

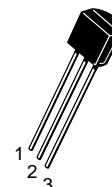
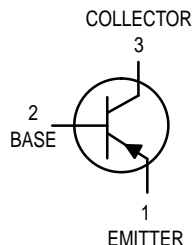
查询"2N4402/D"供应商

General Purpose Transistors

PNP Silicon

2N4402
2N4403*

*Motorola Preferred Device



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

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Collector–Emitter Voltage	V_{CEO}	40	Vdc
Collector–Base Voltage	V_{CBO}	40	Vdc
Emitter–Base Voltage	V_{EBO}	5.0	Vdc
Collector Current — Continuous	I_C	600	mAdc
Total Device Dissipation @ $T_A = 25^\circ\text{C}$ Derate above 25°C	P_D	625 5.0	mW mW/ $^\circ\text{C}$
Total Device Dissipation @ $T_C = 25^\circ\text{C}$ Derate above 25°C	P_D	1.5 12	Watt 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	$R_{\theta JA}$	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 ⁽¹⁾ ($I_C = 1.0 \text{ mAdc}, I_E = 0$)	$V_{(BR)CEO}$	40	—	Vdc
Collector–Base Breakdown Voltage ($I_C = 0.1 \text{ mAdc}, I_E = 0$)	$V_{(BR)CBO}$	40	—	Vdc
Emitter–Base Breakdown Voltage ($I_E = 0.1 \text{ mAdc}, I_C = 0$)	$V_{(BR)EBO}$	5.0	—	Vdc
Base Cutoff Current ($V_{CE} = 35 \text{ Vdc}, V_{EB} = 0.4 \text{ Vdc}$)	I_{BEV}	—	0.1	μAdc
Collector Cutoff Current ($V_{CE} = 35 \text{ Vdc}, V_{EB} = 0.4 \text{ Vdc}$)	I_{CEX}	—	0.1	μAdc

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

Preferred devices are Motorola recommended choices for future use and best overall value.

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

Characteristic	Symbol	Min	Max	Unit
ON CHARACTERISTICS				
DC Current Gain ($I_C = 0.1 \text{ mA dc}, V_{CE} = 1.0 \text{ V dc}$)	h_{FE}	30	—	—
($I_C = 1.0 \text{ mA dc}, V_{CE} = 1.0 \text{ V dc}$)		30	—	
		60	—	
($I_C = 10 \text{ mA dc}, V_{CE} = 1.0 \text{ V dc}$)		50	—	
		100	—	
($I_C = 150 \text{ mA dc}, V_{CE} = 2.0 \text{ V dc}$) ⁽¹⁾		50	150	
		100	300	
($I_C = 500 \text{ mA dc}, V_{CE} = 2.0 \text{ V dc}$) ⁽¹⁾	Both	20	—	
Collector–Emitter Saturation Voltage ⁽¹⁾ ($I_C = 150 \text{ mA dc}, I_B = 15 \text{ mA dc}$) ($I_C = 500 \text{ mA dc}, I_B = 50 \text{ mA dc}$)	$V_{CE(sat)}$	—	0.4 0.75	Vdc
Base–Emitter Saturation Voltage ⁽¹⁾ ($I_C = 150 \text{ mA dc}, I_B = 15 \text{ mA dc}$) ($I_C = 500 \text{ mA dc}, I_B = 50 \text{ mA dc}$)	$V_{BE(sat)}$	0.75 —	0.95 1.3	Vdc

SMALL–SIGNAL CHARACTERISTICS

Current–Gain — Bandwidth Product ($I_C = 20 \text{ mA dc}, V_{CE} = 10 \text{ V dc}, f = 100 \text{ MHz}$)	f_T	150 200	— —	MHz
Collector–Base Capacitance ($V_{CB} = 10 \text{ V dc}, I_E = 0, f = 1.0 \text{ MHz}$)	C_{cb}	—	8.5	pF
Emitter–Base Capacitance ($V_{EB} = 0.5 \text{ V dc}, I_C = 0, f = 1.0 \text{ MHz}$)	C_{eb}	—	30	pF
Input Impedance ($I_C = 1.0 \text{ mA dc}, V_{CE} = 10 \text{ V dc}, f = 1.0 \text{ kHz}$)	h_{ie}	750 1.5 k	7.5 k 15 k	ohms
Voltage Feedback Ratio ($I_C = 1.0 \text{ mA dc}, V_{CE} = 10 \text{ V dc}, f = 1.0 \text{ kHz}$)	h_{re}	0.1	8.0	$\times 10^{-4}$
Small–Signal Current Gain ($I_C = 1.0 \text{ mA dc}, V_{CE} = 10 \text{ V dc}, f = 1.0 \text{ kHz}$)	h_{fe}	30 60	250 500	—
Output Admittance ($I_C = 1.0 \text{ mA dc}, V_{CE} = 10 \text{ V dc}, f = 1.0 \text{ kHz}$)	h_{oe}	1.0	100	μmhos

SWITCHING CHARACTERISTICS

Delay Time	$(V_{CC} = 30 \text{ V dc}, V_{BE} = +2.0 \text{ V dc}, I_C = 150 \text{ mA dc}, I_{B1} = 15 \text{ mA dc})$	t_d	—	15	ns
Rise Time		t_r	—	20	ns
Storage Time	$(V_{CC} = 30 \text{ V dc}, I_C = 150 \text{ mA dc}, I_{B1} = 15 \text{ mA}, I_{B2} = 15 \text{ mA})$	t_s	—	225	ns
Fall Time		t_f	—	30	ns

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

SWITCHING TIME EQUIVALENT TEST CIRCUIT

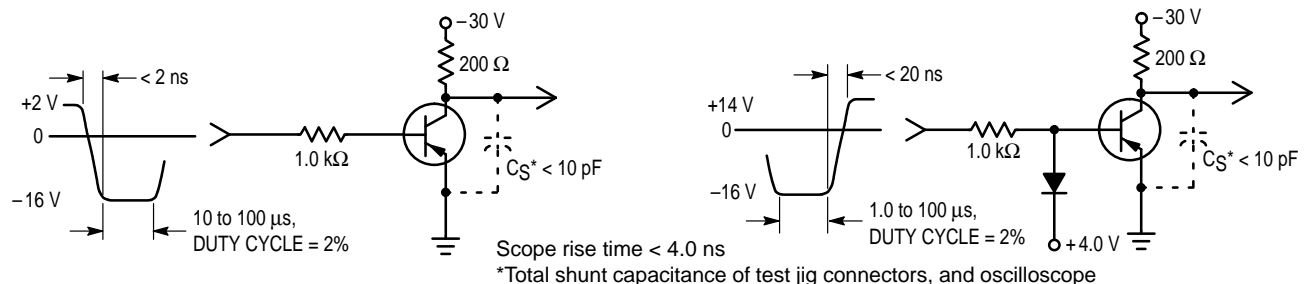


Figure 1. Turn–On Time

Figure 2. Turn–Off Time

TRANSIENT CHARACTERISTICS

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— 25°C - - - 100°C

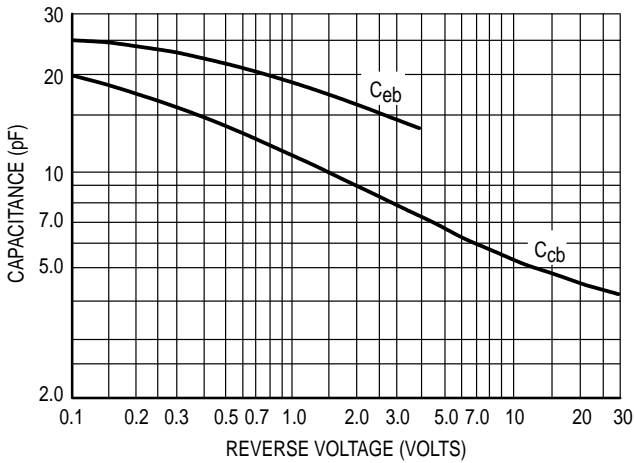


Figure 3. Capacitances

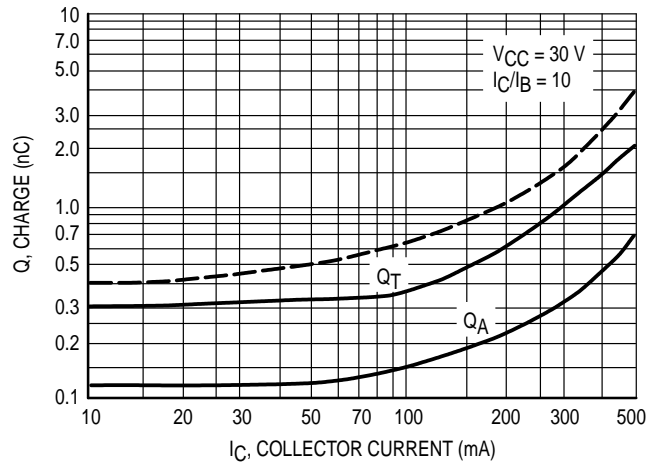


Figure 4. Charge Data

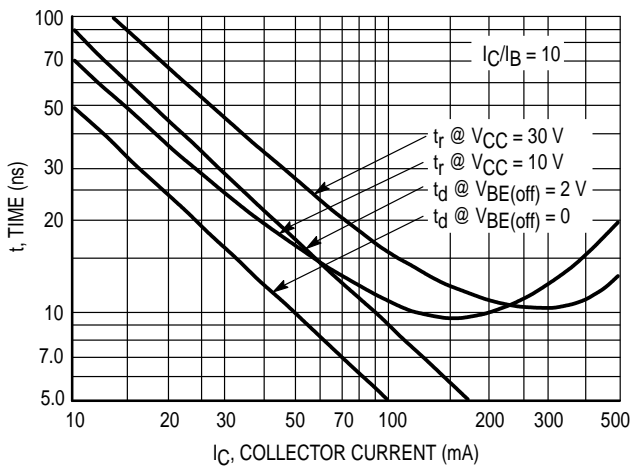


Figure 5. Turn-On Time

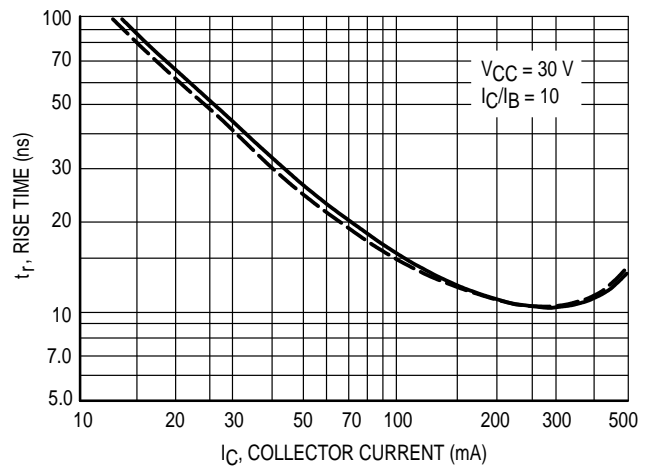


Figure 6. Rise Time

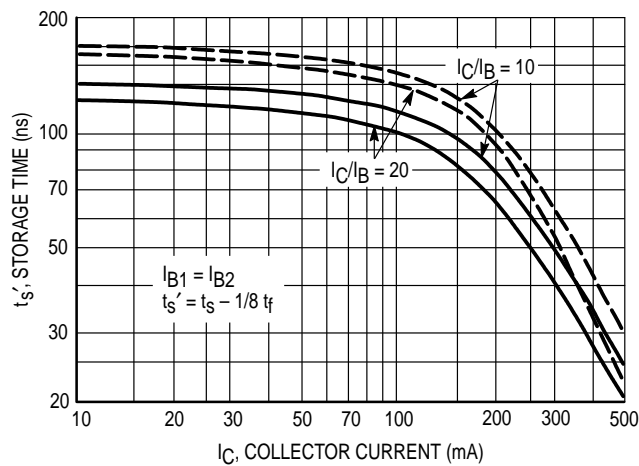


Figure 7. Storage Time

SMALL-SIGNAL CHARACTERISTICS

NOISE FIGURE

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

Bandwidth = 1.0 Hz

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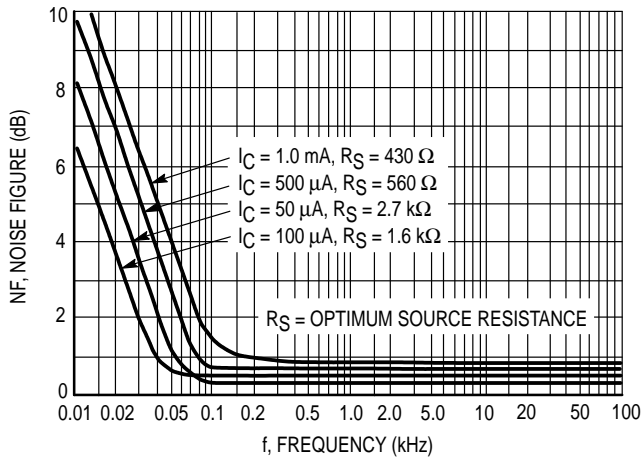


Figure 8. Frequency Effects

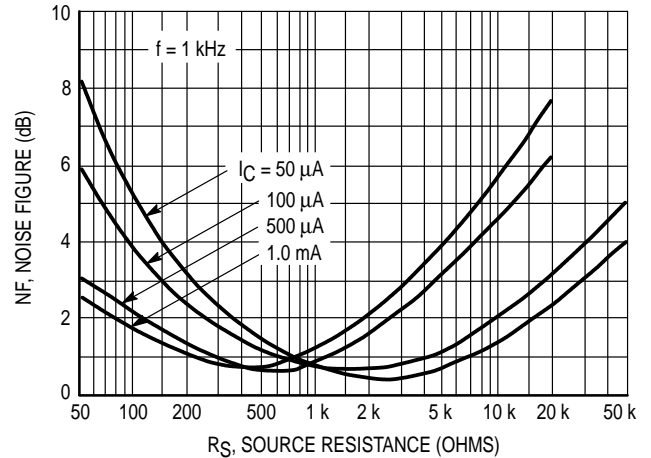


Figure 9. Source Resistance Effects

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.

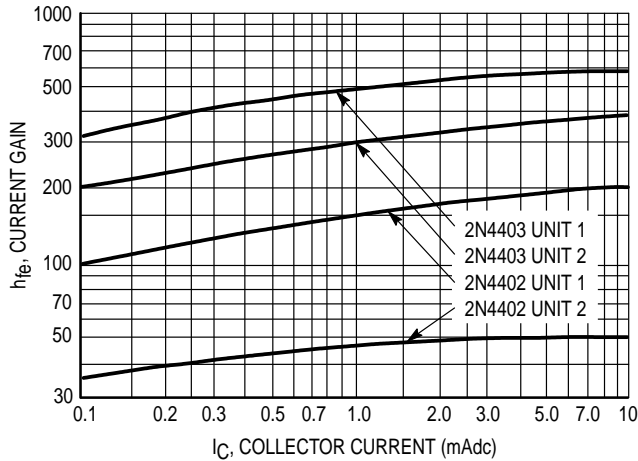


Figure 10. Current Gain

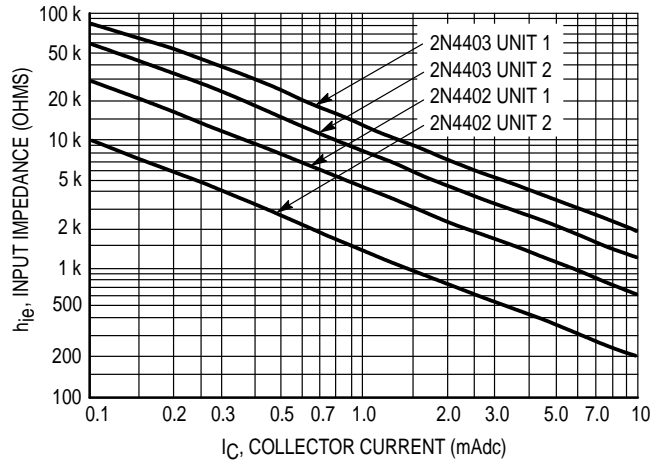


Figure 11. Input Impedance

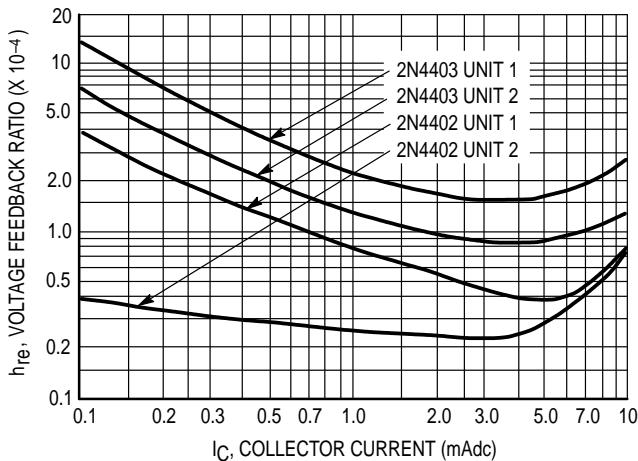


Figure 12. Voltage Feedback Ratio

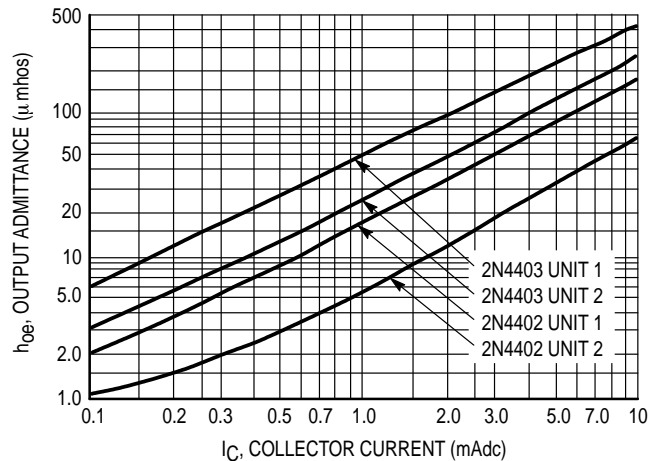


Figure 13. Output Admittance

STATIC CHARACTERISTICS

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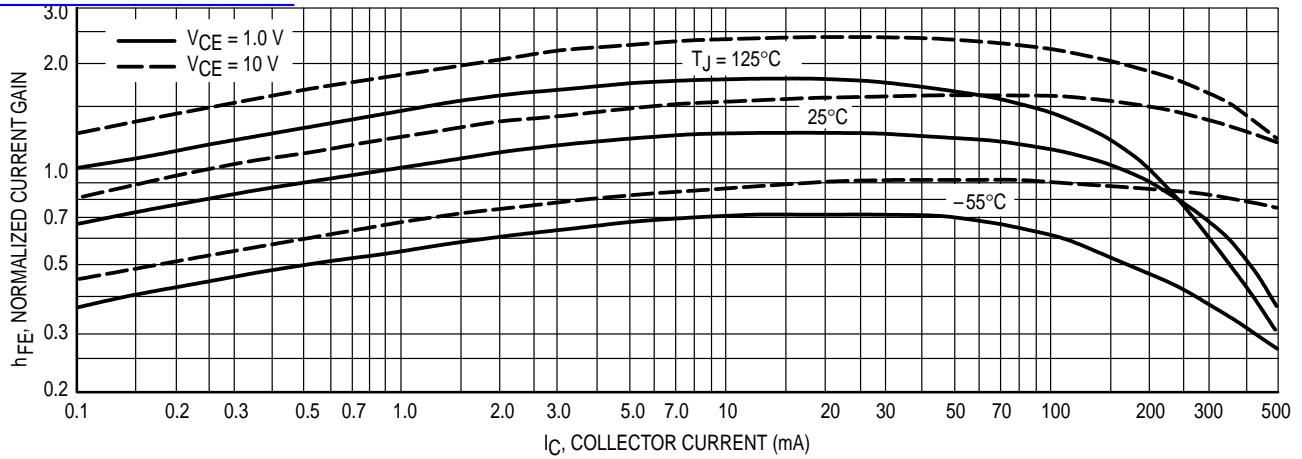


Figure 14. DC Current Gain

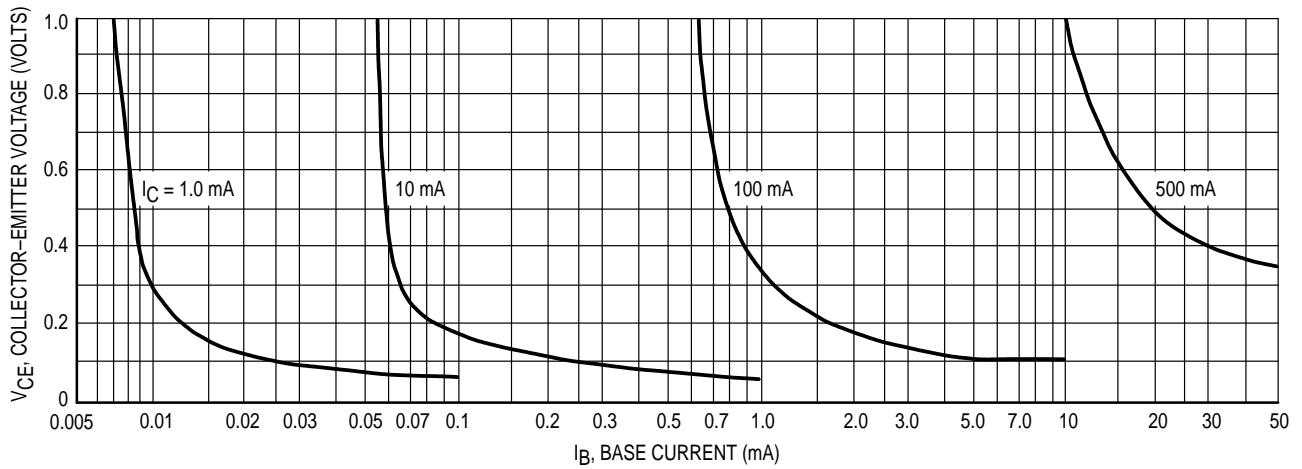


Figure 15. Collector Saturation Region

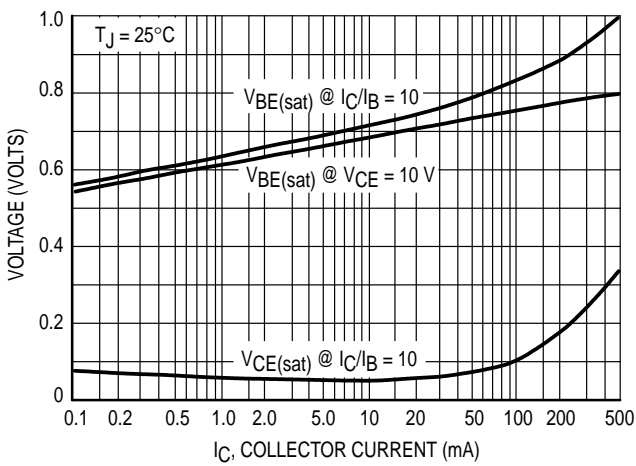


Figure 16. "On" Voltages

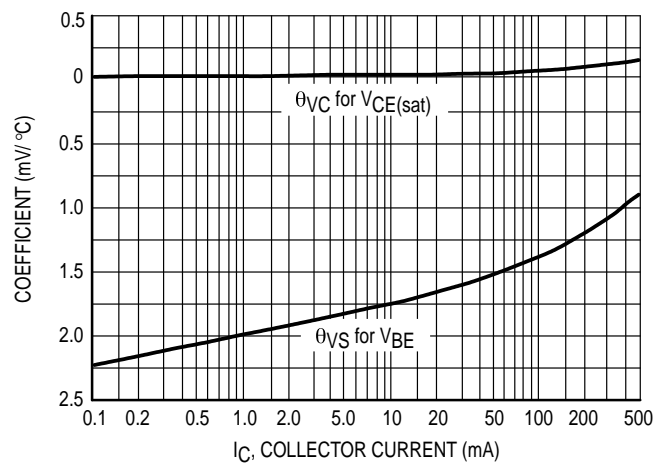
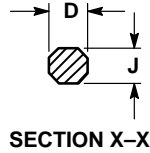
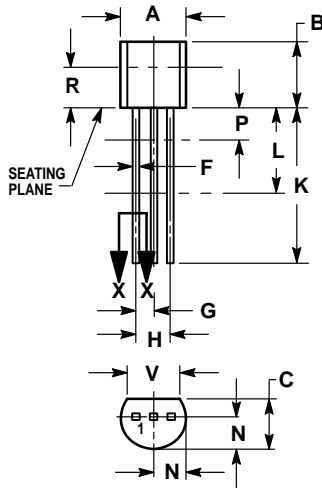


Figure 17. Temperature Coefficients

PACKAGE DIMENSIONS

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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. EMITTER
2. BASE
3. COLLECTOR

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How to reach us:

USA/EUROPE: Motorola Literature Distribution;
P.O. Box 20912; Phoenix, Arizona 85036. 1-800-441-2447

JAPAN: Nippon Motorola Ltd.; Tatsumi-SPD-JLDC, Toshikatsu Otsuki,
6F Seibu-Butsuryu-Center, 3-14-2 Tatsumi Koto-Ku, Tokyo 135, Japan. 03-3521-8315

MFAX: RMFAX0@email.sps.mot.com - TOUCHTONE (602) 244-6609
INTERNET: <http://Design-NET.com>

HONG KONG: Motorola Semiconductors H.K. Ltd.; 8B Tai Ping Industrial Park,
51 Ting Kok Road, Tai Po, N.T., Hong Kong. 852-26629298

