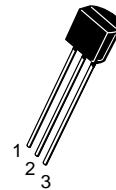
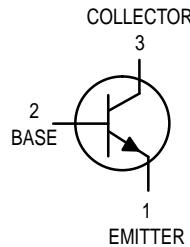


General Purpose Transistor

NPN Silicon

2N4264



CASE 29-04, STYLE 1
TO-92 (TO-226AA)

MAXIMUM RATINGS

| Rating | Symbol | Value | Unit |
|--|----------------|-------------|-------------------------------|
| Collector-Emitter Voltage | V_{CEO} | 15 | Vdc |
| Collector-Base Voltage | V_{CBO} | 30 | Vdc |
| Emitter-Base Voltage | V_{EBO} | 6.0 | Vdc |
| Collector Current — Continuous | I_C | 200 | mAdc |
| Total Device Dissipation @ $T_A = 25^\circ\text{C}$ Derate above 25°C | PD | 350 2.8 | mW mW/ $^\circ\text{C}$ |
| Total Device Dissipation @ $T_C = 25^\circ\text{C}$ Derate above 25°C | PD | 1.0 8.0 | Watts mW/ $^\circ\text{C}$ |
| Operating and Storage Junction Temperature Range | T_J, T_{stg} | -55 to +150 | $^\circ\text{C}$ |

THERMAL CHARACTERISTICS

| Characteristic | Symbol | Max | Unit |
|---|-----------------|-----|--------------------|
| Thermal Resistance, Junction to Ambient | $R_{\theta JA}$ | 357 | $^\circ\text{C/W}$ |
| Thermal Resistance, Junction to Case | $R_{\theta JC}$ | 125 | $^\circ\text{C/W}$ |

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

| Characteristic | Symbol | Min | Max | Unit |
|---|---------------|--------|-----------|-----------|
| OFF CHARACTERISTICS | | | | |
| Collector-Emitter Breakdown Voltage ($I_C = 1.0$ mAdc, $I_B = 0$) | $V_{(BR)CEO}$ | 15 | — | Vdc |
| Collector-Base Breakdown Voltage ($I_C = 10$ μ Adc, $I_E = 0$) | $V_{(BR)CBO}$ | 30 | — | Vdc |
| Emitter-Base Breakdown Voltage ($I_E = 10$ μ Adc, $I_C = 0$) | $V_{(BR)EBO}$ | 6.0 | — | Vdc |
| Base Cutoff Current ($V_{CE} = 12$ Vdc, $V_{EB}(\text{off}) = 0.25$ Vdc) ($V_{CE} = 12$ Vdc, $V_{EB}(\text{off}) = 0.25$ Vdc, $T_A = 100^\circ\text{C}$) | I_{BEV} | — — | 0.1 10 | μ Adc |
| Collector Cutoff Current ($V_{CE} = 12$ Vdc, $V_{EB}(\text{off}) = 0.25$ Vdc) | I_{CEX} | — | 100 | nAdc |

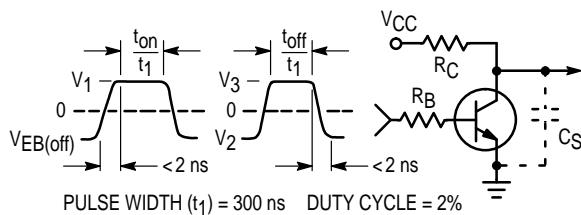
ELECTRICAL CHARACTERISTICS ($T_A = 25^\circ\text{C}$ unless otherwise noted) (Continued)

| Characteristic | Symbol | Min | Max | Unit | |
|--|---|----------------------------------|------------------------------|------|----|
| ON CHARACTERISTICS | | | | | |
| DC Current Gain ($I_C = 1.0 \text{ mA DC}$, $V_{CE} = 1.0 \text{ Vdc}$) ($I_C = 10 \text{ mA DC}$, $V_{CE} = 1.0 \text{ Vdc}$) ($I_C = 10 \text{ mA DC}$, $V_{CE} = 1.0 \text{ Vdc}$, $T_A = -55^\circ\text{C}$) ($I_C = 30 \text{ mA DC}$, $V_{CE} = 1.0 \text{ Vdc}$) ($I_C = 100 \text{ mA DC}$, $V_{CE} = 1.0 \text{ Vdc}$) ⁽¹⁾ ($I_C = 200 \text{ mA DC}$, $V_{CE} = 1.0 \text{ Vdc}$) ⁽¹⁾ | h_{FE} | 25 40 20 40 30 20 | — 160 — — — — | — | |
| Collector-Emitter Saturation Voltage ($I_C = 10 \text{ mA DC}$, $I_B = 1.0 \text{ mA DC}$) ($I_C = 100 \text{ mA DC}$, $I_B = 10 \text{ mA DC}$) ⁽¹⁾ | $V_{CE(\text{sat})}$ | — — | 0.22 0.35 | Vdc | |
| Base-Emitter Saturation Voltage ($I_C = 10 \text{ mA DC}$, $I_B = 1.0 \text{ mA DC}$) ($I_C = 100 \text{ mA DC}$, $I_B = 10 \text{ mA DC}$) ⁽¹⁾ | $V_{BE(\text{sat})}$ | 0.65 0.75 | 0.8 0.95 | Vdc | |
| SMALL-SIGNAL CHARACTERISTICS | | | | | |
| Current-Gain — Bandwidth Product ($I_C = 10 \text{ mA DC}$, $V_{CE} = 10 \text{ Vdc}$, $f = 100 \text{ MHz}$) | f_T | 300 | — | MHz | |
| Input Capacitance ($V_{EB} = 0.5 \text{ Vdc}$, $I_C = 0$, $f = 1.0 \text{ MHz}$) | $C_{i\text{bo}}$ | — | 8.0 | pF | |
| Output Capacitance ($V_{CB} = 5.0 \text{ Vdc}$, $I_E = 0$, $f = 1.0 \text{ MHz}$, $I_E = 0$) | $C_{o\text{bo}}$ | — | 4.0 | pF | |
| SWITCHING CHARACTERISTICS | | | | | |
| Delay Time | $(V_{CC} = 10 \text{ Vdc}, V_{EB(\text{off})} = 2.0 \text{ Vdc},$ $I_C = 100 \text{ mA DC}$, $I_{B1} = 10 \text{ mA DC}$) (Fig. 1, Test Condition C) | t_d | — | 8.0 | ns |
| Rise Time | | t_r | — | 15 | ns |
| Storage Time | $V_{CC} = 10 \text{ Vdc}$, ($I_C = 10 \text{ mA DC}$, for t_s) ($I_C = 100 \text{ mA}$ for t_f) ($I_{B1} = -10 \text{ mA}$) ($I_{B2} = 10 \text{ mA}$) (Fig. 1, Test Condition C) | t_s | — | 20 | ns |
| Fall Time | | t_f | — | 15 | ns |
| Turn-On Time | $(V_{CC} = 3.0 \text{ Vdc}, V_{EB(\text{off})} = 1.5 \text{ Vdc},$ $I_C = 10 \text{ mA DC}$, $I_{B1} = 3.0 \text{ mA DC}$) (Fig. 1, Test Condition A) | t_{on} | — | 25 | ns |
| Turn-Off Time | | t_{off} | — | 35 | ns |
| Storage Time | $(V_{CC} = 10 \text{ Vdc}, I_C = 10 \text{ mA},$ $I_{B1} = I_{B2} = 10 \text{ mA DC}$) (Fig. 1, Test Condition B) | t_s | — | 20 | ns |
| Total Control Charge | | Q_T | — | 80 | pC |

1. Pulse Test: Pulse Width = 300 μs , Duty Cycle = 2.0%.

Figure 1. Switching Time Equivalent Test Circuit

| Test Condition | I_C | V_{CC} | R_S | R_C | $C_S(\text{max})$ | $V_{BE(\text{off})}$ | V_1 | V_2 | V_3 |
|----------------|-------|----------|----------|----------|-------------------|----------------------|-------|-------|-------|
| | mA | V | Ω | Ω | pF | V | V | V | V |
| A | 10 | 3 | 3300 | 270 | 4 | -1.5 | 10.55 | -4.15 | 10.70 |
| B | 10 | 10 | 560 | 960 | 4 | — | — | -4.65 | 6.55 |
| C | 100 | 10 | 560 | 96 | 12 | -2.0 | 6.35 | -4.65 | 6.55 |



CURRENT GAIN CHARACTERISTICS

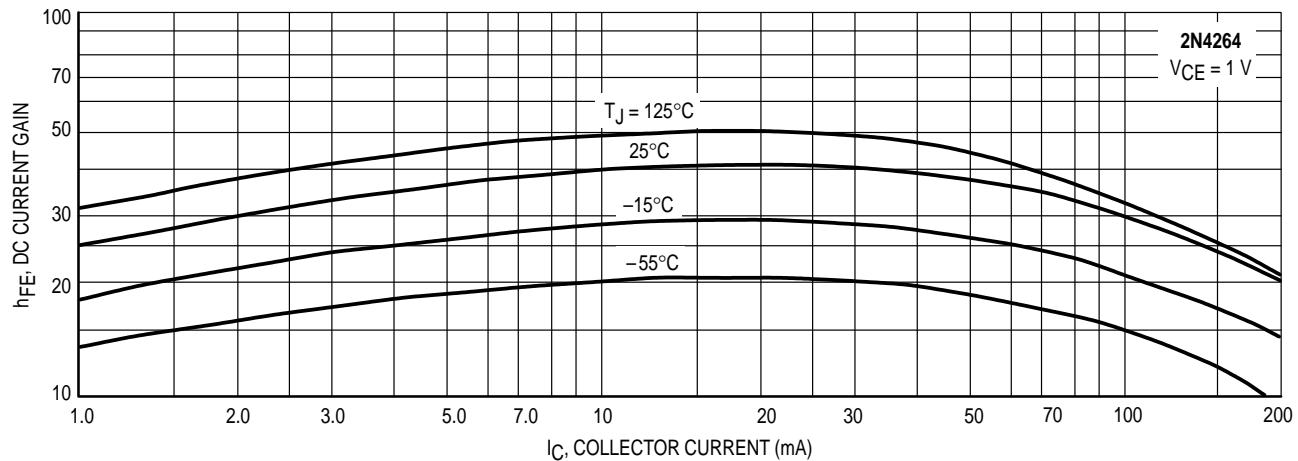


Figure 2. Minimum Current Gain

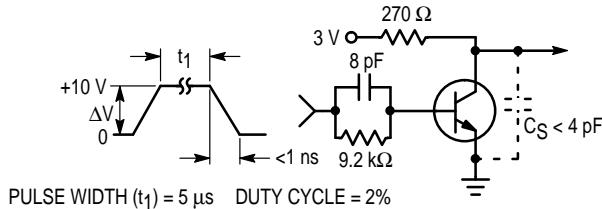
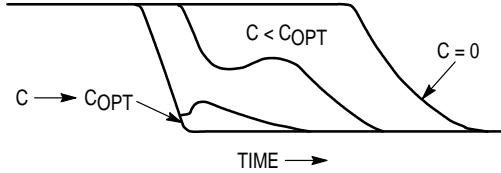
Figure 3. Q_T Test Circuit

Figure 4. Turn-Off Waveform

NOTE 1

When a transistor is held in a conductive state by a base current, I_B , a charge, Q_S , is developed or "stored" in the transistor. Q_S may be written: $Q_S = Q_1 + Q_Y + Q_X$.

Q_1 is the charge required to develop the required collector current. This charge is primarily a function of alpha cutoff frequency. Q_Y is the charge required to charge the collector-base feedback capacity. Q_X is excess charge resulting from overdrive, i.e., operation in saturation.

The charge required to turn a transistor "on" to the edge of saturation is the sum of Q_1 and Q_Y which is defined as the active region charge, Q_A . $Q_A = I_B t_r$ when the transistor is driven by a constant current step

$$(I_B 1) \text{ and } I_B 1 < \frac{I_C}{h_{FE}}$$

If I_B were suddenly removed, the transistor would continue to conduct until Q_S is removed from the active regions through an external path or through internal recombination. Since the internal recombination time is long compared to the ultimate capability of a transistor, a charge, Q_T , of opposite polarity, equal in magnitude, can be stored on an external capacitor, C , to neutralize the internal charge and considerably reduce the turn-off time of the transistor. Figure 3 shows the test circuit and Figure 4 the turn-off waveform. Given Q_T from Figure 13, the external C for worst-case turn-off in any circuit is: $C = Q_T / \Delta V$, where ΔV is defined in Figure 3.

“ON” CONDITION CHARACTERISTICS

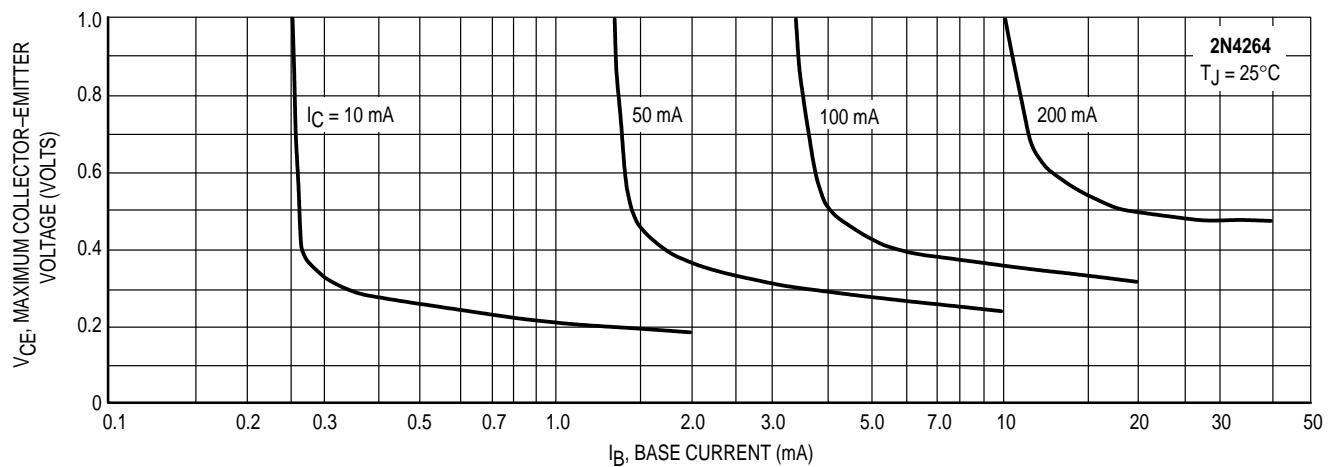


Figure 5. Collector Saturation Region

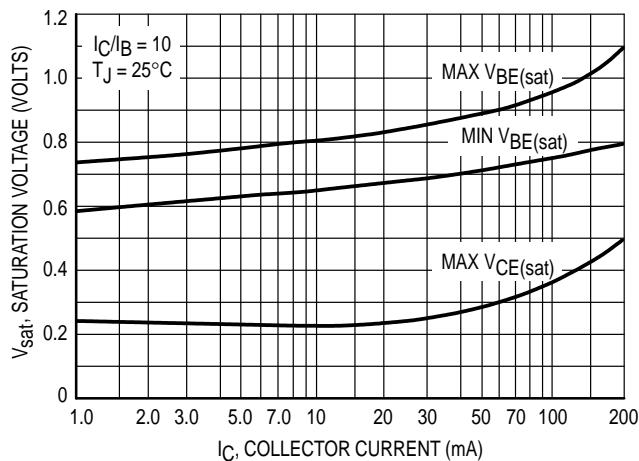


Figure 6. Saturation Voltage Limits

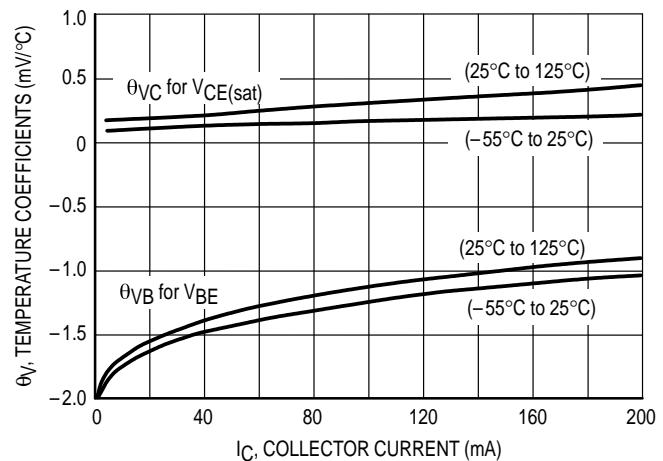


Figure 7. Temperature Coefficients

DYNAMIC CHARACTERISTICS

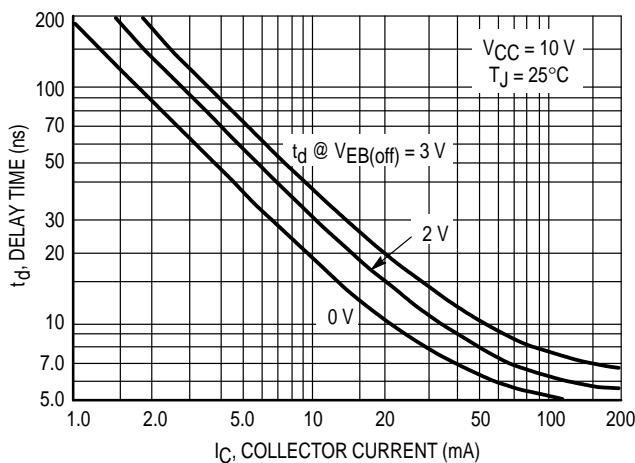


Figure 8. Delay Time

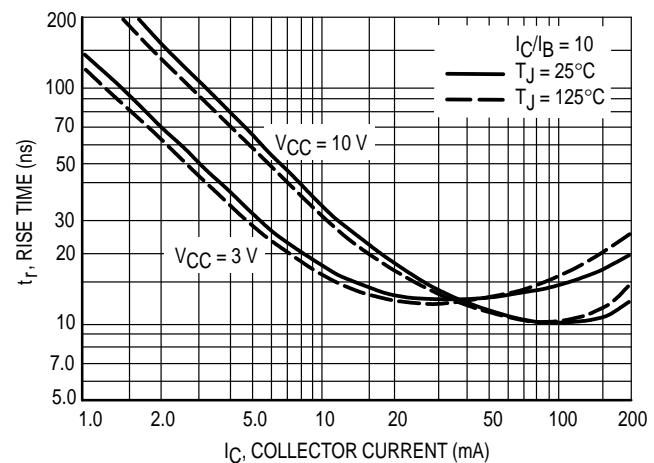


Figure 9. Rise Time

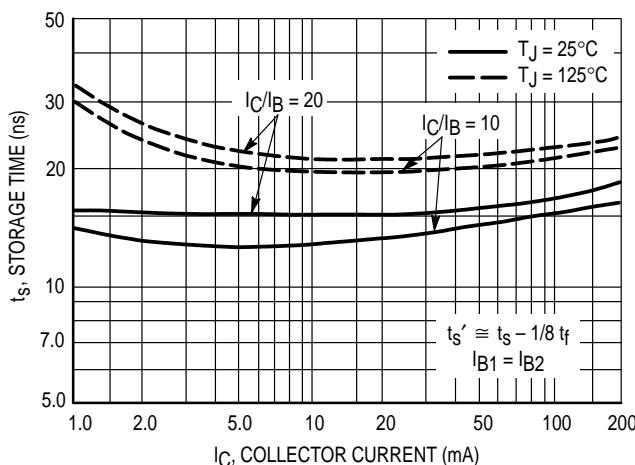


Figure 10. Storage Time

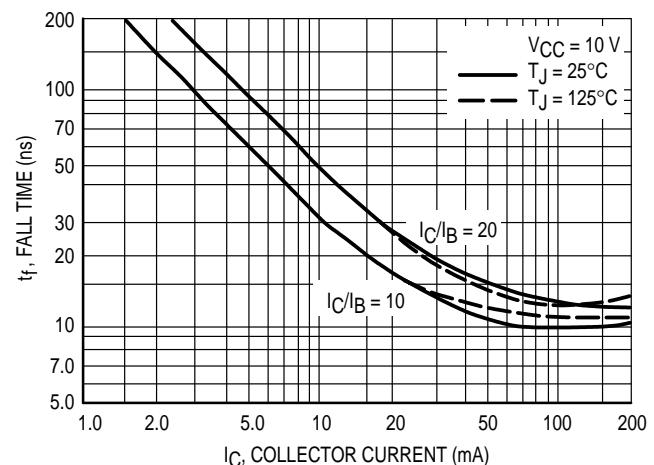


Figure 11. Fall Time

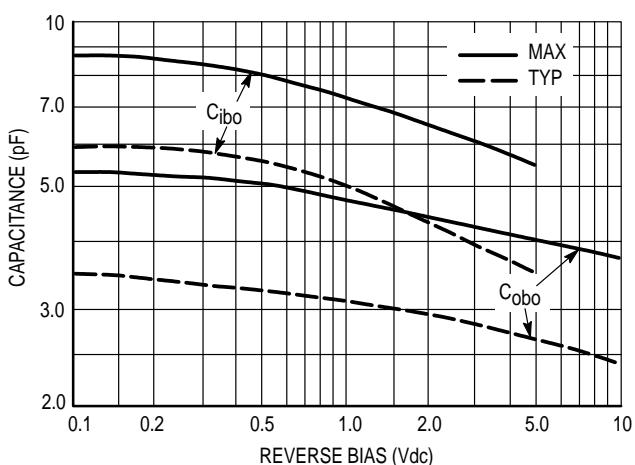


Figure 12. Junction Capacitance

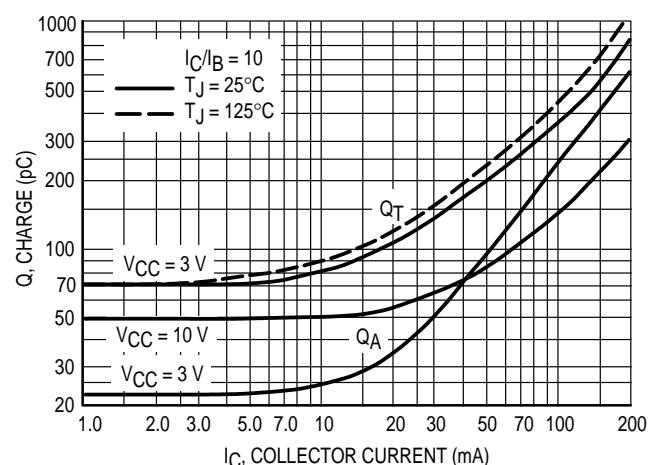
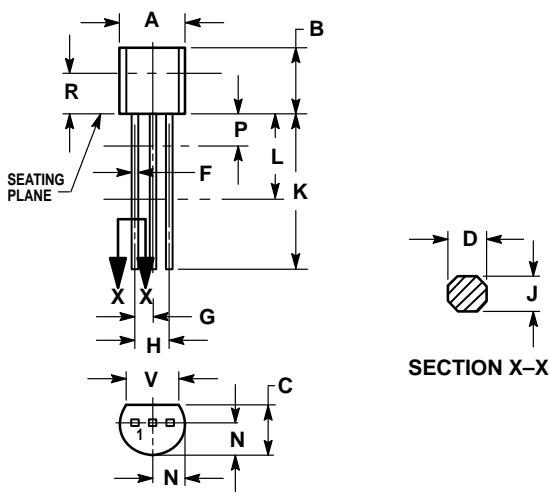


Figure 13. Maximum Charge Data

PACKAGE DIMENSIONS



**CASE 029-04
(TO-226AA)
ISSUE AD**

| DIM | INCHES | | MILLIMETERS | |
|-----|--------|-------|-------------|------|
| | MIN | MAX | MIN | MAX |
| A | 0.175 | 0.205 | 4.45 | 5.20 |
| B | 0.170 | 0.210 | 4.32 | 5.33 |
| C | 0.125 | 0.165 | 3.18 | 4.19 |
| D | 0.016 | 0.022 | 0.41 | 0.55 |
| F | 0.016 | 0.019 | 0.41 | 0.48 |
| G | 0.045 | 0.055 | 1.15 | 1.39 |
| H | 0.095 | 0.105 | 2.42 | 2.66 |
| J | 0.015 | 0.020 | 0.39 | 0.50 |
| K | 0.500 | — | 12.70 | — |
| L | 0.250 | — | 6.35 | — |
| N | 0.080 | 0.105 | 2.04 | 2.66 |
| P | — | 0.100 | — | 2.54 |
| R | 0.115 | — | 2.93 | — |
| V | 0.135 | — | 3.43 | — |

STYLE 1:
PIN 1. Emitter
2. Base
3. Collector

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