

# Silicon PNP Power Transistors

## 2N5194G, 2N5195G

These devices are designed for use in power amplifier and switching circuits; excellent safe area limits.

### Features

- Complement to NPN 2N5191, 2N5192
- These Devices are Pb-Free and are RoHS Compliant\*

### MAXIMUM RATINGS (Note 1)

Rating	Symbol	Value	Unit
Collector-Emitter Voltage 2N5194G 2N5195G	$V_{CEO}$	60 80	Vdc
Collector-Base Voltage 2N5194G 2N5195G	$V_{CB}$	60 80	Vdc
Emitter-Base Voltage	$V_{EB}$	5.0	Vdc
Collector Current	$I_C$	4.0	Adc
Base Current	$I_B$	1.0	Adc
Total Device Dissipation @ $T_C = 25^\circ\text{C}$ Derate above $25^\circ\text{C}$	$P_D$	40 320	W W/ $^\circ\text{C}$
Operating and Storage Junction Temperature Range	$T_J, T_{stg}$	-65 to +150	$^\circ\text{C/W}$

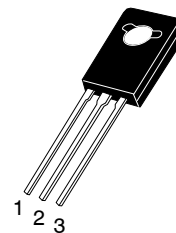
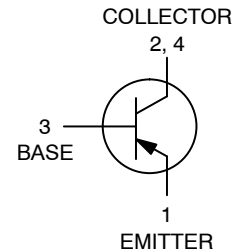
Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

1. Indicates JEDEC registered data.

### THERMAL CHARACTERISTICS

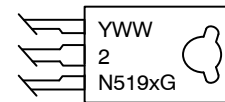
Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction-to-Case	$R_{\theta JC}$	3.12	$^\circ\text{C/W}$

## 4 AMPERE POWER TRANSISTORS PNP SILICON 60 – 80 VOLTS



TO-225  
CASE 77-09  
STYLE 1

### MARKING DIAGRAM



- Y = Year
- WW = Work Week
- 2N519x = Device Code  
x = 4 or 5
- G = Pb-Free Package

### ORDERING INFORMATION

Device	Package	Shipping
2N5195G	TO-225 (Pb-Free)	500 Units / Bulk

### DISCONTINUED (Note 1)

2N5194G	TO-225 (Pb-Free)	500 Units / Bulk
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1. **DISCONTINUED:** This device is not recommended for new design. Please contact your **onsemi** representative for information. The most current information on this device may be available on [www.onsemi.com](http://www.onsemi.com).

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

## 2N5194G, 2N5195G

### ELECTRICAL CHARACTERISTICS ( $T_C = 25^\circ\text{C}$ unless otherwise noted) (Note 2)

Characteristic	Symbol	Min	Max	Unit
<b>OFF CHARACTERISTICS</b>				
Collector-Emitter Sustaining Voltage (Note 3) ( $I_C = 0.1\text{ Adc}$ , $I_B = 0$ ) 2N5194G 2N5195G	$V_{CE(sus)}$	60 80	- -	Vdc
Collector Cutoff Current ( $V_{CE} = 60\text{ Vdc}$ , $I_B = 0$ ) 2N5194G ( $V_{CE} = 80\text{ Vdc}$ , $I_B = 0$ ) 2N5195G	$I_{CEO}$	- -	1.0 1.0	mAdc
Collector Cutoff Current ( $V_{CE} = 60\text{ Vdc}$ , $V_{BE(off)} = 1.5\text{ Vdc}$ ) 2N5194G ( $V_{CE} = 80\text{ Vdc}$ , $V_{BE(off)} = 1.5\text{ Vdc}$ ) 2N5195G ( $V_{CE} = 60\text{ Vdc}$ , $V_{BE(off)} = 1.5\text{ Vdc}$ , $T_C = 125^\circ\text{C}$ ) 2N5194G ( $V_{CE} = 80\text{ Vdc}$ , $V_{BE(off)} = 1.5\text{ Vdc}$ , $T_C = 125^\circ\text{C}$ ) 2N5195G	$I_{CEX}$	- - - -	-0.1 0.1 2.0 2.0	mAdc
Collector Cutoff Current ( $V_{CB} = 60\text{ Vdc}$ , $I_E = 0$ ) 2N5194G ( $V_{CB} = 80\text{ Vdc}$ , $I_E = 0$ ) 2N5195G	$I_{CBO}$	- -	0.1 0.1	mAdc
Emitter Cutoff Current ( $V_{BE} = 5.0\text{ Vdc}$ , $I_C = 0$ )	$I_{EBO}$	-	1.0	mAdc
<b>ON CHARACTERISTICS</b>				
DC Current Gain (Note 3) ( $I_C = 1.5\text{ Adc}$ , $V_{CE} = 2.0\text{ Vdc}$ ) 2N5194G 2N5195G ( $I_C = 4.0\text{ Adc}$ , $V_{CE} = 2.0\text{ Vdc}$ ) 2N5194G 2N5195G	$h_{FE}$	25 20 10 7.0	100 80 - -	-
Collector-Emitter Saturation Voltage (Note 3) ( $I_C = 1.5\text{ Adc}$ , $I_B = 0.15\text{ Adc}$ ) ( $I_C = 4.0\text{ Adc}$ , $I_B = 1.0\text{ Adc}$ )	$V_{CE(sat)}$	- -	0.6 1.4	Vdc
Base-Emitter On Voltage (Note 3) ( $I_C = 1.5\text{ Adc}$ , $V_{CE} = 2.0\text{ Vdc}$ )	$V_{BE(on)}$	-	1.2	Vdc
<b>DYNAMIC CHARACTERISTICS</b>				
Current-Gain - Bandwidth Product ( $I_C = 1.0\text{ Adc}$ , $V_{CE} = 10\text{ Vdc}$ , $f = 1.0\text{ MHz}$ )	$f_T$	2.0	-	MHz

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

2. Indicates JEDEC registered data.

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

# 2N5194G, 2N5195G

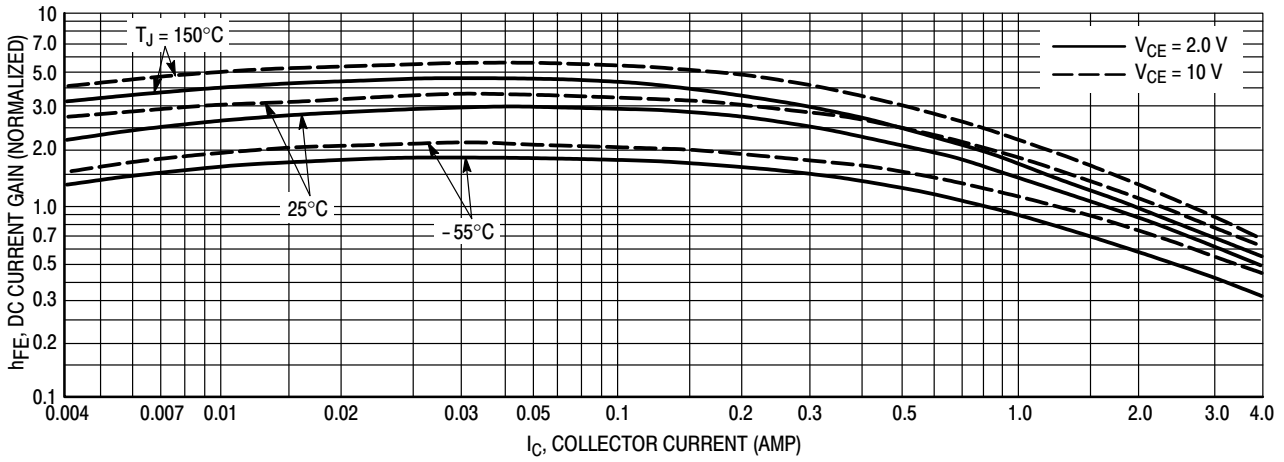


Figure 1. DC Current Gain

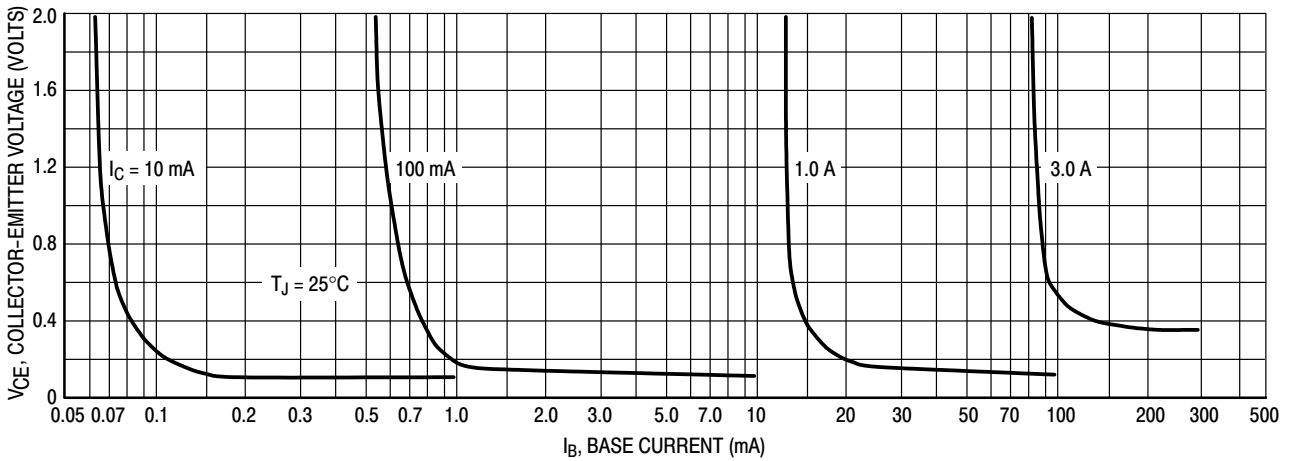


Figure 2. Collector Saturation Region

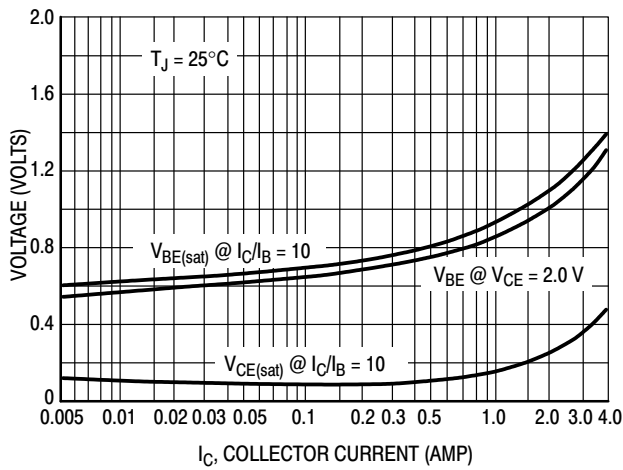


Figure 3. "On" Voltage

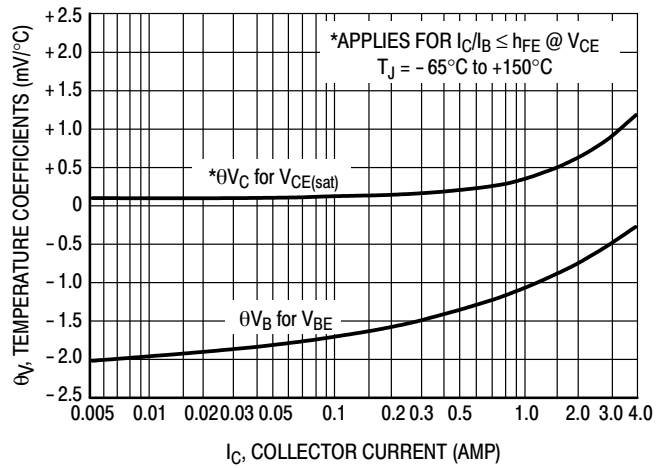


Figure 4. Temperature Coefficients

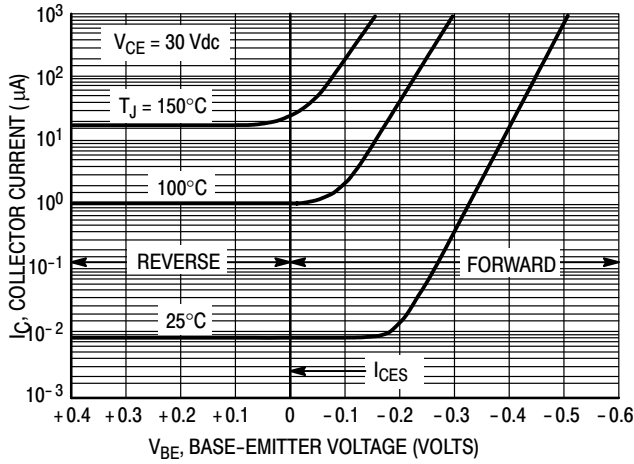


Figure 5. Collector Cut-Off Region

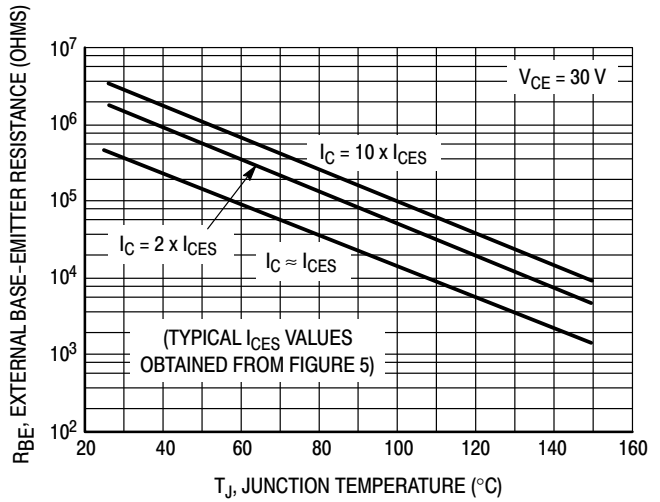


Figure 6. Effects of Base-Emitter Resistance

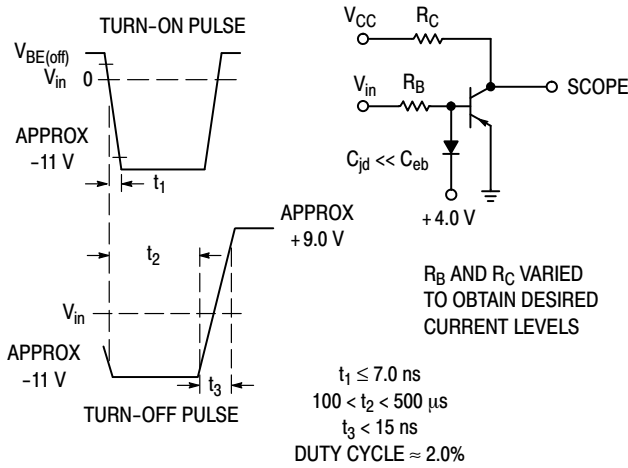


Figure 7. Switching Time Equivalent Test Circuit

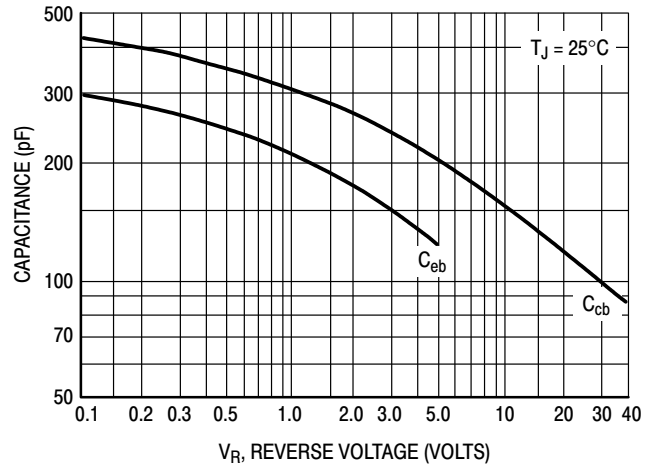


Figure 8. Capacitance

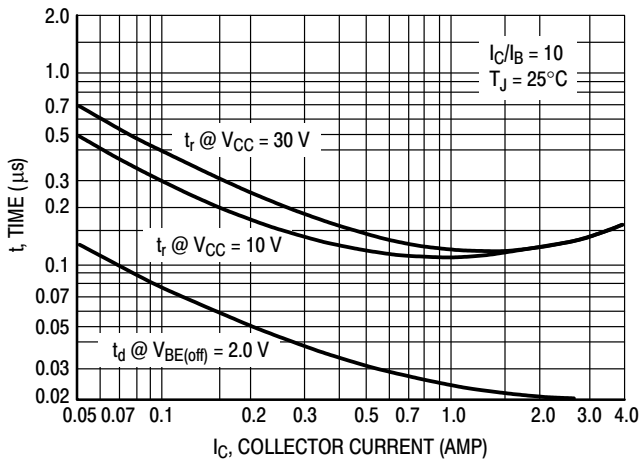


Figure 9. Turn-On Time

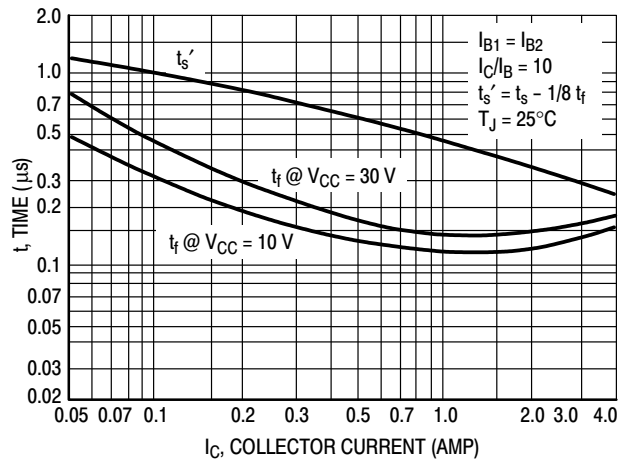
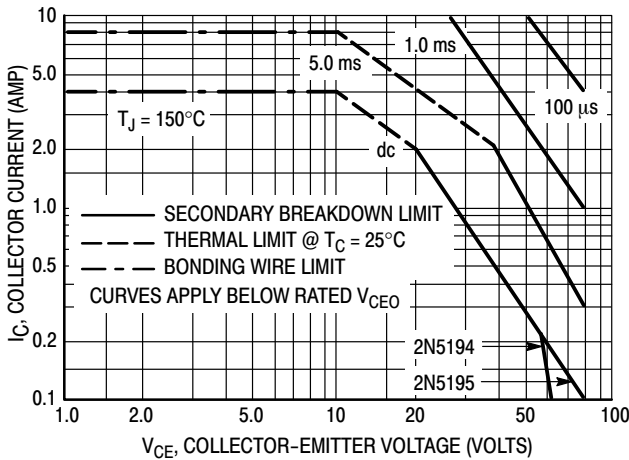


Figure 10. Turn-Off Time

## 2N5194G, 2N5195G

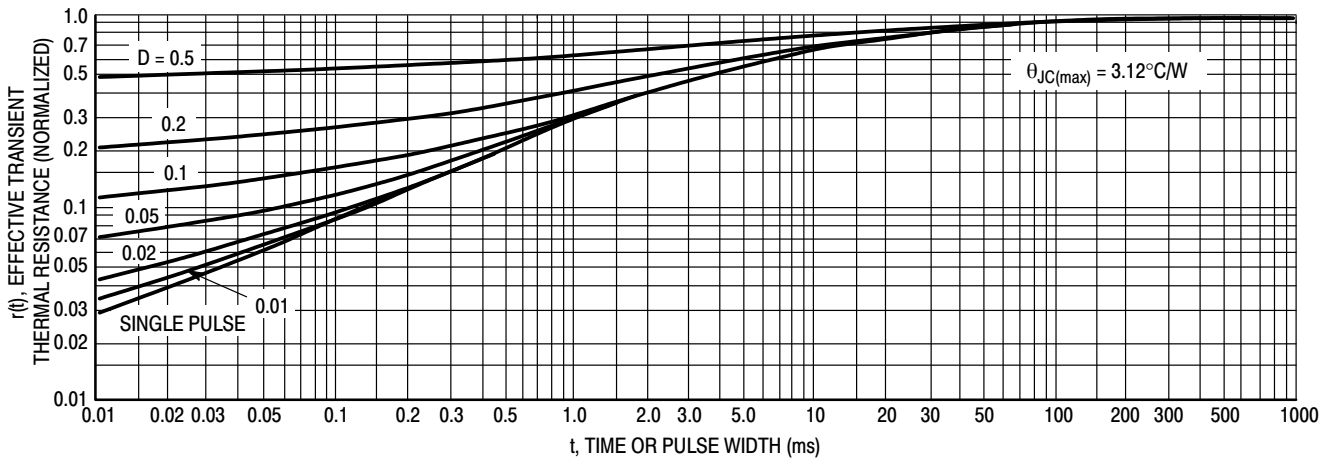


**Figure 11. Rating and Thermal Data Active-Region Safe Operating Area**

### Note 1:

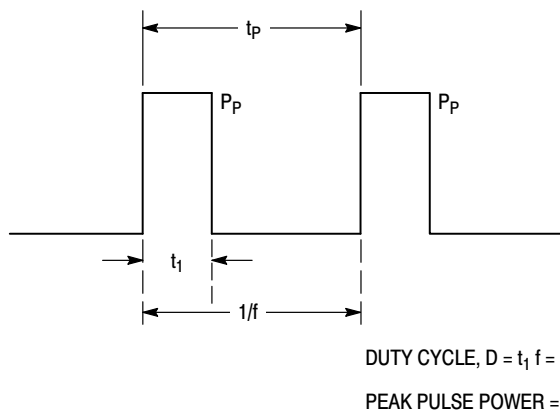
There are two limitations on the power handling ability of a transistor; average junction temperature and second breakdown. Safe operating area curves indicate  $I_C - V_{CE}$  limits of the transistor that must be observed for reliable operation; i.e., the transistor must not be subjected to greater dissipation than the curves indicate.

The data of Figure 11 is based on  $T_{J(pk)} = 150^\circ\text{C}$ .  $T_C$  is variable depending on conditions. Second breakdown pulse limits are valid for duty cycles to 10% provided  $T_{J(pk)} \leq 150^\circ\text{C}$ . At high-case temperatures, thermal limitations will reduce the power that can be handled to values less than the limitations imposed by second breakdown.



**Figure 12. Thermal Response**

### DESIGN NOTE: USE OF TRANSIENT THERMAL RESISTANCE DATA



**Figure 13.**

A train of periodical power pulses can be represented by the model shown in Figure 13. Using the model and the device thermal response, the normalized effective transient thermal resistance of Figure 12 was calculated for various duty cycles.

To find  $\theta_{JC}(t)$ , multiply the value obtained from Figure 12 by the steady state value  $\theta_{JC}$ .

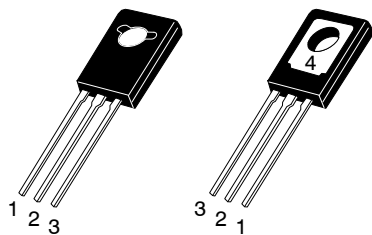
Example:

The 2N5193 is dissipating 50 watts under the following conditions:  $t_1 = 0.1$  ms,  $t_p = 0.5$  ms. ( $D = 0.2$ ).

Using Figure 12, at a pulse width of 0.1 ms and  $D = 0.2$ , the reading of  $r(t_1, D)$  is 0.27.

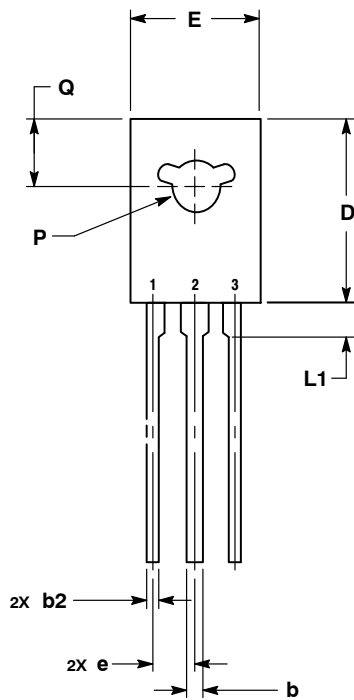
The peak rise in junction temperature is therefore:

$$\Delta T = r(t) \times P_P \times \theta_{JC} = 0.27 \times 50 \times 3.12 = 42.2^\circ\text{C}$$

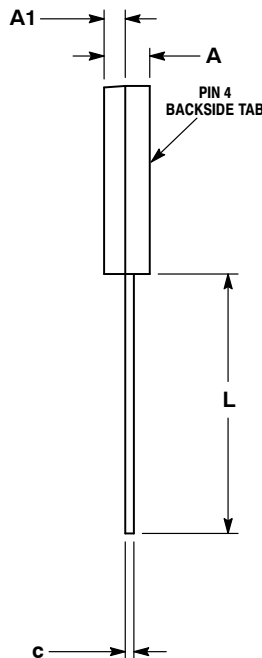


FRONT VIEW BACK VIEW

SCALE 1:1



FRONT VIEW



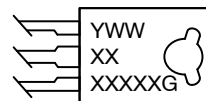
SIDE VIEW

NOTES:

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. CONTROLLING DIMENSION: MILLIMETERS.
3. NUMBER AND SHAPE OF LUGS OPTIONAL.

DIM	MILLIMETERS	
	MIN	MAX
A	2.40	3.00
A1	1.00	1.50
b	0.60	0.90
b2	0.51	0.88
c	0.39	0.63
D	10.60	11.10
E	7.40	7.80
e	2.04	2.54
L	14.50	16.63
L1	1.27	2.54
P	2.90	3.30
Q	3.80	4.20

GENERIC MARKING DIAGRAM\*



- Y = Year
- WW = Work Week
- XXXXX = Device Code
- G = Pb-Free Package

\*This information is generic. Please refer to device data sheet for actual part marking. Pb-Free indicator, "G" or microdot "μ", may or may not be present. Some products may not follow the Generic Marking.

STYLE 1: PIN 1. EMITTER 2., 4. COLLECTOR 3. BASE	STYLE 2: PIN 1. CATHODE 2., 4. ANODE 3. GATE	STYLE 3: PIN 1. BASE 2., 4. COLLECTOR 3. EMITTER	STYLE 4: PIN 1. ANODE 1 2., 4. ANODE 2 3. GATE	STYLE 5: PIN 1. MT 1 2., 4. MT 2 3. GATE
STYLE 6: PIN 1. CATHODE 2., 4. GATE 3. ANODE	STYLE 7: PIN 1. MT 1 2., 4. GATE 3. MT 2	STYLE 8: PIN 1. SOURCE 2., 4. GATE 3. DRAIN	STYLE 9: PIN 1. GATE 2., 4. DRAIN 3. SOURCE	STYLE 10: PIN 1. SOURCE 2., 4. DRAIN 3. GATE

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