

**SWITCHMODE SERIES**

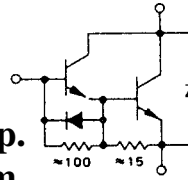
**NPN SILICON POWER DARLINGTON TRANSISTORS WITH BASE-EMITTER SPEEDUP DIODE**

The MJ10004 and MJ10005 darlington transistors are designed for high-voltage, high-speed, power switching in inductive circuits where fall time is critical. They are particularly suited for line operated switch-mode applications such as:

**FEATURES:**

- \*Continuous Collector Current -  $I_C = 20$  A
- \*Switching Regulators
- \*Inverters
- \*Solenoid and Relay Drivers
- \*Motor Controls

**Boca Semiconductor Corp.**  
<http://www.bocasemi.com>

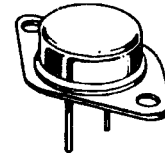


**NPN  
 MJ10004  
 MJ10005**

**20 AMPERE  
 POWER DARLINGTON  
 TRANSISTORS  
 350-400 VOLTS  
 175 WATTS**

**MAXIMUM RATINGS**

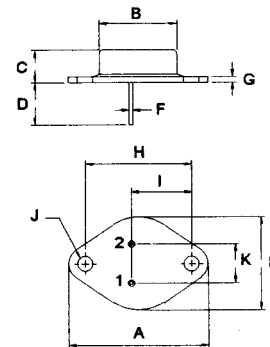
Characteristic	Symbol	MJ10004	MJ10005	Unit
Collector-Emitter Voltage	$V_{CEV}$	450	500	V
Collector-Emitter Voltage	$V_{CEX(SUS)}$	400	450	V
Collector-Emitter Voltage	$V_{CEO(SUS)}$	350	400	V
Emitter-Base Voltage	$V_{EBO}$	8.0		V
Collector Current-Continuous	$I_C$	20		A
-Peak	$I_{CM}$	30		
Base current	$I_B$	2.5		A
Total Power Dissipation @ $T_C=25^\circ C$	$P_D$	175		W
Derate above $25^\circ C$		100		W
		1.0		W/ $^\circ C$
Operating and Storage Junction Temperature Range	$T_J, T_{STG}$	- 65 to +200		$^\circ C$



**TO-3**

**THERMAL CHARACTERISTICS**

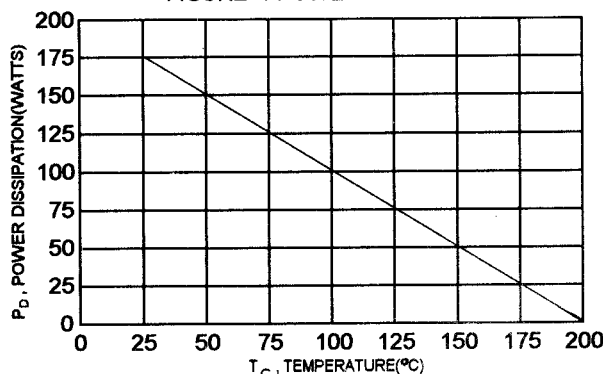
Characteristic	Symbol	Max	Unit
Thermal Resistance Junction to Case	$R_{\theta jc}$	1.0	$^\circ C/W$



PIN 1.BASE  
 2.EMITTER  
 COLLECTOR(CASE)

DIM	MILLIMETERS	
	MIN	MAX
A	38.75	39.96
B	19.28	22.23
C	7.96	9.28
D	11.18	12.19
E	25.20	26.67
F	0.92	1.09
G	1.38	1.62
H	29.90	30.40
I	16.64	17.30
J	3.88	4.36
K	10.67	11.18

**FIGURE -1 POWER DERATING**



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

Characteristic	Symbol	Min	Max	Unit
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**OFF CHARACTERISTICS**

Collector - Emitter Sustaining Voltage ( $I_C = 250\text{ mA}, I_B = 0, V_{\text{clamp}} = \text{Rate } V_{\text{CEO}}$ )	MJ10004 MJ10005	$V_{\text{CEO(sus)}}$	350 400	V
Collector Cutoff Current ( $V_{\text{CE}} = \text{Rated } V_{\text{CEV}}, R_{\text{BE}} = 50\text{ ohm}, T_C = 100^\circ\text{C}$ )		$I_{\text{CER}}$	5.0	mA
Collector Cutoff Current ( $V_{\text{CEV}} = \text{Rated Value}, V_{\text{BE(off)}} = 1.5\text{ V}$ ) ( $V_{\text{CEV}} = \text{Rated Value}, V_{\text{BE(off)}} = 1.5\text{ V}, T_C = 100^\circ\text{C}$ )		$I_{\text{CEV}}$	0.25 5.0	mA
Emitter Cutoff Current ( $V_{\text{EB}} = 2.0\text{ V}, I_C = 0$ )		$I_{\text{EBO}}$	175	mA

**ON CHARACTERISTICS (1)**

DC Current Gain ( $I_C = 5.0\text{ A}, V_{\text{CE}} = 5.0\text{ V}$ ) ( $I_C = 10\text{ A}, V_{\text{CE}} = 5.0\text{ V}$ )		hFE	50 40	600 400
Collector - Emitter Saturation Voltage ( $I_C = 10\text{ A}, I_B = 400\text{ mA}$ ) ( $I_C = 20\text{ A}, I_B = 2.0\text{ A}$ ) ( $I_C = 10\text{ A}, I_B = 400\text{ mA}, T_C = 100^\circ\text{C}$ )		$V_{\text{CE(sat)}}$		1.9 3.0 2.0
Base - Emitter Saturation Voltage ( $I_C = 10\text{ A}, I_B = 400\text{ mA}$ ) ( $I_C = 10\text{ A}, I_B = 400\text{ mA}, T_C = 100^\circ\text{C}$ )		$V_{\text{BE(sat)}}$		2.5 2.5
Diode Forward Voltage ( $I_F = 10\text{ A}$ )		$V_F$		5.0

**DYNAMIC CHARACTERISTICS**

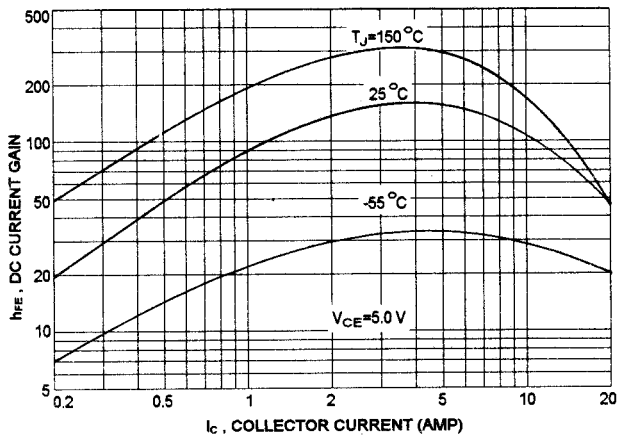
Small-Signal Current Gain(2) ( $I_C = 1.0\text{ A}, V_{\text{CE}} = 10\text{ V}, f = 1.0\text{ MHz}$ )		$ h_{fe} $	10	
Output Capacitance ( $V_{\text{CB}} = 10\text{ V}, I_E = 0, f = 100\text{ kHz}$ )		$C_{ob}$	100	pF

**SWITCHING CHARACTERISTICS**

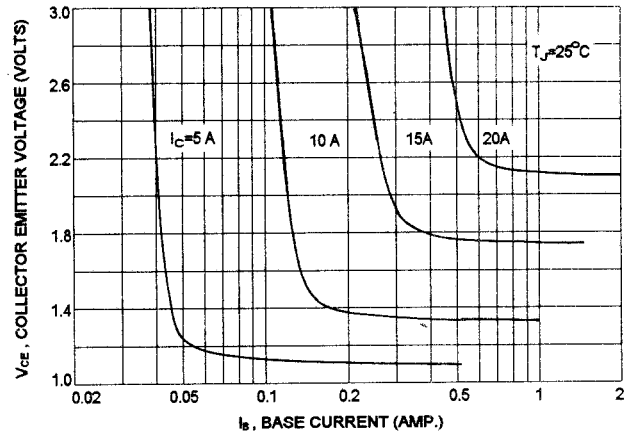
Delay Time	$V_{\text{CC}} = 250\text{ V}, I_C = 10\text{ A}$ $I_{\text{B1}} = 400\text{ mA}, V_{\text{BE(off)}} = 5.0\text{ V}$ $t_p = 50\text{ us}, \text{Duty Cycle} \leq 2\%$	$t_d$	0.2	us
Rise Time		$t_r$	0.6	us
Storage Time		$t_s$	1.5	us
Fall Time		$t_f$	0.5	us

(1) Pulse Test: Pulse width = 300 us , Duty Cycle  $\leq$  2.0%(2)  $f_T = |h_{fe}| \cdot f_{\text{test}}$

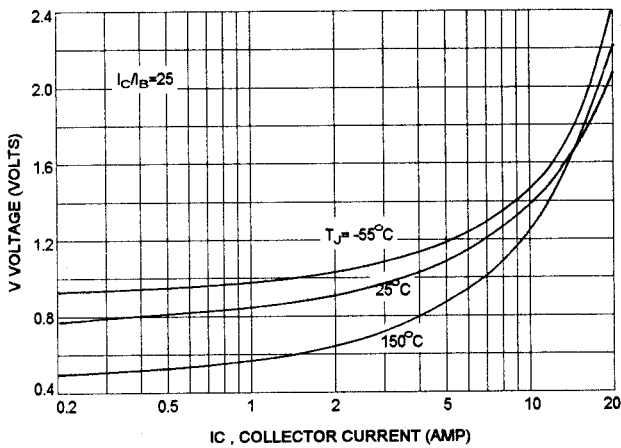
DC CURRENT GAIN



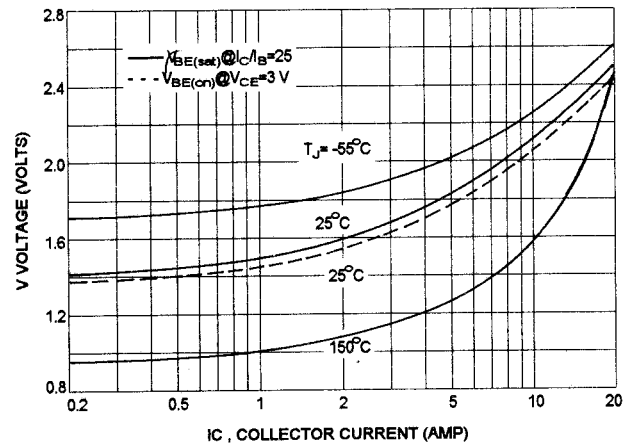
COLLECTOR SATURATION REGION



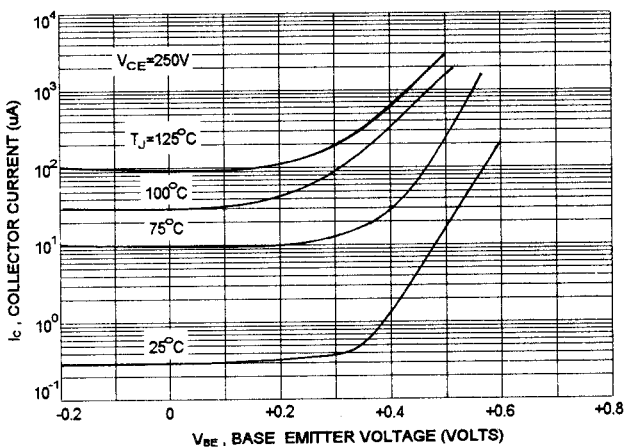
COLLECTOR EMITTER SATURATION VOLTAGE



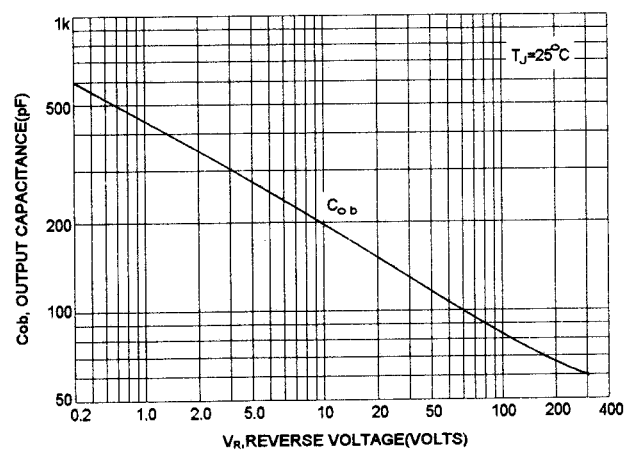
BASE EMITTER VOLTAGE



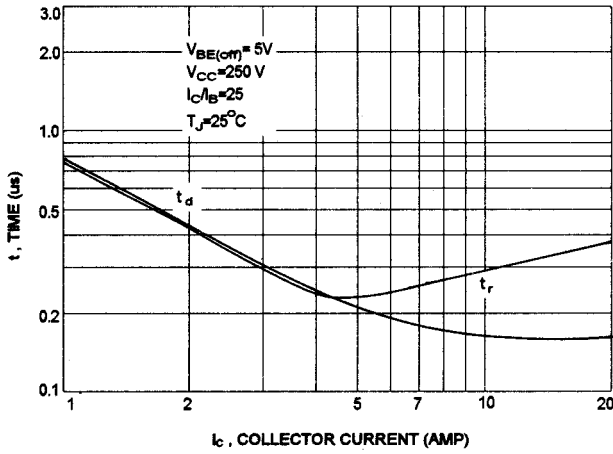
COLLECTOR CUT-OFF REGION



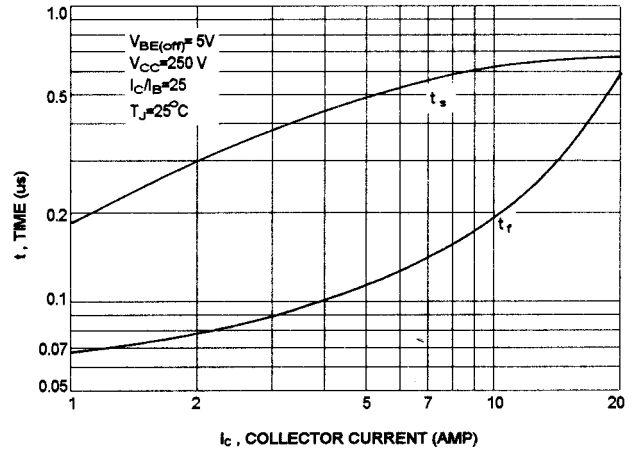
OUTPUT CAPACITANCES



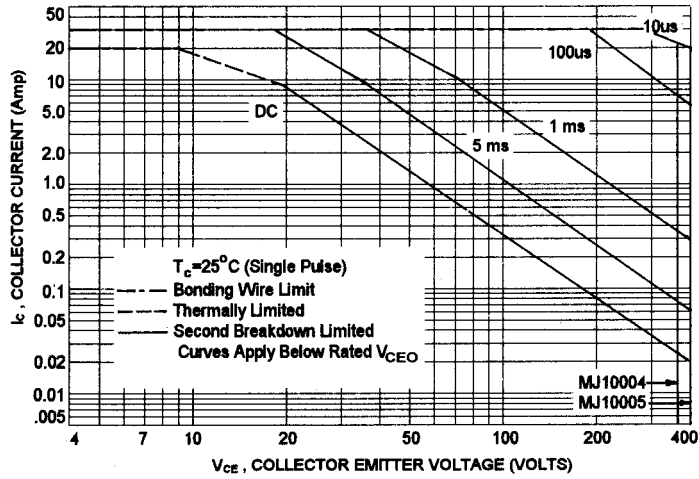
TURN-ON TIME



TURN-OFF TIME



ACTIVE REGION SAFE OPERATING AREA



REVERSE BIAS SWITCHING SAFE OPERATING AREA

