PolyZen

Polymer Enhanced Zener Diode
Micro-Assemblies

PRODUCT: ZEN059V130A24LS

DOCUMENT: **SCD27818**
REV LETTER: C
REV DATE: JULY 26,2016

Specification Status: Released

GENERAL DESCRIPTION

Littelfuse PolyZen devices are polymer-enhanced precision Zener diode micro-assemblies. They offer resettable protection against multi-Watt fault events and spare the need for large heavy heat sinks.

A unique feature of the PolyZen micro-assembly is that the Zener diode is thermally coupled to a resistively non-linear, polymer PTC (Positive Temperature Coefficient) layer. This PTC layer is fully integrated into the device, and is electrically in series between V_{IN} and the diode clamped V_{OUT}.

This polymer PTC layer responds to either extended diode heating or overcurrent events by transitioning from a low to high resistance state, also known as ”tripping”. A tripped PTC will limit current and generate voltage drop. It helps to protect both the Zener diode and the follow-on electronics and effectively increases the diode’s power handling capability.

The Zener diode used for voltage clamping in a PolyZen micro-assembly was selected due to its relatively flat voltage vs current response. This helps improve output voltage clamping, even when input voltage is high and diode current is large.

The polymer-enhanced Zener diode helps protect sensitive portable electronics from damage caused by inductive voltage spikes, voltage transients, improper power supplies, and reverse bias conditions. The PolyZen ZEN059V130A24LS device is particularly useful for USB 2.0/3.0 powered devices; typically, it draws only 500μA of operating current in USB Suspend Mode.

BENEFITS

- Stable Zener diode helps shield downstream electronics from overvoltage and reverse bias
- PTC trip events help to protect the Zener diode and extend its power handling capability
- Analog nature of trip events minimizes upstream inductive spikes
- Minimal power dissipation requirements
- Single component placement

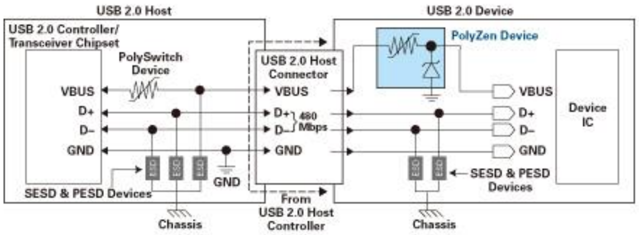
FEATURES

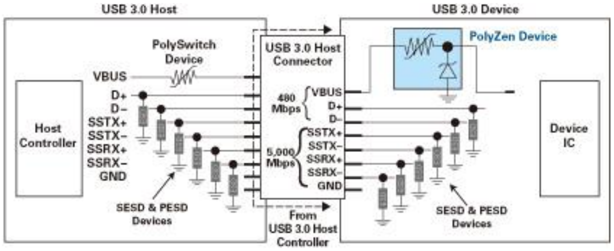
- Meets USB Suspend Mode current requirement - 500μA (typ) @ 5.0V
- Overvoltage transient suppression
- Stable V_Z vs fault current
- Time delayed, overvoltage and reverse bias trip
- Multi-Watt power handling capability
- Integrated device construction
- RoHS Compliant and Halogen Free

TARGET APPLICATIONS

- USB 2.0/3.0 powered consumer electronics, external hard disk drives and solid state devices
- DC power port protection in systems using barrel jacks for power input
- DC power port protection in portable electronics and navigation devices
- DC output voltage regulation
- USB 3.0 hubs and adapter cards
- Laptops and Desktop PCs

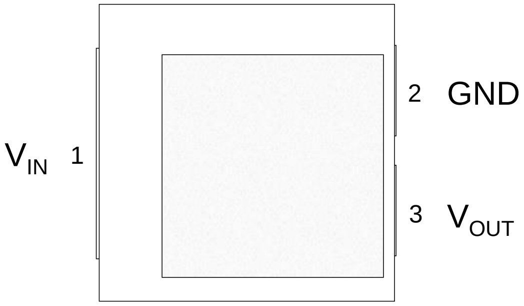
TYPICAL USB 2.0/3.0 APPLICATION BLOCK DIAGRAM



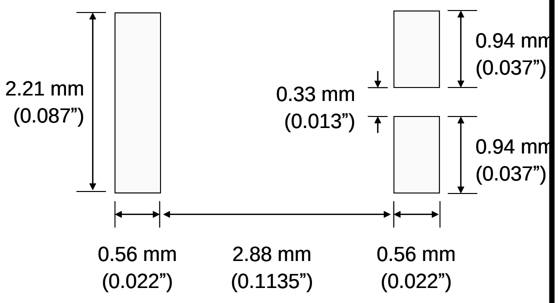


CONFIGURATION INFORMATION

Pin Configuration (Top View)



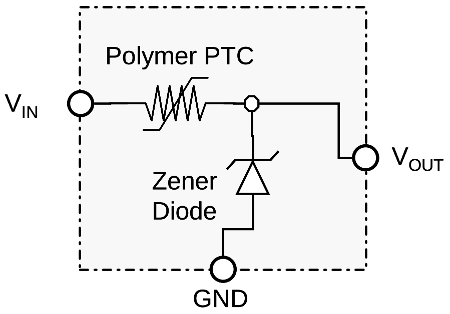
Recommended Pad Dimensions



PIN DESCRIPTION

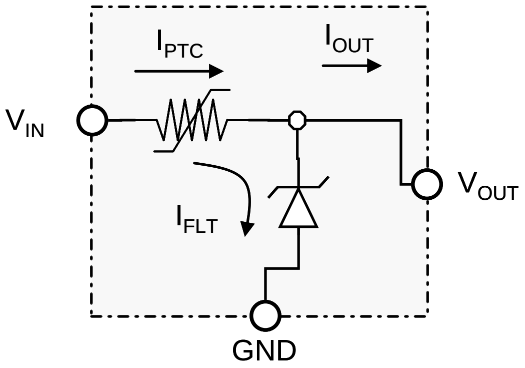
Pin Number	Pin Name	Pin Function
1	V_{IN}	**V_{IN}.** Protected input to Zener diode.
2	GND	**GND**
3	V_{OUT}	**V_{OUT}.** Zener regulated voltage output

BLOCK DIAGRAM



DEFINITION of TERMS

I_{PTC}	Current flowing through the PTC portion of the circuit
I_{FLT}	RMS fault current flowing through the diode
I_{OUT}	Current flowing out the V_{OUT} pin of the device
Trip Event	A condition where the PTC transitions to a high resistance state, thereby significantly limiting I_{PTC} and related currents, and significantly increasing the voltage drop between V_{IN} and V_{OUT}.
Trip Endurance	Time the PTC portion of the device remains both powered and in a tripped state.



GENERAL SPECIFICATIONS

Operating Temperature	-40° to +85°C
Storage Temperature	-40° to +85°C

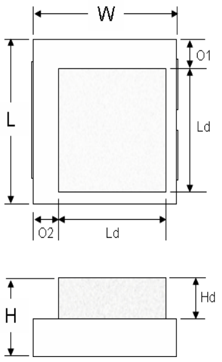
ELECTRICAL CHARACTERISTICS[1-3, 11] (Typical unless otherwise specified)

V_Z[4] (V)			**I_{zt}[4] (A)**	**I_{HOLD}[5] @20°C (A)**	**Operating Current**		**R Typ[6] (Ohms)**	**R_{1Max}[7] (Ohms)**	**V_{Int} Max[8] (V)**		**I_{FLT} Max[9]**		**Tripped Power Dissipation[10] Max**	
Min	Typ	Max			Test Voltage	Max Current			**V_{INT} Max (V)**	**Test Current (A)**	**I_{FLT} Max (A)**	**Test Voltage (V)**	**Value (W)**	**Test Voltage (V)**

						(mA)								
5.8	5.9	6.0	0.1	1.3	5.0	0.65	0.12	0.15	24	3	+6 -40	+24 -16	1.0	24

Note 1: Electrical characteristics determined at 25ºC unless otherwise specified.
Note 2:This device is intended for limited fault protection. Repeated trip events or extended trip endurance can degrade the device and may affect performance to specifications. Performance impact will depend on multiple factors including, but not limited to, voltage, trip current, trip duration, trip cycles, and circuit design. For details or ratings specific to your application contact Littelfuse Circuit Protection directly.
Note 3:Specifications developed using 1.0 ounce 0.045” wide copper traces on dedicated FR4 test boards. Performance in your application may vary.
Note 4:I_{zt} is the current at which V_z is measured ($V_Z = V_{OUT}$). Additional V_Z values are available on request.
Note 5:I_{HOLD} : Maximum steady state I_{PTC} (current entering or exiting the V_{IN} pin of the device) that will not generate a trip event at the specified temperature. Specification assumes I_{FLT} (current flowing through the Zener diode) is sufficiently low so as to prevent the diode from acting as a heat source. Testing is conducted with an “open” Zener.
Note 6:R Typ: Resistance between V_{IN} and V_{OUT} pins during normal operation at room temperature.
Note 7:R_{1Max}: The maximum resistance between V_{IN} and V_{OUT} pins at room temperature, one hour after 1st trip or after reflow soldering.
Note 8:V_{INT} Max: V_{INT} Max relates to the voltage across the PPTC portion of the PolyZen device (V_{IN}-V_{OUT}). V_{INT} Max is defined as the voltage (V_{IN}-V_{OUT}) at which typical qualification devices (98% devices, 95% confidence) survived at least 100 trip cycles and 24hours trip endurance at the specified voltage (V_{IN}-V_{OUT}) and current (I_{PTC}). V_{INT} Max testing is conducted using a "shorted" load (V_{OUT} = 0V). V_{INT} Max is a survivability rating, not a performance rating.
Note 9:I_{FLT} Max: I_{FLT} Max relates to the stead state current flowing through the diode portion of the PolyZen device in a fault condition, prior to a trip event. I_{FLT} Max is defined as the current at which typical qualification devices (12 parts per lot from 3 lots) survived 100 test cycles. RMS fault currents above I_{FLT} Max may permanently damage the diode portion of the PolyZen device. Testing is conducted with NO load connected to V_{OUT}, such that I_{OUT} = 0. “Test voltage” is defined as the voltage between V_{IN} to GND and includes the PolyZen Diode drop. Specification is dependent on the direction of current flow through the diode. I_{FLT} Max is a survivability rating, not a performance rating.
Note 10:The power dissipated by the device when in the “tripped” state, as measured on Littelfuse test boards (see note 3).
Note 11:Specifications based on limited qualification data and subject to change.

MECHANICAL DIMENSIONS



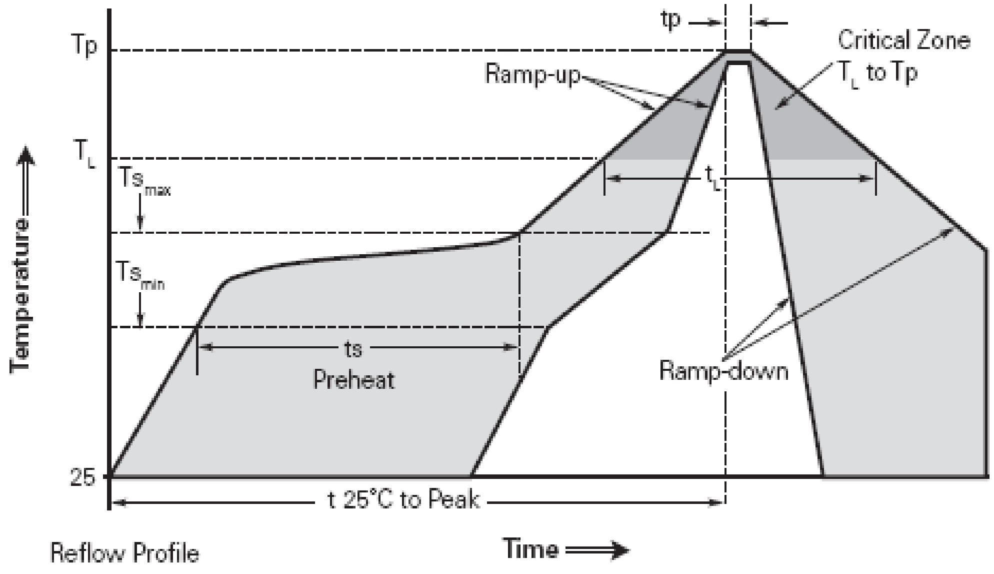
		Min	Typical	Max
Length	L	3.85 mm (0.152”)	4 mm (0.16”)	4.15 mm (0.163")
Width	W	3.85 mm (0.152”)	4 mm (0.16”)	4.15 mm (0.163")
Height	H	1.4mm (0.055”)	1.7 mm (0.067”)	2.0 mm (0.081”)
Length Diode	Ld	-	3.0 mm (0.118”)	-
Height Diode	Hd	-	1.0 mm (0.039”)	-
Offset	O1	-	0.6 mm (0.024”)	-
Offset	O2	-	0.7 mm (0.028”)	-

SOLDER REFLOW RECOMMENDATIONS:

Classification Reflow Profiles

Profile Feature	**Pb-Free Assembly**
Average Ramp-Up Rate (Tsmax to Tp)	3° C/second max.
Preheat	
• Temperature Min (Tsmin)	150 °C
• Temperature Max (Tsmax)	200 °C
• Time (tsmin to tsmax)	60-180 seconds
Time maintained above:	
• Temperature (TL)	217 °C
• Time (tL)	60-150 seconds
Peak/Classification Temperature (Tp)	260 °C
Time within 5 °C of actual Peak Temperature (tp)	20-40 seconds
Ramp-Down Rate	6 °C/second max.
Time 25 °C to Peak Temperature	8 minutes max.

Reflow Profile

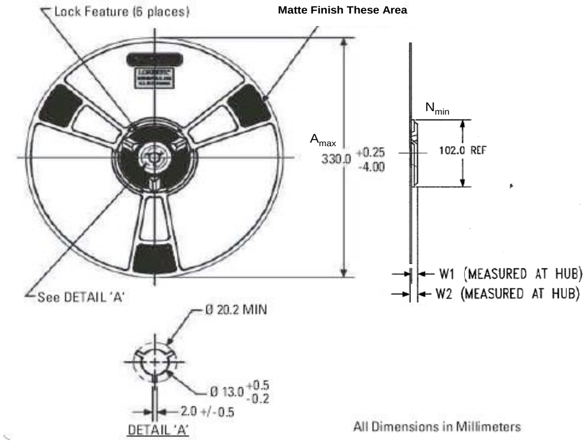


PACKAGING

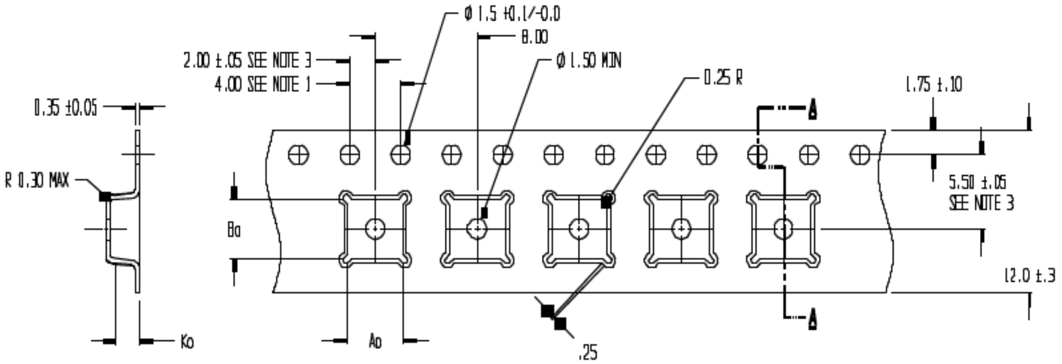
Packaging	Tape & Reel	Standard Box
ZENXXXVXXXAXXLS	3,000	15,000

Reel Dimensions for PolyZen Devices

A_{max} = 330
N_{min} = 102
W_1 = 8.4
W_2 = 11.1



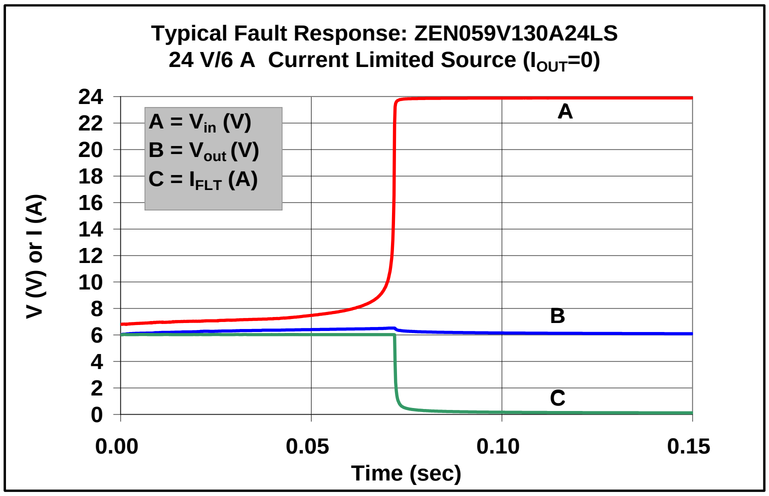
Taped Component Dimensions for PolyZen Devices

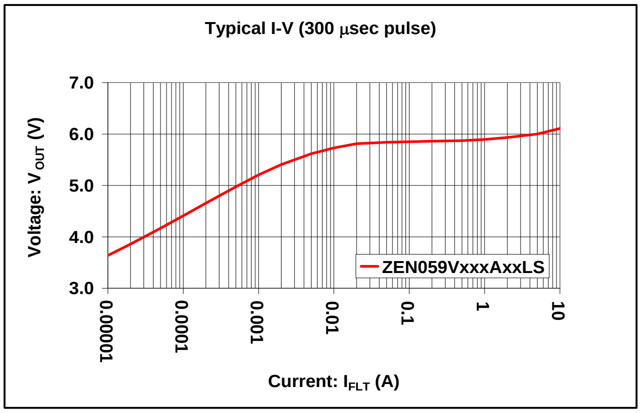


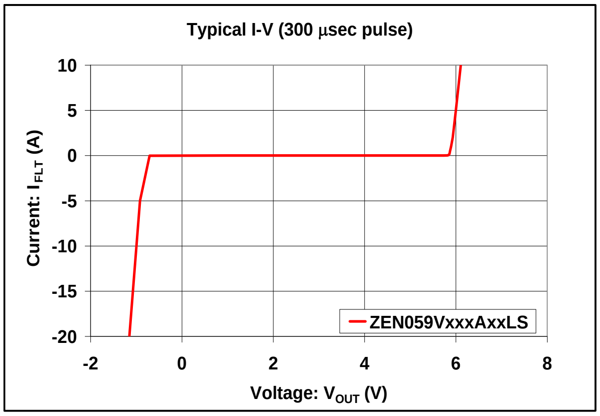
Ao = 4.35
Bo = 4.35
Ko = 2.30

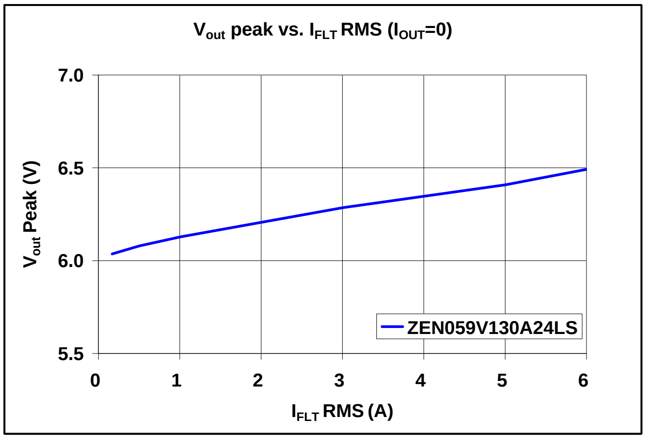
NOTES:
1. 10 SPROCKET HOLE PITCH CUMULATIVE TOLERANCE ±0.2
2. CAMBER IN COMPLIANCE WITH EIA 481
3. POCKET POSITION RELATIVE TO SPROCKET HOLE MEASURED
   AS TRUE POSITION OF POCKET, NOT POCKET HOLE

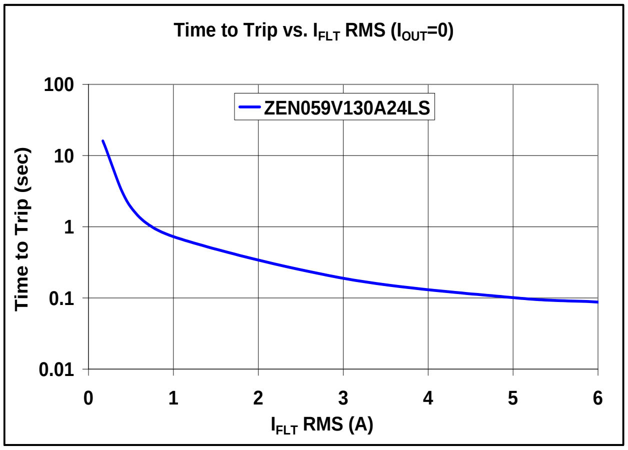
TYPICAL CHARACTERISTICS

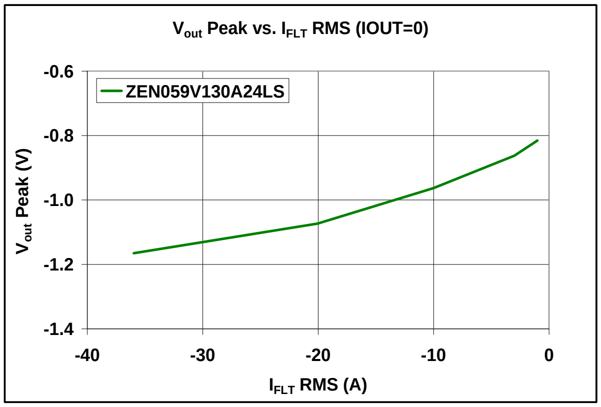







V_{out} peak vs. I_{FLT} RMS (I_{OUT}=0)
7.0
6.5
6.0
5.5
V_{out} Peak (V)
0
1
2
3
4
5
6
I_{FLT} RMS (A)
ZEN059V130A24LS


Time to Trip vs. I_{FLT} RMS (I_{OUT}=0)
100
10
1
0.1
0.01
Time to Trip (sec)
0
1
2
3
4
5
6
I_{FLT} RMS (A)
ZEN059V130A24LS


V_{out} Peak vs. I_{FLT} RMS (IOUT=0)
-0.6
-0.8
-1.0
-1.2
-1.4
V_{out} Peak (V)
-40
-30
-20
-10
0
I_{FLT} RMS (A)
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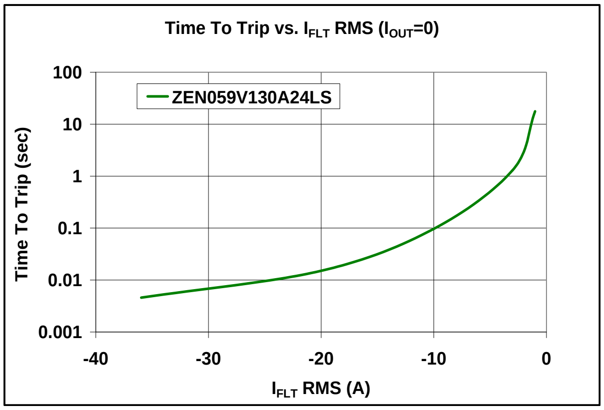
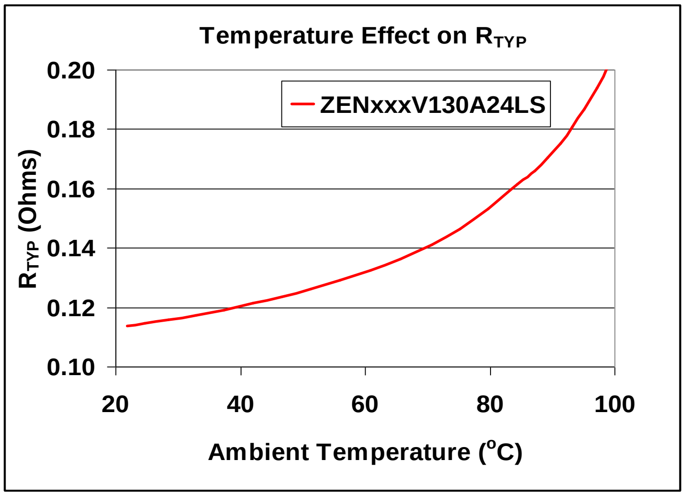
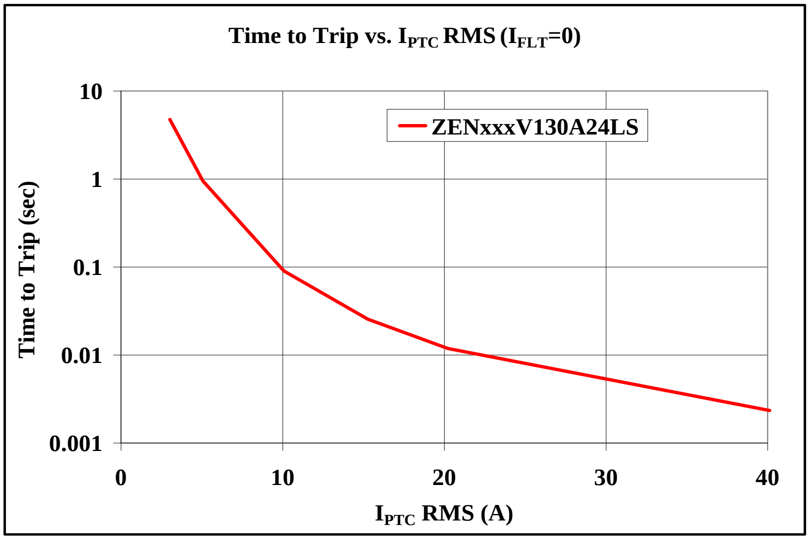

Time To Trip vs. I_{FLT} RMS (I_{OUT}=0)
100
10
1
0.1
0.01
0.001
Time To Trip (sec)
-40
-30
-20
-10
0
I_{FLT} RMS (A)
ZEN059V130A24LS


Temperature Effect on R_{TYP}
0.20
0.18
0.16
0.14
0.12
0.10
R_{TYP} (Ohms)
20
40
60
80
100
Ambient Temperature (°C)
ZENxxxV130A24LS



Materials Information

ROHS Compliant
Directive 2002/95/EC Compliant

ELV Compliant
Directive 2000/53/EC Compliant

Pb-Free
Pb

Halogen Free*
HF

* Halogen Free refers to: **Br≤900ppm, Cl≤900ppm, Br+Cl≤1500ppm.**