

# Complementary Silicon Transistors, Plastic, Medium-Power

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

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

### Features

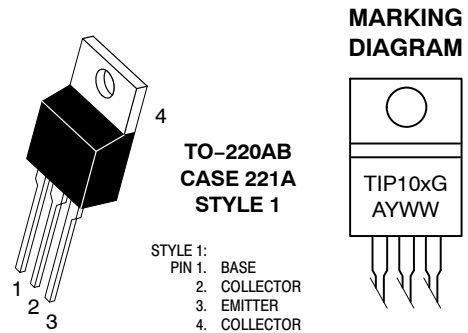
- High DC Current Gain –  
 $h_{FE} = 2500$  (Typ) @  $I_C$   
 $= 4.0$  Adc
- Collector–Emitter Sustaining Voltage – @ 30 mAdc  
 $V_{CEO(sus)} = 60$  Vdc (Min) – TIP100, TIP105  
 $= 80$  Vdc (Min) – TIP101, TIP106  
 $= 100$  Vdc (Min) – TIP102, TIP107
- Low Collector–Emitter Saturation Voltage –  
 $V_{CE(sat)} = 2.0$  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
- These Devices are Pb–Free and are RoHS Compliant



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## DARLINGTON 8 AMPERE COMPLEMENTARY SILICON POWER TRANSISTORS 60–80–100 VOLTS, 80 WATTS



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 on page 3 of this data sheet.

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

## 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 – Peak	$I_C$	8.0 15			Adc
Base Current	$I_B$	1.0			Adc
Total Power Dissipation @ $T_C = 25^\circ\text{C}$ Derate above $25^\circ\text{C}$	$P_D$	80 0.64			W W/ $^\circ\text{C}$
Unclamped Inductive Load Energy (1)	E	30			mJ
Total Power Dissipation @ $T_A = 25^\circ\text{C}$ Derate above $25^\circ\text{C}$	$P_D$	2.0 0.016			W W/ $^\circ\text{C}$
Operating and Storage Junction Temperature Range	$T_J, T_{stg}$	–65 to +150			$^\circ\text{C}$

## THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction-to-Case	$R_{\theta JC}$	1.56	$^\circ\text{C/W}$
Thermal Resistance, Junction-to-Ambient	$R_{\theta JA}$	62.5	$^\circ\text{C/W}$

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

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

Characteristic	Symbol	Min	Max	Unit
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### OFF CHARACTERISTICS

Collector–Emitter Sustaining Voltage (1) ( $I_C = 30\text{ mAdc}$ , $I_B = 0$ )	TIP100, TIP105 TIP101, TIP106 TIP102, TIP107	$V_{CEO(sus)}$	60 80 100	– – –	Vdc
Collector Cutoff Current ( $V_{CE} = 30\text{ Vdc}$ , $I_B = 0$ ) ( $V_{CE} = 40\text{ Vdc}$ , $I_B = 0$ ) ( $V_{CE} = 50\text{ Vdc}$ , $I_B = 0$ )	TIP100, TIP105 TIP101, TIP106 TIP102, TIP107	$I_{CEO}$	– – –	50 50 50	$\mu\text{Adc}$
Collector Cutoff Current ( $V_{CB} = 60\text{ Vdc}$ , $I_E = 0$ ) ( $V_{CB} = 80\text{ Vdc}$ , $I_E = 0$ ) ( $V_{CB} = 100\text{ Vdc}$ , $I_E = 0$ )	TIP100, TIP105 TIP101, TIP106 TIP102, TIP107	$I_{CBO}$	– – –	50 50 50	$\mu\text{Adc}$
Emitter Cutoff Current ( $V_{BE} = 5.0\text{ Vdc}$ , $I_C = 0$ )		$I_{EBO}$	–	8.0	mAdc

### ON CHARACTERISTICS (1)

DC Current Gain ( $I_C = 3.0\text{ Adc}$ , $V_{CE} = 4.0\text{ Vdc}$ ) ( $I_C = 8.0\text{ Adc}$ , $V_{CE} = 4.0\text{ Vdc}$ )	$h_{FE}$	1000 200	20,000 –	–
Collector–Emitter Saturation Voltage ( $I_C = 3.0\text{ Adc}$ , $I_B = 6.0\text{ mAdc}$ ) ( $I_C = 8.0\text{ Adc}$ , $I_B = 80\text{ mAdc}$ )	$V_{CE(sat)}$	– –	2.0 2.5	Vdc
Base–Emitter On Voltage ( $I_C = 8.0\text{ Adc}$ , $V_{CE} = 4.0\text{ Vdc}$ )	$V_{BE(on)}$	–	2.8	Vdc

### DYNAMIC CHARACTERISTICS

Small–Signal Current Gain ( $I_C = 3.0\text{ Adc}$ , $V_{CE} = 4.0\text{ Vdc}$ , $f = 1.0\text{ MHz}$ )	$h_{fe}$	4.0	–	–	
Output Capacitance ( $V_{CB} = 10\text{ Vdc}$ , $I_E = 0$ , $f = 0.1\text{ MHz}$ )	TIP105, TIP106, TIP107 TIP100, TIP101, TIP102	$C_{ob}$	– –	300 200	pF

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  $\leq 300\ \mu\text{s}$ , Duty Cycle  $\leq 2\%$ .

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

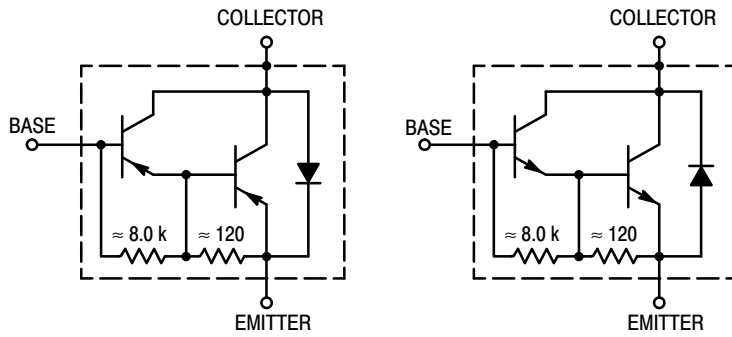


Figure 1. Darlington Circuit Schematic

## 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

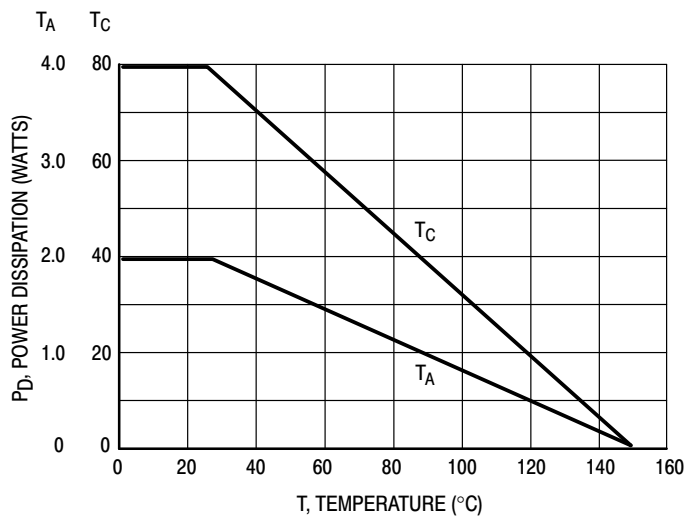


Figure 2. Power Derating

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

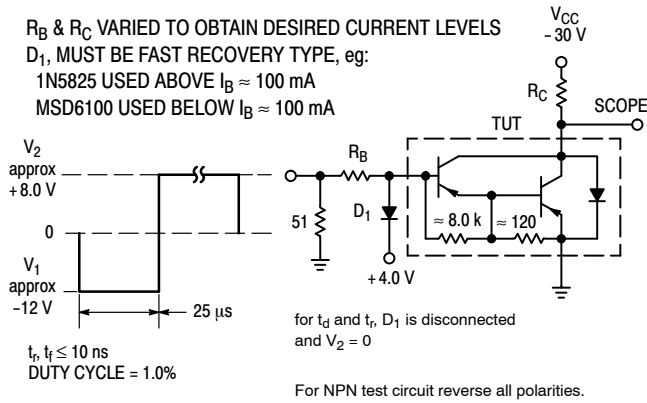


Figure 3. Switching Times Test Circuit

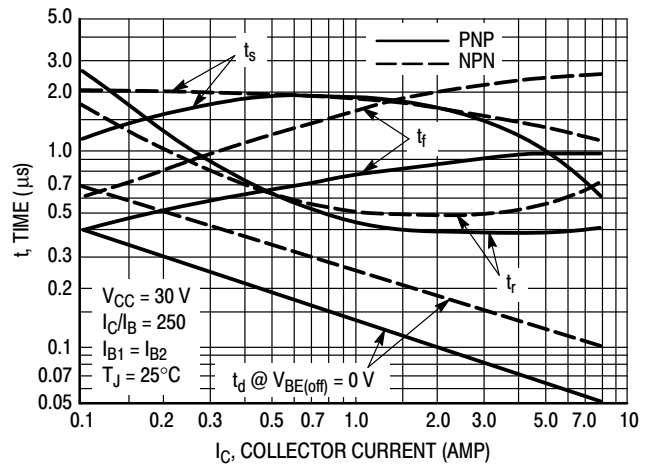


Figure 4. Switching Times

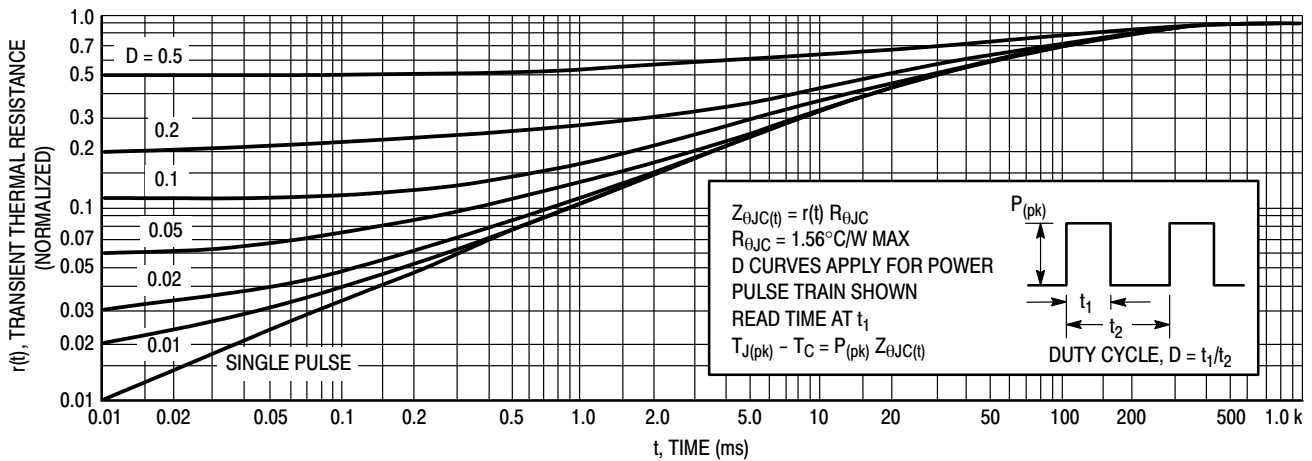


Figure 5. Thermal Response

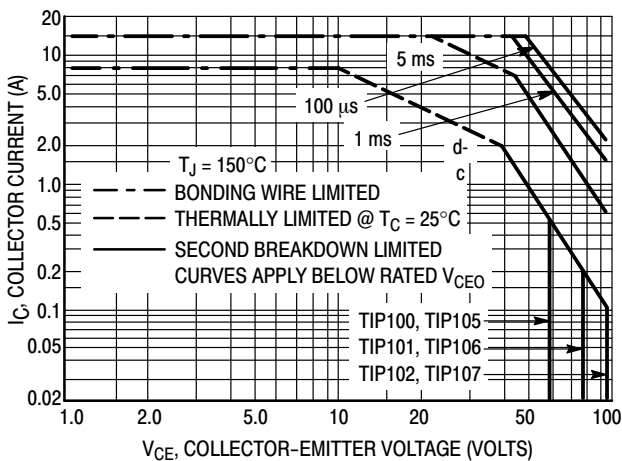


Figure 6. Active-Region Safe Operating Area

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

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

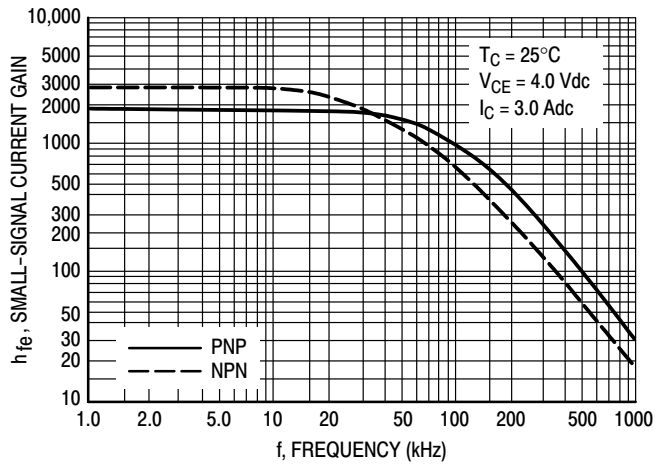


Figure 7. Small-Signal Current Gain

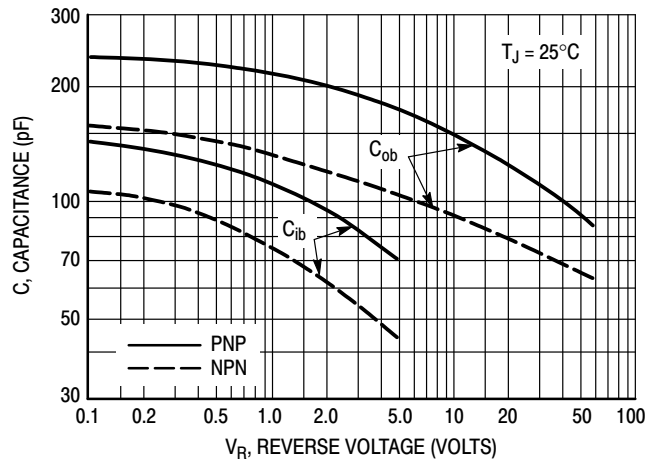


Figure 8. Capacitance

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

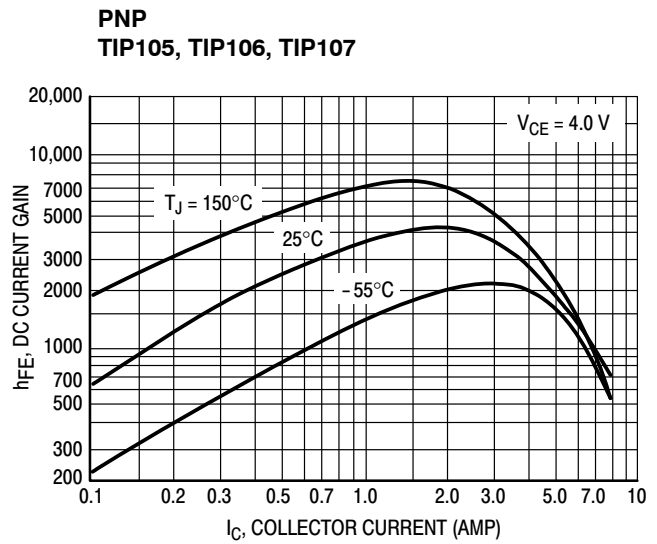
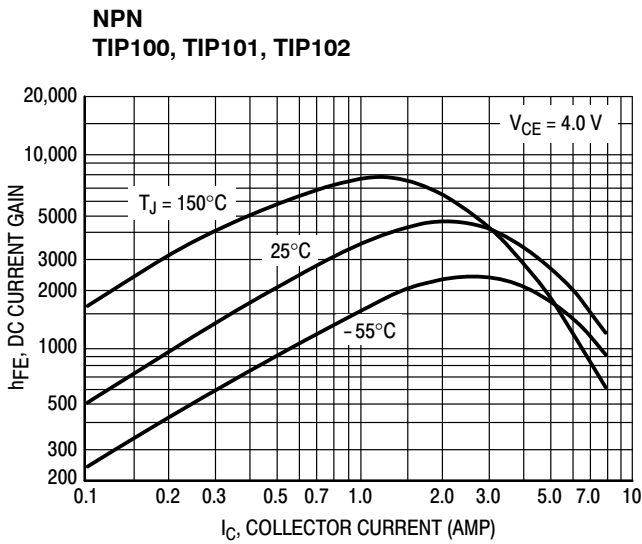


Figure 9. DC Current Gain

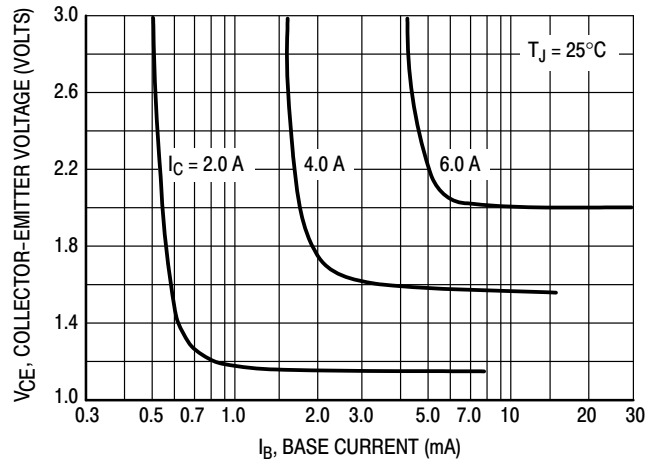
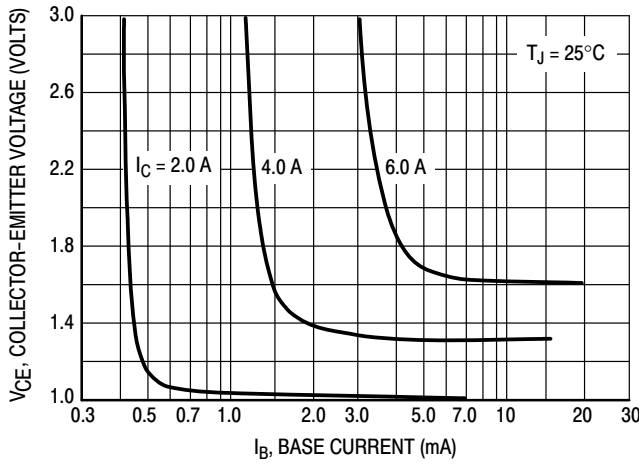


Figure 10. Collector Saturation Region

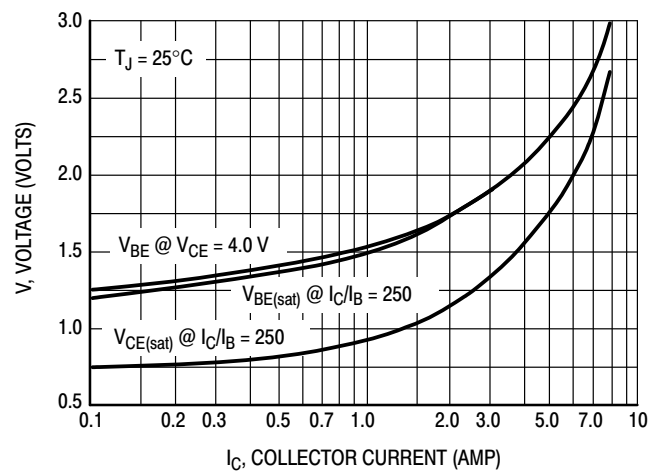
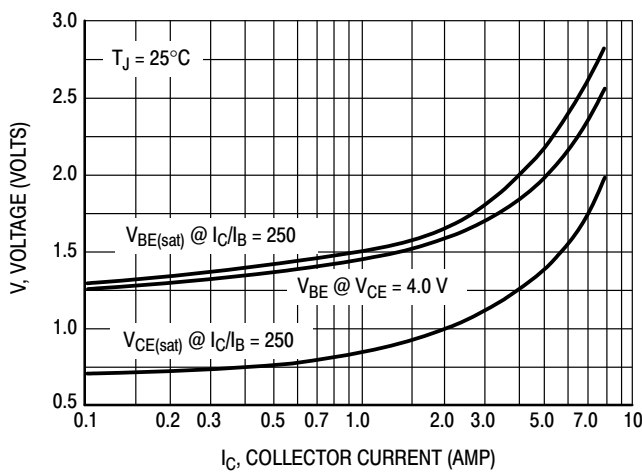


Figure 11. "On" Voltages

# MECHANICAL CASE OUTLINE

## PACKAGE DIMENSIONS

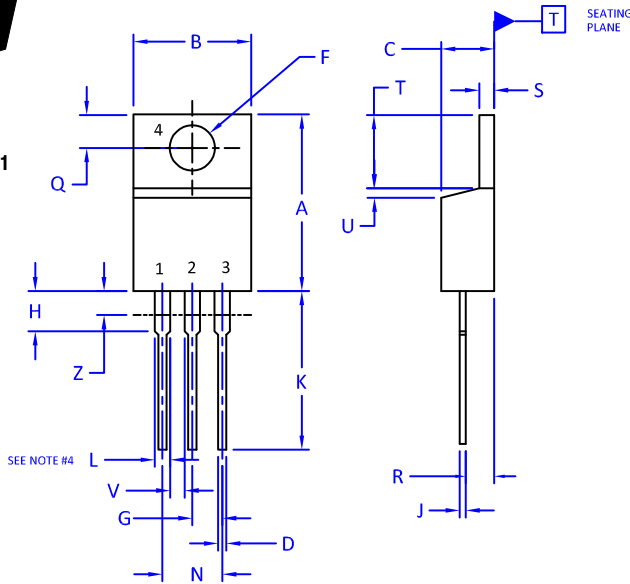
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SCALE 1:1

### TO-220 CASE 221A-09 ISSUE AJ

DATE 05 NOV 2019



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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