

Samantha Watkins

Need to replace your fan? Simply trade it out. Want to add more storage capacity? No problem – just exchange that 500GB SSD for 4TB.

But have you ever worried during one of these activities that your server might spontaneously combust? Probably not. Unknown to some end users, many modern electronics provide protection against current and voltage spikes during what is known as a “hot swap” event.

What Is Hot Swapping and Why Do You Care?

Hot swapping is when the user connects an external device or module to expand system capabilities or provide regular maintenance without powering down the host system. While you see hot swap activity in a variety of applications, protection against these kinds of events is critical in complex systems such as servers. As you can see in [Figure 1](#), a current or voltage spike from a hot swap event can result in hardware damage, expensive repairs, server downtime, or physical injury to yourself or others.

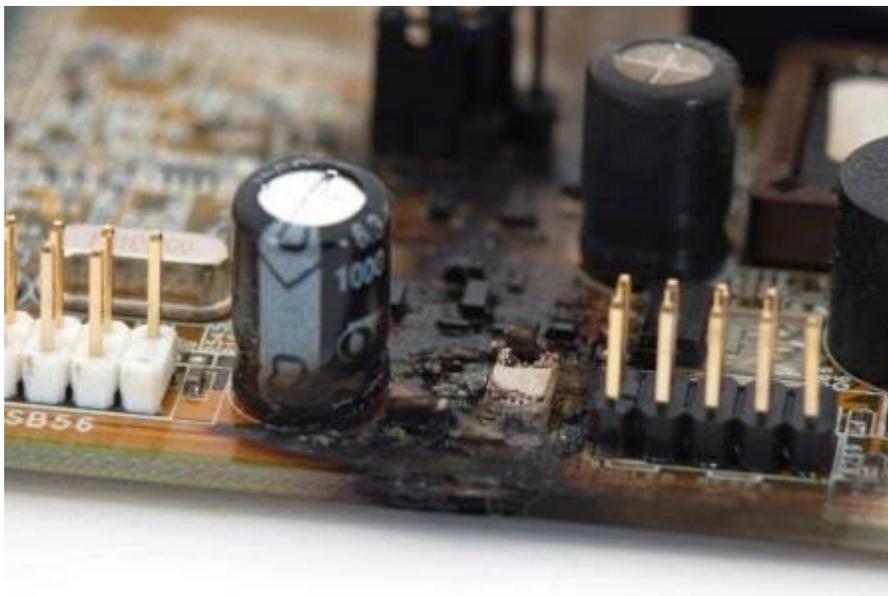


Figure 1. Damage to IC Due to over Voltage and over Current Events.

Where Can This Happen in Your Server?

Many servers are designed to be highly configurable – comprising modules that you can swap in and out as needed including fans, storage devices (HDD and SSDs), and power supply units (PSUs) as shown in [Figure 2](#). You must carefully consider protection near these modules against hot swap events.

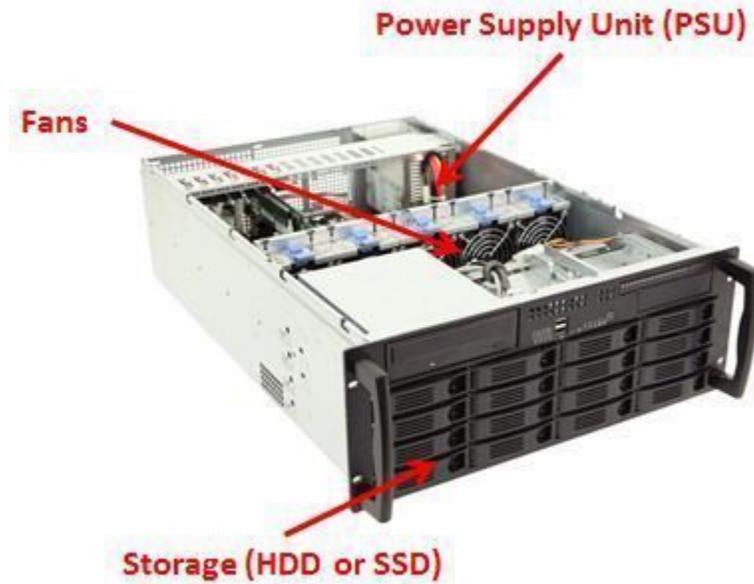


Figure 2. Server Components Including Storage, Fans, and PSUs Are Commonly Hot Swapped.

Typically, you can place protection against hot swapping events on either the module or the host system as shown in [Figure 3](#). Due to the highly configurable nature of servers, the host system or backplane vendor is often different from the module vendors. This makes it difficult to know where protection already exists, but if you are designing a module or backplane, it never hurts to have redundant protection against surges in your server.

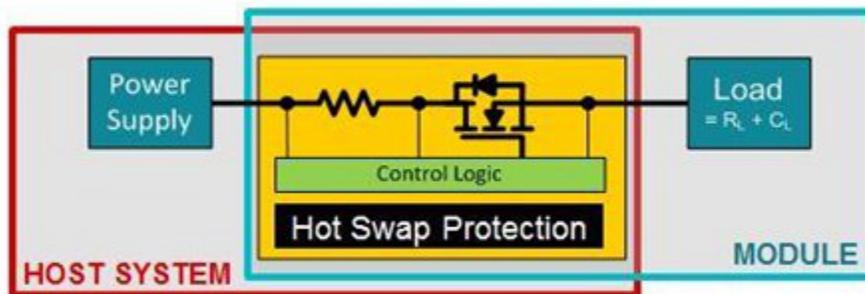


Figure 3. You Can Place Hot Swap Protection on Both the Host System and Module

How Can You Protect against Hot Swap Events in Your Server?

There are many options to protect against hot swap events in a server. Let's take a look at a few common solutions.

Fuses and polyfuses can serve as low-cost solutions – but a large footprint (shown in [Figure 4](#)), degraded performance, and increased maintenance costs can outweigh this benefit over time.

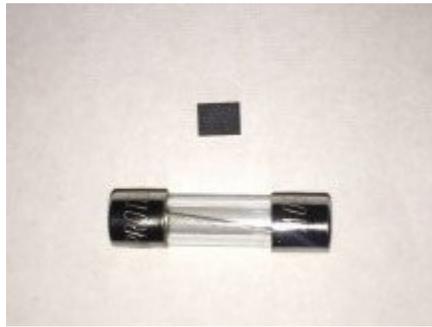


Figure 4. Comparison of Fuse to TI [TPS25942](#) eFuse

Hot swap controllers are another common solution. These devices provide control logic to an external FET and sense resistor that enable design flexibility specifically when setting $R_{DS(ON)}$ and upper current limits. However, for many space-constrained server applications, an [eFuse](#) can provide the necessary protection and save precious board space by integrating the external components.

In addition to integration, eFuses add protection features critical for servers. For example, TI's [TPS25942](#) eFuse offers common protection features required for a hot swap event including adjustable current limit, over voltage protection, and thermal shutdown, as well as general system protection such as programmable soft start, under-voltage protection, and reverse current blocking. Should a hot swap event occur, the [TPS25942](#) recovery options include latched and auto retry versions.

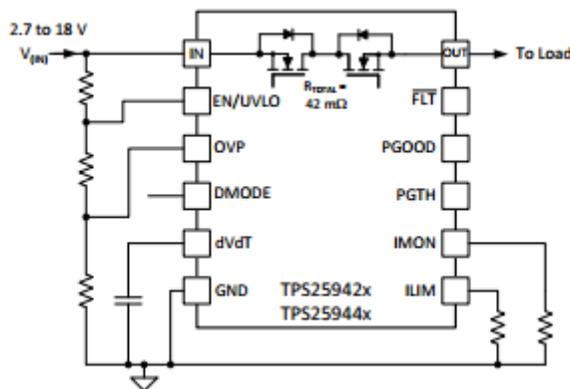


Figure 5. [TPS25942](#) Simplified Schematic.

Along with its protection features, the [TPS25942](#) also offers system status monitoring by providing outputs to the system for power good, fault, and current monitoring. With all these features packed in a 3mm x 4mm QFN, it's easy to see why an eFuse is the right choice for hot swap protection in your server!

So the next time you swap out your fan or install the latest in memory technology – and your super sweet server doesn't erupt into flames – just remember that it's all thanks to hot swap protection. Don't forget to include an [eFuse](#) for hot swap protection in your next server design!

Learn More about Designing with eFuses:

- See how traditional fuses and polyfuses compare to modern TI eFuses, check out: [“Get out of the dark: Upgrade your fuse!”](#)
- For more information on eFuse integration, read [“How to integrate your hot swap with an eFuse”](#)
- To learn more about eFuse fault recovery, read this three-part blog series: [“eFuses: clamping and cutoff and auto retry, oh my!”](#)

IMPORTANT NOTICE AND DISCLAIMER

TI PROVIDES TECHNICAL AND RELIABILITY DATA (INCLUDING DATA SHEETS), DESIGN RESOURCES (INCLUDING REFERENCE DESIGNS), APPLICATION OR OTHER DESIGN ADVICE, WEB TOOLS, SAFETY INFORMATION, AND OTHER RESOURCES "AS IS" AND WITH ALL FAULTS, AND DISCLAIMS ALL WARRANTIES, EXPRESS AND IMPLIED, INCLUDING WITHOUT LIMITATION ANY IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE OR NON-INFRINGEMENT OF THIRD PARTY INTELLECTUAL PROPERTY RIGHTS.

These resources are intended for skilled developers designing with TI products. You are solely responsible for (1) selecting the appropriate TI products for your application, (2) designing, validating and testing your application, and (3) ensuring your application meets applicable standards, and any other safety, security, regulatory or other requirements.

These resources are subject to change without notice. TI grants you permission to use these resources only for development of an application that uses the TI products described in the resource. Other reproduction and display of these resources is prohibited. No license is granted to any other TI intellectual property right or to any third party intellectual property right. TI disclaims responsibility for, and you will fully indemnify TI and its representatives against, any claims, damages, costs, losses, and liabilities arising out of your use of these resources.

TI's products are provided subject to [TI's Terms of Sale](#) or other applicable terms available either on [ti.com](https://www.ti.com) or provided in conjunction with such TI products. TI's provision of these resources does not expand or otherwise alter TI's applicable warranties or warranty disclaimers for TI products.

TI objects to and rejects any additional or different terms you may have proposed.

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265
Copyright © 2023, Texas Instruments Incorporated