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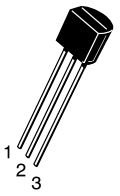
**ON Semiconductor™**

# MPS3638A

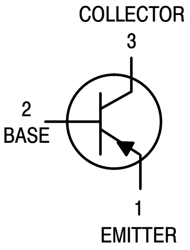
# Switching Transistor

## PNP Silicon

- **This device is available in Pb−free package(s). Specifications herein apply to both standard and Pb−free devices. Please see our website at www.onsemi.com for specific Pb−free orderable part numbers, or contact your local ON Semiconductor sales office or representative.**



**CASE 29−11, STYLE 1**
**TO−92 (TO−226AA)**



### MAXIMUM RATINGS

| Rating | Symbol | Value | Unit |
|---|---|---|---|
| Collector − Emitter Voltage | $V_{CEO}$ | −25 | Vdc |
| Collector − Emitter Voltage | $V_{CES}$ | −25 | Vdc |
| Collector − Base Voltage | $V_{CBO}$ | −25 | Vdc |
| Emitter − Base Voltage | $V_{EBO}$ | −4.0 | Vdc |
| Collector Current — Continuous | $I_C$ | −500 | mAdc |
| Total Device Dissipation @ $T_A = 25°C$<br>Derate above 25°C | $P_D$ | 625<br>5.0 | mW<br>mW/°C |
| Total Device Dissipation @ $T_C = 25°C$<br>Derate above 25°C | $P_D$ | 1.5<br>12 | Watts<br>mW/°C |
| Operating and Storage Junction Temperature Range | $T_J$, $T_{stg}$ | −55 to +150 | °C |

### THERMAL CHARACTERISTICS

| Characteristic | Symbol | Max | Unit |
|---|---|---|---|
| Thermal Resistance, Junction to Ambient | $R_{\theta JA}$(1) | 200 | °C/W |
| Thermal Resistance, Junction to Case | $R_{\theta JC}$ | 83.3 | °C/W |

### ELECTRICAL CHARACTERISTICS ($T_A = 25°C$ unless otherwise noted)

| Characteristic | Symbol | Min | Max | Unit |
|---|---|---|---|---|
| **OFF CHARACTERISTICS** | | | | |
| Collector − Emitter Breakdown Voltage<br>($I_C = −100\ \mu Adc$, $V_{BE} = 0$) | $V_{(BR)CES}$ | −25 | — | Vdc |
| Collector − Emitter Sustaining Voltage(2)<br>($I_C = −10$ mAdc, $I_B = 0$) | $V_{CEO(sus)}$ | −25 | — | Vdc |
| Collector − Base Breakdown Voltage<br>($I_C = −100\ \mu Adc$, $I_E = 0$) | $V_{(BR)CBO}$ | −25 | — | Vdc |
| Emitter − Base Breakdown Voltage<br>($I_E = −100\ \mu Adc$, $I_C = 0$) | $V_{(BR)EBO}$ | −4.0 | — | Vdc |
| Collector Cutoff Current<br>($V_{CE} = −15$ Vdc, $V_{BE} = 0$)<br>($V_{CE} = −15$ Vdc, $V_{BE} = 0$, $T_A = −65°C$) | $I_{CES}$ | <br>—<br>— | <br>−0.035<br>−2.0 | μAdc |
| Emitter Cutoff Current<br>($V_{EB} = −3.0$ V, $I_C = 0$) | $I_{EBO}$ | — | −35 | nA |
| Base Current<br>($V_{CE} = −15$ Vdc, $V_{BE} = 0$) | $I_B$ | — | −0.035 | μAdc |

1. $R_{\theta JA}$ is measured with the device soldered into a typical printed circuit board.
2. Pulse Test: Pulse Width ≤ 300 μs; Duty Cycle ≤ 2.0%.

## ELECTRICAL CHARACTERISTICS ($T_A$ = 25°C unless otherwise noted) (Continued)

### ON CHARACTERISTICS(2)

| Characteristic | Symbol | Min | Max | Unit |
|---|---|---|---|---|
| DC Current Gain | $h_{FE}$ | | | — |
| ($I_C$ = −1.0 mAdc, $V_{CE}$ = −10 Vdc) | | 80 | — | |
| ($I_C$ = −10 mAdc, $V_{CE}$ = −10 Vdc) | | 100 | — | |
| ($I_C$ = −50 mAdc, $V_{CE}$ = −1.0 Vdc) | | 100 | — | |
| ($I_C$ = −300 mAdc, $V_{CE}$ = −2.0 Vdc) | | 20 | — | |
| Collector − Emitter Saturation Voltage | $V_{CE(sat)}$ | | | Vdc |
| ($I_C$ = −50 mAdc, $I_B$ = −2.5 mAdc) | | — | −0.25 | |
| ($I_C$ = −300 mAdc, $I_B$ = −30 mAdc) | | — | −1.0 | |
| Base − Emitter Saturation Voltage | $V_{BE(sat)}$ | | | Vdc |
| ($I_C$ = −50 mAdc, $I_B$ = −2.5 mAdc) | | — | −1.1 | |
| ($I_C$ = −300 mAdc, $I_B$ = −30 mAdc) | | −0.80 | −2.0 | |

### SMALL− SIGNAL CHARACTERISTICS

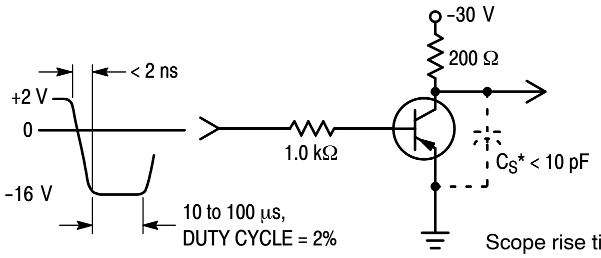
| Characteristic | Symbol | Min | Max | Unit |
|---|---|---|---|---|
| Current − Gain — Bandwidth Product ($V_{CE}$ = −3.0 Vdc, $I_C$ = −50 mAdc, f = 100 MHz) | $f_T$ | 150 | — | MHz |
| Output Capacitance ($V_{CB}$ = −10 Vdc, $I_E$ = 0, f = 1.0 MHz) | $C_{obo}$ | — | 10 | pF |
| Input Capacitance ($V_{EB}$ = −0.5 Vdc, $I_C$ = 0, f = 1.0 MHz) | $C_{ibo}$ | — | 25 | pF |
| Input Impedance ($I_C$ = −10 mAdc, $V_{CE}$ = −10 Vdc, f = 1.0 kHz) | $h_{ie}$ | — | 2000 | kΩ |
| Voltage Feedback Ratio ($I_C$ = −10 mAdc, $V_{CE}$ = −10 Vdc, f = 1.0 kHz) | $h_{re}$ | — | 15 | X $10^{-4}$ |
| Small−Signal Current Gain ($I_C$ = −10 mAdc, $V_{CE}$ = −10 Vdc, f = 1.0 kHz) | $h_{fe}$ | 100 | — | — |
| Output Admittance ($I_C$ = −10 mAdc, $V_{CE}$ = −10 Vdc, f = 1.0 kHz) | $h_{oe}$ | — | 1.2 | mmhos |

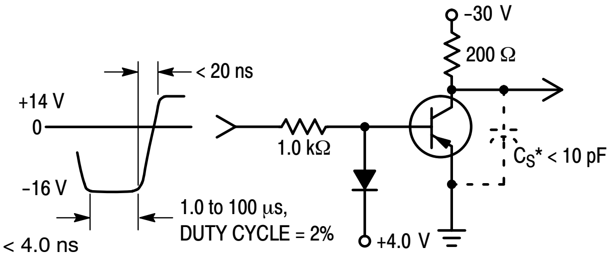
### SWITCHING CHARACTERISTICS

| Characteristic | | Symbol | Min | Max | Unit |
|---|---|---|---|---|---|
| Delay Time | ($V_{CC}$ = −10 Vdc, $I_C$ = −300 mAdc, $I_{B1}$ = −30 mAdc) | $t_d$ | — | 20 | ns |
| Rise Time | | $t_r$ | — | 70 | ns |
| Storage Time | ($V_{CC}$ = −10 Vdc, $I_C$ = −300 mAdc, $I_{B1}$ = −30 mAdc, $I_{B2}$ = −30 mAdc) | $t_s$ | — | 140 | ns |
| Fall Time | | $t_f$ | — | 70 | ns |
| Turn−On Time | ($I_C$ = −300 mAdc, $I_{B1}$ = −30 mAdc) | $t_{on}$ | — | 75 | ns |
| Turn−Off Time | ($I_C$ = −300 mAdc, $I_{B1}$ = −30 mAdc, $I_{B2}$ = 30 mAdc) | $t_{off}$ | — | 170 | ns |

2. Pulse Test: Pulse Width ≤ 300 μs; Duty Cycle ≤ 2.0%.

## SWITCHING TIME EQUIVALENT TEST CIRCUIT





Scope rise time < 4.0 ns
*Total shunt capacitance of test jig connectors, and oscilloscope

Figure 1. Turn−On Time

Figure 2. Turn−Off Time

## TRANSIENT CHARACTERISTICS

—— 25°C   — — 100°C

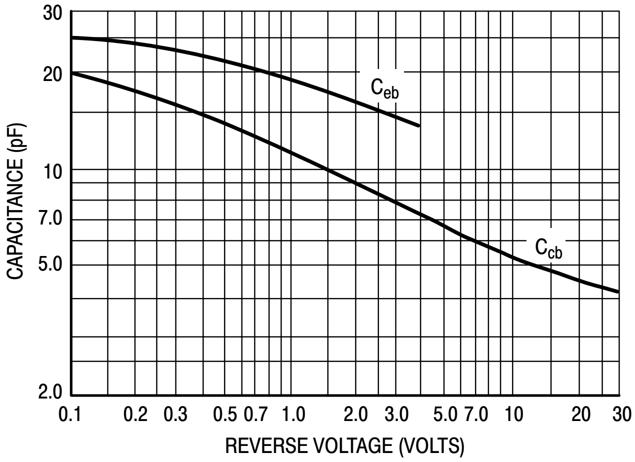


Figure 3. Capacitances

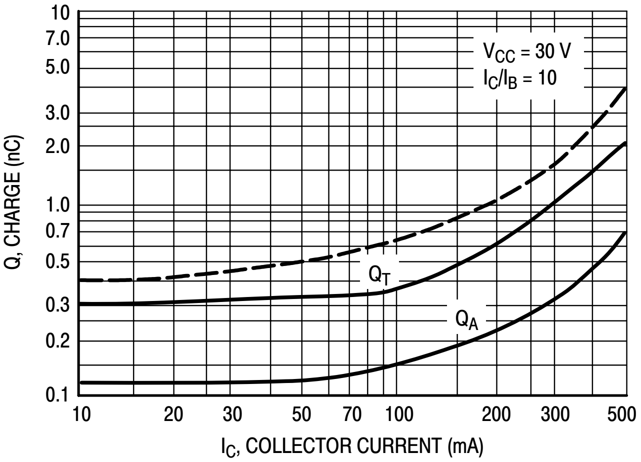


Figure 4. Charge Data

## TRANSIENT CHARACTERISTICS (Continued)

—— 25°C    – – 100°C

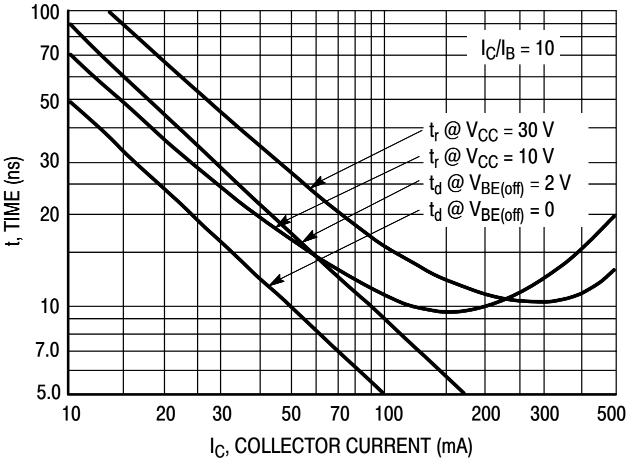


**Figure 5. Turn−On Time**

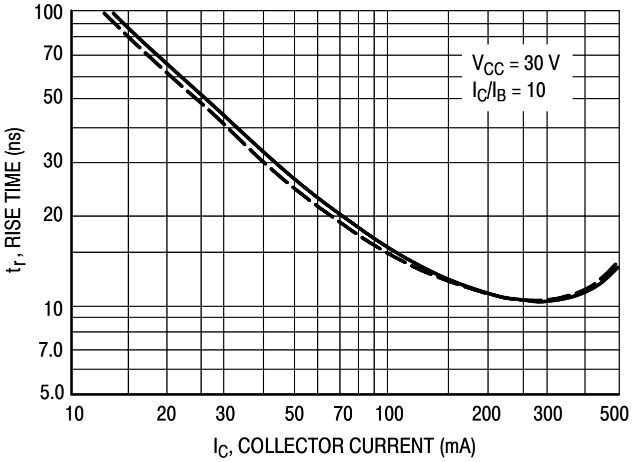


**Figure 6. Rise Time**

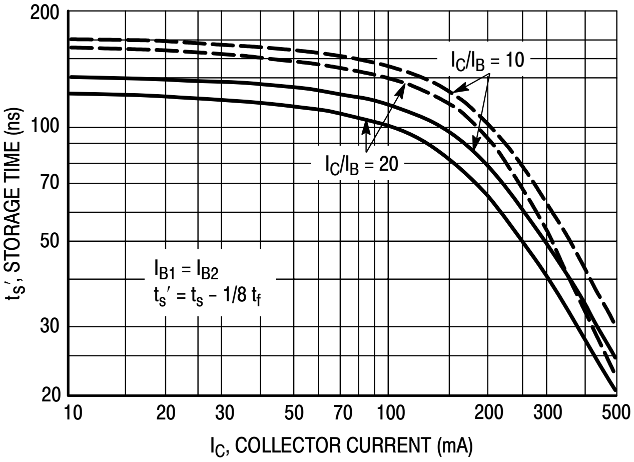


**Figure 7. Storage Time**

## SMALL−SIGNAL CHARACTERISTICS

### NOISE FIGURE

$V_{CE}$ = −10 Vdc, $T_A$ = 25°C
Bandwidth = 1.0 Hz

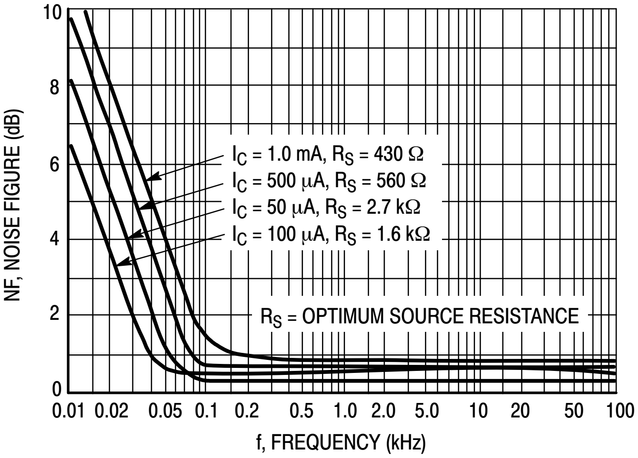


Figure 8. Frequency Effects

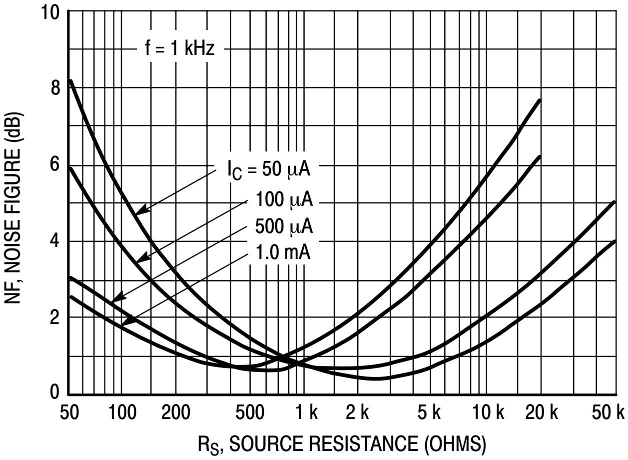


Figure 9. Source Resistance Effects

## h PARAMETERS

$V_{CE} = -10$ Vdc, f = 1.0 kHz, $T_A = 25°C$

This group of graphs illustrates the relationship between $h_{fe}$ and other "h" parameters for this series of transistors. To obtain these curves, a high−gain and a low−gain unit were selected from the 2N4402 line, and the same units were used to develop the correspondingly−numbered curves on each graph.

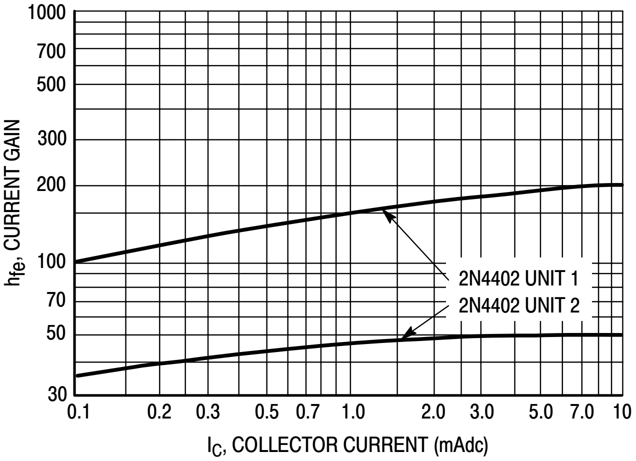


Figure 10. Current Gain

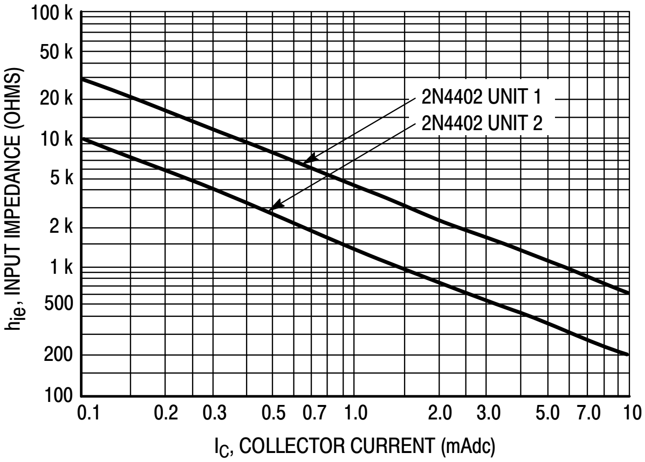


Figure 11. Input Impedance

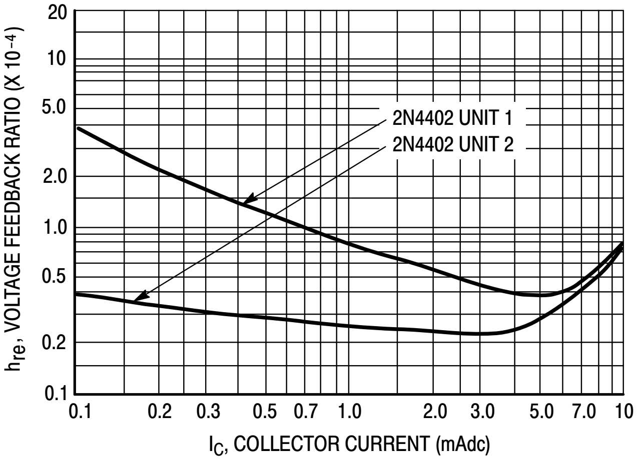


Figure 12. Voltage Feedback Ratio

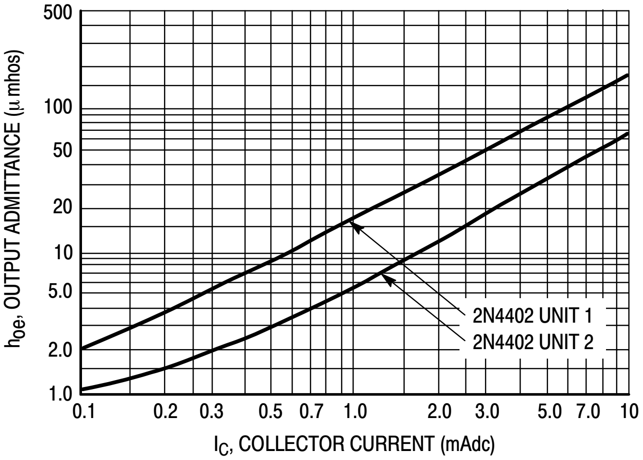


Figure 13. Output Admittance

## STATIC CHARACTERISTICS

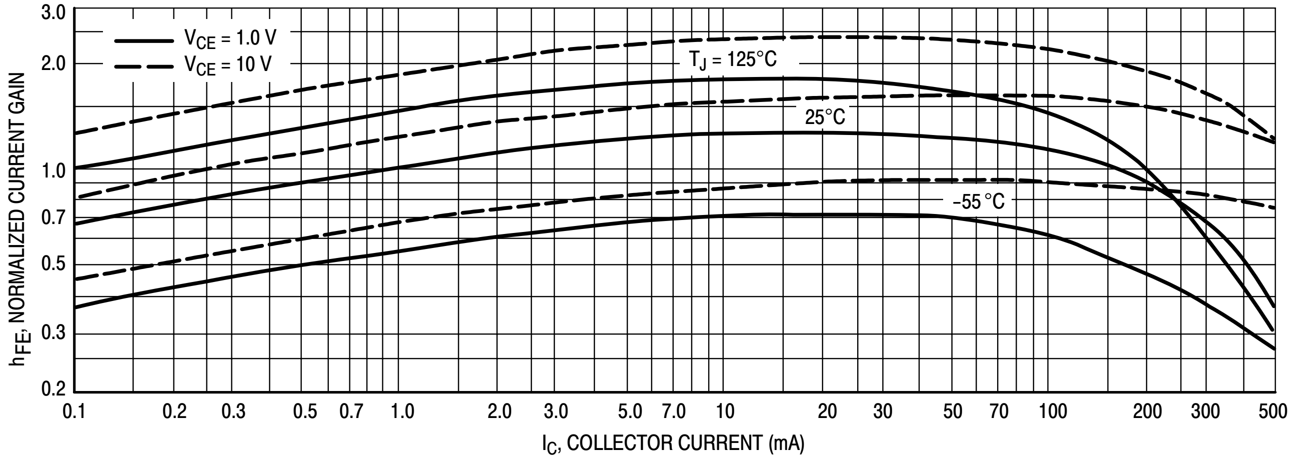


Figure 14. DC Current Gain

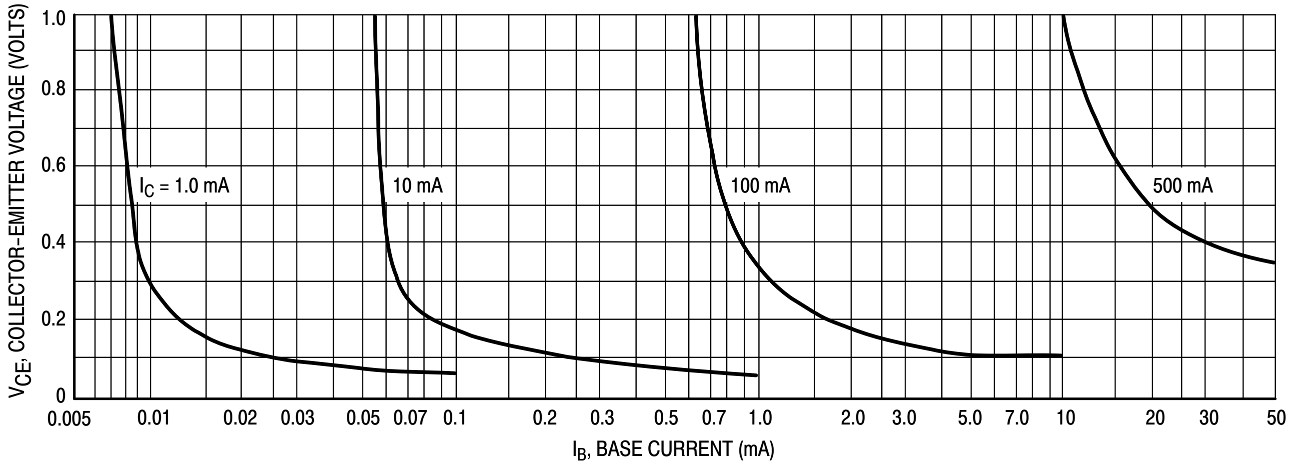


Figure 15. Collector Saturation Region

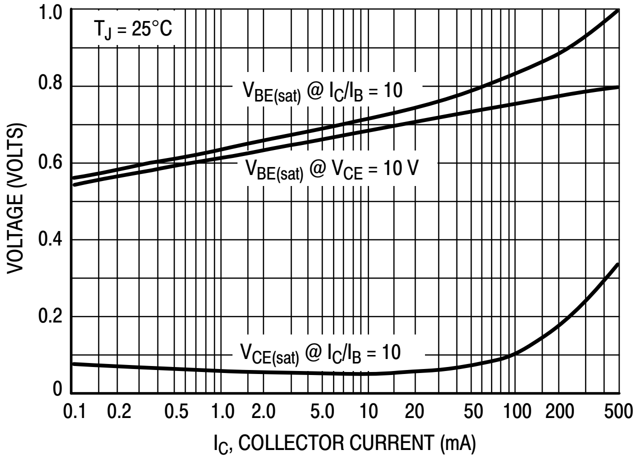


Figure 16. “On” Voltages

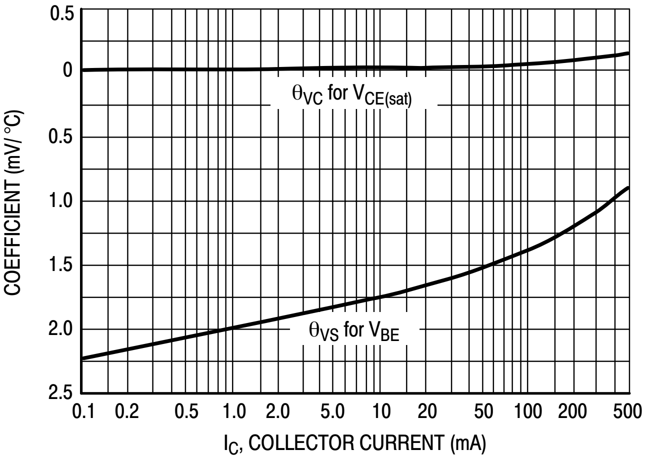
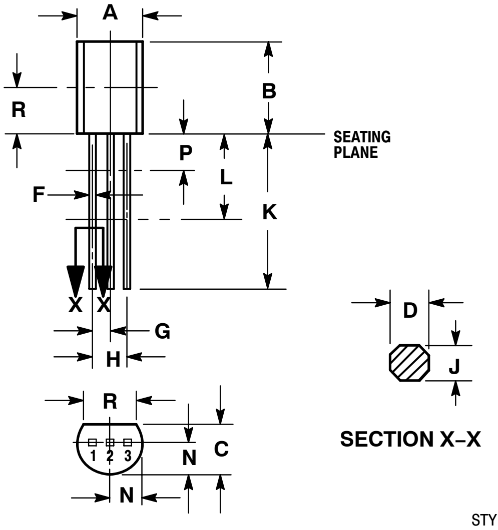


Figure 17. Temperature Coefficients

## PACKAGE DIMENSIONS

### CASE 029–11
### (TO–226AA)
### ISSUE AD



SECTION X–X

NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. CONTOUR OF PACKAGE BEYOND DIMENSION R IS UNCONTROLLED.
4. DIMENSION F APPLIES BETWEEN P AND L. DIMENSIONS D AND J APPLY BETWEEN L AND K MIMIMUM. LEAD DIMENSION IS UNCONTROLLED IN P AND BEYOND DIMENSION K MINIMUM.

| | INCHES | | MILLIMETERS | |
|---|---|---|---|---|
| DIM | MIN | MAX | MIN | MAX |
| A | 0.175 | 0.205 | 4.44 | 5.21 |
| B | 0.290 | 0.310 | 7.37 | 7.87 |
| C | 0.125 | 0.165 | 3.18 | 4.19 |
| D | 0.018 | 0.021 | 0.457 | 0.533 |
| F | 0.016 | 0.019 | 0.407 | 0.482 |
| G | 0.045 | 0.055 | 1.15 | 1.39 |
| H | 0.095 | 0.105 | 2.42 | 2.66 |
| J | 0.018 | 0.024 | 0.46 | 0.61 |
| 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 | 0.135 | --- | 3.43 | --- |

STYLE 1:
PIN 1. EMITTER
2. BASE
3. COLLECTOR

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