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LV56831P

Monolithic Linear IC

Multi Voltage Regulator IC

for Car Audio Systems

Overview

The LV56831P has 4 system regulator, V_{DD} 5V(3.3V), AUDIO(8.5V), AMP remote(12V) and REG(3.3V/5V select). About protection circuits, it has Over-current-protection, Over-voltage-protection and Thermal-shut-down. AMP remote and REG supply is independent terminal from V_{CC} .

Features

- 4 system regulator
 - V_{DD} (LCD micon) : V_{OUT} 5.0V(3.3V), I_O max 300mA, reverse current prevention.
 - Audio : V_{OUT} 8.5V, I_O max 400mA
 - AMP remote : V_{OUT} 12V, I_O max 500mA
 - REG3.3/5V : V_{OUT} 3.3V(5V), I_O max 500mA
- Over-current-protection
- Thermal-shut-down Typ 175°C
- Over-voltage-protection: Typ 21V(except V_{DD})
- Applied Pch-LDMOS for output stages.

(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 or thermal shut down state may degrade the IC's reliability and eventually damage the IC.

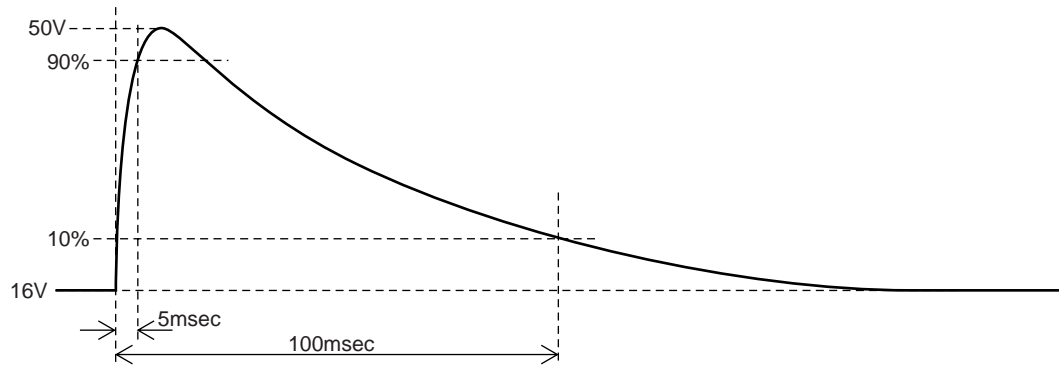
Specifications

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

| Parameter | Conditions | Conditions | Ratings | Unit |
|-------------------------------|---|---|-------------|------|
| Supply voltage | V_{CC} max | | 36 | V |
| Allowable Power dissipation | P_d max (* $T_a \leq 25^\circ\text{C}$) | IC unit | 1.3 | W |
| | | With Al heatsink(50×50×1.5mm ³) | 5.3 | W |
| | | Infinite heat radiation | 26 | W |
| Peak supply voltage | V_{CC} peak | See below pulse wave. | 50 | V |
| Operating ambient temperature | T_{opr} | | -40 to +85 | °C |
| Storage temperature | T_{stg} | | -55 to +150 | °C |
| Junction temperature | T_j max | | 150 | °C |

Stresses exceeding Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stresses above the Recommended Operating Conditions may affect device reliability.

Peak voltage testing pulse wave

Recommended Operating condition at $T_a = 25^\circ\text{C}$

| Parameter | Conditions | Ratings | Unit |
|-------------------------------|---------------------------------------|----------|------|
| Power supply voltage rating 1 | V_{DD} output(5V/3.3V) | 7 to 16 | V |
| Power supply voltage rating 2 | REG output(5V/3.3V): $V_{CC}=V_{CC1}$ | 7 to 16 | V |
| Power supply voltage rating 3 | AUDIO output | 11 to 16 | V |
| Power supply voltage rating 4 | AMP remote output: $V_{CC}=V_{CC1}$ | 13 to 16 | V |

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

| Parameter | Symbol | Conditions | Ratings | | | Unit |
|--|-------------------|---|---------|--------|------|------------------|
| | | | min | typ | max | |
| Quiescent current | I_{CC} | V_{DD} no load, ALL EN terminal = "L" | | 50 | 100 | μA |
| AUDIO_EN Input | | | | | | |
| Low input voltage | V_{IL1} | | 0 | | 0.5 | V |
| High input voltage | V_{IH1} | | 2.0 | | 5.5 | V |
| Input impedance | R_{IH1} | | 280 | 400 | 520 | $\text{k}\Omega$ |
| AMP_EN Input | | | | | | |
| Low input voltage | V_{IL2} | | 0 | | 0.5 | V |
| High input voltage | V_{IH2} | | 2.0 | | 5.5 | V |
| Input impedance | R_{IH2} | | 280 | 400 | 520 | $\text{k}\Omega$ |
| REG_EN input | | | | | | |
| Low input voltage | V_{IL3} | | 0 | | 0.5 | V |
| High input voltage | V_{IH3} | | 2.0 | | 5.5 | V |
| Input impedance | R_{IH3} | | 280 | 400 | 520 | $\text{k}\Omega$ |
| V_{DD} (5V/3.3V)output(reverse current prevention diode implemented) | | | | | | |
| V_{DD} output voltage 1 | V_{O11} | $I_{O11} = 200\text{mA}$, IKV_{DD} is connected to 5PIN. | 4.75 | 5.0 | 5.25 | V |
| V_{DD} output current 1 | I_{O11} | $V_{O11} \geq 4.7\text{V}$ | 300 | | | mA |
| V_{DD} output voltage 2 | V_{O12} | $I_{O12} = 200\text{mA}$, $IKV_{DD} = \text{GND}$ | 3.13 | 3.3 | 3.47 | V |
| V_{DD} output current 2 | I_{O12} | $V_{O12} \geq 3.1\text{V}$ | 300 | | | mA |
| Line regulation | ΔV_{OLN1} | $7\text{V} < V_{CC} < 16\text{V}$, $I_{O1} = 200\text{mA}$ | | 50 | 100 | mV |
| Load regulation | ΔV_{OLD1} | $1\text{mA} < I_{O11}$, $I_{O12} < 200\text{mA}$ | | 80 | 150 | mV |
| Dropout voltage 1 | V_{DROP1} | $I_{O1} = 200\text{mA}$ (implemented diode) | | 1.5 | 2.5 | V |
| V_{CC} ripple rejection | R_{REJ1} | $f=120\text{Hz}$, $I_{O1}=200\text{mA}$ | 40(*2) | 50(*2) | | dB |
| V_{DD} reverse current | I_{REV} | $V_{O11}=5.0\text{V}$, $V_{CC}=0\text{V}$ | | 10 | 100 | μA |
| AMP remote output ; AMP_EN = High | | | | | | |
| USB output voltage 1 | V_{O2} | $I_{O2} = 400\text{mA}$ | 11.4 | 12 | 12.6 | V |
| USB output current 1 | I_{O2} | $V_{O2} \geq 11.3\text{V}$ | 500 | | | mA |
| Line regulation | ΔV_{OLN2} | $13\text{V} < V_{CC1} < 16\text{V}$, $I_{O2} = 400\text{mA}$ | | 50 | 100 | mV |
| Load regulation | ΔV_{OLD2} | $10\text{mA} < I_{O2} < 400\text{mA}$ | | 80 | 160 | mV |
| Dropout voltage 1 | V_{DROP2} | $I_{O2} = 400\text{mA}$ | | 0.4 | 0.8 | V |
| V_{CC1} ripple rejection | R_{REJ2} | $f=120\text{Hz}$, $I_{O2}=400\text{mA}$ | 40(*2) | 50(*2) | | dB |

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| Parameter | Symbol | Conditions | Ratings | | | Unit |
|--------------------------------------|--------------------|--|---------|--------|------|------|
| | | | min | typ | max | |
| AUDIO output ; AUDIO_EN = High | | | | | | |
| AUDIO output voltage | V _{O3} | I _{O3} = 300mA | 8.1 | 8.5 | 8.9 | V |
| AUDIO output current | I _{O3} | V _{O3} ≥ 8V | 400 | | | mA |
| Line regulation | ΔV _{OLN3} | 10V < V _{CC} < 16V, I _{O3} = 300mA | | 30 | 100 | mV |
| Load regulation | ΔV _{OLD3} | 1mA < I _{O3} < 300mA | | 70 | 140 | mV |
| Dropout voltage | V _{DROP3} | I _{O3} = 300mA | | 0.6 | 1.05 | V |
| V _{CC} ripple rejection | R _{REJ3} | f = 120Hz, I _{O3} =300mA | 40(*2) | 50(*2) | | dB |
| REG (3.3V/5V) Output ; REG_EN = High | | | | | | |
| REG output voltage 1 | V _{O41} | I _{O41} = 400mA, IKREG is connected to 10PIN. | 4.75 | 5 | 5.25 | V |
| REG output current 1 | I _{O41} | V _{O41} ≥ 4.7V | 500 | | | mA |
| REG output voltage 2 | V _{O42} | I _{O42} = 400mA, IKREG=GND | 3.13 | 3.3 | 3.47 | V |
| REG output current 2 | I _{O42} | V _{O42} ≥ 3.1V | 500 | | | mA |
| Line regulation | ΔV _{OLN4} | 7V < V _{CC1} < 16V, I _{O4} = 400mA | | 30 | 100 | mV |
| Load regulation | ΔV _{OLD4} | 1mA < I _{O4} < 400mA | | 80 | 150 | mV |
| Dropout voltage | V _{DROP4} | I _{O4} = 400mA | | 1.0 | 1.5 | V |
| V _{CC1} ripple rejection | R _{REJ4} | f = 120Hz, I _{O4} =400mA | 40(*2) | 50(*2) | | dB |

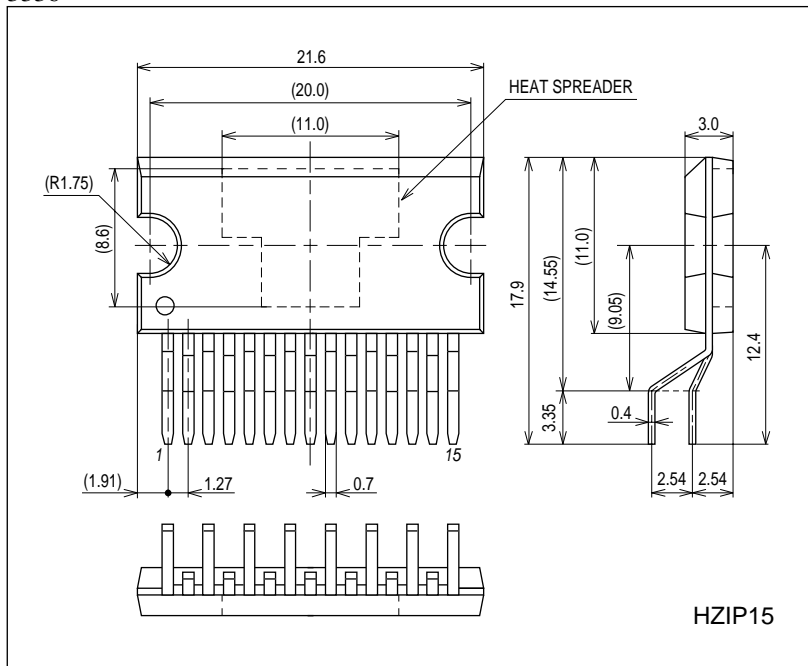
*1: The entire specification has been defined based on the tests performed under the conditions where T_j and $T_a (=25^\circ\text{C})$ are almost equal. There tests were performed with pulse load to minimize the increase of junction temperature(T_j).

*2 : design certification

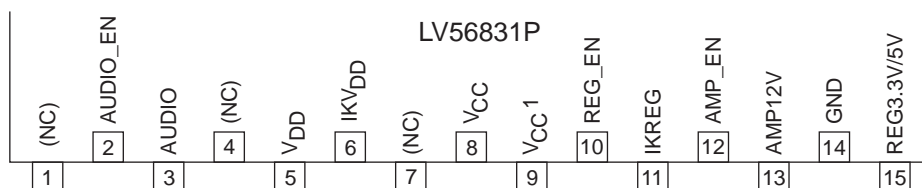
Package Dimensions

unit : mm (typ)

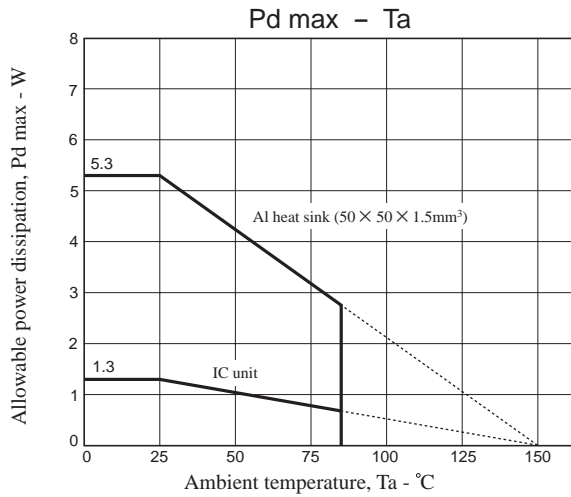
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Pin assignment



Allowable power dissipation derating curve



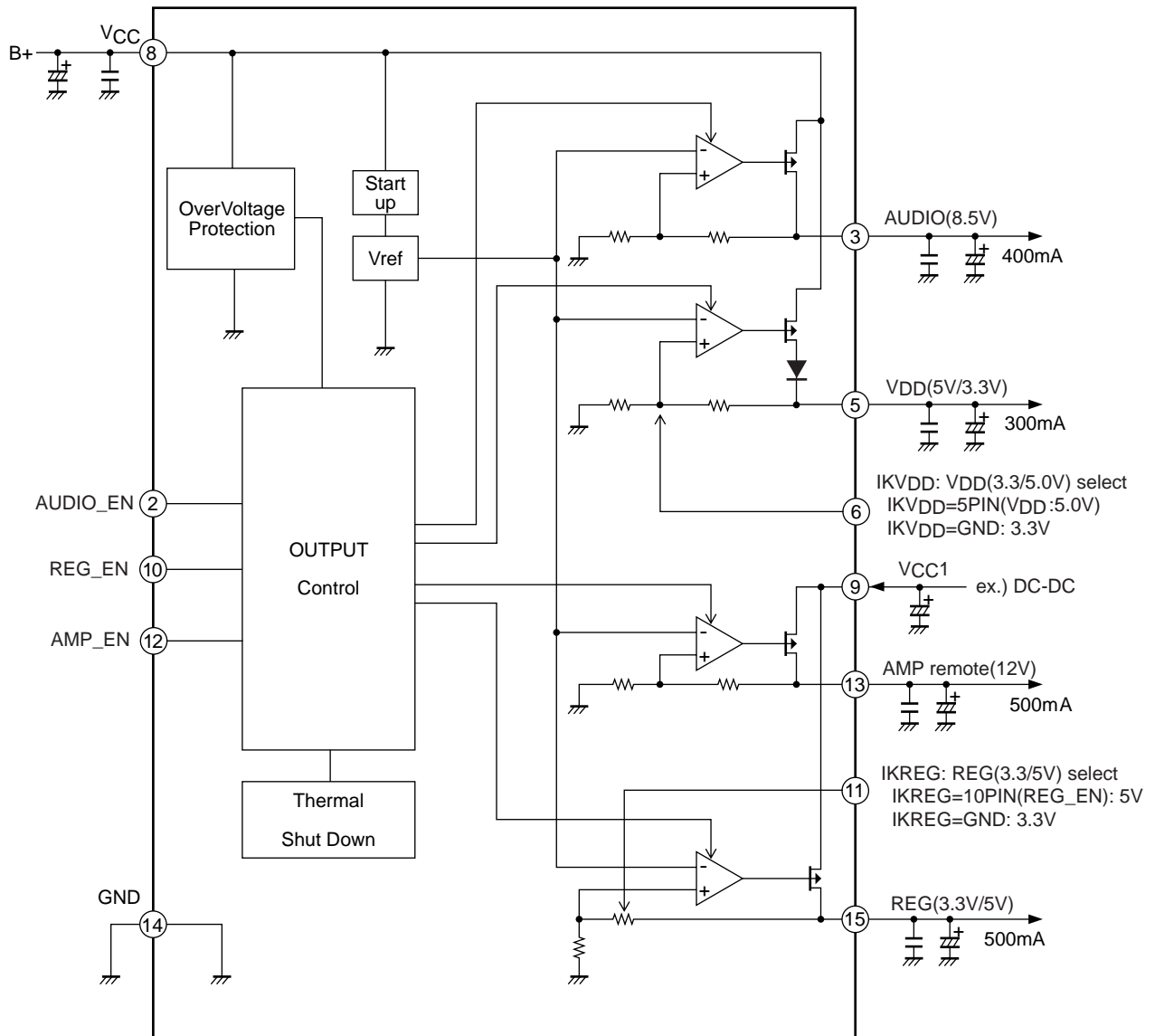
(a) IC unit(HZIP15)

(b) With Al heatsink(50×50×1.5mm³)

Al heatsink mounting conditions

Tightening torque: 39N·cm, using silicone grease

Block Diagram



Pin Function

| Pin No. | Pin name | Description | Equivalent Circuit |
|---------|-------------------|--|--------------------|
| 1 | N.C. | - | - |
| 2 | AUDIO_EN | AUDIO output CTRL | |
| 3 | AUDIO | AUDIO output when AUDIO_EN = High, ON 8.5V/0.4A | |
| 4 | N.C. | - | - |
| 5 | V _{DD} | V _{DD} output 5.0V, 3.3V/0.3A | |
| 6 | IKV _{DD} | V _{DD} output voltage select OPEN : V _{DD} = 5.0V GND : V _{DD} = 3.3V | |
| 7 | N.C. | - | - |
| 8 | V _{CC} | V _{CC} | |
| 9 | V _{CC} 1 | V _{CC} 1 | |

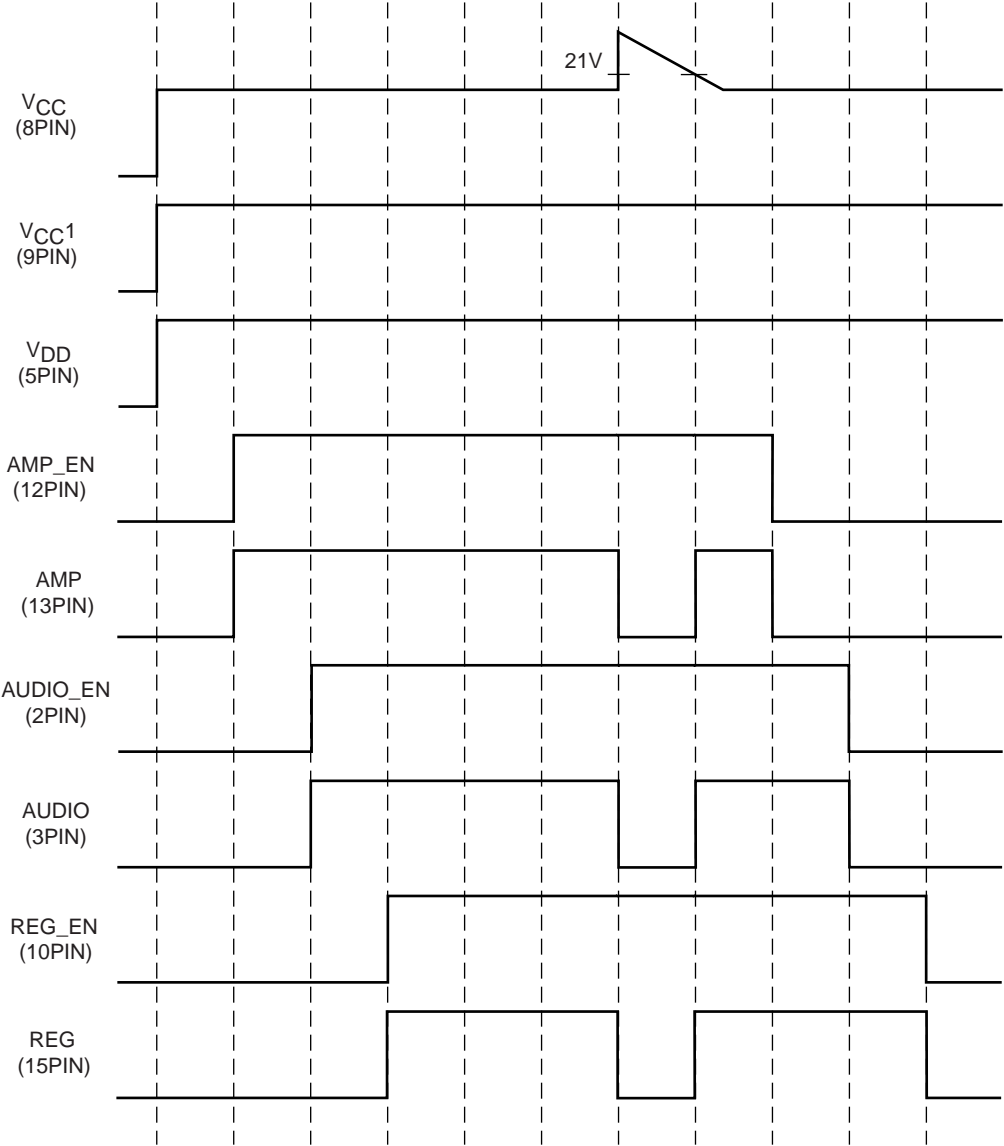
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| Pin No. | Pin name | Description | Equivalent Circuit |
|---------|----------|--|--------------------|
| 10 | REG_EN | REG output CTRL | |
| 11 | IKREG | REG output voltage select OPEN : REG = 3.3V GND : REG = 5.0V | |
| 12 | AMP_EN | AMP output CTRL | |
| 13 | AMP | AMP output when AMP_EN = High, ON 12V, 0.5A | |
| 14 | GND | GND | |
| 15 | REG | REG output when REG_EN = High, ON 5.0V, 3.3V/0.5A | |

Timing Chart



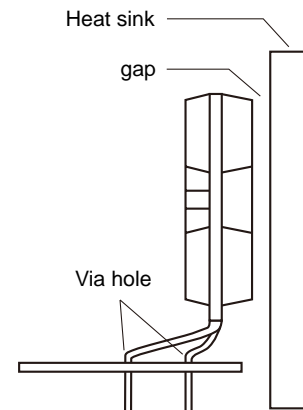
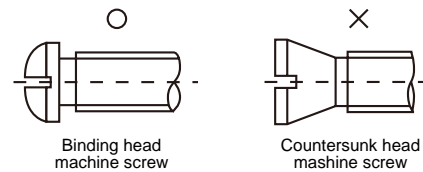
HZIP15 Heat sink attachment

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.
- Our company 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.

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