

## General Description

The AOZ8936DI is a multi-channel combo transient voltage suppressor array designed to protect high speed data lines such as USB3.1, USB2.0, and VBUS from damaging ESD events.

This device incorporates 2 channels for USB2.0, 4 channels for USB3.1 and 1 channel for VBUS.

The AOZ8936DI comes in a RoHS compliant and Halogen Free DFN4.1x2.0 package and is rated for -40°C to +125°C junction temperature range.

## Features

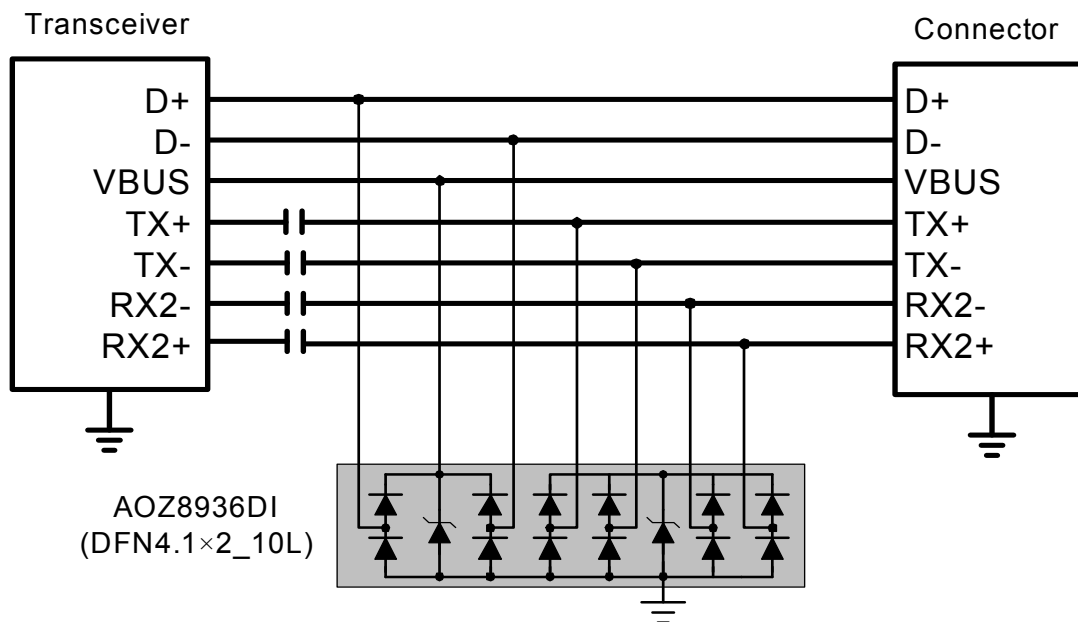
- IEC61000-4-2, ESD immunity (Contact/Air):
  - ± 30/30 kV (USB 3.1)
  - ± 24/30 kV (USB 2.0)
  - ± 30/30 kV (VBUS)
- IEC61000-4-5, Surge Immunity (8/20µs):
  - ± 6 A (USB 3.1)
  - ± 4 A (USB 2.0)
  - ± 15 A (VBUS)
- Capacitance between I/O to GND:
  - 0.4pF (USB 3.1)
  - 1.75pF (USB 2.0)
  - 120pF (VBUS)

## Applications

- USB 3.1/3.2 & USB 2.0
- Monitors and flat panel displays
- Set-top-box
- Notebook computers



## Typical Application



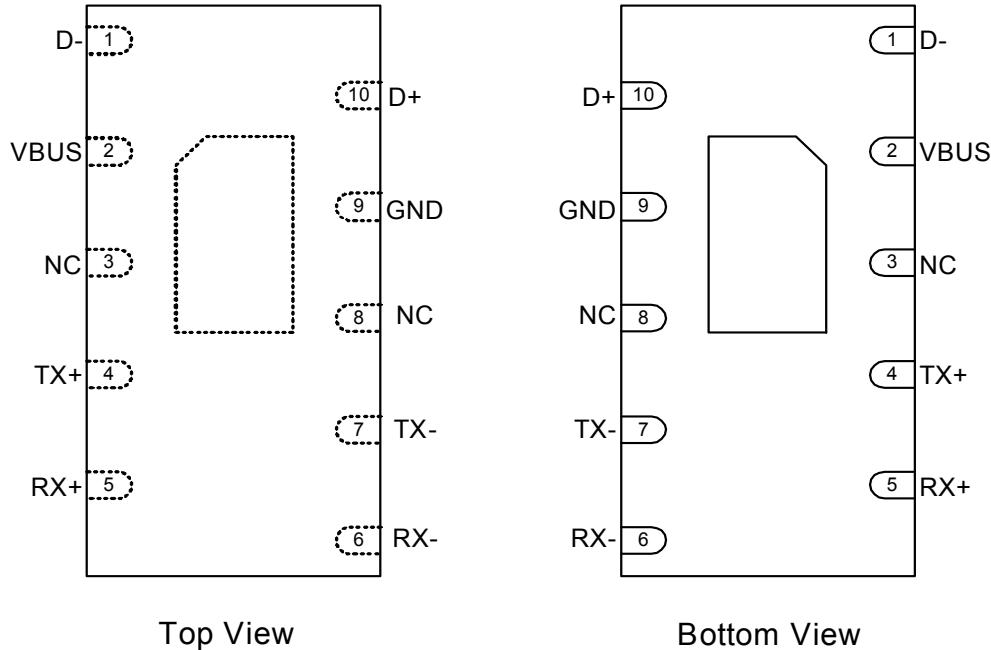
## Ordering Information

Part Number	Ambient Temperature Range	Package	Environmental
AOZ8936DI	-40°C to +125°C	DFN4.1X2_10L	Green Product



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

## Pin Configuration



## Absolute Maximum Ratings

Exceeding the Absolute Maximum ratings may damage the device.

Parameter	Rating		
	Pin 1 & Pin 10 (USB 2.0)	Pin 4 to Pin 7 (USB 3.1/3.2)	Pin 2 (VBUS)
Storage Temperature ( $T_S$ )	-65°C to +150°C	-65°C to +150°C	-65 °C to +150°C
ESD Rating per IEC61000-4-2, contact <sup>(1)</sup>	±24 kV	±30 kV	±30 kV
ESD Rating per IEC61000-4-2, air <sup>(1)</sup>	±30 kV	±30 kV	±30 kV
8/20µs Surge IEC61000-4-5	±4 A	±6 A	±15 kV

### Notes:

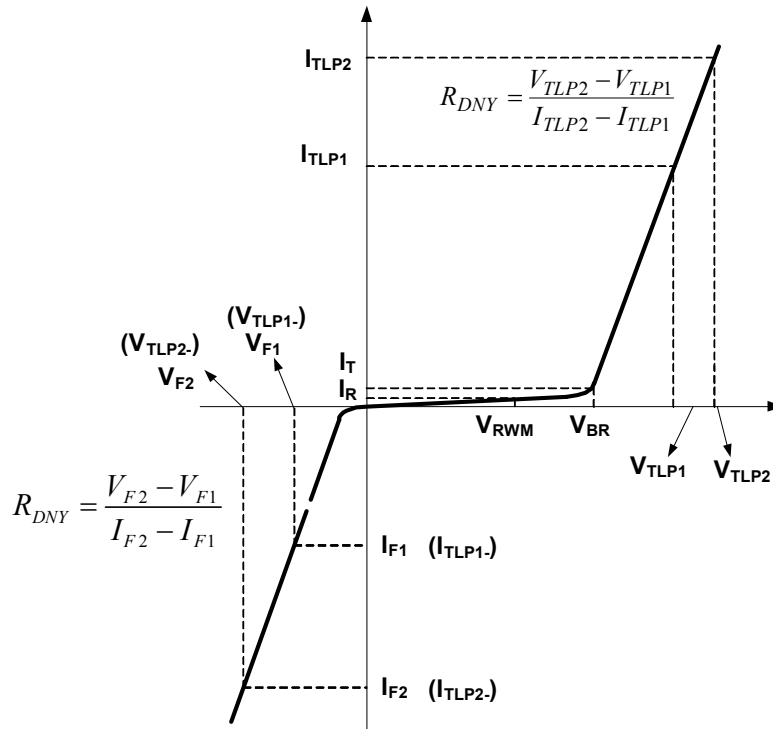
- IEC 61000-4-2 discharge with  $C_{Discharge} = 150\text{pF}$ ,  $R_{Discharge} = 330\Omega$ .
- Human Body Discharge per MIL-STD-883, Method 3015  $C_{Discharge} = 100\text{pF}$ ,  $R_{Discharge} = 1.5\text{k}\Omega$ .

## Maximum Operating Ratings

Parameter	Rating
Junction Temperature ( $T_J$ )	-40°C to +125°C

### Electrical Characteristics

T<sub>A</sub> = 25°C unless otherwise specified. Any I/O Pin to GND.



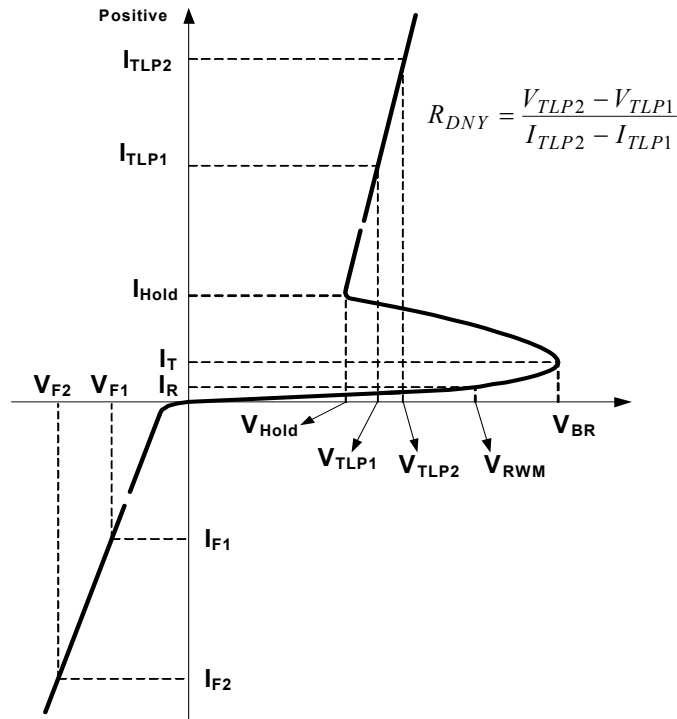
Pin1 & Pin 10 (D+, D- of USB 2.0)						
Symbol	Parameter	Conditions	Min.	Typ.	Max.	Units
V <sub>RWM</sub>	Reverse Working Voltage				5.5	V
V <sub>BR</sub>	Reverse Breakdown Voltage	I <sub>T</sub> = 100μA	6.6			V
I <sub>R</sub>	Reverse Leakage Current	V <sub>T</sub> = Max, V <sub>RWM</sub>			1	μA
V <sub>F</sub>	Forward Voltage		0.7	0.85	0.95	V
V <sub>CL</sub>	Clamping Voltage <sup>(3)(4)</sup> (100ns Transmission Line Pulse)	I <sub>TLP</sub> = 1A I <sub>TLP</sub> = -1A		11 -1.5		V
		I <sub>TLP</sub> = 16A I <sub>TLP</sub> = -16A		18 -7.5		
R <sub>DNY</sub>	Dynamic Resistance <sup>(3)(4)</sup>	I <sub>TLP</sub> = 1A to 16A I <sub>TLP</sub> = -1A to -16A			0.45 0.40	Ω
I <sub>PP</sub>	Peak Pulse Current <sup>(3)</sup> IEC61000-4-5 Surge 8/20μs	Any I/O Pin to GND GND to any I/O Pin			±4	A
V <sub>CL</sub>	Clamping Voltage <sup>(3)</sup> IEC61000-4-5 Surge 8/20μs	I <sub>PP</sub> = 1A I <sub>PP</sub> = -1A		10 -2		V
		I <sub>PP</sub> = 4A I <sub>PP</sub> = -4A		12.5 -4.5		
C <sub>j</sub>	Junction Capacitance <sup>(3)</sup>	V <sub>BUS</sub> =3.3V, f = 1MHz, Any I/O Pin to GND		1.75	2	pF

**Notes:**

- 3. These specifications are guaranteed by design and characterization.
- 4. Measurements performed using a 100ns Transmission Line Pulse (TLP) system.

## Electrical Characteristics

T<sub>A</sub> = 25°C unless otherwise specified. Any I/O Pin to GND.



Pin 4 to Pin 7 (TX+, TX-, RX+, RX- of USB 3.1/3.2)

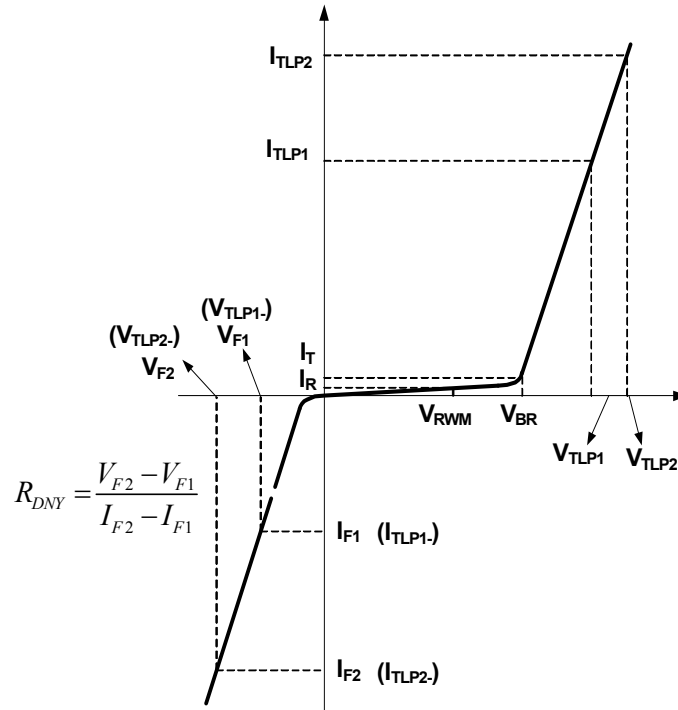
Symbol	Parameter	Conditions	Min.	Typ.	Max.	Units
V <sub>RWM</sub>	Reverse Working Voltage				5.5	V
V <sub>BR</sub>	Reverse Breakdown Voltage	I <sub>T</sub> = 100μA	6.6			
I <sub>R</sub>	Reverse Leakage Current	V <sub>T</sub> = Max, V <sub>RWM</sub>			100	nA
V <sub>F</sub>	Forward Voltage		0.7	0.85	0.95	V
V <sub>CL</sub>	Clamping Voltage <sup>(3)(4)</sup> (100ns Transmission Line Pulse)	I <sub>TLP</sub> = 1A I <sub>TLP</sub> = -1A		1.5 -1.5		V
		I <sub>TLP</sub> = 16A I <sub>TLP</sub> = -16A		6 -4		
R <sub>DNY</sub>	Dynamic Resistance <sup>(3)(4)</sup>	I <sub>TLP</sub> =1 to 16A I <sub>TLP</sub> =-1 to -16A			0.30 0.20	Ω
I <sub>PP</sub>	Peak Pulse Current <sup>(3)</sup> IEC61000-4-5 Surge 8/20μs	Any I/O Pin to GND GND to any I/O Pin			±6	A
V <sub>CL</sub>	Clamping Voltage <sup>(3)</sup> IEC61000-4-5 Surge 8/20μs	I <sub>PP</sub> =1A I <sub>PP</sub> =-1A		2 -2		V
		I <sub>PP</sub> =6A I <sub>PP</sub> =-6A		6 -5		
C <sub>J</sub>	Junction Capacitance	V <sub>I/O</sub> = 1.65V, f = 1MHz, Any I/O Pin to GND		0.4	0.6	pF

**Notes:**

3. These specifications are guaranteed by design and characterization.
4. Measurements performed using a 100ns Transmission Line Pulse (TLP) system.

## Electrical Characteristics

T<sub>A</sub> = 25°C unless otherwise specified. Pin 2 to GND.



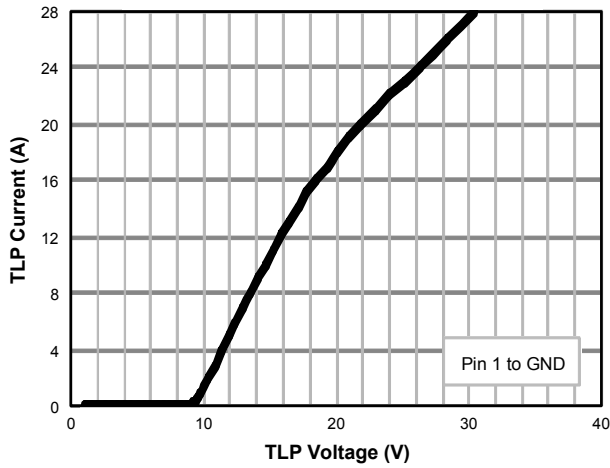
Pin 2 (VBUS)						
Symbol	Parameter	Conditions	Min.	Typ.	Max.	Units
V <sub>RWM</sub>	Reverse Working Voltage				5.5	V
V <sub>BR</sub>	Reverse Breakdown Voltage	I <sub>T</sub> = 1mA	6.6			
I <sub>R</sub>	Reverse Leakage Current	V <sub>T</sub> = Max, V <sub>RWM</sub>			1	μA
V <sub>F</sub>	Forward Voltage		0.7	0.85	0.95	V
V <sub>CL</sub>	Clamping Voltage <sup>(3)(4)</sup> (100ns Transmission Line Pulse)	I <sub>TLP</sub> = 1A I <sub>TLP</sub> = -1A		9 -1		V
		I <sub>TLP</sub> = 16A I <sub>TLP</sub> = -16A		12 -3		
R <sub>DNY</sub>	Dynamic Resistance <sup>(3)(4)</sup>	I <sub>TLP</sub> =1 to 16A I <sub>TLP</sub> =-1 to -16A			0.20 0.13	Ω
I <sub>PP</sub>	Peak Pulse Current <sup>(3)</sup> IEC61000-4-5 Surge 8/20μs	Any I/O Pin to GND GND to any I/O Pin			±15	A
V <sub>CL</sub>	Clamping Voltage <sup>(3)</sup> IEC61000-4-5 Surge 8/20μs	I <sub>PP</sub> =1A I <sub>PP</sub> =-1A		9 -1.3		V
		I <sub>PP</sub> =15A I <sub>PP</sub> =-15A		15 -3		
C <sub>J</sub>	Junction Capacitance	V <sub>I/O</sub> = 0V, f = 1MHz, Any I/O Pin to GND		120		pF

**Notes:**

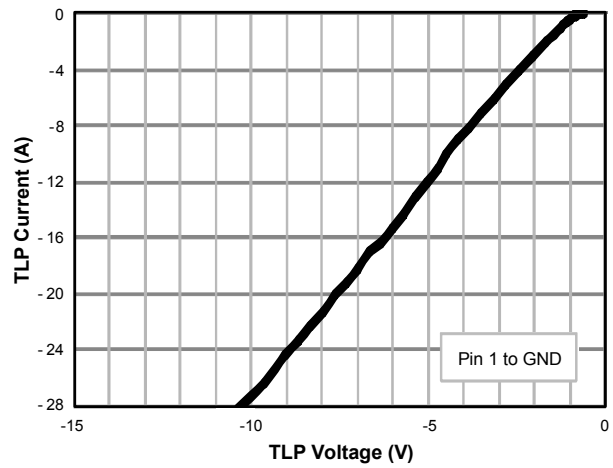
- 3. These specifications are guaranteed by design and characterization.
- 4. Measurements performed using a 100ns Transmission Line Pulse (TLP) system.

## Typical Performance Characteristics

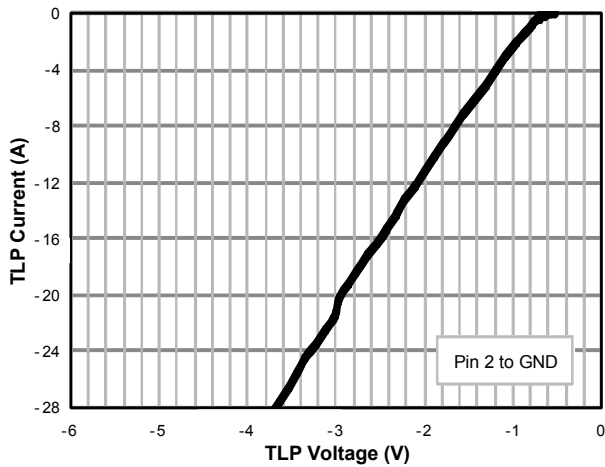
**Positive Transmission Line Pulse**  
( $t_p=100\text{ns}$ ,  $t_r=0.2\text{ns}$ )



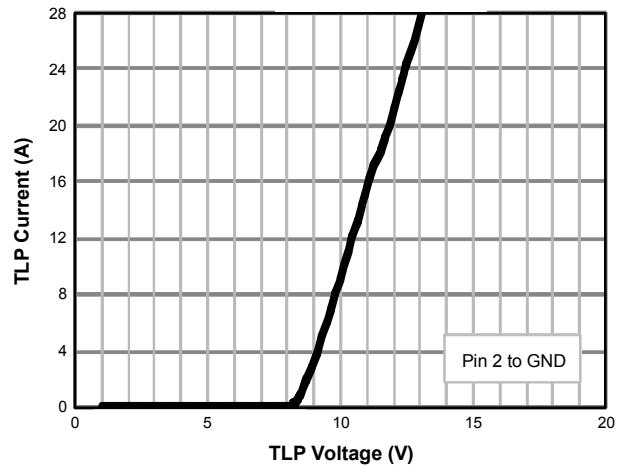
**Negative Transmission Line Pulse**  
( $t_p=100\text{ns}$ ,  $t_r=0.2\text{ns}$ )



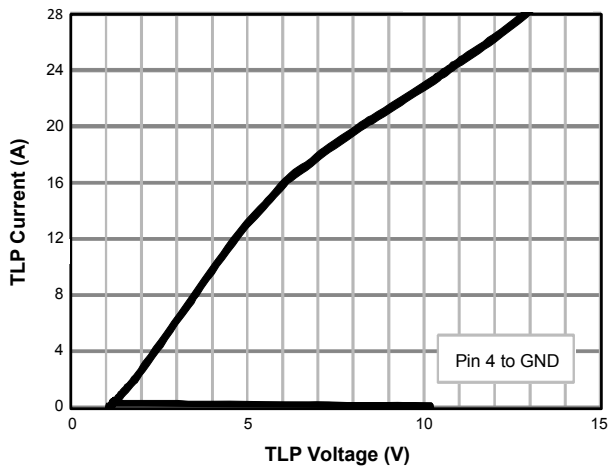
**Negative Transmission Line Pulse**  
( $t_p=100\text{ns}$ ,  $t_r=0.2\text{ns}$ )



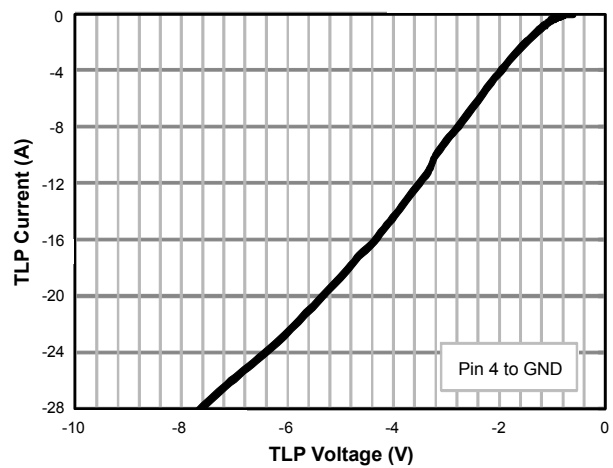
**Positive Transmission Line Pulse**  
( $t_p=100\text{ns}$ ,  $t_r=0.2\text{ns}$ )



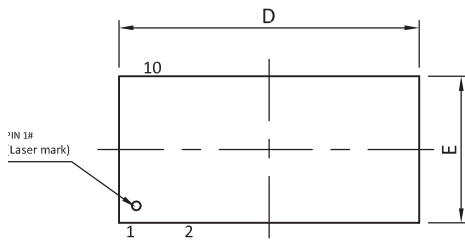
**Positive Transmission Line Pulse**  
( $t_p=100\text{ns}$ ,  $t_r=0.2\text{ns}$ )



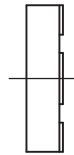
**Negative Transmission Line Pulse**  
( $t_p=100\text{ns}$ ,  $t_r=0.2\text{ns}$ )



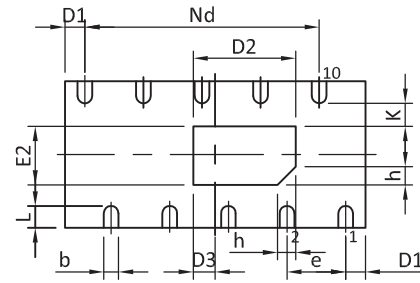
Package Dimensions, DFN4.1x2.0-10L, EP1\_S



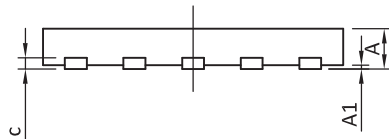
TOP VIEW



SIDE VIEW



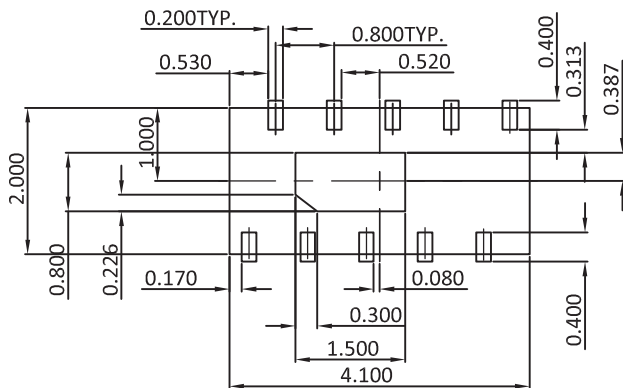
BOTTOM VIEW



SIDE VIEW

SYMBOLS	DIMENSION IN MILLIMETRES			DIMENSION IN INCHS		
	MIN.	NOM.	MAX.	MIN.	NOM.	MAX.
A	0.45	0.50	0.55	0.018	0.020	0.022
A1	---	0.02	0.05	----	0.001	0.002
b	0.15	0.20	0.25	0.006	0.008	0.010
c	0.10	0.15	0.20	0.004	0.006	0.008
D	4.00	4.10	4.20	0.157	0.161	0.165
D1	0.20	0.25	0.30	0.008	0.010	0.012
D2	1.30	1.40	1.50	0.051	0.055	0.059
D3	0.25	0.30	0.35	0.010	0.012	0.014
e	0.80 BSC			0.031 BSC		
Nd	3.20 BSC			0.126 BSC		
E	1.90	2.00	2.10	0.075	0.079	0.083
E2	0.70	0.80	0.90	0.028	0.031	0.035
K	0.20	---	---	0.008	----	----
L	0.25	0.30	0.35	0.010	0.012	0.014
h	0.15	0.20	0.25	0.006	0.008	0.010

LAND PATTERN RECOMMENDATIONS



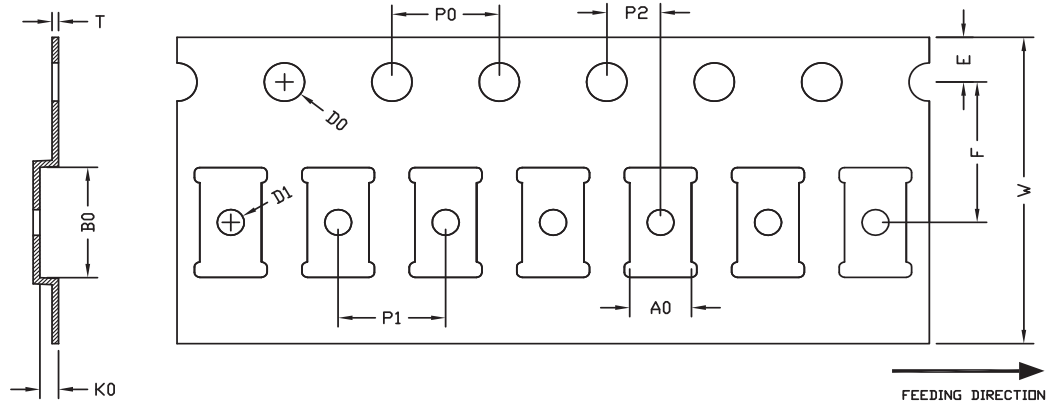
UNIT: mm

NOTES

1. CONTROLLING DIMENSION IS MILLIMETER.  
CONVERTED INCH DIMENSIONS ARE NOT NECESSARILY EXACT.

### Tape and Reel Dimensions, DFN4.1x2.0-10L, EP1\_S

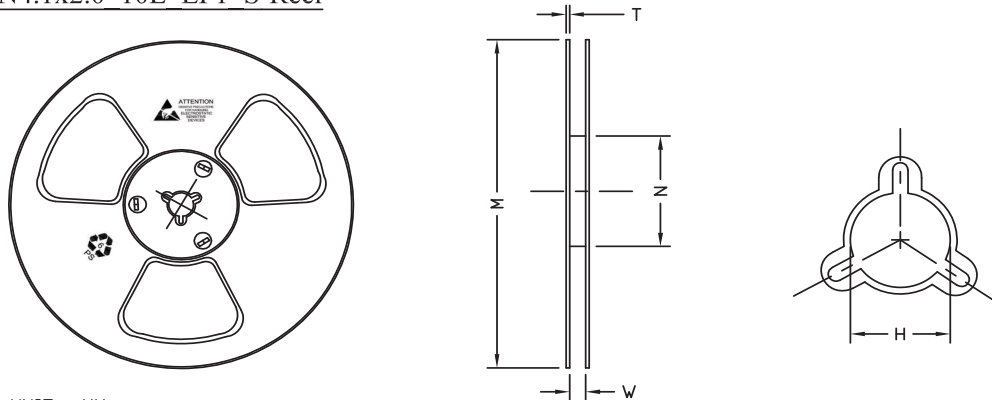
DFN4.1x2.0 10L EP1 S Carrier Tape



UNIT: MM

PACKAGE	A0	B0	K0	D0	D1	W	E	F	P0	P1	P2	T
DFN4.1x2.0	2.30 ±0.05	4.30 ±0.05	0.70 ±0.05	1.50 <sup>+0.1</sup> <sub>-0.0</sub>	1.00 Min.	12.00 <sup>+0.30</sup> <sub>-0.10</sub>	1.75 ±0.10	5.50 ±0.05	4.00 ±0.10	4.00 ±0.10	2.00 ±0.05	0.25 ±0.03

DFN4.1x2.0 10L EP1 S Reel



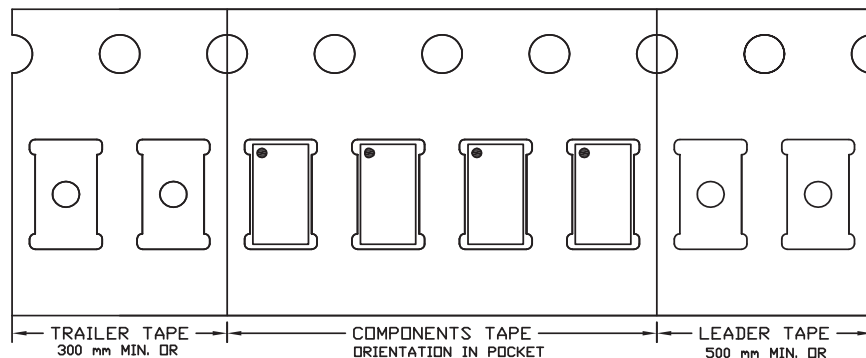
UNIT: MM

TAPE SIZE	REEL SIZE	M	N	W	T	H	K	S	G	R	V
12 mm	φ329	φ329.00 ±1.00	φ100.00 ±1.00	12.80 ±1.00	2.00 ±0.30	φ13.30 ±0.30	---	---	---	---	---

DFN4.1x2.0 10L EP1 S Package Tape

Leader / Trailer  
& Orientation

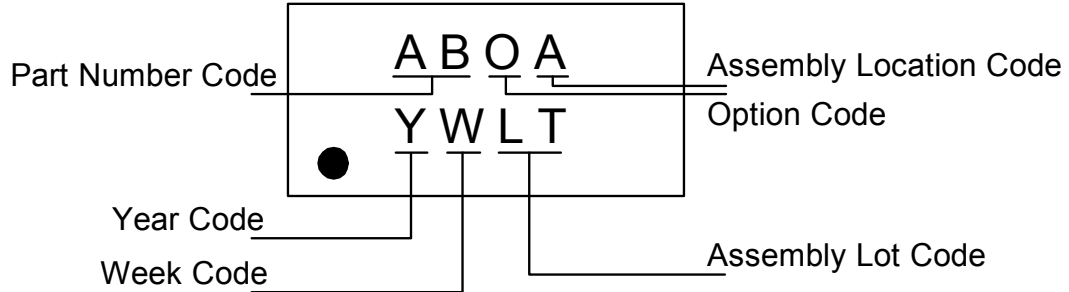
Unit Per Reel:  
6000pcs





**Part Marking**

**AOZ8936DI**  
**(DFN4.1x2.0\_10L)**



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- 2. A critical component in any component of a life support, device, or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.