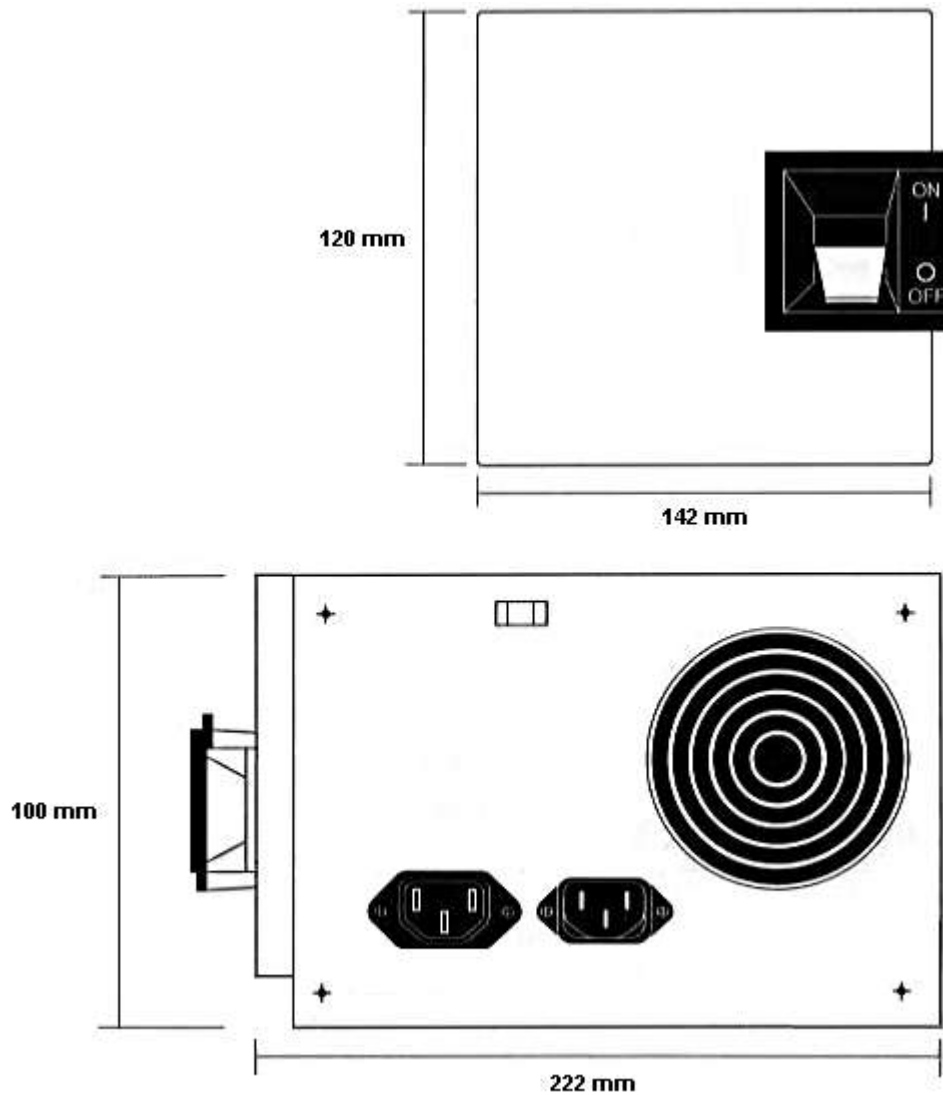


PC/XT Form Factor

The first PC was of course the IBM PC. Its power supply, and that of its hard-drive-equipped successor, the IBM PC/XT, used the same original form factor. These systems were all desktop units, with the power supply tucked into the rear of the case on the right-hand side, and controlled via an up/down toggle switch. While the PC/XT power supply began as an IBM design, IBM's key decision to keep the PC architecture *open* allowed "clone" manufacturers to make similar PC boxes and use the same size and shape of power supply for interoperability. In this manner, the first PC form factor "standard" was born.



[Diagram](#) of the side and rear views of a PC/XT form factor power supply, with approximate dimensions. The "bullseye" on the right is the fan outlet. The voltage selection switch is at the top in the middle, and the connections for the power cord and monitor pass-through are on the bottom.

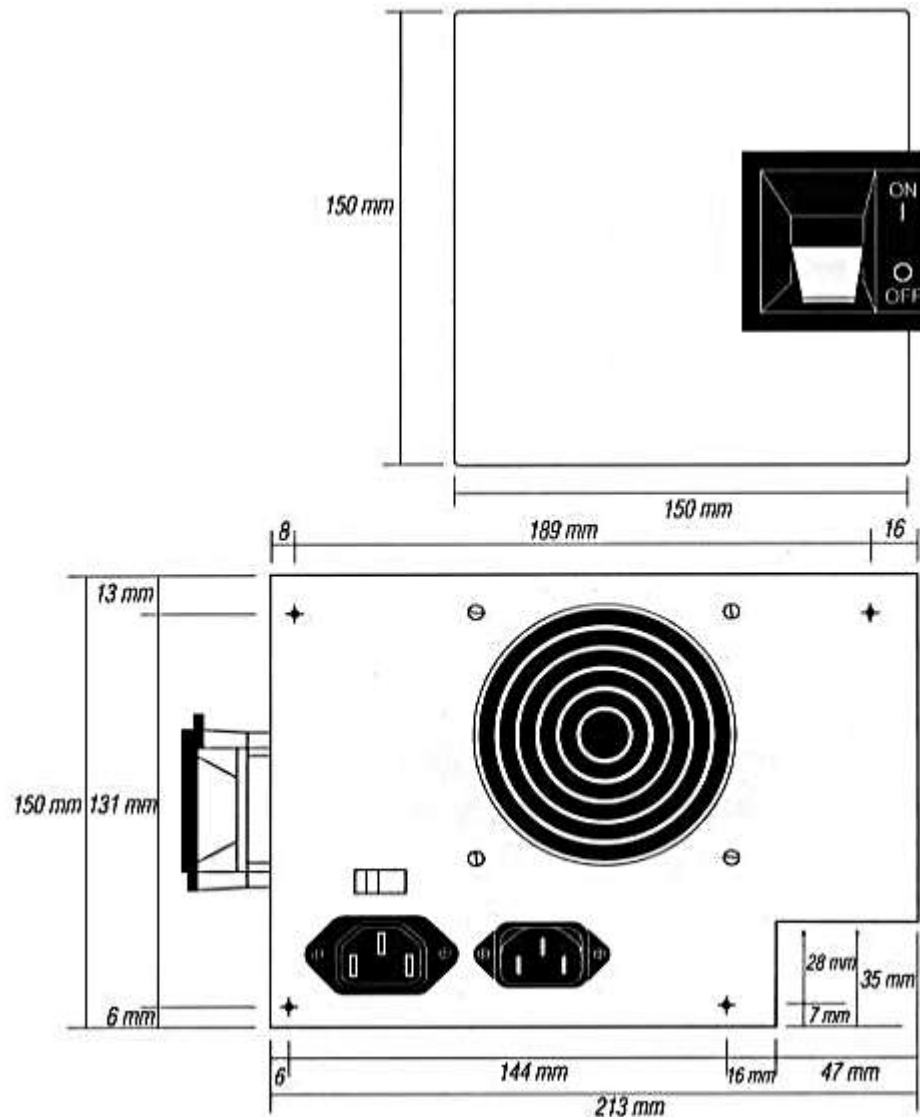
PC/XT units were sold as desktop boxes only. Equipped with only one or two 5.25" (low-density) floppy disk drives for storage, and having limited expansion possibilities, the original PC came with a

very low-powered supply by today's standards: 63.5 W. The XT added the first PC hard disk drive and an appropriately doubled power supply rating: 130 W (still relatively small by today's standards.) These [IBM power supplies](#) were physically large for their output--not surprising, since they used much older components and were designed before some power supply functions were combined into integrated circuits. They were also very well-made, another reason for their somewhat large size. They of course are used in [PC/XT form factor system cases](#) and with PC/XT [motherboards](#). The PC/XT was the first form factor to use the well-known pair of six-conductor [motherboard connectors](#) that were used through the Baby AT and LPX form factors, and the four-conductor [disk drive connectors](#) that are still used to this day.

These units are of course not only obsolete today but heading rapidly into "antique" status. You will still find them in use however, usually as dumb terminals for larger minicomputers, or for controlling industrial equipment. This is as much a testament to the quality of these first PC [power supplies](#) as anything.

[AT Form Factor](#)

In 1984 IBM introduced the IBM PC/AT, "AT" standing for "advanced technology", an abbreviation whose use still survives to this day [in some contexts](#). Very similar in overall physical design to the PC and XT models that preceded it, the power supply in these units was increased in size and changed slightly in shape, establishing it as a distinct form factor. Whereas "clone" manufacturers made a few PC/XT units compatible with the IBM PC and XT, it was with the AT that the PC world really began to explode. Many different manufacturers began creating AT-compatible [systems](#) and with them, AT form factor power supplies. The original [AT power supply](#) provided 192 W--a respectable figure, especially for the time, which represented a tripling of the original PC's power supply output just three years later. It is used in [AT form factor cases](#) and with AT or Baby AT form factor [motherboards](#). It has the same motherboard and drive connectors as the PC/XT form factor.



[Diagram](#) of the side and rear views of an AT desktop form factor power supply, with approximate dimensions. The fan here has been moved to the middle of the back of the supply, and the voltage selector switch has been placed near the power cord receptacle, a much more sensible location. Note the distinctive "missing corner" at the bottom right of the rear view, which was created to allow part of the power supply to "overhang" part of the motherboard.

The AT form factor was the first to introduce [tower-style cases](#) and systems to the PC world. The desktop power supply and tower power supply were internally the same. The only difference was in the on/off switch. The desktop used the same red toggle switch as the PC and XT, while the tower introduced the first remote [power switch](#) in the PC world. The control wires for the switch were passed through the same hole in the front of the power supply case that was used for the motherboard and drive connector bundle.

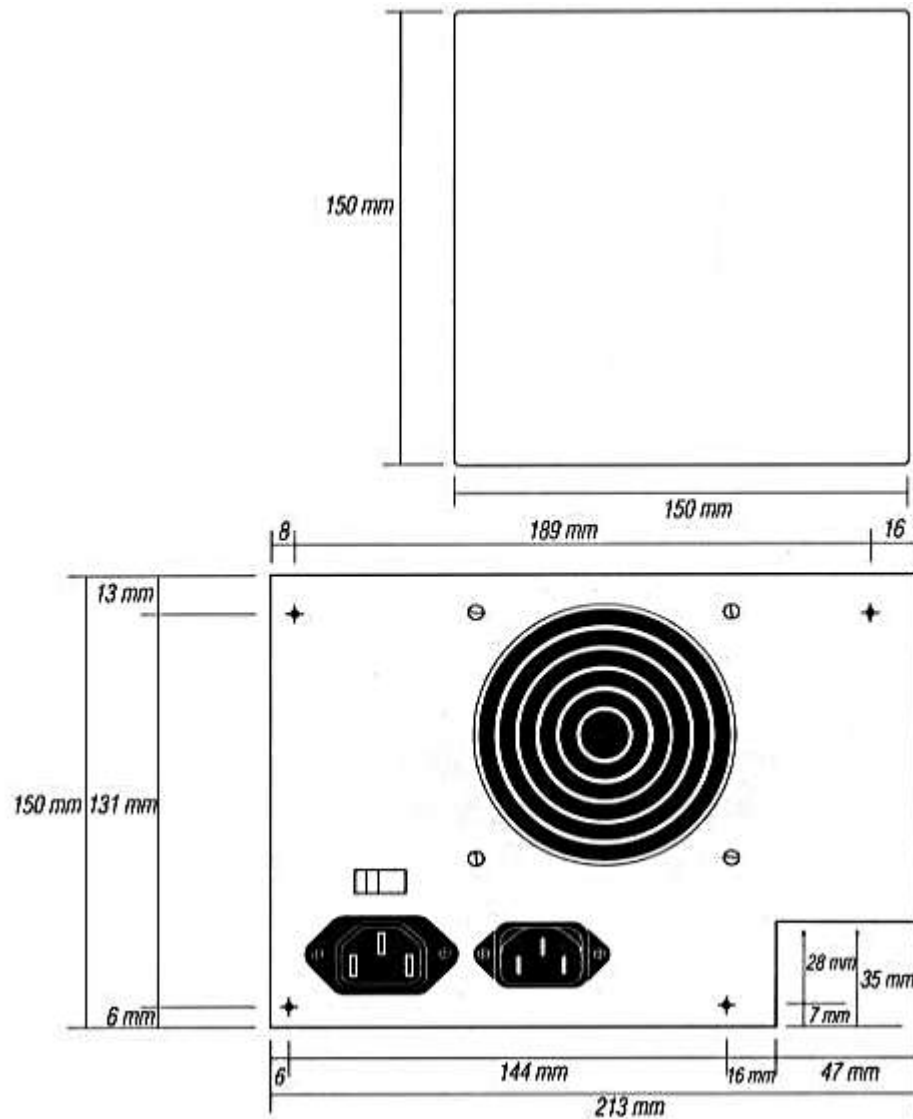
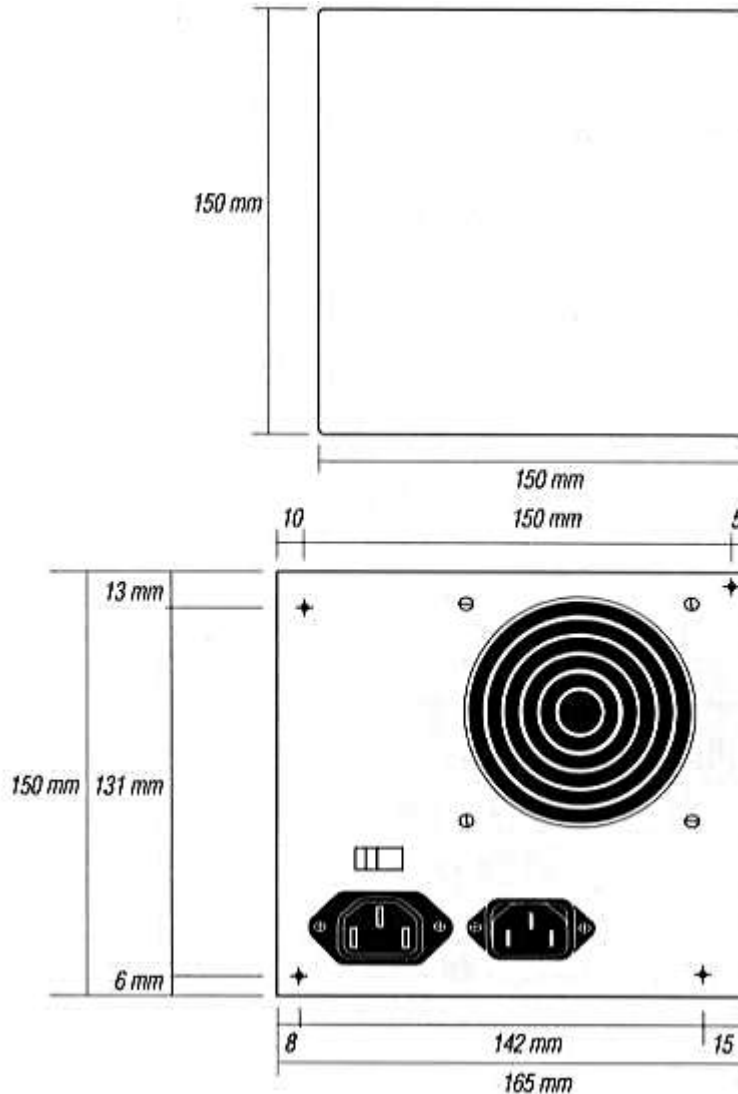


Diagram of the side and rear views of an AT tower form factor power supply, with approximate dimensions. The only change is the removal of the toggle switch in favor of a remote power switch (not shown).

The AT form factor is now obsolete of course, though many of these systems remain in use. After only a few years, the AT form factor was quickly dethroned by its smaller successor, the Baby AT form factor, due to the advantages of the latter's smaller size, so far fewer AT systems than Baby AT systems are found today.

Baby AT Form Factor

The Baby AT form factor is so named because it is a smaller version of the original AT form factor. It has the same height and depth, but is about 2" narrower. Since it is "similar but smaller", the Baby [AT power supply](#) will fit both in [Baby AT form factor cases](#) and in [full-size AT cases](#) as well, in both tower and desktop styles. It has the same output [motherboard](#) and drive connectors as the AT. Due to this flexibility, and the fact that it was introduced at around the time that PCs began to really grow in popularity, the Baby AT form factor reigned as the most popular design for over a decade--far longer than any other. From around 1985 to 1995, a large percentage of new PCs were Baby ATs (though later on [LPX](#) form factor [power supplies](#) came to be used in many Baby AT systems.)



[Diagram](#) of the side and rear views of a Baby AT form factor power supply, with approximate dimensions. Note that the dimensions are very similar to that of the AT form factor; essentially the "overhang" shown on the right side of the AT power supply rear view was removed because smaller Baby AT motherboards and supplies no longer required it. A desktop version also exists that is the same except for the addition of an external toggle switch on the side

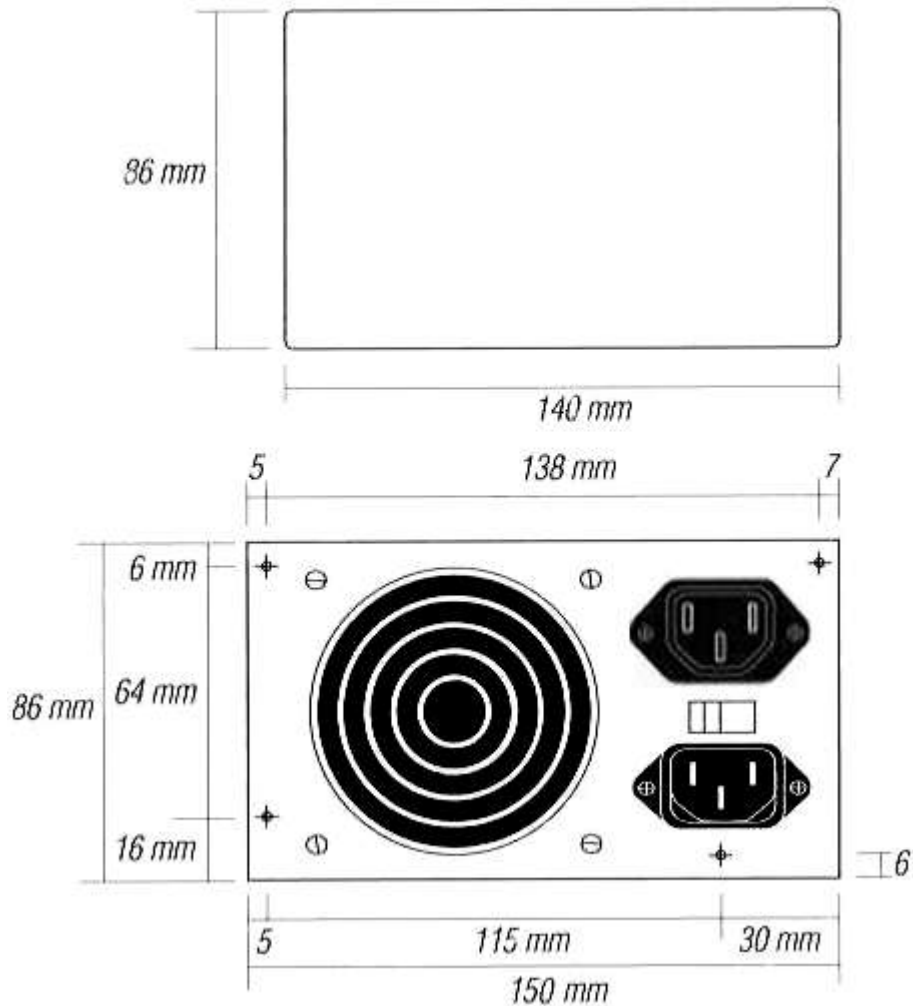
(as shown in the AT desktop style diagram on [the AT form factor page](#).)

The Baby AT power supply was made in both a tower and desktop configuration, like the full-sized AT, and like the full-sized AT these differ only in the type of power switch used. Unlike the full-sized AT, however, in the Baby AT form factor tower versions became much more popular. Even in many desktop systems, tower-style power supplies began to be installed for the simple reason that most users prefer having a power switch on the front of the case and not in the rear.

This form factor has now been replaced in new systems by the ATX and other form factors. However, the huge installed base has given Baby AT *momentum* and given manufacturers of new components incentive to provide upgrade options for the millions who still use these systems.

LPX Form Factor

One power supply form factor that has given Baby AT a run for its money over the last 15 years has been the LPX form factor. The "LP" in "LPX" stands for "low profile", another name given to these power supplies. They are also often called "slimline" power supplies because [LPX cases](#) are often called slimline cases, and "PS/2" power supplies after the famous IBM model. The main goal of this form factor is size reduction. The height in particular of the power supply is significantly reduced, facilitating the design of much smaller, consumer-oriented PCs. The connectors of the LPX form factor power supply are the same as that of the Baby AT and AT.



[Diagram](#) of the side and rear views of an LPX form factor power supply, with approximate dimensions. Note the much smaller height dimension compared to the AT or Baby AT form factors; the power cord outlet and monitor pass-through have been moved next to the power supply fan vent instead of below it. This is key to allowing the production of smaller, "slimline" PC systems. Many LPX systems no longer have the monitor pass-through. All of these systems use remote power switches.

While never officially specified as a standard, the LPX or "slimline" power supply basically became one anyway. Due to its small size and convenient rectangular shape, these [power supplies](#) were put into all sorts of cases; not just LPX cases but [Baby AT](#) and even [full-sized AT cases](#). Until the rise of its anointed successor, NLX, LPX systems were made in large quantity, and millions of these power supplies are still in use.

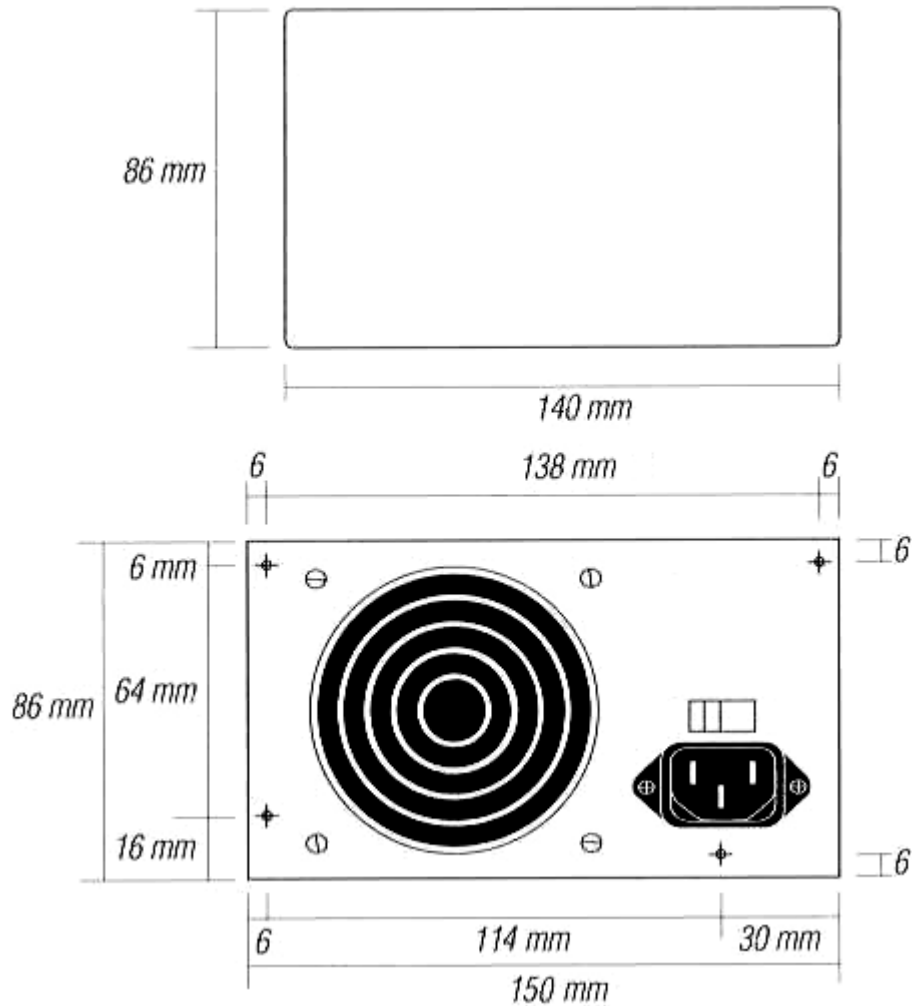


Rear view of an LPX power supply, showing its power cord and [motherboard](#) and drive connectors.

ATX (NLX) Form Factor

At the time of its introduction by Intel in 1995, the ATX form factor was the most significant change in system design since the invention of the PC over a decade earlier. Although it took several years to "catch on", the ATX form factor and its variants are now the standard in a large segment of the marketplace. In addition, the NLX [motherboard](#) and [case](#) form factor--designed to replace LPX--intentionally use the same power supply because Intel wanted to avoid having another power supply form factor on the market. Therefore, the ATX form factor is sometimes called the "ATX/NLX" form factor.

On the outside, the ATX power supply appears virtually identical to an LPX power supply in terms of its dimensions and component placement. The biggest visible difference between the two is that the [power pass-through](#) outlet for the monitor has been removed (primarily because modern monitors always come with their own power cord these days, so the pass-through hasn't been commonly used for some time.)



[Diagram](#) of the side and rear views of an ATX/NLX form factor power supply, with approximate dimensions. Note that the dimensions are essentially unchanged from those of the LPX form factor. The biggest change is the removal of the monitor power pass-through connector from the standard. By the time ATX was introduced these were rarely used by modern [PC monitors](#) in any event.

The *inside* of the ATX form factor, however, is an entirely different story. The ATX [power supply design](#) differs from the previous market standards, the [Baby AT](#) and [LPX](#) form factors, in several important ways:

- **True Standard:** The ATX form factor is a standard, as opposed to the "de facto standards" of prior form factors. You can find detailed specifications about ATX and other newer form factors at the [Platform Development Support Web Site](#). Included there is a [document](#) specific to the ATX power supply.
- **+3.3 V Power:** ATX systems were the first to include [+3.3 V power](#) directly, avoiding the need for voltage regulators to provide it on the [motherboard](#)

- **Soft Power:** ATX systems were the ones where the [+5 Standby and Power On](#) signals were introduced. These signals are used along with a change to the way the [power switch](#) works, as part of the "Soft Power" feature that enables features such as allowing the operating system to turn off the PC.
- **Additional Signals:** ATX defines several [additional signals](#) used for fan control, IEEE 1394 compatibility, and more.
- **Changed Motherboard Connectors:** Breaking with 15 years of tradition created by the PC/XT, AT, Baby AT and LPX form factors, Intel specified new motherboard connectors for the ATX form factor. This was in part due to the additional signals used by the ATX power supply and motherboards. For compatibility, some motherboards include both the new and old style of connector. [Read more about the motherboard connectors here.](#)
- **Modified Fan Direction and Placement:** One of the goals of the original ATX specification was to change the way the [power supply fan](#) worked. At around the time ATX was introduced, cooling fans were becoming the standard for the newer, faster CPUs on the market. Instead of exhausting air out the back of the case as had always been the norm, Intel wanted to use this exhaust air to cool the processor directly, saving the cost of a cooling fan. Therefore, the ATX specification calls for the fan to run in the opposite direction and be placed near the CPU's location on the motherboard, to blow on it for cooling. The other advantage of this method is that it keeps the system cleaner, since air entering the case all comes from one place, and can be filtered if necessary.

Unfortunately, while a good idea, this hasn't worked out quite the way Intel hoped. The primary problem is that newer CPUs continue to generate more and more heat as they get faster, and a regular power supply fan doesn't have enough flow to cool them properly. This problem is compounded by the fact that the air blowing on the CPU is warmed by the components in the power supply itself, so it is several degrees above ambient temperature before it ever gets near the CPU. Thus, newer versions of the ATX specification make the fan direction optional. The newest ATX power supplies have gone back to the old style of placing the fan on the back of the power supply and exhausting air to the outside.



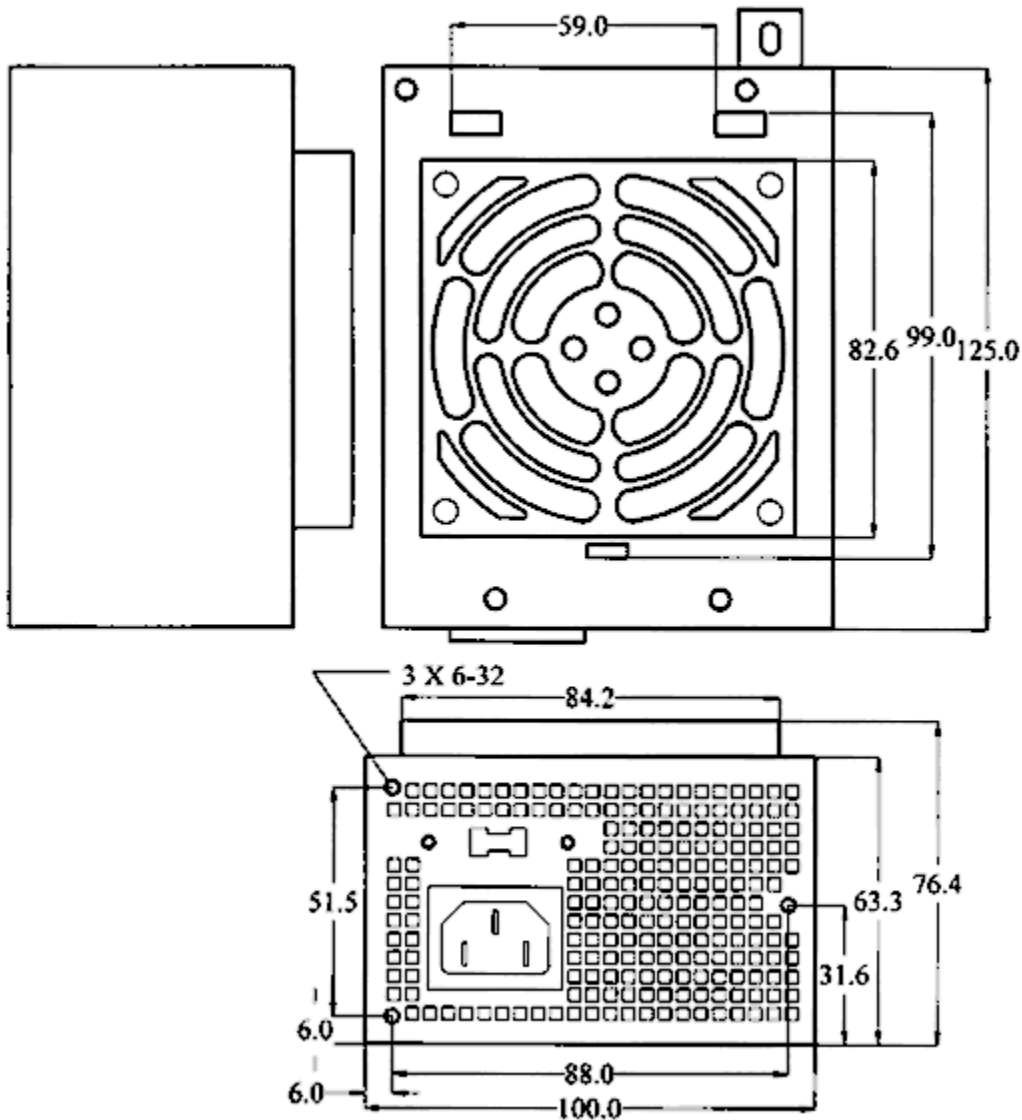
Rear view of an ATX power supply, showing its motherboard and drive connectors. This power supply blows air out of the system; the vents on the side are for drawing air from the inside of the system case.

Since it has become the [industry standard](#), ATX power supplies are found everywhere. Ostensibly designed to work with ATX cases and ATX (and Mini-ATX) motherboards, ATX power supplies are also used in NLX systems, as mentioned above. They can also be used for microATX motherboards in microATX cases if the case is large enough, because the ATX and SFX main [motherboard connectors](#) are essentially the same.

SFX Form Factor

As part of the continuing trend towards smaller and smaller PCs, Intel in 1997 introduced the new microATX form factor, based upon the original ATX form factor. In 1999, Intel produced the FlexATX addendum to the microATX specification, detailing plans for an even smaller [motherboard](#) and case standard. Neither of these form factors include specifications for a power supply. Instead, Intel created the *SFX* power supply form factor, which they may optionally use. The "S" in "SFX" is for "small" of course! [microATX and FlexATX](#) systems can also use the [ATX power supply](#), though since miniaturization is the key with these systems, the SFX power supply makes much more sense. You can find detailed specifications on the SFX power supply form factor at the [Platform Development Support Web Site](#).

The SFX specification actually calls for a default configuration, and several options. The "regular" SFX power supply is nominally 100 mm wide, 125 mm deep and 63.5 mm in height. It includes a 60 mm [power supply fan](#) for cooling. An optional configuration calls for the placement of a larger fan on the top of the power supply. This fan option is 80 mm and is very often selected by manufacturers as it provides for improved system cooling. It increases the height of the supply by about 10 mm. Another option is for an *extra-small* power supply with dimensions of only 100 x 125 x 50, and a 40 mm power supply fan. This configuration however requires an additional fan for [system cooling](#), because the small 40 mm fan is only sufficient to cool the power supply itself.



Clockwise from upper left: side, top and rear view [diagrams](#) of the SFX standard design power supply, with the optional top-mounted fan included.

In many ways the SFX form factor could be considered a "little brother" to ATX. It is mostly interchangeable with the ATX power supply. The main SFX [motherboard connector](#) is 20 pins, in the same shape and size as the ATX connector, and 19 of the pins are the same as those of ATX. The one difference here is that the SFX power supply specification does not call for providing the [-5 V compatibility voltage](#). The reason is that -5 V is only required for [ISA bus](#) compatibility, and since Intel wants to move new systems away from ISA (to [PCI](#) and [AGP](#) only) it intentionally left -5 V off the specification (presumably to save on the cost of the power supply). Systems that need -5 V and want to use the SFX power supply must generate it on the motherboard. The SFX power supply specification calls for the power supply fan to be internally thermally speed-controlled, but an additional "Fan On/Off" signal is included on the SFX optional motherboard connector. Another issue with ATX exchangeability is that an SFX power supply equipped only with the standard 60 mm fan may have considerable trouble cooling a large ATX system case.



View of the top and side of an SFX power supply, showing the top-mounted cooling fan.

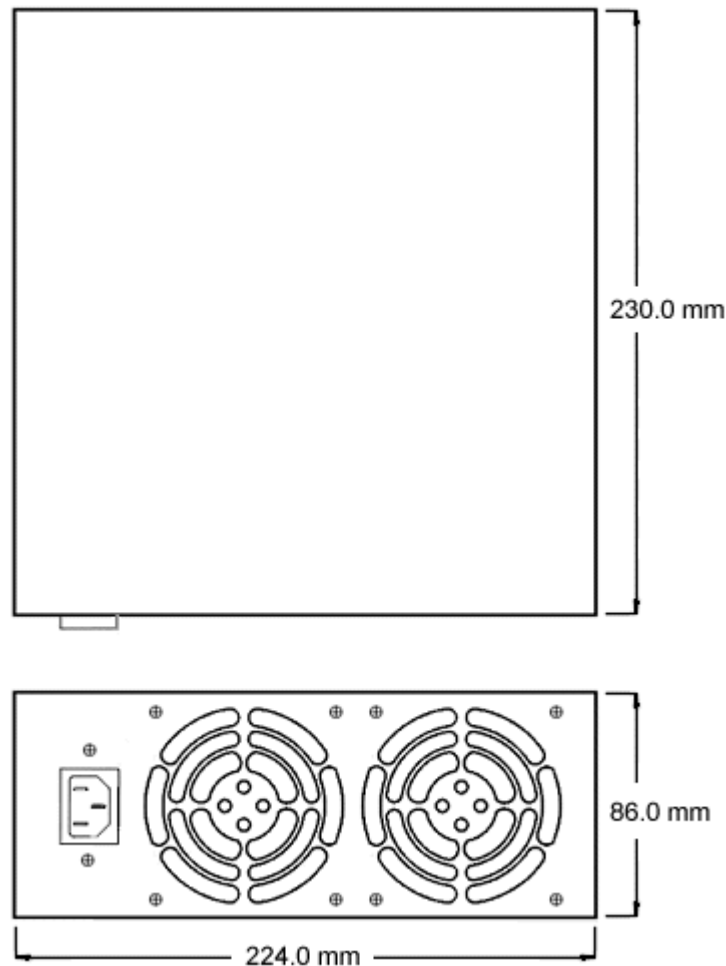
The specified [output rating](#) of the SFX power supply is 90 W. This is sufficient to run rather small systems with low-powered CPUs and few peripherals, but makes things a bit tight and leaves little room for expansion. Fortunately, some manufacturers are producing [SFX power supplies](#) with much higher output ratings.

WTX Form Factor

If the SFX form factor is the little brother to ATX, WTX isn't quite its big brother. WTX is more like its overgrown third cousin from a distant country. :^) Introduced by Intel (who else) in 1998, and revised in 1999, the WTX form factor is designed specifically for workstations (thus the "W" in "WTX"). WTX defines a standard for [motherboards](#), [cases](#), and power supplies.

To meet the increased needs of the largest regular PC systems, the WTX form factor is totally different from the other PC form factors. It is designed in a modular way from the ground up to allow it to meet the needs of large, multiple-CPU systems now and in the future. The system is segmented physically into different "zones" where different functions are supposed to be incorporated into the system. The motherboard is mounted on a special mounting plate which gives motherboard makers the flexibility to design boards without "hard-coded" mounting hole restrictions. For its part, the power supply has been completely changed to suit the needs of these larger systems. The best way to really understand the WTX form factor is to [download](#) and read the specifications that are available at the [WTX Home Page](#).

Unsurprisingly, WTX power supplies are large and powerful. The WTX specification actually includes design guides for three specific sizes of power supply: 460 W, 610 W, and a whopping 800 W, though manufacturers are not limited to those particular numbers. For designs up to about 500 W, a single [power supply fan](#) is specified, with overall power supply dimensions of 150 mm width x 230 mm depth x 86 mm height. For larger capacity supplies, a dual-fan configuration is recommended, which increases the width of the package to 224 mm.



Top and rear view [diagrams](#) of a dual-fan configuration WTX form factor power supply.

The [motherboard connectors](#) used for the WTX are completely different from, though similar in concept, those of ATX and SFX. Two large connectors with a total of 46 pins (6 reserved for future use) are the main connection to the WTX motherboard (or set of boards). Several additional connectors are also optional for powering additional CPUs or other devices. The WTX power supply also supplies several [extra signals](#) unique to the WTX form factor. WTX supplies are intended to be matched to WTX motherboards and put in WTX form factor cases. They normally include a large number of [drive connectors](#) to run a large number of hard disk drives and other devices, or special wiring to accommodate [RAID](#) bays.

Comparison of Power Supply Form Factors

This table is a summary comparison of the different power supply form factors. It shows their dimensions, the usual style of [system](#) in which they are used, and what sort of [motherboard connectors](#) they provide. It also shows for each power supply form factor, the typical cases and motherboards that are used with it. These lists should not be considered exhaustive. Also bear in mind that some combinations are much more common than others. "AT/ATX Combo" refers to cases designed to fit either AT or [ATX power supplies](#), and [motherboards](#) designed with both AT and ATX style connectors.



Note: SFX and ATX power supplies can generally be interchanged in systems sized to hold them because their 20-pin main motherboard connectors are *almost* identical. They are *not* however exactly identical: the SFX power supply does not provide the [-5 V signal](#) that may be required for some systems that use certain ISA bus expansion cards.

Form Factor	Typical Dimensions (W x D x H, mm)	Usual Style(s)	Motherboard Connectors	Match to Case Form Factor	Match to Motherboard Form Factor
PC/XT	222 x 142 x 120	Desktop	AT Style	PC/XT	PC/XT
AT	213 x 150 x 150	Desktop or Tower	AT Style	AT	AT, Baby AT
Baby AT	165 x 150 x 150	Desktop or Tower	AT Style	Baby AT, AT, AT/ATX Combo	AT, Baby AT, AT/ATX Combo
LPX	150 x 140 x 86	Desktop	AT Style	LPX, some Baby AT, AT/ATX Combo	LPX, AT, Baby AT, AT/ATX Combo
ATX/NLX	150 x 140 x 86	Desktop or Tower	ATX Style	ATX, Mini-ATX, Extended ATX, NLX, microATX, AT/ATX Combo	ATX, Mini-ATX, Extended ATX, NLX, microATX, FlexATX
SFX	100 x 125 x 63.5 *	Desktop or Tower	ATX Style	microATX, FlexATX, ATX, Mini-ATX, NLX	microATX, FlexATX, ATX, Mini-ATX, NLX
WTX	150 x 230 x 86 (single fan) 224 x 230 x 86 (double fan)	Tower	WTX Style	WTX	WTX

* Standard configuration, not including additional top-mounted fan, if any. 50 mm height option also exists. [See here for more details.](#)