

# 2N5038

## NPN Silicon Transistors

Fast switching speeds and high current capacity ideally suit these parts for use in switching regulators, inverters, wide-band amplifiers and power oscillators in industrial and commercial applications.

### Features

- High Speed -  $t_f = 0.5 \mu s$  (Max)
- High Current -  $I_{C(max)} = 30$  Amps
- Low Saturation -  $V_{CE(sat)} = 2.5$  V (Max) @  $I_C = 20$  Amps
- Pb-Free Package is Available\*

### MAXIMUM RATINGS (Note 1)

| Rating                                                                     | Symbol            | Value       | Unit               |
|----------------------------------------------------------------------------|-------------------|-------------|--------------------|
| Collector-Emitter Voltage                                                  | $V_{CEO}$         | 90          | Vdc                |
| Collector-Base Voltage                                                     | $V_{CBO}$         | 150         | Vdc                |
| Collector-Emitter Voltage                                                  | $V_{CEV}$         | 150         | Vdc                |
| Emitter-Base Voltage                                                       | $V_{EBO}$         | 7           | Vdc                |
| Collector Current - Continuous<br>Peak (Note 2)                            | $I_C$<br>$I_{CM}$ | 20<br>30    | Adc                |
| Base Current - Continuous                                                  | $I_B$             | 5           | Adc                |
| Total Device Dissipation @ $T_C = 25^\circ C$<br>Derate above $25^\circ C$ | $P_D$             | 140<br>0.8  | W<br>W/ $^\circ C$ |
| Operating and Storage Junction<br>Temperature Range                        | $T_J, T_{stg}$    | -65 to +200 | $^\circ C$         |

### THERMAL CHARACTERISTICS

| Characteristics                      | Symbol          | Max  | Unit         |
|--------------------------------------|-----------------|------|--------------|
| Thermal Resistance, Junction-to-Case | $R_{\theta JC}$ | 1.25 | $^\circ C/W$ |

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. Indicates JEDEC Registered Data.
2. Pulse Test: Pulse Width  $\leq 10$  ms, Duty Cycle  $\leq 50\%$ .

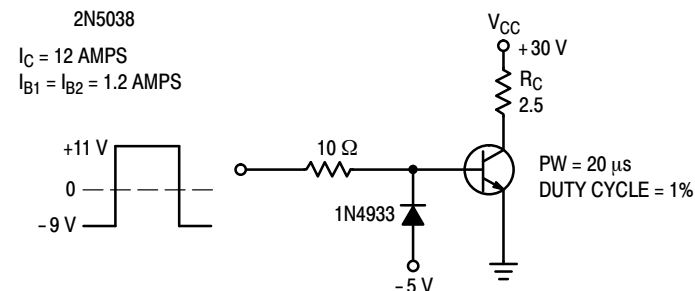


Figure 1. Switching Time Test Circuit

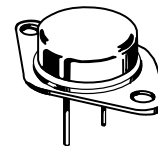
\*For additional information on our Pb-Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.



ON Semiconductor®

<http://onsemi.com>

20 AMPERE  
NPN SILICON  
POWER TRANSISTORS  
90 VOLTS - 140 WATTS



TO-204AA (TO-3)  
CASE 1-07  
STYLE 1

### MARKING DIAGRAMS



G = Pb-Free Package  
A = Assembly Location  
YY = Year  
WW = Work Week  
MEX = Country of Origin

### ORDERING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 2 of this data sheet.

**ELECTRICAL CHARACTERISTICS** ( $T_C = 25^\circ\text{C}$  unless otherwise noted) (Note 3)

| Characteristic                                                                                                                                                                         | Symbol         | Min    | Max      | Unit |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|--------|----------|------|
| <b>OFF CHARACTERISTICS</b>                                                                                                                                                             |                |        |          |      |
| Collector-Emitter Sustaining Voltage (Note 4)<br>( $I_C = 200\text{ mAdc}$ , $I_B = 0$ )                                                                                               | $V_{CEO(sus)}$ | 90     | -        | Vdc  |
| Collector Cutoff Current<br>( $V_{CE} = 140\text{ Vdc}$ , $V_{BE(off)} = 1.5\text{ V}$ )<br>( $V_{CE} = 100\text{ Vdc}$ , $V_{BE(off)} = 1.5\text{ Vdc}$ , $T_C = 150^\circ\text{C}$ ) | $I_{CEX}$      | -<br>- | 50<br>10 | mAdc |
| Emitter Cutoff Current<br>( $V_{EB} = 5\text{ Vdc}$ , $I_C = 0$ )<br>( $V_{EB} = 7\text{ Vdc}$ , $I_C = 0$ )                                                                           | $I_{EBO}$      | -<br>- | 5<br>50  | mAdc |
| <b>ON CHARACTERISTICS</b> (Note 4)                                                                                                                                                     |                |        |          |      |
| DC Current Gain<br>( $I_C = 12\text{ Adc}$ , $V_{CE} = 5\text{ Vdc}$ )                                                                                                                 | $h_{FE}$       | 20     | 100      | -    |
| Collector-Emitter Saturation Voltage<br>( $I_C = 20\text{ Adc}$ , $I_B = 5\text{ Adc}$ )                                                                                               | $V_{CE(sat)}$  | -      | 2.5      | Vdc  |
| Base-Emitter Saturation Voltage<br>( $I_C = 20\text{ Adc}$ , $I_B = 5\text{ Adc}$ )                                                                                                    | $V_{BE(sat)}$  | -      | 3.3      | Vdc  |
| <b>DYNAMIC CHARACTERISTICS</b>                                                                                                                                                         |                |        |          |      |
| Magnitude of Common-Emitter Small-Signal Short-Circuit Forward Current Transfer Ratio<br>( $I_C = 2\text{ Adc}$ , $V_{CE} = 10\text{ Vdc}$ , $f = 5\text{ MHz}$ )                      | $ h_{fe} $     | 12     | -        | -    |

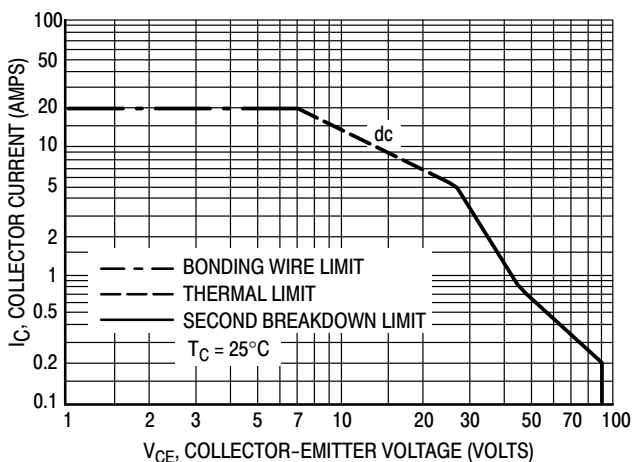
**SWITCHING CHARACTERISTICS**

| <b>RESISTIVE LOAD</b> |                                                                                         |       |   |     |               |
|-----------------------|-----------------------------------------------------------------------------------------|-------|---|-----|---------------|
| Rise Time             | $(V_{CC} = 30\text{ Vdc})$<br>$(I_C = 12\text{ Adc}, I_{B1} = I_{B2} = 1.2\text{ Adc})$ | $t_r$ | - | 0.5 | $\mu\text{s}$ |
| Storage Time          |                                                                                         | $t_s$ | - | 1.5 | $\mu\text{s}$ |

3. Indicates JEDEC Registered Data.

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

| Device  | Package             | Shipping         |
|---------|---------------------|------------------|
| 2N5038  | TO-204              | 100 Units / Tray |
| 2N5038G | TO-204<br>(Pb-Free) |                  |

**Figure 2. Forward Bias Safe Operating Area**

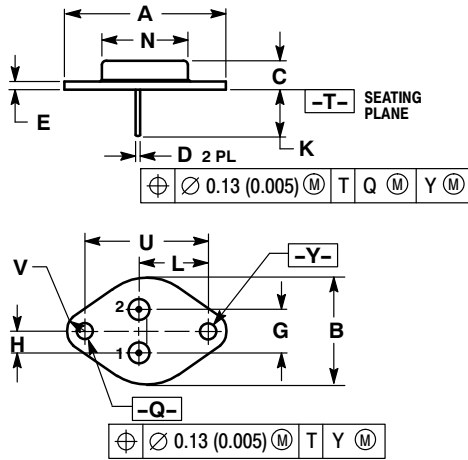
There are two limitations on the power handling ability of a transistor: average junction temperature and second breakdown. Safe operating area curves indicate  $I_C - V_{CE}$  limits of the transistor that must be observed for reliable operation; i.e., the transistor must not be subjected to greater dissipation than the curves indicate.

Second breakdown pulse limits are valid for duty cycles to 10%. At high case temperatures, thermal limitations may reduce the power that can be handled to values less than the limitations imposed by second breakdown.

# 2N5038

## PACKAGE DIMENSIONS

### CASE 1-07 TO-204AA (TO-3) ISSUE Z



- NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
  2. CONTROLLING DIMENSION: INCH.
  3. ALL RULES AND NOTES ASSOCIATED WITH REFERENCED TO-204AA OUTLINE SHALL APPLY.

| DIM | INCHES    |           | MILLIMETERS |       |
|-----|-----------|-----------|-------------|-------|
|     | MIN       | MAX       | MIN         | MAX   |
| A   | 1.550 REF | 39.37 REF |             |       |
| B   | ---       | 1.050     | ---         | 26.67 |
| C   | 0.250     | 0.335     | 6.35        | 8.51  |
| D   | 0.038     | 0.043     | 0.97        | 1.09  |
| E   | 0.055     | 0.070     | 1.40        | 1.77  |
| G   | 0.430 BSC | 10.92 BSC |             |       |
| H   | 0.215 BSC | 5.46 BSC  |             |       |
| K   | 0.440     | 0.480     | 11.18       | 12.19 |
| L   | 0.665 BSC | 16.89 BSC |             |       |
| N   | ---       | 0.830     | ---         | 21.08 |
| Q   | 0.151     | 0.165     | 3.84        | 4.19  |
| U   | 1.187 BSC | 30.15 BSC |             |       |
| V   | 0.131     | 0.188     | 3.33        | 4.77  |

STYLE 1:  
PIN 1. BASE  
2. EMITTER  
CASE: COLLECTOR