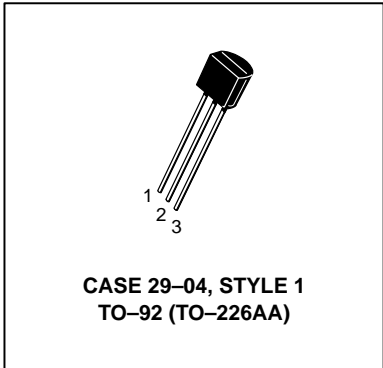
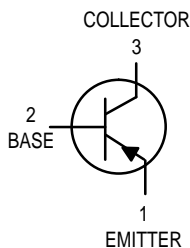


# Switching Transistors

## PNP Silicon

**MPS3638,A**



### 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 @ $T_A = 25^\circ\text{C}$ 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	$^\circ\text{C}/\text{W}$
Thermal Resistance, Junction to Case	$R_{\theta JC}$	83.3	$^\circ\text{C}/\text{W}$

### 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 ( $I_C = -100 \mu\text{Adc}, V_{BE} = 0$ )	$V_{(BR)CES}$	–25	—	Vdc
Collector–Emitter Sustaining Voltage <sup>(2)</sup> ( $I_C = -10 \text{ mAdc}, I_B = 0$ )	$V_{CEO(sus)}$	–25	—	Vdc
Collector–Base Breakdown Voltage ( $I_C = -100 \mu\text{Adc}, I_E = 0$ )	$V_{(BR)CBO}$	–25	—	Vdc
Emitter–Base Breakdown Voltage ( $I_E = -100 \mu\text{Adc}, I_C = 0$ )	$V_{(BR)EBO}$	–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	$\mu\text{Adc}$
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	$\mu\text{Adc}$

- $R_{\theta JA}$  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	—	—
( $I_C = -10 \text{ mAdc}$ , $V_{CE} = -10 \text{ Vdc}$ )	MPS3638 MPS3638A	20 100	— —	—
( $I_C = -50 \text{ mAdc}$ , $V_{CE} = -1.0 \text{ Vdc}$ )	MPS3638 MPS3638A	30 100	— —	—
( $I_C = -300 \text{ mAdc}$ , $V_{CE} = -2.0 \text{ Vdc}$ )	MPS3638 MPS3638A	20 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  $\leq 300 \mu\text{s}$ ; Duty Cycle  $\leq 2.0\%$ .

SWITCHING TIME EQUIVALENT TEST CIRCUIT

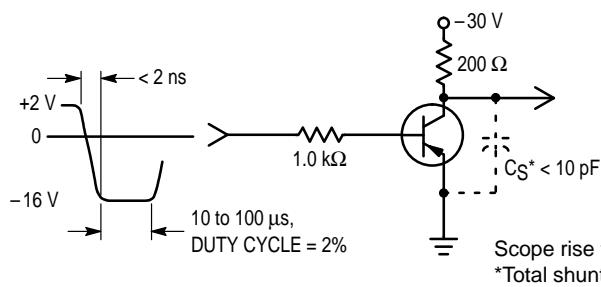


Figure 1. Turn-On Time

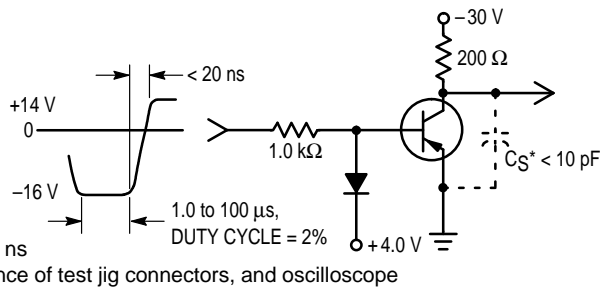


Figure 2. Turn-Off Time

TRANSIENT CHARACTERISTICS

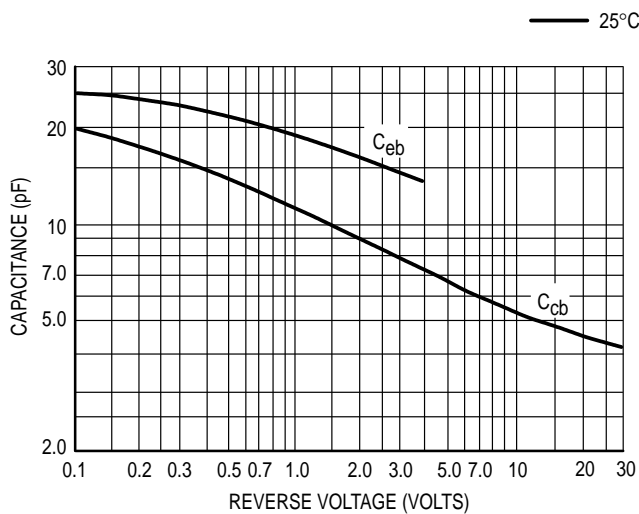


Figure 3. Capacitances

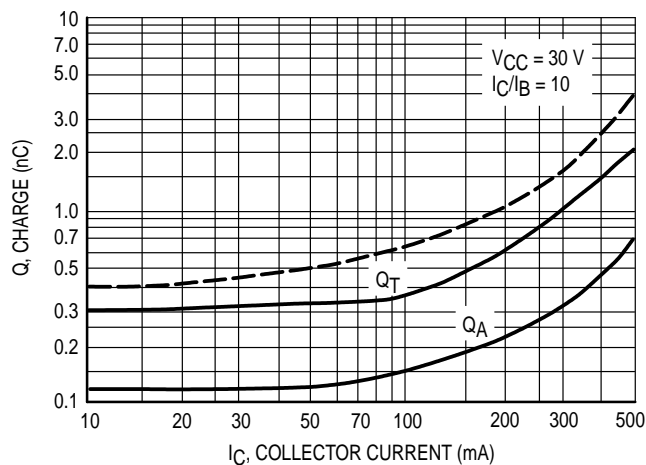


Figure 4. Charge Data

TRANSIENT CHARACTERISTICS (Continued)

— 25°C    - - - 100°C

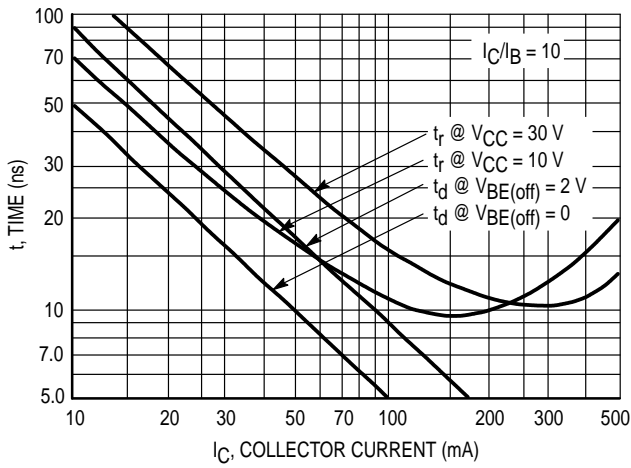


Figure 5. Turn-On Time

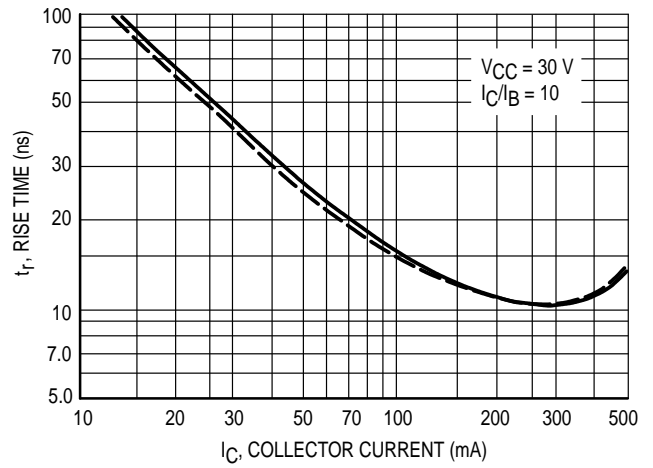


Figure 6. Rise Time

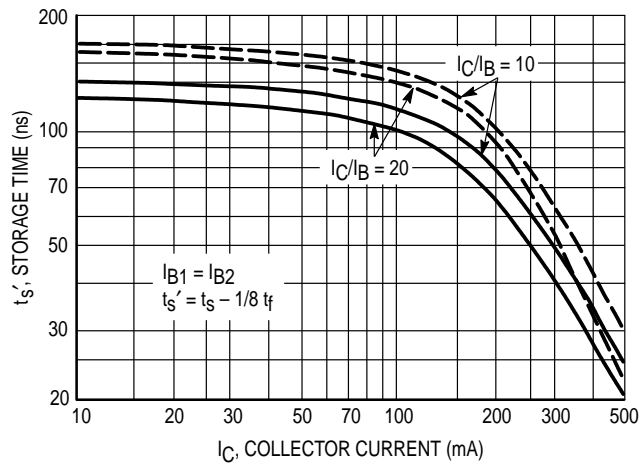


Figure 7. Storage Time

SMALL-SIGNAL CHARACTERISTICS

NOISE FIGURE

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

Bandwidth = 1.0 Hz

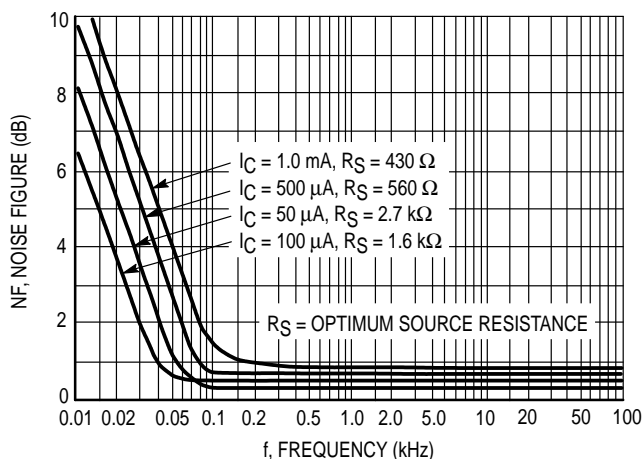


Figure 8. Frequency Effects

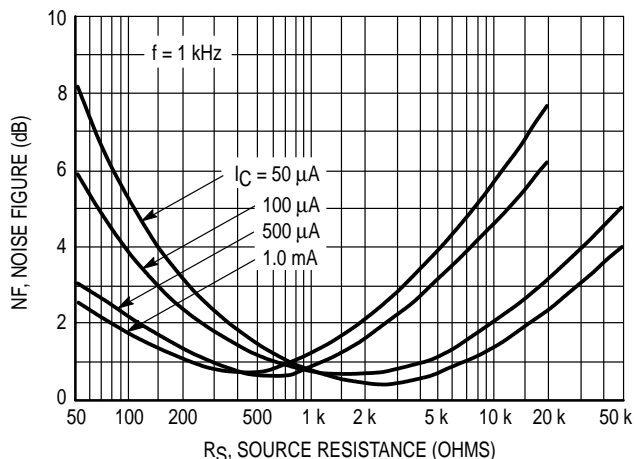


Figure 9. Source Resistance Effects

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.

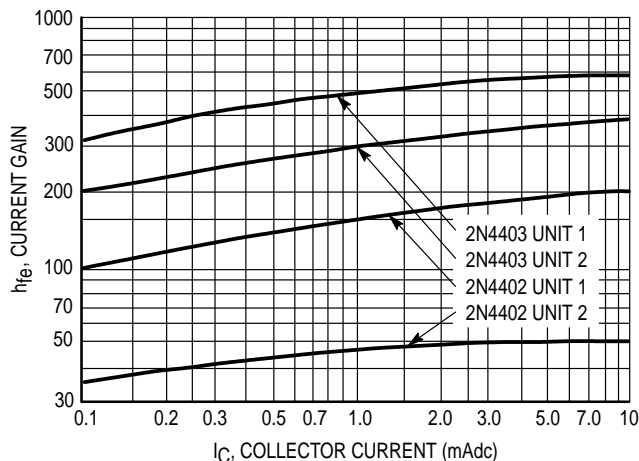


Figure 10. Current Gain

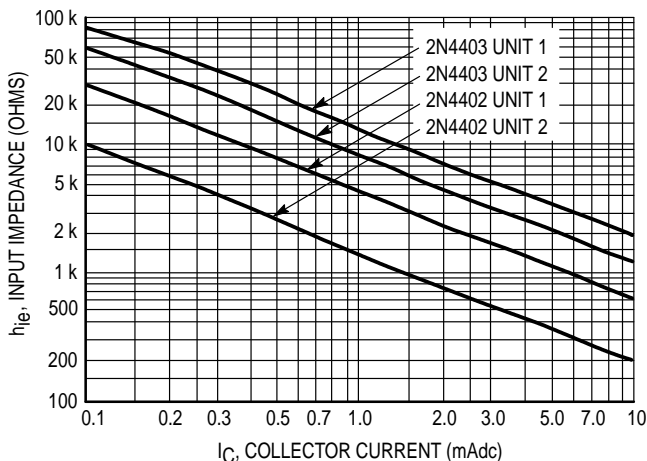


Figure 11. Input Impedance

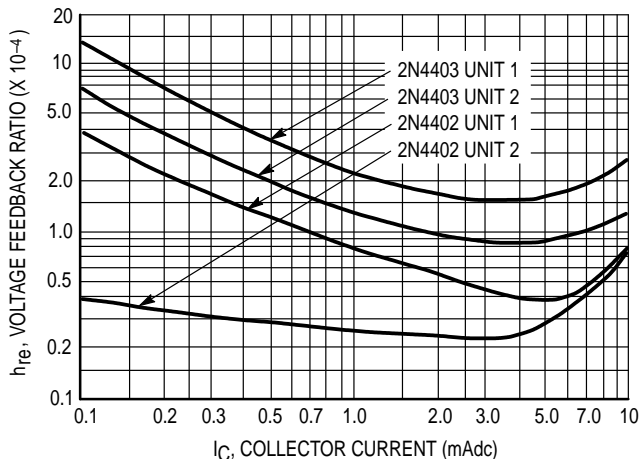


Figure 12. Voltage Feedback Ratio

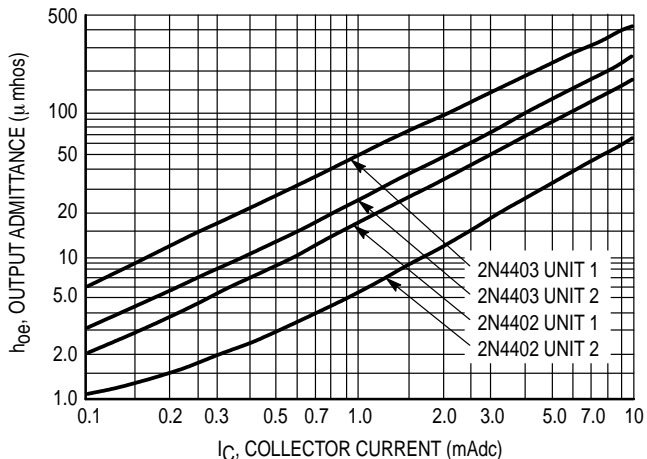


Figure 13. Output Admittance

STATIC CHARACTERISTICS

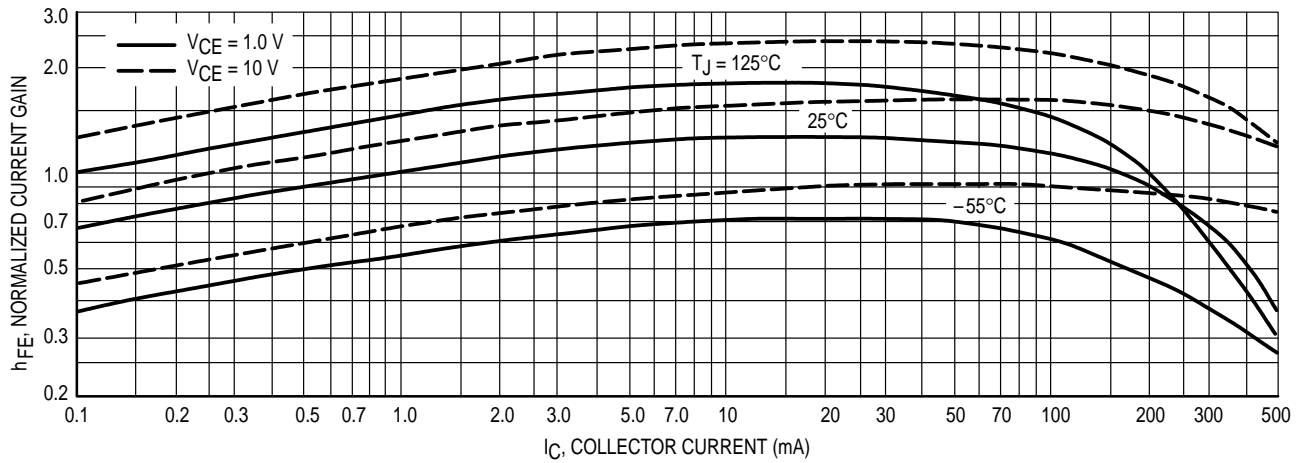


Figure 14. DC Current Gain

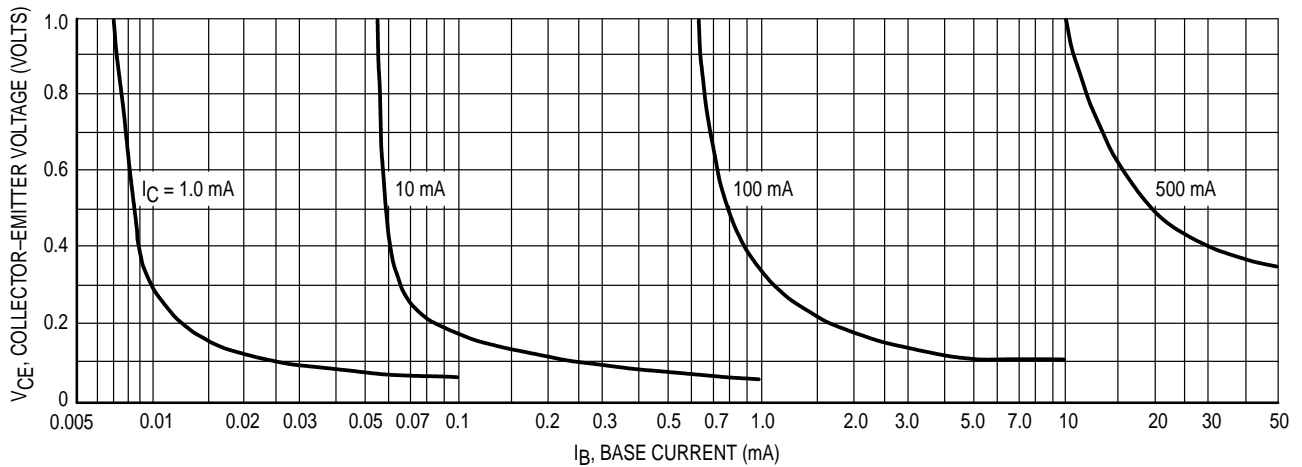


Figure 15. Collector Saturation Region

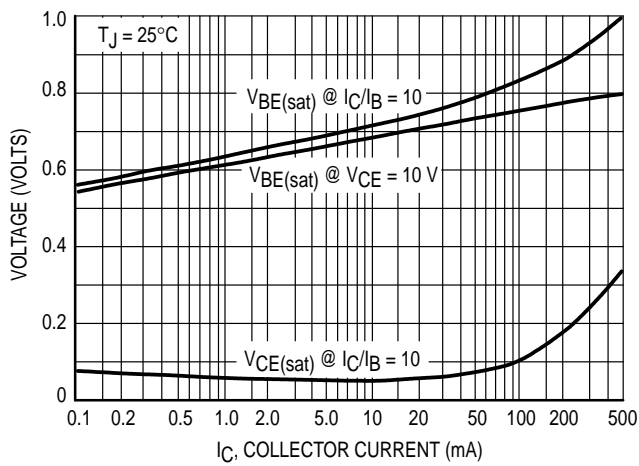


Figure 16. "On" Voltages

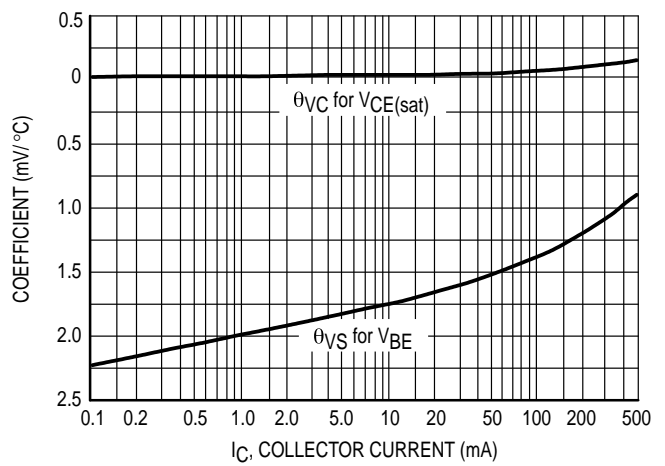
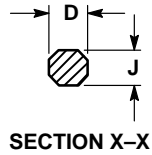
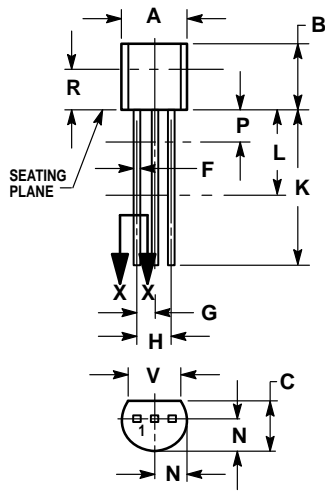


Figure 17. Temperature Coefficients

PACKAGE DIMENSIONS




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

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