Paralleling Power Supplies [1]

Q: My EuroSynth system needs more power, can I just add an extra power supply and wire it in parallel to my existing supply?

A: Well the simple answer is no.

Why? Because the majority of power supply designs in use in EuroSynth systems are not designed to work in parallel.

Wiring two or more power supplies in parallel won't work, as each supply, having its own output voltage regulation, will be trying not only to maintain regulation of its output voltage versus changes in the load, but also attempting to regulate against the closed loops of the other supplies.

For supplies which include their own traditional internal error amplifier and reference, just placing multiple supplies in parallel is not an effective way to make a high power array.

Parametric differences from supply to supply will always cause one supply — the one with the highest output-referred reference voltage — to carry all of the load current, while all of the remaining supplies will carry no load.

In this case, as the load exceeds the capability of this 'lead' supply, it may enter a constant-current limit mode (which may or may not be a rated mode of operation), or it may interpret the overload as a fault and shut down. Depending on the supply in question, these responses could lead to overstress, especially if they occur as part of regular operation in the application.

Further, for cases where the supply shuts down due to an overload, the supply in the array with the next-highest reference voltage will be forced to carry the entire load, and will similarly shut down. This will quickly lead to collapse of the entire supply rail.

There are methods that can be employed to allow parallel power supply operation but in practise these are not viable for varying reasons.

One approach adds small ballast resistors in series with each supply's output, to equalise the distribution of the load current among the supplies in the array even when their control loops are seeking dissimilar output voltages, as shown in Figure 1. The ballast resistors create some loss of load regulation, depending on the spread of setpoint errors that the ballasting intends to overcome. However, these ballast resistors also dissipate heat, which degrades system efficiency.

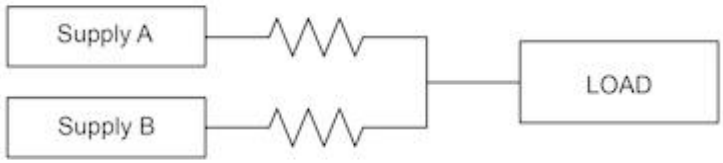

Figure 1.

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Another simple solution to this direct-connect dilemma is to just use a diode between each supply and the common tie point of all supplies, a technique commonly referred to as diode-ORing as shown in Figure 2.

ORing diodes are very effective at preventing a supply from sinking current away from the shared output, but are generally insufficient to address sharing errors among supplies with independent error amplifiers, because the conduction knee is abrupt enough that parametric differences in the supplies' setpoints will still lead to significant sharing imbalances.

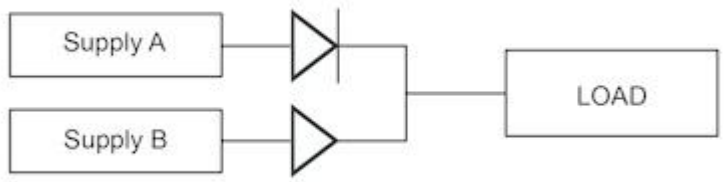

Figure 2.

Another issue with diode-ORing is the need to be able to adjust the power supply outputs to compensate for voltage drops across the diodes. This may be viable with power supplies inside the EuroSynth that may offer an adjustment feature but is not an option with external supplies which come with a fixed output voltage. Not being able to adjust the power supply output will result in power rails within the system that are generally 'out of specification'.

Both of these solutions require additional componentry to be added to a system and that is generally not a practical option.

[1] From an article by Vicor Corporation published in Electronics Online March 2016.