

# Complementary Silicon Plastic Power Transistors

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

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

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

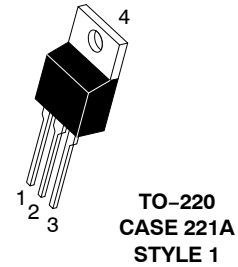
Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

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

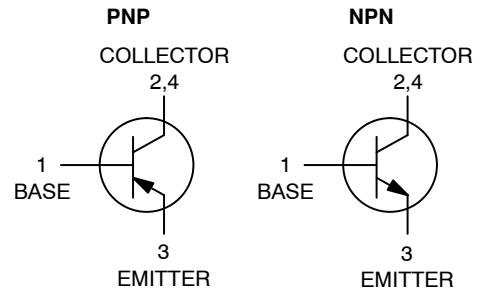
### THERMAL CHARACTERISTICS

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

\*For additional information on our Pb-Free strategy and soldering details, please download the [onsemi Soldering and Mounting Techniques Reference Manual, SOLDERRM/D](#).



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



### 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.

NOTE: Some of the devices on this data sheet have been **DISCONTINUED**. Please refer to the table on page 6.

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

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

Symbol	Characteristic	Min	Max	Unit
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### OFF CHARACTERISTICS

$V_{CE(sus)}$	Collector-Emitter Sustaining Voltage (Note 2) (I <sub>C</sub> = 30 mAdc, I <sub>B</sub> = 0) TIP31G, TIP32G TIP31AG, TIP32AG TIP31BG, TIP32BG TIP31CG, TIP32CG	40 60 80 100	- - - -	Vdc
$I_{CEO}$	Collector Cutoff Current (V <sub>CE</sub> = 30 Vdc, I <sub>B</sub> = 0) TIP31G, TIP32G, TIP31AG, TIP32AG (V <sub>CE</sub> = 60 Vdc, I <sub>B</sub> = 0) TIP31BG, TIP31CG, TIP32BG, TIP32CG	- -	0.3 0.3	mAdc
$I_{CES}$	Collector Cutoff Current (V <sub>CE</sub> = 40 Vdc, V <sub>EB</sub> = 0) TIP31G, TIP32G (V <sub>CE</sub> = 60 Vdc, V <sub>EB</sub> = 0) TIP31AG, TIP32AG (V <sub>CE</sub> = 80 Vdc, V <sub>EB</sub> = 0) TIP31BG, TIP32BG (V <sub>CE</sub> = 100 Vdc, V <sub>EB</sub> = 0) TIP31CG, TIP32CG	- - - -	200 200 200 200	μAdc
$I_{EBO}$	Emitter Cutoff Current (V <sub>BE</sub> = 5.0 Vdc, I <sub>C</sub> = 0)	-	1.0	mAdc

### ON CHARACTERISTICS (Note 2)

$h_{FE}$	DC Current Gain (I <sub>C</sub> = 1.0 Adc, V <sub>CE</sub> = 4.0 Vdc) (I <sub>C</sub> = 3.0 Adc, V <sub>CE</sub> = 4.0 Vdc)	25 10	- 50	-
$V_{CE(sat)}$	Collector-Emitter Saturation Voltage (I <sub>C</sub> = 3.0 Adc, I <sub>B</sub> = 375 mAdc)	-	1.2	Vdc
$V_{BE(on)}$	Base-Emitter On Voltage (I <sub>C</sub> = 3.0 Adc, V <sub>CE</sub> = 4.0 Vdc)	-	1.8	Vdc

### DYNAMIC CHARACTERISTICS

$f_T$	Current-Gain - Bandwidth Product (I <sub>C</sub> = 500 mAdc, V <sub>CE</sub> = 10 Vdc, f <sub>test</sub> = 1.0 MHz)	3.0	-	MHz
$h_{fe}$	Small-Signal Current Gain (I <sub>C</sub> = 0.5 Adc, V <sub>CE</sub> = 10 Vdc, f = 1.0 kHz)	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)

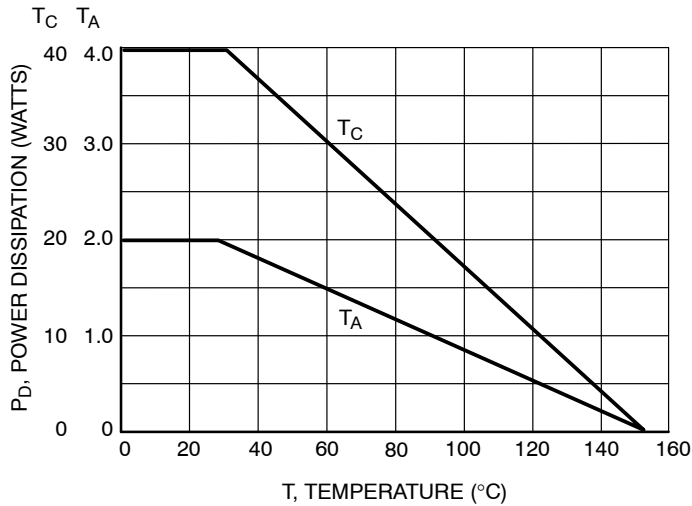
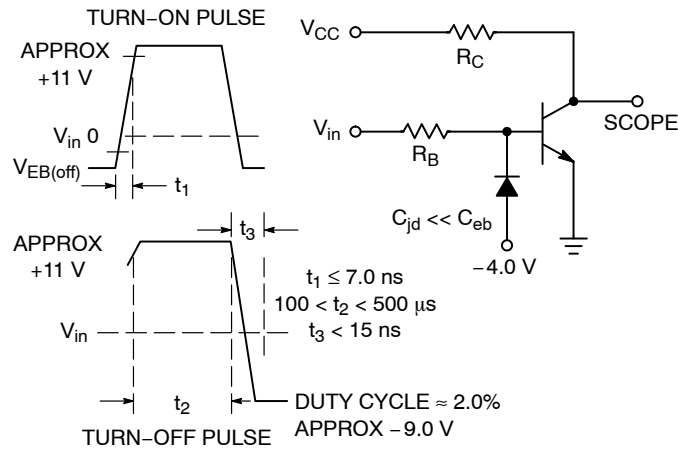


Figure 1. Power Derating



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

Figure 2. Switching Time Equivalent Circuit

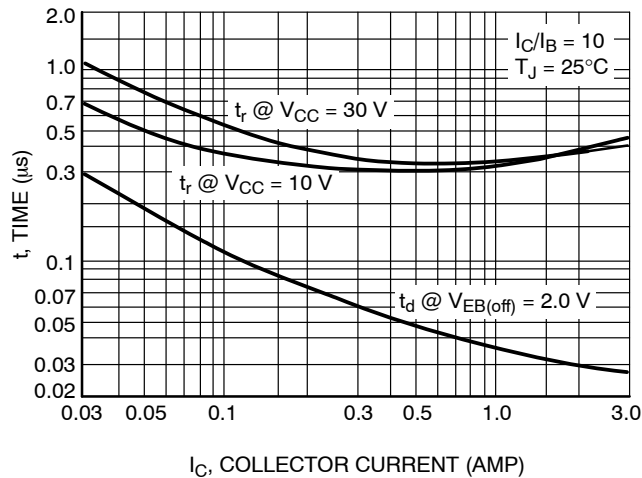


Figure 3. Turn-On Time

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

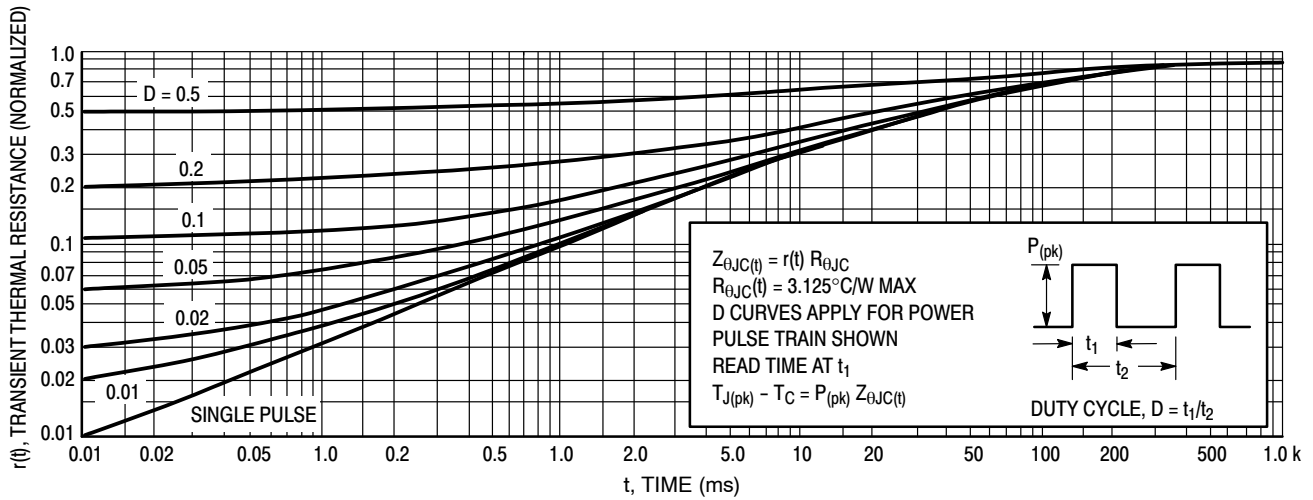


Figure 4. Thermal Response

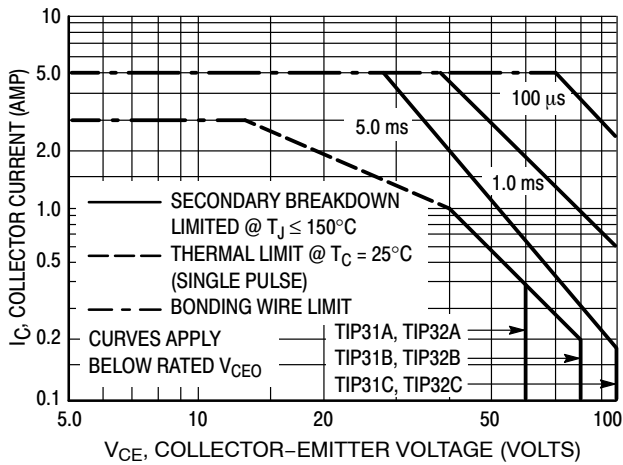


Figure 5. Active Region Safe Operating Area

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  $T_{J(pk)} \leq 150^\circ\text{C}$ .  $T_{J(pk)}$  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.

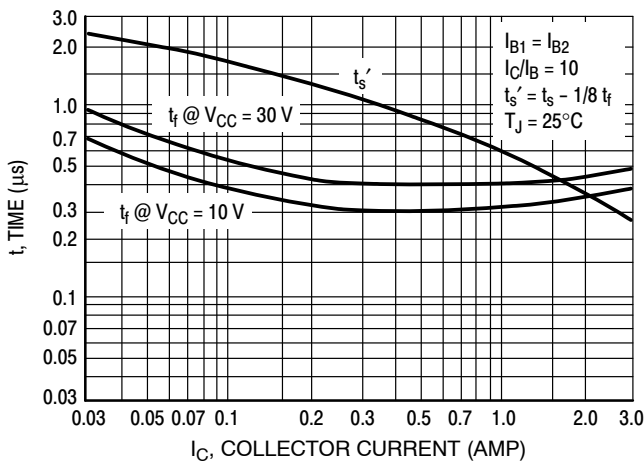


Figure 6. Turn-Off Time

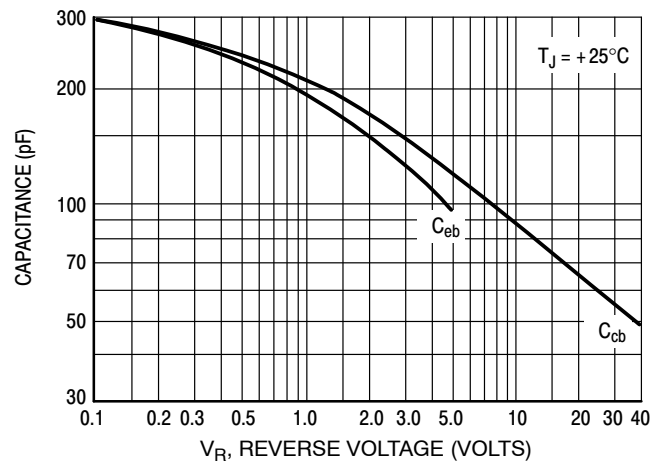


Figure 7. Capacitance

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

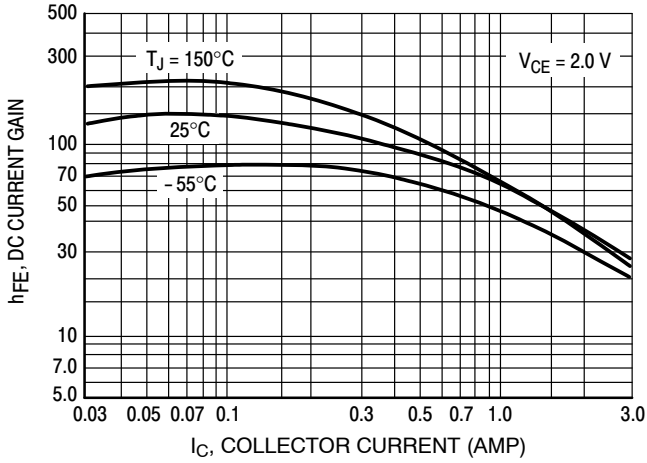


Figure 8. DC Current Gain

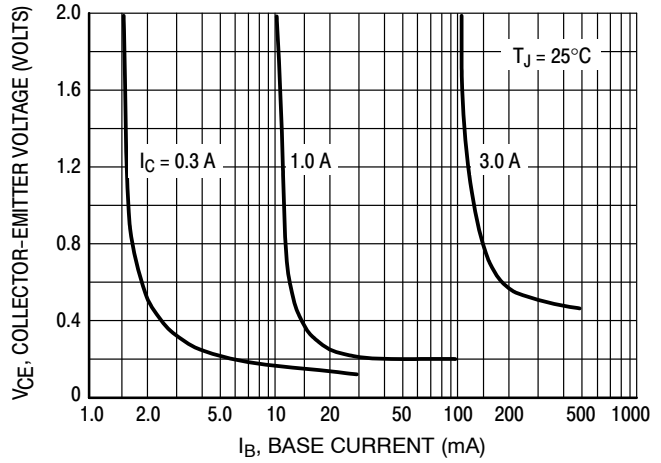


Figure 9. Collector Saturation Region

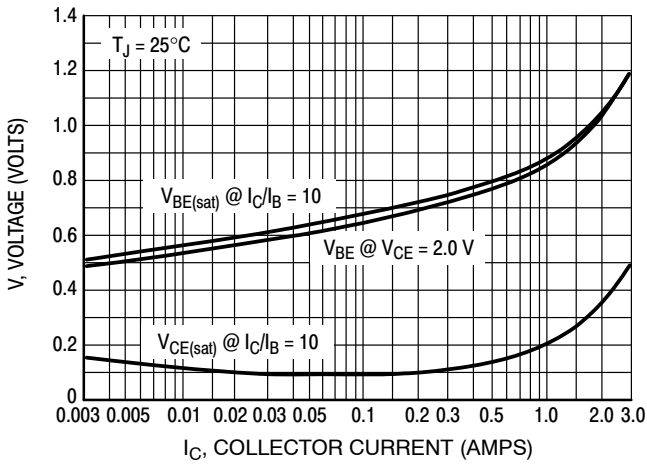


Figure 10. "On" Voltages

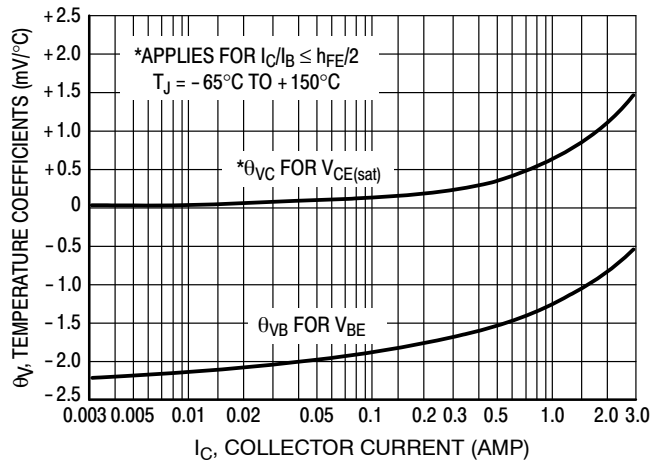


Figure 11. Temperature Coefficients

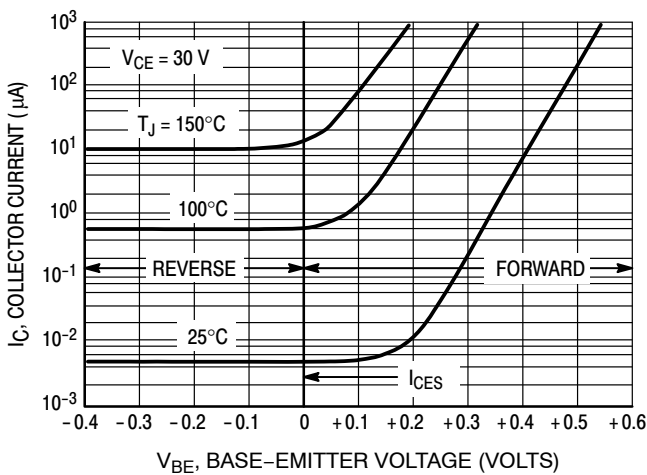


Figure 12. Collector Cut-Off Region

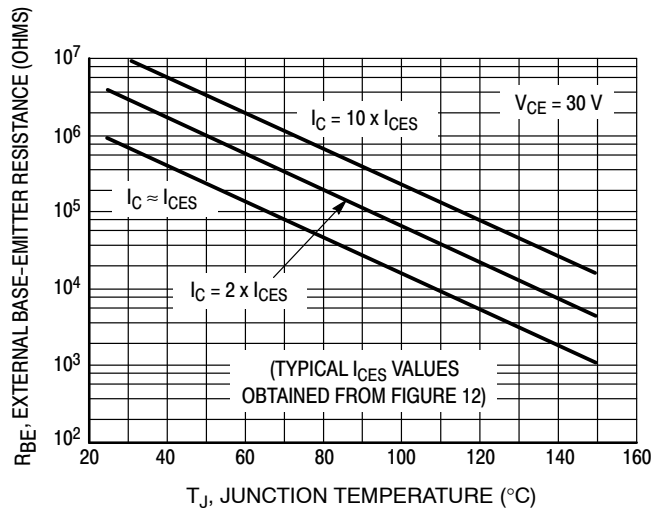


Figure 13. Effects of Base-Emitter Resistance

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

**ORDERING INFORMATION**

Device	Package	Shipping
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

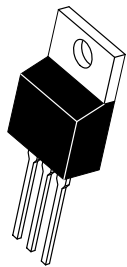
**DISCONTINUED** (Note 3)

TIP31G	TO-220 (Pb-Free)	50 Units / Rail
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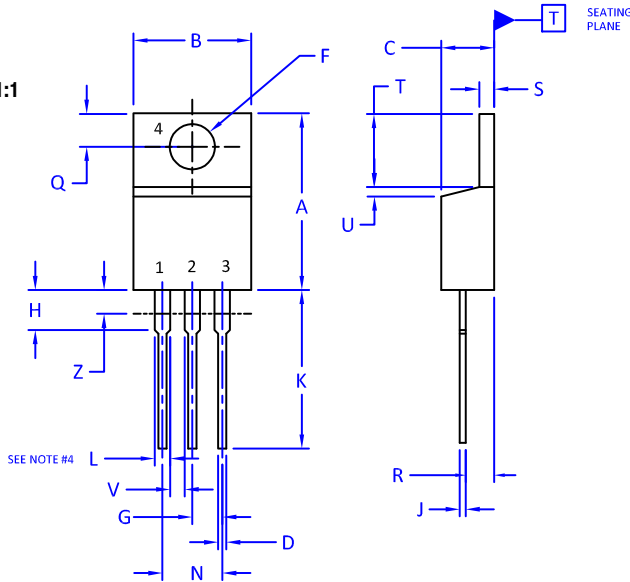
3. **DISCONTINUED:** This device is not recommended for new design. Please contact your **onsemi** representative for information. The most current information on this device may be available on [www.onsemi.com](http://www.onsemi.com).

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

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	3.60	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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