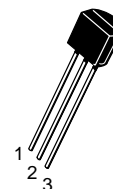
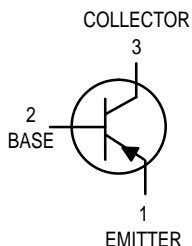


# Switching Transistors

## PNP Silicon

**MPS3638,A**



CASE 29-04, 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	mA <sub>dc</sub>
Total Device Dissipation @ $T_A = 25^\circ\text{C}$ Derate above $25^\circ\text{C}$	$P_D$	625 5.0	mW mW/ $^\circ\text{C}$
Total Device Dissipation @ $T_C = 25^\circ\text{C}$ Derate above $25^\circ\text{C}$	$P_D$	1.5 12	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	$R_{\theta JA}^{(1)}$	200	$^\circ\text{C/W}$
Thermal Resistance, Junction to Case	$R_{\theta JC}$	83.3	$^\circ\text{C/W}$

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

Characteristic	Symbol	Min	Max	Unit
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### OFF CHARACTERISTICS

Collector–Emitter Breakdown Voltage ( $I_C = -100 \mu\text{A}_{dc}$ , $V_{BE} = 0$ )	$V_{(BR)CES}$	–25	—	Vdc
Collector–Emitter Sustaining Voltage <sup>(2)</sup> ( $I_C = -10 \text{ mA}_{dc}$ , $I_B = 0$ )	$V_{CEO(sus)}$	–25	—	Vdc
Collector–Base Breakdown Voltage ( $I_C = -100 \mu\text{A}_{dc}$ , $I_E = 0$ )	$V_{(BR)CBO}$	–25	—	Vdc
Emitter–Base Breakdown Voltage ( $I_E = -100 \mu\text{A}_{dc}$ , $I_C = 0$ )	$V_{(BR)EBO}$	–4.0	—	Vdc
Collector Cutoff Current ( $V_{CE} = -15 \text{ Vdc}$ , $V_{BE} = 0$ ) ( $V_{CE} = -15 \text{ Vdc}$ , $V_{BE} = 0$ , $T_A = -65^\circ\text{C}$ )	$I_{CES}$	— —	–0.035 –2.0	$\mu\text{A}_{dc}$
Emitter Cutoff Current ( $V_{EB} = -3.0 \text{ V}$ , $I_C = 0$ )	$I_{EBO}$	—	–35	nA
Base Current ( $V_{CE} = -15 \text{ Vdc}$ , $V_{BE} = 0$ )	$I_B$	—	–0.035	$\mu\text{A}_{dc}$

- $R_{\theta JA}$  is measured with the device soldered into a typical printed circuit board.
- Pulse Test: Pulse Width  $\leq 300 \mu\text{s}$ ; Duty Cycle  $\leq 2.0\%$ .

**MPS3638,A****ELECTRICAL CHARACTERISTICS** ( $T_A = 25^\circ\text{C}$  unless otherwise noted) (Continued)

Characteristic	Symbol	Min	Max	Unit
<b>ON CHARACTERISTICS(2)</b>				
DC Current Gain ( $I_C = -1.0\text{ mAdc}$ , $V_{CE} = -10\text{ Vdc}$ )	$h_{FE}$	80	—	—
( $I_C = -10\text{ mAdc}$ , $V_{CE} = -10\text{ Vdc}$ )		20	—	—
( $I_C = -50\text{ mAdc}$ , $V_{CE} = -1.0\text{ Vdc}$ )		30	—	—
( $I_C = -300\text{ mAdc}$ , $V_{CE} = -2.0\text{ Vdc}$ )		20	—	—
Collector–Emitter Saturation Voltage ( $I_C = -50\text{ mAdc}$ , $I_B = -2.5\text{ mAdc}$ ) ( $I_C = -300\text{ mAdc}$ , $I_B = -30\text{ mAdc}$ )	$V_{CE(sat)}$	— —	—0.25 —1.0	Vdc
Base–Emitter Saturation Voltage ( $I_C = -50\text{ mAdc}$ , $I_B = -2.5\text{ mAdc}$ ) ( $I_C = -300\text{ mAdc}$ , $I_B = -30\text{ mAdc}$ )	$V_{BE(sat)}$	— —0.80	—1.1 —2.0	Vdc

**SMALL–SIGNAL CHARACTERISTICS**

Current–Gain — Bandwidth Product ( $V_{CE} = -3.0\text{ Vdc}$ , $I_C = -50\text{ mAdc}$ , $f = 100\text{ MHz}$ )	$f_T$	100 150	— —	MHz
Output Capacitance ( $V_{CB} = -10\text{ Vdc}$ , $I_E = 0$ , $f = 1.0\text{ MHz}$ )	$C_{obo}$	— —	20 10	pF
Input Capacitance ( $V_{EB} = -0.5\text{ Vdc}$ , $I_C = 0$ , $f = 1.0\text{ MHz}$ )	$C_{ibo}$	— —	65 25	pF
Input Impedance ( $I_C = -10\text{ mAdc}$ , $V_{CE} = -10\text{ Vdc}$ , $f = 1.0\text{ kHz}$ )	$h_{ie}$	—	2000	k $\Omega$
Voltage Feedback Ratio ( $I_C = -10\text{ mAdc}$ , $V_{CE} = -10\text{ Vdc}$ , $f = 1.0\text{ kHz}$ )	$h_{re}$	— —	26 15	$\times 10^{-4}$
Small–Signal Current Gain ( $I_C = -10\text{ mAdc}$ , $V_{CE} = -10\text{ Vdc}$ , $f = 1.0\text{ kHz}$ )	$h_{fe}$	25 100	— —	—
Output Admittance ( $I_C = -10\text{ mAdc}$ , $V_{CE} = -10\text{ Vdc}$ , $f = 1.0\text{ kHz}$ )	$h_{oe}$	—	1.2	mmhos

**SWITCHING CHARACTERISTICS**

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

2. Pulse Test: Pulse Width  $\leq 300\text{ }\mu\text{s}$ ; Duty Cycle  $\leq 2.0\%$ .

## SWITCHING TIME EQUIVALENT TEST CIRCUIT

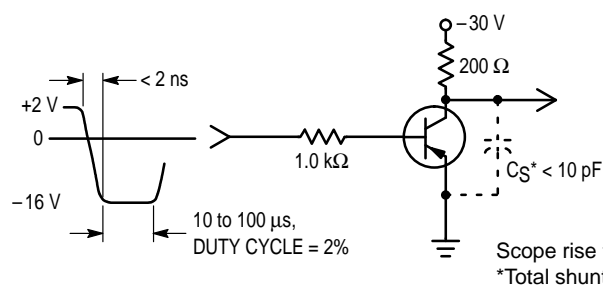


Figure 1. Turn-On Time

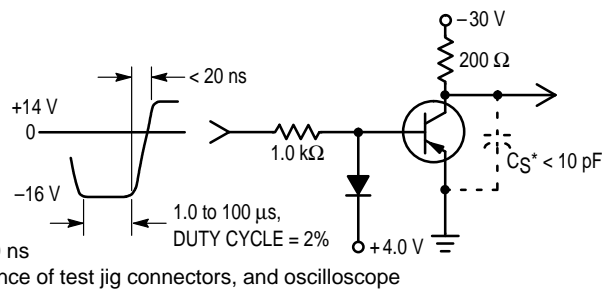


Figure 2. Turn-Off Time

## TRANSIENT CHARACTERISTICS

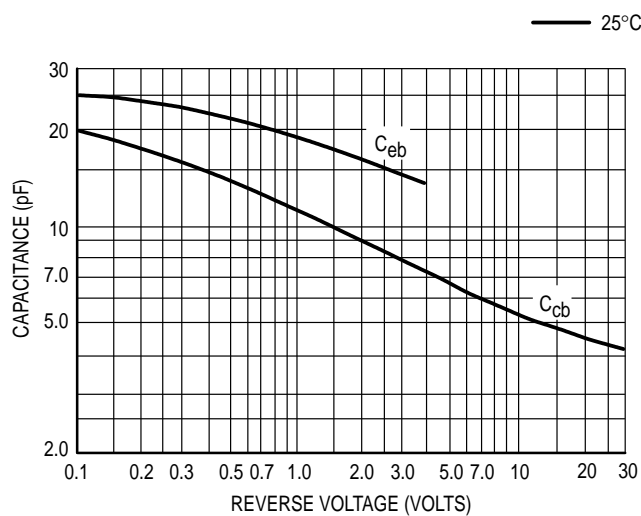


Figure 3. Capacitances

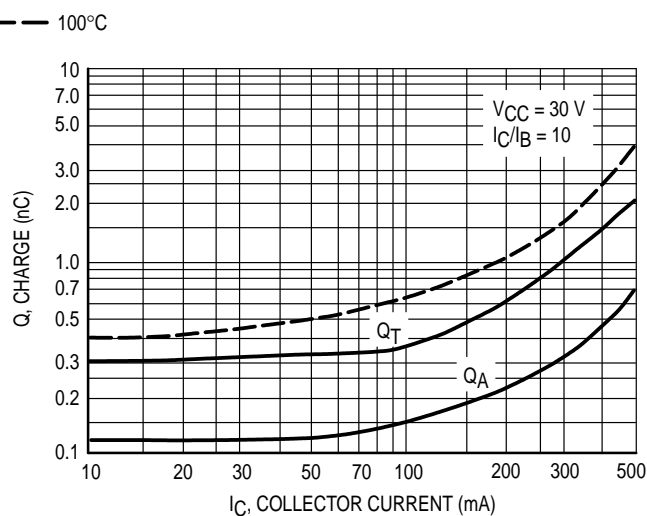


Figure 4. Charge Data

## TRANSIENT CHARACTERISTICS (Continued)

— 25°C    - - - 100°C

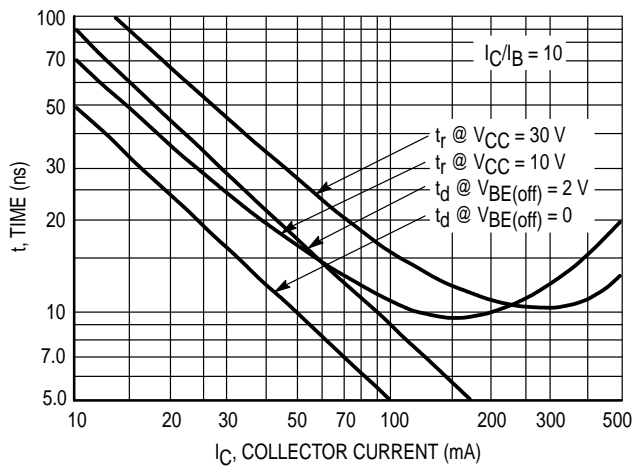


Figure 5. Turn-On Time

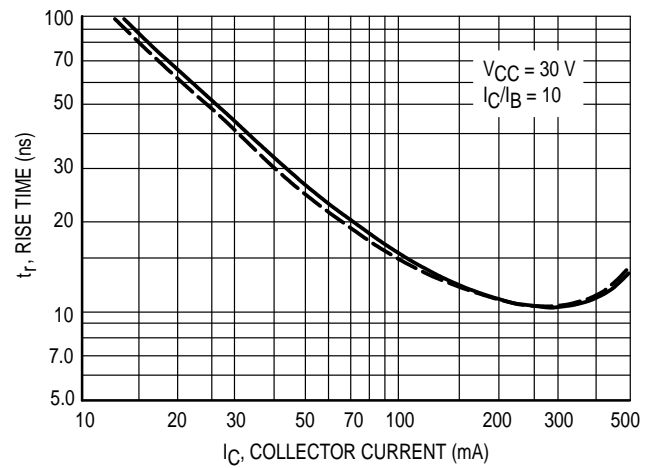


Figure 6. Rise Time

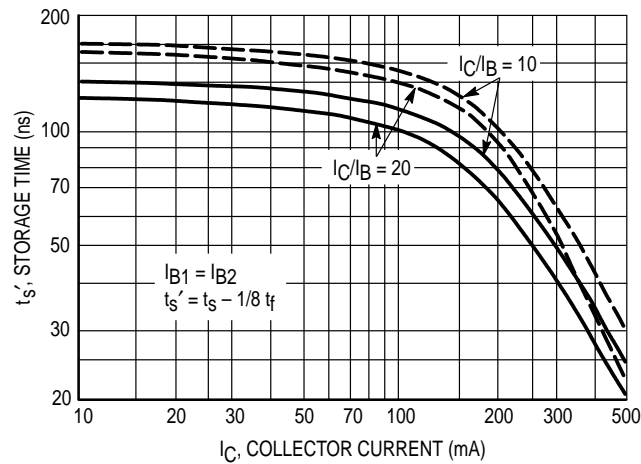


Figure 7. Storage Time

## SMALL-SIGNAL CHARACTERISTICS

## NOISE FIGURE

$$V_{CE} = -10 \text{ Vdc}, T_A = 25^\circ\text{C}$$

Bandwidth = 1.0 Hz

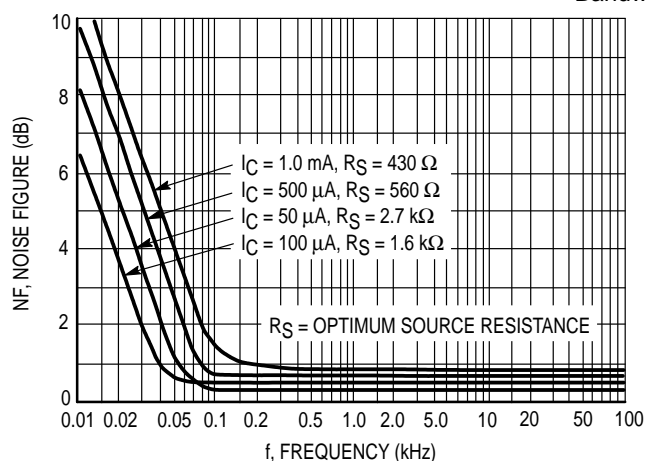


Figure 8. Frequency Effects

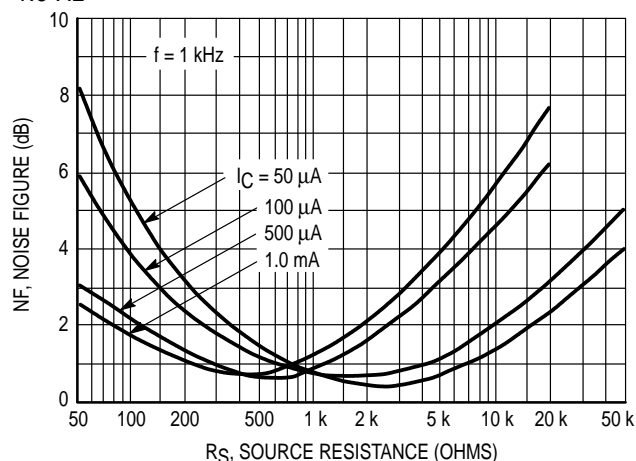


Figure 9. Source Resistance Effects

## h PARAMETERS

$$V_{CE} = -10 \text{ Vdc}, f = 1.0 \text{ kHz}, T_A = 25^\circ\text{C}$$

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 both the 2N4402 and 2N4403 lines, and the same units were used to develop the correspondingly-numbered curves on each graph.

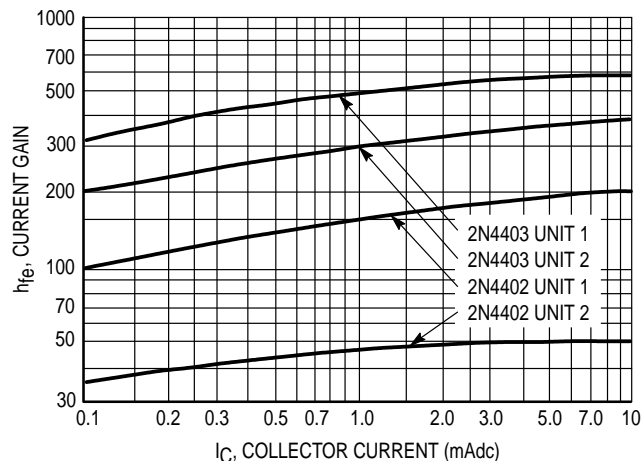


Figure 10. Current Gain

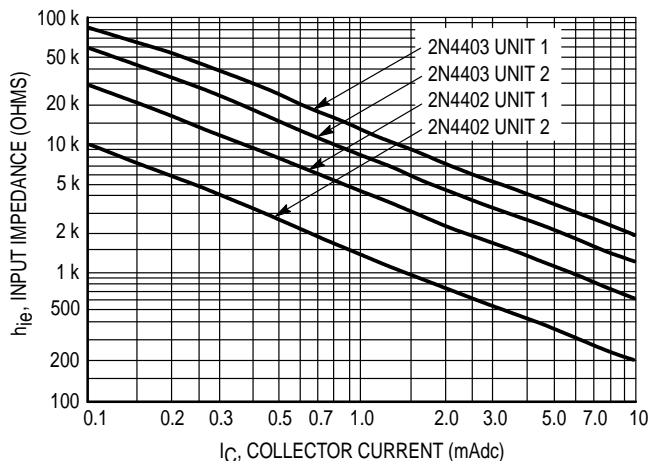


Figure 11. Input Impedance

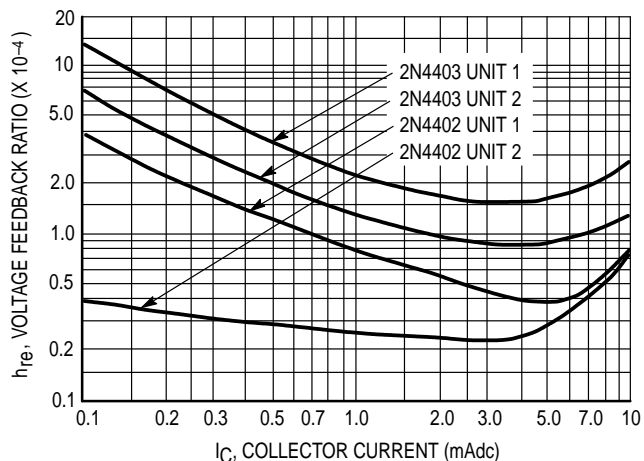


Figure 12. Voltage Feedback Ratio

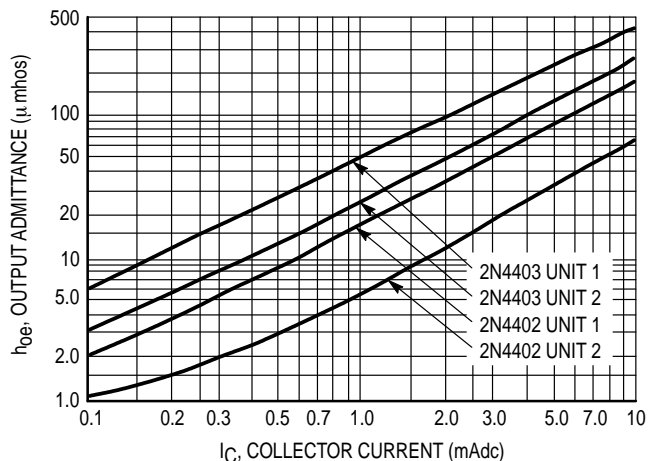


Figure 13. Output Admittance

## STATIC CHARACTERISTICS

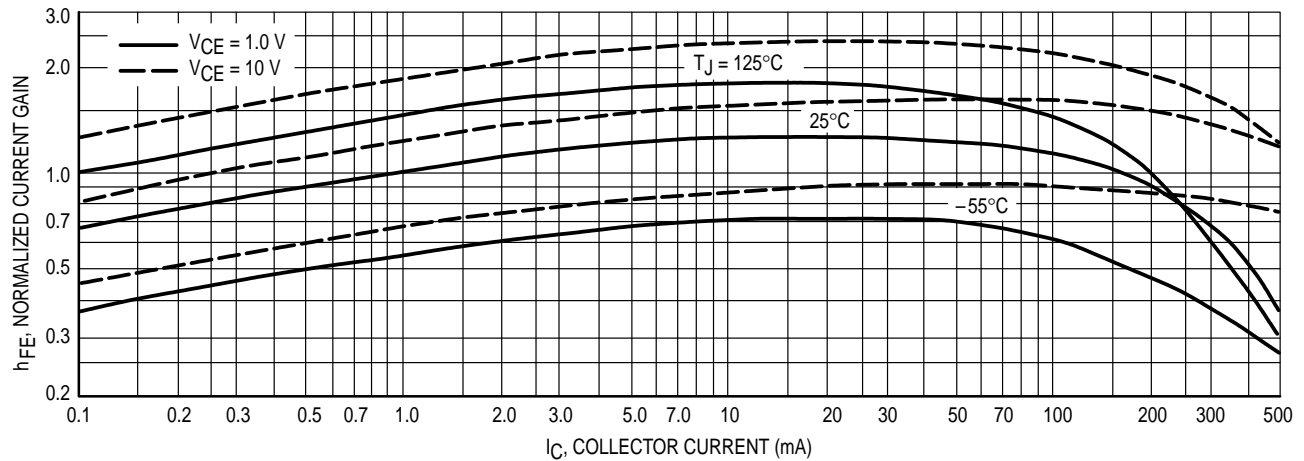


Figure 14. DC Current Gain

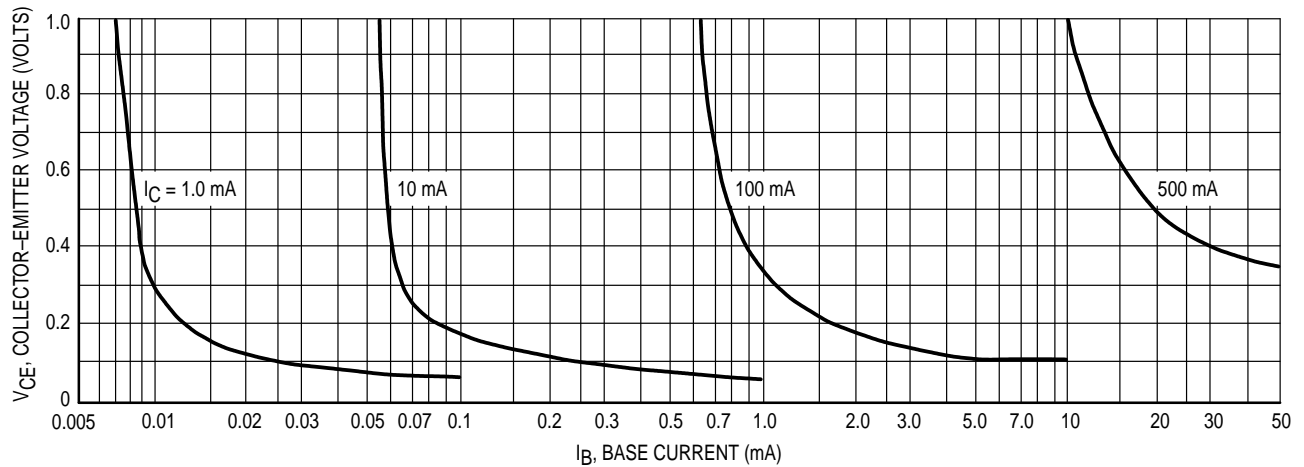


Figure 15. Collector Saturation Region

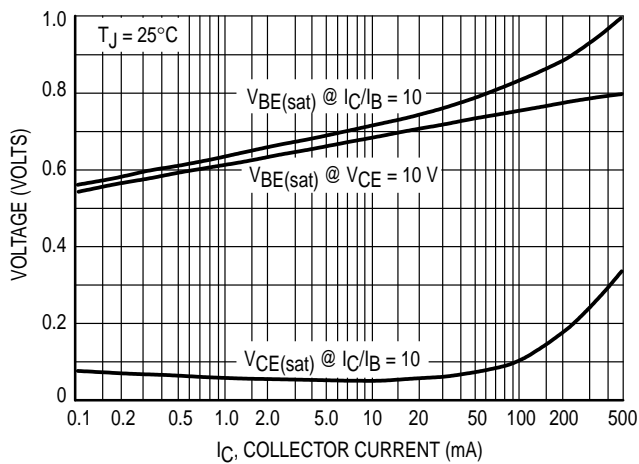


Figure 16. "On" Voltages

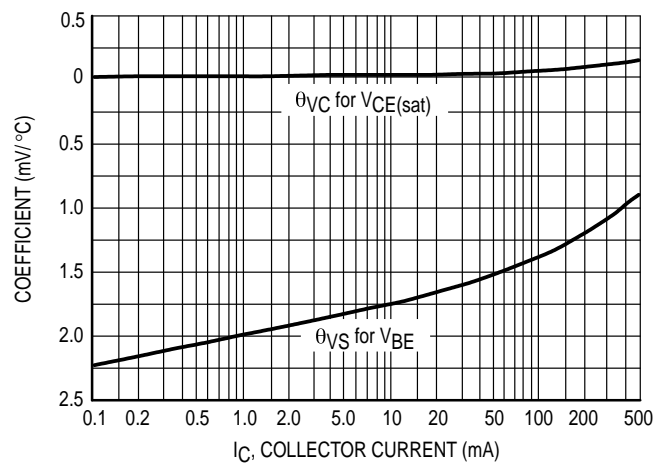
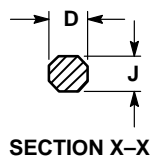
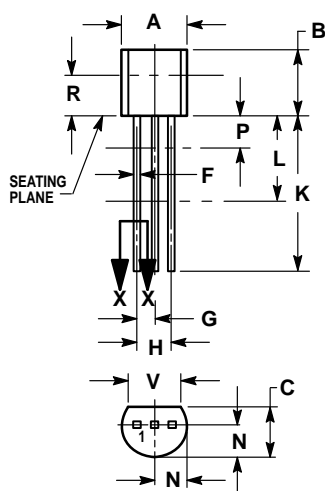


Figure 17. Temperature Coefficients

## PACKAGE DIMENSIONS



SECTION X-X

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


## 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. DIMENSION D AND J APPLY BETWEEN L AND K. MINIMUM LEAD DIMENSION IS UNCONTROLLED IN P AND BEYOND DIMENSION K MINIMUM.

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:

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

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