

# HA1397

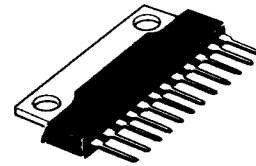
## 20W Audio Power Amplifier

The Hitachi B-class power amplifier HA1397 is specifically designed for Hi-Fi stereos, encapsulated in a high performance package.

The HA1397, like HA1370, yields 20W typ of output power over the wide range from 20Hz to 20kHz at 1% total harmonic distortion.

### ■ FEATURES

- High Output Power
  - 20W typ ( $\pm B_1 = \pm 22V$ ,  $R_L = 8\Omega$ ,  $f = 20\text{Hz}$  to  $20\text{kHz}$ , THD=1%)
  - 18W typ ( $\pm B_1 = \pm 22V$ ,  $R_L = 8\Omega$ ,  $f = 20\text{Hz}$  to  $20\text{kHz}$ , THD=0.5%)
  - $\pm B_1$ : Supply Voltage,  $R_L$ : Load Resistance,  $f$ : Frequency, THD: Total Harmonic Distortion,  $+B_2 = 25V$  (constant)
- Low THD and Low Cross Over Distortion
  - 0.02% typ ( $\pm B_1 = 22V$ ,  $R_L = 8\Omega$ ,  $f = 1\text{kHz}$ ,  $P_{out} = 2W$ )
  - 0.04% typ ( $\pm B_1 = 22V$ ,  $R_L = 8\Omega$ ,  $f = 20\text{Hz}$  to  $20\text{kHz}$ ,  $P_{out} = 2W$ )
- Wide Frequency Range  
5Hz to 120kHz (−1dB)
- Thermal Shut-down Circuit included

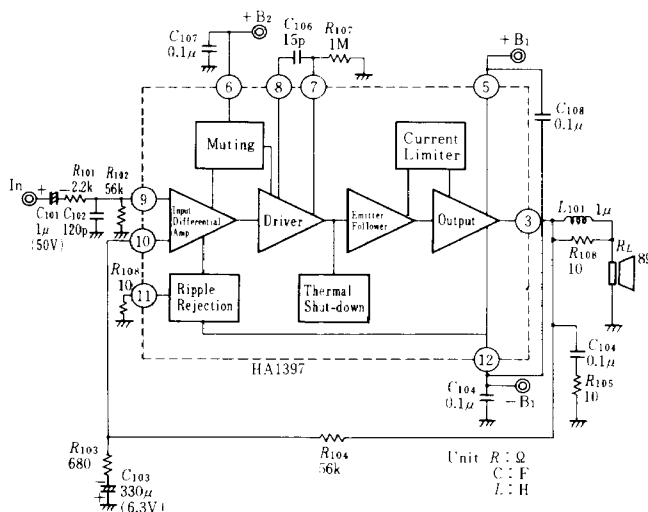


(SP-12T)

As a protection circuit, automatically reduces the output power and the current when the chip temperature exceeds  $150^\circ\text{C}$

- Muting Circuit included  
Minimizing pop noise at power-switching
- Single-in-Line Structure  
Simple mounting on heat-sink

### ■ BLOCK DIAGRAM & TYPICAL APPLICATION



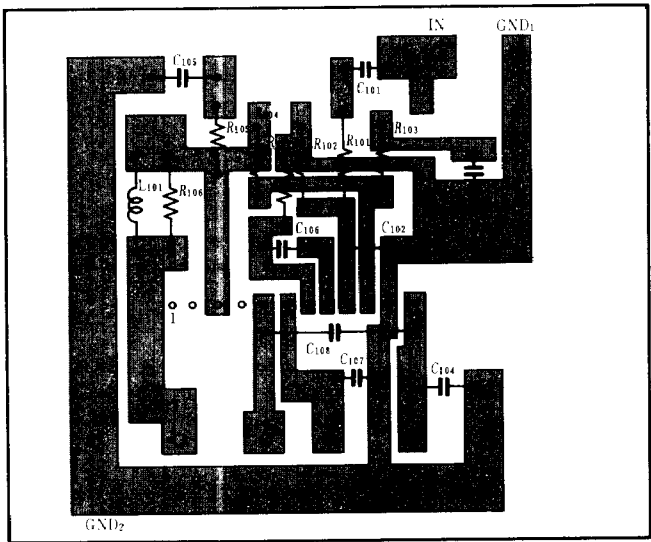
■ ELECTRICAL CHARACTERISTICS

(Unless otherwise specified,  $\pm B_1 = \pm 25V$ ,  $+B_2 = 25V$ ,  $R_L = 8\Omega$ ,  $R_g = 600\Omega$ ,  $T_a = 25^\circ C$ )

Item	Symbol	Test Conditions	min.	typ.	max.	Unit
Quiescent Current (Pin-5)	$+I_{Q1}$	$V_{in} = 0$	20	60	120	mA
Quiescent Current (Pin-6)	$+I_{Q2}$	$V_{in} = 0$	—	—	22	mA
Quiescent Current (Pin-12)	$-I_{Q1}$	$V_{in} = 0$	—	—	152	mA
Output Offset Voltage	$\Delta V_o$	$V_{in} = 0$ , DC Voltage at Pin-3	—	0	$\pm 0.1$	V
Input Resistance	$R_{in}$	$f = 1kHz$ , $R_{102} = 56k\Omega$	—	55	—	k $\Omega$
Voltage Gain (Closed Loop)	$G_V$	$f = 1kHz$ , $R_{103} = 680\Omega$ , $R_{104} = 56k\Omega$	—	38	—	dB
Voltage Gain (Open Loop)	$G_{V(OL)}$	$f = 1kHz$ , $R_{103} = 0$	—	88	—	dB
Output Power*	$P_{O1}$	$f = 20kHz$ , $THD = 0.5\%$ , $R_L = 8\Omega$	15	18	—	W
	$P_{O2}$	$f = 20kHz$ , $THD = 0.7\%$ , $R_L = 4\Omega$	15	18	—	W
Total Harmonic Distortion	$THD$	$f = 20kHz$ , $P_{out} = 2W$	—	0.04	0.20	%
Output Noise Voltage	$V_n$	$R_g = 5.1k\Omega$ , $BW = 20Hz$ to $20kHz$	—	0.35	0.50	mV
Supply Voltage Ripple Rejection Ratio	$SVR$	$R_g = 5.1k\Omega$ , $f_{ripple} = 100Hz$ (Pin-12)	52	60	—	dB

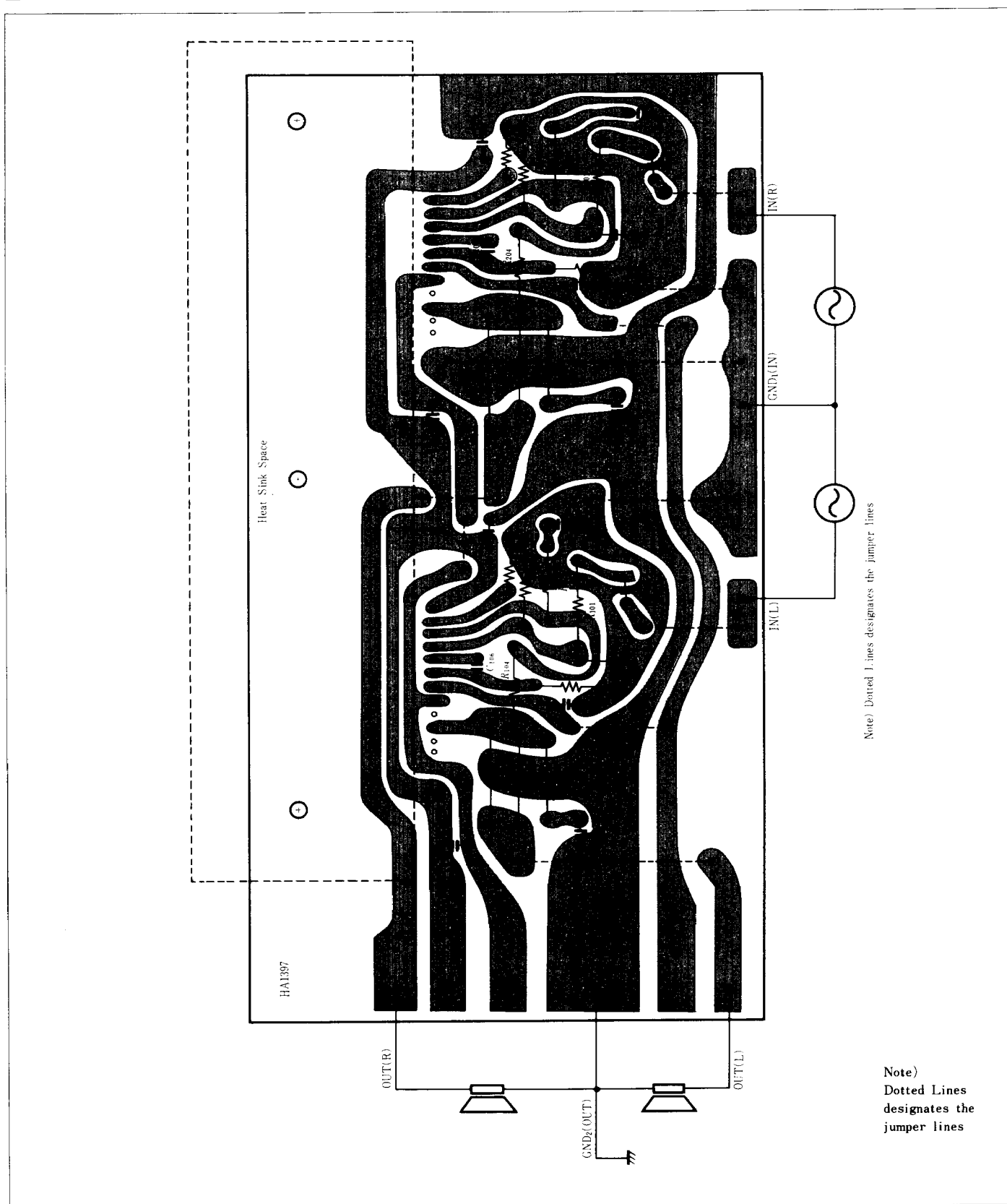
Note : \*  $P_{O1} : \pm B_1 = \pm 22V$ ,  $P_{O2} : \pm B_1 = \pm 19V$

■ PC-BOARD LAYOUT PATTERN

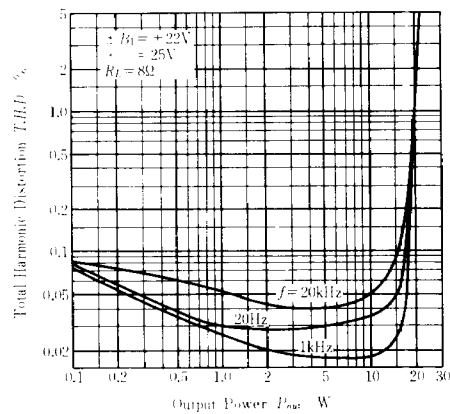


(Top View)  
GND1 : Input Side GND  
GND2 : Output Side GND

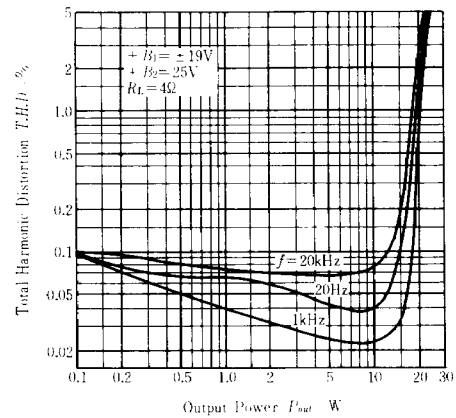
### ■ P.C. BOARD LAYOUT PATTERN FOR STEREO APPLICATION CIRCUIT



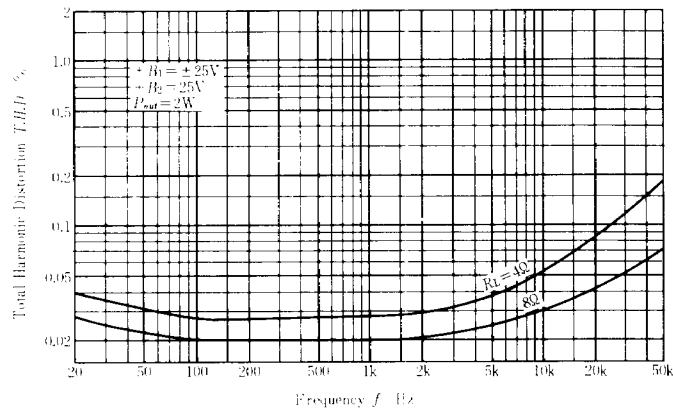
### TOTAL HARMONIC DISTORTION VS. OUTPUT POWER (1)



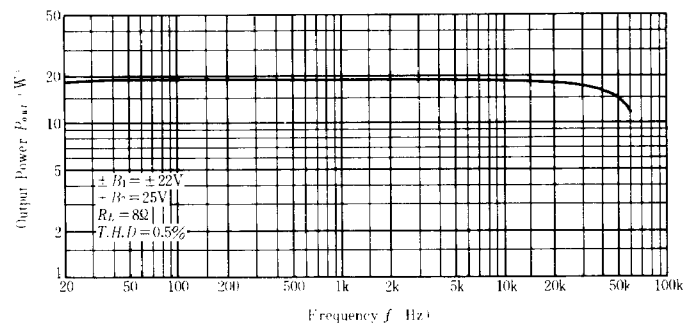
### TOTAL HARMONIC DISTORTION VS. OUTPUT POWER (2)



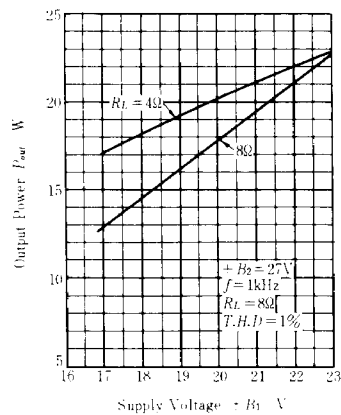
### TOTAL HARMONIC DISTORTION VS. FREQUENCY



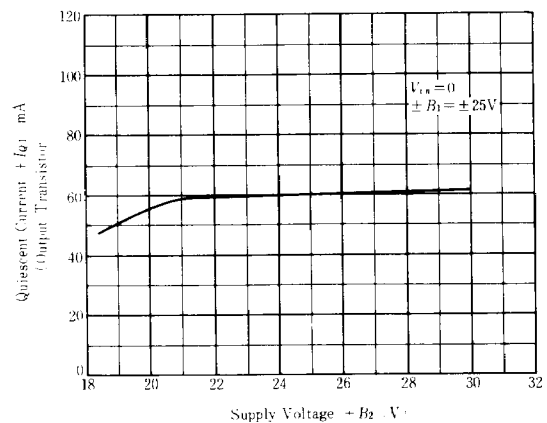
### OUTPUT POWER VS. FREQUENCY



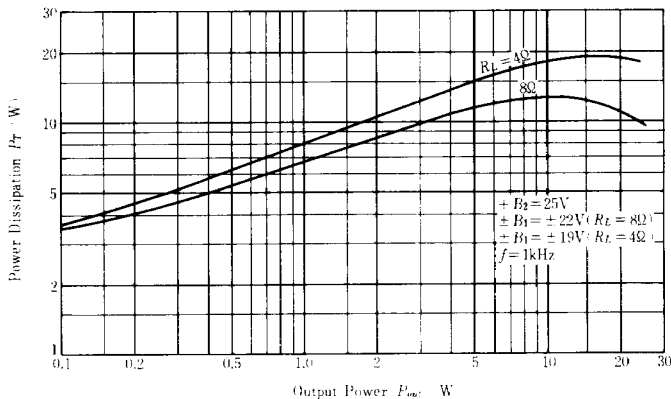
### OUTPUT POWER VS. SUPPLY VOLTAGE



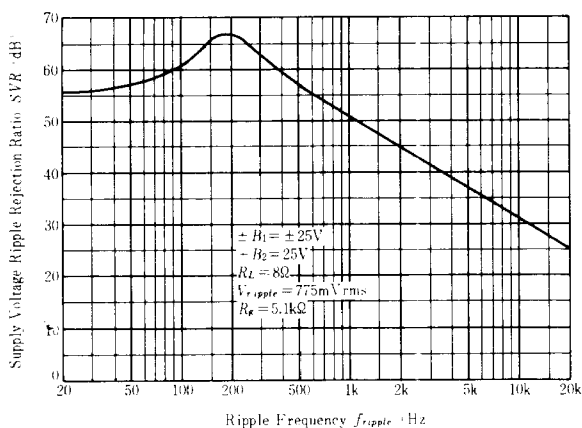
### QUIESCENT CURRENT VS. SUPPLY VOLTAGE



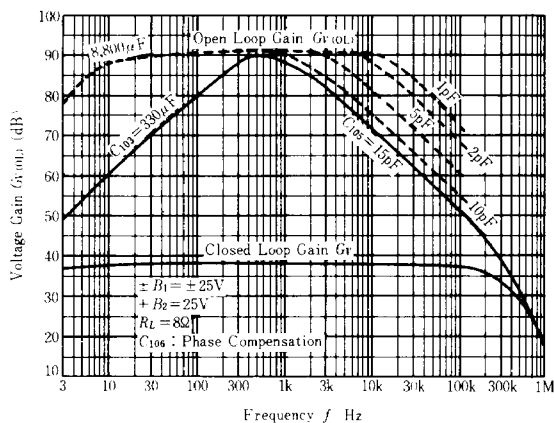
## POWER DISSIPATION VS. OUTPUT POWER



## SUPPLY VOLTAGE RIPPLE REJECTION RATIO VS. RIPPLE FREQUENCY

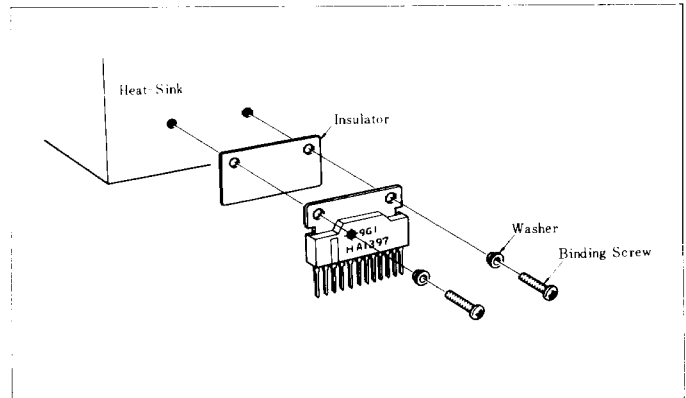


## VOLTAGE GAIN VS. FREQUENCY



## ■ CAUTION FOR MOUNTING

The header should be insulated electrically by using washers on the screwing-holes.



## Mounting

HA1397's insulator and washer are available. Concurrent order with the IC's will be taken.

Insulator (Mica): SK-51B

Washer: YC-40B

Caution) A grounded header in the IC-operating may damage the IC.

## ■ PRECAUTIONS ON THE ELECTRICAL CHARACTERISTICS

- HA1397 has three pins for the power supply. Pin-5 and pin-12 are for the main supply, plus and minus  $B_1$  to which the non-regulated supply would be accepted. Pin-6 is for the driver stage and the regulated supply (less than 5mV) is required.
- The amplifier does not operate until pin-6 comes up to about 12V. The muting time period will be set by the time of pin-6 to come up to the 12V point. Since the purpose of this muting system is to prevent the "pop-sound" from the pre-amplifier and others at the power-on, the inadequate use of pin-6 like controlling the pin-6 voltage during the normal operation may cause pop-noise trouble.
- For symmetrical clipping of the output waveform, set the pin-6 voltage 2 to 3 V higher at the rated maximum output than pin-5.
- $R_{108}$  between pin-11 and GND is to prevent the excessive transient current in case of testing the raw PC-board with the imperfect power supply grounding at the assembly line. Therefore, the use of  $R_{108}$  is recommended for the actual set production.

5. The following precautions should be taken into account for AM/FM receiver use.

(1) Take a sufficient distance from the power IC to the AM bar antenna. The best way is to take it out of the set casing. The distance from the antenna to the speaker terminals must also be taken into account.

(2) The standard application provides 100kHz or more frequency characteristics (voltage gain).

For receiver use, connect a phase compensation capacitor of 22pF to 47pF between pins 7 and 8, to achieve a proper range of the frequency.

(3) Maximum level of volume under a high input level may cause over-clipping and harmonics-return to the AM bar antenna. To prevent over-driving at the power stage, set +B<sub>2</sub> supply voltage below 25V.

(4) A long distance from the IC's supply pin to the filtering capacitor may deteriorate the actual AM receiving, connect electrolytic sensitivity. For high sensitivity of AM receiving, connect electrolytic capacitors of over 47μF/35V between ±B<sub>1</sub> (pins 5 and 12) and GND, or connect an additional capacitor of approximately 10pF between pins 7 and 10.

## ■ HANDLING CAUTIONS

### 1. MOUNTING

1-1. For mounting the SP-12T and SP-12TA packages on the heat sink, 4 to 8kg·cm of screwing-torque is recommended; excessive torque will cause device deformation, resulting in pellet-crack, connector-lead-wire-breaking, etc., and too less torque will increase the heat resistance.

1-2. The use of screws needs the following cautions.

- 1) Use the standardized binding-head screws.
- 2) Oval counter-sunk screws, subjecting the IC to intense stress, must not be used.
- 3) To the use of tapping screws the cautions for binding-torque strength must be applied.
- 4) Use a tapping screw diameter smaller than an IC mounting-hole.

1-3. Heat sink screw-holes should be at 20±0.2mm intervals, coincident with the IC screw-hole intervals.

In IC-binding, metal-fittings striking on the plastic of the IC may cause characteristics-deterioration or package-crack.

1-4. Poor flatness of heat sink sometimes prevents effective heat-sinking or subjects the IC surface to intense stress, causing characteristics-deterioration or package-crack.

- 1) 0.1mm max. of heat-sink flatness error for the contact area (16mm×31mm) will be tolerated.
- 2) Contact-surface ruggedness should not exceed 25μm.
- 3) For aluminum, copper, or iron plates, check them for no burr and mold them for screw-holes.
- 4) Cutting chips between the IC header and the heat sink will cause heat-sinking deterioration.
- 5) The heat-sink hole diameter should not exceed 4.0mm.

1-5. As silicone grease, the Shin'etsu Chemical Industry G746 is recommended. Coarse grease or an excessive amount of grease may cause intensive stress to the IC, when binding.

1-6. Screw the IC on the heat sink, before soldering the lead wires on the printed circuit board (PCB). Screwing after the soldering may cause strain of PCB and of the heat sink, resulting in characteristics-deterioration of the IC.

1-7. Direct soldering of lead wires to the header will deteriorate the IC life characteristics.

For the method and conditions of lead-wire forming, users are requested to contact the vendor.

1-8. Soldering should be done within the soldering heat test standard, specifying that lead wires, up to 1 to 1.5mm off the IC body, are kept in solder at 260°C for 10 seconds and at 350°C for 3 seconds.

Use a soldering iron grounded.

1-9. Two or more IC's on one heat sink will increase thermal resistance per IC.

### 2. TRANSPORTING

Transporting the IC's or IC-containing products needs the following cautions.

2-1. Cases for IC-transporting must not be electrified by concussion-rubbing, etc. This can be prevented by using conductive cases or aluminum foil.

2-2. In handling, human bodies and clothes should be grounded via sufficiently with resistance, to prevent static electricity from damaging the IC's. To remove electrification possibility, put an approx. 1MΩ-resistance at the body side between GND and the body.

2-3. In IC-mounted PCB transporting, no static-electricity should be generated. Shorting the IC pins to obtain equipotentiality is an effective method.

The rubber of PCB-carrying belt conveyors needs antistatic treatment.

2-4. Mechanical concussion or shock should be minimized in IC- or PCB-transporting.

### 3. TESTING

3-1. Static electricity and electric-appliance leak must be avoided in IC testing or handling, there being times when open pins might separately touch measuring devices, human bodies, benches, soldering irons, belt conveyors, etc.

3-2. In IC testing, IC testers should not apply surge voltage to the IC's or should contain clamping circuit, to prevent accidental leak from measuring-devices or pins for curve tracer, oscilloscope, pulse generator or DC voltage regulator.

3-3. Avoid false pin-connection, inverted pin-insertion and pins short in IC testing.

Check external-capacitor for no charge before IC testing, to prevent pin-damaging possibility.

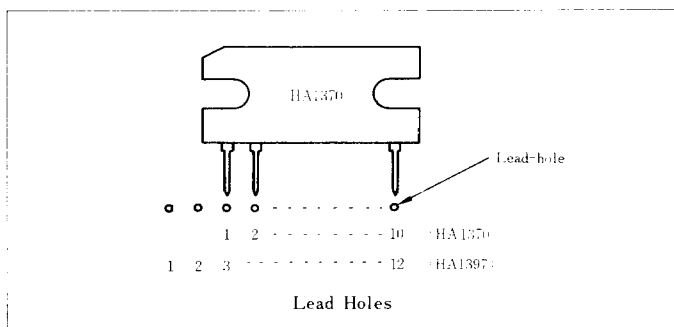
3-4. Before PCB-operation testing, check for no wiring bridges pin bridges.

### ■ CAUTIONS FOR HA1370-HA1397 EXCHANGING

Please refer to the following cautions for HA1370-replacing to HA1397.

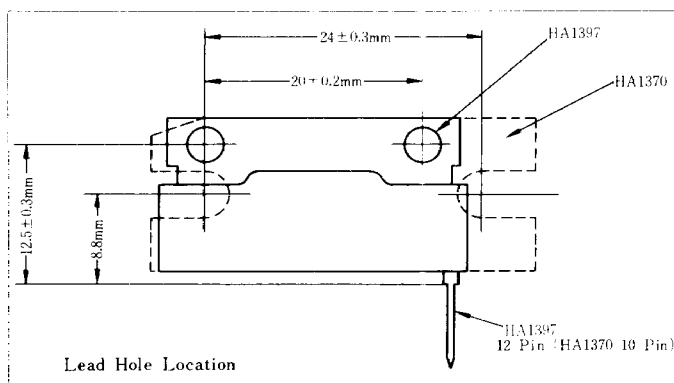
#### 1. Two more lead holes should be added on the PC board.

Pins 1 to 10 of HA1370 correspond to pins 3 to 12 of HA1397. For the HA1397 floating pins 1 and 2, two more holes should be added on the HA1370 PC board, next to the pin-1 hole.



#### 2. The screw-holes on the heat-sink should be relocated.

Fig. shows the screw-holes location for HA1397. The screw holes should be made 3.7mm higher, shortening the hole-to-hole distance by 4mm.



#### 3. Use washers at the screwing-holes

Electrical insulation of the header should be protect by using washers on the screwing-holes.