

AI Server Fan Drive Applications using NCP81295 and NCP81428 Smart Fuse

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INTRODUCTION AND SYSTEM REQUIREMENTS

Modern servers rely on redundant 12 V BLDC fans for cooling loads that generate large amounts of heat such as GPU's. Fan startup current, locked-rotor conditions, cable inductance, and hot-swap events all place demands on the power-distribution network. The NCP81428 and NCP81295 Smart Fuse (Electronic Fuse or eFuse) provides protection, monitoring, and telemetry for these loads.

NCP81428 SOLUTION OVERVIEW

The NCP81428 integrates a low $R_{DS(on)}$ MOSFET, hot-swap controller, telemetry, fault logging, and PMBus communications. A dedicated Smart Fuse per fan module improves fault isolation and allows system firmware to identify degraded or failed fans, adjust system for fan speed or board heating adding further intelligence to the system implementation.

NCP81295 SOLUTION OVERVIEW

The NCP81295 integrates a low $R_{DS(on)}$ MOSFET and analog hot-swap controller. The NCP81295 features the

same protections as NCP81428 but without PMBus for loads that do not require telemetry.

DESIGN CONSIDERATIONS FOR SERVER FAN LOADS

Server fans commonly draw several times their rated operating current during startup. Soft-start settings, overcurrent thresholds, and fault timers should be selected to allow normal startup while still protecting the system from stalled-rotor and short-circuit events. PMBus telemetry can be used to monitor fan health trends over time.

Although BLDC fans contain internal commutation electronics, the motor windings and wiring harness remain inductive. When current is interrupted, stored energy can generate voltage transients. An external Schottky diode connected from the fan supply node to ground provides a controlled freewheel path, reducing output overshoot, negative transients, EMI, and MOSFET stress.

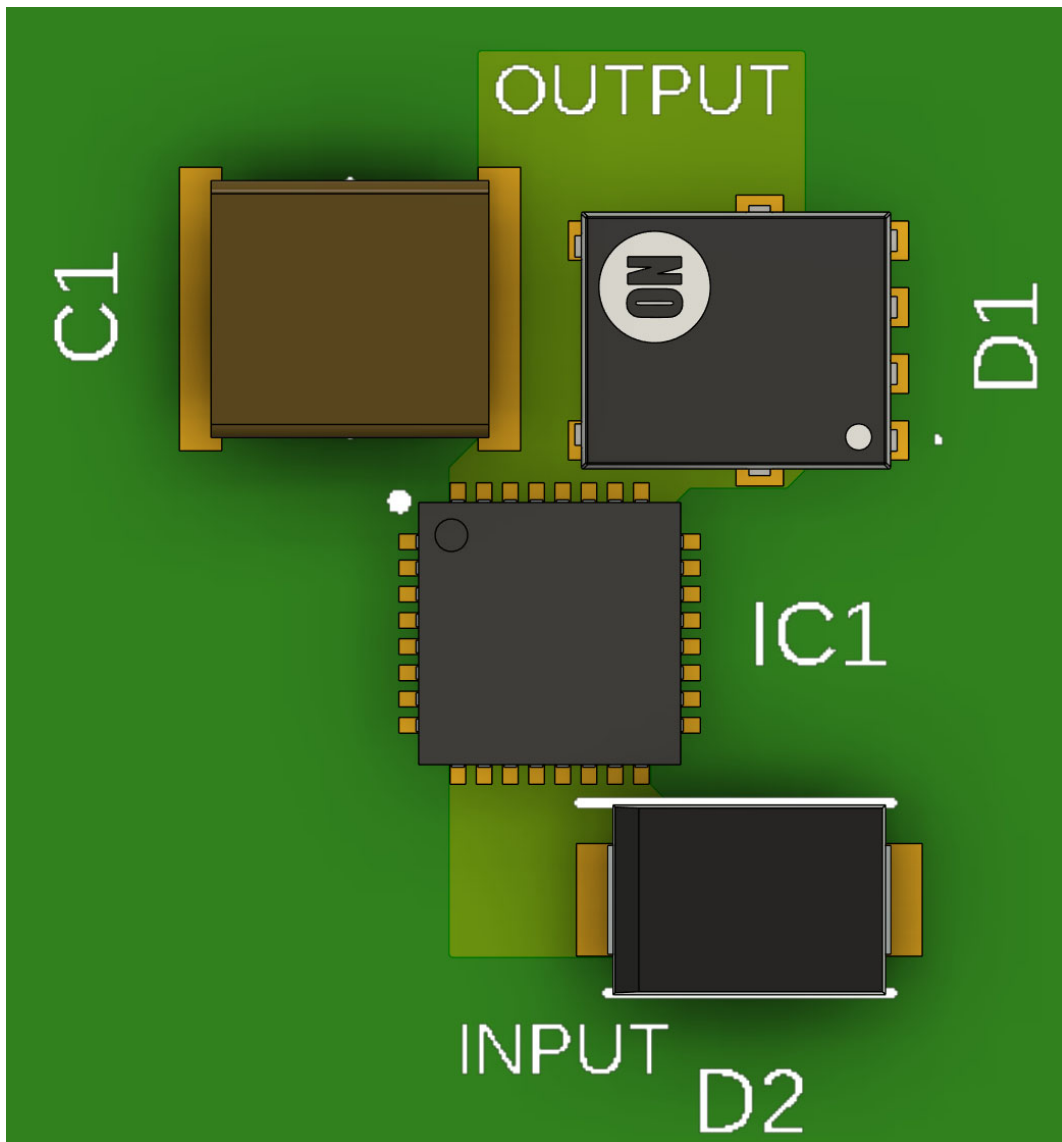


Figure 1. High Level Recommended Layout for Smart Fuse Products
C1 = Output MLCC Cap, D1 = Output Schottky, D2 = Input TVS

LAYOUT CONSIDERATIONS

Proper sizing of the output capacitor (COUT) is an important companion to the Schottky diode. During fault shutdown or rapid load-current transitions, the output capacitor absorbs a portion of the energy stored in the fan inductance and cable harness. Insufficient capacitance can result in excessive voltage excursions at VOUT, while adequate capacitance helps maintain a controlled output waveform and reduces stress on the Smart Fuse. In server applications, low-ESR ceramic or polymer capacitors located close to the fan connector are recommended. Designers should evaluate worst-case fan current, cable inductance, and shutdown conditions to ensure the capacitor can absorb transient energy without exceeding the maximum voltage rating of the fan electronics or the Smart Fuse. When long harnesses are present, additional bulk capacitance may be required. The combination of properly

sized COUT and a Schottky clamp diode provides the most robust protection against inductive transients.

Large VIN and VOUT copper regions, abundant thermal vias beneath the exposed pad, and short high-current paths improve thermal performance. Multiple fan channels should use consistent routing practices to achieve uniform current sharing and temperature rise.

CONCLUSION

The NCP81428 and NCP81295 provide a compact solution for protection in 12 V server fan power distribution. Combining current limiting, fault protection, telemetry, PMBus monitoring, properly sized output capacitance, and a Schottky freewheel diode results in a robust design capable of addressing startup surges, fault conditions, and inductive-load transients.

REVISION HISTORY

Revision	Description of Changes	Date
0	Initial document release.	9/29/2026

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