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# TVS Diode Arrays (SPA® Diodes)

## Low Capacitance ESD Protection - SP0502B Series

## SP0502B Series 1pF 15kV Diode Arrays

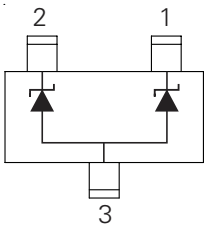
AUTOMOTIVE GRADE | RoHS | Pb | GREEN

## Description

The SP0502B is a low capacitance TVS diode array designed to protect high-speed data interfaces from over-voltage caused by ESD (electrostatic discharge), CDE (Cable Discharge Events), and EFT (electrical fast transients). It has a typical capacitance of only 0.3pF (pin 1 to 2) making it suitable for use on circuits operating in excess of 3GHz without signal attenuation.

The SP0502BXTG is in a small SOT-523 package and each device can be configured to protect 1 bidirectional line or two unidirectional lines. The combination of small size, ultra-low capacitance, and high level of ESD protection makes it an ideal solution for applications such as HDMI, USB, MDDI, antennas, and DisplayPort.

## Functional Block Diagram and Pinout




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.

## Features

- RoHS compliant and lead-free
- ESD protection of ±15kV contact discharge, ±20kV air discharge, (IEC 61000-4-2)
- EFT, IEC 61000-4-4, 40A (5/50ns)
- Lightning protection, IEC 61000-4-5 2nd edition, 2A ($t_p$=8/20µs)
- Stand-off voltage of 5V
- Low capacitance of 1pF @ $V_R$=0V (MAX)
- Low leakage current of 0.5µA at 5V (MAX)
- Small form factor (SOT523) and low profile (<1mm)
- No insertion loss to >3.0GHz
- AEC-Q101 qualified

## Additional Information

**Datasheet** | **Resources** | **Samples**

## Applications

- High-Definition Multimedia Interface (HDMI)
- Mobile Display Digital Interface (MDDI)
- RF/Antenna Circuits
- USB 2.0
- DisplayPort
- Mobile - Smartphone, Tablet, Notebook



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## Absolute Maximum Ratings

| Symbol | Parameter | Value | Units |
|---|---|---|---|
| $P_{PK}$ | Peak Pulse Power ($t_P$=8/20µs) | 25 | W |
| $I_{PP}$ | Peak Pulse Current ($t_P$=8/20µs) | 2 | A |
| $T_{OP}$ | Operating Temperature | -40 to 125 | °C |
| $T_{STOR}$ | Storage Temperature | -55 to 150 | °C |

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

## Thermal Information

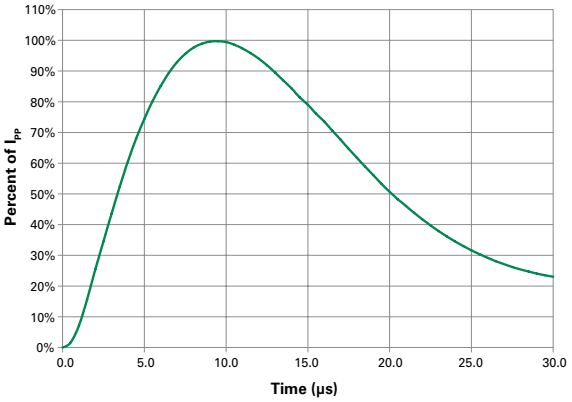
| Parameter | Rating | Units |
|---|---|---|
| Storage Temperature Range | -55 to 150 | °C |
| Maximum Junction Temperature | 150 | °C |
| Maximum Lead Temperature (Soldering 20-40s) | 260 | °C |

## Electrical Characteristics ($T_{OP}$ = 25°C)

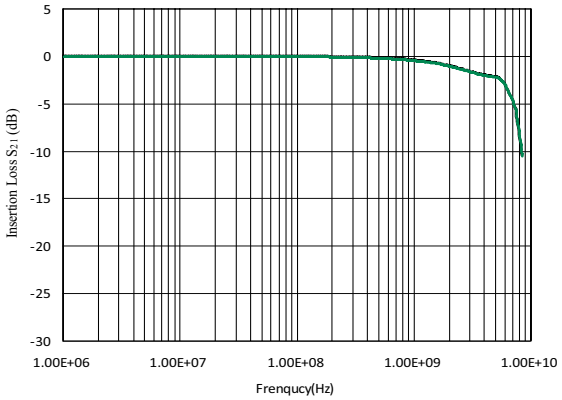
| Parameter | Symbol | Test Conditions | Min | Typ | Max | Units |
|---|---|---|---|---|---|---|
| Reverse Standoff Voltage | $V_{RWM}$ | $I_R$≤1µA, Pin1 or Pin2 to Pin3 and Pin1 to Pin2 | | | 5.0 | V |
| Reverse Breakdown Voltage | $V_{BR}$ | $I_t$=1mA, Pin1 or Pin2 to Pin3 | 6 | | | V |
| Leakage Current | $I_{LEAK}$ | $V_R$=5V | | | 0.5 | µA |
| Clamp Voltage[1] | $V_C$ | $I_{PP}$=1A, $t_p$=8/20µs, Pin 1 to Pin 2 | | | 12 | V |
| Dynamic Resistance[2] | $R_{DYN}$ | TLP, tp=100ns, I/O to GND | | 0.45 | | Ω |
| ESD Withstand Voltage[1] | $V_{ESD}$ | IEC 61000-4-2 (Contact Discharge) | ±15 | | | kV |
| | | IEC 61000-4-2 (Air Discharge) | ±20 | | | kV |
| Diode Capacitance[1] | $C_{I/O-I/O}$ | Reverse Bias=0V, f=1MHz; Pin 1 to Pin2 | | 0.25 | 0.5 | pF |
| | $C_{I/O-GND}$ | Reverse Bias=0V, f=1MHz; Pin 1 or Pin2 to Pin 3 | | | 1.0 | pF |

Note:
1 Parameter is guaranteed by design and/or device characterization.
2 Transmission Line Pulse (TLP) with 100ns width and 200ps rise time.

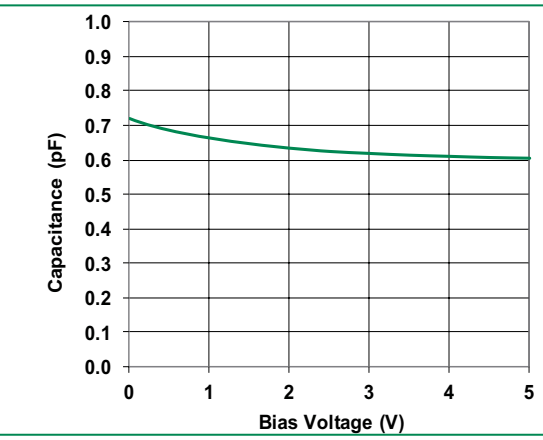
## Pulse Waveform



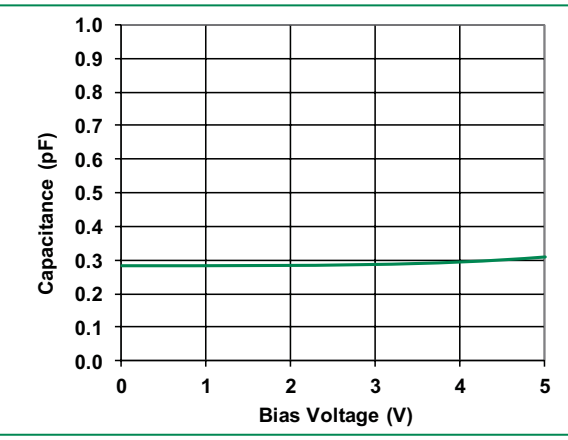

## Insertion Loss of Pin 1 to Pin 2 (I/O to I/O)



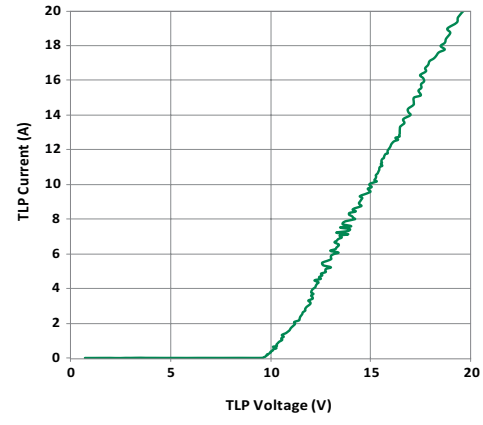

## Capacitance vs. Reverse Bias (Pin 1 or Pin 2 to Pin 3)




## Capacitance vs. Reverse Bias (I/O-I/O) (Pin 1 to Pin 2)




## Transmission Line Pulse (TLP)





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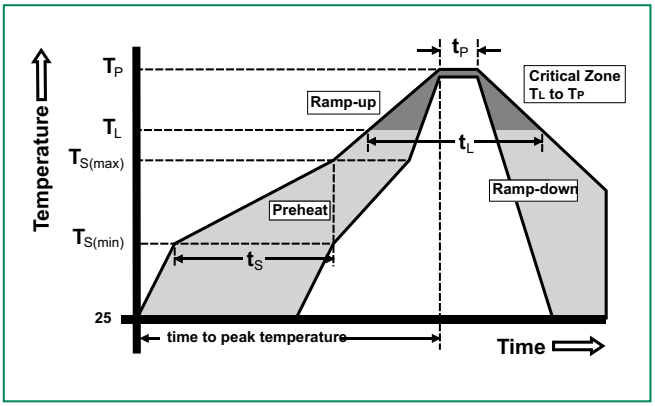
## Product Characteristics

| | |
|---|---|
| **Lead Plating** | Pre-Plated Frame |
| **Lead Material** | Copper Alloy |
| **Lead Coplanarity** | 0.0004 inches (0.102mm) |
| **Substrate material** | Silicon |
| **Body Material** | Molded Epoxy |
| **Flammability** | UL 94 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 |

## Ordering Information

| Part Number | Package | Size | Marking | Min. Order Qty. |
|---|---|---|---|---|
| SP0502BXTG | SOT523 | 1.6x1.6mm | 3** | 3000 |

## Part Numbering System

SP 0502B - X T G

- SP 0502B: TVS Diode Arrays (SPA® Diodes) Series
- X: Package — SOT523 (1.6x1.6mm)
- T: T= Tape & Reel
- G: G= Green

## Part Marking System

3 **

- 3: Product Series — 3 = SP0502B
- **: Date Code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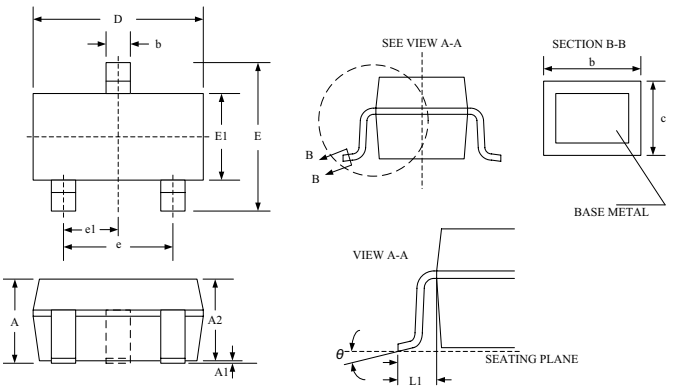
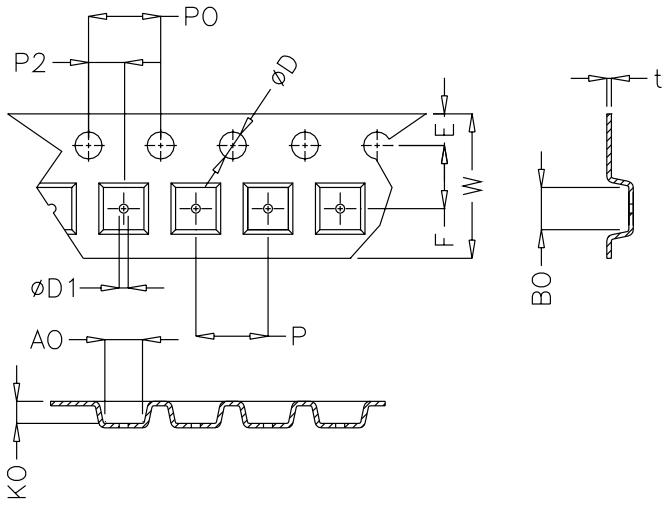
## Package Dimensions — SOT523




| | Millimetres | | | Inches | | |
|---|---|---|---|---|---|---|
| | Min | Typ | Max | Min | Typ | Max |
| **A** | 0.60 | - | 0.90 | 0.023 | - | 0.035 |
| **A1** | 0.00 | - | 0.10 | 0.000 | - | 0.004 |
| **A2** | 0.60 | 0.75 | 0.80 | 0.023 | 0.030 | 0.031 |
| **b** | 0.15 | - | 0.30 | 0.005 | - | 0.012 |
| **c** | 0.10 | - | 0.20 | 0.003 | - | 0.008 |
| **D** | 1.50 | 1.60 | 1.70 | 0.059 | 0.063 | 0.067 |
| **e** | 1.00 BSC | | | 0.039 BSC | | |
| **e1** | 0.50 BSC | | | 0.020 BSC | | |
| **E** | 1.45 | 1.60 | 1.75 | 0.057 | 0.063 | 0.069 |
| **E1** | 0.75 | 0.80 | 0.85 | 0.029 | 0.031 | 0.033 |
| **L1** | 0.22 REF | | | 0.009 RFE | | |
| θ | 0° | - | 8° | 0° | – | 8° |

## Embossed Carrier Tape & Reel Specification — SOT523




| | Millimetres | | Inches | |
|---|---|---|---|---|
| | Min | Max | Min | Max |
| **E** | 1.65 | 1.85 | 0.065 | 0.073 |
| **F** | 3.45 | 3.55 | 0.135 | 0.139 |
| **P2** | 1.95 | 2.05 | 0.077 | 0.081 |
| **D** | 1.40 | 1.60 | 0.055 | 0.063 |
| **D1** | 0.45 | 0.55 | 0.017 | 0.021 |
| **P0** | 3.90 | 4.10 | 0.154 | 0.161 |
| **10P0** | 40.0+/- 0.20 | | 1.574+/-0.008 | |
| **W** | 7.70 | 8.10 | 0.303 | 0.318 |
| **P** | 3.90 | 4.10 | 0.153 | 0.161 |
| **A0** | 1.73 | 1.83 | 0.068 | 0.072 |
| **B0** | 1.73 | 1.83 | 0.068 | 0.072 |
| **K0** | 0.64 | 0.74 | 0.025 | 0.029 |
| **t** | 0.22 max | | 0.009 max | |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