

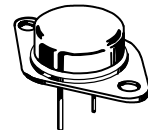
# High-Power NPN Silicon Transistors

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

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

- High Collector–Emitter Sustaining Voltage —  
 $V_{CE(sus)} = 80 \text{ Vdc (Min) @ } I_C = 200 \text{ mAdc (2N5303)}$
- 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)**

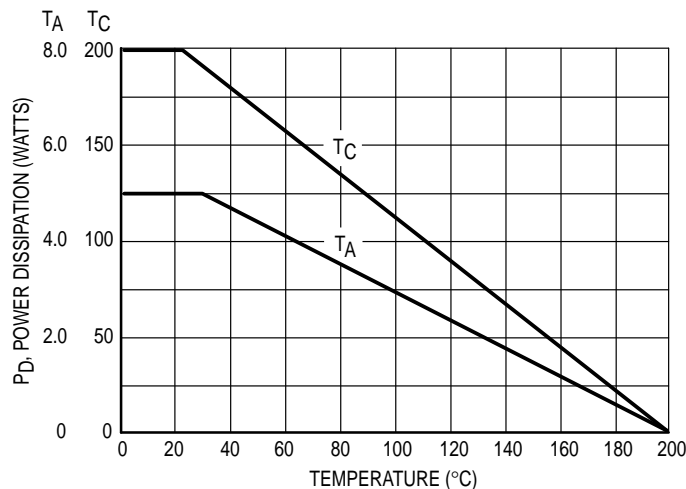
**\*MAXIMUM RATINGS**

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			Watts
		1.14			$\text{W}/^\circ\text{C}$
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	$^\circ\text{C}/\text{W}$
Thermal Resistance, Case to Ambient	$\theta_{CA}$	34	$^\circ\text{C}/\text{W}$

\* Indicates JEDEC Registered Data.



**Figure 1. Power Temperature Derating Curve**

## 2N5301 2N5302 2N5303

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

Characteristic	Symbol	Min	Max	Unit	
<b>*OFF CHARACTERISTICS</b>					
Collector–Emitter Sustaining Voltage (Note 1) ( $I_C = 200\text{ mAdc}$ , $I_B = 0$ )	2N5301 2N5302 2N5303	$V_{CE(sus)}$	40 60 80	— — —	Vdc
Collector Cutoff Current ( $V_{CE} = 40\text{ Vdc}$ , $I_B = 0$ ) ( $V_{CE} = 60\text{ Vdc}$ , $I_B = 0$ ) ( $V_{CE} = 80\text{ Vdc}$ , $I_B = 0$ )	2N5301 2N5302 2N5303	$I_{CEO}$	— — —	5.0 5.0 5.0	mAdc
Collector Cutoff Current ( $V_{CE} = 40\text{ Vdc}$ , $V_{EB(off)} = 1.5\text{ Vdc}$ ) ( $V_{CE} = 60\text{ Vdc}$ , $V_{EB(off)} = 1.5\text{ Vdc}$ ) ( $V_{CE} = 80\text{ Vdc}$ , $V_{EB(off)} = 1.5\text{ Vdc}$ )	2N5301 2N5302 2N5303	$I_{CEX}$	— — —	1.0 1.0 1.0	mAdc
Collector Cutoff Current ( $V_{CE} = 40\text{ Vdc}$ , $V_{EB(off)} = 1.5\text{ Vdc}$ , $T_C = 150^\circ\text{C}$ ) ( $V_{CE} = 60\text{ Vdc}$ , $V_{EB(off)} = 1.5\text{ Vdc}$ , $T_C = 150^\circ\text{C}$ ) ( $V_{CE} = 80\text{ Vdc}$ , $V_{EB(off)} = 1.5\text{ Vdc}$ , $T_C = 150^\circ\text{C}$ )	2N5301 2N5302 2N5303	$I_{CEX}$	— — —	10 10 10	mAdc
Collector Cutoff Current ( $V_{CB} = 40\text{ Vdc}$ , $I_E = 0$ ) ( $V_{CB} = 80\text{ Vdc}$ , $I_E = 0$ ) ( $V_{CB} = 80\text{ Vdc}$ , $I_E = 0$ )	2N5301 2N5302 2N5303	$I_{CBO}$	— — —	1.0 1.0 1.0	mAdc
Emitter Cutoff Current ( $V_{BE} = 5.0\text{ Vdc}$ , $I_C = 0$ )		$I_{EBO}$	—	5.0	mAdc

### ON CHARACTERISTICS

DC Current Gain (Note 1) *( $I_C = 1.0\text{ Adc}$ , $V_{CE} = 2.0\text{ Vdc}$ ) *( $I_C = 10\text{ Adc}$ , $V_{CE} = 2.0\text{ Vdc}$ ) *( $I_C = 15\text{ Adc}$ , $V_{CE} = 2.0\text{ Vdc}$ ) ( $I_C = 20\text{ Adc}$ , $V_{CE} = 4.0\text{ Vdc}$ ) ( $I_C = 30\text{ Adc}$ , $V_{CE} = 4.0\text{ Vdc}$ )	ALL TYPES 2N5303 2N5301, 2N5302 2N5303 2N5301, 2N5302	$h_{FE}$	40 15 15 5.0 5.0	— 60 60 — —	—
*Collector–Emitter Saturation Voltage (Note 1) ( $I_C = 10\text{ Adc}$ , $I_B = 1.0\text{ Adc}$ ) ( $I_C = 10\text{ Adc}$ , $I_B = 1.0\text{ Adc}$ ) ( $I_C = 15\text{ Adc}$ , $I_B = 1.5\text{ Adc}$ ) ( $I_C = 20\text{ Adc}$ , $I_B = 2.0\text{ Adc}$ ) ( $I_C = 20\text{ Adc}$ , $I_B = 4.0\text{ Adc}$ ) ( $I_C = 30\text{ Adc}$ , $I_B = 6.0\text{ Adc}$ )	2N5301, 2N5302 2N5303 2N5303 2N5301, 2N5302 2N5303 2N5301, 2N5302	$V_{CE(sat)}$	— — — — — —	0.75 1.0 1.5 2.0 2.0 3.0	Vdc
*Base Emitter Saturation Voltage (Note 1) ( $I_C = 10\text{ Adc}$ , $I_B = 1.0\text{ Adc}$ ) ( $I_C = 15\text{ Adc}$ , $I_B = 1.5\text{ Adc}$ ) ( $I_C = 15\text{ Adc}$ , $I_B = 1.5\text{ Adc}$ ) ( $I_C = 20\text{ Adc}$ , $I_B = 2.0\text{ Adc}$ ) ( $I_C = 20\text{ Adc}$ , $I_B = 4.0\text{ Adc}$ )	ALL TYPES 2N5301, 2N5302 2N5303 2N5301, 2N5302 2N5303	$V_{BE(sat)}$	— — — — —	1.7 1.8 2.0 2.5 2.5	Vdc
*Base–Emitter On Voltage (Note 1) ( $I_C = 10\text{ Adc}$ , $V_{CE} = 2.0\text{ Vdc}$ ) ( $I_C = 15\text{ Adc}$ , $V_{CE} = 2.0\text{ Vdc}$ ) ( $I_C = 20\text{ Adc}$ , $V_{CE} = 4.0\text{ Vdc}$ ) ( $I_C = 30\text{ Adc}$ , $V_{CE} = 4.0\text{ Vdc}$ )	2N5303 2N5301, 2N5302 2N5303 2N5301, 2N5302	$V_{BE(on)}$	— — — —	1.5 1.7 25 3.0	Vdc

### \*DYNAMIC CHARACTERISTICS

Current–Gain — Bandwidth Product ( $I_C = 1.0\text{ Adc}$ , $V_{CE} = 10\text{ Vdc}$ , $f = 1.0\text{ MHz}$ )	$f_T$	2.0	—	MHz
Small–Signal Current Gain ( $I_C = 1.0\text{ Adc}$ , $V_{CE} = 10\text{ Vdc}$ , $f = 1.0\text{ kHz}$ )	$h_{fe}$	40	—	—

### \*SWITCHING CHARACTERISTICS

Rise Time	$(V_{CC} = 30\text{ Vdc}$ , $I_C = 10\text{ Adc}$ , $I_{B1} = I_{B2} = 1.0\text{ Adc}$ )	$t_r$	—	1.0	$\mu\text{s}$
Storage Time		$t_s$	—	2.0	$\mu\text{s}$
Fall Time		$t_f$	—	1.0	$\mu\text{s}$

\* Indicates JEDEC Registered Data.

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

SWITCHING TIME EQUIVALENT TEST CIRCUITS

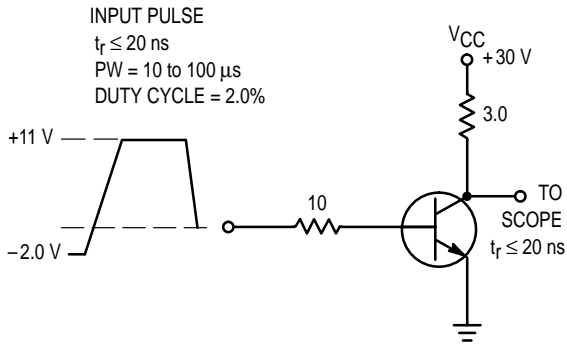


Figure 2. Turn-On time

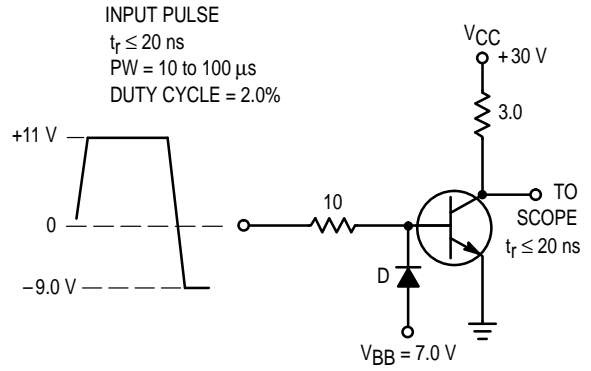


Figure 3. Turn-Off time

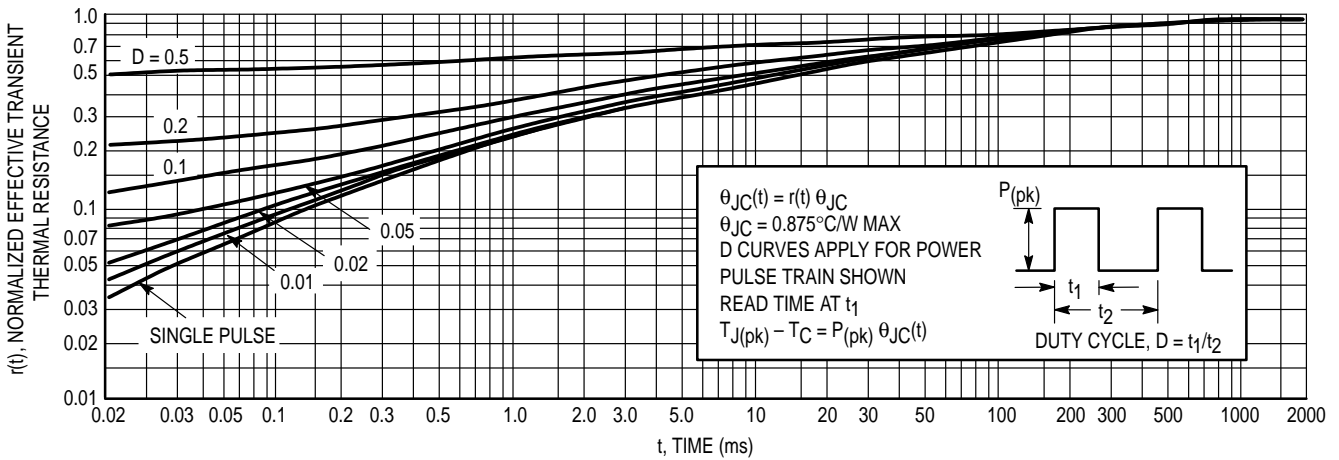


Figure 4. Thermal Response

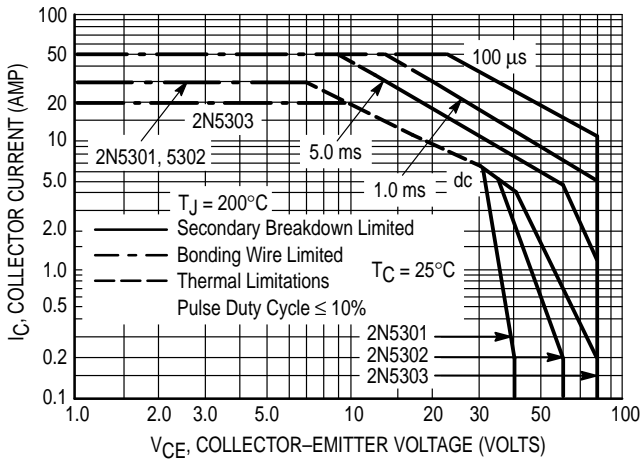


Figure 5. Active-Region Safe Operating Area

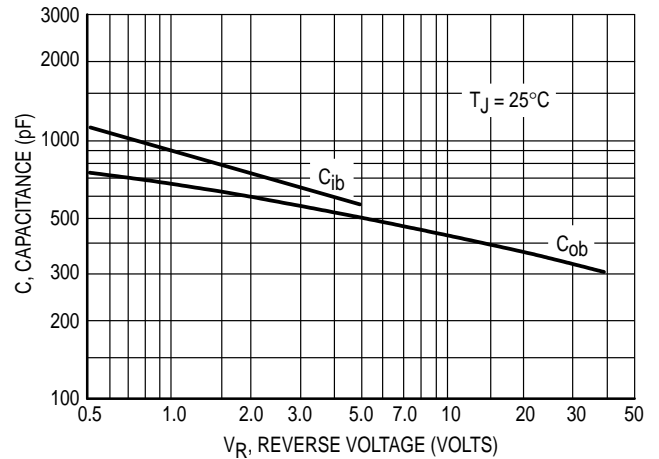
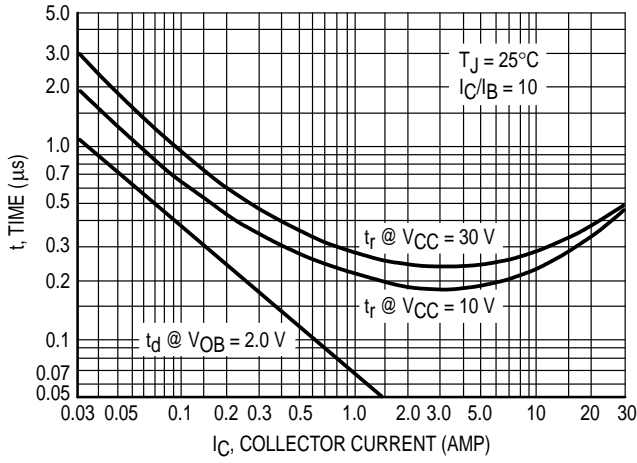
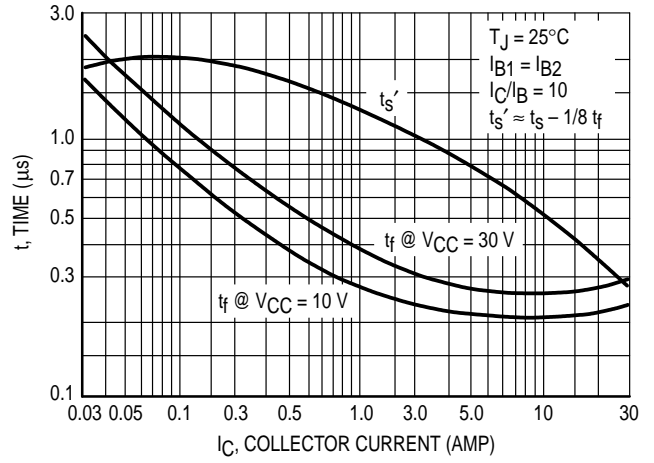


Figure 6. Capacitance versus Voltage

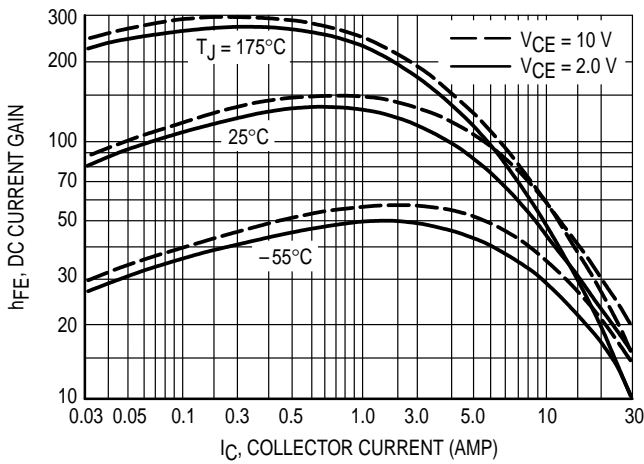
**2N5301 2N5302 2N5303**



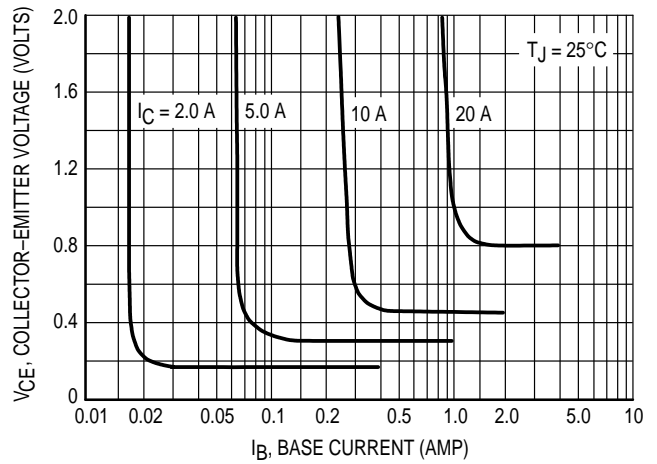
**Figure 7. Turn-On Time**



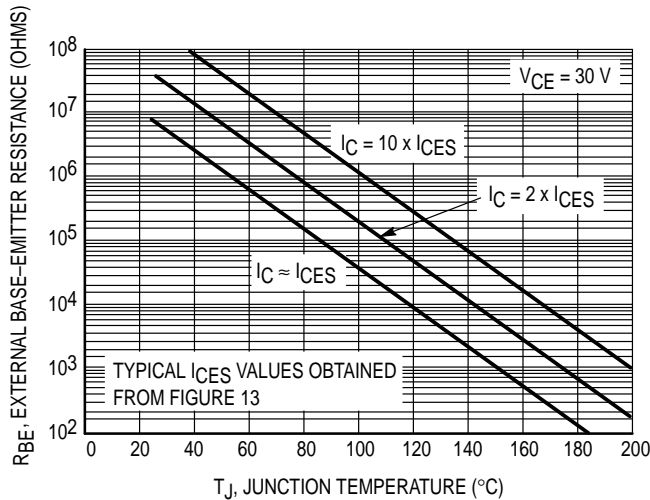
**Figure 8. Turn-Off Time**



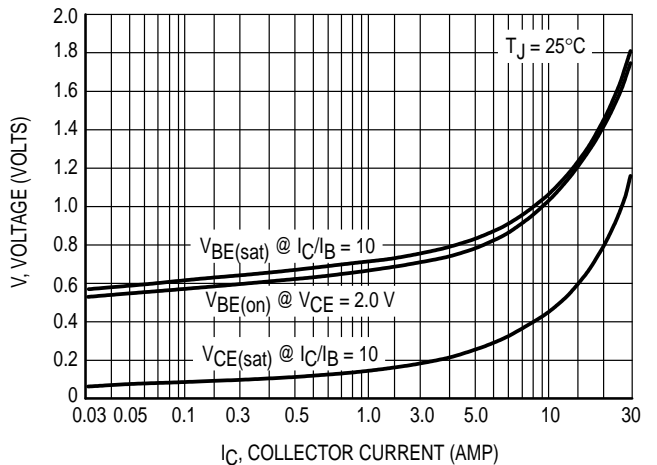
**Figure 9. DC Current Gain**



**Figure 10. Collector Saturation Region**



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



**Figure 12. "On" Voltages**

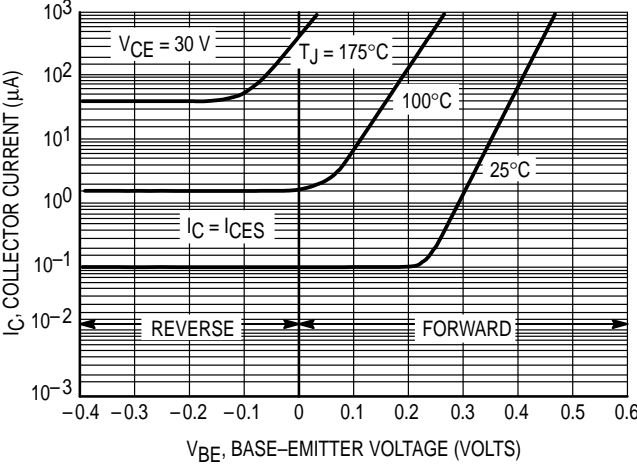


Figure 13. Collector Cut-Off Region

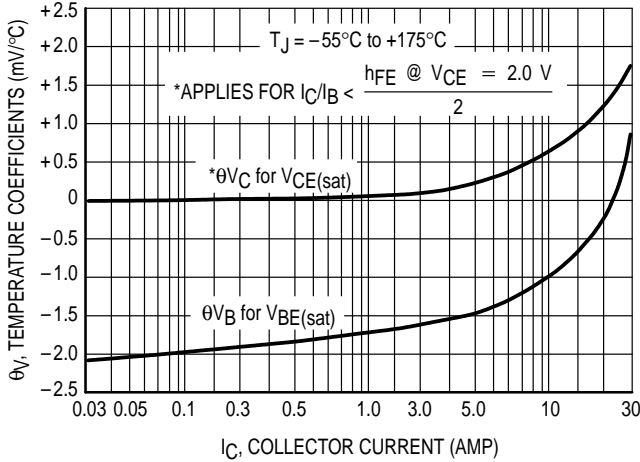
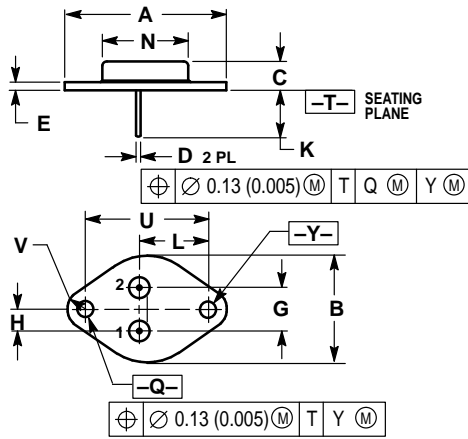


Figure 14. Temperature Coefficients

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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