

AQxx Series 450W Discrete Unidirectional TVS Diode

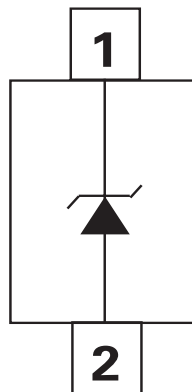


Description

The unidirectional AQxx series is designed to replace multilayer varistors (MLVs) in electronic equipment for low speed and DC applications. It will protect any sensitive equipment from damage due to electrostatic discharge (ESD) and other transient events.

The AQxx series can safely absorb repetitive ESD strikes at $\pm 30\text{kV}$ (contact discharge, IEC 61000-4-2) without performance degradation and safely dissipate 30A (AQ05) of 8/20 μs induced surge current (IEC 61000-4-5) with very low clamping voltages.

Pinout and Functional Block Diagram



Features

- ESD, IEC 61000-4-2, $\pm 30\text{kV}$ contact, $\pm 30\text{kV}$ air
- EFT, IEC 61000-4-4, 40A (5/50ns)
- Lightning, IEC 61000-4-5 2nd edition, 30A ($t_p=8/20\mu\text{s}$, AQ05)
- Low clamping voltage
- Low leakage current
- Small SOD323 package fits 0805 footprints
- AEC-Q101 qualified
- Moisture Sensitivity Level(MSL -1)
- Halogen free, lead free and RoHS compliant

Applications

- Switches / Buttons
- Test Equipment / Instrumentation
- Point-of-Sale Terminals
- Medical Equipment
- Notebooks / Desktops / Servers
- Computer Peripherals
- CAN Bus protection
- Automotive applications

Life Support Note:

Not Intended for Use in Life Support or Life Saving Applications

The products shown herein are not designed for use in life sustaining or life saving applications unless otherwise expressly indicated.

Absolute Maximum Ratings

| Symbol | Parameter | Value | Units |
|------------|--------------------------------------|------------|-------|
| P_{pk} | Peak Pulse Power ($t_p=8/20\mu s$) | 450 | W |
| T_{OP} | Operating Temperature | -40 to 150 | °C |
| T_{STOR} | Storage Temperature | -55 to 150 | °C |

Notes:

CAUTION: Stresses above those listed in "Absolute Maximum Ratings" may cause permanent damage to the component. This is a stress only rating and operation of the component at these or any other conditions above those indicated in the operational sections of this specification is not implied.

AQ05 Electrical Characteristics ($T_{OP}=25^\circ C$)

| Parameter | Symbol | Test Conditions | Min | Typ | Max | Units |
|------------------------------------|------------|--------------------------------------|----------|------|------|----------|
| Reverse Standoff Voltage | V_{RWM} | $I_R \leq 1\mu A$ | | | 5.0 | V |
| Reverse Voltage Drop | V_R | $I_R = 1mA$ | 6.0 | | | V |
| Leakage Current | I_{LEAK} | $V_R = 5V$ | | | 1.0 | μA |
| Clamp Voltage ¹ | V_C | $I_{PP} = 1A, t_p = 8/20\mu s, Fwd$ | | | 9.8 | V |
| | | $I_{PP} = 10A, t_p = 8/20\mu s, Fwd$ | | | 13.0 | V |
| Dynamic Resistance ² | R_{DYN} | TLP, $t_p = 100ns$, I/O to Ground | | 0.22 | | Ω |
| Peak Pulse Current | I_{PP} | $t_p = 8/20\mu s$ | | | 30.0 | A |
| ESD Withstand Voltage ¹ | V_{ESD} | IEC 61000-4-2 (Contact Discharge) | ± 30 | | | kV |
| | | IEC 61000-4-2 (Air Discharge) | ± 30 | | | kV |
| Diode Capacitance ¹ | C_D | Reverse Bias=0V, f=1MHz | | | 350 | pF |

AQ12 Electrical Characteristics ($T_{OP}=25^\circ C$)

| Parameter | Symbol | Test Conditions | Min | Typ | Max | Units |
|------------------------------------|-------------|--------------------------------------|----------|------|------|----------|
| Reverse Standoff Voltage | V_{RWM} | $I_R \leq 1\mu A$ | | | 12.0 | V |
| Reverse Voltage Drop | V_R | $I_R = 1mA$ | 13.3 | | | V |
| Leakage Current | I_{LEAK} | $V_R = 12V$ | | | 1.0 | μA |
| Clamp Voltage ¹ | V_C | $I_{PP} = 1A, t_p = 8/20\mu s, Fwd$ | | | 18.5 | V |
| | | $I_{PP} = 10A, t_p = 8/20\mu s, Fwd$ | | | 22.5 | V |
| Dynamic Resistance ² | R_{DYN} | TLP, $t_p = 100ns$, I/O to Ground | | 0.29 | | Ω |
| Peak Pulse Current | I_{PP} | $t_p = 8/20\mu s$ | | | 17.0 | A |
| ESD Withstand Voltage ¹ | V_{ESD} | IEC 61000-4-2 (Contact Discharge) | ± 30 | | | kV |
| | | IEC 61000-4-2 (Air Discharge) | ± 30 | | | kV |
| Diode Capacitance ¹ | C_{D-GND} | Reverse Bias=0V, f=1MHz | | | 150 | pF |

AQ15 Electrical Characteristics (T_{op}=25°C)

| Parameter | Symbol | Test Conditions | Min | Typ | Max | Units |
|------------------------------------|----------------------|---|------|------|------|-------|
| Reverse Standoff Voltage | V _{RWM} | I _R ≤ 1 μA | | | 15.0 | V |
| Reverse Voltage Drop | V _R | I _R = 1 mA | 16.7 | | | V |
| Leakage Current | I _{LEAK} | V _R = 15V | | | 1.0 | μA |
| Clamp Voltage ¹ | V _C | I _{PP} = 1A, t _p = 8/20μs, Fwd | | | 24.0 | V |
| | | I _{PP} = 10A, t _p = 8/20μs, Fwd | | | 30.0 | V |
| Dynamic Resistance ² | R _{DYN} | TLP, tp=100ns, I/O to Ground | | 0.34 | | Ω |
| Peak Pulse Current | I _{PP} | t _p = 8/20μs | | | 12.0 | A |
| ESD Withstand Voltage ¹ | V _{ESD} | IEC 61000-4-2 (Contact Discharge) | ±30 | | | kV |
| | | IEC 61000-4-2 (Air Discharge) | ±30 | | | kV |
| Diode Capacitance ¹ | C _{I/O-GND} | Reverse Bias=0V, f=1MHz | | | 100 | pF |

AQ24 Electrical Characteristics (T_{op}=25°C)

| Parameter | Symbol | Test Conditions | Min | Typ | Max | Units |
|------------------------------------|----------------------|--|------|------|------|-------|
| Reverse Standoff Voltage | V _{RWM} | I _R ≤ 1 μA | | | 24.0 | V |
| Reverse Voltage Drop | V _R | I _R = 1 mA | 26.7 | | | V |
| Leakage Current | I _{LEAK} | V _R = 24V | | | 1.0 | μA |
| Clamp Voltage ¹ | V _C | I _{PP} = 1A, t _p = 8/20μs, Fwd | | | 34.0 | V |
| | | I _{PP} = 5A, t _p = 8/20μs, Fwd | | | 42.0 | V |
| Dynamic Resistance ² | R _{DYN} | TLP, tp=100ns, I/O to Ground | | 0.49 | | Ω |
| Peak Pulse Current | I _{PP} | t _p = 8/20μs | | | 7.0 | A |
| ESD Withstand Voltage ¹ | V _{ESD} | IEC 61000-4-2 (Contact Discharge) | ±30 | | | kV |
| | | IEC 61000-4-2 (Air Discharge) | ±30 | | | kV |
| Diode Capacitance ¹ | C _{I/O-GND} | Reverse Bias=0V, f=1MHz | | | 65 | pF |

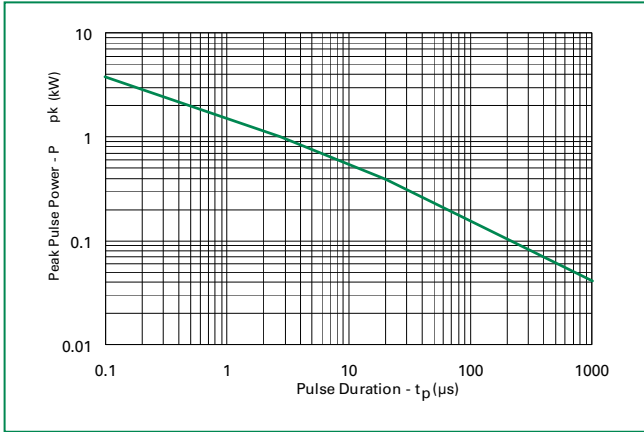
AQ36 Electrical Characteristics (T_{op}=25°C)

| Parameter | Symbol | Test Conditions | Min | Typ | Max | Units |
|------------------------------------|----------------------|--|------|------|------|-------|
| Reverse Standoff Voltage | V _{RWM} | I _R ≤ 1 μA | | | 36.0 | V |
| Reverse Voltage Drop | V _R | I _R = 1 mA | 40.0 | | | V |
| Leakage Current | I _{LEAK} | V _R = 36V | | | 1.0 | μA |
| Clamp Voltage ¹ | V _C | I _{PP} = 1A, t _p = 8/20μs, Fwd | | | 50.0 | V |
| | | I _{PP} = 5A, t _p = 8/20μs, Fwd | | | 62.0 | V |
| Dynamic Resistance ² | R _{DYN} | TLP, tp=100ns, I/O to Ground | | 0.61 | | Ω |
| Peak Pulse Current | I _{PP} | t _p = 8/20μs | | | 5.0 | A |
| ESD Withstand Voltage ¹ | V _{ESD} | IEC 61000-4-2 (Contact Discharge) | ±30 | | | kV |
| | | IEC 61000-4-2 (Air Discharge) | ±30 | | | kV |
| Diode Capacitance ¹ | C _{I/O-GND} | Reverse Bias=0V, f=1MHz | | | 50 | pF |

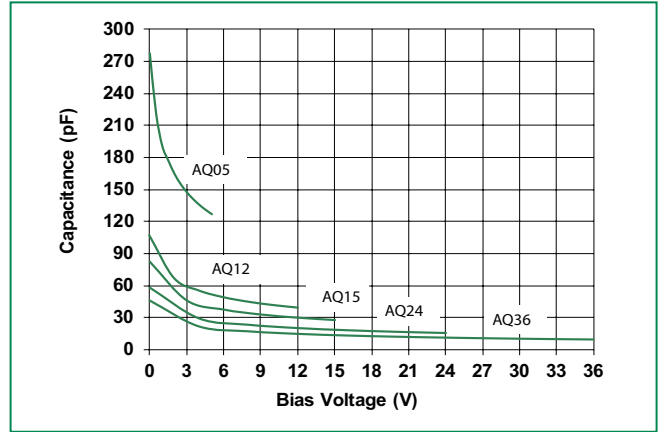
Note:

- Parameter is guaranteed by design and/or component characterization.
- Transmission Line Pulse (TLP) with 100ns width, 2ns rise time, and average window t1=70ns to t2= 90ns

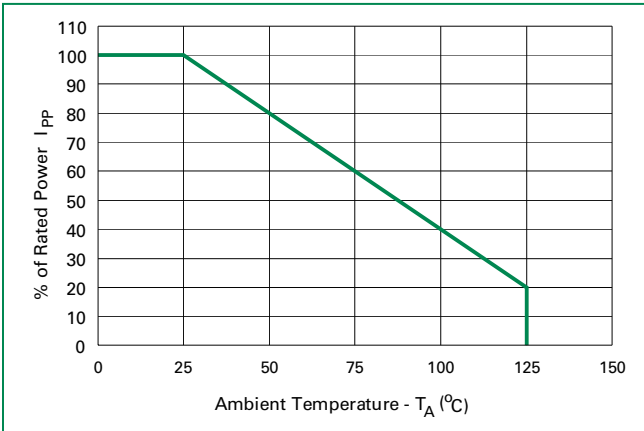
Non-Repetitive Peak Pulse Power vs. Pulse Time



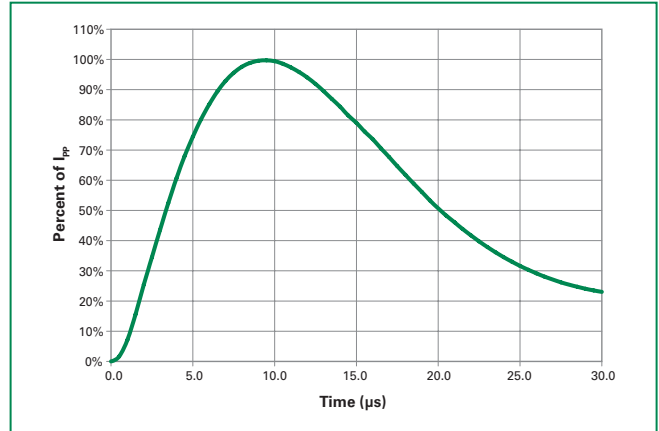
Capacitance vs. Bias



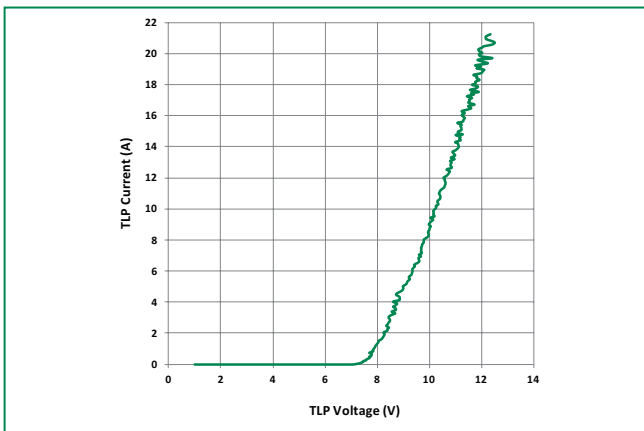
Power Derating Curve



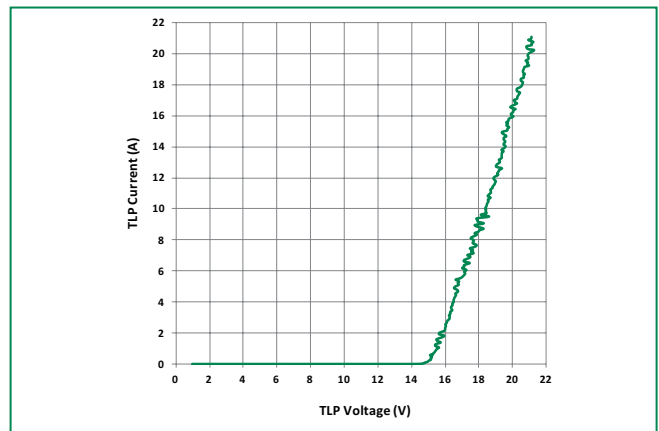
8/20μs Pulse Waveform



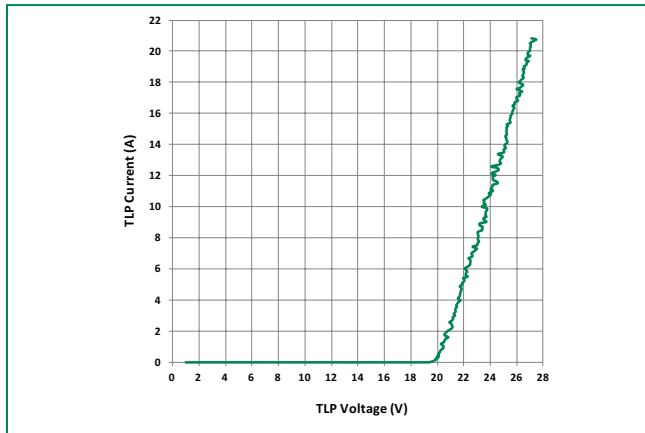
AQ05 Transmission Line Pulsing(TLP) Plot



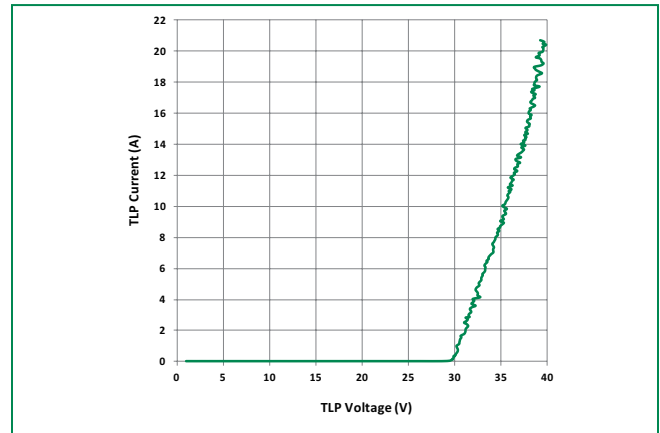
AQ12 Transmission Line Pulsing(TLP) Plot



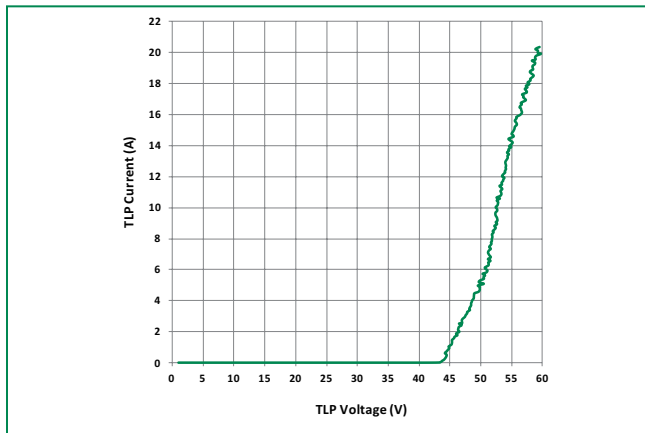
AQ15 Transmission Line Pulsing(TLP) Plot



AQ24 Transmission Line Pulsing(TLP) Plot



AQ36 Transmission Line Pulsing(TLP) Plot



Product Characteristics

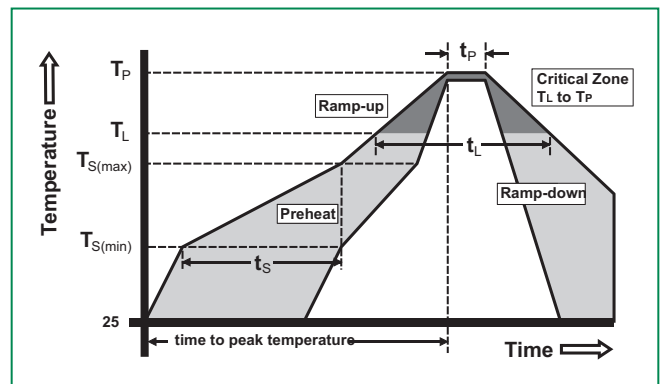
| | |
|---------------------------|--|
| Lead Plating | Matte Tin |
| Lead Material | Copper Alloy |
| Lead Coplanarity | 0.0004 inches (0.102mm) |
| Substrate material | Silicon |
| Body Material | Molded Epoxy |
| Flammability | UL Recognized epoxy meeting flammability rating V-0. |

Notes :

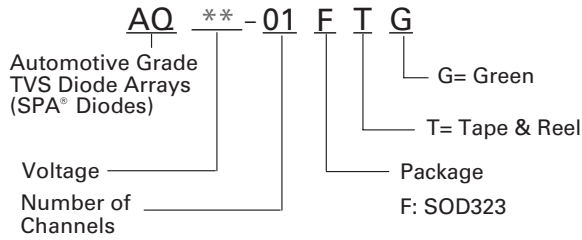
1. All dimensions are in millimeters
2. Dimensions include solder plating.
3. Dimensions are exclusive of mold flash & metal burr.
4. Blo is facing up for mold and facing down for trim/form, i.e. reverse trim/form.
5. Package surface matte finish VDI 11-13.

Soldering Parameters

| | | |
|--|------------------------------------|-------------------------|
| Reflow Condition | Pb – Free assembly | |
| Pre Heat | - Temperature Min ($T_{s(min)}$) | 150°C |
| | - Temperature Max ($T_{s(max)}$) | 200°C |
| | - Time (min to max) (t_s) | 60 – 180 secs |
| Average ramp up rate (Liquidus) Temp (T_L) to peak | | 3°C/second max |
| $T_{s(max)}$ to T_L - Ramp-up Rate | | 3°C/second max |
| Reflow | - Temperature (T_L) (Liquidus) | 217°C |
| | - Temperature (t_L) | 60 – 150 seconds |
| Peak Temperature (T_p) | | 260 ^{+0/-5} °C |
| Time within 5°C of actual peak Temperature (t_p) | | 20 – 40 seconds |
| Ramp-down Rate | | 6°C/second max |
| Time 25°C to peak Temperature (T_p) | | 8 minutes Max. |
| Do not exceed | | 260°C |



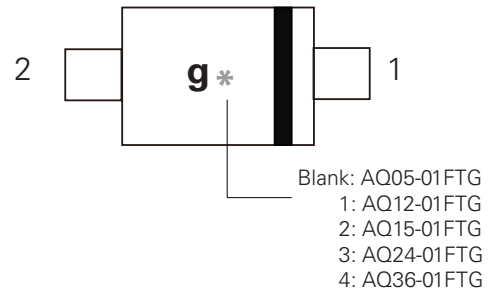
Part Numbering System



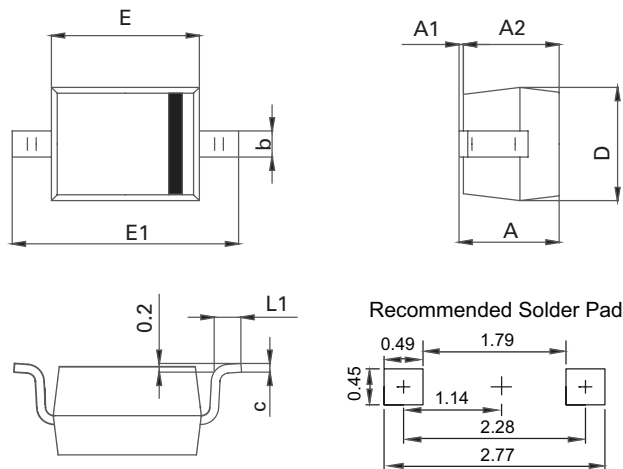
Ordering Information

| Part Number | Package | Marking | Min. Order Qty. |
|-------------|---------|---------|-----------------|
| AQ05-01FTG | SOD323 | g | 3000 |
| AQ12-01FTG | SOD323 | g1 | 3000 |
| AQ15-01FTG | SOD323 | g2 | 3000 |
| AQ24-01FTG | SOD323 | g3 | 3000 |
| AQ36-01FTG | SOD323 | g4 | 3000 |

Part Marking System



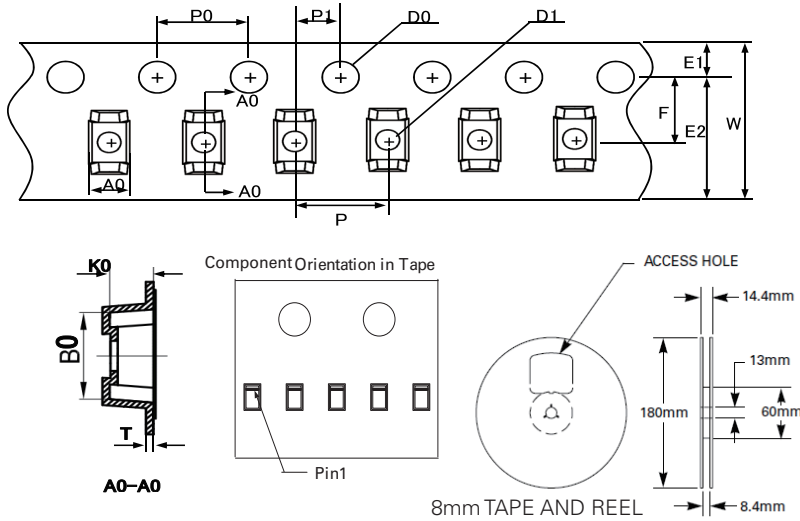
Package Dimensions -SOD323



Unit: mm

| Symbol | SOD323 | | | |
|-----------|-------------|------|--------|-------|
| | Millimeters | | Inches | |
| | Min | Max | Min | Max |
| A | 0.80 | 1.14 | 0.031 | 0.045 |
| A1 | 0.00 | 0.10 | 0.000 | 0.004 |
| A2 | 0.80 | 1.04 | 0.031 | 0.014 |
| b | 0.25 | 0.35 | 0.010 | 0.014 |
| c | 0.08 | 0.15 | 0.003 | 0.006 |
| D | 1.15 | 1.45 | 0.045 | 0.057 |
| E | 1.60 | 1.90 | 0.063 | 0.075 |
| E1 | 2.44 | 2.70 | 0.096 | 0.106 |
| L1 | 0.25 | 0.45 | 0.010 | 0.018 |

Embossed Carrier Tape & Reel Specification – SOD323



| Symbol | Millimeters |
|--------|-------------------|
| A0 | 1.36min/1.62max |
| B0 | 2.90+/-0.10 |
| W | 8.0+0.3/-0.10 |
| D0 | 1.50+0.10 |
| D1 | ø1.00min/ø1.25max |
| E | 1.75+/-0.10 |
| E2 | - |
| F | 3.50+/-0.05 |
| P0 | 4.00+/-0.10 |
| P | 4.00+/-0.10 |
| P1 | 2.00+/-0.05 |
| K0 | 1.15min/1.45max |
| T | 0.254+/-0.13 |

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