

White Paper: Power Supplies

Posted 02/1/08 at 06:53:41PM | by Mike Chin

Digg [submit](#)



It's important for a PSU to maintain a consistent voltage within a specific range; providing more voltage can lead to a shortened life span for the part.

A decade ago, there were few well-known power-supply brands for DIY computer enthusiasts. Some people sought out specific models normally sold in bulk to commercial system integrators, but none of these products was individually boxed. How dramatically things have changed!

Today, the DIY computer builder has a bewildering array of retail-packaged power-supply choices. Most of these companies source the power supplies from the actual manufacturers and then market and distribute them under their own brands. So aside from colorful boxes, shiny paint jobs, blinking LED fans, fancy cables, and eye-popping four-digit power ratings, do the new retail power supplies offer any functional advantages over the plain gray boxes of old?

To answer this question, we're delving into the fundamentals: What are the real functions of a computer power supply?

Riding the Rails

The Power Supply Unit (PSU) converts AC electricity into regulated DC voltages, which it then delivers to the components inside your computer. Several different DC voltages are needed, the main ones being +12V, +5V, +3.3V, -12V, and 5V standby. Each voltage rail has a specific set of functions:

- **+12V:** In recent years, this has become the main rail to power most of the computer's

RELATED CATEGORIES:

[From the Magazine](#)

[2007](#)

[November 2007](#)

[White Paper](#)

RELATED ARTICLES

PC Building Guide FAQ: Part 1

Having first time builder's angst and considering a Dell instead? Dude, don't! Paul Lilly answers some common questions to get you started on the path towards DIY Utopia!

White Paper: Flash Memory

Mc every gadget, gizmo, whatsit, and whc uses this technology. Here's how it wo

White Paper: PCI Express 2.0

PCI Express 2.0 spec was finalized a year ago this month, and we're finally seeing hardware designed for it. Let's at PCI-E's evolution.

components. The motherboard uses DC-to-DC conversion of the 12V rail to provide the <1.5VDC needed for the CPU. It's also used to provide additional juice directly to power-hungry videocards, with direct connection via 6-pin and 8-pin PCIe power connectors. +12V is also used to power hard drive motors and fans.

- **+5V:** The motherboard and many of its components use +5V.
- **+3.3V:** Used to run system memory, videocards, and other circuits.
- **-12V:** Provided for backward compatibility, mostly with some types of serial port circuits, typically with a current limit of <1A.
- **+5V standby (SB):** Always on as long as the power supply is plugged into AC and its main switch is left on, +5VSB is used to power the "soft" turn on/off circuitry in the motherboard that tells the PSU to power up or power down. It is also used for "self-powered" USB devices.

Each output voltage rail has a maximum current capability, expressed in amperes (A). Note that voltage multiplied by current equals power. Normally, the maximum power capability of each voltage rail should add up to total rated power, but this is not always the case. With no-name PSUs, false labeling is quite common; the rated power seems to always be greater than the sum of individual rail power. With quality brands, sometimes the reverse is true: The sum power of individual lines is greater than the PSU's rated power. This is because the maximum capability of each line cannot be delivered simultaneously without overloading the primary DC transformer. Look for combined maximum current/power ratings.

The main output connectors on modern PSUs are

- A 24-pin or 20+4-pin main ATX for the motherboard
- A 4-pin ATX 12V or an 8-pin ATX 12V for the motherboard (the 8-pin versions is mainly for high-current CPU and dual-CPU boards)
- Two 12V 6-pin and two 12V 6/8-pin auxiliaries for high-power PCIe videocards
- A 4-pin "Molex" for IDE hard drive (and other peripheral) power
- A SATA hard drive power connector
- A floppy drive power connector

Regulate This!

The ATX12V specification calls for a range of $\pm 5\%$ on the +12V, +5V, and +3.3V rails, and $\pm 10\%$ on the remaining lines. The voltage monitoring software in motherboards is not really accurate enough to check on VR; a multimeter with probes across the output terminals is needed. Many enthusiasts erroneously believe that higher DC voltage is always better; in reality, higher voltage can lead to early component failure. What's more important is that the voltage is kept within specified limits under all conditions.

240VA is a limit on some consumer electronics safety standards. The 18A current limit for 12V was intended to keep the VA in the PSU output cables below that 240VA limit. This requirement is achieved by inserting a simple limiter to keep the current below 18A on any 12V line cable. With several cables, the total 12V current could exceed 18A, however. But marketing materials have exaggerated this technicality into "multiple 12V rails"; some PSUs are even advertised as having four or five "independent" 12V rails. In reality, most PSUs limit the current on each 12V cable to <20A, and virtually none have more than one 12V rail. All the 12V wires connect to the same 12V transformer. The exceptions are some extremely high-power units (~1kW), in which having two separate 12V circuits can actually make engineering-design sense.

Power Shift

A desktop PC does not require a constant level of power. The power requirements depend on what the PC is being asked to do. Most home PCs remain in low or idle mode about a third of the time that they are powered on.

When the CPU or videocards are at full load (during intensive video or photo editing, serious number crunching, or extended 3D gaming), the power demand can jump to double that of idle load. In most cases, recommendations by manufacturers and technical magazines about how "big" a PSU should be are based on the maximum possible theoretical load of the system components, plus added headroom capacity. This results in unrealistically high power recommendations. The recommended PSU power rating is more than double that of maximum loads seen in real-life applications.

Power Conversion and Efficiency

Computer PSUs are switching mode types, which means that the PSU switches on and off upwards of 100,000 times per second; this provide relatively high efficiency at low cost compared to linear (non-switching) power supplies.

The conversion from AC to DC always requires some signal filtration, and there's some energy loss into heat; the lower the loss, the higher the efficiency. Efficiency is defined as the ratio between DC output and the AC input required for that output, and it is expressed as a percentage. Efficiency does not stay constant; it varies somewhat with power output.

[View](#) / [Add Comment\(s\)](#)

-ADVERTISEMENT-



List Price: ~~-\$49.95-~~
Your Price: **\$39.95**

Trend Micro
Internet Security 2008

- Powered by the PC-cillin Engine
- Home network protection
- Data theft protection
- Parental controls

Buy Now

The advertisement features a central image of the software box for Trend Micro Internet Security 2008. The box is red and white with a woman working on a laptop. A green circular badge in the top right corner of the box says '\$10 off'. The background of the ad is white with a light green border.

Comments

[login](#) or [register](#) to post comments

Well done.

Submitted by allc0re on Sat, 2008-02-02 20:37.

I've always wondered why some manufacturers claim "dual rails". Who makes the most efficient power supply? Is it PC Power and Cooling or Antec (or neither)?

[login](#) or [register](#) to post comments
