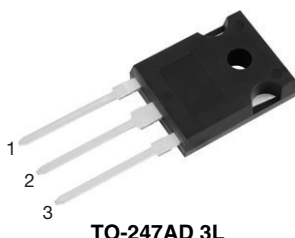
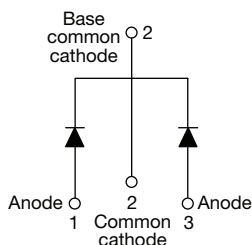


# Hyperfast Rectifier, 2 x 30 A FRED Pt® G5


**TO-247AD 3L**


## FEATURES

- Hyperfast and optimized  $Q_{rr}$
- Best in class forward voltage drop and switching losses trade off
- Optimized for high speed operation
- 175 °C maximum operating junction temperature
- Polyimide passivation
- AEC-Q101 qualified meets JESD 201 class 1A whisker test
- Material categorization: for definitions of compliance please see [www.vishay.com/doc?99912](http://www.vishay.com/doc?99912)


**RoHS**  
COMPLIANT  
HALOGEN  
**FREE**

## LINKS TO ADDITIONAL RESOURCES



3D Models


Application  
Notes

## PRIMARY CHARACTERISTICS

|                                   |                |
|-----------------------------------|----------------|
| $I_{F(AV)}$ , per leg             | 30 A           |
| $V_R$                             | 600 V          |
| $V_F$ at $I_F$ at 125 °C, per leg | 1.3 V          |
| $t_{rr}$ (typ.)                   | 22             |
| $I_{FSM}$ , per leg               | 310            |
| $T_J$ max.                        | 175 °C         |
| Package                           | TO-247AD 3L    |
| Circuit configuration             | Common cathode |

## DESCRIPTION / APPLICATIONS

Featuring a unique combination of low conduction and switching losses, this rectifier is the right choice for soft switched and resonant converters, as well as medium frequency hard switching converters. This device is specifically designed to improve efficiency of high speed LLC output rectification stages of EV / HEV on-board battery chargers

## MECHANICAL DATA

**Case:** TO-247AD 3L

Molding compound meets UL 94 V-0 flammability rating

**Terminal:** matte tin plated leads, solderable per J-STD-002

## ABSOLUTE MAXIMUM RATINGS

| PARAMETER                                  | SYMBOL         | TEST CONDITIONS  | VALUES      | UNITS |
|--|----------------|--|-------------|-------|
| Repetitive peak reverse voltage, per leg   | $V_{RRM}$      |  | 600         | V     |
| Average rectified forward current, per leg | $I_{F(AV)}$    | $T_C = 117\text{ °C}$ , $D = 0.50$                       | 30          | A     |
| Non-repetitive peak surge current, per leg | $I_{FSM}$      | $T_C = 25\text{ °C}$ , $t_p = 10\text{ ms}$ , sine wave  | 310         |       |
| Repetitive peak forward current, per leg   | $I_{FRM}$      | $T_C = 117\text{ °C}$ , $D = 0.50$ , $f = 20\text{ kHz}$ | 60          |       |
| Operating junction and storage temperature | $T_J, T_{Stg}$ |  | -55 to +175 | °C    |

## ELECTRICAL SPECIFICATIONS ( $T_J = 25\text{ °C}$ unless otherwise specified)

| PARAMETER                                    | SYMBOL        | TEST CONDITIONS                             | MIN. | TYP. | MAX. | UNITS         |
|--|---------------|---|------|------|------|---------------|
| Breakdown voltage, blocking voltage, per leg | $V_{BR}, V_R$ | $I_R = 100\text{ }\mu\text{A}$              | 600  | -    | -    | V             |
| Forward voltage, per leg                     | $V_F$         | $I_F = 30\text{ A}$                         | -    | 1.6  | 2.1  |               |
|  |               | $I_F = 30\text{ A}$ , $T_J = 125\text{ °C}$ | -    | 1.3  | -    |               |
| Reverse leakage current, per leg             | $I_R$         | $V_R = V_R$ rated                           | -    | -    | 20   | $\mu\text{A}$ |
|  |               | $T_J = 125\text{ °C}$ , $V_R = V_R$ rated   | -    | -    | 500  |               |
| Junction capacitance, per leg                | $C_T$         | $V_R = 200\text{ V}$                        | -    | 36   | -    | pF            |
| Series inductance, per leg                   | $L_S$         | Measured to lead 5 mm from package body     | -    | 8    | -    | nH            |

**DYNAMIC RECOVERY CHARACTERISTICS** ( $T_J = 25\text{ }^{\circ}\text{C}$  unless otherwise specified)

| PARAMETER                        | SYMBOL    | TEST CONDITIONS   | MIN. | TYP. | MAX. | UNITS |
|----------------------------------|-----------|---|------|------|------|-------|
| Reverse recovery time, per leg   | $t_{rr}$  | $I_F = 1.0\text{ A}$ , $di_F/dt = 100\text{ A}/\mu\text{s}$ , $V_R = 30\text{ V}$ | -    | 22   | -    | ns    |
|                                  |           | $T_J = 25\text{ }^{\circ}\text{C}$  | -    | 39   | -    |       |
|                                  |           | $T_J = 125\text{ }^{\circ}\text{C}$   | -    | 50   | -    |       |
| Peak recovery current, per leg   | $I_{RRM}$ | $T_J = 25\text{ }^{\circ}\text{C}$  | -    | 14   | -    | A     |
|                                  |           | $T_J = 125\text{ }^{\circ}\text{C}$   | -    | 24   | -    |       |
| Reverse recovery charge, per leg | $Q_{rr}$  | $T_J = 25\text{ }^{\circ}\text{C}$  | -    | 253  | -    | nC    |
|                                  |           | $T_J = 125\text{ }^{\circ}\text{C}$   | -    | 785  | -    |       |
| Reverse recovery time, per leg   | $t_{rr}$  | $T_J = 25\text{ }^{\circ}\text{C}$  | -    | 41   | -    | ns    |
|                                  |           | $T_J = 125\text{ }^{\circ}\text{C}$   | -    | 56   | -    |       |
| Peak recovery current, per leg   | $I_{RRM}$ | $T_J = 25\text{ }^{\circ}\text{C}$  | -    | 16   | -    | A     |
|                                  |           | $T_J = 125\text{ }^{\circ}\text{C}$   | -    | 27   | -    |       |
| Reverse recovery charge, per leg | $Q_{rr}$  | $T_J = 25\text{ }^{\circ}\text{C}$  | -    | 306  | -    | nC    |
|                                  |           | $T_J = 125\text{ }^{\circ}\text{C}$   | -    | 952  | -    |       |

**THERMAL - MECHANICAL SPECIFICATIONS**

| PARAMETER                                      | SYMBOL            | TEST CONDITIONS         | MIN.       | TYP. | MAX.       | UNITS                       |
|--|-------------------|-------------------------|------------|------|------------|-----------------------------|
| Thermal resistance, junction-to-case, per leg  | $R_{thJC}$        |                         | -          | -    | 1.1        | $^{\circ}\text{C}/\text{W}$ |
| Weight   |                   |                         | -          | 5.5  | -          | g                           |
| Mounting torque                                |                   |                         | 6<br>(5)   | -    | 12<br>(10) | kgf · cm<br>(lbf · in)      |
| Maximum junction and storage temperature range | $T_J$ , $T_{Stg}$ |                         | -55        | -    | 175        | $^{\circ}\text{C}$          |
| Marking device                                 |                   | Case style: TO-247AD 3L | C5PX6006LH |      |            |                             |

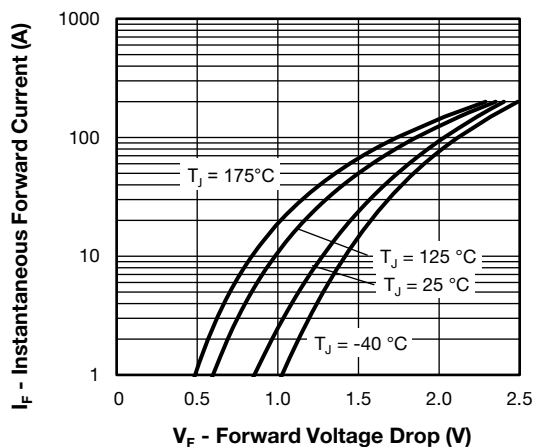


Fig. 1 - Typical Forward Voltage Drop Characteristics, per Leg

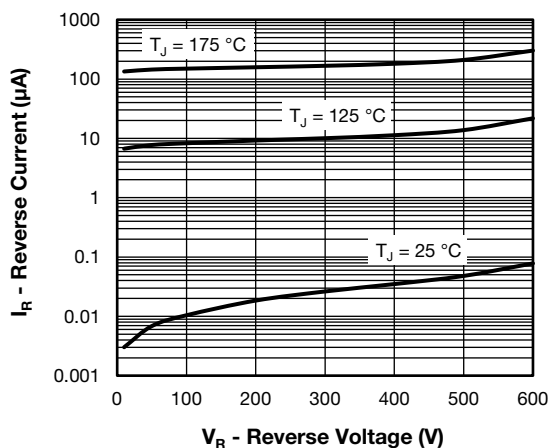


Fig. 2 - Typical Values of Reverse Current vs. Reverse Voltage, per Leg

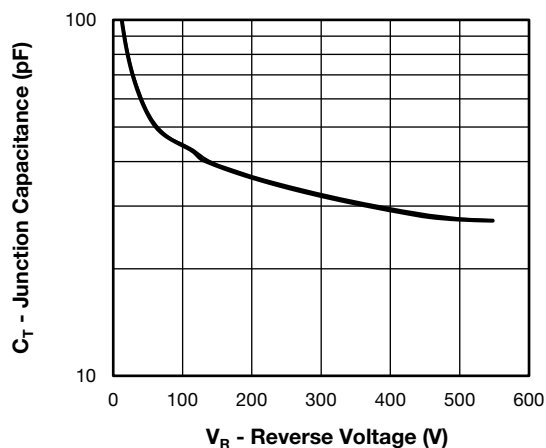


Fig. 3 - Typical Junction Capacitance vs. Reverse Voltage, per Leg

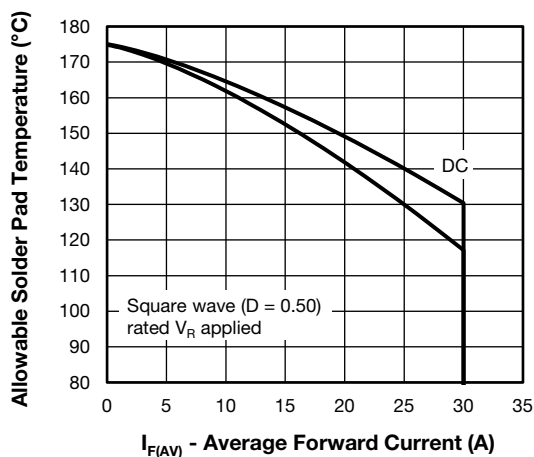


Fig. 4 - Maximum Allowable Case Temperature vs. Average Forward Current, per Leg

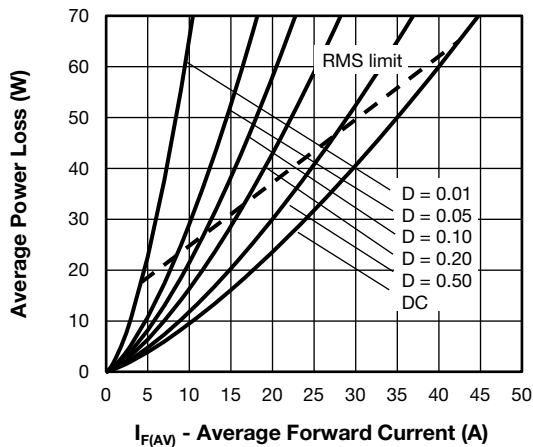
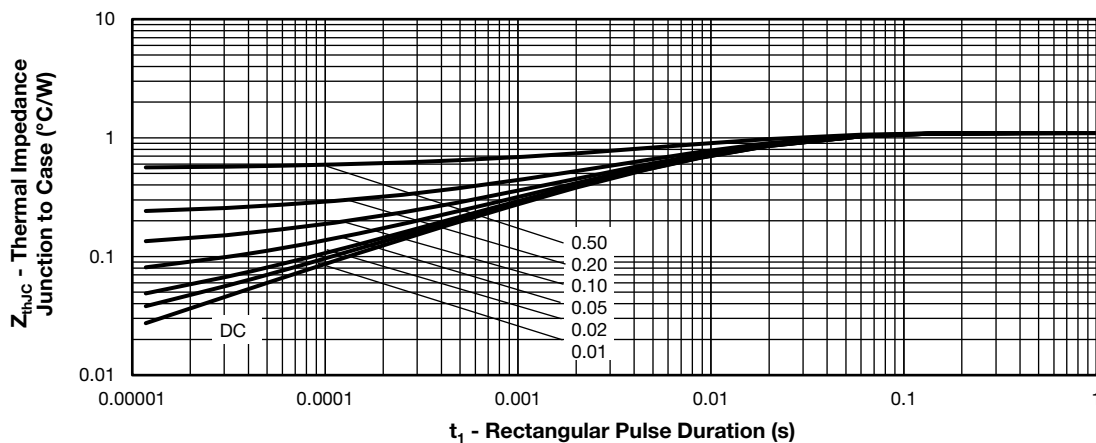
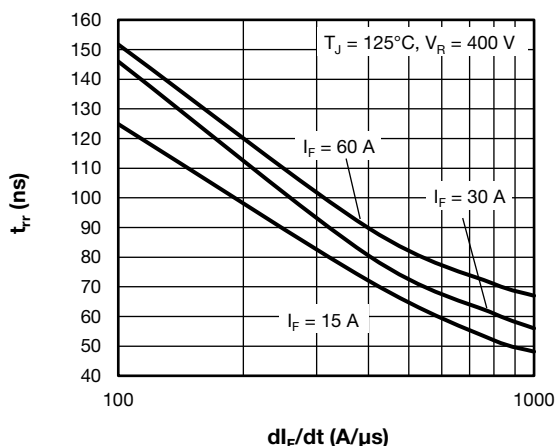
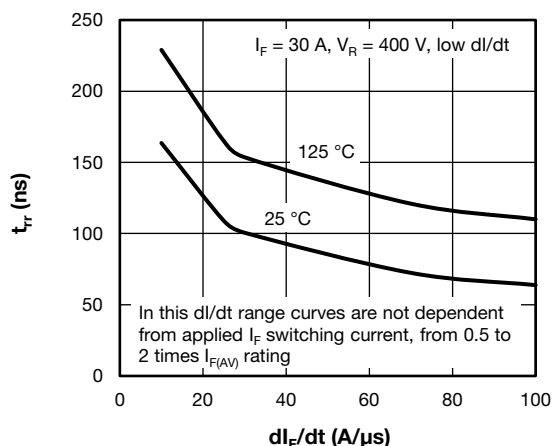
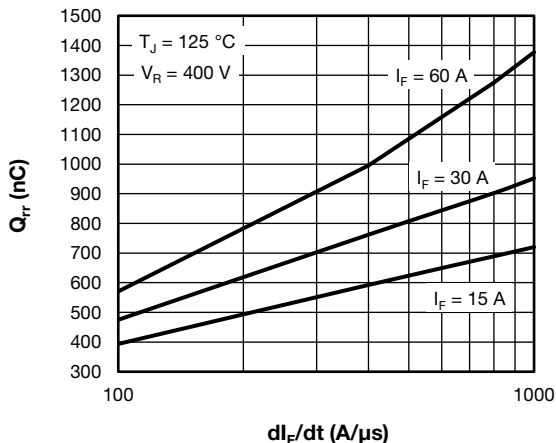
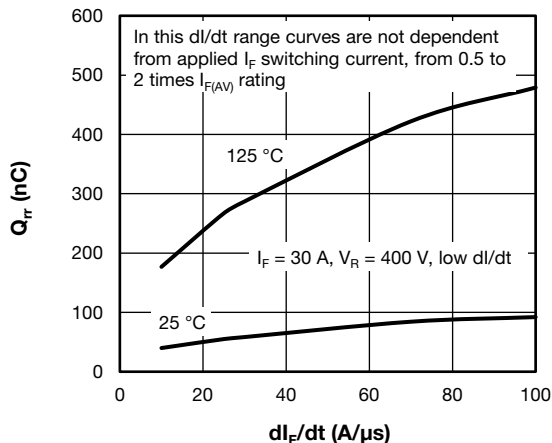
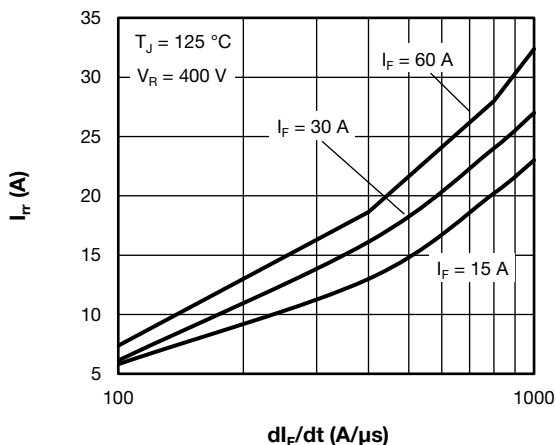
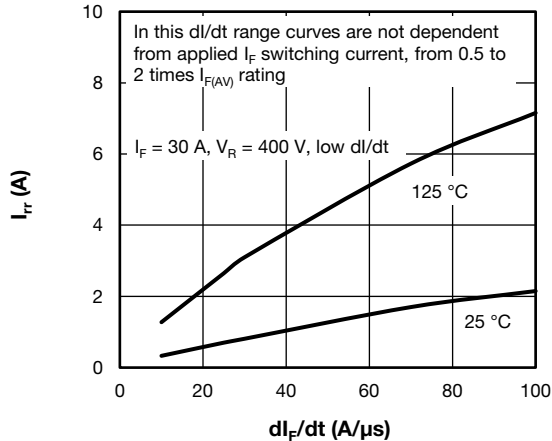


Fig. 5 - Average Power Loss vs. Average Forward Current, per Leg


Fig. 6 - Thermal Impedance  $Z_{thJC}$  - Characteristics, per Leg


Fig. 7 - Typical Reverse Recovery Time vs.  $dI_F/dt$ , per Leg

Fig. 10 - Typical Reverse Recovery Time vs.  $dI_F/dt$ , per Leg

Fig. 8 - Typical Reverse Recovery Charge vs.  $dI_F/dt$ , per Leg

Fig. 11 - Typical Reverse Recovery Charge vs.  $dI_F/dt$ , per Leg

Fig. 9 - Typical Reverse Recovery Current vs.  $dI_F/dt$ , per Leg

Fig. 12 - Typical Reverse Recovery Current vs.  $dI_F/dt$ , per Leg

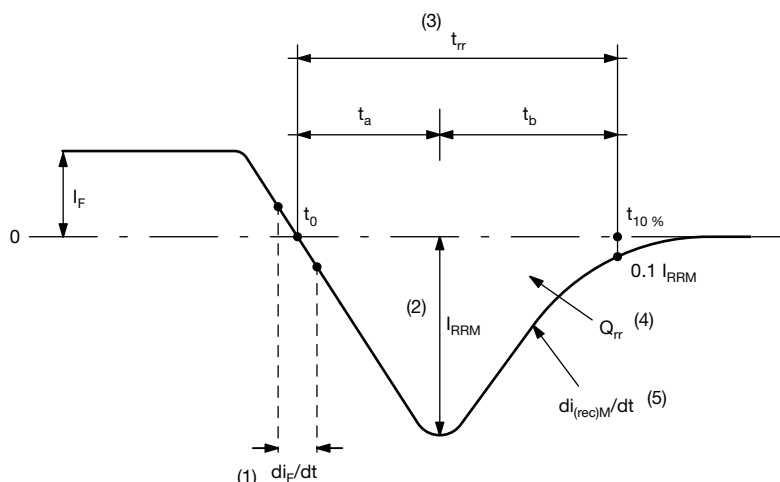


Fig. 13 - Reverse Recovery Waveform and Definitions

**Notes**

- (1)  $di_F/dt$  - rate of change of current through zero crossing  
(2)  $I_{RRM}$  - peak reverse recovery current  
(3)  $t_{rr}$  - reverse recovery time measured from  $t_0$ , crossing point of negative going  $I_F$ , to point  $t_{10\%}$ ,  $0.1 I_{RRM}$   
(4)  $Q_{rr}$  - area under curve defined by  $t_0$  and  $t_{10\%}$

$$Q_{rr} = \int_{t_0}^{t_{10\%}} I(t) dt$$

- (5)  $di_{(rec)M}/dt$  - peak rate of change of current during  $t_b$  portion of  $t_{rr}$

**ORDERING INFORMATION TABLE**

| Device code | VS- | C   | 5 | P | X | 60 | 06 | L | H | N3 |
|-------------|-----|---|---|---|---|----|----|---|---|----|
|             | 1   | 2   | 3 | 4 | 5 | 6  | 7  | 8 | 9 | 10 |
| 1           | -   | Vishay Semiconductors product                                 |   |   |   |    |    |   |   |    |
| 2           | -   | Circuit configuration   |   |   |   |    |    |   |   |    |
|             |     | C = common cathode  |   |   |   |    |    |   |   |    |
| 3           | -   | FRED Pt® Gen 5  |   |   |   |    |    |   |   |    |
| 4           | -   | P = TO-247 package  |   |   |   |    |    |   |   |    |
| 5           | -   | Process type:   |   |   |   |    |    |   |   |    |
|             |     | X = hyperfast recovery  |   |   |   |    |    |   |   |    |
| 6           | -   | Current rating (60 = 60 A)                                    |   |   |   |    |    |   |   |    |
| 7           | -   | Voltage rating (06 = 600 V)                                   |   |   |   |    |    |   |   |    |
| 8           | -   | Package: L = long lead (TO-247AD)                             |   |   |   |    |    |   |   |    |
| 9           | -   | H = AEC-Q101 qualified  |   |   |   |    |    |   |   |    |
| 10          | -   | Environmental digit:  |   |   |   |    |    |   |   |    |
|             |     | N3 = halogen-free, RoHS-compliant, and totally lead (Pb)-free |   |   |   |    |    |   |   |    |

**ORDERING INFORMATION (Example)**

| PREFERRED P/N   | QUANTITY PER TUBE | MINIMUM ORDER QUANTITY | PACKAGING DESCRIPTION   |
|-----------------|-------------------|------------------------|-------------------------|
| VS-C5PX6006LHN3 | 25                | 500                    | Antistatic plastic tube |

**LINKS TO RELATED DOCUMENTS**

|                          |  |
|--------------------------|--|
| Dimensions               | <a href="http://www.vishay.com/doc?95626">www.vishay.com/doc?95626</a> |
| Part marking information | <a href="http://www.vishay.com/doc?95007">www.vishay.com/doc?95007</a> |



### TO-247AD 3L

**DIMENSIONS** in millimeters and inches



| SYMBOL | MILLIMETERS |       | INCHES |       | NOTES |
|--------|-------------|-------|--------|-------|-------|
|        | MIN.        | MAX.  | MIN.   | MAX.  |       |
| A      | 4.65        | 5.31  | 0.183  | 0.209 |       |
| A1     | 2.21        | 2.59  | 0.087  | 0.102 |       |
| A2     | 1.50        | 2.49  | 0.059  | 0.098 |       |
| b      | 0.99        | 1.40  | 0.039  | 0.055 |       |
| b1     | 0.99        | 1.35  | 0.039  | 0.053 |       |
| b2     | 1.65        | 2.39  | 0.065  | 0.094 |       |
| b3     | 1.65        | 2.34  | 0.065  | 0.092 |       |
| b4     | 2.59        | 3.43  | 0.102  | 0.135 |       |
| b5     | 2.59        | 3.38  | 0.102  | 0.133 |       |
| c      | 0.38        | 0.89  | 0.015  | 0.035 |       |
| c1     | 0.38        | 0.84  | 0.015  | 0.033 |       |
| D      | 19.71       | 20.70 | 0.776  | 0.815 | 3     |
| D1     | 13.08       | -     | 0.515  | -     | 4     |

| SYMBOL    | MILLIMETERS |       | INCHES    |       | NOTES |
|-----------|-------------|-------|-----------|-------|-------|
|           | MIN.        | MAX.  | MIN.      | MAX.  |       |
| D2        | 0.51        | 1.30  | 0.020     | 0.051 |       |
| E         | 15.29       | 15.87 | 0.602     | 0.625 | 3     |
| E1        | 13.46       | -     | 0.53      | -     |       |
| e         | 5.46 BSC    |       | 0.215 BSC |       |       |
| $\Phi K$  | 0.254       |       | 0.010     |       |       |
| L         | 19.81       | 20.32 | 0.780     | 0.800 |       |
| L1        | 3.71        | 4.29  | 0.146     | 0.169 |       |
| $\Phi P$  | 3.56        | 3.66  | 0.14      | 0.144 |       |
| $\Phi P1$ | -           | 6.98  | -         | 0.275 |       |
| Q         | 5.31        | 5.69  | 0.209     | 0.224 |       |
| R         | 4.52        | 5.49  | 0.178     | 0.216 |       |
| S         | 5.51 BSC    |       | 0.217 BSC |       |       |

#### Notes

- Dimensioning and tolerancing per ASME Y14.5M-1994
- Contour of slot optional
- Dimension D and E do not include mold flash. These dimensions are measured at the outermost extremes of the plastic body
- Thermal pad contour optional with dimensions D1 and E1
- Lead finish uncontrolled in L1
- $\Phi P$  to have a maximum draft angle of 1.5 to the top of the part with a maximum hole diameter of 3.91 mm (0.154")
- Outline conforms to JEDEC® outline TO-247 with exception of dimension A min., D, E min., Q min., S, and note 4



## 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.