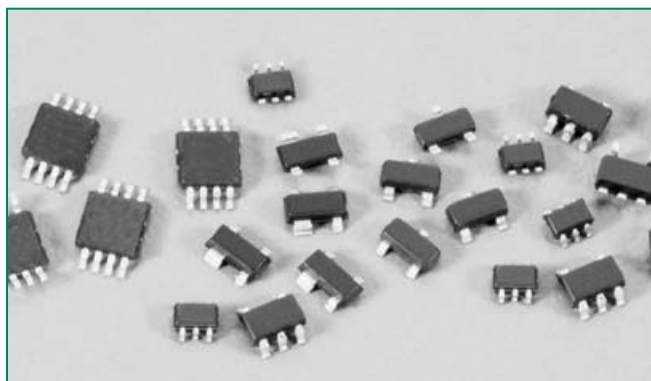


**HF RoHS Pb GREEN SP050xBA Lead-Free/Green Series**

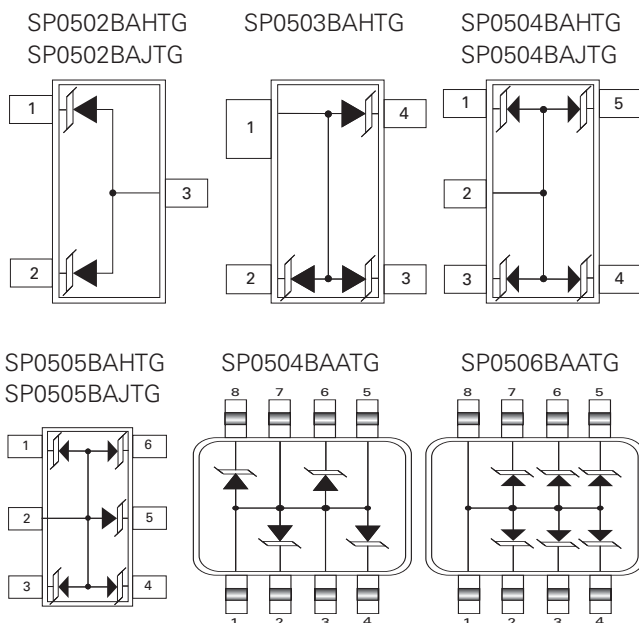


### Description

The surface mount family of arrays are designed to suppress ESD and other transient overvoltage events. These arrays are used to meet the International Electrotechnical Compatibility (IEC transient immunity standards IEC 61000-4-2 for Electrostatic Discharge Requirements). The series are used to help protect sensitive digital or analog input circuits on data, signal, or control lines with voltage levels up to 5VDC.

The monolithic silicon arrays are comprised of specially designed structures for transient voltage suppression (TVS). The size and shape of these structures have been tailored for transient protection. The low capacitance and clamp voltage are ideal for high speed signal line protection.

### Pinout



### Features

- An Array of 2, 3, 4, 5 or 6 TVS Avalanche Diodes in a ultra small SC70, SOT-23, SOT-143, MSOP or TSSOP packages
- ESD Capability Standards
  - IEC 61000-4-2, Direct Discharge ..... 20kV (Level 4)
  - IEC 61000-4-2, Air Discharge ..... 30kV (Level 4)
  - MIL STD 883 3015.7 ..... 30kV
- Input Protection for Applications Up to 5VDC
- Fast Response Time ..... <1ns
- Low Input Capacitance ..... 30pF Typical
- Operating Temperature Range ..... -40°C to 85°C

### Applications

- Mobile phone handsets
- Personal Digital Assistants (PDA)
- Portable handheld equipment (Laptop, Palmtop computers)
- Computer port, keyboard (USB1.1)
- Digital still cameras
- Digital video cameras
- MP3 players

### Absolute Maximum Ratings

| Parameter                         | Rating       | Units |
|-----------------------------------|--------------|-------|
| Storage Temperature Range         | -65 to + 150 | °C    |
| Package Power Dissipation         |              |       |
| SC70                              | 0.2          | W     |
| SOT23-3, SOT23-5, SOT23-6, SOT143 | 0.225        | W     |
| TSSOP, MSOP                       | 0.5          | W     |

### Electrical Characteristics $T_A = +25^\circ\text{C}$ , Unless Otherwise Specified

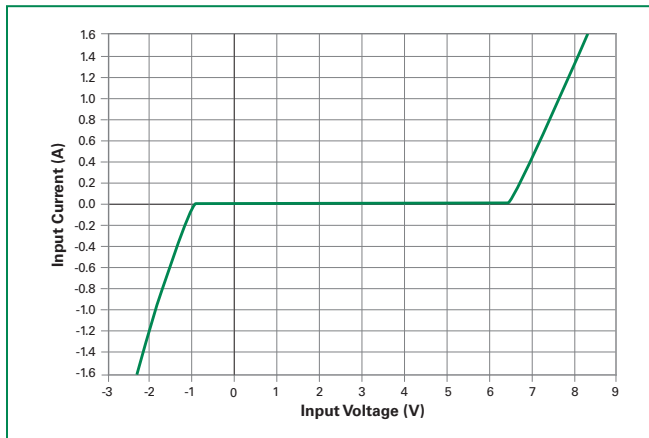
| Parameter                          | Test Conditions             | Min  | Typ  | Max  | Units    |
|------------------------------------|-----------------------------|------|------|------|----------|
| Reverse Standoff Voltage           | $I_R \leq 1\mu\text{A}$     | -    | -    | 5.5  | V        |
| Reverse Standoff Leakage Current   | $V = 5.0\text{V}$           |      | 1    | 100  | nA       |
| Signal Clamp Voltage               |                             |      |      |      |          |
| Positive                           | $I = 10\text{mA}$           | 5.6  | 6.8  | 8    | V        |
| Negative                           | $I = 10\text{mA}$           | -1.2 | -0.8 | -0.4 | V        |
| Clamp Voltage during ESD           |                             |      |      |      |          |
| MIL-STD-883 Method 3015 (HBM) test |                             |      |      |      |          |
| + 8kV                              |                             |      | 12   |      | V        |
| - 8kV                              |                             |      | -8   |      | V        |
| ESD Test Level (1)                 |                             |      |      |      |          |
| IEC-61000-2, Contact discharge     |                             | 20   |      |      | kV       |
| MIL-STD-883 Method 3015 (HBM)      |                             | 30   |      |      | kV       |
| Capacitance                        | $2.5\text{V} @ 1\text{Mhz}$ |      | 30   |      | pF       |
| Turn on/off Time                   |                             |      | <1   |      | ns       |
| Temperature Range                  |                             |      |      |      |          |
| Operating                          |                             | -40  |      | 85   | °C       |
| Storage                            |                             | -65  |      | 150  | °C       |
| Diode Dynamic Resistance           |                             |      |      |      |          |
| Forward Conduction                 |                             |      | 1.0  |      | $\Omega$ |
| Reverse Conduction                 |                             |      | 1.4  |      | $\Omega$ |

Note:

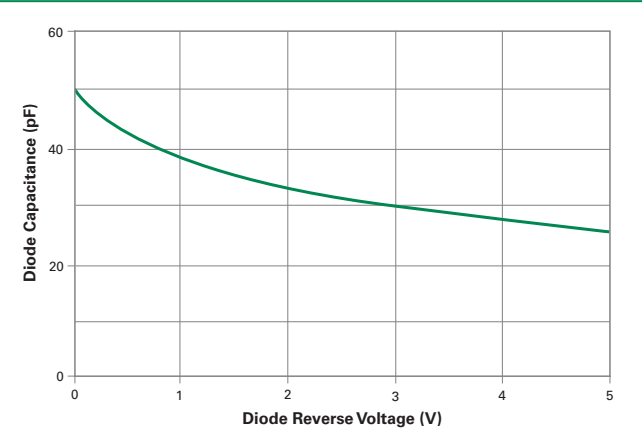
(1) ESD voltage applied between channel pins and ground, one pin at a time; all other channel pins are open; all ground pins are grounded.

### Typical Input VI Characteristics

(Pulse-mode measurements, pulse width = 0.7 mS nominal)

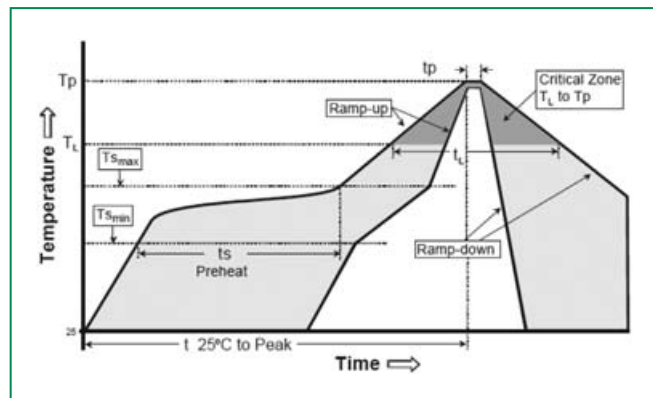


### Typical Diode Capacitance vs. Reverse Voltage

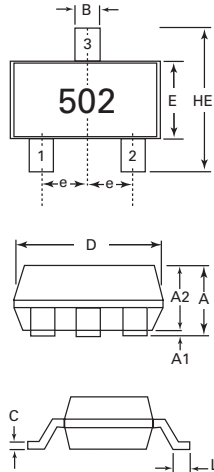


### Soldering Parameters - Wave Soldering

|                                                        |                                    |                         |
|--------------------------------------------------------|------------------------------------|-------------------------|
| 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 |                                    | 5°C/second max          |
| $T_{s(max)}$ to $T_L$ - Ramp-up Rate                   |                                    | 5°C/second max          |
| Reflow                                                 | - Temperature ( $T_L$ ) (Liquidus) | 217°C                   |
|                                                        | - Temperature ( $t_L$ )            | 60 – 150 seconds        |
| Peak Temperature ( $T_p$ )                             |                                    | 250 <sup>+0/-5</sup> °C |
| Time within 5°C of actual peak Temperature ( $t_p$ )   |                                    | 20 – 40 seconds         |
| Ramp-down Rate                                         |                                    | 5°C/second max          |
| Time 25°C to peak Temperature ( $T_p$ )                |                                    | 8 minutes Max.          |
| Do not exceed                                          |                                    | 260°C                   |

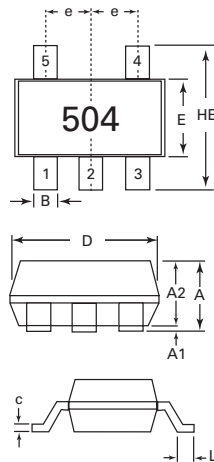


**Package Dimensions - SC70**



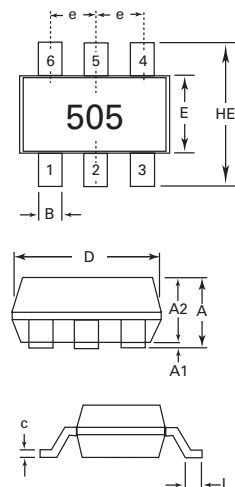
SP0502BAJTG - SC70-3

| Package   | SC70-3         |      |           |       |
|-----------|----------------|------|-----------|-------|
| Pins      | 3              |      |           |       |
| JEDEC     | MO-203 Issue A |      |           |       |
|           | Millimeters    |      | Inches    |       |
|           | Min            | Max  | Min       | Max   |
| <b>A</b>  | 0.80           | 1.10 | 0.031     | 0.043 |
| <b>A1</b> | 0.00           | 0.10 | 0.00      | 0.004 |
| <b>A2</b> | 0.70           | 1.00 | 0.028     | 0.039 |
| <b>B</b>  | 0.15           | 0.30 | 0.006     | 0.012 |
| <b>c</b>  | 0.08           | 0.25 | 0.003     | 0.010 |
| <b>D</b>  | 1.85           | 2.25 | 0.073     | 0.089 |
| <b>E</b>  | 1.15           | 1.35 | 0.045     | 0.053 |
| <b>e</b>  | 0.66 BSC       |      | 0.026 BSC |       |
| <b>HE</b> | 2.00           | 2.40 | 0.079     | 0.094 |
| <b>L</b>  | 0.26           | 0.46 | 0.010     | 0.018 |



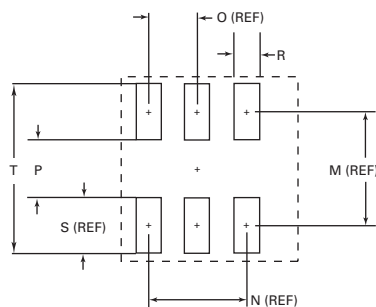
SP0504BAJTG - SC70-5

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



SP0505BAJTG - SC70-6

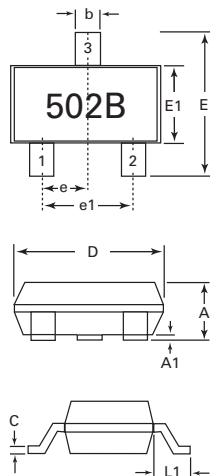
Recommended Pad Layout



| Package   | SC70-6         |      |           |       |
|-----------|----------------|------|-----------|-------|
| Pins      | 6              |      |           |       |
| JEDEC     | MO-203 Issue A |      |           |       |
|           | Millimeters    |      | Inches    |       |
|           | Min            | Max  | Min       | Max   |
| <b>A</b>  | 0.80           | 1.10 | 0.031     | 0.043 |
| <b>A1</b> | 0.00           | 0.10 | 0.00      | 0.004 |
| <b>A2</b> | 0.70           | 1.00 | 0.028     | 0.039 |
| <b>B</b>  | 0.15           | 0.30 | 0.006     | 0.012 |
| <b>c</b>  | 0.08           | 0.25 | 0.003     | 0.010 |
| <b>D</b>  | 1.85           | 2.25 | 0.073     | 0.089 |
| <b>E</b>  | 1.15           | 1.35 | 0.045     | 0.053 |
| <b>e</b>  | 0.65 BSC       |      | 0.026 BSC |       |
| <b>HE</b> | 2.00           | 2.40 | 0.079     | 0.094 |
| <b>L</b>  | 0.26           | 0.46 | 0.010     | 0.018 |
| <b>M</b>  | -              | 1.60 | -         | 0.063 |
| <b>N</b>  | -              | 1.30 | -         | 0.051 |
| <b>O</b>  | -              | 0.65 | -         | 0.026 |
| <b>P</b>  | -              | 0.70 | -         | 0.028 |
| <b>R</b>  | -              | 0.35 | -         | 0.014 |
| <b>S</b>  | -              | 0.90 | -         | 0.035 |
| <b>T</b>  | -              | 2.50 | -         | 0.098 |

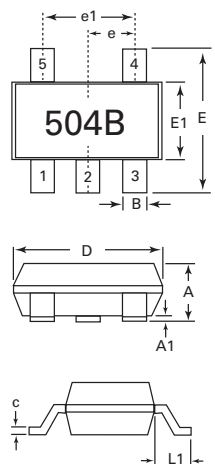
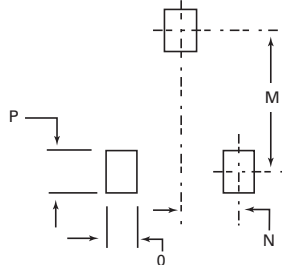
Lead-Free/Green SP050xBA

## Package Dimensions - SOT23



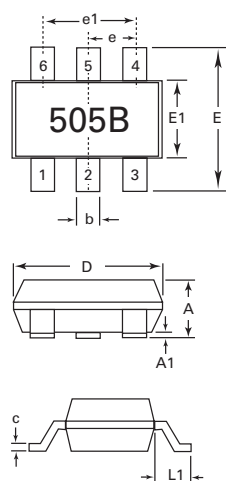
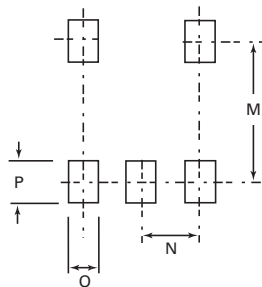
SP0502BAHT - SOT23-3

Recommended Pad Layout



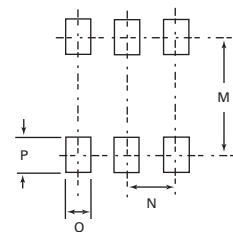
SP0504BAHTG - SOT23-5

Recommended Pad Layout



SP0505BAHTG - SOT23-6

Recommended Pad Layout

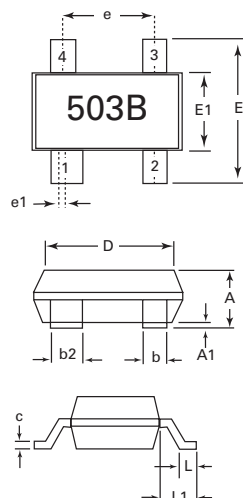


| Package   | SOT23-3     |      |           |         |
|-----------|-------------|------|-----------|---------|
| Pins      | 3           |      |           |         |
| JEDEC     | TO-236      |      |           |         |
|           | Millimeters |      | Inches    |         |
|           | Min         | Max  | Min       | Max     |
| <b>A</b>  | 0.89        | 1.12 | 0.035     | 0.044   |
| <b>A1</b> | 0.01        | 0.1  | 0.0004    | 0.004   |
| <b>b</b>  | 0.3         | 0.5  | 0.012     | 0.020   |
| <b>c</b>  | 0.08        | 0.2  | 0.003     | 0.008   |
| <b>D</b>  | 2.8         | 3.04 | 0.110     | 0.120   |
| <b>E</b>  | 2.1         | 2.64 | 0.083     | 0.104   |
| <b>E1</b> | 1.2         | 1.4  | 0.047     | 0.055   |
| <b>e</b>  | 0.95 BSC    |      | 0.038 BSC |         |
| <b>e1</b> | 1.90 BSC    |      | 0.075 BSC |         |
| <b>L1</b> | 0.54 REF    |      | 0.021 REF |         |
| <b>M</b>  |             | 2.29 |           | .090    |
| <b>N</b>  |             | 0.95 |           | 0.038   |
| <b>O</b>  |             | 0.78 |           | .030TYP |
| <b>P</b>  |             | 0.78 |           | .030TYP |

| Package   | SOT23-5     |      |           |         |
|-----------|-------------|------|-----------|---------|
| Pins      | 5           |      |           |         |
| JEDEC     | MO-178      |      |           |         |
|           | Millimeters |      | Inches    |         |
|           | Min         | Max  | Min       | Max     |
| <b>A</b>  | -           | 1.45 | -         | 0.057   |
| <b>A1</b> | 0           | 0.15 | 0         | 0.006   |
| <b>b</b>  | 0.3         | 0.5  | 0.012     | 0.020   |
| <b>c</b>  | 0.08        | 0.22 | 0.003     | 0.009   |
| <b>D</b>  | 2.75        | 3.05 | 0.108     | 0.120   |
| <b>E</b>  | 2.6         | 3.0  | 0.102     | 0.118   |
| <b>E1</b> | 1.45        | 1.75 | 0.057     | 0.069   |
| <b>e</b>  | 0.95 BSC    |      | 0.038 BSC |         |
| <b>e1</b> | 1.90 BSC    |      | 0.075 BSC |         |
| <b>L1</b> | 0.60 REF    |      | 0.024 REF |         |
| <b>M</b>  |             | 2.59 |           | .102    |
| <b>N</b>  |             | 0.95 |           | .038    |
| <b>O</b>  |             | 0.69 |           | .027TYP |
| <b>P</b>  |             | 0.99 |           | .039TYP |

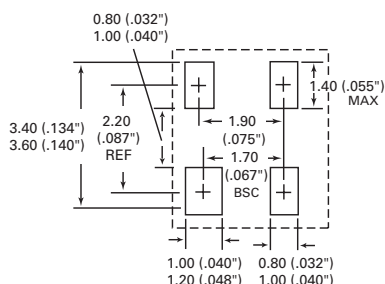
| Package   | SOT23-6     |      |           |         |
|-----------|-------------|------|-----------|---------|
| Pins      | 6           |      |           |         |
| JEDEC     | MO-178      |      |           |         |
|           | Millimeters |      | Inches    |         |
|           | Min         | Max  | Min       | Max     |
| <b>A</b>  | -           | 1.45 | -         | 0.057   |
| <b>A1</b> | 0           | 0.15 | 0         | 0.006   |
| <b>b</b>  | 0.3         | 0.5  | 0.012     | 0.020   |
| <b>c</b>  | 0.08        | 0.22 | 0.003     | 0.009   |
| <b>D</b>  | 2.75        | 3.05 | 0.108     | 0.120   |
| <b>E</b>  | 2.6         | 3.0  | 0.102     | 0.118   |
| <b>E1</b> | 1.45        | 1.75 | 0.057     | 0.069   |
| <b>e</b>  | 0.95 BSC    |      | 0.038 BSC |         |
| <b>e1</b> | 1.90 BSC    |      | 0.075 BSC |         |
| <b>L1</b> | 0.60 REF    |      | 0.024 REF |         |
| <b>M</b>  |             | 2.59 |           | .102    |
| <b>N</b>  |             | 0.95 |           | 0.038   |
| <b>O</b>  |             | 0.69 |           | .027TYP |
| <b>P</b>  |             | 0.99 |           | .039TYP |

### Package Dimensions - SOT143



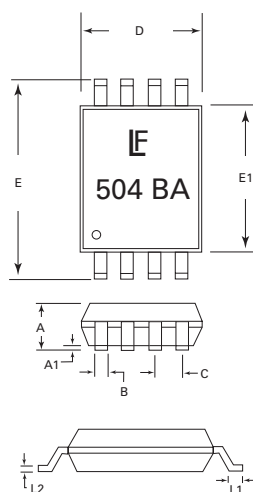
SP0503BAHTG - SOT143-4

Recommended Pad Layout



| Package   | SOT143-4    |      |           |       |
|-----------|-------------|------|-----------|-------|
| Pins      | 4           |      |           |       |
| JEDEC     | TO-253      |      |           |       |
|           | Millimeters |      | Inches    |       |
|           | Min         | Max  | Min       | Max   |
| <b>A</b>  | 0.08        | 1.22 | 0.003     | 0.048 |
| <b>A1</b> | 0.05        | 0.15 | 0.002     | 0.006 |
| <b>b</b>  | 0.30        | 0.50 | 0.012     | 0.020 |
| <b>b2</b> | 0.76        | 0.89 | 0.030     | 0.035 |
| <b>c</b>  | 0.08        | 0.20 | 0.003     | 0.008 |
| <b>D</b>  | 2.80        | 3.04 | 0.110     | 0.120 |
| <b>E</b>  | 2.10        | 2.64 | 0.082     | 0.104 |
| <b>E1</b> | 1.20        | 1.40 | 0.047     | 0.055 |
| <b>e</b>  | 1.92 BSC    |      | 0.076 BSC |       |
| <b>e1</b> | 0.20 BSC    |      | 0.008 BSC |       |
| <b>L</b>  | 0.4         | 0.6  | 0.016     | 0.024 |
| <b>L1</b> | 0.550 REF   |      | 0.022 REF |       |

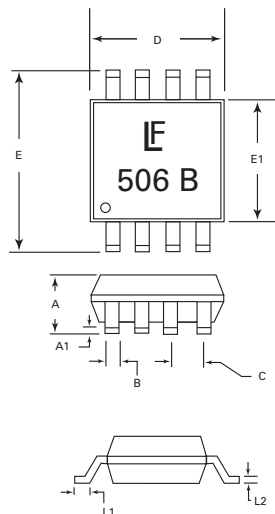
### Package Dimensions - TSSOP



SP0504BAATG - TSSOP-8

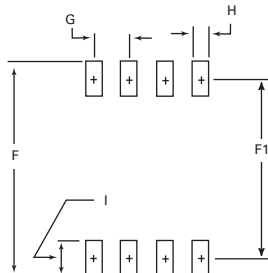
| Package   | TSSOP-8     |       |          |          |
|-----------|-------------|-------|----------|----------|
| Pins      | 8           |       |          |          |
|           | Millimeters |       | Inches   |          |
|           | Min         | Max   | Min      | Max      |
| <b>D</b>  | 2.90        | 3.10  | 0.114    | .122     |
| <b>E</b>  | 6.40 REF    |       | .252 REF |          |
| <b>E1</b> | 4.29        | 4.50  | .17      | .18      |
| <b>A</b>  | 1.194 REF   |       | .047 REF |          |
| <b>A1</b> | 0.051       | 0.152 | .002     | 0.006    |
| <b>B</b>  | -           | 0.30  | -        | 0.012TYP |
| <b>C</b>  | -           | 0.66  | -        | TYP      |
| <b>L1</b> | 0.51        | 0.76  | .020     | .030     |
| <b>L2</b> | 0.102       | 0.203 | .004     | .008     |

### Package Dimensions - MSOP



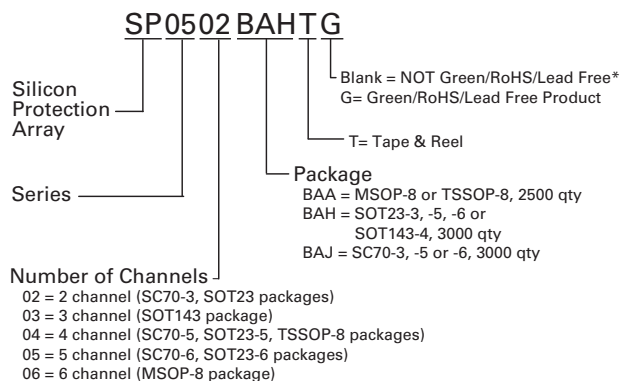
SP0506BAATG - MSOP-8

Recommended Pad Layout



| Package   | MSOP-8      |         |        |          |
|-----------|-------------|---------|--------|----------|
| Pins      | 8           |         |        |          |
|           | Millimeters |         | Inches |          |
|           | Min         | Max     | Min    | Max      |
| <b>D</b>  | 2.90        | 3.10    | 0.114  | .122     |
| <b>E</b>  | 4.78        | 4.98    | .188   | .196     |
| <b>E1</b> | 2.90        | 3.10    | .114   | .122     |
| <b>A</b>  | 0.87        | 1.17    | .034   | .046     |
| <b>A1</b> | 0.05        | 0.25    | .002   | 0.010    |
| <b>B</b>  | -           | 0.30TYP | -      | 0.012TYP |
| <b>C</b>  | -           | 0.65TYP | -      | 0.026TYP |
| <b>L1</b> | 0.52        | 0.54    | 0.020  | 0.021    |
| <b>L2</b> | -           | 0.18TYP | -      | .007TYP  |
| <b>F</b>  | -           | 5.28    | -      | .208     |
| <b>F1</b> | -           | 4.24    | -      | .167     |
| <b>G</b>  | -           | 0.65    | -      | 0.026    |
| <b>H</b>  | -           | 0.38    | -      | .015     |
| <b>I</b>  | -           | 1.04    | -      | .041     |

### Part Numbering System



### Product Characteristics

|                            |                                                                      |
|----------------------------|----------------------------------------------------------------------|
| <b>Lead Plating</b>        | "G" Green version - Matte Tin (Sn);<br>*Non-Green version - Tin Lead |
| <b>Lead Material</b>       | Copper Alloy                                                         |
| <b>Lead Coplanarity</b>    | 0.004 inches (0.102mm)                                               |
| <b>Substitute Material</b> | Silicon                                                              |
| <b>Body Material</b>       | Molded Epoxy                                                         |
| <b>Flammability</b>        | UL94-V-0                                                             |

Notes:

1. All dimensions are in millimeters.
2. Dimensions include solder plating.
3. Dimensions are exclusive of mold flash & metal burr.
4. All specifications comply to JEDEC SPEC MO-203 ISSUE A.
5. Blo is facing up for mold and facing down for trim/form, i.e. reverse trim/form.
6. Package surface matte finish VDI 11-13.

### Ordering Information

\*NOTE: To order NON-Green/RoHS/Lead Free version of product, remove "G" at the end of part number.

| Part Number | CH | Package Type | Quantity Per Reel |
|-------------|----|--------------|-------------------|
| SP0502BAHTG | 2  | SOT23-3      | 3000              |
| SP0503BAHTG | 3  | SOT143-4     | 3000              |
| SP0504BAHTG | 4  | SOT23-5      | 3000              |
| SP0505BAHTG | 5  | SOT23-6      | 3000              |
| SP0504BAATG | 4  | TSSOP-8      | 3000              |
| SP0506BAATG | 6  | MSOP-8       | 4000              |
| SP0502BAJTG | 2  | SC70-3       | 3000              |
| SP0504BAJTG | 4  | SC70-5       | 3000              |
| SP0505BAJTG | 5  | SC70-6       | 3000              |

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Littelfuse:

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[SP0505BAHTG](#)