

 ICOM

# SERVICE MANUAL

VHF/UHF FM TRANSCEIVER

**IC-207H**

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Icom Inc.

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## INTRODUCTION

This service manual describes the latest service information for the **IC-207H** VHF/UHF FM TRANSCEIVER at the time of publication.

MODEL	VERSION	SYMBOL
IC-207H	Europe	EUR
	Italy	ITA
	U.S.A	USA
	Asia	SEA

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

## DANGER

**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.



## 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>

1150000760 IC SC-1091 IC-207H MAIN UNIT 5 pieces  
8810009020 Screw FH M2.6 x 5 ZK IC-207H Bottom cover 10 pieces

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

## REPAIR NOTES

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 50 dB to 60 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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## TABLE OF CONTENTS

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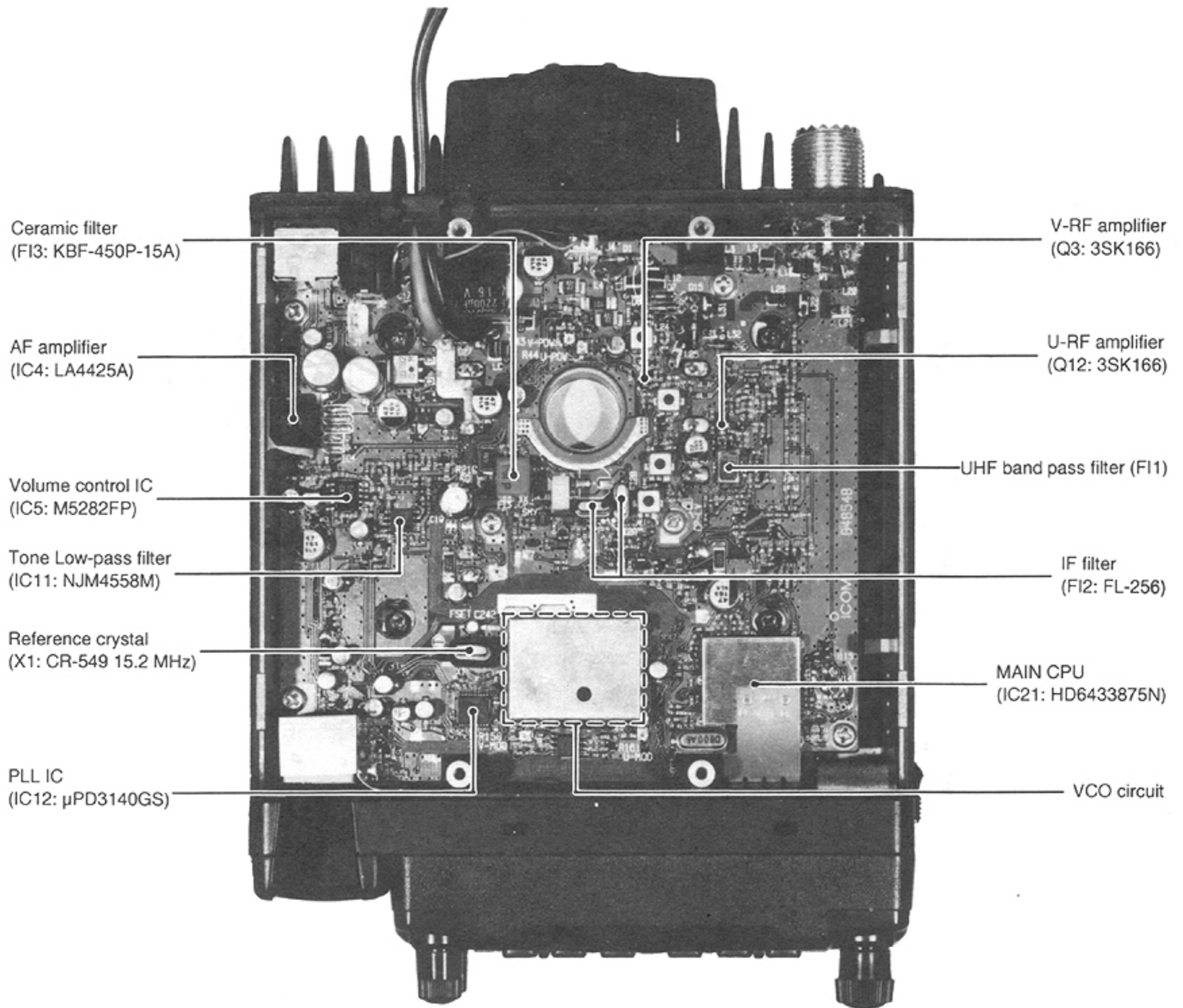
<b>SECTION 1</b>	<b>SPECIFICATIONS</b>	
<b>SECTION 2</b>	<b>INSIDE VIEW</b>	
<b>SECTION 3</b>	<b>DISASSEMBLY INSTRUCTIONS</b>	
<b>SECTION 4</b>	<b>CIRCUIT DESCRIPTION</b>	
4 - 1	RECEIVER CIRCUITS .....	4 - 1
4 - 2	TRANSMITTER CIRCUITS .....	4 - 2
4 - 3	PLL CIRCUITS .....	4 - 4
4 - 4	POWER SUPPLY CIRCUITS .....	4 - 4
4 - 5	PORT ALLOCATIONS .....	4 - 5
<b>SECTION 5</b>	<b>ADJUSTMENT PROCEDURES</b>	
5 - 1	PLL AND TRASMITTER ADJUSTMENTS .....	5 - 1
5 - 2	RECEIVER ADJUSTMENT .....	5 - 3
<b>SECTION 6</b>	<b>PARTS LIST</b>	
<b>SECTION 7</b>	<b>MECHANICAL PARTS</b>	
<b>SECTION 8</b>	<b>SEMI-CONDUCTOR INFORMATION</b>	
<b>SECTION 9</b>	<b>BOARD LAYOUTS</b>	
9 - 1	CONTROL UNIT .....	9 - 1
9 - 2	MAIN UNIT .....	9 - 3
<b>SECTION 10</b>	<b>BLOCK DIAGRAM</b>	
<b>SECTION 11</b>	<b>VOLTAGE DIAGRAM</b>	
11 - 1	CONTROL UNIT .....	11 - 1
11 - 2	MAIN UNIT .....	11 - 3

# SECTION 1 SPECIFICATIONS

		144 MHz band	430 (440) MHz band	
GENERAL	Frequency coverage	U.S.A	Tx: 140 MHz–150 MHz* <sup>1</sup> Rx: 118 MHz–174 MHz* <sup>1</sup>	440 MHz–450 MHz
		Europe	144 MHz–146 MHz	430 MHz–440 MHz
		S.E. Asia	Tx: 140 MHz–150 MHz* <sup>1</sup> Rx: 136 MHz–174 MHz* <sup>1</sup>	430 MHz–440 MHz
		Italy	Tx: 144 MHz–148 MHz* <sup>1</sup> Rx: 136 MHz–174 MHz* <sup>1</sup>	Tx: 430 MHz–440 MHz Rx: 400 MHz–479 MHz* <sup>2</sup>
	Guaranteed frequency range: * <sup>1</sup> 144 MHz–148 MHz, * <sup>2</sup> 430 MHz–440 MHz			
Mode		FM (F3E), AM (USA Rx only, 118–136 MHz)		
Frequency stability		±10 ppm (–10 °C to +60 °C; +14 °F to +140 °F)		
Tuning steps		5, 10, 12.5, 15, 20, 25, 30, 50 kHz or 1 MHz		
External DC power		13.8 V DC ±15 %		
Current drain (at 13.8 V)	Tx	High power	12.0 A	11.0 A
		Mid-High power	7.0 A	6.5 A
		Mid-Low power	5.5 A	5.5 A
		Low power	4.5 A	4.5 A
	Rx	Maximum audio	1.0 A	
		Squelch closed	0.8 A	
Usable temperature range		–10 °C to +60 °C (+14 °F to +140 °F)		
Dimensions (Projections not included)		140 (W) × 40 (H) × 185.4 (D) mm 5 1/2 (W) × 1 5/8 (H) × 7 5/16 (D) in		
Antenna connector		SO-239 (50 Ω)		
Weight		1.17 kg; 2.58 lbs		
TRANSMITTER	RF output power (at 13.8 V DC)	High : 50 W Mid-High : 20 W Mid-Low : 10 W Low : 5 W	High : 35 W Mid-High : 20 W Mid-Low : 10 W Low : 5 W	
	Modulation system	Variable reactance frequency modulation		
	Max. frequency deviation	±5.0 kHz		
	Spurious emissions	Less than –60 dB		
Microphone connector		8-pin modular plug (600 Ω)		
RECEIVER	Receive system	Double-conversion superheterodyne		
	Intermediate frequencies	1st : 46.05 MHz 2nd : 450 kHz		
	Sensitivity	Less than 0.18 μV at 12 dB SINAD (typ.)		
	Squelch sensitivity	Less than 0.13 μV		
	Selectivity	More than 12 kHz/ –6 dB Less than 30 kHz/ –60 dB		
	Spurious and image rejection ratio	More than 60 dB		
	Audio output power (at 13.8 V)	More than 2.0 W at 10 % distortion with an 8 Ω load		
External speaker connector		2-conductor 3.5 mm (1/8") (8 Ω)		

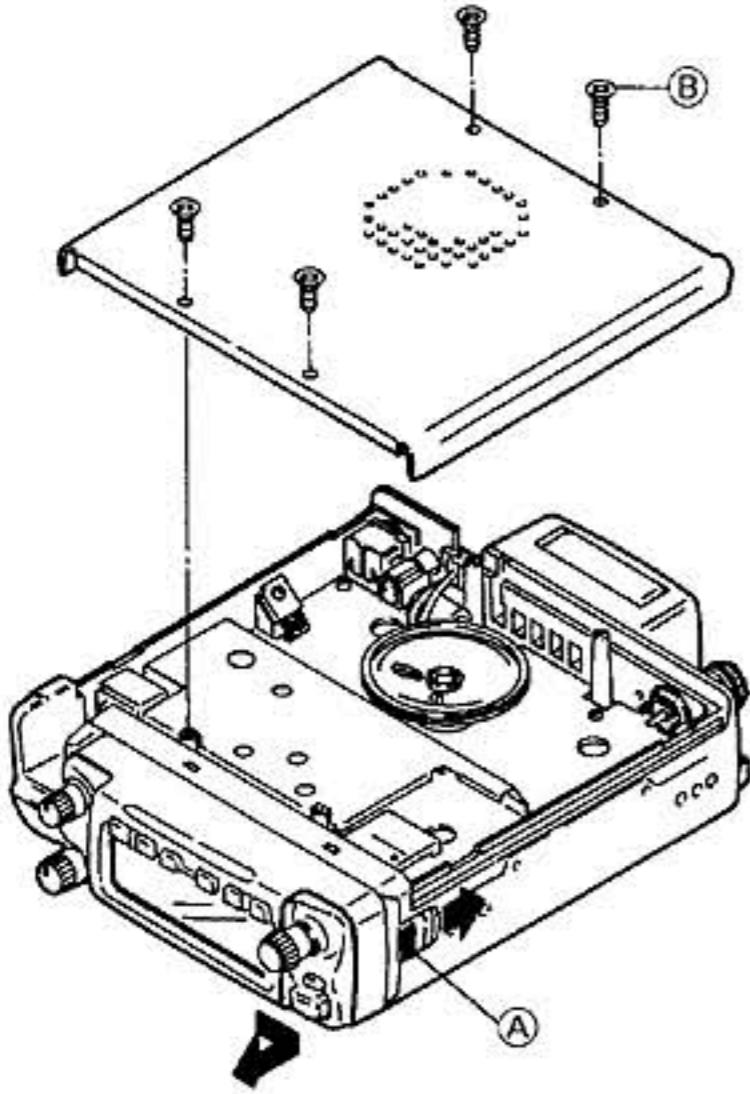
All stated specifications are subject to change without notice or obligation.

## SECTION 2    INSIDE VIEW

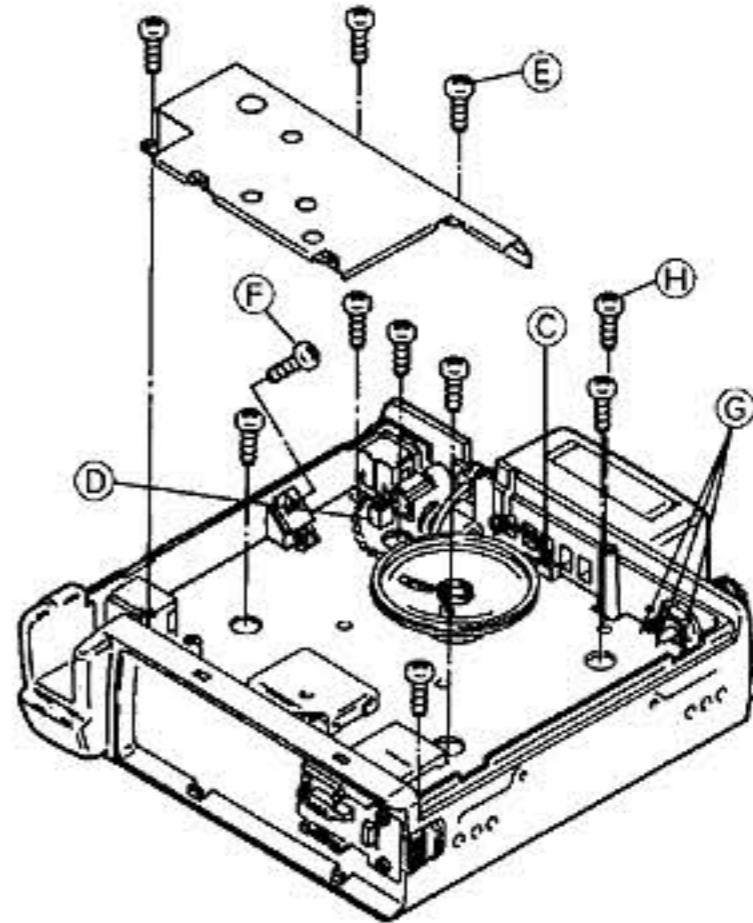


## SECTION 3 DISASSEMBLY INSTRUCTIONS

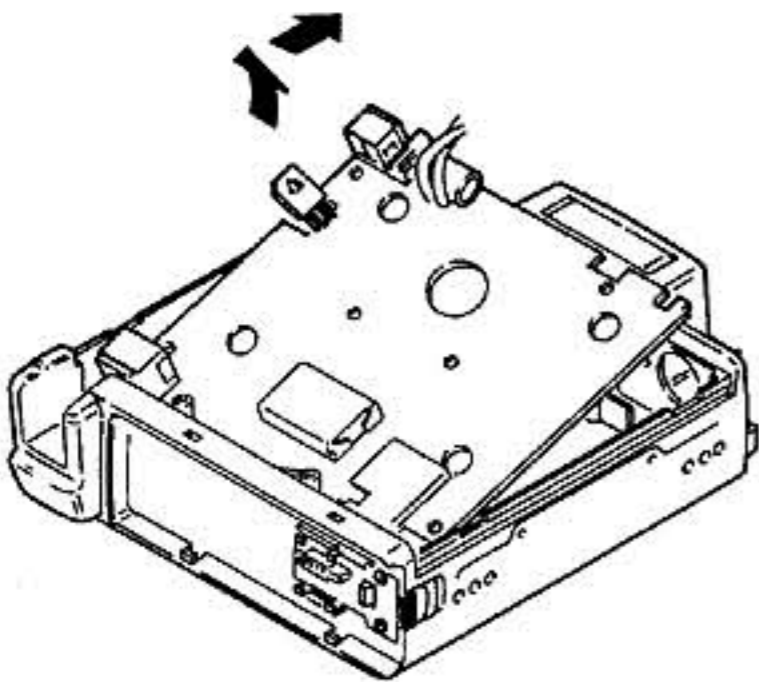
- ① Push the release button (A), then detach the control panel.
- ② Unscrew 4 screws (B) from bottom cover.  
⚠WARNING! NEVER attempt to open the cover using your finger nails, this may result in injury.



- ③ Disconnect the connector (C) from J4.
- ④ Disconnect the connector (D) from J1 and remove the speaker.
- ⑤ Unscrew 3 screws (E) and remove the shield case.
- ⑥ Unscrew 1 screw (F) from IC4.
- ⑦ Unsolder 3 points (G) from the antenna connector.
- ⑧ Unscrew 7 screws (H).



- ⑨ Remove the MAIN unit from the chassis.



## SECTION 4 CIRCUIT DESCRIPTION

### 4-1 RECEIVER CIRCUITS

#### 4-1-1 DUPLEXER CIRCUIT

The transceiver has a duplexer (low-pass and high-pass filters) on the first stage from the antenna connector to separate the signals into VHF and UHF signals. The low-pass filter (L1–L3, C1–C3) is for VHF signals and the high-pass filter (L20, L21, C75–C77) is for UHF signals. The separated signals are applied to each RF circuit.

#### 4-1-2 VHF ANTENNA SWITCHING CIRCUIT

The antenna switching circuit functions as a low-pass filter while receiving. However, its impedance becomes very high while transmitting by turning ON diodes (D7, D8). Thus transmit signals are blocked from entering the receiver circuits. The antenna switching circuit employs a  $1/4 \lambda$  type diode switching system. The passed signals are then applied to the RF amplifier circuit.

#### 4-1-3 VHF SQUELCH ATTENUATOR CIRCUIT

The current flow of the antenna switching circuit (D7, D8) is controlled by the [SQL] control via Q111. When the [SQL] control is rotated clockwise deeper than 12 o'clock, the current of D7 and D8 is increased. In this case, D7 and D8 act as an attenuator (max. 10 dB).

#### 4-1-4 VHF RF CIRCUIT

The RF circuit amplifies signals within the range of frequency coverage and filters out-of-band signals.

The signal from the antenna switching circuit passes through a tunable bandpass filter (D10, L14, L15) where the object signals are led to the RF amplifier circuit (Q3).

The amplified signals at Q3 are then applied to the 3-stage tunable bandpass filter (D11–D13, D127, L16–L18) to suppress unwanted signals. The filtered signals are then applied to the 1st mixer circuit (Q4).

D10–D13 employ varactor diodes, that are controlled by the PLL lock voltage, to track the band pass filters. The PLL lock voltage is amplified at the DC-amplifier circuit (IC29, D129) and then applied to these diodes.

#### 4-1-5 VHF 1ST MIXER CIRCUIT

The 1st mixer circuit converts the received signals to a fixed frequency of the 1st IF signal with a 1st LO (V-VCO output) frequency. By changing the PLL frequency, only the desired frequency will be passed through a pair of crystal filters at the next stage of the mixer.

The signals from the RF circuit are mixed with the 1st LO signal at the 1st mixer circuit (Q4) to produce a 46.05 MHz 1st IF signal.

#### 4-1-6 1ST IF CIRCUIT

The 1st IF signal from either the VHF or UHF 1st mixer circuit is applied to a pair of crystal filters (FI2) to suppress out-of-band signals via a matching circuit (L38, C129). The filtered signal is amplified at the IF amplifier (Q54) and is then applied to the 2nd mixer circuit (IC10).

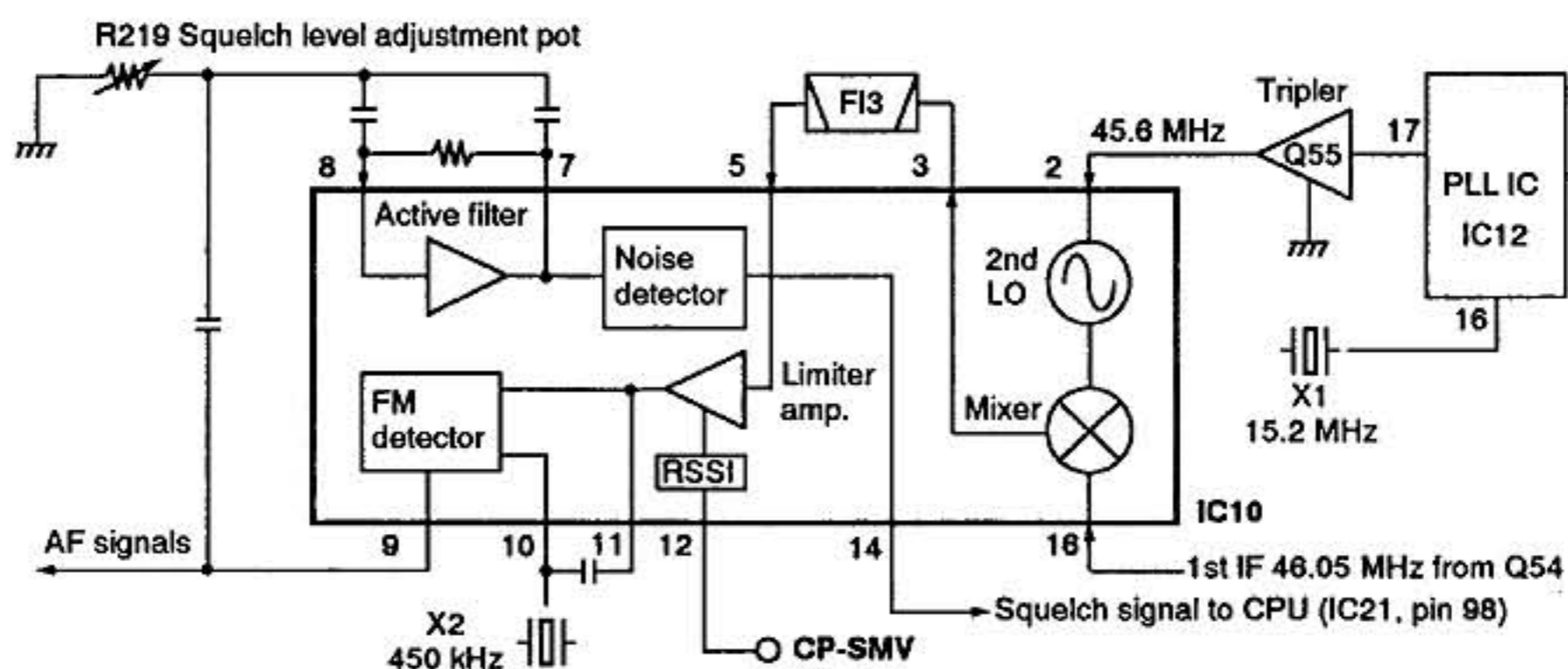
#### 4-1-7 2ND IF AND DEMODULATOR CIRCUITS

The 2nd mixer circuit converts the 1st IF signal to a 2nd IF signal. A double superheterodyne system (which converts receive signals twice) improves the image rejection ratio and obtains stable receiver gain.

The FM IF IC (IC10) contains the 2nd local oscillator, 2nd mixer, limiter amplifier, quadrature detector, and s-meter detector circuits, etc.

The 1st IF signal from Q54 is applied to the 2nd mixer section of IC10 (pin 16), and is mixed with the 45.6 MHz 2nd LO signal generated by the tripler circuit (Q55) to produce the 450 kHz 2nd IF signal.

### 2ND MIXER AND DEMODULATOR CIRCUITS



The 2nd IF signal from IC10 (pin 3) is passed through the ceramic filter (F13), where unwanted signals are suppressed, and is then applied to the 2nd IF and limiter amplifiers in IC10 (pin 5). The signal is applied to the FM detector section in IC10 for demodulation into AF signals.

The FM detector circuit employs a quadrature detection method (linear phase detection), which uses a ceramic discriminator (X2) for phase delay to obtain a non-adjusting circuit. The detected signal from IC10 (pin 9) is applied to the AF circuit and DIN connector (J3, pin 4) for data operation through the DATAOUT line.

#### 4-1-8 AF AMPLIFIER CIRCUIT

The AF amplifier circuit amplifies the detected signals to drive a speaker. The AF circuit includes an AF mute circuit for the squelch.

AF signals from IC10 (pin 9) pass through the squelch mute switch (Q58), and are then applied to the active filter (Q57, Q56) which functions as a high-pass filter to subaudible tone signals for tone squelch operation.

The filtered signals pass through the volume control IC (IC5) and are then applied to the AF power amplifier (IC4, pin 1) via the AF mute switch (Q22). The amplified signals from IC4 (pin 4) drive the internal speaker (SP1) when no plug is connected to the [EXT EP] jack (J2).

#### 4-1-9 SQUELCH CIRCUIT

A noise squelch circuit cuts out AF signals when no RF signal is received. By detecting noise components in the AF signal, the squelch circuit switches the squelch mute and AF mute switches.

Some of the noise components in the AF signals from IC10 (pin 9) are passed through the active filter (IC10, pins 8, 7), and then applied to the noise detector section. The variable resistor (R219) adjusts the input level of the active filter, and the level is used for squelch threshold reference. The detected noise signals are applied to the CPU (IC1, pin 98) via the SQLS line.

The [SQL] (CONTROL unit; R39) controls the input level of the sub-CPU (CONTROL unit; IC1, pin 8) in DC voltage. The sub-CPU reads the angle of the [SQL] rotation, then sends the squelch data to the CPU incorporated in the RDATA line. The CPU then controls the squelch mute (Q58) and AF mute (Q22) switches via the DMUT and AMUT lines, respectively.

#### 4-1-10 UHF RF AND UHF 1ST MIXER CIRCUITS

The UHF RF signals are passed through part of a duplexer (high-pass filter; L20, L21, C75–C77). The signals are again passed through the low-pass filter (L22, L23, C78), antenna switching circuit (D15, D21–D23), and then amplified at the RF amplifier (Q12). A bandpass filter (F11) is used at the next stage of the RF amplifier. The RF switch (D24, D25) turns on the UHF RF circuit when a UHF signal is received.

The filtered signals from the bandpass filter (F11) are mixed with a 1st LO signal at the mixer circuit (Q13) to produce a 46.05 MHz 1st IF signal. The 1st LO signal is the PLL output frequency which comes from the U-VCO circuit (Q33, Q34).

## 4-2 TRANSMITTER CIRCUITS

### 4-2-1 MICROPHONE AMPLIFIER CIRCUIT

The microphone amplifier circuit amplifies audio signals from the microphone or the DIN connector to a level needed at the modulation circuit. The microphone amplifier circuit is commonly used for both the VHF and UHF bands.

The AF signals from the microphone are adjusted to match impedance at the MIC sensitivity switching circuit (IC28, D123). The adjusted AF signals (or 1200 bps packet signals from the DIN connector) pass through the MIC mute switch (Q75) and are then amplified at the microphone amplifier (Q72). The amplified signals are applied to the IDC amplifier (IC14b, pin 6) to control the maximum deviation. The output signals from the IDC amplifier (IC14b, pin 7) are passed through the splatter filter (IC14a, pin 3, 1) and then applied to each VCO circuit via the deviation adjustment pot.

The 9600 bps packet signals from the DIN connector (J3, pin 1) pass through the modulation switch (Q76, Q77) and are then applied to the buffer amplifier (IC13b). The amplified signals are then applied to the VCO circuit.

When 9600 bps packet signals are over-modulated, the 9600 bps limiter (IC13a) outputs a low level signal from pin 1 and the output signal is applied to the CPU (IC 21, pin 13) to stop transmission.

### 4-2-2 VHF MODULATION CIRCUIT

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

Audio signals from IC14a pass through the frequency deviation control (R158), are then applied to the modulation circuit (D31) via the V-MOD mute switch (Q39) to change the reactance of D31, and modulate the oscillated signal at the V-VCO circuit (Q30, Q31). The VCO output is buffer-amplified at Q29 and Q27, and is then applied to the band switching circuit (D30).

### 4-2-3 VHF DRIVE AMPLIFIER CIRCUIT

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

The signals from the band switch (D30) pass through the low-pass filter (L49, C188, C189) and T/R switch (D6), and are then applied to the attenuator (R12–R14). The transmit signal from the attenuator is amplified at the pre-drive (Q2) and drive (Q1) amplifiers to obtain an approximate 26 dBm signal level. The amplified signal is then applied to the RF power amplifier (IC1).



#### 4-2-4 VHF POWER AMPLIFIER CIRCUIT

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

IC1 is a power module which has amplification output capabilities of about 60 W. The RF signal from the drive amplifier (Q1) is applied to IC1 (pin 1). The amplified signal from the power amplifier (IC1, pin 4) is passed through the antenna switching circuit (D1) and is then applied to the antenna connector via a low-pass filter (L1-L3, C1-C3).

#### 4-2-5 APC CIRCUIT

The APC circuit protects the power module (IC1: VHF, IC3: UHF) and drive amplifier (Q1: VHF, Q9: UHF) from a mismatched output load and stabilizes transmit output power.

The APC detector circuit (D2 and D3: VHF, D16 and D17: UHF) detects forward signals and rectified signals respectively. The combined voltage is at a minimum level when the antenna is matched at 50  $\Omega$  and increases when it is mismatched. The combined voltage is applied to the APC amplifier (IC2, pin 3) and compared with a reference voltage which is supplied from the CPU (IC21, pins 68-75) as the POWC signal.

The output voltage from the APC amplifier (IC2, pin 4) is applied to the APC control circuit (Q6-Q8) to control the bias voltage of the PA module (IC1: VHF, IC3: UHF) and drive amplifier (Q1: VHF, Q9: UHF).

#### 4-2-6 UHF MODULATION CIRCUIT

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

Audio signals from IC14a pass through the frequency deviation control (R161), are then applied to the modulation circuit (D126) via the U-MOD mute switch (Q40) to change the reactance of D126, and modulate the oscillated signal at the U-VCO circuit (Q34, Q35). The VCO output is buffer-amplified at Q33 and Q27, and is then applied to the V/UHF switching circuit (D30).

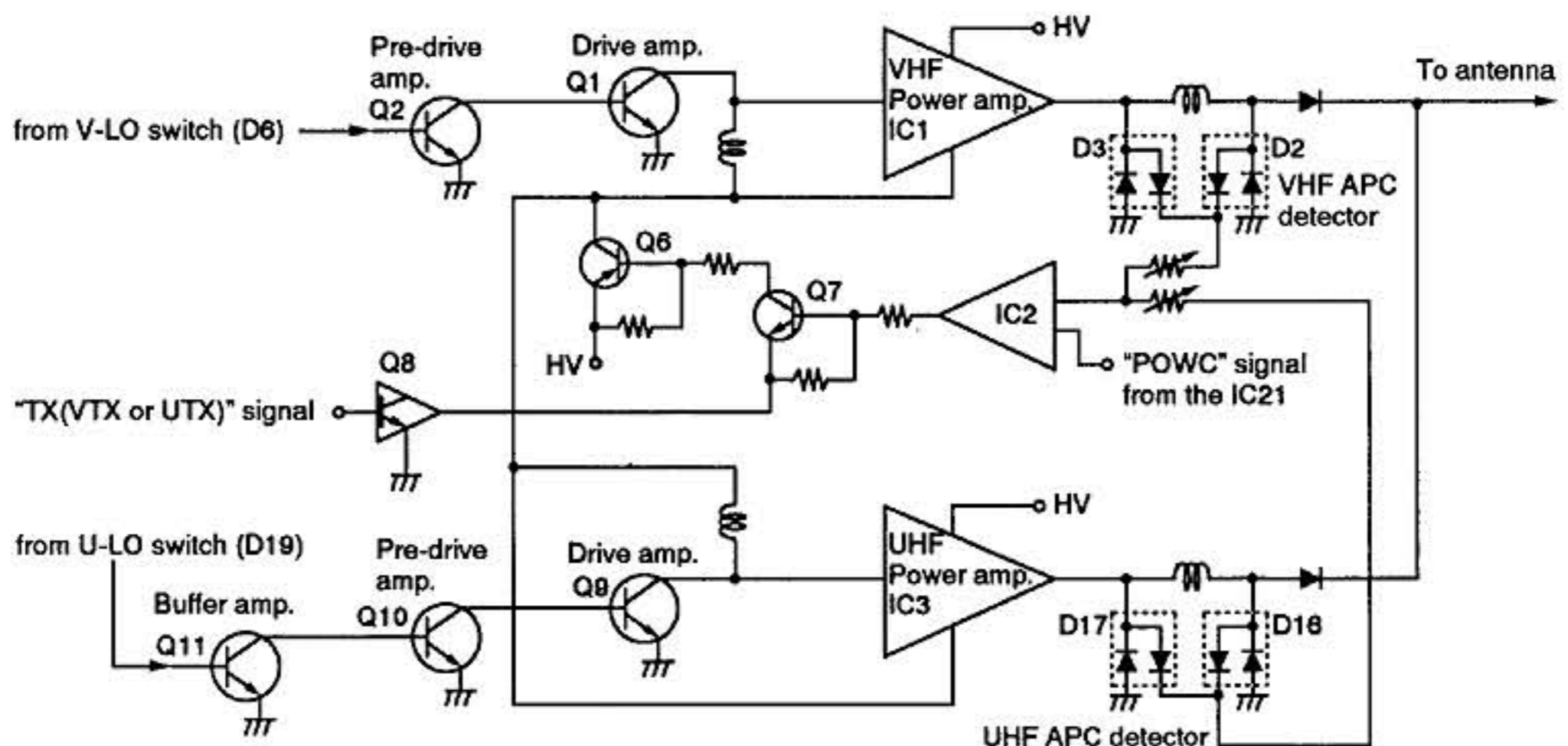
#### 4-2-7 UHF DRIVE AND POWER AMPLIFIER CIRCUITS

The switched signal from the band switch (D30) is amplified at the buffer, pre-drive and the drive amplifiers (Q11, Q10, Q9) after being passed through the low-pass filter (L61, C111, C112) and T/R switch (D19). Then the amplified signal is applied to the UHF power amplifier circuit.

The drivers (Q9, Q10) obtain an approximate 26 dBm signal level.

The amplified signal from the drive amplifier (Q9) is applied to pin 5 of the power amplifier which has amplification output capabilities of about 40 W. The power amplified signal is output from pin 1 and then applied to the antenna connector via the antenna switching circuit (D15) and bandpass filter (L20-L23, C75-C78).

#### APC CIRCUIT



## 4-3 PLL CIRCUITS

### 4-3-1 GENERAL

A PLL circuit provides stable oscillation of the transmit frequency and the receive local frequency. The PLL circuit compares the phase of the divided VCO frequency to the reference frequency. The PLL output frequency is controlled by a crystal oscillator and the divided ratio of the programmable divider. IC12 is a dual PLL IC which controls VCO circuits for both VHF and UHF.

### 4-3-2 VHF LOOP

The generated signal at the V-VCO (Q30, Q31, D31) enters the PLL IC (IC12, pin 2) via buffer-amplifiers (Q29, Q28), is divided at the programmable divider section and is then applied to the phase detector section.

The phase detector compares the input signal with a reference frequency, and then outputs the out-of-phase signal (pulse-type signals) from pin 8.

The pulse-type signal is converted into DC voltage (lock voltage) at the loop filter (R172, R178, C252), and then applied to the V-VCO to stabilize the oscillated frequency.

The lock voltage is also applied to the RX tunable bandpass filter as the tuning signal via the DC amplifier circuit (IC29, D129).

### 4-3-3 UHF LOOP

The generated signal at the U-VCO (Q34, Q35, D33) enters the PLL IC (IC12, pin 2) via buffer-amplifiers (Q33, Q28), is divided at the programmable divider section and is then applied to the phase detector section.

The phase detector compares the input signal with a reference frequency, and then outputs the out-of-phase signal (pulse-type signals) from pin 8.

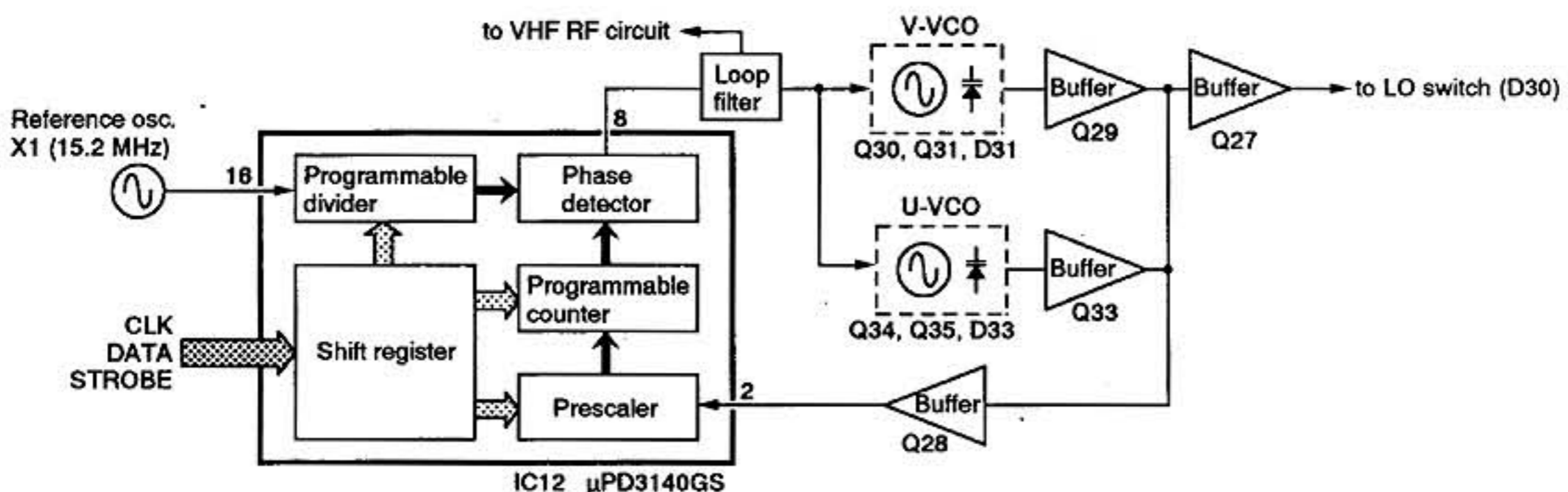
The pulse-type signal is converted into DC voltage (lock voltage) at the loop filter (R172, R178, C252), and then applied to the U-VCO to stabilize the oscillated frequency.

## 4-4 POWER SUPPLY CIRCUITS

### 4-4-1 VOLTAGE LINE

Line	Description
HV	The 13.8 V external DC power from the power connector.
13.8 V	The same voltage as the HV line which is controlled by the power switching circuit (Q25, Q26). When the [PWR] switch is pushed, the CPU outputs the control signal to the power switching circuit to turn the circuit ON.
8 V	Common 8 V converted from the 13.8 V line at the 8 V regulator circuit (IC8).
6 V	Common 6 V converted from the 13.8 V line at the 6 V regulator circuit (IC7, D29).
CPU5V	Common 5 V for the CPU produced at the CPU5V regulator circuit (IC6). The circuit outputs the voltage regardless of the power ON/OFF condition.
PLL5V	Common 5 V for PLL circuits produced from the CPU5V at the PLL 5V regulator circuit (Q45, Q46) using a control signal from the 8 V line.
VT8V	8 V for VHF transmitter circuits converted from the 8 V line at the VT8V regulator circuit (Q37, Q38).
UT8V	8 V for UHF transmitter circuits converted from the 8 V line at the UT8V regulator circuit (Q52, Q53).
RX8V	8 V for common receiver circuits produced from the 4R8V and 1R8V line at the RX8V switching circuit (D41).

### PLL CIRCUIT



## 4-5 PORT ALLOCATIONS

### 4-5-1 CPU (MAIN unit IC21)

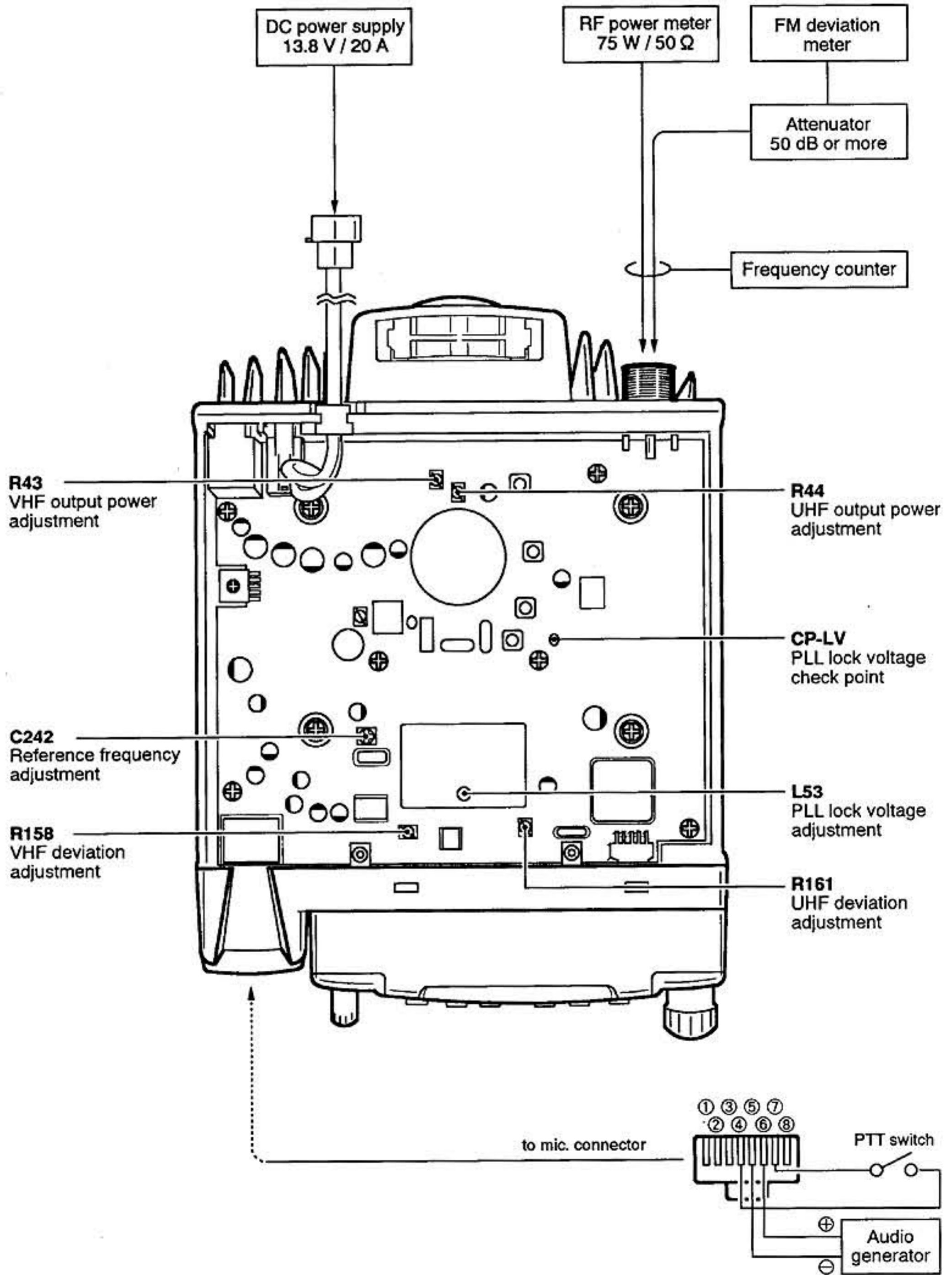
Pin number	Port name	Description
1	TONEIN	Input port for CTCSS decoded signals.
9	RES	Input port for the reset circuit signals.
12	FANC	Outputs cooling fan control signal. High: Fan activates
13	LIMIT	Input port to detect over modulation for packet transmission. Low: Over modulation
16	RDATA	Input port for serial signal from the sub-CPU (CONTROL unit, IC1).
17	TDATA	Output port for serial signal from the sub-CPU (CONTROL unit, IC1).
22	EXTMIC	Input port to detect optional wireless microphone (HM-90) connection. Low: HM-90 is connected
23	MICIN	Input port for microphone serial signal via the buffer-amp.
24	PTTP	Input port for packet PTT signal. High: Packet PTT switch is ON
25	E-TONE	Outputs 1750 Hz Europe tone signal.
26	PTTM	Input port for PTT switch.
33-35	ISTB2-ISTB0	Output port for initial matrix.
36-39	INI0-INI3	Input ports for initial matrix.
40	STBPL	Outputs strobe signals for PLL circuit.
41	SCK	Outputs clock to PLL.
42	SDATA	Outputs data signal to PLL.
43	UNLK	Input port for PLL unlock signal. High: PLL unlock
44	ESI	Input port for serial signal from EEPROM IC (IC25).
45	ESO	Output port for serial signal to EEPROM IC (IC25).
46	ECK	Outputs clock signal for the EEPROM IC (IC25).
48	AMUT	Outputs AF mute switch (Q22) control signal. High: During squelched
49	DMUT	Outputs squelch mute switch (Q58) control signal. High: During squelched

Pin number	Port name	Description
50	MMUT	Outputs MIC mute switch control signal. High: Microphone audio is muted
51	DTMUT	Outputs DTMF mute signal. High: DTMF signals are muted
52	UTX	Output UT8V regulator (Q52, Q53) control signal. High: While transmitting on UHF band
53	VTX	Output VT8V regulator (Q38, Q37) control signal. High: While transmitting on VHF band
54	1RX	Outputs 1RX-BIAS selector (Q64, Q68) control signal. High: During RX on VHF band.
56	4RX	Outputs 4RX-BIAS selector (Q65, Q68) control signal. High: During RX on UHF band.
59	PCTRL	Outputs power switching circuit control signal. High: While turning power ON
60	VCOS	Outputs shift signal for V-VCO circuit.
61	UVC0V	Outputs U-VCO 8 V switch (Q41, Q43) control signal.
62	VVC0V	Outputs V-VCO 8 V switch (Q42, Q43) control signal.
64-67	ATTC0-ATTC3	Output squelch attenuator control signal.
68-75	LPOC0-LPOC7	Output port for output power control signal.
77-84	VOLC0-VOLC7	Output volume level signals.
90	CTCSS	Outputs CTCSS tone signals.
91	DTMFE	Output port : DTMF signals while transmitting. : Beep audio signals while receiving.
98	SQLS	Input port for noise signals.
99	SMET	Input port for S-meter level signal.
100	MU/D	Input port for up/down signal from a microphone. 0 V: [UP] 0.45 V: [DN]

## SECTION 5 ADJUSTMENT PROCEDURES

### 5-1 PLL AND TRANSMITTER ADJUSTMENTS

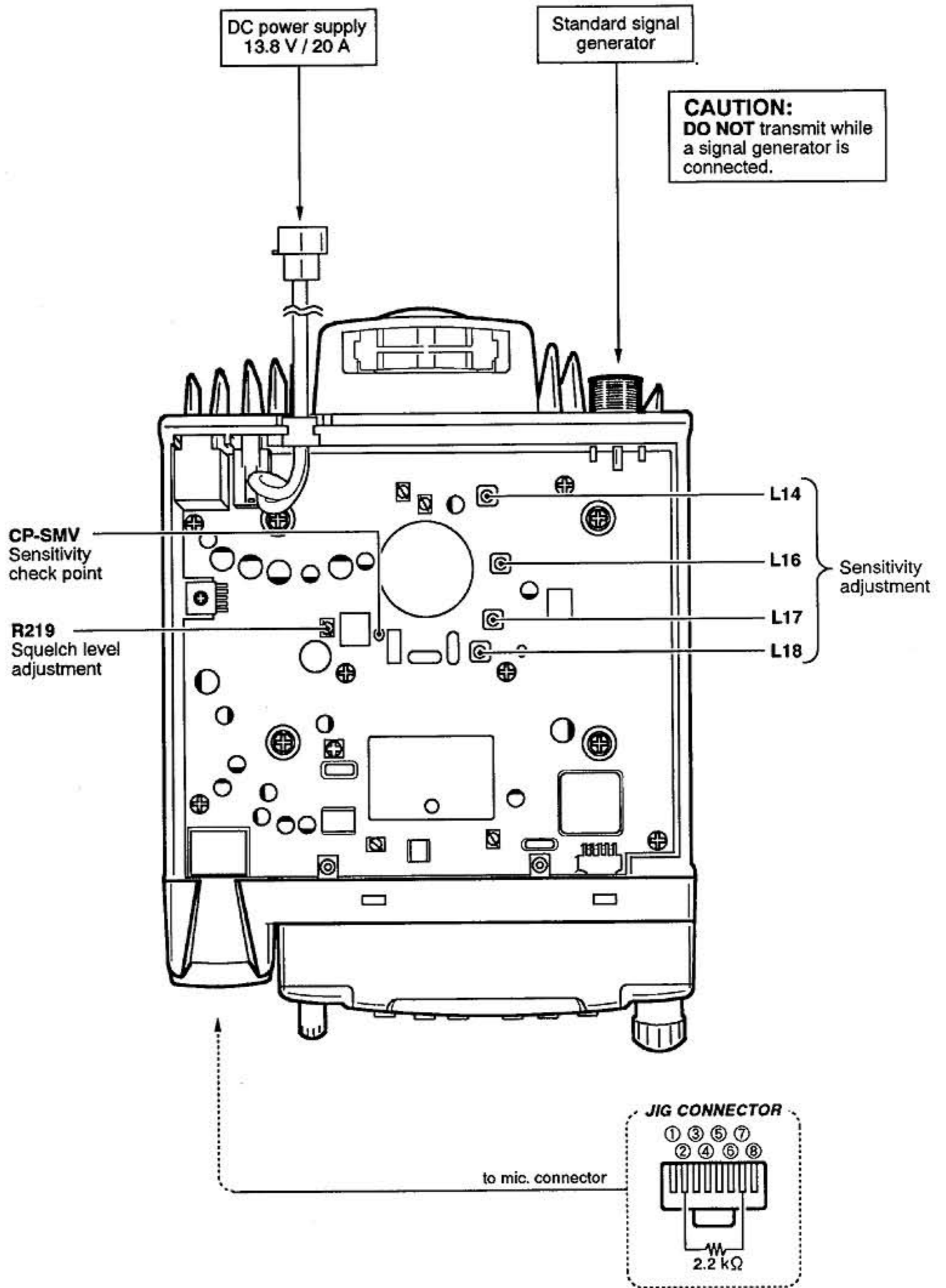
ADJUSTMENT	ADJUSTMENT CONDITIONS	MEASUREMENT		VALUE	ADJUSTMENT		
		UNIT	LOCATION		UNIT	ADJUST	
PLL LOCK VOLTAGE	1 <ul style="list-style-type: none"> <li>Operating frequency: 145.000 MHz</li> <li>Receiving</li> </ul>	MAIN	Connect a digital multi-meter or an oscilloscope to the CP-LV.	2.5V	MAIN	L53	
PLL REFERENCE FREQUENCY	1 <ul style="list-style-type: none"> <li>Operating frequency: 440.000 MHz</li> <li>Simplex</li> <li>Transmitting</li> </ul>	Rear panel	Loosely couple a frequency counter to the antenna connector.	440.0000 MHz	MAIN	C242	
VHF OUTPUT POWER	1 <ul style="list-style-type: none"> <li>Operating frequency: 146.000 MHz (USA, SEA versions) 145.000 MHz (All other versions)</li> <li>[High/Low] switch: High</li> <li>Simplex</li> <li>Transmitting</li> </ul>	Rear panel	Connect an RF power meter to the antenna connector.	50 W	MAIN	R43	
	2 <ul style="list-style-type: none"> <li>[High/Low] switch: Low</li> </ul>			5 W			Verify
	3 <ul style="list-style-type: none"> <li>[High/Low] switch: Mid-Low</li> </ul>			10 W			
	4 <ul style="list-style-type: none"> <li>[High/Low] switch: Mid-High</li> </ul>			20 W			
UHF OUTPUT POWER	1 <ul style="list-style-type: none"> <li>Operating frequency: 445.000 MHz (USA version only) 435.000 MHz (All other versions)</li> <li>[High/Low] switch: High</li> <li>Simplex</li> <li>Transmitting</li> </ul>	Rear panel	Connect an RF power meter to the antenna connector.	35 W	MAIN	R44	
	2 <ul style="list-style-type: none"> <li>[High/Low] switch: Low</li> </ul>			5 W			Verify
	3 <ul style="list-style-type: none"> <li>[High/Low] switch: Mid-Low</li> </ul>			10 W			
	4 <ul style="list-style-type: none"> <li>[High/Low] switch: Mid-High</li> </ul>			20 W			
FREQUENCY DEVIATION	1 <ul style="list-style-type: none"> <li>Operating frequency: 146.000 MHz (USA, SEA versions) 145.000 MHz (All other versions)</li> <li>Connect an audio generator to the microphone connector and set as; 20 mV/1.0 kHz</li> <li>Set an FM deviation meter as; <ul style="list-style-type: none"> <li>HPF : 50 Hz</li> <li>LPF : 20 kHz</li> <li>De-emphasis : OFF</li> <li>Detector : (P - P)/2</li> </ul> </li> <li>CTCSS tone: OFF</li> <li>Simplex</li> <li>Transmitting</li> </ul>	Rear panel	Connect an FM deviation meter to the antenna connector through an attenuator.	±4.8 kHz	MAIN	R158	
	2 <ul style="list-style-type: none"> <li>Operating frequency: 445.000 MHz (USA version only) 435.000 MHz (All other versions)</li> </ul>					R161	



## 5-2 RECEIVER ADJUSTMENT

ADJUSTMENT	ADJUSTMENT CONDITIONS	MEASUREMENT		VALUE	ADJUSTMENT	
		UNIT	LOCATION		UNIT	ADJUST
VHF SENSITIVITY	1 <ul style="list-style-type: none"> <li>• Operating frequency: 145.000 MHz</li> <li>• Connect an SSG to the antenna connector and set as;               <ul style="list-style-type: none"> <li>Level : 1 mV* (-47 dBm)</li> <li>Mod. : 1.0 kHz (<math>\pm 3.5</math> kHz Dev.)</li> </ul> </li> <li>• Receiving</li> </ul>	MAIN	Connect a DC volt meter to the CP-SMV.	Maximum DC voltage	MAIN	Adjust in sequence L14, L16 L17, L18
SQUELCH LEVEL	1 <ul style="list-style-type: none"> <li>• Operating frequency:               <ul style="list-style-type: none"> <li>146.000 MHz (USA, SEA versions)</li> <li>145.000 MHz (All other versions)</li> </ul> </li> <li>• Squelch level : 7 (Use HM-98)</li> <li>• R219 : Max. clockwise</li> <li>• Connect an SSG to the antenna connector and set as;               <ul style="list-style-type: none"> <li>Level : 0.079<math>\mu</math>V* (-129 dBm)</li> <li>Mod. : 1.0 kHz (<math>\pm 3.5</math> kHz Dev.)</li> </ul> </li> <li>• Receiving</li> </ul>	Speaker		At the point where the AF signal just appears.	MAIN	R219
S-METER	1 <ul style="list-style-type: none"> <li>• Connect a JIG to the microphone connector then turn ON the power.</li> <li>• Operating frequency:               <ul style="list-style-type: none"> <li>146.000 MHz (USA, SEA versions)</li> <li>145.000 MHz (All other versions)</li> </ul> </li> <li>• Connect an SSG to the antenna connector and set as;               <ul style="list-style-type: none"> <li>Level : 1.0 <math>\mu</math>V* (-107 dBm)</li> <li>Mod. : 1.0 kHz (<math>\pm 3.5</math> kHz Dev.)</li> </ul> </li> <li>• Receiving</li> </ul>	Front panel		Push and hold the [S. MW] key, or push the [MW] key of the HM-98. <ul style="list-style-type: none"> <li>• Verify that S-meter shows S3 (4 dots).</li> </ul>		
	2 <ul style="list-style-type: none"> <li>• Operating frequency:               <ul style="list-style-type: none"> <li>445.000 MHz (USA version only)</li> <li>435.000 MHz (All other versions)</li> </ul> </li> <li>• Connect an SSG to the antenna connector and set as;               <ul style="list-style-type: none"> <li>Level : 1.0 <math>\mu</math>V* (-107 dBm)</li> <li>Mod. : 1.0 kHz (<math>\pm 3.5</math> kHz Dev.)</li> </ul> </li> <li>• Receiving</li> </ul>					

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



# SECTION 6 PARTS LIST

## [CONTROL UNIT]

REF. NO.	ORDER NO.	DESCRIPTION
IC1	1140006530	S.IC M38222M2-122HP
IC2	1110003500	S.IC S-80742SL-A6-T1
IC3	1130005720	S.IC TC7W04F (TE12L)
IC4	1180000420	S.IC TA78L05F (TE12R)
Q1	1530002060	S.TRANSISTOR 2SC4081 T107 R
Q2	1520000270	S.TRANSISTOR 2SB1182 TL Q
Q3	1530002060	S.TRANSISTOR 2SC4081 T107 R
Q4	1510000620	S.TRANSISTOR 2SA1576 T107 S
Q5	1530002060	S.TRANSISTOR 2SC4081 T107 R
D1	1750000550	S.DIODE 1SS355 TE-17
D2	1750000550	S.DIODE 1SS355 TE-17
X1	6060000810	S.CERAMIC EFOS4914E3
R1	7030000060	S.RESISTOR MCR10EZHZ 2.2 Ω (2R2)
R2	7030000060	S.RESISTOR MCR10EZHZ 2.2 Ω (2R2)
R3	7030003560	S.RESISTOR ERJ3GEYJ 103 V (10 kΩ)
R4	7030003560	S.RESISTOR ERJ3GEYJ 103 V (10 kΩ)
R5	7030003560	S.RESISTOR ERJ3GEYJ 103 V (10 kΩ)
R6	7030000360	S.RESISTOR MCR10EZHZ 680 Ω (681)
R7	7030000320	S.RESISTOR MCR10EZHZ 330 Ω (331)
R8	7030003560	S.RESISTOR ERJ3GEYJ 103 V (10 kΩ)
R9	7030003640	S.RESISTOR ERJ3GEYJ 473 V (47 kΩ)
R10	7030003440	S.RESISTOR ERJ3GEYJ 102 V (1 kΩ)
R11	7030003440	S.RESISTOR ERJ3GEYJ 102 V (1 kΩ)
R12	7030003680	S.RESISTOR ERJ3GEYJ 104 V (100 kΩ)
R13	7030003440	S.RESISTOR ERJ3GEYJ 102 V (1 kΩ)
R14	7030003680	S.RESISTOR ERJ3GEYJ 104 V (100 kΩ)
R15	7030003680	S.RESISTOR ERJ3GEYJ 104 V (100 kΩ)
R16	7030003760	S.RESISTOR ERJ3GEYJ 474 V (470 kΩ)
R17	7030003720	S.RESISTOR ERJ3GEYJ 224 V (220 kΩ)
R18	7030003720	S.RESISTOR ERJ3GEYJ 224 V (220 kΩ)
R19	7030003520	S.RESISTOR ERJ3GEYJ 472 V (4.7 kΩ)
R20	7030003480	S.RESISTOR ERJ3GEYJ 222 V (2.2 kΩ)
R21	7030003680	S.RESISTOR ERJ3GEYJ 104 V (100 kΩ)
R22	7030003560	S.RESISTOR ERJ3GEYJ 103 V (10 kΩ)
R23	7030003640	S.RESISTOR ERJ3GEYJ 473 V (47 kΩ)
R24	7030003560	S.RESISTOR ERJ3GEYJ 103 V (10 kΩ)
R25	7030003440	S.RESISTOR ERJ3GEYJ 102 V (1 kΩ)
R26	7030003440	S.RESISTOR ERJ3GEYJ 102 V (1 kΩ)
R27	7030003440	S.RESISTOR ERJ3GEYJ 102 V (1 kΩ)
R28	7030003440	S.RESISTOR ERJ3GEYJ 102 V (1 kΩ)
R29	7030003440	S.RESISTOR ERJ3GEYJ 102 V (1 kΩ)
R30	7030003440	S.RESISTOR ERJ3GEYJ 102 V (1 kΩ)
R31	7030003440	S.RESISTOR ERJ3GEYJ 102 V (1 kΩ)
R32	7030003440	S.RESISTOR ERJ3GEYJ 102 V (1 kΩ)
R33	7030003520	S.RESISTOR ERJ3GEYJ 472 V (4.7 kΩ)
R34	7030003440	S.RESISTOR ERJ3GEYJ 102 V (1 kΩ)
R35	7030003440	S.RESISTOR ERJ3GEYJ 102 V (1 kΩ)
R36	7030003440	S.RESISTOR ERJ3GEYJ 102 V (1 kΩ)
R37	7030003440	S.RESISTOR ERJ3GEYJ 102 V (1 kΩ)
R39	7210002920	VARIABLE EVU-F2AF20B55 (560K)
R40	7030003640	S.RESISTOR ERJ3GEYJ 473 V (47 kΩ)
R41	7030003440	S.RESISTOR ERJ3GEYJ 102 V (1 kΩ)
R43	7210002920	VARIABLE EVU-F2AF20B55 (560K)
R44	7030003640	S.RESISTOR ERJ3GEYJ 473 V (47 kΩ)
C1	4030006860	S.CERAMIC C1608 JB 1H 102K-T-A
C2	4510004630	S.ELECTROLYTIC ECEV1CA100SR
C3	4030006860	S.CERAMIC C1608 JB 1H 102K-T-A
C4	4030009000	S.CERAMIC C2012 JB 1C 224K-T-A
C5	4030006860	S.CERAMIC C1608 JB 1H 102K-T-A
C6	4510004630	S.ELECTROLYTIC ECEV1CA100SR

## [CONTROL UNIT]

REF. NO.	ORDER NO.	DESCRIPTION
C7	4510004630	S.ELECTROLYTIC ECEV1CA100SR
C8	4030006860	S.CERAMIC C1608 JB 1H 102K-T-A
C9	4030007090	S.CERAMIC C1608 CH 1H 470J-T-A
C10	4030007090	S.CERAMIC C1608 CH 1H 470J-T-A
C11	4030007090	S.CERAMIC C1608 CH 1H 470J-T-A
C12	4030007090	S.CERAMIC C1608 CH 1H 470J-T-A
C13	4030007090	S.CERAMIC C1608 CH 1H 470J-T-A
C14	4030007090	S.CERAMIC C1608 CH 1H 470J-T-A
C15	4030007090	S.CERAMIC C1608 CH 1H 470J-T-A
C16	4030007090	S.CERAMIC C1608 CH 1H 470J-T-A
C17	4030007090	S.CERAMIC C1608 CH 1H 470J-T-A
C18	4030007090	S.CERAMIC C1608 CH 1H 470J-T-A
C19	4030007090	S.CERAMIC C1608 CH 1H 470J-T-A
C20	4030007090	S.CERAMIC C1608 CH 1H 470J-T-A
C21	4030007090	S.CERAMIC C1608 CH 1H 470J-T-A
C22	4030006860	S.CERAMIC C1608 JB 1H 472K-T-A
C23	4030006860	S.CERAMIC C1608 JB 1H 472K-T-A
DS1	5080000330	LAMP HRS-7219A-RE
DS2	5080000330	LAMP HRS-7219A-RE
DS3	5030001470	LCD LD-HU4649E
S1	2250000370	ENCODER EVQ-VENF0124B
S2	2260001890	S.SWITCH SKQDPA
S3	2260001890	S.SWITCH SKQDPA
S4	2260001890	S.SWITCH SKQDPA
S5	2260001890	S.SWITCH SKQDPA
S6	2260001890	S.SWITCH SKQDPA
S7	2260001890	S.SWITCH SKQDPA
S8	2260001890	S.SWITCH SKQDPA
S9	2260001890	S.SWITCH SKQDPA
S10	2260001890	S.SWITCH SKQDPA
J1	6510019310	CONNECTOR 1729 FRONT CONNECTOR
W2	7030003880	S.JUMPER ERJ3GE JPW V
EP1	0910047622	PCB B 4853B
EP2	8930041630	LCD CONTACT SRCN-1893-SP-N-W

S.=Surface mount



[MAIN UNIT]

REF. NO.	ORDER NO.	DESCRIPTION
IC1	1150000780	IC SC-1091
IC2	1110002750	S.IC TA75S01F (TE85R)
IC3	1150001620	IC SC-1318
IC4	1110003090	IC LA4425A
IC5	1110003300	S.IC M5282FP 70CD
IC6	1180001070	S.IC TA7805F(TE18L)
IC7	1180000420	S.IC TA78L05F (TE12R)
IC8	1180001250	S.IC TA7808F(TE18L)
IC9	1110001971	S.IC $\mu$ PC1678G-T1
IC10	1110003490	S.IC TA31136FN(D)
IC11	1110000960	S.IC NJM4558M(T1)
IC12	1130007610	S.IC $\mu$ PD3140GS-E1 (DS8)
IC13	1110000980	S.IC NJM4558M(T1)
IC14	1110000980	S.IC NJM4558M(T1)
IC21	1140006430	S.IC HD8433875NA39H
IC22	1130006550	S.IC TC7S08FU (TE85R)
IC23	1110002750	S.IC TA75S01F (TE85R)
IC24	1130007110	S.IC TC7W04FU(TE12L)
IC26	1180000340	S.IC X25180S(5V)
IC27	1110003500	S.IC S-80742SL-A8-T1
IC28	1130007020	S.IC TC7S08FU(TE85R)
IC29	1130008560	S.IC TC75S51F (TE85L)
Q1	1530002340	S.TRANSISTOR 2SC2954-T2B
Q2	1530002680	S.TRANSISTOR 2SC3357-T2
Q3	1580000490	S.FET 3SK166-2-T7
Q4	1580000480	S.FET 3SK184-S (TX)
Q5	1590000430	S.TRANSISTOR DTC144EU T107
Q6	1510000980	S.TRANSISTOR 2SA1870 TLE
Q7	1530002280	S.TRANSISTOR 2SC4081 T107 S
Q8	1590001320	S.TRANSISTOR DTC143ZU T107
Q9	1530002340	S.TRANSISTOR 2SC2954-T2B
Q10	1530002680	S.TRANSISTOR 2SC3357-T2
Q11	1530002920	S.TRANSISTOR 2SC4226-T2 R25
Q12	1580000490	S.FET 3SK166-2-T7
Q13	1580000480	S.FET 3SK184-S (TX)
Q14	1590000430	S.TRANSISTOR DTC144EU T107
Q15	1530002920	S.TRANSISTOR 2SC4226-T2 R25
Q16	1530002920	S.TRANSISTOR 2SC4226-T2 R25
Q17	1530002060	S.TRANSISTOR 2SC4081 T107 R
Q18	1530002920	S.TRANSISTOR 2SC4226-T2 R25
Q19	1580000480	S.FET 3SK184-S (TX)
Q20	1590000430	S.TRANSISTOR DTC144EU T107
Q21	1530002920	S.TRANSISTOR 2SC4226-T2 R25
Q22	1530003090	S.TRANSISTOR 2SC4213-B (TE85R)
Q23	1520000200	S.TRANSISTOR 2SB798-T2 DK
Q24	1530002060	S.TRANSISTOR 2SC4081 T107 R
Q25	1520000270	S.TRANSISTOR 2SB1182 TL Q
Q26	1590002110	S.TRANSISTOR DTC143XU T107
Q27	1530002920	S.TRANSISTOR 2SC4226-T2 R25
Q28	1530002900	S.TRANSISTOR 2SC4226-T2 R45
Q29	1530002920	S.TRANSISTOR 2SC4226-T2 R25
Q30	1530002920	S.TRANSISTOR 2SC4226-T2 R25
Q31	1530002920	S.TRANSISTOR 2SC4226-T2 R25
Q32	1590000430	S.TRANSISTOR DTC144EU T107
Q33	1530002920	S.TRANSISTOR 2SC4226-T2 R25
Q34	1530002920	S.TRANSISTOR 2SC4226-T2 R25
Q35	1530002920	S.TRANSISTOR 2SC4226-T2 R25
Q37	1510000580	S.TRANSISTOR 2SA1382-GR (TE85R)
Q38	1530002080	S.TRANSISTOR 2SC4081 T107 R
Q39	1530003090	S.TRANSISTOR 2SC4213-B (TE85R)
Q40	1530003090	S.TRANSISTOR 2SC4213-B (TE85R)
Q41	1590001040	S.TRANSISTOR DTA113ZU T107
Q42	1590001040	S.TRANSISTOR DTA113ZU T107
Q43	1590002270	S.TRANSISTOR UMG9N TL
Q44	1530002060	S.TRANSISTOR 2SC4081 T107 R
Q45	1590000980	S.TRANSISTOR DTB123EK T147
Q46	1590000430	S.TRANSISTOR DTC144EU T107
Q48	1530002850	S.TRANSISTOR 2SC4116-BL (TE85R)
Q52	1510000580	S.TRANSISTOR 2SA1382-GR (TE85R)
Q53	1530002060	S.TRANSISTOR 2SC4081 T107 R
Q54	1530002900	S.TRANSISTOR 2SC4226-T2 R45
Q55	1530002380	S.TRANSISTOR 2SC4215-Y (TE85R)
Q56	1530002060	S.TRANSISTOR 2SC4081 T107 R
Q57	1530002060	S.TRANSISTOR 2SC4081 T107 R

[MAIN UNIT]

REF. NO.	ORDER NO.	DESCRIPTION
Q58	1590001450	S.FET 2SJ144-GR (TE85R)
Q59	1530002060	S.TRANSISTOR 2SC4081 T107 R
Q60	1580000530	S.FET 2SK880-GR (TE85R)
Q61	1580000530	S.FET 2SK880-GR (TE85R)
Q62	1590001450	S.FET 2SJ144-GR (TE85R)
Q63	1590002410	S.TRANSISTOR UMH2N TN
Q64	1590000980	S.TRANSISTOR DTB123EK T147
Q65	1590000980	S.TRANSISTOR DTB123EK T147
Q66	1590000980	S.TRANSISTOR DTB123EK T147
Q67	1590000980	S.TRANSISTOR DTB123EK T147
Q68	1590002270	S.TRANSISTOR UMG9N TL
Q69	1590002270	S.TRANSISTOR UMG9N TL
Q70	1530002060	S.TRANSISTOR 2SC4081 T107 R
Q71	1530002060	S.TRANSISTOR 2SC4081 T107 R
Q72	1530002060	S.TRANSISTOR 2SC4081 T107 R
Q73	1590001450	S.FET 2SJ144-GR (TE85R)
Q75	1590001450	S.FET 2SJ144-GR (TE85R)
Q76	1590001450	S.FET 2SJ144-GR (TE85R)
Q77	1590000430	S.TRANSISTOR DTC144EU T107
Q79	1590000430	S.TRANSISTOR DTC144EU T107
Q101	1540000250	S.TRANSISTOR 2SD999-T2 CK
Q102	1590002420	S.TRANSISTOR UMD3N TL
Q103	1530002060	S.TRANSISTOR 2SC4081 T107 R
Q104	1530002060	S.TRANSISTOR 2SC4081 T107 R
Q105	1510000780	S.TRANSISTOR 2SA1586-Y (TE85R)
Q108	1530002060	S.TRANSISTOR 2SC4081 T107 R
Q109	1530002060	S.TRANSISTOR 2SC4081 T107 R
Q111	1530002060	S.TRANSISTOR 2SC4081 T107 R
D1	1710000310	DIODE MI407
D2	1790000980	S.DIODE MA742(TX)
D3	1790000980	S.DIODE MA742(TX)
D4	1750000370	S.DIODE DA221 TL
D5	1750000550	S.DIODE 1SS355 TE-17
D6	1790000450	S.DIODE MA862(TX)
D7	1710000290	DIODE MI308
D8	1710000290	DIODE MI308
D9	1750000550	S.DIODE 1SS355 TE-17
D10	1720000370	S.VARICAP HVU350TRF
D11	1720000370	S.VARICAP HVU350TRF
D12	1720000370	S.VARICAP HVU350TRF
D13	1720000370	S.VARICAP HVU350TRF
D14	1750000550	S.DIODE 1SS355 TE-17
D15	1710000310	DIODE MI407
D16	1790000980	S.DIODE MA742(TX)
D17	1790000980	S.DIODE MA742(TX)
D18	1750000370	S.DIODE DA221 TL
D19	1790000820	S.DIODE MA77(TW)
D20	1790000450	S.DIODE MA862(TX)
D21	1710000730	S.DIODE MI809-T11
D22	1710000290	DIODE MI308
D23	1750000550	S.DIODE 1SS355 TE-17
D24	1790000450	S.DIODE MA862(TX)
D25	1790000450	S.DIODE MA862(TX)
D26	1790001010	S.ZENER MA8043-L(TX)
D27	1730000520	ZENER RD20E B2
D28	1790000700	DIODE DSA3A1
D29	1750000550	S.DIODE 1SS355 TE-17
D30	1790000450	S.DIODE MA862(TX)
D31	1720000370	S.VARICAP HVU350TRF
D32	1790000820	S.DIODE MA77(TW)
D33	1720000640	S.VARICAP 1SV284 (TPH3)
D35	1750000550	S.DIODE 1SS355 TE-17
D36	1160000080	S.DIODE DAN202U T107
D37	1790000880	S.DIODE MA133(TX)
D38	1730002340	S.ZENER MA8047-M(TX)
D39	1790000980	S.DIODE MA742(TX)
D40	1790001520	S.ZENER MA8075-L(TX)
D41	1160000080	S.DIODE DAN202U T107
D42	1160000080	S.DIODE DAN202U T107
D43	1790000980	S.DIODE MA742(TX)
D44	1790000660	S.DIODE MA728(TW)
D45	1160000080	S.DIODE DAN202U T107
D101	1730002280	S.ZENER MA8091-M(TX)
D102	1730002280	S.ZENER MA8091-M(TX)

S.=Surface mount

## [MAIN UNIT]

REF. NO.	ORDER NO.	DESCRIPTION	
D103	1750000550	S.DIODE	1SS355 TE-17
D104	1750000550	S.DIODE	1SS355 TE-17
D105	1750000550	S.DIODE	1SS355 TE-17
D106	1750000550	S.DIODE	1SS355 TE-17
D108	1750000180	S.DIODE	DA114 T107 [EUR], [ITA]
D109	1160000080	S.DIODE	DAN202U T107 [SEA]
	1750000180	S.DIODE	DA114 T107 except [SEA]
D110	1750000550	S.DIODE	1SS355 TE-17 except [EUR]
D111	1750000550	S.DIODE	1SS355 TE-17 [ITA], [SEA]
D112	1750000550	S.DIODE	1SS355 TE-17 [USA], [SEA]
D115	1710000600	DIODE	1SS254 [EUR]
D117	1750000550	S.DIODE	1SS355 TE-17 except [ITA]
D118	1750000550	S.DIODE	1SS355 TE-17 except [ITA]
D119	1750000550	S.DIODE	1SS355 TE-17 except [USA]
D120	1750000550	S.DIODE	1SS355 TE-17
D121	1750000550	S.DIODE	1SS355 TE-17
D123	1750000550	S.DIODE	1SS355 TE-17
D126	1720000640	S.VARICAP	1SV284 (TPH3)
D127	1750000550	S.DIODE	1SS355 TE-17
D128	1750000550	S.DIODE	1SS355 TE-17
D129	1790000980	S.DIODE	MA742(TX)
FI1	2040001020	S.SAW	EFCH445MWNP1 [USA]
	2040001000	S.SAW	EFCH435MWNP1 except [USA]
FI2	2010002040	MONOLITHIC CERAMIC	FL-258 (46.05 MHz)
FI3	2020001150		KBF-450P-15A
X1	6050009820	XTAL	CR-549 (15.2 MHz)
X2	6070000200	DISCRIMINATOR	CDB450C24
X11	6050009800	S.XTAL	SMD-49 (8.000 MHz)
L1	6110002150	COIL	LA-385
L2	6110001550	COIL	LA-235
L3	6110001810	COIL	LA-244
L4	6170000230	COIL	LW-25
L5	6110001550	COIL	LA-235
L6	6110001550	COIL	LA-235
L7	6200005740	S.COIL	ELJRE 47NG-F
L8	6200003410	S.COIL	LL2012-F68NK
L9	6200005710	S.COIL	ELJRE 27NG-F
L10	6200003410	S.COIL	LL2012-F68NK
L11	6200005690	S.COIL	ELJRE 18NG-F
L12	6110001570	COIL	LA-237
L13	6110001560	COIL	LA-236
L14	6150004360	S.COIL	LS-491
L15	6200004800	S.COIL	MLF1608D R15K-T
L16	6150004360	S.COIL	LS-491
L17	6150004360	S.COIL	LS-491
L18	6150004360	S.COIL	LS-491
L19	6200004800	S.COIL	MLF1608D R15K-T
L20	6110001520	COIL	LA-232
L21	6110001590	COIL	LA-242
L22	6110001520	COIL	LA-232
L23	6110002130	COIL	LA-383
L24	6170000230	COIL	LW-25
L25	6110001520	COIL	LA-232 [USA]
	6110001590	COIL	LA-242 except [USA]
L26	6200005680	S.COIL	ELJRE 15NG-F
L27	6200005700	S.COIL	ELJRE 22NG-F
L28	6200005700	S.COIL	ELJRE 22NG-F
L29	6200005660	S.COIL	ELJRE 10NG-F
L30	6200005720	S.COIL	ELJRE 33NG-F
L31	6110001520	COIL	LA-232
L32	6110001520	COIL	LA-232
L35	6200005740	S.COIL	ELJRE 47NG-F
L36	6200005710	S.COIL	ELJRE 27NG-F
L37	6200005690	S.COIL	ELJRE 18NG-F [SEA]
	6200006980	S.COIL	ELJRE R10G-F except [SEA]
L38	6200003960	S.COIL	MLF1608A 1R0K-T
L39	6200005740	S.COIL	ELJRE 47NG-F
L40	6200005850	S.COIL	ELJRE 8N2Z-F
L41	6200005850	S.COIL	ELJRE 8N2Z-F

## [MAIN UNIT]

REF. NO.	ORDER NO.	DESCRIPTION	
L42	6200005680	S.COIL	ELJRE 15NG-F
L43	6200005850	S.COIL	ELJRE 8N2Z-F
L44	6200005850	S.COIL	ELJRE 8N2Z-F
L45	6200005680	S.COIL	ELJRE 15NG-F
L46	6200005670	S.COIL	ELJRE 12NG-F
L47	6200005660	S.COIL	ELJRE 10NG-F
L48	6200005660	S.COIL	ELJRE 10NG-F
L49	6200005740	S.COIL	ELJRE 47NG-F
L50	6200003540	S.COIL	MLF1608D R22K-T
L51	6200005720	S.COIL	ELJRE 33NG-F
L52	6200003540	S.COIL	MLF1608D R22K-T
L53	6130002420	S.COIL	LB-270
L54	6200004480	S.COIL	MLF1608D R82K-T
L55	6200005710	S.COIL	ELJRE 27NG-F
L56	6200002320	S.COIL	LQN 1A 8N8J04
L57	6200004480	S.COIL	MLF1608D R82K-T
L58	6200002850	S.COIL	NL 252018T-R82J
L59	6200002850	S.COIL	NL 252018T-R82J
L60	6200002090	S.COIL	ELJFB 681K-F
L61	6200005690	S.COIL	ELJRE 18NG-F [SEA]
	6200005700	S.COIL	ELJRE 22NG-F except [SEA]
L101	6200005950	S.COIL	LQH 3N 2R2M04 (Q20)
L102	6200004920	S.COIL	MLF1608A 2R2K-T
L103	6200004920	S.COIL	MLF1608A 2R2K-T
L104	6200004920	S.COIL	MLF1608A 2R2K-T
L105	6200005950	S.COIL	LQH 3N 2R2M04 (Q20)
L106	6200004920	S.COIL	MLF1608A 2R2K-T
L107	6200001520	S.COIL	MLF2012D R82K-T
L108	6200004920	S.COIL	MLF1608A 2R2K-T
L110	6200005740	S.COIL	ELJRE 47NG-F
L111	6200002850	S.COIL	NL 252018T-R18J
L112	6200002850	S.COIL	NL 252018T-R82J
L113	6200000050	S.COIL	LQH 3N R39M 04
L114	6200005190	S.COIL	MLF1608D R56K-T
L115	6200005700	S.COIL	ELJRE 22NG-F
L121	6200005690	S.COIL	ELJRE 18NG-F except [SEA]
L122	6200005690	S.COIL	ELJRE 18NG-F except [SEA]
R1	7030001130	S.RESISTOR	MCR50JZHJ 100 Ω (101)
R2	7030003320	S.RESISTOR	ERJ3GEYJ 101 V (100 Ω)
R3	7030003320	S.RESISTOR	ERJ3GEYJ 101 V (100 Ω)
R4	7030001050	S.RESISTOR	MCR50JZHJ 22 Ω (220)
R5	7030003520	S.RESISTOR	ERJ3GEYJ 472 V (4.7 kΩ)
R6	7030003430	S.RESISTOR	ERJ3GEYJ 821 V (820 Ω)
R7	7030003440	S.RESISTOR	ERJ3GEYJ 102 V (1 kΩ)
R8	7030000180	S.RESISTOR	MCR10EZHZJ 22 Ω (220)
R9	7030000180	S.RESISTOR	MCR10EZHZJ 22 Ω (220)
R10	7030003520	S.RESISTOR	ERJ3GEYJ 472 V (4.7 kΩ)
R11	7030003440	S.RESISTOR	ERJ3GEYJ 102 V (1 kΩ)
R12	7030003340	S.RESISTOR	ERJ3GEYJ 151 V (150 Ω)
R13	7030003270	S.RESISTOR	ERJ3GEYJ 390 V (39 Ω)
R14	7030003340	S.RESISTOR	ERJ3GEYJ 151 V (150 Ω)
R15	7030003520	S.RESISTOR	ERJ3GEYJ 472 V (4.7 kΩ)
R16	7030003880	S.RESISTOR	ERJ3GEYJ 104 V (100 kΩ)
R17	7030003880	S.RESISTOR	ERJ3GEYJ 104 V (100 kΩ)
R18	7030003840	S.RESISTOR	ERJ3GEYJ 473 V (47 kΩ)
R19	7030003880	S.RESISTOR	ERJ3GEYJ 104 V (100 kΩ)
R21	7030003320	S.RESISTOR	ERJ3GEYJ 101 V (100 Ω)
R22	7030003240	S.RESISTOR	ERJ3GEYJ 220 V (22 Ω)
R24	7030003350	S.RESISTOR	ERJ3GEYJ 181 V (180 Ω)
R25	7030003880	S.RESISTOR	ERJ3GEYJ 104 V (100 kΩ)
R26	7030003880	S.RESISTOR	ERJ3GEYJ 104 V (100 kΩ)
R27	7030003880	S.RESISTOR	ERJ3GEYJ 104 V (100 kΩ)
R28	7030003520	S.RESISTOR	ERJ3GEYJ 472 V (4.7 kΩ)
R29	7030003880	S.RESISTOR	ERJ3GEYJ 104 V (100 kΩ)
R30	7030003520	S.RESISTOR	ERJ3GEYJ 472 V (4.7 kΩ)
R31	7030003420	S.RESISTOR	ERJ3GEYJ 681 V (680 Ω)
R32	7030003560	S.RESISTOR	ERJ3GEYJ 103 V (10 kΩ)
R33	7030001190	S.RESISTOR	MCR50JZHJ 330 Ω (331)
R34	7030003650	S.RESISTOR	ERJ3GEYJ 563 V (56 kΩ)
R35	7030003610	S.RESISTOR	ERJ3GEYJ 273 V (27 kΩ)
R36	7030003610	S.RESISTOR	ERJ3GEYJ 273 V (27 kΩ)
R37	7030003790	S.RESISTOR	ERJ3GEYJ 824 V (820 kΩ)
R38	7030003880	S.RESISTOR	ERJ3GEYJ 104 V (100 kΩ)
R39	7030003560	S.RESISTOR	ERJ3GEYJ 103 V (10 kΩ)

S.=Surface mount











[MAIN UNIT]

REF. NO.	ORDER NO.	DESCRIPTION
C447	4030007010	S.CERAMIC C1608 CH 1H 100D-T-A
C489	4030011080	S.CERAMIC GRM42-6 CH 080D 500PT
C490	4030007090	S.CERAMIC C1608 CH 1H 470J-T-A
C491	4510005310	S.ELECTROLYTIC ECEV1CA220SR
C492	4550002890	S.TANTALUM TESVA 1A 225M1-8L
C493	4030008860	S.CERAMIC C1608 JB 1H 102K-T-A
C494	4550002890	S.TANTALUM TESVA 1A 225M1-8L
C495	4030009570	S.CERAMIC C1608 CH 1H 0R3B-T-A
C496	4030008860	S.CERAMIC C1608 JB 1H 102K-T-A
C497	4030008860	S.CERAMIC C1608 JB 1H 102K-T-A
C498	4030008860	S.CERAMIC C1608 JB 1H 102K-T-A
C499	4030008860	S.CERAMIC C1608 JB 1H 102K-T-A
C500	4030011080	S.CERAMIC GRM42-6 CH 080D 500PT
C501	4030008860	S.CERAMIC C1608 JB 1H 102K-T-A
C502	4030008860	S.CERAMIC C1608 JB 1H 102K-T-A
C503	4030008860	S.CERAMIC C1608 JB 1H 102K-T-A
C504	4030008860	S.CERAMIC C1608 JB 1H 102K-T-A
C505	4030008860	S.CERAMIC C1608 JB 1H 102K-T-A
C506	4030008860	S.CERAMIC C2012 JF 1C 105Z-T-A
C507	4030008860	S.CERAMIC C1608 JB 1H 102K-T-A
C508	4030008980	S.CERAMIC C1608 CH 1H 070D-T-A
C509	4030008560	S.CERAMIC C1608 CH 1H 300J-T-A
C510	4030008860	S.CERAMIC C1608 JB 1H 102K-T-A
C512	4510004640	S.ELECTROLYTIC ECEV1CA470SP
C513	4030010780	S.CERAMIC C1608 CH 1H 1R5C-T-A
C517	4030007170	S.CERAMIC C1608 CH 1H 221J-T-A
C518	4030007170	S.CERAMIC C1608 CH 1H 221J-T-A
C521	4030006990	S.CERAMIC C1608 CH 1H 080D-T-A except [SEA]
C522	4030007030	S.CERAMIC C1608 CH 1H 150J-T-A except [SEA]
C523	4030007000	S.CERAMIC C1608 CH 1H 090D-T-A except [SEA]
C526	4030008980	S.CERAMIC C1608 CH 1H 070D-T-A except [SEA]
C527	4030006870	S.CERAMIC C1608 JB 1H 222K-T-A except [SEA]
J1	8510014790	CONNECTOR 53253-0210
J2	8450001440	CONNECTOR HSJ1403-01-010
J3	8450001840	CONNECTOR TCS7588-43-201
J4	8510014960	S.CONNECTOR B2B-ZR-SM3-TF
J11	8510016480	CONNECTOR 52018-8845
J12	8510019321	CONNECTOR 1726 REAR CONNECTOR-1
W1	7120000470	JUMPER ERDS2T0
W2	7120000470	JUMPER ERDS2T0
W3	7120000470	JUMPER ERDS2T0
W4	8900004880	CABLE OPC-465
W5	7030003860	S.JUMPER ERJ3GE JPW V
W6	7030003860	S.JUMPER ERJ3GE JPW V
W7	7030003860	S.JUMPER ERJ3GE JPW V
W9	7030000010	S.JUMPER MCR10EZHZ JPW (000)
W14	7120000470	JUMPER ERDS2T0 except [EUR]
W15	7030003860	S.JUMPER ERJ3GE JPW V
W16	7030003860	S.JUMPER ERJ3GE JPW V
W17	7030003860	S.JUMPER ERJ3GE JPW V
W18	7030003860	S.JUMPER ERJ3GE JPW V
W19	7030003860	S.JUMPER ERJ3GE JPW V
W20	7030003860	S.JUMPER ERJ3GE JPW V
W21	7030003860	S.JUMPER ERJ3GE JPW V
W22	7030003860	S.JUMPER ERJ3GE JPW V
W23	7030003860	S.JUMPER ERJ3GE JPW V
W24	7030003860	S.JUMPER ERJ3GE JPW V
W29	7030003860	S.JUMPER ERJ3GE JPW V
W30	7030003860	S.JUMPER ERJ3GE JPW V
W31	7030003860	S.JUMPER ERJ3GE JPW V
W32	7030000010	S.JUMPER MCR10EZHZ JPW (000)
W33	7030000010	S.JUMPER MCR10EZHZ JPW (000)
W34	7030003860	S.JUMPER ERJ3GE JPW V
W36	7030003860	S.JUMPER ERJ3GE JPW V
W37	7030000010	S.JUMPER MCR10EZHZ JPW (000)
W38	7030000010	S.JUMPER MCR10EZHZ JPW (000)
W39	7030000010	S.JUMPER MCR10EZHZ JPW (000)

[MAIN UNIT]

REF. NO.	ORDER NO.	DESCRIPTION
W40	7030000010	S.JUMPER MCR10EZHZ JPW (000)
W41	7030003860	S.JUMPER ERJ3GE JPW V
W42	7030003860	S.JUMPER ERJ3GE JPW V
W43	7030003860	S.JUMPER ERJ3GE JPW V
W44	7030003860	S.JUMPER ERJ3GE JPW V [SEA]
W45	7030003860	S.JUMPER ERJ3GE JPW V [SEA]
EPI	0910047635	PCB B 4854E

S.=Surface mount



# SECTION 7 MECHANICAL PARTS

## [CONTROL UNIT]

REF. NO.	ORDER NO.	DESCRIPTION	QTY.
J1	6510019310	1729 front connector	1
R39	7210002920	EVU-F2AF20B55 (560K) [SQL]	1
R43	7210002920	EVU-F2AF20B55 (560K) [VOL]	1
S1	2250000370	Encoder EVQ-VENF0124B	1
DS3	5030001470	LCD LD-HU4649E	1
EP2	8930041630	LCD CONTACT SRCN-1893-SP-N-W	1
MP1	8210014720	1893 front panel (A)	1
MP2	8210014160	1893 rear panel [SEA]	1
	8210014830	1893 rear panel (A) expect [SEA]	1
MP3	8930041850	1893 LCD filter	1
MP4	8210014170	1893 reflector	1
MP5	8930041530	1893 A-key	1
MP6	8930041540	1893 B-key	1
MP7	8610010311	Knob K224-1	1
MP8	8930006440	Spring (F)	1
MP9	8610010320	Knob K225	6
MP10	8930041880	1893 key sponge	1
MP11	8610010330	Knob N257	1
MP13	8610010340	Knob N258	1
MP15	8610010350	Knob N259	1
MP17	8810008990	PH BT M2 X10 ZK	3
MP18	8810008990	PH BT M2 X10 ZK	2
MP20	8510011220	1893 LCD plate	1
MP21	8930043831	Insulation sheet (FF)-1	3

## [MAIN UNIT]

REF. NO.	ORDER NO.	DESCRIPTION	QTY.
J3	6450001840	Connector TCS7568-43-201	1
J12	6510019321	1729 rear connector-1	1
MP1	8510009720	1647 VCO case	1
MP2	8930037120	1647 M-holder	2
MP3	8930038170	1647 spacer	1
MP4	8510011290	1893 A-CPU plate	1
MP5	8510011310	1893 A-shield plate	1
MP6	8510011300	1893 modular plate expect [SEA]	1

## [UNPACKING]

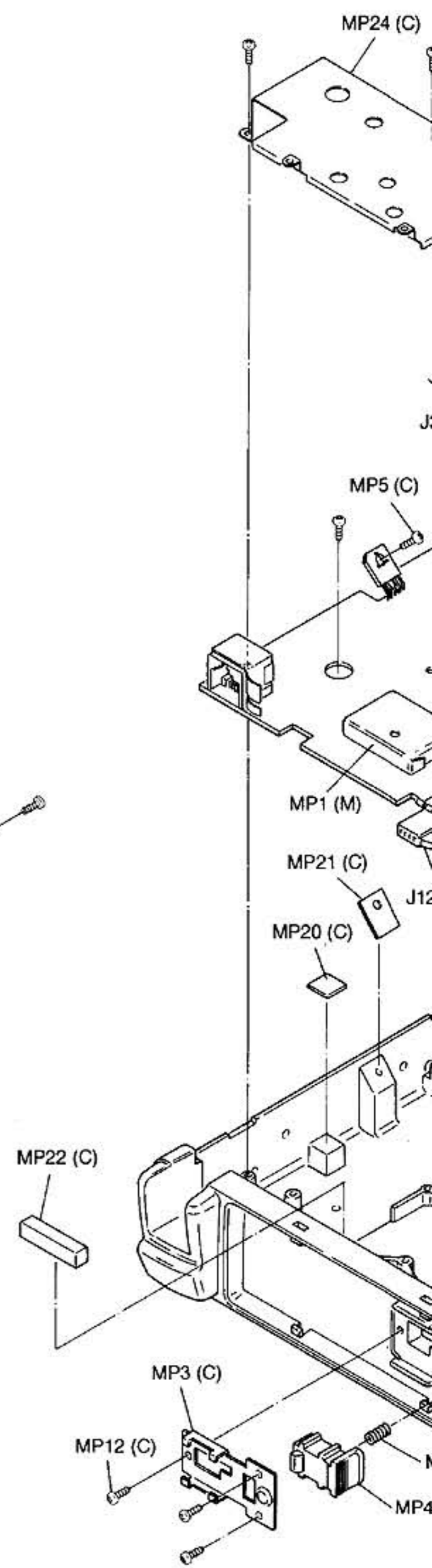
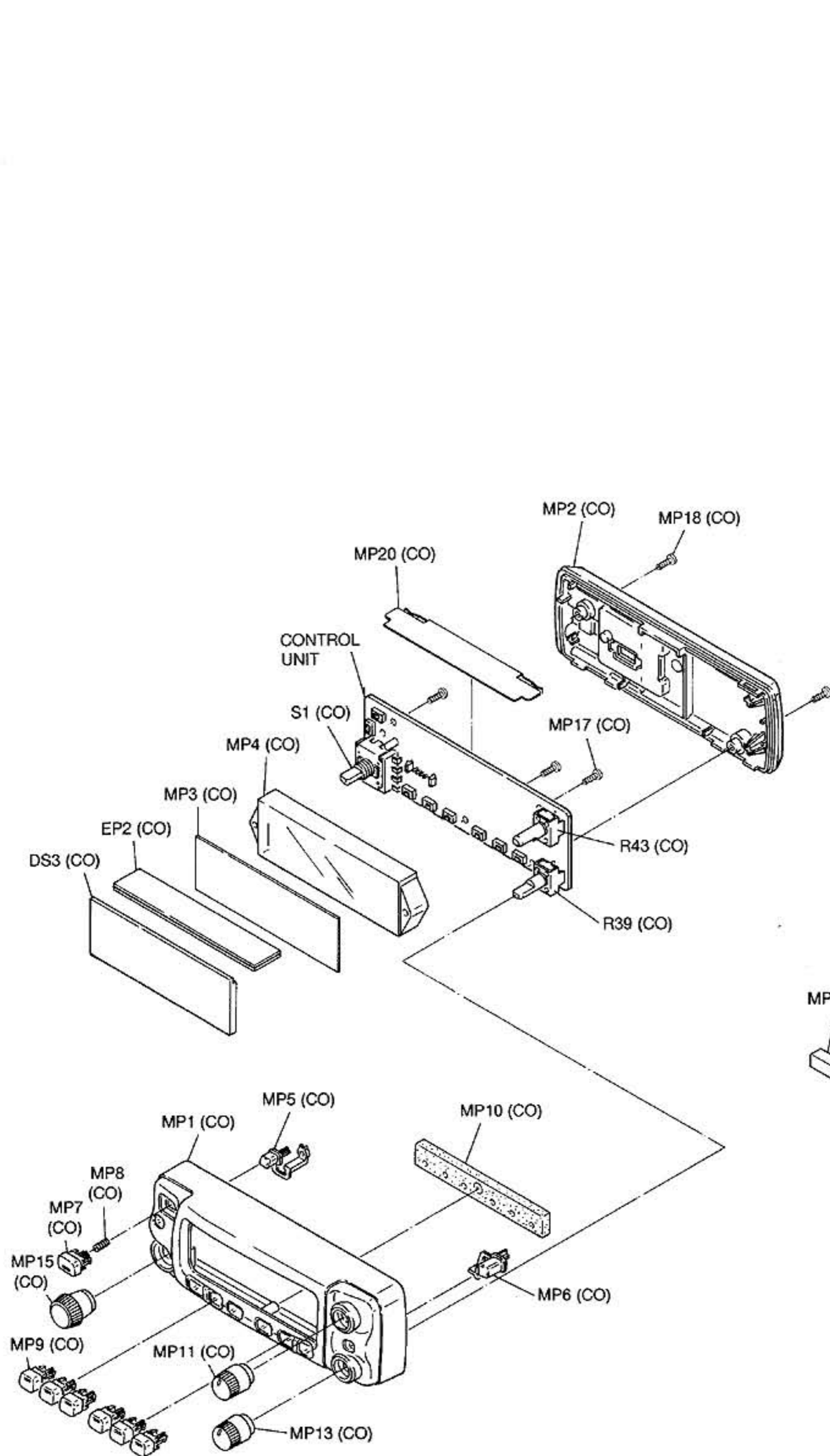
REF. NO.	ORDER NO.	DESCRIPTION	QTY.
F1	5210000080	Fuse FGB 20A	1
W1	Optional product	Cable OPC-346	1
MC1	Optional product	Microphone HM-98 expect [SEA]	1
	Optional product	Microphone HM-96 [SEA]	
MP1	8010016380	1542 MOBIL BRACKET (B)	1
MP3	8820000530	Flange volt M4 X 8 NI	4
MP4	8810000470	PH M5 X12 (+-)	4
MP5	8810000950	PH A M5 X16	4
MP6	8850000150	Flat washer M 5 NI BS	4
MP7	8850000390	Spring washer M 5	4
MP8	8830000120	Nut M 5	4

## [CHASSIS PART]

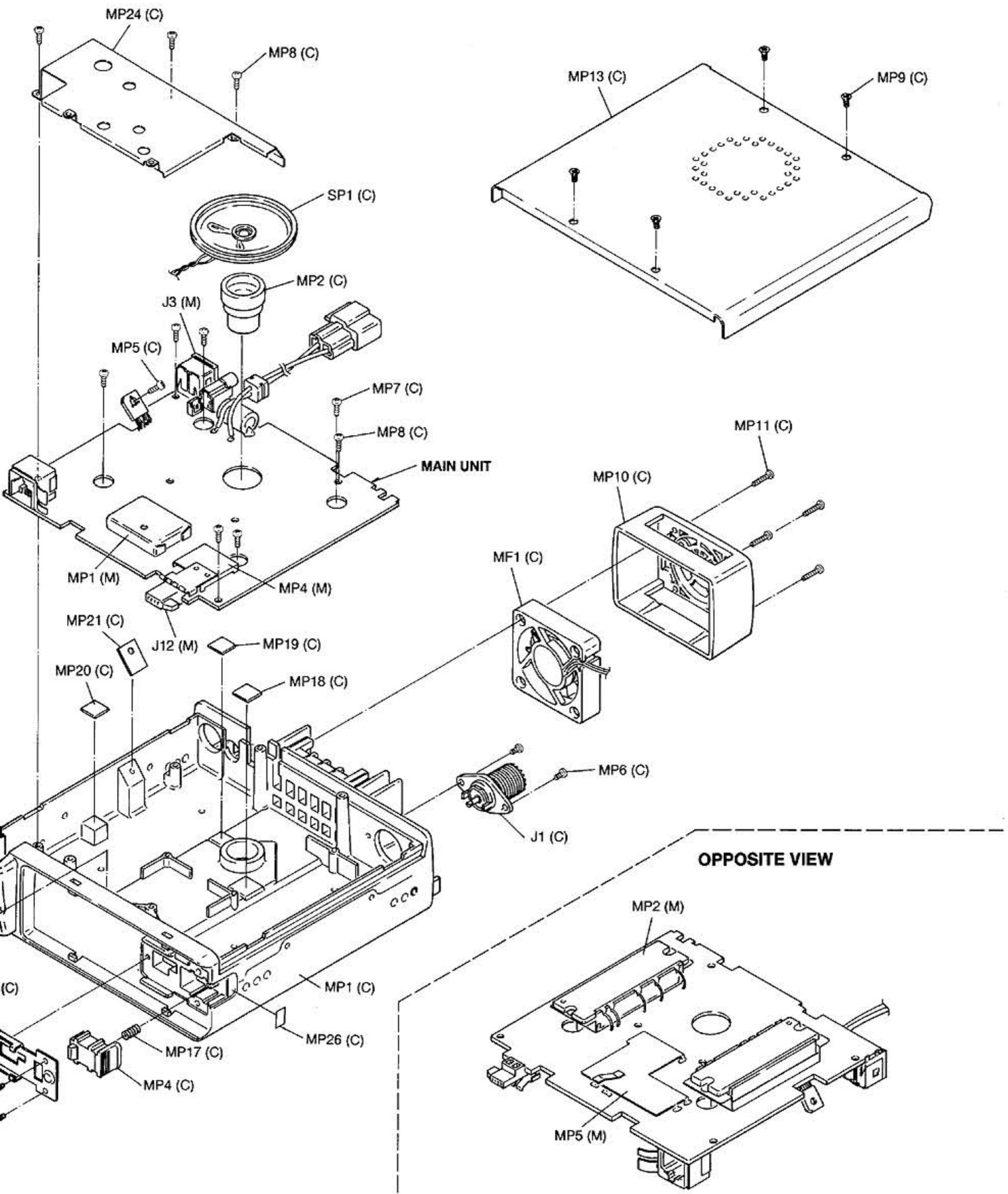
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J1	6510004880	Connector MR-DSE-01	1
MF1	2710000590	Fan MF40D-12H-001	1
SP1	2510000820	Speaker VS-57-0814	1
MP1	8010016782	1893 chassis-2	1
MP2	8930041571	1893 SP rubber-1	1
MP3	8930041551	1893 OPC plate-1	1
MP4	8930041560	1893 release button	1
MP5	8810009140	PH M2.6 X 6 ZK	1
MP6	8810008630	PH BT M3 X 6 NI-ZU	2
MP7	8810008660	PH BT M3 X 8 NI-ZU	4
MP8	8810008660	PH BT M3 X 8 NI-ZU	6
MP9	8810009020	FH M2.6 X 5 ZK	4
MP10	8110005750	1729 fan cover	1
MP11	8810009110	PH 0 M2.6 X16 ZK	4
MP12	8810009140	PH M2.6 X 6 ZK	3
MP13	8110005960	1893 cover	1
MP17	8930041870	Spring (AC)	1
MP18	8930039610	Thermally sheet (C)	1
MP19	8930039610	Thermally sheet (C)	1
MP20	8930039610	Thermally sheet (C)	1
MP21	8930043010	1893 sheet	1
MP22	8930043020	Rubber sheet (AC)	1
MP24	8510011200	1893 shield cover	1
MP26	8930043840	1893 A-sheet	1

### Screw abbreviations

BT: Self-tapping      PH: Pan head  
 FH: Flat head        ZK: Black  
 NI-ZK: Nickel-Zinc    BS: Brass



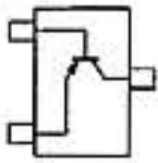
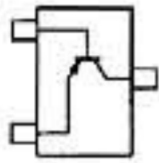
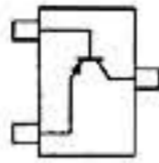
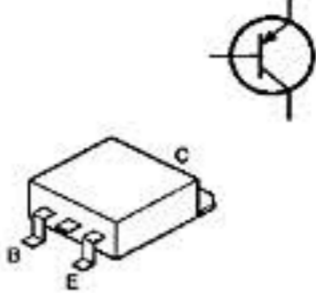
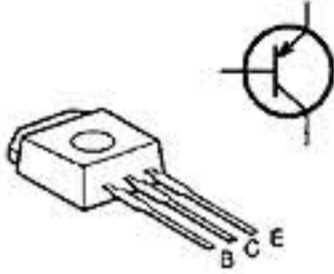
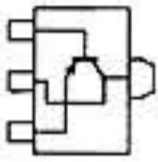
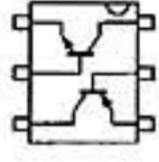
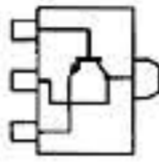
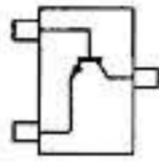
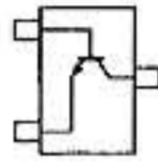
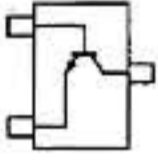
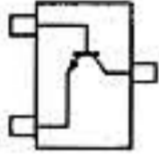
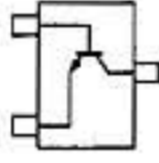
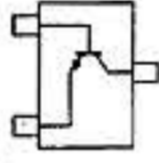
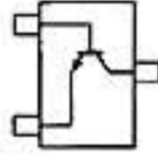
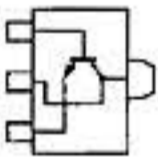
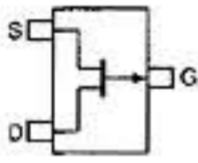
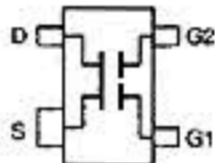
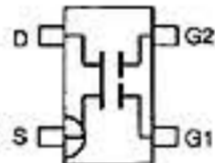
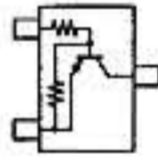
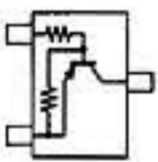
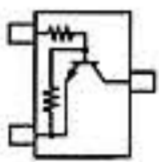
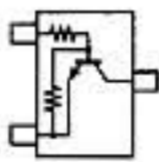
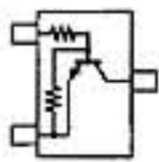
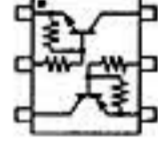
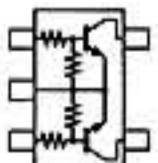
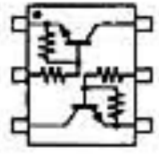
Unit abbreviations: (CO)  
(M)



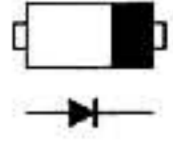
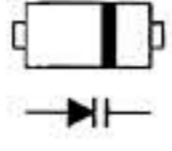
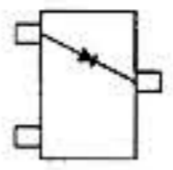
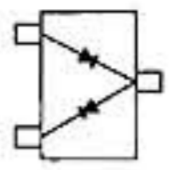
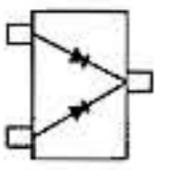
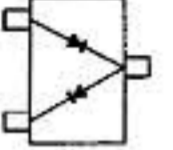
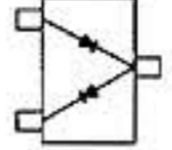
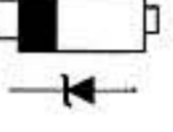
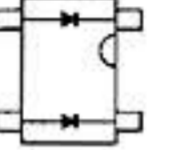
Unit abbreviations: (CO): CONTROL UNIT (C): CHASSIS PART (M) : MAIN UNIT

# SECTION 8 SEMI-CONDUCTOR INFORMATION

## • TRANSISTOR AND FET'S

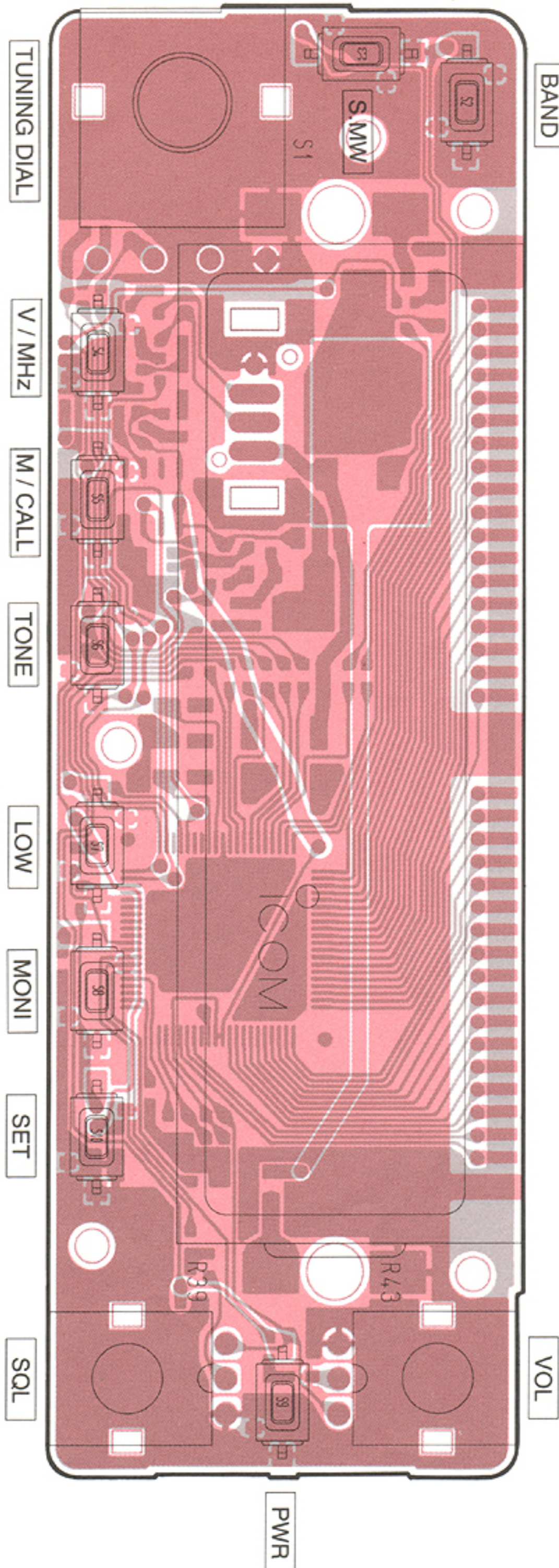
<p><b>2SA1362 GR</b> (Symbol: AEG)</p> 	<p><b>2SA1576 S</b> (Symbol: FS)</p> 	<p><b>2SA1586 Y</b> (Symbol: SY)</p> 	<p><b>2SA1870 TLE</b> (Symbol: A1870)</p> 	<p><b>2SB1182</b> (Symbol: B1182)</p> 
<p><b>2SB798 DK</b> (Symbol: DK)</p> 	<p><b>2SC2954</b> (Symbol: QK)</p> 	<p><b>2SC3357</b> (Symbol: RK)</p> 	<p><b>2SC4081 R</b> (Symbol: BR)</p> 	<p><b>2SC4081 S</b> (Symbol: BS)</p> 
<p><b>2SC4116 BL</b> (Symbol: LL)</p> 	<p><b>2SC4213 B</b> (Symbol: AB)</p> 	<p><b>2SC4215 Y</b> (Symbol: QY)</p> 	<p><b>2SC4226 R25</b> (Symbol: R25)</p> 	<p><b>2SC4228 T2</b> (Symbol: R45)</p> 
<p><b>2SD999 CK</b> (Symbol: CK)</p> 	<p><b>2SJ144 GR</b> (Symbol: VG)</p> 	<p><b>3SK166 2</b> (Symbol: K)</p> 	<p><b>3SK184 S</b> (Symbol: 3R)</p> 	<p><b>DTA113ZU</b> (Symbol: 111)</p> 
<p><b>DTB123EK</b> (Symbol: F12)</p> 	<p><b>DTC143XU T107</b> (Symbol: 43)</p> 	<p><b>DTC143ZU</b> (Symbol: 123)</p> 	<p><b>DTC144EU</b> (Symbol: 26)</p> 	<p><b>UMD3N TL</b> (Symbol: D3)</p> 
<p><b>UMG9N TL</b> (Symbol: G9)</p> 	<p><b>UMH2N TN</b> (Symbol: H2)</p> 			

• DIODES

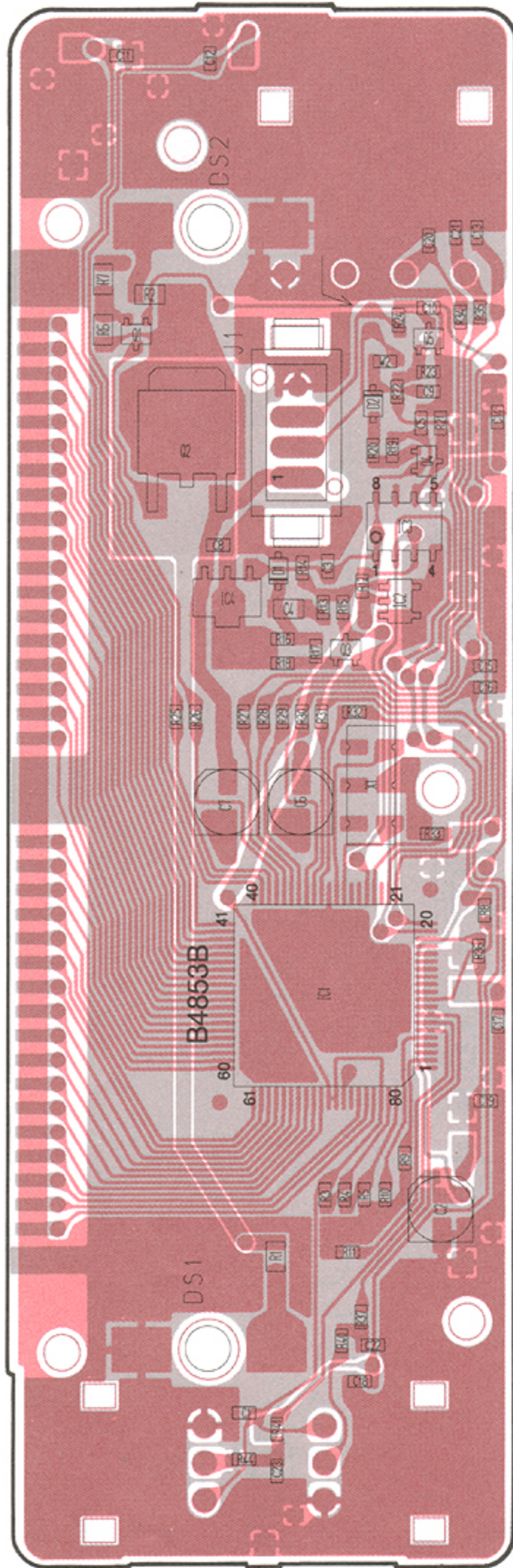
<p><b>1SS355</b> (Symbol: A)</p> 	<p><b>1SV284 (TPH3)</b> (Symbol: TL)</p> 	<p><b>DA114</b> (Symbol: AV)</p> 	<p><b>DA221</b> (Symbol: K)</p> 	<p><b>DAN202U</b> (Symbol: N)</p> 
<p><b>MA133</b> (Symbol: MP)</p> 	<p><b>MA742</b> (Symbol: M1U)</p> 	<p><b>MA8075 L (TX)</b> (Symbol: 7_5)</p> 	<p><b>MA862</b> (Symbol: M1I)</p> 	

# SECTION 9 BOARD LAYOUTS

● TOP VIEW



● BOTTOM VIEW

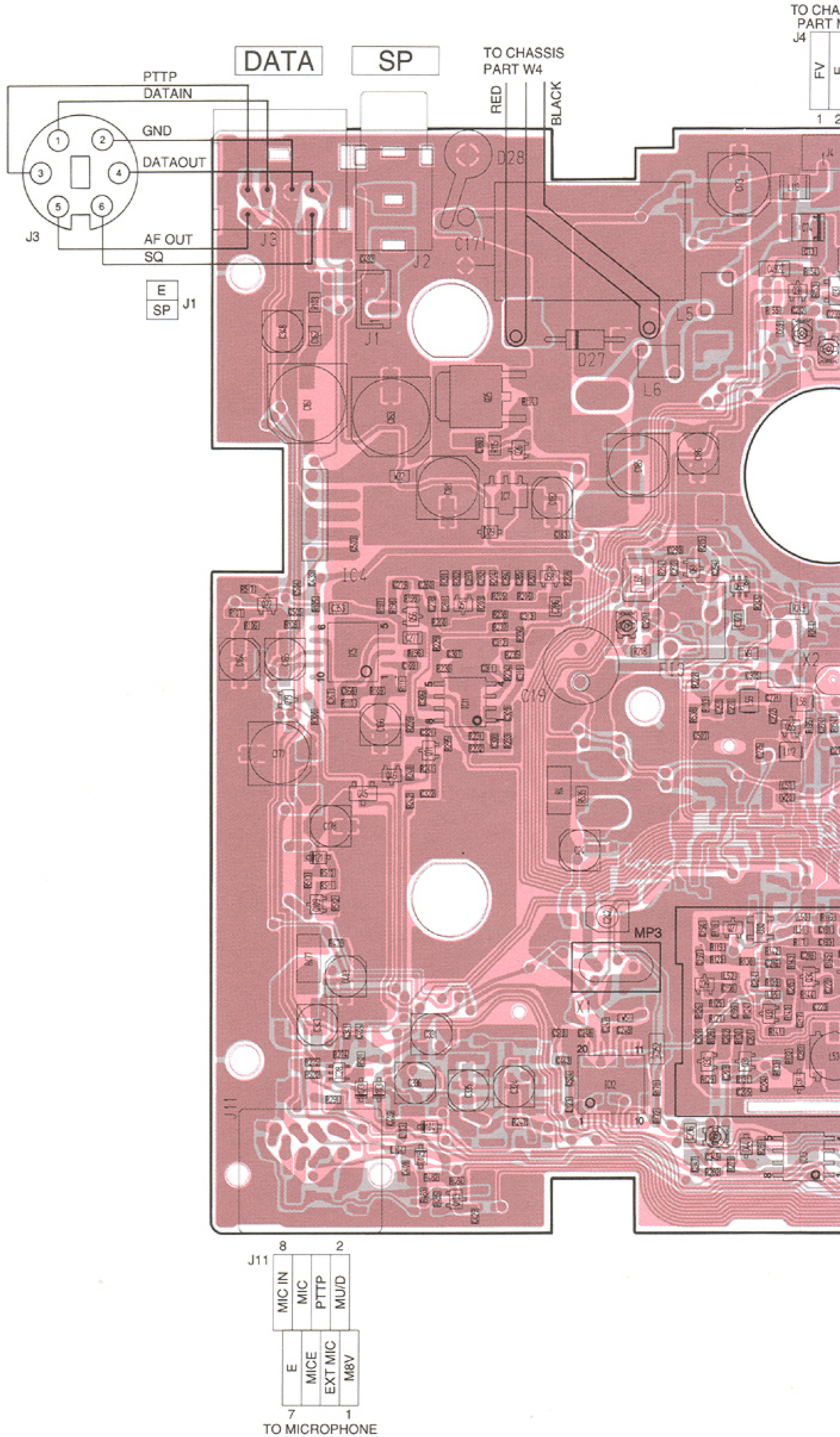


J1	
4	GND
	RDATA
	TDATA
1	HV

TO MAIN UNIT J12

# 9-2 MAIN UNIT

## ● TOP VIEW



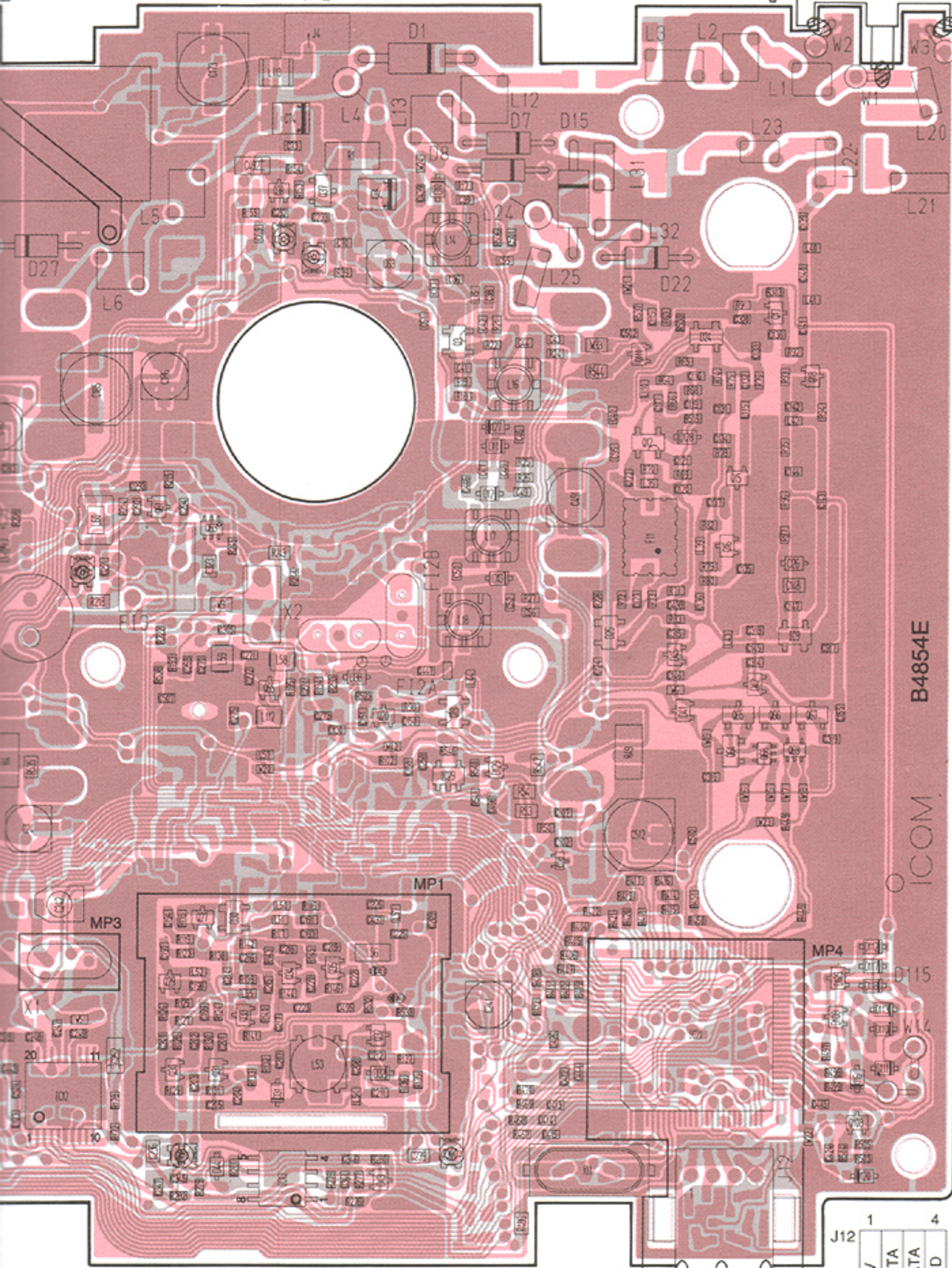
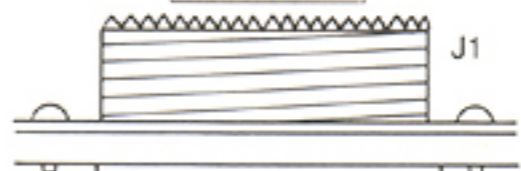


BLACK IS

TO CHASSIS  
PART MF1

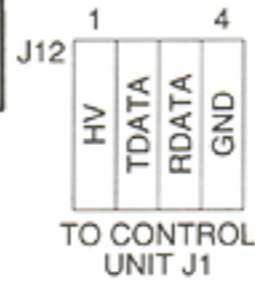


ANT

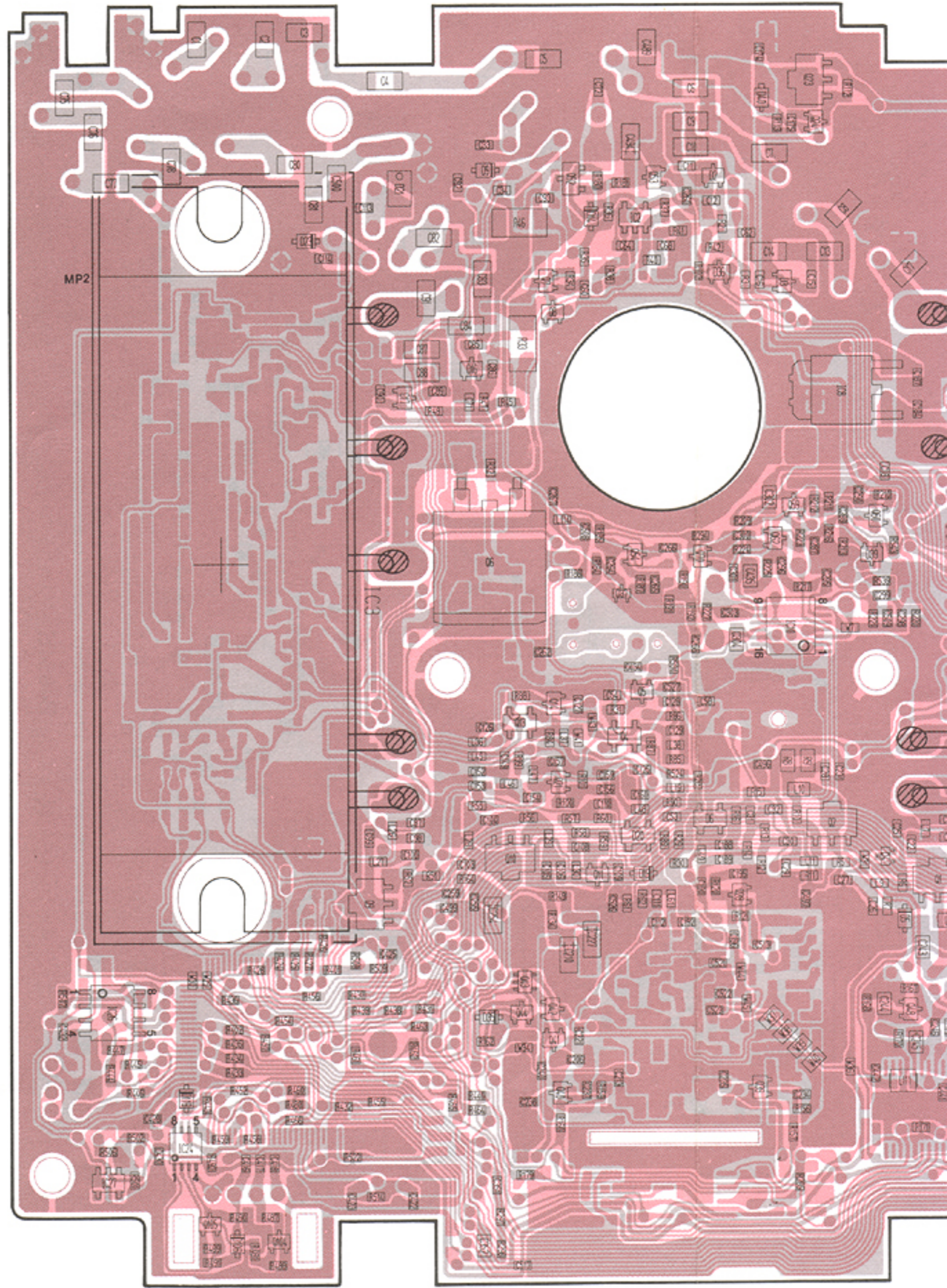


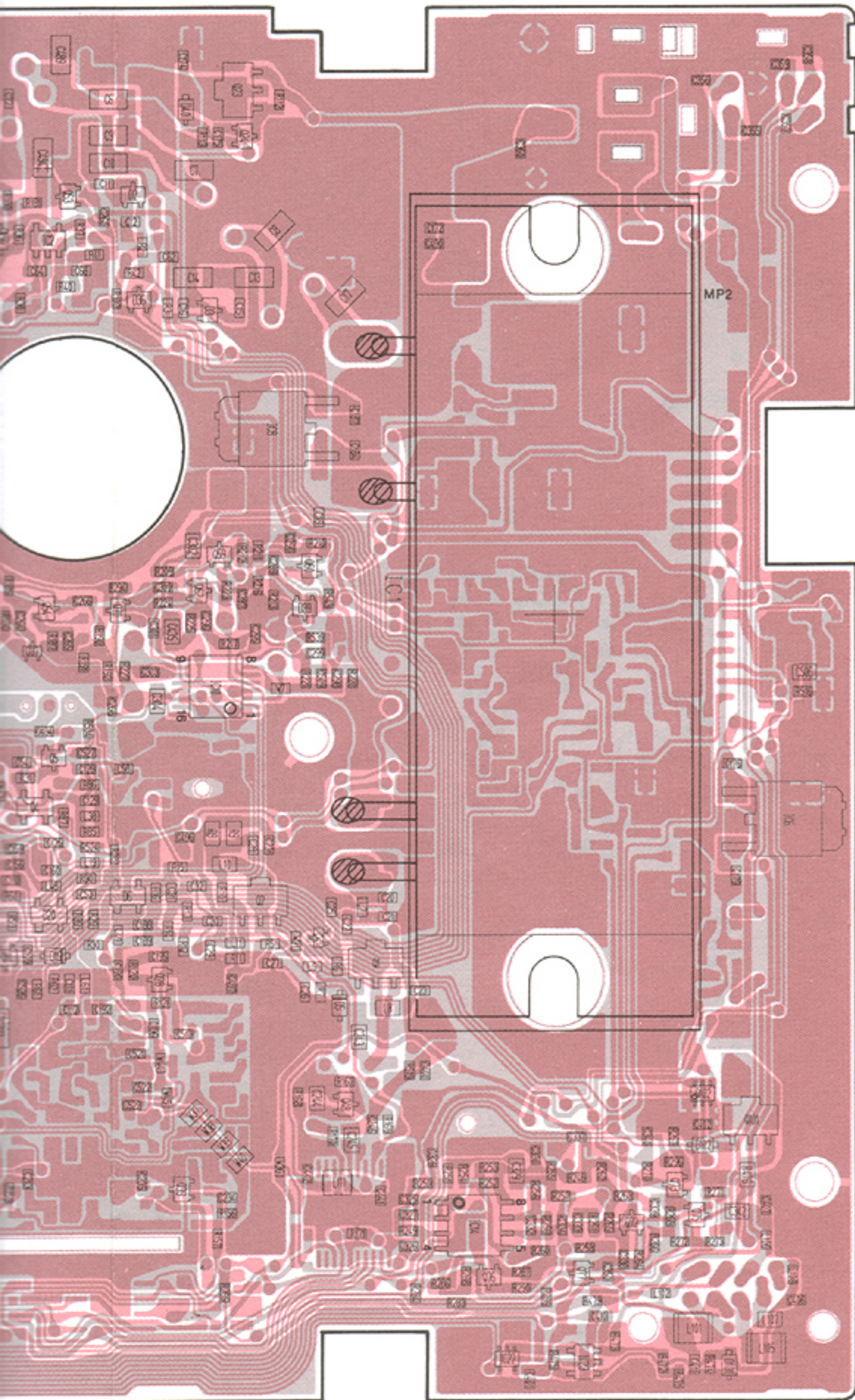
B4854E

ICOM

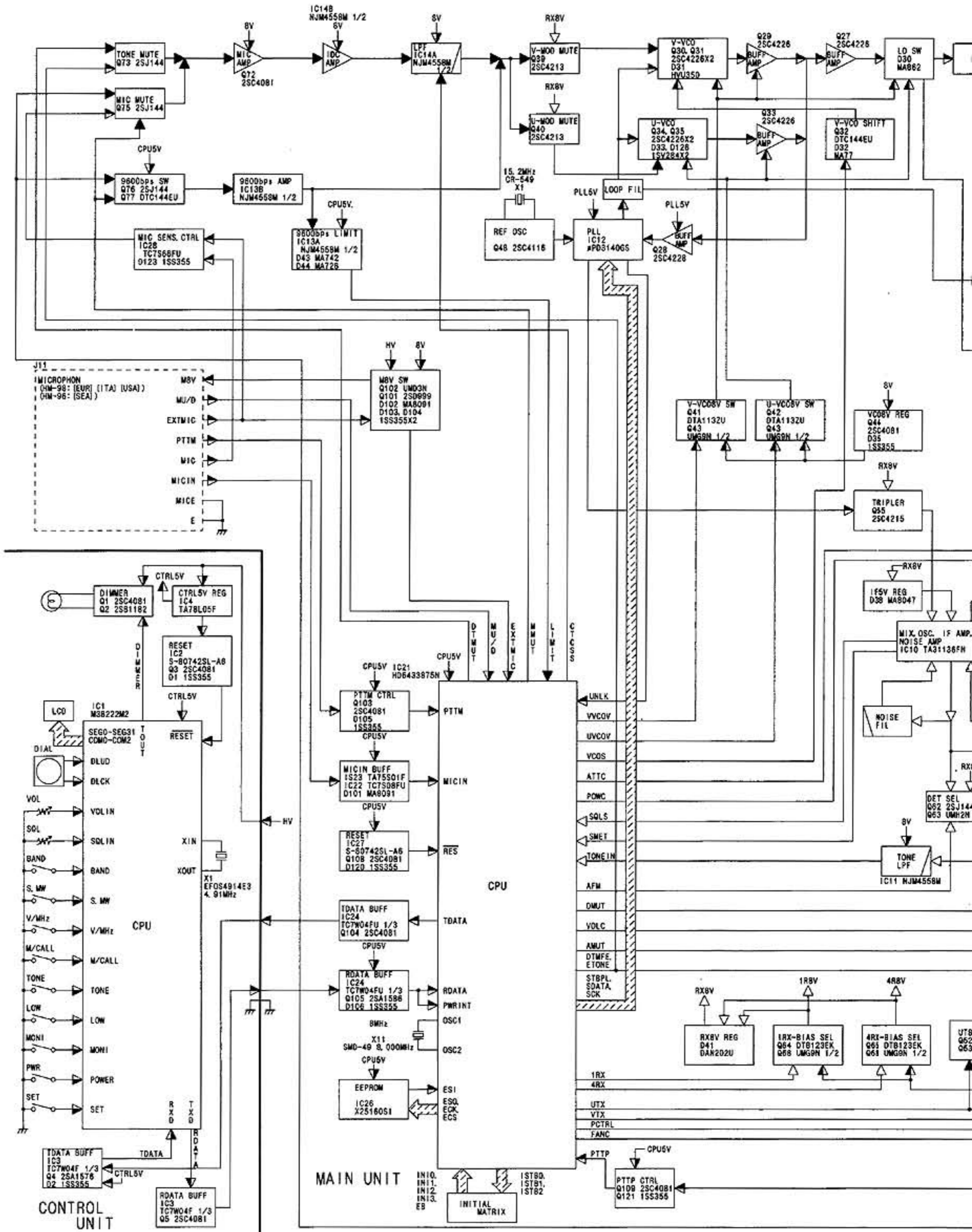


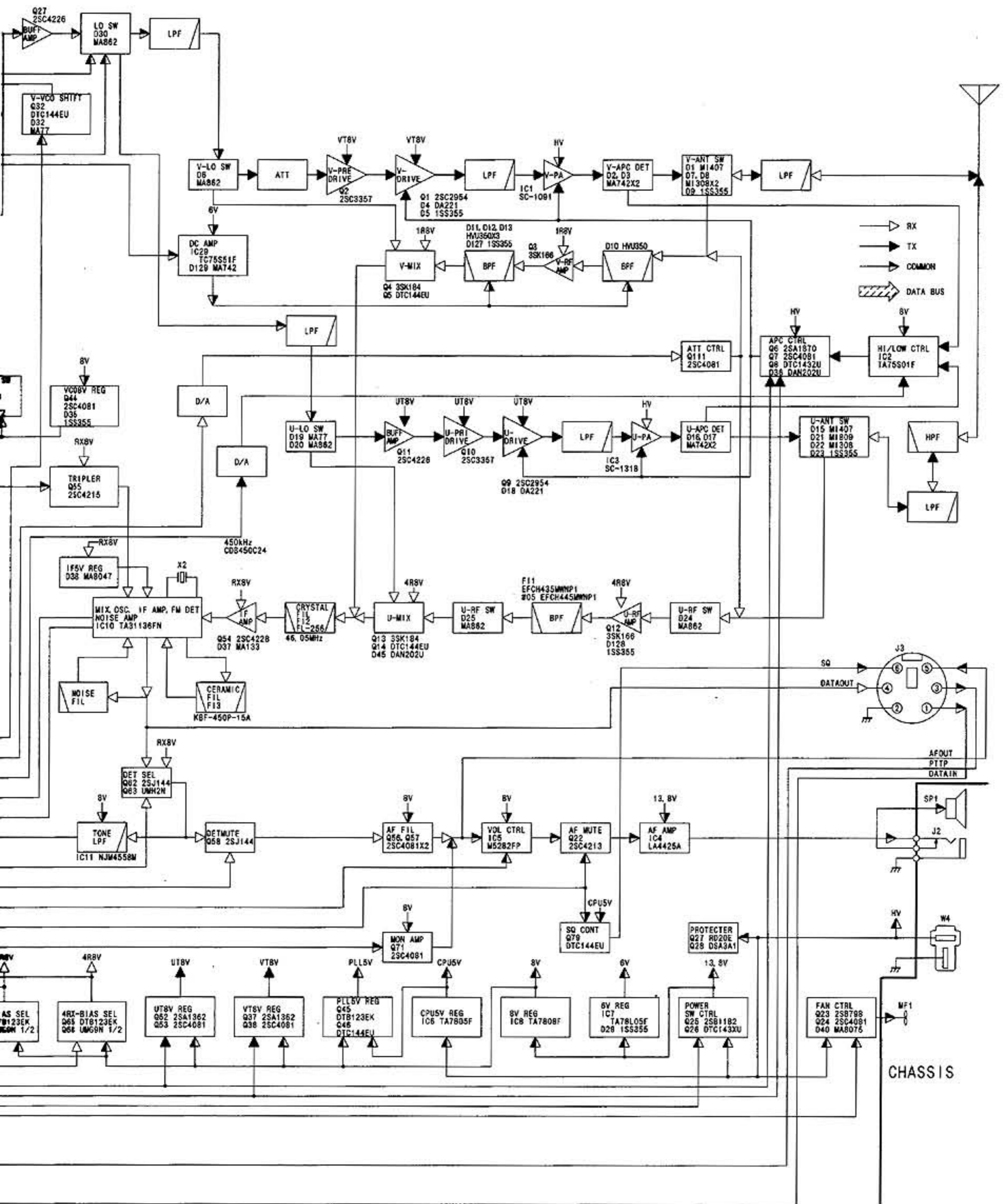
● BOTTOM VIEW





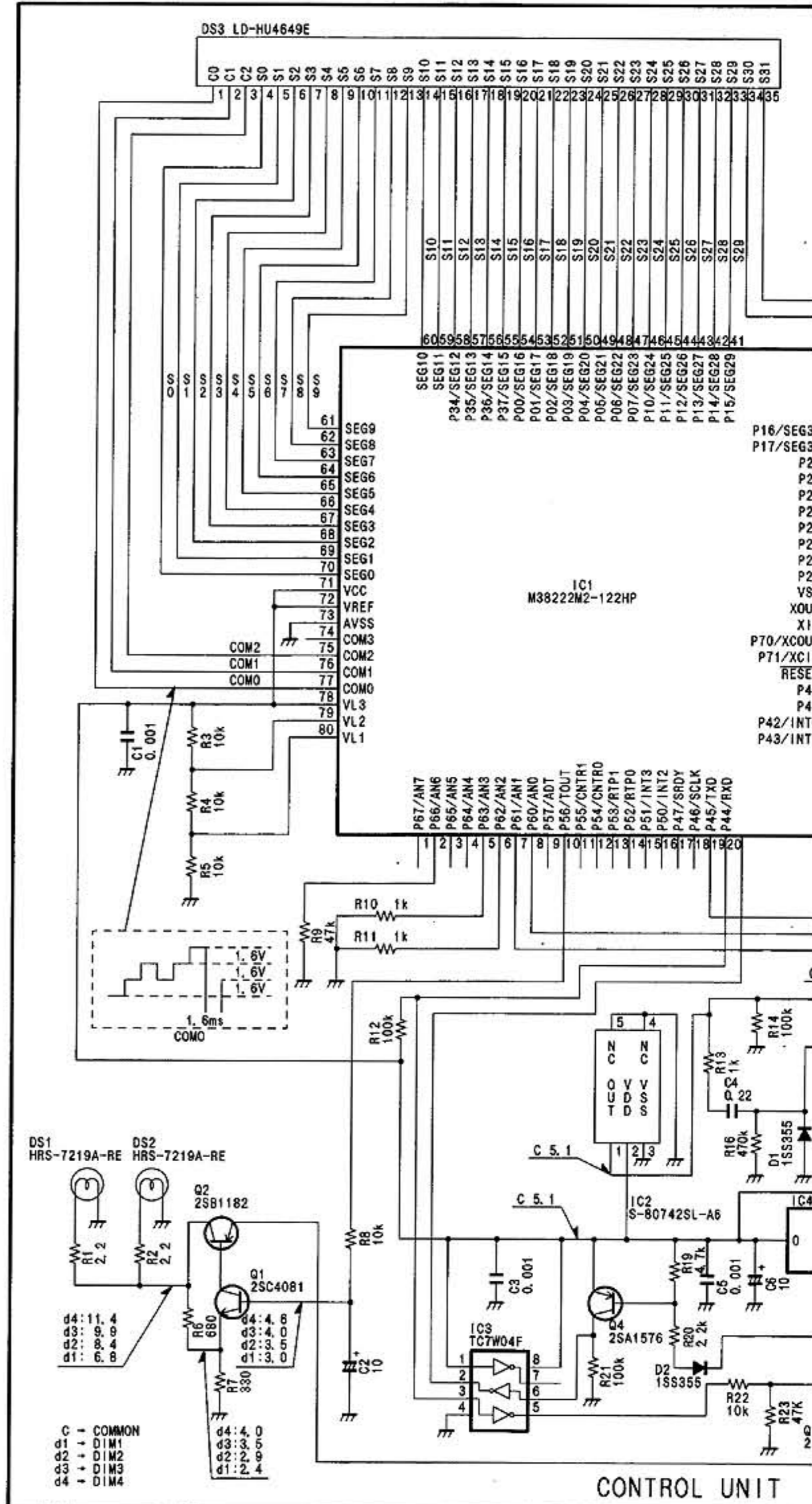
# SECTION 10 BLOCK DIAGRAM



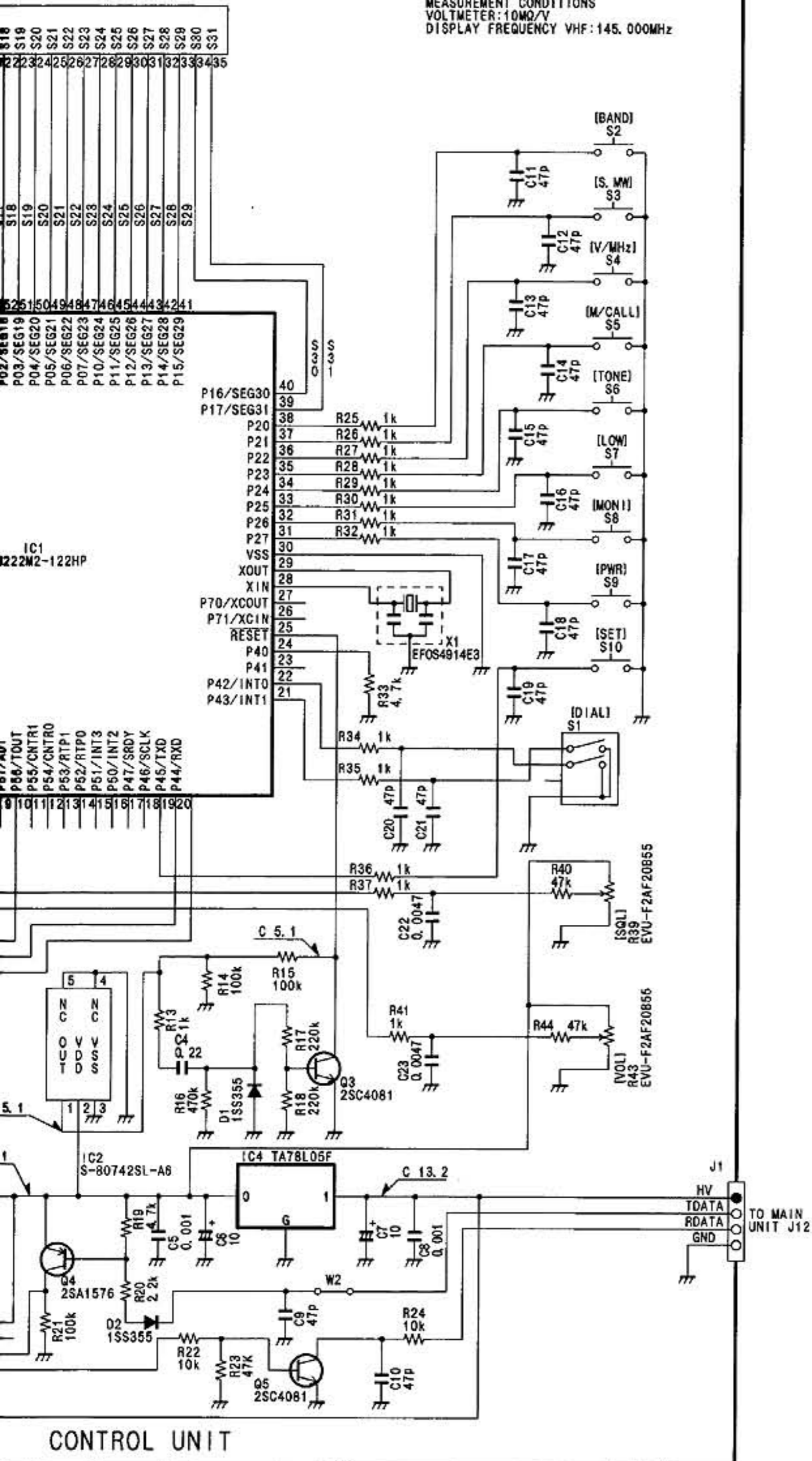


# SECTION 11 VOLTAGE DIAGRAM

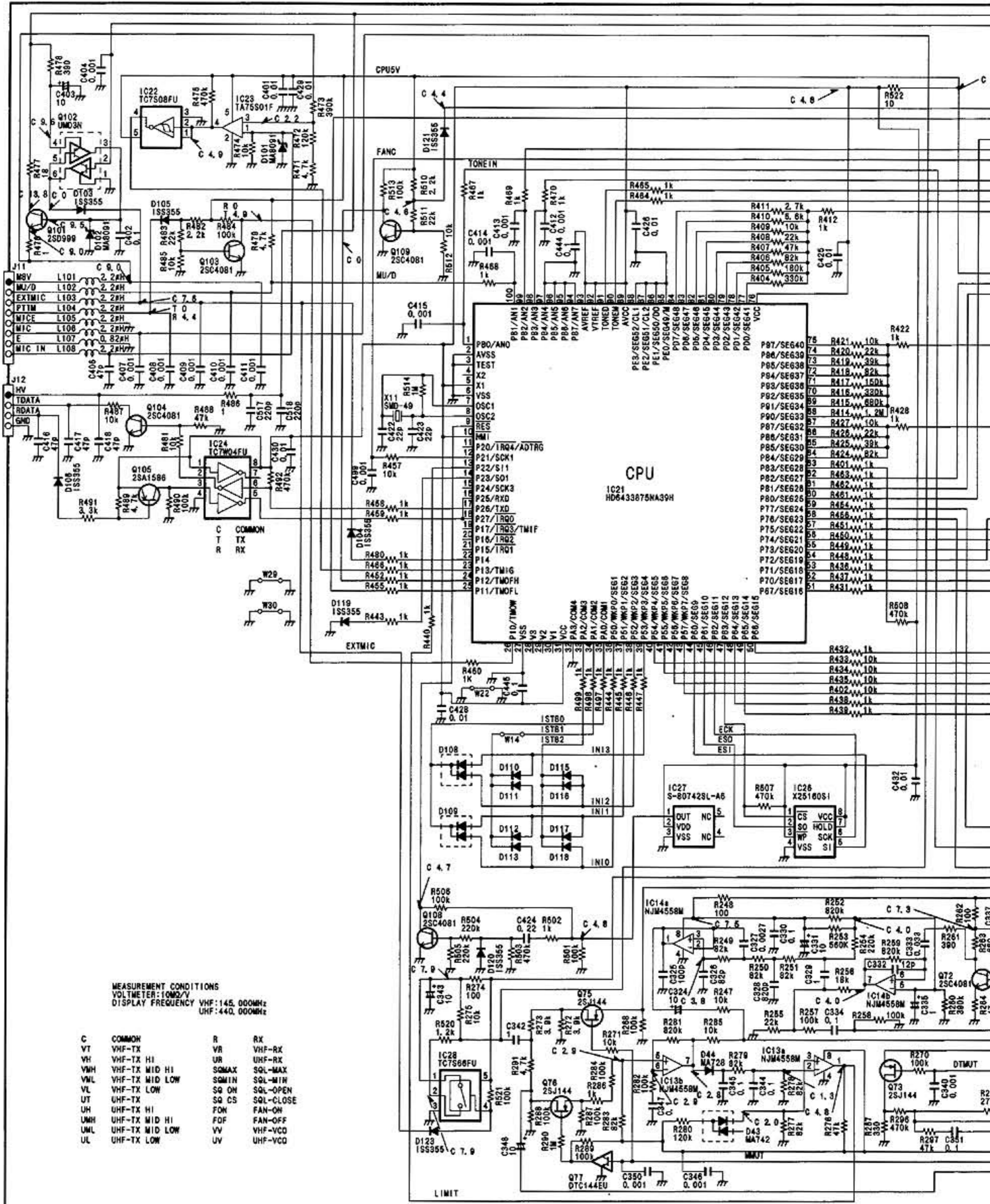
## 11-1 CONTROL UNIT



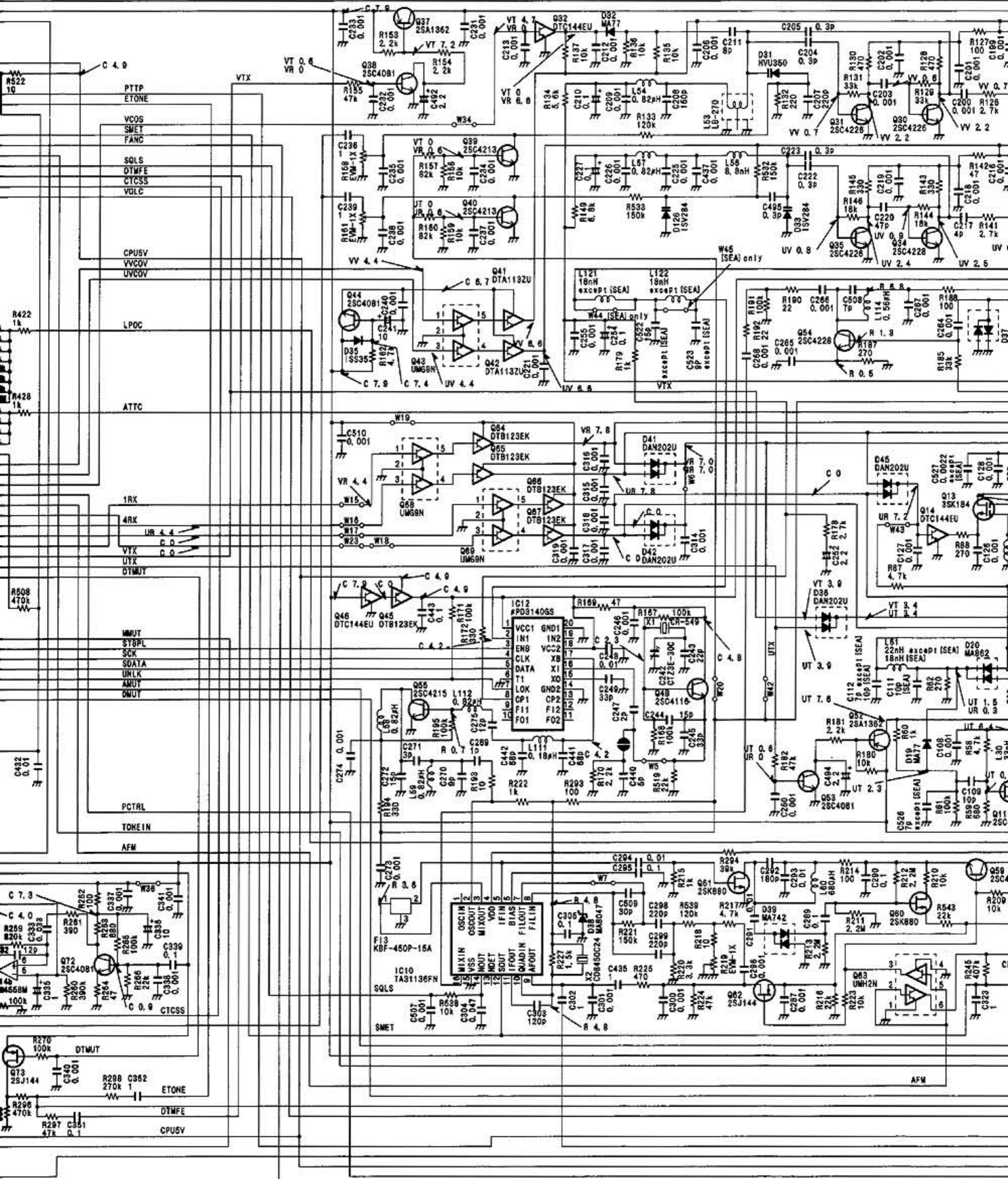
MEASUREMENT CONDITIONS  
 VOLTMETER: 10MΩ/V  
 DISPLAY FREQUENCY VHF: 145.000MHz

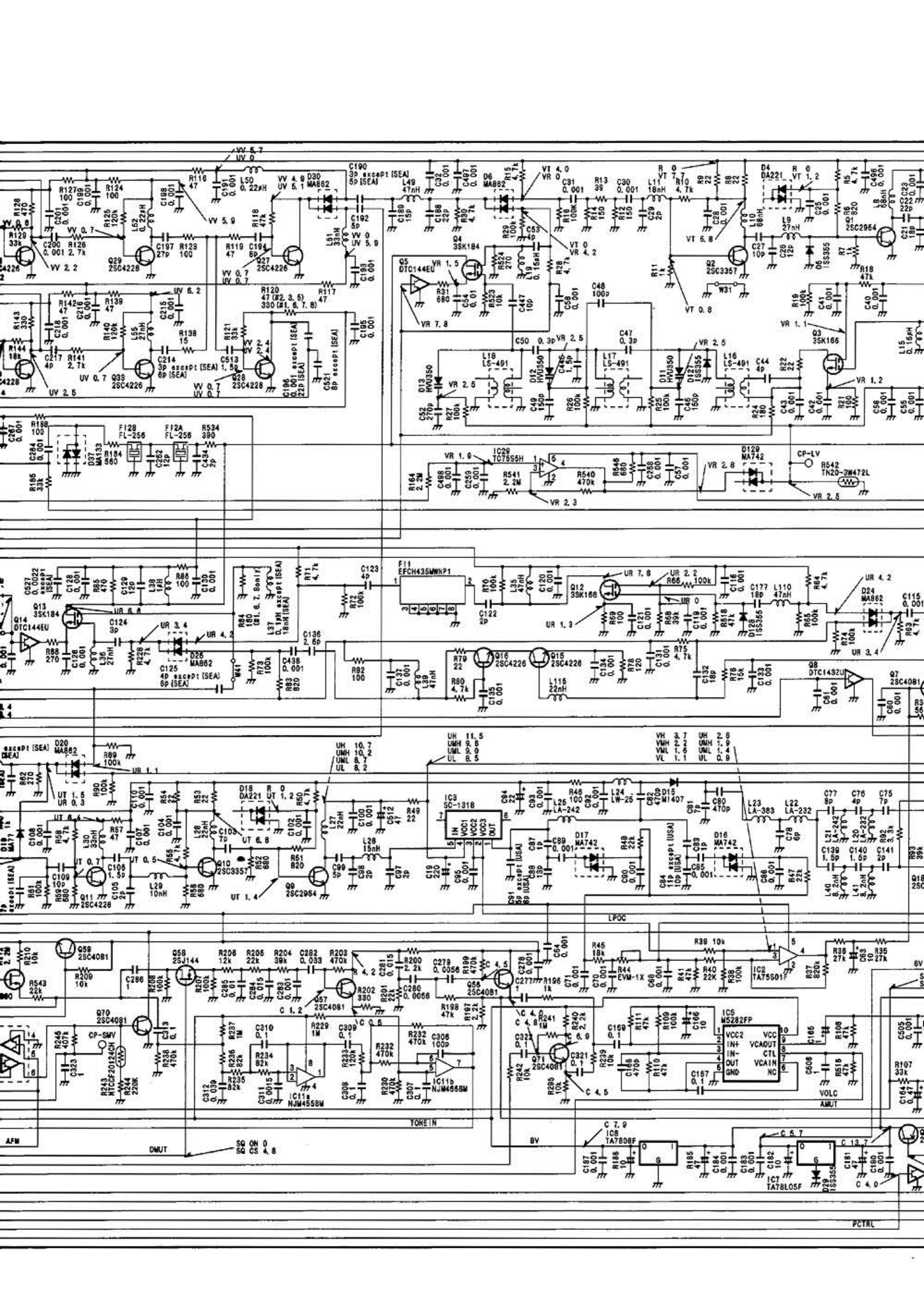


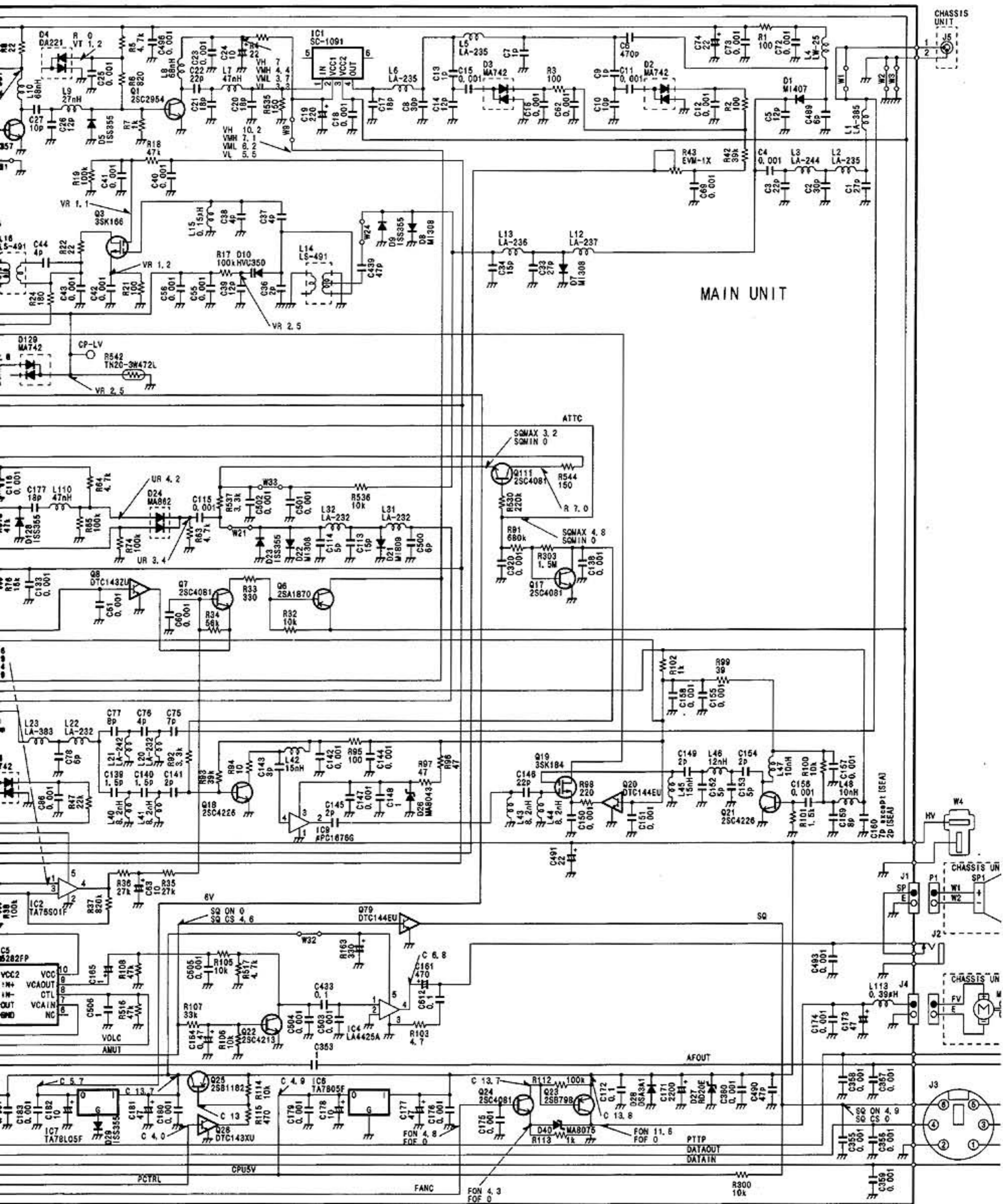
# 11-2 MAIN UNIT











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