The widespread availability of external and universal power supplies has made charger-induced system failure a leading cause of device warranty returns. Designing in additional safeguards to help prevent damage that may be caused by the use of unauthorized charging systems is complicated by the fact that the solution itself must accommodate smaller electronic packages.

The most cost-effective way to implement a power bus for portable electronics is with a standard DC barrel jack. However, because this connector is so commonly used, the user may accidentally connect the incorrect power supply to electronic equipment at home or while traveling. Faults may also occur when using commercially available universal power supplies that come with a variety of connectors. These devices allow the user to dial in the voltage to levels as high as 24V, as well as switch polarity.

Transient protection is especially critical when designing peripherals that may be powered off computer buses and automotive power buses. Automotive power buses are notoriously dirty. Although they are nominally 12V, they can range in normal operation from 8V to 16V. Still, battery currents can exceed 100 Amps and be stopped instantly via a relay or fuse, generating large inductive spikes on the bus and increasing voltage by five times or more.

Although typical computer power supplies provide regulated lines at 5V +/-5%, and 12V +/-5%, under certain circumstances the voltage at these lines may exceed 5.25V and 12.6V, causing damage to the system or unprotected peripherals. Voltage spikes can occur when there is inductance in the power bus and a rapid change in current occurs. This change can result from a hot disconnect of a peripheral, an internal system shutdown, or other internal power fluctuations.

Under the new USB 3.0 specification, high-powered devices will be able to source up 0.9A of current, and new types of powering devices, such as Powered-B connector devices, may provide up to 1A, as opposed to 0.5A in the USB 2.0 specification. These higher current applications require more reliable and robust circuit protection to help prevent damage caused by overvoltage transients and overcurrent conditions.

PolyZen devices are designed to help lock out inappropriate power supplies. The device is particularly effective at clamping and smoothing inductive voltage spikes. In response to an inductive spike, the device’s Zener diode element shunts current to ground until the voltage is reduced to the normal operating range. In the case of a wrong-voltage power supply, the device clamps the voltage, shunts excess power to ground, and eventually locks out the wrong supply.

The relatively flat voltage vs. current response of the PolyZen device helps clamp the output voltage, even when input voltage and source currents vary. It helps provide coordinated protection with a component that protects like a Zener diode, but is capable of withstanding very-high-power fault conditions - without requiring any special heat-sinking structures beyond normal PCB traces.
**PolyZen Device Helps Protect Portable Electronics from Charger-Induced Failure**

**Typical Circuit— “On Board” Protection**

![Typical Circuit Diagram](image)

**Power Conditioning (AC to DC converter output)**

![Power Conditioning Diagram](image)

**Electrical Characteristics (Performance ratings @ 25°C unless otherwise specified)**

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Min</th>
<th>Typ</th>
<th>Max</th>
<th>$I_{ZT}$ @ 20°C (A)</th>
<th>$I_{HOLD}$ (A)</th>
<th>$R_{max}$ (Ω)</th>
<th>$V_{INT MAX}$ (V)</th>
<th>$I_{FLT MAX}$ (A)</th>
<th>$V_{FLT MAX}$ (V)</th>
<th>Test Voltage (V)</th>
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</table>

LS module height is 1.7mm typical. YM module height is 1.2mm typical. YC module height is 1.3mm typical.

† Typical operating current is 550μA @ 5.0V which meets USB suspend mode requirement.
PolyZen Device Helps Protect Portable Electronics from Charger-Induced Failure

Typical Performance Curves

Figure PZ2: $V_{OUT}$ Peak vs $I_{FLT}$ RMS ($I_{OUT} = 0$)

Figure PZ3: Time-to-Trip vs $I_{FLT}$ RMS ($I_{OUT} = 0$)

Figure PZ4: $V_{OUT}$ Peak vs $I_{FLT}$ RMS ($I_{OUT} = 0$)

Figure PZ5: Time-to-Trip vs $I_{FLT}$ RMS ($I_{OUT} = 0$)

Figure PZ6: $V_{OUT}$ Peak vs $I_{FLT}$ RMS ($I_{OUT} = 0$)

Figure PZ7: Time-to-Trip vs $I_{FLT}$ RMS ($I_{OUT} = 0$)

E  = ZEN164V130A24LS
D  = ZEN132V130A24LS
C  = ZEN098V130A24LS
A  = ZEN056V1yyA24LS/GS
B  = ZENxxxV230A16LS
C  = ZENxxxV075A48LS/M

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Typical Performance Curves

**Figure PZ8**  
Temperature Effect on $I_{\text{HOLD}}$ ($I_{\text{FLT}} = 0$)

- A = ZEN056V130A16YM
- B = ZENxxxV130A16LS
- C = ZENxxxV175A12YM
- D = ZENxxxV175A24LS

**Figure PZ9**  
Time-to-Trip vs $I_{\text{PTC}}$ RMS ($I_{\text{FLT}} = 0$)

- A = ZEN056V130A16YM
- B = ZENxxxV230A16LS
- C = ZENxxxV075A48LS

**Figure PZ10**  
$V_{\text{OUT}}$ Peak vs. $I_{\text{FLT}}$ RMS ($I_{\text{OUT}} = 0$)

- A = ZEN056V130A16YM
- B = ZEN132V130A16LS
- C = ZEN132V130A16YM

**Figure PZ11**  
Time-to-Trip vs $I_{\text{FLT}}$ RMS ($I_{\text{OUT}} = 0$)

- A = ZEN056V130A16YM
- B = ZEN132V130A16LS
- C = ZEN132V130A16YM
- D = ZEN132V175A12YM

**Figure PZ12**  
$V_{\text{OUT}}$ Peak vs. $I_{\text{FLT}}$ RMS ($I_{\text{OUT}} = 0$)

- A = ZEN056V130A16YM
- B = ZENxxxV130A16LS

**Figure PZ13**  
Time-to-Trip vs $I_{\text{FLT}}$ RMS ($I_{\text{OUT}} = 0$)

- A = ZEN056V130A16YM
- B = ZEN132V130A16LS
- C = ZENxxxV175A12YM

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Typical Performance Curves

Figure PZ14: Temperature Effect on \( I_{\text{HOLD}} \) (\( I_{\text{FLT}} = 0 \))

Figure PZ15: Time-to-Trip vs. \( I_{\text{PTC}} \) RMS (\( I_{\text{FLT}} = 0 \))

Figure PZ16: \( V_{\text{OUT}} \) Peak vs. \( I_{\text{FLT}} \) RMS (\( I_{\text{OUT}} = 0 \))

Figure PZ17: Time-to-Trip vs. \( I_{\text{PTC}} \) RMS (\( I_{\text{OUT}} = 0 \))

Figure PZ18: \( V_{\text{OUT}} \) Peak vs. \( I_{\text{FLT}} \) RMS (\( I_{\text{OUT}} = 0 \))

Figure PZ19: Time-to-Trip vs. \( I_{\text{PTC}} \) RMS (\( I_{\text{OUT}} = 0 \))
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Typical Performance Curves

**Figure PZ20**

Temperature Effect on $I_{\text{HOLD}}$ ($I_{\text{FLT}} = 0$)

A = ZENxxxV130A24YC  
B = ZENxxxV230A16YC  
C = ZENxxxV260A16YC

**Figure PZ21**

Time-to-Trip vs. $I_{\text{PSC}}$ RMS ($I_{\text{FLT}} = 0$)

A = ZENxxxV130A24YC  
B = ZENxxxV2yyA16YC

**Basic Operation Examples**

**Figure PZ22**

Hot-Plug Response
ZEN056V130A24LS vs a 22V/120W Universal Power Supply

A = $V_{\text{IN}}$  
B = $V_{\text{OUT}}$  
C = CURRENT ($I_{\text{FLT}}$)  
D = POWER

- Capacitive Current Spike
- Current Pulled to GND via diode
- Supply Voltage dropped by current
- Supply Voltage returns to normal
- PPTC switches to high resistance
- Output Voltage remains clamped

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Basic Operation Examples

Figure PZ23

Typical Fault Response: ZEN056V1150A24LS
20V, 3.5A Current Limited Source (I_{OUT}=0)

Figure PZ24

Typical Fault Response: ZEN059V1300A24LS
24V, 6A Current Limited Source (I_{OUT}=0)

Figure PZ25

Typical Fault Response: ZEN065V1300A24LS
24V, 5.0A Current Limited Source (I_{OUT}=0)

Figure PZ26

Typical Fault Response: ZEN096V1300A24LS
24V, 3.5A Current Limited Source (I_{OUT}=0)

Figure PZ27

Typical Fault Response: ZEN132V1300A24LS
24V, 2.0A Current Limited Source (I_{OUT}=0)

Figure PZ28

Typical Fault Response: ZEN164V1300A24LS
24V, 1.0A Current Limited Source (I_{OUT}=0)
PolyZen Device Helps Protect Portable Electronics from Charger-Induced Failure

Basic Operation Examples

![Figure PZ29](image1)

![Figure PZ30](image2)

![Figure PZ31](image3)

![Figure PZ32](image4)

![Figure PZ33](image5)

![Figure PZ34](image6)
PolyZen Device Helps Protect Portable Electronics from Charger-Induced Failure

Basic Operation Examples

**Figure PZ35**

Typical Fault Response: ZEN056V130A16YM
20V/3A Current Limited Source ($I_{\text{OUT}} = 0$)

```
Voltage (V) or Current (A) vs. Time (s)
A = $V_{\text{IN}}$ (V)
B = $V_{\text{OUT}}$ (V)
C = $I_{\text{FLT}}$ (A)
```

**Figure PZ36**

Typical Fault Response: ZEN056V175A12YM
12V/3A Current Limited Source ($I_{\text{OUT}} = 0$)

```
Voltage (V) or Current (A) vs. Time (s)
A = $V_{\text{IN}}$ (V)
B = $V_{\text{OUT}}$ (V)
C = $I_{\text{FLT}}$ (A)
```

**Figure PZ37**

Typical Fault Response: ZEN132V130A16YM
20V/1A Current Limited Source ($I_{\text{OUT}} = 0$)

```
Voltage (V) or Current (A) vs. Time (s)
A = $V_{\text{IN}}$ (V)
B = $V_{\text{OUT}}$ (V)
C = $I_{\text{FLT}}$ (A)
```

**Figure PZ38**

Typical Fault Response: ZEN132V175A12YM
20V/1A Current Limited Source ($I_{\text{OUT}} = 0$)

```
Voltage (V) or Current (A) vs. Time (s)
A = $V_{\text{IN}}$ (V)
B = $V_{\text{OUT}}$ (V)
C = $I_{\text{FLT}}$ (A)
```

**Figure PZ39**

Typical Fault Response: ZEN056V130A24YC
24V/3A Current Limited Source ($I_{\text{OUT}} = 0$)

```
Voltage (V) or Current (A) vs. Time (s)
A = $V_{\text{IN}}$ (V)
B = $V_{\text{OUT}}$ (V)
C = $I_{\text{FLT}}$ (A)
```

**Figure PZ40**

Typical Fault Response: ZEN056V230A16YC
20V/3A Current Limited Source ($I_{\text{OUT}} = 0$)

```
Voltage (V) or Current (A) vs. Time (s)
A = $V_{\text{IN}}$ (V)
B = $V_{\text{OUT}}$ (V)
C = $I_{\text{FLT}}$ (A)
```
PolyZen Device Helps Protect Portable Electronics from Charger-Induced Failure

Basic Operation Examples

Figure PZ41

Typical Fault Response: ZEN056V260A16YC
20V/3A Current Limited Source (I_{OUT} = 0)

Voltage (V) or Current (A)

A = V_{IN} (V)
B = V_{OUT} (V)
C = I_{FLT} (A)

Time (s)

Figure PZ42

Typical Fault Response: ZEN132V130A24YC
24V/1A Current Limited Source (I_{OUT} = 0)

Voltage (V) or Current (A)

A = V_{IN} (V)
B = V_{OUT} (V)
C = I_{FLT} (A)

Time (s)

Figure PZ43

Typical Fault Response: ZEN132V230A16YC
20V/1A Current Limited Source (I_{OUT} = 0)

Voltage (V) or Current (A)

A = V_{IN} (V)
B = V_{OUT} (V)
C = I_{FLT} (A)

Time (s)

Figure PZ44

Typical Fault Response: ZEN132V260A16YC
20V/1A Current Limited Source (I_{OUT} = 0)

Voltage (V) or Current (A)

A = V_{IN} (V)
B = V_{OUT} (V)
C = I_{FLT} (A)

Time (s)
PolyZen Device Helps Protect Portable Electronics from Charger-Induced Failure

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
- Hold currents up to 2.6A
- Power handling on the order of 30 watts
- Stable VZ vs. fault current
- Time delayed, overvoltage trip
- Time delayed, reverse-bias trip
- Power handling on the order of 100 watts
- Integrated device construction
- RoHS compliant

Applications
- Cell phones
- PDAs
- Personal Navigation Devices
  - MP3 players
  - DVD players
  - Digital cameras
- USB hubs
- Printers
- Scanners
- Hard Disk Drives
- Desk phones
- PBX phones

Summary
The PolyZen device's unique ability to withstand high inrush currents make it suitable to help protect portable electronics and other lowpower DC devices such as cell phones, PDAs, MP3 players, digital cameras and USB hubs. Transient protection is particularly important for peripherals that can be powered off computer buses and automotive power buses. PolyZen devices are designed to help lock out inappropriate power supplies and are especially effective at clamping and smoothing inductive voltage spikes.

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