

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

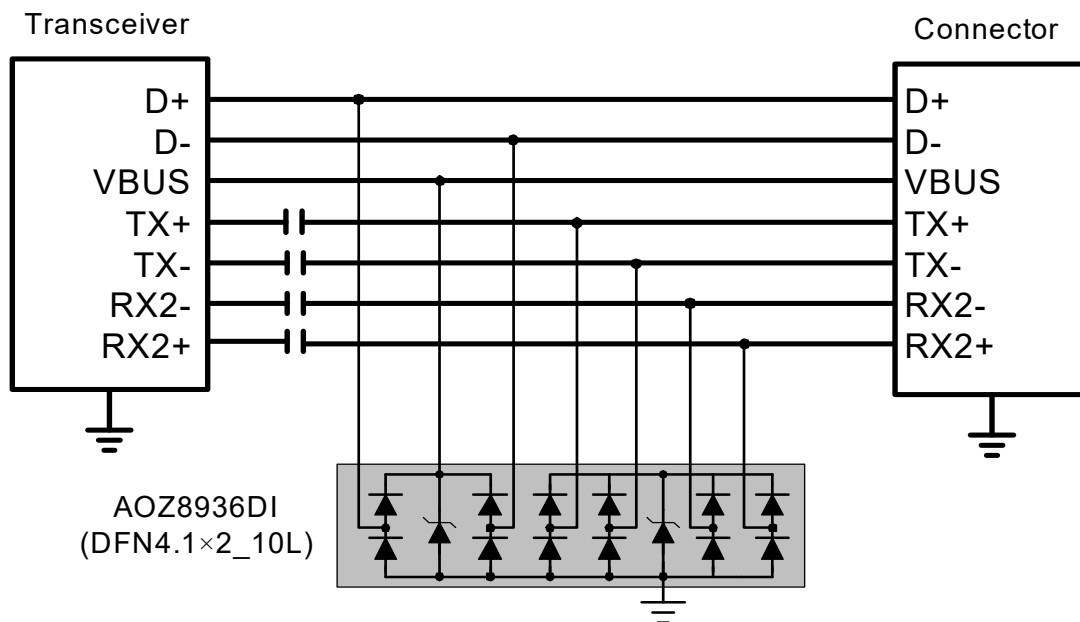
- IEC61000-4-2, ESD immunity (Contact/Air):
 - ± 30/30 kV (USB 3.1)
 - ± 24/30 kV (USB 2.0)
 - ± 30/30 kV (VBUS)
- IEC61000-4-5, Surge Immunity (8/20µs):
 - ± 6 A (USB 3.1)
 - ± 4 A (USB 2.0)
 - ± 15 A (VBUS)
- Capacitance between I/O to GND:
 - 0.4pF (USB 3.1)
 - 1.75pF (USB 2.0)
 - 120pF (VBUS)

Applications

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



Typical Application



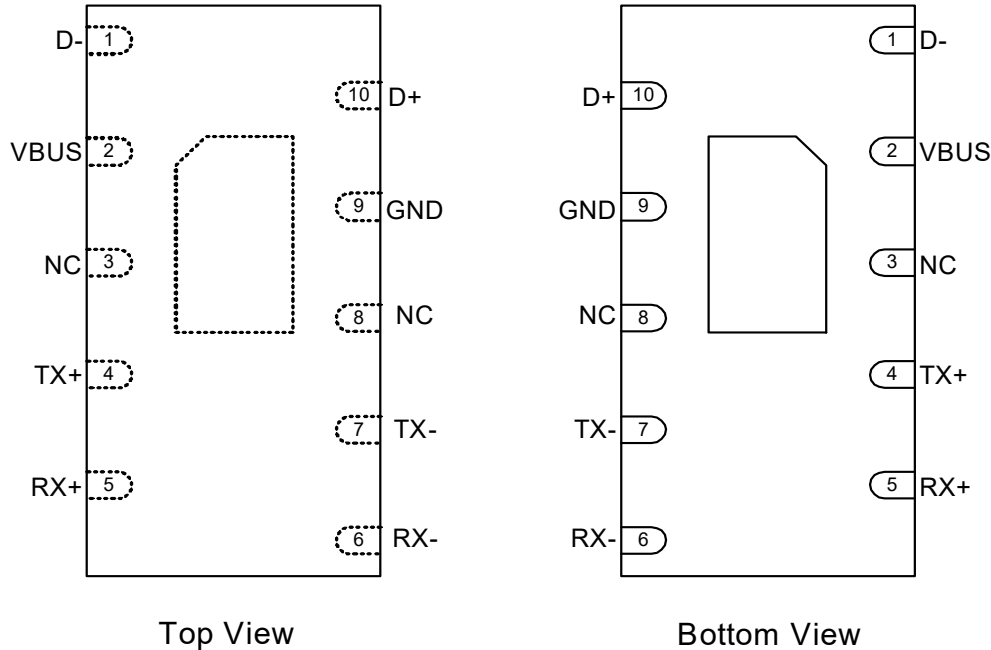
Ordering Information

| 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 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 ⁽¹⁾ | ±24 kV | ±30 kV | ±30 kV |
| ESD Rating per IEC61000-4-2, air ⁽¹⁾ | ±30 kV | ±30 kV | ±30 kV |
| 8/20µs Surge IEC61000-4-5 | ±4 A | ±6 A | ±15 kV |

Notes:

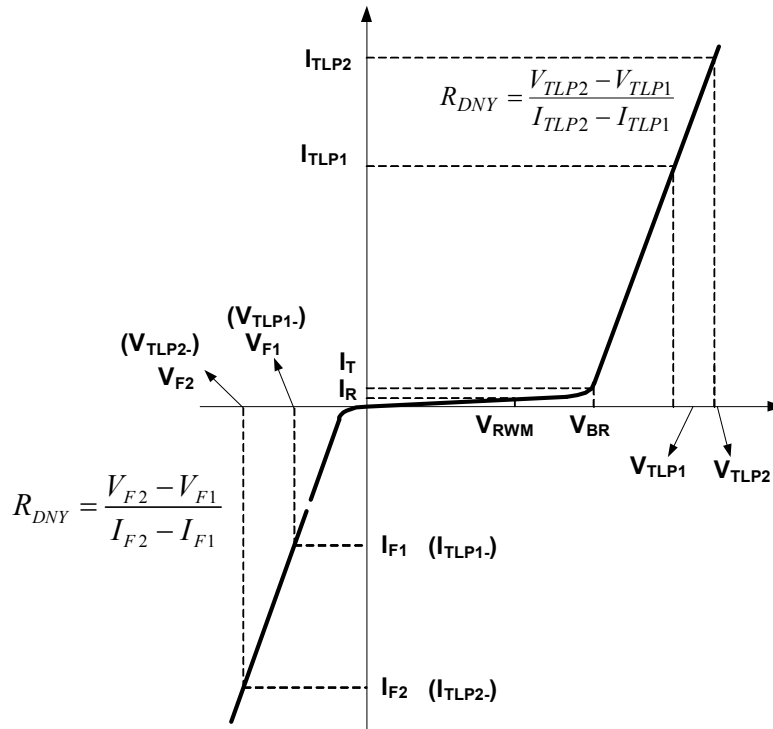
- IEC 61000-4-2 discharge with $C_{Discharge} = 150\text{pF}$, $R_{Discharge} = 330\Omega$.
- Human Body Discharge per MIL-STD-883, Method 3015 $C_{Discharge} = 100\text{pF}$, $R_{Discharge} = 1.5\text{k}\Omega$.

Maximum Operating Ratings

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

Electrical Characteristics

T_A = 25°C unless otherwise specified. Any I/O Pin to GND.



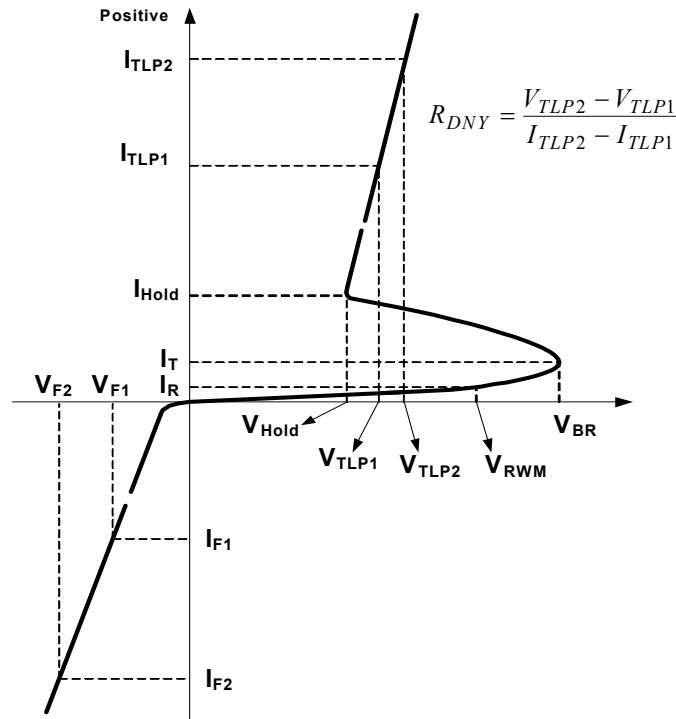
| Pin1 & Pin 10 (D+, D- of USB 2.0) | | | | | | |
|-----------------------------------|---|--|------|--------------|--------------|-------|
| Symbol | Parameter | Conditions | Min. | Typ. | Max. | Units |
| V _{RWM} | Reverse Working Voltage | | | | 5.5 | V |
| V _{BR} | Reverse Breakdown Voltage | I _T = 100μA | 6.6 | | | V |
| I _R | Reverse Leakage Current | V _T = Max, V _{RWM} | | | 1 | μA |
| V _F | Forward Voltage | | 0.7 | 0.85 | 0.95 | V |
| V _{CL} | Clamping Voltage ⁽³⁾⁽⁴⁾ (100ns Transmission Line Pulse) | I _{TLP} = 1A I _{TLP} = -1A | | 11 -1.5 | | V |
| | | I _{TLP} = 16A I _{TLP} = -16A | | 18 -7.5 | | |
| R _{DNY} | Dynamic Resistance ⁽³⁾⁽⁴⁾ | I _{TLP} = 1A to 16A I _{TLP} = -1A to -16A | | | 0.45 0.40 | Ω |
| I _{PP} | Peak Pulse Current ⁽³⁾ IEC61000-4-5 Surge 8/20μs | Any I/O Pin to GND GND to any I/O Pin | | | ±4 | A |
| V _{CL} | Clamping Voltage ⁽³⁾ IEC61000-4-5 Surge 8/20μs | I _{PP} = 1A I _{PP} = -1A | | 10 -2 | | V |
| | | I _{PP} = 4A I _{PP} = -4A | | 12.5 -4.5 | | |
| C _j | Junction Capacitance ⁽³⁾ | V _{BUS} =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_A = 25°C unless otherwise specified. Any I/O Pin to GND.



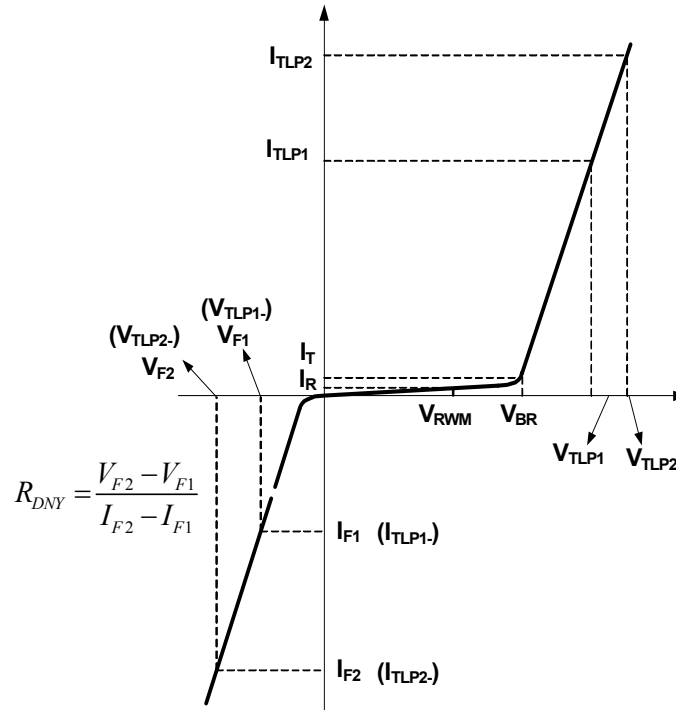
| Pin 4 to Pin 7 (TX+, TX-, RX+, RX- of USB 3.1/3.2) | | | | | | |
|--|---|--|------|-------------|--------------|-------|
| Symbol | Parameter | Conditions | Min. | Typ. | Max. | Units |
| V _{RWM} | Reverse Working Voltage | | | | 5.5 | V |
| V _{BR} | Reverse Breakdown Voltage | I _T = 100µA | 6.6 | | | |
| I _R | Reverse Leakage Current | V _T = Max, V _{RWM} | | | 100 | nA |
| V _F | Forward Voltage | | 0.7 | 0.85 | 0.95 | V |
| V _{CL} | Clamping Voltage ⁽³⁾⁽⁴⁾ (100ns Transmission Line Pulse) | I _{TLP} = 1A I _{TLP} = -1A | | 1.5 -1.5 | | V |
| | | I _{TLP} = 16A I _{TLP} = -16A | | 6 -4 | | |
| R _{DNY} | Dynamic Resistance ⁽³⁾⁽⁴⁾ | I _{TLP} =1 to 16A I _{TLP} =-1 to -16A | | | 0.30 0.20 | Ω |
| I _{PP} | Peak Pulse Current ⁽³⁾ IEC61000-4-5 Surge 8/20µs | Any I/O Pin to GND GND to any I/O Pin | | | ±6 | A |
| V _{CL} | Clamping Voltage ⁽³⁾ IEC61000-4-5 Surge 8/20µs | I _{PP} =1A I _{PP} =-1A | | 2 -2 | | V |
| | | I _{PP} =6A I _{PP} =-6A | | 6 -5 | | |
| C _J | Junction Capacitance | V _{I/O} = 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_A = 25°C unless otherwise specified. Pin 2 to GND.



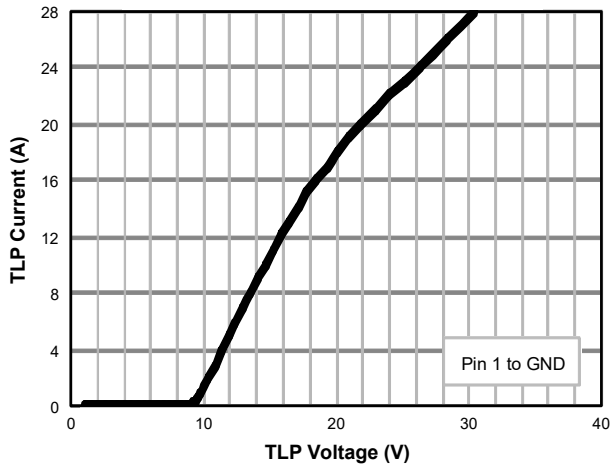
| Pin 2 (VBUS) | | | | | | |
|------------------|---|--|------|-----------|--------------|-------|
| Symbol | Parameter | Conditions | Min. | Typ. | Max. | Units |
| V _{RWM} | Reverse Working Voltage | | | | 5.5 | V |
| V _{BR} | Reverse Breakdown Voltage | I _T = 1mA | 6.6 | | | |
| I _R | Reverse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

Notes:

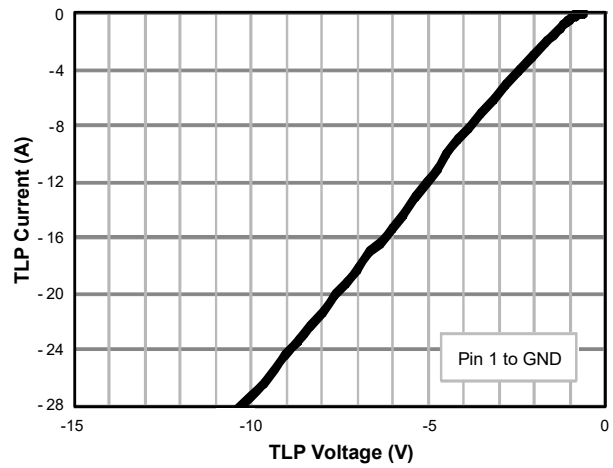
- 3. These specifications are guaranteed by design and characterization.
- 4. Measurements performed using a 100ns Transmission Line Pulse (TLP) system.

Typical Performance Characteristics

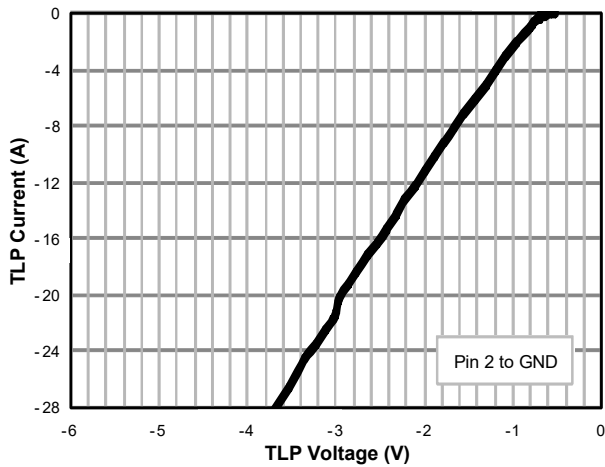
Positive Transmission Line Pulse
($t_p=100\text{ns}$, $t_r=0.2\text{ns}$)



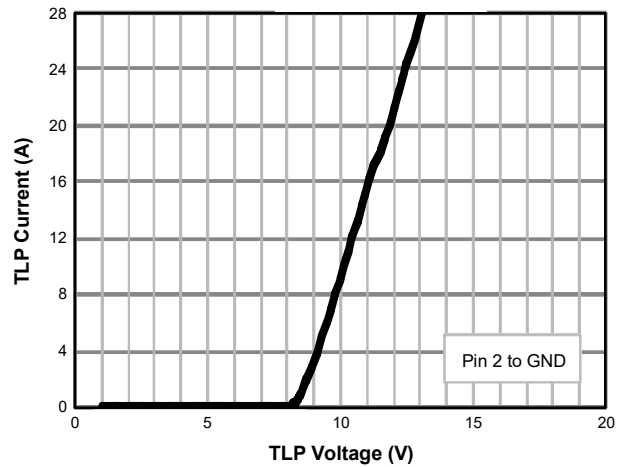
Negative Transmission Line Pulse
($t_p=100\text{ns}$, $t_r=0.2\text{ns}$)



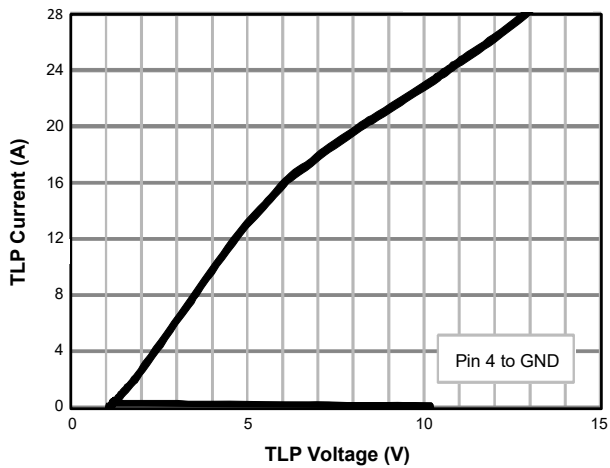
Negative Transmission Line Pulse
($t_p=100\text{ns}$, $t_r=0.2\text{ns}$)



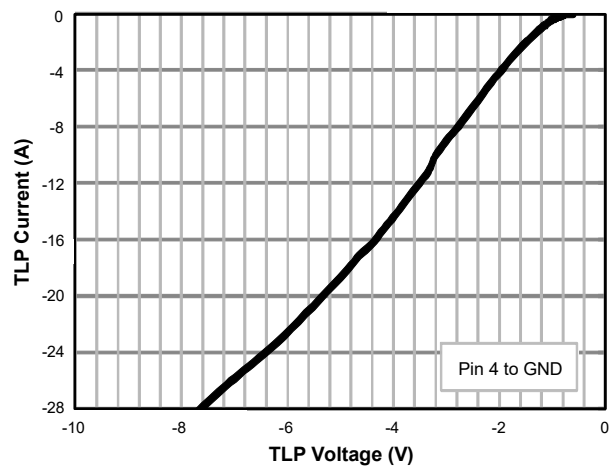
Positive Transmission Line Pulse
($t_p=100\text{ns}$, $t_r=0.2\text{ns}$)



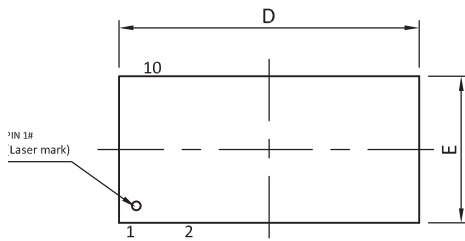
Positive Transmission Line Pulse
($t_p=100\text{ns}$, $t_r=0.2\text{ns}$)



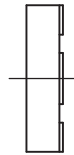
Negative Transmission Line Pulse
($t_p=100\text{ns}$, $t_r=0.2\text{ns}$)



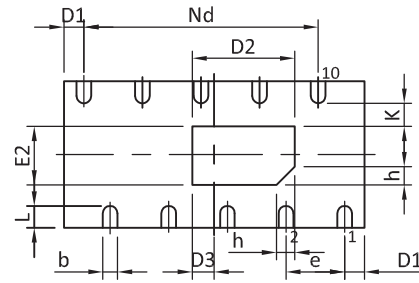
Package Dimensions, DFN4.1x2.0-10L, EP1_S



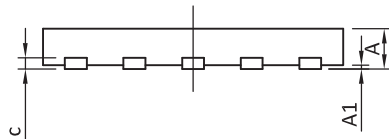
TOP VIEW



SIDE VIEW



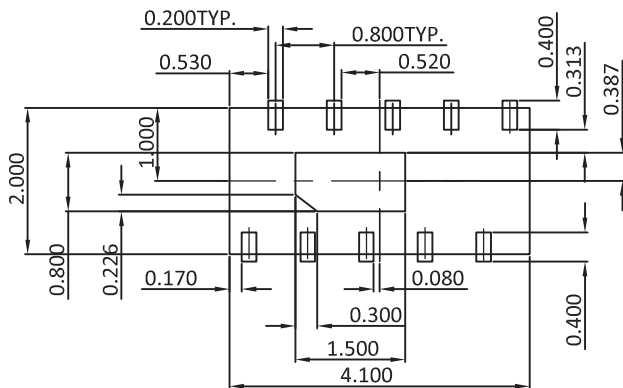
BOTTOM VIEW



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



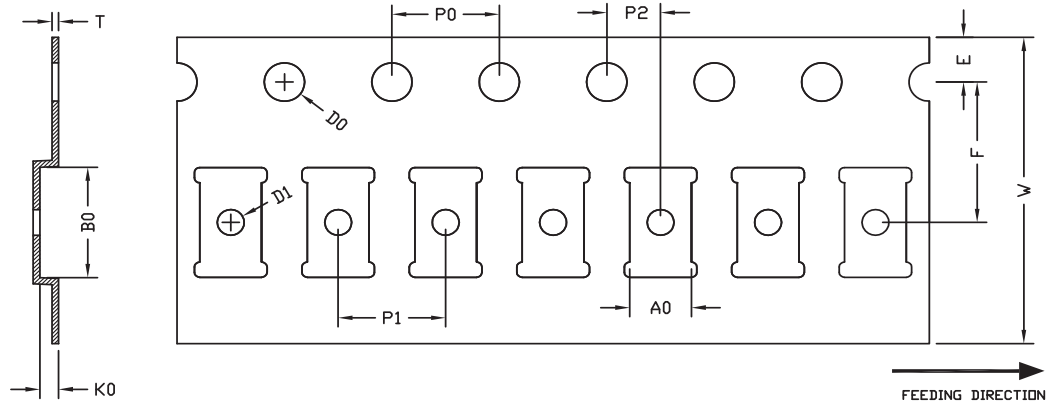
UNIT: mm

NOTES

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

Tape and Reel Dimensions, DFN4.1x2.0-10L, EP1_S

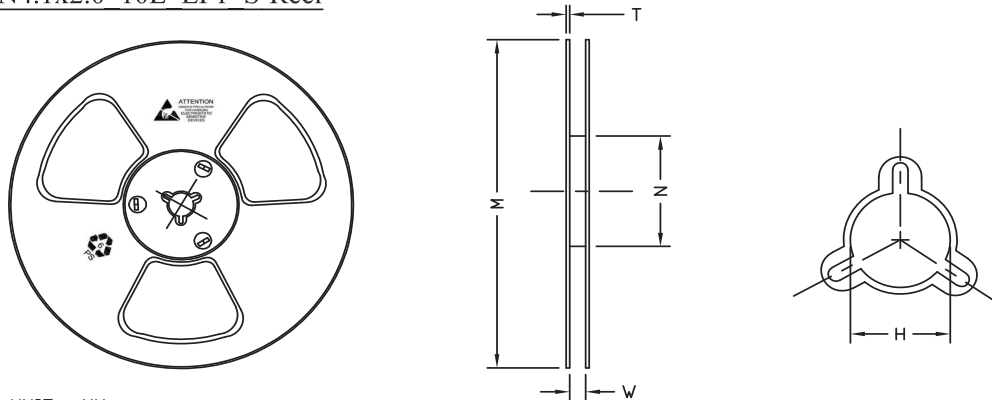
DFN4.1x2.0 10L EP1 S Carrier Tape



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 ^{+0.1} _{-0.0} | 1.00 Min. | 12.00 ^{+0.30} _{-0.10} | 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



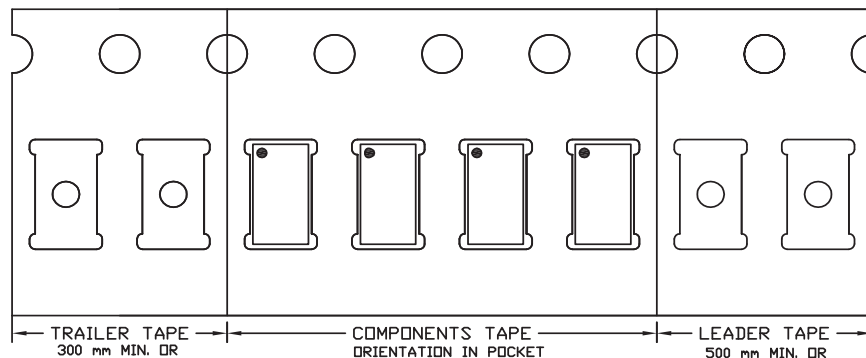
UNIT: MM

| 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

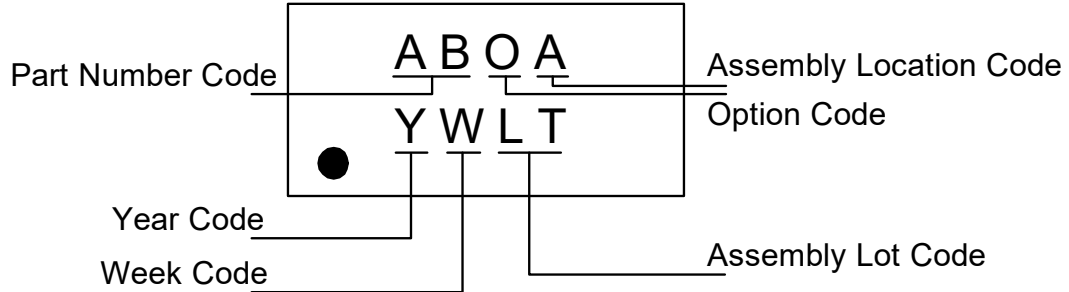
Leader / Trailer
& Orientation

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.

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