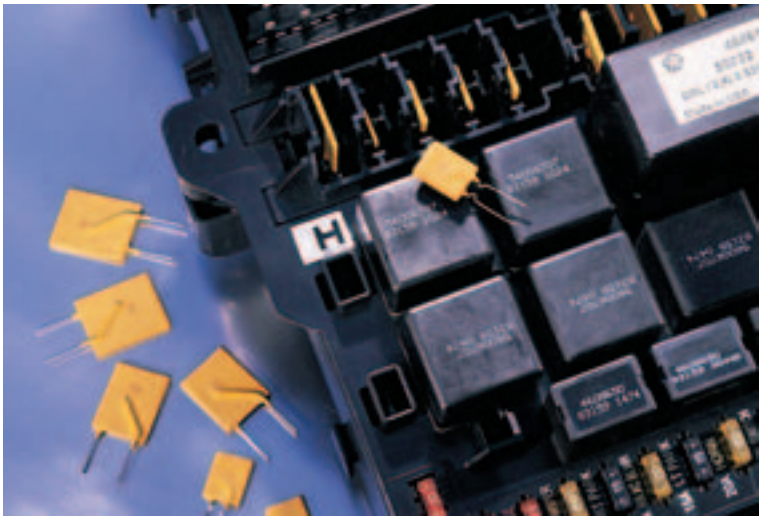
Automobile Harness Protection
Application Overview

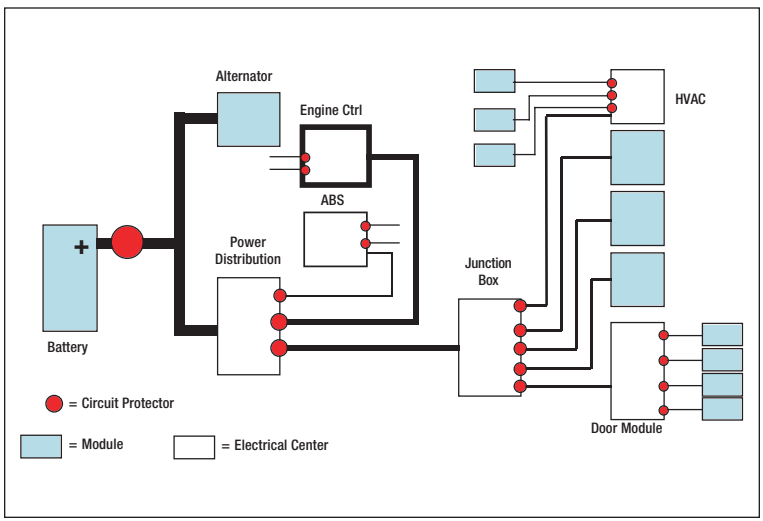
Problem/Solution

The wiring harness architecture of automobiles has been required to undergo considerable change as vehicle electrical and electronic content has increased over recent years, and continues to do so.

Ideally a vehicle harness has a hierarchal structure resembling that of a tree; main power trunks dividing into smaller and smaller branches with overcurrent protection at each node. This system results in the use of smaller wires—which save volume, weight and cost—and maximum system protection together with fault isolation—reducing warranty costs and increasing customer satisfaction.

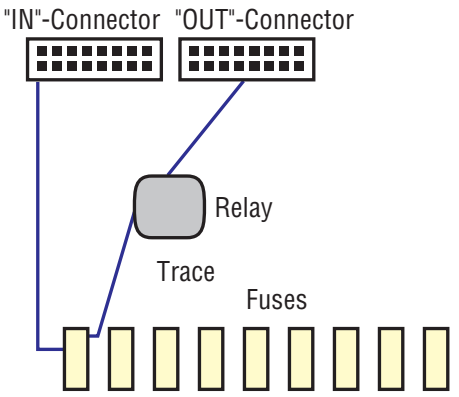
Figure 1 shows a greatly simplified version of such a scheme with each electrical center either feeding a module or yet another electrical center. Unfortunately the sheer number of circuits now employed has made the ideal system hard to realize in practice. With many tens of circuits emanating from an electrical center, it has become almost impossible to route all the wires in and out of a single box and at the same time locate it in a driver accessible position. System designers have resorted to: (i) combining loads, so sacrificing wire size optimization and fault isolation; (ii) literally burying electrical centers where they are only accessible at increased cost by trained service personnel; and (iii) routing back and forth between various functional systems, increasing wiring length, size and cost. For example, in practice, the HVAC system will pass power output protection and switching functions such as vent motors, blower fan and A/C clutch, to the junction box and power distribution center where its relays and fuses will be located.





Using resettable circuit protection that does not need to be driver accessible, such as PolySwitch PPTC devices, offers a number of solutions that may be used separately or in combination. For example, a single junction box located in the instrument panel may still be employed, but instead of being positioned close to the conventional fuses, the PPTCs

Figure 1. Conventional Current Routing



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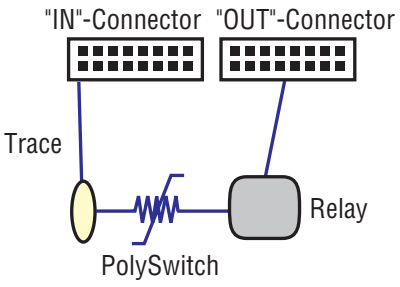
can be located inside the box—saving frontal area, and close to the connectors—reducing the volume consumed by whatever system is used to bus current around the box. See Figure 2.

Alternatively, the electrical centers can be divided into smaller units and relocated around the vehicle with no need to consider accessibility. Furthermore, with the availability of self resetting circuit protection and the very high reliability that can now be expected from relays, modules can switch and protect their own output loads and still be positioned without consideration for any user access.

In these ways, the use of PPTCs allows the electrical architecture to be designed to more closely reflect the ideal tree structure with its previously described benefits.

Through-hole devices lend themselves to use in boxes using circuit boards or IDC wired busses, while strap devices can be used in those that use metal fret routing. PPTCs are also available in much lower current ratings than conventional fuses and are therefore more appropriate for use in protecting command functions. If the electrical center or module has a printed circuit board then surface mounted PPTCs can offer further packaging benefits.

Figure 2. Current Routing using PPTCs



Typical Protection Requirements

Automotive wiring harnesses must be protected from damage and fire hazards in the event of a short-circuit in the vehicle wiring. Circuits typically require 0.10 to 30A of current at system voltages of 14V.

Technology Comparison

Fuses are one-use devices that must be replaced when they blow. This characteristic requires that fuses be mounted in accessible fuse boxes—a requirement that dictates system architecture and forces packaging and system layout compromises. PolySwitch resettable devices latch into a high-resistance state when a fault occurs. Once the fault and power are removed, the device automatically resets and is ready for normal operation.

Using PPTCs has the added advantage of making the overcurrent protection tamper-proof. Unlike fuses that have nominal current ratings from 2A to 30A in the same form-factor and which are often substituted for one larger than the design value or are jumped out of circuit, PPTCs cannot be readily accessed, changed or abused by the user.

Device Selection

Devices typically used for wiring protection applications include the AHR, AGR, AHS, and ASMD series of PolySwitch resettable devices.