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# 2N4403

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  | $I_C$          | 600            | mAdc                       |
| Total Device Dissipation<br>@ $T_A = 25^\circ\text{C}$<br>Derate above $25^\circ\text{C}$ | $P_D$          | 625<br>5.0     | mW<br>mW/ $^\circ\text{C}$ |
| Total Device Dissipation<br>@ $T_C = 25^\circ\text{C}$<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<br>+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 | $^\circ\text{C}/\text{W}$ |

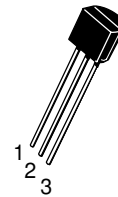
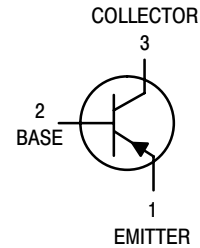
Maximum ratings are those values beyond which device damage can occur. Maximum ratings applied to the device are individual stress limit values (not normal operating conditions) and are not valid simultaneously. If these limits are exceeded, device functional operation is not implied, damage may occur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

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



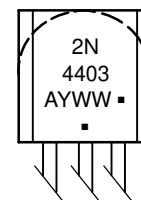
ON Semiconductor®

<http://onsemi.com>



TO-92  
CASE 29  
STYLE 1

#### MARKING DIAGRAM



2N4403 = Device Code  
A = Assembly Location  
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.

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

## 2N4403

### ELECTRICAL CHARACTERISTICS (T<sub>A</sub> = 25°C unless otherwise noted)

| Characteristic   | Symbol               | Min | Max | Unit             |
|--|----------------------|-----|-----|------------------|
| <b>OFF CHARACTERISTICS</b>   |                      |     |     |                  |
| Collector–Emitter Breakdown Voltage (Note 1)<br>(I <sub>C</sub> = 1.0 mA <sub>dc</sub> , I <sub>B</sub> = 0) | V <sub>(BR)CEO</sub> | 40  | –   | V <sub>dc</sub>  |
| Collector–Base Breakdown Voltage<br>(I <sub>C</sub> = 0.1 mA <sub>dc</sub> , I <sub>E</sub> = 0)             | V <sub>(BR)CBO</sub> | 40  | –   | V <sub>dc</sub>  |
| Emitter–Base Breakdown Voltage<br>(I <sub>E</sub> = 0.1 mA <sub>dc</sub> , I <sub>C</sub> = 0)               | V <sub>(BR)EBO</sub> | 5.0 | –   | V <sub>dc</sub>  |
| Base Cutoff Current<br>(V <sub>CE</sub> = 35 V <sub>dc</sub> , V <sub>EB</sub> = 0.4 V <sub>dc</sub> )       | I <sub>BEV</sub>     | –   | 0.1 | μA <sub>dc</sub> |
| Collector Cutoff Current<br>(V <sub>CE</sub> = 35 V <sub>dc</sub> , V <sub>EB</sub> = 0.4 V <sub>dc</sub> )  | I <sub>CEX</sub>     | –   | 0.1 | μA <sub>dc</sub> |

### ON CHARACTERISTICS

|  |                      |                              |                         |                 |
|--|----------------------|------------------------------|-------------------------|-----------------|
| DC Current Gain<br>(I <sub>C</sub> = 0.1 mA <sub>dc</sub> , V <sub>CE</sub> = 1.0 V <sub>dc</sub> )<br>(I <sub>C</sub> = 1.0 mA <sub>dc</sub> , V <sub>CE</sub> = 1.0 V <sub>dc</sub> )<br>(I <sub>C</sub> = 10 mA <sub>dc</sub> , V <sub>CE</sub> = 1.0 V <sub>dc</sub> )<br>(I <sub>C</sub> = 150 mA <sub>dc</sub> , V <sub>CE</sub> = 2.0 V <sub>dc</sub> ) (Note 1)<br>(I <sub>C</sub> = 500 mA <sub>dc</sub> , V <sub>CE</sub> = 2.0 V <sub>dc</sub> ) (Note 1) | h <sub>FE</sub>      | 30<br>60<br>100<br>100<br>20 | –<br>–<br>–<br>300<br>– | –               |
| Collector–Emitter Saturation Voltage (Note 1)<br>(I <sub>C</sub> = 150 mA <sub>dc</sub> , I <sub>B</sub> = 15 mA <sub>dc</sub> )<br>(I <sub>C</sub> = 500 mA <sub>dc</sub> , I <sub>B</sub> = 50 mA <sub>dc</sub> )  | V <sub>CE(sat)</sub> | –<br>–                       | 0.4<br>0.75             | V <sub>dc</sub> |
| Base–Emitter Saturation Voltage (Note 1)<br>(I <sub>C</sub> = 150 mA <sub>dc</sub> , I <sub>B</sub> = 15 mA <sub>dc</sub> )<br>(I <sub>C</sub> = 500 mA <sub>dc</sub> , I <sub>B</sub> = 50 mA <sub>dc</sub> )   | V <sub>BE(sat)</sub> | 0.75<br>–                    | 0.95<br>1.3             | V <sub>dc</sub> |

### SMALL–SIGNAL CHARACTERISTICS

|  |                 |       |      |                    |
|--|-----------------|-------|------|--------------------|
| Current–Gain – Bandwidth Product (I <sub>C</sub> = 20 mA <sub>dc</sub> , V <sub>CE</sub> = 10 V <sub>dc</sub> , f = 100 MHz) | f <sub>T</sub>  | 200   | –    | MHz                |
| Collector–Base Capacitance (V <sub>CB</sub> = 10 V <sub>dc</sub> , I <sub>E</sub> = 0, f = 1.0 MHz)                          | C <sub>cb</sub> | –     | 8.5  | pF                 |
| Emitter–Base Capacitance (V <sub>EB</sub> = 0.5 V <sub>dc</sub> , I <sub>C</sub> = 0, f = 1.0 MHz)                           | C <sub>eb</sub> | –     | 30   | pF                 |
| Input Impedance (I <sub>C</sub> = 1.0 mA <sub>dc</sub> , V <sub>CE</sub> = 10 V <sub>dc</sub> , f = 1.0 kHz)                 | h <sub>ie</sub> | 1.5 k | 15 k | Ω                  |
| Voltage Feedback Ratio (I <sub>C</sub> = 1.0 mA <sub>dc</sub> , V <sub>CE</sub> = 10 V <sub>dc</sub> , f = 1.0 kHz)          | h <sub>re</sub> | 0.1   | 8.0  | X 10 <sup>–4</sup> |
| Small–Signal Current Gain (I <sub>C</sub> = 1.0 mA <sub>dc</sub> , V <sub>CE</sub> = 10 V <sub>dc</sub> , f = 1.0 kHz)       | h <sub>fe</sub> | 60    | 500  | –                  |
| Output Admittance (I <sub>C</sub> = 1.0 mA <sub>dc</sub> , V <sub>CE</sub> = 10 V <sub>dc</sub> , f = 1.0 kHz)               | h <sub>oe</sub> | 1.0   | 100  | μmhos              |

### SWITCHING CHARACTERISTICS

|              |   |                |   |     |    |
|--------------|---|----------------|---|-----|----|
| Delay Time   | (V <sub>CC</sub> = 30 V <sub>dc</sub> , V <sub>BE</sub> = +2.0 V <sub>dc</sub> ,<br>I <sub>C</sub> = 150 mA <sub>dc</sub> , I <sub>B1</sub> = 15 mA <sub>dc</sub> ) | t <sub>d</sub> | – | 15  | ns |
| Rise Time    |   | t <sub>r</sub> | – | 20  | ns |
| Storage Time | (V <sub>CC</sub> = 30 V <sub>dc</sub> , I <sub>C</sub> = 150 mA <sub>dc</sub> ,<br>I <sub>B1</sub> = 15 mA, I <sub>B2</sub> = 15 mA)                                | t <sub>s</sub> | – | 225 | ns |
| Fall Time    |   | t <sub>f</sub> | – | 30  | ns |

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

# 2N4403

## ORDERING INFORMATION

| Device      | Package            | Shipping†           |
|-------------|--------------------|---------------------|
| 2N4403      | TO-92              | 5,000 Units / Box   |
| 2N4403G     | TO-92<br>(Pb-Free) | 5,000 Units / Box   |
| 2N4403RL    | TO-92              | 2,000 / Tape & Reel |
| 2N4403RLG   | TO-92<br>(Pb-Free) | 2,000 / Tape & Reel |
| 2N4403RLRA  | TO-92              | 2,000 / Tape & Reel |
| 2N4403RLRAG | TO-92<br>(Pb-Free) | 2,000 / Tape & Reel |
| 2N4403RLRM  | TO-92              | 2,000 / Ammo Pack   |
| 2N4403RLRMG | TO-92<br>(Pb-Free) | 2,000 / Ammo Pack   |
| 2N4403RLRP  | TO-92              | 2,000 / Ammo Pack   |
| 2N4403RLRPG | TO-92<br>(Pb-Free) | 2,000 / 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.

## SWITCHING TIME EQUIVALENT TEST CIRCUIT

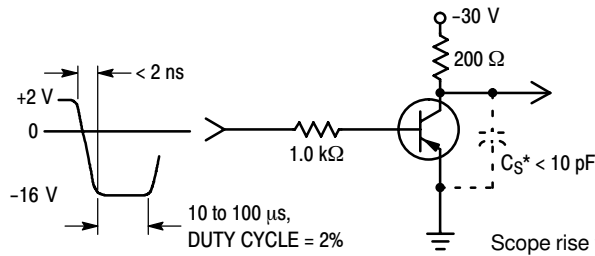


Figure 1. Turn-On Time

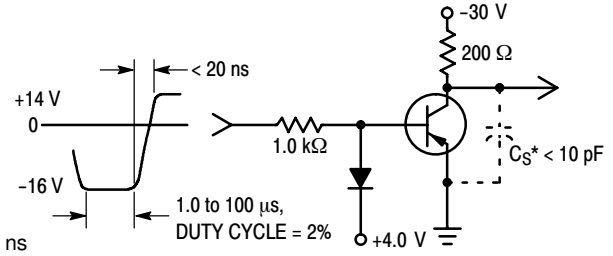


Figure 2. Turn-Off Time

## TRANSIENT CHARACTERISTICS

— 25°C    - - - 100°C

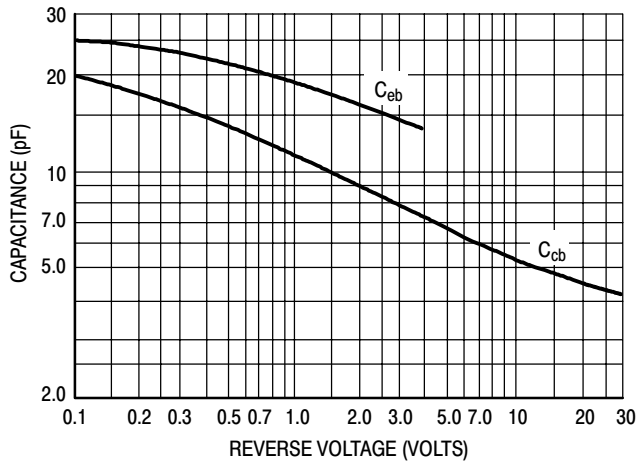


Figure 3. Capacitances

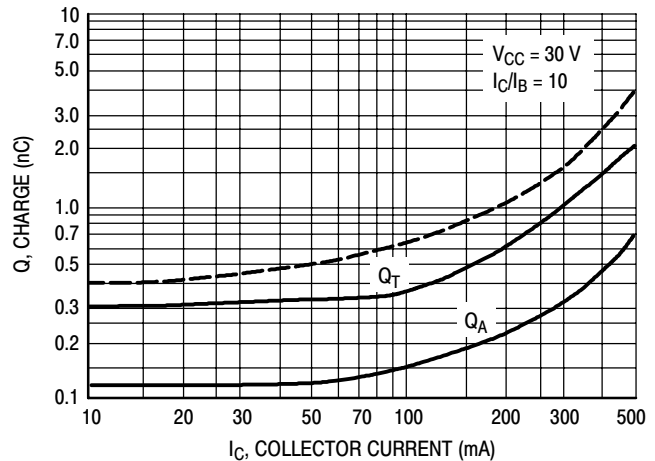


Figure 4. Charge Data

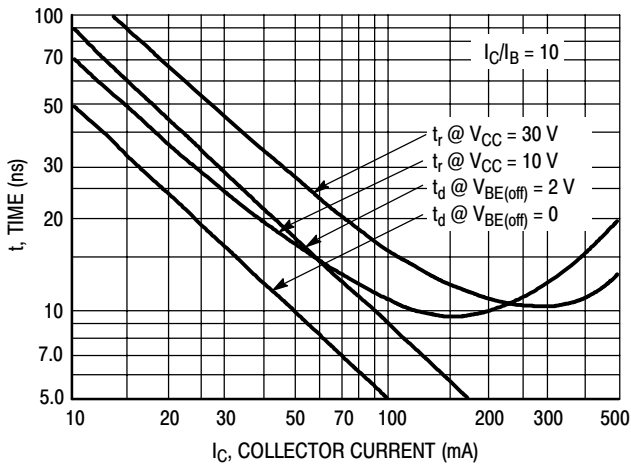


Figure 5. Turn-On Time

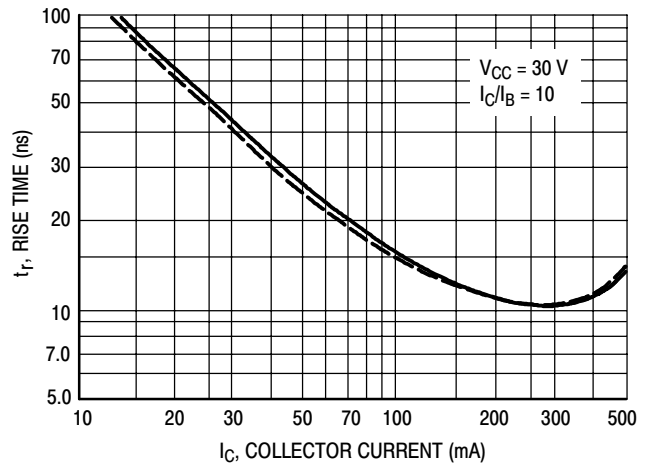


Figure 6. Rise Time

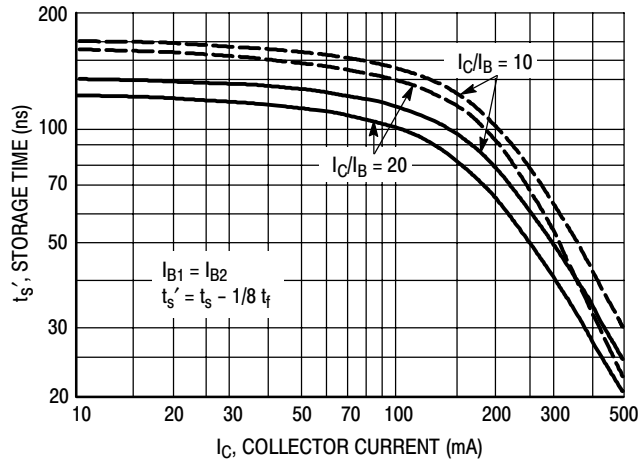


Figure 7. Storage Time

**SMALL-SIGNAL CHARACTERISTICS**  
**NOISE FIGURE**

$V_{CE} = -10$  Vdc,  $T_A = 25^\circ\text{C}$ ; Bandwidth = 1.0 Hz

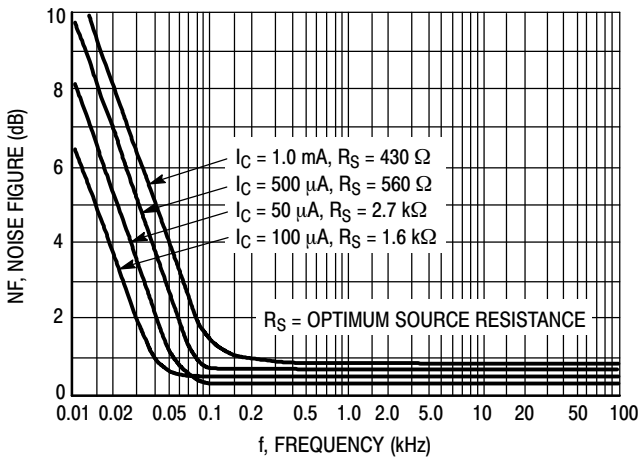


Figure 8. Frequency Effects

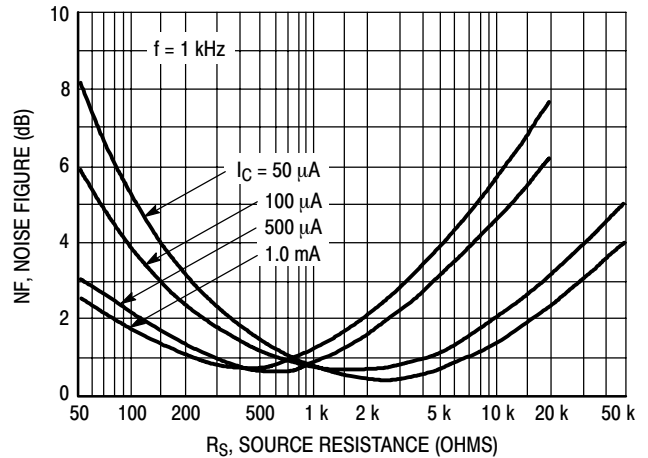


Figure 9. Source Resistance Effects

# 2N4403

## h PARAMETERS

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

This group of graphs illustrates the relationship between  $h_{fe}$  and other "h" parameters for this series of transistors. To obtain these curves, a high-gain and a low-gain unit were

selected from the 2N4403 lines, and the same units were used to develop the correspondingly-numbered curves on each graph.

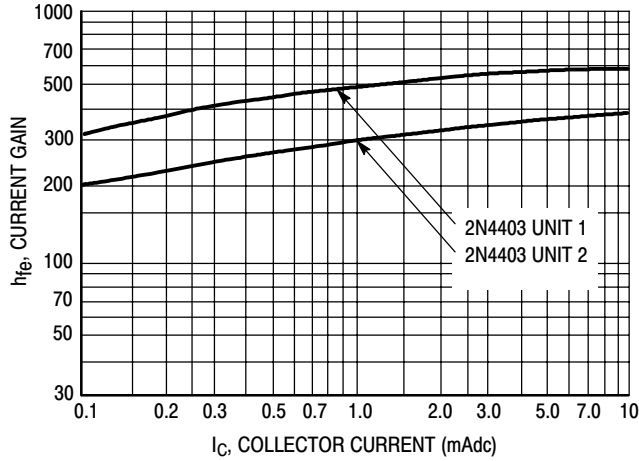


Figure 10. Current Gain

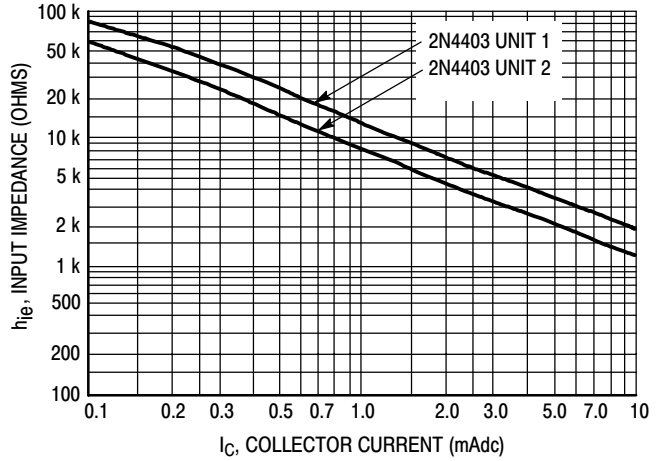


Figure 11. Input Impedance

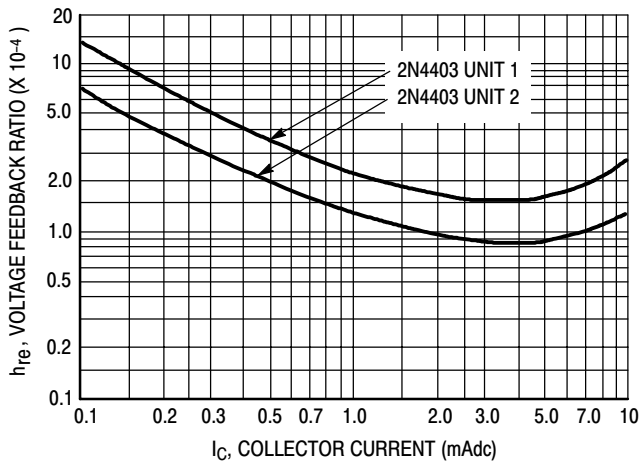


Figure 12. Voltage Feedback Ratio

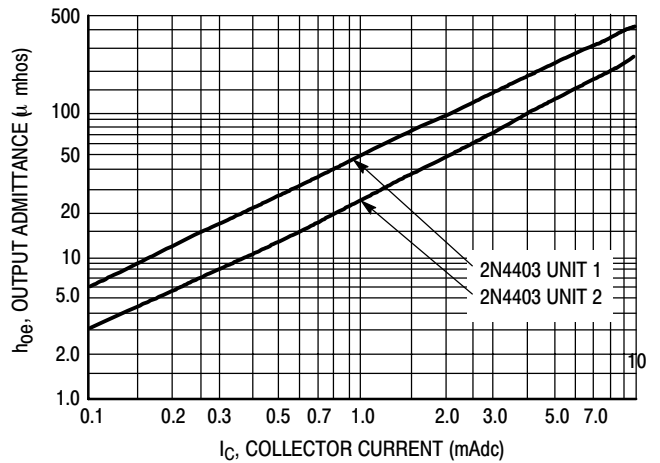


Figure 13. Output Admittance

# 2N4403

## STATIC CHARACTERISTICS

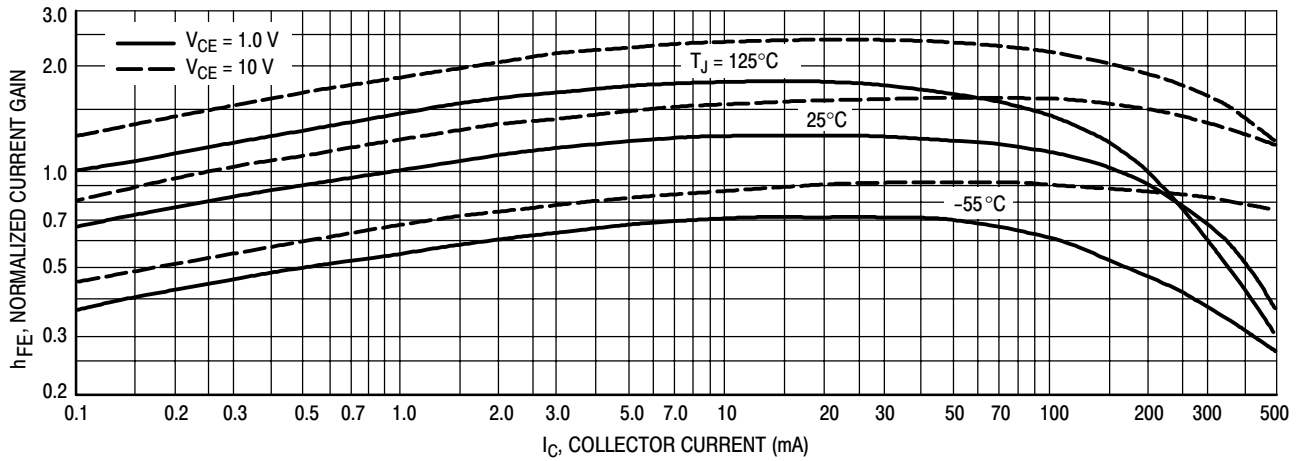


Figure 14. DC Current Gain

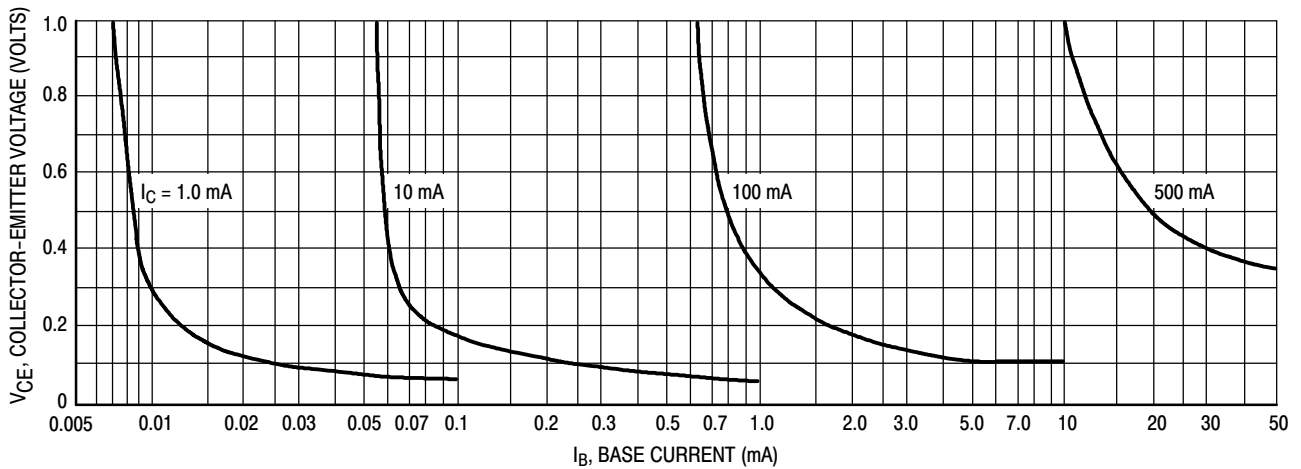


Figure 15. Collector Saturation Region

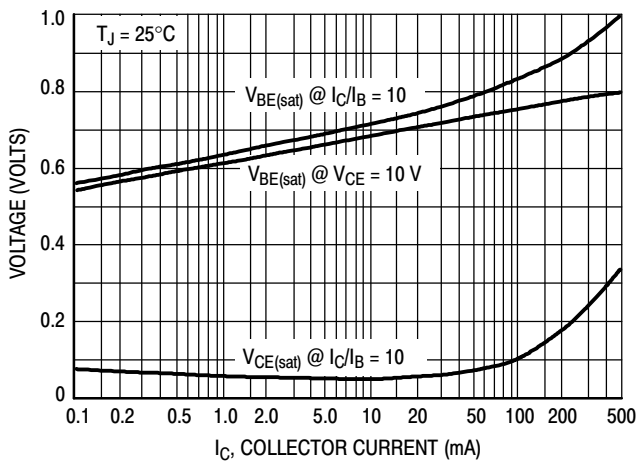


Figure 16. "On" Voltages

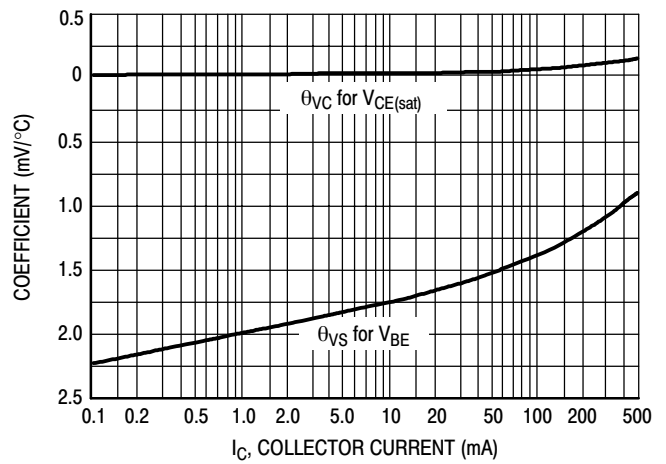
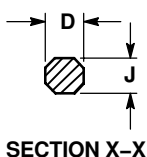
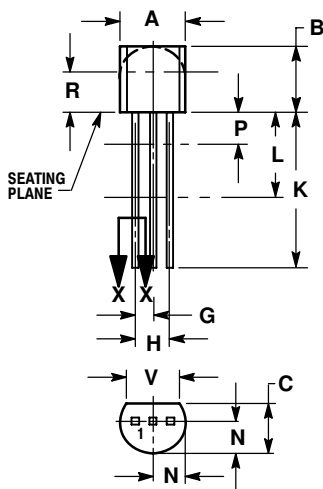


Figure 17. Temperature Coefficients

# 2N4403

## 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

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