

INTERNATIONAL RECTIFIER



2N681 & 2N5204 SERIES

25 and 35 Amp RMS SCRs

Major Ratings and Characteristics

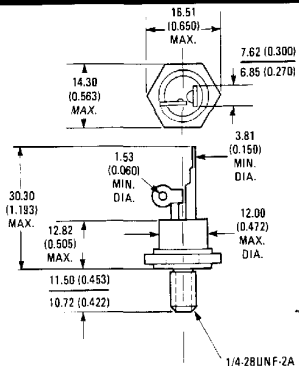
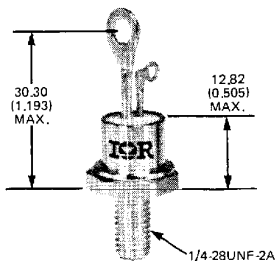
| | 2N681-92 | 2N5204-07 | Units | |
|--------------------------|-------------|-------------|------------------|------|
| I_T (RMS) | 25 | 35 | A | |
| I_T (AV) | 16* | 22* | A | |
| @ T_C | -65 to 65* | -40 to 40 | °C | |
| I_{TSM} | @ 50 Hz | 145 | A | |
| | @ 60 Hz | 150* | | 285 |
| | | | | 300* |
| i^2t | @ 50 Hz | 103 | A ² s | |
| | @ 60 Hz | 94 | | 410 |
| | | | | 375 |
| I_{GT} | 40 | 40 | mA | |
| dv/dt | — | 100* | V/ μ s | |
| di/dt | 75–100 | 100 | A/ μ s | |
| T_J | -65 to 125* | -40 to 125* | °C | |
| V_{RRM}, V_{DRM} range | 25–800 | 600–1200 | V | |

*JEDEC registered value.

Description/Features

- General purpose stud mounted
- Broad forward and reverse voltage range – through 1200 volts
- Can be supplied to meet stringent military, aerospace and other high-reliability requirements

CASE STYLE AND DIMENSIONS



Conforms to JEDEC Outline TO-208AA (TO-48)
Dimensions in Millimeters and (Inches)

VOLTAGE RATINGS (Applied gate voltage zero or negative)

| Part Numbers | V_{RRM} , V_{DRM} - Max. Repetitive Peak Reverse and Off-State Voltage (V) | V_{RSM} Max. Non Repetitive Peak Reverse Voltage $t_p < 5$ ms (V) |
|--------------|---|---|
| | $T_J = -65^{\circ}\text{C}$ to 125°C | $T_J = -65^{\circ}\text{C}$ to 125°C |
| 2N681 | 25* | 35* |
| 2N682 | 50* | 75* |
| 2N683 | 100* | 150* |
| 2N685 | 200* | 300* |
| 2N687 | 300* | 400* |
| 2N688 | 400* | 500* |
| 2N689 | 500* | 600* |
| 2N690 | 600* | 720* |
| 2N691 | 700* | 840* |
| 2N692 | 800* | 960* |
| | $T_J = -40^{\circ}\text{C}$ to 125°C | $T_J = -40^{\circ}\text{C}$ to 125°C |
| 2N5204 | 600 | 720 |
| 2N5205 | 800 | 960 |
| 2N5206 | 1000 | 1200 |
| 2N5207 | 1200 | 1440 |

ELECTRICAL SPECIFICATIONS

| | | 2N681-92 | 2N5204-07 | Units | Conditions |
|-------------------|--|-------------------------------------|------------------------------|-----------------------------|---|
| ON-STATE | | | | | |
| $I_T(\text{RMS})$ | Max. RMS on-state current | 25 | 35 | A | |
| $I_T(\text{AV})$ | Max. average on-state current | 16* | 22* | A | |
| | @ $T_C =$ | -65 to 65* | -40 to 40* | $^{\circ}\text{C}$ | 180° half sine wave conduction |
| I_{TSM} | Max. peak one cycle, non-repetitive surge current | 145 | 285 | A | 50 Hz half cycle sine wave or 6 ms rectangular pulse |
| | | 150* | 300* | | 60 Hz half cycle sine wave or 5 ms rectangular pulse |
| | | 170 | 340 | | 50 Hz half cycle sine wave or 6 ms rectangular pulse |
| | | 180 | 355 | | 60 Hz half cycle sine wave or 5 ms rectangular pulse |
| | | | | | Following any rated load condition, and with rated V_{RRM} applied following surge. |
| | | | | | Same conditions as above except with V_{RRM} applied following surge = 0. |
| I^2t | Max. I^2t capability, for fusing | 103 | 410 | A^2s | $t = 10$ ms |
| | | 94 | 375 | | $t = 8.3$ ms |
| I^2t | Max. I^2t capability, for individual device fusing | 145 | 580 | A^2s | $t = 10$ ms |
| | | 135 | 530 | | $t = 8.3$ ms |
| $I^2\sqrt{t}$ | Max. $I^2\sqrt{t}$ capability, for individual device fusing $\text{\textcircled{1}}$ | 1450 | 5800 | $\text{A}^2\sqrt{\text{s}}$ | $t = 0.1$ to 10 ms initial $T_J \leq 125^{\circ}\text{C}$ V_{RRM} following surge = 0. |
| V_{TM} | Max. peak on-state voltage | 2* | 2.3* | V | $T_J = 25^{\circ}\text{C}$, $I_T(\text{AV}) = 16\text{A}$ (50A peak) 2N681, $I_T(\text{AV}) = 22\text{A}$ (70A peak) 2N5204 |
| I_H | Max. holding current | 20 @ 25°C \dagger | 200* @ -40°C | mA | Anode supply = 24V, initial $I_T = 1.0\text{A}$. |
| BLOCKING | | | | | |
| dv/dt | Min. critical rate-of-rise of off-state voltage | 100 \dagger | 100* | V/ μs | $T_J = 125^{\circ}\text{C}$. Exponential to 100% rated V_{DRM} |
| | | 250 \dagger | 250 | | $T_J = 125^{\circ}\text{C}$. Exponential to 67% rated V_{DRM} |
| | | | | | Gate open circuited. |

*JEDEC Registered value.

 $\text{\textcircled{1}}$ I^2t for time $t_x = I^2\sqrt{t} \cdot \sqrt{t_x}$. \dagger Typical

ELECTRICAL SPECIFICATIONS (Continued)

| | | 2N681-92 | 2N5204-07 | Units | Conditions | |
|--|---|---|--------------------------------------|---|---|--|
| BLOCKING (Continued) | | | | | | |
| $I_{R(-)}$ & $I_{D(-)}$ Max. reverse and off-state current V_{RRM} & $V_{DRM} =$ | 5V | $I_{R(AV)}$ & $I_{D(AV)}$ (Average Values) | I_{RM} & I_{DM} (Peak Values) | mA | $T_J = 125^\circ\text{C}$, gate open circuited. | |
| | 25 to 150V | 6.5* | — | | | |
| | 200 & 250V | 6.0* | — | | | |
| | 300V | 5.0* | — | | | |
| | 400V | 4.0* | — | | | |
| | 500V | 3.0* | — | | | |
| | 600V | 2.5* | 3.3* | | | |
| | 700V | 2.25* | — | | | |
| | 800V | 2.0* | 2.5* | | | |
| | 1000V | — | 2.0* | | | |
| 1200V | — | 1.7* | | | | |
| SWITCHING | | | | | | |
| t_d | Typical delay time | 1 | 1 | μs | $T_C = 25^\circ\text{C}$, $V_{DM} = \text{rated } V_{DRM}$, $I_{TM} = 10\text{A}$ dc resistive circuit. Gate pulse: 10V, 40 Ω source, $t_p = 6 \mu\text{s}$, $t_r = 0.1 \mu\text{s}$. | |
| di/dt | Max. non-repetitive rate of rise of turned-on current $V_{DM} =$ | 25 to 600V | 100 | — | A/ μs | $T_C = 125^\circ\text{C}$, $V_{DM} = \text{rated } V_{DRM}$, $I_{TM} = 2 \times di/dt$. Gate pulse: 20V, 15 Ω , $t_p = 6 \mu\text{s}$, $t_r = 0.1 \mu\text{s}$ max. Per JEDEC standard RS-397, 5.2.2.6. |
| | | 700 to 800V | 75 | — | | |
| | | — | 100 | | $T_C = 125^\circ\text{C}$, $V_{DM} = 600\text{V}$, $I_{TM} = 200\text{A}$ @ 400 Hz, max., Gate pulse: 20V, 15 Ω , $t_p = 6 \mu\text{s}$, $t_r = 0.1 \mu\text{s}$ max. Per JEDEC standard RS-397, 5.2.2.6. | |
| TRIGGERING | | | | | | |
| P_{GM} | Max. peak gate power | 5* | 60* | W | $t_p \leq 5$ ms for 2N681 series; $t_p \leq 500 \mu\text{s}$ for 2N5204 series. | |
| $P_{G(AV)}$ | Max. average gate power | 0.5* | 0.5* | W | | |
| $+I_{GM}$ | Max. peak positive gate current | 2* | 2 | A | | |
| $+V_{GM}$ | Max. peak positive gate voltage | 10* | — | V | | |
| $-V_{GM}$ | Max. peak negative gate voltage | 5* | 5* | V | | |
| I_{GT} | Max. required DC gate current to trigger | 80* | 80* | mA | $T_C = \text{min. rated value}$. Max. required gate trigger current is the lowest value which will trigger all units with +6V anode-to-cathode. $T_C = 25^\circ\text{C}$ $T_C = 125^\circ\text{C}$ | |
| | | 40 | 40 | | | |
| | | 18.5 | 20 | | | |
| | Typical DC gate current to trigger | 30 | 30 | $T_C = 25^\circ\text{C}$ +6V anode-to-cathode | | |
| V_{GT} | Max. required DC gate voltage to trigger | 3* | 3* | V | $T_C = -65^\circ\text{C}$. Max. required gate trigger voltage is the lowest value which will trigger all units with +6V anode-to-cathode. $T_C = 25^\circ\text{C}$ | |
| | | 2 | 2 | | | |
| | Typical DC gate voltage to trigger | 1.5 | 1.5 | $T_C = 25^\circ\text{C}$ +6V anode-to-cathode | | |
| V_{GD} | Max. DC gate voltage not to trigger | 0.25* | 0.25* | V | $T_C = 125^\circ\text{C}$. Max. gate voltage not to trigger is the maximum value which will not trigger any unit with rated V_{DRM} anode-to-cathode. | |

THERMAL-MECHANICAL SPECIFICATIONS

| | | 2N681-92 | 2N5204-07 | Units | Conditions |
|------------|--|------------------|--------------|-----------|--|
| T_J | Operating junction temperature range | -65° to 125° | -40° to 125° | °C | |
| T_{stg} | Storage temperature range | -65° to 125° | -40° to 125° | °C | |
| R_{thJC} | Max. internal thermal resistance, junction to case | 1.5 | 1.5* | deg. C/W | DC operation |
| R_{thCS} | Thermal resistance, case to sink | 0.35 | 0.35 | deg. C/W | Mounting surface smooth, flat and greased. |
| | Mounting torque to nut ±10% | 20,(27.5) | | lbf · in. | Lubricated threads (non-lubricated threads). |
| | | 0.23(.32) | | kgf · m | |
| | | 2.3(3.1) | | N·m | |
| | to device | 25 | | lbf · in. | Lubricated threads. |
| | | 0.29 | | kgf · m | |
| | | 2.8 | | N·m | |
| wt | Approximate weight | 14(0.49) | 14 (0.5) | g (oz.) | |
| | Case Style | TO-208AA (TO-48) | | | |

*JEDEC Registered value.

2N681 Series

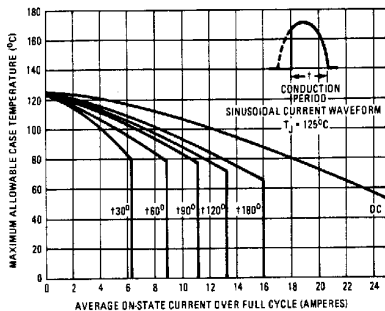


Fig. 1 – Maximum Allowable Case Temperature Vs. Average On-State Current, 2N681 Series

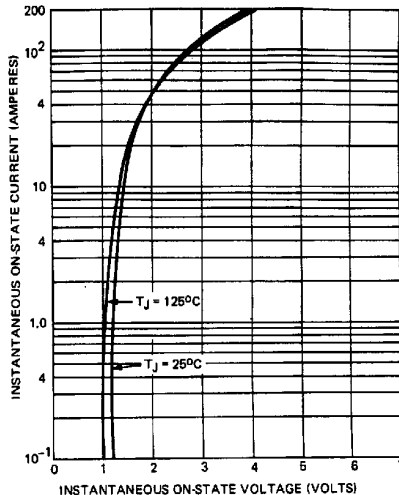


Fig. 2 – Maximum On-State Voltage Vs. Current, 2N681 Series

2N681 Series

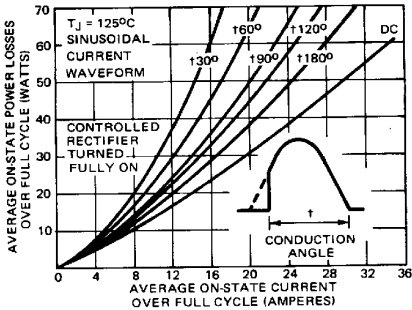


Fig. 3 — Maximum Low Level On-State Power Loss Vs. Current (Sinusoidal Current Waveform), 2N681 Series

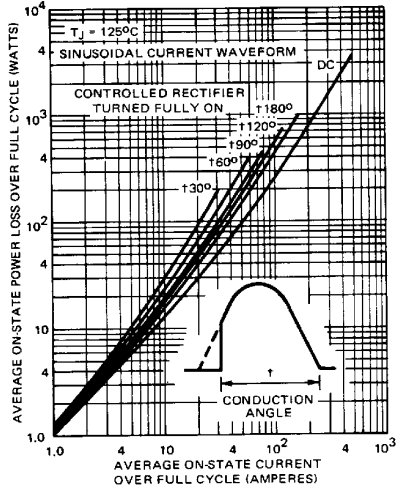


Fig. 4 — Maximum High Level On-State Power Loss Vs. Current (Sinusoidal Current Waveform), 2N681 Series

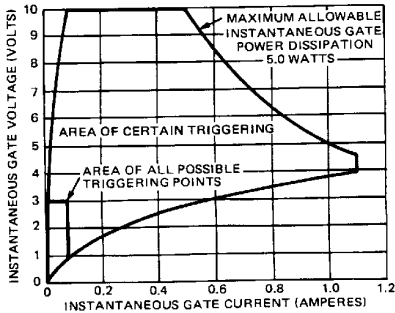


Fig. 5 — Gate Characteristics, 2N681 Series

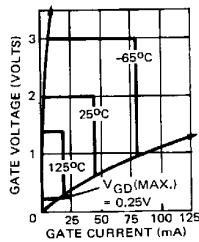


Fig. 5A — Area of All Possible Triggering Points Vs. Temperature 2N681 Series

2N681 Series

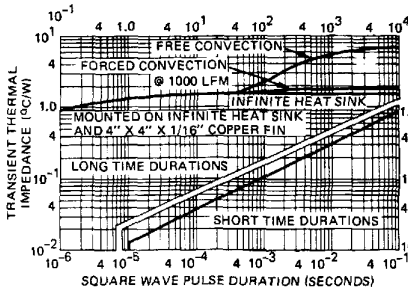


Fig. 6 – Maximum Transient Thermal Impedance, Junction to Case, Vs. Pulse Duration, 2N681 Series

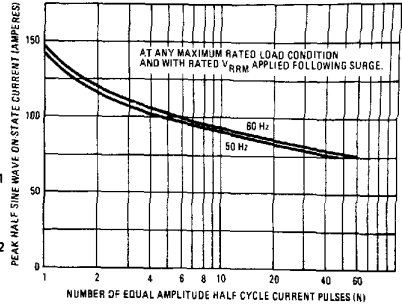


Fig. 7 – Maximum Non-Repetitive Surge Current, Vs. Number of Current Pulses, 2N681 Series

2N5204 Series

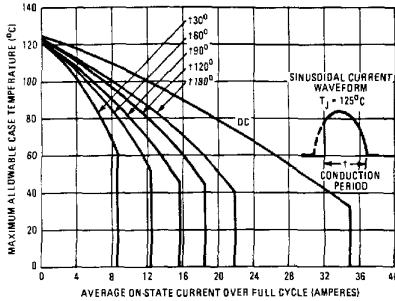


Fig. 8 – Maximum Allowable Case Temperature Vs. Average On-State Current (Sinusoidal Current Waveform), 2N5204 Series

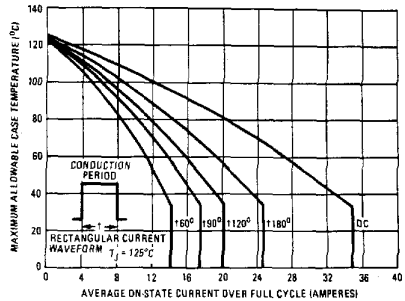


Fig. 9 – Maximum Allowable Case Temperature Vs. Average On-State Current (Rectangular Current Waveform), 2N5204 Series

2N5204 Series

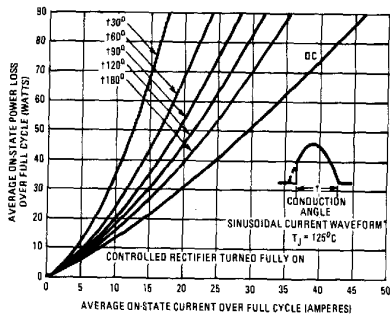


Fig. 10 — Maximum Low-Level On-State Power Loss Vs. Average On-State Current (Sinusoidal Current Waveform), 2N5204 Series

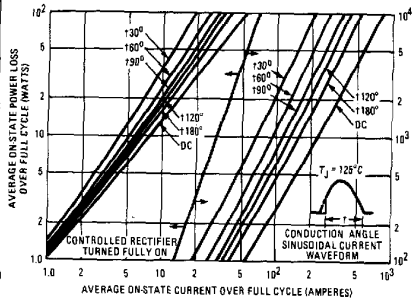


Fig. 11 — Maximum High-Level On-State Power Loss Vs. Average On-State Current (Sinusoidal Current Waveform), 2N5204 Series

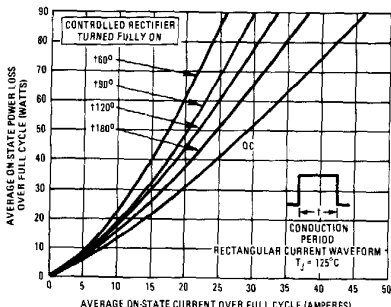


Fig. 12 — Maximum Low-Level On-State Power Loss Vs. Average On-State Current (Rectangular Current Waveform), 2N5204 Series

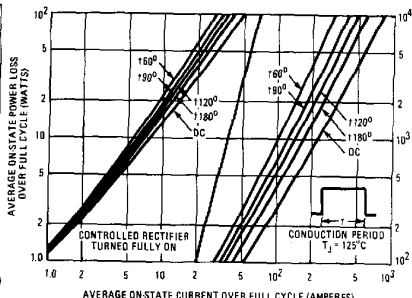


Fig. 13 — Maximum High-Level On-State Power Loss Vs. Average On-State Current (Rectangular Current Waveform), 2N5204 Series

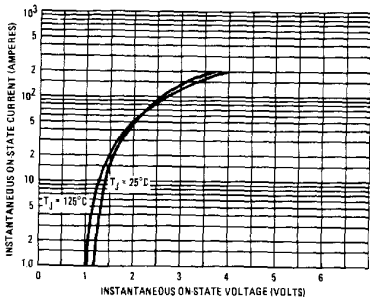


Fig. 14 — Maximum Instantaneous On-State Voltage Vs. Instantaneous On-State Current, 2N5204 Series

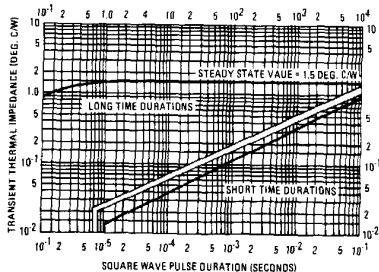


Fig. 15 — Maximum Transient Thermal Resistance, Junction to Case, Vs. Pulse Duration, 2N5204 Series