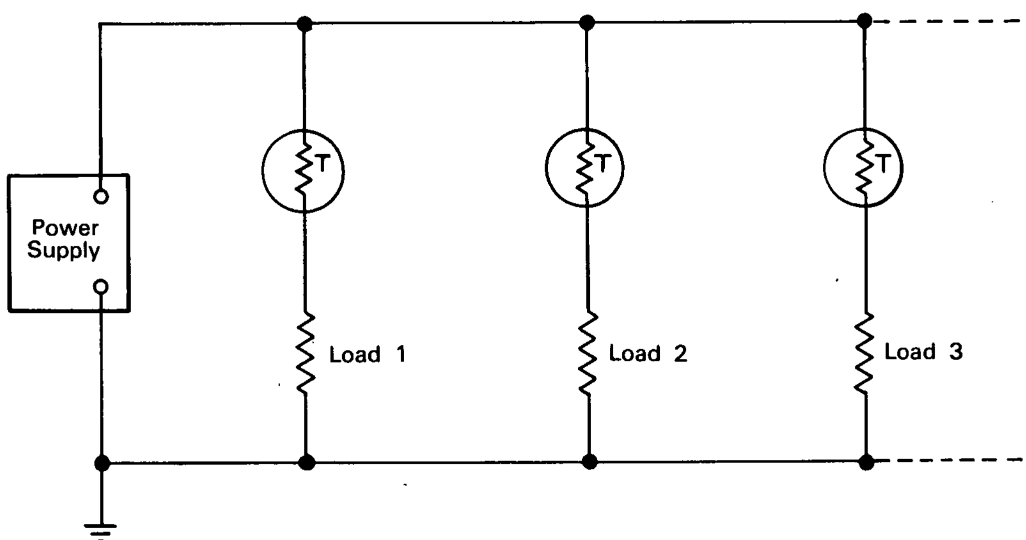
November 1964 Brief 64-10281

NASA TECH BRIEF

This NASA Tech Brief is issued by the Technology Utilization Division to acquaint industry with the technical content of an innovation derived from the space program.

PTC Thermistor Protects Multiloaded Power Supplies



The problem: Prevention of power loss in parallel branches of a multiload circuit, should an overload occur in one of the branches. The protective device must be self-resetting, capable of handling short-duration transients, and must withstand shock and vibration.

The solution: A properly selected PTC (positive-temperature-coefficient) thermistor placed in series with each branch load. The thermistor should be selected so that (1) its nominal resistance is negligible compared to the branch load, (2) its response time is long enough to endure switching transients, and (3) its critical (Curie) temperature is well above the ambient temperature range in which the equipment operates.

How it's done: At temperatures below the critical temperature (typically about 120° C), the nominal resistance of a PTC thermistor is relatively low. In this temperature range, the thermistor's rise of resistance with temperature is very small. Above the critical temperature, however, the temperature coefficient of resistance of a PTC transistor may be as much as +10% per °C and under conditions of overload its resistance can increase to as much as fifty times the nominal value.

An overload condition in any branch will cause excessive current to flow through the thermistor in that branch, and the corresponding I^2R increase will raise the temperature of the thermistor. The temperature rise is a function of the nominal resistance of the thermistor, its dissipation constant, and the overload current. The time required to reach the critical temperature is a function of the thermistor material. The increase in resistance accompanying the temperature rise decreases the current flowing through the branch load to an equilibrium value which will be maintained

(continued overleaf)

as long as the overload persists. When the overload is corrected, the reduction in current will cause the PTC thermistor to revert to its nominal resistance.

Notes:

1. The PTC thermistor can be used in any circuit requiring current limiting or intended overload resetting. PTC thermistors with appropriate characteristics may also be used as fuses to open branch circuits when overloads exceed prescribed values.
2. To minimize the effects of ambient temperature on the thermistor, vacuum encapsulation is suggested.
3. Individual applications will determine the necessary thermistor parameters. These devices are available with the following characteristics: (1) nominal resistance values from approximately 1 ohm to 10,000 ohms; (2) resistance change at the critical temperature from about 2.5 to 5 times nominal resistance; (3) response time from less than a second to 100 seconds; and (4) power dissipation from a few milliwatts to 2 watts.
4. Inquiries concerning this innovation may be directed to:

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   Reference: B64-10281

Patent status: NASA encourages commercial use of this innovation. No patent action is contemplated.

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