



SANYO Semiconductors

## DATA SHEET

An ON Semiconductor Company

# LV5684PVC — Bi-CMOS LSI

## For Car Audio Systems Multi-Power Supply IC

### Overview

The LV5684PVC is a power supply IC suitable for USB/CD receiver system for car audio system.

This IC integrates 5 systems of regulator output, 2 systems of high side power switch, overcurrent protector, overvoltage protector and overheat protector

Supply for V<sub>DD</sub> and SW33V outputs is low voltage specification, which enables drastic reduction of power dissipation compared to the existing model. (the package is HZIP15J).

### Features

- Low consumption current: 50μA (typ, only V<sub>DD</sub> output is in operation)
- 5 systems of regulator output
  - V<sub>DD</sub> for microcontroller: output voltage: 3.3V, maximum output current: 350mA reverse current protection implemented.
  - For system: output voltage: 3.3V, maximum output current: 450mA
  - For audio: output voltage: 5 to 9V (set by external resistors), maximum output current: 250mA
  - For illumination: output voltage: 5 to 12V (set by external resistors), maximum output current: 300mA
  - For CD: output voltage: 5V/8V, maximum output current: 1300mA
- 2 lines of high side switch with interlock V<sub>CC</sub>
  - EXT: Maximum output current: 350mA, voltage difference between input and output: 0.5V
  - ANT: Maximum output current: 300mA, voltage difference between input and output: 0.5V
- Supply input
  - V<sub>6IN</sub>: 6V for V<sub>DD</sub>, system (SW33V)
  - V<sub>CC1</sub>: For internal reference voltage, control circuits
    - In case of voltage drop of V<sub>6IN</sub>, V<sub>CC1</sub> supplies to V<sub>DD</sub> output.
  - V<sub>CC2</sub>: For AUDIO, illumination, CD, EXT/ANT
- Overcurrent protector
- Overvoltage protector(OVP): V<sub>CC1</sub>, V<sub>CC2</sub> Typ 23V (All outputs except V<sub>DD</sub> are turned off)
- Overvoltage shutdown(OVS): V<sub>6IN</sub> Typ 23V (All outputs except V<sub>DD</sub> are turned off)
- Overheat protector: Typ 175°C

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- PchLDMOS is used in power output block

(Warning) The protector functions only improve the IC's tolerance and they do not guarantee the safety of the IC if used under the conditions out of safety range or ratings. Use of the IC such as use under overcurrent protection range, thermal shutdown state or V6IN OVS condition may degrade the IC's reliability and eventually damage the IC.

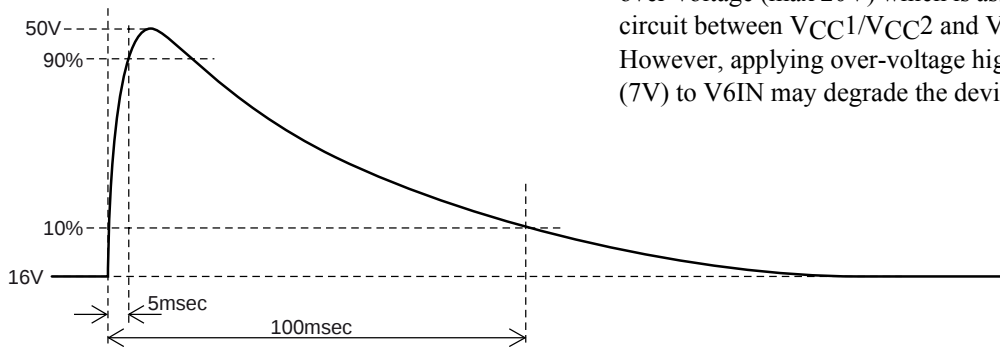
## Specifications

### Absolute Maximum Ratings at Ta = 25°C

| Parameter                     | Conditions           | Conditions                           |           | Ratings     | Unit |
|-------------------------------|----------------------|--------------------------------------|-----------|-------------|------|
| Supply voltage                | V <sub>CC</sub> max  | V <sub>CC</sub> 1, V <sub>CC</sub> 2 |           | 36          | V    |
|                               | V <sub>6IN</sub> max | V <sub>6IN</sub> (*)                 |           | 7           | V    |
| Input voltage                 | V <sub>IN</sub> max  | CTRL1, CTRL2                         |           | 7           | V    |
| Allowable power dissipation   | Pd max               | Independent IC                       | Ta ≤ 25°C | 1.5         | W    |
|                               |                      | Al heat sink *                       |           | 5.6         | W    |
|                               |                      | With an infinity heat sink           |           | 32.5        | W    |
| Peak supply voltage           | V <sub>CC</sub> peak | See below for the waveform applied.  |           | 50          | V    |
| Operating ambient temperature | Topr                 |                                      |           | -40 to +85  | °C   |
| Storage temperature           | Tstg                 |                                      |           | -55 to +150 | °C   |
| Junction temperature          | Tj max               |                                      |           | 150         | °C   |

\* : When the Aluminum heat sink (50mm × 50mm × 1.5mm) is used

### Waveform of surge test (V<sub>CC</sub>1, V<sub>CC</sub>2)



\*V6IN is designed to tolerant toward short period of over-voltage (max 20V) which is assumed in condition of short circuit between V<sub>CC</sub>1/V<sub>CC</sub>2 and V6IN. However, applying over-voltage higher than maximum rating (7V) to V6IN may degrade the device reliability

### Recommended Operating range at Ta = 25°C

#### V<sub>CC</sub>1

| Parameter                  | Conditions             | Ratings | Unit |
|----------------------------|------------------------|---------|------|
| Operating supply voltage 1 | V <sub>DD</sub> output | 7 to 16 | V    |

#### V<sub>CC</sub>2

| Parameter                  | Conditions                        | Ratings    | Unit |
|----------------------------|-----------------------------------|------------|------|
| Operating supply voltage 2 | ILM output (10V)                  | 12 to 16   | V    |
|                            | ILM output (8V)                   | 10 to 16   | V    |
| Operating supply voltage 3 | AUDIO output (9V)                 | 10 to 16   | V    |
| Operating supply voltage 4 | CD output (I <sub>O</sub> = 1.3A) | 10.5 to 16 | V    |
|                            | CD output (I <sub>O</sub> ≤ 1A)   | 10 to 16   | V    |
| Operating supply voltage 5 | EXT output, ANT output            | 10 to 16   | V    |

#### V6IN

| Parameter                  | Conditions                           | Ratings    | Unit |
|----------------------------|--------------------------------------|------------|------|
| Operating supply voltage 6 | V <sub>DD</sub> output, SW33V output | 5.7 to 6.5 | V    |

# LV5684PVC

**Electrical Characteristics** at  $V_{CC1} = V_{CC2} = 14.4V$ ,  $V_{6IN} = 6V$  at  $T_a = 25^\circ C$  (\*1)

| Parameter                                                                               | Symbol            | Conditions                                                                                               | Ratings |      |       | Unit      |
|-----------------------------------------------------------------------------------------|-------------------|----------------------------------------------------------------------------------------------------------|---------|------|-------|-----------|
|                                                                                         |                   |                                                                                                          | min     | typ  | max   |           |
| Quiescent current                                                                       | $I_{CC}$          | $V_{DD}$ w/out load, CTRL1/2 = "L/L"                                                                     |         | 50   | 100   | $\mu A$   |
| <b>CTRL1 input (ANT/EXT/ILM)</b>                                                        |                   |                                                                                                          |         |      |       |           |
| Low input voltage                                                                       | $V_{IL1}$         |                                                                                                          | 0       |      | 0.5   | V         |
| M1 input voltage                                                                        | $V_{IM11}$        |                                                                                                          | 0.8     | 1.1  | 1.4   | V         |
| M2 input voltage                                                                        | $V_{IM21}$        |                                                                                                          | 1.9     | 2.2  | 2.5   | V         |
| High input voltage                                                                      | $V_{IH1}$         |                                                                                                          | 2.9     | 3.3  | 5.5   | V         |
| Input impedance                                                                         | $R_{IH1}$         | input voltage $\leq 3.3V$                                                                                | 280     | 400  | 480   | $k\Omega$ |
| <b>CTRL2 input (CD/AUDIO/SW33V)</b>                                                     |                   |                                                                                                          |         |      |       |           |
| Low input voltage                                                                       | $V_{IL2}$         |                                                                                                          | 0       |      | 0.5   | V         |
| M1 input voltage                                                                        | $V_{IM12}$        |                                                                                                          | 0.8     | 1.1  | 1.4   | V         |
| M2 input voltage                                                                        | $V_{IM22}$        |                                                                                                          | 1.9     | 2.2  | 2.5   | V         |
| High input voltage                                                                      | $V_{IH2}$         |                                                                                                          | 2.9     | 3.3  | 5.5   | V         |
| Input impedance                                                                         | $R_{IH2}$         | input voltage $\leq 3.3V$                                                                                | 280     | 400  | 480   | $k\Omega$ |
| <b><math>V_{DD}</math> output (3.3V) (reverse current prevention diode implemented)</b> |                   |                                                                                                          |         |      |       |           |
| Output voltage                                                                          | $V_{O1}$          | $I_{O1} = 200mA$                                                                                         | 3.13    | 3.3  | 3.47  | V         |
| Output current                                                                          | $I_{O1}$          | $V_{O1} \geq 3.1V$                                                                                       | 350     |      |       | mA        |
| Line regulation                                                                         | $\Delta V_{OLN1}$ | $5.7V < V_{6IN} < 6.5V$ , $I_{O1} = 200mA$ or $V_{6IN} = 0V$ , $7.5V < V_{CC1} < 16V$ , $I_{O1} = 200mA$ |         | 30   | 90    | mV        |
| Load regulation                                                                         | $\Delta V_{OLD1}$ | $1mA < I_{O1} < 200mA$                                                                                   |         | 70   | 150   | mV        |
| Dropout voltage                                                                         | $V_{DROP1}$       | $I_{O1} = 200mA$ , $V_{6IN} = 0V$<br>(applicable to $V_{CC1}$ )                                          |         | 2.8  | 3.5   | V         |
| Ripple rejection (*2)                                                                   | $R_{REJ1}$        | $f = 120Hz$ , $V_{6IN}$ or $V_{CC1} = 0.5V_{pp}$<br>$I_{O1} = 200mA$                                     | 40      | 50   |       | dB        |
| Reverse current                                                                         | $I_{rev}$         | $V_{O1} = 3.3V$ , $V_{CC1} = V_{6IN} = 0V$                                                               |         | 1    | 50    | $\mu A$   |
| <b>SW33V output (3.3V) ; CTRL2 = "M1 or M2 or H"</b>                                    |                   |                                                                                                          |         |      |       |           |
| Output voltage                                                                          | $V_{O2}$          | $I_{O2} = 200mA$                                                                                         | 3.13    | 3.3  | 3.47  | V         |
| Output current                                                                          | $I_{O2}$          | $V_{O2} \geq 3.1V$                                                                                       | 450     |      |       | mA        |
| Line regulation                                                                         | $\Delta V_{OLN2}$ | $5.7V < V_{6IN} < 6.5V$ , $I_{O2} = 200mA$                                                               |         | 30   | 90    | mV        |
| Load regulation                                                                         | $\Delta V_{OLD2}$ | $1mA < I_{O2} < 200mA$                                                                                   |         | 70   | 150   | mV        |
| Dropout voltage                                                                         | $V_{DROP2}$       | $I_{O2} = 200mA$                                                                                         |         | 0.25 | 0.5   | V         |
| Ripple rejection (*2)                                                                   | $R_{REJ2}$        | $f = 120Hz$ , $V_{6IN}$ or $V_{CC1} = 0.5V_{pp}$<br>$I_{O2} = 200mA$                                     | 40      | 50   |       | dB        |
| <b>AUDIO (5-9V)output ; CTRL2 = "M1 or M2 or H"</b>                                     |                   |                                                                                                          |         |      |       |           |
| AUDIO_F voltage                                                                         | $V_{I3}$          |                                                                                                          | 1.212   | 1.25 | 1.288 | V         |
| AUDIO_F input current                                                                   | $I_{IN3}$         |                                                                                                          | -1      |      | 1     | $\mu A$   |
| AUDIO output voltage 1                                                                  | $V_{O3}$          | $I_{O3} = 150mA$ , $R3 = 30k\Omega$ , $R4 = 5.6k\Omega$ (*3)                                             | 7.65    | 8.0  | 8.35  | V         |
| AUDIO output voltage 2                                                                  | $V_{O3'}$         | $I_{O3} = 150mA$ , $R3 = 27k\Omega$ , $R4 = 4.7k\Omega$ (*3)                                             | 8.13    | 8.5  | 8.87  | V         |
| AUDIO output voltage 3                                                                  | $V_{O3''}$        | $I_{O3} = 150mA$ , $R3 = 24k\Omega$ , $R4 = 3.9k\Omega$ (*3)                                             | 8.6     | 9.0  | 9.4   | V         |
| AUDIO output voltage 4                                                                  | $V_{O3'''}$       | $I_{O3} = 150mA$ , $R3 = 30k\Omega$ , $R4 = 10k\Omega$ (*3)                                              | 4.75    | 5.0  | 5.25  | V         |
| AUDIO output current                                                                    | $I_{O3}$          |                                                                                                          | 250     |      |       | mA        |
| Line regulation                                                                         | $\Delta V_{OLN3}$ | $10V < V_{CC2} < 16V$ , $I_{O3} = 150mA$                                                                 |         | 30   | 90    | mV        |
| Load regulation                                                                         | $\Delta V_{OLD3}$ | $1mA < I_{O3} < 150mA$                                                                                   |         | 70   | 150   | mV        |
| Dropout voltage 1                                                                       | $V_{DROP3}$       | $I_{O3} = 150mA$                                                                                         |         | 0.3  | 0.45  | V         |
| Ripple rejection (*2)                                                                   | $R_{REJ3}$        | $f = 120Hz$ , $I_{O3} = 150mA$                                                                           | 40      | 50   |       | dB        |
| <b>ILM (5-12V) output ; CTRL1 = "M1 or M2 or H"</b>                                     |                   |                                                                                                          |         |      |       |           |
| ILM_F voltage                                                                           | $V_{I4}$          |                                                                                                          | 1.212   | 1.25 | 1.288 | V         |
| ILM_F input current                                                                     | $I_{IN4}$         |                                                                                                          | -1      |      | 1     | $\mu A$   |
| ILM output voltage 1                                                                    | $V_{O4}$          | $I_{O4} = 200mA$ , $R1 = 43k\Omega$ , $R2 = 5.1k\Omega$ (*3)                                             | 11.21   | 11.8 | 12.39 | V         |
| ILM output voltage 2                                                                    | $V_{O4'}$         | $I_{O4} = 200mA$ , $R1 = 56k\Omega$ , $R2 = 7.5k\Omega$ (*3)                                             | 9.97    | 10.5 | 11.03 | V         |

\*1 : All the specification is defined based on the tests performed under the conditions where  $T_j$  and  $T_a$  ( $= 25^\circ C$ ) are almost equal. These tests were performed with pulse load to minimize the increase of junction temperature ( $T_j$ ).

\*2 : guaranteed by design

\*3 : Using resistors of tolerance within 1%.

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| Parameter                                                      | Symbol            | Conditions                                                                                                          | Ratings       |               |      | Unit |
|----------------------------------------------------------------|-------------------|---------------------------------------------------------------------------------------------------------------------|---------------|---------------|------|------|
|                                                                |                   |                                                                                                                     | min           | typ           | max  |      |
| ILM output voltage 3                                           | $V_{O4''}$        | $I_{O4} = 200\text{mA}$ , $R1 = 30\text{k}\Omega$ , $R2 = 5.6\text{k}\Omega$ (*3)                                   | 7.6           | 8.0           | 8.4  | V    |
| ILM output voltage 4                                           | $V_{O4'''}$       | $I_{O4} = 200\text{mA}$ , $R1 = 30\text{k}\Omega$ , $R2 = 10\text{k}\Omega$ (*3)                                    | 4.75          | 5.0           | 5.25 | V    |
| ILM output current                                             | $I_{O4}$          |                                                                                                                     | 300           |               |      | mA   |
| Line regulation                                                | $\Delta V_{OLN4}$ | $10\text{V} < V_{CC2} < 16\text{V}$ , $I_{O4} = 200\text{mA}$<br>$R1 = 30\text{k}\Omega$ , $R2 = 5.6\text{k}\Omega$ |               | 30            | 90   | mV   |
| Load regulation                                                | $\Delta V_{OLD4}$ | $1\text{mA} < I_{O4} < 200\text{mA}$                                                                                |               | 70            | 150  | mV   |
| Dropout voltage 1                                              | $V_{DROP4}$       | $I_{O4} = 200\text{mA}$                                                                                             |               | 0.7           | 1.05 | V    |
| Dropout voltage 2                                              | $V_{DROP4'}$      | $I_{O4} = 100\text{mA}$                                                                                             |               | 0.35          | 0.53 | V    |
| Ripple rejection (*2)                                          | $R_{REJ4}$        | $f = 120\text{Hz}$ , $I_{O4} = 200\text{mA}$                                                                        | 40            | 50            |      | dB   |
| <b>CD (5V/8V output) ; CTRL2 = "H" : 8V, CTRL2 = "M2" : 5V</b> |                   |                                                                                                                     |               |               |      |      |
| Output voltage                                                 | $V_{O51}$         | $I_{O5} = 1000\text{mA}$                                                                                            | 4.75          | 5.0           | 5.25 | V    |
|                                                                | $V_{O52}$         | $I_{O5} = 1000\text{mA}$                                                                                            | 7.6           | 8.0           | 8.4  | V    |
| Output current                                                 | $I_{O5}$          | $V_{O51} \geq 4.7\text{V}$ , $V_{O52} \geq 7.6\text{V}$                                                             | 1300          |               |      | mA   |
| Line regulation                                                | $\Delta V_{OLN5}$ | $10.5\text{V} < V_{CC2} < 16\text{V}$ , $I_{O5} = 1000\text{mA}$                                                    |               | 50            | 100  | mV   |
| Load regulation                                                | $\Delta V_{OLD5}$ | $10\text{mA} < I_{O5} < 1000\text{mA}$                                                                              |               | 100           | 200  | mV   |
| Dropout voltage 1                                              | $V_{DROP5}$       | $I_{O5} = 1000\text{mA}$                                                                                            |               | 1.0           | 1.5  | V    |
| Dropout voltage 2                                              | $V_{DROP5'}$      | $I_{O5} = 500\text{mA}$                                                                                             |               | 0.5           | 0.75 | V    |
| Ripple rejection (*2)                                          | $R_{REJ5}$        | $f = 120\text{Hz}$ , $I_{O5} = 1000\text{mA}$                                                                       | 40            | 50            |      | dB   |
| <b>EXT_HS-SW ; CTRL1 = "M2 or H"</b>                           |                   |                                                                                                                     |               |               |      |      |
| Output voltage                                                 | $V_{O6}$          | $I_{O6} = 350\text{mA}$                                                                                             | $V_{CC2}-1.0$ | $V_{CC2}-0.5$ |      | V    |
| Output current                                                 | $I_{O6}$          | $V_{O6} \geq V_{CC2}-1.0$                                                                                           | 350           |               |      | mA   |
| <b>ANT_HS-SW ; CTRL1 = "H"</b>                                 |                   |                                                                                                                     |               |               |      |      |
| Output voltage                                                 | $V_{O7}$          | $I_{O7} = 300\text{mA}$                                                                                             | $V_{CC2}-1.0$ | $V_{CC2}-0.5$ |      | V    |
| Output current                                                 | $I_{O7}$          | $V_{O7} \geq V_{CC2}-1.0$                                                                                           | 300           |               |      | mA   |

\*2 : guaranteed by design

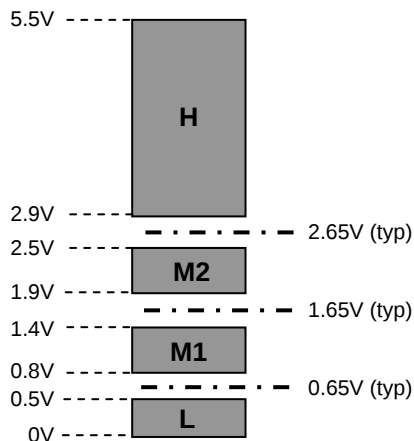
\*3 : Using resistors of tolerance within 1%.

## CTRL logic truth table

| CTRL1 | ANT | EXT | ILM |
|-------|-----|-----|-----|
| H     | ON  | ON  | ON  |
| M2    | OFF | ON  | ON  |
| M1    | OFF | OFF | ON  |
| L     | OFF | OFF | OFF |

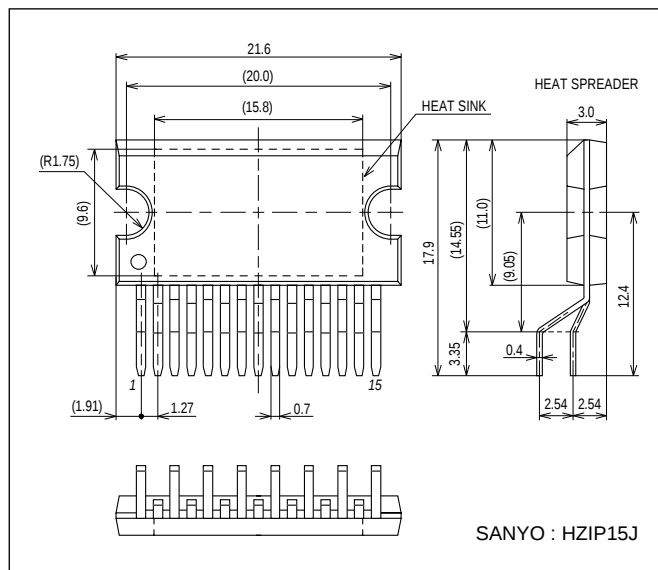
| CTRL2 | CD      | AUDIO | SW33V |
|-------|---------|-------|-------|
| H     | ON (8V) | ON    | ON    |
| M2    | ON (5V) | ON    | ON    |
| M1    | OFF     | ON    | ON    |
| L     | OFF     | OFF   | OFF   |

## CTRL1/2 voltage range and threshold

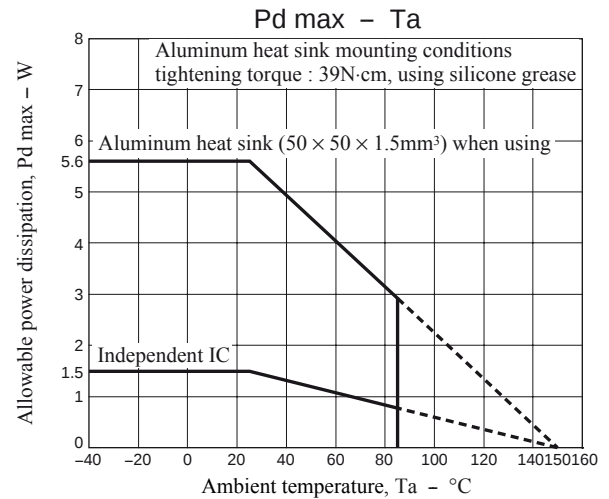


## Package Dimensions

unit : mm (typ)  
3395

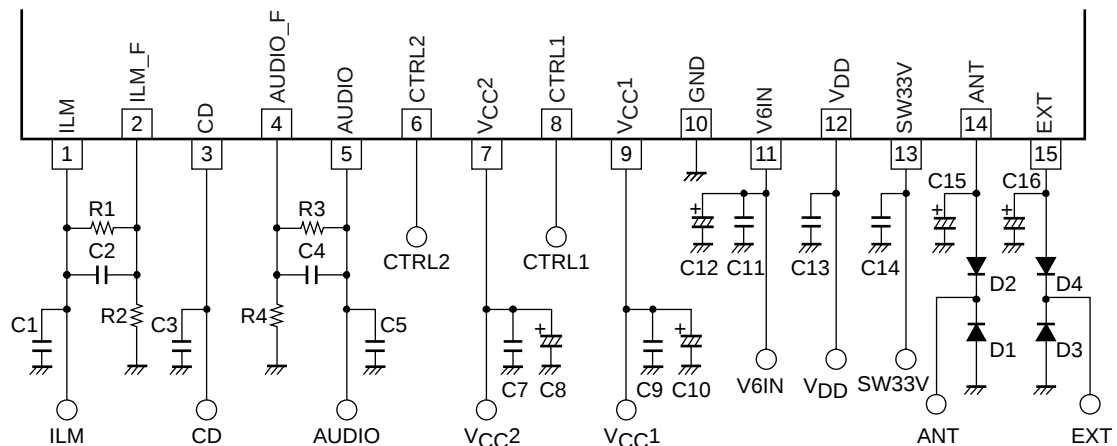


- Allowable power dissipation derating curve



## Application Circuit Example

### LV5684PVC

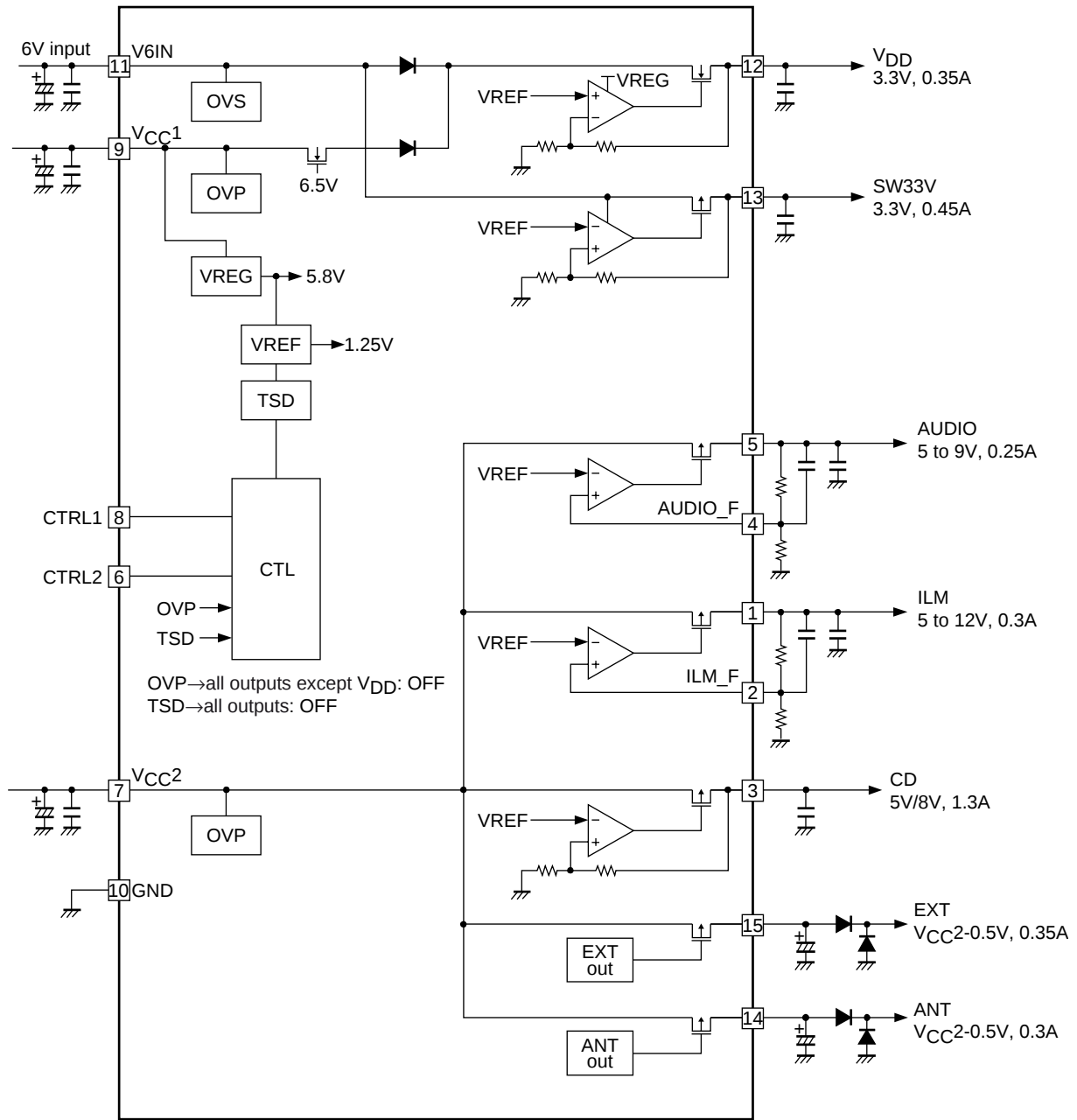


### Peripheral parts

| Part name            | Description                                | Recommended value                                                                                                                                        | Note                                         |
|----------------------|--------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------|
| C1, C3, C5, C13, C14 | output stabilization capacitor             | greater than 10μF (*1)                                                                                                                                   |                                              |
| C2, C4               | output stabilization capacitor             | 0pF                                                                                                                                                      | Ceramic capacitor                            |
| C8, C10, C12         | Capacitor for bypass power supply          | C8: greater than 100μF<br>C10, C12: greater than 47μF                                                                                                    | Make sure to implement close to VCC and GND. |
| C7, C9, C11          | Capacitor for oscillation protector        | greater than 0.22μF                                                                                                                                      |                                              |
| C15, C16             | Capacitor for EXT/ANT output stabilization | greater than 2.2μF                                                                                                                                       |                                              |
| R1, R2               | ILM voltage setting                        | R1/R2<br>43kΩ/5.1kΩ : V <sub>O</sub> = 12V<br>56kΩ/7.5kΩ : V <sub>O</sub> = 10.5V<br>30kΩ/5.6kΩ : V <sub>O</sub> = 8V<br>30kΩ/10kΩ : V <sub>O</sub> = 5V | Use resistors of tolerance within 1%         |
| R3, R4               | AUDIO voltage setting                      | R3/R4<br>30kΩ/10kΩ : V <sub>O</sub> = 5V<br>30kΩ/5.6kΩ : V <sub>O</sub> = 8.0V<br>27kΩ/4.7kΩ : V <sub>O</sub> = 8.5V<br>24kΩ/3.9kΩ : V <sub>O</sub> = 9V | Use resistors of tolerance within 1%         |
| D1, D2, D3, D4       | Internal device protector diode            | SANYO SB1003M3                                                                                                                                           |                                              |

(\*1) Make sure that output capacitors are greater than 10uF and meets the condition of ESR = 0.001 to 10Ω , in which voltage/ temperature dependence and unit differences are taken into consideration. Moreover, in case of electrolytic capacitor, high-frequency characteristics should be sufficiently good.

## Block Diagram



## Pin Function

| Pin No. | Pin name | Description                                        | Equivalent Circuit |
|---------|----------|----------------------------------------------------|--------------------|
| 1       | ILM      | ILM output<br>When CTRL1 = M1, M2, H,<br>ILM is ON |                    |
| 2       | ILM_F    | ILM voltage adjust                                 |                    |

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| Pin No. | Pin name | Description                                                   | Equivalent Circuit |
|---------|----------|---------------------------------------------------------------|--------------------|
| 3       | CD       | CD output<br>When CTRL2 = M2, H,<br>CD is ON<br>5V or 8V/1.3A |                    |
| 4       | AUDIO_F  | AUDIO voltage adjust                                          |                    |
| 5       | AUDIO    | AUDIO output<br>When CTRL2 = M1, M2, H,<br>AUDIO is ON        |                    |
| 6       | CTRL2    | CTRL2 input<br>4-value input                                  |                    |
| 7       | VCC2     | Power supply                                                  |                    |
| 8       | CTRL1    | CTRL1 input<br>4-value input                                  |                    |
| 9       | VCC1     | Power supply                                                  |                    |
| 10      | GND      | GND                                                           |                    |
| 11      | V6IN     | Power supply                                                  |                    |

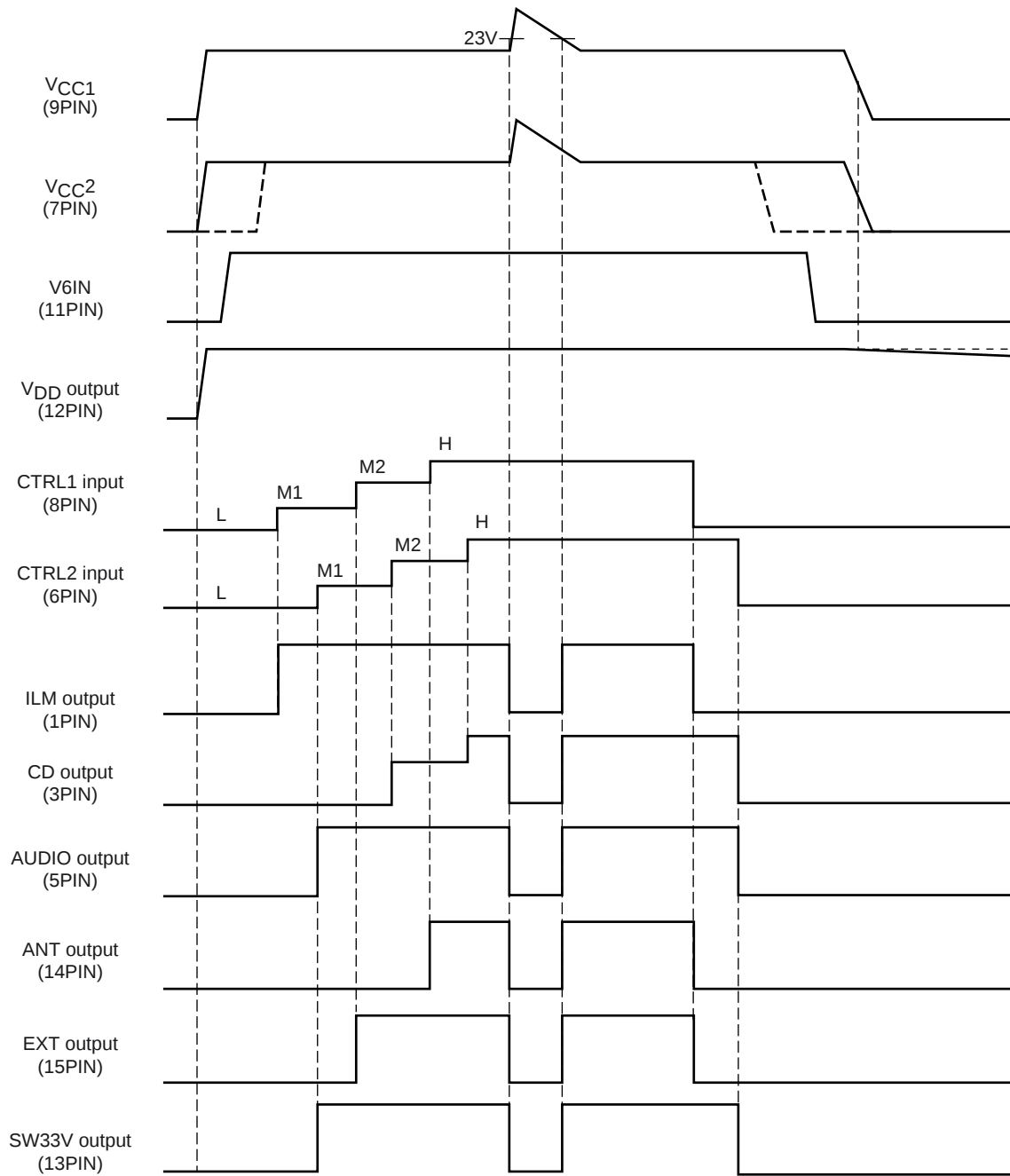
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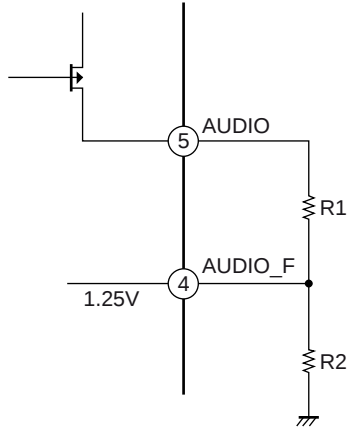
| Pin No. | Pin name        | Description                                                                   | Equivalent Circuit |
|---------|-----------------|-------------------------------------------------------------------------------|--------------------|
| 12      | V <sub>DD</sub> | V <sub>DD</sub> output<br>3.3V/0.35A                                          |                    |
| 13      | SW33V           | SW33V output<br>When CTRL2 = M1, M2, H,<br>SW33V is ON<br>3.3V/0.45A          |                    |
| 14      | ANT             | ANT output<br>When CTRL1 = H,<br>ANT is ON<br>V <sub>CC</sub> -0.5V/300mA     |                    |
| 15      | EXT             | EXT output<br>When CTRL1 = M2, H,<br>EXT is ON<br>V <sub>CC</sub> -0.5V/350mA |                    |

# Timing Chart



Caution: The above values are obtained when typ.

- How to set AUDIO output voltage



$\left[ \text{AUDIO\_F is determined by internal band-gap reference voltage (typ} = 1.25\text{V).} \right]$

AUDIO output voltage expression

$$AUDIO = \left( \frac{R_1}{R_2} + 1 \right) \times 1.25[\text{V}]$$

$$\frac{R_1}{R_2} = \frac{AUDIO}{1.25} - 1$$

Set the ratio of R1 and R2 to satisfy above expression.

(ex) AUDIO = 9V setting

$$\frac{R_1}{R_2} = \frac{9}{1.25} - 1 = 6.2$$

$$\frac{R_1}{R_2} = \frac{24k\Omega}{3.9k\Omega} \cong 6.15$$

$$AUDIO = (6.15 + 1) \times 1.25V \cong \boxed{8.94V}$$

- ILM output voltage is similarly calculated as AUDIO output.

(ex) ILM = 10.5V setting

$$\frac{R_1}{R_2} = \frac{10.5}{1.25} - 1 = 7.4$$

$$\frac{R_1}{R_2} = \frac{56k\Omega}{7.5k\Omega} \cong 7.46$$

$$ILM = (7.46 + 1) \times 1.25V \cong \boxed{10.575V}$$

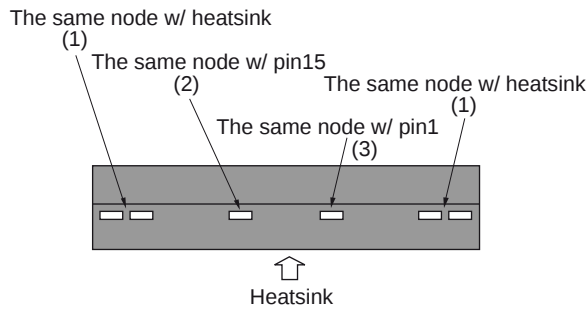
Note : The above values are typical values. These values have variation among the range of their tolerances.

## LV5684PVC

### Warning: Implementing LV5684PVC to the set board

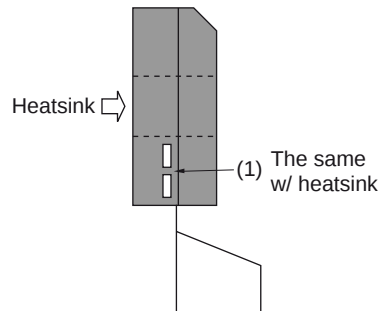
The package of LV5684PVC is HZIP15J which has some metal exposures other than connection pins and heatsink as shown in the diagram below. The electrical potentials of (2) and (3) are the same as those of pin15 and pin1, respectively. (2) (= pin15) is the EXT (High-side switch) output pin and (3) (= pin1) is the ILM (regulator) output pin. When you implement the IC to the set board, make sure that the bolts and the heatsink are out of touch from (2) and (3). If the metal exposures touch the bolts which has the same electrical potential with GND, GND short occurs in ILM output and EXT output. The exposures of (1) are connected to heatsink which has the same electrical potential with substrate of the IC chip (GND). Therefore, (1) and GND electrical potential of the set board can contact each other.

### HZIP15J outline



□ : metal exposure

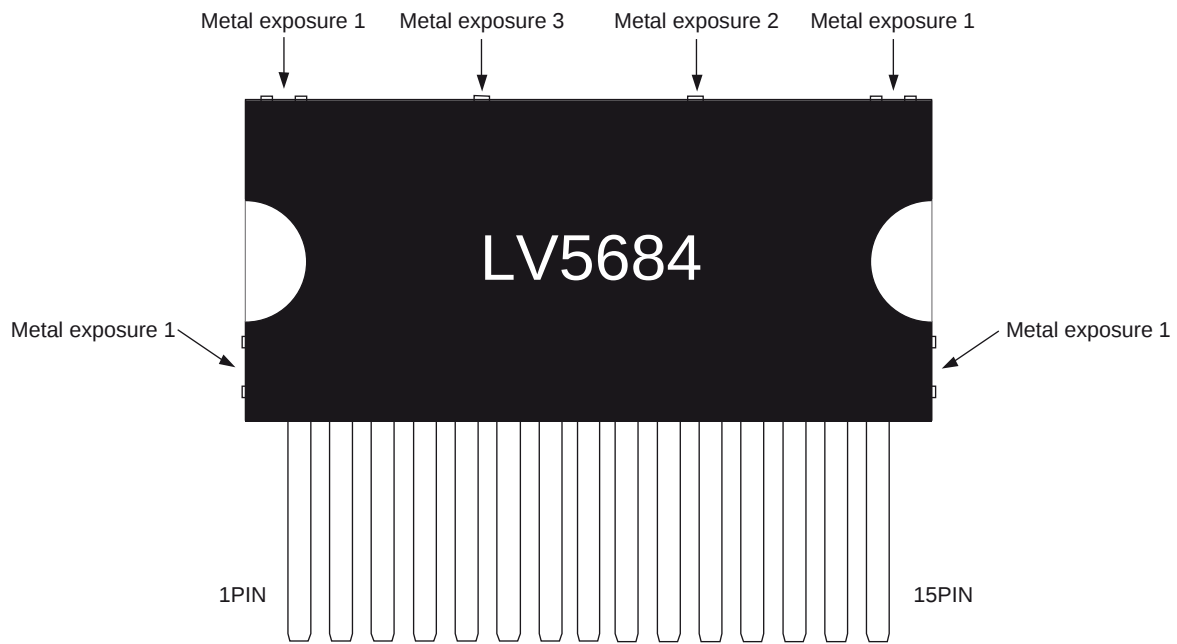
<Top view of HZIP15J>



□ : metal exposure  
\*the same applies to the other side.

<Side view of HZIP15J>

### Frame diagram (HZIP15J)



(Front view)

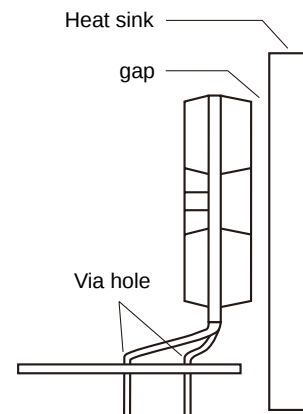
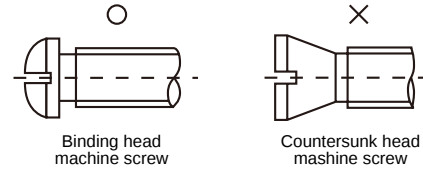
## HZIP15J Heat sink attachment

Heat sinks are used to lower the semiconductor device junction temperature by leading the heat generated by the device to the outer environment and dissipating that heat.

- a. Unless otherwise specified, for power ICs with tabs and power ICs with attached heat sinks, solder must not be applied to the heat sink or tabs.

b. Heat sink attachment

- Use flat-head screws to attach heat sinks.
  - Use also washer to protect the package.
  - Use tightening torques in the ranges 39-59Ncm (4-6kgcm) .
  - If tapping screws are used, do not use screws with a diameter larger than the holes in the semiconductor device itself.
  - Do not make gap, dust, or other contaminants to get between the semiconductor device and the tab or heat sink.
  - Take care a position of via hole .
  - Do not allow dirt, dust, or other contaminants to get between the semiconductor device and the tab or heat sink.
  - Verify that there are no press burrs or screw-hole burrs on the heat sink.
  - Warping in heat sinks and printed circuit boards must be no more than 0.05 mm between screw holes, for either concave or convex warping.
  - Twisting must be limited to under 0.05 mm.
  - Heat sink and semiconductor device are mounted in parallel.
- Take care of electric or compressed air drivers
- The speed of these torque wrenches should never exceed 700 rpm, and should typically be about 400 rpm.



c. Silicone grease

- Spread the silicone grease evenly when mounting heat sinks.
- Sanyo recommends YG-6260 (Momentive Performance Materials Japan LLC)

d. Mount

- First mount the heat sink on the semiconductor device, and then mount that assembly on the printed circuit board.
- When attaching a heat sink after mounting a semiconductor device into the printed circuit board, when tightening up a heat sink with the screw, the mechanical stress which is impossible to the semiconductor device and the pin doesn't hang.

e. When mounting the semiconductor device to the heat sink using jigs, etc.,

- Take care not to allow the device to ride onto the jig or positioning dowel.
- Design the jig so that no unreasonable mechanical stress is applied to the semiconductor device.

f. Heat sink screw holes

- Be sure that chamfering and shear drop of heat sinks must not be larger than the diameter of screw head used.
- When using nuts, do not make the heat sink hole diameters larger than the diameter of the head of the screws used. A hole diameter about 15% larger than the diameter of the screw is desirable.
- When tap screws are used, be sure that the diameter of the holes in the heat sink are not too small. A diameter about 15% smaller than the diameter of the screw is desirable.

- g. There is a method to mount the semiconductor device to the heat sink by using a spring band. But this method is not recommended because of possible displacement due to fluctuation of the spring force with time or vibration.

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