

# 2N6504 Series

Preferred Device

## Silicon Controlled Rectifiers

### Reverse Blocking Thyristors

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

- Glass Passivated Junctions with Center Gate Fire for Greater Parameter Uniformity and Stability
- Small, Rugged, Thermowatt Constructed for Low Thermal Resistance, High Heat Dissipation and Durability
- Blocking Voltage to 800 Volts
- 300 A Surge Current Capability
- Device Marking: Logo, Device Type, e.g., 2N6504, Date Code

#### 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,<br>$T_J = 25$ to $125^\circ\text{C}$ ) | $V_{\text{DRM}}$ ,<br>$V_{\text{RRM}}$ |                 | Volts            |
| 2N6504                                                                                                                    |                                        | 50              |                  |
| 2N6505                                                                                                                    |                                        | 100             |                  |
| 2N6507                                                                                                                    |                                        | 400             |                  |
| 2N6508                                                                                                                    |                                        | 600             |                  |
| 2N6509                                                                                                                    |                                        | 800             |                  |
| On-State RMS Current<br>( $180^\circ$ Conduction Angles; $T_C = 85^\circ\text{C}$ )                                       | $I_{\text{T(RMS)}}$                    | 25              | A                |
| Average On-State Current<br>( $180^\circ$ Conduction Angles; $T_C = 85^\circ\text{C}$ )                                   | $I_{\text{T(AV)}}$                     | 16              | A                |
| Peak Non-repetitive Surge Current<br>(1/2 Cycle, Sine Wave 60 Hz, $T_J = 100^\circ\text{C}$ )                             | $I_{\text{TSM}}$                       | 250             | A                |
| Forward Peak Gate Power<br>(Pulse Width $\leq 1.0 \mu\text{s}$ , $T_C = 85^\circ\text{C}$ )                               | $P_{\text{GM}}$                        | 20              | Watts            |
| Forward Average Gate Power<br>( $t = 8.3 \text{ ms}$ , $T_C = 85^\circ\text{C}$ )                                         | $P_{\text{G(AV)}}$                     | 0.5             | Watts            |
| Forward Peak Gate Current<br>(Pulse Width $\leq 1.0 \mu\text{s}$ , $T_C = 85^\circ\text{C}$ )                             | $I_{\text{GM}}$                        | 2.0             | A                |
| Operating Junction Temperature Range                                                                                      | $T_J$                                  | $-40$ to $+125$ | $^\circ\text{C}$ |
| Storage Temperature Range                                                                                                 | $T_{\text{stg}}$                       | $-40$ to $+150$ | $^\circ\text{C}$ |

\*Indicates JEDEC Registered Data

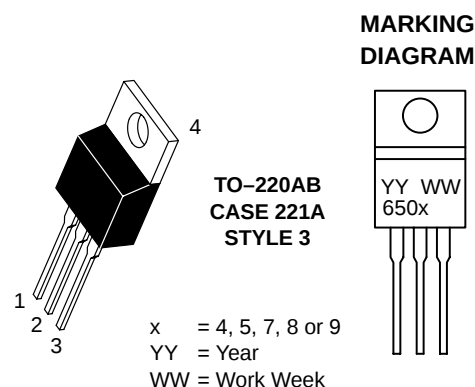
1.  $V_{\text{DRM}}$  and  $V_{\text{RRM}}$  for all types can be applied on a continuous basis. Ratings apply for zero or negative gate voltage; however, positive gate voltage shall not be applied concurrent with negative potential on the anode. Blocking voltages shall not be tested with a constant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



ON Semiconductor™

<http://onsemi.com>

**SCRs**  
**25 AMPERES RMS**  
**50 thru 800 VOLTS**



| PIN ASSIGNMENT |         |
|----------------|---------|
| 1              | Cathode |
| 2              | Anode   |
| 3              | Gate    |
| 4              | Anode   |

#### ORDERING INFORMATION

| Device | Package | Shipping |
|--------|---------|----------|
| 2N6504 | TO220AB | 500/Box  |
| 2N6505 | TO220AB | 500/Box  |
| 2N6507 | TO220AB | 500/Box  |
| 2N6508 | TO220AB | 500/Box  |
| 2N6509 | TO220AB | 500/Box  |

Preferred devices are recommended choices for future use and best overall value.

## 2N6504 Series

### \*THERMAL CHARACTERISTICS

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

### ELECTRICAL CHARACTERISTICS ( $T_C = 25^{\circ}\text{C}$ unless otherwise noted.)

| Characteristic | Symbol | Min | Typ | Max | Unit |
|----------------|--------|-----|-----|-----|------|
|----------------|--------|-----|-----|-----|------|

### OFF CHARACTERISTICS

|                                                                                                                             |                    |   |   |     |               |
|-----------------------------------------------------------------------------------------------------------------------------|--------------------|---|---|-----|---------------|
| *Peak Repetitive Forward or Reverse Blocking Current<br>( $V_{AK} = \text{Rated } V_{DRM} \text{ or } V_{RRM}$ , Gate Open) | $I_{DRM}, I_{RRM}$ | — | — | 10  | $\mu\text{A}$ |
|                                                                                                                             |                    | — | — | 2.0 | $\text{mA}$   |

### ON CHARACTERISTICS

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

### DYNAMIC CHARACTERISTICS

|                                                                                                   |         |   |    |   |                        |
|---------------------------------------------------------------------------------------------------|---------|---|----|---|------------------------|
| Critical Rate of Rise of Off-State Voltage<br>(Gate Open, Rated $V_{DRM}$ , Exponential Waveform) | $dv/dt$ | — | 50 | — | $\text{V}/\mu\text{s}$ |
|---------------------------------------------------------------------------------------------------|---------|---|----|---|------------------------|

\*Indicates JEDEC Registered Data.

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

## 2N6504 Series

### Voltage Current Characteristic of SCR

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

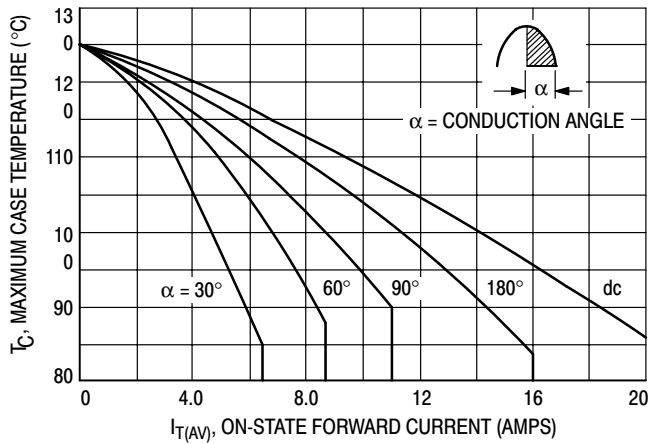
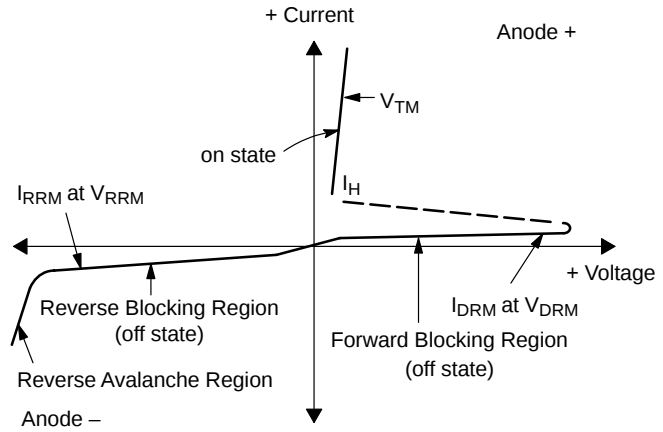


Figure 1. Average Current Derating

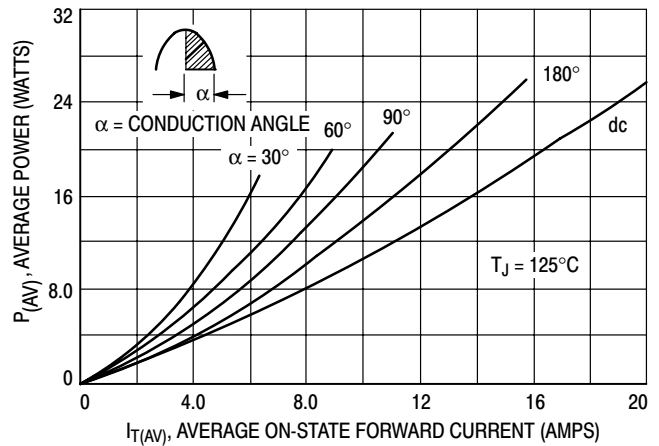


Figure 2. Maximum On-State Power Dissipation

## 2N6504 Series

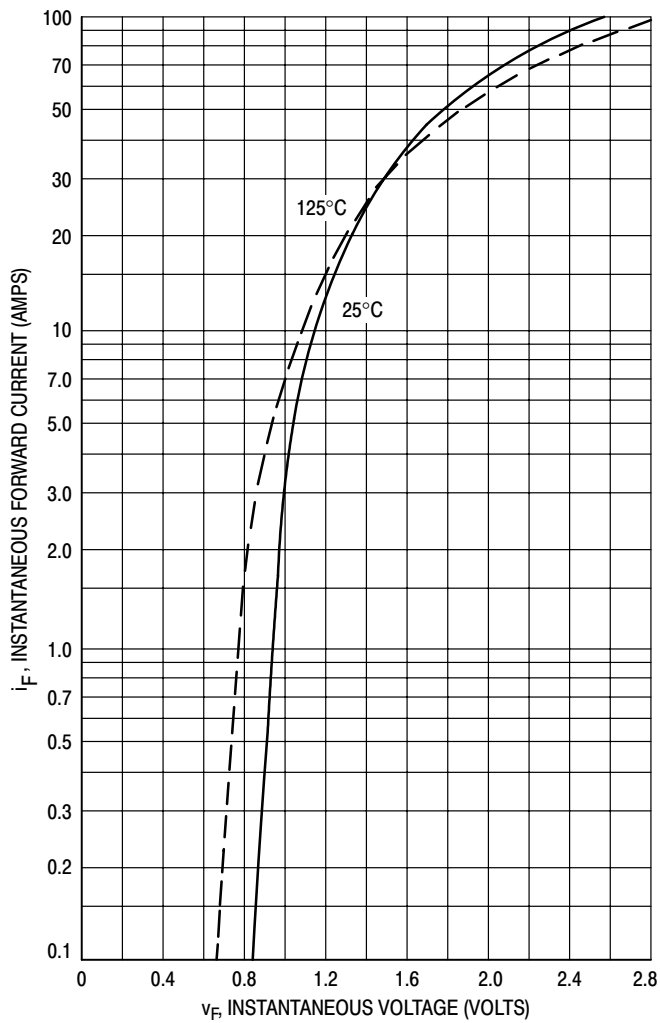


Figure 3. Typical On-State Characteristics

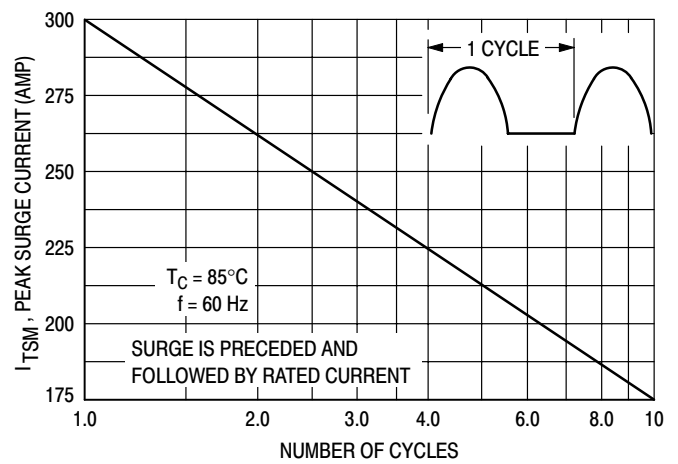


Figure 4. Maximum Non-Repetitive Surge Current

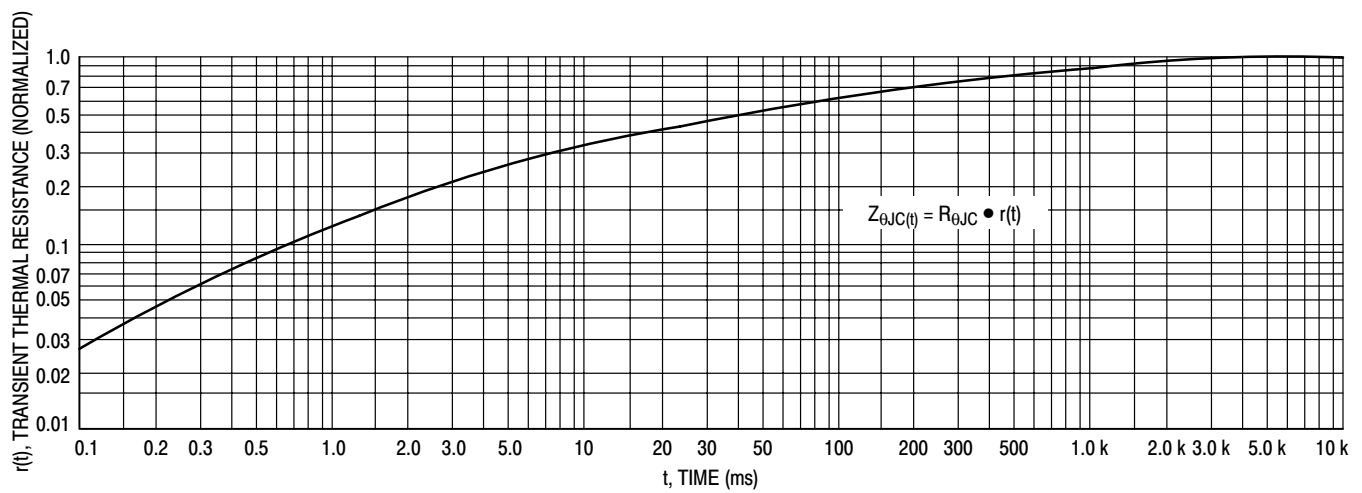


Figure 5. Thermal Response

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### TYPICAL TRIGGER CHARACTERISTICS

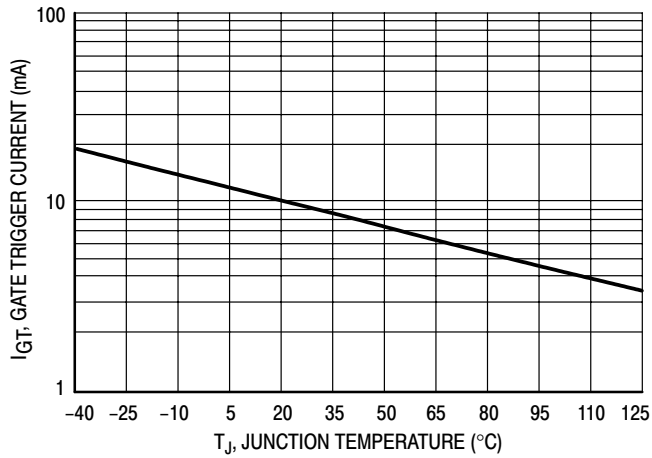


Figure 6. Typical Gate Trigger Current  
versus Junction Temperature

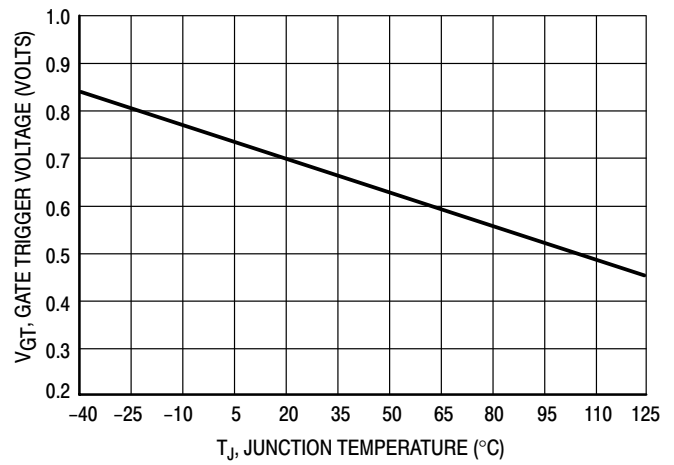


Figure 7. Typical Gate Trigger Voltage  
versus Junction Temperature

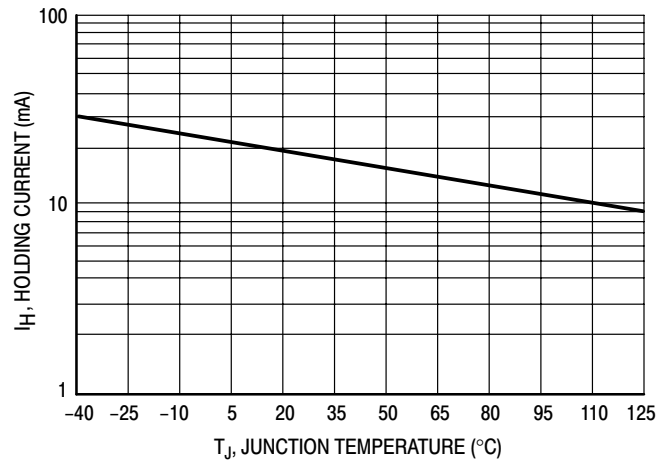
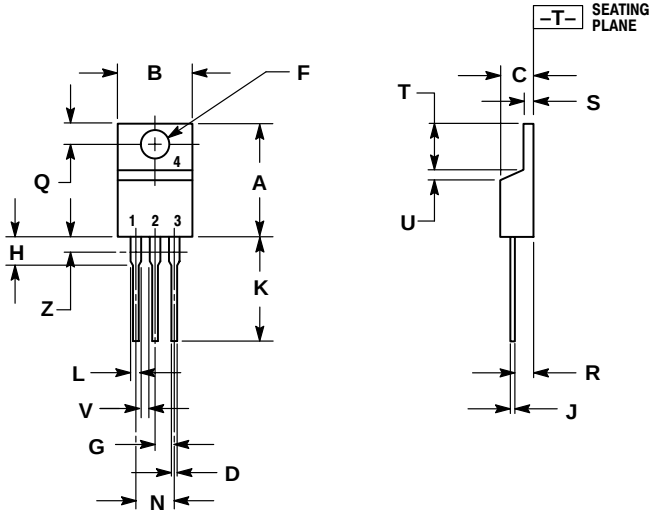


Figure 8. Typical Holding Current  
versus Junction Temperature

# 2N6504 Series

## PACKAGE DIMENSIONS

TO-220AB  
CASE 221A-07  
ISSUE AA



### NOTES:

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.

| DIM | INCHES |       | MILLIMETERS |       |
|-----|--------|-------|-------------|-------|
|     | MIN    | MAX   | MIN         | MAX   |
| A   | 0.570  | 0.620 | 14.48       | 15.75 |
| B   | 0.380  | 0.405 | 9.66        | 10.28 |
| C   | 0.160  | 0.190 | 4.07        | 4.82  |
| D   | 0.025  | 0.035 | 0.64        | 0.88  |
| F   | 0.142  | 0.147 | 3.61        | 3.73  |
| G   | 0.095  | 0.105 | 2.42        | 2.66  |
| H   | 0.110  | 0.155 | 2.80        | 3.93  |
| J   | 0.014  | 0.022 | 0.36        | 0.55  |
| K   | 0.500  | 0.562 | 12.70       | 14.27 |
| L   | 0.045  | 0.060 | 1.15        | 1.52  |
| N   | 0.190  | 0.210 | 4.83        | 5.33  |
| Q   | 0.100  | 0.120 | 2.54        | 3.04  |
| R   | 0.080  | 0.110 | 2.04        | 2.79  |
| S   | 0.045  | 0.055 | 1.15        | 1.39  |
| 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  |

### STYLE 3:

- PIN 1. CATHODE  
2. ANODE  
3. GATE  
4. ANODE

## **Notes**

## 2N6504 Series

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