Intel® Xeon® Processor E5-2400 v3 Product Family

Thermal Mechanical Specification and Design Guide (TMSDG)

January 2015

Order Number: 331593-001US

Revision History

Date	Revision	Description
January 2015	001	• Initial Release

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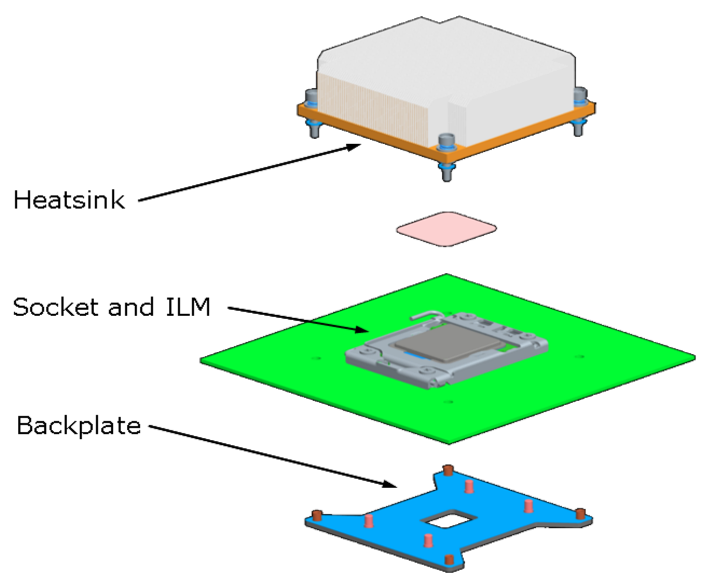
1.0 Introduction

This document provides guidelines for the design of thermal and mechanical solutions for Intel® Xeon® Processor E5-2400 v3 Product Family. Unless specifically required for clarity, this document will use “processor” in place of the specific product names. The components described in this document include:

- The processor thermal solution (heatsink) and associated retention hardware.
- The LGA1356 socket, the Independent Loading Mechanism (ILM), and back plate.

Figure 1. Intel® Xeon® Processor E5-2400 v3 Product Family Socket Stack



The goals of this document are:

- To assist board and system thermal mechanical designers.
- To assist designers and suppliers of processor heatsinks.

1.1 Definition of Terms

Table 1. Terms and Descriptions (Sheet 1 of 2)

Term	Description
BFI	Board Fixture Initiative
Bypass	Bypass is the area between a passive heatsink and any object that can act to form a duct. For this example, it can be expressed as a dimension away from the outside dimension of the fins to the nearest surface.
ICT	In Circuit Test
DTS	Digital Thermal Sensor reports a relative die temperature as an offset from the TCC activation temperature.
EDS	External Design Specification
EDK	Electronic Design Kit: An Electronic Design Kit contains technical documents to aid in the design of systems for Intel products.
EMTS	Electrical, Mechanical, and Thermal Specification
FSC	Fan Speed Control
IHS	Integrated Heat Spreader: a component of the processor package used to enhance the thermal performance of the package. Component thermal solutions interface with the processor at the IHS surface.
ILM	Independent Loading Mechanism provides the force needed to seat the 1356-LGA land package onto the socket contacts.
LGA	Land Grid Array is a type of surface-mount packaging for integrated circuits (ICs) that is notable for having the pins on the socket rather than the integrated circuit. An LGA can be electrically connected to a printed circuit board (PCB) either by the use of a socket or by soldering directly to the board.
LGA1356 Socket	The processor mates with the system board through this surface mount, a 1356-contact socket.
MD	Metal Defined
NCTF	Non-Critical to Function
NEBS	Network Equipment Building System
PECI	The Platform Environment Control Interface (PECI) is a one-wire interface that provides a communication channel between the Intel processor and the chipset components to the external monitoring devices.
PnP	Pick and Place
RSS	Residual Sum of Squares, A statistical tolerance analysis equation.
SMD	Solder Mask Defined
SMT	Surface Mount Technology
T_{CASE}	The case temperature of the processor TTV measured at the geometric center of the topside of the IHS.
T_{CASE_MAX}	The maximum case temperature as specified in a component specification.
TCC	Thermal Control Circuit: the thermal monitor uses the TCC to reduce the die temperature by using clock modulation and/or operating frequency and input voltage adjustment when the die temperature is very near its operating limits.
$T_{CONTROL}$	$T_{CONTROL}$ is a static value below TCC activation used as a trigger point for fan speed control.
TDC	Thermal Design Current
TDP	Thermal Design Power: the thermal solution should be designed to dissipate this target power level. TDP is not the maximum power that the processor can dissipate.
Thermal Monitor	A power reduction feature designed to decrease the temperature after the processor has reached its maximum operating temperature.

Table 1. Terms and Descriptions (Sheet 2 of 2)

Term	Description
Thermal Profile	A line that defines the temperature specification of a processor at a given power level.
TIM	Thermal Interface Material: the thermally conductive compound between the heatsink and the processor case. This material fills the air gaps and voids, and enhances the transfer of the heat from the processor case to the heatsink.
T_{LA}	The measured ambient temperature locally surrounding the processor. The ambient temperature should be measured just upstream of a passive heatsink or at the fan inlet for an active heatsink.
T_{SA}	The system ambient air temperature external to a system chassis. This temperature is usually measured at the chassis air inlets.
TTV	Thermal Test Vehicle
U	A unit of measure used to define server rack spacing height. 1U is equal to 1.75 in, 2U equals 3.50 in, etc.
Ψ_{CA}	Case-to-Ambient Thermal Characterization Parameter (psi). A measure of the thermal solution performance using the total package power. Defined as ($T_{CASE} - T_{LA}$)/Total Package Power. Heat source should always be specified for Ψ measurements.
Ψ_{CS}	Case-to-Sink Thermal Characterization Parameter. A measure of the thermal interface material performance using the total package power. Defined as ($T_{CASE} - T_S$)/Total Package Power.
Ψ_{SA}	Sink-to-Ambient Thermal Characterization Parameter. A measure of the heatsink thermal performance using the total package power. Defined as ($T_S - T_{LA}$)/Total Package Power.

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2.0 LGA1356 Socket

This chapter describes a surface mount, Land Grid Array (LGA) socket intended for the Intel® Xeon® Processor E5-2400 v3 Product Family. The socket provides I/O, power, and ground contacts. The socket contains 1356 contacts arrayed about a cavity in the center of the socket with lead-free solder balls for surface mounting on the motherboard.

The socket has 1356 contacts with 1.016 mm X 1.016 mm pitch (X by Y) in a 43 x 41 grid array with 21 x 17 grid depopulation in the center of the array and selective depopulation elsewhere.

The socket must be compatible with the package (processor) and the Independent Loading Mechanism (ILM). The design includes a back plate which is a key contributor in producing a uniform load on the socket solder joints. Socket loading specifications are listed in Chapter 3.0, "Independent Loading Mechanism (ILM) and Back Plate."

Figure 2. LGA1356 Socket with Pick and Place Cover Removed

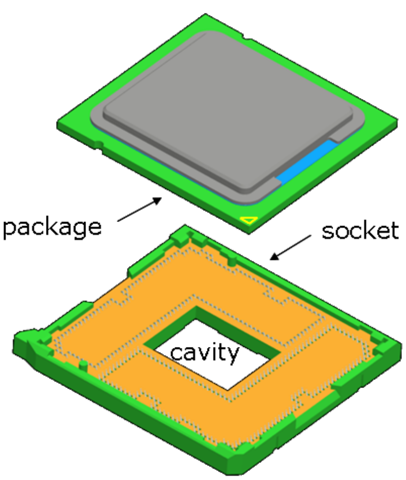
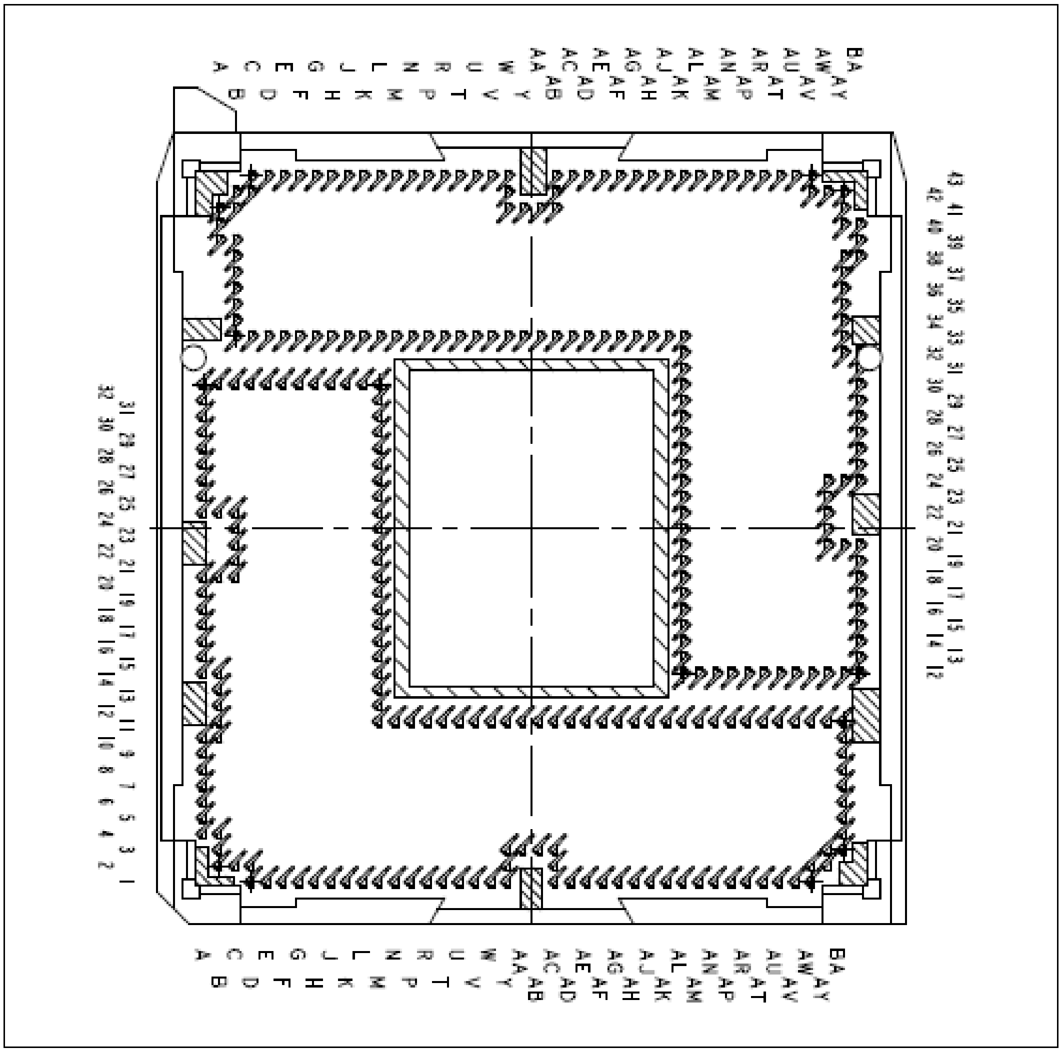


Figure 3. LGA1356 Socket Contact Numbering (Top View of Socket)



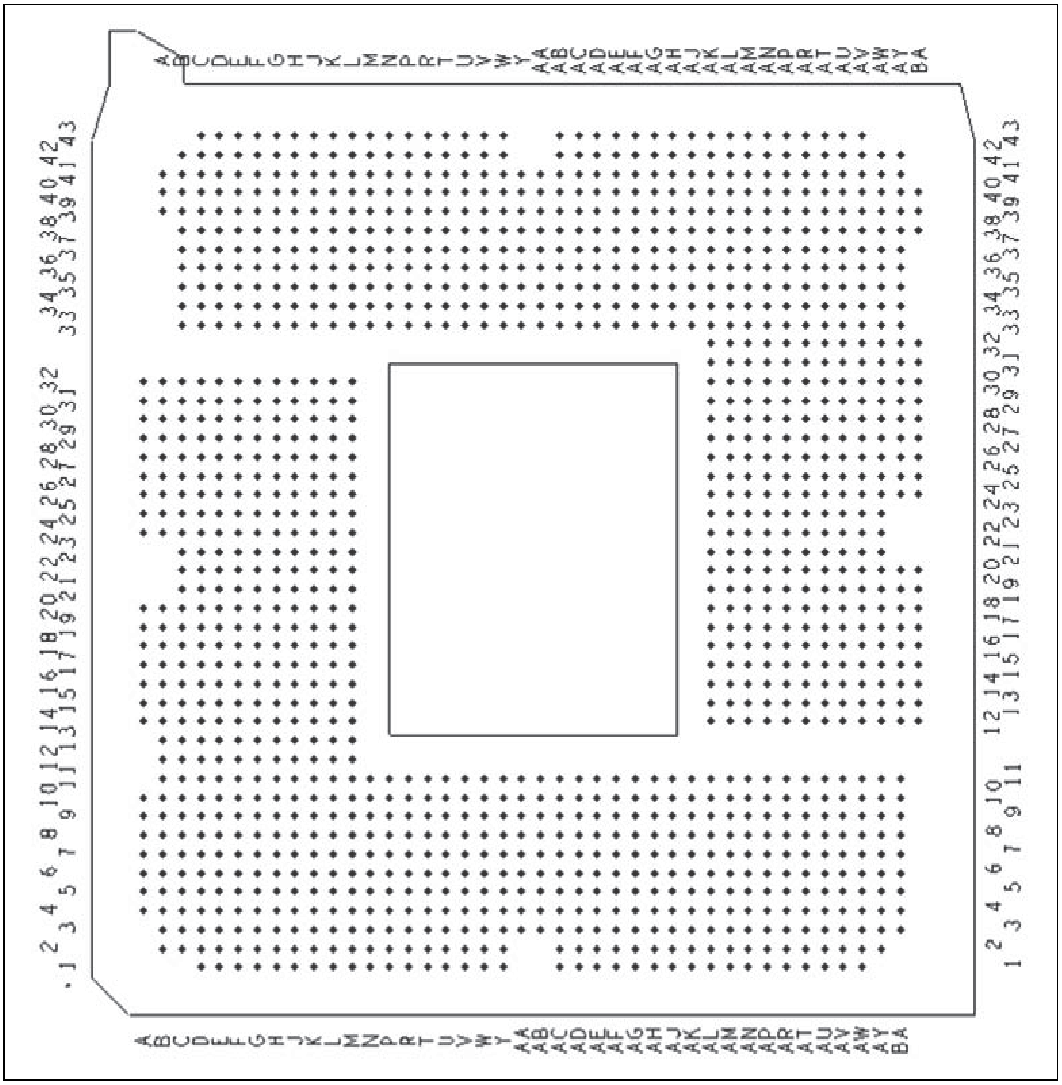
2.1 Board Layout

The land pattern for the LGA1356 socket is 40 mils X 40 mils (X by Y).

Note: There is no round-off (conversion) error between the socket pitch (1.016 mm) and the board pitch (40 mil) as these values are equivalent.

In general, Metal Defined (MD) pads perform better than Solder Mask Defined (SMD) pads under thermal cycling, and the SMD pads perform better than the MD pads under dynamic stress. At this time, complete recommendations for pad definition and pad size do not exist for the LGA1356 socket. See Section 2.9 for more information on the pad definition and pad size.

Figure 4. LGA1356 Socket Land Pattern (Top View of Board)

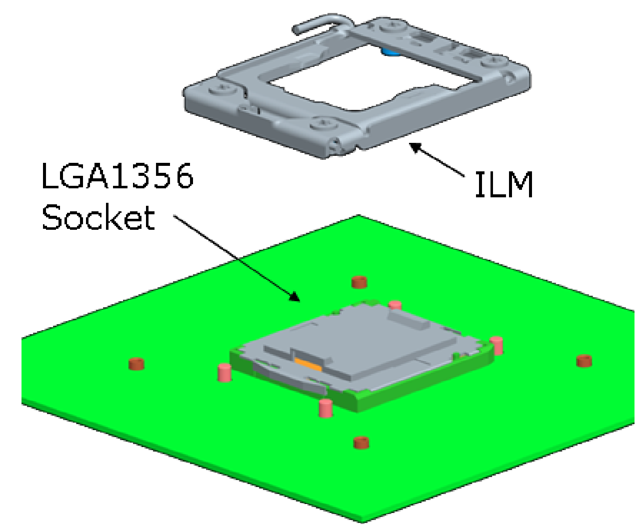


2.2 Attachment to Motherboard

The socket is attached to the motherboard by 1356 solder balls. There are no additional external methods (that is, screw, extra solder, adhesive, and so on) to attach the socket.

As indicated in Figure 5, the ILM is not present during the attach (reflow) process.

Figure 5. Attachment to the Motherboard



2.3 Socket Components

The socket has two main components, the socket body and the Pick and Place (PnP) cover, and is delivered as a single integral assembly. Refer to Appendix C for detailed drawings.

2.3.1 Socket Body Housing

The housing material is thermoplastic or equivalent with UL 94 V-0 flame rating capable of withstanding 260 °C for 40 seconds (typical reflow/rework). The socket coefficient of thermal expansion (in the XY plane) and creep properties, must be such that the integrity of the socket is maintained for the conditions listed in the LGA1366 Socket Validation Reports and the LGA 1356 Addendum.

The color of the housing will be dark as compared to the solder balls to provide the contrast needed for pick and place vision systems. Reports are available from the socket suppliers listed in Appendix A.

2.3.2 Solder Balls

A total of 1356 solder balls corresponding to the contacts are on the bottom of the socket for surface mounting with the motherboard.

The socket has the following solder ball material:

- Lead free SAC (SnAgCu) solder alloy with a silver (Ag) content between 3% and 4% and a melting temperature of approximately 217 °C. The alloy must be compatible with immersion silver (ImAg) motherboard surface finish and an SAC alloy solder paste.

The co-planarity (profile) and true position requirements are defined in Appendix C.

2.3.3 Contacts

Base material for the contacts is high strength copper alloy.

For the area on the socket contacts where the processor lands will mate, there is a 0.381 μm [15 μinches] minimum gold plating over 1.27 μm [50 μinches] minimum nickel underplate.

Caution: No contamination by solder in the contact area is allowed during solder reflow.

All socket contacts are designed such that the contact tip lands within the substrate pad boundary before any actuation load is applied and remains within the pad boundary at final installation, after actuation load is applied.

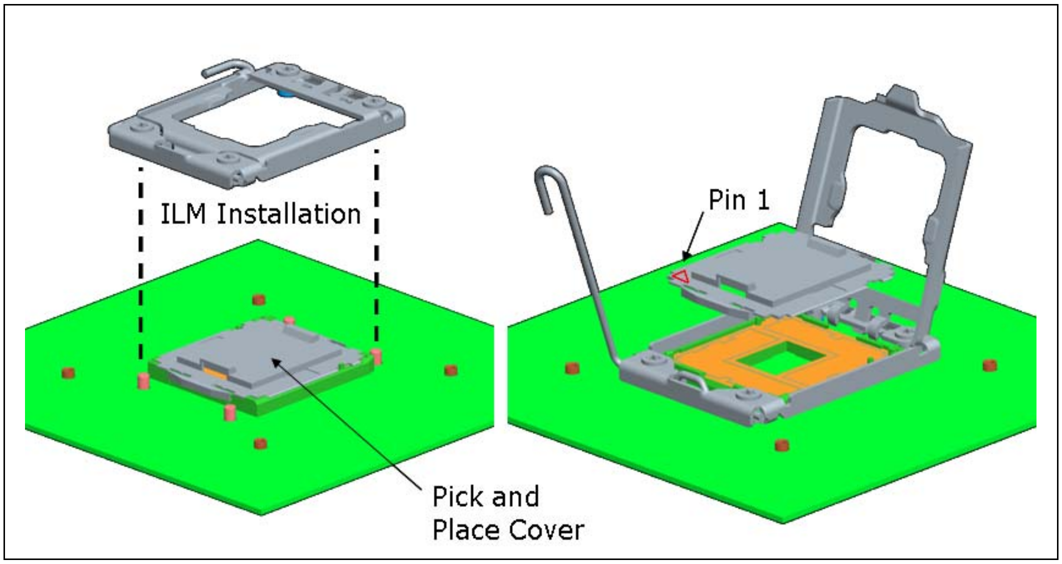
The Pick and Place (PnP) cover provides a planar surface for vacuum pick up that is used to place components on the processor in the Surface Mount Technology (SMT) manufacturing line. The PnP cover remains on the socket during reflow to help prevent contamination during reflow. The PnP cover can withstand 260 °C for 40 seconds (typical reflow/rework profile), and the conditions listed in the LGA1366 Socket Validation Reports without degrading the processor. Reports are available from the socket suppliers listed in Appendix A.

As indicated in Figure 6, the cover remains on the socket during ILM installation, and should remain on whenever possible to help prevent damage to the socket contacts.

Cover retention must be sufficient to support the socket weight during lifting, translation, and placement (board manufacturing), and during board and system shipping and handling.

The covers are designed to be interchangeable between socket suppliers. As indicated in Figure 6, a Pin1 indicator on the cover provides a visual reference for the proper orientation with the socket.

Figure 6. Pick and Place Cover



2.4 Package Installation/Removal

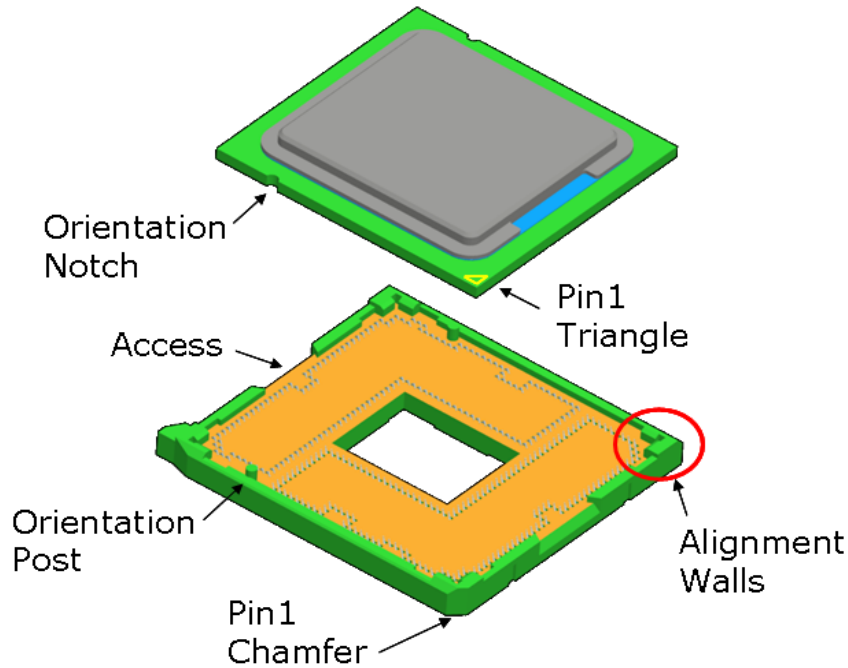
As indicated in Figure 7, access is provided to facilitate manual installation and removal of the package.

To assist in the package orientation and alignment with the socket:

- The package Pin1 triangle and the socket Pin1 chamfer provide visual reference for proper orientation.
- The package substrate has orientation notches along two opposing edges of the package, offset from the centerline. The socket has two corresponding orientation posts to physically prevent mis-orientation of the package. These orientation features also provide initial rough alignment of the package to the socket.
- The package substrate has a -2 mark near the orientation notch on the Pin 1 side. As indicated in Board Keep-in/Keep-Out Zones, Figure 22 and Figure 23, space has been reserved for a -2 mark on the motherboard. These matching marks help prevent system assemblers from installing the incorrect processor into the socket.
- The socket has alignment walls at the four corners to provide final alignment of the package.

See Appendix D for information regarding a tool designed to provide mechanical assistance during processor installation and removal.

Figure 7. Package Installation/Removal Features



2.4.1 Socket Standoffs and Package Seating Plane

Standoffs on the bottom of the socket base establish the minimum socket height after solder reflow and are specified in Appendix C.

Similarly, a seating plane on the topside of the socket establishes the minimum package height. See Section 3.2 for the calculated IHS height above the motherboard.

2.5 Durability

The socket must withstand 30 cycles of processor insertion and removal. The maximum chain contact resistance shown in Table 5 must be met when mated in the 1st and 30th cycles.

The socket pick and place cover must withstand 15 cycles of insertion and removal.

2.6 Markings

There are three markings on the socket:

- LGA1356: Font type is Helvetica Bold - minimum 6 point (2.125 mm).
- Manufacturer's insignia (font size is at the supplier's discretion).
- Lot identification code (allows traceability of the manufacturing date and location).

Note: All markings must withstand 260 °C for 40 seconds (typical reflow/rework profile) without degrading, and must be visible after the socket is mounted on the motherboard.

Note: LGA1356 and manufacturer's insignia are molded or laser marked on the socket side wall.

2.7 Component Insertion Forces

Any actuation must meet or exceed *SEMI S8-95 Safety Guidelines for Ergonomics/ Human Factors Engineering of Semiconductor Manufacturing Equipment*, example Table R2-7 (Maximum Grip Forces).

Note: The socket must be designed so that it requires no force to insert the package into the socket.

2.8 Socket Size

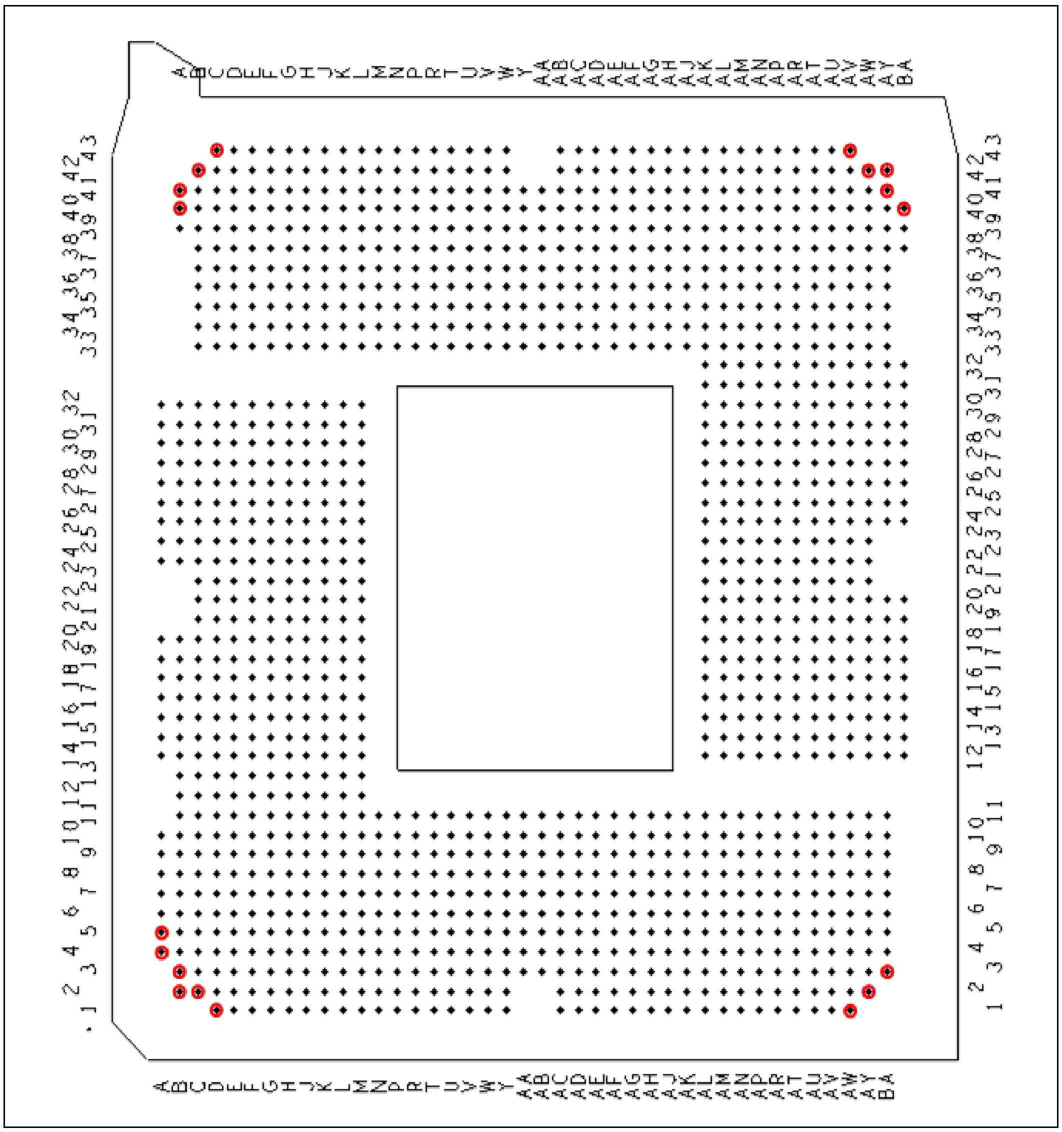
Socket information needed for the motherboard design is given in Appendix C. This information should be used in conjunction with the reference motherboard keep-out drawings provided in Appendix B to ensure compatibility with the reference thermal mechanical components.

2.9 LGA1356 Socket NCTF Solder Joints

Intel has defined selected solder joints of the socket as Non-Critical to Function (NCTF) for post environmental testing. The processor signals at NCTF locations are typically redundant ground or non-critical reserved, so the loss of the solder joint continuity at end of life conditions will not affect the overall product functionality. Figure 8 identifies the NCTF solder joints.

Since corner pads are often more susceptible to solder joint damage, NCTF locations are often placed in the corners. When possible, larger pads may be chosen at NCTF locations to further mitigate against solder joint damage. At this time, complete recommendations for pad definition and pad size do not exist at NCTF locations. CTF locations will likely be 18-mil metal defined on the Intel reference designs.

Figure 8. LGA1356 NCTF Solder Joints



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3.0 Independent Loading Mechanism (ILM) and Back Plate

The Independent Loading Mechanism (ILM) provides the force needed to seat the 1356-land LGA package onto the socket contacts. The ILM is physically separate from the socket body. The assembly of the ILM to the board is expected to occur after the wave solder. The exact assembly location is dependent on manufacturing preference and test flow.

Note: The ILM has two critical functions: deliver the force to seat the processor onto the socket contacts and distribute the resulting compressive load evenly through the socket solder joints.

Note: The mechanical design of the ILM is a key contributor to the overall functionality of the LGA1356 socket. Intel performs detailed studies on the integration of the processor package, socket, and ILM as a system. These studies directly impact the design of the ILM. The Intel reference ILM will be “build to print” from Intel controlled drawings. Intel recommends using the Intel reference ILM. Custom non-Intel ILM designs do not benefit from Intel's detailed studies and may not incorporate critical design parameters.

3.1 Design Concept

The ILM and back plate are assemblies and can be procured from the enabled vendors.

3.1.1 ILM Assembly Design Overview

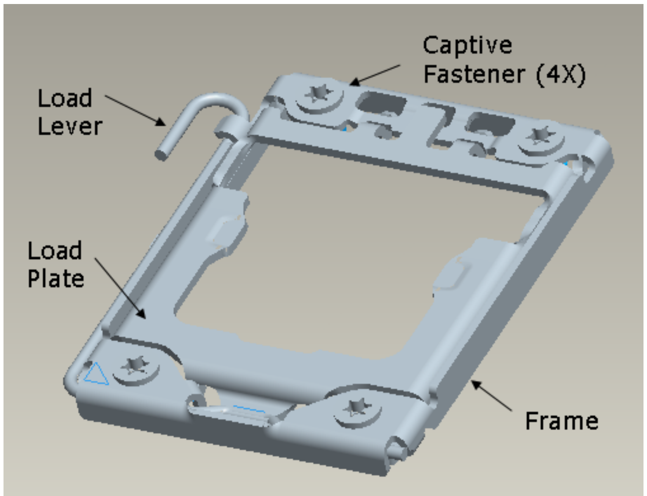
The ILM assembly consists of four major pieces: load lever, load plate, frame, and captive fasteners.

The load lever and load plate are stainless steel. The frame and fasteners are high carbon steel with appropriate plating. The fasteners are fabricated from a high carbon steel. The frame provides the hinge locations for the load lever and load plate.

The ILM assembly design ensures that once assembled to the back plate and the load lever is closed, the only features touching the board are the captive fasteners. The nominal gap of the frame to the board is ~1 mm when the load plate is closed on the empty socket or when closed on the processor package.

When closed, the load plate applies a two point loads onto the IHS at the dimpled features shown in Figure 9. The reaction force from closing the load plate is transmitted to the frame and through the captive fasteners to the back plate. Some of the load is passed through the socket body to the board inducing a slight compression on the solder joints.

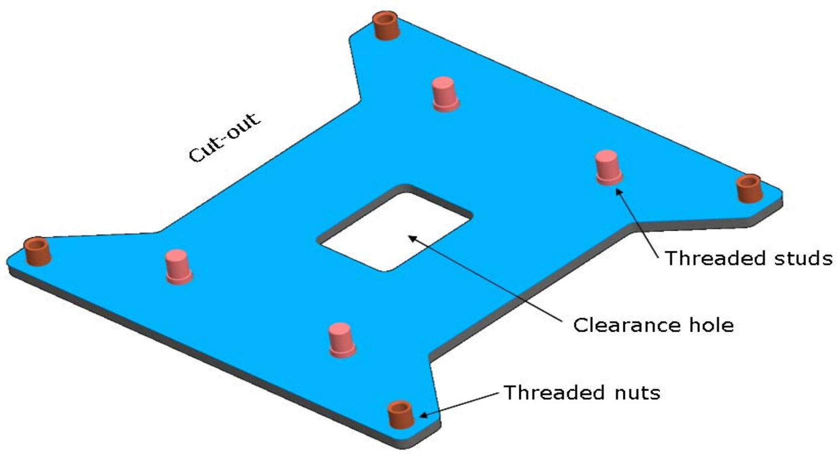
Figure 9. ILM Assembly



3.1.2 ILM Back Plate Design Overview

The unified back plate, shown in Table 10, consists of a flat steel back plate with threaded studs for the ILM attach, and internally threaded nuts for attaching the heatsink. The threaded studs have a smooth surface feature that provides alignment for the back plate to the motherboard for proper assembly of the ILM around the socket. A clearance hole is located at the center of the plate to allow access to test points and backside capacitors. An additional cut-out on two sides provides clearance for backside voltage regulator components. An insulator is also pre-applied.

Figure 10. Back Plate



3.1.3 Durability

The ILM durability requirement is 30 processor cycles. One processor cycle is to install the processor, close the load plate, latch the load lever, unlatch the load lever, and open the load plate.

The ILM durability requirement is six assembly cycles. See Section 3.2 for the assembly procedure. One assembly cycle is fasten the ILM assembly to the back plate with the four captive screws, torque to 9 ± 1 inch-pounds, and unfasten the ILM assembly from the back plate.

3.2 Assembly of ILM to a Motherboard

The ILM design allows a bottoms up assembly of the components to the board. In Step 1 (see Figure 11), the back plate is placed in a fixture. The holes in the motherboard provide alignment to the threaded studs.

In Step 2, the ILM assembly is placed over the socket and threaded studs.

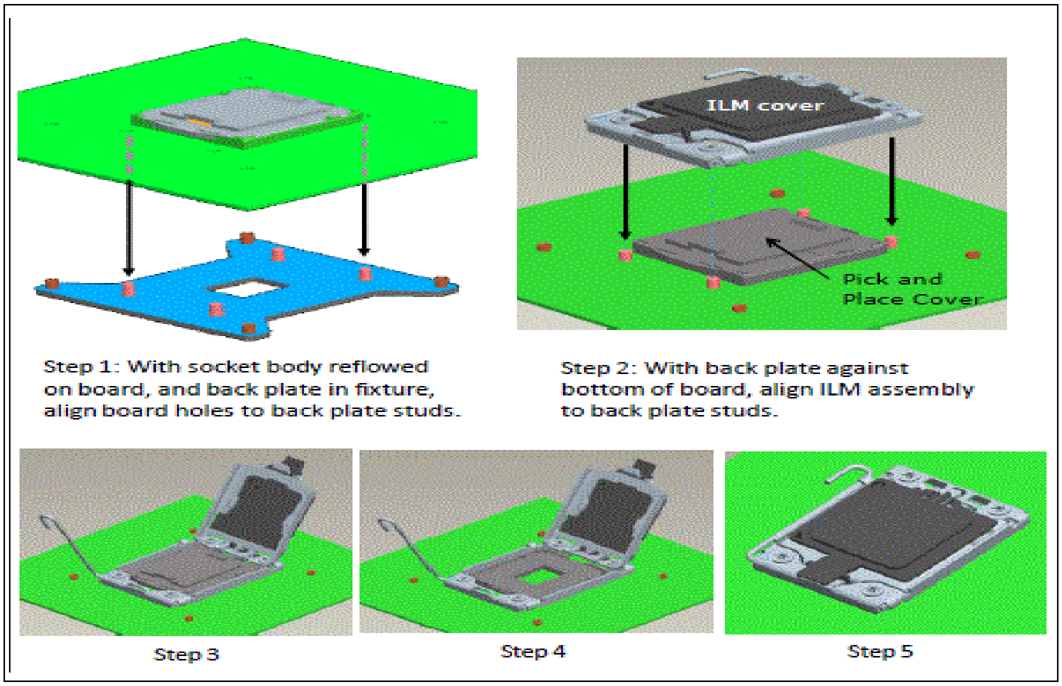
Caution: The Intel reference design ILM cover is not designed to nest over the pick and place cover. This feature helps prevent re-installation of the Pnp cover; a step that can lead to socket bend contacts.

To prevent the ILM cover from popping off during the ILM assembly, the load plate can be unlatched from the load lever when the fasteners are torqued as shown in Step 3. Using a T20 Torx* driver, fasten the ILM assembly to the back plate with the four captive fasteners. Torque to 9 ± 1 inch-pounds.

The PnP cover can then be removed as shown in Step 4, and the load plate can then be closed and latched as shown in Step 5.

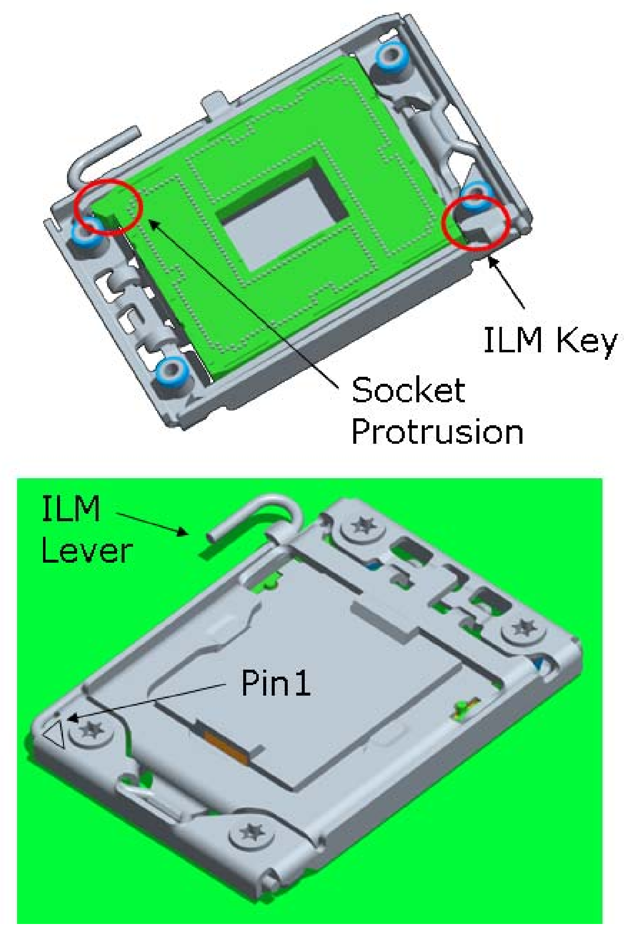
Note: The length of the threaded studs accommodate motherboard thicknesses from 0.062 to 0.100 in. (1.57 to 2.54 mm).

Figure 11. ILM Assembly



As indicated in Figure 12, socket protrusion and ILM key features prevent 180-degree rotation of the ILM assembly with respect to the socket. The result is a specific Pin 1 orientation with respect to the ILM lever.

Figure 12. Pin1 and ILM Lever



3.3 ILM Cover

As indicated in Table 11, "LGA1356 Socket, ILM, and Back Plate" on page 54, ILM covers are available as discrete components and pre-assembled to the ILM load plate.

Note: The ILM cover will interfere with a processor and pop off if the ILM is closed with a processor in the socket.

The ILM cover is designed to be interchangeable between different suppliers validated by Intel. Performance of the pop off feature may decline if the ILM cover supplier is different than the ILM supplier. The ILM cover can be removed manually if the pop off feature is not desirable or not functional.

The ILM cover has a UL94 V-0 flammability rating. The ILM cover durability requirement is 20 cycles (one cycle is install and remove).

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4.0 LGA1356 Socket, ILM, and Back Plate Electrical, Mechanical, and Environmental Specifications

This chapter describes the electrical, mechanical, and environmental specifications for the LGA1356 socket, Independent Loading Mechanism (ILM), and back plate.

4.1 Component Mass

Table 2. Component Mass

Component	Mass
Socket Body, Contacts and PnP Cover	15 gm
ILM Assembly	43 gm
Back Plate	100 gm

4.2 Package / Socket Stack-up Height

Table 3 provides the stack-up height of a processor in the 1356-land LGA package and the LGA1356 socket with the ILM closed and the processor fully seated in the socket.

Table 3. 1356-Land Package and LGA1356 Socket Stack-Up Height

Description	Integrated Stack-Up Height (mm)
From Top of the Board to the Top of IHS	7.763 ± 0.259

Notes:
1. This data is provided for information only, and should be derived from: (a) the height of the socket seating plane above the motherboard after reflow, given in Appendix C, (b) the height of the package from the package seating plane to the top of the IHS, and accounting for its nominal variation and tolerances that are given in the corresponding processor EMTS.
2. This value is a RSS calculation.

4.3 Socket Maximum Temperature

The power dissipated within the socket is a function of the current at the pin level and the effective pin resistance. To ensure socket long-term reliability, Intel defines socket maximum temperature using a via on the underside of the motherboard.

Caution: Exceeding the temperature guidance may result in a socket body deformation, or increases in thermal and electrical resistance which can cause a thermal runaway and eventual electrical failure.

The guidance for socket maximum temperature is listed below:

- Via temperature under socket < 90 °C

The specific via used for temperature measurement is located on the bottom of the motherboard between pins AY24, AY25, BA24, and BA25. See Figure 13.

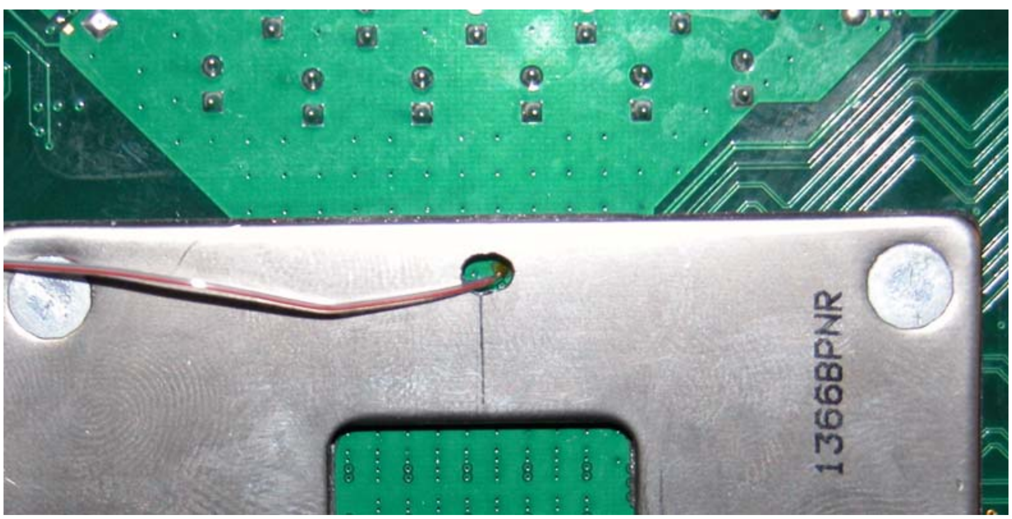
Note: The socket maximum temperature is defined at Thermal Design Current (TDC). In addition, the heatsink performance targets and boundary conditions of Table 7 must be met to limit power dissipation through the socket.

4.3.1 Measuring via Temperature

To measure via temperature:

1. Drill a hole through the back plate at the specific via defined above.
2. Thread a T-type thermocouple (36 - 40 gauge) through the hole and glue it into the specific via on the underside of the motherboard.
3. Once the glue dries, reinstall the back plate and measure the temperature.

Figure 13. Socket Temperature Measurement Location



4.4 Loading Specifications

Since the LGA1356 socket is very similar to the LGA1366 socket, the LGA1356 socket is expected to perform similarly under the conditions listed in the LGA1366 Socket Validation Reports listed in Appendix A with heatsink, ILM, and back plate attached under the loading conditions outlined in this chapter.

Table 4 provides load specifications for the LGA1356 socket with the ILM and back plate installed.

Caution: The maximum limits should not be exceeded during heatsink assembly, shipping conditions, or standard use condition. Exceeding these limits during test may result in component failure. The socket body should not be used as a mechanical reference or load-bearing surface for thermal solutions.

Table 4. Socket and ILM Mechanical Specifications

Parameter	Minimum	Maximum	Notes
Static Compressive Load from the ILM Cover to the Processor IHS	445 N [100 lbf]	623 N [140 lbf]	3, 4, 6
Heatsink Static Compressive Load	0 N [0 lbf]	266 N [60 lbf]	1, 2, 3
Total Static Compressive Load (ILM plus Heatsink)	445 N (100 lbf)	890 N (200 lbf)	3, 4
Dynamic Compressive Load (with heatsink installed)	N/A	890 N [200 lbf]	1, 3, 5, 6
Target Pick and Place Cover Allowable Removal Force	N/A	4.45 - 6.68 N [1.0 - 1.5 lbf]	
Load Lever Actuation Force	N/A	38.3 N [8.6 lbf] in the vertical direction 10.2 N [2.3 lbf] in the lateral direction	

Notes:
1. These specifications apply to uniform compressive loading in a direction perpendicular to the IHS top surface.
2. This is the minimum and maximum static force that can be applied by the heatsink and it's retention solution to maintain the heatsink to IHS interface. This does not imply the Intel reference TIM is validated to these limits.
3. Loading limits are for the LGA1356 socket.
4. This minimum limit defines the compressive force required to electrically seat the processor onto the socket contacts.
5. Dynamic loading is defined as an 11 ms duration average load superimposed on the static load requirement.
6. Test condition used a heatsink mass of 550 gm [1.21 lb] with 50 g acceleration measured at heatsink mass. The dynamic portion of this specification in the product application can have flexibility in specific values, but the ultimate product of mass times acceleration should not exceed this dynamic load.

4.4.1 Board Deflection Guidance

Caution: Exceeding the maximum board deflection may result in socket solder joint failure.

Use of the Intel reference ILM and back plate, and compliance to the maximum heatsink static compressive load in Table 4, will control board deflection to an acceptable level.

Designs that do not meet the design objectives of the Intel reference back plate (defined below), or do not use the Intel reference ILM, or exceed the maximum heatsink static compressive load, should follow the Board deflection measurement methodology in this chapter to assess the risk to the socket solder joint reliability.

Critical design objectives of the Intel reference back plate include:

1. Material thickness (2.2 ± 0.05 mm)
2. Material strength (yield 250 MPa min., ultimate 300 MPa min.)
3. Flatness (Figure 14)
4. Insulator thickness (0.127 mm min.)
5. Outside perimeter minimum size is 46 x 71.2 mm (Figure 15). Customizing beyond the perimeter of back plate should meet the design objectives.
6. Inside window maximum size is 21.8 x 17.3 mm (Figure 15)

Figure 14. Back Plate Flatness

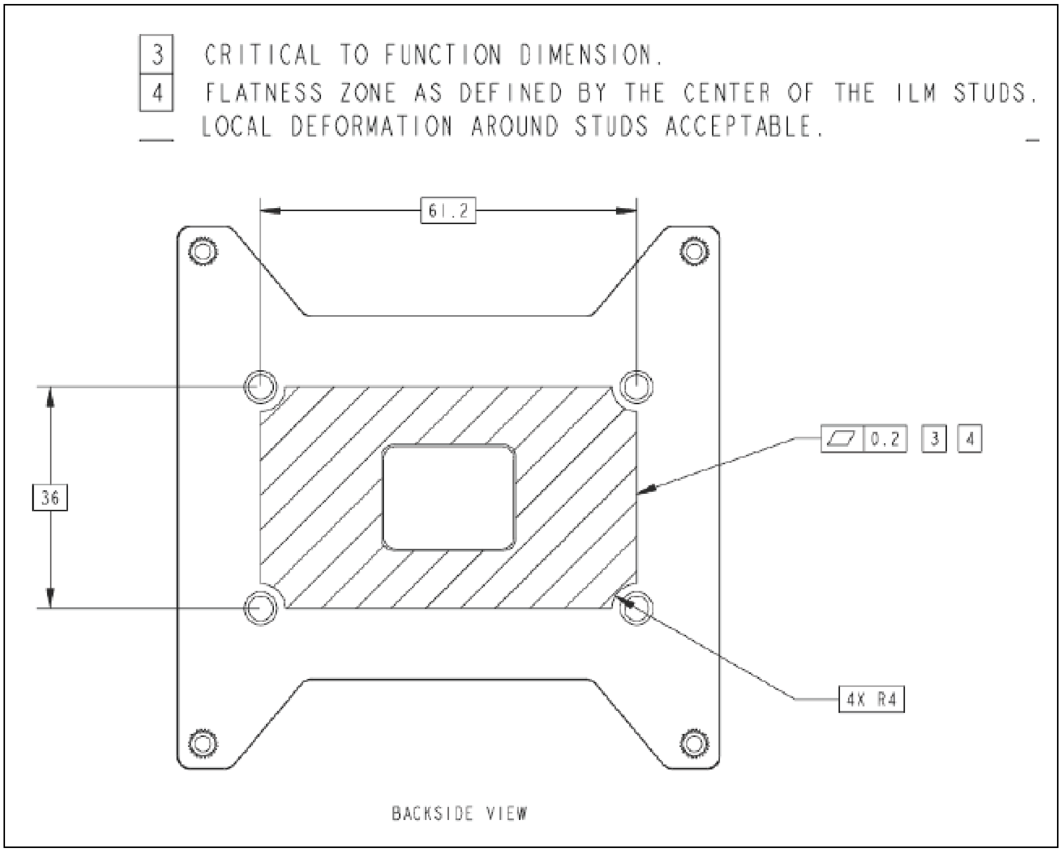
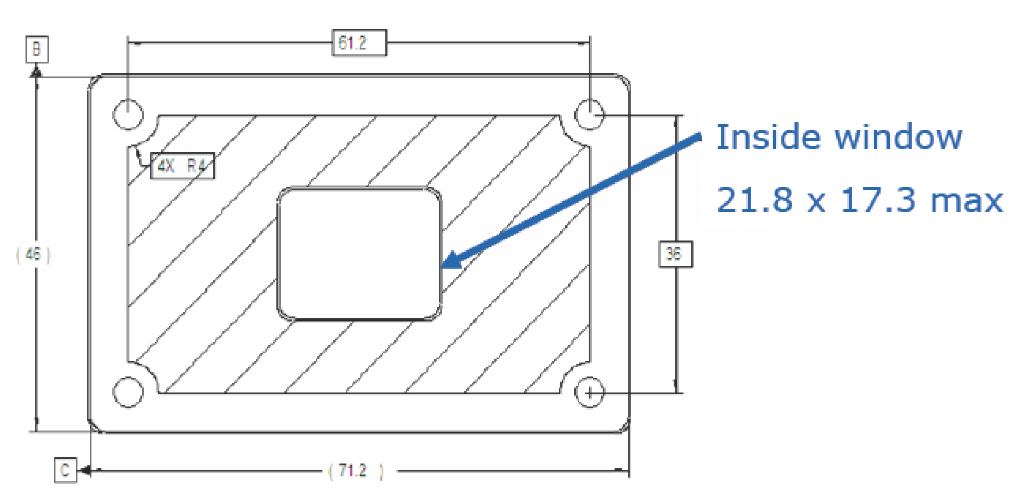


Figure 15. Back Plate Perimeter and Window

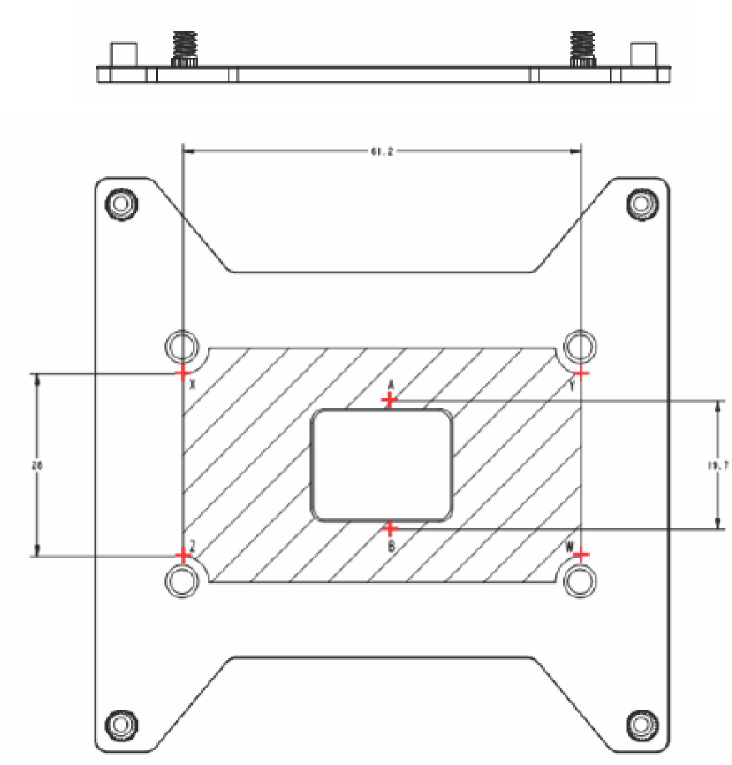


The maximum board deflection guidance is defined with the ILM installed during the total static compressive load. Use back plate displacement as a proxy for board deflection. Displacement is measured from a best fit plane in the socket BGA area as described below:

1. Install the back plate and ILM.
2. Without a processor installed and with the ILM lever unlatched, measure the W, X, Y, Z points to establish the unloaded reference plane. Points W, X,Y, Z are defined in Figure 16.
3. Measure points A and B to determine their distance from the unloaded plane (Step #2) in this unloaded state. Average distance (A, B) from #2 = Unloaded_avg.
4. Load ILM with the processor installed in socket. Install heatsink.
5. Measure W, X, Y, Z points to establish the loaded reference plane.
6. Measure points A and B to determine their distance from the loaded plane (Step #5) in this loaded state. Average distance (A, B) from #5 = Loaded_avg.
7. Loaded-to-unloaded displacement change must be less than 0.35 mm to comply. Loaded_avg - Unloaded_avg < 0.35 mm.

Without a heatsink installed, maximum board deflection is 0.25 mm. Use the procedure above but do not install heatsink in Step #4.

Figure 16. Back Plate Measurement Points



4.4.2 Strain Guidance for LGA1356 Socket

Intel provides manufacturing strain guidance commonly referred to as Board Flexure Initiative or BFI.

Note: Any strain metrology is sensitive to boundary conditions. For BFI strain guidance, the ILM is not assembled to the board. This replicates the boundary conditions of the In Circuit Test (ICT) during motherboard manufacturing.

Note: Intel recommends the use of BFI to prevent solder joint defects from occurring in the test process.

Since the LGA1356 socket is very similar to the LGA1366 socket, the LGA1356 socket is expected to perform similarly under strain. See *BFI Strain Guidance Sheet (LGA1366 socket)* for maximum allowable strain values, see Appendix A. Consult the Intel Customer Quality Engineer for additional guidance in setting up a BFI program in your factory.

Note: When the ILM is attached to the board, the boundary conditions change and the BFI strain limits are not applicable. The ILM, by design, increases stiffness in and around the socket and places the solder joints in compression. Intel does not support strain metrology with the ILM assembled.

4.5 Electrical Requirements

LGA1356 socket electrical requirements are measured from the socket-seating plane of the processor to the component side of the socket PCB to which it is attached. All specifications are maximum values (unless otherwise stated) for a single socket contact but includes effects of adjacent contacts where indicated.

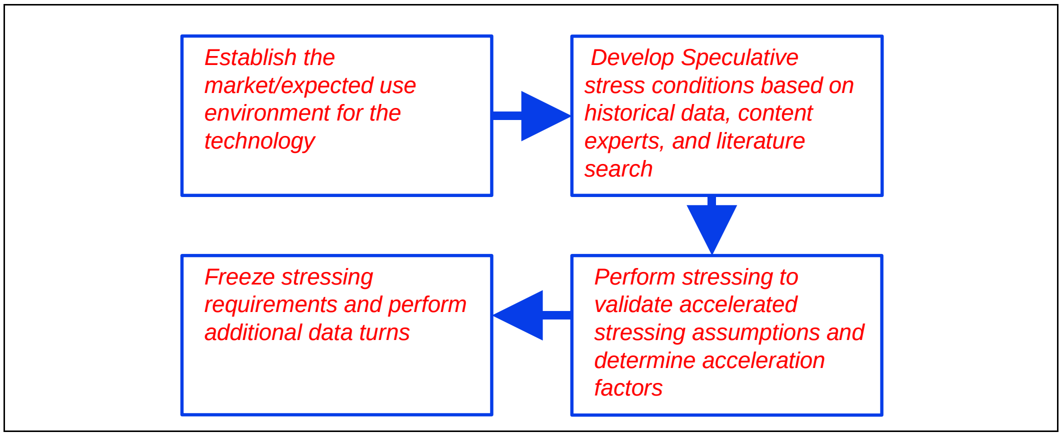
Table 5. Electrical Requirements for LGA1356 Socket

Parameter	Value	Comment
Mated Loop Inductance, Loop	<3.9nH	The inductance calculated for two contacts, considering one forward conductor and one return conductor. These values must be satisfied at the worst-case height of the socket.
Maximum Mutual Capacitance, C	<1 pF	The capacitance between two contacts
Socket Average Contact Resistance (EOL)	15.2 mΩ	The socket average contact resistance target is derived from the average of every chain contact resistance for each part used in testing, with a chain contact resistance defined as the resistance of each chain minus the resistance of shorting bars divided by the number of lands in the daisy chain. The specification listed is at room temperature and has to be satisfied at all time. Socket Contact Resistance: The resistance of the socket contact, solder ball, and the interface resistance to the interposer land.
Maximum Individual Contact Resistance (EOL)	≤ 100 mΩ	The specification listed is at room temperature and has to be satisfied at all time. Socket Contact Resistance: The resistance of the socket contact, solder ball, and the interface resistance to the interposer land; gaps included.
Bulk Resistance Increase	≤ 3 mΩ	The bulk resistance increase per contact from 24 °C to 107 °C
Dielectric Withstand Voltage	360V RMS	
Insulation Resistance	800 MΩ	

4.6 Environmental Requirements

The reliability targets in this chapter are based on the expected field use environment for these products. The test sequence for the LGA1366 socket was developed using the knowledge-based reliability evaluation methodology, which is acceleration factor dependent. A simplified process flow of this methodology can be seen in Figure 17. Since the LGA1356 socket is very similar to the LGA1366 socket, the LGA1356 socket is expected to perform similarly, and socket validation is avoided.

Figure 17. Flow Chart of Knowledge-Based Reliability Evaluation Methodology



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5.0 Thermal Specifications and Solutions

5.1 Processor Thermal Specifications

The processor requires a thermal solution to maintain temperatures within operating limits. Any attempt to operate the processor outside these limits may result in permanent damage to the processor and potentially other components within the system. Maintaining the proper thermal environment is key to reliable, long-term system operation.

A complete solution includes both component and system-level thermal management features. Component-level thermal solutions can include active or passive heatsinks attached to the processor Integrated Heat Spreader (IHS). Typical system-level thermal solutions may consist of system fans combined with ducting and venting.

5.2 Thermal Specifications

To allow optimal operation and long-term reliability of Intel processor-based systems, the processor must remain between the minimum and maximum case temperature (T_{CASE}) specifications. Thermal solutions not designed to provide sufficient thermal cooling may affect the long-term reliability of the processor and system.

Thermal profiles ensure adherence to Intel reliability requirements. Intel assumes system boundary conditions (system ambient, airflow, heatsink performance/pressure drop, preheat, etc.) for each processor SKU. Furthermore, implementing a thermal solution that violates the thermal profile for extended periods of time may result in permanent damage to the processor or reduced life.

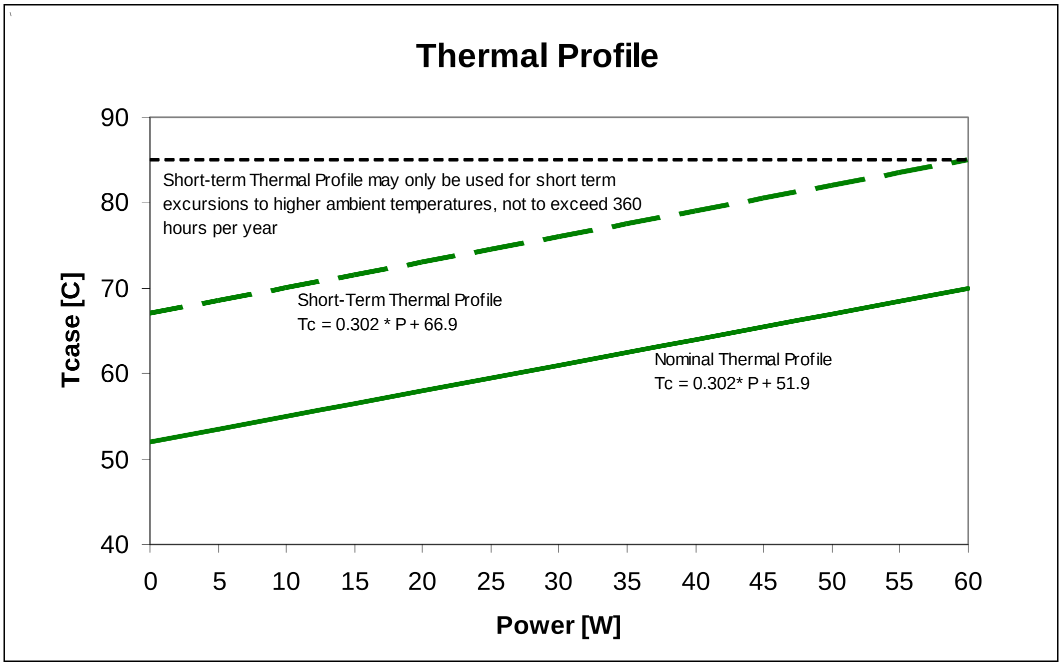
The upper point of the thermal profile consists of the Thermal Design Power (TDP) and the corresponding TCASE_MAX value (x = TDP and y = TCASE_MAX) represents a thermal solution design point. For embedded servers, communications, and storage markets, Intel has SKUs that support thermal profiles with nominal and short-term conditions designed to meet NEBS Level 3 compliance. For these SKUs, operation at either the nominal or short-term thermal profiles should result in virtually no TCC activation. Thermal profiles for these SKUs are found in this chapter as well. Intel recommends that thermal solution designs target the Thermal Design Power (TDP). The Adaptive Thermal Monitor feature is intended to help protect the processor in the event that an application exceeds the TDP recommendation for a sustained time period. The Adaptive Thermal Monitor feature must be enabled for the processor to remain within its specifications.

5.2.1 NEBS Thermal Profile

The NEBS thermal profiles help relieve thermal constraints for short-term NEBS conditions. To help with reliability, the processors must meet the nominal thermal profile under standard operating conditions and can only rise up to the short-term specification for the NEBS excursions (see Figure 18).

Note: The definition of short-term time is clearly defined for NEBS Level 3 conditions, but the key is that it cannot be longer than 360 hours per year.

Figure 18. NEBS Thermal Profile



Notes:
1. The nominal thermal profile must be used for all normal operating conditions, or for products that do not require NEBS Level 3 compliance.
2. The short-term thermal profile may only be used for short-term excursions to higher ambient operating temperatures, not to exceed 360 hours per year as compliant with NEBS Level 3.
3. Implementation of either thermal profile should result in virtually no TCC activation. Utilization of a thermal solution that exceeds the short-term thermal profile, or which operates at the short-term thermal profile for a duration longer than the limits specified in Note 2 above, do not meet the processor thermal specifications and may result in permanent damage to the processor.

5.3 DTS Based Thermal Specification

5.3.1 Implementation

Processor heatsink design must still comply with the T_{CASE} based thermal profile provided in Table 6. Heatsink design compliance can be determined with thermocouple and TTV as with previous processors.

With the heatsink sized to comply with the T_{CASE} based thermal profile, the DTS based thermal specification may be implemented but is not mandatory. In some situations, implementation of the DTS based thermal specification can reduce average fan power and improve acoustics as compared to the T_{CASE} based thermal profile.

When all cores are active, a properly sized heatsink will be able to meet the DTS based thermal specification. When all cores are not active or when Intel® Turbo Boost Technology is active, attempting to comply with the DTS based thermal specification may drive system fans to maximum speed. In such situations, the T_{CASE} temperature will be below the T_{CASE} based thermal profile by design.

5.3.2 DTS Based Thermal Profile

Compliance to DTS based thermal specification is assured when T_{SENSOR} is at or below the DTS Based Thermal Profile (T_{DTS}):

$$T_{SENSOR} \le T_{DTS}$$

Where:

$$T_{SENSOR} = \text{IA32\_TEMPERATURE\_TARGET} + \text{DTS}$$

Since IA32_TEMPERATURE_TARGET is provided in absolute temperature (°C), and DTS varies with power, T_{SENSOR} represents absolute temperature as the processor varies with power. DTS by definition is a negative value.

The DTS Based Thermal Profile (T_{DTS}) is also provided in absolute temperature (°C). The T_{DTS} equations for the Intel® Xeon® Processor E5-2400 v3 Product Families are provided in Table 6. To implement the DTS based thermal specification, these equations must be programmed in firmware.

5.3.3 Power Calculation

To implement the DTS based thermal specification, average power over time must be calculated:

$P = (E2 - E1) / (t2 - t1)$

Where:

t1 = Time stamp 1

t2 = Time stamp 2

E1 = Energy readout at time t1

E2 = Energy readout at time t2

To ensure the power calculation is accurate, the error in the time interval between two time stamps (e) must be small as compared to the duration between time stamps (t2 - t1) such that:

$e/(t2 - t1) << 1$

5.3.4 Margin, Gap and Time Averaging

As indicated in Section 5.3.2, compliance to the DTS based thermal specification is assured when $T_{SENSOR} \leq T_{DTS}$. In other words, compliance is assured when there is margin to T_{DTS}:

m1 = Margin to DTS Based Thermal Profile = $T_{DTS} - T_{SENSOR}$

Compliance to the DTS based thermal specification is not required when $DTS \leq T_{CONTROL}$. In other words, when there is margin to $T_{CONTROL}$:

m2 = Margin to $T_{CONTROL}$ = $T_{CONTROL}$ - DTS

Both DTS and $T_{CONTROL}$ values are assumed to be negative.

The greater of these margins (M) is used to control fan speed:

M = max (m1, m2)

In the following cases, Figure 19 is provided to illustrate margin or gap to an example DTS based thermal profile. Actual DTS based thermal profiles are provided in Table 6.

In the case of positive margin, fan speed can be reduced from the perspective of the processor. See Case 1 and 2 in Figure 19:

Case 1 (m1 > m2): Margin to DTS Based Thermal Profile > Margin to $T_{CONTROL}$

Case 2 (m2 > m1): Margin to $T_{CONTROL}$ > Margin to DTS Based Thermal Profile

In the case of negative margin (gap), the smaller gap value is used to control (increase) fan speed. See Case 3 and 4:

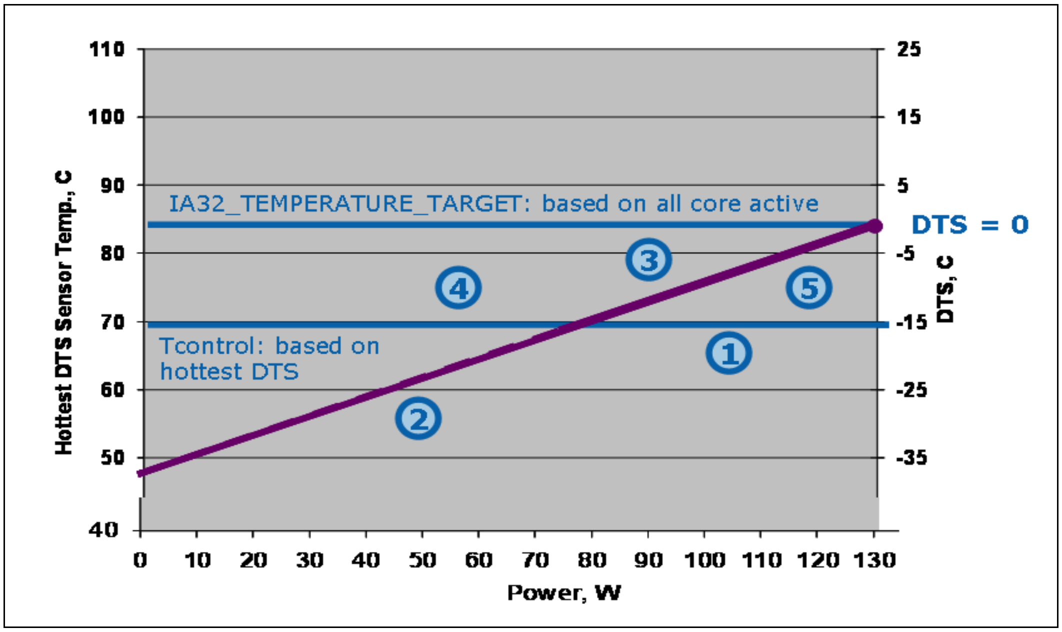
Case 3 (m1 > m2): Gap to DTS Based Thermal Profile < Gap to $T_{CONTROL}$

Case 4 (m2 > m1): Gap to $T_{CONTROL}$ < Gap to DTS Based Thermal Profile

In the case where there is margin to DTS based thermal profile and there is gap to $T_{CONTROL}$, margin to DTS based thermal profile will drive fan speed. See Case 5:

Case 5 (m1 > m2): Margin to DTS Based Thermal Profile > Margin to $T_{CONTROL}$

Figure 19. Margin and Gap



Intel recommends a gap or margin calculation at least once every second. If the gap or margin is calculated more often, Intel recommends to maintain a running time average value of gap or margin for fan speed control:

$$\overline{M}_n = \frac{(\alpha - \Delta t_n)\overline{M}_{n-1} + M_n \Delta t_n}{\alpha}$$

Where:

Δt_n = Time interval over which samples are read

α = Time interval over which the average is calculated

M = Margin (instantaneous value)

The time interval over which the average is calculated (α) must be appropriately matched to the time interval over which samples are read (Δt_n). For example, in some situations, a one second interval (α) is appropriate for samples read every 100 ms.

The use of larger time intervals for gap or margin calculation can lead to Thermal Control Circuit (TCC) activation.

5.4 Thermal Specifications for Thermal Design

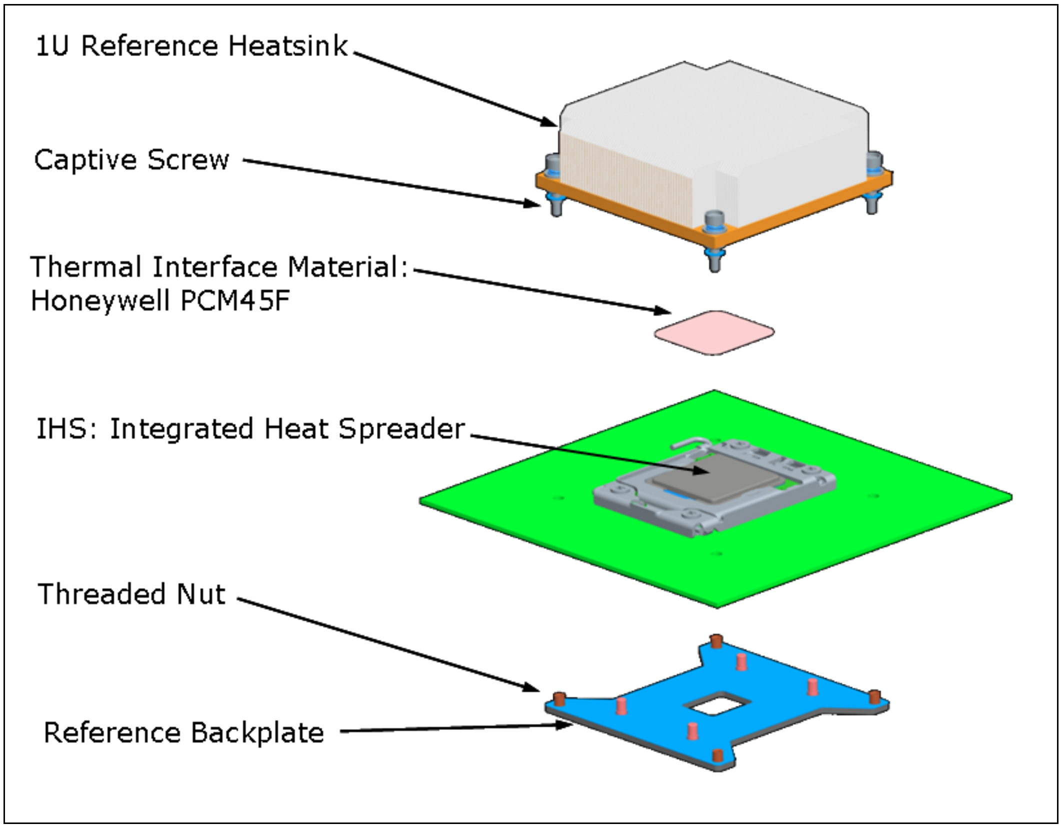
Table 6. Thermal Specifications for Intel® Xeon® Processor E5-2400 v3 Product Family

Processor Number	TDP	Core Count	$T_{CONTROL}$	$T_{CASE-MAX}$	T_{CASE} (°C) Thermal Profile		T_{DTS} (°C) Thermal Profile	
					Nominal	Short-Term	Nominal	Short-Term
E5-2438L v3	70W	10	18	83	T_C = [0.229* P]+52	T_C = [0.229* P]+67	T_{DTS}= [0.321* P]+67	T_{DTS}= [0.321* P]+67
E5-1428L v3	65W	8	18	86	T_C = [0.289* P]+52	T_C = [0.289* P]+67	T_{DTS}= [0.393* P]+52	T_{DTS}= [0.393* P]+67
E5-2428L v3	55W	8	18	93	T_C = [0.474* P]+52	T_C = [0.474* P]+67	T_{DTS}= [0.577* P]+52	T_{DTS}= [0.577* P]+67
E5-2418L v3	50W	6	18	93	T_C = [0.517* P] +52	T_C = [0.517* P] +67	T_{DTS}= [0.633* P]+52	T_{DTS}= [0.633* P]+67
E5-2408L v3	45W	4	18	92	T_C = [0.553* P]+52	T_C = [0.553* P]+67	T_{DTS}= [0.693* P]+52	T_{DTS}= [0.693* P]+67

Notes:
1. These values are specified at VccIN_MAX for all processor frequencies. The systems must be designed to ensure the processor is not subjected to any static Vcc and Icc combination wherein VccIN exceeds VccIN_MAX at a specified Icc. Refer to the electrical loadline specifications.
2. Thermal Design Power (TDP) should be used as a target for processor thermal solution design at maximum T_{CASE}. Processor power may exceed TDP for short durations.
3. Power specifications are defined at all VIDs found in the processor External Design Specification (EDS), Processors may be delivered under multiple VIDs for each frequency.
4. The Nominal Thermal Profile must be used for all normal operating conditions or for products that do not require NEBS Level 3 compliance.
5. The short-term thermal profile may only be used for short-term excursions to higher ambient operating temperatures, not to exceed 96 hours per instance, 360 hours per year, and a maximum of 15 instances per year, as compliant with NEBS Level 3. An operation at the short-term thermal profile for durations exceeding 360 hours per year violates the specifications of the processor.
6. Minimum T_{CASE} Specification is 0°C.
7. DTS max at TDP is 2°C greater than DTS thermal profile at TDP, but applies only when part is operating at thermal design power and is installed in a system using microcode update 0x25 or later.

5.5 1U Assembly

Figure 20. 1U Reference Heatsink Assembly



The assembly process for the 1U reference heatsink begins with the application of the Honeywell* PCM45F thermal interface material to improve conduction from the IHS. Tape and roll format is recommended. Pad size is 35 x 35 mm, thickness is 0.25 mm.

Next, position the heatsink so that the heatsink fins are parallel to the system airflow. While lowering the heatsink onto the IHS, align the four captive screws of the heatsink to the four threaded nuts of the back plate.

Using a #2 Phillips* screw driver, torque the four captive screws to 8 inch-pounds. For the fastener sequencing, start the threads on all four screws before torquing as this may mitigate against cross threading.

This assembly process is designed to produce a static load of 39 - 51 lbf, for 0.062" - 0.100" board thickness, respectively. The Honeywell PCM45F is expected to meet the performance targets in Table 7 from 30 - 60 lbf. From Table 4, the heatsink static compressive load of 0 - 60 lbf allows for designs that vary from the 1U reference heatsink. Example: a customer's unique heatsink with very little static load (as little as 0 lbf) is acceptable from a socket loading perspective as long as the T_{CASE} specification is met.

Compliance to the board keep-out zones in Appendix B is assumed for this assembly process.

5.5.1 Thermal Interface Material (TIM)

TIM should be verified to be within its recommended shelf life before use. Surfaces should be free of foreign materials prior to the application of TIM. Use isopropyl alcohol and a lint free cloth to remove old TIM before applying new TIM.

5.6 Structural Considerations

Target mass of heatsinks should not exceed 500 gm.

As shown in Table 4, the dynamic compressive load of 200 lbf maximum allows for designs that exceed 500 gm as long as the mathematical product does not exceed 200 lbf. Example: a heatsink of a 2-lb mass (908 gm) x 50 g (acceleration) x 2.0 dynamic amplification factor = 200 lbf. The total static compressive load (Table 4) should also be considered in the dynamic assessments.

Direct contact between the back plate and chassis pan will help minimize board deflection during shock. Placement of the board-to-chassis mounting holes also impacts board deflection and resultant socket solder ball stress. Customers need to assess shock for their designs as their heatsink retention (back plate), heatsink mass, and chassis mounting holes may vary.

5.7 Thermal Design

5.7.1 Thermal Characterization Parameter

The case-to-local ambient thermal characterization parameter (Ψ_{CA}) is defined by:

Equation 1. $\Psi_{CA} = (T_{CASE} - T_{LA}) / TDP$

Where:

T_{CASE} = Processor case temperature (°C). For the T_{CASE} specification, see the appropriate External Design Specification (EDS).

T_{LA} = Local ambient temperature in the chassis at the processor (°C).

TDP = TDP (W) assumes all power dissipates through the integrated heat spreader. This inexact assumption is convenient for heatsink design. TTVs are often used to dissipate TDP. Correction offsets account for the differences in the temperature distribution between the processor and TTV.

Equation 2. $\Psi_{CA} = \Psi_{CS} + \Psi_{SA}$

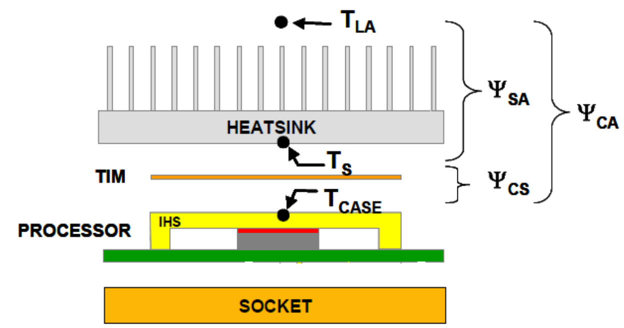
Where:

Ψ_{CS} = Thermal characterization parameter of the TIM (°C/W) is dependent on the thermal conductivity and thickness of the TIM.

Ψ_{SA} = Thermal characterization parameter from heatsink-to-local ambient (°C/W) is dependent on the thermal conductivity and geometry of the heatsink and dependent on the air velocity through the heatsink fins.

Figure 21 illustrates the thermal characterization parameters.

Figure 21. Processor Thermal Characterization Parameter Relationships



5.7.2 Power Thermal Utility

The Intel® Xeon® Processor E5-2400 v3 Power Thermal Utility allows power and thermal testing of the processor.

The thermal solution must be designed to keep the processor T_{CASE} within the specification for the Thermal Design Power (TDP) as specified in the processor External Design Specification (EDS). The default power level from the drop down list represents TDP.

5.8 Thermal Features

More information regarding processor thermal features is contained in the appropriate External Design Specification (EDS).

5.8.1 Fan Speed Control

There are many ways to implement fan speed control. Using processor ambient temperature (in addition to digital thermal sensor) to scale fan speed can improve acoustics when DTS > $T_{CONTROL}$.

Table 7. Fan Speed Control, $T_{CONTROL}$ and DTS Relationship

Condition	FSC Scheme
DTS ≤ $T_{CONTROL}$	FSC can adjust fan speed to maintain DTS ≤ $T_{CONTROL}$ (low acoustic region).
DTS > $T_{CONTROL}$	FSC should adjust fan speed to keep T_{CASE} at or below the thermal profile specification (increased acoustic region).

5.8.2 PECI Averaging and Catastrophic Thermal Management

By averaging DTS over PECI, thermal solution failure can be detected, and a soft shutdown can be initiated to help prevent loss of data.

Thermal data is averaged over a rolling window of 256 mS by default (X = 8):

$$AVG_N = AVG_{N-1} * (1 - 1/2^X) + Temperature * 1/2^X$$

Using a smaller averaging constant could cause premature detection of failure.

Through experimentation, the critical temperature threshold can be estimated. This threshold will likely be a fractional PECI value, for example between a PECI of -0.75 and -0.50. To avoid false shutdowns, initiation of a soft shutdown may be delayed until the PECI reaches a value closer to 0, for example at -0.25.

Since customer designs, boundary conditions, and failure scenarios differ, the above guidance should be tested in the customer's system to prevent loss of data during shutdown.

5.8.3 Thermal Excursion

Under fan failure or other anomalous thermal excursions, T_{CASE} may exceed the thermal profile for a duration totaling less than 360 hours per year without affecting long-term reliability (life) of the processor. For more typical thermal excursions, thermal monitor is expected to control the processor power level as long as conditions do not allow the T_{CASE} to exceed the temperature at which Thermal Control Circuit (TCC) activation initially occurred.

Under more severe anomalous thermal excursions when the processor temperature cannot be controlled at or below this T_{CASE} level by TCC activation, then data integrity is not assured. At some higher threshold, THERMTRIP_N will enable a shut down in an attempt to prevent permanent damage to the processor. A Thermal Test Vehicle (TTV) may be used to check anomalous thermal excursion compliance by ensuring that the processor T_{CASE} value, as measured on the TTV, does not exceed TCASE_MAX at the anomalous power level for the environmental condition of interest. This anomalous power level is equal to 75% of the Thermal Design Power (TDP) limit.

5.8.4 Absolute Processor Temperature

Intel does not test any third-party software that reports absolute processor temperature. As such, Intel cannot recommend the use of software that claims this capability. Since there is part-to-part variation in the TCC activation temperature, use of software that reports absolute temperature can be misleading.

See the Intel® Xeon® Processor E5/E7 v3 Product Family External Design Specification (EDS), Volume Two: Registers for details regarding use of the IA32_TEMPERATURE_TARGET register to determine the minimum absolute temperature at which the TCC will be activated and PROCHOT# will be asserted.

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6.0 Quality and Reliability Requirements

6.1 Test Conditions

Test conditions, qualification, and visual criteria vary by customer.

Socket test conditions are provided in the LGA1366 socket validation reports and LGA1356 Addendum, and are available from socket suppliers listed in Appendix A.

6.2 Intel Reference Component Validation

Intel tests reference components both individually and as an assembly on mechanical test boards, and assesses performance to the envelopes specified in previous sections by varying boundary conditions.

While component validation shows that a reference design is tenable for a limited range of conditions, customers need to assess their specific boundary conditions and perform reliability testing based on their use conditions.

Intel reference components are also used in board functional tests to assess performance for specific conditions.

6.2.1 Board Functional Test Sequence

Each test sequence should start with components (baseboard, heatsink assembly, and so on) that have not been previously submitted to any reliability testing.

6.2.2 Post-Test Pass Criteria

The post-test pass criteria are:

1. No significant physical damage to the heatsink and retention hardware.
2. Heatsink remains seated and its bottom remains mated flat against the IHS surface. No visible gap between the heatsink base and processor IHS. No visible tilt of the heatsink with respect to the retention hardware.
3. No signs of physical damage on the baseboard surface due to impact of the heatsink.
4. No visible physical damage to the processor package.
5. Thermal compliance testing to demonstrate that the case temperature specification can be met.

6.2.3 Recommended BIOS/Processor/Memory Test Procedures

This test is to ensure proper operation of the product before and after environmental stresses with the thermal mechanical enabling components assembled. The test shall be conducted on a fully-operational baseboard that has not been exposed to any battery of tests prior to the test being considered.

The testing setup should include the following components, properly assembled and/or connected:

- Appropriate system baseboard
- Processor and memory
- All enabling components, including the socket and thermal solution parts

The pass criterion is that the system under test shall successfully complete the checking of the BIOS and the basic processor functions and memory without any errors. *Intel® Self Test* is an example of software that can be utilized for this test.

6.3 Material and Recycling Requirements

Material shall be resistant to fungal growth. Examples of non-resistant materials include cellulose materials, animal and vegetable based adhesives, grease, oils, and many hydrocarbons. Synthetic materials such as PVC formulations, certain polyurethane compositions (for example, polyester and some polyethers), plastics which contain organic fillers of laminating materials, paints, and varnishes also are susceptible to fungal growth. If materials are not fungal growth resistant, then MIL-STD-810E, Method 508.4 must be performed to determine material performance.

Any plastic component exceeding 25 gm should be recyclable per the European Blue Angel recycling standards.

The following definitions apply to the use of the terms lead-free, Pb-free, and RoHS compliant.

Lead-Free and Pb-Free: Lead has not been intentionally added, but lead may still exist as an impurity below 1000 ppm.

RoHS Compliant: Lead and other materials banned in the RoHS Directive are either (1) below all applicable substance thresholds as proposed by the EU, or (2) an approved/pending exemption applies.

Note: RoHS implementation details are not fully defined and may change.

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Appendix A Component Suppliers

Various suppliers have developed support components for processors in the LGA1356 package. These suppliers and components are listed as a convenience to customers. Intel does not guarantee quality, reliability, functionality or compatibility of these components. The supplier list and/or the components may be subject to change without notice. Customers are responsible for the thermal, mechanical, and environmental verification of the components with the supplier.

A.1 Intel Enabled Supplier Information

Performance targets for heatsinks are described in Chapter 5.0. Mechanical drawings are provided in Appendix B. Heatsinks assemble to the server back plate in Table 11.

A.1.1 Intel Reference Thermal Solution

Customers can purchase the Intel reference thermal solutions from the suppliers listed in Table 8.

Table 8. Suppliers for the Intel Reference Thermal Solution

Assembly	Component	Description	Supplier PN	Supplier Contact Info
Assembly, Heat Sink, 1U	1U URS Intel Reference Heatsink p/n E32409-001	27 mm 1U Aluminum Fin, Copper Base, includes TIM, capable up to 95W	Fujikura HSA-8078 Rev A	Fujikura America 408-748-6991 Fujikura Taiwan Branch
	1U URS SSI Blade Reference Heatsink p/n E39069-001 refers to E22056 Rev 02 + Snap Cover	25.5 mm 1U Aluminum Fin, Copper Base, includes TIM and Snap Cover, capable up to 95W	Fujikura HSA-8083C	
		Thermal Interface Material	Honeywell* PCM45F	www.honeywell.com

A.1.2 Intel Collaboration Thermal Solution

Customers can purchase the Intel collaboration thermal solutions from the suppliers listed in Table 9.

Table 9. Suppliers for the Intel Collaboration Thermal Solution

Assembly	Component	Description	Supplier PN	Supplier Contact Info
Assembly, Heatsink, Intel® Xeon® Processor E5-2400 v3 Product Family, 2U	2U URS Heatsink Intel Collaboration Heatsink p/n E32410-001	Supplier Designed Solution with Intel-specified retention, includes TIM, up to 95W capable	Foxconn* PN 1A016500	www.foxconn.com
Assembly, Heatsink, Intel® Xeon® Processor E5-2400 v3 Product Family, Pedestal	Tower URS Heatsink Intel Collaboration Heatsink p/n E32412-001	Supplier Designed Solution with Intel-specified retention, includes TIM, up to 95W capable	Chaun-Choung Technology Corp.* (CCI) PN 0007029401	Chaun-Choung Technology Corp (CCI)

A.1.3 Alternative Thermal Solution

Customers can purchase the alternative thermal solutions from the suppliers listed in Table 10.

Table 10. Suppliers for the Alternative Thermal Solution (Sheet 1 of 2)

Assembly	Component	Description	Supplier PN	Thermal Capability
Assembly, Heat Sink, 1U	1U SSI Blade (25.5mm) Alternative URS Heatsink	Standard	TaiSol Corporation* PN 1A1-9031000960-A www.Taisol.com	Not capable for 80W (two-core, one socket); capable for all other SKUs up to 95W
		Standard	Thermaltake* PN CL-P0484 www.Thermaltake.com	Not capable for 80W (two-core, one socket); capable for all other SKUs up to 95W
Assembly Heatsink, 1U	1U (27mm) Alternative URS Heatsink	Standard	CoolerMaster* PN S1N-PJFCS-07-GP www.CoolerMaster.com	Up to 95W capable
		Standard	Aavid Thermalloy* PN 050073 www.AavidThermalloy.com	Up to 95W capable
		Performance	Aavid Thermalloy PN 050231 www.AavidThermalloy.com	Up to 95W capable
		Performance	Aavid Thermalloy PN 050232 www.AavidThermalloy.com	Up to 95W capable
		Standard	CoolJag* PN JYC0B39CTA www.CoolJag.com	Up to 95W capable
		Performance	Taiwan Microloops* PN 99-520040-M03 www.Microloops.com	Up to 95W capable
		Performance	Asia Vital Components* PN SQ42H00001 www.avc.com.tw	Up to 95W capable
		Performance	Dynatron* PN G218 www.Dynatron-Corp.com	Up to 95W capable
		Performance	Delta Electronics* PN DHS-B9090-20 www.deltaww.com	Up to 95W capable
		Performance	Celsia Technologies* PN 01IN001 www.celsiatechnologies.com	Up to 95W capable

Table 10. Suppliers for the Alternative Thermal Solution (Sheet 2 of 2)

Assembly	Component	Description	Supplier PN	Thermal Capability
Assembly, Heatsink, 2U	2U Alternative URS Heatsink	Standard	Asia Vital Components PN SR40400001 www.avc.com.tw	Up to 95W capable
		Standard	Asia Vital Components PN SR41400002 www.avc.com.tw	Up to 95W capable
		Standard	Thermaltake PN CL-P0486 www.Thermaltake.com	Up to 95W capable
		Standard	CoolerMaster PN S2N-PJMHS-07-GP www.CoolerMaster.com	Up to 95W capable
		Standard	TaiSol Corporation PN 1A0-9041000960-A www.Taisol.com	Up to 95W capable
		Low Cost	Dynatron Corporation (Top Motor/Dynaeon) PN G520 www.Dynatron-Corp.com	Not capable for 80W (two-core, one socket); capable for all other SKUs up to 95W
		Low Cost	CoolJag PN JAC0B40A www.CoolJag.com	Not capable for 80W (two-core, one socket); capable for all other SKUs up to 95W
Assembly, Heatsink, Tower	Tower Alternative URS Heatsink	Standard	TaiSol Corporation PN 1A0-9051000960-A www.Taisol.com	Up to 95W capable
		Standard	Thermaltake PN CL-P0485 www.Thermaltake.com	Up to 95W capable
		Standard	Asia Vital Components PN SS40W00001 www.avc.com.tw	Up to 95W capable
Assembly, Heatsink	Pedestal/2U Active Heatsink	Active	Dynatron Corporation* (Top Motor/Dynaeon) PN G555 www.Dynatron-Corp.com	Up to 95W capable

Notes:
1. Standard - Design and technology similar to the Intel reference or collaboration designs; however, may not meet thermal requirements for all processor SKUs.
2. Performance - 1U heatsink designed with premium materials or technology expected to provide optimum thermal performance for all processor SKUs.
3. Low cost - 2U cost-optimized heatsink, expected to meet thermal targets for lower power processor SKUs.

A.1.4 Socket, ILM, and Back Plate

The LGA1356 socket, ILM and back plate are described in Chapter 2.0 and Chapter 3.0, respectively. Socket mechanical drawings are provided in Appendix C.

Table 11. LGA1356 Socket, ILM, and Back Plate

Item	Intel PN	Foxconn*	Tyco*	Molex*
ILM Assembly	D92428-003	PT44L13-4102	1554105-1	475939000
ILM Assembly with ILM Cover	G13666-001	PT44L13-4111	1-1554105-1	475939070
ILM Cover	G14954-001	012-1000-5776	1-2134711-1	475930403
Back Plate	D92433-002	PT44P12-4104	1981467-2	475937000
LGA1356 Socket	E81085-001	PE135627-4371-01H	1554116-1	475943001
Supplier Contact Info		http://www.foxconn.com/	www.te.com	http://www.molex.com/molex/index.jsp

Table 12. Embedded Heatsink Component Suppliers

Component	Description	Supplier PN	Supplier Contact Info
ATCA Reference Heatsink Intel PN E65918-001	ATCA Copper Fin, Copper Base	Fujikura PN: HSA-7901-B	Fujikura America Fujikura Taiwan Branch 886(2)8788-4959

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Appendix B Mechanical Drawings

Table 13. Mechanical Drawing List

Description	Figure
"Board Keepin/Keep-Out Zones (Sheet 1 of 4)"	Figure 22
"Board Keepin/Keep-Out Zones (Sheet 2 of 4)"	Figure 23
"Board Keepin/Keep-Out Zones (Sheet 3 of 4)"	Figure 24
"Board Keepin/Keep-Out Zones (Sheet 4 of 4)"	Figure 25
"ATCA Reference Heat Sink Assembly (Sheet 1 of 2)"	Figure 26
"ATCA Reference Heat Sink Assembly (Sheet 2 of 2)"	Figure 27
"ATCA Reference Heatsink Fin and Base (Sheet 1 of 2)"	Figure 28
"ATCA Reference Heatsink Fin and Base (Sheet 2 of 2)"	Figure 29

Figure 22. Board Keepin/Keep-Out Zones (Sheet 1 of 4)

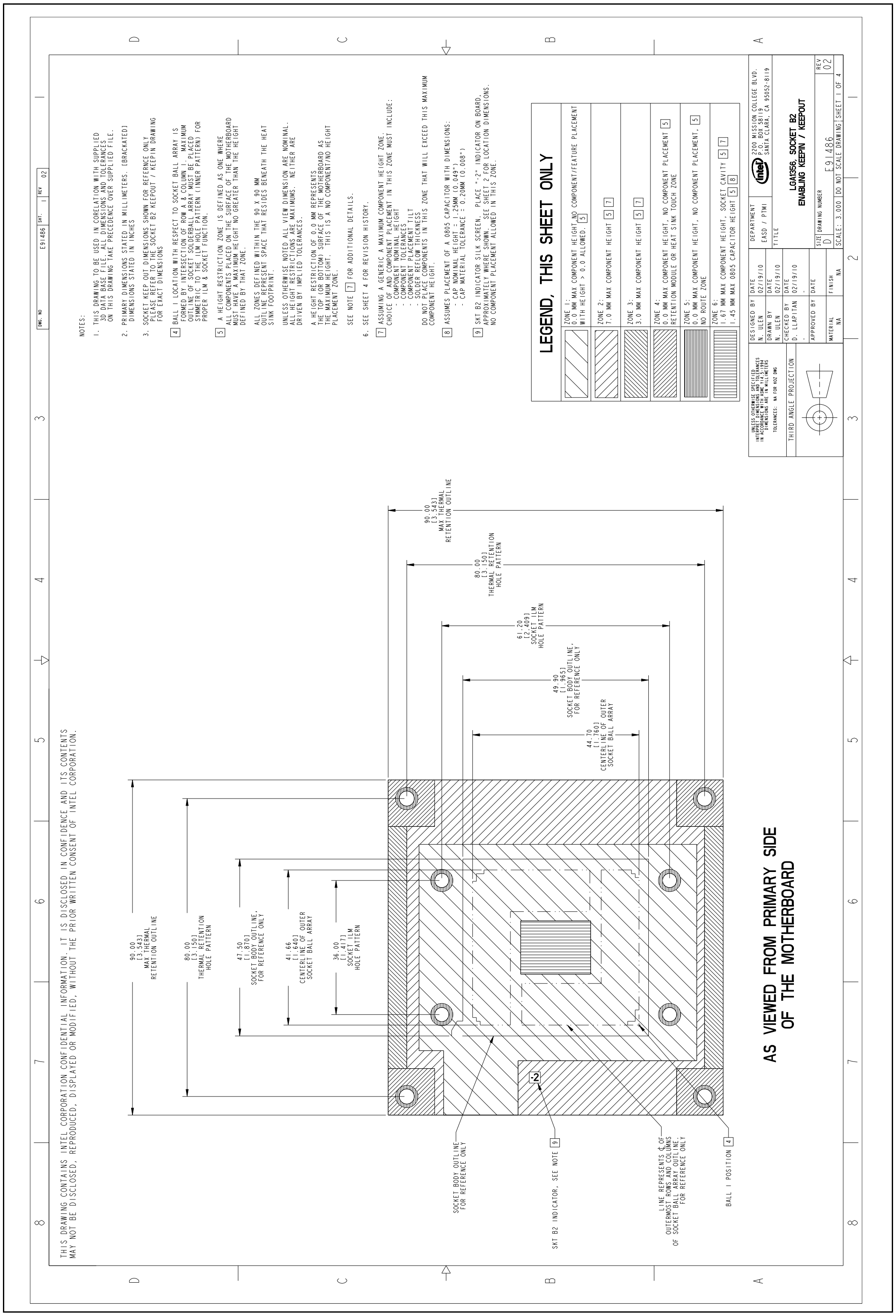


Figure 23. Board Keepin/Keep-Out Zones (Sheet 2 of 4)

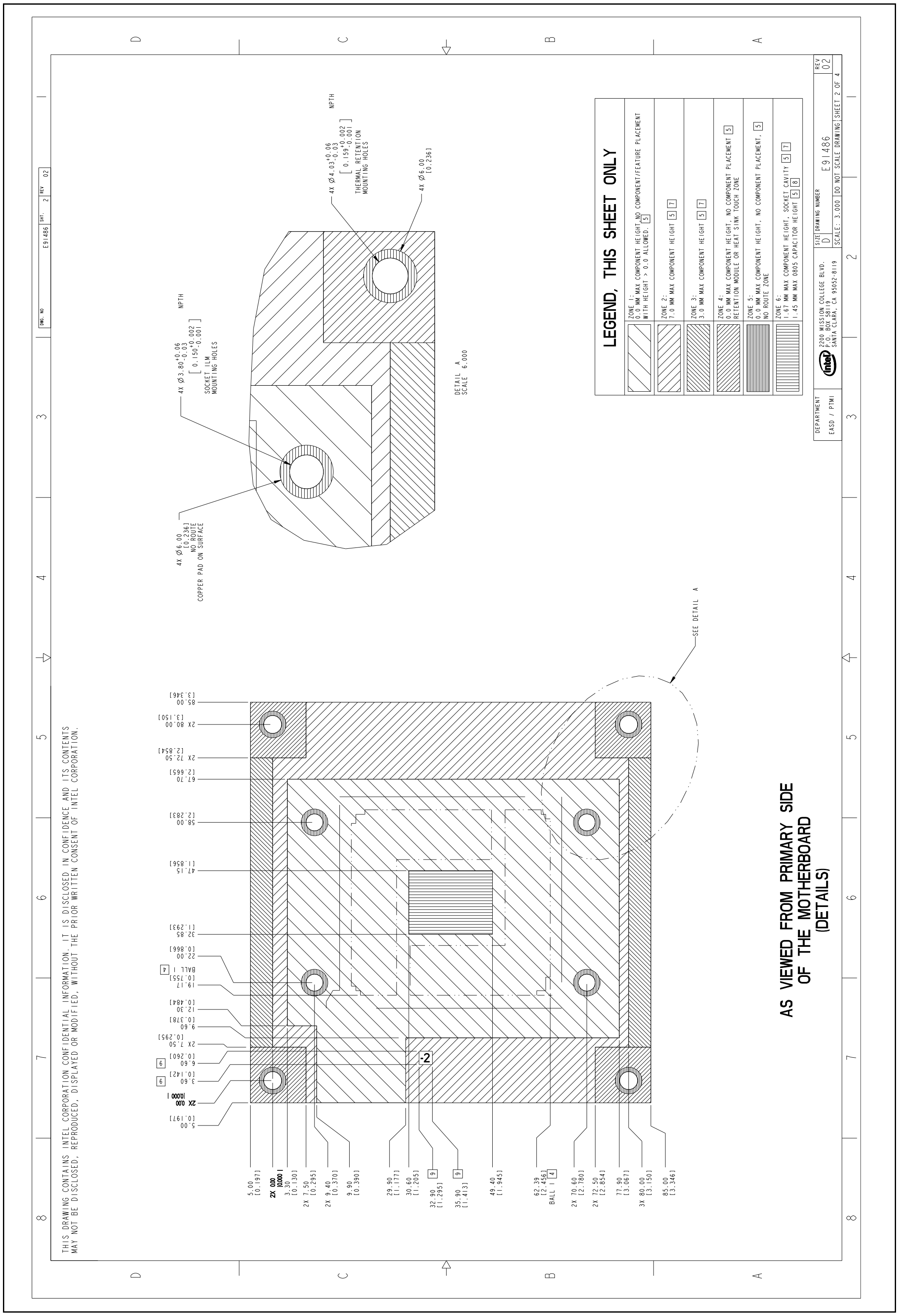


Figure 24. Board Keepin/Keep-Out Zones (Sheet 3 of 4)

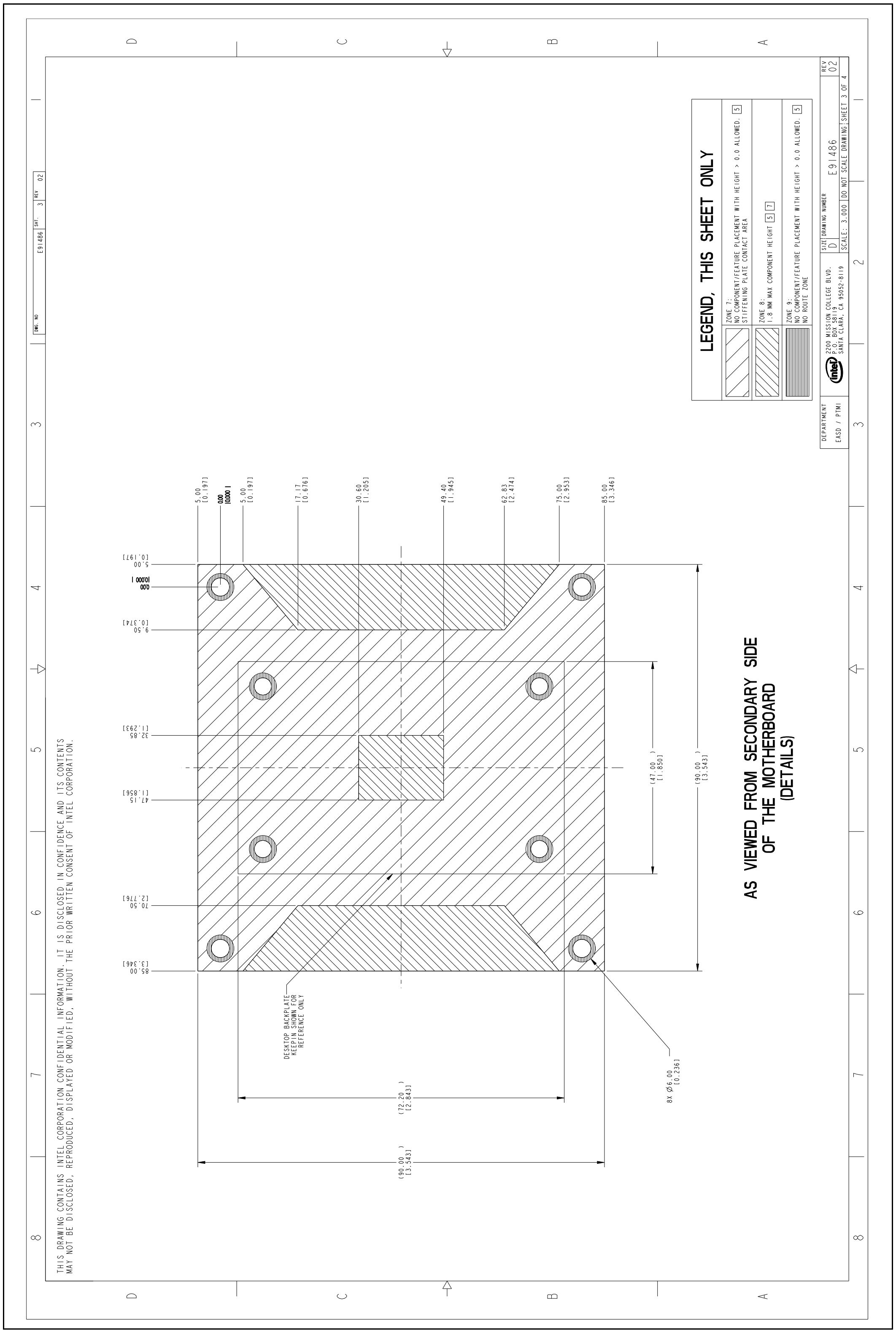


Figure 25. Board Keepin/Keep-Out Zones (Sheet 4 of 4)

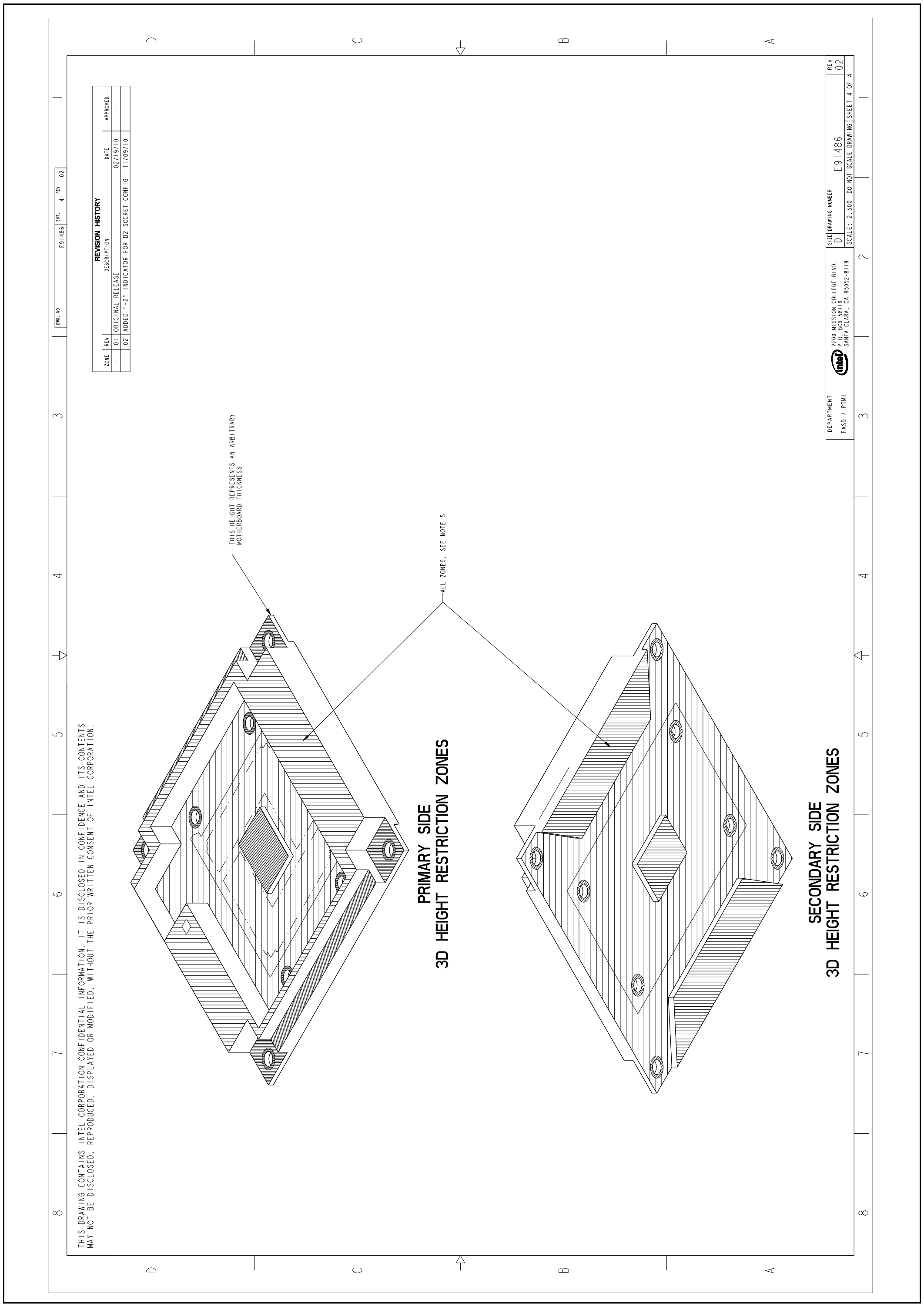


Figure 26. ATCA Reference Heat Sink Assembly (Sheet 1 of 2)

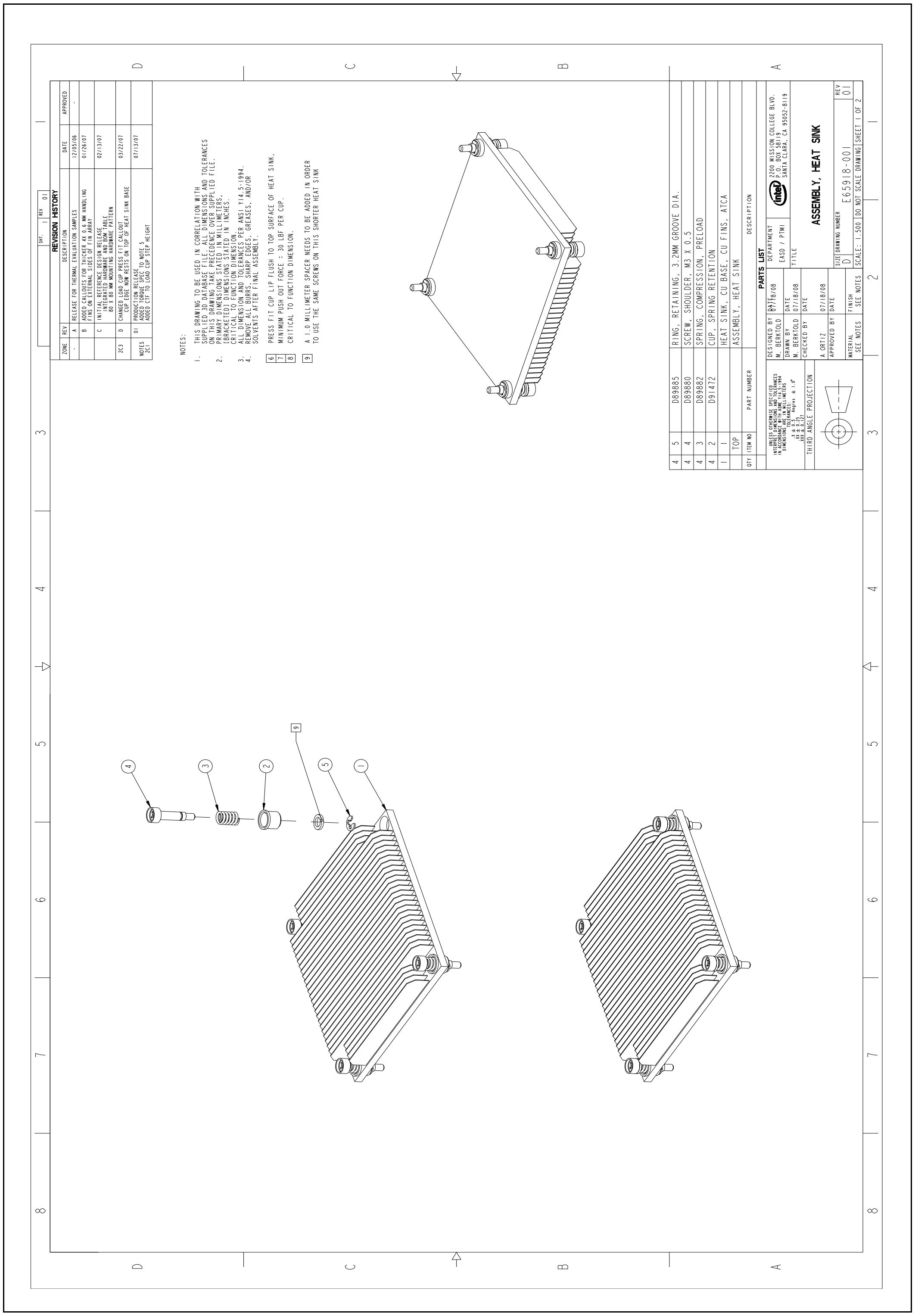


Figure 27. ATCA Reference Heat Sink Assembly (Sheet 2 of 2)

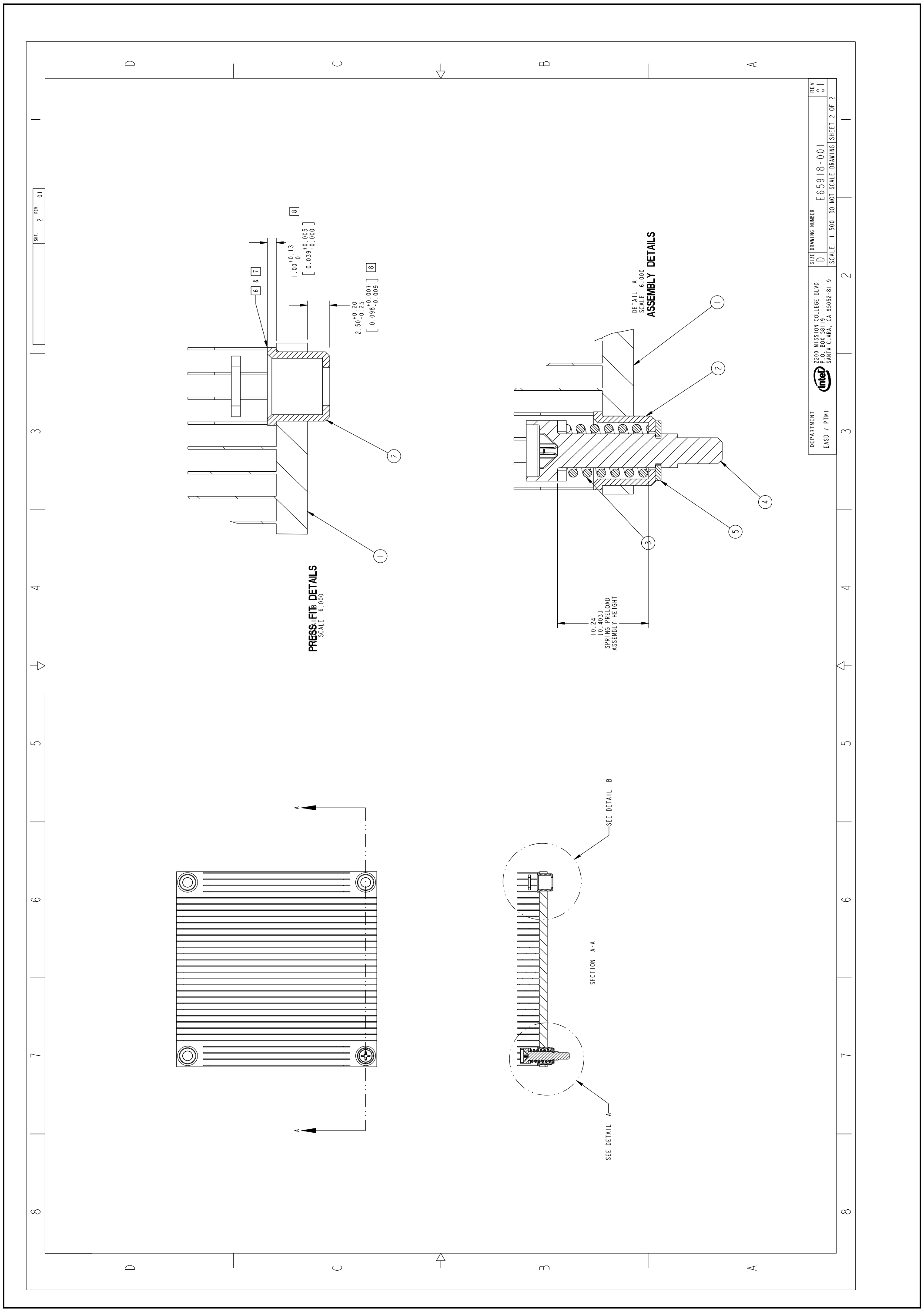


Figure 28. ATCA Reference Heatsink Fin and Base (Sheet 1 of 2)

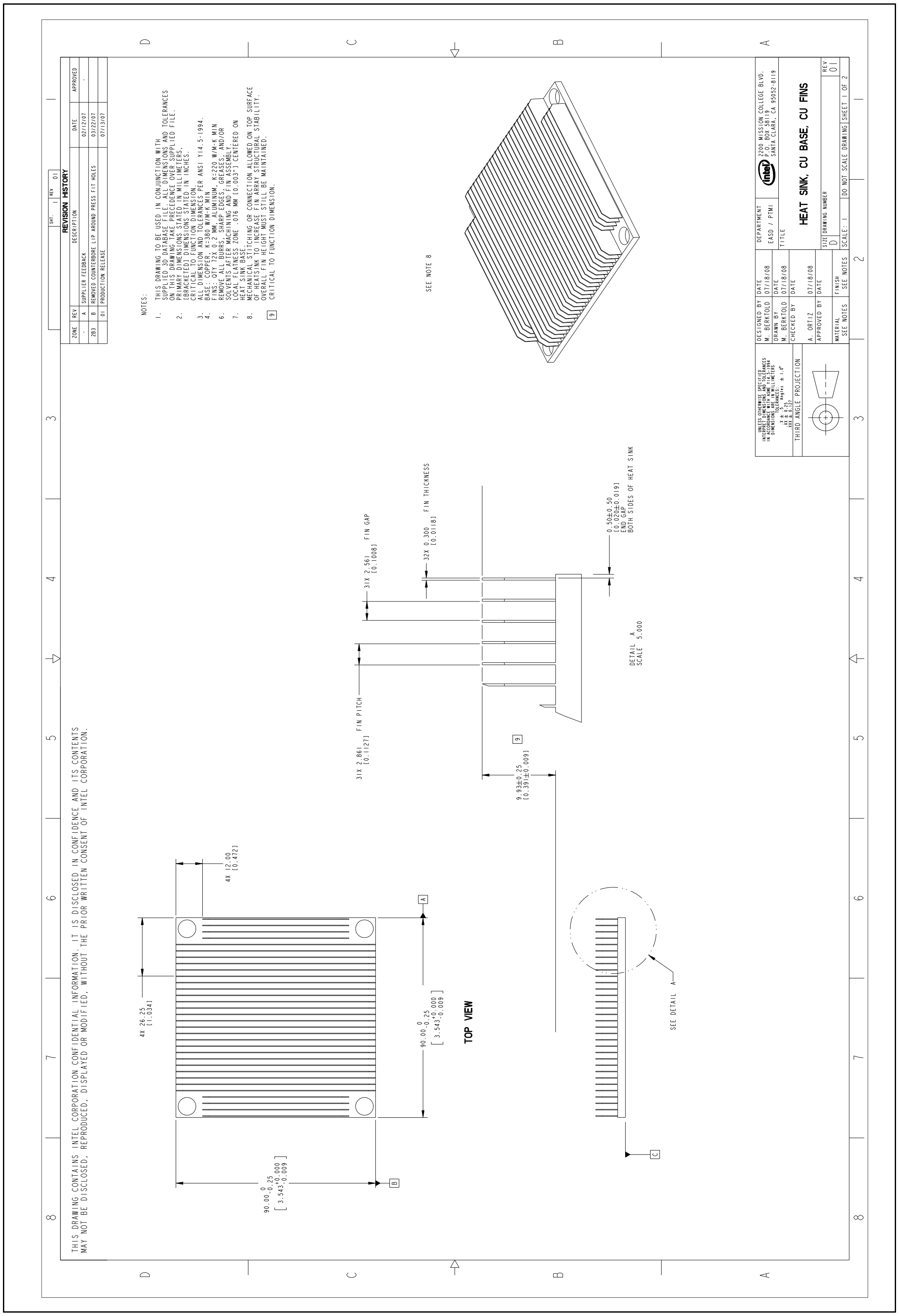
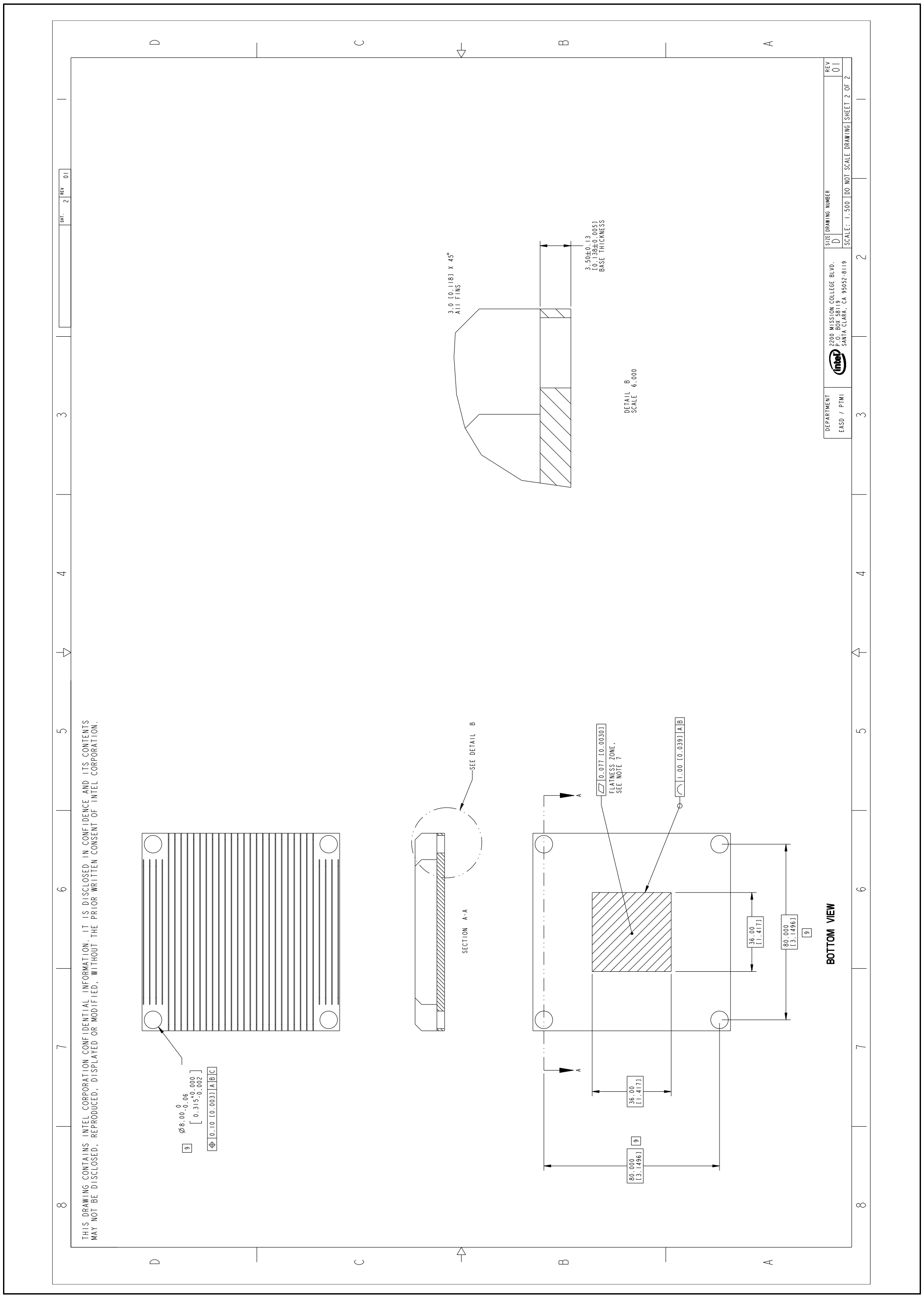


Figure 29. ATCA Reference Heatsink Fin and Base (Sheet 2 of 2)



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Appendix C Package and Socket Mechanical Drawings

Table 14 lists the mechanical drawings included in this appendix.

Table 14. Mechanical Drawing List

Drawing Description	Figure Number
"Package Mechanical Drawing (Sheet 1 of 2)"	Figure 30
"Package Mechanical Drawing (Sheet 2 of 2)"	Figure 31
"Socket Mechanical Drawing (Sheet 1 of 4)"	Figure 32
"Socket Mechanical Drawing (Sheet 2 of 4)"	Figure 33
"Socket Mechanical Drawing (Sheet 3 of 4)"	Figure 34
"Socket Mechanical Drawing (Sheet 4 of 4)"	Figure 35

Figure 30. Package Mechanical Drawing (Sheet 1 of 2)

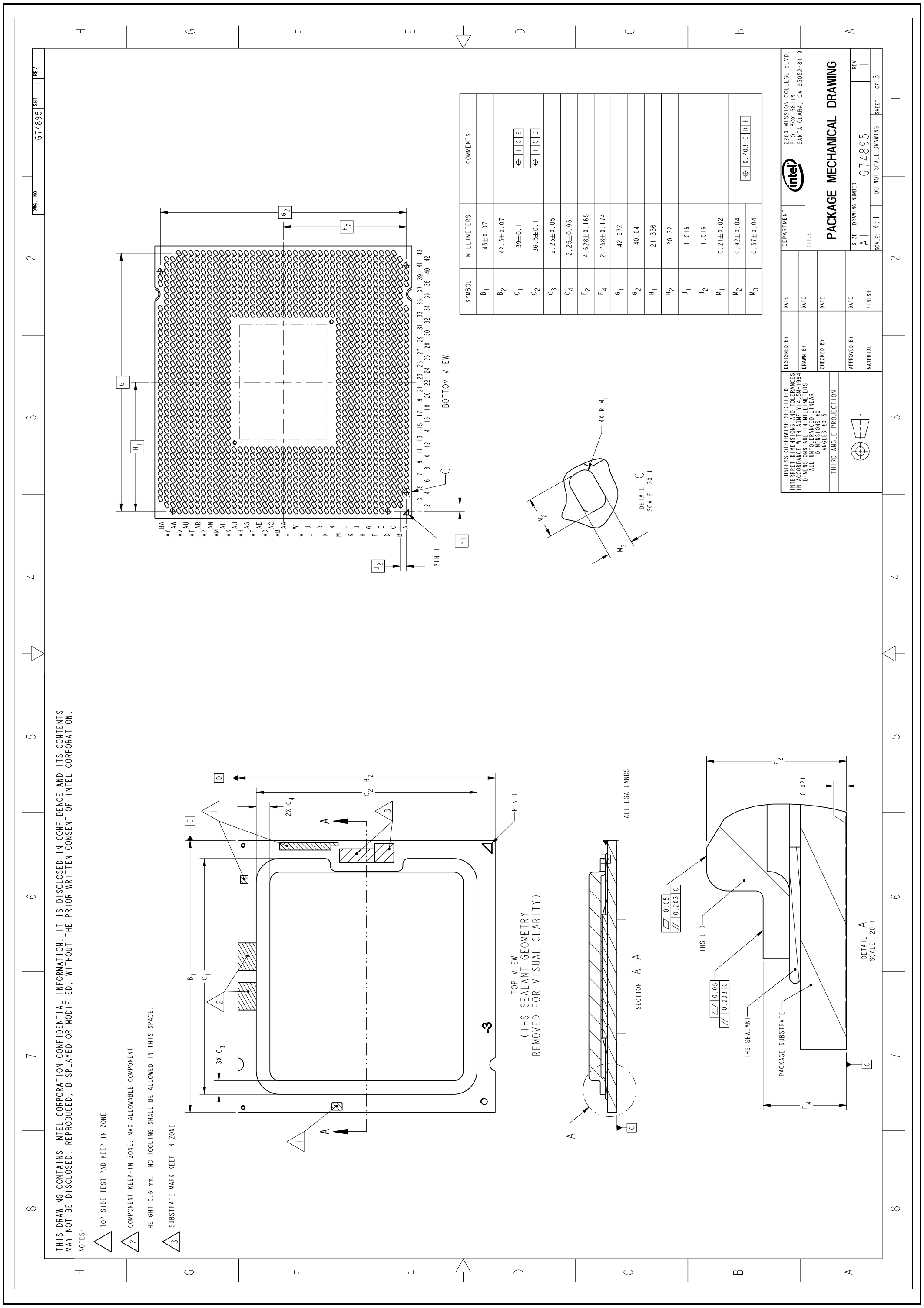


Figure 31. Package Mechanical Drawing (Sheet 2 of 2)

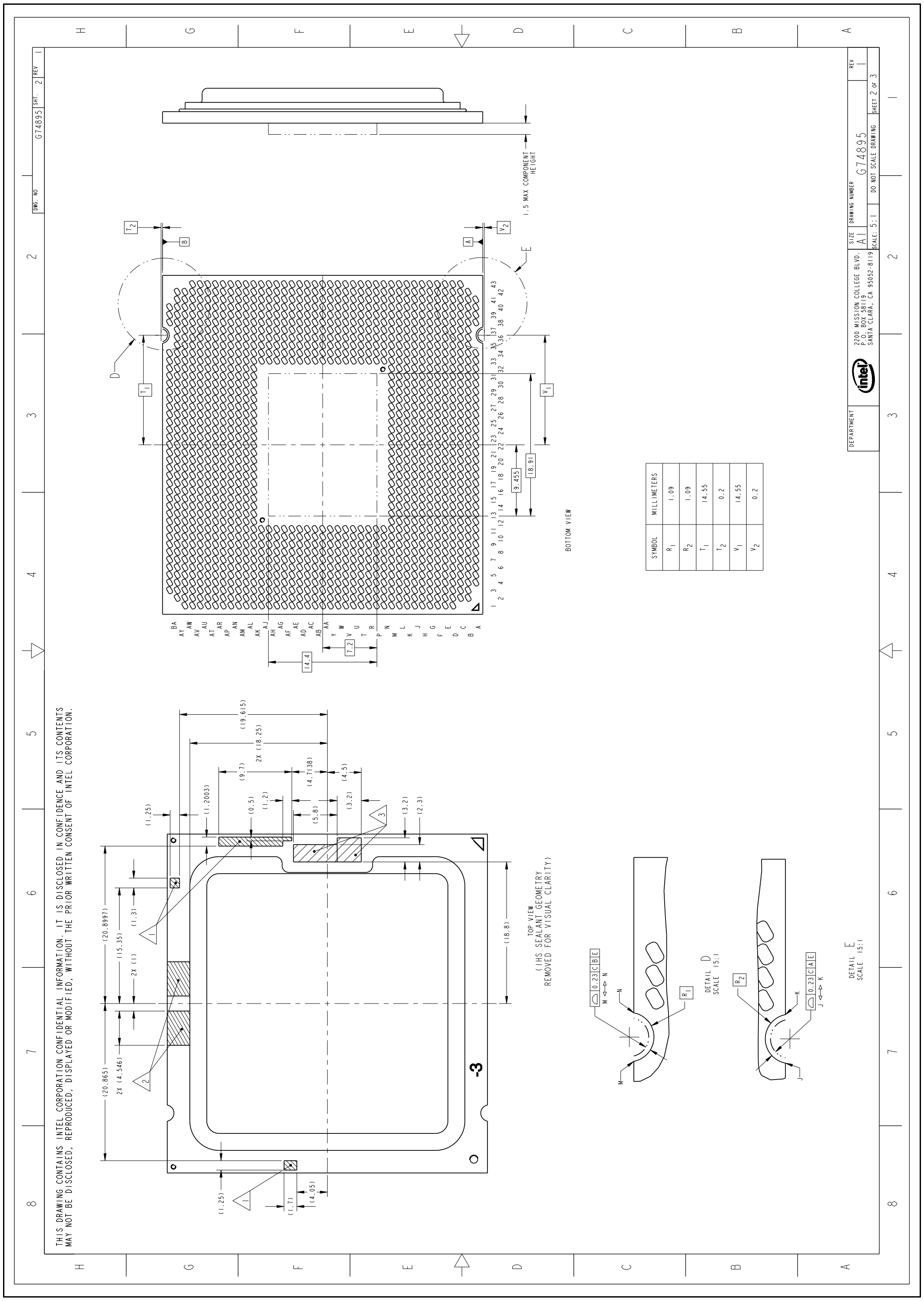


Figure 32. Socket Mechanical Drawing (Sheet 1 of 4)

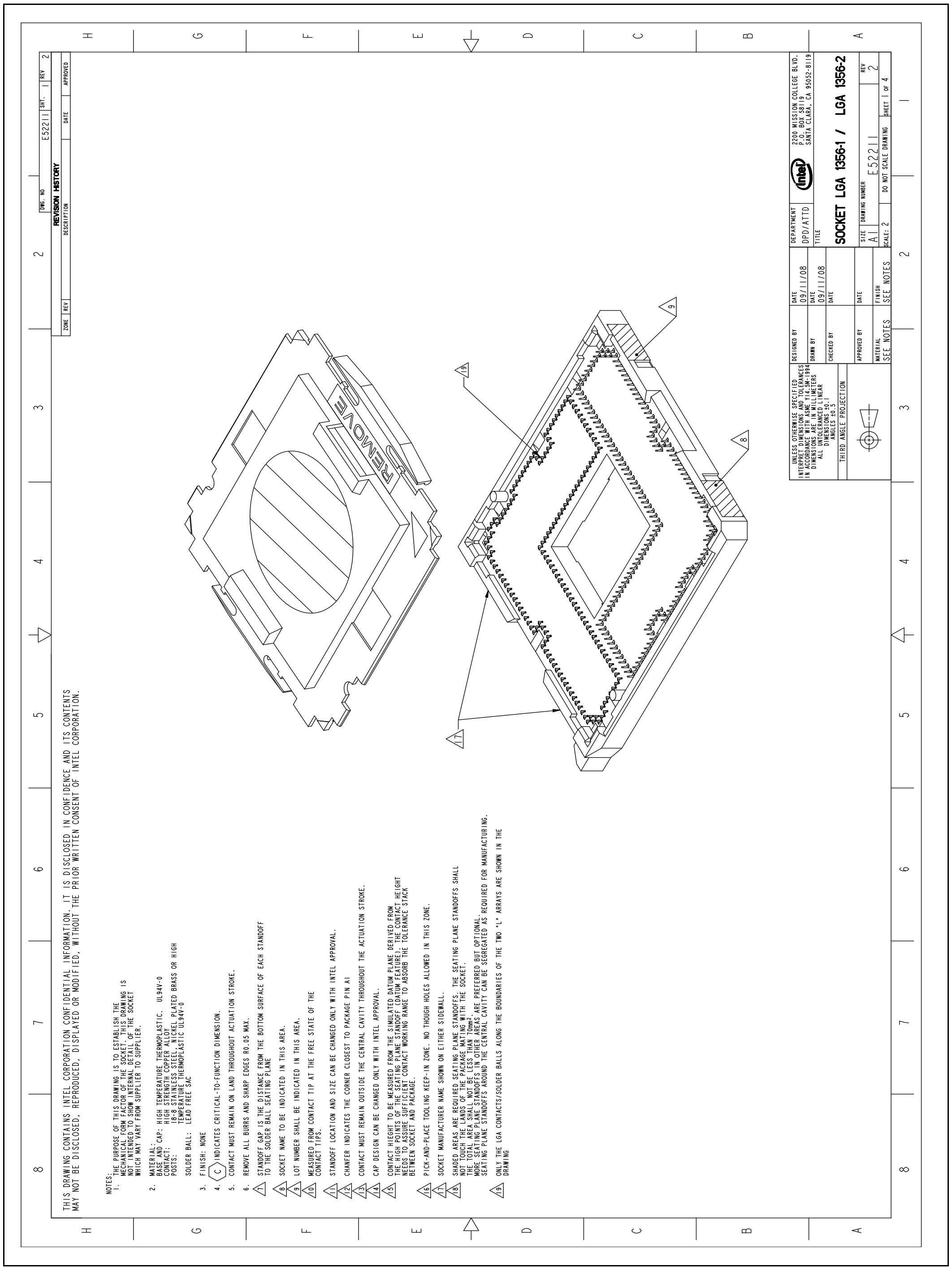


Figure 33. Socket Mechanical Drawing (Sheet 2 of 4)

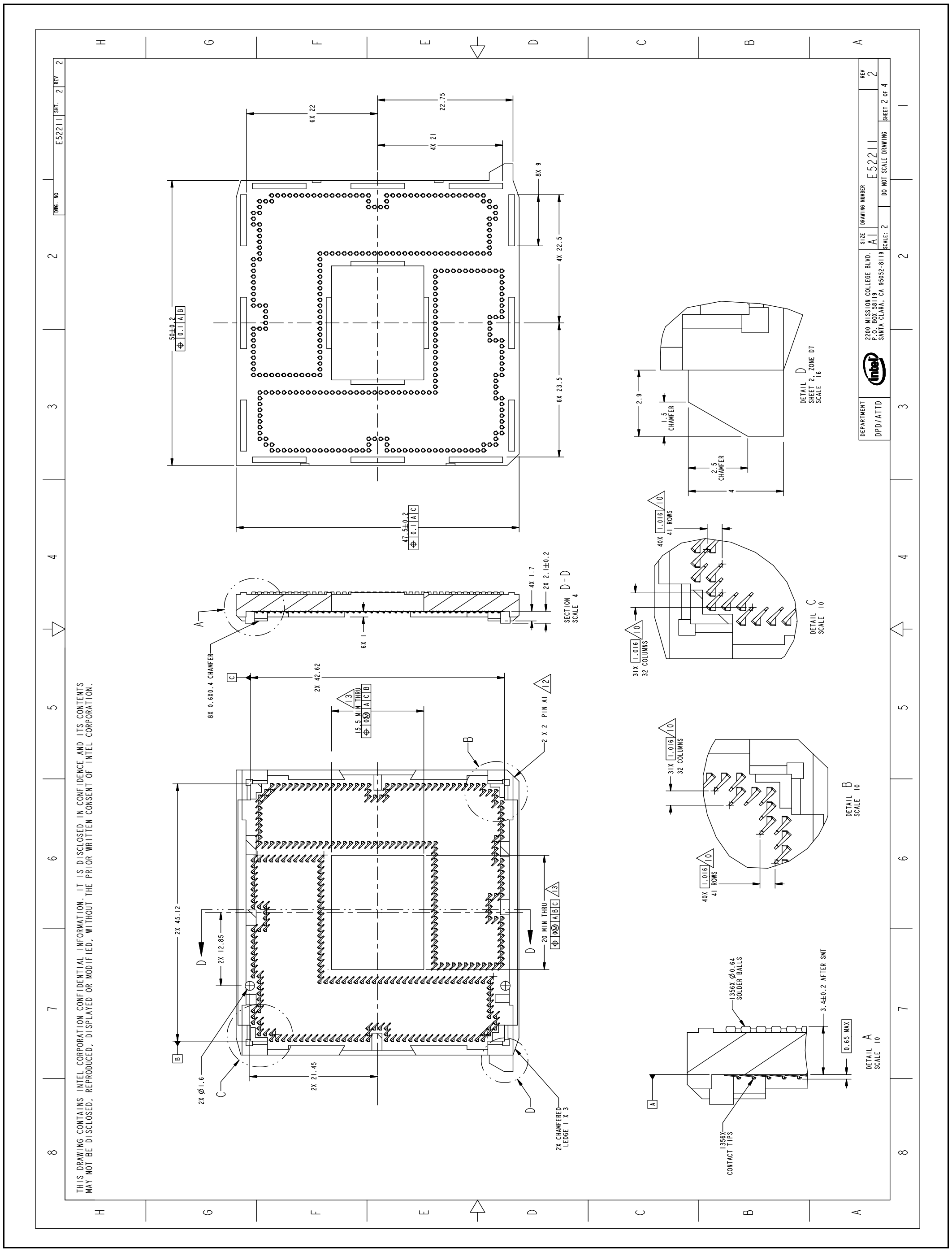


Figure 34. Socket Mechanical Drawing (Sheet 3 of 4)

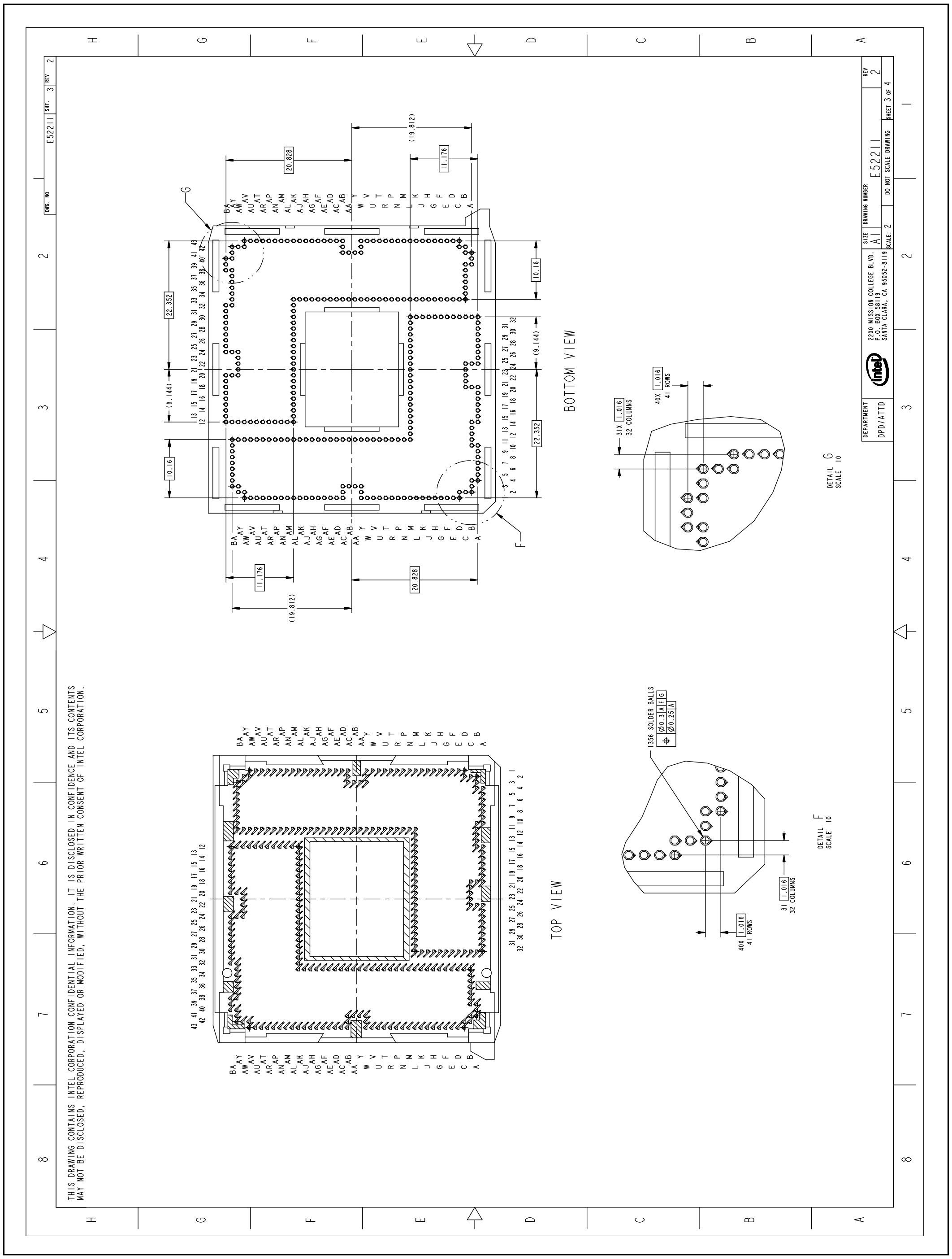
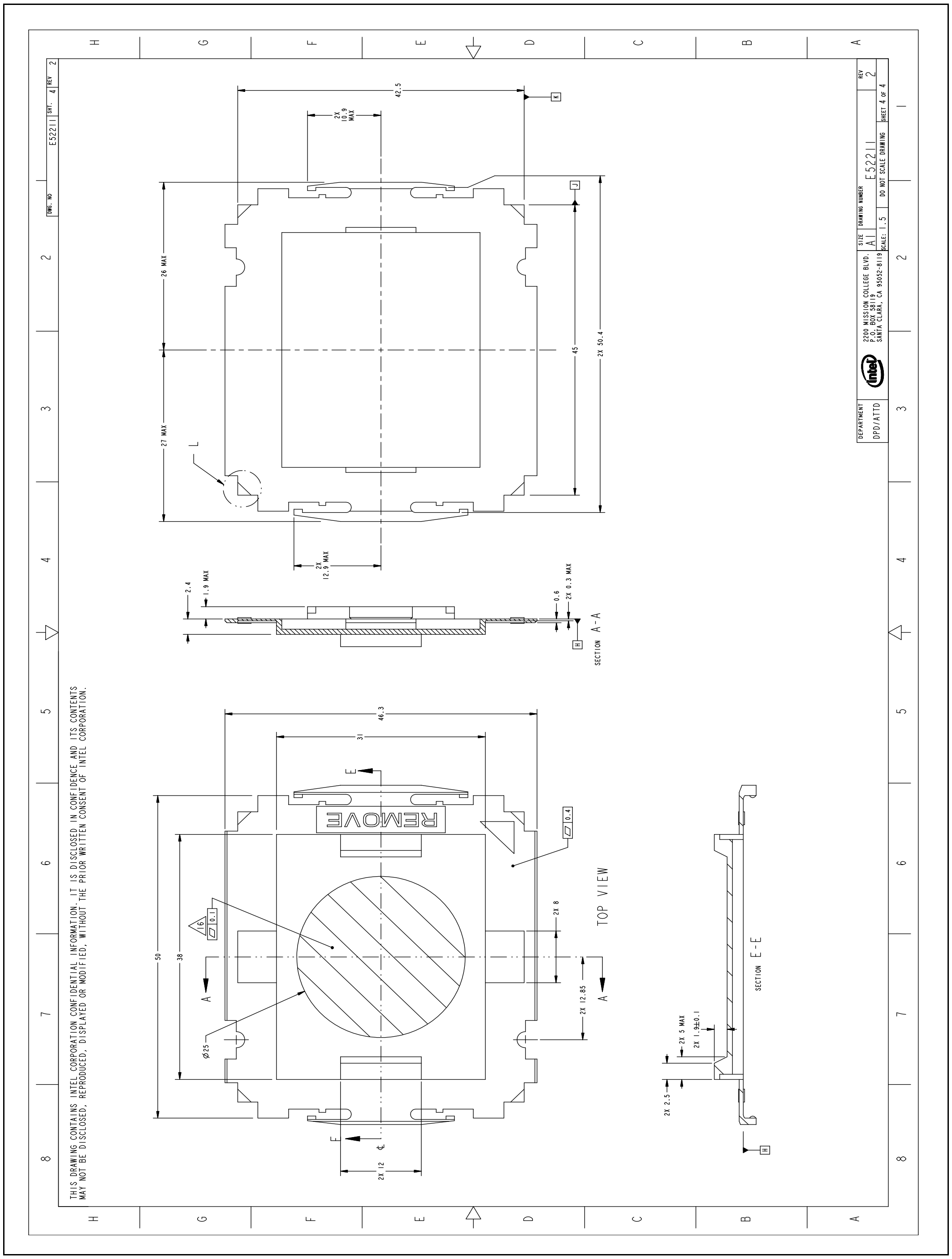


Figure 35. Socket Mechanical Drawing (Sheet 4 of 4)



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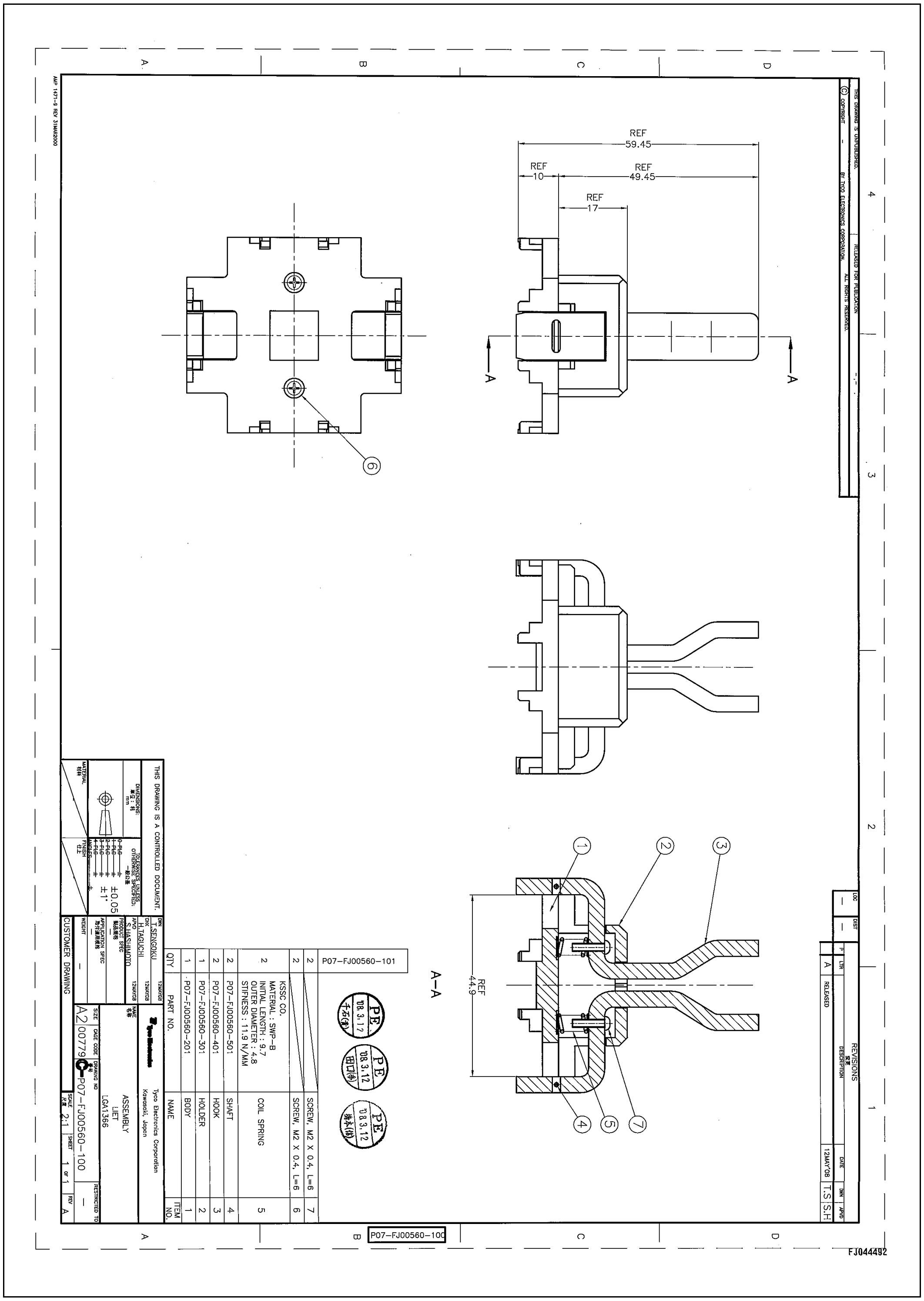
Appendix D Processor Installation Tool

The following optional tool is designed to provide mechanical assistance during processor installation and removal.

Contact the supplier for details regarding this tool:

Tyco Electronics
www.te.com

Figure 36. Processor Installation Tool



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