AOZ8908

Ultra-Low Capacitance TVS Diode Array

General Description

The AOZ8908 is a transient voltage suppressor array designed to protect high speed data lines from Electro Static Discharge (ESD) and lightning.

This device incorporates eight surge rated, low capacitance steering diodes and a Transient Voltage Suppressor (TVS) in a single package. During transient conditions, the steering diodes direct the transient to either the positive side of the power supply line or to ground. They may be used to meet the ESD immunity requirements of IEC 61000-4-2, Level 4 (±15kV air, ±8kV contact discharge).

The AOZ8908 comes in RoHS compliant SOT-23 package. It is rated over a -40°C to +85°C ambient temperature range.

Features

- ESD protection for high-speed data lines:
  - IEC 61000-4-2 (ESD) ±30kV (air), ±30kV (contact)
  - IEC 61000-4-5 (Lightning) 7A (8/20µs)
  - IEC 61000-4-4 (EFT) 40A (5/50nS)
  - Human Body Model (HBM) ±30kV
- Low insertion loss
- Protects four I/O lines
- Low clamping voltage
- Low operating voltage: 5.0V
- Pb-free device
- Green product

Applications

- USB 2.0 Power and Data Line Protection
- Video Graphics Cards
- Monitors and Flat Panel Displays
- Digital Video Interface (DVI)

Green Product

Typical Application

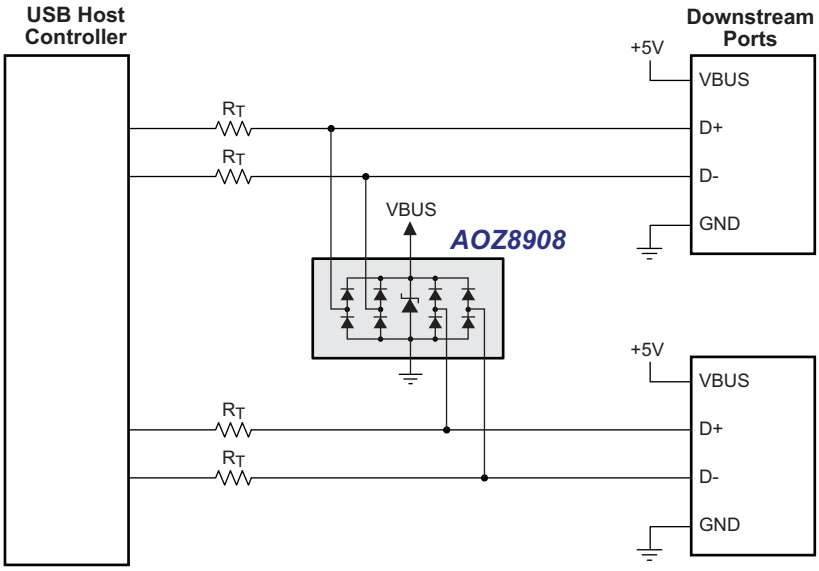


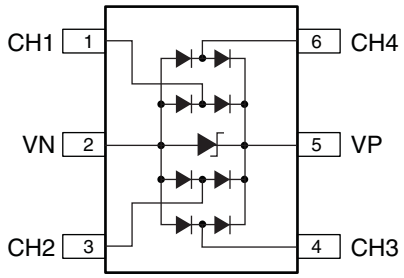
Figure 1. 2 USB High Speed Ports

Ordering Information

Part Number	Ambient Temperature Range	Package	Environmental
AOZ8908CI	-40°C to +85°C	SOT23-6	RoHS Compliant Green Product

AOS Green Products use reduced levels of Halogens, and are also RoHS compliant.
Please visit www.aosmd.com/media/AOSGreenPolicy.pdf for additional information.

Pin Configuration



SOT23-6
(Top View)

Absolute Maximum Ratings

Exceeding the Absolute Maximum ratings may damage the device.

Parameter	Rating
VP – VN	6V
Peak Pulse Current (I_{PP}), t_P = 8/20µs	7A
Peak Power Dissipation (8/20µs) @ 25°C	48W
Storage Temperature (T_S)	-65°C to +150°C
ESD Rating per IEC61000-4-2, contact(1)	±30kV
ESD Rating per IEC61000-4-2, air(2)	±30kV
ESD Rating per Human Body Model(2)	±30kV
Junction Temperature (T_J)	-40°C to +125°C

Notes:
1. IEC 61000-4-2 discharge with $C_{Discharge}$ = 150pF, $R_{Discharge}$ = 330Ω.
2. Human Body Discharge per MIL-STD-883, Method 3015 $C_{Discharge}$ = 100pF, $R_{Discharge}$ = 1.5kΩ.

Electrical Characteristics

T_A = 25°C unless otherwise specified

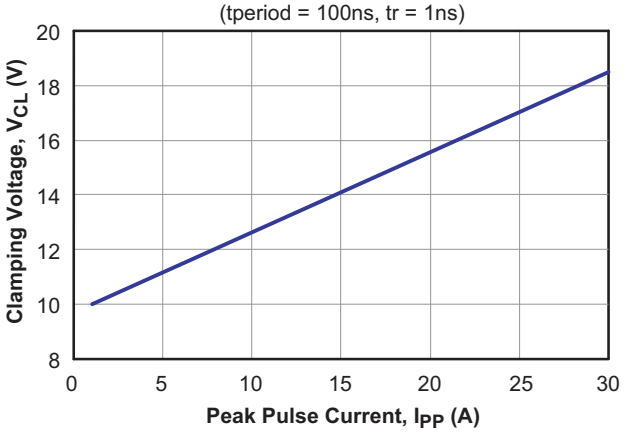
Symbol	Parameter	Conditions	Min.	Typ.	Max.	Units
V_{RWM}	Reverse Working Voltage	Between pin 5 and 2[4]			5.5	V
V_{BR}	Reverse Breakdown Voltage	I_T = 1mA, between pins 5 and 2[5]	6.6			V
I_R	Reverse Leakage Current	V_{RWM} = 5V, between pins 5 and 2			1	µA
V_F	Diode Forward Voltage	I_f = 15mA	0.7	0.85	0.95	V
V_{CL}	Channel Clamp Voltage Positive Transients Negative Transient	I_{PP} = 1A, tp = 100ns, any I/O pin to Ground[3][6][8]		 10.0 -1.5		 V V
	Channel Clamp Voltage Positive Transients Negative Transient	IPP = 16A, tp = 100ns, any I/O pin to Ground[3][6][8]		 14.5 -4.6		 V V
	Channel Clamp Voltage Positive Transients Negative Transient	IPP = 30A, tp = 100ns, any I/O pin to Ground[3][6][8]		 18.5 -6.2		 V V
C_j	Junction Capacitance	V_R = 0V, f = 1Mhz, any I/O pin to Ground[3][7]		1.5	2.0	pF
ΔC_j	Channel Input Capacitance Matching	V_R = 0V, f = 1Mhz, between I/O pins[3][7]			0.03	pF
R_{DYN}	Dynamic Resistance	I_{TLP} = 16A to 30A		0.3		Ω
		I_{TLP} = -16A to -30A		0.15		Ω

Notes:

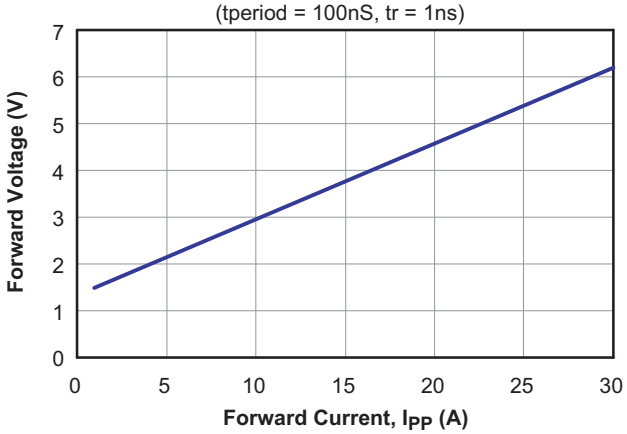
3. These specifications are guaranteed by design.
4. The working peak reverse voltage, V_{RWM}, should be equal to or greater than the DC or continuous peak operating voltage level.
5. V_{BR} is measured at the pulse test current I_T.
6. Measurements performed with no external capacitor on V_P (Pin 5 floating).
7. Measurements performed with V_P biased to 5V (Pin 5 @ 5V), and I/O Pins biased to 3.3V.
8. Measurements performed using a 100 nSec Transmission Line Pulse (TLP) system.

Typical Performance Characteristics

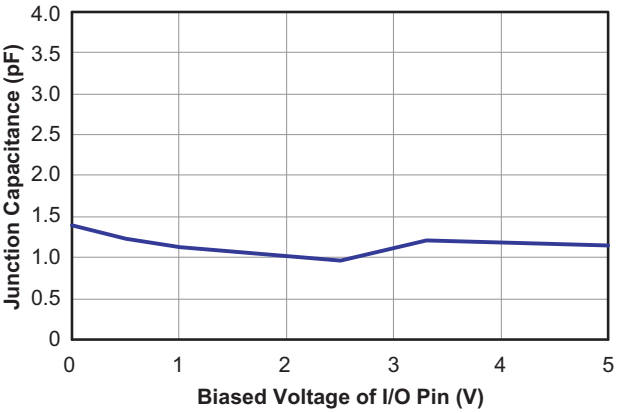
Clamping Voltage vs. Peak Pulse Current
(tperiod = 100ns, tr = 1ns)



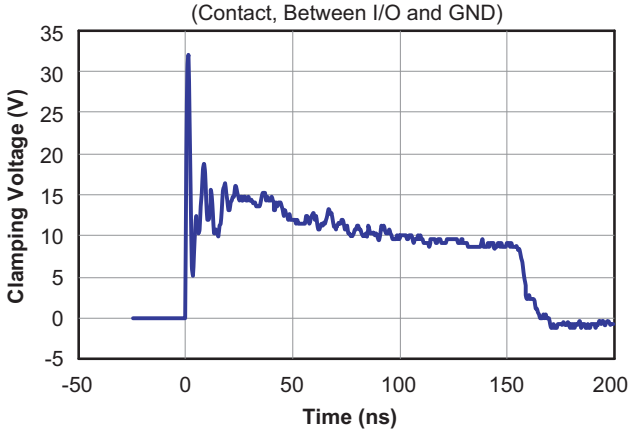
Forward Voltage vs. Forward Current
(tperiod = 100nS, tr = 1ns)



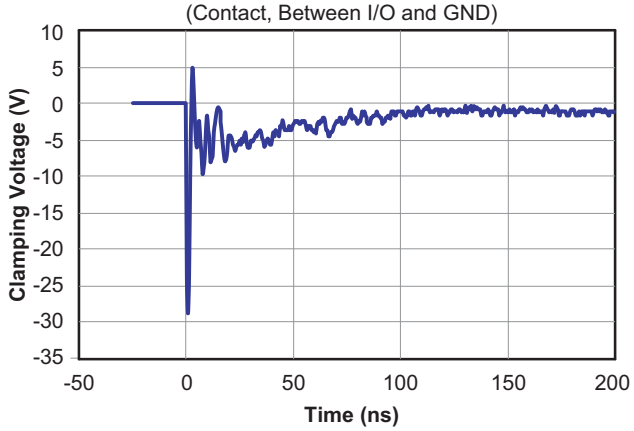
I/O Capacitance at VP = 5V



+8kV ESD Clamping Per IEC 61000-4-2
(Contact, Between I/O and GND)



-8kV ESD Clamping Per IEC 61000-4-2
(Contact, Between I/O and GND)



Application Information

The AOZ8908 TVS is design to protect four data lines from fast damaging transient over-voltage by clamping it to a reference. When the transient on a protected data line exceed the reference voltage the steering diode is forward bias thus, conducting the harmful ESD transient away from the sensitive circuitry under protection.

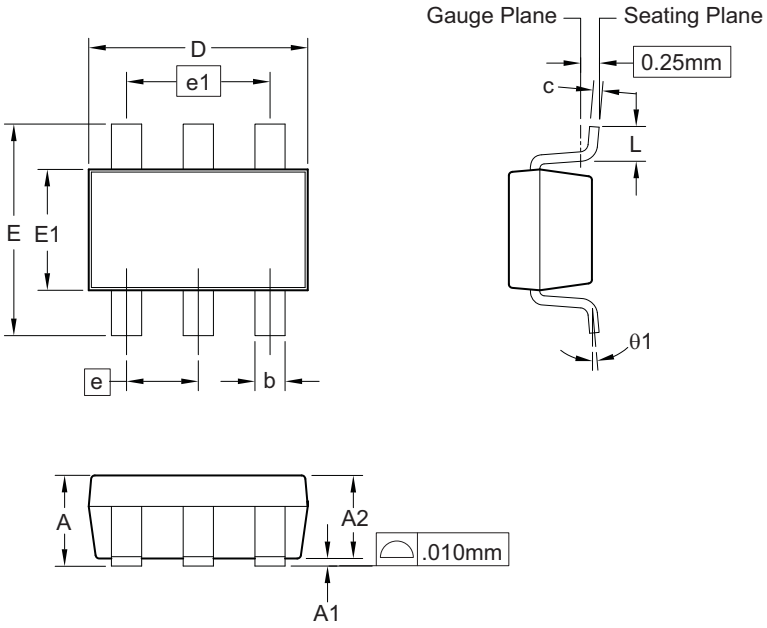
PCB Layout Guidelines

Printed circuit board layout is the key to achieving the highest level of surge immunity on power and data lines. The location of the protection devices on the PCB is the simplest and most important design rule to follow. The AOZ8908 devices should be located as close as possible to the noise source. The placement of the AOZ8908 devices should be used on all data and power lines that enter or exit the PCB at the I/O connector. In most systems, surge pulses occur on data and power lines that enter the PCB through the I/O connector. Placing the AOZ8908 devices as close as possible to the noise source ensures that a surge voltage will be clamped before the pulse can be coupled into adjacent PCB traces. In addition, the PCB should use the shortest possible traces. A short trace length equates to low impedance, which ensures that the surge energy will be dissipated by the AOZ8908 device. Long signal traces will act as antennas to receive energy from fields that are produced by the ESD pulse. By keeping line lengths as short as possible, the efficiency of the line to act as an antenna for ESD related fields is reduced. Minimize interconnecting line lengths by placing devices with the most interconnect as close together as possible. The protection circuits should shunt the surge voltage to either the reference or chassis ground. Shunting the surge voltage directly to the IC's signal ground can cause ground bounce. The clamping performance of TVS diodes on a single ground PCB can be improved by minimizing the impedance with relatively short and wide ground traces. The PCB layout and IC package parasitic inductances can cause significant overshoot to the TVS's clamping voltage. The inductance of the PCB can be reduced by using short trace lengths and multiple layers with separate ground and power planes. One effective method to minimize loop problems is to incorporate a ground plane in the PCB design. The AOZ8908 ultra-low capacitance TVS is designed to protect four high speed data transmission lines from transient over-voltages by clamping them to a fixed reference. The low inductance and construction minimizes voltage overshoot during high current surges. When the voltage on the protected line exceeds the reference voltage the internal steering diodes are forward biased, conducting the transient current away from the sensitive circuitry.

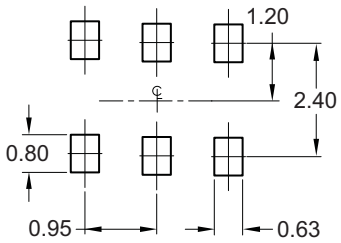
Good circuit board layout is critical for the suppression of ESD induced transients. The following guidelines are recommended:

1. Place the TVS near the IO terminals or connectors to restrict transient coupling.
2. Fill unused portions of the PCB with ground plane.
3. Minimize the path length between the TVS and the protected line.
4. Minimize all conductive loops including power and ground loops.
5. The ESD transient return path to ground should be kept as short as possible.
6. Never run critical signals near board edges.
7. Use ground planes whenever possible.
8. Avoid running critical signal traces (clocks, resets, etc.) near PCB edges.
9. Separate chassis ground traces from components and signal traces by at least 4mm.
10. Keep the chassis ground trace length-to-width ratio <5:1 to minimize inductance.
11. Protect all external connections with TVS diodes.

Package Dimensions, SOT23-6L



RECOMMENDED LAND PATTERN



UNIT: mm

Dimensions in millimeters

Symbols	Min.	Nom.	Max.
A	0.90	—	1.25
A1	0.00	—	0.15
A2	0.70	1.10	1.20
b	0.30	0.40	0.50
c	0.08	0.13	0.20
D	2.70	2.90	3.10
E	2.50	2.80	3.10
E1	1.50	1.60	1.70
e	0.95 BSC		
e1	1.90 BSC		
L	0.30	—	0.60
θ1	0°	—	8°

Dimensions in inches

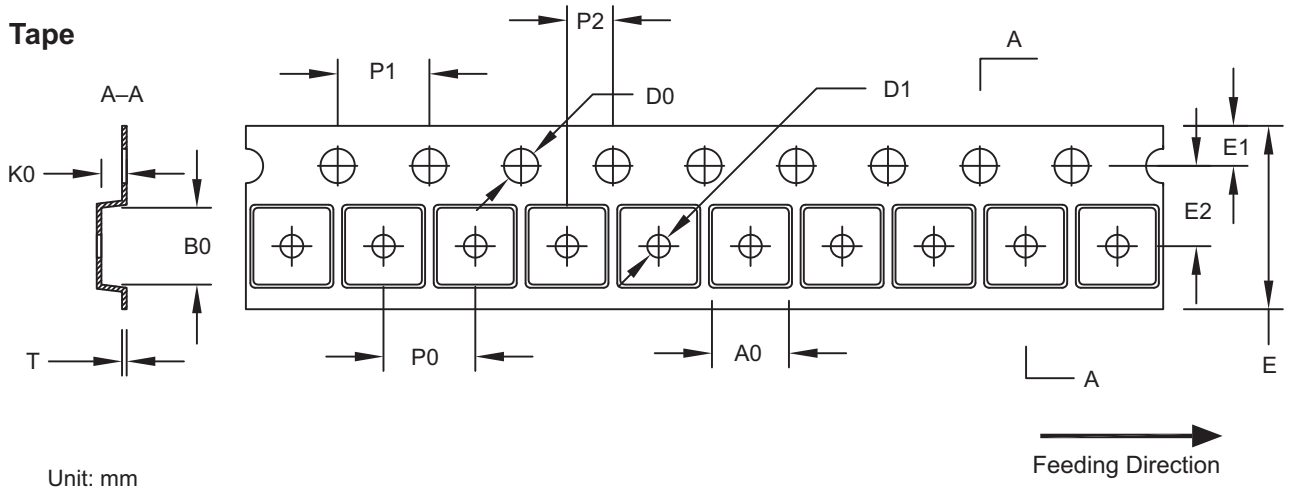
Symbols	Min.	Nom.	Max.
A	0.035	—	0.049
A1	0.00	—	0.006
A2	0.028	0.043	0.047
b	0.012	0.016	0.020
c	0.003	0.005	0.008
D	0.106	0.114	0.122
E	0.098	0.110	0.122
E1	0.059	0.063	0.067
e	0.037 BSC		
e1	0.075 BSC		
L	0.012	—	0.024
θ1	0°	—	8°

Notes:

1. Package body sizes exclude mold flash and gate burrs. Mold flash at the non-lead sides should be less than 5 mils each.
2. Dimension “L” is measured in gauge plane.
3. Tolerance ±0.100 mm (4 mil) unless otherwise specified.
4. Followed from JEDEC MO-178C & MO-193C.
5. Controlling dimension is millimeter. Converted inch dimensions are not necessarily exact.

Tape and Reel Dimensions, SOT23-6L

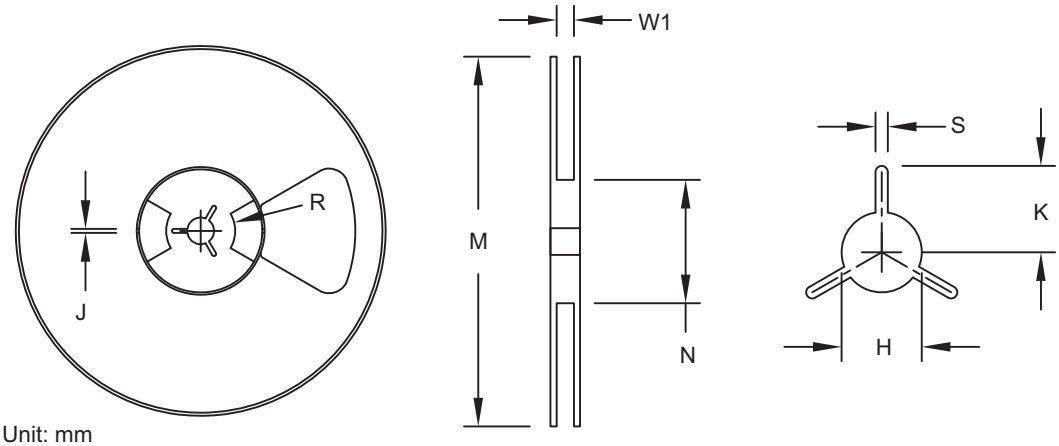
Tape



Unit: mm

Package	A0	B0	K0	D0	D1	E	E1	E2	P0	P1	P2	T
SOT-23	3.15 ±0.10	3.20 ±0.10	1.40 ±0.10	1.50 ±0.05	1.00 ±0.10/-0.0	8.00 ±0.30	1.75 ±0.10	3.50 ±0.05	4.00 ±0.10	4.00 ±0.10	2.00 ±0.05	0.23 ±0.03

Reel

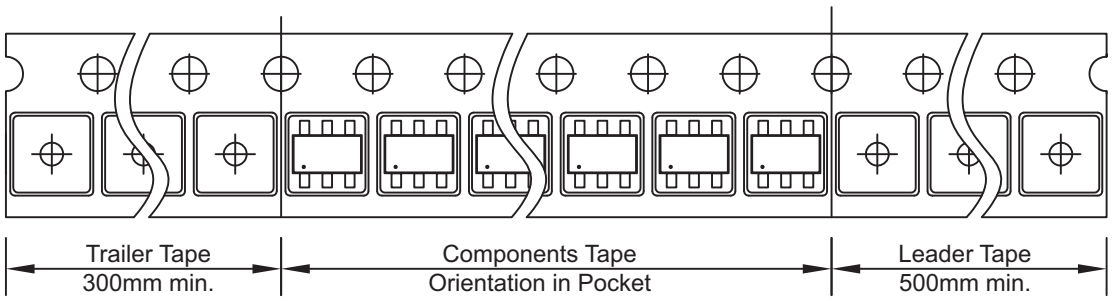


Unit: mm

Tape Size	Reel Size	M	N	W1	H	S	K	R	J
8 mm	ø177.80	ø177.80 MAX.	ø55.00 MIN.	8.40 +1.50/-0.00	ø13.00 +0.50 / -0.20	1.50 MIN.	10.10 MIN.	12.70	4.00 +0.10/-0.10

Leader/Trailer and Orientation

Unit Per Reel:
3000pcs



Part Marking

AOZ8908CI
(SOT-23)