

PN2222, PN2222A

PN2222A is a Preferred Device

General Purpose Transistors

NPN Silicon

MAXIMUM RATINGS

Rating		Symbol	Value	Unit
Collector-Emitter Voltage	PN2222 PN2222A	V_{CEO}	30 40	Vdc
Collector-Base Voltage	PN2222 PN2222A	V_{CBO}	60 75	Vdc
Emitter-Base Voltage	PN2222 PN2222A	V_{EBO}	5.0 6.0	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	Watts mW/ $^\circ\text{C}$
Operating and Storage Junction Temperature Range		T_J, T_{stg}	-55 to +150	$^\circ\text{C}$

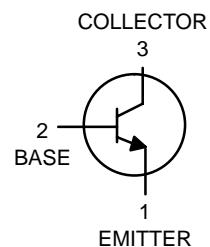
THERMAL CHARACTERISTICS

Characteristic		Symbol	Max	Unit
Thermal Resistance Junction-to-Ambient		$R_{\theta JA}$	200	$^\circ\text{C}/\text{W}$
Thermal Resistance Junction-to-Case		$R_{\theta JC}$	83.3	$^\circ\text{C}/\text{W}$

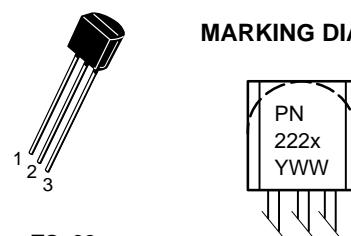


ON Semiconductor™

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MARKING DIAGRAM



TO-92
CASE 29
STYLE 1

PN222x = Device Code
x = 2 or A
Y = Year
WW = Work Week

ORDERING INFORMATION

Device	Package	Shipping
PN2222	TO-92	5000 Units/Box
PN2222A	TO-92	5000 Units/Box
PN2222ARLRA	TO-92	2000/Tape & Reel
PN2222ARLRM	TO-92	2000/Ammo Pack
PN2222ARLRP	TO-92	2000/Ammo Pack

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

PN2222, PN2222A

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

Characteristic	Symbol	Min	Max	Unit
OFF CHARACTERISTICS				
Collector-Emitter Breakdown Voltage ($I_C = 10 \text{ mA}_\text{dc}$, $I_B = 0$)	PN2222 PN2222A	$V_{(\text{BR})\text{CEO}}$	30 40	— —
Collector-Base Breakdown Voltage ($I_C = 10 \mu\text{A}_\text{dc}$, $I_E = 0$)	PN2222 PN2222A	$V_{(\text{BR})\text{CBO}}$	60 75	— —
Emitter-Base Breakdown Voltage ($I_E = 10 \mu\text{A}_\text{dc}$, $I_C = 0$)	PN2222 PN2222A	$V_{(\text{BR})\text{EBO}}$	5.0 6.0	— —
Collector Cutoff Current ($V_{CE} = 60 \text{ V}_\text{dc}$, $V_{EB(\text{off})} = 3.0 \text{ V}_\text{dc}$)	PN2222A	I_{CEX}	—	10
Collector Cutoff Current ($V_{CB} = 50 \text{ V}_\text{dc}$, $I_E = 0$) ($V_{CB} = 60 \text{ V}_\text{dc}$, $I_E = 0$) ($V_{CB} = 50 \text{ V}_\text{dc}$, $I_E = 0$, $T_A = 125^\circ\text{C}$) ($V_{CB} = 50 \text{ V}_\text{dc}$, $I_E = 0$, $T_A = 125^\circ\text{C}$)	PN2222 PN2222A PN2222 PN2222A	I_{CBO}	— — — —	0.01 0.01 10 10
Emitter Cutoff Current ($V_{EB} = 3.0 \text{ V}_\text{dc}$, $I_C = 0$)	PN2222A	I_{EBO}	—	100
Base Cutoff Current ($V_{CE} = 60 \text{ V}_\text{dc}$, $V_{EB(\text{off})} = 3.0 \text{ V}_\text{dc}$)	PN2222A	I_{BL}	—	20

ON CHARACTERISTICS

DC Current Gain ($I_C = 0.1 \text{ mA}_\text{dc}$, $V_{CE} = 10 \text{ V}_\text{dc}$) ($I_C = 1.0 \text{ mA}_\text{dc}$, $V_{CE} = 10 \text{ V}_\text{dc}$) ($I_C = 10 \text{ mA}_\text{dc}$, $V_{CE} = 10 \text{ V}_\text{dc}$) ($I_C = 10 \text{ mA}_\text{dc}$, $V_{CE} = 10 \text{ V}_\text{dc}$, $T_A = -55^\circ\text{C}$) ($I_C = 150 \text{ mA}_\text{dc}$, $V_{CE} = 10 \text{ V}_\text{dc}$) (Note 1.) ($I_C = 150 \text{ mA}_\text{dc}$, $V_{CE} = 1.0 \text{ V}_\text{dc}$) (Note 1.) ($I_C = 500 \text{ mA}_\text{dc}$, $V_{CE} = 10 \text{ V}_\text{dc}$) (Note 1.)	PN2222A only	h_{FE}	35 50 75 35 100 50 30 40	— — — — 300 — — —	—
Collector-Emitter Saturation Voltage (Note 1.) ($I_C = 150 \text{ mA}_\text{dc}$, $I_B = 15 \text{ mA}_\text{dc}$) ($I_C = 500 \text{ mA}_\text{dc}$, $I_B = 50 \text{ mA}_\text{dc}$)	PN2222 PN2222A PN2222 PN2222A	$V_{CE(\text{sat})}$	— — — —	0.4 0.3 1.6 1.0	V_dc
Base-Emitter Saturation Voltage (Note 1.) ($I_C = 150 \text{ mA}_\text{dc}$, $I_B = 15 \text{ mA}_\text{dc}$) ($I_C = 500 \text{ mA}_\text{dc}$, $I_B = 50 \text{ mA}_\text{dc}$)	PN2222 PN2222A PN2222 PN2222A	$V_{BE(\text{sat})}$	— 0.6 — —	1.3 1.2 2.6 2.0	V_dc

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

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

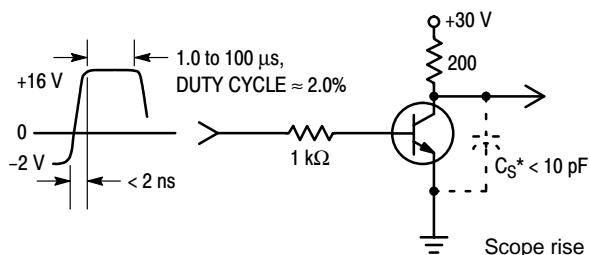
Characteristic	Symbol	Min	Max	Unit
SMALL-SIGNAL CHARACTERISTICS				
Current-Gain – Bandwidth Product (Note 2.) ($I_C = 20 \text{ mA}_\text{dc}$, $V_{CE} = 20 \text{ V}_\text{dc}$, $f = 100 \text{ MHz}$)	f_T	250	—	MHz
		300	—	
Output Capacitance ($V_{CB} = 10 \text{ V}_\text{dc}$, $I_E = 0$, $f = 1.0 \text{ MHz}$)	C_{obo}	—	8.0	pF
Input Capacitance ($V_{EB} = 0.5 \text{ V}_\text{dc}$, $I_C = 0$, $f = 1.0 \text{ MHz}$)	C_{ibo}	—	30	pF
Input Impedance ($I_C = 1.0 \text{ mA}_\text{dc}$, $V_{CE} = 10 \text{ V}_\text{dc}$, $f = 1.0 \text{ kHz}$) ($I_C = 10 \text{ mA}_\text{dc}$, $V_{CE} = 10 \text{ V}_\text{dc}$, $f = 1.0 \text{ kHz}$)	h_{ie}	2.0	8.0	k Ω
		0.25	1.25	
Voltage Feedback Ratio ($I_C = 1.0 \text{ mA}_\text{dc}$, $V_{CE} = 10 \text{ V}_\text{dc}$, $f = 1.0 \text{ kHz}$) ($I_C = 10 \text{ mA}_\text{dc}$, $V_{CE} = 10 \text{ V}_\text{dc}$, $f = 1.0 \text{ kHz}$)	h_{re}	—	8.0	$\times 10^{-4}$
		—	4.0	
Small-Signal Current Gain ($I_C = 1.0 \text{ mA}_\text{dc}$, $V_{CE} = 10 \text{ V}_\text{dc}$, $f = 1.0 \text{ kHz}$) ($I_C = 10 \text{ mA}_\text{dc}$, $V_{CE} = 10 \text{ V}_\text{dc}$, $f = 1.0 \text{ kHz}$)	h_{fe}	50	300	—
		75	375	
Output Admittance ($I_C = 1.0 \text{ mA}_\text{dc}$, $V_{CE} = 10 \text{ V}_\text{dc}$, $f = 1.0 \text{ kHz}$) ($I_C = 10 \text{ mA}_\text{dc}$, $V_{CE} = 10 \text{ V}_\text{dc}$, $f = 1.0 \text{ kHz}$)	h_{oe}	5.0	35	μmhos
		25	200	
Collector Base Time Constant ($I_E = 20 \text{ mA}_\text{dc}$, $V_{CB} = 20 \text{ V}_\text{dc}$, $f = 31.8 \text{ MHz}$)	$r_b' C_c$	—	150	ps
Noise Figure ($I_C = 100 \mu\text{A}_\text{dc}$, $V_{CE} = 10 \text{ V}_\text{dc}$, $R_S = 1.0 \text{ k}\Omega$, $f = 1.0 \text{ kHz}$)	NF	—	4.0	dB

SWITCHING CHARACTERISTICS PN2222A only

Delay Time	$(V_{CC} = 30 \text{ V}_\text{dc}, V_{BE(\text{off})} = -0.5 \text{ V}_\text{dc},$ $I_C = 150 \text{ mA}_\text{dc}, I_{B1} = 15 \text{ mA}_\text{dc}$) (Figure 1)	t_d	—	10	ns
Rise Time		t_r	—	25	ns
Storage Time	$(V_{CC} = 30 \text{ V}_\text{dc}, I_C = 150 \text{ mA}_\text{dc},$ $I_{B1} = I_{B2} = 15 \text{ mA}_\text{dc}$) (Figure 2)	t_s	—	225	ns
Fall Time		t_f	—	60	ns

2. f_T is defined as the frequency at which $|h_{fe}|$ extrapolates to unity.

SWITCHING TIME EQUIVALENT TEST CIRCUITS



*Total shunt capacitance of test jig, connectors, and oscilloscope.

Figure 1. Turn-On Time

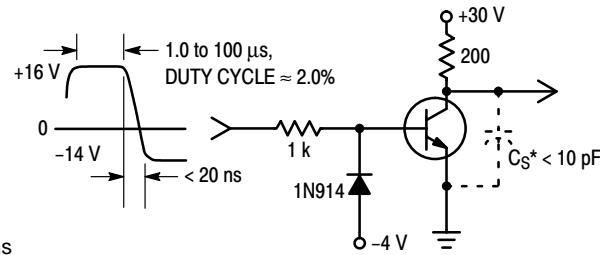


Figure 2. Turn-Off Time

PN2222, PN2222A

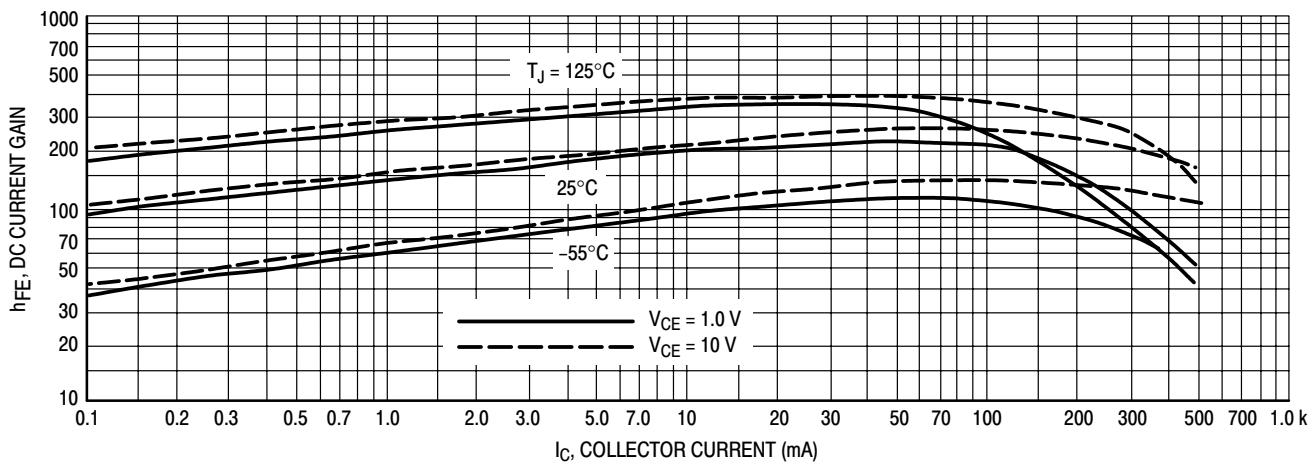


Figure 3. DC Current Gain

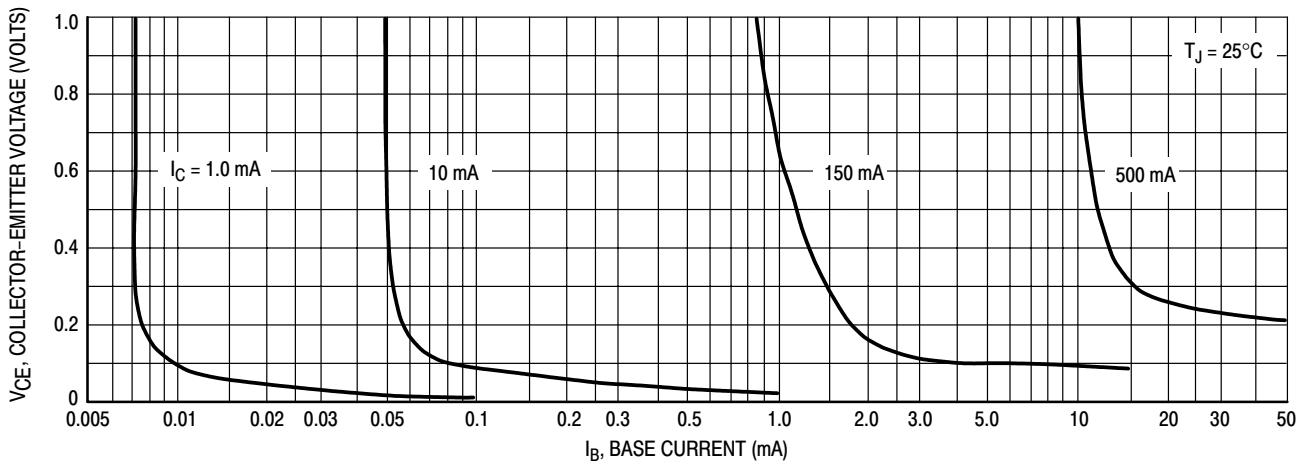


Figure 4. Collector Saturation Region

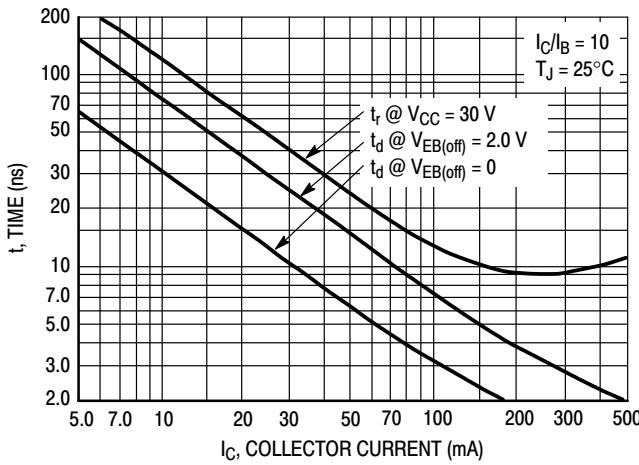


Figure 5. Turn-On Time

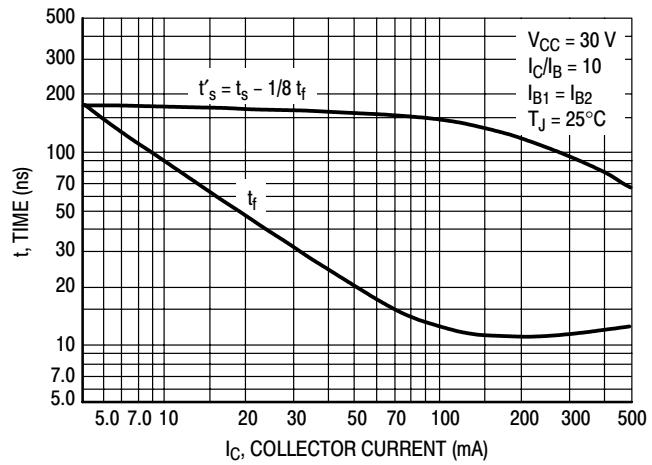


Figure 6. Turn-Off Time

PN2222, PN2222A

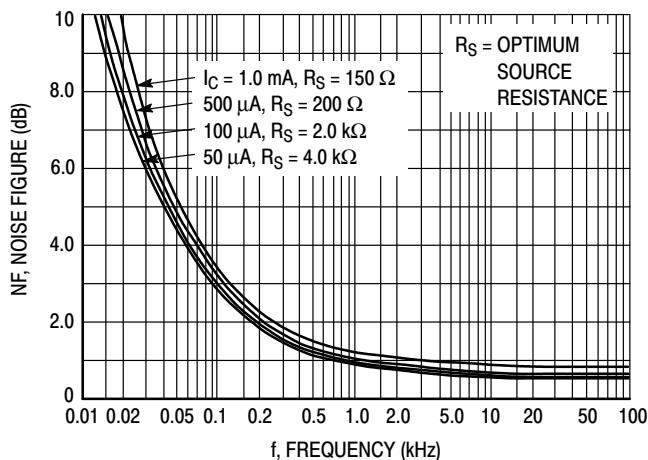


Figure 7. Frequency Effects

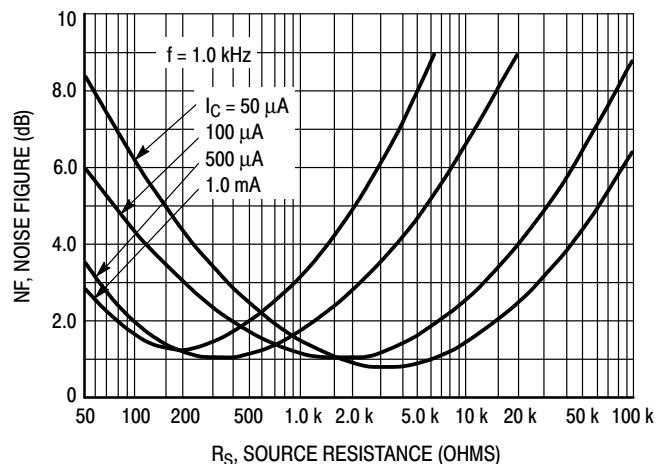


Figure 8. Source Resistance Effects

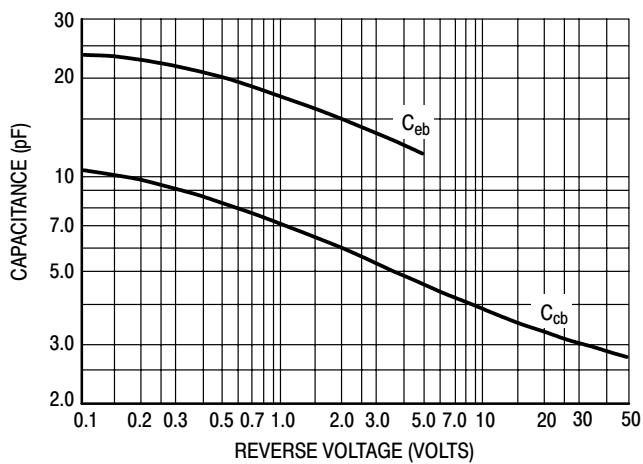


Figure 9. Capacitances

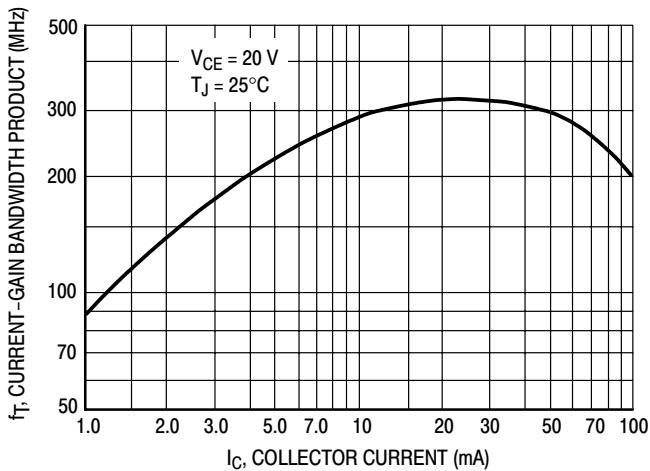


Figure 10. Current-Gain Bandwidth Product

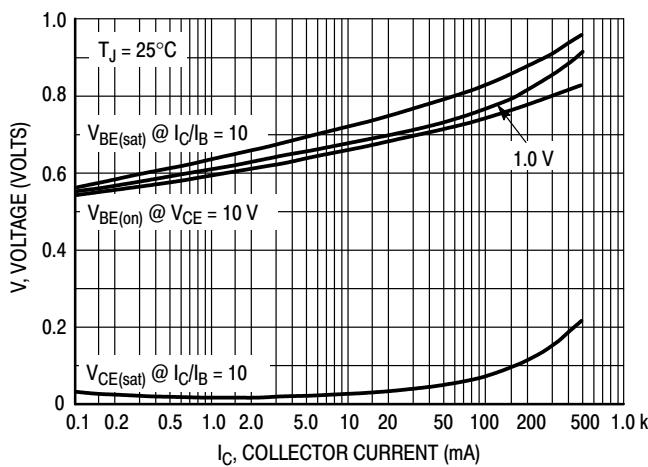


Figure 11. "On" Voltages

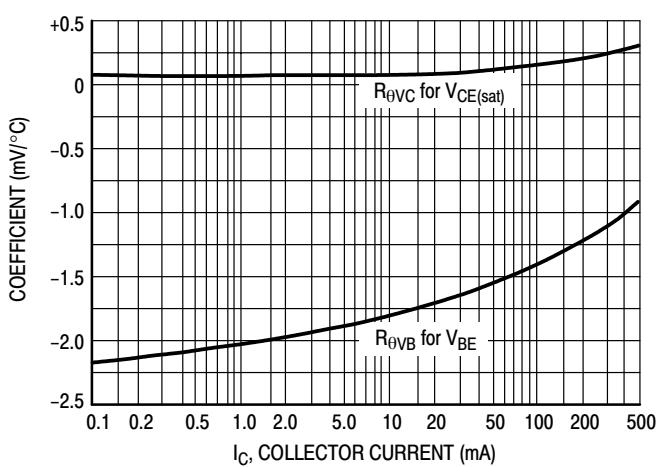
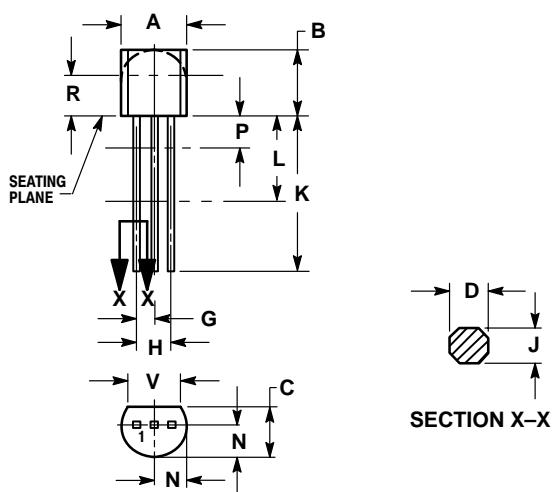


Figure 12. Temperature Coefficients

PN2222, PN2222A

PACKAGE DIMENSIONS

TO-92
TO-226AA
CASE 29-11
ISSUE AL



NOTES:
 1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
 2. CONTROLLING DIMENSION: INCH.
 3. CONTOUR OF PACKAGE BEYOND DIMENSION R IS UNCONTROLLED.
 4. 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	0.021	0.407	0.533
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

Notes

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