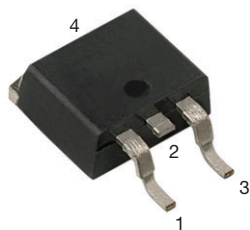
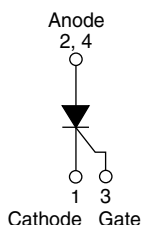


# Thyristor Surface Mount, Phase Control SCR, 16 A


**D<sup>2</sup>PAK (TO-263AB)**


## FEATURES

- Meets MSL level 1, per J-STD-020, LF maximum peak of 260 °C
- AEC-Q101 qualified
- Meets JESD 201 class 1A whisker test
- Flexible solution for reliable AC power rectification
- Easy control peak current at charger power up to reduce passive / electromechanical components
- Material categorization: for definitions of compliance please see [www.vishay.com/doc?99912](http://www.vishay.com/doc?99912)



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

## APPLICATIONS

- On-board and off-board EV / HEV battery chargers
- Renewable energy inverters

## DESCRIPTION

The VS-25TTS16SLHM3 of silicon controlled rectifiers is specifically designed for medium power switching and phase control applications.

## PRIMARY CHARACTERISTICS

|                       |                               |
|-----------------------|-------------------------------|
| $I_{T(AV)}$           | 16 A                          |
| $V_{DRM}/V_{RRM}$     | 1600 V                        |
| $V_{TM}$              | 1.25 V                        |
| $I_{GT}$              | 45 mA                         |
| $T_J$                 | -40 °C to +125 °C             |
| Package               | D <sup>2</sup> PAK (TO-263AB) |
| Circuit configuration | Single SCR                    |

## OUTPUT CURRENT IN TYPICAL APPLICATIONS

| APPLICATIONS   | SINGLE-PHASE BRIDGE | THREE-PHASE BRIDGE | UNITS |
|--|---------------------|--------------------|-------|
| NEMA FR-4 or G10 glass fabric-based epoxy with 4 oz. (140 µm) copper | 3.5                 | 5.5                | A     |
| Aluminum IMS, $R_{thCA} = 15$ °C/W                                   | 8.5                 | 13.5               |       |
| Aluminum IMS with heatsink, $R_{thCA} = 5$ °C/W                      | 16.5                | 25.0               |       |

### Note

- $T_A = 55$  °C,  $T_J = 125$  °C, footprint 300 mm<sup>2</sup>

## MAJOR RATINGS AND CHARACTERISTICS

| PARAMETER         | TEST CONDITIONS     | VALUES      | UNITS |
|-------------------|---------------------|-------------|-------|
| $I_{T(AV)}$       | Sinusoidal waveform | 16          | A     |
| $I_{RMS}$         |                     | 25          |       |
| $V_{RRM}/V_{DRM}$ |                     | 1600        | V     |
| $I_{TSM}$         |                     | 350         | A     |
| $V_T$             | 16 A, $T_J = 25$ °C | 1.25        | 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<br>V | $V_{DRM}$ , MAXIMUM PEAK DIRECT VOLTAGE<br>V | $I_{RRM}/I_{DRM}$ , AT 125 °C<br>mA |
|-----------------|---|--|-------------------------------------|
| VS-25TTS16SLHM3 | 1600  | 1600   | 10                                  |

**ABSOLUTE MAXIMUM RATINGS**

| PARAMETER   | SYMBOL                           | TEST CONDITIONS  |   | VALUES |      | UNITS             |
|---|----------------------------------|--|---|--------|------|-------------------|
|   |                                  |  |   | TYP.   | MAX. |                   |
| Maximum average on-state current                      | I <sub>T(AV)</sub>               | T <sub>C</sub> = 93 °C, 180° conduction half sine wave   |   | 16     |      | A                 |
| Maximum RMS on-state current                          | I <sub>RMS</sub>                 |  |   | 25     |      |                   |
| Maximum peak, one-cycle, non-repetitive surge current | I <sub>TSM</sub>                 | 10 ms sine pulse, rated V <sub>RRM</sub> applied   |   | 300    |      |                   |
|   |                                  | 10 ms sine pulse, no voltage reapplied   |   | 350    |      |                   |
| Maximum I <sup>2</sup> t for fusing                   | I <sup>2</sup> t                 | 10 ms sine pulse, rated V <sub>RRM</sub> applied   |   | 450    |      | A <sup>2</sup> s  |
|   |                                  | 10 ms sine pulse, no voltage reapplied   |   | 630    |      |                   |
| Maximum I <sup>2</sup> √t for fusing                  | I <sup>2</sup> √t                | t = 0.1 ms to 10 ms, no voltage reapplied  |   | 6300   |      | A <sup>2</sup> √s |
| Maximum on-state voltage drop                         | V <sub>TM</sub>                  | 16 A, T <sub>J</sub> = 25 °C   |   | 1.25   |      | V                 |
| On-state slope resistance                             | r <sub>t</sub>                   | T <sub>J</sub> = 125 °C  |   | 12.0   |      | mΩ                |
| Threshold voltage                                     | V <sub>T(TO)</sub>               |  |   | 1.0    |      | V                 |
| Maximum reverse and direct leakage current            | I <sub>RM</sub> /I <sub>DM</sub> | T <sub>J</sub> = 25 °C   | V <sub>R</sub> = Rated V <sub>RRM</sub> /V <sub>DRM</sub> | 0.5    |      | mA                |
|   |                                  | T <sub>J</sub> = 125 °C  |   | 10     |      |                   |
| Holding current                                       | I <sub>H</sub>                   | Anode supply = 6 V, resistive load, initial I <sub>T</sub> = 1 A, T <sub>J</sub> = 25 °C           |   | -      | 150  |                   |
| Maximum latching current                              | I <sub>L</sub>                   | Anode supply = 6 V, resistive load, T <sub>J</sub> = 25 °C   |   | 200    |      |                   |
| Maximum rate of rise of off-state voltage             | dV/dt                            | T <sub>J</sub> = T <sub>J</sub> max., linear to 80 %, V <sub>DRM</sub> = R <sub>g</sub> - 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, $T_J = -10\text{ }^{\circ}\text{C}$ | 60     | mA    |
|   |             | Anode supply = 6 V, resistive load, $T_J = 25\text{ }^{\circ}\text{C}$  | 45     |       |
|   |             | Anode supply = 6 V, resistive load, $T_J = 125\text{ }^{\circ}\text{C}$ | 20     |       |
| Maximum required DC gate voltage to trigger | $V_{GT}$    | Anode supply = 6 V, resistive load, $T_J = -10\text{ }^{\circ}\text{C}$ | 2.5    | V     |
|   |             | Anode supply = 6 V, resistive load, $T_J = 25\text{ }^{\circ}\text{C}$  | 2.0    |       |
|   |             | Anode supply = 6 V, resistive load, $T_J = 125\text{ }^{\circ}\text{C}$ | 1.0    |       |
| Maximum DC gate voltage not to trigger      | $V_{GD}$    | $T_J = 125\text{ }^{\circ}\text{C}$ , $V_{DRM} = \text{Rated value}$    | 0.25   | mA    |
| Maximum DC gate current not to trigger      | $I_{GD}$    |   | 2.0    |       |

**SWITCHING**

| PARAMETER                     | SYMBOL   | TEST CONDITIONS                     | VALUES | UNITS   |
|-------------------------------|----------|-------------------------------------|--------|---------|
| Typical turn-on time          | $t_{gt}$ | $T_J = 25\text{ }^{\circ}\text{C}$  | 0.9    | $\mu s$ |
| Typical reverse recovery time | $t_{rr}$ | $T_J = 125\text{ }^{\circ}\text{C}$ | 4      |         |
| Typical turn-off time         | $t_q$    |                                     | 110    |         |



| THERMAL AND MECHANICAL SPECIFICATIONS                       |                  |  |             |       |
|---|------------------|--|-------------|-------|
| PARAMETER   | SYMBOL           | TEST CONDITIONS                          | VALUES      | UNITS |
| Maximum junction and storage temperature range              | $T_J, T_{Stg}$   |  | -40 to +125 | °C    |
| Soldering temperature                                       | $T_S$            | For 10 s (1.6 mm from case)              | 260         |       |
| Maximum thermal resistance, junction to case                | $R_{thJC}$       | DC operation                             | 1.1         | °C/W  |
| Typical thermal resistance, junction to ambient (PCB mount) | $R_{thJA}^{(1)}$ |  | 40          |       |
| Approximate weight  |                  |  | 2           | g     |
|   |                  |  | 0.07        | oz.   |
| Marking device  |                  | Case style D <sup>2</sup> PAK (TO-263AB) | 25TTS16SH   |       |

Note

(1) When mounted on 1" square (650 mm<sup>2</sup>) PCB of FR-4 or G-10 material 4 oz. (140 μm) copper 40 °C/W

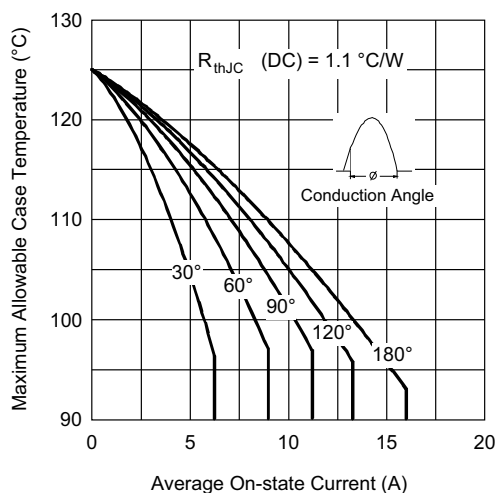


Fig. 1 - Current Rating Characteristics

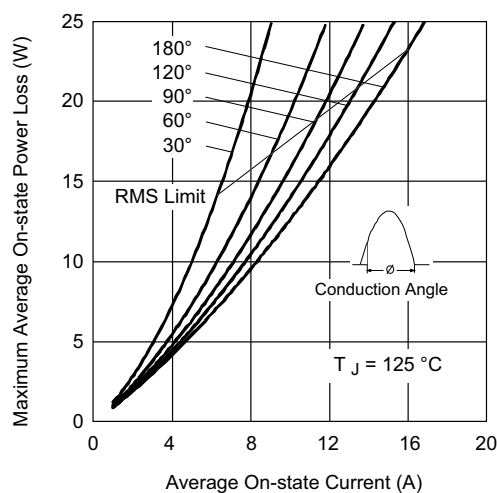


Fig. 3 - On-State Power Loss Characteristics

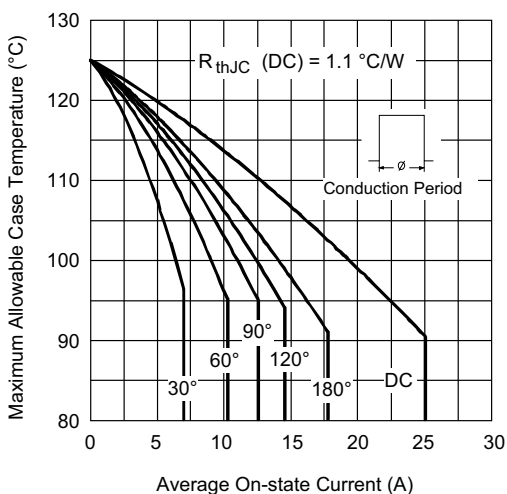


Fig. 2 - Current Rating Characteristics

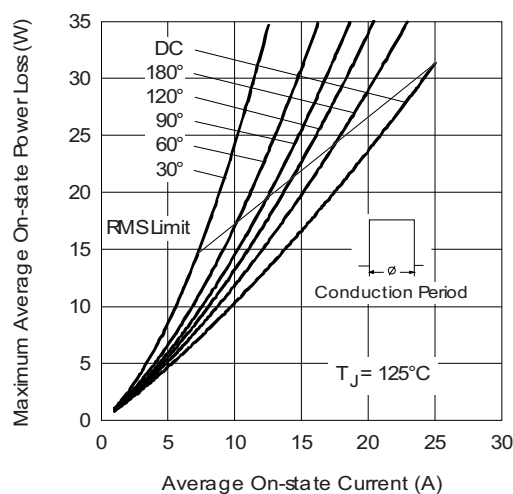


Fig. 4 - On-State Power Loss Characteristics

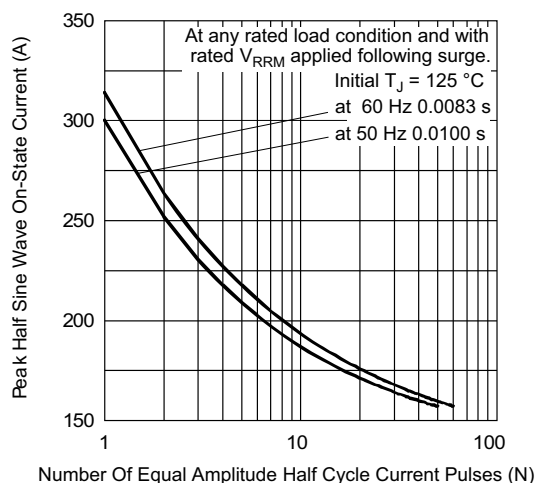


Fig. 5 - Maximum Non-Repetitive Surge Current

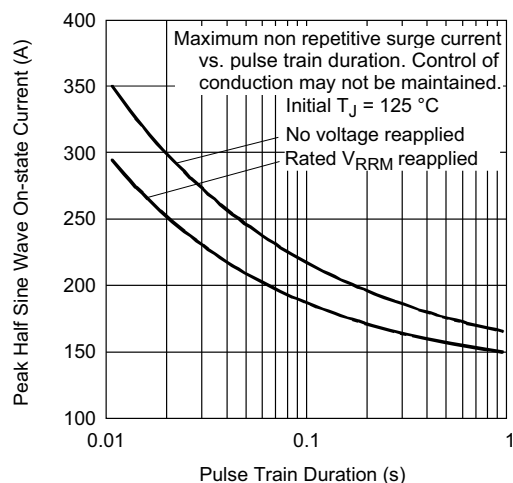


Fig. 6 - Maximum Non-Repetitive Surge Current

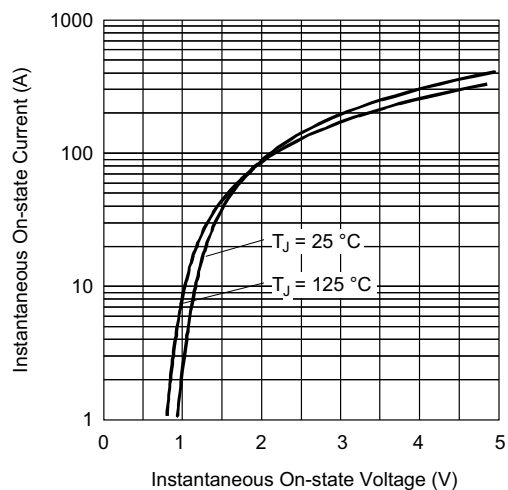


Fig. 7 - On-State Voltage Drop Characteristics

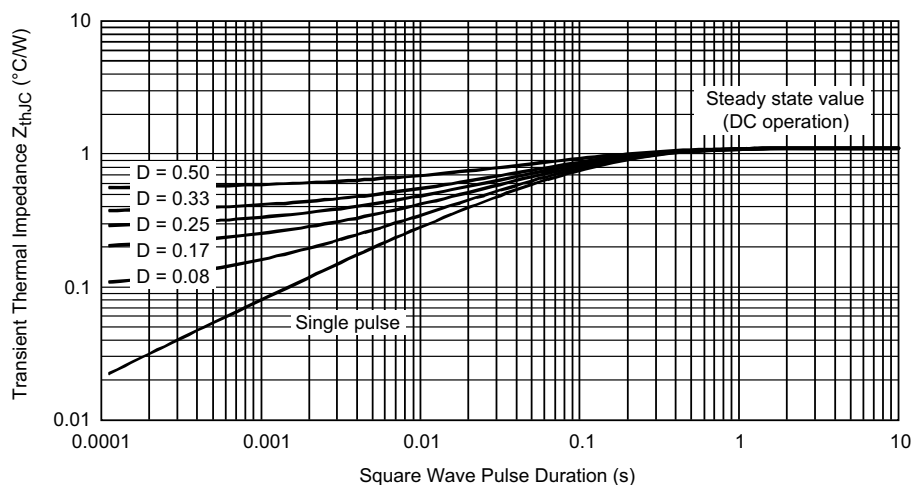
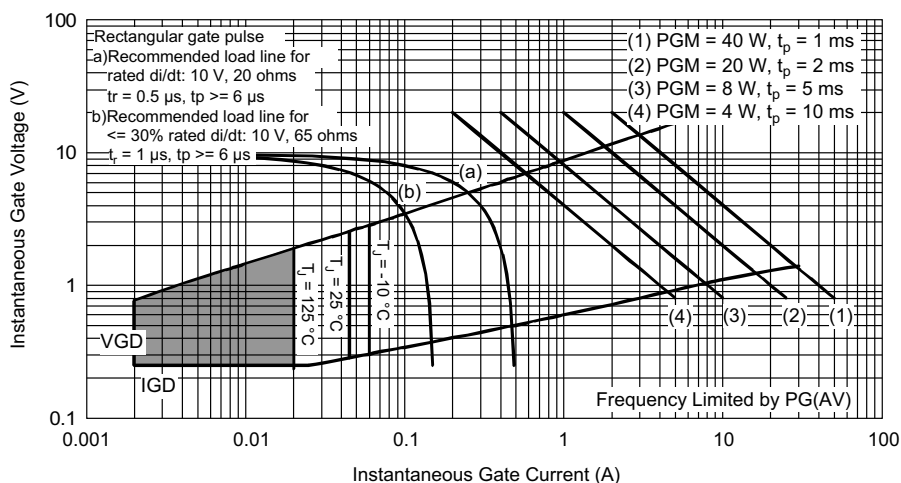


Fig. 8 - Gate Characteristics


Fig. 9 - Thermal Impedance  $Z_{thJC}$  Characteristics

## ORDERING INFORMATION TABLE

| Device code | VS- | 25 | T | T | S | 16 | S | L | H | M3 |
|-------------|-----|----|---|---|---|----|---|---|---|----|
|             | ①   | ②  | ③ | ④ | ⑤ | ⑥  | ⑦ | ⑧ | ⑨ | ⑩  |

- 1** - Vishay Semiconductors product
- 2** - Current rating (25 = 25 A)
- 3** - Circuit configuration:  
T = single thyristor
- 4** - Package:  
T = D<sup>2</sup>PAK (TO-263AB)
- 5** - Type of silicon:  
S = standard recovery rectifier
- 6** - Voltage rating: Voltage code x 100 =  $V_{RRM}$  — **16 = 1600 V**
- 7** - S = surface mountable
- 8** - L = tape and reel (left oriented), for different orientation, contact factory
- 9** - H = AEC-Q101 qualified
- 10** - Environmental digit:  
M3 = halogen-free, RoHS-compliant, and terminations lead (Pb)-free

## ORDERING INFORMATION (Example)

| PREFERRED P/N   | QUANTITY PER T/R | MINIMUM ORDER QUANTITY | PACKAGING DESCRIPTION |
|-----------------|------------------|------------------------|-----------------------|
| VS-25TTS16SLHM3 | 800              | 800                    | 13" diameter reel     |

## LINKS TO RELATED DOCUMENTS

|                          |  |
|--------------------------|--|
| Dimensions               | <a href="http://www.vishay.com/doc?95046">www.vishay.com/doc?95046</a> |
| Part marking information | <a href="http://www.vishay.com/doc?95444">www.vishay.com/doc?95444</a> |
| Packaging information    | <a href="http://www.vishay.com/doc?96317">www.vishay.com/doc?96317</a> |

### D<sup>2</sup>PAK

#### DIMENSIONS in millimeters and inches

Conforms to JEDEC® outline D<sup>2</sup>PAK (SMD-220)



| 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

- Dimensioning and tolerancing per ASME Y14.5 M-1994
- 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
- Thermal pad contour optional within dimension E, L1, D1 and E1
- Dimension b1 and c1 apply to base metal only
- Datum A and B to be determined at datum plane H
- Controlling dimension: inch
- Outline conforms to JEDEC® outline TO-263AB



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