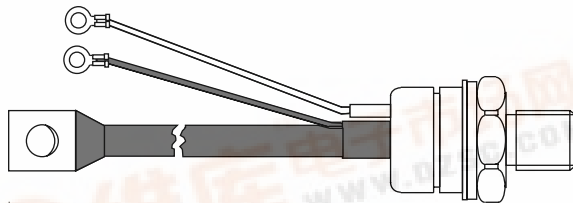




# 180RKI...PbF /181RKI...PbF Series

Vishay High Power Products

## Phase Control Thyristors (Stud Version), 180 A



TO-209AB (TO-93)

### FEATURES

- Hermetic glass-metal seal
- International standard case TO-209AB ( TO-93)
- RoHS compliant
- Lead (Pb)-free
- Designed and qualified for industrial level



RoHS  
COMPLIANT

### PRODUCT SUMMARY

|             |       |
|-------------|-------|
| $I_{T(AV)}$ | 180 A |
|-------------|-------|

### TYPICAL APPLICATIONS

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

### MAJOR RATINGS AND CHARACTERISTICS

| PARAMETER         | TEST CONDITIONS | VALUES      | UNITS             |
|-------------------|-----------------|-------------|-------------------|
| $I_{T(AV)}$       |                 | 180         | A                 |
|                   | $T_C$           | 80          | °C                |
| $I_{T(RMS)}$      |                 | 285         | A                 |
| $I_{TSM}$         | 50 Hz           | 3800        |                   |
|                   | 60 Hz           | 4000        |                   |
| $I^2t$            | 50 Hz           | 72          | kA <sup>2</sup> s |
|                   | 60 Hz           | 66          |                   |
| $V_{DRM}/V_{RRM}$ |                 | 400 to 1000 | V                 |
| $t_q$             | Typical         | 100         | μs                |
| $T_J$             |                 | - 40 to 125 | °C                |

### ELECTRICAL SPECIFICATIONS

#### VOLTAGE RATINGS

| PART 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 |
|-------------|--------------|------------------------------------------------------------------------|------------------------------------------------------|--------------------------------------------------------|
| 180/181RKI  | 40           | 400                                                                    | 500                                                  | 30                                                     |
|             | 80           | 800                                                                    | 900                                                  |                                                        |
|             | 100          | 1000                                                                   | 1100                                                 |                                                        |



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| ABSOLUTE MAXIMUM RATINGS                             |                     |                                                                                                          |                                  |                                                                       |        |                    |
|------------------------------------------------------|---------------------|----------------------------------------------------------------------------------------------------------|----------------------------------|-----------------------------------------------------------------------|--------|--------------------|
| PARAMETER                                            | SYMBOL              | TEST CONDITIONS                                                                                          |                                  |                                                                       | VALUES | UNITS              |
| Maximum average on-state current at case temperature | I <sub>T(AV)</sub>  | 180° conduction, half sine wave                                                                          |                                  |                                                                       | 180    | A                  |
|                                                      |                     |                                                                                                          |                                  |                                                                       | 80     | °C                 |
| Maximum RMS on-state current                         | I <sub>RMS</sub>    | DC at 79 °C case temperature                                                                             |                                  |                                                                       | 285    | 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 | 3800   |                    |
|                                                      |                     | t = 8.3 ms                                                                                               |                                  |                                                                       | 4000   |                    |
|                                                      |                     | t = 10 ms                                                                                                | 100 % V <sub>RRM</sub> reapplied |                                                                       | 3500   |                    |
|                                                      |                     | t = 8.3 ms                                                                                               |                                  |                                                                       | 3660   |                    |
| Maximum I <sup>2</sup> t for fusing                  | I <sup>2</sup> t    | t = 10 ms                                                                                                | No voltage reapplied             |                                                                       | 72     | kA <sup>2</sup> s  |
|                                                      |                     | t = 8.3 ms                                                                                               |                                  |                                                                       | 66     |                    |
|                                                      |                     | t = 10 ms                                                                                                | 100 % V <sub>RRM</sub> reapplied |                                                                       | 61     |                    |
|                                                      |                     | t = 8.3 ms                                                                                               |                                  |                                                                       | 56     |                    |
| Maximum I <sup>2</sup> √t for fusing                 | I <sup>2</sup> √t   | t = 0.1 to 10 ms, no voltage reapplied                                                                   |                                  |                                                                       | 720    | 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 |                                  |                                                                       | 0.83   | 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                                   |                                  |                                                                       | 0.89   |                    |
| 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 |                                  |                                                                       | 0.92   | 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                                     |                                  |                                                                       | 0.81   |                    |
| Maximum on-state voltage                             | V <sub>TM</sub>     | I <sub>pk</sub> = 570 A, T <sub>J</sub> = T <sub>J</sub> maximum, t <sub>p</sub> = 10 ms sine pulse      |                                  |                                                                       | 1.35   | 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 $\Omega$ , $t_r \leq 1 \text{ }\mu\text{s}$<br>$T_J = T_J \text{ maximum}$ , anode voltage $\leq 80 \% V_{DRM}$                      | 300    | A/ $\mu\text{s}$ |
| Typical delay time                                       | $t_d$   | Gate current 1 A, $di_g/dt = 1 \text{ A}/\mu\text{s}$<br>$V_d = 0.67 \% V_{DRM}$ , $T_J = 25 \text{ °C}$                                                 | 1.0    | $\mu\text{s}$    |
| Typical turn-off time                                    | $t_q$   | $I_{TM} = 50 \text{ A}$ , $T_J = T_J \text{ maximum}$ , $di/dt = 10 \text{ A}/\mu\text{s}$ , $V_R = 100 \text{ V}$<br>$dV/dt = 20 \text{ V}/\mu\text{s}$ | 100    |                  |

| BLOCKING                                           |                          |                                                             |        |                  |
|----------------------------------------------------|--------------------------|-------------------------------------------------------------|--------|------------------|
| PARAMETER                                          | SYMBOL                   | TEST CONDITIONS                                             | VALUES | UNITS            |
| Maximum critical rate of rise of off-state voltage | $dV/dt$                  | $T_J = T_J \text{ maximum}$ linear to 80 % rated $V_{DRM}$  | 500    | V/ $\mu\text{s}$ |
| Maximum peak reverse and off-state leakage current | $I_{RRM}$ ,<br>$I_{DRM}$ | $T_J = T_J \text{ maximum}$ rated $V_{DRM}/V_{RRM}$ applied | 30     | mA               |



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| 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     |      | 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<br>value which will trigger all units<br>12 V anode to cathode applied                           | 130    | -    | mA    |
|                                     |                    | T <sub>J</sub> = 25 °C                                         |                                                                                                                                                                   | 65     | 150  |       |
|                                     |                    | T <sub>J</sub> = 125 °C                                        |                                                                                                                                                                   | 35     | -    |       |
| DC gate voltage required to trigger | V <sub>GT</sub>    | T <sub>J</sub> = - 40 °C                                       |                                                                                                                                                                   | 2.0    | -    | V     |
|                                     |                    | T <sub>J</sub> = 25 °C                                         |                                                                                                                                                                   | 1.2    | 2.5  |       |
|                                     |                    | T <sub>J</sub> = 125 °C                                        |                                                                                                                                                                   | 0.9    | -    |       |
| 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           | 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 case    | $R_{thJC}$ | DC operation                                  | 0.15             | K/W              |
| Maximum thermal resistance, junction to ambient | $R_{thCS}$ | Mounting surface, smooth, flat and greased    | 0.04             |                  |
| Mounting force, $\pm 10$ %                      |            | Non-lubricated threads                        | 31<br>(275)      | Nm<br>(lbf · in) |
|                                                 |            | Lubricated threads                            | 24.5<br>(210)    |                  |
| Approximate weight                              |            |                                               | 280              | g                |
| Case style                                      |            | See dimensions - link at the end of datasheet | TO-209AB (TO-93) |                  |

| $\Delta R_{thJC}$ CONDUCTION |                       |                        |                     |       |
|------------------------------|-----------------------|------------------------|---------------------|-------|
| CONDUCTION ANGLE             | SINUSOIDAL CONDUCTION | RECTANGULAR CONDUCTION | TEST CONDITIONS     | UNITS |
| 180°                         | 0.050                 | 0.032                  | $T_J = T_J$ maximum | K/W   |
| 120°                         | 0.063                 | 0.059                  |                     |       |
| 90°                          | 0.080                 | 0.082                  |                     |       |
| 60°                          | 0.118                 | 0.124                  |                     |       |
| 30°                          | 0.225                 | 0.228                  |                     |       |

## Note

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

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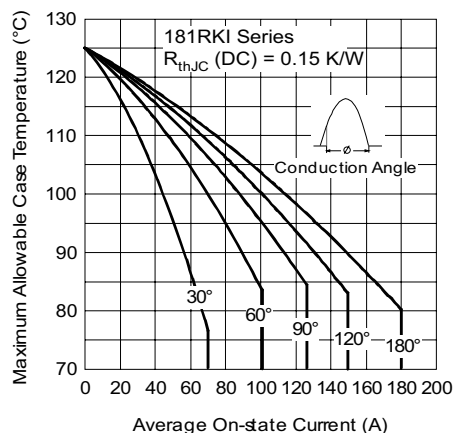


Fig. 1 - Current Ratings Characteristics

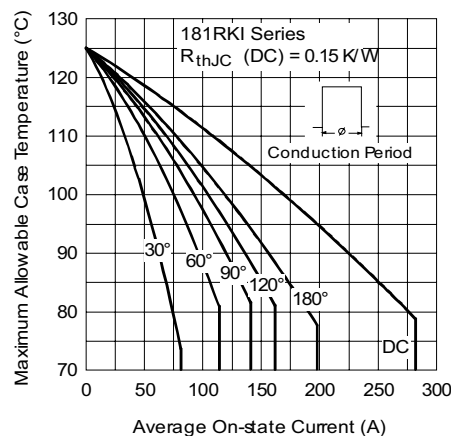


Fig. 2 - Current Ratings Characteristics

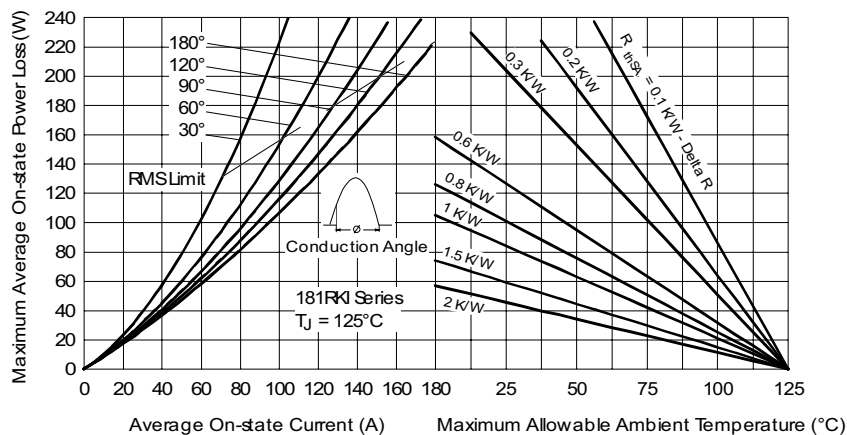


Fig. 3 - On-State Power Loss Characteristics

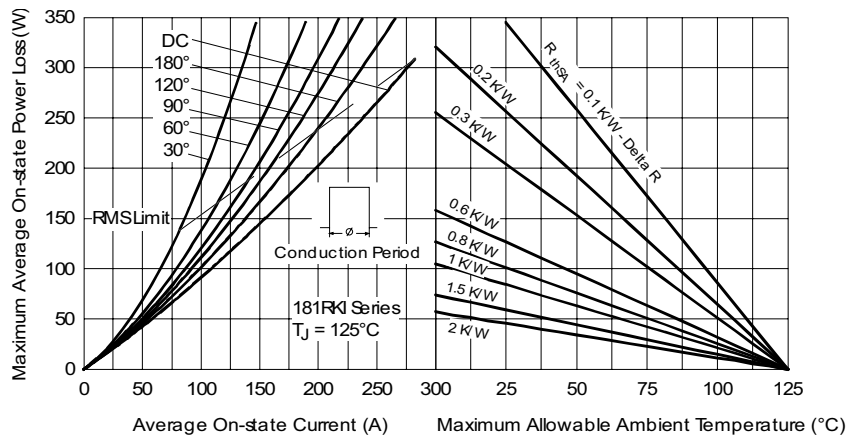


Fig. 4 - On-State Power Loss Characteristics



## 180RKI...PbF /181RKI...PbF Series

Phase Control Thyristors  
(Stud Version), 180 A

Vishay High Power Products

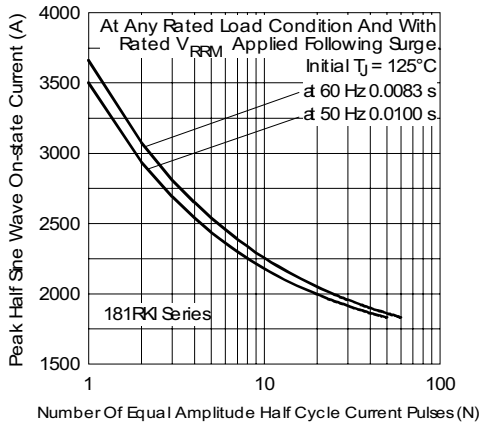


Fig. 5 - Maximum Non-Repetitive Surge Current

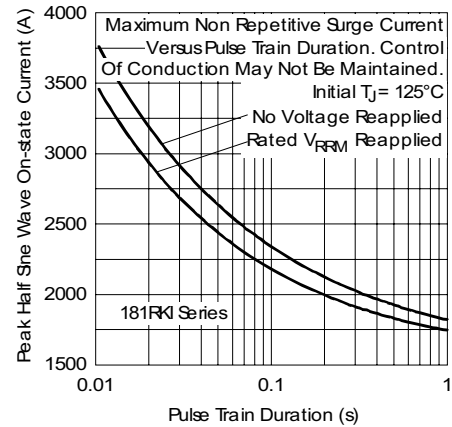


Fig. 6 - Maximum Non-Repetitive Surge Current

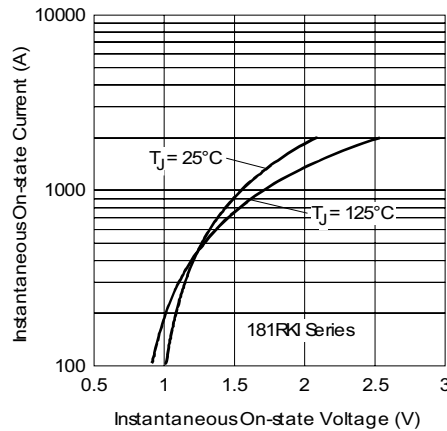


Fig. 7 - On-State Voltage Drop Characteristics

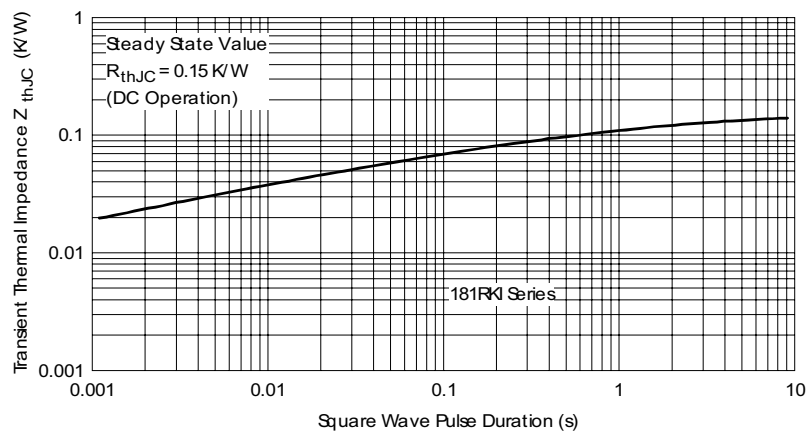


Fig. 8 - Thermal impedance  $Z_{thJC}$  Characteristics

# 180RKI...PbF /181RKI...PbF Series



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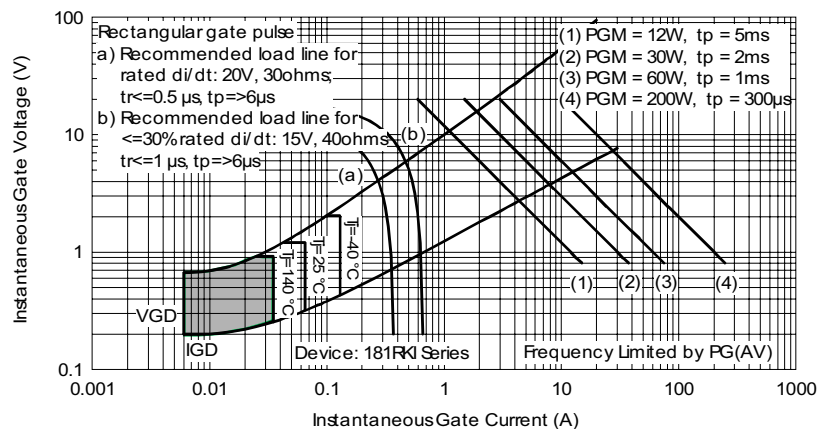


Fig. 9 - Gate Characteristics

## ORDERING INFORMATION TABLE

| Device code | 18                                                                                                                    | 1 | RKI | 100 | PbF |
|-------------|-----------------------------------------------------------------------------------------------------------------------|---|-----|-----|-----|
|             | ①                                                                                                                     | ② | ③   | ④   | ⑤   |
| ①           | - $I_{T(AV)}$ rated average output current (rounded/10)                                                               |   |     |     |     |
| ②           | - 0 = Eyelet terminals (gate and auxiliary cathode leads)<br>1 = Fast-on terminals (gate and auxiliary cathode leads) |   |     |     |     |
| ③           | - Thyristor                                                                                                           |   |     |     |     |
| ④           | - Voltage code x 10 = $V_{RRM}$ (see Voltage Ratings table)                                                           |   |     |     |     |
| ⑤           | - Lead (Pb)-free                                                                                                      |   |     |     |     |

| LINKS TO RELATED DOCUMENTS |                                                                               |
|----------------------------|-------------------------------------------------------------------------------|
| Dimensions                 | <a href="http://www.vishay.com/doc?95077">http://www.vishay.com/doc?95077</a> |



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