TVS Diode Arrays (SPA® Diodes)
Lightning Surge Protection- SP4044 Series

SP4044 Series 1.5pF 24A Diode Array (HDBaseT)

Description

The SP4044 integrates low capacitance diodes with an additional zener diode to protect each I/O pin against ESD and high surge events. This robust device can safely absorb up to 24A per IEC 61000-4-5 2nd edition (tp=8/20μs) without performance degradation and a minimum ±30kV ESD per IEC 61000-4-2 International Standard. Their low loading capacitance also makes them ideal for protecting high speed signal pins.

Pinout

<table>
<thead>
<tr>
<th>I/O 1</th>
<th>GND</th>
<th>NC</th>
<th>I/O 4</th>
<th>GND</th>
<th>NC</th>
<th>I/O 3</th>
<th>NC</th>
</tr>
</thead>
<tbody>
<tr>
<td>NC</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GND</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NC</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I/O 2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Functional Block Diagram

Features

- Low capacitance of 1.5pF (TYP) per I/O
- AEC-Q101 qualified
- Halogen free, Lead free and RoHS compliant
- Moisture Sensitivity Level (MSL Level-1)
- Signal-integrity-preserving straight through routing
- Low leakage current of 1μA (MAX) at 2.8V
- ESD, IEC 61000-4-2, ±30kV contact, ±30kV air
- EFT, IEC 61000-4-4, 40A (5/50ns)
- Lightning, IEC 61000-4-5 2nd edition, 24A (8/20μs)
- Signal-integrity-preserving straight through routing
- Low leakage current of 1μA (MAX) at 2.8V
- ESD, IEC 61000-4-2, ±30kV contact, ±30kV air
- EFT, IEC 61000-4-4, 40A (5/50ns)

Applications

- HDBaseT Protector
- 10/100/1000 Ethernet
- 2.5 and 5 Gigabit Ethernet
- T1/E1 Secondary Protection
- T3/E3 Secondary Protection
- A/V Equipment

Additional Information

Datasheet

Resources

Samples

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.

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# TVS Diode Arrays (SPA® Diodes)

**Lightning Surge Protection - SP4044 Series**

## Absolute Maximum Ratings

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameter</th>
<th>Value</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>(I_{PP})</td>
<td>Peak Current ((t_p=8/20\mu s))</td>
<td>24</td>
<td>A</td>
</tr>
<tr>
<td>(P_{PK})</td>
<td>Peak Pulse Power ((t_p=8/20\mu s))</td>
<td>500</td>
<td>W</td>
</tr>
<tr>
<td>(T_{OP})</td>
<td>Operating Temperature</td>
<td>-40 to 125</td>
<td>°C</td>
</tr>
<tr>
<td>(T_{STOR})</td>
<td>Storage Temperature</td>
<td>-55 to 150</td>
<td>°C</td>
</tr>
</tbody>
</table>

**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.

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

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Test Conditions</th>
<th>Min</th>
<th>Typ</th>
<th>Max</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reverse Standoff Voltage</td>
<td>(V_{RWM})</td>
<td>(I_{SB}=50\text{mA})</td>
<td>2.8</td>
<td></td>
<td></td>
<td>V</td>
</tr>
<tr>
<td>Snap Back Voltage</td>
<td>(V_{SB})</td>
<td>(V_R=2.8\text{V}, \text{I/O to GND})</td>
<td>0.5</td>
<td>1.0</td>
<td></td>
<td>µA</td>
</tr>
<tr>
<td>Reverse Leakage Current</td>
<td>(I_{LEAK})</td>
<td>(I_{PP}=1\text{A}, t_p=8/20\mu s, \text{Fwd})</td>
<td>5.2</td>
<td></td>
<td></td>
<td>V</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(I_{PP}=2\text{A}, t_p=8/20\mu s, \text{Fwd})</td>
<td>6.0</td>
<td></td>
<td></td>
<td>V</td>
</tr>
<tr>
<td>Clamp Voltage</td>
<td>(V_C)</td>
<td>(I_{PP}=1\text{A}, t_p=8/20\mu s, \text{Fwd})</td>
<td></td>
<td></td>
<td></td>
<td>V</td>
</tr>
<tr>
<td>Dynamic Resistance</td>
<td>(R_{DYN})</td>
<td>TLP (t_p=100\text{ns}, \text{Pin 1 to Pin 2})</td>
<td>0.22</td>
<td></td>
<td></td>
<td>Ω</td>
</tr>
<tr>
<td>ESD Withstand Voltage</td>
<td>(V_{ESD})</td>
<td>IEC61000-4-2 (Contact)</td>
<td>±30</td>
<td></td>
<td></td>
<td>kV</td>
</tr>
<tr>
<td></td>
<td></td>
<td>IEC61000-4-2 (Air)</td>
<td>±30</td>
<td></td>
<td></td>
<td>kV</td>
</tr>
<tr>
<td>Diode Capacitance</td>
<td>(C_{I/O-GND})</td>
<td>Reverse Bias=0V</td>
<td>1.5</td>
<td></td>
<td></td>
<td>pF</td>
</tr>
</tbody>
</table>

**Note:**
1. Parameter is guaranteed by design and/or device characterization.
2. Transmission Line Pulse (TLP) test setting: Std.TDR(50Ω),\(t_p=0.2\text{ns}\) ITLP and VTLP averaging window: \(t_1=70\text{ns}\) to end \(t_2=80\text{ns}\)

## Thermal Information

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Rating</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Storage Temperature Range</td>
<td>-55 to 150</td>
<td>°C</td>
</tr>
<tr>
<td>Maximum Junction Temperature</td>
<td>150</td>
<td>°C</td>
</tr>
<tr>
<td>Maximum Lead Temperature (Soldering 20-40s)</td>
<td>260</td>
<td>°C</td>
</tr>
</tbody>
</table>

## 8/20µs Pulse Waveform

![8/20µs Pulse Waveform Graph](image)

## Capacitance vs. Reverse Bias

![Capacitance vs. Reverse Bias Graph](image)
### Soldering Parameters

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

### Product Characteristics

#### Lead Plating
- Pre-Plated Frame

#### Lead Material
- Copper Alloy

#### Lead Coplanarity
- 0.0004 inches (0.102mm)

#### Substrate Material
- Silicon

#### Body Material
- V-0 per UL 94 Molded Epoxy

### 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.
**Package Dimensions — MSOP-10**

<table>
<thead>
<tr>
<th>Package</th>
<th>MSOP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pins</td>
<td>10</td>
</tr>
<tr>
<td>JEDEC</td>
<td>MO-187</td>
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</table>

### Millimeters | Inches

<table>
<thead>
<tr>
<th>DIM</th>
<th>Min</th>
<th>Max</th>
<th>Min</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>-</td>
<td>1.10</td>
<td>-</td>
<td>0.043</td>
</tr>
<tr>
<td>A1</td>
<td>0.00</td>
<td>0.15</td>
<td>0.000</td>
<td>0.006</td>
</tr>
<tr>
<td>B</td>
<td>0.17</td>
<td>0.27</td>
<td>0.007</td>
<td>0.011</td>
</tr>
<tr>
<td>c</td>
<td>0.08</td>
<td>0.23</td>
<td>0.003</td>
<td>0.009</td>
</tr>
<tr>
<td>D</td>
<td>2.90</td>
<td>3.10</td>
<td>0.114</td>
<td>0.122</td>
</tr>
<tr>
<td>E</td>
<td>4.67</td>
<td>5.10</td>
<td>0.184</td>
<td>0.200</td>
</tr>
<tr>
<td>E1</td>
<td>2.90</td>
<td>3.10</td>
<td>0.114</td>
<td>0.122</td>
</tr>
<tr>
<td>e</td>
<td>0.50 BSC</td>
<td>0.020 BSC</td>
<td></td>
<td></td>
</tr>
<tr>
<td>L</td>
<td>0.40</td>
<td>0.80</td>
<td>0.016</td>
<td>0.032</td>
</tr>
</tbody>
</table>

**Embossed Carrier Tape & Reel Specification — MSOP-10**

<table>
<thead>
<tr>
<th>MILLIMETRES</th>
<th>INCHES</th>
</tr>
</thead>
<tbody>
<tr>
<td>E</td>
<td>1.65</td>
</tr>
<tr>
<td>F</td>
<td>5.40</td>
</tr>
<tr>
<td>D</td>
<td>1.50</td>
</tr>
<tr>
<td>D1</td>
<td>1.50 Min</td>
</tr>
<tr>
<td>P0</td>
<td>3.90</td>
</tr>
<tr>
<td>W</td>
<td>11.70</td>
</tr>
<tr>
<td>P</td>
<td>7.90</td>
</tr>
<tr>
<td>A0</td>
<td>5.20</td>
</tr>
<tr>
<td>B0</td>
<td>3.20</td>
</tr>
<tr>
<td>K0</td>
<td>1.20</td>
</tr>
<tr>
<td>t</td>
<td>0.30 +/- 0.05</td>
</tr>
</tbody>
</table>

**Part Numbering System**

- **SP 4044-04ATG**
  - **Series**
  - **Number of Channels**
  - **Package**
  - **A = MSOP10**
  - **G = Green**
  - **T = Tape & Reel**

**Ordering Information**

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Package</th>
<th>Marking</th>
<th>Min. Order Qty.</th>
</tr>
</thead>
<tbody>
<tr>
<td>SP4044-04ATG</td>
<td>MSOP-10</td>
<td>F H4</td>
<td>4000</td>
</tr>
</tbody>
</table>

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