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

| Characteristic | Symbol | Min | Max | Unit |
|---|---|---|---|---|
| **OFF CHARACTERISTICS** | | | | |
| Collector−Emitter Sustaining Voltage (Note 2) ($I_C$ = 30 mAdc, $I_B$ = 0)<br>TIP31G, TIP32G<br>TIP31AG, TIP32AG<br>TIP31BG, TIP32BG<br>TIP31CG, TIP32CG | $V_{CEO(sus)}$ | <br>40<br>60<br>80<br>100 | <br>−<br>−<br>−<br>− | Vdc |
| Collector Cutoff Current ($V_{CE}$ = 30 Vdc, $I_B$ = 0)<br>TIP31G, TIP32G, TIP31AG, TIP32AG<br>($V_{CE}$ = 60 Vdc, $I_B$ = 0)<br>TIP31BG, TIP31CG, TIP32BG, TIP32CG | $I_{CEO}$ | <br>−<br><br>− | <br>0.3<br><br>0.3 | mAdc |
| Collector Cutoff Current ($V_{CE}$ = 40 Vdc, $V_{EB}$ = 0)<br>TIP31G, TIP32G<br>($V_{CE}$ = 60 Vdc, $V_{EB}$ = 0)<br>TIP31AG, TIP32AG<br>($V_{CE}$ = 80 Vdc, $V_{EB}$ = 0)<br>TIP31BG, TIP32BG<br>($V_{CE}$ = 100 Vdc, $V_{EB}$ = 0)<br>TIP31CG, TIP32CG | $I_{CES}$ | <br>−<br><br>−<br><br>−<br><br>− | <br>200<br><br>200<br><br>200<br><br>200 | μAdc |
| Emitter Cutoff Current ($V_{BE}$ = 5.0 Vdc, $I_C$ = 0) | $I_{EBO}$ | − | 1.0 | mAdc |
| **ON CHARACTERISTICS** (Note 2) | | | | |
| DC Current Gain<br>($I_C$ = 1.0 Adc, $V_{CE}$ = 4.0 Vdc)<br>($I_C$ = 3.0 Adc, $V_{CE}$ = 4.0 Vdc) | $h_{FE}$ | <br>25<br>10 | <br>−<br>50 | − |
| Collector−Emitter Saturation Voltage ($I_C$ = 3.0 Adc, $I_B$ = 375 mAdc) | $V_{CE(sat)}$ | − | 1.2 | Vdc |
| Base−Emitter On Voltage ($I_C$ = 3.0 Adc, $V_{CE}$ = 4.0 Vdc) | $V_{BE(on)}$ | − | 1.8 | Vdc |
| **DYNAMIC CHARACTERISTICS** | | | | |
| Current−Gain − Bandwidth Product ($I_C$ = 500 mAdc, $V_{CE}$ = 10 Vdc, $f_{test}$ = 1.0 MHz) | $f_T$ | 3.0 | − | MHz |
| Small−Signal Current Gain ($I_C$ = 0.5 Adc, $V_{CE}$ = 10 Vdc, f = 1.0 kHz) | $h_{fe}$ | 20 | − | − |

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

2. Pulse Test: Pulse Width ≤ 300 μs, Duty Cycle ≤ 2.0%.

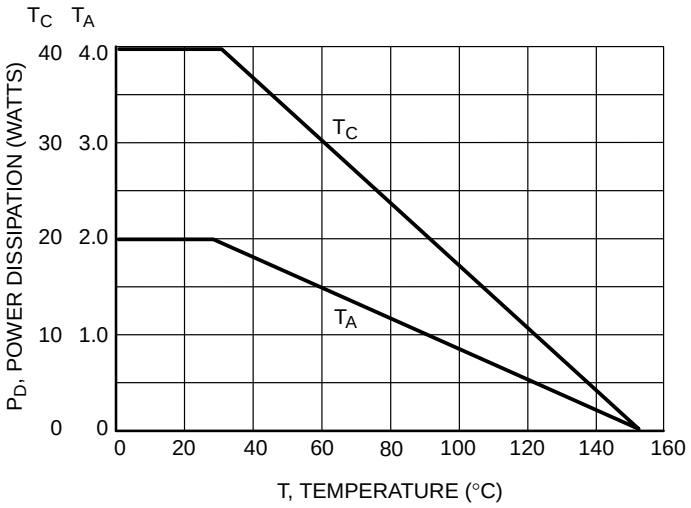
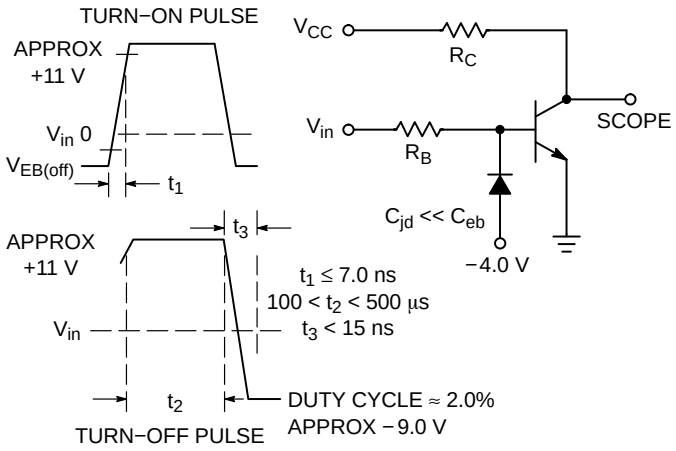



**Figure 1. Power Derating**




$R_B$ and $R_C$ VARIED TO OBTAIN DESIRED CURRENT LEVELS.

**Figure 2. Switching Time Equivalent Circuit**

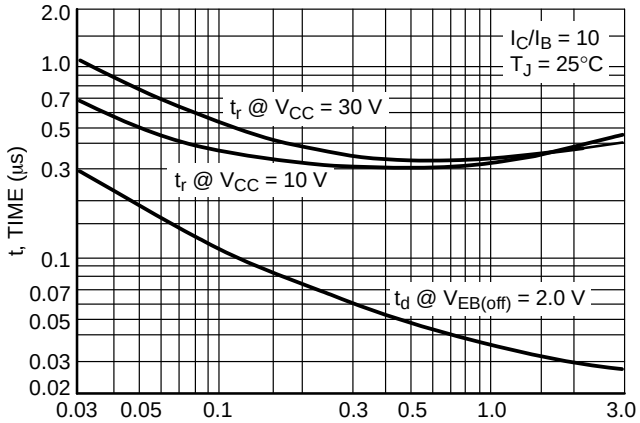



**Figure 3. Turn−On Time**

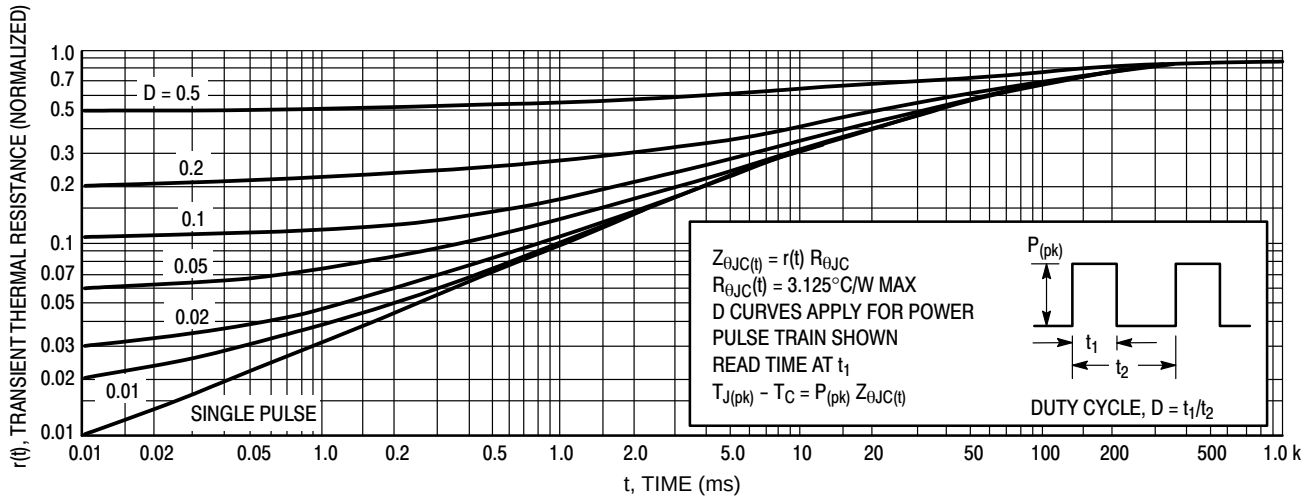



**Figure 4. Thermal Response**

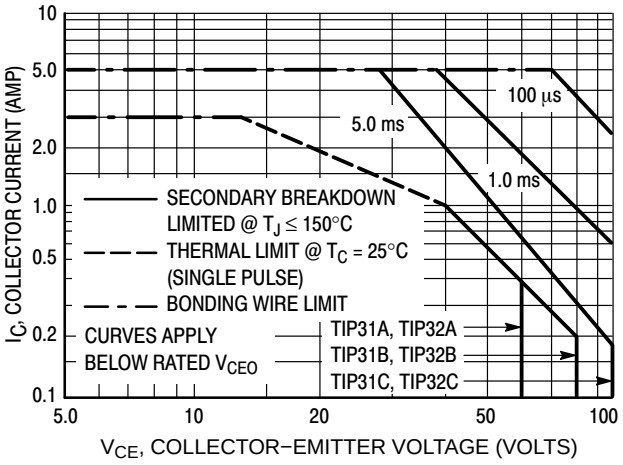



**Figure 5. Active Region Safe Operating Area**

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

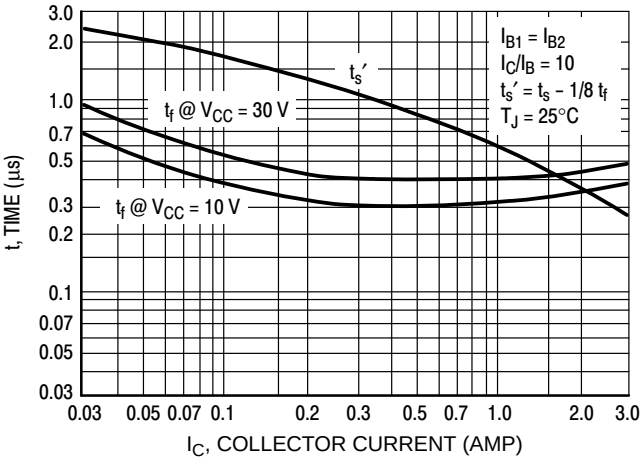



**Figure 6. Turn−Off Time**

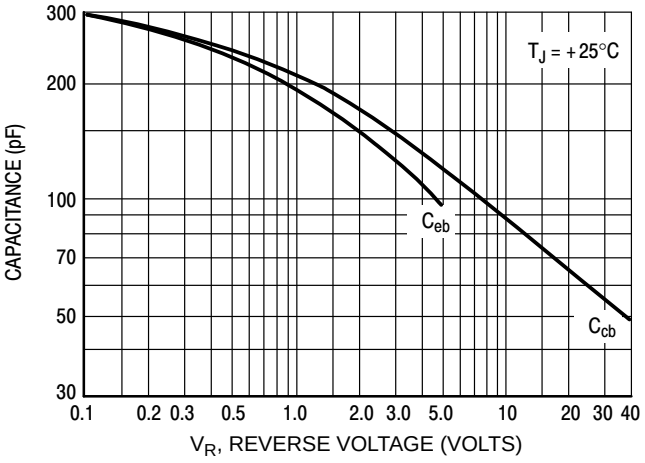



**Figure 7. Capacitance**

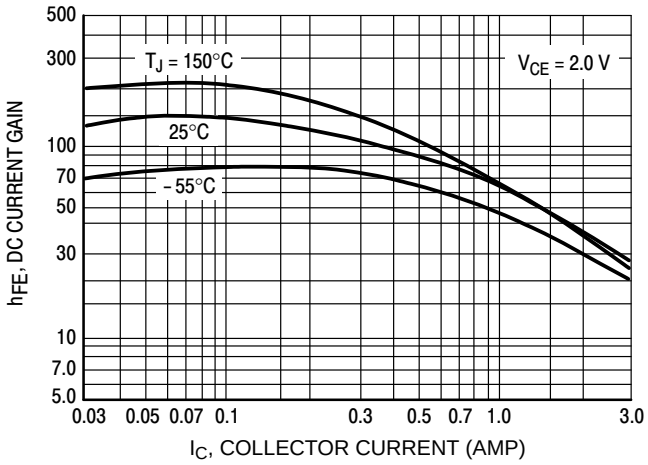



**Figure 8. DC Current Gain**

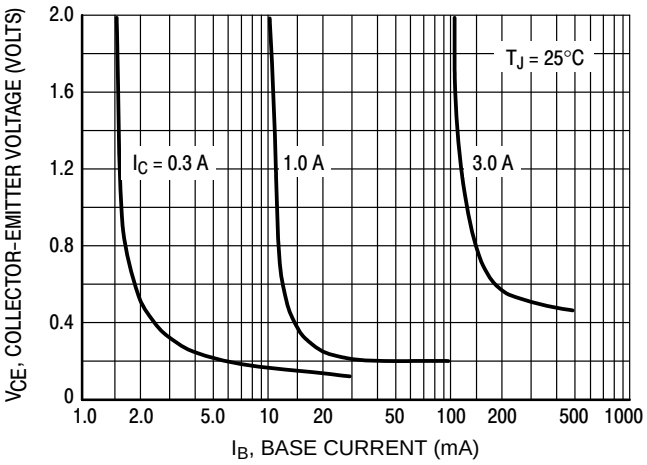



**Figure 9. Collector Saturation Region**

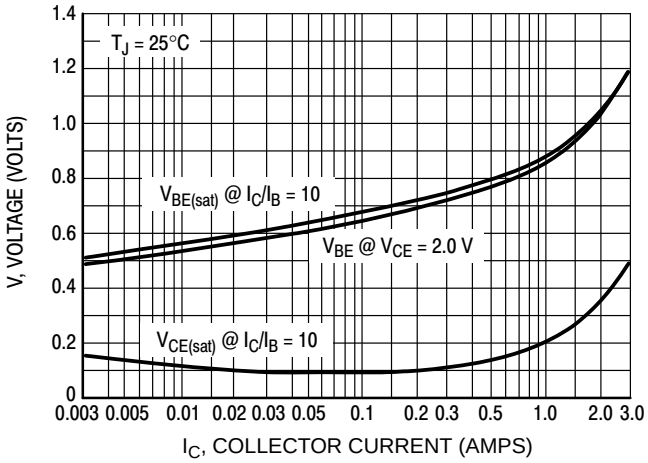



**Figure 10. “On” Voltages**

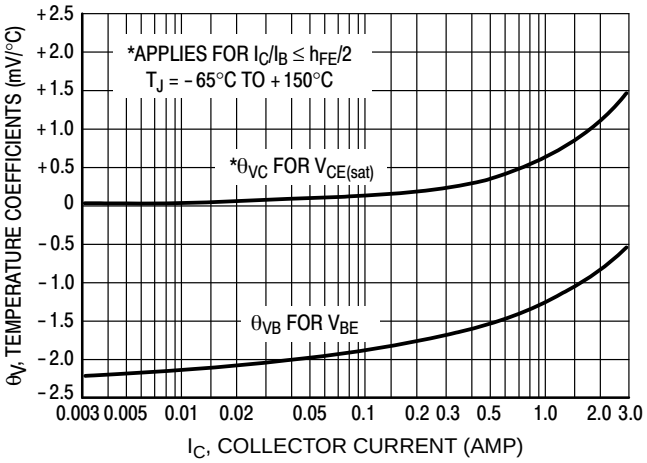



**Figure 11. Temperature Coefficients**

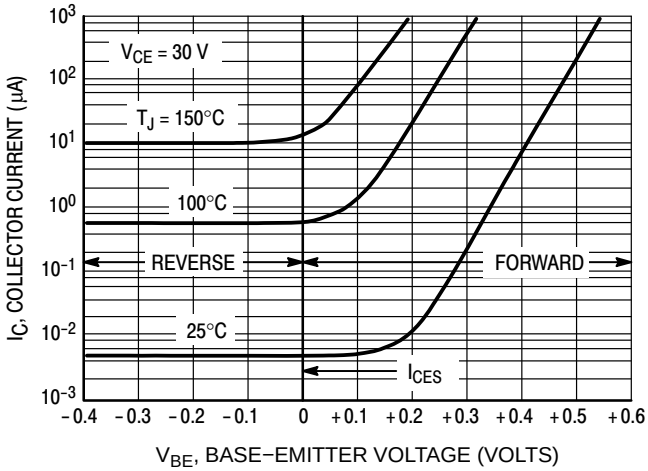



**Figure 12. Collector Cut−Off Region**

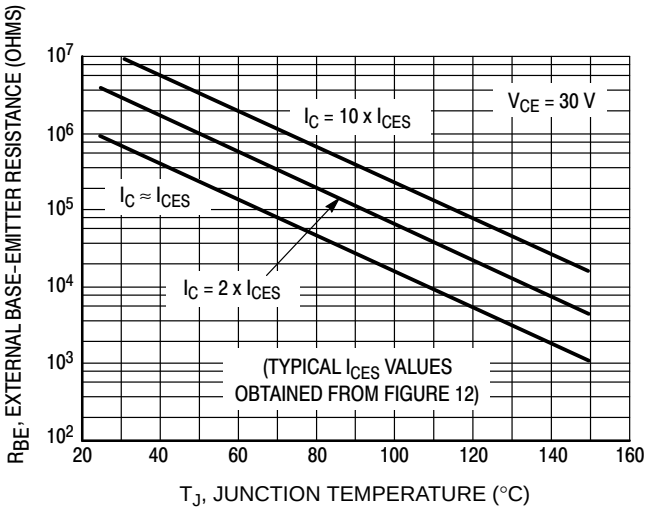



**Figure 13. Effects of Base−Emitter Resistance**

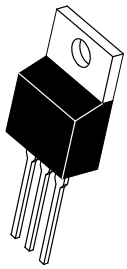
**ORDERING INFORMATION**

| Device | Package | Shipping |
|---|---|---|
| TIP31G | TO−220 (Pb−Free) | 50 Units / Rail |
| TIP31AG | TO−220 (Pb−Free) | 50 Units / Rail |
| TIP31BG | TO−220 (Pb−Free) | 50 Units / Rail |
| TIP31CG | TO−220 (Pb−Free) | 50 Units / Rail |
| TIP32G | TO−220 (Pb−Free) | 50 Units / Rail |
| TIP32AG | TO−220 (Pb−Free) | 50 Units / Rail |
| TIP32BG | TO−220 (Pb−Free) | 50 Units / Rail |
| TIP32CG | TO−220 (Pb−Free) | 50 Units / Rail |

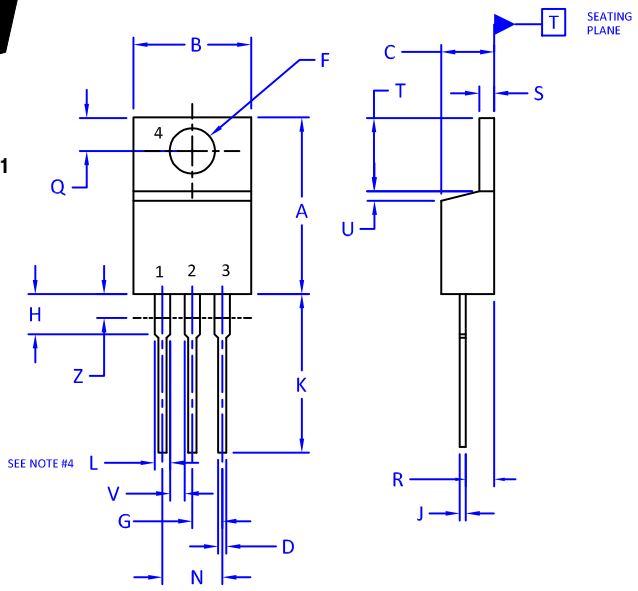
# MECHANICAL CASE OUTLINE
## PACKAGE DIMENSIONS

**TO−220**
CASE 221A
ISSUE AK

DATE 13 JAN 2022



SCALE 1:1




NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 2009.
2. CONTROLLING DIMENSION: INCHES
3. DIMENSION Z DEFINES A ZONE WHERE ALL BODY AND LEAD IRREGULARITIES ARE ALLOWED.
4. MAX WIDTH FOR F102 DEVICE = 1.35MM

| | INCHES | | MILLIMETERS | |
|---|---|---|---|---|
| DIM | MIN. | MAX. | MIN. | MAX. |
| A | 0.570 | 0.620 | 14.48 | 15.75 |
| B | 0.380 | 0.415 | 9.66 | 10.53 |
| C | 0.160 | 0.190 | 4.07 | 4.83 |
| D | 0.025 | 0.038 | 0.64 | 0.96 |
| F | 0.142 | 0.161 | 3.60 | 4.09 |
| G | 0.095 | 0.105 | 2.42 | 2.66 |
| H | 0.110 | 0.161 | 2.80 | 4.10 |
| J | 0.014 | 0.024 | 0.36 | 0.61 |
| 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 | 1.41 |
| 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

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

STYLE 3:
PIN 1. CATHODE
2. ANODE
3. GATE
4. ANODE

STYLE 4:
PIN 1. MAIN TERMINAL 1
2. MAIN TERMINAL 2
3. GATE
4. MAIN TERMINAL 2

STYLE 5:
PIN 1. GATE
2. DRAIN
3. SOURCE
4. DRAIN

STYLE 6:
PIN 1. ANODE
2. CATHODE
3. ANODE
4. CATHODE

STYLE 7:
PIN 1. CATHODE
2. ANODE
3. CATHODE
4. ANODE

STYLE 8:
PIN 1. CATHODE
2. ANODE
3. EXTERNAL TRIP/DELAY
4. ANODE

STYLE 9:
PIN 1. GATE
2. COLLECTOR
3. EMITTER
4. COLLECTOR

STYLE 10:
PIN 1. GATE
2. SOURCE
3. DRAIN
4. SOURCE

STYLE 11:
PIN 1. DRAIN
2. SOURCE
3. GATE
4. SOURCE

STYLE 12:
PIN 1. MAIN TERMINAL 1
2. MAIN TERMINAL 2
3. GATE
4. NOT CONNECTED

| | | |
|---|---|---|
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| **DESCRIPTION:** | **TO−220** | **PAGE 1 OF 1** |

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