

High-Power NPN Silicon Transistors

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

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

*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	A dc
Base Current	I_B	7.5			A dc
Total Device Dissipation @ $T_C = 25^\circ\text{C}$ Derate above 25°C	P_D	200 1.14			Watts W/ $^\circ\text{C}$
Operating and Storage Junction Temperature Range	T_J, T_{stg}	-65 to +200			$^\circ\text{C}$

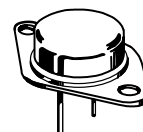
THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	θ_{JC}	0.875	$^\circ\text{C/W}$
Thermal Resistance, Case to Ambient	θ_{CA}	34	$^\circ\text{C/W}$

* Indicates JEDEC Registered Data.

**2N5301
2N5302
2N5303**

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



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

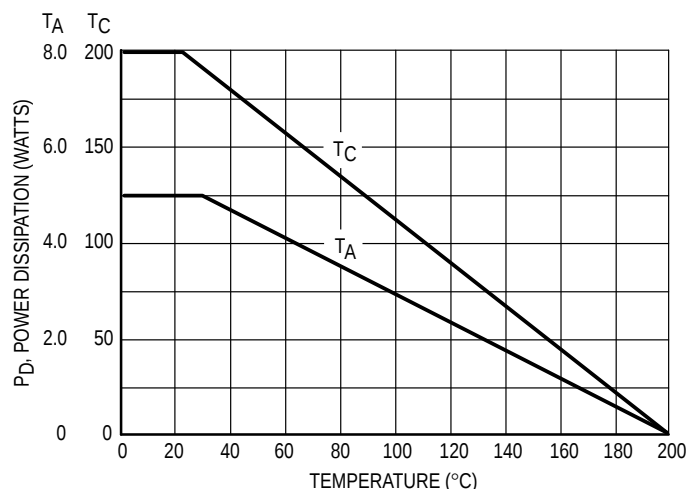


Figure 1. Power Temperature Derating Curve

2N5301 2N5302 2N5303

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

Characteristic	Symbol	Min	Max	Unit
*OFF CHARACTERISTICS				
Collector–Emitter Sustaining Voltage (Note 1) ($I_C = 200\text{ mAdc}$, $I_B = 0$)	$V_{CEO(sus)}$	40 60 80	— — —	Vdc
Collector Cutoff Current ($V_{CE} = 40\text{ Vdc}$, $I_B = 0$) ($V_{CE} = 60\text{ Vdc}$, $I_B = 0$) ($V_{CE} = 80\text{ Vdc}$, $I_B = 0$)	I_{CEO}	— — —	5.0 5.0 5.0	mAdc
Collector Cutoff Current ($V_{CE} = 40\text{ Vdc}$, $V_{EB(off)} = 1.5\text{ Vdc}$) ($V_{CE} = 60\text{ Vdc}$, $V_{EB(off)} = 1.5\text{ Vdc}$) ($V_{CE} = 80\text{ Vdc}$, $V_{EB(off)} = 1.5\text{ Vdc}$)	I_{CEX}	— — —	1.0 1.0 1.0	mAdc
Collector Cutoff Current ($V_{CE} = 40\text{ Vdc}$, $V_{EB(off)} = 1.5\text{ Vdc}$, $T_C = 150^\circ\text{C}$) ($V_{CE} = 60\text{ Vdc}$, $V_{EB(off)} = 1.5\text{ Vdc}$, $T_C = 150^\circ\text{C}$) ($V_{CE} = 80\text{ Vdc}$, $V_{EB(off)} = 1.5\text{ Vdc}$, $T_C = 150^\circ\text{C}$)	I_{CEX}	— — —	10 10 10	mAdc
Collector Cutoff Current ($V_{CB} = 40\text{ Vdc}$, $I_E = 0$) ($V_{CB} = 80\text{ Vdc}$, $I_E = 0$) ($V_{CB} = 80\text{ Vdc}$, $I_E = 0$)	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	μs
Storage Time		t_s	—	2.0	μs
Fall Time		t_f	—	1.0	μs

* Indicates JEDEC Registered Data.

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

SWITCHING TIME EQUIVALENT TEST CIRCUITS

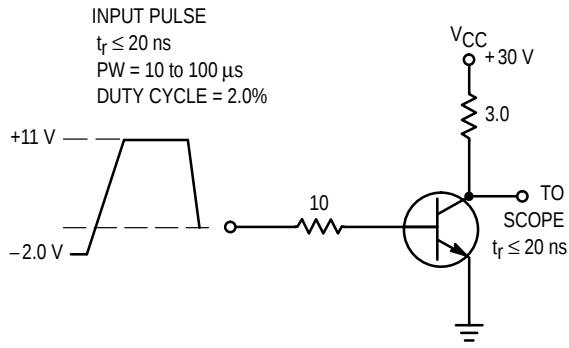


Figure 2. Turn-On time

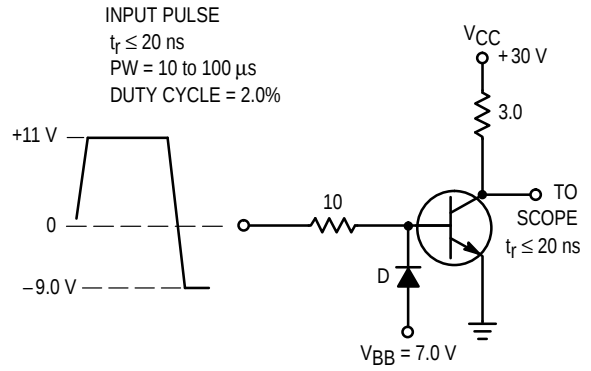


Figure 3. Turn-Off time

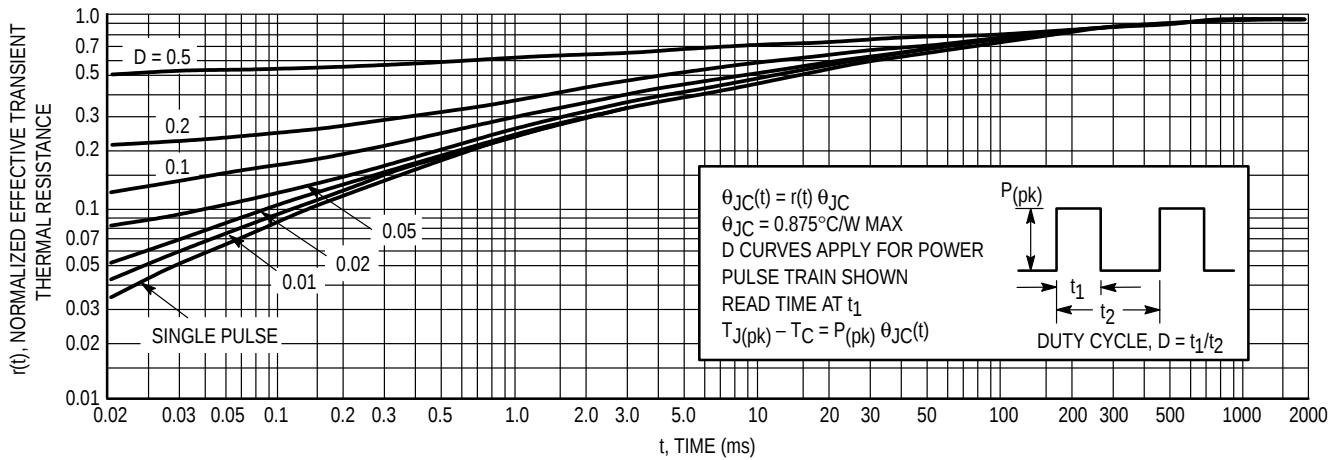


Figure 4. Thermal Response

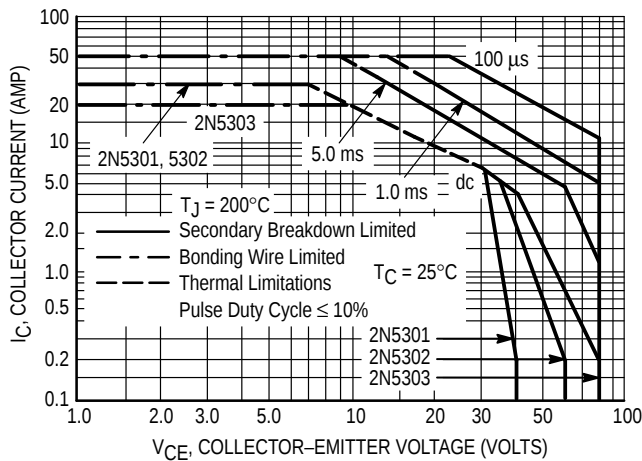


Figure 5. Active-Region Safe Operating Area

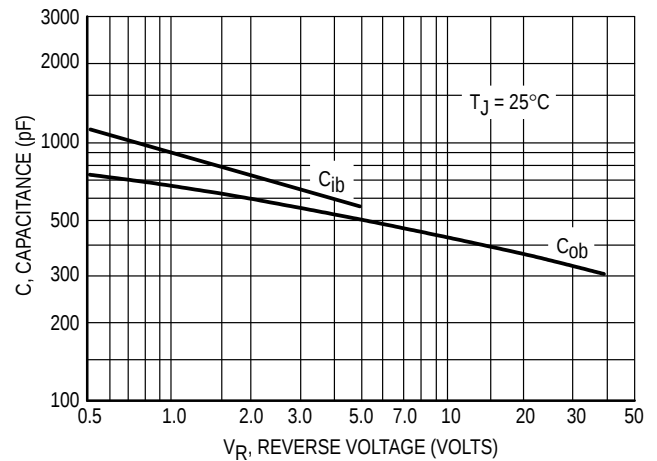


Figure 6. Capacitance versus Voltage

2N5301 2N5302 2N5303

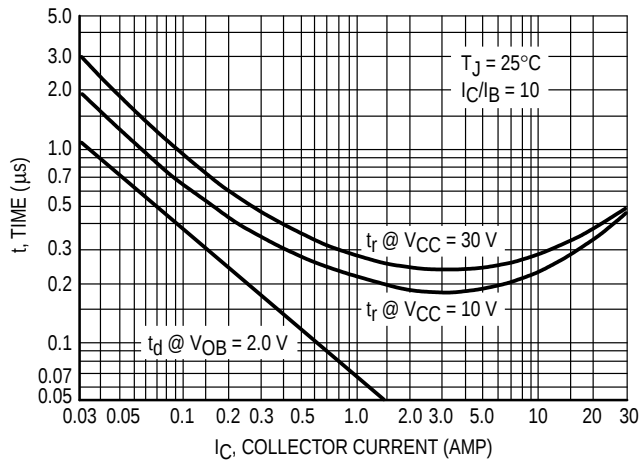


Figure 7. Turn-On Time

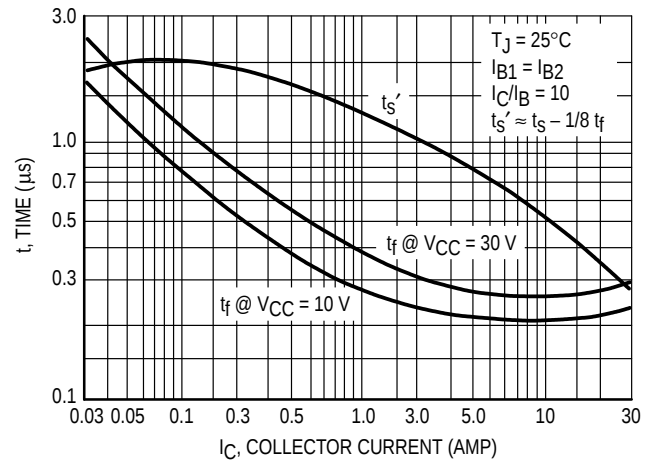


Figure 8. Turn-Off Time

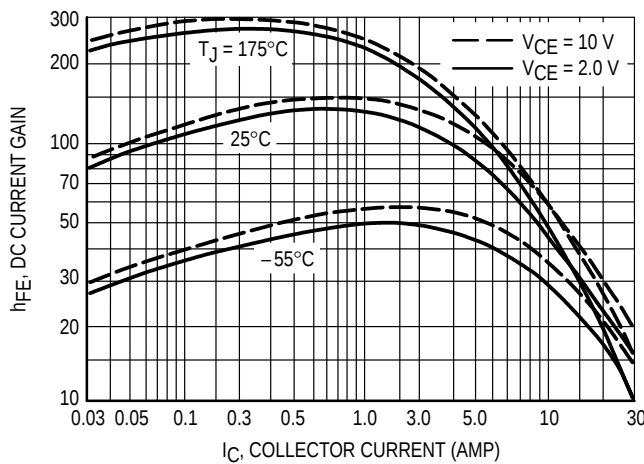


Figure 9. DC Current Gain

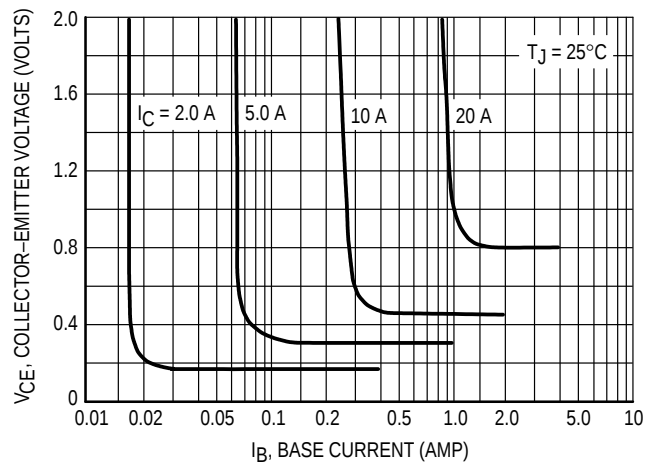


Figure 10. Collector Saturation Region

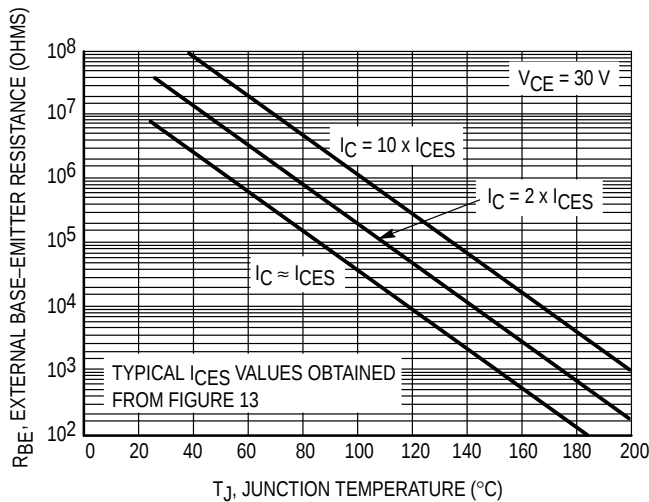


Figure 11. Effects of Base-Emitter Resistance

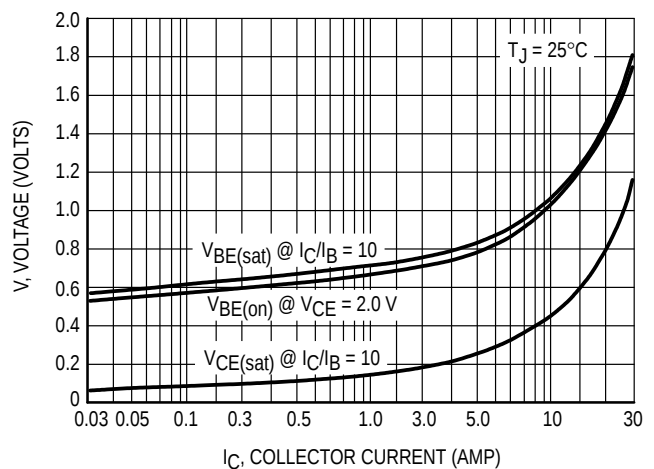


Figure 12. "On" Voltages

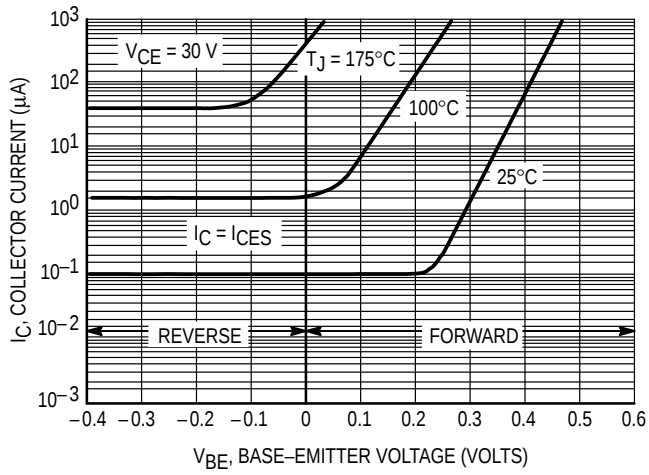


Figure 13. Collector Cut-Off Region

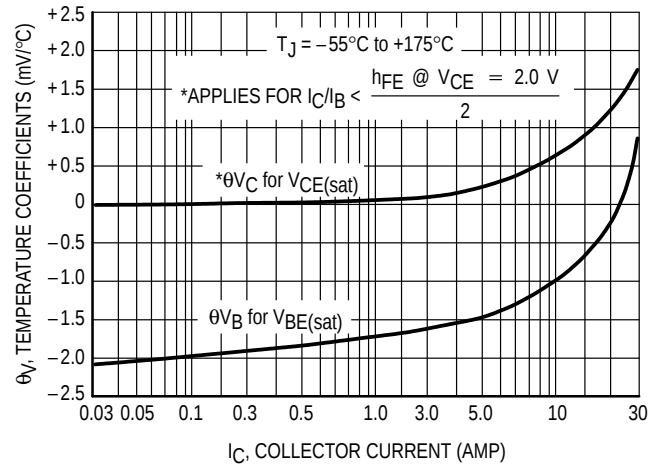
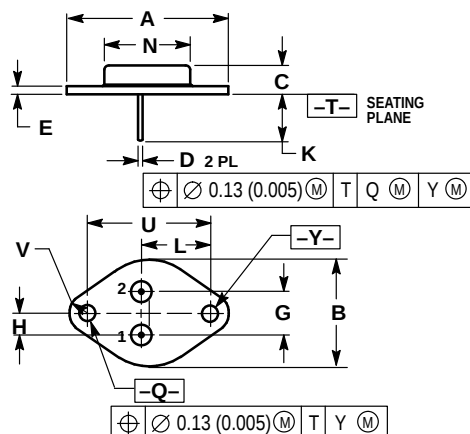


Figure 14. Temperature Coefficients

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:

1. BASE
 2. EMITTER
- CASE: COLLECTOR

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

Motorola reserves the right to make changes without further notice to any products herein. Motorola makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does Motorola assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation consequential or incidental damages. "Typical" parameters can and do vary in different applications. All operating parameters, including "Typicals" must be validated for each customer application by customer's technical experts. Motorola does not convey any license under its patent rights nor the rights of others. Motorola products are not designed, intended, or authorized for use as components in systems intended for surgical implant into the body, or other applications intended to support or sustain life, or for any other application in which the failure of the Motorola product could create a situation where personal injury or death may occur. Should Buyer purchase or use Motorola products for any such unintended or unauthorized application, Buyer shall indemnify and hold Motorola and its officers, employees, subsidiaries, affiliates, and distributors harmless against all claims, costs, damages, and expenses, and reasonable attorney fees arising out of, directly or indirectly, any claim of personal injury or death associated with such unintended or unauthorized use, even if such claim alleges that Motorola was negligent regarding the design or manufacture of the part. Motorola and  are registered trademarks of Motorola, Inc. Motorola, Inc. is an Equal Opportunity/Affirmative Action Employer.

How to reach us:

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
INTERNET: <http://Design-NET.com>

HONG KONG: Motorola Semiconductors H.K. Ltd.; 8B Tai Ping Industrial Park,
51 Ting Kok Road, Tai Po, N.T., Hong Kong. 852-26629298

