

# Darlington Complementary Silicon Power Transistors

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

- High DC Current Gain —  
 $h_{FE} = 3500$  (Typ) @  $I_C = 5.0$  Adc
- Collector–Emitter Sustaining Voltage — @ 100 mA  
 $V_{CEO(sus)} = 80$  Vdc (Min) — 2N6058  
 100 Vdc (Min) — 2N6052, 2N6059
- Monolithic Construction with Built–In Base–Emitter Shunt Resistors
- These devices are available in Pb–free package(s). Specifications herein apply to both standard and Pb–free devices. Please see our website at [www.onsemi.com](http://www.onsemi.com) for specific Pb–free orderable part numbers, or contact your local ON Semiconductor sales office or representative.

## MAXIMUM RATINGS (1)

| Rating  | Symbol         | 2N6058                       | 2N6052<br>2N6059 | Unit                         |
|---|----------------|------------------------------|------------------|------------------------------|
| Collector–Emitter Voltage   | $V_{CEO}$      | 80                           | 100              | Vdc                          |
| Collector–Base Voltage  | $V_{CB}$       | 80                           | 100              | Vdc                          |
| Emitter–Base voltage  | $V_{EB}$       | 5.0                          |                  | Vdc                          |
| Collector Current — Continuous<br>Peak  | $I_C$          | 12<br>20                     |                  | Adc                          |
| Base Current  | $I_B$          | 0.2                          |                  | Adc                          |
| Total Device Dissipation<br>@ $T_C = 25^\circ\text{C}$<br>Derate above $25^\circ\text{C}$ | $P_D$          | 150                          | 0.857            | Watts<br>W/ $^\circ\text{C}$ |
| Operating and Storage Junction<br>Temperature Range                                       | $T_J, T_{stg}$ | –65 to +200 $^\circ\text{C}$ |                  | $^\circ\text{C}$             |

## THERMAL CHARACTERISTICS

| Characteristic                       | Symbol          | Rating | Unit                      |
|--------------------------------------|-----------------|--------|---------------------------|
| Thermal Resistance, Junction to Case | $R_{\theta JC}$ | 1.17   | $^\circ\text{C}/\text{W}$ |

(1) Indicates JEDEC Registered Data.

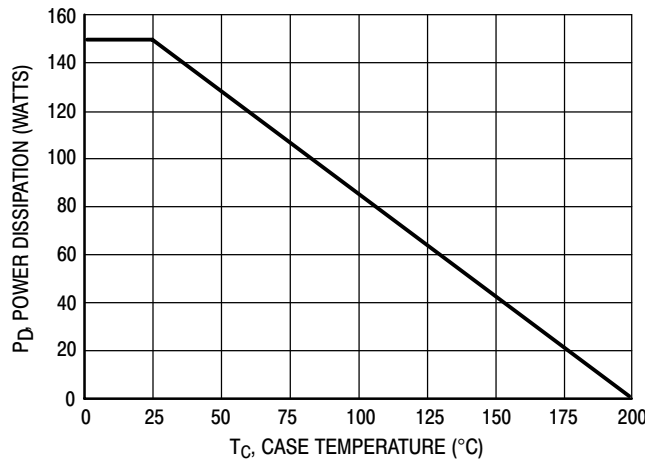


Figure 1. Power Derating

Preferred devices are ON Semiconductor recommended choices for future use and best overall value.

**PNP**  
**2N6052\***

**NPN**  
**2N6058**  
**2N6059\***

\*ON Semiconductor Preferred Device

**DARLINGTON**  
**12 AMPERE**  
**COMPLEMENTARY**  
**SILICON**  
**POWER TRANSISTORS**  
**80 – 100 VOLTS**  
**150 WATTS**

**CASE 1–07**  
**TO–204AA**  
**(TO–3)**

# 2N6052

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

| Characteristic   | Symbol                   | Min       | Max        | Unit |
|--|--------------------------|-----------|------------|------|
| <b>OFF CHARACTERISTICS</b>   |                          |           |            |      |
| Collector–Emitter Sustaining Voltage (2)<br>( $I_C = 100\text{ mA}$ , $I_B = 0$ )  | $V_{CE(sus)}$            | 80<br>100 | —          | Vdc  |
|  | 2N6058<br>2N6052, 2N6059 |           |            |      |
| Collector Cutoff Current<br>( $V_{CE} = 40\text{ Vdc}$ , $I_B = 0$ )<br>( $V_{CE} = 50\text{ Vdc}$ , $I_B = 0$ )   | $I_{CEO}$                | —<br>—    | 1.0<br>1.0 | mAdc |
|  | 2N6058<br>2N6052, 2N6059 |           |            |      |
| Collector Cutoff Current<br>( $V_{CE} = \text{Rated } V_{CEO}$ , $V_{BE(off)} = 1.5\text{ Vdc}$ )<br>( $V_{CE} = \text{Rated } V_{CEO}$ , $V_{BE(off)} = 1.5\text{ Vdc}$ , $T_C = 150^\circ\text{C}$ ) | $I_{CEX}$                | —         | 0.5<br>5.0 | mAdc |
| Emitter Cutoff Current<br>( $V_{BE} = 5.0\text{ Vdc}$ , $I_C = 0$ )  | $I_{EBO}$                | —         | 2.0        | mAdc |

## ON CHARACTERISTICS (2)

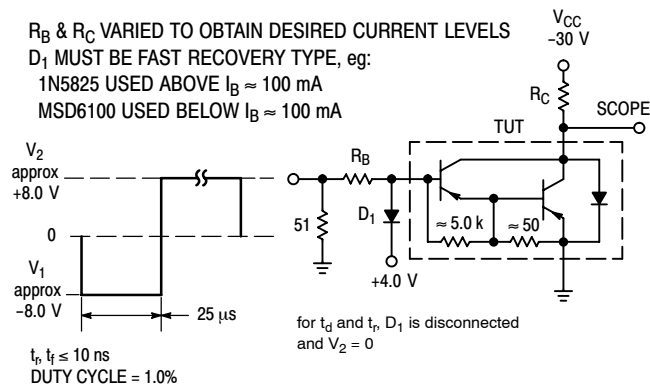
|  |               |            |             |     |
|--|---------------|------------|-------------|-----|
| DC Current Gain<br>( $I_C = 6.0\text{ Adc}$ , $V_{CE} = 3.0\text{ Vdc}$ )<br>( $I_C = 12\text{ Adc}$ , $V_{CE} = 3.0\text{ Vdc}$ )             | $h_{FE}$      | 750<br>100 | 18,000<br>— | —   |
| Collector–Emitter Saturation Voltage<br>( $I_C = 6.0\text{ Adc}$ , $I_B = 24\text{ mA}$ )<br>( $I_C = 12\text{ Adc}$ , $I_B = 120\text{ mA}$ ) | $V_{CE(sat)}$ | —<br>—     | 2.0<br>3.0  | Vdc |
| Base–Emitter Saturation Voltage<br>( $I_C = 12\text{ Adc}$ , $I_B = 120\text{ mA}$ )   | $V_{BE(sat)}$ | —          | 4.0         | Vdc |
| Base–Emitter On Voltage<br>( $I_C = 6.0\text{ Adc}$ , $V_{CE} = 3.0\text{ Vdc}$ )  | $V_{BE(on)}$  | —          | 2.8         | Vdc |

## DYNAMIC CHARACTERISTICS

|  |                         |        |            |     |
|--|-------------------------|--------|------------|-----|
| Magnitude of Common Emitter Small–Signal Short Circuit Forward Current Transfer Ratio<br>( $I_C = 5.0\text{ Adc}$ , $V_{CE} = 3.0\text{ Vdc}$ , $f = 1.0\text{ MHz}$ ) | $ h_{fe} $              | 4.0    | —          | MHz |
| Output Capacitance<br>( $V_{CB} = 10\text{ Vdc}$ , $I_E = 0$ , $f = 0.1\text{ MHz}$ )  | $C_{ob}$                | —<br>— | 500<br>300 | pF  |
|  | 2N6052<br>2N6058/2N6059 |        |            |     |
| Small–Signal Current Gain<br>( $I_C = 5.0\text{ Adc}$ , $V_{CE} = 3.0\text{ Vdc}$ , $f = 1.0\text{ kHz}$ )   | $h_{fe}$                | 300    | —          | —   |

\*Indicates JEDEC Registered Data.

(2) Pulse test: Pulse Width = 300  $\mu\text{s}$ , Duty Cycle = 2.0%.



For NPN test circuit reverse diode and voltage polarities.

Figure 2. Switching Times Test Circuit

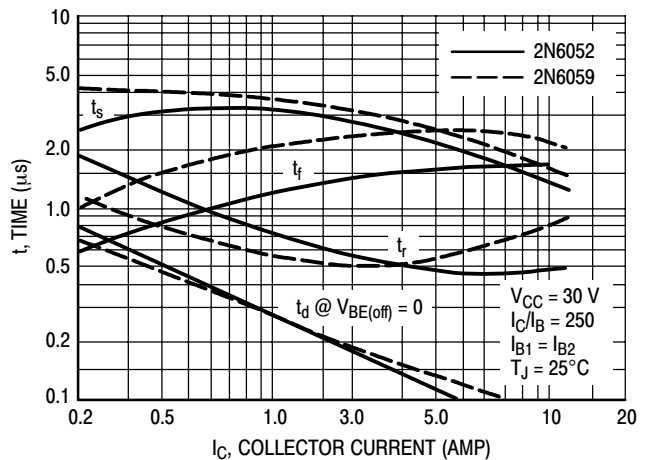
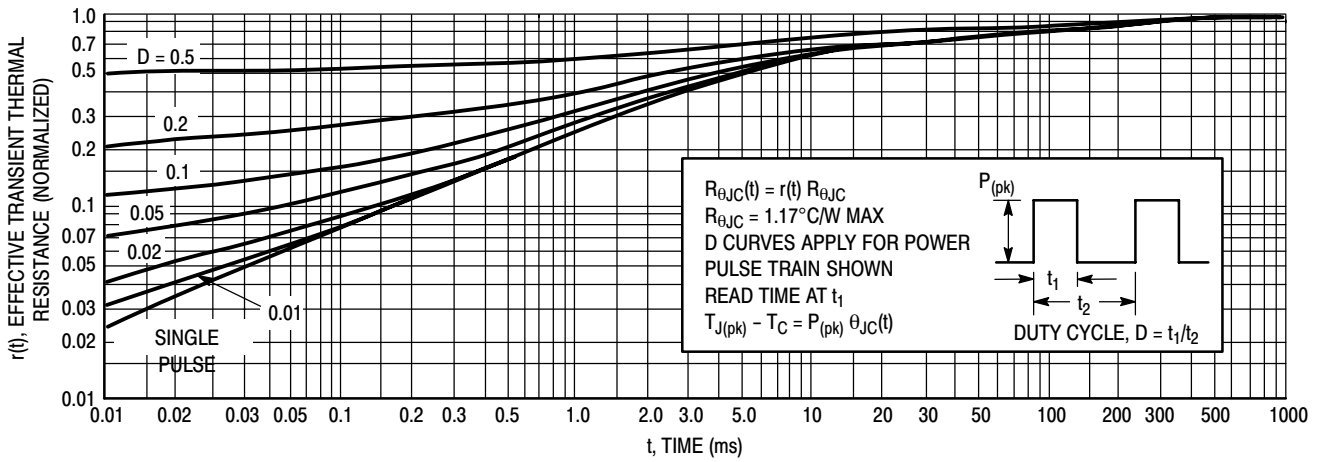


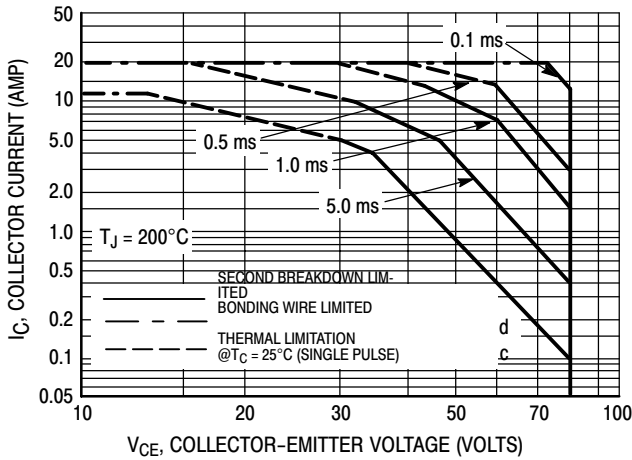
Figure 3. Switching Times

## 2N6052

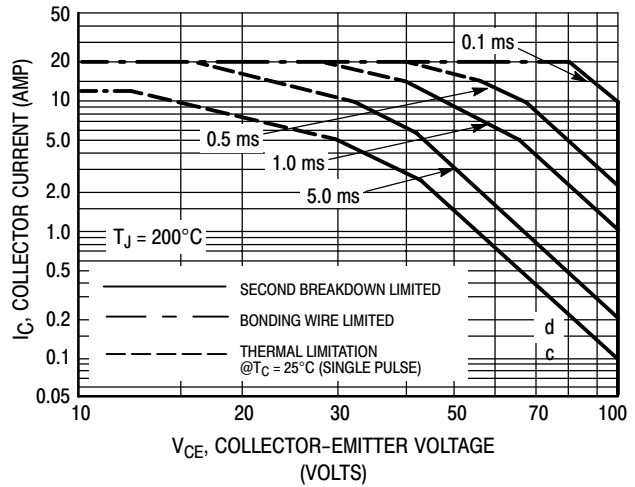


**Figure 4. Thermal Response**

### ACTIVE-REGION SAFE OPERATING AREA



**Figure 5. 2N6058**



**Figure 6. 2N6052, 2N6059**

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 Figures 5, 6, and 7 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  $T_{J(pk)} \leq 200^{\circ}\text{C}$ ;  $T_{J(pk)}$  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.

# 2N6052

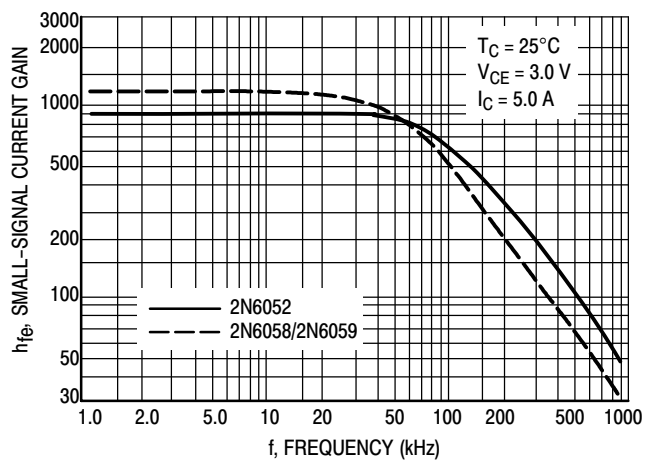


Figure 7. Small-Signal Current Gain

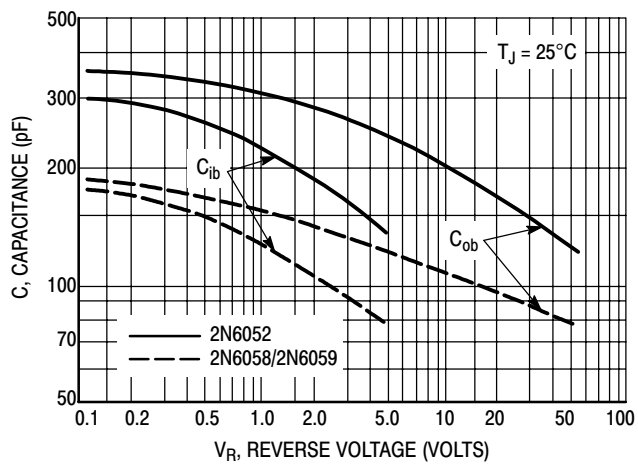


Figure 8. Capacitance

# 2N6052

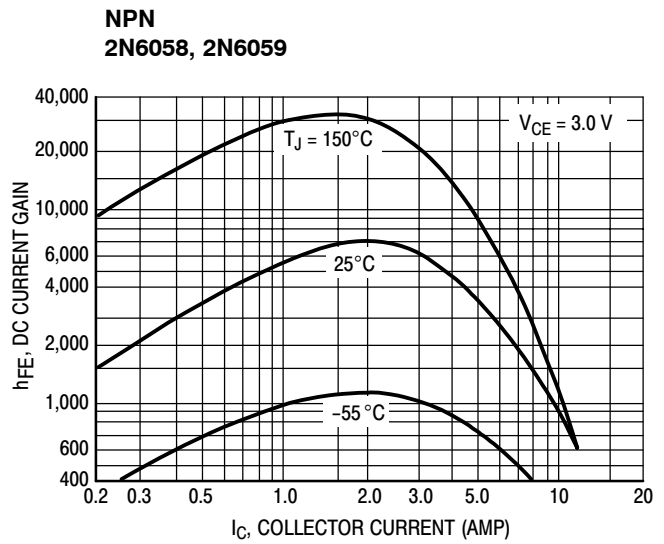
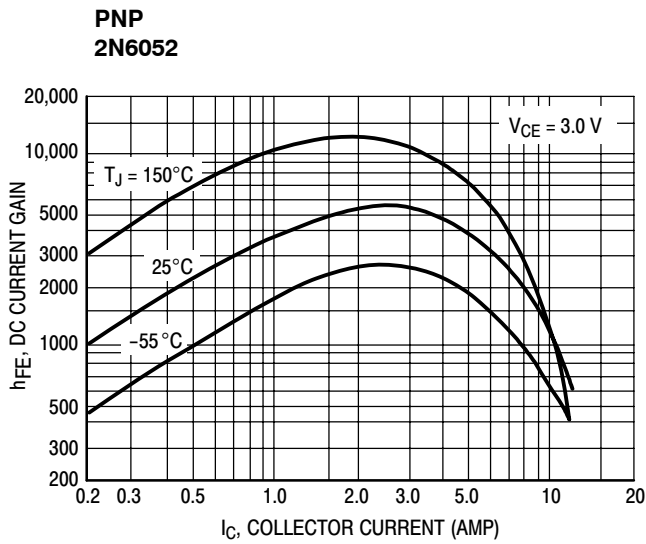


Figure 9. DC Current Gain

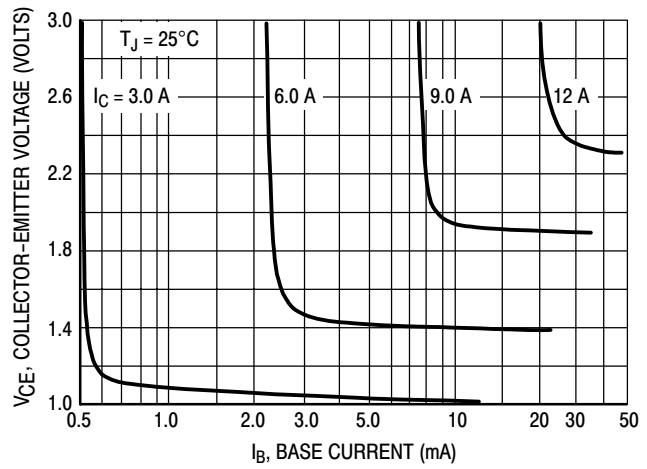
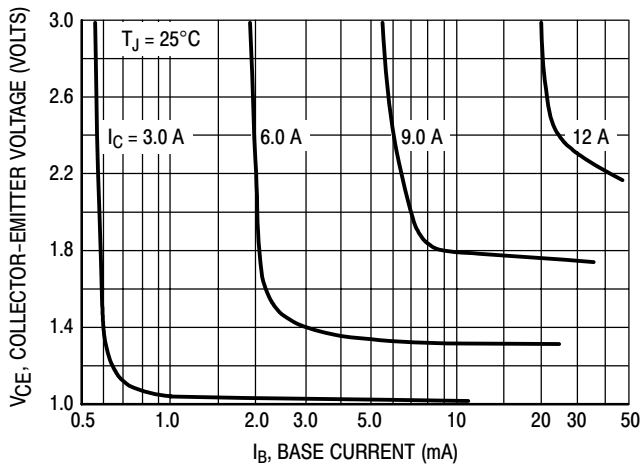


Figure 10. Collector Saturation Region

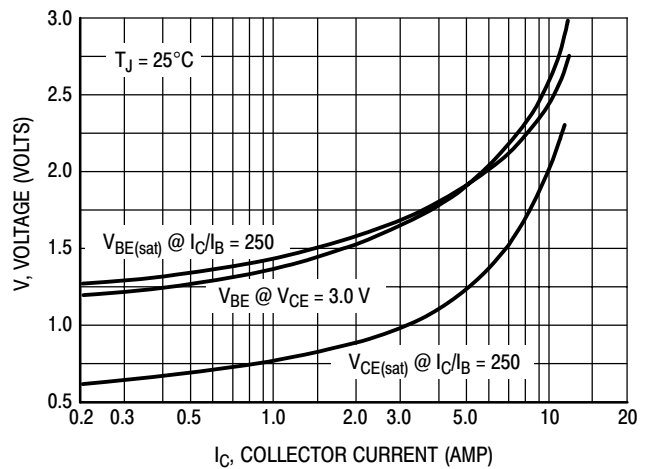
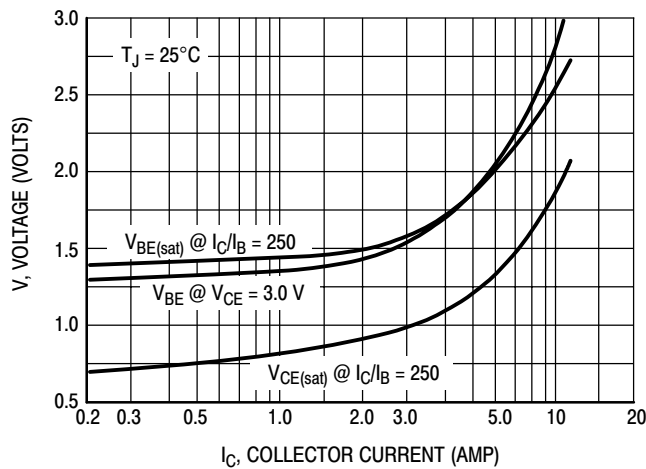
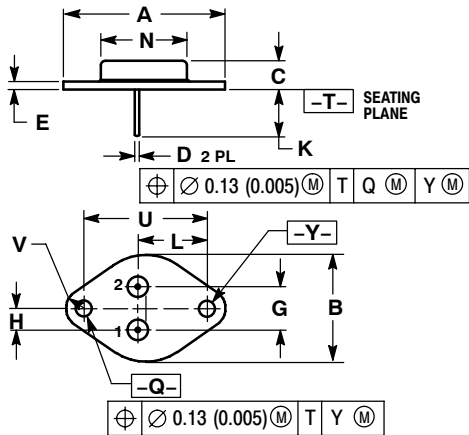


Figure 11. "On" Voltages

# 2N6052

## PACKAGE DIMENSIONS

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



- NOTES:
- DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
  - CONTROLLING DIMENSION: INCH.
  - 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

# Notes

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