

## USB Peripheral Protection using PolyZen Devices

Universal Serial Bus (USB) ports often provide power, which is used to charge peripherals as well as portable electronics products. By the USB specification, a USB compliant supply will provide between 4.75 and 5.25V and at least 0.5A of continuous power.

However faults can still occur making unprotected downstream electronics susceptible to damage. Typical faults include: inductive based voltage spikes, high voltage charger connections (user error), dirty power supply connections.

Although a typical computer power supply is regulated at 5V +/- 5%, this does not mean voltage at the USB port will not exceed 5.25V. Inductively generated voltage spikes can exceed 8V and damage unprotected peripherals. Voltage spikes can occur when there is inductance in the power bus, and a rapid change in current is generated. This rapid change in current can come from a hot disconnect of a peripheral, an internal system shutdown, or other internal power fluctuations. Inductance can be designed in with magnetics, but can also be generated by long cables and other power bus artifacts. The more inductance in the power bus the worse the voltage spike can be in the peripheral. In short, USB devices can be subject to voltages well in excess of 5V, and should be protected from this.

Because USB has become such a ubiquitous charging interface, some vendors also supply AC to DC converters with a USB output. These 3rd party chargers have varied transient suppression and regulation performance. Unprotected devices can be damaged when connected to these 3rd party chargers.

Automotive power buses are notoriously dirty. Although they are nominally 12V, they can range in normal operation from 8V to 16V. However, battery currents can exceed 100 Amps, and be stopped instantly (via relay, or via fuse) generating large inductive spikes on the bus and increasing voltage by 5X or more. Supplies are subject to misconnected batteries and double battery jump starts (24V). A condition known as "Load Dump" can also generate large voltages on the bus. Typical third party power converters may filter some of these events, but internal testing shows that the transient suppression capabilities of these third party power converters varies. Devices being charged via a USB interface are typically not designed to handle this type of voltage fluctuation and will require protection.

The PolyZen ZEN056V130A24LS was specifically designed to protect USB peripherals and devices on the 5V computer bus. Vz at 100mA was selected to be between 5.5 and 5.75V It was designed with the intent to help protect sensitive follow on electronics like flash memory and other 6V capable silicon from inductive voltage spikes, incorrect supplies, dirty power, and other transients.

Based on its principle of operation, the design of the PolyZen device is especially effective at clamping and smoothing inductive voltage spikes. Because it leverages Zener diode technology, when faced with the potential of an inductive spike, it helps shunt current to ground until the voltage is reduced to the normal operating range. In general, the Zener diode of the PolyZen device will help clamp voltage transients and dirty power. In the case where an incorrect voltage power supply is connected, it will clamp the voltage, shunt excess power to ground, and eventually lock out the incorrect power supply.

### Benefits:

- Helps shield downstream electronics from overvoltage and reverse bias
- Trip events shut out overvoltage and reverse bias sources
- Analog nature of trip events minimize upstream inductive spikes
- Helps reduce design costs with single component placement and minimal heat sinking requirements

### Features:

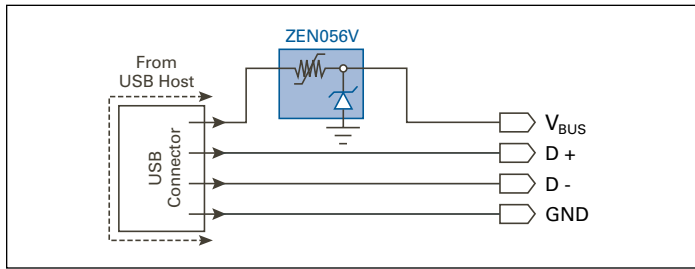
- Overvoltage transient suppression
- Stable VZ vs. fault current
- Time delayed, overvoltage trip
- Time delayed, reverse bias trip
- Power handling on the order of 100 watt
- Integrated device construction
- RoHS compliant

### Applications: USB Peripherals & USB charged devices such as...

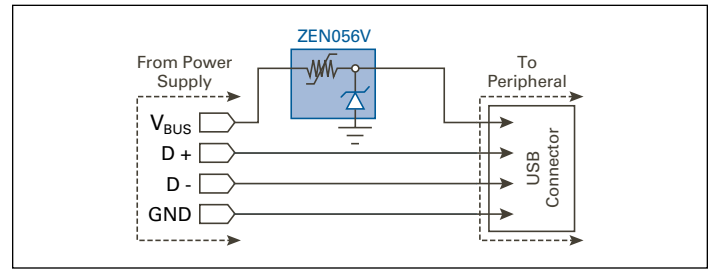
- Cell phones
- PDAs
- MP3 players
- DVD players
- Digital cameras
- USB hubs
- Printers
- Scanners
- Hard Drives



## Typical Circuit—USB Peripherals



## USB Power Conditioning (Host, Hub, Remote Charger)

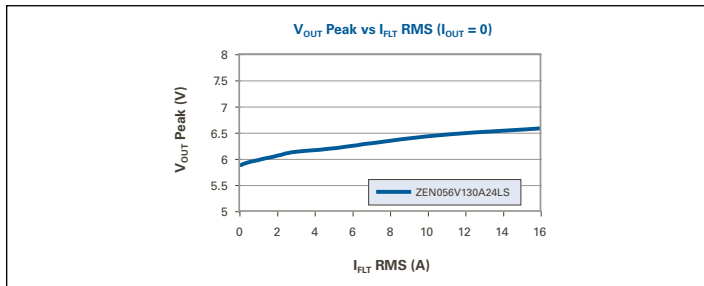


## Electrical Characteristics

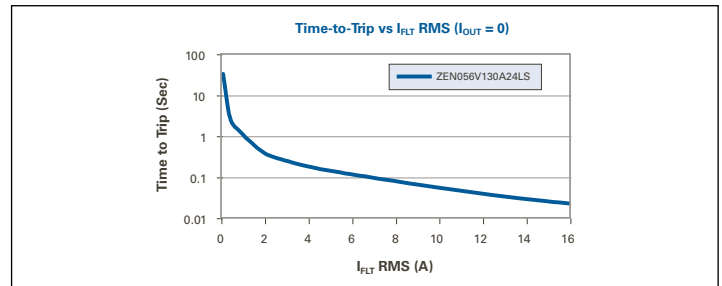
Part Number	$V_Z$ (V)	$I_{zt}$ (A)	$I_{HOLD}$ @ 20°C (A)	$R_{Typ}$ ( $\Omega$ )	$R_{1Max}$ ( $\Omega$ )	$V_{INT Max}$ @ 3A (V)	$I_{FLT Max}$ @ 16V (A)	Power Dissipation (W)
ZEN056V130A24LS	5.6	0.1	1.3	0.12	0.16	24	+10 / -40	0.7

For specification terms and definitions, go to [www.circuitprotection.com/polyzen/](http://www.circuitprotection.com/polyzen/)

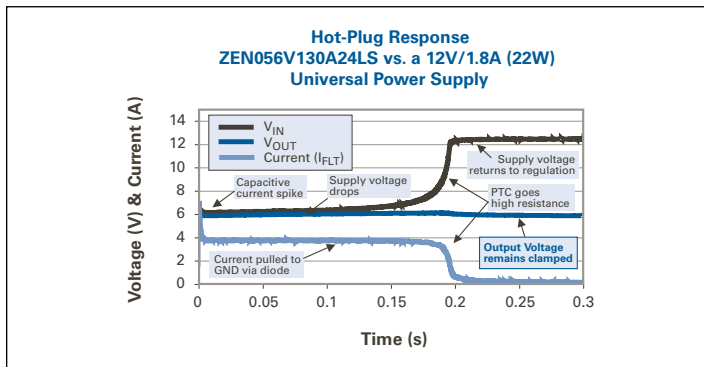
## $V_{OUT}$ Peak vs $I_{FLT}$



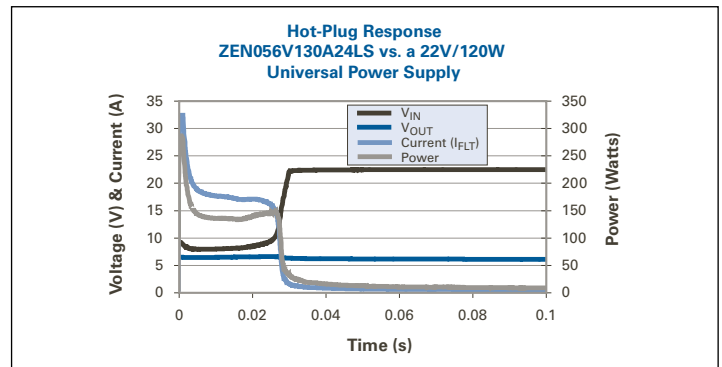
## Time-to-Trip



## Typical Response (22W)



## Typical Response (120W)



## Summary

Raychem Circuit Protection's PolyZen device is designed for overvoltage protection on USB peripherals and devices on the 5V computer bus. The component helps protect sensitive follow-on electronics—such as flash memory and other 6V capable silicon—from inductive voltage spikes, incorrect power supplies, dirty power and other transients. The RoHS-compliant device offers massive power handling in a 4mm package.



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