

## NPN SILICON HIGH-POWER TRANSISTORS

General Purpose use in power amplifier and switching circuit applications.

### FEATURES:

- \* DC Current Gain Specified- 1.0 to 30 A
- \* Low Collector-Emitter Saturation Voltage -  
 $V_{CE(sat)} = 0.75 \text{ V (Max.) @ } I_c = 10 \text{ A - 2N5301, 2N5302}$   
 $V_{CE(sat)} = 1.0 \text{ V (Max.) @ } I_c = 10 \text{ A - 2N5303}$
- \* Complements to PNP 2N4398, 2N4399 and 2N5745

### MAXIMUM RATINGS

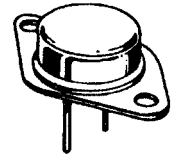
Characteristic	Symbol	2N5301	2N5302	2N5303	Unit
Collector-Emitter Voltage	$V_{CBO}$	40	60	80	V
Collector-Emitter Voltage	$V_{CEO}$	40	60	80	V
Emitter-Base Voltage	$V_{EB}$	5.0			V
Collector Current-Continuous	$I_C$	30	30	20	A
Base current - Continuous	$I_B$	7.5			A
Total Power Dissipation @ $T_c = 25^\circ\text{C}$ Derate above $25^\circ\text{C}$	$P_D$	200 1.14			W W/ $^\circ\text{C}$
Operating and Storage Junction Temperature Range	$T_J, T_{STG}$	- 65 to +200			$^\circ\text{C}$

### THERMAL CHARACTERISTICS

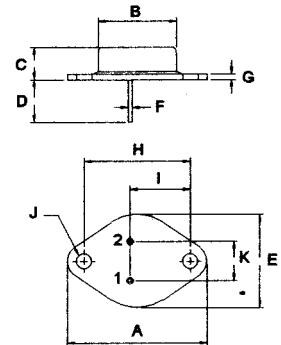
Characteristic	Symbol	Max	Unit
Thermal Resistance Junction to Case	$R_{\theta jc}$	0.875	$^\circ\text{C/W}$

**NPN**  
**2N5301**  
**2N5302**  
**2N5303**

**20 AND 30 AMPERE**  
**NPN SILICON**  
**POWER TRANSISTORS**  
40-80 Volts  
200 Watts

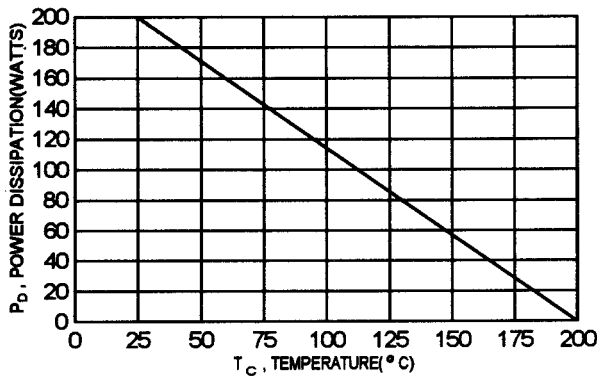


TO-3



PIN 1.BASE  
2.EMITTER  
COLLECTOR(CASE)

FIGURE -1 POWER DERATING



DIM	MILLIMETERS	
	MIN	MAX
A	38.75	39.96
B	19.28	22.23
C	7.96	9.28
D	11.18	12.19
E	25.20	28.67
F	0.92	1.09
G	1.38	1.62
H	29.90	30.40
I	16.64	17.30
J	3.88	4.36
K	10.67	11.18

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) ( $I_c = 200\text{ mA}$ , $I_B = 0$ )	2N5301 2N5302 2N5303	$V_{CE(sus)}$	40 60 80	V
Collector Cutoff Current ( $V_{CE} = 40\text{ V}$ , $I_B = 0$ ) ( $V_{CE} = 60\text{ V}$ , $I_B = 0$ ) ( $V_{CE} = 80\text{ V}$ , $I_B = 0$ )	2N5301 2N5302 2N5303	$I_{CEO}$	5.0 5.0 5.0	mA
Collector Cutoff Current ( $V_{CE} = 40\text{ V}$ , $V_{BE(off)} = 1.5\text{ V}$ ) ( $V_{CE} = 60\text{ V}$ , $V_{BE(off)} = 1.5\text{ V}$ ) ( $V_{CE} = 80\text{ V}$ , $V_{BE(off)} = 1.5\text{ V}$ ) ( $V_{CE} = 40\text{ V}$ , $V_{BE(off)} = 1.5\text{ V}$ , $T_c = 150^\circ\text{C}$ ) ( $V_{CE} = 60\text{ V}$ , $V_{BE(off)} = 1.5\text{ V}$ , $T_c = 150^\circ\text{C}$ ) ( $V_{CE} = 80\text{ V}$ , $V_{BE(off)} = 1.5\text{ V}$ , $T_c = 150^\circ\text{C}$ )	2N5301 2N5302 2N5303 2N5301 2N5302 2N5303	$I_{CEX}$	1.0 1.0 1.0 10 10	mA mA
Collector Cutoff Current ( $V_{CB} = 40\text{ V}$ , $I_E = 0$ ) ( $V_{CB} = 60\text{ V}$ , $I_E = 0$ ) ( $V_{CB} = 80\text{ V}$ , $I_E = 0$ )	2N5301 2N5302 2N5303	$I_{CBO}$	1.0 1.0 1.0	mA
Emitter Cutoff Current ( $V_{EB} = 5.0\text{ V}$ , $I_C = 0$ )	All Types	$I_{EBO}$	5.0	mA

## ON CHARACTERISTICS (1)

DC Current Gain ( $I_c = 1.0\text{ A}$ , $V_{CE} = 2.0\text{ V}$ ) ( $I_c = 10\text{ A}$ , $V_{CE} = 2.0\text{ V}$ ) ( $I_c = 15\text{ A}$ , $V_{CE} = 2.0\text{ V}$ ) ( $I_c = 20\text{ A}$ , $V_{CE} = 4.0\text{ V}$ ) ( $I_c = 30\text{ A}$ , $V_{CE} = 4.0\text{ V}$ )	All Types 2N5303 2N5301,2N5302 2N5303 2N5301,2N5302	$h_{FE}$	40 15 15 5.0 5.0	60 60
Collector-Emitter Saturation Voltage ( $I_c = 10\text{ A}$ , $I_B = 1.0\text{ A}$ )  ( $I_c = 15\text{ A}$ , $I_B = 1.5\text{ A}$ ) ( $I_c = 20\text{ A}$ , $I_B = 2.0\text{ A}$ ) ( $I_c = 20\text{ A}$ , $I_B = 4.0\text{ A}$ ) ( $I_c = 30\text{ A}$ , $I_B = 6.0\text{ A}$ )	2N5301,2N5302 2N5303 2N5303 2N5301,2N5302 2N5303 2N5301,2N5302	$V_{CE(sat)}$	0.75 1.0 1.5 2.0 2.0 3.0	V
Base-Emitter Saturation Voltage ( $I_c = 10\text{ A}$ , $I_B = 1.0\text{ A}$ ) ( $I_c = 15\text{ A}$ , $I_B = 1.5\text{ A}$ )  ( $I_c = 20\text{ A}$ , $I_B = 2.0\text{ A}$ ) ( $I_c = 20\text{ A}$ , $I_B = 4.0\text{ A}$ )	All Types 2N5301,2N5302 2N5303 2N5301,2N5302 2N5303	$V_{BE(sat)}$	1.7 1.8 2.0 2.5 2.5	V
Base-Emitter On Voltage ( $I_c = 10\text{ A}$ , $V_{CE} = 2.0\text{ V}$ ) ( $I_c = 15\text{ A}$ , $V_{CE} = 2.0\text{ V}$ ) ( $I_c = 20\text{ A}$ , $V_{CE} = 4.0\text{ V}$ ) ( $I_c = 30\text{ A}$ , $V_{CE} = 4.0\text{ V}$ )	2N5303 2N5301,2N5302 2N5303 2N5301,2N5302	$V_{BE(on)}$	1.5 1.7 2.5 3.0	V

(1) Pulse Test: Pulse width = 300 us , Duty Cycle  $\leq 2.0\%$

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

Characteristic	Symbol	Min	Max	Unit
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**DYNAMIC CHARACTERISTICS**

Current - Gain -Bandwidth Product (2) ( $I_C = 1.0\text{ A}$ , $V_{CE} = 10\text{ V}$ , $f = 1.0\text{ MHz}$ )	$f_T$	2.0		MHz
Small-Signal Current Gain ( $I_C = 1.0\text{ A}$ , $V_{CE} = 10\text{ V}$ , $f = 1.0\text{ KHz}$ )	$h_{fe}$	40		

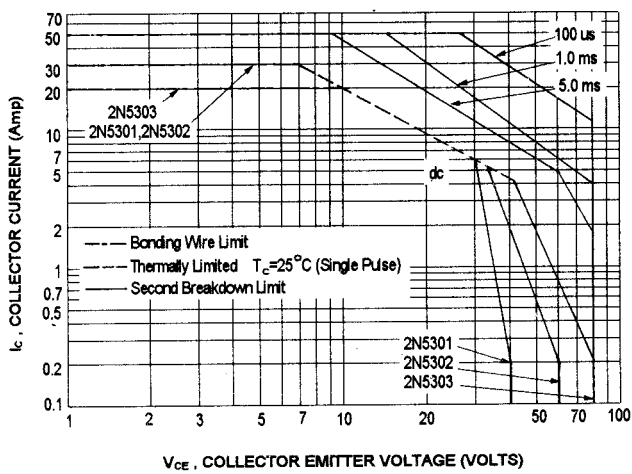
**SWITCHING CHARACTERISTICS**

Rise Time	$V_{CC} = 30\text{ V}$ , $I_C = 10.0\text{ A}$ $I_{B1} = -I_{B2} = 1.0\text{ A}$ $t_p = 0.1\text{ ms}$ Duty Cycle $\leq 2.0\%$	$t_r$	1.0	us
Storage Time		$t_s$	2.0	us
Fall Time		$t_f$	1.0	us

(1) Pulse Test: Pulse width = 300 us , Duty Cycle  $\leq 2.0\%$

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

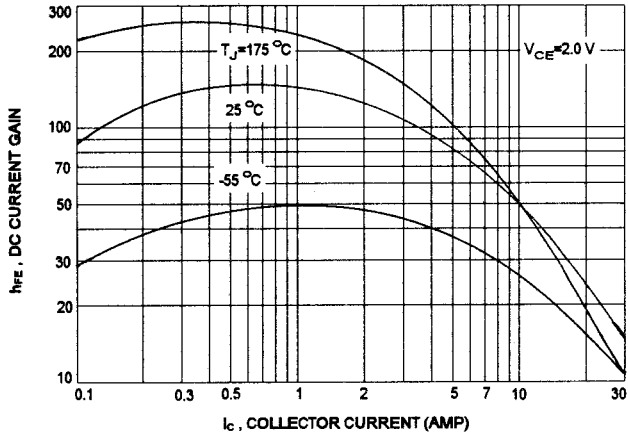
**ACTIVE REGION SAFE OPERATING AREA (SOA)**



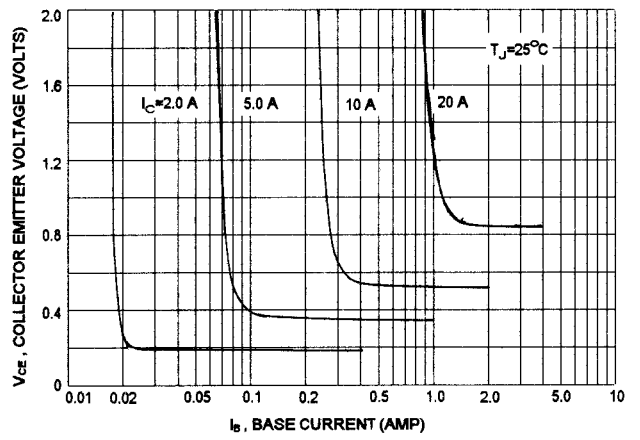
There are two limitation on the power handling ability of a transistor: average junction temperature and second breakdown safe operating area curves indicate  $I_C$ - $V_{CE}$  limits of the transistor that must be observed for reliable operation i.e., the transistor must not be subjected to greater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

The data of SOA curve is base 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  $T_{J(PK)} < 200^\circ\text{C}$ . At high case temperatures, thermal limitation will reduce the power that can be handled to values less than the limitations imposed by second breakdown.

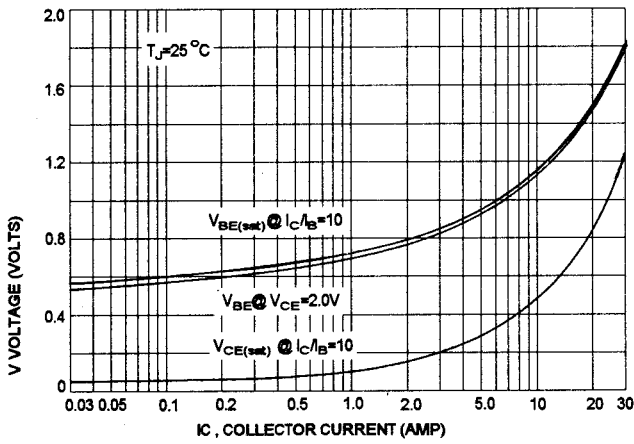
DC CURRENT GAIN



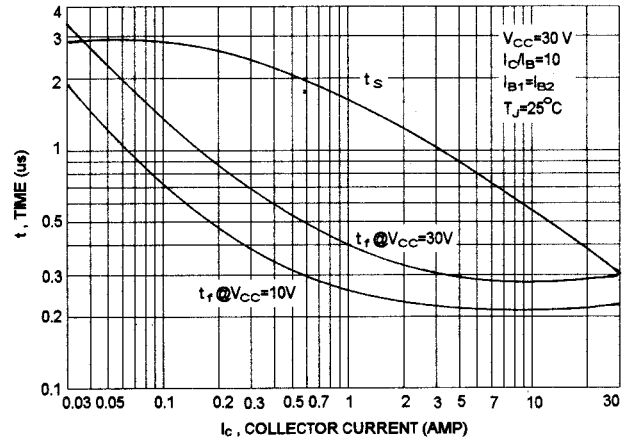
COLLECTOR SATURATION REGION



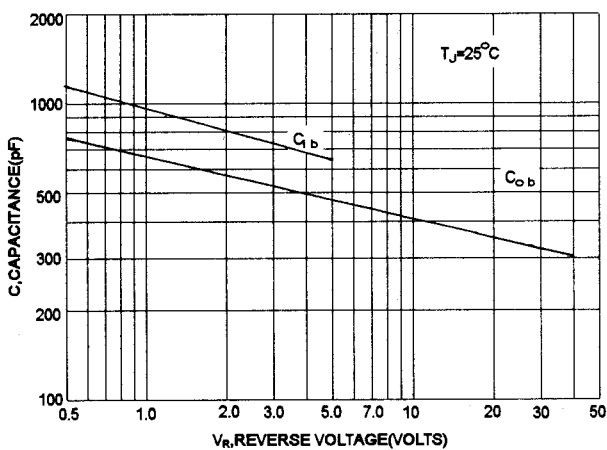
"ON" VOLTAGES



TURN-OFF TIME



CAPACITANCES



COLLECTOR CUT-OFF REGION

