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



ADD-A-PAK

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

## 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

## 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 |
| $I_{T(AV)}$ or $I_{F(AV)}$ | 85 °C | 95 | A |
| $I_{O(RMS)}$ | As AC switch | 210 | |
| $I_{TSM}$, $I_{FSM}$ | 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 |

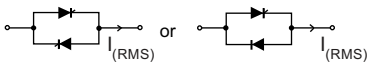

For technical questions within your region: DiodesAmericas@vishay.com, DiodesAsia@vishay.com, DiodesEurope@vishay.com
THIS DOCUMENT IS SUBJECT TO CHANGE WITHOUT NOTICE. THE PRODUCTS DESCRIBED HEREIN AND THIS DOCUMENT ARE SUBJECT TO SPECIFIC DISCLAIMERS, SET FORTH AT www.vishay.com/doc?91000

## 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 |
| | 06 | 600 | 700 | 600 | |
| | 08 | 800 | 900 | 800 | |
| | 10 | 1000 | 1100 | 1000 | |
| | 12 | 1200 | 1300 | 1200 | |
| | 14 | 1400 | 1500 | 1400 | |
| | 16 | 1600 | 1700 | 1600 | |

### ON-STATE CONDUCTION

| PARAMETER | SYMBOL | TEST CONDITIONS | | | VALUES | UNITS |
|---|---|---|---|---|---|---|
| Maximum average on-state current (thyristors) | $I_{T(AV)}$ | 180° conduction, half sine wave, $T_C$ = 85 °C | | | 95 | A |
| Maximum average forward current (diodes) | $I_{F(AV)}$ | | | | | |
| Maximum continuous RMS on-state current, as AC switch | $I_{O(RMS)}$ |  | | | 210 | |
| Maximum peak, one-cycle non-repetitive on-state or forward current | $I_{TSM}$ or $I_{FSM}$ | t = 10 ms | No voltage reapplied | Sinusoidal half wave, initial $T_J = T_J$ maximum | 2000 | |
| | | 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 or 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 peak on-state or forward voltage | $V_{TM}$ | $I_{TM} = \pi \times I_{T(AV)}$ | $T_J$ = 25 °C | | 1.73 | V |
| | $V_{FM}$ | $I_{FM} = \pi \times I_{F(AV)}$ | | | | |
| 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 % x π x $I_{AV} < I < \pi \times I_{AV}$

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


For technical questions within your region: DiodesAmericas@vishay.com, DiodesAsia@vishay.com, DiodesEurope@vishay.com
THIS DOCUMENT IS SUBJECT TO CHANGE WITHOUT NOTICE. THE PRODUCTS DESCRIBED HEREIN AND THIS DOCUMENT ARE SUBJECT TO SPECIFIC DISCLAIMERS, SET FORTH AT www.vishay.com/doc?91000

| 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


For technical questions within your region: DiodesAmericas@vishay.com, DiodesAsia@vishay.com, DiodesEurope@vishay.com
THIS DOCUMENT IS SUBJECT TO CHANGE WITHOUT NOTICE. THE PRODUCTS DESCRIBED HEREIN AND THIS DOCUMENT ARE SUBJECT TO SPECIFIC DISCLAIMERS, SET FORTH AT www.vishay.com/doc?91000

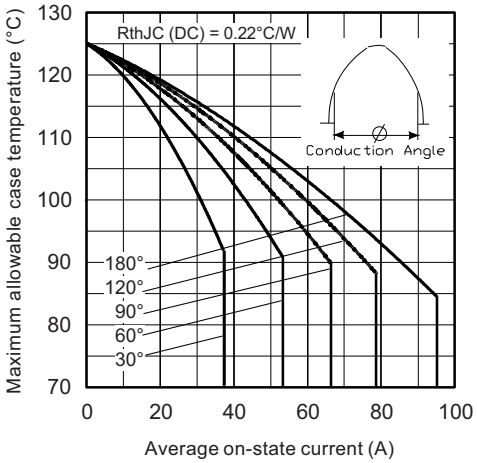



Fig. 1 - Current Ratings Characteristics

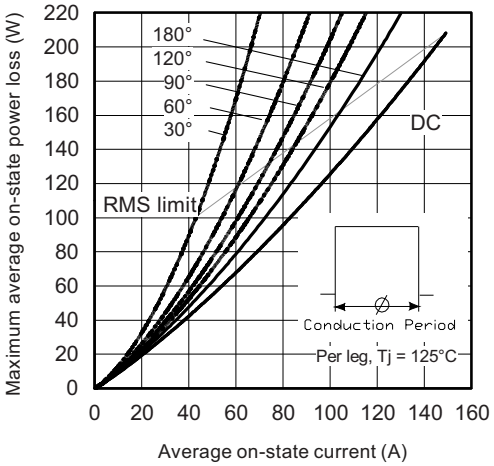



Fig. 4 - On-State Power Loss Characteristics

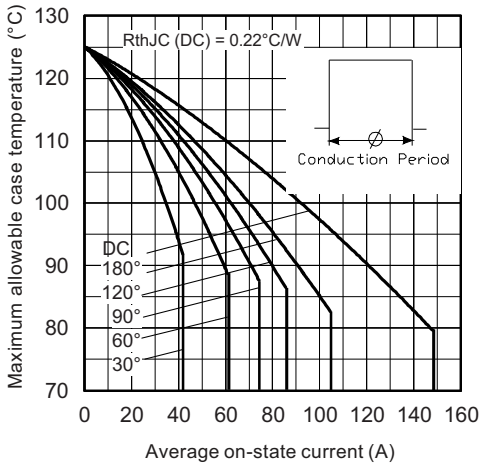



Fig. 2 - Current Ratings Characteristics

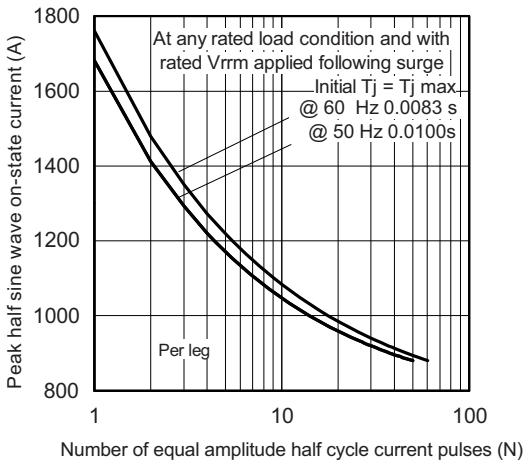



Fig. 5 - Maximum Non-Repetitive Surge Current

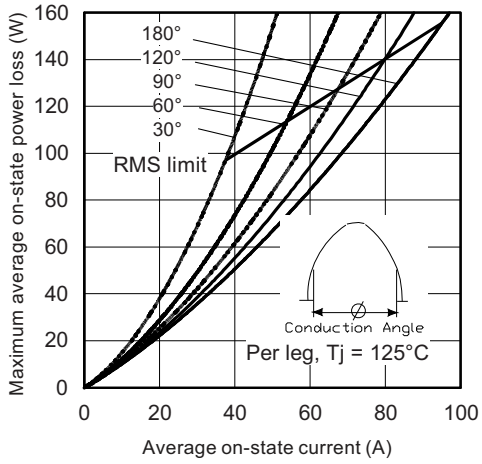



Fig. 3 - On-State Power Loss Characteristics

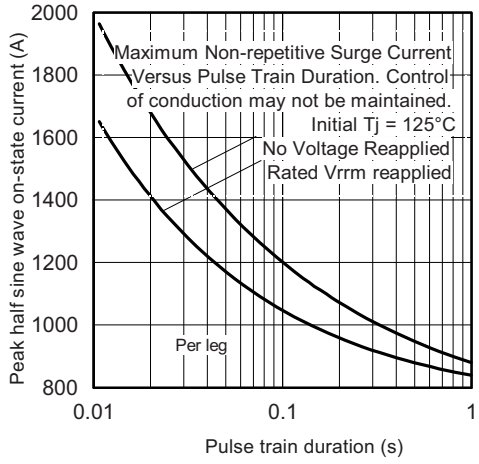



Fig. 6 - Maximum Non-Repetitive Surge Current


For technical questions within your region: DiodesAmericas@vishay.com, DiodesAsia@vishay.com, DiodesEurope@vishay.com
THIS DOCUMENT IS SUBJECT TO CHANGE WITHOUT NOTICE. THE PRODUCTS DESCRIBED HEREIN AND THIS DOCUMENT ARE SUBJECT TO SPECIFIC DISCLAIMERS, SET FORTH AT www.vishay.com/doc?91000

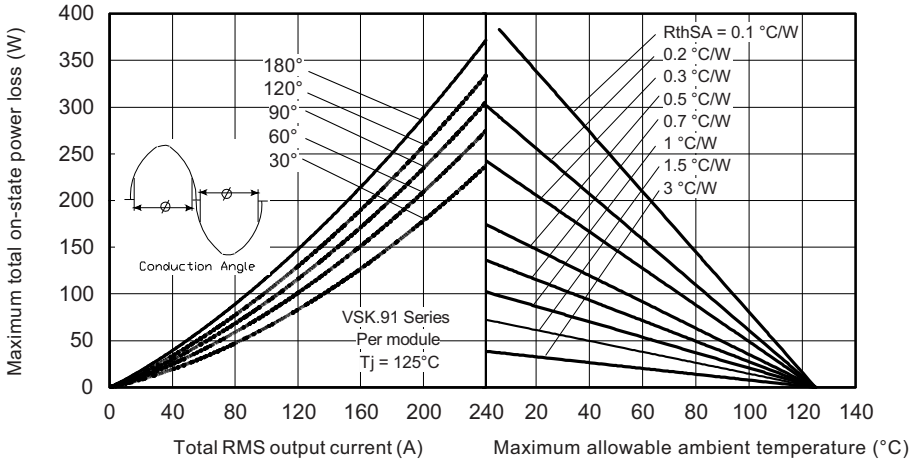



Fig. 7 - On-State Power Loss Characteristics

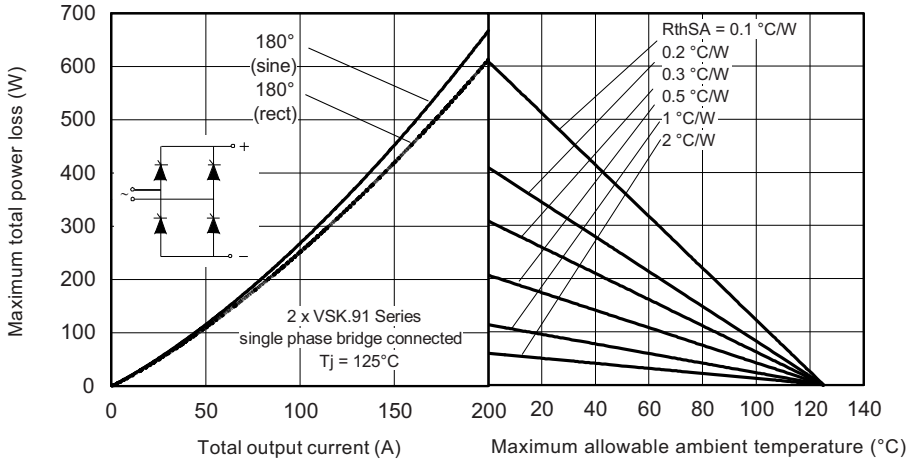



Fig. 8 - On-State Power Loss Characteristics

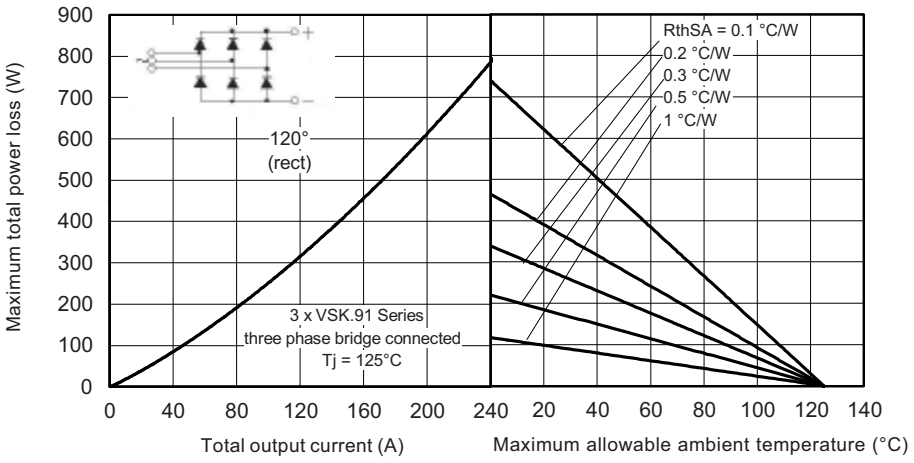



Fig. 9 - On-State Power Loss Characteristics


For technical questions within your region: DiodesAmericas@vishay.com, DiodesAsia@vishay.com, DiodesEurope@vishay.com
THIS DOCUMENT IS SUBJECT TO CHANGE WITHOUT NOTICE. THE PRODUCTS DESCRIBED HEREIN AND THIS DOCUMENT ARE SUBJECT TO SPECIFIC DISCLAIMERS, SET FORTH AT www.vishay.com/doc?91000

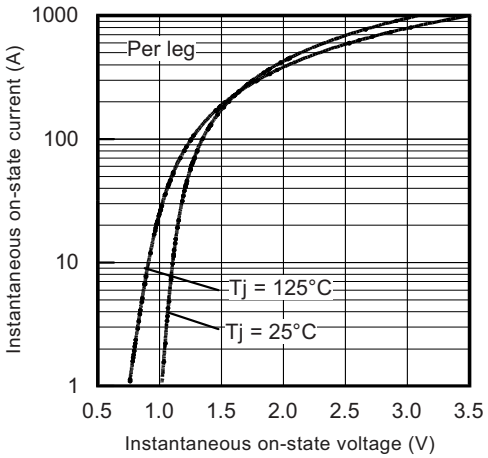



Fig. 10 - On-State Voltage Drop Characteristics

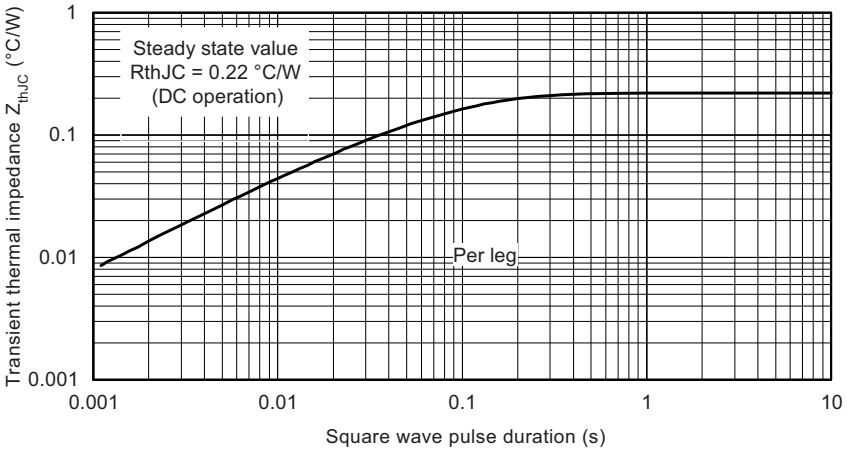



Fig. 11 - Thermal Impedance $Z_{thJC}$ Characteristics

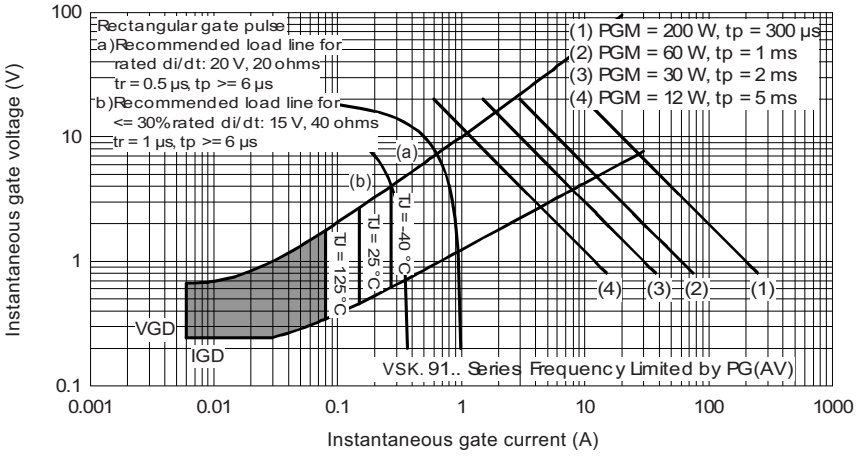



Fig. 12 - Gate Characteristics


For technical questions within your region: DiodesAmericas@vishay.com, DiodesAsia@vishay.com, DiodesEurope@vishay.com
THIS DOCUMENT IS SUBJECT TO CHANGE WITHOUT NOTICE. THE PRODUCTS DESCRIBED HEREIN AND THIS DOCUMENT ARE SUBJECT TO SPECIFIC DISCLAIMERS, SET FORTH AT www.vishay.com/doc?91000

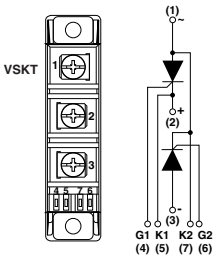
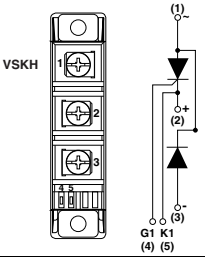
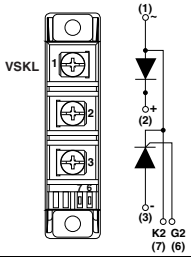
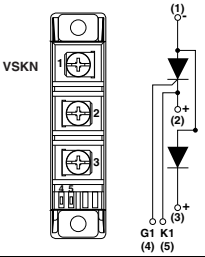
## ORDERING INFORMATION TABLE

| Device code | VS-VS | K | T | 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

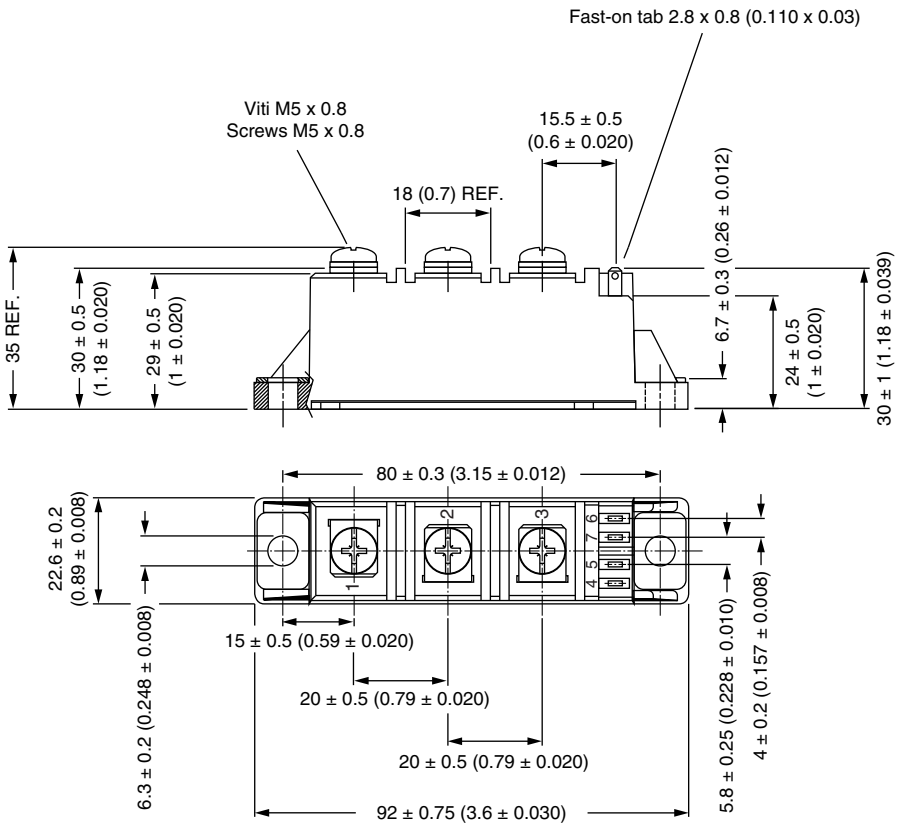
| CIRCUIT DESCRIPTION | CIRCUIT CONFIGURATION CODE | CIRCUIT DRAWING |
|---|---|---|
| Two SCRs doubler circuit | T |   |
| SCR/diode doubler circuit, positive control | H |   |
| SCR/diode doubler circuit, negative control | L |   |
| SCR/diode common anodes | N |   |

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


For technical questions within your region: DiodesAmericas@vishay.com, DiodesAsia@vishay.com, DiodesEurope@vishay.com
THIS DOCUMENT IS SUBJECT TO CHANGE WITHOUT NOTICE. THE PRODUCTS DESCRIBED HEREIN AND THIS DOCUMENT ARE SUBJECT TO SPECIFIC DISCLAIMERS, SET FORTH AT www.vishay.com/doc?91000

# ADD-A-PAK Generation VII - Thyristor

**DIMENSIONS** in millimeters (inches)



# 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.

*© 2024 VISHAY INTERTECHNOLOGY, INC. ALL RIGHTS RESERVED*