General Purpose Transistors

NPN 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}	60	Vdc
Emitter - Base Voltage	V _{EBO}	6.0	Vdc
Collector Current - Continuous	Ic	600	mAdc
Total Device Dissipation @ T _A = 25°C Derate above 25°C	P _D	625 5.0	mW mW/°C
Total Device Dissipation @ T _C = 25°C Derate above 25°C	P _D	1.5 12	W mW/°C
Operating and Storage Junction Temperature Range	T _J , T _{stg}	-55 to +150	°C

THERMAL CHARACTERISTICS

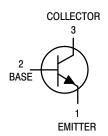
Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction-to-Ambient	$R_{\theta JA}$	200	°C/W
Thermal Resistance, Junction-to-Case	$R_{\theta JC}$	83.3	°C/W

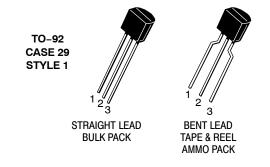
Stresses exceeding Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stresses above the Recommended Operating Conditions may affect device reliability.



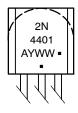
ON Semiconductor®

http://onsemi.com





MARKING DIAGRAM



2N4401 = 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.

^{*}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 ($T_A = 25^{\circ}C$ unless otherwise noted)

Characteristic			Symbol	Min	Max	Unit
OFF CHARACTERISTICS				1	•	•
Collector – Emitter Breakdown Voltage (Note 1) (I _C = 1.0 mAdc, I _B = 0)			V _{(BR)CEO}	40	-	Vdc
Collector – Base Breakdown Voltage $(I_C = 0.1 \text{ mAdc}, I_E = 0)$			V _{(BR)CBO}	60	-	Vdc
Emitter-Base Breakdown V	oltage	$(I_E = 0.1 \text{ mAdc}, I_C = 0)$	V _{(BR)EBO}	6.0	-	Vdc
Base Cutoff Current		(V _{CE} = 35 Vdc, V _{EB} = 0.4 Vdc)	I _{BEV}	-	0.1	μAdc
Collector Cutoff Current		(V _{CE} = 35 Vdc, V _{EB} = 0.4 Vdc)	I _{CEX}	-	0.1	μAdc
ON CHARACTERISTICS (N	lote 1)					
DC Current Gain			h _{FE}	20 40 80 100 40	- - 300 -	-
Collector – Emitter Saturation Voltage $ \begin{array}{c} (I_C = 150 \text{ mAdc}, I_B = 15 \text{ mAdc}) \\ (I_C = 500 \text{ mAdc}, I_B = 50 \text{ mAdc}) \end{array} $			V _{CE(sat)}	- -	0.4 0.75	Vdc
, ,		$(I_C = 150 \text{ mAdc}, I_B = 15 \text{ mAdc})$ $(I_C = 500 \text{ mAdc}, I_B = 50 \text{ mAdc})$	V _{BE(sat)}	0.75 -	0.95 1.2	Vdc
SMALL-SIGNAL CHARAC	TERISTICS					
Current-Gain - Bandwidth	Product (I	C = 20 mAdc, V _{CE} = 10 Vdc, f = 100 MHz)	f _T	250	_	MHz
Collector-Base Capacitance		$(V_{CB} = 5.0 \text{ Vdc}, I_{E} = 0, f = 1.0 \text{ MHz})$	C _{cb}	-	6.5	pF
Emitter-Base Capacitance		$(V_{EB} = 0.5 \text{ Vdc}, I_{C} = 0, f = 1.0 \text{ MHz})$	C _{eb}	-	30	pF
Input Impedance (I _C = 1.0 mAdc		_C = 1.0 mAdc, V _{CE} = 10 Vdc, f = 1.0 kHz)	h _{ie}	1.0	15	kΩ
Voltage Feedback Ratio $(I_C = 1.0 \text{ mAdc}, V_{CE} = 10 \text{ Vdc}, f = 1.0 \text{ kl})$		_C = 1.0 mAdc, V _{CE} = 10 Vdc, f = 1.0 kHz)	h _{re}	0.1	8.0	X 10 ⁻⁴
Small–Signal Current Gain $(I_C = 1.0 \text{ mAdc}, V_{CE} = 10 \text{ Vdc}, f = 1.0 \text{ kHz})$		h _{fe}	40	500	-	
Output Admittance ($I_C = 1.0 \text{ mAdc}$, $V_{CE} = 10 \text{ Vdc}$, $f = 1.0 \text{ kHz}$)		h _{oe}	1.0	30	μmhos	
SWITCHING CHARACTER	ISTICS					
Delay Time (V _{CC} = 30 Vdc, V _{BE} = 2.0 Vdc,		t _d	-	15	ns	
Rise Time	I _C = 150 mAdc, I _{B1} = 15 mAdc)		t _r	-	20	ns
Storage Time (V _{CC} = 30 Vdc, I _C = 150 mAdc,		C = 150 mAdc,	t _s	-	225	ns
Fall Time $I_{B1} = I_{B2} = 15 \text{ mAdc}$		t _f	_	30	ns	

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

ORDERING INFORMATION

Device	Package	Shipping [†]
2N4401	TO-92	5000 Units / Bulk
2N4401G	TO-92 (Pb-Free)	5000 Units / Bulk
2N4401RLRA	TO-92	2000 / Tape & Reel
2N4401RLRAG	TO-92 (Pb-Free)	2000 / Tape & Reel
2N4401RLRMG	TO-92 (Pb-Free)	2000 / Tape & Ammo Box
2N4401RLRP	TO-92	2000 / Tape & Ammo Box
2N4401RLRPG	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.

SWITCHING TIME EQUIVALENT TEST CIRCUITS

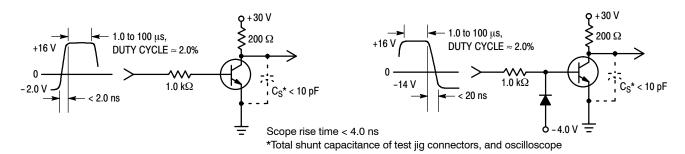


Figure 1. Turn-On Time

Figure 2. Turn-Off Time

TRANSIENT CHARACTERISTICS

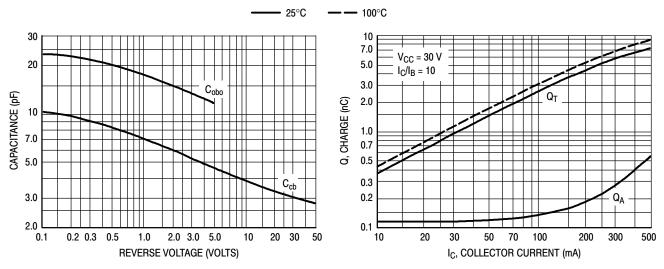


Figure 3. Capacitances

 $I_C/I_B = 10$

300

 $t_r @ V_{CC} = 30 V$

 $t_r @ V_{CC} = 10 V$

 $t_{d} @ V_{EB} = 2.0 V$

 $t_{d} @ V_{EB} = 0$

100

70

50

30

20

10

7.0

5.0

10

20

t, TIME (ns)

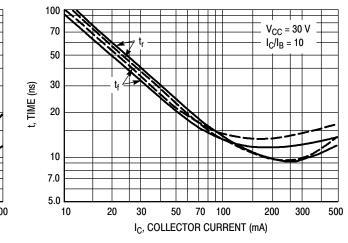


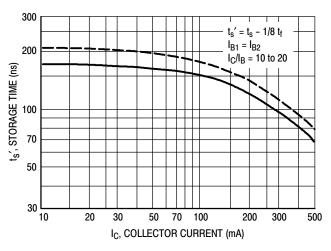
Figure 4. Charge Data

I_C, COLLECTOR CURRENT (mA)

Figure 5. Turn-On Time

70 100

Figure 6. Rise and Fall Times



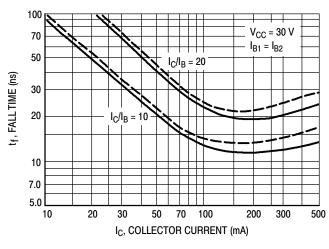
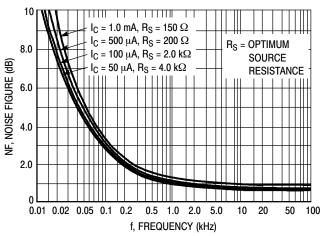


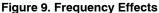
Figure 7. Storage Time

Figure 8. Fall Time

SMALL-SIGNAL CHARACTERISTICS NOISE FIGURE

 V_{CE} = 10 Vdc, T_A = 25°C; Bandwidth = 1.0 Hz





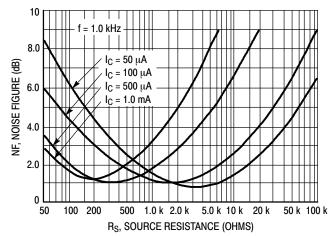


Figure 10. Source Resistance Effects

h PARAMETERS

 V_{CE} = 10 Vdc, f = 1.0 kHz, T_A = 25°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 2N4401 lines, and the same units were used to develop the correspondingly numbered curves on each graph.

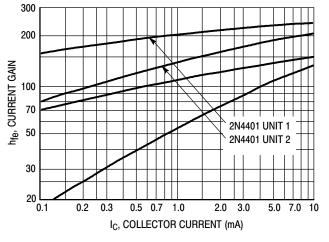


Figure 11. Current Gain

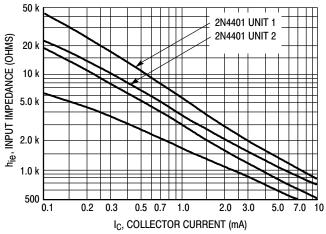


Figure 12. Input Impedance

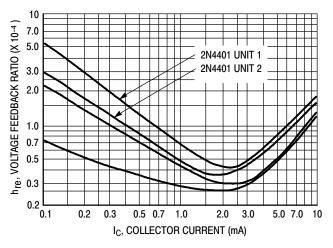


Figure 13. Voltage Feedback Ratio

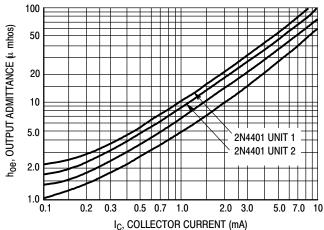


Figure 14. Output Admittance

STATIC CHARACTERISTICS

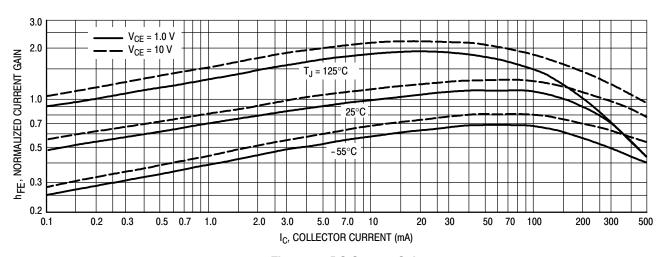


Figure 15. DC Current Gain

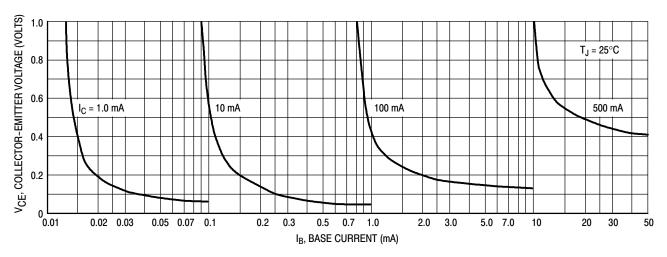


Figure 16. Collector Saturation Region

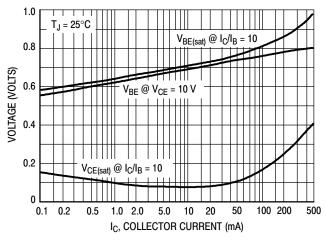


Figure 17. "On" Voltages

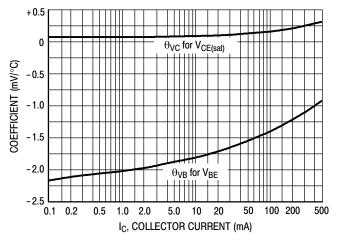
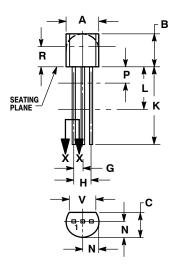


Figure 18. Temperature Coefficients

PACKAGE DIMENSIONS

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



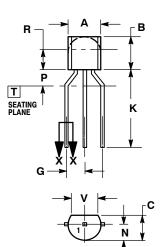
STRAIGHT LEAD **BULK PACK**



NOTES:

- DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
 CONTROLLING DIMENSION: INCH.
- CONTOUR OF PACKAGE BEYOND DIMENSION R
 IS UNCONTROLLED.
- LEAD DIMENSION IS UNCONTROLLED IN P AND BEYOND DIMENSION K MINIMUM.

	INCHES		MILLIN	IETERS
DIM	MIN	MAX	MIN	MAX
Α	0.175	0.205	4.45	5.20
В	0.170	0.210	4.32	5.33
С	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
Н	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
Р		0.100		2.54
R	0.115		2.93	
V	0 135		3.43	



BENT LEAD TAPE & REEL AMMO PACK



NOTES:

- DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
- CONTROLLING DIMENSION: MILLIMETERS
- CONTOUR OF PACKAGE BEYOND
- DIMENSION R IS UNCONTROLLED. LEAD DIMENSION IS UNCONTROLLED IN P AND BEYOND DIMENSION K MINIMUM.

	MILLIMETERS		
DIM	MIN	MAX	
Α	4.45	5.20	
В	4.32	5.33	
С	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		

PIN 1. EMITTER

BASE

COLLECTOR

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