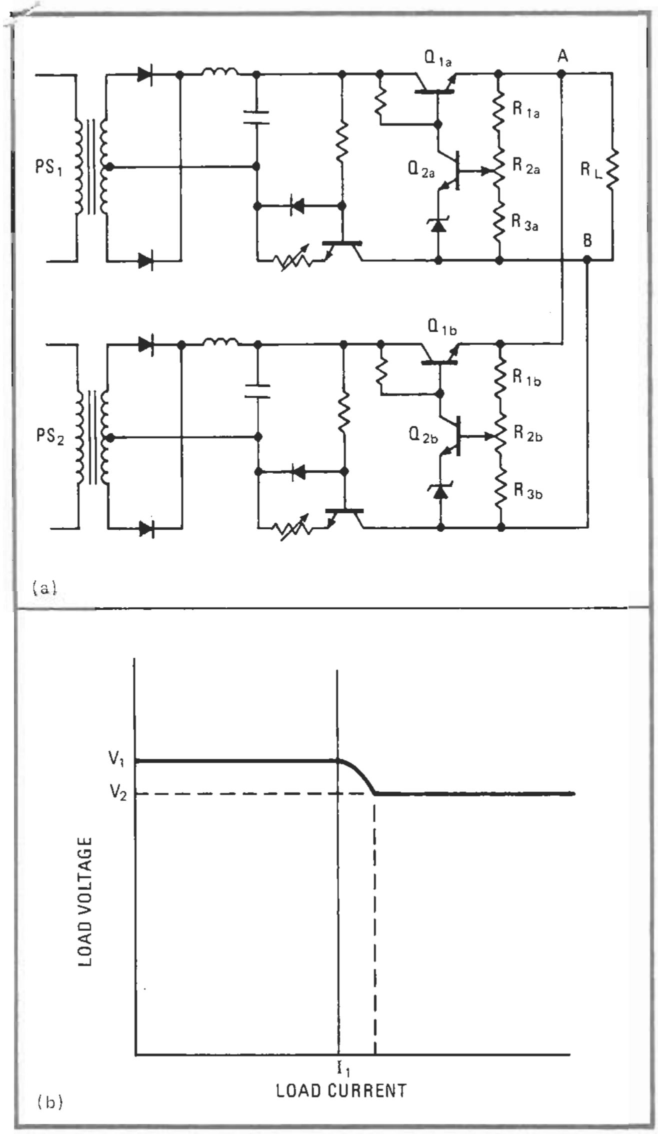
It's easy to connect dc supplies in parallel

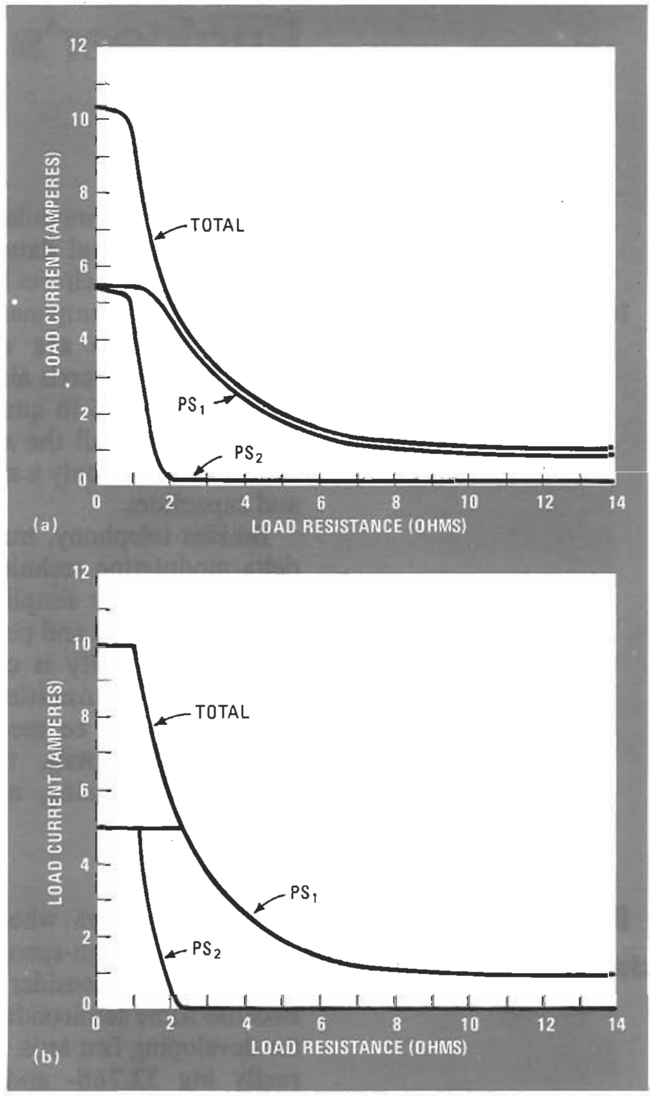
by Shri D. Bhanumurty
Defense Electronics Research Laboratory, Hyderabad, India

Connecting the outputs of two direct-current power supplies in parallel is not as complicated as one might think. Moreover, the supplies may even have different voltage or current capabilities.

The only criterion for parallel operation is that both sources be current-limited. Any such circuit can provide load currents up to the set limits of one supply. The second unit supplies any needed additional current at its rated output voltage, once it determines that the limits of



1. Current takeover. Parallel connection of dc supplies for shared current duties is permissible if both have current-limiting networks (a). Current to load is supplied solely by PS_1 until limit I_1 is reached. Then PS_2 supplies additional current needed at voltage V_2(b).



2. Supply characteristic. If two 10-volt, 5-ampere supplies with 0.1% regulation are connected and placed in operation, the curve in (a) results. PS_2 begins heavy turn-on as PS_1 approaches 5 V. Curves of ideal power supplies connected in parallel (b) show that PS_2 turns on at precise moment the current limit of PS_1 has been reached.

the first source have been reached.

The outputs of two power sources PS_1 and PS_2 are connected as shown in Fig. 1a. They are set at voltages V_1 and V_2 and current limits I_1 and I_2, respectively, where V_1 is slightly greater than V_2 at all times.

Under no-load conditions and until the set current limits of PS_1 are reached, the load voltage will be V_1. This is easily explained. Suppose that because of a power-line voltage increase V_2 temporarily increases. The increase in output voltage will be detected by the current-sensing resistors R_{1b} through R_{3b}. Transistor Q_{2b} will be biased more heavily into the conducting region and will bias Q_{1b} into the back-biased region. Thus, a greater voltage drop will appear across Q_{1b} than before. The output voltage will drop slightly, but will still be above V_2, at $V_2 + \delta$. This δ voltage is the result of compensation for the increase in input voltage at PS_2; however, PS_2 will supply very little current to the load.

As long as the current drawn by the load does not exceed I_1, the voltage across the load will be V_1, and PS_1 will supply all the current. If the current demanded by the load should exceed I_1, the voltage will drop to V_2. R_{1b} through R_{3b} will detect this drop, back-biasing Q_{2b} and forward-biasing Q_{1b}. Thus PS_2 will contribute the additional current demanded by the load (Fig. 1b).

When two dc supplies conduct in parallel, the result is a system characteristic of the kind shown in Fig. 2a, which is a plot of load resistance to load current. Both supplies can deliver 10 volts at 5 amperes, and each has a regulation of 0.1%. PS_1 is set at 10 v, PS_2 to 9.99 v.

Compare Fig. 2a and Fig. 2b, where a plot of load resistance to load current has been made for two ideal supplies. As one may deduce from these plots, a nonideal PS_2 will begin to contribute current to the load before the PS_1 limits have been reached. □

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