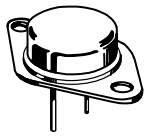
# 2N5301
# 2N5302
# 2N5303

# High-Power NPN Silicon Transistors

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

- High Collector–Emitter Sustaining Voltage —
  $V_{CEO(sus)}$ = 80 Vdc (Min) @ $I_C$ = 200 mAdc (2N5303)
- Low Collector–Emitter Saturation Voltage —
  $V_{CE(sat)}$ = 0.75 Vdc (Max) @ $I_C$ = 10 Adc (2N5301, 2N5302)
  1.0 Vdc (Max) @ $I_C$ = 10 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°C<br>Derate above 25°C | $P_D$ | 200<br>1.14 | | | Watts<br>W/°C |
| Operating and Storage Junction Temperature Range | $T_J$, $T_{stg}$ | –65 to +200 | | | °C |

**THERMAL CHARACTERISTICS**

| Characteristic | Symbol | Max | Unit |
|---|---|---|---|
| Thermal Resistance, Junction to Case | $\theta_{JC}$ | 0.875 | °C/W |
| Thermal Resistance, Case to Ambient | $\theta_{CA}$ | 34 | °C/W |

* Indicates JEDEC Registered Data.

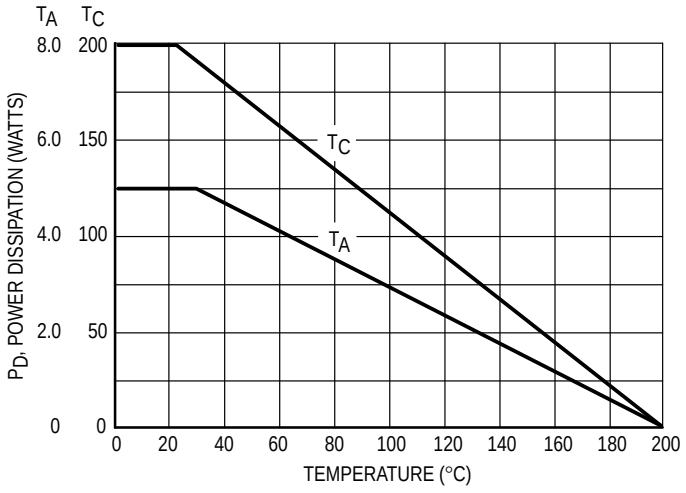



**Figure 1. Power Temperature Derating Curve**

**ELECTRICAL CHARACTERISTICS** ($T_C$ = 25°C unless otherwise noted)

| Characteristic | | Symbol | Min | Max | Unit |
|---|---|---|---|---|---|
| ***OFF CHARACTERISTICS** | | | | | |
| Collector–Emitter Sustaining Voltage (Note 1) | | $V_{CEO(sus)}$ | | | Vdc |
| ($I_C$ = 200 mAdc, $I_B$ = 0) | 2N5301 | | 40 | — | |
| | 2N5302 | | 60 | — | |
| | 2N5303 | | 80 | — | |
| Collector Cutoff Current | | $I_{CEO}$ | | | mAdc |
| ($V_{CE}$ = 40 Vdc, $I_B$ = 0) | 2N5301 | | — | 5.0 | |
| ($V_{CE}$ = 60 Vdc, $I_B$ = 0) | 2N5302 | | — | 5.0 | |
| ($V_{CE}$ = 80 Vdc, $I_B$ = 0) | 2N5303 | | — | 5.0 | |
| Collector Cutoff Current | | $I_{CEX}$ | | | mAdc |
| ($V_{CE}$ = 40 Vdc, $V_{EB(off)}$ = 1.5 Vdc) | 2N5301 | | — | 1.0 | |
| ($V_{CE}$ = 60 Vdc, $V_{EB(off)}$ = 1.5 Vdc) | 2N5302 | | — | 1.0 | |
| ($V_{CE}$ = 80 Vdc, $V_{EB(off)}$ = 1.5 Vdc) | 2N5303 | | — | 1.0 | |
| Collector Cutoff Current | | $I_{CEX}$ | | | mAdc |
| ($V_{CE}$ = 40 Vdc, $V_{EB(off)}$ = 1.5 Vdc, $T_C$ = 150°C) | 2N5301 | | — | 10 | |
| ($V_{CE}$ = 60 Vdc, $V_{EB(off)}$ = 1.5 Vdc, $T_C$ = 150°C) | 2N5302 | | — | 10 | |
| ($V_{CE}$ = 80 Vdc, $V_{EB(off)}$ = 1.5 Vdc, $T_C$ = 150°C) | 2N5303 | | — | 10 | |
| Collector Cutoff Current | | $I_{CBO}$ | | | mAdc |
| ($V_{CB}$ = 40 Vdc, $I_E$ = 0) | 2N5301 | | — | 1.0 | |
| ($V_{CB}$ = 80 Vdc, $I_E$ = 0) | 2N5302 | | — | 1.0 | |
| ($V_{CB}$ = 80 Vdc, $I_E$ = 0) | 2N5303 | | — | 1.0 | |
| Emitter Cutoff Current ($V_{BE}$ = 5.0 Vdc, $I_C$ = 0) | | $I_{EBO}$ | — | 5.0 | mAdc |
| **ON CHARACTERISTICS** | | | | | |
| DC Current Gain (Note 1) | | $h_{FE}$ | | | — |
| *($I_C$ = 1.0 Adc, $V_{CE}$ = 2.0 Vdc) | ALL TYPES | | 40 | — | |
| *($I_C$ = 10 Adc, $V_{CE}$ = 2.0 Vdc) | 2N5303 | | 15 | 60 | |
| *($I_C$ = 15 Adc, $V_{CE}$ = 2.0 Vdc) | 2N5301, 2N5302 | | 15 | 60 | |
| ($I_C$ = 20 Adc, $V_{CE}$ = 4.0 Vdc) | 2N5303 | | 5.0 | — | |
| ($I_C$ = 30 Adc, $V_{CE}$ = 4.0 Vdc) | 2N5301, 2N5302 | | 5.0 | — | |
| *Collector–Emitter Saturation Voltage (Note 1) | | $V_{CE(sat)}$ | | | Vdc |
| ($I_C$ = 10 Adc, $I_B$ = 1.0 Adc) | 2N5301, 2N5302 | | — | 0.75 | |
| ($I_C$ = 10 Adc, $I_B$ = 1.0 Adc) | 2N5303 | | — | 1.0 | |
| ($I_C$ = 15 Adc, $I_B$ = 1.5 Adc) | 2N5303 | | — | 1.5 | |
| ($I_C$ = 20 Adc, $I_B$ = 2.0 Adc) | 2N5301, 2N5302 | | — | 2.0 | |
| ($I_C$ = 20 Adc, $I_B$ = 4.0 Adc) | 2N5303 | | — | 2.0 | |
| ($I_C$ = 30 Adc, $I_B$ = 6.0 Adc) | 2N5301, 2N5302 | | — | 3.0 | |
| *Base Emitter Saturation Voltage (Note 1) | | $V_{BE(sat)}$ | | | Vdc |
| ($I_C$ = 10 Adc, $I_B$ = 1.0 Adc) | ALL TYPES | | — | 1.7 | |
| ($I_C$ = 15 Adc, $I_B$ = 1.5 Adc) | 2N5301, 2N5302 | | — | 1.8 | |
| ($I_C$ = 15 Adc, $I_B$ = 1.5 Adc) | 2N5303 | | — | 2.0 | |
| ($I_C$ = 20 Adc, $I_B$ = 2.0 Adc) | 2N5301, 2N5302 | | — | 2.5 | |
| ($I_C$ = 20 Adc, $I_B$ = 4.0 Adc) | 2N5303 | | — | 2.5 | |
| *Base–Emitter On Voltage (Note 1) | | $V_{BE(on)}$ | | | Vdc |
| ($I_C$ = 10 Adc, $V_{CE}$ = 2.0 Vdc) | 2N5303 | | — | 1.5 | |
| ($I_C$ = 15 Adc, $V_{CE}$ = 2.0 Vdc) | 2N5301, 2N5302 | | — | 1.7 | |
| ($I_C$ = 20 Adc, $V_{CE}$ = 4.0 Vdc) | 2N5303 | | — | 25 | |
| ($I_C$ = 30 Adc, $V_{CE}$ = 4.0 Vdc) | 2N5301, 2N5302 | | — | 3.0 | |
| ***DYNAMIC CHARACTERISTICS** | | | | | |
| Current–Gain — Bandwidth Product ($I_C$ = 1.0 Adc, $V_{CE}$ = 10 Vdc, f = 1.0 MHz) | | $f_T$ | 2.0 | — | MHz |
| Small–Signal Current Gain ($I_C$ = 1.0 Adc, $V_{CE}$ = 10 Vdc, f = 1.0 kHz) | | $h_{fe}$ | 40 | — | — |
| ***SWITCHING CHARACTERISTICS** | | | | | |
| Rise Time | ($V_{CC}$ = 30 Vdc, $I_C$ = 10 Adc, $I_{B1}$ = $I_{B2}$ = 1.0 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 ≤ 300 μs, Duty Cycle ≤ 2.0%.

## SWITCHING TIME EQUIVALENT TEST CIRCUITS

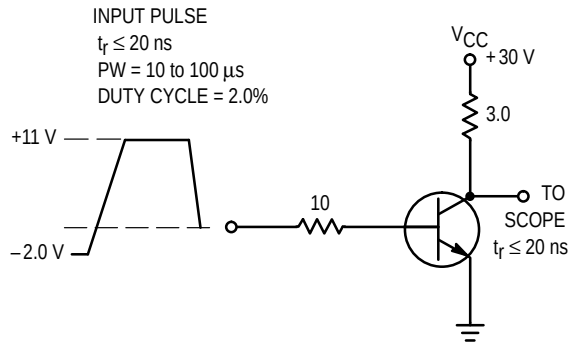



**Figure 2. Turn–On time**

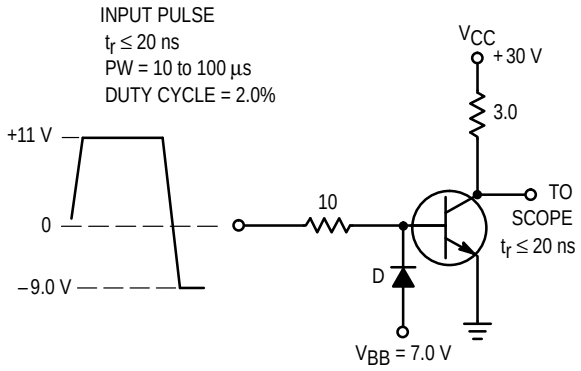



**Figure 3. Turn–Off time**

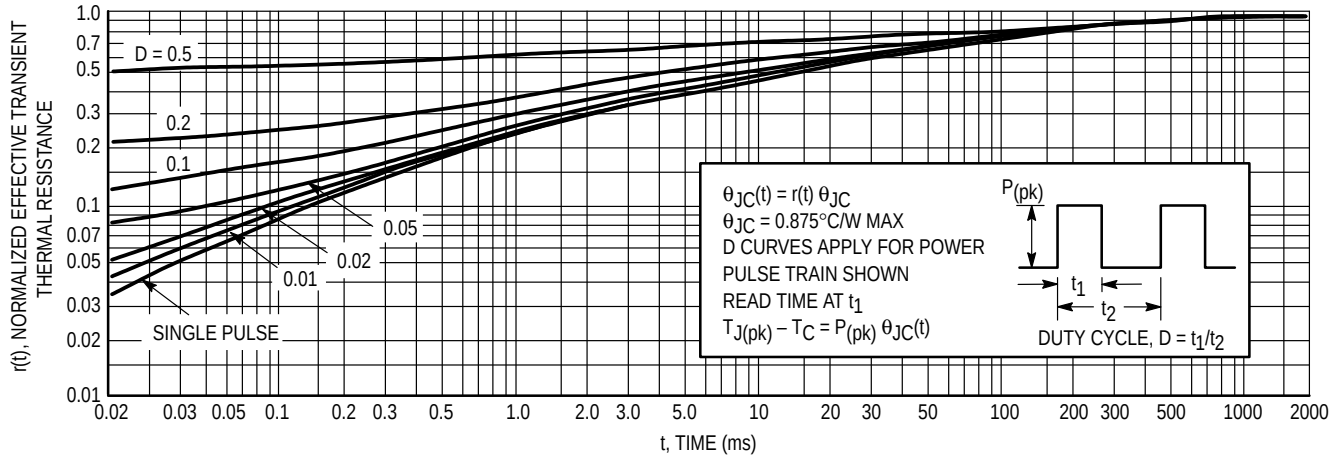



**Figure 4. Thermal Response**

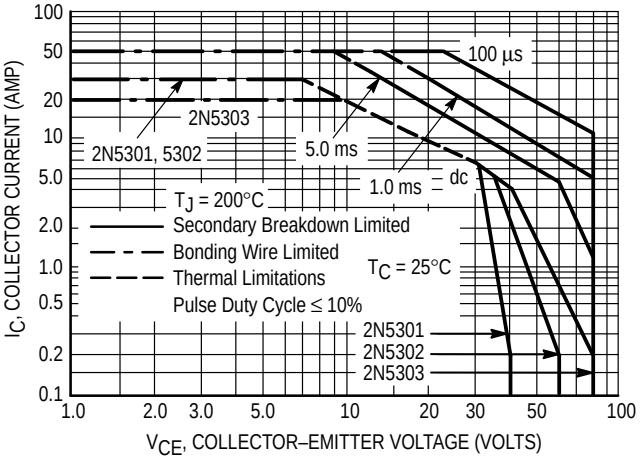



**Figure 5. Active–Region Safe Operating Area**

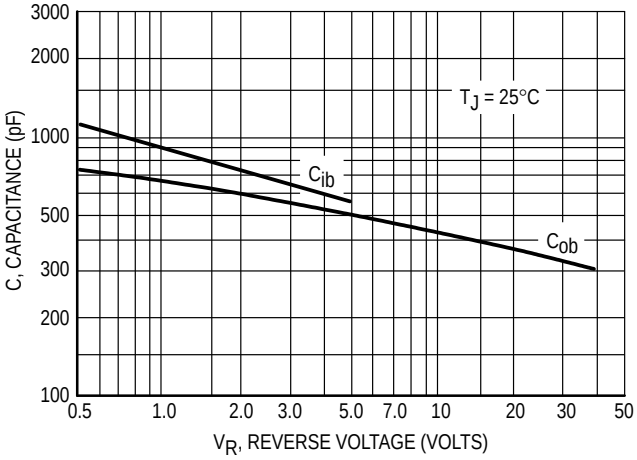



**Figure 6. Capacitance versus Voltage**

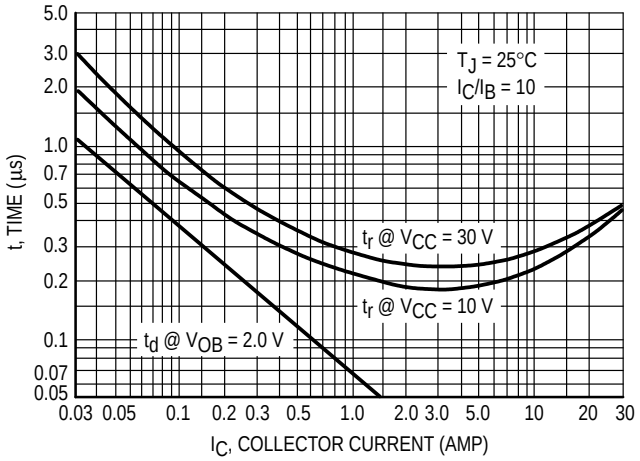



**Figure 7. Turn–On Time**

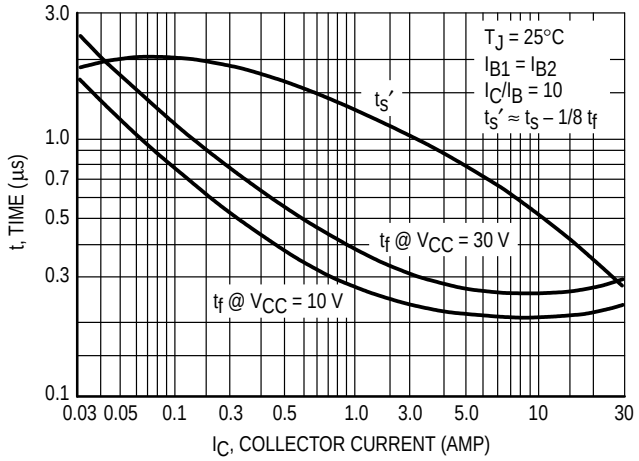



**Figure 8. Turn–Off Time**

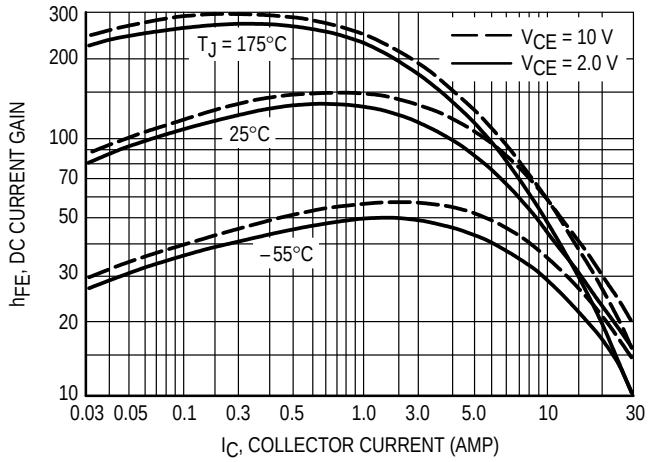



**Figure 9. DC Current Gain**

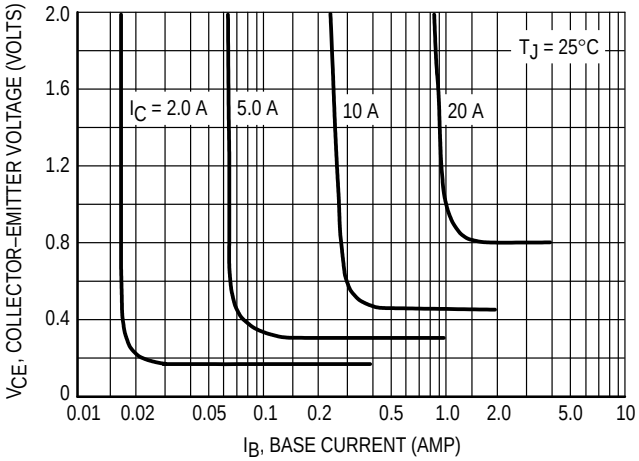



**Figure 10. Collector Saturation Region**

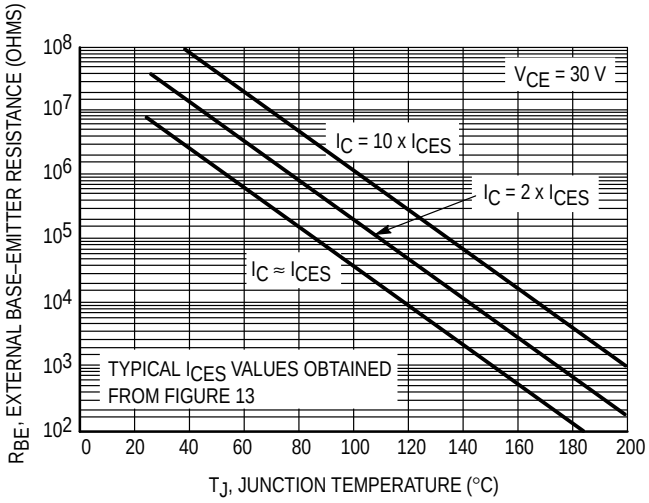



**Figure 11. Effects of Base–Emitter Resistance**

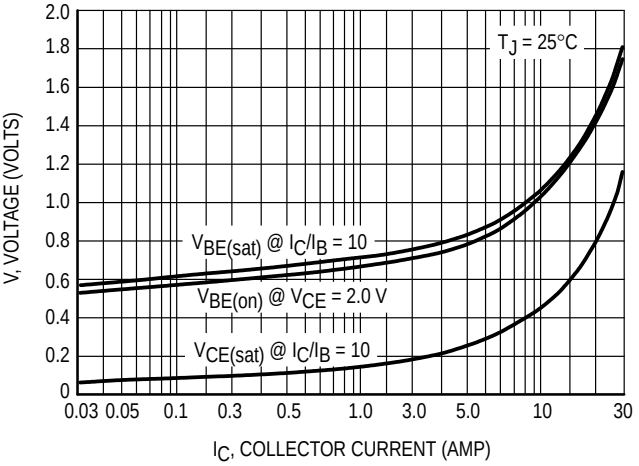



**Figure 12. “On” Voltages**

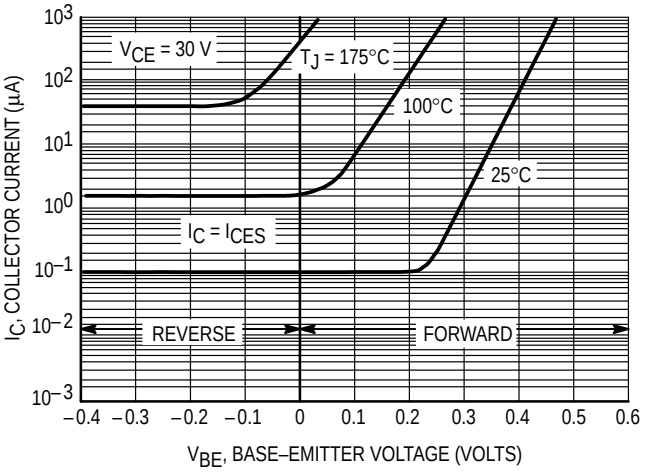



**Figure 13. Collector Cut–Off Region**

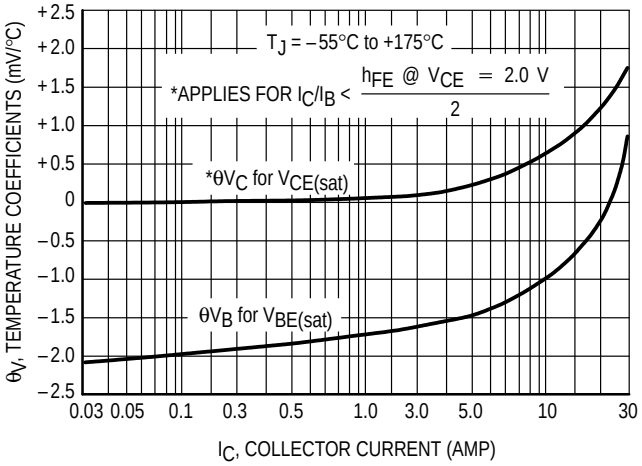
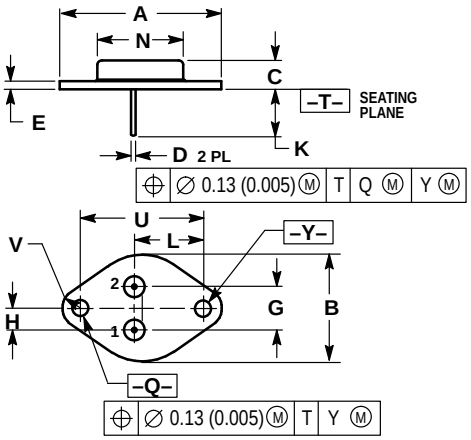



**Figure 14. Temperature Coefficients**

## 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.

| | INCHES | | MILLIMETERS | |
|---|---|---|---|---|
| DIM | 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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