

# PNP - 2N6040, 2N6042, NPN - 2N6043, 2N6045



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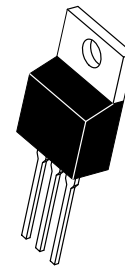
## Plastic Medium-Power Complementary Silicon Transistors

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

### Features

- High DC Current Gain –  $h_{FE} = 2500$  (Typ) @  $I_C = 4.0$  Adc
- Collector–Emitter Sustaining Voltage – @ 100 mAdc –  
 $V_{CEO(sus)} = 60$  Vdc (Min) – 2N6040, 2N6043  
 $= 100$  Vdc (Min) – 2N6042, 2N6045
- Low Collector–Emitter Saturation Voltage –  
 $V_{CE(sat)} = 2.0$  Vdc (Max) @  $I_C = 4.0$  Adc – 2N6043,44  
 $= 2.0$  Vdc (Max) @  $I_C = 3.0$  Adc – 2N6042, 2N6045
- Monolithic Construction with Built–In Base–Emitter Shunt Resistors
- Epoxy Meets UL 94 V–0 @ 0.125 in
- ESD Ratings: Human Body Model, 3B > 8000 V  
Machine Model, C > 400 V
- Pb–Free Packages are Available\*

**DARLINGTON, 8 AMPERES  
COMPLEMENTARY SILICON  
POWER TRANSISTORS  
60 – 100 VOLTS, 75 WATTS**



TO–220AB  
CASE 221A–09  
STYLE 1

### MAXIMUM RATINGS (Note 1)

| Rating  | Symbol                               | Value                  | Unit                     |
|---|--------------------------------------|------------------------|--------------------------|
| Collector–Emitter Voltage   | 2N6040<br>2N6043<br>2N6042<br>2N6045 | $V_{CEO}$<br>60<br>100 | Vdc                      |
| Collector–Base Voltage  | 2N6040<br>2N6043<br>2N6042<br>2N6045 | $V_{CB}$<br>60<br>100  | Vdc                      |
| Emitter–Base Voltage  |                                      | $V_{EB}$<br>5.0        | Vdc                      |
| Collector Current   | Continuous<br>Peak                   | $I_C$<br>8.0<br>16     | A dc                     |
| Base Current  |                                      | $I_B$<br>120           | mAdc                     |
| Total Power Dissipation @ $T_C = 25^\circ\text{C}$<br>Derate above $25^\circ\text{C}$ |                                      | $P_D$<br>75<br>0.60    | W<br>W/ $^\circ\text{C}$ |
| Operating and Storage Junction<br>Temperature Range                                   | $T_J, T_{stg}$                       | –65 to +150            | $^\circ\text{C}$         |

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.

1. Indicates JEDEC Registered Data.

### MARKING DIAGRAM



2N604x = Device Code  
 $x = 0, 2, 3, \text{ or } 5$   
 A = Assembly Location  
 Y = Year  
 WW = Work Week  
 G = Pb–Free Package

### ORDERING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 6 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.

# PNP – 2N6040, 2N6042, NPN – 2N6043, 2N6045

## THERMAL CHARACTERISTICS

| Characteristic                          | Symbol        | Max  | Unit |
|---|---------------|------|------|
| Thermal Resistance, Junction-to-Case    | $\theta_{JC}$ | 1.67 | °C/W |
| Thermal Resistance, Junction-to-Ambient | $\theta_{JA}$ | 57   | °C/W |

## \*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>( $I_C = 100\text{ mAdc}$ , $I_B = 0$ )   | $V_{CE(sus)}$ | 60<br>100             | –<br>–                        | Vdc           |
| Collector Cutoff Current<br>( $V_{CE} = 60\text{ Vdc}$ , $I_B = 0$ )<br>( $V_{CE} = 100\text{ Vdc}$ , $I_B = 0$ )   | $I_{CEO}$     | –<br>–                | 20<br>20                      | $\mu\text{A}$ |
| Collector Cutoff Current<br>( $V_{CE} = 60\text{ Vdc}$ , $V_{BE(off)} = 1.5\text{ Vdc}$ )<br>( $V_{CE} = 100\text{ Vdc}$ , $V_{BE(off)} = 1.5\text{ Vdc}$ )<br>( $V_{CE} = 60\text{ Vdc}$ , $V_{BE(off)} = 1.5\text{ Vdc}$ , $T_C = 150^\circ\text{C}$ )<br>( $V_{CE} = 80\text{ Vdc}$ , $V_{BE(off)} = 1.5\text{ Vdc}$ , $T_C = 150^\circ\text{C}$ )<br>( $V_{CE} = 100\text{ Vdc}$ , $V_{BE(off)} = 1.5\text{ Vdc}$ , $T_C = 150^\circ\text{C}$ ) | $I_{CEX}$     | –<br>–<br>–<br>–<br>– | 20<br>20<br>200<br>200<br>200 | $\mu\text{A}$ |
| Collector Cutoff Current<br>( $V_{CB} = 60\text{ Vdc}$ , $I_E = 0$ )<br>( $V_{CB} = 100\text{ Vdc}$ , $I_E = 0$ )   | $I_{CBO}$     | –<br>–                | 20<br>20                      | $\mu\text{A}$ |
| Emitter Cutoff Current ( $V_{BE} = 5.0\text{ Vdc}$ , $I_C = 0$ )  | $I_{EBO}$     | –                     | 2.0                           | mAdc          |

## ON CHARACTERISTICS

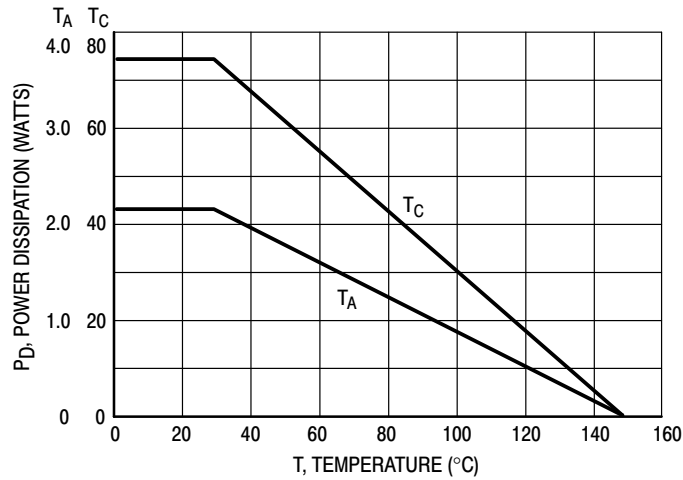
|  |               |                     |                       |     |
|--|---------------|---------------------|-----------------------|-----|
| DC Current Gain<br>( $I_C = 4.0\text{ Adc}$ , $V_{CE} = 4.0\text{ Vdc}$ )<br>( $I_C = 3.0\text{ Adc}$ , $V_{CE} = 4.0\text{ Vdc}$ )<br>( $I_C = 8.0\text{ Adc}$ , $V_{CE} = 4.0\text{ Vdc}$ )            | $h_{FE}$      | 1000<br>1000<br>100 | 20,000<br>20,000<br>– | –   |
| Collector-Emitter Saturation Voltage<br>( $I_C = 4.0\text{ Adc}$ , $I_B = 16\text{ mAdc}$ )<br>( $I_C = 3.0\text{ Adc}$ , $I_B = 12\text{ mAdc}$ )<br>( $I_C = 8.0\text{ Adc}$ , $I_B = 80\text{ Adc}$ ) | $V_{CE(sat)}$ | –<br>–<br>–         | 2.0<br>2.0<br>4.0     | Vdc |
| Base-Emitter Saturation Voltage ( $I_C = 8.0\text{ Adc}$ , $I_B = 80\text{ mAdc}$ )  | $V_{BE(sat)}$ | –                   | 4.5                   | Vdc |
| Base-Emitter On Voltage ( $I_C = 4.0\text{ Adc}$ , $V_{CE} = 4.0\text{ Vdc}$ )   | $V_{BE(on)}$  | –                   | 2.8                   | Vdc |

## DYNAMIC CHARACTERISTICS

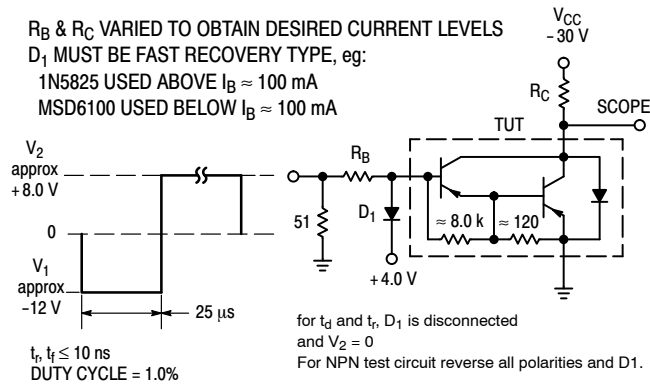
|   |            |        |            |    |
|---|------------|--------|------------|----|
| Small Signal Current Gain ( $I_C = 3.0\text{ Adc}$ , $V_{CE} = 4.0\text{ Vdc}$ , $f = 1.0\text{ MHz}$ ) | $ h_{fe} $ | 4.0    | –          |    |
| Output Capacitance<br>( $V_{CB} = 10\text{ Vdc}$ , $I_E = 0$ , $f = 0.1\text{ MHz}$ )                   | $C_{ob}$   | –<br>– | 300<br>200 | pF |
| Small-Signal Current Gain ( $I_C = 3.0\text{ Adc}$ , $V_{CE} = 4.0\text{ Vdc}$ , $f = 1.0\text{ kHz}$ ) | $h_{fe}$   | 300    | –          | –  |

\*Indicates JEDEC Registered Data.

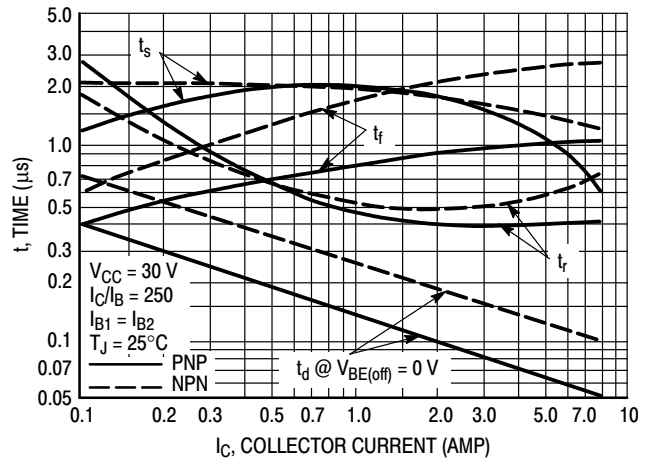
**PNP – 2N6040, 2N6042, NPN – 2N6043, 2N6045**



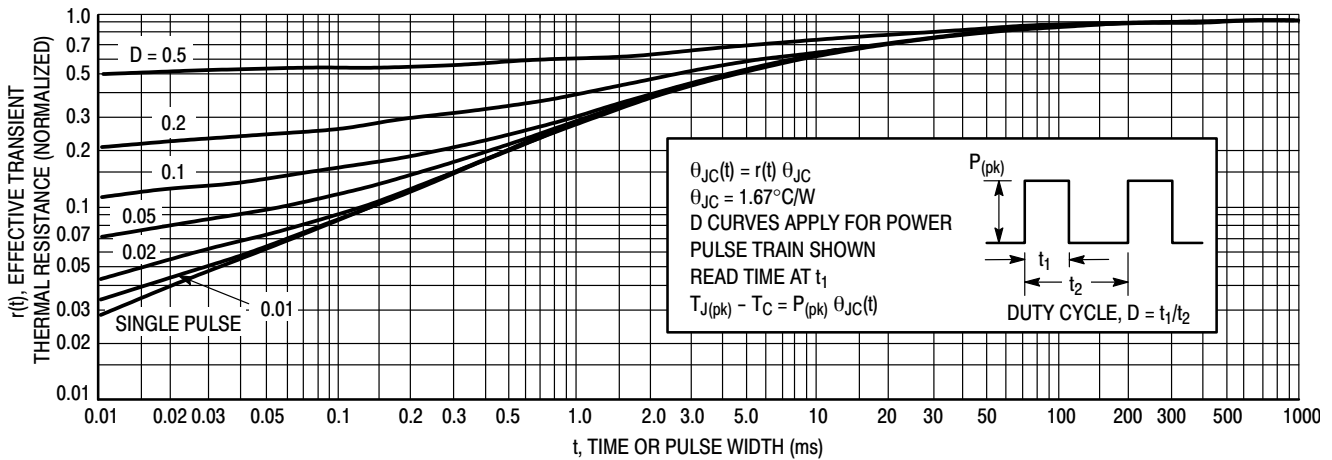
**Figure 1. Power Derating**



**Figure 2. Switching Times Equivalent Circuit**



**Figure 3. Switching Times**



**Figure 4. Thermal Response**

# PNP – 2N6040, 2N6042, NPN – 2N6043, 2N6045

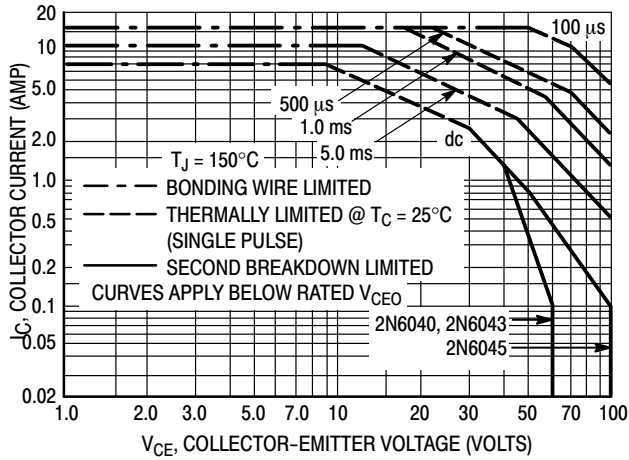


Figure 5. Active-Region Safe Operating Area

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  $T_{J(pk)} = 150^\circ\text{C}$ ;  $T_C$  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 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.

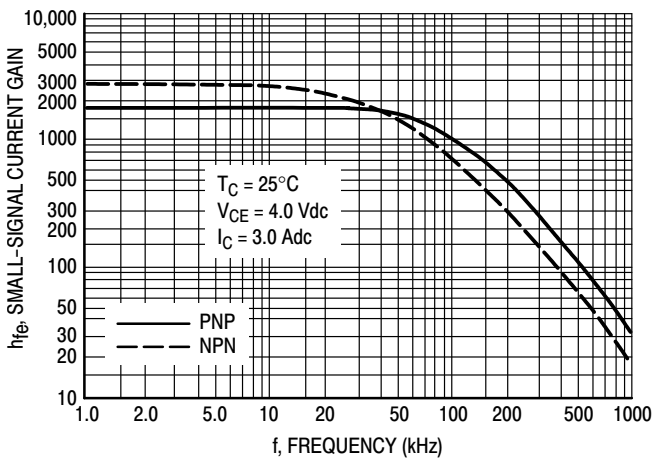


Figure 6. Small-Signal Current Gain

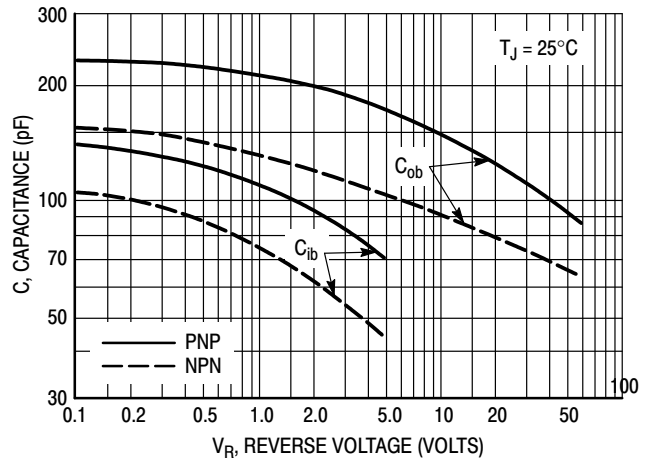
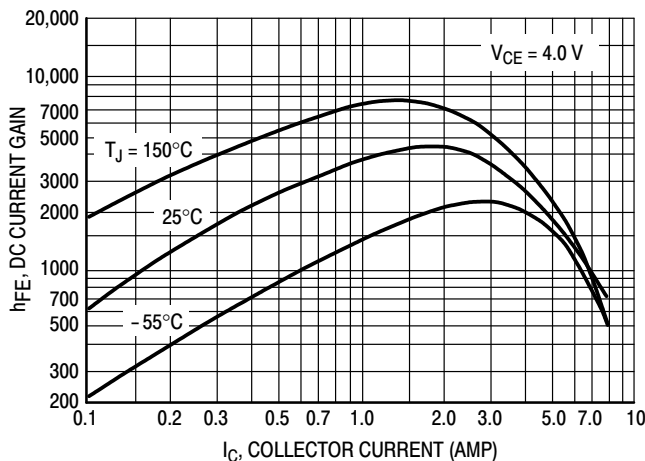


Figure 7. Capacitance

## PNP 2N6040, 2N6042



## NPN 2N6043, 2N6045

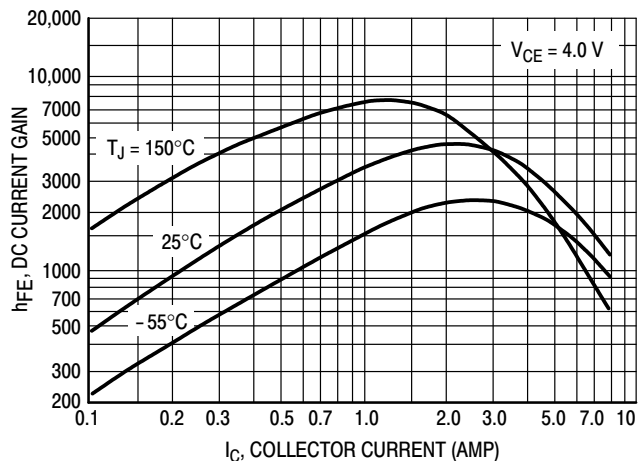


Figure 8. DC Current Gain

PNP – 2N6040, 2N6042, NPN – 2N6043, 2N6045

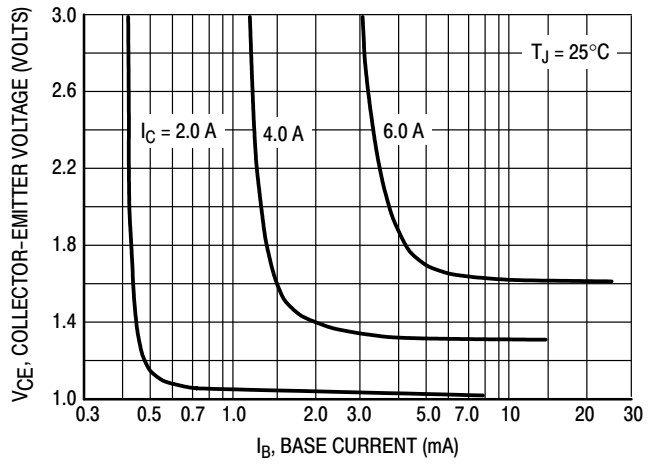
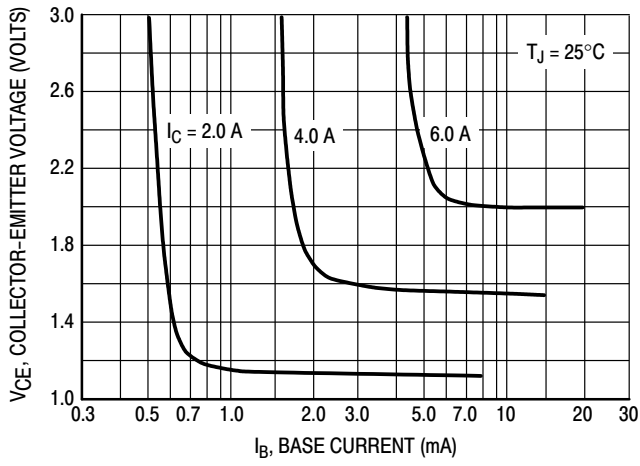


Figure 9. Collector Saturation Region

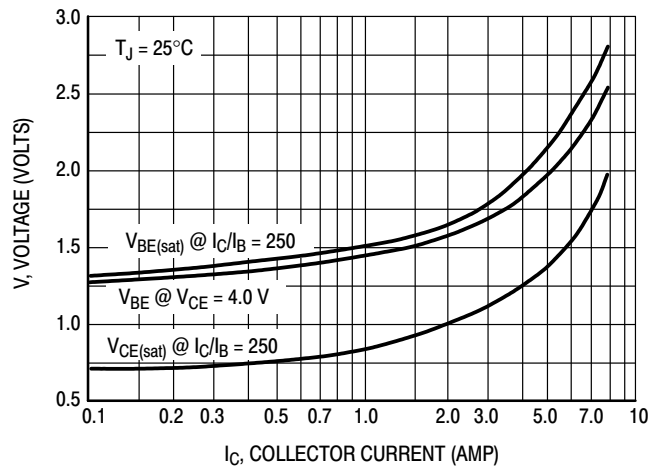
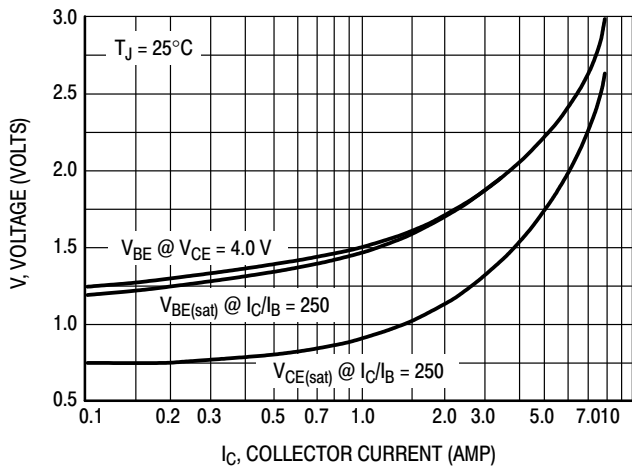


Figure 10. "On" Voltages

**PNP – 2N6040, 2N6042, NPN – 2N6043, 2N6045**

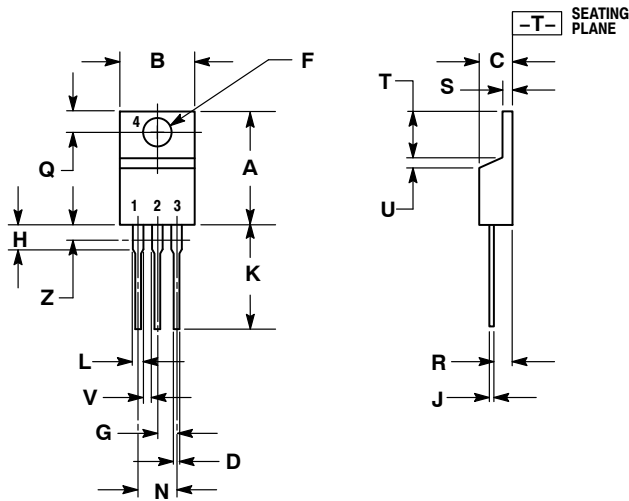
**ORDERING INFORMATION**

| Device  | Package               | Shipping        |
|---------|-----------------------|-----------------|
| 2N6040  | TO-220AB              | 50 Units / Rail |
| 2N6040G | TO-220AB<br>(Pb-Free) |                 |
| 2N6042  | TO-220AB              |                 |
| 2N6042G | TO-220AB<br>(Pb-Free) |                 |
| 2N6043  | TO-220AB              |                 |
| 2N6043G | TO-220AB<br>(Pb-Free) |                 |
| 2N6045  | TO-220AB              |                 |
| 2N6045G | TO-220AB<br>(Pb-Free) |                 |

# PNP – 2N6040, 2N6042, NPN – 2N6043, 2N6045

## PACKAGE DIMENSIONS

### TO-220 CASE 221A-09 ISSUE AG



**NOTES:**

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. DIMENSION Z DEFINES A ZONE WHERE ALL BODY AND LEAD IRREGULARITIES ARE ALLOWED.

| DIM | INCHES |       | MILLIMETERS |       |
|-----|--------|-------|-------------|-------|
|     | MIN    | MAX   | MIN         | MAX   |
| A   | 0.570  | 0.620 | 14.48       | 15.75 |
| B   | 0.380  | 0.405 | 9.66        | 10.28 |
| C   | 0.160  | 0.190 | 4.07        | 4.82  |
| D   | 0.025  | 0.036 | 0.64        | 0.91  |
| F   | 0.142  | 0.161 | 3.61        | 4.09  |
| G   | 0.095  | 0.105 | 2.42        | 2.66  |
| H   | 0.110  | 0.161 | 2.80        | 4.10  |
| J   | 0.014  | 0.025 | 0.36        | 0.64  |
| K   | 0.500  | 0.562 | 12.70       | 14.27 |
| L   | 0.045  | 0.060 | 1.15        | 1.52  |
| N   | 0.190  | 0.210 | 4.83        | 5.33  |
| Q   | 0.100  | 0.120 | 2.54        | 3.04  |
| R   | 0.080  | 0.110 | 2.04        | 2.79  |
| S   | 0.045  | 0.055 | 1.15        | 1.39  |
| T   | 0.235  | 0.255 | 5.97        | 6.47  |
| U   | 0.000  | 0.050 | 0.00        | 1.27  |
| V   | 0.045  | ---   | 1.15        | ---   |
| Z   | ---    | 0.080 | ---         | 2.04  |

**STYLE 1:**

- PIN 1. BASE
- COLLECTOR
- EMITTER
- COLLECTOR

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