

# Complementary Darlington Power Transistors

## DPAK For Surface Mount Applications

Designed for general purpose amplifier and low speed switching applications.

- Lead Formed for Surface Mount Applications in Plastic Sleeves (No Suffix)
- Straight Lead Version in Plastic Sleeves ("–1" Suffix)
- Lead Formed Version Available in 16 mm Tape and Reel ("T4" Suffix)
- Surface Mount Replacements for 2N6040–2N6045 Series, TIP120–TIP122 Series, and TIP125–TIP127 Series
- Monolithic Construction With Built-in Base-Emitter Shunt Resistors
- High DC Current Gain —  $h_{FE} = 2500$  (Typ) @  $I_C = 4.0$  Adc
- Complementary Pairs Simplifies Designs

### MAXIMUM RATINGS

Rating	Symbol	MJD122 MJD127	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 Peak	$I_C$	8 16	Adc
Base Current	$I_B$	120	mAdc
Total Power Dissipation @ $T_C = 25^\circ\text{C}$ Derate above $25^\circ\text{C}$	$P_D$	20 0.16	Watts W/ $^\circ\text{C}$
Total Power Dissipation* @ $T_A = 25^\circ\text{C}$ Derate above $25^\circ\text{C}$	$P_D$	1.75 0.014	Watts 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	$R_{\theta JC}$	6.25	$^\circ\text{C}/\text{W}$
Thermal Resistance, Junction to Ambient*	$R_{\theta JA}$	71.4	$^\circ\text{C}/\text{W}$

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

Characteristic	Symbol	Min	Max	Unit
Collector-Emitter Sustaining Voltage ( $I_C = 30$ mAdc, $I_B = 0$ )	$V_{CEO(sus)}$	100	—	Vdc
Collector Cutoff Current ( $V_{CE} = 50$ Vdc, $I_B = 0$ )	$I_{CEO}$	—	10	$\mu\text{Adc}$

### OFF CHARACTERISTICS

Collector-Emitter Sustaining Voltage ( $I_C = 30$ mAdc, $I_B = 0$ )	$V_{CEO(sus)}$	100	—	Vdc
Collector Cutoff Current ( $V_{CE} = 50$ Vdc, $I_B = 0$ )	$I_{CEO}$	—	10	$\mu\text{Adc}$

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

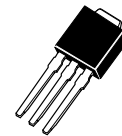
**NPN**  
**MJD122\***  
**PNP**  
**MJD127\***

\*Motorola Preferred Device

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

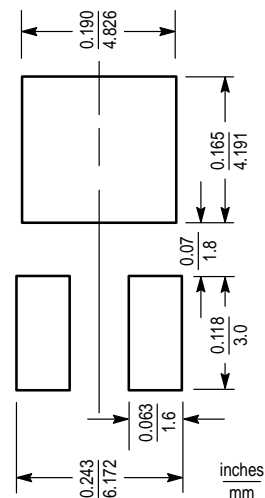


CASE 369A-13



CASE 369-07

### MINIMUM PAD SIZES RECOMMENDED FOR SURFACE MOUNTED APPLICATIONS



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

REV 1

# MJD122 MJD127

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

Characteristic	Symbol	Min	Max	Unit
<b>OFF CHARACTERISTICS — continued</b>				
Collector Cutoff Current ( $V_{CE} = 100\text{ Vdc}$ , $V_{BE(\text{off})} = 1.5\text{ Vdc}$ ) ( $V_{CE} = 100\text{ Vdc}$ , $V_{BE(\text{off})} = 1.5\text{ Vdc}$ , $T_C = 125^\circ\text{C}$ )	$I_{CEX}$	—	10 500	$\mu\text{Adc}$
Collector Cutoff Current ( $V_{CB} = 100\text{ Vdc}$ , $I_E = 0$ )	$I_{CBO}$	—	10	$\mu\text{Adc}$
Emitter Cutoff Current ( $V_{BE} = 5\text{ Vdc}$ , $I_C = 0$ )	$I_{EBO}$	—	2	$\text{mAdc}$

## ON CHARACTERISTICS

DC Current Gain ( $I_C = 4\text{ Adc}$ , $V_{CE} = 4\text{ Vdc}$ ) ( $I_C = 8\text{ Adc}$ , $V_{CE} = 4\text{ Vdc}$ )	$h_{FE}$	1000 100	12,000 —	—
Collector–Emitter Saturation Voltage ( $I_C = 4\text{ Adc}$ , $I_B = 16\text{ mAdc}$ ) ( $I_C = 8\text{ Adc}$ , $I_B = 80\text{ mAdc}$ )	$V_{CE(\text{sat})}$	— —	2 4	$\text{Vdc}$
Base–Emitter Saturation Voltage (1) ( $I_C = 8\text{ Adc}$ , $I_B = 80\text{ mAdc}$ )	$V_{BE(\text{sat})}$	—	4.5	$\text{Vdc}$
Base–Emitter On Voltage ( $I_C = 4\text{ Adc}$ , $V_{CE} = 4\text{ Vdc}$ )	$V_{BE(\text{on})}$	—	2.8	$\text{Vdc}$

## DYNAMIC CHARACTERISTICS

Current–Gain–Bandwidth Product ( $I_C = 3\text{ Adc}$ , $V_{CE} = 4\text{ Vdc}$ , $f = 1\text{ MHz}$ )	$ h_{fe} $	4	—	$\text{MHz}$
Output Capacitance ( $V_{CB} = 10\text{ Vdc}$ , $I_E = 0$ , $f = 0.1\text{ MHz}$ )	$C_{ob}$	— —	300 200	$\text{pF}$
Small–Signal Current Gain ( $I_C = 3\text{ Adc}$ , $V_{CE} = 4\text{ Vdc}$ , $f = 1\text{ kHz}$ )	$h_{fe}$	300	—	—

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

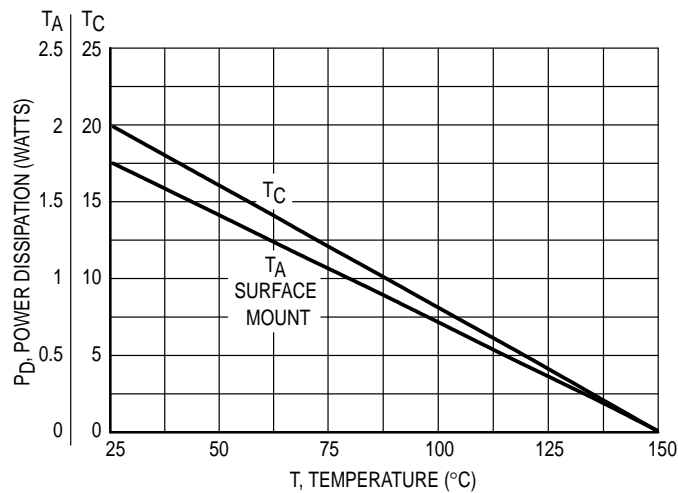


Figure 1. Power Derating

TYPICAL ELECTRICAL CHARACTERISTICS

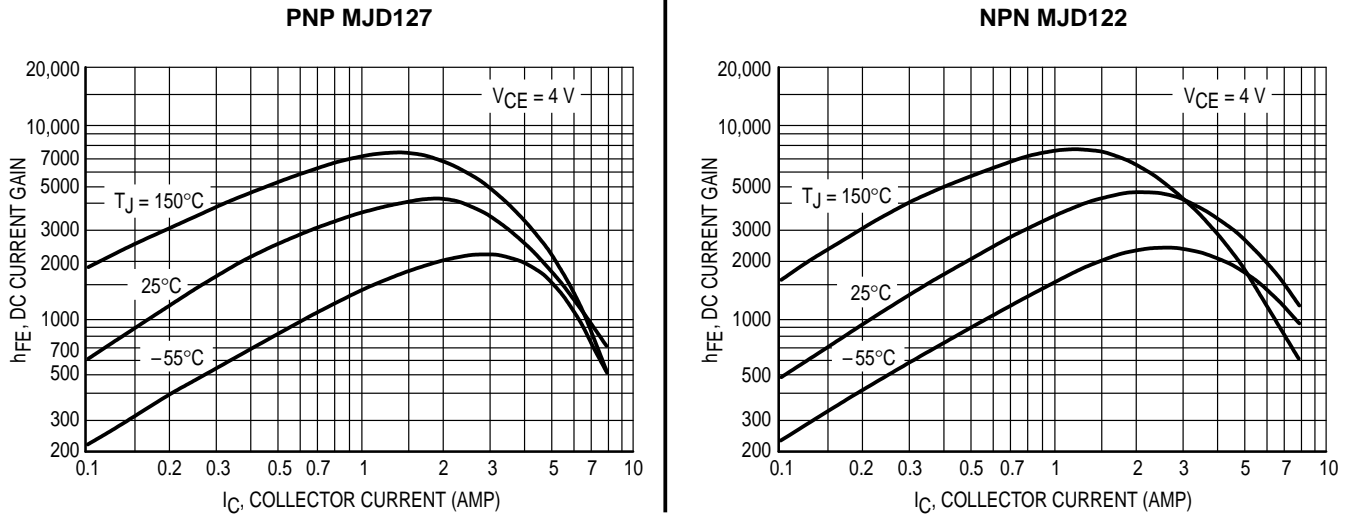


Figure 2. DC Current Gain

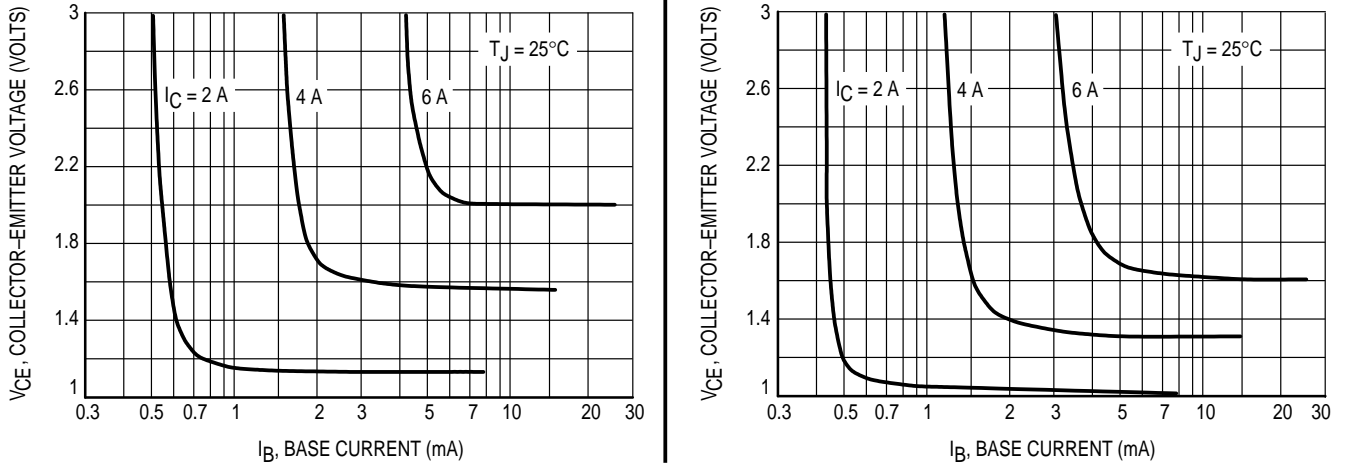


Figure 3. Collector Saturation Region

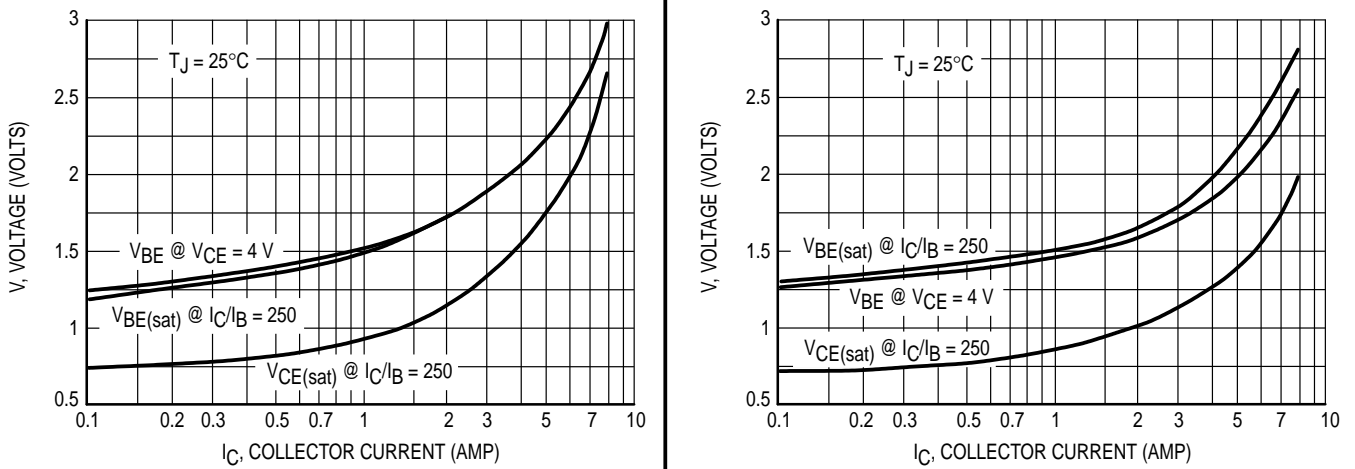


Figure 4. "On" Voltages

TYPICAL ELECTRICAL CHARACTERISTICS

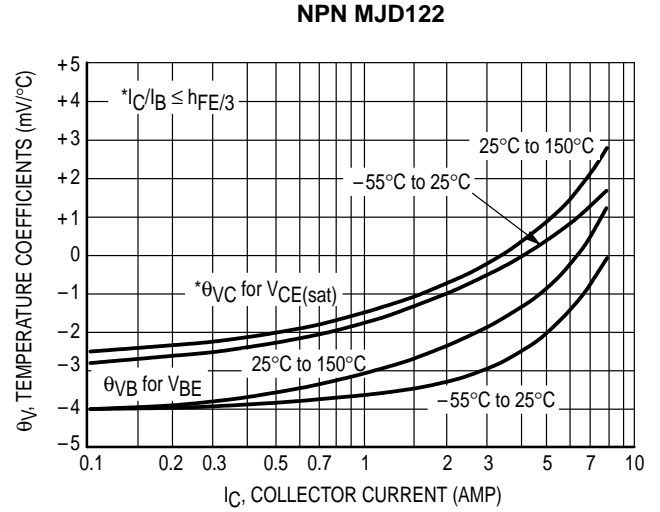
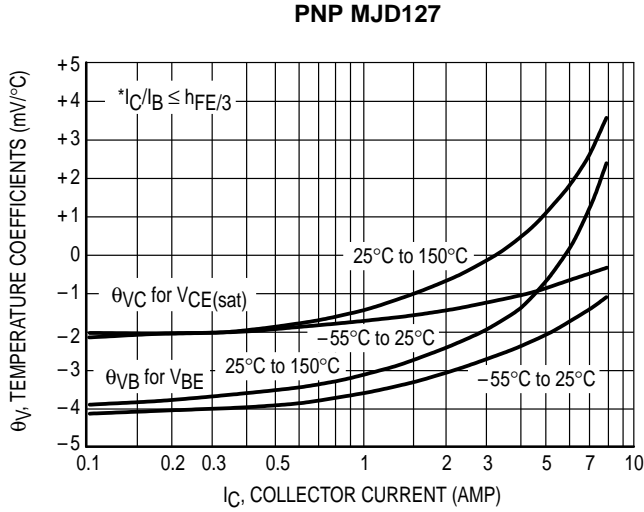


Figure 5. Temperature Coefficients

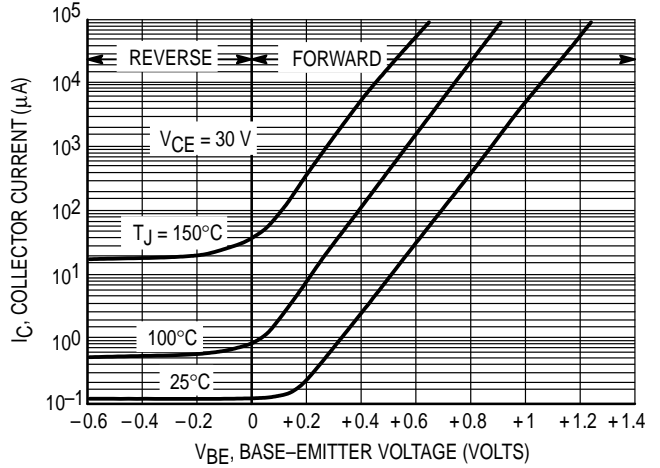
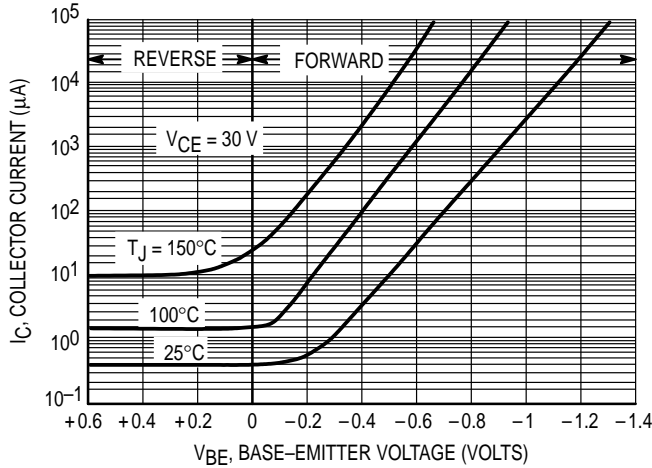


Figure 6. Collector Cut-Off Region

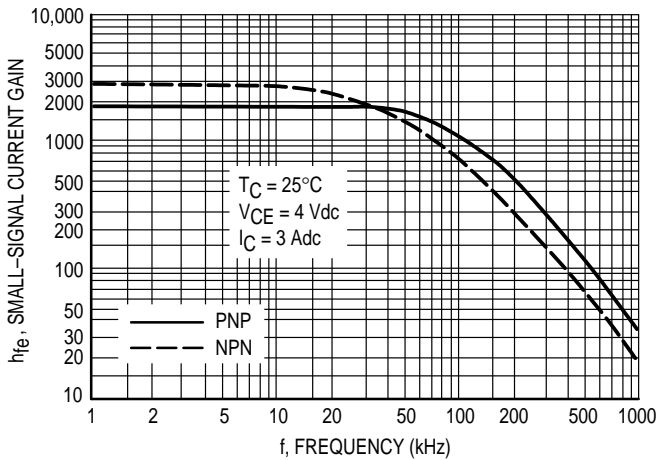


Figure 7. Small-Signal Current Gain

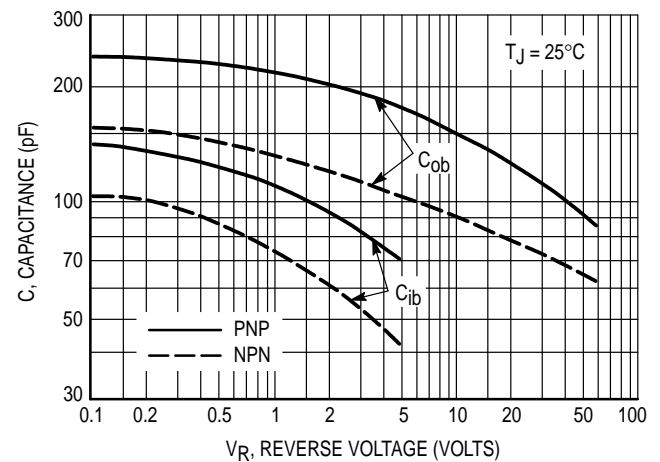


Figure 8. Capacitance

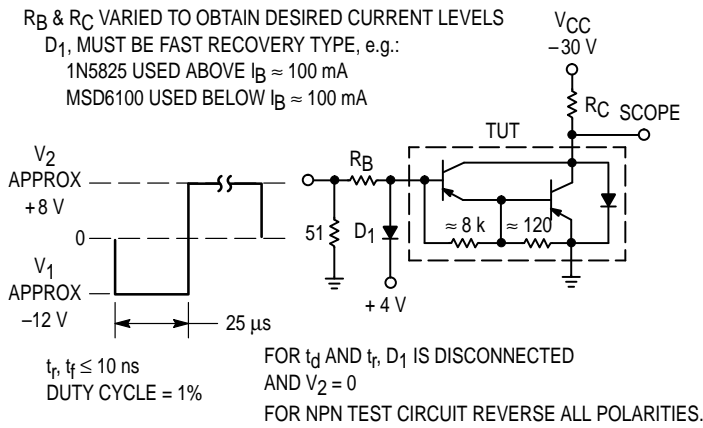


Figure 9. Switching Times Test Circuit

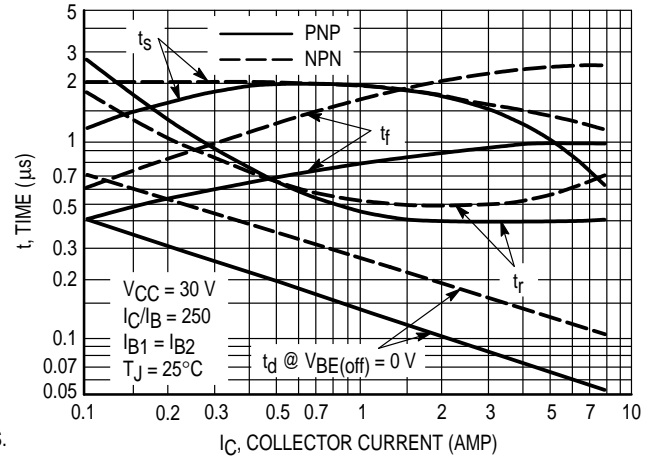


Figure 10. Switching Times

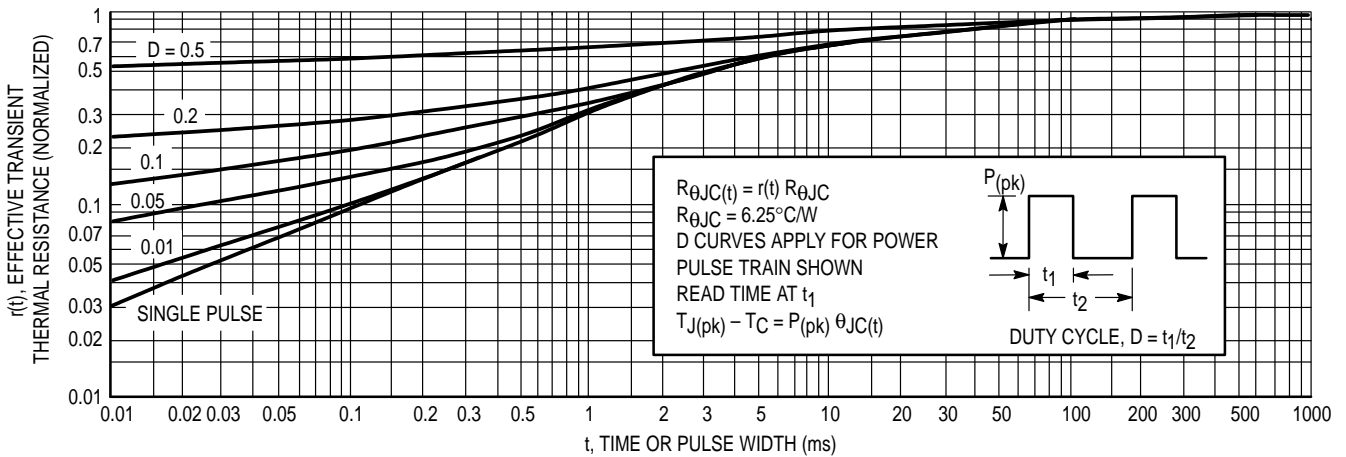


Figure 11. Thermal Response

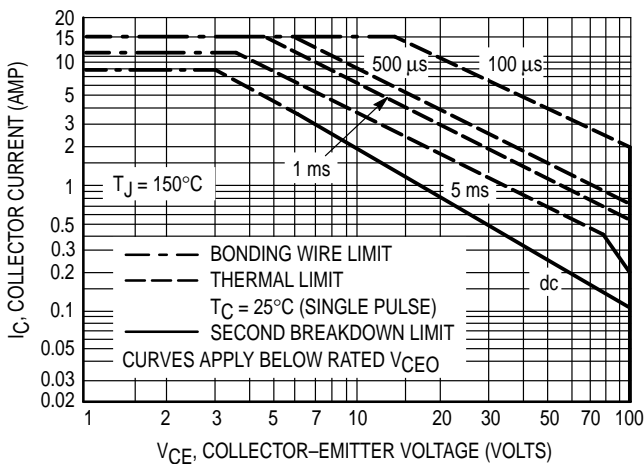


Figure 12. Maximum Forward Bias Safe Operating Area

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 12 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 11. At high case temperatures, thermal limitations will reduce the power that can be handled to values less than the limitations imposed by second breakdown.

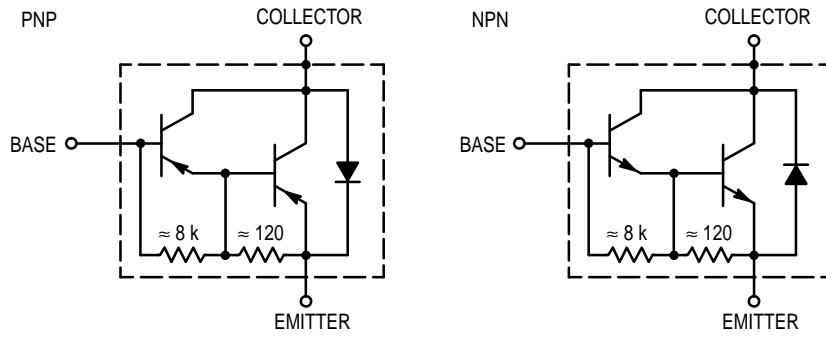
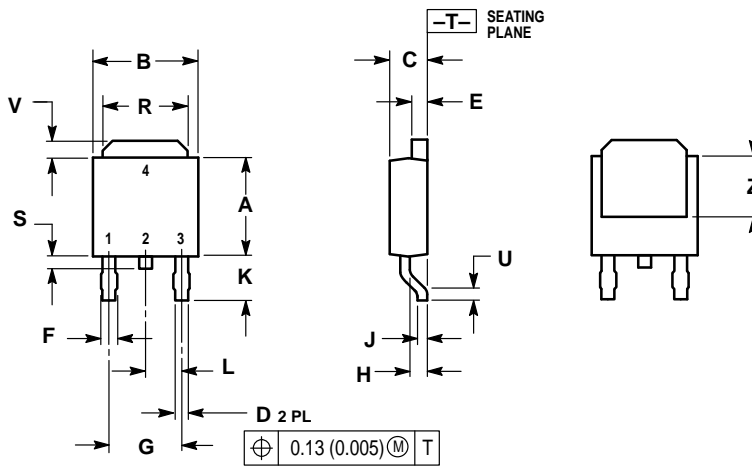


Figure 13. Darlington Schematic

PACKAGE DIMENSIONS

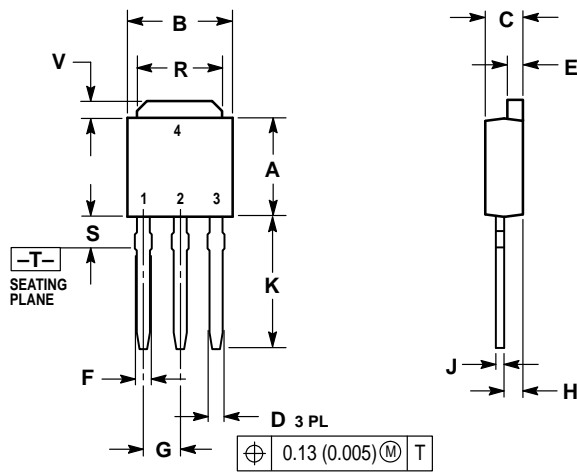


- NOTES:  
 1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.  
 2. CONTROLLING DIMENSION: INCH.

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	—

- STYLE 1:  
 PIN 1. BASE  
 2. COLLECTOR  
 3. EMITTER  
 4. COLLECTOR

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 ISSUE W




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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

- STYLE 1:  
 PIN 1. BASE  
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CASE 369-07  
 ISSUE K

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