HSSOP31 Package Application Note
Mounting Procedure and Instructions for Adding a Heat Sink

Introduction
This document sets out the mounting procedure and instructions for adding a heat sink to the HSSOP31 package.
Content

Introduction.................................................................................................................. 1
1. Features and benefit of the HSSOP31 package .................................................................. 4
2. Markings .......................................................................................................................... 4
3. Dimensions ...................................................................................................................... 4
4. Pad dimensions ............................................................................................................... 5
5. Mounting procedure ....................................................................................................... 5
6. Adding a heat sink .......................................................................................................... 6
7. Calculating the junction temperature and choosing a heat sink ................................... 7

RESTRICTIONS ON PRODUCT USE.................................................................................. 9
Figure 1 HSSOP31 package ........................................................................................................ 4
Figure 2 HSSOP31 package typical markings .............................................................................. 4
Figure 3 P-HSSOP31-0918-0.80-001 .......................................................................................... 4
Figure 4 P-HSSOP31-0918-0.80-002 ........................................................................................ 4
Figure 5 P-HSSOP31-0918-0.80-001 pad dimensions ................................................................. 5
Figure 6 P-HSSOP31-0918-0.80-002 pad dimensions ................................................................. 5
Figure 7 Typical package temperature profile ........................................................................... 5
Figure 8 Adding a heat sink using insulating sheets ................................................................. 6
Figure 9 Adding a heat sink using plastic or gel insulation......................................................... 6
Figure 10 Substrate bending ....................................................................................................... 7
Figure 11 Selecting a heat sink .................................................................................................. 7
1. Features and benefit of the HSSOP31 package

HSSOP31 is a thin and compact package featuring a simplified substrate wiring format with the high-voltage terminals and control terminals on opposite sides of the package. It is available in two configurations: with the exposed parts of the metal frame either facing the substrate or facing upwards.

The metal frame should not be soldered to components such as the heat sink or substrate. Where a heat sink is deemed necessary to dissipate heat associated with the ambient temperature or heat from internal components or peripheral devices, refer to Section 6 below.

2. Markings

3. Dimensions
4. Pad dimensions

![Figure 5 P-HSSOP31-0918-0.80-001 pad dimensions](image1)

![Figure 6 P-HSSOP31-0918-0.80-002 pad dimensions](image2)

5. Mounting procedure

<table>
<thead>
<tr>
<th>Requirements</th>
<th>Reflow</th>
<th>Flow</th>
<th>Soldering iron</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Up to three uses</td>
<td>Not supported</td>
<td>Single use only</td>
</tr>
</tbody>
</table>

① Reflow
- Peak temperature: Maximum 260°C (instantaneous)
- Internal device temperature/period: 230°C or more for 30 – 50 sec
- Pre-heat temperature/period: 180 - 190°C for 60 – 120 sec

Note: Maximum mounting temperature is based on package surface temperature.

Figure 7 shows the temperature profile.
This profile represents the maximum device temperature at which device performance can be guaranteed.
The pre-heat temperature and heating temperature will be governed by factors such as the type of solder paste used, but must be within the range shown in Figure 7.

The package is carefully wrapped to be protected against humidity.

After unwrapping, the package should be maintained at 30°C and 60% RH until the final reflow stage, and mounting should be completed within 168 hours.

![Figure 7 Typical package temperature profile](image3)
② Flow
This package is not suitable for solder flow mounting.

③ Soldering iron
Heating: Via lead tip of soldering iron
Maximum 400°C (at tip) for no more than 3 sec
Repetitions: No repetitions (once only per terminal)

● Other
Check solder bonding strength via in-house testing at the substrate mounting stage.

6. Adding a heat sink
In some cases a heat sink may be necessary to dissipate heat associated with the ambient temperature or heat from internal components or peripheral devices.

● Typical example
① Using insulating sheet

![Figure 8 Adding a heat sink using insulating sheets](image)

Table 2 Required

<table>
<thead>
<tr>
<th>Screws</th>
<th>M3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Insulating material</td>
<td>0.5 mm soft material</td>
</tr>
<tr>
<td>Spacers</td>
<td>t = 2.5 mm, hole diameter = 3.2 mm</td>
</tr>
</tbody>
</table>

② Plastic or gel insulation

![Figure 9 Adding a heat sink using plastic or gel insulation](image)

● Insulating sheet and buffer material
Heat fins fixed to the top of the package can cause device failure due to heat stress. Hard components (such as the heat sink) should be mounted onto the package together with a buffer layer (typically soft insulating sheet or conductive gel). Silicon grease should be avoided.
Mounting to substrate
Where the HSSOP31 package is sandwiched between the heat sink and the substrate, the static load should be no greater than 10 N. The load should be spread uniformly across the device, and screw mountings should not result in substrate bending as shown in Figure 10, as the resulting distortion could cause device damage or failure. Consider using spacers or equivalent to attach the heat sink so as to prevent substrate bending.

Figure 10 Substrate bending

Flatness
The surface beneath the heat sink to which the device is attached must be suitably smooth and flat. The heat sink should likewise show no signs of warping or undulation and should be free of foreign matter such as burrs and scraps from pressing and cutting processes. In the worst-case scenario this could lead to device failure.

Other important information
- The HSSOP31 package is a MOS device and as such should be shielded from electrostatic sources at all times.
- The product has exposed metal frame on one side at the same electrical potential as the GND terminals (pin 11/31). Do not allow live current to pass through the exposed metal frame. Insulating material may be required between the heat sink and/or substrate. Do not use solder between the metal frame and the heat sink or substrate.

7. Calculating the junction temperature and choosing a heat sink
The device junction temperature (bonding temperature) can be estimated from the case temperature and device loss as follows.

\[ T_j = T_c + P \times R_{jc} \]

where
- \( T_j \) is maximum junction temperature (°C)
- \( T_c \) is case temperature (°C)
- \( P \) is device loss (W)
- \( R_{jc} \) is heat resistance between case and junction (°C/W) = 5.22 °C/W approx.
Use the equation below to select the optimum heat sink.

\[ R_f + R_c + R_{jc} < \frac{(T_j - T_a)}{R_{jc}} \]

From the above, we have:

If maximum operating temperature \( T_a = 50^\circ C \), maximum junction temperature \( T_j = 135^\circ C \times 80\% \), thermal resistance between heat sink and case \( R_c = 3^\circ C/W \) and thermal resistance between case and junction \( R_{jc} = 5.22^\circ C/W \) then:

\[ R_f + 3 + 5.22 < \frac{(135 \times 0.8 - 50)}{5} \]
\[ R_f < 3.38 \, ^\circ C/W \]

In this case, the heat sink should have thermal resistance no greater than 3.38 \(^\circ C/W\).
RESTRICTIONS ON PRODUCT USE

Toshiba Corporation and its subsidiaries and affiliates are collectively referred to as "TOSHIBA". Hardware, software and systems described in this document are collectively referred to as "Product".

- TOSHIBA reserves the right to make changes to the information in this document and related Product without notice.
- This document and any information herein may not be reproduced without prior written permission from TOSHIBA. Even with TOSHIBA's written permission, reproduction is permissible only if reproduction is without alteration/omission.
- Though TOSHIBA works continually to improve Product's quality and reliability, Product can malfunction or fail. Customers are responsible for complying with safety standards and for providing adequate designs and safeguards for their hardware, software and systems which minimize risk and avoid situations in which a malfunction or failure of Product could cause loss of human life, bodily injury or damage to property, including data loss or corruption. Before customers use the Product, create designs including the Product, or incorporate the Product into their own applications, customers must also refer to and comply with (a) the latest versions of all relevant TOSHIBA information, including without limitation, this document, the specifications, the data sheets and application notes for Product and the precautions and conditions set forth in the "TOSHIBA Semiconductor Reliability Handbook" and (b) the instructions for the application with which the Product will be used with or for. Customers are solely responsible for all aspects of their own product design or applications, including but not limited to (a) determining the appropriateness of the use of this Product in such design or applications; (b) evaluating and determining the applicability of any information contained in this document, or in charts, diagrams, programs, algorithms, sample application circuits, or any other referenced documents; and (c) validating all operating parameters for such designs and applications. TOSHIBA ASSUMES NO LIABILITY FOR CUSTOMERS' PRODUCT DESIGN OR APPLICATIONS.

- PRODUCT IS NEITHER INTENDED NOR WARRANTED FOR USE IN EQUIPMENTS OR SYSTEMS THAT REQUIRE EXTRAORDINARILY HIGH LEVELS OF QUALITY AND/OR RELIABILITY, AND/OR A MALFUNCTION OR FAILURE OF WHICH MAY CAUSE LOSS OF HUMAN LIFE, BODILY INJURY, SERIOUS PROPERTY DAMAGE AND/OR SERIOUS PUBLIC IMPACT ("UNINTENDED USE"). Except for specific applications as expressly stated in this document, Unintended Use includes, without limitation, equipment used in nuclear facilities, equipment used in the aerospace industry, medical equipment, equipment used for automobiles, trains, ships and other transportation, traffic signaling equipment, equipment used to control combustions or explosions, safety devices, elevators and escalators, devices related to electric power, and equipment used in finance-related fields. IF YOU USE PRODUCT FOR UNINTENDED USE, TOSHIBA ASSUMES NO LIABILITY FOR PRODUCT. For details, please contact your TOSHIBA sales representative.

- Do not disassemble, analyze, reverse-engineer, alter, modify, translate or copy Product, whether in whole or in part.
- Product shall not be used or incorporated into any products or systems whose manufacture, use, sale is prohibited under any applicable laws or regulations.
- The information contained herein is presented only as guidance for Product use. No responsibility is assumed by TOSHIBA for any infringement of patents or any other intellectual property rights of third parties that may result from the use of Product. No license to any intellectual property right is granted by this document, whether express or implied, by estoppel or otherwise.

- ABSENT A WRITTEN SIGNED AGREEMENT, EXCEPT AS PROVIDED IN THE RELEVANT TERMS AND CONDITIONS OF SALE FOR PRODUCT, AND TO THE MAXIMUM EXTENT ALLOWABLE BY LAW, TOSHIBA (1) ASSUMES NO LIABILITY WHATSOEVER, INCLUDING WITHOUT LIMITATION, INDIRECT, CONSEQUENTIAL, SPECIAL, OR INCIDENTAL DAMAGES OR LOSS, INCLUDING WITHOUT LIMITATION, LOSS OF PROFITS, LOSS OF OPPORTUNITIES, BUSINESS INTERRUPTION AND LOSS OF DATA, AND (2) DISCLAIMS ANY AND ALL EXPRESS OR IMPLIED WARRANTIES AND CONDITIONS RELATED TO SALE, USE OF PRODUCT, OR INFORMATION, INCLUDING WARRANTIES OR CONDITIONS OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, ACCURACY OF INFORMATION, OR NONINFRINGEMENT.

Do not use or otherwise make available Product or related software or technology for any military purposes, including without limitation, for the design, development, use, stockpiling or manufacturing of nuclear, chemical, or biological weapons or missile technology products (mass destruction weapons). Product and related software and technology may be controlled under the applicable export laws and regulations including, without limitation, the Japanese Foreign Exchange and Foreign Trade Law and the U.S. Export Administration Regulations. Export and re-export of Product or related software or technology are strictly prohibited except in compliance with all applicable export laws and regulations.

- Please contact your TOSHIBA sales representative for details as to environmental matters such as the RoHS compatibility of Product. Please use Product in compliance with all applicable laws and regulations that regulate the inclusion or use of controlled substances, including without limitation, the EU RoHS Directive. TOSHIBA ASSUMES NO LIABILITY FOR DAMAGES OR LOSSES OCCURRING AS A RESULT OF NONCOMPLIANCE WITH APPLICABLE LAWS AND REGULATIONS.