



# SERVICE MANUAL

VHF TRANSCEIVER (146 ~ 174 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.

To upgrade quality, all electrical and mechanical parts and internal circuits are subject to change without notice or obligation.

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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>

1110000070	IC	μPC358C	IC-V200T	MAIN UNIT	5 pieces
8810002960	Screw	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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## VERSIONS

VERSION NUMBER	DESTINATION	FREQUENCY RANGE	CHANNEL SPACING	OUTPUT POWER	OUTPUT POWER	VERSION NUMBER	DESTINATION	FREQUENCY RANGE	CHANNEL SPACING	OUTPUT POWER	OUTPUT POWER
#13	U. K.	146~174 MHz	12.5 kHz	10 W	CCIR	#28	France	156~168 MHz	25 kHz	25 W	DAPL
#14	Greece	148~160 MHz	12.5 kHz	25 W	CCIR	#29	Holland	146~174 MHz	20 kHz	10 W	ZVEI
#16	Greece	164~174 MHz	12.5 kHz	25 W	CCIR	#30	France	146~174 MHz	12.5 kHz	10 W	CCIR
#20	Sweden	146~174 MHz	25 kHz	10 W	CCIR	#31	Spain	156~168 MHz	25 kHz	25 W	CCIR
#21	Sweden	148~160 MHz	25 kHz	25 W	CCIR	#32	France	148~160 MHz	12.5 kHz	25 W	CCIR
#22	General	148~160 MHz	12.5 kHz	25 W	EEA	#33	U. K.	164~174 MHz	12.5 kHz	25 W	CCIR
#24	Sweden	156~168 MHz	25 kHz	25 W	CCIR	#34	Spain	156~168 MHz	25 kHz	25 W	CCIR
#25	Sweden	164~174 MHz	25 kHz	25 W	CCIR	#35	Germany	146~174 MHz	20 kHz	6 W	ZVEI

# SECTION 1 SPECIFICATIONS

## GENERAL

- Frequency coverage : See VERSIONS on the right page of the inside front cover
- Type of emission : 16K0F3E (#20, #21, #24, #25, #28, #31, #34)  
14K0F3E (#29, #35)  
8K50F3E (#13, #14, #16, #22, #30, #32, #33)
- Antenna impedance : 50  $\Omega$  nominal
- Usable temperature range :  $-30^{\circ}\text{C} \sim +60^{\circ}\text{C}$
- Frequency stability :  $\pm 1.5$  kHz ( $-30^{\circ}\text{C} \sim +60^{\circ}\text{C}$ )
- Power supply requirement : 13.8 V DC  $\pm 15\%$  (negative ground)
- Current drain (at 13.8 V DC) :

Transmit	6 W, 10 W versions	3.0 A
	25 W versions	6.0 A
Receive	Squelched	350 mA
	Max. audio output	1.0 A

- Dimensions : 140 (W) x 50 (H) x 179 (D) mm  
(Projections not included)
- Weight : 1.4 kg
- 5-Tone system : CCIR, ZVEI, EEA, DAPL

## TRANSMITTER

- Output power : 25 W (#14, #16, #21, #22, #24, #25, #28, #31, #32, #33, #34)  
10 W (#13, #20, #29, #30)  
6 W (#35)
- Modulation system : Variable reactance frequency modulation
- Max. frequency deviation :  $\pm 5$  kHz (#20, #21, #25, #28, #31, #34)  
 $\pm 4$  kHz (#29, #35)  
 $\pm 2.5$  kHz (#13, #14, #16, #22, #30, #32, #33)
- Spurious emissions :  $< 0.25$   $\mu\text{W}$
- Audio response :  $+1$  dB  $\sim -3$  dB of  $+6$  dB/octave with 300 Hz to 3000 Hz input
- Noise and hum ratio :  $> 40$  dB (#20, #21, #25, #28, #31, #34)  
 $> 35$  dB (#13, #14, #16, #22, #30, #32, #33)  
 $> 38$  dB (#29, #35)
- Microphone impedance : 600  $\Omega$

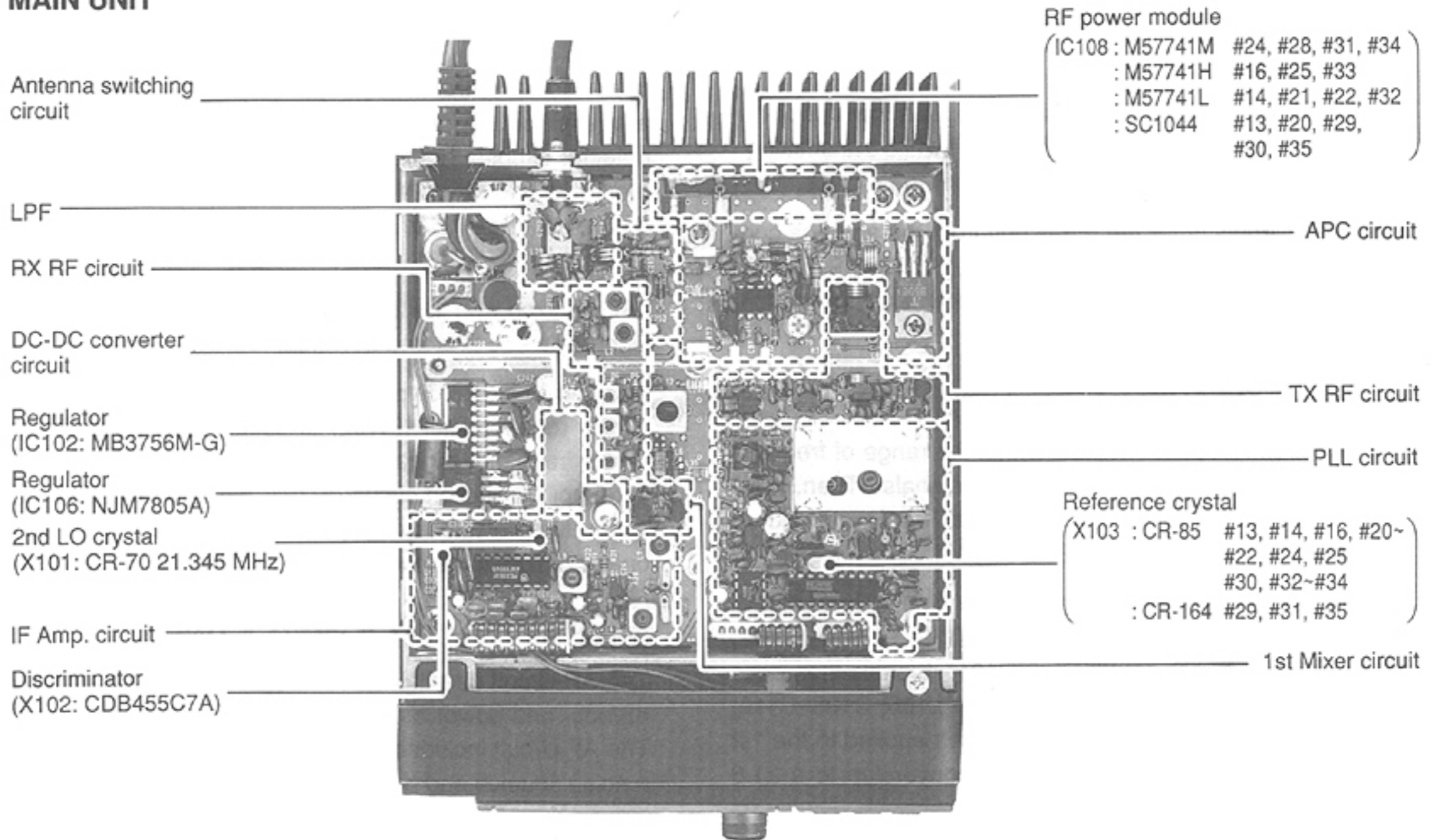
## RECEIVER

- Sensitivity : 0.35  $\mu\text{V}$  (PD) for 12 dB SINAD, signal input modulated by 1 kHz tone at 60 % peak deviation
- Intermediate frequency : 1st 21.8 MHz  
2nd 455 kHz
- Squelch sensitivity : 0.3  $\mu\text{V}$  (Threshold level)
- Adjacent channel selectivity :  $> 70$  dB
- Intermodulation rejection :  $> 70$  dB
- Spurious response rejection :  $> 70$  dB
- Audio response :  $+1$  dB  $\sim -3$  dB of  $-6$  dB/octave with 300 Hz to 3000 Hz deviation
- Audio output impedance : 4  $\Omega$
- Audio output power : 3 W with a 4  $\Omega$  load

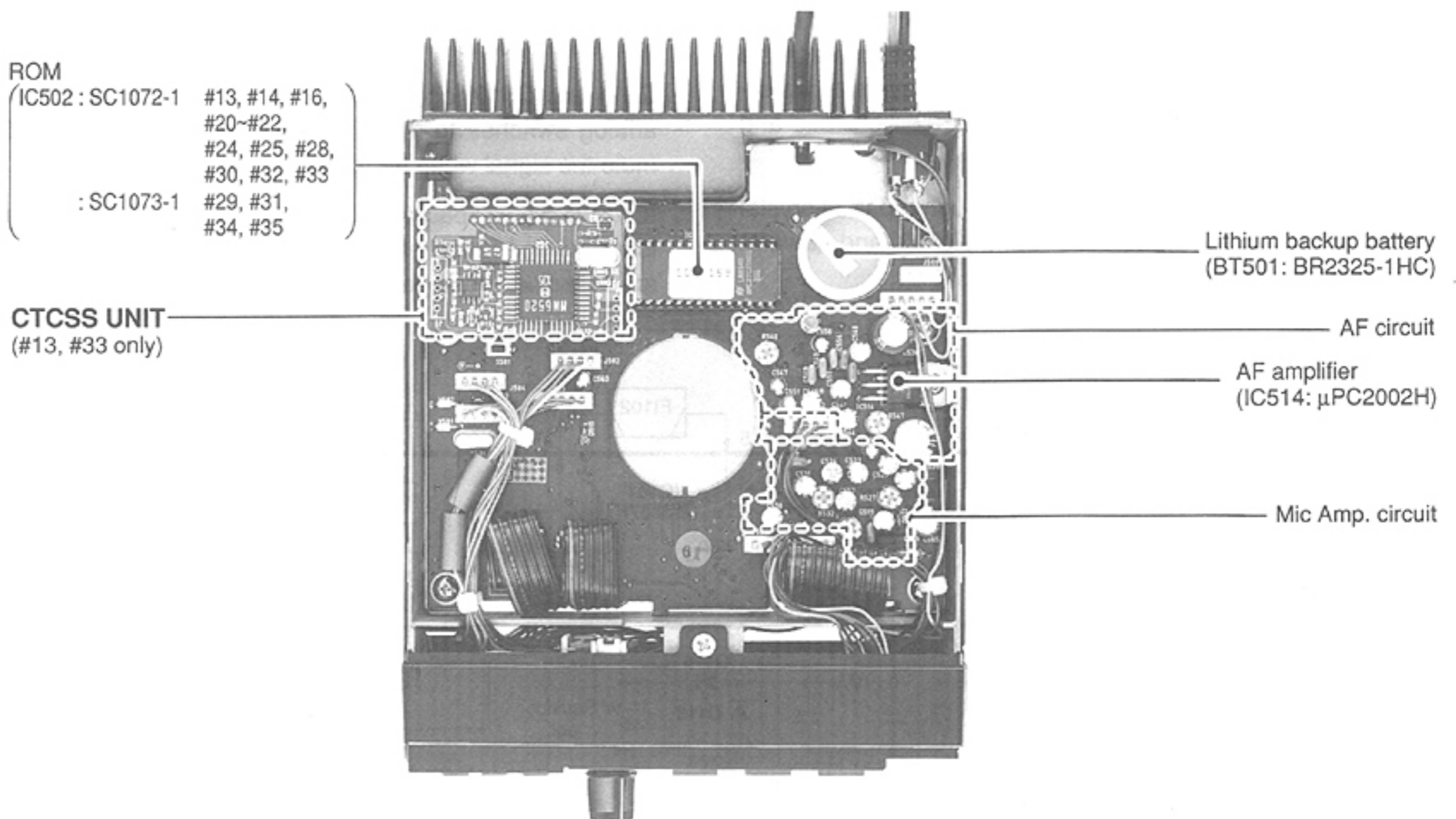
All stated specifications are approximate and subject to change without notice or obligation.

# SECTION 2 INSIDE VIEWS

## • MAIN UNIT



## • LOGIC-A 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 (L127~L129, C203, C207~C213). They are then applied to an antenna switching circuit (D132, D133).

#### 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 (L101, L102, D101~D104, C102, C103, C268) and are amplified at Q101. Signals then pass through a 2-stage bandpass filter (L103~L105, C108~C110, C116, C270, D105~D110). They are then applied to the 1st mixer circuit (Q102, Q103, L106) for conversion to a 21.8 MHz 1st IF signal.

A local oscillator signal (output from Q106) is buffer amplified at Q107 and Q108, passes through a switching circuit (D123, D124) and a 2-stage bandpass filter (L121, L122, C261~C263) and is applied to L106.

#### 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 L107 passes through a pair of crystal filters (F1101) 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 Q104 and is applied to IC101 (pin 16) through L109.

IC101 contains the 2nd LO circuit, 2nd mixer circuit, limiter amplifier circuit, squelch trigger circuit and quadrature detector circuit. The 2nd LO circuit, including X101, generates a 21.345 MHz 2nd LO signal which is used at the 2nd mixer section of IC101.

The 1st IF signal from Q104, which is applied to IC101 (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 (F1102) to suppress unwanted heterodyned frequency signals. The signal is amplified at the limiter amplifier section circuit (IC101, pin 5) and applied to the quadrature detector circuit (IC101, pin 8) and a ceramic resonator (X102) to demodulate the 2nd IF signal to AF signals.

#### 3-1-4 AF CIRCUIT (LOGIC-A 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 IC101 (pin 9) pass through a de-emphasis circuit (R130, C135) 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.

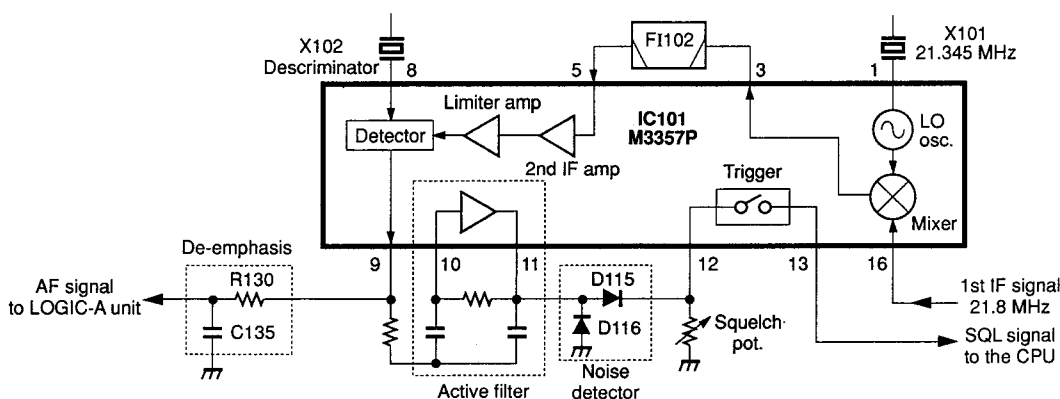


Fig.1 IF CIRCUIT/SQUELCH CIRCUIT

### 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 IC101 (pin 9) are applied to pin 11, (attached to the active filter of IC101), 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 IC101 and then output from pin 11. Amplified noise signals are detected by D115 and D116, and are converted to DC voltage. This voltage is applied to the squelch trigger circuit (IC101, pin 12). The squelch control pot (R543) on the LOGIC-A 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-A 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-A 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 (C518, 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 the 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 Q106 as frequency modulation signals.

### 3-2-2 MODULATION CIRCUIT

The modulation circuit modulates the VCO oscillating signal (RF signal) using the microphone audio signals.

The MOD signal changes the reactance of a diode (D120) to modulate the oscillated signal at the VCO circuit (Q106). The oscillated signal is buffer-amplified at Q107.

The amplified signal passes through the isolating circuit (L117, R142) and is amplified at Q108. The signal is then applied to the transmit/receive switching diodes (D123, D124).

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

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

The signals from the transmit/receive switching circuit (D123) is amplified by Q110, Q111 and Q112 to obtain 500 mW of RF output power. To obtain constant output, the APC circuit applies control voltage to the collector of Q112.

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. Q113 controls D123, Q110, Q111 and Q112 using the T-MUTE signal.

### 3-2-4 POWER AMPLIFIER CIRCUIT (MAIN UNIT)

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

IC108 is an RF power module that can attain 25 W (10 W for #13, #20, #29, #30; 6 W for #35) with an input of 200 mW (136 MHz~174 MHz) as well as obtain stable output over broad bands.

The output power from IC108 (pin 4) passes through an antenna switching circuit and a low-pass filter before being applied to the antenna connector.

Output signals from IC108 pass through a 3-stage low-pass filter consisting of L127~L129, C207~C213 and C203 via D128. This filter suppresses high-frequency spurious signals.

### 3-2-5 APC CIRCUIT (MAIN UNIT)

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

The output power from IC108 is detected by D130 and is converted to DC voltage. The voltage is then applied to the inverting amplifier (IC107) to control the input current of Q112 and IC108 (pin 2) using Q114 and Q115.

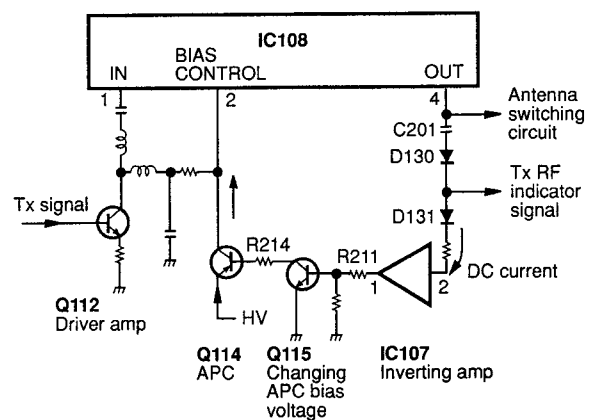


Fig.2 APC CIRCUIT

### 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 12.5 kHz is acquired by X103, Q117, and the divider inside IC104. A signal from the VCO is buffer amplified at Q109, applied to IC104, and divided N times at IC103 and IC104. The divided signal is applied to the phase detector in IC104. Phase detection results in lock voltages being output from pins 12 and 13.

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

Output from IC104 (pins 12 and 13) is converted to DC voltage

in a charge pump circuit consisting of Q118, Q119 and is then applied to a lag-lead type, loop filter consisting of (R204, R205, C249).

The signal passing through the loop filter is applied to varactor diodes D121 and D122 via the RF choke-coil L112 to control the VCO output frequency.

D137 and D138 shorten the lockup time when changing from receive to transmit mode or vice versa.

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

IC105 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.
13.8 V	13.8 V DC from the [VOL] switch.
5 V	Common 5 V converted from the 13.8 V line at IC106.
8 V	Common 8 V converted from the 13.8 V line at IC102.
T8	Transmit 8 V converted from the 13.8 V line at IC102.
R8	Receive 8 V converted from the 13.8 V line at IC102.

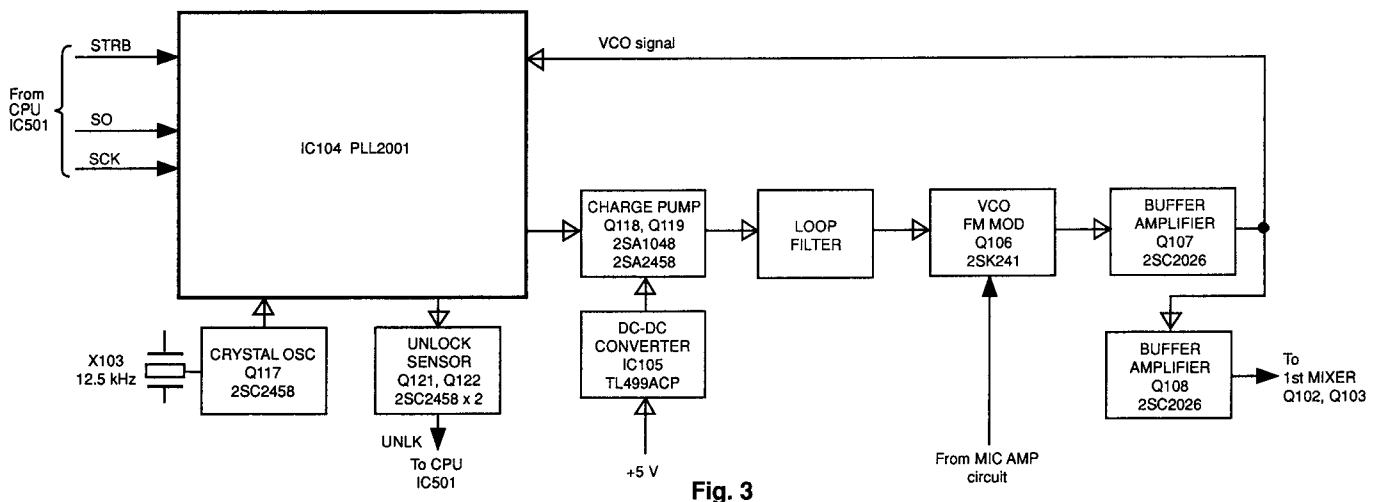


Fig. 3

### 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-A UNIT)

CPU μPD78C06AG'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.

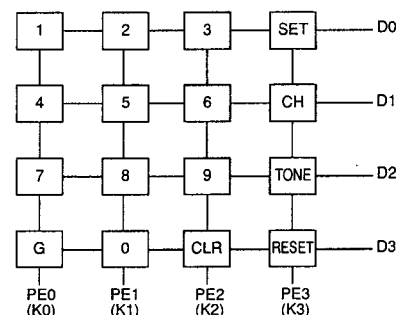


Fig. 4



### 3-4-2 PORT DESCRIPTIONS (LOGIC-A 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 ([SCAN] 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

SC1072 (#13, #14, #16, #20~#22, #24, #25, #28, #30, #32, #33) or SC1073 (#29, #31, #34, #35) is a CMOS, 8191-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

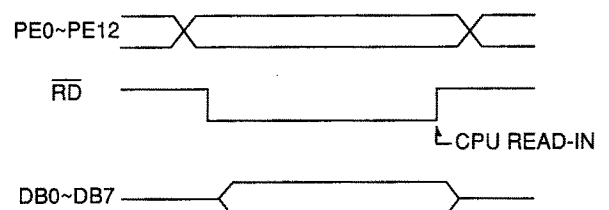


Fig. 5

### 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

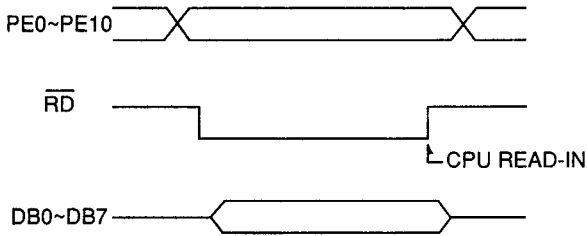


Fig. 6

#### RAM WRITE TIMING DIAGRAM

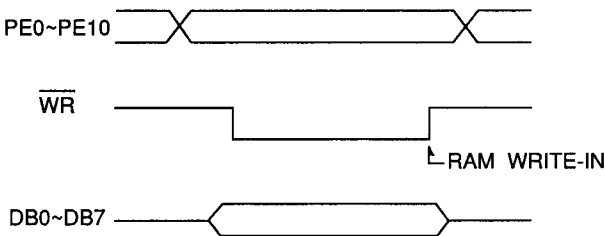


Fig. 7

### 3-4-5 RESET CIRCUIT (LOGIC-A 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 initiate CPU standby.

#### RESET TIMING CHART

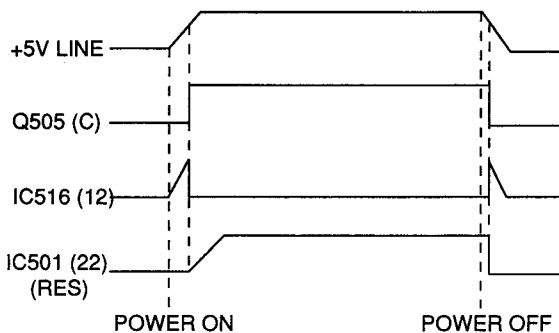


Fig. 8

### 3-5 5-TONE CIRCUITS

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

IC516 (SC-1084; #14, #16, #20~#22, #24, #25, #29, #31, #34, #35) or (SC-1093; #13, #28, #30, #32, #33) is a gate-array IC consisting of a 5-tone encoder/decoder, a 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.
T01, T02	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, S12	56, 7, 6	Serial 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.
K01	5	Output port for 4.48 MHz.
K03	22	Output port for 560 kHz.
OSC1, OSC2	34, 35	Ports for a crystal oscillator.

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

The 5-tone system depends on the transceiver version and signals from the CPU, T01 and T02 as follows:

T01	T02	SC-1084	SC-1093
L	L	EIA	DZVEI
H	L	CCIR	CCIR
L	H	EEA	EEA
H	H	ZVEI	DAPL

L: Solder H: Solder open

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

The programmable 5-tone encoder/decoder described below 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-A UNIT)

Serial CTCSS data from the CPU is converted to parallel 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-A UNIT)

The horn driver circuit consists of IC510 and Q513. If the transceiver acknowledges a 5-tone signal, the 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 CANCEL CIRCUITS (LOGIC-A 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 (FRONT 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.

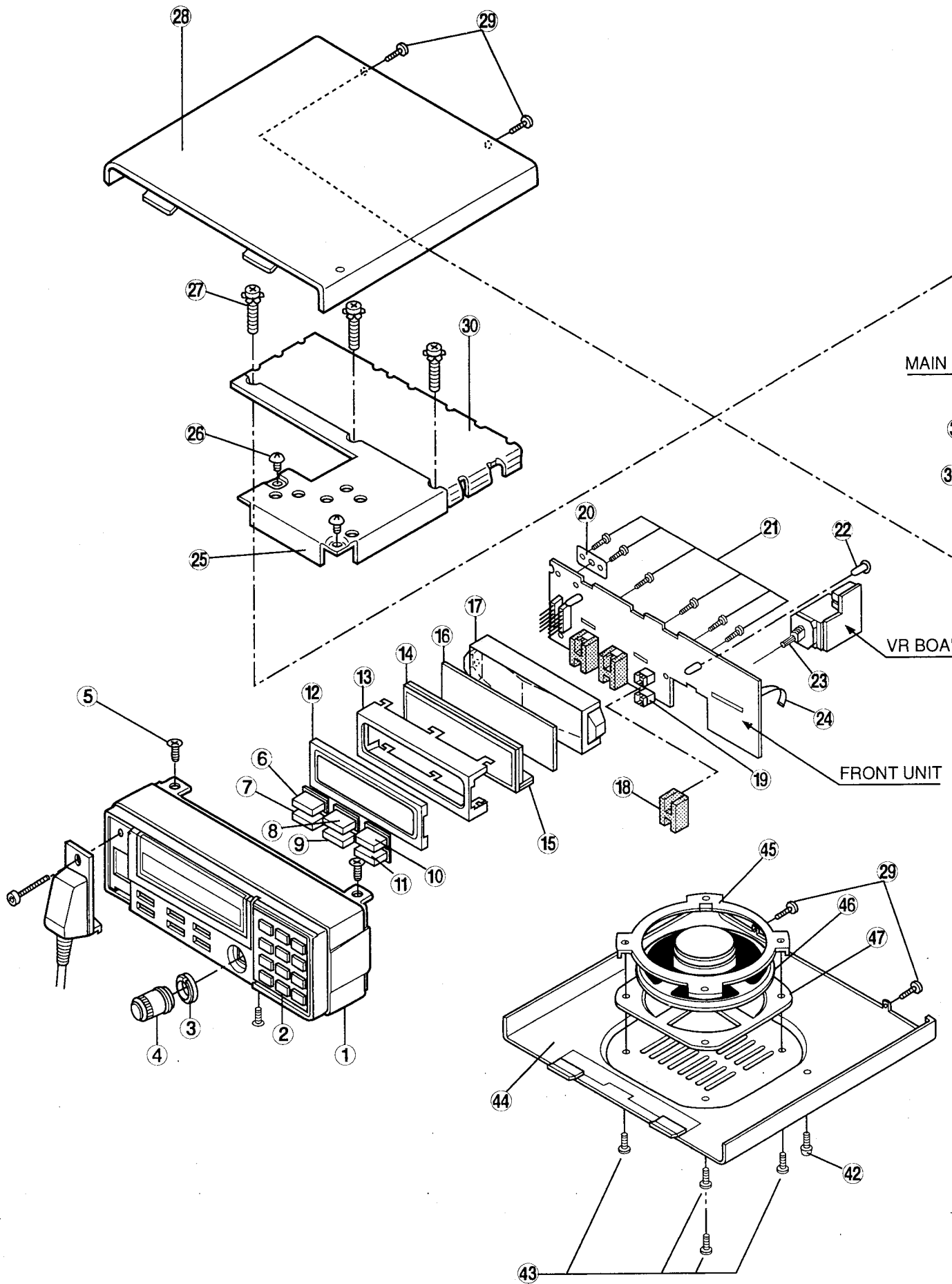
# SECTION 4 MECHANICAL PARTS AND DISASSEMBLY

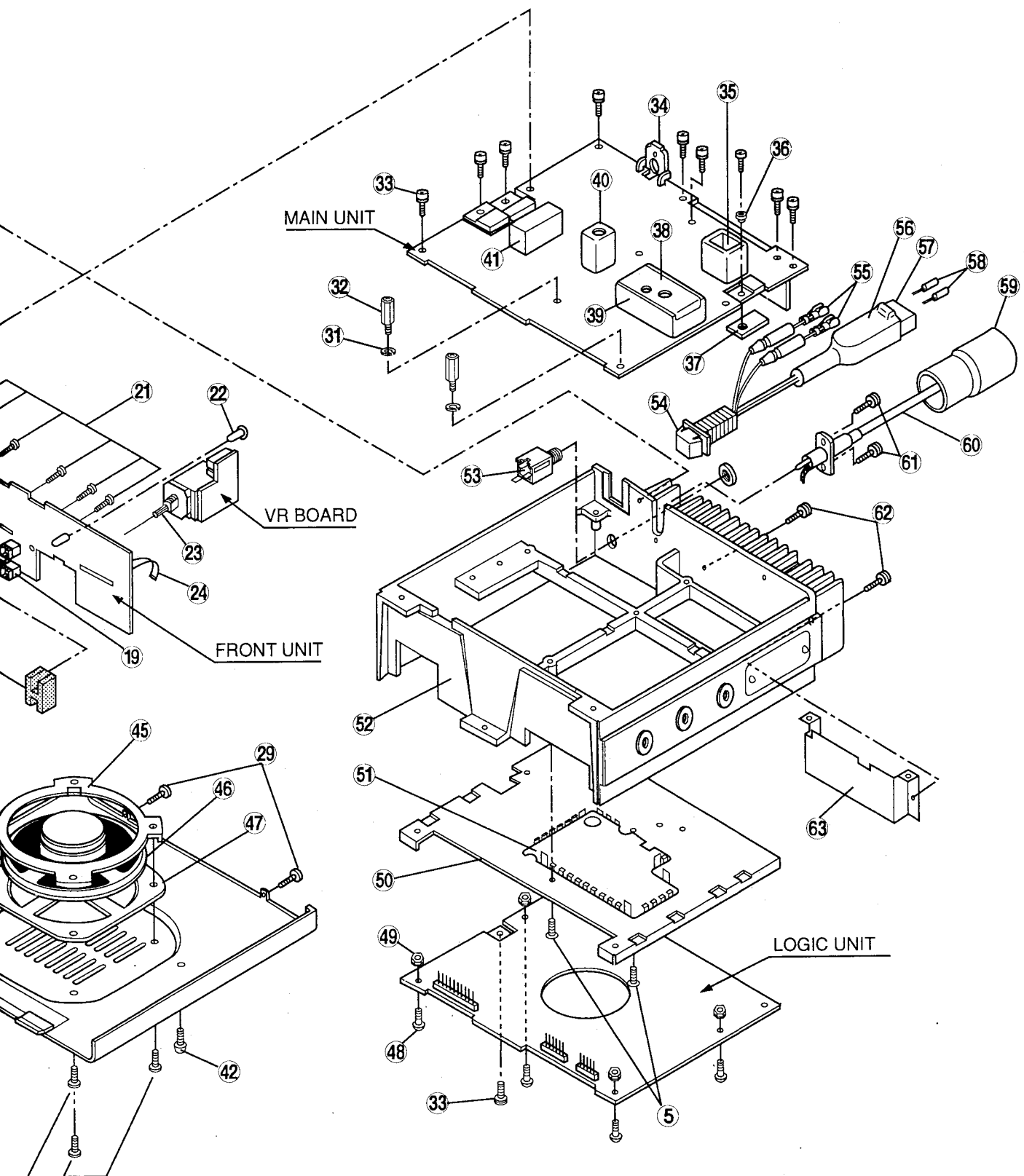
## 4-1 FRONT PANEL AND CHASSIS PARTS

LABEL NO.	ORDER NO.	DESCRIPTION	QTY.
①	8210004700	331 Front Panel	1
②	8010006210	Keyboard (A) (except #28)	1
	8010008150	Keyboard (B) (#28)	1
③	8830000050	VR Nut (B)	1
④	8610003370	VR knob N115	1
⑤	8810002170	Screw FH M3 x 6	5
⑥	8610003361	Button K50 (F)-2 [CALL] (except #28)	1
	8610004881	Button K50 (M)-2 [CALL] (#28)	1
⑦	8610003351	Button K50 (E)-2 [RESET] (except #28)	1
	8610004871	Button K50 (L)-2 [RESET] (#28)	1
⑧	8610003321	Button K50 (B)-2 [SCAN] (except #28)	1
	8610004841	Button K50 (I)-2 [SCAN] (#28)	1
⑨	8610003341	Button K50 (D)-2 [SET] (except #28)	1
	8610004861	Button K50 (K)-2 [SET] (#28)	1
⑩	8610003311	Button K50 (A)-2 [TONE] (except #28)	1
	8610004831	Button K50 (J)-2 [TONE] (#28)	1
⑪	8610003331	Button K50 (C)-2 [CH] (except #28)	1
	8610004851	Button K50 (H)-2 [CH] (#28)	1
⑫	8930010430	331 LCD cover	1
⑬	8930010870	331 LCD holder	1
⑭	5030000260	LCD LR598-A	1
⑮	8930010450	LCD contact SRCN-331	1
⑯	8930010480	331 LCD filter	1
⑰	8010006230	331 LCD reflector	1
⑱	8930010440	331 Switch sheet	3
⑲	2260000680	Switch SKHHBV011A	6
⑳	8930010860	331 Mic base plate	1
㉑	8810001000	Screw B0 M2 x 6	6
㉒	6910001290	T3 Lump cover (Green)	2
㉓	7210001280	Volume (EVK-QVB315A14) 10 kA	1
㉔	8930017190	Grounding spring (F)	1
㉕	8510004341	Main shield case-1	1
㉖	8810000210	Screw PH M3 x 4	2
㉗	8810005000	Setscrew (G) M3 x 17	3
㉘	8110004190	622 Top cover (A)	1

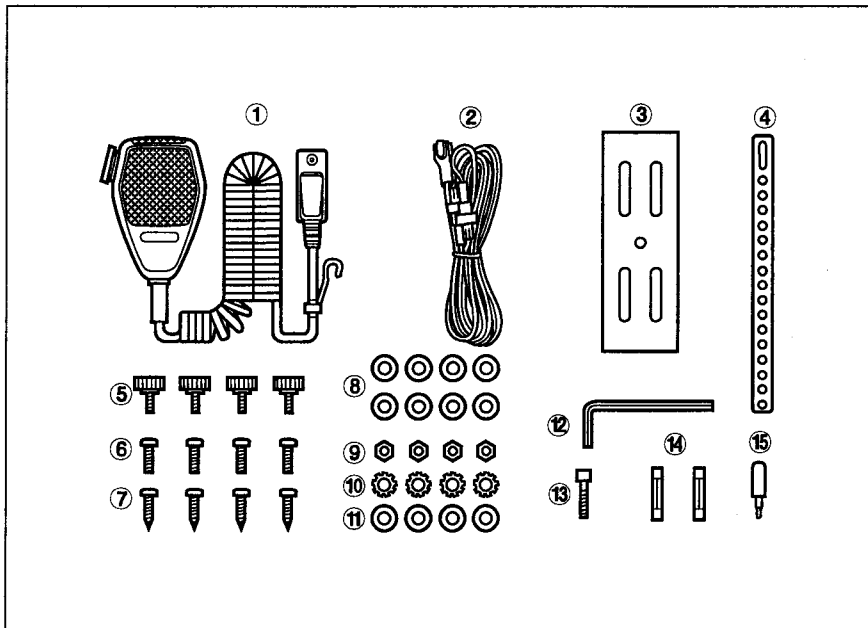
LABEL NO.	ORDER NO.	DESCRIPTION	QTY.
㉙	8810002960	Screw BiH M3 x 6 ZK SUS	4
㉚	8510005271	PA shield plate (B)-1	1
㉛	8850000420	Spring washer M3 NI	2
㉜	8930000100	Standoff (F)	2
㉝	8810003160	Setscrew (A) M3 x 6	10
㉞	8930007481	Cable stopper	1
㉟	8510000020	194 Shield case	1
㊱	6910000280	B17 insulating bushing	1
㊲	8950000230	Insulating sheet TC45A (T = 0.4)	1
㊳	8510006330	855 VCO case (top)	1
㊴	8510006320	855 VCO case	1
㊵	6910001130	10M/M shield case (P10L-A)	1
㊶	8510004150	DC-DC shield case	1
㊷	8810000560	Polyester screw PH M4 x 6	1
㊸	8810003840	Screw BiH M3 x 8 ZK SUS	4
㊹	8110001870	Bottom cover (B) (incl. ㊵ ~ ㊷)	1
㊺	8930006390	Speaker plate	1
㊻	2510000200	Speaker (4 Ω)	1
㊼	8930004950	57 Speaker spacer (includes net)	1
㊽	8810003760	Icom screw C10	4
㊾	8930006080	Half thread spacer C	4
㊿	8010003240	Chassis spacer-1	1
①	8510006770	331 Antenna shield plate	1
②	8010005262	452 chassis (A)-2	1
③	6450000420	Speaker jack H5J0780-01-010	1
④	8900002780	DC cable OPC-274	1
⑤	6510008830	Pin SGF-41-4	2
⑥	6950000180	Connector cover	1
⑦	6510004780	Connector LR-02-1V	1
⑧	6510005150	Pin SLM61T-2.0	2
⑨	6950000040	M type cap (Black)	1
⑩	8900001050	Antenna cable OPC-103	1
⑪	8810003140	Setscrew M2.6 x 8	2
⑫	8810003180	Setscrew M3 x 10	2
⑬	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.	PARTS NO.	DESCRIPTION	
IC101	1110000630	IC	MC3357 P
IC102	1110000390	IC	MB3756M-G
IC103	1110001420	IC	MB501P-G
IC104	1130000520	IC	μPD2833C
IC105	1110000900	IC	TL499ACP
IC106	1180000190	IC	NJM7805A
IC107	1110000070	IC	μPC358C
IC108	1150000250	IC	M57741M (#24, #28, #31, #34)
	1150000260	IC	M57741H (#16, #25, #33)
	1150000270	IC	M57741L (#14, #21, #22, #32)
	1150000360	IC	SC1044 (#13, #20, #29, #30, #35)
Q101	1560000110	FET	2SK241-GR
Q102	1530001810	TRANSISTOR	2SC3355
Q103	1530001810	TRANSISTOR	2SC3355
Q104	1560000110	FET	2SK241-GR
Q105	1530000110	TRANSISTOR	2SC2458-GR
Q106	1560000110	FET	2SK241-GR
Q107	1530000520	TRANSISTOR	2SC2026
Q108	1530000520	TRANSISTOR	2SC2026
Q109	1530000520	TRANSISTOR	2SC2026
Q110	1530000520	TRANSISTOR	2SC2026
Q111	1530000530	TRANSISTOR	2SC2407
Q112	1530000810	TRANSISTOR	2SC2053
Q113	1520000070	TRANSISTOR	2SB561C
Q114	1520000030	TRANSISTOR	2SB596-Y(Z)
Q115	1530000440	TRANSISTOR	2SC945 P
Q116	1530000440	TRANSISTOR	2SC945 P
Q117	1530000110	TRANSISTOR	2SC2458-GR
Q118	1510000080	TRANSISTOR	2SA1048-GR
Q119	1530000110	TRANSISTOR	2SC2458-GR
Q120	1560000010	FET	2SK184-Y
Q121	1530000110	TRANSISTOR	2SC2458-GR
Q122	1530000110	TRANSISTOR	2SC2458-GR
D101	1720000040	VARICAP	1SV153
D102	1720000040	VARICAP	1SV153
D103	1720000040	VARICAP	1SV153
D104	1720000040	VARICAP	1SV153
D105	1720000040	VARICAP	1SV153
D106	1720000040	VARICAP	1SV153
D107	1720000040	VARICAP	1SV153
D108	1720000040	VARICAP	1SV153
D109	1720000040	VARICAP	1SV153
D110	1720000040	VARICAP	1SV153
D111	1790000240	DIODE	1SS99
D113	1730000120	ZENER	RD6.2E B2
D114	1710000160	DIODE	1SS133
D115	1710000040	DIODE	1S953
D116	1710000040	DIODE	1S953
D117	1710000160	DIODE	1SS133
D118	1710000170	DIODE	1SS211
D119	1710000170	DIODE	1SS211
D120	1710000180	DIODE	1SS216
D121	1720000060	VARICAP	1SV50(1)E
D122	1720000060	VARICAP	1SV50(1)E
D123	1710000180	DIODE	1SS216
D124	1710000180	DIODE	1SS216

## [MAIN UNIT]

REF. NO.	PARTS NO.	DESCRIPTION	
D125	1730000390	ZENER	RD4.7E B3
D126	1710000040	DIODE	1S953
D127	1710000170	DIODE	1SS211
D128	1710000290	DIODE	MI308
D130	1790000250	DIODE	1SS97
D131	1710000160	DIODE	1SS133
D132	1710000290	DIODE	MI308
D133	1710000290	DIODE	MI308
D134	1710000040	DIODE	1S953
D135	1710000010	DIODE	15CD11
D136	1720000060	VARICAP	1SV50(1)E
D137	1710000160	DIODE	1SS133
D138	1710000160	DIODE	1SS133
D139	1710000350	DIODE	1N4002
D140	1710000350	DIODE	1N4002
X101	6050002000	XTAL	CR-70
X102	6070000010	DISCRIMINATOR	CDB455C7A
X103	6050002150	XTAL	CR-85 (#13, #14, #16, #20 ~ #22, #24, #25, #28, #30, #32 ~ #34)
	6050002940	XTAL	CR-164 (#29, #31, #35)
FI101	2010001020	FILTER	21M 7B2 (FL-125) (#13, #14, #16, #22, #30, #32, #33)
	2010001050	FILTER	21M15B3 (FL-141) (#20, #21, #24, #25, #28, #29, #31, #34, #35)
FI102	2020000120	CERAMIC	CFW455E (#20, #21, #24, #25, #28, #29, #31, #34, #35)
	2020000150	CERAMIC	CFW455HT (#13, #14, #16, #22, #30, #32, #33)
L101	6150003020	COIL	LS-315
L102	6150003020	COIL	LS-315
L103	6150002800	COIL	LS-296
L104	6150002780	COIL	LS-295
L105	6150002780	COIL	LS-295
L106	6140000930	COIL	LR-116
L107	6150002950	COIL	LS-304
L108	6150002730	COIL	LS-298
L109	6150002720	COIL	LS-297
L110	6180000810	COIL	LAL 03NA 2.2 mH
L111	6130002040	COIL	LB-216
L112	6180000830	COIL	LAL 03NA 3.3 μH
L113	6180000850	COIL	LAL 03NA 4.7 μH
L114	6180000850	COIL	LAL 03NA 4.7 μH
L115	6180000850	COIL	LAL 03NA 4.7 μH
L116	6110001570	COIL	LA-237
L117	6140000930	COIL	LR-116
L118	6110001570	COIL	LA-237
L119	6110001570	COIL	LA-237
L120	6110001560	COIL	LA-236
L121	6110001610	COIL	LA-244
L122	6110001530	COIL	LA-233
L123	6110001550	COIL	LA-235
L124	6110001680	COIL	LA-254
L125	6110001680	COIL	LA-254



[MAIN UNIT]

REF. NO.	PARTS NO.	DESCRIPTION
L126	6170000180	COIL LW-19
L127	6110001590	COIL LA-242 (#13, #20, #29, #30, #35)
	6110001670	COIL LA-253 (#14, #16, #21, #22, #24, #25, #28, #31 ~ #34)
L128	6110001600	COIL LA-243 (#14, #16, #21, #22, #24, #25, #28, #31 ~ #34)
	6110001670	COIL LA-253 (#13, #20, #29, #30, #35)
L129	6110001670	COIL LA-253
L130	6170000150	COIL LW-16
L131	6170000110	COIL LW-12A
L132	6180001460	COIL LAL 03NA 681K
L133	6180000900	COIL LAL 03NA 101K
L134	6180001120	COIL FL 5H 101K
L135	6180000900	COIL LAL 03NA 101K
L136	6110001610	COIL LA-244
L137	6110001550	COIL LA-235
L138	6110001550	COIL LA-235
R101	7010003680	RESISTOR ELR20J 150KΩ
R102	7010003680	RESISTOR ELR20J 150KΩ
R103	7010003190	RESISTOR ELR20J 18Ω
R104	7010003460	RESISTOR ELR20J 3.3KΩ
R105	7010004070	RESISTOR R20J 100Ω
R106	7010003680	RESISTOR ELR20J 150KΩ
R107	7010003680	RESISTOR ELR20J 150KΩ
R108	7010004470	RESISTOR R20J 150KΩ
R109	7010004070	RESISTOR R20J 100Ω
R110	7010004370	RESISTOR R20J 22KΩ
R111	7010003340	RESISTOR ELR20J 330Ω
R112	7010003340	RESISTOR ELR20J 330Ω
R113	7010003400	RESISTOR ELR20J 1KΩ
R114	7010003200	RESISTOR ELR20J 22Ω
R115	7010003200	RESISTOR ELR20J 22Ω
R116	7010004320	RESISTOR R20J 10KΩ
R118	7010004320	RESISTOR R20J 10KΩ
R119	7010003740	RESISTOR ELR20J 470KΩ
R120	7010003280	RESISTOR ELR20J 100Ω
R121	7010001030	RESISTOR R25XJ 100Ω
R122	7010004320	RESISTOR R20J 10KΩ
R123	7010003780	RESISTOR ELR20J 1MΩ
R124	7010003620	RESISTOR ELR20J 47KΩ
R125	7010003420	RESISTOR ELR20J 1.5KΩ (#20, #21, #24, #25, #28, #29, #31, #34, #35)
	7010003440	RESISTOR ELR20J 2.2KΩ (#13, #14, #16, #22, #30, #32, #33)
R126	7010003420	RESISTOR ELR20J 1.5KΩ (#20, #21, #24, #25, #28, #29, #31, #34, #35)
	7010003440	RESISTOR ELR20J 2.2KΩ (#13, #14, #16, #22, #30, #32, #33)
R127	7010003620	RESISTOR ELR20J 47KΩ
R128	7010003420	RESISTOR ELR20J 1.5KΩ
R129	7010003440	RESISTOR ELR20J 2.2KΩ
R130	7010003580	RESISTOR ELR20J 22KΩ
R131	7510000020	THERMISTOR 33D28
R132	7010003720	RESISTOR ELR20J 330KΩ (#20, #21, #24, #25, #28, #29, #31, #34, #35)
	7010003740	RESISTOR ELR20J 470KΩ (#13, #14, #16, #22, #30, #32, #33)
R133	7010003440	RESISTOR ELR20J 2.2KΩ

[MAIN UNIT]

REF. NO.	PARTS NO.	DESCRIPTION
R134	7010003580	RESISTOR ELR20J 22KΩ (#20, #21, #24, #25, #28, #29, #31, #34, #35)
	7010003640	RESISTOR ELR20J 68KΩ (#13, #14, #16, #22, #30, #32, #33)
R135	7010003620	RESISTOR ELR20J 47KΩ
R136	7010003660	RESISTOR ELR20J 100KΩ
R137	7010003340	RESISTOR ELR20J 330Ω
R138	7010003490	RESISTOR ELR20J 5.6KΩ
R139	7010003480	RESISTOR ELR20J 4.7KΩ
R140	7010004070	RESISTOR R20J 100Ω
R141	7010003280	RESISTOR ELR20J 100Ω
R142	7010004030	RESISTOR R20J 47Ω
R143	7010003340	RESISTOR ELR20J 330Ω
R144	7010003340	RESISTOR ELR20J 330Ω
R145	7010003990	RESISTOR R20J 22Ω
R146	7010003440	RESISTOR ELR20J 2.2KΩ
R147	7010004250	RESISTOR R20J 3.3KΩ
R148	7010003320	RESISTOR ELR20J 220Ω
R149	7010003400	RESISTOR ELR20J 1KΩ
R150	7010003260	RESISTOR ELR20J 68Ω
R151	7010004050	RESISTOR R20J 68Ω
R152	7010004170	RESISTOR R20J 680Ω
R153	7010004250	RESISTOR R20J 3.3KΩ
R154	7010004230	RESISTOR R20J 2.2KΩ
R155	7010003320	RESISTOR ELR20J 220Ω
R156	7010003440	RESISTOR ELR20J 2.2KΩ
R157	7010003440	RESISTOR ELR20J 2.2KΩ
R158	7010003440	RESISTOR ELR20J 2.2KΩ
R159	7010003440	RESISTOR ELR20J 2.2KΩ
R160	7010003280	RESISTOR ELR20J 100Ω
R161	7010003280	RESISTOR ELR20J 100Ω
R162	7010003440	RESISTOR ELR20J 2.2KΩ
R163	7010003550	RESISTOR ELR20J 15KΩ
R164	7010004070	RESISTOR R20J 100Ω
R165	7010003280	RESISTOR ELR20J 100Ω
R166	7010003400	RESISTOR ELR20J 1KΩ
R167	7010003280	RESISTOR ELR20J 100Ω
R168	7010003400	RESISTOR ELR20J 1KΩ
R169	7010000130	RESISTOR ELR25J 10Ω
R170	7010004660	RESISTOR R50XJ 15Ω
R171	7010004270	RESISTOR R20J 4.7KΩ
R172	7010003280	RESISTOR ELR20J 100Ω
R173	7010003530	RESISTOR ELR20J 10KΩ
R174	7010004450	RESISTOR R20J 100KΩ
R175	7010003590	RESISTOR ELR20J 27KΩ
R176	7010003660	RESISTOR ELR20J 100KΩ
R177	7010003550	RESISTOR ELR20J 15KΩ
R178	7010004390	RESISTOR R20J 33KΩ
R179	7310000790	TRIMMER RH0651C15J1UA (104)
R180	7010003600	RESISTOR ELR20J 33KΩ
R181	7010003550	RESISTOR ELR20J 15KΩ
R182	7510000020	THERMISTOR 33D28
R183	7010003530	RESISTOR ELR20J 10KΩ
R184	7510000020	THERMISTOR 33D28
R185	7010003440	RESISTOR ELR20J 2.2KΩ
R186	7010003510	RESISTOR ELR20J 6.8KΩ
R187	7010003660	RESISTOR ELR20J 100KΩ
R188	7010003660	RESISTOR ELR20J 100KΩ
R189	7010003440	RESISTOR ELR20J 2.2KΩ
R190	7010003280	RESISTOR ELR20J 100Ω
R191	7010003400	RESISTOR ELR20J 1KΩ
R192	7010004170	RESISTOR R20J 680Ω
R193	7010003650	RESISTOR ELR20J 82KΩ
R194	7010003480	RESISTOR ELR20J 4.7KΩ
R195	7010003670	RESISTOR ELR20J 120KΩ
R196	7010003610	RESISTOR ELR20J 39KΩ
R197	7010003600	RESISTOR ELR20J 33KΩ
R198	7010003740	RESISTOR ELR20J 470KΩ
R199	7010003650	RESISTOR ELR20J 82KΩ

[MAIN UNIT]

REF. NO.	PARTS NO.	DESCRIPTION
R200	7010003530	RESISTOR ELR20J 10KΩ
R201	7010003600	RESISTOR ELR20J 33KΩ
R202	7010003650	RESISTOR ELR20J 82KΩ
R203	7010003400	RESISTOR ELR20J 1KΩ
R204	7010003430	RESISTOR ELR20J 1.8KΩ
R205	7010003580	RESISTOR ELR20J 22KΩ
R206	7010003480	RESISTOR ELR20J 4.7KΩ
R207	7010003660	RESISTOR ELR20J 100KΩ
R208	7010003620	RESISTOR ELR20J 47KΩ
R209	7010004320	RESISTOR R20J 10KΩ
R210	7010003440	RESISTOR ELR20J 2.2KΩ
R211	7010003540	RESISTOR ELR20J 12KΩ
R212	7010003490	RESISTOR ELR20J 5.6KΩ
R213	7010004070	RESISTOR R20J 100Ω
R214	7010003410	RESISTOR ELR20J 1.2KΩ
R215	7010004070	RESISTOR R20J 100Ω
R216	7010003280	RESISTOR ELR20J 100Ω
R217	7010004320	RESISTOR R20J 10KΩ
R218	7010004110	RESISTOR R20J 220Ω
R219	7010004150	RESISTOR R20J 470Ω (#13, #20, #29, #30, #35)
R220	7010003400	RESISTOR ELR20J 1KΩ
C101	4010000500	CERAMIC DD104 B 102K 50V
C102	4010000050	CERAMIC DD104 SL 030C 50V
C103	4010000010	CERAMIC DD104 SL 0.5C 50V
C104	4010000500	CERAMIC DD104 B 102K 50V
C105	4010000500	CERAMIC DD104 B 102K 50V
C106	4010000460	CERAMIC DD104 B 471K 50V
C108	4010000040	CERAMIC DD104 SL 020C 50V
C109	4010000040	CERAMIC DD104 SL 020C 50V
C110	4010000020	CERAMIC DD104 SL 010C 50V
C111	4010000500	CERAMIC DD104 B 102K 50V
C113	4010000500	CERAMIC DD104 B 102K 50V
C114	4010000500	CERAMIC DD104 B 102K 50V
C115	4010000500	CERAMIC DD104 B 102K 50V
C116	4010000050	CERAMIC DD104 SL 030C 50V
C117	4010000500	CERAMIC DD104 B 102K 50V
C118	4010000500	CERAMIC DD104 B 102K 50V
C119	4010000500	CERAMIC DD104 B 102K 50V
C120	4010000520	CERAMIC DD108 B 472K 50V
C121	4010000100	CERAMIC DD104 SL 080D 50V (#20, #21, #24, #25, #28, #29, #31, #34, #35)
	4010000150	CERAMIC DD104 SL 150J 50V (#13, #14, #16, #22, #30, #32, #33)
C122	4010000320	CERAMIC DD104 SL 820J 50V
C123	4010000300	CERAMIC DD104 SL 680J 50V
C124	4010000500	CERAMIC DD104 B 102K 50V
C125	4040000150	BARRIER LAYER UAT 05X 472K
C126	4010000500	CERAMIC DD104 B 102K 50V
C127	4010000340	CERAMIC DD105 SL 121J 50V
C128	4010000300	CERAMIC DD104 SL 680J 50V
C129	4040000260	BARRIER LAYER UZE 08X 104M
C130	4010000320	CERAMIC DD104 SL 820J 50V
C131	4550000320	TANTALUM DN 1V 0.1M
C132	4010000500	CERAMIC DD104 B 102K 50V
C133	4510001100	ELECTROLYTIC 16 MS7 10μF
C134	4510001970	ELECTROLYTIC 50 MS7 0.1μF
C135	4040000260	BARRIER LAYER UZE 08X 104M
C136	4310000010	MYLAR 50 F2D 102K
C137	4310000010	MYLAR 50 F2D 102K (#20, #21, #24, #25, #28, #29, #31, #34, #35)
	4310000050	MYLAR 50 F2D 222K (#13, #14, #16, #22, #30, #32, #33)

[MAIN UNIT]

REF. NO.	PARTS NO.	DESCRIPTION
C138	4010000190	CERAMIC DD104 SL 240J 50V (#13, #14, #16, #22, #30, #32, #33)
	4010000220	CERAMIC DD104 SL 330J 50V (#20, #21, #24, #25, #28, #29, #31, #34, #35)
C139	4310000010	MYLAR 50 F2D 102K (#20, #21, #24, #25, #28, #29, #31, #34, #35)
	4310000050	MYLAR 50 F2D 222K (#13, #14, #16, #22, #30, #32, #33)
C140	4510001150	ELECTROLYTIC 50 MS7 0.47μF
C141	4510001170	ELECTROLYTIC 50 MS7 2.2μF
C142	4310000060	MYLAR 50 F2D 223K
C143	4510000440	ELECTROLYTIC 10 MS 100μF
C144	4010000460	CERAMIC DD104 B 471K 50V
C145	4610001470	TRIMMER CV38D 2001E
C146	4010000210	CERAMIC DD104 SL 300J 50V
C147	4010000500	CERAMIC DD104 B 102K 50V
C148	4010000460	CERAMIC DD104 B 471K 50V
C150	4010000230	CERAMIC DD104 SL 360J 50V
C151	4010000180	CERAMIC DD104 SL 220J 50V
C152	4010003270	CERAMIC DD104 UJ 030C 50V
C153	4010000010	CERAMIC DD104 SL 0.5C 50V
C154	4010003270	CERAMIC DD104 UJ 030C 50V
C155	4010000460	CERAMIC DD104 B 471K 50V
C156	4010000500	CERAMIC DD104 B 102K 50V
C157	4010000500	CERAMIC DD104 B 102K 50V
C158	4010000180	CERAMIC DD104 SL 220J 50V
C159	4010000500	CERAMIC DD104 B 102K 50V
C160	4010000500	CERAMIC DD104 B 102K 50V
C161	4010000460	CERAMIC DD104 B 471K 50V
C162	4010000500	CERAMIC DD104 B 102K 50V
C163	4010000160	CERAMIC DD104 SL 180J 50V
C164	4010000500	CERAMIC DD104 B 102K 50V
C165	4010000500	CERAMIC DD104 B 102K 50V
C166	4010000500	CERAMIC DD104 B 102K 50V
C167	4010000500	CERAMIC DD104 B 102K 50V
C168	4010000160	CERAMIC DD104 SL 180J 50V
C169	4010000160	CERAMIC DD104 SL 180J 50V
C170	4010000500	CERAMIC DD104 B 102K 50V
C171	4010000500	CERAMIC DD104 B 102K 50V
C172	4010000100	CERAMIC DD104 SL 080D 50V
C173	4010000500	CERAMIC DD104 B 102K 50V
C174	4010000500	CERAMIC DD104 B 102K 50V
C175	4010000460	CERAMIC DD104 B 471K 50V
C176	4010000150	CERAMIC DD104 SL 150J 50V
C178	4010000500	CERAMIC DD104 B 102K 50V
C179	4010000460	CERAMIC DD104 B 471K 50V
C180	4010000500	CERAMIC DD104 B 102K 50V
C181	4010000100	CERAMIC DD104 SL 080D 50V
C182	4010000060	CERAMIC DD104 SL 040C 50V (#13, #14, #20 ~ #22, #29, #30, #32, #35)
C183	4010000500	CERAMIC DD104 B 102K 50V
C184	4010000500	CERAMIC DD104 B 102K 50V
C186	4010000460	CERAMIC DD104 B 471K 50V
C187	4010000460	CERAMIC DD104 B 471K 50V
C188	4010000500	CERAMIC DD104 B 102K 50V
C189	4010000460	CERAMIC DD104 B 471K 50V
C190	4010000500	CERAMIC DD104 B 102K 50V
C191	4010000500	CERAMIC DD104 B 102K 50V
C192	4010003850	CERAMIC DD06 SL 080D 500V (#14, #16, #21, #22, #24, #25, #28, #31 ~ #34)
	4010003860	CERAMIC DD06 SL 100D 500V (#13, #20, #29, #30, #35)
C193	4010000460	CERAMIC DD104 B 471K 50V
C194	4010000500	CERAMIC DD104 B 102K 50V
C195	4010000500	CERAMIC DD104 B 102K 50V

[MAIN UNIT]

REF. NO.	PARTS NO.	DESCRIPTION
C196	4010000460	CERAMIC DD104 B 471K 50V
C197	4010000500	CERAMIC DD104 B 102K 50V
C198	4010000460	CERAMIC DD104 B 471K 50V
C199	4010000500	CERAMIC DD104 B 102K 50V
C200	4040000260	BARRIER LAYER UZE 08X 104M
C201	4010003770	CERAMIC DD06 SL 0.5C 500V
C202	4010000460	CERAMIC DD104 B 471K 50V
C203	4010003810	CERAMIC DD06 SL 040C 500V
C204	4010004120	CERAMIC DD07 B 102K 500V
C205	4010003960	CERAMIC DD06 SL 390K 500V
C206	4010003900	CERAMIC DD06 SL 200K 500V
C207	4010003800	CERAMIC DD06 SL 030C 500V (#16, #24, #25, #28, #31, #33, #34)
	4010003820	CERAMIC DD06 SL 050C 500V (#14, #21, #22, #32)
	4010003890	CERAMIC DD06 SL 180K 500V (#13, #20, #29, #30, #35)
C208	4010003900	CERAMIC DD06 SL 200K 500V (#13, #16, #20, #24, #25, #28 ~ #31, #33 ~ #35)
	4010003920	CERAMIC DD06 SL 240K 500V (#14, #21, #22, #32)
C209	4010003820	CERAMIC DD06 SL 050C 500V (#13, #20, #29, #30, #35)
	4010003850	CERAMIC DD06 SL 080D 500V (#14, #16, #21, #22, #24, #25, #28, #31 ~ #34)
C210	4010003920	CERAMIC DD06 SL 240K 500V
C211	4010003780	CERAMIC DD06 SL 010C 500V
C212	4010003820	CERAMIC DD06 SL 050C 500V
C213	4010003830	CERAMIC DD06 SL 060D 500V
C214	4010000500	CERAMIC DD104 B 102K 50V
C215	4010000500	CERAMIC DD104 B 102K 50V
C217	4040000190	BARRIER LAYER UAT 05X 103K
C218	4040000260	BARRIER LAYER UZE 08X 104M
C219	4040000260	BARRIER LAYER UZE 08X 104M
C220	4510002380	ELECTROLYTIC 16 SS 470μF (10X12.5)
C221	4010000520	CERAMIC DD108 B 472K 50V
C222	4510002380	ELECTROLYTIC 16 SS 470μF (10X12.5)
C223	4510002380	ELECTROLYTIC 16 SS 470μF (10X12.5)
C224	4010000500	CERAMIC DD104 B 102K 50V
C225	4040000260	BARRIER LAYER UZE 08X 104M
C226	4510001120	ELECTROLYTIC 25 MS7 4.7μF
C228	4040000260	BARRIER LAYER UZE 08X 104M
C229	4040000260	BARRIER LAYER UZE 08X 104M
C230	4010000640	CERAMIC DD104 CH 040C 50V
C231	4010000500	CERAMIC DD104 B 102K 50V
C232	4010000330	CERAMIC DD105 SL 101J 50V
C233	4010000380	CERAMIC DD107 SL 221J 50V
C234	4010000500	CERAMIC DD104 B 102K 50V
C236	4040000190	BARRIER LAYER UAT 05X 103K
C237	4010000800	CERAMIC DD105 CH 270J 50V
C238	4610001470	TRIMMER CV38D 2001E
C239	4010000500	CERAMIC DD104 B 102K 50V
C240	4010000500	CERAMIC DD104 B 102K 50V
C241	4510001970	ELECTROLYTIC 50 MS7 0.1μF
C242	4510000620	ELECTROLYTIC 25 MS 47μF
C243	4510002850	ELECTROLYTIC 25 SS 22μF
C244	4010000500	CERAMIC DD104 B 102K 50V
C245	4510001310	ELECTROLYTIC 6R3 MS5 22μF
C246	4510000440	ELECTROLYTIC 10 MS 100μF
C247	4010000330	CERAMIC DD105 SL 101J 50V
C248	4040000250	BARRIER LAYER UAT 08X 473M
C249	4550000410	TANTALUM DN 1V 4.7M
C250	4040000190	BARRIER LAYER UAT 05X 103K
C251	4550000320	TANTALUM DN 1V 0.1M
C252	4510001970	ELECTROLYTIC 50 MS7 0.1μF
C253	4510000750	ELECTROLYTIC 10 RE 47μF
C254	4010000500	CERAMIC DD104 B 102K 50V
C255	4510001480	ELECTROLYTIC 50 MS5 2.2μF

[MAIN UNIT]

REF. NO.	PARTS NO.	DESCRIPTION
C256	4010000500	CERAMIC DD104 B 102K 50V
C257	4010000120	CERAMIC DD104 SL 100D 50V (#13, #14, #20 ~ #22, #29, #30, #32, #35)
C258	4010000500	CERAMIC DD104 B 102K 50V
C260	4020000090	CYLINDER UP125 SL 150J
C261	4010000220	CERAMIC DD104 SL 330J 50V
C262	4010000180	CERAMIC DD104 SL 220J 50V
C263	4010000180	CERAMIC DD104 SL 220J 50V
C265	4010000500	CERAMIC DD104 B 102K 50V
C266	4010000500	CERAMIC DD104 B 102K 50V
C267	4010000500	CERAMIC DD104 B 102K 50V
C268	4010000010	CERAMIC DD104 SL 0.5C 50V
C269	4010000010	CERAMIC DD104 SL 0.5C 50V
C270	4010000010	CERAMIC DD104 SL 0.5C 50V
C271	4010000500	CERAMIC DD104 B 102K 50V
C272	4040000260	BARRIER LAYER UZE 08X 104M
C273	4510001100	ELECTROLYTIC 16 MS7 10μF
C274	4010003910	CERAMIC DD06 SL 220K 500V
C276	4510001470	ELECTROLYTIC 50 MS5 1μF
C277	4010000500	CERAMIC DD104 B 102K 50V
C278	4040000260	BARRIER LAYER UZE 08X 104M
C279	4550000320	TANTALUM DN 1V 0.1M
C280	4010000500	CERAMIC DD104 B 102K 50V
C281	4010000500	CERAMIC DD104 B 102K 50V
C282	4510001690	ELECTROLYTIC 6R3 MS7 47μF (5X7)
C283	4040000190	BARRIER LAYER UAT 05X 103K
C284	4550000010	TANTALUM DN 1C 4.7M
C285	4310000060	MYLAR 50 F2D 223K
C286	4010000460	CERAMIC DD104 B 471K 50V
C288	4010000500	CERAMIC DD104 B 102K 50V
C289	4010000500	CERAMIC DD104 B 102K 50V
C290	4010000500	CERAMIC DD104 B 102K 50V
C291	4010000500	CERAMIC DD104 B 102K 50V
C293	4010000520	CERAMIC DD108 B 472K 50V
C294	4010000500	CERAMIC DD104 B 102K 50V
C295	4010000520	CERAMIC DD108 B 472K 50V
C296	4010000500	CERAMIC DD104 B 102K 50V
C297	4010000520	CERAMIC DD108 B 472K 50V
C298	4010000500	CERAMIC DD104 B 102K 50V
C299	4010003800	CERAMIC DD06 SL 030C 500V (#13, #20, #29, #30, #35)
	4010003820	CERAMIC DD06 SL 050C 500V (#14, #21, #22, #32)
EP101	910015504	PCB B 1394D

[LOGIC-A UNIT]

REF. NO.	PARTS NO.	DESCRIPTION
IC501	1140000540	S.IC μPD78C06AG-570-12
IC502	1130004800	IC SC1072-1 (#13, #14, #16, #20 ~ #22, #24, #25, #28, #30, #32, #33)
	1130004810	IC SC1073-1 (#29, #31, #34, #35)
IC503	1130002560	S.IC μPD446G
IC510	1110001350	S.IC TA7555F
IC512	1110000960	S.IC NJM4558M(T1)
IC513	1110000960	S.IC NJM4558M(T1)
IC514	1110000210	IC μPC2002H
IC515	1110000960	S.IC NJM4558M(T1)

S. = Surface mount

[LOGIC-A UNIT]

REF. NO.	PARTS NO.	DESCRIPTION	
IC516	1140000640	S.IC	SC1084 (#14, #16, #20 ~ #22, #24, #25, #29, #31, #34, #35)
	1140000840	S.IC	SC1093 (#13, #28, #30, #32, #33)
IC517	1140000620	S.IC	FX102LG
IC518	1130003610	S.IC	TC4SU69F (TE85R)
IC519	1130003610	S.IC	TC4SU69F (TE85R)
Q501	1510000340	S.TRANSISTOR	2SA1341-TA
Q503	1510000340	S.TRANSISTOR	2SA1341-TA
Q504	1530000980	S.TRANSISTOR	2SC3395-TA
Q505	1510000110	S.TRANSISTOR	2SA1162-Y (TE85R)
Q506	1510000340	S.TRANSISTOR	2SA1341-TA
Q507	1530000980	S.TRANSISTOR	2SC3395-TA
Q508	1530000160	S.TRANSISTOR	2SC2712-Y (TE85RTEM)
Q509	1530000980	S.TRANSISTOR	2SC3395-TA
Q510	1540000150	TRANSISTOR	2SD1225M R
Q511	1590000380	S.FET	2SJ106-Y (TE85R)
Q512	1590000380	S.FET	2SJ106-Y (TE85R)
Q513	1540000300	TRANSISTOR	2SD1286 K
Q514	1530000160	S.TRANSISTOR	2SC2712-Y (TE85RTEM)
Q515	1530000980	S.TRANSISTOR	2SC3395-TA
Q516	1530000980	S.TRANSISTOR	2SC3395-TA
Q517	1530000980	S.TRANSISTOR	2SC3395-TA
Q518	1530000980	S.TRANSISTOR	2SC3395-TA
Q519	1530000160	S.TRANSISTOR	2SC2712-Y (TE85RTEM)
Q520	1530000980	S.TRANSISTOR	2SC3395-TA
Q521	1530000980	S.TRANSISTOR	2SC3395-TA
Q522	1530000160	S.TRANSISTOR	2SC2712-Y (TE85RTEM)
Q523	1530000980	S.TRANSISTOR	2SC3395-TA
D501	1750000020	S.DIODE	1SS184 (TE85R)
D502	1730000730	S.ZENER	RD6.2M-T2B2
D504	1750000040	S.DIODE	1SS190 (TE85R)
D505	1750000010	S.DIODE	1SS181 (TE85R)
D506	1750000040	S.DIODE	1SS190 (TE85R)
D508	1750000060	S.DIODE	1SS196 (TE85R)
D510	1750000020	S.DIODE	1SS184 (TE85R)
D511	1730000410	S.ZENER	RD5.1M-T2B2
D512	1730000180	ZENER	RD8.2E B2
D513	1750000010	S.DIODE	1SS181 (TE85R)
D514	1750000050	S.DIODE	1SS193 (TE85R)
D515	1710000600	DIODE	1SS254
X501	6050003450	XTAL	RF-4A3 FAG NKD (4.480000M)
L501	6180002310	COIL	LAL 02NA 330K
R503	7030000580	S.RESISTOR	MCR10EZHZ 47KΩ (473)
R504	7030000500	S.RESISTOR	MCR10EZHZ 10KΩ (103)
R505	7030000500	S.RESISTOR	MCR10EZHZ 10KΩ (103)
R506	7030000500	S.RESISTOR	MCR10EZHZ 10KΩ (103)
R507	7030000500	S.RESISTOR	MCR10EZHZ 10KΩ (103)
R508	7030000580	S.RESISTOR	MCR10EZHZ 47KΩ (473)
R509	7030000580	S.RESISTOR	MCR10EZHZ 47KΩ (473)
R510	7030000670	S.RESISTOR	MCR10EZHZ 270KΩ (274)
R512	7030000580	S.RESISTOR	MCR10EZHZ 47KΩ (473)
R513	7030000580	S.RESISTOR	MCR10EZHZ 47KΩ (473)
R514	7030000540	S.RESISTOR	MCR10EZHZ 22KΩ (223)
R515	7030000540	S.RESISTOR	MCR10EZHZ 22KΩ (223)
R516	7030000550	S.RESISTOR	MCR10EZHZ 27KΩ (273)
R517	7030000970	S.RESISTOR	MCR10EZHZ 2.2MΩ (225)
R518	7030000580	S.RESISTOR	MCR10EZHZ 47KΩ (473)
R519	7030000740	S.RESISTOR	MCR10EZHZ 1MΩ (105)
R520	7030000580	S.RESISTOR	MCR10EZHZ 47KΩ (473)

[LOGIC-A UNIT]

REF. NO.	PARTS NO.	DESCRIPTION	
R521	7030000460	S.RESISTOR	MCR10EZHZ 4.7KΩ (472)
R522	7030000580	S.RESISTOR	MCR10EZHZ 47KΩ (473)
R523	7030000580	S.RESISTOR	MCR10EZHZ 47KΩ (473)
R524	7030000580	S.RESISTOR	MCR10EZHZ 47KΩ (473)
R525	7030000460	S.RESISTOR	MCR10EZHZ 4.7KΩ (472)
R526	7030000520	S.RESISTOR	MCR10EZHZ 15 KΩ (153)
R527	7310000750	TRIMMER	RH0651C14J2WA (103)
R528	7030000390	S.RESISTOR	MCR10EZHZ 1.2KΩ (122)
R529	7310000800	TRIMMER	RH0651CJ5J01A (224)
R530	7030000480	S.RESISTOR	MCR10EZHZ 6.8KΩ (682)
R531	7030000700	S.RESISTOR	MCR10EZHZ 470KΩ (474)
R532	7310000740	TRIMMER	RH0651CS3J2KA (472)
R533	7030000670	S.RESISTOR	MCR10EZHZ 270KΩ (274)
R534	7030000630	S.RESISTOR	MCR10EZHZ 120KΩ (124)
R535	7030000580	S.RESISTOR	MCR10EZHZ 47KΩ (473)
R536	7030000570	S.RESISTOR	MCR10EZHZ 39KΩ (393)
R537	7030000560	S.RESISTOR	MCR10EZHZ 33KΩ (333)
R538	7030000570	S.RESISTOR	MCR10EZHZ 39KΩ (393)
R539	7030000260	S.RESISTOR	MCR10EZHZ 100Ω (101)
R540	7310000820	TRIMMER	RH0651C16J0RA (105)
R541	7010004680	RESISTOR	R50XJ 33Ω
R542	7030000380	S.RESISTOR	MCR10EZHZ 1KΩ (102)
R543	7310000780	TRIMMER	RH0651CS4J25A (473)
R544	7030000020	S.RESISTOR	MCR10EZHZ 1Ω (010)
R545	7030000330	S.RESISTOR	MCR10EZHZ 390Ω (391)
R546	7030000060	S.RESISTOR	MCR10EZHZ 2.2Ω (2R2)
R547	7310000780	TRIMMER	RH0651CS4J25A (473)
R548	7030000740	S.RESISTOR	MCR10EZHZ 1MΩ (105)
R549	7030000500	S.RESISTOR	MCR10EZHZ 10KΩ (103)
R550	7030000740	S.RESISTOR	MCR10EZHZ 1MΩ (105)
R551	7030000260	S.RESISTOR	MCR10EZHZ 100Ω (101)
R552	7030000490	S.RESISTOR	MCR10EZHZ 8.2KΩ (822)
R553	7030000710	S.RESISTOR	MCR10EZHZ 560KΩ (564)
R554	7030000500	S.RESISTOR	MCR10EZHZ 10KΩ (103)
R555	7030000490	S.RESISTOR	MCR10EZHZ 8.2KΩ (822)
R556	7030000550	S.RESISTOR	MCR10EZHZ 27KΩ (273)
R557	7030000560	S.RESISTOR	MCR10EZHZ 33KΩ (333)
R558	7030000590	S.RESISTOR	MCR10EZHZ 56KΩ (563)
R559	7030000500	S.RESISTOR	MCR10EZHZ 10KΩ (103)
R560	7030000500	S.RESISTOR	MCR10EZHZ 10KΩ (103)
R561	7030000490	S.RESISTOR	MCR10EZHZ 8.2KΩ (822)
R562	7030000740	S.RESISTOR	MCR10EZHZ 1MΩ (105)
R563	7030000740	S.RESISTOR	MCR10EZHZ 1MΩ (105)
R564	7030000390	S.RESISTOR	MCR10EZHZ 1.2KΩ (122)
R565	7030000390	S.RESISTOR	MCR10EZHZ 1.2KΩ (122)
R566	7030000390	S.RESISTOR	MCR10EZHZ 1.2KΩ (122)
R568	7030000580	S.RESISTOR	MCR10EZHZ 47KΩ (473)
R569	7030000580	S.RESISTOR	MCR10EZHZ 47KΩ (473)
R570	7030000580	S.RESISTOR	MCR10EZHZ 47KΩ (473)
R571	7030000460	S.RESISTOR	MCR10EZHZ 4.7KΩ (472)
R572	7030000260	S.RESISTOR	MCR10EZHZ 100Ω (101)
R573	7030000380	S.RESISTOR	MCR10EZHZ 1KΩ (102)
R574	7030000500	S.RESISTOR	MCR10EZHZ 10KΩ (103)
R575	7030000620	S.RESISTOR	MCR10EZHZ 100KΩ (104)
R576	7030000620	S.RESISTOR	MCR10EZHZ 100KΩ (104)
R577	7030000730	S.RESISTOR	MCR10EZHZ 820KΩ (824)
R578	7030000460	S.RESISTOR	MCR10EZHZ 4.7KΩ (472)
R579	7030000580	S.RESISTOR	MCR10EZHZ 47KΩ (473)
R580	7030000620	S.RESISTOR	MCR10EZHZ 100KΩ (104)
R581	7030000620	S.RESISTOR	MCR10EZHZ 100KΩ (104)
R582	7030000620	S.RESISTOR	MCR10EZHZ 100KΩ (104)
R583	7030000580	S.RESISTOR	MCR10EZHZ 47KΩ (473)
R584	7030000580	S.RESISTOR	MCR10EZHZ 47KΩ (473)
R585	7030000580	S.RESISTOR	MCR10EZHZ 47KΩ (473)
R586	7030000580	S.RESISTOR	MCR10EZHZ 47KΩ (473)
R587	7030000500	S.RESISTOR	MCR10EZHZ 10KΩ (103)
R588	7030000460	S.RESISTOR	MCR10EZHZ 4.7KΩ (472)
R589	7030000580	S.RESISTOR	MCR10EZHZ 47KΩ (473)
R590	7030000580	S.RESISTOR	MCR10EZHZ 47KΩ (473)
R591	7030000460	S.RESISTOR	MCR10EZHZ 4.7KΩ (472)
R592	7030000430	S.RESISTOR	MCR10EZHZ 2.7KΩ (272)

S. = Surface mount

[LOGIC-A UNIT]

REF. NO.	PARTS NO.	DESCRIPTION	
R593	7030000580	S.RESISTOR	MCR10EZHZJ 47KΩ (473)
C503	4030001140	S.CERAMIC	GRM40 F 103Z 50PT
C504	4030001140	S.CERAMIC	GRM40 F 103Z 50PT
C507	4030001140	S.CERAMIC	GRM40 F 103Z 50PT
C508	4030000630	S.CERAMIC	GRM40 SL 100D 50PT
C509	4030003060	S.CERAMIC	GRM40 SL 300J 50PT
C510	4550000320	TANTALUM	DN 1V 0.1M
C512	4030001140	S.CERAMIC	GRM40 F 103Z 50PT
C515	4030001110	S.CERAMIC	GRM40 B 222K 50PT
C516	4550002690	S.TANTALUM	TESVB 1A 335M-12L
C517	4030001150	S.CERAMIC	GRM40 F 104Z 25PT
C518	4310000020	MYLAR	50 F2D 103K
C519	4510000780	ELECTROLYTIC	16 RE 10μF
C520	4510001970	ELECTROLYTIC	50 MS7 0.1μF
C521	4510000900	ELECTROLYTIC	50 RE 1μF
C523	4510000910	ELECTROLYTIC	50 RE 2.2μF
C524	4510000840	ELECTROLYTIC	25 RE 4.7μF
C525	4560000130	CERAMIC	D33Y5V 1E 473Z21
C526	4030001110	S.CERAMIC	GRM40 B 222K 50PT
C527	4310000020	MYLAR	50 F2D 103K
C528	4310000010	MYLAR	50 F2D 102K
C529	4030000740	S.CERAMIC	GRM40 SL 101J 50PT
C530	4510000900	ELECTROLYTIC	50 RE 1μF
C531	4510000840	ELECTROLYTIC	25 RE 4.7μF
C532	4030001100	S.CERAMIC	GRM40 B 102K 50PT
C533	4030001100	S.CERAMIC	GRM40 B 102K 50PT
C534	4030001150	S.CERAMIC	GRM40 F 104Z 25PT
C535	4030001100	S.CERAMIC	GRM40 B 102K 50PT
C537	4030001150	S.CERAMIC	GRM40 F 104Z 25PT
C538	4510002380	ELECTROLYTIC	16 SS 470μF (10X12.5)
C539	4510002380	ELECTROLYTIC	16 SS 470μF (10X12.5)
C540	4510000780	ELECTROLYTIC	16 RE 10μF
C541	4510000840	ELECTROLYTIC	25 RE 4.7μF
C542	4310000020	MYLAR	50 F2D 103K
C543	4030001140	S.CERAMIC	GRM40 F 103Z 50PT
C544	4510000890	ELECTROLYTIC	50 RE 0.47μF
C545	4030001140	S.CERAMIC	GRM40 F 103Z 50PT
C546	4510000890	ELECTROLYTIC	50 RE 0.47μF
C547	4510001120	ELECTROLYTIC	25 MS7 4.7μF
C548	4310000020	MYLAR	50 F2D 103K
C549	4310000020	MYLAR	50 F2D 103K
C550	4310000020	MYLAR	50 F2D 103K
C551	4510001140	ELECTROLYTIC	50 MS7 0.22μF
C552	4030001140	S.CERAMIC	GRM40 F 103Z 50PT
C553	4510001100	ELECTROLYTIC	16 MS7 10μF
C554	4310000010	MYLAR	50 F2D 102K
C555	4510000900	ELECTROLYTIC	50 RE 1μF
C556	4510001140	ELECTROLYTIC	50 MS7 0.22μF
C557	4510000840	ELECTROLYTIC	25 RE 4.7μF
C559	4030001140	S.CERAMIC	GRM40 F 103Z 50PT
C560	4030001140	S.CERAMIC	GRM40 F 103Z 50PT
C561	4030000700	S.CERAMIC	GRM40 SL 470J 50PT
C562	4030000740	S.CERAMIC	GRM40 SL 101J 50PT
C563	4510001120	ELECTROLYTIC	25 MS7 4.7μF
C564	4030000670	S.CERAMIC	GRM40 SL 220J 50PT
C565	4510004170	ELECTROLYTIC	10 MS7 220μF
S501	2260000390	SWITCH	SKHLAB064A
BT501	3020000040	LITHIUM	BR2325-1HC
EP501	910016827	PCB	B 1584G

[FRONT UNIT]

REF. NO.	PARTS NO.	DESCRIPTION	
IC401	1130000790	S.IC	μPD7225G00
Q401	1510000110	S.TRANSISTOR	2SA1162-Y (TE85R)
D401	1750000050	S.DIODE	1SS193 (TE85R)
D402	1750000050	S.DIODE	1SS193 (TE85R)
D403	1750000050	S.DIODE	1SS193 (TE85R)
D404	1750000050	S.DIODE	1SS193 (TE85R)
D405	1750000050	S.DIODE	1SS193 (TE85R)
D406	1750000050	S.DIODE	1SS193 (TE85R)
R401	7030000500	S.RESISTOR	MCR10EZHZJ 10KΩ (103)
R402	7030000500	S.RESISTOR	MCR10EZHZJ 10KΩ (103)
R403	7030000650	S.RESISTOR	MCR10EZHZJ 180KΩ (184)
R404	7030000500	S.RESISTOR	MCR10EZHZJ 10KΩ (103)
R405	7030000580	S.RESISTOR	MCR10EZHZJ 47KΩ (473)
R406	7030000380	S.RESISTOR	MCR10EZHZJ 1KΩ (102)
C401	4030001100	S.CERAMIC	GRM40 B 102K 50PT
C402	4030001100	S.CERAMIC	GRM40 B 102K 50PT
C403	4030001100	S.CERAMIC	GRM40 B 102K 50PT
C404	4030001100	S.CERAMIC	GRM40 B 102K 50PT
C405	4030001100	S.CERAMIC	GRM40 B 102K 50PT
C406	4030001090	S.CERAMIC	GRM40 B 471K 50PT
C407	4030001090	S.CERAMIC	GRM40 B 471K 50PT
C408	4030001100	S.CERAMIC	GRM40 B 102K 50PT
C409	4030001100	S.CERAMIC	GRM40 B 102K 50PT
C410	4030001100	S.CERAMIC	GRM40 B 102K 50PT
C411	4030001100	S.CERAMIC	GRM40 B 102K 50PT
C412	4030001100	S.CERAMIC	GRM40 B 102K 50PT
DS401	5030000260	LCD	LR598-A
DS402	5080000110	LAMP	BQ031-22403A
DS403	5080000110	LAMP	BQ031-22403A
S401	2260000680	SWITCH	SKHBBV011A
S402	2260000680	SWITCH	SKHBBV011A
S403	2260000680	SWITCH	SKHBBV011A
S404	2260000680	SWITCH	SKHBBV011A
S405	2260000680	SWITCH	SKHBBV011A
S406	2260000680	SWITCH	SKHBBV011A
EP401	910015292	PCB	B 1396B

[VR UNIT]

REF. NO.	PARTS NO.	DESCRIPTION	
R1	7210001280	VARIABLE	EVK-QVB 315 A14 (10KA)
EP1	910014791	PCB	B 1444A

[CHASSIS UNIT]

REF. NO.	PARTS NO.	DESCRIPTION	
C1	4010000520	CERAMIC	DD108 B 472K 50V

S. = Surface mount

[CTCSS UNIT] (#13, #33 only)

REF. NO.	PARTS NO.	DESCRIPTION	
IC1	1110000960	S.IC	NJM4558M(T1)
IC2	1130001830	S.IC	MN6520
Q3	1530000980	S.TRANSISTOR 2SC3395-TA	
X1	6050003110	XTAL	RF-4A3 FAC NKD (4.194304M)
R1	7030000660	S.RESISTOR	MCR10EZHZ 220KΩ (224)
R2	7030000660	S.RESISTOR	MCR10EZHZ 220KΩ (224)
R3	7030000660	S.RESISTOR	MCR10EZHZ 220KΩ (224)
R4	7030000660	S.RESISTOR	MCR10EZHZ 220KΩ (224)
R5	7030000670	S.RESISTOR	MCR10EZHZ 270KΩ (274)
R6	7030000660	S.RESISTOR	MCR10EZHZ 220KΩ (224)
R7	7030000650	S.RESISTOR	MCR10EZHZ 180KΩ (184)
R8	7030000500	S.RESISTOR	MCR10EZHZ 10KΩ (103)
R9	7030000520	S.RESISTOR	MCR10EZHZ 15KΩ (153)
R11	7030000500	S.RESISTOR	MCR10EZHZ 10KΩ (103)
R12	7030000420	S.RESISTOR	MCR10EZHZ 2.2KΩ (222)
R13	7030000500	S.RESISTOR	MCR10EZHZ 10KΩ (103)
R14	7030000640	S.RESISTOR	MCR10EZHZ 150KΩ (154)
R15	7030000380	S.RESISTOR	MCR10EZHZ 1KΩ (102)
C1	4030001140	S.CERAMIC	GRM40 F 103Z 50PT
C2	4030003330	S.CERAMIC	GRM40 B 223K 50PT
C3	4030001090	S.CERAMIC	GRM40 B 471K 50PT
C4	4030003320	S.CERAMIC	GRM40 F 333Z 50PT
C5	4030003180	S.CERAMIC	GRM40 SL 271J 50PT
C6	4550000920	S.TANTALUM	TESVA 1D 474M1-8L
C7	4550000790	S.TANTALUM	TESVD 0J 476M-12L
C8	4030001150	S.CERAMIC	GRM40 F 104Z 25PT
C9	4030000660	S.CERAMIC	GRM40 SL 180J 50PT
C10	4030000660	S.CERAMIC	GRM40 SL 180J 50PT
C11	4550000920	S.TANTALUM	TESVA 1D 474M1-8L
C12	4030001150	S.CERAMIC	GRM40 F 104Z 25PT
C13	4550000920	S.TANTALUM	TESVA 1D 474M1-8L
EP1	910014232	PCB	B 1244B

S. = Surface mount

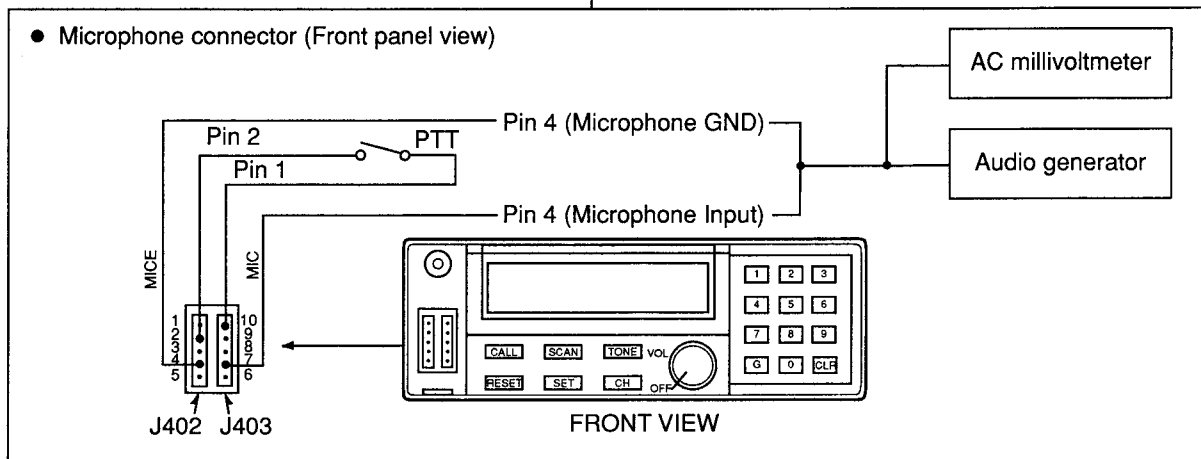
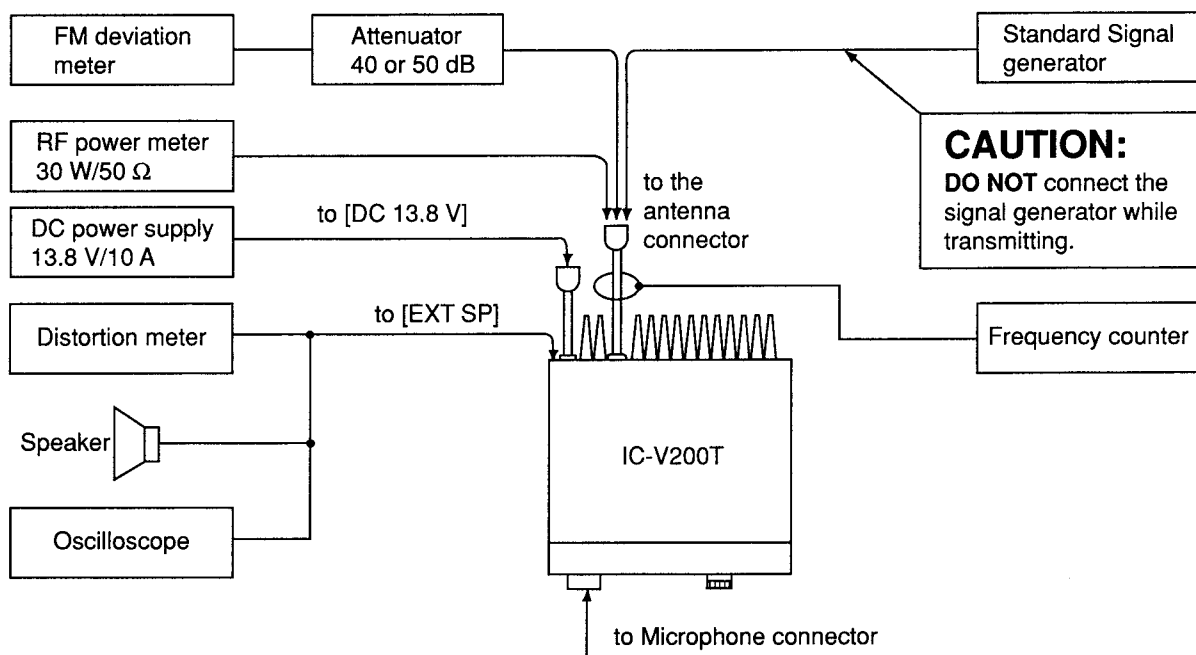
# SECTION 6 ADJUSTMENT PROCEDURES

## 6-1 PREPARATION BEFORE SERVICING

### ■ REQUIRED TEST EQUIPMENT

EQUIPMENT	GRADE AND RANGE	EQUIPMENT	GRADE AND RANGE
DC power supply	Output voltage : 13.8 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 : 130 ~ 180 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 ~ 180 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 : 180 MHz Measuring range : 0 ~ ±5 kHz
Standard signal generator (SSG)	Frequency range : 130 ~ 180 MHz Output level : -127 ~ -17 dBm (0.1 μV ~ 32 mV)	External speaker	Impedance : 4 Ω

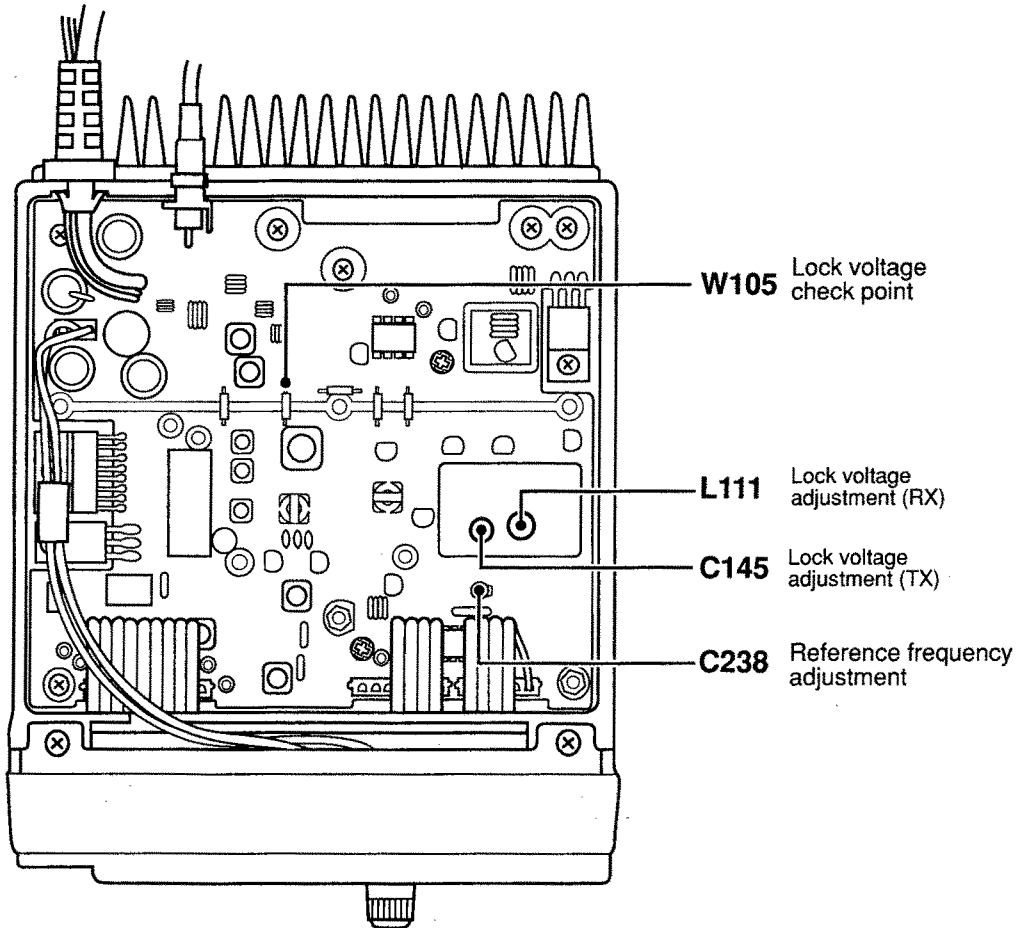
### ■ CONNECTIONS



## 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 50 Ω 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	C238
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: 146.0000 MHz</li> <li>● Connect the RF power meter or a 50 Ω dummy load to the antenna connector.</li> <li>● Receiving</li> </ul>	MAIN	Connect the DC voltmeter to W105.	3.0 V	MAIN	L111
	2 <ul style="list-style-type: none"> <li>● Transmitting</li> </ul>			3.0 V		C145
3	After adjustment, fix L111 and C145 in place with paraffin.					

### • MAIN UNIT



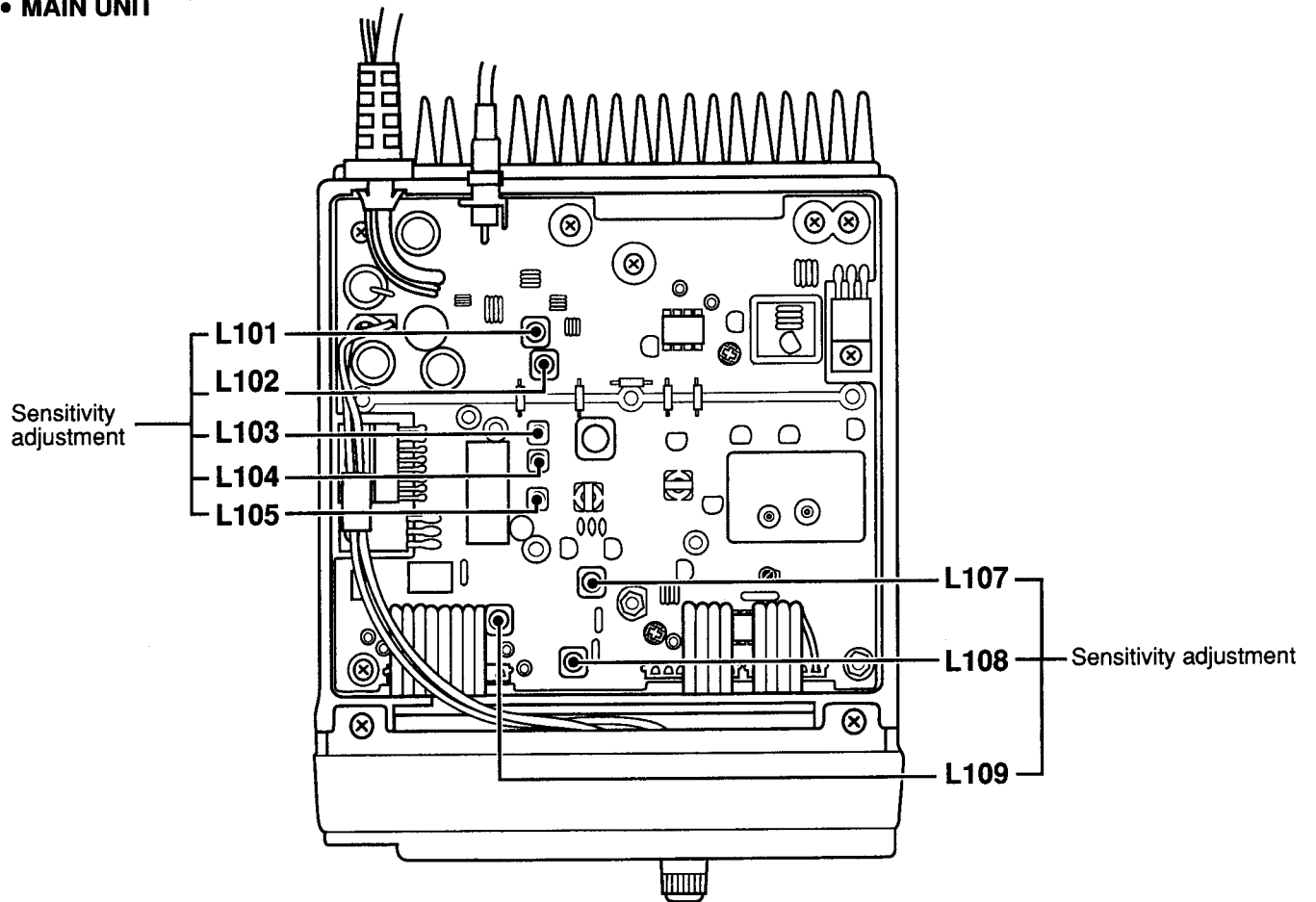


## 6-3 RECEIVER ADJUSTMENT

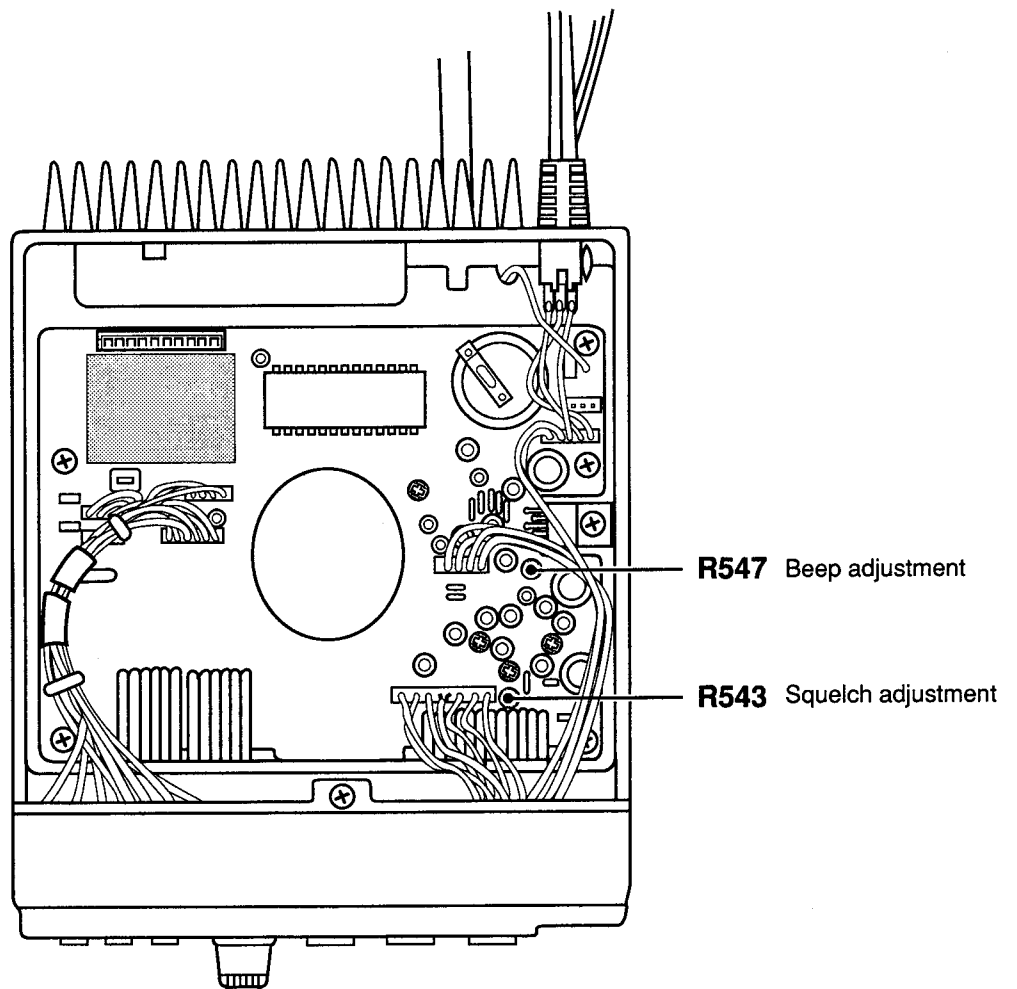
ADJUSTMENT	ADJUSTMENT CONDITIONS	MEASUREMENT		VALUE	ADJUSTMENT POINT		
		UNIT	LOCATION		UNIT	ADJUST	
SENSITIVITY	NOTE: When the sensitivity is less than 0.35 $\mu\text{V}$ (12 dB SINAD) on every channel, the following sensitivity adjustment is not necessary. Skip to squelch adjustment below. This transceiver automatically sends an answer back code when a 5-tone code is received. Be careful when connecting the SSG to the antenna connector.						
	1	<ul style="list-style-type: none"> <li>● Select any channel.</li> <li>● Connect the SSG to the antenna connector and set as:                Level : 1 <math>\mu\text{V}^*</math> (-107 dBm)                Modulation : 1 kHz                Deviation : <math>\pm 3.5</math> kHz                    (#20, #21, #24, #25)                    (#28, #31, #34)  <math>\pm 2.8</math> kHz (#29, #35)  <math>\pm 1.75</math> kHz                    (#13, #14, #16, #22)                    (#30, #32, #33)</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.	Minimum distortion level	MAIN	Adjust in sequence L101, L102, L103, L104, L105, L107, L108, L109
SQUELCH	NOTE: Before squelch adjustment, be sure that the sensitivity on every channel is less than 0.35 $\mu\text{V}$ (12 dB SINAD).						
	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-A	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>● Receiving</li> </ul>	Rear panel	Connect the oscilloscope to the [EXT SP] jack with a 4 $\Omega$ load.	1.5 Vp-p	LOGIC-A	R547

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

• MAIN UNIT



• LOGIC-A UNIT

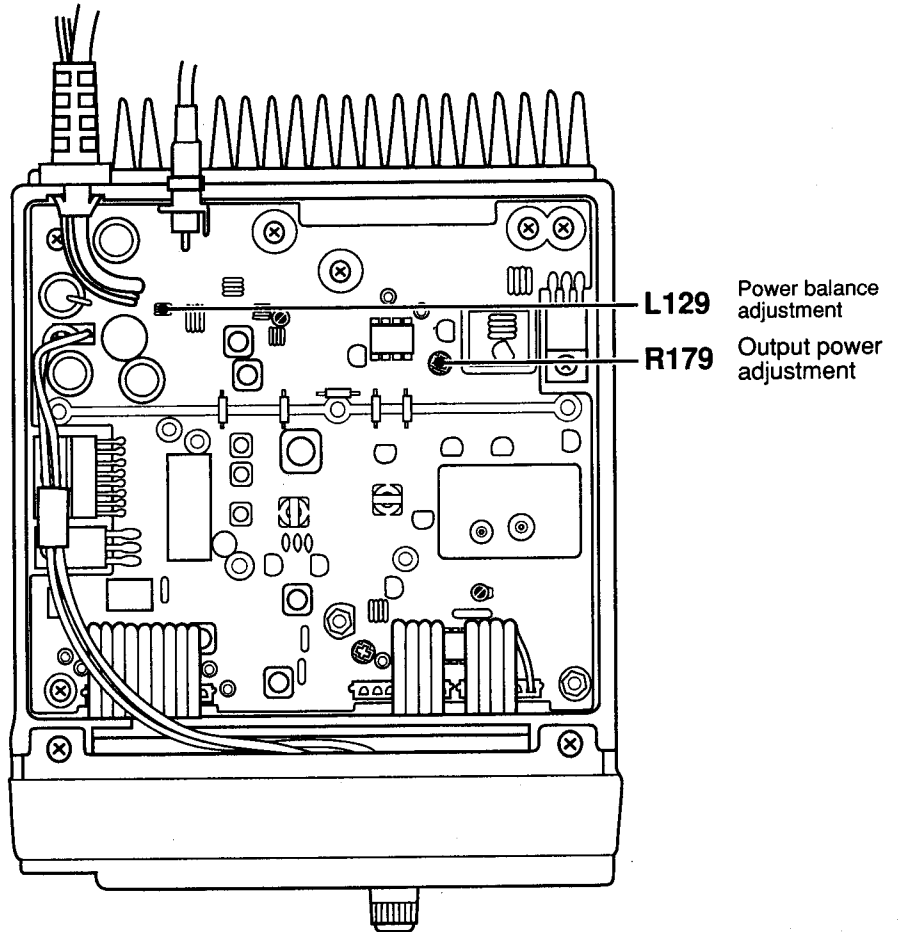


## 6-4 TRANSMITTER ADJUSTMENT

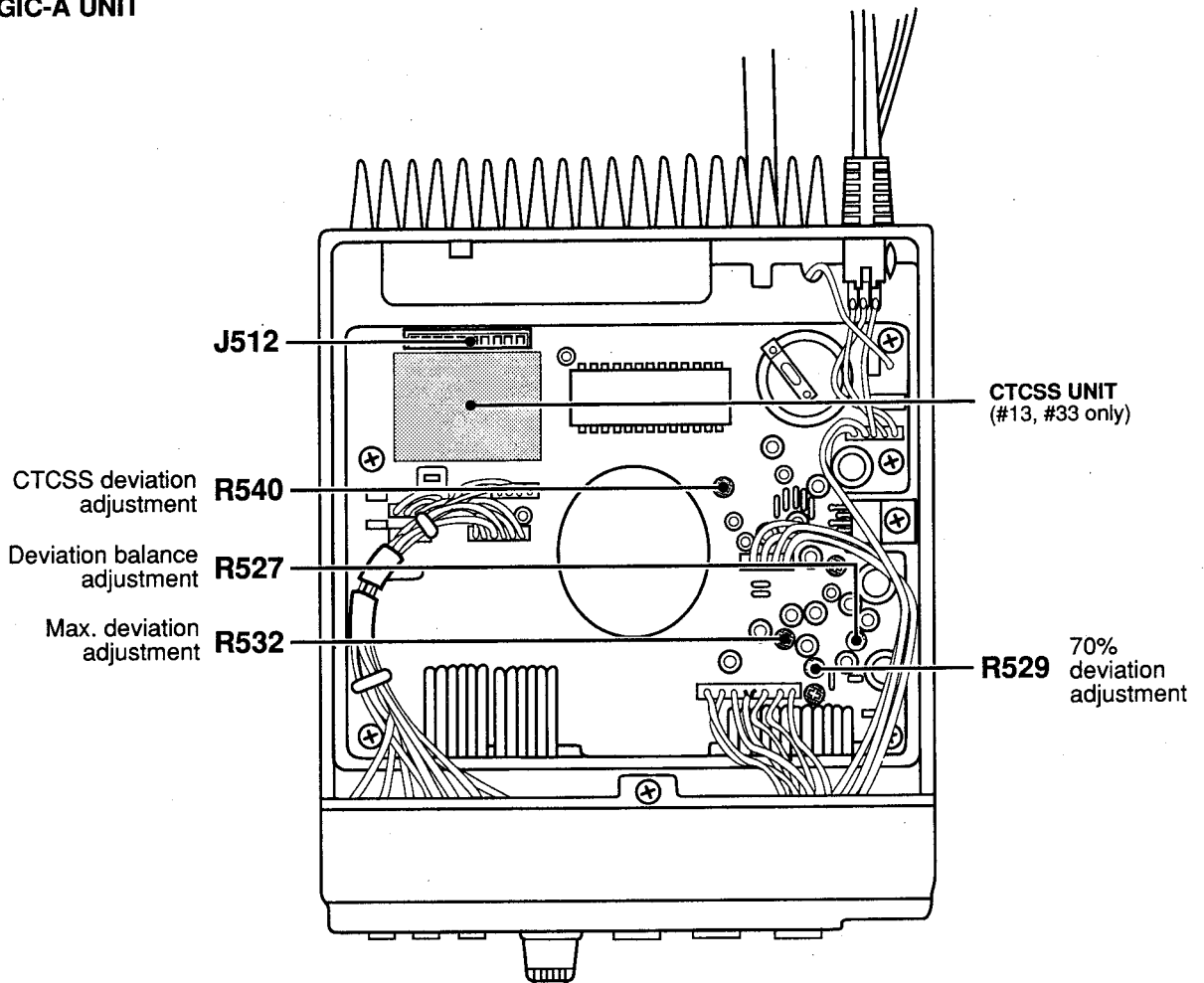
ADJUSTMENT	ADJUSTMENT CONDITIONS	MEASUREMENT		VALUE	ADJUSTMENT POINT		
		UNIT	LOCATION		UNIT	ADJUST	
OUTPUT POWER	1 <ul style="list-style-type: none"> <li>● Select any channel.</li> <li>● Connect the RF power meter to the antenna connector.</li> <li>● Transmitting</li> </ul>	MAIN	RF power meter	25 W (#14, #16, #21, #22, #24, #25, #28, #31 ~ #34) 10 W (#13, #20, #29, #30) 6 W (#35)	MAIN	R179	
	2 <ul style="list-style-type: none"> <li>● Power balance adjustment in the frequency range.</li> </ul>					L129	
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:                Level : 50 mV                Modulation : 1.0 kHz</li> <li>● Set the FM deviation meter as:                HPF : OFF                LPF : 20 kHz                De-emphasis : OFF                Detector : (P-P)/2</li> <li>● R529 (LOGIC-A) : CCW</li> <li>● Transmitting</li> </ul>	Rear panel	Connect the FM deviation meter to the antenna connector via the attenuator.	±4.4 kHz (#20, #21, #24, #25, #28, #31, #34) ±3.6 kHz (#29, #35) ±2.2 kHz (#13, #14, #16, #22, #30, #32, #33)	LOGIC-A	R532	
	2 <ul style="list-style-type: none"> <li>● Set the FM deviation meter as:                Detector : +P and -P</li> </ul>					Symmetrical deviation level	R527
	3 <ul style="list-style-type: none"> <li>● Set the audio generator as:                Level : 5.0 mV</li> </ul>					±3.5 kHz (#20, #21, #24, #25, #28, #31, #34) ±2.8 kHz (#29, #35) ±1.75 kHz (#13, #14, #16, #22, #30, #32, #33)	R529
	4 <ul style="list-style-type: none"> <li>● Set the audio generator as:                Level : 50 mV</li> </ul>					±3.7 kHz ~ ±4.6 kHz (#20, #21, #24, #25, #28, #31, #34) ±3 kHz ~ ±3.7 kHz (#29, #35) ±1.75 kHz ~ ±2.3 kHz (#13, #14, #16, #22, #30, #32, #33)	Verify
	5 <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.                Frequency : Select any channel.                Tone number : 37</li> <li>● Set the FM deviation meter as:                HPF : OFF                LPF : 20 kHz                De-emphasis : OFF                Detector : (P-P)/2</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.	±0.5 kHz (#20, #21, #24, #25, #28, #31, #34) ±0.4 kHz (#29, #35) ±0.3 kHz (#13, #14, #16, #22, #30, #32, #33)	LOGIC-A	R540	

\* See p. 6-1 for connection.

• MAIN UNIT



• LOGIC-A UNIT

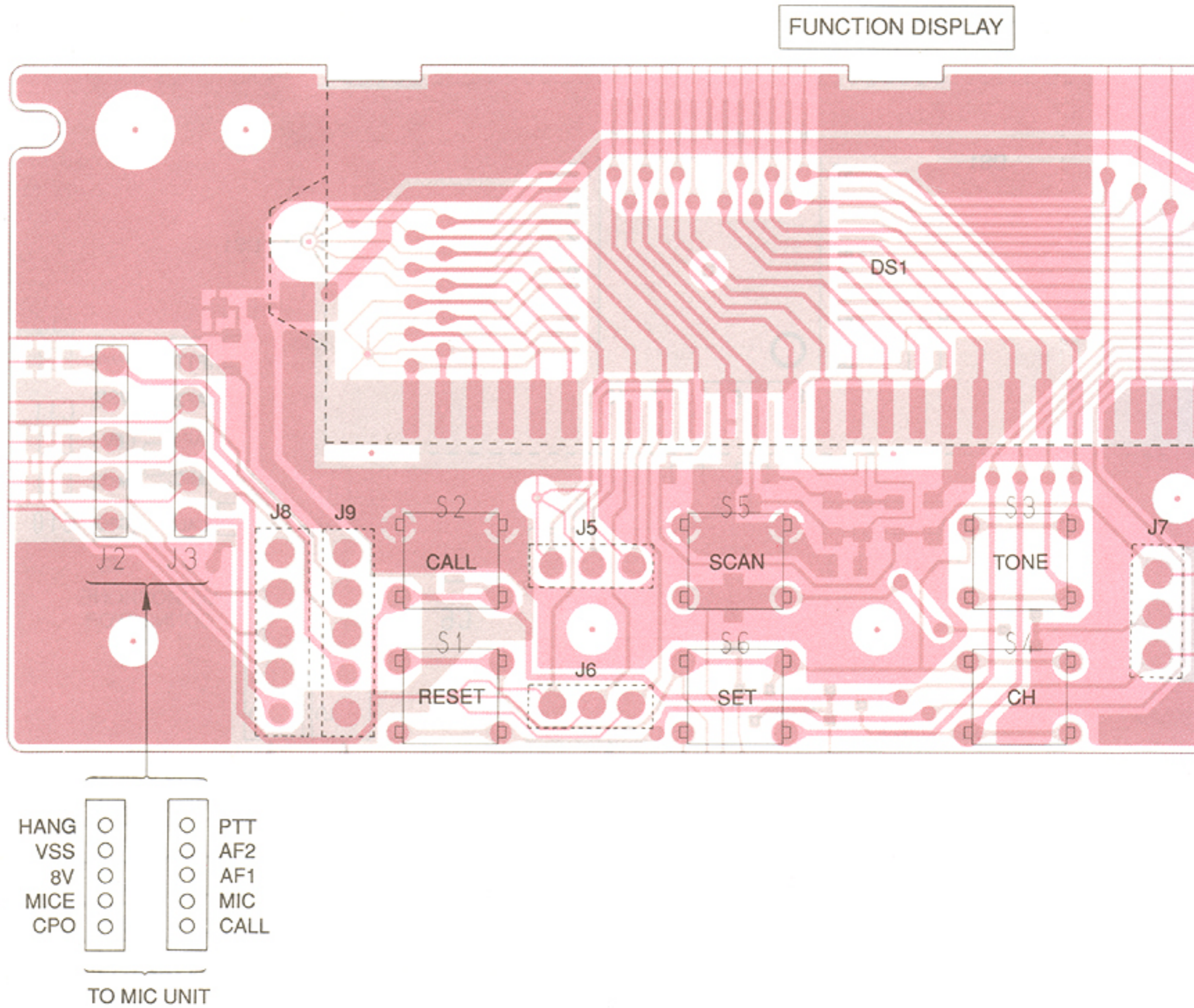


# SECTION 7 BOARD LAYOUTS

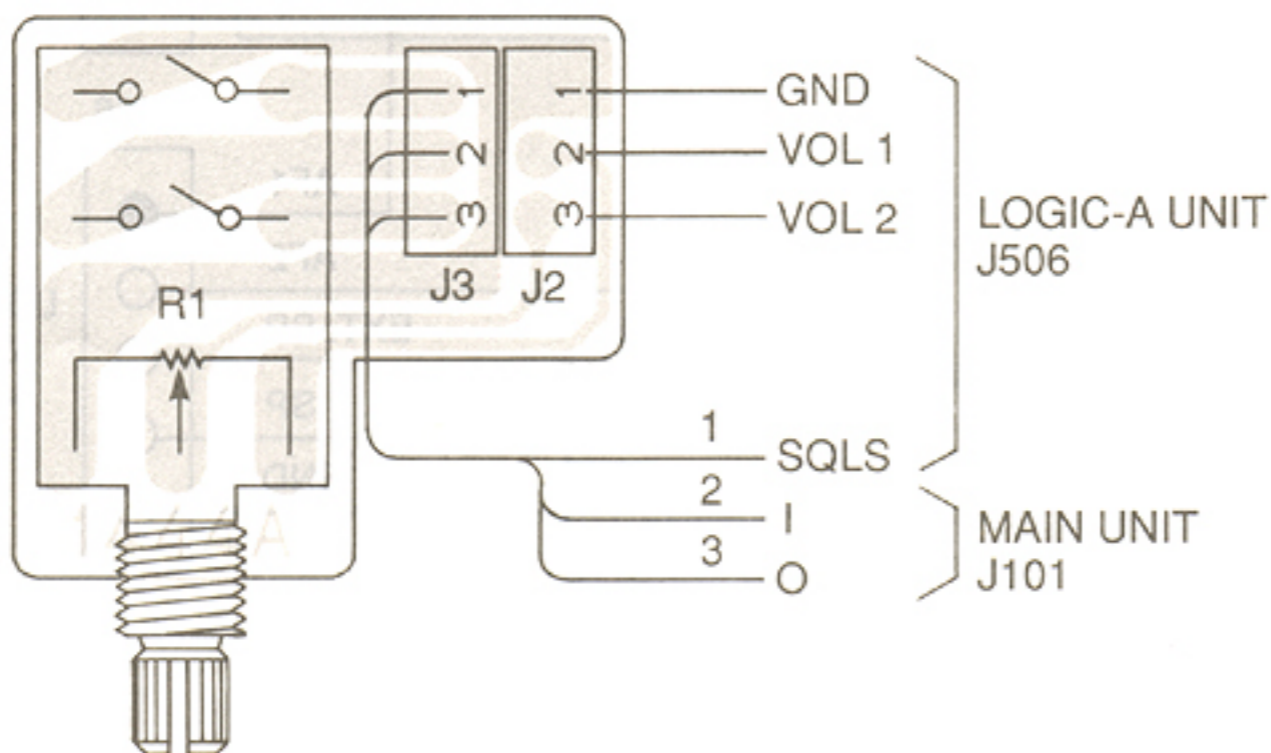
## 7-1 FRONT, VR AND CTCSS UNITS

### • FRONT UNIT (TOP VIEW)

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

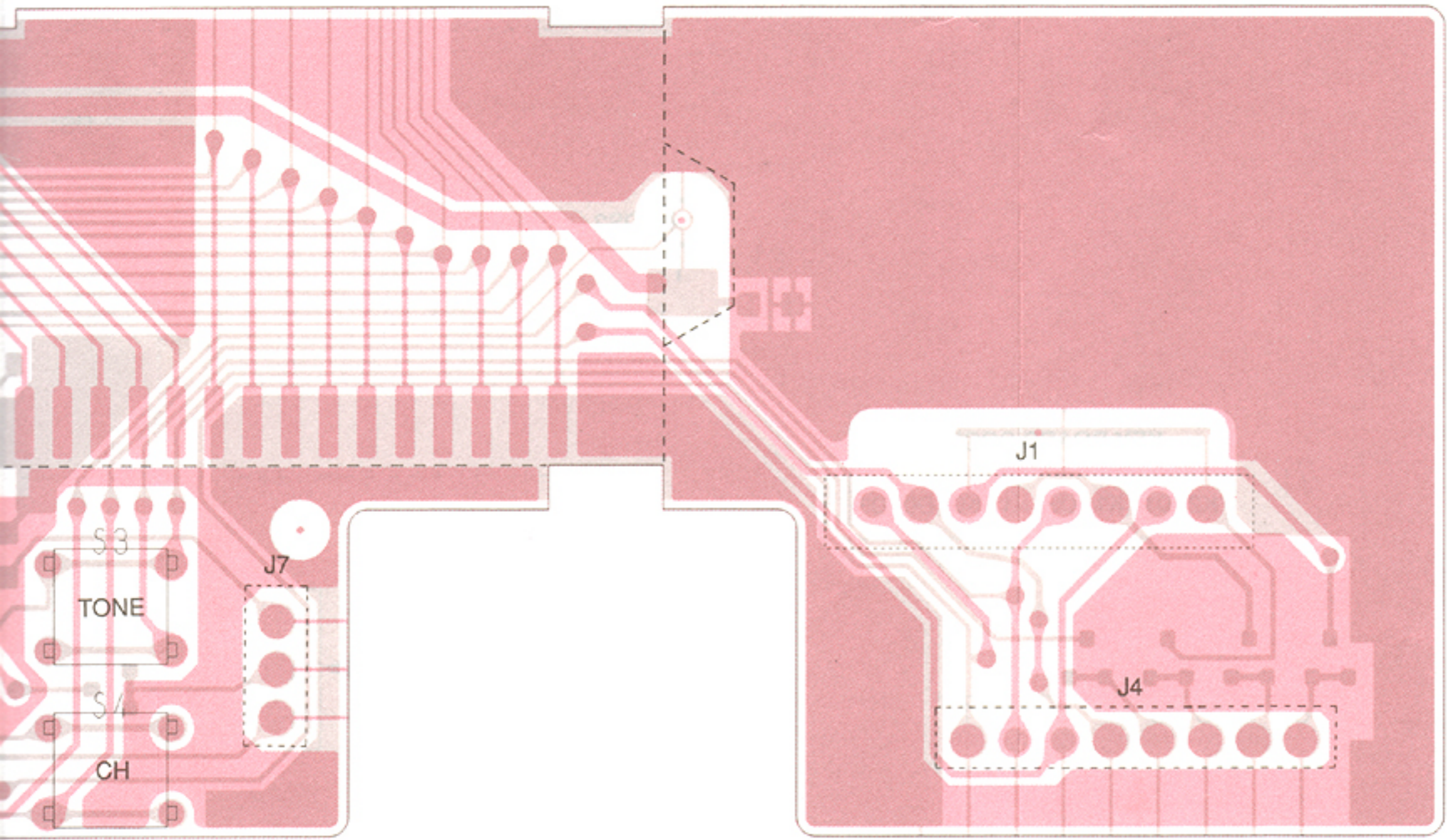


### • VR UNIT

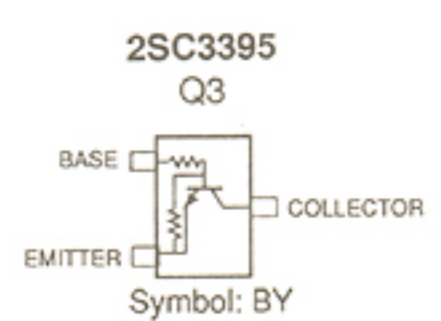
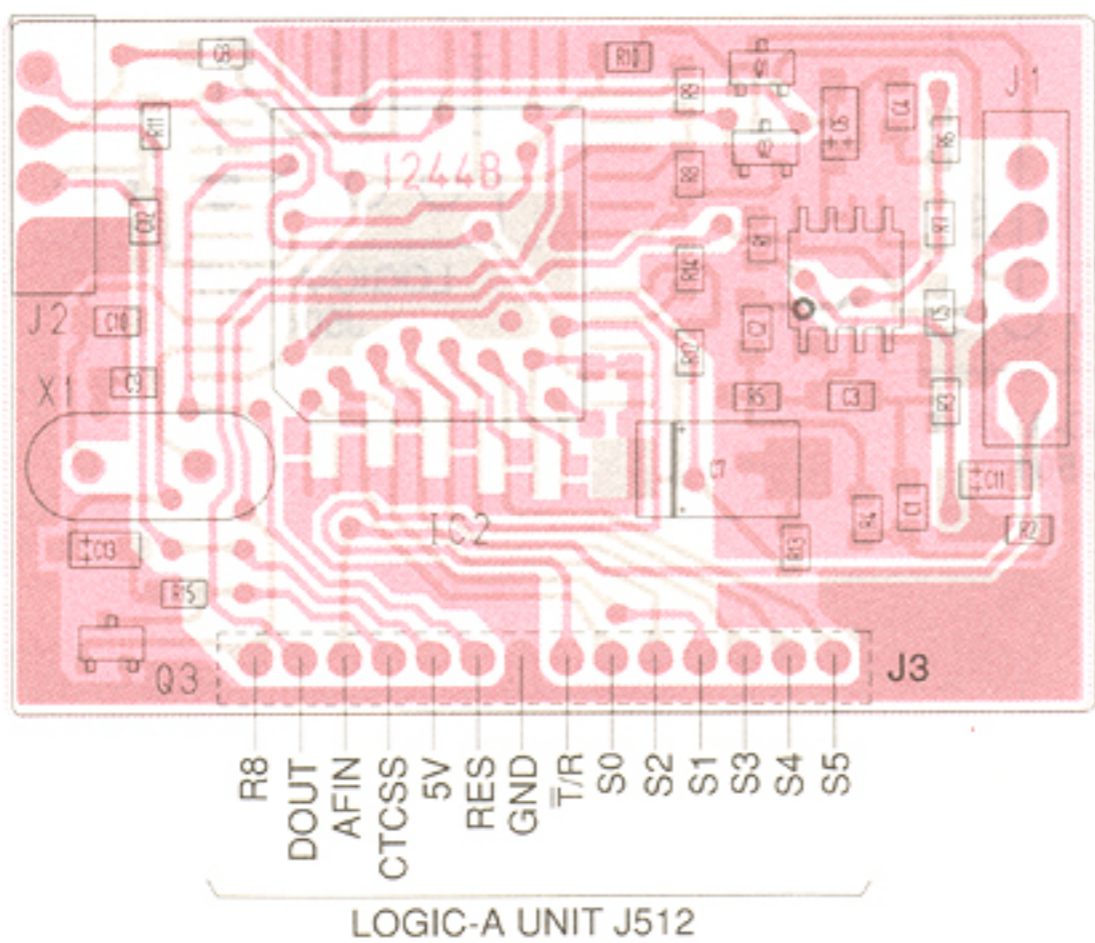


The combination of this page and the next page shows the unit layout in the same configuration as the actual P.C. Board.

DISPLAY

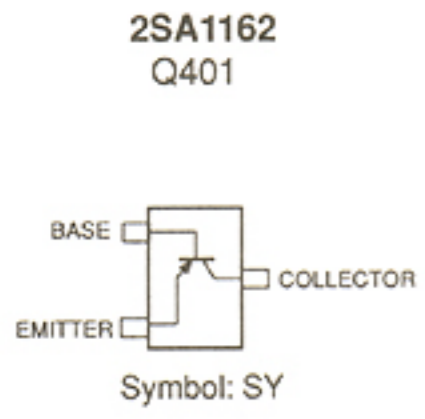


• CTCSS UNIT (#13, #33 only)

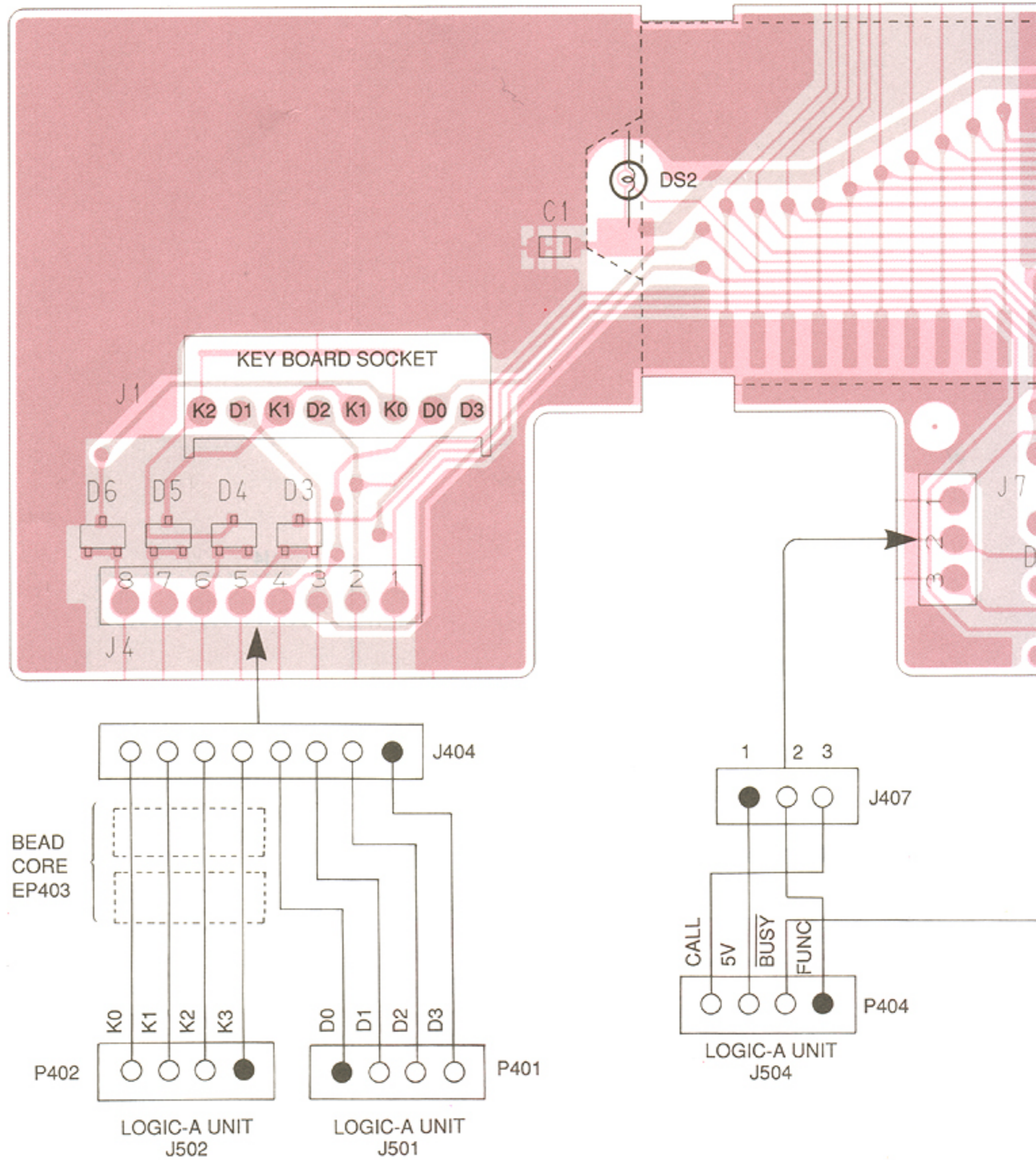
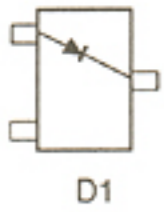


• FRONT UNIT (BOTTOM VIEW)

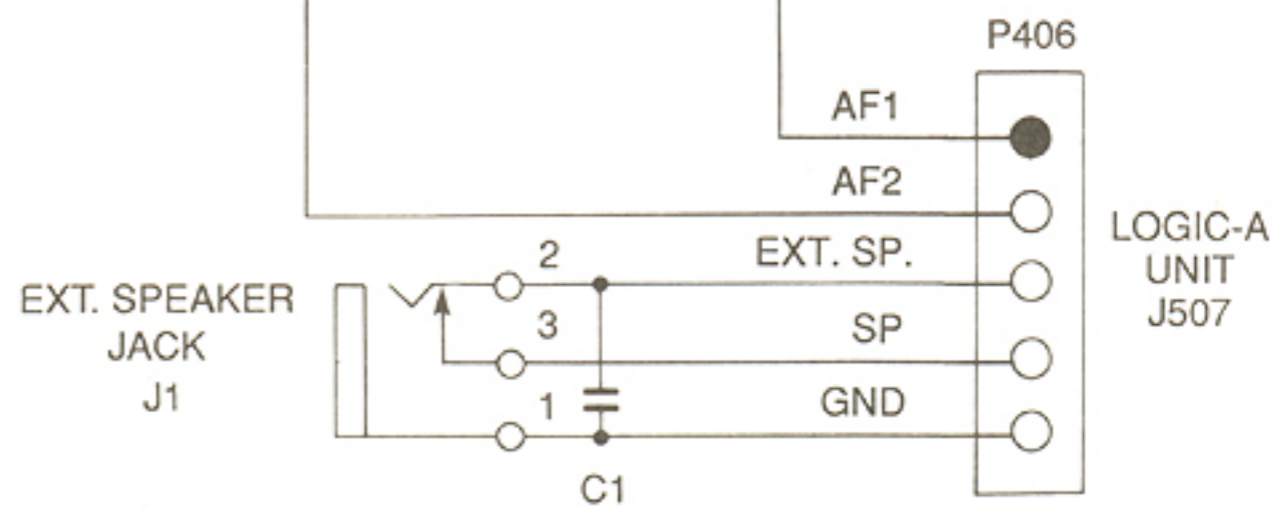
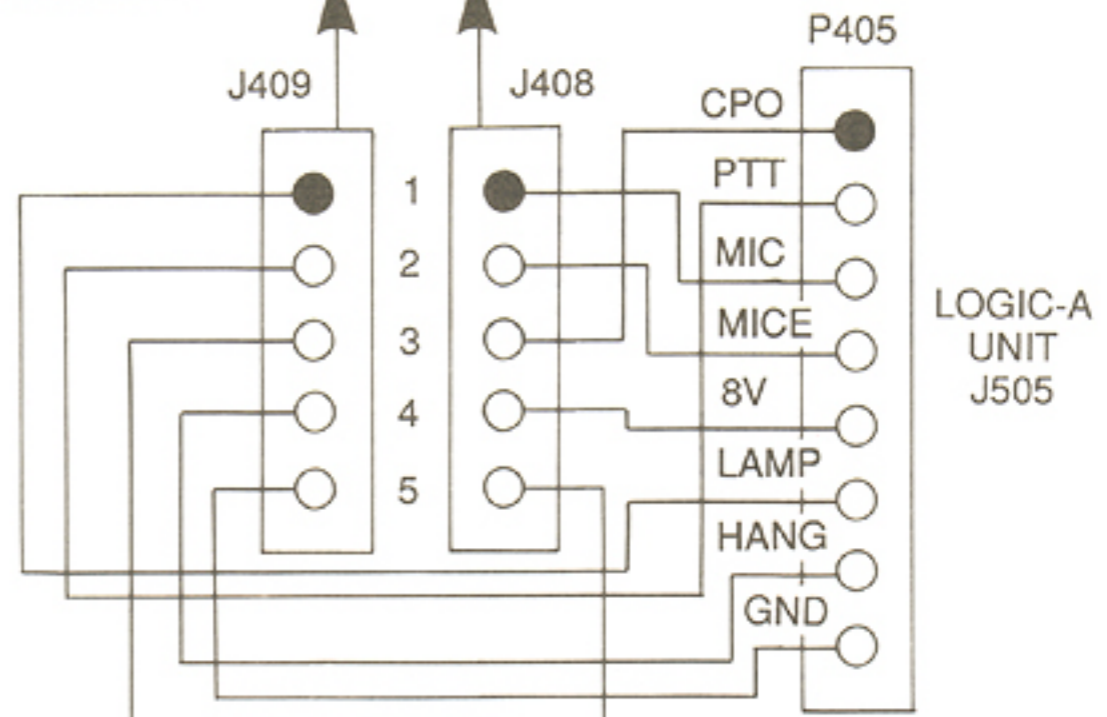
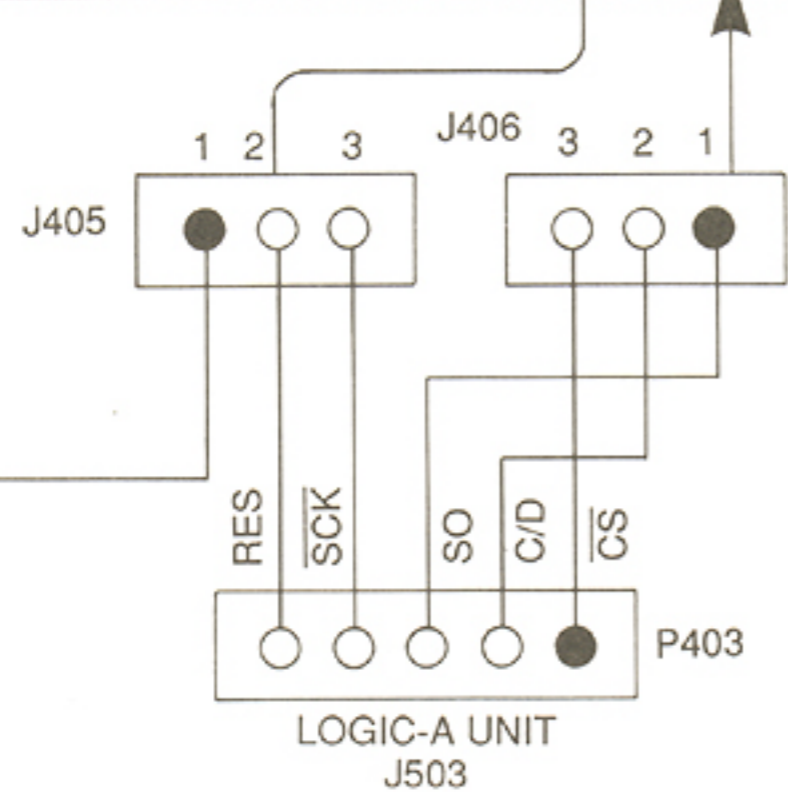
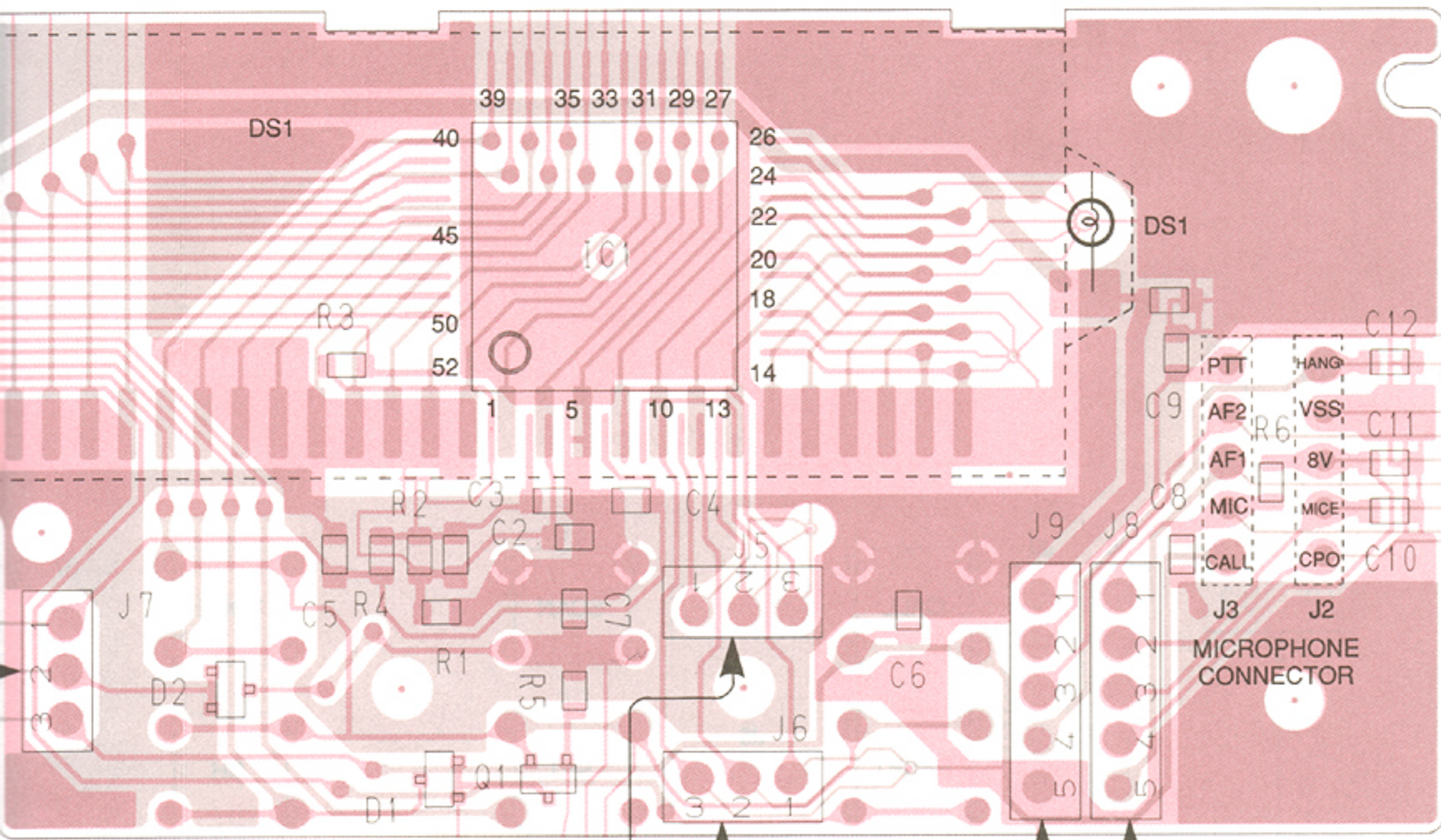
NOTE: Add "400" to the indicated number on the FRONT unit for actual part number.



1SS193  
D401, D402, D403  
D404, D405, D406



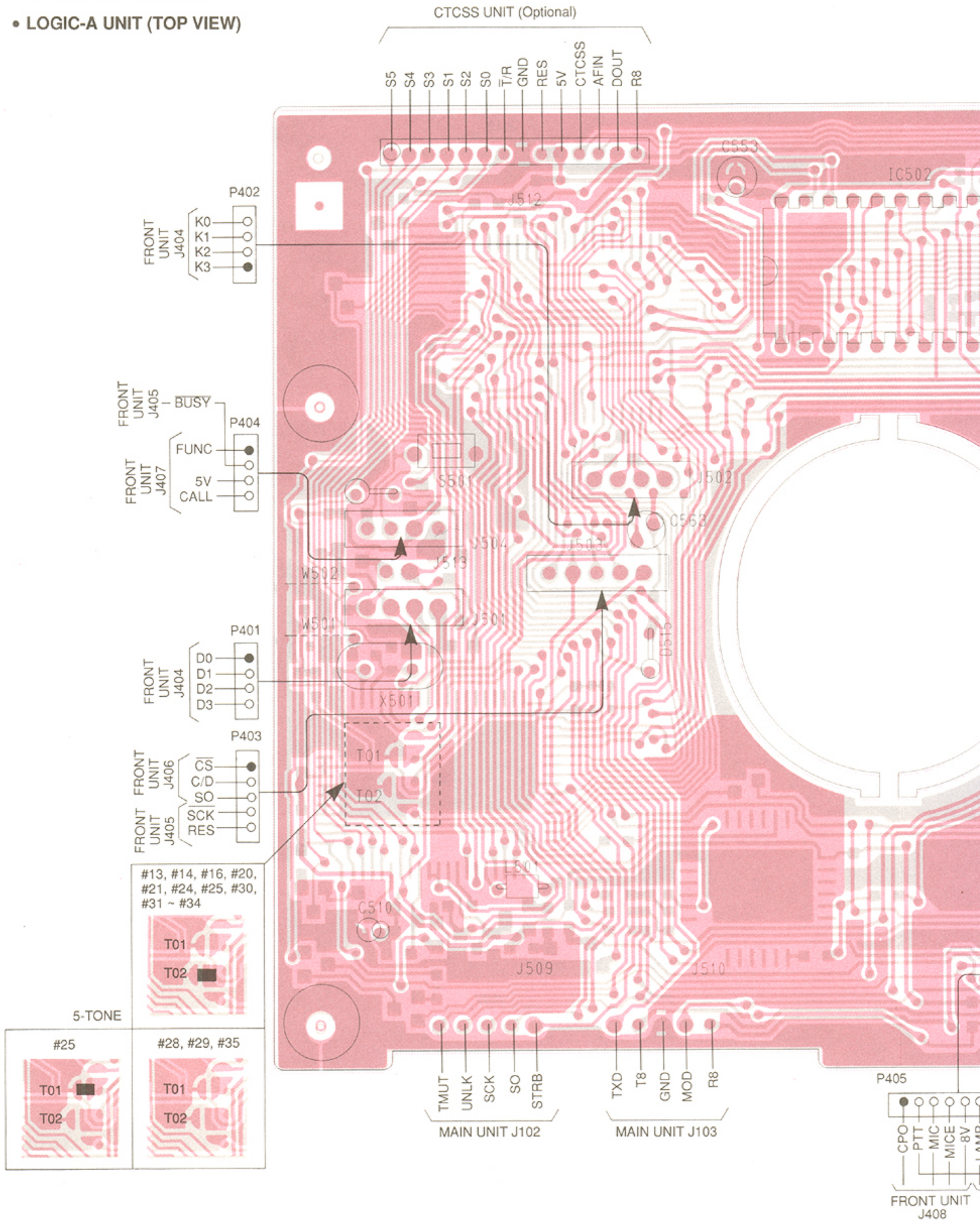
FUNCTION DISPLAY



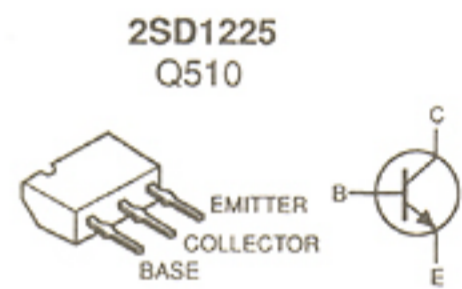
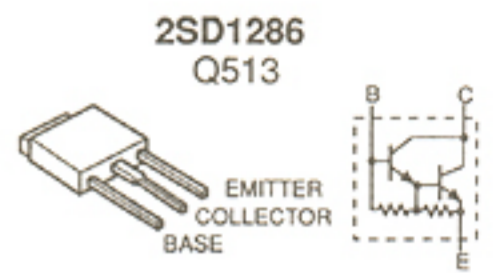
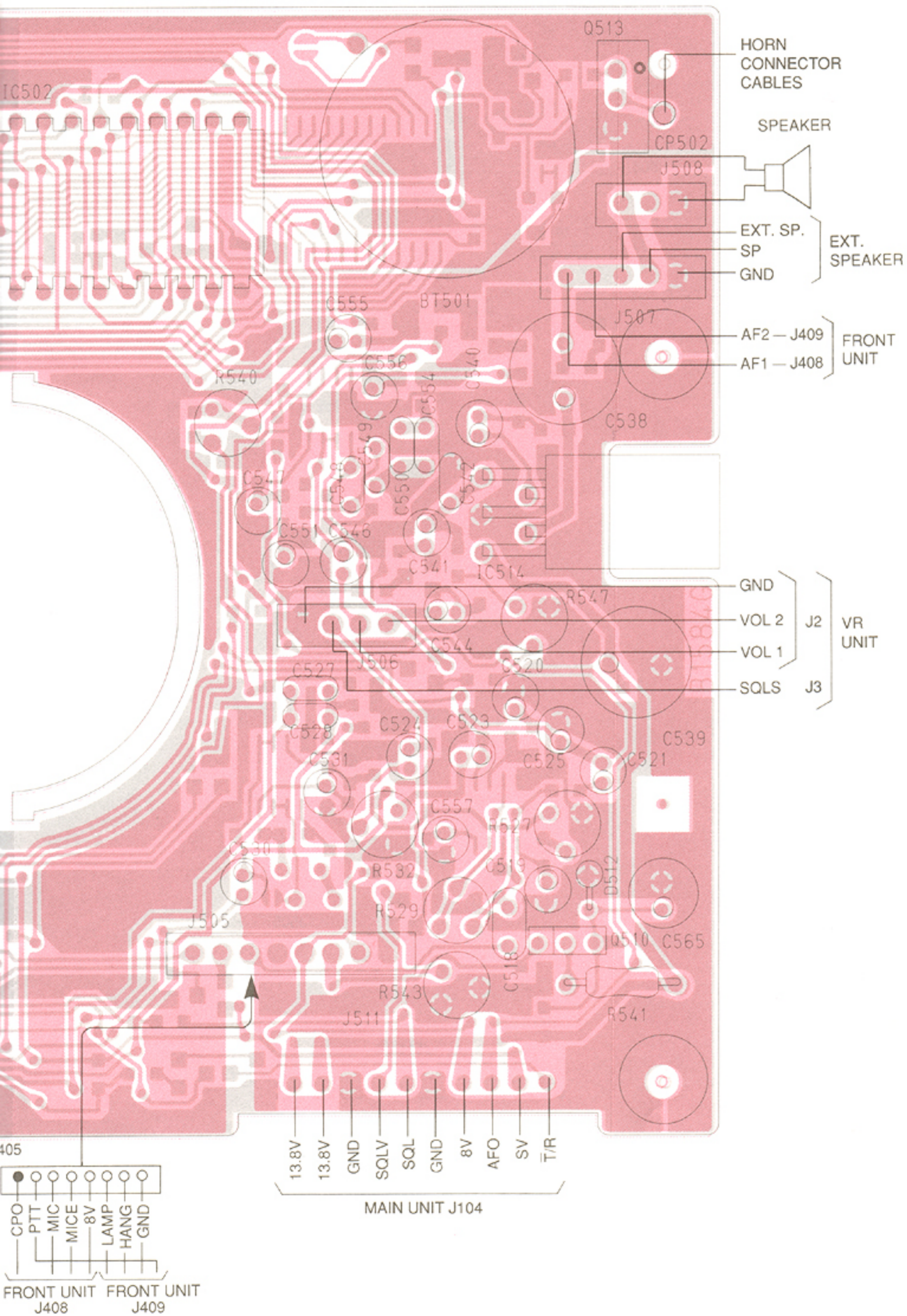


# 7-2 LOGIC-A UNIT

## • LOGIC-A 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.



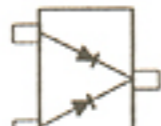
• LOGIC UNIT (BOTTOM VIEW)

**RD6.2M B2**  
D502



Symbol: 622

**1SS184**  
D501, D510



Symbol: B3

**1SS181**  
D505, D513



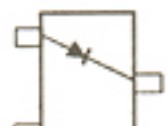
Symbol: A3

**1SS190**  
D504, D506



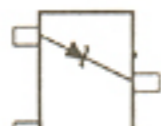
Symbol: E3

**1SS193**  
D514



Symbol: F3

**RD5.1M B2**  
D511



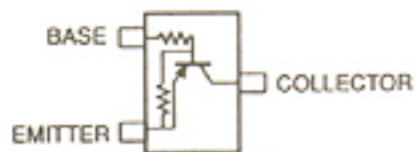
Symbol: 512

**1SS196**  
D508



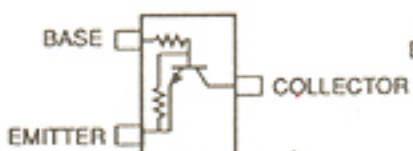
Symbol: G3

**2SA1341**  
Q501, Q503, Q506



Symbol: BL

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



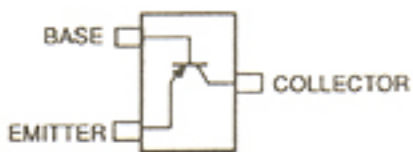
Symbol: BY

**2SC2712**  
Q508, Q514, Q519  
Q522



Symbol: LY

**2SA1162**  
Q505

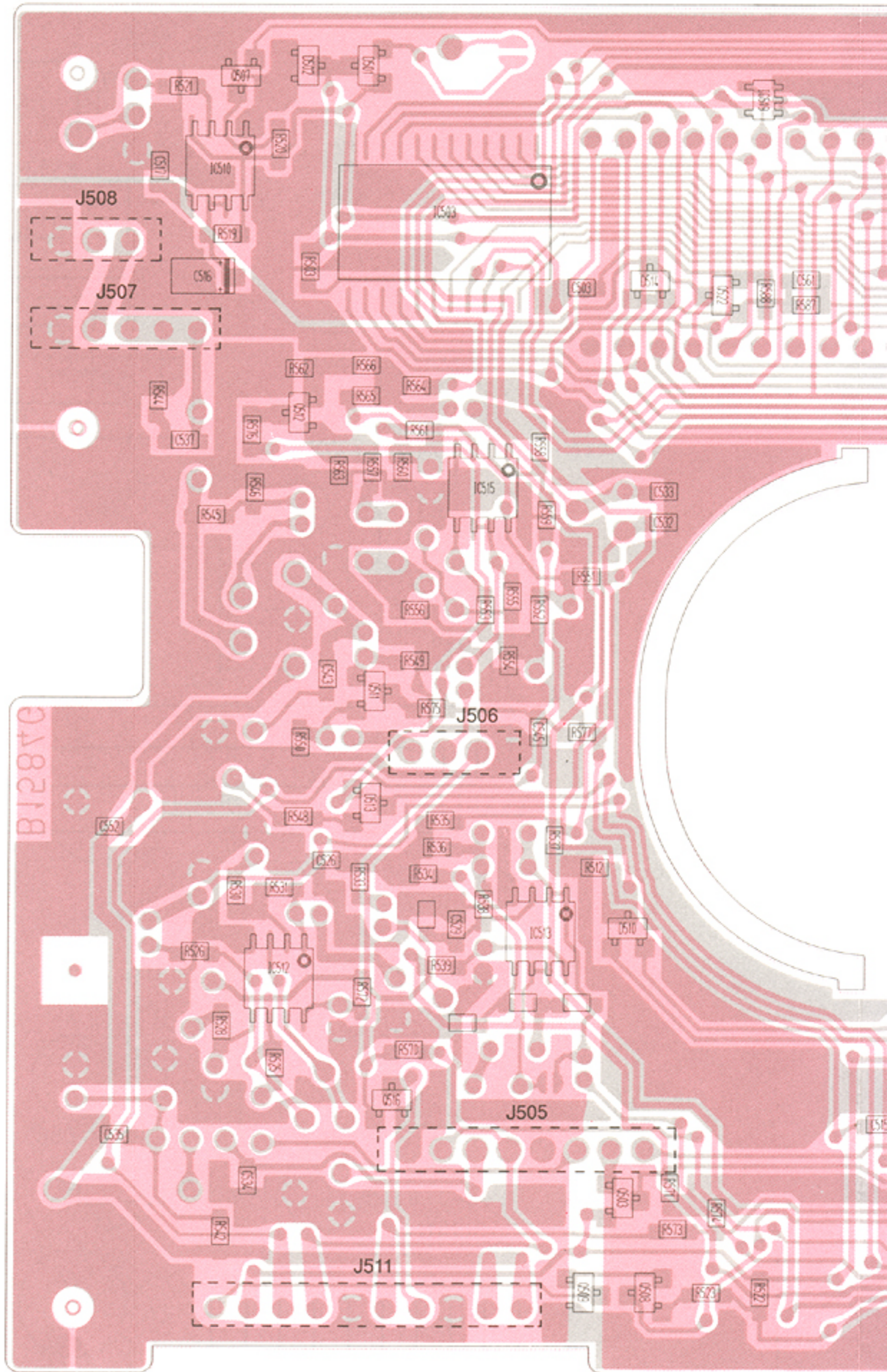


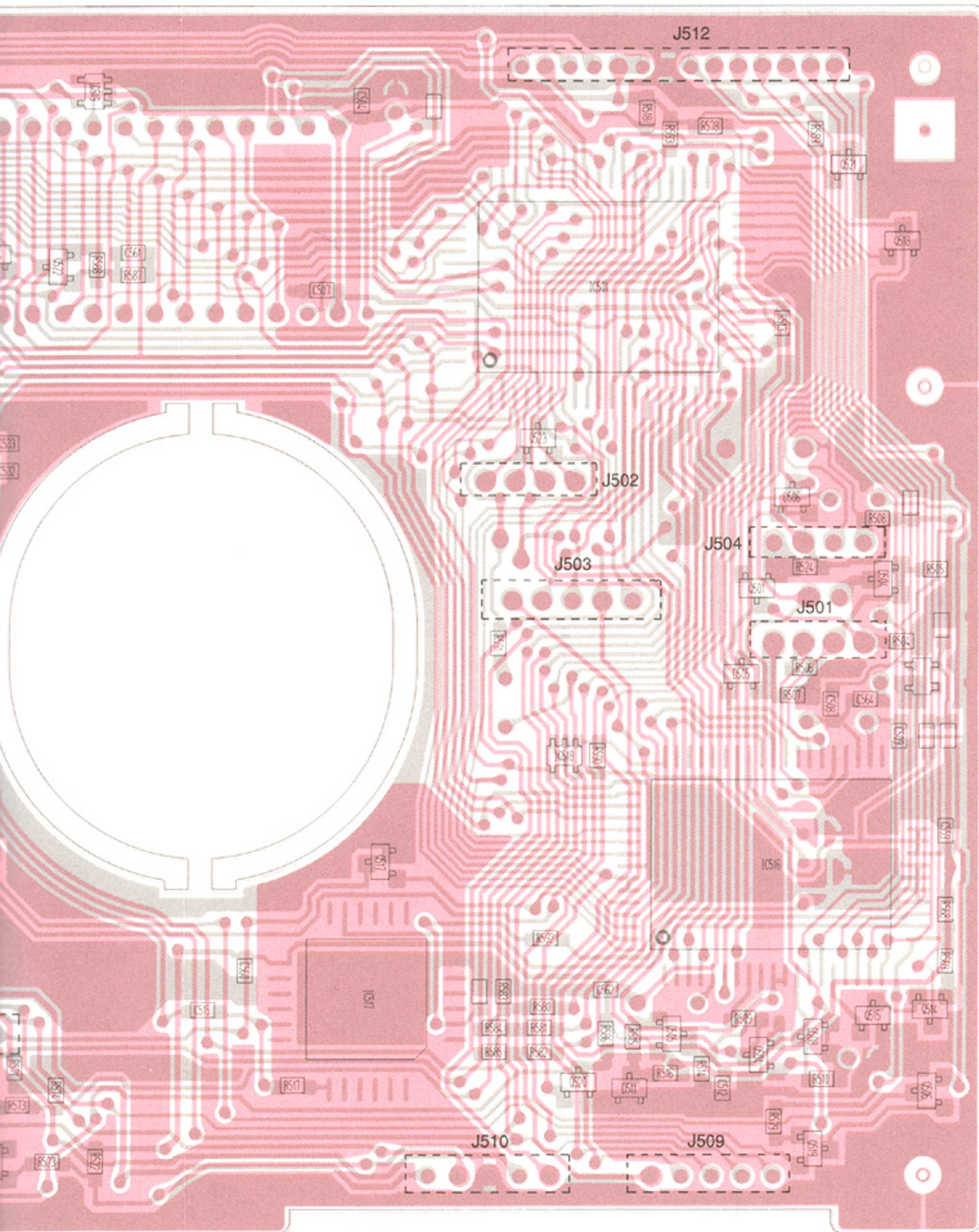
Symbol: SY

**2SJ106**  
Q511, Q512



Symbol: VY



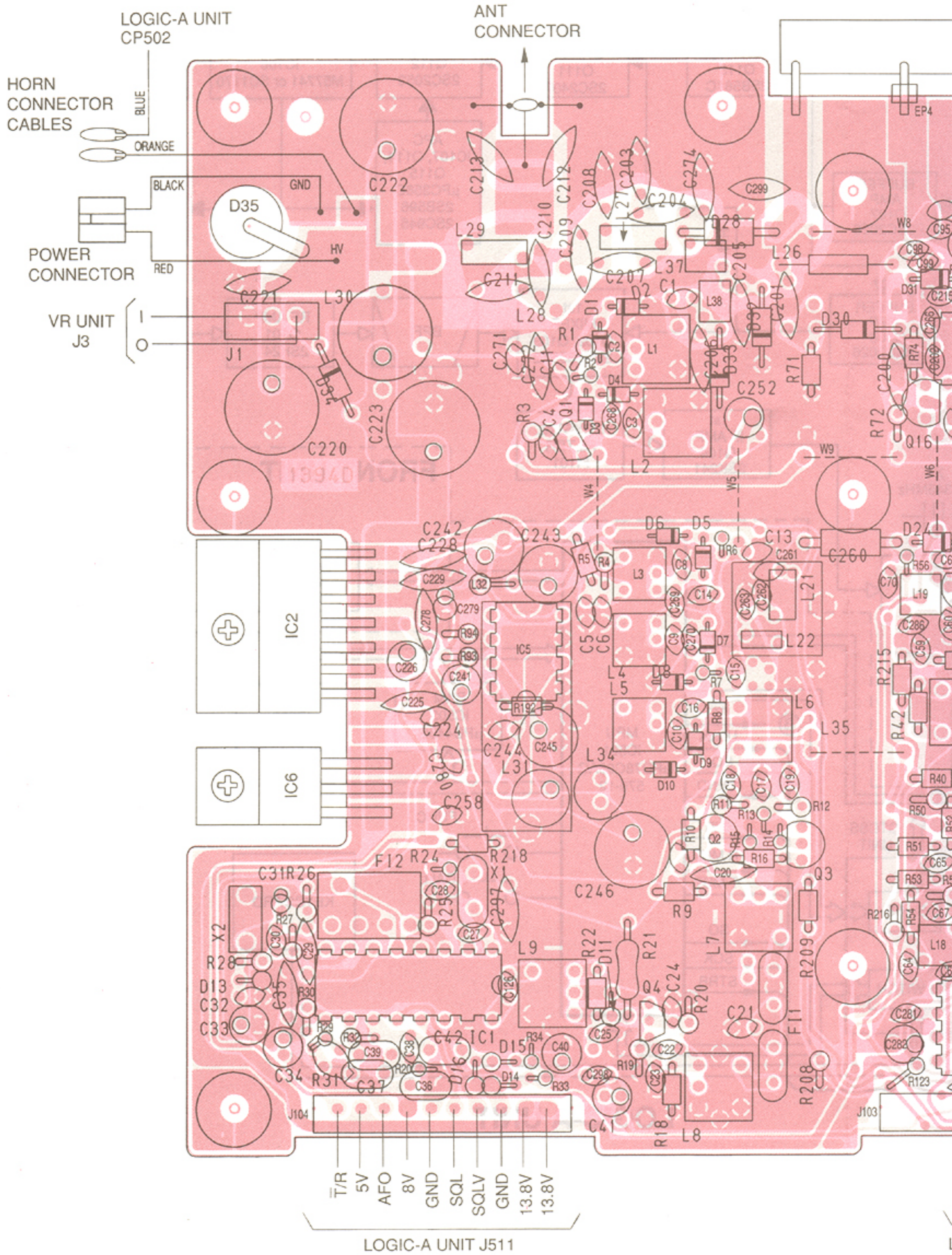


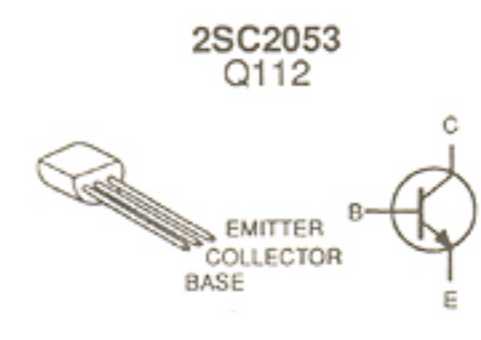
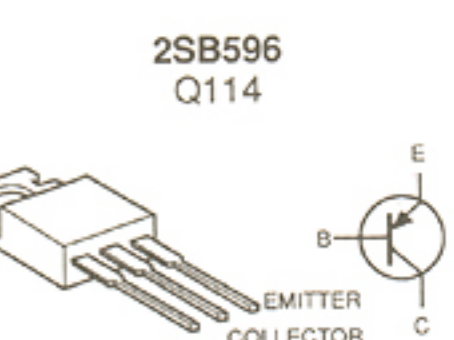
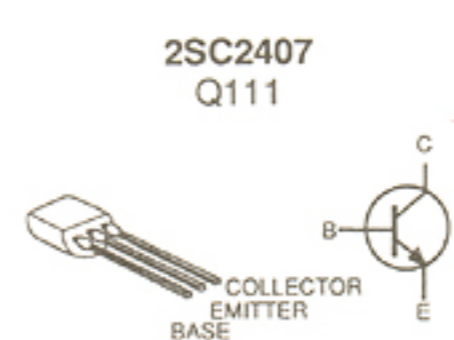
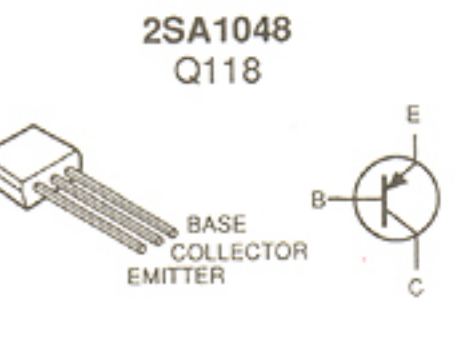
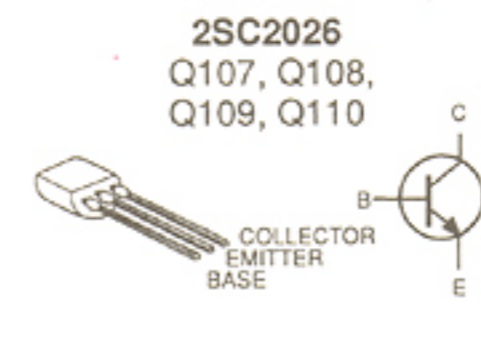
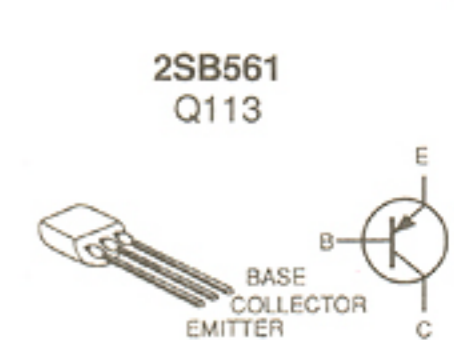
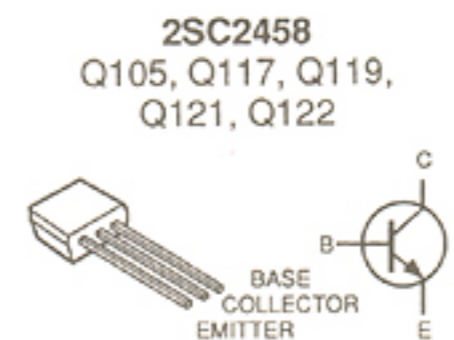
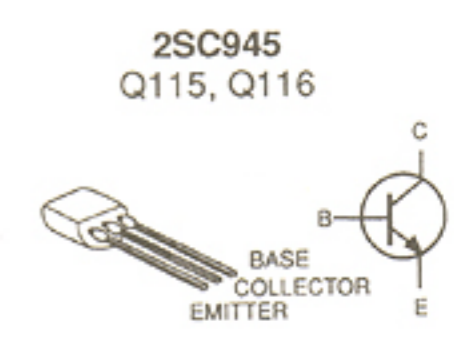
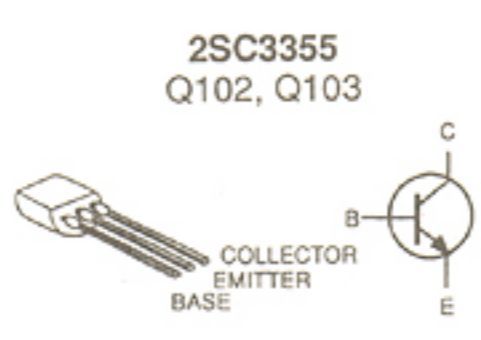
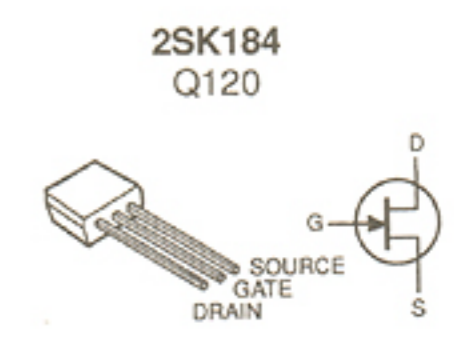
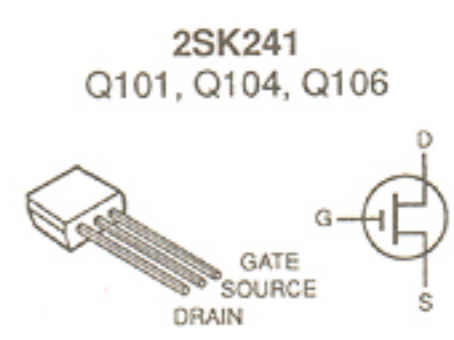
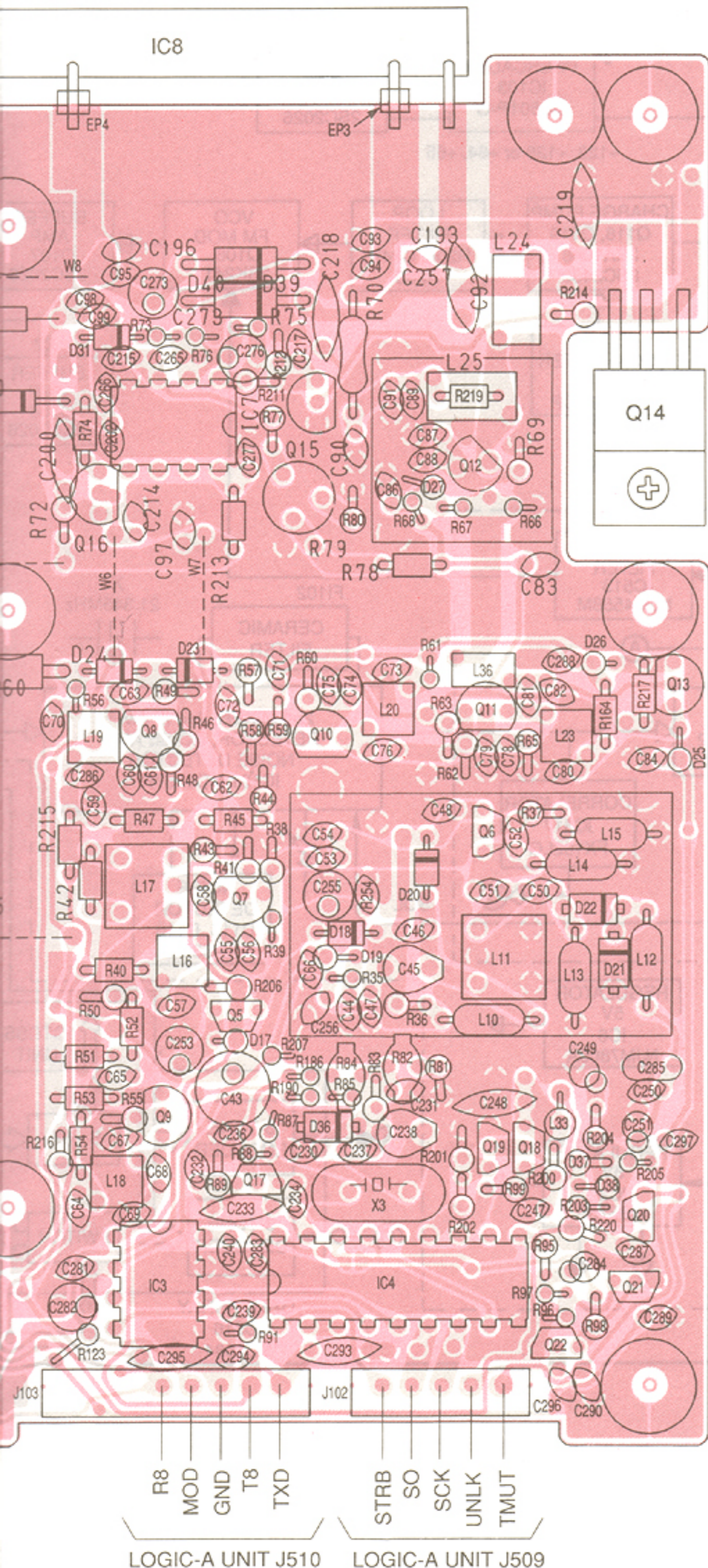
# 7-3 MAIN UNIT

## • MAIN UNIT (TOP VIEW)

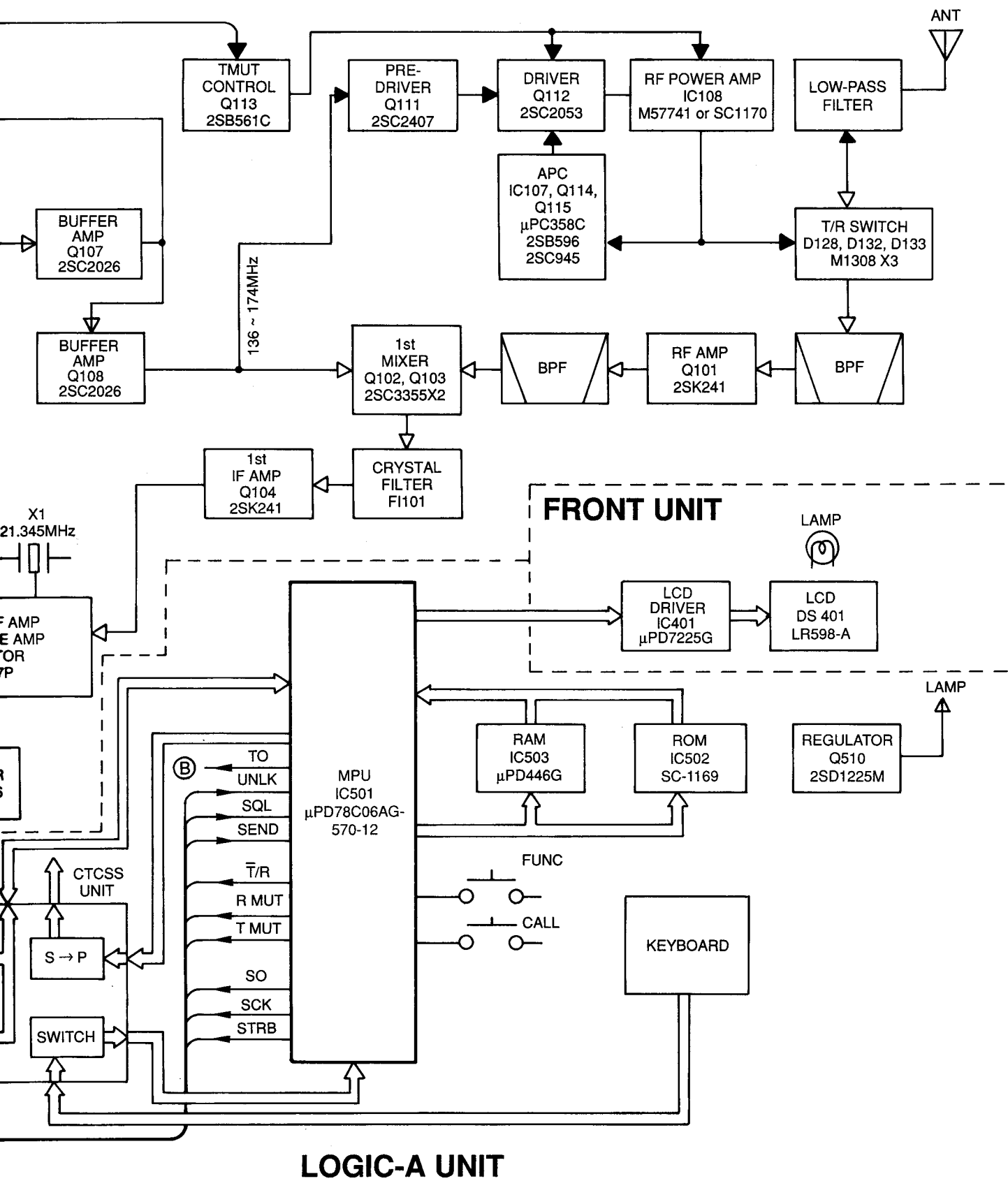
NOTE: Add "100" to indicated numbers with 1 or 2 digits only on the MAIN unit for actual part number.

[e.g.] Q1 → Q101 R21 → R121 J1 → J101



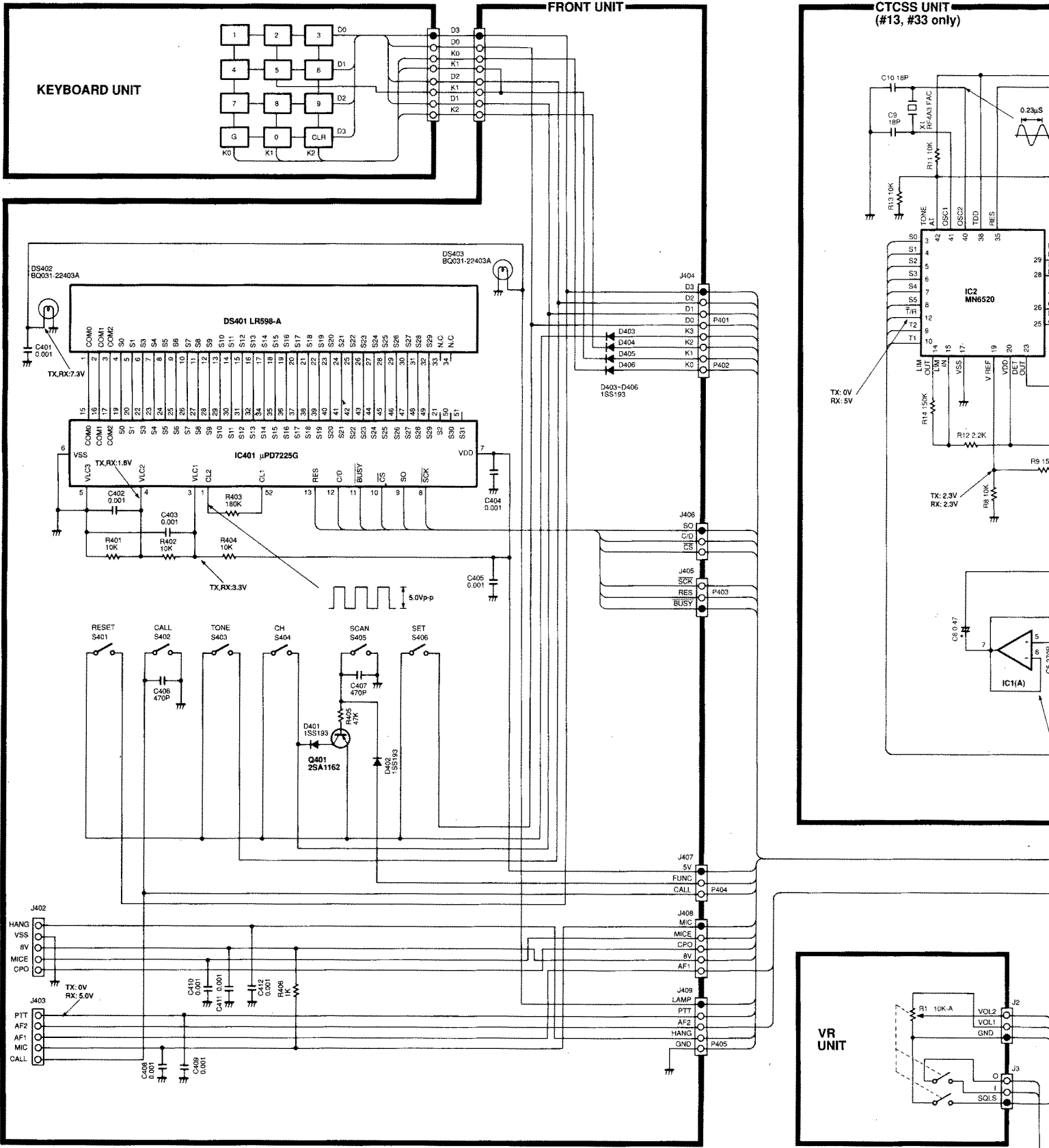






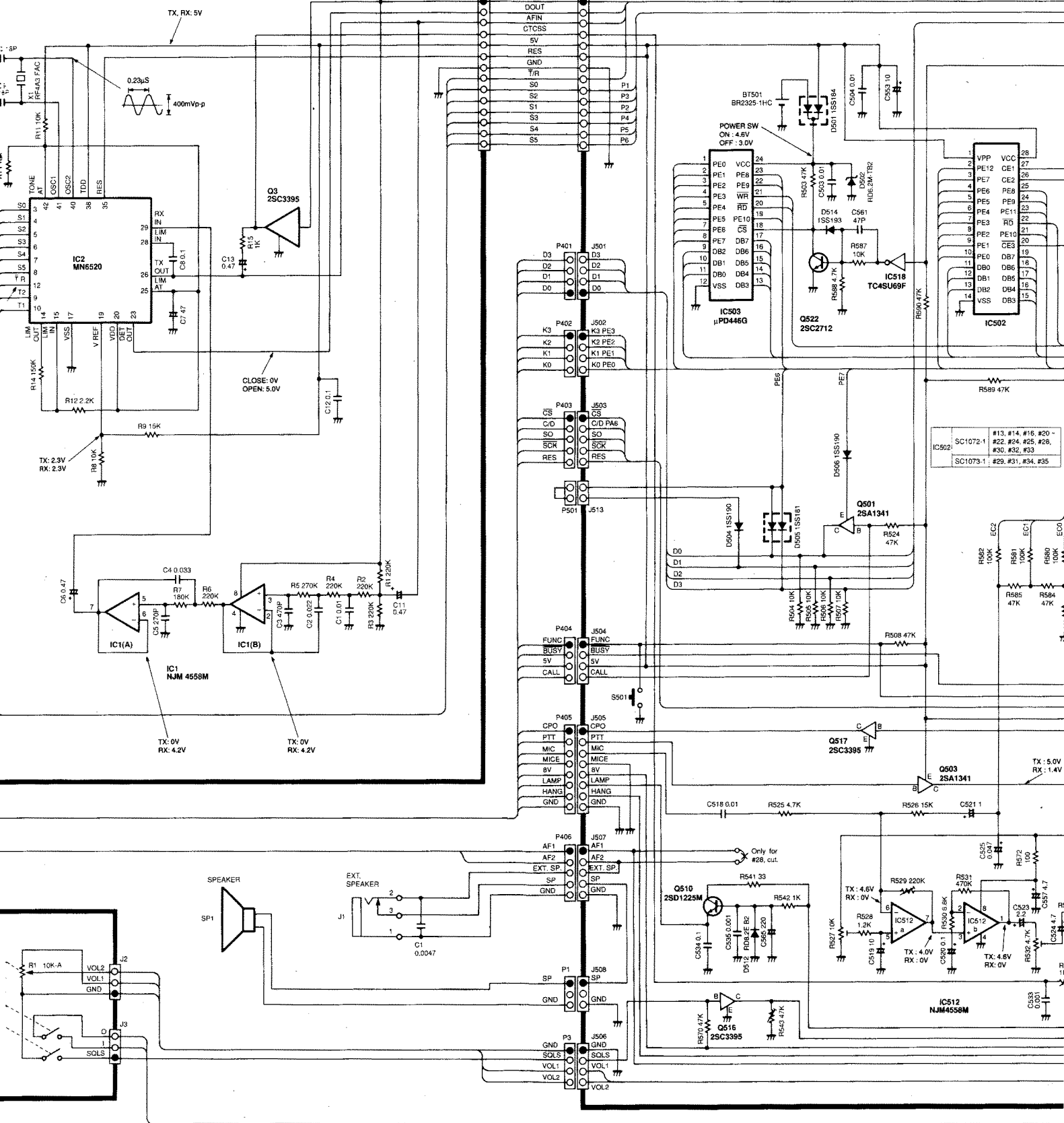


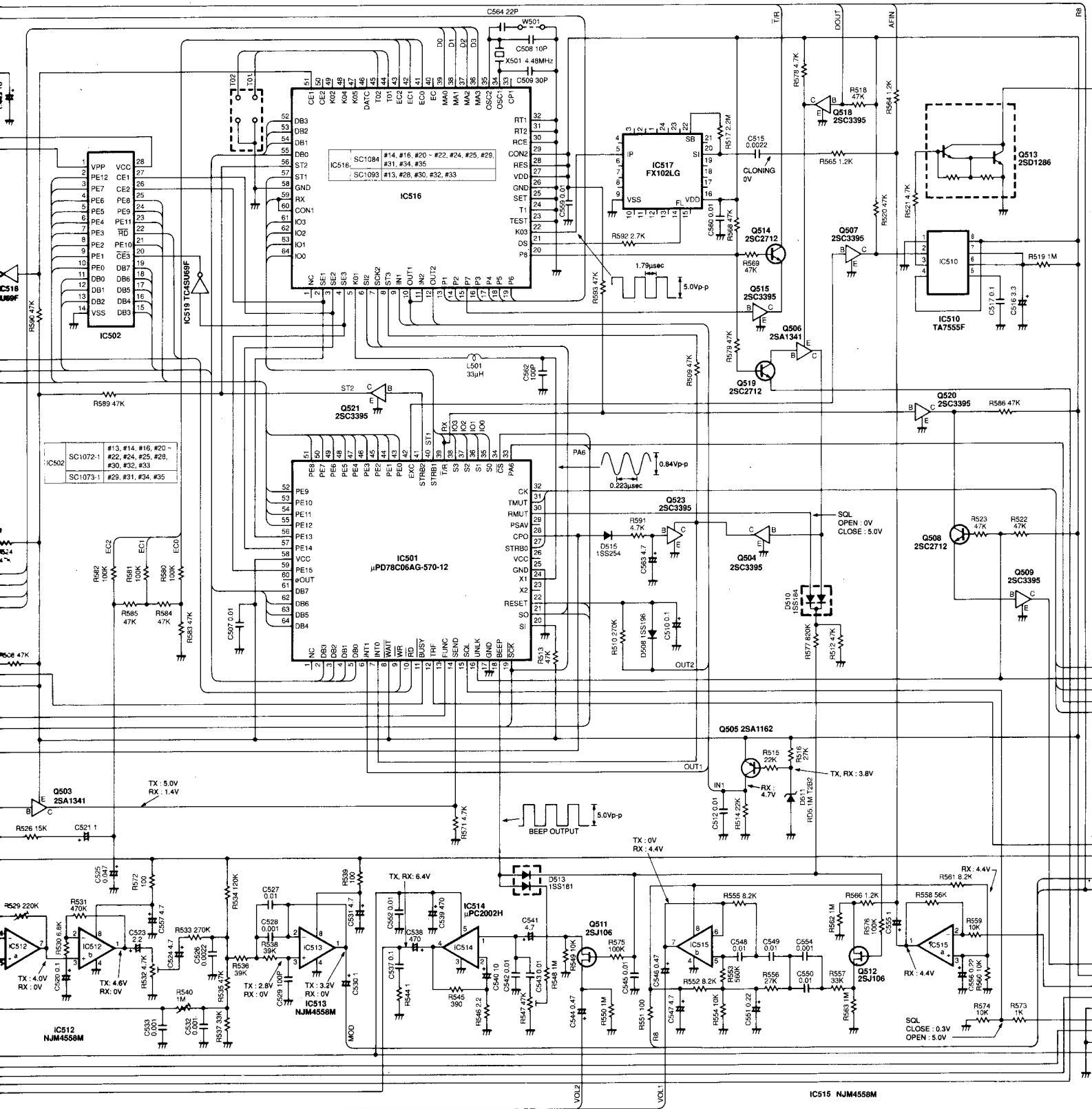
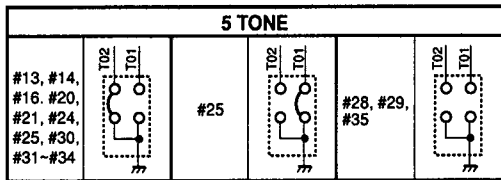
# SECTION 9 VOLTAGE DIAGRAM



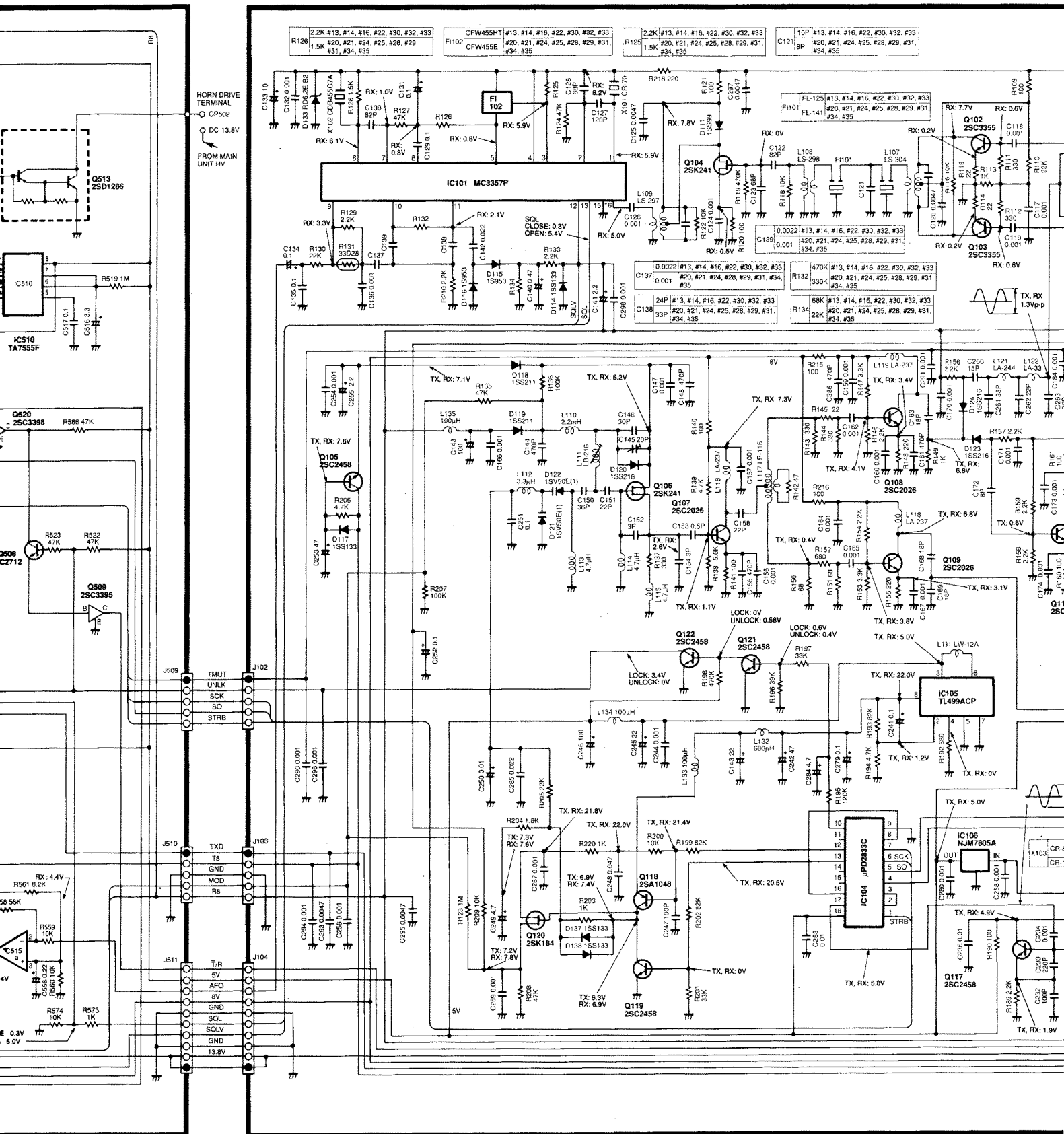
CSS UNIT  
#3, #33 only

LOGIC-A UNIT





IC515 NJM4558M



R126	2.2K	#13, #14, #16, #22, #30, #32, #33
	1.5K	#20, #21, #24, #25, #28, #29, #31, #34, #35

F102	CFW455HT	#13, #14, #16, #22, #30, #32, #33
	CFW455E	#20, #21, #24, #25, #28, #29, #31, #34, #35

R125	2.2K	#13, #14, #16, #22, #30, #32, #33
	1.5K	#20, #21, #24, #25, #28, #29, #31, #34, #35

C121	15P	#13, #14, #16, #22, #30, #32, #33
	BP	#20, #21, #24, #25, #28, #29, #31, #34, #35

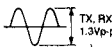
F101	FL-125	#13, #14, #16, #22, #30, #32, #33
	FL-141	#20, #21, #24, #25, #28, #29, #31, #34, #35

C137	0.0022	#13, #14, #16, #22, #30, #32, #33
	0.001	#20, #21, #24, #25, #28, #29, #31, #34, #35

R132	470K	#13, #14, #16, #22, #30, #32, #33
	330K	#20, #21, #24, #25, #28, #29, #31, #34, #35

C138	24P	#13, #14, #16, #22, #30, #32, #33
	33P	#20, #21, #24, #25, #28, #29, #31, #34, #35

R134	58K	#13, #14, #16, #22, #30, #32, #33
	22K	#20, #21, #24, #25, #28, #29, #31, #34, #35





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