PolySwitch technology offers resettable protection strategy

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Motor drives and controls are subjected to some of the harshest operating environments, yet are depended upon for consistent, reliable operation. Field failures are inevitable so choosing the right circuit protection strategy is important to help ensure product reliability and to minimize service costs to manufacturers and customers. The PolySwitch Polymeric Positive Temperature Coefficient (PPTC) resettable circuit protection devices from Raychem Circuit Protection help protect motor drive and control systems from some common failures, resulting in a more robust and reliable product.

These PPTC devices are available in leaded, axial, chip, disc and surface-mount configurations. The small form factor of the PPTC helps conserve board space, while their resettable functionality allows for placement in inaccessible locations, in contrast to traditional fuses that require user-accessibility for replacement. Since PPTC devices are solid-state, they are also able to withstand mechanical shock and vibration, helping to provide reliable protection in a variety of applications.

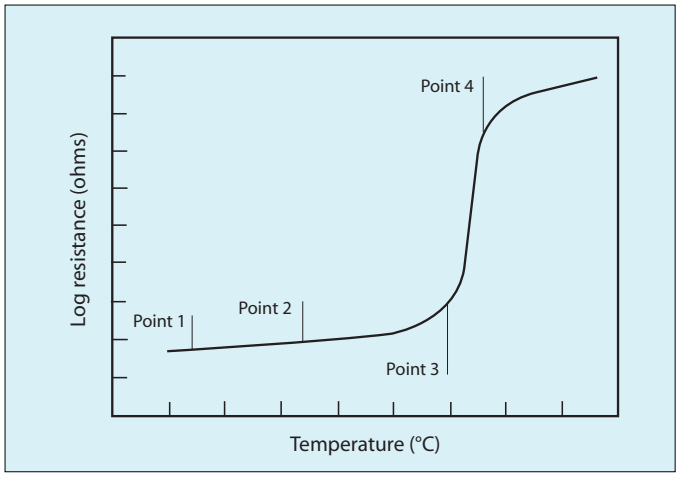

Fig. 1: Typical resistance versus temperature characteristic.

Principle of operation

PPTC devices are made from a conductive polymer blend of specially formulated plastics and conductive particles. At normal temperature, the conductive particles form low-resistance chains in the polymer. However, if the temperature rises above the device's switching temperature, the crystallites in the polymer melt and become amorphous. This increase in volume during the crystalline melting phase causes separation of the conductive particles and results in a non-linear increase in the resistance of the device. The heating can take place from external sources or can be generated internally by resistive heating from an overcurrent condition. The increased resistancdû educes the amount of current that can flow under the fault condition, helping to protect the equipment in the circuit. **Fig. 1** presents the typical resistance versus temperature characteristic of a PolySwitch device. Note that the resistance value changes by several orders of magnitude at the trip point of approximately 120°C.

Once the power is removed and the fault is cleared, the temperature of the PolySwitch device drops below its trip temperature, allowing it to reset to its low resistance state which enables the circuit to operate normally. The high resistance change and resettability characteristics of the PolySwitch devices enable them to help protect electronic circuits from failure due to both overtemperature and overcurrent faults.

Power supply protection

PolySwitch devices have long been used to help protect the DC outputs of power supplies from overload and short circuit failures. With the development of the LVR family, a PolySwitch device can now be used on the AC mains side of the power input, adding the AC Line transformer and other line side devices to the protection envelope of the PolySwitch device family of products. In addition, the AC Line transformer and other line side devices will help protect the power supply in cases where a neutral line is inadvertently disconnected or when an AC line voltage is applied to a 24Vac input.

LVR devices are suitable for power systems with maximum input currents of up to 400mA at either 120Vac or 240Vac.

I/O interface protection

Many drives and controllers have communications and data interfaces for information transfer between various system components. The wires used for these interfaces sometimes run adjacent to AC or DC power cables. These wiring bundles can be at risk to shorts due to normal wear, accidents, miswiring during installation, or unrelated work going on at a central panel. If a power cable is shorted to a communications line, a PolySwitch device will help prevent communications interface damage to any system connected to the shorted line. In some cases, a large number of systems could be affected.

Overtemperature protection

Since PolySwitch devices respond to temperature increases from external sources, as well as internal I^2R heating, these devices can be thermally connected to high power devices to help protect them from damage due to overheating. Thermal connection can be made by placing devices in contact with one another or by proximity.

The contact method is more appropriate for applications wherein the PolySwitch device can easily be placed in physical contact with the device it is intended to help protect. A good example is a transformer. A PolySwitch device can be taped to the outside windings or housing to create thermal contact. It is then designed into a circuit that notifies the controller if the transformer is overheating so that the system can be shut down.

The proximity method is appropriate for power semiconductor protection and is most effective when a small, surface-mount PolySwitch device shares a copper pad with the power device. This provides an inexpensive thermal link that allows the PolySwitch to trip as the temperature exceeds its trip point; thus indicating that the power device is overheating and should be shut down. In this application, there is some thermal delay so this solution would not be able to protect the power device from conditions where massive currents flow and the part fails in milliseconds. However, for most overload conditions, this configuration can be used to help protect the power device.

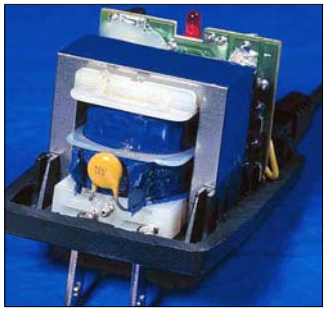

Fig. 2: Thermal connection can be made either by contact or proximity methods.

Stalled motor protection

Moving machinery is always subject to jams or breakages that could result in a stalled motor. Continuing to drive power into a stalled motor can

result in a damaged motor, a blown drive section, or both. Placing a PolySwitch device in series with the motor drive can help protect both the motor and the drive electronics from failure under stalled or excessive load conditions. When the fault is cleared (and power is removed), the system begins normal operation with no service or part replacement necessary.

PolySwitch devices are one of the most common methods of protecting seat, window and other electric motors in the auto industry. Applying a PolySwitch device in these applications requires consideration of the added series resistance and the device's maximum hold current rating. Maximum room temperature operating currents of 15A at 16V and 9A at 30V can be accommodated.

Additionally, the PolySwitch device allows the motor drive or controller system to remain operational when external faults result in overcurrent or overtemperature conditions. The benefit is a very robust and reliable product that helps to protect the system should other components fail. □