Assemblies of Hybrids

Board Mounted Converters Vs. Assembly of Hybrids

Before the availability of miniature modules made distributed power architectures popular, multi-output power supplies were usually concentrated in centralized power supply boxes. The power supply contained one or more inverter stages. Regulated sub-outputs were either PWM derived, obtained from magnetic amplifiers or linear regulator post regulators.

Hybrid DC-DC Converters are often associated with distributed power concepts. Distributed power is a system where local converter/regulators are used instead of a centralized power supply. In the distributed system, bus voltage is fed to individual subassemblies. The hybrid DC-DC Converter modules are packaged within the subassemblies, and created the regulated and filtered voltages needed by the subassemblies locally. Many hybrid DC-DC Converters are used in applications such as this.

However, the centralized power supply assembly has not been eliminated by the availability of modules, but is instead often constructed out of assemblies of hybrids. Centralized power supplies are often contained on plug in assembles such as VME racks and SEM modules. The centralized box approach still offers advantages in many applications. In some cases, the power supply needs to be physically or electrically isolated from the load because the load is sensitive to electrical noise, the heat generated by the power supply or some other aspect. A centralized assembly also provides the user with an LRU (Line Replaceable Unit) format with heatsinking and connectors.

Now that a wide range of hybrid DC-DC Converters are readily available, many users are constructing their own centralized power supplies and assemblies using modules. can deliver, is needed, an assembly of hybrids offers fewer advantages.

When are Assemblies of Hybrids Better than a Custom Power Supply?

A number of considerations lead the choice to use an assembly of hybrids instead of a full custom power supply. First consider the total number of outputs and the power level of each output. Assemblies of hybrids are more suited for higher number of outputs with each output at relatively low power. When only one output, or a small number of outputs, at a power level considerably higher than single hybrid DC-DC Converters can deliver, is needed, an assembly of hybrids offers fewer advantages.

Second, consider the quantity of units to be produced to weigh the development cost and availability of development talent versus the production cost. An assembly of hybrids tends to have a higher unit cost than a non-modular power supply. However, an assembly of hybrids will require far less design time than required to develop a non-modular power supply. With the building block approach of using multiple hybrids, the majority of the development work has been done, and is embodied within the hybrids. For lower quantity applications, an assembly of hybrids can be very cost effective.

In addition, assemblies of hybrids offer the benefit of previously developed documentation because of the building block approach. MDI can provide interface, source and specification control drawings for its hybrid DC-DC Converters. Many MDI hybrid DC-DC Converters have a full set of detailed analyses available.

Multiple output power supplies built with single inverters and post regulated outputs often suffer from cross regulation effects. These effects are exacerbated by dynamic conditions. Better isolation between outputs is provided by assemblies of hybrids, due to individual regulating loops.

In comparing between a power supply with a single inverter and an assembly of hybrids, the former has a lower parts count. However, the assembly of hybrids can still offer smaller size and weight due to elimination of intermediate packages and higher frequency operation. Also, assemblies of hybrids are generally more robust than multi-output power supplies built with a single inverter. This is because the physically smaller elements of the hybrid DC-DC Converter have a higher shock and vibration resistance than the larger, discrete elements.

Additional Functions

Assemblies of hybrids provide additional functions beyond just packaging hybrids in a housing. These functions include the following:

Bus Switching:

Power supplies are often powered from redundant power buses. Relays of solid state switches are needed to select the desired power bus. If relays are used, the voltage rise time presented to the DC-DC Converters will be very high. In this event, some form of

inrush current limiting will be needed to avoid loading down the power bus and to avoid damage to the relays.

Inrush Current Limiting:

When powered by a voltage source having a fast rise time, large current spikes can flow to charge up the input capacitance within the hybrid DC-DC Converter. Active circuitry can efficiently slow the rise time of the input voltage, minimizing input inrush currents.

Fuses/Circuit Breakers:

Fuses or circuit breakers (either mechanical or solid state) are often needed on the input power lines to prevent failures from propagating to the power bus.

Reverse Polarity Protection:

This function is often desired to prevent damage to the assembly during evaluation and test. Protection against damage caused by reverse polarity is normally never needed for the actual application with the exception of vehicles.

Input Hold Up:

The assembly can provide energy storage which allows power to be delivered for a certain time even if input power sags or is interrupted. This function often requires reverse polarity protection to prevent the stored energy from feeding the interrupted power line.

Additional Input Filtering:

When using several converters in an assembly, the input EMI emissions can add algebraically if they are synchronized. Therefore, in an assembly of multiple hybrid DC-DC Converters, it is often desirable to add supplemental input filtering to ensure that the overall assembly meets its EMI specifications. Care must be taken not to add too much impedance, since added impedance preceding a switching regulator may cause "Middlebrook" criteria type oscillation.

Additional Output Filtering:

When ultra low output ripple is desired, additional filtering between the converters and the load can be added in an assembly. The desired frequency spectrum of the output determines the type of filter used.