

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	$^\circ\text{C}$

Maximum ratings are those values beyond which device damage can occur. Maximum ratings applied to the device are individual stress limit values (not normal operating conditions) and are not valid simultaneously. If these limits are exceeded, device functional operation is not implied, damage may occur and reliability may be affected.

THERMAL CHARACTERISTICS

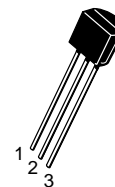
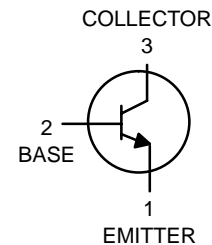
Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction-to-Ambient	$R_{\theta JA}$	200	$^\circ\text{C}/\text{W}$
Thermal Resistance, Junction-to-Case	$R_{\theta JC}$	83.3	$^\circ\text{C}/\text{W}$

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



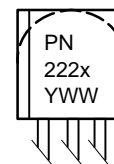
ON Semiconductor®

<http://onsemi.com>



TO-92
CASE 29
STYLE 1

MARKING DIAGRAM



PN222 = Device Code
x = 2 or A
Y = Year
WW = Work Week

ORDERING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 2 of this data sheet.

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

PN2222, PN2222A

ORDERING INFORMATION

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

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

Characteristic	Symbol	Min	Max	Unit	
OFF CHARACTERISTICS					
Collector–Emitter Breakdown Voltage (I _C = 10 mAdc, I _B = 0)	PN2222 PN2222A	V _{(BR)CEO}	30 40	– –	Vdc
Collector–Base Breakdown Voltage (I _C = 10 μAdc, I _E = 0)	PN2222 PN2222A	V _{(BR)CBO}	60 75	– –	Vdc
Emitter–Base Breakdown Voltage (I _E = 10 μAdc, I _C = 0)	PN2222 PN2222A	V _{(BR)EBO}	5.0 6.0	– –	Vdc
Collector Cutoff Current (V _{CE} = 60 Vdc, V _{EB(off)} = 3.0 Vdc)	PN2222A	I _{CEX}	–	10	nAdc
Collector Cutoff Current (V _{CB} = 50 Vdc, I _E = 0)	PN2222	I _{CBO}	–	0.01	μAdc
(V _{CB} = 60 Vdc, I _E = 0)	PN2222A		–	0.01	
(V _{CB} = 50 Vdc, I _E = 0, T _A = 125°C)	PN2222		–	10	
(V _{CB} = 50 Vdc, I _E = 0, T _A = 125°C)	PN2222A		–	10	
Emitter Cutoff Current (V _{EB} = 3.0 Vdc, I _C = 0)	PN2222A	I _{EBO}	–	100	nAdc
Base Cutoff Current (V _{CE} = 60 Vdc, V _{EB(off)} = 3.0 Vdc)	PN2222A	I _{BL}	–	20	nAdc

ON CHARACTERISTICS

DC Current Gain (I _C = 0.1 mAdc, V _{CE} = 10 Vdc) (I _C = 1.0 mAdc, V _{CE} = 10 Vdc) (I _C = 10 mAdc, V _{CE} = 10 Vdc) (I _C = 10 mAdc, V _{CE} = 10 Vdc, T _A = –55°C) (I _C = 150 mAdc, V _{CE} = 10 Vdc) (Note 1) (I _C = 150 mAdc, V _{CE} = 1.0 Vdc) (Note 1) (I _C = 500 mAdc, V _{CE} = 10 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 mAdc, I _B = 15 mAdc) (I _C = 500 mAdc, I _B = 50 mAdc)	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 mAdc, I _B = 15 mAdc) (I _C = 500 mAdc, I _B = 50 mAdc)	PN2222 PN2222A PN2222 PN2222A	V _{BE(sat)}	– 0.6 – –	1.3 1.2 2.6 2.0	Vdc

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

PN2222, PN2222A

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

SWITCHING CHARACTERISTICS (PN2222A only)

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

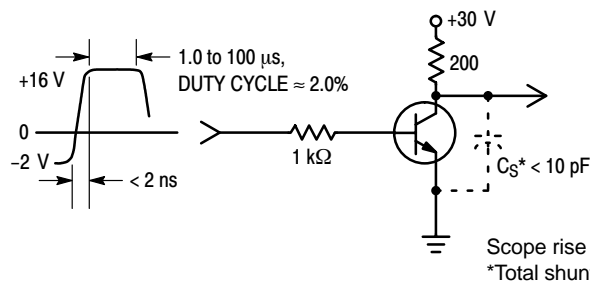


Figure 1. Turn-On Time

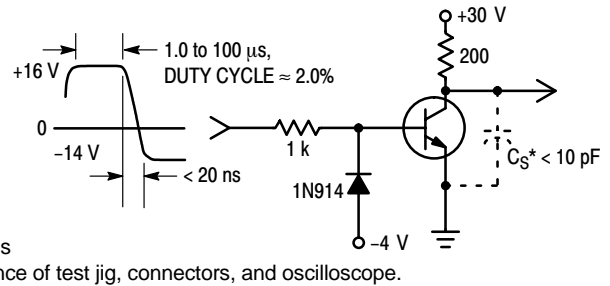


Figure 2. Turn-Off Time

PN2222, PN2222A

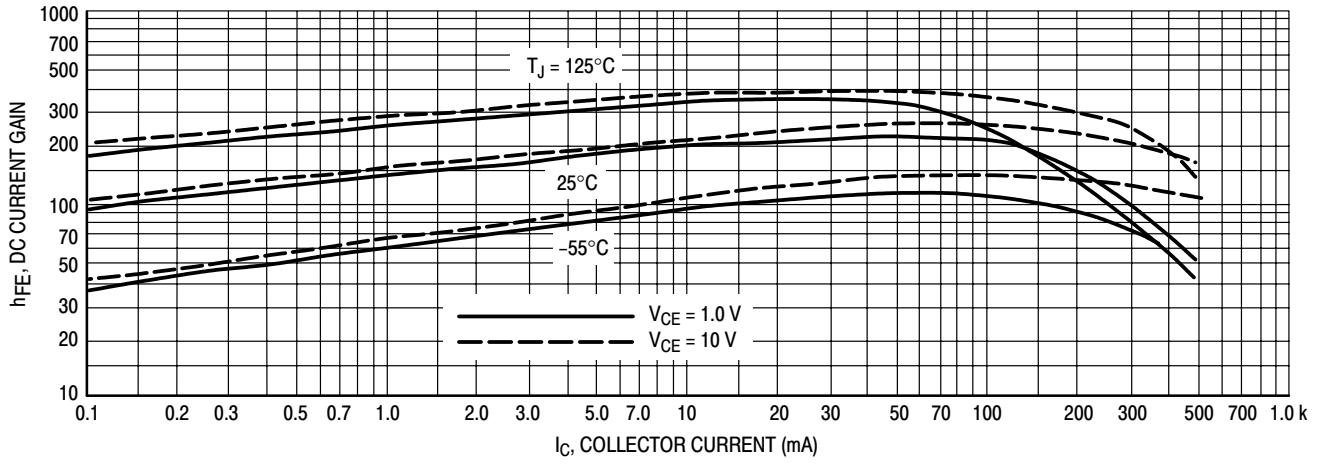


Figure 3. DC Current Gain

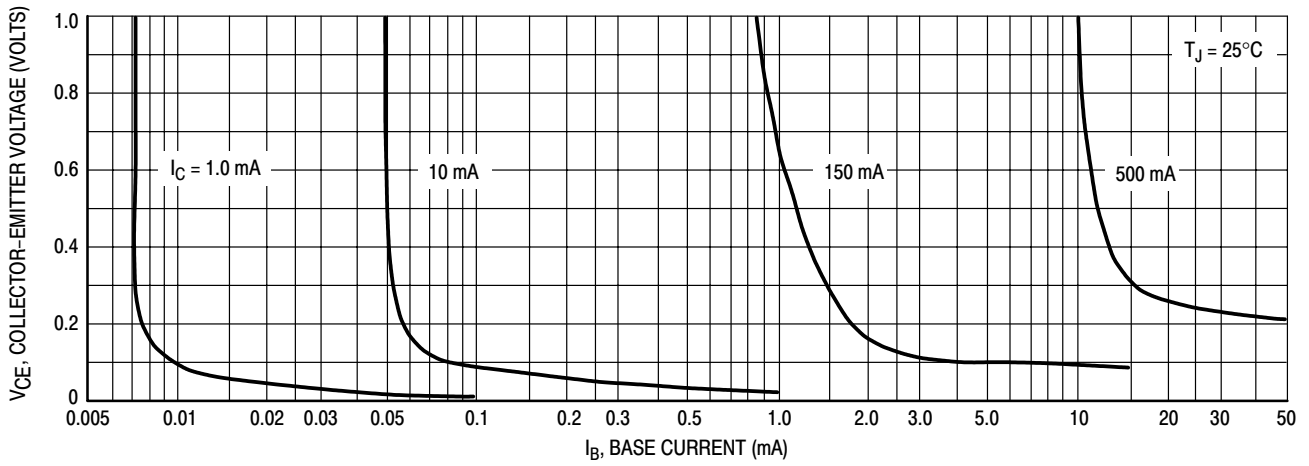


Figure 4. Collector Saturation Region

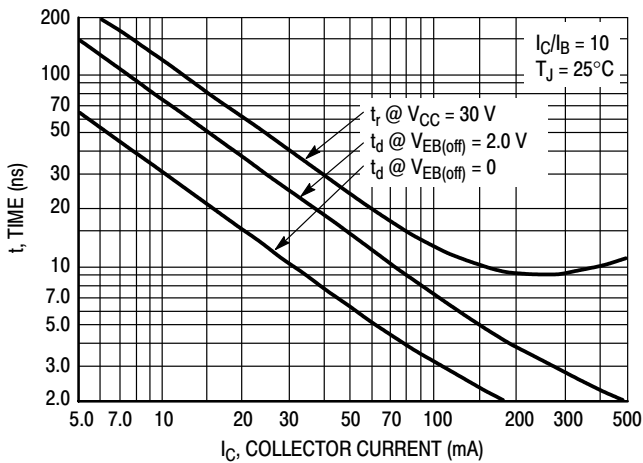


Figure 5. Turn-On Time

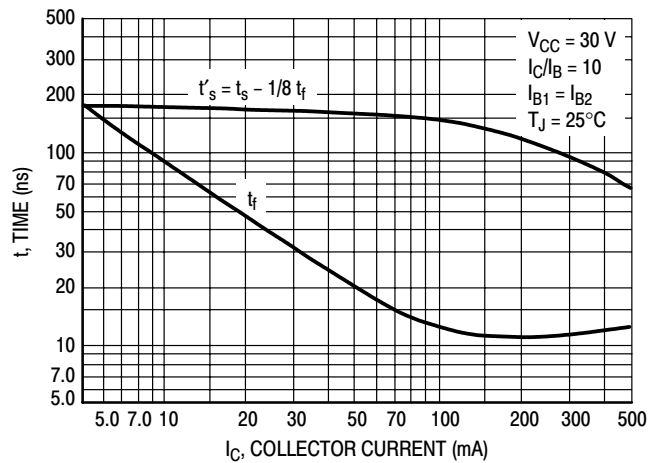


Figure 6. Turn-Off Time

PN2222, PN2222A

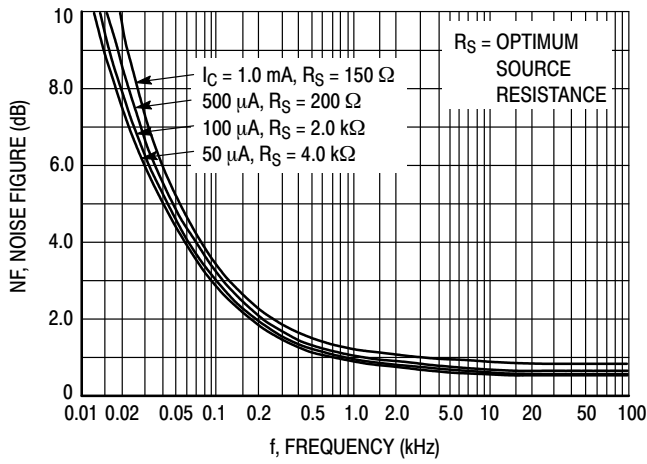


Figure 7. Frequency Effects

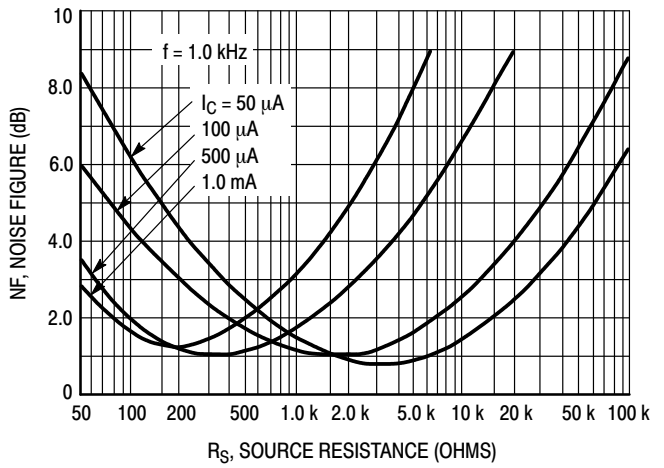


Figure 8. Source Resistance Effects

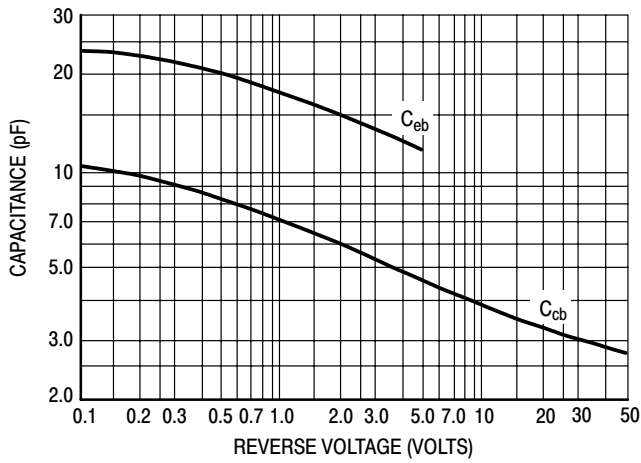


Figure 9. Capacitances

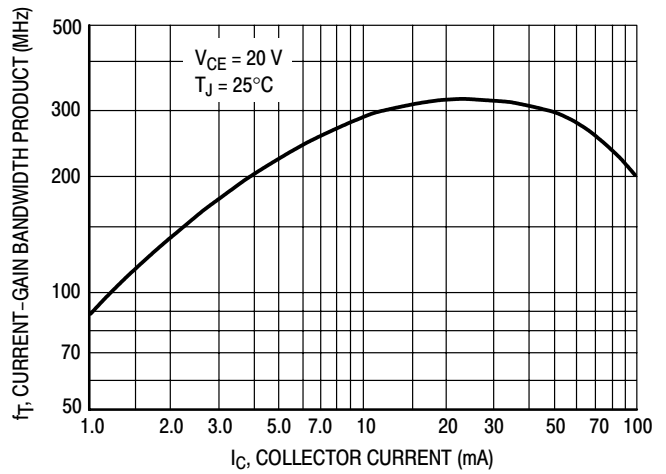


Figure 10. Current-Gain Bandwidth Product

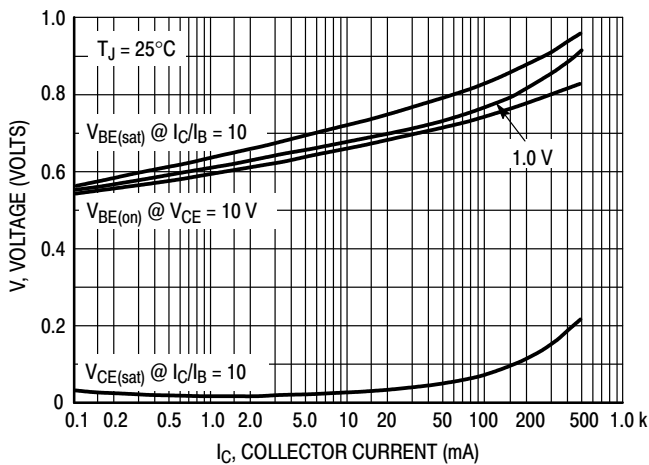


Figure 11. "On" Voltages

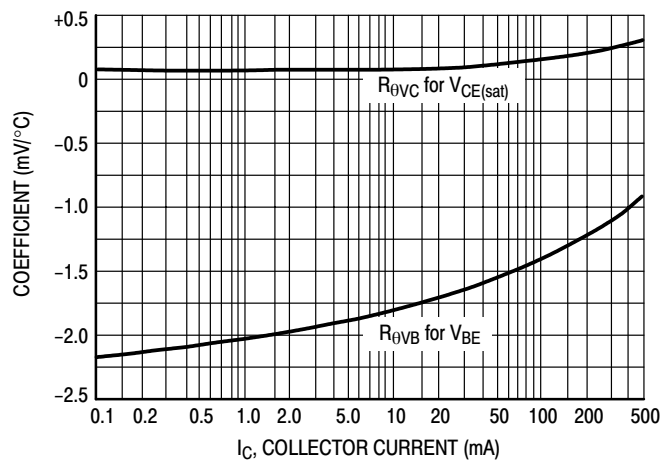
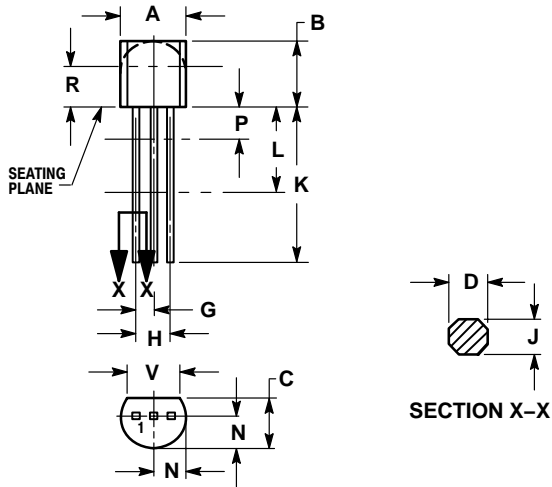


Figure 12. Temperature Coefficients

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:

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 61312, Phoenix, Arizona 85082-1312 USA
Phone: 480-829-7710 or 800-344-3860 Toll Free USA/Canada
Fax: 480-829-7709 or 800-344-3867 Toll Free USA/Canada
Email: orderlit@onsemi.com

N. American Technical Support: 800-282-9855 Toll Free USA/Canada

Japan: ON Semiconductor, Japan Customer Focus Center
2-9-1 Kamimeguro, Meguro-ku, Tokyo, Japan 153-0051
Phone: 81-3-5773-3850

ON Semiconductor Website: <http://onsemi.com>

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

For additional information, please contact your local Sales Representative.

This datasheet has been download from:

www.datasheetcatalog.com

Datasheets for electronics components.