

# TIP31G, TIP31AG, TIP31BG, TIP31CG (NPN), TIP32G, TIP32AG, TIP32BG, TIP32CG (PNP)

## Complementary Silicon Plastic Power Transistors

Designed for use in general purpose amplifier and switching applications.

### Features

- High Current Gain – Bandwidth Product
- Compact TO-220 Package
- These Devices are Pb-Free and are RoHS Compliant\*

### MAXIMUM RATINGS

| Rating                                                                                                    | Symbol         | Value                 | Unit                     |
|-----------------------------------------------------------------------------------------------------------|----------------|-----------------------|--------------------------|
| Collector – Emitter Voltage<br>TIP31G, TIP32G<br>TIP31AG, TIP32AG<br>TIP31BG, TIP32BG<br>TIP31CG, TIP32CG | $V_{CEO}$      | 40<br>60<br>80<br>100 | Vdc                      |
| Collector–Base Voltage<br>TIP31G, TIP32G<br>TIP31AG, TIP32AG<br>TIP31BG, TIP32BG<br>TIP31CG, TIP32CG      | $V_{CB}$       | 40<br>60<br>80<br>100 | Vdc                      |
| Emitter–Base Voltage                                                                                      | $V_{EB}$       | 5.0                   | Vdc                      |
| Collector Current – Continuous                                                                            | $I_C$          | 3.0                   | Adc                      |
| Collector Current – Peak                                                                                  | $I_{CM}$       | 5.0                   | Adc                      |
| Base Current                                                                                              | $I_B$          | 1.0                   | Adc                      |
| Total Power Dissipation<br>@ $T_C = 25^\circ\text{C}$<br>Derate above $25^\circ\text{C}$                  | $P_D$          | 40<br>0.32            | W<br>W/ $^\circ\text{C}$ |
| Total Power Dissipation<br>@ $T_A = 25^\circ\text{C}$<br>Derate above $25^\circ\text{C}$                  | $P_D$          | 2.0<br>0.016          | W<br>W/ $^\circ\text{C}$ |
| Unclamped Inductive Load Energy<br>(Note 1)                                                               | E              | 32                    | mJ                       |
| Operating and Storage Junction Temperature Range                                                          | $T_J, T_{stg}$ | -65 to +150           | $^\circ\text{C}$         |

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

1.  $I_C = 1.8\text{ A}$ ,  $L = 20\text{ mH}$ , P.R.F. = 10 Hz,  $V_{CC} = 10\text{ V}$ ,  $R_{BE} = 100\ \Omega$

### THERMAL CHARACTERISTICS

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

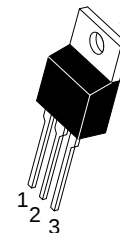
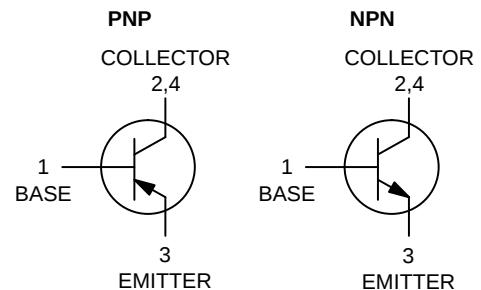
\*For additional information on our Pb-Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.



ON Semiconductor®

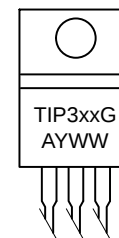
[www.onsemi.com](http://www.onsemi.com)

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



TO-220  
CASE 221A  
STYLE 1

### 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 on page 6 of this data sheet.

# TIP31G, TIP31AG, TIP31BG, TIP31CG (NPN), TIP32G, TIP32AG, TIP32BG, TIP32CG (PNP)

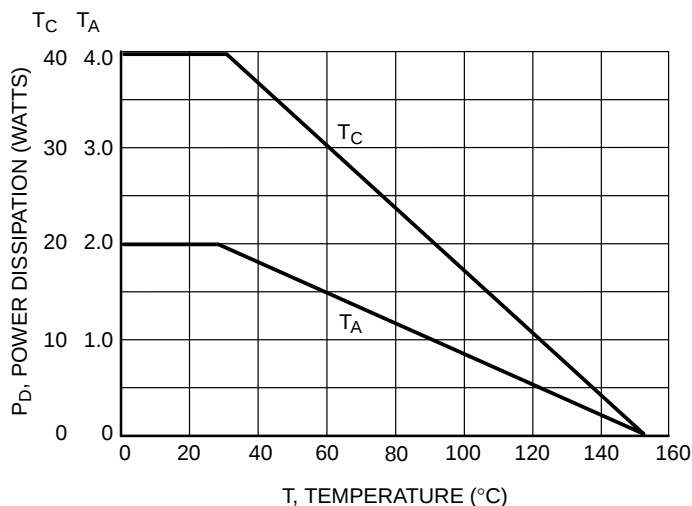
## ELECTRICAL CHARACTERISTICS (T<sub>C</sub> = 25°C unless otherwise noted)

| Characteristic                                                                                                                                                                                                                                                                                                      | Symbol                | Min                   | Max                      | Unit |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|-----------------------|--------------------------|------|
| <b>OFF CHARACTERISTICS</b>                                                                                                                                                                                                                                                                                          |                       |                       |                          |      |
| Collector-Emitter Sustaining Voltage (Note 2)<br>(I <sub>C</sub> = 30 mAdc, I <sub>B</sub> = 0)<br>TIP31G, TIP32G<br>TIP31AG, TIP32AG<br>TIP31BG, TIP32BG<br>TIP31CG, TIP32CG                                                                                                                                       | V <sub>CEO(sus)</sub> | 40<br>60<br>80<br>100 | –<br>–<br>–<br>–         | Vdc  |
| Collector Cutoff Current<br>(V <sub>CE</sub> = 30 Vdc, I <sub>B</sub> = 0)<br>TIP31G, TIP32G, TIP31AG, TIP32AG<br>(V <sub>CE</sub> = 60 Vdc, I <sub>B</sub> = 0)<br>TIP31BG, TIP31CG, TIP32BG, TIP32CG                                                                                                              | I <sub>CEO</sub>      | –<br>–                | 0.3<br>0.3               | mAdc |
| Collector Cutoff Current<br>(V <sub>CE</sub> = 40 Vdc, V <sub>EB</sub> = 0)<br>TIP31G, TIP32G<br>(V <sub>CE</sub> = 60 Vdc, V <sub>EB</sub> = 0)<br>TIP31AG, TIP32AG<br>(V <sub>CE</sub> = 80 Vdc, V <sub>EB</sub> = 0)<br>TIP31BG, TIP32BG<br>(V <sub>CE</sub> = 100 Vdc, V <sub>EB</sub> = 0)<br>TIP31CG, TIP32CG | I <sub>CES</sub>      | –<br>–<br>–<br>–      | 200<br>200<br>200<br>200 | μAdc |
| Emitter Cutoff Current<br>(V <sub>BE</sub> = 5.0 Vdc, I <sub>C</sub> = 0)                                                                                                                                                                                                                                           | I <sub>EBO</sub>      | –                     | 1.0                      | mAdc |
| <b>ON CHARACTERISTICS</b> (Note 2)                                                                                                                                                                                                                                                                                  |                       |                       |                          |      |
| DC Current Gain<br>(I <sub>C</sub> = 1.0 Adc, V <sub>CE</sub> = 4.0 Vdc)<br>(I <sub>C</sub> = 3.0 Adc, V <sub>CE</sub> = 4.0 Vdc)                                                                                                                                                                                   | h <sub>FE</sub>       | 25<br>10              | –<br>50                  | –    |
| Collector-Emitter Saturation Voltage<br>(I <sub>C</sub> = 3.0 Adc, I <sub>B</sub> = 375 mAdc)                                                                                                                                                                                                                       | V <sub>CE(sat)</sub>  | –                     | 1.2                      | Vdc  |
| Base-Emitter On Voltage<br>(I <sub>C</sub> = 3.0 Adc, V <sub>CE</sub> = 4.0 Vdc)                                                                                                                                                                                                                                    | V <sub>BE(on)</sub>   | –                     | 1.8                      | Vdc  |
| <b>DYNAMIC CHARACTERISTICS</b>                                                                                                                                                                                                                                                                                      |                       |                       |                          |      |
| Current-Gain – Bandwidth Product<br>(I <sub>C</sub> = 500 mAdc, V <sub>CE</sub> = 10 Vdc, f <sub>test</sub> = 1.0 MHz)                                                                                                                                                                                              | f <sub>T</sub>        | 3.0                   | –                        | MHz  |
| Small-Signal Current Gain<br>(I <sub>C</sub> = 0.5 Adc, V <sub>CE</sub> = 10 Vdc, f = 1.0 kHz)                                                                                                                                                                                                                      | h <sub>fe</sub>       | 20                    | –                        | –    |

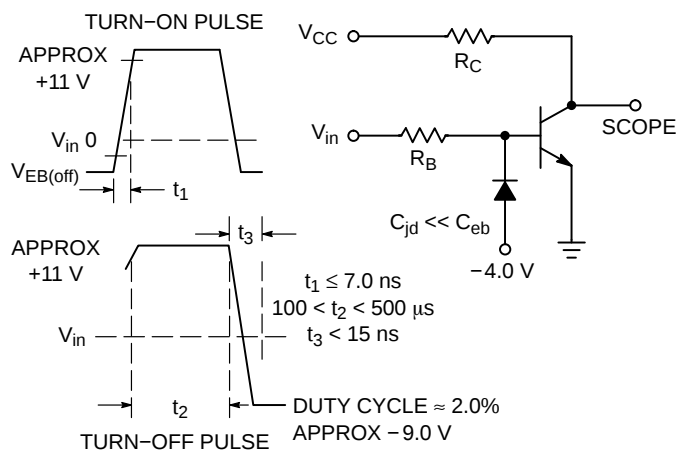
Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

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

**TIP31G, TIP31AG, TIP31BG, TIP31CG (NPN), TIP32G, TIP32AG, TIP32BG, TIP32CG (PNP)**

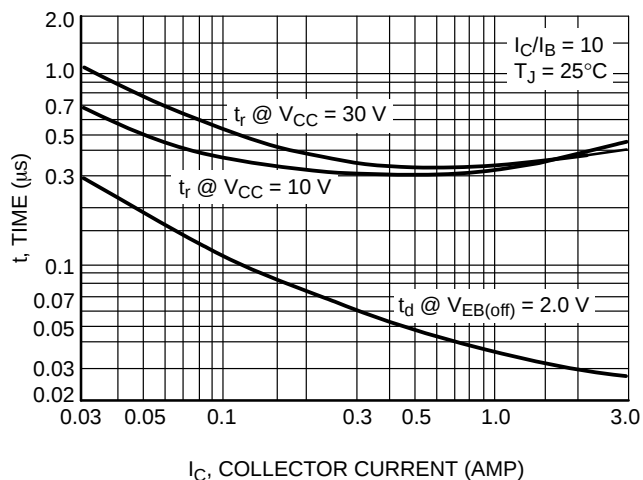


**Figure 1. Power Derating**



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

**Figure 2. Switching Time Equivalent Circuit**



**Figure 3. Turn-On Time**

# TIP31G, TIP31AG, TIP31BG, TIP31CG (NPN), TIP32G, TIP32AG, TIP32BG, TIP32CG (PNP)

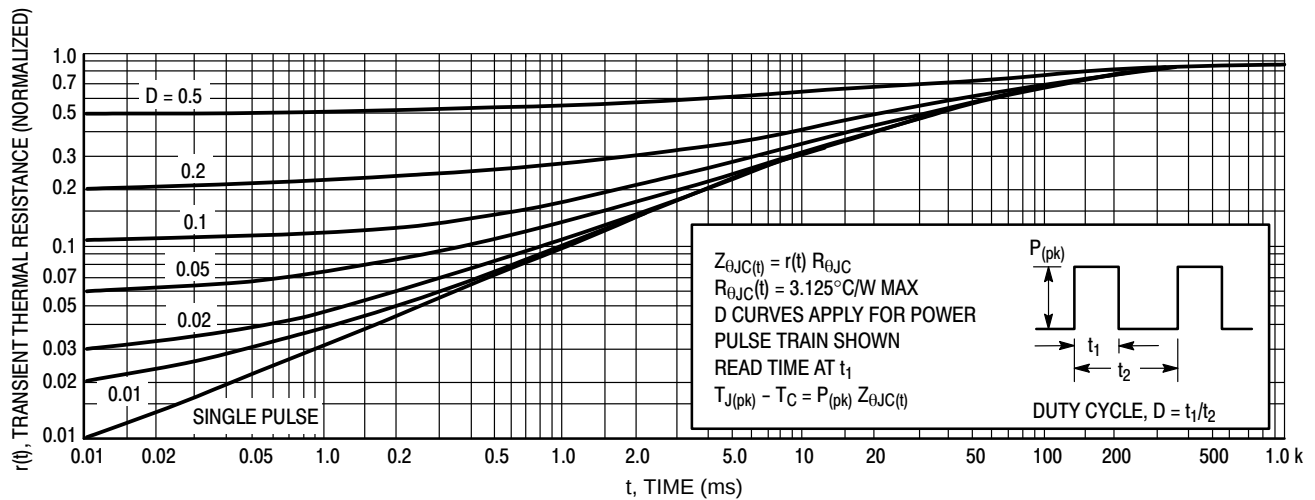


Figure 4. Thermal Response

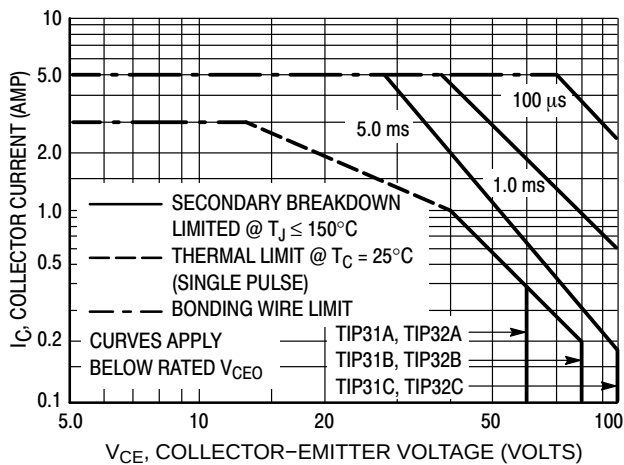


Figure 5. Active Region Safe Operating Area

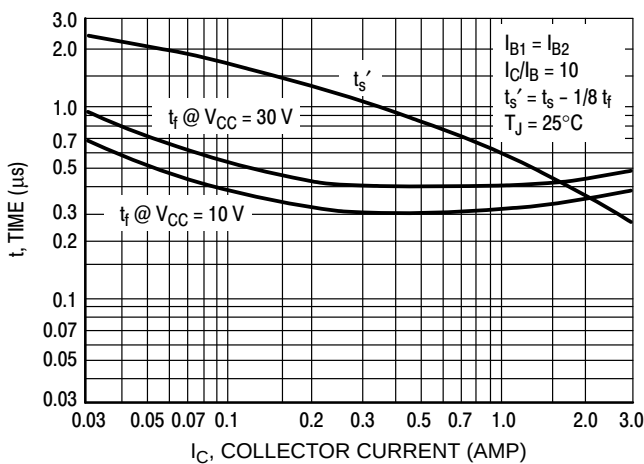


Figure 6. Turn-Off Time

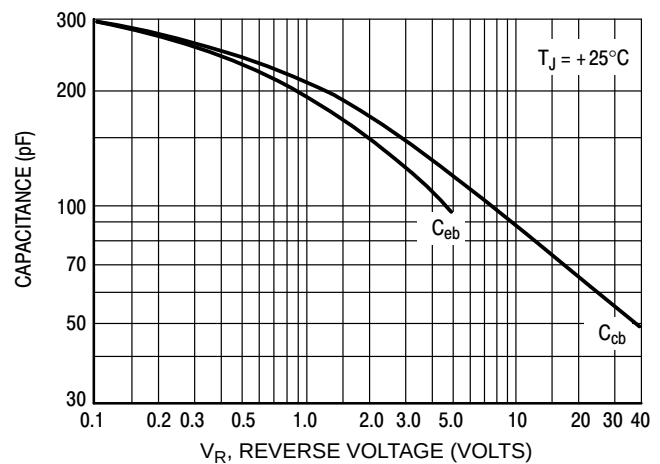
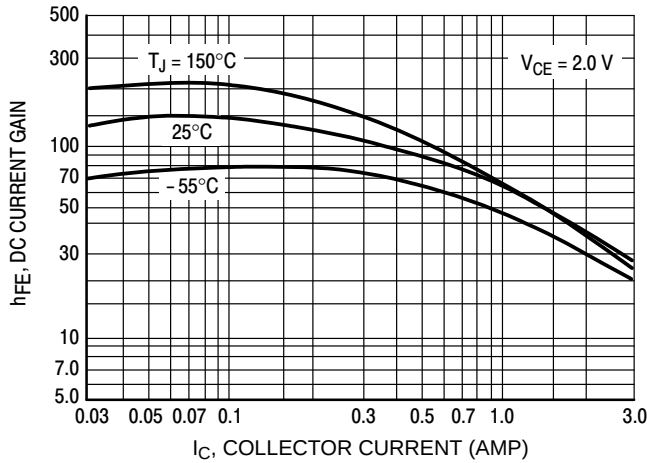
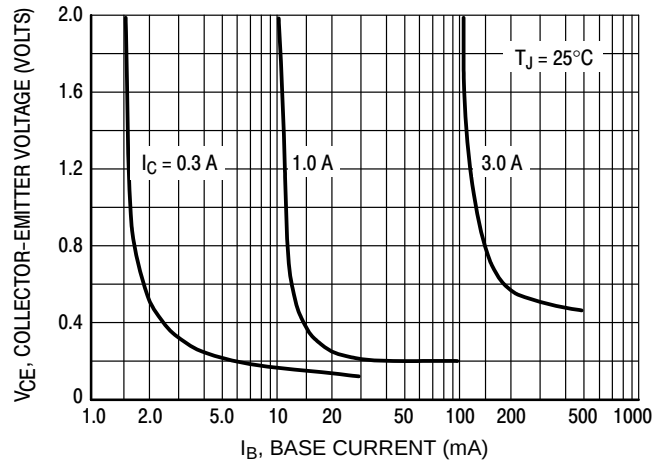


Figure 7. Capacitance

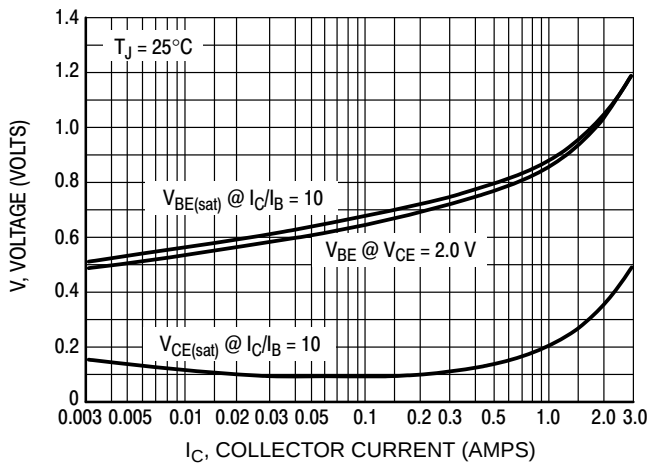
**TIP31G, TIP31AG, TIP31BG, TIP31CG (NPN), TIP32G, TIP32AG, TIP32BG, TIP32CG (PNP)**



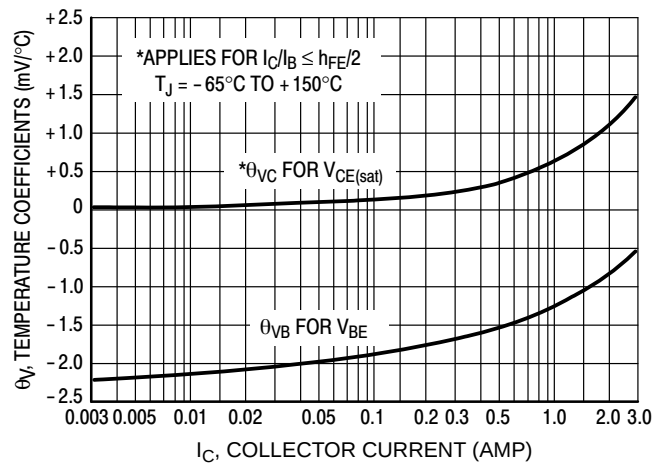
**Figure 8. DC Current Gain**



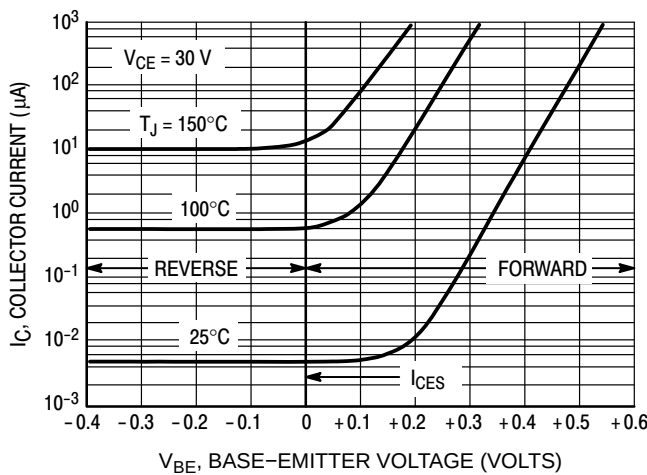
**Figure 9. Collector Saturation Region**



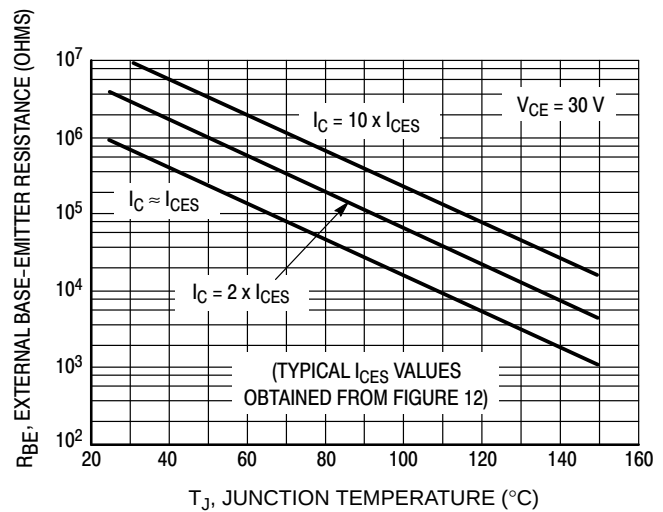
**Figure 10. "On" Voltages**



**Figure 11. Temperature Coefficients**



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



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

**TIP31G, TIP31AG, TIP31BG, TIP31CG (NPN), TIP32G, TIP32AG, TIP32BG,  
TIP32CG (PNP)**

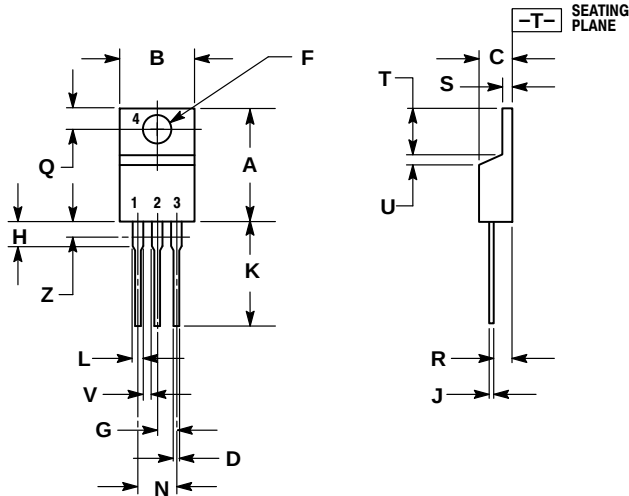
**ORDERING INFORMATION**

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

# TIP31G, TIP31AG, TIP31BG, TIP31CG (NPN), TIP32G, TIP32AG, TIP32BG, TIP32CG (PNP)

## PACKAGE DIMENSIONS

TO-220  
CASE 221A-09  
ISSUE AH



- 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  | 0.415 | 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 | 3.61        | 4.09  |
| G   | 0.095  | 0.105 | 2.42        | 2.66  |
| H   | 0.110  | 0.161 | 2.80        | 4.10  |
| J   | 0.014  | 0.024 | 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        | 1.39  |
| 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

ON Semiconductor and the  are registered trademarks of Semiconductor Components Industries, LLC (SCILLC) or its subsidiaries in the United States and/or other countries. SCILLC owns the rights to a number of patents, trademarks, copyrights, trade secrets, and other intellectual property. A listing of SCILLC's product/patent coverage may be accessed at [www.onsemi.com/site/pdf/Patent-Marking.pdf](http://www.onsemi.com/site/pdf/Patent-Marking.pdf). SCILLC reserves the right to make changes without further notice to any products herein. SCILLC makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does SCILLC assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation special, consequential or incidental damages. "Typical" parameters which may be provided in SCILLC data sheets and/or specifications can and do vary in different applications and actual performance may vary over time. All operating parameters, including "Typicals" must be validated for each customer application by customer's technical experts. SCILLC does not convey any license under its patent rights nor the rights of others. SCILLC products are not designed, intended, or authorized for use as components in systems intended for surgical implant into the body, or other applications intended to support or sustain life, or for any other application in which the failure of the SCILLC product could create a situation where personal injury or death may occur. Should Buyer purchase or use SCILLC products for any such unintended or unauthorized application, Buyer shall indemnify and hold SCILLC and its officers, employees, subsidiaries, affiliates, and distributors harmless against all claims, costs, damages, and expenses, and reasonable attorney fees arising out of, directly or indirectly, any claim of personal injury or death associated with such unintended or unauthorized use, even if such claim alleges that SCILLC was negligent regarding the design or manufacture of the part. SCILLC is an Equal Opportunity/Affirmative Action Employer. This literature is subject to all applicable copyright laws and is not for resale in any manner.

## PUBLICATION ORDERING INFORMATION

### LITERATURE FULFILLMENT:

Literature Distribution Center for ON Semiconductor  
P.O. Box 5163, Denver, Colorado 80217 USA  
Phone: 303-675-2175 or 800-344-3860 Toll Free USA/Canada  
Fax: 303-675-2176 or 800-344-3867 Toll Free USA/Canada  
Email: [orderlit@onsemi.com](mailto:orderlit@onsemi.com)

N. American Technical Support: 800-282-9855 Toll Free  
USA/Canada  
Europe, Middle East and Africa Technical Support:  
Phone: 421 33 790 2910  
Japan Customer Focus Center  
Phone: 81-3-5817-1050

ON Semiconductor Website: [www.onsemi.com](http://www.onsemi.com)

Order Literature: <http://www.onsemi.com/orderlit>

For additional information, please contact your local Sales Representative