

# 2N6667, 2N6668

## Darlington Silicon Power Transistors

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

- High DC Current Gain –  
 $h_{FE} = 3500$  (Typ) @  $I_C = 4.0$  Adc
- Collector-Emitter Sustaining Voltage – @ 200 mAdc  
 $V_{CE(sus)} = 60$  Vdc (Min) – 2N6667  
 $= 80$  Vdc (Min) – 2N6668
- Low Collector-Emitter Saturation Voltage –  
 $V_{CE(sat)} = 2.0$  Vdc (Max) @  $I_C = 5.0$  Adc
- Monolithic Construction with Built-In Base-Emitter Shunt Resistors
- TO-220AB Compact Package
- Complementary to 2N6387, 2N6388
- These Devices are Pb-Free and are RoHS Compliant\*

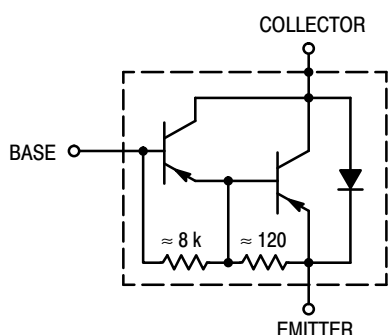


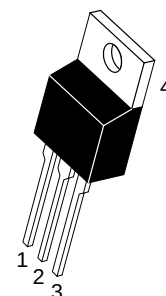
Figure 1. Darlington Schematic



**ON Semiconductor®**

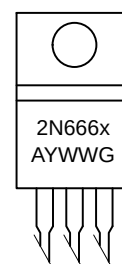
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**PNP SILICON  
DARLINGTON  
POWER TRANSISTORS  
10 A, 60–80 V, 65 W**



TO-220  
CASE 221A  
STYLE 1

### MARKING DIAGRAM



x = 7 or 8  
A = Assembly Location  
Y = Year  
WW = Work Week  
G = Pb-Free Package

### ORDERING INFORMATION

| Device  | Package             | Shipping      |
|---------|---------------------|---------------|
| 2N6667G | TO-220<br>(Pb-Free) | 50 Units/Rail |
| 2N6668G | TO-220<br>(Pb-Free) | 50 Units/Rail |

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

# 2N6667, 2N6668

## MAXIMUM RATINGS (Note 1)

| Rating                                                                                 | Symbol         | 2N6667       | 2N6668 | Unit                     |
|----------------------------------------------------------------------------------------|----------------|--------------|--------|--------------------------|
| Collector-Emitter Voltage                                                              | $V_{CEO}$      | 60           | 80     | Vdc                      |
| Collector-Base Voltage                                                                 | $V_{CB}$       | 60           | 80     | Vdc                      |
| Emitter-Base Voltage                                                                   | $V_{EB}$       | 5.0          |        | Vdc                      |
| Collector Current – Continuous<br>– Peak                                               | $I_C$          | 10<br>15     |        | Adc                      |
| Base Current                                                                           | $I_B$          | 250          |        | mAdc                     |
| Total Device Dissipation @ $T_C = 25^\circ\text{C}$<br>Derate above $25^\circ\text{C}$ | $P_D$          | 65<br>0.52   |        | W<br>W/ $^\circ\text{C}$ |
| Total Device Dissipation @ $T_A = 25^\circ\text{C}$<br>Derate above $25^\circ\text{C}$ | $P_D$          | 2.0<br>0.016 |        | W<br>W/ $^\circ\text{C}$ |
| 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.

## THERMAL CHARACTERISTICS

| Characteristic                          | Symbol          | Max  | Unit               |
|-----------------------------------------|-----------------|------|--------------------|
| Thermal Resistance, Junction to Case    | $R_{\theta JC}$ | 1.92 | $^\circ\text{C/W}$ |
| Thermal Resistance, Junction to Ambient | $R_{\theta JA}$ | 62.5 | $^\circ\text{C/W}$ |

## ELECTRICAL CHARACTERISTICS (Note 1) ( $T_C = 25^\circ\text{C}$ unless otherwise noted)

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

### OFF CHARACTERISTICS

|                                                                                                                                                                                                                                                                                                                                                      |                                      |                |                  |                          |                             |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------|----------------|------------------|--------------------------|-----------------------------|
| Collector-Emitter Sustaining Voltage (Note 2)<br>( $I_C = 200\text{ mAdc}$ , $I_B = 0$ )                                                                                                                                                                                                                                                             | 2N6667<br>2N6668                     | $V_{CEO(sus)}$ | 60<br>80         | –<br>–                   | Vdc                         |
| Collector Cutoff Current ( $V_{CE} = 60\text{ Vdc}$ , $I_B = 0$ )<br>( $V_{CE} = 80\text{ Vdc}$ , $I_B = 0$ )                                                                                                                                                                                                                                        | 2N6667<br>2N6668                     | $I_{CEO}$      | –<br>–           | 1.0<br>1.0               | mAdc                        |
| Collector Cutoff Current<br>( $V_{CE} = 60\text{ Vdc}$ , $V_{EB(off)} = 1.5\text{ Vdc}$ )<br>( $V_{CE} = 80\text{ Vdc}$ , $V_{EB(off)} = 1.5\text{ Vdc}$ )<br>( $V_{CE} = 60\text{ Vdc}$ , $V_{EB(off)} = 1.5\text{ Vdc}$ , $T_C = 125^\circ\text{C}$ )<br>( $V_{CE} = 80\text{ Vdc}$ , $V_{EB(off)} = 1.5\text{ Vdc}$ , $T_C = 125^\circ\text{C}$ ) | 2N6667<br>2N6668<br>2N6667<br>2N6668 | $I_{CEX}$      | –<br>–<br>–<br>– | 300<br>300<br>3.0<br>3.0 | $\mu\text{Adc}$<br><br>mAdc |
| Emitter Cutoff Current ( $V_{BE} = 5.0\text{ Vdc}$ , $I_C = 0$ )                                                                                                                                                                                                                                                                                     |                                      | $I_{EBO}$      | –                | 5.0                      | mAdc                        |

### ON CHARACTERISTICS (Note 1)

|                                                                                                                                                 |               |             |            |     |
|-------------------------------------------------------------------------------------------------------------------------------------------------|---------------|-------------|------------|-----|
| DC Current Gain ( $I_C = 5.0\text{ Adc}$ , $V_{CE} = 3.0\text{ Vdc}$ )<br>( $I_C = 10\text{ Adc}$ , $V_{CE} = 3.0\text{ Vdc}$ )                 | $h_{FE}$      | 1000<br>100 | 20000<br>– | –   |
| Collector-Emitter Saturation Voltage ( $I_C = 5.0\text{ Adc}$ , $I_B = 0.01\text{ Adc}$ )<br>( $I_C = 10\text{ Adc}$ , $I_B = 0.1\text{ Adc}$ ) | $V_{CE(sat)}$ | –<br>–      | 2.0<br>3.0 | Vdc |
| Base-Emitter Saturation Voltage ( $I_C = 5.0\text{ Adc}$ , $I_B = 0.01\text{ Adc}$ )<br>( $I_C = 10\text{ Adc}$ , $I_B = 0.1\text{ Adc}$ )      | $V_{BE(sat)}$ | –<br>–      | 2.8<br>4.5 | Vdc |

### DYNAMIC CHARACTERISTICS

|                                                                                                                       |            |      |     |    |
|-----------------------------------------------------------------------------------------------------------------------|------------|------|-----|----|
| Current Gain – Bandwidth Product ( $I_C = 1.0\text{ Adc}$ , $V_{CE} = 5.0\text{ Vdc}$ , $f_{test} = 1.0\text{ MHz}$ ) | $ h_{fe} $ | 20   | –   | –  |
| Output Capacitance ( $V_{CB} = 10\text{ Vdc}$ , $I_E = 0$ , $f = 1.0\text{ MHz}$ )                                    | $C_{ob}$   | –    | 200 | pF |
| Small-Signal Current Gain ( $I_C = 1.0\text{ Adc}$ , $V_{CE} = 5.0\text{ Vdc}$ , $f = 1.0\text{ kHz}$ )               | $h_{fe}$   | 1000 | –   | –  |

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.

1. Indicates JEDEC Registered Data.
2. Pulse Test: Pulse Width  $\leq 300\text{ }\mu\text{s}$ , Duty Cycle  $\leq 2\%$ .

## 2N6667, 2N6668

$R_B$  &  $R_C$  VARIED TO OBTAIN DESIRED CURRENT LEVELS

$D_1$ , MUST BE FAST RECOVERY TYPES e.g.,

1N5825 USED ABOVE  $I_B \approx 100$  mA

MSD6100 USED BELOW  $I_B \approx 100$  mA

FOR  $t_d$  AND  $t_r$ ,  $D_1$  IS DISCONNECTED AND  $V_2 = 0$

$t_r, t_f \leq 10$  ns

DUTY CYCLE = 1.0%

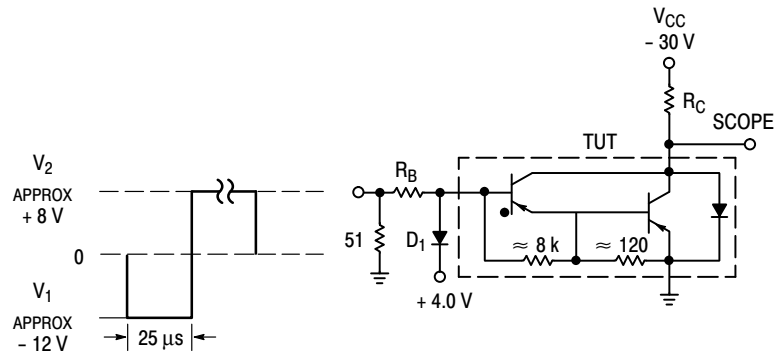


Figure 2. Switching Times Test Circuit

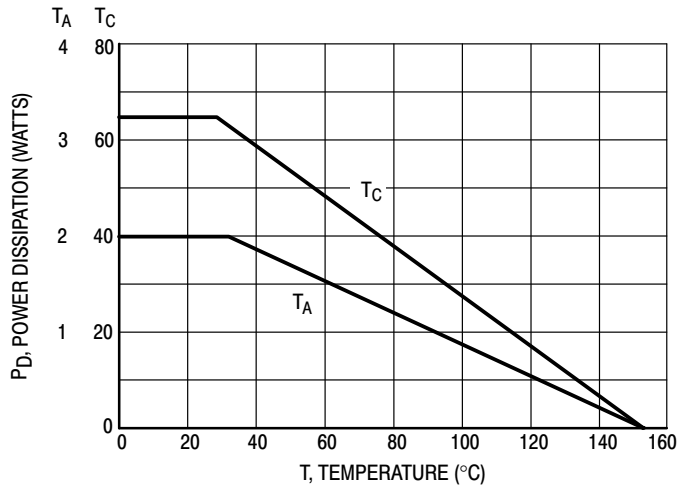


Figure 3. Power Derating

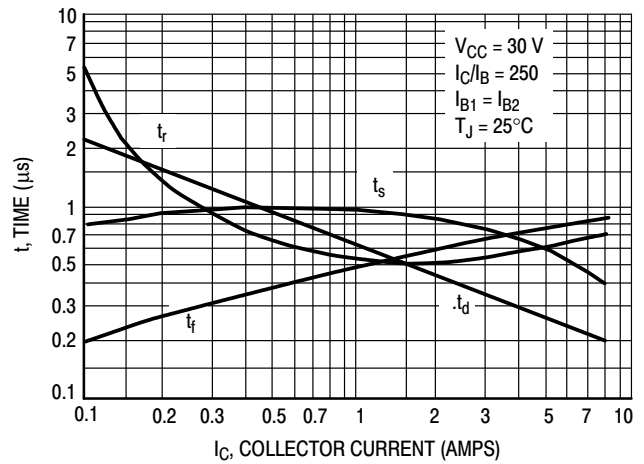


Figure 4. Typical Switching Times

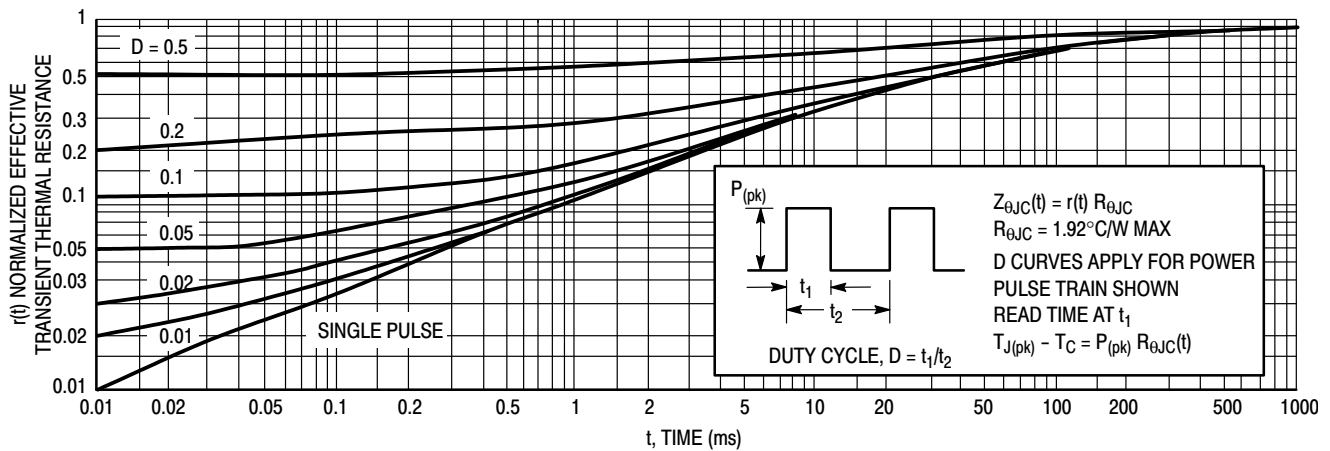


Figure 5. Thermal Response

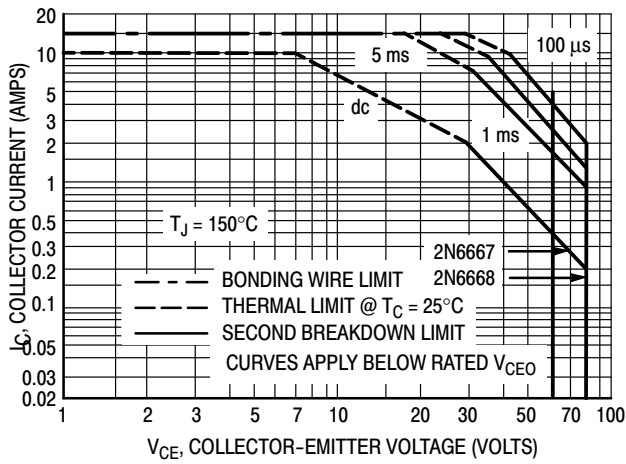


Figure 6. Maximum Safe Operating Area

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.

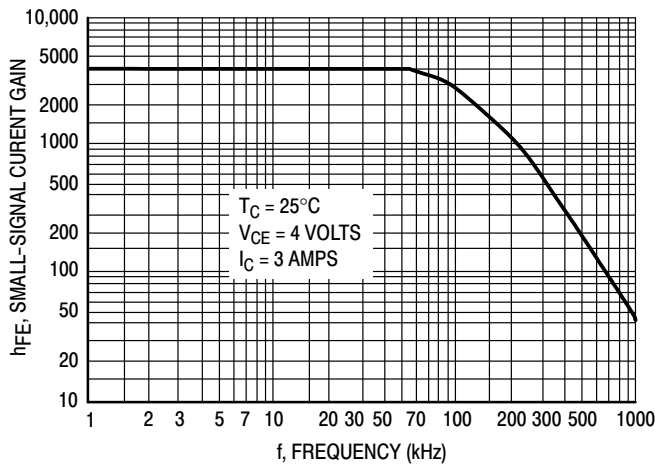


Figure 7. Typical Small-Signal Current Gain

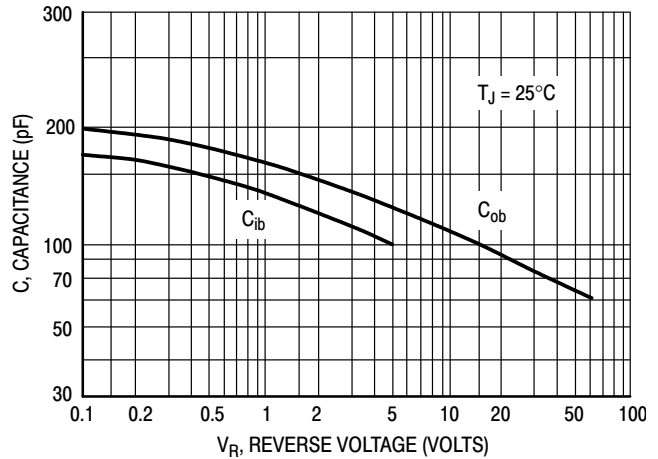


Figure 8. Typical Capacitance

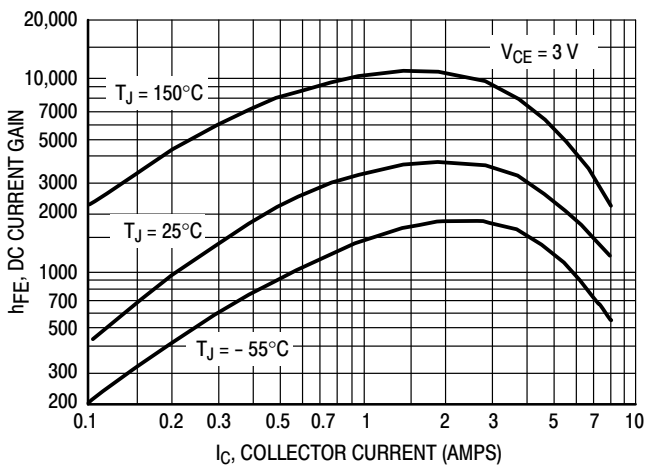


Figure 9. Typical DC Current Gain

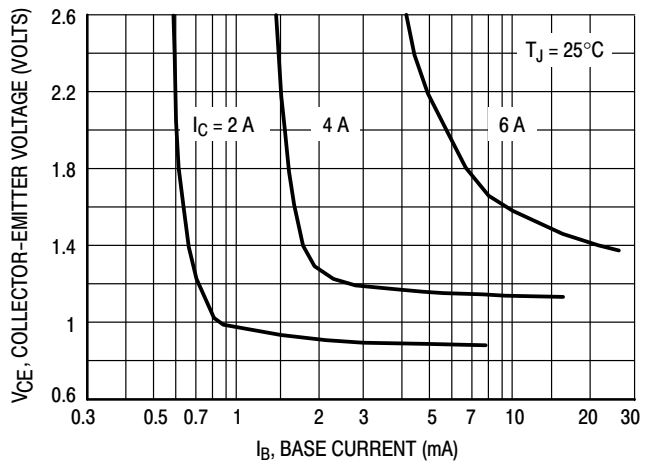


Figure 10. Typical Collector Saturation Region

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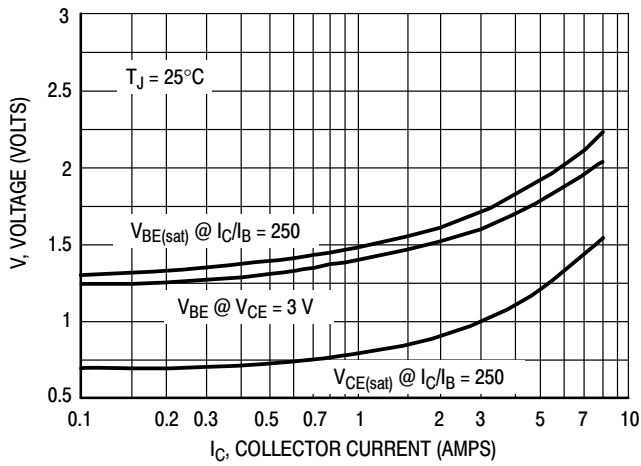


Figure 11. Typical "On" Voltages

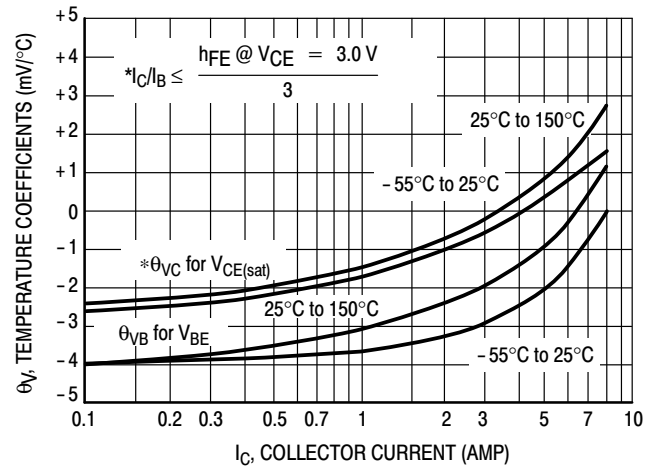


Figure 12. Typical Temperature Coefficients

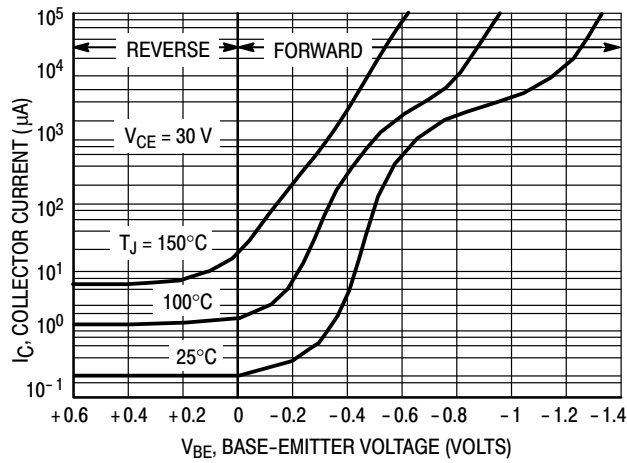
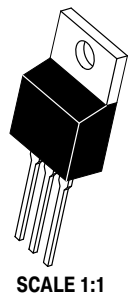


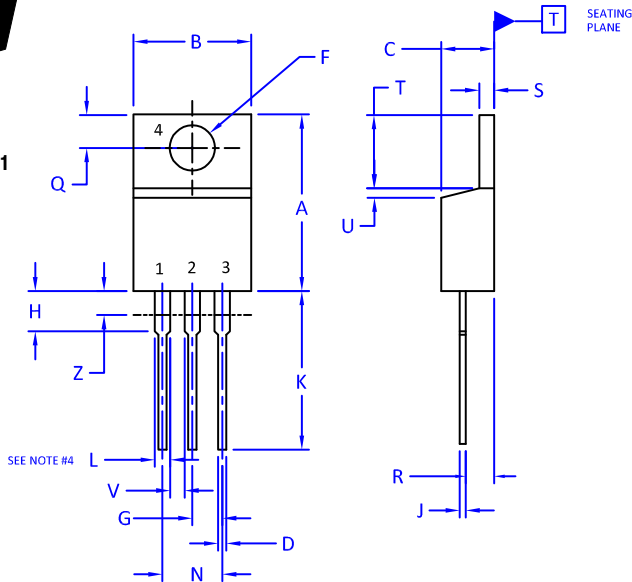
Figure 13. Typical Collector Cut-Off Region

# MECHANICAL CASE OUTLINE PACKAGE DIMENSIONS



## TO-220 CASE 221A ISSUE AK

DATE 13 JAN 2022



### 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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