# TIP100, TIP101, TIP102 (NPN); TIP105, TIP106, TIP107 (PNP)

# Plastic Medium-Power Complementary Silicon Transistors

Designed for general−purpose amplifier and low−speed switching applications.

**Features**

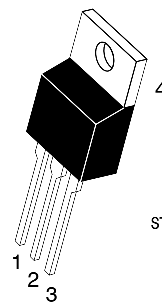
- High DC Current Gain −
  $h_{FE}$ = 2500 (Typ) @ $I_C$
  = 4.0 Adc
- Collector−Emitter Sustaining Voltage − @ 30 mAdc
  $V_{CEO(sus)}$ = 60 Vdc (Min) − TIP100, TIP105
  = 80 Vdc (Min) − TIP101, TIP106
  = 100 Vdc (Min) − TIP102, TIP107
- Low Collector−Emitter Saturation Voltage −
  $V_{CE(sat)}$ = 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
- Pb−Free Packages are Available*

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

**ON Semiconductor®**

**http://onsemi.com**

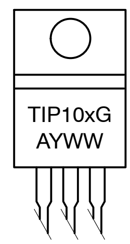
**DARLINGTON 8 AMPERE COMPLEMENTARY SILICON POWER TRANSISTORS 60−80−100 VOLTS, 80 WATTS**




**TO−220AB**
**CASE 221A**
**STYLE 1**

STYLE 1:
PIN 1. BASE
2. COLLECTOR
3. EMITTER
4. COLLECTOR

**MARKING DIAGRAM**




| | |
|---|---|
| TIP10x | = Device Code |
| x | = 0, 1, 2, 5, 6, or 7 |
| 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 3 of this data sheet.

## MAXIMUM RATINGS

| Rating | Symbol | TIP100, TIP105 | TIP101, TIP106 | TIP102, 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°C<br>Derate above 25°C | $P_D$ | 80<br>0.64 | | | W<br>W/°C |
| Unclamped Inductive Load Energy (1) | E | 30 | | | mJ |
| Total Power Dissipation @ $T_A$ = 25°C<br>Derate above 25°C | $P_D$ | 2.0<br>0.016 | | | W<br>W/°C |
| Operating and Storage Junction Temperature Range | $T_J$, $T_{stg}$ | −65 to +150 | | | °C |

## THERMAL CHARACTERISTICS

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

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

## ELECTRICAL CHARACTERISTICS ($T_C$ = 25°C unless otherwise noted)

| Characteristic | | Symbol | Min | Max | Unit |
|---|---|---|---|---|---|
| **OFF CHARACTERISTICS** | | | | | |
| Collector−Emitter Sustaining Voltage (1)<br>($I_C$ = 30 mAdc, $I_B$ = 0) | <br>TIP100, TIP105<br>TIP101, TIP106<br>TIP102, TIP107 | $V_{CEO(sus)}$ | <br>60<br>80<br>100 | <br>–<br>–<br>– | Vdc |
| Collector Cutoff Current<br>($V_{CE}$ = 30 Vdc, $I_B$ = 0)<br>($V_{CE}$ = 40 Vdc, $I_B$ = 0)<br>($V_{CE}$ = 50 Vdc, $I_B$ = 0) | <br>TIP100, TIP105<br>TIP101, TIP106<br>TIP102, TIP107 | $I_{CEO}$ | <br>–<br>–<br>– | <br>50<br>50<br>50 | μAdc |
| Collector Cutoff Current<br>($V_{CB}$ = 60 Vdc, $I_E$ = 0)<br>($V_{CB}$ = 80 Vdc, $I_E$ = 0)<br>($V_{CB}$ = 100 Vdc, $I_E$ = 0) | <br>TIP100, TIP105<br>TIP101, TIP106<br>TIP102, TIP107 | $I_{CBO}$ | <br>–<br>–<br>– | <br>50<br>50<br>50 | μAdc |
| Emitter Cutoff Current ($V_{BE}$ = 5.0 Vdc, $I_C$ = 0) | | $I_{EBO}$ | – | 8.0 | mAdc |
| **ON CHARACTERISTICS (1)** | | | | | |
| DC Current Gain<br>($I_C$ = 3.0 Adc, $V_{CE}$ = 4.0 Vdc)<br>($I_C$ = 8.0 Adc, $V_{CE}$ = 4.0 Vdc) | | $h_{FE}$ | <br>1000<br>200 | <br>20,000<br>– | – |
| Collector−Emitter Saturation Voltage<br>($I_C$ = 3.0 Adc, $I_B$ = 6.0 mAdc)<br>($I_C$ = 8.0 Adc, $I_B$ = 80 mAdc) | | $V_{CE(sat)}$ | <br>–<br>– | <br>2.0<br>2.5 | Vdc |
| Base−Emitter On Voltage ($I_C$ = 8.0 Adc, $V_{CE}$ = 4.0 Vdc) | | $V_{BE(on)}$ | – | 2.8 | Vdc |
| **DYNAMIC CHARACTERISTICS** | | | | | |
| Small−Signal Current Gain ($I_C$ = 3.0 Adc, $V_{CE}$ = 4.0 Vdc, f = 1.0 MHz) | | $h_{fe}$ | 4.0 | – | – |
| Output Capacitance ($V_{CB}$ = 10 Vdc, $I_E$ = 0, f = 0.1 MHz) | TIP105, TIP106, TIP107<br>TIP100, TIP101, TIP102 | $C_{ob}$ | –<br>– | 300<br>200 | pF |

2. Pulse Test: Pulse Width ≤ 300 μs, Duty Cycle ≤ 2%.

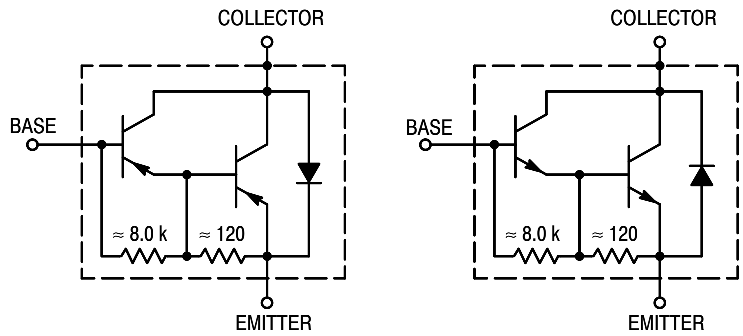



**Figure 1. Darlington Circuit Schematic**

## ORDERING INFORMATION

| Device | Package | Shipping |
|---|---|---|
| TIP100 | TO−220 | 50 Units / Rail |
| TIP100G | TO−220 (Pb−Free) | 50 Units / Rail |
| TIP101 | TO−220 | 50 Units / Rail |
| TIP101G | TO−220 (Pb−Free) | 50 Units / Rail |
| TIP102 | TO−220 | 50 Units / Rail |
| TIP102G | TO−220 (Pb−Free) | 50 Units / Rail |
| TIP105 | TO−220 | 50 Units / Rail |
| TIP105G | TO−220 (Pb−Free) | 50 Units / Rail |
| TIP106 | TO−220 | 50 Units / Rail |
| TIP106G | TO−220 (Pb−Free) | 50 Units / Rail |
| TIP107 | TO−220 | 50 Units / Rail |
| TIP107G | TO−220 (Pb−Free) | 50 Units / Rail |

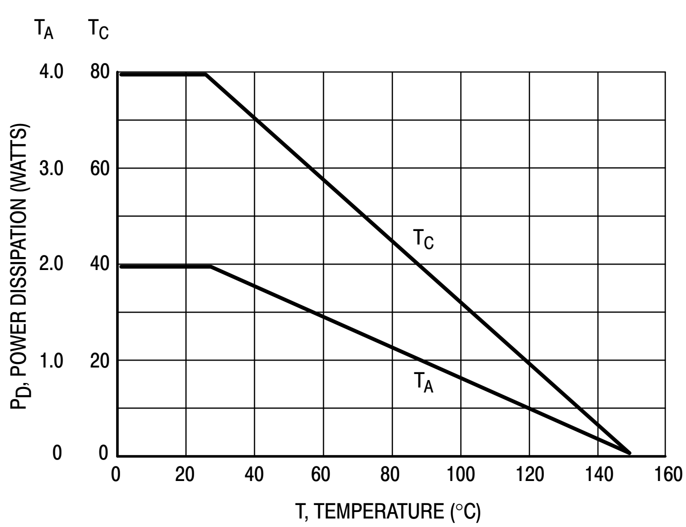



**Figure 2. Power Derating**

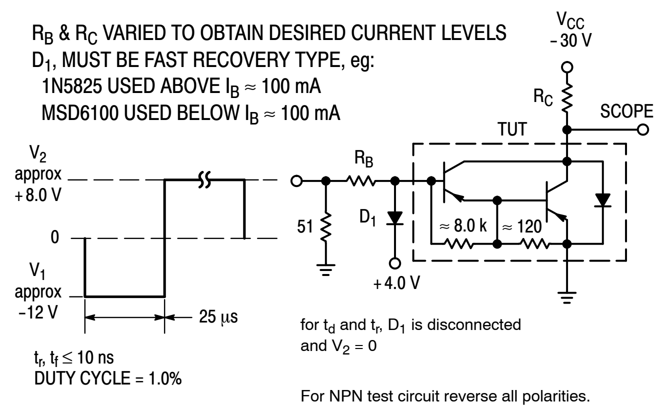



**Figure 3. Switching Times Test Circuit**

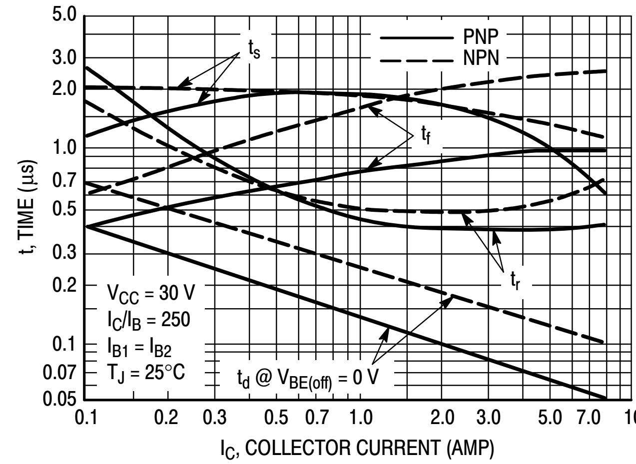



**Figure 4. Switching Times**

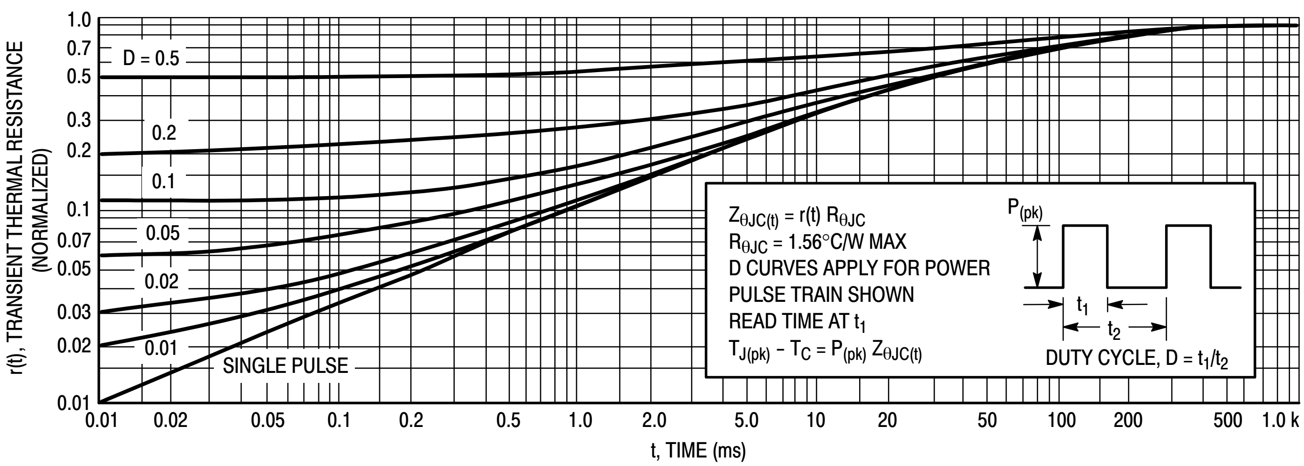



**Figure 5. Thermal Response**

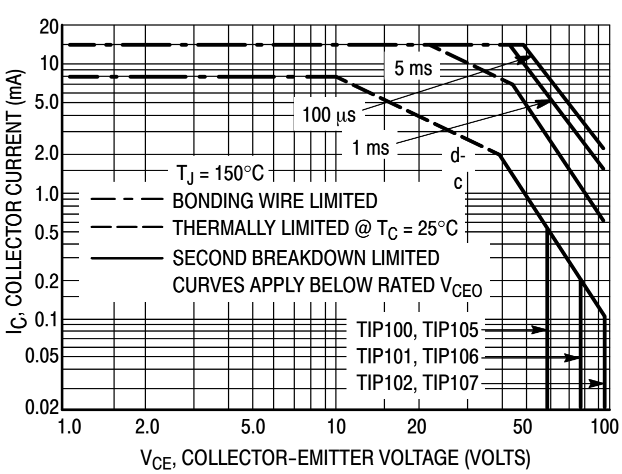



**Figure 6. Active−Region Safe Operating Area**

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 6 is based on $T_{J(pk)} = 150°C$; $T_C$ is variable depending on conditions. Second breakdown pulse limits are valid for duty cycles to 10% provided $T_{J(pk)} < 150°C$. $T_{J(pk)}$ may be calculated from the data in Figure 5. At high case temperatures, thermal limitations will reduce the power that can be handled to values less than the limitations imposed by second breakdown

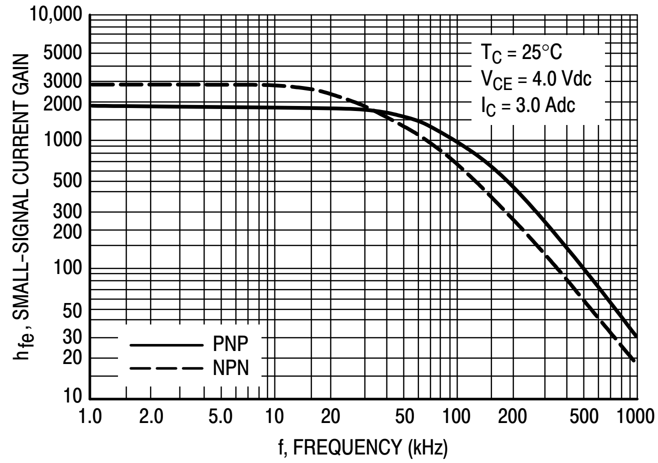



**Figure 7. Small−Signal Current Gain**

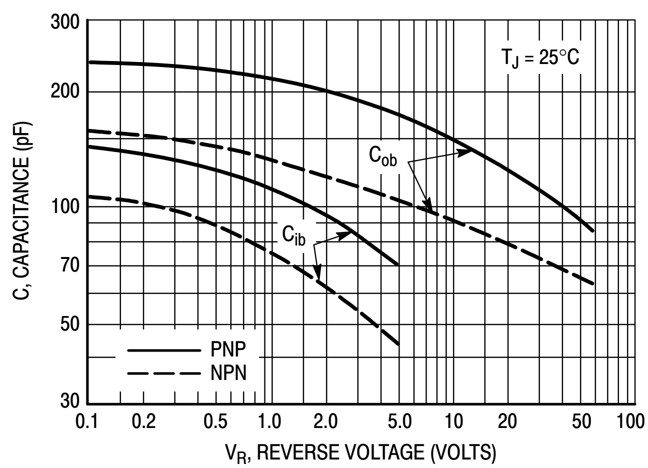



**Figure 8. Capacitance**

**NPN**
**TIP100, TIP101, TIP102**

**PNP**
**TIP105, TIP106, TIP107**

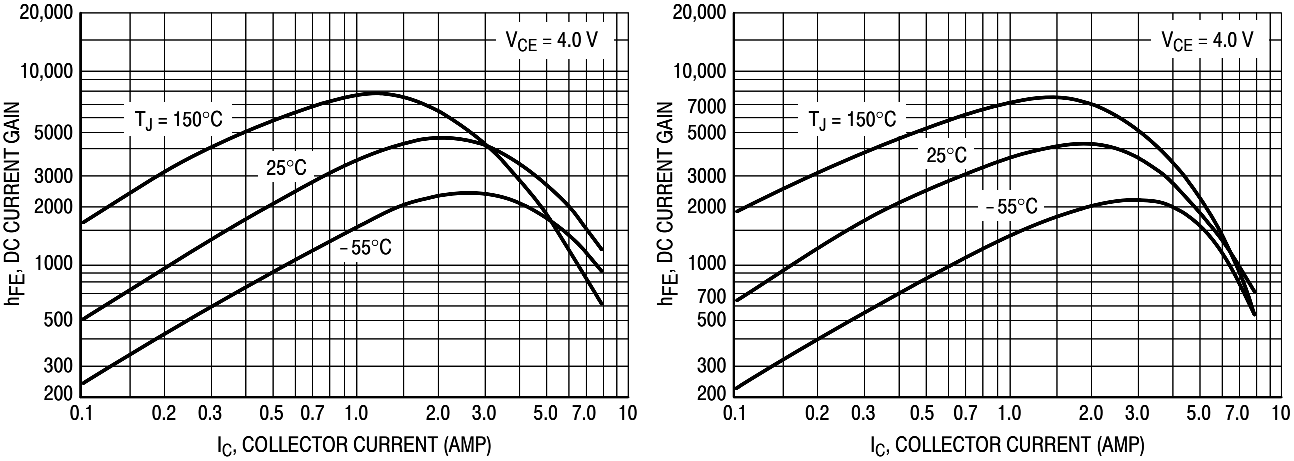



**Figure 9. DC Current Gain**

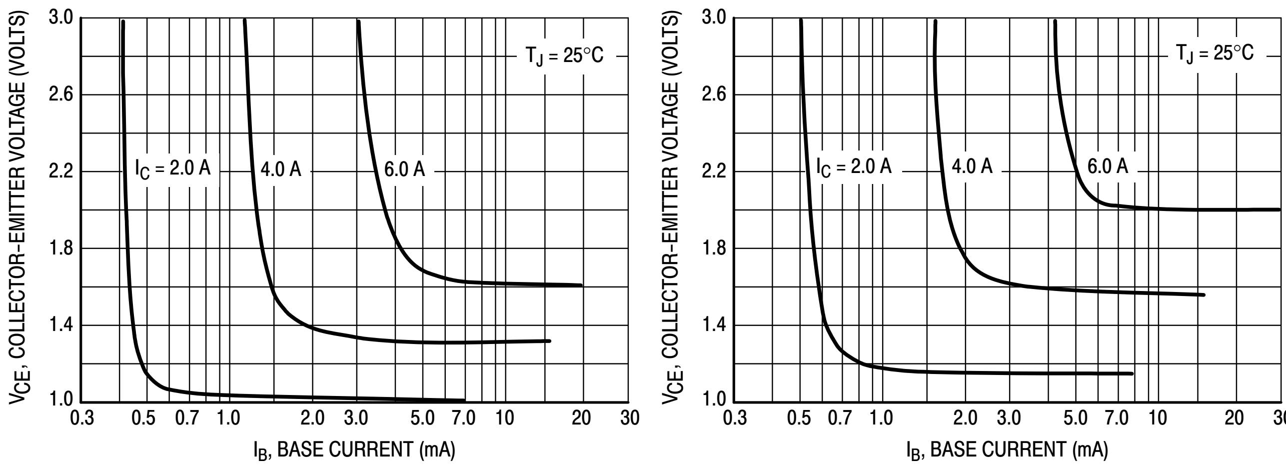



**Figure 10. Collector Saturation Region**

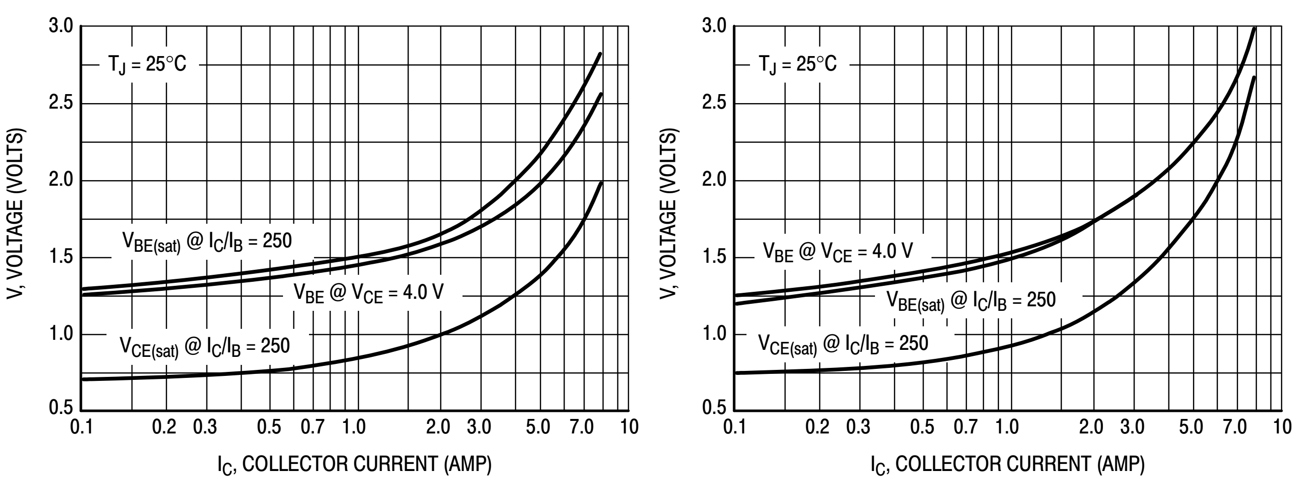
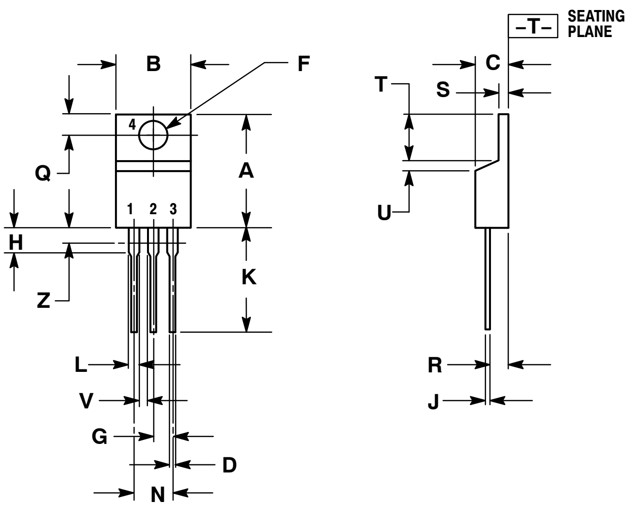



**Figure 11. “On” Voltages**

## 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.

| | INCHES | | MILLIMETERS | |
|---|---|---|---|---|
| DIM | 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
2. COLLECTOR
3. EMITTER
4. COLLECTOR



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