

# 2N3906

Preferred Device

## 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 dc                      |
| Total Device Dissipation @ $T_A = 25^\circ\text{C}$<br>Derate above $25^\circ\text{C}$ | $P_D$          | 625<br>5.0  | mW<br>mW/ $^\circ\text{C}$ |
| Total Power Dissipation @ $T_A = 60^\circ\text{C}$                                     | $P_D$          | 250         | mW                         |
| Total Device Dissipation @ $T_C = 25^\circ\text{C}$<br>Derate above $25^\circ\text{C}$ | $P_D$          | 1.5<br>12   | W<br>mW/ $^\circ\text{C}$  |
| Operating and Storage Junction<br>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  | $^\circ\text{C/W}$ |
| Thermal Resistance, Junction-to-Case    | $R_{\theta JC}$ | 83.3 | $^\circ\text{C/W}$ |

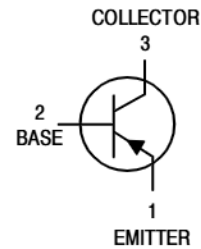
Stresses exceeding Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stresses above the Recommended Operating Conditions may affect device reliability.

1. Indicates Data in addition to JEDEC Requirements.

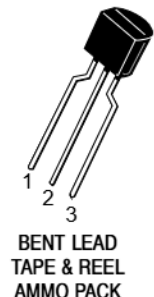
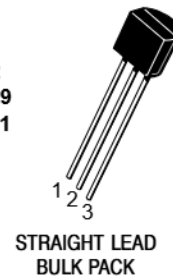


ON Semiconductor®

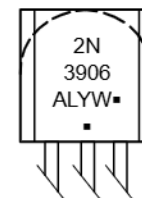
<http://onsemi.com>



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.

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, 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) | ( $I_C = 1.0\text{ mAdc}$ , $I_B = 0$ )                  | $V_{(BR)CEO}$ | 40  | –  | Vdc  |
| Collector–Base Breakdown Voltage             | ( $I_C = 10\text{ }\mu\text{Adc}$ , $I_E = 0$ )          | $V_{(BR)CBO}$ | 40  | –  | Vdc  |
| Emitter–Base Breakdown Voltage               | ( $I_E = 10\text{ }\mu\text{Adc}$ , $I_C = 0$ )          | $V_{(BR)EBO}$ | 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                      | ( $I_C = 0.1\text{ mAdc}$ , $V_{CE} = 1.0\text{ Vdc}$ )<br>( $I_C = 1.0\text{ mAdc}$ , $V_{CE} = 1.0\text{ Vdc}$ )<br>( $I_C = 10\text{ mAdc}$ , $V_{CE} = 1.0\text{ Vdc}$ )<br>( $I_C = 50\text{ mAdc}$ , $V_{CE} = 1.0\text{ Vdc}$ )<br>( $I_C = 100\text{ mAdc}$ , $V_{CE} = 1.0\text{ Vdc}$ ) | $h_{FE}$      | 60<br>80<br>100<br>60<br>30 | –<br>–<br>300<br>–<br>– | –   |
| Collector–Emitter Saturation Voltage | ( $I_C = 10\text{ mAdc}$ , $I_B = 1.0\text{ mAdc}$ )<br>( $I_C = 50\text{ mAdc}$ , $I_B = 5.0\text{ mAdc}$ )                                                                                                                                                                                      | $V_{CE(sat)}$ | –<br>–                      | 0.25<br>0.4             | Vdc |
| Base–Emitter Saturation Voltage      | ( $I_C = 10\text{ mAdc}$ , $I_B = 1.0\text{ mAdc}$ )<br>( $I_C = 50\text{ mAdc}$ , $I_B = 5.0\text{ mAdc}$ )                                                                                                                                                                                      | $V_{BE(sat)}$ | 0.65<br>–                   | 0.85<br>0.95            | Vdc |

**SMALL–SIGNAL CHARACTERISTICS**

|                                  |                                                                                                                      |           |     |     |                  |
|----------------------------------|----------------------------------------------------------------------------------------------------------------------|-----------|-----|-----|------------------|
| Current–Gain – Bandwidth Product | ( $I_C = 10\text{ mAdc}$ , $V_{CE} = 20\text{ Vdc}$ , $f = 100\text{ MHz}$ )                                         | $f_T$     | 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                  | ( $I_C = 1.0\text{ mAdc}$ , $V_{CE} = 10\text{ Vdc}$ , $f = 1.0\text{ kHz}$ )                                        | $h_{ie}$  | 2.0 | 12  | k $\Omega$       |
| Voltage Feedback Ratio           | ( $I_C = 1.0\text{ mAdc}$ , $V_{CE} = 10\text{ Vdc}$ , $f = 1.0\text{ kHz}$ )                                        | $h_{re}$  | 0.1 | 10  | $\times 10^{-4}$ |
| Small–Signal Current Gain        | ( $I_C = 1.0\text{ mAdc}$ , $V_{CE} = 10\text{ Vdc}$ , $f = 1.0\text{ kHz}$ )                                        | $h_{fe}$  | 100 | 400 | –                |
| Output Admittance                | ( $I_C = 1.0\text{ mAdc}$ , $V_{CE} = 10\text{ Vdc}$ , $f = 1.0\text{ kHz}$ )                                        | $h_{oe}$  | 3.0 | 60  | $\mu\text{mhos}$ |
| Noise Figure                     | ( $I_C = 100\text{ }\mu\text{Adc}$ , $V_{CE} = 5.0\text{ Vdc}$ , $R_S = 1.0\text{ k}\Omega$ , $f = 1.0\text{ kHz}$ ) | NF        | –   | 4.0 | dB               |

**SWITCHING CHARACTERISTICS**

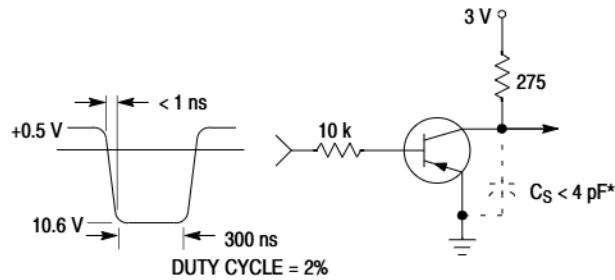
|              |                                                                                                                 |                |   |     |    |
|--------------|-----------------------------------------------------------------------------------------------------------------|----------------|---|-----|----|
| Delay Time   | (V <sub>CC</sub> = 3.0 Vdc, V <sub>BE</sub> = 0.5 Vdc,<br>I <sub>C</sub> = 10 mAdc, I <sub>B1</sub> = 1.0 mAdc) | 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 mAdc, I <sub>B1</sub> = I <sub>B2</sub> = 1.0 mAdc)             | t <sub>s</sub> | – | 225 | ns |
| Fall Time    | (V <sub>CC</sub> = 3.0 Vdc, I <sub>C</sub> = 10 mAdc, I <sub>B1</sub> = I <sub>B2</sub> = 1.0 mAdc)             | t <sub>f</sub> | – | 75  | ns |

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

## ORDERING INFORMATION

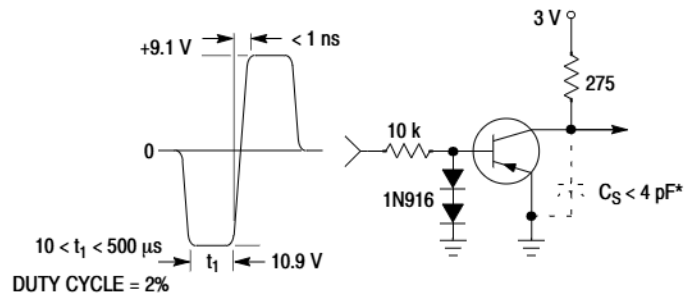
| Device      | Package            | Shipping <sup>†</sup> |
|-------------|--------------------|-----------------------|
| 2N3906      | TO-92              | 5000 Units / Bulk     |
| 2N3906G     | TO-92<br>(Pb-Free) | 5000 Units / Bulk     |
| 2N3906RL1   | TO-92              | 5000 Units / Bulk     |
| 2N3906RL1G  | TO-92<br>(Pb-Free) | 5000 Units / Bulk     |
| 2N3906RLRA  | TO-92              | 2000 / Tape & Reel    |
| 2N3906RLRAG | TO-92<br>(Pb-Free) | 2000 / Tape & Reel    |
| 2N3906RLRM  | TO-92              | 2000 / Ammo Pack      |
| 2N3906RLRMG | TO-92<br>(Pb-Free) | 2000 / Ammo Pack      |
| 2N3906RLRP  | TO-92              | 2000 / Tape & Reel    |
| 2N3906RLRPG | TO-92<br>(Pb-Free) | 2000 / Tape & Reel    |

<sup>†</sup>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

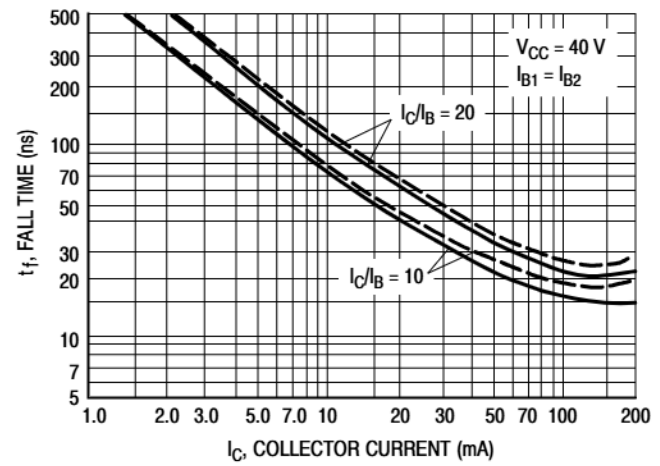
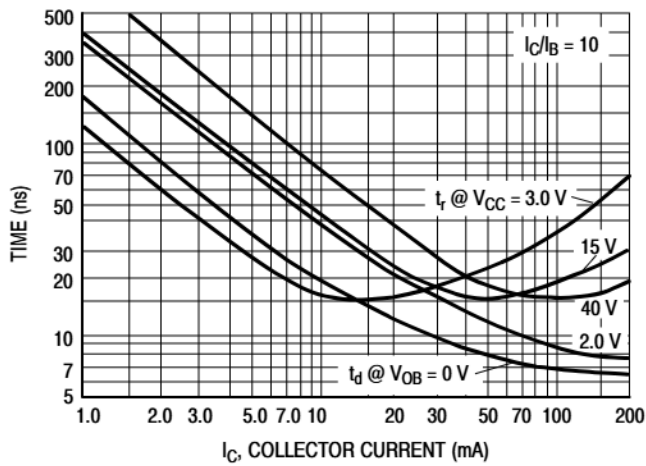
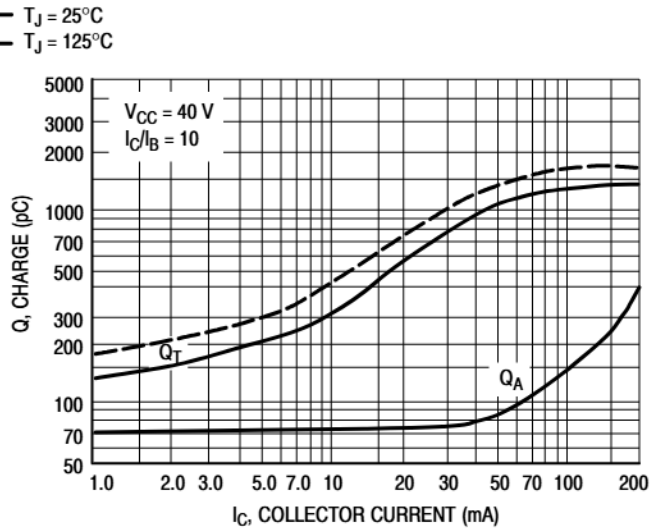
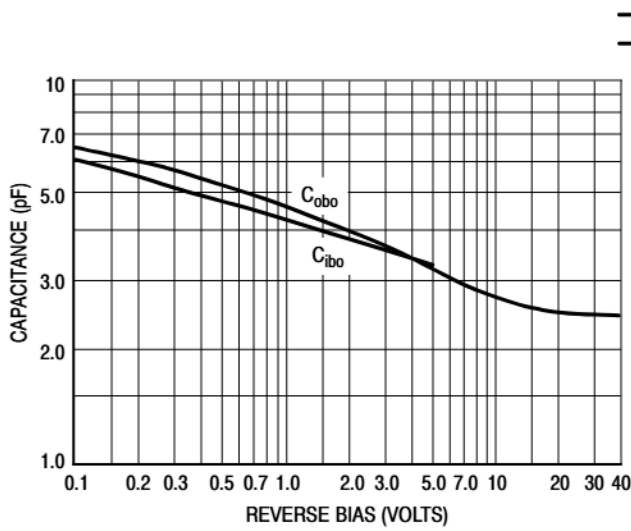
**Figure 1. Delay and Rise Time Equivalent Test Circuit**



\* Total shunt capacitance of test jig and connectors

**Figure 2. Storage and Fall Time Equivalent Test Circuit**

TYPICAL TRANSIENT CHARACTERISTICS



# **TYPICAL AUDIO SMALL-SIGNAL CHARACTERISTICS** **NOISE FIGURE VARIATIONS**

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

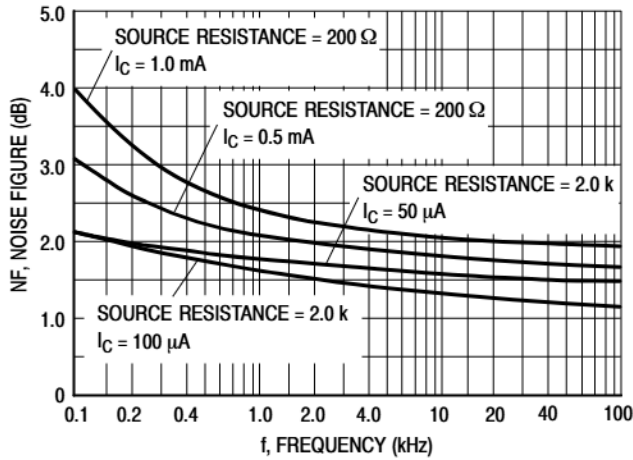


Figure 7.

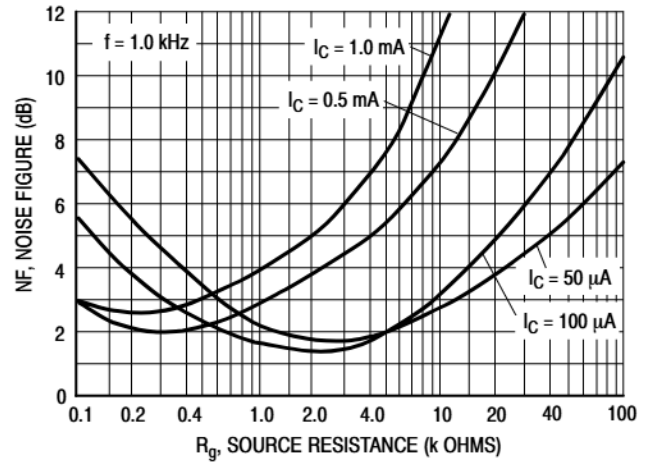


Figure 8.

## **h PARAMETERS**

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

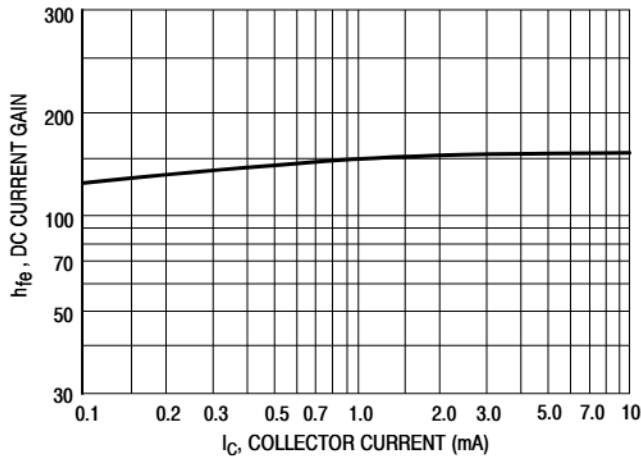


Figure 9. Current Gain

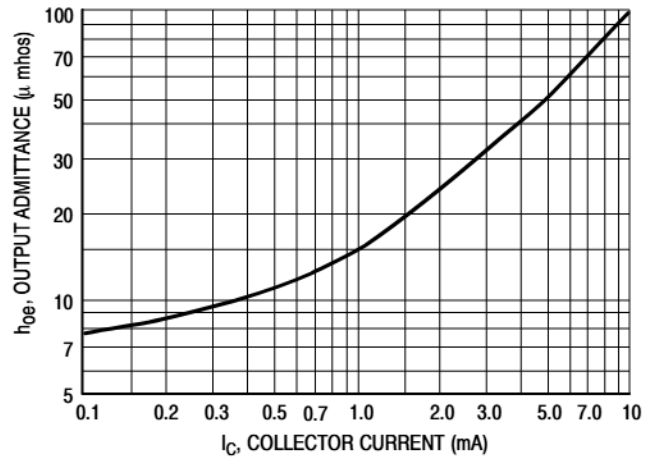


Figure 10. Output Admittance

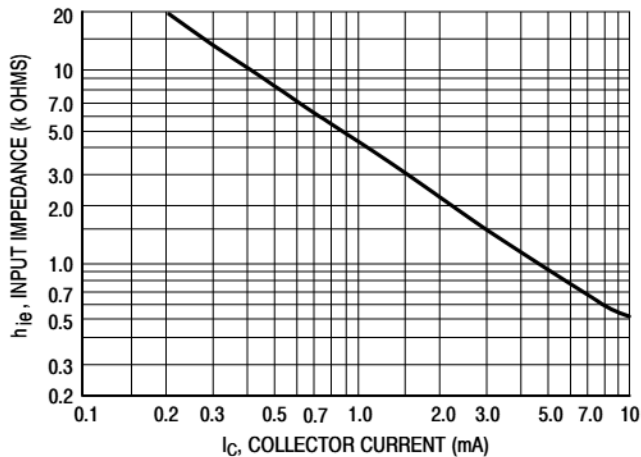


Figure 11. Input Impedance

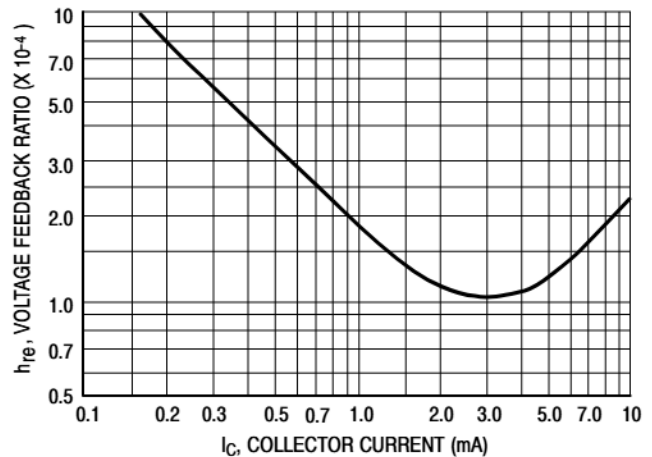


Figure 12. Voltage Feedback Ratio

TYPICAL STATIC CHARACTERISTICS

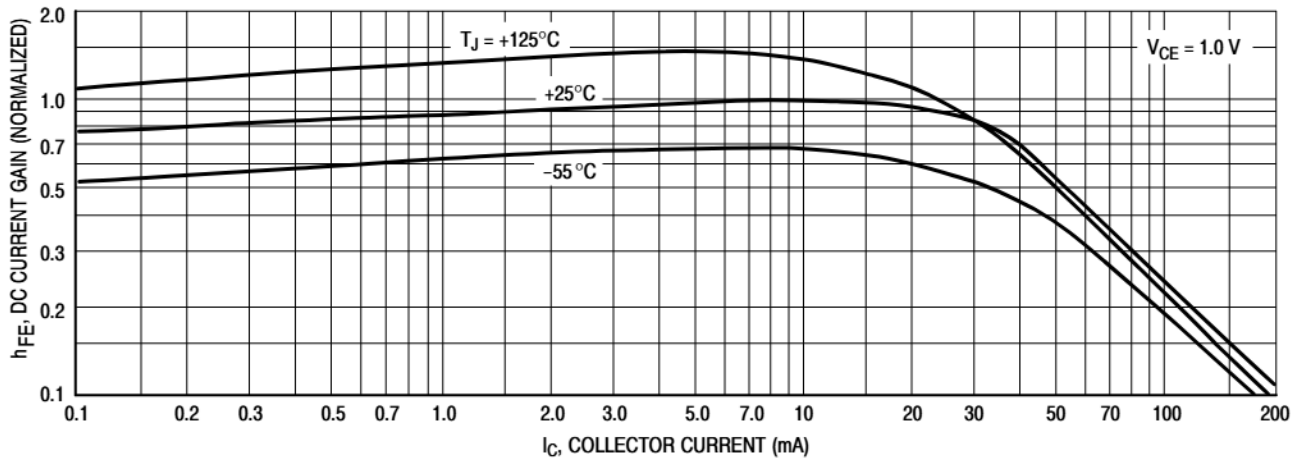


Figure 13. DC Current Gain

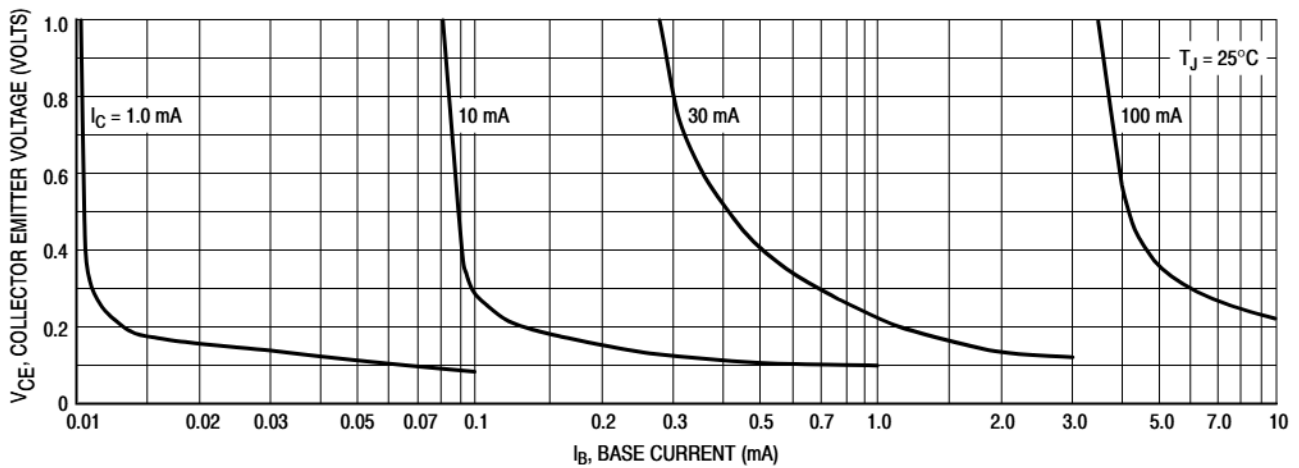


Figure 14. Collector Saturation Region

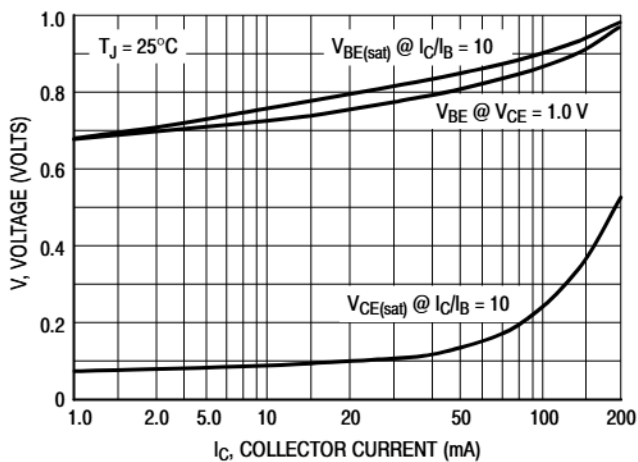


Figure 15. "ON" Voltages

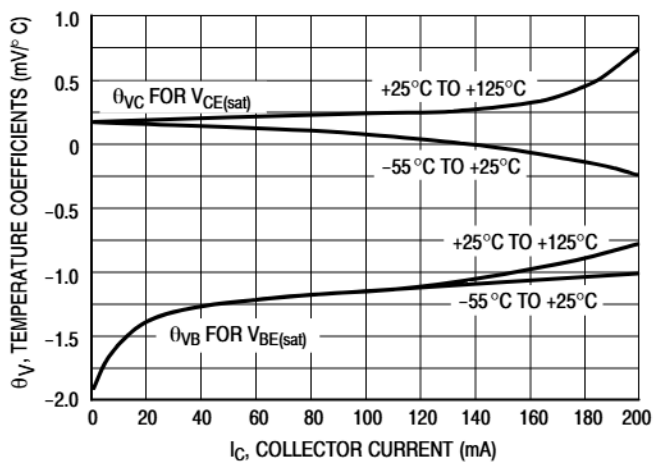
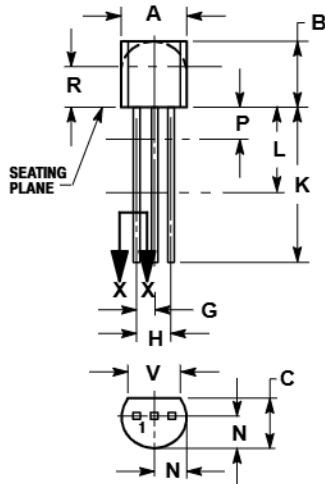
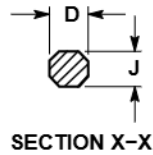


Figure 16. Temperature Coefficients

## PACKAGE DIMENSIONS

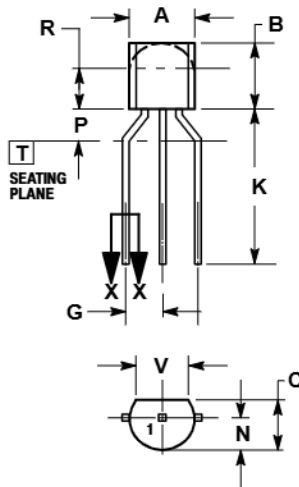
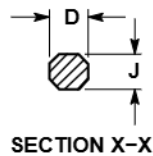
TO-92 (TO-226)  
CASE 29-11  
ISSUE AMSTRAIGHT LEAD  
BULK PACK

SECTION X-X

## 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

SECTION X-X

## 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

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