

# Complementary Darlington Power Transistors

## DPAK For Surface Mount Applications

Designed for general purpose power and switching such as output or driver stages in applications such as switching regulators, converters, and power amplifiers.

- Lead Formed for Surface Mount Applications in Plastic Sleeves (No Suffix)
- Straight Lead Version in Plastic Sleeves ("1" Suffix)
- Lead Formed Version in 16 mm Tape and Reel ("T4" Suffix)
- Surface Mount Replacements for TIP110–TIP117 Series
- Monolithic Construction With Built-in Base–Emitter Shunt Resistors
- High DC Current Gain —

$$h_{FE} = 2500 \text{ (Typ) @ } I_C = 2.0 \text{ Adc}$$

- Complementary Pairs Simplifies Designs

### MAXIMUM RATINGS

| Rating                                                                                 | Symbol         | MJD112<br>MJD117 | Unit                         |
|----------------------------------------------------------------------------------------|----------------|------------------|------------------------------|
| Collector–Emitter Voltage                                                              | $V_{CEO}$      | 100              | Vdc                          |
| Collector–Base Voltage                                                                 | $V_{CB}$       | 100              | Vdc                          |
| Emitter–Base Voltage                                                                   | $V_{EB}$       | 5                | Vdc                          |
| Collector Current — Continuous<br>Peak                                                 | $I_C$          | 2<br>4           | Adc                          |
| Base Current                                                                           | $I_B$          | 50               | mAdc                         |
| Total Power Dissipation @ $T_C = 25^\circ\text{C}$<br>Derate above $25^\circ\text{C}$  | $P_D$          | 20<br>0.16       | Watts<br>W/ $^\circ\text{C}$ |
| Total Power Dissipation* @ $T_A = 25^\circ\text{C}$<br>Derate above $25^\circ\text{C}$ | $P_D$          | 1.75<br>0.014    | Watts<br>W/ $^\circ\text{C}$ |
| Operating and Storage Junction<br>Temperature Range                                    | $T_J, T_{stg}$ | –65 to +150      | $^\circ\text{C}$             |

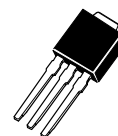
**NPN**  
**MJD112\***  
**PNP**  
**MJD117\***

\*ON Semiconductor Preferred Device

**SILICON**  
**POWER TRANSISTORS**  
**2 AMPERES**  
**100 VOLTS**  
**20 WATTS**

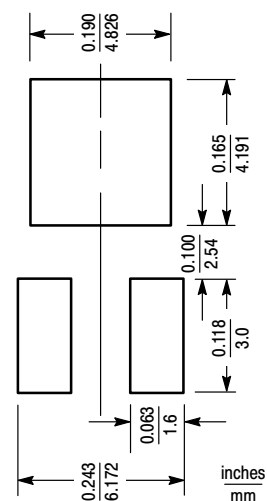


CASE 369A–13



CASE 369–07

### MINIMUM PAD SIZES RECOMMENDED FOR SURFACE MOUNTED APPLICATIONS



Preferred devices are ON Semiconductor recommended choices for future use and best overall value.

# MJD112 MJD117

## THERMAL CHARACTERISTICS

| Characteristic                           | Symbol          | Max  | Unit                 |
|------------------------------------------|-----------------|------|----------------------|
| Thermal Resistance, Junction to Case     | $R_{\theta JC}$ | 6.25 | $^{\circ}\text{C/W}$ |
| Thermal Resistance, Junction to Ambient* | $R_{\theta JA}$ | 71.4 | $^{\circ}\text{C/W}$ |

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

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

### OFF CHARACTERISTICS

|                                                                                  |               |     |    |                 |
|----------------------------------------------------------------------------------|---------------|-----|----|-----------------|
| Collector–Emitter Sustaining Voltage (1)<br>( $I_C = 30\text{ mA}$ , $I_B = 0$ ) | $V_{CE(sus)}$ | 100 | —  | Vdc             |
| Collector Cutoff Current<br>( $V_{CE} = 50\text{ Vdc}$ , $I_B = 0$ )             | $I_{CEO}$     | —   | 20 | $\mu\text{Adc}$ |
| Collector Cutoff Current<br>( $V_{CB} = 100\text{ Vdc}$ , $I_E = 0$ )            | $I_{CBO}$     | —   | 20 | $\mu\text{Adc}$ |
| Emitter Cutoff Current<br>( $V_{BE} = 5\text{ Vdc}$ , $I_C = 0$ )                | $I_{EBO}$     | —   | 2  | mAdc            |
| Collector–Cutoff Current ( $V_{CB} = 80\text{ Vdc}$ , $I_E = 0$ )                | $I_{CBO}$     | —   | 10 | $\mu\text{Adc}$ |
| Emitter–Cutoff Current ( $V_{BE} = 5\text{ Vdc}$ , $I_C = 0$ )                   | $I_{EBO}$     | —   | 2  | mAdc            |

### ON CHARACTERISTICS

|                                                                                                                                                                                     |               |                    |                  |     |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|--------------------|------------------|-----|
| DC Current Gain<br>( $I_C = 0.5\text{ Adc}$ , $V_{CE} = 3\text{ Vdc}$ )<br>( $I_C = 2\text{ Adc}$ , $V_{CE} = 3\text{ Vdc}$ )<br>( $I_C = 4\text{ Adc}$ , $V_{CE} = 3\text{ Vdc}$ ) | $h_{FE}$      | 500<br>1000<br>200 | —<br>12,000<br>— | —   |
| Collector–Emitter Saturation Voltage<br>( $I_C = 2\text{ Adc}$ , $I_B = 8\text{ mAdc}$ )<br>( $I_C = 4\text{ Adc}$ , $I_B = 40\text{ mAdc}$ )                                       | $V_{CE(sat)}$ | —<br>—             | 2<br>3           | Vdc |
| Base–Emitter Saturation Voltage ( $I_C = 4\text{ Adc}$ , $I_B = 40\text{ mAdc}$ )                                                                                                   | $V_{BE(sat)}$ | —                  | 4                | Vdc |
| Base–Emitter On Voltage ( $I_C = 2\text{ Adc}$ , $V_{CE} = 3\text{ Vdc}$ )                                                                                                          | $V_{BE(on)}$  | —                  | 2.8              | Vdc |

### DYNAMIC CHARACTERISTICS

|                                                                                                                 |          |        |            |     |
|-----------------------------------------------------------------------------------------------------------------|----------|--------|------------|-----|
| Current–Gain — Bandwidth Product<br>( $I_C = 0.75\text{ Adc}$ , $V_{CE} = 10\text{ Vdc}$ , $f = 1\text{ MHz}$ ) | $f_T$    | 25     | —          | MHz |
| Output Capacitance<br>( $V_{CB} = 10\text{ Vdc}$ , $I_E = 0$ , $f = 0.1\text{ MHz}$ )                           | $C_{ob}$ | —<br>— | 200<br>100 | pF  |

(1) Pulse Test: Pulse Width  $\leq 300\text{ }\mu\text{s}$ , Duty Cycle  $\leq 2\%$ .

\*These ratings are applicable when surface mounted on the minimum pad sizes recommended.

# MJD112 MJD117

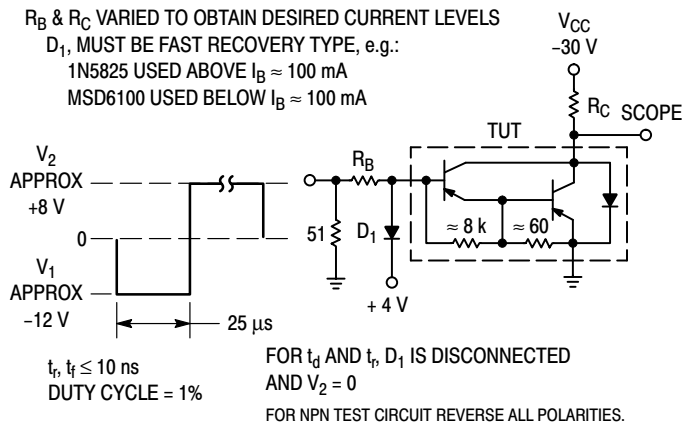


Figure 1. Switching Times Test Circuit

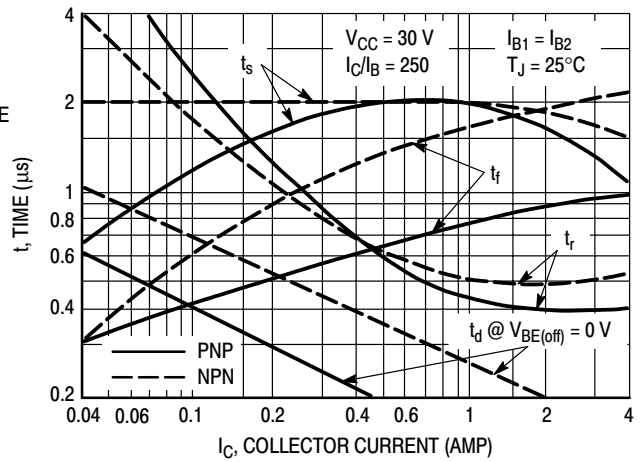


Figure 2. Switching Times

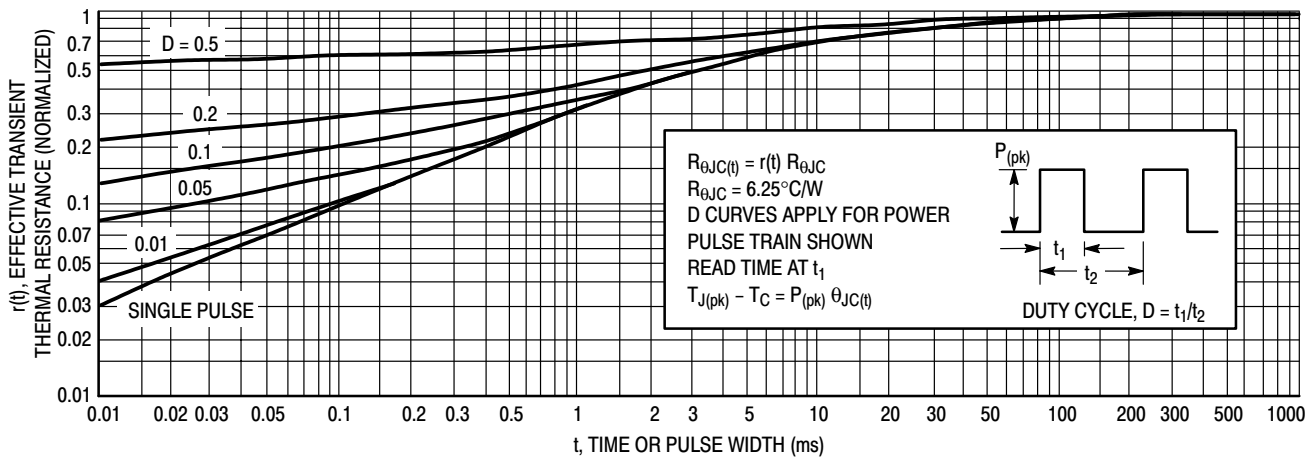


Figure 3. Thermal Response

ACTIVE-REGION SAFE-OPERATING AREA

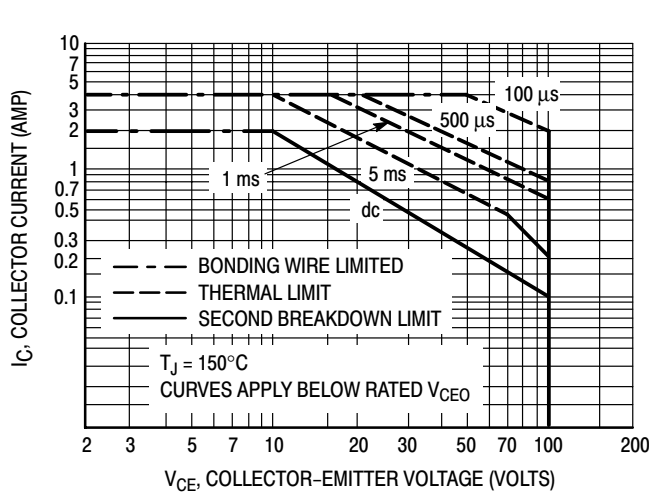


Figure 4. Maximum Rated Forward Biased Safe Operating Area

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 Figures 5 and 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 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.

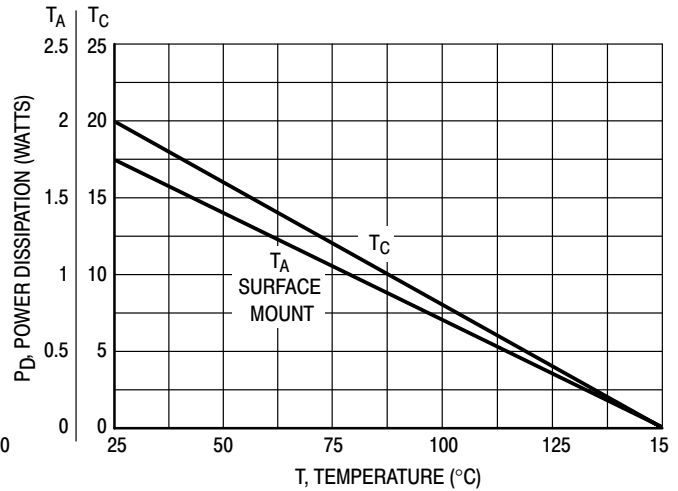


Figure 5. Power Derating

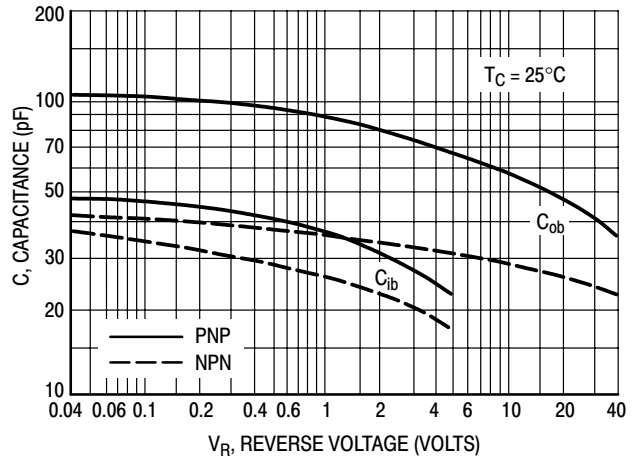
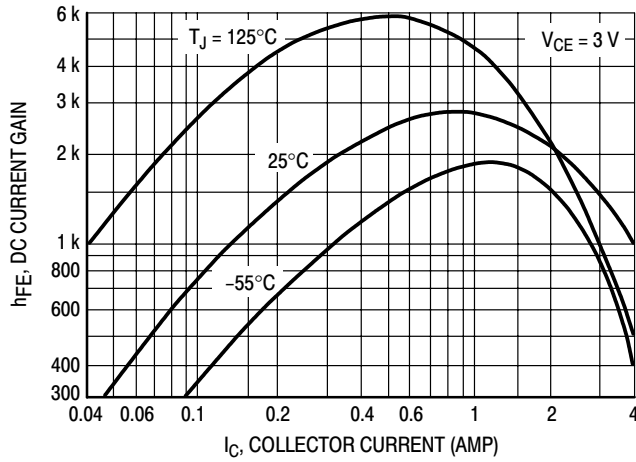


Figure 6. Capacitance

TYPICAL ELECTRICAL CHARACTERISTICS

NPN MJD112



PNP MJD117

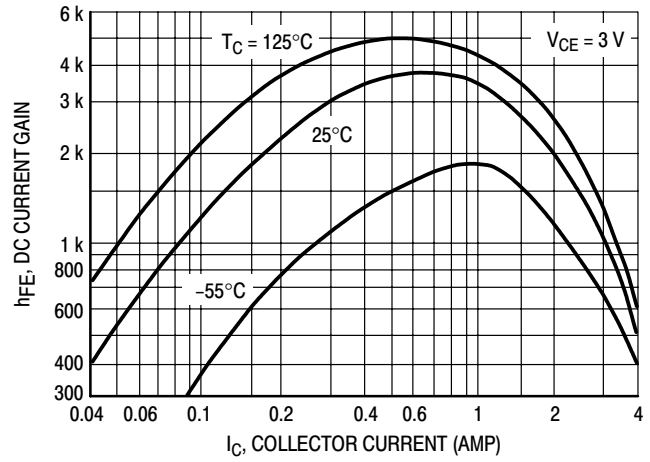


Figure 7. DC Current Gain

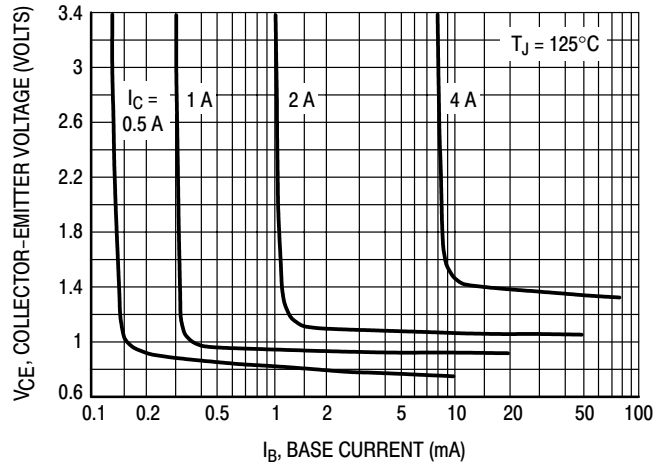
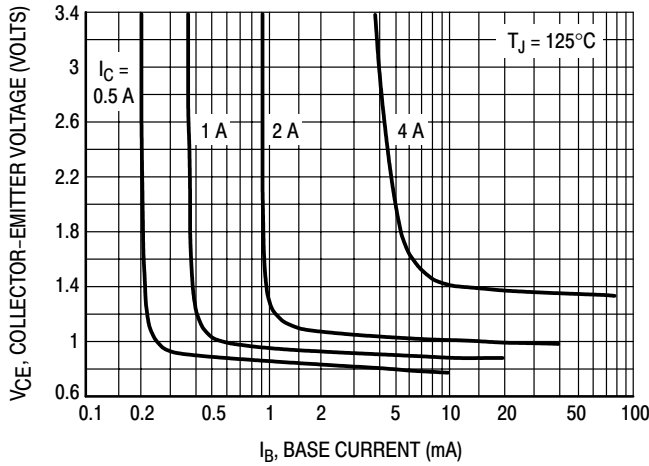


Figure 8. Collector Saturation Region

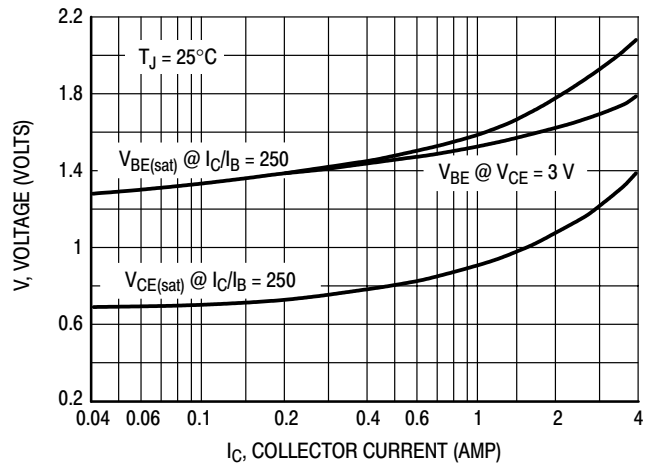
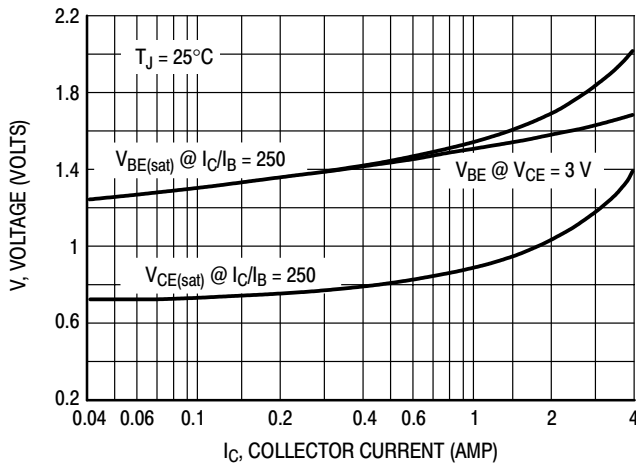
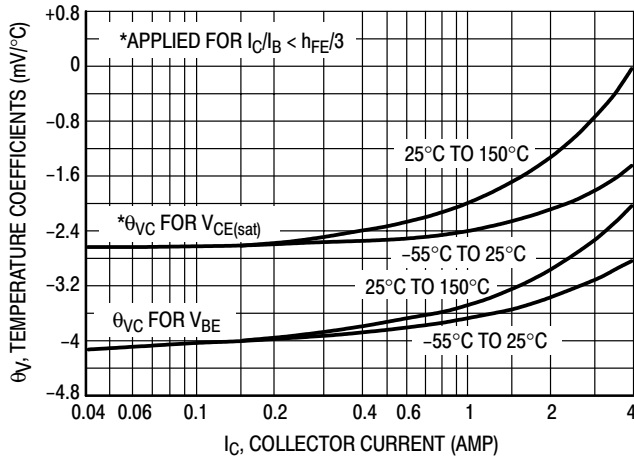


Figure 9. "On Voltages"

NPN MJD112



PNP MJD117

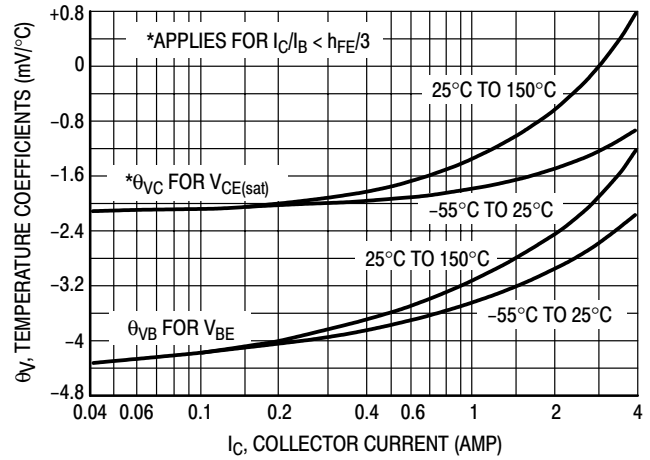


Figure 10. Temperature Coefficients

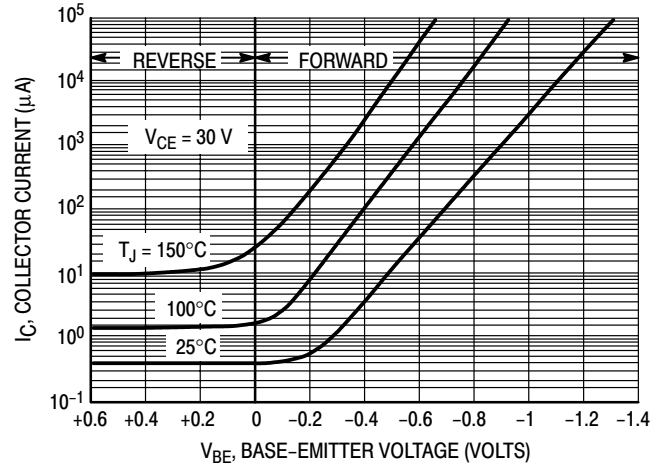
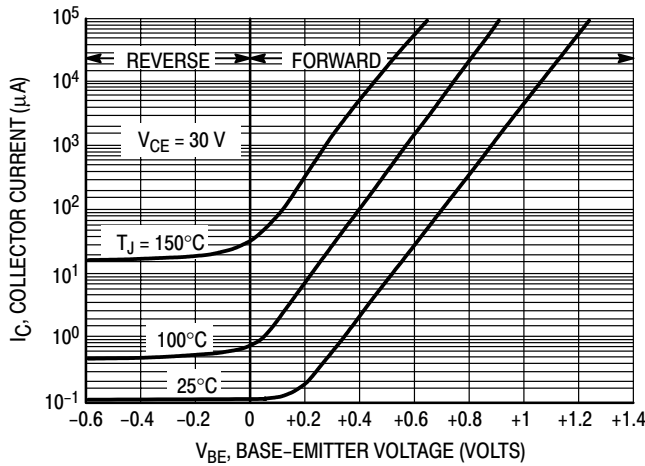


Figure 11. Collector Cut-Off Region

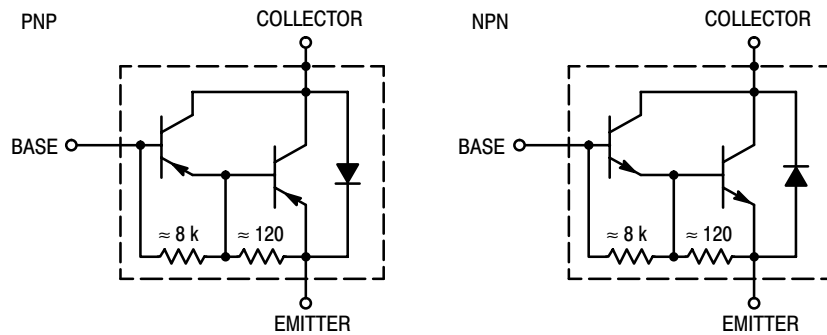
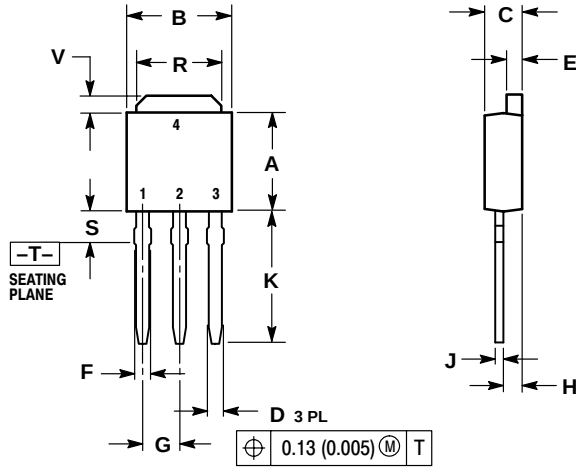


Figure 12. Darlington Schematic

# MJD112 MJD117

## PACKAGE DIMENSIONS

### DPAK CASE 369-07 ISSUE M



#### NOTES:

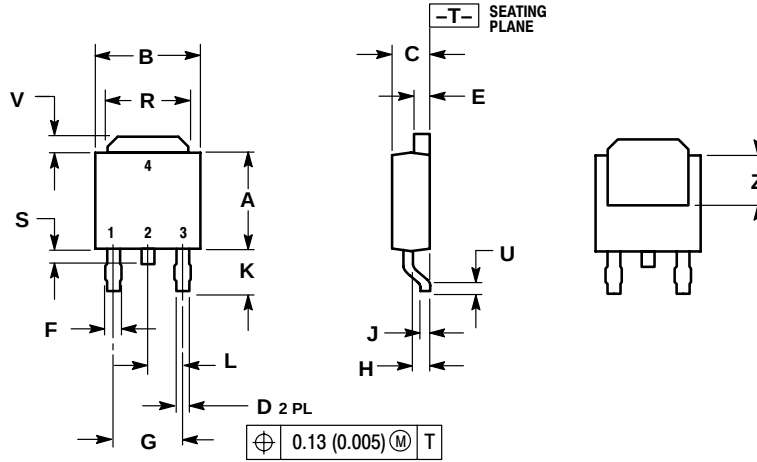
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.

| DIM | INCHES    |       | MILLIMETERS |      |
|-----|-----------|-------|-------------|------|
|     | MIN       | MAX   | MIN         | MAX  |
| A   | 0.235     | 0.250 | 5.97        | 6.35 |
| B   | 0.250     | 0.265 | 6.35        | 6.73 |
| C   | 0.086     | 0.094 | 2.19        | 2.38 |
| D   | 0.027     | 0.035 | 0.69        | 0.88 |
| E   | 0.033     | 0.040 | 0.84        | 1.01 |
| F   | 0.037     | 0.047 | 0.94        | 1.19 |
| G   | 0.090 BSC |       | 2.29 BSC    |      |
| H   | 0.034     | 0.040 | 0.87        | 1.01 |
| J   | 0.018     | 0.023 | 0.46        | 0.58 |
| K   | 0.350     | 0.380 | 8.89        | 9.65 |
| R   | 0.175     | 0.215 | 4.45        | 5.46 |
| S   | 0.050     | 0.090 | 1.27        | 2.28 |
| V   | 0.030     | 0.050 | 0.77        | 1.27 |

# MJD112 MJD117

## PACKAGE DIMENSIONS

### DPAK CASE 369A-13 ISSUE AA



- NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
  2. CONTROLLING DIMENSION: INCH.

| DIM | INCHES    |       | MILLIMETERS |      |
|-----|-----------|-------|-------------|------|
|     | MIN       | MAX   | MIN         | MAX  |
| A   | 0.235     | 0.250 | 5.97        | 6.35 |
| B   | 0.250     | 0.265 | 6.35        | 6.73 |
| C   | 0.086     | 0.094 | 2.19        | 2.38 |
| D   | 0.027     | 0.035 | 0.69        | 0.88 |
| E   | 0.033     | 0.040 | 0.84        | 1.01 |
| F   | 0.037     | 0.047 | 0.94        | 1.19 |
| G   | 0.180 BSC |       | 4.58 BSC    |      |
| H   | 0.034     | 0.040 | 0.87        | 1.01 |
| J   | 0.018     | 0.023 | 0.46        | 0.58 |
| K   | 0.102     | 0.114 | 2.60        | 2.89 |
| L   | 0.090 BSC |       | 2.29 BSC    |      |
| R   | 0.175     | 0.215 | 4.45        | 5.46 |
| S   | 0.020     | 0.050 | 0.51        | 1.27 |
| U   | 0.020     | ---   | 0.51        | ---  |
| V   | 0.030     | 0.050 | 0.77        | 1.27 |
| Z   | 0.138     | ---   | 3.51        | ---  |

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