



SANYO Semiconductors

# DATA SHEET

An ON Semiconductor Company

## LV5680P — Monolithic Linear IC For Car Audio Systems Multi-Power Supply System IC

### Overview

The LV5680P is a multi-power supply system IC that provides four regulator outputs and two high side switches as well as a number of protection functions including overcurrent protection, overvoltage protection and overheat protection. It is an optimal power supply IC for car audio and car entertainment systems and similar products.

### Features

- Four regulator output systems
  - For microcontroller: 5.0V output voltage, 200mA maximum output current
  - For CD drive: 8.0V output voltage, 1300mA maximum output current
  - For illumination: 8 to 12V output voltage (output can be set with external resistors), 300mA maximum output current
  - For audio systems: 8 to 9V output voltage (output voltage can be set with external resistors), 300mA maximum output current
- Two  $V_{CC}$ -linked high side switch systems
  - EXT: 350mA maximum output current, 0.5V voltage difference between input and output.
  - ANT: 300mA maximum output current, 0.5V voltage difference between input and output.
- Two  $V_{DD}$  5V-linked high side switch systems
  - SW5V: 200mA maximum output current, 0.2V voltage difference between input and output.
  - ACC (accessory voltage detection output): 100mA maximum output current, 0.2V voltage difference between input and output.
- Overcurrent protection function
- Overvoltage protection function, typ 21V (excluding  $V_{DD}$  5V output)
- Overheat protection function, typ 175°C
- On-chip accessory voltage detection circuit
- P-channel LDMOS used for 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 over current protection range or thermal shutdown state may degrade the IC's reliability and eventually damage the IC.

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# LV5680P

## Specifications

### Absolute Maximum Ratings at $T_a = 25^\circ\text{C}$

| Parameter                     | Conditions    | Conditions                          | Ratings                     | Unit             |   |
|-------------------------------|---------------|-------------------------------------|-----------------------------|------------------|---|
| Supply voltage                | $V_{CC}$ max  |                                     | 36                          | V                |   |
| Peak supply voltage           | $V_{CC}$ peak | See below for the waveform applied. | 50                          | V                |   |
| Allowable Power dissipation   | $P_d$ max     | Independent IC                      | $T_a \leq 25^\circ\text{C}$ | 1.5              | W |
|                               |               | Al heat sink *                      |                             | 5.6              | W |
|                               |               | With an infinity heat sink          |                             | 32.5             | W |
| Junction temperature          | $T_j$ max     |                                     | 150                         | $^\circ\text{C}$ |   |
| Operating ambient temperature | $T_{opr}$     |                                     | -40 to +85                  | $^\circ\text{C}$ |   |
| Storage temperature           | $T_{stg}$     |                                     | -55 to +150                 | $^\circ\text{C}$ |   |

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

### Allowable Operating range at $T_a = 25^\circ\text{C}$

| Parameter                  | Conditions                              | Ratings    | Unit |
|----------------------------|---|------------|------|
| Operating supply voltage 1 | $V_{DD}$ output, SW output, ACC output  | 7.5 to 16  | V    |
| Operating supply voltage 2 | ILM output at 10V                       | 12 to 16   | V    |
|                            | ILM output at 8V                        | 10 to 16   | V    |
| Operating supply voltage 3 | Audio output at 9V                      | 10 to 16   | V    |
| Operating supply voltage 4 | CD output (CD output current = 1.3A)    | 10.5 to 16 | V    |
|                            | CD output (CD output current $\leq$ 1A) | 10 to 16   | V    |

### Electrical Characteristics at $V_{CC} = 14.4\text{V}$ , $T_a = 25^\circ\text{C}$ (\*6)

| Parameter  | Symbol            | Conditions  | Ratings |      |      | Unit             |
|--|-------------------|---|---------|------|------|------------------|
|  |                   |   | min     | typ  | max  |                  |
| Current drain  | $I_{CC}$          | $V_{DD}$ no load, CTRL1/2 = [L/L], ACC = 0V                                 |         | 400  | 800  | $\mu\text{A}$    |
| <b>CTRL1 Input</b>   |                   |   |         |      |      |                  |
| Low input voltage  | $V_{IL1}$         |   | 0       |      | 0.5  | V                |
| M1 input voltage   | $V_{IM1}$         |   | 0.8     | 1.1  | 1.4  | V                |
| M2 input voltage   | $V_{IM2}$         |   | 1.9     | 2.2  | 2.5  | V                |
| High input voltage   | $V_{IH1}$         |   | 2.9     | 3.3  | 5.5  | V                |
| Input impedance  | $R_{IH1}$         |   | 350     | 500  | 650  | $\text{k}\Omega$ |
| <b>CTRL2 Input</b>   |                   |   |         |      |      |                  |
| Low input voltage  | $V_{IL2}$         |   | 0       |      | 0.5  | V                |
| M input voltage  | $V_{IM2}$         |   | 1.1     | 1.65 | 2.1  | V                |
| High input voltage   | $V_{IH2}$         |   | 2.5     | 3.3  | 5.5  | V                |
| Input impedance  | $R_{IH2}$         |   | 350     | 500  | 650  | $\text{k}\Omega$ |
| <b><math>V_{DD}</math> 5V Output *1</b> <b>The <math>V_{DD}</math> 5V output supplies the output currents of SW 5V and ACC 5V.</b> |                   |   |         |      |      |                  |
| Output voltage 1   | $V_{O1}$          | $I_{O1} = 200\text{mA}$ , $I_{O7}$ , $I_{O8} = 0\text{A}$                   | 4.75    | 5.0  | 5.25 | V                |
| Output voltage 2   | $V_{O1}'$         | $I_{O1} = 200\text{mA}$ , $I_{O7} = 200\text{mA}$ , $I_{O8} = 100\text{mA}$ | 4.75    | 5.0  | 5.25 | V                |
| Output total current   | $I_{to1}$         | $V_{O1} \geq 4.75\text{V}$ , $I_{to1} = I_{O1} + I_{O7} + I_{O8}$           | 500     |      |      | mA               |
| Line regulation  | $\Delta V_{OLN1}$ | $7.5\text{V} < V_{CC} < 16\text{V}$ , $I_{O1} = 200\text{mA}$ *2            |         | 30   | 90   | mV               |
| Load regulation  | $\Delta V_{OLD1}$ | $1\text{mA} < I_{O1} < 200\text{mA}$ *2                                     |         | 70   | 150  | mV               |
| Dropout voltage 1  | $V_{DROP1}$       | $I_{O1} = 200\text{mA}$ *2  |         | 1.0  | 1.5  | V                |
| Dropout voltage 2  | $V_{DROP1}'$      | $I_{O1} = 100\text{mA}$ *2  |         | 0.7  | 1.05 | V                |
| Dropout voltage 3  | $V_{DROP1}''$     | $I_{O1} + I_{O7} + I_{O8} = 500\text{mA}$                                   |         | 2.5  | 3.75 | V                |
| Ripple rejection   | $R_{REJ1}$        | $f = 120\text{Hz}$ , $I_{O1} = 200\text{mA}$ *2                             | 40      | 50   |      | dB               |
| <b>CD Output ; CTRL2 = [H]</b>   |                   |   |         |      |      |                  |
| Output voltage   | $V_{O2}$          | $I_{O2} = 1000\text{mA}$  | 7.6     | 8.0  | 8.4  | V                |
| Output current   | $I_{O2}$          | $V_{O2} \geq 7.6\text{V}$   | 1300    |      |      | mA               |
| Line regulation  | $\Delta V_{OLN2}$ | $10.5\text{V} < V_{CC} < 16\text{V}$ , $I_{O2} = 1000\text{mA}$             |         | 50   | 100  | mV               |

\*1 : The  $V_{DD}$  5V output also supplies the output currents of SW 5V and ACC 5V. Therefore, the current supply capability of the  $V_{DD}$  5V output and its other electrical characteristics are affected by the output statuses of SW 5V and ACC 5V.

\*2 : SW 5V and ACC 5V are not subject to a load.

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| Parameter  | Symbol            | Conditions  | Ratings       |              |       | Unit      |
|--|-------------------|---|---------------|--------------|-------|-----------|
|  |                   |   | min           | typ          | max   |           |
| Load regulation                                  | $\Delta V_{OLD2}$ | $10mA < I_{O2} < 1000mA$                              |               | 100          | 200   | mV        |
| Dropout voltage 1                                | $V_{DROP2}$       | $I_{O2} = 1000mA$                                     |               | 1.0          | 1.5   | V         |
| Dropout voltage 2                                | $V_{DROP2}'$      | $I_{O2} = 500mA$                                      |               | 0.5          | 0.75  | V         |
| Ripple rejection                                 | $R_{REJ2}$        | $f = 120Hz, I_{O2} = 1000mA$                          | 40            | 50           |       | dB        |
| <b>AUDIO (8-9V) Output ; CTRL2 = [M]</b>         |                   |   |               |              |       |           |
| AUDIO_F pin voltage                              | $V_{I3}$          |   | 1.222         | 1.260        | 1.298 | V         |
| AUDIO_F pin inflow current                       | $I_{IN3}$         |   | -1            |              | 1     | $\mu A$   |
| AUDIO output voltage 1                           | $V_{O3}$          | $I_{O3} = 200mA, R2 = 30k\Omega, R3 = 5.6k\Omega *3$  | 7.65          | 8.0          | 8.35  | V         |
| AUDIO output voltage 2                           | $V_{O3}'$         | $I_{O3} = 200mA, R2 = 27k\Omega, R3 = 4.7k\Omega *3$  | 8.13          | 8.5          | 8.87  | V         |
| AUDIO output voltage 3                           | $V_{O3}''$        | $I_{O3} = 200mA, R2 = 24k\Omega, R3 = 3.9k\Omega *3$  | 8.6           | 9.0          | 9.4   | V         |
| AUDIO output current                             | $I_{O3}$          |   | 300           |              |       | mA        |
| Line regulation                                  | $\Delta V_{OLN3}$ | $10V < V_{CC} < 16V, I_{O3} = 200mA$                  |               | 30           | 90    | mV        |
| Load regulation                                  | $\Delta V_{OLD3}$ | $1mA < I_{O3} < 200mA$                                |               | 70           | 150   | mV        |
| Dropout voltage 1                                | $V_{DROP3}$       | $I_{O3} = 200mA$                                      |               | 0.3          | 0.45  | V         |
| Dropout voltage 2                                | $V_{DROP3}'$      | $I_{O3} = 100mA$                                      |               | 0.15         | 0.23  | V         |
| Ripple rejection                                 | $R_{REJ3}$        | $f = 120Hz, I_{O3} = 200mA$                           | 40            | 50           |       | dB        |
| <b>ILM (8-12V) Output ; CTRL1 = [M1]</b>         |                   |   |               |              |       |           |
| ILM_F pin voltage                                | $V_{I4}$          |   | 1.222         | 1.260        | 1.298 | V         |
| ILM output voltage 1                             | $V_{O4}$          | $I_{O4} = 200mA$                                      | 11.4          | 12.0         | 12.6  | V         |
| ILM output voltage 2                             | $V_{O4}'$         | $I_{O4} = 200mA, R1 = 270k\Omega *4$                  | 8.5           | 10.0         | 11.5  | V         |
| ILM output voltage 3                             | $V_{O4}''$        | $I_{O4} = 200mA, R1 = 100k\Omega *4$                  | 6.8           | 8.0          | 9.2   | V         |
| ILM output current                               | $I_{O4}$          | $R1 = 270k\Omega$                                     | 300           |              |       | mA        |
| Line regulation                                  | $\Delta V_{OLN4}$ | $12V < V_{CC} < 16V, I_{O4} = 200mA, R1 = 270k\Omega$ |               | 30           | 90    | mV        |
| Load regulation                                  | $\Delta V_{OLD4}$ | $1mA < I_{O4} < 200mA$                                |               | 70           | 150   | mV        |
| Dropout voltage 1                                | $V_{DROP4}$       | $I_{O4} = 200mA$                                      |               | 0.7          | 1.05  | V         |
| Dropout voltage 2                                | $V_{DROP4}'$      | $I_{O4} = 100mA$                                      |               | 0.35         | 0.53  | V         |
| Ripple rejection                                 | $R_{REJ4}$        | $f = 120Hz, I_{O4} = 200mA$                           | 40            | 50           |       | dB        |
| <b>Remoto (EXT) ; CTRL1 = [M2]</b>               |                   |   |               |              |       |           |
| Output voltage                                   | $V_{O5}$          | $I_{O5} = 350mA$                                      | $V_{CC}-1.0$  | $V_{CC}-0.5$ |       | V         |
| Output current                                   | $I_{O5}$          | $V_{O5} \geq V_{CC}-1.0$                              | 350           |              |       | mA        |
| <b>ANT remoto ; CTRL1 = [H]</b>                  |                   |   |               |              |       |           |
| Output voltage                                   | $V_{O6}$          | $I_{O6} = 300mA$                                      | $V_{CC}-1.0$  | $V_{CC}-0.5$ |       | V         |
| Output current                                   | $I_{O6}$          | $V_{O6} \geq V_{CC}-1.0$                              | 300           |              |       | mA        |
| <b>SW 5V Output ; CTRL2 = [M]</b>                |                   |   |               |              |       |           |
| Output voltage 1                                 | $V_{O7}$          | $I_{O7} = 1mA, I_{O1}, I_{O8} = 0A *5$                | $V_{O1}-0.25$ | $V_{O1}$     |       | V         |
| Output voltage 2                                 | $V_{O7}'$         | $I_{O7} = 200mA, I_{O1}, I_{O8} = 0A *5$              | $V_{O1}-0.45$ | $V_{O1}-0.2$ |       | V         |
| Output current                                   | $I_{O7}$          | $V_{O7} \geq 4.55$                                    | 200           |              |       | mA        |
| <b>ACC Detection ; ACC Integration 5V output</b> |                   |   |               |              |       |           |
| ACC detection voltage                            | $V_{TH8}$         |   | 2.8           | 3.0          | 3.2   | V         |
| Hysteresis width                                 | $V_{HIS8}$        |   | 0.2           | 0.3          | 0.4   | V         |
| Input impedance                                  | $Z_{I8}$          | (Pull-down resistance internal)                       | 42            | 60           | 78    | $k\Omega$ |
| ACC output voltage 1                             | $V_{O8}$          | $I_{O8} = 0.5mA, I_{O1}, I_{O7} = 0A *5$              | $V_{O1}-0.25$ | $V_{O1}$     |       | V         |
| ACC output voltage 2                             | $V_{O8}'$         | $I_{O8} = 100mA, I_{O1}, I_{O7} = 0A *5$              | $V_{O1}-0.45$ | $V_{O1}-0.2$ |       | V         |
| ACC output voltage                               | $I_{O8}$          | $V_{O8} \geq 4.55$                                    | 100           |              |       | mA        |

\*3 : When a component with a resistance accuracy of  $\pm 1\%$  is used

<Reference> When a component with a resistance accuracy of  $\pm 0.5\%$  is used,  $V_{O3}''$  is  $8.67V \leq 9.0V \leq 9.33V$ .

\*4 : When a component with a resistance accuracy of  $\pm 1\%$  is used

The absolute accuracy of the internal resistance is  $\pm 15\%$ .

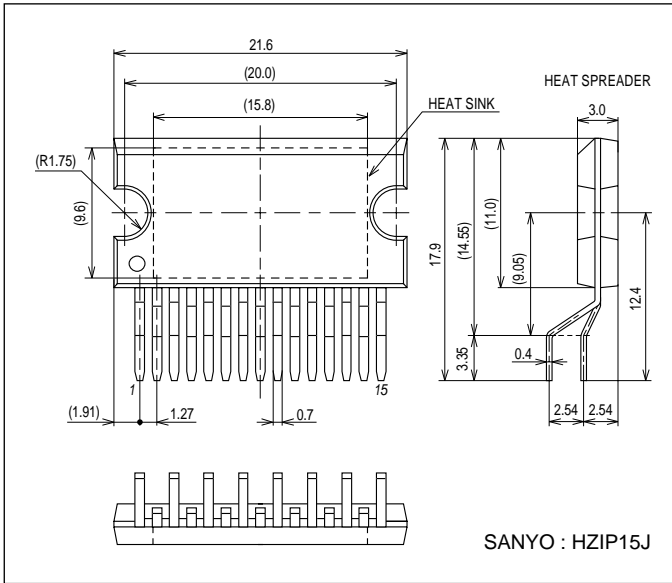
\*5 : Since the SW 5V and ACC 5V are output from  $V_{DD} 5V$  through the SW, the voltage drops by an amount equivalent to the ON resistance of the SW.

\*6: The entire specification has been defined based on the tests performed under the conditions where  $T_j$  and  $T_a$  ( $=25^\circ C$ ) are almost equal. There tests were performed with pulse load to minimize the increase of junction temperature ( $T_j$ ).

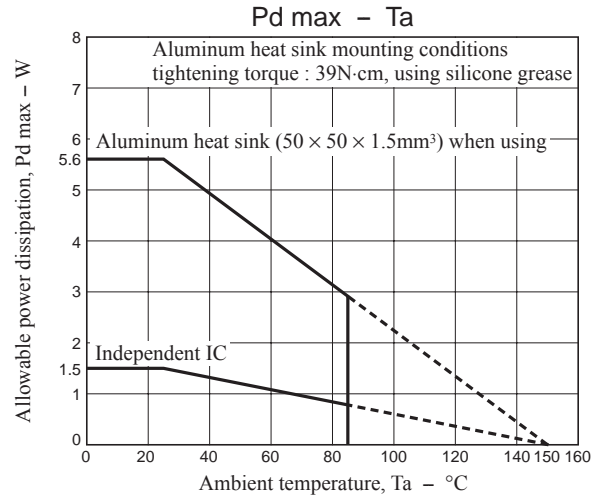
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## Package Dimensions

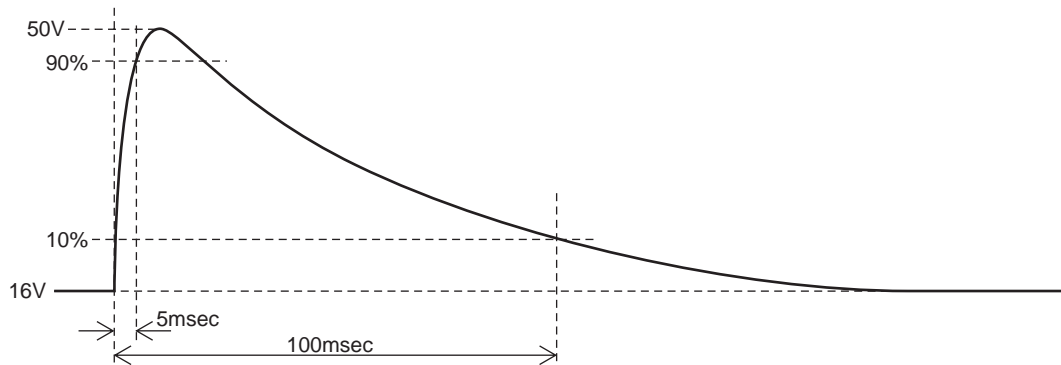
unit : mm (typ)  
3395



### • Allowable power dissipation derating curve

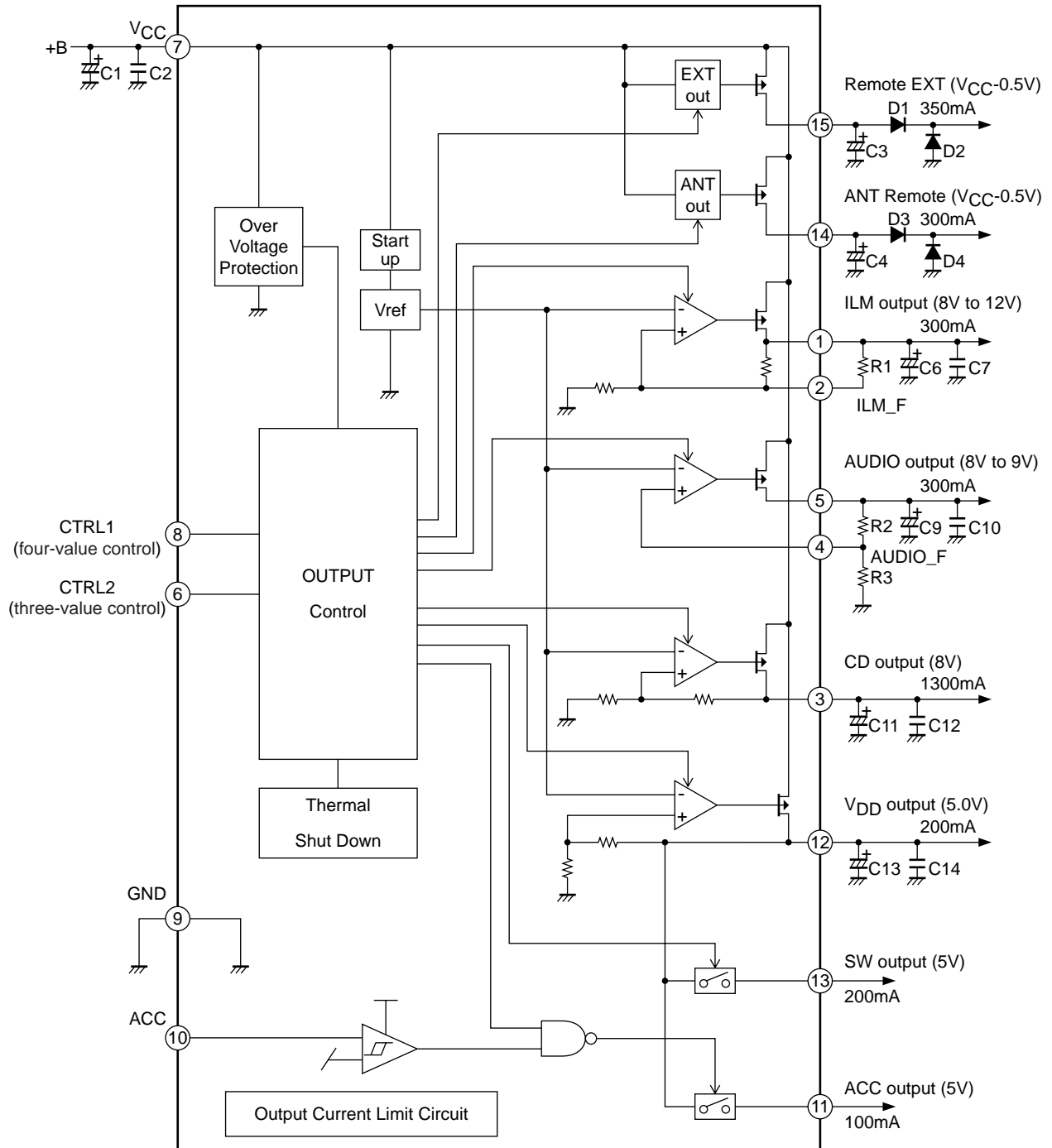


### • Waveform applied during surge test



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## Block Diagram



## Pin Function

| Pin No. | Pin name | Description  | Equivalent Circuit |
|---------|----------|--|--------------------|
| 1       | ILM      | ILM output pin<br>ON when CTRL1 = M1, M2, H<br>12.0V/300mA |                    |
| 2       | ILM_F    | ILM output voltage adjustment pin                          |                    |

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| Pin No. | Pin name | Description  | Equivalent Circuit |
|---------|----------|--|--------------------|
| 3       | CD       | CD output pin<br>ON when CTRL2 = M, H<br>8.0V/1.3A |                    |
| 4       | AUDIO_F  | AUDIO output voltage adjustment pin                |                    |
| 5       | AUDIO    | AUDIO output pin<br>ON when CTRL2 = M, H           |                    |
| 6       | CTRL2    | CTRL2 input pin<br>three-value input               |                    |
| 7       | VCC      | Supply terminal                                    |                    |
| 8       | CTRL1    | CTRL1 input pin<br>four-value input                |                    |
| 9       | GND      | GND pin  |                    |

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| Pin No. | Pin name           | Description  | Equivalent Circuit |
|---------|--------------------|--|--------------------|
| 10      | ACC                | Accessory input  |                    |
| 11      | ACC5V              | Accessory detection output<br>ON when ACC > 3V                         |                    |
| 12      | V <sub>DD</sub> 5V | V <sub>DD</sub> 5V output pin<br>5.0V/200mA                            |                    |
| 13      | SW5V               | SW5V output pin<br>ON when CTRL2 = M, H                                |                    |
| 14      | ANT                | ANT output pin<br>ON when CTRL1 = H<br>V <sub>CC</sub> -0.5V/300mA     |                    |
| 15      | EXT                | EXT output pin<br>ON when CTRL1 = M2, H<br>V <sub>CC</sub> -0.5V/350mA |                    |

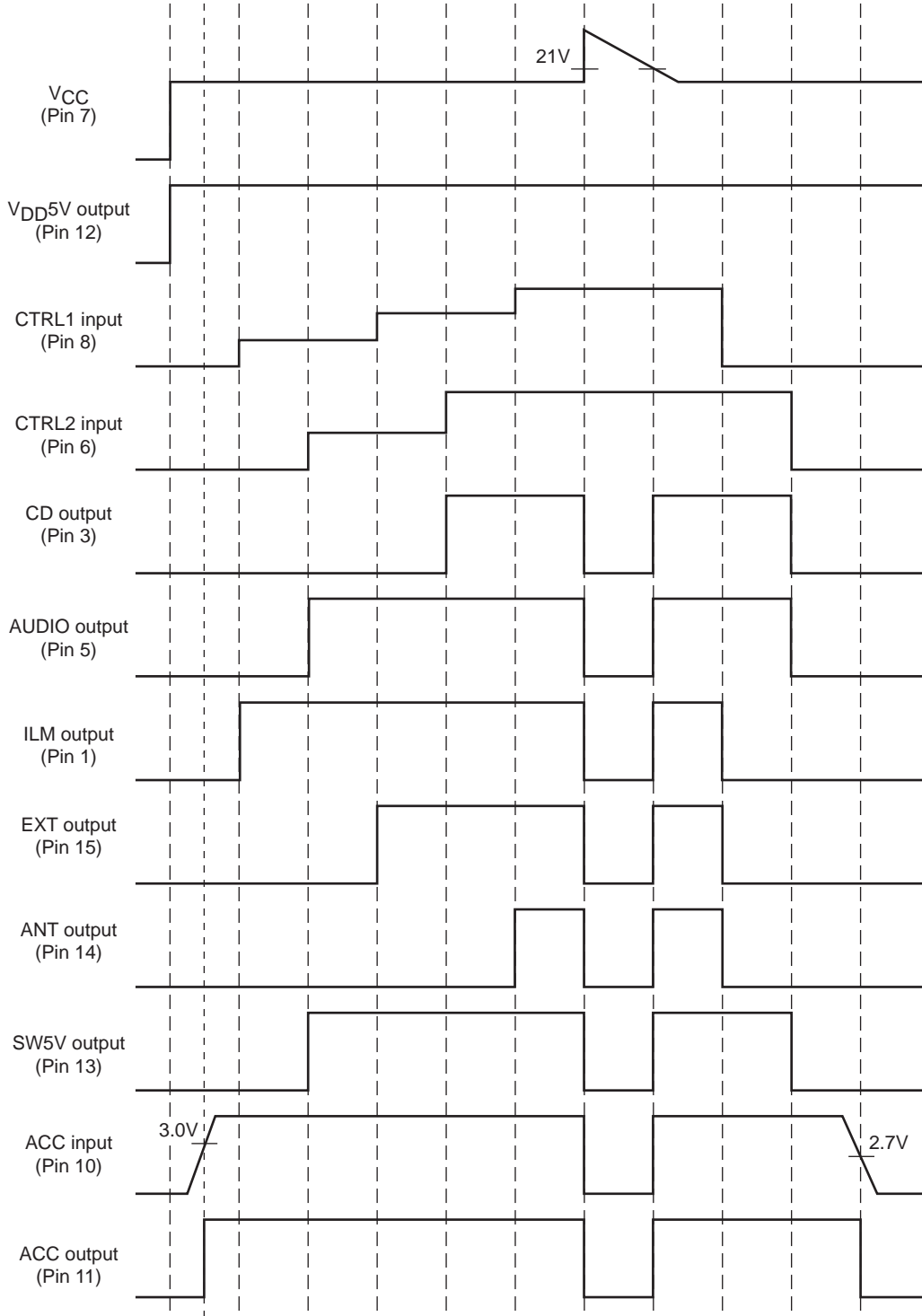
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**CTRL Pin Output Truth Table**

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

| CTRL2 | CD  | AUDIO | SW5 |
|-------|-----|-------|-----|
| L     | OFF | OFF   | OFF |
| M     | OFF | ON    | ON  |
| H     | ON  | ON    | ON  |

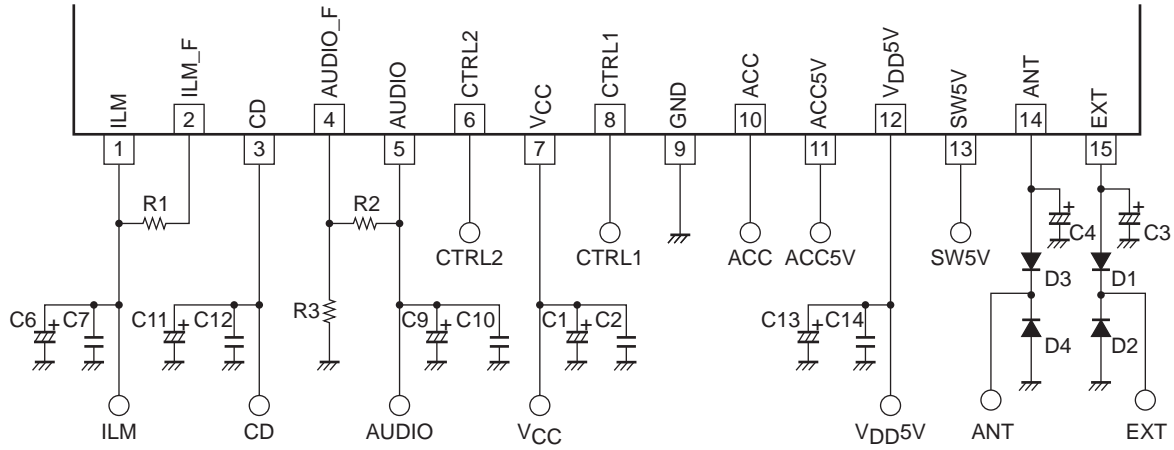
**Timing Chart**





# LV5680P

## Recommended Operation Circuit



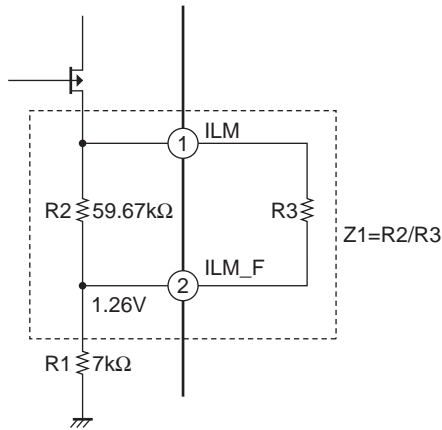
### Peripheral parts list

| Name of part      | Description                                    | Recommended value  | Remarks   |
|-------------------|--|--|---|
| C1                | Power supply bypass capacitor                  | 100 $\mu$ F or more  | These capacitors must be placed near the V <sub>CC</sub> and GND pins.          |
| C2                | Oscillation prevention capacitor               | 0.22 $\mu$ F or more   |   |
| C3                | EXT output stabilization capacitor             | 2.2 $\mu$ F or more  |   |
| C4                | ANT output stabilization capacitor             | 2.2 $\mu$ F or more  |   |
| C6, C9, C11, C13  | Output stabilization capacitor                 | 4.7 $\mu$ F or more  | Electrolytic capacitor *  |
| C7, C10, C12, C14 | Output stabilization capacitor                 | 0.22 $\mu$ F or more   | Ceramic capacitor *   |
| R1                | Resistor for ILM voltage adjustment            | ILM output voltage<br>R1:without = 12.0V<br>:270k $\Omega$ = 10.0V<br>:100k $\Omega$ = 8.0V  | A resistor with resistance accuracy as low as less than $\pm 1\%$ must be used. |
| R2, R3            | Resistor for AUDIO voltage setting             | AUDIO output voltage<br>R2/R3:30k $\Omega$ /5.6k $\Omega$ = 8.0V<br>:27k $\Omega$ /4.7k $\Omega$ = 8.5V<br>:24k $\Omega$ /3.9k $\Omega$ = 9.0V | A resistor with resistance accuracy as low as less than $\pm 1\%$ must be used. |
| D1, D2, D3, D4    | Diode for internal device breakdown protection |  |   |

\* : In order to stabilize the regulator outputs, it is recommended that the electrolytic capacitor and ceramic capacitor be connected in parallel.

Furthermore, the values listed above do not guarantee stabilization during the overcurrent protection operations of the regulator, so oscillation may occur during an overcurrent protection operation.

## • ILM output voltage setting method



The ILM\_F voltage is determined by the internal band gap voltage of the IC (typ = 1.26V).

Formula for ILM voltage calculation

$$Z_1 = R_2 // R_3 = \frac{R_2 \cdot R_3}{R_2 + R_3}$$

$$ILM = \frac{1.26[V]}{R_1} \times Z_1 + 1.26[V]$$

$$Z_1 = \frac{(ILM - 1.26) \cdot R_1}{1.26} \quad R_3 = \frac{R_2 \cdot Z_1}{R_2 - Z_1}$$

Example : ILM = 9V setting method

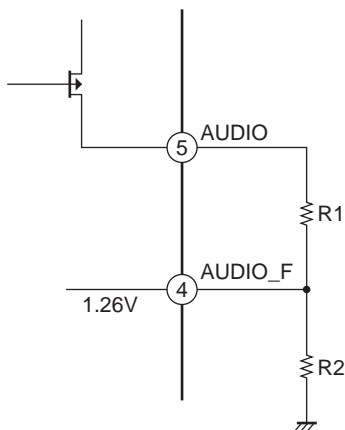
$$Z_1 = \frac{(9V - 1.26V) \cdot 7k\Omega}{1.26V} \cong 43k\Omega$$

When R3 = 150k, the ILM output voltage will be as follows:

$$Z_1' = \frac{59.67k\Omega \cdot 150k\Omega}{59.67k\Omega + 150k\Omega} \cong 42.69k\Omega$$

$$ILM = \frac{1.26V}{7k\Omega} \times 42.69k\Omega + 1.26V \cong \boxed{8.94V}$$

## • AUDIO output voltage setting method



The AUDIO\_F voltage is determined by the internal band gap voltage of the IC (typ = 1.26V).

Formula for AUDIO voltage calculation

$$AUDIO = \frac{1.26[V]}{R_2} \times R_1 + 1.26[V]$$

$$\frac{R_1}{R_2} = \frac{(AUDIO - 1.26)}{1.26}$$

The circuit must be designed in such a way that the R1:R2 ratio satisfies the formula given above for the AUDIO voltage that has been set.

Example : AUDIO = 8.5V setting method

$$\frac{R_1}{R_2} = \frac{(8.5 - 1.26)}{1.26} \cong 5.75$$

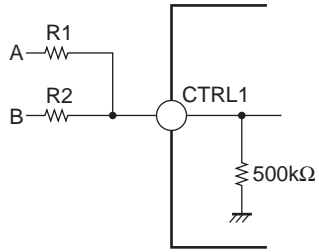
$$\frac{R_1}{R_2} = \frac{27k\Omega}{4.7k\Omega} \cong 5.74$$

$$AUDIO = 1.26V \times 5.74 + 1.26V \cong \boxed{8.49V}$$

Note : In the above, the typical values are given in all instances for the values used and, as such, they will vary due to the effects of production-related variations of the IC and external resistors.

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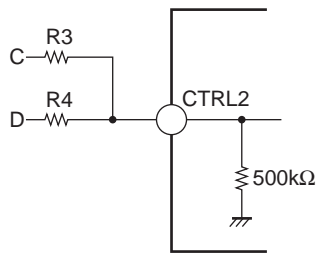
## • CTRL1 Application Circuit Example



(1) 3.3V input:  $R1 = 4.7k\Omega$ ,  $R2 = 10k\Omega$

| A    | B    | CTRL1 |
|------|------|-------|
| 0V   | 0V   | 0V    |
| 0V   | 3.3V | 1.05V |
| 3.3V | 0V   | 2.23V |
| 3.3V | 3.3V | 3.20V |

## • CTRL2 Application Circuit Example



(1) 3.3V input:  $R3 = R4 = 4.7k\Omega$

| A    | B    | CTRL2 |
|------|------|-------|
| 0V   | 0V   | 0V    |
| 0V   | 3.3V | 1.61V |
| 3.3V | 0V   | 1.61V |
| 3.3V | 3.3V | 3.29V |

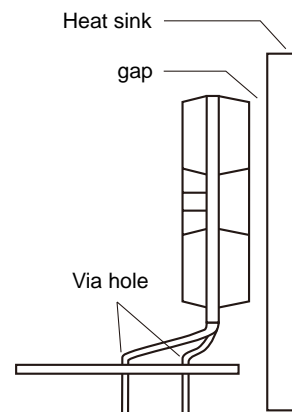
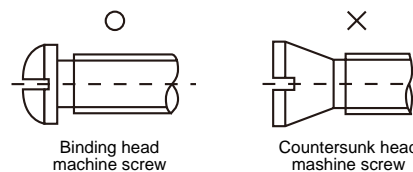
## HZIP15J Heat sink attachment

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 not 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.

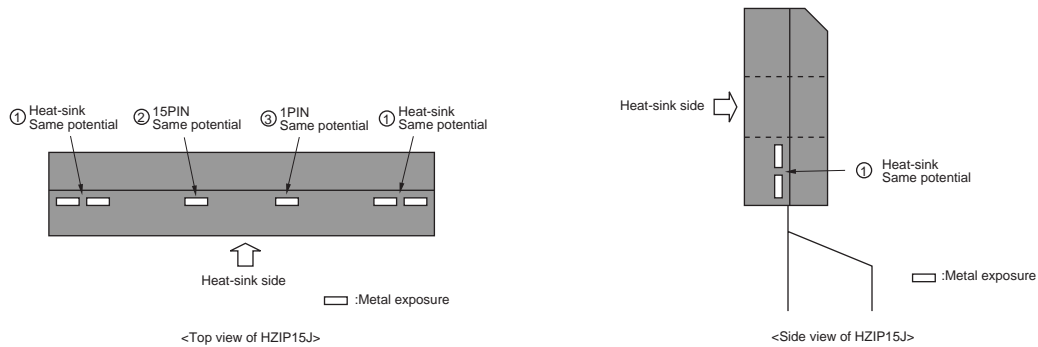
- g. There is a method to mount the semiconductor device to the heat sink by using a spring band. But this method is not recommended because of possible displacement due to fluctuation of the spring force with time or vibration.

### Caution for implementing LV5680P to a system board

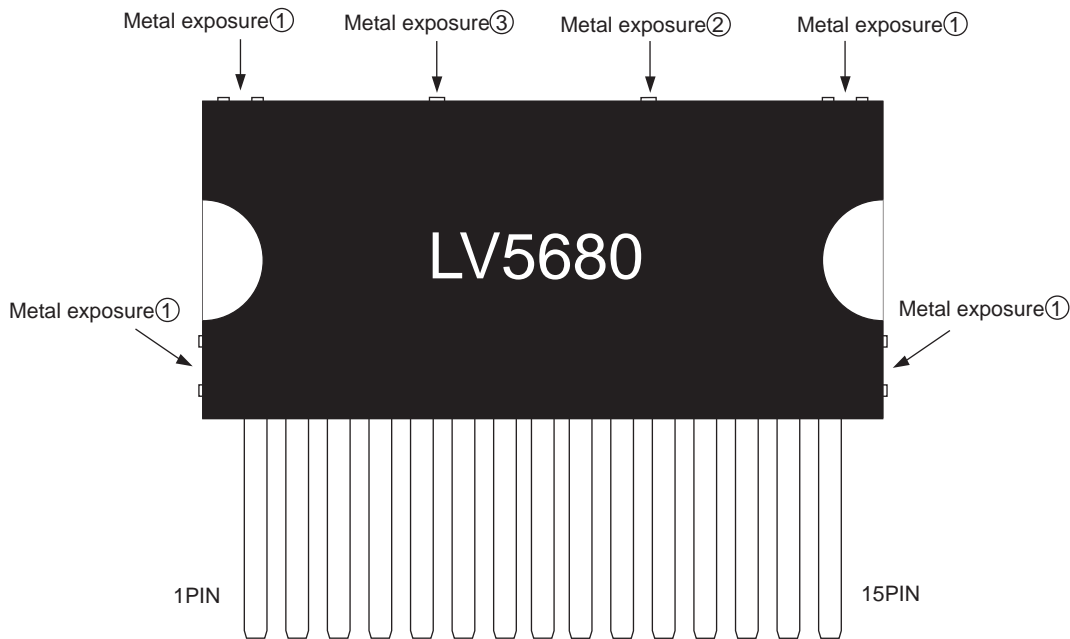
The package of LV5680P is HZIP15J which has some metal exposures other than connection pins and heatsink as shown in the diagram below. The electrical potentials of (2) and (3) are the same as those of pin 15 and pin 1, respectively. (2) (=pin 15) is the  $V_{CC}$  pin and (3) (=pin 1) is the ILM (regulator) 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  $V_{CC}$ . 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 connect each other.

# LV5680P

- HZIP15J outline



- Frame diagram (LV5680P) \*In the system power supply other than LV5680P, pin assignment may differ.



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