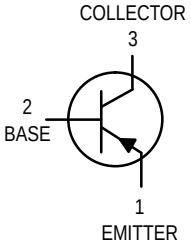
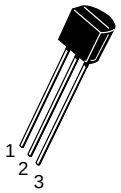
General Purpose Transistors
PNP Silicon

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

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

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

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

Characteristic		Symbol	Min	Max	Unit
ON CHARACTERISTICS					
DC Current Gain		h_{FE}			—
(I_C = 0.1 mAdc, V_{CE} = 1.0 Vdc)	2N4403		30	—	
(I_C = 1.0 mAdc, V_{CE} = 1.0 Vdc)	2N4402		30	—	
	2N4403		60	—	
(I_C = 10 mAdc, V_{CE} = 1.0 Vdc)	2N4402		50	—	
	2N4403		100	—	
(I_C = 150 mAdc, V_{CE} = 2.0 Vdc)(1)	2N4402		50	150	
	2N4403		100	300	
(I_C = 500 mAdc, V_{CE} = 2.0 Vdc)(1)	Both		20	—	
Collector–Emitter Saturation Voltage(1)		$V_{CE(sat)}$			Vdc
(I_C = 150 mAdc, I_B = 15 mAdc)			—	0.4	
(I_C = 500 mAdc, I_B = 50 mAdc)			—	0.75	
Base–Emitter Saturation Voltage(1)		$V_{BE(sat)}$			Vdc
(I_C = 150 mAdc, I_B = 15 mAdc)			0.75	0.95	
(I_C = 500 mAdc, I_B = 50 mAdc)			—	1.3	
SMALL–SIGNAL CHARACTERISTICS					
Current–Gain — Bandwidth Product		f_T			MHz
(I_C = 20 mAdc, V_{CE} = 10 Vdc, f = 100 MHz)	2N4402		150	—	
	2N4403		200	—	
Collector–Base Capacitance (V_{CB} = 10 Vdc, I_E = 0, f = 1.0 MHz)		C_{cb}	—	8.5	pF
Emitter–Base Capacitance (V_{EB} = 0.5 Vdc, I_C = 0, f = 1.0 MHz)		C_{eb}	—	30	pF
Input Impedance		h_{ie}			ohms
(I_C = 1.0 mAdc, V_{CE} = 10 Vdc, f = 1.0 kHz)	2N4402		750	7.5 k	
	2N4403		1.5 k	15 k	
Voltage Feedback Ratio (I_C = 1.0 mAdc, V_{CE} = 10 Vdc, f = 1.0 kHz)		h_{re}	0.1	8.0	X 10^{-4}
Small–Signal Current Gain		h_{fe}			—
(I_C = 1.0 mAdc, V_{CE} = 10 Vdc, f = 1.0 kHz)	2N4402		30	250	
	2N4403		60	500	
Output Admittance (I_C = 1.0 mAdc, V_{CE} = 10 Vdc, f = 1.0 kHz)		h_{oe}	1.0	100	μmhos
SWITCHING CHARACTERISTICS					
Delay Time	(V_{CC} = 30 Vdc, V_{BE} = +2.0 Vdc, I_C = 150 mAdc, I_{B1} = 15 mAdc)	t_d	—	15	ns
Rise Time		t_r	—	20	ns
Storage Time	(V_{CC} = 30 Vdc, I_C = 150 mAdc, I_{B1} = 15 mA, I_{B2} = 15 mA)	t_s	—	225	ns
Fall Time		t_f	—	30	ns

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

SWITCHING TIME EQUIVALENT TEST CIRCUIT

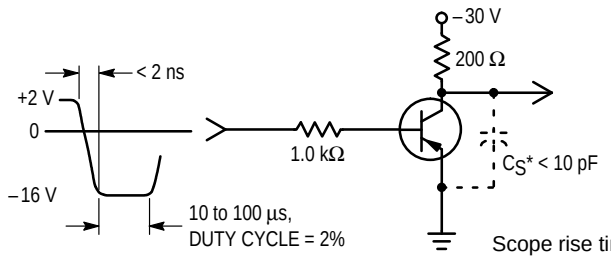


Figure 1. Turn–On Time

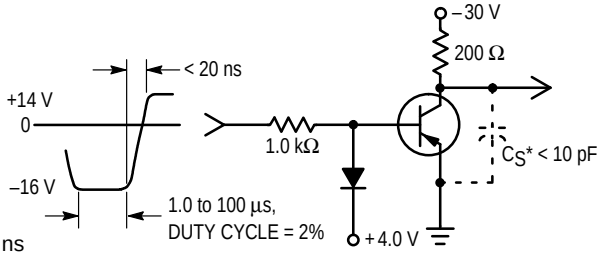


Figure 2. Turn–Off Time

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

TRANSIENT CHARACTERISTICS

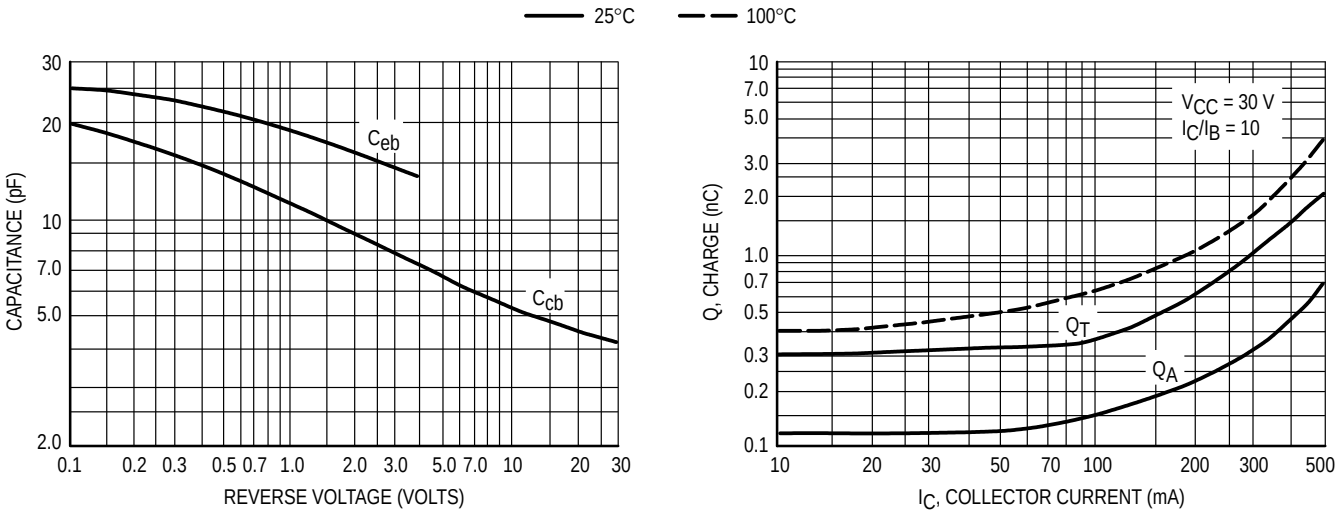


Figure 3. Capacitances

Figure 4. Charge Data

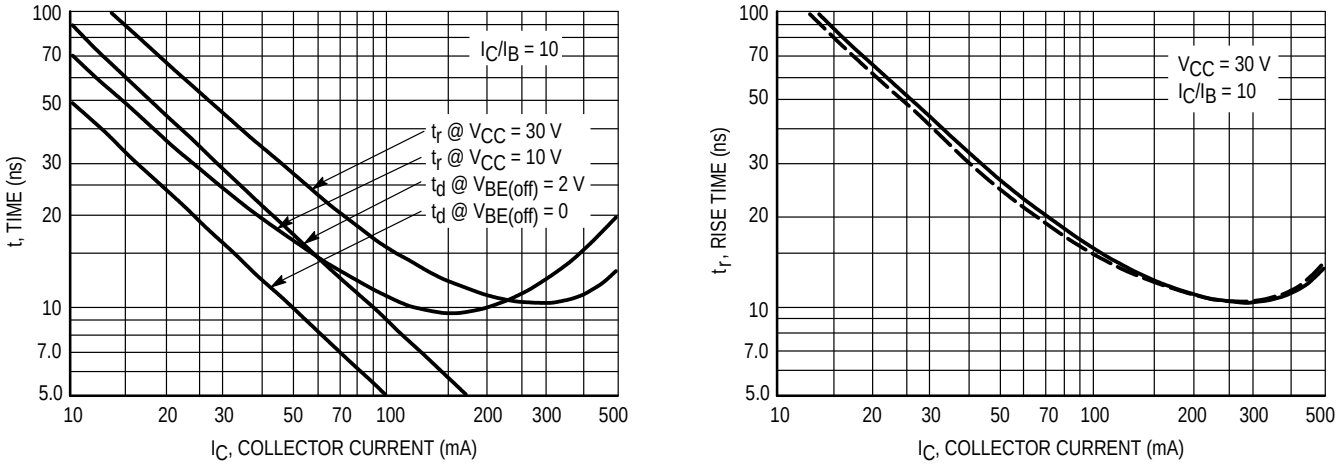


Figure 5. Turn–On Time

Figure 6. Rise Time

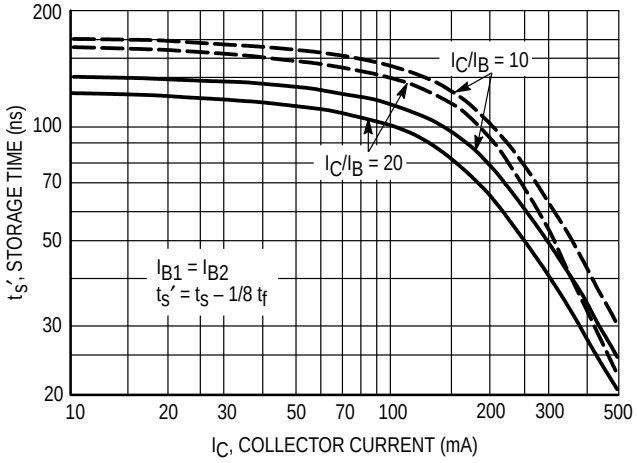


Figure 7. Storage Time

SMALL–SIGNAL CHARACTERISTICS

NOISE FIGURE

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

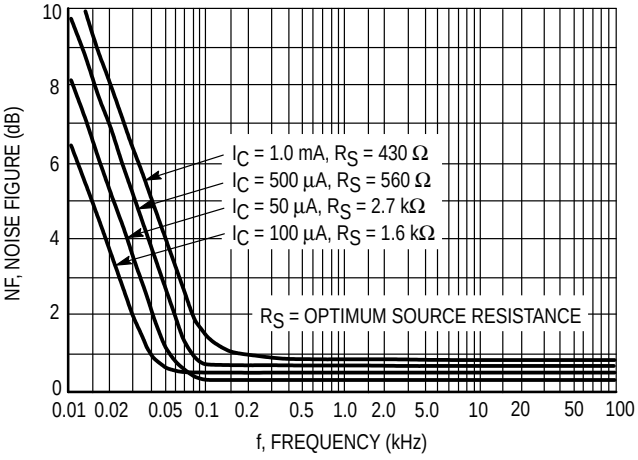


Figure 8. Frequency Effects

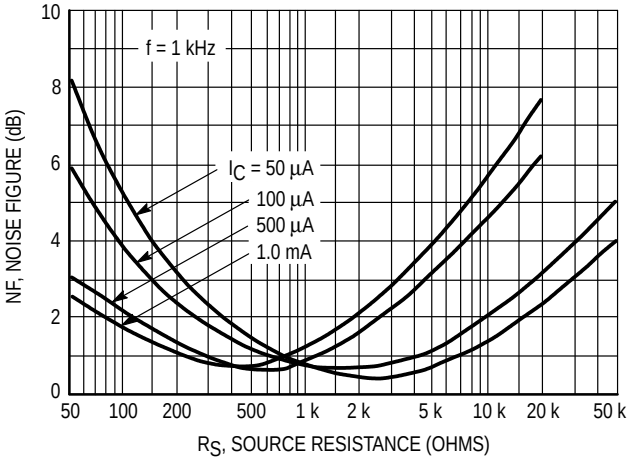


Figure 9. Source Resistance Effects

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

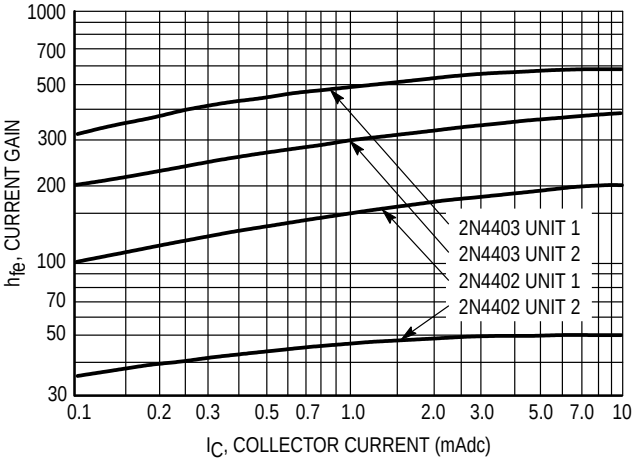


Figure 10. Current Gain

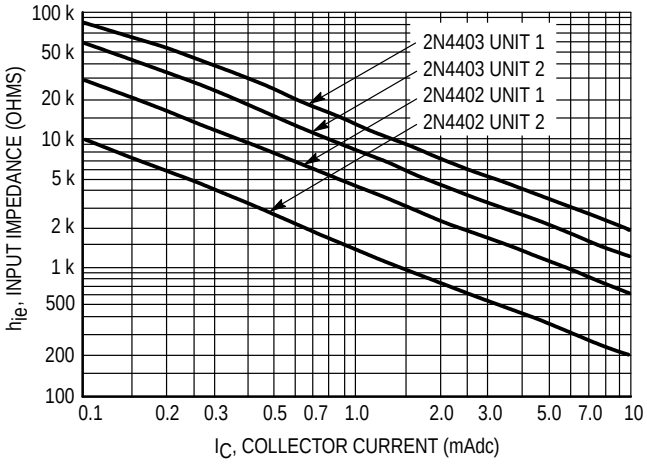


Figure 11. Input Impedance

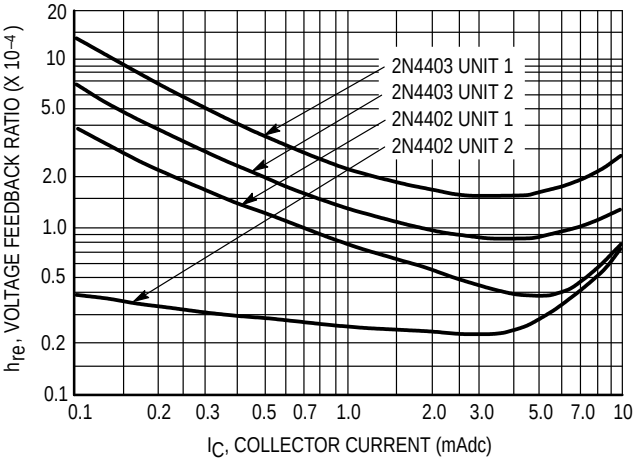


Figure 12. Voltage Feedback Ratio

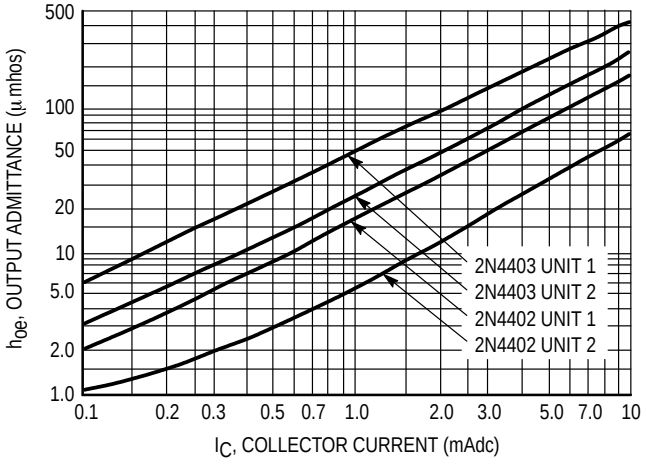


Figure 13. Output Admittance

STATIC CHARACTERISTICS

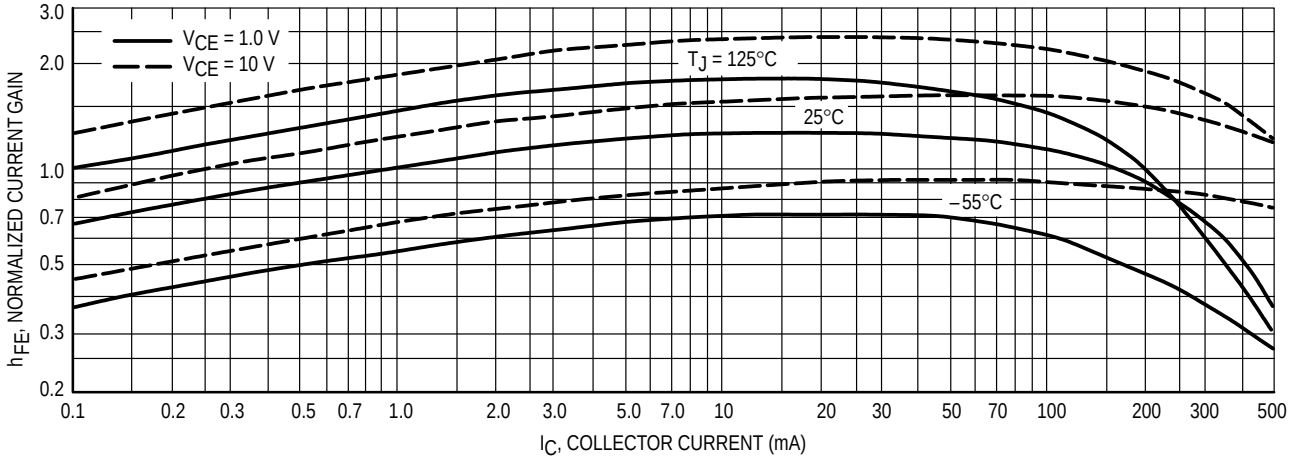


Figure 14. DC Current Gain

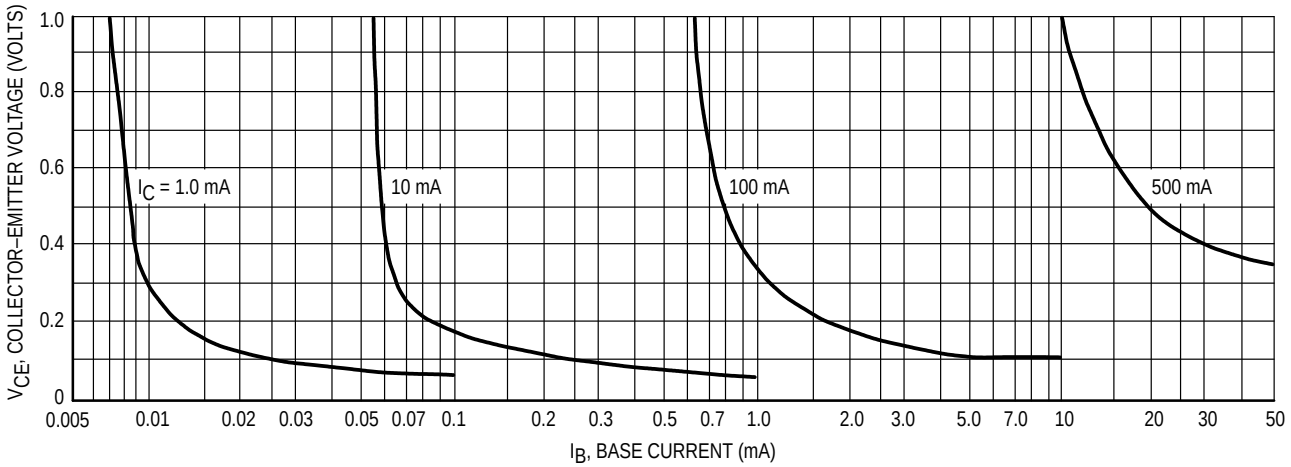


Figure 15. Collector Saturation Region

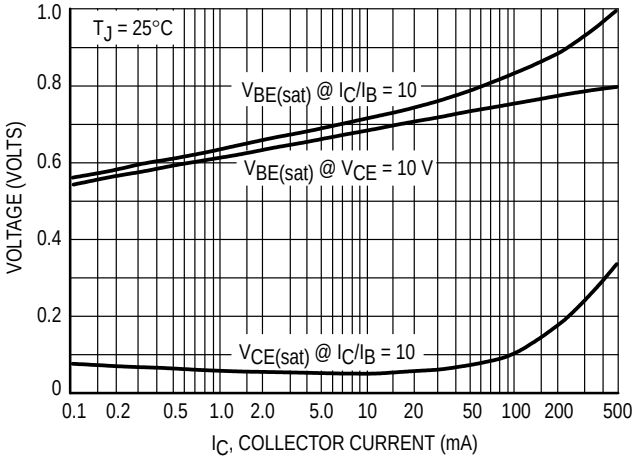


Figure 16. “On” Voltages

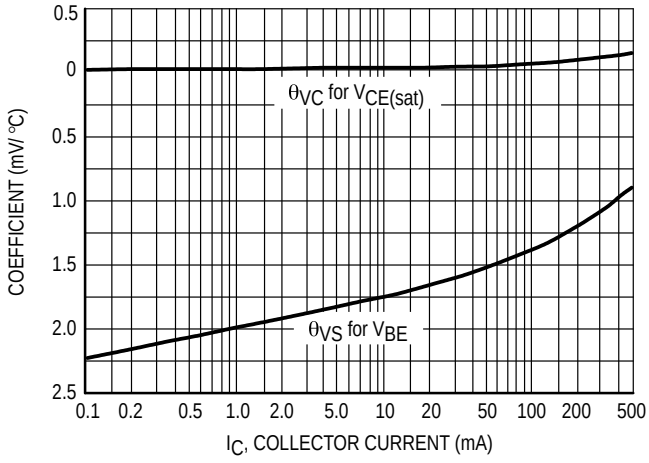
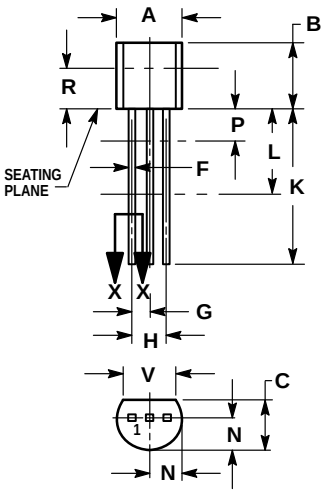
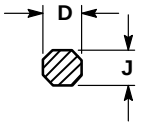


Figure 17. Temperature Coefficients

PACKAGE DIMENSIONS





SECTION X–X

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.

	INCHES		MILLIMETERS	
DIM	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	—

CASE 029–04
(TO–226AA)
ISSUE AD

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

How to reach us:
USA/EUROPE: Motorola Literature Distribution;
P.O. Box 20912; Phoenix, Arizona 85036. 1–800–441–2447

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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

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