# AAP Gen 7 (TO-240AA) Power Modules
# Thyristor/Thyristor, 95 A

ADD-A-PAK

## FEATURES

- High voltage
- Industrial standard package
- Low thermal resistance
- UL approved file E78996
- Designed and qualified for industrial level
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912

RoHS COMPLIANT

## BENEFITS

- Excellent thermal performances obtained by the usage of exposed direct bonded copper substrate
- Up to 1600 V
- High surge capability
- Easy mounting on heatsink

| PRIMARY CHARACTERISTICS | |
|---|---|
| $I_{T(AV)}$ | 95 A |
| Type | Modules - thyristor, standard |
| Package | AAP Gen 7 (TO-240AA) |

## MECHANICAL DESCRIPTION

The AAP Gen 7 (TO-240AA), new generation of AAP module, combines the excellent thermal performances obtained by the usage of exposed direct bonded copper substrate, with advanced compact simple package solution and simplified internal structure with minimized number of interfaces.

## ELECTRICAL DESCRIPTION

These modules are intended for general purpose high voltage applications such as high voltage regulated power supplies, lighting circuits, temperature and motor speed control circuits, UPS and battery charger.

| MAJOR RATINGS AND CHARACTERISTICS | | | |
|---|---|---|---|
| SYMBOL | CHARACTERISTICS | VALUES | UNITS |
| $I_{T(AV)}$ | 85 °C | 95 | A |
| $I_{T(RMS)}$ | | 150 | |
| $I_{TSM}$ | 50 Hz | 2000 | |
| | 60 Hz | 2094 | |
| $I^2t$ | 50 Hz | 20 | $kA^2s$ |
| | 60 Hz | 18.26 | |
| $I^2\sqrt{t}$ | | 200 | $kA^2\sqrt{s}$ |
| $V_{RRM}$ | Range | 400 to 1600 | V |
| $T_{Stg}$ | | -40 to +125 | °C |
| $T_J$ | | -40 to +125 | °C |

## ELECTRICAL SPECIFICATIONS

### VOLTAGE RATINGS

| TYPE NUMBER | VOLTAGE CODE | $V_{RRM}$, MAXIMUM REPETITIVE PEAK REVERSE VOLTAGE V | $V_{RSM}$, MAXIMUM NON-REPETITIVE PEAK REVERSE VOLTAGE V | $V_{DRM}$, MAXIMUM REPETITIVE PEAK OFF-STATE VOLTAGE, GATE OPEN CIRCUIT V | $I_{RRM}$, $I_{DRM}$ AT 125 °C mA |
|---|---|---|---|---|---|
| VS-VSK.91 | 04 | 400 | 500 | 400 | 15 |
| | 08 | 800 | 900 | 800 | |
| | 12 | 1200 | 1300 | 1200 | |
| | 16 | 1600 | 1700 | 1600 | |

### ON-STATE CONDUCTION

| PARAMETER | SYMBOL | TEST CONDITIONS | | | VALUES | UNITS |
|---|---|---|---|---|---|---|
| Maximum average on-state current | $I_{T(AV)}$ | 180° conduction, half sine wave, $T_C$ = 85 °C | | | 95 | A |
| Maximum continuous RMS on-state current | $I_{T(RMS)}$ | DC | | | 150 | |
| | | $T_C$ | | | 78 | °C |
| Maximum peak, one-cycle non-repetitive on-state current | $I_{TSM}$ | t = 10 ms | No voltage reapplied | Sinusoidal half wave, initial $T_J = T_J$ maximum | 2000 | A |
| | | t = 8.3 ms | | | 2094 | |
| | | t = 10 ms | 100 % $V_{RRM}$ reapplied | | 1682 | |
| | | t = 8.3 ms | | | 1760 | |
| Maximum $I^2t$ for fusing | $I^2t$ | t = 10 ms | No voltage reapplied | Initial $T_J = T_J$ maximum | 20 | $kA^2s$ |
| | | t = 8.3 ms | | | 18.26 | |
| | | t = 10 ms | 100 % $V_{RRM}$ reapplied | | 14.14 | |
| | | t = 8.3 ms | | | 12.91 | |
| Maximum $I^2\sqrt{t}$ for fusing | $I^2\sqrt{t}$ (1) | t = 0.1 ms to 10 ms, no voltage reapplied $T_J = T_J$ maximum | | | 200 | $kA^2\sqrt{s}$ |
| Maximum value of threshold voltage | $V_{T(TO)}$ (2) | Low level (3) | $T_J = T_J$ maximum | | 0.97 | V |
| | | High level (4) | | | 1.1 | |
| Maximum value of on-state slope resistance | $r_t$ (2) | Low level (3) | $T_J = T_J$ maximum | | 2.76 | mΩ |
| | | High level (4) | | | 2.38 | |
| Maximum on-state voltage drop | $V_{TM}$ | $I_{TM} = \pi \times I_{T(AV)}$ | $T_J$ = 25 °C | | 1.73 | V |
| Maximum non-repetitive rate of rise of turned on current | dI/dt | $T_J$ = 25 °C, from 0.67 $V_{DRM}$, $I_{TM} = \pi \times I_{T(AV)}$, $I_g$ = 500 mA, $t_r$ < 0.5 µs, $t_p$ > 6 µs | | | 150 | A/µs |
| Maximum holding current | $I_H$ | $T_J$ = 25 °C, anode supply = 6 V, resistive load, gate open circuit | | | 250 | mA |
| Maximum latching current | $I_L$ | $T_J$ = 25 °C, anode supply = 6 V, resistive load | | | 400 | |

**Notes**

(1) $I^2t$ for time $t_x = I^2\sqrt{t} \times \sqrt{t_x}$

(2) Average power = $V_{T(TO)} \times I_{T(AV)} + r_t \times (I_{T(RMS)})^2$

(3) 16.7 % $\times \pi \times I_{AV} < I < \pi \times I_{AV}$

(4) $I > \pi \times I_{AV}$

| TRIGGERING | | | | | |
|---|---|---|---|---|---|
| **PARAMETER** | **SYMBOL** | **TEST CONDITIONS** | | **VALUES** | **UNITS** |
| Maximum peak gate power | $P_{GM}$ | | | 12 | W |
| Maximum average gate power | $P_{G(AV)}$ | | | 3.0 | |
| Maximum peak gate current | $I_{GM}$ | | | 3.0 | A |
| Maximum peak negative gate voltage | $-V_{GM}$ | | | 10 | V |
| Maximum gate voltage required to trigger | $V_{GT}$ | $T_J$ = - 40 °C | Anode supply = 6 V resistive load | 4.0 | |
| | | $T_J$ = 25 °C | | 2.5 | |
| | | $T_J$ = 125 °C | | 1.7 | |
| Maximum gate current required to trigger | $I_{GT}$ | $T_J$ = - 40 °C | Anode supply = 6 V resistive load | 270 | mA |
| | | $T_J$ = 25 °C | | 150 | |
| | | $T_J$ = 125 °C | | 80 | |
| Maximum gate voltage that will not trigger | $V_{GD}$ | $T_J$ = 125 °C, rated $V_{DRM}$ applied | | 0.25 | V |
| Maximum gate current that will not trigger | $I_{GD}$ | $T_J$ = 125 °C, rated $V_{DRM}$ applied | | 6 | mA |

| BLOCKING | | | | |
|---|---|---|---|---|
| **PARAMETER** | **SYMBOL** | **TEST CONDITIONS** | **VALUES** | **UNITS** |
| Maximum peak reverse and off-state leakage current at $V_{RRM}$, $V_{DRM}$ | $I_{RRM}$, $I_{DRM}$ | $T_J$ = 125 °C, gate open circuit | 15 | mA |
| Maximum RMS insulation voltage | $V_{INS}$ | 50 Hz | 3000 (1 min)<br>3600 (1 s) | V |
| Maximum critical rate of rise of off-state voltage | dV/dt | $T_J$ = 125 °C, linear to 0.67 $V_{DRM}$ | 1000 | V/µs |

| THERMAL AND MECHANICAL SPECIFICATIONS | | | | | |
|---|---|---|---|---|---|
| **PARAMETER** | | **SYMBOL** | **TEST CONDITIONS** | **VALUES** | **UNITS** |
| Junction operating and storage temperature range | | $T_J$, $T_{Stg}$ | | -40 to +125 | °C |
| Maximum internal thermal resistance, junction to case per leg | | $R_{thJC}$ | DC operation | 0.22 | °C/W |
| Typical thermal resistance, case to heatsink per module | | $R_{thCS}$ | Mounting surface flat, smooth and greased | 0.1 | |
| Mounting torque ± 10 % | to heatsink | | A mounting compound is recommended and the torque should be rechecked after a period of 3 hours to allow for the spread of the compound. | 4 | Nm |
| | busbar | | | 3 | |
| Approximate weight | | | | 75 | g |
| | | | | 2.7 | oz. |
| Case style | | | JEDEC® | AAP Gen 7 (TO-240AA) | |

| ΔR CONDUCTION PER JUNCTION | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **DEVICES** | **SINE HALF WAVE CONDUCTION** | | | | | **RECTANGULAR WAVE CONDUCTION** | | | | | **UNITS** |
| | **180°** | **120°** | **90°** | **60°** | **30°** | **180°** | **120°** | **90°** | **60°** | **30°** | |
| VSK.91.. | 0.04 | 0.048 | 0.063 | 0.085 | 0.125 | 0.033 | 0.052 | 0.067 | 0.088 | 0.127 | °C/W |

**Note**

- Table shows the increment of thermal resistance $R_{thJC}$ when devices operate at different conduction angles than DC

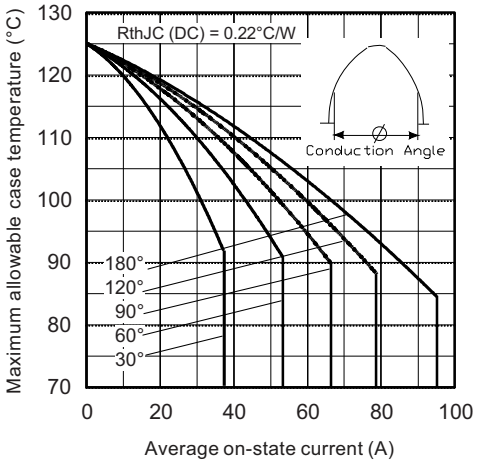



Fig. 1 - Current Ratings Characteristics

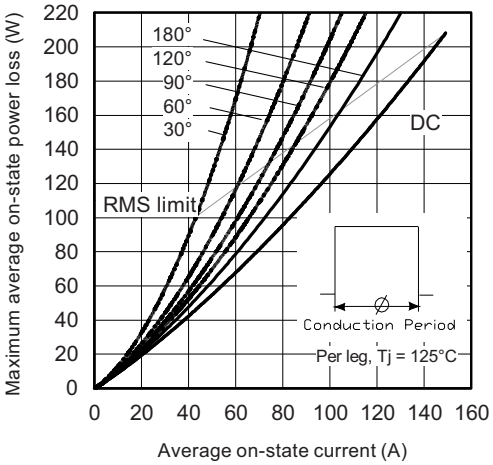



Fig. 4 - On-State Power Loss Characteristics

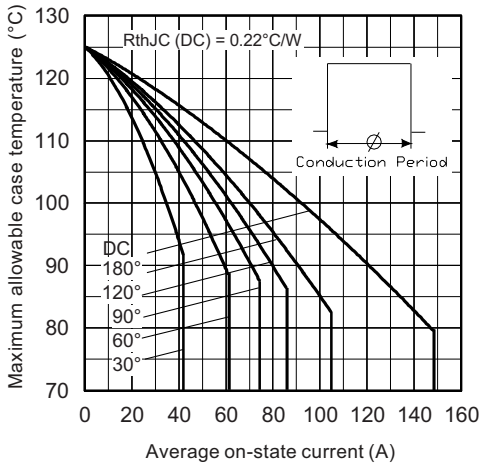



Fig. 2 - Current Ratings Characteristics

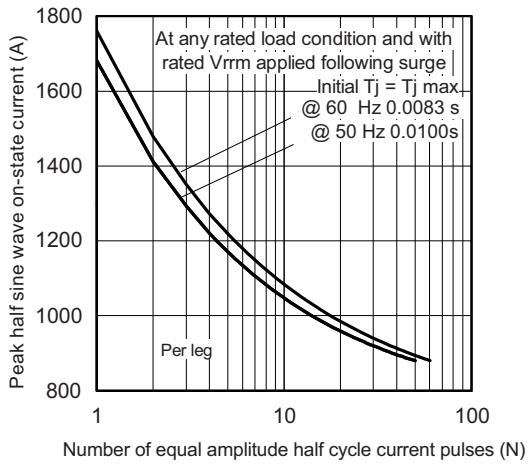



Fig. 5 - Maximum Non-Repetitive Surge Current

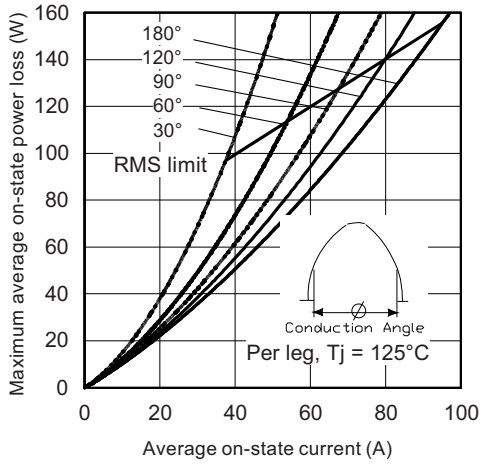



Fig. 3 - On-State Power Loss Characteristics

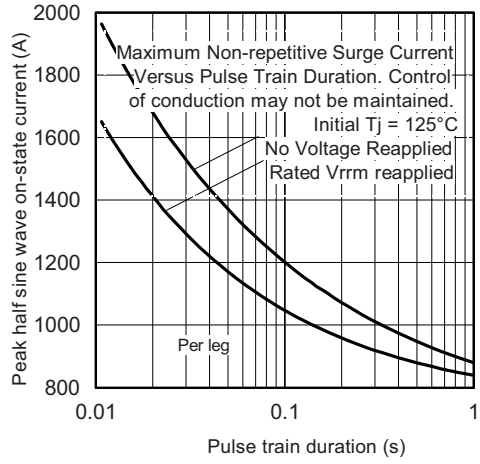



Fig. 6 - Maximum Non-Repetitive Surge Current

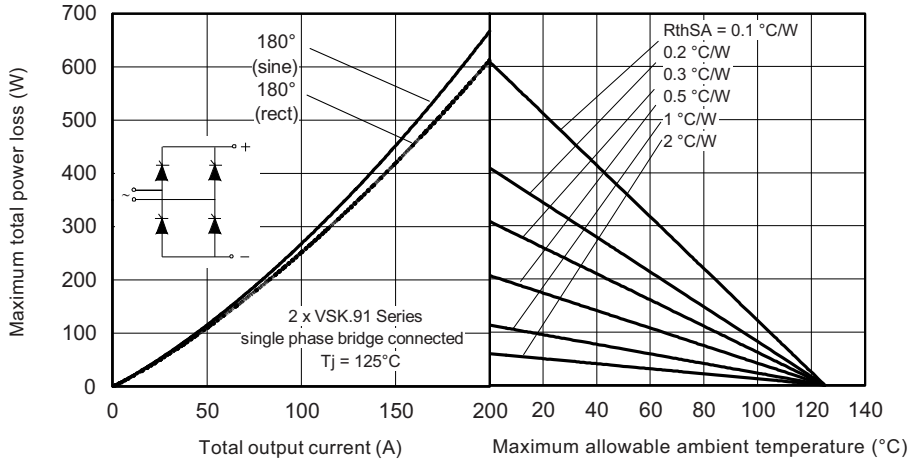



Fig. 7 - On-State Power Loss Characteristics

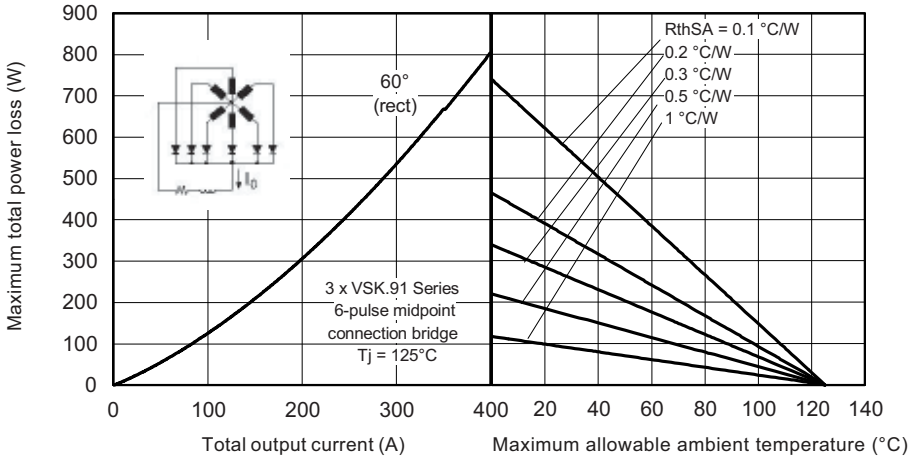



Fig. 8 - On-State Power Loss Characteristics

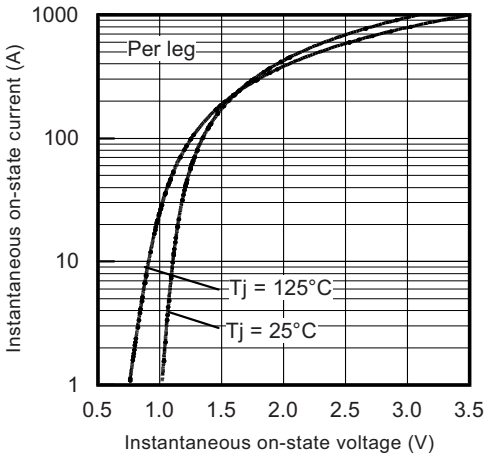



Fig. 9 - On-State Voltage Characteristics

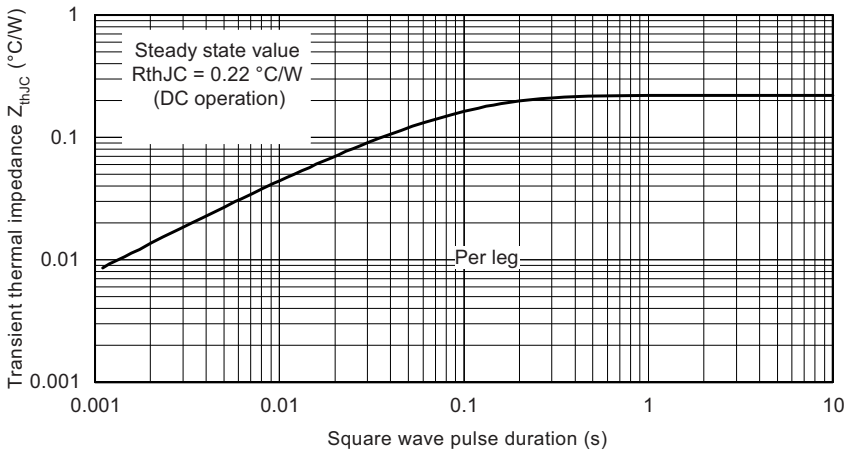



Fig. 10 - Thermal Impedance $Z_{thJC}$ Characteristics

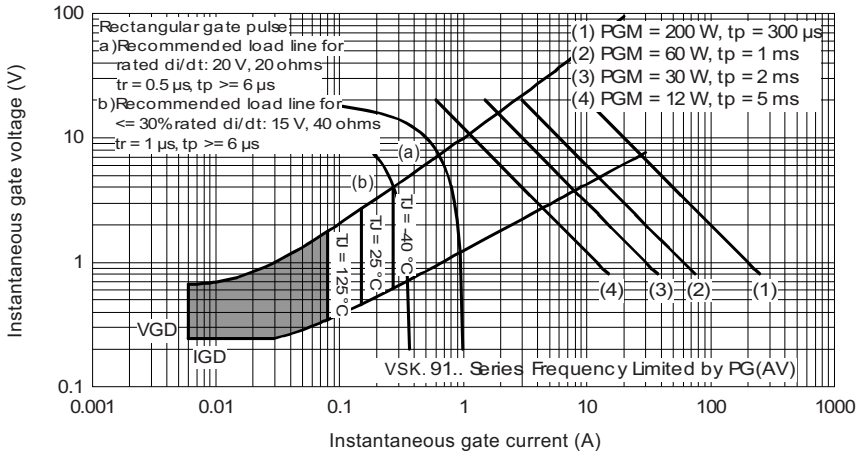



Fig. 11 - Gate Characteristics

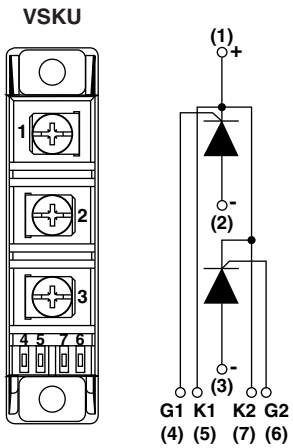
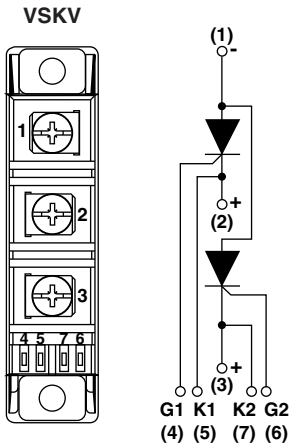
## ORDERING INFORMATION TABLE

| Device code | VS-VS | K | U | 91 | / | 16 |
|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | | 5 |

| | | |
|---|---|---|
| 1 | - | Vishay Semiconductors product |
| 2 | - | Module type |
| 3 | - | Circuit configuration (see Circuit Configuration table) |
| 4 | - | Current code (95 A) |
| 5 | - | Voltage code (see Voltage Ratings table) |

**Note**

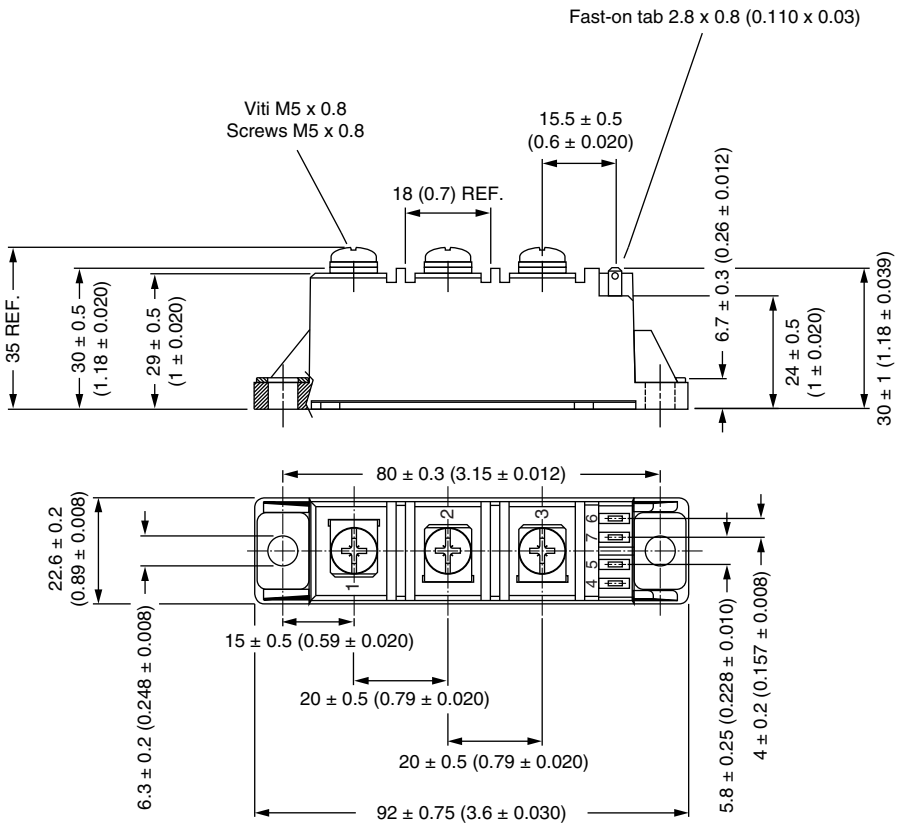
- To order the optional hardware go to www.vishay.com/doc?95172

| CIRCUIT CONFIGURATION | | |
|---|---|---|
| **CIRCUIT DESCRIPTION** | **CIRCUIT CONFIGURATION CODE** | **CIRCUIT DRAWING** |
| Two SCRs common cathodes | U |   |
| Two SCRs common anodes | V |   |

| LINKS TO RELATED DOCUMENTS | |
|---|---|
| Dimensions | www.vishay.com/doc?95368 |

# ADD-A-PAK Generation VII - Thyristor

**DIMENSIONS** in millimeters (inches)



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