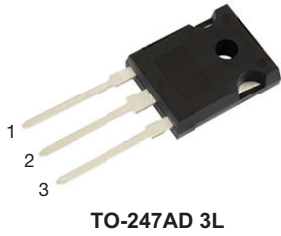
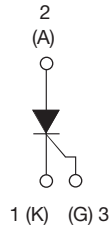




## Thyristor High Voltage, Phase Control SCR, 40 A



TO-247AD 3L



### FEATURES

- Low  $I_{GT}$
- 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

| PRIMARY CHARACTERISTICS |                   |
|-------------------------|-------------------|
| $I_{T(AV)}$             | 35 A              |
| $V_{DRM}/V_{RRM}$       | 1200 V            |
| $V_{TM}$                | 1.45 V            |
| $I_{GT}$                | 150 mA            |
| $T_J$                   | -40 °C to +125 °C |
| Package                 | TO-247AD 3L       |
| Circuit configuration   | Single SCR        |

### APPLICATIONS

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

### DESCRIPTION

The VS-40TPS12.. high voltage series of silicon controlled rectifiers are specifically designed for medium power switching and phase control applications.

| MAJOR RATINGS AND CHARACTERISTICS |                            |               |            |
|-----------------------------------|----------------------------|---------------|------------|
| PARAMETER                         | TEST CONDITIONS            | VALUES        | UNITS      |
| $I_{T(AV)}$                       | Sinusoidal waveform        | 35            | A          |
| $I_{RMS}$                         |                            | 55            |            |
| $V_{RRM}/V_{DRM}$                 |                            | 1200          | V          |
| $I_{TSM}$                         |                            | 600           | A          |
| $V_T$                             | 40 A, $T_J = 25\text{ °C}$ | 1.45          | V          |
| dv/dt                             |                            | 500           | V/ $\mu$ s |
| di/dt                             |                            | 100           | A/ $\mu$ s |
| $T_J$                             |                            | - 40 to + 125 | °C         |

| VOLTAGE RATINGS |  |  |                                   |
|-----------------|--|--|-----------------------------------|
| PART NUMBER     | $V_{RRM}/V_{DRM}$ , MAXIMUM REPETITIVE PEAK AND OFF-STATE VOLTAGE<br>V | $V_{RSM}$ , MAXIMUM NON-REPETITIVE PEAK REVERSE VOLTAGE<br>V | $I_{RRM}/I_{DRM}$ AT 125 °C<br>mA |
| VS-40TPS12ALHM3 | 1200   | 1300   | 10                                |



| ABSOLUTE MAXIMUM RATINGS                             |                   |   |  |        |                   |
|--|-------------------|---|--|--------|-------------------|
| PARAMETER  | SYMBOL            | TEST CONDITIONS   |  | VALUES | UNITS             |
| Maximum average on-state current                     | $I_{T(AV)}$       | $T_C = 79\text{ }^\circ\text{C}$ , 180° conduction half sine wave                                 |  | 35     | A                 |
| Maximum continuous RMS on-state current as AC switch | $I_{T(RMS)}$      |   |  | 55     |                   |
| Maximum peak, one-cycle non-repetitive surge current | $I_{TSM}$         | 10 ms sine pulse, rated $V_{RRM}$ applied   |  | 500    | A <sup>2</sup> s  |
|  |                   | 10 ms sine pulse, no voltage reapplied  |  | 600    |                   |
| Maximum $I^2t$ for fusing                            | $I^2t$            | 10 ms sine pulse, rated $V_{RRM}$ applied   |  | 1250   |                   |
|  |                   | 10 ms sine pulse, no voltage reapplied  |  | 1760   |                   |
| Maximum $I^2\sqrt{t}$ for fusing                     | $I^2\sqrt{t}$     | $t = 0.1\text{ ms to }10\text{ ms}$ , no voltage reapplied  |  | 17 600 | A <sup>2</sup> √s |
| Low level value of threshold voltage                 | $V_{T(TO)1}$      | $T_J = 125\text{ }^\circ\text{C}$   |  | 1.02   | V                 |
| High level value of threshold voltage                | $V_{T(TO)2}$      |   |  | 1.23   |                   |
| Low level value of on-state slope resistance         | $r_{t1}$          |   |  | 9.74   | mΩ                |
| High level value of on-state slope resistance        | $r_{t2}$          |   |  | 7.50   |                   |
| Maximum peak on-state voltage                        | $V_{TM}$          | 110 A, $T_J = 25\text{ }^\circ\text{C}$   |  | 1.85   | V                 |
| Maximum rate of rise of turned-on current            | $di/dt$           | $T_J = 25\text{ }^\circ\text{C}$  |  | 100    | A/μs              |
| Maximum holding current                              | $I_H$             | Anode supply = 6 V, resistive load, initial $T_J = 1\text{ A}$ , $I_T = 25\text{ }^\circ\text{C}$ |  | 300    | mA                |
| Maximum latching current                             | $I_L$             | Anode supply = 6 V, resistive load, $T_J = 25\text{ }^\circ\text{C}$                              |  | 350    |                   |
| Maximum reverse and direct leakage current           | $I_{RRM}/I_{DRM}$ | $T_J = 25\text{ }^\circ\text{C}$  |  | 0.5    | mA                |
|  |                   | $T_J = 125\text{ }^\circ\text{C}$   |  | 10     |                   |
| Maximum rate of rise of off-state voltage            | $dv/dt$           | $T_J = T_J$ maximum, linear to 80 % $V_{DRM}$ , $R_g - k = 100\text{ }\Omega$                     |  | 500    | V/μs              |

| TRIGGERING                                  |             |  |  |        |       |
|---|-------------|--|--|--------|-------|
| PARAMETER                                   | SYMBOL      | TEST CONDITIONS  |  | VALUES | UNITS |
| Maximum peak gate power                     | $P_{GM}$    |  |  | 10     | W     |
| Maximum average gate power                  | $P_{G(AV)}$ |  |  | 2.5    |       |
| Maximum peak gate current                   | $I_{GM}$    |  |  | 2.5    | A     |
| Maximum peak negative gate voltage          | $-V_{GM}$   |  |  | 10     | V     |
| Maximum required DC gate voltage to trigger | $V_{GT}$    | $T_J = -40\text{ }^\circ\text{C}$                                  |  | 2.0    | V     |
|   |             | $T_J = 25\text{ }^\circ\text{C}$                                   |  | 1.7    |       |
|   |             | $T_J = 125\text{ }^\circ\text{C}$                                  |  | 1.3    |       |
| Maximum required DC gate current to trigger | $I_{GT}$    | $T_J = -40\text{ }^\circ\text{C}$                                  |  | 150    | mA    |
|   |             | $T_J = 25\text{ }^\circ\text{C}$                                   |  | 40     |       |
|   |             | $T_J = 125\text{ }^\circ\text{C}$                                  |  | 20     |       |
| Maximum DC gate voltage not to trigger      | $V_{GD}$    | $T_J = 125\text{ }^\circ\text{C}$ , $V_{DRM} = \text{rated value}$ |  | 0.15   | V     |
| Maximum DC gate current not to trigger      | $I_{GD}$    |  |  | 1      | mA    |



| THERMAL AND 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                         | 0.6           | °C/W                   |
| Maximum thermal resistance, junction to ambient | $R_{thJA}$     |                                      | 40            |                        |
| Maximum thermal resistance, case to heat sink   | $R_{thCS}$     | Mounting surface, smooth and greased | 0.20          |                        |
| Approximate weight                              |                |                                      | 6             | g                      |
|   |                |                                      | 0.21          | oz.                    |
| Mounting torque                                 | minimum        |                                      | 6 (5)         | kgf · cm<br>(lbf · in) |
|   | maximum        |                                      | 12 (10)       |                        |
| Marking device                                  |                | Case style TO-247AD 3L               | 40TPS12ALH    |                        |

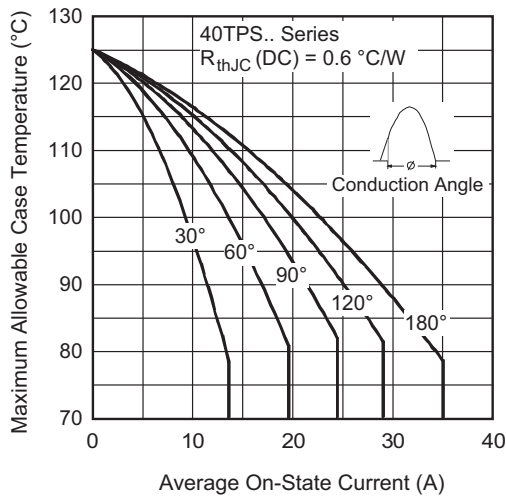


Fig. 1 - Current Rating Characteristics

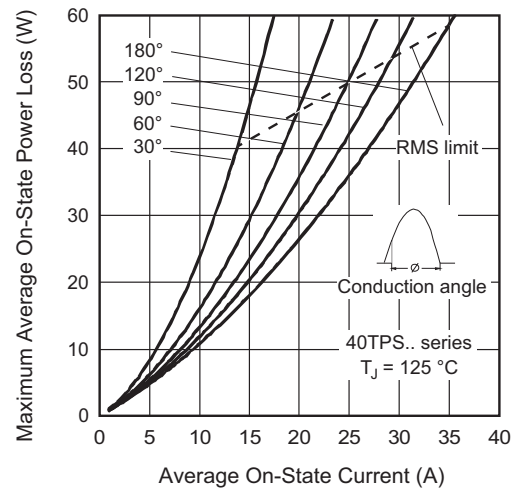


Fig. 3 - On-State Power Loss Characteristics

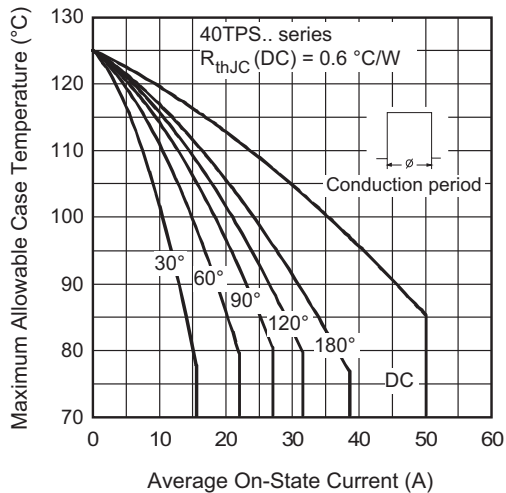


Fig. 2 - Current Rating Characteristics

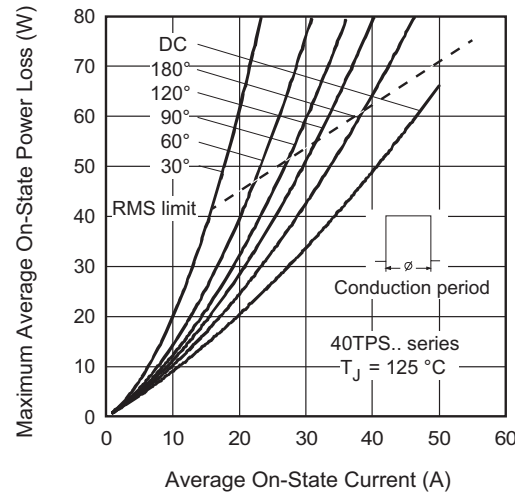


Fig. 4 - On-State Power Loss Characteristics

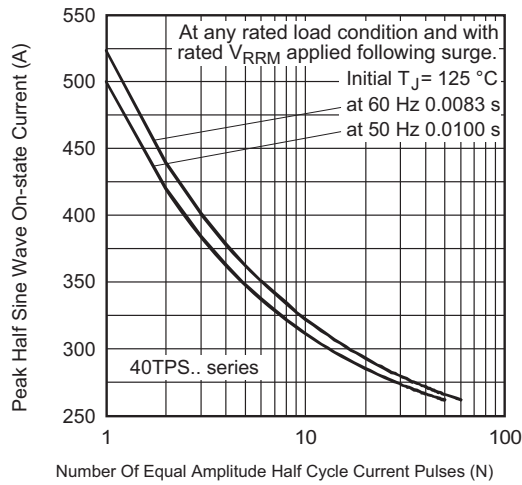


Fig. 5 - Maximum Non-Repetitive Surge Current

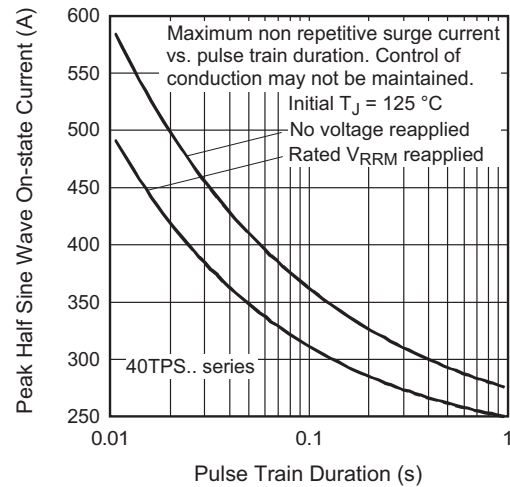


Fig. 6 - Maximum Non-Repetitive Surge Current

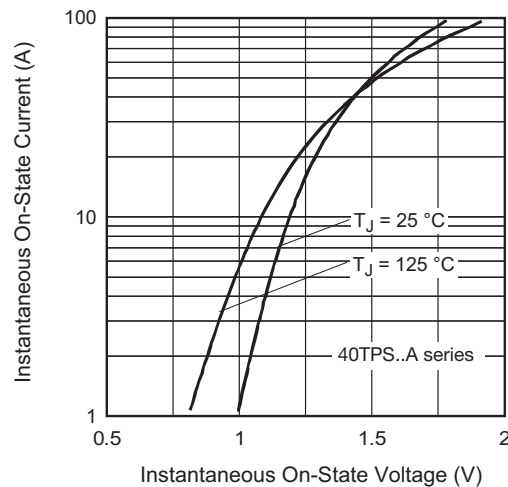


Fig. 7 - On-State Voltage Drop Characteristics

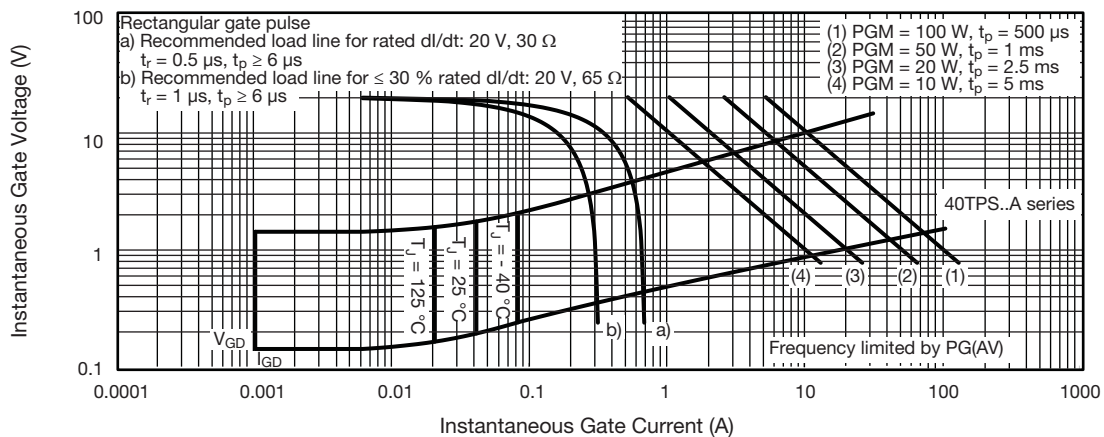


Fig. 8 - Gate Characteristics

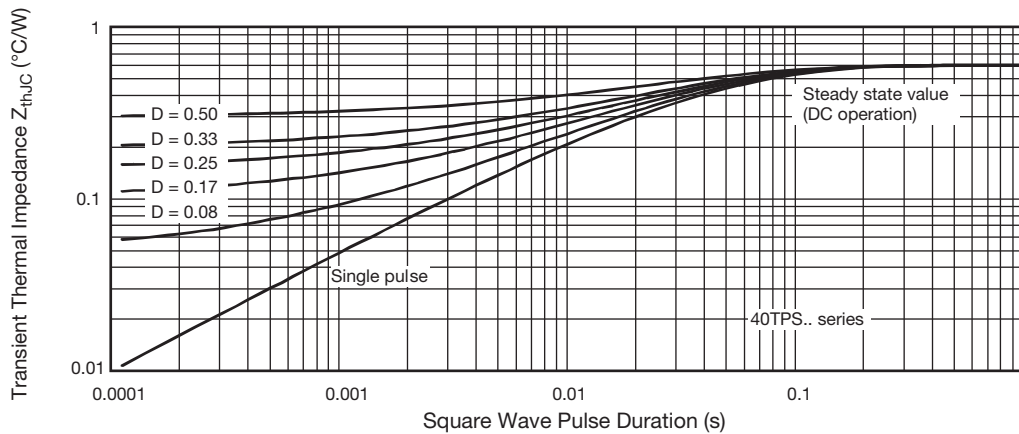


Fig. 9 - Thermal Impedance  $Z_{thJC}$  Characteristics

**ORDERING INFORMATION TABLE**

|             |            |           |          |          |          |           |          |          |          |           |
|-------------|------------|-----------|----------|----------|----------|-----------|----------|----------|----------|-----------|
| Device code | <b>VS-</b> | <b>40</b> | <b>T</b> | <b>P</b> | <b>S</b> | <b>12</b> | <b>A</b> | <b>L</b> | <b>H</b> | <b>M3</b> |
|             | ①          | ②         | ③        | ④        | ⑤        | ⑥         | ⑦        | ⑧        | ⑨        | ⑩         |

- 1** - Vishay Semiconductors product
- 2** - Current rating (40 = 40 A)
- 3** - Circuit configuration:  
T = thyristor
- 4** - Package:  
P = TO-247
- 5** - Type of silicon:  
S = standard recovery rectifier
- 6** - Voltage ratings ————— 12 = 1200 V
- 7** -
  - A = Low Igt selection 40 mA maximum
  - None = standard Igt selection
- 8** - L = long leads
- 9** - H = AEC-Q101 qualified
- 10** - Environmental digit:  
M3 = halogen-free, RoHS-compliant, and terminations lead (Pb)-free

| <b>ORDERING INFORMATION (Example)</b> |                   |                        |                          |
|---------------------------------------|-------------------|------------------------|--------------------------|
| PREFERRED P/N                         | QUANTITY PER TUBE | MINIMUM ORDER QUANTITY | PACKAGING DESCRIPTION    |
| VS-40TPS12ALHM3                       | 25                | 500                    | Antistatic plastic tubes |

| <b>LINKS TO RELATED DOCUMENTS</b> |  |
|-----------------------------------|--|
| 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 | SYMBOL | MILLIMETERS |       | INCHES    |       | NOTES |
|--------|-------------|-------|--------|-------|-------|--------|-------------|-------|-----------|-------|-------|
|        | MIN.        | MAX.  | MIN.   | MAX.  |       |        | MIN.        | MAX.  | MIN.      | MAX.  |       |
| A      | 4.65        | 5.31  | 0.183  | 0.209 |       | D2     | 0.51        | 1.30  | 0.020     | 0.051 |       |
| A1     | 2.21        | 2.59  | 0.087  | 0.102 |       | E      | 15.29       | 15.87 | 0.602     | 0.625 | 3     |
| A2     | 1.50        | 2.49  | 0.059  | 0.098 |       | E1     | 13.46       | -     | 0.53      | -     |       |
| b      | 0.99        | 1.40  | 0.039  | 0.055 |       | e      | 5.46 BSC    |       | 0.215 BSC |       |       |
| b1     | 0.99        | 1.35  | 0.039  | 0.053 |       | Ø K    | 2.54        |       | 0.010     |       |       |
| b2     | 1.65        | 2.39  | 0.065  | 0.094 |       | L      | 19.81       | 20.32 | 0.780     | 0.800 |       |
| b3     | 1.65        | 2.34  | 0.065  | 0.092 |       | L1     | 3.71        | 4.29  | 0.146     | 0.169 |       |
| b4     | 2.59        | 3.43  | 0.102  | 0.135 |       | Ø P    | 3.56        | 3.66  | 0.14      | 0.144 |       |
| b5     | 2.59        | 3.38  | 0.102  | 0.133 |       | Ø P1   | -           | 6.98  | -         | 0.275 |       |
| c      | 0.38        | 0.89  | 0.015  | 0.035 |       | Q      | 5.31        | 5.69  | 0.209     | 0.224 |       |
| c1     | 0.38        | 0.84  | 0.015  | 0.033 |       | R      | 4.52        | 5.49  | 0.178     | 0.216 |       |
| D      | 19.71       | 20.70 | 0.776  | 0.815 | 3     | S      | 5.51 BSC    |       | 0.217 BSC |       |       |
| D1     | 13.08       | -     | 0.515  | -     | 4     |        |             |       |           |       |       |

**Notes**

- (1) Dimensioning and tolerancing per ASME Y14.5M-1994
- (2) Contour of slot optional
- (3) Dimension D and E do not include mold flash. These dimensions are measured at the outermost extremes of the plastic body
- (4) Thermal pad contour optional with dimensions D1 and E1
- (5) Lead finish uncontrolled in L1
- (6) Ø 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")
- (7) Outline conforms to JEDEC® outline TO-247 with exception of dimension A min., D, E min., Q min., S, and note 4



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