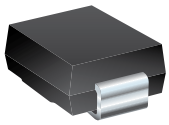
POWER PLAY SOLUTIONS™

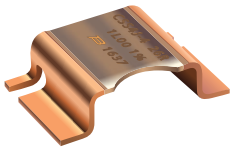
Server Power Bus Protection and Sensing



Model 5.0SMDJ Series

Model SMF4L Series

Model CSS2H Series



Model CSS4J Series

BACKGROUND

Servers have been used for data crunching for multiple decades. Their usage varies from a simple desktop server housed in an individual office to cloud-based enterprise servers located in huge datacenters that allow multiple offices and users to connect via high-speed networks.
As servers brought a new era of the computing revolution to people in offices, the internet and how users interact with data has prompted the reinvention of Central Office (CO) equipment, which has basically not changed in more than a half century. With the incoming 5G network, there is now an effort underway to re-architect the CO into a design that resembles that of a datacenter. This effort is also known as CORD (Central Office Re-architected as a Datacenter). The CORD transformation involves housing servers, routers and switches requiring 24/7 uptime together.

CHALLENGE

To support the stringent requirement of 24/7, reliable operation in datacenters and COS, servers and other switchgears typically implement add-in cards that can be "hot-swapped" so that operators do not take the system out of service during repairs or upgrades. Servers and routers are predominantly powered by a +12 volt power supply with tens of amperes of load current or higher that will be interrupted for milliseconds during a hot-swapping event. Due to such a high di/dt at hot-swapping, this sudden interruption of current will typically cause hundreds of volts of surge at the card input (see Figure 1) and, thereby, expose the hot-swap controller to electrical overstress and eventual failure.

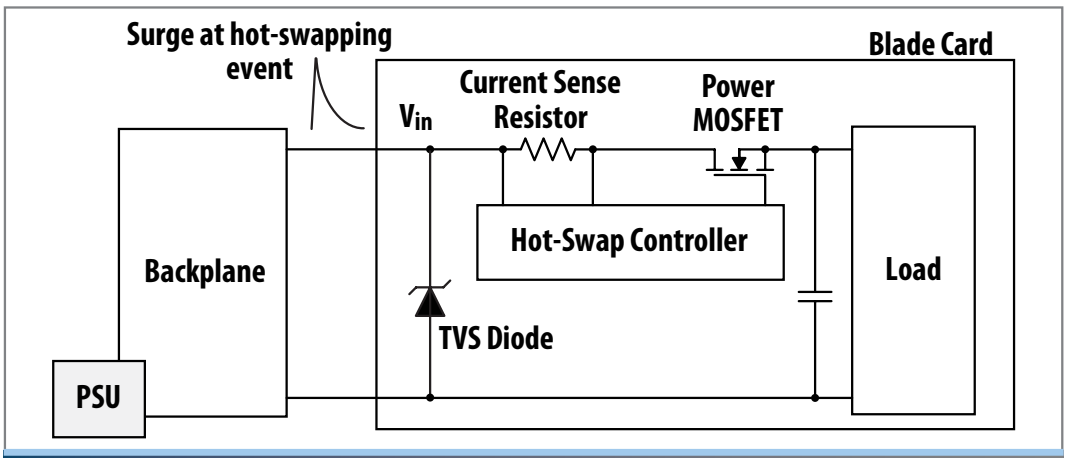


*Figure 1: Blade Card Front-End Schematics**

** The schematic above illustrates the application protection and does not constitute the complete circuit design. Customers should verify actual device performance in their specific applications.*

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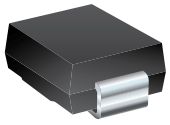

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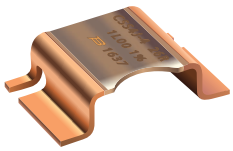

Model CSS4J Series

PROTECTING HOT-SWAP CONTROLLERS

Hot-swap controller circuity is commonly used to meet the mission-critical 24/7 uptime requirement by monitoring the voltage across the accurate current sense resistor (R_{sense}) and converting it to the current level internally. Once the measured current level exceeds its default current limit, the circuitry then switches off the external MOSFET. This R_{sense} has to be low in resistance and its resistance can be in the range of sub-milliohms. The power rating needs to be high enough to tolerate thermal derating while the resistance tolerance and temperature coefficient of resistance (TCR) must be low so as not to trigger an overcurrent event incorrectly.

It is also necessary to account for the transient voltage the hot-swap controller will experience during a plug/unplug event. As the hot-swap controller interrupts the current flow, the high di/dt and input inductance typically generate a high-voltage surge, which can easily exceed twice the supply voltage. A typical method for addressing transients is to place a TVS diode at the input to absorb the inductive surge. The power rating of this TVS diode must be larger than the surge energy.

BOURNS SERVER PROTECTION SOLUTIONS

Bourns offers an extensive portfolio of sensing and protection products for server applications.

Shunt Resistors:

Bourns offers a wide portfolio of current sense resistors. In particular, the Model CSS Series is an electro-beam welded metal strip shunt resistor with power ratings up to 12 W and resistance as low as 0.2 mΩ. Bourns® Model CSS Series handles up to 273 A (Table 1), which meets the current rating requirements of most mission-critical high power datacenter equipment. It is worth mentioning that the CSS4J-4026 series, a 4-terminal R_{sense}, makes it easier to visually inspect soldering to ensure high reliability at manufacturing. It also assists in lowering overall TCR. The CSS Series shunt resistors features a TCR of < 50 ppm/°C, which is much lower than that of copper trace on a printed circuit board (3900 ppm/°C). For more details, please refer to the *Using Current Sense Resistors for Accurate Current Measurement Application Note.*

Model	Photo	Current Rating	Power Rating	Resistance Range	No. of Terminals
CSS2H-2512		up to 140 A	2 to 6 W	0.3 to 5 mΩ	2 terminals
CSS2H-3920		up to 245 A	3 to 12 W	0.2 to 5 mΩ	2 terminals
CSS2H-5930		up to 273 A	4 to 15 W	0.2 to 3 mΩ	2 terminals
CSS4J-4026		up to 158 A	3 to 5 W	0.2 to 3 mΩ	4 terminals

Table 1: Specification Summary - CSS Series

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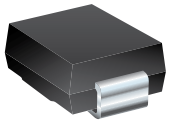

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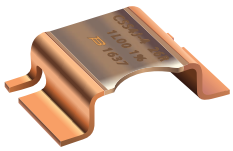

Model CSS4J Series

BOURNS SERVER PROTECTION SOLUTIONS (CONTINUED)

TVS Diodes:

Bourns also offers a variety of TVS diodes ranging from 400 W to 7000 W power rating (Table 2) to combat various overvoltage events in a server application. Specifically, the 5.0SMDJ series has a 5000 W power rating where Bourns® Model 5.0SMDJ13A and 5.0SMDJ14A are commonly used to protect 12 V-based hot-swap controllers. To accommodate for a different power bus voltage, e.g. -48 V, the Model 5.0SMDJ51A is a good option. Table 2 shows Bourns® TVS diodes at different power rating comparisons.

Model	Photo	Package Type	Peak Pulse Power (W) (10/1000 µs)	Peak Pulse Power (A) (10/1000 µs)	Standoff Voltage (V)	Breakdown Voltage (V)
SMF4L		SOD-123FL	400	20.1 ~ 4.3	12 ~ 58	13.3 ~ 64.4
SMAJ		DO-214AC (SMA)	400	43.5 ~ 0.5	6.4 ~ 522	5 ~ 495
SMBJ		DO-214AA (SMB)	600	65.3 ~ 0.8	6.4 ~ 522	5 ~ 495
SMCJ		DO-214AB (SMC)	1500	163 ~ 2	6.4 ~ 522	5 ~ 495
SMLJ		DO-214AB (SMC)	3000	326 ~ 11	6.4 ~ 189	5 ~ 170
5.0SMDJ		DO-214AB (SMC)	5000	543.6 ~ 18.2	6.4 ~ 189	5 ~ 170
SM8SF-Q		0.41 ″ x 0.32 ″	7000	180 ~ 120	24 ~ 36	26.7 ~ 40
SM8S-Q		DO-218	6600	254 ~ 95	16 ~ 43	17.8 ~ 47.8

Table 2: Specification Summary - TVS Diodes

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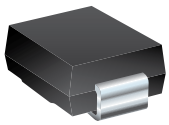

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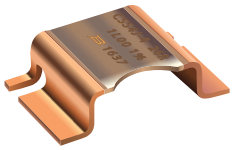

Model CSS4J Series

SUMMARY

To meet the ever-growing demand for constant connectivity and instantaneous data uploading, servers and network equipment commonly implement hot-swappable cards. Using add-in cards enables the replacement or adding of components without the need to stop or shut down the system to deliver 24/7 reliability and uptime. Important in these designs is for these cards to be protected against overvoltage and overcurrent events during hot plug/unplug events. Bourns offers a rich portfolio of TVS diodes and shunt resistors that offer proven protection of sensitive downstream components in a blade or hot-swappable card against damaging surges up to the devices rated limits.

BOURNS®

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