Circuit Isolation and Protection

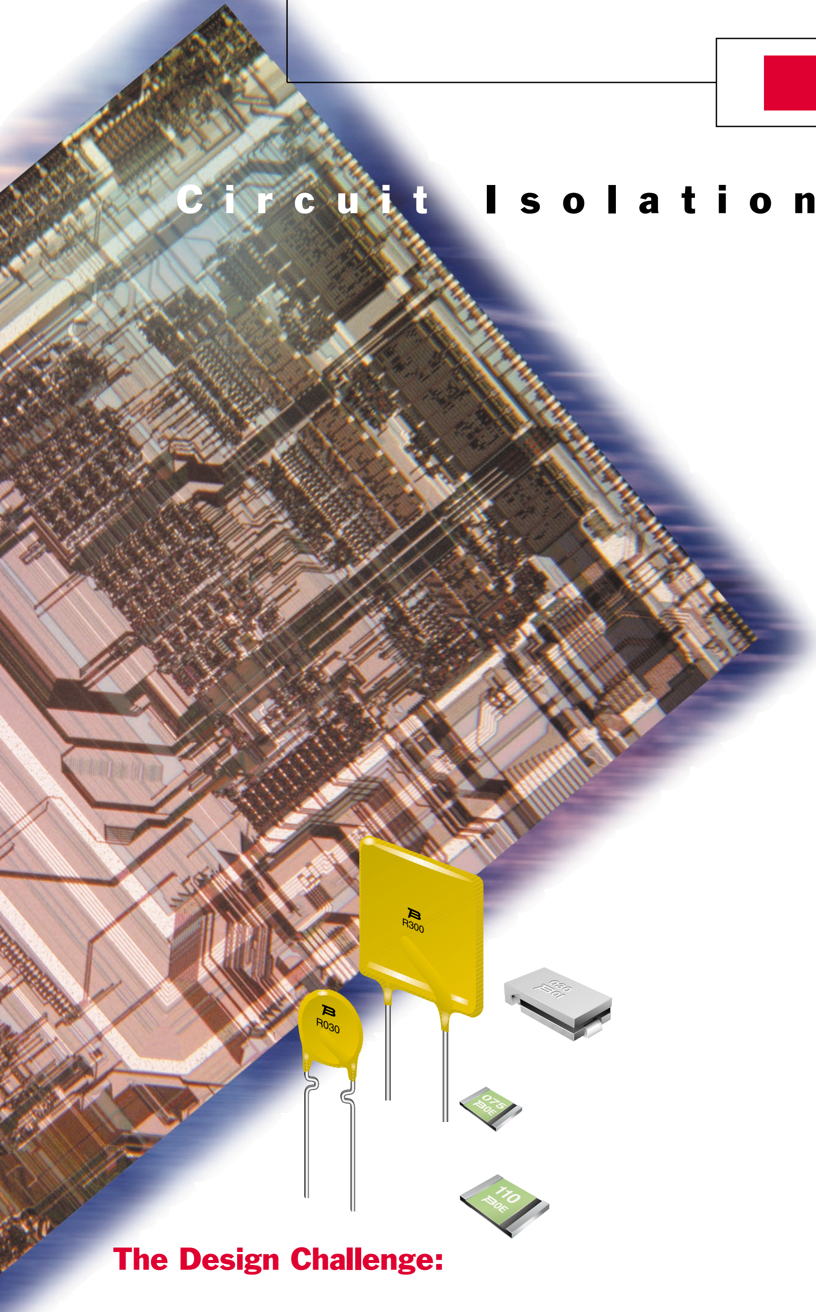

Figure 1

$$R(T) = R_1 + R_2$$

(Calculation 1)

Resistances in parallel are added using the parallel resistance formula $Rt = 1/((1/R_1)+(1/R_2))$ where Rt is the total resistance of the two resistors in parallel. R_1 and R_2 (see Figure 2) are the values of the resistors in the parallel circuit.

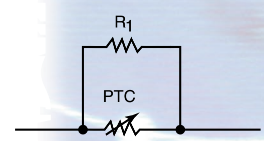

Figure 2

$$R(T)= 1/((1/R_1) + 1/(R_2))$$

(Calculation 2)

A MULTIFUSE PPTC device is chosen depending on the value of each branch resistance and the voltage applied. (See Calculation 3 and Figure 3.) With the known voltage of the power supply and the calculated value of the branch circuit, we can determine the current of the branch. For the branch at node one, the calculated resistance is 8 ohms. We then determine the current using the voltage of 24 volts and Ohm's law. The current is 3 amps, so we choose the MF-R300. In the same way, the value of current at node 2 is determined to be 2 amps, so the MF-R200 is chosen.

If the overall resistance is calculated (see Calculation 2), the current can be solved by using Ohm's law. The overall current calculation should equal the sum of the current at node 1 (I1) and node 2 (I2) where I(T) = I1 + I2.

The Design Challenge:

How to separate a part of a circuit from the power source while maintaining the integrity of the remaining circuit in a working status. In instances where a part of a system could be damaged and the remaining section will need to continue to operate, the following circuit design is an option.

The Application:

A series of circuits are attached to the secondary side of the transformer or single bus bar from the power supply. The total resistance of each circuit branch is calculated using the algebraic form of Ohm's law. (Voltage = Resistance X Current.) Typically, the inductance and capacitance are negligible when compared to the overall impedance of the device. In series, the resistance is added directly (see Figure 1.)

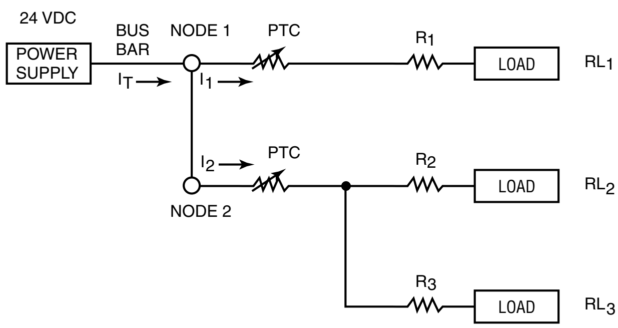

Figure 3

R(T1) @node 1 = R1 + RL1 = 8 ohms

R(T2) @node 2 = 1/((1/(R2 + RL2)) + (1/(R3 + RL3)) = 12 ohms

V = IR
V = I1 (R1 + RL1) = I1 8 ohms V = 24 Vdc
24Vdc/8 ohms = 3 Amps = I1 @ node 1

V = IR
V = I2 R(T2) = I2 12 ohms V= 24 Vdc
24Vdc/12 ohms = 2 Amps = I2 @ node 2

The Ihold for the PPTC device R1 at Node 1 will be 3 amps, so an MF-R300 will be chosen

The Ihold for the PPTC device R2 at Node 2 will be 2 amps, so an MF-R200 will be chosen.

I(T) for the circuit will be I1 + I2 = 5 amps. So the Imax over current rating of the PPTC is not violated.

(Calculation 3)

If there is a short circuit at load RL2, the current, which is the same current through the MF-R200 at node 2 (R2), will rise. As this occurs, the I2R will also rise. As the I2R rises, the resistance of the PPTC will rise exponentially. According to Ohm's law, as the resistance rises, the current will drop sharply. This will not affect the circuit at node 1. The current will be blocked from node 2 until the fault condition is removed and the PPTC is reset through thermal radiant dissipation. The entire resistance of node 2 becomes exponentially high, causing I2 to go towards 0 amps. Thus the total current I(T) = I1.