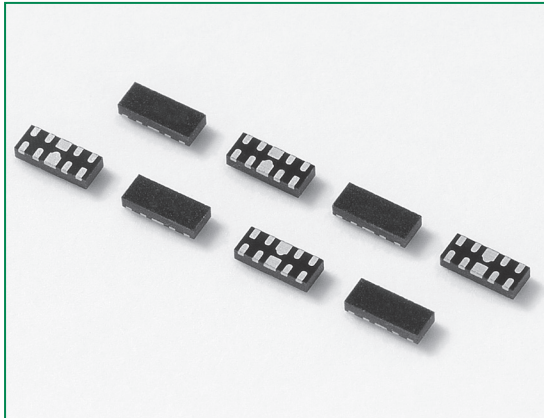
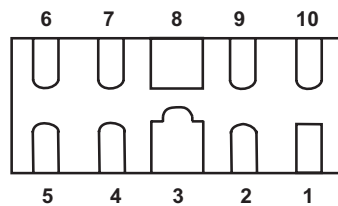


## SP0524P Series 0.5pF Diode Array

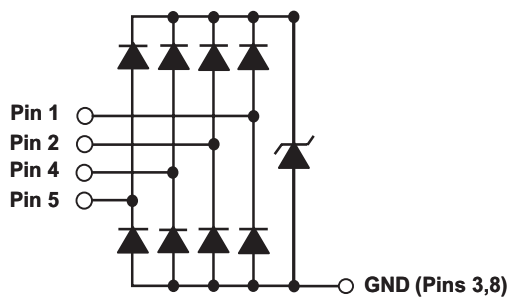


### Pinout



\*Pins 6, 7, 9, 10 are not internally connected but should be connected to the trace.

### Functional Block Diagram



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.

### Description

The SP0524P integrates 4 channels of ultra low capacitance rail-to-rail diodes and an additional zener diode to provide protection for electronic equipment that may experience destructive electrostatic discharges (ESD). This robust device can safely absorb repetitive ESD strikes above the maximum level specified in the IEC61000-4-2 international standard ( $\pm 8\text{kV}$  contact discharge) without performance degradation. The extremely low loading capacitance also makes it ideal for protecting high speed signal pins such as HDMI, USB3.0, USB2.0, and IEEE 1394.

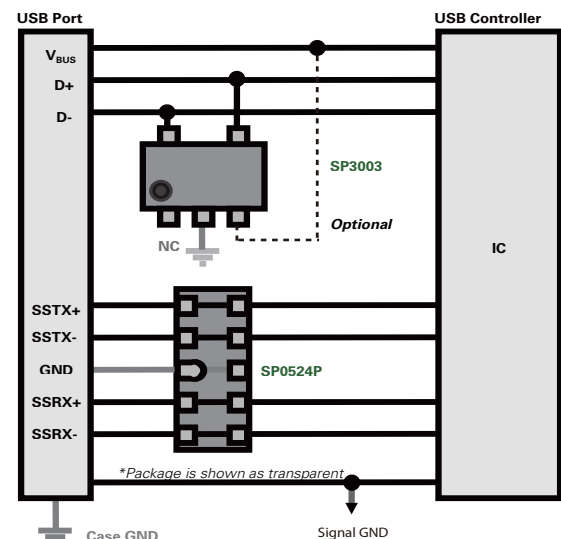
### Features

- ESD, IEC61000-4-2,  $\pm 12\text{kV}$  contact,  $\pm 25\text{kV}$  air
- EFT, IEC61000-4-4, 40A ( $t_p=5/50\text{ns}$ )
- Lightning, IEC61000-4-5, 4A ( $t_p=8/20\mu\text{s}$ )
- Low capacitance of 0.5pF (TYP) per I/O
- Low leakage current of  $1.5\mu\text{A}$  (MAX) at 5V
- Small form factor  $\mu\text{DFN}$  (JEDEC MO-229) package saves board space

### Applications

- LCD/PDP TVs
- External Storages
- DVD/ Blue-Ray Players
- Desktops
- MP3/PMP
- Set Top Boxes
- Mobile Phones
- Notebooks
- Digital Cameras

### Application Example for USB3.0



### Absolute Maximum Ratings

| Symbol     | Parameter                        | Value      | Units |
|------------|----------------------------------|------------|-------|
| $I_{PP}$   | Peak Current ( $t_p=8/20\mu s$ ) | 4.0        | A     |
| $T_{OP}$   | Operating Temperature            | -55 to 125 | °C    |
| $T_{STOR}$ | Storage Temperature              | -60 to 150 | °C    |

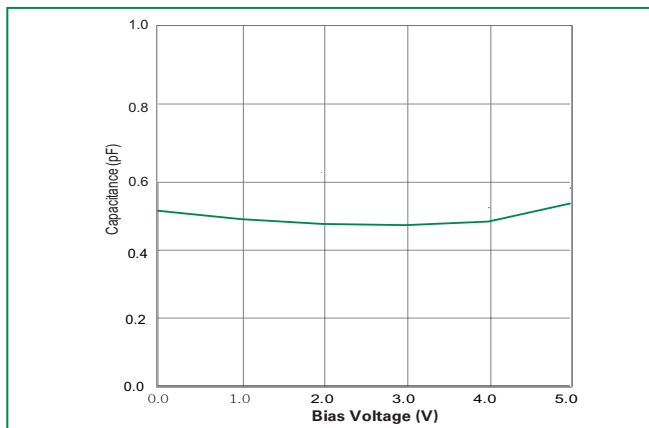
CAUTION: Stresses above those listed in "Absolute Maximum Ratings" may cause permanent damage to the device. This is a stress only rating and operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied.

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

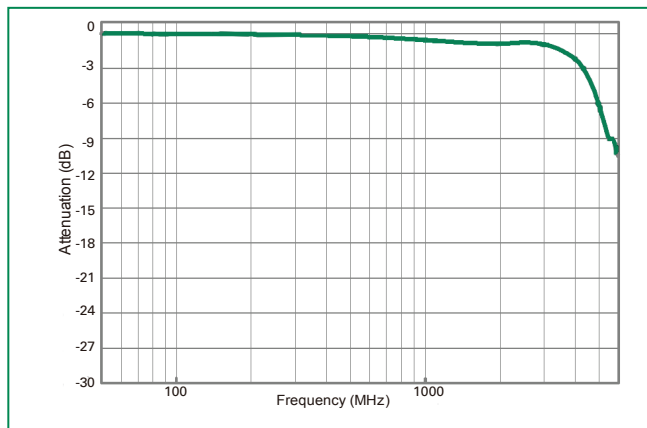
| Parameter                          | Symbol        | Test Conditions                           | Min      | Typ | Max | Units    |
|------------------------------------|---------------|-------------------------------------------|----------|-----|-----|----------|
| Reverse Standoff Voltage           | $V_{RWM}$     | $I_R \leq 1\mu A$                         |          |     | 5.0 | V        |
| Reverse Leakage Current            | $I_{LEAK}$    | $V_R=5V$ , Any I/O to GND                 |          |     | 1.5 | $\mu A$  |
| Clamp Voltage <sup>1</sup>         | $V_C$         | $I_{PP}=1A$ , $t_p=8/20\mu s$ , Fwd       |          | 6.6 |     | V        |
|                                    |               | $I_{PP}=2A$ , $t_p=8/20\mu s$ , Fwd       |          | 7.0 |     | V        |
| Dynamic Resistance                 | $R_{DYN}$     | $(V_{C2} - V_{C1}) / (I_{PP2} - I_{PP1})$ |          | 0.4 |     | $\Omega$ |
| ESD Withstand Voltage <sup>1</sup> | $V_{ESD}$     | IEC61000-4-2 (Contact)                    | $\pm 12$ |     |     | kV       |
|                                    |               | IEC61000-4-2 (Air)                        | $\pm 25$ |     |     | kV       |
| Diode Capacitance <sup>1</sup>     | $C_{I/O-GND}$ | Reverse Bias=0V, f=1 MHz                  |          | 0.5 |     | pF       |
| Diode Capacitance <sup>1</sup>     | $C_{I/O-I/O}$ | Reverse Bias=0V, f=1 MHz                  |          | 0.3 |     | pF       |

Note: <sup>1</sup> Parameter is guaranteed by design and/or device characterization.

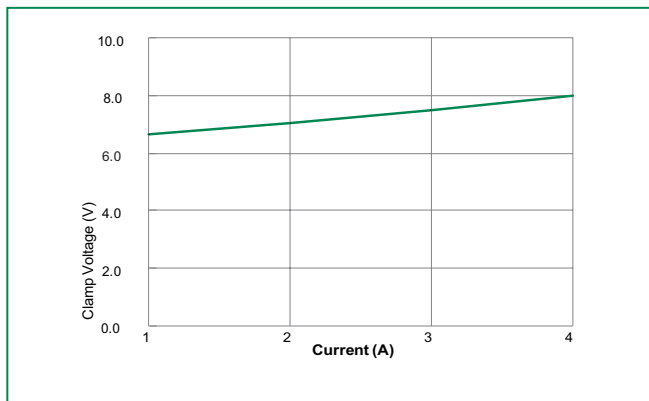
### Capacitance vs. Bias Voltage



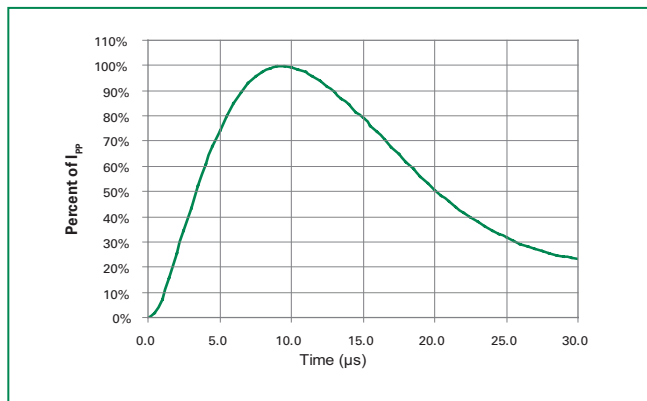
### Insertion Loss (S21) I/O to GND



### Clamping Voltage vs. $I_{PP}$

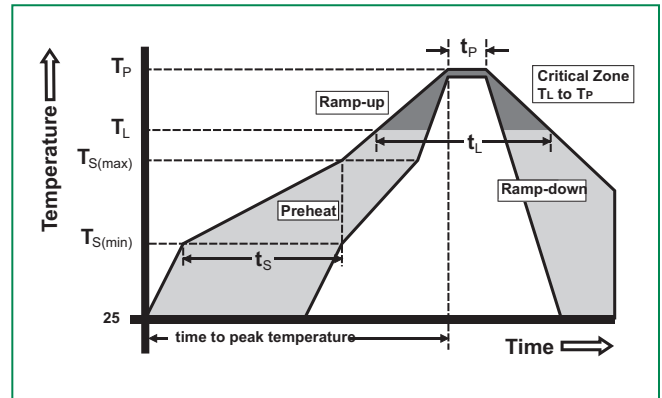


### Pulse Waveform

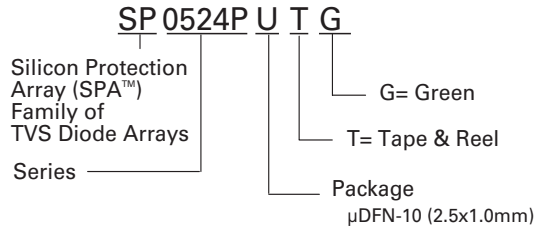


### Soldering Parameters

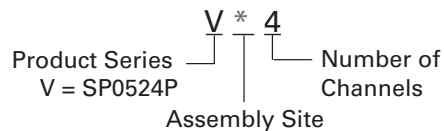
|                                                        |                                    |                         |
|--------------------------------------------------------|------------------------------------|-------------------------|
| Reflow Condition                                       |                                    | 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 <sup>+0/-5</sup> °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



### Part Marking System



### Product Characteristics

|                            |                         |
|----------------------------|-------------------------|
| <b>Lead Plating</b>        | Pre-Plated Frame        |
| <b>Lead Material</b>       | Copper Alloy            |
| <b>Lead Coplanarity</b>    | 0.0004 inches (0.102mm) |
| <b>Substitute Material</b> | Silicon                 |
| <b>Body Material</b>       | Molded Epoxy            |
| <b>Flammability</b>        | UL 94 V-0               |

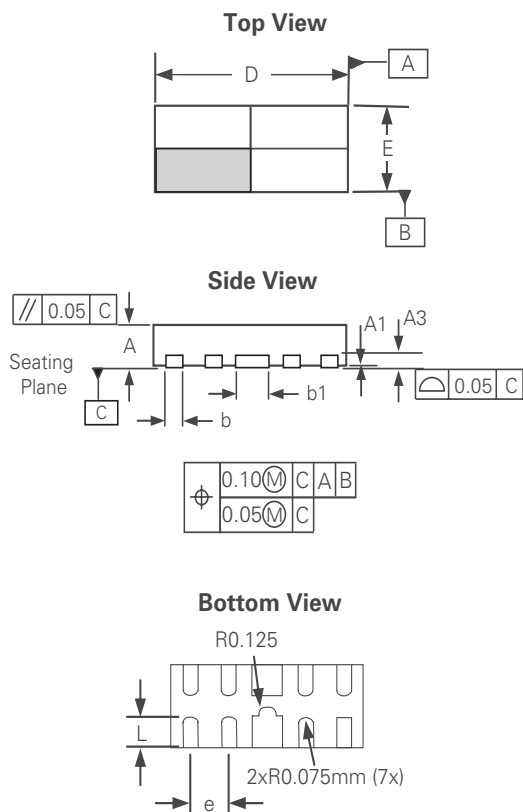
Notes :

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.

### Ordering Information

| Part Number | Package      | Marking | Min. Order Qty. |
|-------------|--------------|---------|-----------------|
| SP0524PUTG  | $\mu$ DFN-10 | V*4     | 3000            |

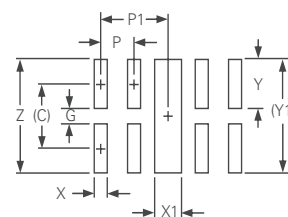
**Package Dimensions —  $\mu$ DFN-10 (2.5x1.0x0.5mm)**



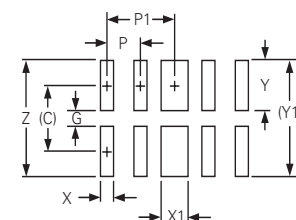
| Package | $\mu$ DFN-10 (2.5x1.0x0.5mm) |       |      |           |       |       |
|---------|------------------------------|-------|------|-----------|-------|-------|
| JEDEC   | MO-229                       |       |      |           |       |       |
| Symbol  | Millimeters                  |       |      | Inches    |       |       |
|         | Min                          | Nom   | Max  | Min       | Nom   | Max   |
| A       | 0.48                         | 0.515 | 0.55 | 0.019     | 0.020 | 0.021 |
| A1      | 0.00                         | —     | 0.05 | 0.000     |       | 0.022 |
| A3      | 0.125 Ref                    |       |      | 0.005 Ref |       |       |
| b       | 0.15                         | 0.20  | 0.25 | 0.006     | 0.008 | 0.012 |
| b1      | 0.35                         | 0.40  | 0.45 | 0.014     | 0.016 | 0.018 |
| D       | 2.40                         | 2.50  | 2.60 | 0.094     | 0.098 | 0.102 |
| E       | 0.90                         | 1.00  | 1.10 | 0.035     | 0.039 | 0.043 |
| e       | 0.50 BSC                     |       |      | 0.020 BSC |       |       |
| L       | 0.30                         | 0.365 | 0.43 | 0.012     | 0.014 | 0.016 |

| Soldering Pad Layout Dimensions |         |            |
|---------------------------------|---------|------------|
|                                 | Inch    | Millimeter |
| C                               | (0.034) | (0.875)    |
| G                               | 0.008   | 0.20       |
| P                               | 0.020   | 0.50       |
| P1                              | 0.039   | 1.00       |
| X                               | 0.008   | 0.20       |
| X1                              | 0.016   | 0.40       |
| Y                               | 0.027   | 0.675      |
| Y1                              | (0.061) | (1.55)     |
| Z                               | 0.061   | 1.55       |

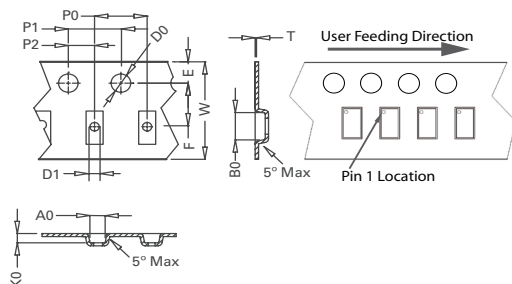
**Recommended Soldering Pad Layout**



**Alternative Soldering Pad Layout**



**Embossed Carrier Tape & Reel Specification —  $\mu$ DFN-10**



| Package | $\mu$ DFN-10 (2.5x1.0x0.5mm) |
|---------|------------------------------|
| Symbol  | Millimeters                  |
| A0      | 1.30 +/- 0.10                |
| B0      | 2.83 +/- 0.10                |
| D0      | Ø 1.50 + 0.10                |
| D1      | Ø 1.00 + 0.25                |
| E       | 1.75 +/- 0.10                |
| F       | 3.50 +/- 0.05                |
| K0      | 0.65 +/- 0.10                |
| P0      | 4.00 +/- 0.10                |
| P1      | 4.00 +/- 0.10                |
| P2      | 2.00 +/- 0.05                |
| T       | 0.254 +/- 0.02               |
| W       | 8.00 + 0.30 /- 0.10          |

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