

# ON Semiconductor

## Is Now



To learn more about onsemi™, please visit our website at  
[www.onsemi.com](http://www.onsemi.com)

onsemi and onsemi. and other names, marks, and brands are registered and/or common law trademarks of Semiconductor Components Industries, LLC dba "onsemi" or its affiliates and/or subsidiaries in the United States and/or other countries. onsemi owns the rights to a number of patents, trademarks, copyrights, trade secrets, and other intellectual property. A listing of onsemi product/patent coverage may be accessed at [www.onsemi.com/site/pdf/Patent-Marking.pdf](http://www.onsemi.com/site/pdf/Patent-Marking.pdf). onsemi reserves the right to make changes at any time to any products or information herein, without notice. The information herein is provided "as-is" and onsemi makes no warranty, representation or guarantee regarding the accuracy of the information, product features, availability, functionality, or suitability of its products for any particular purpose, nor does onsemi 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. Buyer is responsible for its products and applications using onsemi products, including compliance with all laws, regulations and safety requirements or standards, regardless of any support or applications information provided by onsemi. "Typical" parameters which may be provided in onsemi 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. onsemi does not convey any license under any of its intellectual property rights nor the rights of others. onsemi products are not designed, intended, or authorized for use as a critical component in life support systems or any FDA Class 3 medical devices or medical devices with a same or similar classification in a foreign jurisdiction or any devices intended for implantation in the human body. Should Buyer purchase or use onsemi products for any such unintended or unauthorized application, Buyer shall indemnify and hold onsemi 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 onsemi was negligent regarding the design or manufacture of the part. onsemi is an Equal Opportunity/Affirmative Action Employer. This literature is subject to all applicable copyright laws and is not for resale in any manner. Other names and brands may be claimed as the property of others.

# 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         | 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 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

| 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 | $^\circ\text{C/W}$ |

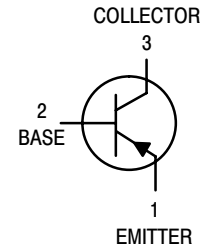
Stresses exceeding Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stresses above the Recommended Operating Conditions may affect device reliability.

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

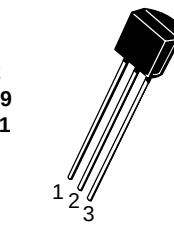


ON Semiconductor®

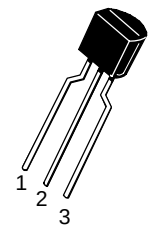
<http://onsemi.com>



TO-92  
CASE 29  
STYLE 1

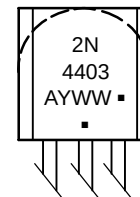


STRAIGHT LEAD  
BULK PACK



BENT LEAD  
TAPE & REEL  
AMMO PACK

#### 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 2 of this data sheet.

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

## 2N4403

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

| Characteristic                                                                          | Symbol        | Min | Max | Unit            |
|-----------------------------------------------------------------------------------------|---------------|-----|-----|-----------------|
| <b>OFF CHARACTERISTICS</b>                                                              |               |     |     |                 |
| Collector–Emitter Breakdown Voltage (Note 1)<br>( $I_C = 1.0\text{ mAdc}$ , $I_B = 0$ ) | $V_{(BR)CEO}$ | 40  | –   | Vdc             |
| Collector–Base Breakdown Voltage<br>( $I_C = 0.1\text{ mAdc}$ , $I_E = 0$ )             | $V_{(BR)CBO}$ | 40  | –   | Vdc             |
| Emitter–Base Breakdown Voltage<br>( $I_E = 0.1\text{ mAdc}$ , $I_C = 0$ )               | $V_{(BR)EBO}$ | 5.0 | –   | Vdc             |
| Base Cutoff Current<br>( $V_{CE} = 35\text{ Vdc}$ , $V_{EB} = 0.4\text{ Vdc}$ )         | $I_{BEV}$     | –   | 0.1 | $\mu\text{Adc}$ |
| Collector Cutoff Current<br>( $V_{CE} = 35\text{ Vdc}$ , $V_{EB} = 0.4\text{ Vdc}$ )    | $I_{CEX}$     | –   | 0.1 | $\mu\text{Adc}$ |

### ON CHARACTERISTICS

|                                                                                                                                                                                                                                                                                                                                         |               |                              |                         |     |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|------------------------------|-------------------------|-----|
| DC Current Gain<br>( $I_C = 0.1\text{ mAdc}$ , $V_{CE} = 1.0\text{ Vdc}$ )<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>( $I_C = 150\text{ mAdc}$ , $V_{CE} = 2.0\text{ Vdc}$ ) (Note 1)<br>( $I_C = 500\text{ mAdc}$ , $V_{CE} = 2.0\text{ Vdc}$ ) (Note 1) | $h_{FE}$      | 30<br>60<br>100<br>100<br>20 | –<br>–<br>–<br>300<br>– | –   |
| Collector–Emitter Saturation Voltage (Note 1)<br>( $I_C = 150\text{ mAdc}$ , $I_B = 15\text{ mAdc}$ )<br>( $I_C = 500\text{ mAdc}$ , $I_B = 50\text{ mAdc}$ )                                                                                                                                                                           | $V_{CE(sat)}$ | –<br>–                       | 0.4<br>0.75             | Vdc |
| Base–Emitter Saturation Voltage (Note 1)<br>( $I_C = 150\text{ mAdc}$ , $I_B = 15\text{ mAdc}$ )<br>( $I_C = 500\text{ mAdc}$ , $I_B = 50\text{ mAdc}$ )                                                                                                                                                                                | $V_{BE(sat)}$ | 0.75<br>–                    | 0.95<br>1.3             | Vdc |

### SMALL–SIGNAL CHARACTERISTICS

|                                                                                                                  |          |       |      |                  |
|------------------------------------------------------------------------------------------------------------------|----------|-------|------|------------------|
| Current–Gain – Bandwidth Product<br>( $I_C = 20\text{ mAdc}$ , $V_{CE} = 10\text{ Vdc}$ , $f = 100\text{ MHz}$ ) | $f_T$    | 200   | –    | MHz              |
| Collector–Base Capacitance<br>( $V_{CB} = 10\text{ Vdc}$ , $I_E = 0$ , $f = 1.0\text{ MHz}$ )                    | $C_{cb}$ | –     | 8.5  | pF               |
| Emitter–Base Capacitance<br>( $V_{EB} = 0.5\text{ Vdc}$ , $I_C = 0$ , $f = 1.0\text{ MHz}$ )                     | $C_{eb}$ | –     | 30   | pF               |
| Input Impedance<br>( $I_C = 1.0\text{ mAdc}$ , $V_{CE} = 10\text{ Vdc}$ , $f = 1.0\text{ kHz}$ )                 | $h_{ie}$ | 1.5 k | 15 k | $\Omega$         |
| Voltage Feedback Ratio<br>( $I_C = 1.0\text{ mAdc}$ , $V_{CE} = 10\text{ Vdc}$ , $f = 1.0\text{ kHz}$ )          | $h_{re}$ | 0.1   | 8.0  | $\times 10^{-4}$ |
| Small–Signal Current Gain<br>( $I_C = 1.0\text{ mAdc}$ , $V_{CE} = 10\text{ Vdc}$ , $f = 1.0\text{ kHz}$ )       | $h_{fe}$ | 60    | 500  | –                |
| Output Admittance<br>( $I_C = 1.0\text{ mAdc}$ , $V_{CE} = 10\text{ Vdc}$ , $f = 1.0\text{ kHz}$ )               | $h_{oe}$ | 1.0   | 100  | $\mu\text{mhos}$ |

### SWITCHING CHARACTERISTICS

|              |                                                                                                                   |       |   |     |    |
|--------------|-------------------------------------------------------------------------------------------------------------------|-------|---|-----|----|
| Delay Time   | $(V_{CC} = 30\text{ Vdc}$ , $V_{BE} = +2.0\text{ Vdc}$ ,<br>$I_C = 150\text{ mAdc}$ , $I_{B1} = 15\text{ mAdc}$ ) | $t_d$ | – | 15  | ns |
| Rise Time    |                                                                                                                   | $t_r$ | – | 20  | ns |
| Storage Time | $(V_{CC} = 30\text{ Vdc}$ , $I_C = 150\text{ mAdc}$ ,<br>$I_{B1} = 15\text{ mA}$ , $I_{B2} = 15\text{ mA}$ )      | $t_s$ | – | 225 | ns |
| Fall Time    |                                                                                                                   | $t_f$ | – | 30  | ns |

1. Pulse Test: Pulse Width  $\leq 300\text{ }\mu\text{s}$ , Duty Cycle  $\leq 2.0\%$ .

### ORDERING INFORMATION

| Device      | Package            | Shipping <sup>†</sup> |
|-------------|--------------------|-----------------------|
| 2N4403      | TO–92              | 5000 Units / Bulk     |
| 2N4403G     | TO–92<br>(Pb–Free) | 5000 Units / Bulk     |
| 2N4403RLRA  | TO–92              | 2000 / Tape & Reel    |
| 2N4403RLRAG | TO–92<br>(Pb–Free) | 2000 / Tape & Reel    |
| 2N4403RLRM  | TO–92              | 2000 / Ammo Pack      |
| 2N4403RLRMG | TO–92<br>(Pb–Free) | 2000 / Ammo Pack      |
| 2N4403RLRPG | TO–92<br>(Pb–Free) | 2000 / Ammo Pack      |

<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.

# SWITCHING TIME EQUIVALENT TEST CIRCUIT

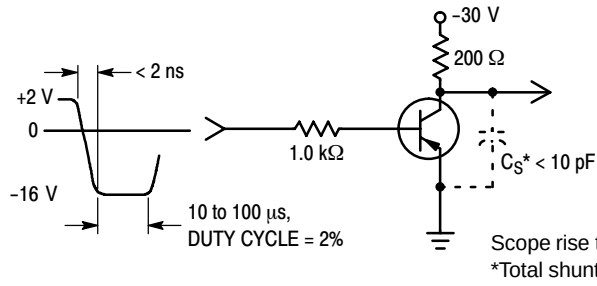


Figure 1. Turn-On Time

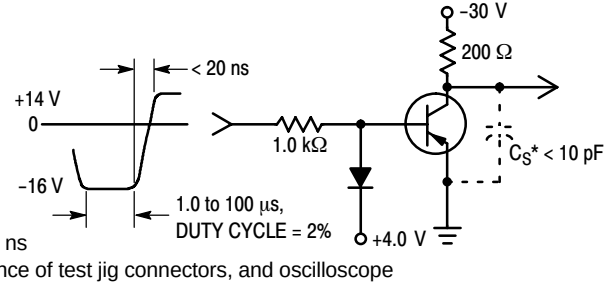


Figure 2. Turn-Off Time

## TRANSIENT CHARACTERISTICS

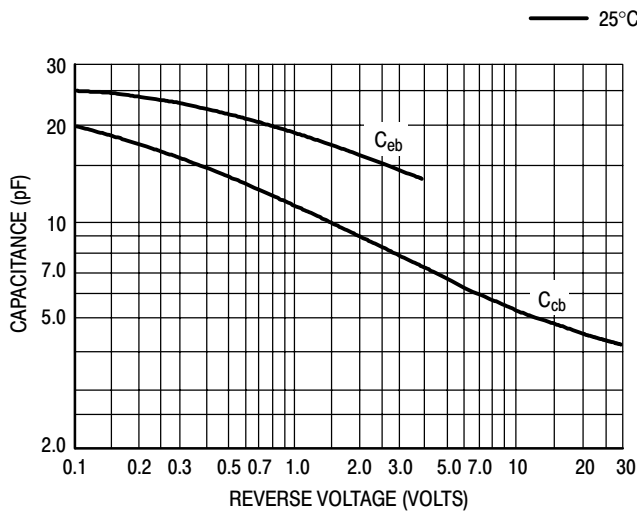


Figure 3. Capacitances

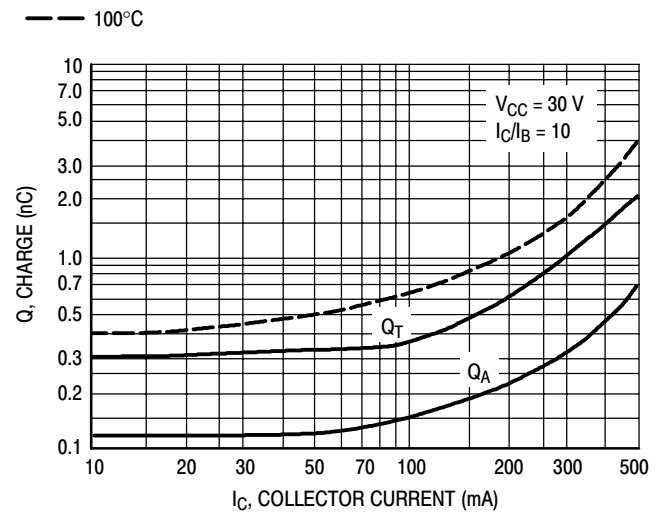
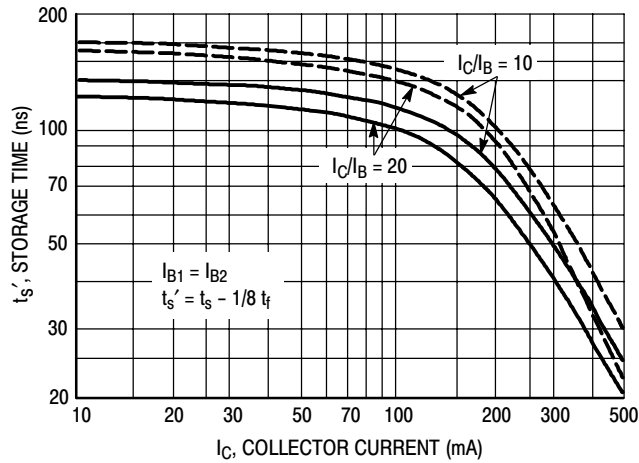
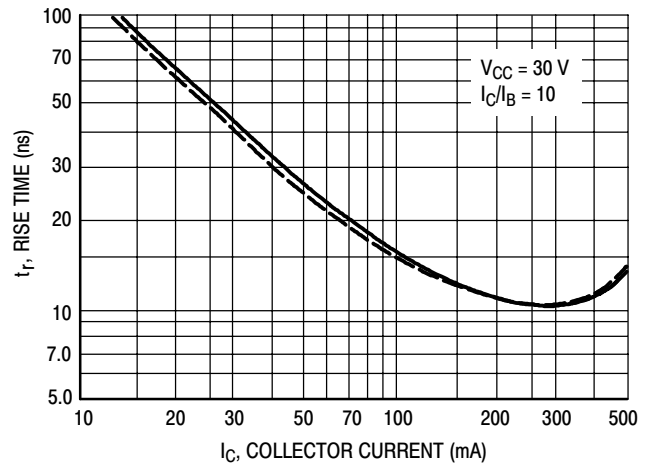
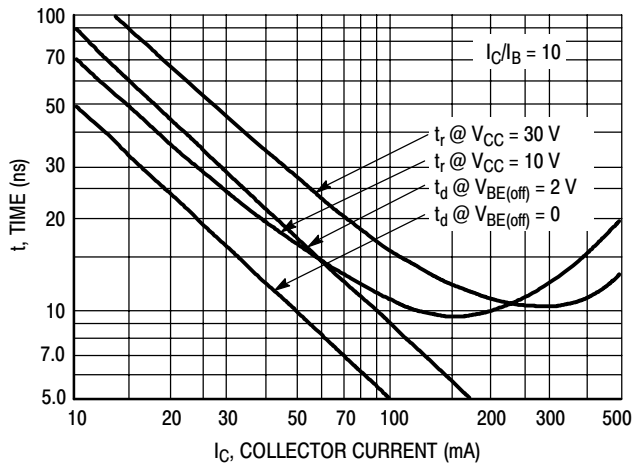


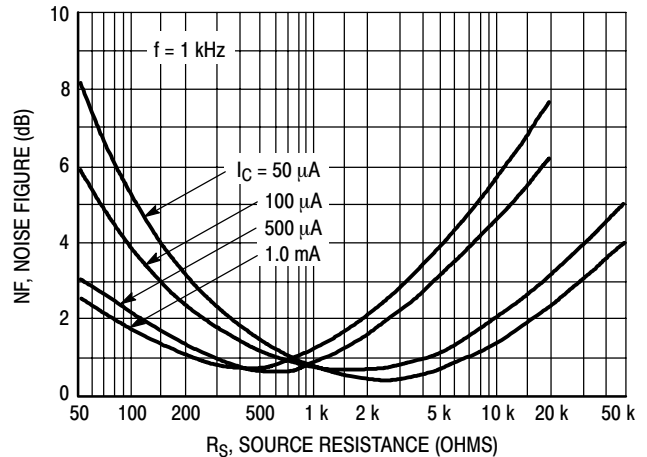
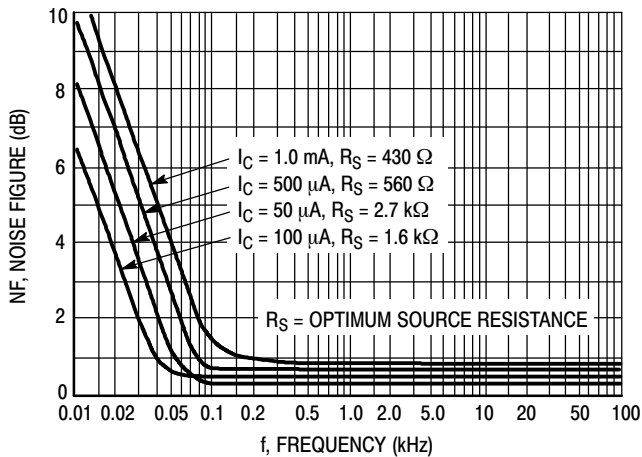
Figure 4. Charge Data

## 2N4403



### SMALL-SIGNAL CHARACTERISTICS NOISE FIGURE

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



## 2N4403

### h PARAMETERS

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

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.

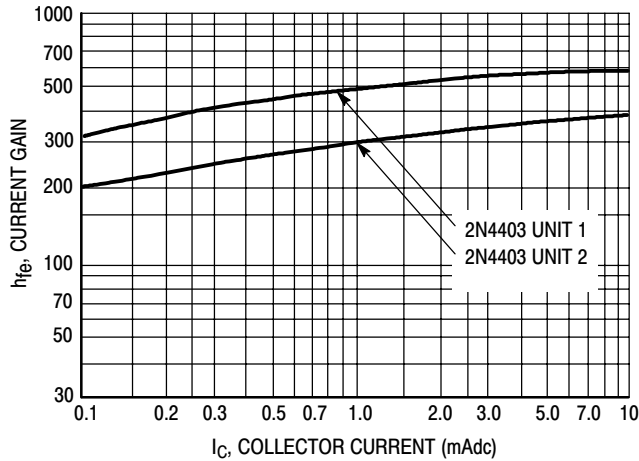


Figure 10. Current Gain

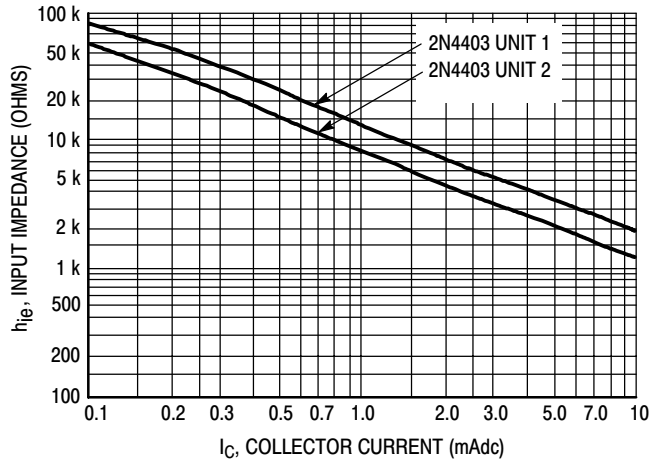


Figure 11. Input Impedance

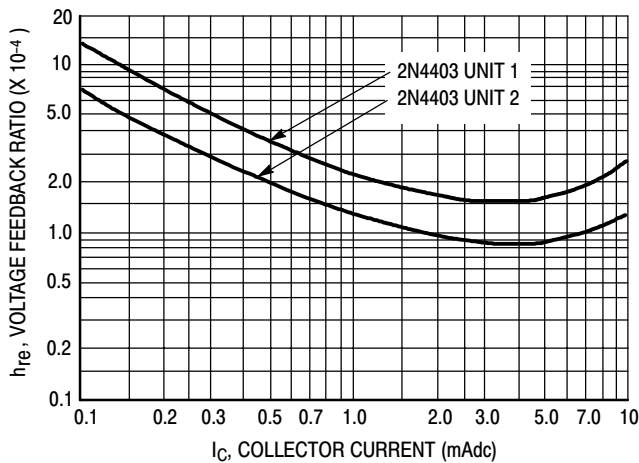


Figure 12. Voltage Feedback Ratio

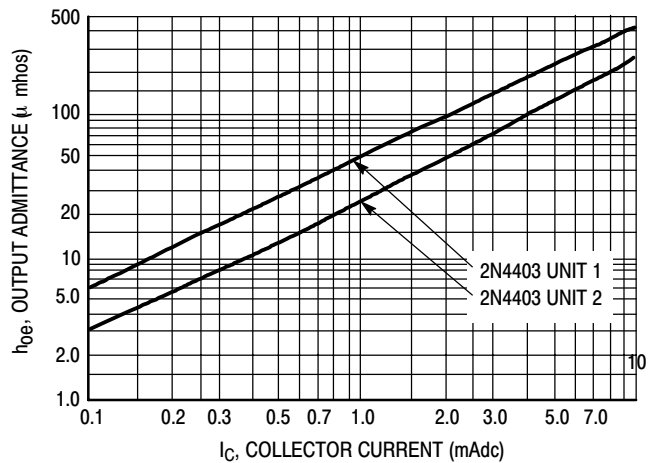


Figure 13. Output Admittance

STATIC CHARACTERISTICS

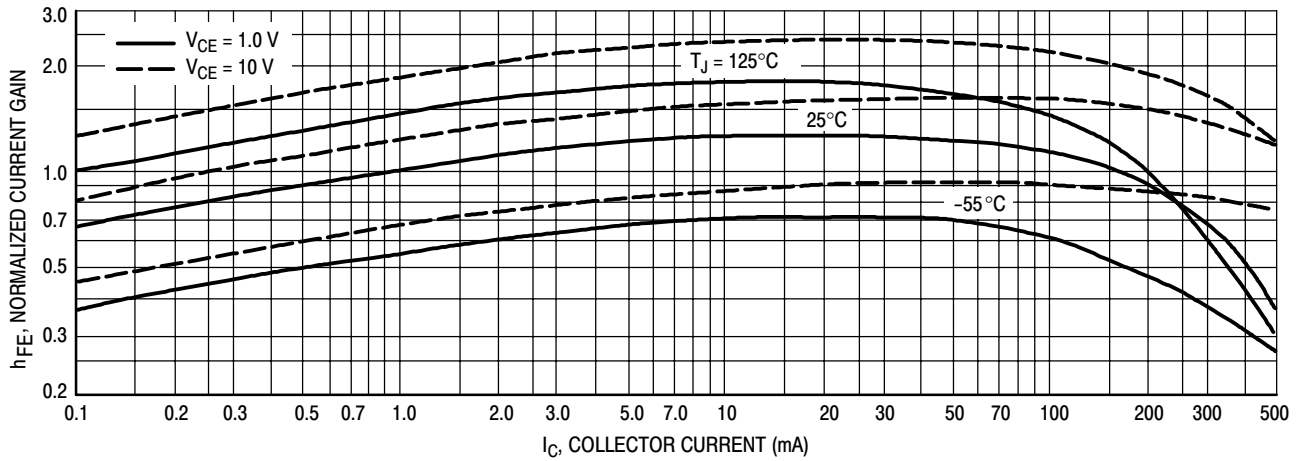


Figure 14. DC Current Gain

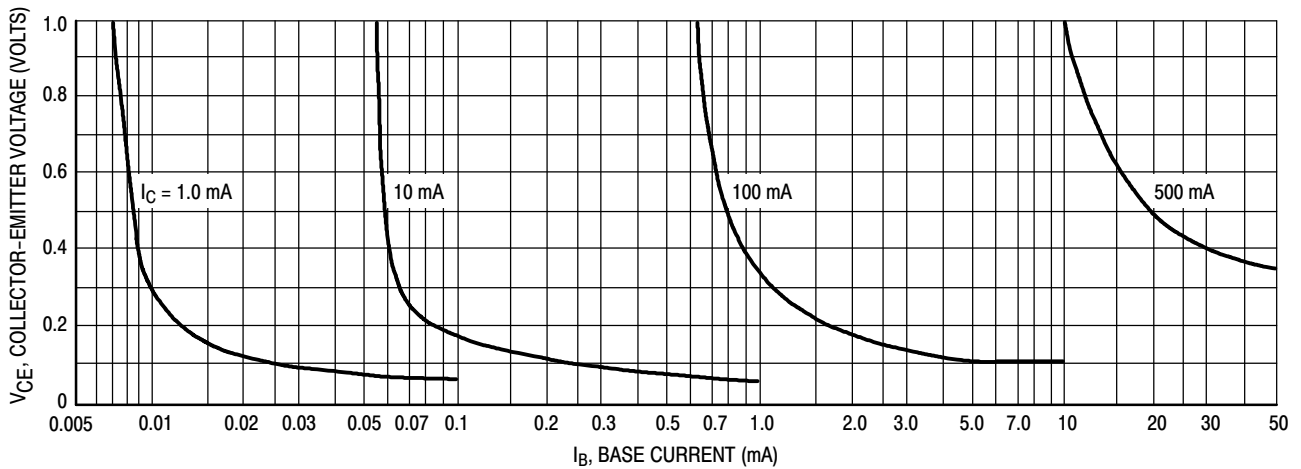


Figure 15. Collector Saturation Region

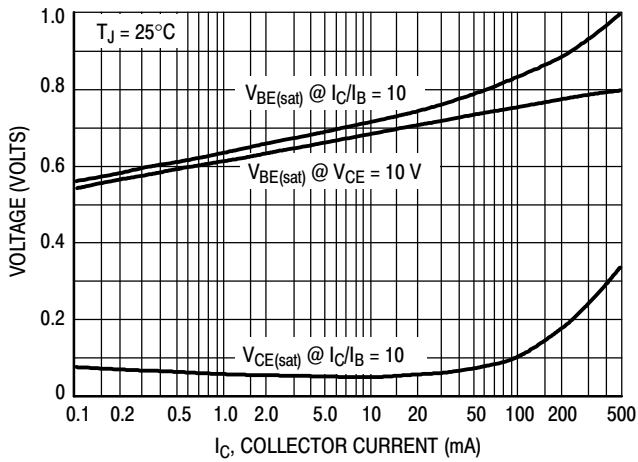


Figure 16. "On" Voltages

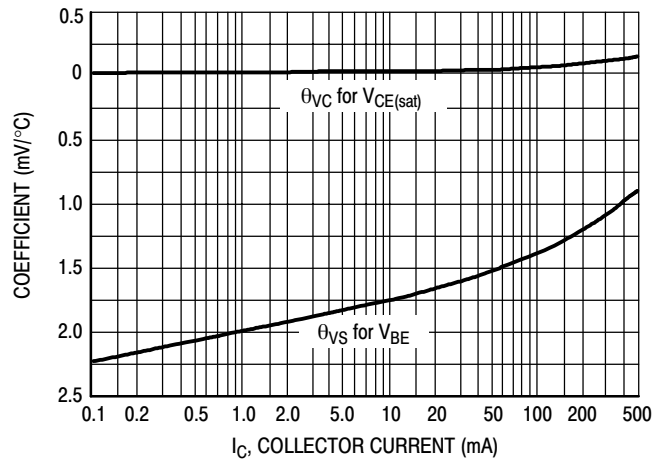
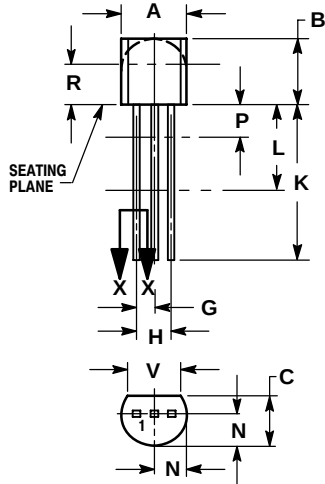


Figure 17. Temperature Coefficients

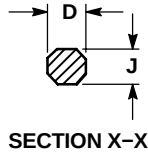
# 2N4403

## PACKAGE DIMENSIONS

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



STRAIGHT LEAD  
BULK PACK

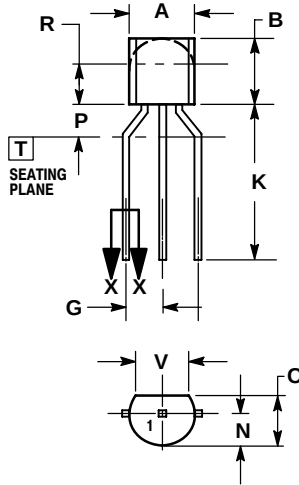


SECTION X-X

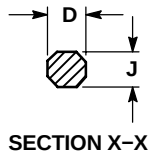
#### NOTES:

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. 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