

High-Power NPN Silicon Transistors

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

- High Collector–Emitter Sustaining Voltage —
 $V_{CEO(sus)} = 100 \text{ Vdc (Min)} \text{ — } 2N6338$
 $= 120 \text{ Vdc (Min)} \text{ — } 2N6339$
 $= 140 \text{ Vdc (Min)} \text{ — } 2N6340$
 $= 150 \text{ Vdc (Min)} \text{ — } 2N6341$
- 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	I_C					Adc
Continuous		25				
Peak		50				
Base Current	I_B	10				Adc
Total Device Dissipation	P_D					Watts
@ $T_C = 25^\circ\text{C}$		200				$\text{W}/^\circ\text{C}$
Derate above 25°C		1.14				
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	θ_{JC}	0.875	$^\circ\text{C}/\text{W}$

* Indicates JEDEC Registered Data.

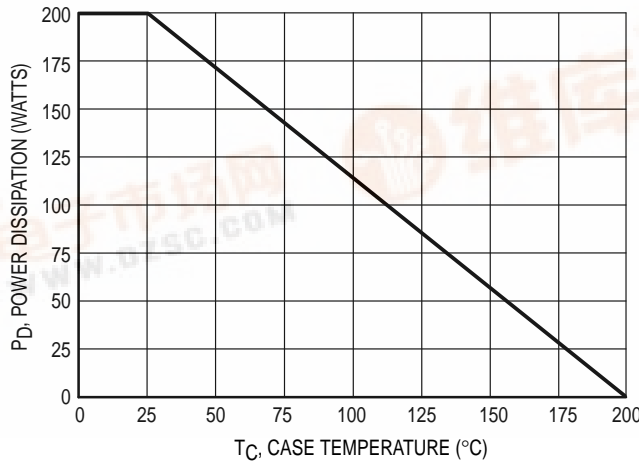


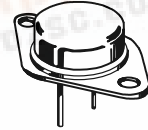
Figure 1. Power Derating

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

2N6338
2N6339
2N6340
2N6341*

*Motorola Preferred Device

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



CASE 1–07
TO–204AA
(TO–3)

2N6338 2N6339 2N6340 2N6341

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

Characteristic	Symbol	Min	Max	Unit	
OFF CHARACTERISTICS					
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	μAdc
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	μAdc mAdc
Collector Cutoff Current ($V_{CB} = \text{Rated } V_{CB}$, $I_E = 0$)		I_{CBO}	—	10	μAdc
Emitter Cutoff Current ($V_{BE} = 6.0\text{ Vdc}$, $I_C = 0$)		I_{EBO}	—	100	μAdc

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

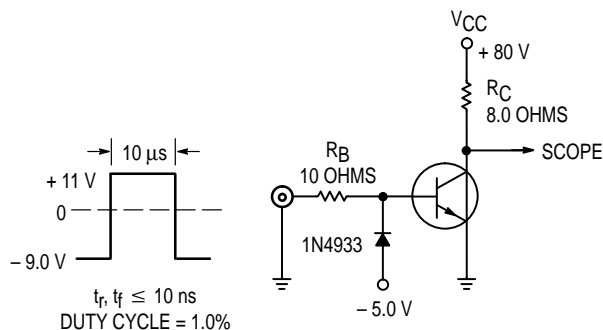
SWITCHING CHARACTERISTICS

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	μs
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	μs
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	μs

* 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

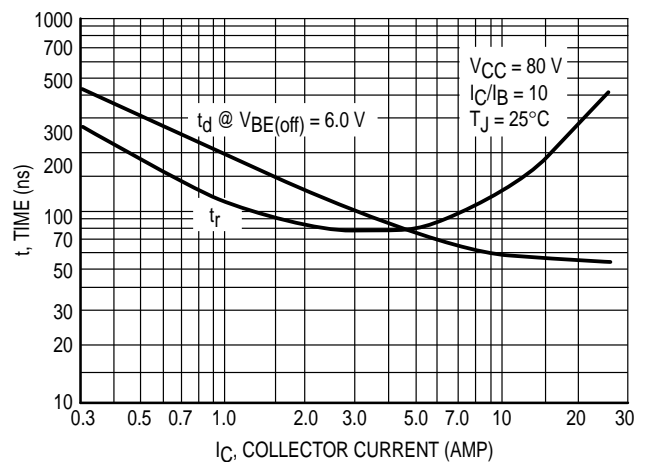


Figure 3. Turn–On Time

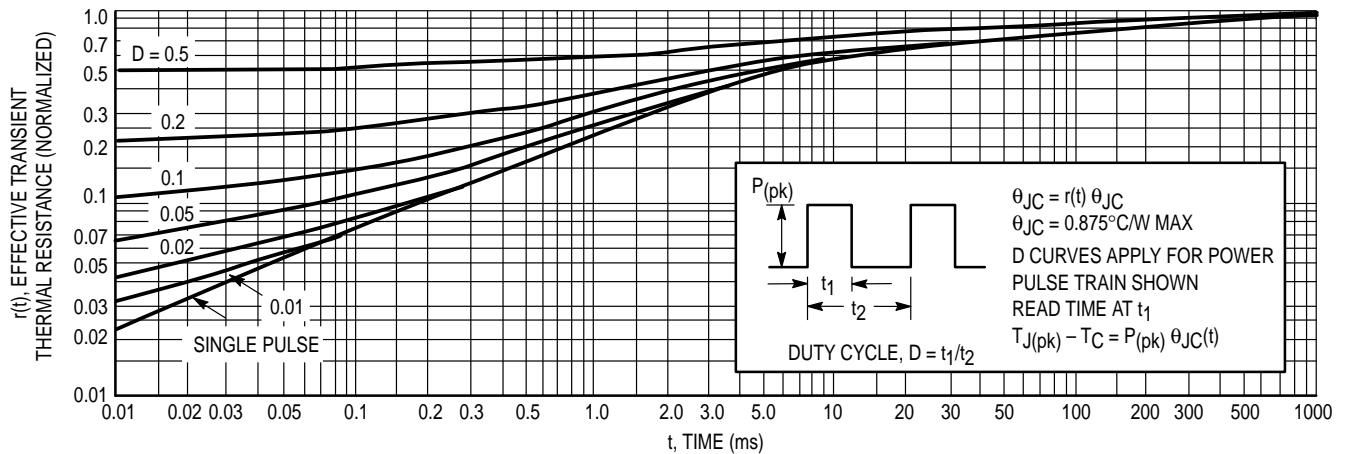


Figure 4. Thermal Response

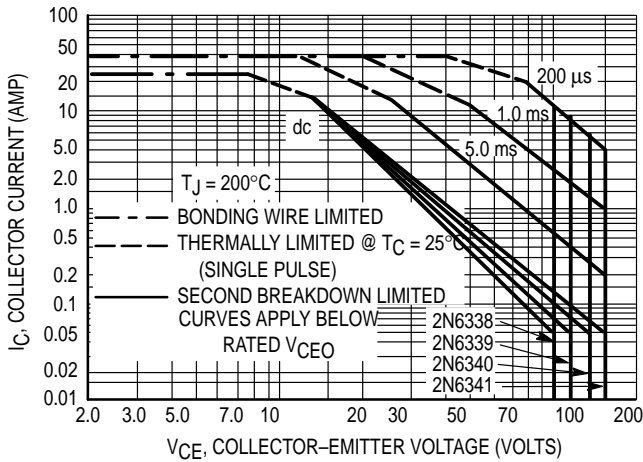


Figure 5. Active Region Safe Operating Area

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.

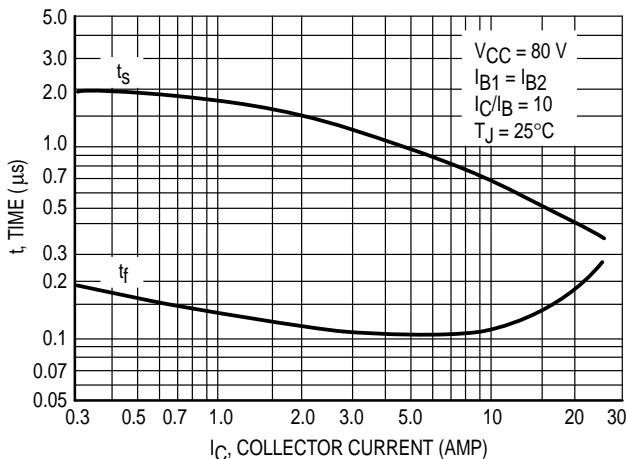


Figure 6. Turn-Off Time

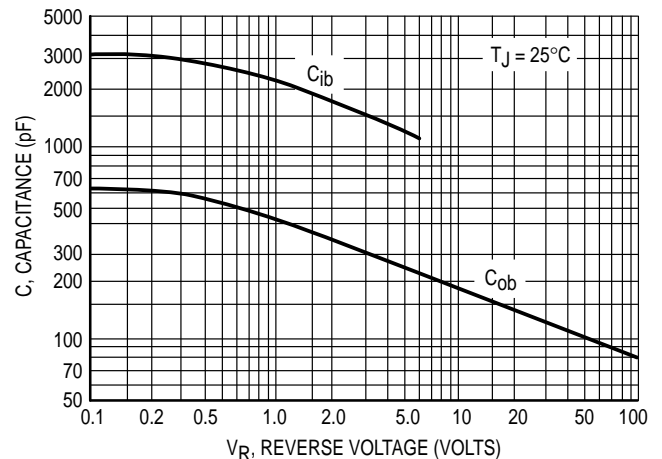
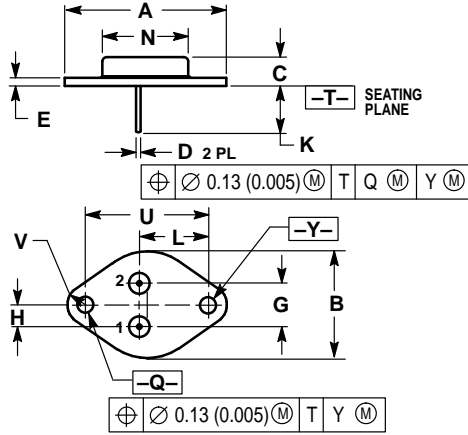


Figure 7. Capacitance

2N6338 2N6339 2N6340 2N6341

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:
1. BASE
 2. EMITTER
- CASE: COLLECTOR

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

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