

# High-Power NPN Silicon Transistors

... designed for use in industrial–military power amplifier and switching circuit applications.

- High Collector–Emitter Sustaining Voltage —  
 $V_{CEO(sus)} = 100 \text{ Vdc (Min) — 2N6338}$   
 $= 120 \text{ Vdc (Min) — 2N6339}$   
 $= 140 \text{ Vdc (Min) — 2N6340}$   
 $= 150 \text{ Vdc (Min) — 2N6341}$
- High DC Current Gain —  
 $h_{FE} = 30 - 120 @ I_C = 10 \text{ Adc}$   
 $= 12 \text{ (Min) } @ I_C = 25 \text{ Adc}$
- Low Collector–Emitter Saturation Voltage —  
 $V_{CE(sat)} = 1.0 \text{ Vdc (Max) } @ I_C = 10 \text{ Adc}$
- Fast Switching Times @  $I_C = 10 \text{ Adc}$   
 $t_r = 0.3 \mu\text{s (Max)}$   
 $t_s = 1.0 \mu\text{s (Max)}$   
 $t_f = 0.25 \mu\text{s (Max)}$
- Complement to 2N6436–38

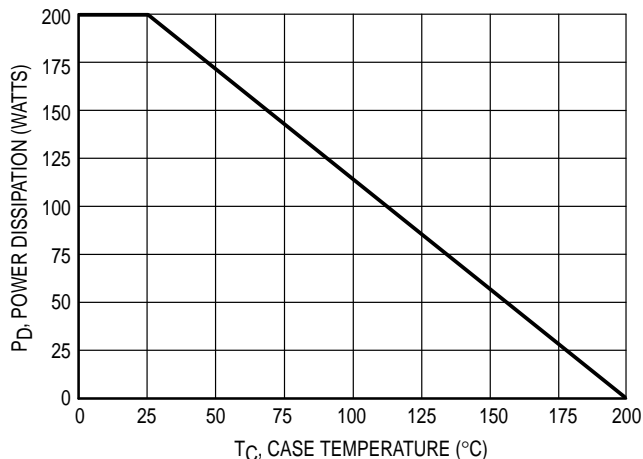
**\*MAXIMUM RATINGS**

Rating	Symbol	2N6338	2N6339	2N6340	2N6341	Unit
Collector–Base Voltage	$V_{CB}$	120	140	160	180	Vdc
Collector–Emitter Voltage	$V_{CEO}$	100	120	140	150	Vdc
Emitter–Base Voltage	$V_{EB}$	6.0				Vdc
Collector Current Continuous	$I_C$					A
Peak						
Base Current	$I_B$	10				A
Total Device Dissipation @ $T_C = 25^\circ\text{C}$ Derate above $25^\circ\text{C}$	$P_D$	200				Watts W/°C
		1.14				
Operating and Storage Junction Temperature Range	$T_J, T_{stg}$	–65 to +200				°C

**THERMAL CHARACTERISTICS**

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	$\theta_{JC}$	0.875	°C/W

\* Indicates JEDEC Registered Data.



**Figure 1. Power Derating**

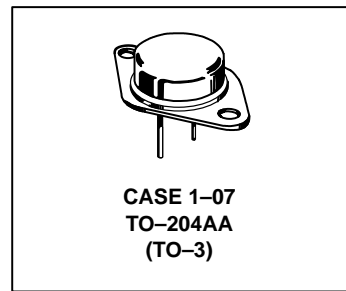
Preferred devices are Motorola recommended choices for future use and best overall value.

REV 7

**2N6338**  
**2N6339**  
**2N6340**  
**2N6341\***

\*Motorola Preferred Device

**25 AMPERE**  
**POWER TRANSISTORS**  
**NPN SILICON**  
**100, 120, 140, 150 VOLTS**  
**200 WATTS**



**2N6338 2N6339 2N6340 2N6341**

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

Characteristic	Symbol	Min	Max	Unit	
<b>OFF CHARACTERISTICS</b>					
Collector–Emitter Sustaining Voltage (1) ( $I_C = 50\text{ mAdc}$ , $I_B = 0$ )	2N6338 2N6339 2N6340 2N6341	$V_{CEO(sus)}$	100 120 140 150	— — — —	Vdc
Collector Cutoff Current ( $V_{CE} = 50\text{ Vdc}$ , $I_B = 0$ ) ( $V_{CE} = 60\text{ Vdc}$ , $I_B = 0$ ) ( $V_{CE} = 70\text{ Vdc}$ , $I_B = 0$ ) ( $V_{CE} = 75\text{ Vdc}$ , $I_B = 0$ )	2N6338 2N6339 2N6340 2N6341	$I_{CEO}$	— — — —	50 50 50 50	$\mu\text{Adc}$
Collector Cutoff Current ( $V_{CE} = \text{Rated } V_{CEO}$ , $V_{EB(off)} = 1.5\text{ Vdc}$ ) ( $V_{CE} = \text{Rated } V_{CEO}$ , $V_{EB(off)} = 1.5\text{ Vdc}$ , $T_C = 150^\circ\text{C}$ )		$I_{CEX}$	— —	10 1.0	$\mu\text{Adc}$ mAdc
Collector Cutoff Current ( $V_{CB} = \text{Rated } V_{CB}$ , $I_E = 0$ )		$I_{CBO}$	—	10	$\mu\text{Adc}$
Emitter Cutoff Current ( $V_{BE} = 6.0\text{ Vdc}$ , $I_C = 0$ )		$I_{EBO}$	—	100	$\mu\text{Adc}$

**ON CHARACTERISTICS (1)**

DC Current Gain ( $I_C = 0.5\text{ Adc}$ , $V_{CE} = 2.0\text{ Vdc}$ ) ( $I_C = 10\text{ Adc}$ , $V_{CE} = 2.0\text{ Vdc}$ ) ( $I_C = 25\text{ Adc}$ , $V_{CE} = 2.0\text{ Vdc}$ )	$h_{FE}$	50 30 12	— 120 —	—
Collector Emitter Saturation Voltage ( $I_C = 10\text{ Adc}$ , $I_B = 1.0\text{ Adc}$ ) ( $I_C = 25\text{ Adc}$ , $I_B = 2.5\text{ Adc}$ )	$V_{CE(sat)}$	— —	1.0 1.8	Vdc
Base–Emitter Saturation Voltage ( $I_C = 10\text{ Adc}$ , $I_B = 1.0\text{ Adc}$ ) ( $I_C = 25\text{ Adc}$ , $I_B = 2.5\text{ Adc}$ )	$V_{BE(sat)}$	— —	1.8 2.5	Vdc
Base–Emitter On Voltage ( $I_C = 10\text{ Adc}$ , $V_{CE} = 2.0\text{ Vdc}$ )	$V_{BE(on)}$	—	1.8	Vdc

**DYNAMIC CHARACTERISTICS**

Current–Gain — Bandwidth Product (2) ( $I_C = 1.0\text{ Adc}$ , $V_{CE} = 10\text{ Vdc}$ , $f_{test} = 10\text{ MHz}$ )	$f_T$	40	—	MHz
Output Capacitance ( $V_{CB} = 10\text{ Vdc}$ , $I_E = 0$ , $f = 0.1\text{ MHz}$ )	$C_{ob}$	—	300	pF

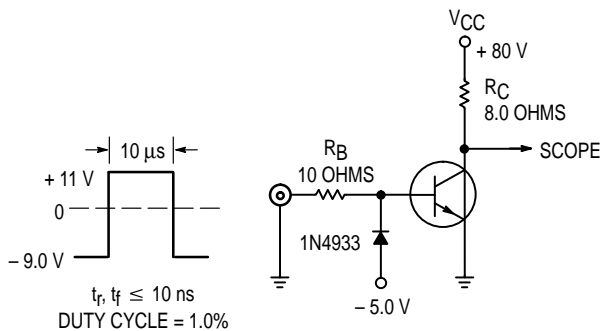
**SWITCHING CHARACTERISTICS**

Rise Time ( $V_{CC} \approx 80\text{ Vdc}$ , $I_C = 10\text{ Adc}$ , $I_{B1} = 1.0\text{ Adc}$ , $V_{BE(off)} = 6.0\text{ Vdc}$ )	$t_r$	—	0.3	$\mu\text{s}$
Storage Time ( $V_{CC} \approx 80\text{ Vdc}$ , $I_C = 10\text{ Adc}$ , $I_{B1} = I_{B2} = 1.0\text{ Adc}$ )	$t_s$	—	1.0	$\mu\text{s}$
Fall Time ( $V_{CC} \approx 80\text{ Vdc}$ , $I_C = 10\text{ Adc}$ , $I_{B1} = I_{B2} = 1.0\text{ Adc}$ )	$t_f$	—	0.25	$\mu\text{s}$

\* Indicates JEDEC Registered Data.

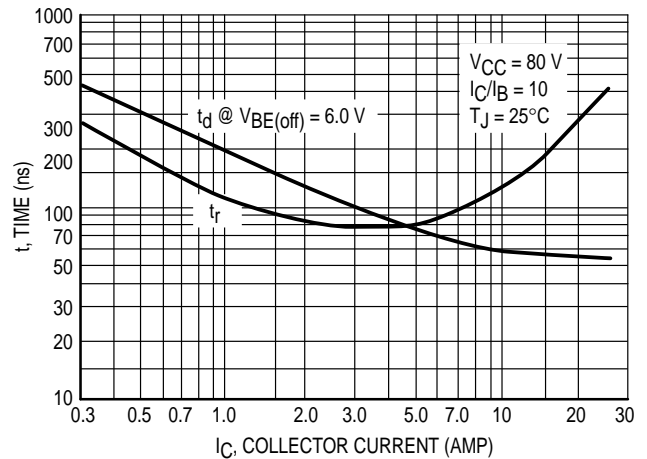
(1) Pulse Test: Pulse Width  $\leq 300\ \mu\text{s}$ , Duty Cycle  $\leq 2.0\%$ .

(2)  $f_T = |h_{fe}| \cdot f_{test}$ .



NOTE: For information on Figures 3 and 6,  $R_B$  and  $R_C$  were varied to obtain desired test conditions.

**Figure 2. Switching Time Test Circuit**



**Figure 3. Turn–On Time**

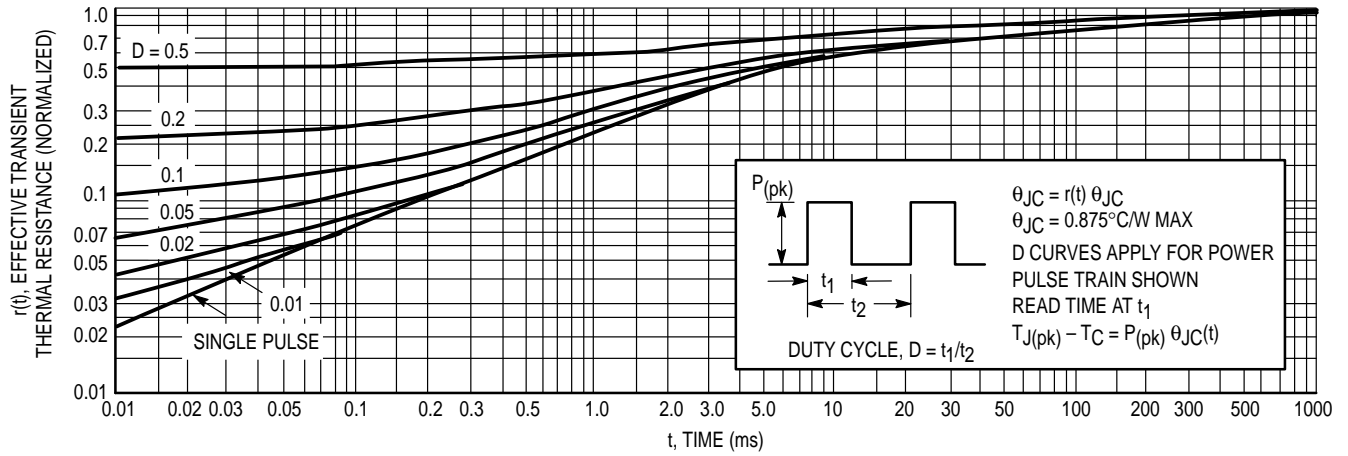


Figure 4. Thermal Response

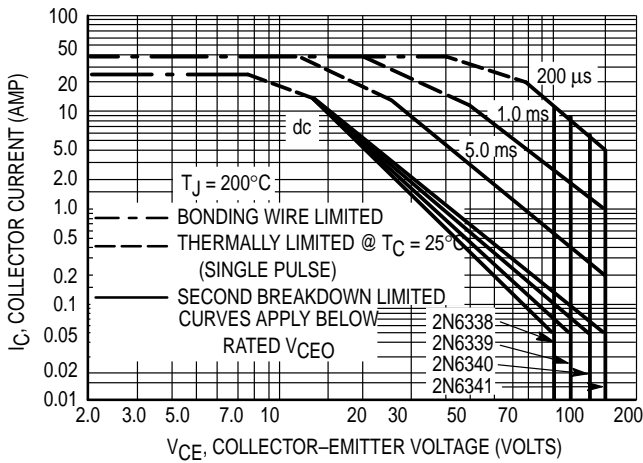


Figure 5. Active Region Safe Operating Area

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.

The data of Figure 5 is based on  $T_{J(pk)} = 200^\circ\text{C}$ ;  $T_C$  is variable depending on conditions. Second breakdown pulse limits are valid for duty cycles to 10% provided  $T_{J(pk)} \leq 200^\circ\text{C}$ .  $T_{J(pk)}$  may be calculated from the data in Figure 4. At high case temperatures, thermal limitations will reduce the power that can be handled to values less than the limitations imposed by second breakdown.

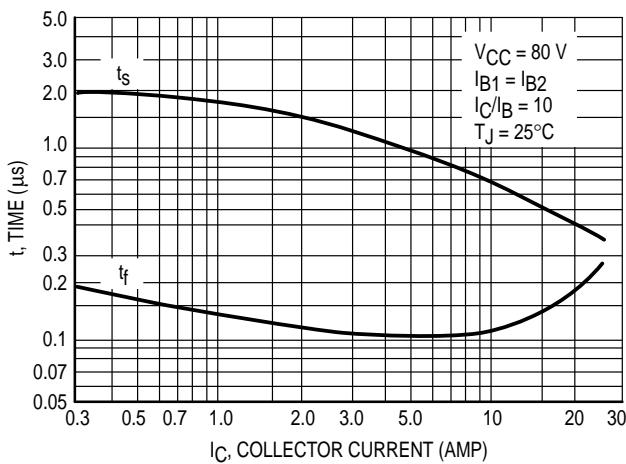


Figure 6. Turn-Off Time

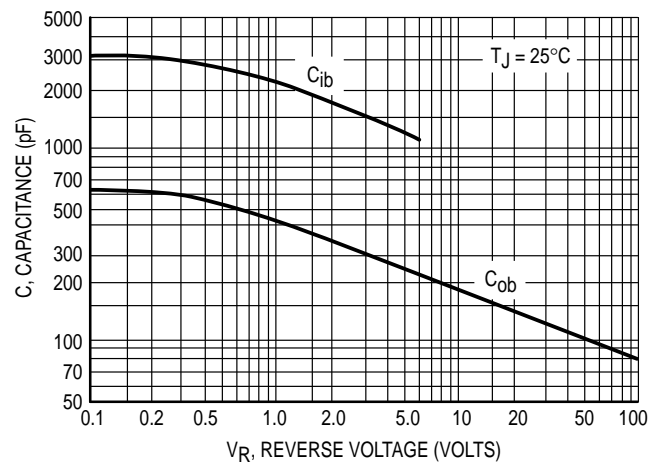
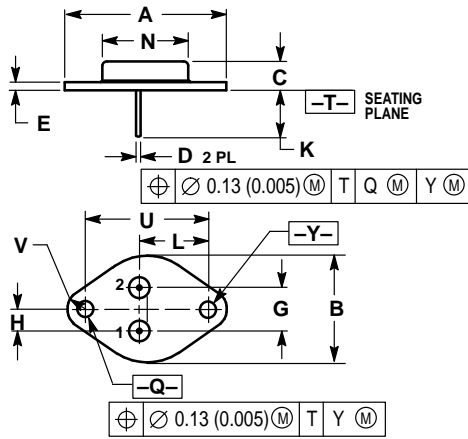


Figure 7. Capacitance

PACKAGE DIMENSIONS



- 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

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

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