Description

The SP3004 has ultra low capacitance rail-to-rail diodes with an additional zener diode fabricated in a proprietary silicon avalanche technology to protect each I/O pin providing a high level of protection for electronic equipment that may experience destructive electrostatic discharges (ESD). These robust diodes can safely absorb repetitive ESD strikes at the maximum level (Level 4) specified in the IEC 61000-4-2 international standard without performance degradation. Their very low loading capacitance also makes them ideal for protecting high speed signal pins such as HDMI, DVI, USB2.0, and IEEE 1394.

Features

- RoHS compliant and Lead-free
- Low capacitance of 0.85pF (TYP) per I/O
- ESD protection of ±12kV contact discharge, ±15kV air discharge, (IEC 61000-4-2)
- EFT protection, IEC 61000-4-4, 40A (5/50ns)
- Low leakage of 10nA MAX with $V_{cc}=3.3V$
- Small SOT563 package saves board space
- Lightning Protection, IEC 61000-4-5, 2nd Edition, 4A (8/20µs)
- AEC-Q101 qualified

Applications

- Computer Peripherals
- Mobile Phones
- PDA's
- Digital Cameras
- Network Hardware/Ports
- Test Equipment
- Medical Equipment

Application Example

A single 4 channel SP300x-04 device can be used to protect four of the data lines in a HDMI/DVI interface. Two (2) SP300x-04 devices provide protection for the main data lines. Low voltage ASIC HDMI/DVI drivers can also be protected with the SP300x-04, the +$V_{cc}$ pins on the SP300x-04 can be substituted with a suitable bypass capacitor or in some backdrive applications the +$V_{cc}$ of the SP300x-04 can be floated or NC.

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.
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.

### 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 ($t_{r}=8/20\mu s$)</td>
<td>4</td>
<td>A</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>

### 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>

### 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>$V_{RVM}$</td>
<td>$I_R \leq 1\mu A$</td>
<td>6</td>
<td>V</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reverse Leakage Current(^1)</td>
<td>$I_{LEAK}$</td>
<td>$V_R=3.3V$</td>
<td>10</td>
<td>nA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Clamp Voltage(^1)</td>
<td>$V_C$</td>
<td>$I_V=1A$, $t_r=8/20\mu s$, Fwd</td>
<td>10.0</td>
<td>12.0</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>11.8</td>
<td>15.0</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>ESD Withstand Voltage(^1)</td>
<td>$V_{ESD}$</td>
<td>IEC 61000-4-2 (Contact)</td>
<td>±12</td>
<td>kV</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>IEC 61000-4-2 (Air)</td>
<td>±15</td>
<td>kV</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dynamic Resistance</td>
<td>$R_{DYN}$</td>
<td>$(V C2 - V C1) / (I P2 - I P1)$</td>
<td>1.8</td>
<td>Ω</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Diode Capacitance(^1)</td>
<td>$C_{I/O-GND}$</td>
<td>Reverse Bias=0V</td>
<td>0.95</td>
<td>1.1</td>
<td>1.25</td>
<td>pF</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>0.7</td>
<td>0.85</td>
<td>1</td>
<td>pF</td>
</tr>
<tr>
<td></td>
<td>$C_{I/O-I/O}$</td>
<td>Reverse Bias=0V</td>
<td>0.5</td>
<td>pF</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: Parameter is guaranteed by design and/or device characterization.

### Insertion Loss (S21) I/O to GND

![Insertion Loss Graph]

### Capacitance vs. Bias Voltage

![Capacitance vs. Bias Graph]
TVS Diode Array (SPA® Diodes)
Low Capacitance ESD Protection - SP3004 Series

Capacitance vs. Frequency

Leakage Current vs Temperature

Soldering Parameters

Reflow Condition  Pb – Free assembly
Pre Heat
- Temperature Min (T(min))  150°C
- Temperature Max (T(max))  200°C
- Time (min to max) (t)  60 – 180 secs
Average ramp up rate (Liquidus) Temp (T) to peak  3°C/second max
T(max) to T - Ramp-up Rate  3°C/second max
Reflow
- Temperature (T) (Liquidus)  217°C
- Temperature (t)  60 – 150 seconds
Peak Temperature (T)
Average ramp down rate  6°C/second max
Time within 5°C of actual peak Temperature (t)  20 – 40 seconds
Ramp-down Rate  6°C/second max
Time 25°C to peak Temperature (t)  8 minutes Max.
Do not exceed  260°C

Product Characteristics

<table>
<thead>
<tr>
<th>Lead Plating</th>
<th>Pre-Plated Frame</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lead Material</td>
<td>Copper Alloy</td>
</tr>
<tr>
<td>Lead Coplanarity</td>
<td>0.0004 inches (0.102mm)</td>
</tr>
<tr>
<td>Substitute Material</td>
<td>Silicon</td>
</tr>
<tr>
<td>Body Material</td>
<td>Molded Epoxy</td>
</tr>
<tr>
<td>Flammability</td>
<td>UL 94 V-0</td>
</tr>
</tbody>
</table>

Notes:
1. All dimensions are in millimeters.
2. Dimensions include solder plating.
3. Dimensions are exclusive of mold flash & metal burr.
4. Pin is facing up for mold and facing down for trim/form, i.e. reverse trim/form.

Specifications are subject to change without notice.
Revised: 09/06/19
**TVS Diode Array (SPA® Diodes)**

Low Capacitance ESD Protection - SP3004 Series

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**Part Numbering System**

**SP 3004 -04 X T G**

- **Series**: SP3004 (TVS Diode Arrays)
- **Number of Channels**: -04 = 4 channel

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**Part Marking System**

- **Product Series**: G = SP3004 series
- **Assembly Site**: (varies)
- **Number of Channels**: G*4

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**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>SP3004-04XTG</td>
<td>SOT563</td>
<td>G*4</td>
<td>3000</td>
</tr>
</tbody>
</table>

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**Embossed Carrier Tape & Reel Specification — SOT563**

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