



## 2N6504 Series



### Description

Designed primarily for half-wave ac control applications, such as motor controls, heating controls and power supply crowbar circuits.

### Features

- Glass Passivated Junctions for Greater Parameter Uniformity and Stability
- Small, Rugged, Thermowatt Construction for Low Thermal Resistance, High Heat Dissipation and Durability
- Blocking Voltage to 800 Volts
- 300 A Surge Current Capability
- Pb-Free Package is Available

### Pin Out



### Functional Diagram



### Additional Information



**Datasheet**



**Resources**



**Samples**

### Maximum Ratings ( $T_J = 25^\circ\text{C}$ unless otherwise noted)

| Rating                                                                                                               | Symbol                 | Value                          | Unit             |
|----------------------------------------------------------------------------------------------------------------------|------------------------|--------------------------------|------------------|
| Peak Repetitive Off-State Voltage (Note 1)<br>(Gate Open, Sine Wave 50 to 60 Hz, $T_J = 25$ to $125^\circ\text{C}$ ) | $V_{DRM}$<br>$V_{RRM}$ | 50<br>100<br>400<br>600<br>800 | V                |
| On-State RMS Current (180° Conduction Angles; $T_C = 85^\circ\text{C}$ )                                             | $I_{T(RMS)}$           | 25                             | A                |
| Average On-State Current (180° Conduction Angles; $T_C = 85^\circ\text{C}$ )                                         | $I_{T(AV)}$            | 16                             | A                |
| Peak Non-repetitive Surge Current<br>(1/2 Cycle, Sine Wave 60 Hz, $T_J = 100^\circ\text{C}$ )                        | $I_{TSM}$              | 250                            | A <sup>2</sup> s |
| Forward Peak Gate Power (Pulse Width $\leq 1.0 \mu\text{s}$ , $T_C = 85^\circ\text{C}$ )                             | $P_{GM}$               | 20                             | W                |
| Forward Average Gate Power ( $t = 8.3 \text{ ms}$ , $T_C = 85^\circ\text{C}$ )                                       | $P_{G(AV)}$            | 0.5                            | W                |
| Forward Peak Gate Current (Pulse Width $\leq 1.0 \mu\text{s}$ , $T_C = 85^\circ\text{C}$ )                           | $I_{GM}$               | 2.0                            | A                |
| Operating Junction Temperature Range                                                                                 | $T_J$                  | -40 to +125                    | $^\circ\text{C}$ |
| Storage Temperature Range                                                                                            | $T_{stg}$              | -40 to +125                    | $^\circ\text{C}$ |

Stresses exceeding Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stresses above the Recommended Operating Conditions may affect device reliability.

1.  $V_{DRM}$  and  $V_{RRM}$  for all types can be applied on a continuous basis. Ratings apply for zero or negative gate voltage; however, positive gate voltage shall not be applied concurrent with negative potential on the anode. Blocking voltages shall not be tested with a constant current source such that the voltage ratings of the devices are exceeded.

### Thermal Characteristics

| Rating                                                                          | Symbol          | Value | Unit                      |
|---------------------------------------------------------------------------------|-----------------|-------|---------------------------|
| *Thermal Resistance, Junction to Case                                           | $R_{\theta JC}$ | 1.5   | $^\circ\text{C}/\text{W}$ |
| *Maximum Lead Temperature for Soldering Purposes, 1/8" from case for 10 seconds | $T_L$           | 260   | $^\circ\text{C}$          |

\* Indicates JEDEC Registered Data.

### Electrical Characteristics - OFF ( $T_C = 25^\circ\text{C}$ unless otherwise noted)

| Characteristic                                                                   | Symbol                 | Min | Typ | Max | Unit          |
|----------------------------------------------------------------------------------|------------------------|-----|-----|-----|---------------|
| †Peak Repetitive Blocking Current<br>( $V_{AK} = V_{DRM} = V_{RRM}$ ; Gate Open) | $I_{DRM}$<br>$I_{RRM}$ | -   | -   | 1.0 | $\mu\text{A}$ |
|                                                                                  |                        | -   | -   | 2.0 | mA            |

### Electrical Characteristics - ON ( $T_C = 25^\circ\text{C}$ unless otherwise noted; Electricals apply in both directions)

| Characteristic                                                                                                        | Symbol   | Min                                                                            | Typ | Max | Unit          |
|-----------------------------------------------------------------------------------------------------------------------|----------|--------------------------------------------------------------------------------|-----|-----|---------------|
| * Forward On-State Voltage (Note 2) ( $I_{TM} = 50 \text{ A}$ )                                                       | $V_{TM}$ | -                                                                              | -   | 1.8 | V             |
| * Gate Trigger Current (Continuous dc)<br>( $V_{AK} = \text{Rated } V_{DRM} \text{ or } V_{RRM}$ ; Gate Open)         | $I_{GT}$ | -                                                                              | 9.0 | 30  | mA            |
|                                                                                                                       |          | -                                                                              | -   | 75  |               |
| * Gate Trigger Voltage (Continuous dc) ( $V_{AK} = 12 \text{ Vdc}$ , $R_L = 100 \Omega$ , $T_C = -40^\circ\text{C}$ ) | $V_{GT}$ | -                                                                              | 1.0 | 1.5 | V             |
| Gate Non-Trigger Voltage ( $V_{AK} = 12 \text{ Vdc}$ , $R_L = 100 \Omega$ , $T_J = 125^\circ\text{C}$ )               | $V_{GD}$ | 0.2                                                                            | -   | -   | V             |
| *Holding Current ( $V_D = 12 \text{ Vdc}$ ,<br>Initiating Current = 200 mA, Gate Open)                                | $I_H$    | -                                                                              | 18  | 40  | mA            |
|                                                                                                                       |          | -                                                                              | -   | 80  |               |
| * Turn-On Time ( $I_{TM} = 25 \text{ A}$ , $I_{GT} = 50 \text{ mAdc}$ )                                               | $t_{gt}$ | -                                                                              | 1.5 | 2.0 | $\mu\text{s}$ |
| Turn-Off Time ( $V_{RM} = \text{rated voltage}$ )                                                                     | $t_q$    | ( $I_{TM} = 25 \text{ A}$ , $I_R = 25 \text{ A}$ )                             | -   | 15  | $\mu\text{s}$ |
|                                                                                                                       |          | ( $I_{TM} = 25 \text{ A}$ , $I_R = 25 \text{ A}$ , $T_J = 125^\circ\text{C}$ ) | -   | 35  |               |

\* Indicates JEDEC Registered Data

2. Pulse Test: Pulse Width  $\leq 300 \mu\text{sec}$ , Duty Cycle  $\leq 2\%$ .

### Dynamic Characteristics

| Characteristic                                                                           | Symbol   | Min | Typ | Max | Unit       |
|------------------------------------------------------------------------------------------|----------|-----|-----|-----|------------|
| Critical Rate of Rise of Off-State Voltage (Gate Open, Rated VDRM, Exponential Waveform) | dv/dt(c) | -   | 50  | -   | V/ $\mu$ s |

### Voltage Current Characteristic of SCR

| Symbol    | Parameter                                 |
|-----------|-------------------------------------------|
| $V_{DRM}$ | Peak Repetitive Forward Off State Voltage |
| $I_{DRM}$ | Peak Forward Blocking Current             |
| $V_{RRM}$ | Peak Repetitive Reverse Off State Voltage |
| $I_{RRM}$ | Peak Reverse Blocking Current             |
| $V_{TM}$  | Maximum On State Voltage                  |
| $I_H$     | Holding Current                           |



Figure 1. Average Current Derating



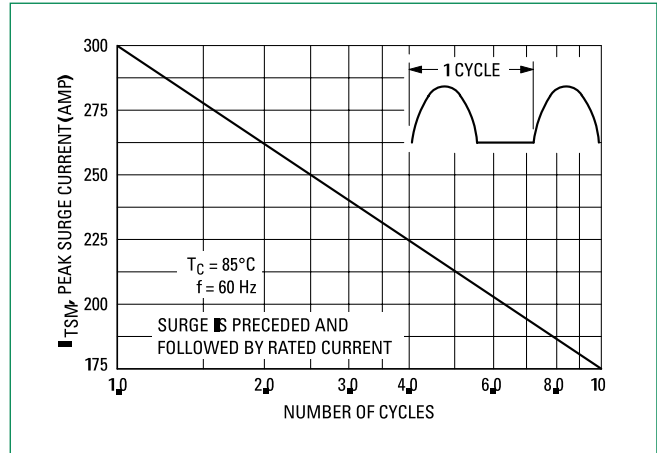
Figure 2. Maximum On-State Power Dissipation



**Figure 3. Typical On-State Characteristics**



**Figure 4. Maximum Non-Repetitive Surge Current**

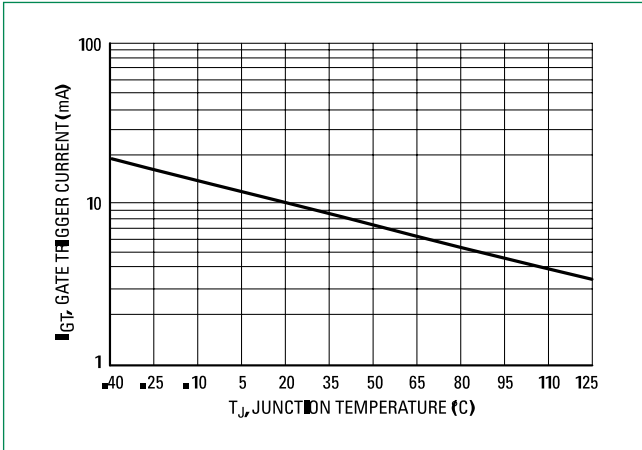


**Figure 5. Thermal Response**



**Typical Trigger Characteristics**

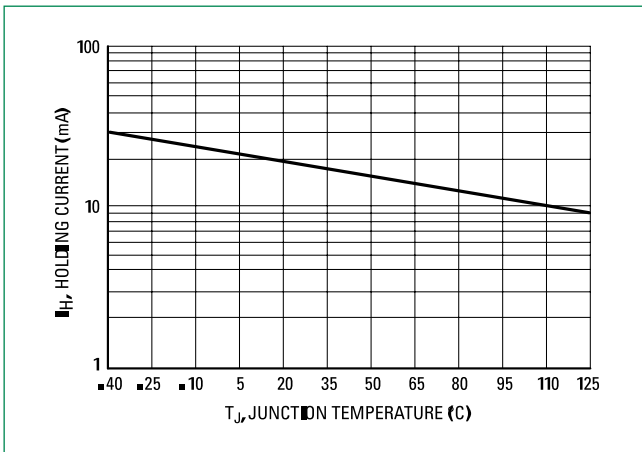
**Figure 6. Typical Gate Trigger Current vs. Junction Temperature**



**Figure 7. Typical Gate Trigger Voltage vs. Junction Temperature**



**Figure 8. Typical Holding Current vs. Junction Temperature**



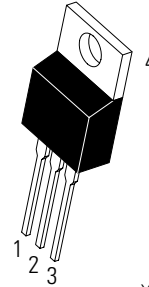
### Dimensions



| Dim | Inches |       | Millimeters |       |
|-----|--------|-------|-------------|-------|
|     | Min    | Max   | Min         | Max   |
| A   | 0.590  | 0.620 | 14.99       | 15.75 |
| B   | 0.380  | 0.420 | 9.65        | 10.67 |
| C   | 0.178  | 0.188 | 4.52        | 4.78  |
| D   | 0.025  | 0.035 | 0.64        | 0.89  |
| F   | 0.142  | 0.147 | 3.61        | 3.73  |
| G   | 0.095  | 0.105 | 2.41        | 2.67  |
| H   | 0.110  | 0.130 | 2.79        | 3.30  |
| J   | 0.018  | 0.024 | 0.46        | 0.61  |
| K   | 0.540  | 0.575 | 13.72       | 14.61 |
| L   | 0.060  | 0.075 | 1.52        | 1.91  |
| N   | 0.195  | 0.205 | 4.95        | 5.21  |
| Q   | 0.105  | 0.115 | 2.67        | 2.92  |
| R   | 0.085  | 0.095 | 2.16        | 2.41  |
| S   | 0.045  | 0.060 | 1.14        | 1.52  |
| T   | 0.235  | 0.255 | 5.97        | 6.47  |
| U   | 0.000  | 0.050 | 0.00        | 1.27  |
| V   | 0.045  | ---   | 1.15        | ---   |
| Z   | ---    | 0.080 | ---         | 2.04  |

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. DIMENSION Z DEFINES A ZONE WHERE ALL BODY AND LEAD IRREGULARITIES ARE ALLOWED.

### Part Marking System



**TO-220AB  
Case 221A  
Style 3**



Y =Year  
M =Month  
A =Assembly Site  
AKA =Diode Polarity  
G =Pb-Free Package

| Pin Assignment |         |
|----------------|---------|
| 1              | Cathode |
| 2              | Anode   |
| 3              | Gate    |
| 4              | Anode   |

### Ordering Information

| Device   | Package            | Shipping        |
|----------|--------------------|-----------------|
| 2N6504   | TO-220AB           | 500 Units / Box |
| 2N6504G  | TO-220AB (Pb-Free) |                 |
| 2N6505   | TO-220AB           |                 |
| 2N6505G  | TO-220AB (Pb-Free) | 500 Units / Box |
| 2N6505T  | TO-220AB           |                 |
| 2N6505TG | TO-220AB (Pb-Free) | 500 Units / Box |
| 2N6507   | TO-220AB           |                 |
| 2N6507G  | TO-220AB (Pb-Free) | 500 Units / Box |
| 2N6507T  | TO-220AB           |                 |
| 2N6507TG | TO-220AB (Pb-Free) | 500 Units / Box |
| 2N6508   | TO-220AB           |                 |
| 2N6508G  | TO-220AB (Pb-Free) | 500 Units / Box |
| 2N6508TG | TO-220AB           |                 |
| 2N6509   | TO-220AB (Pb-Free) | 500 Units / Box |
| 2N6509G  | TO-220AB           |                 |
| 2N6509T  | TO-220AB (Pb-Free) | 500 Units / Box |
| 2N6509TG | TO-220AB           |                 |

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