



# Phase Control Thyristors (Hockey PUK Version), 990 A



B-PUK (TO-200AC)

### FEATURES

- Center amplifying gate
- Metal case with ceramic insulator
- International standard case B-PUK (TO-200AC)
- Designed and qualified for industrial level
- Material categorization: for definitions of compliance please see [www.vishay.com/doc?99912](http://www.vishay.com/doc?99912)



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COMPLIANT

### TYPICAL APPLICATIONS

- DC motor controls
- Controlled DC power supplies
- AC controllers

| PRIMARY CHARACTERISTICS |   |
|-------------------------|---|
| $I_{T(AV)}$             | 990 A   |
| $V_{DRM}/V_{RRM}$       | 800 V, 1200 V, 1400 V, 1600 V, 1800 V, 2000 V |
| $V_{TM}$                | 1.62 V  |
| $I_{GT}$                | 100 mA  |
| $T_J$                   | -40 °C to +125 °C                             |
| Package                 | B-PUK (TO-200AC)                              |
| Circuit configuration   | Single SCR                                    |

| MAJOR RATINGS AND CHARACTERISTICS |                 |             |                   |
|-----------------------------------|-----------------|-------------|-------------------|
| PARAMETER                         | TEST CONDITIONS | VALUES      | UNITS             |
| $I_{T(AV)}$                       |                 | 990         | A                 |
|                                   | $T_{hs}$        | 55          | °C                |
| $I_{T(RMS)}$                      |                 | 2000        | A                 |
|                                   | $T_{hs}$        | 25          | °C                |
| $I_{TSM}$                         | 50 Hz           | 17 800      | A                 |
|                                   | 60 Hz           | 18 700      |                   |
| $I^2t$                            | 50 Hz           | 1591        | kA <sup>2</sup> s |
|                                   | 60 Hz           | 1452        |                   |
| $V_{DRM}/V_{RRM}$                 |                 | 800 to 2000 | V                 |
| $t_q$                             | Typical         | 150         | µs                |
| $T_J$                             |                 | -40 to 125  | °C                |

| VOLTAGE RATINGS |              |  |  |  |
|-----------------|--------------|--|--|--|
| TYPE NUMBER     | VOLTAGE CODE | $V_{DRM}/V_{RRM}$ , MAXIMUM REPETITIVE PEAK AND OFF-STATE VOLTAGE<br>V | $V_{RSM}$ , MAXIMUM NON-REPETITIVE PEAK VOLTAGE<br>V | $I_{DRM}/I_{RRM}$ MAXIMUM AT $T_J = T_J$ MAXIMUM<br>mA |
| VS-ST730CL      | 08           | 800  | 900  | 80   |
|                 | 12           | 1200   | 1300   |  |
|                 | 14           | 1400   | 1500   |  |
|                 | 16           | 1600   | 1700   |  |
|                 | 18           | 1800   | 1900   |  |
|                 | 20           | 2000   | 2100   |  |



| <b>ABSOLUTE MAXIMUM RATINGS</b>                          |                |   |                           |           |                    |
|--|----------------|---|---------------------------|-----------|--------------------|
| PARAMETER  | SYMBOL         | TEST CONDITIONS   |                           | VALUES    | UNITS              |
| Maximum average on-state current at heatsink temperature | $I_{T(AV)}$    | 180° conduction, half sine wave double side (single side) cooled                        |                           | 990 (375) | A                  |
|  |                |   |                           | 55 (85)   | °C                 |
| Maximum RMS on-state current                             | $I_{T(RMS)}$   | DC at 25 °C heatsink temperature double side cooled                                     |                           | 2000      | A                  |
| Maximum peak, one-cycle non-repetitive surge current     | $I_{TSM}$      | t = 10 ms   | No voltage reapplied      | 17 800    |                    |
|  |                | t = 8.3 ms  |                           | 18 700    |                    |
|  |                | t = 10 ms   | 100 % $V_{RRM}$ reapplied | 15 000    |                    |
|  |                | t = 8.3 ms  |                           | 15 700    |                    |
| Maximum $I^2t$ for fusing                                | $I^2t$         | t = 10 ms   | No voltage reapplied      | 1591      | kA <sup>2</sup> s  |
|  |                | t = 8.3 ms  |                           | 1452      |                    |
|  |                | t = 10 ms   | 100 % $V_{RRM}$ reapplied | 1125      |                    |
|  |                | t = 8.3 ms  |                           | 1027      |                    |
| Maximum $I^2\sqrt{t}$ for fusing                         | $I^2\sqrt{t}$  | t = 0.1 to 10 ms, no voltage reapplied  |                           | 15 910    | kA <sup>2</sup> √s |
| Low level value of threshold voltage                     | $V_{T(TO)1}$   | (16.7 % $\times \pi \times I_{T(AV)} < I < \pi \times I_{T(AV)}$ , $T_J = T_J$ maximum) |                           | 0.98      | V                  |
| High level value of threshold voltage                    | $V_{T(TO)2}$   | (I $> \pi \times I_{T(AV)}$ , $T_J = T_J$ maximum)                                      |                           | 1.12      |                    |
| Low level value of on-state slope resistance             | $r_{\theta 1}$ | (16.7 % $\times \pi \times I_{T(AV)} < I < \pi \times I_{T(AV)}$ , $T_J = T_J$ maximum) |                           | 0.32      | mΩ                 |
| High level value of on-state slope resistance            | $r_{\theta 2}$ | (I $> \pi \times I_{T(AV)}$ , $T_J = T_J$ maximum)                                      |                           | 0.27      |                    |
| Maximum on-state voltage                                 | $V_{TM}$       | $I_{pk} = 2000$ A, $T_J = T_J$ maximum, $t_p = 10$ ms sine pulse                        |                           | 1.62      | V                  |
| Maximum holding current                                  | $I_H$          | $T_J = 25$ °C, anode supply 12 V resistive load   |                           | 600       | mA                 |
| Typical latching current                                 | $I_L$          |   |                           | 1000      |                    |

| <b>SWITCHING</b>   |        |  |  |        |       |
|--|--------|--|--|--------|-------|
| PARAMETER  | SYMBOL | TEST CONDITIONS  |  | VALUES | UNITS |
| Maximum non-repetitive rate of rise of turned-on current | di/dt  | Gate drive 20 V, 20 Ω, $t_r \leq 1$ μs<br>$T_J = T_J$ maximum, anode voltage $\leq 80$ % $V_{DRM}$                       |  | 1000   | A/μs  |
| Typical delay time                                       | $t_d$  | Gate current 1 A, $dI_g/dt = 1$ A/μs<br>$V_d = 0.67$ % $V_{DRM}$ , $T_J = 25$ °C   |  | 1.0    | μs    |
| Typical turn-off time                                    | $t_q$  | $I_{TM} = 750$ A, $T_J = T_J$ maximum, di/dt = 60 A/μs,<br>$V_R = 50$ V, dV/dt = 20 V/μs, gate 0 V 100 Ω, $t_p = 500$ μs |  | 150    |       |

| <b>BLOCKING</b>                                    |                          |  |  |        |       |
|--|--------------------------|--|--|--------|-------|
| PARAMETER  | SYMBOL                   | TEST CONDITIONS                                      |  | VALUES | UNITS |
| Maximum critical rate of rise of off-state voltage | dV/dt                    | $T_J = T_J$ maximum linear to 80 % rated $V_{DRM}$   |  | 500    | V/μs  |
| Maximum peak reverse and off-state leakage current | $I_{RRM}$ ,<br>$I_{DRM}$ | $T_J = T_J$ maximum, rated $V_{DRM}/V_{RRM}$ applied |  | 80     | mA    |



| TRIGGERING                          |             |  |  |      |       |    |
|-------------------------------------|-------------|--|--|------|-------|----|
| PARAMETER                           | SYMBOL      | TEST CONDITIONS                              | VALUES   |      | UNITS |    |
|                                     |             |  | Typ.   | Max. |       |    |
| Maximum peak gate power             | $P_{GM}$    | $T_J = T_J$ maximum, $t_p \leq 5$ ms         | 10.0   |      | W     |    |
| Maximum average gate power          | $P_{G(AV)}$ | $T_J = T_J$ maximum, $f = 50$ Hz, $d\% = 50$ | 2.0  |      |       |    |
| Maximum peak positive gate current  | $I_{GM}$    | $T_J = T_J$ maximum, $t_p \leq 5$ ms         | 3.0  |      | A     |    |
| Maximum peak positive gate voltage  | $+V_{GM}$   | $T_J = T_J$ maximum, $t_p \leq 5$ ms         | 20   |      | V     |    |
| Maximum peak negative gate voltage  | $-V_{GM}$   |  | 5.0  |      |       |    |
| DC gate current required to trigger | $I_{GT}$    | $T_J = -40$ °C                               | Maximum required gate trigger/ current/voltage are the lowest value which will trigger all units 12 V anode to cathode applied | 200  | -     | mA |
|                                     |             | $T_J = 25$ °C                                |  | 100  | 200   |    |
|                                     |             | $T_J = 125$ °C                               |  | 50   | -     |    |
| DC gate voltage required to trigger | $V_{GT}$    | $T_J = -40$ °C                               |  | 2.5  | -     | V  |
|                                     |             | $T_J = 25$ °C                                |  | 1.8  | 3.0   |    |
|                                     |             | $T_J = 125$ °C                               |  | 1.1  | -     |    |
| DC gate current not to trigger      | $I_{GD}$    | $T_J = T_J$ maximum                          | 10   |      | mA    |    |
| DC gate voltage not to trigger      | $V_{GD}$    |  | 0.25   |      | V     |    |

| THERMAL AND MECHANICAL SPECIFICATIONS            |              |   |                  |           |
|--|--------------|---|------------------|-----------|
| PARAMETER  | SYMBOL       | TEST CONDITIONS                               | VALUES           | UNITS     |
| Maximum operating junction temperature range     | $T_J$        |   | -40 to 125       | °C        |
| Maximum storage temperature range                | $T_{Stg}$    |   | -40 to 150       |           |
| Maximum thermal resistance, junction to heatsink | $R_{thJ-hs}$ | DC operation single side cooled               | 0.073            | K/W       |
|  |              | DC operation double side cooled               | 0.031            |           |
| Maximum thermal resistance, case to heatsink     | $R_{thC-hs}$ | DC operation single side cooled               | 0.011            |           |
|  |              | DC operation double side cooled               | 0.006            |           |
| Mounting force, $\pm 10$ %                       |              |   | 14 700<br>(1500) | N<br>(kg) |
| Approximate weight                               |              |   | 255              | g         |
| Case style                                       |              | See dimensions - link at the end of datasheet | B-PUK (TO-200AC) |           |

| $\Delta R_{thJ-hs}$ CONDUCTION |                       |             |                        |             |                     |       |
|--------------------------------|-----------------------|-------------|------------------------|-------------|---------------------|-------|
| CONDUCTION ANGLE               | SINUSOIDAL CONDUCTION |             | RECTANGULAR CONDUCTION |             | TEST CONDITIONS     | UNITS |
|                                | SINGLE SIDE           | DOUBLE SIDE | SINGLE SIDE            | DOUBLE SIDE |                     |       |
| 180°                           | 0.009                 | 0.009       | 0.006                  | 0.006       | $T_J = T_J$ maximum | K/W   |
| 120°                           | 0.011                 | 0.011       | 0.010                  | 0.011       |                     |       |
| 90°                            | 0.014                 | 0.014       | 0.015                  | 0.015       |                     |       |
| 60°                            | 0.020                 | 0.020       | 0.021                  | 0.021       |                     |       |
| 30°                            | 0.036                 | 0.036       | 0.036                  | 0.036       |                     |       |

**Note**

- The table above shows the increment of thermal resistance  $R_{thJ-hs}$  when devices operate at different conduction angles than DC

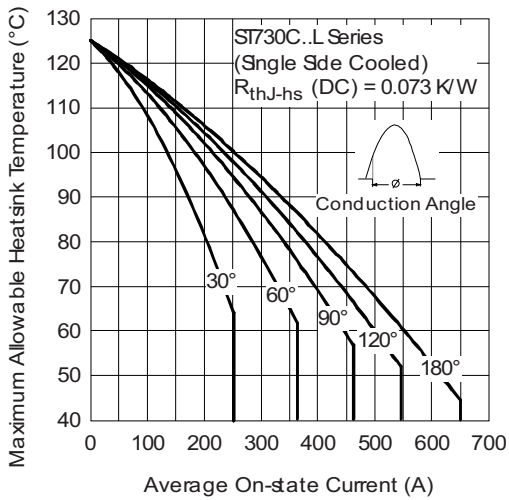


Fig. 1 - Current Ratings Characteristics

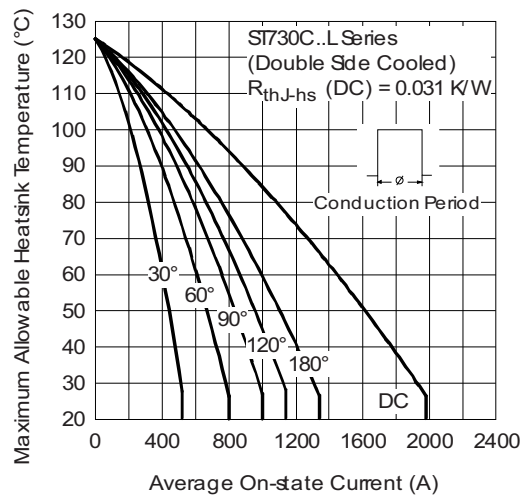


Fig. 4 - Current Ratings Characteristics

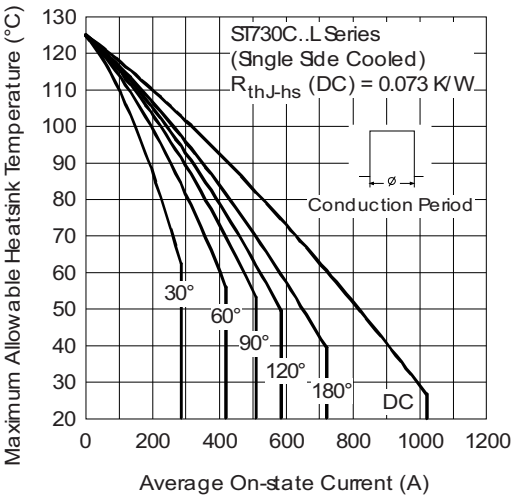


Fig. 2 - Current Ratings Characteristics

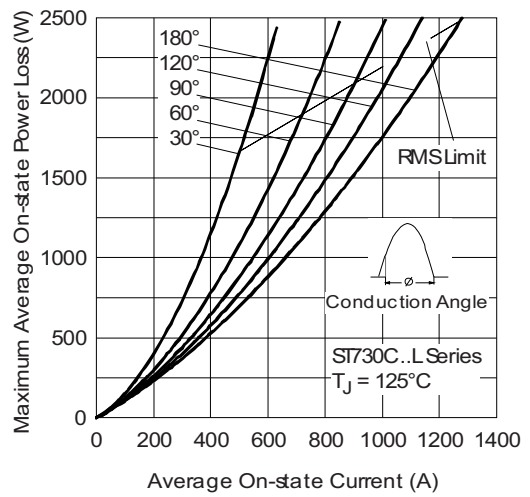


Fig. 5 - On-State Power Loss Characteristics

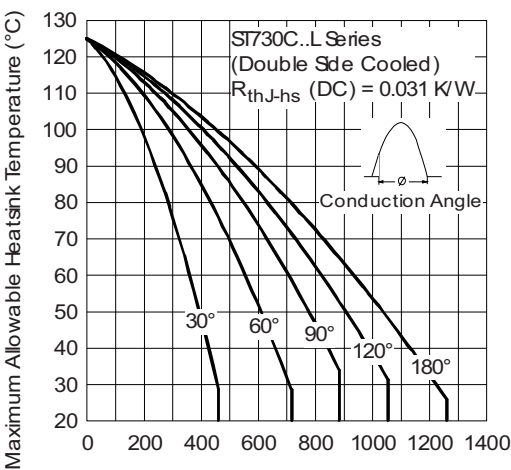


Fig. 3 - Current Ratings Characteristics

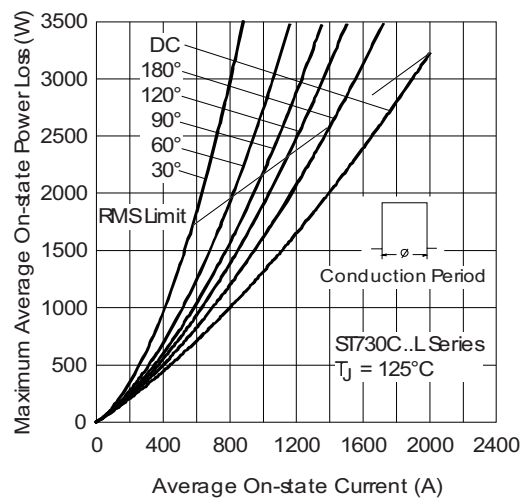


Fig. 6 - On-State Power Loss Characteristics

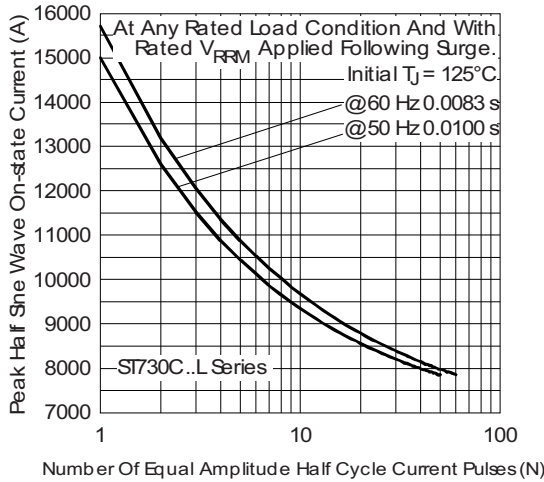


Fig. 7 - Maximum Non-Repetitive Surge Current Single and Double Side Cooled

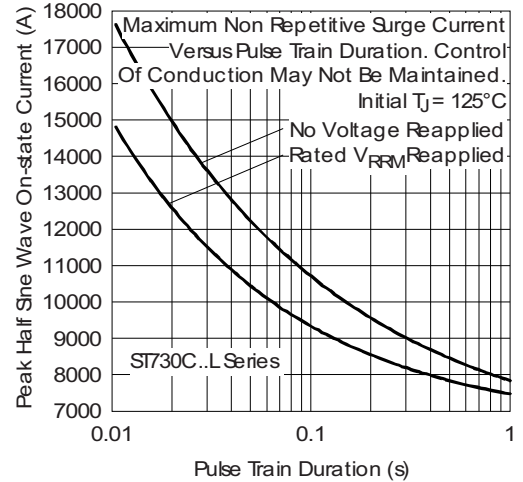


Fig. 8 - Maximum Non-Repetitive Surge Current Single and Double Side Cooled

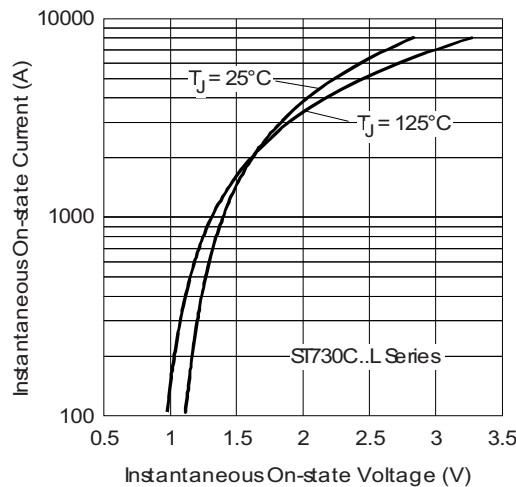


Fig. 9 - On-State Voltage Drop Characteristics

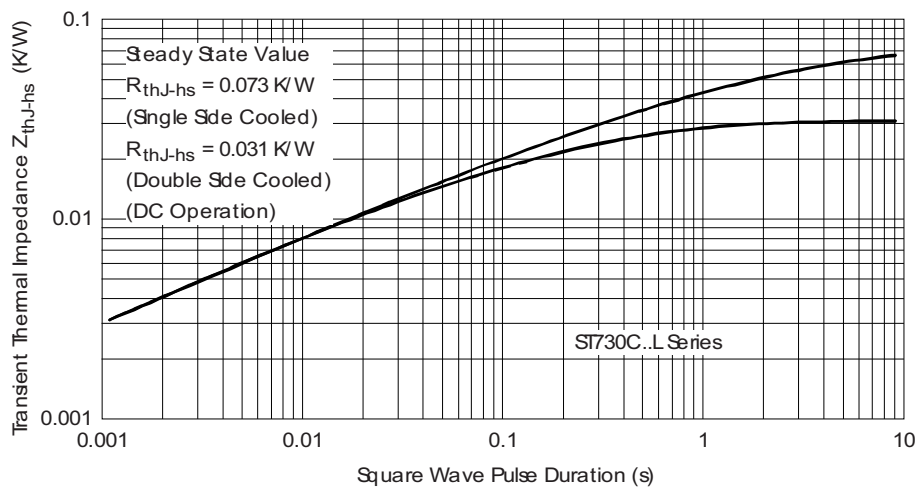


Fig. 10 - Thermal Impedance  $Z_{thj-hs}$  Characteristics

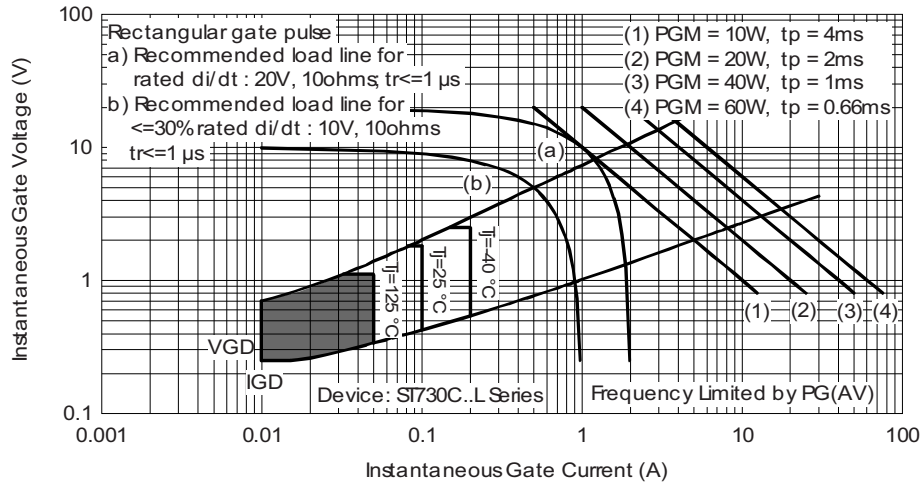


Fig. 11 - Gate Characteristics

**ORDERING INFORMATION TABLE**

|             |            |           |           |          |          |           |          |          |          |
|-------------|------------|-----------|-----------|----------|----------|-----------|----------|----------|----------|
| Device code | <b>VS-</b> | <b>ST</b> | <b>73</b> | <b>0</b> | <b>C</b> | <b>20</b> | <b>L</b> | <b>1</b> | <b>-</b> |
|             | (1)        | (2)       | (3)       | (4)      | (5)      | (6)       | (7)      | (8)      | (9)      |

- 1** - Vishay Semiconductors product
- 2** - Thyristor
- 3** - Essential part number
- 4** - 0 = converter grade
- 5** - C = ceramic PUK
- 6** - Voltage code x 100 = V<sub>RRM</sub> (see Voltage Ratings table)
- 7** - L = PUK case B-PUK (TO-200AC)
- 8** - 0 = eyelet terminals (gate and auxiliary cathode unsoldered leads)  
 1 = fast-on terminals (gate and auxiliary cathode unsoldered leads)  
 2 = eyelet terminals (gate and auxiliary cathode soldered leads)  
 3 = fast-on terminals (gate and auxiliary cathode soldered leads)
- 9** - Critical dV/dt: • None = 500 V/μs (standard selection)  
 • L = 1000 V/μs (special selection)

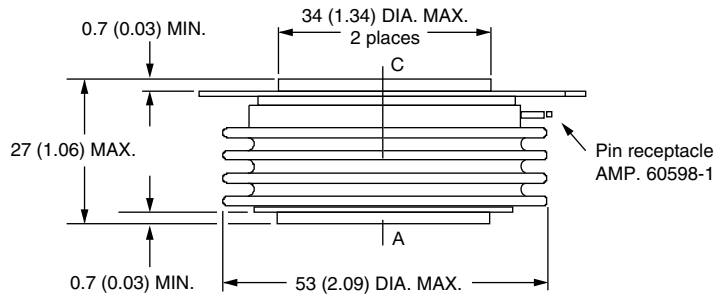
| LINKS TO RELATED DOCUMENTS |  |
|----------------------------|--|
| Dimensions                 | <a href="http://www.vishay.com/doc?95076">www.vishay.com/doc?95076</a> |



## B-PUK (TO-200AC)

**DIMENSIONS** in millimeters (inches)

Creepage distance: 36.33 (1.430) minimum  
Strike distance: 17.43 (0.686) minimum



**Note:**  
A = Anode  
C = Cathode



Quote between upper and lower pole pieces has to be considered after application of mounting force (see thermal and mechanical specification)



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