ATX specification

February 1996

Release 1.1

Release 1.1 Specification Changes:

Since the introduction of the ATX specification (Revision 1.0 dated July 1995), feedback has been received from a number of OEMs, chassis manufactures, and industry sources developing products based on the ATX formfactor. This feedback has prompted the following changes to the specification:

1) Optional Mounting Hole

Concern has been expressed over the location of the “optional” mounting hole and the fact that it conflicts with the need to place I/O connectors in the same location. In response, the “optional” mounting hole, has been moved 0.4” (10.17mm) down toward the bottom edge of the board. Refer to figure 3 for details.

A few responses indicated a preference for this hole be made permanent rather than optional. However, most agreed that this hole must stay “optional” to support existing ATX boards that have through hole components in that location. This means a spacer between the baseboard and the chassis must still be removable in this location.

2) Height Restriction Specification

The revision 1.1 specification eases the height restrictions on the right side of the board to supply more flexibility to chassis designers and accommodate future board requirements. Note both the height limits and boundaries have been changed in this area. Refer to figure 8 for details.

3) Airflow Direction

Computer OEMs and power supply manufactures have indicated that the ATX specification did not state which direction air should flow through the chassis. While many different cooling methods exists for ATX, the most prevalent solution in the market has the power supply fan sucking air from outside the chassis and blowing it across the processor. See power supply section 4.0 for details on airflow.

4) Metal EMI Containment I/O Shield

Integrators of ATX chassis, power supplies, and baseboards have expressed that it is difficult to fit different EMI shields for each new baseboard into their chassis. The initial ATX specification defined a specific cut-out area for I/O, but the specification did not specify how to attach a shield to this area and resulted in incompatible I/O shield designs across various ATX chassis. In response, revision 1.1 of the specification incorporates a keepout area around the cut-out area to which a computer supplier can attached an I/O shield. It also specifies a range for the thickness of the chassis backpanel the clip will be attached to. These new specifications give shield vendors the capability to design and build shields which can be attached to any chassis designed to the specifications. Refer to figures 3 and 5 for details.

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Revision 1.1, February 1996

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1. Executive Summary

ATX is an evolution of the popular Baby-AT form-factor defined to address four major areas of improvement over today's predominant form-factors: enhanced ease-of-use, better support for current and future I/O, better support for current and future processor technology, and reduction in total system cost.

ATX combines the best functionality from each of the two current industry standard form factors: the high integration of LPX and the expandability of Baby AT. The ATX form factor is essentially a Baby AT baseboard rotated 90 degrees within the chassis enclosure and providing a new mounting configuration for the power supply. The processor is relocated away from the expansion slots, allowing them all to hold full length add-in cards. The longer side of the board is used to host more on-board I/O.

A change to the system form-factor is ultimately of little benefit if it doesn't reduce overall system cost. ATX achieves this in a number of ways. By integrating more I/O down onto the board and better positioning the hard drive and floppy connectors (which allows the use of shorter cables), material cost of cables and add-in cards is reduced. By reducing the number of cables in the system, manufacturing time and inventory holding costs are also reduced. Another benefit of integrated I/O down is the potential for lower EMI emissions with the removal of serial and parallel cables which can act like little antennas. Video-playback enhanced graphics and audio, the main hardware building blocks to support multi-media, are now becoming a standard on many PCs. At the entry level, these features are quickly becoming a commodity, and so to reduce cost in a highly dollar sensitive market segment, it makes sense to migrate these features down to the baseboard itself. Finally, by using a power supply that is specially optimized for ATX, it is possible to reduce cooling costs and lower acoustical noise. An ATX power supply, which has a side mounted fan, allows direct cooling of the processor and add-in cards making a secondary fan or active heatsink unnecessary in most system applications.

Feature	Benefit
Double height flexible I/O panel allows higher integration	• Lower system cost • Fewer cables • Improved reliability • Shorter assembly time • Support for future connectivity and I/O standards like USB, TV in/out, ISDN, etc. • Integrated graphics allows use of unified frame buffer architecture
Relocated drive I/O means shorter cables	• Reduced cost • Support for faster drives such as PIO Mode 4/5 IDE drives
System cooled by single fan in the power supply	• Reduced cost • More ergonomic (Reduced noise) • Improved reliability
Relocated CPU and memory	• All full length expansion slots • Ease of use, upgrading the CPU • Ease of use, upgrading memory • Ease of use, adding cards • Relocated CPU allows easier use of bulk capacitance and voltage regulation circuitry

Table 1 : ATX Feature Summary

The ATX specification is written as an open specification for the industry, designed to add value to the Intel architecture PC.

2. ATX form-factor overview

The ATX form-factor improves over Baby AT and LPX in a number of ways. By modifying the power supply orientation and specification and rotating the Baby AT baseboard through 90 degrees, the processor can be relocated away from the expansion slots, and the longer side of the board can be used to host more on-board I/O. The ATX power supply, rather than blowing air out of the chassis, as in most Baby AT platforms, provides airflow through the chassis, and across the processor.

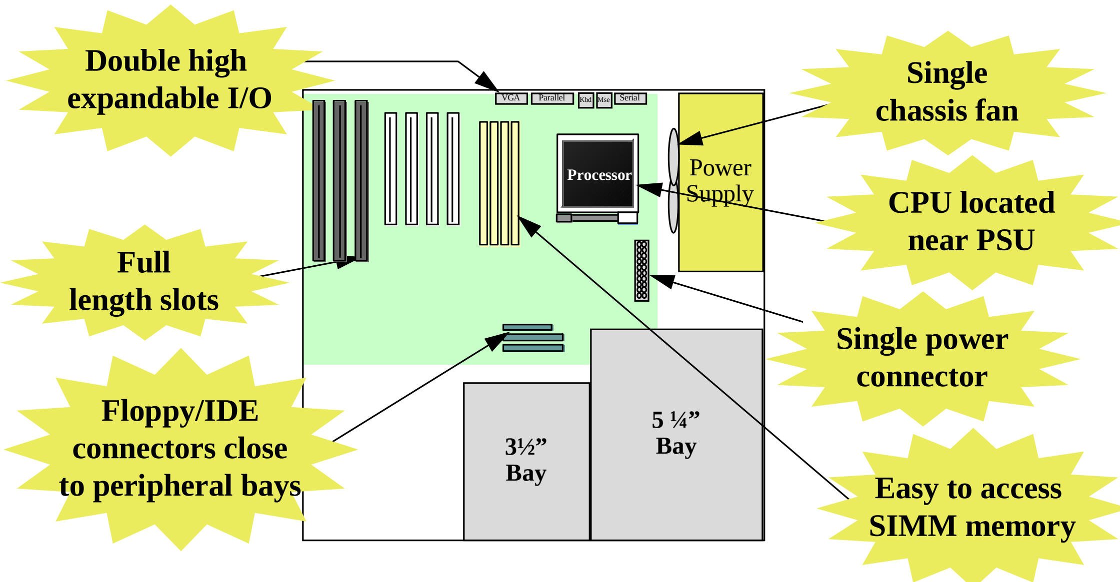

Figure 1 : Summary of ATX chassis features

2.1 Improving the end-user experience

By simply rotating the board through 90 degrees within the chassis, the end-user gains a great deal in ease-of-use and improved functionality.

1. With the processor relocated, all expansion slots can be full-length.
2. Since the processor is not located between or under the add-in cards, a processor upgrade can now be performed without removing the installed cards.
3. The SIMM* connectors can be relocated away from the expansion bays and slots, increasing ease-of-use by giving easy access to the user for memory upgrades, and increasing the total number of available full length slots.
4. The use of only one fan within the system reduces noise levels.
5. More I/O is integrated onto the baseboard, improving reliability and reducing the number of cables.
6. Disk I/O connectors are located closer to the peripheral bays, reducing cable lengths. This reduces the clutter in the chassis and allows the use of faster hard disk drives.
7. With increased ease of use, and a reduction in cable complexity, the technical support burden is lowered.

2.2 Benefits to manufacturers

As well as improving functionality, the ATX form-factor also reduces total system cost. This is achieved by moving more I/O onto the baseboard and reducing the number of fans and cables within the system, cutting material and installation cost. The mounting hole positions for the ATX form-factor baseboard were carefully chosen to be backward compatible with previous form-factor generations. Where possible, ATX utilizes the same mounting holes as Baby AT and full AT, simplifying the design of multi-purpose chassis. Full details can be found in section 3.2.

Another benefit is the potential for reduced EMI emissions through the use of integrated I/O connectors on the baseboard. Baby AT designs require that the parallel and serial I/O off the baseboard be cabled up to connectors on the chassis backpanel. These cables, not required on ATX baseboards, may act as small antennas that pick up and radiate unwanted EMI in Baby AT designs.

2.3 Mini-ATX : a future avenue for cost reduction

ATX has been designed with headroom for the future. An ATX board measures 12" x 9.6" (305mm x 244mm). This board size allows a manufacturer to cut two boards out of every 24" x 18" (660mm x 457mm) panel. To optimize the panel utilization at the printed circuit board manufacturer a smaller ATX form-factor, Mini-ATX, may be implemented that allows manufacturers to achieve four printed circuit boards per panel. Board size could be reduced from 12" x 9.6" (305mm x 244mm) to a Mini-ATX size of 11.2" x 8.2" (284mm x 208mm). This would reduce the cost of the printed circuit board by approximately 30%. To standardize the inevitable migration towards this cost-reduced future form-factor, Mini-ATX is fully defined in this specification alongside full ATX.

3. Layout

The following section describes the mechanical specification of the ATX form-factor baseboard, including physical size, mounting hole placement, connector placement and component height constraints. Where appropriate, details of Mini-ATX are also included. This will enable chassis manufacturers to plan ahead now for this future development.

3.1 Board Size

The maximum allowable width for the ATX board is 12 inches (305mm), the same width as a full AT board. This allows many existing AT form-factor chassis to accept Baby AT, Full AT, ATX or Mini-ATX form-factor boards with a minimum number of changes. A full size ATX board is 12 inches wide by 9.6 inches deep (305mm x 244mm). The size of a Mini-ATX is 11.2" x 8.2" (284mm x 208mm).

3.2 Mounting hole placement

Where possible, the ATX mounting holes line up with mounting holes used for Full AT and Baby AT boards. As shown in figure 2, three new holes (one optional) have been defined and added along the front edge of a full size ATX board to provide mechanical support. For the exact location of the mounting holes, refer to figure 3.

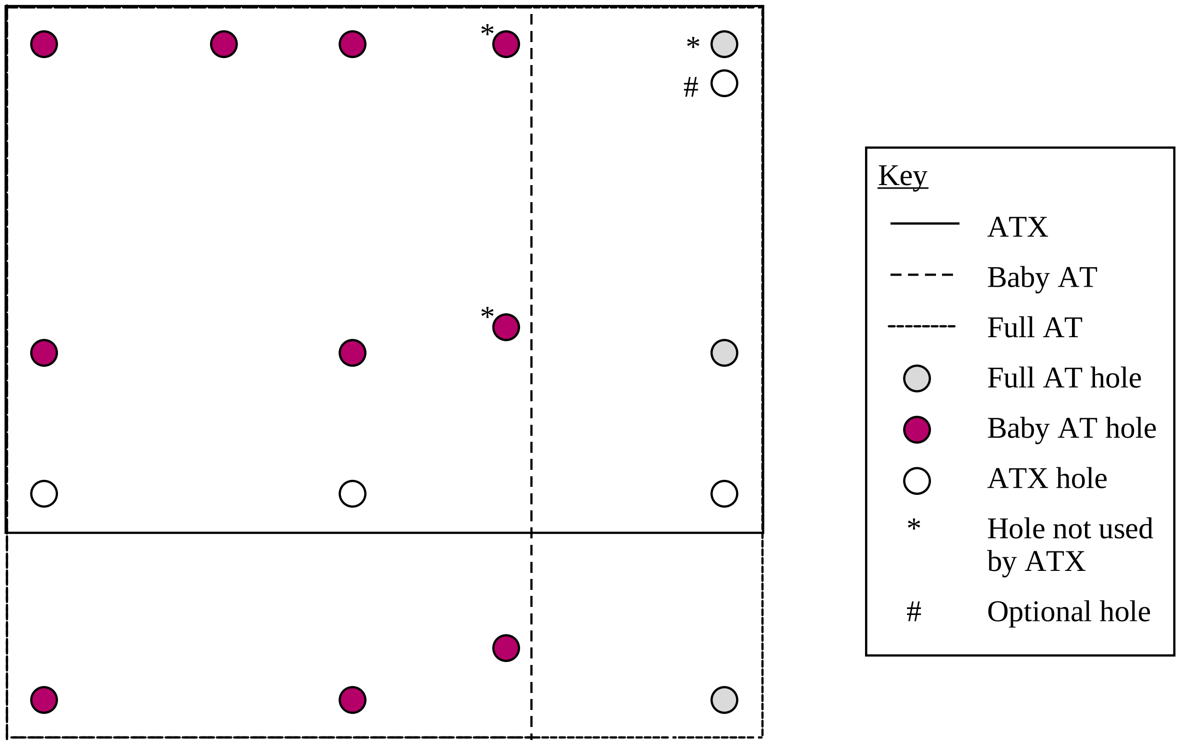

Figure 2 : ATX, Baby AT and Full AT form-factor mounting holes

Two holes located on the right edge of the Baby AT board are not supported in the ATX form-factor (as shown in figure 2). Mechanical support is not required in that location on ATX, and its presence would present unwanted difficulty in placement and routing of an ATX board. The top hole, located on the right edge of Full AT boards was supported as an option in the initial ATX specification Revision 1.0. However, designers that wanted to take advantage of this hole found it restricted the available I/O connector space. In response, the optional hole location is moved down 0.4" (10.2mm) in Revision 1.1 of the ATX specification as shown in Figure 2. To remain backward compatible with existing ATX baseboard designs, the new hole location is still optional and the chassis standoff for this location must be removable to prevent interference with potential through hole components in this area. If the optional hole in not used and additional support of the baseboard is required, use of a rubber bumper is suggested.

3.3 Connector placement

The location of the PCI and ISA connectors as well as the allowable placement area for I/O connectors on the back panel are clearly defined in figure 3. The specification provides recommendations, but the exact locations of other connectors are left to the judgment of the motherboard designer working in conjunction with the system integrator.

3.3.1 Expansion slots

The ATX form-factor supports up to seven expansion slots. These slots may be any combination of ISA, PCI or shared ISA/PCI. Figure 3 shows a typical combination of the three ISA slots, three PCI slots and one shared ISA/PCI slot. The location of pin 1 is defined for each of the connectors. If a combination other than that shown in Figure 3 is desired, baseboard designers should extrapolate the location of pin one on each of the connectors. The slot spacing must remain constant. To allow all add-in cards to be full length, it is recommended that the height of any board component located to the left of the right edge of the seventh slot (plus clearance for the board components) is less than 0.6 inches (15.2mm). Further details on component height constraints can be found in section 3.4. It is suggested that mechanical support be implemented under expansion slots for extra support during add-in card insertion.

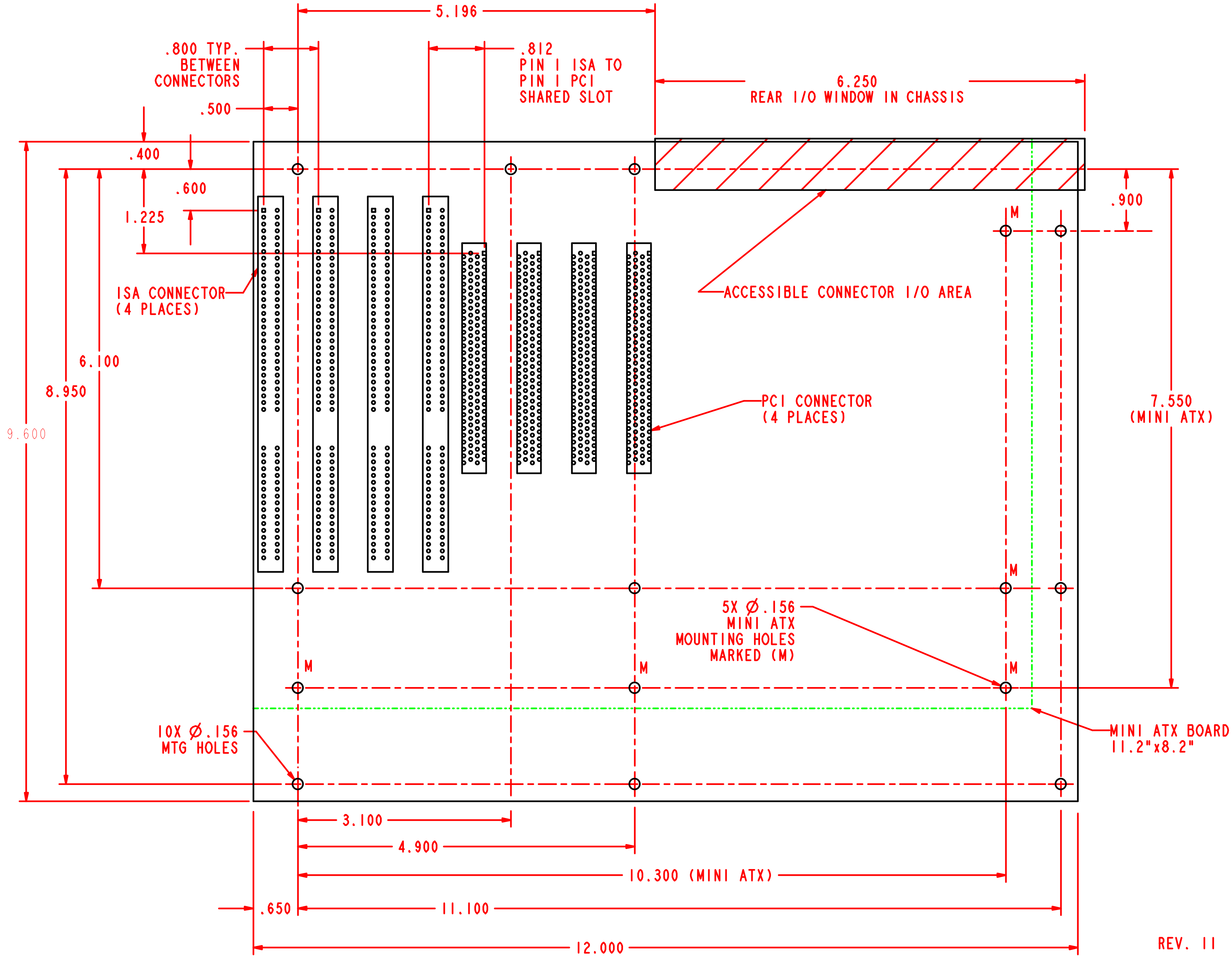

Figure 3 : Sample ATX/Mini-ATX layout diagram
(all dimensions shown in inches)

3.3.2 Power input

Two power supply trends are driving change in the board power input connectors. First, to support future processor technologies and the expected transition to 3.3V PCI add-in cards, a 3.3V output option is required directly from the power supply. Second, with the introduction of new operating systems, such as Microsoft* Windows* 95, that support the ability to power down the system from software, a soft-power connector will increasingly become a requirement. These two changes imply that two more connectors are required (3.3V and soft-power) in addition to the two already used on power supplies today. To reduce both material and manufacturing costs, ATX combines all four of these into a single 20-pin connector interface to the power supply which incorporates standard ±5V and ±12V, optional 3.3V and soft-power signals. Use of this connector will reduce production costs by cutting installation time and connection error rate. The connector pinout is shown in Figure 4. The board mounted header is the Molex 39-29-9202 or equivalent. This mates with the power supply connector, Molex 39-01-2200 or equivalent.

3.3V *	11	1	3.3V *
-12V	12	2	3.3V *
COM	13	3	COM
PS-ON	14	4	5V
COM	15	5	COM
COM	16	6	5V
COM	17	7	COM
-5V	18	8	PW-OK
5V	19	9	5VSB
5V	20	10	12V

* optional

Figure 4 : ATX Power connector pin out

The exact location of the power connector is not specified. It is recommended that it be placed along the right edge of the board considering the location of the processor, core logic and clearance for the peripheral bays. Locating the power connector near the CPU will help to ensure clean power.

3.3.3 Disk I/O

The exact locations of the floppy, IDE and/or SCSI I/O connectors are not specified. It is recommended that they be placed along the front edge of the board to the right of the expansion slots. When placing connectors, the designer should keep in mind that proper clearance must be provided for the chassis peripheral bays.

3.3.4 Front panel I/O

The exact location of the front panel I/O connector is not specified. It is recommended that it be placed along the front edge of the board to the right of the expansion slots. When placing the connector, the designer should keep in mind that proper clearance must be provided for the chassis peripheral bays. Locating the front panel I/O connector along the left edge of the board is not recommended due to limited clearance with a full length add-in card. Locating it along the front edge of the board under the expansion slots using a right angle header may be acceptable provided clearance for the add-in cards and mechanical retention of the mating connector are properly accounted for.

3.3.5 Back panel I/O

With the PC platform evolving so fast, it makes sense to retain the greatest level of flexibility possible for external I/O. The multimedia explosion has demonstrated how user needs for enhanced I/O can change quickly over time. With future technologies such as Universal Serial Bus likely to quickly become standard features on PC platforms, it makes sense to retain flexibility for the future. ATX defines a stacked I/O area to the rear of the chassis which is 6.25 inches (158mm) wide by 1.75 inches (44.5mm) tall. This allows the use of stacked connectors on the baseboard to maximize the amount of I/O space available. As shown in Figure 5, the bottom of the back panel opening is located 0.15 inches (3.8mm) below the top of the baseboard. In addition, a 0.2" (5.1mm) keepout zone has been defined around the outside edge of the cutout area. This optional keepout zone provides a reserved space that can be used to clip our suggested I/O shield to the chassis backpanel. If a chassis violates the keepout zone it loses the opportunity to support an I/O shield which can be designed to fit all ATX chassis which meet the following specifications, as detailed in figure 7.

- Cutout Size = 6.25"(159mm)x1.75"(44.5mm)
- Distance from top of baseboard to bottom of I/O cutout hole = 0.15"(3.8mm)
- Allowable thickness of a chassis back panel that the I/O shield can clip into is in the range of 0.040"(1.02mm) to 0.048"(1.23mm)
- The face of all I/O connectors overhang the board edge by 0.045"(1.16mm)

To retain maximum flexibility, the exact positioning of connectors within the I/O shield is left to the discretion of the baseboard designer (working in conjunction with the system integrator); however, two I/O panel configurations are shown below (Figures 5 and 6) as examples.

Figure 5 shows an example implementation for a standard I/O back panel, featuring a serial port, PS/2* mouse port, PS/2 keyboard port, parallel port, and secondary serial port. This configuration would be suitable for high-end boards requiring graphics and audio flexibility.

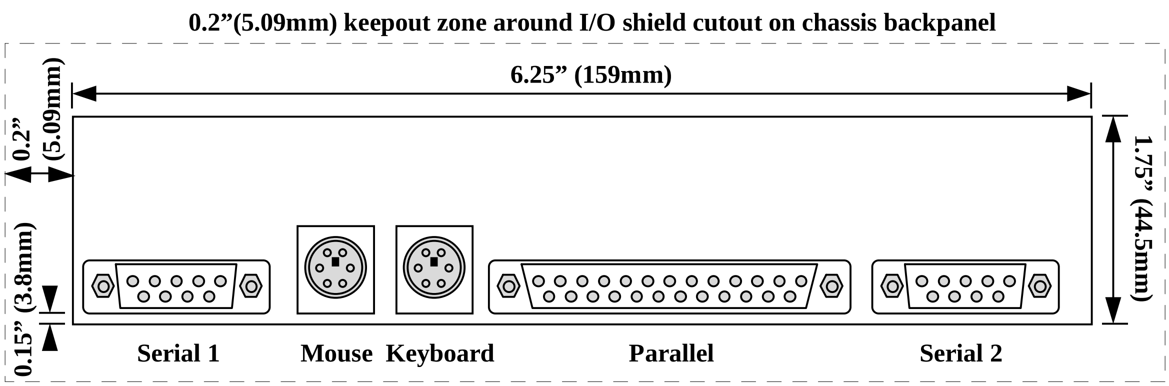

Figure 5 : Example standard I/O back panel, no video, no audio

The example multimedia I/O panel is a superset of the standard I/O panel. To position the VGA* connector close to the probable location of the on-board graphics controller, the VGA connector replaces the second serial connector. Since the ATX form-factor board is fitted with a PS/2 style mouse connector, the need for a second serial port (for use with a serial mouse) is reduced. Some manufacturers may therefore wish to ship ATX form-factor products with only one serial port. For those manufacturers still requiring two serial ports on systems, a multimedia I/O panel could accommodate a second serial port directly above the first with a stacked connector.

Figure 6 shows an example multimedia I/O panel, featuring stacked serial ports, stacked keyboard and mouse, stacked audio jacks and midi port, and parallel port and VGA connector. LAN, modem or ISDN connectors could be added if the manufacturer so desired.

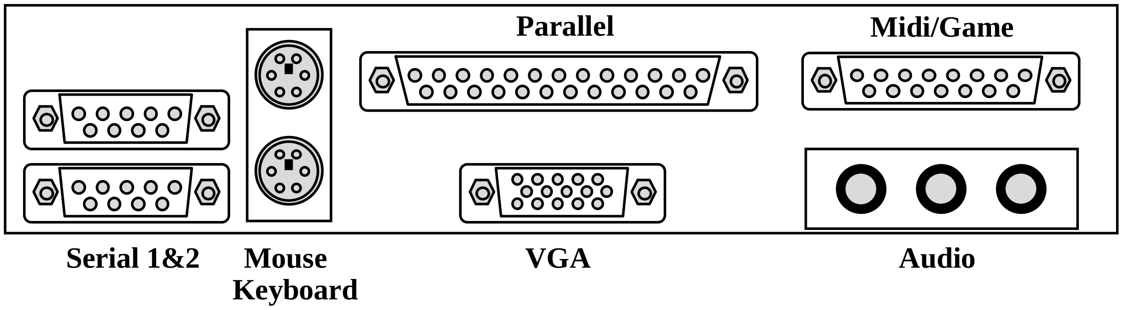

Figure 6 : Example multimedia I/O back panel

This layout is of course only an example - the ATX form factor allows complete flexibility in the layout of rear panel I/O. Baseboard and chassis vendors should work together to agree on their own preferred layouts.

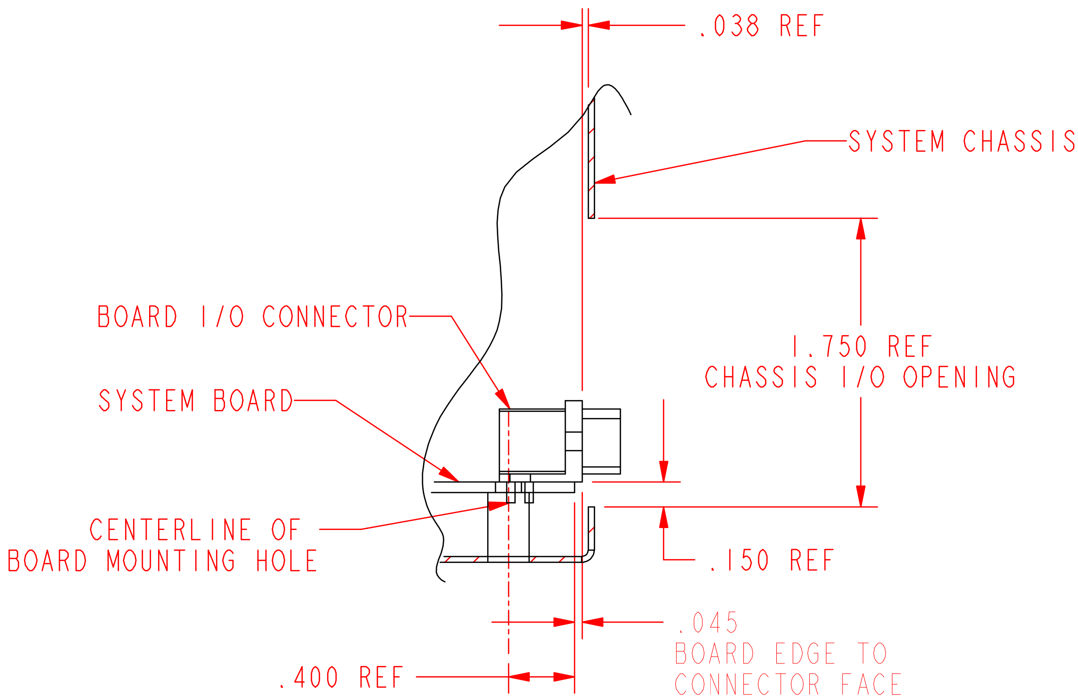

Figure 7: Detail side view of I/O connector placement in I/O back panel

(all dimensions shown in inches)

3.3.6 Memory sockets

The exact location of the memory sockets, be they SIMM, DIMM or some other type of connector, is not rigidly specified. Ideally, the sockets should be located to the right of the seventh expansion slot and far enough toward the back edge of the board to clear the chassis peripheral bays. This will enable easy upgrade by the end user. Their exact location will be dictated by the CPU and core logic placement requirements. Two of the most likely locations are

a) placed rear to front between the CPU and the seventh expansion slot, or
b) placed left to right between the CPU and the front edge of the board.

3.3.7 Processor

The exact location of the CPU is not specified. It is recommended that it be located behind the external I/O connectors and to the right of the seventh expansion slot, such that it receives sufficient cooling. It may be cooled from either the fan located in the power supply, an active heat sink (fan attached to the CPU) or normal airflow through the chassis. The exact method will depend on the specific CPU cooling requirements.

3.4 Height constraints

One of the major advantages of the ATX form factor is its accessibility and ease of expansion. Figure 8 shows the suggested height constraints for the components on the PC board. The bottom right corner of the board is the most constrained because of the 5.25 inch and 3.5 inch peripherals. If the chassis manufacturer places the drive carriers optimally, only one corner of the full size ATX will be overlapped. If the board is smaller than the full ATX then this height constraint may not be an issue. The top right corner of the board has two height constraints defined to accommodate a power supply being placed over this area in a mini-tower configuration. 2.20 inches (55.9mm) for a power supply (with external fan) or 2.75"(69.85mm) for a power supply (with integrated fan*).

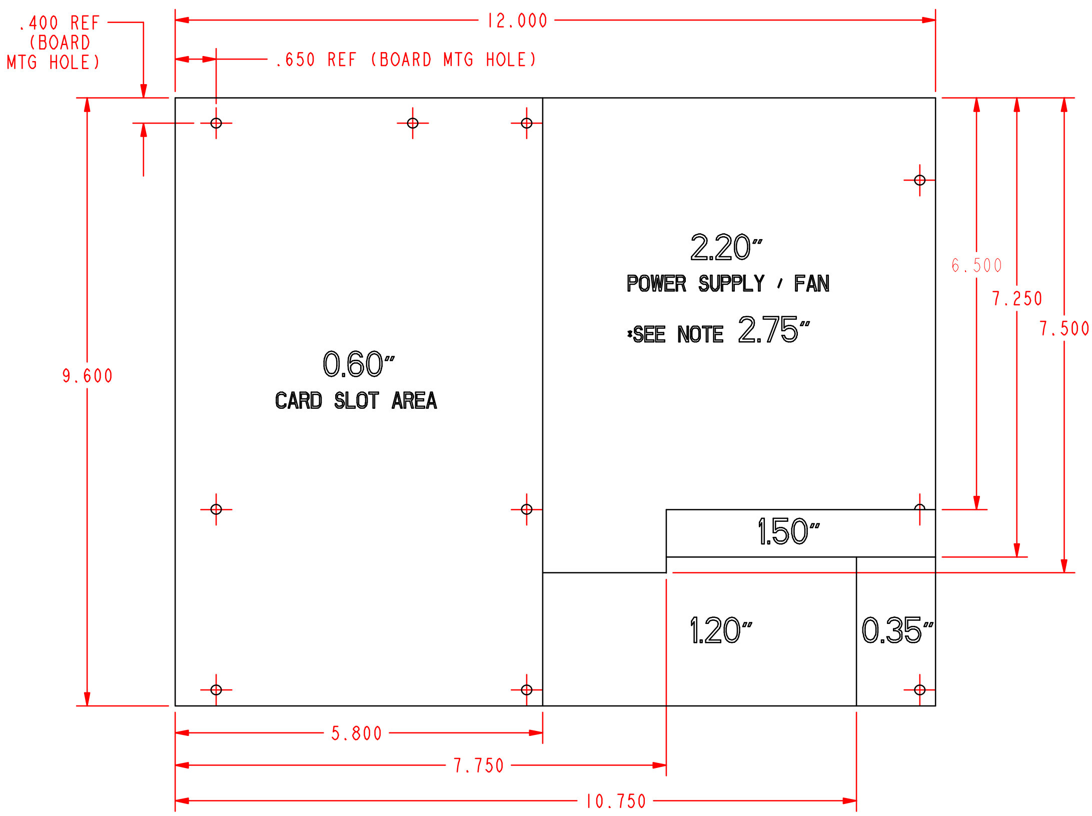

Figure 8 : ATX height restrictions
(all dimensions in inches)

*Note 1: For future baseboard designs which may require additional height clearance in this area, a minimum height restriction of 2.75" has been specified. Chassis designs that place the power supply over this area and need to support a baseboard requiring the extra clearance, a power supply with the fan internal to the power supply housing will be required.

Note 2: Height restrictions are based on a typical ATX implementation in a desktop of mini-tower chassis with 3.5" and 5.25" peripheral bays.

4. ATX power supply

The standard PS/2 power supply unit can be modified to better support the ATX form-factor. These modifications include adding a 3.3V supply rail, repositioning the fan to move air across the processor, and consolidating the baseboard connectors into one 20 pin header. Initial units of ATX power supplies will ship with externally mounted fans that pull air from outside the chassis and blow air across the processor. Over time, as integration improves, power supply versions will be developed where the fan is moved inside the PSU casing. Although pulling air through the power supply from outside the chassis is the most common airflow solution, other airflow solutions maybe implemented to meet the specific cooling requirements of different ATX chassis. For example, one alternative cooling solution would be to use a standard PS/2 power supply, modified with the 20 pin power connector, without repositioning the fan, but use an active heatsink (heatsink with small fan mounted on top) to cool the microprocessor.

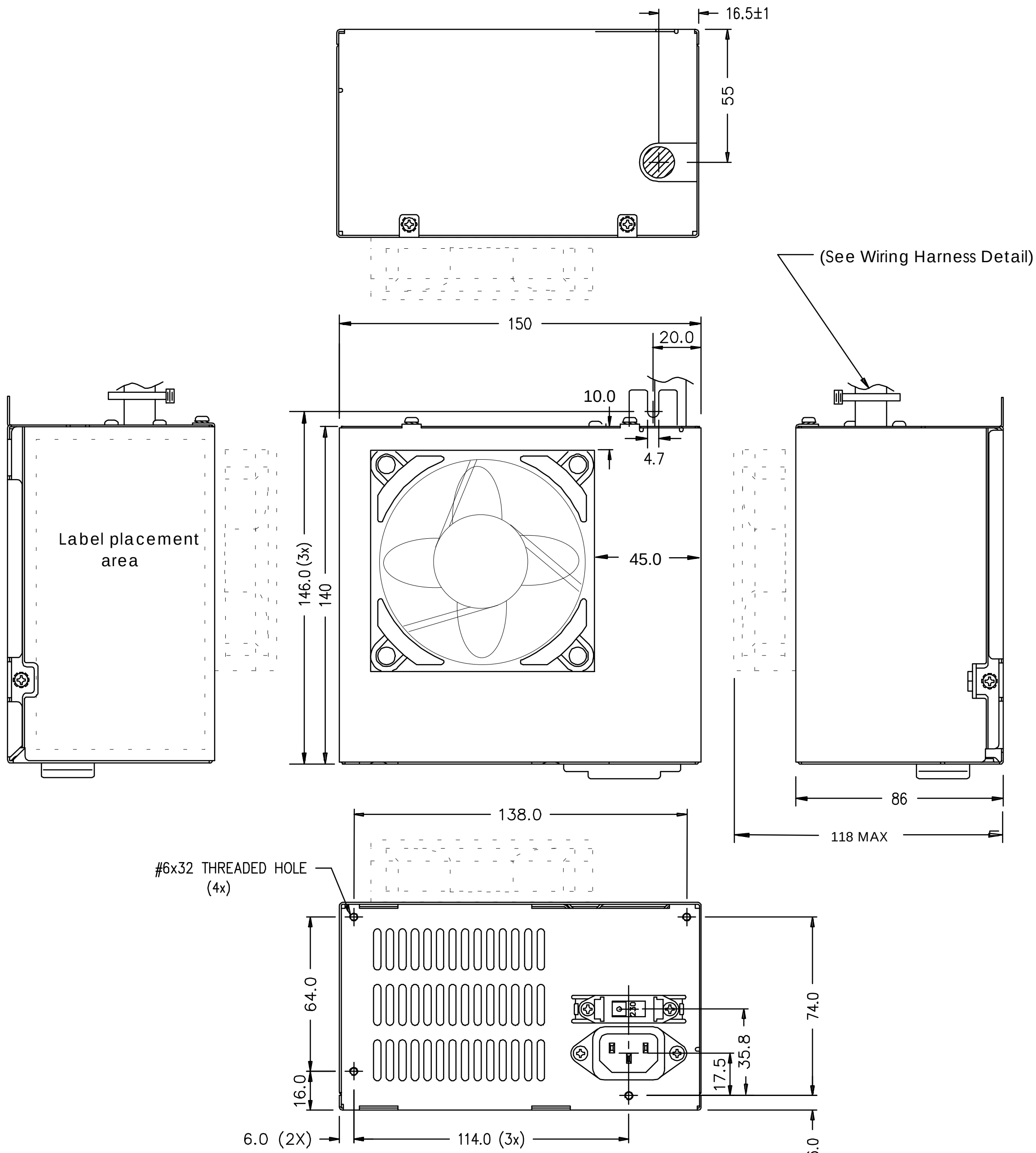

Figure 9 : ATX Power supply mechanical diagram
(all dimensions in millimeters)

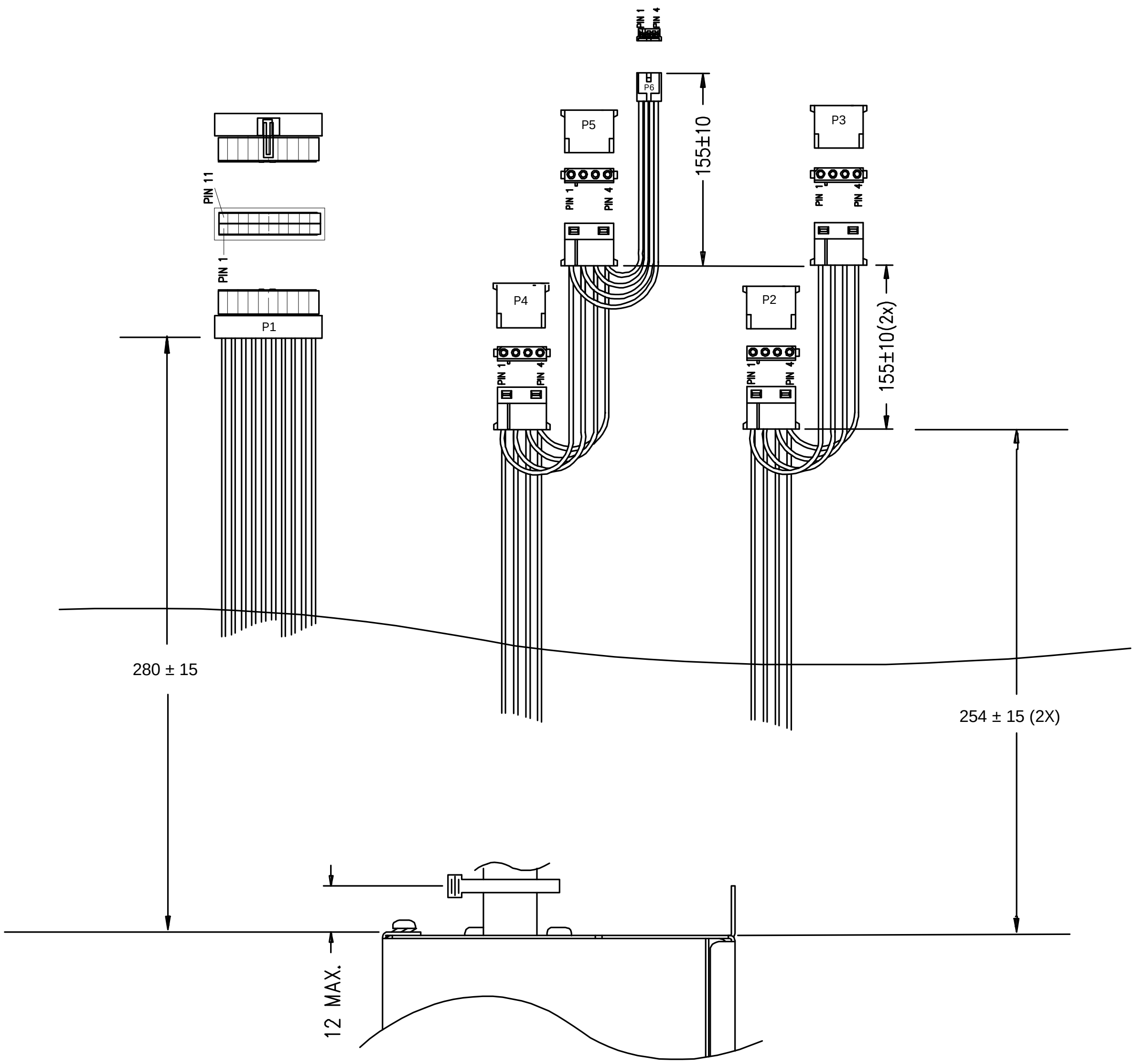

Figure 10 : ATX Power supply wiring harness
(all dimensions in millimeters)