

PN2222, PN2222A

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

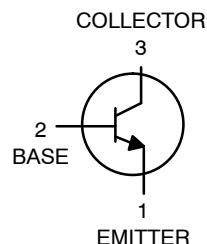
Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction-to-Ambient	$R_{\theta JA}$	200	$^\circ\text{C}/\text{W}$
Thermal Resistance, Junction-to-Case	$R_{\theta JC}$	83.3	$^\circ\text{C}/\text{W}$

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.

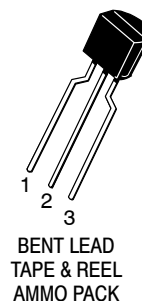
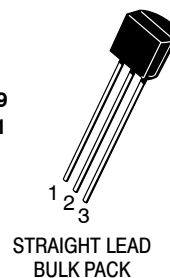


ON Semiconductor®

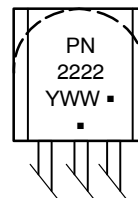
<http://onsemi.com>



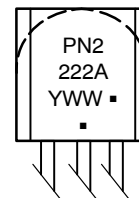
TO-92
CASE 29
STYLE 1



MARKING DIAGRAM



PN2222



PN2222A

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 3 of this data sheet.

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

PN2222, PN2222A

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

Characteristic		Symbol	Min	Max	Unit
OFF CHARACTERISTICS					
Collector – Emitter Breakdown Voltage ($I_C = 10\text{ mA}$, $I_B = 0$)	PN2222 PN2222A	$V_{(BR)CEO}$	30 40	– –	Vdc
Collector – Base Breakdown Voltage ($I_C = 10\text{ }\mu\text{A}$, $I_E = 0$)	PN2222 PN2222A	$V_{(BR)CBO}$	60 75	– –	Vdc
Emitter – Base Breakdown Voltage ($I_E = 10\text{ }\mu\text{A}$, $I_C = 0$)	PN2222 PN2222A	$V_{(BR)EBO}$	5.0 6.0	– –	Vdc
Collector Cutoff Current ($V_{CE} = 60\text{ Vdc}$, $V_{EB(off)} = 3.0\text{ Vdc}$)	PN2222A	I_{CEX}	–	10	nAdc
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	μAdc
Emitter Cutoff Current ($V_{EB} = 3.0\text{ Vdc}$, $I_C = 0$)	PN2222A	I_{EBO}	–	100	nAdc
Base Cutoff Current ($V_{CE} = 60\text{ Vdc}$, $V_{EB(off)} = 3.0\text{ Vdc}$)	PN2222A	I_{BL}	–	20	nAdc

ON CHARACTERISTICS

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

SMALL-SIGNAL CHARACTERISTICS

Current – Gain – Bandwidth Product (Note 2) ($I_C = 20\text{ mA}$, $V_{CE} = 20\text{ Vdc}$, $f = 100\text{ MHz}$)	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 ($I_C = 1.0\text{ mA}$, $V_{CE} = 10\text{ Vdc}$, $f = 1.0\text{ kHz}$) ($I_C = 10\text{ mA}$, $V_{CE} = 10\text{ Vdc}$, $f = 1.0\text{ kHz}$)	PN2222A PN2222A	h_{ie}	2.0 0.25	8.0 1.25	k Ω
Voltage Feedback Ratio ($I_C = 1.0\text{ mA}$, $V_{CE} = 10\text{ Vdc}$, $f = 1.0\text{ kHz}$) ($I_C = 10\text{ mA}$, $V_{CE} = 10\text{ Vdc}$, $f = 1.0\text{ kHz}$)	PN2222A PN2222A	h_{re}	– –	8.0 4.0	$\times 10^{-4}$
Small-Signal Current Gain ($I_C = 1.0\text{ mA}$, $V_{CE} = 10\text{ Vdc}$, $f = 1.0\text{ kHz}$) ($I_C = 10\text{ mA}$, $V_{CE} = 10\text{ Vdc}$, $f = 1.0\text{ kHz}$)	PN2222A PN2222A	h_{fe}	50 75	300 375	–

1. Pulse Test: Pulse Width $\leq 300\text{ }\mu\text{s}$, Duty Cycle $\leq 2.0\%$.
2. f_T is defined as the frequency at which $|h_{fe}|$ extrapolates to unity.

PN2222, PN2222A

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

Characteristic	Symbol	Min	Max	Unit
SMALL-SIGNAL CHARACTERISTICS				
Output Admittance ($I_C = 1.0\text{ mA}$, $V_{CE} = 10\text{ Vdc}$, $f = 1.0\text{ kHz}$) ($I_C = 10\text{ mA}$, $V_{CE} = 10\text{ Vdc}$, $f = 1.0\text{ kHz}$)	h_{oe}	5.0 25	35 200	μMhos
Collector Base Time Constant ($I_E = 20\text{ mA}$, $V_{CB} = 20\text{ Vdc}$, $f = 31.8\text{ MHz}$)	$rb'C_c$	–	150	ps
Noise Figure ($I_C = 100\text{ }\mu\text{A}$, $V_{CE} = 10\text{ Vdc}$, $R_S = 1.0\text{ k}\Omega$, $f = 1.0\text{ kHz}$)	NF	–	4.0	dB

SWITCHING CHARACTERISTICS (PN2222A only)

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

ORDERING INFORMATION

Device	Package	Shipping [†]
PN2222G	TO-92 (Pb-Free)	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
PN2222ARLRPG	TO-92 (Pb-Free)	2000 / Tape & Ammo Box

[†]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.

SWITCHING TIME EQUIVALENT TEST CIRCUITS

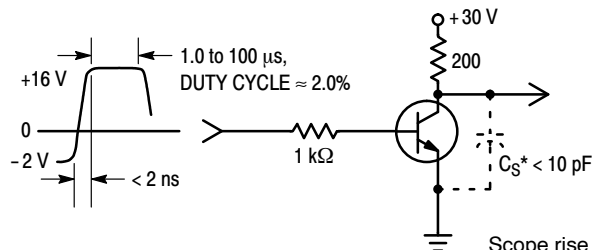


Figure 1. Turn-On Time

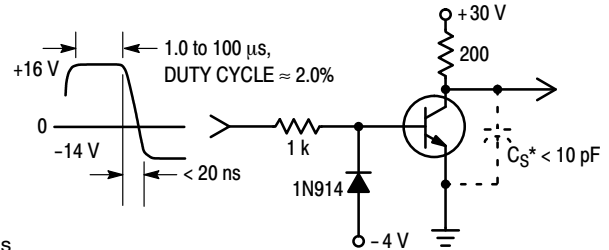


Figure 2. Turn-Off Time

PN2222, PN2222A

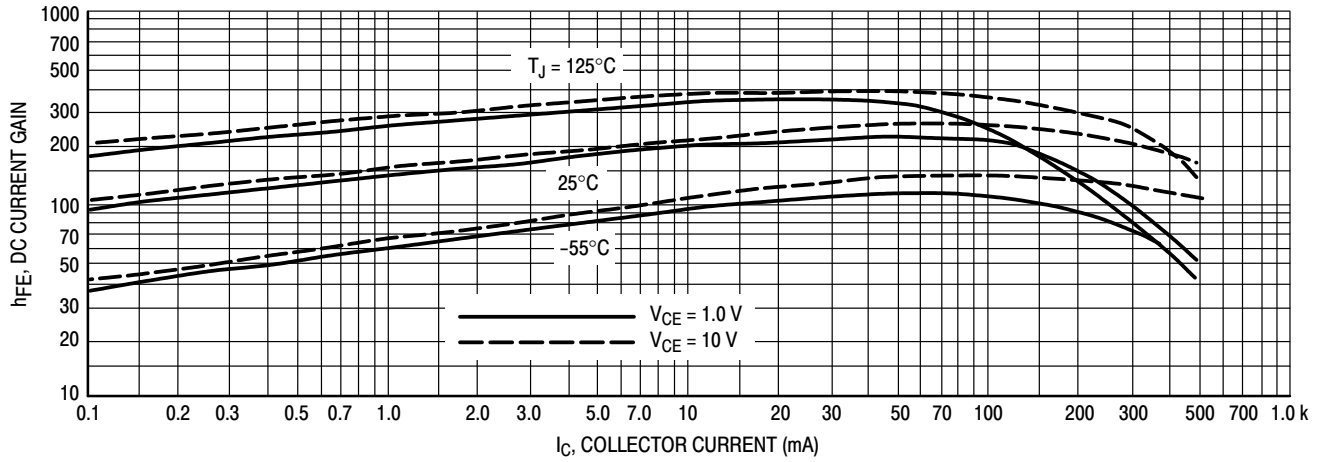


Figure 3. DC Current Gain

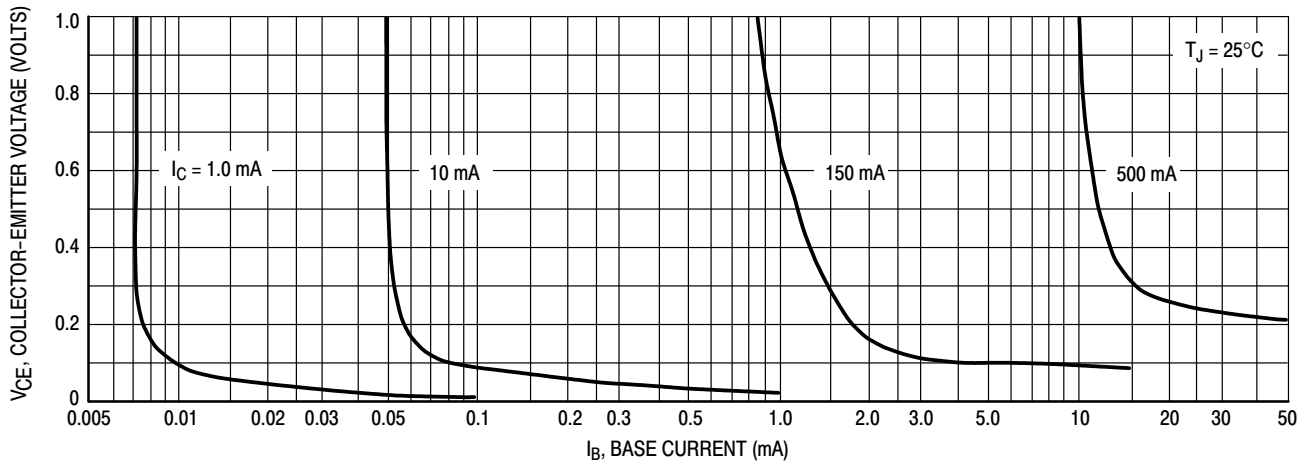


Figure 4. Collector Saturation Region

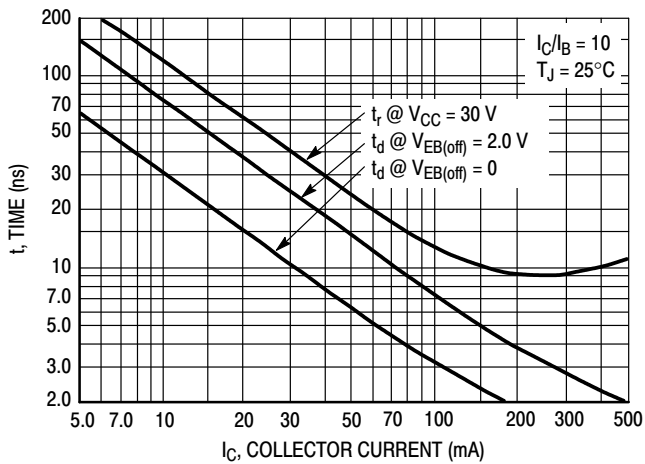


Figure 5. Turn-On Time

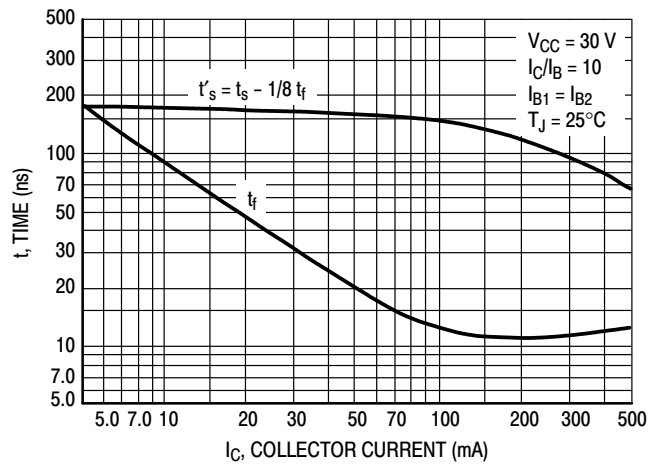


Figure 6. Turn-Off Time

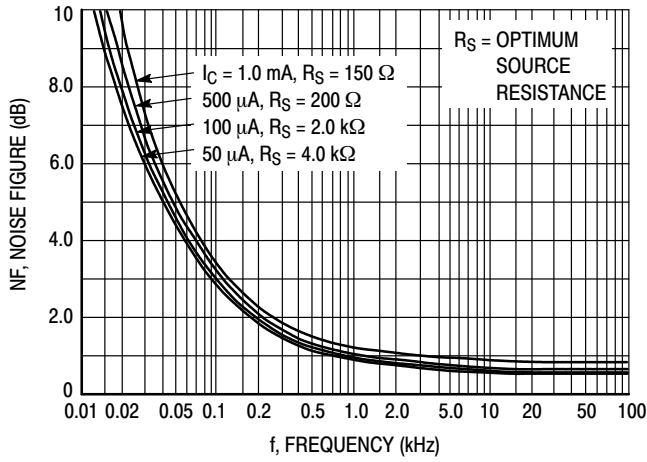


Figure 7. Frequency Effects

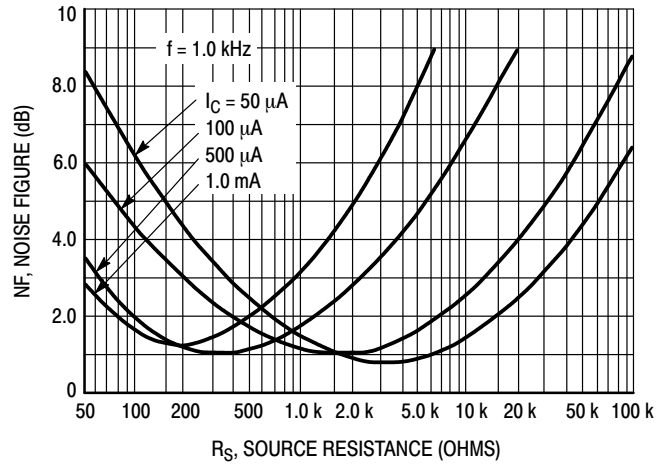


Figure 8. Source Resistance Effects

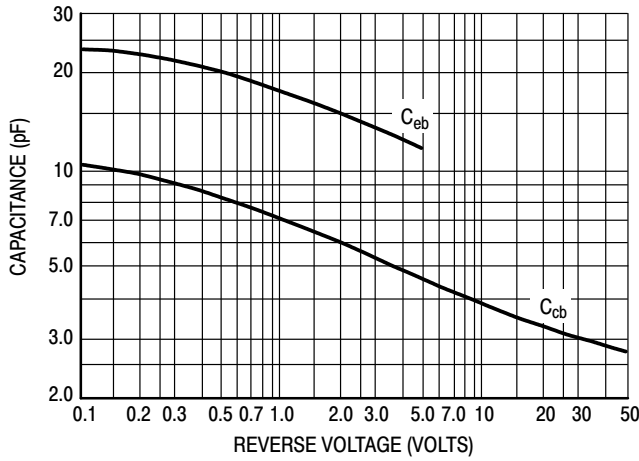


Figure 9. Capacitances

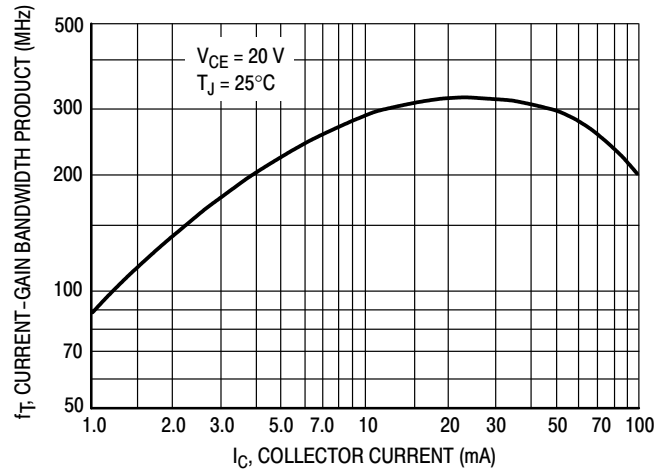


Figure 10. Current-Gain Bandwidth Product

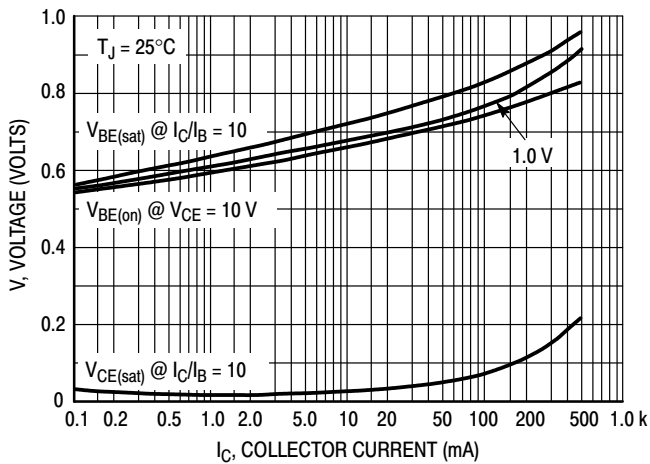


Figure 11. "On" Voltages

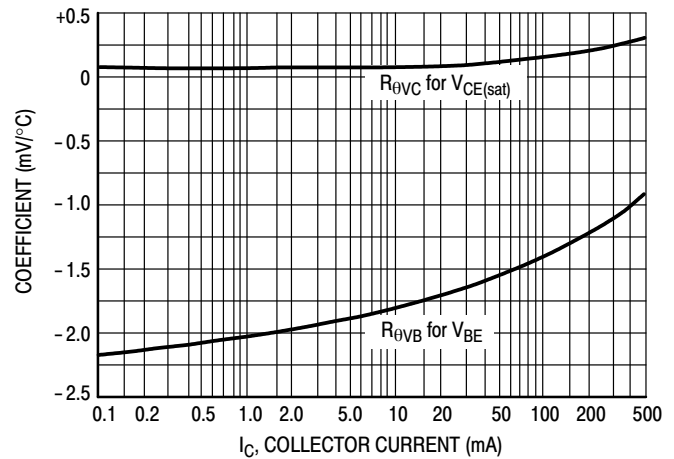
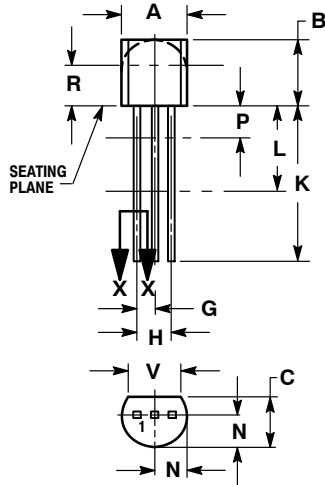


Figure 12. Temperature Coefficients

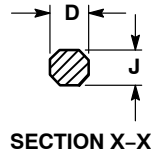
PN2222, PN2222A

PACKAGE DIMENSIONS

TO-92 (TO-226)
CASE 29-11
ISSUE AM



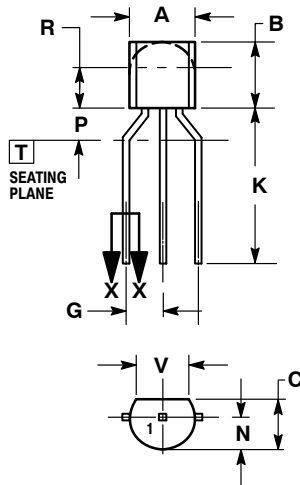
STRAIGHT LEAD
BULK PACK



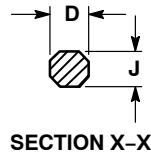
NOTES:

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	---



BENT LEAD
TAPE & REEL
AMMO PACK



NOTES:

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. CONTROLLING DIMENSION: MILLIMETERS.
3. CONTOUR OF PACKAGE BEYOND DIMENSION R IS UNCONTROLLED.
4. LEAD DIMENSION IS UNCONTROLLED IN P AND BEYOND DIMENSION K MINIMUM.

DIM	MILLIMETERS	
	MIN	MAX
A	4.45	5.20
B	4.32	5.33
C	3.18	4.19
D	0.40	0.54
G	2.40	2.80
J	0.39	0.50
K	12.70	---
N	2.04	2.66
P	1.50	4.00
R	2.93	---
V	3.43	---

STYLE 1:

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

ON Semiconductor and  are registered trademarks of Semiconductor Components Industries, LLC (SCILLC). SCILLC reserves the right to make changes without further notice to any products herein. SCILLC makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does SCILLC assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation special, consequential or incidental damages. "Typical" parameters which may be provided in SCILLC data sheets and/or specifications can and do vary in different applications and actual performance may vary over time. All operating parameters, including "Typicals" must be validated for each customer application by customer's technical experts. SCILLC does not convey any license under its patent rights nor the rights of others. SCILLC products are not designed, intended, or authorized for use as components in systems intended for surgical implant into the body, or other applications intended to support or sustain life, or for any other application in which the failure of the SCILLC product could create a situation where personal injury or death may occur. Should Buyer purchase or use SCILLC products for any such unintended or unauthorized application, Buyer shall indemnify and hold SCILLC and its officers, employees, subsidiaries, affiliates, and distributors harmless against all claims, costs, damages, and expenses, and reasonable attorney fees arising out of, directly or indirectly, any claim of personal injury or death associated with such unintended or unauthorized use, even if such claim alleges that SCILLC was negligent regarding the design or manufacture of the part. SCILLC is an Equal Opportunity/Affirmative Action Employer. This literature is subject to all applicable copyright laws and is not for resale in any manner.

PUBLICATION ORDERING INFORMATION

LITERATURE FULFILLMENT:

Literature Distribution Center for ON Semiconductor
P.O. Box 5163, Denver, Colorado 80217 USA
Phone: 303-675-2175 or 800-344-3860 Toll Free USA/Canada
Fax: 303-675-2176 or 800-344-3867 Toll Free USA/Canada
Email: orderlit@onsemi.com

N. American Technical Support: 800-282-9855 Toll Free
USA/Canada
Europe, Middle East and Africa Technical Support:
Phone: 421 33 790 2910
Japan Customer Focus Center
Phone: 81-3-5773-3850

ON Semiconductor Website: www.onsemi.com

Order Literature: <http://www.onsemi.com/orderlit>

For additional information, please contact your local Sales Representative