

# Plastic Medium-Power Complementary Silicon Transistors

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

- High DC Current Gain —  
 $h_{FE} = 2500$  (Typ) @  $I_C = 4.0$  Adc
- Collector-Emitter Sustaining Voltage — @ 30 mAdc  
 $V_{CEO(sus)} = 60$  Vdc (Min) — TIP100, TIP105  
 $= 80$  Vdc (Min) — TIP101, TIP106  
 $= 100$  Vdc (Min) — TIP102, TIP107
- Low Collector-Emitter Saturation Voltage —  
 $V_{CE(sat)} = 2.0$  Vdc (Max) @  $I_C = 3.0$  Adc  
 $= 2.5$  Vdc (Max) @  $I_C = 8.0$  Adc
- Monolithic Construction with Built-in Base-Emitter Shunt Resistors
- TO-220AB Compact Package

## \*MAXIMUM RATINGS

| Rating                                                                                | Symbol         | TIP100,<br>TIP105 | TIP101,<br>TIP106 | TIP102,<br>TIP107 | Unit                         |
|---------------------------------------------------------------------------------------|----------------|-------------------|-------------------|-------------------|------------------------------|
| Collector-Emitter Voltage                                                             | $V_{CEO}$      | 60                | 80                | 100               | Vdc                          |
| Collector-Base Voltage                                                                | $V_{CB}$       | 60                | 80                | 100               | Vdc                          |
| Emitter-Base Voltage                                                                  | $V_{EB}$       | 5.0               |                   |                   | Vdc                          |
| Collector Current — Continuous<br>Peak                                                | $I_C$          | 8.0<br>15         |                   |                   | Adc                          |
| Base Current                                                                          | $I_B$          | 1.0               |                   |                   | Adc                          |
| Total Power Dissipation @ $T_C = 25^\circ\text{C}$<br>Derate above $25^\circ\text{C}$ | $P_D$          | 80<br>0.64        |                   |                   | Watts<br>W/ $^\circ\text{C}$ |
| Unclamped Inductive Load Energy (1)                                                   | E              | 30                |                   |                   | mJ                           |
| Total Power Dissipation @ $T_A = 25^\circ\text{C}$<br>Derate above $25^\circ\text{C}$ | $P_D$          | 2.0<br>0.016      |                   |                   | Watts<br>W/ $^\circ\text{C}$ |
| Operating and Storage Junction<br>Temperature Range                                   | $T_J, T_{stg}$ | -65 to +150       |                   |                   | $^\circ\text{C}$             |

## THERMAL CHARACTERISTICS

| Characteristic                          | Symbol          | Max  | Unit               |
|-----------------------------------------|-----------------|------|--------------------|
| Thermal Resistance, Junction to Case    | $R_{\theta JC}$ | 1.56 | $^\circ\text{C/W}$ |
| Thermal Resistance, Junction to Ambient | $R_{\theta JA}$ | 62.5 | $^\circ\text{C/W}$ |

(1)  $I_C = 1.1$  A,  $L = 50$  mH, P.R.F. = 10 Hz,  $V_{CC} = 20$  V,  $R_{BE} = 100 \Omega$ .

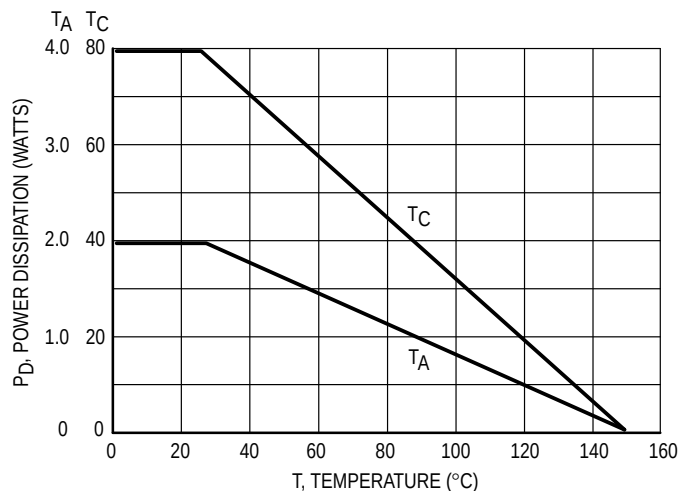


Figure 1. Power Derating

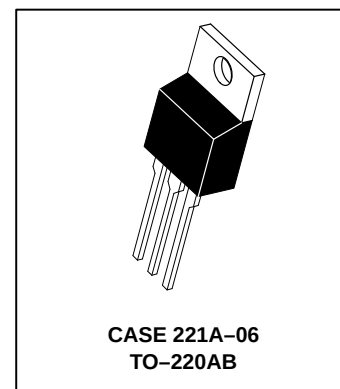
Preferred devices are Motorola recommended choices for future use and best overall value.

REV 7

**NPN**  
**TIP100**  
**TIP101\***  
**TIP102\***  
**PNP**  
**TIP105**  
**TIP106\***  
**TIP107\***

\*Motorola Preferred Device

**DARLINGTON**  
**8 AMPERE**  
**COMPLEMENTARY SILICON**  
**POWER TRANSISTORS**  
**60-80-100 VOLTS**  
**80 WATTS**



# TIP100 TIP101 TIP102 TIP105 TIP106 TIP107

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

| Characteristic                                                                                                                                                | Symbol        | Min             | Max            | Unit            |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|-----------------|----------------|-----------------|
| <b>OFF CHARACTERISTICS</b>                                                                                                                                    |               |                 |                |                 |
| Collector–Emitter Sustaining Voltage (1)<br>( $I_C = 30\text{ mAdc}$ , $I_B = 0$ )                                                                            | $V_{CE(sus)}$ | 60<br>80<br>100 | —<br>—<br>—    | Vdc             |
| Collector Cutoff Current<br>( $V_{CE} = 30\text{ Vdc}$ , $I_B = 0$ )<br>( $V_{CE} = 40\text{ Vdc}$ , $I_B = 0$ )<br>( $V_{CE} = 50\text{ Vdc}$ , $I_B = 0$ )  | $I_{CEO}$     | —<br>—<br>—     | 50<br>50<br>50 | $\mu\text{Adc}$ |
| Collector Cutoff Current<br>( $V_{CB} = 60\text{ Vdc}$ , $I_E = 0$ )<br>( $V_{CB} = 80\text{ Vdc}$ , $I_E = 0$ )<br>( $V_{CB} = 100\text{ Vdc}$ , $I_E = 0$ ) | $I_{CBO}$     | —<br>—<br>—     | 50<br>50<br>50 | $\mu\text{Adc}$ |
| Emitter Cutoff Current<br>( $V_{BE} = 5.0\text{ Vdc}$ , $I_C = 0$ )                                                                                           | $I_{EBO}$     | —               | 8.0            | mAdc            |

## ON CHARACTERISTICS (1)

|                                                                                                                                                     |               |             |             |     |
|-----------------------------------------------------------------------------------------------------------------------------------------------------|---------------|-------------|-------------|-----|
| DC Current Gain<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>200 | 20,000<br>— | —   |
| Collector–Emitter Saturation Voltage<br>( $I_C = 3.0\text{ Adc}$ , $I_B = 6.0\text{ mAdc}$ )<br>( $I_C = 8.0\text{ Adc}$ , $I_B = 80\text{ mAdc}$ ) | $V_{CE(sat)}$ | —<br>—      | 2.0<br>2.5  | Vdc |
| Base–Emitter On Voltage<br>( $I_C = 8.0\text{ Adc}$ , $V_{CE} = 4.0\text{ Vdc}$ )                                                                   | $V_{BE(on)}$  | —           | 2.8         | Vdc |

## DYNAMIC CHARACTERISTICS

|                                                                                                            |          |        |            |    |
|------------------------------------------------------------------------------------------------------------|----------|--------|------------|----|
| Small–Signal Current Gain<br>( $I_C = 3.0\text{ Adc}$ , $V_{CE} = 4.0\text{ Vdc}$ , $f = 1.0\text{ MHz}$ ) | $h_{fe}$ | 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 |

(1) Pulse Test: Pulse Width  $\leq 300\text{ }\mu\text{s}$ , Duty Cycle  $\leq 2\%$ .

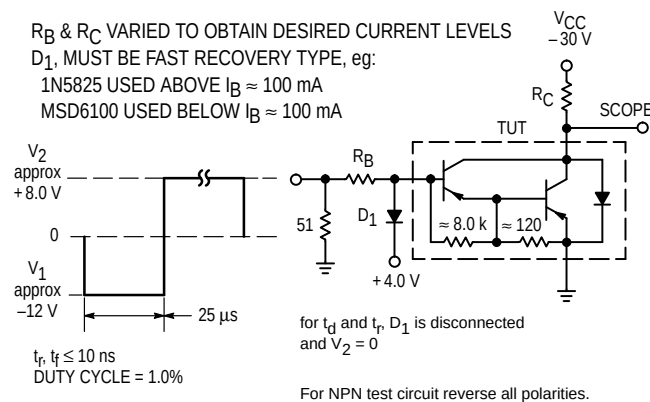


Figure 2. Switching Times Test Circuit

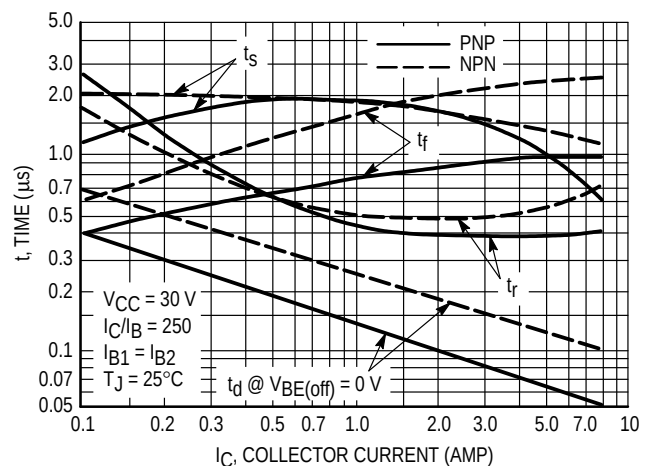


Figure 3. Switching Times

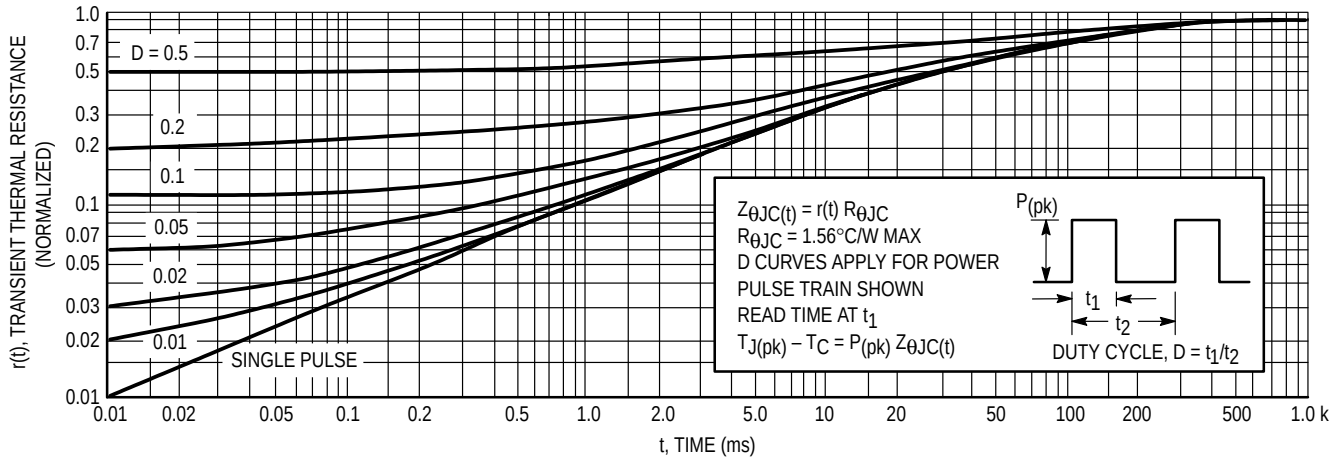


Figure 4. Thermal Response

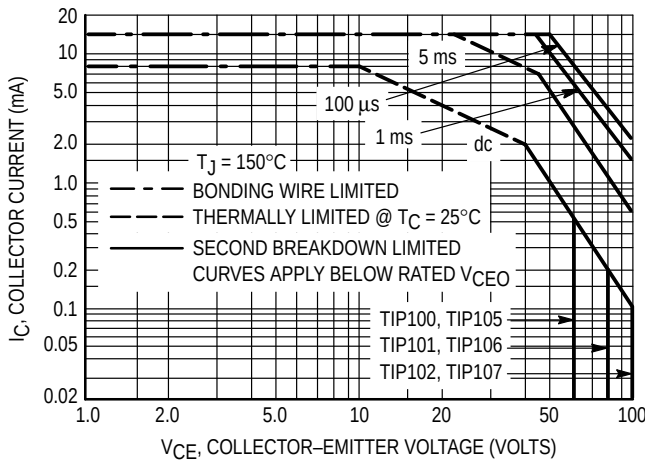


Figure 5. Active-Region Safe Operating Area

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

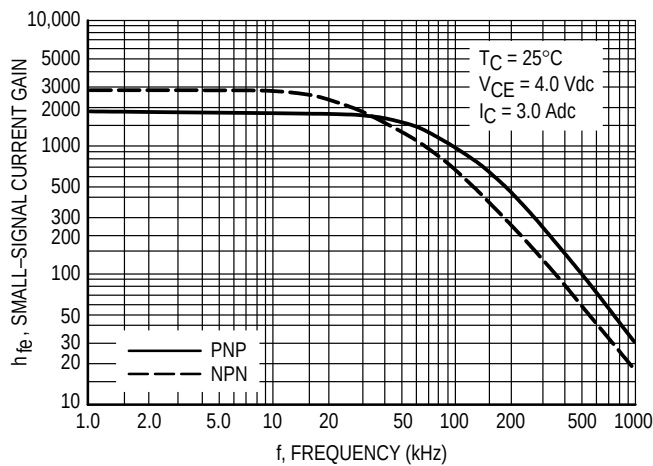


Figure 6. Small-Signal Current Gain

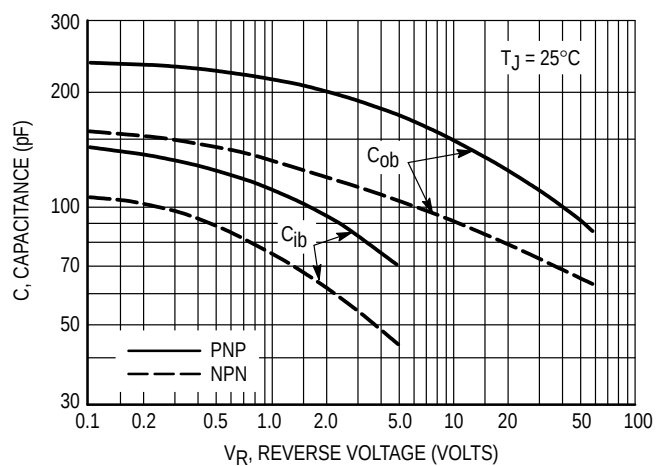
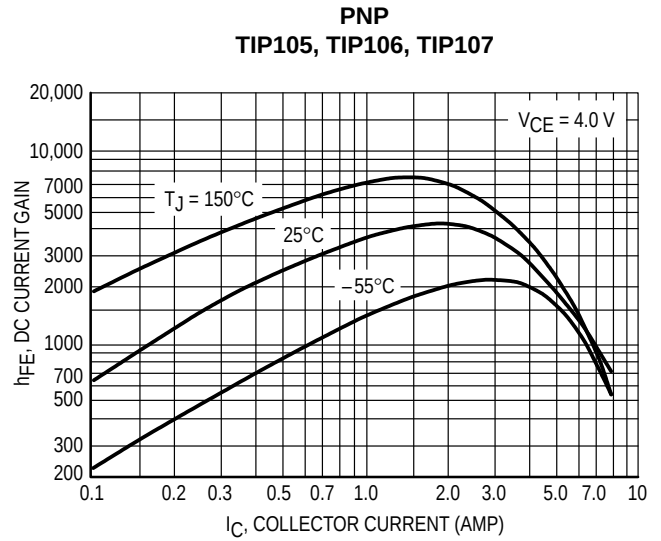
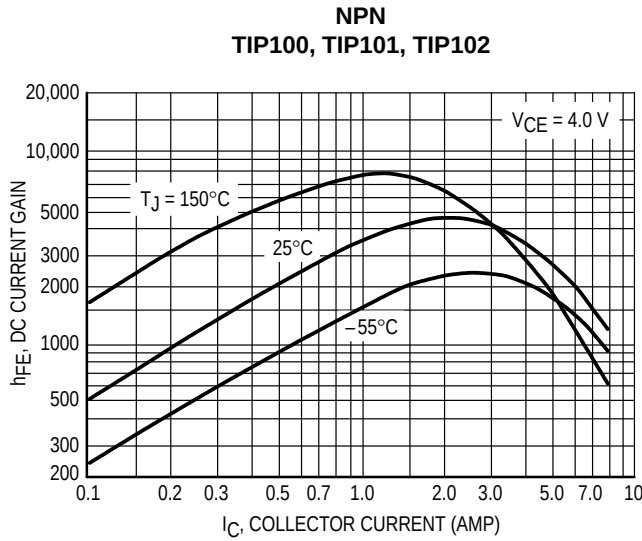
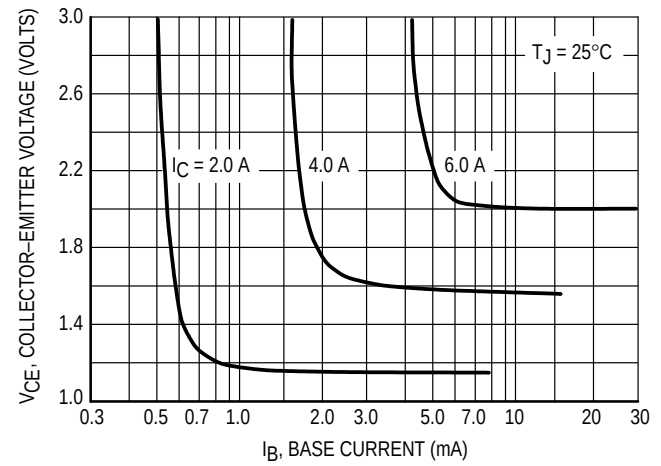
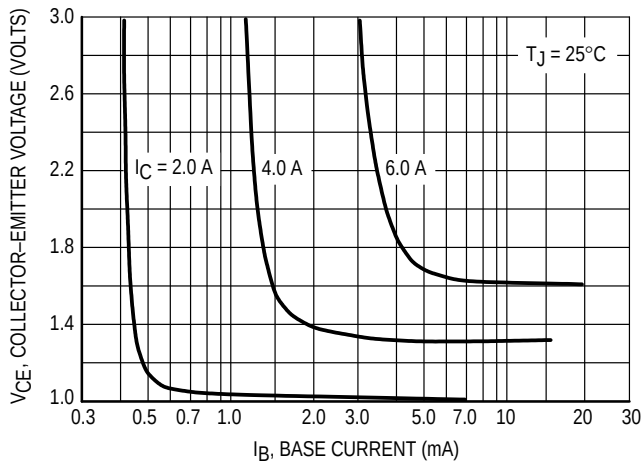


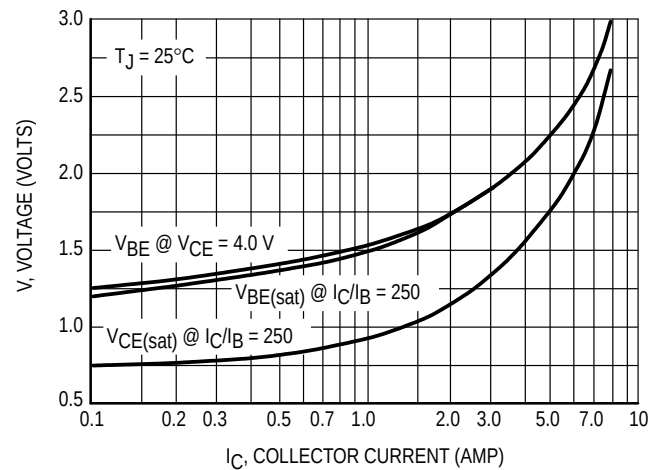
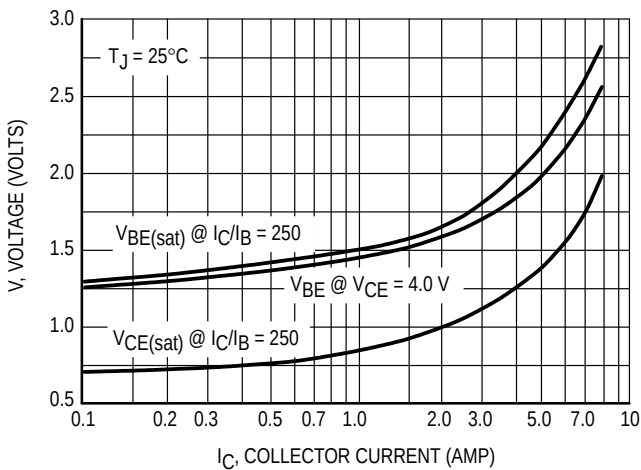
Figure 7. Capacitance



**Figure 8. DC Current Gain**

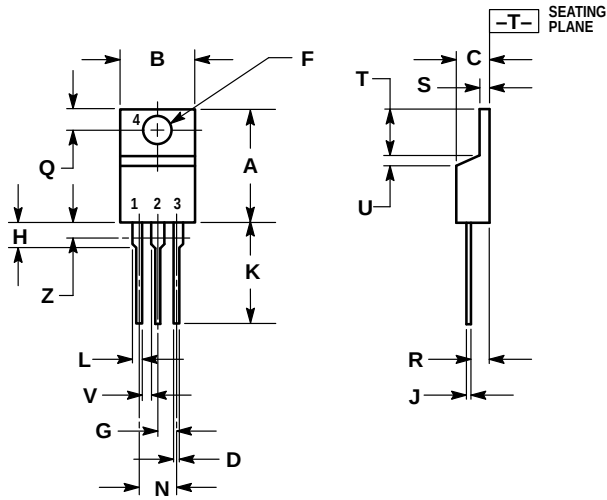


**Figure 9. Collector Saturation Region**



**Figure 10. "On" Voltages**

**TIP100 TIP101 TIP102 TIP105 TIP106 TIP107**  
**PACKAGE DIMENSIONS**



- 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  | 0.035 | 0.64        | 0.88  |
| F   | 0.142  | 0.147 | 3.61        | 3.73  |
| G   | 0.095  | 0.105 | 2.42        | 2.66  |
| H   | 0.110  | 0.155 | 2.80        | 3.93  |
| J   | 0.018  | 0.025 | 0.46        | 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

**CASE 221A-06**  
**TO-220AB**  
**ISSUE Y**

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