Intel® 82801DB I/O Controller Hub 4 (ICH4)

Design Guide

Intel® 82801DB ICH4 Thermal and Mechanical Design Guidelines

October 2002

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Revision History

Revision	Description	Date
-001	Initial Release.	May 2002
-002	Added minimum temperature to Table 1	October 2002

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1 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 can 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 can be expected to meet specified performance requirements. Operation outside the functional limit can 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® 82801DB ICH4.

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 can 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 ICH4. Properly designed solutions should provide adequate cooling to maintain the ICH4 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 ICH4 at or below those recommended in this document, a system designer can ensure the proper functionality, performance, and reliability of these components.

1.1 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.
Intel® ICH4	I/O Controller Hub 4. The chipset component that contains the primary PCI interface, LPC interface, USB, ATA-33, and other legacy functions.
MBGA	Mini Ball Grid Array. A version of the BGA with a smaller ball pitch.
MCH	Memory Controller Hub. The chipset component that contains the processor interface and the memory interface.
P64H2	Intel® 82870P2 PCI/PCI-X 64-bit Hub 2. The chipset component that interfaces the PCI-X buses.
$T_{case\text{-}nhs}$	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.
$T_{die\text{-}nhs}$	The maximum die temperature without any package thermal solution. This temperature is measured at the geometric center of the top of the package die.
$T_{die\text{-}hs}$	The maximum die temperature with the reference thermal solution attached. This temperature is measured at the geometric center of the top of the package die.
TDP	Thermal Design Power. Thermal solutions should be designed to dissipate this target power level.

1.2 Reference Documents

Document	Document Number / Location
Intel® 82801DB I/O Controller Hub 4 (ICH4) Datasheet	290744
BGA/OLGA Assembly Development Guide	
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 Packaging Technology

The ICH4 component is available in a 31 mm square, 4-layer MBGA package shown in Appendix A (Figure 1). Package information is also provided in the *Intel® 82801DB I/O Controller Hub 4 (ICH4) Datasheet*.

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3 Thermal Specifications

3.1 Case Temperature and Thermal Design Power

To ensure proper operation and reliability of the ICH4 component, the case temperatures must be at or below the value specified in Table 1. System and/or component level thermal solutions are required to maintain the case temperature below the maximum temperature specification. Any thermal solution should be capable of dissipating the TDP listed in Table 1.

Table 1. Intel® ICH4 Thermal Specifications

Parameter	Minimum/Maximum	Notes
$T_{case-nhs}$	110 °C (maximum)	1
$T_{case-nhs}$	0 °C (minimum)	1
TDP	2.2 W	

NOTES:

1. $T_{case-nhs}$ is defined as the maximum package case temperature without any package thermal solution.

3.2 Case Temperature Metrology

The component case temperature should be measured at the geometric center of the package case top. Refer to Appendix A for package dimensions.

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4 Reference Thermal Solution

Based on a component local operating environment of natural convection with a maximum local-ambient temperature of 55 °C, the ICH4 component does not require an attached heatsink to meet thermal specifications. The local-ambient conditions are based on a 35 °C external-ambient temperature at sea level, where external-ambient refers to the environment external to the system. 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 to 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 2 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 2. 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 ICH4. Unless otherwise specified the units in the figure are in millimeters.

Figure 1. Intel® ICH4 Package Dimensions

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NOTES:

1. ALL DIMENSIONS AND TOLERANCES CONFORM TO ANSI Y14.5M-1982.
2. DIMENSION IS MEASURED AT THE MAXIMUM SOLDER BALL DIAMETER, PARALLEL TO PRIMARY DATUM -C-.
3. PRIMARY DATUM -C- AND SEATING PLANE ARE DEFINED BY THE SPHERICAL CROWNS OF THE SOLDER BALLS.
4. ALL DIMENSIONS UNLESS OTHERWISE SPECIFIED ARE IN MILLIMETERS

TOP VIEW: 31.00 ±0.20; 26.00 ±0.25; PIN #1 IDENTIFIER; 16.96 REF; 3 X ø1.00 THRU; 45° CHAMFER 4 PLACES

BOTTOM VIEW: ø 0.90 / 0.60; ø 0.30 S C A S B S; PIN #1 CORNER; 1.27; 1.53 REF

SIDE VIEW: 2.38 ±0.21; 1.17 ±0.05; 30°; 0.61 ±0.06; 0.60 ±0.10; 0.15 C; 0.20; SEATING PLANE

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN MILLIMETERS. TOLERANCE: DECIMALS X ±0.1, XX ±0.05, XXX ±0.030; ANGLES ±1°

intel CORP. 5000 W. CHANDLER BLVD. CHANDLER, ARIZONA 85226

421L BGA CUSTOMER DRAWING 31.00 X 31.00 X 0.61

SIZE D FSCM NO 34649 DRAWING NO 710091 SCALE 4/1 SHEET 1 OF 1