

PN2222, PN2222A

PN2222A is a Preferred Device

General Purpose Transistors

NPN Silicon

Features

- Pb-Free Packages are Available*

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	W mW/ $^\circ\text{C}$
Operating and Storage Junction Temperature Range	T_J, T_{stg}	-55 to +150	$^\circ\text{C}$

THERMAL CHARACTERISTICS

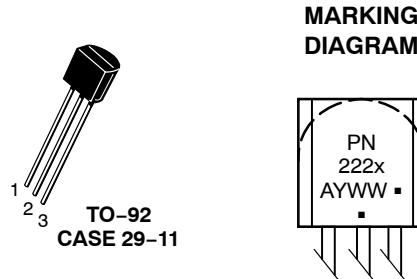
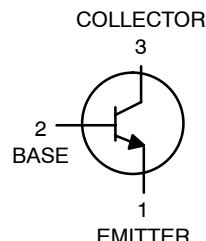
Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction-to-Ambient	$R_{\theta JA}$	200	$^\circ\text{C/W}$
Thermal Resistance, Junction-to-Case	$R_{\theta JC}$	83.3	$^\circ\text{C/W}$

Stresses exceeding Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stresses above the Recommended Operating Conditions may affect device reliability.



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MARKING
DIAGRAM

PN222 = Device Code
x = A or 2
A = Assembly Location
Y = Year
WW = Work Week
▪ = Pb-Free Package

(Note: Microdot may be in either location)

ORDERING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 6 of this data sheet.

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

*For additional information on our Pb-Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERMM/D.

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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 ($V_{CE} = 60 \text{ Vdc}$, $V_{EB(\text{off})} = 3.0 \text{ Vdc}$)	PN2222A	I_{CEX}	–	10
Collector Cutoff Current ($V_{CB} = 50 \text{ Vdc}$, $I_E = 0$) ($V_{CB} = 60 \text{ Vdc}$, $I_E = 0$) ($V_{CB} = 50 \text{ Vdc}$, $I_E = 0$, $T_A = 125^\circ\text{C}$) ($V_{CB} = 50 \text{ Vdc}$, $I_E = 0$, $T_A = 125^\circ\text{C}$)	PN2222 PN2222A PN2222 PN2222A	I_{CBO}	– – – –	0.01 0.01 10 10
Emitter Cutoff Current ($V_{EB} = 3.0 \text{ Vdc}$, $I_C = 0$)	PN2222A	I_{EBO}	–	100
Base Cutoff Current ($V_{CE} = 60 \text{ Vdc}$, $V_{EB(\text{off})} = 3.0 \text{ Vdc}$)	PN2222A	I_{BL}	–	20

ON CHARACTERISTICS

DC Current Gain ($I_C = 0.1 \text{ mA}_\text{dc}$, $V_{CE} = 10 \text{ Vdc}$) ($I_C = 1.0 \text{ mA}_\text{dc}$, $V_{CE} = 10 \text{ Vdc}$) ($I_C = 10 \text{ mA}_\text{dc}$, $V_{CE} = 10 \text{ Vdc}$) ($I_C = 10 \text{ mA}_\text{dc}$, $V_{CE} = 10 \text{ Vdc}$, $T_A = -55^\circ\text{C}$) ($I_C = 150 \text{ mA}_\text{dc}$, $V_{CE} = 10 \text{ Vdc}$) (Note 1) ($I_C = 150 \text{ mA}_\text{dc}$, $V_{CE} = 1.0 \text{ Vdc}$) (Note 1) ($I_C = 500 \text{ mA}_\text{dc}$, $V_{CE} = 10 \text{ Vdc}$) (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	Vdc
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	Vdc

SMALL-SIGNAL CHARACTERISTICS

Current – Gain – Bandwidth Product (Note 2) ($I_C = 20 \text{ mA}_\text{dc}$, $V_{CE} = 20 \text{ Vdc}$, $f = 100 \text{ MHz}$)	PN2222 PN2222A	f_T	250 300	– –	MHz
Output Capacitance ($V_{CB} = 10 \text{ Vdc}$, $I_E = 0$, $f = 1.0 \text{ MHz}$)		C_{obo}	–	8.0	pF
Input Capacitance ($V_{EB} = 0.5 \text{ Vdc}$, $I_C = 0$, $f = 1.0 \text{ MHz}$)	PN2222 PN2222A	C_{ibo}	– –	30 25	pF
Input Impedance ($I_C = 1.0 \text{ mA}_\text{dc}$, $V_{CE} = 10 \text{ Vdc}$, $f = 1.0 \text{ kHz}$) ($I_C = 10 \text{ mA}_\text{dc}$, $V_{CE} = 10 \text{ Vdc}$, $f = 1.0 \text{ kHz}$)	PN2222A PN2222A	h_{ie}	2.0 0.25	8.0 1.25	kΩ
Voltage Feedback Ratio ($I_C = 1.0 \text{ mA}_\text{dc}$, $V_{CE} = 10 \text{ Vdc}$, $f = 1.0 \text{ kHz}$) ($I_C = 10 \text{ mA}_\text{dc}$, $V_{CE} = 10 \text{ Vdc}$, $f = 1.0 \text{ kHz}$)	PN2222A PN2222A	h_{re}	– –	8.0 4.0	$\times 10^{-4}$
Small-Signal Current Gain ($I_C = 1.0 \text{ mA}_\text{dc}$, $V_{CE} = 10 \text{ Vdc}$, $f = 1.0 \text{ kHz}$) ($I_C = 10 \text{ mA}_\text{dc}$, $V_{CE} = 10 \text{ Vdc}$, $f = 1.0 \text{ kHz}$)	PN2222A PN2222A	h_{fe}	50 75	300 375	–

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

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

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

Characteristic	Symbol	Min	Max	Unit
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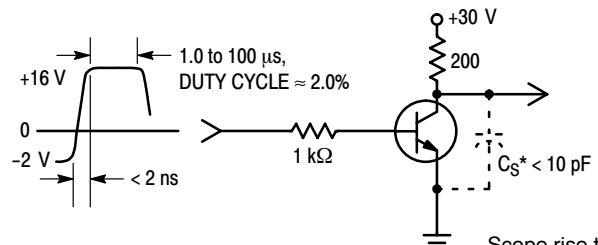
SMALL-SIGNAL CHARACTERISTICS

Output Admittance ($I_C = 1.0 \text{ mA}_\text{dc}$, $V_{CE} = 10 \text{ V}_\text{dc}$, $f = 1.0 \text{ kHz}$) ($I_C = 10 \text{ mA}_\text{dc}$, $V_{CE} = 10 \text{ V}_\text{dc}$, $f = 1.0 \text{ kHz}$)	PN2222A PN2222A	h_{oe}	5.0 25	35 200	μMhos
Collector Base Time Constant ($I_E = 20 \text{ mA}_\text{dc}$, $V_{CB} = 20 \text{ V}_\text{dc}$, $f = 31.8 \text{ MHz}$)	PN2222A	$r_b' C_c$	-	150	ps
Noise Figure ($I_C = 100 \mu\text{A}_\text{dc}$, $V_{CE} = 10 \text{ V}_\text{dc}$, $R_S = 1.0 \text{ k}\Omega$, $f = 1.0 \text{ kHz}$)	PN2222A	NF	-	4.0	dB

SWITCHING CHARACTERISTICS (PN2222A only)

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

SWITCHING TIME EQUIVALENT TEST CIRCUITS



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

Figure 1. Turn-On Time

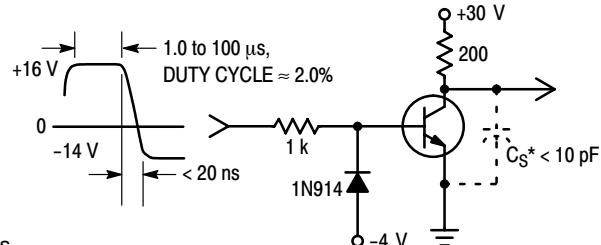


Figure 2. Turn-Off Time

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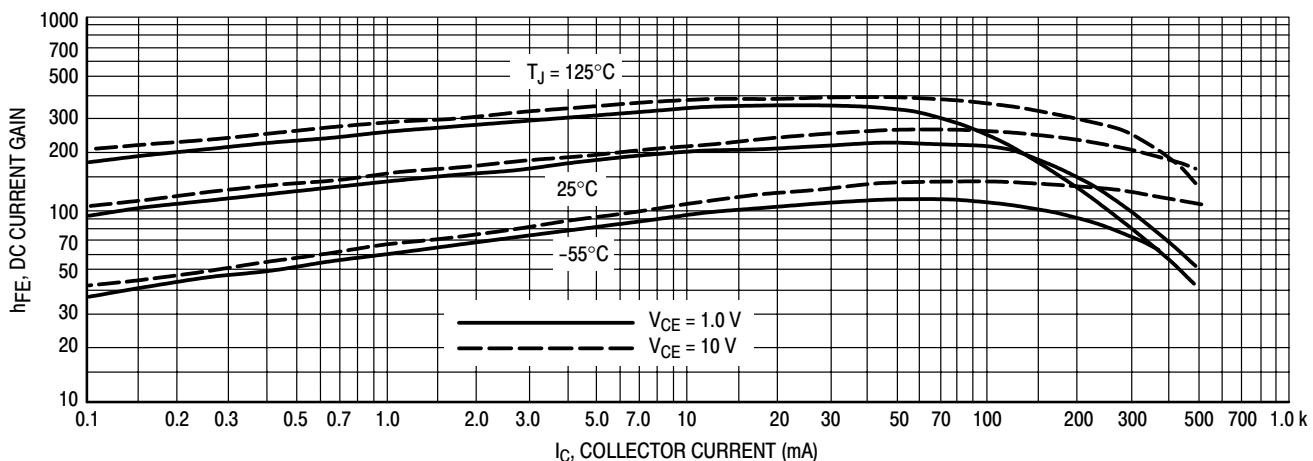


Figure 3. DC Current Gain

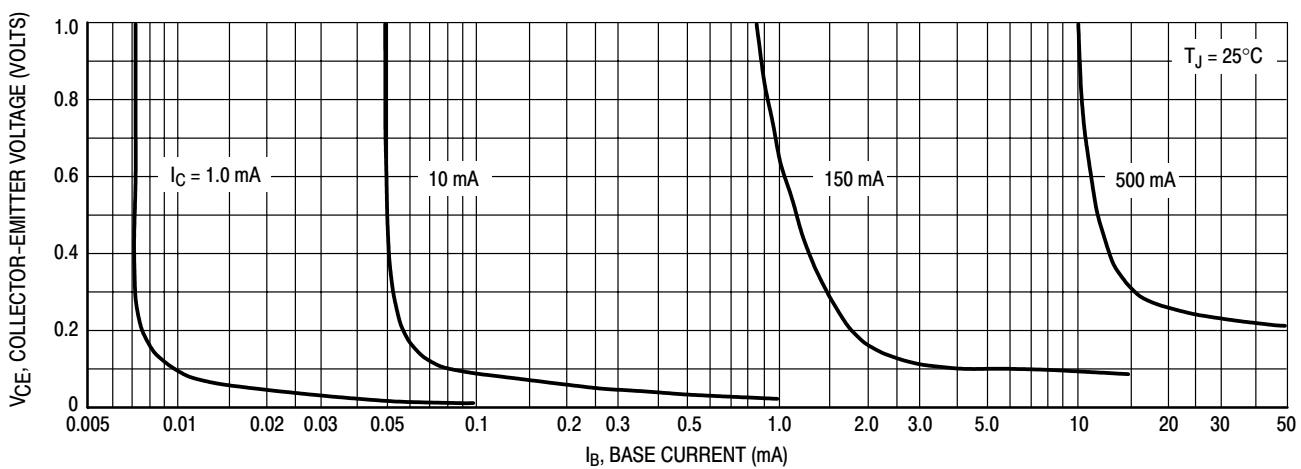


Figure 4. Collector Saturation Region

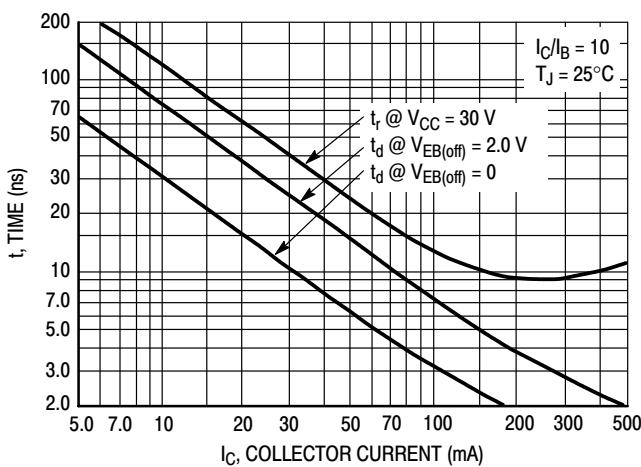


Figure 5. Turn-On Time

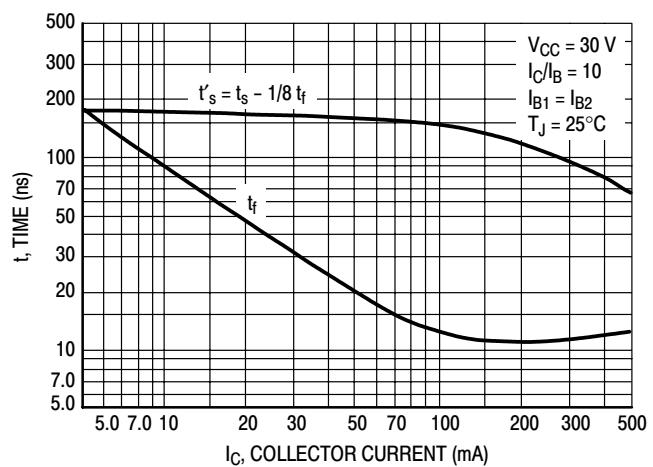
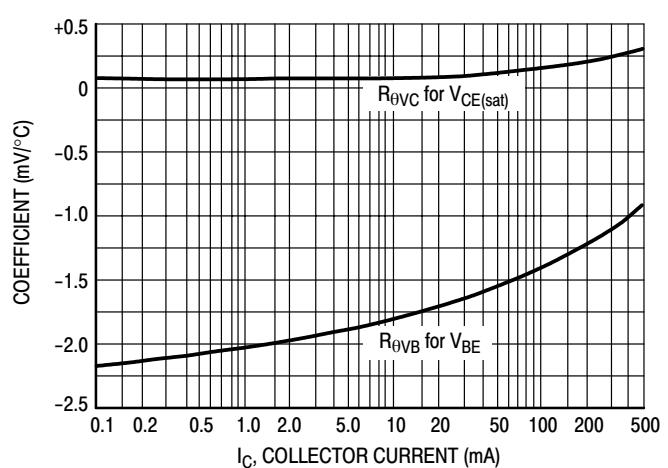
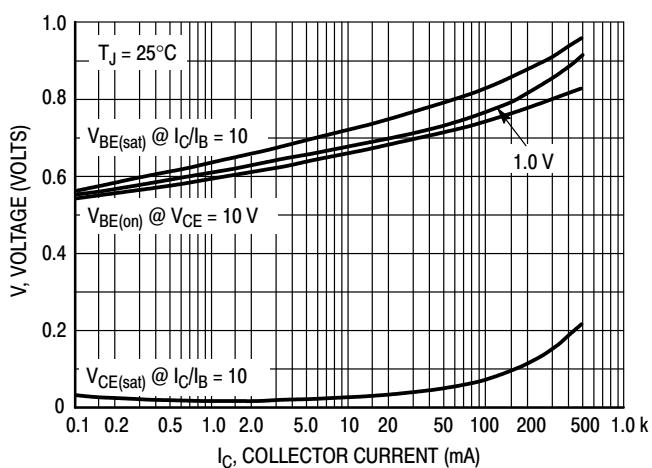
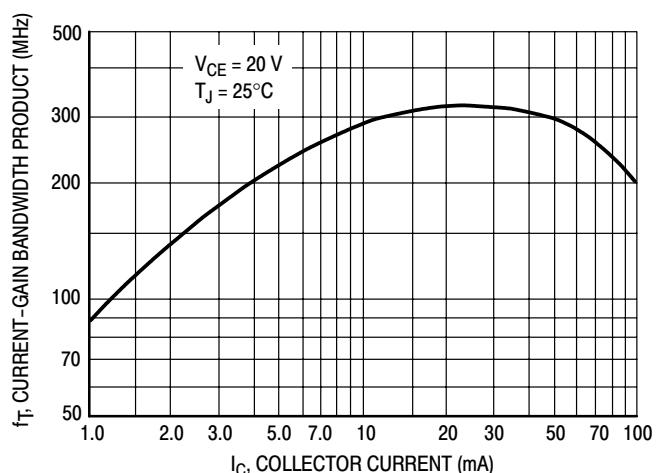
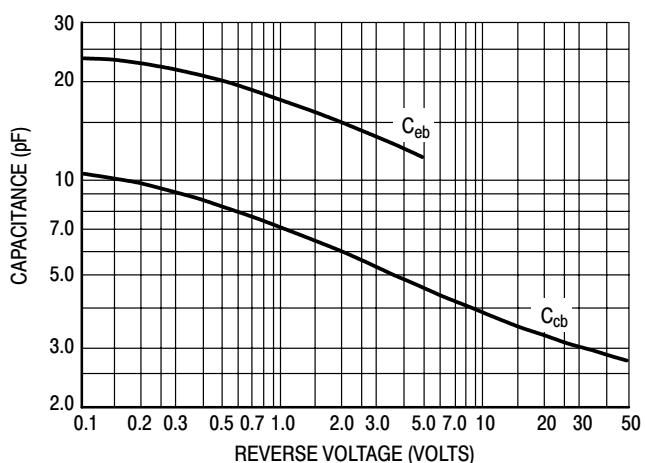
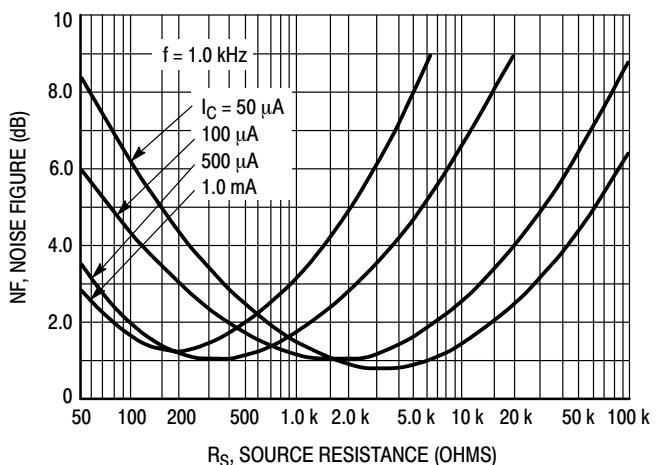
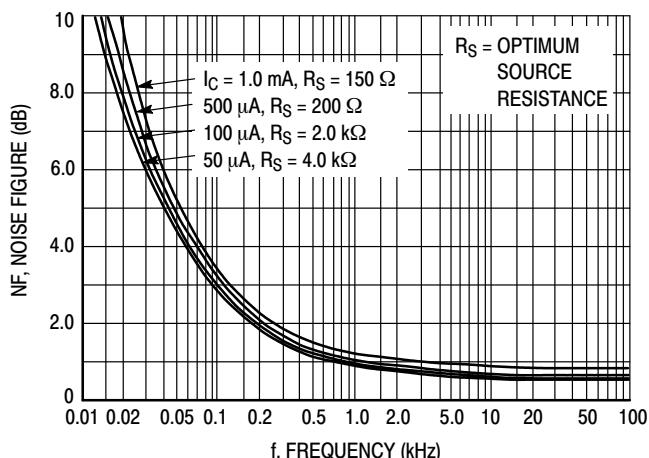


Figure 6. Turn-Off Time

PN2222, PN2222A



PN2222, PN2222A

ORDERING INFORMATION

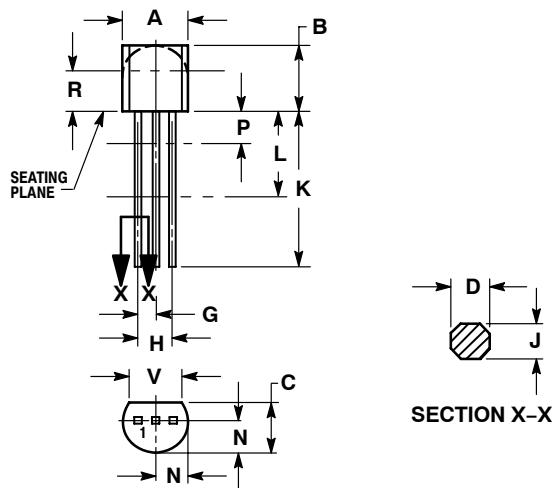
Device	Package	Shipping[†]
PN2222	TO-92	5000 Units / Bulk
PN2222G	TO-92 (Pb-Free)	5000 Units / Bulk
PN2222A	TO-92	5000 Units / Bulk
PN2222AG	TO-92 (Pb-Free)	5000 Units / Bulk
PN2222ARLRA	TO-92	2000 / Tape & Reel
PN2222ARLRAG	TO-92 (Pb-Free)	2000 / Tape & Reel
PN2222ARLRM	TO-92	2000 / Tape & Ammo Box
PN2222ARLRMG	TO-92 (Pb-Free)	2000 / Tape & Ammo Box
PN2222ARLRP	TO-92	2000 / Tape & Ammo Pack
PN2222ARLRPG	TO-92 (Pb-Free)	2000 / Tape & Ammo Pack

[†]For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.

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

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