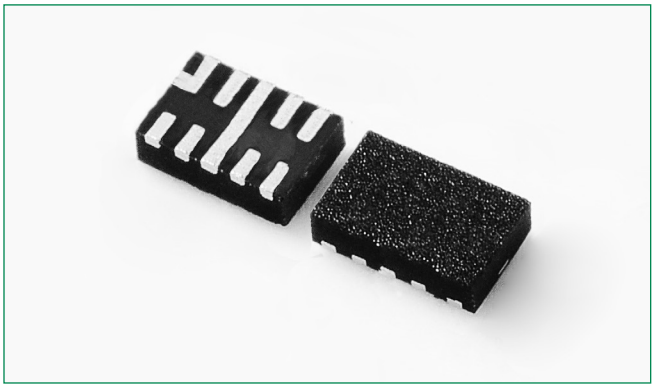
# TVS Diode Array (SPA® Diodes)

## General Purpose ESD Protection - SP5003 Series

## SP5003 Series 4 Channel Common Mode Filter

RoHS Pb GREEN

**OBSOLETE** DATE: 12/31/2020 PCN/ECN# ESU270-49
REPLACED BY: N/A

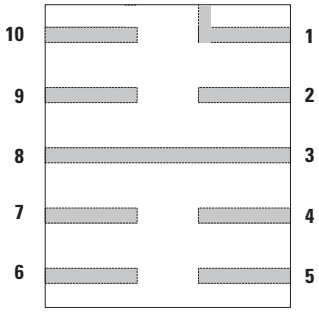


## Description

The SP5003 Series is a highly integrated Common Mode Filter (CMF) providing both ESD protection and EMI common mode noise filtering for systems using high speed differential serial interfaces, such as MIPI D-PHY or HDMI.

The SP5003 Series can protect and filter two differential line pairs in a small RoHS-compliant TDFN-10 package, with cost and space savings over discrete solutions.

## Pinout

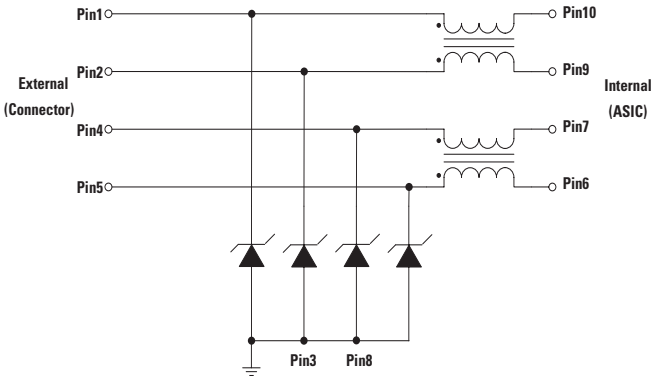



**Note:** Bottom-view

## Features

- Large differential bandwidth > 4.0 GHz
- High Common Mode Stop Band Attenuation: > 16 dB at 900 MHz
- Common Mode Imped ance: Zc: 32Ω at 100 MHz
- TDFN-10 2.50mm × 2.00mm × 0.75mm package with 0.50mm lead pitch
- ±15kV ESD protection per channel (IEC 61000-4-2 Level 4, contact discharge)
- RoHS-compliant, Lead-free packaging
- Moisture Sensitivity Level (MSL-1)

## Functional Block Diagram




## Applications

- HDMI/DVI Display in Mobile Phones
- MIPI D-PHY (CSI-2, DSI, etc) in Mobile Phones and Digital Still Cameras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## Absolute Maximum Ratings

| Symbol | Parameter | Value | Units |
|---|---|---|---|
| $I_{DC}$ | DC Current Per Line | 100 | mA |
| $P_{DC}$ | DC Package Power Rating | 0.5 | Watts |
| $T_{OP}$ | Operating Temperature | -40 to 125 | °C |
| $T_{STOR}$ | Storage Temperature | -55 to 150 | °C |

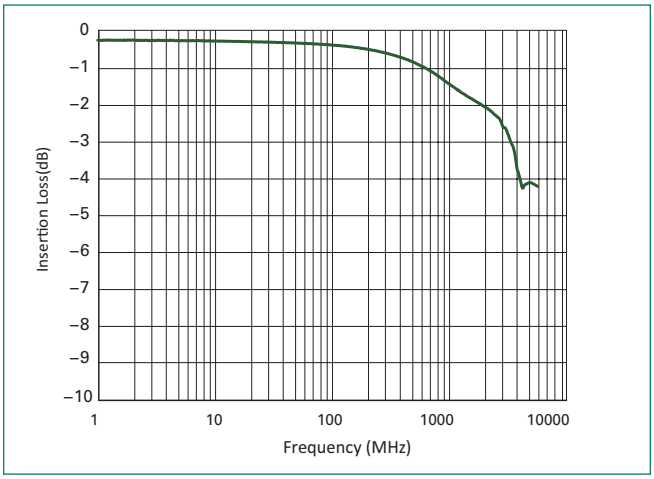
**CAUTION:** Stresses above those listed in "Absolute Maximum Ratings" may cause permanent damage to the component. This is a stress only rating and operation of the component at these or any other conditions above those indicated in the operational sections of this specification is not implied.

## Electrical Characteristics ($T_{OP}$=25°C)

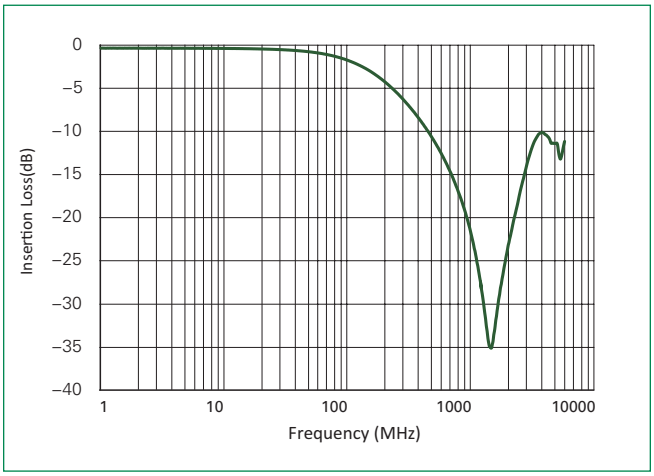
| Parameter | Symbol | Test Conditions | Min | Typ | Max | Units |
|---|---|---|---|---|---|---|
| Channel Resistance | $R_{CH}$ | Pins 1–10, 2–9, 4–7 and 5–6 | | 3.5 | 5.0 | Ω |
| Total Channel Capacitance | $C_{TOTAL}$ | $V_{I/O}$ = 1.65VDC Reverse Bias; f=1MHz, 30m$V_{AC}$ | | 0.8 | 1.3 | pF |
| Reverse Standoff Voltage | $V_{RWM}$ | | | | 5.0 | V |
| Breakdown Voltage | $V_{BR}$ | $I_T$=1mA | 6.0 | 8.0 | 10.0 | V |
| Forward Voltage at $I_F$ | $V_F$ | $I_F$=1mA | 0.4 | 0.7 | 1.5 | V |
| Reverse Leakage Current | $I_{LEAK}$ | $V_{Leak}$=+3.3V | | 0.01 | 0.10 | µA |
| Dynamic Resistance[2,3] | $R_{DYN}$ | Positive (tp=8/20µs) | | 1.36 | | Ω |
| | | Negative (tp=8/20µs) | | 0.6 | | |
| | | TLP, tp=100ns, I/O to GND | | 0.42 | | |
| ESD Withstand Voltage[1,2] | $V_{ESD}$ | IEC 61000-4-2 (Contact Discharge) | ±15 | | | kV |
| | | IEC 61000-4-2 (Air Discharge) | ±30 | | | kV |
| Differential Mode Cutoff Frequency[2] | $F_{3dB}$ | $Z_{SOURCE}$=50 Ω, $Z_{LOAD}$50 Ω | | 4.0 | | GHz |
| Common Mode Impedance | $Z_C$ | @100MHz | | 32 | | Ω |
| Common Mode Stop Band Attenuation[2] | $F_{atten}$ | f=900MHz | | 16 | | dB |

**Notes:**
**1.** ESD zapping at I/O pins (1,2,4,5) with respect to GND.
**2.** Guaranteed by design.
**3.** Transmission Line Pulse (TLP) with 100ns width and 200ps rise time.

## Differential Mode Attenuation vs. Frequency




## Common Mode Attenuation vs. Frequency





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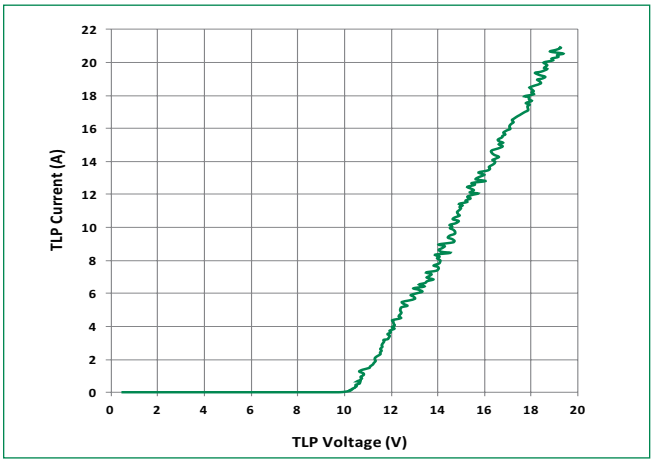
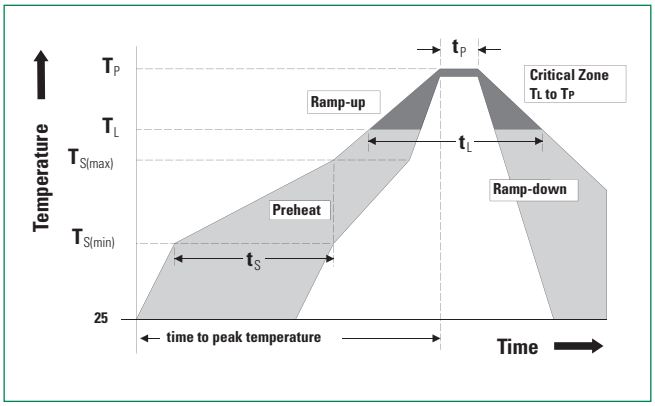
## Transmission Line Pulsing (TLP) Plot




## Soldering Parameters

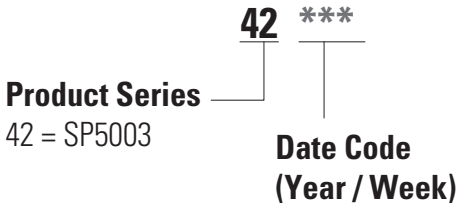
| | | |
|---|---|---|
| **Reflow Condition** | | Pb – Free assembly |
| **Pre Heat** | **- Temperature Min ($T_{s(min)}$)** | 150°C |
| | **- Temperature Max ($T_{s(max)}$)** | 200°C |
| | **- Time (min to max) ($t_s$)** | 60 – 180 secs |
| **Average ramp up rate (Liquidus) Temp ($T_L$) to peak** | | 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 |



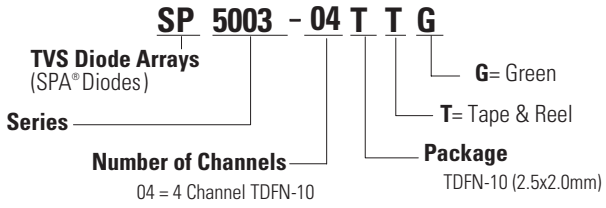

## Ordering Information

| Part Number | Package | Size | Marking | Min. Order Qty. |
|---|---|---|---|---|
| SP5003-04TTG | TDFN-10 | 2.5x2.0mm | 42*** | 3000 |

## Part Marking System




## Part Numbering System





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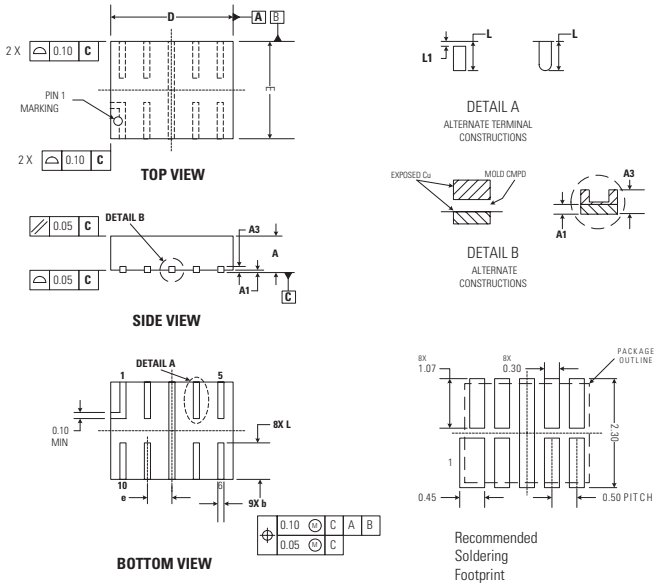
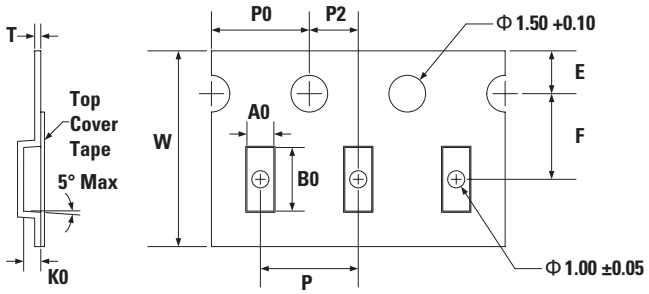
## Package Dimensions —TDFN-10



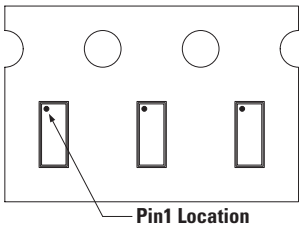

| Symbol | TDFN-10 JEDEC MO-229 | | | |
|---|---|---|---|---|
| | Millimeters | | Inches | |
| | Min | Max | Min | Max |
| A | 0.70 | 0.80 | 0.028 | 0.031 |
| A1 | 0.00 | 0.05 | 0.000 | 0.002 |
| A3 | 0.2 REF | | 0.008 REF | |
| b | 0.15 | 0.25 | 0.006 | 0.010 |
| D | 2.50 BSC | | 0.098 BSC | |
| E | 2.00 BSC | | 0.079 BSC | |
| e | 0.50 BSC | | 0.020 BSC | |
| L | 0.70 | 0.90 | 0.028 | 0.035 |
| L1 | 0.05 | 0.15 | 0.002 | 0.006 |

## Tape & Reel Specification –TDFN-10




| Symbol | Dimensions Millimetres |
|---|---|
| E | 1.75+/- 0.10 |
| F | 3.5 +/- 0.05 |
| P | 4.0 +/- 0.10 |
| P0 | 4.0 +/- 0.10 |
| P2 | 2.0 +/- 0.05 |
| W | 8.00 +0.30/- 0.10 |
| A0 | 2.19 +/- 0.05 |
| B0 | 2.77 +/- 0.05 |
| K0 | 1.05 +/- 0.05 |
| T | 0.25+/- 0.02 |

**Device Orientation in Tape**





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