

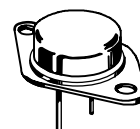
# High-Power NPN Silicon Transistors

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

... for use in power amplifier and switching circuits applications.

- High Collector–Emitter Sustaining Voltage —  
 $V_{CEO(sus)} = 80 \text{ Vdc (Min) @ } I_C = 200 \text{ mAdc (2N5303)}$
- Low Collector–Emitter Saturation Voltage —  
 $V_{CE(sat)} = 0.75 \text{ Vdc (Max) @ } I_C = 10 \text{ Adc (2N5301, 2N5302)}$   
 $1.0 \text{ Vdc (Max) @ } I_C = 10 \text{ Adc (2N5303)}$
- Excellent Safe Operating Area —  
200 Watt dc Power Rating to 30 Vdc (2N5303)
- Complements to PNP 2N4398, 2N4399 and 2N5745

**20 AND 30 AMPERE**  
**POWER TRANSISTORS**  
**NPN SILICON**  
**40–60–80 VOLTS**  
**200 WATTS**



**CASE 1–07**  
**TO–204AA**  
**(TO–3)**

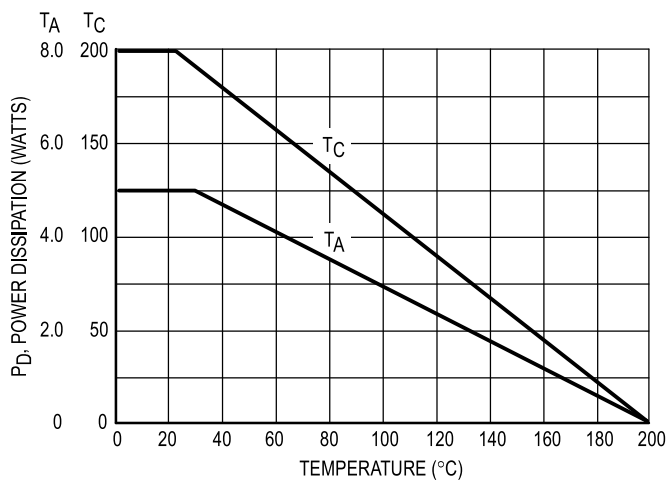
**\*MAXIMUM RATINGS**

Rating	Symbol	2N5301	2N5302	2N5303	Unit
Collector–Emitter Voltage	$V_{CEO}$	40	60	80	Vdc
Collector–Base Voltage	$V_{CB}$	40	60	80	Vdc
Collector Current — Continuous	$I_C$	30	30	20	Adc
Base Current	$I_B$	7.5			Adc
Total Device Dissipation @ $T_C = 25^\circ\text{C}$ Derate above $25^\circ\text{C}$	$P_D$	200 1.14			Watts 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	$\theta_{JC}$	0.875	$^\circ\text{C/W}$
Thermal Resistance, Case to Ambient	$\theta_{CA}$	34	$^\circ\text{C/W}$

\* Indicates JEDEC Registered Data.



**Figure 1. Power Temperature Derating Curve**



## 2N5301 2N5302 2N5303

### ELECTRICAL CHARACTERISTICS (T<sub>C</sub> = 25°C unless otherwise noted)

Characteristic		Symbol	Min	Max	Unit
<b>*OFF CHARACTERISTICS</b>					
Collector–Emitter Sustaining Voltage (Note 1) (I <sub>C</sub> = 200 mA <sub>dc</sub> , I <sub>B</sub> = 0)	2N5301 2N5302 2N5303	V <sub>CEO(sus)</sub>	40 60 80	— — —	V <sub>dc</sub>
Collector Cutoff Current (V <sub>CE</sub> = 40 V <sub>dc</sub> , I <sub>B</sub> = 0) (V <sub>CE</sub> = 60 V <sub>dc</sub> , I <sub>B</sub> = 0) (V <sub>CE</sub> = 80 V <sub>dc</sub> , I <sub>B</sub> = 0)	2N5301 2N5302 2N5303	I <sub>CEO</sub>	— — —	5.0 5.0 5.0	mA <sub>dc</sub>
Collector Cutoff Current (V <sub>CE</sub> = 40 V <sub>dc</sub> , V <sub>EB(off)</sub> = 1.5 V <sub>dc</sub> ) (V <sub>CE</sub> = 60 V <sub>dc</sub> , V <sub>EB(off)</sub> = 1.5 V <sub>dc</sub> ) (V <sub>CE</sub> = 80 V <sub>dc</sub> , V <sub>EB(off)</sub> = 1.5 V <sub>dc</sub> )	2N5301 2N5302 2N5303	I <sub>CEX</sub>	— — —	1.0 1.0 1.0	mA <sub>dc</sub>
Collector Cutoff Current (V <sub>CE</sub> = 40 V <sub>dc</sub> , V <sub>EB(off)</sub> = 1.5 V <sub>dc</sub> , T <sub>C</sub> = 150°C) (V <sub>CE</sub> = 60 V <sub>dc</sub> , V <sub>EB(off)</sub> = 1.5 V <sub>dc</sub> , T <sub>C</sub> = 150°C) (V <sub>CE</sub> = 80 V <sub>dc</sub> , V <sub>EB(off)</sub> = 1.5 V <sub>dc</sub> , T <sub>C</sub> = 150°C)	2N5301 2N5302 2N5303	I <sub>CEX</sub>	— — —	10 10 10	mA <sub>dc</sub>
Collector Cutoff Current (V <sub>CB</sub> = 40 V <sub>dc</sub> , I <sub>E</sub> = 0) (V <sub>CB</sub> = 80 V <sub>dc</sub> , I <sub>E</sub> = 0) (V <sub>CB</sub> = 80 V <sub>dc</sub> , I <sub>E</sub> = 0)	2N5301 2N5302 2N5303	I <sub>CBO</sub>	— — —	1.0 1.0 1.0	mA <sub>dc</sub>
Emitter Cutoff Current (V <sub>BE</sub> = 5.0 V <sub>dc</sub> , I <sub>C</sub> = 0)		I <sub>EBO</sub>	—	5.0	mA <sub>dc</sub>

### ON CHARACTERISTICS

DC Current Gain (Note 1) *(I <sub>C</sub> = 1.0 A <sub>dc</sub> , V <sub>CE</sub> = 2.0 V <sub>dc</sub> ) *(I <sub>C</sub> = 10 A <sub>dc</sub> , V <sub>CE</sub> = 2.0 V <sub>dc</sub> ) *(I <sub>C</sub> = 15 A <sub>dc</sub> , V <sub>CE</sub> = 2.0 V <sub>dc</sub> ) (I <sub>C</sub> = 20 A <sub>dc</sub> , V <sub>CE</sub> = 4.0 V <sub>dc</sub> ) (I <sub>C</sub> = 30 A <sub>dc</sub> , V <sub>CE</sub> = 4.0 V <sub>dc</sub> )	ALL TYPES 2N5303 2N5301, 2N5302 2N5303 2N5301, 2N5302	h <sub>FE</sub>	40 15 15 5.0 5.0	— 60 60 — —	—
*Collector–Emitter Saturation Voltage (Note 1) (I <sub>C</sub> = 10 A <sub>dc</sub> , I <sub>B</sub> = 1.0 A <sub>dc</sub> ) (I <sub>C</sub> = 10 A <sub>dc</sub> , I <sub>B</sub> = 1.0 A <sub>dc</sub> ) (I <sub>C</sub> = 15 A <sub>dc</sub> , I <sub>B</sub> = 1.5 A <sub>dc</sub> ) (I <sub>C</sub> = 20 A <sub>dc</sub> , I <sub>B</sub> = 2.0 A <sub>dc</sub> ) (I <sub>C</sub> = 20 A <sub>dc</sub> , I <sub>B</sub> = 4.0 A <sub>dc</sub> ) (I <sub>C</sub> = 30 A <sub>dc</sub> , I <sub>B</sub> = 6.0 A <sub>dc</sub> )	2N5301, 2N5302 2N5303 2N5303 2N5301, 2N5302 2N5303 2N5301, 2N5302	V <sub>CE(sat)</sub>	— — — — — —	0.75 1.0 1.5 2.0 2.0 3.0	V <sub>dc</sub>
*Base Emitter Saturation Voltage (Note 1) (I <sub>C</sub> = 10 A <sub>dc</sub> , I <sub>B</sub> = 1.0 A <sub>dc</sub> ) (I <sub>C</sub> = 15 A <sub>dc</sub> , I <sub>B</sub> = 1.5 A <sub>dc</sub> ) (I <sub>C</sub> = 15 A <sub>dc</sub> , I <sub>B</sub> = 1.5 A <sub>dc</sub> ) (I <sub>C</sub> = 20 A <sub>dc</sub> , I <sub>B</sub> = 2.0 A <sub>dc</sub> ) (I <sub>C</sub> = 20 A <sub>dc</sub> , I <sub>B</sub> = 4.0 A <sub>dc</sub> )	ALL TYPES 2N5301, 2N5302 2N5303 2N5301, 2N5302 2N5303	V <sub>BE(sat)</sub>	— — — — —	1.7 1.8 2.0 2.5 2.5	V <sub>dc</sub>
*Base–Emitter On Voltage (Note 1) (I <sub>C</sub> = 10 A <sub>dc</sub> , V <sub>CE</sub> = 2.0 V <sub>dc</sub> ) (I <sub>C</sub> = 15 A <sub>dc</sub> , V <sub>CE</sub> = 2.0 V <sub>dc</sub> ) (I <sub>C</sub> = 20 A <sub>dc</sub> , V <sub>CE</sub> = 4.0 V <sub>dc</sub> ) (I <sub>C</sub> = 30 A <sub>dc</sub> , V <sub>CE</sub> = 4.0 V <sub>dc</sub> )	2N5303 2N5301, 2N5302 2N5303 2N5301, 2N5302	V <sub>BE(on)</sub>	— — — —	1.5 1.7 25 3.0	V <sub>dc</sub>

### \*DYNAMIC CHARACTERISTICS

Current–Gain — Bandwidth Product (I <sub>C</sub> = 1.0 A <sub>dc</sub> , V <sub>CE</sub> = 10 V <sub>dc</sub> , f = 1.0 MHz)	f <sub>T</sub>	2.0	—	MHz
Small–Signal Current Gain (I <sub>C</sub> = 1.0 A <sub>dc</sub> , V <sub>CE</sub> = 10 V <sub>dc</sub> , f = 1.0 kHz)	h <sub>fe</sub>	40	—	—

### \*SWITCHING CHARACTERISTICS

Rise Time	(V <sub>CC</sub> = 30 V <sub>dc</sub> , I <sub>C</sub> = 10 A <sub>dc</sub> , I <sub>B1</sub> = I <sub>B2</sub> = 1.0 A <sub>dc</sub> )	t <sub>r</sub>	—	1.0	μs
Storage Time		t <sub>s</sub>	—	2.0	μs
Fall Time		t <sub>f</sub>	—	1.0	μs

\* Indicates JEDEC Registered Data.

Note 1: Pulse Width ≤ 300 μs, Duty Cycle ≤ 2.0%.

SWITCHING TIME EQUIVALENT TEST CIRCUITS

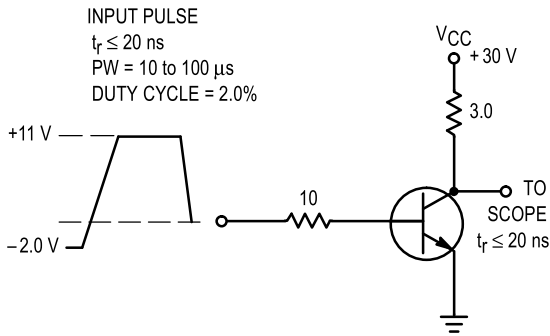


Figure 2. Turn-On time

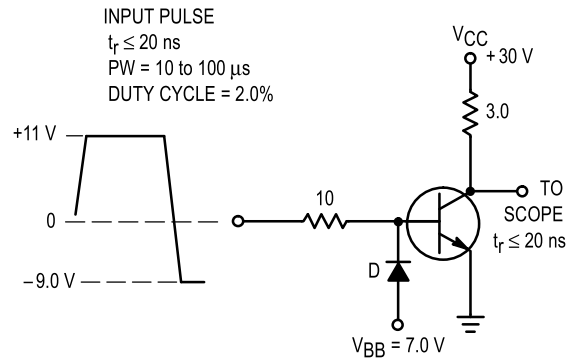


Figure 3. Turn-Off time

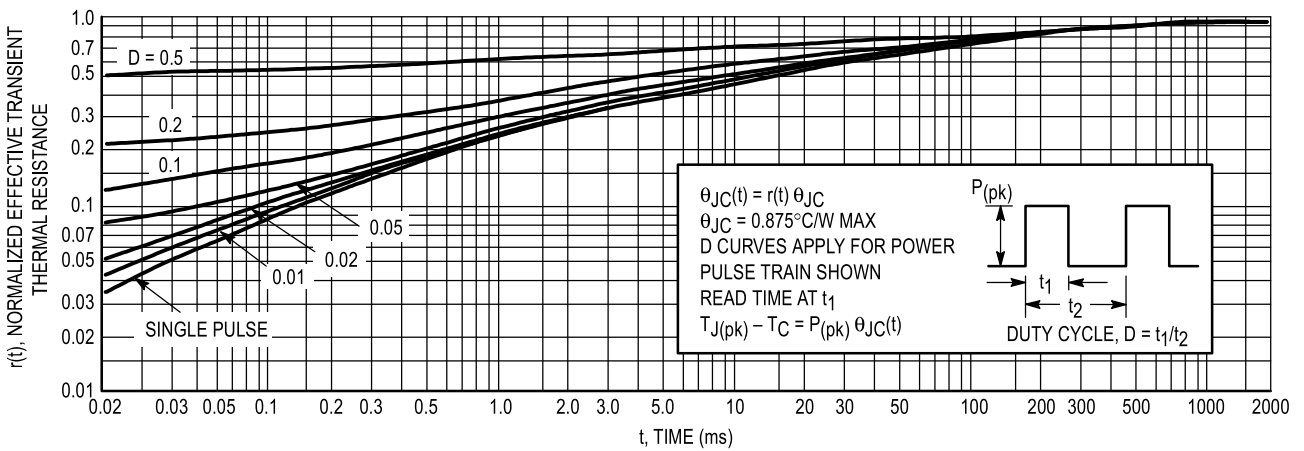


Figure 4. Thermal Response

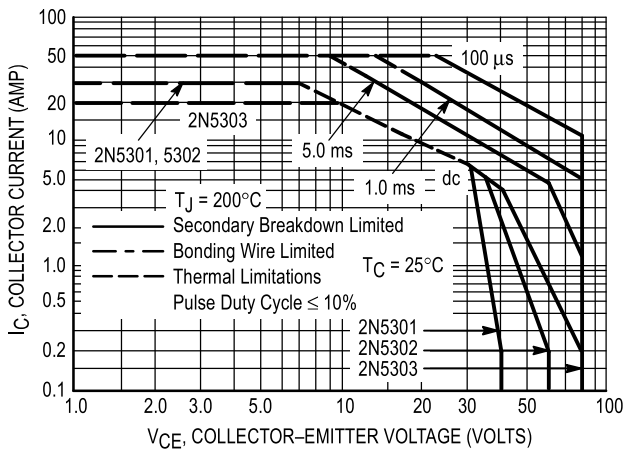


Figure 5. Active-Region Safe Operating Area

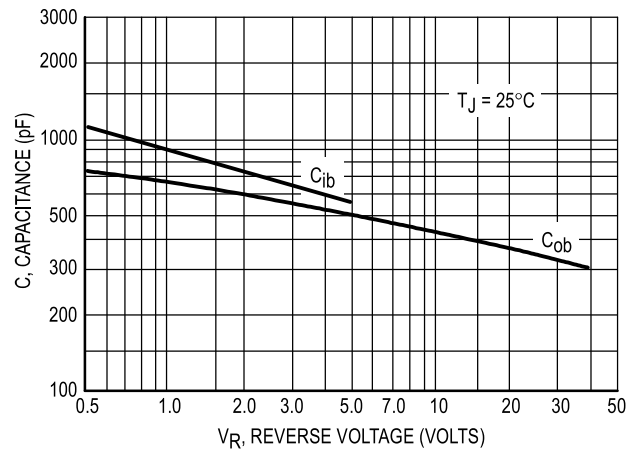
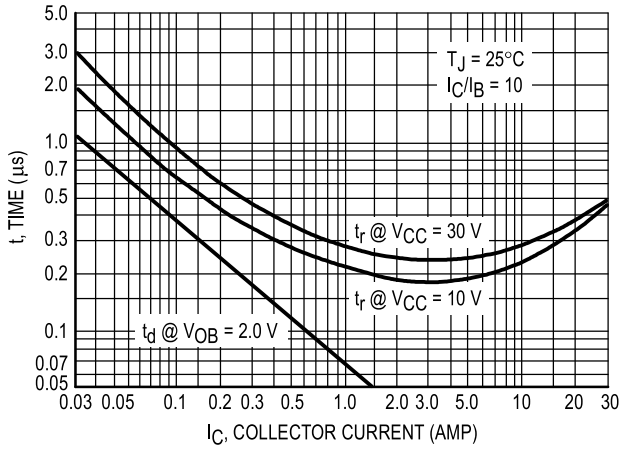
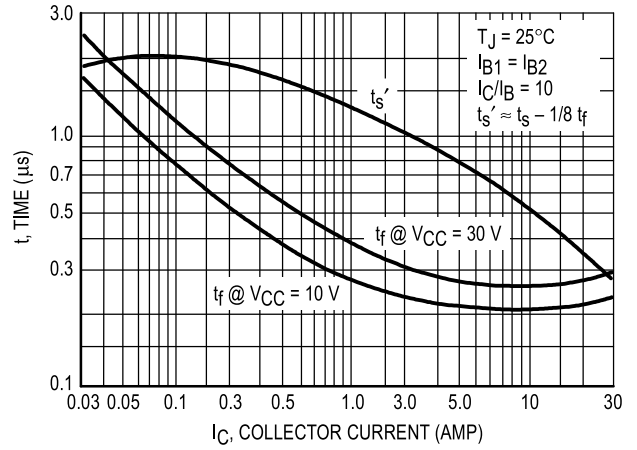


Figure 6. Capacitance versus Voltage

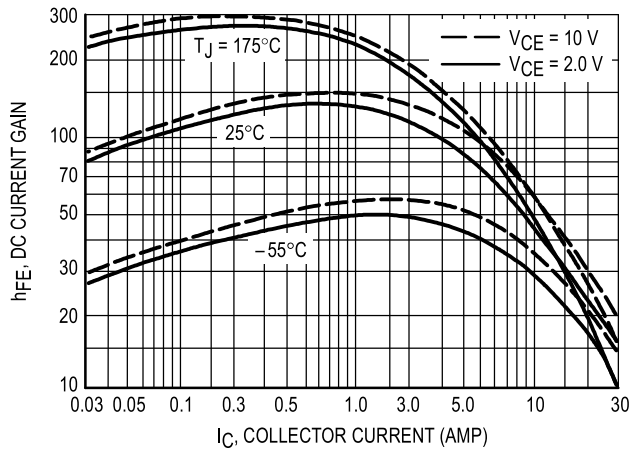
**2N5301 2N5302 2N5303**



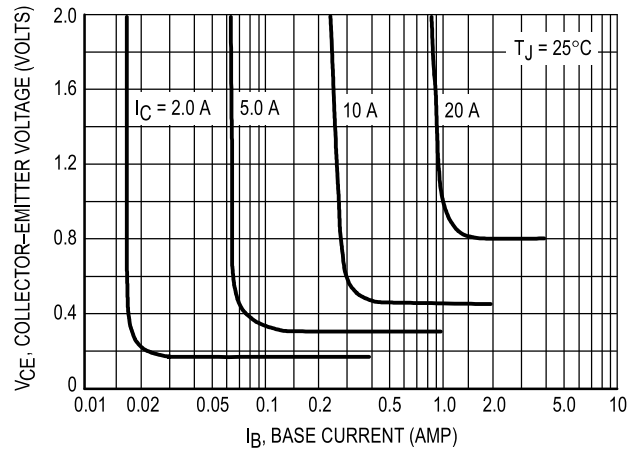
**Figure 7. Turn-On Time**



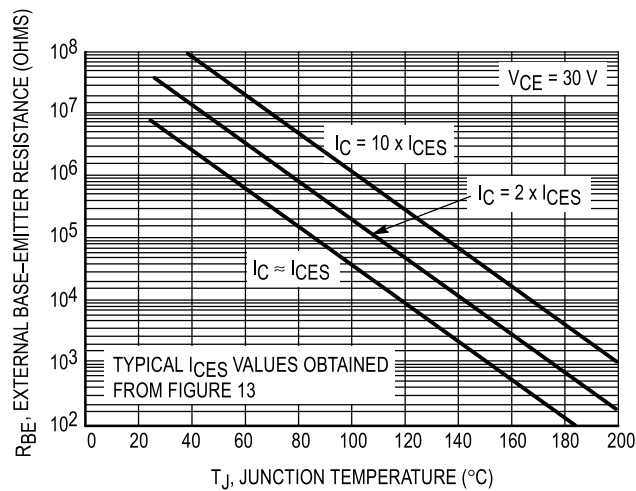
**Figure 8. Turn-Off Time**



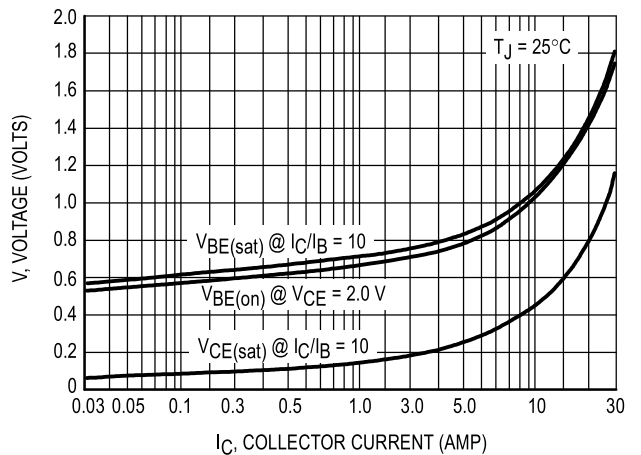
**Figure 9. DC Current Gain**



**Figure 10. Collector Saturation Region**



**Figure 11. Effects of Base-Emitter Resistance**



**Figure 12. "On" Voltages**

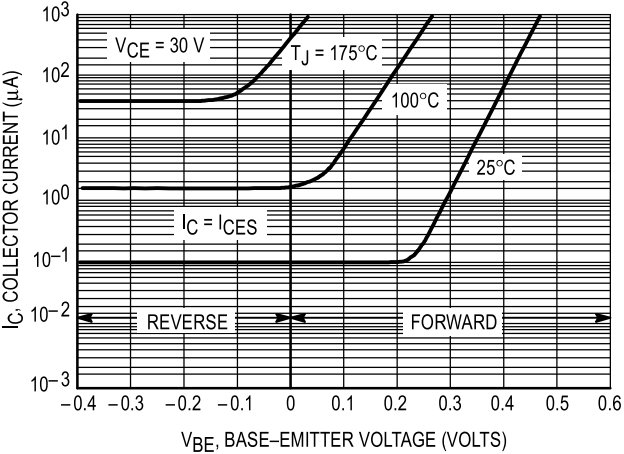


Figure 13. Collector Cut-Off Region

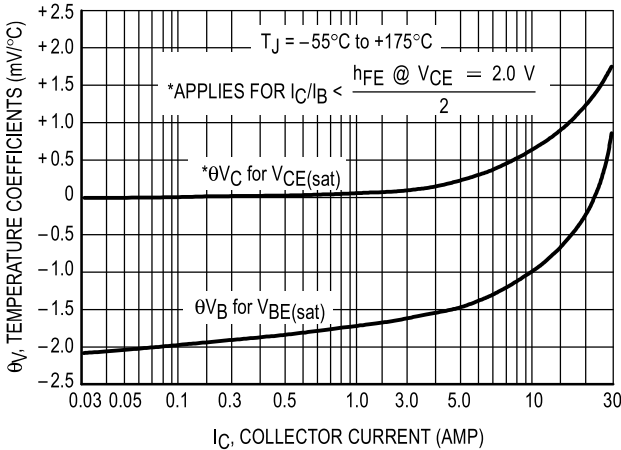
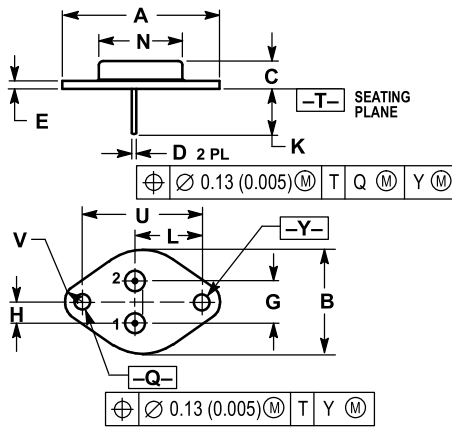


Figure 14. Temperature Coefficients

2N5301 2N5302 2N5303

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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 USA / EUROPE: Motorola Literature Distribution;  
 P.O. Box 20912; Phoenix, Arizona 85036. 1-800-441-2447

JAPAN: Nippon Motorola Ltd.; Tatsumi-SPD-JLDC, Toshikatsu Otsuki,  
 6F Seibu-Butsuryu-Center, 3-14-2 Tatsumi Koto-Ku, Tokyo 135, Japan. 03-3521-8315

MFAX: RMFAX0@email.sps.mot.com - TOUCHTONE (602) 244-6609  
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HONG KONG: Motorola Semiconductors H.K. Ltd.; 8B Tai Ping Industrial Park,  
 51 Ting Kok Road, Tai Po, N.T., Hong Kong. 852-26629298

