POWERING DYNAMIC LOADS

Vicor DC-DC converters provide a well regulated output voltage when operating under conditions for which they are specified. If your application includes occasional demands outside of normal operating conditions, be sure to plan for these exceptions.

Below are discussions of Vicor converters' current limiting safety feature and design strategies that will allow your power system to maintain stable output voltages and sufficient available power levels in applications with widely and/or rapidly fluctuating loads.

Current Limiting

Vicor DC-DC converters have a current limiting safety feature which causes the output voltage and available power to drop sharply as soon as the load demands power greater than the rating of the converter.

Two forms of current limiting are used: straight-line and straight-line/foldback (standard in VI-200 series converters only with ≤5 volt outputs).

With **straight-line current limiting** (see Figure 1), when the output current reaches the current limit setpoint, the output voltage and available power drop in a straight line to zero. Straight-line current limiting prevents latchup due to turn-on delay or temporary overload when converters are configured for bipolar operation or connected in series.

Vicor's **foldback current limiting** is a combination of straight-line and foldback (see Figure 2). When the current limit is reached, the output voltage and power drop in a straight line to approximately 2.0 volts, below which the current will decrease. The foldback feature minimizes the power consumed by an external short. However, even with foldback current limiting, a 5 volt, 300 watt supply could source a minimum of 60 amps into a short circuit—sufficient to cause significant damage. To avoid this, the designer might consider a distributed power architecture approach—a small supply on each PC card limits fault currents and their potential damage.

For VI-200 series, where ≤5 volt output converters are to be configured for bipolar operation or connected

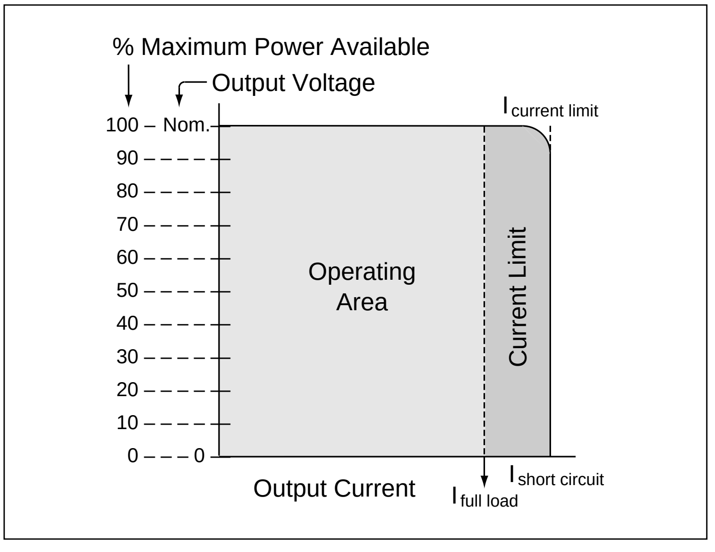

Figure 1—*Straight-line current limit*

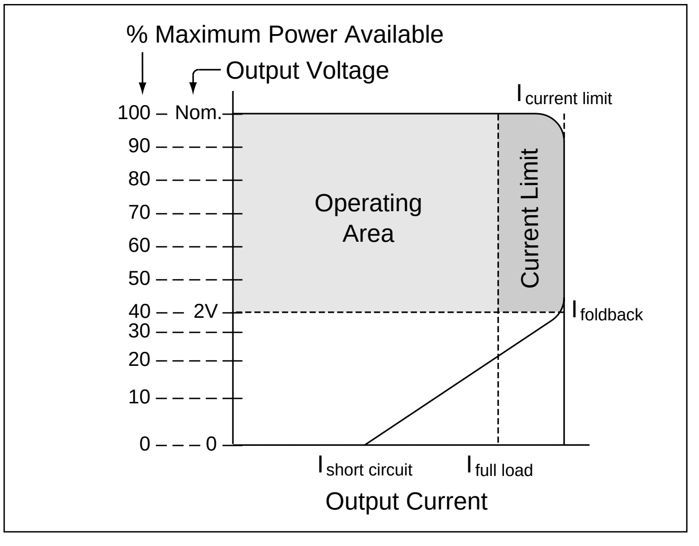

Figure 2—*Foldback current limit*

in series, straightline current limiting may be requested in place of foldback.

High Inertia Loads

When equipment such as disc drives, fans, and motion control systems are turned on, the current drawn to get these devices moving increases briefly but significantly. If this current exceeds the converter's current limit setpoint, available power will drop, increasing the time it takes to accelerate the load or possibly preventing startup. Systems that require minimum acceleration time or frequently drive the converter beyond its rated power should use a converter sized to meet peak power requirements. In systems where a single power supply drives multiple loads, the loads may be turned on sequentially to minimize the peak power required.

In motion control systems that must also decelerate a mass, or in applications where the load current has a high crest factor, a zener or other energy absorbing device should be added across the output of the supply, since most power converters are not designed to sink current.

Constant Power Loads

Devices such as DC-DC converters, and to some degree tungsten lamps and PTC thermistors, exhibit a certain amount of negative impedance. As the input voltage drops, the current drawn by the load increases. To avoid exceeding a converter's current limit, be sure to determine the maximum current to be drawn and size the converter so that it will source this current at the minimum operating voltage of the load.

High di/dt Loads

DC-DC converters have a finite response time to changes in load. Consequently, the output voltage will not remain constant if the output is subjected to loads with di/dt that exceeds the converter's response time. To decrease the voltage deviation, external capacitance can be added at the expense of increased recovery time. The addition of a preload on the output will also help to minimize output voltage deviation specifically if the application is operating from a “no load” state.

Currents demanded by high speed digital logic, such as bus terminators and RF/microwave transmitters, can easily exceed 100A/µs. Current demands of this magnitude require a low ESR surface-mount tantalum capacitor placed close to the load to deliver the peak current and a specially compensated high speed DC-DC converter, such as a Vicor TachoMod, to deliver the average current.

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Consult Vicor's application engineering department for dynamic load applications where significant external capacitance is required.

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