intel®

AP-588

APPLICATION NOTE

Mechanical Assembly and Customer Manufacturing Technology for S.E.C. Cartridge Processors

July 1997

Order Number: 243333-001

Copies of documents which have an ordering number and are referenced in this document, or other Intel literature, may be obtained from:

Intel Corporation
P.O. Box 7641
Mt. Prospect IL 60056-7641

or call 1-800-879-4683
or visit Intel's website at http://www.intel.com

CONTENTS

FIGURES

TABLES

1.0. INTRODUCTION

The Pentium® II processor is the next in the Intel386™, Intel486™, Pentium and Pentium Pro line of Intel processors. The Pentium II processor, like the Pentium Pro processor, implements a Dynamic Execution micro-architecture — a unique combination of multiple branch prediction, data flow analysis and speculative execution. This enables the Pentium II processor to deliver higher performance than the Pentium processor, while maintaining binary compatibility with all previous Intel architecture processors. The Pentium II processor also executes MMX™ technology instructions for enhanced media and communication performance. The Pentium II processor utilizes multiple low-power states such as AutoHALT, Stop-Grant, Sleep and Deep Sleep to conserve power during idle times.

The Pentium II processor utilizes the same multi-processing System Bus technology as the Pentium Pro processor. This allows for a higher level of performance for both uni-processor and two-way multi-processor (2-way MP) systems. Memory is cacheable for up to 512 MB of addressable memory space, allowing significant headroom for business desktop systems.

The Pentium II processor System Bus operates in the same manner as the Pentium Pro processor System Bus. The Pentium II processor System Bus uses GTL+ signal technology. The Pentium II processor deviates from the Pentium Pro processor by using commercially available die for the L2 cache. The L2 cache (the TagRAM and burst pipelined synchronous static RAM (BSRAM) memories) are now multiple die. Transfer rates between the Pentium II processor core and the L2 cache are one-half the processor core clock frequency and scale with the processor core frequency. Both the TagRAM and BSRAM receive clocked data directly from the Pentium II processor core. As with the Pentium Pro processor, the L2 cache does not connect to the Pentium II processor System Bus (see Figure 1).

With the Pentium II processor, Intel has abandoned traditional processor architecture to ensure performance growth into future generations. The change to Single Edge Contact (S.E.C.) cartridge package technology was to ensure the Pentium II processor could handle the increasing demands for power from businesses and consumers interested in the new world of multimedia (see Figure 2). Previous package technologies become hampered by an increasing disparity between the speed of the processor and the ability of the system to get data to the processor. The starvation of the processor due to system bandwidth gets worse as processors are called upon to handle digital video and high-end 3-D graphics, or as users seek better performance when running multiple tasks simultaneously or managing high-speed communications.

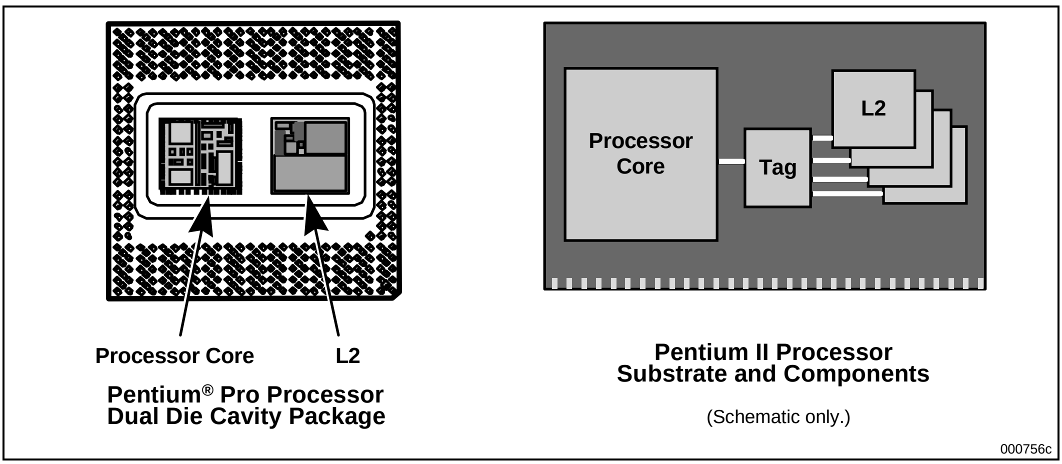


Figure 1. Second Level (L2) Cache Implementations

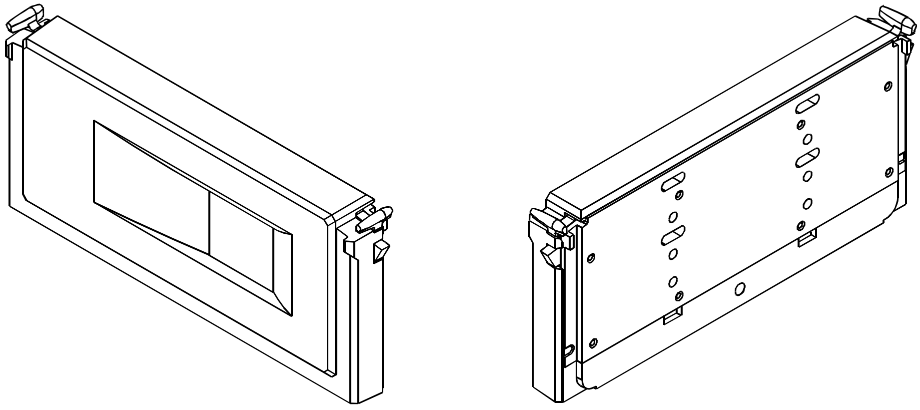


Figure 2. Single Edge Contact Cartridge Package

The new design employs what's known as Dual Independent Bus Architecture, which in the case of the Pentium II increases the PC's ability to move data to the chip by as much as 300 percent. It has two separate paths or buses between the processor core and the Level 2 cache, and the processor core and system memory. The two buses will enable users to avoid the processing stalls that can occur when a processor doesn't get enough information to operate efficiently. To avoid the bottleneck, Intel broke the mold for processor designs, moving from its traditional socket architecture – which itself changed with each iteration of the x86 architecture – to a package design known as the Single Edge Contact cartridge.

Intel has introduced a variety of innovative package designs over the years: surface mount, small out-line, very thin package, multilayer molded plastic quad flatpacks (PQFP), and the Tape Carrier Package (TCP) format. The latest configuration for optimum microprocessor performance is the Single Edge Contact (S.E.C.) cartridge package. The S.E.C. cartridge package combines an area array packaged processor core, industry standard, pipelined burst SRAMs (BSRAMs), an Intel developed second level cache TagRAM and a thermal solution attach point. The entry of the S.E.C. cartridge package technology continues the commitment to providing packaging solutions which meet Intel's rigorous criteria for quality and performance.

1.1. Purpose of this Document

This application note is meant to familiarize the reader with the S.E.C. cartridge package technology developed by Intel and related issues for the Personal Computer Original Equipment Manufacturer (PC OEM) The first section will detail the manufacturing technology used by Intel for the S.E.C. cartridge. The second half of the document will describe an enabled mechanical solution for use in PC OEM systems and impacts that solution has on the PC OEM manufacturing process.

1.2. References

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

- *Pentium® II Processor at 233 MHz, 266 MHz and 300 MHz* datasheet (Order Number 243335)
- AP-485, *Intel Processor Identification with the CPUID Instruction* (Order Number 241618)
- AP-585, *Pentium® II Processor GTL+ Guidelines* (Order Number 243330)
- AP-586, *Pentium® II Processor Thermal Design Guidelines* (Order Number 243333)
- AP-587, *Pentium® II Processor Power Distribution Guidelines* (Order Number 243332)
- AP-589, *Pentium® II Processor Electro-Magnetic Interference* (Order Number 243334)

- *Pentium® II Processor Specification Update* (Order Number 243337)
- *Pentium® II Processor I/O Buffer Models*, IBIS Format (Electronic Form)
- *Pentium® II Processor Developer's Manual* (Order Number 243341)
- *Packaging* Databook (Order Number 240800)
- *Slot 1 Connector Design Guidelines*, located at the Intel website
- *Mechanical Support Pieces for S.E.C. Cartridge Processors,* located at the Intel website
- *Pentium® II Processor Supplier's Guide,* located at the Intel website
- Intel website: http://developer.intel.com/design/PentiumII or http://www.intel.com

2.0. SINGLE EDGE CONTACT CARTRIDGE PACKAGE

The Pentium II processor is the first microprocessor product from Intel corporation to utilize the Single Edge Contact (S.E.C.) cartridge packaging technology. The S.E.C. cartridge allows the L2 cache to remain tightly coupled to the processor, while enabling use of high volume commercial SRAM components. The L2 cache is performance optimized and tested at the cartridge level. The S.E.C. cartridge utilizes surface mount technology and a substrate with an edge finger connection. The S.E.C. cartridge package introduced on the Pentium II processor will also be used in future Slot 1 processors.

The S.E.C. cartridge has the following features: a thermal plate, a cover and a substrate with an edge finger connection. The thermal plate allows standardized heatsink attachment or customized thermal solutions. The full enclosure of the thermal plate, cover and skirt also protects the surface mount components. The edge finger connection maintains socketability for system configuration. The edge finger connection uses a connector that is noted as the 'Slot 1 connector' in this and other documentation.

2.1. S.E.C. Cartridge Terminology

The following terms are used often in this document and are explained here for clarification (see Figure 3 and Figure 4):

- **Pentium II processor** — The entire product including internal components, substrate, thermal plate and cover.
- **S.E.C. cartridge** — The new processor packaging technology is called a "Single Edge Contact cartridge."
- **Processor substrate** —The structure on which the components are mounted inside the S.E.C. cartridge (with or without components attached).
- **Processor core** — The processor's execution engine.
- **Thermal plate** — The surface used to connect a heatsink or other thermal solutions to the processor.
- **Cover** — The processor casing on the opposite side of the thermal plate.
- **Latch arms** — A processor feature that can be utilized as a means for securing the processor in the retention mechanism.
- **Skirt** — With the thermal plate and cover, completes the enclosure of processor substrate.

The L2 cache, TagRAM and BSRAMs, keep industry standard names.

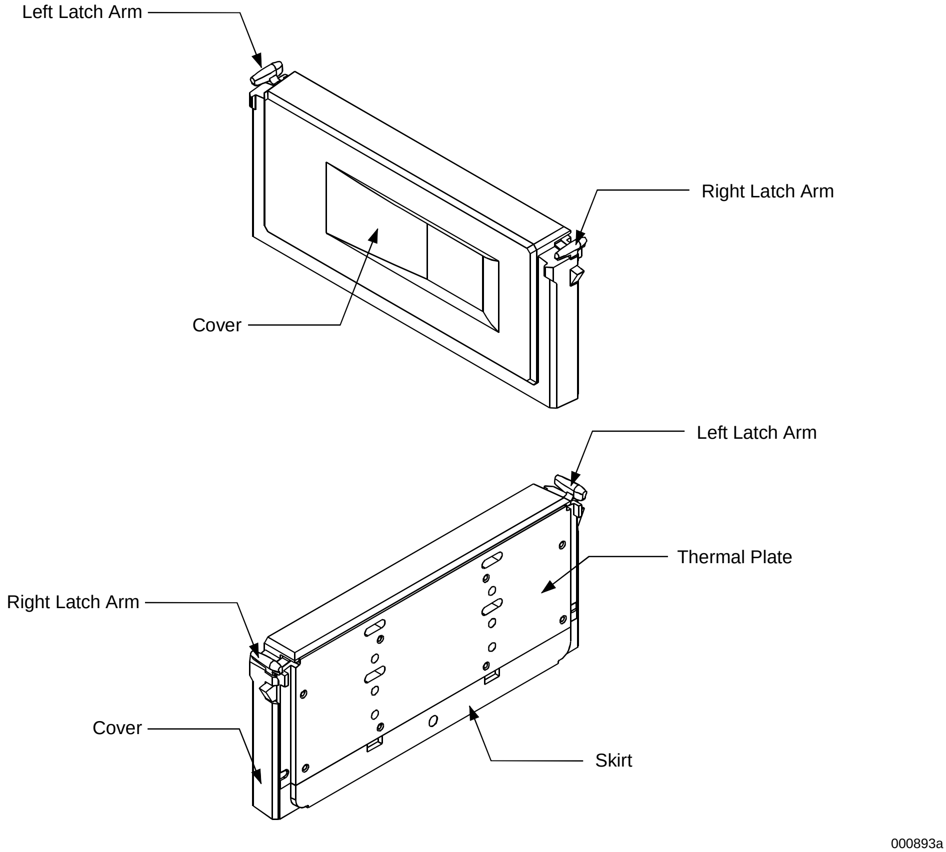


Figure 3. S.E.C. Cartridge — Thermal Plate and Cover Side Views

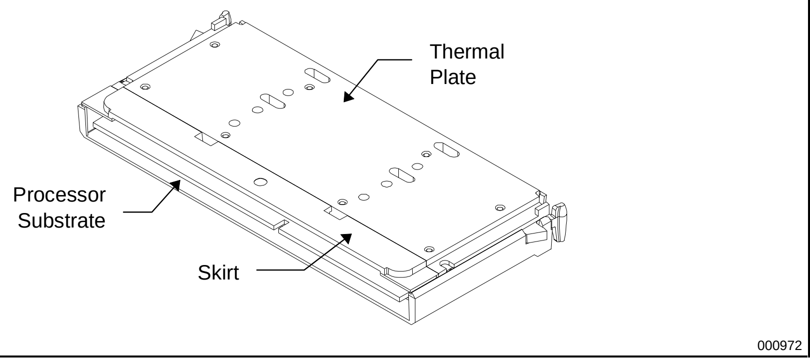


Figure 4. S.E.C. Cartridge — Skirt and Substrate Details Shown

Additional terms referred to in this and other related documentation are the Mechanical Support Pieces (MSPs), which are used on the system to connect the processor to the system baseboard, and retention of the processor during system shock and vibration. The MSPs represent one solution for retention of the processor in the Slot 1 connector. This application note will focus on the use of these pieces:

- **Slot 1 Connector** — The connector that the S.E.C. cartridge plugs into, just as the Pentium Pro processor uses Socket 8.
- **Retention Mechanism** — A mechanical piece which holds the cartridge in the Slot 1 connector.
- **Retention Mechanism Attach Mount** — A mechanical piece which secures the retention mechanism to the baseboard.
- **Heatsink Support** — The support pieces that are mounted on the motherboard to provide added support for heatsinks. The heatsink support consists of heatsink support base, top bar and base pins.
- **Dual Retention Mechanism** — A mechanical piece which holds two S.E.C. cartridges in two Slot 1 connectors for a 2-way SMP processor system.

Other mechanical solutions are not investigated in detail in this document.

2.2. S.E.C. Cartridge Package Assembly and Construction

2.2.1. S.E.C. CARTRIDGE PACKAGE ASSEMBLY

Figure 5 shows an exploded view of the S.E.C. cartridge package. The S.E.C. cartridge core, substrate, thermal plate, thermal plate attach clips, protective cover with latches, and the skirt are shown. The edge fingers are protected on four sides by the cover and skirt assembly, reducing the risk of contamination. The sides of the cover have latch arms for possible mechanical attachment into a retention mechanism, which is necessary to stabilize and secure the S.E.C. cartridge package in the Slot 1 connector during system shock and vibration. See Section 3.4. for more information on the MSP retention mechanism for the S.E.C. cartridge package. For complete mechanical information for the S.E.C. cartridge package, please see the *Pentium® II Processor at 233 MHz, 266 MHz and 300 MHz* datasheet.

All materials used in the S.E.C. cartridge package undergo testing to assure that only the highest quality materials are used. Suppliers for thermal plates, covers, substrates, memory chips, capacitors, resistors, and indirect materials such as solder paste, participate in rigorous testing of materials properties. Testing is performed across multiple lots, and correlation of lot data to manufacturing performance at Intel is determined. Suppliers also undergo quality audits in order to demonstrate manufacturability and quality-to-performance specifications.

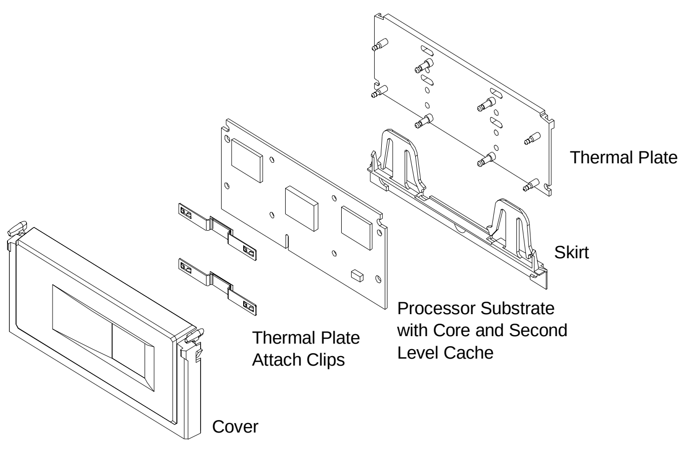


Figure 5. Exploded View of S.E.C. Cartridge Package

2.2.2. S.E.C. CARTRIDGE PACKAGE SUBSTRATE

The S.E.C. cartridge contains an area array packaged processor core, L2 cache components (TagRAM and BSRAMs for the Pentium II processor) mounted onto a substrate. The substrate has contact fingers on one edge that provide the electro-mechanical connection to the Slot 1 connector (and thus to the system baseboard) (see Figure 6). The substrate is fabricated of standard FR-4 based organic laminate material and has a minimum flammability rating of 94V–0. Copper trace and power plane parametrics, along with other key performance and manufacturing designs, have been selected to provide optimum electrical performance. The edge finger contacts are plated with 30 microns of gold over a nickel barrier layer for a reliable substrate edge finger to Slot 1 connector electrical contact. The edge fingers are equally distributed between the primary and secondary sides of the substrate (121 edge finger contacts per side, 242 total contacts for the S.E.C. cartridge). The contact areas of these edge fingers are maximized by using a two-sided staggered design for the placement of the fingers. A key slot is provided in the edge finger array, off center of the card length, to prevent improper placement of the S.E.C. cartridge substrate into the Slot 1 connector (see Figure 7). See the *Pentium® II Processor at 233 MHz, 266 MHz and 300 MHz* datasheet for detailed mechanical dimensions and signal listing for the substrate edge fingers.

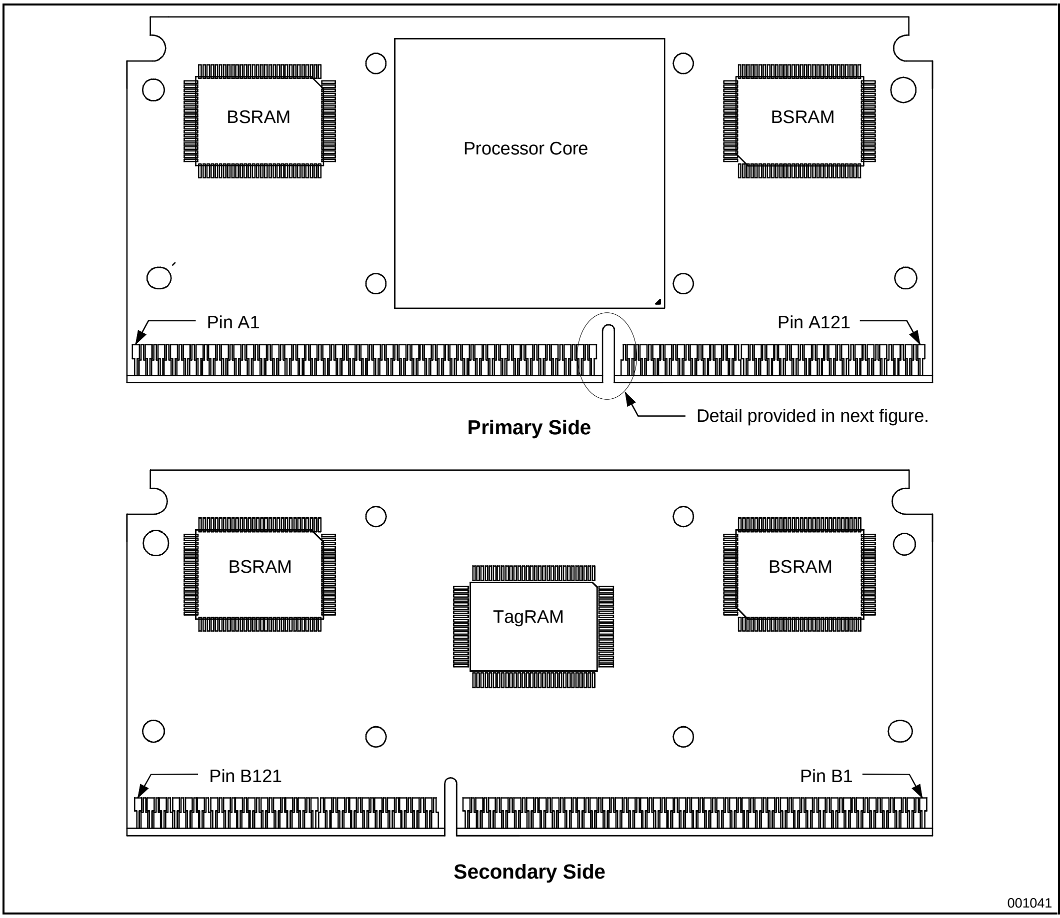


Figure 6. Mechanical Schematic of S.E.C. Cartridge Substrate with Core and L2 Cache

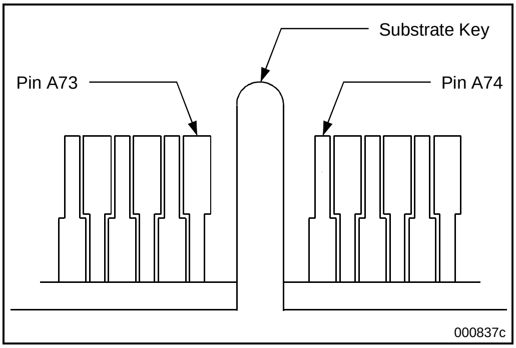


Figure 7. Substrate Edge Finger Contact and Key Detail

The edge fingers are specified to last for a maximum of 50 insertions. This is to ensure an upper limit for the contact resistance to the Slot 1 connector (and meet electrical performance requirements). Intel has performed internal testing showing functionality of single S.E.C. cartridge processors after 5000 insertions. While insertion/extraction cycling above 50 insertions may cause an increase in the contact resistance (above a maximum specified limit provided in the *Pentium® II Processor at 233 MHz, 266 MHz and 300 MHz* datasheet) and a degradation in the material integrity of the edge finger gold plating (and possible oxidation buildup), it is possible to have processor functionality above the specified limit. The actual number of insertions before processor failure will vary based upon system configuration and environmental conditions.

2.2.3. PROCESSOR CORE PACKAGE BODY MATERIALS

The processor core for the S.E.C. cartridge consists of the silicon logic die, mounted and interconnected to a multilayer plastic laminate body (also referred to as a Plastic Land Grid Array (PLGA)) (see Figure 8). The laminate structure is Bismaleimide Triazine (BT) resin with laminated Cu foil interconnects. The logic die is gold wedge wire bonded to the component package, and attached directly to the Ni plated Cu heat slug for optimum heat dissipation (Note, the heat slug is subsequently thermally attached to the S.E.C. cartridge thermal plate for connection to the system thermal solution). The cavity of the logic core body is encapsulated with a high temperature thermoset polymer coating to provide mechanical and environmental protection. Surface mounted capacitors are attached to the exterior of the package to provide added decoupling capacitance. The logic core package to substrate interconnects use eutectic tin-lead (SnPb) solder balls.

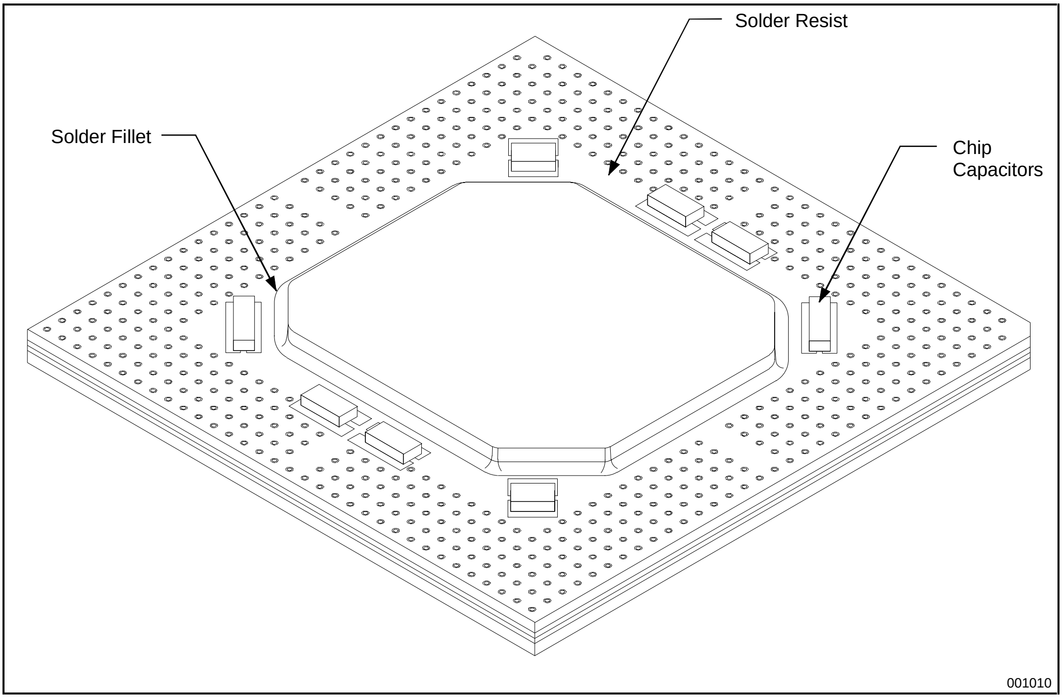


Figure 8. Example Processor Core (PLGA)

2.2.4. BSRAM

The BSRAMs in the S.E.C. cartridge package is packaged in commercially available QFP packages and are chosen for their ability to meet Intel's quality and performance requirements.

2.2.5. COVER, LATCHES AND SKIRT

The cover, latches, and skirt for the S.E.C. cartridge package are made of a molded high grade plastic which has a minimum flammability rating of 94V–0. The cover and skirt have a scratch resistant, textured finish, which allows easy ink and laser marking for package identification. It is recommended that the S.E.C. cartridge package not be subjected to storage temperatures above 85°C, based on the assembly materials maximum continuous use temperature. (See the *Pentium® II Processor at 233 MHz, 266 MHz and 300 MHz* datasheet for recommended storage and operational temperature maximums.)

2.2.6. THERMAL PLATE

The thermal plate is made of aluminum, with a black anodized coating. To improve thermal conduction, the thermal plate is attached directly to the heat slug on the processor core using a thermal interface material (i.e. thermal grease). Stainless steel spring clips attach to pins, which extend from the thermal plate through the substrate, to secure the thermal plate to the logic core package body. Intel has performed extensive testing to assure that the thermal interface material is non-volatile, and that it will continue to provide an effective thermal path over the lifetime of the S.E.C. cartridge processor.

2.3. S.E.C. Cartridge Package Assembly and Test

The processor core, TagRAM, BSRAMs and other components are assembled onto the substrate using traditional SMT processes and methodologies. The S.E.C. cartridge package assembly and test flow is shown in Figure 9.

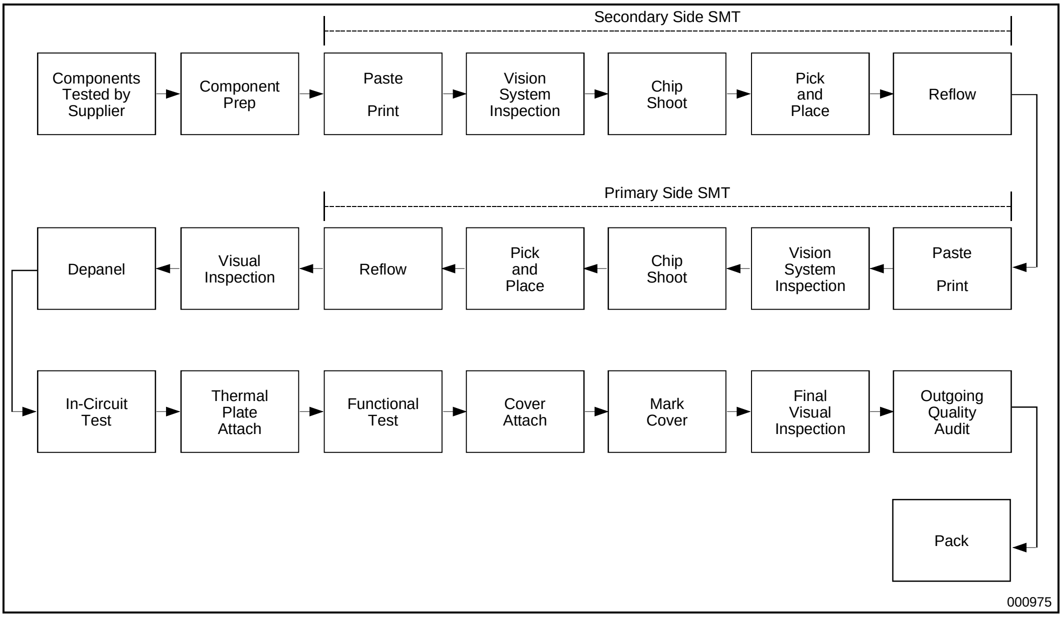


Figure 9. S.E.C. Cartridge Package Assembly/Test Process Flow

2.4. Package Handling and Shipping Media

The S.E.C. cartridge package was designed to be a robust packaging solution for processors. Sealed, desiccant, ESD protective bags are not required, and thus not used, during shipping of the processors from Intel. The S.E.C. cartridge processor, though, should be unpacked at ESD workstations. But, the package is **not** meant to survive severe mishandling such as: dropping the processor from a workstation table top to the floor; breaking of latch arms; insertion of long metal objects into the thermal plate holes and slots; foreign material contact on substrate edge fingers; and any attempt to disassemble the cartridge package. Also, surface mount technology (SMT) moisture levels are not applicable for the cartridge processor.

This section will provide additional handling guidelines and information on the shipping media used for the processors. The *Pentium® II Processor at 233 MHz, 266 MHz and 300 MHz* datasheet contains specific operational and storage specifications for the processor.

2.4.1. S.E.C. Cartridge Handling Precautions for ESD Protection

Electrical fields are able to penetrate electrical devices. An ungrounded person handling a component or computer board in a non-static shielding container can cause a large charge to be transferred through the container into the sensitive electronic device.

Eliminating static electricity in the work place is accomplished by grounding operators, equipment (including the use of dissipative table mats) and parts (components and computer boards). Grounding prevents static charge buildup and electrostatic potential differences. Electrical field damage is averted by transporting products in special electrostatic shielding packages (i.e. antistatic or dissipative carriers).

Refer to the *Packaging* Databook for detailed information, guideline and recommendations on proper precautions against component damage due to ESD. The *Packaging* Databook also contains information on package handling, electrical overstress and other information.

2.4.2. PENTIUM® II PROCESSOR SHIPPING MEDIA DESCRIPTION AND SPECIFICATIONS

The S.E.C. Cartridge Processor is packaged in a shipping box using materials which are different from PGA processors. (See Figure 10 and Figure 11.) As shown, a plastic insert is first placed into the shipping box. The S.E.C. cartridge processors are loaded into the thermo-formed ESD plastic (industry name is XEROSTAT 1000) with the substrate edge fingers down. The ESD plastic insert is an electrically dissipative, Recycled High Density Polyethylene (RHDPE) molded plastic which meets JEDEC registered outline drawings. As shown in Figure 11, the insert closes over the S.E.C cartridge processor in a clam-shell fashion. There are ten S.E.C. cartridge packages per insert, oriented edge finger side down, allowing the laser mark on the top edge of the S.E.C. cartridge to be visible when the top of the shipping box and insert are opened. The outer box is constructed from corrugated cardboard and has a conductive carbon coating inside to dissipate any electrostatic charge.

The static-dissipative insert in the shipping box is recyclable. Contact Intel for further information.

2.5. S.E.C. Cartridge Package Quality and Reliability

The S.E.C. cartridge package components with a test vehicle substrate were used in reliability stress evaluations. Table 1 lists the environmental test conditions which were used in the study.

After each of the stress conditions described in Table 1, electrical end-point testing was performed to verify that the processor under test had not degraded. All processors under stress passed after every environmental stress test exposure.

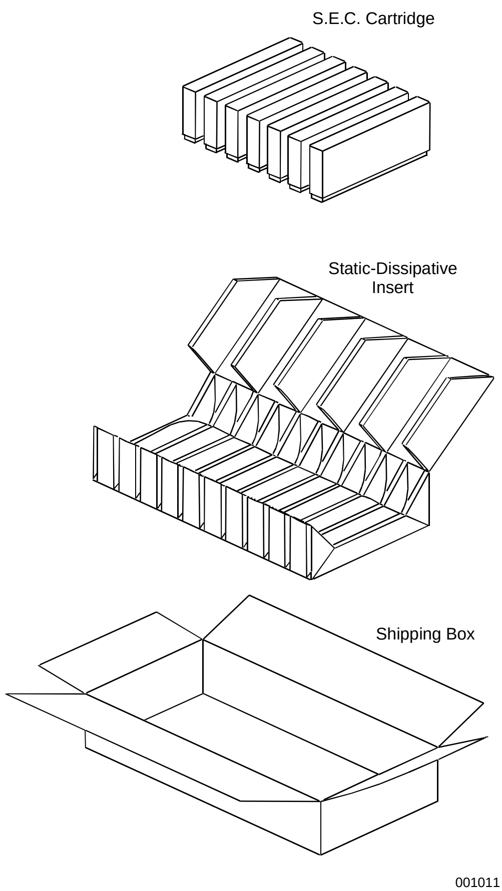


Figure 10. Pentium® II Processor Shipping Box — Exploded View

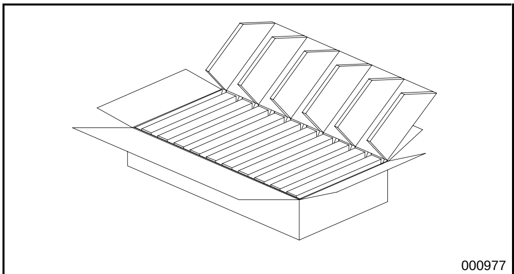


Figure 11. Pentium® II Processor Shipping Box — Assembled View

Table 1. Environmental Test Conditions for S.E.C. Cartridge Package

Test	Condition	Duration	Test Configuration
Temperature Cycling	40°C to 85°C	1000 cycles 15 min soak at each extreme	S.E.C. Cartridge Package
Random Vibration	5 Hz to 20 Hz 0.01 g^2/Hz sloping to 0.02 g^2/Hz (flat) 20 Hz – 500 Hz 0.02 g2/Hz (flat) Area under PSD curve is 3.1 grms	10 min/axis	S.E.C. Cartridge Package, Slot 1 Connector, and Retention Mechanism
Mechanical Shock	Trapezoidal 50G Velocity change of 170 in/sec	Three drops in each of six directions	S.E.C. Cartridge Package, Slot 1 Connector, and Retention Mechanism
Biased Humidity	85%RH: 55C (3.3V bias)	500 hours	S.E.C. Cartridge Package

2.6. S.E.C. Cartridge Package Change Control

New products at Intel undergo development phases prior to production. Once the product has gone through the development phases and entered into production, it is still possible that changes may occur. A change is any modification that could impact performance, appearance, quality, reliability, functionality, interchangeability, cleanliness, handling, or manufacturability of the supplied materials. This may apply to any change in the raw materials used directly or indirectly in the supplier’s manufacturing process (including changing suppliers), any change in the manufacturing flow, or any change in handling or shipping materials used internally or in shipment to Intel.

In the event that a change is made to the S.E.C. cartridge package, Intel will qualify the changed material prior to approving the change for implementation. For any form, fit or function change, Intel will notify customers using the same criteria used for other Intel components.

2.7. S.E.C. Cartridge Marking

In order to identify S.E.C. cartridge package (and processor) history, each unit is marked with the lot number and other information about the unit. This will enable traceability through the manufacturing process, factory planning and logistics, and shop floor control links to the actual units. Both human readable markings and an encoded 2-D matrix mark are provided. See Figure 12, Figure 13 and Table 2 for details on marking of the S.E.C. cartridge package.

2.7.1. WHAT IS A 2-D DATA MATRIX MARK?

The 2-D data matrix is a dynamically varying two-dimensional encoding of a literal information set with the appearance of a random checkerboard. The high dot density within the small marking area enables a higher information content than would be feasible with bar coding, allowing unit level traceability.

The 2-D data is encoded in direct binary form of the encoding computer language (ASCII), eliminating the need for conversion tables. The code is readable from any angle, and the readers incorporate a system of error correcting in the encryption, which provides improved reading robustness and minimizes decoding errors. The matrix conforms to the Electronic Industry Association (EIA) standard. Please see the EIA standard for further information on the data matrix encoding.

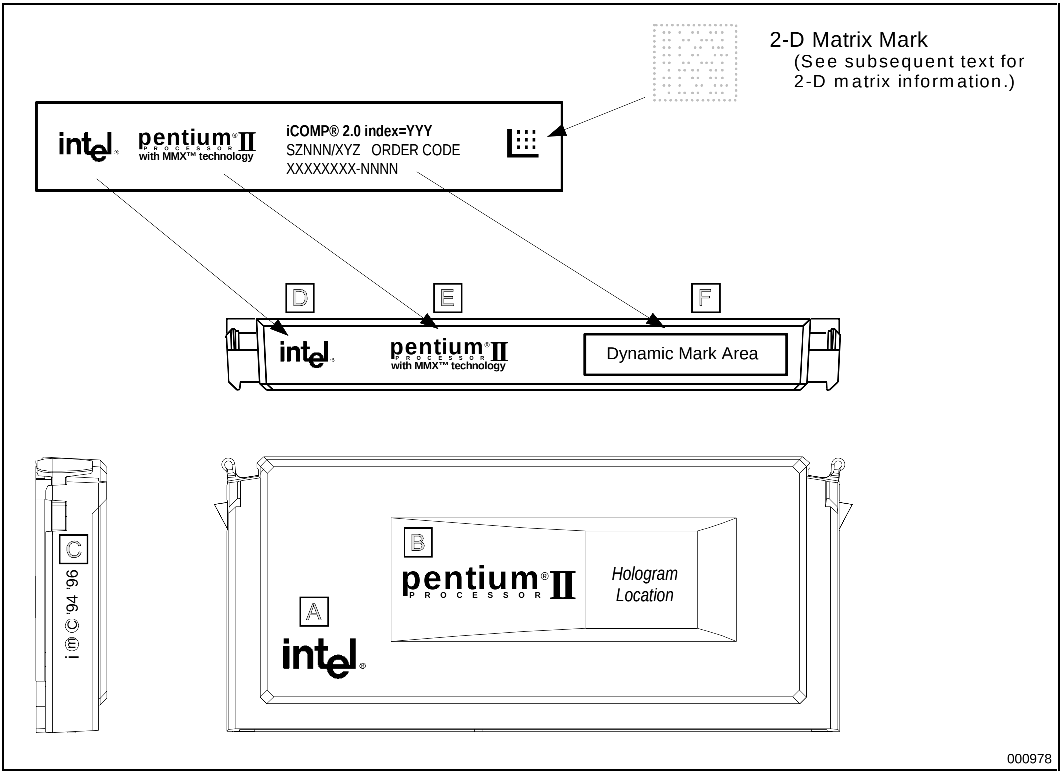


Figure 12. Processor Markings

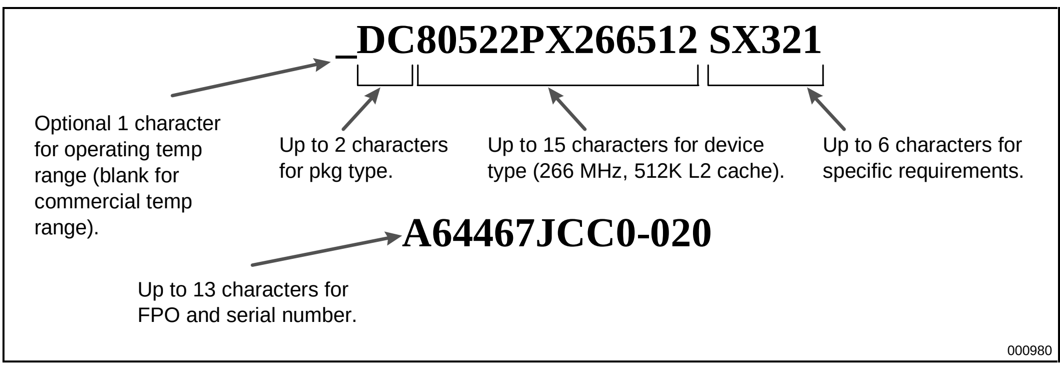


Figure 13. Dynamic Mark Information for the S.E.C. Cartridge

Table 2. Description Table for Processor Markings

Code Letter	Description
A	Logo
B	Product Name
C	Trademark
D	Logo
E	Product Name
F	Dynamic Mark Area – with 2-D matrix

Information on sources of 2-D data matrix mark readers is available at http://developer.intel.com/design/PentiumII. A 2-D Matrix (see Figure 14) has the following appearance features:

- A visual appearance of a random checkerboard
- High dot density
- Small marking area (6 mm x 6 mm)
- High information content
- 2-D code varies as binary information corresponds to dot pattern array
- Matrix Intended to Conform to New EIA Standard
- This EIA (Electronic Industry Association) standard in final stages of public balloting under: PN-3132
- 2-D Matrix Code Potential Use at Customers for Automated Tracking of Components in Manufacturing, Factory Logistics and Shop Floor Control

Figure 14. 2-D Data Matrix

The 2-D Matrix Code visible to customers contains:

- Intel's UCC ID Number
- Seven alphanumeric characters indicating the Universal Company Code (UCC)
- Intel's UCC ID is 0735858
- Pentium II Processor Product Code (e.g., _DC80522PX233512 SX321)
- FPO# + Serial Number (e.g., A64467JCC0-006)

2.8. S.E.C. Cartridge Processor Return Policy

The processor should be returned directly to the local Quality Support Center via your components Customer Quality Engineer (CQE) contact. Within the U.S., the S.E.C. cartridge can also be returned via the 1-800-628-8686 (Intel hotline). The following procedure is only applicable for returns needing analysis. All other returns need to be handled through the normal RMA process. Heatsinks should **not** be removed. A description of the failure mode should be enclosed (contact your CQE for a Failure Analysis/Correlation Request (FACR) checklist). S.E.C. cartridge returns will follow standard microprocessor FACR process and throughput commitments.

- Cartridge/heatsink should be returned in appropriate packing
  - Incorporate ESD Dissipative boxes/bags
  - Place unit into an ESD bag and wrap unit with at least two to four inches of wrapping. For multiple returns, ensure that individual units are wrapped and cushioned with at least two to four inches of bubble wrap/foam between units and between unit and outer box.
  - Pentium II processor return packaging is available through a third-party vendor as listed in the *Pentium® II Processor Supplier's Guide,* located at the Intel website.
  - Return box contains the white cardboard small box and the foam insert
  - If desired, a bigger box holding five small boxes is also available
- Return Box Dimensions
  - Five-pack master box
  - Small white box (#M427), 4" x 4" x 7"
  - Foam insert set, die cut center (1) approximately 5.16" x 2.3" inside diameter, pads (2) approximately 1" thick

3.0. S.E.C. CARTRIDGE MECHANICAL SUPPORT PIECES

The S.E.C. cartridge processor package is a significant form factor change from previous processor generations. The change was required due to limitations in PGA style packaging and the need to increase flexibility in product offerings. As the cartridge development evolved, it was imperative to ensure good electrical contact between the S.E.C. cartridge substrate and the Slot 1 connector. To keep the Slot 1 connector simple, the Slot 1 connector does NOT have features to retain the S.E.C. cartridge during significant, but realistic, environmental conditions. These conditions are encountered during normal transport of baseboards (with processors installed) and systems in an OEM production line and eventual shipment to an end user.

Intel has enabled a mechanical solution meant to support the S.E.C. cartridge processor package and ensure retention of the processor into the Slot 1 connector. This specific solution is referred to as the Mechanical Support Pieces (MSPs). These pieces represent only one possible solution to ensure the processor stays in the Slot 1 connector. Other methods and mechanical solutions will NOT be covered by this document. This document will only provide details on the use and operation of the MSPs. While each OEM must perform actual validation for mechanical ensuring the processor stays in the Slot 1 connector, Intel has shown that, through shock and vibration test validation, these pieces will provide adequate mechanical support of the processor, when used correctly.

The MSPs consist of the Slot 1 connector, retention mechanism (RM), retention mechanism attach mount (RMAM) and heatsink support (HSS). Slot 1 connector provides the electrical path between the processor and the other logic components on the baseboard. The RM holds the processor into the Slot 1 connector during mechanical shock and vibration. The RMAM attaches the RM to the baseboard. The HSS dampens the impact the mass of the heatsink during mechanical shock and vibration. Figure 15, Figure 16 and Figure 17 provide illustrations of all MSPs and how they interact with the processor. Please note that example heatsinks are shown throughout Section 3.0., Section 4.0. and Section 5.0. Heatsinks and thermal solutions are the responsibility of the OEM manufacturer. Please refer to application note AP-586, *Pentium® II Processor Thermal Design Guidelines* for further information on heatsink designs.

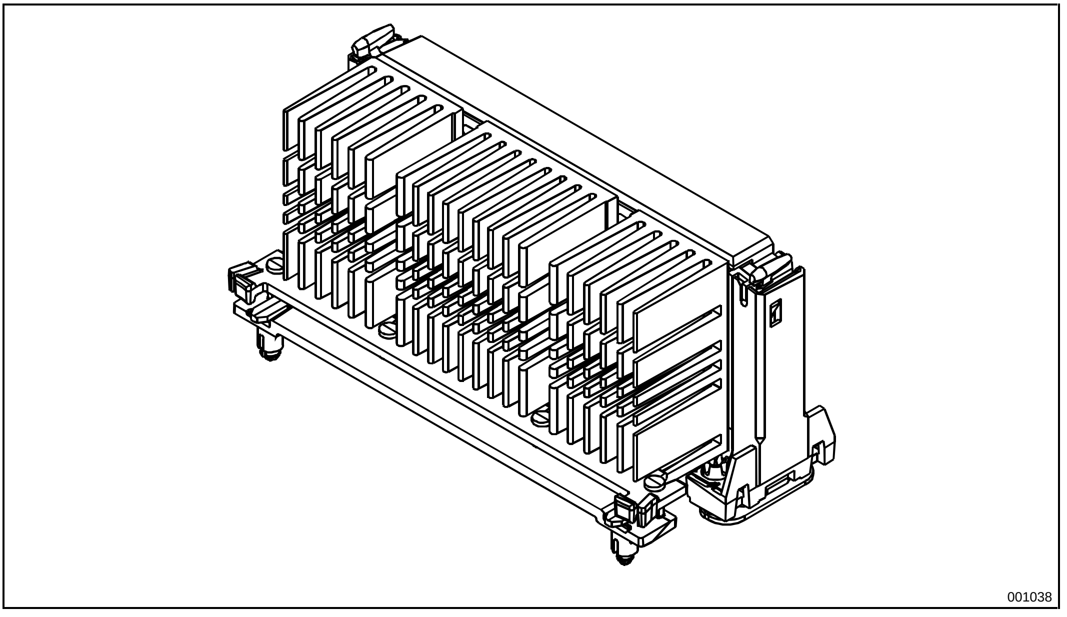


Figure 15. Pentium® II Processor with All Mechanical Support Pieces, Full Assembly
(Example heatsink attached.)

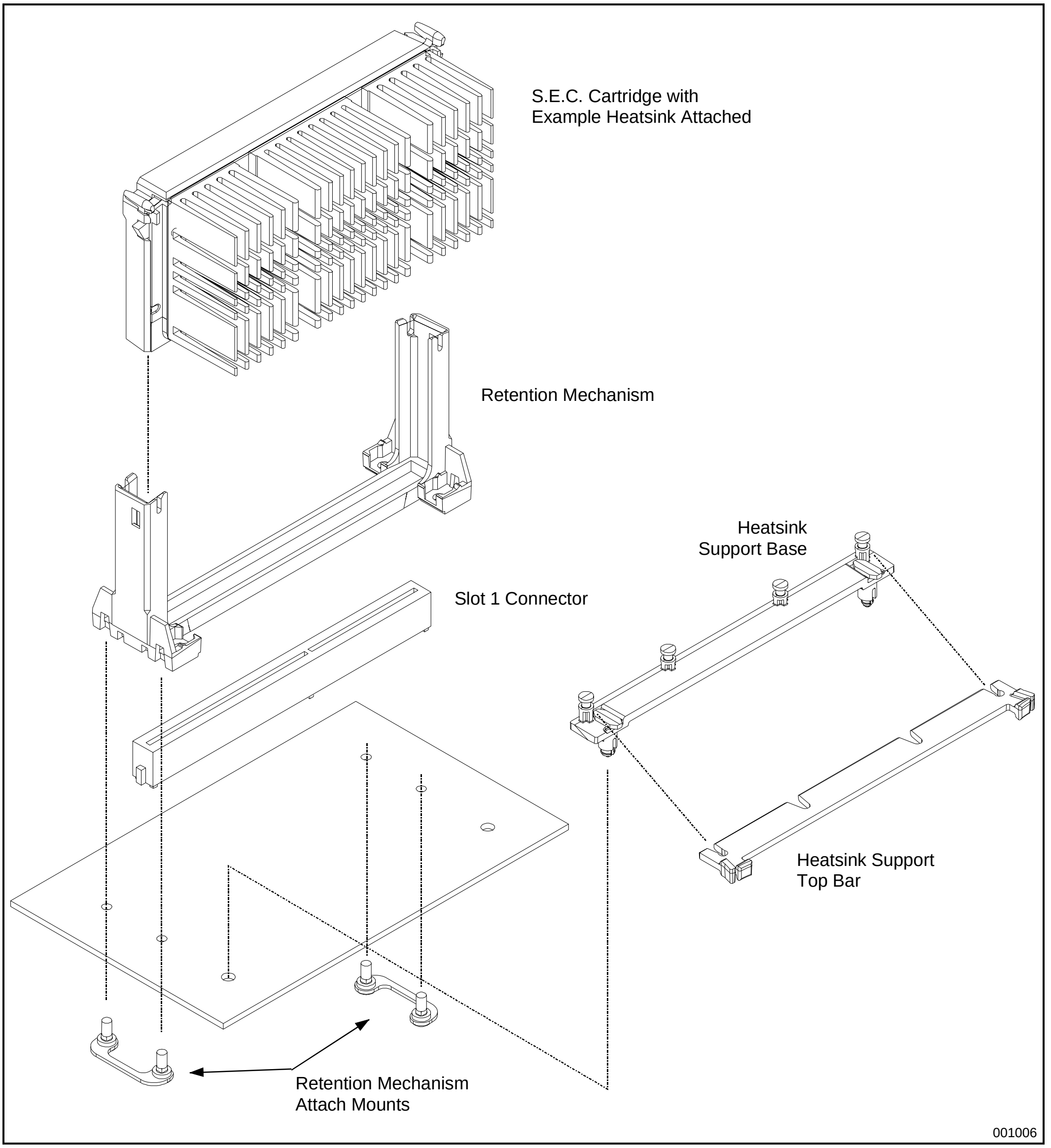


Figure 16. Exploded View of Pentium® II Processor with All Mechanical Support Pieces
(Example heatsink attached to processor.)

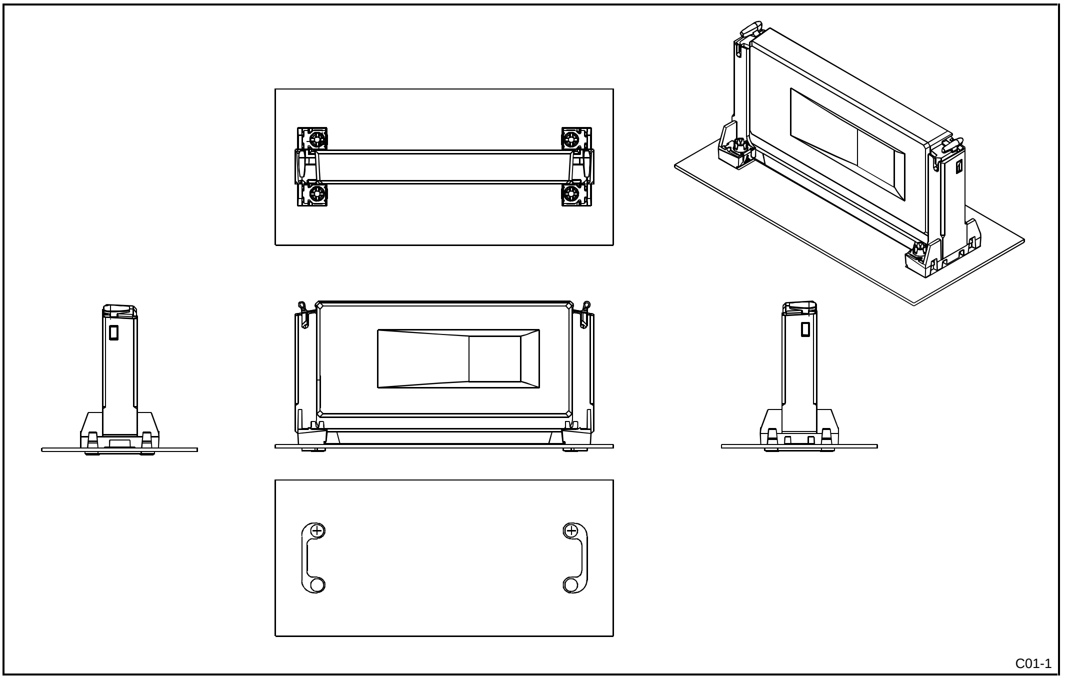


Figure 17. S.E.C. Cartridge, Retention Mechanism and Attach Mount Assembly (Multiple Views)

Figure 18 provides the basic baseboard footprint for the Slot 1 connector, RMAM, HSS and RM pieces. Mechanical dimensions and other structural information for the MSPs are located in the *Slot 1 Connector Design Guidelines* and the *Mechanical Support Pieces for S.E.C. Cartridge Processors,* both located at the Intel website. Intel does not supply the MSPs or equipment described in this application note. Refer to the updated *Pentium® II Processor Supplier's Guide,* located at the Intel website for supplier information.

3.1. Slot 1 Connector

The Slot 1 connector is a 242 contact, 1.0 mm pitch, edge connector intended for the S.E.C. cartridge package technology. The Slot 1 connector mounts on the baseboard and allows insertion and removal of the processor from the baseboard (see Figure 19). Mechanical, electrical and other technical details of the Slot 1 connector can be found in the *Slot 1 Connector Design Guidelines*.

3.1.1. OTHER CONNECTOR FORM FACTORS: RESTRICTIONS AND REQUIREMENTS

The Slot 1 connector is only one of the possible connector solutions for the S.E.C. cartridge processor. Any other solution for providing the electro-mechanical connection between the processor and the baseboard must meet the processor specifications as defined in the *Pentium® II Processor at 233 MHz, 266 MHz and 300 MHz* datasheet.

Some items to consider for other connector form factors are listed in Table 3. Please contact your local Intel representative for further information. Intel does not support, nor provided enabling for connector solutions other than the Slot 1 connector as defined in the *Slot 1 Connector Design Guidelines*.

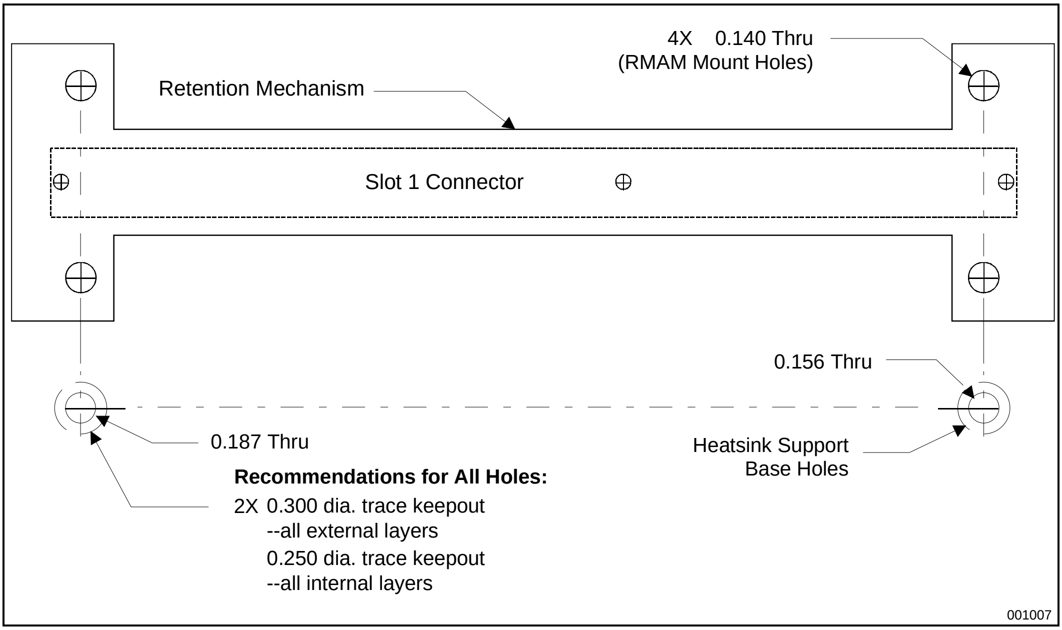


Figure 18. Baseboard Retention Mechanism, Slot 1 Connector Recommended Heatsink Support Hole Locations and Sizes

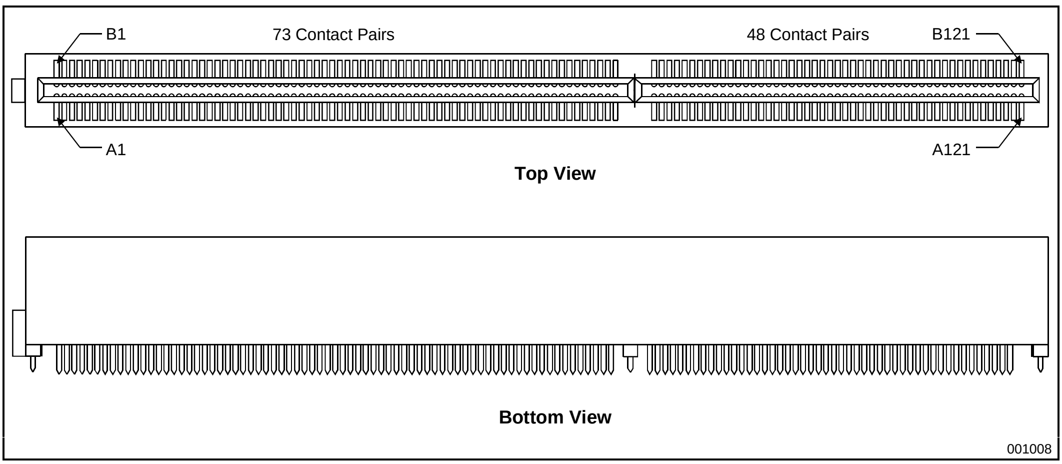


Figure 19. Slot 1 Connector

Table 3. Connector Specifications for Slot 1 Processors

Pin Inductance Specification	Ensures transient voltage drop requirements for correct processor core operation. It is currently at lowest capability for high volume, low cost vendors.
AC Transients	Ensures voltage transient requirements are met for correct processor core operation.
Contact Resistance Specified	Is needed to ensure static voltage drop requirements for correct processor core operation. Pentium® II processor current requirements as high as 14.2A.
Crosstalk Levels Specified	Provides for 66 MHz and higher System Bus operation.
Propagation Delay Specified	Provides for 66 MHz and higher System Bus operation.

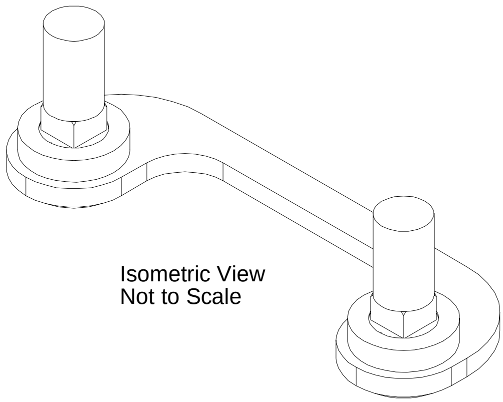
A right angle connector (i.e. 90° connector) is one possible solution for the Slot 1 processors, but places an increased burden on the baseboard design and voltage delivery system to the processor to meet the required processor specifications. Table 4 contains a basic parameter comparison of the two different types of connectors. Also, the 90° connector may not work with Intel enabled debug and analysis tools and equipment. Other connector solutions (riser card, straddle mount connectors) also require a thorough examination of electrical and mechanical requirements. If a connector solution other than the Slot 1 connector is considered, it is recommend to perform a thorough electrical and mechanical impact assessment (including manufacturing) before completion of the baseboard and system design.

3.2. Mechanical Retention Mechanism Attach Mount

The Retention Mechanism Attach Mount (RMAM) is a small assembly that is part of the Mechanical Support Pieces (MSP) (see Figure 20). The RMAM holds the retention mechanism to the baseboard using the captured nuts on the retention mechanism. The attach mount assembly (two studs and bridge) requires approximately 44 lbs-f to insert into the baseboard (using the defined holes shown in Figure 18). The RMAM studs are threaded and are fabricated from brass, and the bridge is molded plastic. The RMAM is designed to be inserted from the bottom of the baseboard. See the *Mechanical Support Pieces for S.E.C. Cartridge Processors* for further mechanical details of the RMAM that are not presented here. Figure 21 provides details on RMAM and baseboard interaction, providing depths underneath the baseboard itself.

Table 4. Comparison of Slot 1 Connector to a 90° Connector (a.k.a. Right Angle)

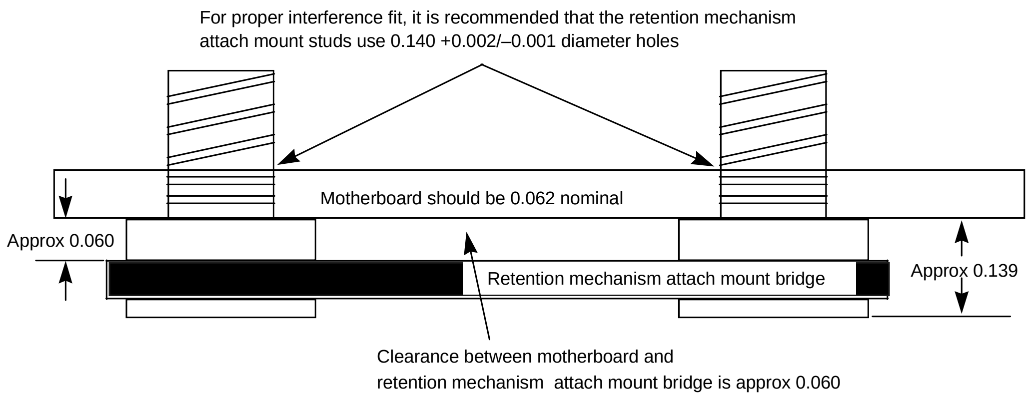
Parameter	Slot 1 Connector	90° Connector (Estimated Values)	Delta
Pin Inductance	10 nH	25 nH	2.5X Worse
Contact Resistance	10 mΩ	25 mΩ	2.5X Worse
Crosstalk	<10%	13%	1.3X Worse
Prop Delay	<150 ps	375 ps	2.5x Worse



NOTE: RMAM studs are threaded for use with the RM captured nuts.

000981

Figure 20. Retention Mechanism Attach Mount Assembly



Drawing not to scale.

All dimensions in inches.

NOTES:

1. The area underneath the retention mechanism attach mount bridge can be used for routing and traces, but should be considered a keepout zone for components.
2. The trace keepout for all layers around the holes should be 0.350 inch diameter.

000982

Figure 21. Retention Mechanism Attach Mount Baseboard Interaction Details

3.3. Heatsink Support

The typical thermal solution for the S.E.C. cartridge package is a heatsink attached to the thermal plate (see Figure 22). The weight of a typical passive heatsink is 200 to 250 grams. The torque generated in mechanical shock or vibration by the moment arm of the unsupported heatsink may be sufficient to cause damage to the baseboard or the S.E.C. cartridge (see Figure 23). Therefore, Intel has enabled a secondary mechanical piece to support the heatsink in order to minimize damage during shock and vibration: the heatsink support.

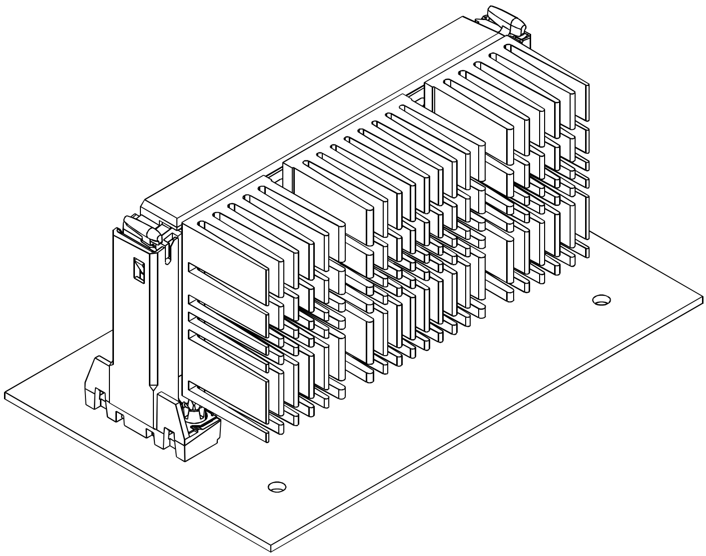


Figure 22. S.E.C. Cartridge with Retention Mechanism

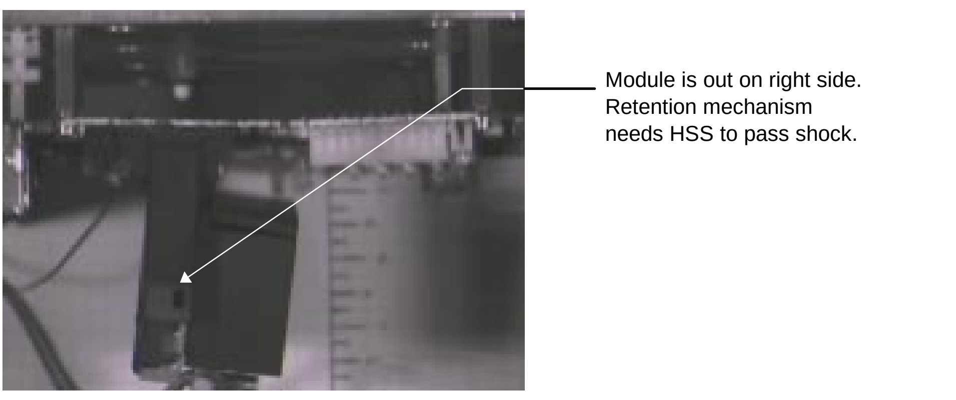


Figure 23. +Z Drop (Without heatsink support, cartridge is not retained.)

The heatsink support (HSS) is comprised of two pieces: the heatsink support base (or simply base) and the heatsink support top bar (or simply top bar). The base mounts to the system baseboard. The base uses two pins to ensure the base bulbs fully expand on the bottom side of the baseboard. The top bar clamps to the two outside posts in the base, securing the heatsink (the inner posts act as guides for the top bar). See Figure 24 for the heatsink support assembly steps. See Figure 15 and Figure 16 for an example heatsink mounted on the S.E.C. cartridge with a HSS. Further mechanical specifications and requirements of the HSS are documented in *Mechanical Support Pieces for S.E.C. Cartridge Processors*.

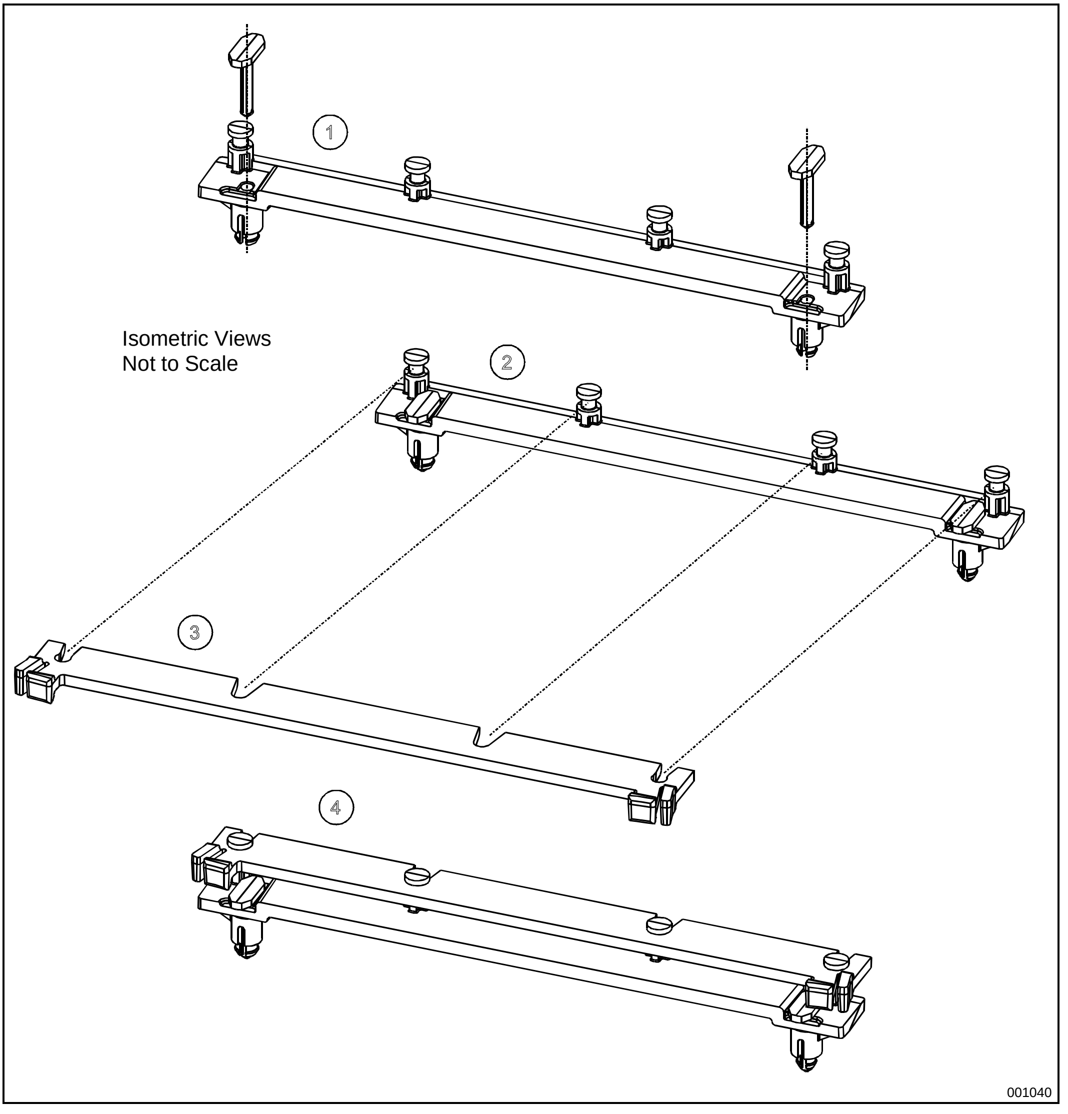


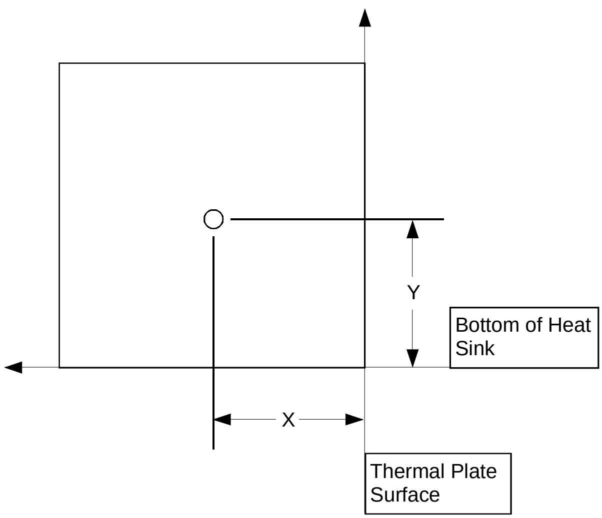
Figure 24. Heatsink Support Assembly Steps

The HSS has been designed for a specific type of heatsink size and shape. Figure 25 provides maximum distance the center of gravity can be, from the baseboard and thermal plate, to not exceed the design limitations of the HSS. The HSS is designed to support a maximum heatsink weight of 250 grams (and stay within the center of gravity limitations provided in Figure 25). Using empirical testing, Intel has verified the HSS, when used with the RM and RMAM, supports the maximum weight heatsink during system shock and vibration testing for a maximum force of 30 G's (in a standard ATX chassis, with all mounting holes used in the baseboard).

3.4. Retention Mechanism

3.4.1. RETENTION MECHANISM MECHANICAL DESCRIPTION

The retention mechanism (RM) holds the S.E.C. cartridge package in the Slot 1 connector during mechanical shock and vibration. The RM is not symmetrical; if placed around the Slot 1 connector incorrectly, the processor latch arms will not engage into the RM post slots. The RM, though, is designed to engage with a matching polarization key on the Slot 1 connector for correct assembly onto the baseboard. The RM also aids in processor alignment to the Slot 1 connector during insertion of the processor. The RM contains draft angles, lead-ins and chamfers for smooth travel of the processor down the posts and into the connector (see Figure 26, Figure 27 and Figure 28 and the *Mechanical Support Pieces for S.E.C. Cartridge Processors*).



Chassis Type	X Cg	Y Cg
ATX	1.2"	1.0"
LPX	1.4"	0.7"

000896

Figure 25. Recommended Heatsink Center of Gravity for Use with the Heatsink Support

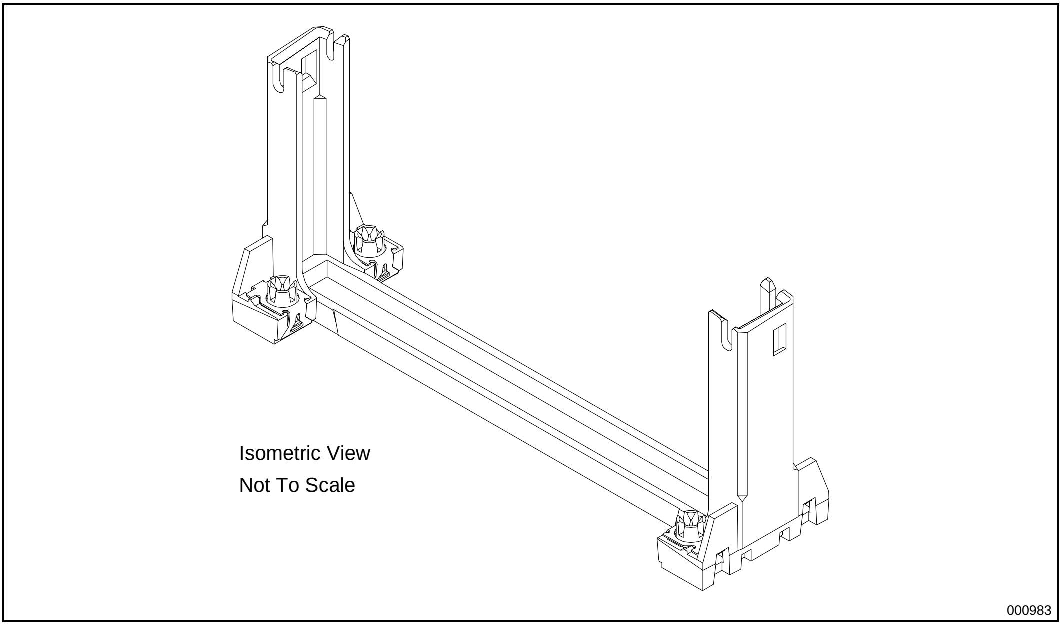


Figure 26. Retention Mechanism, Assembled, Isometric View

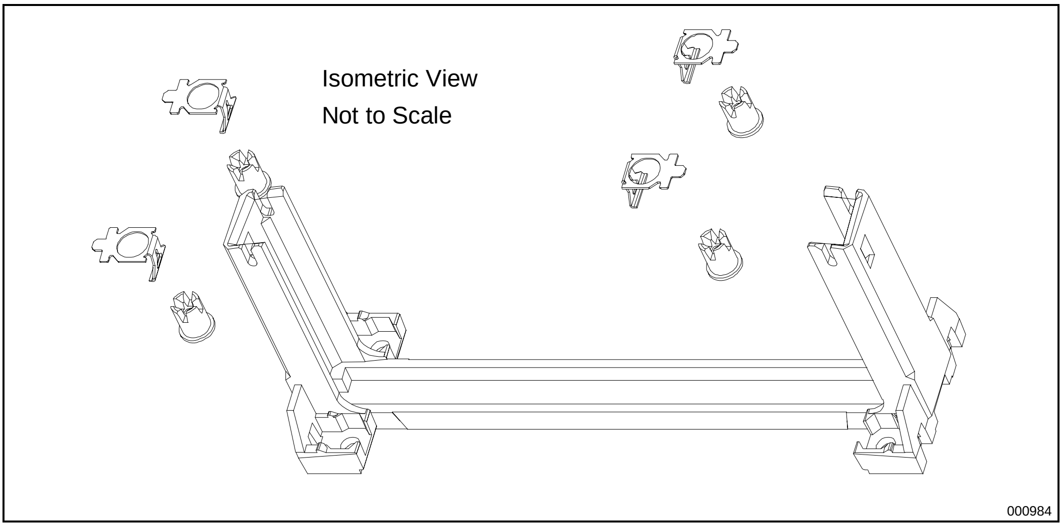


Figure 27. Retention Mechanism, Exploded View with Captured Nut and Retaining Clip

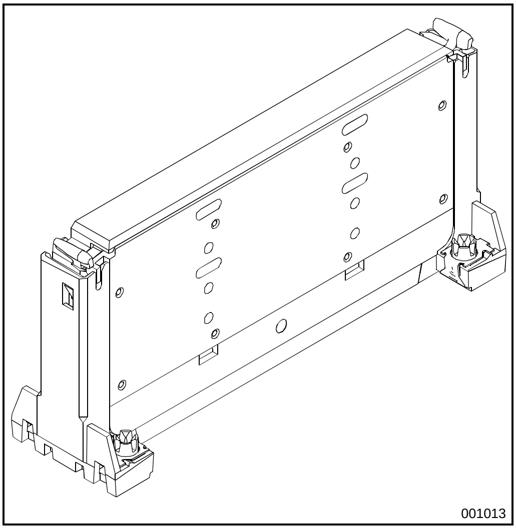


Figure 28. S.E.C. Cartridge in Retention Mechanism

The processor latch arms do not rigidly hold the processor into the Slot 1 connector. The mechanical force of the Slot 1 connector contacts provide some friction, grabbing of the processor. The RM and latch arms are designed to allow a small amount of back-out of the connector before stopping the travel of the processor. The vertical travel associated with this back-out is comprehended in specifications for the processor (particularly the substrate), Slot 1 connector and the RM.

The RM is comprised of three pieces: RM body, captured nuts and retaining clips (see Figure 27). The RM body is the plastic housing which supports the processor. The retaining clips keep the captured nut assembled into the RM body. The captured nut screws onto the RMAM for a secure fit onto a baseboard. All three pieces are specified in the *Mechanical Support Pieces for S.E.C. Cartridge Processors*.

3.4.2. MULTI-PROCESSOR RETENTION MECHANISM CONCEPTS

Multi-processor-based systems are possible for the Slot 1 processor. The baseboard, though, must comprehend the retention and support of two S.E.C. cartridge packages. This section will highlight one possible mechanical solution for this type of system.

Figure 29 and Figure 30 provide views of the Dual Retention Mechanism (DRM). The DRM is based upon the RM described in Section 3.4.1. The DRM provides optimal spacing of the two Slot 1 connectors for both mechanical and electrical requirements. As with the RM, the DRM uses the latch arms for retention of the S.E.C. cartridge package into the Slot 1 connector during mechanical shock and vibration. The DRM, though, also allows the heatsink support to be eliminated for one of the processor. The DRM uses additional material structure to provide for mechanical retention and support of one of the heatsinks. The other processor, though, should utilize a heatsink support (or other similar mechanism) to ensure no damage occurs during shock and vibration testing. See Section 3.3. for details on the heatsink support.

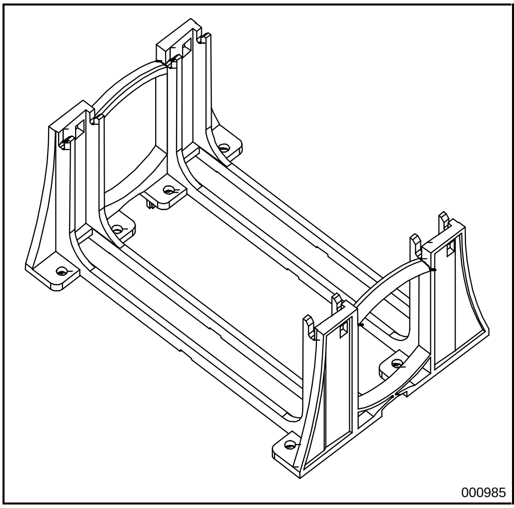
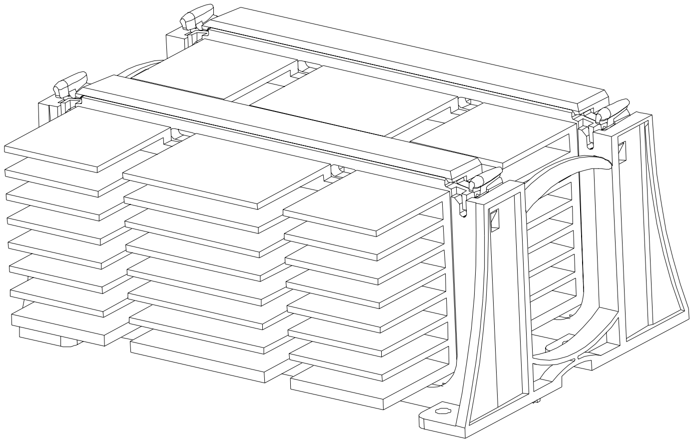


Figure 29. Dual Retention Mechanism



NOTES:
1. Each processor has an example heatsink installed.
2. Heatsink is not supplied by Intel.
3. The front processor most likely should have a heatsink support solution also installed.

000986

Figure 30. Dual Retention Mechanism with Processors Installed
(Example heatsinks attached to processors.)

Other considerations for the retention and placement of multiple processors to be addressed are transfer of heat away from the processors, baseboard to chassis mounting holes, baseboard size and the location of other peripherals inside the chassis. A detailed study should be performed to correctly design a multi-processor system with the correct mechanical solution(s). See the *Mechanical Support Pieces for S.E.C. Cartridge Processors* for further information on the DRM.

4.0. BASEBOARD INTEGRATION MANUFACTURING GUIDELINES

The S.E.C. cartridge processor and mechanical solution pieces (MSP) introduce manufacturing concerns and issues that were not present in previous processor generations. It is important to understand the impact to manufacturing for each of these pieces. All pieces are recommended for a robust solution for the S.E.C. cartridge processor.

This section will address issues surrounding baseboard manufacturing and preparation. Section 5.0. will address issues surrounding system integration. At each step, manufacturing information and third party contacts for specific manufacturing tooling and hardware will be provided when possible.

The Pentium II processor, utilizing the S.E.C. cartridge package technology, requires manufacturing steps which are different from traditional OEM baseboard and systems manufacturing. The S.E.C. cartridge package requires a Slot 1 connector, retention mechanism, retention mechanism attach mount and heatsink support. The heatsink for the S.E.C. cartridge package might be attached using Rivscrews*, which is different from attach solutions for the Pentium or Pentium Pro processors. Baseboard and systems manufacturing should carefully evaluate the integration of the processor and mechanical support pieces in the to manufacturing environment.

4.1. Introduction and Suggested Integration Flow

Table 5 and Figure 31 provide the overall list of materials and suggested manufacturing flow for the integration of the S.E.C. cartridge processor (and MSP), into the baseboard and system manufacturing flow. Baseboard related items highlighted in each will be covered in this section. The other materials and manufacturing steps will be covered in Section 5.0.

Table 5. Pentium® II Processor Enabled Mechanical Solution and Materials List

Assembly Type	Quantity per Board and System
Board Assembly	
Slot 1 Connector	**1**
Retention Mechanism Attach Mount	**2**
Heatsink Support (bottom)	**1**
System Assembly	
Heatsink	1
Thermal Grease	1
Heatsink Clip or Rivscrews*	2 or 4
Retention Mechanism	1
Heatsink Support (Top Bar)	1

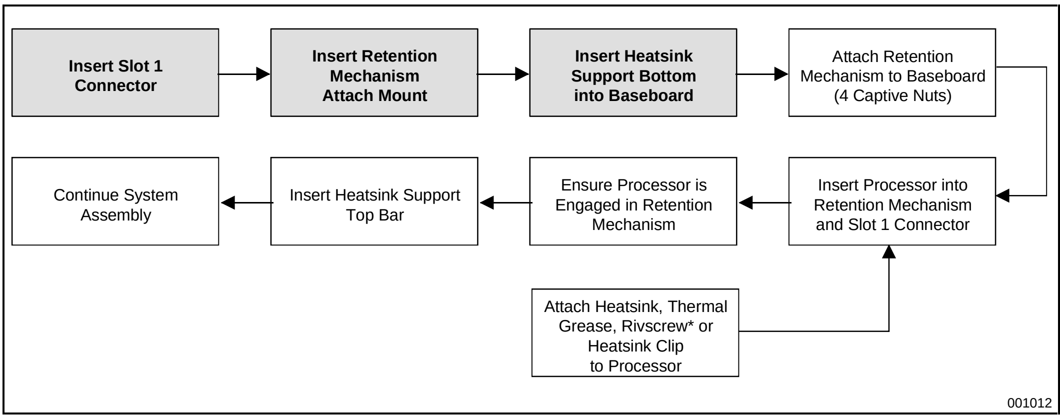


Figure 31. Suggested Baseboard/System Integration Manufacturing Flow
(Bolded boxes covered in this section.)

As shown in Figure 31, it is recommended to perform Slot 1 connector installation, RMAM mounting and HSS base installation during the baseboard manufacturing process. The Slot 1 connector mounts similar to other edge connectors (PCI, ISA, AGP), but has specific requirements to ensure correct integration with the other MSP. The attach mount is a bottom side integration piece; a specific press is available for high volume manufacturing environments. The heatsink support base is also recommended to be installed at the end of the baseboard assembly line. The HSS base is low profile, allowing shipping of baseboards in high density containers (i.e. using the same shipping containers as for previous processor generations. See Section 5.3.4. for other information on installation issues).

4.1.1. RECOMMENDED SLOT 1 CONNECTOR INSERTION STEPS AND REQUIREMENTS

NOTE

Only use Slot 1 connectors which are stored correctly in the supplier packaging. It is not recommended to use components which are loose or stacked without completely inspecting the component leads for alignment.

1. Pick the Slot 1 connectors, one at a time, from the supplier packaging and ensure that no contact is made with the lead area of the component. Supplier packaging should be placed on the line so the retention features do not rest on the packaging material.

2. Place the Slot 1 connectors on the board so that all the leads are within their corresponding PTH (using the retention features as a guide, see Figure 32) and allow it to rest on the retention feature before the application of any insertion force.

3. Ensure that the Slot 1 connector stands vertically, that is, does not tend to lean to one side or another and sit evenly on the board, (if this happens, remove the Slot 1 connector and inspect the lead alignment). Note: Depending on the vendor, the Slot 1 connector may not stand vertically and will have to be held in place by hand.

4. Apply uniform insertion force to 2 positions on the Slot 1 connector(1/3 and 2/3 along the length of the component, (see Figure 33). Ensure that the Slot 1 connector enters the board smoothly. An operator can listen for the sound of a lead bending on the substrate.

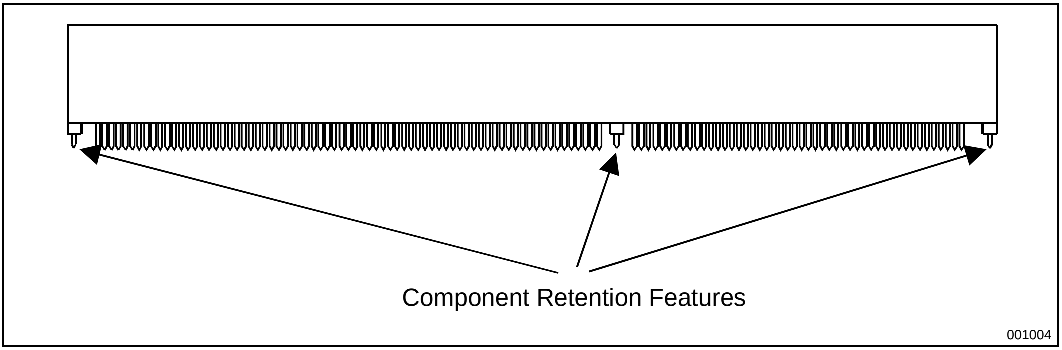


Figure 32. Slot 1 Connector, Retention Features Highlighted

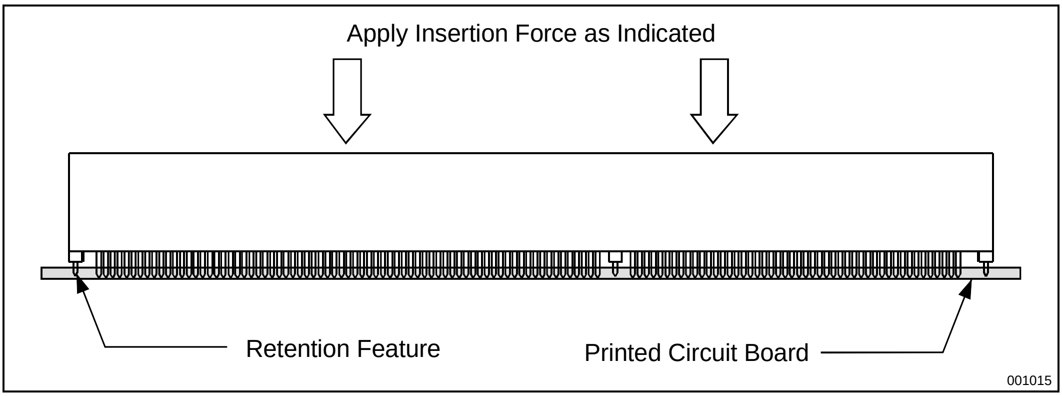


Figure 33. Slot 1 Connector Mounted in Baseboard

5. Apply force to the area directly above the retention features to ensure that the component is seated correctly.

6. Inspect for lead penetration for quality assembly.

7. Figure 34 provides Slot 1 connector assembly guidelines that are recommended to be met to ensure the S.E.C. cartridge package interacts correctly with the remaining enabled mechanical pieces. The recommended process capability along both axis is to ensure the S.E.C. cartridge package can interface correctly with the Slot 1 connector and other enabled mechanical pieces (retention mechanism, etc.)

4.2. Retention Mechanism Attach Mount Installation

For the RMAM to work correctly, the attach mount stud must be fully inserted into the baseboard with a snug fit. The attach mount stud must be straight (normal or perpendicular) to the baseboard for purposes of attaching Retention Module. Figure 35 shows a baseboard with Slot 1 connector and RMAM installed.

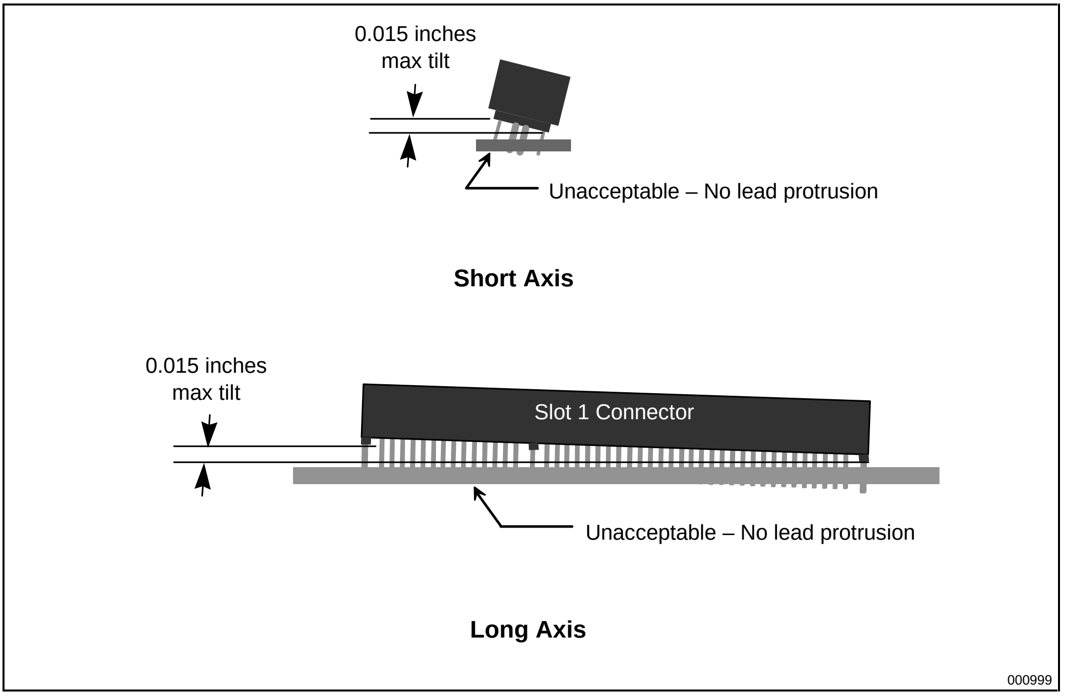


Figure 34. Recommended Process Capability to Ensure Correct Interaction of S.E.C. Cartridge Package and Mechanical Support Pieces

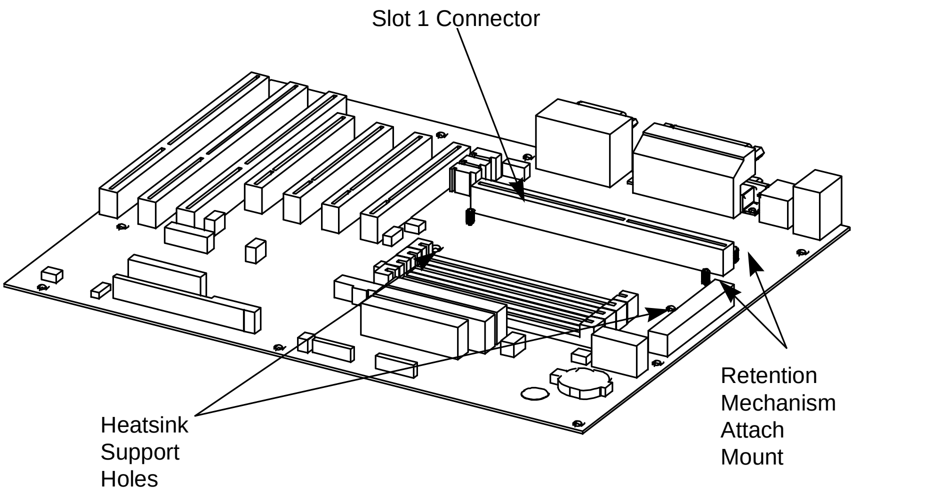


Figure 35. ATX Baseboard with Slot 1 Connector and RMAM Installed (Heatsink support base holes are also shown.)

4.2.1. ATTACH MOUNT ASSEMBLY CRITERIA

The RMAM studs should be protruding through the board on the top side as in Figure 35, Figure 36 and Figure 37. The RMAM studs are designed to contact the baseboard hole in four locations in the hole, rather than around the entire circumference of the baseboard itself.

There should be no cracking of the laminate around the holes through which the attach mount studs protrude. Cracks will typically be emanating radially from the hole edges. Cracks would occur due to an incorrect assembly that uses either too much force, incorrectly aligned studs, incorrectly sized holes in baseboard or incorrectly manufactured RMAM.

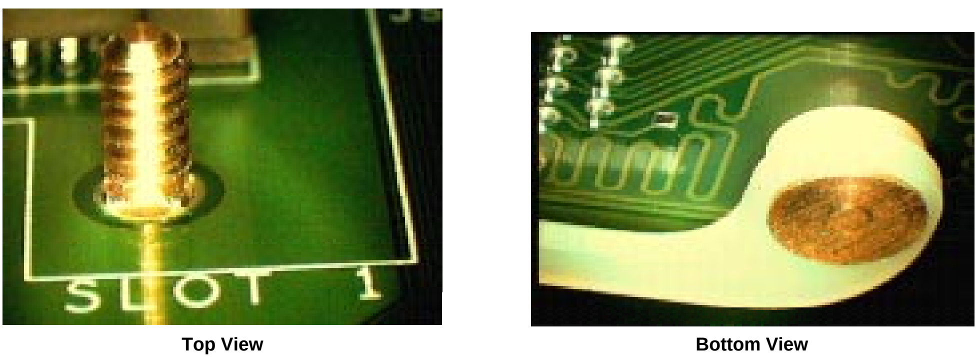


Figure 36. Attach Mount Installed in Baseboard

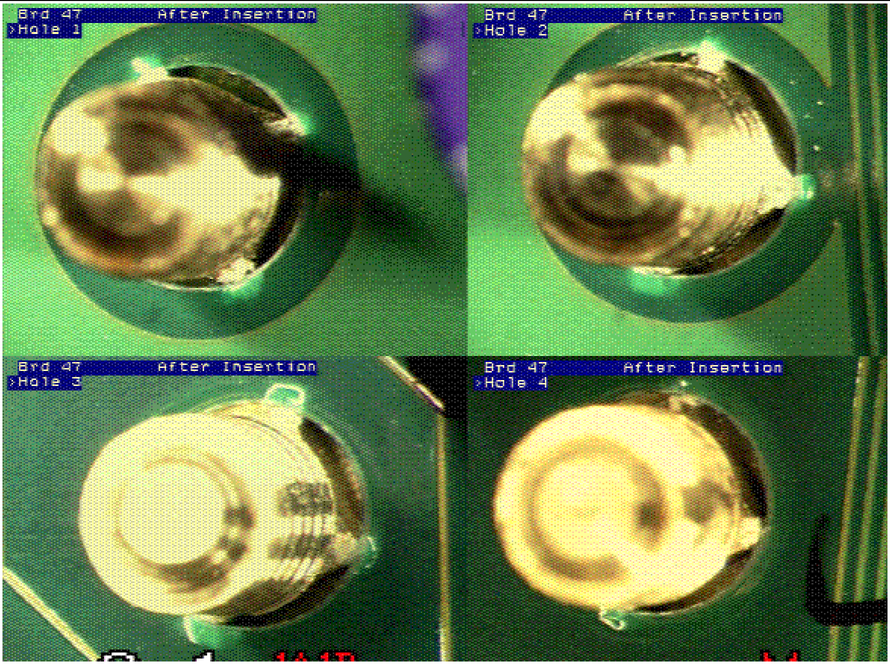


Figure 37. HVM Equipment for Installation of the RMAM into Baseboards

4.2.1.1. HVM Enabled Procedures and Equipment for RMAM Installation

Intel has enabled a set of machinery for efficient installation of the RMAM in High Volume Manufacturing (HVM) environments. The machinery is a press which performs the insertion of the RMAM into the baseboard, from the bottom side. The machine is pneumatically driven, and requires baseboard specific jigs and fixtures to properly hold the baseboard and RMAM. The machine can also be used to rework (i.e. remove) an incorrectly processed RMAM. The *Pentium® II Processor Supplier's Guide,* located at the Intel website, provides a list of suppliers for equipment for HVM presses, jigs and fixtures.

4.3. Heatsink Support Base Installation

The heatsink support is a multiple piece solution to provide mechanical retention of the heatsink during shock and vibration environmental stresses. This section will provide the recommended steps of installation of the base and base pins. The base and base pins should be installed at the end of the baseboard manufacturing line. The top bar MUST be installed AFTER the processor is placed in the RM (which is AFTER the heatsink is installed to the processor). See Section 5.3.3. for further information on top bar installation.

The base relies on bulbs and pins to correctly engage with the baseboard. The bulb in legs of the HSS base must protrude through the board on the bottom side for a secure fit. See Figure 38 for an example of a correctly installed base. To complete the installation, the HSS base pins must be installed. The pins are not shown in Figure 38, but provide the necessary resistance to ensure the bulb does not disengage from the baseboard.

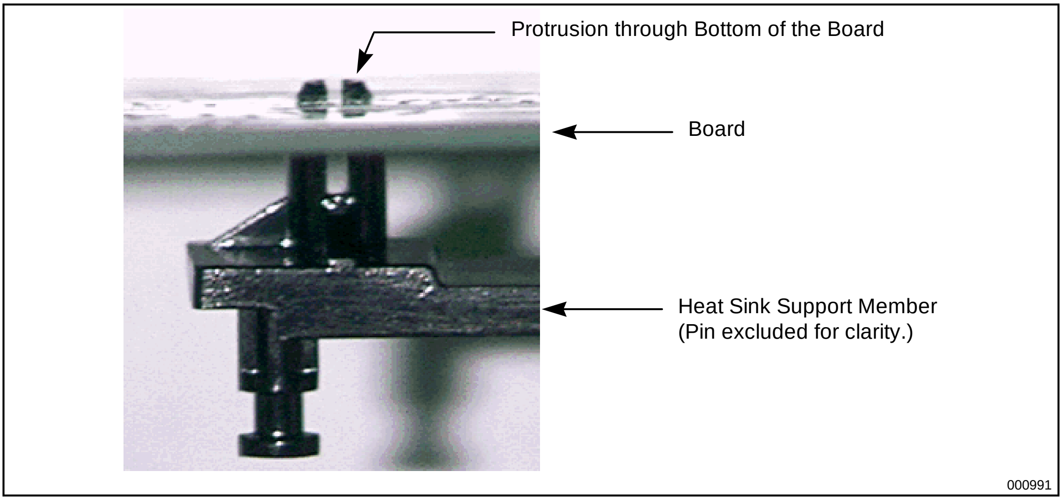


Figure 38. Correct Installation of Heatsink Support Base into Baseboard
(View from bottom side of board.)

5.0. SYSTEM INTEGRATION MANUFACTURING GUIDELINES

5.1. Introduction and Suggested Integration Flow

Table 6 and Figure 39 provide the overall list of materials and manufacturing flow for the integration of the S.E.C. cartridge processor and MSP into the baseboard and system manufacturing flow. System integration related items highlighted in each will be covered in this section. The other materials and manufacturing steps are covered in Section 3.4.

Table 6. Pentium® II Processor Enabled Mechanical Solution and Materials List

Assembly Type	Quantity per Board and System
Board Assembly	
Slot 1 Connector	1
Retention Mechanism Attach Mount	2
Heatsink Support (base)	1
System Assembly	
Heatsink	**1**
Thermal Grease	**1**
Heatsink Clip or Rivscrews*	**2 or 4**
Retention Mechanism	**1**
Heatsink Support (Top Bar)	**1**

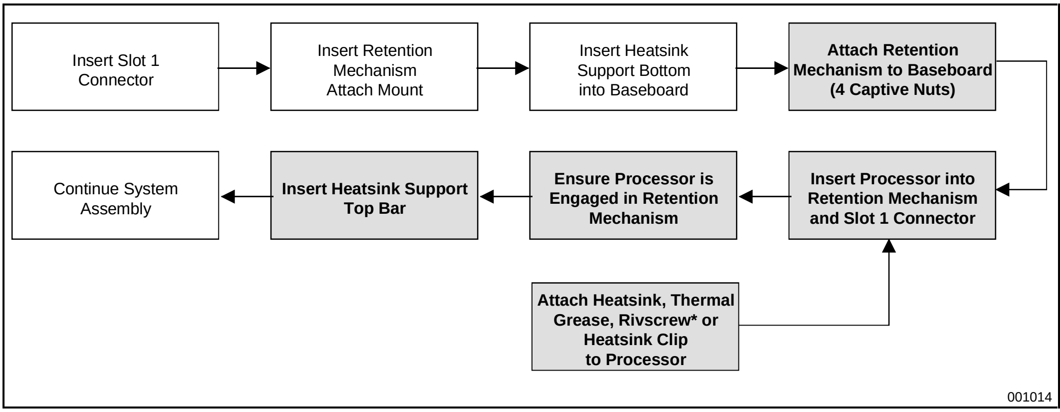


Figure 39. Suggested Baseboard/System Integration Manufacturing Flow
(Bolded boxes covered in this subsection.)

5.2. Heatsink Attachment to the Thermal Plate

The S.E.C. cartridge package provides two standard methods for thermal solution attach: Rivscrews and heatsink clips. (Other attach solutions are possible, but have not been thoroughly investigated by Intel.) Thermal solutions must provide adequate thermal conduction paths to remove the heat generated by the processor and dissipate that heat into the system environment. The system environment must then ensure adequate overall circulation to properly cool the processor and other internal components. Each solution, though, requires good thermal interface material contact and subsequent cooling performance. The application note AP-586, *Pentium® II Processor Thermal Design Guidelines*, provides detailed information on the thermal interface management and heatsink design guidelines. The thermal plate is the location for attachment location for processor thermal solutions. This section will describe attachment of the heatsink using Rivscrews and spring clips.

5.2.1. RIVSCREW* ATTACHMENT TO THE THERMAL PLATE

With the S.E.C. cartridge package, a new method for heatsink attachment has been enabled. Rivscrew technology has been enabled for use for heatsink attachment. As with heatsink clips, Rivscrews provide a strong clamping force to ensure good thermal grease bond line creation. Rivscrews also strongly attach to the thermal plate to ensure an adequate mechanical hold to pass system mechanical shock and vibration requirements (see Figure 40). (See the *Pentium® II Processor at 233 MHz, 266 MHz and 300 MHz* datasheet for Rivscrew hole locations on the thermal plate.)

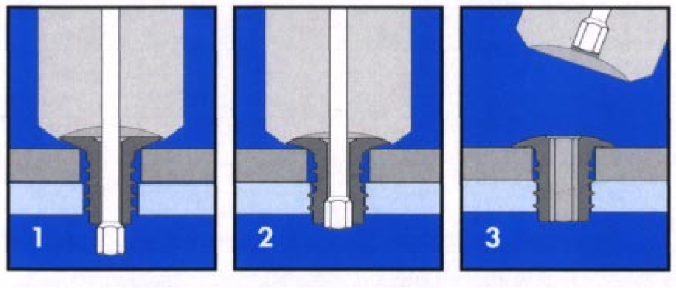


Figure 40. Rivscrew* Processing Sequence to Thermal Plate, Clamping Heatsink

The Rivscrew is a simple, high speed batch feed fastener, designed for applications in aluminum, plastics and composite materials. Each processed Rivscrew and associated threaded hole is unique. The insertion of the Rivscrew can be done using a variety of manual and automated tools. Rivscrews and the tools needed for insertion are supplied by Avdel Textron. The Rivscrew attach mechanism uses a specialized rivet (the Rivscrew itself) that is inserted through a hole in the heatsink into the thermal plate. Intel recommends the use of Rivscrew 1712-3510 for heatsink attachment to the S.E.C. cartridge processor package. Rivscrews can be installed with either manual or automatic machinery. See the *Pentium® II Processor Supplier's Guide,* located at the Intel website, and contact Avdel Cherry Textron for further information on manual and automated installation solutions.

5.2.1.1. Heatsink Recommendations for use with Rivscrews*

Figure 41 through Figure 43 provide the recommended guides for heatsink designs using Rivscrews. It is important to follow these guidelines to ensure the Rivscrew installation does not damage the processor. The recommended heatsink base thickness is 0.140 ±0.010 inches.

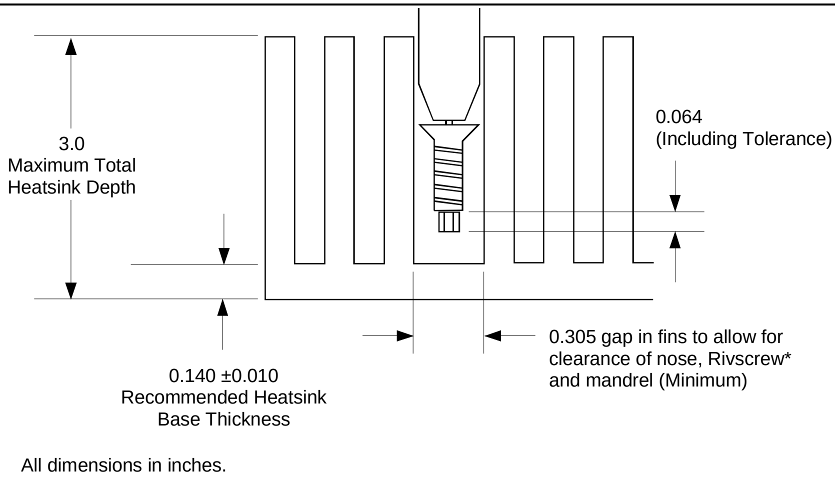


Figure 41. Heatsink Recommendations and Guidelines for Use with Rivscrews*

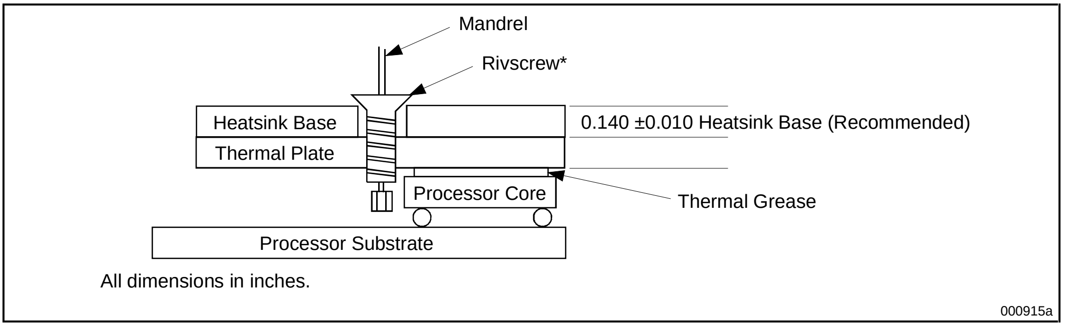


Figure 42. Heatsink Rivscrew* and Thermal Plate Recommendations and Guidelines

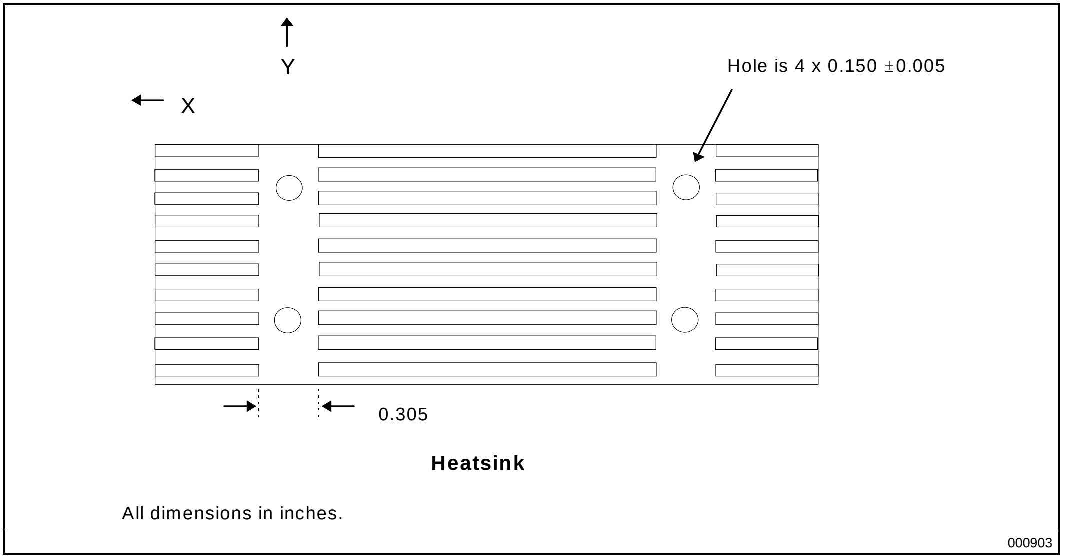


Figure 43. General Rivscrew* Heatsink Mechanical Recommendations

5.2.1.2. HVM Enabled Procedures and Equipment for Production Rivscrew* Heatsink Attach

Intel has enabled a machine for efficient Rivscrew attachment of the heatsink in an HVM environment. (See Figure 44.) The machine installs the four (4) Rivscrews simultaneously, reducing the overall time for heatsink installation. This machine relies on the use of the four "outer" heatsink attach holes on the thermal plate and will not work if the close-set holes are utilized. The Intel enabled heatsink solution uses this hole set. Intel recommends the use of heatsinks that have thermal grease applied to the heatsink, rather than the S.E.C. cartridge itself. The machinery is a combination of four individual Rivscrew insertion heads together with a set of jigs that hold the S.E.C. cartridge and heatsink in place during the insertion process. The machinery requires only pneumatic (shop air) and electric power for use. The heatsink jigs are application-specific to ensure ease of heatsink placement for the operator. The S.E.C. jig ensures that the S.E.C. can be placed in only the correct orientation and that the latches are in the "out" position and ready for the subsequent S.E.C. insertion step. It is recommended that the heatsink and heatsink jigs be designed to allow for placement in only the correct orientation. See the *Pentium® II Processor Supplier's Guide*, located at the Intel website, for supplier information.

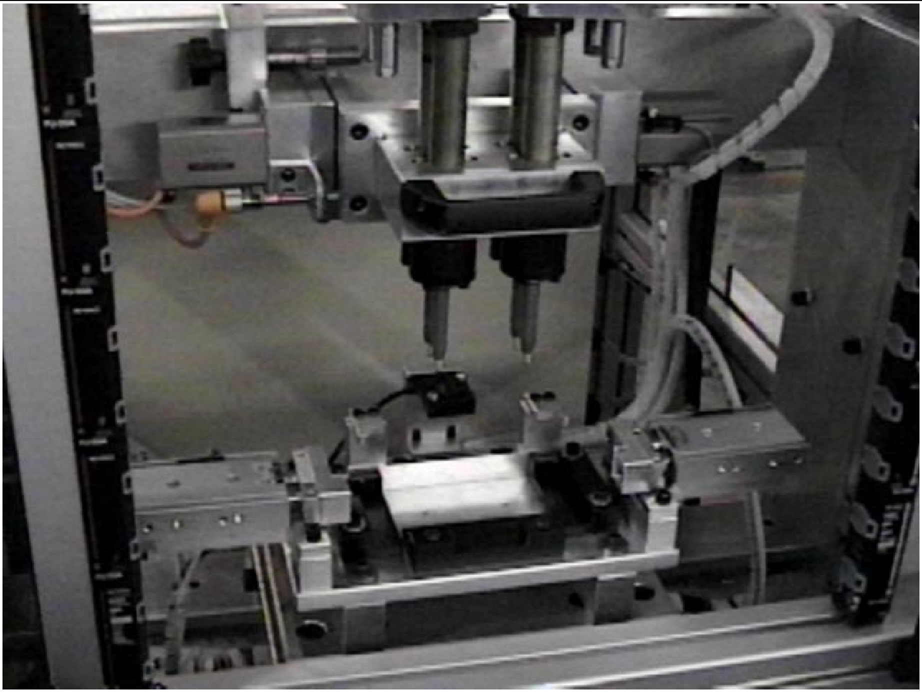

001018

Figure 44. Four-Head Rivscrew* Machine

5.2.2. HEATSINK ATTACHMENT USING SPRING CLIPS

5.2.2.1. Heatsink Clip Attach Hole Size

A number of vendors have heatsink spring clips for heatsink attachment (see Figure 45). Refer to the *Pentium® II Processor Supplier's Guide*, located at the Intel website, for further information. Contact the vendor for specific information on their heatsink clip design. The dimensions of the heatsink clip attach holes for the Pentium II processor are presented in the *Pentium® II Processor at 233 MHz, 266 MHz and 300 MHz* datasheet. The clarified dimensions of the heatsink clip attach holes are shown below and all four clip attach holes are identical. The slot in the skirt is also approximately the same size as shown in Figure 46.

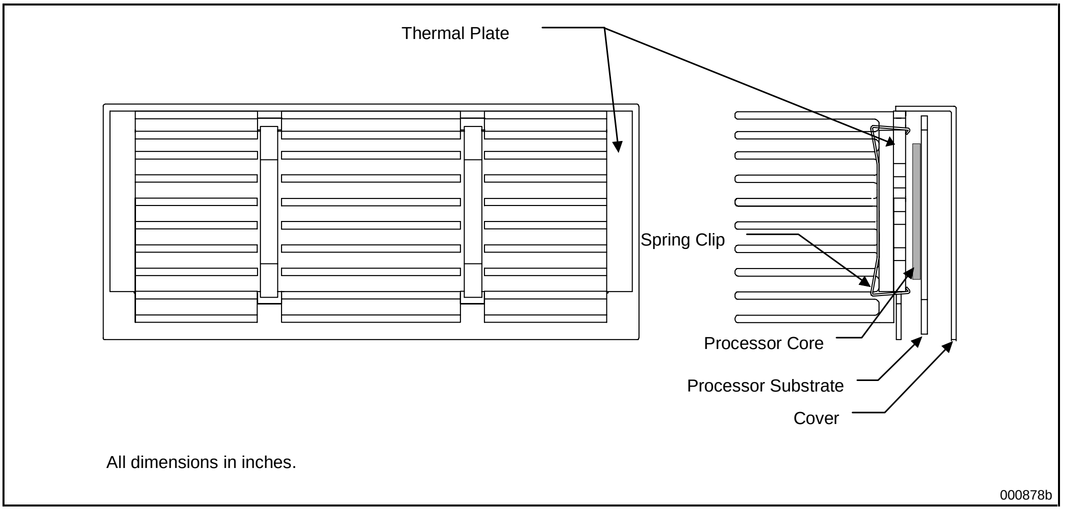


Figure 45. Heatsink Attachment Using Spring Clips
(Example heatsink shown.)

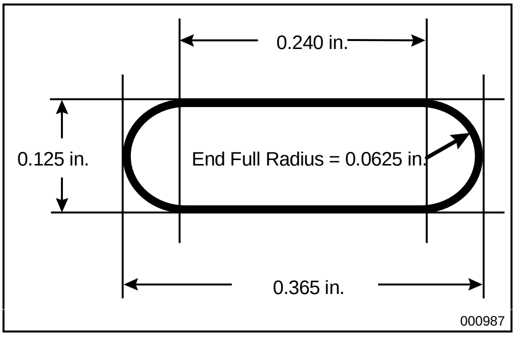


Figure 46. Heatsink Clip Hole Size in Thermal Plate and Skirt

5.2.2.2. Heatsink Clip Clearance and Working Volume Specification

The heatsink clip must work within a specific volumetric specification defined in the *Pentium® II Processor at 233 MHz, 266 MHz and 300 MHz* datasheet. The volumetric specification is defined to ensure the heatsink clip does not damage the processor core, substrate or any other passive or active component with the S.E.C. cartridge package itself. Any heatsink clip design which violates the usable volumetric specification can cause unpredictable processor behavior, damage the processor and system and ultimately cause system failure. It is recommended this specification be followed very closely.

5.2.2.3. Pentium® II Processor Heatsink Clip Design Considerations

To ensure that heatsink clips designed for the Pentium II processor provide a robust heatsink attach solution, the following recommendations and concerns should be considered:

- Heatsink clips for the Pentium II processor should be designed to never touch the processor substrate. Care should be taken to make sure there is no physical interference with the substrate during and after clip installation or removal. Intel recommends incorporating a "shoulder" or other fail-safe mechanism to prevent the clip from making physical contact with the substrate. Factory, field service and end user installation and removal procedures should be considered. The clearance to the substrate is shown in the *Pentium® II Processor at 233 MHz, 266 MHz and 300 MHz* datasheet.
- The heatsink clip should be designed to meet all the specifications listed in the *Pentium® II Processor at 233 MHz, 266 MHz and 300 MHz* datasheet.

- Heatsink clips should be designed to meet a Pentium II processor system's shock and vibration requirements. Designs should be validated using shock and vibration testing.
- Human interface concerns such as installation pressure and potential for injury during the installation and removal process should be addressed.
- The thermal expansion characteristics of the heatsink clip material should be analyzed to ensure that the retention force of the clip does not relax due to temperature exposure over time.
- The impact of a heatsink clip design on EMI emissions should be evaluated and characterized.
- The heatsink clip should be designed to provide adequate clamping force to ensure a robust interface between the heatsink, thermal plate and thermal interface material.
- During the stamp-cut process of making heatsink clips, burrs can be formed. It is recommended the clip designer be cognizant of possible burrs production; a burr can impact installation/removal ease and other clip usability features.

5.2.2.4. High Volume Enabled Procedures for Spring Clip Heatsink Attach

The spring clip used for heatsink attach on the S.E.C. cartridge package is specific to the supplier and/or system designer. It is recommended to contact one of the suppliers listed in the *Pentium® II Processor Supplier's Guide,* located at the Intel website, for further information and usage of the spring clip heatsink attach. Ensure the guidelines and requirements listed above are adhered to.

5.3. Baseboard Preparation

5.3.1. MANUAL INSTALLATION OF THE RETENTION MECHANISM

To manually install the Intel enabled RM, use a Phillips #2 manual torque screwdriver capable of a 6.0 in.-lb. (0.678 N-m). The screwdriver should also have a shaft longer than 2 inches for clearance around the RM. To install the RM (Label B in Figure 47), locate Slot 1 connector and the four attach mount studs (Label C in Figure 47) on the baseboard. To position the RM, orient it as shown in Figure 47. The external polarization key on the Slot 1 connector mates into the notch in the RM (Label A in Figure 47). When it is properly seated, the RM "pedestals" fit flush with the baseboard. The RM side rails are 0.020 inches off the baseboard to allow for top layer trace routing.

CAUTION

Over tightening the captive nuts on the RM can damage the baseboard. Tighten the captive nuts (Label D in Figure 47) to no more than 6 in.-lb. ±1 in.-lb. (0.678 N-m ±0.113 N-m). A recommended procedure is to finger tighten all four captive nuts to ensure correct engagement on the threads of the mounting studs, then secure the retention mechanism by tightening the captive nuts with a torque screwdriver.

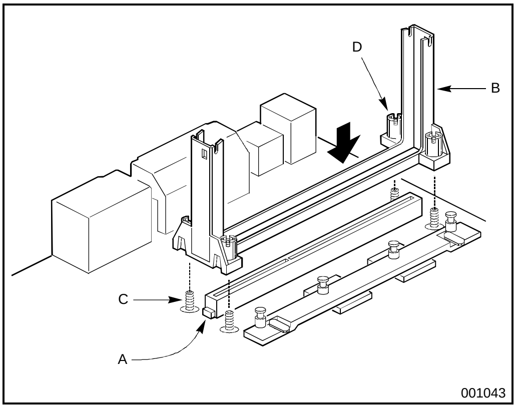


Figure 47. Installation of the Retention Mechanism

Installation of the processor is the next step. The processor latch arms must be in the "out" position before installation into the RM. Insert the processor in the retention mechanism as shown in Figure 48 (the processor has an example heatsink installed on the thermal plate). Push the processor down into Slot 1 connector until it is firmly seated and the latch arms fully engage into the RM posts. An audible click can be heard from the processor seating in the Slot 1 connector and the latch arms engaging in the RM posts.

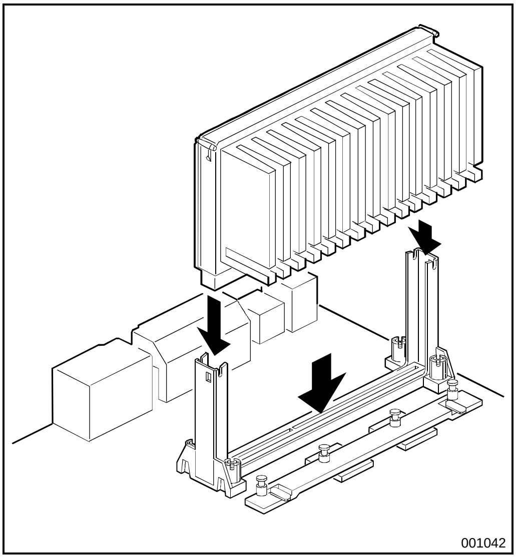


Figure 48. Installing the Processor into the Retention Mechanism
(Example heatsink shown.)

Due to the mechanical interaction between the S.E.C. cartridge and the Slot 1 connector, a maximum of 25 lbs-f is required to insert the processor into the Slot 1 connector. If the RM is also installed on the baseboard, the insertion force will be increased due to the additional interaction of the RM to S.E.C. cartridge package. The S.E.C. cartridge should not encounter more than 70 lbs-f during insertion into the Slot 1 connector. A higher insertion force applied to the processor will possibly damage the package, resulting in system failure. The system integrator, though, must ensure the baseboard is adequately supported during processor installation. An incorrectly supported baseboard might encounter Slot 1 connector, trace or component damage during installation of the processor. The processor should be inserted enough to hear an audible click of the latch arms into the RM and to ensure the heatsink and heatsink support interact correctly. The latch arms are “out” when the processor is shipped from the Intel factories. It is not recommended to push the latch arms “in” during insertion into the RM and Slot 1 connector. The latch arms are designed to engage into the RM automatically. It is recommended to have the operator ensure the latch arms are “out” and correctly engaged in the RM after insertion.

5.3.2. HVM ENABLED PROCEDURES AND EQUIPMENT FOR THE ENABLED RETENTION MECHANISM

Intel has enabled a set of machinery for efficient installation of the RM in HVM environments. The machinery is pneumatically powered, and consists of four fixtured pneumatic screwdrivers together with baseboard-specific mounting jigs to properly hold the baseboard and RM. The machine tightens the captured nuts to the attach mount studs, while minimizing the potential for screwdriver damage to the S.E.C. cartridge and baseboard. The machine can also be used to rework (i.e., remove) an incorrectly processed RM. (See Figure 49.) Refer to the *Pentium® II Processor Supplier’s Guide,* located at the Intel website, for supplier information.

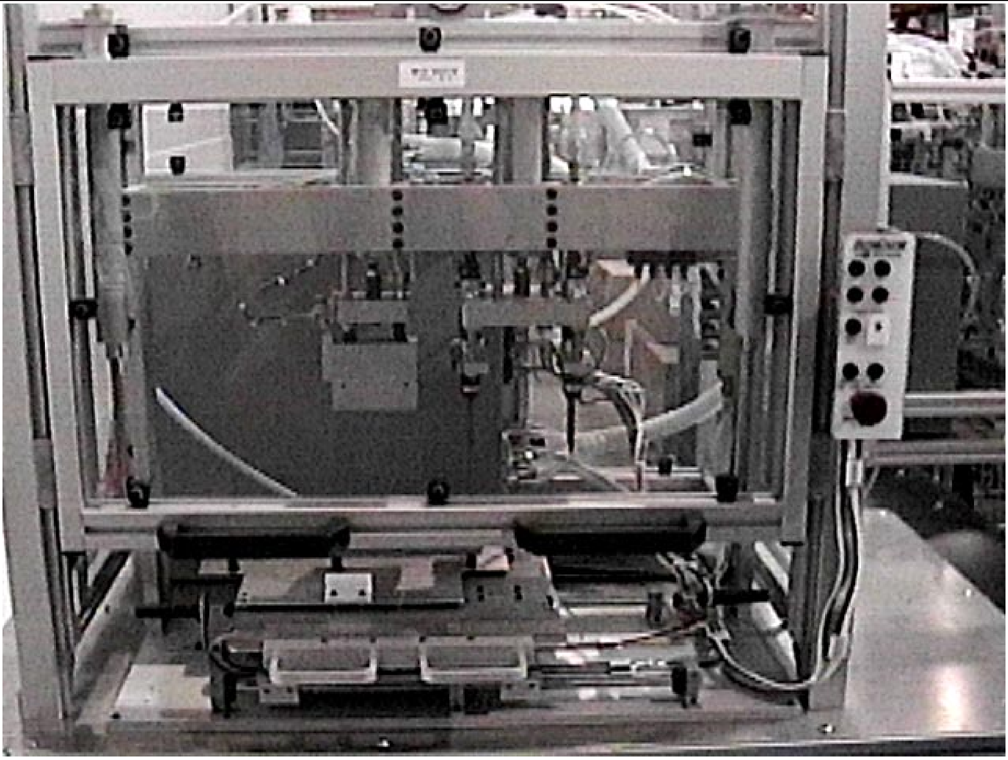

001019

Figure 49. Retention Mechanism/S.E.C. Cartridge Installation Tool

5.3.3. HEATSINK TOP BAR INSTALLATION

Once the processor is installed in the RM, the heatsink support top bar must be installed for complete retention of the heatsink. It is recommended to have the top bar installed, immediately following processor installation, in the manufacturing line. The top bar slides over the bottom fin of the heatsink and snaps onto the two outer posts on the base. (The two inner posts act as guides only.) See Figure 50 for installation of the top bar.

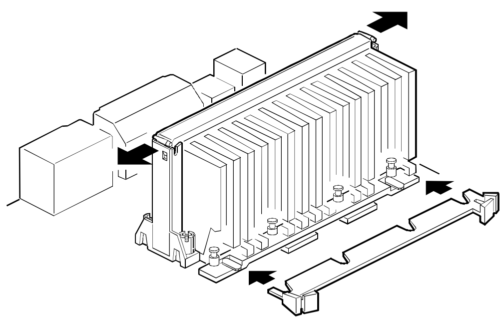

001044

Figure 50. Heatsink Support Top Bar Installation
(Example heatsink shown.)

5.3.4. OTHER SYSTEM AND BASEBOARD ASSEMBLY ISSUES

For some chassis designs (e.g. ATX), the S.E.C. cartridge may need to be inserted into the Slot 1 connector before the baseboard is assembled in to the chassis. Or the power supply unit (PSU) may need to be installed after the baseboard in placed into the chassis. It is important to ensure adequate distance is allowed between the S.E.C. cartridge and the PSU during installation, removal and shock/vibration environmental testing (see Figure 51 and Figure 52). Also, the memory modules (SIMMs or DIMMs) may need to be inserted before the S.E.C. cartridge; the spacing between the heatsink support base and memory modules should be evaluated. These types of issues should be addressed as the S.E.C. cartridge processor is evaluated for introduction to the manufacturing flow.

5.4. Removal of Processor and Mechanical Support Pieces

Once installed, it is possible to disassemble the processor and mechanical support pieces. It is recommended to follow the correct procedure as outlined in this section. Improper use of force or effort can damage the processor, mechanical support pieces or baseboard. Pushing on the motherboard or components during processor removal can cause damage.

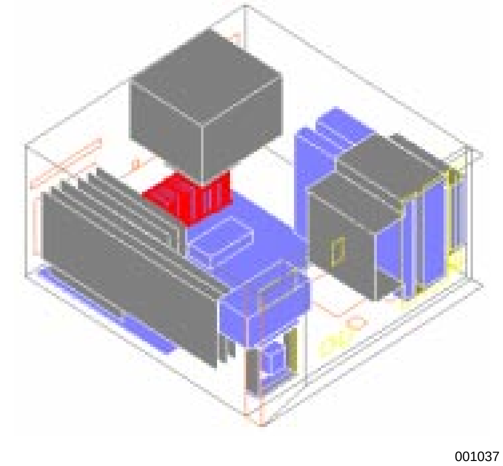


Figure 51. Placement of S.E.C. Cartridge Package in ATX Form Factor Chassis

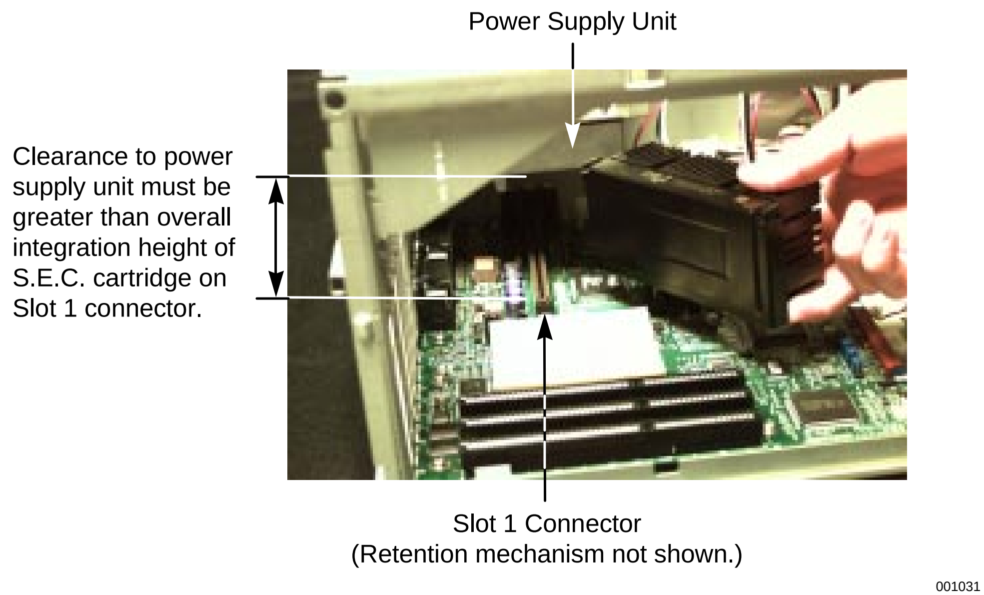


Figure 52. S.E.C. Cartridge Processor in ATX Chassis, Power Supply Unit Clearance Shown

The first step is to remove the HSS top bar. Remove the top bar from the base as shown in Figure 53. During the removal, press in on the top bar latches to release the top bar from the HSS base. Once the top bar has been disconnected from the base, remove the top bar from the heatsink fin spacing and place aside.

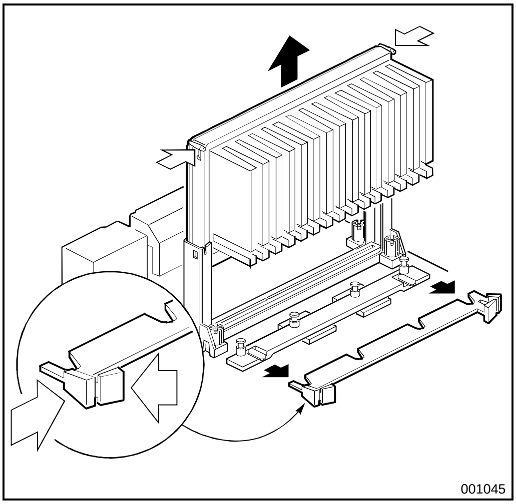


Figure 53. Removing the Heatsink Support Top Bar and the Processor
(Example heatsink shown.)

The next step is to remove the processor. As shown in Figure 53, first press the latches into the "detent" or removal location. (In this location, the latches will stay inside the S.E.C. cartridge cover for processor removal.) The latch arms will "snap" into this position. Once the latch arms are in place, grab the S.E.C. cartridge package at the top. If necessary, safely press on the motherboard's plastic connectors to gain leverage while removing the processor. Place the processor aside.

To remove the heatsink support base from the motherboard, it is recommended to use a removal tool. See the *Pentium® II Processor Supplier's Guide,* located at the Intel website, for information on removal tool supplies. Before actual removal of the base can occur, remove the two base pins from the base with fingers (see Figure 54).

Place the heatsink support removal tool (A in Figure 55) over the two outside posts of the heatsink support base (B in Figure 55) as shown. Make sure that the tool is fully engaged with the posts.

Carefully rock the tool back and forth until the heatsink support retention posts disengage from the holes in the motherboard (see Figure 56). There will be an audible click when the retention posts disengage. Remove the tool and heatsink support base from the motherboard.

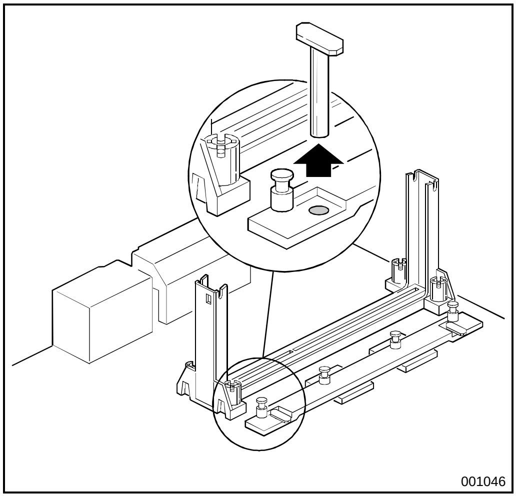


Figure 54. Removing the Heatsink Support Retention Pins

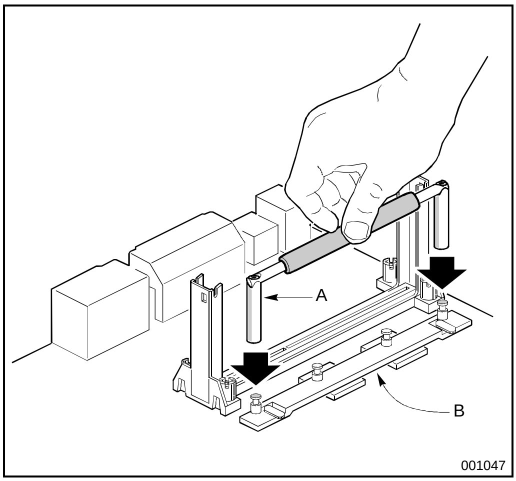


Figure 55. Placing the Heatsink Support Base Removal Tool on the Retention Pins

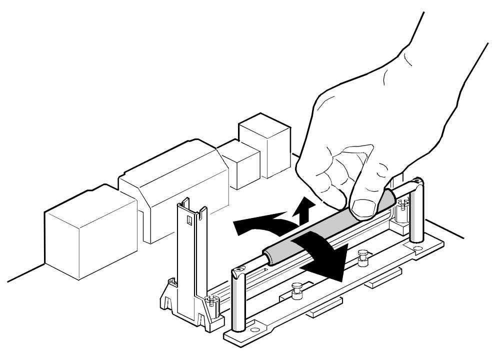


Figure 56. Using the Heatsink Support Base Removal Tool

The RM can be removed by unscrewing the captured nuts from the RMAM studs. After unscrewing the nuts, the RM can be lifted off of the studs and Slot 1 connector and placed aside.

5.5. Reuse of Processor and Mechanical Support Pieces

The processor and mechanical support pieces are robust components, meant for use in PC OEM manufacturing and system environments. The processor is “reusable” within the specification limits defined in the *Pentium® II Processor at 233 MHz, 266 MHz and 300 MHz* datasheet. The mechanical support pieces can be removed from the baseboard as described above. Removal, though, is NOT recommended for the Slot 1 connector and RMAM. Each of these pieces interacts with the baseboard material and could damage the board if removed incorrectly. Also, if removed, each mechanical piece should receive a thorough inspection to ensure mechanical integrity.

6.0. INTEL BOXED PENTIUM® II PROCESSOR INTEGRATION GUIDELINES

The Pentium II processor is also offered as a Boxed processor. The term "boxed processor" refers to processors specifically designed and packaged for system integrators, who use off-the-shelf system components to assemble personal computer systems. System integrators use varied combinations of chassis, power supplies, baseboard form factors, and peripherals. This provides for a wide variety of thermal environments in which the processor must operate within thermal specifications. For this reason, boxed processors include an active cooling solution (hereafter referred to as the fan heatsink) that is specially designed for the particular processor. Boxed processors also come with all the necessary hardware and installation instructions to integrate the Boxed processor into a system.

6.1. Boxed Processor Fan Heatsink

For the Boxed Pentium II processor, the fan heatsink is already attached to the processor’s thermal plate before the unit is shipped, using a high quality thermal grease and Rivscrews*. Specifications for the Boxed Pentium II processor’s fan heatsink can be found in the *Pentium® II Processor at 233 MHz, 266 MHz and 300 MHz* datasheet.

The fan heatsink comes in two pieces: a molded aluminum heatsink base and a plastic fan-shroud that attaches to the base. The shroud is made of a molded high grade plastic.

The fan heatsink requires clearance around the unit for proper airflow and cooling efficiency. The fan heatsink also requires the air-intake temperature to not exceed a specified limit, in order to keep the processor thermal plate below its maximum temperature. Clearance requirements and air-intake temperature requirements are defined in the *Pentium® II Processor at 233 MHz, 266 MHz and 300 MHz* datasheet.

6.2. Boxed Processor Mechanical and Electrical Support Pieces

6.2.1. FAN HEATSINK SUPPORTS

The fan heatsink, like the passive heatsink, requires a mechanical support mechanism in addition to the processor retention mechanism that is described in Section 3.0. However, the fan heatsink cannot use the same passive heatsink supports as described in Section 3.0. Instead, specially designed fan heatsink supports are included with the Boxed Pentium II processor. The fan heatsink supports consist of two triangular brackets and two plastic "pegs". The supports are made of a molded high grade plastic. The fan heatsink supports attach to the fan shroud and use the same heatsink support holes on the baseboard as the passive heatsink supports. Location and sizes of the heatsink support holes are defined in the *Pentium® II*

Processor at 233 MHz, 266 MHz and 300 MHz datasheet. Baseboards for system integrators must come with no items installed in the heatsink support holes. If any item (such as the heatsink support base) is installed in the heatsink support holes, it must be removed prior to installation of the Boxed processor.

6.2.2. FAN POWER CABLE

The fan heatsink also requires power to drive the integrated fan and provide needed airflow. A fan power cable is included with the Boxed Pentium II processor and connects the fan power connector to a power header on the baseboard. Specifications and location of the fan power header on the baseboard are defined in the *Pentium® II Processor at 233 MHz, 266 MHz and 300 MHz* datasheet.

6.3. Boxed Processor System Integration Manufacturing Guidelines

Table 7 and Figure 57 provide the overall list of materials and manufacturing flow for the integration of the Boxed Pentium II processor and support pieces into the system manufacturing flow. Baseboard Integration described in Section 4.0. is essentially the same.

Table 7. Boxed Pentium® II Processor System Assembly and Material List

Assembly Type	Quantity per System
System Assembly	
Processor with Attached Fan Heatsink	**1**
Retention Mechanism	**1**
Fan Heatsink Support	**2 (L & R)**
Fan Heatsink Support Peg	**2 (L & R)**
Fan Power Cable	**1**

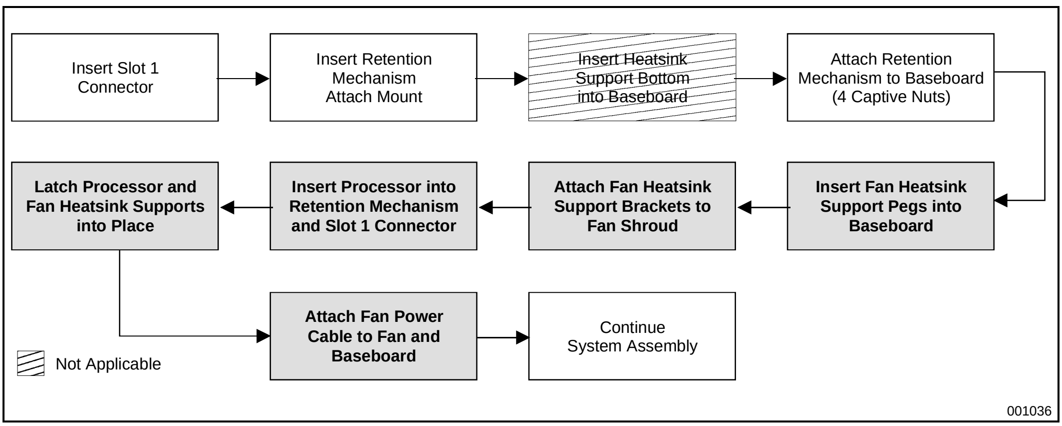


Figure 57. Suggested System Integration Manufacturing Flow
(Bolded boxes covered in this subsection.)

6.3.1. PRE-INSTALLATION PREPARATION

1. Be sure that the baseboard kit includes a retention mechanism and instructions for installing it onto the baseboard.
2. Be sure that the Boxed Pentium II processor kit includes the following:
   - One processor with fan heatsink attached
   - One heatsink support set containing two black plastic pegs and two black plastic supports
   - One power cable
3. Place the baseboard on an ESD workbench (not in a chassis). Be sure that the baseboard is bare (that is, no SIMMs, cables, or cards are installed) and that the holes for the fan heatsink support pegs are empty. If a passive heatsink support is installed on the baseboard, consult the manufacturer's documentation for instructions to remove it.

6.3.2. BASEBOARD PREPARATION – INSTALLATION OF THE RETENTION MECHANISM

Baseboards for system integrators should be shipped with a retention mechanism and include instructions on installing the retention mechanism, since such a design may be specific to that baseboard. In general, however, the procedure in Section 5.3.1. can be followed to install the retention mechanism in the baseboard (see Figure 47).

6.3.3. INSTALLING THE BOXED PROCESSOR (See Figure 58 through Figure 61)

1. Mount the two black plastic pegs onto the baseboard. These pegs will be used to attach the fan heatsink supports. Notice that one hole and base of one peg are larger than the other hole and peg base. Push each peg into its hole firmly until you hear it "click" into place.

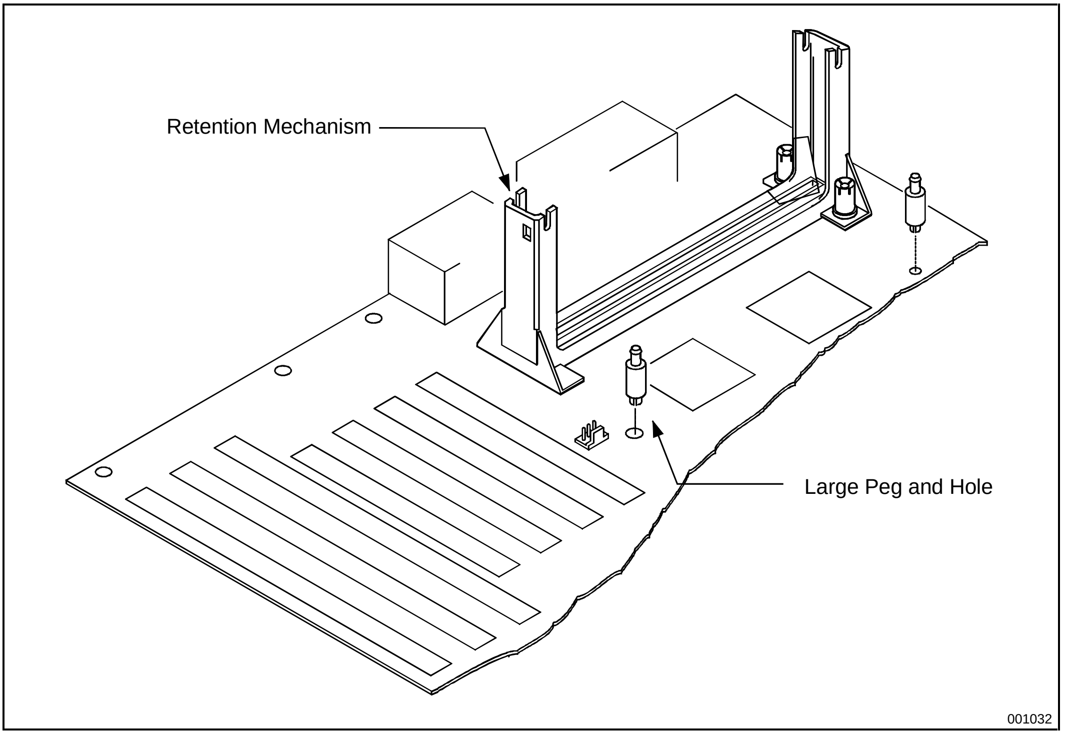


Figure 58. Baseboard Preparation for Boxed Processor

2. Slide the black plastic support onto each end of the fan heatsink, making sure that the hole and clip are on the outside edge of the support. (If the supports are reversed, the holes will not line up with the pegs on the baseboard.) Slide each support toward the center of the processor until the support is seated in the outside groove in the fan housing.

3. Slide the clip (A) on each support toward the processor, exposing the hole that will fit over the peg on the baseboard. Push the latches (B) on the processor toward the center of the processor until they click into place. (Refer to Figure 60.)

4. Hold the processor so that the fan shroud is facing toward the pegs on the baseboard. Slide the processor (C) into the retention mechanism and slide the supports onto the pegs. Ensure that the pegs on the baseboard slide into the holes in the heatsink support. Push the processor down firmly, with even pressure on both sides of the top, until it is seated.

5. Slide the clips on the supports (D) forward until they click into place to hold the pegs securely. (Apply slight pressure on the peg and push the peg toward the clip while pushing the clip forward.) Push the latches on the processor (E) outward until they click into place in the retention mechanism. The latches must be secured for proper seating of the processor in Slot 1. (Refer to Figure 61.)

6. Attach the small end of the power cable (F) to the three-pin connector on the processor, and then attach the large end to the three-pin power header on the baseboard. Consult the baseboard documentation to find the connector.

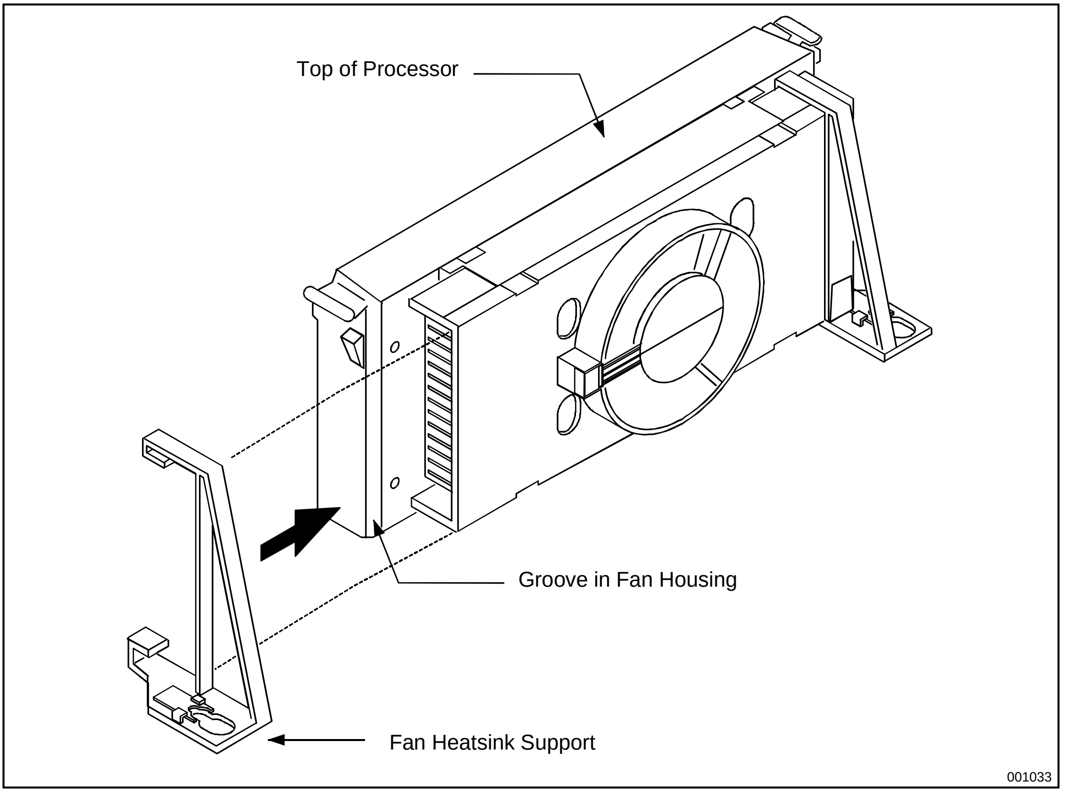


Figure 59. Boxed Processor Fan Heatsink Preparation

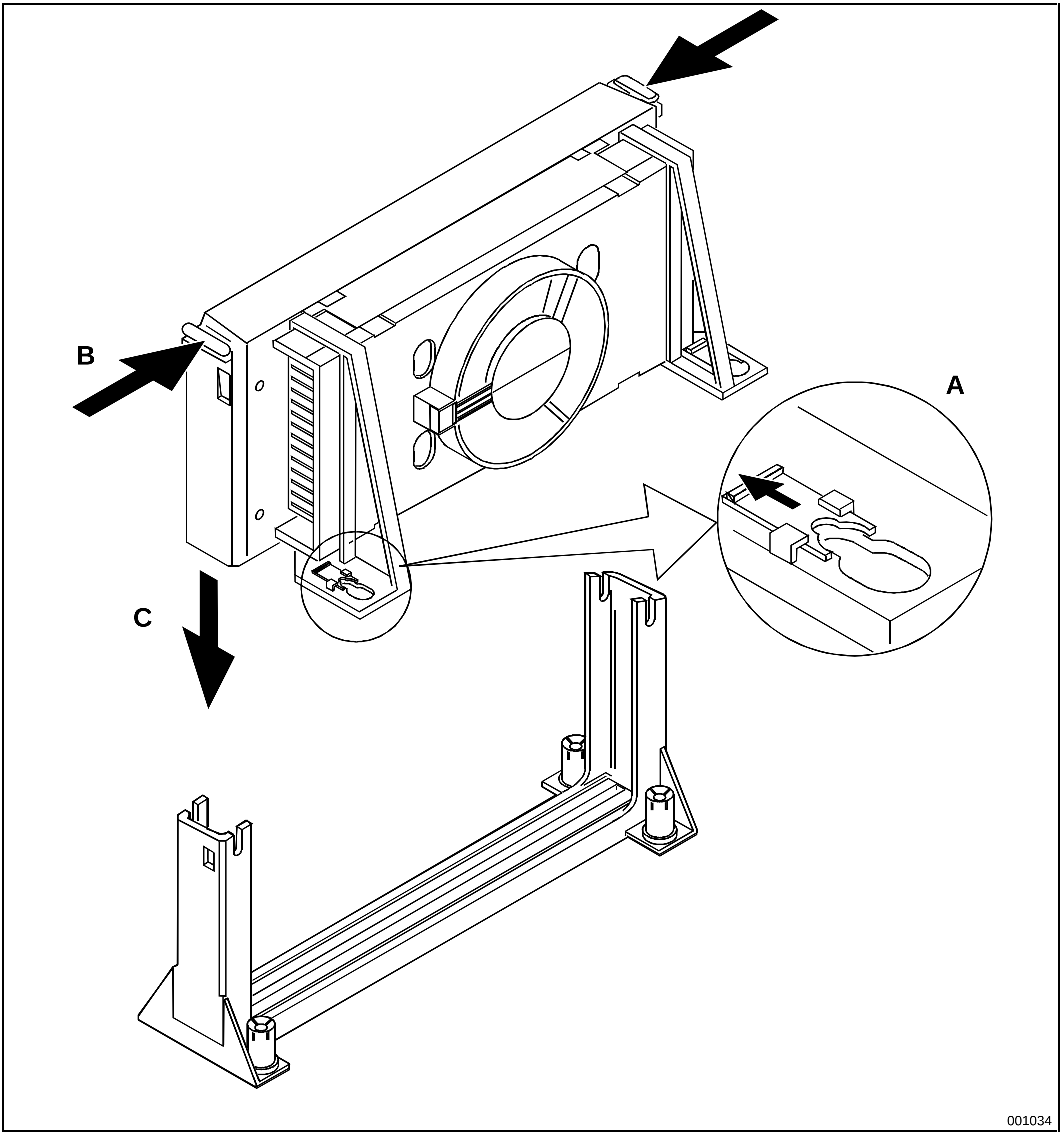


Figure 60. Boxed Processor Installation into Retention Mechanism

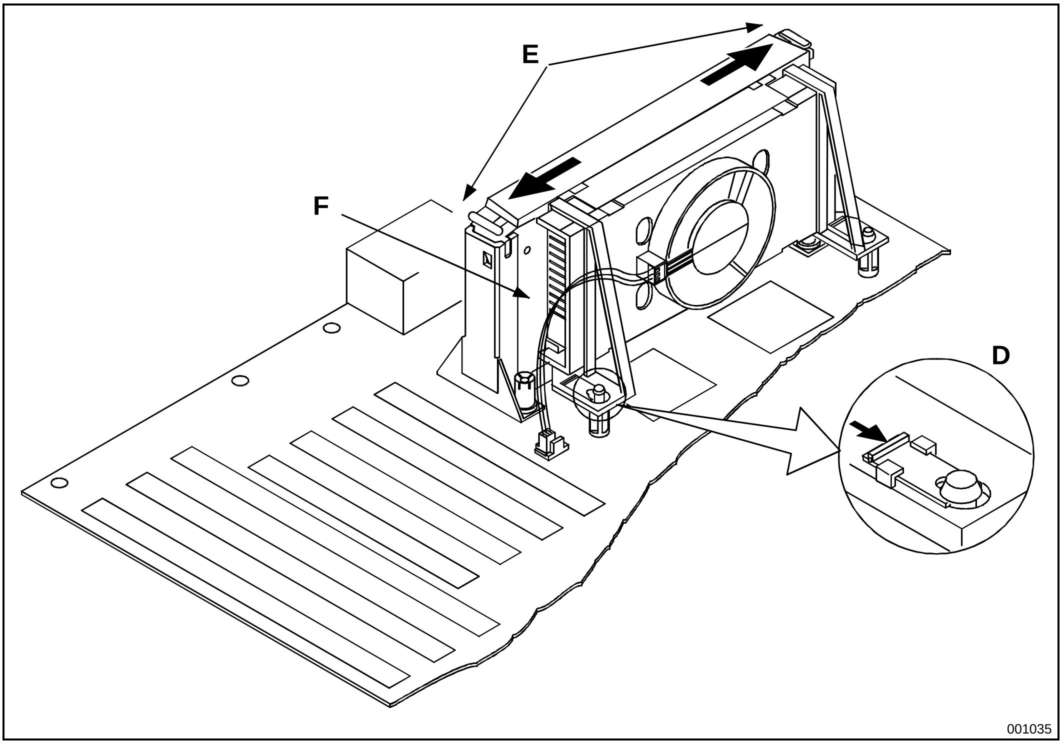


Figure 61. Boxed Processor Installation Baseboard Finishing Steps

6.3.4. REMOVING THE BOXED PROCESSOR

First, remove the baseboard from the chassis. To remove the boxed processor from the baseboard, follow these steps (the reverse of the installation process).

Disconnect the fan power cable from the baseboard.

Slide the clips backward to disengage the pegs in the baseboard. Push the latches on the processor toward the center of the processor until they click into place.

Lift one end of the processor until it is freed from Slot 1. Lift the other end of the processor until it is freed from Slot 1. Lift the entire processor (with fan heatsink supports attached) until it is free from the retention mechanism.

If needed, remove the heatsink support pegs from the baseboard and discard them. With one hand, squeeze together the two halves of the peg on the bottom side of the baseboard. With the other hand, pull the peg out of the hole in the baseboard. Do not reuse the pegs.