Intel® E8500 Chipset North Bridge (NB) and eXternal Memory Bridge (XMB)

Thermal/Mechanical Design Guide

March 2005

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Revision History

Document Number	Revision Number	Description	Date
306749	001	• Initial release of this document	March 2005

NOTE: Not all revisions may be published.

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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. Typical methods to improve heat dissipation include selective use of ducting, and/or passive heatsinks.

The goals of this document are to:

- Outline the thermal and mechanical operating limits and specifications for the Intel® E8500 chipset North Bridge (NB) component and the Intel® E8500 chipset eXternal Memory Bridge (XMB) component.
- Describe two reference thermal solutions that meet the specification of the E8500 chipset NB component.
- Describe a reference thermal solution that meets the specification of the E8500 chipset XMB component.

Properly designed thermal solutions provide adequate cooling to maintain the E8500 chipset die temperatures at or below thermal specifications. This is accomplished by providing a low local-ambient temperature, ensuring adequate local airflow, and minimizing the die to local-ambient thermal resistance. By maintaining the E8500 chipset die temperature at or below the specified limits, a system designer can ensure the proper functionality, performance, and reliability of the chipset. Operation outside the functional limits can degrade system performance and may cause permanent changes in the operating characteristics of the component.

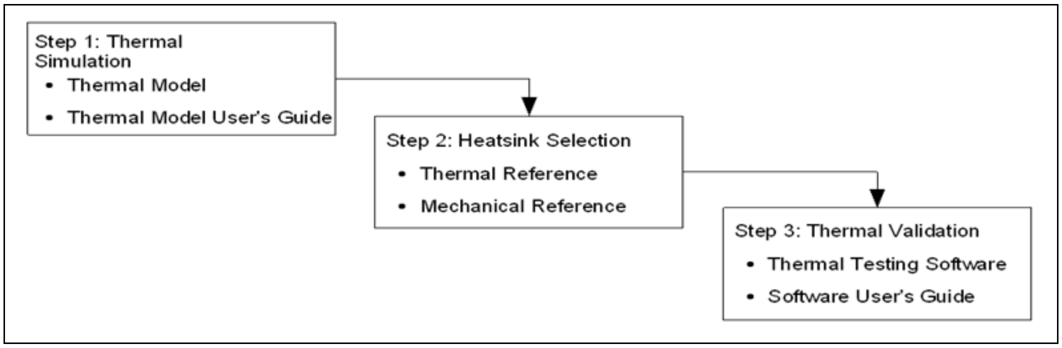
The simplest and most cost effective method to improve the inherent system cooling characteristics is through careful chassis design and placement of fans, vents, and ducts. When additional cooling is required, component thermal solutions may be implemented in conjunction with system thermal solutions.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

This document addresses thermal design and specifications for the E8500 chipset NB and XMB components only. For thermal design information on other chipset components, refer to the respective component datasheet. For the Intel® 6700PXH 64-bit PCI Hub, refer to the *Intel® 6700PXH 64-bit PCI Hub Thermal Design Guidelines*. For the ICH5, refer to the *Intel® 82801EB I/O Controller Hub 5 (ICH5) and Intel® 82801ER I/O Controller Hub 5 R (ICH5R) Thermal Design Guide*.

1.1 Design Flow

To develop a reliable, cost-effective thermal solution, several tools have been provided to the system designer. Figure 1-1 illustrates the design process implicit to this document and the tools appropriate for each step.

Figure 1-1. Thermal Design Process



1.2 Definition of Terms

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.
BLT	Bond line thickness. Final settled thickness of the thermal interface material after installation of heatsink.
ICH5	I/O controller hub. The chipset component that contains the primary PCI interface, LPC interface, USB, S-ATA, and other legacy functions.
IHS	Integrated Heat Spreader, Integral part of the NB package. It enhances dissipation of heat generated by the NB die and provides interface surface between NB die and cooling solution.
IMI	Independent memory Interfaces. Port connecting the NB to the XMB
Intel® 6700PXH 64-bit PCI Hub	The chipset component that performs PCI bridging functions between the PCI Express* interface and the PCI Bus. It contains two PCI bus interfaces that can be independently configured to operate in PCI (33 or 66 MHz) or PCI-X* mode 1 (66, 100 or 133 MHz), for either 32- or 64-bit PCI devices.
T_{case_max}	Maximum die temperature allowed. This temperature is measured at the geometric center of the top of the package die.
T_{case_min}	Minimum die temperature allowed. 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. TDP is not the maximum power that the chipset can dissipate.
TIM	Thermal interface material. Thermally conductive material installed between two surfaces to improve heat transfer and reduce interface contact resistance.
NB	Intel® E8500 chipset North Bridge Component. The chipset component that provides the interconnect to the processors, XMBs and various I/O components.

XMB — Intel® E8500 chipset eXternal Memory Bridge Component. The chipset component that bridges the IMI and DDR interfaces.

1.3 Reference Documents

The reader of this specification should also be familiar with material and concepts presented in the following documents:

- *Intel® 82801EB I/O Controller Hub 5 (ICH5) and Intel® 82801ER I/O Controller Hub 5 R (ICH5R) Thermal Design Guide*
- *Intel® 82801EB I/O Controller Hub 5 (ICH5) and Intel® 82801ER I/O Controller Hub 5 R (ICH5R) Datasheet*
- *Intel® 6700PXH 64-bit PCI Hub Thermal/Mechanical Design Guidelines*
- *Intel® 6700PXH 64-bit PCI Hub Datasheet*
- *Intel® E8500 Chipset North Bridge (NB) Datasheet*
- *Intel® E8500 Chipset North Bridge (NB) Specification Update*
- *Intel® E8500 Chipset eXternal Memory Bridge (XMB) Datasheet*
- *Intel® E8500 Chipset eXternal Memory Bridge (XMB) Specification Update*
- *64-bit Intel® Xeon™ Processor MP with up to 8MB L3 Cache Datasheet*
- *64-bit Intel® Xeon™ Processor MP with up to 8MB L3 Cache Thermal/Mechanical Design Guidelines*
- *64-bit Intel® Xeon™ Processor MP with 1MB L2 Cache Datasheet*
- *64-bit Intel® Xeon™ Processor MP with 1MB L2 Cache Thermal/Mechanical Design Guidelines*
- *BGA/OLGA Assembly Development Guide*
- Various system thermal design suggestions (http://www.formfactors.org)

Note: Unless otherwise specified, these documents are available through your Intel field sales representative. Some documents may not be available at this time.

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2 Packaging Technology

The E8500 chipsets consist of four individual components: the NB, the XMB, the Intel® 6700PXH 64-bit PCI Hub and the I/O controller hub (ICH5r). The E8500 chipset NB component use a 42.5 mm squared, 12-layer flip chip ball grid array (FC-BGA) package (see Figure 2-1 through Figure 2-3). The E8500 chipset XMB component uses a 37.5mm squared, 10-layer FB-BGA package (see Figure 2-4 through Figure 2-6). For information on the Intel 6700PXH 64-bit PCI Hub package, refer to the *Intel® 6700PXH 64-bit PCI Hub Thermal/Mechanical Design Guide*. For information on the ICH5 package, refer to the *Intel® 82801EB I/O Controller Hub 5 (ICH5) and Intel® 82801ER I/O Controller Hub 5 R (ICH5R) Thermal Design Guide*.

Figure 2-1. NB Package Dimensions (Top View)

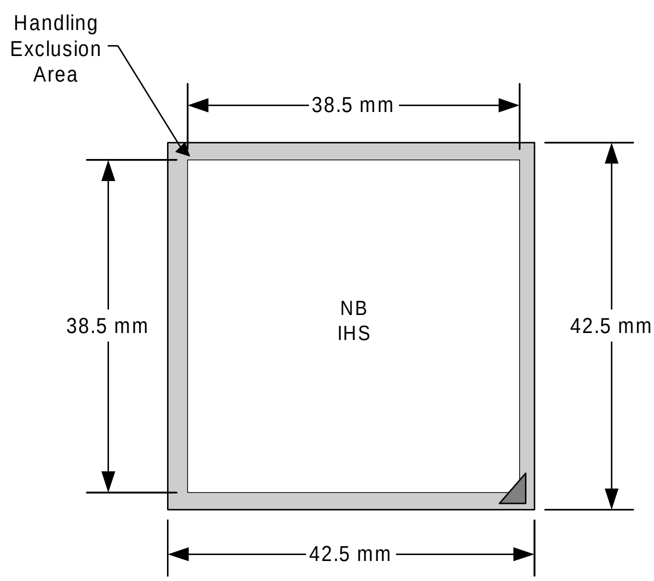
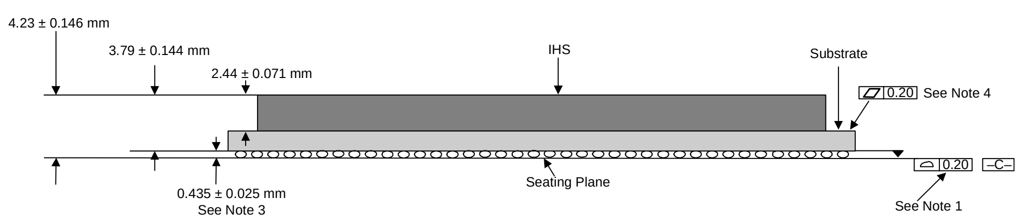
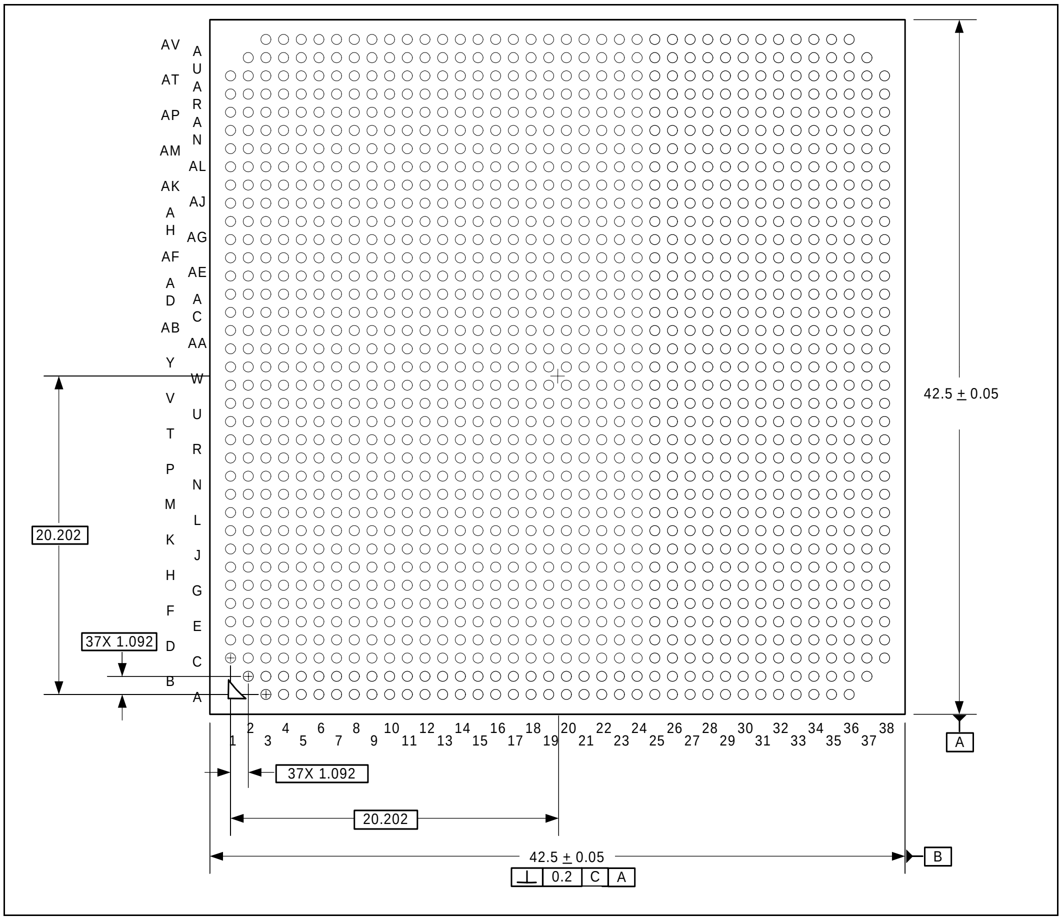


Figure 2-2. NB Package Dimensions (Side View)



Notes:
1. Primary datum -C- and seating plan are defined by the spherical crowns of the solder balls (shown before motherboard attach)
2. All dimensions and tolerances conform to ANSI Y14.5M-1994
3. BGA has a pre-SMT height of 0.5mm and post-SMT height of 0.41-0.46mm
4. Shown before motherboard attach; FCBGA has a convex (dome shaped) orientation before reflow and is expected to have a slightly concave (bowl shaped) orientation after reflow

Figure 2-3. NB Package Dimensions (Bottom View)



NOTES:
1. All dimensions are in millimeters.
2. All dimensions and tolerances conform to ANSI Y14.5M-1994.

Figure 2-4. XMB Package Dimensions (Top View)

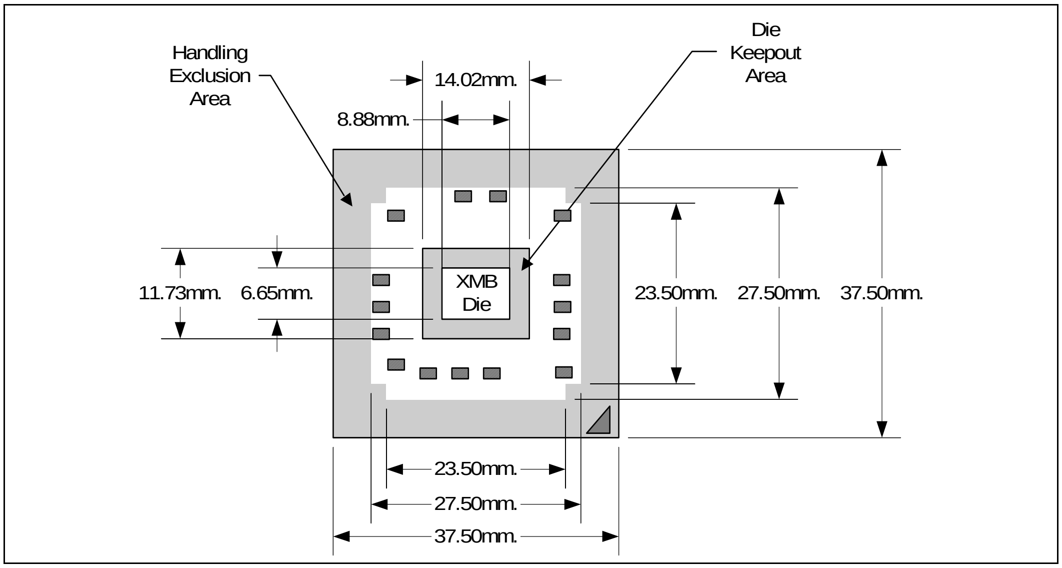
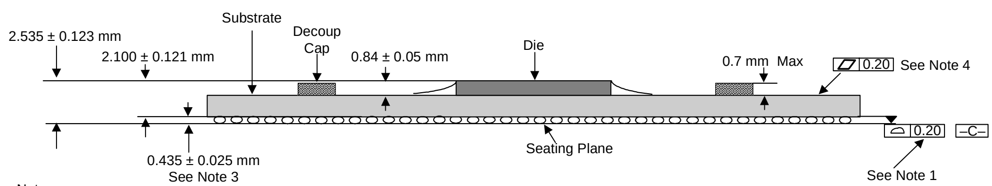
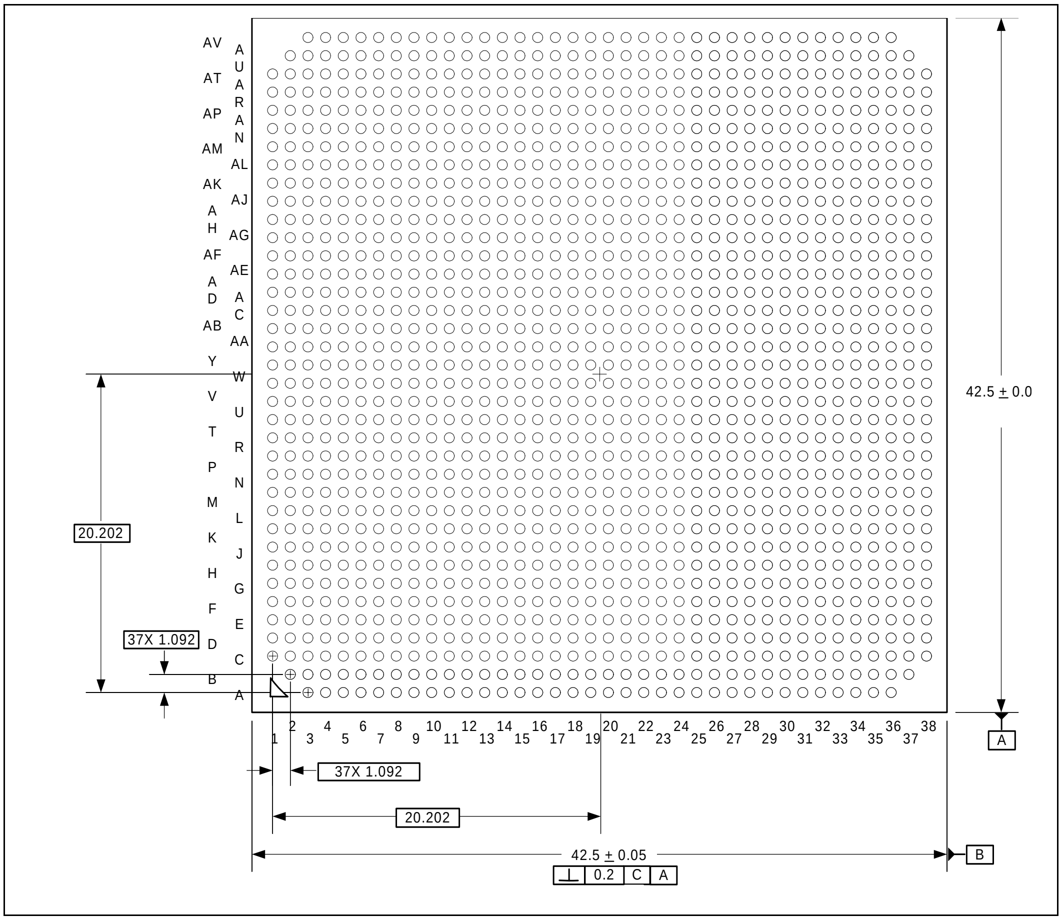


Figure 2-5. XMB Package Dimensions (Side View)



Notes:
1. Primary datum -C- and seating plan are defined by the spherical crowns of the solder balls (shown before motherboard attach)
2. All dimensions and tolerances conform to ANSI Y14.5M-1994
3. BGA has a pre-SMT height of 0.5mm and post-SMT height of 0.41-0.46mm
4. Shown before motherboard attach; FCBGA has a convex (dome shaped) orientation before reflow and is expected to have a slightly concave (bowl shaped) orientation after reflow

Figure 2-6. XMB Package Dimensions (Bottom View)



2.1 Package Mechanical Requirements

The E8500 chipset NB package has an IHS and the XMB package has an exposed bare die which is capable of sustaining a maximum static normal load of 15-lbf. The package is NOT capable of sustaining a dynamic or static compressive load applied to any edge of the bare die. These mechanical load limits must not be exceeded during heatsink installation, mechanical stress testing, standard shipping conditions and/or any other use condition.

Notes:

1. The heatsink attach solutions must not include continuous stress onto the chipset package with the exception of a uniform load to maintain the heatsink-to-package thermal interface.
2. These specifications apply to uniform compressive loading in a direction perpendicular to the bare die/IHS top surface.
3. These specifications are based on limited testing for design characterization. Loading limits are for the package only

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3 Thermal Specifications

3.1 Thermal Design Power (TDP)

Analysis indicates that real applications are unlikely to cause the E8500 chipset NB/XMB components to consume maximum power dissipation for sustained time periods. Therefore, in order to arrive at a more realistic power level for thermal design purposes, Intel characterizes power consumption based on known platform benchmark applications. The resulting power consumption is referred to as the Thermal Design Power (TDP). TDP is the target power level that the thermal solutions should be designed to. TDP is not the maximum power that the chipset can dissipate.

For TDP specifications, see Table 3-1 for the E8500 chipset NB component and Table 3-2 for the E8500 chipset XMB component FC-BGA packages have poor heat transfer capability into the board and have minimal thermal capability without a thermal solution. Intel recommends that system designers plan for one or more heatsinks when using the E8500 chipsets NB/XMB components.

3.2 Die Case Temperature Specifications

To ensure proper operation and reliability of the E8500 chipset NB/XMB components, the die temperatures must be at or between the maximum/minimum operating temperature ranges as specified in Table 3-1 and Table 3-2. System and/or component level thermal solutions are required to maintain these temperature specifications. Refer to Section 5 for guidelines on accurately measuring package die temperatures.

Table 3-1. Intel® E8500 Chipset NB Thermal Specifications

Parameter	Value	Notes
T_{case_max}	104°C	
T_{case_min}	5°C	
$TDP_{with\ 1\ XMB\ attached}$	17.9W	
$TDP_{with\ 2\ XMBs\ attached}$	19.8W	
$TDP_{with\ 3\ XMBs\ attached}$	22.4W	
$TDP_{with\ 4\ XMBs\ attached}$	24.5W	

NOTE:
1. These specifications are based on silicon characterization, however, they may be updated as further data becomes available.

Table 3-2. Intel® E8500 Chipset XMB Thermal Specifications

Parameter	Value	Notes
T_{case_max}	105°C	
T_{case_min}	5°C	
$TDP_{dual\ channel}$	9.1W	DDR-266
$TDP_{dual\ channel}$	9.3W	DDR-333
$TDP_{dual\ channel}$	8.5W	DDR2-400

NOTE:
1. These specifications are based on silicon characterization, however, they may be updated as further data becomes available.

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4 Thermal Simulation

Intel provides thermal simulation models of the E8500 chipset NB/XMB components and associated user's guides to aid system designers in simulating, analyzing, and optimizing their thermal solutions in an integrated, system-level environment. The models are for use with the commercially available Computational Fluid Dynamics (CFD)-based thermal analysis tool FLOTHERM* (version 3.1 or higher) by Flomerics, Inc. These models are also available in ICEPAK* format. Contact your Intel field sales representative to order the thermal models and user's guides.

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5 Thermal Metrology

The system designer must make temperature measurements to accurately determine the thermal performance of the system. Intel has established guidelines for proper techniques to measure the NB/XMB die temperatures. Section 5.1 provides guidelines on how to accurately measure the NB/XMB die temperatures. Section 5.2 contains information on running an application program that will emulate anticipated maximum thermal design power. The flowchart in Figure 5-1 offers useful guidelines for thermal performance and evaluation.

5.1 Die Case Temperature Measurements

To ensure functionality and reliability, the T_{case} of the NB/XMB must be maintained at or between the maximum/minimum operating range of the temperature specification as noted in Table 3-1 and Table 3-2. The surface temperature at the geometric center of the die corresponds to T_{case}. Measuring T_{case} requires special care to ensure an accurate temperature measurement.

Temperature differences between the temperature of a surface and the surrounding local ambient air can introduce errors in the measurements. The measurement errors could be due to a poor thermal contact between the thermocouple junction and the surface of the package, heat loss by radiation and/or convection, conduction through thermocouple leads, and/or contact between the thermocouple cement and the heatsink base (if a heatsink is used). For maximize measurement accuracy, only the 0° thermocouple attach approach is recommended.

Zero Degree Angle Attach Methodology

1. Mill a 3.3 mm (0.13 in.) diameter and 1.5 mm (0.06 in.) deep hole centered on the bottom of the heatsink base.
2. Mill a 1.3 mm (0.05 in.) wide and 0.5 mm (0.02 in.) deep slot from the centered hole to one edge of the heatsink. The slot should be parallel to the heatsink fins (see Figure 5-2).
3. Attach thermal interface material (TIM) to the bottom of the heatsink base.
4. Cut out portions of the TIM to make room for the thermocouple wire and bead. The cutouts should match the slot and hole milled into the heatsink base.
5. Attach a 36 gauge or smaller calibrated K-type thermocouple bead or junction to the center of the top surface of the die using a high thermal conductivity cement. During this step, ensure no contact is present between the thermocouple cement and the heatsink base because any contact will affect the thermocouple reading. **It is critical that the thermocouple bead makes contact with the die** (see Figure 5-3).
6. Attach heatsink assembly to the NB/XMB and route thermocouple wires out through the milled slot.

Figure 5-1. Thermal Solution Decision Flowchart

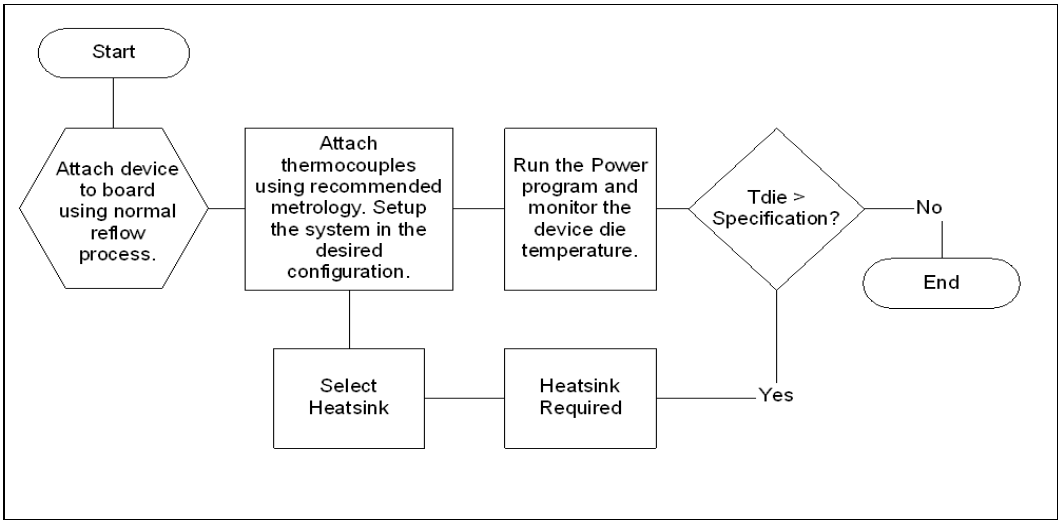

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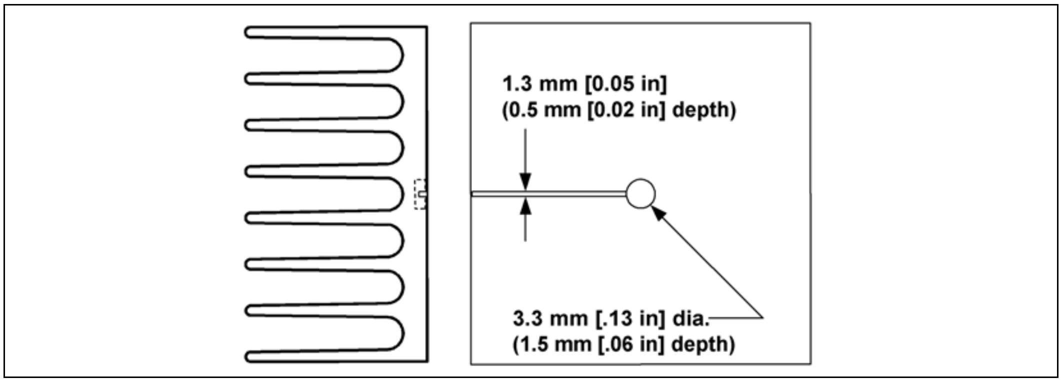
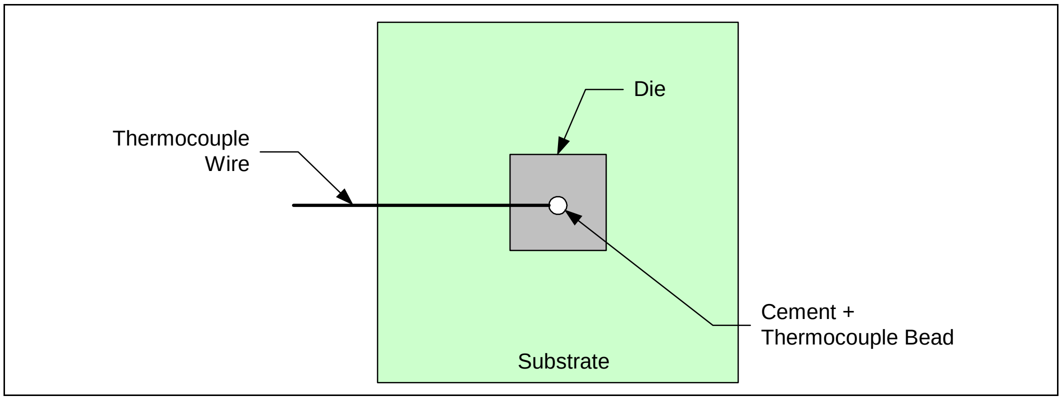
Figure 5-2. Zero Degree Angle Attach Heatsink Modifications



NOTE: Not to scale.

Figure 5-3. Zero Degree Angle Attach Methodology (Top View)



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NOTE: Not to scale.

5.2 Power Simulation Software

The power simulation software is a utility designed to dissipate the thermal design power on an E8500 chipset NB component or XMB component when used in conjunction with the 64-bit Intel® Xeon™ processor MP. The combination of the above mentioned processor and the higher bandwidth capability of the E8500 chipsets enable higher levels of system performance. To assess the thermal performance of the chipset thermal solution under "worst-case realistic application" conditions, Intel is developing a software utility that operates the chipset at near worst-case thermal power dissipation.

The power simulation software being developed should only be used to test thermal solutions at or near the thermal design power. Figure 5-1 shows a decision flowchart for determining thermal solution needs. Real world applications may exceed the thermal design power limit for transient time periods. For power supply current requirements under these transient conditions, please refer to each component's datasheet for the ICC (Max Power Supply Current) specification. Contact your Intel field sales representative to order the power utility software and user's guide.

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6 NB Reference Thermal Solution #1

Intel has developed two different reference thermal solutions designed to meet the cooling needs of the E8500 chipset NB component under operating environments and specifications defined in this document. This chapter describes the overall requirements for the 1st NB reference thermal solution including critical-to-function dimensions, operating environment, and validation criteria. Other chipset components may or may not need attached thermal solutions, depending on your specific system local-ambient operating conditions. For information on the Intel® 6700PXH 64-bit PCI Hub, refer to thermal specification in the *Intel® 6700PXH 64-bit PCI Hub Thermal/Mechanical Design Guide*. For information on the ICH5, refer to thermal specification in the *Intel® 82801EB I/O Controller Hub 5 (ICH5) and Intel® 82801ER I/O Controller Hub 5 R (ICH5R) Thermal Design Guide*.

6.1 Operating Environment

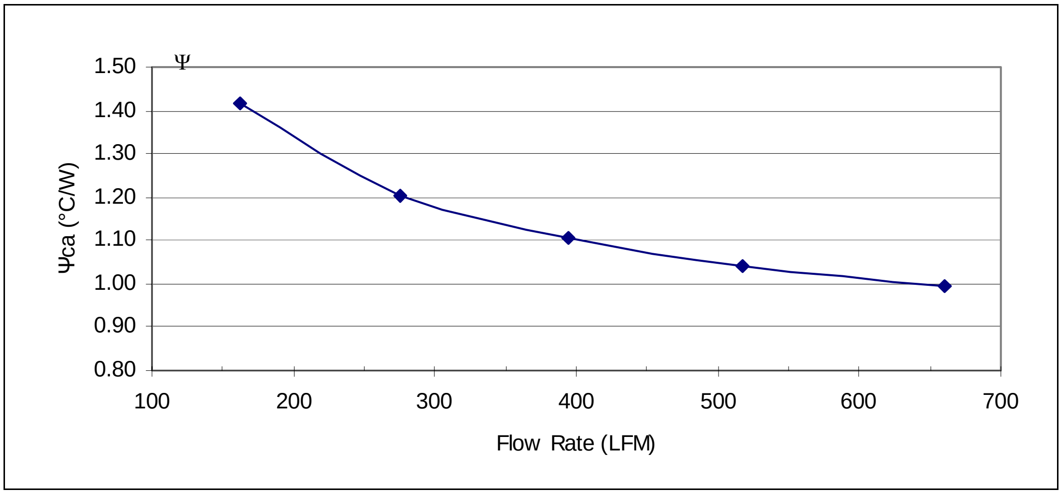
The reference thermal solution was designed assuming a maximum local-ambient temperature of 52°C. The minimum recommended airflow velocity through the cross section of the heatsink fins is 400 linear feet per minute (lfm). The approaching airflow temperature is assumed to be equal to the local-ambient temperature. The thermal designer must carefully select the location to measure airflow to obtain an accurate estimate. These local-ambient conditions are based on a 35°C external-ambient temperature at sea level. (External-ambient refers to the environment external to the system.)

The fasteners associated for this reference thermal solution is intended to be used on 0.062” thickness motherboard

6.2 Heatsink Performance

Figure 6-1 depicts the measured thermal performance of the 1st NB reference thermal solution versus approach air velocity. Since this data was measured at sea level, a correction factor would be required to estimate thermal performance at other altitudes.

Figure 6-1. First NB Reference Heatsink Measured Thermal Performance vs. Approach Velocity

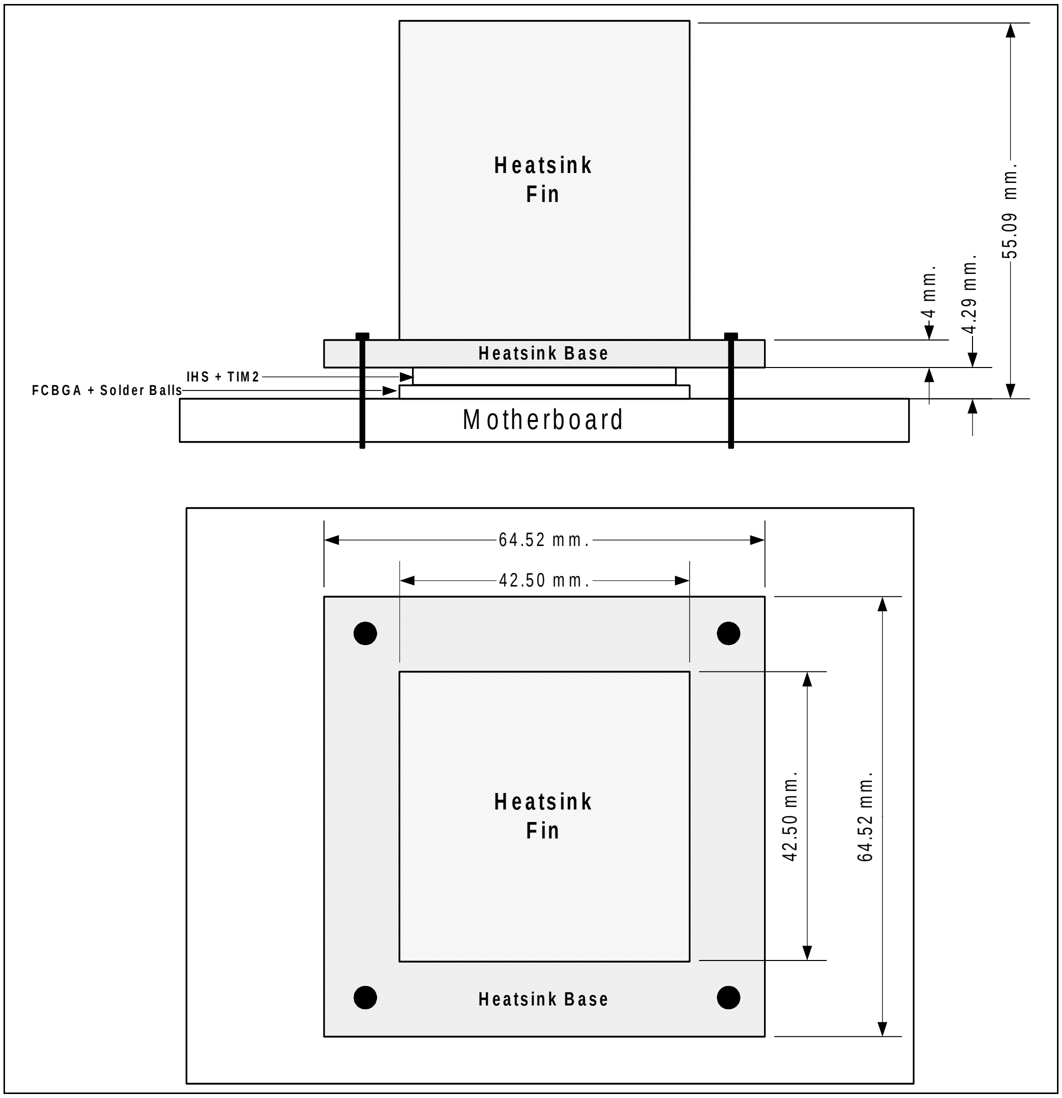


6.3 Mechanical Design Envelope

While each design may have unique mechanical volume and height restrictions or implementation requirements, the height, width, and depth constraints typically placed on the E8500 chipset NB thermal solution are shown in Figure 6-2.

When using heatsinks that extend beyond the NB reference heatsink envelope shown in Figure 6-2, any motherboard components placed between the heatsink and motherboard cannot exceed 4.14 mm (0.16 in.) in height.

Figure 6-2. First NB Reference Heatsink Volumetric Envelope



6.4 Board-Level Components Keepout Dimensions

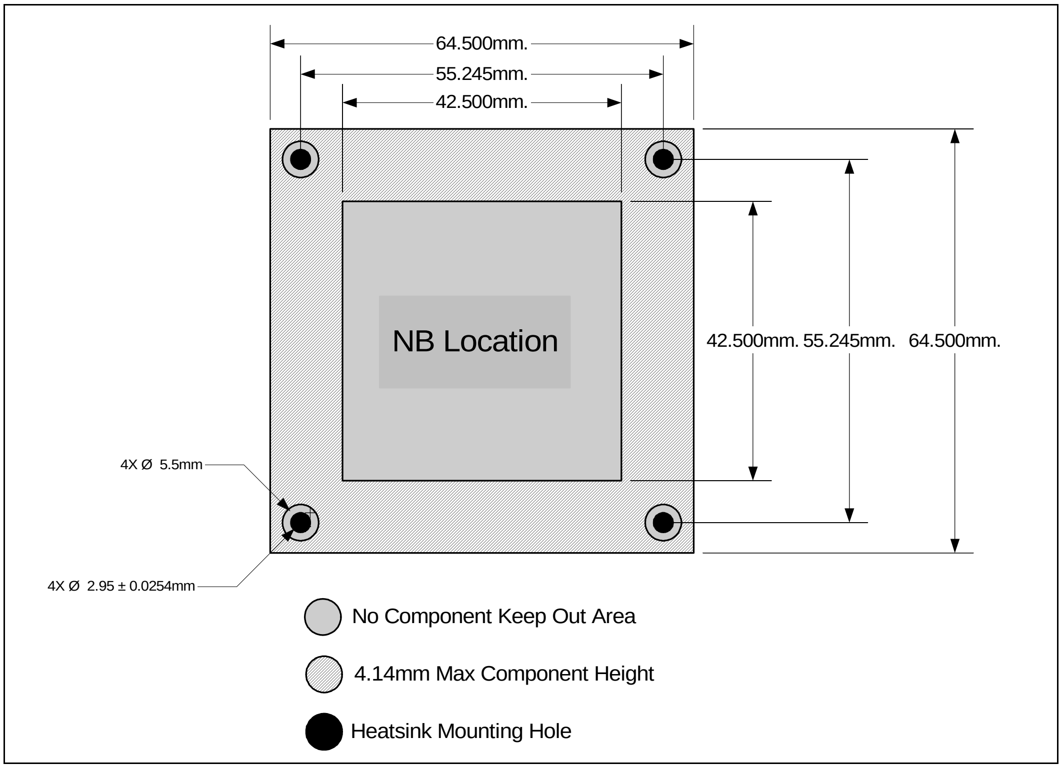
The location of hole pattern and keepout zones for the reference thermal solution are shown in Figure 6-3.

6.5 First NB Heatsink Thermal Solution Assembly

The reference thermal solution for the chipset NB component is a passive extruded heatsink with thermal interface. It is attached to the board by using four retaining Tuflok* fasteners. Figure 6-4 shows the reference thermal solution assembly and associated components.

Full mechanical drawings of the thermal solution assembly and the heatsink are provided in Appendix B. Appendix A contains vendor information for each thermal solution component.

Figure 6-3. First NB Heatsink Board Component Keepout

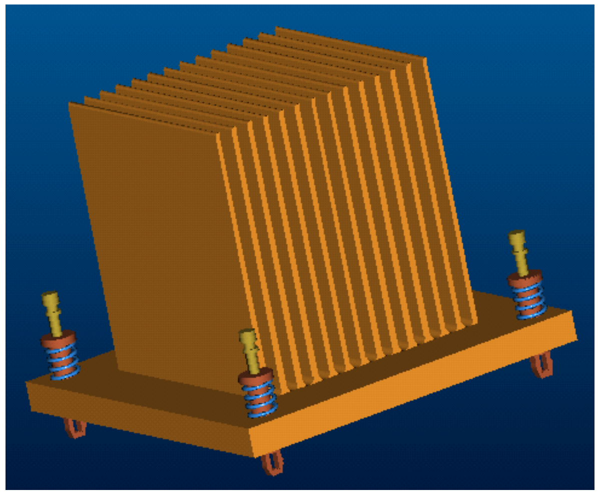


NOTE: All dimensions are in millimeters.

6.5.1 Heatsink Orientation

Since this solution is based on a unidirectional heatsink, mean airflow direction must be aligned with the direction of the heatsink fins.

Figure 6-4. First NB Heatsink Assembly



6.5.2 Extruded Heatsink Profiles

The reference NB thermal solution uses an extruded heatsink for cooling the chipset NB. Figure 6-5 shows the heatsink profile. Appendix A lists a supplier for this extruded heatsink. Other heatsinks with similar dimensions and increased thermal performance may be available. Full mechanical drawing of this heatsink is provided in Appendix B.

6.5.3 Mechanical Interface Material

There is no mechanical interface material associated with this reference solution.

6.5.4 Thermal Interface Material

A TIM provides improved conductivity between the die and heatsink. The reference thermal solution uses Chomerics THERMFLOW* T710, 0.127 mm (0.005 in.) thick, 38.5 mm x 38.5 mm (1.5 in. x 1.5 in.) square.

Note: Unflowed or “dry” Chomerics THERMFLOW T710 has a material thickness of 0.005 inch. The flowed or “wet” Chomerics THERMFLOW T710 has a material thickness of ~0.0025 inch after it reaches its phase change temperature.

6.5.4.1 Effect of Pressure on TIM Performance

As mechanical pressure increases on the TIM, the thermal resistance of the TIM decreases. This phenomenon is due to the decrease of the bond line thickness (BLT). BLT is the final settled thickness of the thermal interface material after installation of heatsink. The effect of pressure on the thermal resistance of the Chomerics THERMFLOW T710 TIM is shown in Table 6-1 The heatsink clip provides enough pressure for the TIM to achieve a thermal conductivity of 0.17°C inch^2/W.

Table 6-1. Chomerics THERMFLOW* T710 TIM Performance as a Function of Attach Pressure

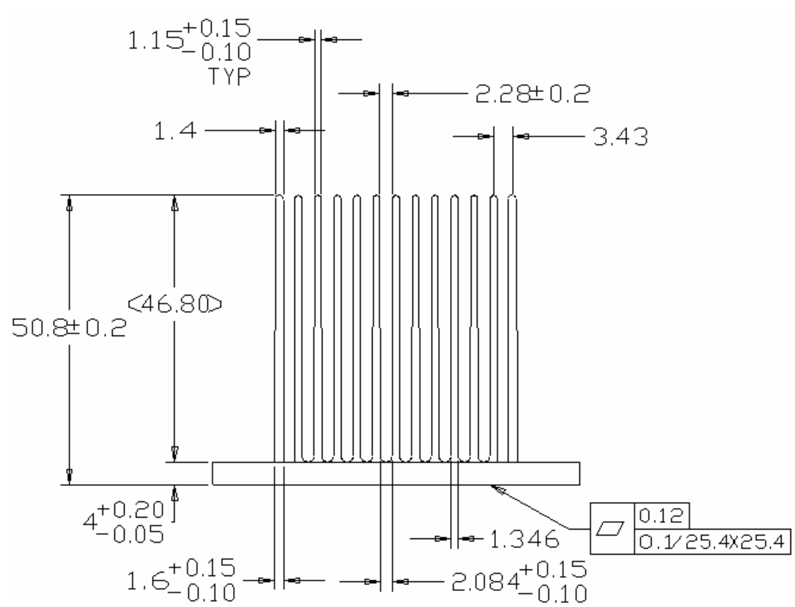
Pressure (psi)	Thermal Resistance (°C × in^2)/W
5	0.37
10	0.30
20	0.21
30	0.17

NOTE:
1. All measured at 50°C.

6.5.5 Heatsink Retaining Fastener

The reference solution uses four heatsink retaining Tufloks. The fasteners attach the heatsink to the motherboard by expanding its Tuflok prong to snap into each of the four heatsink mounting holes. These fasteners are intended to be used on a 0.062" thickness motherboard with either of the two NB reference thermal solutions. See Appendix B for a mechanical drawing of the fastener.

Figure 6-5. First NB Heatsink Extrusion Profile



6.6 Reliability Guidelines

Each motherboard, heatsink and attach combination may vary the mechanical loading of the component. Based on the end user environment, the user should define the appropriate reliability test criteria and carefully evaluate the completed assembly prior to use in high volume. Some general recommendations are shown in Table 6-2.

Table 6-2. Reliability Guidelines

Test (1)	Requirement	Pass/Fail Criteria (2)
Mechanical Shock	50 g, board level, 11 msec, 3 shocks/axis	Visual Check and Electrical Functional Test
Random Vibration	7.3 g, 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	Visual Check
Humidity	85% relative humidity, 55°C, 1000 hours	Visual Check

NOTES:
1. It is recommended that the above tests be performed on a sample size of at least twelve assemblies from three lots of material.
2. Additional pass/fail criteria may be added at the discretion of the user.

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7 NB Reference Thermal Solution #2

Intel has developed two different reference thermal solutions designed to meet the cooling needs of the E8500 chipset NB component under operating environments and specifications defined in this document. This chapter describes the overall requirements for the 2nd NB reference thermal solution including critical-to-function dimensions, operating environment, and validation criteria. Other chipset components may or may not need attached thermal solutions, depending on your specific system local-ambient operating conditions. For information on the Intel® 6700PXH 64-bit PCI Hub, refer to thermal specification in the *Intel® 6700PXH 64-bit PCI Hub Thermal/Mechanical Design Guidelines*. For information on the ICH5, refer to thermal specification in the *Intel® 82801EB I/O Controller Hub 5 (ICH5) and Intel® 82801ER I/O Controller Hub 5 R (ICH5R) Thermal Design Guide*.

7.1 Operating Environment

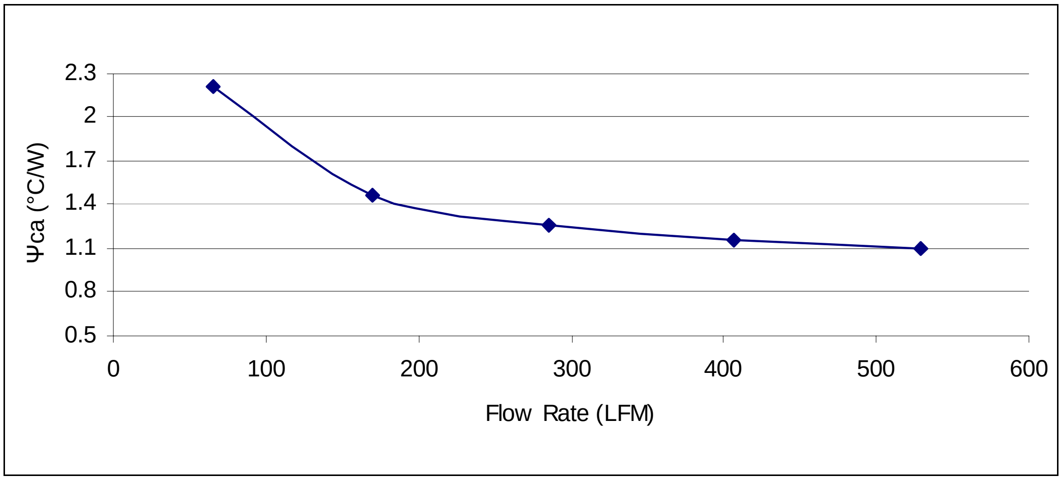
The reference thermal solution was designed assuming a maximum local-ambient temperature of 52°C. The minimum recommended airflow velocity through the cross section of the heatsink fins is 400 linear feet per minutes (lfm). The approaching airflow temperature is assumed to be equal to the local-ambient temperature. The thermal designer must carefully select the location to measure airflow to obtain an accurate estimate. These local-ambient conditions are based on a 35°C external-ambient temperature at sea level. (External-ambient refers to the environmental external to the system.)

The fastener for this reference thermal solution is intended to be used on motherboard with thickness between 0.085” and 0.093”.

7.2 Heatsink Performance

Figure 7-1 depicts the measured thermal performance of the 2nd NB reference thermal solution versus approach air velocity. Since this data was measured at sea level, a correction factor would be required to estimate thermal performance at other altitudes.

Figure 7-1. Second NB Reference Heatsink Measured Thermal Performance vs. Approach Velocity

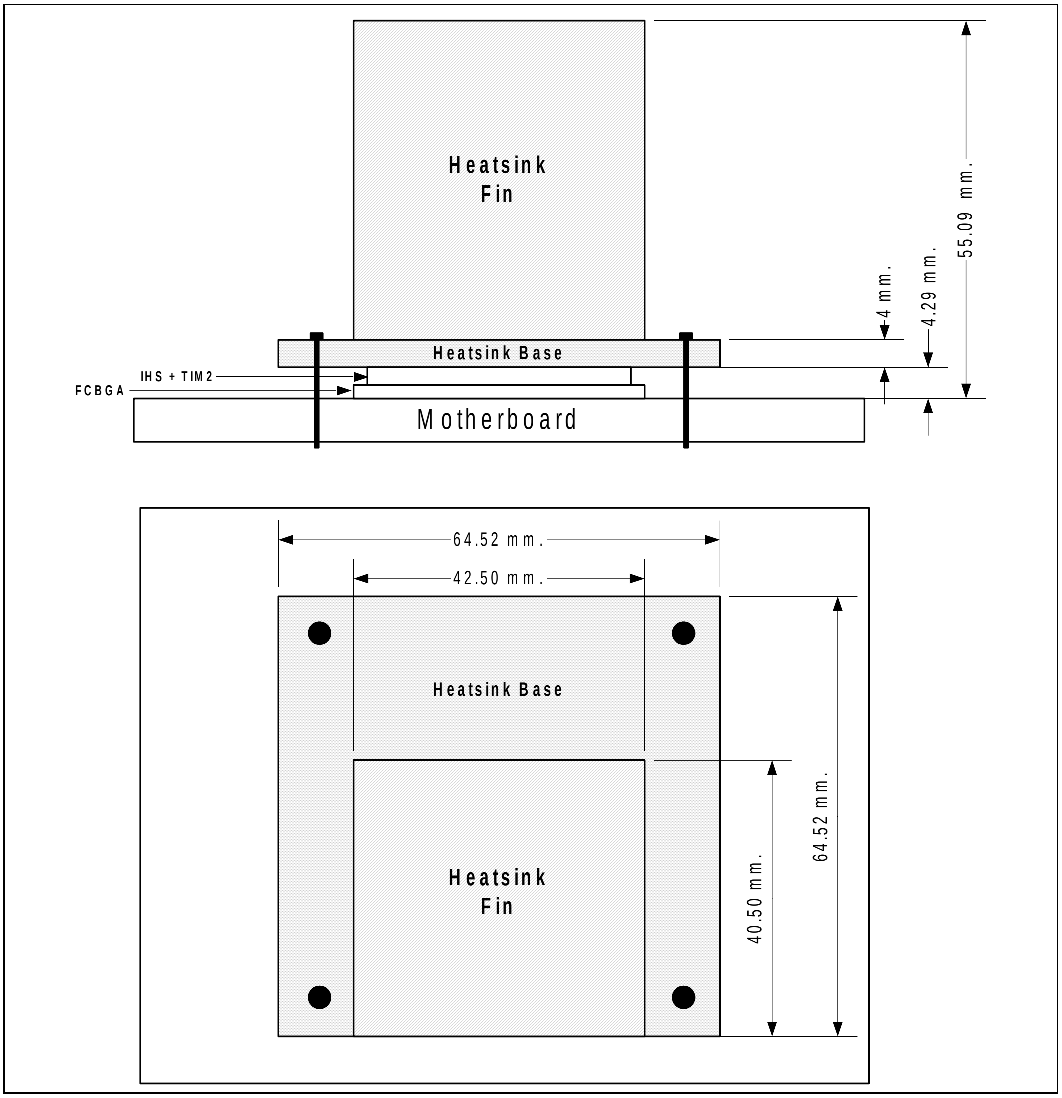


7.3 Mechanical Design Envelope

While each design may have unique mechanical volume and height restrictions or implementation requirements, the height, width, and depth constraints typically placed on the E8500 chipset NB thermal solution are shown in Figure 7-2.

When using heatsinks that extend beyond the NB reference heatsink envelope shown in Figure 7-2, any motherboard components placed between the heatsink and motherboard cannot exceed 4.14 mm (0.16 in.) in height.

Figure 7-2. Second NB Reference Heatsink Volumetric Envelope



7.4 Board-Level Components Keepout Dimensions

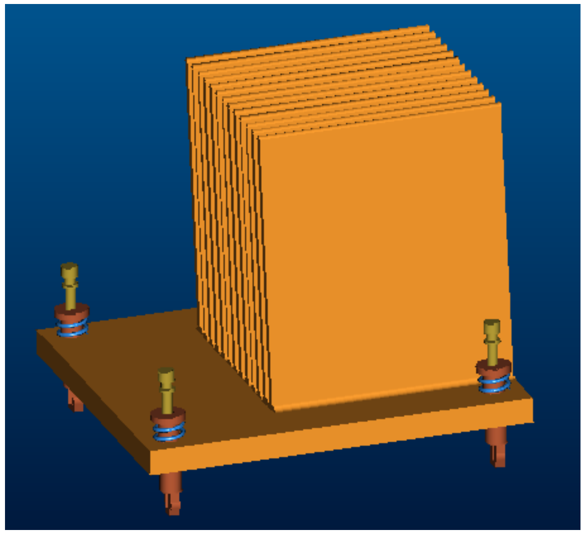
Please refer to Section 6.4 for detail.

7.5 Second NB Heatsink Thermal Solution Assembly

The reference thermal solution for the chipset NB component is a passive extruded heatsink with thermal interlace. It is attached to the board by using four retaining Tuflok fasteners. Figure 7-3 shows the reference thermal solution assembly and associated components.

Full mechanical drawings of the thermal solution assembly and the heatsink are provided in Appendix B. Appendix A contains vendor information for each thermal solution component.

Figure 7-3. Second NB Heatsink Assembly



7.5.1 Heatsink Orientation

Since this solution is based on a unidirectional heatsink, mean airflow direction must be aligned with the direction of the heatsink fins.

7.5.2 Extruded Heatsink Profiles

Please refer to Section 6.5.2 for detail.

7.5.3 Mechanical Interface Material

There is no mechanical interface material associated with this reference solution.

7.5.4 Thermal Interface Material

Please refer to Section 6.5.4 for detail.

7.5.4.1 Effect of Pressure on TIM Performance

Please refer to Section 6.5.4.1 for detail.

7.5.5 Heatsink Retaining Fastener

The reference solution uses four heatsink retaining Tufloks. The fasteners attached the heatsink to the motherboard by expanding its Tuflok prong to snap into each of the four heatsink mounting holes. These fasteners are intended to be used on 0.085” to 0.093” thickness motherboard with either of the two NB reference thermal solutions. See Appendix B for a mechanical drawing of the fastener.

7.6 Reliability Guidelines

Please refer to Section 6.6 for detail.

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8 XMB Reference Thermal Solution

Intel has developed one different reference thermal solution designed to meet the cooling needs of the E8500 chipset XMB component under operating environments and specifications defined in this document. This chapter describes the overall requirements for the XMB reference thermal solution including critical-to-function dimensions, operating environment, and validation criteria. Other chipset components may or may not need attached thermal solutions, depending on your specific system local-ambient operating conditions. For information on the Intel® 6700PXH 64-bit PCI Hub, refer to thermal specification in the *Intel® 6700PXH 64-bit PCI Hub Thermal/Mechanical Design Guide*. For information on the ICH5, refer to thermal specification in the *Intel® 82801EB I/O Controller Hub 5 (ICH5) and Intel® 82801ER I/O Controller Hub 5 R (ICH5R) Thermal Design Guide.*

8.1 Operating Environment

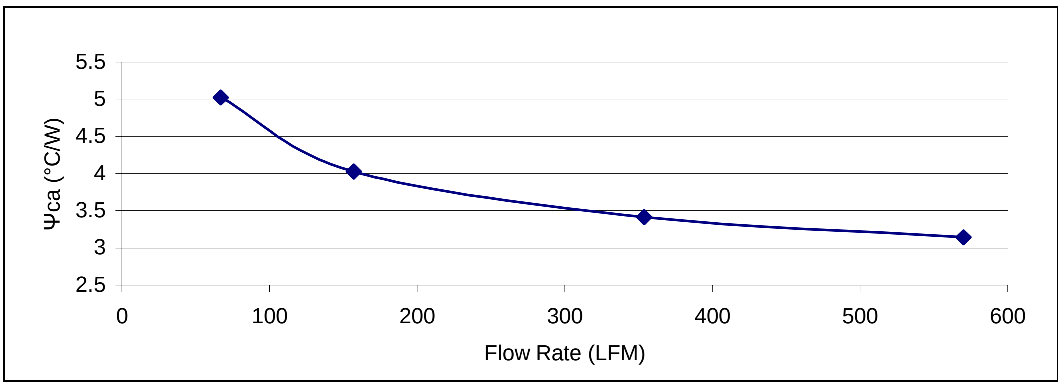
The reference thermal solution was designed assuming a maximum local-ambient temperature of 57°C. The minimum recommended airflow velocity through the cross section of the heatsink fins is 300 linear feet per minute (lfm). The approaching airflow temperature is assumed to be equal to the local-ambient temperature. The thermal designer must carefully select the location to measure airflow to obtain an accurate estimate. These local-ambient conditions are based on a 35°C external-ambient temperature at sea level. (External-ambient refers to the environment external to the system.)

The fasteners associated for this reference thermal solution is intended to be used on 0.062” thickness motherboard.

8.2 Heatsink Performance

Figure 8-1 depicts the measured thermal performance of the XMB reference thermal solution versus approach air velocity. Since this data was measured at sea level, a correction factor would be required to estimate thermal performance at other altitudes.

Figure 8-1. XMB Reference Heatsink Measured Thermal Performance vs. Approach Velocity

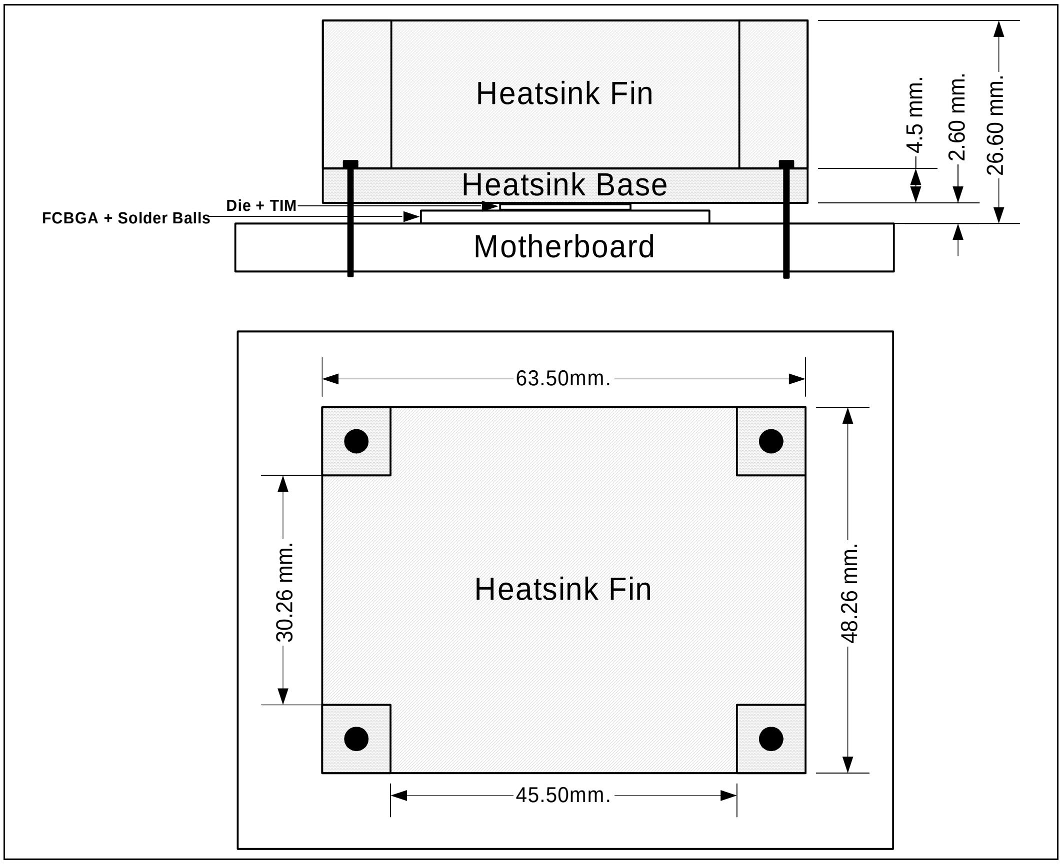


8.3 Mechanical Design Envelope

While each design may have unique mechanical volume and height restrictions or implementation requirements, the height, width and depth constraints typically placed on the E8500 chipset XMB thermal solution are showing in Figure 8-2.

When using heatsinks that extend beyond the XMB reference heatsink envelope shown in Figure 8-2, any motherboard components placed between the heatsink and motherboard cannot exceed 2.48 mm (0.10 in.) in height.

Figure 8-2. XMB Reference Heatsink Volumetric Envelope



8.4 Board-Level Components Keepout Dimensions

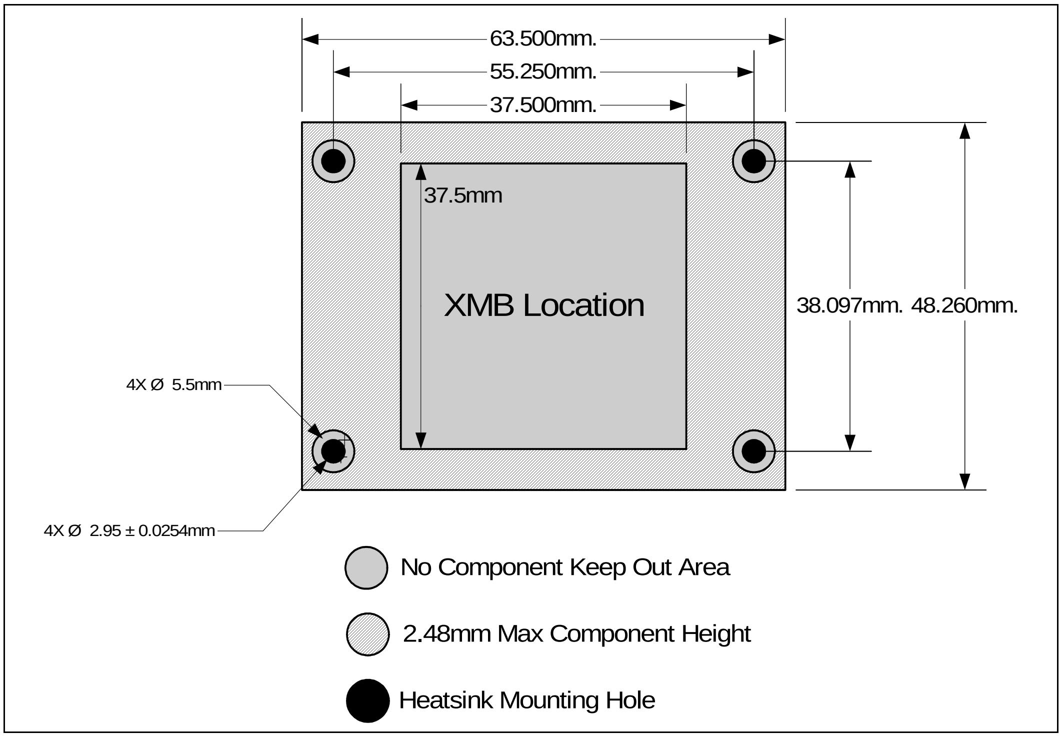
The locations of holes pattern and keepout zones for the reference thermal solution are shown in Figure 8-3.

8.5 XMB Heatsink Thermal Solution Assembly

The reference thermal solution for the chipset XMB component is a passive extruded heatsink with thermal interface. It is attached to the board by using four retaining Tuflok fasteners. Figure 8-4 shows the reference thermal solution assembly and associated components.

Full mechanical drawings of the thermal solution assembly and the heatsink are provided in Appendix B. Appendix A contains vendor information for each thermal solution component.

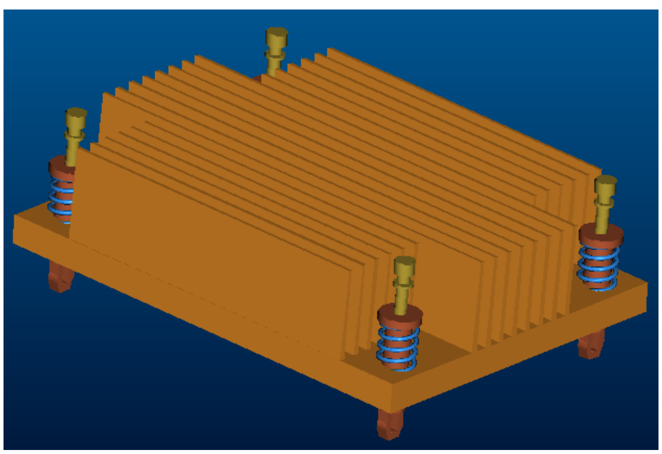
Figure 8-3. XMB Heatsink Board Component Keepout



8.5.1 Heatsink Orientation

Since this solution is based on a unidirectional heatsink, mean airflow direction must be aligned with the direction of the heatsink fins.

Figure 8-4. XMB Heatsink Assembly



8.5.2 Extruded Heatsink Profiles

The reference XMB thermal solution uses an extruded heatsink for cooling the chipset XMB. Figure 8-5 shows the heatsink profile. Appendix A lists a supplier for this extruded heatsink. Other heatsinks with similar dimensions and increased thermal performance may be available. A full mechanical drawing of this heatsink is provided in Appendix B.

8.5.3 Mechanical Interface Material

There is no mechanical interface material associated with this reference solution.

8.5.4 Thermal Interface Material

A TIM provides improved conductivity between the die and the heatsink. The reference thermal solution uses Chomerics THERMFLOW T710, 0.127 mm (0.005 in.) thick, 17.8 mm x 17.8 mm (0.7 in. x 0.7 in.) square.

Note: Unflowed or “dry” Chomerics THERMFLOW T710 has a material thickness of 0.005 inch. The flowed or “wet” Chomerics THERMFLOW T710 has a material thickness of ~0.0025 inch after it reaches its phase change temperature.

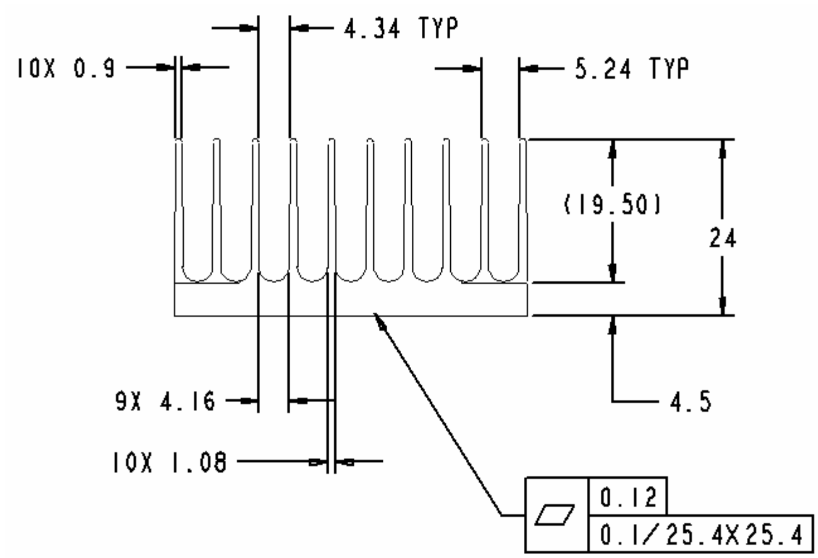
8.5.4.1 Effect of Pressure on TIM Performance

Please refer to Section 6.5.4.1 for detail.

8.5.5 Heatsink Retaining Fastener

The reference solution uses four heatsink retaining Tufloks. The fasteners attached the heatsink to the motherboard by expanding its Tuflok prong to snap into each of the four heatsink mounting hole. These fasteners are intended to be used on a 0.062” thickness motherboard. See Appendix B for a mechanical drawing of the fastener.

Figure 8-5. XMB Heatsink Extrusion Profile



8.6 Reliability Guidelines

Please refer to Section 6.6 for detail.

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A Thermal Solution Component Suppliers

Table A-1. NB Heatsink Thermal Solution #1

Part	Intel Part Number	Supplier (Part Number)	Contact Information
Heatsink Assembly includes: • Unidirectional Fin Heatsink • Thermal Interface Material • Retaining Fastener	C23120-001	CCI/ACK	Harry Lin (USA) 714-739-5797 hlinack@aol.com Monica Chih (Taiwan) 866-2-29952666, x131 monica_chih@ccic.com.tw
Unidirectional Fin Heatsink (64.52 x 64.52 x 50.8 mm)	C19221-001	CCI/ACK	Harry Lin (USA) 714-739-5797 hlinack@aol.com Monica Chih (Taiwan) 866-2-29952666, x131 monica_chih@ccic.com.tw
Thermal Interface (T710)	689850-001	Chomerics (69-12-21937-T710)	Todd Sousa (USA) 360-606-8171 tsousa@parker.com
Retaining Fastener	-	ITW Fastex* (8034-00-9909)	Ron Schmidt (USA) 847-299-2222 rschmidt@itwfastex.com Henry Lu (Taiwan) (886) 7-811-9206 Ext. 10 henry@mail.itwasia.com.tw

Table A-2. NB Heatsink Thermal Solution #2

Part	Intel Part Number	Supplier (Part Number)	Contact Information
Heatsink Assembly includes: • Unidirectional Fin Heatsink • Thermal Interface Material • Retaining Fastener	C44148-001	CCI/ACK	Harry Lin (USA) 714-739-5797 hlinack@aol.com Monica Chih (Taiwan) 866-2-29952666, x131 monica_chih@ccic.com.tw
Unidirectional Fin Heatsink (64.52 x 64.52 x 50.8 mm)	C44147-001	CCI/ACK	Harry Lin (USA) 714-739-5797 hlinack@aol.com Monica Chih (Taiwan) 866-2-29952666, x131 monica_chih@ccic.com.tw
Thermal Interface (T710)	689850-001	Chomerics (69-12-21937-T710)	Todd Sousa (USA) 360-606-8171 tsousa@parker.com
Retaining Fastener	-	ITW Fastex* (8047-00-9909)	Ron Schmidt (USA) 847-299-2222 rschmidt@itwfastex.com Henry Lu (Taiwan) (886) 7-811-9206 Ext. 10 henry@mail.itwasia.com.tw

Table A-3. XMB Heatsink Thermal Solution

Part	Intel Part Number	Supplier (Part Number)	Contact Information
Heatsink Assembly includes: • Unidirectional Fin Heatsink • Thermal Interface Material • Retaining Fastener	C23124-001	CCI/ACK	Harry Lin (USA) 714-739-5797 hlinack@aol.com Monica Chih (Taiwan) 866-2-29952666, x131 monica_chih@ccic.com.tw
Unidirectional Fin Heatsink (64.52 x 64.52 x 50.8 mm)	C19222-001	CCI/ACK	Harry Lin (USA) 714-739-5797 hlinack@aol.com Monica Chih (Taiwan) 866-2-29952666, x131 monica_chih@ccic.com.tw
Thermal Interface (T-710)	689850-001	Chomerics (69-12-22000-T710)	Todd Sousa (USA) 360-606-8171 tsousa@parker.com

Table A-3. XMB Heatsink Thermal Solution

Retaining Fastener	-	ITW Fastex* (8034-00-9909)	Ron Schmidt (USA) 847-299-2222 rschmidt@itwfastex.com Henry Lu (Taiwan) (886) 7-811-9206 Ext. 10 henry@mail.itwasia.com.tw

Note: The enabled components may not be currently available from all suppliers. Contact the supplier directly to verify time of component availability.

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B Mechanical Drawings

Table B-1. Mechanical Drawing List

Drawing Description	Figure Number
NB Heatsink #1 Assembly Drawing	Figure B-1
NB Heatsink #1 Drawing	Figure B-2
NB Heatsink #2 Assembly Drawing	Figure B-3
NB Heatsink #2 Drawing	Figure B-4
XMB Heatsink Assembly Drawing	Figure B-5
XMB Heatsink Drawing	Figure B-6

Figure B-1. NB Heatsink #1 Assembly Drawing

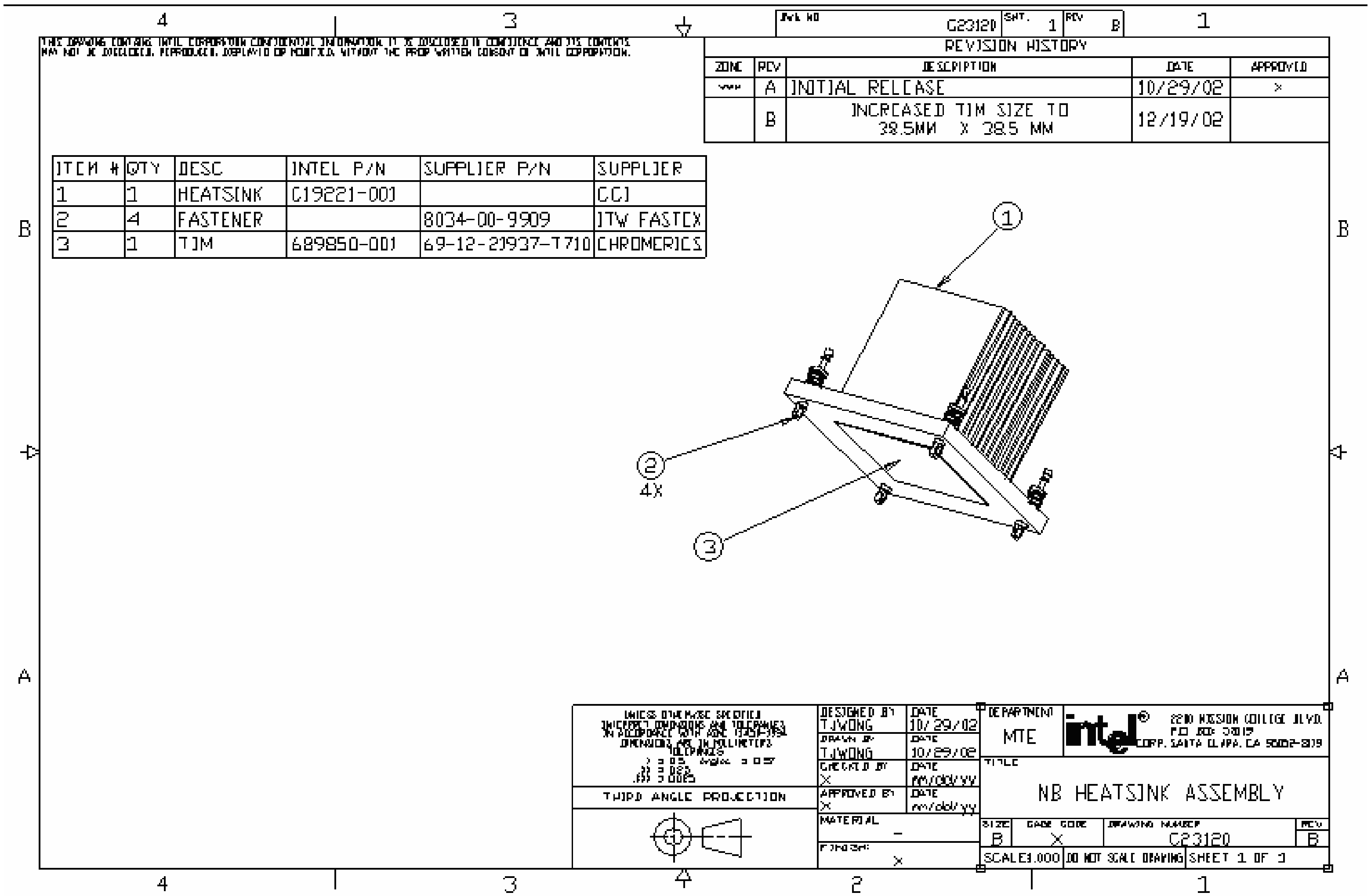


Figure B-2. NB Heatsink #1 Drawing

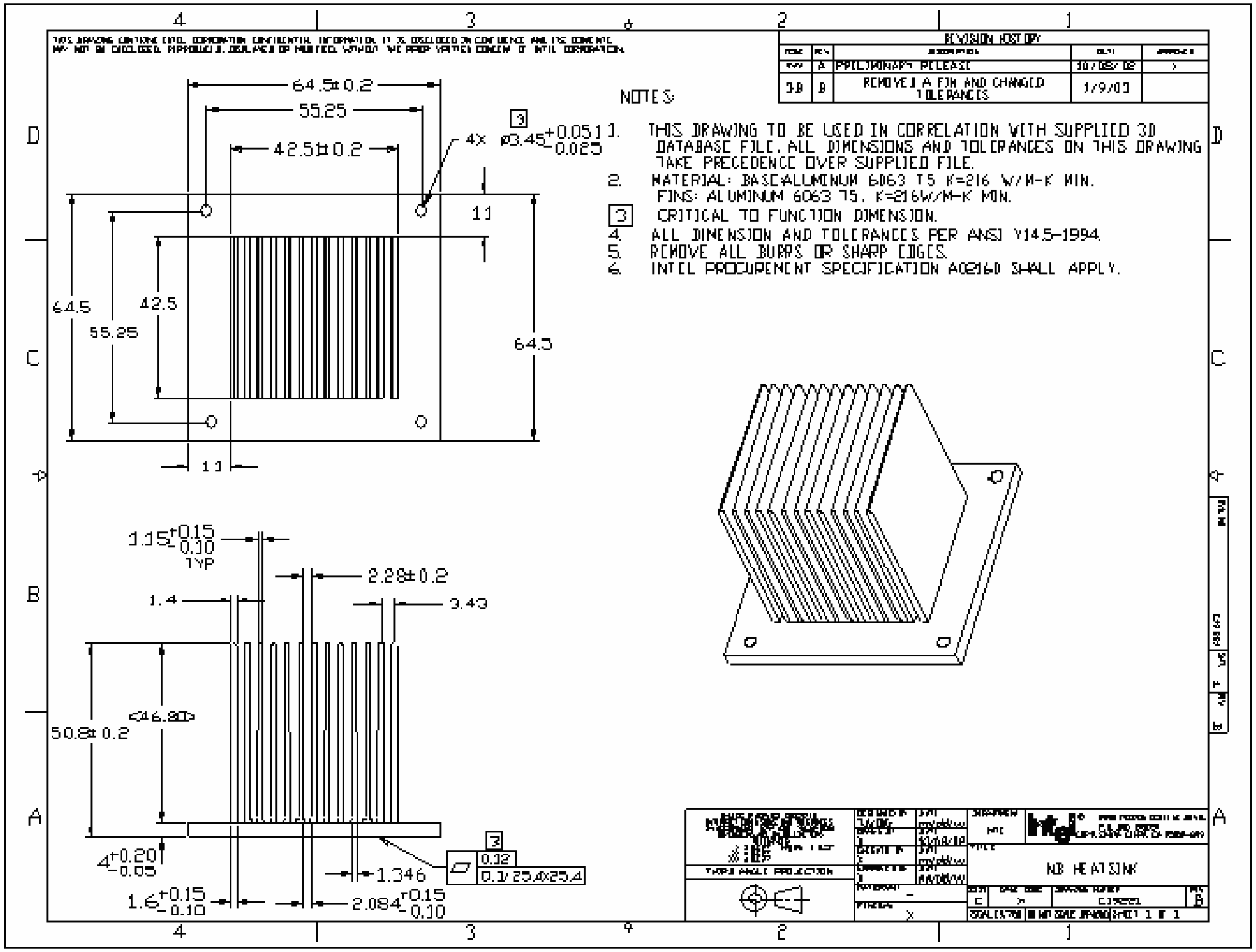


Figure B-3. NB Heatsink #2 Assembly Drawing

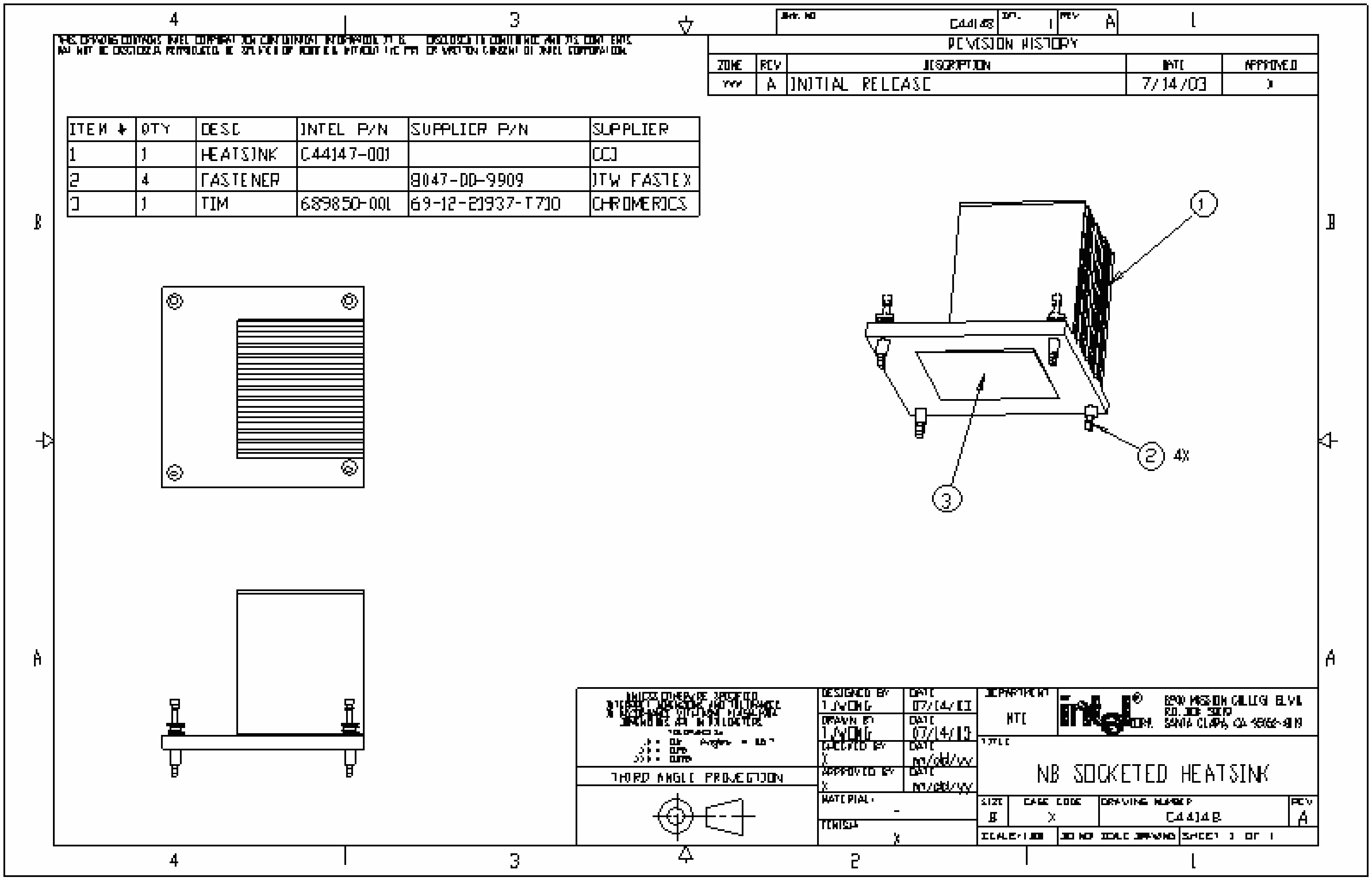


Figure B-4. NB Heatsink #2 Drawing

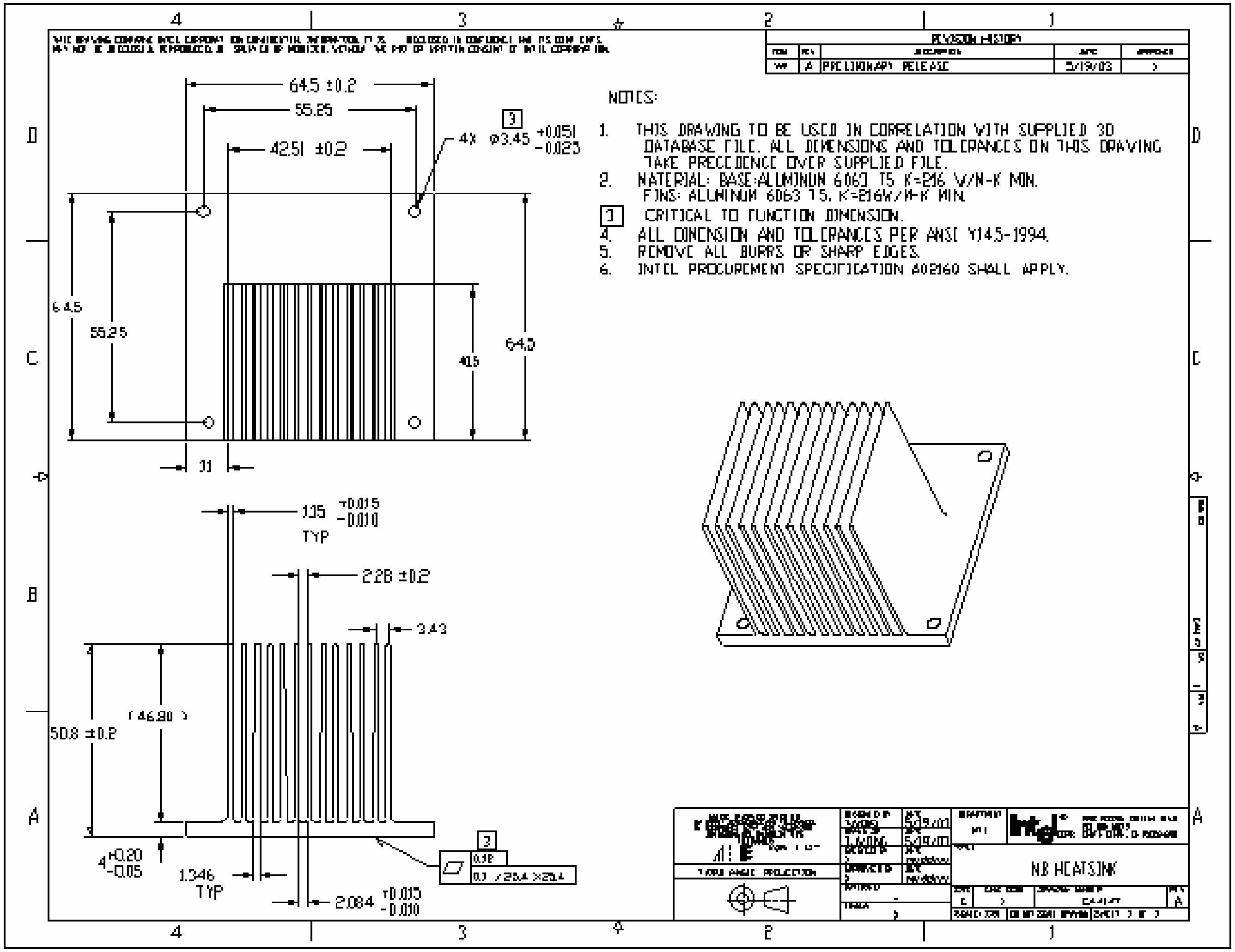


Figure B-5. XMB Heatsink Assembly Drawing

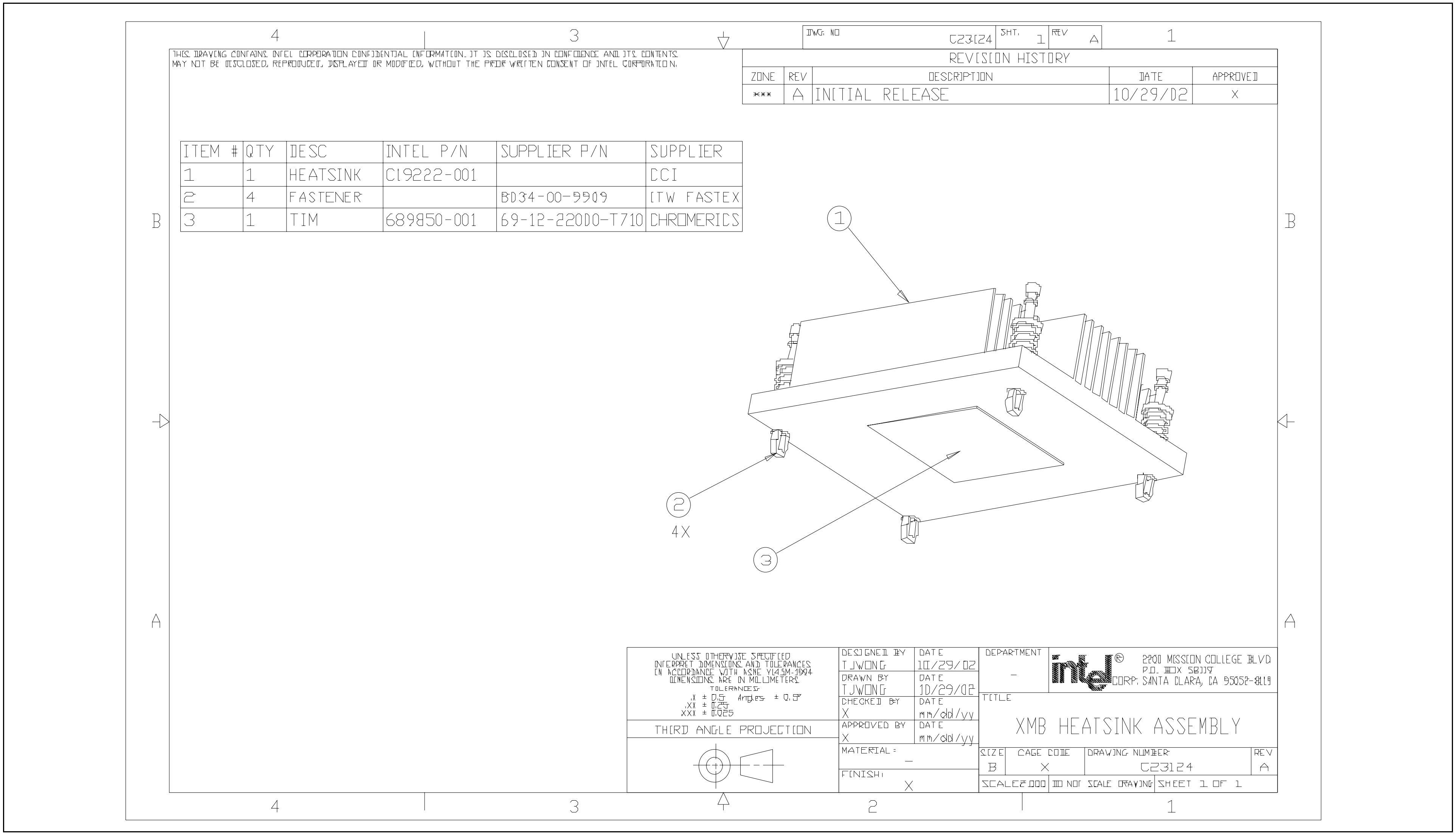
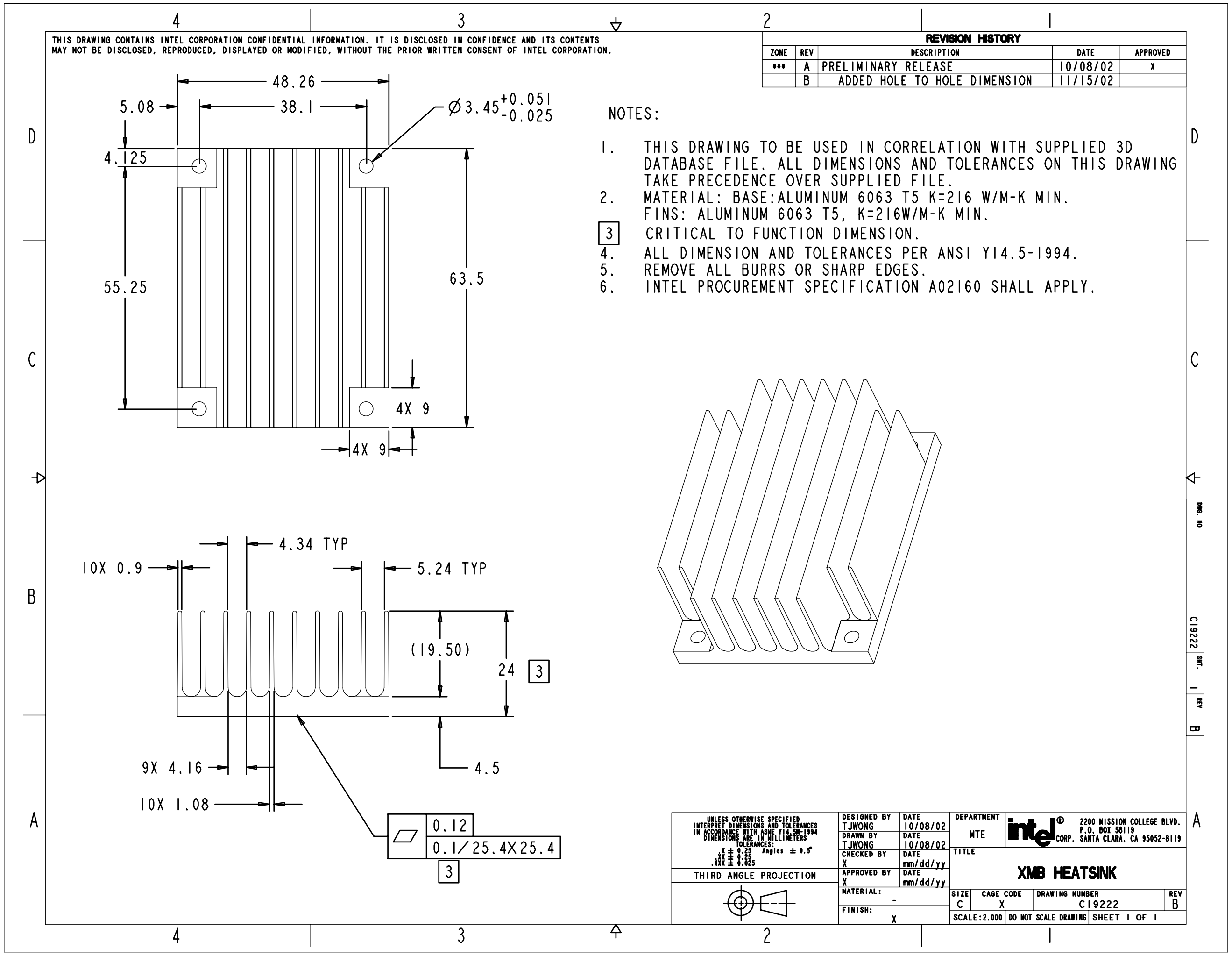


Figure B-6. XMB Heatsink Drawing



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