2N4401RLRMG Datasheet

DiGi Electronics Part Number	2N4401RLRMG-DG
Manufacturer	onsemi
Manufacturer Product Number	2N4401RLRMG
Description	TRANS NPN 40V 0.6A TO92
Detailed Description	Bipolar (BJT) Transistor NPN 40 V 600 mA 250MHz 625 mW Through Hole TO-92 (TO-226)

Purchase and inquiry

Manufacturer Product Number:	Manufacturer:
2N4401RLRMG	onsemi
Series:	Product Status:
-	Obsolete
Transistor Type:	Current - Collector (Ic) (Max):
NPN	600 mA
Voltage - Collector Emitter Breakdown (Max):	Vce Saturation (Max) @ Ib, Ic:
40 V	750mV @ 50mA, 500mA
Current - Collector Cutoff (Max):	DC Current Gain (hFE) (Min) @ Ic, Vce:
-	100 @ 150mA, 1V
Power - Max:	Frequency - Transition:
625 mW	250MHz
Operating Temperature:	Mounting Type:
-55°C ~ 150°C (TJ)	Through Hole
Package / Case:	Supplier Device Package:
TO-226-3, TO-92-3 Long Body (Formed Leads)	TO-92 (TO-226)
Base Product Number:	
2N4401	

Environmental & Export classification

Moisture Sensitivity Level (MSL):	REACH Status:
1 (Unlimited)	REACH Unaffected
ECCN:	HTSUS:
EAR99	8541.21.0075

2N4401

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	I_C	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.
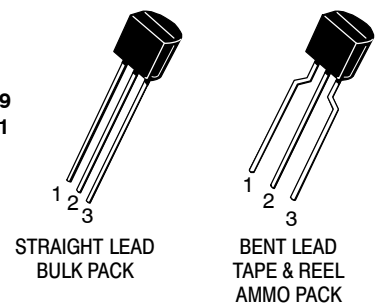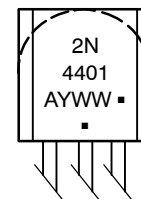
ON Semiconductor®

http://onsemi.com

COLLECTOR
3

2
BASE

1
EMITTER

**TO−92
CASE 29
STYLE 1**

STRAIGHT LEAD
BULK PACK

BENT LEAD
TAPE & REEL
AMMO PACK
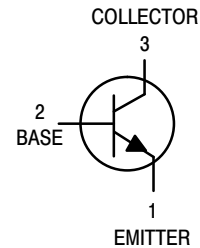
MARKING DIAGRAM

2N
4401
AYWW ■

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.

2N4401

ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted)

Characteristic		Symbol	Min	Max	Unit
OFF CHARACTERISTICS					
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 mAdc, I_E = 0)	$V_{(BR)CBO}$	60	–	Vdc
Emitter–Base Breakdown Voltage	(I_E = 0.1 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 (Note 1)					
DC Current Gain		h_{FE}			–
	(I_C = 0.1 mAdc, V_{CE} = 1.0 Vdc)		20	–	
	(I_C = 1.0 mAdc, V_{CE} = 1.0 Vdc)		40	–	
	(I_C = 10 mAdc, V_{CE} = 1.0 Vdc)		80	–	
	(I_C = 150 mAdc, V_{CE} = 1.0 Vdc)		100	300	
	(I_C = 500 mAdc, V_{CE} = 2.0 Vdc)		40	–	
Collector–Emitter Saturation Voltage	(I_C = 150 mAdc, I_B = 15 mAdc)	$V_{CE(sat)}$	–	0.4	Vdc
	(I_C = 500 mAdc, I_B = 50 mAdc)		–	0.75	
Base–Emitter Saturation Voltage	(I_C = 150 mAdc, I_B = 15 mAdc)	$V_{BE(sat)}$	0.75	0.95	Vdc
	(I_C = 500 mAdc, I_B = 50 mAdc)		–	1.2	
SMALL–SIGNAL CHARACTERISTICS					
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 Vdc, I_E = 0, f = 1.0 MHz)	C_{cb}	–	6.5	pF
Emitter–Base Capacitance	(V_{EB} = 0.5 Vdc, I_C = 0, f = 1.0 MHz)	C_{eb}	–	30	pF
Input Impedance	(I_C = 1.0 mAdc, V_{CE} = 10 Vdc, f = 1.0 kHz)	h_{ie}	1.0	15	k Ω
Voltage Feedback Ratio	(I_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 mAdc, V_{CE} = 10 Vdc, f = 1.0 kHz)	h_{fe}	40	500	–
Output Admittance	(I_C = 1.0 mAdc, V_{CE} = 10 Vdc, f = 1.0 kHz)	h_{oe}	1.0	30	μmhos
SWITCHING CHARACTERISTICS					
Delay Time	(V_{CC} = 30 Vdc, V_{BE} = 2.0 Vdc, I_C = 150 mAdc, I_{B1} = 15 mAdc)	t_d	–	15	ns
Rise Time		t_r	–	20	ns
Storage Time	(V_{CC} = 30 Vdc, I_C = 150 mAdc, I_{B1} = I_{B2} = 15 mAdc)	t_s	–	225	ns
Fall Time		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.

2N4401

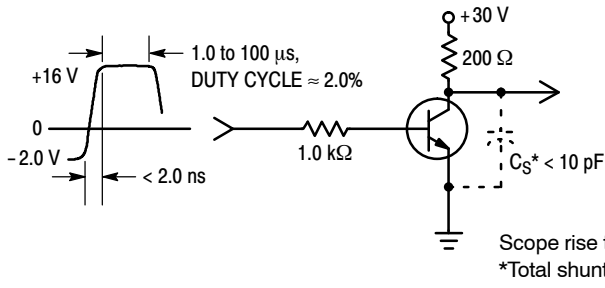## SWITCHING TIME EQUIVALENT TEST CIRCUITS

Figure 1. Turn−On Time
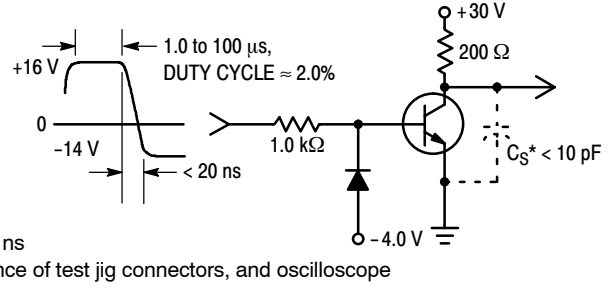
Figure 2. Turn−Off Time

Scope rise time < 4.0 ns
*Total shunt capacitance of test jig connectors, and oscilloscope
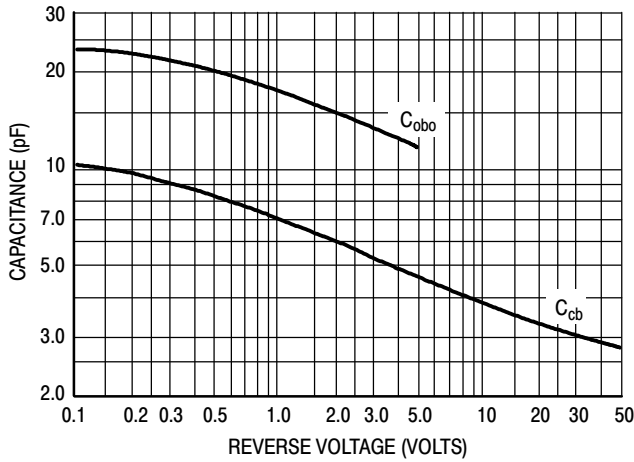
TRANSIENT CHARACTERISTICS

—— 25°C   − − − 100°C
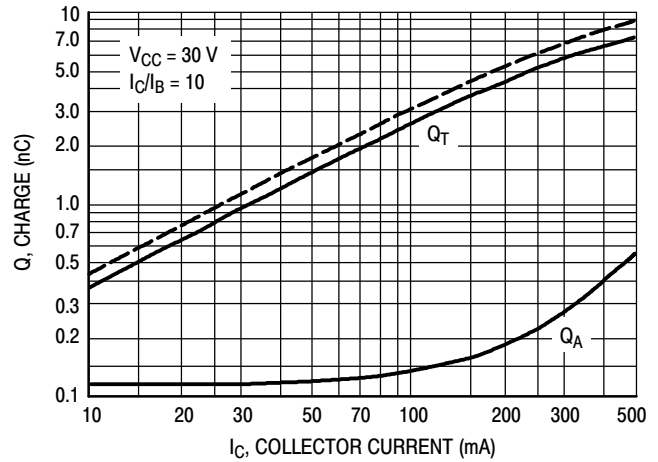
Figure 3. Capacitances
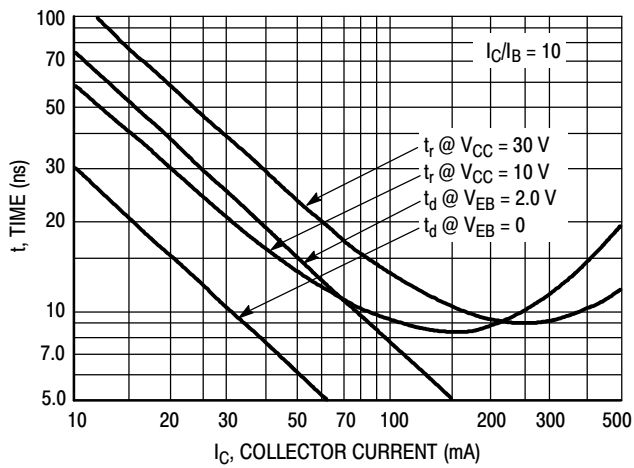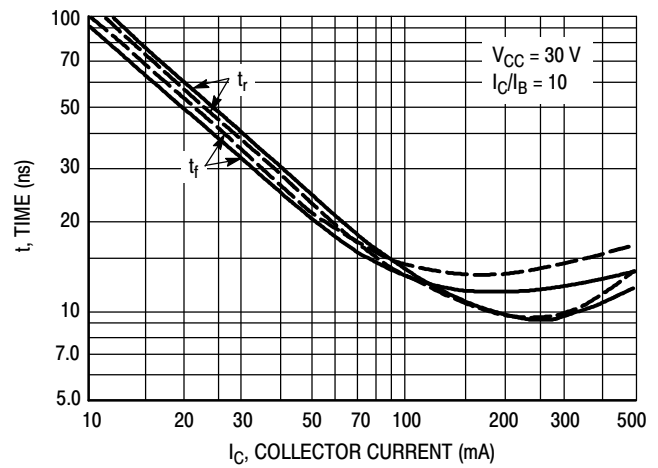
Figure 4. Charge Data

Figure 5. Turn−On Time

Figure 6. Rise and Fall Times

2N4401
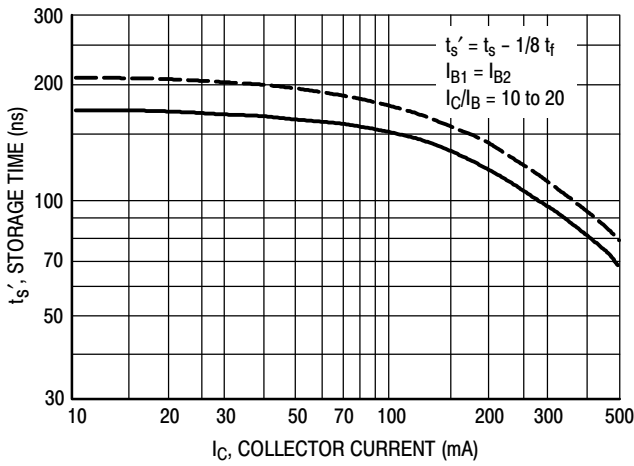
Figure 7. Storage Time
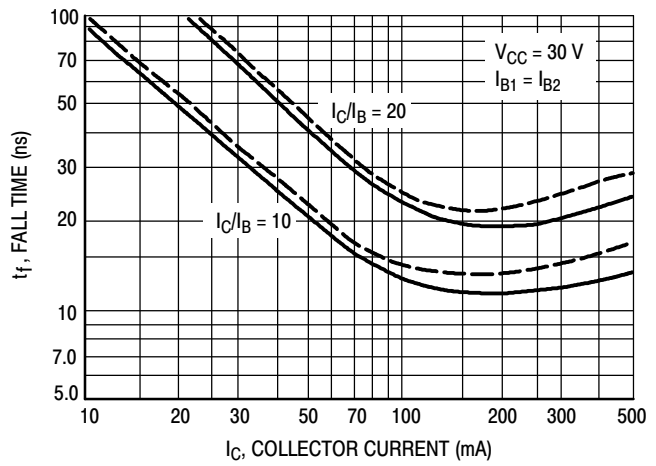
Figure 8. Fall Time

SMALL−SIGNAL CHARACTERISTICS
NOISE FIGURE
V_{CE} = 10 Vdc, T_A = 25°C; Bandwidth = 1.0 Hz
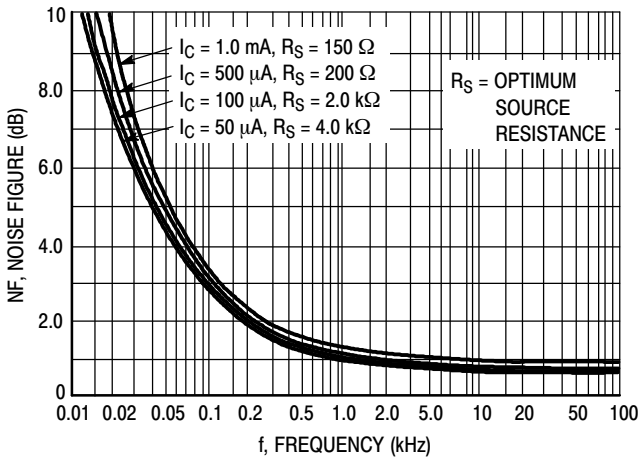
Figure 9. Frequency Effects
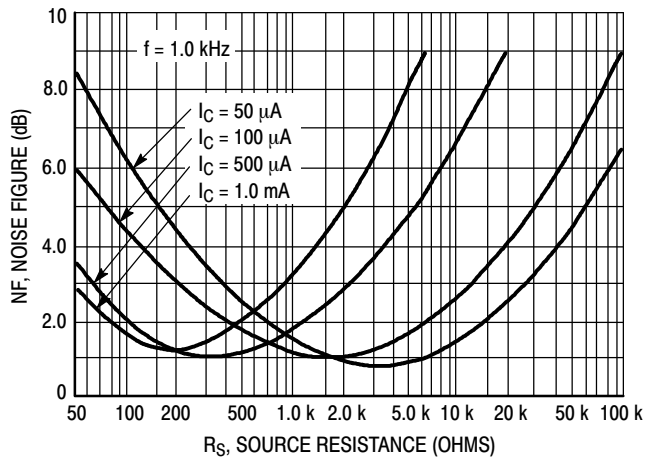
Figure 10. Source Resistance Effects

2N4401

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.
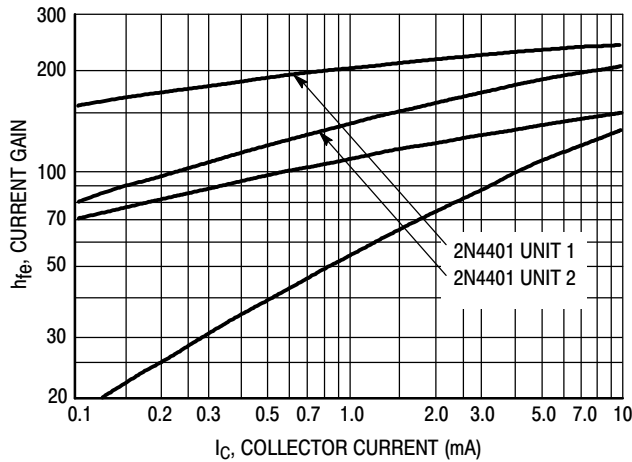
Figure 11. Current Gain
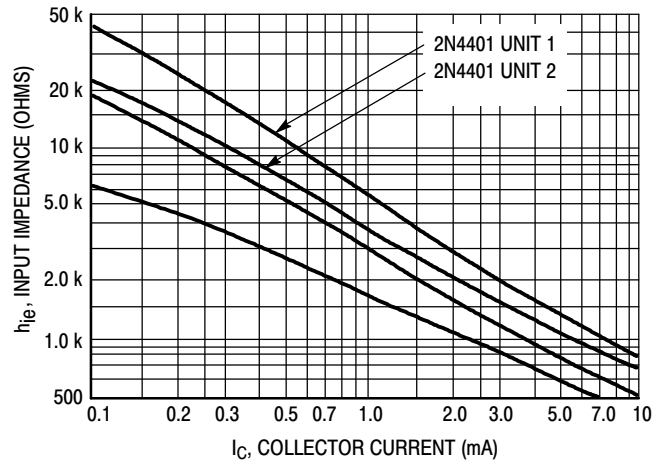
Figure 12. Input Impedance
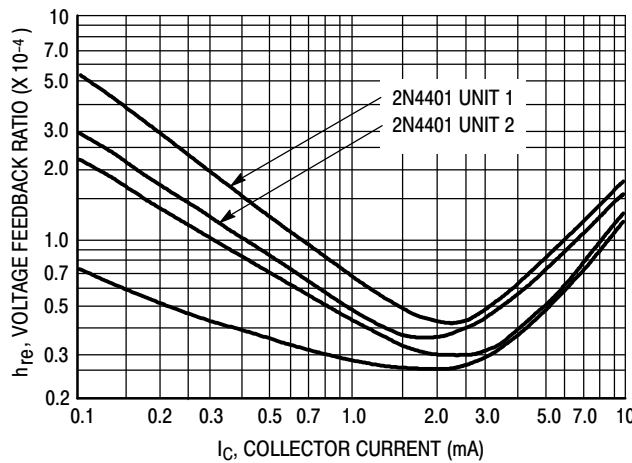
Figure 13. Voltage Feedback Ratio
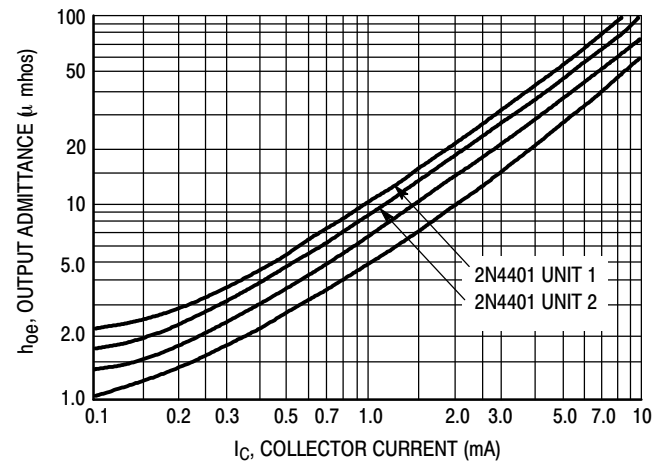
Figure 14. Output Admittance

2N4401

STATIC CHARACTERISTICS
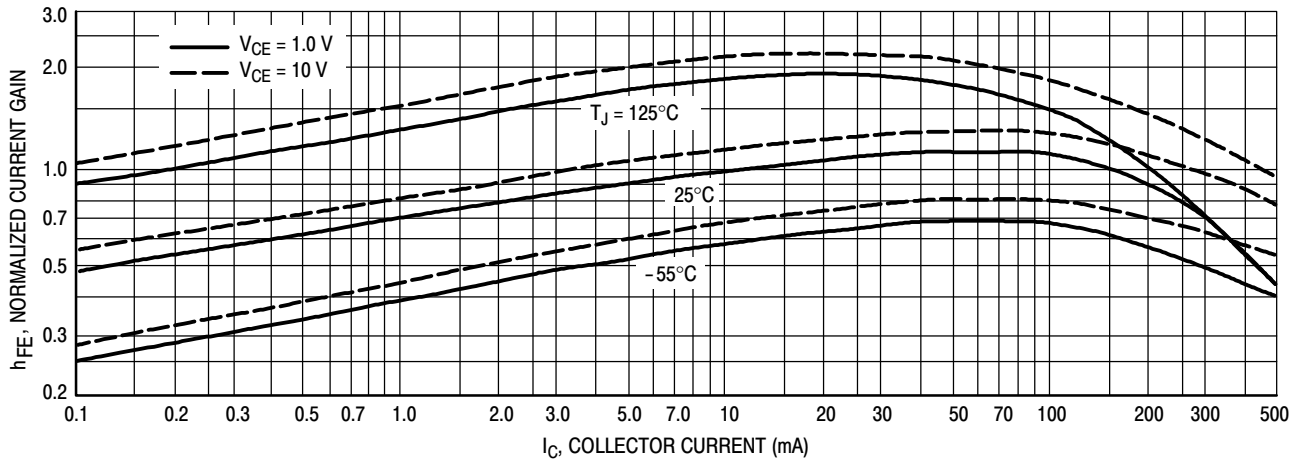
Figure 15. DC Current Gain
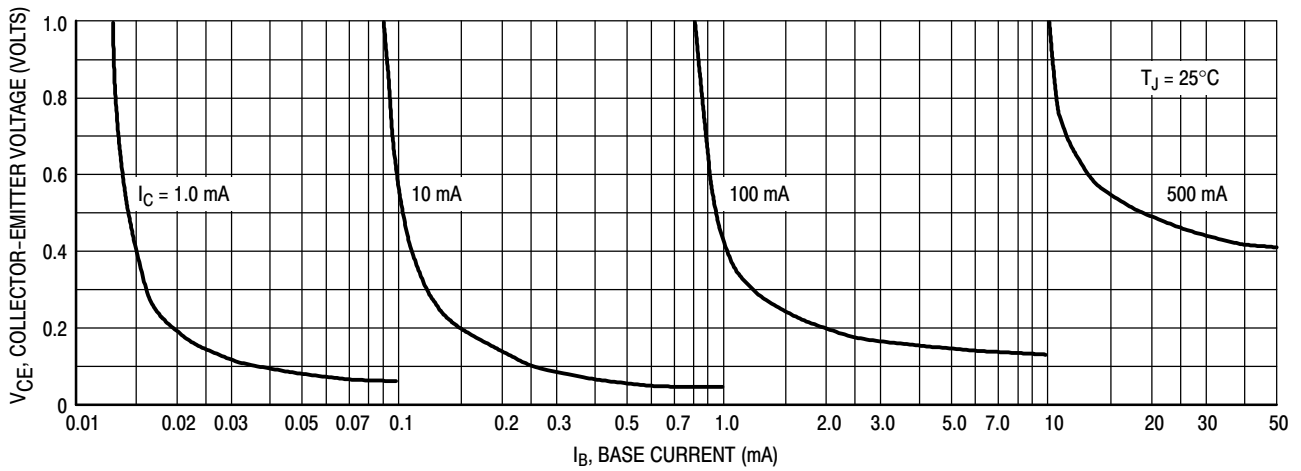
Figure 16. Collector Saturation Region
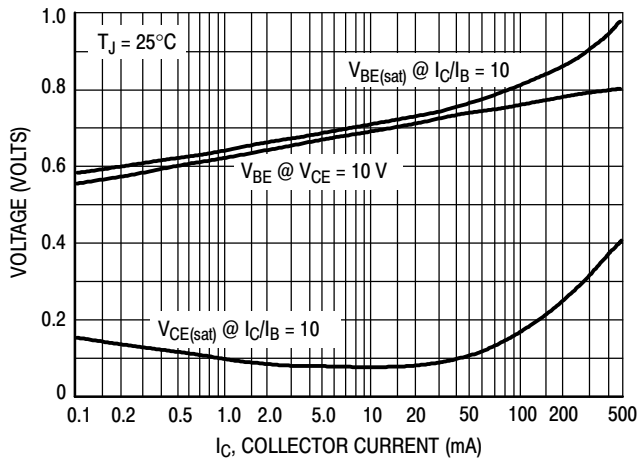
Figure 17. "On" Voltages
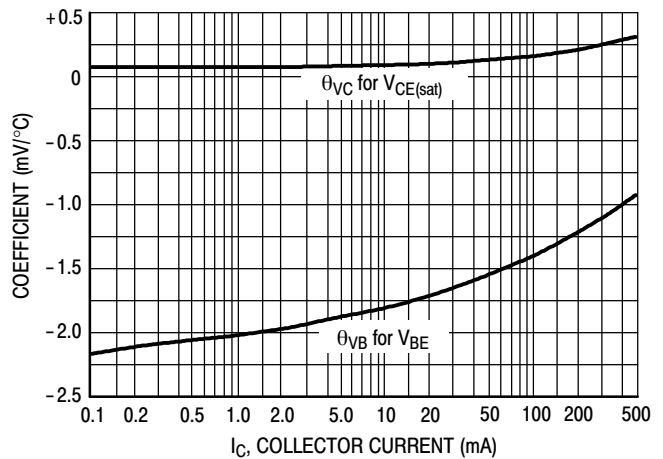
Figure 18. Temperature Coefficients

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MECHANICAL CASE OUTLINE
PACKAGE DIMENSIONS
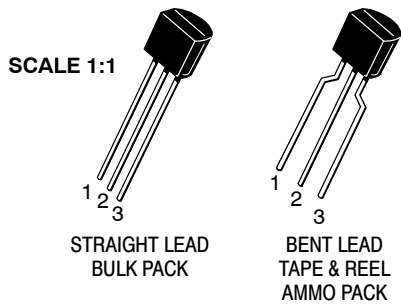
SCALE 1:1

TO−92 (TO−226)
CASE 29−11
ISSUE AM

DATE 09 MAR 2007

1 2 3
STRAIGHT LEAD
BULK PACK

1 2 3
BENT LEAD
TAPE & REEL
AMMO PACK

STRAIGHT LEAD
BULK PACK

SECTION X−X
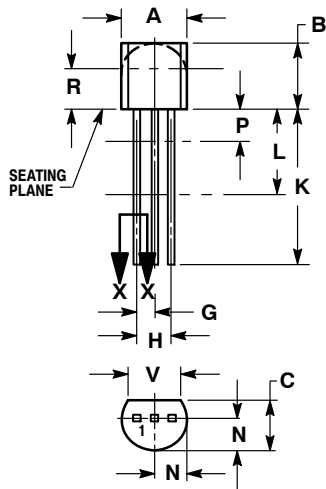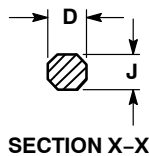
NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. CONTOUR OF PACKAGE BEYOND DIMENSION R IS UNCONTROLLED.
4. LEAD DIMENSION IS UNCONTROLLED IN P AND BEYOND DIMENSION K MINIMUM.

DIM	INCHES MIN	INCHES MAX	MILLIMETERS MIN	MILLIMETERS 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
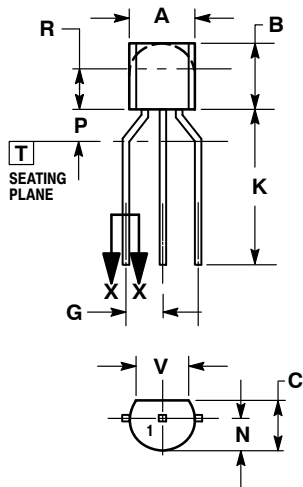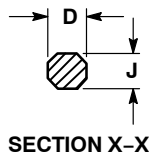
NOTES:
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. CONTROLLING DIMENSION: MILLIMETERS.
3. CONTOUR OF PACKAGE BEYOND DIMENSION R IS UNCONTROLLED.
4. LEAD DIMENSION IS UNCONTROLLED IN P AND BEYOND DIMENSION K MINIMUM.

DIM	MILLIMETERS MIN	MILLIMETERS 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	---

STYLES ON PAGE 2

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DESCRIPTION:	TO−92 (TO−226)		PAGE 1 OF 2

TO−92 (TO−226)
CASE 29−11
ISSUE AM

DATE 09 MAR 2007

STYLE 1:
PIN 1. EMITTER
  2. BASE
  3. COLLECTOR

STYLE 2:
PIN 1. BASE
  2. EMITTER
  3. COLLECTOR

STYLE 3:
PIN 1. ANODE
  2. ANODE
  3. CATHODE

STYLE 4:
PIN 1. CATHODE
  2. CATHODE
  3. ANODE

STYLE 5:
PIN 1. DRAIN
  2. SOURCE
  3. GATE

STYLE 6:
PIN 1. GATE
  2. SOURCE & SUBSTRATE
  3. DRAIN

STYLE 7:
PIN 1. SOURCE
  2. DRAIN
  3. GATE

STYLE 8:
PIN 1. DRAIN
  2. GATE
  3. SOURCE & SUBSTRATE

STYLE 9:
PIN 1. BASE 1
  2. EMITTER
  3. BASE 2

STYLE 10:
PIN 1. CATHODE
  2. GATE
  3. ANODE

STYLE 11:
PIN 1. ANODE
  2. CATHODE & ANODE
  3. CATHODE

STYLE 12:
PIN 1. MAIN TERMINAL 1
  2. GATE
  3. MAIN TERMINAL 2

STYLE 13:
PIN 1. ANODE 1
  2. GATE
  3. CATHODE 2

STYLE 14:
PIN 1. EMITTER
  2. COLLECTOR
  3. BASE

STYLE 15:
PIN 1. ANODE 1
  2. CATHODE
  3. ANODE 2

STYLE 16:
PIN 1. ANODE
  2. GATE
  3. CATHODE

STYLE 17:
PIN 1. COLLECTOR
  2. BASE
  3. EMITTER

STYLE 18:
PIN 1. ANODE
  2. CATHODE
  3. NOT CONNECTED

STYLE 19:
PIN 1. GATE
  2. ANODE
  3. CATHODE

STYLE 20:
PIN 1. NOT CONNECTED
  2. CATHODE
  3. ANODE

STYLE 21:
PIN 1. COLLECTOR
  2. EMITTER
  3. BASE

STYLE 22:
PIN 1. SOURCE
  2. GATE
  3. DRAIN

STYLE 23:
PIN 1. GATE
  2. SOURCE
  3. DRAIN

STYLE 24:
PIN 1. EMITTER
  2. COLLECTOR/ANODE
  3. CATHODE

STYLE 25:
PIN 1. MT 1
  2. GATE
  3. MT 2

STYLE 26:
PIN 1. V_{CC}
  2. GROUND 2
  3. OUTPUT

STYLE 27:
PIN 1. MT
  2. SUBSTRATE
  3. MT

STYLE 28:
PIN 1. CATHODE
  2. ANODE
  3. GATE

STYLE 29:
PIN 1. NOT CONNECTED
  2. ANODE
  3. CATHODE

STYLE 30:
PIN 1. DRAIN
  2. GATE
  3. SOURCE

STYLE 31:
PIN 1. GATE
  2. DRAIN
  3. SOURCE

STYLE 32:
PIN 1. BASE
  2. COLLECTOR
  3. EMITTER

STYLE 33:
PIN 1. RETURN
  2. INPUT
  3. OUTPUT

STYLE 34:
PIN 1. INPUT
  2. GROUND
  3. LOGIC

STYLE 35:
PIN 1. GATE
  2. COLLECTOR
  3. EMITTER

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DESCRIPTION:	TO−92 (TO−226)		PAGE 2 OF 2

ADDITIONAL INFORMATION

◊

OUR CERTIFICATE

DiGi provide top-quality products and perfect service for customer worldwide through standardization, technological innovation and continuous improvement. DiGi through third-party certification, we striciy control the quality of products and services. Welcome your RFQ to Email: Info@DiGi-Electronics.com