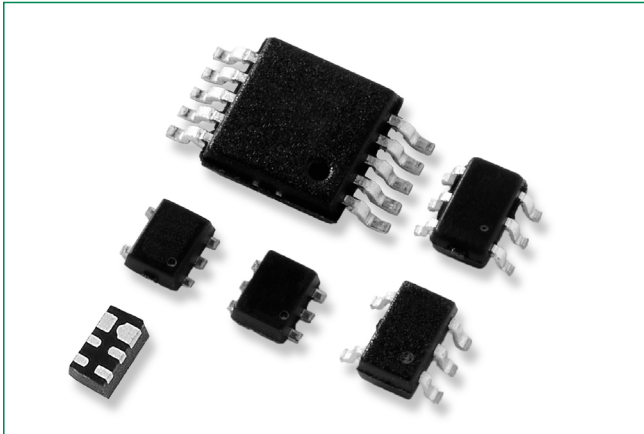


# SP3003 Series

## 0.65pF Diode Array



### Additional Information



Resources

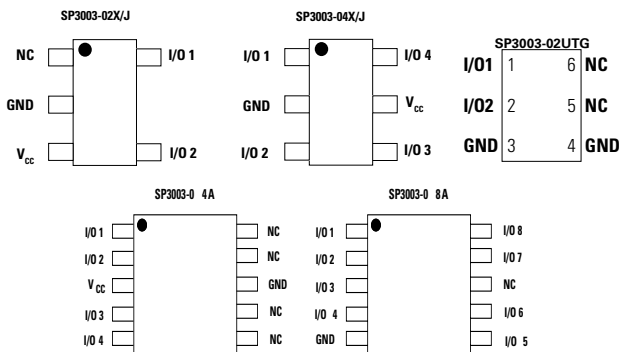


Accessories

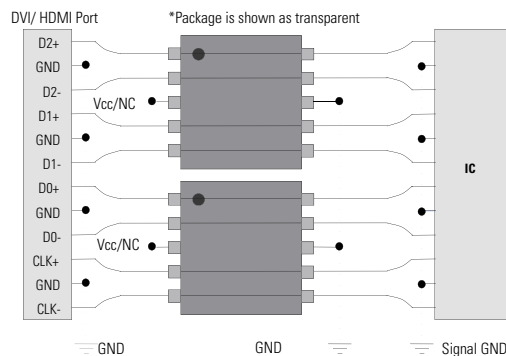


Samples

### Pinout



### Application Example



### Description

The SP3003 has ultra low capacitance rail-to-rail diodes with an additional protection 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 specified in the IEC 61000-4-2 international standard (Level 4,  $\pm 8\text{kV}$  contact discharge and  $\pm 15\text{ kV}$  air discharge 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.

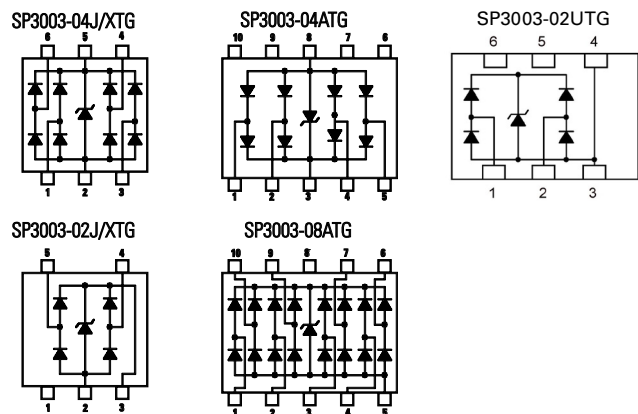
### Features & Benefits

- ESD protection of  $\pm 8\text{kV}$  contact discharge,  $\pm 15\text{kV}$  air discharge, (IEC 61000-4-2)
- EFT protection, IEC 61000-4-4, 40A (5/50ns)
- Lightning, 2.5A (8/20 $\mu\text{s}$  as defined in IEC 61000-4-5 2nd Edition)
- Low capacitance of 0.65pF (TYP) per I/O
- Low leakage current of 0.5 $\mu\text{A}$  (MAX) at 5V
- Complete line of small packaging helps save board space (SC70, SOT553, SOT563, MSOP10,  $\mu\text{DFN-6L}$ )
- AEC-Q101 qualified
- RoHS compliant and lead-free
- Moisture Sensitivity Level(MSL-1)

### Applications

- LCD/ PDP TVs
- DVD Players
- Desktops
- MP3/ PMP
- Digital Cameras
- Set Top Boxes
- Mobile Phones
- Notebooks
- Computer Peripherals

### 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.

A single, 4 channel SP3003-04 component can be used to protect four (4) of the data lines in a HDMI/DVI interface so two (2) SP3003-04 components provide protection for all eight (8) TMDS lines.

# SP3003 Series

## 0.65pF Diode Array

### Absolute Maximum Ratings

| Symbol     | Parameter                        | Value      | Units |
|------------|----------------------------------|------------|-------|
| $I_{PP}$   | Peak Current ( $t_p=8/20\mu s$ ) | 2.5        | A     |
| $T_{OP}$   | Operating Temperature            | -40 to 125 | °C    |
| $T_{STOR}$ | Storage Temperature              | -55 to 150 | °C    |

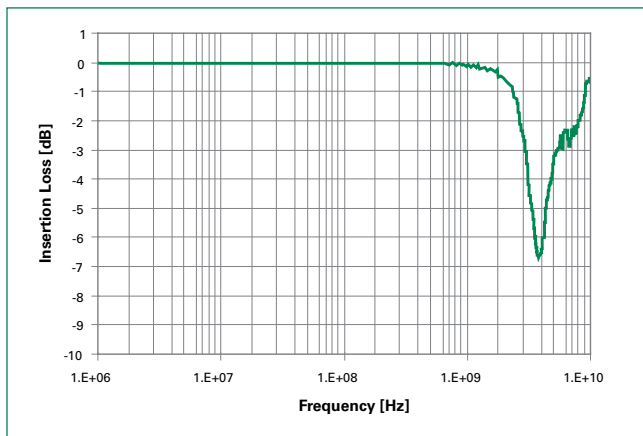
**Caution:** Stresses above those listed in "Absolute Maximum Ratings" may cause permanent damage to the component. This is a stress only rating and operation of the component at these or any other conditions above those indicated in the operational sections of this specification is not implied.

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

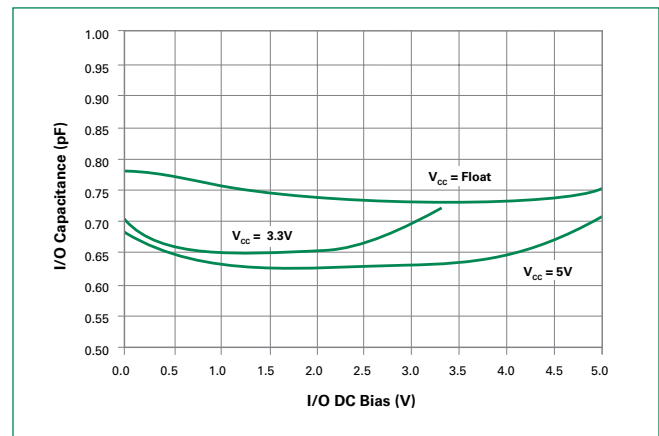
| Parameter                          | Symbol        | Test Conditions            | Min      | Typ  | Max  | Units   |
|------------------------------------|---------------|----------------------------|----------|------|------|---------|
| Reverse Standoff Voltage           | $V_{RWM}$     | $I_R \leq 1\mu A$          |          |      | 6    | V       |
| Reverse Leakage Current            | $I_{LEAK}$    | $V_R=5V$                   |          |      | 0.5  | $\mu A$ |
| Clamp Voltage <sup>1</sup>         | $V_C$         | $I_{PP}=1A, t_p=8/20\mu s$ |          | 10.0 | 12.0 | V       |
|                                    |               | $I_{PP}=2A, t_p=8/20\mu s$ |          | 11.8 | 15.0 | V       |
| ESD Withstand Voltage <sup>1</sup> | $V_{ESD}$     | IEC61000-4-2 (Contact)     | $\pm 8$  |      |      | kV      |
|                                    |               | IEC61000-4-2 (Air)         | $\pm 15$ |      |      | kV      |
| Diode Capacitance <sup>1</sup>     | $C_{I/O-GND}$ | Reverse Bias=0V            | 0.7      | 0.8  | 0.95 | pF      |
|                                    |               | Reverse Bias=1.65V         | 0.55     | 0.65 | 0.8  | pF      |
| Diode Capacitance <sup>1</sup>     | $C_{I/O-I/O}$ | Reverse Bias=0V            |          | 0.35 |      | pF      |

**Note: 1.** Parameter is guaranteed by design and/or component characterization.

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



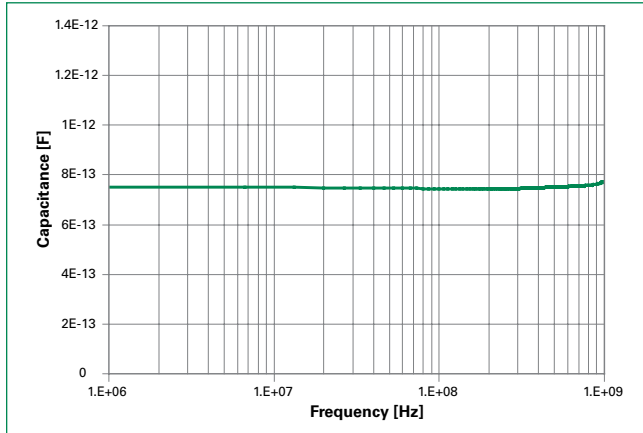
### Capacitance I/O - GND vs. Bias Voltage



# SP3003 Series

## 0.65pF Diode Array

### Capacitance vs. Frequency

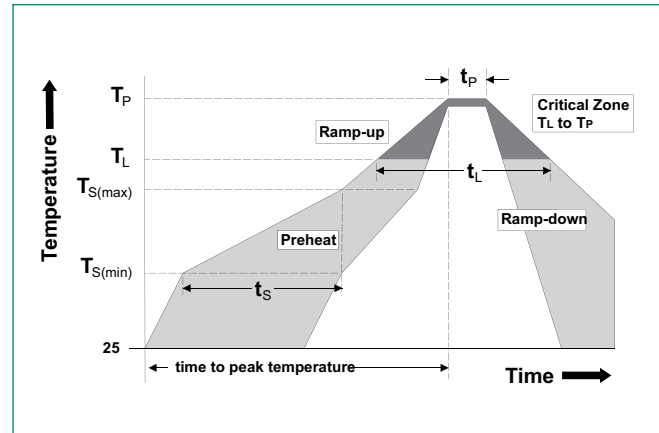


### Product Characteristics

|                           |                                                                    |
|---------------------------|--------------------------------------------------------------------|
| <b>Lead Plating</b>       | Matte Tin (SC70-x) Pre-Plated Frame (SOT5x3, $\mu$ DFN-6, MSOP-10) |
| <b>Lead Material</b>      | Copper Alloy                                                       |
| <b>Lead Coplanarity</b>   | 0.0004 inches (0.102mm)                                            |
| <b>Substrate Material</b> | Silicon                                                            |
| <b>Body Material</b>      | Molded Compound                                                    |
| <b>Flammability</b>       | UL Recognized compound meeting flammability rating V-0             |

### Soldering Parameters

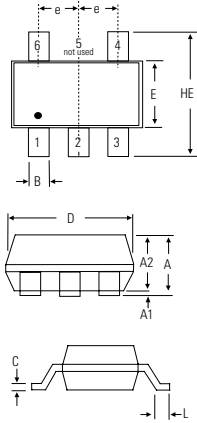
| Reflow Condition                                       |                                    | Pb – Free assembly      |
|--------------------------------------------------------|------------------------------------|-------------------------|
| Pre Heat                                               | - Temperature Min ( $T_{s(min)}$ ) | 150°C                   |
|                                                        | - Temperature Max ( $T_{s(max)}$ ) | 200°C                   |
|                                                        | - Time (min to max) ( $t_s$ )      | 60 – 120 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 ( $t_p$ )   |                                    | 30 seconds              |
| Ramp-down Rate                                         |                                    | 6°C/second max          |
| Time 25°C to peak Temperature ( $T_p$ )                |                                    | 8 minutes Max.          |
| Do not exceed                                          |                                    | 260°C                   |



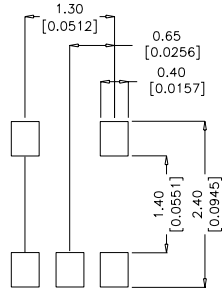
# SP3003 Series

## 0.65pF Diode Array

### Package Dimensions — SC70-5

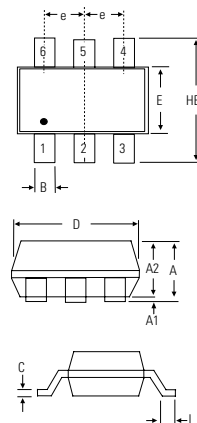


Recommended Solder Pad Layout

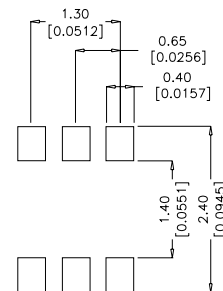


| Package | SC70-5      |      |           |       |
|---------|-------------|------|-----------|-------|
| Pins    | 5           |      |           |       |
| JEDEC   | MO-203      |      |           |       |
| Symbol  | Millimeters |      | Inches    |       |
|         | Min         | Max  | Min       | Max   |
| A       | 0.80        | 1.10 | 0.031     | 0.043 |
| A1      | 0.00        | 0.10 | 0.000     | 0.004 |
| A2      | 0.70        | 1.00 | 0.028     | 0.039 |
| B       | 0.15        | 0.30 | 0.006     | 0.012 |
| c       | 0.08        | 0.25 | 0.003     | 0.010 |
| D       | 1.85        | 2.25 | 0.073     | 0.089 |
| E       | 1.15        | 1.35 | 0.045     | 0.053 |
| e       | 0.65 BSC    |      | 0.026 BSC |       |
| HE      | 2.00        | 2.40 | 0.079     | 0.094 |
| L       | 0.26        | 0.46 | 0.010     | 0.018 |

### Package Dimensions — SC70-6

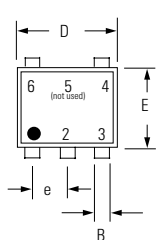


Recommended Solder Pad Layout

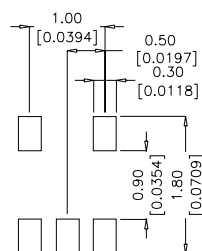


| Package | SC70-6      |      |           |       |
|---------|-------------|------|-----------|-------|
| Pins    | 6           |      |           |       |
| JEDEC   | MO-203      |      |           |       |
| Symbol  | Millimeters |      | Inches    |       |
|         | Min         | Max  | Min       | Max   |
| A       | 0.80        | 1.10 | 0.031     | 0.043 |
| A1      | 0.00        | 0.10 | 0.000     | 0.004 |
| A2      | 0.70        | 1.00 | 0.028     | 0.039 |
| B       | 0.15        | 0.30 | 0.006     | 0.012 |
| c       | 0.08        | 0.25 | 0.003     | 0.010 |
| D       | 1.85        | 2.25 | 0.073     | 0.089 |
| E       | 1.15        | 1.35 | 0.045     | 0.053 |
| e       | 0.65 BSC    |      | 0.026 BSC |       |
| HE      | 2.00        | 2.40 | 0.079     | 0.094 |
| L       | 0.26        | 0.46 | 0.010     | 0.018 |

### Package Dimensions — SOT553



Recommended Solder Pad Layout

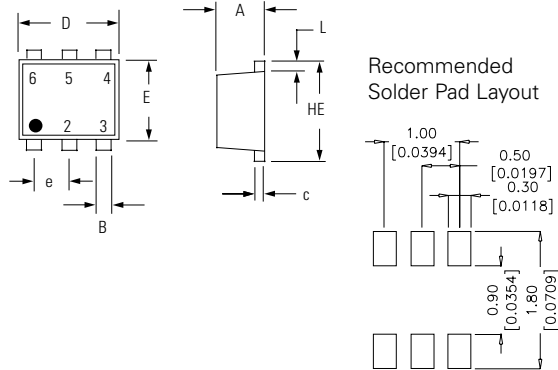


| Package | SOT 553     |      |           |       |
|---------|-------------|------|-----------|-------|
| Pins    | 5           |      |           |       |
| Symbol  | Millimeters |      | Inches    |       |
|         | Min         | Max  | Min       | Max   |
| A       | 0.50        | 0.60 | 0.020     | 0.024 |
| B       | 0.17        | 0.27 | 0.007     | 0.011 |
| c       | 0.08        | 0.18 | 0.003     | 0.007 |
| D       | 1.50        | 1.70 | 0.059     | 0.067 |
| E       | 1.10        | 1.30 | 0.043     | 0.051 |
| e       | 0.50 BSC    |      | 0.020 BSC |       |
| L       | 0.10        | 0.30 | 0.004     | 0.012 |
| HE      | 1.50        | 1.70 | 0.059     | 0.067 |

# SP3003 Series

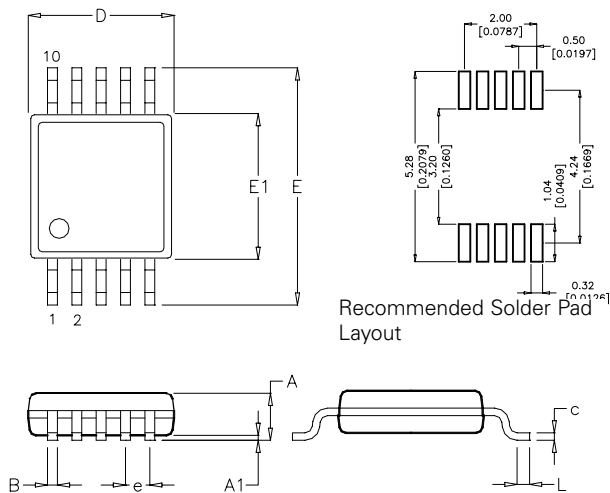
## 0.65pF Diode Array

## Package Dimensions – SOT563



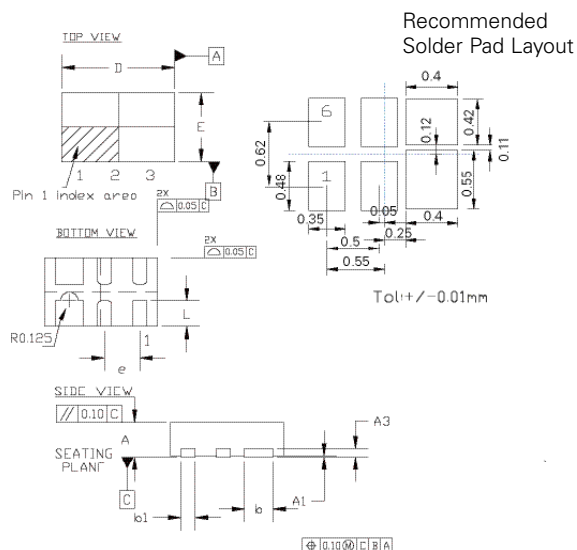
| Package | SOT 563     |      |           |       |
|---------|-------------|------|-----------|-------|
| Pins    | 6           |      |           |       |
| Symbol  | Millimeters |      | Inches    |       |
|         | Min         | Max  | Min       | Max   |
| A       | 0.50        | 0.60 | 0.020     | 0.024 |
| B       | 0.17        | 0.27 | 0.007     | 0.011 |
| c       | 0.08        | 0.18 | 0.003     | 0.007 |
| D       | 1.50        | 1.70 | 0.059     | 0.067 |
| E       | 1.10        | 1.30 | 0.043     | 0.051 |
| e       | 0.50 BSC    |      | 0.020 BSC |       |
| L       | 0.10        | 0.30 | 0.004     | 0.012 |
| HE      | 1.50        | 1.70 | 0.059     | 0.067 |

## Package Dimensions — MSOP10



| Package   | MSOP10      |      |           |       |
|-----------|-------------|------|-----------|-------|
| JEDEC     | MO-187      |      |           |       |
| Pins      | 10          |      |           |       |
| Symbol    | Millimeters |      | Inches    |       |
|           | Min         | Max  | Min       | Max   |
| <b>A</b>  | -           | 1.10 | -         | 0.043 |
| <b>A1</b> | 0.00        | 0.15 | 0.000     | 0.006 |
| <b>B</b>  | 0.17        | 0.27 | 0.007     | 0.011 |
| <b>c</b>  | 0.08        | 0.23 | 0.003     | 0.009 |
| <b>D</b>  | 2.90        | 3.10 | 0.114     | 0.122 |
| <b>E</b>  | 4.67        | 5.10 | 0.184     | 0.200 |
| <b>E1</b> | 2.90        | 3.10 | 0.114     | 0.122 |
| <b>e</b>  | 0.50 BSC    |      | 0.020 BSC |       |
| <b>HE</b> | 0.40        | 0.80 | 0.016     | 0.031 |

## Package Dimensions —μDFN-6L

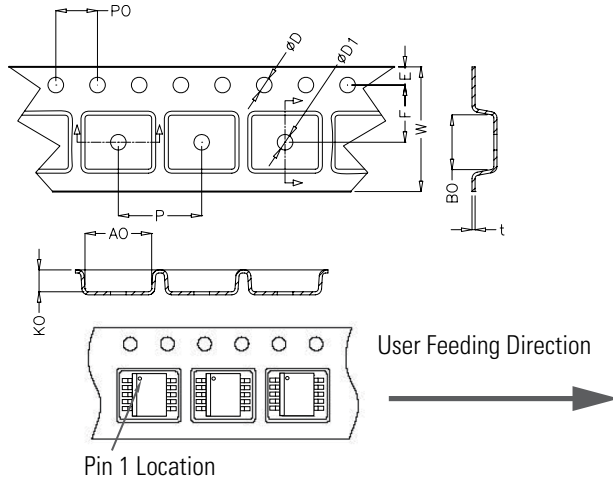


| Package   | μDFN-6L     |      |          |       |
|-----------|-------------|------|----------|-------|
| JEDEC     | MO-229      |      |          |       |
| Pins      | 6           |      |          |       |
| Symbol    | Millimeters |      | Inches   |       |
|           | Min         | Max  | Min      | Max   |
| <b>A</b>  | 0.45        | 0.55 | 0.018    | 0.022 |
| <b>A1</b> | 0.00        | 0.05 | 0.000    | 0.002 |
| <b>A3</b> | 0.125REF    |      | 0.005REF |       |
| <b>b</b>  | 0.35        | 0.45 | 0.014    | 0.018 |
| <b>b1</b> | 0.15        | 0.25 | 0.006    | 0.010 |
| <b>D</b>  | 1.55        | 1.65 | 0.062    | 0.065 |
| <b>D2</b> | -           | -    | -        | -     |
| <b>E</b>  | 0.95        | 1.05 | 0.038    | 0.042 |
| <b>E2</b> | -           | -    | -        | -     |
| <b>e</b>  | 0.50REF     |      | 0.020REF |       |
| <b>L</b>  | 0.33        | 0.43 | 0.013    | 0.017 |

# SP3003 Series

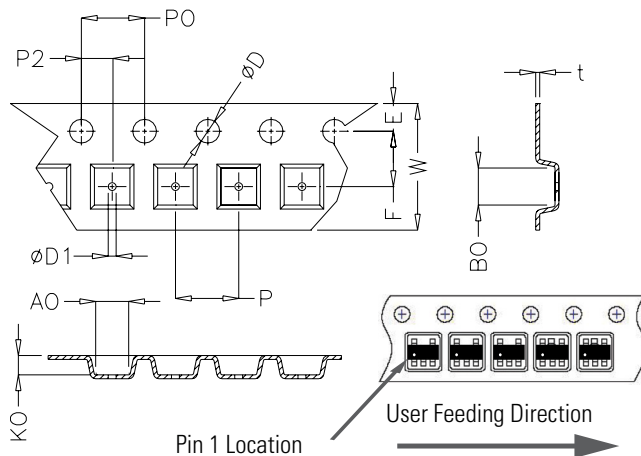
## 0.65pF Diode Array

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



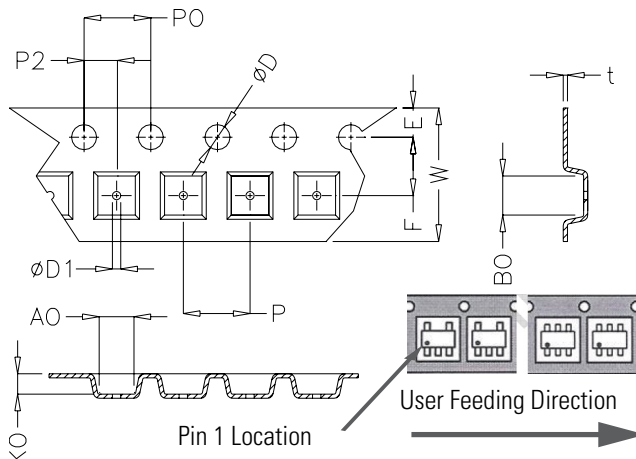
| Symbol | Millimetres |       | Inches        |       |
|--------|-------------|-------|---------------|-------|
|        | Min         | Max   | Min           | Max   |
| E      | 1.65        | 1.85  | 0.065         | 0.073 |
| F      | 5.40        | 5.60  | 0.213         | 0.220 |
| D      | 1.50        | 1.60  | 0.059         | 0.063 |
| D1     | 1.50 Min    |       | 0.059 Min     |       |
| P0     | 3.90        | 4.10  | 0.154         | 0.161 |
| 10P0   | 40.0 ± 0.20 |       | 1.574 ± 0.008 |       |
| W      | 11.90       | 12.10 | 0.469         | 0.476 |
| P      | 7.90        | 8.10  | 0.311         | 0.319 |
| A0     | 5.20        | 5.40  | 0.205         | 0.213 |
| B0     | 3.20        | 3.40  | 0.126         | 0.134 |
| K0     | 1.20        | 1.40  | 0.047         | 0.055 |
| t      | 0.30 ± 0.05 |       | 0.012 ± 0.002 |       |

### Embossed Carrier Tape & Reel Specifications — SC70-5 and SC70-6



| Symbol | Millimetres |      | Inches        |       |
|--------|-------------|------|---------------|-------|
|        | Min         | Max  | Min           | Max   |
| E      | 1.65        | 1.85 | 0.064         | 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     | 1.00        | 1.25 | 0.039         | 0.049 |
| 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     | 2.14        | 2.34 | 0.084         | 0.092 |
| B0     | 2.24        | 2.44 | 0.088         | 0.096 |
| K0     | 1.12        | 1.32 | 0.044         | 0.052 |
| t      | 0.27 max    |      | 0.010 max     |       |

### Embossed Carrier Tape & Reel Specifications — SOT553 and SOT563

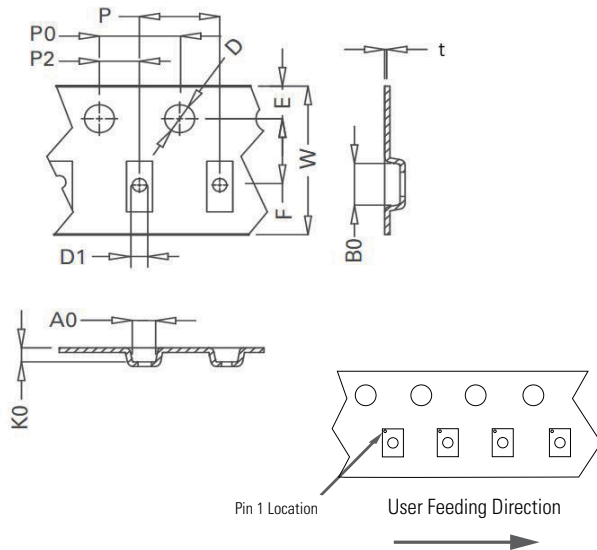


| Symbol | Millimetres |      | Inches        |       |
|--------|-------------|------|---------------|-------|
|        | Min         | Max  | Min           | Max   |
| E      | 1.65        | 1.85 | 0.064         | 0.073 |
| F      | 3.45        | 3.55 | 0.135         | 0.139 |
| P2     | 1.95        | 2.05 | 0.076         | 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     |       |

# SP3003 Series

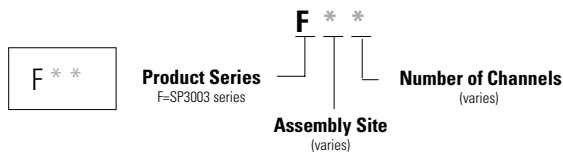
## 0.65pF Diode Array

### Embossed Carrier Tape & Reel Specification — $\mu$ DFN-6L



| Symbol | Millimetres |      | Inches      |       |
|--------|-------------|------|-------------|-------|
|        | Min         | Max  | Min         | Max   |
| E      | 1.65        | 1.85 | 0.064       | 0.073 |
| F      | 3.45        | 3.55 | 0.135       | 0.139 |
| P2     | 1.95        | 2.05 | 0.076       | 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      | 7.90        | 8.30 | 0.311       | 0.319 |
| P      | 3.90        | 4.10 | 0.154       | 0.161 |
| A0     | 1.15        | 1.25 | 0.045       | 0.049 |
| B0     | 1.75        | 1.85 | 0.069       | 0.073 |
| K0     | 0.65        | 0.75 | 0.026       | 0.03  |
| t      | 0.22 max    |      | 0.009 max   |       |

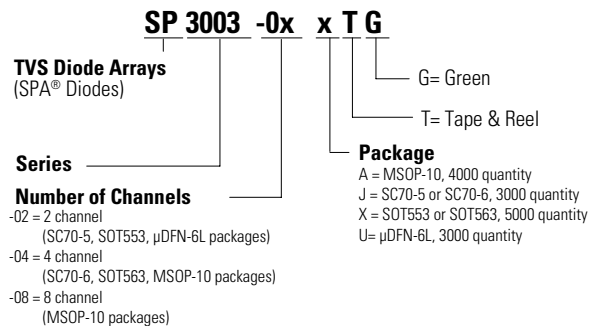
### Part Marking System



### Ordering Information

| Part Number  | Package      | Marking | Min. Order Qty. |
|--------------|--------------|---------|-----------------|
| SP3003-02JTG | SC70-5       | F*2     | 3000            |
| SP3003-02UTG | $\mu$ DFN-6L | F*2     | 3000            |
| SP3003-02XTG | SOT553       | F*2     | 3000            |
| SP3003-04ATG | MSOP-10      | F*4     | 4000            |
| SP3003-04JTG | SC70-6       | F*4     | 3000            |
| SP3003-04XTG | SOT563       | F*4     | 3000            |
| SP3003-08ATG | MSOP-10      | F*8     | 4000            |

### Part Numbering System



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