Circuit Protecting Warning Lights

The Design Challenge:

1. Determine a solution to signal (visually) an overcurrent fault condition while maintaining a working load.

2. Determine a solution to signal (visually, audibly, or both) an overcurrent fault condition while maintaining a working load.

3. Determine a solution to signal (visually, audibly, or both) an overcurrent fault condition while removing the load from the current path.

The Solution:

Multifuse® Polymer Positive Temperature Coefficients (PPTCs) are the perfect solution for this circuit protection challenge. MULTIFUSE PPTCs are made from a conductive plastic, formed into thin sheets with electrodes attached to either side. The conductive plastic is manufactured from a non-conductive semi-crystalline polymer and a highly conductive carbon black. The conductive carbon black filler material in the MULTIFUSE PPTC device is extruded into a polymer with a semi-crystalline structure. The semi-crystalline structure densely packs the carbon particles into its crystalline boundary so they are close enough together to allow current to follow through the polymer insulator via numerous carbon chains. During fault conditions, excessive current flows through the MULTIFUSE PPTC device. I^2R heating causes the conductive plastic material's temperature to rise. As this self-heating continues, the material's temperature continues to rise until it exceeds its phase transformation temperature. As the material passes through this phase transformation temperature, the densely packed semi-crystalline polymer matrix changes to an amorphous structure. This change is accompanied by a relatively small expansion. As the conductive particles move apart, the resistance of the device increases exponentially. The device will stay in this state until the over fault condition is reduced within normal parameters and the MULTIFUSE PPTC cools down, allowing the polymer to shrink back to its original size. This allows the conductive carbon molecular chains to rebond to one another and conduct current.

The Application:

1. In a situation where there is a need for an overvoltage signal with continued work of the load, a MULTIFUSE PPTC is used in series with the load. A circuit consisting of a PPTC, normally closed relay and a lamp such as SK3 or SG40 (similar to an 1156 automotive light bulb) in parallel is set in series with the load. (See Figure 1.) During normal operating parameters, the current will take the path of least resistance through the PPTC. On power up, the coil of the relay will energize and open the contacts, stopping all current flow to the alarm system. As the current rises and the I^2R increases, current will cease to flow through the PPTC and the relay coil. This will cause a state change in the normally closed contactors enabling the alarm system and allowing current to continue through the alarm circuit. In

return, this will allow current to continue to follow through the device, and the load operates in a fault condition.

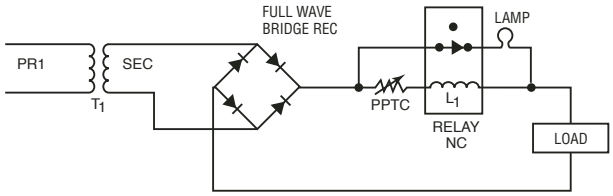

Figure 1

2. The addition of an audible signaling device is possible in this application as well. The voltage drop across the lamp and audible signal will decrease the amount of power to the load, making the circuit more robust. The light and signaling devices are placed in series. They are then placed in parallel with the PPTC and normally closed relay coil. This completed circuit is placed in series between the load and power supply. (See Figure 2.) Typically, a MULTIFUSE PPTC acts as a conductor, with little voltage drop compared to that of the lamp and signaling device. The signaling device can be a standard off-the-shelf buzzer or a horn and lamp in the above circuit.

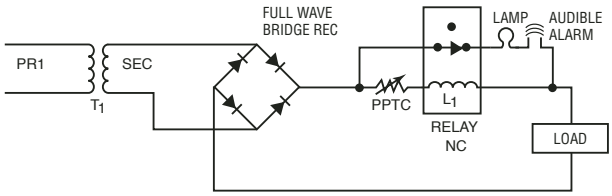

Figure 2

This circuit can also be used to control a 120VAC signaling system. (See Figure 3.) The coil of a two pole normally closed relay is placed between the PPTC and load. The normally closed contacts are placed in parallel with the relay coil and PPTC. When the circuit is initially powered, the inrush currents will energize the relay coil and open the contacts. This will isolate the warning circuit from the 120V power source. In the event an overcurrent or heating issue occurs, the PPTC will trip and the coil will be de-energized. This will cause the contactors to connect, enabling the alarm circuit. The load will continue to operate under a fault condition until maintenance personnel can determine the appropriate action.

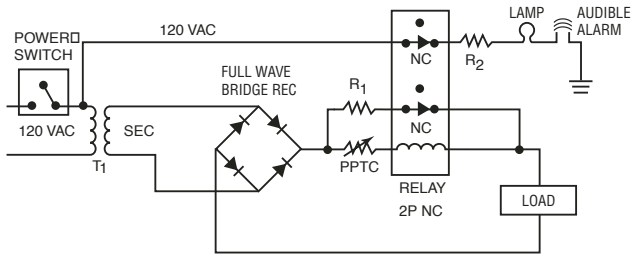

Figure 3

3. The third option for signaling is the use of the PPTC with a light and/or signaling device with the current switched from the load. This is accomplished by placing a normally open relay coil L_1 of the warning circuit in parallel with the load. A Multifuse PPTC is placed in series with the load between the load and the warning circuit relay coil L_1. (See Figure 4.) Another normally closed relay coil L_2 is placed in series between the PPTC and load. When the circuit is powered on, L_1 will energize and close the contacts in relay R_1. L_2 will energize and open the contacts of relay R_2. In the event of an over circuit situation, the PPTC will trip and block current to the load and coil L_2 will de-energize closing the normally closed contacts of R_2. Current will continue to flow through L_1 keeping the normally open contacts closed presenting a path for the 120V current flow to the warning system. In the event power is shut off at the transformer, coils L_1 and L_2 will de-energize causing the contacts of relay 1 to close and relay 2 to open isolating the warning circuit for a controlled shutdown of the system.

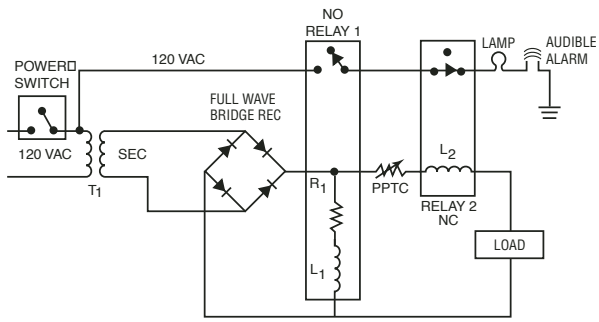

Figure 4

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