

# Complementary 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 ("L" Suffix)
- Lead Formed Version Available in 16 mm Tape and Reel ("T4" Suffix)
- Electrically Similar to MJE2955 and MJE3055
- DC Current Gain Specified to 10 Amperes
- High Current Gain-Bandwidth Product —  $f_T = 2.0 \text{ MHz (Min) @ } I_C = 500 \text{ mAdc}$

### MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Collector-Emitter Voltage	$V_{CEO}$	60	Vdc
Collector-Base Voltage	$V_{CB}$	70	Vdc
Emitter-Base Voltage	$V_{EB}$	5	Vdc
Collector Current	$I_C$	10	Adc
Base Current	$I_B$	6	Adc
Total Power Dissipation @ $T_C = 25^\circ\text{C}$ Derate above $25^\circ\text{C}$	$P_{DT}$	20 0.16	Watts W/ $^\circ\text{C}$
Total Power Dissipation (1) @ $T_A = 25^\circ\text{C}$ Derate above $25^\circ\text{C}$	$P_D$	1.75 0.014	Watts W/ $^\circ\text{C}$
Operating and Storage Junction Temperature Range	$T_J, T_{stg}$	-55 to +150	$^\circ\text{C}$

### 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 (1)	$R_{\theta JA}$	71.4	$^\circ\text{C/W}$

(1) These ratings are applicable when surface mounted on the minimum pad sizes recommended.  
†Safe Area Curves are indicated by Figure 1. Both limits are applicable and must be observed.

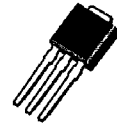
**NPN**  
**MJD2955**  
**PNP**  
**MJD3055**

\*Motorola Preferred Device

**SILICON**  
**POWER TRANSISTORS**  
**10 AMPERES**  
**60 VOLTS**  
**20 WATTS**

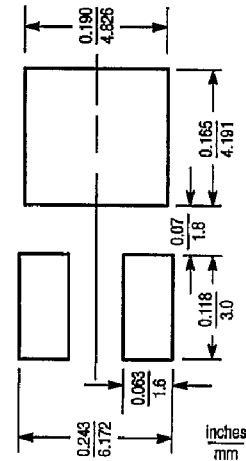


CASE 369A-13



CASE 369-07

### MINIMUM PAD SIZES RECOMMENDED FOR SURFACE MOUNTED APPLICATIONS



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

Characteristic	Symbol	Min	Max	Unit
<b>OFF CHARACTERISTICS</b>				
Collector-Emitter Sustaining Voltage (1) ( $I_C = 30\text{ mAdc}$ , $I_B = 0$ )	$V_{CEO(sus)}$	60	—	Vdc
Collector Cutoff Current ( $V_{CE} = 30\text{ Vdc}$ , $I_B = 0$ )	$I_{CEO}$	—	50	$\mu\text{Adc}$
Collector Cutoff Current ( $V_{CE} = 70\text{ Vdc}$ , $V_{EB(off)} = 1.5\text{ Vdc}$ ) ( $V_{CE} = 70\text{ Vdc}$ , $V_{EB(off)} = 1.5\text{ Vdc}$ , $T_C = 150^\circ\text{C}$ )	$I_{CEX}$	—	0.02 2	mAdc
Collector Cutoff Current ( $V_{CB} = 70\text{ Vdc}$ , $I_E = 0$ ) ( $V_{CB} = 70\text{ Vdc}$ , $I_E = 0$ , $T_C = 150^\circ\text{C}$ )	$I_{CBO}$	—	0.02 2	mAdc
Emitter Cutoff Current ( $V_{BE} = 5\text{ Vdc}$ , $I_C = 0$ )	$I_{EBO}$	—	0.5	mAdc
<b>ON CHARACTERISTICS</b>				
DC Current Gain (1) ( $I_C = 4\text{ Adc}$ , $V_{CE} = 4\text{ Vdc}$ ) ( $I_C = 10\text{ Adc}$ , $V_{CE} = 4\text{ Vdc}$ )	$h_{FE}$	20 5	100 —	—
Collector-Emitter Saturation Voltage (1) ( $I_C = 4\text{ Adc}$ , $I_B = 0.4\text{ Adc}$ ) ( $I_C = 10\text{ Adc}$ , $I_B = 3.3\text{ Adc}$ )	$V_{CE(sat)}$	—	1.1 8	Vdc
Base-Emitter On Voltage (1) ( $I_C = 4\text{ Adc}$ , $V_{CE} = 4\text{ Vdc}$ )	$V_{BE(on)}$	—	1.8	Vdc
<b>DYNAMIC CHARACTERISTICS</b>				
Current-Gain — Bandwidth Product ( $I_C = 500\text{ mAdc}$ , $V_{CE} = 10\text{ Vdc}$ , $f = 500\text{ kHz}$ )	$f_T$	2	—	MHz

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

TYPICAL CHARACTERISTICS

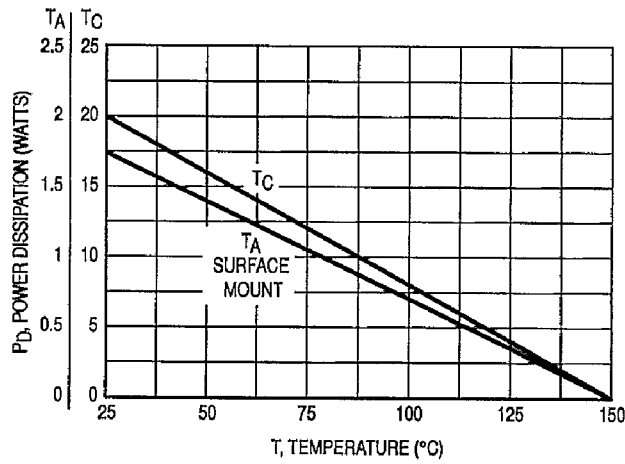


Figure 1. Power Derating

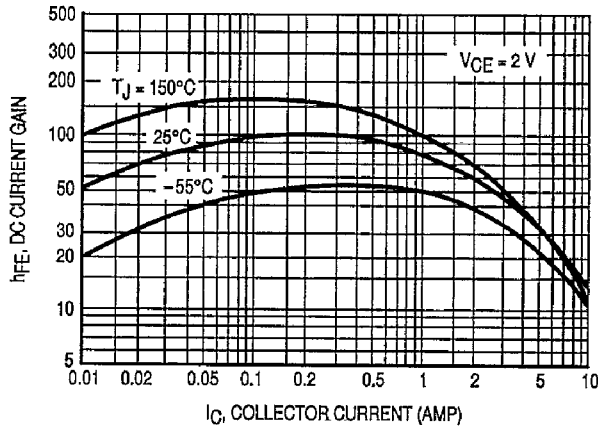


Figure 2. DC Current Gain

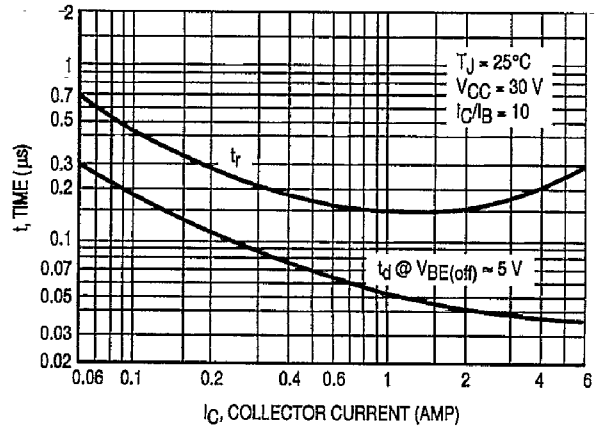


Figure 3. Turn-On Time

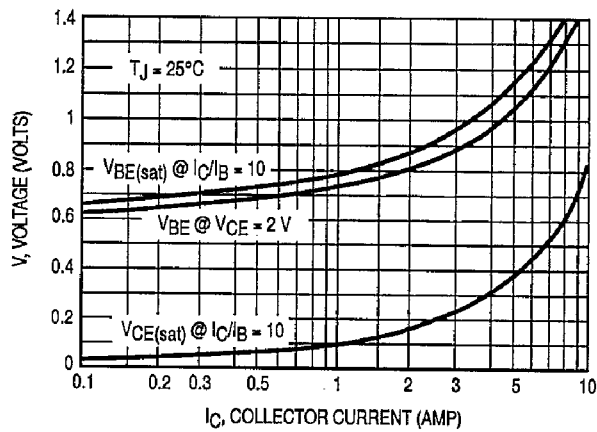


Figure 4. "On" Voltages, MJD3055

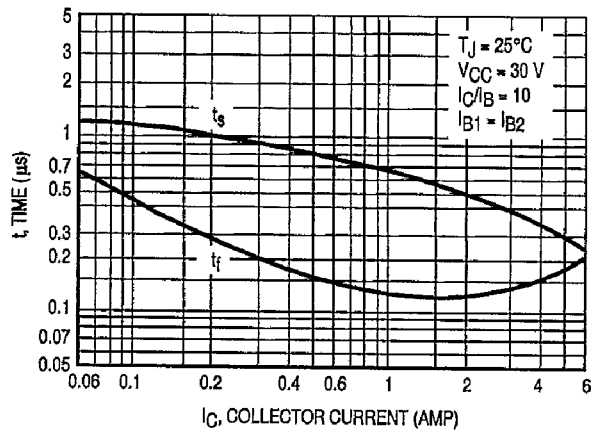


Figure 5. Turn-Off Time

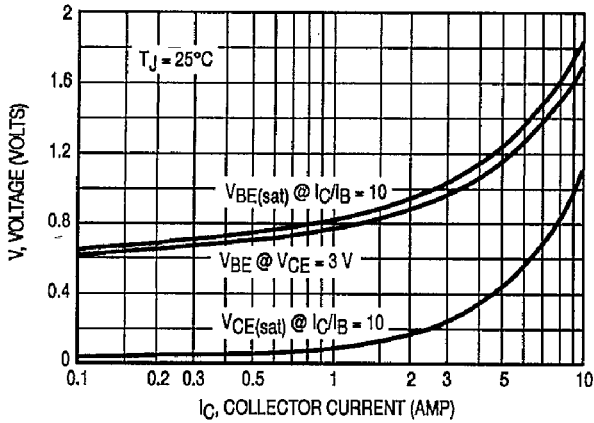


Figure 6. "On" Voltages, MJD2955

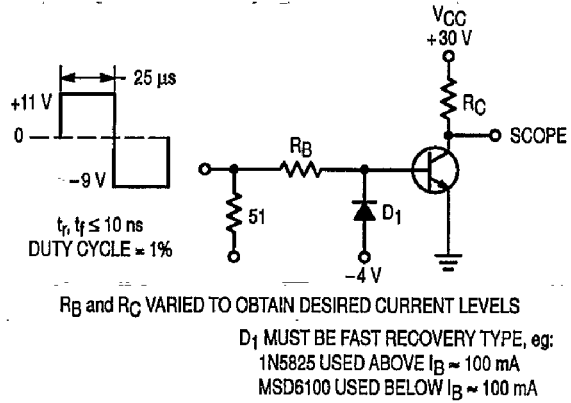


Figure 7. Switching Time Test Circuit

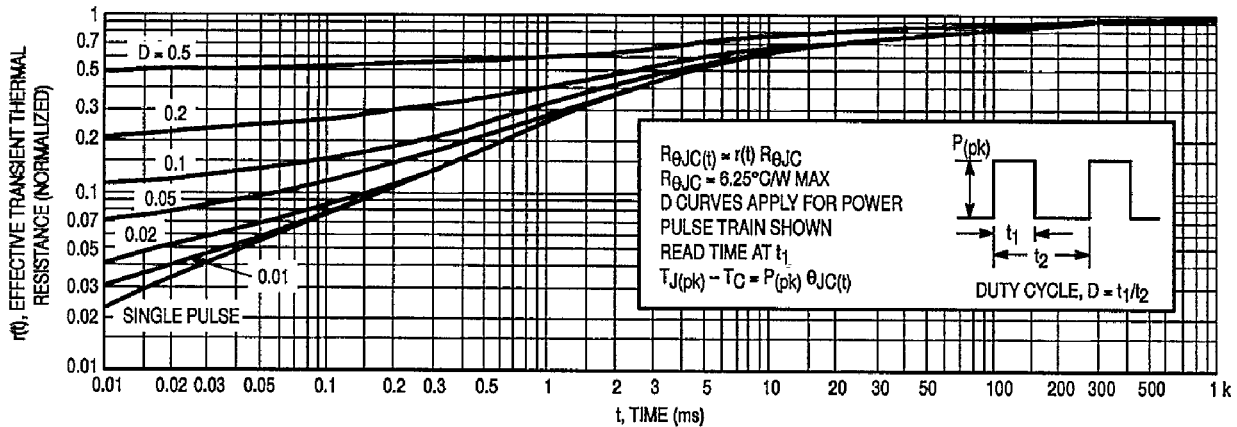


Figure 8. Thermal Response

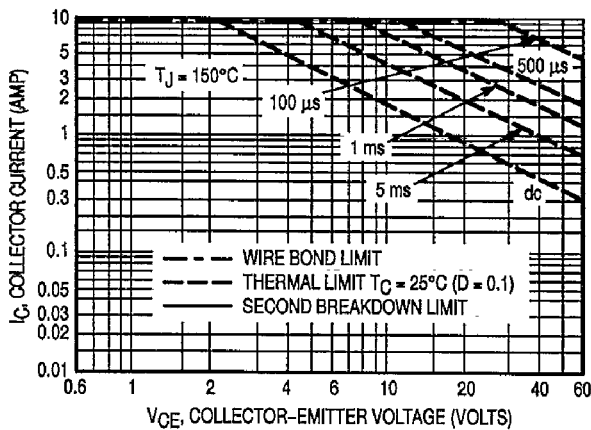


Figure 9. Maximum Forward Bias Safe Operating Area

**FORWARD BIAS SAFE OPERATING AREA INFORMATION**

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

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

Characteristic	Symbol	Min	Max	Unit
<b>ON CHARACTERISTICS (1)</b>				
DC Current Gain ( $I_C = 1 \text{ Adc}, V_{CE} = 4 \text{ Vdc}$ ) ( $I_C = 2 \text{ Adc}, V_{CE} = 4 \text{ Vdc}$ )	$h_{FE}$	1000 500	— —	—
Collector–Emitter Saturation Voltage ( $I_C = 2 \text{ Adc}, I_B = 8 \text{ mA}$ )	$V_{CE(sat)}$	—	2.5	Vdc
Base–Emitter On Voltage ( $I_C = 2 \text{ Adc}, V_{CE} = 4 \text{ Vdc}$ )	$V_{BE(on)}$	—	2.8	Vdc
<b>DYNAMIC CHARACTERISTICS</b>				
Small–Signal Current Gain ( $I_C = 0.75 \text{ Adc}, V_{CE} = 10 \text{ Vdc}, f = 1 \text{ kHz}$ )	$h_{fe}$	25	—	—
Output Capacitance ( $V_{CB} = 10 \text{ Vdc}, I_E = 0, f = 0.1 \text{ MHz}$ )	$C_{ob}$	— —	200 100	pF
	MJD6036 MJD6039			

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

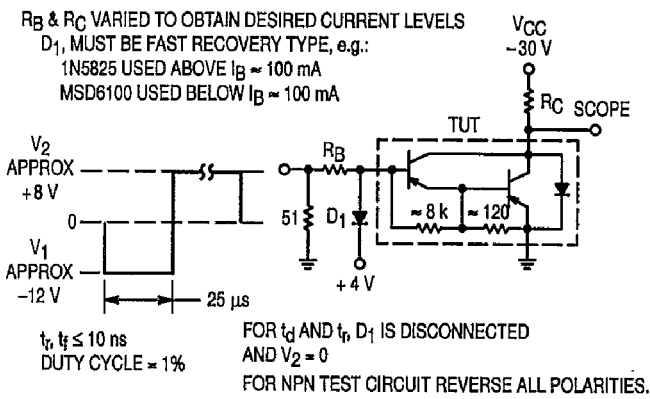


Figure 1. Switching Times Test Circuit

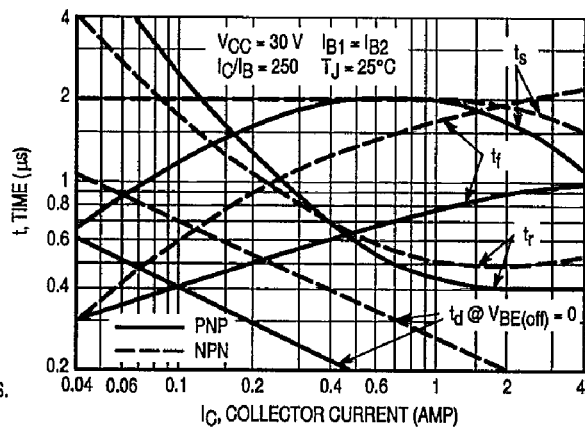


Figure 2. Switching Times

TYPICAL ELECTRICAL CHARACTERISTICS

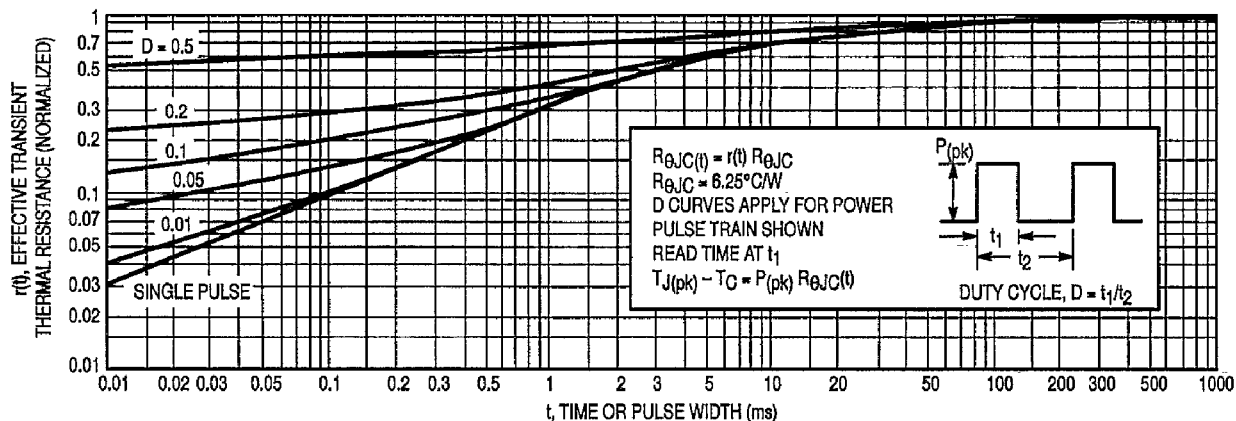


Figure 3. Thermal Response

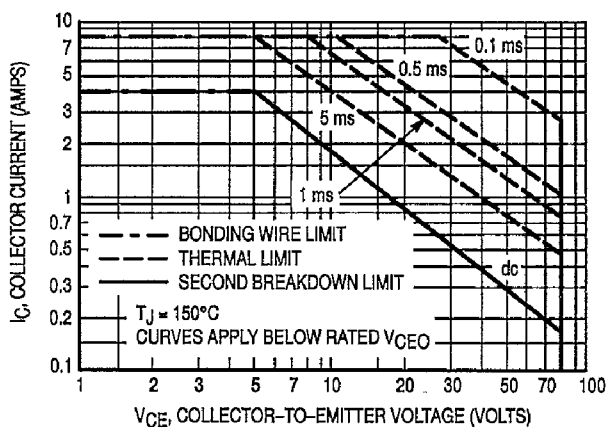


Figure 4. Maximum Rated Forward Biased Safe Operating Area

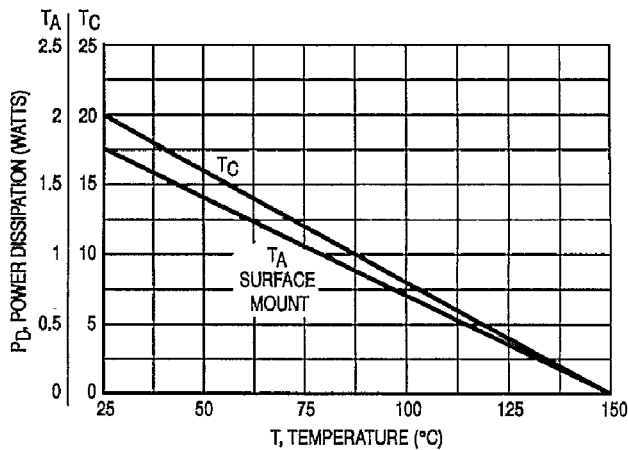


Figure 5. Power Derating

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 6 and 7 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.

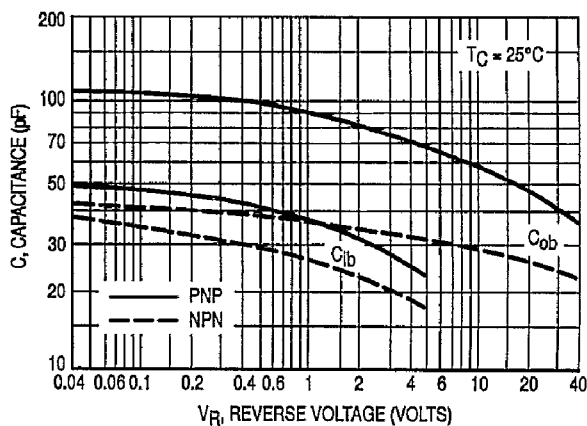
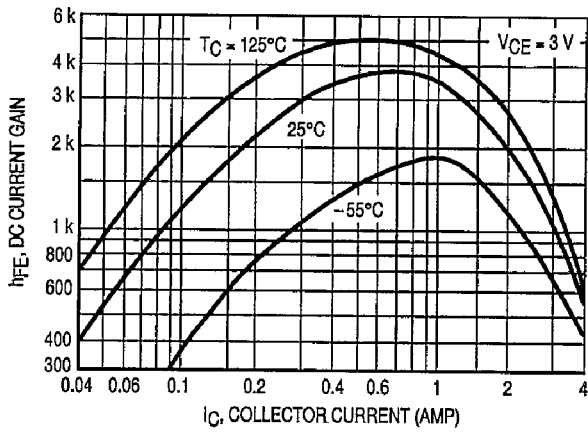


Figure 6. Capacitance

TYPICAL ELECTRICAL CHARACTERISTICS

PNP MJD6036



NPN MJD6039

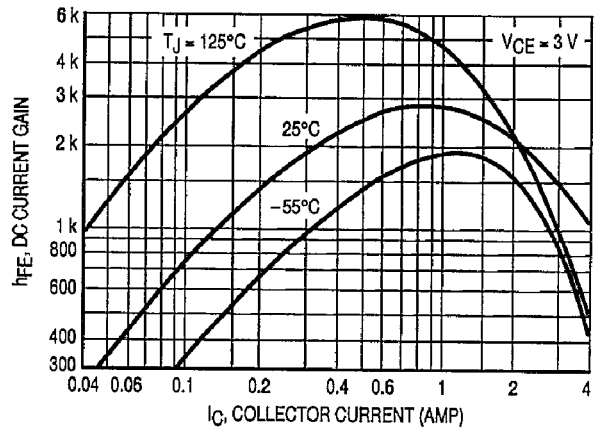


Figure 7. DC Current Gain

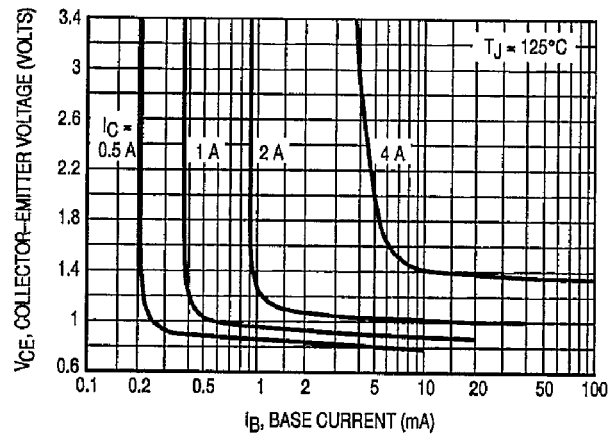
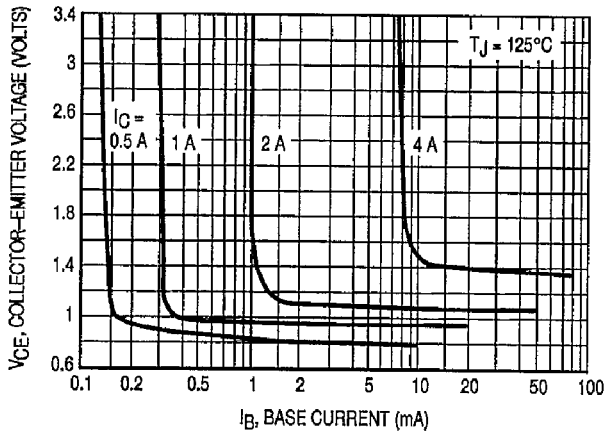


Figure 8. Collector Saturation Region

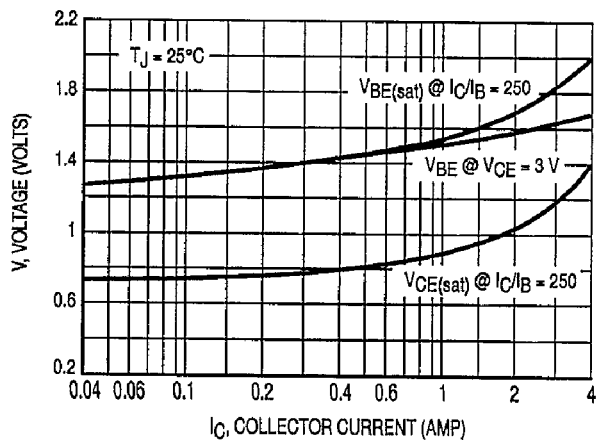
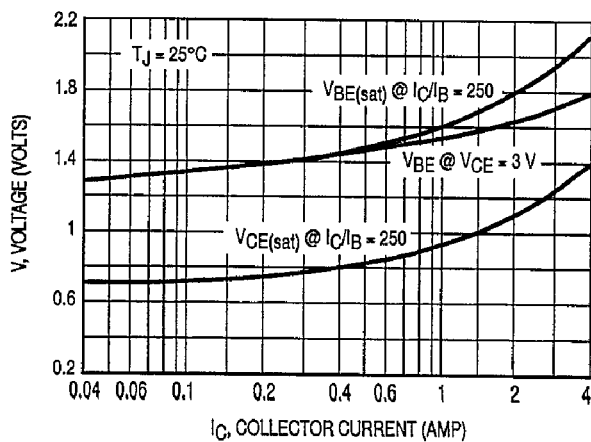
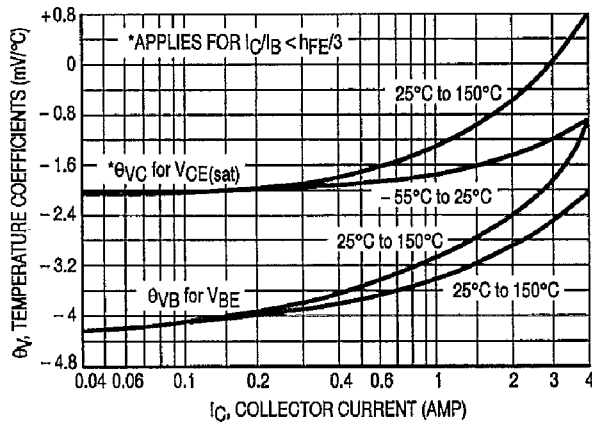


Figure 9. "On" Voltages

MJD6036 MJD6039

PNP MJD6036



NPN MJD6039

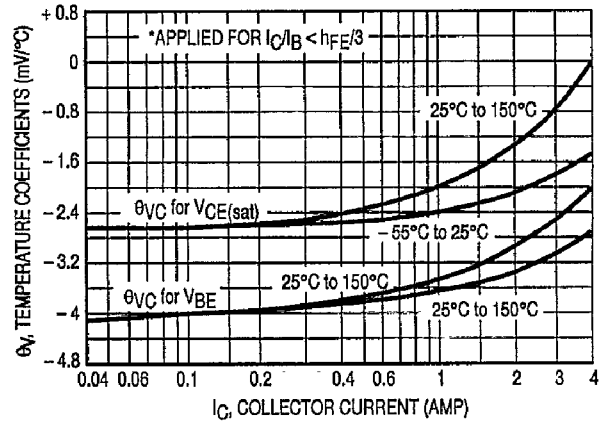


Figure 10. Temperature Coefficients

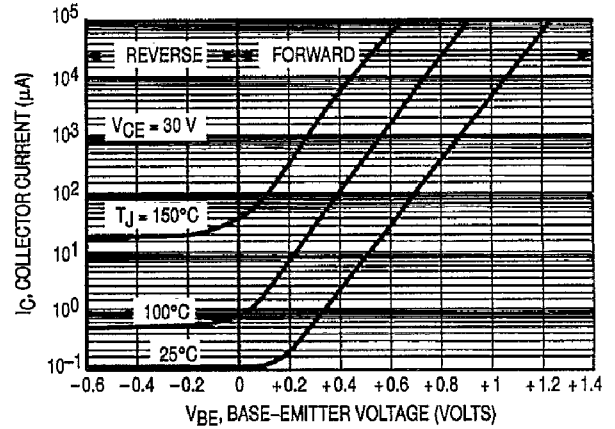
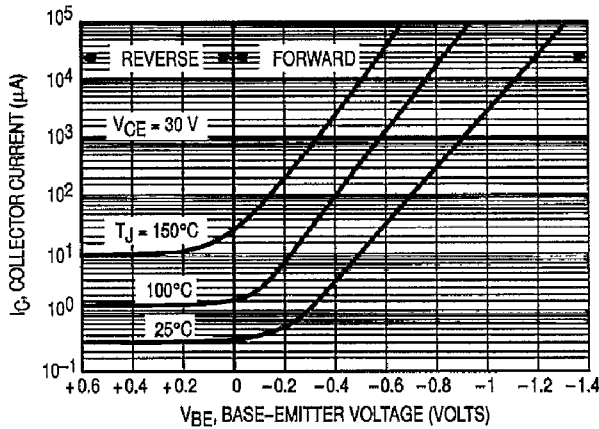


Figure 11. Collector Cut-Off Region

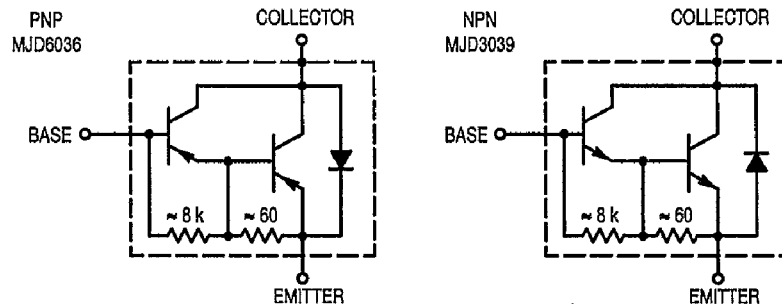


Figure 12. Darlington Schematic