

# 2N3906

## General Purpose Transistors

### PNP Silicon



ON Semiconductor®

<http://onsemi.com>

#### Features

- Pb-Free Packages are Available\*

#### MAXIMUM RATINGS

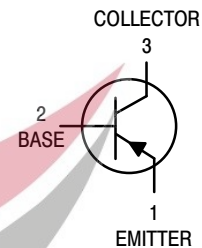
Rating	Symbol	Value	Unit
Collector – Emitter Voltage	$V_{CEO}$	40	Vdc
Collector – Base Voltage	$V_{CBO}$	40	Vdc
Emitter – Base Voltage	$V_{EBO}$	5.0	Vdc
Collector Current – Continuous	$I_C$	200	mA dc
Total Device Dissipation @ $T_A = 25^\circ\text{C}$ Derate above $25^\circ\text{C}$	$P_D$	625 5.0	mW mW/ $^\circ\text{C}$
Total Power Dissipation @ $T_A = 60^\circ\text{C}$	$P_D$	250	mW
Total Device Dissipation @ $T_C = 25^\circ\text{C}$ Derate above $25^\circ\text{C}$	$P_D$	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 (Note 1)

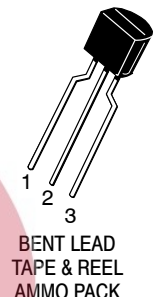
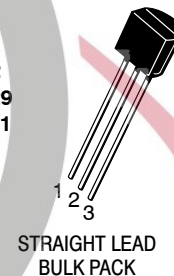
Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction-to-Ambient	$R_{\theta JA}$	200	$^\circ\text{C}/\text{W}$
Thermal Resistance, Junction-to-Case	$R_{\theta JC}$	83.3	$^\circ\text{C}/\text{W}$

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.

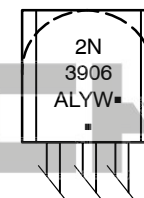
1. Indicates Data in addition to JEDEC Requirements.



TO-92  
CASE 29  
STYLE 1



#### MARKING DIAGRAM



A = Assembly Location  
L = Wafer Lot  
Y = Year  
W = 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.

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

Characteristic	Symbol	Min	Max	Unit
----------------	--------	-----	-----	------

**OFF CHARACTERISTICS**

Collector – Emitter Breakdown Voltage (Note 2)	( $I_C = 1.0\text{ mA}$ , $I_B = 0$ )	$V_{(BR)CEO}$	40	–	Vdc
Collector – Base Breakdown Voltage	( $I_C = 10\text{ }\mu\text{A}$ , $I_E = 0$ )	$V_{(BR)CBO}$	40	–	Vdc
Emitter – Base Breakdown Voltage	( $I_E = 10\text{ }\mu\text{A}$ , $I_C = 0$ )	$V_{(BR)EBO}$	5.0	–	Vdc
Base Cutoff Current	( $V_{CE} = 30\text{ Vdc}$ , $V_{EB} = 3.0\text{ Vdc}$ )	$I_{BL}$	–	50	nAdc
Collector Cutoff Current	( $V_{CE} = 30\text{ Vdc}$ , $V_{EB} = 3.0\text{ Vdc}$ )	$I_{CEX}$	–	50	nAdc

**ON CHARACTERISTICS** (Note 2)

DC Current Gain	( $I_C = 0.1\text{ mA}$ , $V_{CE} = 1.0\text{ Vdc}$ ) ( $I_C = 1.0\text{ mA}$ , $V_{CE} = 1.0\text{ Vdc}$ ) ( $I_C = 10\text{ mA}$ , $V_{CE} = 1.0\text{ Vdc}$ ) ( $I_C = 50\text{ mA}$ , $V_{CE} = 1.0\text{ Vdc}$ ) ( $I_C = 100\text{ mA}$ , $V_{CE} = 1.0\text{ Vdc}$ )	$h_{FE}$	60 80 100 60 30	– – 300 – –	–
Collector – Emitter Saturation Voltage	( $I_C = 10\text{ mA}$ , $I_B = 1.0\text{ mA}$ ) ( $I_C = 50\text{ mA}$ , $I_B = 5.0\text{ mA}$ )	$V_{CE(sat)}$	– –	0.25 0.4	Vdc
Base – Emitter Saturation Voltage	( $I_C = 10\text{ mA}$ , $I_B = 1.0\text{ mA}$ ) ( $I_C = 50\text{ mA}$ , $I_B = 5.0\text{ mA}$ )	$V_{BE(sat)}$	0.65 –	0.85 0.95	Vdc

**SMALL-SIGNAL CHARACTERISTICS**

Current – Gain – Bandwidth Product	( $I_C = 10\text{ mA}$ , $V_{CE} = 20\text{ Vdc}$ , $f = 100\text{ MHz}$ )	$f_T$	250	–	MHz
Output Capacitance	( $V_{CB} = 5.0\text{ Vdc}$ , $I_E = 0$ , $f = 1.0\text{ MHz}$ )	$C_{obo}$	–	4.5	pF
Input Capacitance	( $V_{EB} = 0.5\text{ Vdc}$ , $I_C = 0$ , $f = 1.0\text{ MHz}$ )	$C_{ibo}$	–	10	pF
Input Impedance	( $I_C = 1.0\text{ mA}$ , $V_{CE} = 10\text{ Vdc}$ , $f = 1.0\text{ kHz}$ )	$h_{ie}$	2.0	12	k $\Omega$
Voltage Feedback Ratio	( $I_C = 1.0\text{ mA}$ , $V_{CE} = 10\text{ Vdc}$ , $f = 1.0\text{ kHz}$ )	$h_{re}$	0.1	10	$\times 10^{-4}$
Small-Signal Current Gain	( $I_C = 1.0\text{ mA}$ , $V_{CE} = 10\text{ Vdc}$ , $f = 1.0\text{ kHz}$ )	$h_{fe}$	100	400	–
Output Admittance	( $I_C = 1.0\text{ mA}$ , $V_{CE} = 10\text{ Vdc}$ , $f = 1.0\text{ kHz}$ )	$h_{oe}$	3.0	60	$\mu\text{mhos}$
Noise Figure	( $I_C = 100\text{ }\mu\text{A}$ , $V_{CE} = 5.0\text{ Vdc}$ , $R_S = 1.0\text{ k}\Omega$ , $f = 1.0\text{ kHz}$ )	NF	–	4.0	dB

**SWITCHING CHARACTERISTICS**

Delay Time	(V <sub>CC</sub> = 3.0 Vdc, V <sub>BE</sub> = 0.5 Vdc, I <sub>C</sub> = 10 mA, I <sub>B1</sub> = 1.0 mA)	t <sub>d</sub>	–	35	ns
Rise Time		t <sub>r</sub>	–	35	ns
Storage Time	(V <sub>CC</sub> = 3.0 Vdc, I <sub>C</sub> = 10 mA, I <sub>B1</sub> = I <sub>B2</sub> = 1.0 mA)	t <sub>s</sub>	–	225	ns
Fall Time	(V <sub>CC</sub> = 3.0 Vdc, I <sub>C</sub> = 10 mA, I <sub>B1</sub> = I <sub>B2</sub> = 1.0 mA)	t <sub>f</sub>	–	75	ns

2. Pulse Test: Pulse Width  $\leq 300\text{ }\mu\text{s}$ ; Duty Cycle  $\leq 2\%$ .

# ORDERING INFORMATION

Device	Package	Shipping†
2N3906	TO-92	5000 Units / Bulk
2N3906G	TO-92 (Pb-Free)	5000 Units / Bulk
2N3906RL1	TO-92	2000 / Tape & Reel
2N3906RL1G	TO-92 (Pb-Free)	2000 / Tape & Reel
2N3906RLRA	TO-92	2000 / Tape & Reel
2N3906RLRAG	TO-92 (Pb-Free)	2000 / Tape & Reel
2N3906RLRM	TO-92	2000 / Tape & Ammo Box
2N3906RLRMG	TO-92 (Pb-Free)	2000 / Tape & Ammo Box
2N3906RLRP	TO-92	2000 / Tape & Ammo Box
2N3906RLRPG	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.

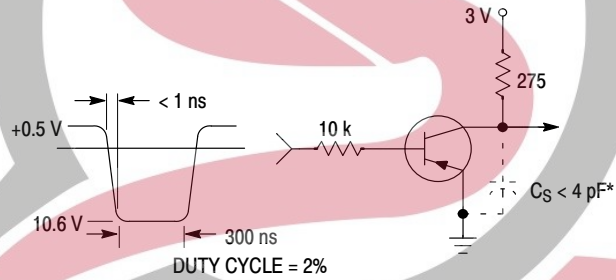


Figure 1. Delay and Rise Time Equivalent Test Circuit

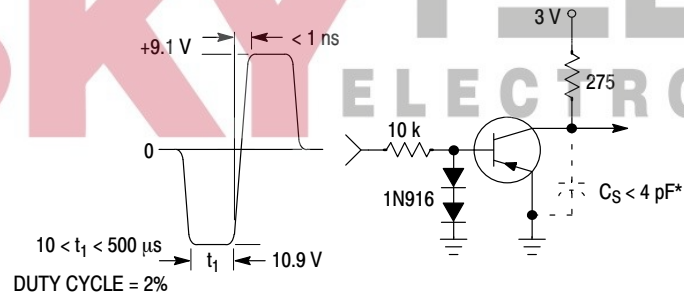


Figure 2. Storage and Fall Time Equivalent Test Circuit

## TYPICAL TRANSIENT CHARACTERISTICS

—  $T_J = 25^\circ\text{C}$   
 - -  $T_J = 125^\circ\text{C}$

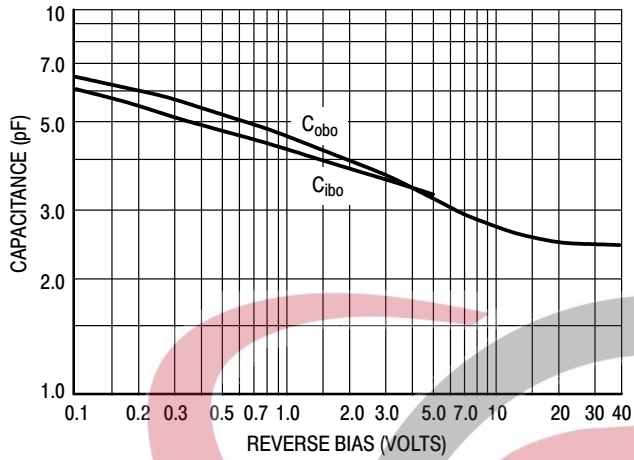


Figure 3. Capacitance

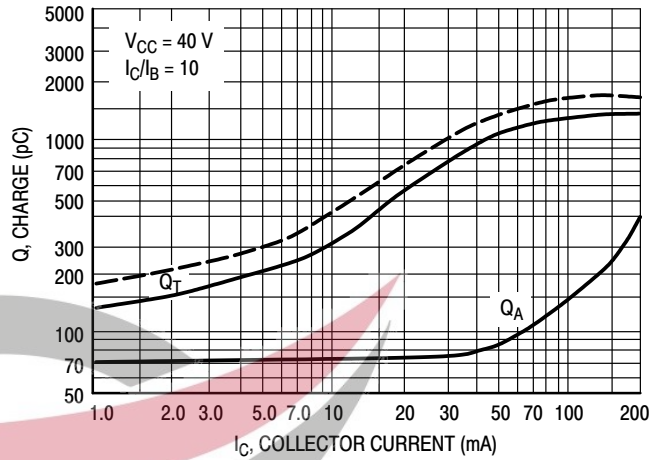


Figure 4. Charge Data

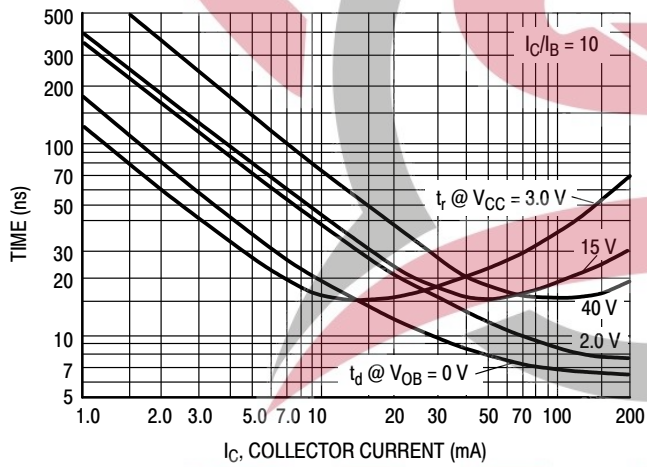


Figure 5. Turn-On Time

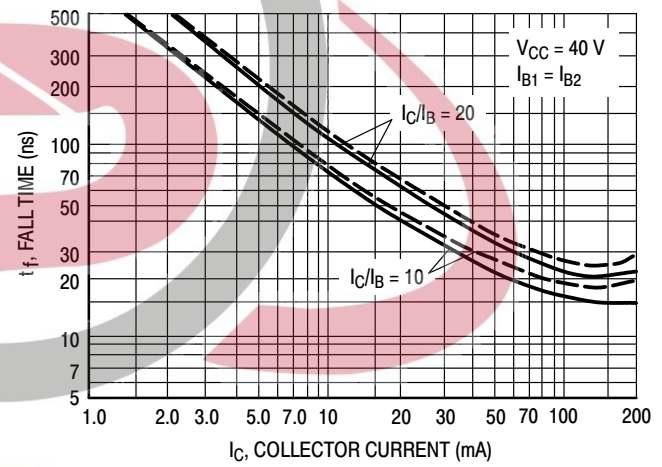


Figure 6. Fall Time

# TYPICAL AUDIO SMALL-SIGNAL CHARACTERISTICS NOISE FIGURE VARIATIONS

( $V_{CE} = -5.0$  Vdc,  $T_A = 25^\circ\text{C}$ , Bandwidth = 1.0 Hz)

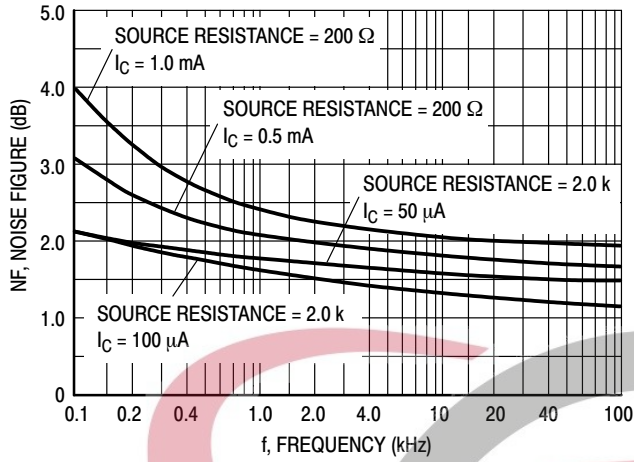


Figure 7.

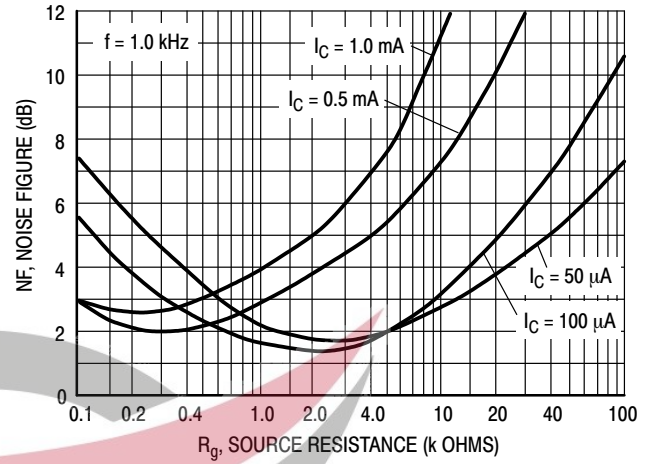


Figure 8.

## h PARAMETERS

( $V_{CE} = -10$  Vdc,  $f = 1.0$  kHz,  $T_A = 25^\circ\text{C}$ )

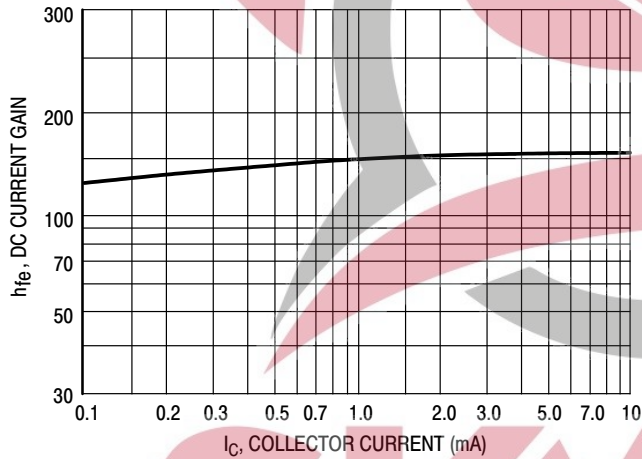


Figure 9. Current Gain

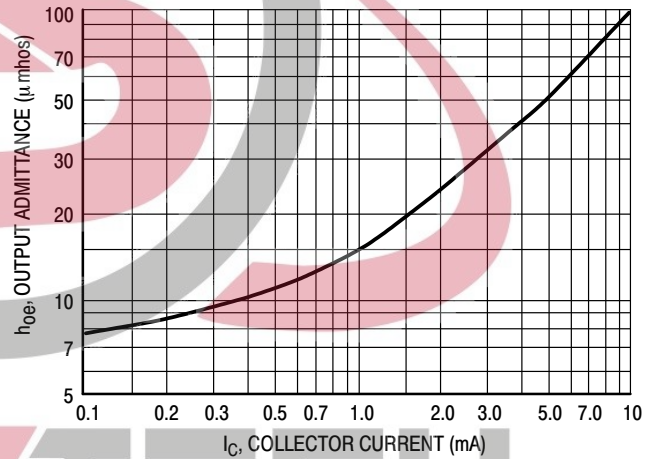


Figure 10. Output Admittance

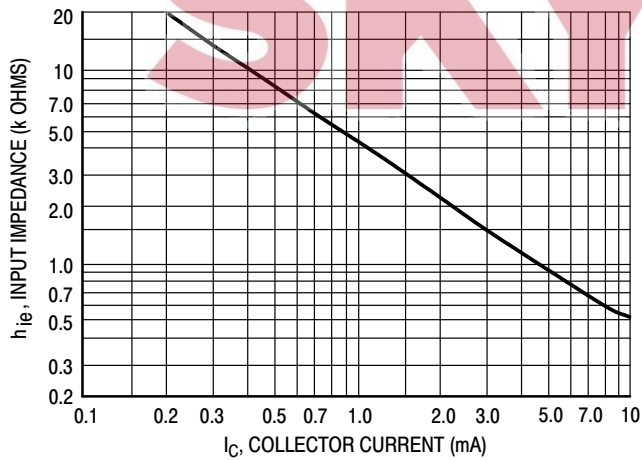


Figure 11. Input Impedance

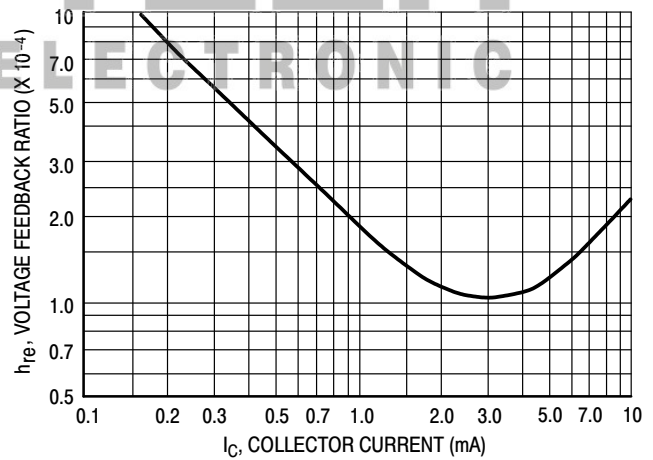


Figure 12. Voltage Feedback Ratio



## TYPICAL STATIC CHARACTERISTICS

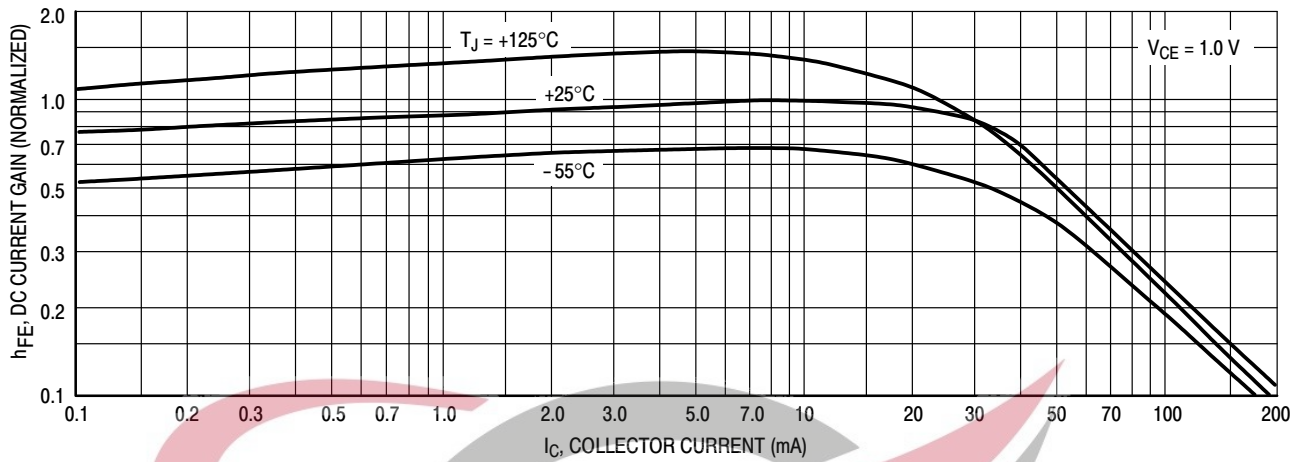


Figure 13. DC Current Gain

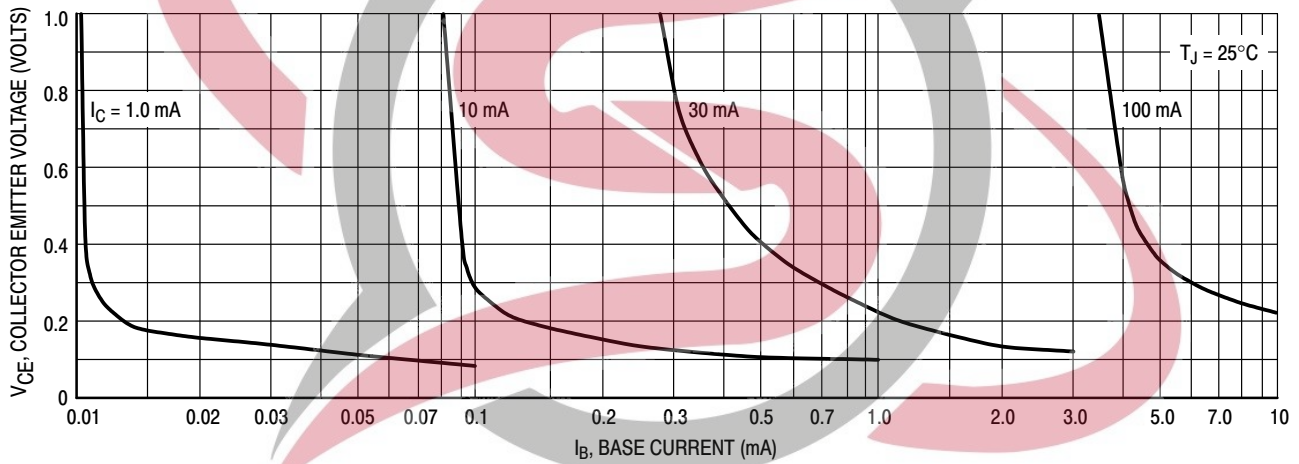


Figure 14. Collector Saturation Region

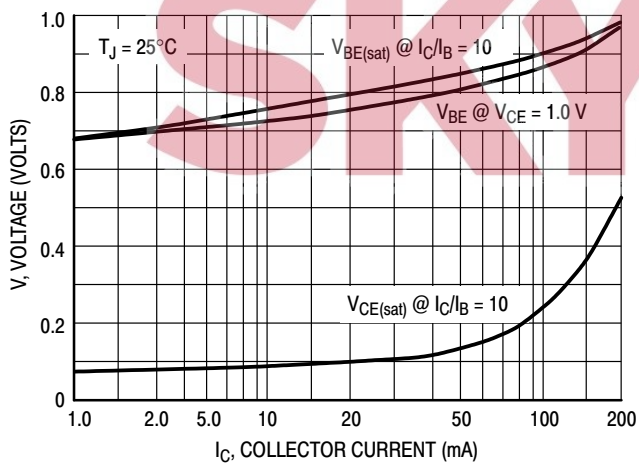


Figure 15. "ON" Voltages

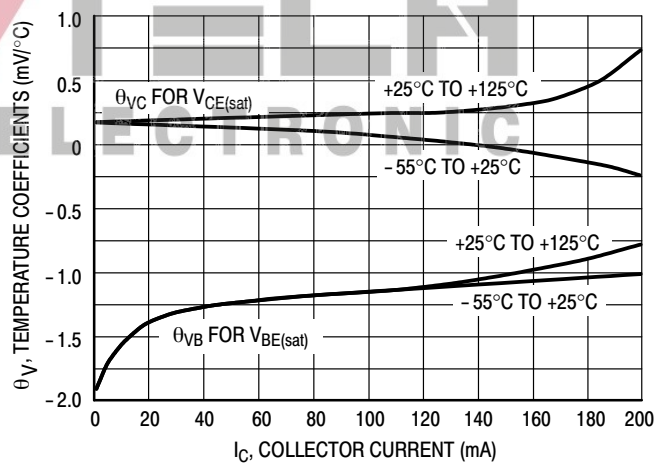
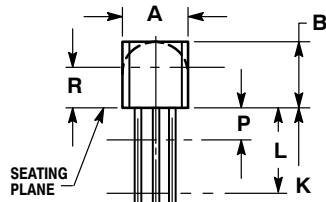


Figure 16. Temperature Coefficients

## PACKAGE DIMENSIONS

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

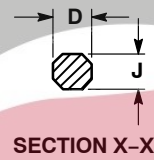
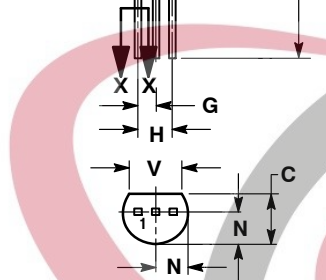


STRAIGHT LEAD  
BULK PACK

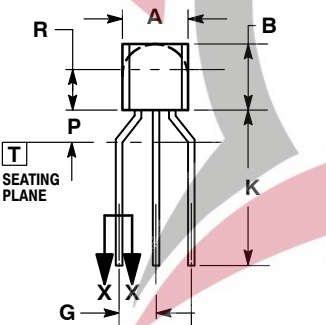
## NOTES:

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	---



SECTION X-X

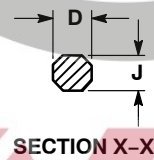
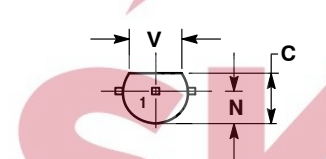


BENT LEAD  
TAPE & REEL  
AMMO PACK

## 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	---



SECTION X-X

STYLE 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](mailto: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](http://www.onsemi.com)

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

For additional information, please contact your local Sales Representative