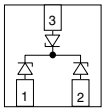
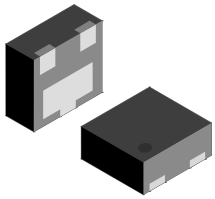
# 2-Line Low Capacitance, Bidirectional and Symmetrical (BiSy) ESD Protection Diode



DFN1110-3A

## FEATURES

- Small DFN1110-3A
- 2-line ESD protection
- Working range ± 5.5 V
- Low leakage current $I_R$ < 0.05 µA
- Low load capacitance $C_D$ < 0.45 pF
- ESD immunity acc. IEC 61000-4-2
  ± 20 kV contact discharge
  ± 20 kV air discharge
- ESD capability according to AEC-Q101:
  human body model: class H3B: > 8 kV
- e3 - pins side wall plated with tin (Sn)
- AOI capable
- AEC-Q101 qualified available
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912

Pb-free

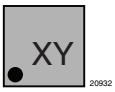
e3

RoHS COMPLIANT

HALOGEN FREE

GREEN (5-2008)

## MARKING (example only)




Dot = pin marking
X = date code
Y = type code (see table below)

## LINKS TO ADDITIONAL RESOURCES

3D Models

SPICE Models

## ORDERING INFORMATION

| PART NUMBER (EXAMPLE) | ENVIRONMENTAL AND QUALITY CODE | | | PACKAGING CODE | ORDERING CODE (EXAMPLE) |
|---|---|---|---|---|---|
| | AEC-Q101 QUALIFIED | RoHS-COMPLIANT + LEAD (Pb)-FREE TERMINATIONS | TIN PLATED | 10K PER 7" REEL (8 mm TAPE) 10K/BOX = MOQ | |
| | | GREEN | | | |
| VBUS05M2-HT5 | - | G | 3 | -08 | VBUS05M2-HT5-G3-08 |
| VBUS05M2-HT5 | H | G | 3 | -08 | VBUS05M2-HT5HG3-08 |

## PACKAGE DATA

| DEVICE NAME | PACKAGE NAME | TYPE CODE | WEIGHT | MOLDING COMPOUND FLAMMABILITY RATING | MOISTURE SENSITIVITY LEVEL | SOLDERING CONDITIONS |
|---|---|---|---|---|---|---|
| VBUS05M2-HT5 | DFN1110-3A | M | 1.43 mg | UL 94 V-0 | MSL level 1 (according J-STD-020) | Peak temperature max. 260 °C |

## ABSOLUTE MAXIMUM RATINGS

| PARAMETER | TEST CONDITIONS | SYMBOL | VALUE | UNIT |
|---|---|---|---|---|
| Peak pulse current | Acc. IEC 61000-4-5; $t_P$ = 8/20 µs; single shot | $I_{PPM}$ | 3.4 | A |
| Peak pulse power | Acc. IEC 61000-4-5; $t_P$ = 8/20 µs; single shot | $P_{PP}$ | 60 | W |
| ESD immunity | Contact discharge acc. IEC 61000-4-2; 10 pulses | $V_{ESD}$ | ± 20 | kV |
| | Air discharge acc. IEC 61000-4-2; 10 pulses | | ± 20 | |
| Operating temperature | Junction temperature | $T_J$ | -55 to +150 | °C |
| Storage temperature | | $T_{STG}$ | -55 to +150 | °C |

| **ELECTRICAL CHARACTERISTICS** (pin 1 or pin 2 to pin 3; in both directions) ($T_{amb}$ = 25 °C, unless otherwise specified) | | | | | | |
|---|---|---|---|---|---|---|
| **PARAMETER** | **TEST CONDITIONS/REMARKS** | **SYMBOL** | **MIN.** | **TYP.** | **MAX.** | **UNIT** |
| Protection paths | Number of lines which can be protected | $N_{channel}$ | - | - | 2 | 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 | $I_R$ | - | < 0.001 | 0.1 | µA |
| Reverse breakdown voltage | At $I_R$ = 1 mA | $V_{BR}$ | 7.5 | 8.5 | 9.5 | V |
| Reverse clamping voltage | At $I_{PP}$ = 1 A | $V_C$ | - | 11 | 13 | V |
| | At $I_{PP}$ = $I_{PPM}$ = 3.4 A | $V_C$ | - | 15 | 18 | V |
| Clamping voltage | Transmission line pulse (TLP), $t_p$ = 100 ns $I_{TLP}$ = 8 A | $V_{C-TLP}$ | - | 20 | - | V |
| | Transmission line pulse (TLP), $t_p$ = 100 ns $I_{TLP}$ = 16 A | $V_{C-TLP}$ | - | 27 | - | V |
| Dynamic resistance | Transmission line pulse (TLP), $t_p$ = 100 ns | $R_{DYN}$ | - | 1 | - | Ω |
| Capacitance | At $V_R$ = 0 V; f = 1 MHz | $C_D$ | - | 0.37 | 0.45 | pF |
| | At $V_R$ = 3.3 V; f = 1 MHz | | - | 0.37 | 0.45 | pF |

## APPLICATION NOTE

The VBUS05M2-HT5 is a two-line ESD protection device with a bidirectional and symmetrical (BiSy) breakdown and clamping performance made for application with a voltage working range up to ± 5.5 V. The high ESD immunity and a very low capacitance makes it usable for high frequency applications like USB2.0, USB3.0, or HDMI.

With the VBUS05M2-HT5 two high speed data lines can be protected against transient voltage signals like ESD (electro static discharge). Connected to the data line (pin 1 and pin 2) and to ground (pin 3) negative transients will be clamped close above the 5.5 V working range.

## SCHEMATIC DIAGRAM

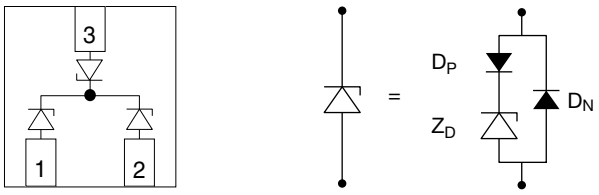



Fig. A

The simplified schematic diagram in Fig. A shows three identical Z-diodes with the cathode on pin 1, 2, or 3 and common anodes. In reality each Z-diode consist of one Z-diode for the adjustment of the breakdown voltage, and two low capacitance switching diodes which provide the low capacitance. Positive transients will be clamped through the switching diode $D_P$ and the Z-diode $Z_D$ while negative transients will be clamped through the switching diode $D_N$.

## TYPICAL CHARACTERISTICS ($T_{amb}$ = 25 °C, unless otherwise specified)

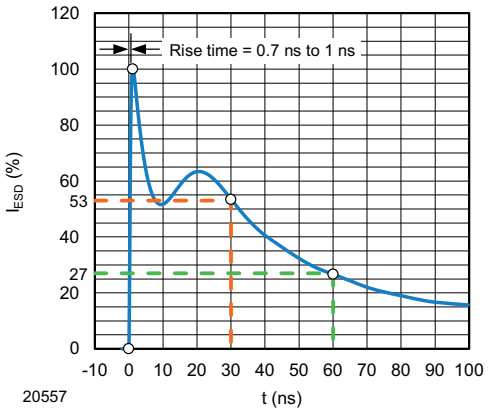



Fig. 1 - ESD Discharge Current Wave Form acc. IEC 61000-4-2 (330 Ω/150 pF)

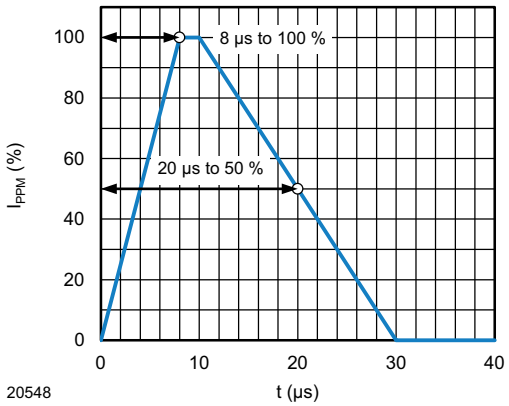



Fig. 2 - 8/20 µs Peak Pulse Current Wave Form acc. IEC 61000-4-5

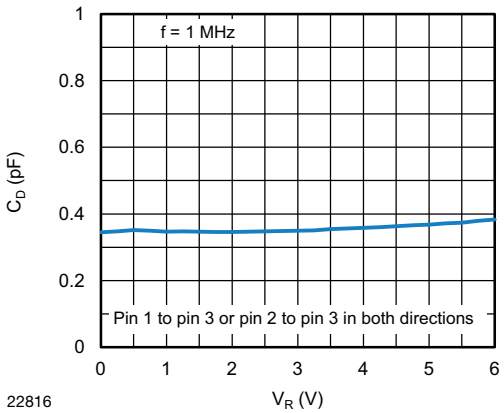



Fig. 3 - Typical Capacitance vs. Reverse Voltage

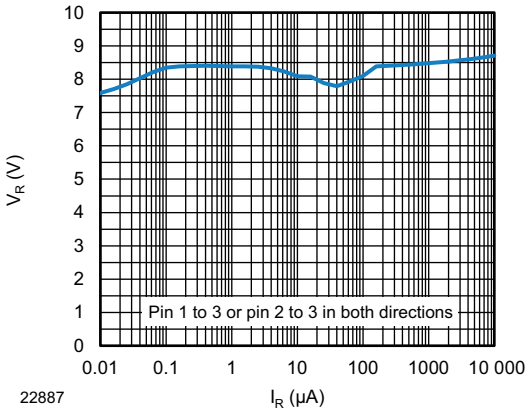



Fig. 4 - Typical Reverse Voltage vs. Reverse Current

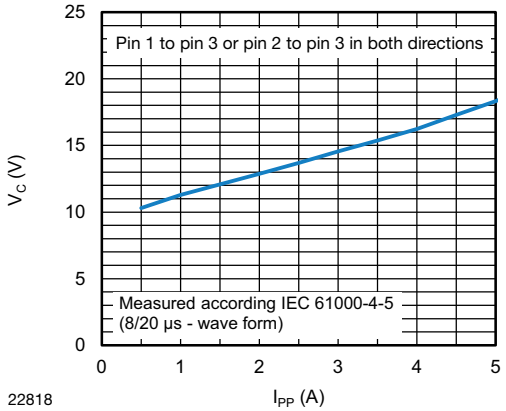



Fig. 5 - Typical Peak Clamping Voltage vs. Peak Pulse Current

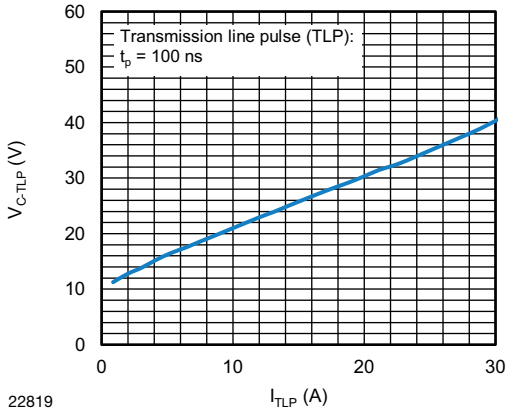
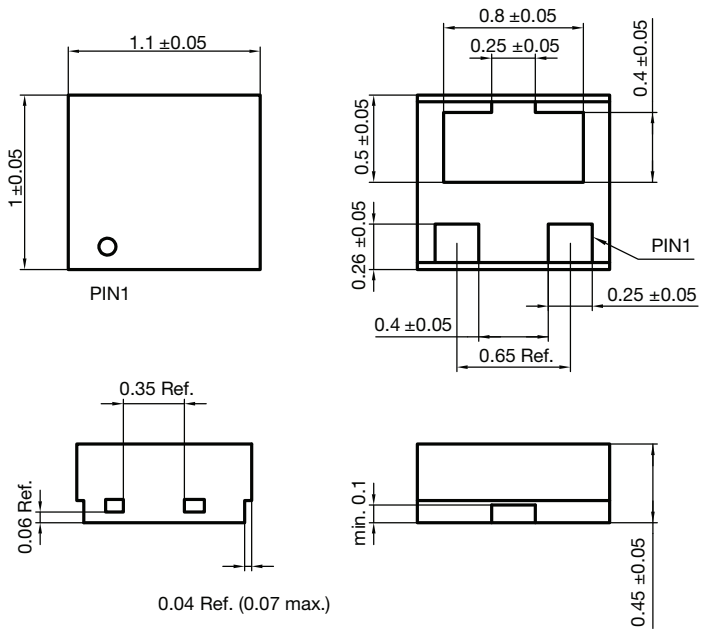
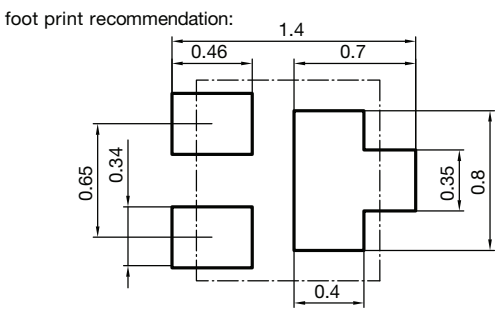



Fig. 6 - Typical Peak Forward Voltage vs. Forward Current

**PACKAGE DIMENSIONS** in millimeters (inches)




Document no.: S8-V-3906.04-062 (4)
Package name: DFN1110-3A
Created - Date: 04-Apr-2019

# 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.

Hyperlinks included in this datasheet may direct users to third-party websites. These links are provided as a convenience and for informational purposes only. Inclusion of these hyperlinks does not constitute an endorsement or an approval by Vishay of any of the products, services or opinions of the corporation, organization or individual associated with the third-party website. Vishay disclaims any and all liability and bears no responsibility for the accuracy, legality or content of the third-party website or for that of subsequent links.

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.