

# Darlington Complementary Silicon Power Transistors

## 2N6284 (NPN); 2N6286, 2N6287 (PNP)

These packages are designed for general-purpose amplifier and low-frequency switching applications.

### Features

- High DC Current Gain @  $I_C = 10 \text{ A dc}$  –  
 $h_{FE} = 2400 \text{ (Typ) – 2N6284}$   
 $= 4000 \text{ (Typ) – 2N6287}$
- Collector-Emitter Sustaining Voltage –  
 $V_{CE(sus)} = 100 \text{ V dc (Min)}$
- Monolithic Construction with Built-In Base-Emitter Shunt Resistors
- Pb-Free Packages are Available\*

### MAXIMUM RATINGS (Note 1)

| Rating                                                                                | Symbol         | Value        | Unit                     |
|---------------------------------------------------------------------------------------|----------------|--------------|--------------------------|
| Collector-Emitter Voltage<br>2N6286<br>2N6284/87                                      | $V_{CEO}$      | 80<br>100    | Vdc                      |
| Collector-Base Voltage<br>2N6286<br>2N6284/87                                         | $V_{CB}$       | 80<br>100    | Vdc                      |
| Emitter-Base Voltage                                                                  | $V_{EB}$       | 5.0          | Vdc                      |
| Collector Current – Continuous<br>Peak                                                | $I_C$          | 20<br>40     | Adc                      |
| Base Current                                                                          | $I_B$          | 0.5          | Adc                      |
| Total Power Dissipation @ $T_C = 25^\circ\text{C}$<br>Derate above $25^\circ\text{C}$ | $P_D$          | 160<br>0.915 | W<br>W/ $^\circ\text{C}$ |
| Operating and Storage Temperature<br>Range                                            | $T_J, T_{stg}$ | -65 to +200  | $^\circ\text{C}$         |

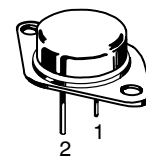
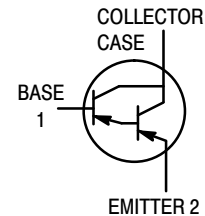
### THERMAL CHARACTERISTICS (Note 1)

| Characteristic                       | Symbol          | Max  | Unit               |
|--------------------------------------|-----------------|------|--------------------|
| Thermal Resistance, Junction-to-Case | $R_{\theta JC}$ | 1.09 | $^\circ\text{C/W}$ |

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.

## 20 AMPERE COMPLEMENTARY SILICON POWER TRANSISTORS 100 VOLTS, 160 WATTS



TO-204AA (TO-3)  
CASE 1-07  
STYLE 1

### MARKING DIAGRAM



2N628x = Device Code  
x = 4, 6 or 7  
G = Pb-Free Package  
A = Location Code  
YY = Year  
WW = Work Week  
MEX = Country of Origin

### ORDERING INFORMATION

| Device  | Package           | Shipping       |
|---------|-------------------|----------------|
| 2N6284  | TO-3              | 100 Units/Tray |
| 2N6284G | TO-3<br>(Pb-Free) | 100 Units/Tray |
| 2N6286  | TO-3              | 100 Units/Tray |
| 2N6286G | TO-3<br>(Pb-Free) | 100 Units/Tray |
| 2N6287  | TO-3              | 100 Units/Tray |
| 2N6287G | TO-3<br>(Pb-Free) | 100 Units/Tray |

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

## 2N6284 (NPN); 2N6286, 2N6287 (PNP)

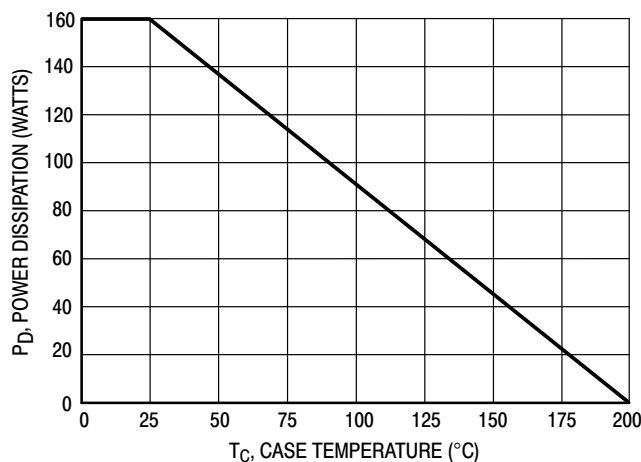


Figure 1. Power Derating

### ELECTRICAL CHARACTERISTICS (T<sub>C</sub> = 25°C unless otherwise noted) (Note 2)

| Characteristic                                                                                                                                                                                               | Symbol                | Min       | Max        | Unit |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|-----------|------------|------|
| <b>OFF CHARACTERISTICS</b>                                                                                                                                                                                   |                       |           |            |      |
| Collector-Emitter Sustaining Voltage<br>(I <sub>C</sub> = 0.1 Adc, I <sub>B</sub> = 0)                                                                                                                       | V <sub>CEO(sus)</sub> | 80<br>100 | –<br>–     | Vdc  |
| Collector Cutoff Current<br>(V <sub>CE</sub> = 40 Vdc, I <sub>B</sub> = 0)<br>(V <sub>CE</sub> = 50 Vdc, I <sub>B</sub> = 0)                                                                                 | I <sub>CEO</sub>      | –<br>–    | 1.0<br>1.0 | mAdc |
| Collector Cutoff Current<br>(V <sub>CE</sub> = Rated V <sub>CB</sub> , V <sub>BE(off)</sub> = 1.5 Vdc)<br>(V <sub>CE</sub> = Rated V <sub>CB</sub> , V <sub>BE(off)</sub> = 1.5 Vdc, T <sub>C</sub> = 150°C) | I <sub>CEX</sub>      | –<br>–    | 0.5<br>5.0 | mAdc |
| Emitter Cutoff Current<br>(V <sub>BE</sub> = 5.0 Vdc, I <sub>C</sub> = 0)                                                                                                                                    | I <sub>EBO</sub>      | –         | 2.0        | mAdc |

### ON CHARACTERISTICS (Note 3)

|                                                                                                                                                     |                      |            |             |     |
|-----------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|------------|-------------|-----|
| DC Current Gain<br>(I <sub>C</sub> = 10 Adc, V <sub>CE</sub> = 3.0 Vdc)<br>(I <sub>C</sub> = 20 Adc, V <sub>CE</sub> = 3.0 Vdc)                     | h <sub>FE</sub>      | 750<br>100 | 18,000<br>– | –   |
| Collector-Emitter Saturation Voltage<br>(I <sub>C</sub> = 10 Adc, I <sub>B</sub> = 40 mAdc)<br>(I <sub>C</sub> = 20 Adc, I <sub>B</sub> = 200 mAdc) | V <sub>CE(sat)</sub> | –<br>–     | 2.0<br>3.0  | Vdc |
| Base-Emitter On Voltage<br>(I <sub>C</sub> = 10 Adc, V <sub>CE</sub> = 3.0 Vdc)                                                                     | V <sub>BE(on)</sub>  | –          | 2.8         | Vdc |
| Base-Emitter Saturation Voltage<br>(I <sub>C</sub> = 20 Adc, I <sub>B</sub> = 200 mAdc)                                                             | V <sub>BE(sat)</sub> | –          | 4.0         | Vdc |

### DYNAMIC CHARACTERISTICS

|                                                                                                                                                            |                 |        |            |     |
|------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|--------|------------|-----|
| Magnitude of Common Emitter Small-Signal Short-Circuit Forward Current Transfer Ratio<br>(I <sub>C</sub> = 10 Adc, V <sub>CE</sub> = 3.0 Vdc, f = 1.0 MHz) | h <sub>fe</sub> | 4.0    | –          | MHz |
| Output Capacitance<br>(V <sub>CB</sub> = 10 Vdc, I <sub>E</sub> = 0, f = 0.1 MHz)                                                                          | C <sub>ob</sub> | –<br>– | 400<br>600 | pF  |
| Small-Signal Current Gain<br>(I <sub>C</sub> = 10 Adc, V <sub>CE</sub> = 3.0 Vdc, f = 1.0 kHz)                                                             | h <sub>fe</sub> | 300    | –          | –   |

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 = 300 μs, Duty Cycle = 2%

## 2N6284 (NPN); 2N6286, 2N6287 (PNP)

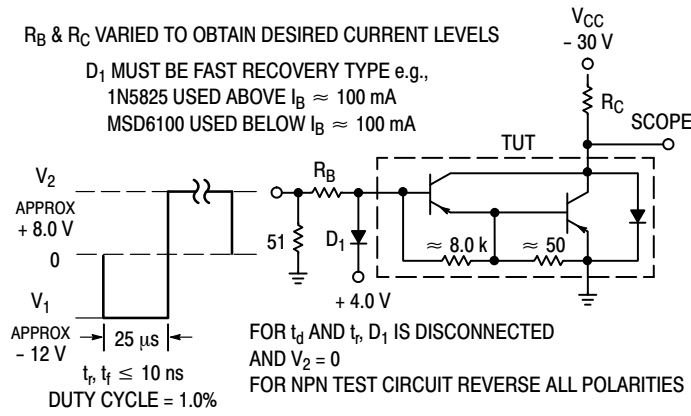


Figure 2. Switching Times Test Circuit

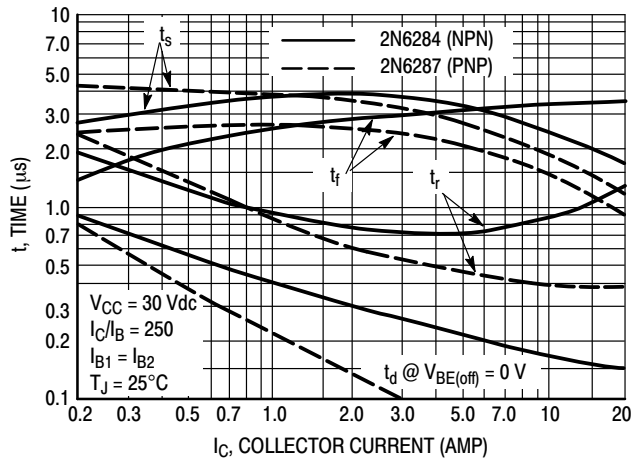


Figure 3. Switching Times

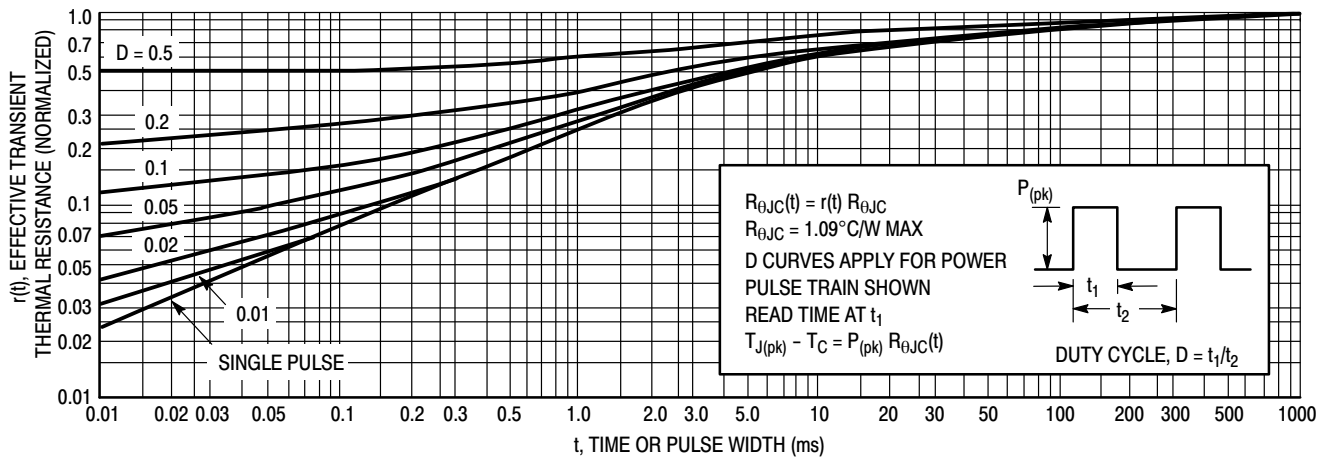


Figure 4. Thermal Response

## 2N6284 (NPN); 2N6286, 2N6287 (PNP)

### ACTIVE-REGION SAFE OPERATING AREA

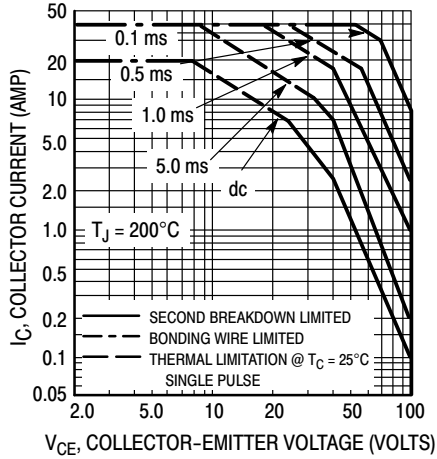


Figure 5. 2N6284, 2N6287

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 5 is based on  $T_{J(pk)} = 200^\circ\text{C}$ ;  $T_C$  is variable depending on conditions. Second breakdown pulse limits are valid for duty cycles to 10% provided  $T_{J(pk)} < 200^\circ\text{C}$ .  $T_{J(pk)}$  may be calculated from the data in Figure 4. At high case temperatures, thermal limitations will reduce the power that can be handled to values less than the limitations imposed by second breakdown.

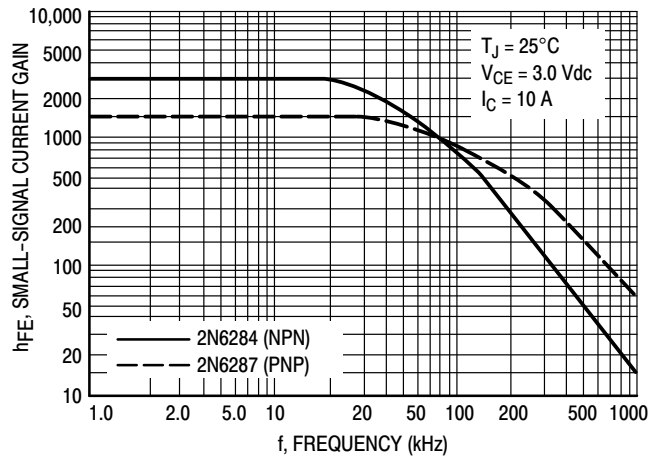


Figure 6. Small-Signal Current Gain

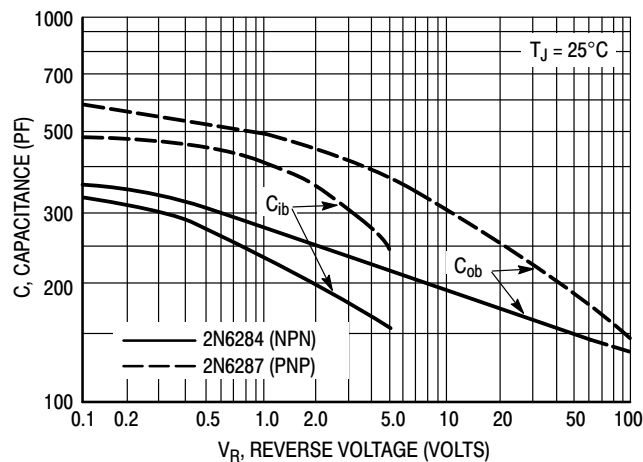


Figure 7. Capacitance

## 2N6284 (NPN); 2N6286, 2N6287 (PNP)

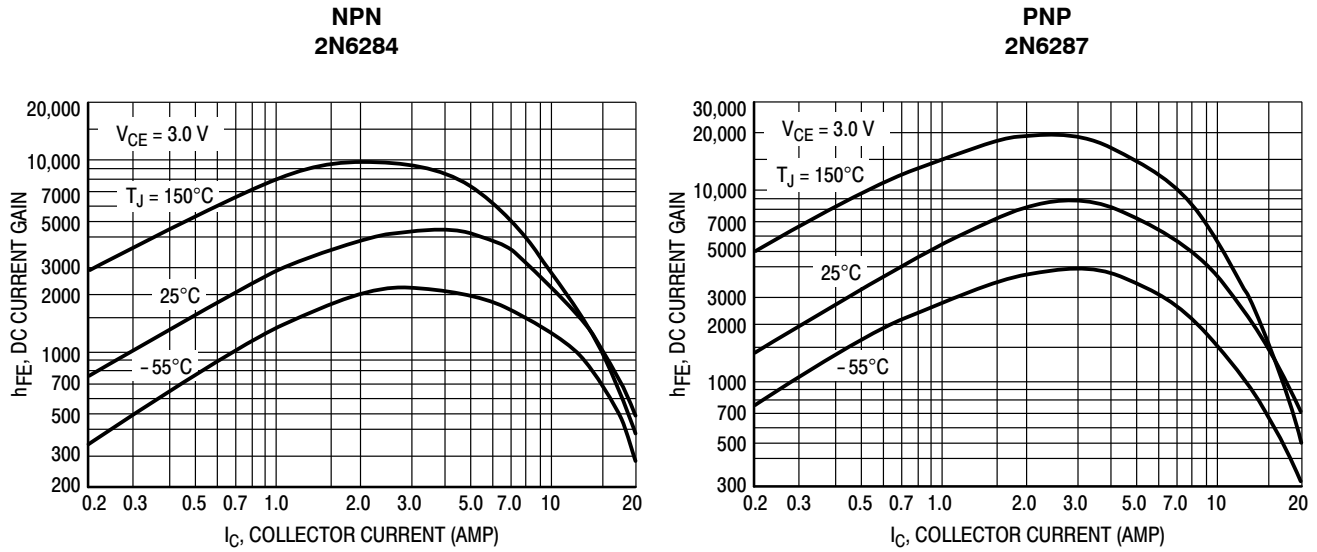


Figure 8. DC Current Gain

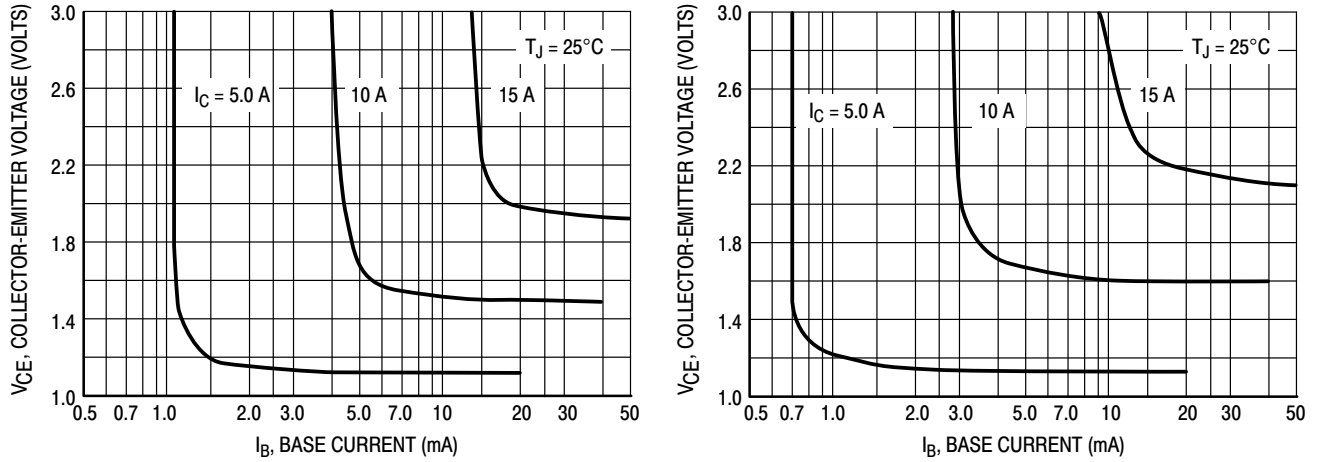


Figure 9. Collector Saturation Region

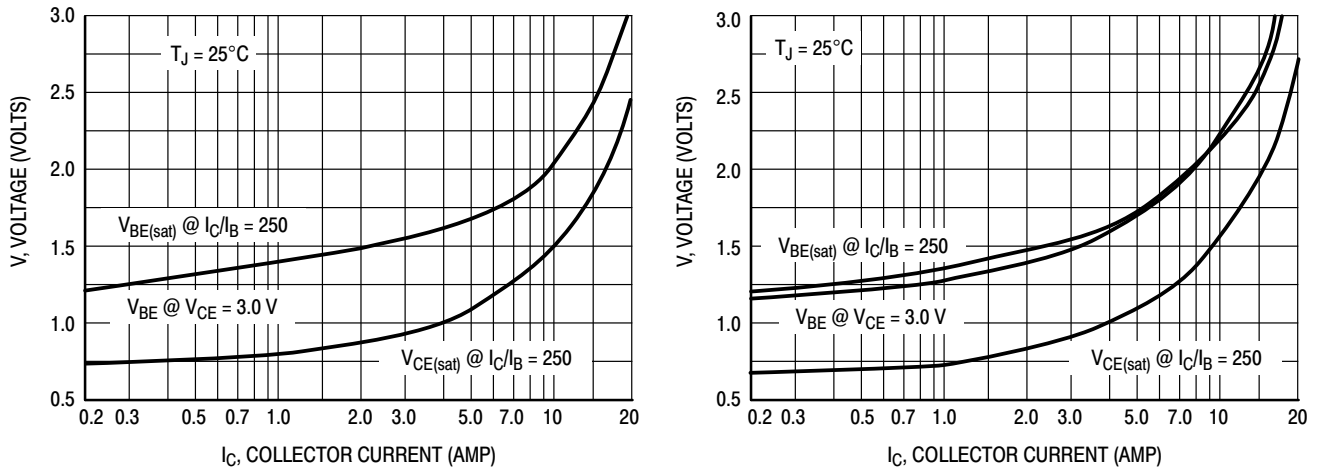


Figure 10. "On" Voltages

## 2N6284 (NPN); 2N6286, 2N6287 (PNP)

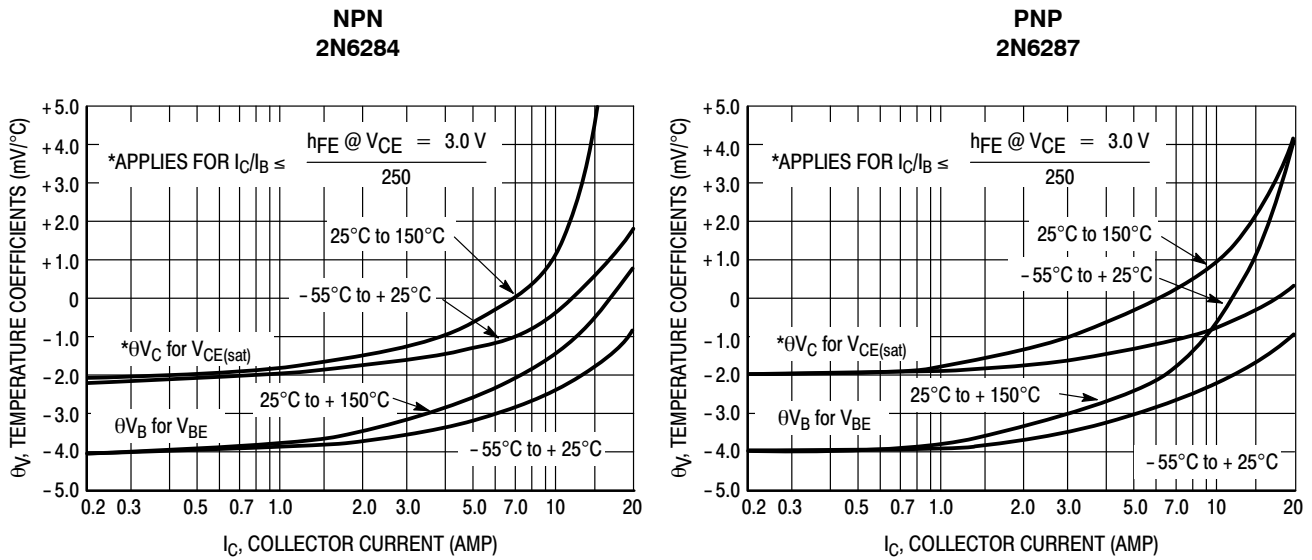


Figure 11. Temperature Coefficients

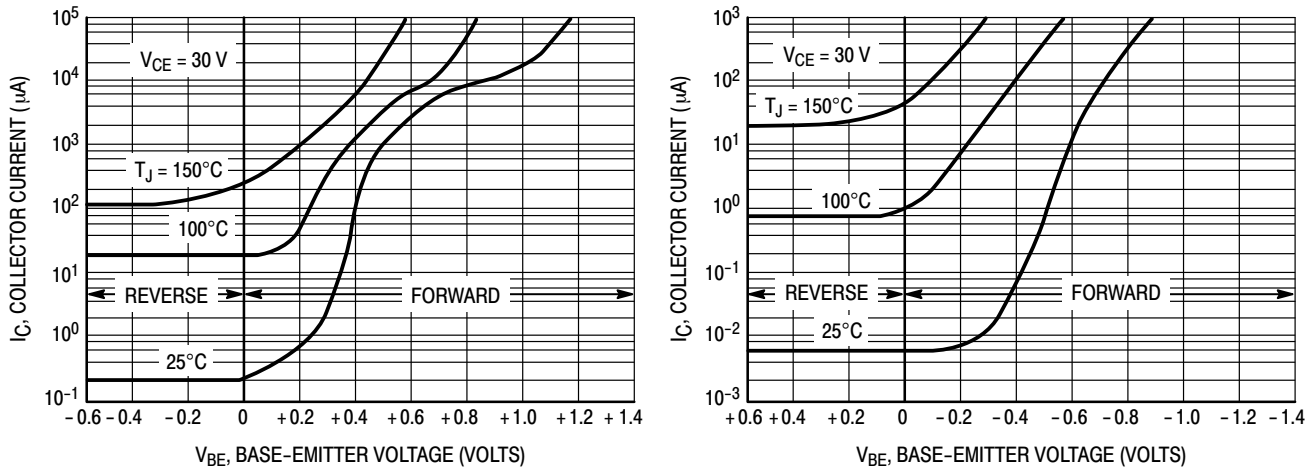


Figure 12. Collector Cut-Off Region

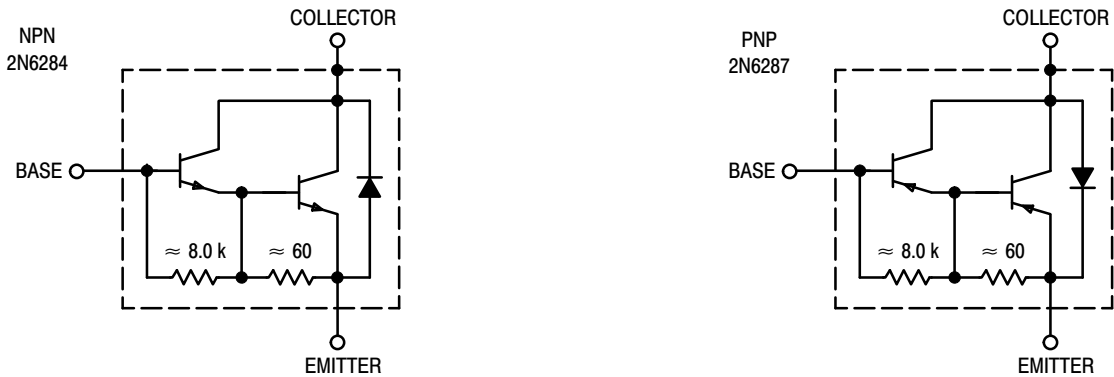
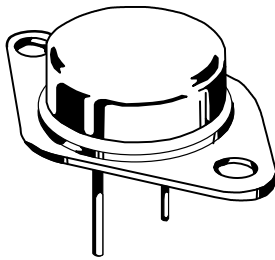


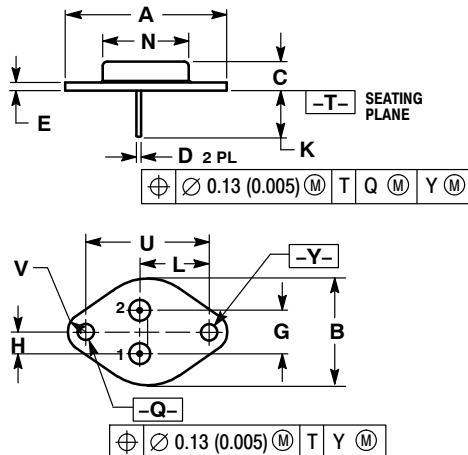
Figure 13. Darlington Schematic



TO-204 (TO-3)  
CASE 1-07  
ISSUE Z

DATE 10 MAR 2000

SCALE 1:1



NOTES:

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. ALL RULES AND NOTES ASSOCIATED WITH REFERENCED TO-204AA OUTLINE SHALL APPLY.

| DIM | INCHES    |       | MILLIMETERS |       |
|-----|-----------|-------|-------------|-------|
|     | MIN       | MAX   | MIN         | MAX   |
| A   | 1.550 REF |       | 39.37 REF   |       |
| B   | ---       | 1.050 | ---         | 26.67 |
| C   | 0.250     | 0.335 | 6.35        | 8.51  |
| D   | 0.038     | 0.043 | 0.97        | 1.09  |
| E   | 0.055     | 0.070 | 1.40        | 1.77  |
| G   | 0.430 BSC |       | 10.92 BSC   |       |
| H   | 0.215 BSC |       | 5.46 BSC    |       |
| K   | 0.440     | 0.480 | 11.18       | 12.19 |
| L   | 0.665 BSC |       | 16.89 BSC   |       |
| N   | ---       | 0.830 | ---         | 21.08 |
| Q   | 0.151     | 0.165 | 3.84        | 4.19  |
| U   | 1.187 BSC |       | 30.15 BSC   |       |
| V   | 0.131     | 0.188 | 3.33        | 4.77  |

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

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

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

STYLE 4:  
PIN 1. GROUND  
2. INPUT  
CASE: OUTPUT

STYLE 5:  
PIN 1. CATHODE  
2. EXTERNAL TRIP/DELAY  
CASE: ANODE

STYLE 6:  
PIN 1. GATE  
2. EMITTER  
CASE: COLLECTOR

STYLE 7:  
PIN 1. ANODE  
2. OPEN  
CASE: CATHODE

STYLE 8:  
PIN 1. CATHODE #1  
2. CATHODE #2  
CASE: ANODE

STYLE 9:  
PIN 1. ANODE #1  
2. ANODE #2  
CASE: CATHODE

|                  |               |                                                                                                                                                                                     |
|------------------|---------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
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