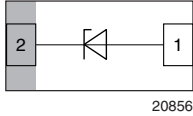
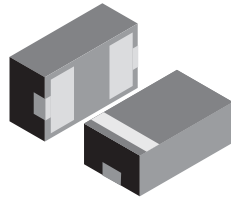




## Low Capacitance, Single-Line ESD Protection Diode



20856



20855

### MARKING (example only)



Bar = cathode marking  
Y = type code (see table below)  
X = date code

### DESIGN SUPPORT TOOLS

[click logo to get started](#)



### FEATURES

- Ultra compact LLP1006-2L package
- Low package profile < 0.4 mm
- 1-line ESD protection
- High surge current acc. IEC 61000-4-5  $I_{PPM} > 3 A$
- Low leakage current  $I_R < 0.1 \mu A$
- Low load capacitance  $C_D = 0.9 pF$
- ESD immunity acc. IEC 61000-4-2  $\pm 15 kV$  contact discharge  $\pm 15 kV$  air discharge
- Soldering can be checked by standard vision inspection; no X-ray necessary
- Pin plating NiPdAu (e4) no whisker growth
- e4 - precious metal (e.g. Ag, Au, NiPd, NiPdAu) (no Sn)
- PATENT(S): [www.vishay.com/patents](http://www.vishay.com/patents)
- Material categorization: for definitions of compliance please see [www.vishay.com/doc?99912](http://www.vishay.com/doc?99912)



| ORDERING INFORMATION |                    |   |                        |
|----------------------|--------------------|---|------------------------|
| DEVICE NAME          | ORDERING CODE      | TAPED UNITS PER REEL (8 mm TAPE ON 7" REEL) | MINIMUM ORDER QUANTITY |
| VBUS051BD-HD1        | VBUS051BD-HD1-GS08 | 8000  | 8000                   |

| PACKAGE DATA  |              |           |         |                                      |                                   |                              |
|---------------|--------------|-----------|---------|--------------------------------------|-----------------------------------|------------------------------|
| DEVICE NAME   | PACKAGE NAME | TYPE CODE | WEIGHT  | MOLDING COMPOUND FLAMMABILITY RATING | MOISTURE SENSITIVITY LEVEL        | SOLDERING CONDITIONS         |
| VBUS051BD-HD1 | LLP1006-2L   | A         | 0.72 mg | UL 94 V-0                            | MSL level 1 (according J-STD-020) | Peak temperature max. 260 °C |

| ABSOLUTE MAXIMUM RATINGS VBUS051BD-HD1 |  |           |             |      |
|--|--|-----------|-------------|------|
| PARAMETER                              | TEST CONDITIONS                                      | SYMBOL    | VALUE       | UNIT |
| Peak pulse current                     | Acc. IEC 61000-4-5; $t_p = 8/20 \mu s$ ; single shot | $I_{PPM}$ | 3           | A    |
| Peak pulse power                       | Acc. IEC 61000-4-5; $t_p = 8/20 \mu s$ ; single shot | $P_{PP}$  | 45          | W    |
| ESD immunity                           | Contact discharge acc. IEC 61000-4-2; 10 pulses      | $V_{ESD}$ | $\pm 15$    | kV   |
|  | Air discharge acc. IEC 61000-4-2; 10 pulses          |           | $\pm 15$    | kV   |
| Operating temperature                  | Junction temperature                                 | $T_J$     | -55 to +145 | °C   |
| Storage temperature                    |  | $T_{STG}$ | -55 to +150 | °C   |

PATENT(S): [www.vishay.com/patents](http://www.vishay.com/patents)

This Vishay product is protected by one or more United States and international patents.

| <b>ELECTRICAL CHARACTERISTICS VBUS051BD-HD1</b><br>(Ratings at 25 °C ambient temperature, unless otherwise specified) |  |                      |      |        |      |               |
|---|--|----------------------|------|--------|------|---------------|
| PARAMETER   | TEST CONDITIONS/REMARKS  | SYMBOL               | MIN. | TYP.   | MAX. | UNIT          |
| Protection paths  | Number of lines which can be protected                                 | $N_{\text{channel}}$ | -    | -      | 1    | lines         |
| Reverse stand-off voltage   | Max. reverse working voltage   | $V_{\text{RWM}}$     | -    | -      | 5    | V             |
| Reverse voltage   | At $I_{\text{R}} = 0.1 \mu\text{A}$ ; pin 2 to pin 1                   | $V_{\text{R}}$       | 5    | -      | -    | V             |
| Reverse current   | At $V_{\text{R}} = V_{\text{RWM}} = 5 \text{ V}$ ; pin 2 to pin 1      | $I_{\text{R}}$       | -    | < 0.01 | 0.1  | $\mu\text{A}$ |
| Reverse breakdown voltage   | At $I_{\text{R}} = 1 \text{ mA}$ ; pin 2 to pin 1                      | $V_{\text{BR}}$      | 6.9  | 7.9    | 8.7  | V             |
| Reverse clamping voltage  | At $I_{\text{PP}} = 3 \text{ A}$ ; acc. IEC 61000-4-5; pin 2 to pin 1  | $V_{\text{C}}$       | -    | -      | 16   | V             |
| Forward clamping voltage  | At $I_{\text{F}} = 3 \text{ A}$ ; acc. IEC 61000-4-5; pin 1 to pin 2   | $V_{\text{F}}$       | -    | 3.4    | 4    | V             |
| Capacitance   | At $V_{\text{R}} = 0 \text{ V}$ ; $f = 1 \text{ MHz}$ ; pin 2 to pin 1 | $C_{\text{D}}$       | -    | 0.9    | 1.3  | pF            |

### APPLICATION NOTE

The VBUS051BD-HD1 is an ESD protection device with the characteristic of a Z-diode with a high ESD immunity and a very low capacitance which makes it usable for high frequency applications like USB2.0 or HDMI.

With the VBUS051BD-HD1 one high speed data line can be protected against transient voltage signals like ESD (electro static discharge). Connected to the data line (pin 2) and to ground (pin 1) negative transients will be clamped close below the ground level while positive transients will be clamped close above the 5 V working range. The clamping behavior of the VBUS051BD-HD1 is bidirectional but asymmetrical (BiAs) and so it offers the best protection for applications running up to 5 V.

### TYPICAL CHARACTERISTICS ( $T_{\text{amb}} = 25 \text{ }^{\circ}\text{C}$ , unless otherwise specified)

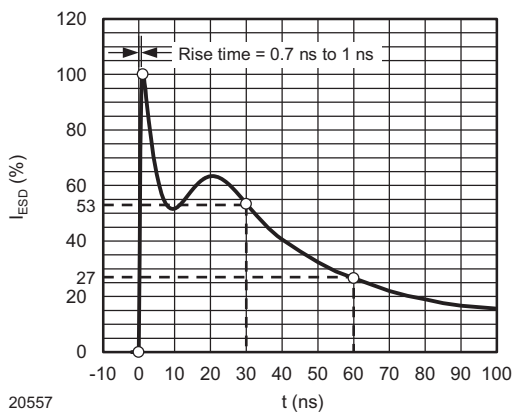


Fig. 1 - ESD Discharge Current Wave Form  
acc. IEC 61000-4-2 (330  $\Omega$ /150 pF)

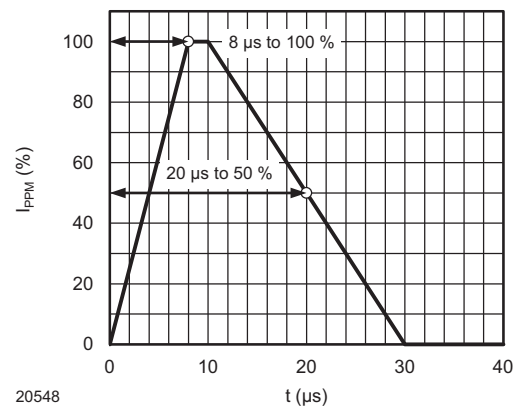


Fig. 2 - 8/20  $\mu\text{s}$  Peak Pulse Current Wave Form  
acc. IEC 61000-4-5

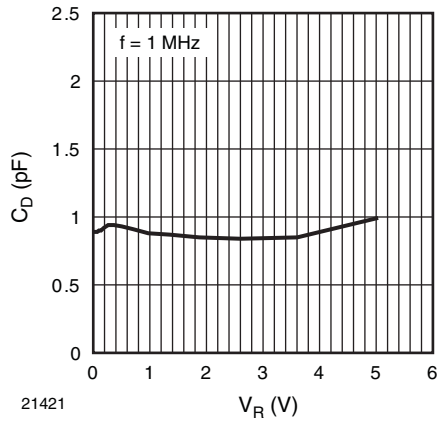


Fig. 3 - Typical Capacitance  $C_D$  vs. Reverse Voltage  $V_R$

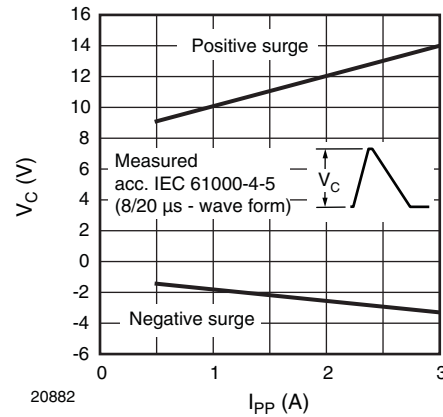


Fig. 6 - Typical Peak Clamping Voltage  $V_C$  vs. Peak Pulse Current  $I_{PP}$

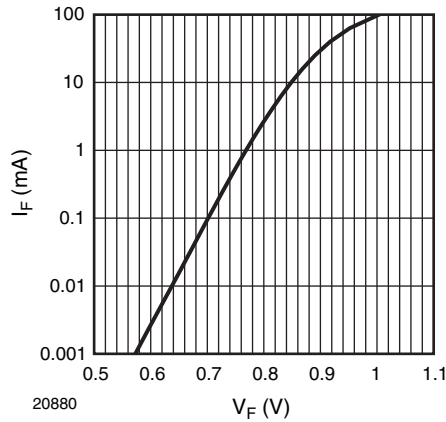


Fig. 4 - Typical Forward Current  $I_F$  vs. Forward Voltage  $V_F$

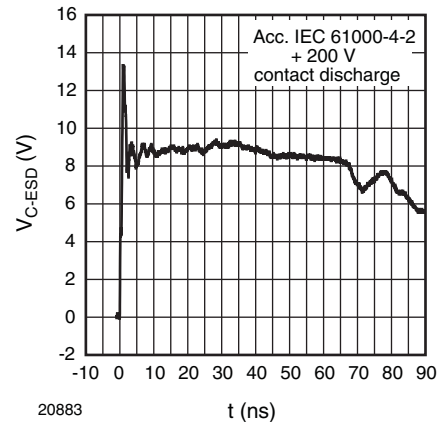


Fig. 7 - Typical Clamping Performance at +200 V Contact Discharge (acc. IEC 61000-4-2)

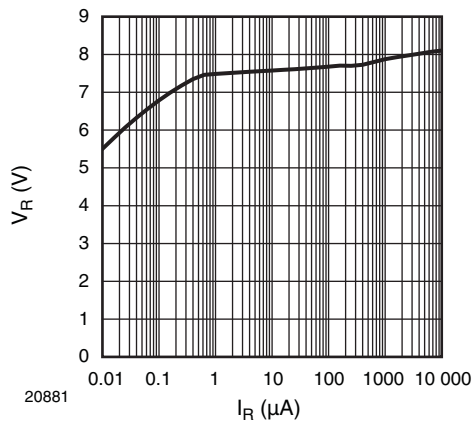


Fig. 5 - Typical Reverse Voltage  $V_R$  vs. Reverse Current  $I_R$

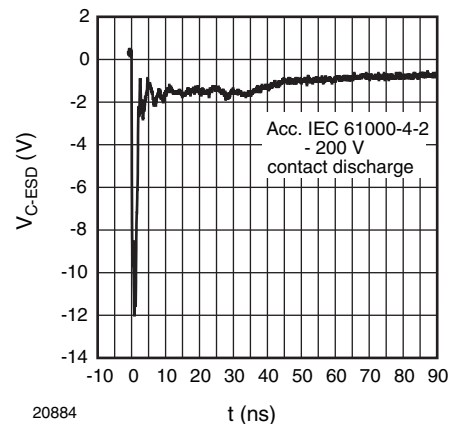
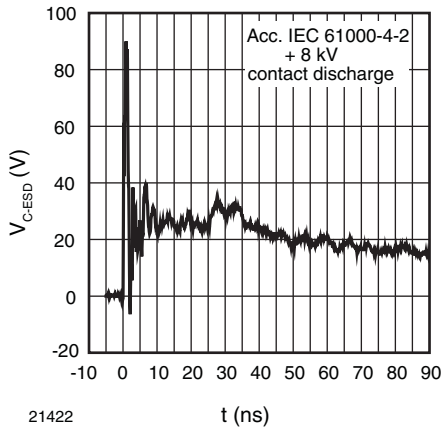
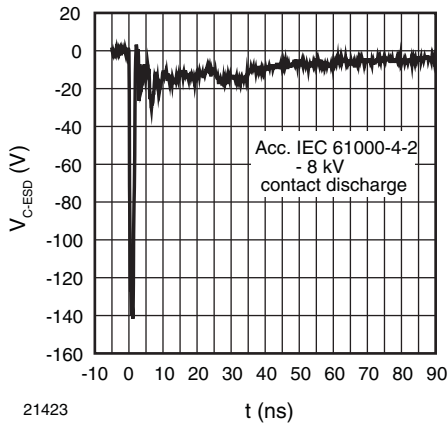


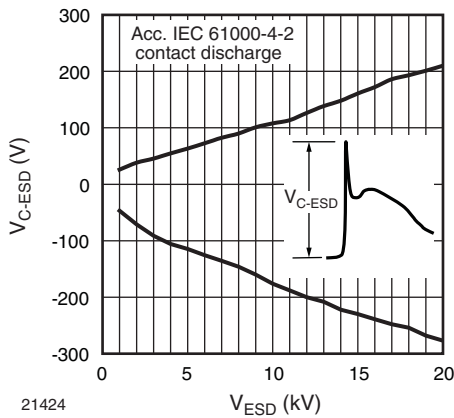
Fig. 8 - Typical Clamping Performance at -200 V Contact Discharge (acc. IEC 61000-4-2)



21422  
Fig. 9 - Typical Clamping Performance at + 8 kV Contact Discharge (acc. IEC 61000-4-2)



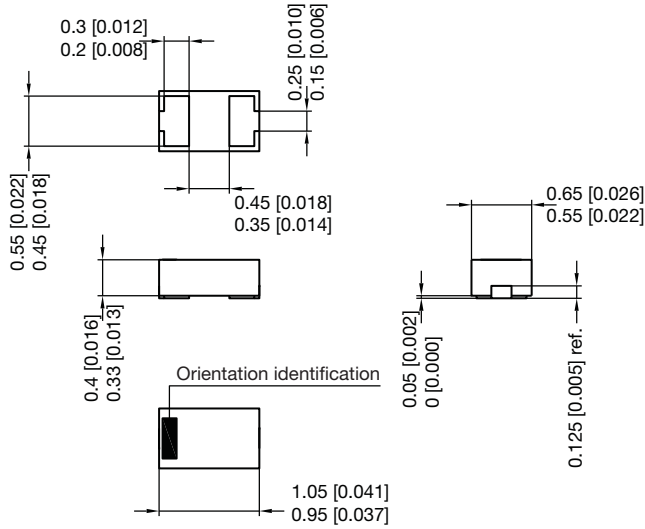
21423  
Fig. 10 - Typical Clamping Performance at - 8 kV Contact Discharge (acc. IEC 61000-4-2)



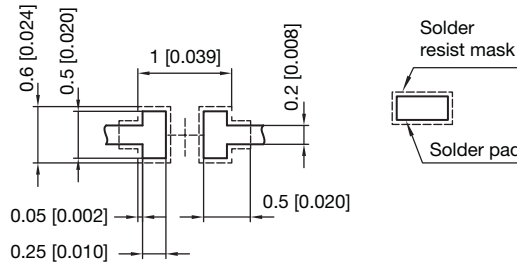
21424  
Fig. 11 - Typical Peak. Clamping Voltage at ESD Contact Discharge (acc. IEC 61000-4-2)



**PACKAGE DIMENSIONS** in millimeters (inches) **LLP1006-2L**

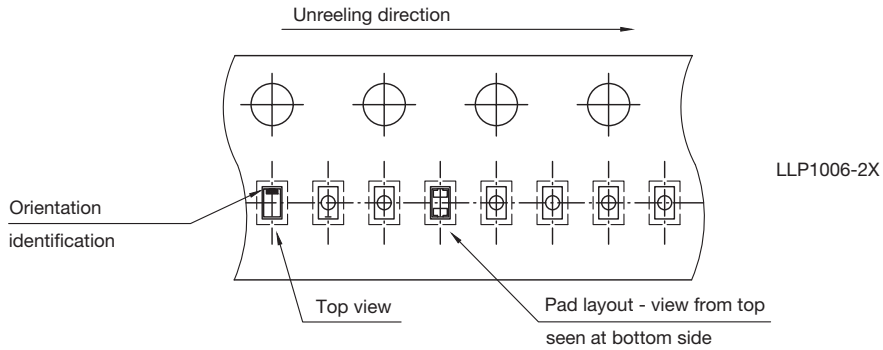


Foot print recommendation:



Pad Design Patented:  
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20812



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02.05.2017  
22965



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