

# (PNP) 2N6034, 2N6035, 2N6036; (NPN) 2N6038, 2N6039

## Plastic Darlington Complementary Silicon Power Transistors

Plastic Darlington complementary silicon power transistors are designed for general purpose amplifier and low-speed switching applications.

### Features

- ESD Ratings: Machine Model, C; > 400 V  
Human Body Model, 3B; > 8000 V
- Epoxy Meets UL 94 V-0 @ 0.125 in
- Pb-Free Packages are Available\*

### MAXIMUM RATINGS

| Rating                                                                                 | Symbol         | Value          | Unit                      |
|----------------------------------------------------------------------------------------|----------------|----------------|---------------------------|
| Collector-Emitter Voltage<br>2N6034<br>2N6035, 2N6038<br>2N6036, 2N6039                | $V_{CEO}$      | 40<br>60<br>80 | Vdc                       |
| Collector-Base Voltage<br>2N6034<br>2N6035, 2N6038<br>2N6036, 2N6039                   | $V_{CBO}$      | 40<br>60<br>80 | Vdc                       |
| Emitter-Base Voltage                                                                   | $V_{EBO}$      | 5.0            | Vdc                       |
| Collector Current<br>Continuous<br>Peak                                                | $I_C$          | 4.0<br>8.0     | Adc<br>Apc                |
| Base Current                                                                           | $I_B$          | 100            | mApc                      |
| Total Device Dissipation @ $T_C = 25^\circ\text{C}$<br>Derate above $25^\circ\text{C}$ | $P_D$          | 40<br>320      | W<br>mW/ $^\circ\text{C}$ |
| Total Device Dissipation @ $T_C = 25^\circ\text{C}$<br>Derate above $25^\circ\text{C}$ | $P_D$          | 1.5<br>12      | W<br>mW/ $^\circ\text{C}$ |
| Operating and Storage Junction<br>Temperature Range                                    | $T_J, T_{stg}$ | -65 to<br>+150 | $^\circ\text{C}$          |

### THERMAL CHARACTERISTICS

| Characteristic                          | Symbol          | Max  | Unit               |
|-----------------------------------------|-----------------|------|--------------------|
| Thermal Resistance, Junction-to-Case    | $R_{\theta JC}$ | 3.12 | $^\circ\text{C/W}$ |
| Thermal Resistance, Junction-to-Ambient | $R_{\theta JA}$ | 83.3 | $^\circ\text{C/W}$ |

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.

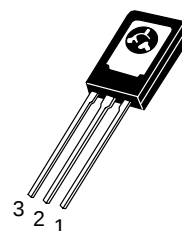
\*For additional information on our Pb-Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.



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## 4.0 AMPERES DARLINGTON COMPLEMENTARY SILICON POWER TRANSISTORS 40, 60, 80 VOLTS, 40 WATTS



TO-225AA  
CASE 77  
STYLE 1

### MARKING DIAGRAM



Y = Year  
WW = Work Week  
2N603x = Device Code  
x = 4, 5, 6, 8, 9  
G = Pb-Free Package

### ORDERING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 5 of this data sheet.

# (PNP) 2N6034, 2N6035, 2N6036; (NPN) 2N6038, 2N6039

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

| Characteristic                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Symbol        | Min                        | Max                                    | Unit          |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|----------------------------|----------------------------------------|---------------|
| <b>OFF CHARACTERISTICS</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |               |                            |                                        |               |
| Collector-Emitter Sustaining Voltage<br>( $I_C = 100\text{ mAdc}$ , $I_B = 0$ )                                                                                                                                                                                                                                                                                                                                                                                                                                    | $V_{CE(sus)}$ | 40<br>60<br>80             | –<br>–<br>–                            | Vdc           |
| Collector-Cutoff Current<br>( $V_{CE} = 40\text{ Vdc}$ , $I_B = 0$ )<br>( $V_{CE} = 60\text{ Vdc}$ , $I_B = 0$ )<br>( $V_{CE} = 80\text{ Vdc}$ , $I_B = 0$ )                                                                                                                                                                                                                                                                                                                                                       | $I_{CEO}$     | –<br>–<br>–                | 100<br>100<br>100                      | $\mu\text{A}$ |
| Collector-Cutoff Current<br>( $V_{CE} = 40\text{ Vdc}$ , $V_{BE(off)} = 1.5\text{ Vdc}$ )<br>( $V_{CE} = 60\text{ Vdc}$ , $V_{BE(off)} = 1.5\text{ Vdc}$ )<br>( $V_{CE} = 80\text{ Vdc}$ , $V_{BE(off)} = 1.5\text{ Vdc}$ )<br>( $V_{CE} = 40\text{ Vdc}$ , $V_{BE(off)} = 1.5\text{ Vdc}$ , $T_C = 125^\circ\text{C}$ )<br>( $V_{CE} = 60\text{ Vdc}$ , $V_{BE(off)} = 1.5\text{ Vdc}$ , $T_C = 125^\circ\text{C}$ )<br>( $V_{CE} = 80\text{ Vdc}$ , $V_{BE(off)} = 1.5\text{ Vdc}$ , $T_C = 125^\circ\text{C}$ ) | $I_{CEX}$     | –<br>–<br>–<br>–<br>–<br>– | 100<br>100<br>100<br>500<br>500<br>500 | $\mu\text{A}$ |
| Collector-Cutoff Current<br>( $V_{CB} = 40\text{ Vdc}$ , $I_E = 0$ )<br>( $V_{CB} = 60\text{ Vdc}$ , $I_E = 0$ )<br>( $V_{CB} = 80\text{ Vdc}$ , $I_E = 0$ )                                                                                                                                                                                                                                                                                                                                                       | $I_{CBO}$     | –<br>–<br>–                | 0.5<br>0.5<br>0.5                      | mAdc          |
| Emitter-Cutoff Current ( $V_{BE} = 5.0\text{ Vdc}$ , $I_C = 0$ )                                                                                                                                                                                                                                                                                                                                                                                                                                                   | $I_{EBO}$     | –                          | 2.0                                    | mAdc          |
| <b>ON CHARACTERISTICS</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |               |                            |                                        |               |
| DC Current Gain<br>( $I_C = 0.5\text{ Adc}$ , $V_{CE} = 3.0\text{ Vdc}$ )<br>( $I_C = 2.0\text{ Adc}$ , $V_{CE} = 3.0\text{ Vdc}$ )<br>( $I_C = 4.0\text{ Adc}$ , $V_{CE} = 3.0\text{ Vdc}$ )                                                                                                                                                                                                                                                                                                                      | $h_{FE}$      | 500<br>750<br>100          | –<br>15,000<br>–                       | –             |
| Collector-Emitter Saturation Voltage<br>( $I_C = 2.0\text{ Adc}$ , $I_B = 8.0\text{ mAdc}$ )<br>( $I_C = 4.0\text{ Adc}$ , $I_B = 40\text{ mAdc}$ )                                                                                                                                                                                                                                                                                                                                                                | $V_{CE(sat)}$ | –<br>–                     | 2.0<br>3.0                             | Vdc           |
| Base-Emitter Saturation Voltage<br>( $I_C = 4.0\text{ Adc}$ , $I_B = 40\text{ mAdc}$ )                                                                                                                                                                                                                                                                                                                                                                                                                             | $V_{BE(sat)}$ | –                          | 4.0                                    | Vdc           |
| Base-Emitter On Voltage<br>( $I_C = 2.0\text{ Adc}$ , $V_{CE} = 3.0\text{ Vdc}$ )                                                                                                                                                                                                                                                                                                                                                                                                                                  | $V_{BE(on)}$  | –                          | 2.8                                    | Vdc           |
| <b>DYNAMIC CHARACTERISTICS</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |               |                            |                                        |               |
| Small-Signal Current-Gain<br>( $I_C = 0.75\text{ Adc}$ , $V_{CE} = 10\text{ Vdc}$ , $f = 1.0\text{ MHz}$ )                                                                                                                                                                                                                                                                                                                                                                                                         | $ h_{fe} $    | 25                         | –                                      | –             |
| Output Capacitance<br>( $V_{CB} = 10\text{ Vdc}$ , $I_E = 0$ , $f = 0.1\text{ MHz}$ )                                                                                                                                                                                                                                                                                                                                                                                                                              | $C_{ob}$      | –<br>–                     | 200<br>100                             | $\mu\text{F}$ |

\*Indicates JEDEC Registered Data.

# (PNP) 2N6034, 2N6035, 2N6036; (NPN) 2N6038, 2N6039

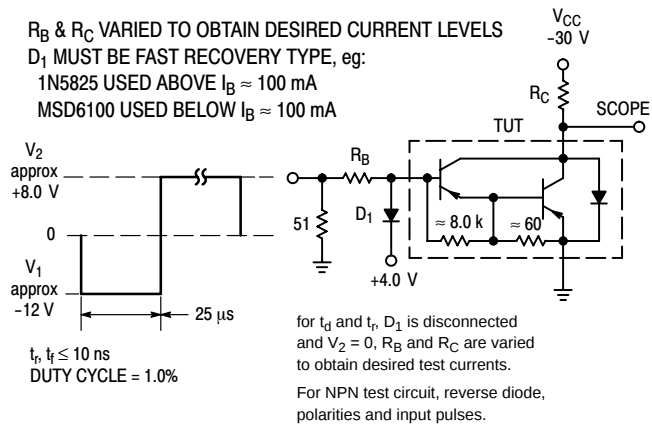


Figure 1. Switching Times Test Circuit

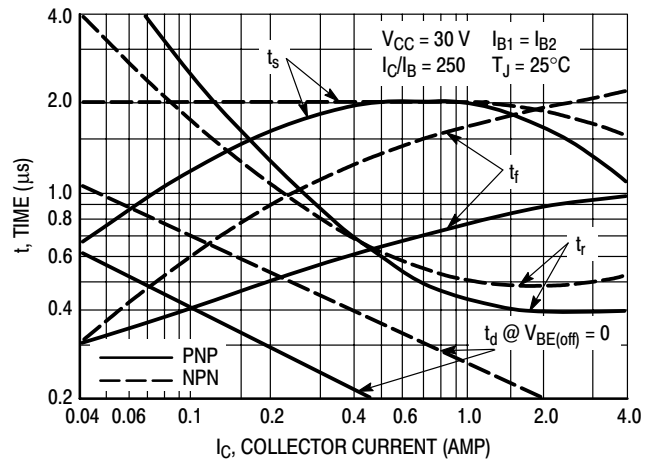


Figure 2. Switching Times

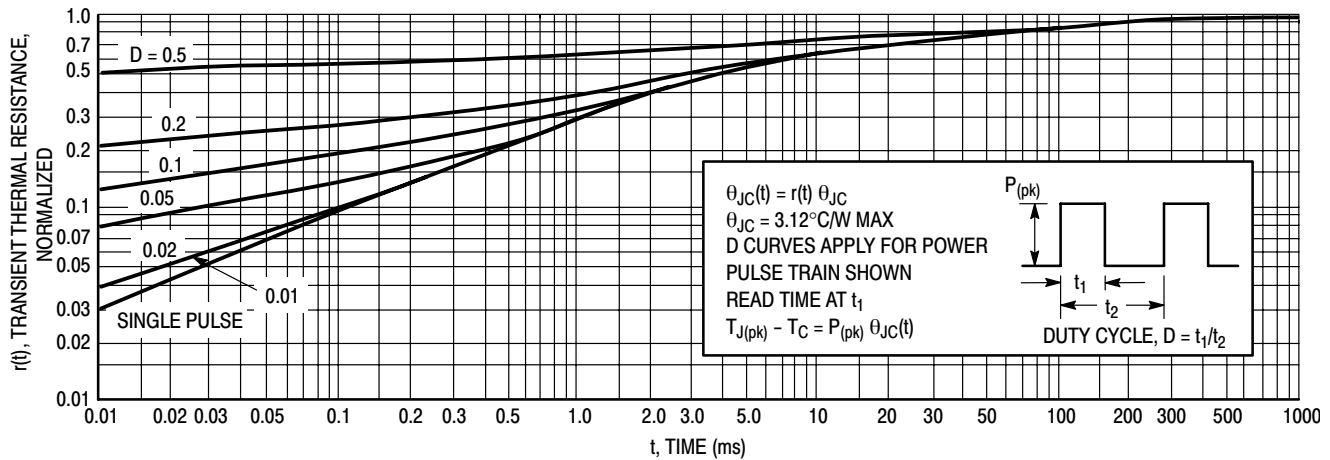


Figure 3. Thermal Response

# (PNP) 2N6034, 2N6035, 2N6036; (NPN) 2N6038, 2N6039

## ACTIVE-REGION SAFE-OPERATING AREA

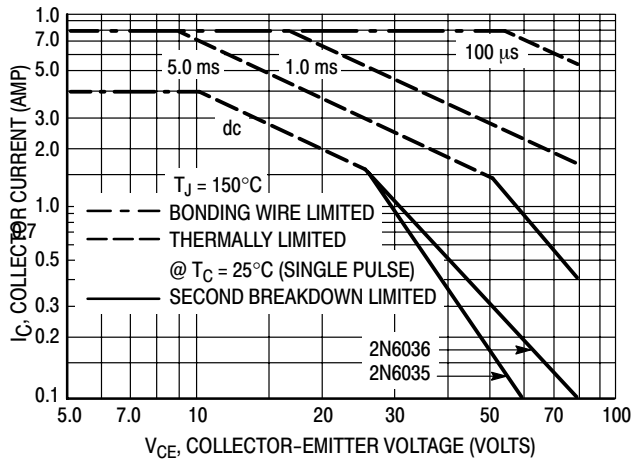


Figure 4. 2N6035, 2N6036

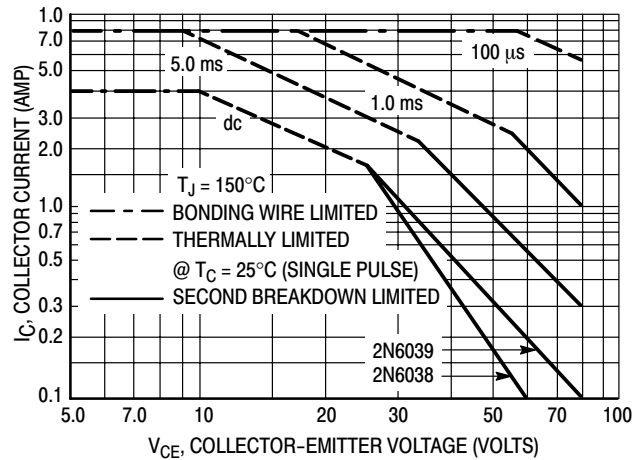


Figure 5. 2N6038, 2N6039

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 4 and 5 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  $T_{J(pk)} < 150^\circ\text{C}$ .  $T_{J(pk)}$  may be calculated from the data in Figure 3. At high case temperatures, thermal limitations will reduce the power that can be handled to values less than the limitations imposed by second breakdown.

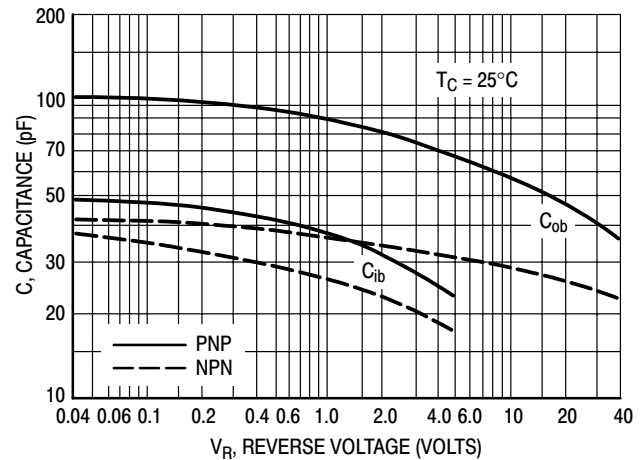
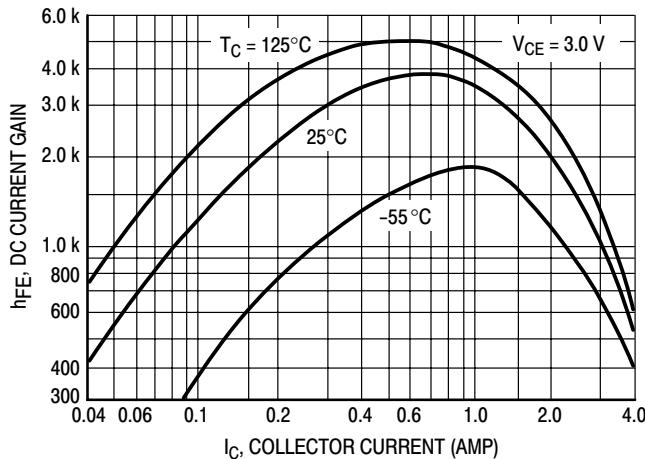


Figure 6. Capacitance

### PNP 2N6034, 2N6035, 2N6036



### NPN 2N6038, 2N6039

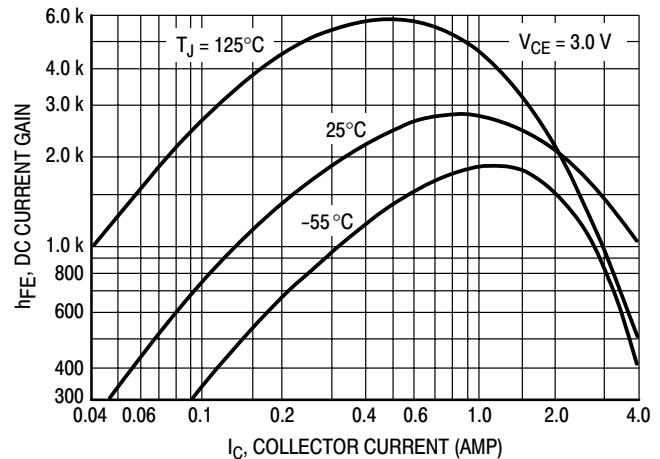


Figure 7. DC Current Gain

## (PNP) 2N6034, 2N6035, 2N6036; (NPN) 2N6038, 2N6039

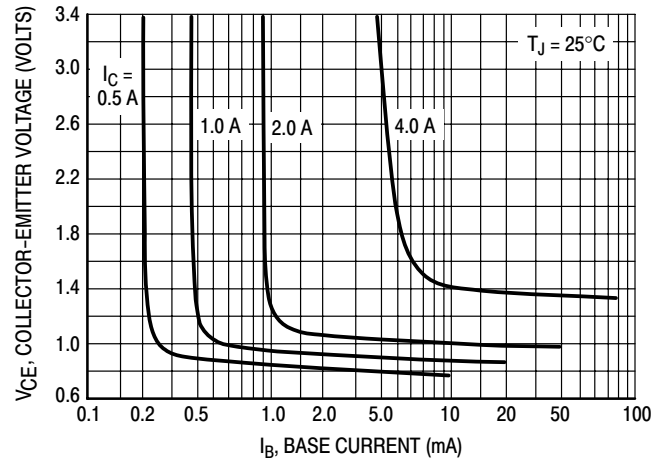
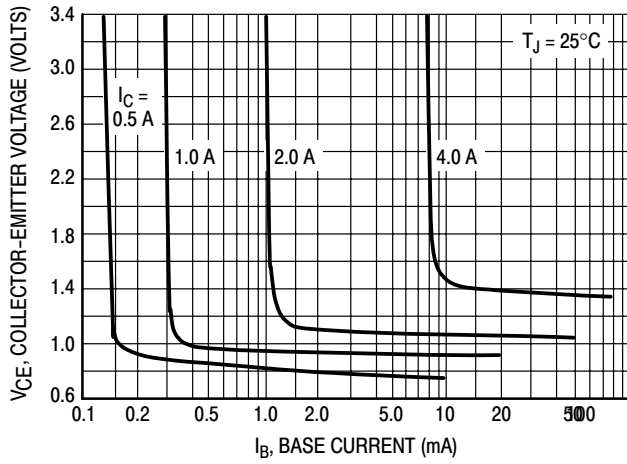


Figure 8. Collector Saturation Region

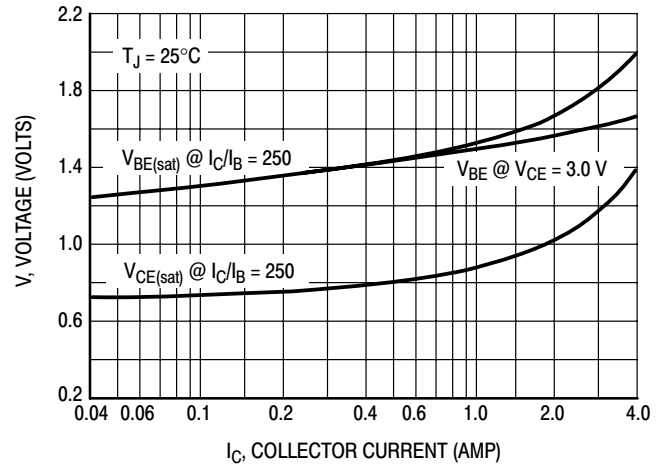
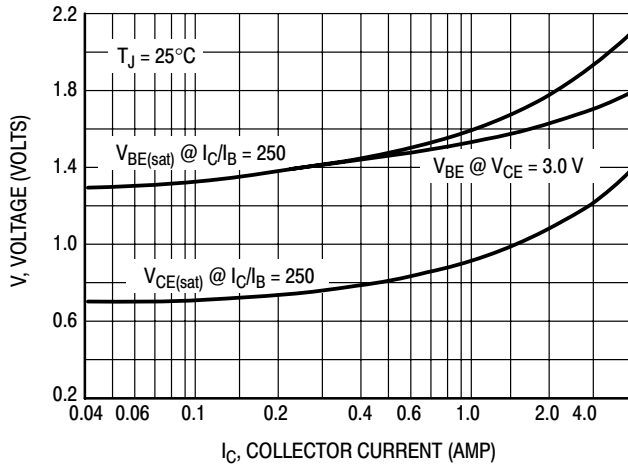


Figure 9. "On" Voltages

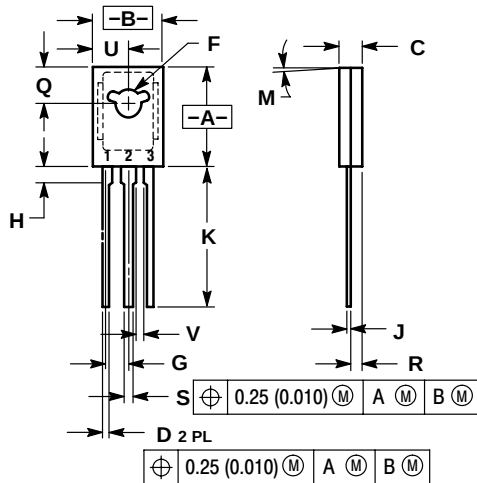
### ORDERING INFORMATION

| Device  | Package               | Shipping        |
|---------|-----------------------|-----------------|
| 2N6034  | TO-225AA              | 500 Units / Box |
| 2N6034G | TO-225AA<br>(Pb-Free) |                 |
| 2N6035  | TO-225AA              |                 |
| 2N6035G | TO-225AA<br>(Pb-Free) |                 |
| 2N6036  | TO-225AA              |                 |
| 2N6036G | TO-225AA<br>(Pb-Free) |                 |
| 2N6038  | TO-225AA              |                 |
| 2N6038G | TO-225AA<br>(Pb-Free) |                 |
| 2N6039  | TO-225AA              |                 |
| 2N6039G | TO-225AA<br>(Pb-Free) |                 |

# (PNP) 2N6034, 2N6035, 2N6036; (NPN) 2N6038, 2N6039

## PACKAGE DIMENSIONS

TO-225AA  
CASE 77-09  
ISSUE Z



### NOTES:

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. 077-01 THRU -08 OBSOLETE, NEW STANDARD 077-09.

| DIM | INCHES    |       | MILLIMETERS |       |
|-----|-----------|-------|-------------|-------|
|     | MIN       | MAX   | MIN         | MAX   |
| A   | 0.425     | 0.435 | 10.80       | 11.04 |
| B   | 0.295     | 0.305 | 7.50        | 7.74  |
| C   | 0.095     | 0.105 | 2.42        | 2.66  |
| D   | 0.020     | 0.026 | 0.51        | 0.66  |
| F   | 0.115     | 0.130 | 2.93        | 3.30  |
| G   | 0.094 BSC |       | 2.39 BSC    |       |
| H   | 0.050     | 0.095 | 1.27        | 2.41  |
| J   | 0.015     | 0.025 | 0.39        | 0.63  |
| K   | 0.575     | 0.655 | 14.61       | 16.63 |
| M   | 5° TYP    |       | 5° TYP      |       |
| Q   | 0.148     | 0.158 | 3.76        | 4.01  |
| R   | 0.045     | 0.065 | 1.15        | 1.65  |
| S   | 0.025     | 0.035 | 0.64        | 0.88  |
| U   | 0.145     | 0.155 | 3.69        | 3.93  |
| V   | 0.040     | ---   | 1.02        | ---   |

### STYLE 1:

1. EMITTER
2. COLLECTOR
3. BASE

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