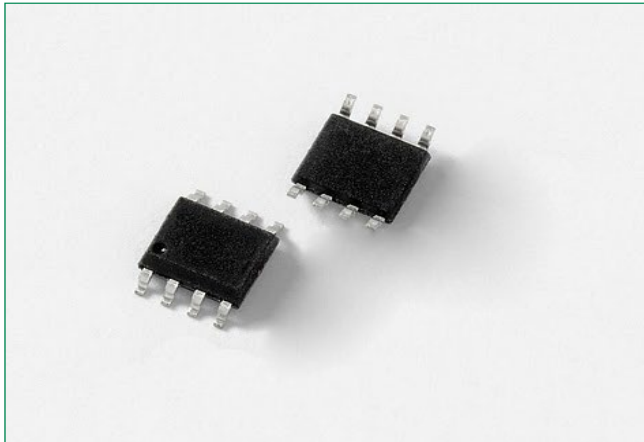
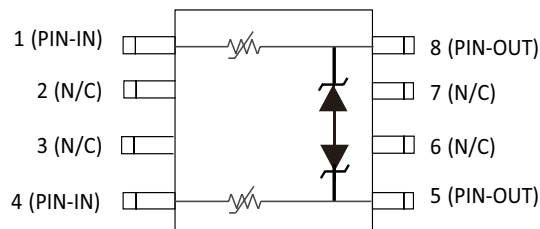


## SP4031 Series



### Functional Block Diagram



### Features

- ESD, IEC 61000-4-2,  $\pm 30\text{kV}$  contact,  $\pm 30\text{kV}$  air
- EFT, IEC 61000-4-4, 40A (5/50ns)
- Lightning, 35A (8/20 as defined in IEC 61000-4-5 2nd edition)
- Low capacitance of 2.5pF (@ $V_R=0\text{V}$ )
- Moisture Sensitivity Level (MSL -1)
- Lead free and RoHS compliant
- This SP4031 hybrid component provides a tested and proved protection solution for high-speed interfaces such as 10/100/1000BaseT applications
- Low parasitic capacitance
- Low operating voltage (<3.3 V)
- Low breakdown voltage (>3.5V)

### Description

The SP4031 hybrid protector offers both overcurrent and differential only overvoltage protection for applications such as 10/100/1000BaseT ports. Compliant with the newest standards of overvoltage per industry standard ITU-T K.21. Tested to basic tests levels 2.5kV overvoltage. Flow-through package layout allows PCB trace routing directly through the SP4031 without changing pitch dimensions, thus having less impact on normal signal high frequency components.

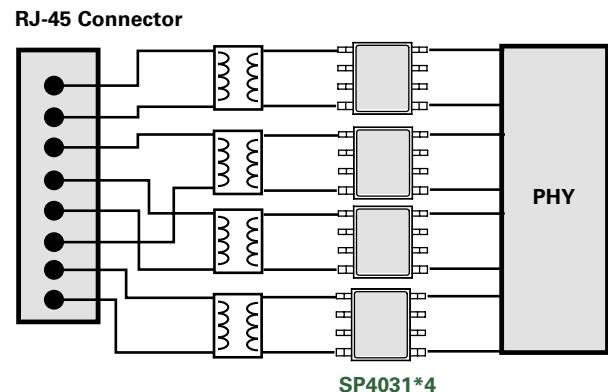
During a prolonged overvoltage event such as a power fault, this component will present a high impedance. The high impedance state will reset once the power fault event has ended. During a fast transient event, the component will clamp, thus protecting any downstream chipsets.

These components can safely absorb up to 35A per IEC 61000-4-5 2<sup>nd</sup> edition ( $t_p=8/20\mu\text{s}$ ) without performance degradation and a minimum  $\pm 30\text{kV}$  ESD per IEC 61000-4-2 International Standard. The low loading capacitance and high surge capability makes the SP4031 ideal for protecting telecommunication ports such as Ethernet and other high speed data interfaces.

### Applications

- 10/100/1000BaseT Ethernet
- ITU K.21 Basic level compliance
- ADSL/VDSL/G.fast modem
- Industrial Ethernet

### Application Example



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.

### Absolute Maximum Ratings

| Symbol     | Parameter                        | Value     | Units |
|------------|----------------------------------|-----------|-------|
| $T_{OP}$   | Operating Temperature            | -40 to 85 | °C    |
| $I_{PP}$   | Peak Current ( $t_p=8/20\mu s$ ) | 35        | A     |
| $T_{STOR}$ | Storage Temperature              | -55 to 85 | °C    |

Notes:

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.

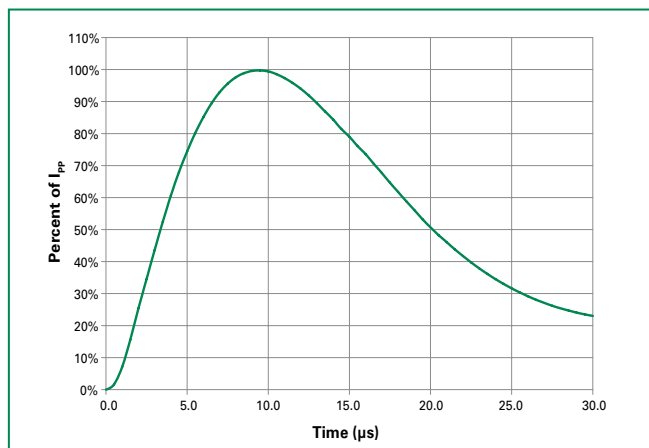
### Electrical Characteristics, Pin1 to Pin5 ( $T_{OP} = 25^\circ C$ )

| Parameter                          | Symbol        | Test Conditions                            | Min      | Typ  | Max | Units    |
|------------------------------------|---------------|--------------------------------------------|----------|------|-----|----------|
| Reverse Standoff Voltage           | $V_{RWM}$     | $I_R = 1\mu A$                             |          |      | 3.3 | V        |
| Breakdown Voltage                  | $V_{BR}$      | $I_R = 1mA$                                | 3.5      | 4.5  |     | V        |
| Reverse Leakage Current            | $I_{LEAK}$    | $V_R = 3.3V$                               |          |      | 0.5 | $\mu A$  |
| Clamp Voltage <sup>1</sup>         | $V_C$         | $I_{PP}=1A, t_p=8/20\mu s$ , Pin5 to Pin8  |          | 6    | 7.5 | V        |
|                                    |               | $I_{PP}=35A, t_p=8/20\mu s$ , Pin5 to Pin8 |          | 29.5 | 35  | V        |
| Dynamic Resistance <sup>2</sup>    | $R_{DYN}$     | TLP, $t_p=100ns$ , Pin5 to Pin8            |          | 0.45 |     | $\Omega$ |
| ESD Withstand Voltage <sup>1</sup> | $V_{ESD}$     | IEC 61000-4-2 (Contact Discharge)          | $\pm 30$ |      |     | kV       |
|                                    |               | IEC 61000-4-2 (Air Discharge)              | $\pm 30$ |      |     | kV       |
| Diode Capacitance <sup>1</sup>     | $C_{I/O-I/O}$ | Reverse Bias=0V, $f=1MHz$                  |          | 2    | 2.5 | pF       |

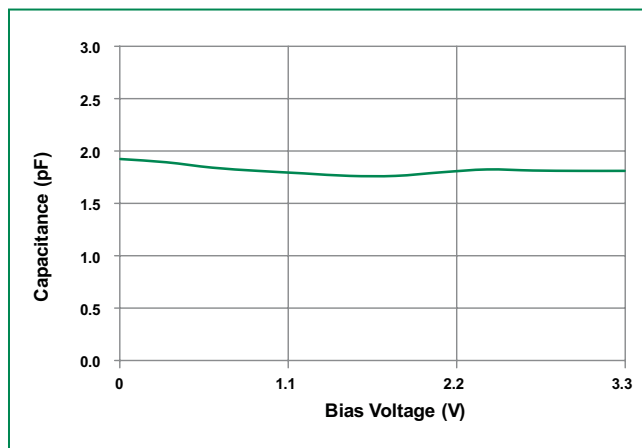
Notes: 1 Parameter is guaranteed by design and/or component characterization.

2. Transmission Line Pulse (TLP) with 100ns width, 2ns rise time, and average window  $t_1=70ns$  to  $t_2=90ns$

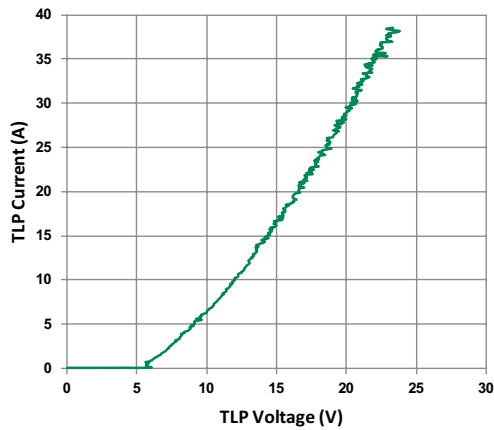
### 8/20 Pulse Waveform



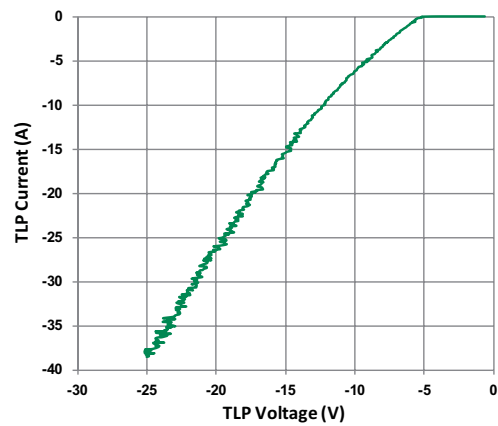
### Capacitance vs. Reverse Bias



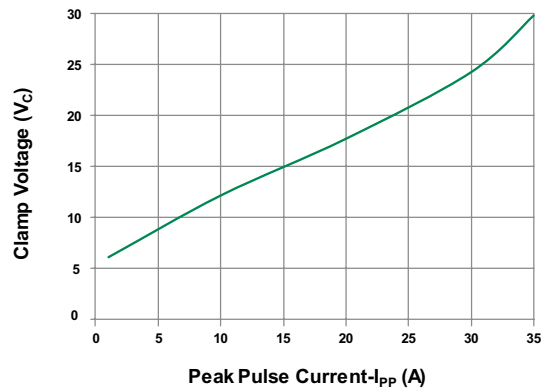
### Positive Transmission Line Pulsing (TLP) Plot



### Negative Transmission Line Pulsing (TLP) Plot

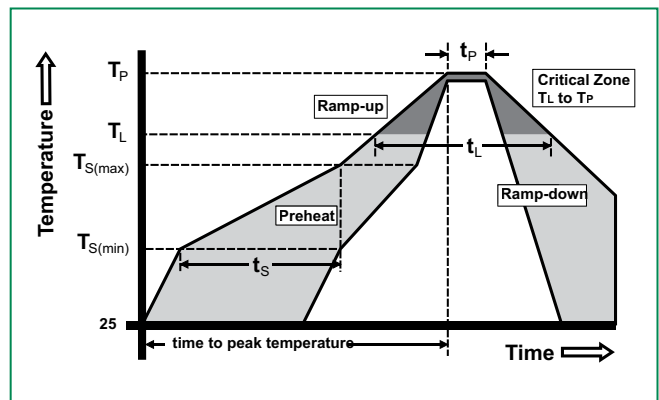


### Clamping voltage vs. $I_{PP}$ for 8/20 $\mu$ S waveshape



### 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 $^{+0/-5}$ °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              |



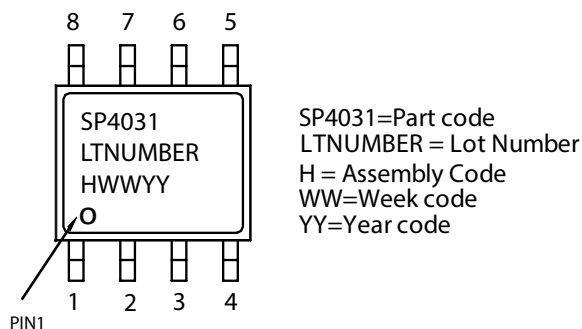
### Product Characteristics

|                           |                                                        |
|---------------------------|--------------------------------------------------------|
| <b>Lead Plating</b>       | Pre-Plated Frame                                       |
| <b>Lead Material</b>      | Copper Alloy                                           |
| <b>Lead Coplanarity</b>   | 0.004 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 |

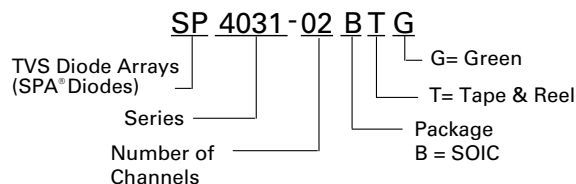
### Ordering Information

| Part Number  | Package          | Min. Order Qty. |
|--------------|------------------|-----------------|
| SP4031-02BTG | SOIC Tape & Reel | 2500            |

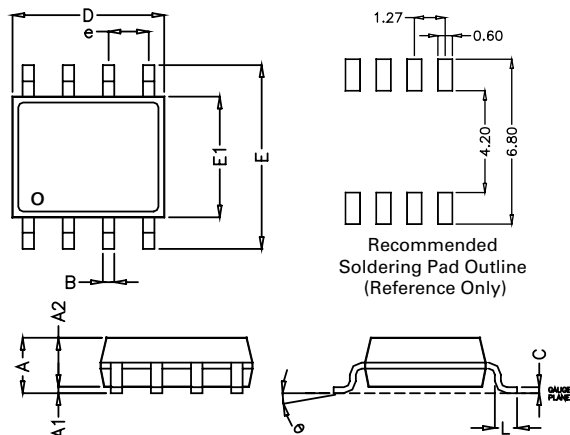
### Part Marking System



### Part Numbering System

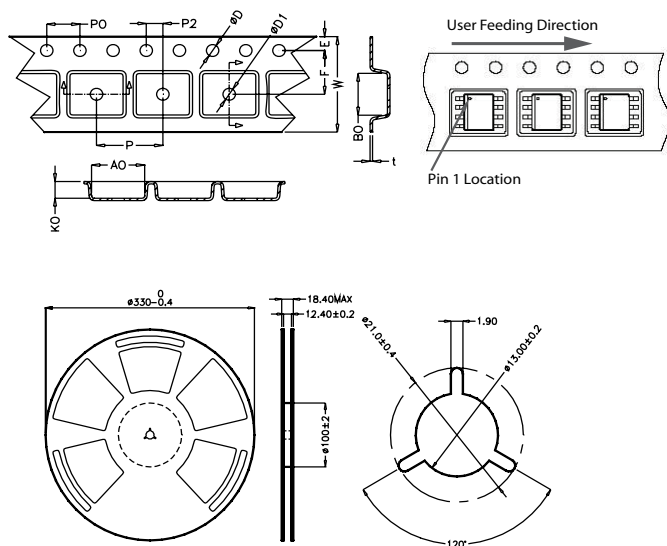


### Package Dimensions of SOIC-8



| Package   | SOIC        |      |           |       |
|-----------|-------------|------|-----------|-------|
| Pins      | 8           |      |           |       |
| JEDEC     | MS-012      |      |           |       |
|           | Millimeters |      | Inches    |       |
|           | Min         | Max  | Min       | Max   |
| <b>A</b>  | 1.35        | 1.75 | 0.053     | 0.069 |
| <b>A1</b> | 0.10        | 0.25 | 0.004     | 0.010 |
| <b>A2</b> | 1.25        | 1.65 | 0.050     | 0.065 |
| <b>B</b>  | 0.31        | 0.51 | 0.012     | 0.020 |
| <b>c</b>  | 0.17        | 0.25 | 0.007     | 0.010 |
| <b>D</b>  | 4.80        | 5.00 | 0.189     | 0.197 |
| <b>E</b>  | 5.80        | 6.20 | 0.228     | 0.244 |
| <b>E1</b> | 3.80        | 4.00 | 0.150     | 0.157 |
| <b>e</b>  | 1.27 BSC    |      | 0.050 BSC |       |
| <b>L</b>  | 0.40        | 1.27 | 0.016     | 0.050 |

**Embossed Carrier Tape & Reel Specification — SOIC Package**



|             | Millimeters   |      | Inches          |       |
|-------------|---------------|------|-----------------|-------|
|             | Min           | Max  | Min             | Max   |
| <b>E</b>    | 1.65          | 1.85 | 0.065           | 0.073 |
| <b>F</b>    | 5.4           | 5.6  | 0.213           | 0.22  |
| <b>P2</b>   | 1.95          | 2.05 | 0.077           | 0.081 |
| <b>D</b>    | 1.5           | 1.6  | 0.059           | 0.063 |
| <b>D1</b>   | 1.50 Min      |      | 0.059 Min       |       |
| <b>P0</b>   | 3.9           | 4.1  | 0.154           | 0.161 |
| <b>10P0</b> | 40.0 +/- 0.20 |      | 1.574 +/- 0.008 |       |
| <b>W</b>    | 11.9          | 12.1 | 0.468           | 0.476 |
| <b>P</b>    | 7.9           | 8.1  | 0.311           | 0.319 |
| <b>A0</b>   | 6.3           | 6.5  | 0.248           | 0.256 |
| <b>B0</b>   | 5.1           | 5.3  | 0.2             | 0.209 |
| <b>K0</b>   | 2             | 2.2  | 0.079           | 0.087 |
| <b>t</b>    | 0.30 +/- 0.05 |      | 0.012 +/- 0.002 |       |

**Disclaimer Notice** - Information furnished is believed to be accurate and reliable. However, users should independently evaluate the suitability of and test each product selected for their own applications. Littelfuse products are not designed for, and may not be used in, all applications.

Read complete Disclaimer Notice at <http://www.littelfuse.com/disclaimer-electronics>.

©2019 Littelfuse, Inc.

Specifications are subject to change without notice.

Revision: 02/28/19