

**SP3213 0.09pF 12kV Bidirectional Discrete TVS**

**AUTOMOTIVE GRADE** **HF** **RoHS** **Pb** **GREEN**



**Description**

The SP3213 is a bidirectional TVS Diode that provides ultra low capacitance and a high level of protection for electronic equipment that may experience destructive electrostatic discharges (ESD). The typical capacitance of 0.09pF helps ensure signal integrity on the most challenging consumer electronics interfaces such as USB 3.2, 3.1, HDMI 2.1, 2.0, DisplayPort, Thunderbolt, and V-by-One®.

It can safely absorb repetitive ESD strikes at ±12kV (contact discharge, IEC 61000-4-2) without performance degradation and safely dissipate 2A of 8/20µs surge current (IEC 61000-4-5 2<sup>nd</sup> edition).

**Pinout**



**Features**

- ESD, IEC 61000-4-2, ±12kV contact, ±18kV air
- EFT, IEC 61000-4-4, 40A (5/50ns)
- Lightning, 2A (8/20 as defined in IEC 61000-4-5 2<sup>nd</sup> Edition)
- Low leakage current of 0.02µA(TYP) at 5V
- Space efficient 0201 footprint
- AEC-Q101 qualified and PPAP capable
- Halogen free, lead free and RoHS compliant
- Moisture Sensitivity Level(MSL -1)

**Functional Block Diagram**



**Applications**

- Ultra-high speed data lines
- USB 3.2, 3.1, 3.0, and 2.0
- HDMI 2.1, 2.0, 1.4a, 1.3
- DisplayPort(TM)
- Thunderbolt (Light Peak)
- V-by-One®
- LVDS interfaces
- Consumer, mobile and portable electronics
- Tablet PC and external storage with high speed interfaces

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 |
|------------|--|------------|-------|
| $I_{PP}$   | Peak Pulse Current ( $t_p=8/20\mu s$ ) | 2          | 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.

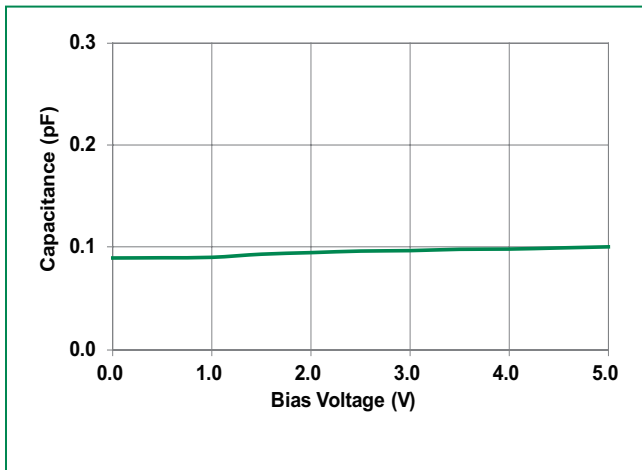
### Electrical Characteristics ( $T_{OP}=25^\circ C$ )

| Parameter                          | Symbol        | Test Conditions                            | Min      | Typ  | Max | Units    |
|------------------------------------|---------------|--|----------|------|-----|----------|
| Reverse Standoff Voltage           | $V_{RWM}$     | $I_R=1\mu A$ , I/O to I/O                  |          |      | 5   | V        |
| Breakdown Voltage                  | $V_{BR}$      | $I_R=1mA$ , I/O to I/O                     | 6.2      | 7.5  |     | V        |
| Reverse Leakage Current            | $I_{LEAK}$    | $V_R=5V$                                   |          | 0.02 | 0.1 | $\mu A$  |
| Clamp Voltage <sup>1</sup>         | $V_C$         | $I_{PP}=1A$ , $t_p=8/20\mu s$ , I/O to I/O |          | 12   | 15  | V        |
|                                    |               | $I_{PP}=2A$ , $t_p=8/20\mu s$ , I/O to I/O |          | 14.5 | 18  | V        |
| Dynamic Resistance <sup>2</sup>    | $R_{DYN}$     | TLP, $t_p=100ns$ , I/O to I/O              |          | 1.2  |     | $\Omega$ |
| ESD Withstand Voltage <sup>1</sup> | $V_{ESD}$     | IEC 61000-4-2 (Contact Discharge)          | $\pm 12$ |      |     | kV       |
|                                    |               | IEC 61000-4-2 (Air Discharge)              | $\pm 18$ |      |     | kV       |
| Diode Capacitance <sup>1</sup>     | $C_{I/O-I/O}$ | Reverse Bias=0V, $f=1MHz$ , I/O to I/O     |          | 0.09 |     | pF       |

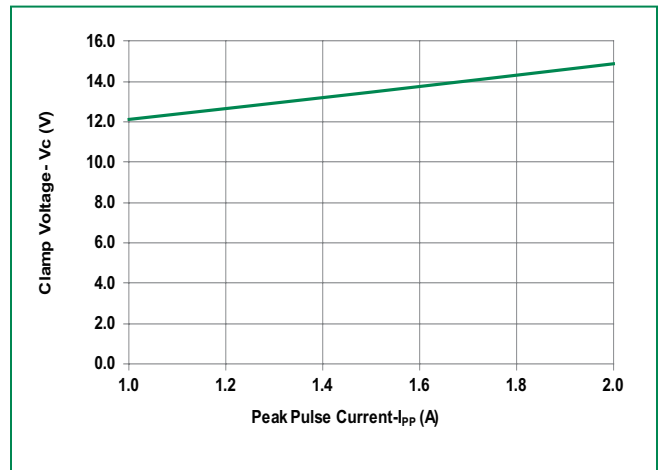
**Note:** 1 Parameter is guaranteed by design and/or component characterization.

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

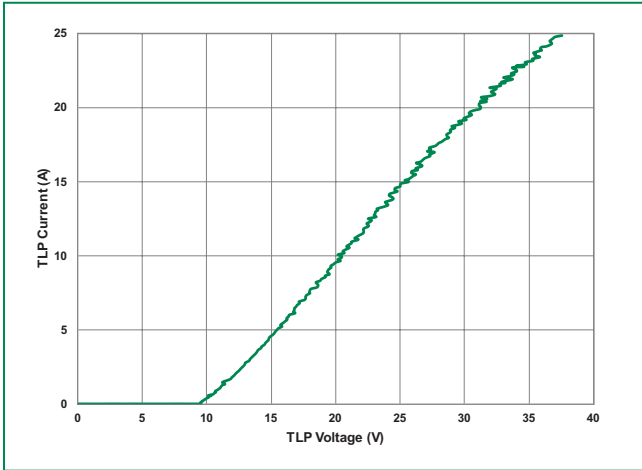
### Capacitance vs. Reverse Bias



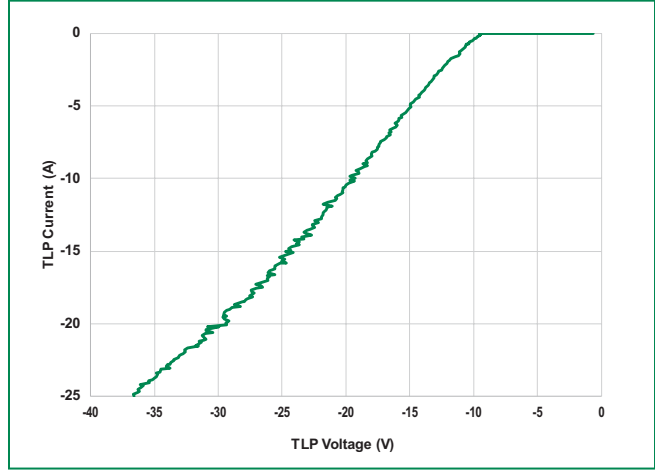
### Clamping Voltage vs. $I_{PP}$



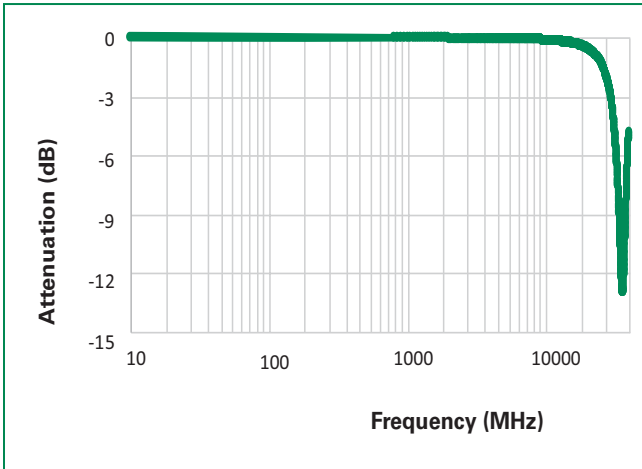
**Positive Transmission Line Pulsing(TLP) Plot**



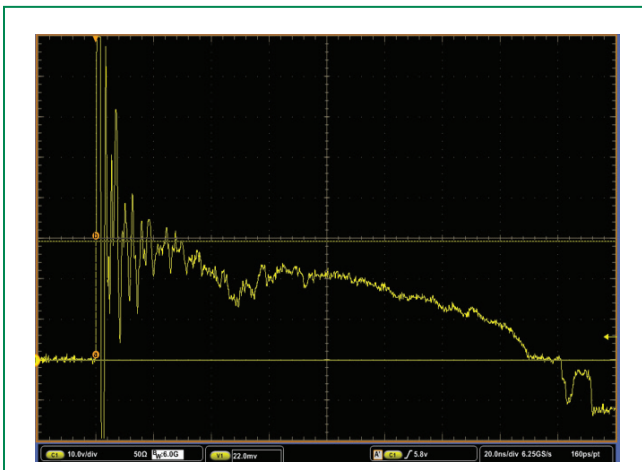
**Negative Transmission Line Pulsing(TLP) Plot**



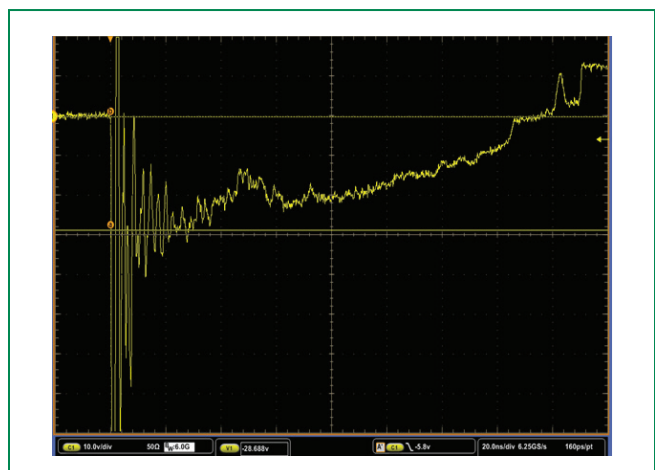
**Insertion Loss (S21) I/O to GND**



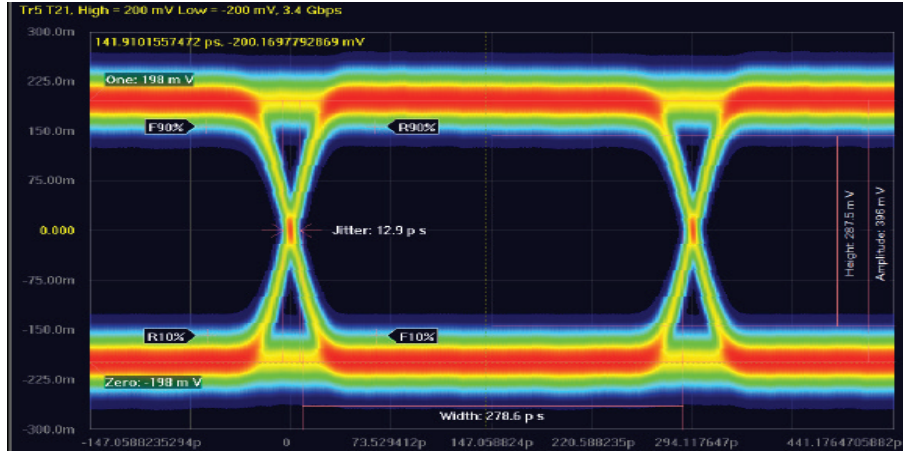
**IEC 61000-4-2 +8kV Contact ESD Clamping Voltage**



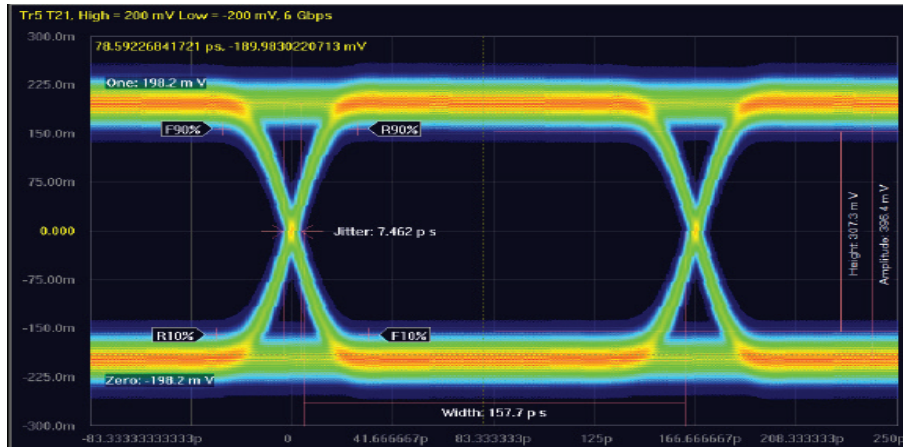
**IEC 61000-4-2 -8kV Contact ESD Clamping Voltage**



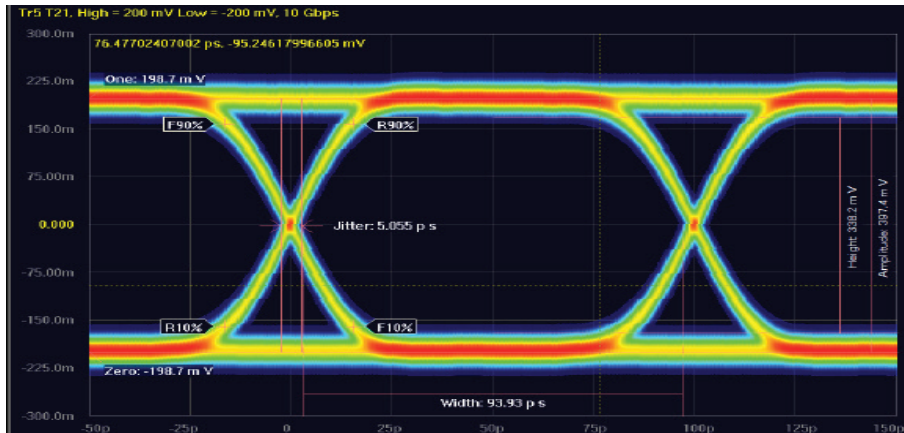
**3.4 Gbps, High Speed Display interfaces**



**6 Gbps, SATA, HDMI 2.x interfaces**

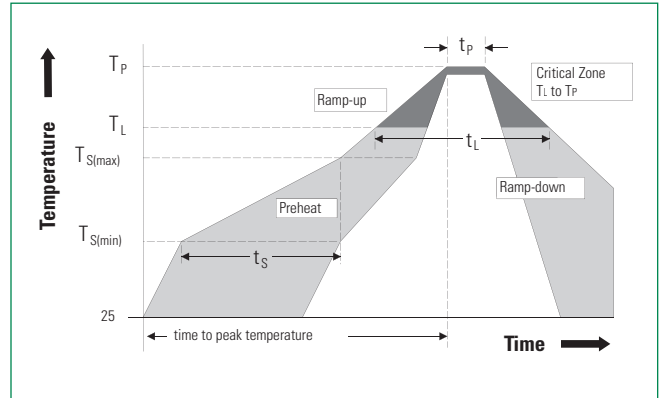


**10 Gbps, USB 3.1 Gen 2, Thunderbolt**

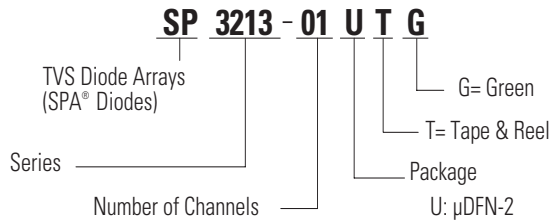


### Soldering Parameters

|  |                                    |                         |
|--|------------------------------------|-------------------------|
| <b>Reflow Condition</b>  |                                    | Pb – Free assembly      |
| <b>Pre Heat</b>  | - Temperature Min ( $T_{s(min)}$ ) | 150°C                   |
|  | - Temperature Max ( $T_{s(max)}$ ) | 200°C                   |
|  | - Time (min to max) ( $t_s$ )      | 60 – 180 secs           |
| <b>Average ramp up rate (Liquidus) Temp (<math>T_L</math>) to peak</b> |                                    | 3°C/second max          |
| <b><math>T_{s(max)}</math> to <math>T_L</math> - Ramp-up Rate</b>      |                                    | 3°C/second max          |
| <b>Reflow</b>  | - Temperature ( $T_L$ ) (Liquidus) | 217°C                   |
|  | - Temperature ( $t_L$ )            | 60 – 150 seconds        |
| <b>Peak Temperature (<math>T_p</math>)</b>                             |                                    | 260 <sup>+0/-5</sup> °C |
| <b>Time within 5°C of actual peak Temperature (<math>t_p</math>)</b>   |                                    | 20 – 40 seconds         |
| <b>Ramp-down Rate</b>  |                                    | 6°C/second max          |
| <b>Time 25°C to peak Temperature (<math>T_p</math>)</b>                |                                    | 8 minutes Max.          |



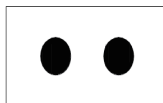
### Part Numbering System



### Product Characteristics

|                           |  |
|---------------------------|--|
| <b>Lead Plating</b>       | Pre-Plated Frame                                       |
| <b>Lead Material</b>      | Copper Alloy   |
| <b>Substrate Material</b> | Silicon  |
| <b>Body Material</b>      | Molded Compound  |
| <b>Flammability</b>       | UL Recognized compound meeting flammability rating V-0 |

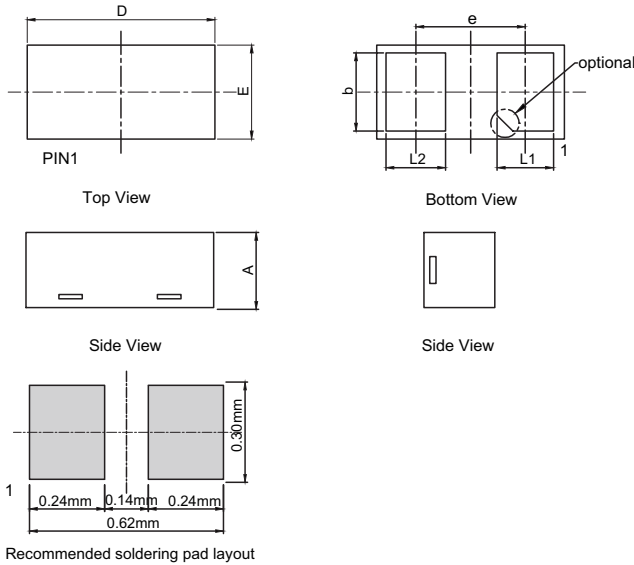
### Part Marking System



### Ordering Information

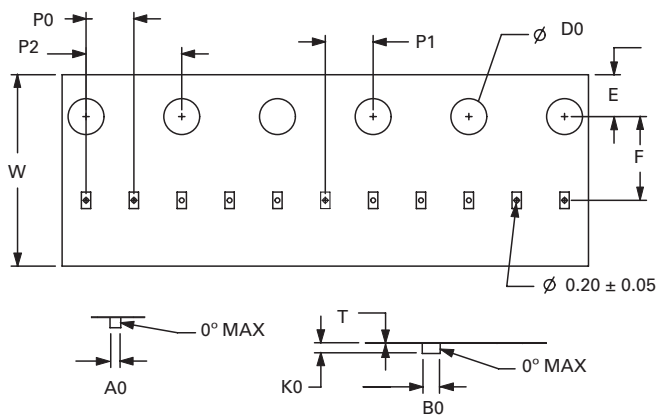
| Part Number  | Package | Min. Order Qty. |
|--------------|---------|-----------------|
| SP3213-01UTG | µDFN-2  | 15000           |

**Package Dimensions —  $\mu$ DFN-2 (0201)**



| Package   | $\mu$ DFN-2 (0201) |      |           |       |
|-----------|--------------------|------|-----------|-------|
| JEDEC     | MO-236             |      |           |       |
| Symbol    | Millimeters        |      | Inches    |       |
|           | Min                | Max  | Min       | Max   |
| <b>A</b>  | 0.25               | 0.33 | 0.010     | 0.013 |
| <b>b</b>  | 0.18               | 0.28 | 0.007     | 0.011 |
| <b>L1</b> | 0.12               | 0.22 | 0.005     | 0.009 |
| <b>L2</b> | 0.13               | 0.23 | 0.005     | 0.009 |
| <b>D</b>  | 0.60 BSC           |      | 0.024 BSC |       |
| <b>E</b>  | 0.30 BSC           |      | 0.012 BSC |       |
| <b>e</b>  | 0.35 REF           |      | 0.014 REF |       |

**Embossed Carrier Tape & Reel Specification —  $\mu$ DFN-2**



| Symbol    | Millimeters |      | Inches |       |
|-----------|-------------|------|--------|-------|
|           | Min         | Max  | Min    | Max   |
| <b>A0</b> | 0.33        | 0.40 | 0.013  | 0.016 |
| <b>B0</b> | 0.63        | 0.70 | 0.025  | 0.028 |
| <b>D0</b> | 1.40        | 1.60 | 0.055  | 0.063 |
| <b>E</b>  | 1.65        | 1.85 | 0.065  | 0.073 |
| <b>F</b>  | 3.45        | 3.55 | 0.136  | 0.140 |
| <b>K0</b> | 0.30        | 0.39 | 0.012  | 0.015 |
| <b>P0</b> | 1.90        | 2.10 | 0.075  | 0.083 |
| <b>P1</b> | 1.95        | 2.05 | 0.077  | 0.081 |
| <b>P2</b> | 3.90        | 4.10 | 0.154  | 0.161 |
| <b>T</b>  | 0.13        | 0.25 | 0.005  | 0.010 |
| <b>W</b>  | 7.90        | 8.30 | 0.311  | 0.327 |

