

NPN Silicon Transistors

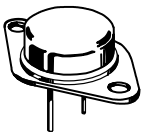
... fast switching speeds and high current capacity ideally suit these parts for use in switching regulators, inverters, wide-band amplifiers and power oscillators in industrial and commercial applications.

- High Speed — $t_f = 0.5 \mu s$ (Max)
- High Current — $I_C(max) = 30$ Amps
- Low Saturation — $V_{CE(sat)} = 2.5$ V (Max) @ $I_C = 20$ Amps

2N5038*
2N5039

*Motorola Preferred Device

**20 AMPERE
NPN SILICON
POWER TRANSISTORS
75 and 90 VOLTS
140 WATTS**



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

***MAXIMUM RATINGS**

Rating	Symbol	2N5038	2N5039	Unit
Collector–Base Voltage	V _{CBO}	150	120	Vdc
Collector–Emitter Voltage	V _{CEV}	150	120	Vdc
Emitter–Base Voltage	V _{EBO}	7		Vdc
Collector Current — Continuous Peak (1)	I _C	20		Adc
	I _{CM}	30		
Base Current — Continuous	I _B	5		Adc
Total Device Dissipation @ T _C = 25°C Derate above 25°C	P _D	140		Watts W/°C
		0.8		
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	$R_{\theta JC}$	1.25	$^\circ C/W$

* Indicates JEDEC Registered Data.
(1) Pulse Test: Pulse Width ≤ 10 ms, Duty Cycle $\leq 50\%$.

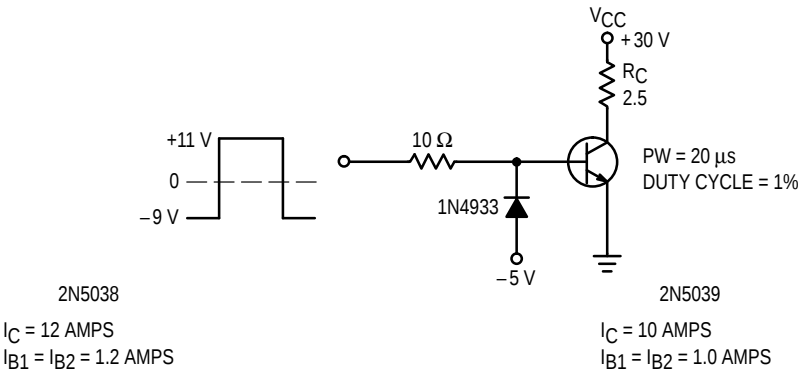


Figure 1. Switching Time Test Circuit

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

REV 7

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

Characteristic	Symbol	Min	Max	Unit
OFF CHARACTERISTICS				
Collector–Emitter Sustaining Voltage (1) ($I_C = 200\text{ mAdc}$, $I_B = 0$)	$V_{CEO(sus)}$	90 75	— —	Vdc
Collector Cutoff Current ($V_{CE} = 140\text{ Vdc}$, $V_{BE(off)} = 1.5\text{ V}$) ($V_{CE} = 110\text{ Vdc}$, $V_{BE(off)} = 1.5\text{ V}$) ($V_{CE} = 100\text{ Vdc}$, $V_{BE(off)} = 1.5\text{ Vdc}$, $T_C = 150^\circ\text{C}$) ($V_{CE} = 85\text{ Vdc}$, $V_{BE(off)} = 1.5\text{ Vdc}$, $T_C = 150^\circ\text{C}$)	I_{CEX}	— — — —	50 50 10 10	mAdc
Emitter Cutoff Current ($V_{EB} = 5\text{ Vdc}$, $I_C = 0$) ($V_{EB} = 7\text{ Vdc}$, $I_C = 0$)	I_{EBO}	— — —	5 15 50	mAdc

ON CHARACTERISTICS (1)

DC Current Gain ($I_C = 12\text{ Adc}$, $V_{CE} = 5\text{ Vdc}$) ($I_C = 10\text{ Adc}$, $V_{CE} = 5\text{ Vdc}$)	h_{FE}	20 20	100 100	—
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

DYNAMIC CHARACTERISTICS

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	—	—
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SWITCHING CHARACTERISTICS

RESISTIVE LOAD					
Rise Time	$(V_{CC} = 30\text{ Vdc})$ ($I_C = 12\text{ Adc}$, $I_{B1} = I_{B2} = 1.2\text{ Adc}$)	2N5038	t_r	—	0.5 μs
Storage Time			t_s	—	1.5 μs
Fall Time	($I_C = 10\text{ Adc}$, $I_{B1} = I_{B2} = 1\text{ Adc}$)	2N5039	t_f	—	0.5 μs

* Indicates JEDEC Registered Data.

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

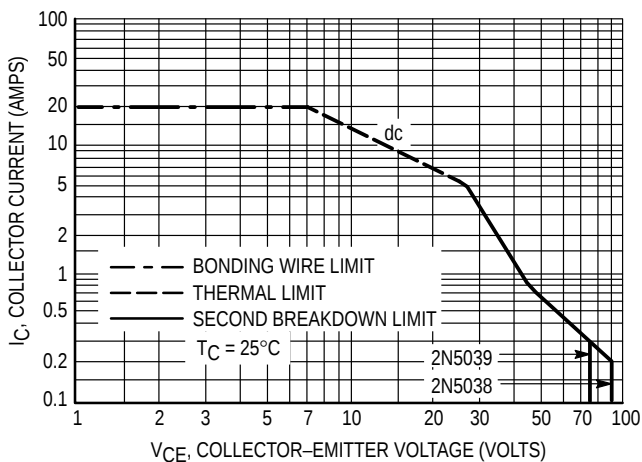
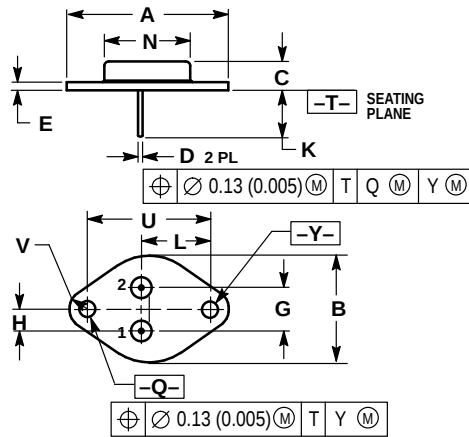


Figure 2. Forward Bias Safe Operating Area

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.

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
- EMITTER
- COLLECTOR

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

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