

TIP31, TIP31A, TIP31B, TIP31C, (NPN), TIP32, TIP32A, TIP32B, TIP32C, (PNP)



ON Semiconductor®

<http://onsemi.com>

Complementary Silicon Plastic Power Transistors

Designed for use in general purpose amplifier and switching applications.

Features

- Collector–Emitter Saturation Voltage –
 $V_{CE(sat)} = 1.2 \text{ Vdc (Max) @ } I_C = 3.0 \text{ Adc}$
- Collector–Emitter Sustaining Voltage –
 $V_{CEO(sus)} = 40 \text{ Vdc (Min) – TIP31, TIP32}$
 $= 60 \text{ Vdc (Min) – TIP31A, TIP32A}$
 $= 80 \text{ Vdc (Min) – TIP31B, TIP32B}$
 $= 100 \text{ Vdc (Min) – TIP31C, TIP32C}$
- High Current Gain – Bandwidth Product
 $f_T = 3.0 \text{ MHz (Min) @ } I_C = 500 \text{ mAdc}$
- Compact TO–220 AB Package
- Pb–Free Packages are Available*

MAXIMUM RATINGS

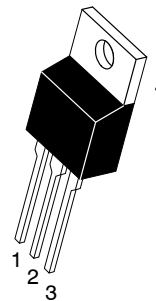
| Rating | Symbol | Value | Unit |
|---|----------------|-----------------------|--------------------------|
| Collector – Emitter Voltage TIP31, TIP32 TIP31A, TIP32A TIP31B, TIP32B TIP31C, TIP32C | V_{CEO} | 40 60 80 100 | Vdc |
| Collector–Base Voltage TIP31, TIP32 TIP31A, TIP32A TIP31B, TIP32B TIP31C, TIP32C | V_{CB} | 40 60 80 100 | Vdc |
| Emitter–Base Voltage | V_{EB} | 5.0 | Vdc |
| Collector Current Continuous Peak | I_C | 3.0 5.0 | Adc |
| Base Current | I_B | 1.0 | Adc |
| Total Power Dissipation @ $T_C = 25^\circ\text{C}$ Derate above 25°C | P_D | 40 0.32 | W W/ $^\circ\text{C}$ |
| Total Power Dissipation @ $T_A = 25^\circ\text{C}$ Derate above 25°C | P_D | 2.0 0.016 | W W/ $^\circ\text{C}$ |
| Unclamped Inductive Load Energy (Note 1) | E | 32 | mJ |
| Operating and Storage Junction 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. $I_C = 1.8 \text{ A}$, $L = 20 \text{ mH}$, P.R.F. = 10 Hz, $V_{CC} = 10 \text{ V}$, $R_{BE} = 100 \Omega$

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

3 AMPERE POWER TRANSISTORS COMPLEMENTARY SILICON 40–60–80–100 VOLTS, 40 WATTS



TO–220AB
CASE 221A
STYLE 1

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

MARKING DIAGRAM



TIP3xx = Device Code
xx = 1, 1A, 1B, 1C,
2, 2A, 2B, 2C,
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.

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THERMAL CHARACTERISTICS

| Characteristic | Symbol | Max | Unit |
|---|-----------------|-------|------|
| Thermal Resistance, Junction-to-Ambient | $R_{\theta JA}$ | 62.5 | °C/W |
| Thermal Resistance, Junction-to-Case | $R_{\theta JC}$ | 3.125 | °C/W |

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

| Characteristic | Symbol | Min | Max | Unit |
|----------------|--------|-----|-----|------|
|----------------|--------|-----|-----|------|

OFF CHARACTERISTICS

| | | | | | |
|---|--|---------------|-----------------------|--------------------------|-----------------|
| Collector-Emitter Sustaining Voltage (Note 2) ($I_C = 30 \text{ mAdc}$, $I_B = 0$) | TIP31, TIP32 TIP31A, TIP32A TIP31B, TIP32B TIP31C, TIP32C | $V_{CE(sus)}$ | 40 60 80 100 | - - - - | Vdc |
| Collector Cutoff Current ($V_{CE} = 30 \text{ Vdc}$, $I_B = 0$) ($V_{CE} = 60 \text{ Vdc}$, $I_B = 0$) | TIP31, TIP32, TIP31A, TIP32A TIP31B, TIP31C, TIP32B, TIP32C | I_{CEO} | - - | 0.3 0.3 | mAdc |
| Collector Cutoff Current ($V_{CE} = 40 \text{ Vdc}$, $V_{EB} = 0$) ($V_{CE} = 60 \text{ Vdc}$, $V_{EB} = 0$) ($V_{CE} = 80 \text{ Vdc}$, $V_{EB} = 0$) ($V_{CE} = 100 \text{ Vdc}$, $V_{EB} = 0$) | TIP31, TIP32 TIP31A, TIP32A TIP31B, TIP32B TIP31C, TIP32C | I_{CES} | - - - - | 200 200 200 200 | μAdc |
| Emitter Cutoff Current ($V_{BE} = 5.0 \text{ Vdc}$, $I_C = 0$) | | I_{EBO} | - | 1.0 | mAdc |

ON CHARACTERISTICS (Note 2)

| | | | | | |
|--|--|---------------|----------|---------|-----|
| DC Current Gain ($I_C = 1.0 \text{ Adc}$, $V_{CE} = 4.0 \text{ Vdc}$) ($I_C = 3.0 \text{ Adc}$, $V_{CE} = 4.0 \text{ Vdc}$) | | h_{FE} | 25 10 | - 50 | - |
| Collector-Emitter Saturation Voltage ($I_C = 3.0 \text{ Adc}$, $I_B = 375 \text{ mAdc}$) | | $V_{CE(sat)}$ | - | 1.2 | Vdc |
| Base-Emitter On Voltage ($I_C = 3.0 \text{ Adc}$, $V_{CE} = 4.0 \text{ Vdc}$) | | $V_{BE(on)}$ | - | 1.8 | Vdc |

DYNAMIC CHARACTERISTICS

| | | | | | |
|--|--|----------|-----|---|-----|
| Current-Gain – Bandwidth Product ($I_C = 500 \text{ mAdc}$, $V_{CE} = 10 \text{ Vdc}$, $f_{test} = 1.0 \text{ MHz}$) | | f_T | 3.0 | - | MHz |
| Small-Signal Current Gain ($I_C = 0.5 \text{ Adc}$, $V_{CE} = 10 \text{ Vdc}$, $f = 1.0 \text{ kHz}$) | | h_{fe} | 20 | - | - |

2. Pulse Test: Pulse Width $\leq 300 \mu\text{s}$, Duty Cycle $\leq 2.0\%$.

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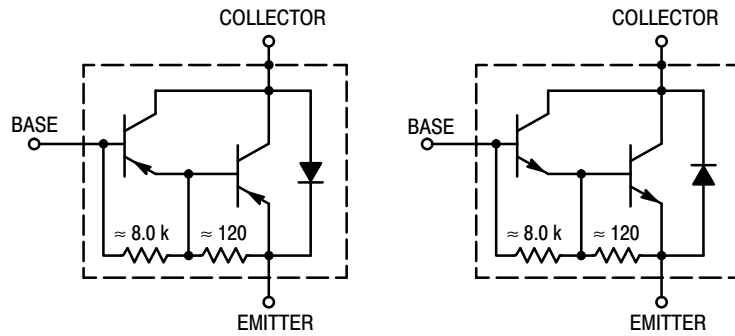


Figure 1. Darlington Circuit Schematic

ORDERING INFORMATION

| Device | Package | Shipping |
|---------|---------------------|-----------------|
| TIP31 | TO-220 | 50 Units / Rail |
| TIP31G | TO-220 (Pb-Free) | 50 Units / Rail |
| TIP31A | TO-220 | 50 Units / Rail |
| TIP31AG | TO-220 (Pb-Free) | 50 Units / Rail |
| TIP31B | TO-220 | 50 Units / Rail |
| TIP31BG | TO-220 (Pb-Free) | 50 Units / Rail |
| TIP31C | TO-220 | 50 Units / Rail |
| TIP31CG | TO-220 (Pb-Free) | 50 Units / Rail |
| TIP32 | TO-220 | 50 Units / Rail |
| TIP32G | TO-220 (Pb-Free) | 50 Units / Rail |
| TIP32A | TO-220 | 50 Units / Rail |
| TIP32AG | TO-220 (Pb-Free) | 50 Units / Rail |
| TIP32B | TO-220 | 50 Units / Rail |
| TIP32BG | TO-220 (Pb-Free) | 50 Units / Rail |
| TIP32C | TO-220 | 50 Units / Rail |
| TIP32CG | TO-220 (Pb-Free) | 50 Units / Rail |

TIP31, TIP31A, TIP31B, TIP31C, (NPN), TIP32, TIP32A, TIP32B, TIP32C, (PNP)

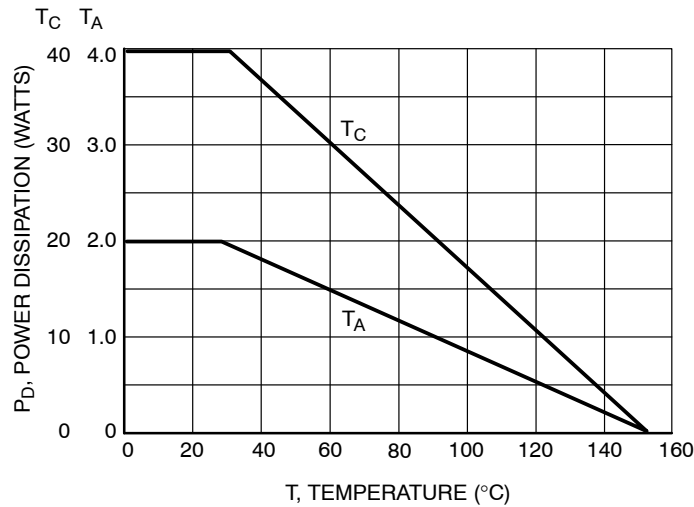
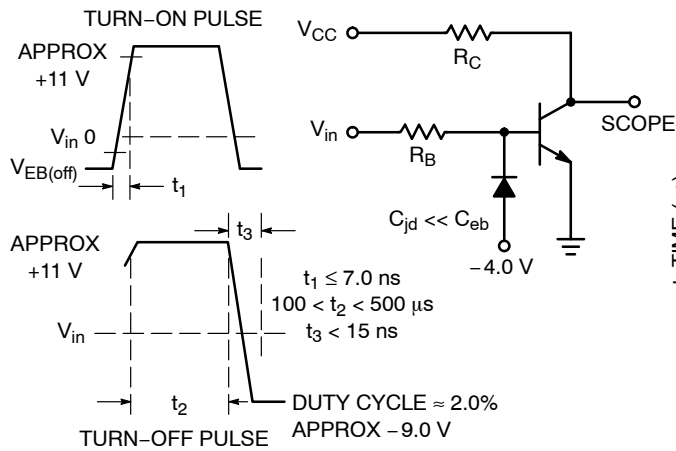


Figure 2. Power Derating



R_B and R_C VARIED TO OBTAIN DESIRED CURRENT LEVELS.

Figure 3. Switching Time Equivalent Circuit

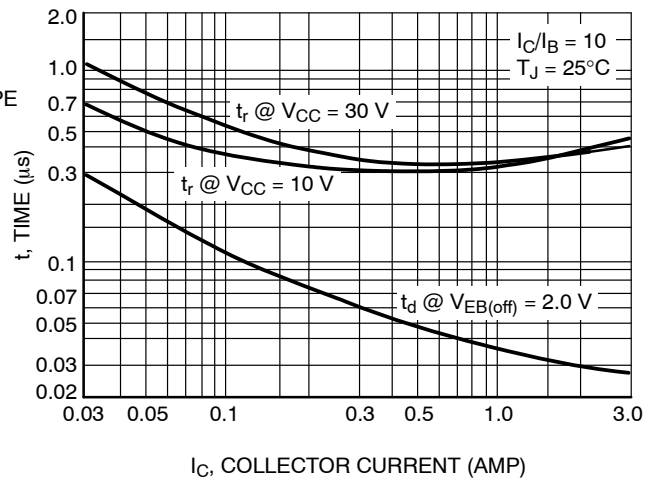


Figure 4. Turn-On Time

TIP31, TIP31A, TIP31B, TIP31C, (NPN), TIP32, TIP32A, TIP32B, TIP32C, (PNP)

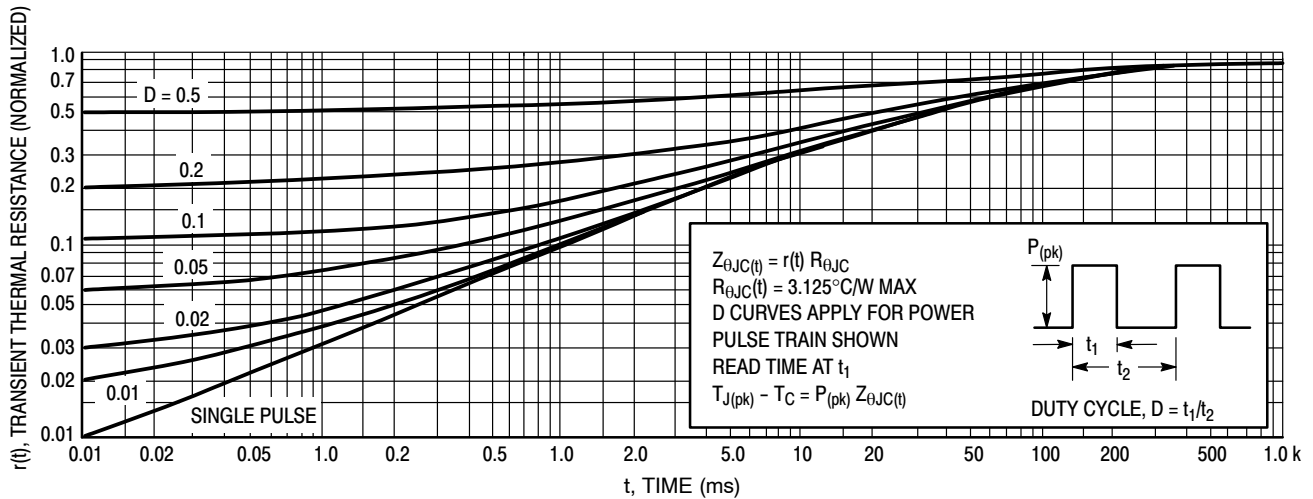


Figure 5. Thermal Response

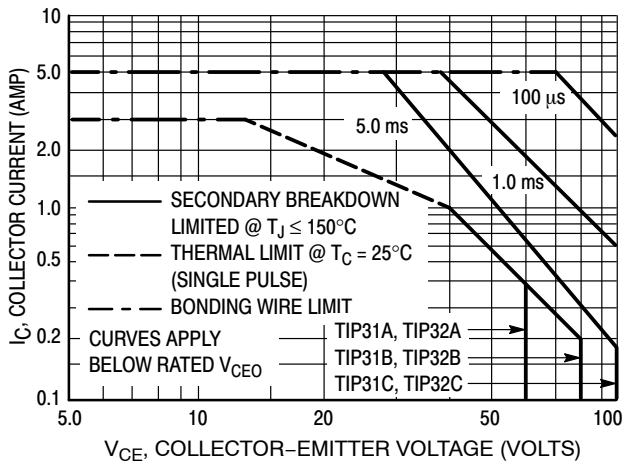


Figure 6. Active Region Safe Operating Area

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 $T_{J(pk)} = 150^\circ\text{C}$; T_C is variable depending on conditions. Second breakdown pulse limits are valid for duty cycles to 10% provided $T_{J(pk)} \leq 150^\circ\text{C}$. $T_{J(pk)}$ 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.

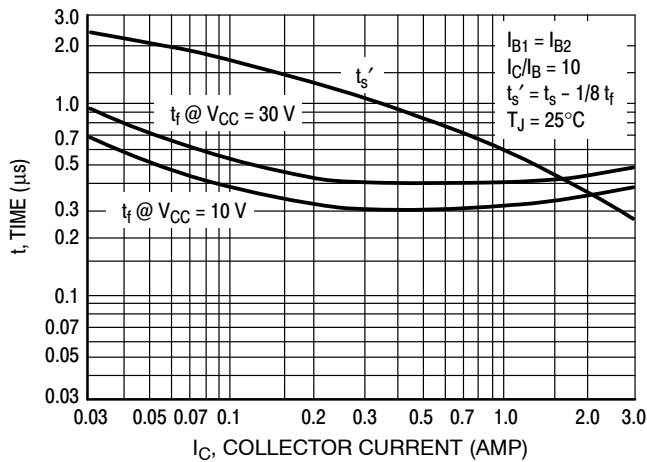


Figure 7. Turn-Off Time

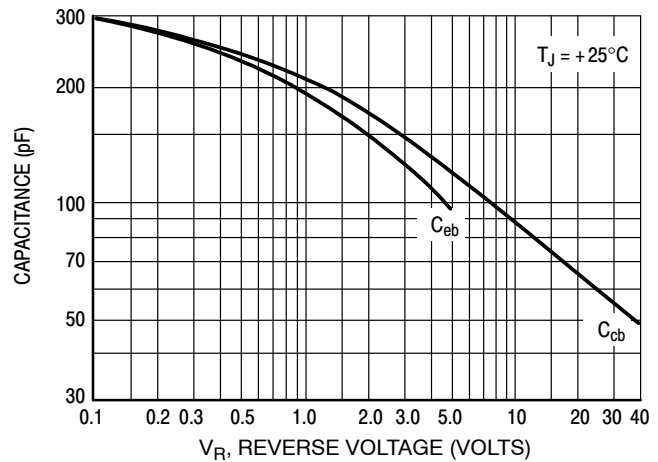


Figure 8. Capacitance

TIP31, TIP31A, TIP31B, TIP31C, (NPN), TIP32, TIP32A, TIP32B, TIP32C, (PNP)

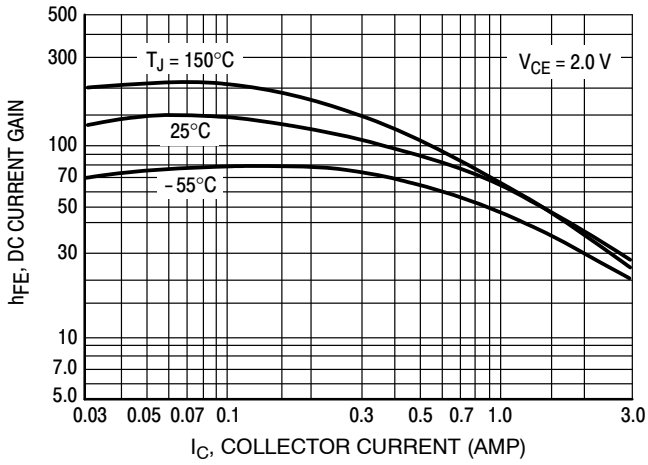


Figure 9. DC Current Gain

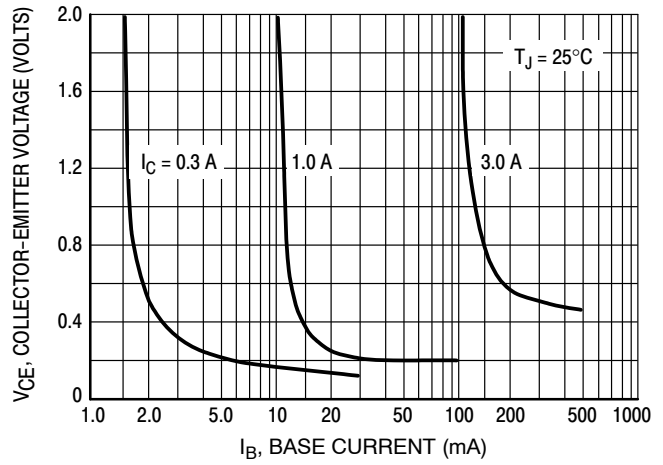


Figure 10. Collector Saturation Region

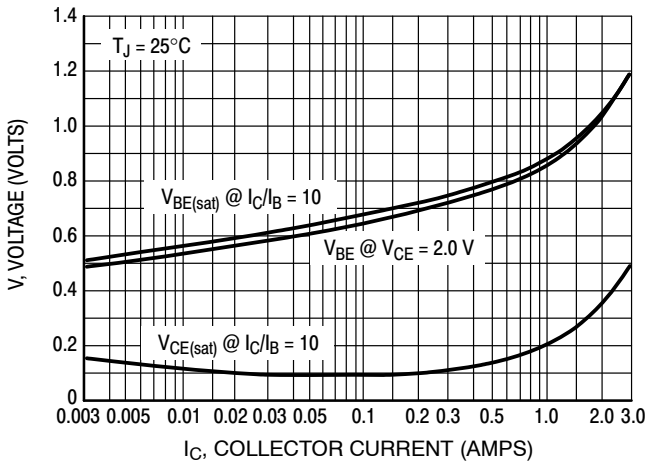


Figure 11. "On" Voltages

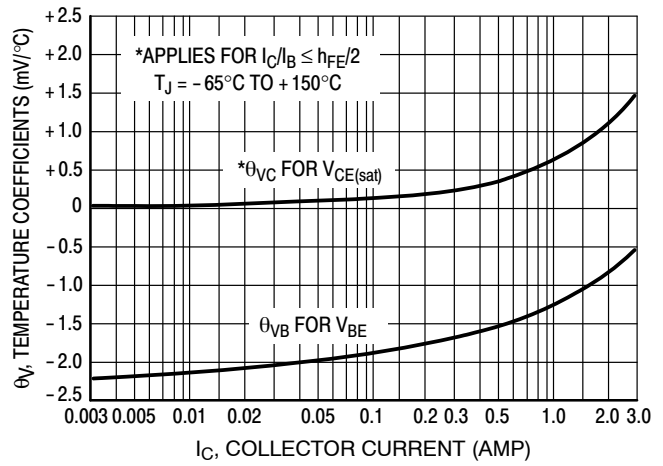


Figure 12. Temperature Coefficients

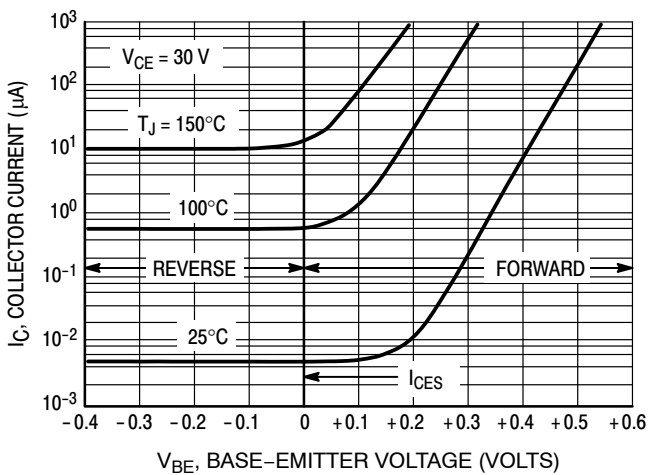


Figure 13. Collector Cut-Off Region

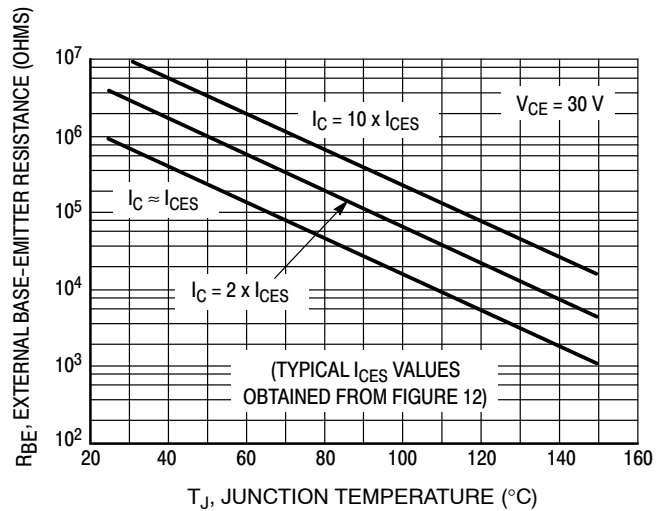
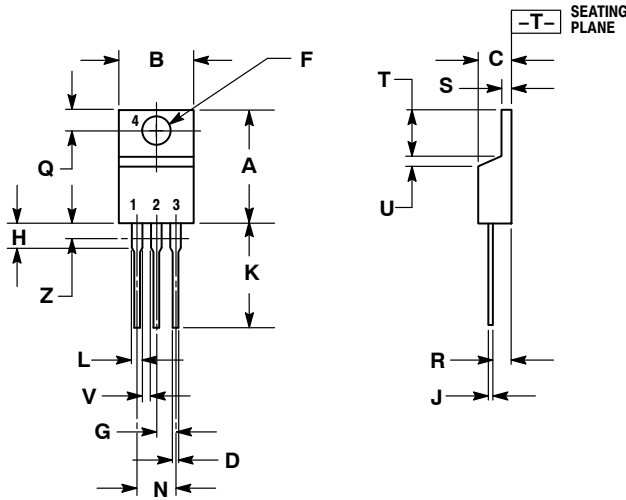


Figure 14. Effects of Base-Emitter Resistance

TIP31, TIP31A, TIP31B, TIP31C, (NPN), TIP32, TIP32A, TIP32B, TIP32C, (PNP)

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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