

## Phase Control Thyristors (Hockey PUK Version), 350 A



A-PUK (TO-200AB)

### FEATURES

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

### PRIMARY CHARACTERISTICS

|                       |                                                 |
|-----------------------|-------------------------------------------------|
| $I_{T(AV)}$           | 350 A                                           |
| $V_{DRM}/V_{RRM}$     | 400 V, 800 V, 1200 V, 1600 V,<br>1800 V, 2000 V |
| $V_{TM}$              | 1.96 V                                          |
| $I_{GT}$              | 90 mA                                           |
| $T_J$                 | -40 °C to +125 °C                               |
| Package               | A-PUK (TO-200AB)                                |
| Circuit configuration | Single SCR                                      |

### MAJOR RATINGS AND CHARACTERISTICS

| PARAMETER         | TEST CONDITIONS | VALUES      | UNITS             |
|-------------------|-----------------|-------------|-------------------|
| $I_{T(AV)}$       |                 | 350         | A                 |
|                   | $T_{hs}$        | 55          | °C                |
| $I_{T(RMS)}$      |                 | 660         | A                 |
|                   | $T_{hs}$        | 25          | °C                |
| $I_{TSM}$         | 50 Hz           | 5000        | A                 |
|                   | 60 Hz           | 5230        |                   |
| $I^2t$            | 50 Hz           | 125         | kA <sup>2</sup> s |
|                   | 60 Hz           | 114         |                   |
| $V_{DRM}/V_{RRM}$ |                 | 400 to 2000 | V                 |
| $t_q$             | Typical         | 100         | µs                |
| $T_J$             |                 | -40 to +125 | °C                |

### ELECTRICAL SPECIFICATIONS

#### 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-ST180C..C | 04           | 400                                                                    | 500                                                  | 30                                                     |
|              | 08           | 800                                                                    | 900                                                  |                                                        |
|              | 12           | 1200                                                                   | 1300                                                 |                                                        |
|              | 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                                         |                                  | 350 (140)                                                             | A                  |                   |
|                                                          |                     |                                                                                                          |                                  | 55 (85)                                                               | °C                 |                   |
| Maximum RMS on-state current                             | I <sub>T(RMS)</sub> | DC at 25 °C heatsink temperature double side cooled                                                      |                                  | 660                                                                   |                    |                   |
| 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 | 5000               | A                 |
|                                                          |                     | t = 8.3 ms                                                                                               |                                  |                                                                       | 5230               |                   |
|                                                          |                     | t = 10 ms                                                                                                | 100 % V <sub>RRM</sub> reapplied |                                                                       | 4200               |                   |
|                                                          |                     | t = 8.3 ms                                                                                               |                                  |                                                                       | 4400               |                   |
| Maximum I <sup>2</sup> t for fusing                      | I <sup>2</sup> t    | t = 10 ms                                                                                                | No voltage reapplied             |                                                                       | 125                | kA <sup>2</sup> s |
|                                                          |                     | t = 8.3 ms                                                                                               |                                  |                                                                       | 114                |                   |
|                                                          |                     | t = 10 ms                                                                                                | 100 % V <sub>RRM</sub> reapplied |                                                                       | 88                 |                   |
|                                                          |                     | t = 8.3 ms                                                                                               |                                  |                                                                       | 81                 |                   |
| Maximum I <sup>2</sup> √t for fusing                     | I <sup>2</sup> √t   | t = 0.1 to 10 ms, no voltage reapplied                                                                   |                                  | 1250                                                                  | 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 |                                  | 1.08                                                                  | 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                                   |                                  | 1.14                                                                  |                    |                   |
| 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 |                                  | 1.18                                                                  | 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                                   |                                  | 1.14                                                                  |                    |                   |
| Maximum on-state voltage                                 | V <sub>TM</sub>     | I <sub>pk</sub> = 750 A, T <sub>J</sub> = T <sub>J</sub> maximum, t <sub>p</sub> = 10 ms sine pulse      |                                  | 1.96                                                                  | V                  |                   |
| Maximum holding current                                  | I <sub>H</sub>      | T <sub>J</sub> = 25 °C, anode supply 12 V resistive load                                                 |                                  | 600                                                                   | mA                 |                   |
| Maximum (typical) latching current                       | I <sub>L</sub>      |                                                                                                          |                                  | 1000 (300)                                                            |                    |                   |

| 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                                    | $t_q$   | $I_{TM} = 300$ A, $T_J = T_J$ maximum, $di/dt = 20$ A/μs,<br>$V_R = 50$ V, $dV/dt = 20$ V/μs, gate 0 V 100 Ω, $t_p = 500$ μs | 100    |       |

| 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 | $I_{RRM}, I_{DRM}$ | $T_J = T_J$ maximum, rated $V_{DRM}/V_{RRM}$ applied | 30     | mA    |

**TRIGGERING**

| PARAMETER                           | SYMBOL             | TEST CONDITIONS                                                | VALUES                                                                                                                                                            |      | UNIT<br>S |    |
|-------------------------------------|--------------------|----------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|-----------|----|
|                                     |                    |                                                                | 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                                                                                                                                                                |      | 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>  |                                                                | 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/<br>current/voltage are the lowest value<br>which will trigger all units 12 V<br>anode to cathode applied                           | 180  | -         | mA |
|                                     |                    | T <sub>J</sub> = 25 °C                                         |                                                                                                                                                                   | 90   | 150       |    |
|                                     |                    | T <sub>J</sub> = 125 °C                                        |                                                                                                                                                                   | 40   | -         |    |
| DC gate voltage required to trigger | V <sub>GT</sub>    | T <sub>J</sub> = - 40 °C                                       |                                                                                                                                                                   | 2.9  | -         | V  |
|                                     |                    | T <sub>J</sub> = 25 °C                                         |                                                                                                                                                                   | 1.8  | 3.0       |    |
|                                     |                    | T <sub>J</sub> = 125 °C                                        |                                                                                                                                                                   | 1.2  | -         |    |
| DC gate current not to trigger      | I <sub>GD</sub>    | T <sub>J</sub> = T <sub>J</sub> maximum                        | Maximum gate current/voltage not<br>to trigger is the maximum value<br>which will not trigger any unit with<br>rated V <sub>DRM</sub> anode to cathode<br>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           | UNIT<br>S |
|--------------------------------------------------|--------------|-----------------------------------------------|------------------|-----------|
| 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               | 0.17             | K/W       |
|                                                  |              | DC operation double side cooled               | 0.08             |           |
| Maximum thermal resistance, case to heatsink     | $R_{thC-hs}$ | DC operation single side cooled               | 0.033            |           |
|                                                  |              | DC operation double side cooled               | 0.017            |           |
| Mounting force, $\pm 10$ %                       |              |                                               | 4900<br>(500)    | N<br>(kg) |
| Approximate weight                               |              |                                               | 50               | g         |
| Case style                                       |              | See dimensions - link at the end of datasheet | A-PUK (TO-200AB) |           |

 **$\Delta R_{thJC}$  CONDUCTION**

| CONDUCTION ANGLE | SINUSOIDAL CONDUCTION |             | RECTANGULAR CONDUCTION |             | TEST CONDITIONS     | UNITS |
|------------------|-----------------------|-------------|------------------------|-------------|---------------------|-------|
|                  | SINGLE SIDE           | DOUBLE SIDE | SINGLE SIDE            | DOUBLE SIDE |                     |       |
| 180°             | 0.015                 | 0.015       | 0.011                  | 0.011       | $T_J = T_J$ maximum | K/W   |
| 120°             | 0.018                 | 0.019       | 0.019                  | 0.019       |                     |       |
| 90°              | 0.024                 | 0.024       | 0.026                  | 0.026       |                     |       |
| 60°              | 0.035                 | 0.035       | 0.036                  | 0.037       |                     |       |
| 30°              | 0.060                 | 0.060       | 0.060                  | 0.061       |                     |       |

**Note**

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

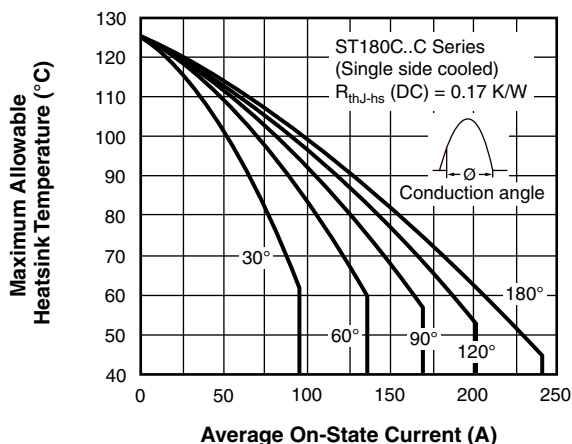


Fig. 1 - Current Ratings Characteristics

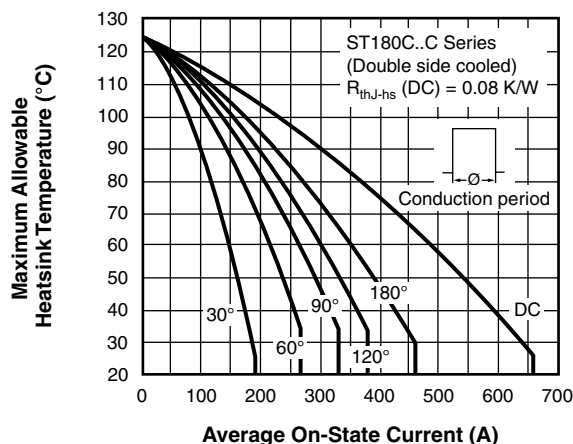


Fig. 4 - Current Ratings Characteristics

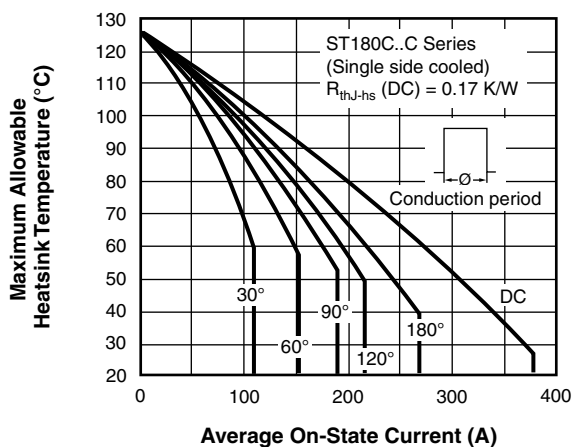


Fig. 2 - Current Ratings Characteristics

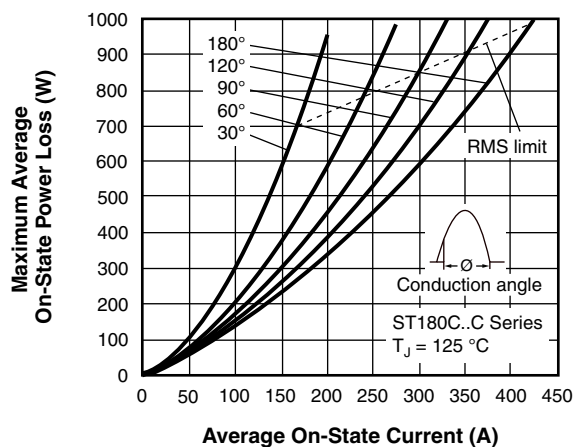


Fig. 5 - On-State Power Loss Characteristics

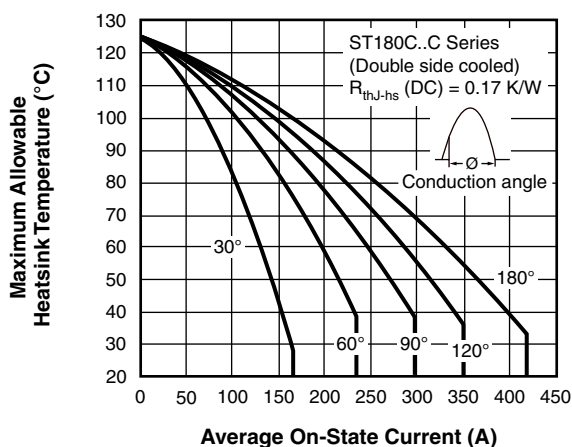


Fig. 3 - Current Ratings Characteristics

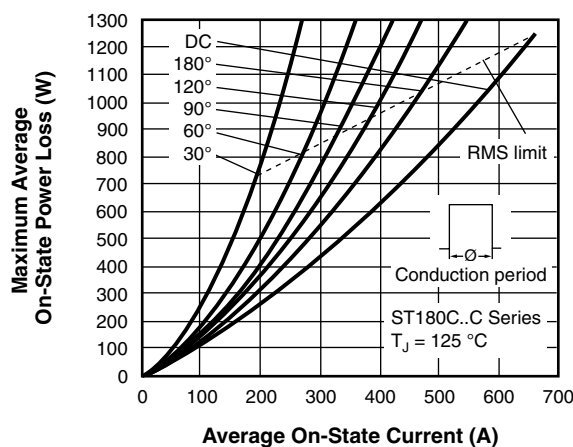


Fig. 6 - On-State Power Loss Characteristics

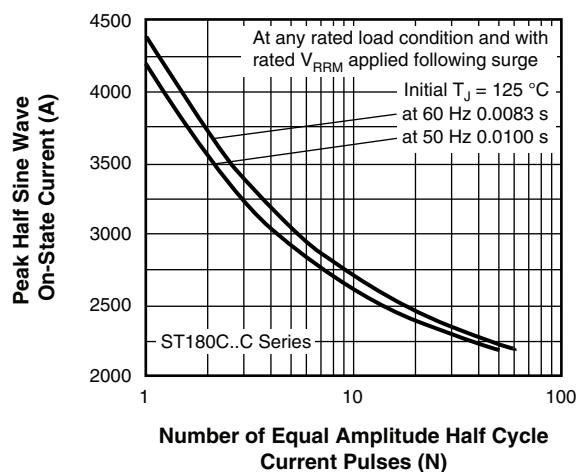


Fig. 7 - Maximum Non-Repetitive Surge Current Single and Double Side Cooled

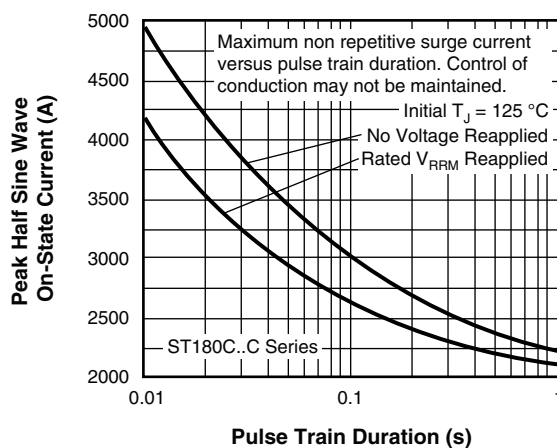


Fig. 8 - Maximum Non-Repetitive Surge Current Single and Double Side Cooled

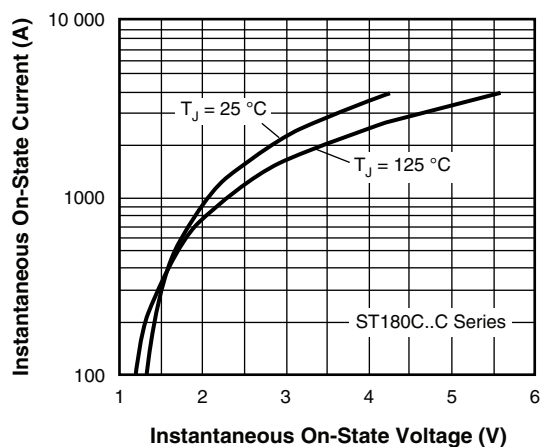


Fig. 9 - On-State Voltage Drop Characteristics

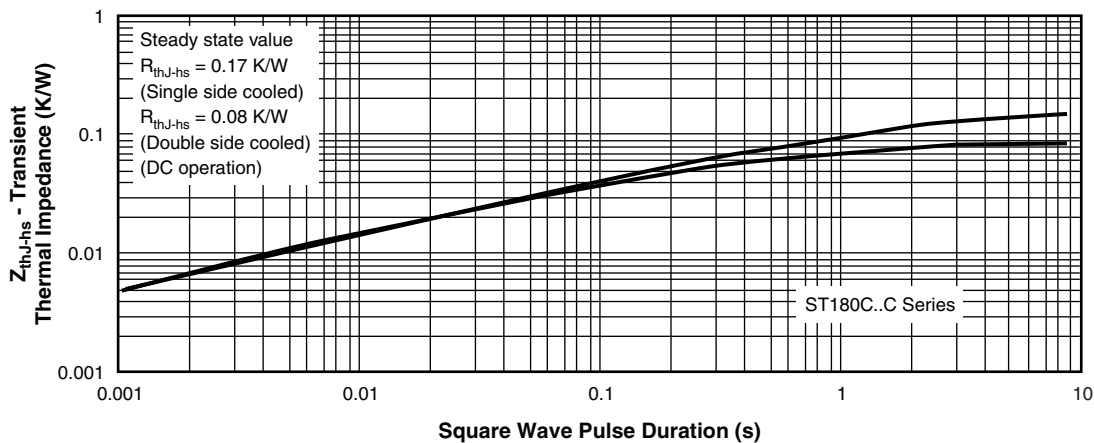


Fig. 10 - Thermal Impedance  $Z_{thJ-hs}$  Characteristics

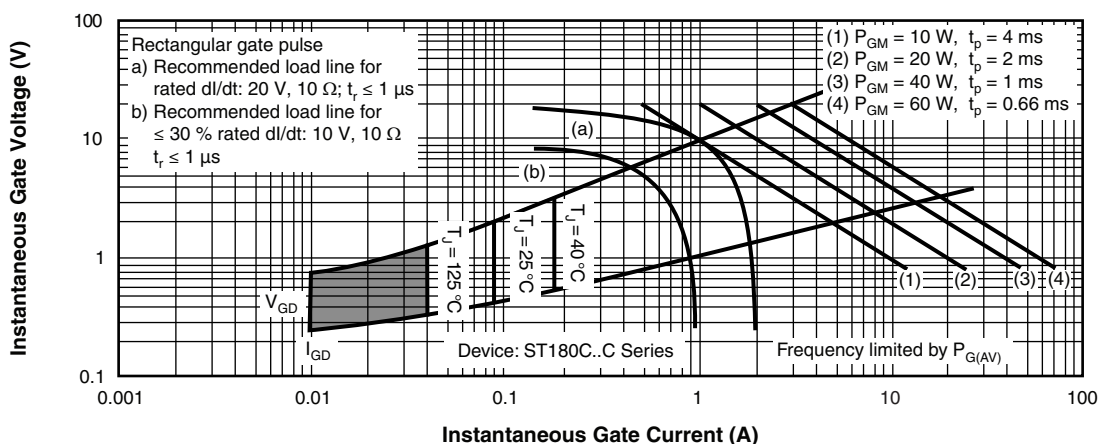


Fig. 11 - Gate Characteristics

### ORDERING INFORMATION TABLE

| Device code | VS- | ST | 18 | 0 | C | 20 | C | 1 | - |
|-------------|-----|----|----|---|---|----|---|---|---|
|             | 1   | 2  | 3  | 4 | 5 | 6  | 7 | 8 | 9 |

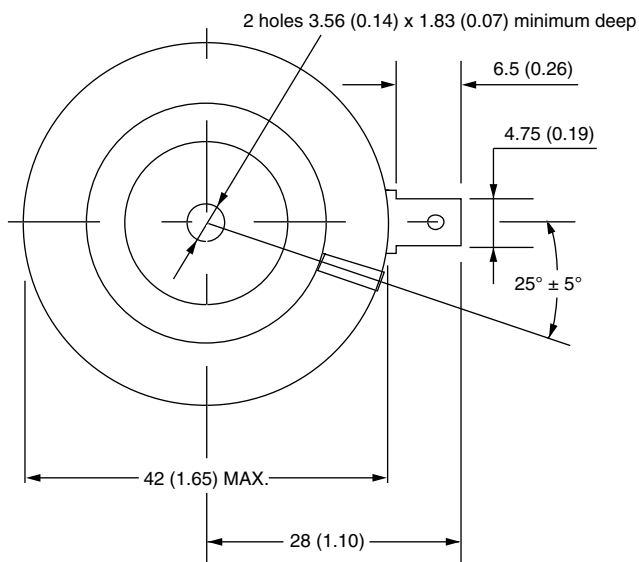
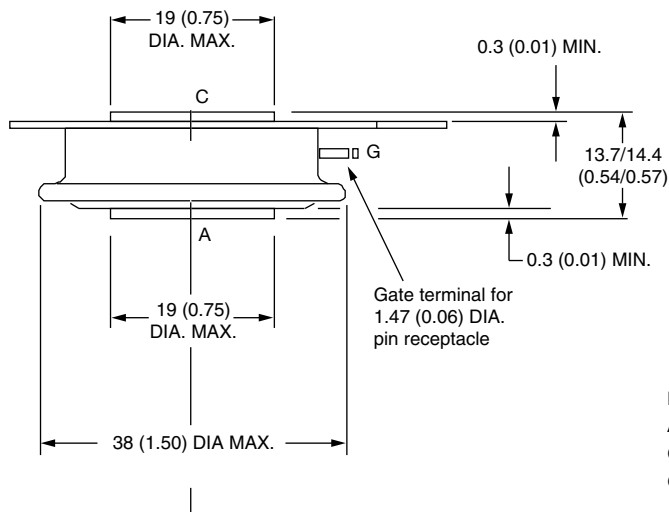
- 1** - Vishay Semiconductors product
- 2** - Thyristor
- 3** - Essential part number
- 4** - 0 = converter grade
- 5** - C = ceramic PUK
- 6** - Voltage code x 100 =  $V_{RRM}$  (see Voltage Ratings table)
- 7** - C = PUK case A-PUK (TO-200AB)
- 8** - 0 = eyelet terminals (gate and auxiliary cathode 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/ $\mu s$  (standard selection)  
• L = 1000 V/ $\mu s$  (special selection)

| LINKS TO RELATED DOCUMENTS |                                                                        |
|----------------------------|------------------------------------------------------------------------|
| Dimensions                 | <a href="http://www.vishay.com/doc?95074">www.vishay.com/doc?95074</a> |

## A-PUK (TO-200AB)

### DIMENSIONS in millimeters (inches)

Anode to gate  
Creepage distance: 7.62 (0.30) minimum  
Strike distance: 7.12 (0.28) 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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