

# 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 -  $t_f = 0.5 \mu\text{s}$  (Max)
- High Current -  $I_{C(\text{max})} = 30$  Amps
- Low Saturation -  $V_{CE(\text{sat})} = 2.5$  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	$I_C$	20	Adc
Collector Current - Peak (Note 2)	$I_{CM}$	30	
Base Current - Continuous	$I_B$	5	Adc
Total Device Dissipation @ $T_C = 25^\circ\text{C}$ Derate above $25^\circ\text{C}$	$P_D$	140 0.8	W W/ $^\circ\text{C}$
Operating and Storage Junction Temperature Range	$T_J, T_{stg}$	-65 to +200	$^\circ\text{C}$

### THERMAL CHARACTERISTICS

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

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  $\leq 50\%$ .

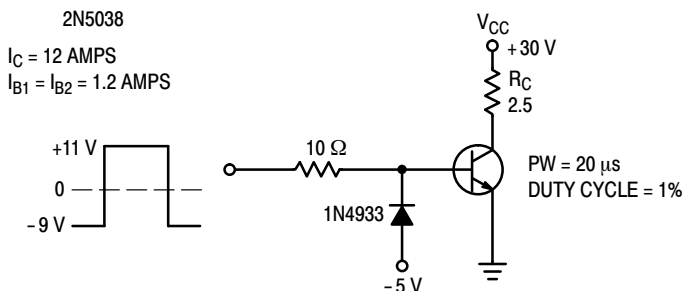


Figure 1. Switching Time Test Circuit

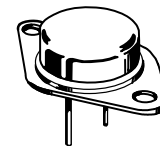
\*For additional information on our Pb-Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.



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**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.

## 2N5038

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

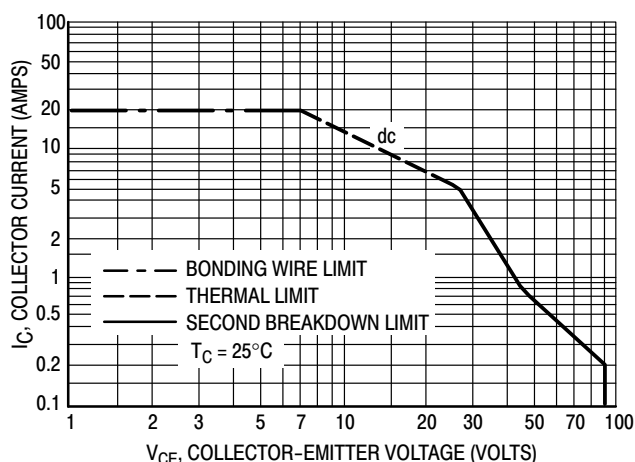
Characteristic	Symbol	Min	Max	Unit
<b>OFF CHARACTERISTICS</b>				
Collector-Emitter Sustaining Voltage (Note 4) ( $I_C = 200\text{ mAdc}$ , $I_B = 0$ )	$V_{CEO(sus)}$	90	-	Vdc
Collector Cutoff Current ( $V_{CE} = 140\text{ Vdc}$ , $V_{BE(off)} = 1.5\text{ V}$ ) ( $V_{CE} = 100\text{ Vdc}$ , $V_{BE(off)} = 1.5\text{ Vdc}$ , $T_C = 150^\circ\text{C}$ )	$I_{CEX}$	-	50 10	mAdc
Emitter Cutoff Current ( $V_{EB} = 5\text{ Vdc}$ , $I_C = 0$ ) ( $V_{EB} = 7\text{ Vdc}$ , $I_C = 0$ )	$I_{EBO}$	-	5 50	mAdc
<b>ON CHARACTERISTICS (Note 4)</b>				
DC Current Gain ( $I_C = 12\text{ Adc}$ , $V_{CE} = 5\text{ Vdc}$ )	$h_{FE}$	20	100	-
Collector-Emitter Saturation Voltage ( $I_C = 20\text{ Adc}$ , $I_B = 5\text{ Adc}$ )	$V_{CE(sat)}$	-	2.5	Vdc
Base-Emitter Saturation Voltage ( $I_C = 20\text{ Adc}$ , $I_B = 5\text{ Adc}$ )	$V_{BE(sat)}$	-	3.3	Vdc
<b>DYNAMIC CHARACTERISTICS</b>				
Magnitude of Common-Emitter Small-Signal Short-Circuit Forward Current Transfer Ratio ( $I_C = 2\text{ Adc}$ , $V_{CE} = 10\text{ Vdc}$ , $f = 5\text{ MHz}$ )	$ h_{fe} $	12	-	-
<b>SWITCHING CHARACTERISTICS</b>				
<b>RESISTIVE LOAD</b>				
Rise Time	$(V_{CC} = 30\text{ Vdc})$	$t_r$	-	0.5 $\mu\text{s}$
Storage Time	$(I_C = 12\text{ Adc}$ , $I_{B1} = I_{B2} = 1.2\text{ Adc}$ )	$t_s$	-	1.5 $\mu\text{s}$

3. Indicates JEDEC Registered Data.

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

### ORDERING INFORMATION

Device	Package	Shipping
2N5038	TO-204	100 Units / Tray
2N5038G	TO-204 (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.

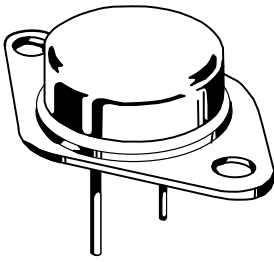
Second breakdown pulse limits are valid for duty cycles to 10%. At high case temperatures, thermal limitations may reduce the power that can be handled to values less than the limitations imposed by second breakdown.

# MECHANICAL CASE OUTLINE PACKAGE DIMENSIONS

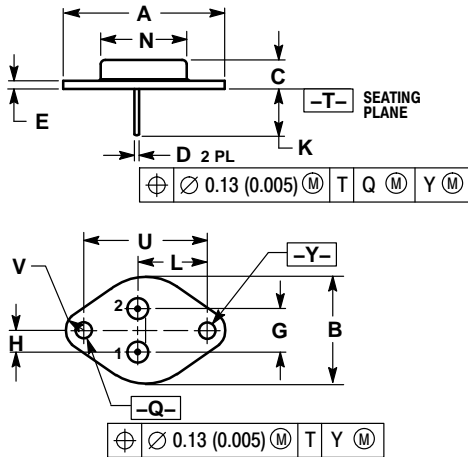


## TO-204 (TO-3) CASE 1-07 ISSUE Z

DATE 05/18/1988



SCALE 1:1



- 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

- |  |  |   |   |   |
|--|--|---|---|---|
| <p>STYLE 1:<br/>PIN 1. BASE<br/>2. EMITTER<br/>CASE: COLLECTOR</p> | <p>STYLE 2:<br/>PIN 1. BASE<br/>2. COLLECTOR<br/>CASE: EMITTER</p> | <p>STYLE 3:<br/>PIN 1. GATE<br/>2. SOURCE<br/>CASE: DRAIN</p>           | <p>STYLE 4:<br/>PIN 1. GROUND<br/>2. INPUT<br/>CASE: OUTPUT</p>       | <p>STYLE 5:<br/>PIN 1. CATHODE<br/>2. EXTERNAL TRIP/DELAY<br/>CASE: ANODE</p> |
| <p>STYLE 6:<br/>PIN 1. GATE<br/>2. EMITTER<br/>CASE: COLLECTOR</p> | <p>STYLE 7:<br/>PIN 1. ANODE<br/>2. OPEN<br/>CASE: CATHODE</p>     | <p>STYLE 8:<br/>PIN 1. CATHODE #1<br/>2. CATHODE #2<br/>CASE: ANODE</p> | <p>STYLE 9:<br/>PIN 1. ANODE #1<br/>2. ANODE #2<br/>CASE: CATHODE</p> |   |

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