



**SERVICE
MANUAL**

COLOR VIDEO SOUNDER

FF-88

DANGER! HIGH VOLTAGE

HIGH VOLTAGE WARNING

High voltages of up to hundreds of thousands of volts are used in this unit. **BEWARE** of high voltage when removing the outer cover of the unit. When working on the interior, avoid direct contact with the high voltage circuitry especially on the CRT unit and the transmit circuit.

Electric shock of 1000 volts or more causes instant electrocution and death; and, even an electric shock of only 100 volts can kill you.

PREVENTING ELECTRIC SHOCK

After removing the outer cover, immediately discharge completely the capacitor with a screwdriver according to the procedure on page 6-1. Failing to discharge the capacitor will result in electric shock.

FIRST AID IN CASE OF ELECTRIC SHOCK

A stable foothold is essential to prevent more extensive or additional injuries. When injured by electric shock, disinfect the burn completely and begin first aid as soon as possible. To avoid electric shock, all adjustments should be made using an insulated turning tool.

ORDERING PARTS

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>

1130002160	IC	μPD4052BC	FF-88	MAIN UNIT	5 pieces
8810006350	Screw	Setscrew M3 x 20 SUS	FF-88	REAR UNIT	10 pieces

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

REPAIR NOTE

1. Make sure a problem is internal before disassembling the unit.
2. **DO NOT** open the unit until the unit is disconnected from the power source.
3. **DO NOT** force any of the variable components. Turn them slowly and smoothly.
4. **DO NOT** short any circuits of electronics parts. An insulated turning tool **MUST** be used for all adjustments.
5. **DO NOT** keep power ON for a long time when the unit is defective.
6. **READ** the instructions of the test equipment thoroughly before connecting equipment to the unit.

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SECTION 1 SPECIFICATIONS

- Basic range

Meters	5	10	20	40	80	160	240	320	640
Feet	15	30	60	120	250	500	750	1000	2000
Fathoms	3	5	10	20	40	80	120	160	320
Hiro	4	8	15	30	60	120	180	250	500

- Bottom-lock range

Meters	2	5	10	20	40	80
Feet	6	15	30	60	120	240
Fathoms	1.5	3	5	10	20	40
Hiro	1.5	3	5	10	20	40

- Phased range

Meter	0 ~ 640
Feet	0 ~ 2000
Fathoms	0 ~ 320
Hiro	0 ~ 500

- Display : 8 in rectangular color CRT
- Picture advance speed : Freeze (0), 1 ~ 4
- Pulse width : Normal, Long
- Transmission frequency : 50 kHz, 200 kHz
- Output power : 200 W (rms)
600 W (rms) (High power type)
- Color presentation : 12 colors
- Power supply requirement : 11 ~ 40 V DC
- Power consumption : 40 W standard
- Dimensions : 250 (H) x 250 (W) x 288 (D) mm; 9.8(H) x 9.8 (W) x 11.3(D) in
(projections not included)
- Weight : 7.5 kg; 16.5 lb
- Usable temperature range : 0 ~ +50°C; +32°F ~ +122°F

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

SECTION 2 CIRCUIT DESCRIPTION

2-1 TRANSMITTER CIRCUITS

2-1-1 CARRIER SIGNAL GENERATOR CIRCUIT

The carrier signal generator circuit consists of X3, IC5, C27, C40 and R34. X3 is a ceramic resonator and oscillates 3.2 MHz for multiplication of the transmit frequency. IC5 (pin 12) outputs the oscillated signal and the signal enters a frequency divider circuit (IC6). IC6 divides the signal and pins 4 and 6 output 200 kHz and 50 kHz respectively as carrier signals.

2-1-2 TRANSMIT FREQUENCY SWITCHING CIRCUIT

The 200 kHz and 50 kHz signals are applied to the switching circuit (IC8). Frequency selection for 200 kHz or 50 kHz is controlled by signal lines, TX-TRIG and 50/200 on IC26.

When TX-TRIG line is "HIGH," Y1 and Y2 (IC8) are "LOW." When the TX-TRIG and 50/200 lines are "LOW," Y1 (IC8) is connected to D01 and Y2 is connected to D02. Thus, the 50 kHz signal is selected. When the 50/200 line is "HIGH," Y1 is connected to D11 and Y2 is connected to D12. Thus, 200 kHz is selected.

2-1-3 TRANSMIT OUTPUT CIRCUIT

The transmit output circuit consists of two circuits; the driver and output circuits. The driver circuit consists of IC11, Q16, Q17, Q9 and Q10. The output circuit consists of Q5, Q7 and T1.

The Darlington connection, used for switching circuits, consists of a pair of transistors for Q16 and Q17, and for Q9 and Q10. This is because the next circuit which consists of FETs requires quick switching time for leading and trailing characteristics.

IC11 and related components adjust switching time for preventing overlap of output pulses. C31 and R1 form a charging/discharging circuit. When no transmission is occurring, transmit power is charged into the circuit and energy outputs at the next moment.

2-1-4 OUTPUT POWER CONTROL CIRCUIT

This circuit consists of IC10, Q11, Q12 and Q13. A signal from the LOGIC UNIT controls voltage to be applied to the primary winding of T1 through these components.

2-1-5 DIODE ISOLATION CIRCUIT

D11, D12, D14 and D24 are symmetry-type silicon-varister diodes. Interior connection is simulated as shown in the diagram (Fig. 1).

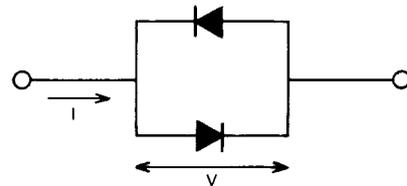


Fig. 1

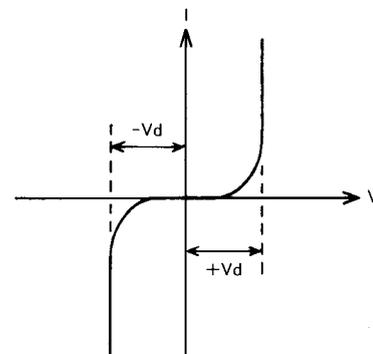


Fig. 2

Fig. 2 shows the diode's electronic characteristics. When the voltage is $+V_d$ or less, internal resistance is infinite. This condition is the same as when a diode is off. When the voltage exceeds $+V_d$, internal resistance for each diode is at its minimum level. This condition is the same as when a diode is turned ON.

When transmitting, high voltage is applied to the circuit and when receiving, no voltage is applied. Therefore, the receiver circuit is protected from high power transmit signals when transmitting; and, the receiver circuit is isolated from the transmitter circuit when receiving.

2-2 RECEIVER CIRCUITS

2-2-1 50 kHz BUFFER AMPLIFIER CIRCUIT

The buffer amplifier circuit consists of L4, IC2, L2 and D1 ~ D4. L4 is a matching coil for the next stage. When transmitting, D1 ~ D4 protect the buffer amplifier circuit from high voltage transmit pulses. IC2 is an amplifier and the gain is controlled by voltage which is applied to IC2 (pin 5).

2-2-2 200 kHz BUFFER AMPLIFIER CIRCUIT

The buffer amplifier circuit consists of L5, IC3, L3, D5 ~ 8. The circuit operation is the same as the circuit of a 50 kHz buffer amplifier.

2-2-3 STC CIRCUIT

The STC circuit consists of the STC generator circuit and STC control circuit. The STC generator circuit consists of Q3, Q4, Q15 and C17. The STC control circuit consists of IC10 and D19.

When the STC-OFF line on J9 is "LOW," C17 is charged as Q4 is turned ON through Q23 and Q15. When the STC-OFF line is "HIGH," C17 is gradually discharged and saw-tooth wave signals are generated.

2-2-4 LOCAL OSCILLATOR CIRCUIT

X1 and X2 are crystal units for the local oscillator circuit.

The local oscillator circuit oscillates a local frequency according to the receive frequency. The oscillator frequency is 507 kHz when the receive frequency is 50 kHz since the equipment IF frequency is 457 kHz. In the same way, when the receive frequency is 200 kHz, the oscillator frequency is 655 kHz.

When the 50/200 line is "LOW," IC9 (pin 11) outputs 505 kHz signals. When the line is "HIGH," IC9 (pin 11) outputs 655 kHz signals.

2-2-5 MIXER CIRCUIT

IC1 is an IC chip for a double multiplexer and acts as a mixer circuit.

When IC1 (pin 9) is "LOW," an input signal of 50 kHz is mixed with a local oscillator frequency of 507 kHz and pins 3 and 13 output a 457 kHz IF signal. When pin 9 is "HIGH," a 200 kHz signal is mixed with a 655 kHz oscillator signal.

2-2-6 BAND FILTER CIRCUIT

The circuit is designed to be used at 455 kHz. FI1 is a 455 kHz band filter that eliminates other band signals (± 3 KHz). Q26 acts as an amplifier.

2-2-7 SENSITIVITY CONTROL CIRCUIT

Receiver sensitivity is controlled by a signal to be applied to IC4 (pin 5). The signal is generated at the VR UNIT and is applied to IC4 through IC7.

2-2-8 IF AMPLIFIER CIRCUIT

IC4 is the IF amplifier. A parallel oscillator circuit with the primary winding of L7 and C14 resonates at 455 kHz. R48 is a thermistor and keeps receive sensitivity constant throughout different environmental temperatures.

2-2-9 DETECTOR CIRCUIT

The circuit consists of D15, D16, C11, C12, R14 and R15. IC7 acts as a buffer amplifier.

2-2-10 A/D CONVERTER CIRCUIT

Zener diode (D23) produces a reference voltage of 7.5 V DC. The voltage is divided by R58 ~ R73. IC20, IC21 and IC22 are comparators and compare receive signal strength with the reference voltage. The output signal is applied to encoder IC chips (IC23 and 24).

Each encoder IC chip converts the input analog signal to a 4-bit digital signal. The converted signal is applied to the bus interface circuit in the LOGIC UNIT.

2-2-11 TRANSCEIVER CONTROL CIRCUIT

IC26 and Q23 on MAIN UNIT control the STC, the transmit/receive control, and the frequency selection circuits with signals from the LOGIC UNIT.

2-2-12 ALARM OUTPUT CIRCUIT

IC4 (pin 25) on the LOGIC UNIT drives the relay, RL3. When pin 25 is "HIGH," the relay is ON and the pin is "LOW," thus, relay is OFF. When the relay is ON, pin 1 and 3 on J3 are made short.

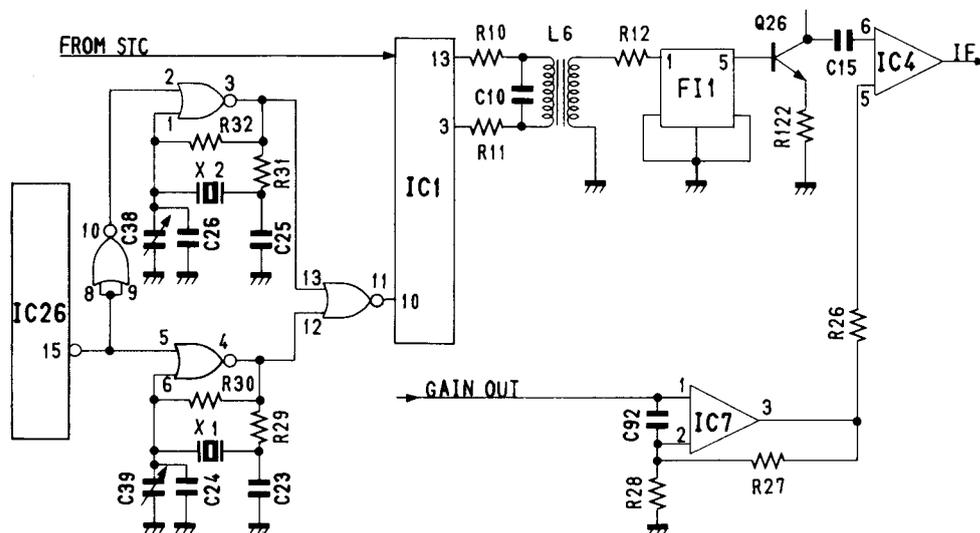


Fig. 3

2-2-13 D/A BUFFER CIRCUIT

Signals converted from digital to analog on the LOGIC UNIT are applied to IC17 (pin 3) through the A/D line. The IC chip acts as a buffer amplifier.

IC19 saves signals from IC18 and the signals are used as a transmit output power control signal.

Output signals from IC17 (pin 7) are used for controlling the display intensity.

2-2-14 CRT CONTROL CIRCUIT

IC16 generates an address signal and an RGB signal corresponding to display coordinates and the address of DRAM. This IC chip also generates vertical signals and synchronicity signals for the CRT display.

IC12 ~ 15 are DRAMs and are used for video RAMs. Each chip has a capacity of 64 k bytes.

Q18 ~ 22 form an emitter-follower connection and control the gain of RGB signals.

PIN NUMBER	PORT NUMBER	DESCRIPTION
33 ~ 40	VA0 ~ VA7	Connect the video memory address to DRAM.
41 ~ 56	VD0 ~ VD1	Output the video data. These ports are connected as a 4 bit data of each DRAM.
10 ~ 12	R.G.B	Outputs R.G.B. color signal. This port is connected to the R.G.B. drive circuit.
6	H-SYNC	Outputs horizontal synchronizing signal. 63.5 μ sec.
7	SYNC	Outputs vertical synchronizing signal.
57	WEL	Outputs 8 bit LSB writing signal.
58	WEM	Outputs 8 bit MSB writing signal.
59	1/4CLK	Outputs 1/4 dividing signal. This signal is used as system clock.
62	CAS	Outputs strove signal for file address.
63	RAS	Outputs strove signal for line address.

2-2-15 9 V REGULATOR

A 12 V DC signal is applied to IC27 through the 12V line on J2 and the IC outputs a 9 V regulated DC signal.

2-3 REGULATOR CIRCUITS

2-3-1 INPUT CIRCUIT

11 ~ 40 V DC power is applied to the REGULATOR UNIT through J1. L1 is a line filter and filters radio frequency signals to prevent their application to the switching circuit.

2-3-2 SWITCH CIRCUIT

SW1 and SW2 (P1) from the REGULATOR UNIT are connected to the power switch on the front panel. IC3 is an IC chip for controlling the switching regulator.

At first, when DC power is applied to J1, a pulse is applied to IC1 (pin 10) through C3 and IC1 is reset.

When the power switch is pushed once, IC2 (pin 6) and IC1 (pin 3) are "HIGH," then Q4 is turned ON and DC power is applied to IC3 (pin 12). When the power switch is held again for more than 1 second, DC power is charged into C5 through R3. IC2 (pin 8) becomes "HIGH" 1 second after the power switch is pushed. Therefore, IC2 (pin 13) becomes "LOW." Then, Q4 is turned OFF.

Q2, Q3, and Q5 constantly prevent DC power voltage of 13 V DC or less from being applied to IC3 (pin 12).

2-3-3 SWITCHING CONTROL CIRCUIT

IC3 includes oscillator circuits and a switching control. The oscillator frequency is 160 kHz and oscillates sawtooth waves. R30 adjusts the oscillation frequency.

2-3-4 SWITCHING CIRCUIT

Pin 9 and pin 10 of IC3 control to switch Q8 and Q9. By switching Q8 and Q9, the primary winding of T1 is alternately connected to and disconnected from the DC power.

2-3-5 RECTIFIER CIRCUIT

Output power from the secondary winding of T1 is rectified by D6 ~ D8, D10, and D11. Output that is rectified by D5 is applied to a 3-terminal regulator chip, IC4. 5 V is applied to this rectified output at IC4.

2-3-6 OUTPUT VOLTAGE CONTROL CIRCUIT

100 V output is divided by R22, R31 and R32. The divided voltage is applied to a terminal of IC6 as reference voltage. When the output voltage increases above 100 V, a current of IC6 increases and the voltage of IC3 (pin 2) decreases. The voltage controls the switching time and controls the output voltage of 100 V.

2-3-7 EXCESS VOLTAGE PROTECTION CIRCUIT

Input voltage is divided between R9 and R10. The divided voltage is applied to IC3 (pin 15). When the voltage is higher than +44 V DC, IC3 is turned OFF.

2-4 LOGIC CIRCUITS

2-4-1 CPU AND THE PERIPHERAL CIRCUIT

The LOGIC UNIT consists of CPU, ROM, RAM and an address decoder. CPU and a control circuit control all functions. The interrupt signal functions in the following way:

① CPU [IC1]

The CPU acts as a computer circuit to control all functions and to respond to all kinds of interruptions. The CPU uses a 3.58 MHz clock signal from IC16 on the MAIN UNIT.

• SAMPLING TIME INTERRUPTION

This interruption is required according to each processing timing pulse.

• UART INTERRUPTION

This interruption is required when IC5 receives the LORAN-C serial data through the LORAN-C interface.

• TIME INSTRUMENTATION INTERRUPTION

IC7 requires an interruption when IC16 on the MAIN UNIT counts the vertical synchronizing signal 2 times. This interruption checks the switch condition on the SWITCH BOARD and reads the counting value of speed and temperature.

② ROM [IC2]

ROM has 32 k byte capacity. ROM contains a system operating program.

③ RAM [IC3]

RAM has 8 k byte capacity. RAM memorizes all kinds of data while the system is working. A back up battery preserves the data already memorized at the time the power is turned OFF.

④ ADDRESS DECODER [IC8, IC9, IC13]

The address decoder outputs all chip selector and I/O peripheral signals.

• MEMORY DECODER [IC8]

The memory map is as follows:

0000H	8000H	A000H
ROM	RAM	No use

• I/O DECODER [IC8, IC9, IC13]

Each I/O map is as follows:

I/O ADDRESS	I/O PERIPHERAL	
80H	PPI	[IC4]
90H	CRTC (MAIN)	[IC16]
A0H	CTC	[IC7]
B0H	PIT	[IC6]
C0H	UART	[IC5]
D0H	A/D CONVERTER	[IC10]

⑤ CTC [IC7]

IC7 consists of 4 independent channels and uses an interruption controller on all except channel 3. Channel operation is as follows:

• Channel 0

This channel is driven from IC6 and uses sampling interruption.

• Channel 1

This channel uses interruption from IC5.

• Channel 2

This channel requires interruption which counts IC16's vertical synchronizing signal (33.3788 ms) 2 times on the MAIN UNIT.

• Channel 3

This channel counts the pulse from the impeller.

2-4-2 TIMER CIRCUIT

The timer circuit consists of a sampling interruption control, a CRTC interruption control, an interface interruption control for the navigation receiver, a counter and sampling period for the impeller, a clock for LORAN-C interface baud, and a counter for temperature interface.

① PIT [IC6]

• Channel 0

This channel divides the system clock (3.58 MHz) into necessity times and outputs the pulse to IC7.

• Channel 1

This channel divides the system clock into 47 equal time periods and outputs the baud rate pulse (76.17 kHz). This output uses a baud rate clock.

• Channel 2

This channel counts the frequency for the temperature condition.

2-4-3 A/D CONVERTER CIRCUIT

The receive data which converts an analog signal to a 4 bit digital signal on the MAIN unit is applied to IC3.

① BUS INTERFACE [IC10]

The data which is converted to 4 bit digital reads low-ranking 4 bit data and outputs the interface data to IC3. High-ranking 4 bit data uses an input port on the SWITCH UNIT.

2-4-4 LORAN-C INTERFACE CIRCUIT

This circuit receives the data which concerns your own ship's position from LORAN C navigation equipment.

① **UART [IC5]**

IC5 receives serial data from the navigation receiver. The receiving clock is supplied from PIT (channel 1). When this signal is not received correctly, the compass screen does not appear.

② **OPTO ISOLATOR [IC15]**

IC15 isolates the main power supply line from the LORAN-C navigation system and sends the LORAN-C data to UART.

2-4-5 IMPELLER CIRCUIT

This circuit receives a pulse from the impeller and shapes the pulse.

① **WAVEFORM SHAPING [IC13]**

IC13 receives the impeller waveform shapes the waveform, and sends the waveform to CTC (channel 3).

2-4-6 WATER TEMPERATURE INTERFACE CIRCUIT

This circuit converts the voltage to a frequency and measures the water temperature.

① **V/F CONVERTER [IC11]**

Thermistor resistance changes according to the temperature and according to the control voltage of IC11 (pin 7). Thus, the water temperature can be measured.

2-4-7 D/A CONVERTER CIRCUIT

This circuit converts 8 bit data to an analog signal from a PA port on the PPI unit and applies it to a D/A converter on the MAIN unit.

① **COMMON D/A CONVERTER [R12]**

R12 converts 8 bit data from a PA port (PPI) to an analog signal.

② **NEGATIVE VOLTAGE CONVERTER [IC13]**

IC13 produces negative voltage for a D/A converter. A square wave from channel 1 (PIT) is buffered at IC13 and is rectified at D22 and D23.

2-4-8 PPI PERIPHERAL CIRCUIT

This circuit reads the jumper setting data and applies it to each control signal on the MAIN UNIT.

① **BUZZER CONTROL**

The output signal from IC4 (pin 15) controls the oscillating circuit for the buzzer (IC12). When "HIGH" is selected, the buzzer is turned ON. When "LOW" is selected, the buzzer is turned OFF.

The output signal from IC4 (pin 14) controls the buzzer tone. When "HIGH" is selected, the tone is low. When "LOW" is selected, the tone is normal.

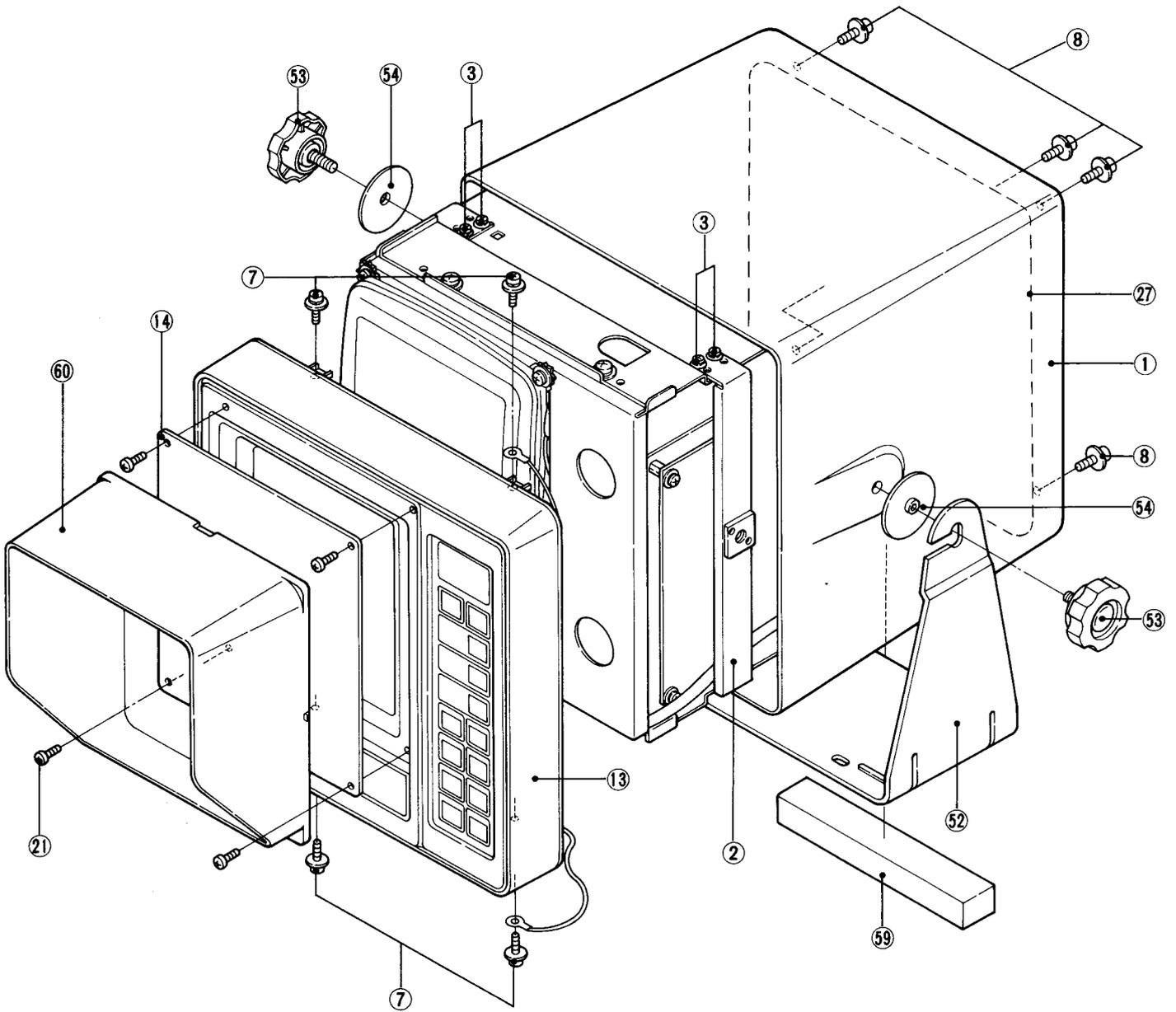
② **PPI [IC4]**

IC4 consists of 3 ports. Each port functions as follows.

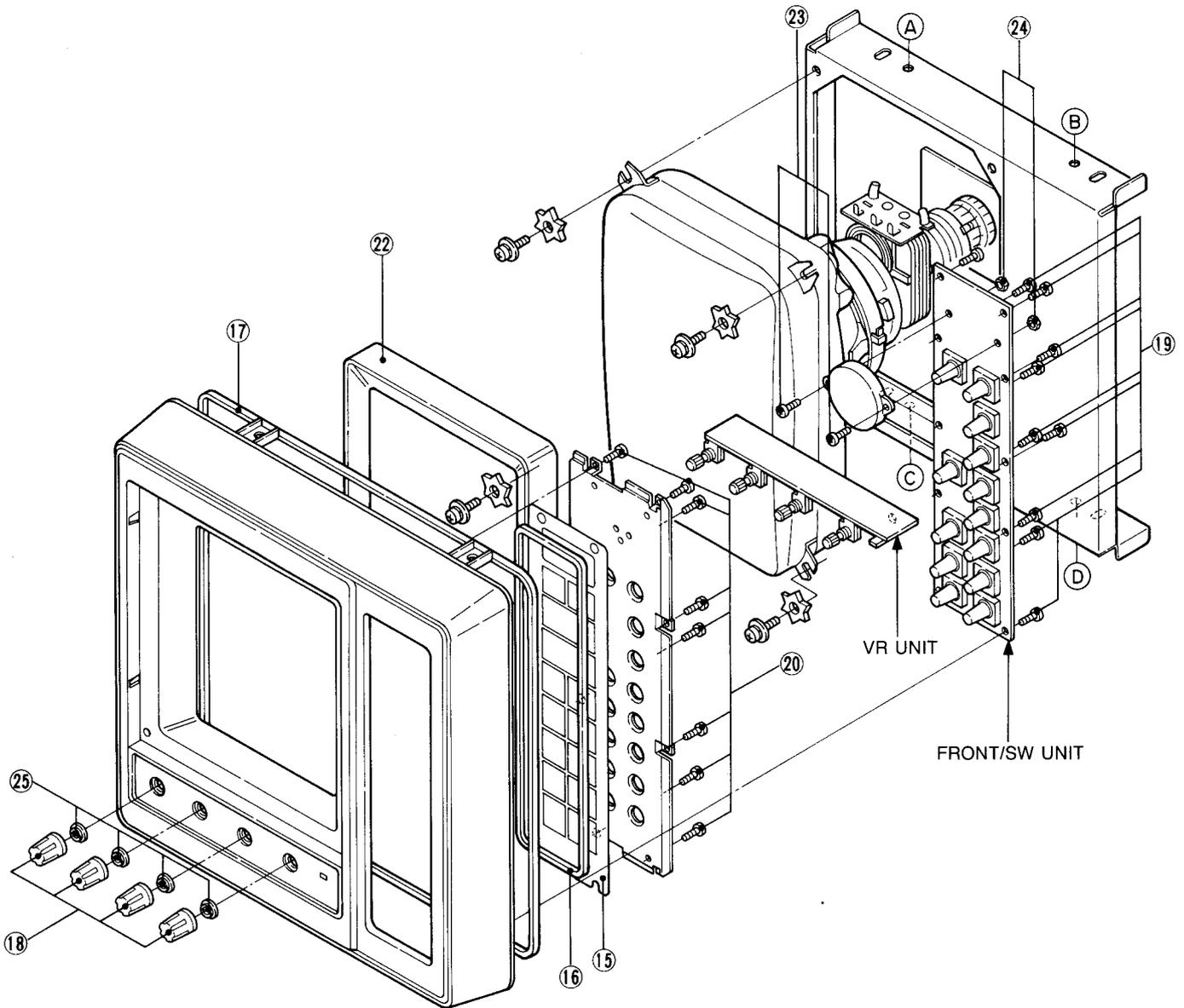
PORT NUMBER	PORT NAME	PIN NUMBER	DESCRIPTION
PORT A	PA0	4	Output low-ranking 4-bit data for the D/A converter, SW BOARD MATRIX, and jumper matrix.
	PA1	3	
	PA2	2	
	PA3	1	
	PA4	40	Output high-ranking 4-bit data for the D/A converter. The D/A converter's resolution is 8-bit (256 steps).
	PA5	39	
	PA6	38	
PORT B	PA7	37	
	PB0	18	Output selected channel of D/A converter. D/A converter has 5 channels.
	PB1	19	
	PB2	20	
	PB3	21	Outputs selected strove signal of D/A converter. H: Not selected L: selected
	PB4	22	Not used
	PB5	23	Outputs frequency of the signal in use. H: 50 kHz L: 200 kHz
PORT C	PB6	24	Outputs illumination ON/OFF selecting signal. H: ON L: OFF
	PB7	25	Outputs alarm ON/OFF selecting signal. H: ON L: OFF
	PC0	14	Outputs buzzer sound frequency. H: High sound L: Low sound
	PC1	15	Outputs buzzer ON/OFF selecting signal. H: ON L: OFF
	PC2	16	Outputs STC control signal. H: OFF L: ON
	PC3	17	Outputs transmit control signal. H: ON L: OFF
	PC4	13	Inputs jumper matrix data.
PC5	12		
PC6	11		
PC7	10		

SECTION 3 MECHANICAL PARTS AND DISASSEMBLY

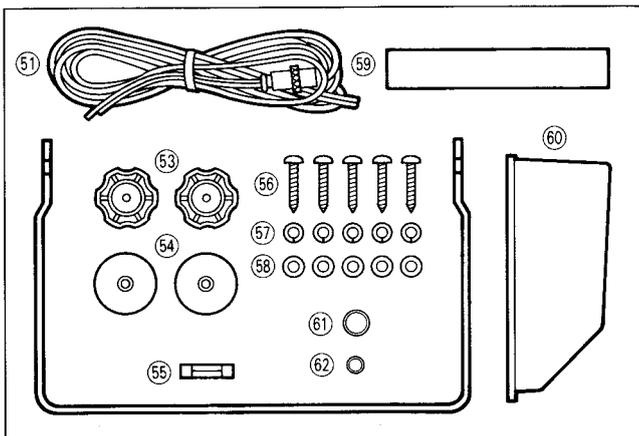
3-1 DISASSEMBLY FOR COVER AND CASE



3-2 DISASSEMBLY FOR SWITCH AND VOLUME

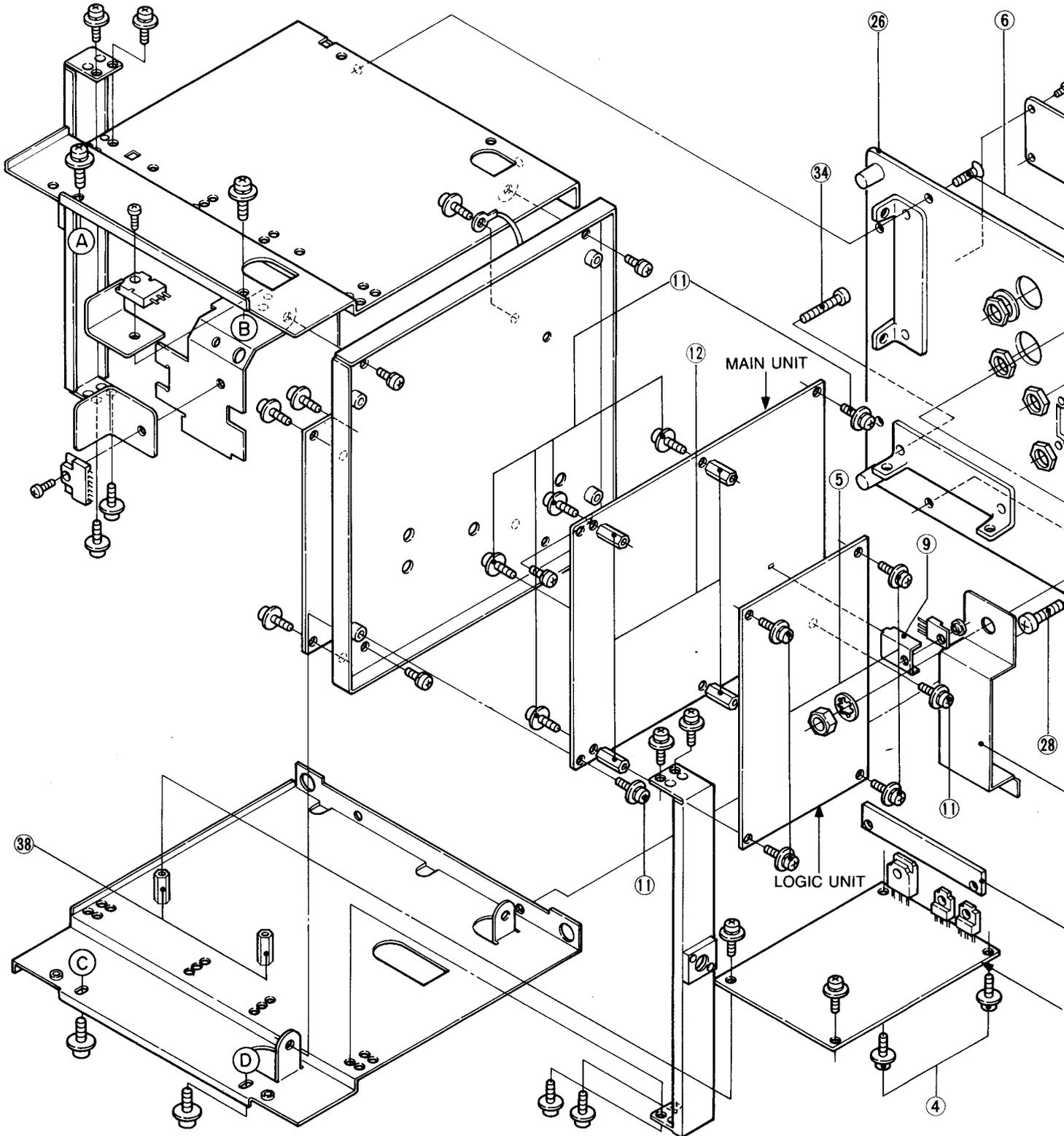


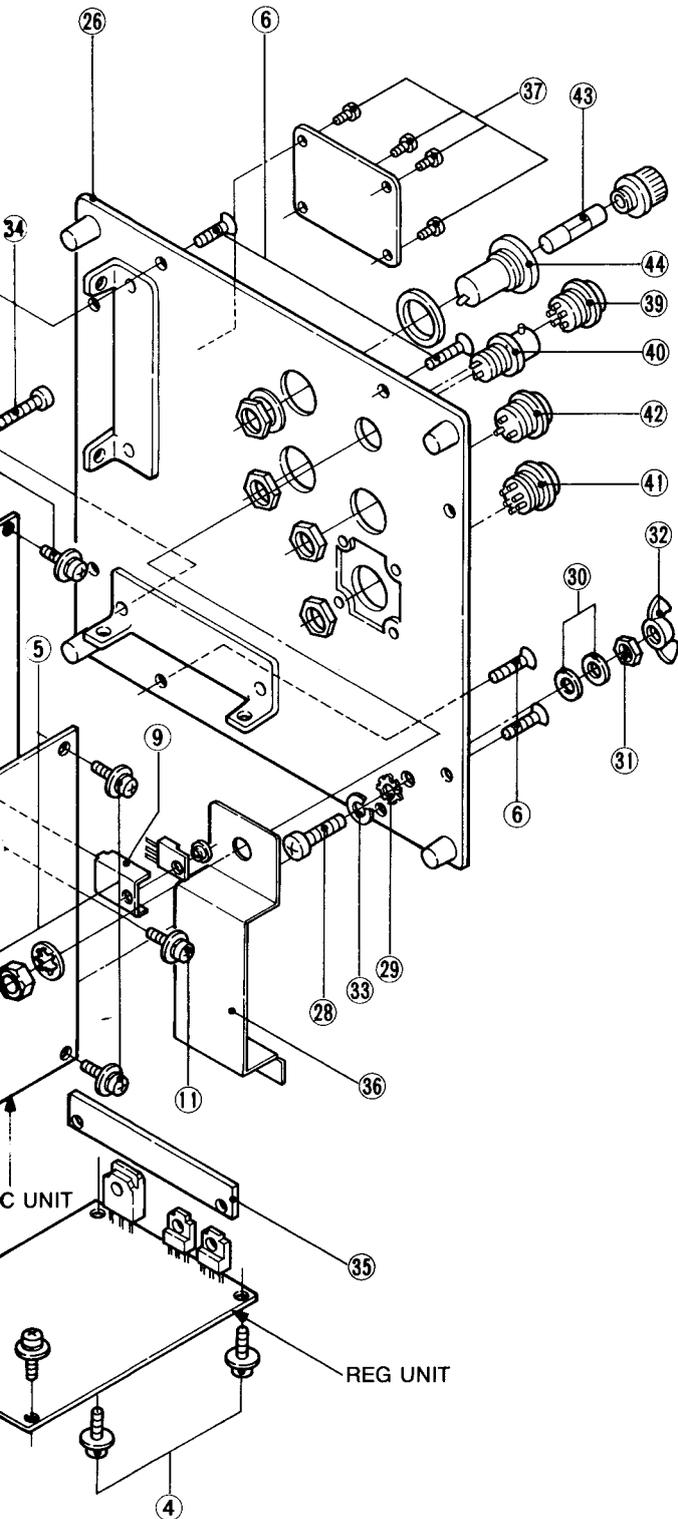
•SUPPLIED ACCESORIES



LABEL NUMBER	ORDER NUMBER	DESCRIPTION	Qty.
51	optional	OPC-275	1
52	8010010390	Mounting bracket	1
53	8820000610	Mounting bracket knob G2-6-20	2
54	8930015280	Mounting bracket rubber	2
55	5210000060	Fuse FGB 5A	2
56	8810001500	Screw A0 M6 x 30 SUS	5
57	8850000510	Spring washer M6 SUS	5
58	8850000190	Flat washer M6 (6x13x1.0) SUS	5
59	8930019690	Sponge (CK)	1
60	8010010590	827 Hood	1
61	8930010000	Connector cover	1
62	8930019500	BNC-R Connector cover	1

3-3 DISASSEMBLY FOR INSIDE PARTS



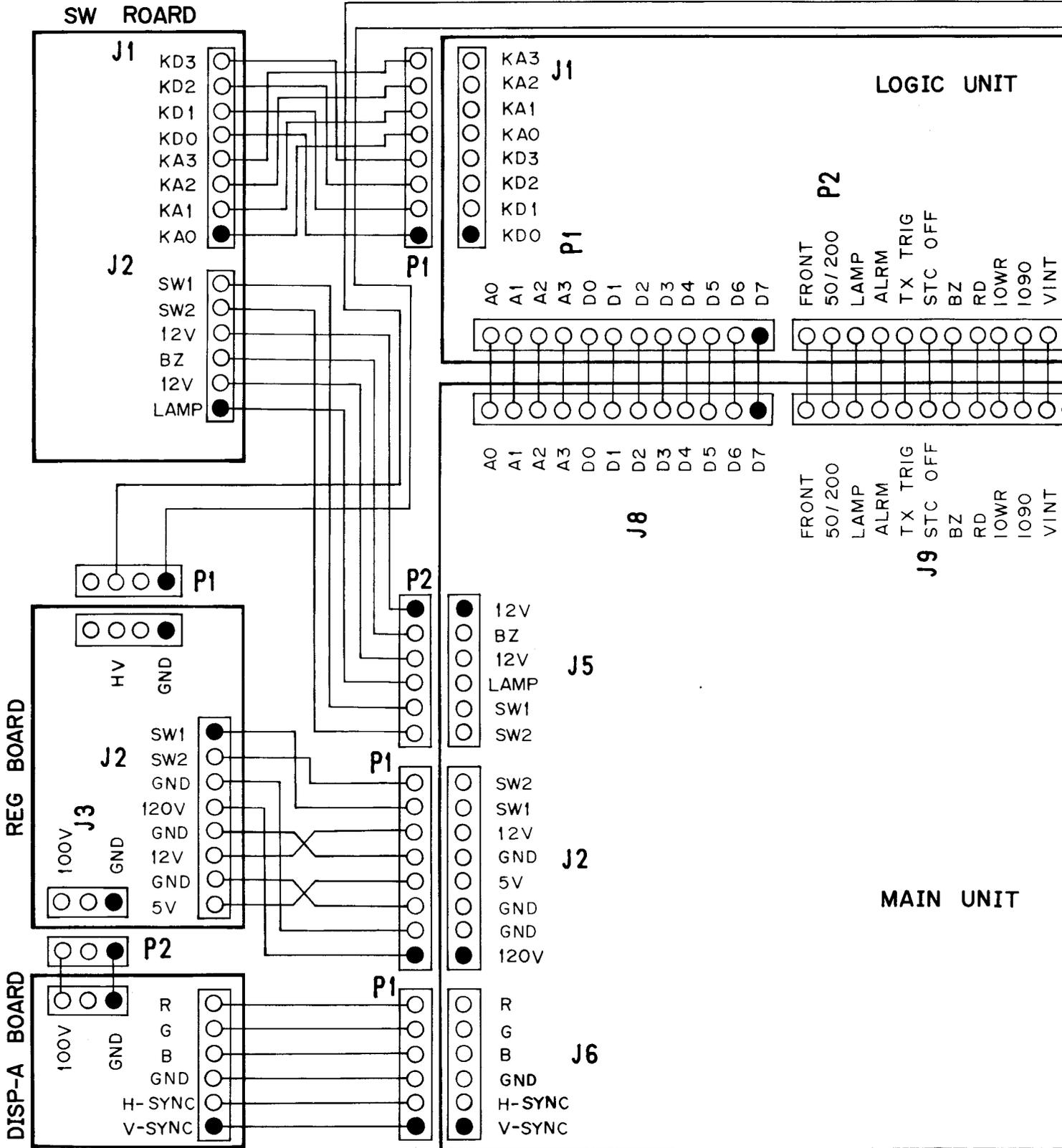


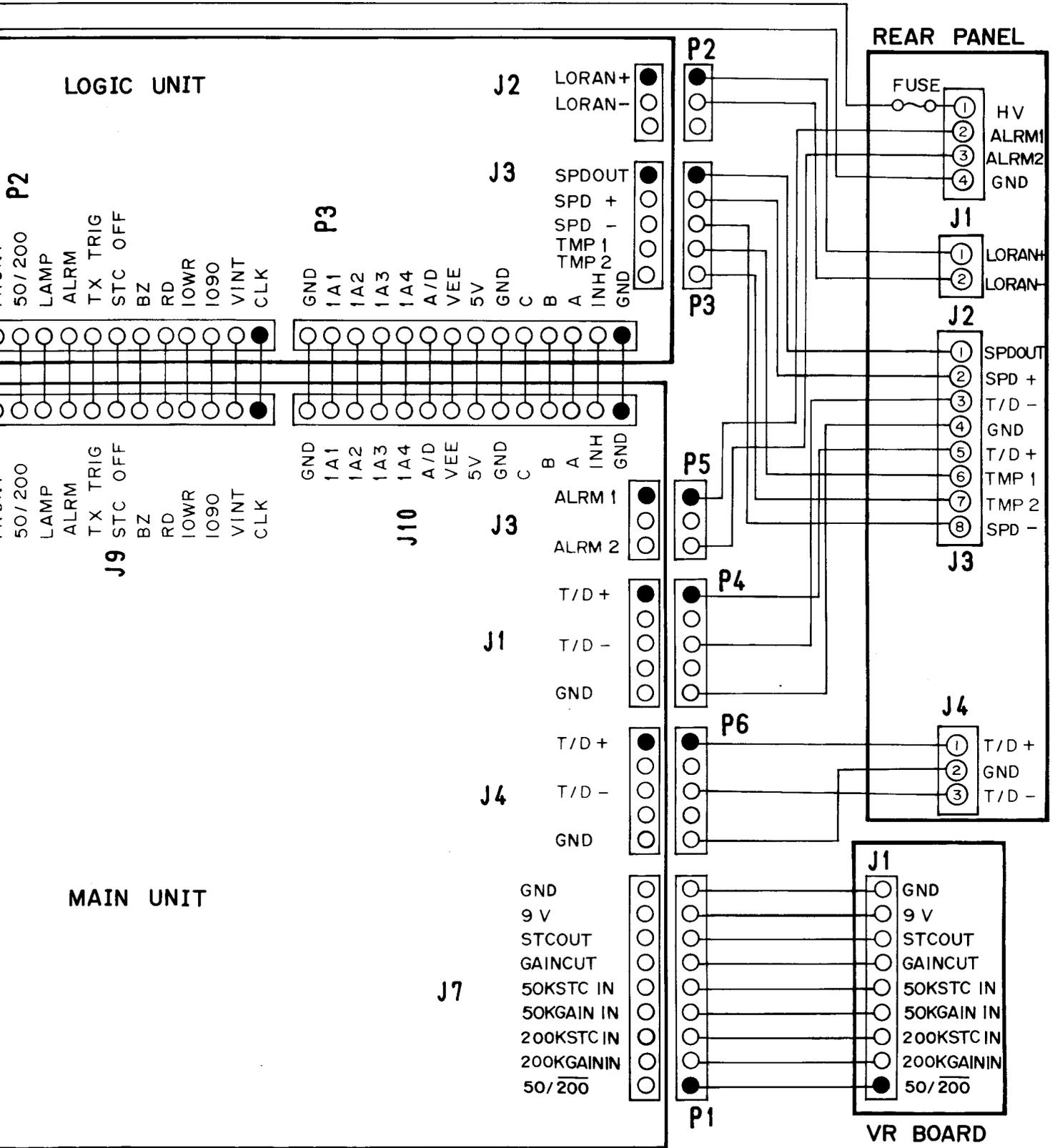
LABEL NUMBER	ORDER NUMBER	DESCRIPTION	Qty.
①	8010010610	749 Case	1
②	8010010340	749 Bracket holder	2
③	8810003360	Setscrew C M3 x 6	8
④	8810003360	Setscrew C M3 x 6	2
⑤	8810003360	Setscrew C M3 x 6	4
⑥	8810002510	Screw FH M3 x 6 SUS	4
⑦	8810003390	Setscrew C M4 x 8	4
⑧	8810006320	Setscrew C M4 x 10 SUS	4
⑨	8410000030	AF heat sink	1
⑩	8810003160	Setscrew A M3 x 6	1
⑪	8810003360	Setscrew C M3 x 6	8
⑫	8930000670	Standoff (Q)	4
⑬	8210005970	827 Front panel (B)	1
⑭	8310020630	746 Screen	1
⑮	8010010560	827 Switch board	1
⑯	8930019240	Keyboard rubber seal	1
⑰	8930019210	Front rubber seal	1
⑱	8610006770	Knob N141 (B)	4
⑲	8810001040	Screw PH B0 M2.6 x 6	8
⑲	8810001040	Screw PH B0 M2.6 x 6	8
⑲	8810006020	Icom tapping screw (A)	4
⑲	8930019450	746 CRT rubber seal	1
⑲	8810000030	Screw PH M2 x 6	2
⑲	8830000170	Nut M2 Ni BS	2
⑲	8830000550	VR nut (E)	4
⑲	8010010170	827 Rear panel	1
⑲	8930019200	Rear panel rubber seal	1
⑲	8810000700	Screw PH M5 x 20 SUS	1
⑲	8850000600	Star washer M5 SUS	1
⑲	8850000180	Flat washer M5 SUS	2
⑲	8830000250	Nut M5 SUS	1
⑲	8830000370	Wing nut M5 SUS	1
⑲	8850000500	Spring washer M5 SUS	1
⑲	8810006350	Setscrew A M3 x 20 SUS	2
⑲	8930019390	FET plate	1
⑲	8930019410	827 shield plate	1
⑲	8810006260	Screw PH M3 x 5 SUS	4
⑲	8930000520	Thread spacer (B)	2
⑲	6510007560	Power/Alarm connector FM14-4S	1
⑲	6510011420	NMEA connector 31-10	1
⑲	6510012160	Transducer B connector FM214-8S	1
⑲	6510011410	Transducer A connector FM-143	1
⑲	5210000060	Fuse FGB 5A	1
⑲	5220000140	Fuse holder FH-042	1

SCREW ABBREVIATIONS

PH : Pan head FH : Flat head B0 : Self-tapping screw
 SUS : Stainless NI : Nickel BS : Brass

SECTION 4 CONNECTOR ASSEMBLY





SECTION 5 FUNCTION CHECKLIST

FUNCTION	OPERATION		CONFIRMATION	
POWER ON/OFF	1	Push [POWER] once.	1	Beep sound is emitted, and "ICOM" appears.
	2	Push and hold [POWER].	2	The unit is turned OFF.
CPU RESET	1	Turn power OFF.	1	The unit is turned OFF.
	2	While pushing [UP] and [DOWN], turn power ON.	2	<ul style="list-style-type: none"> • The BASIC screen appears. • Frequency indicator shows H. • Range indicator shows 40 m.
SENSITIVITY	1	Rotate [HIGH GAIN] control.	1	Display color is changed.
	2	Adjust [HIGH GAIN] to make the color of the sea floor reddish brown.	2	The [HIGH GAIN] control is between the 8 o'clock and 12 o'clock position.
	3	Push [FREQ] to select the LOW frequency.	3	"LOW" indicator appears. Follow the same procedure as for [HIGH GAIN].
STC	1	Rotate [LOW STC] control.	1	Sensitivity of the sea surface changes.
	2	Push [FREQ] to select the HIGH frequency.	2	Follow the same procedure as for [LOW STC]. * After confirmation, rotate [HIGH STC] and [LOW STC] counterclockwise.
BRIGHTNESS	1	Push [BRT] several times.	1	Brightness varies among 5 levels. * After confirmation, select brightest level.
MODE	1	Push [MODE] several times.	1	Mode changes. * Number of modes are fixed depending on other settings. See INSTRUCTION MANUAL p.8 for details.
FREQUENCY	1	Select the BASIC screen.	1	The BASIC screen is selected.
	2	Push [FREQ] several times.	2	Frequency alternates between 200 kHz and 50 kHz.
DEPTH RANGE (200 W type)	1	Push [RANGE].	1	"RANGE" appears in the upper right corner of the screen.
	2	Push [UP] or [DOWN].	2	The depth range is from 5 to 320 m. (8 steps) * 600 W type has a depth range of 5 to 640 m. (9 steps).
DISPLAY SWEEP SPEED	1	Select a 40 m depth range.	1	The 40 m depth range is selected.
	2	Push [DSP SPD], and push [UP] or [DOWN].	2	An indication of the grade "DSP SPD 4" – "DSP SPD 0" appears in the upper right corner of the screen. "DSP SPD 0" : freeze "DSP SPD 1" : very slow "DSP SPD 4" : very fast
PHASE SHIFT	1	Push [SHIFT].	1	"SHIFT" appears in the upper right corner of the screen.
	2	Push [UP] or [DOWN].	1	The phase shift changes.
PART EXPANSION	1	Select a "0" phase shift.	1	The "0" phase shift is selected.
	2	Push [ZOOM].	2	White "ZOOM" appears in the upper right corner of the screen. Then, the basic screen changes to the basic + part expansion screen.
	3	Push [UP] or [DOWN].	3	The part expansion range changes in 5 steps.
	4	Push [VRM].	4	"VRM" appears in the upper right corner of the screen and variable range marker appears.
	5	Push [UP] or [DOWN].	5	The variable range marker moves up and down and the depth indication changes.
BOTTOM EXPANSION	1	Push [BTM ZOOM].	1	"BTM ZOOM" appears in the upper right corner of the screen. Then, the basic screen changes to the basic + bottom expansion screen.
	2	Push [UP] or [DOWN].	2	The bottom expansion range changes in 5 steps.

FUNCTION	OPERATION		CONFIRMATION	
DEPTH MEASUREMENT	1	Select the BASIC screen.	1	The BASIC screen is selected.
	2	Push [VRM].	2	The variable range marker and the digital depth indication appears on the screen.
	3	Push [UP] or [DOWN].	3	The digital depth indication changes and the marker moves.
EVENT	1	Push [EVENT].	1	"EVENT" appears in the upper right corner of the screen.
	2	Push and hold [EVENT] for 2 sec.	2	Red EVENT number appears next to "EVENT" during memory writing, and turns white when memory writing has been completed.
	3	Repeat STEP 2 several times.	3	When there is no blank EVENT memory, "FL" appears.
AUTO	1	Set the bottom color to reddish brown.	1	The bottom color changes to reddish brown.
	2	Push [AUTO].	2	Red "AUTO" appears in the top center of the screen. The depth range and phase shift automatically change.
	3	Push [AUTO] again.	3	"AUTO" disappears.
SET MENU 1	1	Select MENU 1 screen.	1	The MENU 1 screen is selected.
	2	Push [UP] or [DOWN].	2	The cursor [>] moves.
KEY PANEL	1	Push [UP] or [DOWN] to set the cursor to "ILLUM."	1	The cursor moves to the left side of "ILLUM."
	2	Push [BRT/SET].	2	Cursor and "ILLUM" turn red.
	3	Push [UP] or [DOWN].	3	The selected condition turns red.
	4	Push [BRT/SET] again.	4	Cursor and "ILLUM" turn white.
INTERFERENCE REDUCTION	1	Push [UP] or [DOWN] to set the cursor to "IR."	1	The cursor moves to the left side of "IR."
	2	Push [BRT/SET].	2	Cursor and "IR" turn red.
	3	Push [UP] or [DOWN].	3	The selected condition turns red.
	4	Push [BRT/SET] again.	4	Cursor and "IR" turn white.
NOISE REDUCTION	1	Push [UP] or [DOWN] to set the cursor to "NR."	1	The cursor moves to the left side of "NR."
	2	Push [BRT/SET].	2	Cursor and "NR" turn red.
	3	Push [UP] or [DOWN].	3	The selected level turns red.
	4	Push [BRT/SET] again.	4	Cursor and "NR" turn white.
TRANSMIT PULSE	1	Push [UP] or [DOWN] to set the cursor to "PL."	1	The cursor moves to the left side of "PL."
	2	Push [BRT/SET].	2	Cursor and "PL" turn red.
	3	Push [UP] or [DOWN].	3	The selected condition turns red.
	4	Push [BRT/SET] again.	4	Cursor and "PL" turn white.
TRANSMIT POWER (600 W type)	1	Push [UP] or [DOWN] to set the cursor to "TX POWER."	1	The cursor moves to the left side of "TX POWER."
	2	Push [BRT/SET].	2	Cursor and "TX POWER" turn red.
	3	Push [UP] or [DOWN].	3	The selected condition turns red.
	4	Push [BRT/SET] again.	4	Cursor and "TX POWER" turn white.
BOTTOM DISCRIMINATION	1	Push [UP] or [DOWN] to set the cursor to "DISCR."	1	The cursor moves to the left side of "DISCR."
	2	Push [BRT/SET].	2	Cursor and "DISCR" turn red.
	3	Push [UP] or [DOWN].	3	The selected condition turns red.
	4	Push [BRT/SET] again.	4	Cursor and "DISCR" turn white.
TRIP LOG	1	Push [UP] or [DOWN] to set the cursor to "TRIP LOG."	1	The cursor moves to the left side of "TRIP LOG."
	2	Push [BRT/SET].	2	Cursor and "TRIP LOG" turn red.
	3	Push [UP] or [DOWN].	3	"RST" turns red.
	4	Push [BRT/SET].	4	Trip log is set to 0.0 NM and "RST" turns white.
SET MENU 2	2	Select the MENU 2 screen.	1	The MENU 2 screen is selected.
	2	Push [UP] or [DOWN].	2	The cursor [>] moves.

FUNCTION	OPERATION	CONFIRMATION
EVENT	<ol style="list-style-type: none"> 1 Push [UP] or [DOWN] to set the cursor to "EVENT." 2 Push [BRT/SET]. 3 Push [UP] or [DOWN]. 4 Push [BRT/SET]. 5 Push [UP] or [DOWN]. 6 Push [BRT/SET]. 7 Push [MODE]. 8 Push [MODE] several times. 	<ol style="list-style-type: none"> 1 The cursor moves to the left side of "EVENT." 2 Cursor and "EVENT" turn red. 3 The selected condition turns red. 4 Red "ON" turns green. 5 The desired EVENT number and input data change. 6 Cursor and "EVENT" turn white and "ON" turns red. 7 The MENU screen changes to the BASIC screen. 8 Set contents are displayed on the BASIC + EVENT screen. * After confirmation, select the MENU 2 screen.
SHALLOW ALARM	<ol style="list-style-type: none"> 1 Push [UP] or [DOWN]. 2 Push [BRT/SET]. 3 Push [UP] or [DOWN]. 4 Push [BRT/SET] at "ON" position. 5 Push [UP] or [DOWN]. 6 Push [BRT/SET]. 7 Push [MODE]. 8 Push one of the keys on the front panel. 	<ol style="list-style-type: none"> 1 Set the cursor to "SHLOW ALM." 2 Cursor and "SHLOW ALM" turn red. 3 The selected condition turns red. 4 "ON" turns green and the value turns red. 5 Changes the value. Select "30". 6 Cursor and "30" turn white, and "ON" turns red. 7 The BASIC screen appears. The alarm sounds when sea bottom appears shallower than the shallow alarm setting. 8 Stops the alarm sound. * After confirmation, turn the alarm function OFF.
DEEP ALARM	<ol style="list-style-type: none"> 1 Push [UP] or [DOWN]. 2 Push [BRT/SET]. 3 Push [UP] or [DOWN]. 4 Push [BRT/SET] when "ON" is red. 5 Push [UP] or [DOWN]. 6 Push [BRT/SET]. 7 Push [MODE]. 8 Push one of the keys on the front panel. 	<ol style="list-style-type: none"> 1 Set the cursor to "DEEP ALM." 2 Cursor and "DEEP ALM" turn red. 3 The selected condition turns red. 4 "ON" turns green and the value turns red. 5 Changes the value and select "30." 6 Cursor and "30" turn white, and "ON" turns red. 7 The BASIC screen appears. The alarm sounds when sea bottom appears deeper than the depth alarm setting. 8 Stops the alarm sounds. * After confirmation, turn the alarm function OFF.
TEMPERATURE ALARM	<ol style="list-style-type: none"> 1 Push [UP] or [DOWN] to set the cursor to "TEMP ALM." 2 Push [BRT/SET]. 3 Push [UP] or [DOWN]. 4 Push [BRT/SET] when "OFF" is red. 5 Push [UP] or [DOWN]. 6 Push [BRT/SET]. 	<ol style="list-style-type: none"> 1 The cursor moves to the left side of "TEMP ALM." 2 Cursor and "TEMP ALM" turn red. 3 The selected condition turns red. 4 "OFF" turns green and the value turns red. 5 The value changes. Then, select "0." 6 Cursor, "TEMP ALM" and "0" turn red.
SET MENU 3	<ol style="list-style-type: none"> 1 Select the MENU 3 screen. 2 Push [UP] or [DOWN]. 	<ol style="list-style-type: none"> 1 The MENU 3 screen is selected. 2 The cursor [>] moves.
DATA INDICATOR	<ol style="list-style-type: none"> 1 Push [UP] or [DOWN] to set the cursor to "NMBSRS." 2 Push [BRT/SET]. 3 Push [UP] or [DOWN]. 4 Push [BRT/SET]. 	<ol style="list-style-type: none"> 1 The cursor moves to the left side of "NMBSRS." 2 Cursor and "NMBSRS" turn red. 3 The selected condition turns red. When "ON" is selected, the following data appears: <ul style="list-style-type: none"> 1) Display backing color 2) Water temperature *1 3) Ship speed *1 4) Trip log *1 5) Latitude and longitude *2 *1 The EX-983 or EX-1010 (options) is necessary. *2 Navigation receiver system is necessary. Select "ON." 4 "NMBSRS" turn white.

FUNCTION	OPERATION		CONFIRMATION	
DISPLAY BACKING COLOR	1	Push [UP] or [DOWN] to set the cursor to "BKG COL."	1	The cursor moves to the left side of "BKG COL."
	2	Push [BRT/SET].	2	Cursor and "BKG COL" turn red.
	3	Push [UP] or [DOWN].	3	The selected condition turns red. Screen color changes to blue or black.
	4	Push [BRT/SET].	4	Cursor and "BKG COL" turn white.
SPEED SYNCHRONIZATION	1	Push [UP] or [DOWN] to set the cursor to "BKG COL."	1	The cursor moves to the left side of "DISP SYNC."
	2	Push [BRT/SET].	2	Cursor and "SPD SYNC" turn red.
	3	Push [UP] or [DOWN].	3	The selected condition turns red. When "ON" is selected, "SPD SYNC" appears in the upper left corner of the screen. Select "OFF" position.
	4	Push [BRT/SET].	4	Cursor and "SPD SYNC" turn white.
WATER DEPTH	1	Push [UP] or [DOWN] to set the cursor to "DEPTH."	1	The cursor moves to the left side of "DEPTH."
	2	Push [BRT/SET].	2	Cursor and "DEPTH" turn red.
	3	Push [UP] or [DOWN].	3	The selected unit turns red.
	4	Push [BRT/SET].	4	Cursor and "DEPTH" turn white.
	5	Push [MODE].	5	The BASIC screen appears and the selected unit of measure is displayed.
DRAFT CORRECTION	1	Push [UP] or [DOWN] to set the cursor to "OFFSET."	1	The cursor moves to the left side of "OFFSET."
	2	Push [BRT/SET].	2	Cursor and "OFFSET" turn red.
	3	Push [UP] or [DOWN].	3	The distance changes. Set 10 M.
	4	Push [BRT/SET].	4	Cursor and "OFFSET" turn white.
	5	Push [MODE].	5	The transducer position changes to 10M.
NMEA DATA	1	Push [UP] or [DOWN] to set the cursor to "NMEA DATA."	1	The cursor moves to the left side of "NMEA DATA."
	2	Push [BRT/SET].	2	Cursor and "NMEA DATA" turn red.
	3	Push [UP] or [DOWN].	3	The selected format turns red.
	4	Push [BRT/SET].	4	Cursor and "NMEA DATA" turn white. * After confirmation. Select the 0183 data format.
WATER TEMPARATURE	1	Push [UP] or [DOWN] to set the cursor to "TEMP."	1	The cursor moves to the left side of "TEMP."
	2	Push [BRT/SET].	2	Cursor and "TEMP" turn red.
	3	Push [UP] or [DOWN].	3	The selected unit turns red. The figure in the upper left corner changes. * After confirmation, set the cursor to "°C."
SHIP SPEED	1	Push [UP] or [DOWN] to set the cursor to "SPEED."	1	The cursor moves to the left side of "SPEED."
	2	Push [BRT/SET].	2	Cursor and "SPEED" turn red.
	3	Push [UP] or [DOWN].	3	The selected unit turns red. The figure in the upper left corner changes. * After confirmation, set the cursor to "KT."
SPEED ADJUSTMENT	1	Push [UP] or [DOWN] to set the cursor to "SPD ADJ."	1	The cursor moves to the left side of "SPD ADJ."
	2	Push [BRT/SET].	2	Cursor and "SPD ADJ" turn red.
	3	Push [UP] or [DOWN].	3	The pulse rate changes.
	4	Push [BRT/SET].	4	Cursor and "SPD ADJ" turn red.
CPU RESET	1	See page 5-1.		

SECTION 6 ADJUSTMENT PROCEDURES

6-1 PREPARATION BEFORE SERVICING

■ REQUIRED TEST EQUIPMENT

EQUIPMENT	GRADE AND RANGE
DC power supply	Output voltage : 11 ~ 40 V DC Current capacity : 3 A or more
Frequency counter	Frequency range : 0.1 ~ 10 MHz Frequency accuracy: ± 1 ppm or better Sensitivity : 100 mV or better
Ammeter	Measurement capability : 50 μ A

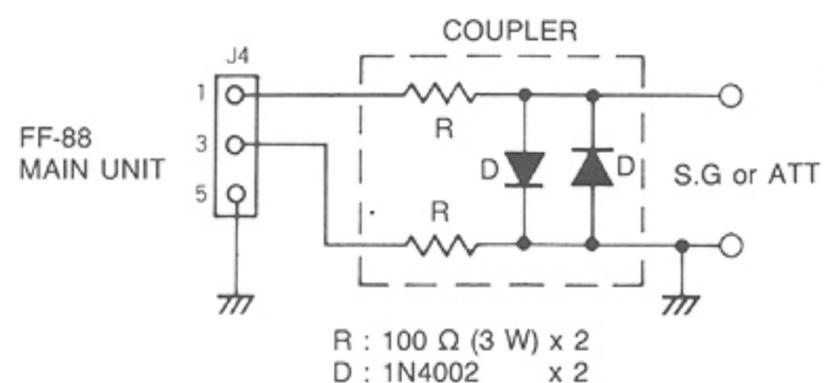
EQUIPMENT	GRADE AND RANGE
Oscilloscope	Frequency range : DC ~ 20 MHz Measuring range : 0.01 ~ 10 V
Standard signal generator	Frequency range : 0.1 ~ 1 MHz Output level : -127 ~ -17 dBm (0.1 μ V ~ 32 mV)
DC voltmeter	Input impedance : 50 k Ω /DC or better

■ CONNECTION



■ COUPLER DESCRIPTION

A coupler should be prepared by each user. The coupler will protect the signal generator from transmitter power.

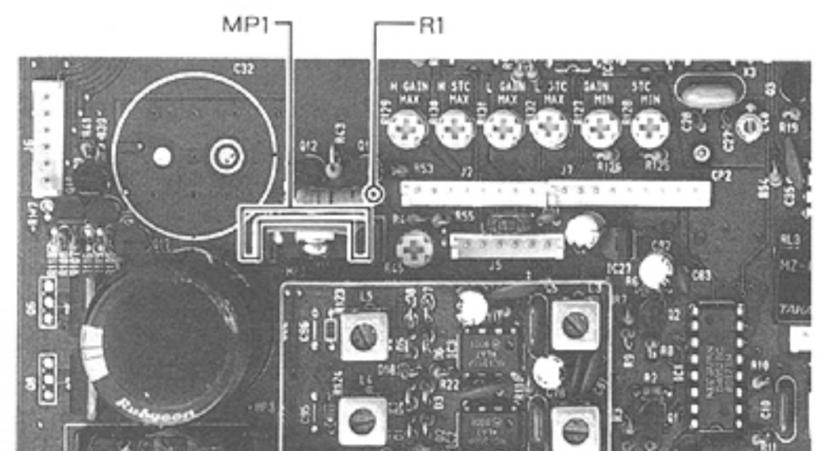


■ HOW TO DISCHARGE

Even after the unit is turned OFF, electricity remains in the +120 V line. Be careful not to short other parts or the line.

- A foot of R1 (J2 connector side) on the MAIN UNIT must be grounded.

Using a screwdriver with an insulated grip, make a short circuit in the line between the heatsink of Q11 (MP1) and R1 (J2 connector side).



A part of the MAIN UNIT

6-2 RECEIVER ADJUSTMENT

ADJUSTMENT	ADJUSTMENT CONDITIONS	MEASUREMENT		VALUE	ADJUSTMENT POINT	
		UNIT	LOCATION		UNIT	ADJUST
RECEIVE FREQUENCY	1	MAIN	Connect the frequency counter to CP3.	507 kHz	MAIN	C39
	2			655 kHz		C38
SENSITIVITY	1	MAIN	Connect the oscilloscope to J4.	Maximum wave form	MAIN	L2, L4, L6, L7
	2			Maximum wave form		L3, L5
	3			0.5 V		R127
	4			6.0 V		R129
	5			Less than 1 V		Verify
	6			6.0 V		R131
STC SENSITIVITY	1	MAIN	Connect the oscilloscope to the cathode of D17 and D18.	8.0 Vp-p	MAIN	R128
	2			Adjust R130 to the point where voltage is just changed from sawtooth wave form to straight wave form.		R130
	3			8.0 ± 0.5 Vp-p		Verify
	4			Adjust R132 to the point where voltage is just changed from sawtooth wave form to straight wave form.		R132

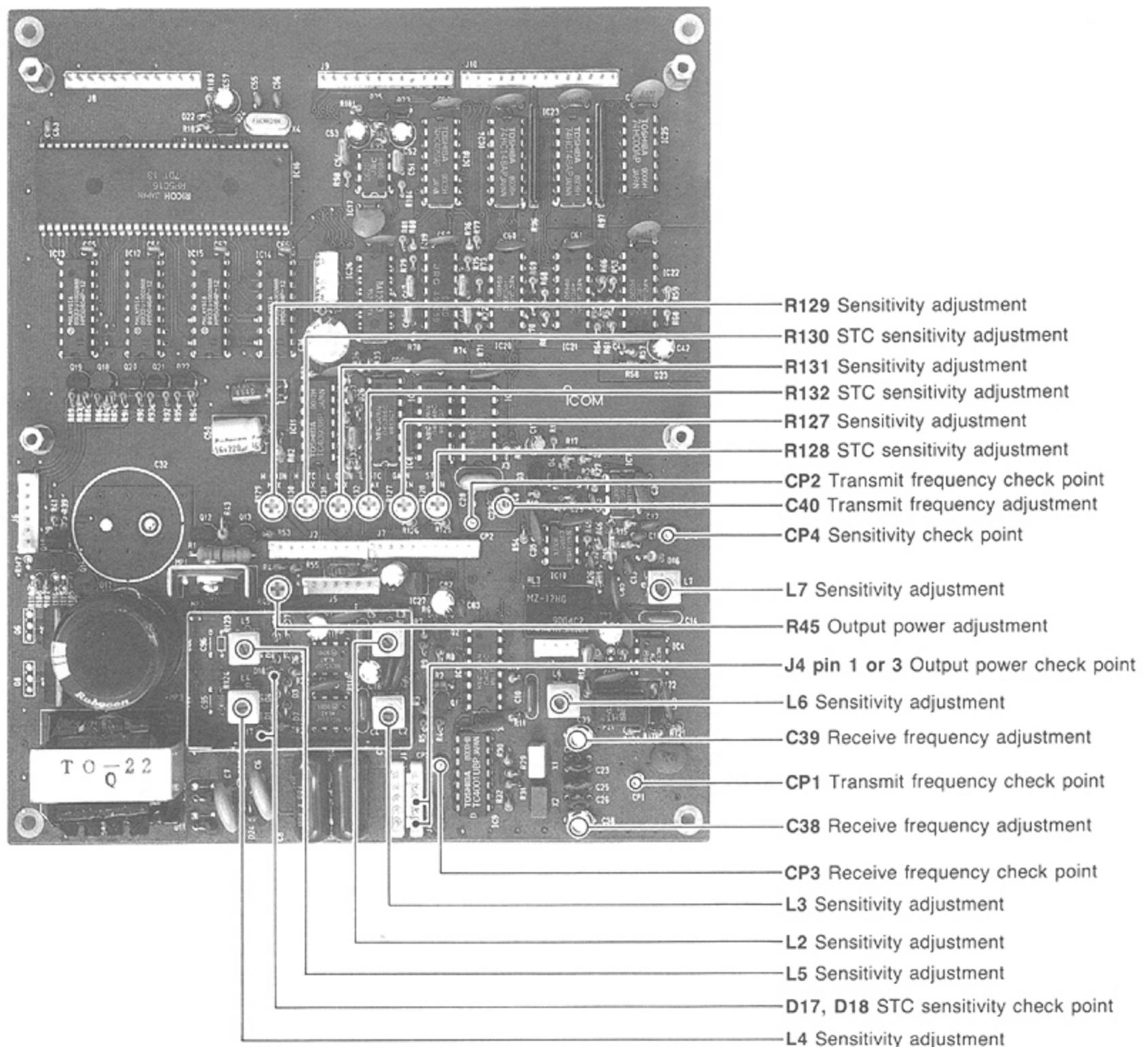
CW : Clockwise

CCW : Counterclockwise

6-3 TRANSMITTER ADJUSTMENT

ADJUSTMENT	ADJUSTMENT CONDITIONS	MEASUREMENT		VOLUME	ADJUSTMENT POINT	
		UNIT	LOCATION		UNIT	ADJUST
TRANSMIT FREQUENCY	1 • Connect a transducer to the [TRANSDUCER A] connector.	MAIN	Connect the frequency counter between CP1 and CP2.	3.2 MHz	MAIN	C40
OUTPUT POWER	1 • Connect a transducer to the [TRANSDUCER A] connector. • Frequency indicator : H • Depth readout : 5 m	MAIN	Connect the oscilloscope between pin 1 and pin 3 (J4).	800 Vp-p (maximum wave point A)	MAIN	R45
	2 • Frequency indicator : L • Depth readout : 5 and 320 m			560 ~ 840 Vp-p		Verify
	3 • Frequency indicator : H • Depth readout : 5 and 320 m			640 ~ 960 Vp-p		Verify

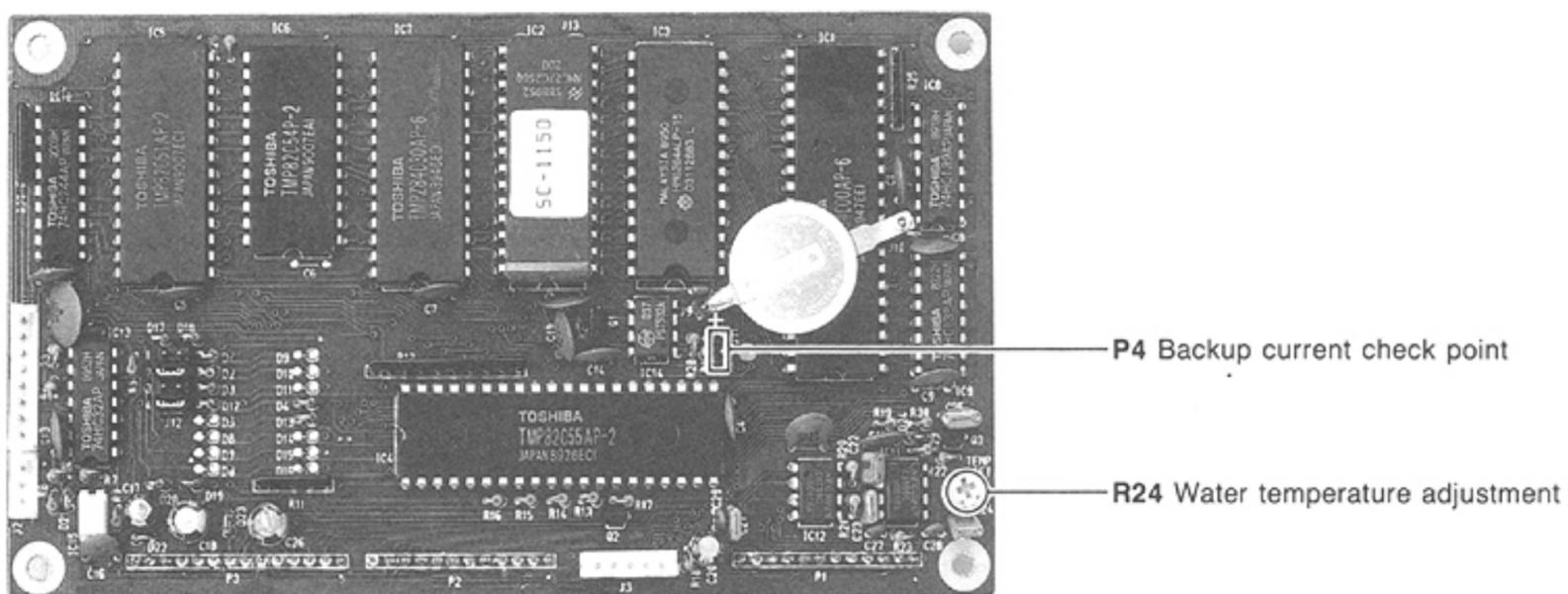
■ MAIN UNIT



6-4 LOGIC UNIT ADJUSTMENT

ADJUSTMENT	ADJUSTMENT CONDITIONS	MEASUREMENT		VALUE	ADJUSTMENT POINT	
		UNIT	LOCATION		UNIT	ADJUST
WATER TEMPERATURE	1	LOGIC	Temperature display	16°C	LOGIC	R24
BACK UP CURRENT	1		Connect the ammeter to P4.			Less than 3 μ V
NOTE: After adjustment, reconnect the plug.						

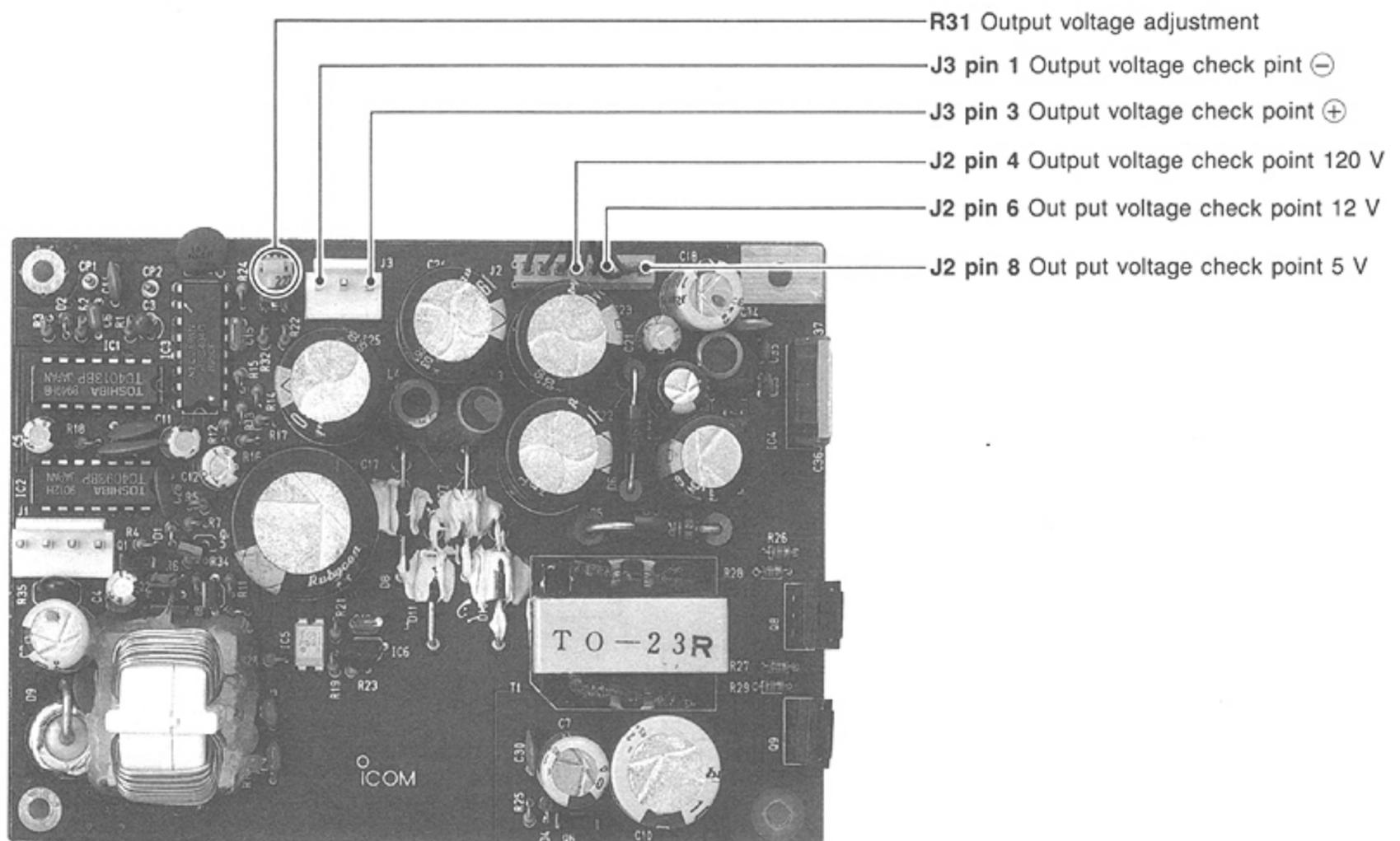
■ LOGIC UNIT



6-5 REG UNIT ADJUSTMENT

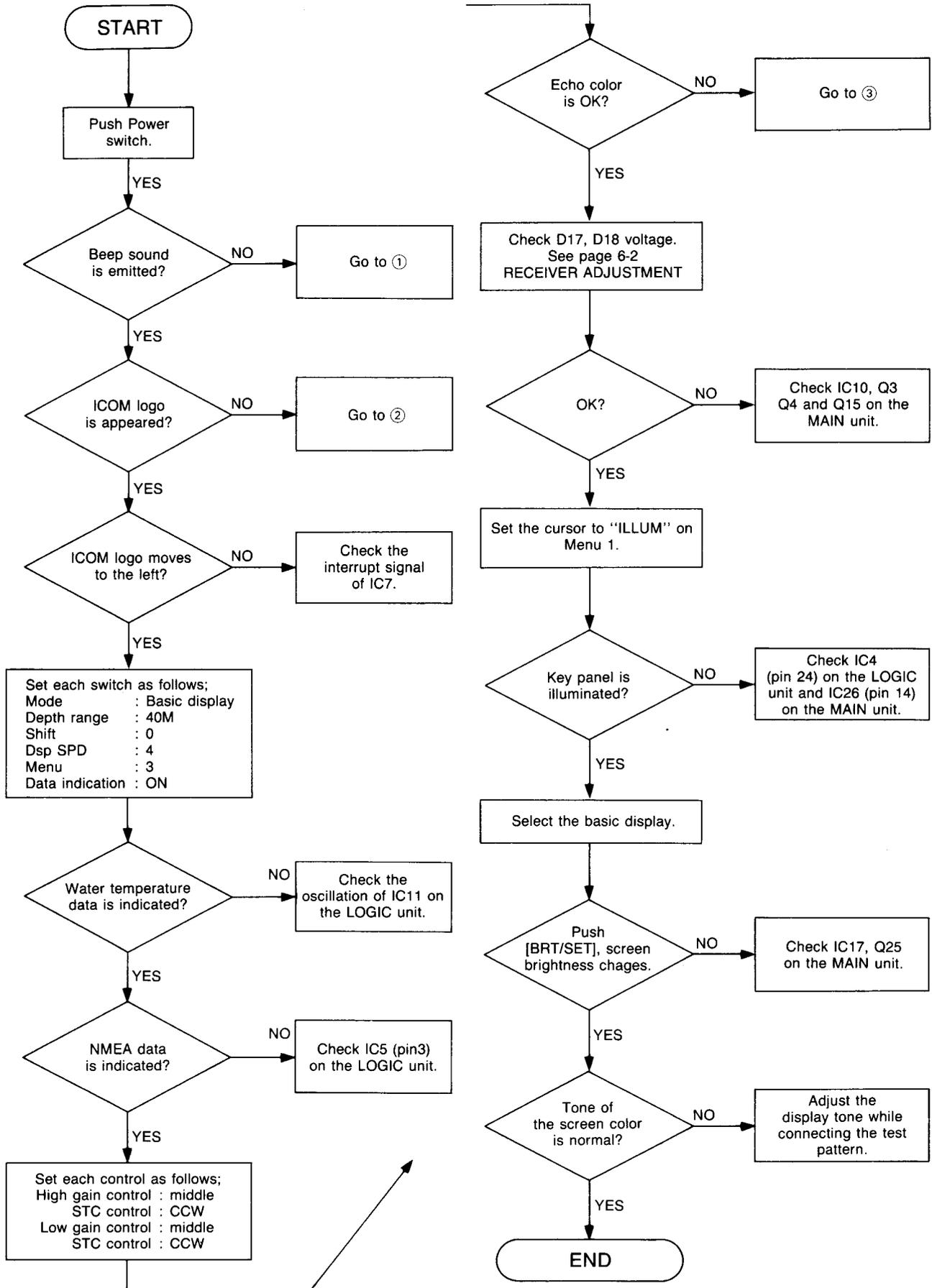
ADJUSTMENT	ADJUSTMENT CONDITIONS	MEASUREMENT		VALUE	ADJUSTMENT POINT		
		UNIT	LOCATION		UNIT	ADJUST	
OUTPUT VOLTAGE	1 • Power switch : ON	REG	Connect the DC voltmeter to J3 as shown below.	100 V	REG	R31	
			Connect the DC voltmeter to J2 as shown below.			5 V \pm 0.1 V (pin 8)	Verify
						12 V \pm 1.0 V (pin 6)	Verify
						120 V \pm 2.0 V (pin 4)	Verify

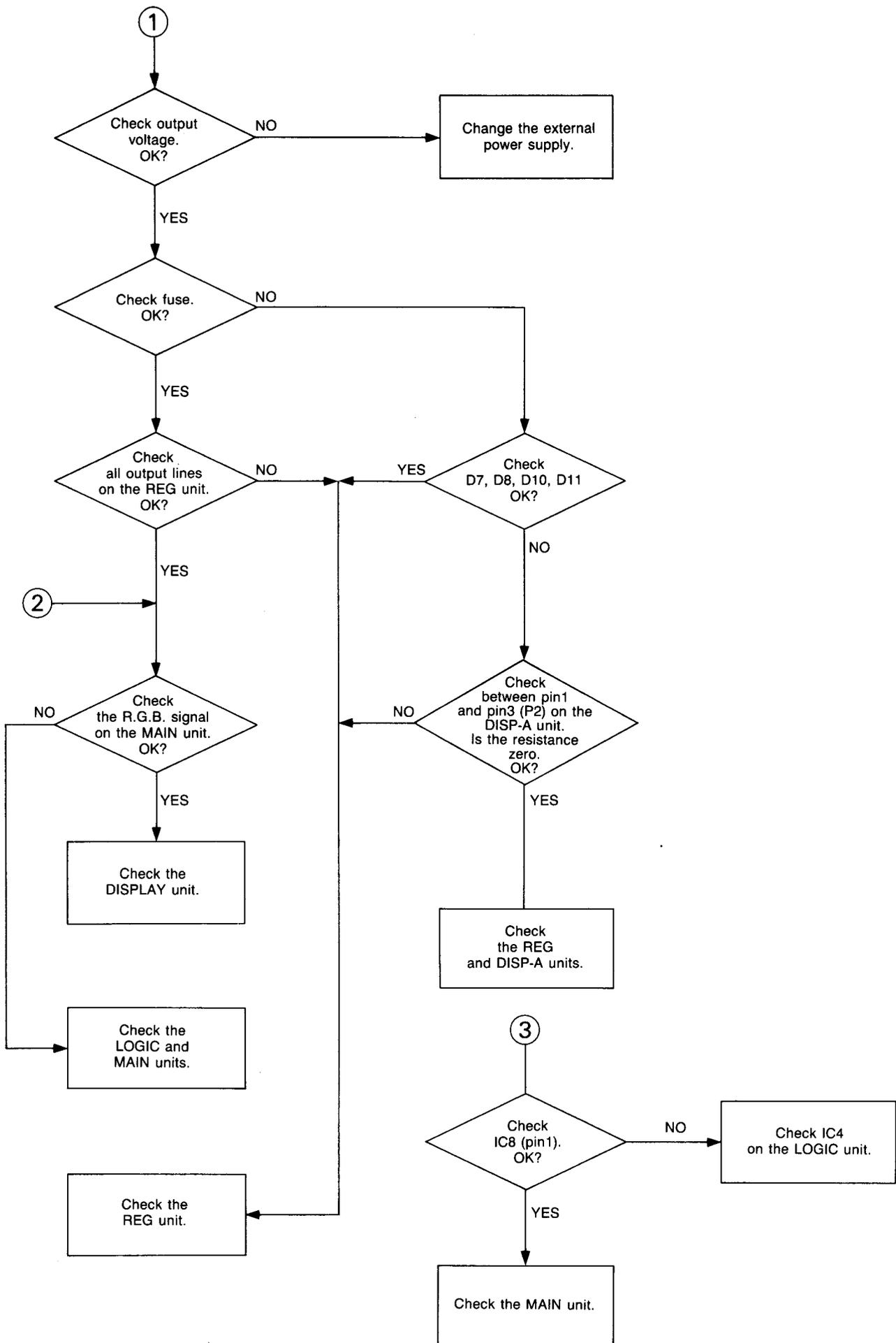
■ REG UNIT



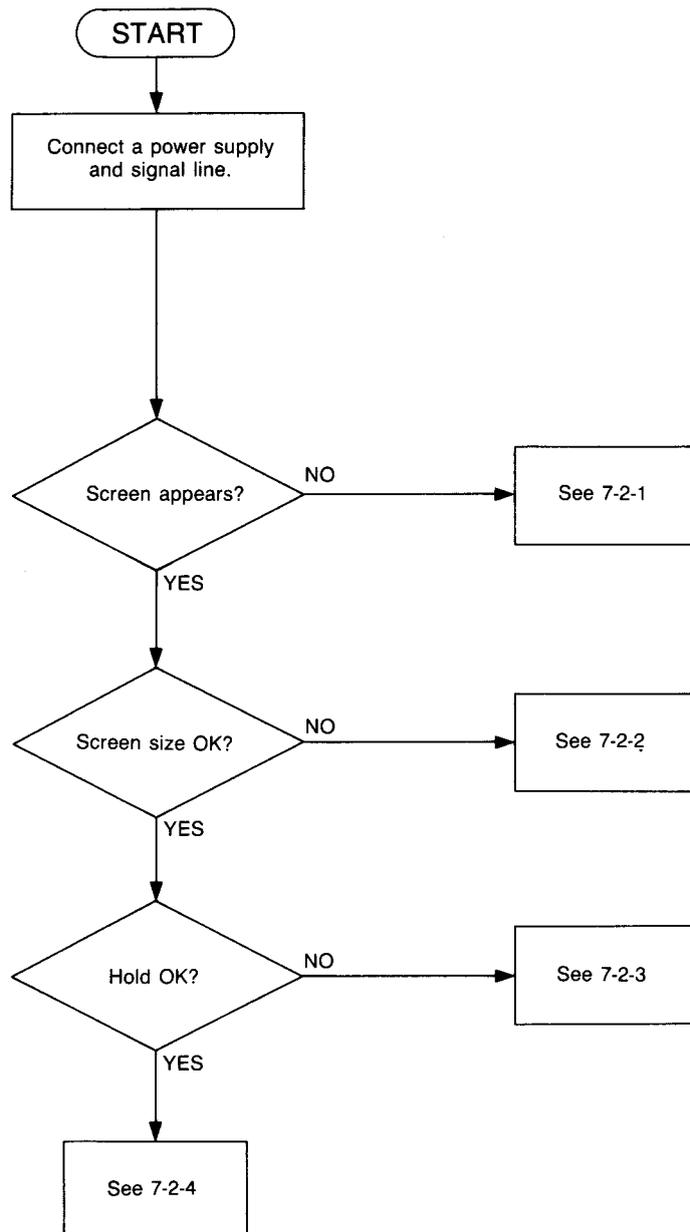
SECTION 7 TROUBLESHOOTING FLOW CHART

7-1 TROUBLESHOOTING CHART FOR MAIN UNIT



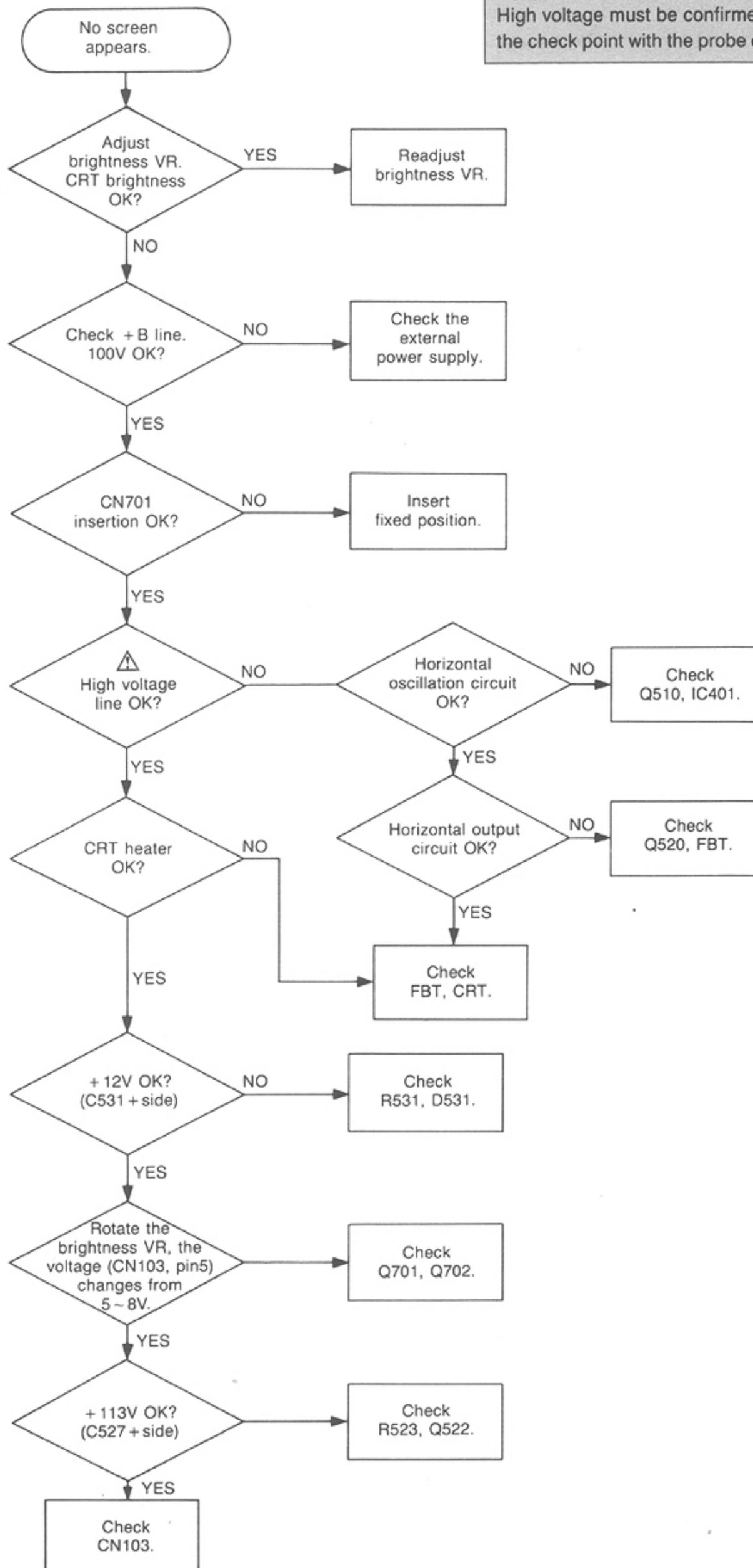


7-2 TROUBLESHOOTING CHART FOR CRT UNIT

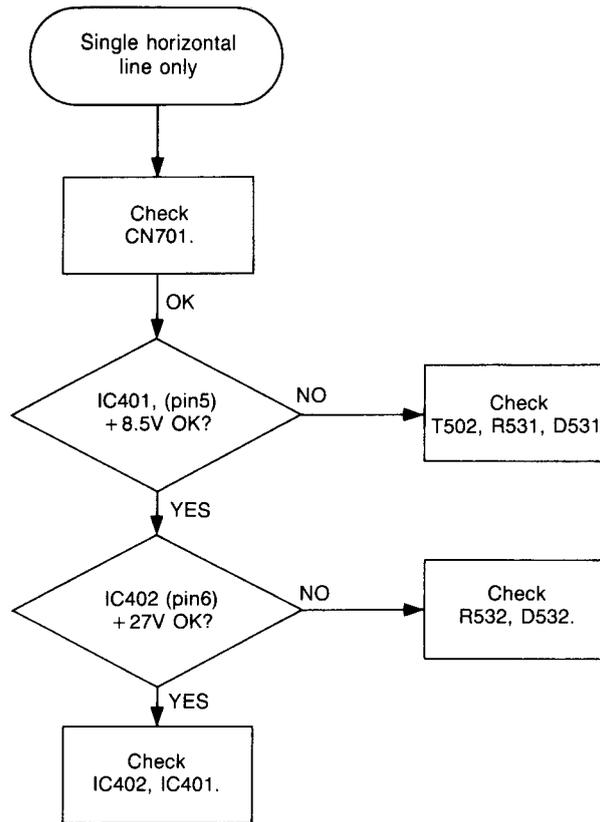


7-2-1 WHEN NO DISPLAY APPEARS.

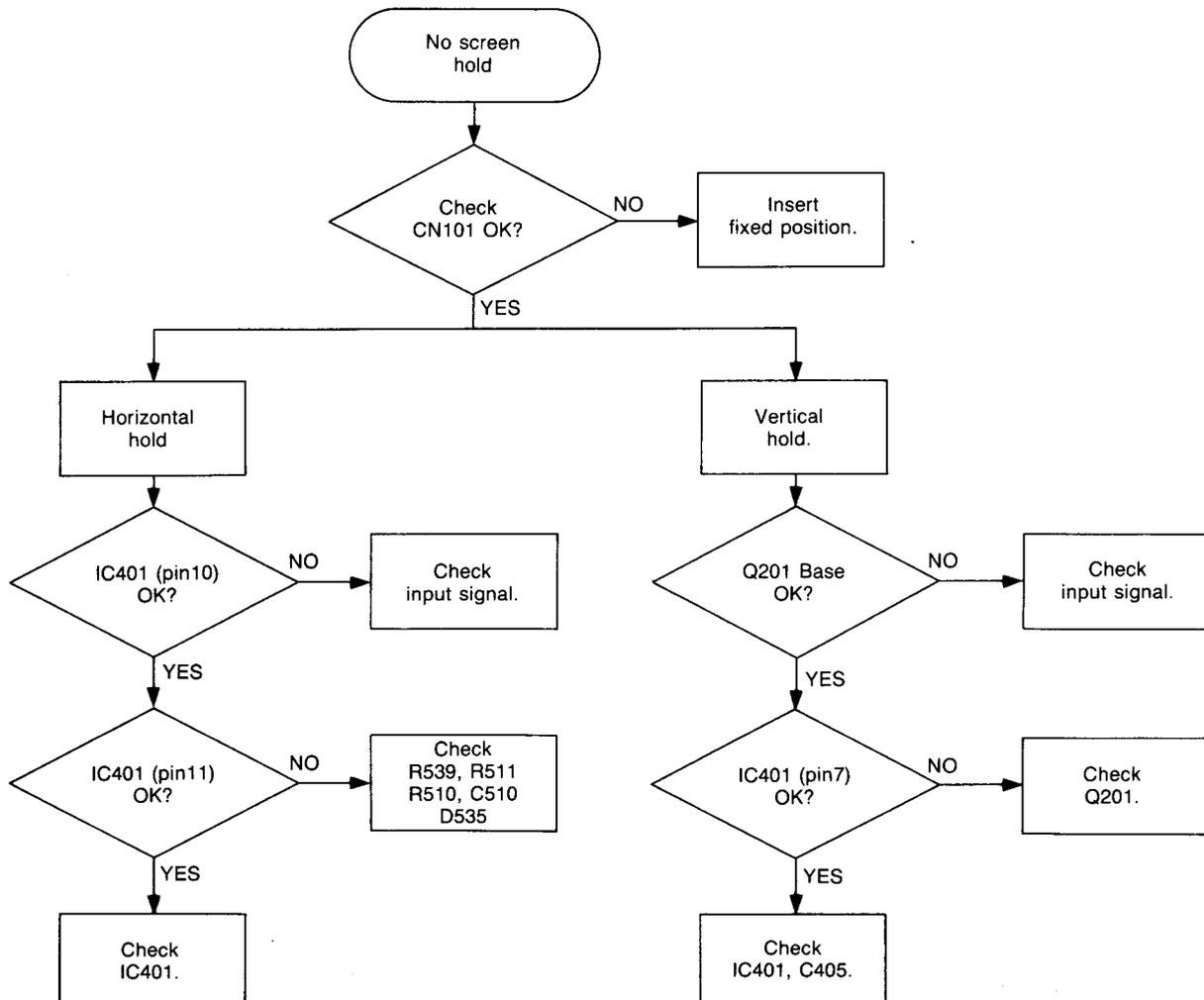
⚠ WARNING: NEVER allow measuring equipment to touch the high voltage check point. High voltage must be confirmed by approaching the check point with the probe of an oscilloscope.



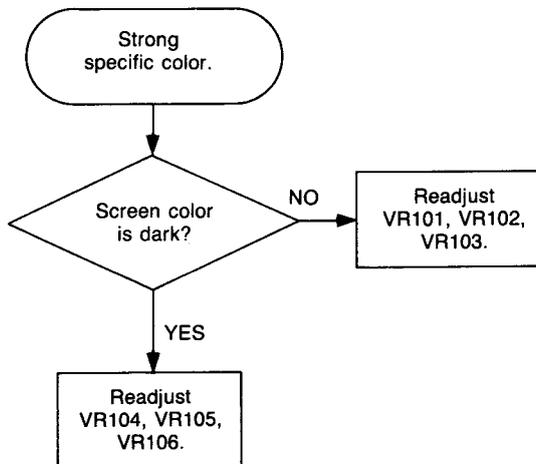
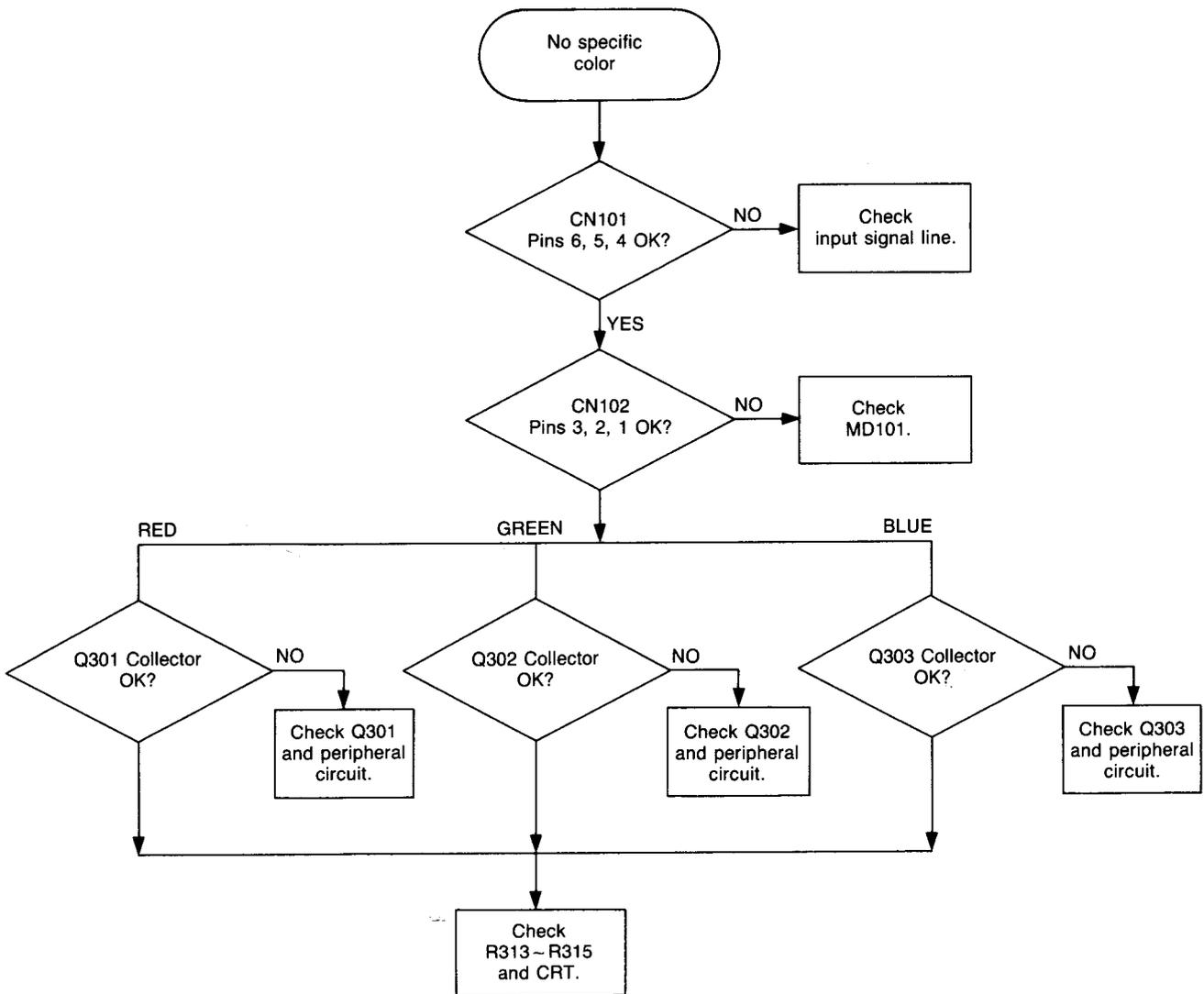
7-2-2 WHEN SCREEN SIZE IS INCORRECT.



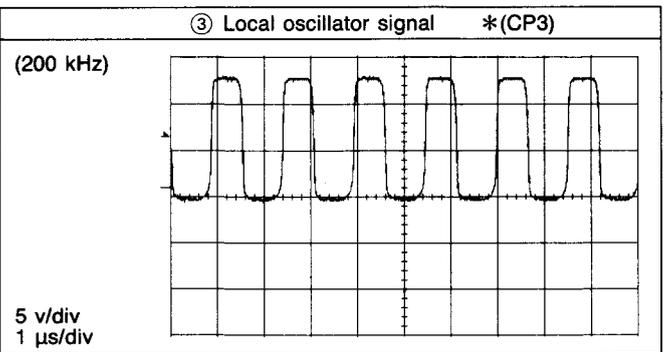
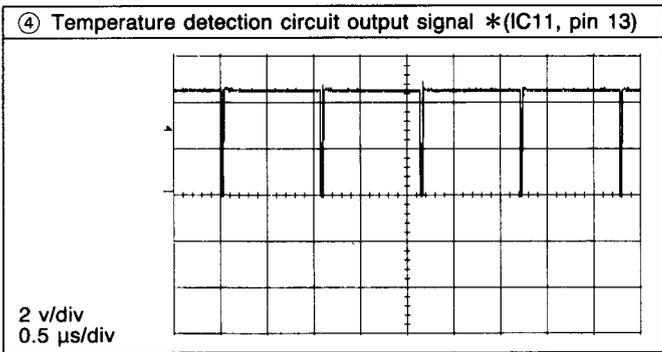
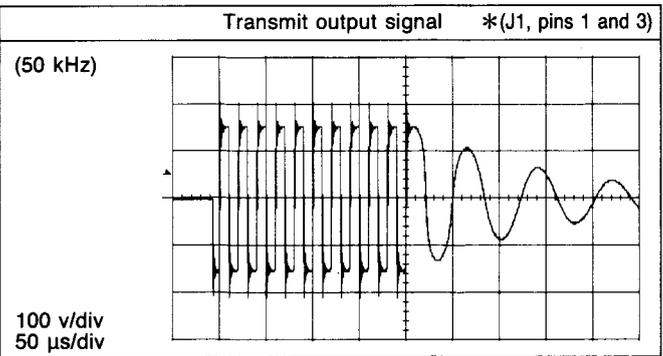
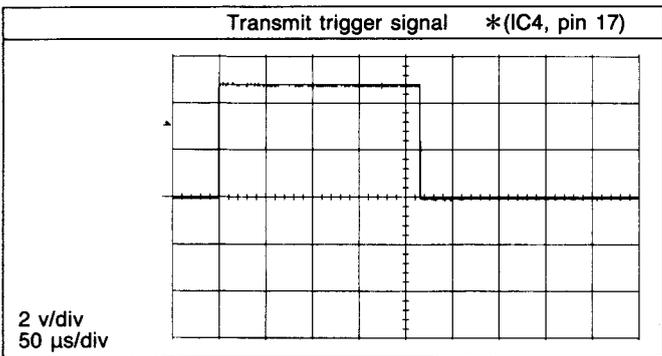
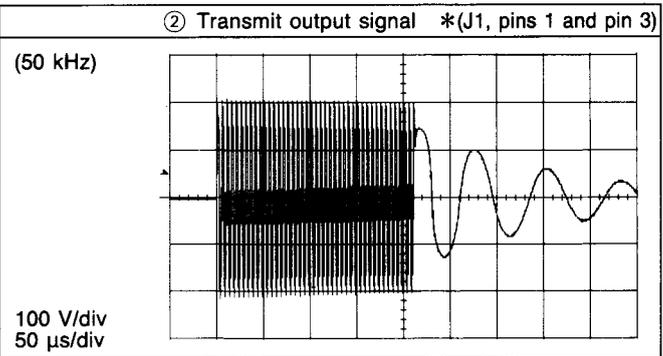
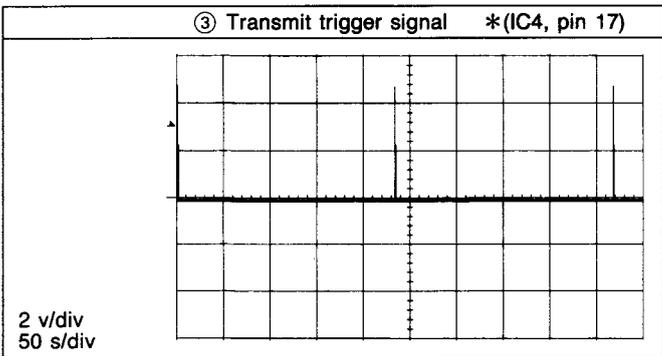
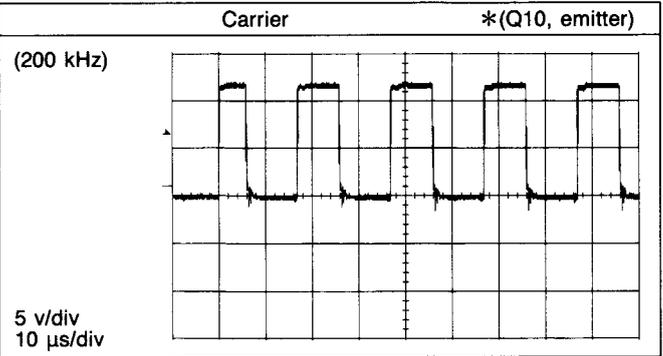
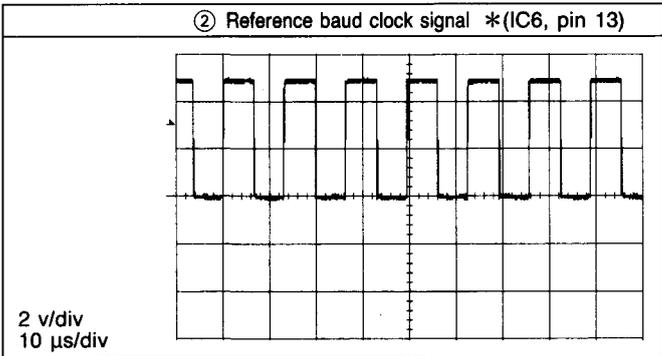
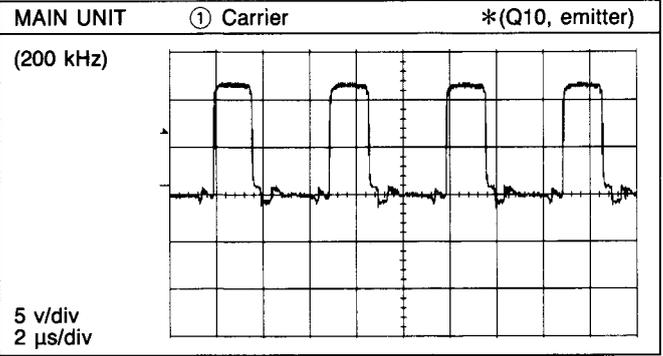
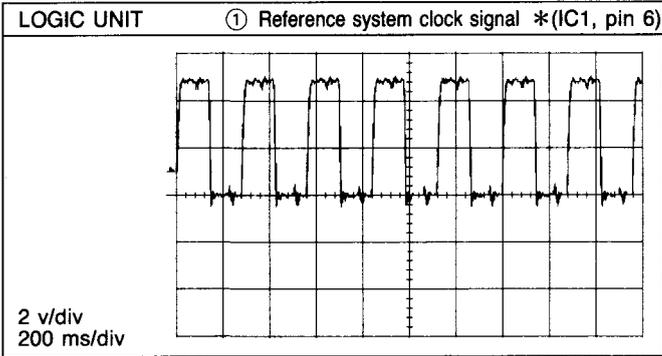
7-2-3 WHEN SCREEN DISPLAY IS NOT HOLDING.



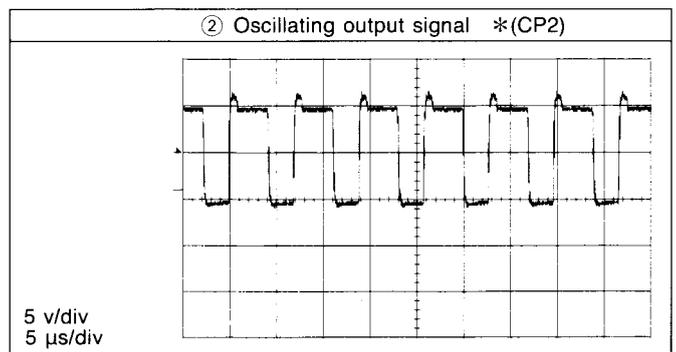
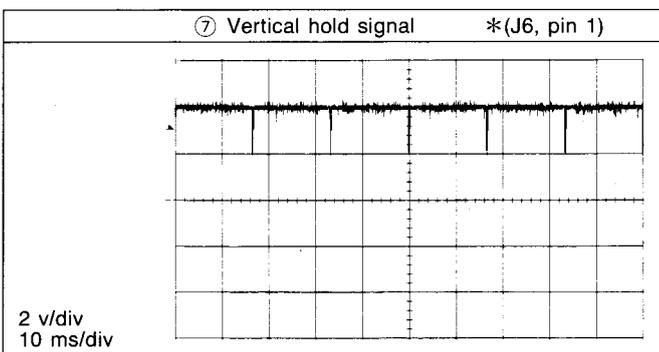
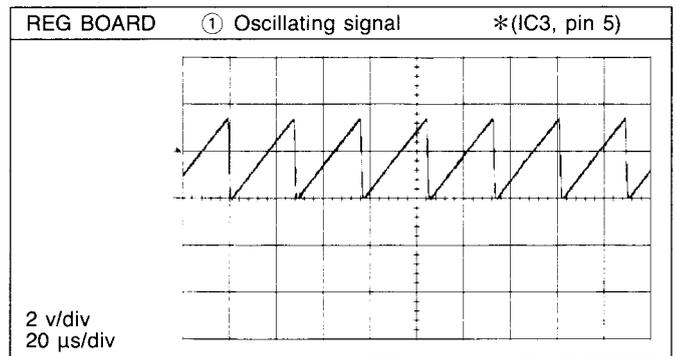
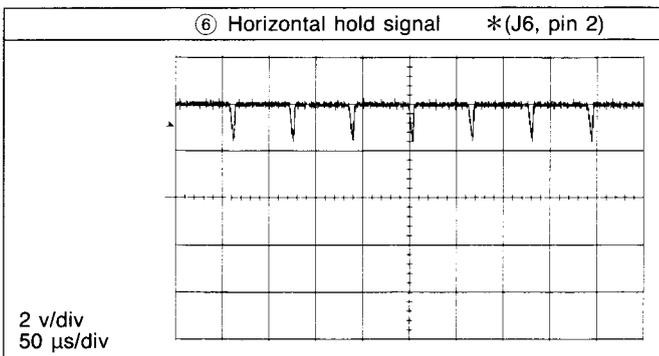
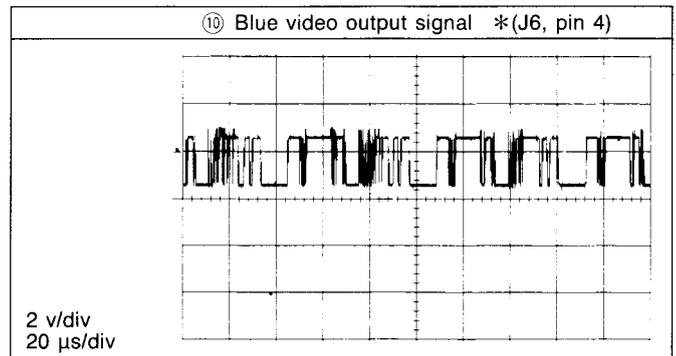
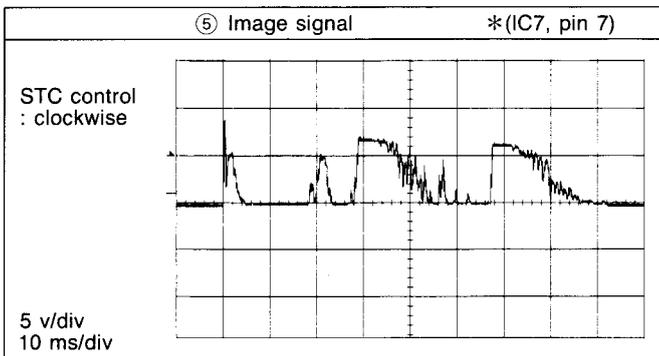
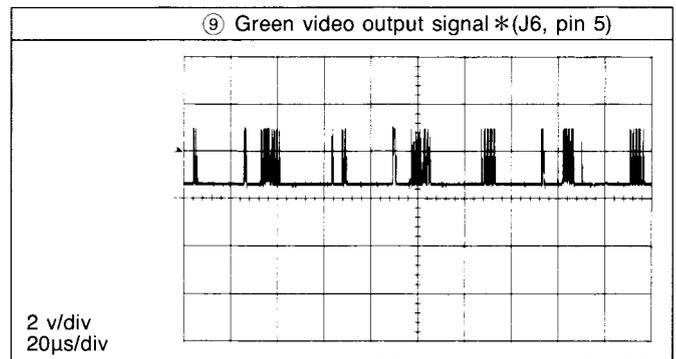
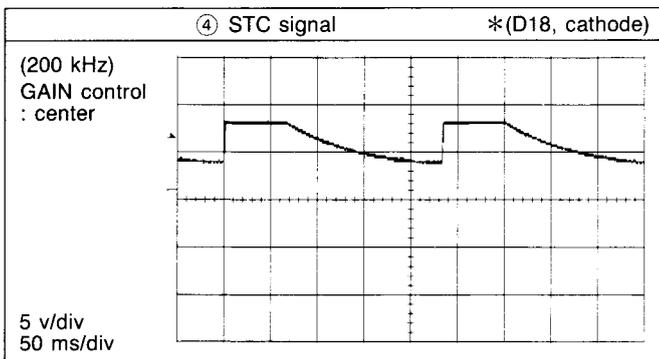
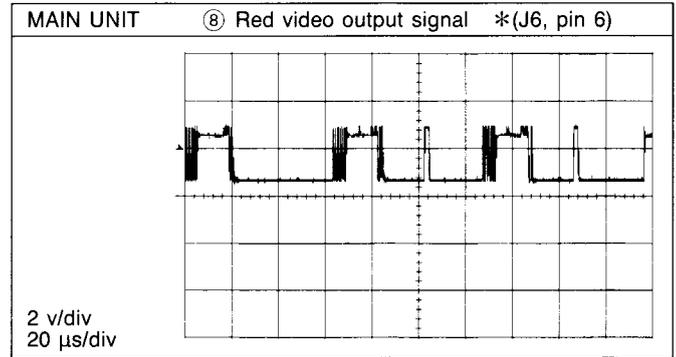
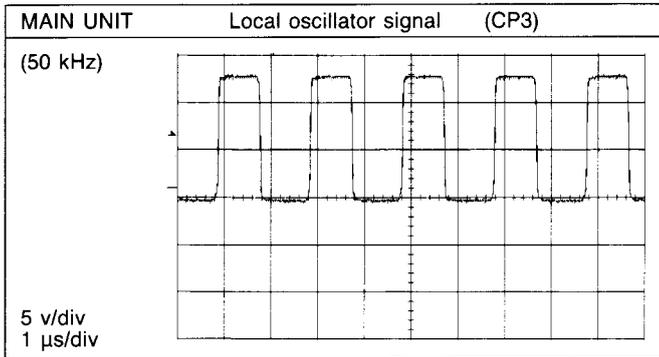
7-2-4 WHEN COLOR IS INCORRECT.



SECTION 8 SIGNAL DESCRIPTIONS



Power supply requirement : DC 12V DEPTH RANGE : 40 m DEPTH SPEED : 4 Auto : OFF
 MODE : Basic Simulator : EX-780 Phase shift : 0 Frequency : High



SECTION 9 TRANSDUCER INSTALLATION

WARNING

This installation procedure is only a reference for transducer assembly. The installation method varies according to each ship. Therefore, only ship dealers or repair shop personnel may install the transducer.

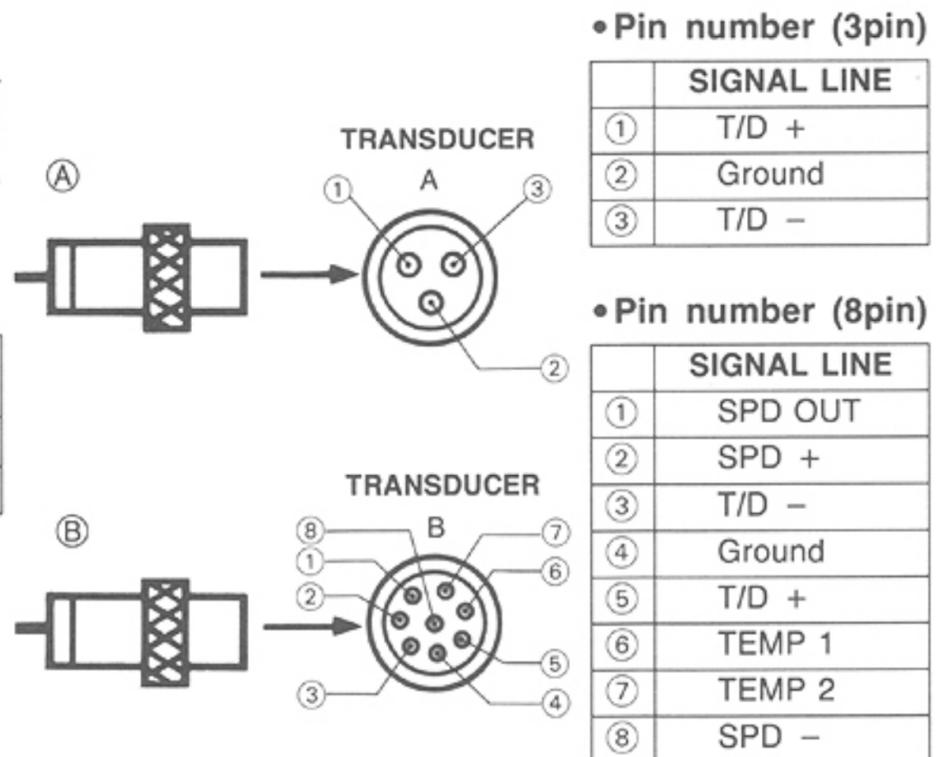
ICOM is NOT liable for injury or damage resulting from installation.

9-1 CONNECTOR INFORMATION

The FF-88 allows the use of other transducer types or speed/temperature sensors. AIRMAR Model B44 and ST61 can use this unit. To connect these transducer or sensor, see connector information as at right.

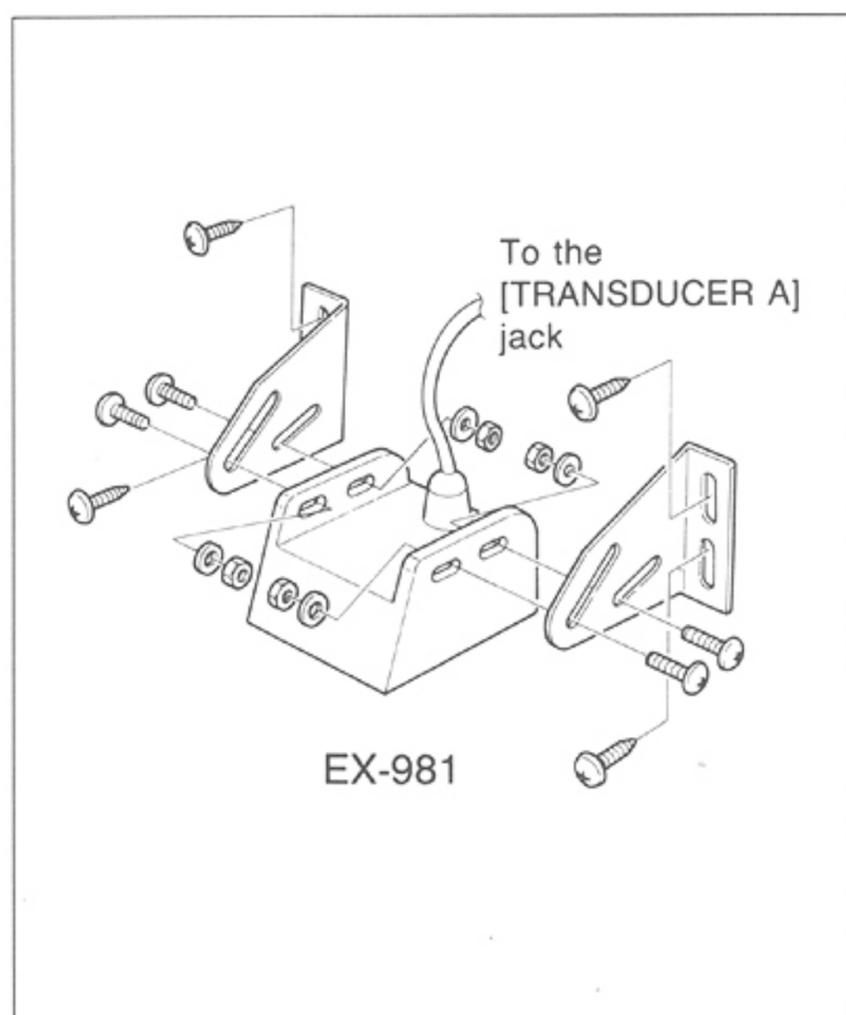
• Connector order number

LABEL NUMBER	ORDER NUMBER	DESCRIPTION
Ⓐ	6510007530	FM14-3P
Ⓑ	6510000210	FM14-8P



9-2 EX-981 TRANSOM TYPE TRANSDUCER

The transom type transducer is suitable for smaller boats.



9-2-1 INSTALLATION LOCATION OF TRANSDUCER

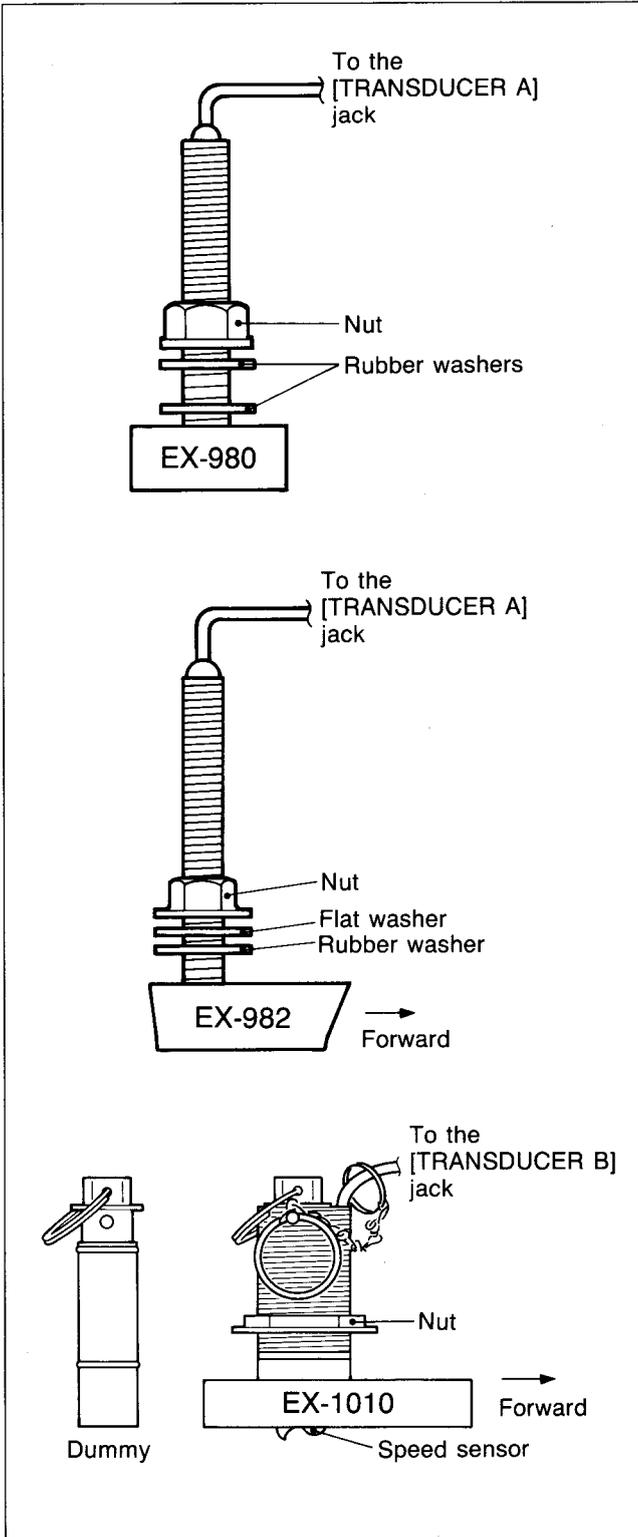
To ensure accurate readings, place the transducer in a location where few bubbles will be produced during operation.

9-2-2 INSTALLATION

- ① After determining a desirable transom mounting location, drill 4 holes.
- ② Fix the mounting bracket using 4 self-tapping screws.
- ③ Mount the transducer using 4 screws, 4 nuts, and 4 flat washers.
- ④ Adjust the transducer so that its radiation face is angled slightly up toward the bow side (approx. 3° ~ 5°) making it parallel to the water's surface.
- ⑤ Connect the cable from the transducer to the [TRANSDUCER A] jack on the rear panel.
- ⑥ This cable should be kept as far as possible away from the engine and other electrical system wiring.
- ⑦ Never cut the cable to shorten it; coil any excess cable and secure it in place.

9-3 EX-980, EX-982, EX-1010 THROUGH HULL TYPE TRANSDUCER

The through hull type transducer is suitable for large ships. Do not expose a plastic through hull transducer to solvents. Strong solvents such as acetone and methylene chloride may damage the transducer.



9-3-1 INSTALLATION LOCATION OF TRANSDUCER

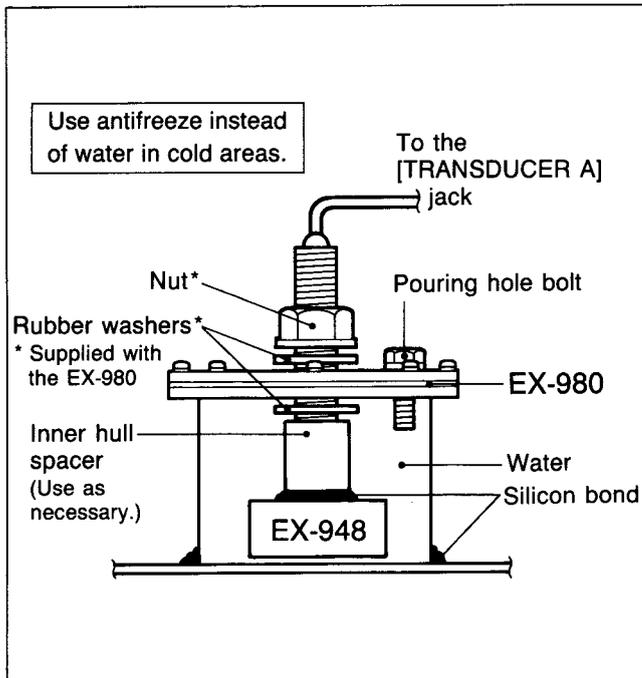
- The transducer must be mounted on a liner. Fabricate a liner and mount it on the hull bottom so that the transducer may be horizontal or angled slightly up toward the bow side (approx. 3°).
- When installing the waterproof stuffing tube, apply the general waterproofing with paint and putty.

9-3-2 INSTALLATION

- ① Usual installation procedure begins with drilling a 3 mm (1/8 in) pilot hole from INSIDE the hull to check for access. However, when a strake or other hull irregularity is near the selected mounting location, you should drill from the OUTSIDE.
- ② Using a 50 mm (2 in) diameter hole drill, drill a hole from the outside of the hull.
- ③ Sand or clean the area around the hole, inside and outside, to ensure that the sealing compound adheres properly to the hull.
- ④ Remove the nut of the housing, and apply a thick layer of sealant around the lip of the housing.
- ⑤ A thin layer should also be applied up the sidewalls to a height of 6 mm (1/4 in) greater than the hull thickness. This will ensure there is sealant material in the threads to hold the housing nut securely in place.
- ⑥ From the outside of the hull, push the housing into the hole and twist the housing to squeeze out excess sealant.
- ⑦ From the outside, remove excess sealant to guarantee smooth water flow over the transducer; and, from the inside, tighten the nut.
- ⑧ Route the cable to the instrument and be careful not to tear the cable jacket when passing the cable through the bulkheads.
- ⑨ As soon as the boat is placed in water, immediately check around the through-hull hole for leaks.
- ⑩ When the boat will not be driven for a long time, change the speed sensor to the equipped dummy to protect the sensor from seaweed.

9-4 EX-948 INNER HULL TYPE TRANSDUCER

This kit is designed for use with the EX-980 inside of the hull.



9-4-1 INSTALLATION LOCATION OF TRANSDUCER

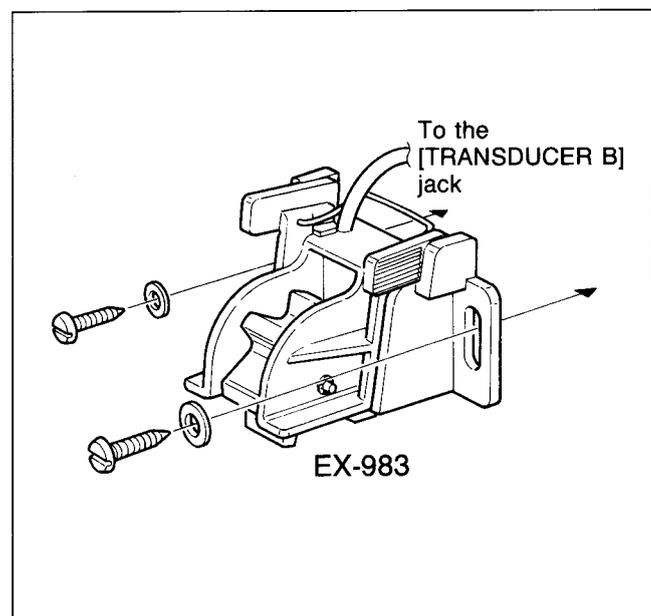
- Inside-hull systems cannot be used with hulls made of the following materials: Wood balsa, FRP including styrol, wood FRP coating, or synthetic resin coating.
- Sensitivity may be lower with a through hull type. Avoid using this type in deep waters.
- Never use an acetic silicon bond.

9-4-2 INSTALLATION

- ① Cut the inner hull case to fit the hull curvature. Clean oil, rust, dirt, salt, water, etc. from the inner hull attaching part with sandpaper.
- ② Apply a silicon bond to the side to be attached to the inner hull case. Attach the case to the hull perpendicularly. Apply the silicon bond also around the outside of the case.

- ③ Attach the transducer to the inner hull plate. Set the inner hull rubber washer between the inner hull plate and the case, and tighten the 8 screws to attach the plate to the case.
- ④ When using an inner hull tube, the tube must be attached to the transducer using the silicon bond.
- ⑤ After the silicon bond has congealed, pour water or castor oil from the pouring hole. Tighten the pouring bolt.
- ⑥ Mix an antifreezing solution with the pouring liquid for usage in cold temperature zones.

9-5 EX-983 THROUGH HULL TYPE TRANSDUCER



9-5-1 INSTALLATION LOCATION OF TRANSDUCER

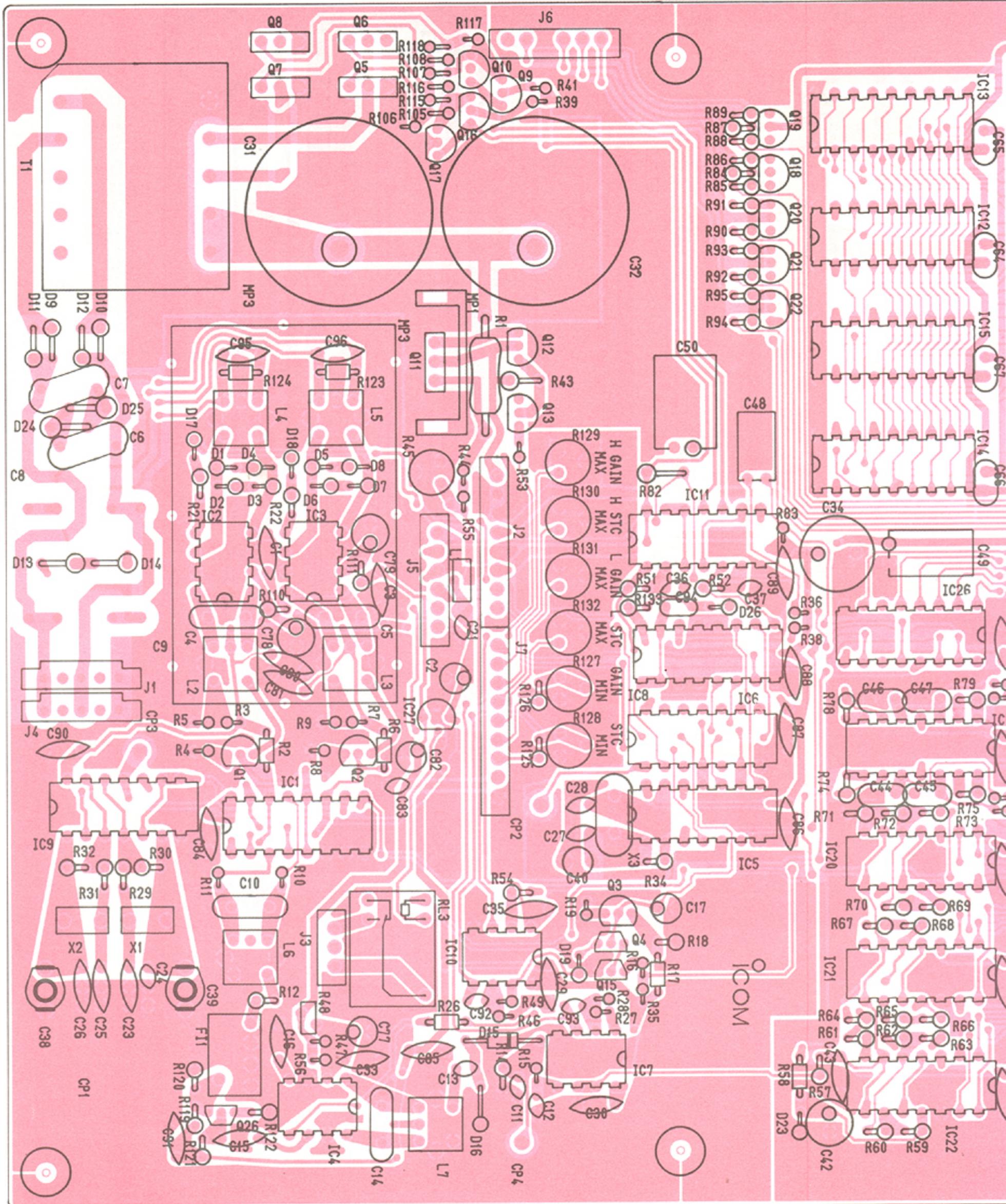
To ensure accurate readings, the sensor should be positioned within the indicated shaded area where it will be in clear water and free of bubbles.

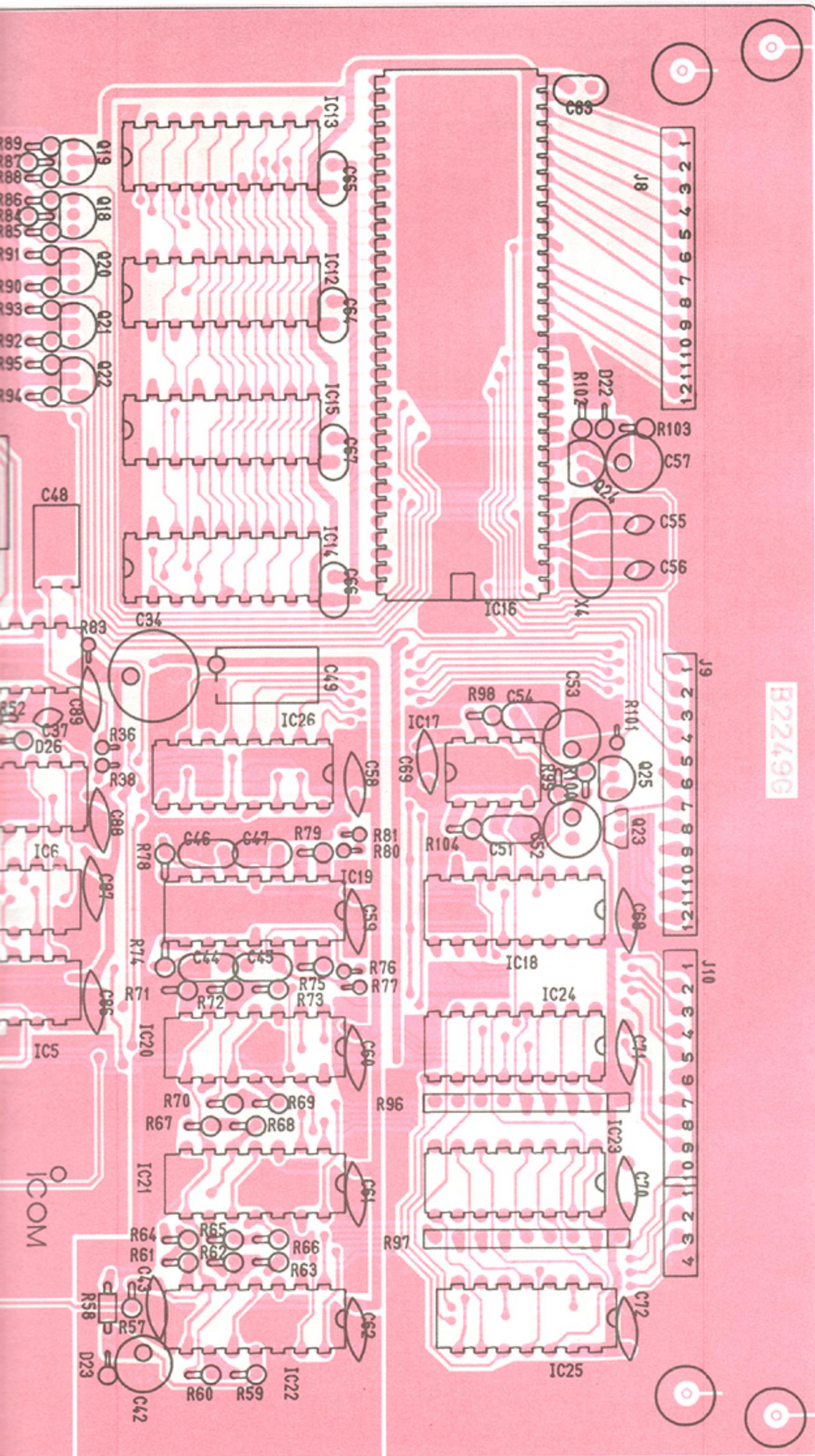
9-5-2 INSTALLATION

- ① After determining a desirable transom mounting location, drill 2 holes.
- ② Fix the sensor using 2 self-tapping screws.

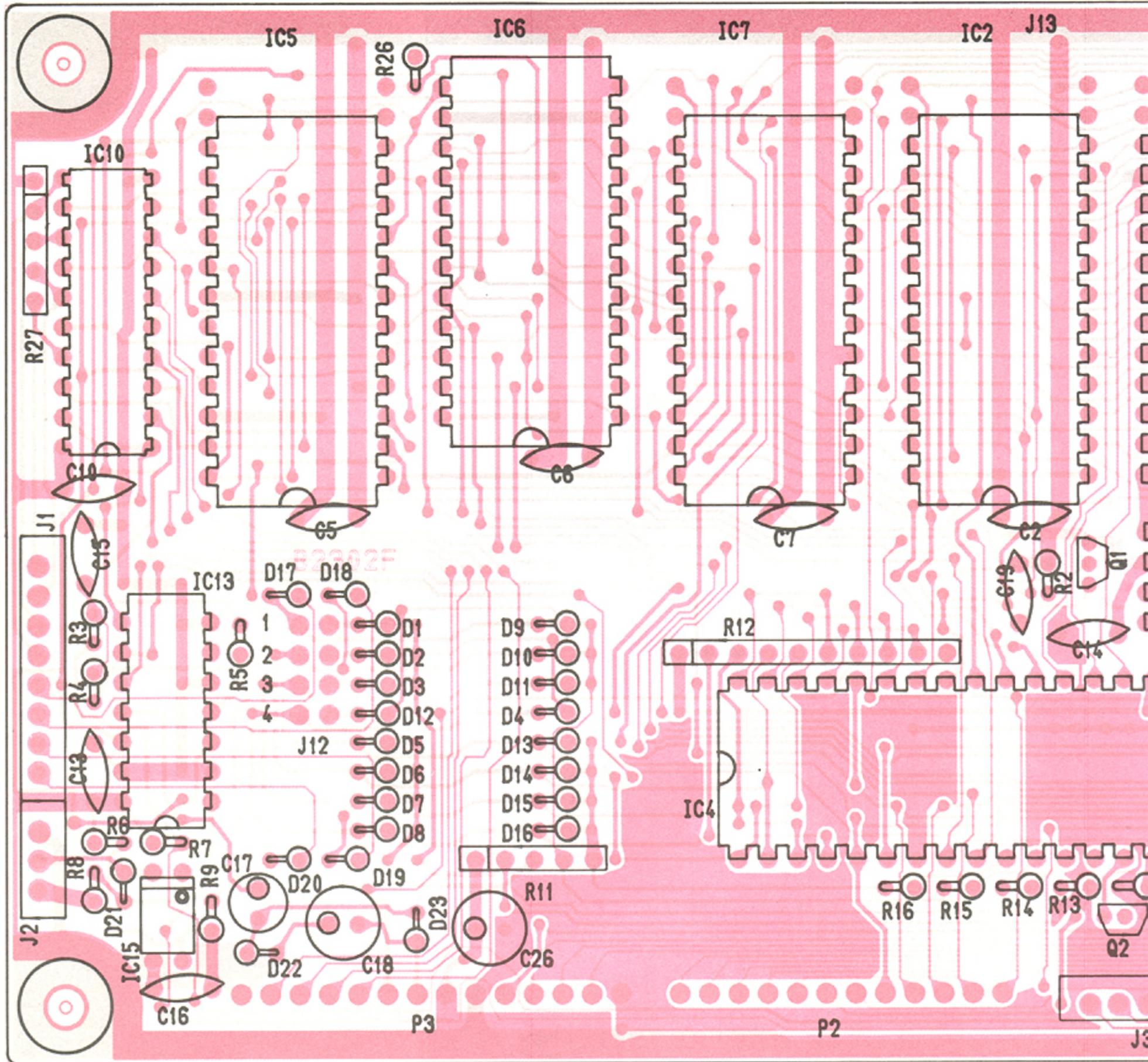
SECTION 10 BOARD LAYOUTS

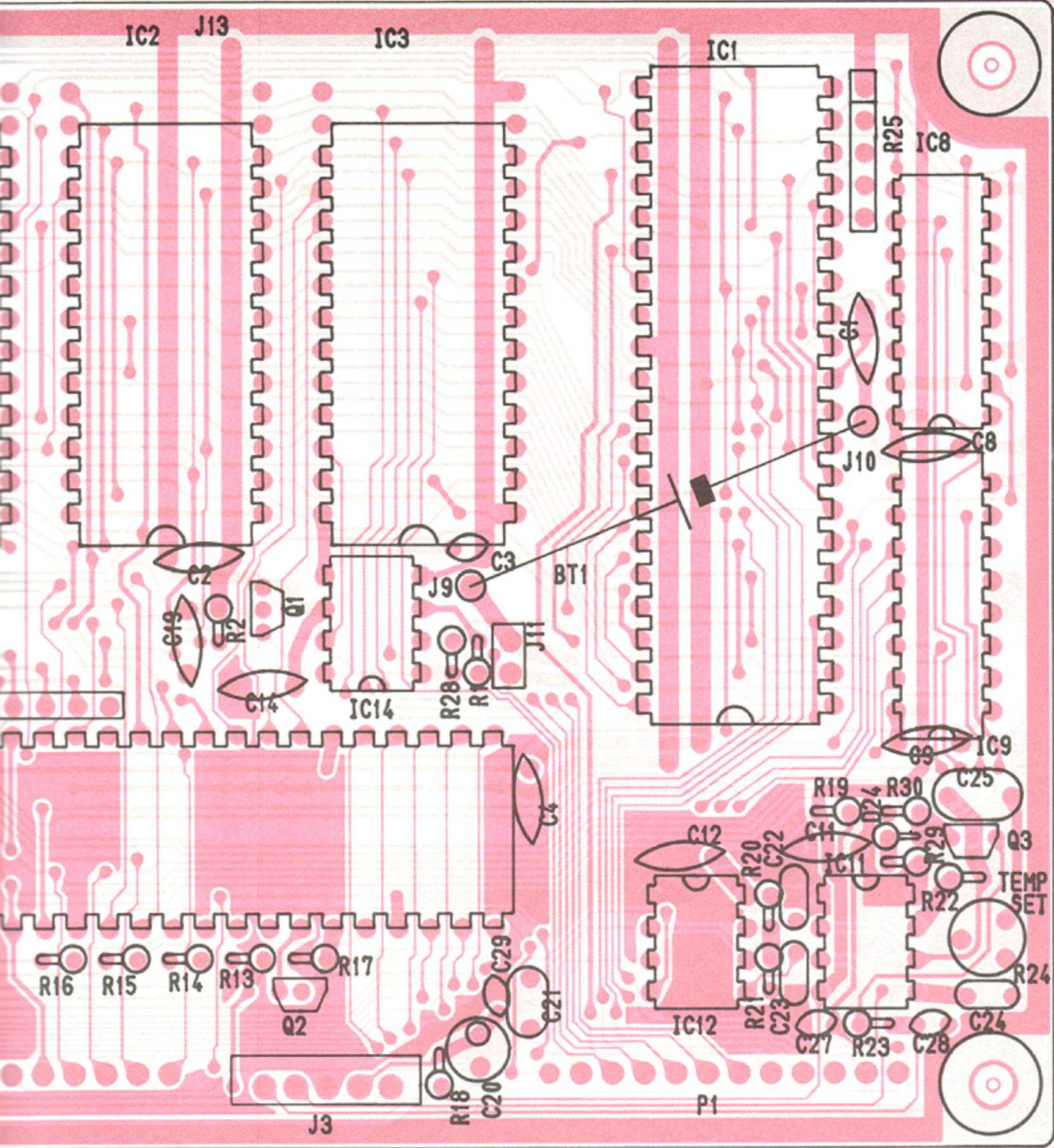
10-1 MAIN UNIT



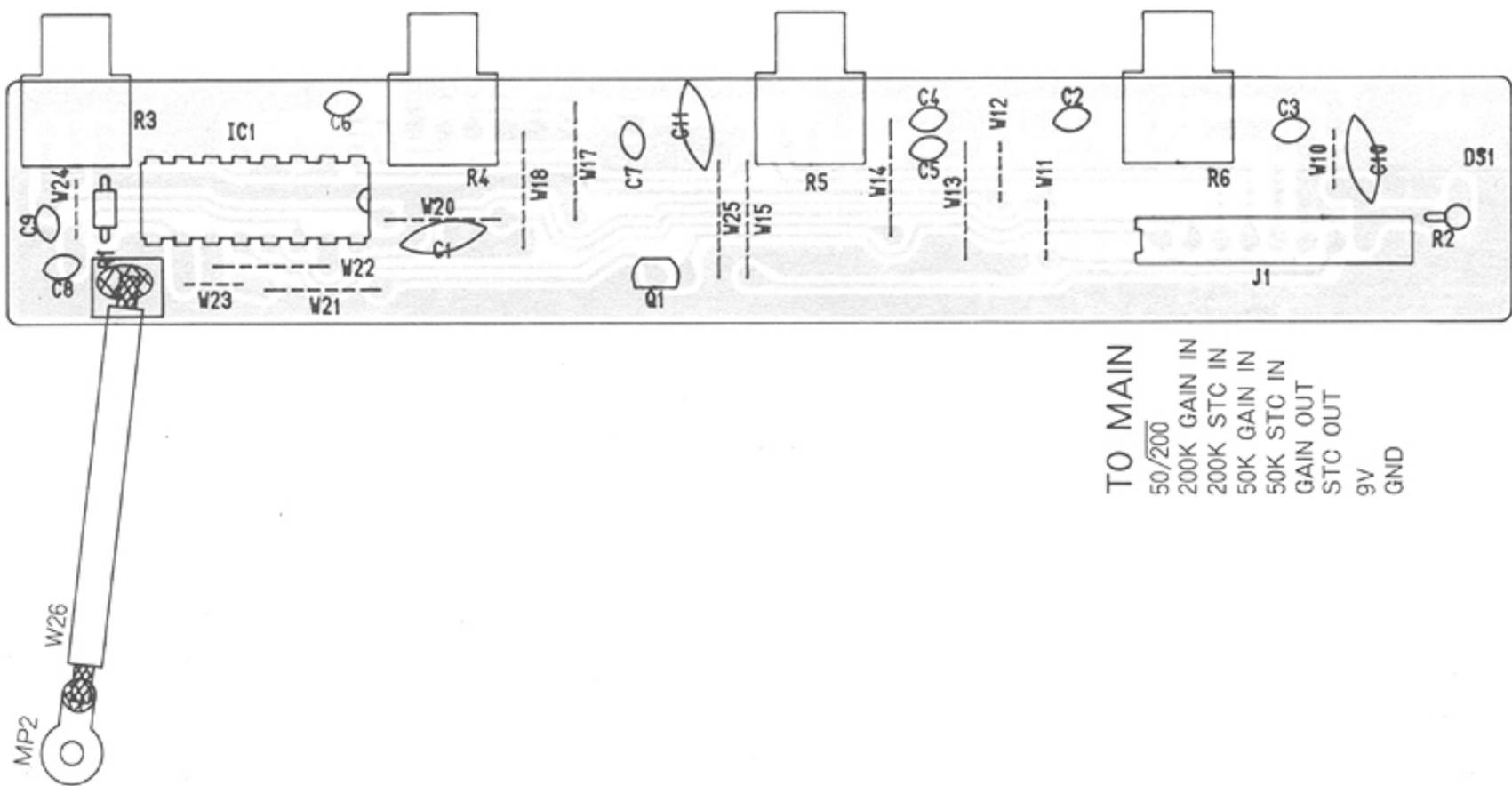


10-2 LOGIC UNIT

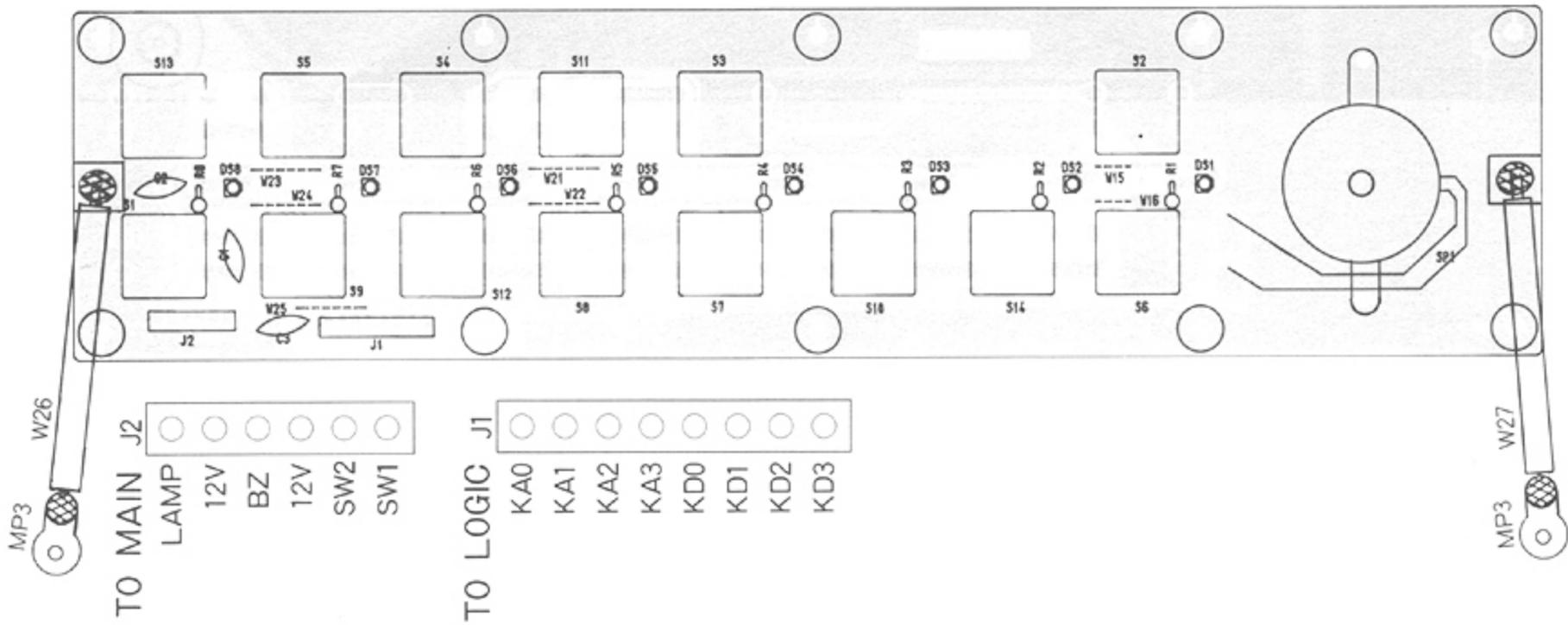




10-3 VR UNIT



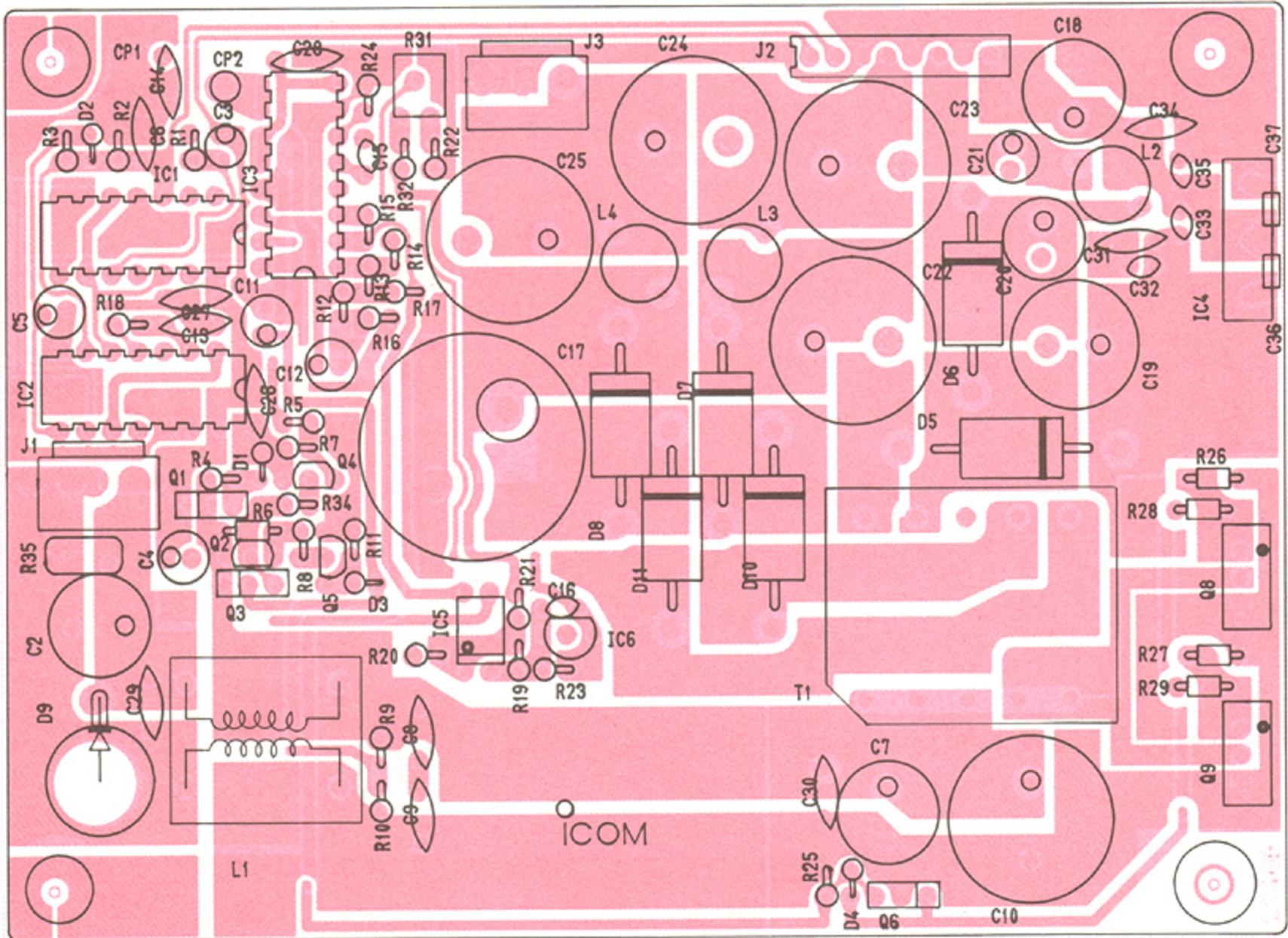
10-4 FRONT/SW UNIT



10-5 REG UNIT

TO MAIN

- SW1
- SW2
- GND
- 120V
- GND
- 12V
- GND
- 5V



SECTION 11 PARTS LIST

[ACC UNIT]

REF. NO.	ORDER NO.	DESCRIPTION	
F1	5210000060	Fuse	FGB 5A
W1	8900002810	OPC-Cable	OPC-275

[DISP-A UNIT]

REF. NO.	ORDER NO.	DESCRIPTION	
DS1	5070000020	CRT	MC-818DM1

[MAIN UNIT]

REF. NO.	ORDER NO.	DESCRIPTION	
IC1	1130002160	IC	μ PD4052BC
IC2	1110002290	IC	MC1350P
IC3	1110002290	IC	MC1350P
IC4	1110002290	IC	MC1350P
IC5	1130001270	IC	μ PD4069UBC
IC6	1130002060	IC	μ PD4024BC
IC7	1110000070	IC	μ PC358C
IC8	1130004980	IC	μ PD4539BC
IC9	1130000020	IC	TC4001UBP
IC10	1110000070	IC	μ PC358C
IC11	1130001750	IC	TC4093BP
IC12	1130005040	IC	HM50464RP12ML
IC13	1130005040	IC	HM50464RP12ML
IC14	1130005040	IC	HM50464RP12ML
IC15	1130005040	IC	HM50464RP12ML
IC16	1130005210	IC	RP5C16
IC17	1110002310	IC	NJM062D
IC18	1130005090	IC	TC74HC4051AP
IC19	1110002320	IC	NJM064D
IC20	1110002230	IC	μ PC339C
IC21	1110002230	IC	μ PC339C
IC22	1110002230	IC	μ PC339C
IC23	1130005060	IC	TC74HC148AP
IC24	1130005060	IC	TC74HC148AP
IC25	1130004270	IC	TC74HC00AP
IC26	1110002240	IC	BA12003
IC27	1180000080	IC	NJM78L09A

Q1	1530000050	Transistor	2SC1815-GR
Q2	1530000050	Transistor	2SC1815-GR
Q3	1530000050	Transistor	2SC1815-GR
Q4	1510000220	Transistor	2SA1345
Q5	1560000610	FET	2SK894
Q7	1560000610	FET	2SK894
Q9	1530000050	Transistor	2SC1815-GR
Q10	1510000060	Transistor	2SA1015-GR
Q11	1530002300	Transistor	2SC4051
Q12	1530002770	Transistor	2SC2230-Y
Q13	1530002770	Transistor	2SC2230-Y
Q15	1530000960	Transistor	2SC3399
Q16	1530000050	Transistor	2SC1815-GR
Q17	1510000060	Transistor	2SA1015-GR
Q18	1530000050	Transistor	2SC1815-GR
Q19	1530000050	Transistor	2SC1815-GR
Q20	1510000060	Transistor	2SA1015-GR
Q21	1510000060	Transistor	2SA1015-GR
Q22	1510000060	Transistor	2SA1015-GR
Q23	1530000970	Transistor	2SC3402
Q24	1510000060	Transistor	2SA1015-GR
Q25	1530000050	Transistor	2SC1815-GR
Q26	1530000110	Transistor	2SC2458-GR

[MAIN UNIT]

REF. NO.	ORDER NO.	DESCRIPTION	
D1	1710000680	Diode	1N4148
D2	1710000680	Diode	1N4148
D3	1710000680	Diode	1N4148
D4	1710000680	Diode	1N4148
D5	1710000680	Diode	1N4148
D6	1710000680	Diode	1N4148
D7	1710000680	Diode	1N4148
D8	1710000680	Diode	1N4148
D11	1790000800	Diode	VR-60SS
D12	1790000800	Diode	VR-60SS
D14	1790000800	Diode	VR-60SS
D15	1710000330	Diode	1K60
D16	1710000330	Diode	1K60
D17	1710000160	Diode	1SS133
D18	1710000160	Diode	1SS133
D19	1710000050	Diode	1SS53
D22	1710000540	Diode	1S1588
D23	1730001800	Zener	RD7.5E B1
D24	1790000800	Diode	VR-60SS
D26	1710000160	Diode	1SS133
L1	6140001010	Coil	LR-125
L2	6150003650	Coil	LS-412
L3	6150003660	Coil	LS-413
L4	6150003670	Coil	LS-414
L5	6150003680	Coil	LS-415
L6	6150003690	Coil	LS-416
L7	6150003700	Coil	LS-417
RL3	6330000180	Relay	MZ-12HG
T1	5920000360	Transformer	TO-22
F11	2020000150	Filter	CFW455HT
X1	6060000460	Ceralock	CSB507E
X2	6060000410	Ceralock	CSB655P
X3	6060000400	Ceralock	CSA3.20MG
X4	6050004780	Crystal	RF-4A3 FAK NKD
R1	7070000640	Resistor	CRH200 R-02J 470 Ω
R2	7010004150	Resistor	R20J 470 Ω
R3	7010003490	Resistor	ELR20J 5.6k Ω
R4	7010003360	Resistor	ELR20J 470 Ω
R5	7010003490	Resistor	ELR20J 5.6k Ω
R6	7010004150	Resistor	R20J 470 Ω
R7	7010003490	Resistor	ELR20J 5.6k Ω
R8	7010003360	Resistor	ELR20J 470 Ω
R9	7010003490	Resistor	ELR20J 5.6k Ω
R10	7010003420	Resistor	ELR20J 1.5k Ω
R11	7010003420	Resistor	ELR20J 1.5k Ω
R12	7010003440	Resistor	ELR20J 2.2k Ω
R14	7010003600	Resistor	ELR20J 33k Ω
R15	7010003660	Resistor	ELR20J 100k Ω
R16	7010003620	Resistor	ELR20J 47k Ω
R17	7010004340	Resistor	R20J 15k Ω
R18	7010003420	Resistor	ELR20J 1.5k Ω
R19	7010003540	Resistor	ELR20J 12k Ω
R21	7010003620	Resistor	ELR20J 47k Ω
R22	7010003620	Resistor	ELR20J 47k Ω
R26	7010004380	Resistor	R20J 27k Ω
R27	7010003620	Resistor	ELR20J 47k Ω
R28	7010003620	Resistor	ELR20J 47k Ω
R29	7010003530	Resistor	ELR20J 10k Ω

[MAIN UNIT]

REF. NO.	ORDER NO.	DESCRIPTION
R30	7010003780	Resistor ELR20J 1M Ω
R31	7010003530	Resistor ELR20J 10k Ω
R32	7010003780	Resistor ELR20J 1M Ω
R34	7010003780	Resistor ELR20J 1M Ω
R35	7010003620	Resistor ELR20J 47k Ω
R36	7010003530	Resistor ELR20J 10k Ω
R38	7010003530	Resistor ELR20J 10k Ω
R39	7010003210	Resistor ELR20J 27 Ω
R41	7010003210	Resistor ELR20J 27 Ω
R43	7070000650	Resistor CRH100X R-02J 15k Ω
R44	7010003700	Resistor ELR20J 220k Ω
R45	7310000770	Trimmer RH0651CN4J0TA
R46	7010003530	Resistor ELR20J 10k Ω
R48	7510000100	Thermistor ERT-D2FGL601S
R49	7010003540	Resistor ELR20J 12k Ω
R51	7010003530	Resistor ELR20J 10k Ω
R52	7010003530	Resistor ELR20J 10k Ω
R53	7010003630	Resistor ELR20J 56k Ω
R54	7010003490	Resistor ELR20J 5.6k Ω
R55	7010003530	Resistor ELR20J 10k Ω
R56	7010003300	Resistor ELR20J 150 Ω
R57	7010003440	Resistor ELR20J 2.2k Ω
R58	7010004230	Resistor R20J 2.2k Ω
R59	7010003420	Resistor ELR20J 1.5k Ω
R60	7010003390	Resistor ELR20J 820 Ω
R61	7010003370	Resistor ELR20J 560 Ω
R62	7010003400	Resistor ELR20J 1k Ω
R63	7010003450	Resistor ELR20J 2.7k Ω
R64	7010003350	Resistor ELR20J 390 Ω
R65	7010003290	Resistor ELR20J 120 Ω
R66	7010003350	Resistor ELR20J 390 Ω
R67	7010003330	Resistor ELR20J 270 Ω
R68	7010003340	Resistor ELR20J 330 Ω
R69	7010003330	Resistor ELR20J 270 Ω
R70	7010003320	Resistor ELR20J 220 Ω
R71	7010003390	Resistor ELR20J 820 Ω
R73	7010003310	Resistor ELR20J 180 Ω
R74	7010003280	Resistor ELR20J 100 Ω
R75	7010003280	Resistor ELR20J 100 Ω
R76	7010003400	Resistor ELR20J 1k Ω
R77	7010003400	Resistor ELR20J 1k Ω
R78	7010003280	Resistor ELR20J 100 Ω
R79	7010003280	Resistor ELR20J 100 Ω
R80	7010003400	Resistor ELR20J 1k Ω
R81	7010003400	Resistor ELR20J 1k Ω
R82	7010004770	Resistor R50XJ 330 Ω
R83	7010003400	Resistor ELR20J 1k Ω
R84	7010003480	Resistor ELR20J 4.7k Ω
R85	7010003400	Resistor ELR20J 1k Ω
R86	7010003360	Resistor ELR20J 470 Ω
R87	7010003480	Resistor ELR20J 4.7k Ω
R88	7010003400	Resistor ELR20J 1k Ω
R89	7010003360	Resistor ELR20J 470 Ω
R90	7010003400	Resistor ELR20J 1k Ω
R91	7010003360	Resistor ELR20J 470 Ω
R92	7010003400	Resistor ELR20J 1k Ω
R93	7010003360	Resistor ELR20J 470 Ω
R94	7010003400	Resistor ELR20J 1k Ω
R95	7010003360	Resistor ELR20J 470 Ω
R96	7410000180	Array RMX-8 103K
R97	7410000180	Array RMX-8 103K
R98	7010003280	Resistor ELR20J 100 Ω
R99	7010003400	Resistor ELR20J 1k Ω
R100	7010003400	Resistor ELR20J 1k Ω
R101	7010003340	Resistor ELR20J 330 Ω
R102	7010003330	Resistor ELR20J 270 Ω
R103	7010003400	Resistor ELR20J 1k Ω
R104	7010003280	Resistor ELR20J 100 Ω
R105	7010003280	Resistor ELR20J 100 Ω
R106	7010003300	Resistor ELR20J 150 Ω
R107	7010003280	Resistor ELR20J 100 Ω
R108	7010003300	Resistor ELR20J 150 Ω
R110	7010003280	Resistor ELR20J 100 Ω
R111	7010003280	Resistor ELR20J 100 Ω
R119	7010003550	Resistor ELR20J 15k Ω

[MAIN UNIT]

REF. NO.	ORDER NO.	DESCRIPTION
R120	7010003440	Resistor ELR20J 2.2k Ω
R121	7010003430	Resistor ELR20J 1.8k Ω
R122	7010003330	Resistor ELR20J 270 Ω
R124	7010004190	Resistor R20J 1k Ω
R125	7010003640	Resistor ELR20J 68k Ω
R126	7010003640	Resistor ELR20J 68k Ω
R127	7310000790	Trimmer RH0651C15J1UA
R128	7310000790	Trimmer RH0651C15J1UA
R129	7310000790	Trimmer RH0651C15J1UA
R130	7310000790	Trimmer RH0651C15J1UA
R131	7310000790	Trimmer RH0651C15J1UA
R132	7310000790	Trimmer RH0651C15J1UA
R133	7010003530	Resistor ELR20J 10k Ω
C1	4040000260	Barrier Layer UZE 08X 104M
C2	4510002640	Electrolytic 25 SS 47 μ F
C3	4040000260	Barrier Layer UZE 08X 104M
C4	4310000750	Mylar ECH-S 1H822JZ
C5	4310000740	Mylar ECH-S 1H472JZ
C6	4010005160	Ceramic DE1207 B 222K 2KV
C7	4010005160	Ceramic DE1207 B 222K 2KV
C8	4310000720	Mylar HAC2K 103K
C9	4310000720	Mylar HAC2K 103K
C10	4310000730	Mylar ECH-S1821JZ
C11	4040000110	Barrier Layer UAT 04X 222K
C12	4040000430	Barrier Layer RAU 05SA 221K
C13	4040000110	Barrier Layer UAT 04X 222K
C14	4310000730	Mylar ECH-S1821JZ
C15	4040000260	Barrier Layer UZE 08X 104M
C16	4040000260	Barrier Layer UZE 08X 104M
C17	4510001490	Electrolytic 50 MS5 3R3 μ F
C21	4010000500	Ceramic DD104 B 102K 50V
C23	4010000920	Ceramic DD107 CH 820J 50V
C24	4010000720	Ceramic DD104 CH 120J 50V
C25	4010000940	Ceramic DD107 CH 101J 50V
C26	4010000880	Ceramic DD106 CH 560J 50V
C27	4010000650	Ceramic DD104 CH 050C 50V
C28	4010000800	Ceramic DD105 CH 270J 50V
C29	4040000260	Barrier Layer UZE 08X 104M
C30	4040000260	Barrier Layer UZE 08X 104M
C31	4510004210	Electrolytic 180 RSP 470 M B30
C33	4040000260	Barrier Layer UZE 08X 104M
C34	4510002350	Electrolytic 16 MS9 220 μ F
C35	4040000260	Barrier Layer UZE 08X 104M
C36	4010000330	Ceramic DD105 SL 101J 50V
C37	4010000330	Ceramic DD105 SL 101J 50V
C38	4610001380	Trimmer ECRAA120F11
C39	4610001380	Trimmer ECRAA120F11
C40	4610000820	Trimmer ECRGA035M30
C42	4510001360	Electrolytic 16 MS5 22 μ F
C43	4010000530	Ceramic DD112 B 103K 50V
C44	4310000020	Mylar F2D 50V 103K
C45	4310000020	Mylar F2D 50V 103K
C46	4310000020	Mylar F2D 50V 103K
C47	4310000020	Mylar F2D 50V 103K
C48	4510001770	Electrolytic 16 RBP 10 μ F
C49	4510002870	Electrolytic 25 SS 100 μ F
C50	4510002440	Electrolytic 16 SS 220 μ F
C51	4310000010	Mylar F2D 50V 102K
C52	4510001360	Electrolytic 16 MS5 22 μ F
C53	4510001360	Electrolytic 16 MS5 22 μ F
C54	4310000020	Mylar F2D 50V 103K
C55	4010000220	Ceramic DD104 SL 330J 50V
C56	4010000220	Ceramic DD104 SL 330J 50V
C57	4510001360	Electrolytic 16 MS5 22 μ F
C58	4010000570	Ceramic DD108 F 223Z 50V
C59	4010000570	Ceramic DD108 F 223Z 50V
C60	4010000570	Ceramic DD108 F 223Z 50V
C61	4010000570	Ceramic DD108 F 223Z 50V
C62	4010000570	Ceramic DD108 F 223Z 50V
C63	4560000020	Ceramic D33Y5V 1E 104Z21
C64	4560000020	Ceramic D33Y5V 1E 104Z21
C65	4560000020	Ceramic D33Y5V 1E 104Z21
C66	4560000020	Ceramic D33Y5V 1E 104Z21

[MAIN UNIT]

REF. NO.	ORDER NO.	DESCRIPTION	
C67	4560000020	Ceramic	D33Y5V 1E 104Z21
C68	4010000570	Ceramic	DD108 F 223Z 50V
C69	4010000570	Ceramic	DD108 F 223Z 50V
C70	4010000570	Ceramic	DD108 F 223Z 50V
C71	4010000570	Ceramic	DD108 F 223Z 50V
C72	4010000570	Ceramic	DD108 F 223Z 50V
C77	4510002810	Electrolytic	16 SS 47 μ F
C78	4510002810	Electrolytic	16 SS 47 μ F
C79	4510002810	Electrolytic	16 SS 47 μ F
C80	4040000260	Barrier Layer	UZE 08X 104M
C81	4040000260	Barrier Layer	UZE 08X 104M
C82	4510002940	Electrolytic	50 SS 1 μ F
C83	4040000190	Barrier Layer	UAT 05X 103K
C84	4040000260	Barrier Layer	UZE 08X 104M
C85	4040000260	Barrier Layer	UZE 08X 104M
C86	4040000260	Barrier Layer	UZE 08X 104M
C87	4040000260	Barrier Layer	UZE 08X 104M
C88	4040000260	Barrier Layer	UZE 08X 104M
C89	4040000260	Barrier Layer	UZE 08X 104M
C90	4040000260	Barrier Layer	UZE 08X 104M
C91	4040000260	Barrier Layer	UZE 08X 104M
C92	4010000330	Ceramic	DD105 SL 101J 50V
C93	4010000330	Ceramic	DD105 SL 101J 50V
C94	4310000010	Mylar	F2D 50V 102K

J1	6510002270	Connector	TL25P05V1
J2	6510003440	Connector	B08B-EH-S
J3	6510003390	Connector	B03B-EH-S
J4	6510002270	Connector	TL25P05V1
J5	6510003420	Connector	B06B-EH-S
J6	6510003420	Connector	B06B-EH-S
J7	6510003450	Connector	B09B-EH-S
J8	6510007340	Connector	SB12P-HVQ-CA
J9	6510007340	Connector	SB12P-HVQ-CA
J10	6510010290	Connector	SB14P-HVQ-CA

CP1	6510003100	Check Point	RT01T-1.3B
CP2	6510003100	Check Point	RT01T-1.3B
CP3	6510003100	Check Point	RT01T-1.3B
CP4	6510003100	Check Point	RT01T-1.3B

EP1	0910023677	P.C.Board	B 2249G
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[LOGIC UNIT]

REF. NO.	ORDER NO.	DESCRIPTION	
IC1	1140001500	IC	TMPZ84C00AP-6
IC2	1130005620	IC	SC-1150
IC3	1130003770	IC	HM6264ALP15LL
IC4	1140001520	IC	TMP82C55AP-2
IC5	1140001530	IC	TMP82C51AP-2
IC6	1140001540	IC	TMP82C54P-2
IC7	1140001510	IC	TMPZ84C30AP-6
IC8	1130005070	IC	TC74HC139AP
IC9	1130005080	IC	TC74HC138AP
IC10	1130004290	IC	TC74HC244AP
IC11	1110001460	IC	μ PC1555C
IC12	1110001460	IC	μ PC1555C
IC13	1130002551	IC	TC74HC32AP
IC14	1110002390	IC	PST-532A
IC15	1170000170	IC	TLP521-1
Q1	1510000220	Transistor	2SA1345
Q2	1530000970	Transistor	2SC3402
Q3	1510000080	Transistor	2SA1048-GR

[LOGIC UNIT]

REF. NO.	ORDER NO.	DESCRIPTION	
D1	1710000540	Diode	1S1588
D2	1710000540	Diode	1S1588
D3	1710000540	Diode	1S1588
D4	1710000540	Diode	1S1588
D12	1710000540	Diode	1S1588
D13	1710000540	Diode	1S1588
D17	1710000540	Diode	1S1588
D18	1710000540	Diode	1S1588
D19	1710000540	Diode	1S1588
D20	1710000540	Diode	1S1588
D21	1710000540	Diode	1S1588
D22	1710000540	Diode	1S1588
D23	1710000540	Diode	1S1588
D24	1710000160	Diode	1S1588
R1	7010003370	Resistor	ELR20J 560 Ω
R2	7010003530	Resistor	ELR20J 10k Ω
R3	7010003530	Resistor	ELR20J 10k Ω
R4	7010003530	Resistor	ELR20J 10k Ω
R5	7010003660	Resistor	ELR20J 100k Ω
R6	7010003480	Resistor	ELR20J 4.7k Ω
R7	7010003530	Resistor	ELR20J 10k Ω
R8	7010003360	Resistor	ELR20J 470 Ω
R9	7010003530	Resistor	ELR20J 10k Ω
R11	7410000080	Array	RMX-4 473K
R12	7410000500	Array	RKM10L 103J
R13	7010003480	Resistor	ELR20J 4.7k Ω
R14	7010003480	Resistor	ELR20J 4.7k Ω
R15	7010003480	Resistor	ELR20J 4.7k Ω
R16	7010003480	Resistor	ELR20J 4.7k Ω
R17	7010003480	Resistor	ELR20J 4.7k Ω
R18	7010003280	Resistor	ELR20J 100 Ω
R19	7010003400	Resistor	ELR20J 1k Ω
R20	7010003400	Resistor	ELR20J 1k Ω
R21	7010003560	Resistor	ELR20J 18k Ω
R22	7010003380	Resistor	ELR20J 680 Ω
R23	7010003360	Resistor	ELR20J 470 Ω
R24	7310000690	Trimmer	RH0651CN2J02A
R25	7410000080	Array	RMX-4 473K
R26	7010003660	Resistor	ELR20J 100k Ω
R27	7410000080	Array	RMX-4 473K
R28	7010003530	Resistor	ELR20J 10k Ω
R29	7010003540	Resistor	ELR20J 12k Ω
R30	7010003600	Resistor	ELR20J 33k Ω
C1	4010000570	Ceramic	DD108 F 223Z 50V
C2	4010000570	Ceramic	DD108 F 223Z 50V
C3	4560000060	Ceramic	D33Y5V 1H 104Z21
C4	4010000570	Ceramic	DD108 F 223Z 50V
C5	4010000570	Ceramic	DD108 F 223Z 50V
C6	4010000570	Ceramic	DD108 F 223Z 50V
C7	4010000570	Ceramic	DD108 F 223Z 50V
C8	4010000570	Ceramic	DD108 F 223Z 50V
C9	4010000570	Ceramic	DD108 F 223Z 50V
C10	4010000570	Ceramic	DD108 F 223Z 50V
C11	4010000570	Ceramic	DD108 F 223Z 50V
C12	4010000570	Ceramic	DD108 F 223Z 50V
C13	4010000570	Ceramic	DD108 F 223Z 50V
C14	4010000570	Ceramic	DD108 F 223Z 50V
C15	4010000530	Ceramic	DD112 B 103K 50V
C16	4010004120	Ceramic	DD07 B 102K 500V
C17	4510001360	Electrolytic	16 MS5 22 μ F
C18	4510002650	Electrolytic	16 MS7 100 μ F
C19	4040000260	Barrier Layer	UZE 08X 104M
C20	4510001360	Electrolytic	16 MS5 22 μ F
C21	4310000050	Mylar	F2D 50V 222K
C22	4310000200	Mylar	F2D 50V 153K
C23	4310000020	Mylar	F2D 50V 103K
C24	4310000020	Mylar	F2D 50V 103K
C25	4310000120	Mylar	F2D 50V 473K
C26	4510002650	Electrolytic	16 MS7 100 μ F
C27	4010000500	Ceramic	DD104 B 102K 50V
C28	4010000500	Ceramic	DD104 B 102K 50V

[LOGIC UNIT]

REF. NO.	ORDER NO.	DESCRIPTION	
C29	4010000500	Ceramic	DD104 B 102K 50V
BT1	3020000020	Lithium Battery	BR2032-1T2
J1	6510003440	Connector	B08B-EH-S
J2	6510003390	Connector	B03B-EH-S
J3	6510003410	Connector	B05B-EH-S
J9	6510003080	Connector	RT01T-1.0B
J10	6510003080	Connector	RT01T-1.0B
J11	6910003140	Connector	IMSA-9202B-1-02T
J12	6910003160	Connector	IMSA-9202B-2-08T
J13	2610000200	Crystal Socket	ICC05-028 360T
P1	6510011770	Plug	HKP-12FDS2
P2	6510011770	Plug	HKP-12FDS2
P3	6510011790	Plug	HKP-14FDS2
P4	6910001010	Connector	IMSA-9201B-HT
P6	6910001010	Connector	IMSA-9201B-HT
P7	6910001010	Connector	IMSA-9201B-HT
P8	6910001010	Connector	IMSA-9201B-HT
EP1	0910024346	P.C.Board	B 2302F

[FRONT/SW UNIT]

REF. NO.	ORDER NO.	DESCRIPTION	
R1	7010003380	Resistor	ELR20J 680Ω
R2	7010003380	Resistor	ELR20J 680Ω
R3	7010003380	Resistor	ELR20J 680Ω
R4	7010003380	Resistor	ELR20J 680Ω
R5	7010003380	Resistor	ELR20J 680Ω
R6	7010003380	Resistor	ELR20J 680Ω
R7	7010003380	Resistor	ELR20J 680Ω
R8	7010003380	Resistor	ELR20J 680Ω
C1	4040000260	Barrier Layer	UZE 08X 104M
C2	4040000260	Barrier Layer	UZE 08X 104M
C3	4040000260	Barrier Layer	UZE 08X 104M
DS1	5040000820	LED	SLN-210MC
DS2	5040000820	LED	SLN-210MC
DS3	5040000820	LED	SLN-210MC
DS4	5040000820	LED	SLN-210MC
DC5	5040000820	LED	SLN-210MC
DS6	5040000820	LED	SLN-210MC
DS7	5040000820	LED	SLN-210MC
DS8	5040000820	LED	SLN-210MC
S1	2260000720	Switch	SKHKAA064A
S2	2260000720	Switch	SKHKAA064A
S3	2260000720	Switch	SKHKAA064A
S4	2260000720	Switch	SKHKAA064A
S5	2260000720	Switch	SKHKAA064A
S6	2260000720	Switch	SKHKAA064A
S7	2260000720	Switch	SKHKAA064A
S8	2260000720	Switch	SKHKAA064A
S9	2260000720	Switch	SKHKAA064A
S10	2260000720	Switch	SKHKAA064A
S11	2260000720	Switch	SKHKAA064A
S12	2260000720	Switch	SKHKAA064A
S13	2260000720	Switch	SKHKAA064A
S14	2260000720	Switch	SKHKAA064A
SP1	2520000070	Speaker	EFBRQ38C01

[FRONT/SW UNIT]

REF. NO.	ORDER NO.	DESCRIPTION	
EP1	0910027651	P.C.Board	B 2771A

[VR UNIT]

REF. NO.	ORDER NO.	DESCRIPTION	
IC1	1130002160	IC	μPD4052BC
Q1	1530000960	Transistor	2SC3399
R1	7010004190	Resistor	R20J 1kΩ
R2	7010003360	Resistor	ELR20J 470Ω
R3	7210001010	Variable	RK097111000AA
R4	7210001010	Variable	RK097111000AA
R5	7210001010	Variable	RK097111000AA
R6	7210001010	Variable	RK097111000AA
C1	4040000260	Barrier Layer	UZE 08X 104M
C2	4560000060	Ceramic	D33Y5V 1H 104Z21
C3	4560000060	Ceramic	D33Y5V 1H 104Z21
C4	4560000060	Ceramic	D33Y5V 1H 104Z21
C5	4560000060	Ceramic	D33Y5V 1H 104Z21
C6	4560000060	Ceramic	D33Y5V 1H 104Z21
C7	4560000060	Ceramic	D33Y5V 1H 104Z21
C8	4560000060	Ceramic	D33Y5V 1H 104Z21
C9	4560000060	Ceramic	D33Y5V 1H 104Z21
C10	4040000260	Barrier Layer	UZE 08X 104M
C11	4040000260	Barrier Layer	UZE 08X 104M

DS1	5040001430	LED	SLB-25VR 3F
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EP1	0910027661	P.C.Board	B 2772A
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[REAR UNIT]

REF. NO.	ORDER NO.	DESCRIPTION	
F1	5210000060	Fuse	FGB 5A
F2	5220000140	Fuse Holder	FH-042
J1	6510007560	Connector	FM14-4S
J2	6510011420	Connector	31-10
J3	6510012160	Connector	FM214-8S
J4	6510011410	Connector	FM-143
EP1	6910000630	Bead core	FSOH070RN
EP2	6910000630	Bead core	FSOH070RN
EP3	6910000630	Bead core	FSOH070RN
EP4	6910000630	Bead core	FSOH070RN

[REG UNIT]

REF. NO.	ORDER NO.	DESCRIPTION	
IC1	1130000050	IC	TC4013BP
IC2	1130001750	IC	TC4093BP
IC3	1110001950	IC	μPC494C
IC4	1180000670	IC	SI-3052V
IC5	1170000190	IC	TLP521-1
IC6	1110002260	IC	μPC1093J

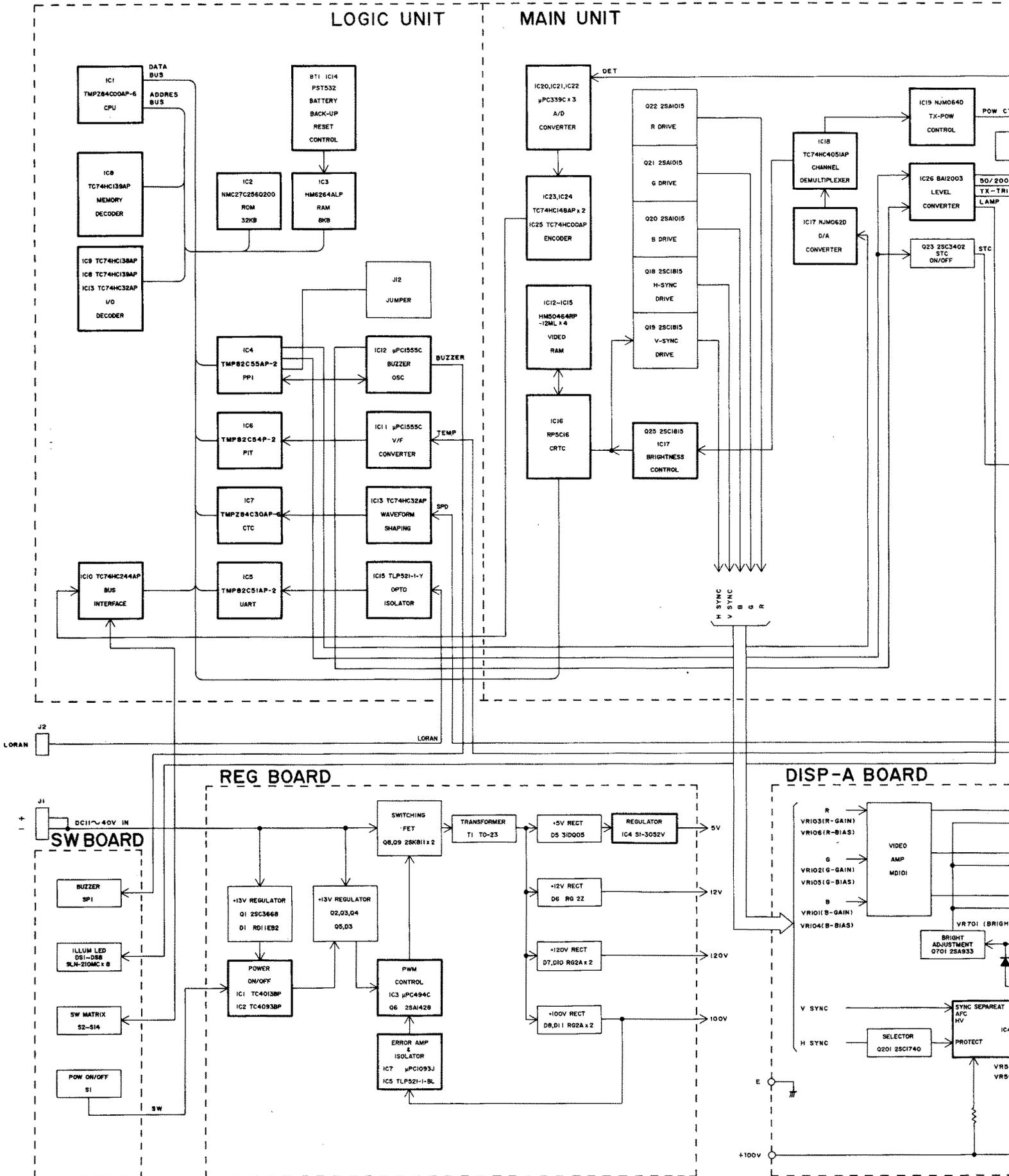
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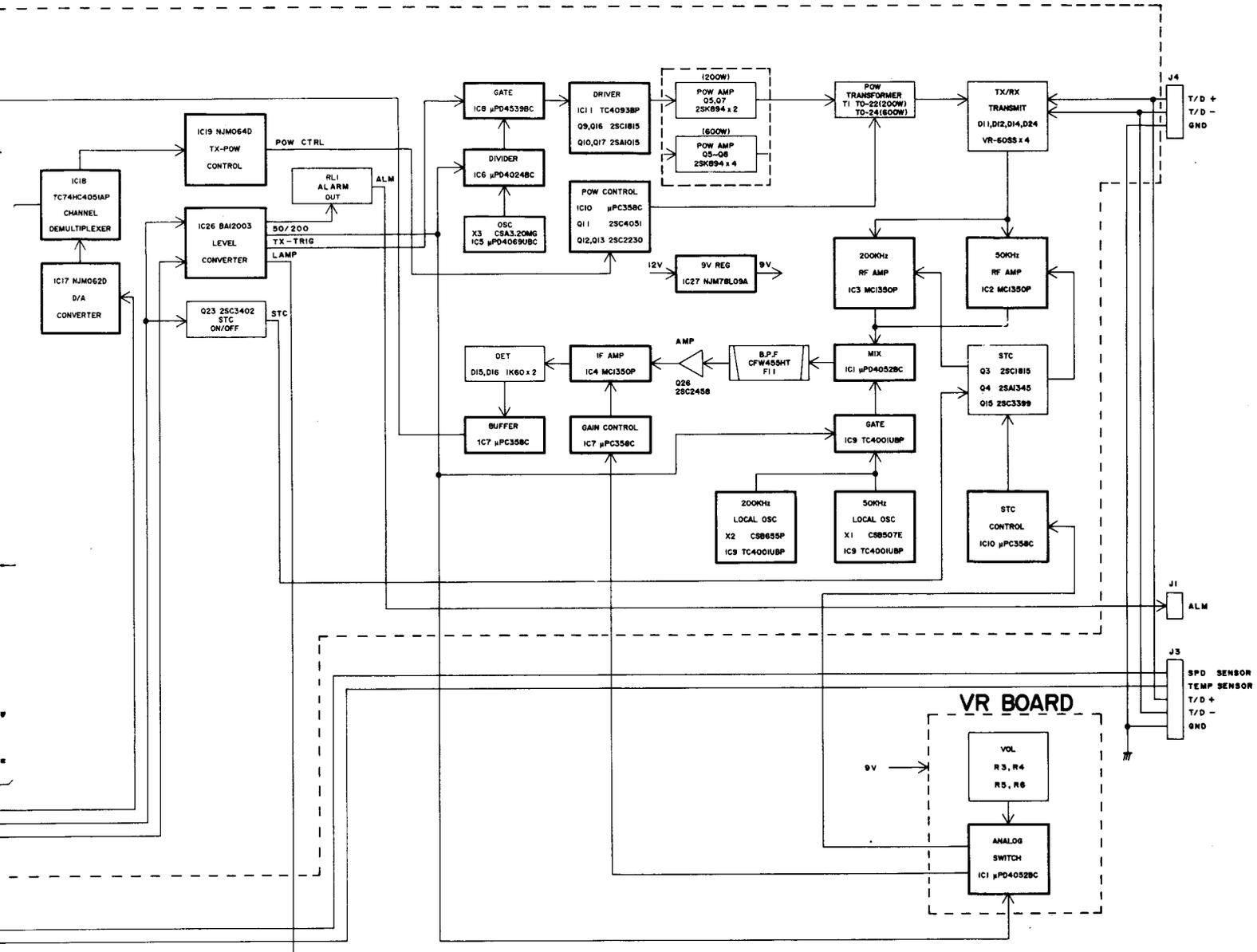
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Q1	1530002760	Transistor	2SC3668-Y
Q2	1510000250	Transistor	2SA1175 FF
Q3	1510000720	Transistor	2SA1428-Y
Q4	1530000591	Transistor	2SC2785 EL
Q5	1530000591	Transistor	2SC2785 EL
Q6	1510000720	Transistor	2SA1428-Y
Q8	1560000580	FET	2SK811
Q9	1560000580	FET	2SK811
D1	1730000240	Zener	RD11E B2
D2	1710000160	Diode	1SS133
D3	1730000240	Zener	RD11E B2
D4	1710000160	Diode	1SS133
D6	1790000770	Diode	RG-2Z
D7	1790000760	Diode	RG-2A
D8	1790000760	Diode	RG-2A
D9	1710000010	Diode	15CD11
D10	1790000760	Diode	RG-2A
D11	1790000760	Diode	RG-2A
L1	6190000640	Coil	TF2528S-102Y5R0-01
L2	6170000110	Coil	LW-12A
L3	6170000110	Coil	LW-12A
L4	6170000110	Coil	LW-12A
T1	5920000370	Transformer	TO-23
R1	7010003620	Resistor	ELR20J 47k Ω
R2	7010003530	Resistor	ELR20J 10k Ω
R3	7010003660	Resistor	ELR20J 100k Ω
R4	7010003530	Resistor	ELR20J 10k Ω
R5	7010003530	Resistor	ELR20J 10k Ω
R6	7010004320	Resistor	R20J 10k Ω
R7	7010003530	Resistor	ELR20J 10k Ω
R8	7010003490	Resistor	ELR20J 5.6k Ω
R9	7010003580	Resistor	ELR20J 22k Ω
R10	7010003600	Resistor	ELR20J 33k Ω
R11	7010003530	Resistor	ELR20J 10k Ω
R12	7010003580	Resistor	ELR20J 22k Ω
R13	7010003530	Resistor	ELR20J 10k Ω
R14	7010003530	Resistor	ELR20J 10k Ω
R15	7010003580	Resistor	ELR20J 22k Ω
R16	7010003450	Resistor	ELR20J 2.7k Ω
R17	7010003490	Resistor	ELR20J 5.6k Ω
R18	7010003530	Resistor	ELR20J 10k Ω
R19	7010003360	Resistor	ELR20J 470 Ω
R20	7010003480	Resistor	ELR20J 4.7k Ω
R21	7010003590	Resistor	ELR20J 27k Ω
R22	7010003400	Resistor	ELR20J 1k Ω
R23	7010003630	Resistor	ELR20J 56k Ω
R24	7010003510	Resistor	ELR20J 6.8k Ω
R25	7010003420	Resistor	ELR20J 1.5k Ω
R26	7010004220	Resistor	R20J 1.8k Ω
R27	7010004220	Resistor	R20J 1.8k Ω
R28	7010003980	Resistor	R20J 18 Ω
R29	7010003980	Resistor	R20J 18 Ω
R31	7310003350	Trimmer	RV-179
R32	7010003650	Resistor	ELR20J 82k Ω
R34	7010003490	Resistor	ELR20J 5.6k Ω
R35	7540000060	Surge Absorber	ERZC05DK560
C2	4510004390	Electrolytic	50 SS 330 μ F
C3	4550000340	Tantalum	DN 1C 100M
C4	4510002810	Electrolytic	16 SS 47 μ F
C5	4510002840	Electrolytic	25 SS 10 μ F
C6	4560000010	Ceramic	D55X5T 1H 104M
C7	4510004390	Electrolytic	50 SS 330 μ F
C8	4560000010	Ceramic	D55X5T 1H 104M
C9	4560000010	Ceramic	D55X5T 1H 104M
C10	4510003030	Electrolytic	50 SS 1000 μ F

[REG UNIT]

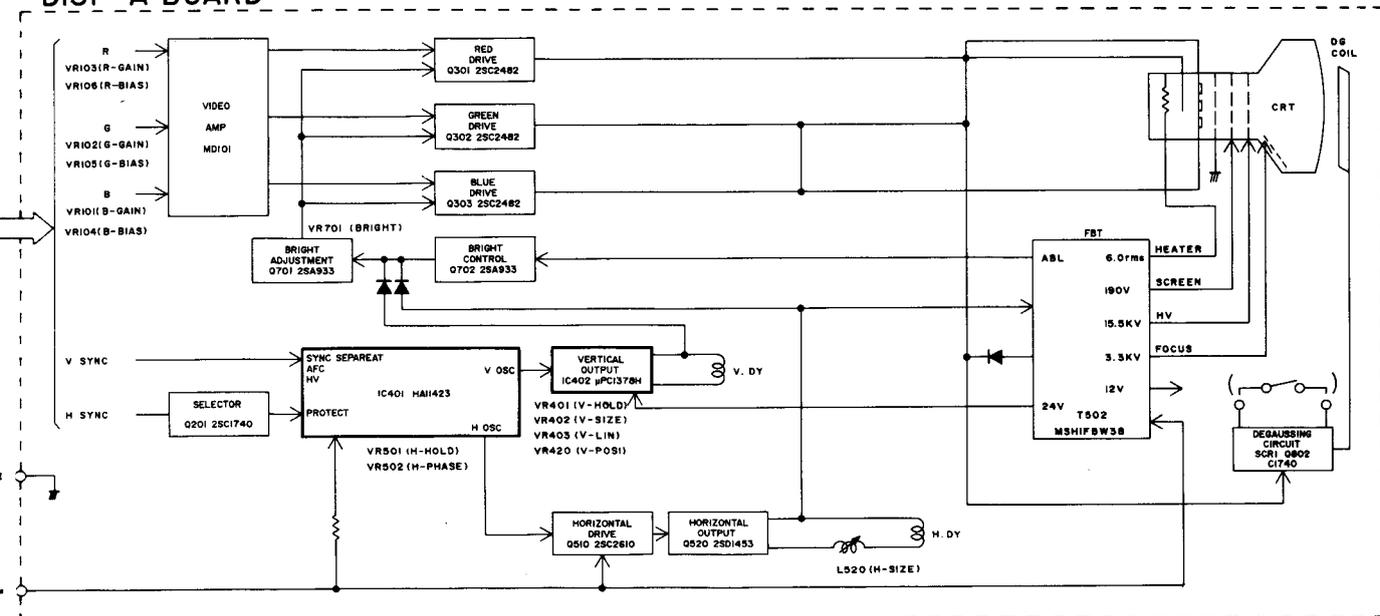
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C11	4510002810	Electrolytic	16 SS 47 μ F
C12	4510003040	Electrolytic	16 SS 100 μ F
C13	4010000530	Ceramic	DD112 B 103K 50V
C14	4010004120	Ceramic	DD07 B 102K 500V
C15	4310000010	Mylar	F2D 50V 102K
C16	4310000020	Mylar	F2D 50V 103K
C17	4510004190	Electrolytic	160 MXP 270 M A25
C18	4510002820	Electrolytic	16 SS 1000 μ F
C19	4510004280	Electrolytic	25 GXB 1000 μ F
C20	4510004270	Electrolytic	25 GXB 220 μ F
C21	4510003040	Electrolytic	16 SS 100 μ F
C22	4510004200	Electrolytic	160 TWSH 33 μ F
C23	4510004200	Electrolytic	160 TWSH 33 μ F
C24	4510004200	Electrolytic	160 TWSH 33 μ F
C25	4510004200	Electrolytic	160 TWSH 33 μ F
C26	4040000260	Barrier Layer	UZE 08X 104M
C27	4040000260	Barrier Layer	UZE 08X 104M
C28	4040000260	Barrier Layer	UZE 08X 104M
C29	4010000520	Ceramic	DD108 B 472K 50V
C30	4010000520	Ceramic	DD108 B 472K 50V
C31	4010000520	Ceramic	DD108 B 472K 50V
C32	4010000500	Ceramic	DD104 B 102K 50V
C33	4010000500	Ceramic	DD104 B 102K 50V
C34	4010000520	Ceramic	DD108 B 472K 50V
C35	4010000500	Ceramic	DD104 B 102K 50V
J1	6510011440	Connector	B4P-VH
J3	6510011430	Connector	B3P-VH
CP1	6510003100	Check Point	RT01T-1.3B
CP2	6510003100	Check Point	RT01T-1.3B
EP1	0910027902	P.C.Board	B 2746B
EP3	6910005020	Bead core	HF70BB3.5X10X1.3
EP4	6910005020	Bead core	HF70BB3.5X10X1.3
EP5	6910005030	Bead core	HF50BB5X10X1.8
EP6	6910005030	Bead core	HF50BB5X10X1.8

SECTION 12 BLOCK DIAGRAM



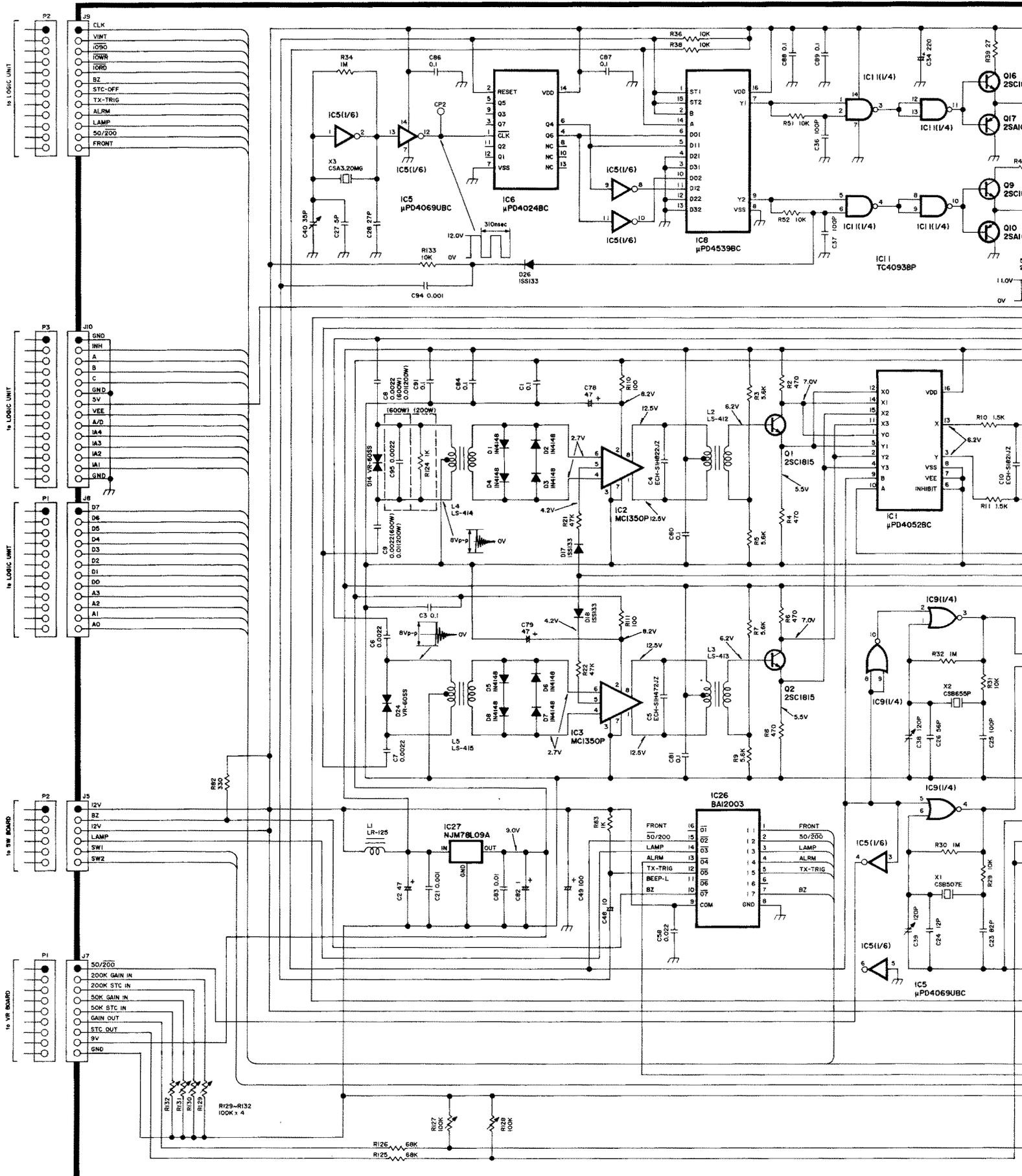


DISP-A BOARD

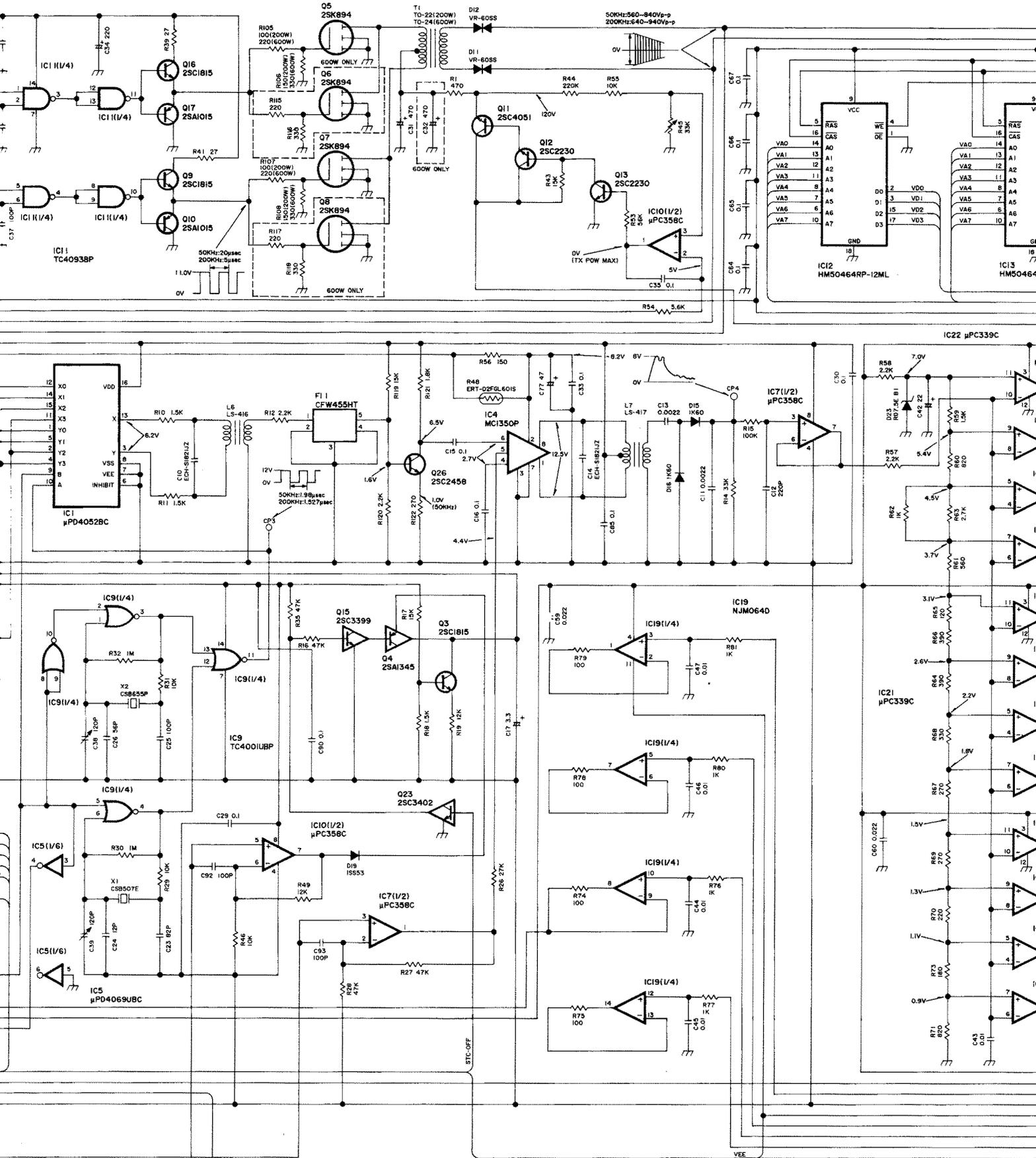


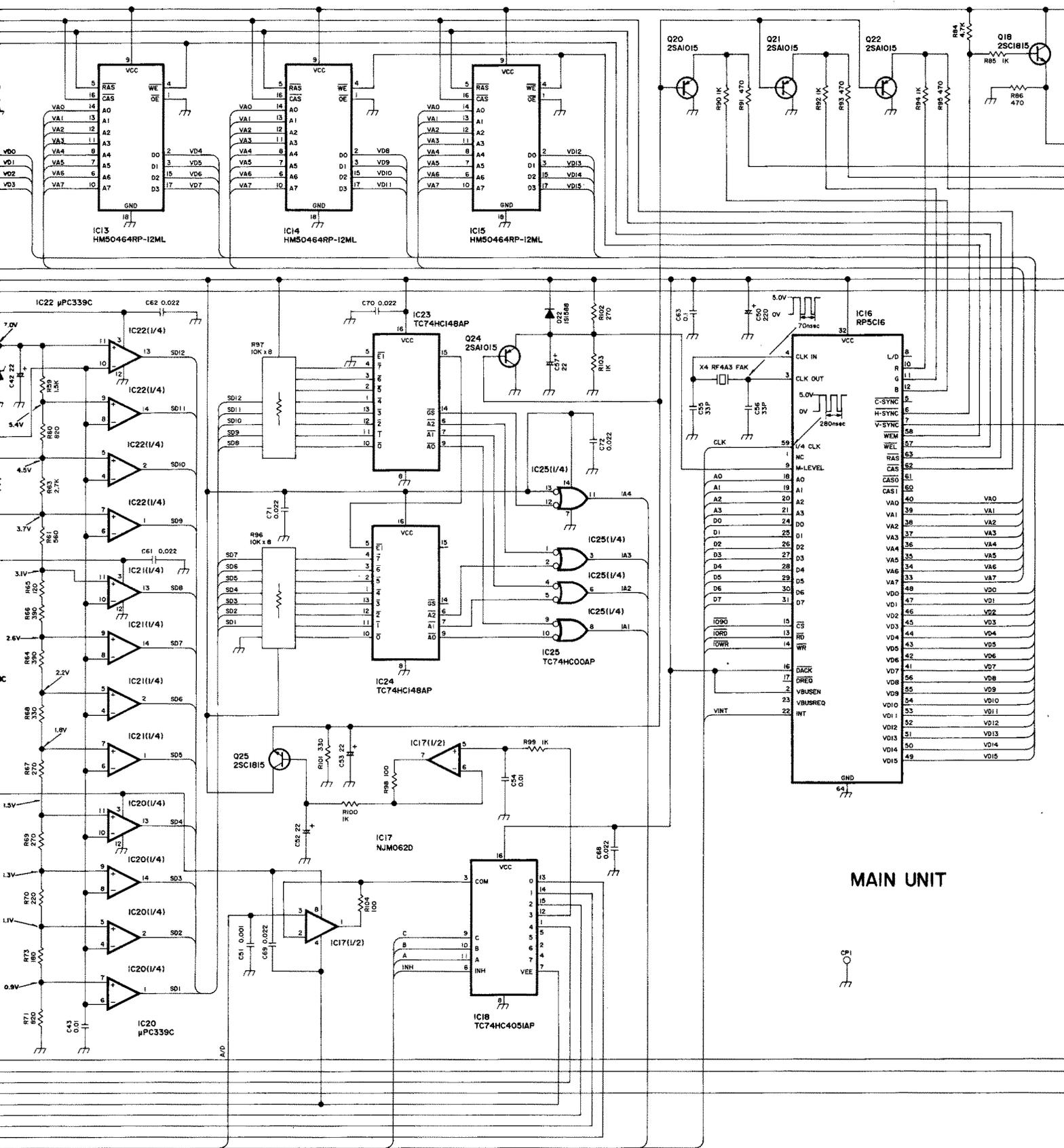
SECTION 13 VOLTAGE DIAGRAM

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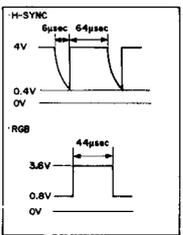
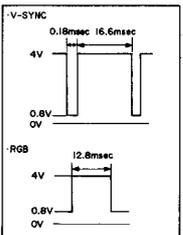
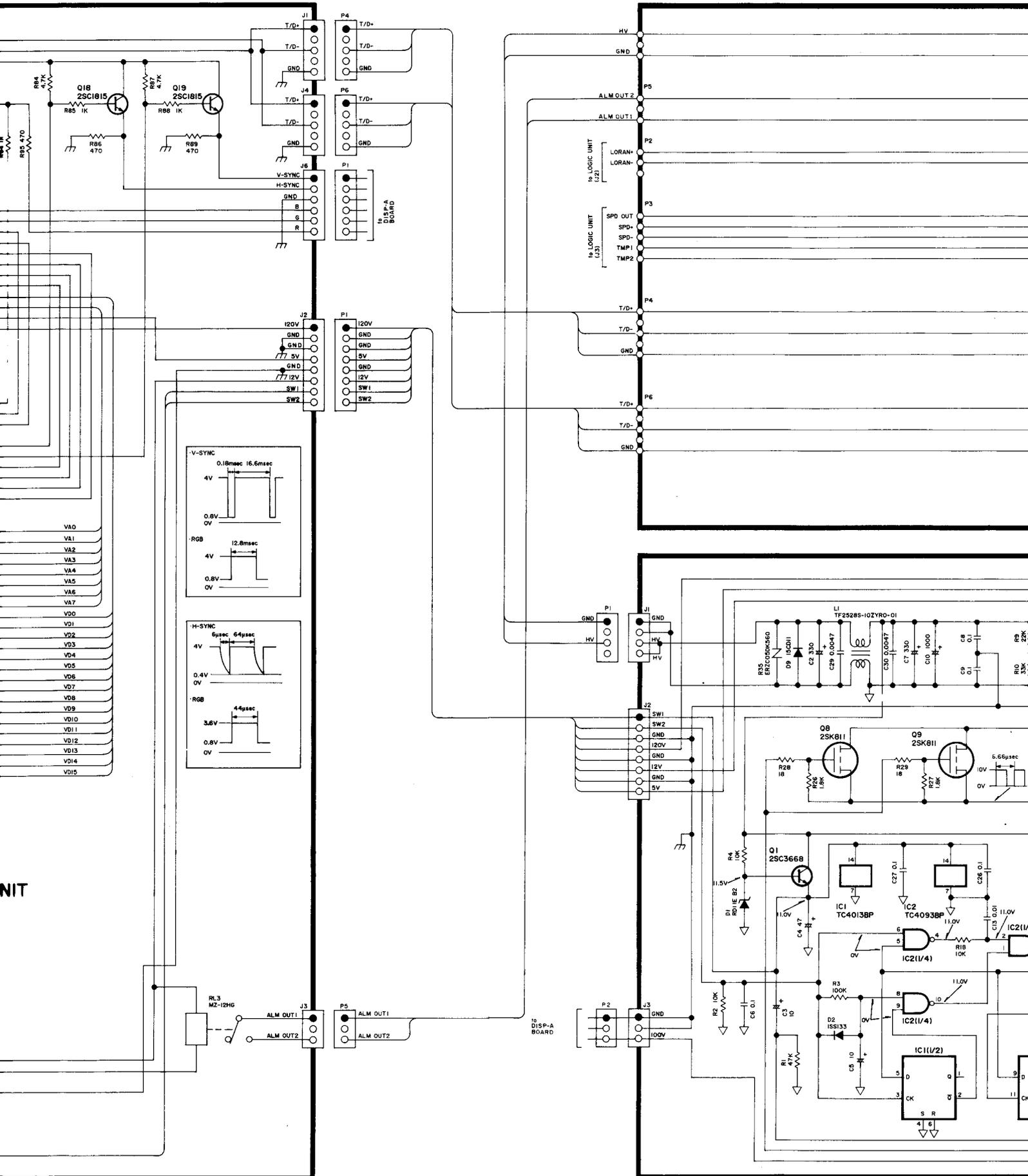
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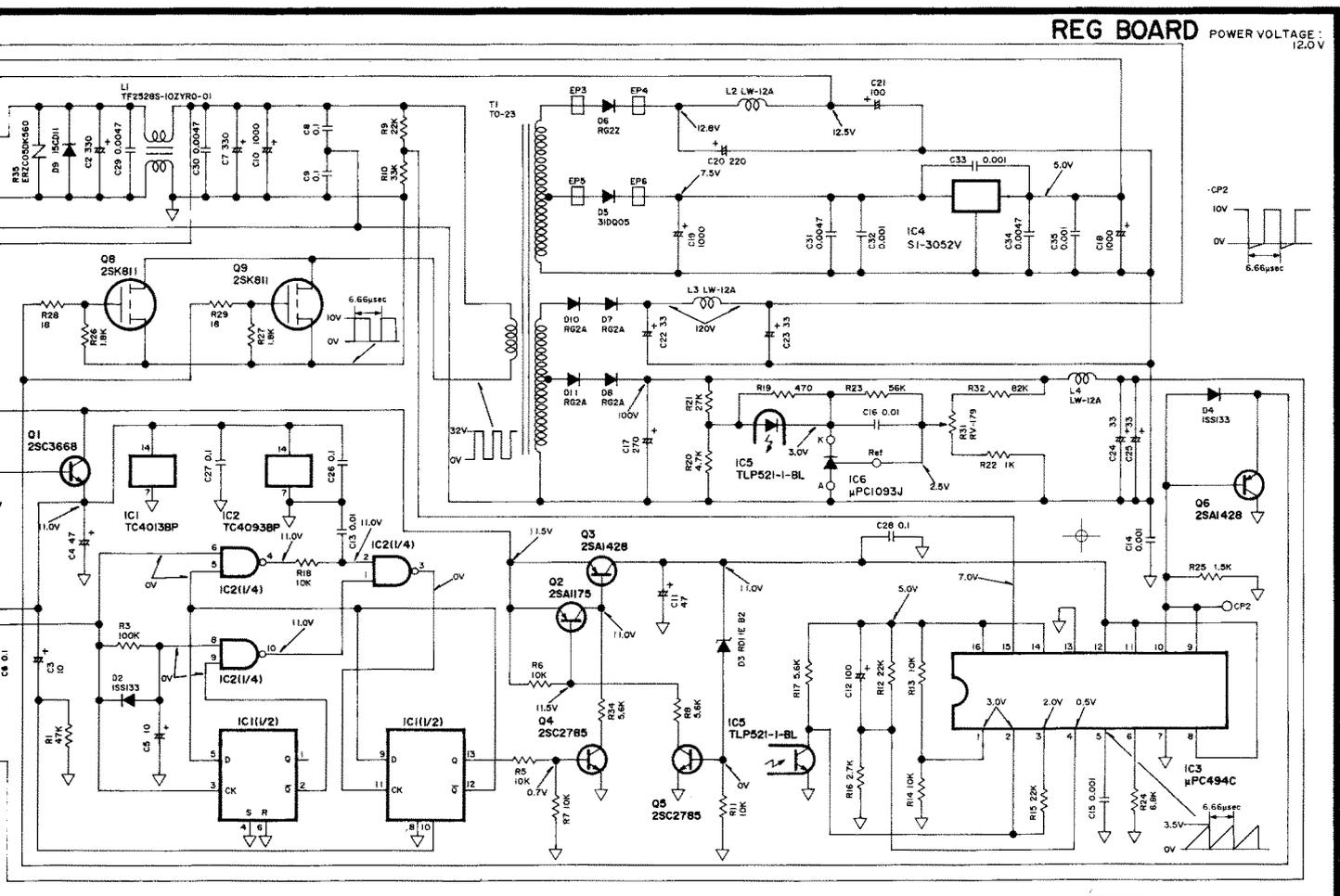
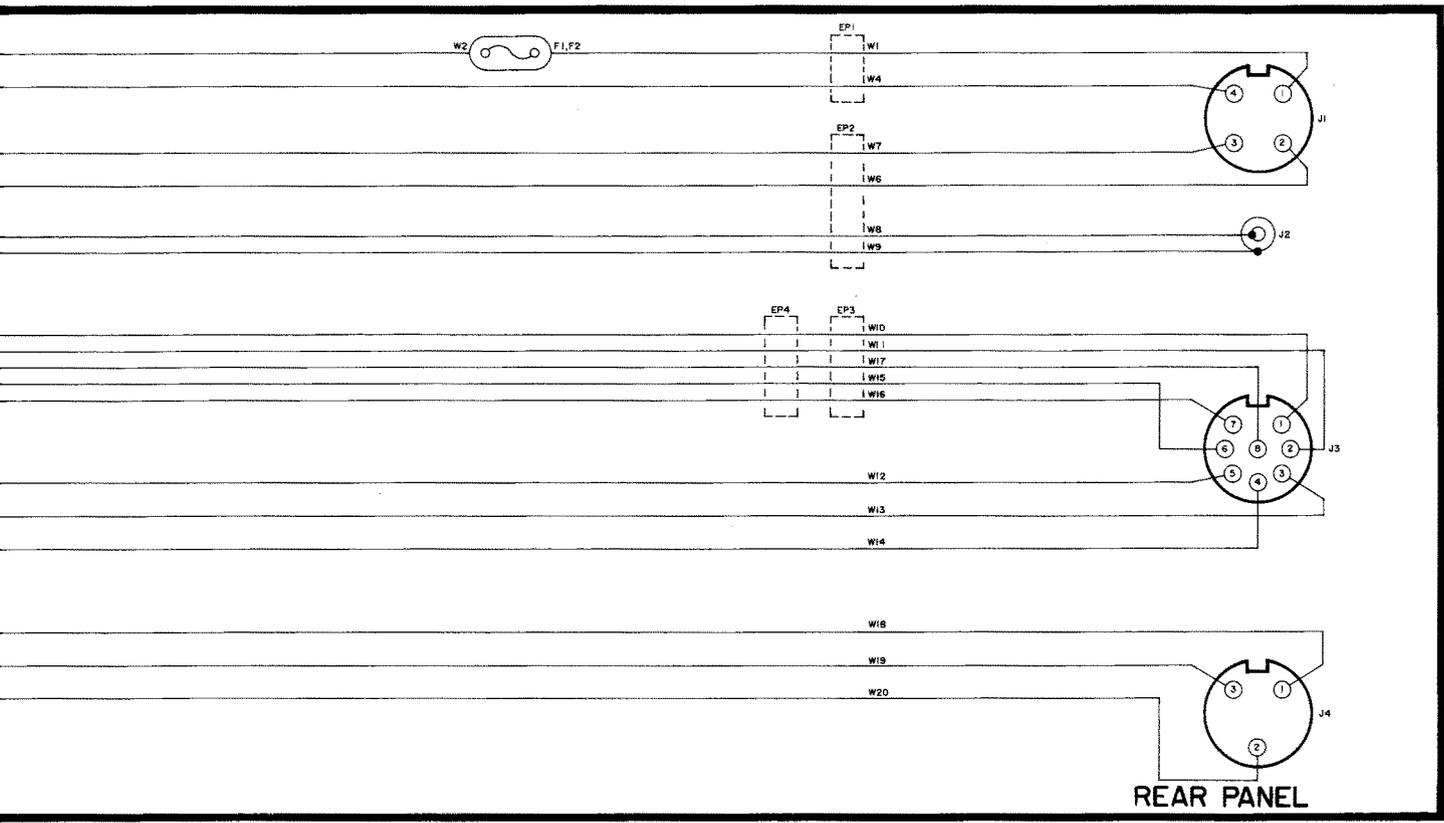
MAIN UNIT

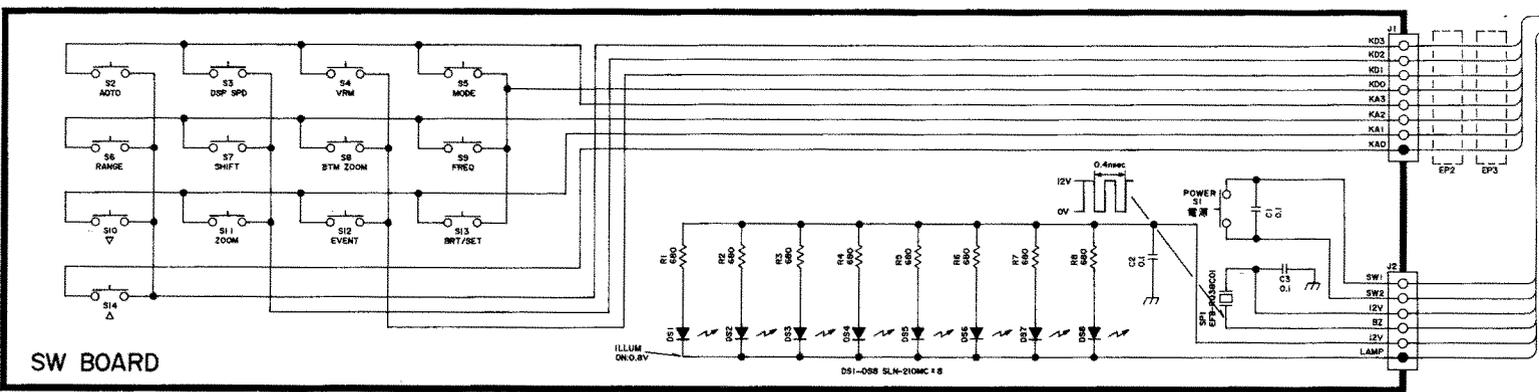
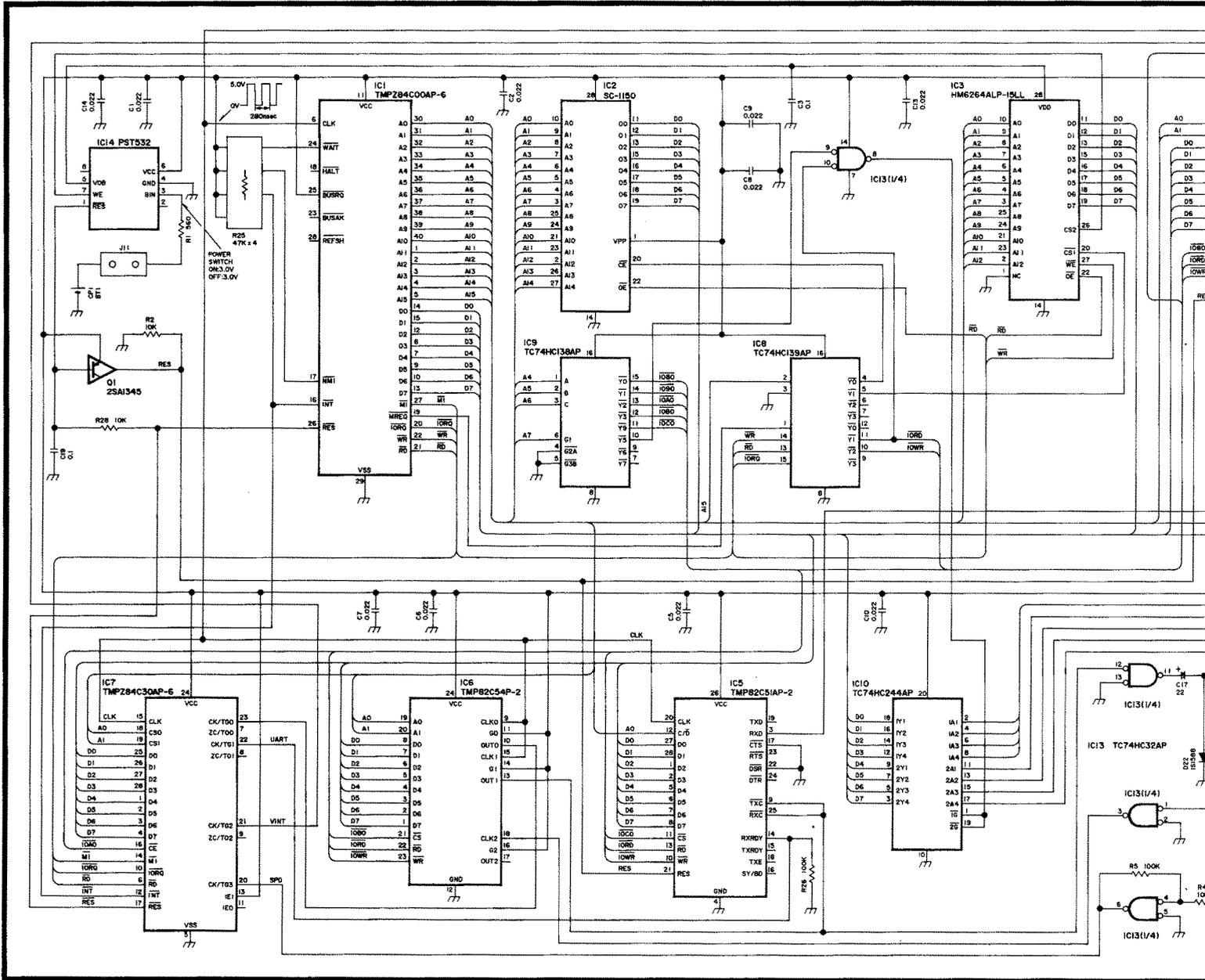




- VA0
- VA1
- VA2
- VA3
- VA4
- VA5
- VA6
- VA7
- VD0
- VD1
- VD2
- VD3
- VD4
- VD5
- VD6
- VD7
- VD8
- VD9
- VD10
- VD11
- VD12
- VD13
- VD14
- VD15

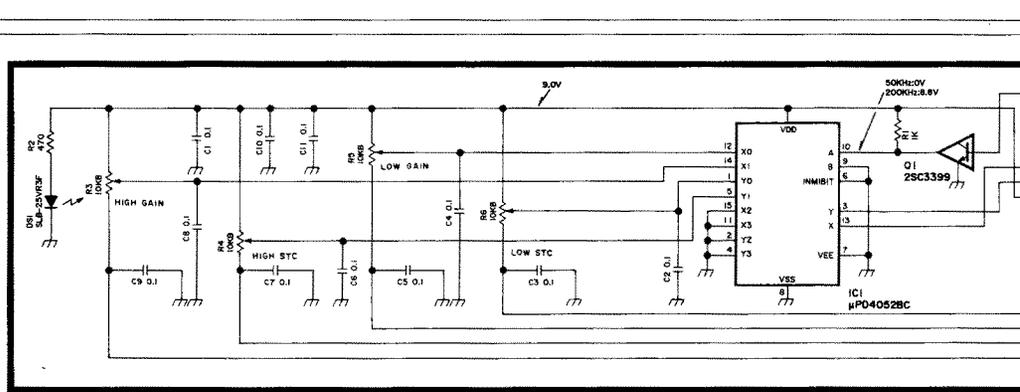
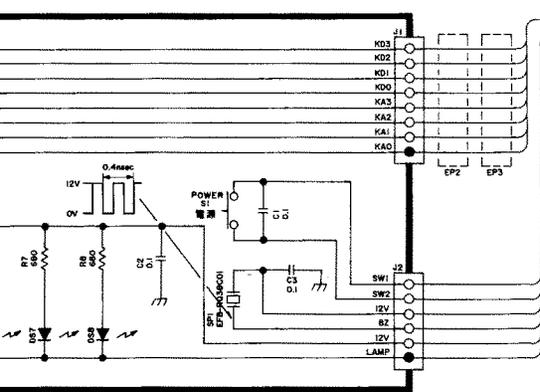
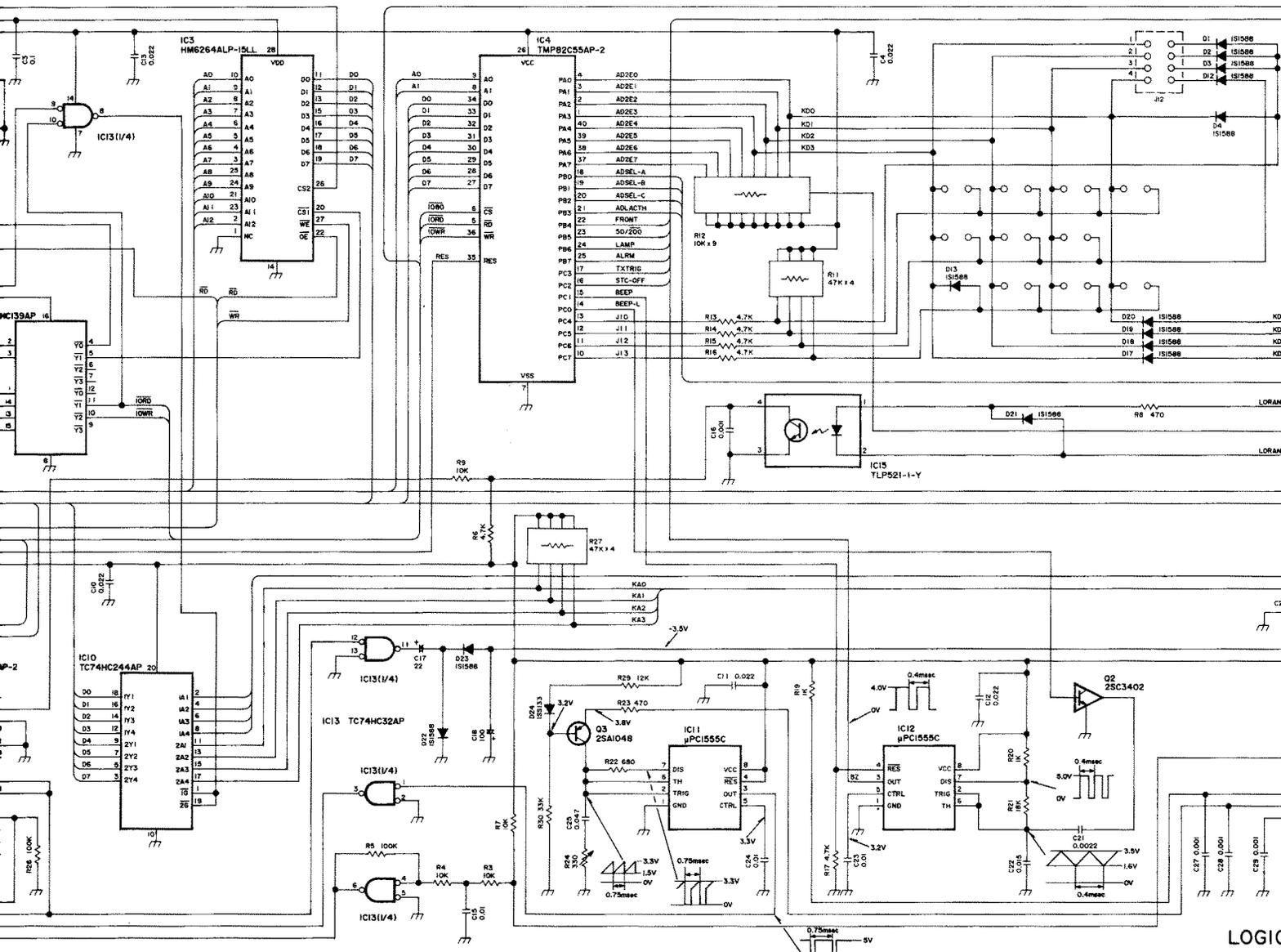
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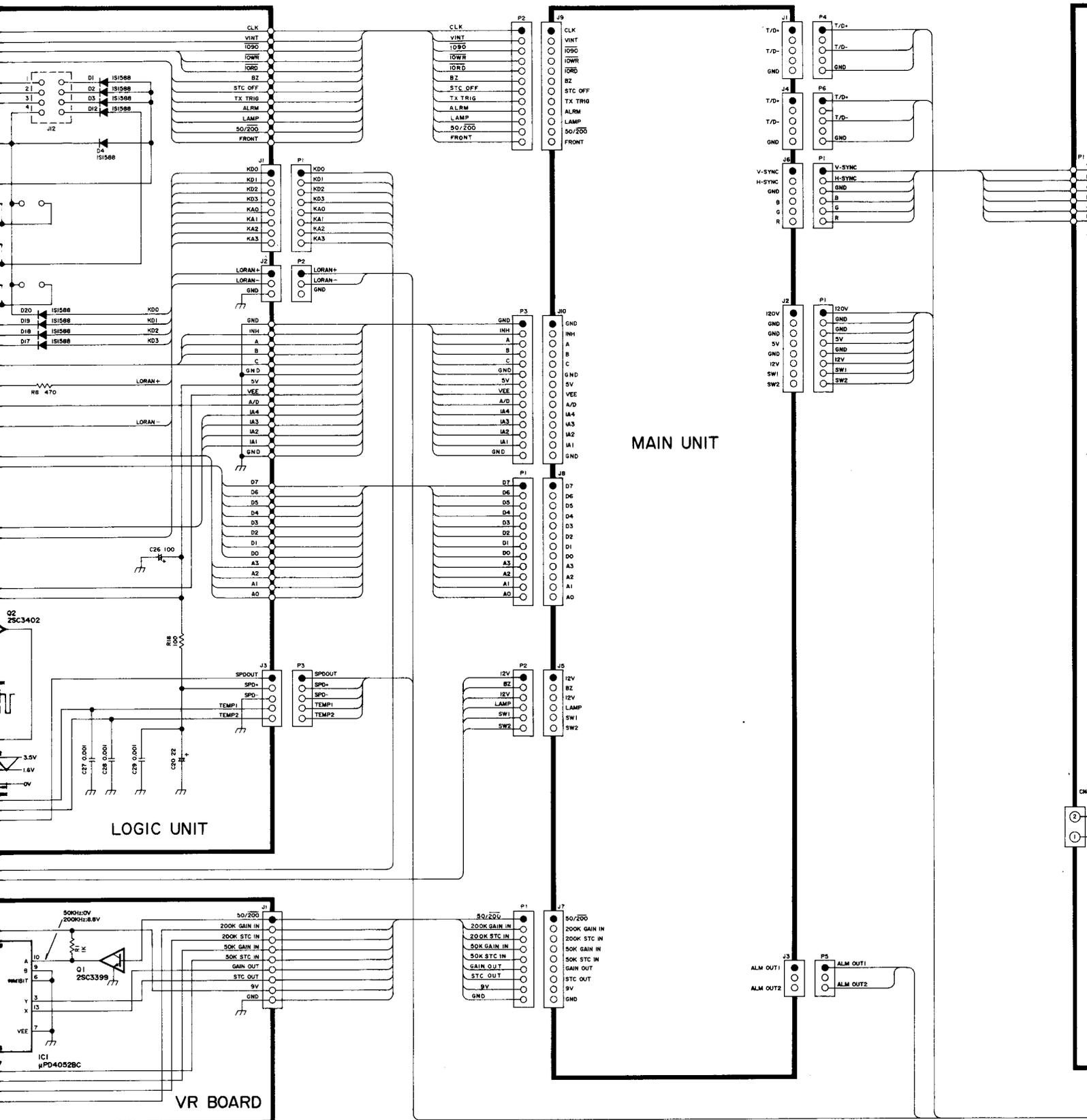


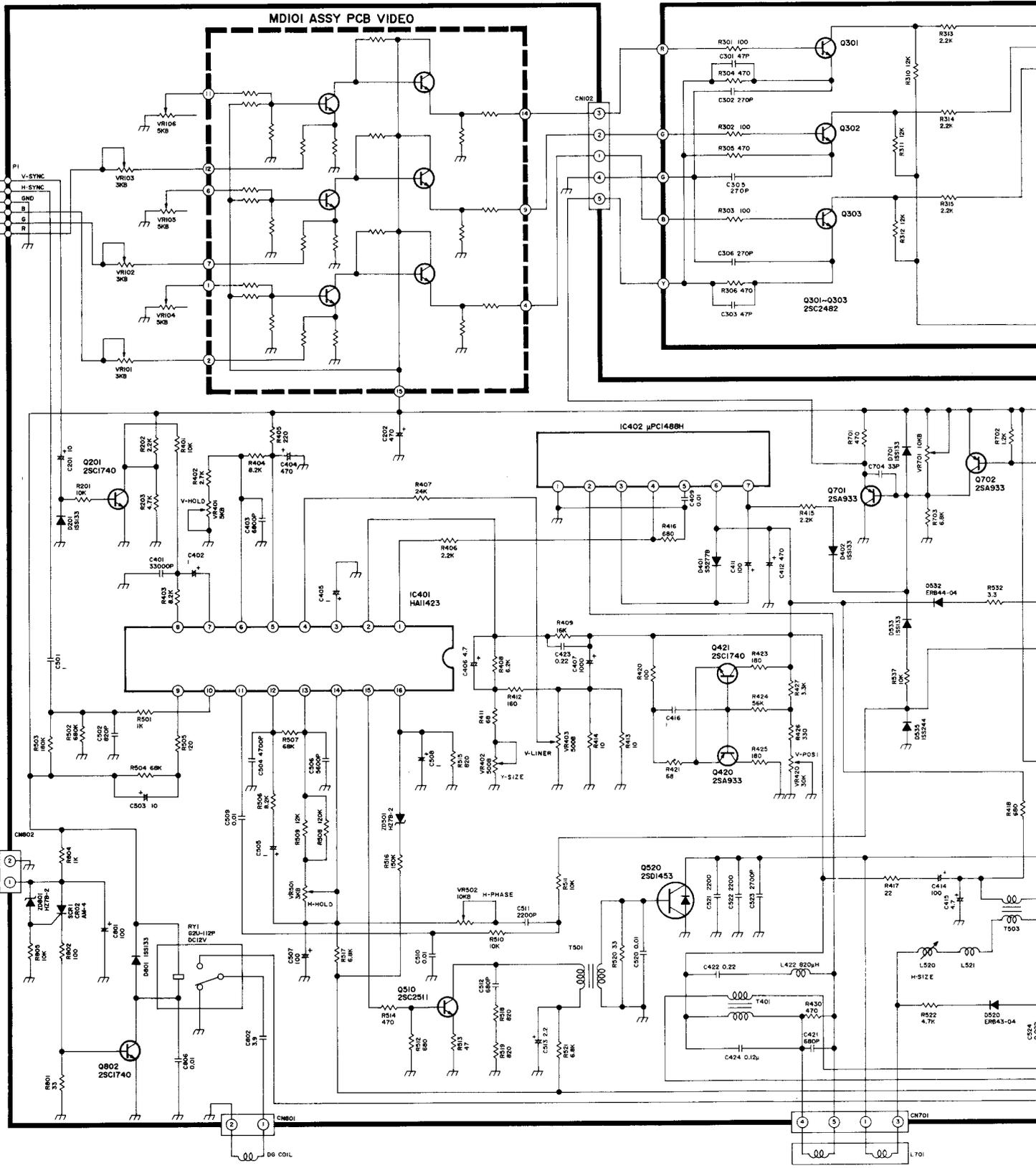
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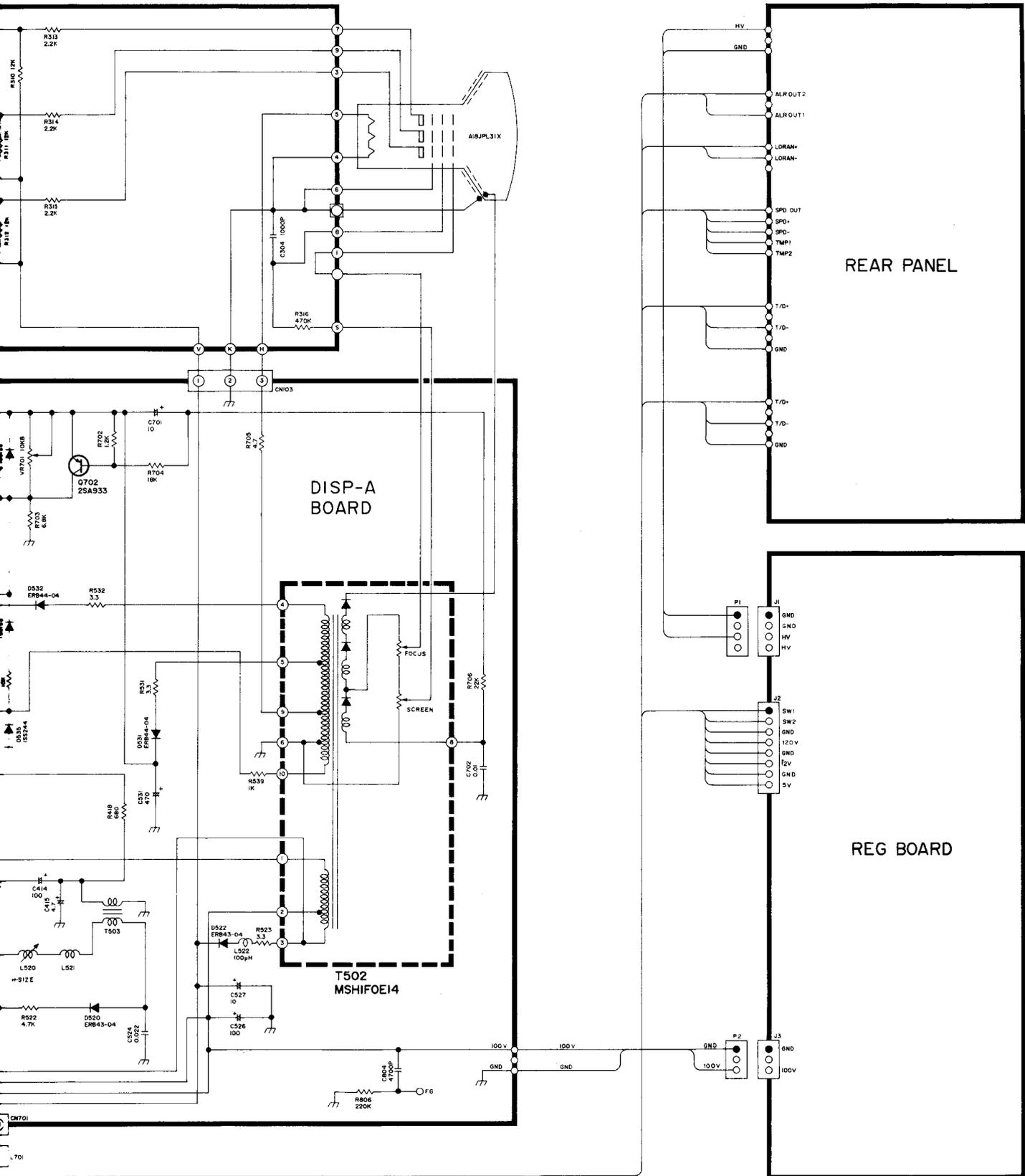
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