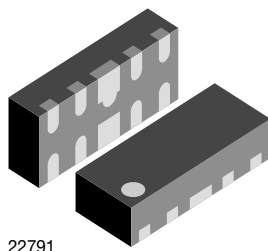
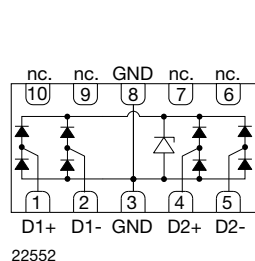


4-Line BUS-Port ESD Protection - Flow Through Design



FEATURES

- Compact LLP2510-10M package
- Low package height < 0.6 mm
- 4-line ESD protection
- Low leakage current $I_R < 0.1 \mu A$
- Low capacitance between I/O lines: 0.3 pF
- Ideal for high speed data line like
 - HDMI, DisplayPort, eSATA
 - USB, 1394/firewire
 - Thunderbolt
- ESD immunity acc. IEC 61000-4-2
 - ± 15 kV contact discharge
 - ± 15 kV air discharge
- Soldering can be checked by standard vision inspection, no X-ray necessary
- e3 - Sn
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912



MARKING (example only)



Dot = pin 1 marking

YY = type code (see table below)

XX = date code

DESIGN SUPPORT TOOLS click logo to get started



| ORDERING INFORMATION | | | |
|----------------------|--------------------|--|------------------------|
| DEVICE NAME | ORDERING CODE | TAPED UNITS PER REEL (8 mm TAPE ON 7" REEL) | MINIMUM ORDER QUANTITY |
| VBUS54GD-FBL | VBUS54GD-FBL-G3-08 | 3000 | 30 000 |

| PACKAGE DATA | | | | | | |
|--------------|--------------|-----------|--------|---|--------------------------------------|--------------------------|
| DEVICE NAME | PACKAGE NAME | TYPE CODE | WEIGHT | MOLDING COMPOUND FLAMMABILITY RATING | MOISTURE SENSITIVITY LEVEL | SOLDERING CONDITIONS |
| VBUS54GD-FBL | LLP2510-10M | 4G | 3.9 mg | UL 94 V-0 | MSL level 1 (according J-STD-020) | 260 °C/10 s at terminals |

| ABSOLUTE MAXIMUM RATINGS VBUS54GD-FBL | | | | |
|---------------------------------------|--|-----------|-------------|------|
| 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} | ± 15 | kV |
| | Air discharge acc. IEC 61000-4-2; 10 pulses | | ± 15 | |
| Operating temperature | Junction temperature | T_J | -40 to +125 | °C |
| Storage temperature | | T_{STG} | -55 to +150 | °C |

ELECTRICAL CHARACTERISTICS VBUS54GD-FBL (PIN 1, 2, 4 OR 5 TO PIN 3)

(T_{amb} = 25 °C, unless otherwise specified)

| PARAMETER | TEST CONDITIONS/REMARKS | SYMBOL | MIN. | TYP. | MAX. | UNIT |
|-------------------------------|---|----------------------|------|------|------|-------|
| Protection paths | Number of lines which can be protected | N _{channel} | - | - | 4 | lines |
| Reverse stand-off voltage | Max. reverse working voltage | V _{RWM} | - | - | 5.5 | V |
| Reverse voltage | at I _R = 0.1 μA | V _R | 5.5 | - | - | V |
| Reverse current | at V _{RWM} = 5.5 V | I _R | - | 0.02 | 0.1 | μA |
| Reverse breakdown voltage | at I _R = 1 mA | V _{BR} | 6.9 | 7.5 | 8.7 | V |
| Reverse clamping voltage | at I _{PP} = 1 A | V _C | - | 9.1 | 11 | V |
| | at I _{PP} = I _{PPM} = 3 A | V _C | - | 12 | 15 | V |
| Forward clamping voltage | at I _{PP} = 1 A | V _F | - | 2.1 | 2.4 | V |
| | at I _{PP} = 3 A | V _F | - | 3.5 | 4.5 | V |
| Clamping voltage | Transmission line pulse (TLP), t _p = 100 ns I _{TLP} = 8 A | V _{C-TLP} | - | 15 | - | V |
| | Transmission line pulse (TLP), t _p = 100 ns I _{TLP} = 16 A | V _{C-TLP} | - | 21 | - | V |
| Dynamic resistance | Transmission line pulse (TLP), t _p = 100 ns | R _{DYN} | - | 0.76 | - | Ω |
| Capacitance | at V _R = 0 V; f = 1 MHz | C _D | - | 0.6 | 0.75 | pF |
| | at V _R = 3.3 V; f = 1 MHz | | - | 0.65 | 0.75 | pF |
| Capacitance between I/O lines | at V _R = 3.3 V; f = 1 MHz | C _{DD} | - | 0.3 | 0.4 | pF |

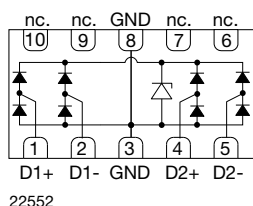
APPLICATION NOTE

The **VBUS54GD-FBL** is a four-line 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, USB3.0 or HDMI.

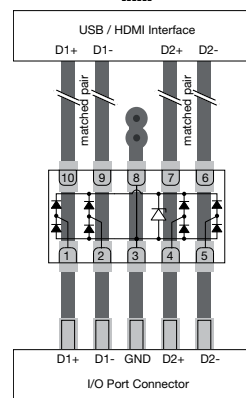
With the **VBUS54GD-FBL** four high speed data lines can be protected against transient voltage signals like ESD (electro static discharge). Connected to the data line (pin 1, 2 and pin 4, 5) and to ground (pin 3 and 8) negative transients will be clamped close below the ground level while positive transients will be clamped close above the 5.5 V working range. The clamping behavior of the **VBUS54GD-FBL** is bidirectional but asymmetrical (**BiAs**) and so it offers the best protection for applications running up to 5.5 V.

Pin configuration:

- Pin 3 and 8 are internally shorted and have to be connected to ground
- Pin 1, 2 and 4, 5 are the inputs for the data lines D₁₊ and D₁₋ and D₂₊ and D₂₋.
- Pin 6, 7 and 9, 10 are not connected internally



22552



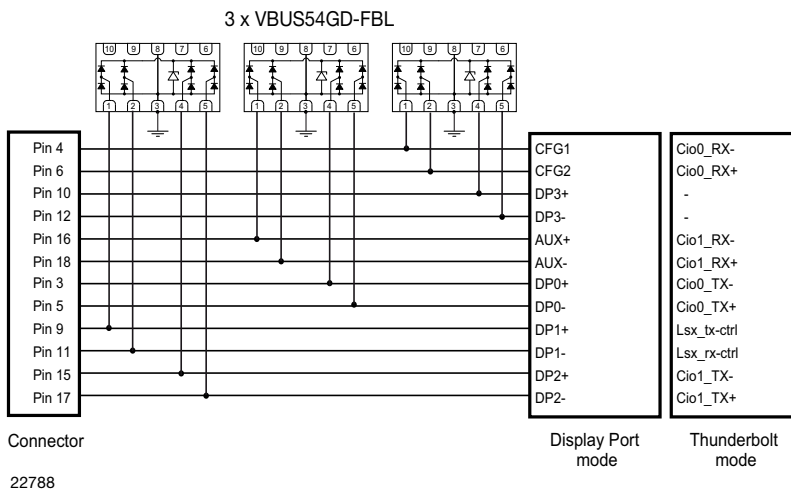
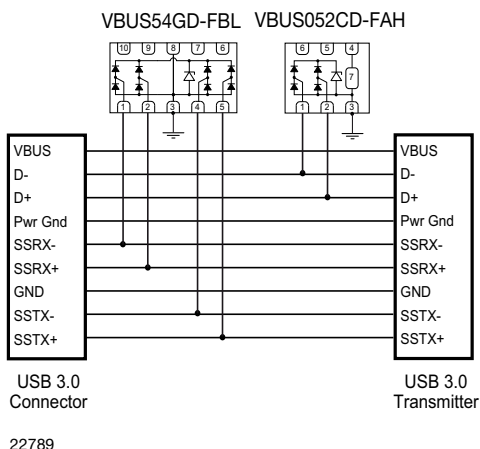
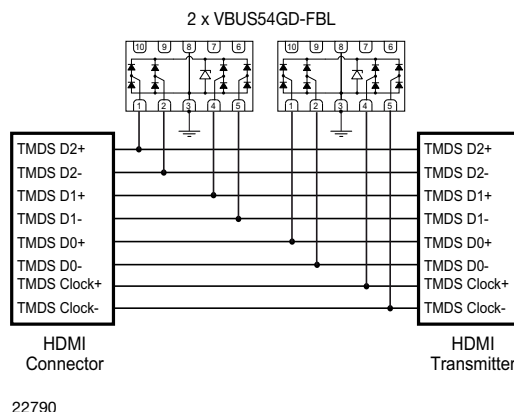
22553

FLOW THROUGH DESIGN

Modern digital transmission lines can be clocked up to 480 Mbit/s (USB2.0) or 1.65 Gbit/s (HDMI).

At such high data rates the transmission lines like cables or the line traces on the PCBs have to be very homogeneous regarding their surge impedance. This requires well defined trace dimensions as trace width and distance which have to be calculated depending on the requested surge impedance (e.g. 50 Ω) and the PCB material and layer dimensions. Any device connected to the data lines - like ESD protection devices - have to be connected with minimal changes in these trace dimensions and distances.

With the package in the so called "Flow Through Design" this is possible. The lines are running straight along the PCB while the **VBUS54GD-FBL** is placed on top without any via or loops.

CONNECTION DIAGRAM EXAMPLE FOR THUNDERBOLT DATA PORT

CONNECTION DIAGRAM EXAMPLE FOR USB 3.0 DATA PORT

CONNECTION DIAGRAM EXAMPLE FOR HDMI DATA PORT


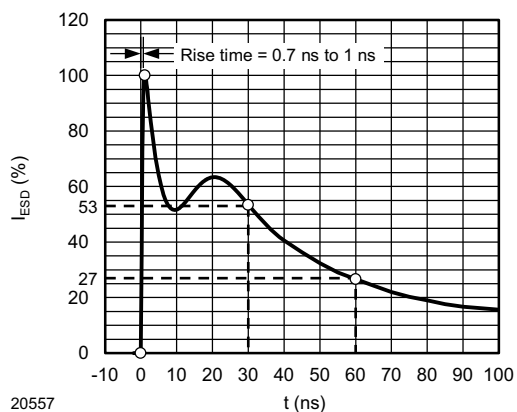
TYPICAL CHARACTERISTICS ($T_{amb} = 25\text{ }^{\circ}\text{C}$, unless otherwise specified)


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

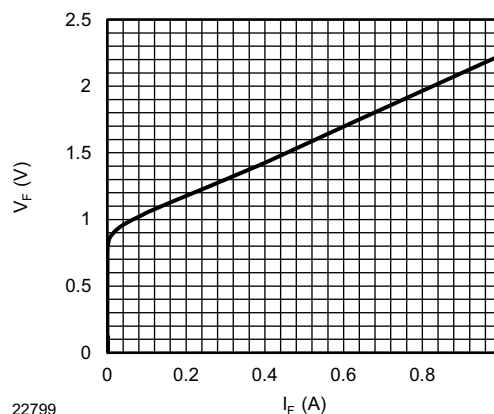


Fig. 4 - Typical Forward Voltage vs. Forward Current

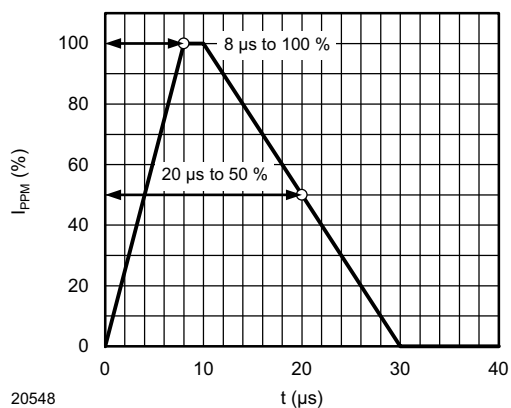


Fig. 2 - 8/20 μ s Peak Pulse Current Wave Form
acc. IEC 61000-4-5

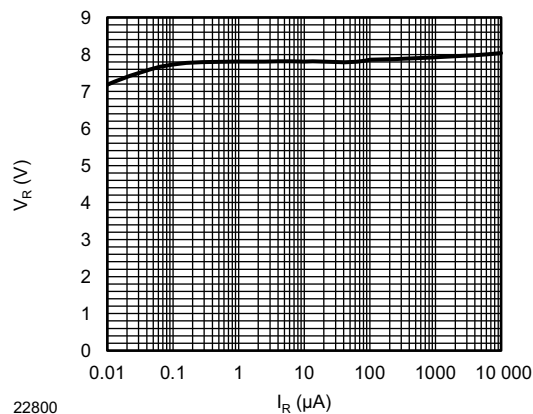


Fig. 5 - Typical Reverse Voltage vs. Reverse Current

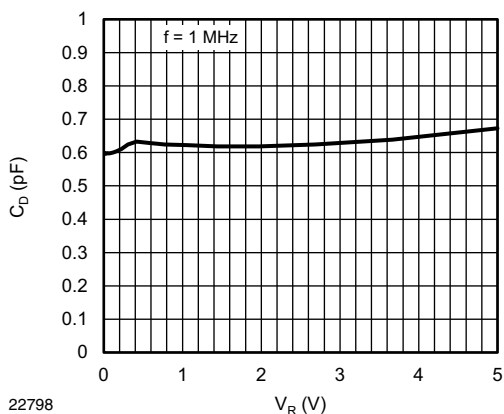


Fig. 3 - Typical Capacitance vs. Reverse Voltage

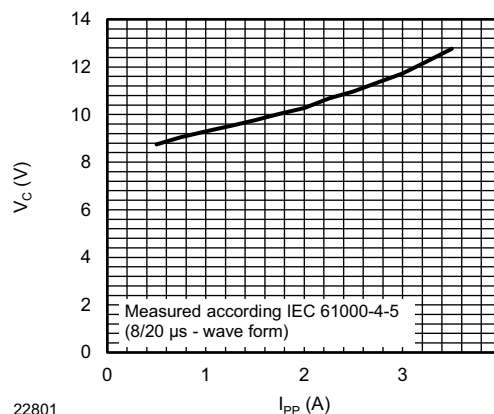


Fig. 6 - Typical Peak Clamping Voltage vs. Peak Pulse Current

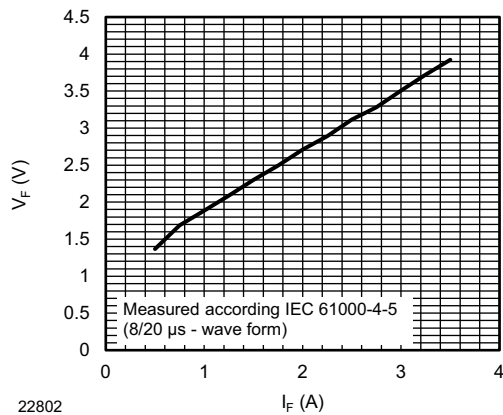


Fig. 7 - Typical Peak Forward Voltage vs. Forward Current

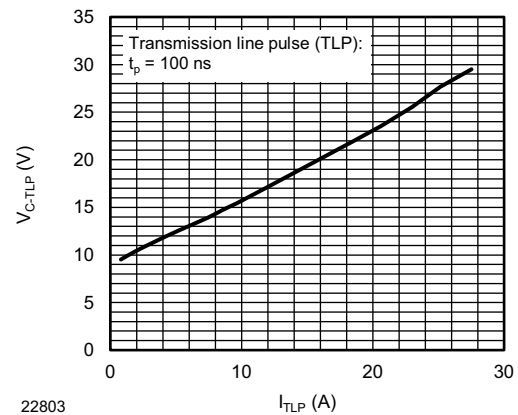
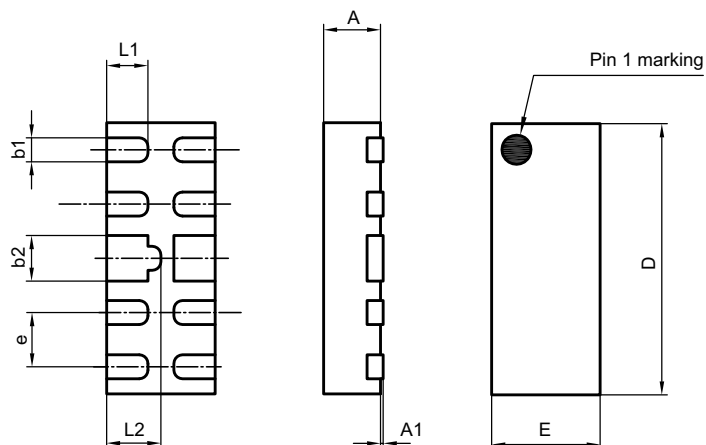


Fig. 8 - Typical Clamping Voltage vs. Peak Pulse Current

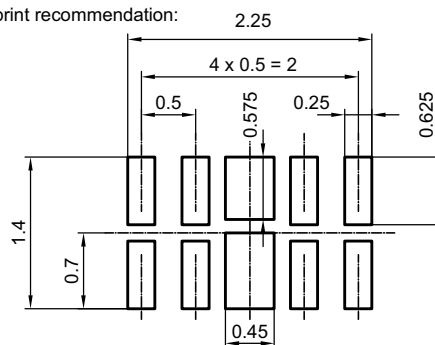
PACKAGE DIMENSIONS in millimeters: **LLP2510-10M**

Package = Chip Dimensions in mm



| | Millimeters | | |
|----|-------------|------|-------|
| | Min. | Nom. | Max. |
| A | 0.455 | - | 0.555 |
| A1 | 0.00 | - | 0.05 |
| b1 | 0.19 | - | 0.25 |
| b2 | 0.39 | - | 0.45 |
| D | 2.45 | - | 2.55 |
| E | 0.95 | - | 1.05 |
| e | - | 0.50 | - |
| L1 | 0.35 | - | 0.41 |
| L2 | 0.48 | - | 0.54 |

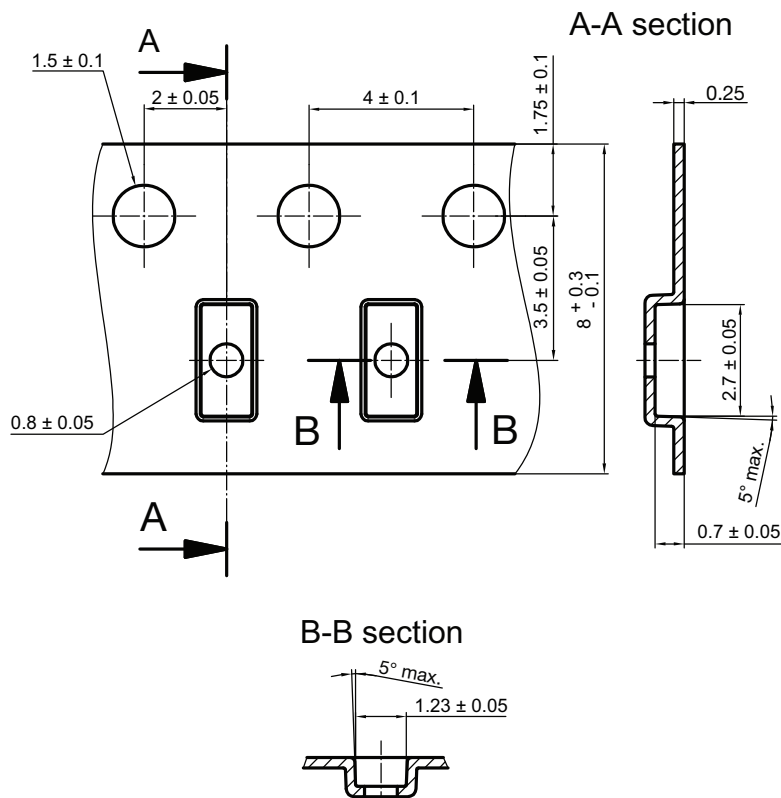
foot print recommendation:



Document no.: S8-V-3906.04-040 (4)

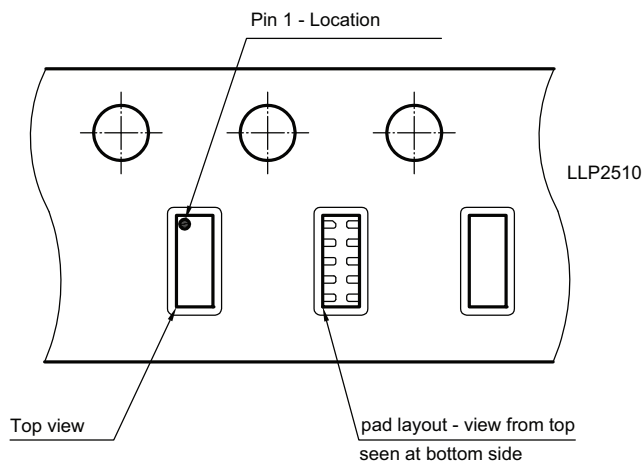
Created - Date: 27. July 2015

22804

CARRIER TAPE in millimeters **LLP2510-10M**


Cummulative tolerances of 10 sprocket holes is $\pm 0.2 \text{ mm}$

Document no. S8-V-3906.04-0028 (4)
Created - Date: 08. Jul. 2011

ORIENTATION IN CARRIER TAPE LLP2510-10M


Document no. S8-V-3906.04-0029 (4)
Created - Date: 07. Jul. 2011



Disclaimer

ALL PRODUCT, PRODUCT SPECIFICATIONS AND DATA ARE SUBJECT TO CHANGE WITHOUT NOTICE TO IMPROVE RELIABILITY, FUNCTION OR DESIGN OR OTHERWISE.

Vishay Intertechnology, Inc., its affiliates, agents, and employees, and all persons acting on its or their behalf (collectively, "Vishay"), disclaim any and all liability for any errors, inaccuracies or incompleteness contained in any datasheet or in any other disclosure relating to any product.

Vishay makes no warranty, representation or guarantee regarding the suitability of the products for any particular purpose or the continuing production of any product. To the maximum extent permitted by applicable law, Vishay disclaims (i) any and all liability arising out of the application or use of any product, (ii) any and all liability, including without limitation special, consequential or incidental damages, and (iii) any and all implied warranties, including warranties of fitness for particular purpose, non-infringement and merchantability.

Statements regarding the suitability of products for certain types of applications are based on Vishay's knowledge of typical requirements that are often placed on Vishay products in generic applications. Such statements are not binding statements about the suitability of products for a particular application. It is the customer's responsibility to validate that a particular product with the properties described in the product specification is suitable for use in a particular application. Parameters provided in datasheets and / or specifications may vary in different applications and performance may vary over time. All operating parameters, including typical parameters, must be validated for each customer application by the customer's technical experts. Product specifications do not expand or otherwise modify Vishay's terms and conditions of purchase, including but not limited to the warranty expressed therein.

Except as expressly indicated in writing, Vishay products are not designed for use in medical, life-saving, or life-sustaining applications or for any other application in which the failure of the Vishay product could result in personal injury or death. Customers using or selling Vishay products not expressly indicated for use in such applications do so at their own risk. Please contact authorized Vishay personnel to obtain written terms and conditions regarding products designed for such applications.

No license, express or implied, by estoppel or otherwise, to any intellectual property rights is granted by this document or by any conduct of Vishay. Product names and markings noted herein may be trademarks of their respective owners.