

# 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 @ $T_A = 25^\circ\text{C}$ Derate above $25^\circ\text{C}$	$P_D$	625 5.0	mW mW/ $^\circ\text{C}$
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

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

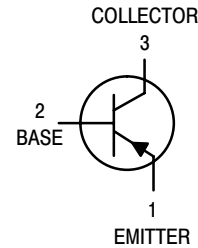
Stresses exceeding Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stresses above the Recommended Operating Conditions may affect device reliability.

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

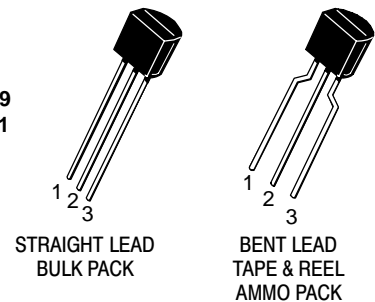


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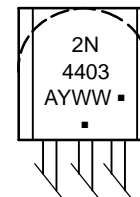
TO-92  
CASE 29  
STYLE 1



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<sub>A</sub> = 25°C unless otherwise noted)

Characteristic	Symbol	Min	Max	Unit	
<b>OFF CHARACTERISTICS</b>					
Collector–Emitter Breakdown Voltage (Note 1)	(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	(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	(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	(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	(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	(I <sub>C</sub> = 0.1 mA <sub>dc</sub> , V <sub>CE</sub> = 1.0 V <sub>dc</sub> )	h <sub>FE</sub>	30	–	–
	(I <sub>C</sub> = 1.0 mA <sub>dc</sub> , V <sub>CE</sub> = 1.0 V <sub>dc</sub> )		60	–	–
	(I <sub>C</sub> = 10 mA <sub>dc</sub> , V <sub>CE</sub> = 1.0 V <sub>dc</sub> )		100	–	–
	(I <sub>C</sub> = 150 mA <sub>dc</sub> , V <sub>CE</sub> = 2.0 V <sub>dc</sub> ) (Note 1)		100	300	–
	(I <sub>C</sub> = 500 mA <sub>dc</sub> , V <sub>CE</sub> = 2.0 V <sub>dc</sub> ) (Note 1)		20	–	–
Collector–Emitter Saturation Voltage (Note 1)	(I <sub>C</sub> = 150 mA <sub>dc</sub> , I <sub>B</sub> = 15 mA <sub>dc</sub> ) (I <sub>C</sub> = 500 mA <sub>dc</sub> , I <sub>B</sub> = 50 mA <sub>dc</sub> )	V <sub>CE(sat)</sub>	–	0.4	V <sub>dc</sub>
			–	0.75	
Base–Emitter Saturation Voltage (Note 1)	(I <sub>C</sub> = 150 mA <sub>dc</sub> , I <sub>B</sub> = 15 mA <sub>dc</sub> ) (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	0.95	V <sub>dc</sub>
			–	1.3	

### 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> , 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> , 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%.

### ORDERING INFORMATION

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

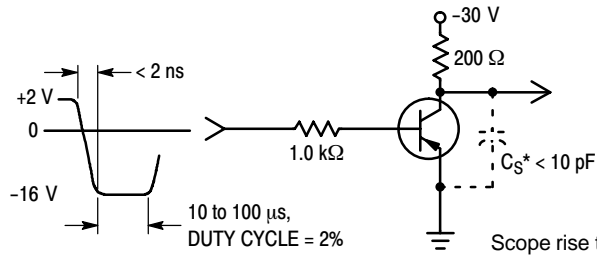


Figure 1. Turn-On Time

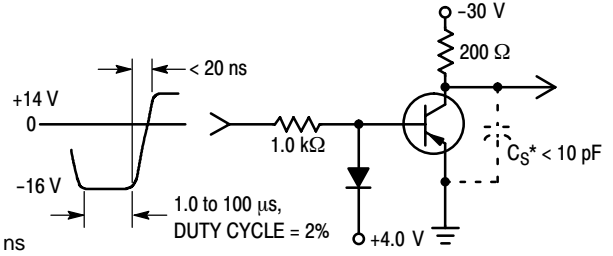


Figure 2. Turn-Off Time

Scope rise time <math>< 4.0\text{ ns}</math>  
 \*Total shunt capacitance of test jig connectors, and oscilloscope

TRANSIENT CHARACTERISTICS

— 25°C    - - - 100°C

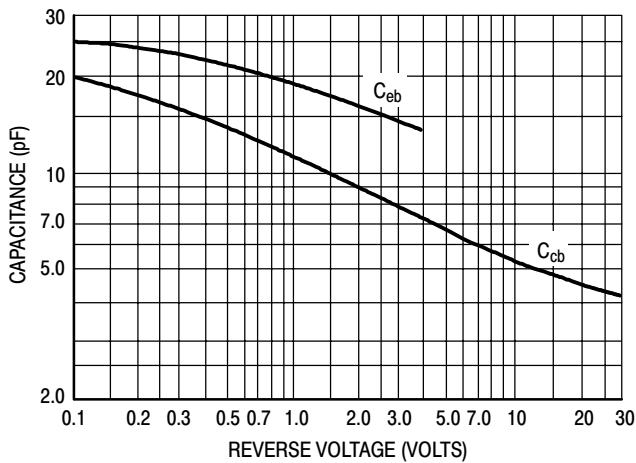


Figure 3. Capacitances

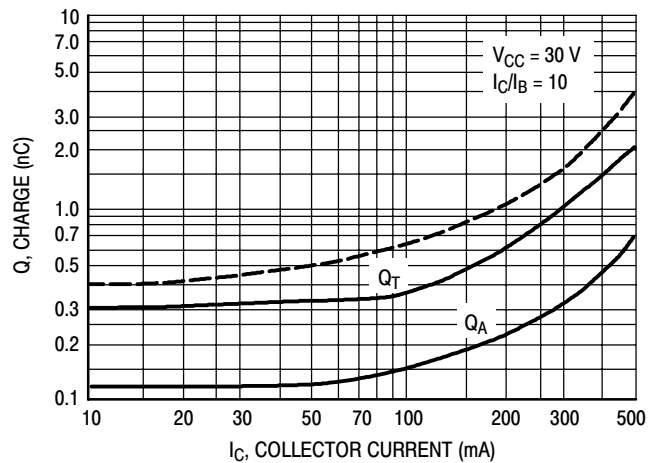


Figure 4. Charge Data

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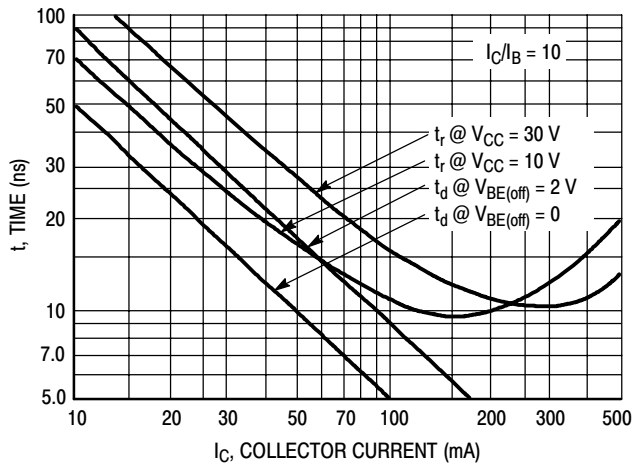


Figure 5. Turn-On Time

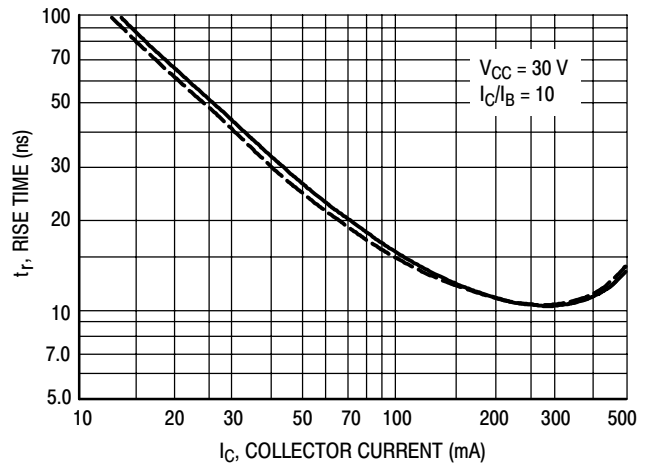


Figure 6. Rise Time

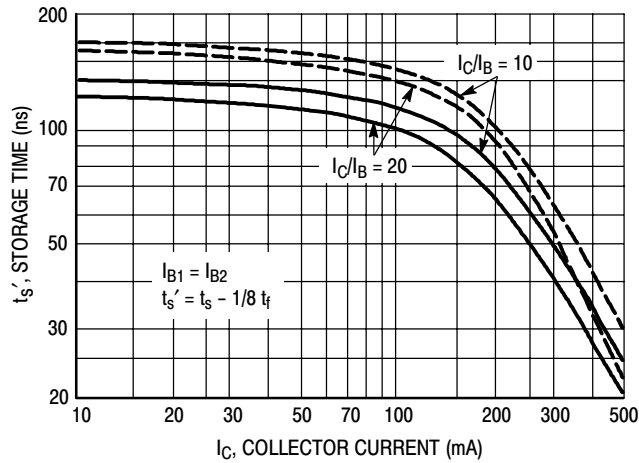


Figure 7. Storage Time

## SMALL-SIGNAL CHARACTERISTICS NOISE FIGURE

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

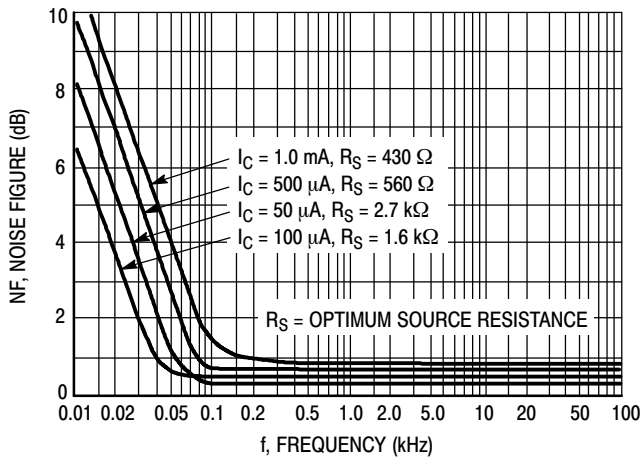


Figure 8. Frequency Effects

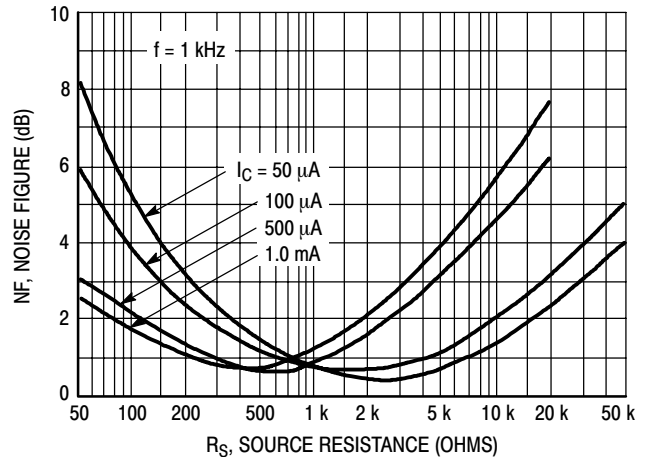


Figure 9. Source Resistance Effects

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## 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.

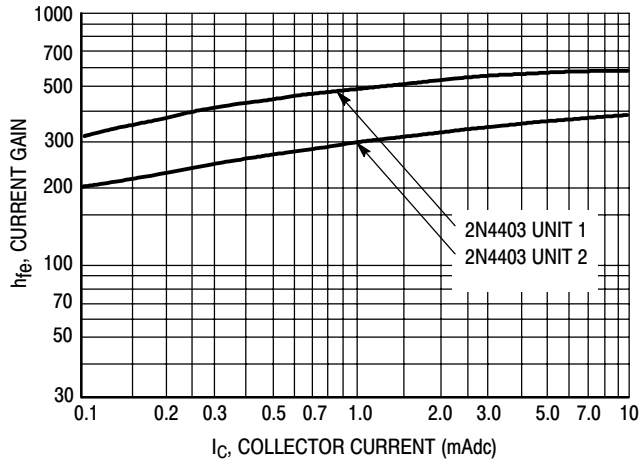


Figure 10. Current Gain

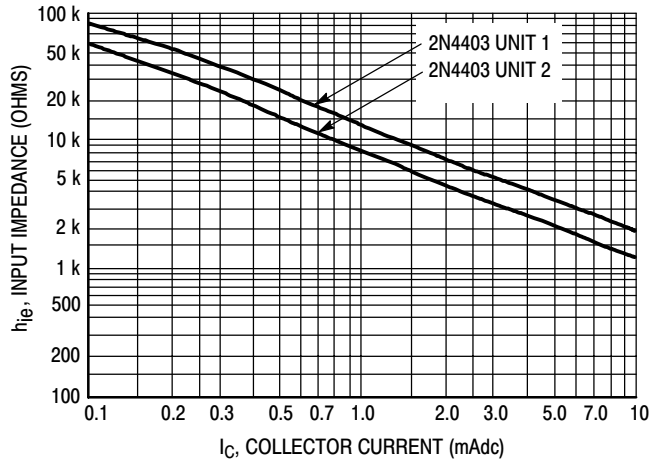


Figure 11. Input Impedance

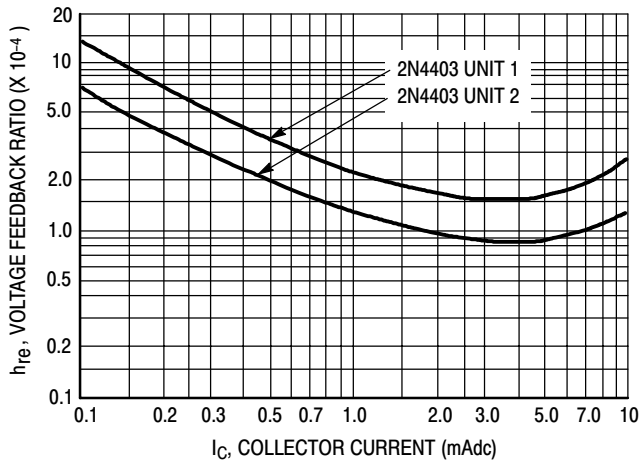


Figure 12. Voltage Feedback Ratio

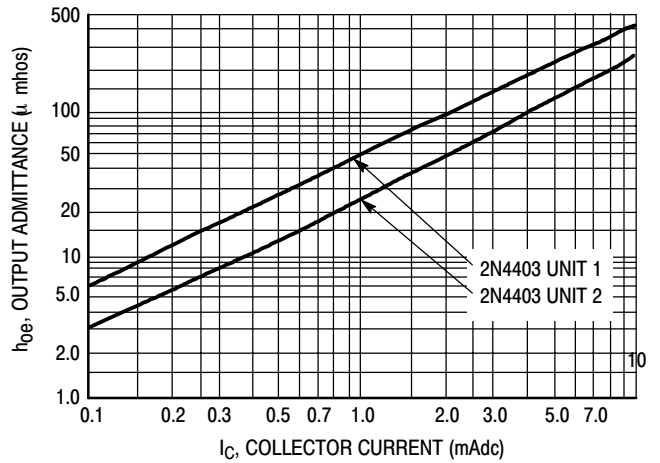


Figure 13. Output Admittance

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## STATIC CHARACTERISTICS

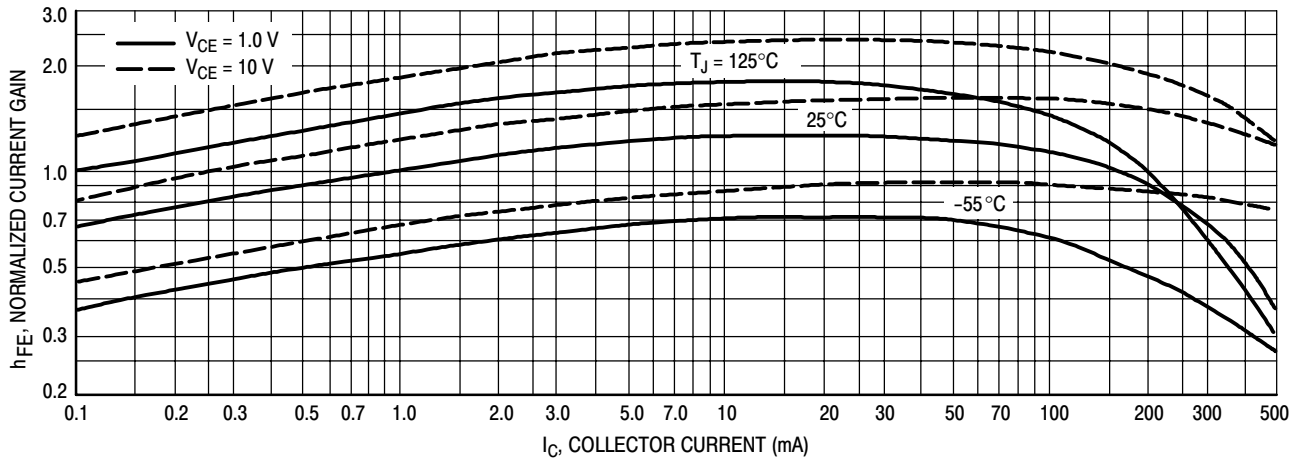


Figure 14. DC Current Gain

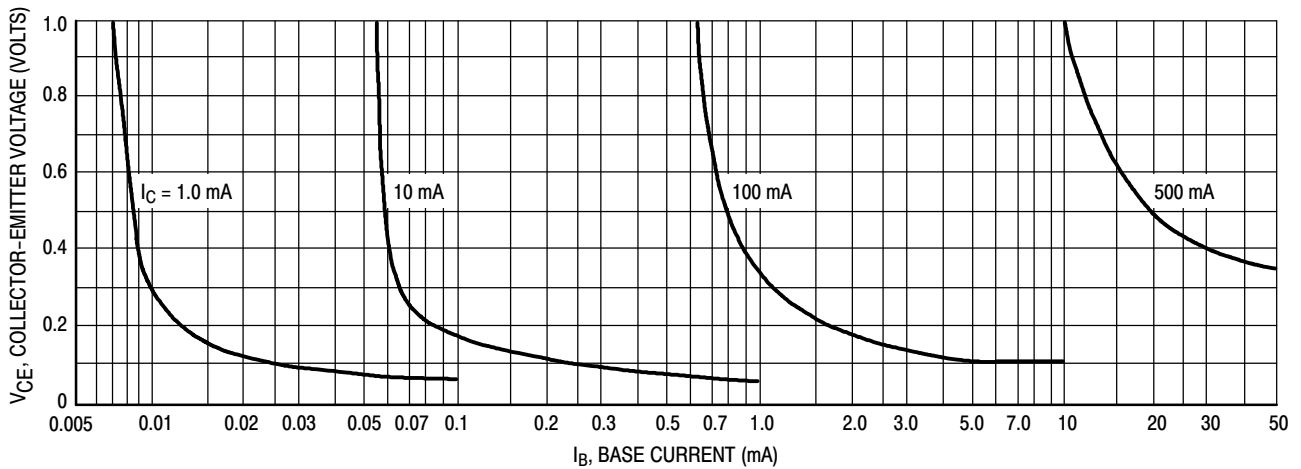


Figure 15. Collector Saturation Region

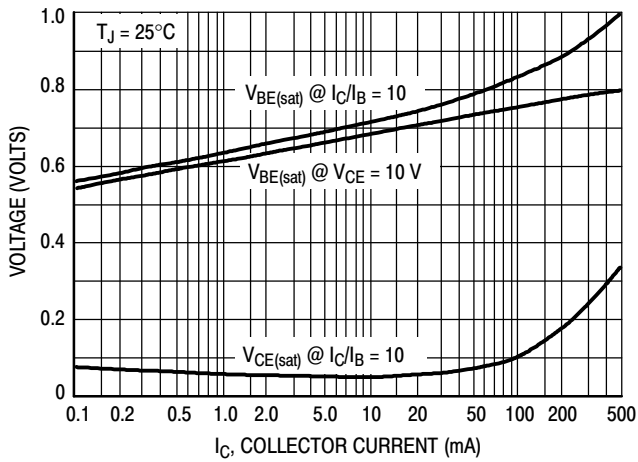


Figure 16. "On" Voltages

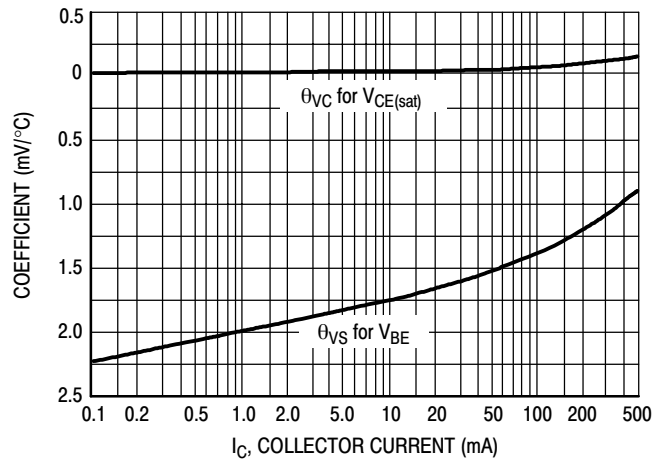
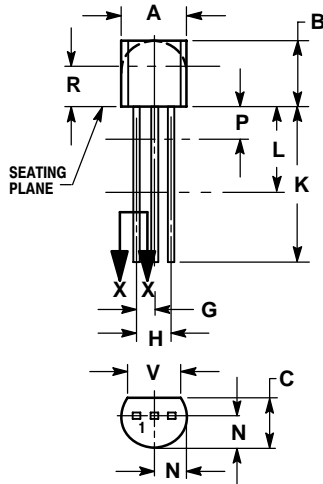


Figure 17. Temperature Coefficients

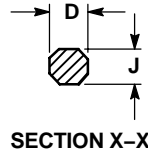
# 2N4403

## PACKAGE DIMENSIONS

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



STRAIGHT LEAD  
BULK PACK

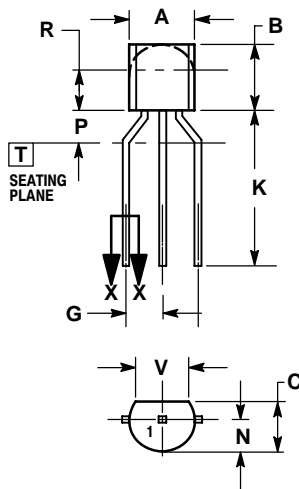


SECTION X-X

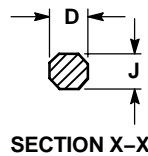
NOTES:

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. PIN 1. EMITTER
2. BASE
3. COLLECTOR

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