Builder's Guide for 2P Capable Servers and Workstations

A concise manual to assist System Builders in assembling high performance servers and workstations using the AMD Athlon™ MP Processor

Note: *The product(s) received may vary in appearance from the products illustrated.*

Failure to install the AMD Athlon processor properly may adversely affect operation and may void your warranty coverage.

DO NOT install the processor if it has been damaged.

Table of Contents

Hardware Considerations

Starting the System

Other Items

Hardware Considerations

The selection of the proper system hardware is critical to the success of the finished system. For best results, a system builder should *always* contact the supplier or vendor for each of the components to verify that each of the chosen component supports the desired system configuration. The following data is a basic guideline that has been tested and approved by the Engineering staff at AMD.

System Enclosures or Case Selection

The choice of the appropriate system enclosure depends on many factors as follows:

1. It must be compatible with the chosen motherboard and power supply.
2. It must be large enough to contain all the devices required.
3. It must be small enough to fit into its intended space.
4. It must be cost effective.
5. It must be reasonably easy to assemble (compared to other choices).
6. It must have good fit and finish, e.g., no razor-sharp edges.
7. It must allow enough airflow through the system to adequately cool all the internal components, especially critical parts like the processor.

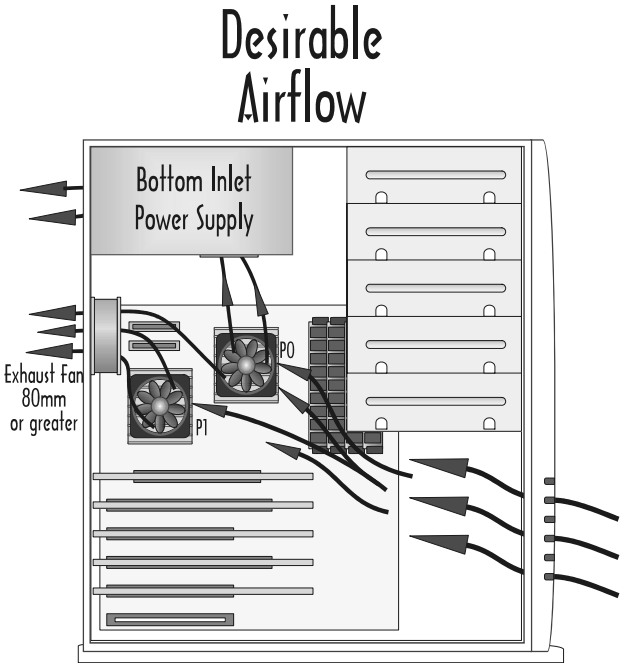
Basic Case Selection Guidelines

The first six factors are relatively self-evident – the seventh one can be elusive. Here are some basic guidelines to aid in finding an enclosure with adequate cooling capability:

- Standard horizontal cases are not recommended – *use vertical cases only.*
- For a rack-mounted chassis, check with the chassis supplier as to its suitability.
- Cases with an added fan in the back cool better than cases without an added fan.
- Fans 80mm or larger work best.
- Cables inside the enclosure can cause airflow disruptions. Cable-tie and route the cables out of the path of the cooling airflow.
- For vertical cases, power supplies with ATX-style bottom air intake vents maintain a better thermal environment than power supplies with just a front air intake vent.
- When the system is in a vertical case, there must be clear space in front of the case to allow cooling air to flow in and space behind the case for the heated air to flow out.
- The rear fans must all pull air in the same direction, otherwise one fan pulls warm air out of the enclosure while the other fan pulls the preheated air back into the enclosure.
- Front intake fans have not proven to be a significant benefit for vertical cases.

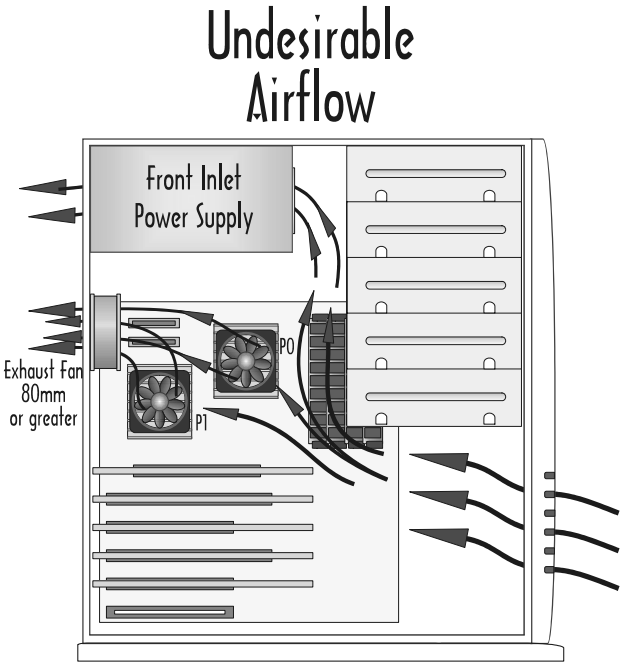
Figures 1 and 2 on page 2 show the airflow patterns in a vertical case with either a front-inlet power supply or a bottom-inlet power supply. Testing by the AMD engineers has found the bottom-inlet power supply to be desirable, the figures illustrate why this is.

The configuration in Figure 1 is the preferred configuration.



Testing by the AMD thermal engineers has shown that the airflow pattern seen in Figure 1 is more desirable than the airflow pattern seen in Figure 2. When the bottom inlet power supply is used, nearly all the air flows near or through the area of the processors. As a result of this, the processors remain cooler. Since the heatsinks are heat radiators, like the radiator in your automobile, they need airflow to function properly. The more airflow there is, the better they function.

Figure 1. Desirable Airflow: Power Supply with Bottom Inlet



A power supply with a front air inlet causes a portion of the airflow to be diverted directly through the power supply, never passing near the heatsinks. With this type of power supply, there is a greater potential for overheating problems.

Therefore, the AMD thermal engineers do not recommend using power supplies with the front air inlet configuration.

Figure 2. Undesirable Airflow: Power Supply with Front Inlet

Power Supply Considerations

Calculating System Power Consumption

The total combined wattage for the system configuration must be less than the output of the power supply used. Overall current usage limitation on the power supply should not exceed a combined system power output for the +5 V and +3.3 V outputs.

Use Table 1 and Table 2 on page 4 to calculate the system power consumption. For current and voltage requirements of add-in boards and peripherals, refer to your vendor's documents. List the peak current for each board and device applicable in the appropriate voltage level column. Add the currents in each column, then go to next worksheet (Table 2).

Table 1. Power Worksheet 1

Component	Item Qty	Maximum Current at Each Voltage Level				
		+3.3 V	+5 V	+12 V	–12 V	5 VSB
Motherboard w/on-board devices						
System fan						
Processor fan						
Memory module						
AGP VGA card						
PCI modem card						
PCI sound card						
PCI NIC card						
PCI SCSI card						
Other PCI card/Bus card						
PCI RAID card						
IDE hard drive						
SCSI hard drive						
CD-ROM drive						
CD-RW drive						
DVD drive						
Floppy drive						
Tape drive						
ZIP drive						
USB devices						
IEEE 1394 devices						
Keyboard						
Mouse						
Other devices (if any)						
Total Current for devices:						
Processor		---			---	---

Total Combined Power Used by the System

1. From *Power Worksheet 1,* enter the total current for each column.
2. Multiply the voltage by the total current to get the total wattage for each voltage level.
3. Add the total wattage for each voltage level to arrive at a total combined power usage on the power supply.

Table 2. Power Worksheet 2

Voltage Level and Total Current (V x A = W)			Total Watts for Each Voltage Level
+3.3 V	x	(total amps)	Total Watts for +3.3 V
+5 V	x	(total amps)	Total Watts for +5 V
+12 V (I/O)	x	(total amps)	Total Watts for +12 V (I/O)
+12 V (CPU)	x	(total amps)	Total Watts for +12 V (CPU)
–12 V	x	(total amps)	Total Watts for –12 V
+5 VSB	x	(total amps)	Total Watts for 5 VSB
Total =			**Total Combined Wattage =**

Note: *To calculate the processor current at 12 V VRM source:*

$$\mathbf{I} = \left[\frac{(\textbf{Processor Core Voltage} \times \textbf{Processor Core Current})}{\textbf{12}}\right] \times \textbf{1,25}$$

Where

12 = VRM source voltage and 1.25 is the reciprocal of the 80% voltage regulator efficiency

Server and Workstation Platform Power Supplies

Depending on the motherboard vendors' design requirements, the server/workstation built using the AMD-760™ MPX chipset can use either an ATX12V power supply, an EPS12V, or a power supply that follows a new power supply specification AMD calls the GES Power Supply Specification. To support high-end server and workstation platform power requirements, AMD has developed a power supply *AMD GES Design Guide* that details the specifications of an alternate power supply that can support dual processors server and workstation platform power requirements. This design guide supports the power supply companies and is intended to aid in building of an infrastructure to support the current AMD platform, but is not exclusive to all supporting AMD 2P configurations.

The AMD GES specification supports higher currents on 12 V rails, since most of the next generation server/workstation designs require higher currents on 12 V rail. Details of the AMD GES requirements can be obtained from AMD Field representatives.

Dual AMD Athlon™ Processor White-Box Power Supply Load Requirements Design Guide, order# 24613 lists the AMD GES, ATX12V and EPS 12V power supply output load rating requirements and connector pin-out requirements. As of the release of this document, there are no AMD dual processor motherboards utilizing the SSI EPS 12V Power Supply Design Guidelines. However, future boards may utilize this industry standard.

Note: *It is imperative that system builders ensure that the power supply of choice and the selected chassis are mechanically compatible.*

The AMD dual-processor power supplies are similar to existing *Extended ATX 12V* power supplies, but should not be limited to that form factor. In order to have a reliable and cost-effective system, system builders should calculate the power requirements for the intended configuration. The Power Worksheet 1 and Power Worksheet 2 included with this document can assist in this calculation.

When using a power supply, connector modifications may be required. If connector modifications are not possible or desired, please reference the motherboard page on www.amd.com to match the motherboard connector pin-outs to the associated power supplies.

System vendors can refer to the AMD website for a listing of power supply form-factors and also power supply vendor contact information. AMD MP systems utilizing the AMD Athlon MP processors can be built using the industry-standard ATX 12V power supplies in addition to the AMD GES specification power supplies.

Note: *System builders should refer to the motherboard manual to check the type of power connector and type of power supply the motherboard uses. The motherboard, power supply, and case must be mechanically and electrically compatible.*

Table 3 lists the target output ratings for the various types of power supplies used in dual-processor AMD Athlon processor-based systems.

Table 3. DC Characteristics—Output

Rail (VDC)	Required Current Min (Amps)	Notes
+3.3 V	27 A	
+5 V	29 A	
+12 V CPU	16.5 A	Found on Connector P2
+12 V I/O	13 A	Found on Connector P1
–12 V	0.8 A	
+5 VR	2.0 A	

AMD GES Power Connector and Pin-Out Requirements

The AMD dual processor power supply (AMD GES Specification) shall have connectors and pin-outs as listed in Tables 4 and 5.

Note: *Pins must be rated for 6 Amps or more.*

Table 4. Connector P1: 24-Pin Molex 39-01-2240 or Equivalent

AWG	SIGNAL	PIN	PIN	SIGNAL	AWG
16	+5 V	1	13	+5 V	16
16	+5 V	2	14	+5 V	16
16	GND	3	15	GND	16
16	GND	4	16	+5VR (+5VSB)	16
16	PWR_ON#	5	17	–12 V	16
16	GND	6	18	GND	16
16	+3.3 V	7	19	+3.3 V	16
16	+3.3 V	8	20	+3.3 V	16
16	GND	9	21	+3.3 V	16
16	GND	10	22	GND	16
16	+12 V-I/O	11	23	GND	16
16	+12 V-I/O	12	24	+12 V-I/O	16

Table 5. Connector P2: 8-Pin Molex 39-01-2080 or Equivalent
(Dedicated for Processor Power)

AWG	SIGNAL	PIN	PIN	SIGNAL	AWG
16	+5 V	1	5	GND	16
16	PWRGOOD	2	6	+12 V-CPU	16
16	GND	3	7	+12 V-CPU	16
16	GND	4	8	+12 V-CPU	16

Appropriate GES/ATX 12 V Power Supplies

AMD partners with power supply companies to ensure that a supporting infrastructure exists for system builders. The list of these power supply vendors and contacts is located on the AMD website at: http://www.amd.com. This list is not inclusive of all vendors who offer products that can support AMD MP configurations, but it is to be used as guidance or for the purpose of convenience to locate a supporting vendor.

ATX12V Power Supplies

Data on the ATX12V power supplies can be found at:
http://www.formfactors.org/developer/specs/atx/atx12vPSDGV1.pdf

Heatsink and Fan Setup Section

Ensure that the recommended heatsink and thermal interface are properly installed prior to powering up the motherboard. See Socket A processor heatsink installation on pages 8-11 for details.

Special Guidelines

- Pay special attention to the following guidelines while installing the processor:
- Never operate the processors without having an approved heatsink fully and properly attached with the appropriate thermal interface. In order to function, the heatsink must be attached to the socket with the supplied clip.
- Make sure the heatsink used has been tested and qualified by AMD for the megahertz rating of the processor used.
- Never run a processor at megahertz speeds greater than the rated megahertz speed.
- Always use an appropriate amount of an AMD-recommended thermal phase-change compound (see Table 6 below).

  Note: *Thermal grease is* **never** *a recommended solution.*
- *Never* power up the board with the processor heatsink fans unplugged.
- Plug the fans into the fan header connector on the motherboard or power supply as specified by the motherboard manual.
- If the heatsink needs to be removed from the processor, the old phase-change material must be completely removed from the heatsink and processor. Then, new material listed in Table 6 must be installed.

  Note: *Only use a soft plastic scraper to gently remove the old phase-change material from the heatsink and/or the processor.*
- Go to the AMD Athlon MP section of www.amd.com for details and listings of available heatsinks.

Caution: *The processor(s) will be destroyed if all these guidelines are not followed.*

Table 6 lists the approved thermal interface material. Always check the technical section of the AMD website for any updates to this information.

Table 6. Suggested Thermal Interface Material

Vendor	Material Part # or Name	Material Type
Bergquist	HF225UT	Phase-Change
Chromerics	T725	Phase-Change
Honeywell	PCM45	Phase-Change
Power Devices	Powerfilm	Phase-Change
ShinEtsu	PCS-TC011T-13	Phase-Change
Thermagon	T-pcm905C	Phase-Change

How to Install the Heatsink(s)

1. Installation in a 2P Capable System

- The installation of the processor and heatsink in a dual-processor capable server or workstation is basically the same as the heatsink installing a processor in a conventional AMD Athlon™ processor-based desktop system. The only significant difference is that if you are installing only one processor into the dual-processor system, it is important that you install it in the optimal socket.
- When only a single processor is installed in a 2P capable motherboard, it should go into Socket P0, not Socket P1 (as shown in photo on right). Installing the processor into Socket P0 will enable the Super-Bypass function.

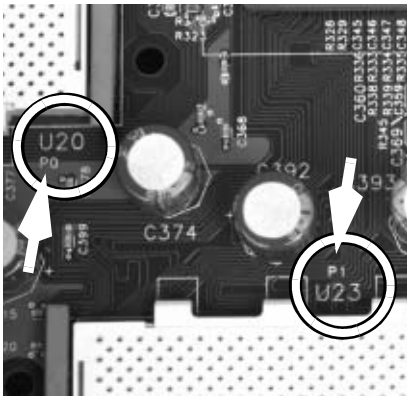


Photo 1. Socket IDs on motherboard

Note: ***Super-Bypass allows the system controller to internally bypass certain memory pipeline stages for optimal performance when only a single processor is present.***

2. Place the processor into the socket as shown

- To insert the processor, the socket locking arm must be raised (pull out slightly, then lift up).
- Verify that all 4 rubber pads (arrows) are on the processor, contact your supplier if they are not there.
- Gently place the processor into the socket; no force will be needed if everything is positioned correctly.
- The cut corner or the corner with the triangle must be located near the locking arm pivot (circled).
- When the processor is in the socket properly, lower the arm and latch it.
- Do not apply any power (*voltage*) to the system until the heatsink is fully installed.

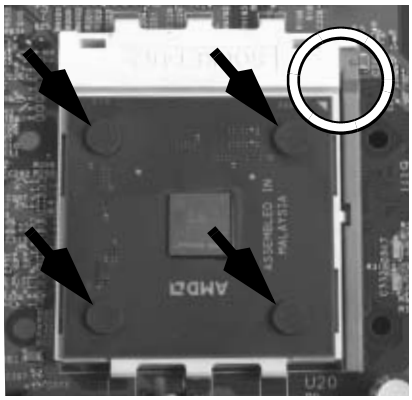


Photo 2. Rubber Pads and Corner ID

Caution: **If voltage is applied before the heatsink is fully installed, the processor *will* overheat and failure *will* result!**

3. Remove the plastic cover or plastic tape from the bottom of the heatsink

- A portion of the bottom of the heatsink is covered with a rectangle of *phase-change* thermal interface material. This material is protected by either a plastic cover *(like a lid)* over the complete bottom of the heatsink, or a length of plastic tape covering the thermal interface material area. Do not uncover the bottom of the heatsink until you are ready to install it. The thermal interface material must be kept clean to function properly. If the interface material is damaged before the installation is completed, the old interface material *must* be removed and new interface material installed. (Go to the technical area of www.amd.com for details and a list of approved products.)

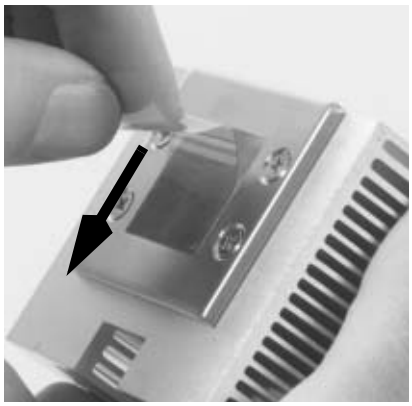


Photo 3. Removing thermal interface tape

- If you have the plastic cover, just pull to remove.
- If your heatsink has the plastic tape tab, pull quickly at a right angle to the surface of the heatsink to remove only the thin plastic tape, not the soft thermal interface material.

Caution: **Failure to remove the plastic tape film *will* cause overheating and processor failure.**

How to Install the Heatsink(s), continued

4. Place the heatsink on the processor, but do not press the heatsink down on the processor
   - Notice that the clip is not symmetrical (top arrow).
   - Verify that the clip pressure point is directly over the die (circled).

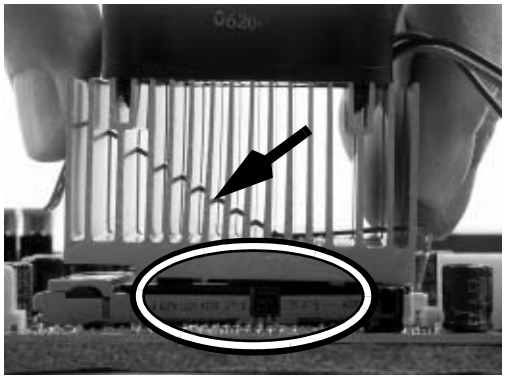


Photo 4. Placing the heatsink on processor

5. When the heatsink is properly placed, it is sitting only on the rubber pads
   - Once the clip is attached, the heatsink is pushed down onto the processor die.

Note: Your heatsink may vary in appearance from the heatsink illustrated.

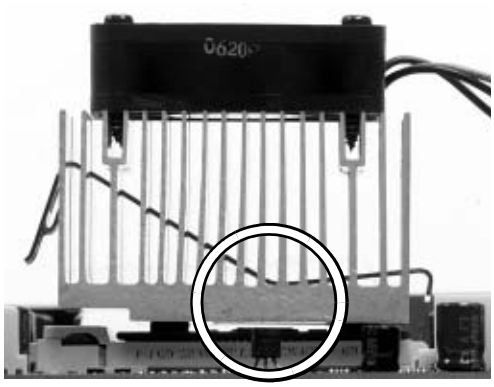


Photo 5. Proper location on processor

Never allow either of the next two situations to occur.

6. The heatsink cannot touch any part of the processor socket (see Photo 6)
   - If the heatsink does rest on the socket, the processor will overheat and failure will result.

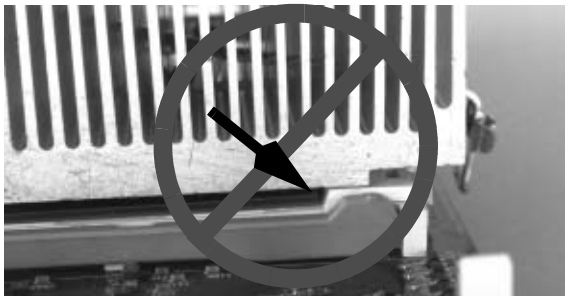


Photo 6. Heatsink *can not* touch socket

7. Do not push on the processor die with the heatsink (see Photo 7)
   - If you do, the die can crack and processor failure will result.

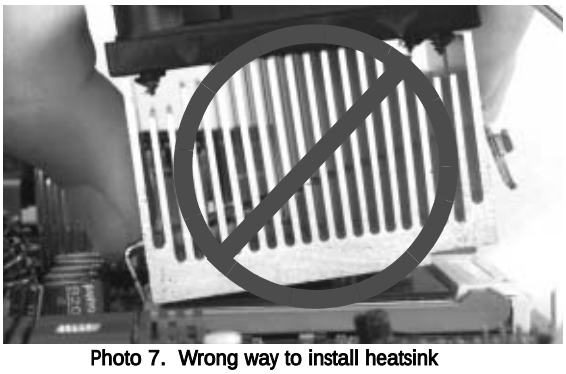


Photo 7. Wrong way to install heatsink

How to Install the Heatsink(s), continued

8. Installing the retention clip

Part 1

- Make sure the clip is aligned with the plastic lug on the socket (circled).
- Use the appropriate tool to push *straight down* on the heatsink clip.
- Do not apply any pressure to the heatsink itself.

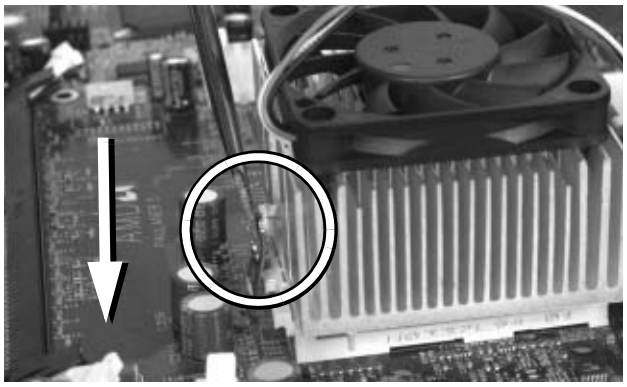


Photo 8. Push clip straight down

Part 2

- Next, push *down* and *slightly away* from the socket so the clip can move past the plastic socket lug.

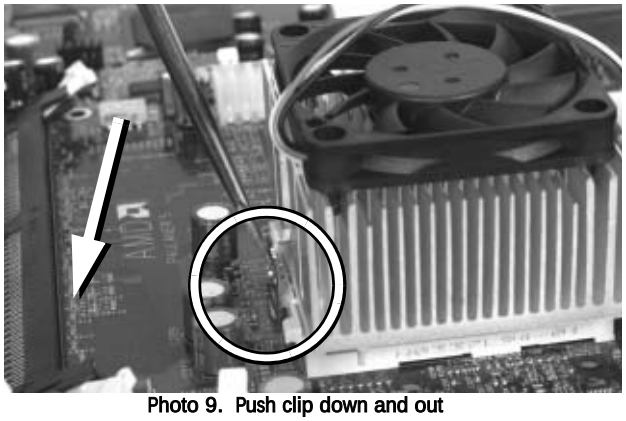


Photo 9. Push clip down and out

Part 3

- Finally, push *down* and *slightly inward* to secure the clip onto the plastic socket lug.

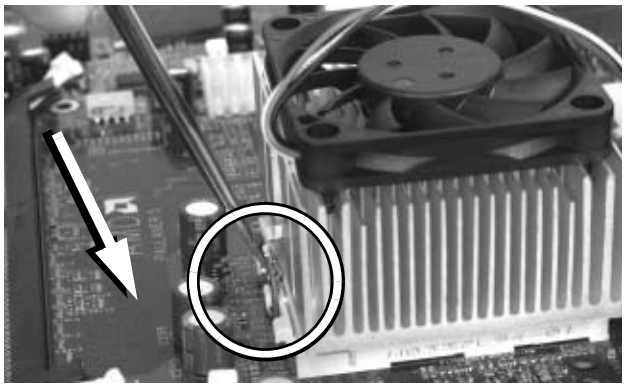


Photo 10. Push clip down and in to fasten

Notes:

- It is critical that the retention clip is properly aligned with the plastic socket lug (as circled in Photo 11).
- When the heatsink is attached, verify the retention clip is fully seated on the plastic socket lug.
- After heatsink is attached, plug the heatsink/fan power lead into its power connector on the motherboard.

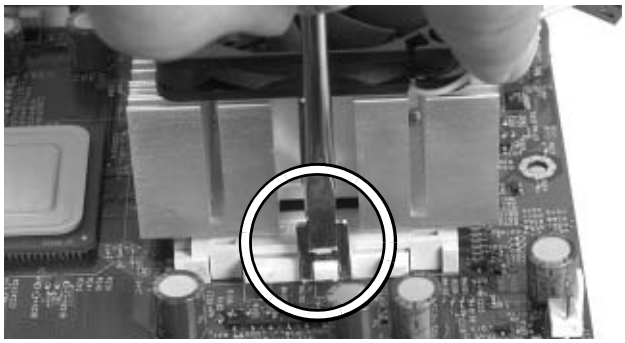


Photo 11. Always keep clip aligned with lug

How to Install the Heatsink(s), final

9. Install the power cable for the heatsink fan

- Connect the cable to the appropriate power connector either to the dedicated socket on the motherboard or to the power connector on the power supply. Check the motherboard manual for the proper installation method.

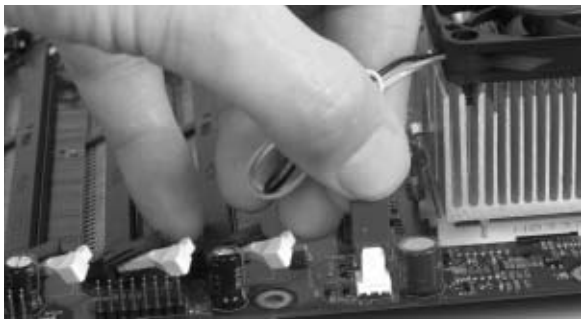


Photo 12. Plug fan into power source

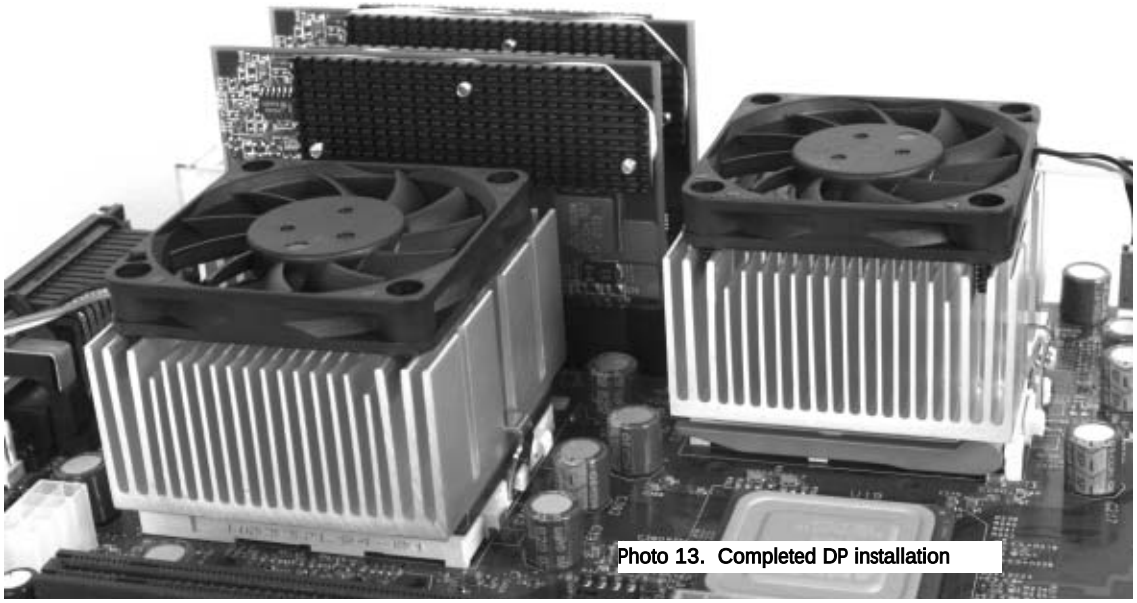


Photo 13. Completed DP installation

10. Check the installation completely before starting the system

- Verify that the heatsink is resting squarely on the processor and touching only the processor (The heatsink can never be resting or touching any part of the socket.).
- Make certain that the plastic tape at the bottom of the heatsink has been removed. Always make sure the thermal interface material has not been removed.
- Check that the long end of the retention clip is attached to the side of the socket with the ledge, and that it is securely attached.
- Double-check that the retention clip is firmly attached to the center lugs on both ends of the socket.
- Confirm that the heatsink/fan power lead is attached to the proper connector on the motherboard or on the power supply *(check the motherboard manual to verify the proper method).*
- When the system is first powered-on, verify that the processor heatsink/fan is turning at a rapid rate. It the fan is not turning at a rapid rate, then it is either defective or it is binding.
- For a DP machine, repeat the complete procedure.

Note:If a heatsink is removed for any reason, the old thermal interface material must be completely removed. Then, new AMD-recommended phase-change thermal interface material must be installed on the heatsink. To remove the old material, a soft scraper must be used. Otherwise, the die may be damaged and processor failure will result. Go to www.amd.com if more details are required.

Memory Guidelines

DDR Memory

AMD has selected an independent testing company, Computer Memory Test Labs (CMTL), to do the compatibility testing. CMTL is an independent test facility and is able to test RAM modules from different module suppliers. System builders should access the CMTL web site at www.cmtlabs.com and view the approved memory module list for the specific motherboard manufacturer and motherboard model.

Memory Supported

AMD-760™ MPX chipset-based dual-processor motherboards currently support the following RAM memory features:

- Support for up to four registered DDR DIMMS
- Supports 64-Mbyte, 128-Mbyte, 256-Mbyte, and 512-Mbyte memory technology
- Supports up to 4 Gbytes of RAM memory

  Note: *With 4 Gbytes of RAM installed, a portion is devoted to system resources. Therefore, less than 4-Gbytes of memory will be available for the operating system and application software.*
- Supports production DIMMs from major DRAM memory manufacturers. Only registered-type memory modules are to be used.

  Note: *For maximum server and workstation performance, the AMD-760 MPX chipset is designed to work only with* registered *memory. Your memory supplier can normally supply the proper type. Visit the www.amd.com website for further details.*

Optimal Memory DIMMs Populating Procedure

DIMM modules must be populated in order, starting with the DIMM1 slot and ending with DIMM4 slot. DIMM slots 2, 3 or 4 cannot be populated alone. (If the slots are not marked, DIMM1 is the slot closest to chipset.)

The information in Table 7 delineates the proper order.

Table 7. Memory Module Installation Order

DIMM Qty Installed	Appropriate DIMM Slot(s)
Single DIMM	Use slot DIMM1
Two DIMMs	Use slots DIMM1 and DIMM2
Three DIMMs	Use slots DIMM1, DIMM2, and DIMM3
Four DIMMs	Use slots DIMM1, DIMM2, DIMM3, and DIMM4

Processor and Chipset Guidelines

Dual Processor Requirements

For AMD dual processor platform, both of the AMD Athlon™ MP processors must be of the same frequency.

Note: *Both processors* must *be AMD Athlon MP processors.*

Single Processor Requirements

In addition to the dual processor (2P) configuration, the board can be booted with a single processor installed. The dual processor chipset allows either processor to be installed in a 1P configuration. It is advisable to install the processor in the P0 socket to enable the *Super-Bypass* function. Super-Bypass allows the system controller to internally bypass certain memory pipe stages for optimal performance when only processor P0 is present.

Note: *At the time of the release of this document, the AMD Athlon MP processors is the only validated and supported processor for use with either the AMD-760™ MP chipset or the AMD-760 MPX chipset. Therefore, AMD can not recommend the use of the combination of either the AMD-760 MP chipset or the AMD-760 MPX chipset and the AMD Athlon XP processor. Because this is not an approved product configuration, the AMD Technical Support staff can not answer any questions concerning this specific combination.*

Always check the AMD website (http:\\www.amd.com) for updated product and technical data. Besides viewing all of the latest available information regarding the AMD family of products, you can also verify if there has been any change in the compatibility status of the AMD-760™ MPX or the AMD-760 MP chipset when used with a uni-processor installation of an AMD Athlon XP processor.

Starting the System

Power-Up Procedure

Ensure that both the power connectors are plugged in to the motherboard before powering up the board. If the board uses a Voltage Regulator Module (VRM), ensure that the installed processor has its associated VRM installed before starting the system.

Caution: *For boards that use a removable VRM, failure to install the proper VRM before installing the processor and turning on the main power supply can lead to immediate processor failure. If the board has a power regulator built into the motherboard, no special precautions are necessary.*

Dual Processor and Single Processor Guidelines

In addition to the dual-processor (2P) setup, the board can be booted with a single processor installed.

Note: *See the Processor and Chipset section for this data.*

Drivers and Utilities

Check your local NDA website or the AMD Public website at www.amd.com for the latest versions of the AMD chipset drivers and utilities. Or, you can contact your local AMD field representative.

For the add-on cards (video graphics, SCSI, etc.), contact the manufacturer of the card for the latest drivers.

EMI Reduction Techniques

These Electro-Magnetic Interference (EMI) reduction techniques can be implemented with relatively short lead-times at the final system-assembly stage. Proper Electromagnetic Compatibility (EMC) and motherboard design techniques are assumed. For more information on these techniques, please refer to the *AMD Socket A Motherboard Design Guide*, order# 24363 or *AMD Athlon™ Processor EMC Design Application Note*, order# 23828. (These documents are located on the AMD website.)

The effectiveness of all the EMI-reduction techniques varies from system to system. This document helps identify and close the common EMI energy path(s) that allow radiated emissions to escape from the chassis enclosure.

EMI Emissions

EMI emissions from a computer system must be controlled and kept below regulatory limits. Radiated EMI emissions are measured with an antenna, typically ten meters away from the computer system under test. There are different EMI standards for systems marketed in the United States and Europe, and all standards are continually updated. Typically, most computers must meet FCC Class "B" for the US and CE Class "B" EMI requirements to be sold in Europe.

Common System EMI Energy Paths and Solutions

This is a list of common paths for EMI. Each path is followed by a potential solution(s). This list is presented in the best order of evaluation and in relative simplicity to solution implementation.

1. Processor Heat Sink Fan Cable

   The large loop to the power connector is a potential problem. Shorten this length as much as possible by routing the cable in a serpentine manner and tying it with a plastic twist-tie. This solution can reduce emissions by 5 dB. Also, shortening the cable path by routing the fan power cable through the heat sink fins (to allow more direct routing) can decrease EMI emissions.

2. Internal Power Cable Routing

   The internal power cable is can pick up EMI inside the system and can radiate it through the AC power cord. To avoid this, route the internal power cable next to the metal chassis away from the I/O connectors and as far away from the processor heatsink as possible.

3. Other Internal Cable Routing

   Cables inside the system should be routed along the metal chassis and away from EMI sources, such as the microprocessor, clock modules, and high-speed VLSI modules. Power cables for drives should be bundled near the power supply, separate from the ATX power cable, and away from the processor heatsink. Always route the front LED cables away from EMI sources, flat to the chassis, and away from the fan openings. Front USB cables must use shielded internal cable that is grounded to the chassis at the I/O connector.

   Generally, route all cables cleanly and keep them away from the memory modules. If there are failing signals at 100, 300, 500, or 700 MHz (100/200 MHz memory), or 400, 666, and 933 MHz (133/266 MHz memory), the most likely cause is the memory DIMMs.

4. Rear I/O Connector Shield
   The rear plate that touches the rear I/O ports should be made of a metal that has good spring quality such as stainless steel or spring-hardened steel. Typically, the most vulnerable rear I/O cables are the audio and joystick cables. If EMI emissions drop when these cables are disconnected, improve the shield-to-chassis grounding for these cables.
5. Motherboard-to-Chassis Ground Too Close to the Processor
   Most motherboards have a screw connection between the motherboard ground and the chassis, usually within 20 mm to 40 mm of the processor. EMI tests have shown that in some cases insulating these motherboard groundpoints from the chassis ground can reduce EMI emissions. This solution works because some chassis designs offer lower impedance at high frequency than the material (FR4) of which the motherboard is made.
6. Processor Heatsink Fin Orientation
   The fins on the heatsink may create a waveguide that directs the EMI energy toward the fin ends. If the current heatsink on a system is suspected of causing EMI problems, a heatsink with fins running the opposite direction may reduce EMI levels for that system.
7. Processor Heatsink Grounding
   In some systems, a ground strap connection to the heatsink can reduce EMI emissions by 4 dB or more. Typically it is better to ground the heat sink to the power supply or to a chassis location close to the power supply.
8. Spread-Spectrum Clocking
   Spread-Spectrum (SS) clocking means the clock signal is intentionally varied to spread the timing clock energy over a small frequency range. Go to the BIOS and make sure this is enabled. Always modulate the spread downward so that the processor never runs above its rated speed.
9. Chassis Shielding
   Verify that the chassis is sealed tightly at all seams; even a paper-thin gap is a problem. Remember, it is the length, not the width, of a gap or seam in the chassis that compromises EMI shielding. Empty front drive bays should have multi-contact EMI shielding covers. Sometimes it is still necessary to add finger-stock material to reduce the length of the gaps between the drive and the chassis when the drive bays are populated. Rivets used on the chassis or power supply case can also be a problem if they are more than five centimeters apart. Too much space between rivets forms a slot antenna. If this condition is suspected, try another brand power supply with different construction details.

Problem Not Solved

If excessive system level EMI emissions still exist after attempting all the listed system EMI reduction techniques, then try to determine if the EMI emissions emanate from the system I/O cables (including the AC power cord) or from aperture leaks in the system chassis.

If emissions emanate from a particular I/O cable, then improved filtering or cable shielding may be required on that cable. If EMI emissions emanate from slots or seams in the chassis enclosure, try placing copper tape across apertures to improve shielding effectiveness. If copper tape reduces emission levels to a satisfactory level, then chassis sheet metal changes or conductive EMI gasketing may be needed at that location.

AMD Athlon™ MP Processor-Based System Build Checklist

Always verify that the system you are building only uses components from the *AMD recommended* list, or follow the recommendations outlined in this document to select a suitable component, and then follow this checklist to build your system

For additional configuration informations, go to: http://www1.amd.com/athlon/config

- ❑ Ensure the selected motherboard is appropriate for the chosen processor model and frequency. Check the AMD Athlon™ MP processor recommended motherboard list as to compatibility.
- ❑ Verify that your case follows the system case (chassis) airflow guidelines on the AMD website.
- ❑ Select your power supply from one on the AMD recommended power supply list. (Or check that the one installed in your chassis is on the list.)
  Note: *If needed, install the recommended power supply before the installation of other components.*
- ❑ Ensure that you are properly grounded at all times during the system construction to protect the delicate electronic components from static electricity damage.
- ❑ Install the selected hard drives, floppy, DVD or CD-ROM player, and other devices into the chassis.
  Note: *Check the hard drive installation guide. For full performance, you MUST also install the appropriate data cable (see drive installation instructions).*
- ❑ Remove the motherboard from its protective packaging and place it on a firm (but not hard) surface, ideally the surface will be a grounded anti-static pad.
- ❑ Remove the AMD Athlon MP processor from its protective packaging (always make sure you are electrically grounded), install the processor into the motherboard socket, then install only an AMD recommended heatsink and fan assembly. For more specific information, follow the instructions found in the *Processor Installation Guide* on the AMD website.
- ❑ Install the assembled motherboard and processor with heatsink into the chassis. Always install any standoffs needed to support the motherboard, especially in the areas where cards will be placed.
- ❑ Check the motherboard for any jumper settings. (Most motherboards do not require jumpers.)
- ❑ Ensure the selected memory (256 Mbytes or more are recommended for server/workstations) is shown on the motherboard maker's recommended memory list. If the motherboard manufacturer does not have a verified/recommended memory listing, check with the memory supplier to verify that they have tested your chosen motherboard and deemed it to be compatible with the RAM memory modules you plan to use.
- ❑ Install the recommended memory into the motherboard. Be sure to install the RAM in the sequence required for the chosen motherboard. Verify each memory DIMM is inserted all the way into the socket and locked in place.
- ❑ Install a high-performance AGP video graphics card. Have the latest drivers available (see the website of the card maker). You will need the drivers shortly.
- ❑ Connect the power cables to the drives and motherboard.
- ❑ Connect the hard drive, floppy, and DVD (CD-ROM) data cables in the normal manner. Verify that the cables are installed securely and with the proper edge near Pin 1.
- ❑ Connect the monitor data cable, keyboard cable, and mouse cable to the rear of the system.
- ❑ Install the AC line power cord on the power supply and connect to the power outlet.
- ❑ Go to the websites of the motherboard vendor or the chipset maker for the latest drivers and utilities.
- ❑ Check your motherboard vendor's web site for the latest version of the BIOS, AGP miniport driver and bus mastering IDE driver. (AMD has drivers available for its chipsets. See www.amd.com.)
- ❑ Check the peripheral manufacturer's web site for the latest drivers for the sound card, network interface card, the video graphics card, and any other added devices.
- ❑ Power the system on and begin loading software and drivers, following the installation instructions.
- ❑ Make sure the system starts and runs reliably with just the graphics card installed. Restart and run the system multiple times. Test the system operations with your long-duration testing software.
- ❑ If other cards are to be installed, install them now–one at a time. Turn off the system and unplug it before installing each card. Restart the system after every card installation.
  Note: *If you have difficulties with the installation of any of the cards or drivers, read the AMD technical document entitled "Complex Configurations and IRQ Info", available on the AMD website.*
- ❑ As you install each card, verify the card is properly installed (connector fully inserted into the slot, front and back) and that the retention screws are in place.

Test the complete system for proper operation. If system functions properly, load any other software.