

# 2N3906

## General Purpose Transistors

### PNP Silicon

#### 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 <sub>dc</sub>
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	$^\circ\text{C}/\text{W}$

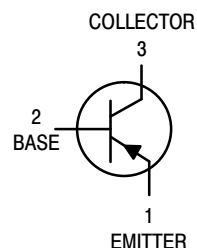
Stresses exceeding Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stresses above the Recommended Operating Conditions may affect device reliability.

1. Indicates Data in addition to JEDEC Requirements.

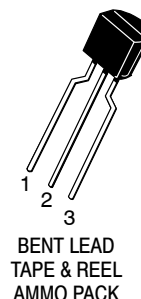
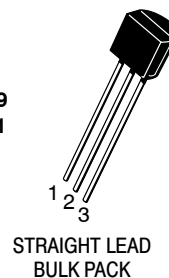


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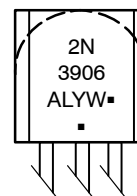
<http://onsemi.com>



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
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**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**

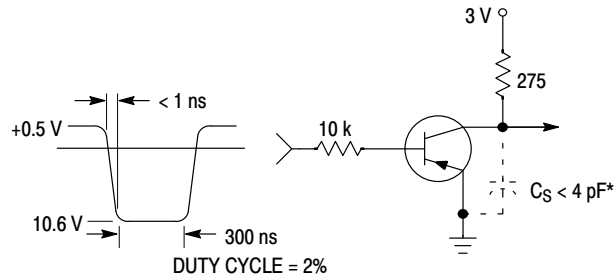
Delay Time	(V <sub>CC</sub> = 3.0 Vdc, V <sub>BE</sub> = 0.5 Vdc, I <sub>C</sub> = 10 mA, I <sub>B1</sub> = 1.0 mA)	t <sub>d</sub>	–	35	ns
Rise Time		t <sub>r</sub>	–	35	ns
Storage Time	(V <sub>CC</sub> = 3.0 Vdc, I <sub>C</sub> = 10 mA, I <sub>B1</sub> = I <sub>B2</sub> = 1.0 mA)	t <sub>s</sub>	–	225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

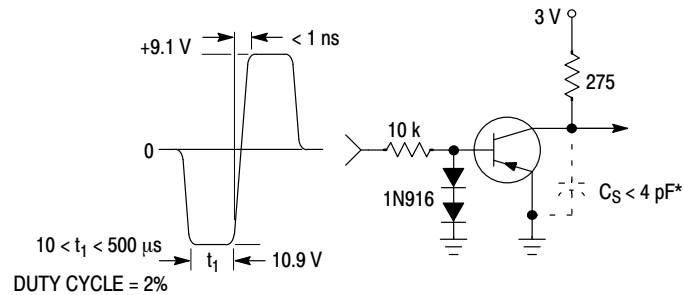
Device	Package	Shipping†
2N3906	TO-92	5000 Units / Bulk
2N3906G	TO-92 (Pb-Free)	5000 Units / Bulk
2N3906RL1	TO-92	2000 / Tape & Reel
2N3906RL1G	TO-92 (Pb-Free)	2000 / Tape & Reel
2N3906RLRA	TO-92	2000 / Tape & Reel
2N3906RLRAG	TO-92 (Pb-Free)	2000 / Tape & Reel
2N3906RLRM	TO-92	2000 / Tape & Ammo Box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



\* Total shunt capacitance of test jig and connectors

Figure 1. Delay and Rise Time Equivalent Test Circuit



\* Total shunt capacitance of test jig and connectors

Figure 2. Storage and Fall Time Equivalent Test Circuit

## TYPICAL TRANSIENT CHARACTERISTICS

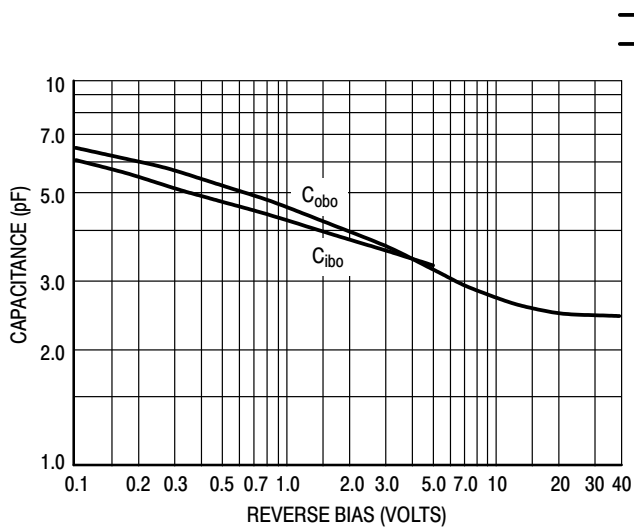


Figure 3. Capacitance

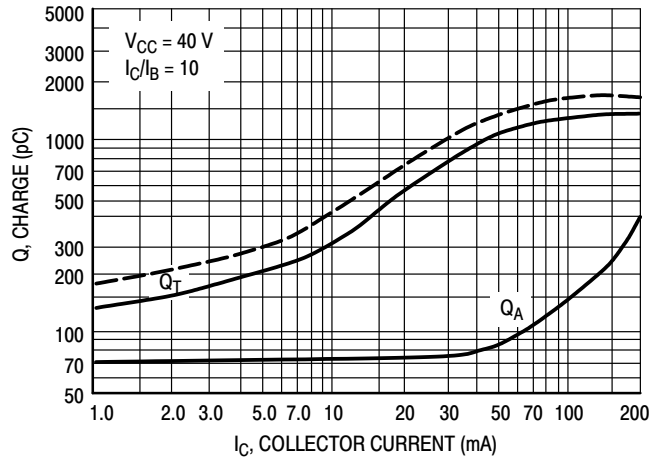


Figure 4. Charge Data

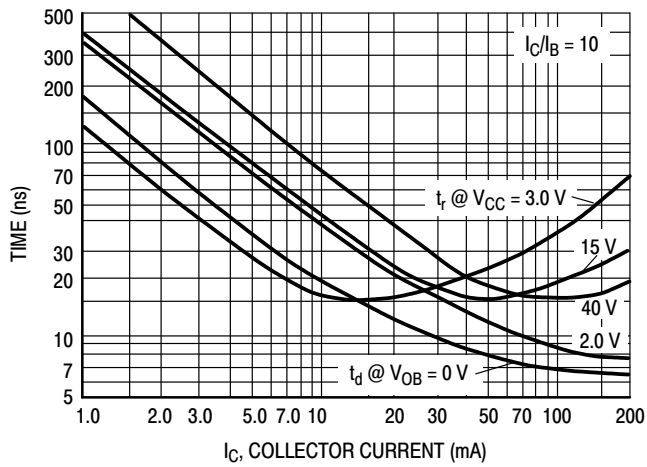


Figure 5. Turn-On Time

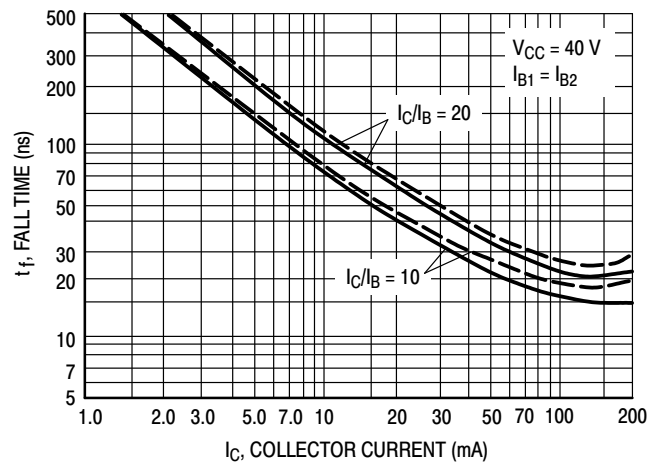


Figure 6. Fall Time

# TYPICAL AUDIO SMALL-SIGNAL CHARACTERISTICS NOISE FIGURE VARIATIONS

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

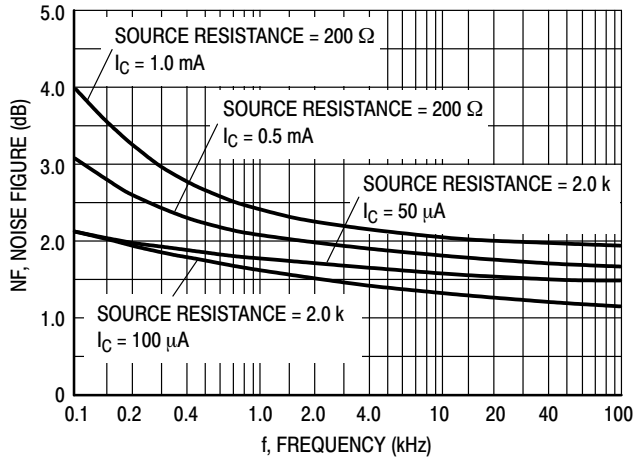


Figure 7.

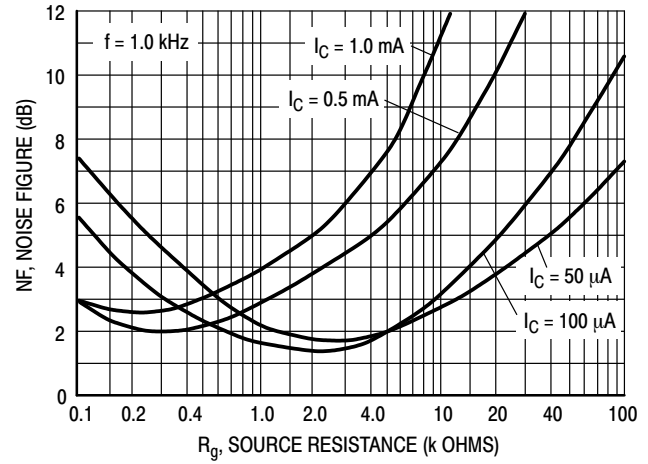


Figure 8.

## h PARAMETERS

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

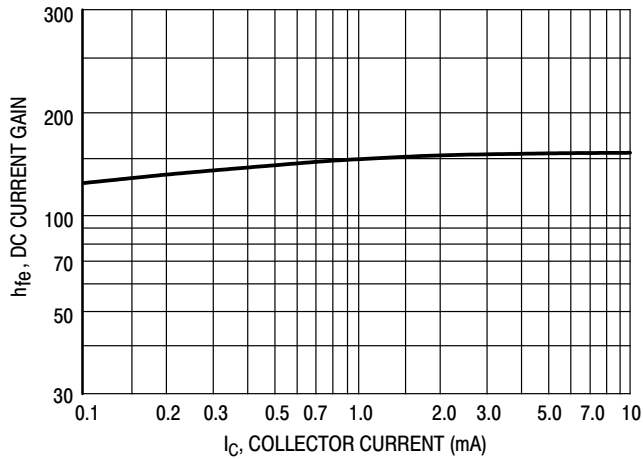


Figure 9. Current Gain

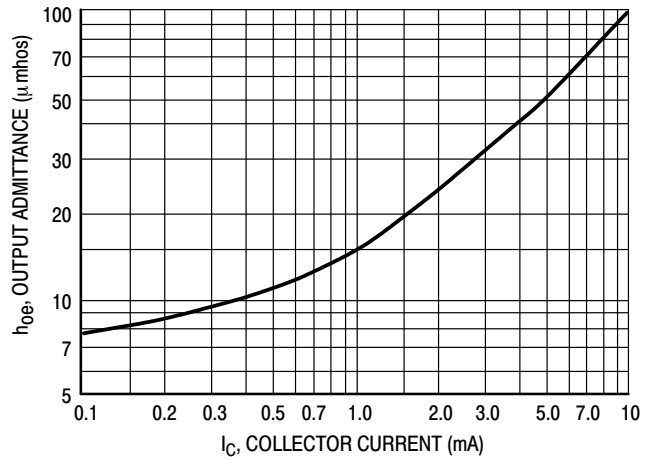


Figure 10. Output Admittance

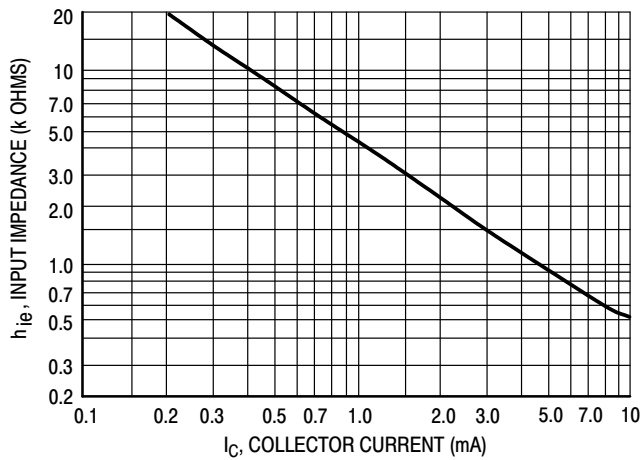


Figure 11. Input Impedance

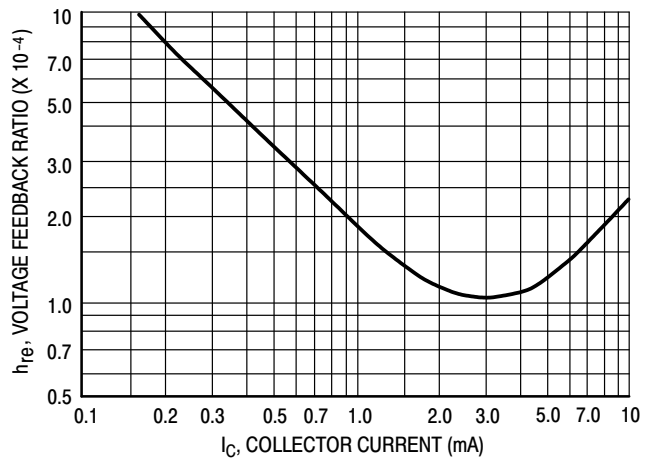


Figure 12. Voltage Feedback Ratio

## TYPICAL STATIC CHARACTERISTICS

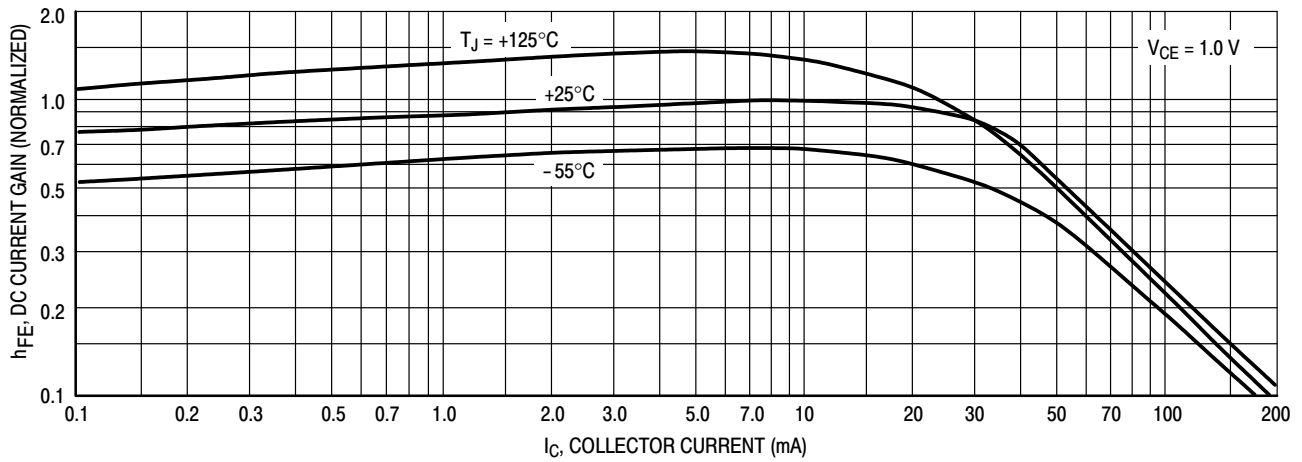


Figure 13. DC Current Gain

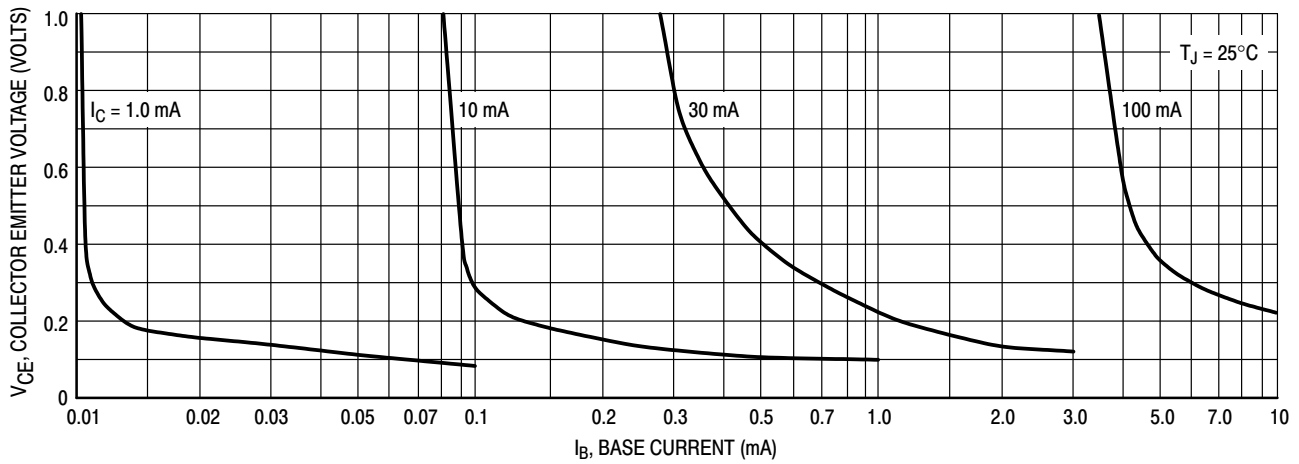


Figure 14. Collector Saturation Region

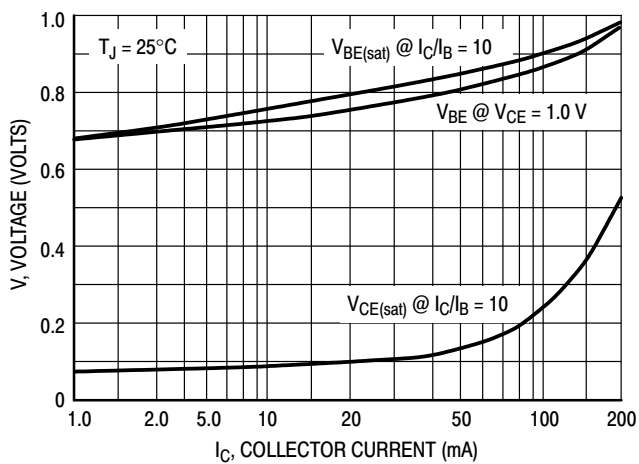


Figure 15. "ON" Voltages

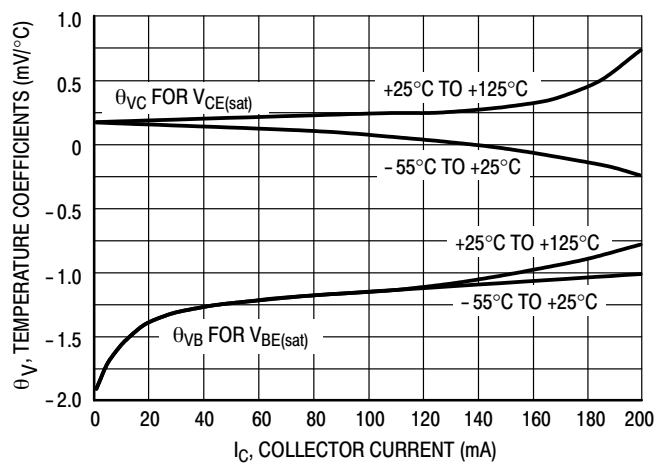


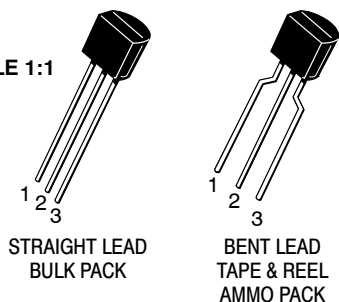
Figure 16. Temperature Coefficients

# MECHANICAL CASE OUTLINE PACKAGE DIMENSIONS

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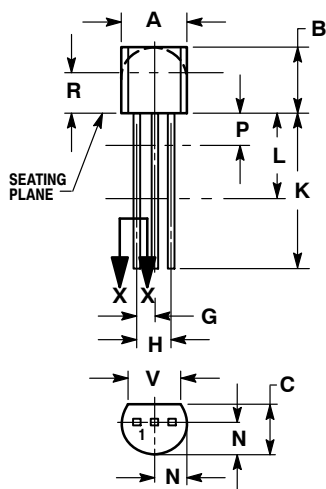
ON

SCALE 1:1

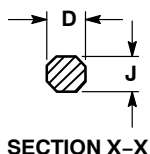


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CASE 29-11  
ISSUE AM

DATE 09 MAR 2007



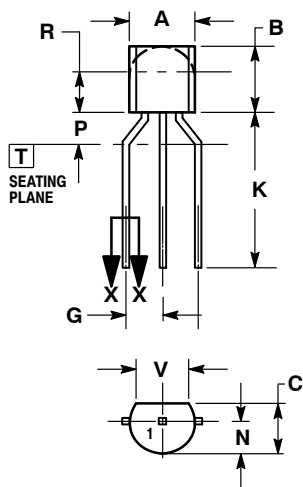
STRAIGHT LEAD  
BULK PACK



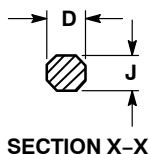
NOTES:

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	---

STYLES ON PAGE 2

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

DATE 09 MAR 2007

STYLE 1: PIN 1. EMITTER 2. BASE 3. COLLECTOR	STYLE 2: PIN 1. BASE 2. EMITTER 3. COLLECTOR	STYLE 3: PIN 1. ANODE 2. ANODE 3. CATHODE	STYLE 4: PIN 1. CATHODE 2. CATHODE 3. ANODE	STYLE 5: PIN 1. DRAIN 2. SOURCE 3. GATE
STYLE 6: PIN 1. GATE 2. SOURCE & SUBSTRATE 3. DRAIN	STYLE 7: PIN 1. SOURCE 2. DRAIN 3. GATE	STYLE 8: PIN 1. DRAIN 2. GATE 3. SOURCE & SUBSTRATE	STYLE 9: PIN 1. BASE 1 2. EMITTER 3. BASE 2	STYLE 10: PIN 1. CATHODE 2. GATE 3. ANODE
STYLE 11: PIN 1. ANODE 2. CATHODE & ANODE 3. CATHODE	STYLE 12: PIN 1. MAIN TERMINAL 1 2. GATE 3. MAIN TERMINAL 2	STYLE 13: PIN 1. ANODE 1 2. GATE 3. CATHODE 2	STYLE 14: PIN 1. EMITTER 2. COLLECTOR 3. BASE	STYLE 15: PIN 1. ANODE 1 2. CATHODE 3. ANODE 2
STYLE 16: PIN 1. ANODE 2. GATE 3. CATHODE	STYLE 17: PIN 1. COLLECTOR 2. BASE 3. EMITTER	STYLE 18: PIN 1. ANODE 2. CATHODE 3. NOT CONNECTED	STYLE 19: PIN 1. GATE 2. ANODE 3. CATHODE	STYLE 20: PIN 1. NOT CONNECTED 2. CATHODE 3. ANODE
STYLE 21: PIN 1. COLLECTOR 2. EMITTER 3. BASE	STYLE 22: PIN 1. SOURCE 2. GATE 3. DRAIN	STYLE 23: PIN 1. GATE 2. SOURCE 3. DRAIN	STYLE 24: PIN 1. EMITTER 2. COLLECTOR/ANODE 3. CATHODE	STYLE 25: PIN 1. MT 1 2. GATE 3. MT 2
STYLE 26: PIN 1. $V_{CC}$ 2. GROUND 2 3. OUTPUT	STYLE 27: PIN 1. MT 2. SUBSTRATE 3. MT	STYLE 28: PIN 1. CATHODE 2. ANODE 3. GATE	STYLE 29: PIN 1. NOT CONNECTED 2. ANODE 3. CATHODE	STYLE 30: PIN 1. DRAIN 2. GATE 3. SOURCE
STYLE 31: PIN 1. GATE 2. DRAIN 3. SOURCE	STYLE 32: PIN 1. BASE 2. COLLECTOR 3. EMITTER	STYLE 33: PIN 1. RETURN 2. INPUT 3. OUTPUT	STYLE 34: PIN 1. INPUT 2. GROUND 3. LOGIC	STYLE 35: PIN 1. GATE 2. COLLECTOR 3. EMITTER

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