
D407	1730002150	Zener	02CZ6.8-X (TE85R)
D408	1730002150	Zener	02CZ6.8-X (TE85R)
D409	1730002150	Zener	02CZ6.8-X (TE85R)
D410	1730002150	Zener	02CZ6.8-X (TE85R)
D411	1730002150	Zener	02CZ6.8-X (TE85R)
D412	1730002150	Zener	02CZ6.8-X (TE85R)
D413	1730002150	Zener	02CZ6.8-X (TE85R)
R401	7030000500	Resistor	MCR10EZHZ 10 kΩ (103)
R402	7030000500	Resistor	MCR10EZHZ 10 kΩ (103)
R403	7030000650	Resistor	MCR10EZHZ 180 kΩ (184)
R404	7030000500	Resistor	MCR10EZHZ 10 kΩ (103)
R405	7030000580	Resistor	MCR10EZHZ 47 kΩ (473)
R406	7030000380	Resistor	MCR10EZHZ 1 kΩ (102)
C401	4030001100	Ceramic	GRM40 B 102K 50PT
C402	4030001100	Ceramic	GRM40 B 102K 50PT
C403	4030001100	Ceramic	GRM40 B 102K 50PT
C404	4030001100	Ceramic	GRM40 B 102K 50PT
C405	4030001100	Ceramic	GRM40 B 102K 50PT
C406	4030001090	Ceramic	GRM40 B 471K 50PT
C407	4030001090	Ceramic	GRM40 B 471K 50PT
C408	4030001100	Ceramic	GRM40 B 102K 50PT
C409	4030001100	Ceramic	GRM40 B 102K 50PT
C410	4030001100	Ceramic	GRM40 B 102K 50PT
C411	4030001100	Ceramic	GRM40 B 102K 50PT
C412	4030001100	Ceramic	GRM40 B 102K 50PT
DS401	5030000260	LCD	LR598-A
DS402	5080000110	LED	BQ031-22403A
DS403	5080000110	LED	BQ031-22403A
S401	2260000680	Switch	SKHHBV011A
S402	2260000680	Switch	SKHHBV011A
S403	2260000680	Switch	SKHHBV011A
S404	2260000680	Switch	SKHHBV011A
S405	2260000680	Switch	SKHHBV011A
S406	2260000680	Switch	SKHHBV011A
EP402	8930010450	LCD contact strip SRCN-331	
EP401	0910030771	P.C. Board	B 3127A (FRONT)
EP403	6910000630	Bead core	FSOH070RN

**[VR UNIT]**

REF. NO.	ORDER NO.	DESCRIPTION	
R1	7210001280	Variable Resistor	EVK-QVB315A14 (10KA)
EP1	0910014791	P.C. Board	B 1444A (VR)
EP2	6910000630	Bead core	FSOH070RN

**[CHASSIS UNIT]**

REF. NO.	ORDER NO.	DESCRIPTION	
C1	4010000520	Ceramic	DD108 B 472K 50V

**[CTCSS UNIT] : Optional**

REF. NO.	ORDER NO.	DESCRIPTION	
IC701	1110000960	IC	NJM4558M (T1)
IC702	1130001830	IC	MN6520
Q703	1530000980	Transistor	2SC3395-TA
X701	6050003110	Crystal	RF-4A3 FAC NKD (4.194304M)
R701	7030000660	Resistor	MCR10EZHZ 220 kΩ (224)
R702	7030000660	Resistor	MCR10EZHZ 220 kΩ (224)
R703	7030000660	Resistor	MCR10EZHZ 220 kΩ (224)
R704	7030000660	Resistor	MCR10EZHZ 220 kΩ (224)
R705	7030000670	Resistor	MCR10EZHZ 270 kΩ (274)
R706	7030000660	Resistor	MCR10EZHZ 220 kΩ (224)
R707	7030000650	Resistor	MCR10EZHZ 180 kΩ (184)
R708	7030000500	Resistor	MCR10EZHZ 10 kΩ (103)
R709	7030000520	Resistor	MCR10EZHZ 15 kΩ (153)
R711	7030000500	Resistor	MCR10EZHZ 10 kΩ (103)
R712	7030000420	Resistor	MCR10EZHZ 2.2 kΩ (222)
R713	7030000500	Resistor	MCR10EZHZ 10 kΩ (103)
R714	7030000640	Resistor	MCR10EZHZ 150 kΩ (154)
R715	7030000380	Resistor	MCR10EZHZ 1 kΩ (102)
C701	4030001140	Ceramic	GRM40 F 103Z 50PT
C702	4030003330	Ceramic	GRM40 B 223K 50PT
C703	4030001090	Ceramic	GRM40 B 471K 50PT
C704	4030003320	Ceramic	GRM40 F 333Z 50PT
C705	4030003180	Ceramic	GRM40 SL 271J 50PT
C706	4550000920	Tantalum	TESVA 1D 474M1-8L
C707	4550000790	Tantalum	TESVD 0J 476M-12L
C708	4030001150	Ceramic	GRM40 F 104Z 25PT
C709	4030000660	Ceramic	GRM40 SL 180J 50PT
C710	4030000660	Ceramic	GRM40 SL 180J 50PT
C711	4550000920	Tantalum	TESVA 1D 474M1-8L
C712	4030001150	Ceramic	GRM40 F 104Z 25PT
C713	4550000920	Tantalum	TESVA 1D 474M1-8L
EP701	0910014232	P.C. Board	B 1244B (CTCSS)

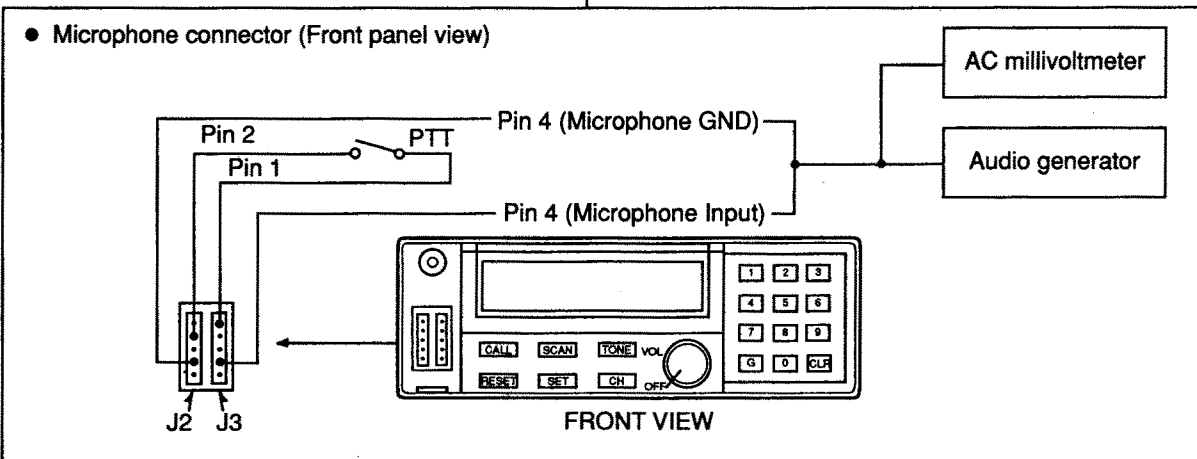
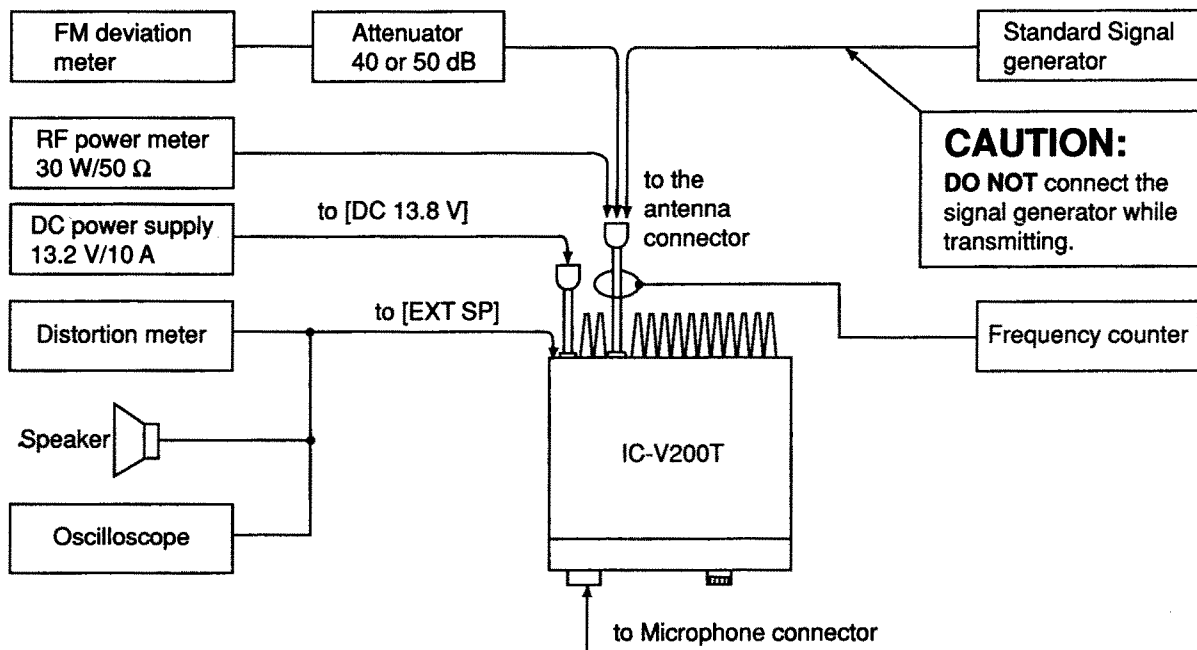
# SECTION 6 ADJUSTMENT PROCEDURES

## 6-1 PREPARATION BEFORE SERVICING

### REQUIRED TEST EQUIPMENT

EQUIPMENT	GRADE AND RANGE	EQUIPMENT	GRADE AND RANGE
DC power supply	Output voltage : 13.2 V DC Current capacity : 10 A or more	Audio generator	Frequency range : 300 ~ 3000 Hz Output level : 1 ~ 100 mV
RF power meter (terminated type)	Measuring range : 1 ~ 30 W Frequency range : 50 ~ 100 MHz Impedance : 50 Ω SWR : Less than : 1.2 : 1	Attenuator	Power attenuation : 40 or 50 dB Capacity : 10 W or more
Frequency counter	Frequency range : 0.1 ~ 100 MHz Frequency accuracy : ± 1 ppm or better Sensitivity : 100 mV or better	AC millivoltmeter	Measuring range : 2 ~ 200 mV
		Oscilloscope	Frequency range : DC ~ 20 MHz Measuring range : 0.01 ~ 10 V
Distortion meter	Frequency range : 1 kHz ± 10 Hz Measuring range : 1 ~ 100%	DC voltmeter	Input impedance : 50 kΩ/DC or better
		FM deviation meter	Frequency minimum : 100 MHz Measuring range : 0 ~ ±5 kHz
Standard signal generator (SSG)	Frequency range : 0.1 ~ 100 MHz Output level : -127 ~ -17 dBm (0.1 μV ~ 32 mV)	External speaker	Impedance : 4 Ω

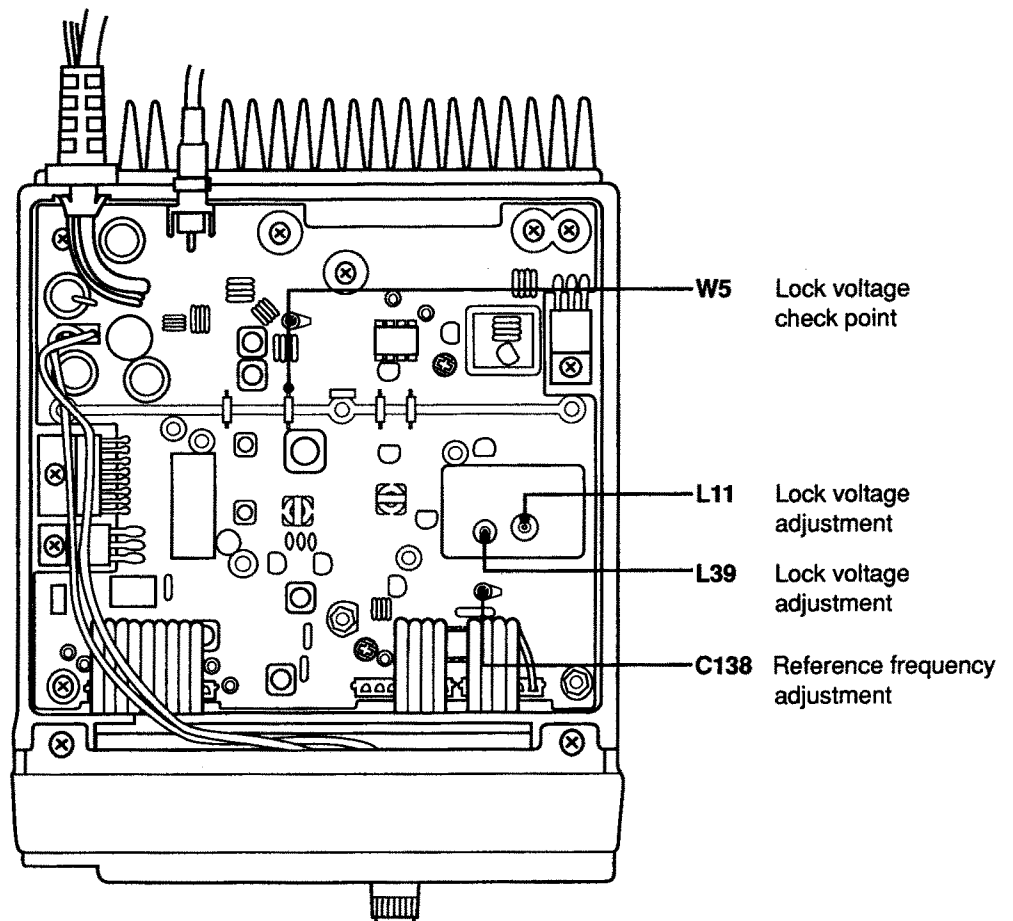
### CONNECTIONS



## 6-2 PLL ADJUSTMENT

ADJUSTMENT	ADJUSTMENT CONDITIONS	MEASUREMENT		VALUE	ADJUSTMENT POINT	
		UNIT	LOCATION		UNIT	ADJUST
REFERENCE FREQUENCY	1 <ul style="list-style-type: none"> <li>• Select any channel.</li> <li>• Connect the RF power meter or a 50Ω dummy load to the antenna connector.</li> <li>• Transmitting</li> </ul>	Rear panel	Loosely couple the frequency counter to the antenna connector.	Same frequency as the programmed one. To check the programmed frequency, refer to the programming manual.	MAIN	C138
LOCK VOLTAGE	NOTE: Lock voltage affects the C/N ratio. When changing the operating frequency, refer to the programming manual.					
	1 <ul style="list-style-type: none"> <li>• Operating frequency: 68.0000 MHz</li> <li>• Connect the RF power meter or a 50Ω dummy load to the antenna connector.</li> <li>• Receiving</li> </ul>	MAIN	Connect the DC voltmeter to W5.	4.0 V (68 MHz) 11.0 ± 2.0 V (88 MHz)	MAIN	L11
	2 <ul style="list-style-type: none"> <li>• Transmitting</li> </ul>			3.0 V		L39
	3 <ul style="list-style-type: none"> <li>• Operating frequency: 88.0000 MHz</li> <li>• Receiving</li> </ul>			11.0 ± 2.0 V		Verify
	4 <ul style="list-style-type: none"> <li>• Transmitting</li> </ul>			12.0 ± 2.0 V		
5	After adjustment, fix L11 and L39 in place with paraffin.					

### • MAIN UNIT

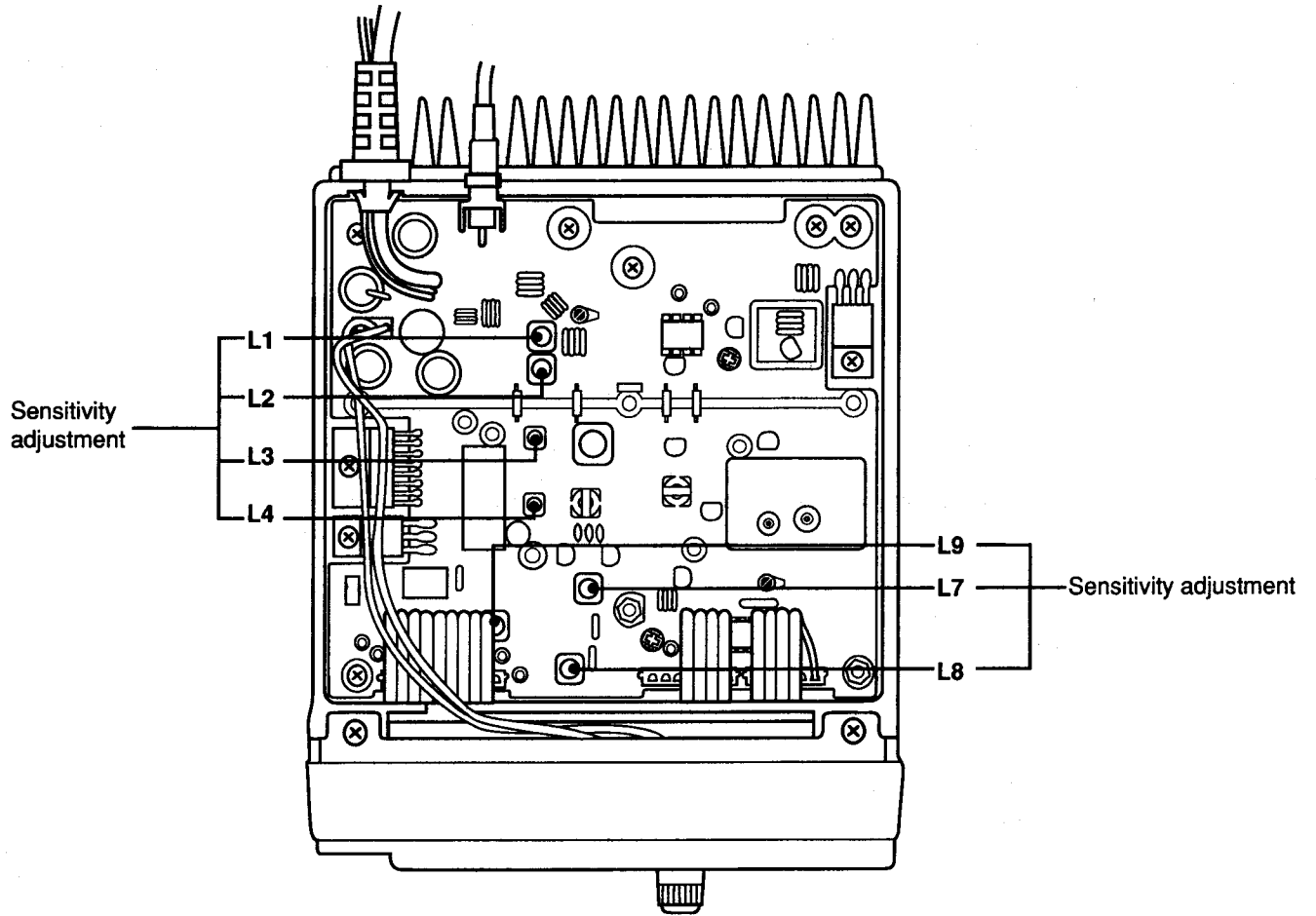


## 6-3 RECEIVER ADJUSTMENT

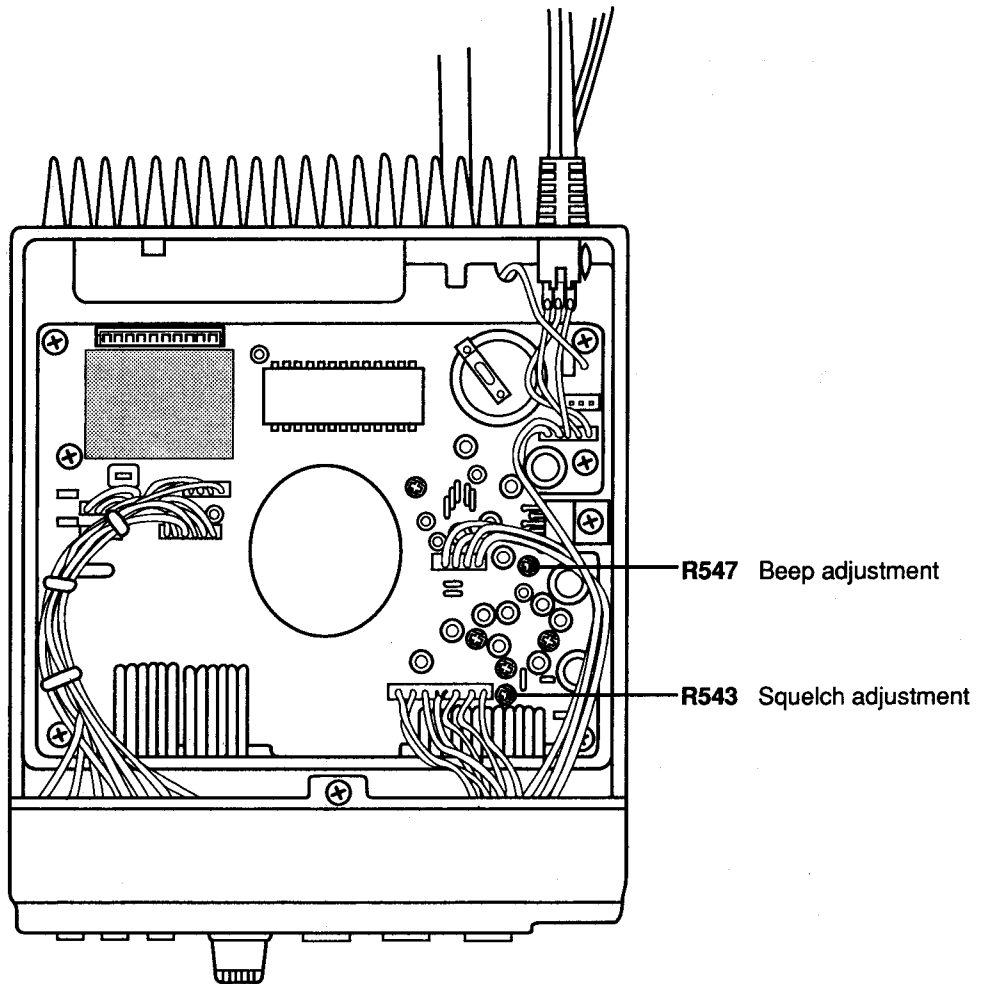
ADJUSTMENT	ADJUSTMENT CONDITIONS	MEASUREMENT		VALUE	ADJUSTMENT POINT		
		UNIT	LOCATION		UNIT	ADJUST	
SENSITIVITY	<p>NOTE: When the sensitivity is less than <math>0.56 \mu\text{V}</math> (12 dB SINAD) on every channel, the following sensitivity adjustment is not necessary. Skip to squelch adjustment below.            This transceiver automatically sends an answer back code when a 5-tone code is received.            Be careful when connecting the SSG to the antenna connector.</p>						
	1	<ul style="list-style-type: none"> <li>Select any channel.</li> <li>Connect the SSG to the antenna connector and set as:               <ul style="list-style-type: none"> <li>Level : <math>1 \text{ mV}^*</math> (<math>-47 \text{ dBm}</math>)</li> <li>Modulation : <math>1 \text{ kHz}</math></li> <li>Deviation : <math>\pm 3.5 \text{ kHz}</math></li> </ul> </li> </ul> <p style="text-align: center;">           (#64, #65, #66, )            (#67, #69)  <math>\pm 2.8 \text{ kHz}</math> (#63)  <math>\pm 1.75 \text{ kHz}</math>            (#61, #62, #68)         </p> <ul style="list-style-type: none"> <li>[RESET] switch : ON</li> <li>[VOL] control : PULL (Squelch opens).</li> <li>Receiving</li> </ul>	MAIN	Connect the distortion meter to the [EXT SP] jack with a $4 \Omega$ load.	Minimum distortion level	MAIN	Adjust in sequence L1, L2, L3, L4, L7, L8, L9
	2	<ul style="list-style-type: none"> <li>Set the SSG as:               <ul style="list-style-type: none"> <li>Level : <math>0.56 \mu\text{V}</math> (<math>-112 \text{ dBm}</math>)</li> </ul> </li> </ul>					Adjust in sequence L1, L2, L3, L4, L7, L8, L9
SQUELCH	<p>NOTE: Before squelch adjustment, be sure that the sensitivity on every channel is less than <math>0.56 \mu\text{V}</math> (12 dB SINAD).</p>						
	1	<ul style="list-style-type: none"> <li>Select any channel.</li> <li>Connect the SSG to the antenna connector.</li> <li>[RESET] switch : ON</li> <li>[VOL] control : PULL (squelch opens).</li> <li>Receiving</li> </ul>	MAIN	Connect the distortion meter to the [EXT SP] jack with a $4 \Omega$ load.	8 dB SINAD (40 % distortion)	MAIN	SSG level
	2	[VOL] control : PUSH	Bottom cover	Speaker	Squelch closes.	LOGIC	R543
3	Adjust SSG's level so that SINAD level becomes 12 dB (20 % distortion).	Squelch opens.			Verify		
BEEP	1	<ul style="list-style-type: none"> <li>Select any channel.</li> <li>[RESET] switch : ON</li> <li>[VOL] control : Center</li> <li>Receiving</li> </ul>	Rear panel	Connect the oscilloscope to the [EXT SP] jack with a $4 \Omega$ load.	1.5 Vp-p	LOGIC	R547

\* This output level of the standard signal generator (SSG) is indicated as SSG's open circuit.

• MAIN UNIT



• LOGIC UNIT

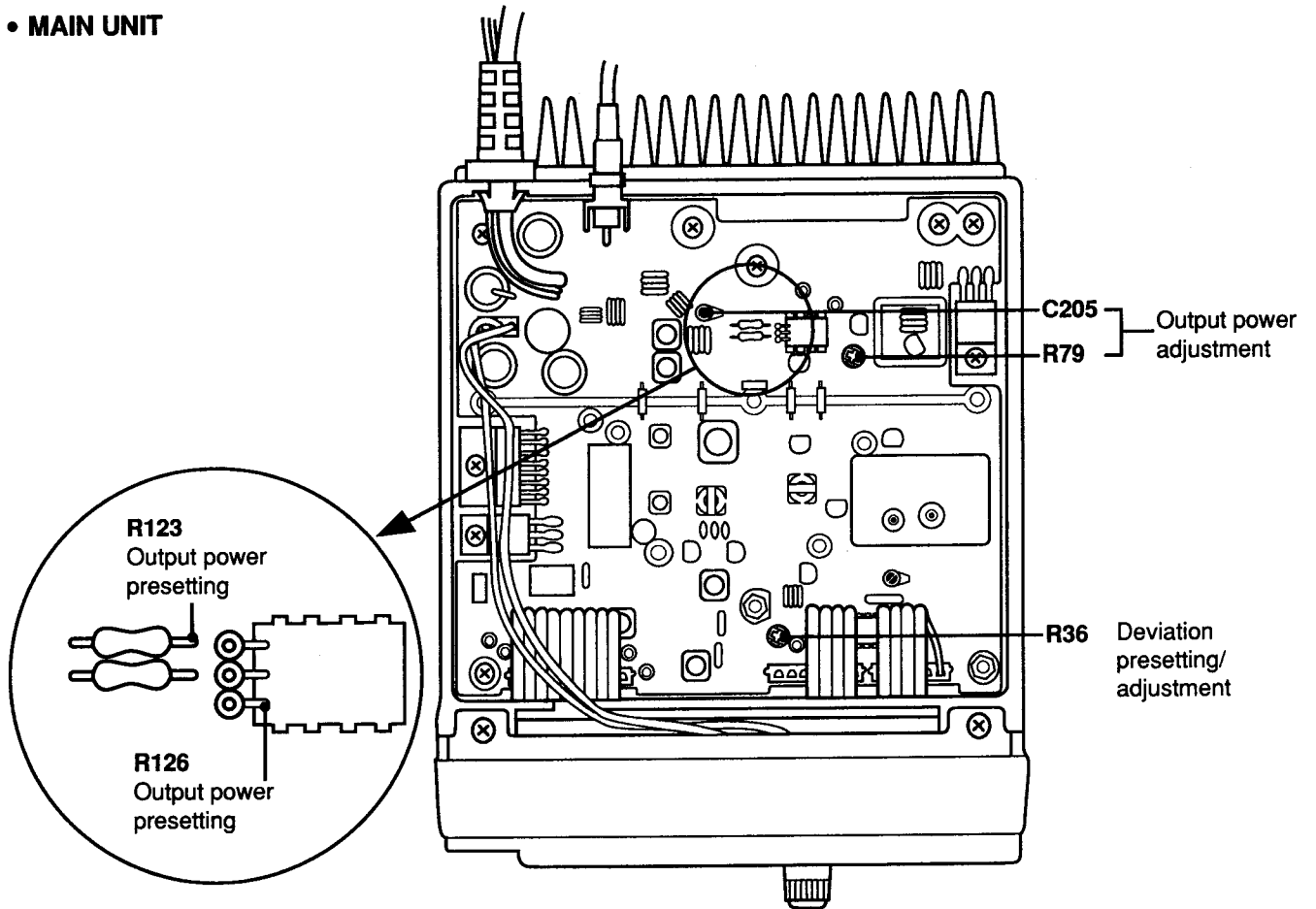


## 6-4 TRANSMITTER ADJUSTMENT

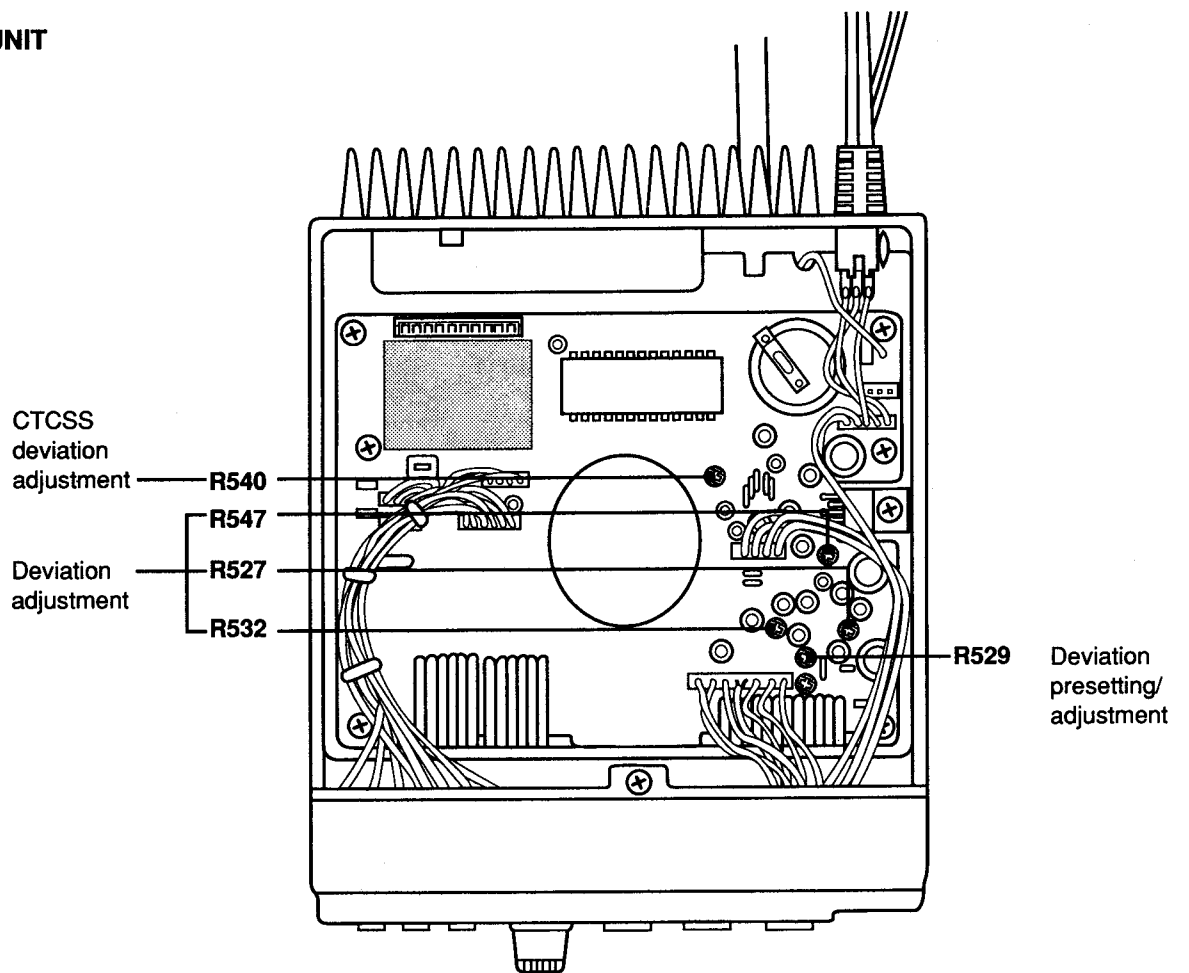
ADJUSTMENT	ADJUSTMENT CONDITIONS	MEASUREMENT		VALUE	ADJUSTMENT POINT			
		UNIT	LOCATION		UNIT	ADJUST		
OUTPUT POWER	1 <ul style="list-style-type: none"> <li>Select any channel.</li> <li>Connect the RF power meter to the antenna connector.</li> <li>Ground R126 (MAIN) with the wire.</li> <li>Transmitting</li> </ul>	MAIN	Connect the DC voltmeter to R123.	Minimum	MAIN	C205		
	2 <ul style="list-style-type: none"> <li>Remove the wire from R126</li> </ul>					RF power meter	25 W (#61 ~ #68) 10 W (#69)	R79
DEVIATION	1 <ul style="list-style-type: none"> <li>Select any channel.</li> <li>Connect the audio generator to the microphone connector* with an AC millivoltmeter and set as:               <ul style="list-style-type: none"> <li>Level : 50 mV</li> <li>Modulation : 1.0 kHz</li> </ul> </li> <li>Set the FM deviation meter as:               <ul style="list-style-type: none"> <li>HPF : OFF</li> <li>LPF : 20 kHz</li> <li>De-emphasis : OFF</li> <li>Detector : (P-P)/2</li> </ul> </li> <li>R529 (LOGIC) : CCW</li> <li>R36 (MAIN) : Center</li> <li>Transmitting</li> </ul>	Rear panel	Connect the FM deviation meter to the antenna connector via the attenuator.	$\pm 4.3$ kHz (#64, #65, #66, #67, #69) $\pm 3.5$ kHz (#63) $\pm 2.1$ kHz (#61, #62, #68)	LOGIC	R532		
	2 <ul style="list-style-type: none"> <li>Set the FM deviation meter as:               <ul style="list-style-type: none"> <li>Detector : P and -P</li> </ul> </li> </ul>					Symmetrical deviation level	R527	
	3 <ul style="list-style-type: none"> <li>Operating frequency: 68.0000 MHz</li> </ul>					Same level as step 1	MAIN	R36
	4 <ul style="list-style-type: none"> <li>Set the audio generator as:               <ul style="list-style-type: none"> <li>Level : 5.0 mV</li> </ul> </li> </ul>					$\pm 3.3$ kHz (#64, #65, #66, #67, #69) $\pm 2.6$ kHz (#63) $\pm 1.6$ kHz (#61, #62, #68)	LOGIC	R529
	5 <ul style="list-style-type: none"> <li>Set the audio generator as:               <ul style="list-style-type: none"> <li>Level : 50 mV</li> </ul> </li> </ul>					$\pm 3.0$ kHz ~ $\pm 4.6$ kHz (#64, #65, #66, #67, #69) $\pm 2.4$ kHz ~ $\pm 3.7$ kHz (#63) $\pm 1.5$ kHz ~ $\pm 2.3$ kHz (#61, #62, #68)		Verify
	6 <ul style="list-style-type: none"> <li>Repeat steps 3 ~ 4 several times for precision.</li> </ul>							
CTCSS DEVIATION	1 <ul style="list-style-type: none"> <li>Connect the optional UT-31 to J512.               <ul style="list-style-type: none"> <li>Frequency : 68 MHz</li> <li>Tone number : 37</li> </ul> </li> <li>Set the FM deviation meter as:               <ul style="list-style-type: none"> <li>HPF : OFF</li> <li>LPF : 20 kHz</li> <li>De-emphasis : OFF</li> <li>Detector : (P-P)/2</li> </ul> </li> <li>Apply no signal to the microphone connector.</li> <li>Transmitting</li> </ul>	Rear panel	Connect the FM deviation meter to the antenna connector via the attenuator.	$\pm 0.5$ kHz (#64, #65, #66, #67, #69) $\pm 0.4$ kHz (#63) $\pm 0.3$ kHz (#61, #62, #68)	LOGIC	R540		

\* See p. 6-1 for connection.

• MAIN UNIT



• LOGIC UNIT



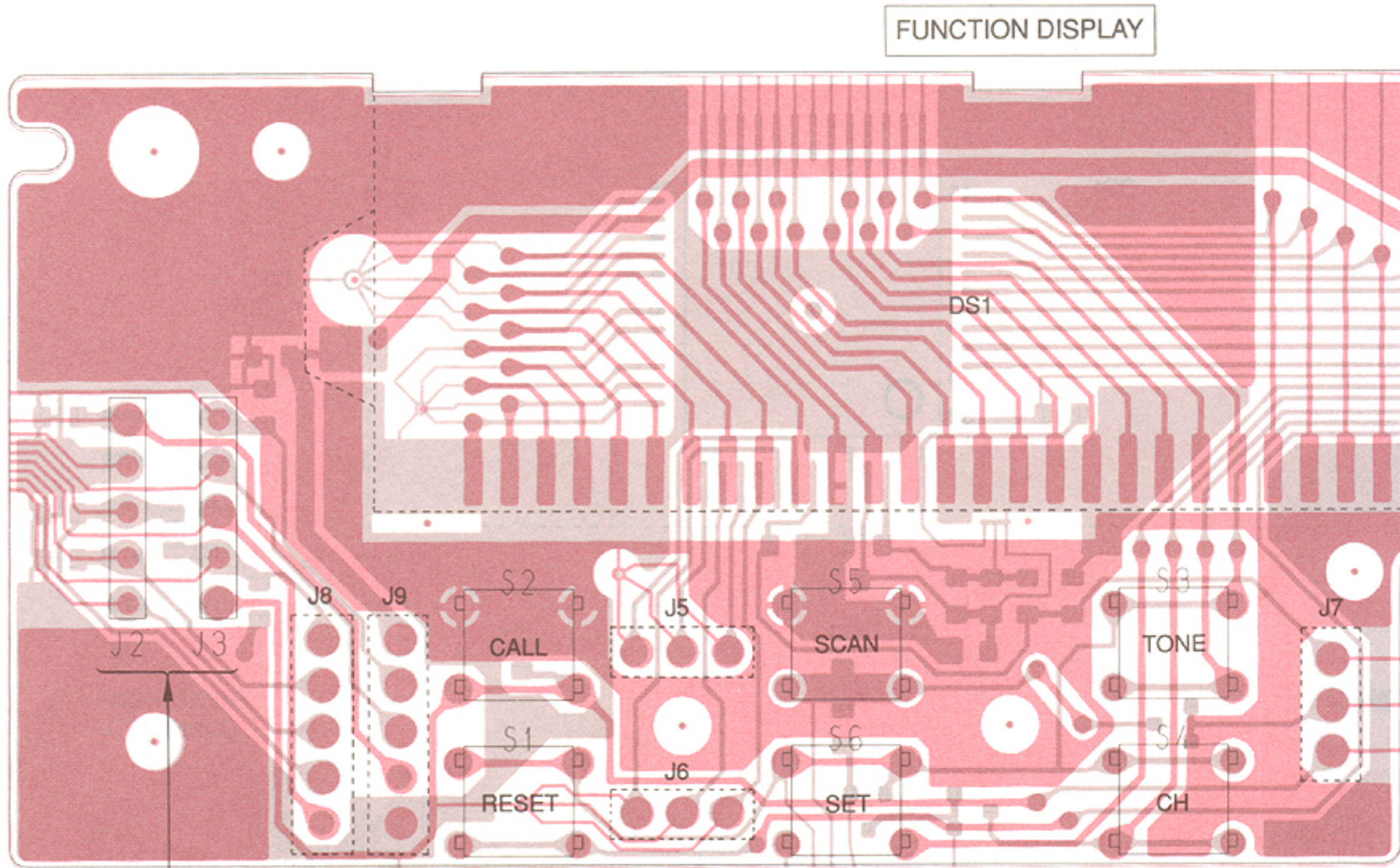


# SECTION 7 BOARD LAYOUTS

## 7-1 FRONT, VR AND CTCSS UNITS

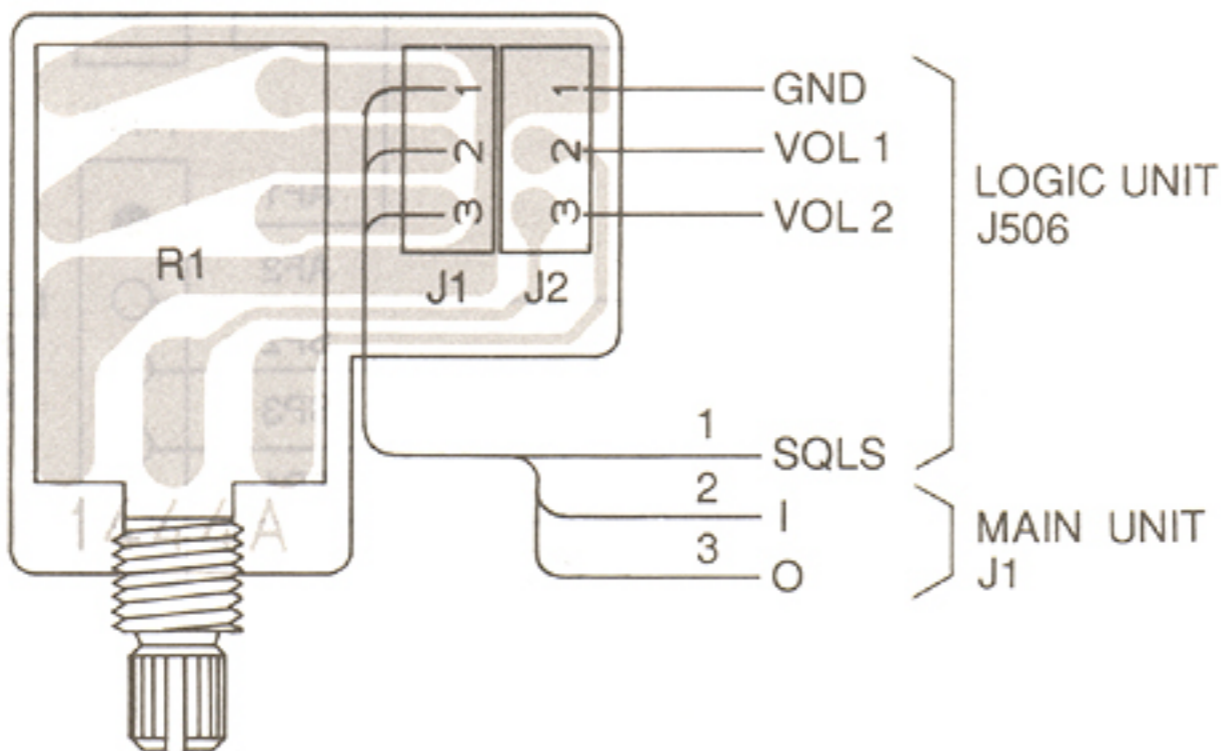
### • FRONT UNIT (TOP VIEW)

NOTE: Add "400" to the indicated number on the Front unit for actual part number.



### • CTCSS

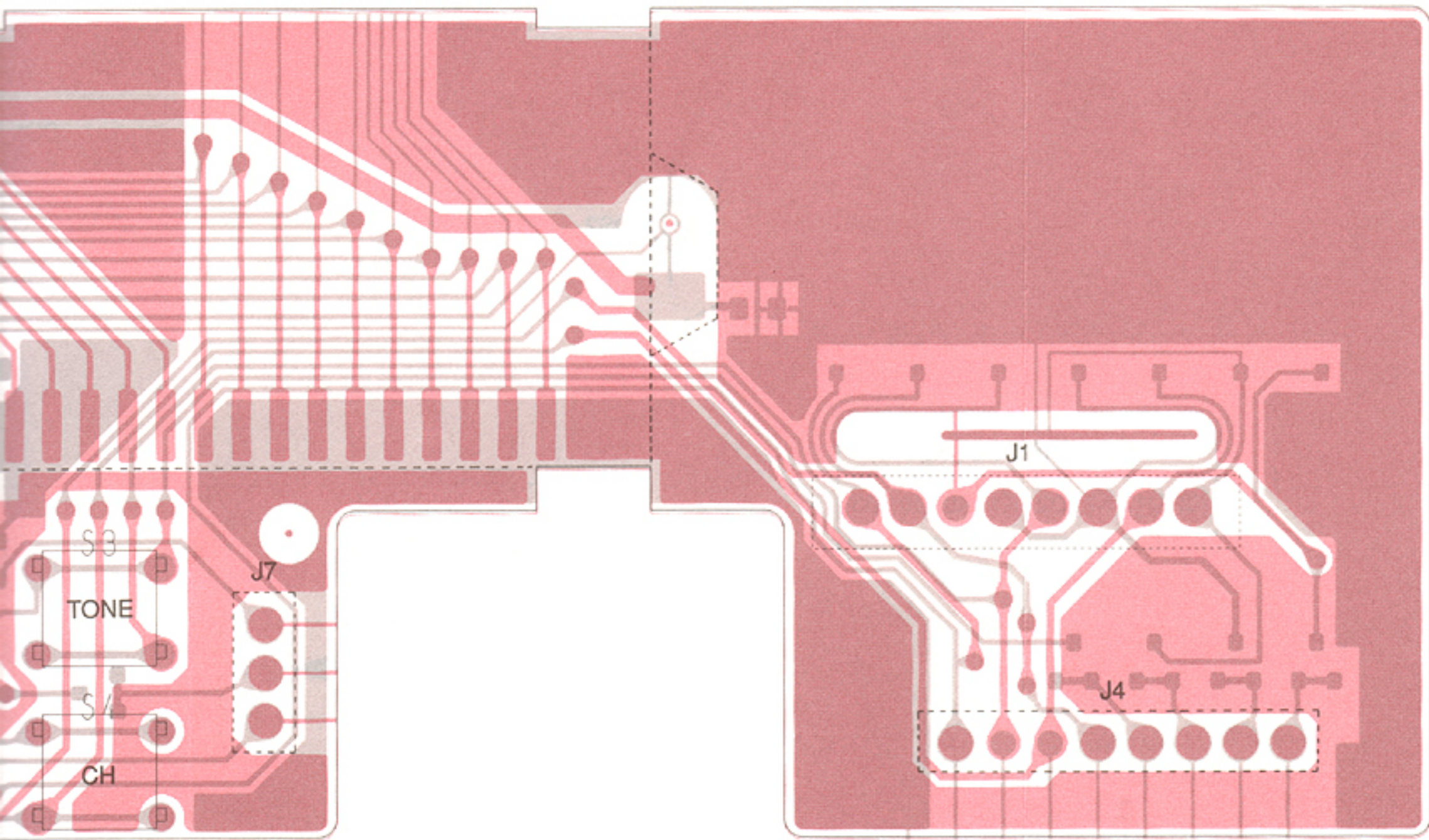
### VR UNIT



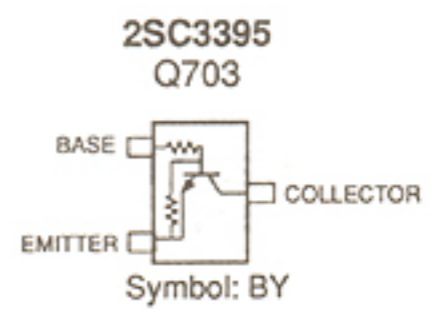
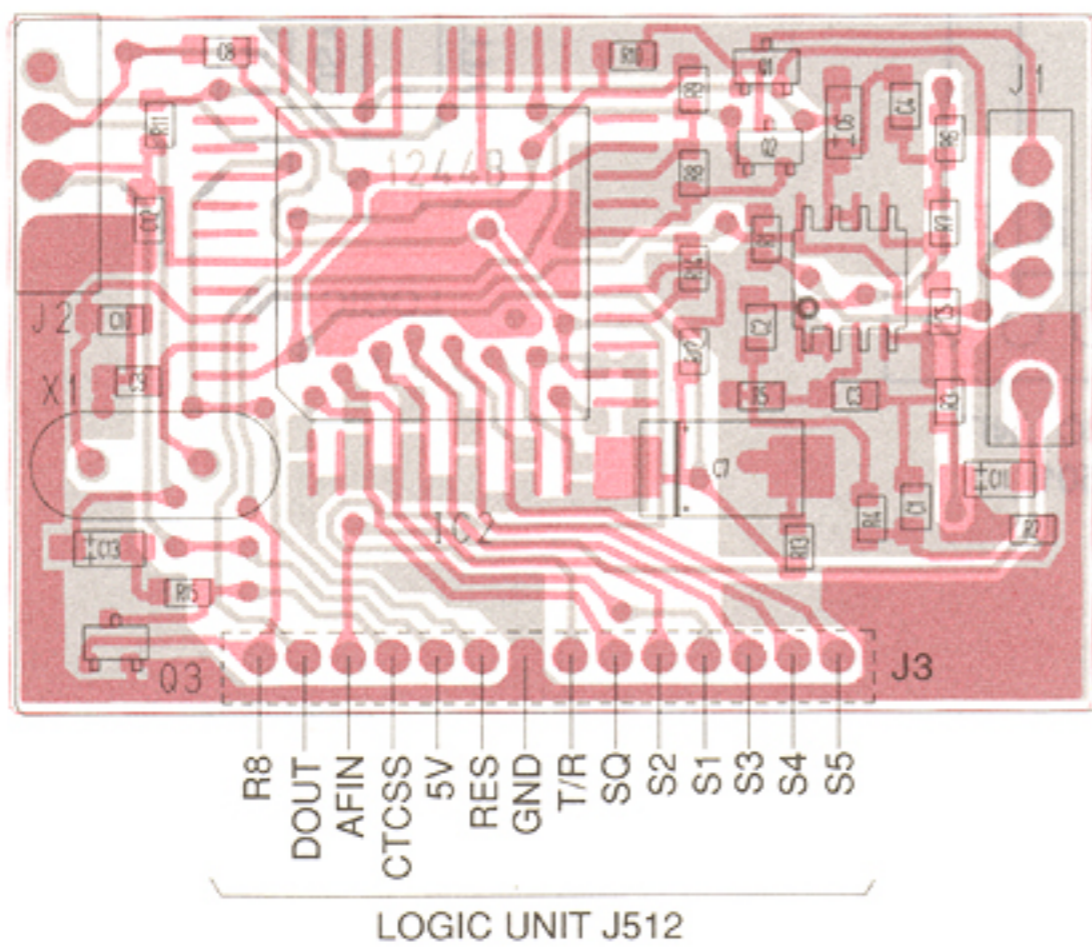


The combination of the Front unit and the next page shows the unit layout in the same configuration as the actual P.C. Board.

PLAY



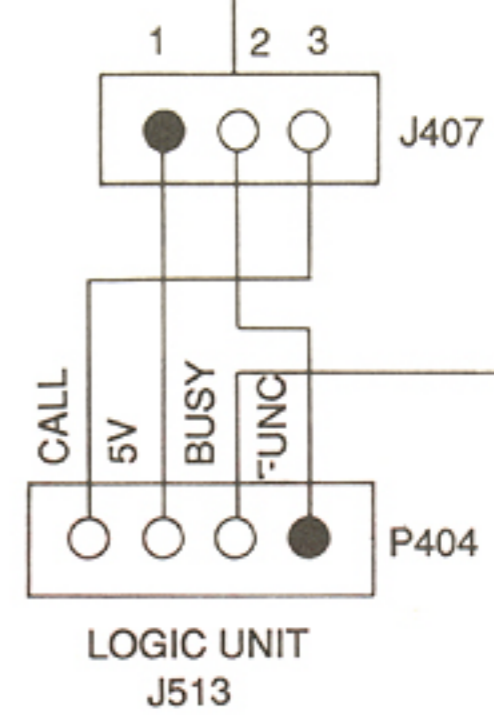
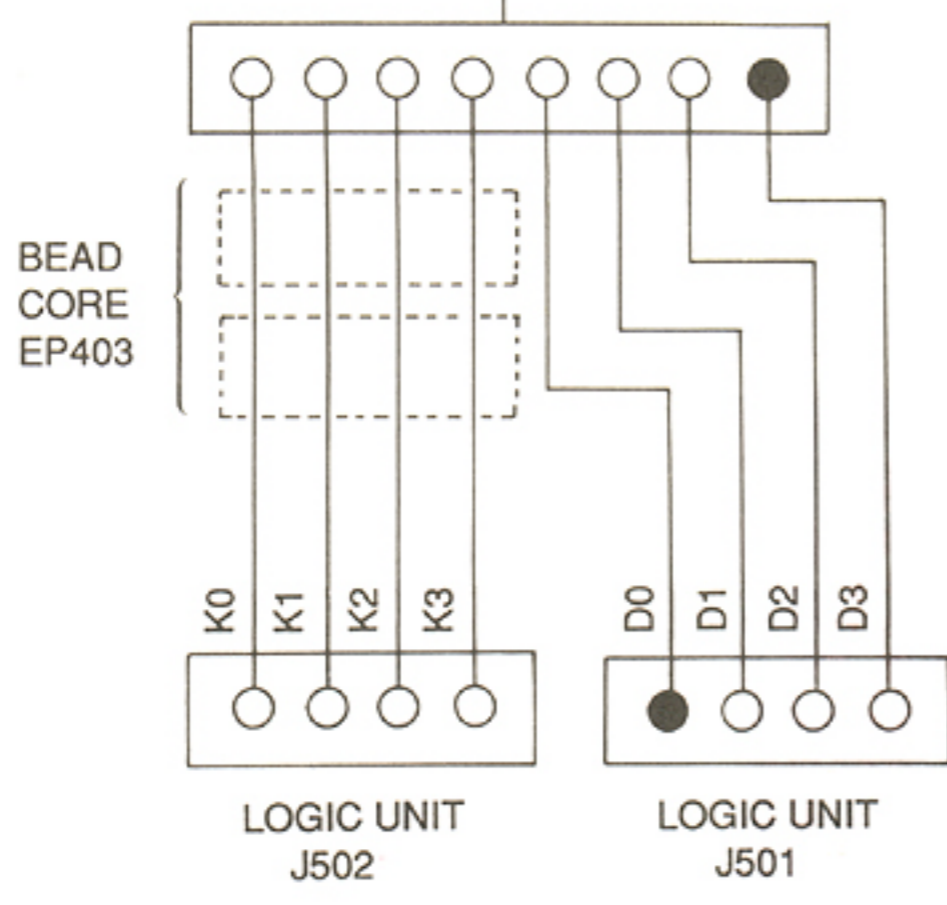
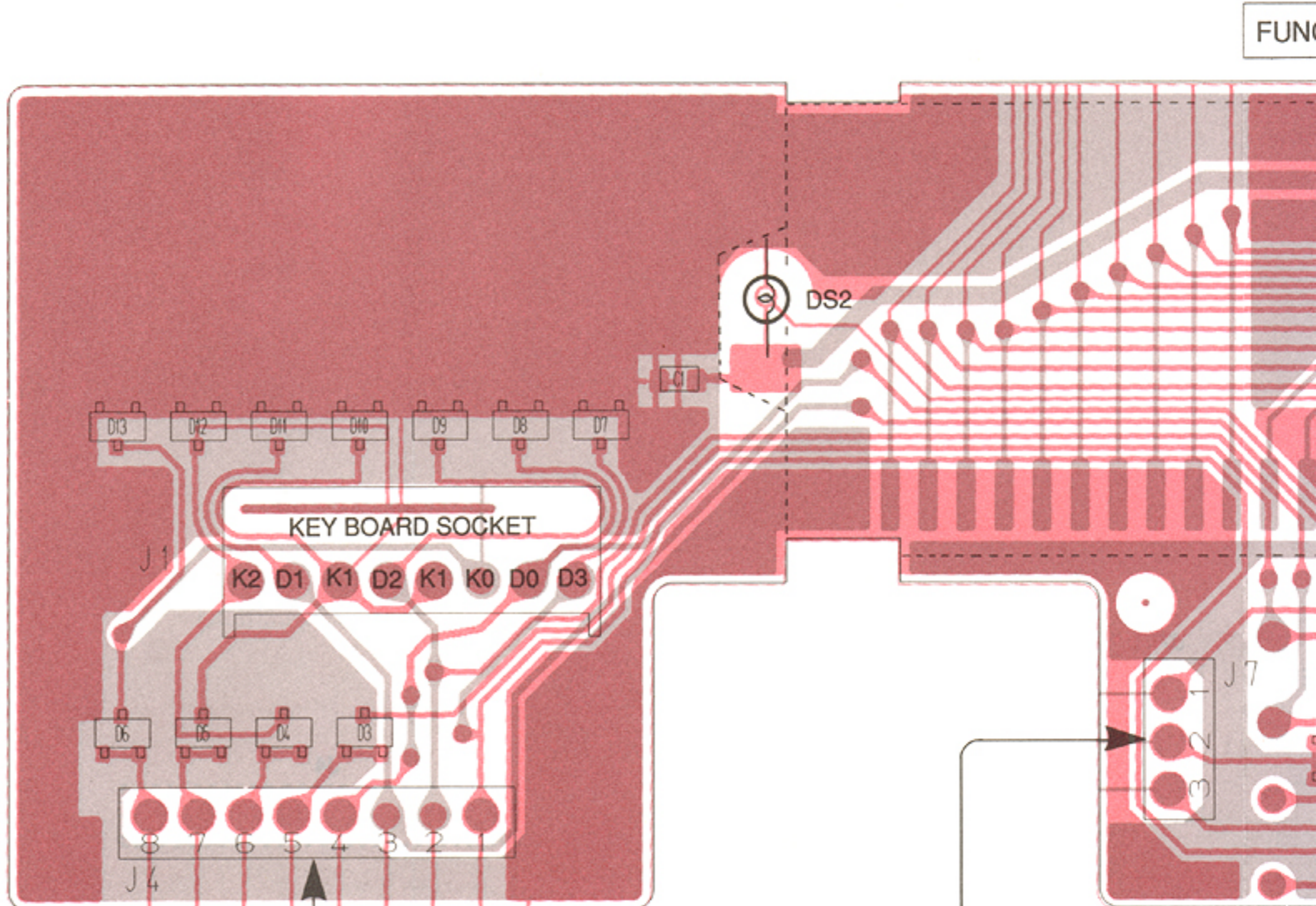
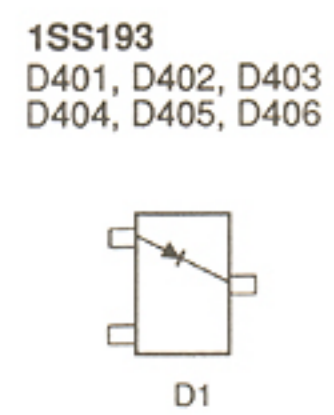
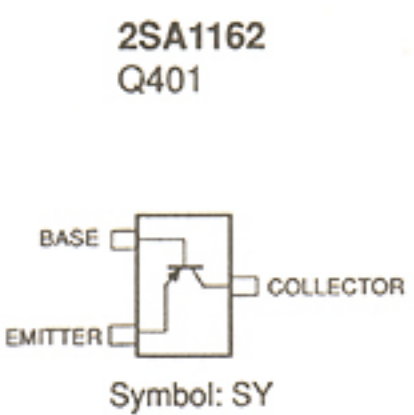
• CTCSS UNIT (Optional)





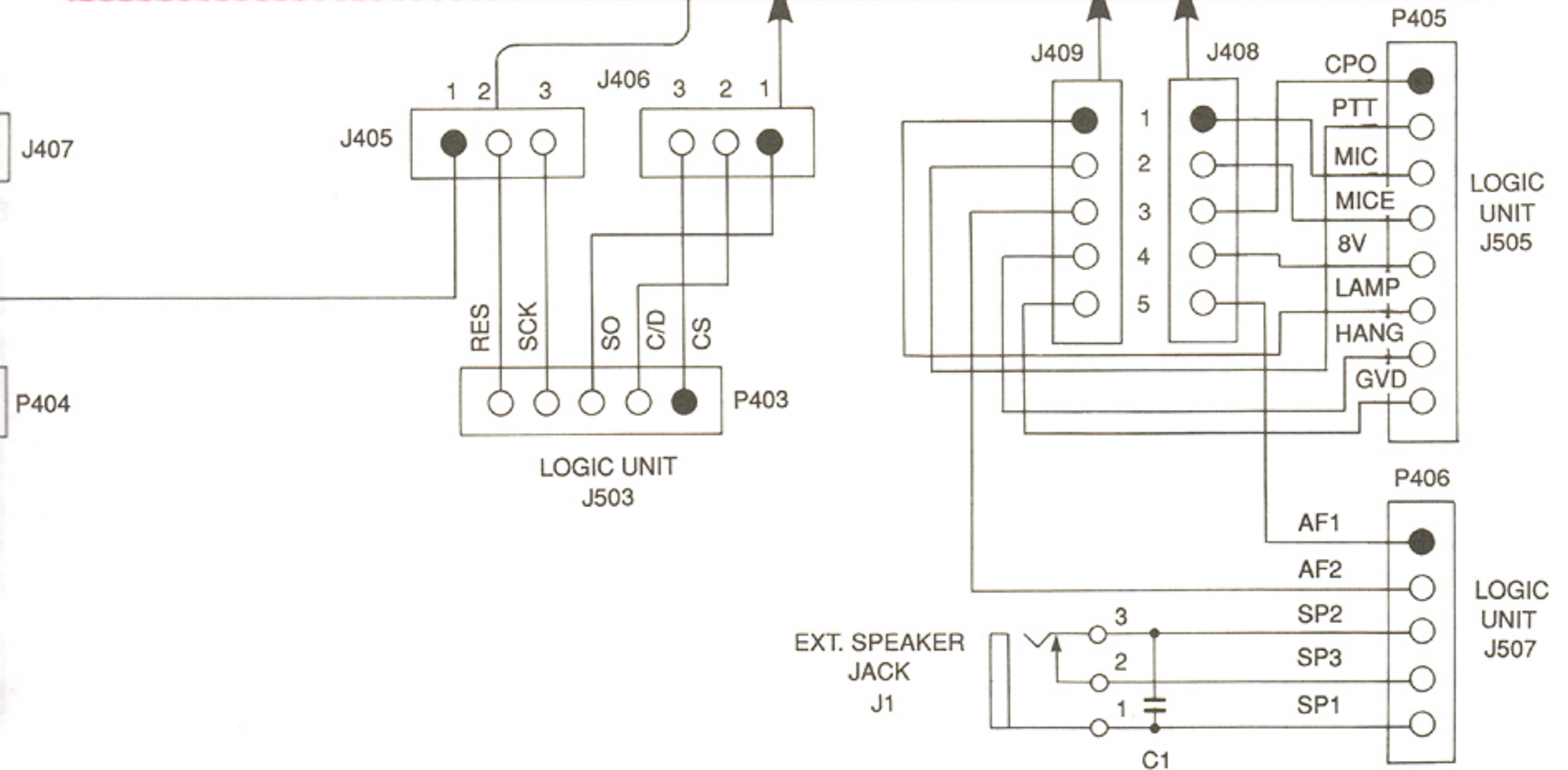
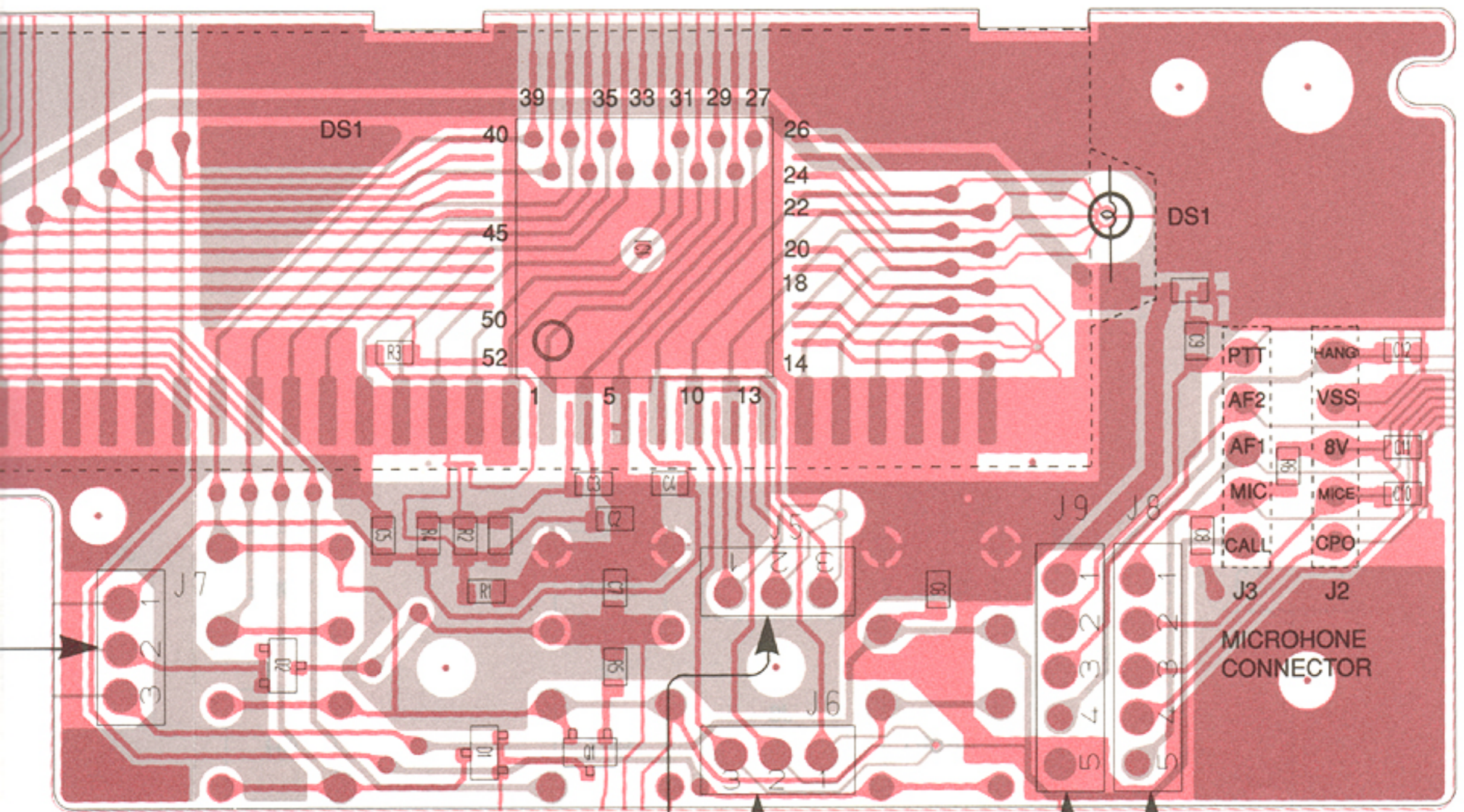
• FRONT UNIT (BOTTOM VIEW)

NOTE: Add "400" to the indicated number on the Front unit for actual part number.





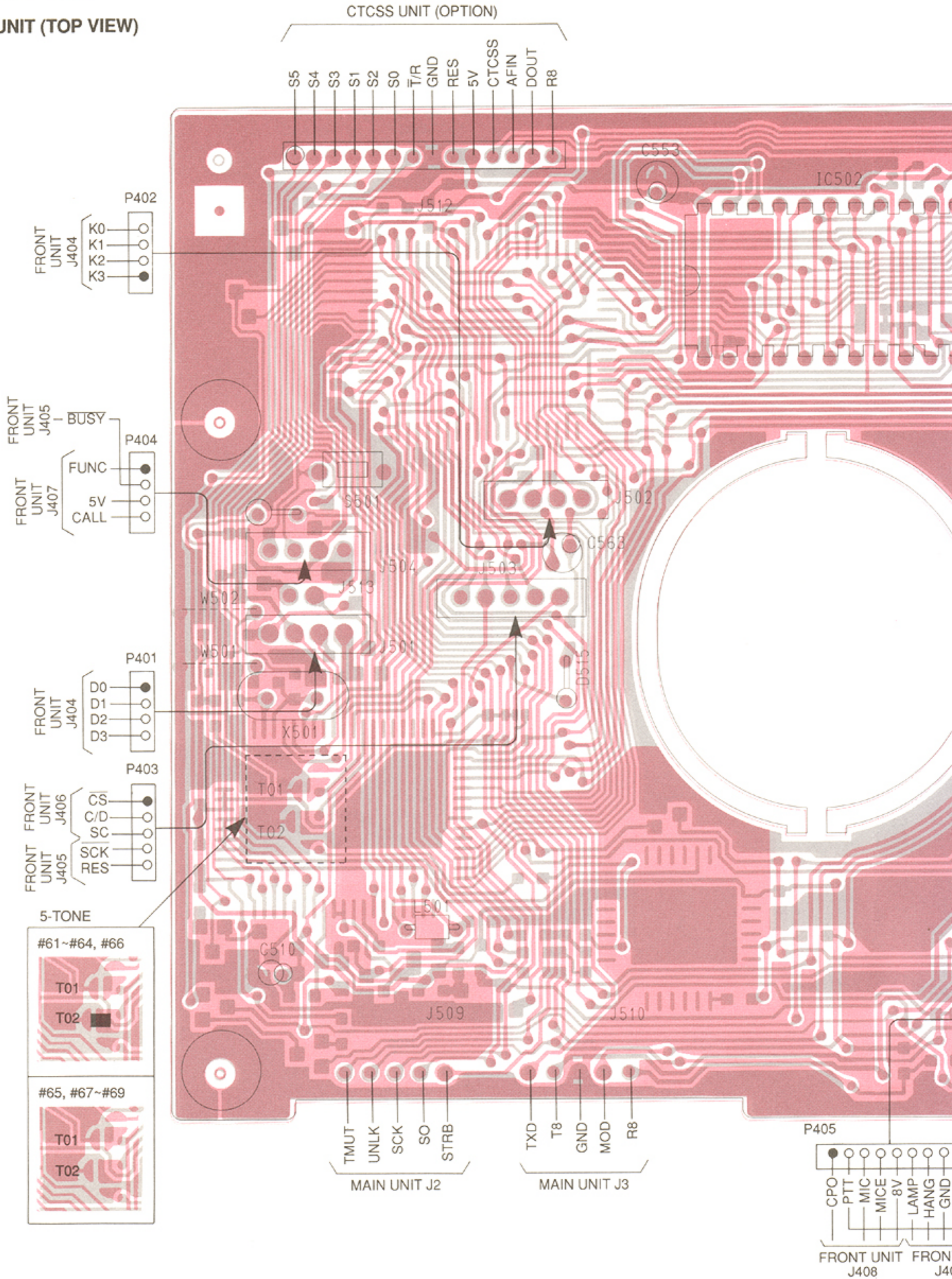
FUNCTION DISPLAY





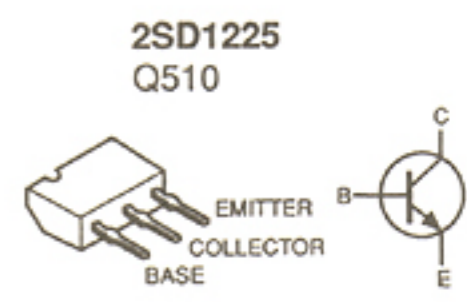
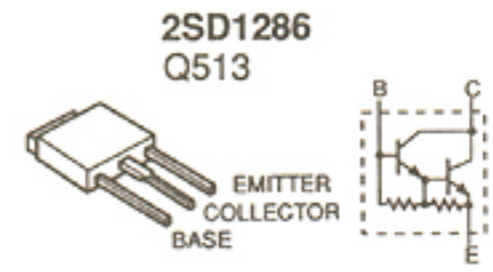
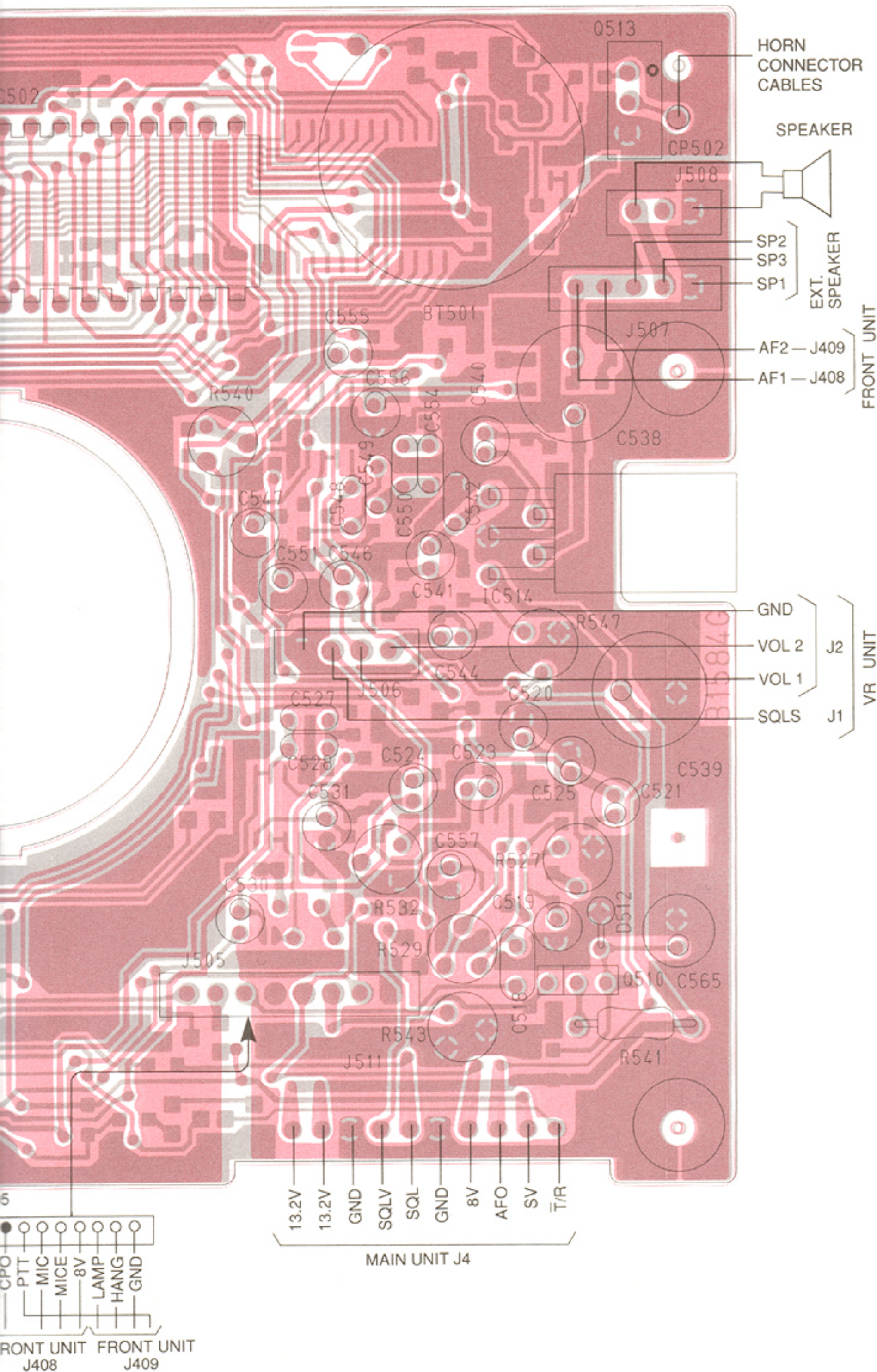
# 7-2 LOGIC UNIT

## • LOGIC UNIT (TOP VIEW)





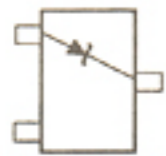
The combination of this page and the next page shows the unit layout in the same configuration as the actual P.C. Board.





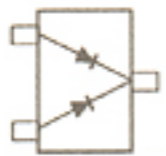
• LOGIC UNIT (BOTTOM VIEW)

RD6.2M B2  
D502



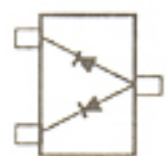
Symbol: 622

1SS184  
D501, D510



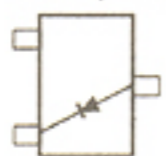
Symbol: B3

1SS181  
D505, D513



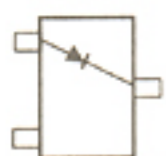
Symbol: A3

1SS190  
D504, D506



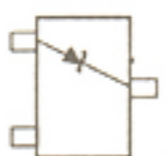
Symbol: E3

1SS193  
D514



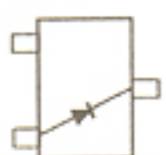
Symbol: F3

RD5.1M B2  
D511



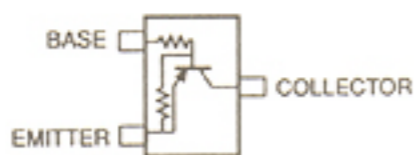
Symbol: 512

1SS196  
D508



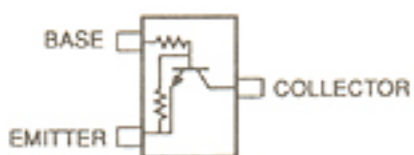
Symbol: G3

2SA1341  
Q501, Q503, Q506



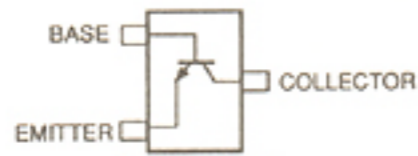
Symbol: BL

2SC3395  
Q504, Q507, Q509  
Q515, Q516, Q517  
Q518, Q520, Q521  
Q523



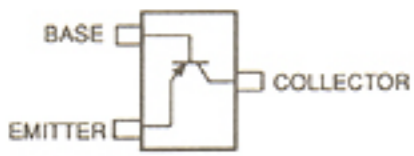
Symbol: BY

2SC2712  
Q508, Q514, Q519  
Q522



Symbol: LY

2SA1162  
Q505

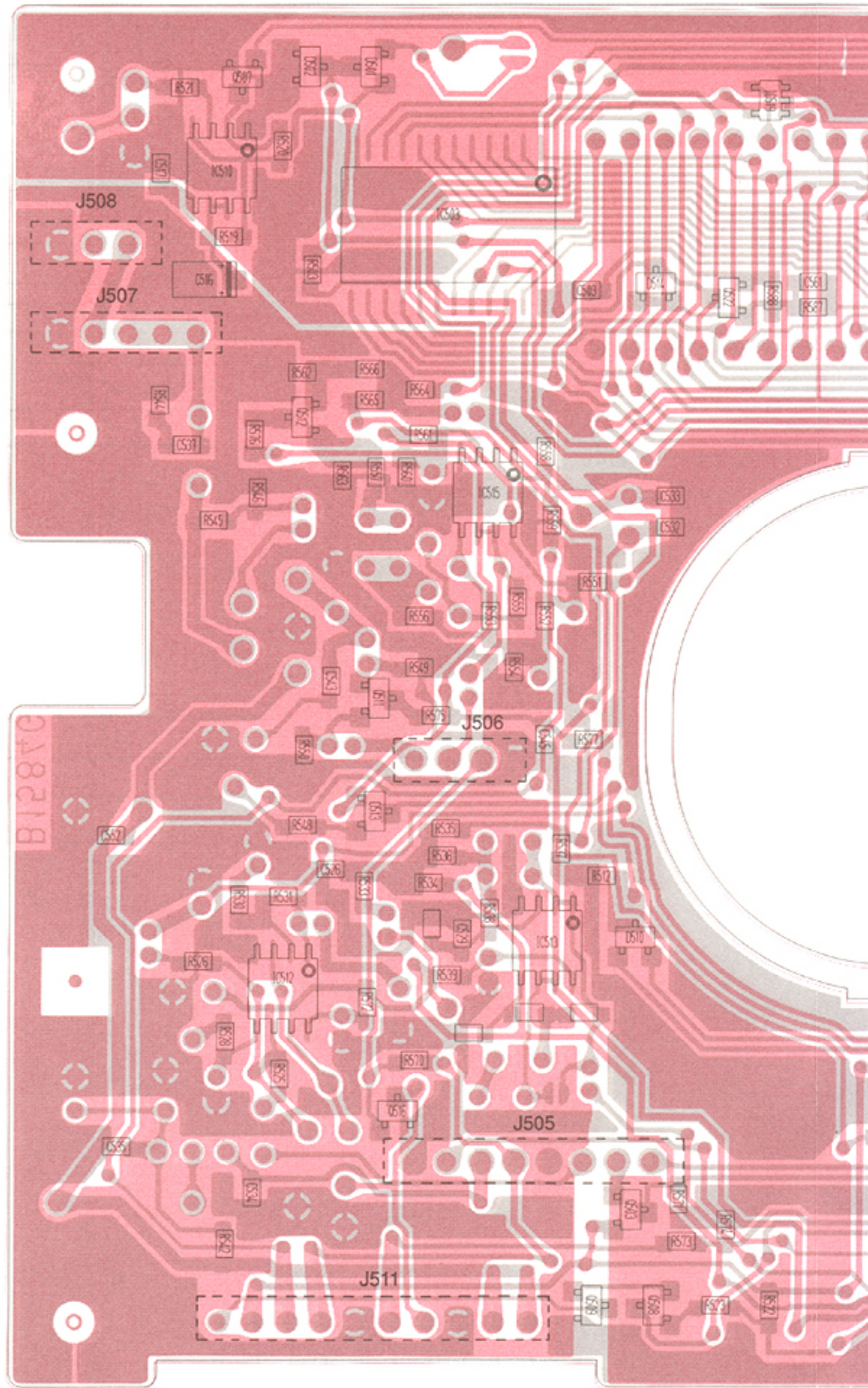


Symbol: SY

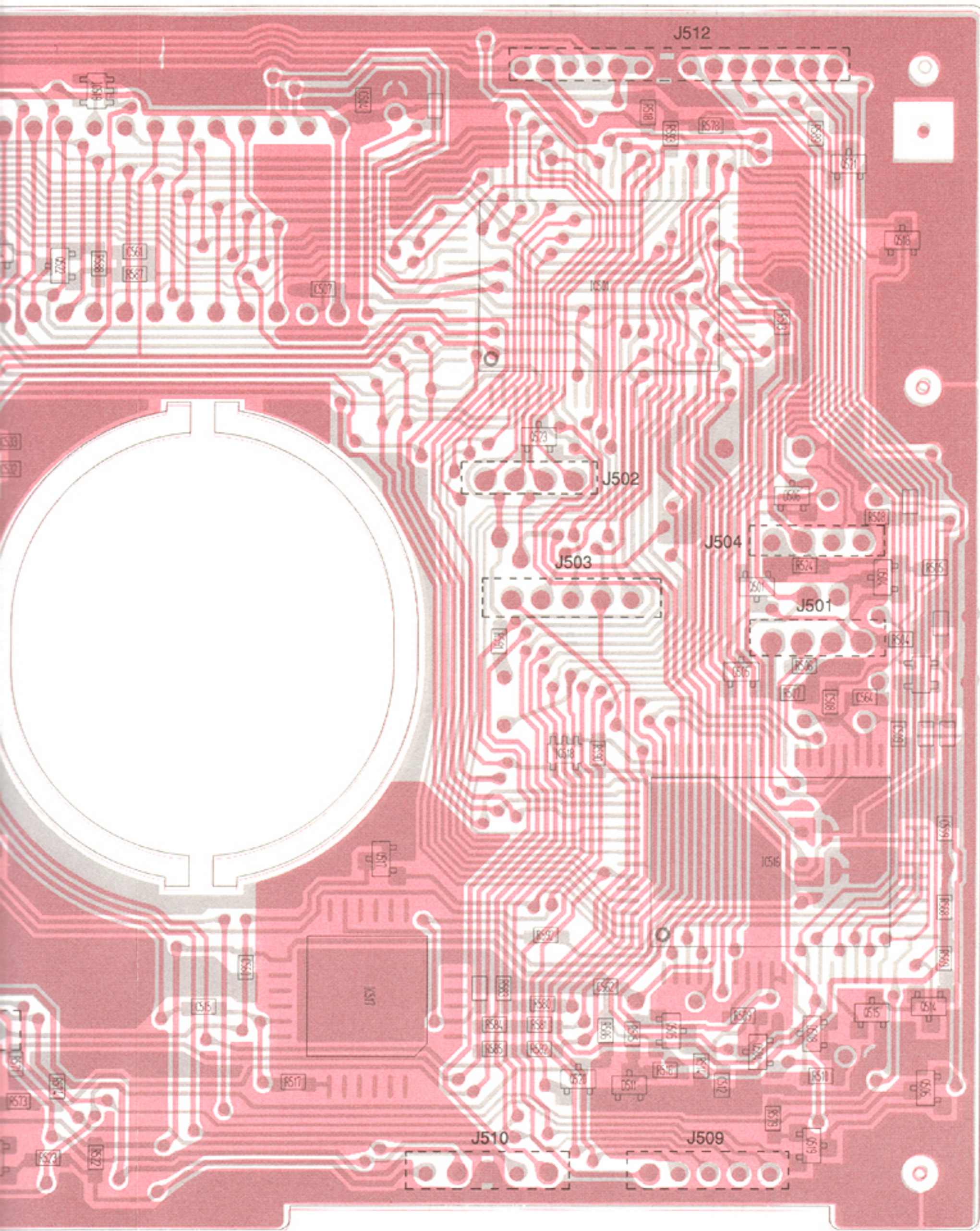
2SJ106  
Q511, Q512



Symbol: VY



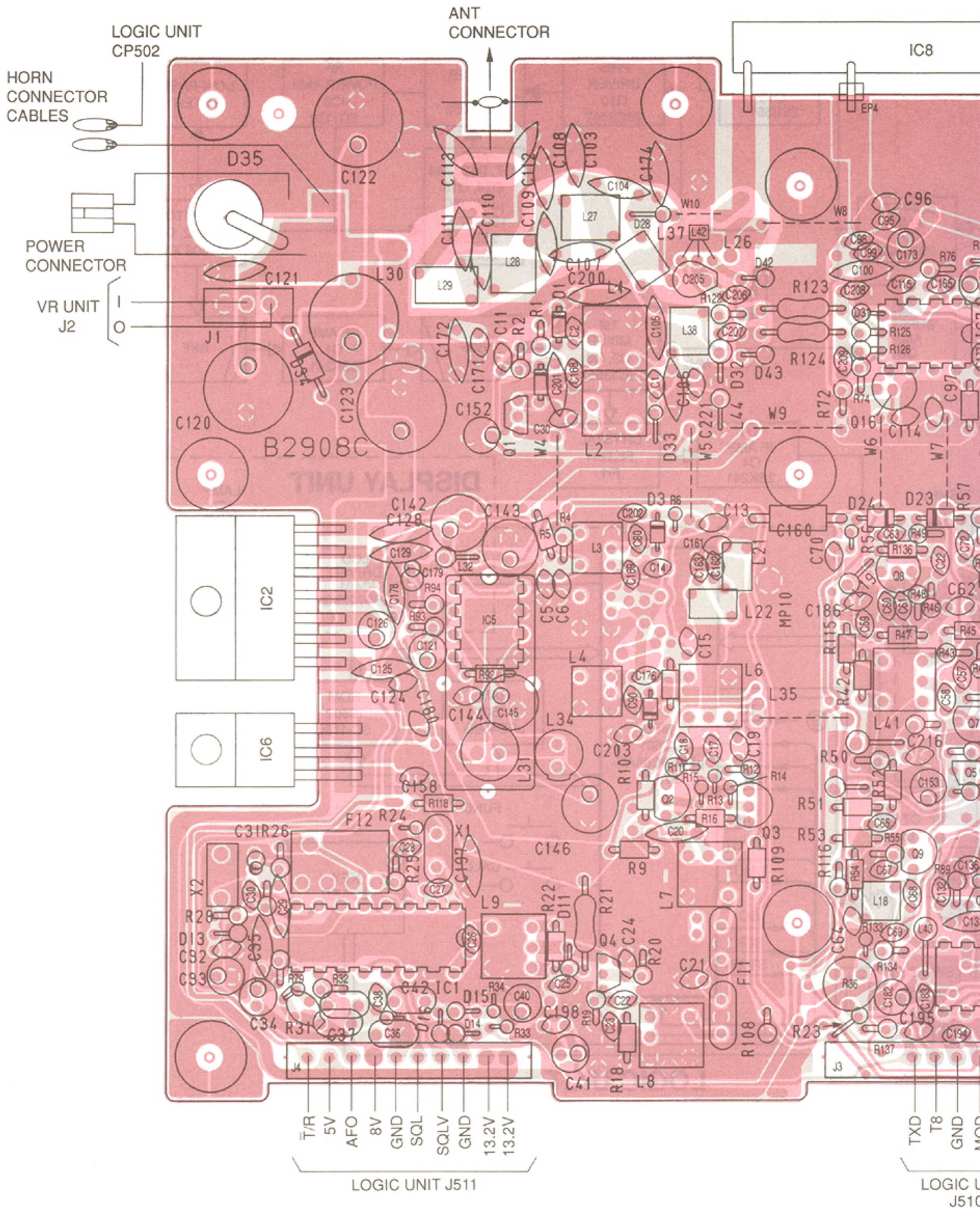




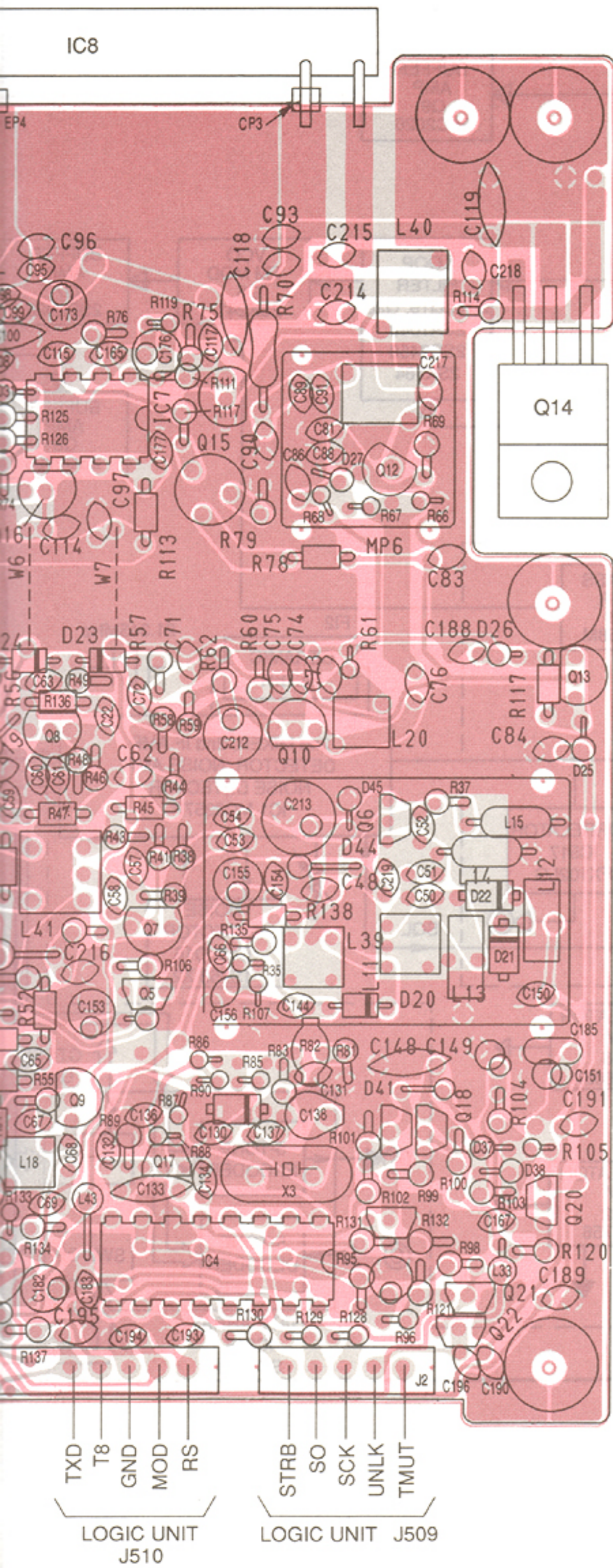


# 7-3 MAIN UNIT

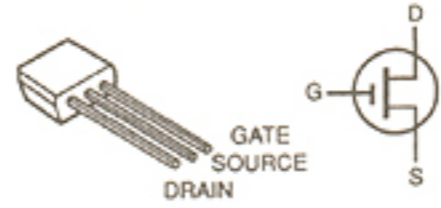
## • MAIN UNIT (TOP VIEW)



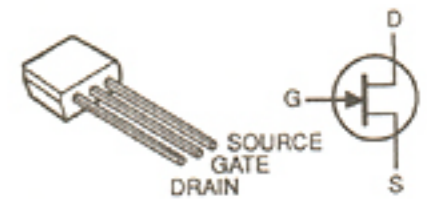




**2SK241**  
Q1, Q4, Q6



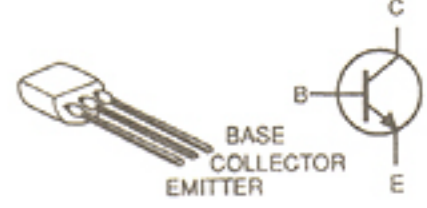
**2SK184**  
Q20



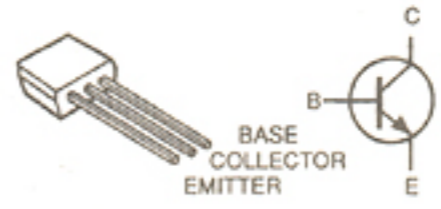
**2SC3355**  
Q2, Q3



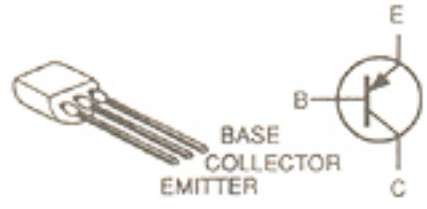
**2SC945**  
Q15, Q16



**2SC2458**  
Q5, Q17, Q19  
Q21, Q22, Q23



**2SB561**  
Q13



**2SC2026**  
Q7, Q8, Q9



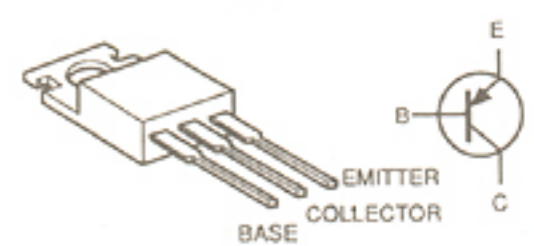
**2SA1048**  
Q18



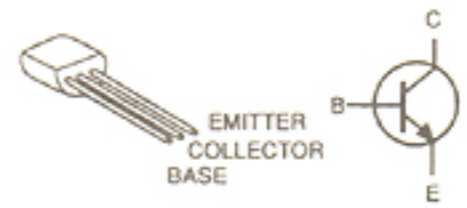
**2SC2407**  
Q10, Q11



**2SB596**  
Q14

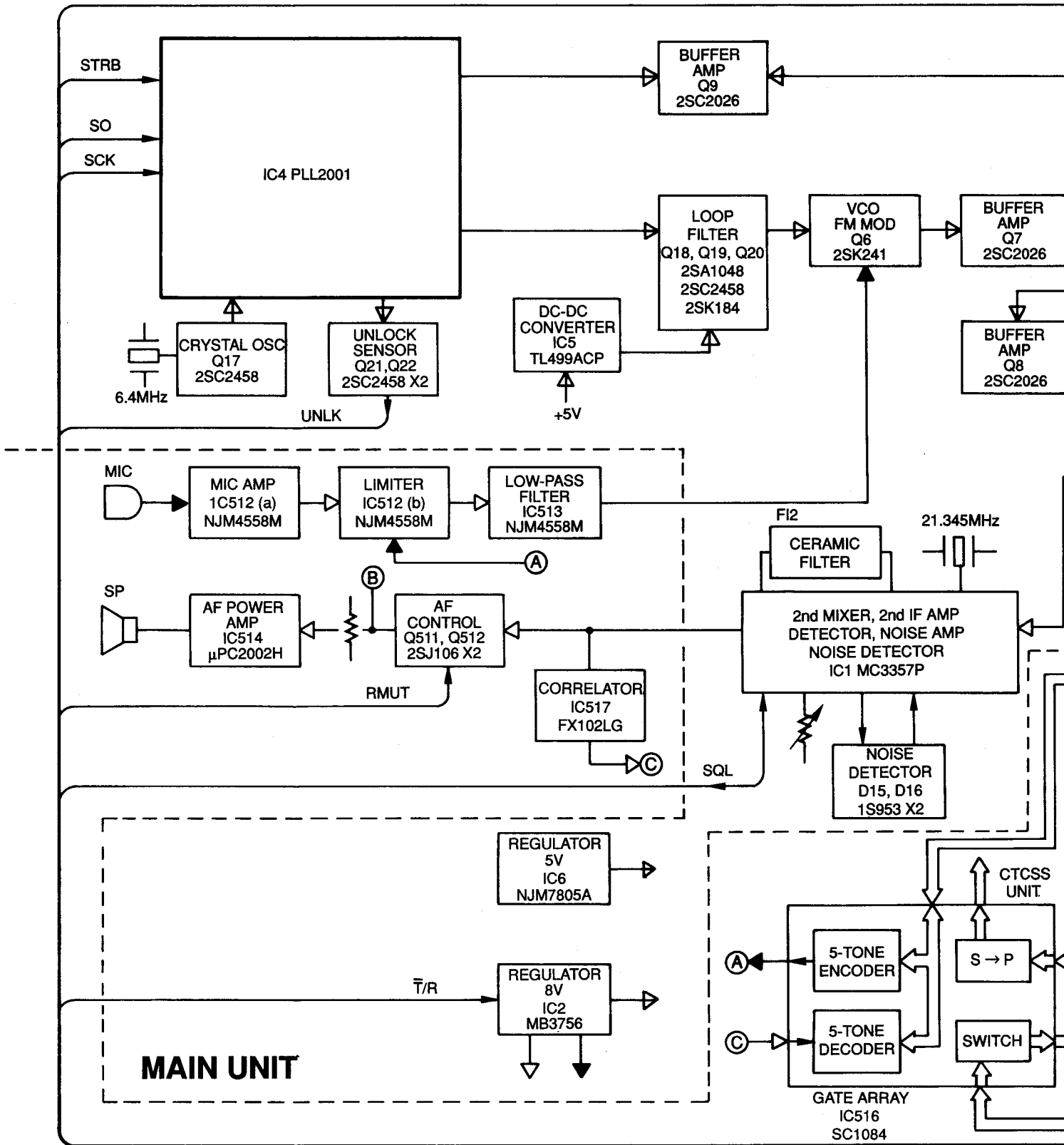


**2SC2053**  
Q12

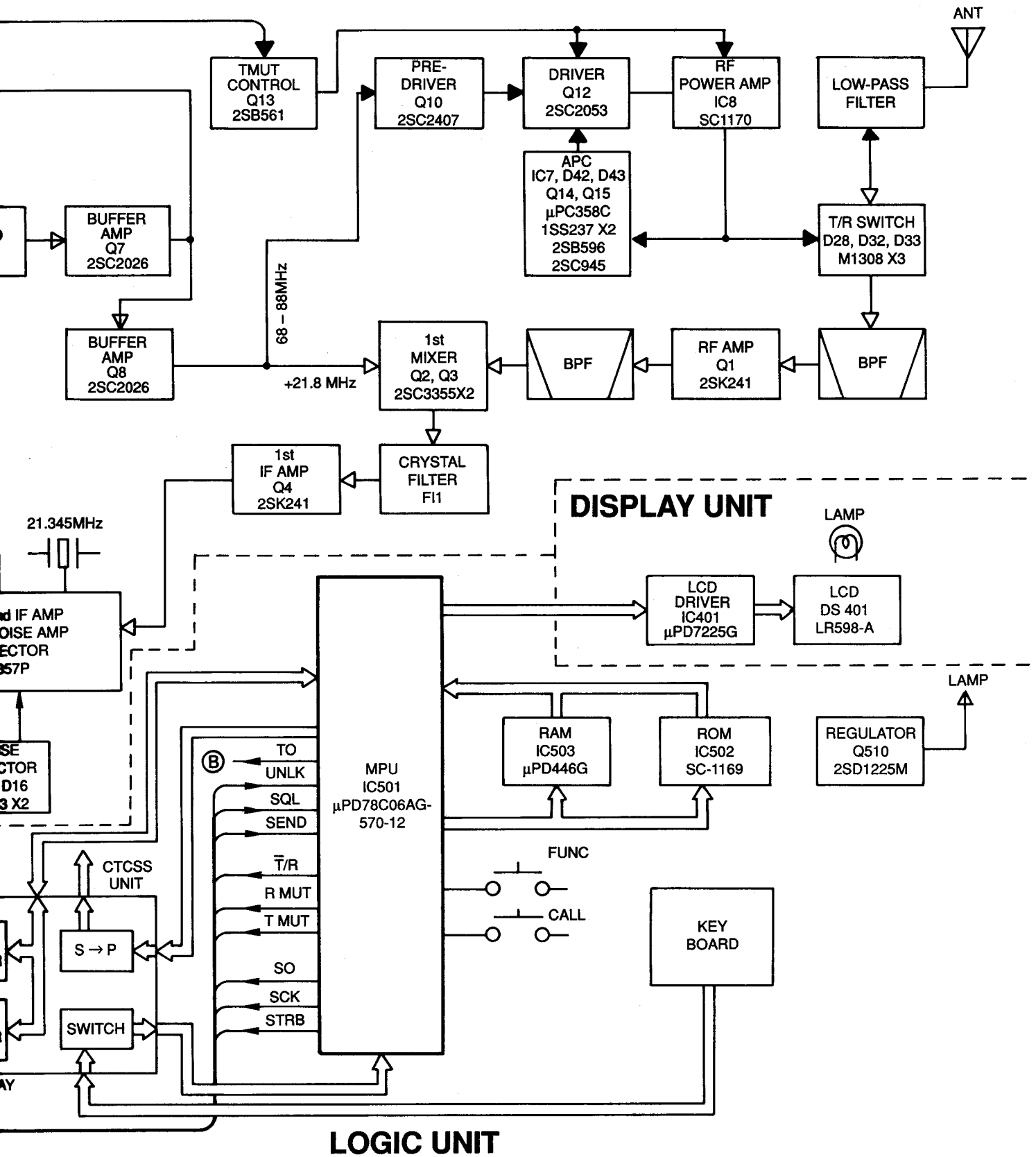




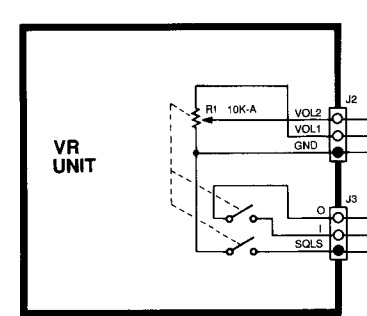
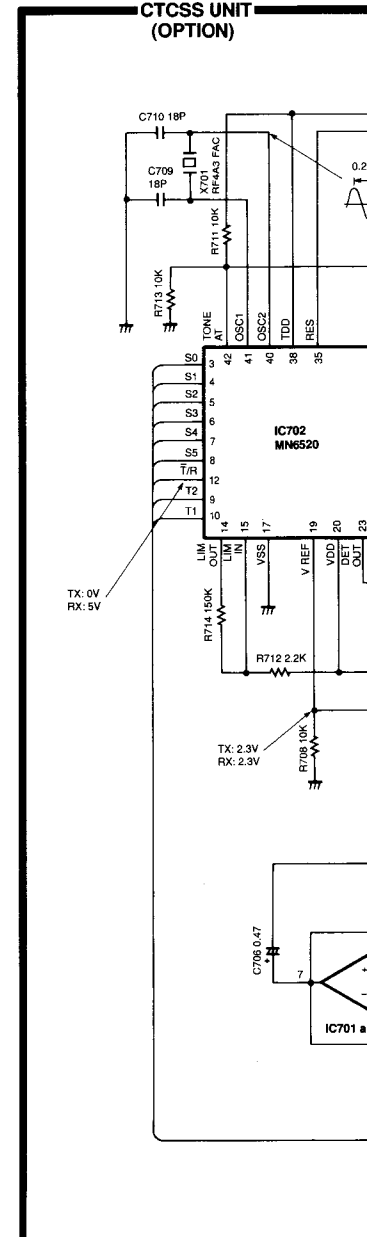
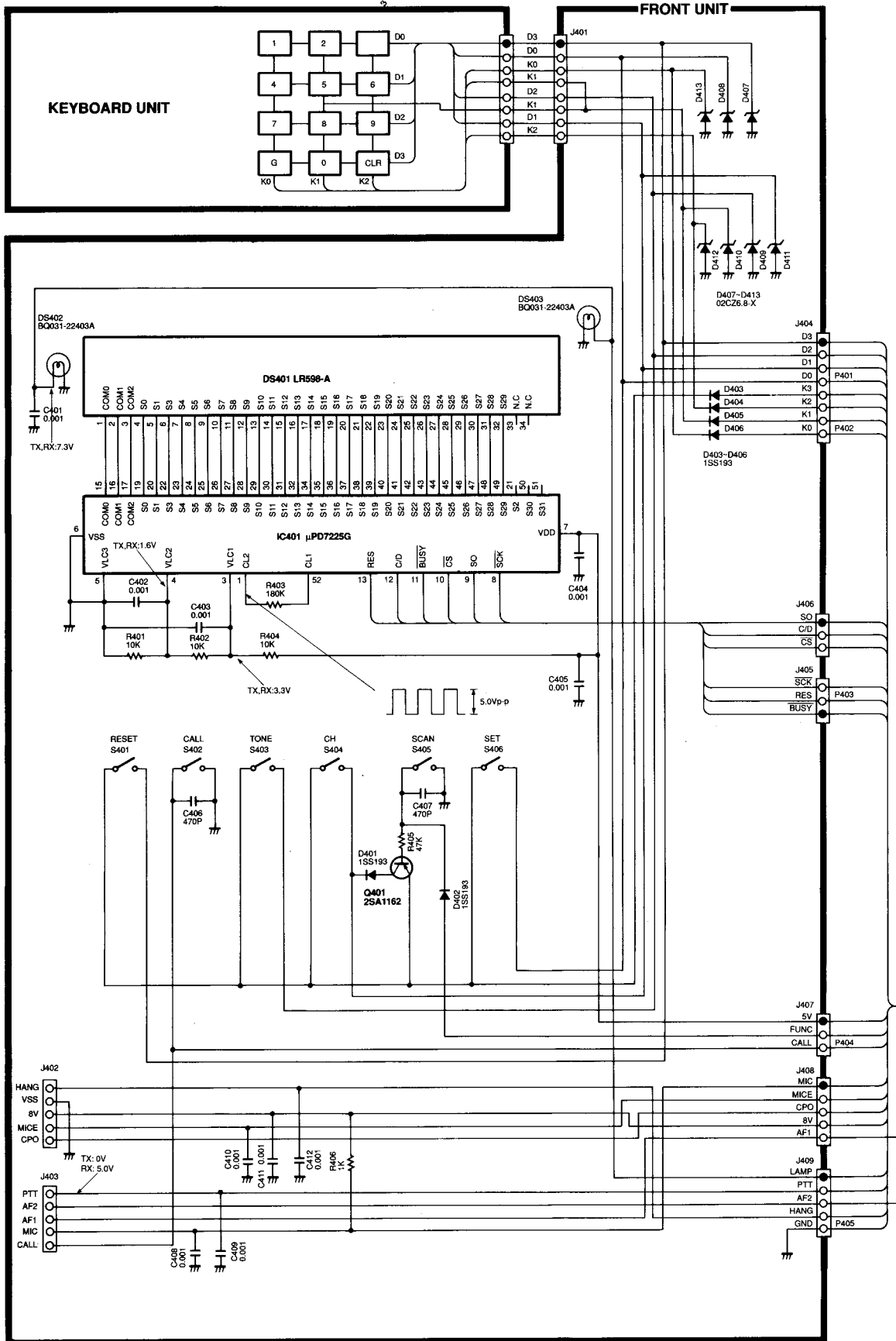
# SECTION 8 BLOCK DIAGRAM



- ▷ RECEIVE MODE
- ▷ TRANSMIT MODE
- ▷ COMMON MODE

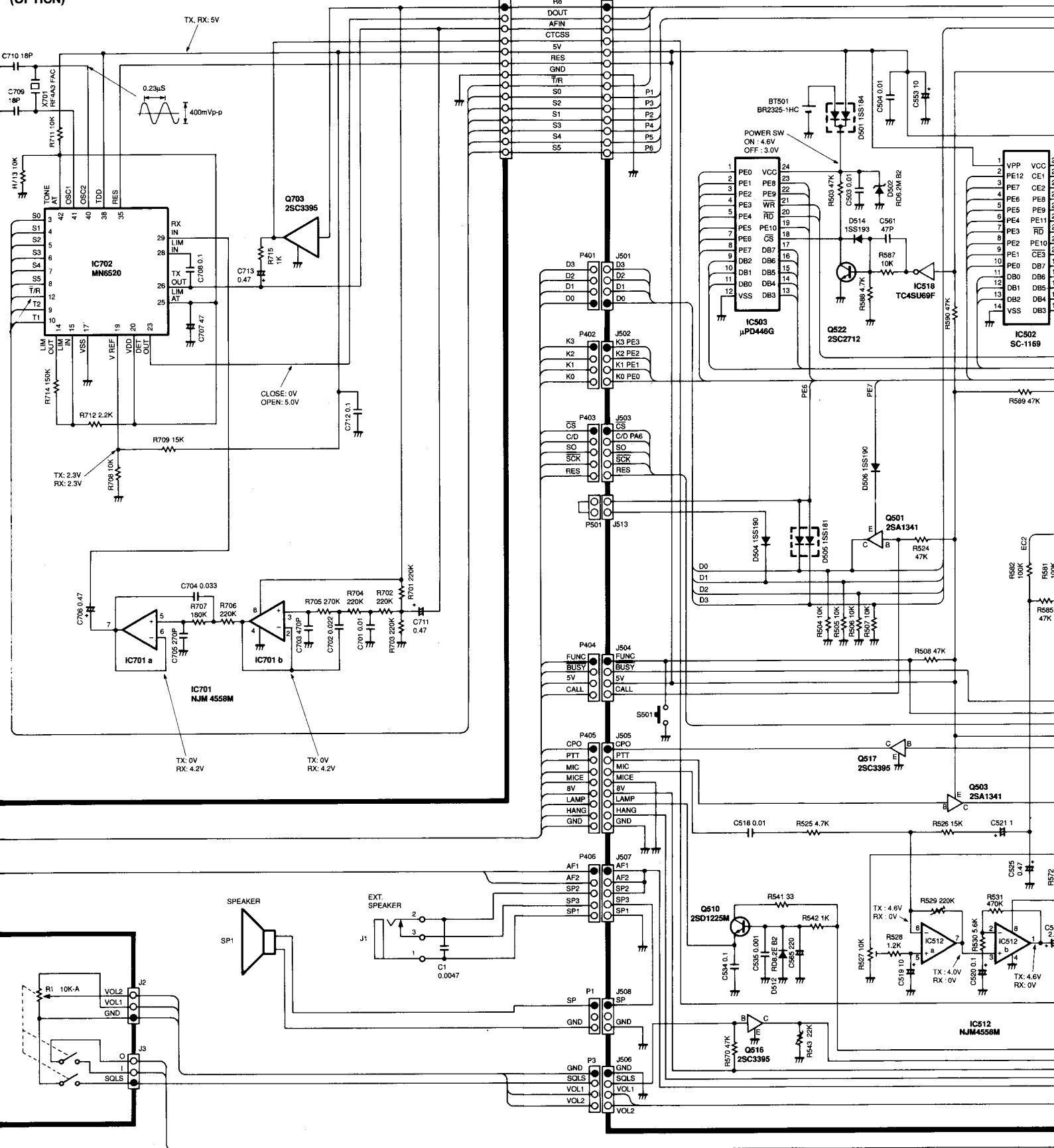


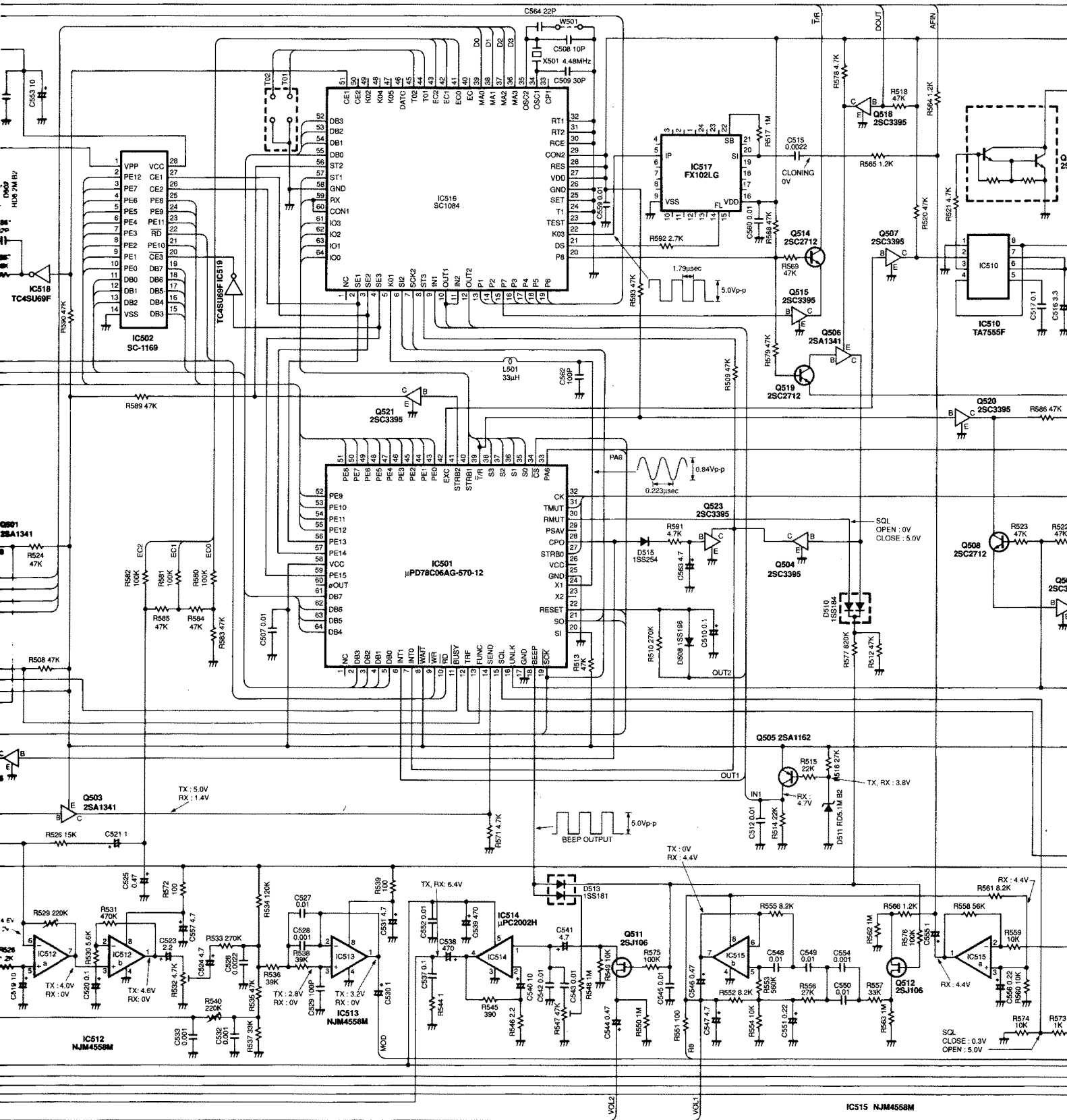
# SECTION 9 VOLTAGE DIAGRAM



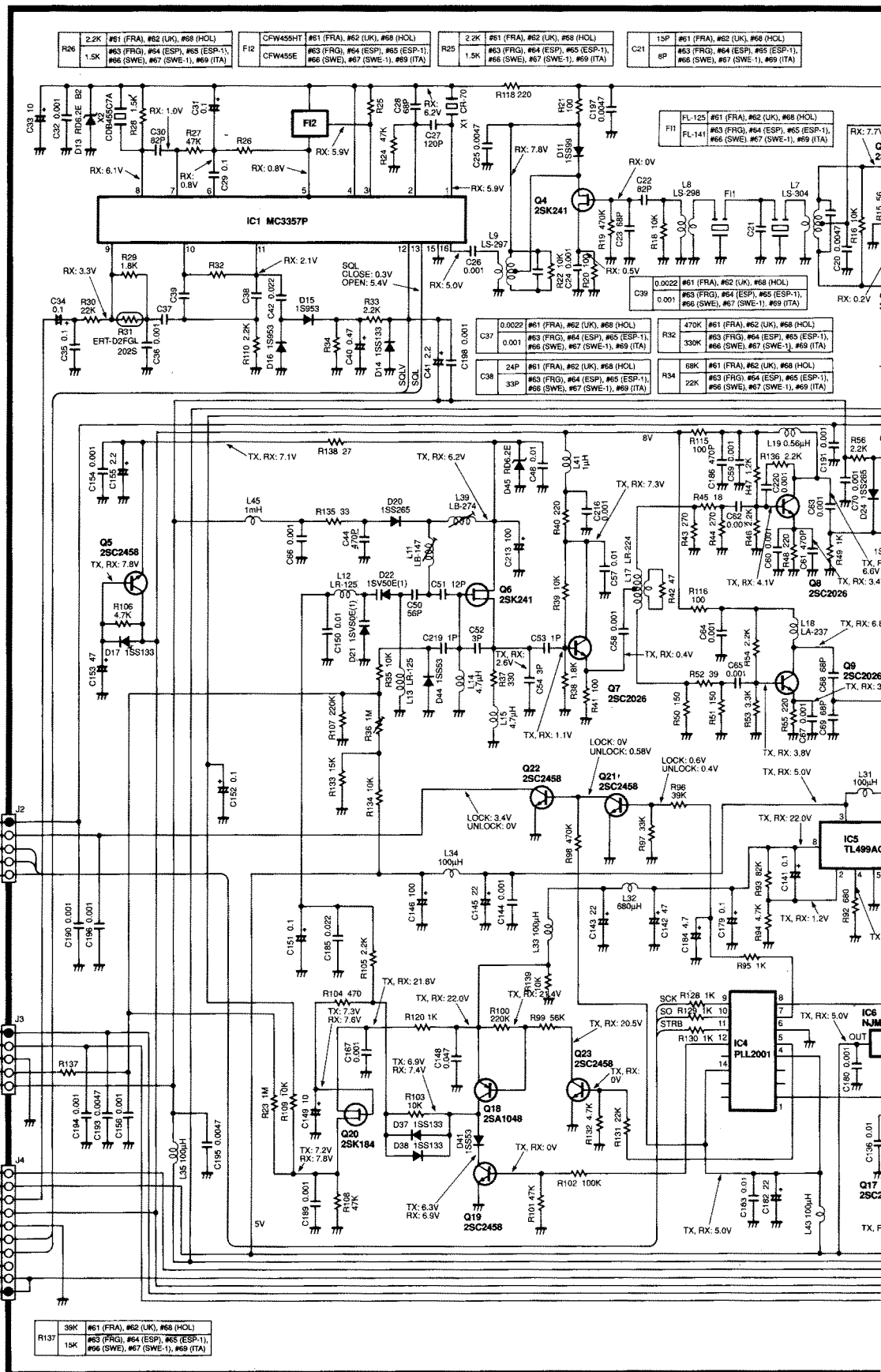
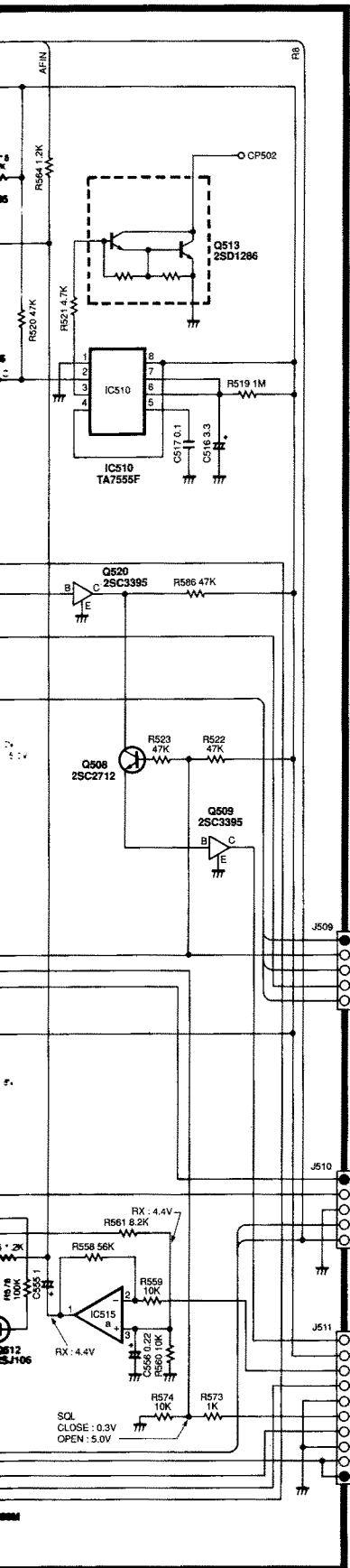
**CTCSS UNIT (OPTION)**

**LOGIC UNIT**





IC515 NJM4558M



R26	2.2K	#61 (FRA), #62 (UK), #68 (HOL)
	1.5K	#63 (FRG), #64 (ESP), #65 (ESP-1), #66 (SWE), #67 (SWE-1), #69 (ITA)

F12	CFW455HT	#61 (FRA), #62 (UK), #68 (HOL)
	CFW455E	#63 (FRG), #64 (ESP), #65 (ESP-1), #66 (SWE), #67 (SWE-1), #69 (ITA)

R25	2.2K	#61 (FRA), #62 (UK), #68 (HOL)
	1.5K	#63 (FRG), #64 (ESP), #65 (ESP-1), #66 (SWE), #67 (SWE-1), #69 (ITA)

C21	15P	#61 (FRA), #62 (UK), #68 (HOL)
	8P	#63 (FRG), #64 (ESP), #65 (ESP-1), #66 (SWE), #67 (SWE-1), #69 (ITA)

F11	FL-125	#61 (FRA), #62 (UK), #68 (HOL)
	FL-141	#63 (FRG), #64 (ESP), #65 (ESP-1), #66 (SWE), #67 (SWE-1), #69 (ITA)

C37	0.0022	#61 (FRA), #62 (UK), #68 (HOL)
	0.001	#63 (FRG), #64 (ESP), #65 (ESP-1), #66 (SWE), #67 (SWE-1), #69 (ITA)

R32	470K	#61 (FRA), #62 (UK), #68 (HOL)
	330K	#63 (FRG), #64 (ESP), #65 (ESP-1), #66 (SWE), #67 (SWE-1), #69 (ITA)

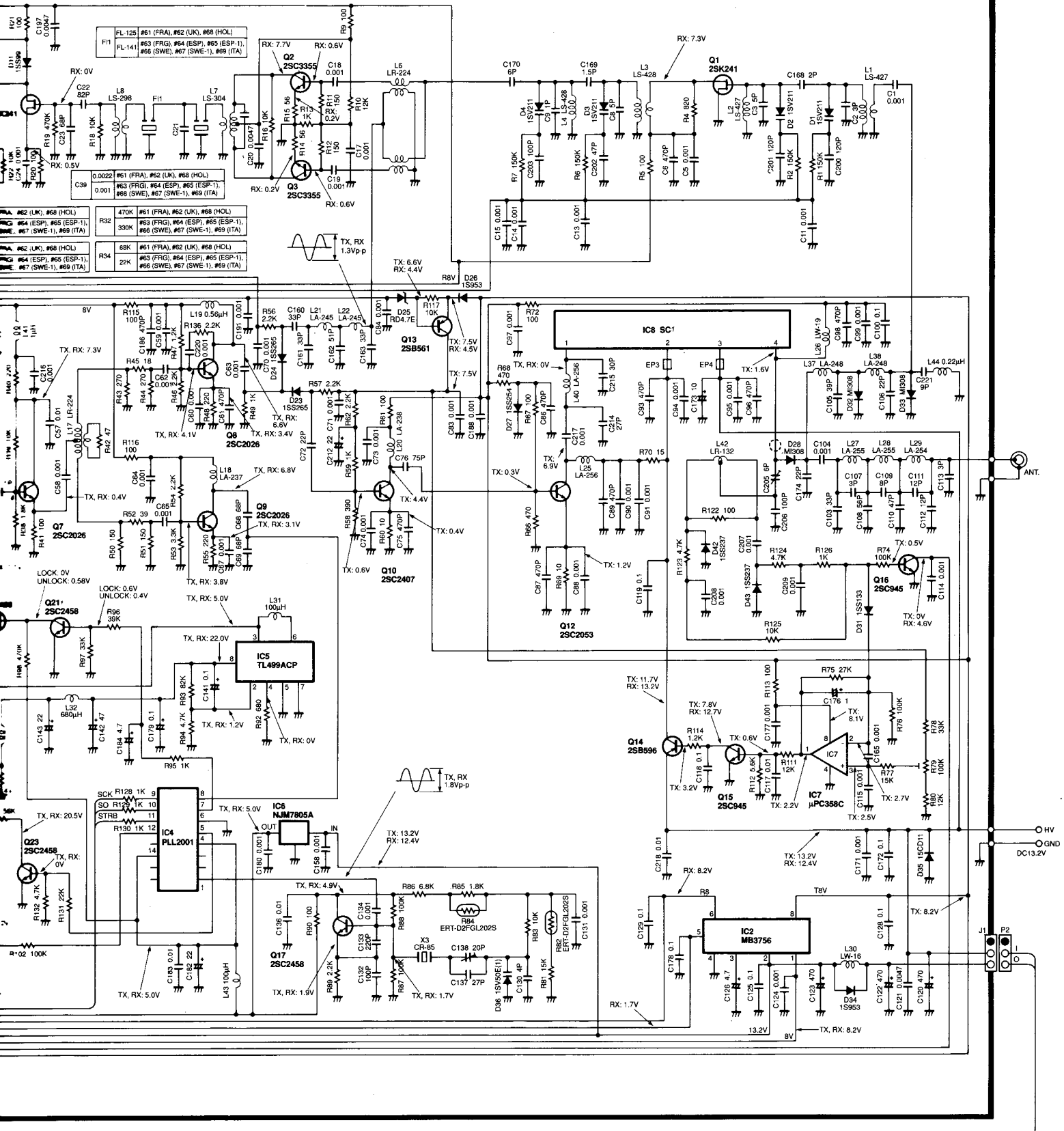
C38	24P	#61 (FRA), #62 (UK), #68 (HOL)
	33P	#63 (FRG), #64 (ESP), #65 (ESP-1), #66 (SWE), #67 (SWE-1), #69 (ITA)

R34	68K	#61 (FRA), #62 (UK), #68 (HOL)
	22K	#63 (FRG), #64 (ESP), #65 (ESP-1), #66 (SWE), #67 (SWE-1), #69 (ITA)

R137	38K	#61 (FRA), #62 (UK), #68 (HOL)
	19K	#63 (FRG), #64 (ESP), #65 (ESP-1), #66 (SWE), #67 (SWE-1), #69 (ITA)

MAIN UNIT

15P	#61 (FRA), #62 (UK), #68 (HOL)
BP	#63 (FRG), #64 (ESP), #65 (ESP-1), #66 (SWE), #67 (SWE-1), #69 (ITA)





## 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>  
18102 Sky Park South, Suite 52-B, Irvine, CA 92714, U.S.A.  
Phone : (714) 852-8026  
Fax : (714) 852-8716

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, F.R.G.  
Phone : 0211 346047  
Fax : 0211 333639  
Telex : 8588082 ICOM D

### Icom (Australia) Pty. Ltd.

A.C.N 006 092 575  
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, CT6 8LD, U.K.  
Phone : 0227 741741  
Fax : 0227 360155  
Telex : 965179 ICOM G

### Icom France S.a

Zac de la Plaine, Rue Brindejonc des Moulinais  
BP 5804, 31505 Toulouse Cedex, France  
Phone : 61. 20. 31. 49 Fax : 61. 34. 05. 91  
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