Title: **Current Sharing for Better Systems Performance and Fault Tolerance**

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Power architects often employ multiple power supplies or power converters to increase output power or to provide fault tolerance. The need for increased power is usually satisfied by paralleling two or more converters. Fault tolerant systems also use power supplies in parallel, but in addition may use Or'ing diodes to isolate modules in the event of an output fault.

Current sharing is required to parallel supplies for increasing power. Although current sharing is generally not required for 2N redundant supplies it does provide better systems performance. Current sharing is required, however, for N+1 redundancy. An important issue involving the management of multiple power supplies or power converters is current sharing and how best to accomplish it.

Current sharing brings a number of benefits to parallel arrays. Current sharing improves transient response because the load step is shared 1/N by each of N converters. Each supply ages the same amount if equal current sharing is implemented, and thermals are usually less demanding on systems where multiple supplies are used. Modular converters are often employed in redundant applications and in parallel to increase power, such as in scalable power systems, where they can be economically expanded and may provide hot-swap capability.

Current sharing can be implemented in a number of different ways; each has advantages and disadvantages.

Driver/booster arrays for the expansion of power usually contain one intelligent module or driver, and one or more power-train-only modules or boosters. The driver is used to set and control output voltage, while booster modules are used to increase output power to meet system requirements. The advantages are that the array has only a single control loop, and it provides excellent transient response because there are no loop-within-a-loop stability issues. An advantage of driver-booster arrays is that load sharing is very accurate even during dynamic load conditions. Driver-booster arrays where only one driver is used do not support redundant operation.

The "droop share" approach to current sharing employs a resistance in series with the load or an active circuit which allows the output voltage to drop in response to increasing load. The droop share circuit has the advantages of simplicity and low cost. It is limited in application because it usually requires manual adjustment of the output voltage to achieve current sharing. Also, output voltage regulation is degraded in droop share circuits due to the series resistance.

DC-coupled single-wire paralleling involves two or more identical modules, each containing a circuit which monitors the current being delivered by each supply. This circuit actively adjusts the output voltage of each supply so that the current being delivered by each one is equal. They have, however, a number of disadvantages. Multiple control loops can cause stability problems, and they provide poor transient response when a module fails. They are also susceptible to single-point failures that can defeat current sharing and, at worst, cause a chain of failures to occur.

A new fault-immune power architecture (Figure 1) is available that uses a digital current-sharing signal. Since it is an AC signal, it can be DC blocked, eliminating offsets in the system. Such modules give designers the ability to achieve high levels of availability and reliability. Additional advantages include excellent transient response, a high degree of immunity from system noise, and no loop-within-a-loop control problems.

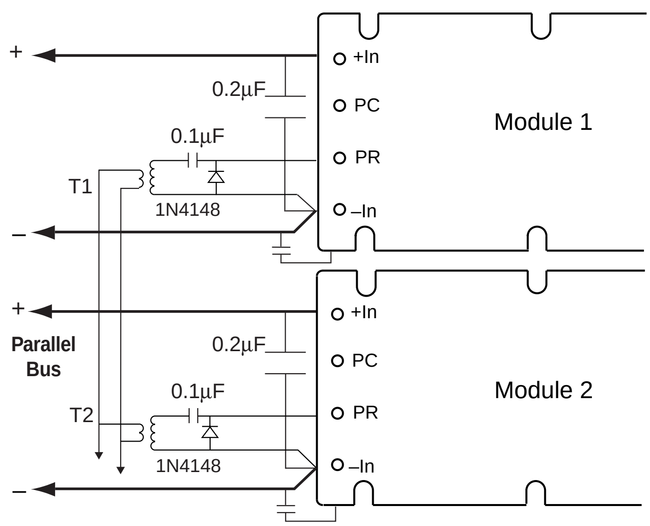

Figure 1. New power architecture, shown using a transformer-coupled interface, provides load sharing, SELV isolation from the primary source, and a high degree of immunity from system noise.