

## Phase Control Thyristors (Hockey PUK Version), 1473 A



K-PUK (A-24)

### FEATURES

- Center amplifying gate
- Metal case with ceramic insulator
- International standard case K-PUK (A-24)
- High profile hockey PUK
- 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

|                       |                                                           |
|-----------------------|-----------------------------------------------------------|
| $I_{T(AV)}$           | 1473 A                                                    |
| $V_{DRM}/V_{RRM}$     | 1200 V, 1400 V, 1600 V, 1800 V,<br>2000 V, 2200 V, 2400 V |
| $V_{TM}$              | 1.80 V                                                    |
| $I_{GT}$              | 100 mA                                                    |
| $T_J$                 | -40 °C to +125 °C                                         |
| Package               | K-PUK (A-24)                                              |
| Circuit configuration | Single SCR                                                |

### MAJOR RATINGS AND CHARACTERISTICS

| PARAMETER         | TEST CONDITIONS | VALUES       | UNITS              |
|-------------------|-----------------|--------------|--------------------|
| $I_{T(AV)}$       |                 | 1473         | A                  |
|                   | $T_{hs}$        | 55           | °C                 |
| $I_{T(RMS)}$      |                 | 2913         | A                  |
|                   | $T_{hs}$        | 25           | °C                 |
| $I_{TSM}$         | 50 Hz           | 20.0         | A                  |
|                   | 60 Hz           | 21.2         |                    |
| $I^2t$            | 50 Hz           | 2000         | kA <sup>2</sup> s  |
|                   | 60 Hz           | 1865         |                    |
| $I^2\sqrt{t}$     |                 | 20 000       | kA <sup>2</sup> √s |
| $V_{DRM}/V_{RRM}$ | Range           | 1200 to 2400 | V                  |
| $t_q$             | Typical         | 300          | μs                 |
| $T_J$             | Range           | -40 to +125  | °C                 |

### ELECTRICAL SPECIFICATIONS

#### VOLTAGE RATINGS

| TYPE NUMBER   | VOLTAGE CODE | $V_{RRM}$ , MAXIMUM REPETITIVE PEAK REVERSE VOLTAGE<br>V | $V_{RSM}$ , MAXIMUM NON-REPETITIVE PEAK REVERSE VOLTAGE<br>V | $I_{RRM}$ MAXIMUM AT $T_J = 125\text{ °C}$<br>mA |
|---------------|--------------|----------------------------------------------------------|--------------------------------------------------------------|--------------------------------------------------|
| VS-ST1000C..K | 12           | 1200                                                     | 1300                                                         | 100                                              |
|               | 14           | 1400                                                     | 1500                                                         |                                                  |
|               | 16           | 1600                                                     | 1700                                                         |                                                  |
|               | 18           | 1800                                                     | 1900                                                         |                                                  |
|               | 20           | 2000                                                     | 2100                                                         |                                                  |
|               | 22           | 2200                                                     | 2300                                                         |                                                  |
|               | 24           | 2400                                                     | 2500                                                         |                                                  |



| 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<br>Double side (single side) cooled                                       |                                  |                                                                       | 1473 (630) | A                  |
|                                                          |                     |                                                                                                           |                                  |                                                                       | 55 (85)    | °C                 |
| Maximum RMS on-state current                             | I <sub>T(RMS)</sub> | DC at 25 °C heatsink temperature double side cooled                                                       |                                  |                                                                       | 6540       | A                  |
| 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 | 20.0       | kA                 |
|                                                          |                     | t = 8.3 ms                                                                                                |                                  |                                                                       | 21.2       |                    |
|                                                          |                     | t = 10 ms                                                                                                 | 100 % V <sub>RRM</sub> reapplied |                                                                       | 17.0       |                    |
|                                                          |                     | t = 8.3 ms                                                                                                |                                  |                                                                       | 18.1       |                    |
| Maximum I <sup>2</sup> t for fusing                      | I <sup>2</sup> t    | t = 10 ms                                                                                                 | No voltage reapplied             |                                                                       | 2000       | kA <sup>2</sup> s  |
|                                                          |                     | t = 8.3 ms                                                                                                |                                  |                                                                       | 1865       |                    |
|                                                          |                     | t = 10 ms                                                                                                 | 100 % V <sub>RRM</sub> reapplied |                                                                       | 1445       |                    |
|                                                          |                     | t = 8.3 ms                                                                                                |                                  |                                                                       | 1360       |                    |
| Maximum I <sup>2</sup> √t for fusing                     | I <sup>2</sup> √t   | t = 0.1 ms to 10 ms, no voltage reapplied                                                                 |                                  |                                                                       | 20 000     | 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 |                                  |                                                                       | 0.950      | 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                                    |                                  |                                                                       | 1.024      |                    |
| 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 |                                  |                                                                       | 0.283      | 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                                    |                                  |                                                                       | 0.265      |                    |
| Maximum on-state voltage drop                            | V <sub>TM</sub>     | I <sub>pk</sub> = 3000 A, T <sub>J</sub> = 125 °C, t <sub>p</sub> = 10 ms sine pulse                      |                                  |                                                                       | 1.80       | 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                                             | 1.9    | μs    |
| Typical turn-off time                                    | $t_q$   | $I_{TM} = 550$ A, $T_J = T_J$ maximum, $di/dt = 40$ A/μs,<br>$V_R = 50$ V, $dV/dt = 20$ V/μs, gate 0 V 100 Ω, $t_p = 500$ μs | 300    |       |

| 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 | 100    | 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         | 16     |      | W     |
| Maximum peak average gate power     | $P_{G(AV)}$ | $T_J = T_J$ maximum, $f = 50$ Hz, $d\% = 50$ | 3      |      |       |
| 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  | $+V_{GM}$   |                                              | 20     |      | V     |
| Maximum peak negative gate voltage  | $-V_{GM}$   |                                              | 5.0    |      |       |
| DC gate current required to trigger | $I_{GT}$    | $T_J = -40$ °C                               | 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                               | 1.4    | -    | V     |
|                                     |             | $T_J = 25$ °C                                | 1.1    | 3.0  |       |
|                                     |             | $T_J = 125$ °C                               | 0.9    | -    |       |
| 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 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               | 0.042            | K/W       |
|                                                  |              | DC operation double side cooled               | 0.021            |           |
| Maximum thermal resistance, case to heatsink     | $R_{thC-hs}$ | DC operation single side cooled               | 0.006            |           |
|                                                  |              | DC operation double side cooled               | 0.003            |           |
| Mounting force, $\pm 10$ %                       |              |                                               | 24 500<br>(2500) | N<br>(kg) |
| Approximate weight                               |              |                                               | 425              | g         |
| Case style                                       |              | See dimensions - link at the end of datasheet | K-PUK (A-24)     |           |

| $\Delta R_{thJC}$ CONDUCTION |                       |             |                        |             |                     |       |
|------------------------------|-----------------------|-------------|------------------------|-------------|---------------------|-------|
| CONDUCTION ANGLE             | SINUSOIDAL CONDUCTION |             | RECTANGULAR CONDUCTION |             | TEST CONDITIONS     | UNITS |
|                              | SINGLE SIDE           | DOUBLE SIDE | SINGLE SIDE            | DOUBLE SIDE |                     |       |
| 180°                         | 0.003                 | 0.003       | 0.002                  | 0.002       | $T_J = T_J$ maximum | K/W   |
| 120°                         | 0.004                 | 0.004       | 0.004                  | 0.004       |                     |       |
| 90°                          | 0.005                 | 0.005       | 0.005                  | 0.005       |                     |       |
| 60°                          | 0.007                 | 0.007       | 0.007                  | 0.007       |                     |       |
| 30°                          | 0.012                 | 0.012       | 0.012                  | 0.012       |                     |       |

**Note**

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

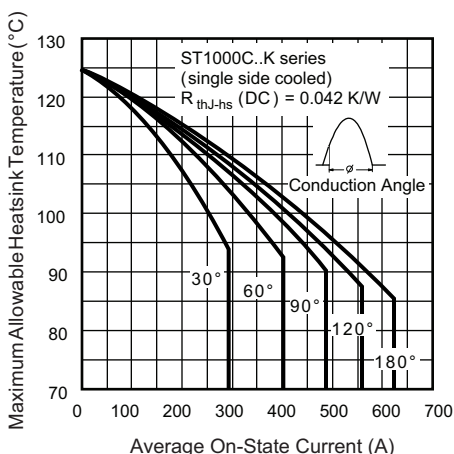


Fig. 1 - Current Ratings Characteristics

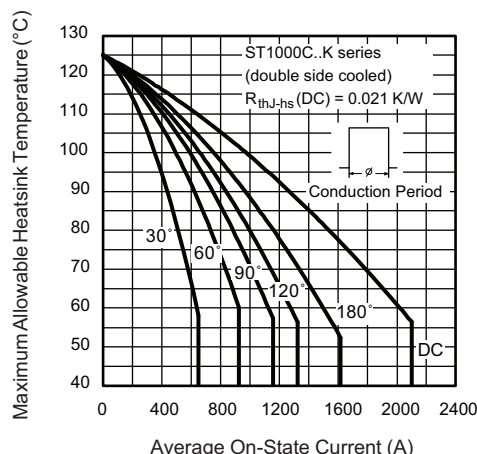


Fig. 4 - Current Ratings Characteristics

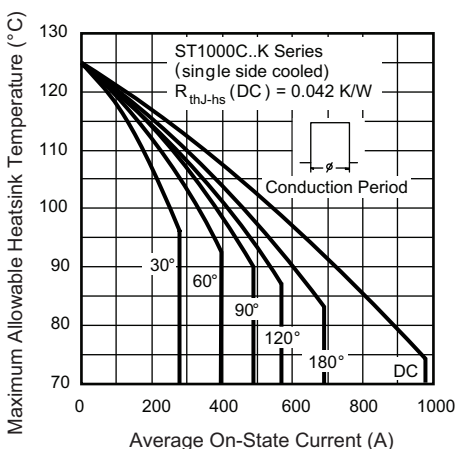


Fig. 2 - Current Ratings Characteristics

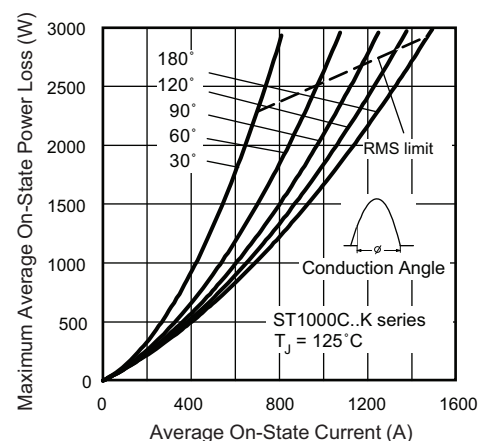


Fig. 5 - On-State Power Loss Characteristics

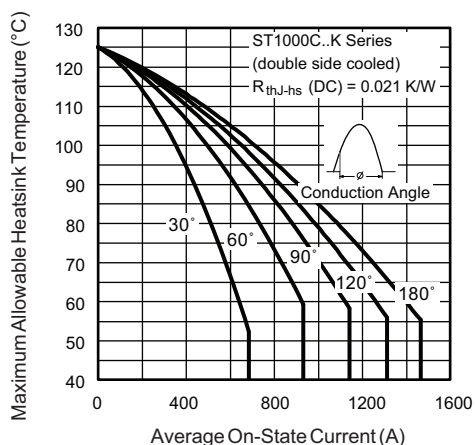


Fig. 3 - Current Ratings Characteristics

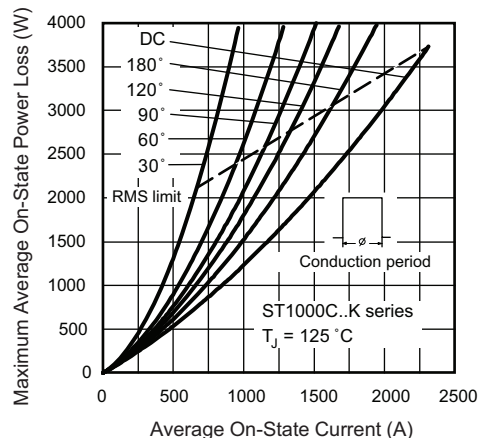


Fig. 6 - On-State Power Loss Characteristics

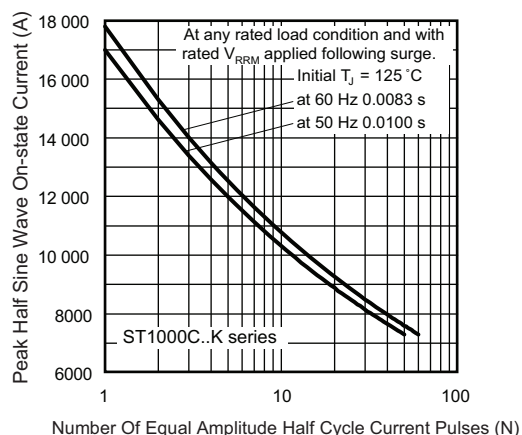


Fig. 7 - Maximum Non-Repetitive Surge Current  
Single and Double Side Cooled

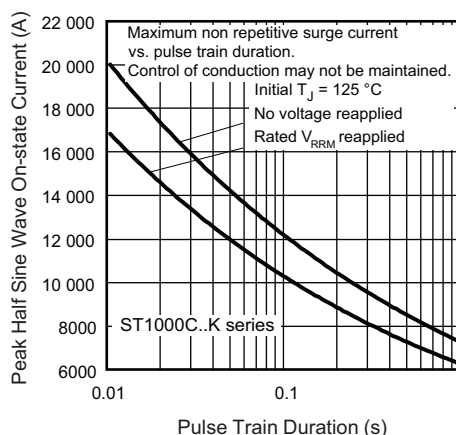


Fig. 8 - Maximum Non-Repetitive Surge Current  
Single and Double Side Cooled

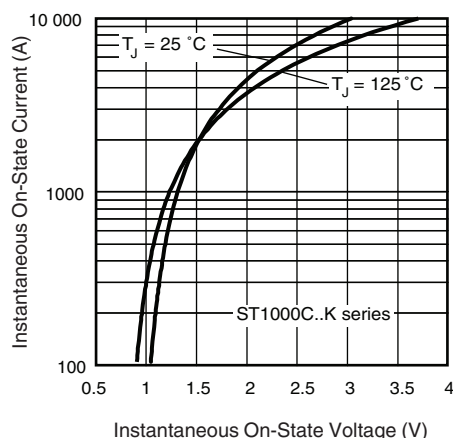


Fig. 9 - On-State Voltage Drop Characteristics

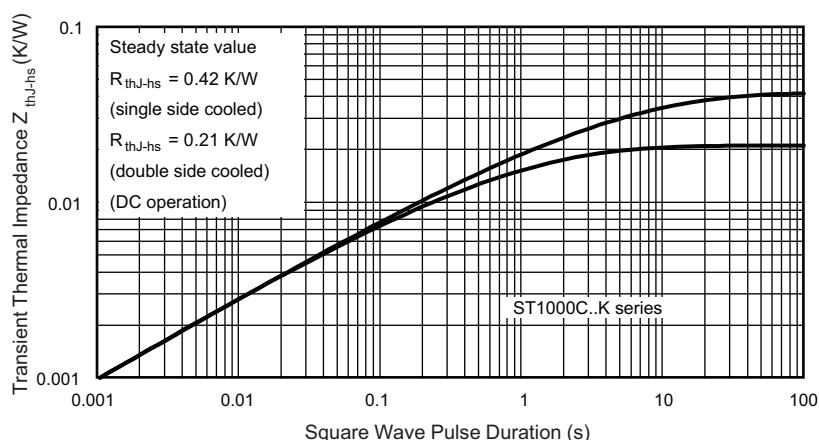


Fig. 10 - Thermal Impedance  $Z_{thJ-hs}$  Characteristics

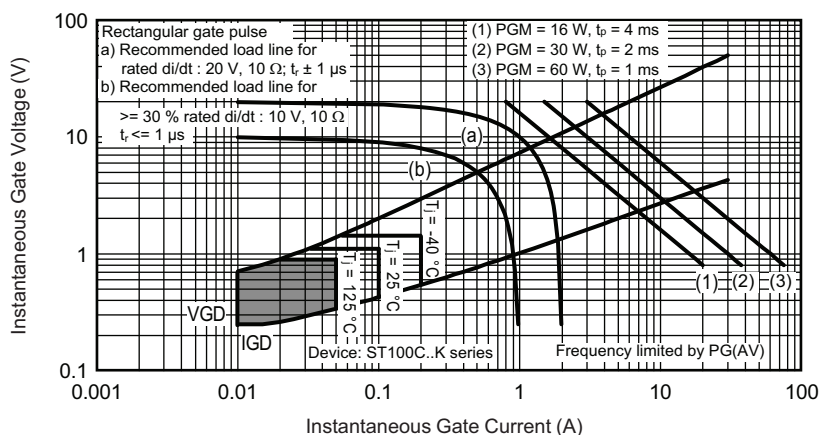


Fig. 11 - Gate Characteristics

## ORDERING INFORMATION TABLE

| Device code | VS- | ST                                                                  | 100 | 0 | C | 24 | K | 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           | -   | K = PUK case K-PUK (A-24)                                           |     |   |   |    |   |   |   |
| 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

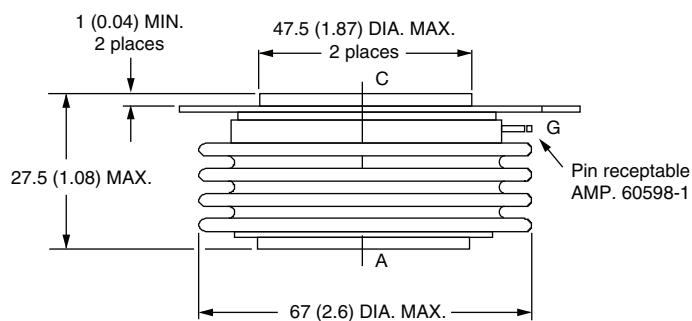
[www.vishay.com/doc?95081](http://www.vishay.com/doc?95081)



## K-PUK (A-24)

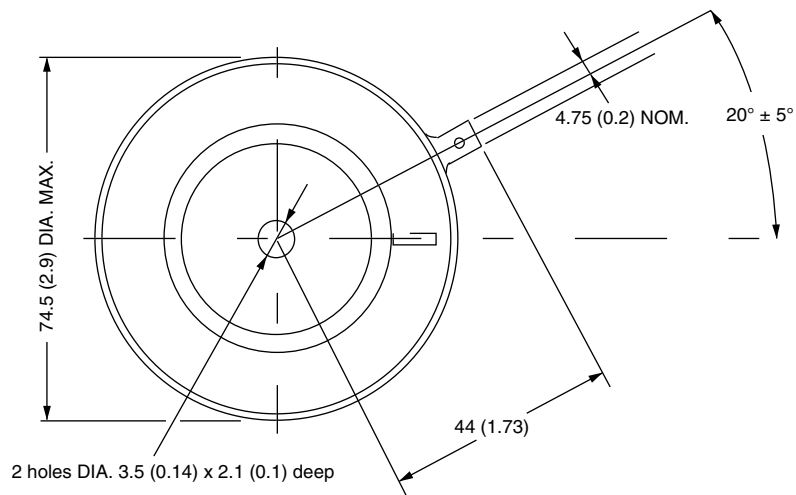
### DIMENSIONS in millimeters (inches)

Creepage distance: 28.88 (1.137) minimum  
Strike distance: 17.99 (0.708) minimum



#### Note:

A = Anode  
C = Cathode  
G = Gate



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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