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.

Features

- Large differential bandwidth > 4.0 GHz
- High Common Mode Stop Band Attenuation: > 16 dB at 900 MHz
- Common Mode Impedance: Zc: 32Ω at 100 MHz
- TDFN-10 2.50mm x 2.00mm x 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)

Applications

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

Pinout

Note: Bottom-view

Functional Block Diagram
### Absolute Maximum Ratings

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameter</th>
<th>Value</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>( I_{DC} )</td>
<td>DC Current Per Line</td>
<td>100</td>
<td>mA</td>
</tr>
<tr>
<td>( P_{DC} )</td>
<td>DC Package Power Rating</td>
<td>0.5</td>
<td>Watts</td>
</tr>
<tr>
<td>( T_{OP} )</td>
<td>Operating Temperature</td>
<td>-40 to 125</td>
<td>°C</td>
</tr>
<tr>
<td>( T_{STOR} )</td>
<td>Storage Temperature</td>
<td>-55 to 150</td>
<td>°C</td>
</tr>
</tbody>
</table>

**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 \((T_{OP}=25°C)\)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Test Conditions</th>
<th>Min</th>
<th>Typ</th>
<th>Max</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Channel Resistance</td>
<td>( R_{CH} )</td>
<td>Pins 1–10, 2–9, 4–7 and 5–6</td>
<td>3.5</td>
<td>5.0</td>
<td>7.0</td>
<td>Ω</td>
</tr>
<tr>
<td>Total Channel Capacitance</td>
<td>( C_{TOTAL} )</td>
<td>( V_{IO} = 1.65\text{DC Reverse Bias; f}=1\text{MHz, 30mV}_{AC} )</td>
<td>0.8</td>
<td>1.3</td>
<td></td>
<td>pF</td>
</tr>
<tr>
<td>Reverse Standoff Voltage</td>
<td>( V_{WR} )</td>
<td></td>
<td>5.0</td>
<td></td>
<td></td>
<td>V</td>
</tr>
<tr>
<td>Breakdown Voltage</td>
<td>( V_{BR} )</td>
<td>( I_{BR}=1\text{mA} )</td>
<td>6.0</td>
<td>8.0</td>
<td>10.0</td>
<td>V</td>
</tr>
<tr>
<td>Forward Voltage at ( I_{F} )</td>
<td>( V_{F} )</td>
<td>( I_{F}=1\text{mA} )</td>
<td>0.4</td>
<td>0.7</td>
<td>1.5</td>
<td>V</td>
</tr>
<tr>
<td>Reverse Leakage Current</td>
<td>( I_{LEAK} )</td>
<td>( V_{LEAK}=+3.3\text{V} )</td>
<td>0.01</td>
<td>0.10</td>
<td></td>
<td>μA</td>
</tr>
<tr>
<td>Dynamic Resistance(^{2, 3})</td>
<td>( R_{DYN} )</td>
<td>Positive ((tp=8/20\mu\text{s}))</td>
<td>1.36</td>
<td></td>
<td></td>
<td>Ω</td>
</tr>
<tr>
<td>ESD Withstand Voltage(^{1, 2})</td>
<td>( V_{ESD} )</td>
<td>( IEC 61000-4-2 (Contact Discharge) )</td>
<td>±15</td>
<td></td>
<td></td>
<td>kV</td>
</tr>
<tr>
<td>Differential Mode Cutoff Frequency(^{2})</td>
<td>( F_{3dB} )</td>
<td>( IEC 61000-4-2 (Air Discharge) )</td>
<td>±30</td>
<td></td>
<td></td>
<td>kV</td>
</tr>
<tr>
<td>Common Mode Impedance</td>
<td>( Z_{CM} )</td>
<td>( Z_{SOURCE}=50 \Omega, Z_{LOAD}=50 \Omega )</td>
<td>4.0</td>
<td></td>
<td></td>
<td>GHz</td>
</tr>
<tr>
<td>Common Mode Stop Band Attenuation(^{2})</td>
<td>( F_{MAX} )</td>
<td>( \omega=100\text{MHz} )</td>
<td>32</td>
<td></td>
<td></td>
<td>Ω</td>
</tr>
</tbody>
</table>

**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

![Differential Mode Attenuation vs. Frequency](image)

### Common Mode Attenuation vs. Frequency

![Common Mode Attenuation vs. Frequency](image)
**Soldering Parameters**

- **Reflow Condition**: Pb – Free assembly
- **Pre Heat**:
  - Temperature Min ($T_{min}$)
  - Temperature Max ($T_{max}$)
  - Time (min to max) ($t_s$)
  - Average ramp up rate (Liquidus) Temp ($T_L$) to peak
- **$T_{max}$ to $T_L$ - Ramp-up Rate**: 3°C/second max
- **Reflow**:
  - Temperature ($T_L$) (Liquidus)
  - Temperature ($t_L$)
- **Peak Temperature ($T_P$)**: 260±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**

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Package</th>
<th>Size</th>
<th>Marking</th>
<th>Min. Order Qty.</th>
</tr>
</thead>
<tbody>
<tr>
<td>SP5003-04TTG</td>
<td>TDFN-10</td>
<td>2.5x2.0mm</td>
<td>42***</td>
<td>3000</td>
</tr>
</tbody>
</table>

**Part Marking System**

- **Part Numbering System**
  - **Number of Channels**
    - 04 = 4 Channel TDFN-10
  - **Series**: SP 5003 - 04 T T G
  - **Package**: TDFN-10 (2.5x2.0mm)
  - **Date Code**
    - 42 = SP5003
  - **Date Code**
    - (Year / Week)

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Revised: 03/23/20
**Package Dimensions —TDFN-10**

**Tape & Reel Specification —TDFN-10**

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