

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



TO-200AC (B-PUK)

### FEATURES

- Center amplifying gate
- Metal case with ceramic insulator
- International standard case TO-200AC (B-PUK)
- 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)


**RoHS**  
COMPLIANT

### TYPICAL APPLICATIONS

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

### PRODUCT SUMMARY

|                   |                                               |
|-------------------|-----------------------------------------------|
| Package           | TO-200AC (B-PUK)                              |
| Diode variation   | Single SCR                                    |
| $I_{T(AV)}$       | 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                              |

### 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                                                 |                                                        |

**ABSOLUTE MAXIMUM RATINGS**

| PARAMETER                                                | SYMBOL              | TEST CONDITIONS                                                                                          |                                  |                                                                       | VALUES    | UNITS              |
|----------------------------------------------------------|---------------------|----------------------------------------------------------------------------------------------------------|----------------------------------|-----------------------------------------------------------------------|-----------|--------------------|
| Maximum average on-state current at heatsink temperature | I <sub>T(AV)</sub>  | 180° conduction, half sine wave double side (single side) cooled                                         |                                  |                                                                       | 990 (375) | A                  |
|                                                          |                     |                                                                                                          |                                  |                                                                       | 55 (85)   | °C                 |
| Maximum RMS on-state current                             | I <sub>T(RMS)</sub> | DC at 25 °C heatsink temperature double side cooled                                                      |                                  |                                                                       | 2000      |                    |
| Maximum peak, one-cycle non-repetitive surge current     | I <sub>TSM</sub>    | t = 10 ms                                                                                                | No voltage reapplied             | Sinusoidal half wave, initial T <sub>J</sub> = T <sub>J</sub> maximum | 17 800    | A                  |
|                                                          |                     | t = 8.3 ms                                                                                               |                                  |                                                                       | 18 700    |                    |
|                                                          |                     | t = 10 ms                                                                                                | 100 % V <sub>RRM</sub> reapplied |                                                                       | 15 000    |                    |
|                                                          |                     | t = 8.3 ms                                                                                               |                                  |                                                                       | 15 700    |                    |
| Maximum I <sup>2</sup> t for fusing                      | I <sup>2</sup> t    | t = 10 ms                                                                                                | No voltage reapplied             |                                                                       | 1591      | kA <sup>2</sup> s  |
|                                                          |                     | t = 8.3 ms                                                                                               |                                  |                                                                       | 1452      |                    |
|                                                          |                     | t = 10 ms                                                                                                | 100 % V <sub>RRM</sub> reapplied |                                                                       | 1125      |                    |
|                                                          |                     | t = 8.3 ms                                                                                               |                                  |                                                                       | 1027      |                    |
| Maximum I <sup>2</sup> √t for fusing                     | I <sup>2</sup> √t   | t = 0.1 to 10 ms, no voltage reapplied                                                                   |                                  |                                                                       | 15 910    | kA <sup>2</sup> √s |
| Low level value of threshold voltage                     | V <sub>T(TO)1</sub> | (16.7 % × π × I <sub>T(AV)</sub> < I < π × I <sub>T(AV)</sub> ), T <sub>J</sub> = T <sub>J</sub> maximum |                                  |                                                                       | 0.98      | V                  |
| High level value of threshold voltage                    | V <sub>T(TO)2</sub> | (I > π × I <sub>T(AV)</sub> ), T <sub>J</sub> = T <sub>J</sub> maximum                                   |                                  |                                                                       | 1.12      |                    |
| Low level value of on-state slope resistance             | r <sub>t1</sub>     | (16.7 % × π × I <sub>T(AV)</sub> < I < π × I <sub>T(AV)</sub> ), T <sub>J</sub> = T <sub>J</sub> maximum |                                  |                                                                       | 0.32      | mΩ                 |
| High level value of on-state slope resistance            | r <sub>t2</sub>     | (I > π × I <sub>T(AV)</sub> ), T <sub>J</sub> = T <sub>J</sub> maximum                                   |                                  |                                                                       | 0.27      |                    |
| Maximum on-state voltage                                 | V <sub>TM</sub>     | I <sub>pk</sub> = 2000 A, T <sub>J</sub> = T <sub>J</sub> maximum, t <sub>p</sub> = 10 ms sine pulse     |                                  |                                                                       | 1.62      | V                  |
| Maximum holding current                                  | I <sub>H</sub>      | T <sub>J</sub> = 25 °C, anode supply 12 V resistive load                                                 |                                  |                                                                       | 600       | mA                 |
| Typical latching current                                 | I <sub>L</sub>      |                                                                                                          |                                  |                                                                       | 1000      |                    |

**SWITCHING**

| 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    |       |

**BLOCKING**

| 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 <sub>GM</sub>    | T <sub>J</sub> = T <sub>J</sub> maximum, t <sub>p</sub> ≤ 5 ms |                                                                                                                                                       | 10.0   |      | W     |
| Maximum average gate power          | P <sub>G(AV)</sub> | T <sub>J</sub> = T <sub>J</sub> maximum, f = 50 Hz, d% = 50    |                                                                                                                                                       | 2.0    |      |       |
| Maximum peak positive gate current  | I <sub>GM</sub>    | T <sub>J</sub> = T <sub>J</sub> maximum, t <sub>p</sub> ≤ 5 ms |                                                                                                                                                       | 3.0    |      | A     |
| Maximum peak positive gate voltage  | + V <sub>GM</sub>  | T <sub>J</sub> = T <sub>J</sub> maximum, t <sub>p</sub> ≤ 5 ms |                                                                                                                                                       | 20     |      | V     |
| Maximum peak negative gate voltage  | - V <sub>GM</sub>  |                                                                |                                                                                                                                                       | 5.0    |      |       |
| DC gate current required to trigger | I <sub>GT</sub>    | T <sub>J</sub> = -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 <sub>J</sub> = 25 °C                                         |                                                                                                                                                       | 100    | 200  |       |
|                                     |                    | T <sub>J</sub> = 125 °C                                        |                                                                                                                                                       | 50     | -    |       |
| DC gate voltage required to trigger | V <sub>GT</sub>    | T <sub>J</sub> = -40 °C                                        |                                                                                                                                                       | 2.5    | -    | V     |
|                                     |                    | T <sub>J</sub> = 25 °C                                         |                                                                                                                                                       | 1.8    | 3.0  |       |
|                                     |                    | T <sub>J</sub> = 125 °C                                        |                                                                                                                                                       | 1.1    | -    |       |
| DC gate current not to trigger      | I <sub>GD</sub>    | T <sub>J</sub> = T <sub>J</sub> maximum                        | Maximum gate current/voltage not to trigger is the maximum value which will not trigger any unit with rated V <sub>DRM</sub> anode to cathode applied | 10     |      | mA    |
| DC gate voltage not to trigger      | V <sub>GD</sub>    |                                                                |                                                                                                                                                       | 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 | TO-200AC (B-PUK) |           |  |

| $\Delta R_{thJ-hs}$ 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 <sub>J</sub> = T <sub>J</sub> 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

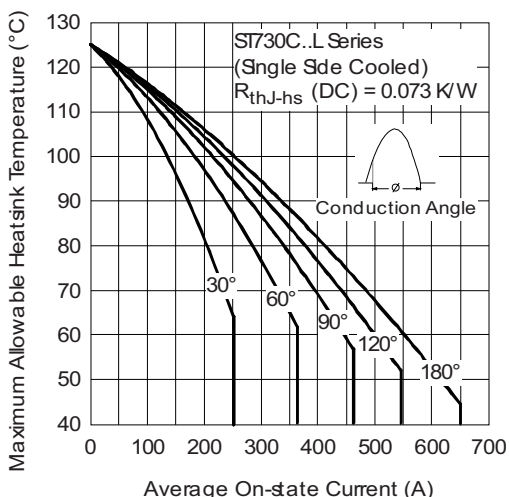


Fig. 1 - Current Ratings Characteristics

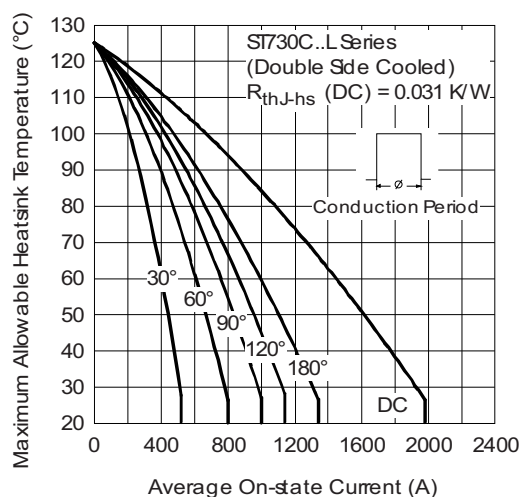


Fig. 4 - Current Ratings Characteristics

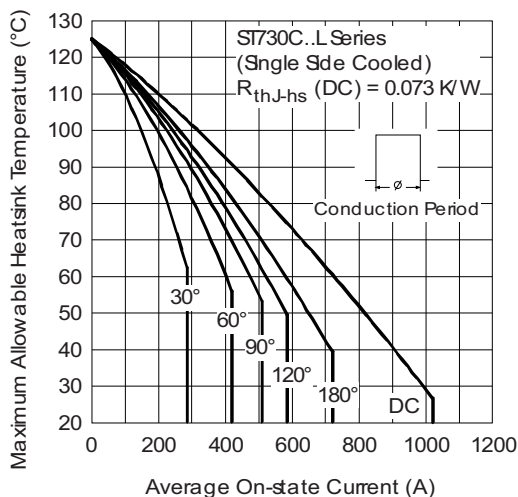


Fig. 2 - Current Ratings Characteristics

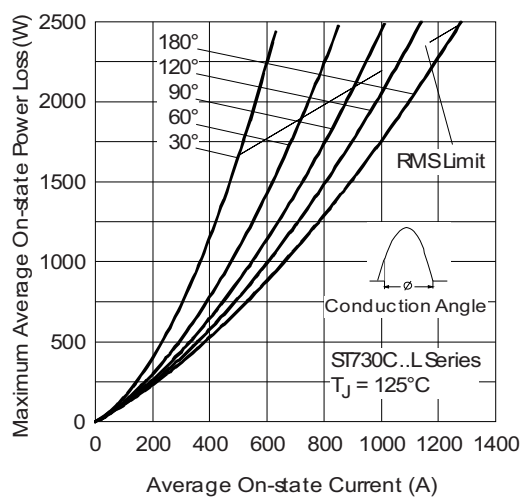


Fig. 5 - On-State Power Loss Characteristics

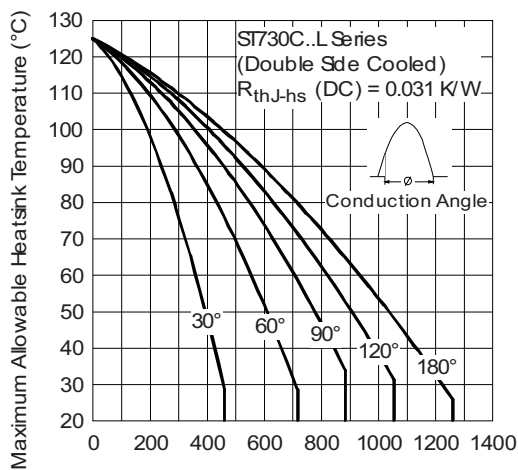


Fig. 3 - Current Ratings Characteristics

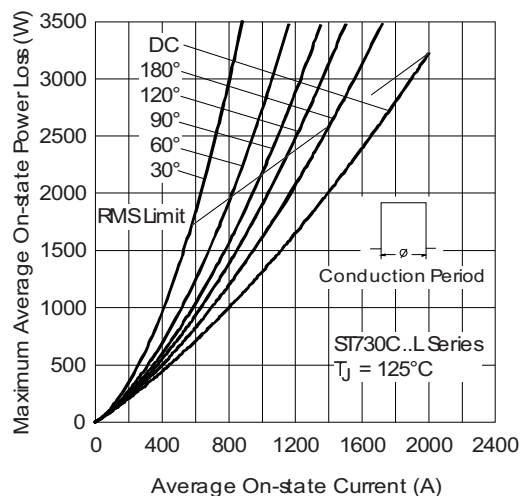


Fig. 6 - On-State Power Loss Characteristics

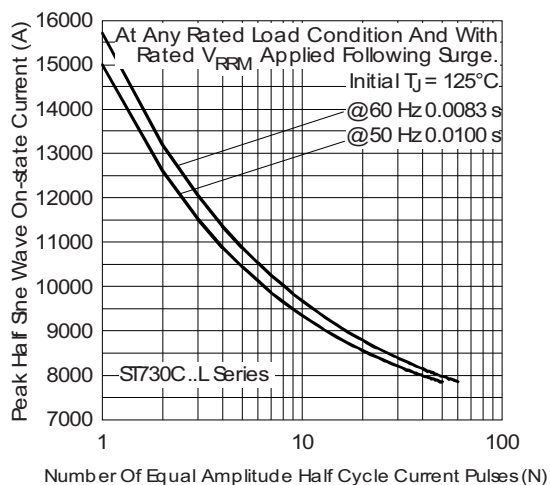


Fig. 7 - Maximum Non-Repetitive Surge Current  
Single and Double Side Cooled

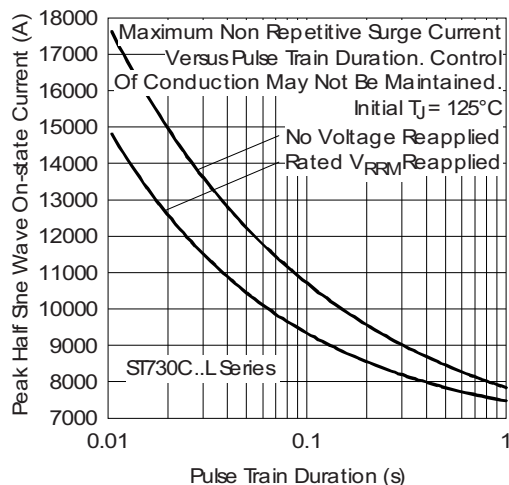


Fig. 8 - Maximum Non-Repetitive Surge Current  
Single and Double Side Cooled

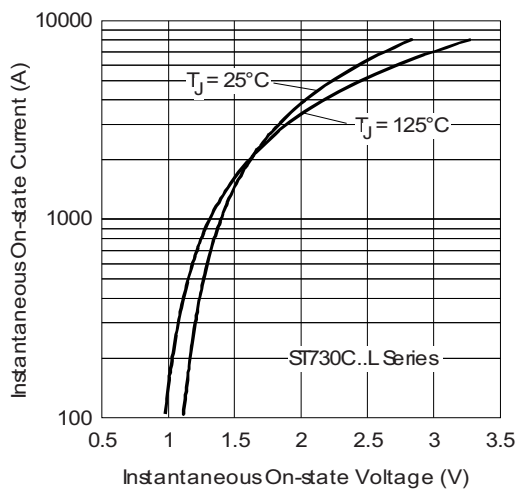


Fig. 9 - On-State Voltage Drop Characteristics

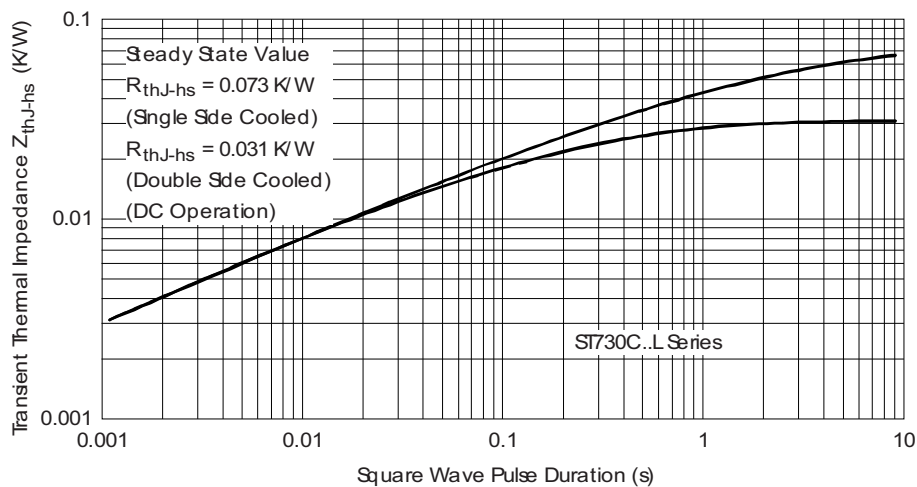


Fig. 10 - Thermal Impedance  $Z_{thJ-hs}$  Characteristics

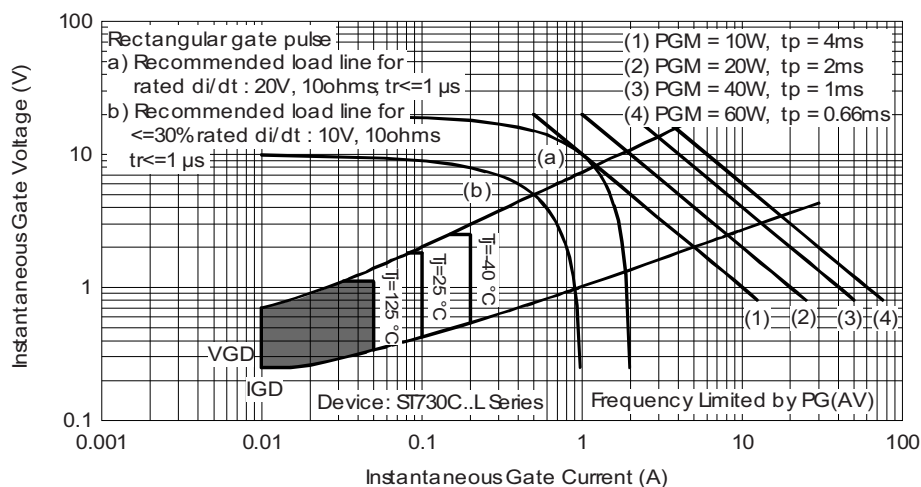


Fig. 11 - Gate Characteristics

## ORDERING INFORMATION TABLE

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

|          |   |                                                                     |
|----------|---|---------------------------------------------------------------------|
| <b>1</b> | - | Vishay Semiconductors product                                       |
| <b>2</b> | - | Thyristor                                                           |
| <b>3</b> | - | Essential part number                                               |
| <b>4</b> | - | 0 = Converter grade                                                 |
| <b>5</b> | - | C = Ceramic PUK                                                     |
| <b>6</b> | - | Voltage code x 100 = $V_{RRM}$ (see Voltage Ratings table)          |
| <b>7</b> | - | L = PUK case TO-200AC (B-PUK)                                       |
| <b>8</b> | - | 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)   |
| <b>9</b> | - | Critical $dV/dt$ : • None = 500 V/ $\mu s$ (standard selection)     |
|          |   | • L = 1000 V/ $\mu s$ (special selection)                           |

## LINKS TO RELATED DOCUMENTS

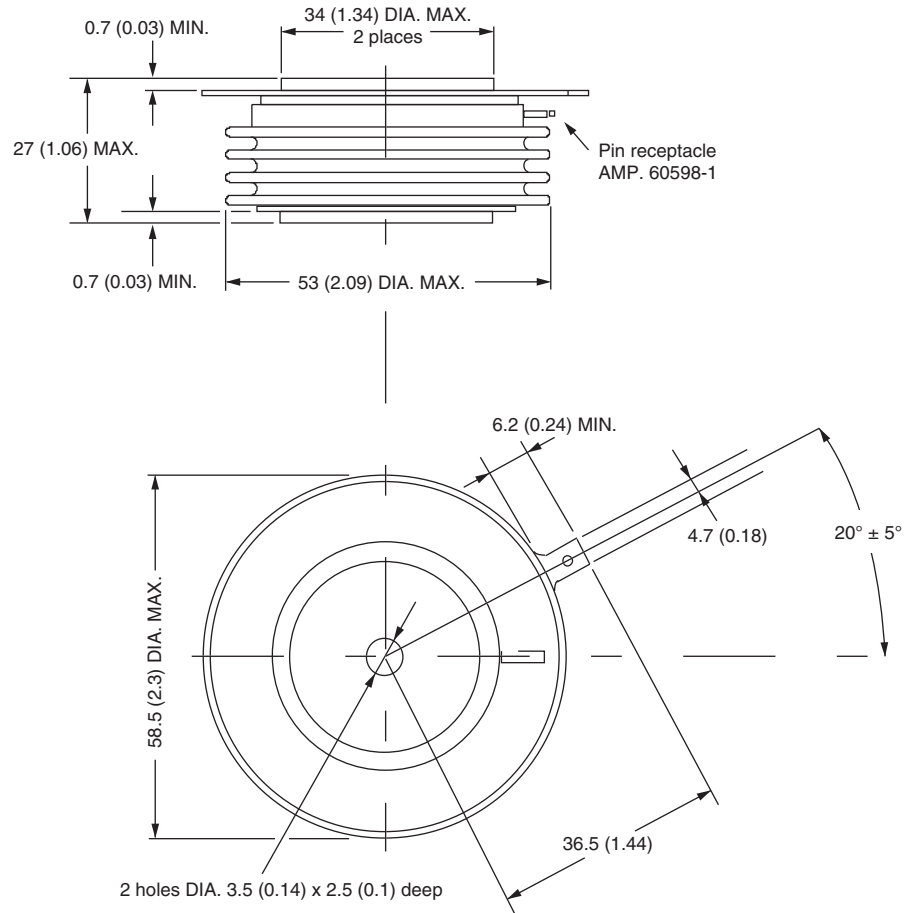
Dimensions

[www.vishay.com/doc?95076](http://www.vishay.com/doc?95076)

## TO-200AC (B-PUK)

### DIMENSIONS in millimeters (inches)

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



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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