

## Inverter Grade Thyristors (Hockey PUK Version), 515 A



B-PUK (TO-200AC)

### FEATURES

- Metal case with ceramic insulator
- All diffused design
- Center amplifying gate
- Guaranteed high  $dV/dt$
- Guaranteed high  $dI/dt$
- International standard case B-PUK (TO-200AC)
- High surge current capability
- Low thermal impedance
- High speed performance
- 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

### PRIMARY CHARACTERISTICS

|                       |                              |
|-----------------------|------------------------------|
| Package               | B-PUK (TO-200AC)             |
| Circuit configuration | Single SCR                   |
| $I_{T(AV)}$           | 515 A                        |
| $V_{DRM}/V_{RRM}$     | 400 V, 800 V, 1000 V, 1200 V |
| $V_{TM}$              | 2.16 V                       |
| $I_{TSM}$ at 50 Hz    | 7950 A                       |
| $I_{TSM}$ at 60 Hz    | 8320 A                       |
| $I_{GT}$              | 200 mA                       |
| $T_C/T_{hs}$          | 55 °C                        |

### TYPICAL APPLICATIONS

- Inverters
- Choppers
- Induction heating
- All types of force-commutated converters

### MAJOR RATINGS AND CHARACTERISTICS

| PARAMETER         | TEST CONDITIONS | VALUES      | UNITS             |
|-------------------|-----------------|-------------|-------------------|
| $I_{T(AV)}$       |                 | 515         | A                 |
|                   | $T_{hs}$        | 55          | °C                |
| $I_{T(RMS)}$      |                 | 995         | A                 |
|                   | $T_{hs}$        | 25          | °C                |
| $I_{TSM}$         | 50 Hz           | 7950        | A                 |
|                   | 60 Hz           | 8320        |                   |
| $I^2t$            | 50 Hz           | 316         | kA <sup>2</sup> s |
|                   | 60 Hz           | 289         |                   |
| $V_{DRM}/V_{RRM}$ |                 | 400 to 1200 | V                 |
| $t_q$             | Range           | 10 to 30    | μs                |
| $T_J$             |                 | -40 to 125  | °C                |

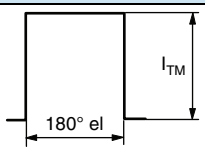
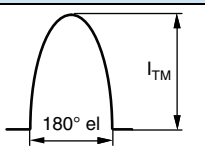
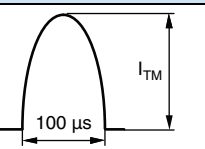
#### Note

- $t_q$  = 10 μs to 20 μs for 400 V to 800 V devices  
 $t_q$  = 15 μs to 30 μs for 1000 V to 1200 V devices



## ELECTRICAL SPECIFICATIONS

| VOLTAGE RATINGS |              |                                                          |                                                      |                                                        |
|-----------------|--------------|----------------------------------------------------------|------------------------------------------------------|--------------------------------------------------------|
| TYPE NUMBER     | VOLTAGE CODE | $V_{DRM}/V_{RRM}$ , MAXIMUM REPETITIVE PEAK 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-ST303C..L    | 04           | 400                                                      | 500                                                  | 50                                                     |
|                 | 08           | 800                                                      | 900                                                  |                                                        |
|                 | 10           | 1000                                                     | 1100                                                 |                                                        |
|                 | 12           | 1200                                                     | 1300                                                 |                                                        |

| CURRENT CARRYING CAPABILITY      |                                                                                   |     |                                                                                    |      |                                                                                     |      |       |
|----------------------------------|-----------------------------------------------------------------------------------|-----|------------------------------------------------------------------------------------|------|-------------------------------------------------------------------------------------|------|-------|
| FREQUENCY                        |  |     |  |      |  |      | UNITS |
| 50 Hz                            | 1130                                                                              | 950 | 1800                                                                               | 1540 | 5660                                                                                | 4990 | A     |
| 400 Hz                           | 1010                                                                              | 820 | 1850                                                                               | 1570 | 2830                                                                                | 2420 |       |
| 1000 Hz                          | 680                                                                               | 530 | 1560                                                                               | 1300 | 1490                                                                                | 1220 |       |
| 2500 Hz                          | 230                                                                               | 140 | 690                                                                                | 510  | 540                                                                                 | 390  |       |
| Recovery voltage $V_R$           | 50                                                                                |     | 50                                                                                 |      | 50                                                                                  |      | V     |
| Voltage before turn-on $V_D$     | $V_{DRM}$                                                                         |     | $V_{DRM}$                                                                          |      | $V_{DRM}$                                                                           |      |       |
| Rise of on-state current $di/dt$ | 50                                                                                |     | -                                                                                  |      | -                                                                                   |      | A/μs  |
| Heatsink temperature             | 40                                                                                | 55  | 40                                                                                 | 55   | 40                                                                                  | 55   | °C    |
| Equivalent values for RC circuit | 10/0.47                                                                           |     | 10/0.47                                                                            |      | 10/0.47                                                                             |      | Ω/μF  |

| ON-STATE CONDUCTION                                        |                     |                                                                                                           |                                  |                                                                       |           |                    |                   |
|------------------------------------------------------------|---------------------|-----------------------------------------------------------------------------------------------------------|----------------------------------|-----------------------------------------------------------------------|-----------|--------------------|-------------------|
| 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                                          |                                  |                                                                       | 515 (190) | A                  |                   |
|                                                            |                     |                                                                                                           |                                  |                                                                       | 55 (85)   | °C                 |                   |
| Maximum RMS on-state current                               | I <sub>T(RMS)</sub> | DC at 25 °C heatsink temperature double side cooled                                                       |                                  |                                                                       | 995       | A                  |                   |
| Maximum peak, one half 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 | 7950      |                    |                   |
|                                                            |                     | t = 8.3 ms                                                                                                |                                  |                                                                       | 8320      |                    |                   |
|                                                            |                     | t = 10 ms                                                                                                 | 100 % V <sub>RRM</sub> reapplied |                                                                       | 6690      |                    |                   |
|                                                            |                     | t = 8.3 ms                                                                                                |                                  |                                                                       | 7000      |                    |                   |
| Maximum I <sup>2</sup> t for fusing                        | I <sup>2</sup> t    | t = 10 ms                                                                                                 | No voltage reapplied             |                                                                       | 316       |                    | kA <sup>2</sup> s |
|                                                            |                     | t = 8.3 ms                                                                                                |                                  |                                                                       | 289       |                    |                   |
|                                                            |                     | t = 10 ms                                                                                                 | 100 % V <sub>RRM</sub> reapplied |                                                                       | 224       |                    |                   |
|                                                            |                     | t = 8.3 ms                                                                                                |                                  |                                                                       | 204       |                    |                   |
| Maximum I <sup>2</sup> √t for fusing                       | I <sup>2</sup> √t   | t = 0.1 to 10 ms, no voltage reapplied                                                                    |                                  |                                                                       | 3160      | kA <sup>2</sup> √s |                   |
| Maximum peak on-state voltage                              | V <sub>TM</sub>     | I <sub>TM</sub> = 1255 A, T <sub>J</sub> = T <sub>J</sub> maximum, t <sub>p</sub> = 10 ms sine wave pulse |                                  |                                                                       | 2.16      | V                  |                   |
| 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  |                                  |                                                                       | 1.44      |                    |                   |
| 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                                    |                                  |                                                                       | 1.48      |                    |                   |
| Low level value of forward 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  |                                  |                                                                       | 0.57      | mΩ                 |                   |
| High level value of forward slope resistance               | r <sub>t2</sub>     | (I > π × I <sub>T(AV)</sub> ), T <sub>J</sub> = T <sub>J</sub> maximum                                    |                                  |                                                                       | 0.56      |                    |                   |
| Maximum holding current                                    | I <sub>H</sub>      | T <sub>J</sub> = 25 °C, I <sub>T</sub> > 30 A                                                             |                                  |                                                                       | 600       | mA                 |                   |
| Typical latching current                                   | I <sub>L</sub>      | T <sub>J</sub> = 25 °C, V <sub>A</sub> = 12 V, R <sub>a</sub> = 6 Ω, I <sub>G</sub> = 1 A                 |                                  |                                                                       | 1000      |                    |                   |



| SWITCHING                                                |         |                                                                                                                                                                                              |        |            |
|----------------------------------------------------------|---------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|------------|
| PARAMETER                                                | SYMBOL  | TEST CONDITIONS                                                                                                                                                                              | VALUES | UNITS      |
| Maximum non-repetitive rate of rise of turned on current | $di/dt$ | $T_J = T_J$ maximum, $V_{DRM} = \text{rated } V_{DRM}$<br>$I_{TM} = 2 \times di/dt$                                                                                                          | 1000   | A/ $\mu$ s |
| Typical delay time                                       | $t_d$   | $T_J = 25^\circ\text{C}$ , $V_{DM} = \text{Rated } V_{DRM}$ , $I_{TM} = 50\text{ A DC}$ , $t_p = 1\text{ }\mu\text{s}$<br>Resistive load, gate pulse: 10 V, 5 $\Omega$ source                | 0.83   | $\mu$ s    |
| Maximum turn-off time <sup>(1)</sup>                     | $t_q$   | $T_J = T_J$ maximum,<br>$I_{TM} = 550\text{ A}$ , commutating $di/dt = 40\text{ A}/\mu\text{s}$<br>$V_R = 50\text{ V}$ , $t_p = 500\text{ }\mu\text{s}$ , $dV/dt$ : See table in device code | 10     |            |
|                                                          |         |                                                                                                                                                                                              | 30     |            |

**Note**

<sup>(1)</sup>  $t_q = 10\text{ }\mu\text{s}$  to  $20\text{ }\mu\text{s}$  for 400 V to 800 V devices;  $t_q = 15\text{ }\mu\text{s}$  to  $30\text{ }\mu\text{s}$  for 1000 V to 1200 V devices

| 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 % $V_{DRM}$ ,<br>higher value available on request | 500    | V/ $\mu$ s |
| Maximum peak reverse and off-state leakage current | $I_{RRM}$ ,<br>$I_{DRM}$ | $T_J = T_J$ maximum, rated $V_{DRM}/V_{RRM}$ applied                                 | 50     | mA         |

| TRIGGERING                                  |             |                                                                          |        |       |
|---------------------------------------------|-------------|--------------------------------------------------------------------------|--------|-------|
| PARAMETER                                   | SYMBOL      | TEST CONDITIONS                                                          | VALUES | UNITS |
| Maximum peak gate power                     | $P_{GM}$    | $T_J = T_J$ maximum, $f = 50\text{ Hz}$ , $d\% = 50$                     | 60     | W     |
| Maximum average gate power                  | $P_{G(AV)}$ |                                                                          | 10     |       |
| Maximum peak positive gate current          | $I_{GM}$    | $T_J = T_J$ maximum, $t_p \leq 5\text{ ms}$                              | 10     | A     |
| Maximum peak positive gate voltage          | $+V_{GM}$   |                                                                          | 20     | V     |
| Maximum peak negative gate voltage          | $-V_{GM}$   |                                                                          | 5      |       |
| Maximum DC gate current required to trigger | $I_{GT}$    | $T_J = 25^\circ\text{C}$ , $V_A = 12\text{ V}$ , $R_a = 6\text{ }\Omega$ | 200    | mA    |
| Maximum DC gate voltage required to trigger | $V_{GT}$    |                                                                          | 3      | V     |
| Maximum DC gate current not to trigger      | $I_{GD}$    | $T_J = T_J$ maximum, rated $V_{DRM}$ applied                             | 20     | mA    |
| Maximum 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       | $^\circ\text{C}$ |
| Maximum storage temperature range                | $T_{Stg}$    |                                               | -40 to 150       |                  |
| Maximum thermal resistance, junction to heatsink | $R_{thJ-hs}$ | DC operation single side cooled               | 0.11             | K/W              |
|                                                  |              | DC operation double side cooled               | 0.05             |                  |
| Maximum thermal resistance, case to heatsink     | $R_{thC-hs}$ | DC operation single side cooled               | 0.011            |                  |
|                                                  |              | DC operation double side cooled               | 0.005            |                  |
| Mounting force, $\pm 10\%$                       |              |                                               | 9800<br>(1000)   | N<br>(kg)        |
| Approximate weight                               |              |                                               | 250              | 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             |
|                                | SINGLE SIDE           | DOUBLE SIDE | SINGLE SIDE            | DOUBLE SIDE |                             |
| 180°                           | 0.012                 | 0.010       | 0.008                  | 0.008       | $T_J = T_J \text{ maximum}$ |
| 120°                           | 0.014                 | 0.015       | 0.014                  | 0.014       |                             |
| 90°                            | 0.018                 | 0.018       | 0.019                  | 0.019       |                             |
| 60°                            | 0.026                 | 0.027       | 0.027                  | 0.028       |                             |
| 30°                            | 0.045                 | 0.046       | 0.046                  | 0.046       |                             |
|                                |                       |             |                        |             | K/W                         |

**Note**

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

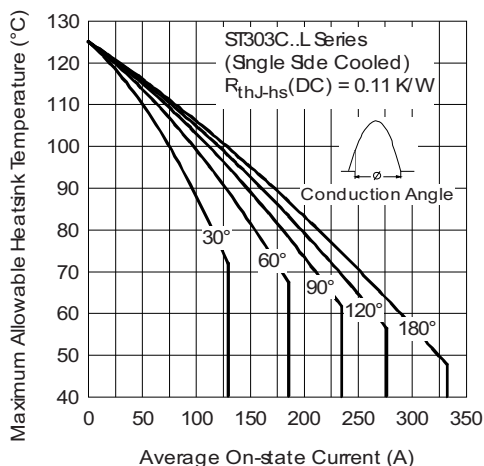


Fig. 1 - Current Ratings Characteristics

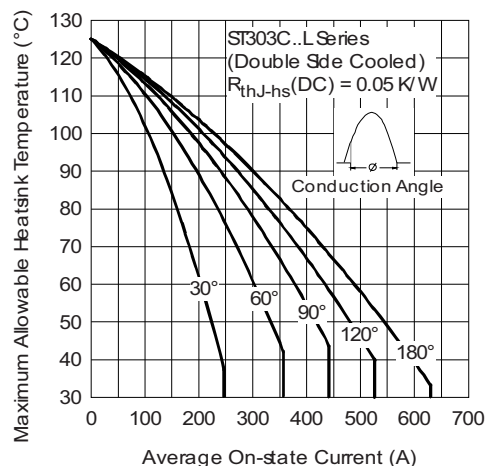


Fig. 3 - Current Ratings Characteristics

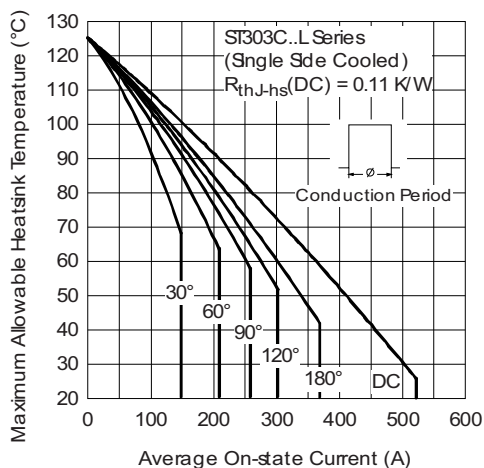


Fig. 2 - Current Ratings Characteristics

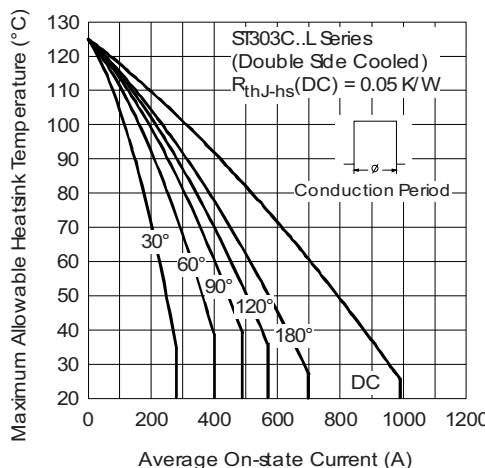


Fig. 4 - Current Ratings Characteristics

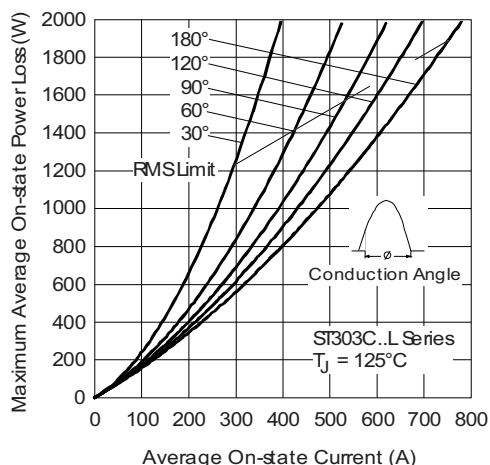


Fig. 5 - On-State Power Loss Characteristics

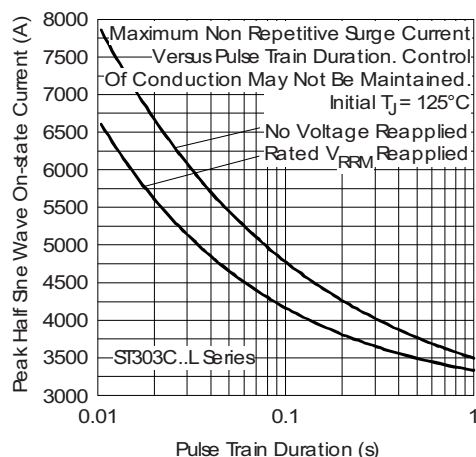


Fig. 8 - Maximum Non-Repetitive Surge Current Single and Double Side Cooled

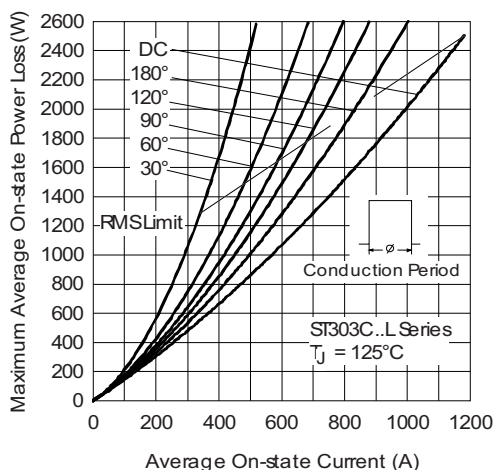


Fig. 6 - On-state Power Loss Characteristics

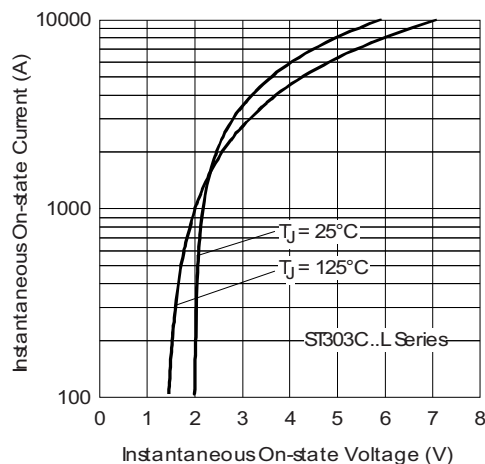


Fig. 9 - On-state Voltage Drop Characteristics

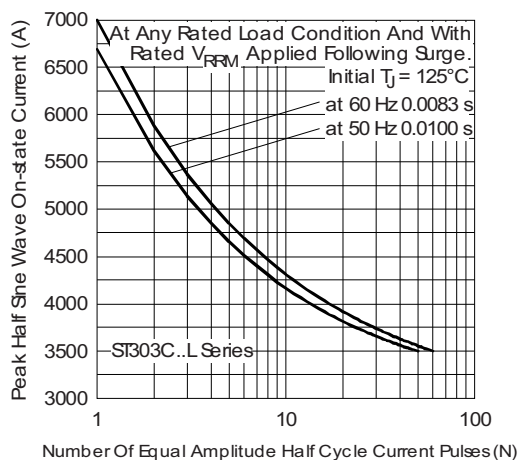


Fig. 7 - Maximum Non-Repetitive Surge Current Single and Double Side Cooled

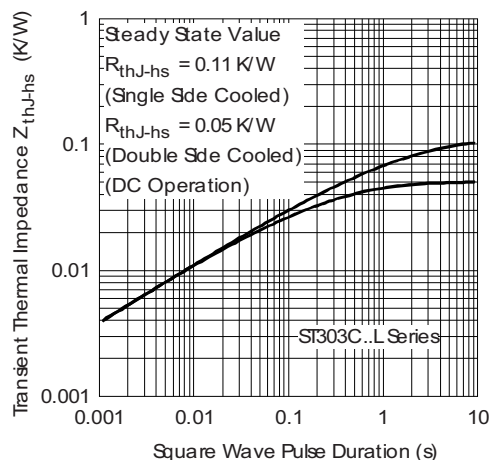


Fig. 10 - Thermal Impedance  $Z_{thJ-hs}$  Characteristics

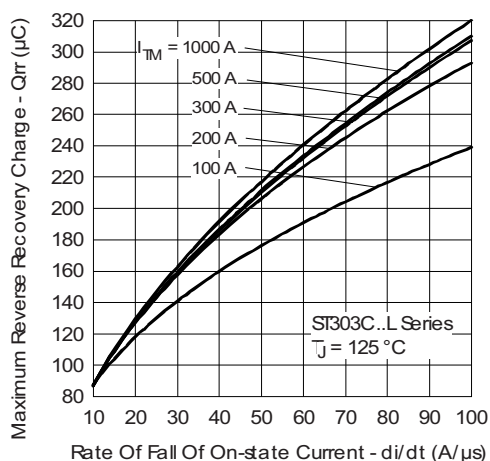


Fig. 11 - Reverse Recovered Charge Characteristics

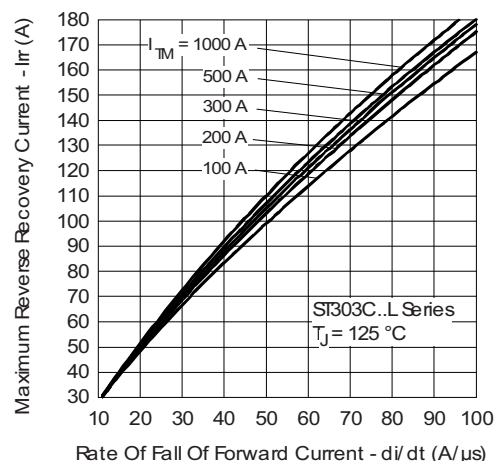


Fig. 12 - Reverse Recovery Current Characteristics

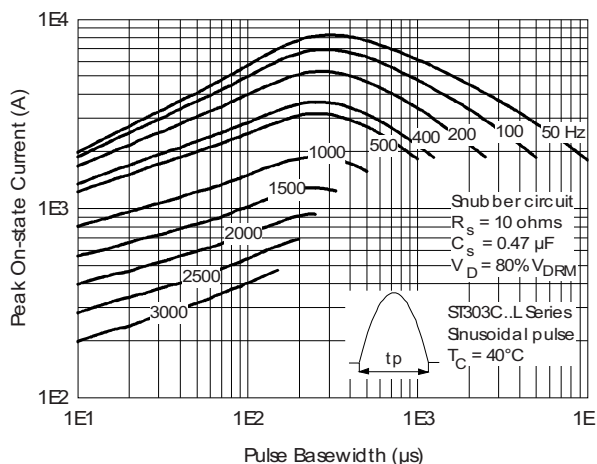


Fig. 13 - Frequency Characteristics

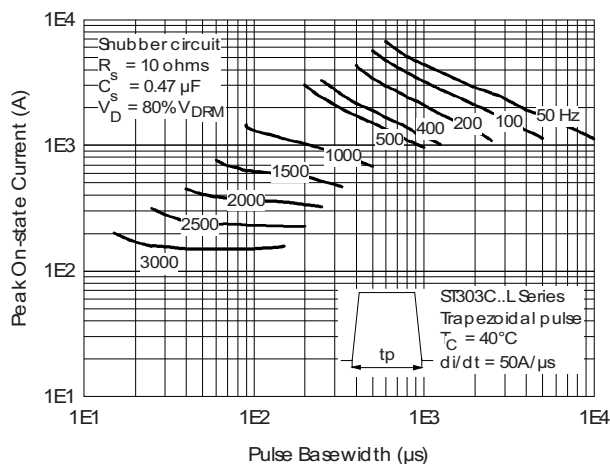
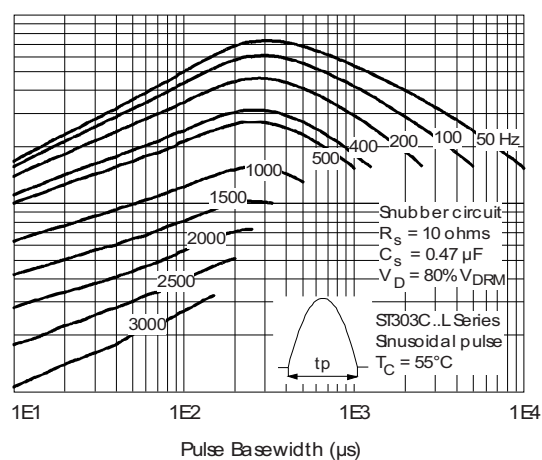
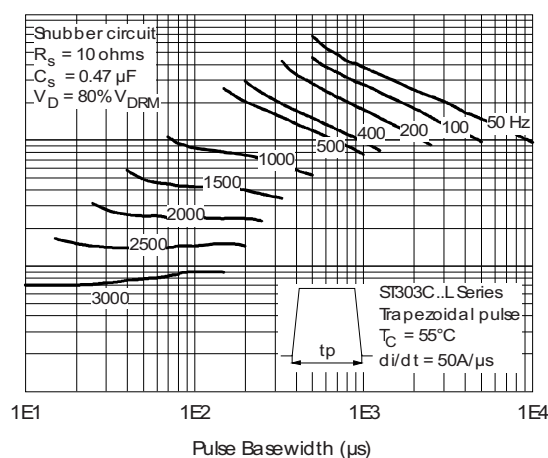


Fig. 14 - Frequency Characteristics



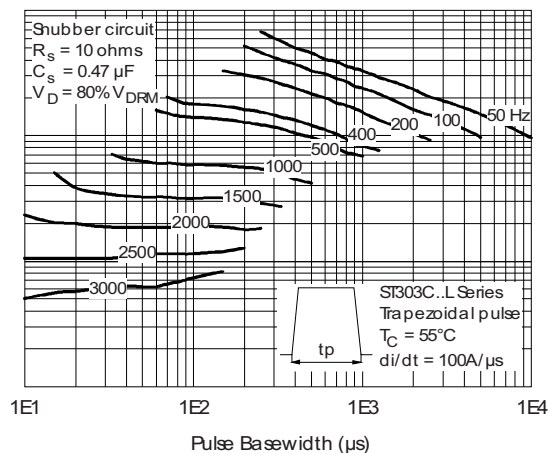
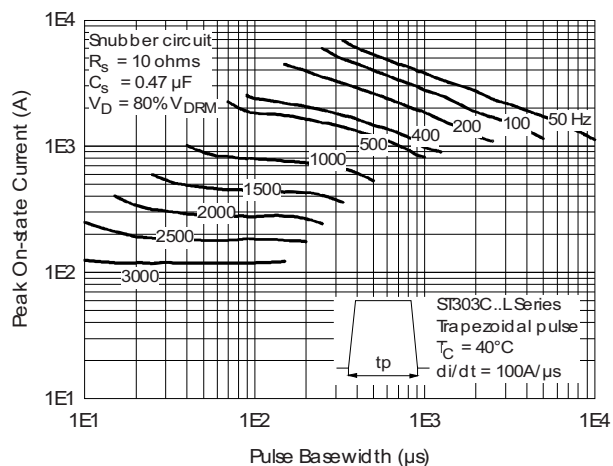


Fig. 15 - Frequency Characteristics

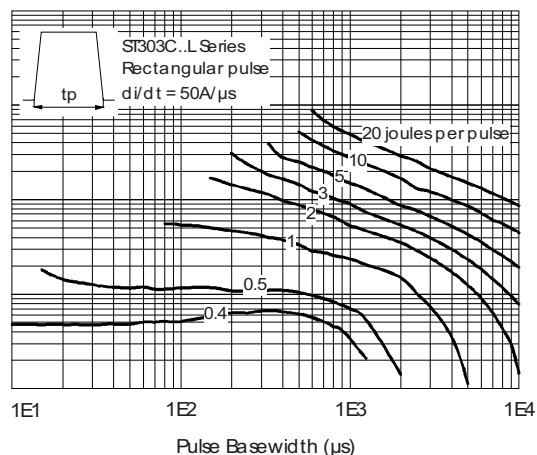
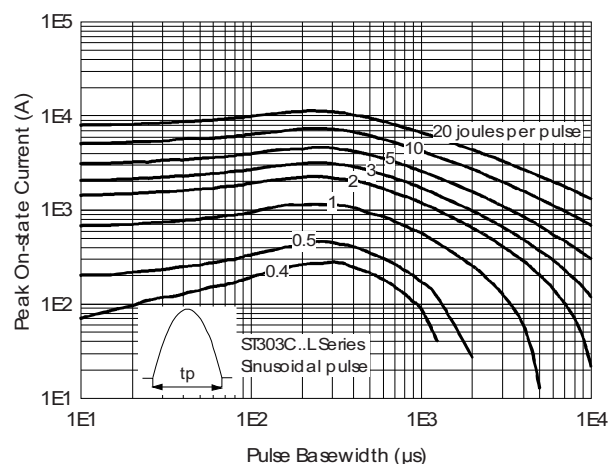


Fig. 16 - Maximum On-State Energy Power Loss Characteristics

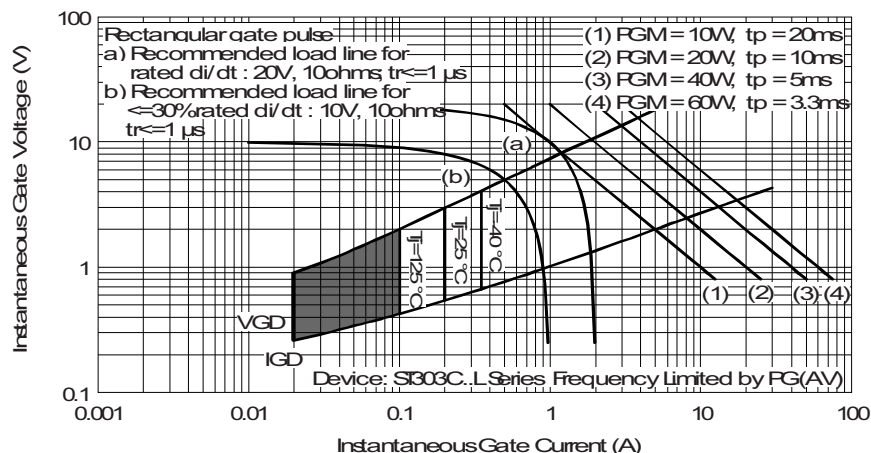


Fig. 17 - Gate Characteristics





## ORDERING INFORMATION TABLE

|             |            |           |           |          |          |           |          |          |          |          |          |
|-------------|------------|-----------|-----------|----------|----------|-----------|----------|----------|----------|----------|----------|
| Device code | <b>VS-</b> | <b>ST</b> | <b>30</b> | <b>3</b> | <b>C</b> | <b>12</b> | <b>L</b> | <b>H</b> | <b>K</b> | <b>1</b> | <b>-</b> |
|             | ①          | ②         | ③         | ④        | ⑤        | ⑥         | ⑦        | ⑧        | ⑨        | ⑩        | ⑪        |

- 1** - Vishay Semiconductors product
- 2** - Thyristor
- 3** - Essential part number
- 4** - 3 = fast turn-off
- 5** - C = ceramic PUK
- 6** - Voltage code x 100 =  $V_{RRM}$   
(see Voltage Ratings table)
- 7** - C = PUK case B-PUK (TO-200AC)
- 8** - Reapplied dV/dt code (for  $t_q$  test condition)
- 9** -  $t_q$  code
- 10** - 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)
- 11** - Critical dV/dt:
  - None = 500 V/ $\mu$ s (standard value)
  - L = 1000 V/ $\mu$ s (special selection)

| dV/dt - t <sub>q</sub> combinations available    |    |    |    |     |            |     |
|--------------------------------------------------|----|----|----|-----|------------|-----|
| dV/dt (V/μs)                                     |    | 20 | 50 | 100 | 200        | 400 |
| t <sub>q</sub> (μs)<br>up to 800 V               | 10 | CN | DN | EN  | <b>FN*</b> | HN  |
|                                                  | 12 | CM | DM | EM  | FM         | HM  |
|                                                  | 15 | CL | DL | EL  | <b>FL*</b> | HL  |
|                                                  | 20 | CK | DK | EK  | <b>FK*</b> | HK  |
| t <sub>q</sub> (μs)<br>only for<br>1000 V/1200 V | 15 | CL | -  | -   | -          | -   |
|                                                  | 18 | CP | DP | -   | -          | -   |
|                                                  | 20 | CK | DK | EK  | <b>FK*</b> | HK  |
|                                                  | 25 | CJ | DJ | EJ  | <b>FJ*</b> | HJ  |
|                                                  | 30 | -  | DH | EH  | FH         | HH  |

\* Standard part number.

All other types available only on request.

## LINKS TO RELATED DOCUMENTS

Dimensions

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

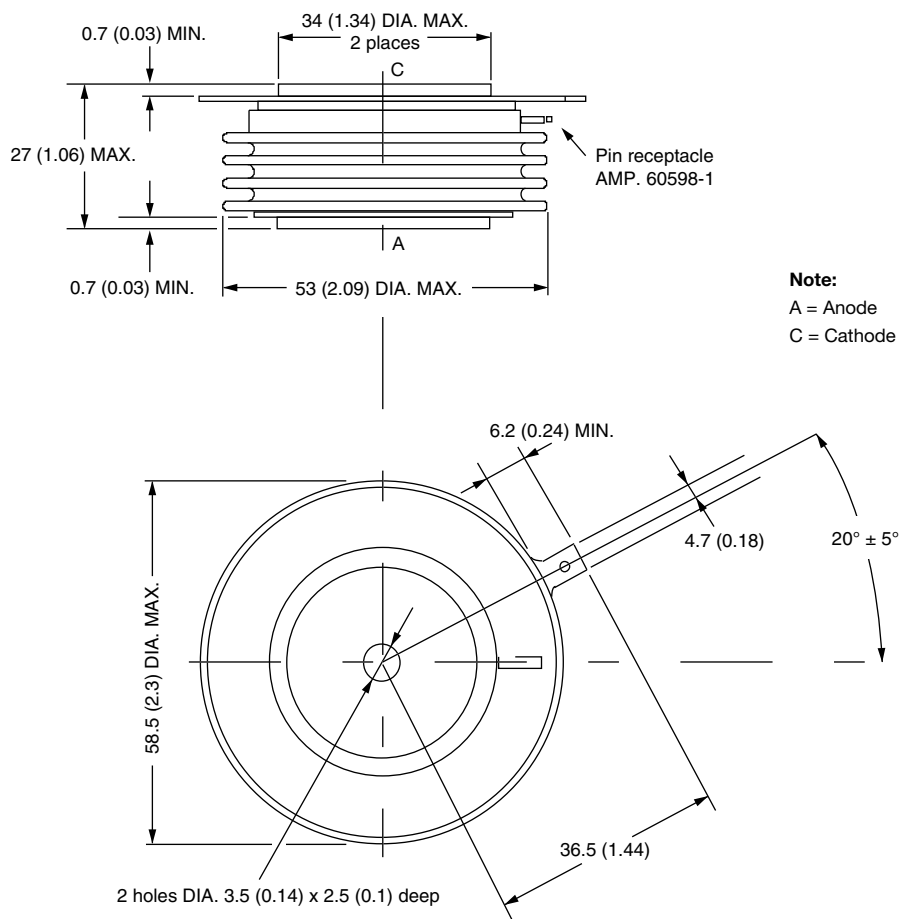




## B-PUK (TO-200AC)

### 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)



## Disclaimer

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