# Intel® 6300ESB I/O Controller Hub

## Thermal and Mechanical Design Guide

*February 2004*

Order Number: 300682-001

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## Revision History

| Date | Revision | Description |
|---|---|---|
| February 2004 | 1.0 | Initial release of this document. |

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# 1.0 Introduction

As the complexity of computer systems increases, so do the power dissipation requirements. Care must be taken to ensure that the additional power is properly dissipated. Heat may be dissipated using improved system cooling and/or attaching passive heatsinks.

The objective of thermal management is to ensure that the temperatures of all components in a system are maintained within functional limits. The functional temperature limit is the range within which the electrical circuits may be expected to meet specified performance requirements. Operation outside the functional limit may degrade system performance, cause logic errors, or cause component and/or system damage. Temperatures exceeding the maximum operating limits may result in irreversible changes in the operating characteristics of the component. The goal of this document is to provide an understanding of the operating limits of the Intel® 6300ESB I/O Controller Hub (ICH).

The simplest and most cost effective method is to improve the inherent system cooling characteristics through careful design and placement of fans, vents, and ducts. When additional cooling is required, component thermal solutions may be implemented in conjunction with system thermal solutions. The size of the fan or heatsink may be varied to balance size and space constraints with acoustic noise.

This document presents the conditions and requirements to properly design a cooling solution for systems using the Intel 6300ESB ICH. Properly designed solutions should provide adequate cooling to maintain the Intel 6300ESB ICH case temperatures at or below thermal specifications. This is accomplished by providing a low local-ambient temperature, ensuring adequate local airflow, and minimizing the case to local-ambient thermal resistance. By maintaining the case temperatures of the Intel 6300ESB ICH at or below those recommended in this document, a system designer may ensure the proper functionality, performance, and reliability of these components.

## 1.1 Definition of Terms

**Table 1. Definition of Terms**

| Term | Definition |
|---|---|
| BGA | Ball Grid Array. A package type defined by a resin-fiber substrate, onto which a die is mounted, bonded and encapsulated in molding compound. The primary electrical interface is an array of solder balls attached to the substrate opposite the die and molding compound. |
| $T_{case\text{-}nhs}$ | The maximum package case temperature without any package thermal solution. This temperature is measured at the geometric center of the top of the package case. |
| $T_{j\text{-}max}$ | The maximum component temperature specification measured at the hottest point in the processor die. |
| TDP | Thermal Design Power. Thermal solutions should be designed to dissipate this target power level. |
| LFM | Linear Feet Per Minute. A measure of airflow emitted from a forced convection device, such as an axial fan or blower. |

## 1.2 Reference Documents

**Table 2. Reference Documents**

| Document | Document Number / Location |
|---|---|
| Intel® 6300ESB I/O Controller Hub Datasheet | 300641 |
| Thermal Design Suggestions for Various Form Factors | http://www.formfactors.org |

**NOTE:** Unless otherwise noted, these documents are available through your Intel Field Sales representative

# 2.0 Packaging Technology

The Intel 6300ESB ICH component is available in a 37.5 mm square package as shown in Appendix A, "Mechanical Drawings". Package information is also provided in the *Intel® 6300ESB I/O Controller Hub Datasheet*.

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# 3.0 Thermal Specifications

## 3.1 Case Temperature and Thermal Design Power

To ensure proper operation and reliability of the Intel 6300ESB ICH component, the case and junction temperatures must be at or below the values specified in Table 3. System and/or component level thermal solutions are required to maintain the case temperature below the maximum temperature specification while dissipating the thermal design power (TDP) listed in Table 3.

**Table 3. Intel® 6300ESB I/O Controller Hub Thermal Specifications**

| Parameter | Maximum | Notes |
|---|---|---|
| $T_{case-nhs}$ | 105 °C | 1 |
| $T_{j-max}$ | 115 °C | 2 |
| TDP | 3.9 W | |

**NOTES:**
1. $T_{case-nhs}$ is defined as the maximum package case temperature without a thermal solution attached.
2. $T_{j-max}$ is defined as the maximum component temperature specification measured at the hottest point in the processor die.

## 3.2 Case Temperature Metrology

The component case temperature should be measured by attaching a thermocouple to the geometric center of the package case top. Refer to Appendix A, “Mechanical Drawings” for package dimensions.

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# 4.0 Reference Thermal Solution

Based on a component local operating environment of natural convection (zero LFM of airflow) with a maximum local-ambient temperature of 55° C, the Intel 6300ESB ICH component does not require an attached heatsink to meet thermal specifications. For systems where the local-ambient temperature is severe (greater than 55° C, natural convection), a component level thermal solution or system thermal solution improvement may be required. Attaching a heatsink to the package case and/or improving airflow at the component may be potential solutions.

## 4.1 Reliability Requirements

If an attached heatsink is implemented due to a severe component local operating environment, the reliability requirements in Table 4 are recommended. Each motherboard, heatsink, and attach combination may vary the mechanical loading of the component. It is recommended that the user carefully evaluate the reliability of the completed assembly prior to use in high volume.

**Table 4. Reliability Requirements**

| Test[1] | Requirement | Pass/Fail Criteria[2] |
|---|---|---|
| Mechanical Shock | 50g, board level, 11 msec, 3 shocks/axis | Visual check and electrical functional test |
| Random Vibration | 7.3g, board level, 45 min/axis, 50 Hz to 2000 Hz | Visual check and electrical functional test |
| Temperature Life | 85° C, 2000 hours total, checkpoints at 168, 500, 1000, and 2000 hours | Visual check |
| Thermal Cycling | -5° C to +70° C, 500 cycles, ° C/min rise and fall | Visual check |
| Humidity | 85% relative humidity, 55° C, 1000 hours | Visual check |

**NOTES:**
1. The above tests should be performed on a sample size of at least 12 assemblies from 3 lots of material.
2. Additional pass/fail criteria may be added at the discretion of the user.

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# Appendix A Mechanical Drawings

Figure 1 shows the package dimensions for the Intel 6300ESB ICH. Unless otherwise specified, the units in the figure are in millimeters.

## Figure 1. Intel® 6300ESB I/O Controller Hub Package Dimensions