BOURNS®

AI Datacenter Hot-Swap Protection

APPLICATION BRIEF

Situation

AI workloads are pushing rack power densities into territory that traditional datacenter architectures were not designed to support. As bus voltages migrate from 12 V to 48 V—and as ±400 VAC and 800 VDC distribution move from concept to deployment—the hot-swap stage becomes a known transient-susceptibility point in the rack power chain.

The hot-swap controller limits inrush current when a board is plugged into a live rail and acts as the circuit breaker for the load.

The controller and the components it protects are themselves vulnerable to overvoltage events: inductive kickback during faulty load disconnect and surge transients propagating from upstream. In dense AI racks running with tight voltage and current margins, those transients can exceed component ratings and damage the controller, the load, or both.

This brief identifies the four-component protection set that Bourns recommends for hot-swap stages in AI datacenter equipment.

Solution

Figure 1 shows the protection topology around a typical hot-swap controller. Bourns covers each function with parts engineered for the current and voltage envelope of modern AI rack power.

Inrush current sensing

Hot-swap controllers regulate inrush current by sensing the voltage across an external current sense resistor in series with the load. The Bourns® CSS2H-2512R-L500FE delivers 0.5 mΩ resistance with a 6 W power rating at 70 °C and a low TCR of ±75 ppm/°C—the precision needed for accurate inrush regulation under the high transient currents typical of 48 V buses and the higher-voltage rails coming next.

Overvoltage clamping—high-voltage rails

As datacenter distribution moves from 48 V toward ±400 VAC and 800 VDC, hot-swap stages need clamps engineered for the higher voltage envelope. The through-hole PTVS3-430C-TH has a 430 V working voltage and absorbs peak pulse currents up to 3,000 A on an 8/20 µs surge waveform.

Two PTVS3-430C-TH diodes placed in series support working voltages up to 860 V—providing the headroom needed for ±400 VAC and 800 VDC rails as those architectures roll out.

Overvoltage clamping—low-profile and tight-pitch designs

Where board real estate is constrained, or working voltages are 86 V or below, the Bourns® PTVS1 and the Bourns® PTVS2 DFN families deliver 1 kA and 2 kA peak pulse currents, respectively, in an 8 mm × 6 mm × 2.5 mm DFN package. Like the through-hole PTVS3, DFN PTVS devices can be stacked in series for higher-voltage applications.

Bulk capacitor discharge

The hot-swap controller charges a bulk capacitor at a controlled rate during board insertion. A discharge path is required to clear residual voltage after the event. The Bourns® UB3-8R75G2 wirewound resistor—8 Ω at a 2 W power rating—provides a controlled discharge path sized for typical hot-swap hold-up capacitance.

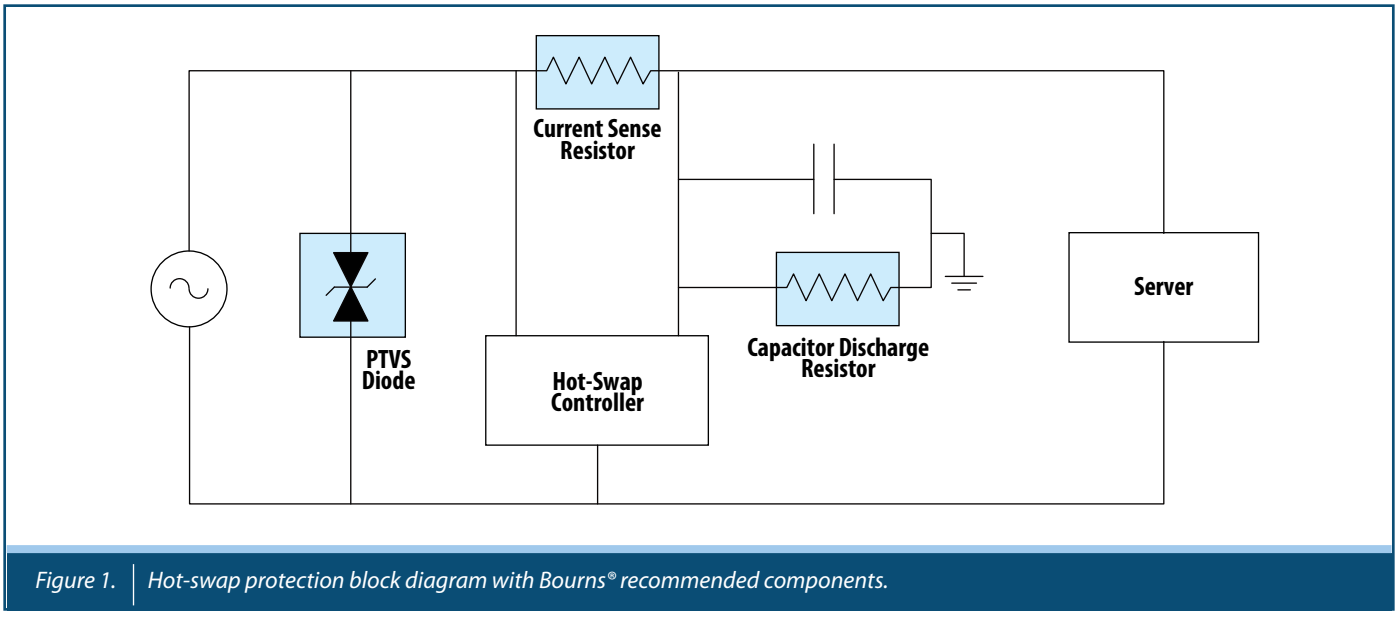

Figure 1. | *Hot-swap protection block diagram with Bourns® recommended components.*

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Benefits

- **Single-source coverage of the protection stage.** Bourns offers recommended components for key hot-swap protection functions, including transient clamping, current sensing, and capacitor discharge, helping reduce the need to source comparable protection devices from multiple suppliers.
- **Engineered for AI rack voltage envelopes.** The Bourns® PTVS3-430C-TH at 430 V working voltage—or stacked in series at 860 V—addresses the ±400 VAC and 800 VDC distribution architectures coming into AI deployments; the Bourns® CSS2H-2512 series handles the high-current sense paths required at 48 V and beyond.
- **Series-stackable clamping.** Both through-hole and DFN PTVS families support series configurations, allowing designers to reach 860 V (PTVS3) or scale DFN clamps to higher rails without changing the protection topology.
- **Datasheet-traceable precision.** The Bourns® CSS2H Current Sense Resistor with ±75 ppm/°C TCR and the UB3 discharge resistor with 8 Ω/2 W rating provide designers with traceable specs for closed-loop simulation and qualification.

Recommended Products

Bourns components mapped to each protection function in the hot-swap stage:

Product Image	Recommended Products	Specifications & Features
	**Power TVS Diodes (Through-hole)** Transient clamp—high voltage PTVS3-430C-TH	• Working voltage: 15-470 V • Peak pulse current: 1-20 kA (8/20 µs) • Through-hole and SMD packages; bidirectional; series-stackable for higher voltage rails.
	**Power TVS Diodes (SMD)** Transient clamp—low profile PTVS1-086C-H PTVS2-086C-H	• Working voltage: 22-86 V • Peak pulse current: 1 kA (PTVS1), 2 kA (PTVS2), 8/20 µs • Compact 8 × 6 × 2.5 mm DFN; bidirectional; series-stackable for higher voltage rails.
	**Power Wirewound Resistor** Bulk capacitor discharge UB3-8R75G2	• Resistance: 8 Ω (range 0.02 Ω-260 kΩ) • Power rating: 2 W (family: 1-15 W) • Low TCR ±20 ppm/°C; through-hole; wirewound technology.
	**Current Sense Resistor** Inrush current sensing CSS2H-2512R-L500FE	• Resistance: 0.5 mΩ (range 0.2-5 mΩ) • Power rating: 6 W at 70 °C (family: 1.5-15 W) • TCR ±75 ppm/°C; surface mount; low thermal EMF.

Next Steps

Search the full Bourns® hot-swap protection portfolio at bourns.com/products/circuit-protection, or contact a Bourns® Field Applications Engineer for a coordinated review of your AI datacenter hot-swap design.