

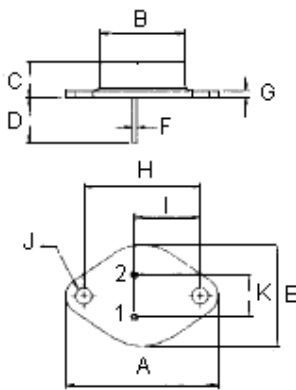


NPN silicon power darlington transistors with base-emitter speedup diode. The MJ1004 darlington transistors are designed for high-voltage, high-speed, power switching in inductive circuits where fall time is critical. They are particularly suited for line operated switch-mode applications.

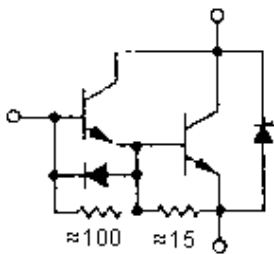
**Features:**

- Continuous collector current -  $I_C = 20A$ .
- Switching regulators.
- Inverters.
- Solenoid and relay drivers.
- Motor controls.

**TO-3**



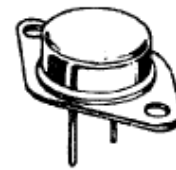
Pin 1. Base  
2. Emitter  
Collector (Case)



Dimensions	Minimum	Maximum
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

Dimensions : Millimetres

**NPN  
MJ10004**  
  
20 Ampere  
Power Darlington  
Transistors  
350-400 Volts  
175 Watts



**TO-3**

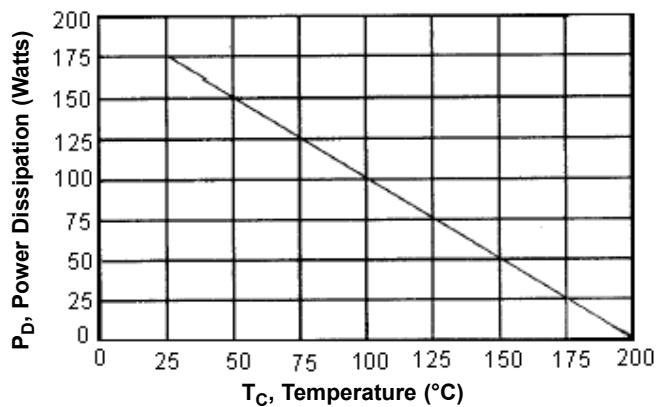
## Maximum Ratings

Characteristic	Symbol	MJ10004	Unit
Collector-Emitter Voltage	$V_{CEV}$	450	V
Collector-Emitter Voltage	$V_{CEX(SUS)}$	400	
Collector-Emitter Voltage	$V_{CEO(SUS)}$	350	
Emitter-Base Voltage	$V_{EBO}$	80	A
Collector Current-Continuous	$I_C$	20	
-Peak	$I_{CM}$	30	
Base Current-Peak	$I_B$	2.5	
Total Power Dissipation at $T_C = 25^\circ\text{C}$ at $T_C = 100^\circ\text{C}$ Derate above $25^\circ\text{C}$	$P_D$	175 100 1.0	W W W/ $^\circ\text{C}$
Operating and Storage Junction Temperature Range	$T_J, T_{STG}$	-65 to +200	$^\circ\text{C}$

## Thermal Characteristics

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

Power Derating



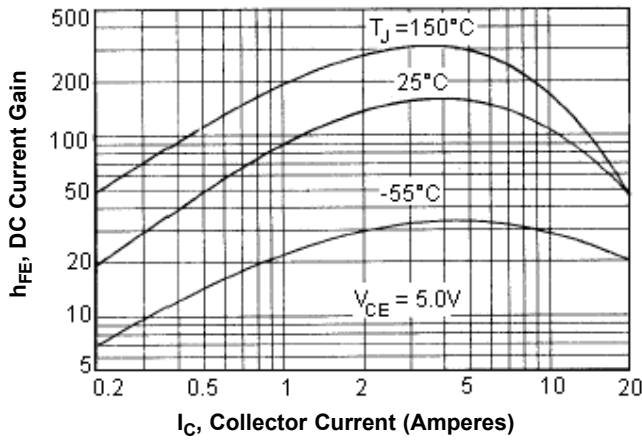
**Electrical Characteristics** ( $T_C = 25^\circ\text{C}$  unless otherwise noted)

Characteristic	Symbol	Minimum	Maximum	Unit	
<b>Off Characteristics</b>					
Collector-Emitter Sustaining Voltage ( $I_C = 250\text{mA}$ , $I_B = 0$ , $V_{\text{clamp}} = \text{Rate } V_{\text{CEO}}$ )	$V_{\text{CEO (sus)}}$	350	-	V	
Collector Cut off Current ( $V_{\text{CE}} = \text{Rated } V_{\text{CEV}}$ , $R_{\text{BE}} = 50\Omega$ , $T_C = 100^\circ\text{C}$ )	$V_{\text{CER}}$	-	5.0		
Collector Cut off 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 Cut off Current ( $V_{\text{EB}} = 2.0\text{V}$ , $I_C = 0$ )	$I_{\text{EBO}}$	-	175		
<b>On Characteristics (1)</b>					
DC Current Gain ( $I_C = 5.0\text{A}$ , $V_{\text{CE}} = 5.0\text{V}$ ) ( $I_C = 10\text{A}$ , $V_{\text{CE}} = 5.0\text{V}$ )	$h_{\text{FE}}$	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	V	
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		
<b>Dynamic Characteristics</b>					
Small-Signal Current Gain (2) ( $I_C = 1.0\text{A}$ , $V_{\text{CE}} = 10\text{V}$ , $f = 1.0\text{MHz}$ )	$ h_{\text{fe}} $	10	-	-	
Output Capacitance ( $V_{\text{CB}} = 10\text{V}$ , $I_E = 0$ , $f = 100\text{kHz}$ )	$C_{\text{ob}}$	100	-	pF	
<b>Switching Characteristics</b>					
Delay Time	$V_{\text{CC}} = 250\text{V}$ , $I_C = 10\text{A}$ $I_{\text{B1}} = 400\text{mA}$ , $V_{\text{BE (off)}} = 5.0\text{V}$ $t_p = 50\mu\text{s}$ , Duty Cycle $\leq 2\%$	$t_d$	-	0.2	$\mu\text{s}$
Rise Time		$t_r$	-	0.6	
Storage Time		$t_s$	-	1.5	
Fall Time		$t_f$	-	0.5	

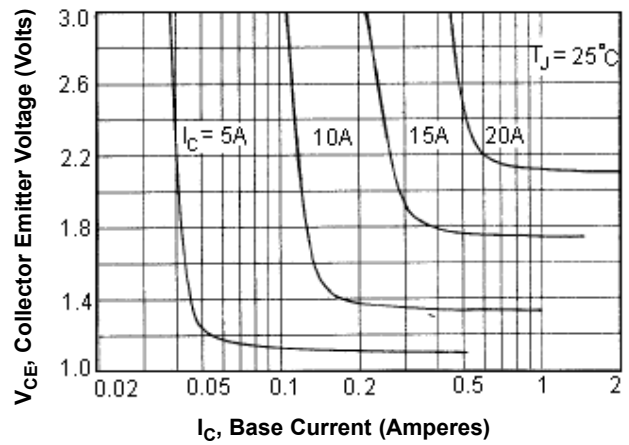
(1) Pulse Test : Pulse Width =  $300\mu\text{s}$ , Duty Cycle  $\leq 2.0\%$ .

(2)  $f_T = |h_{\text{fe}}| \cdot f_{\text{test}}$

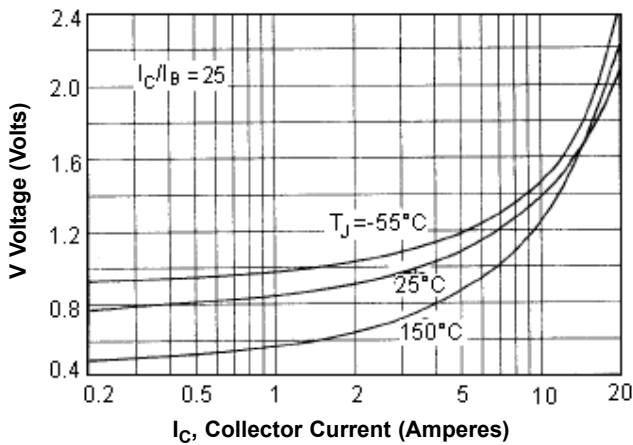
DC Current Gain



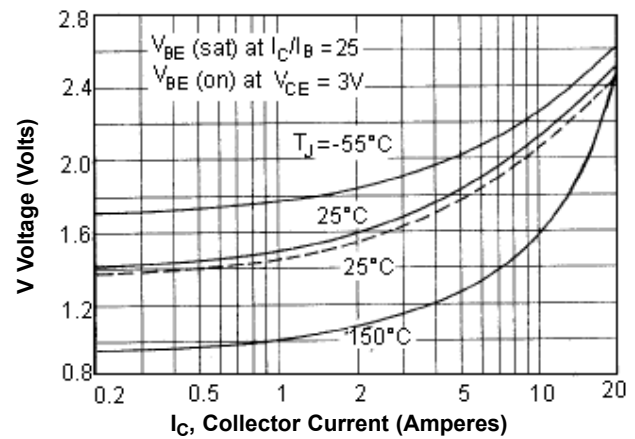
Collector Saturation Region



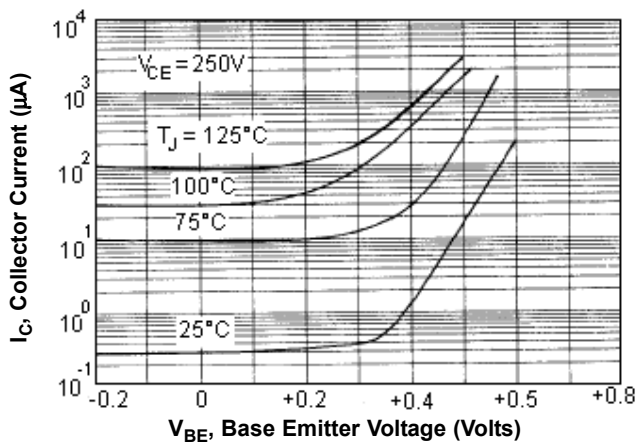
Collector Emitter Saturation Voltage



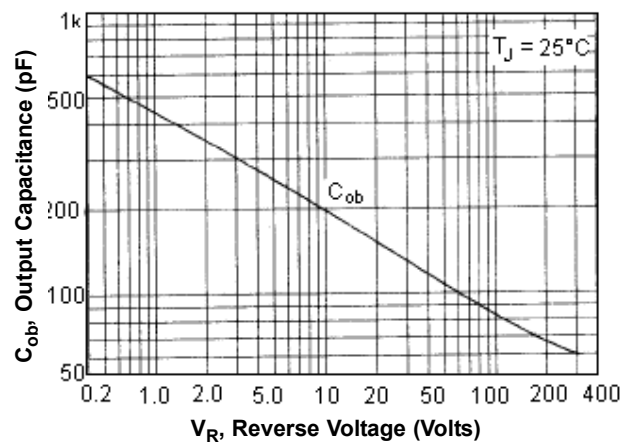
Base Emitter Voltage



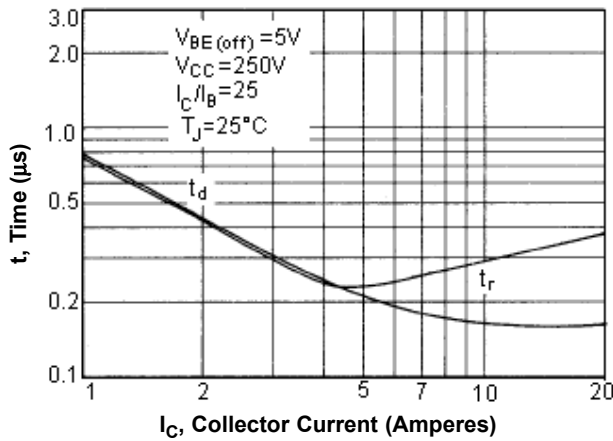
Collector Cut-Off Region



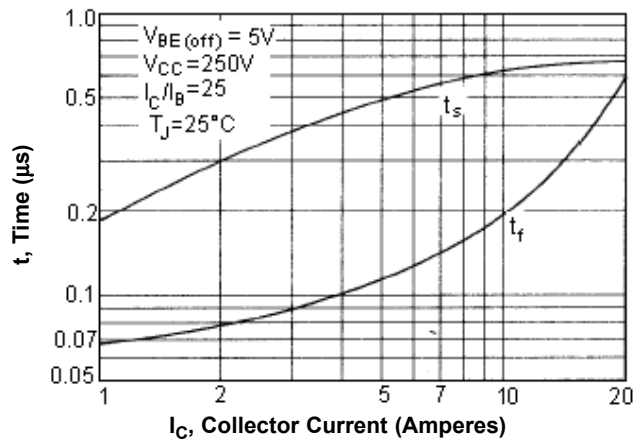
Output Capacitances



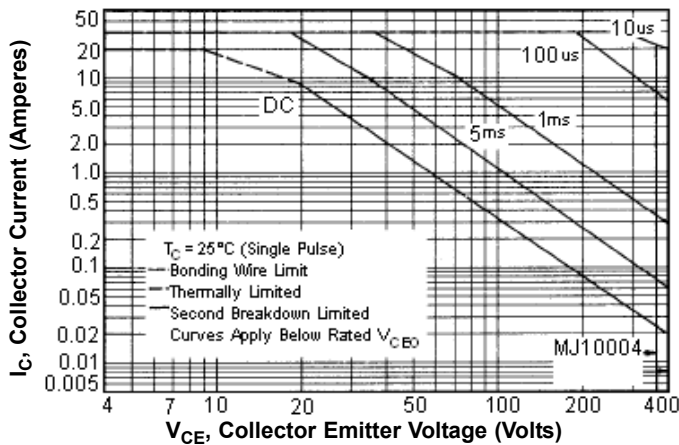
**Turn-On Time**



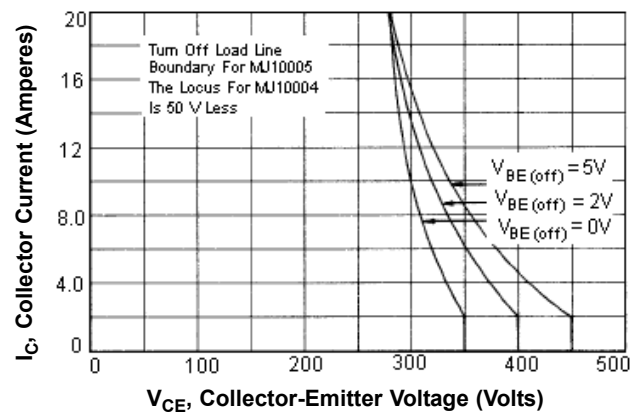
**Turn-Off Time**



**Active Region Safe Operating Area**



**Reverse Bias Switching Safe Operating Area**



## Part Number Table

Description	Part Number
Darlington Transistor, TO-3	MJ10004

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