Parallel Operation of Switchmode Power Supplies

In many applications it is desirable to connect multiple DC power supplies in parallel. This may be done to increase the total current available or for redundancy.

When increased current is the goal, the ideal situation is to have the total load current split evenly among the supplies in parallel. For example, if 4 supplies are used to deliver 20A it is best to have each supply loaded to 5A. Evenly splitting the load current means each supply will be operating properly. If a supply is required to go from no load to full load instantaneously (which is the case when a supply delivering almost all of the load current fails), it may go into current limiting. Proper load sharing also means the operating life will be maximized (the MTBF is longer at 80% of full load than at 100%).

Proper load sharing can only be accomplished when the output voltage of the supplies are at the same level at the point where they are commoned. This means that voltage drop in the wiring must also be taken into account. For example, if the terminals of one supply are used as the common point (i.e. two supplies are connected in parallel by daisy-chaining the output terminals and the load is connected directly to the terminals of one supply), then the voltage drop in the wires between the two supplies may affect the load sharing. An imbalance of as little as 50-75mV can lead to the supply with the highest output voltage delivering virtually all of the load current. If the output current rating is not sufficient for such a load current, the power supply will shutdown because of over-current or over-temperature. Maintaining a zero imbalance condition is very difficult - temperature fluctuation, component tolerances, and power supply location (i.e. wire lengths) are some of the factors that can influence the output voltage.

Redundancy presents similar conditions. In this situation the output voltage imbalance is not critical because the failure of one supply does not create an overcurrent condition for the remaining supply (or supplies). However, if there is an imbalance, the remaining supply may go from no (or minimal) load to full load instantaneously and as discussed above, the supply may be shutdown by the overcurrent protection circuitry.

Often in applications involving parallel power supplies diodes are used to prevent a supply with a low output voltage from drawing current from a supply with a higher output voltage. This approach does not improve the load sharing situation and also introduces a voltage drop as well as additional heat dissipation. For example, a typical diode with a 0.7V drop used with a 10A power supply would have to be rated for 7W of power dissipation. This means a heat sink is required and the heat dissipation may affect other devices in the control circuitry. Schottky diodes offer a lower voltage drop and thus less heat dissipation, but still do not eliminate the problems.

To overcome these problems it is best if the power supplies connected in parallel can adjust their outputs to maintain zero current imbalance. This feature must be designed into the power supply. All the supplies are linked together so that a change in output current in one supply is compensated for by the other supplies. The result is the total load current is evenly split among the supplies.

Weidmuller's new connectPower 300W supply offers this feature. By simply wiring the "Load Share" terminals together the total load current is evenly split among as many as 5 power supplies. No external diodes are required and it is not necessary to adjust each supply to the same output voltage - this is done automatically.