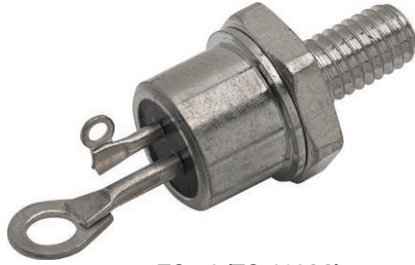




## Phase Control Thyristor RMS SCRs, 25 A, 35 A



TO-48 (TO-208AA)

**FEATURES**

- General purpose stud mounted
- Broad forward and reverse voltage range - through 1200 V
- Material categorization: for definitions of compliance please see [www.vishay.com/doc?99912](http://www.vishay.com/doc?99912)


**RoHS**  
COMPLIANT

| PRIMARY CHARACTERISTICS |   |
|-------------------------|---|
| $I_{T(AV)}$             | 16 A, 22 A  |
| $I_{T(RMS)}$            | 25 A, 35 A  |
| $V_{DRM}/V_{RRM}$       | 25 V, 50 V, 100 V, 150 V, 200 V, 250 V, 300 V, 400 V, 500 V, 600 V, 700 V, 800 V, 1000 V 1200 V |
| $V_{TM}$                | 2.3 V   |
| $I_{GT}$                | 60 mA   |
| $T_J$                   | -40 °C to +125 °C   |
| Package                 | TO-48 (TO-208AA)  |
| Circuit configuration   | Single SCR  |

| MAJOR RATINGS AND CHARACTERISTICS |                 |                            |                            |                  |
|-----------------------------------|-----------------|----------------------------|----------------------------|------------------|
| PARAMETER                         | TEST CONDITIONS | VALUES<br>2N681-92         | VALUES<br>2N5205-07        | UNITS            |
| $I_{T(AV)}$                       |                 | 16 <sup>(1)</sup>          | 22 <sup>(1)</sup>          | A                |
|                                   | $T_C$           | -65 to +65 <sup>(1)</sup>  | -40 to +40                 | °C               |
| $I_{T(RMS)}$                      |                 | 25                         | 35                         | A                |
| $I_{TSM}$                         | 50 Hz           | 145                        | 285                        | A                |
|                                   | 60 Hz           | 150 <sup>(1)</sup>         | 300 <sup>(1)</sup>         |                  |
| $I^2t$                            | 50 Hz           | 103                        | 410                        | A <sup>2</sup> s |
|                                   | 60 Hz           | 94                         | 375                        |                  |
| $I_{GT}$                          |                 | 40                         | 40                         | mA               |
| $dV/dt$                           |                 | -                          | 100 <sup>(1)</sup>         | V/ $\mu$ s       |
| $dl/dt$                           |                 | 75 to 100                  | 100                        | A/ $\mu$ s       |
| $V_{DRM}$                         | Range           | 25 to 800                  | 600 to 1200                | V                |
| $V_{RRM}$                         | Range           | 25 to 800                  | 600 to 1200                | V                |
| $T_J$                             |                 | -65 to +125 <sup>(1)</sup> | -40 to +125 <sup>(1)</sup> | °C               |

**Note**
<sup>(1)</sup> JEDEC® registered value



## ELECTRICAL SPECIFICATIONS

| VOLTAGE RATINGS (APPLIED GATE VOLTAGE ZERO OR NEGATIVE) |  |  |                   |
|---|--|--|-------------------|
| TYPE NUMBER   | $V_{RRM}/V_{DRM}$ , MAXIMUM REPETITIVE PEAK REVERSE AND OFF-STATE VOLTAGE<br>V | $V_{RSM}$ , MAXIMUM NON-REPETITIVE PEAK REVERSE VOLTAGE ( $t_p < 5$ ms)<br>V | $T_J$             |
| VS-2N681  | 25   | 35   | -65 °C to +125 °C |
| VS-2N682  | 50   | 75   |                   |
| VS-2N683  | 100  | 150  |                   |
| VS-2N684  | 150  | 200  |                   |
| VS-2N685  | 200  | 300  |                   |
| VS-2N686  | 250  | 350  |                   |
| VS-2N687  | 300  | 400  |                   |
| VS-2N688  | 400  | 500  |                   |
| VS-2N689  | 500  | 600  |                   |
| VS-2N690  | 600  | 720  |                   |
| VS-2N691  | 700  | 840  |                   |
| VS-2N692  | 800  | 960  |                   |
| VS-2N5205   | 800  | 960  | -40 °C to +125 °C |
| VS-2N5206   | 1000   | 1200   |                   |
| VS-2N5207   | 1200   | 1440   |                   |

## Note

- JEDEC registered values

| ABSOLUTE MAXIMUM RATINGS                                      |                              |   |  |                           |                              |                   |
|---|------------------------------|---|--|---------------------------|------------------------------|-------------------|
| PARAMETER   | SYMBOL                       | TEST CONDITIONS   |  | VALUES<br>2N681-92        | VALUES<br>2N5205-07          | UNITS             |
| Maximum average on-state current at case temperature          | $I_{T(AV)}$                  | 180° half sine wave conduction  |  | 16 <sup>(1)</sup>         | 22 <sup>(1)</sup>            | A                 |
|   |                              |   |  | -65 to +65 <sup>(1)</sup> | -40 to +40 <sup>(1)</sup>    | °C                |
| Maximum RMS on-state current                                  | $I_{T(RMS)}$                 |   |  | 25                        | 35                           | A                 |
| Maximum peak, one-cycle non-repetitive surge current          | $I_{TSM}$                    | 50 Hz half cycle sine wave or 6 ms rectangular pulse  | Following any rated load condition, and with rated $V_{RRM}$ applied following surge | 145                       | 285                          | A                 |
|   |                              | 60 Hz half cycle sine wave or 5 ms rectangular pulse  |  | 150 <sup>(1)</sup>        | 300 <sup>(1)</sup>           |                   |
|   |                              | 50 Hz half cycle sine wave or 6 ms rectangular pulse  | Same conditions as above except with $V_{RRM}$ applied following surge = 0           | 170                       | 340                          |                   |
|   |                              | 60 Hz half cycle sine wave or 5 ms rectangular pulse  |  | 180                       | 355                          |                   |
| Maximum $I^2t$ capability for fusing                          | $I^2t$                       | t = 10 ms   | Rated $V_{RRM}$ applied following surge, initial $T_J = 125$ °C                      | 103                       | 410                          | A <sup>2</sup> s  |
|   |                              | t = 8.3 ms  |  | 94                        | 375                          |                   |
| Maximum $I^2t$ capability for individual device fusing        | $I^2t$                       | t = 10 ms   | $V_{RRM} = 0$ following surge, initial $T_J = 125$ °C                                | 145                       | 580                          |                   |
|   |                              | t = 8.3 ms  |  | 135                       | 530                          |                   |
| Maximum $I^2\sqrt{t}$ capability for individual device fusing | $I^2\sqrt{t}$ <sup>(2)</sup> | t = 0.1 ms to 10 ms, initial $T_J < 125$ °C<br>$V_{RRM}$ applied following surge = 0          |  | 1450                      | 5800                         | A <sup>2</sup> √s |
| Maximum peak on-state voltage                                 | $V_{TM}$                     | $T_J = 25$ °C, $I_{T(AV)} = 16$ A (50 A peak) 2N681,<br>$I_{T(AV)} = 22$ A (70 A peak) 2N5204 |  | 2 <sup>(1)</sup>          | 2.3 <sup>(1)</sup>           | V                 |
| Maximum holding current                                       | $I_H$                        | Anode supply 24 V, initial $I_T = 1.0$ A  |  | 20 at 25 °C (typical)     | 200 <sup>(1)</sup> at -40 °C | mA                |

## Notes

- <sup>(1)</sup> JEDEC registered value  
<sup>(2)</sup>  $I^2t$  for time  $t_x = I^2\sqrt{t} \cdot \sqrt{t_x}$



| SWITCHING  |                |  |                    |                     |       |
|--|----------------|--|--------------------|---------------------|-------|
| PARAMETER  | SYMBOL         | TEST CONDITIONS  | VALUES<br>2N681-92 | VALUES<br>2N5205-07 | UNITS |
| Maximum non-repetitive rate of rise of turned-on current | di/dt          | T <sub>C</sub> = 125 °C, V <sub>DM</sub> = Rated V <sub>DRM</sub> , I <sub>TM</sub> = 2 x di/dt, gate pulse = 20 V, 15 Ω, t <sub>p</sub> = 6 μs, t <sub>r</sub> = 0.1 μs maximum<br>Per JEDEC standard RS-397, 5.2.2.6 | 100                | -                   | A/μs  |
|  |                |  | 75                 | -                   |       |
|  |                |  | -                  | 100                 |       |
| Typical delay time                                       | t <sub>d</sub> | T <sub>C</sub> = 25 °C, V <sub>DM</sub> = Rated V <sub>DRM</sub> , I <sub>TM</sub> = 10 A<br>DC resistive circuit, gate pulse = 10 V, 40 Ω source, t <sub>p</sub> = 6 μs, t <sub>r</sub> = 0.1 μs                      | 1                  | 1                   | μs    |

| BLOCKING   |                                     |  |  |                     |       |    |
|--|-------------------------------------|--|--|---------------------|-------|----|
| PARAMETER  | SYMBOL                              | TEST CONDITIONS  | VALUES<br>2N681-92                           | VALUES<br>2N5205-07 | UNITS |    |
| Minimum critical rate of rise of off-state voltage | dV/dt                               | T <sub>J</sub> = 125 °C, exponential to 100 % rated V <sub>DRM</sub> | 100 (typical)                                | 100 <sup>(1)</sup>  | V/μs  |    |
|  |                                     | T <sub>J</sub> = 125 °C, exponential to 67 % rated V <sub>DRM</sub>  | 250 (typical)                                | 250                 |       |    |
| Maximum reverse leakage current                    | I <sub>DRM</sub> , I <sub>RRM</sub> | T <sub>J</sub> = 125 °C  | V <sub>RRM</sub> , V <sub>DRM</sub> = 400 V  | 3.5                 | -     | mA |
|  |                                     |  | V <sub>RRM</sub> , V <sub>DRM</sub> = 500 V  | 3.5                 | -     |    |
|  |                                     |  | V <sub>RRM</sub> , V <sub>DRM</sub> = 600 V  | 2.5                 | 3.3   |    |
|  |                                     |  | V <sub>RRM</sub> , V <sub>DRM</sub> = 700 V  | 2.2                 | -     |    |
|  |                                     |  | V <sub>RRM</sub> , V <sub>DRM</sub> = 800 V  | 2                   | 2.5   |    |
|  |                                     |  | V <sub>RRM</sub> , V <sub>DRM</sub> = 1000 V | -                   | 2     |    |
|  |                                     |  | V <sub>RRM</sub> , V <sub>DRM</sub> = 1200 V | -                   | 1.7   |    |

**Note**

<sup>(1)</sup> JEDEC registered value

| TRIGGERING                                  |                    |  |  |                     |       |
|---|--------------------|--|--|---------------------|-------|
| PARAMETER                                   | SYMBOL             | TEST CONDITIONS  | VALUES<br>2N681-92   | VALUES<br>2N5205-07 | UNITS |
| Maximum peak gate power                     | P <sub>GM</sub>    | t <sub>p</sub> < 5 ms for 2N681 series;<br>t <sub>p</sub> < 500 μs for 2N5204 series | 5 <sup>(1)</sup>   | 60 <sup>(1)</sup>   | W     |
| Maximum average gate power                  | P <sub>G(AV)</sub> |  | 0.5 <sup>(1)</sup>   | 0.5 <sup>(1)</sup>  |       |
| Maximum peak positive gate current          | +I <sub>GM</sub>   |  | 2 <sup>(1)</sup>   | 2                   | A     |
| Maximum peak positive gate voltage          | +V <sub>GM</sub>   |  | 10 <sup>(1)</sup>  | -                   | V     |
| Maximum peak negative gate voltage          | -V <sub>GM</sub>   |  | 5 <sup>(1)</sup>   | 5 <sup>(1)</sup>    |       |
| Maximum required DC gate current to trigger | I <sub>GT</sub>    | T <sub>C</sub> = min. rated value  | Maximum required gate trigger current is the lowest value which will trigger all units with + 6 V anode to cathode |                     | mA    |
|   |                    | T <sub>C</sub> = 25 °C   | 40   | 40                  |       |
|   |                    | T <sub>C</sub> = 125 °C  | 18.5   | 20                  |       |
| Typical DC gate current to trigger          |                    | T <sub>C</sub> = 25 °C, + 6 V anode to cathode                                       | 30   | 30                  |       |
| Maximum required DC gate voltage to trigger | V <sub>GT</sub>    | T <sub>C</sub> = -65 °C  | Maximum required gate trigger voltage is the lowest value which will trigger all units with + 6 V anode to cathode |                     | V     |
|   |                    | T <sub>C</sub> = 25 °C   | 2  | 2                   |       |
| Typical DC gate voltage to trigger          |                    | T <sub>C</sub> = 25 °C, + 6 V anode to cathode                                       | 1.5  | 1.5                 |       |
| Maximum DC gate voltage not to trigger      | V <sub>GD</sub>    | T <sub>C</sub> = 125 °C  | 0.25 <sup>(1)</sup>  | 0.25 <sup>(1)</sup> | V     |

**Note**

<sup>(1)</sup> JEDEC registered value



| THERMAL AND MECHANICAL SPECIFICATIONS                 |                |  |                           |                           |          |
|---|----------------|--|---------------------------|---------------------------|----------|
| PARAMETER   | SYMBOL         | TEST CONDITIONS                                | VALUES 2N681-92           | VALUES 2N5205-07          | UNITS    |
| Operating junction and storage temperature range      | $T_J, T_{Stg}$ |  | -65 to 125 <sup>(1)</sup> | -40 to 125 <sup>(1)</sup> | °C       |
| Maximum internal thermal resistance, junction to case | $R_{thJC}$     | DC operation                                   | 1.5                       | 1.5 <sup>(1)</sup>        | °C/W     |
| Typical thermal resistance, case to sink              | $R_{thCS}$     | Mounting surface, smooth, flat and greased     | 0.35                      | 0.35                      |          |
| Mounting torque ± 10 %                                | to nut         | Lubricated threads<br>(Non-lubricated threads) | 20 (27.5)                 |                           | lbf · in |
|   |                |  | 0.23 (0.32)               |                           | kgf · cm |
|   |                |  | 2.3 (3.1)                 |                           | N · m    |
|   | to device      | Lubricated threads                             | 25                        |                           | lbf · in |
|   |                |  | 0.29                      |                           | kgf · cm |
|   |                |  | 2.8                       |                           | N · m    |
| Approximate weight                                    |                |  | 14                        | 14                        | g        |
|   |                |  | 0.49                      | 0.5                       | oz.      |
| Case style  |                |  | TO-48 (TO-208AA)          |                           |          |

**Note**

<sup>(1)</sup> JEDEC registered value

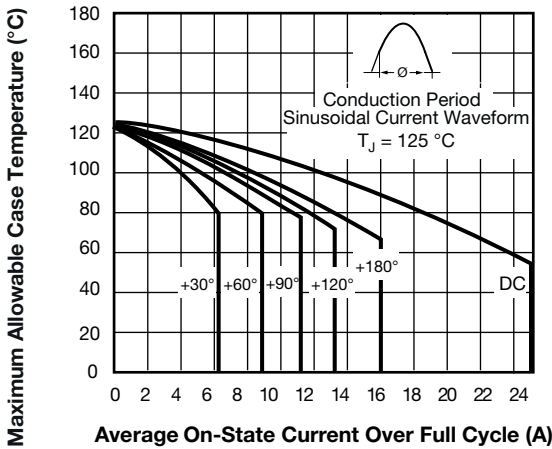


Fig. 1 - Maximum Allowable Case Temperature vs. Average On-State Current, 2N681 Series

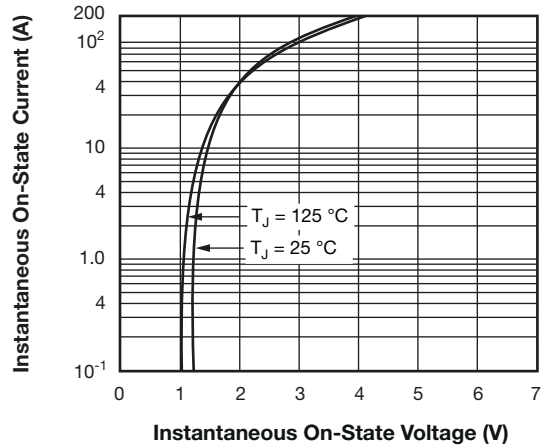
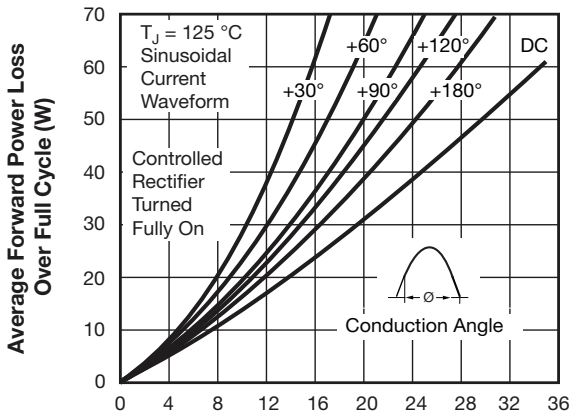
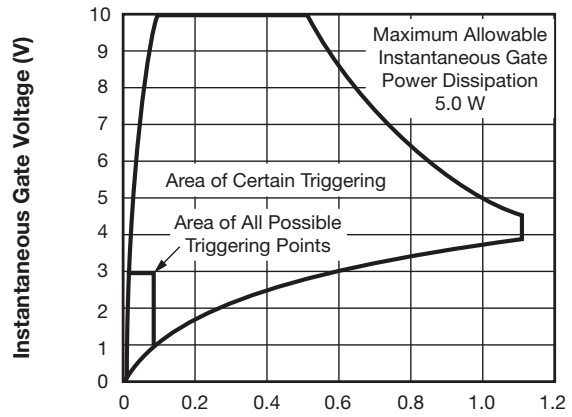


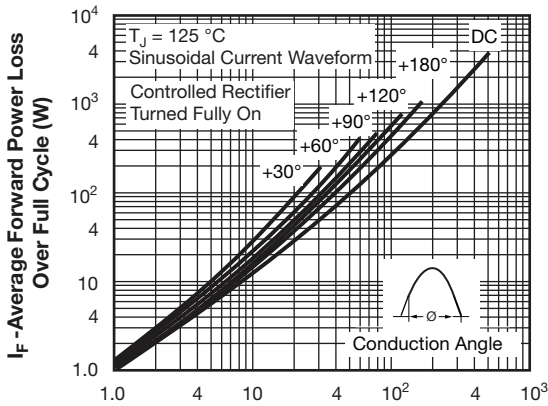
Fig. 2 - Maximum On-State Voltage vs. Current, 2N681 Series



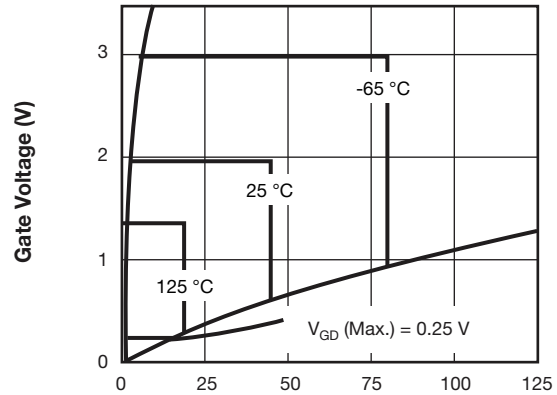
**Average On-State Current Over Full Cycle (A)**  
 Fig. 3 - Maximum Low Level On-State Power Loss vs. Current (Sinusoidal Current Waveform), 2N681 Series



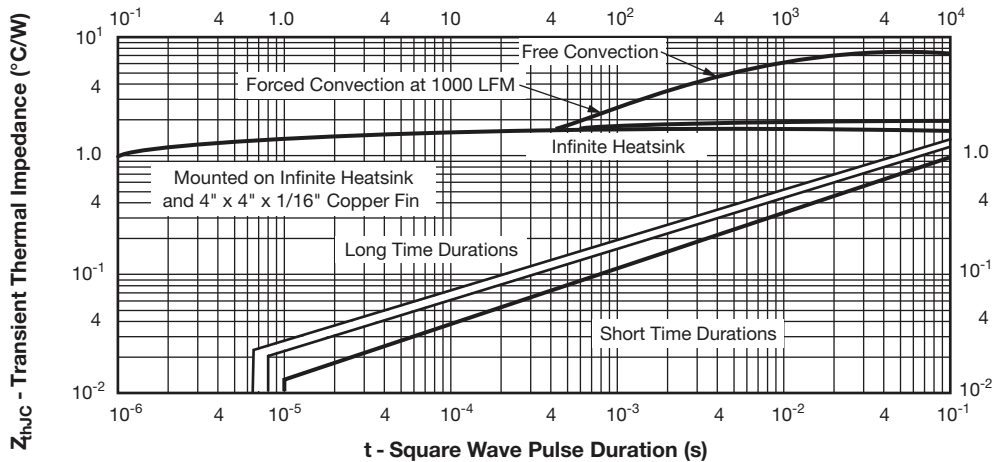
**Instantaneous Gate Current (A)**  
 Fig. 5 - Gate Characteristics, 2N681 Series



**Average On-State Current Over Full Cycle (A)**  
 Fig. 4 - Maximum High Level On-State Power Loss vs. Current (Sinusoidal Current Waveform), 2N681 Series



**Gate Current (mA)**  
 Fig. 5a - Area of All Possible Triggering Points vs. Temperature, 2N681 Series



**t - Square Wave Pulse Duration (s)**  
 Fig. 6 - Maximum Transient Thermal Impedance, Junction to Case, vs. Pulse Duration, 2N681 Series

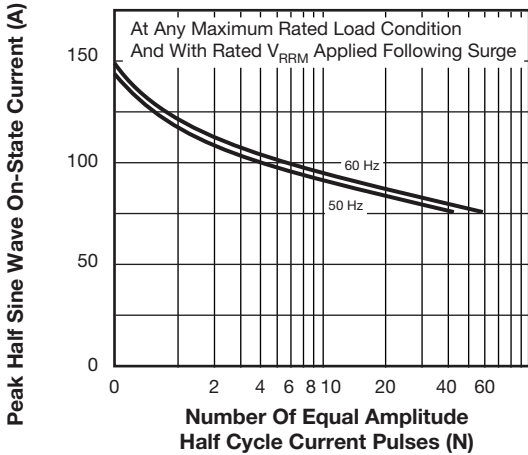


Fig. 7 - Maximum Non-Repetitive Surge Current vs. Number of Current Pulses, 2N681 Series

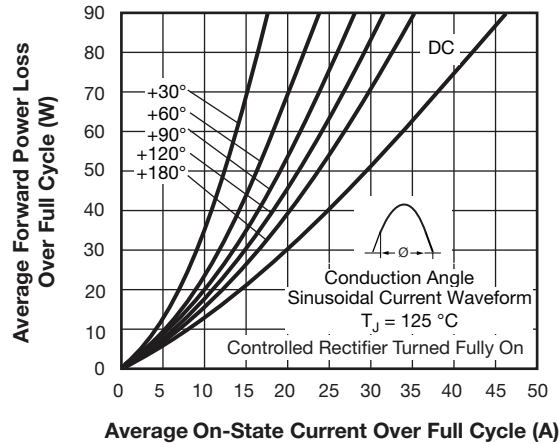


Fig. 10 - Maximum Low-Level On-State Power Loss vs. Average On-State Current (Sinusoidal Current Waveform), 2N5205 Series

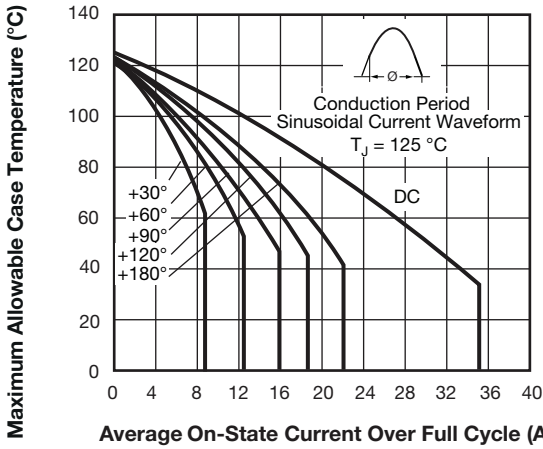


Fig. 8 - Maximum Allowable Case Temperature vs. Average On-State Current (Sinusoidal Current Waveform), 2N5205 Series

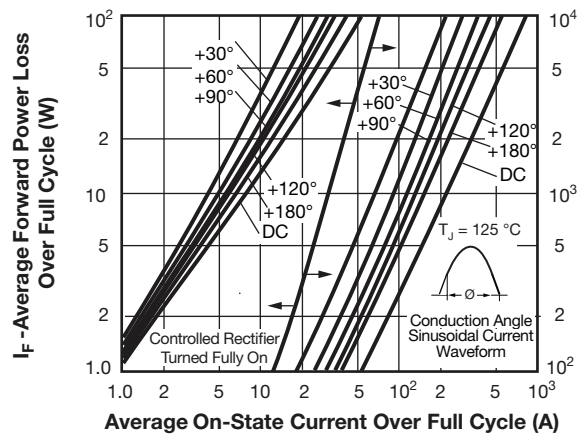


Fig. 11 - Maximum High-Level On-State Power Loss vs. Average On-State Current (Sinusoidal Current Waveform), 2N5205 Series

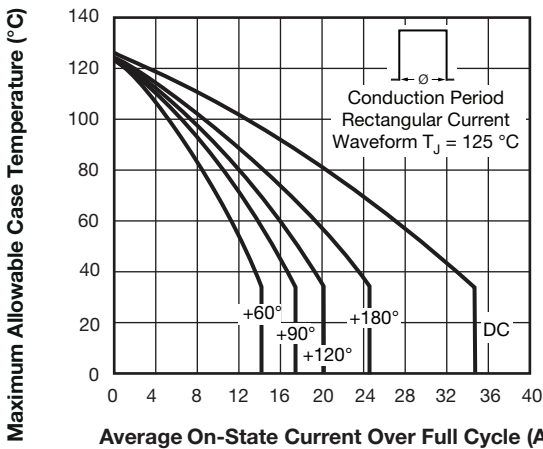


Fig. 9 - Maximum Allowable Case Temperature vs. Average On-State Current (Rectangular Current Waveform), 2N5205 Series

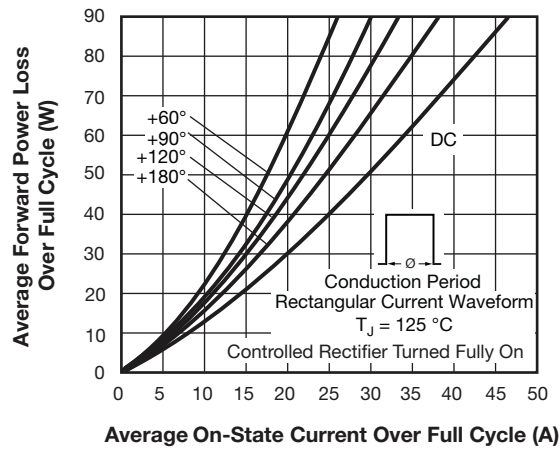


Fig. 12 - Maximum Low-Level On-State Power Loss vs. Average On-State Current (Rectangular Current Waveform), 2N5205 Series

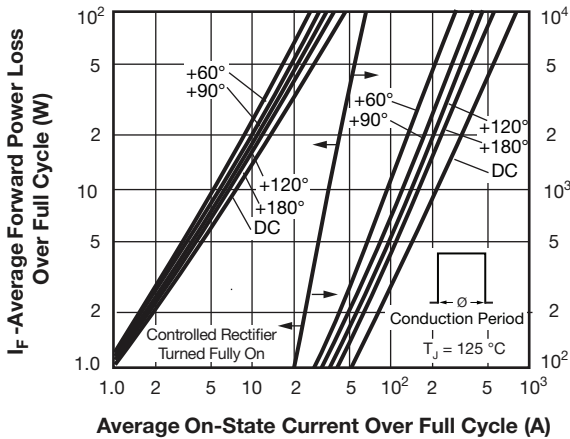


Fig. 13 - Maximum High-Level On-State Power Loss vs. Average On-State Current (Rectangular Current Waveform), 2N5205 Series

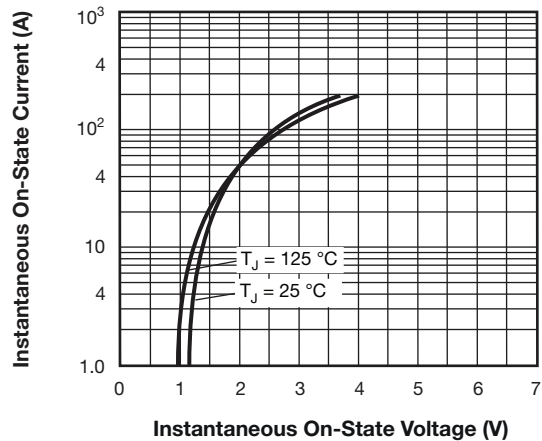


Fig. 14 - Maximum Instantaneous On-State Voltage vs. Instantaneous On-State Current, 2N5205 Series

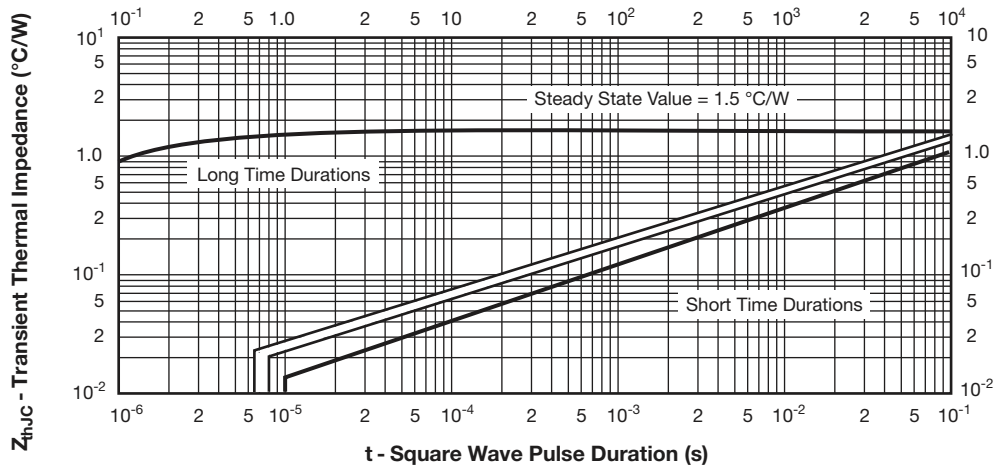


Fig. 15 - Maximum Transient Thermal Resistance, Junction to Case vs. Pulse Duration, 2N5205 Series

LINKS TO RELATED DOCUMENTS

Dimensions

[www.vishay.com/doc?95333](http://www.vishay.com/doc?95333)



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