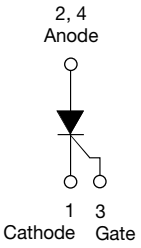
# Thyristor High Voltage, Surface Mount Phase Control SCR, 16 A


D²PAK (TO-263AB)




## FEATURES

- Meets MSL level 1, per J-STD-020, LF maximum peak of 245 °C
- Designed and qualified according JEDEC®-JESD 47
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912

RoHS COMPLIANT
HALOGEN FREE

## APPLICATIONS

- Input rectification (soft start)
- Vishay input diodes, switches and output rectifiers which are available in identical package outlines

## DESCRIPTION

The VS-16TTS..S-M3 high voltage series of silicon controlled rectifiers are specifically designed for medium power switching and phase control applications. The glass passivation technology used has reliable operation up to 125 °C junction temperature.

| PRIMARY CHARACTERISTICS | |
|---|---|
| $I_{T(AV)}$ | 10 A |
| $V_{DRM}/V_{RRM}$ | 800 V, 1200 V |
| $V_{TM}$ | 1.4 V |
| $I_{GT}$ | 60 mA |
| $T_J$ | -40 °C to 125 °C |
| Package | D²PAK (TO-263AB) |
| Circuit configuration | Single SCR |

| OUTPUT CURRENT IN TYPICAL APPLICATIONS | | | |
|---|---|---|---|
| APPLICATIONS | SINGLE-PHASE BRIDGE | THREE-PHASE BRIDGE | UNITS |
| NEMA FR-4 or G-10 glass fabric-based epoxy with 4 oz. (140 µm) copper | 2.5 | 3.5 | A |
| Aluminum IMS, $R_{thCA}$ = 15 °C/W | 6.3 | 9.5 | |
| Aluminum IMS with heatsink, $R_{thCA}$ = 5 °C/W | 14.0 | 18.5 | |

**Note**

- $T_A$ = 55 °C, $T_J$ = 125 °C, footprint 300 mm²

| MAJOR RATINGS AND CHARACTERISTICS | | | |
|---|---|---|---|
| PARAMETER | TEST CONDITIONS | VALUES | UNITS |
| $I_{T(AV)}$ | Sinusoidal waveform | 10 | A |
| $I_{RMS}$ | | 16 | |
| $V_{RRM}/V_{DRM}$ | | 800 to 1200 | V |
| $I_{TSM}$ | | 200 | A |
| $V_T$ | 10 A, $T_J$ = 25 °C | 1.4 | V |
| dV/dt | | 500 | V/µs |
| dI/dt | | 150 | A/µs |
| $T_J$ | | -40 to +125 | °C |

| VOLTAGE RATINGS | | | |
|---|---|---|---|
| PART NUMBER | $V_{RRM}$, MAXIMUM PEAK REVERSE VOLTAGE V | $V_{DRM}$, MAXIMUM PEAK DIRECT VOLTAGE V | $I_{RRM}/I_{DRM}$ AT 125 °C mA |
| VS-16TTS08S-M3 | 800 | 800 | 10 |
| VS-16TTS12S-M3 | 1200 | 1200 | |

| ABSOLUTE MAXIMUM RATINGS | | | | | |
|---|---|---|---|---|---|
| PARAMETER | SYMBOL | TEST CONDITIONS | VALUES | | UNITS |
| | | | TYP. | MAX. | |
| Maximum average on-state current | $I_{T(AV)}$ | $T_C$ = 98 °C, 180° conduction, half sine wave | 10 | | A |
| Maximum RMS on-state current | $I_{RMS}$ | | 16 | | |
| Maximum peak, one-cycle, non-repetitive surge current | $I_{TSM}$ | 10 ms sine pulse, rated $V_{RRM}$ applied | 170 | | |
| | | 10 ms sine pulse, no voltage reapplied | 200 | | |
| Maximum $I^2t$ for fusing | $I^2t$ | 10 ms sine pulse, rated $V_{RRM}$ applied | 144 | | $A^2s$ |
| | | 10 ms sine pulse, no voltage reapplied | 200 | | |
| Maximum $I^2\sqrt{t}$ for fusing | $I^2\sqrt{t}$ | t = 0.1 ms to 10 ms, no voltage reapplied | 2000 | | $A^2\sqrt{s}$ |
| Maximum on-state voltage drop | $V_{TM}$ | 10 A, $T_J$ = 25 °C | 1.4 | | V |
| On-state slope resistance | $r_t$ | $T_J$ = 125 °C | 24.0 | | mΩ |
| Threshold voltage | $V_{T(TO)}$ | | 1.1 | | V |
| Maximum reverse and direct leakage current | $I_{RM}/I_{DM}$ | $T_J$ = 25 °C; $V_R$ = rated $V_{RRM}/V_{DRM}$ | 0.5 | | mA |
| | | $T_J$ = 125 °C | 10 | | |
| Holding current | $I_H$ | Anode supply = 6 V, resistive load, initial $I_T$ = 1 A, $T_J$ = 25 °C | - | 150 | |
| Maximum latching current | $I_L$ | Anode supply = 6 V, resistive load, $T_J$ = 25 °C | 200 | | |
| Maximum rate of rise of off-state voltage | dV/dt | $T_J$ = $T_J$ max. linear to 80 % $V_{DRM}$ = $R_g$ - k = open | 500 | | V/µs |
| Maximum rate of rise of turned-on current | dI/dt | | 150 | | A/µs |

| TRIGGERING | | | | |
|---|---|---|---|---|
| PARAMETER | SYMBOL | TEST CONDITIONS | VALUES | UNITS |
| Maximum peak gate power | $P_{GM}$ | | 8.0 | W |
| Maximum average gate power | $P_{G(AV)}$ | | 2.0 | |
| Maximum peak positive gate current | + $I_{GM}$ | | 1.5 | A |
| Maximum peak negative gate voltage | - $V_{GM}$ | | 10 | V |
| Maximum required DC gate current to trigger | $I_{GT}$ | Anode supply = 6 V, resistive load, $T_J$ = - 10 °C | 90 | mA |
| | | Anode supply = 6 V, resistive load, $T_J$ = 25 °C | 60 | |
| | | Anode supply = 6 V, resistive load, $T_J$ = 125 °C | 35 | |
| Maximum required DC gate voltage to trigger | $V_{GT}$ | Anode supply = 6 V, resistive load, $T_J$ = - 10 °C | 3.0 | V |
| | | Anode supply = 6 V, resistive load, $T_J$ = 25 °C | 2.0 | |
| | | Anode supply = 6 V, resistive load, $T_J$ = 125 °C | 1.0 | |
| Maximum DC gate voltage not to trigger | $V_{GD}$ | $T_J$ = 125 °C, $V_{DRM}$ = Rated value | 0.25 | |
| Maximum DC gate current not to trigger | $I_{GD}$ | | 2.0 | mA |

| SWITCHING | | | | |
|---|---|---|---|---|
| PARAMETER | SYMBOL | TEST CONDITIONS | VALUES | UNITS |
| Typical turn-on time | $t_{gt}$ | $T_J$ = 25 °C | 0.9 | µs |
| Typical reverse recovery time | $t_{rr}$ | $T_J$ = 125 °C | 4 | |
| Typical turn-off time | $t_q$ | | 110 | |

| THERMAL - MECHANICAL SPECIFICATIONS | | | | |
|---|---|---|---|---|
| **PARAMETER** | **SYMBOL** | **TEST CONDITIONS** | **VALUES** | **UNITS** |
| Maximum junction and storage temperature range | $T_J$, $T_{Stg}$ | | -40 to +125 | °C |
| Maximum thermal resistance, junction to case | $R_{thJC}$ | DC operation | 1.3 | °C/W |
| Typical thermal resistance, junction to ambient | $R_{thJA}$ | PCB mount (1) | 40 | |
| Approximate weight | | | 2 | g |
| | | | 0.07 | oz. |
| Marking device | | Case style $D^2PAK$ (TO-263AB) | 16TTS08S | |
| | | | 16TTS12S | |

**Note**

(1) When mounted on 1" square (650 $mm^2$) PCB of FR-4 or G-10 material 4 oz. (140 µm) copper 40 °C/W.
For recommended footprint and soldering techniques refer to application note #AN-994

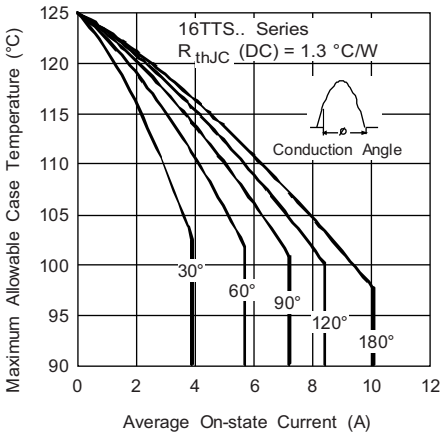



Fig. 1 - Current Rating Characteristics

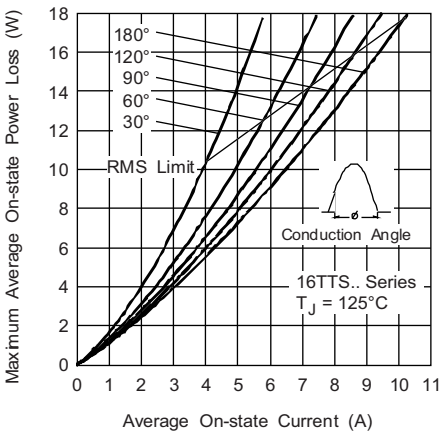



Fig. 3 - On-State Power Loss Characteristics

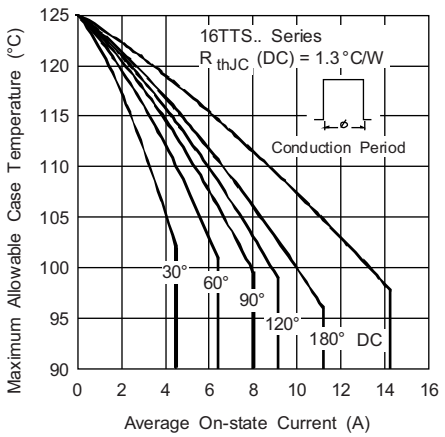



Fig. 2 - Current Rating Characteristics

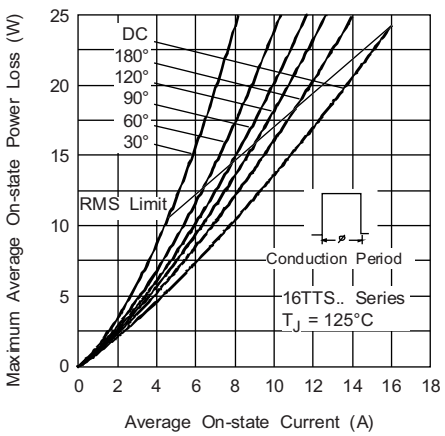



Fig. 4 - On-State Power Loss Characteristics

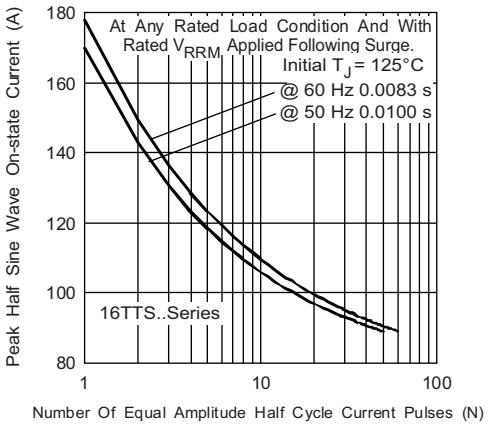



Fig. 5 - Maximum Non-Repetitive Surge Current

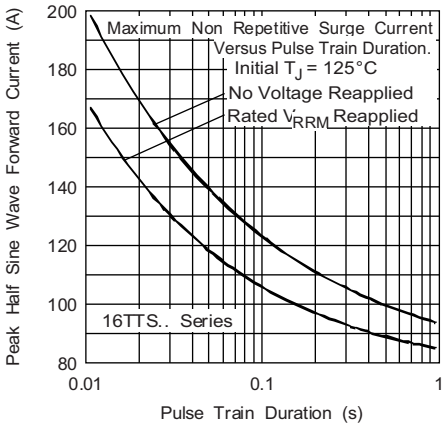



Fig. 6 - Maximum Non-Repetitive Surge Current

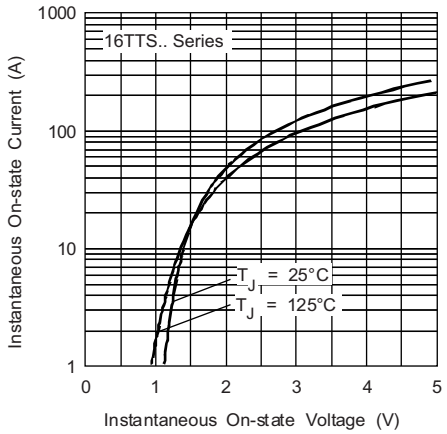



Fig. 7 - On-State Voltage Drop Characteristics

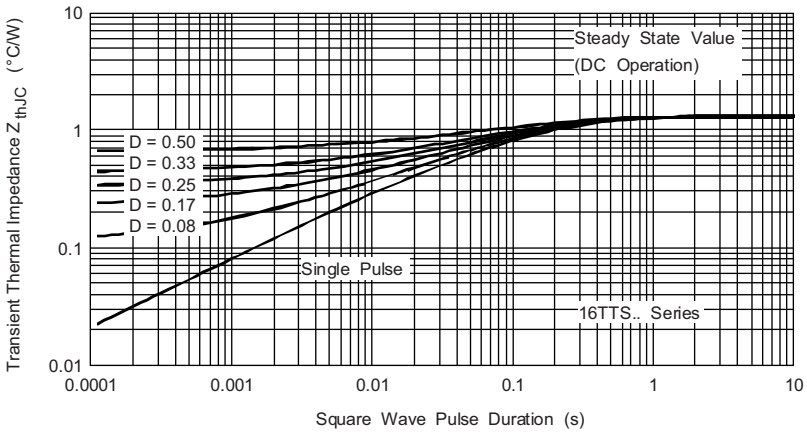



Fig. 8 - Thermal Impedance $Z_{thJC}$ Characteristics

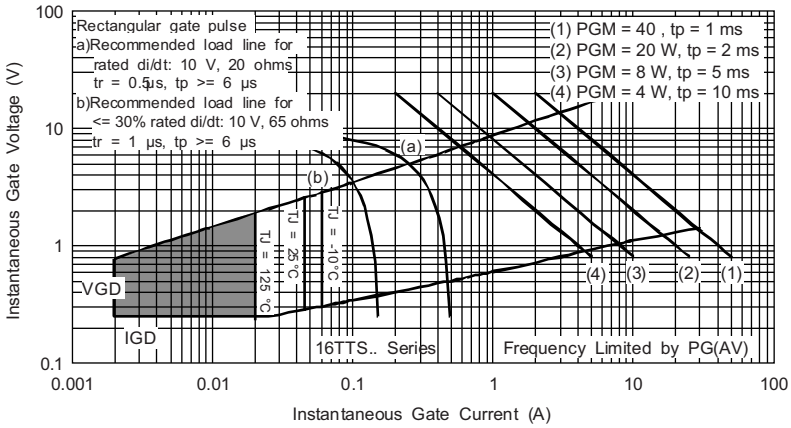



Fig. 9 - Gate Characteristics

## ORDERING INFORMATION TABLE

**Device code**

| VS- | 16 | T | T | S | 12 | S | TRL | -M3 |
|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |

1 - Vishay Semiconductors product

2 - Current rating

3 - Circuit configuration:
T = single thyristor

4 - Package:
T = $D^2PAK$ (TO-263AB)

5 - Type of silicon:
S = standard recovery rectifier

6 - Voltage rating: voltage code x 100 = $V_{RRM}$ (08 = 800 V, 12 = 1200 V)

7 - S = surface mountable

8 - • None = tube
• TRL = tape and reel (left oriented)
• TRR = tape and reel (right oriented)

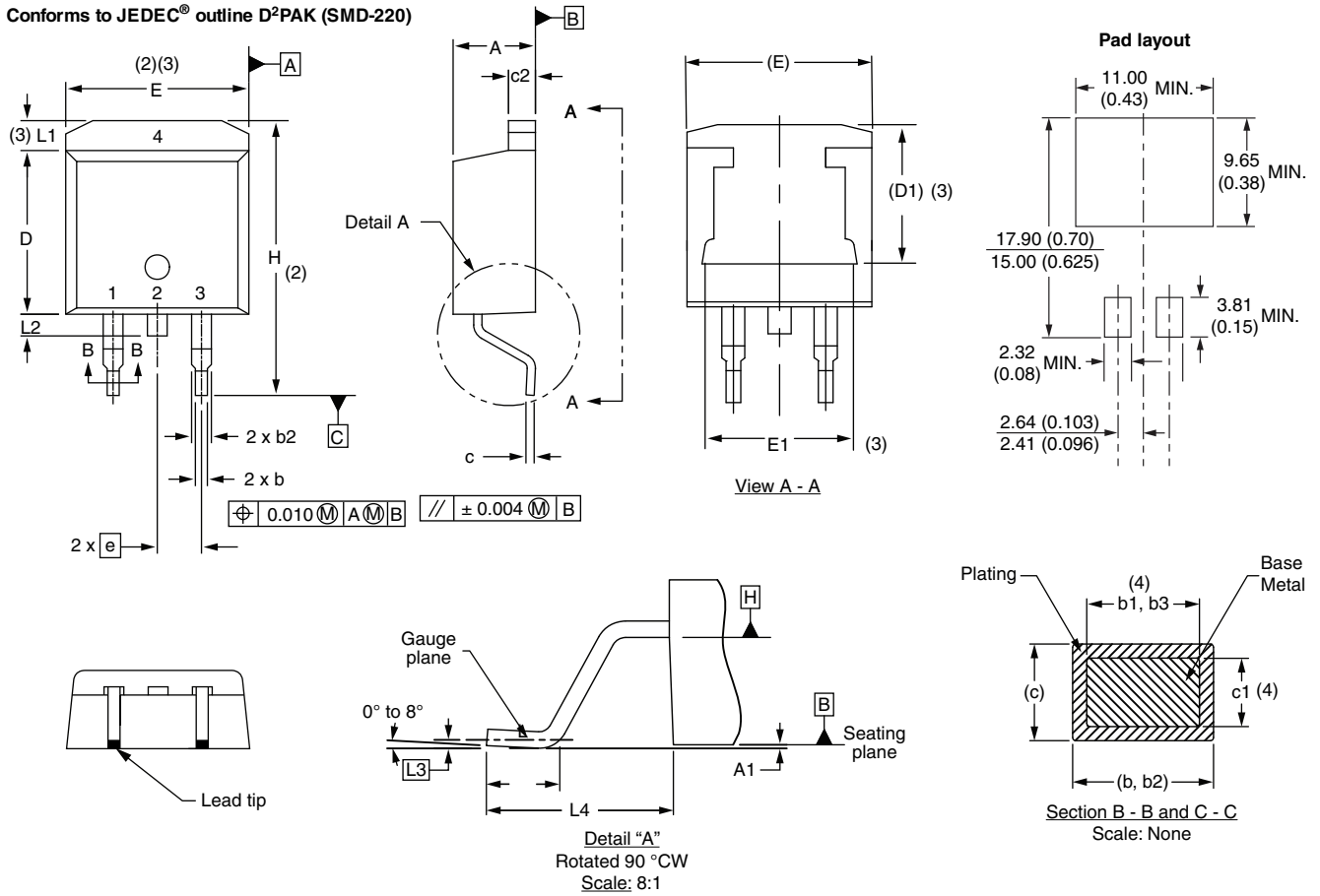
9 - -M3 = halogen-free, RoHS-compliant, and terminations lead (Pb)-free

| **ORDERING INFORMATION** (Example) | | |
|---|---|---|
| **PREFERRED P/N** | **BASE QUANTITY** | **PACKAGING DESCRIPTION** |
| VS-16TTS08S-M3 | 50 | Antistatic plastic tubes |
| VS-16TTS08STRL-M3 | 800 | 13" diameter plastic tape and reel |
| VS-16TTS08STRR-M3 | 800 | 13" diameter plastic tape and reel |
| VS-16TTS12S-M3 | 50 | Antistatic plastic tubes |
| VS-16TTS12STRL-M3 | 800 | 13" diameter plastic tape and reel |
| VS-16TTS12STRR-M3 | 800 | 13" diameter plastic tape and reel |

| **LINKS TO RELATED DOCUMENTS** | |
|---|---|
| Dimensions | www.vishay.com/doc?96164 |
| Part marking information | www.vishay.com/doc?95444 |
| Packaging information | www.vishay.com/doc?96424 |
| SPICE model | www.vishay.com/doc?96772 |

# $D^2PAK$

**DIMENSIONS** in millimeters and inches




| SYMBOL | MILLIMETERS | | INCHES | | NOTES |
|---|---|---|---|---|---|
| | MIN. | MAX. | MIN. | MAX. | |
| A | 4.06 | 4.83 | 0.160 | 0.190 | |
| A1 | 0.00 | 0.254 | 0.000 | 0.010 | |
| b | 0.51 | 0.99 | 0.020 | 0.039 | |
| b1 | 0.51 | 0.89 | 0.020 | 0.035 | 4 |
| b2 | 1.14 | 1.78 | 0.045 | 0.070 | |
| b3 | 1.14 | 1.73 | 0.045 | 0.068 | 4 |
| c | 0.38 | 0.74 | 0.015 | 0.029 | |
| c1 | 0.38 | 0.58 | 0.015 | 0.023 | 4 |
| c2 | 1.14 | 1.65 | 0.045 | 0.065 | |
| D | 8.51 | 9.65 | 0.335 | 0.380 | 2 |

| SYMBOL | MILLIMETERS | | INCHES | | NOTES |
|---|---|---|---|---|---|
| | MIN. | MAX. | MIN. | MAX. | |
| D1 | 6.86 | 8.00 | 0.270 | 0.315 | 3 |
| E | 9.65 | 10.67 | 0.380 | 0.420 | 2, 3 |
| E1 | 7.90 | 8.80 | 0.311 | 0.346 | 3 |
| e | 2.54 BSC | | 0.100 BSC | | |
| H | 14.61 | 15.88 | 0.575 | 0.625 | |
| L | 1.78 | 2.79 | 0.070 | 0.110 | |
| L1 | - | 1.65 | - | 0.066 | 3 |
| L2 | 1.27 | 1.78 | 0.050 | 0.070 | |
| L3 | 0.25 BSC | | 0.010 BSC | | |
| L4 | 4.78 | 5.28 | 0.188 | 0.208 | |

**Notes**

(1) Dimensioning and tolerancing per ASME Y14.5 M-1994

(2) Dimension D and E do not include mold flash. Mold flash shall not exceed 0.127 mm (0.005") per side. These dimensions are measured at the outmost extremes of the plastic body

(3) Thermal pad contour optional within dimension E, L1, D1 and E1

(4) Dimension b1 and c1 apply to base metal only

(5) Datum A and B to be determined at datum plane H

(6) Controlling dimension: inches

(7) Outline conforms to JEDEC® outline TO-263AB

# 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.

Vishay products are not designed for use in life-saving or life-sustaining applications or any application in which the failure of the Vishay product could result in personal injury or death unless specifically qualified in writing by Vishay. 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.