

# SOLUTIONS TECH BRIEF

Technical solutions on circuit protection from Littelfuse, Inc.

## Littelfuse Diodes for Voltage Suppression

Littelfuse Diode assemblies are designed to clamp surge voltages caused by electromagnetic components and to perform uni-directional blocking of the flow of current in a circuit.

Littelfuse Diodes are available in ATO® and MINI® size packages in 1 to 1.5 amp ratings and from 50 to 1000 peak inverse voltage (PIV) ratings.

### The Danger of a Voltage Spike in a Network

A Diode is connected across the coils of relays or inductive loads to suppress an overvoltage condition, called a voltage surge or spike. The coil of any control relay for motor applications generates a voltage spike when it is turned off.

Due to the inductive nature of the load, when a relay is energized, the contacts close and a magnetic field builds up in the coil of the relay. When the relay is turned off, energy stored in that magnetic field has to dissipate. A voltage spike is one way the energy is

### Littelfuse Diode Advantages

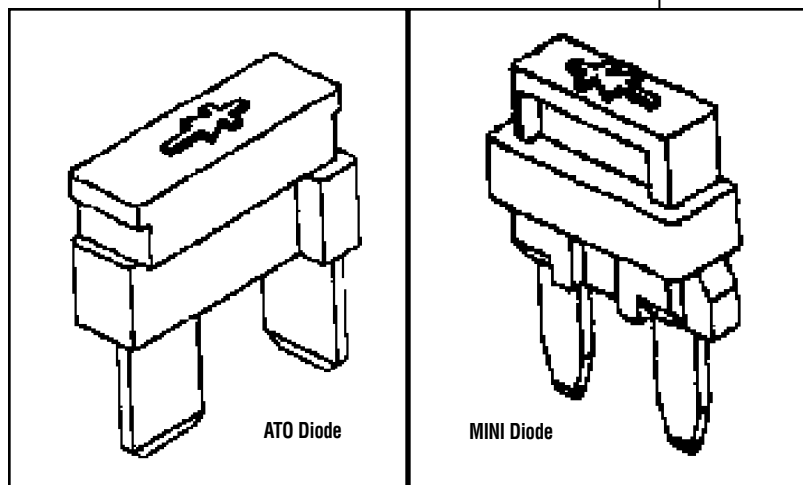
- Convenient Package
- Reliable Bladed Termination
- Polarized Termination
- Quick Fix
- Customizable
- Impact Resistant
- High Quality

dissipated. This only occurs when an inductive load is energized, not a resistive load.

If a voltage spike reaches the battery, it can travel through the entire electrical system of the vehicle, damaging sensitive solid state electronics. Computer chips are very voltage sensitive, because overvoltage can cause a microscopic spark between the contacts which damages the interior construction of the chip and makes it no longer usable. An example of an application in a vehicle that requires protection from voltage spikes is the Generic Electronics Module (GEM) which controls automatic headlights, open-door chimes and windshield wiper circuits.

### Applications for Diodes

Littelfuse Diodes can be used in a variety of applications requiring voltage suppression. Diodes are becoming increasingly popular, and are currently designed in by major North American automotive original equipment manufacturers.



## Applications *continued*

The Diode is strategically placed in the circuit to block a voltage spike. Here are a few examples of inductive loads that cause these voltage spikes:

- Air conditioning fan motors
- Power window motors
- Clutch coils
- Starter motors

In addition, if a car is jump-started with the cables connected incorrectly, it can cause a voltage spike. In these cases, a Diode will protect the vehicle's electronics from being damaged by overvoltage.

A Diode can also be used for redirecting current, often in a "Quick Fix" situation where a creative solution is needed without major design changes. In these cases, the Diode is strategically placed at a junction in the circuit to direct the current in a certain direction.

## The Difference Between Diodes and Fuses

Although Littelfuse produces ATO and MINI Fuses in the same sizes as the Littelfuse Diodes, the products are quite different. A fuse is designed to open, to protect a circuit from an overcurrent condition. A Diode is not designed to open. It protects applications connected to the circuit from damage due to overvoltage conditions or redirects the current.

## The Function of a Diode

A Diode is a bipolar semiconductor, made of silicon, also called a die. Since the Diode is unidirectional, it can be placed in the circuit before the relay that will cause the voltage spike. When the spike is produced it will travel in the opposite direction of the current and pass into the Diode. The Diode only allows current to pass through in the other direction, so it stops the current from carrying the voltage to the battery and the rest of the vehicle electrical system.

## The Advantages of Littelfuse Diodes

The advantages of the Littelfuse Diode assemblies are due to the unique way the Diode is packaged. Traditionally, Diodes had to be spliced into one of the leads of the wiring harness or soldered to a circuit board, a time-consuming task that is very costly when automated on a production line.

Littelfuse Diode assemblies, however, can be easily added to any circuit through the fuse block. With the same bladed termination design of Littelfuse automotive fuses, the Diodes are simply plugged right into the fuse block next to the fuses. And as well as providing convenience, the bladed terminations are also a very reliable method of termination.

To ensure proper use, Littelfuse Diodes feature polarized termination so they cannot be plugged in the wrong way. The terminals are perpendicular and therefore can only be plugged in one way. This protective feature is important because the Diode would not operate properly if inserted incorrectly, leaving the electronic devices unprotected.

The innovative Diode package enables use as a "Quick Fix" when auto manufacturers need to add surge protection late in the design phase or after the vehicle is manufactured. Because Littelfuse Diodes are easily inserted into the fuse block, they can be added later without difficulty. This ease of installation also facilitates use of Diodes for options that are only included on a small number of vehicles.

Littelfuse's efficient design also allows the Diode ratings to be changed easily within the body of the Diode, customized for a customer's specific requirements. Littelfuse Diodes are durable and impact-resistant, carrying the same quality guarantee held by Littelfuse circuit protection products. Littelfuse products are manufactured in QS-9000 certified facilities.

### Diode Specifications

Operating Temp:	-40°C to +85°C
Diode Rating:	1.0 - 1.5 A
Max PIV:	50 to 1000 PIV
Body Material:	Thermoplastic
Termination Material:	CRS (Ni/Zn Plated)
Termination Retention:	25 N



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