

# High-Current Complementary Silicon Transistors

... for use as output devices in complementary general purpose amplifier applications.

- High DC Current Gain —  $h_{FE} = 1000$  (Min) @  $I_C = 25$  Adc  
 $h_{FE} = 400$  (Min) @  $I_C = 50$  Adc
- Curves to 100 A (Pulsed)
- Diode Protection to Rated  $I_C$
- Monolithic Construction with Built-In Base-Emitter Shunt Resistor
- Junction Temperature to +200°C

## MAXIMUM RATINGS

Rating	Symbol	MJ11028 MJ11029	MJ11030 MJ11031	MJ11032 MJ11033	Unit
Collector-Emitter Voltage	$V_{CEO}$	60	90	120	Vdc
Collector-Base Voltage	$V_{CB}$	60	90	120	Vdc
Emitter-Base Voltage	$V_{EB}$	5			Vdc
Collector Current — Continuous	$I_C$	50			Adc
Peak	$I_{CM}$	100			
Base Current — Continuous	$I_B$	2			Adc
Total Power Dissipation @ $T_C = 25^\circ\text{C}$ Derate above $25^\circ\text{C}$ @ $T_C = 100^\circ\text{C}$	$P_D$	300 1.71			Watts W/°C
Operating and Storage Junction Temperature Range	$T_J, T_{stg}$	-55 to +200			°C

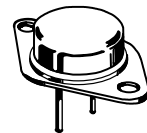
## THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Maximum Lead Temperature for Soldering Purposes for $\leq 10$ seconds	$T_L$	275	°C
Thermal Resistance Junction to Case	$R_{\theta JC}$	0.584	°C

**NPN**  
**MJ11028**  
**MJ11030**  
**MJ11032\***  
**PNP**  
**MJ11029**  
**MJ11031**  
**MJ11033\***

\*Motorola Preferred Device

**50 AMPERE  
COMPLEMENTARY  
SILICON  
DARLINGTON  
POWER TRANSISTORS  
60-120 VOLTS  
300 WATTS**



**CASE 197A-05  
TO-204AE (TO-3)**

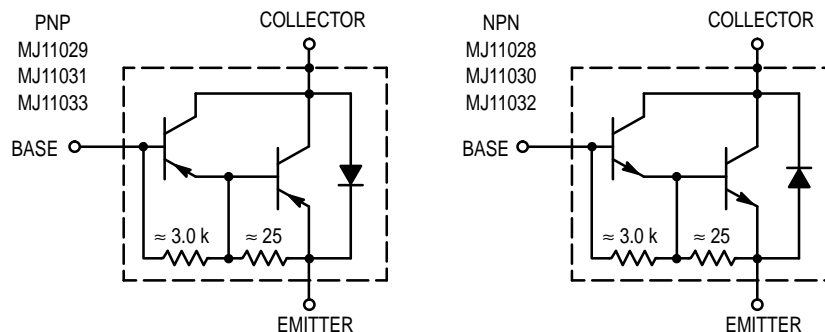


Figure 1. Darlington Circuit Schematic

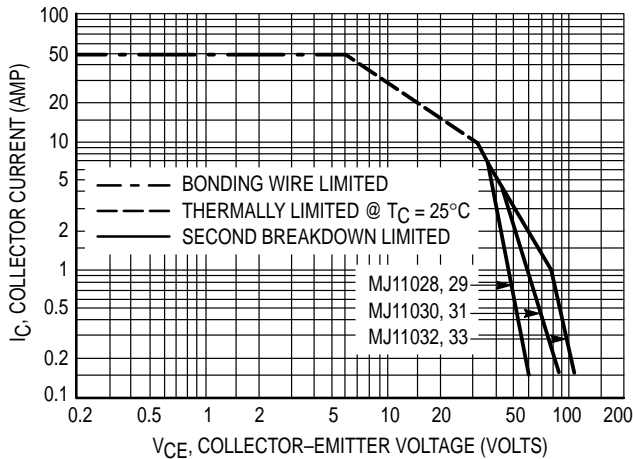
Preferred devices are Motorola recommended choices for future use and best overall value.

**MJ11028 MJ11030 MJ11032 MJ11029 MJ11031 MJ11033**

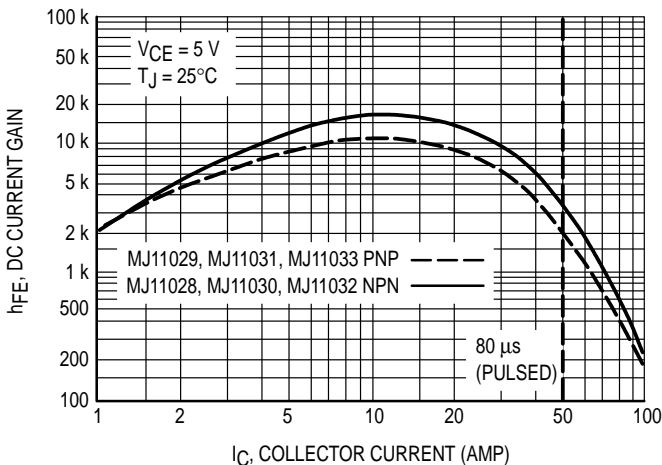
**ELECTRICAL CHARACTERISTICS** ( $T_C = 25^\circ\text{C}$  unless otherwise noted)

Characteristic	Symbol	Min	Max	Unit
<b>OFF CHARACTERISTICS</b>				
Collector–Emitter Breakdown Voltage (1) ( $I_C = 100\text{ mA}$ , $I_B = 0$ )	MJ11028, MJ11029 MJ11030, MJ11031 MJ11032, MJ11033	$V_{(BR)CEO}$	60 90 120	Vdc
Collector–Emitter Leakage Current ( $V_{CE} = 60\text{ Vdc}$ , $R_{BE} = 1\text{ k ohm}$ ) ( $V_{CE} = 90\text{ Vdc}$ , $R_{BE} = 1\text{ k ohm}$ ) ( $V_{CE} = 120\text{ Vdc}$ , $R_{BE} = 1\text{ k ohm}$ ) ( $V_{CE} = 60\text{ Vdc}$ , $R_{BE} = 1\text{ k ohm}$ , $T_C = 150^\circ\text{C}$ ) ( $V_{CE} = 90\text{ Vdc}$ , $R_{BE} = 1\text{ k ohm}$ , $T_C = 150^\circ\text{C}$ ) ( $V_{CE} = 120\text{ Vdc}$ , $R_{BE} = 1\text{ k ohm}$ , $T_C = 150^\circ\text{C}$ )	MJ11028, MJ11029 MJ11030, MJ11031 MJ11032, MJ11033 MJ11028, MJ11029 MJ11030, MJ11031 MJ11032, MJ11033	$I_{CER}$	— — — — — —	2 2 2 10 10 10
Emitter Cutoff Current ( $V_{BE} = 5\text{ Vdc}$ , $I_C = 0$ )		$I_{EBO}$	—	5
Collector–Emitter Leakage Current ( $V_{CE} = 50\text{ Vdc}$ , $I_B = 0$ )		$I_{CEO}$	—	2
<b>ON CHARACTERISTICS (1)</b>				
DC Current Gain ( $I_C = 25\text{ Adc}$ , $V_{CE} = 5\text{ Vdc}$ ) ( $I_C = 50\text{ Adc}$ , $V_{CE} = 5\text{ Vdc}$ )		$h_{FE}$	1 k 400	18 k —
Collector–Emitter Saturation Voltage ( $I_C = 25\text{ Adc}$ , $I_B = 250\text{ mA}$ ) ( $I_C = 50\text{ Adc}$ , $I_B = 500\text{ mA}$ )		$V_{CE(sat)}$	— —	2.5 3.5
Base–Emitter Saturation Voltage ( $I_C = 25\text{ Adc}$ , $I_B = 200\text{ mA}$ ) ( $I_C = 50\text{ Adc}$ , $I_B = 300\text{ mA}$ )		$V_{BE(sat)}$	— —	3.0 4.5

(1) Pulse Test: Pulse Width  $\leq 300\ \mu\text{s}$ , Duty Cycle  $\leq 2.0\%$ .



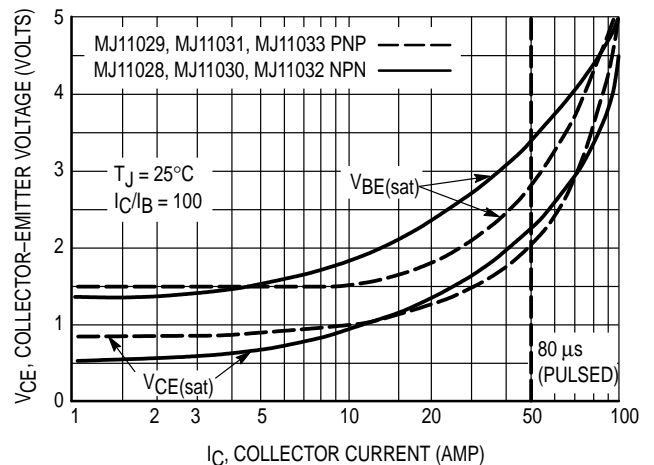
**Figure 2. DC Safe Operating Area**



**Figure 3. DC Current Gain**


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 2 is based on  $T_J(pk) = 200^\circ\text{C}$ ;  $T_C$  is variable depending on conditions. 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 4. "On" Voltage**



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