

## High-Power NPN Silicon Transistors

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

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

### \*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 @ $T_C = 25^\circ\text{C}$<br>Derate above $25^\circ\text{C}$ | $P_D$          | 200<br>1.14 |        |        | Watts<br>W/ $^\circ\text{C}$ |
| Operating and Storage Junction<br>Temperature Range                                    | $T_J, T_{stg}$ | -65 to +200 |        |        | $^\circ\text{C}$             |

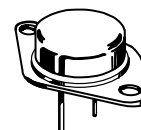
### THERMAL CHARACTERISTICS

| 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    | $^\circ\text{C/W}$ |

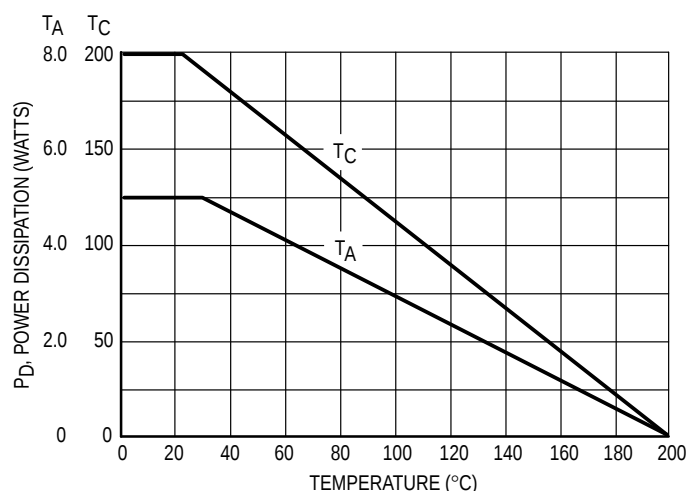
\* Indicates JEDEC Registered Data.

**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 |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|----------------|-------------------|------|
| <b>*OFF CHARACTERISTICS</b>                                                                                                                                                                                                                                                                                     |                |                |                   |      |
| Collector–Emitter Sustaining Voltage (Note 1)<br>( $I_C = 200\text{ mAdc}$ , $I_B = 0$ )                                                                                                                                                                                                                        | $V_{CEO(sus)}$ | 40<br>60<br>80 | —<br>—<br>—       | Vdc  |
| Collector Cutoff Current<br>( $V_{CE} = 40\text{ Vdc}$ , $I_B = 0$ )<br>( $V_{CE} = 60\text{ Vdc}$ , $I_B = 0$ )<br>( $V_{CE} = 80\text{ Vdc}$ , $I_B = 0$ )                                                                                                                                                    | $I_{CEO}$      | —<br>—<br>—    | 5.0<br>5.0<br>5.0 | mAdc |
| Collector Cutoff Current<br>( $V_{CE} = 40\text{ Vdc}$ , $V_{EB(off)} = 1.5\text{ Vdc}$ )<br>( $V_{CE} = 60\text{ Vdc}$ , $V_{EB(off)} = 1.5\text{ Vdc}$ )<br>( $V_{CE} = 80\text{ Vdc}$ , $V_{EB(off)} = 1.5\text{ Vdc}$ )                                                                                     | $I_{CEX}$      | —<br>—<br>—    | 1.0<br>1.0<br>1.0 | mAdc |
| Collector Cutoff Current<br>( $V_{CE} = 40\text{ Vdc}$ , $V_{EB(off)} = 1.5\text{ Vdc}$ , $T_C = 150^\circ\text{C}$ )<br>( $V_{CE} = 60\text{ Vdc}$ , $V_{EB(off)} = 1.5\text{ Vdc}$ , $T_C = 150^\circ\text{C}$ )<br>( $V_{CE} = 80\text{ Vdc}$ , $V_{EB(off)} = 1.5\text{ Vdc}$ , $T_C = 150^\circ\text{C}$ ) | $I_{CEX}$      | —<br>—<br>—    | 10<br>10<br>10    | mAdc |
| Collector Cutoff Current<br>( $V_{CB} = 40\text{ Vdc}$ , $I_E = 0$ )<br>( $V_{CB} = 80\text{ Vdc}$ , $I_E = 0$ )<br>( $V_{CB} = 80\text{ Vdc}$ , $I_E = 0$ )                                                                                                                                                    | $I_{CBO}$      | —<br>—<br>—    | 1.0<br>1.0<br>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)<br>*( $I_C = 1.0\text{ Adc}$ , $V_{CE} = 2.0\text{ Vdc}$ )<br>*( $I_C = 10\text{ Adc}$ , $V_{CE} = 2.0\text{ Vdc}$ )<br>*( $I_C = 15\text{ Adc}$ , $V_{CE} = 2.0\text{ Vdc}$ )<br>( $I_C = 20\text{ Adc}$ , $V_{CE} = 4.0\text{ Vdc}$ )<br>( $I_C = 30\text{ Adc}$ , $V_{CE} = 4.0\text{ Vdc}$ )                                                          | ALL TYPES<br>2N5303<br>2N5301, 2N5302<br>2N5303<br>2N5301, 2N5302                | $h_{FE}$      | 40<br>15<br>15<br>5.0<br>5.0 | —<br>60<br>60<br>—<br>—                 | —   |
| *Collector–Emitter Saturation Voltage (Note 1)<br>( $I_C = 10\text{ Adc}$ , $I_B = 1.0\text{ Adc}$ )<br>( $I_C = 10\text{ Adc}$ , $I_B = 1.0\text{ Adc}$ )<br>( $I_C = 15\text{ Adc}$ , $I_B = 1.5\text{ Adc}$ )<br>( $I_C = 20\text{ Adc}$ , $I_B = 2.0\text{ Adc}$ )<br>( $I_C = 20\text{ Adc}$ , $I_B = 4.0\text{ Adc}$ )<br>( $I_C = 30\text{ Adc}$ , $I_B = 6.0\text{ Adc}$ ) | 2N5301, 2N5302<br>2N5303<br>2N5303<br>2N5301, 2N5302<br>2N5303<br>2N5301, 2N5302 | $V_{CE(sat)}$ | —<br>—<br>—<br>—<br>—<br>—   | 0.75<br>1.0<br>1.5<br>2.0<br>2.0<br>3.0 | Vdc |
| *Base Emitter Saturation Voltage (Note 1)<br>( $I_C = 10\text{ Adc}$ , $I_B = 1.0\text{ Adc}$ )<br>( $I_C = 15\text{ Adc}$ , $I_B = 1.5\text{ Adc}$ )<br>( $I_C = 15\text{ Adc}$ , $I_B = 1.5\text{ Adc}$ )<br>( $I_C = 20\text{ Adc}$ , $I_B = 2.0\text{ Adc}$ )<br>( $I_C = 20\text{ Adc}$ , $I_B = 4.0\text{ Adc}$ )                                                            | ALL TYPES<br>2N5301, 2N5302<br>2N5303<br>2N5301, 2N5302<br>2N5303                | $V_{BE(sat)}$ | —<br>—<br>—<br>—<br>—        | 1.7<br>1.8<br>2.0<br>2.5<br>2.5         | Vdc |
| *Base–Emitter On Voltage (Note 1)<br>( $I_C = 10\text{ Adc}$ , $V_{CE} = 2.0\text{ Vdc}$ )<br>( $I_C = 15\text{ Adc}$ , $V_{CE} = 2.0\text{ Vdc}$ )<br>( $I_C = 20\text{ Adc}$ , $V_{CE} = 4.0\text{ Vdc}$ )<br>( $I_C = 30\text{ Adc}$ , $V_{CE} = 4.0\text{ Vdc}$ )                                                                                                              | 2N5303<br>2N5301, 2N5302<br>2N5303<br>2N5301, 2N5302                             | $V_{BE(on)}$  | —<br>—<br>—<br>—             | 1.5<br>1.7<br>25<br>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  $\leq 300\text{ }\mu\text{s}$ , Duty Cycle  $\leq 2.0\%$ .

# SWITCHING TIME EQUIVALENT TEST CIRCUITS

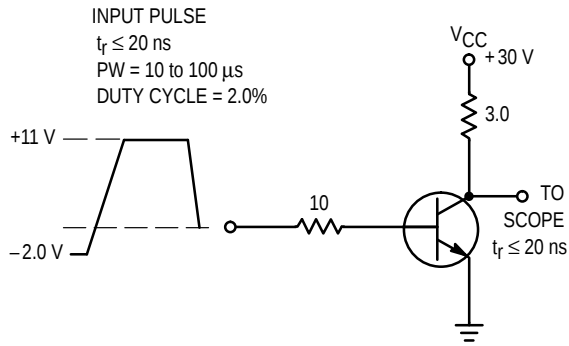


Figure 2. Turn-On time

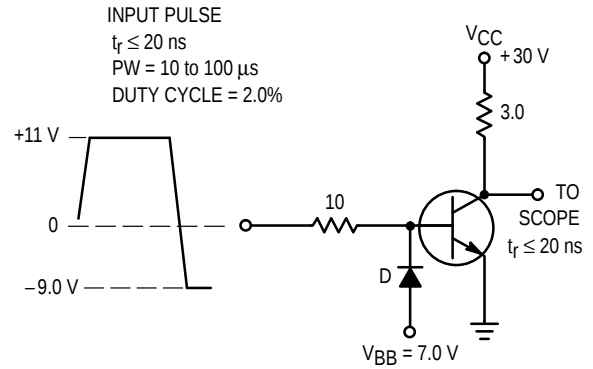


Figure 3. Turn-Off time

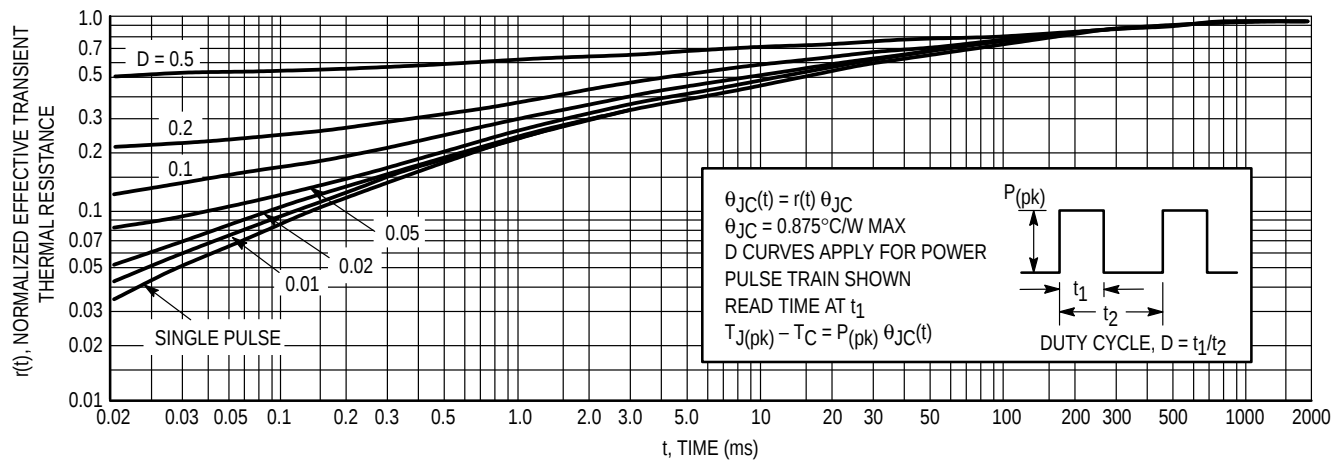


Figure 4. Thermal Response

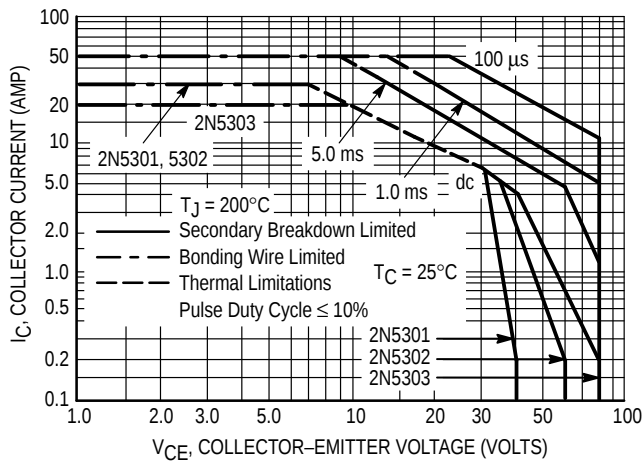


Figure 5. Active-Region Safe Operating Area

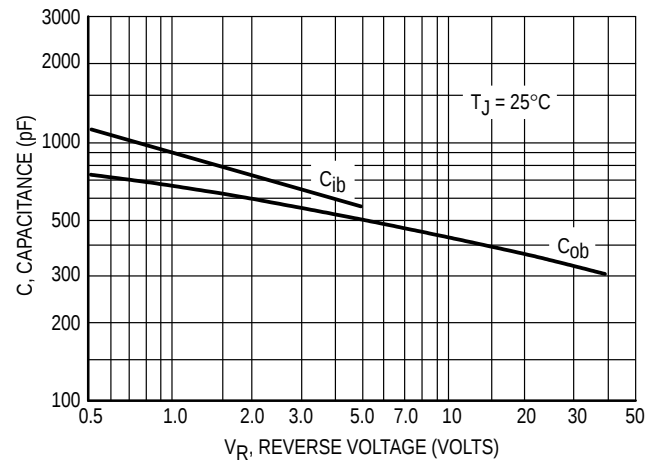


Figure 6. Capacitance versus Voltage

## 2N5301 2N5302 2N5303

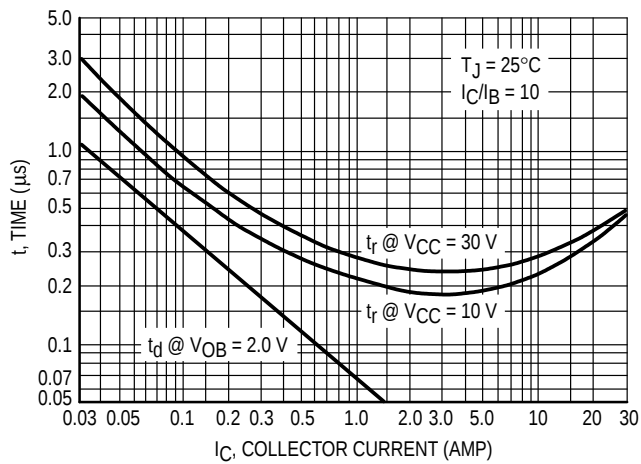


Figure 7. Turn-On Time

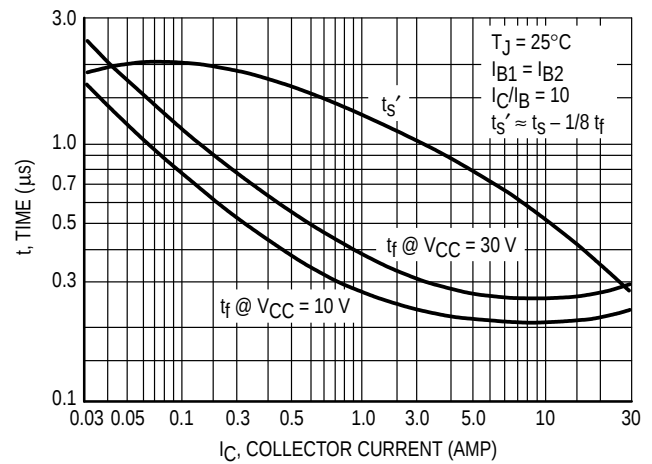


Figure 8. Turn-Off Time

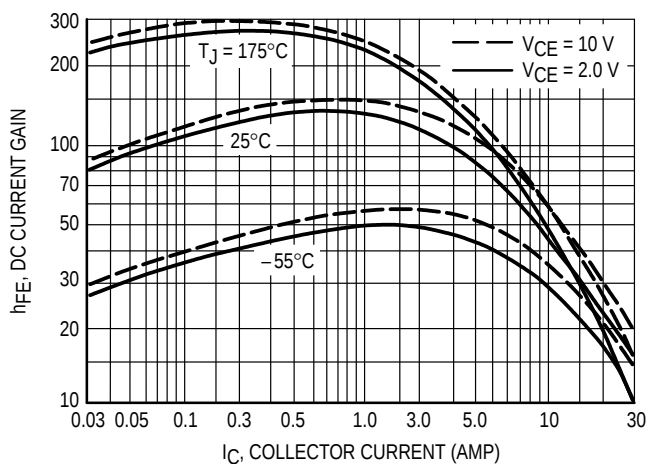


Figure 9. DC Current Gain

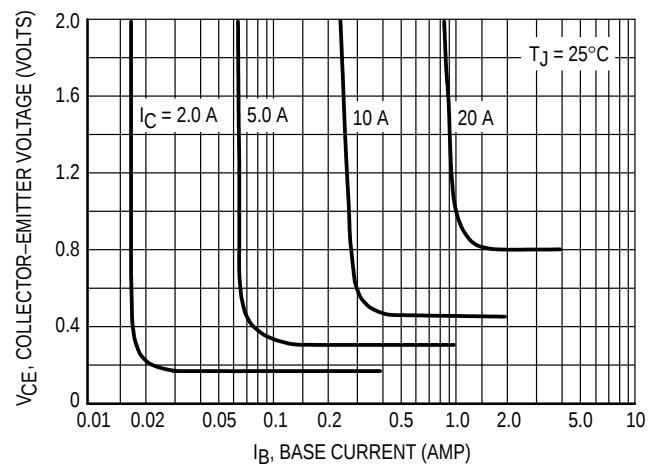


Figure 10. Collector Saturation Region

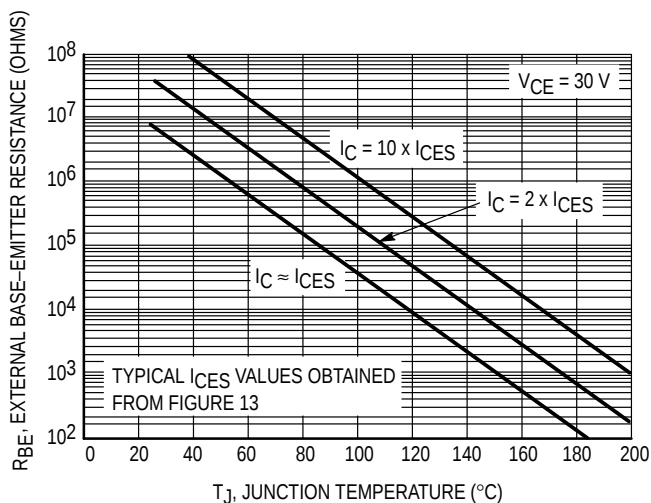


Figure 11. Effects of Base-Emitter Resistance

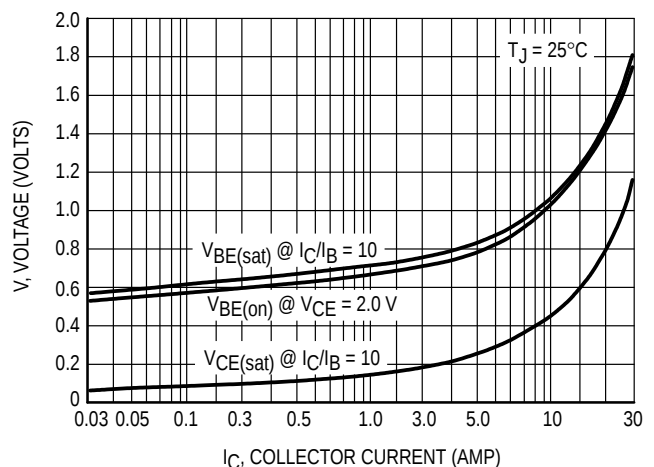


Figure 12. "On" Voltages

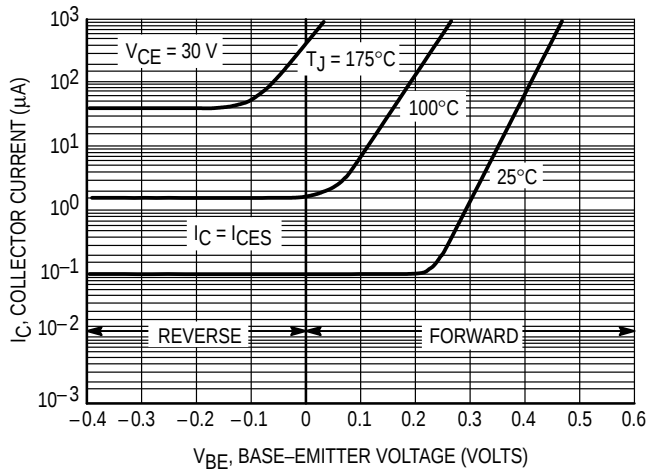


Figure 13. Collector Cut-Off Region

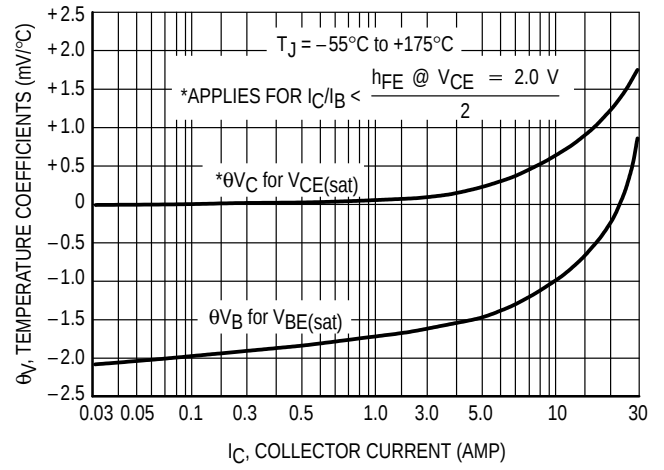
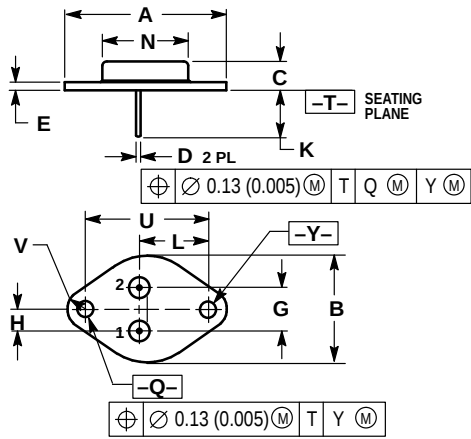


Figure 14. Temperature Coefficients

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:
- PIN 1: BASE
  - EMITTER
- CASE: COLLECTOR

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

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