

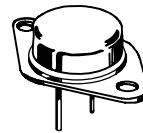
# NPN Silicon Transistors

... 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.

- 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
- **This device is available in Pb-free package(s). Specifications herein apply to both standard and Pb-free devices. Please see our website at [www.onsemi.com](http://www.onsemi.com) for specific Pb-free orderable part numbers, or contact your local ON Semiconductor sales office or representative.**

**2N5038**

**20 AMPERE  
NPN SILICON  
POWER TRANSISTOR  
90 VOLTS  
140 WATTS**



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

**\*MAXIMUM RATINGS**

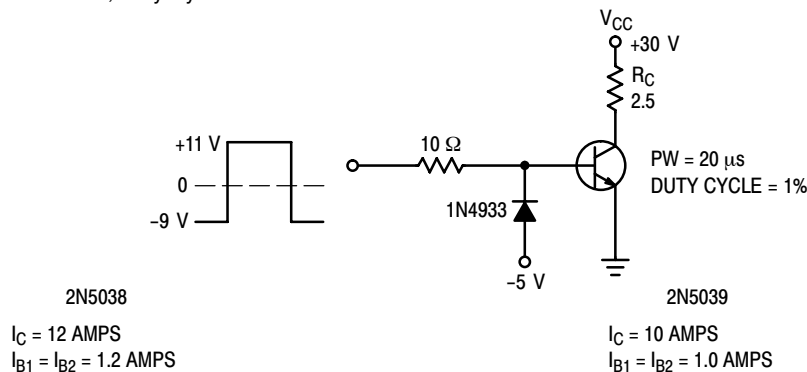
Rating	Symbol	Value	Unit
Collector-Base Voltage	$V_{CB0}$	150	Vdc
Collector-Emitter Voltage	$V_{CEV}$	150	Vdc
Emitter-Base Voltage	$V_{EBO}$	7	Vdc
Collector Current – Continuous	$I_C$	20	Adc
Peak (1)	$I_{CM}$	30	
Base Current – Continuous	$I_B$	5	Adc
Total Device Dissipation @ $T_C = 25^\circ\text{C}$	$P_D$	140	Watts
Derate above $25^\circ\text{C}$		0.8	W/ $^\circ\text{C}$
Operating and Storage Junction Temperature Range	$T_J, T_{stg}$	-65 to +200	$^\circ\text{C}$

**THERMAL CHARACTERISTICS**

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

\*Indicates JEDEC Registered Data.

(1) Pulse Test: Pulse Width  $\leq 10$  ms, Duty Cycle  $\leq 50\%$ .



**Figure 1. Switching Time Test Circuit**

## 2N5038

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

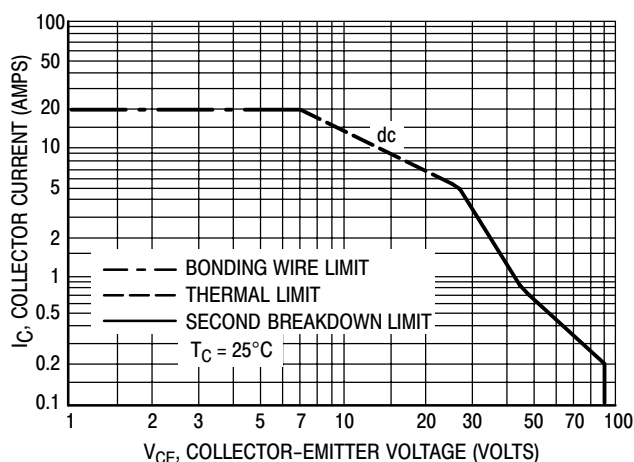
Characteristic	Symbol	Min	Max	Unit
<b>OFF CHARACTERISTICS</b>				
Collector–Emitter Sustaining Voltage (2) ( $I_C = 200\text{ mA}$ , $I_B = 0$ )	$V_{CEO(sus)}$	90	–	Vdc
Collector Cutoff Current ( $V_{CE} = 140\text{ Vdc}$ , $V_{BE(off)} = 1.5\text{ V}$ ) ( $V_{CE} = 100\text{ Vdc}$ , $V_{BE(off)} = 1.5\text{ Vdc}$ , $T_C = 150^\circ\text{C}$ )	$I_{CEX}$	–	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 (2)</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	–	–

### SWITCHING CHARACTERISTICS

RESISTIVE LOAD					
Rise Time	$(V_{CC} = 30\text{ Vdc})$ $(I_C = 12\text{ Adc}, I_{B1} = I_{B2} = 1.2\text{ Adc})$	$t_r$	–	0.5	$\mu\text{s}$
Storage Time		$t_s$	–	1.5	$\mu\text{s}$

\*Indicates JEDEC Registered Data.

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



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

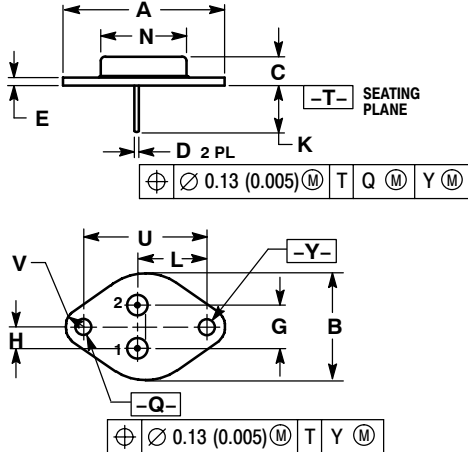
There are two limitations on the power handling ability of a transistor: average junction temperature and second breakdown. Safe operating area curves indicate  $I_C - V_{CE}$  limits of the transistor that must be observed for reliable operation; i.e., the transistor must not be subjected to greater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

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