

# Darlington Transistor TO-3



## Description

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 tim 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

## Maximum Ratings

Characteristic	Symbol	MJ10004	Unit
Collector-Emitter Voltage	$V_{CEV}$	450	V
	$V_{CEX(SUS)}$	400	
	$V_{CEO(SUS)}$	350	
Emitter-Base Voltage	$V_{EBO}$	80	A
Collector Current -Continuous -Peak	$I_C$	20	
	$I_{CM}$	30	
Base Current-Peak	$I_B$	2.5	
Total Power Dissipation at $T_C = 25^\circ C$ Derate above $25^\circ C$ at $T_C = 100^\circ C$	$P_D$	175 100 1	W W W/ $^\circ C$
Operating and Storage Junction Temperature Range	$T_J, T_{STG}$	-65 to +200	$^\circ C$

## Thermal Characteristics

Characteristic	Symbol	Maximum	Unit
Thermal Resistance Junction to Case	$R_{\theta jc}$	1	$^\circ C/W$

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

Characteristic	Symbol	Minimum	Maximum	Unit
<b>Off Characteristics</b>				
Collector-Emitter Sustaining Voltage ( $I_C = 250\text{mA}$ , $I_B = 0$ $V_{\text{clamp}} = \text{Rate } V_{\text{CEO}}$ )	$V_{\text{EO (sus)}}$	350	-	V
Collector Cutoff Current ( $V_{\text{CE}} = \text{Rated } V_{\text{CEV}}$ , $R_{\text{BE}} = 50\Omega$ , $T_C = 100^\circ\text{C}$ )	$V_{\text{CER}}$	-	5	
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	mA
Emitter Cutoff Current ( $V_{\text{EB}} = 2\text{V}$ , $I_C = 0$ )	$I_{\text{EBO}}$	-	175	

### On Characteristics (1)

DC Current Gain ( $I_C = 5\text{A}$ , $V_{\text{CE}} = 5\text{V}$ ) ( $I_C = 10\text{A}$ , $V_{\text{CE}} = 5\text{V}$ )	$h_{\text{FE}}$	50 40	600 400	-
Collector-Emitter Saturation Voltage ( $I_C = 10\text{A}$ , $I_B = 400\text{mA}$ ) ( $I_C = 20\text{A}$ , $I_B = 2\text{A}$ ) ( $I_C = 10\text{A}$ , $I_B = 400\text{mA}$ $T_C = 100^\circ\text{C}$ )	$V_{\text{CE (sat)}}$	-	1.9 3 2	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	

### Dynamic Characteristics

Small-Signal Current Gain ( $I_C = 10\text{A}$ , $V_{\text{CE}} = 10\text{V}$ , $f = 1\text{MHz}$ )	$ h_{\text{fe}} $	10	-	-
Output Capacitance ( $V_{\text{CB}} = 10\text{V}$ , $I_E = 0$ , $f = 100\text{kHz}$ )	$C_{\text{ob}}$	100	-	pF

### Switching Characteristics

Delay Time	$V_{\text{CC}} = 250\text{V}$ , $I_C = 10\text{A}$ $I_{\text{B1}} = 400\text{mA}$ , $V_{\text{BE (off)}} = 5\text{V}$ $t_p = 50\mu\text{s}$ , 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	

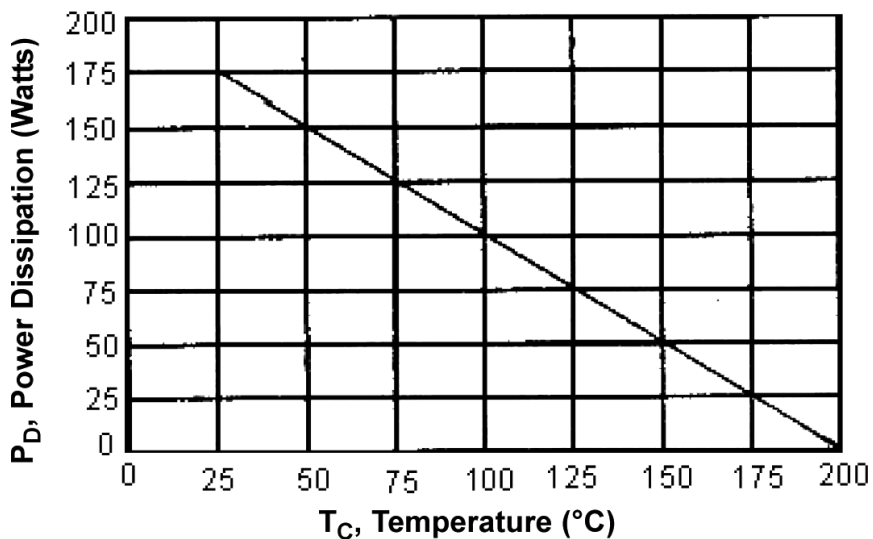
(1) Pulse Test : Pulse Width =  $300\mu\text{s}$ , Duty Cycle 2%.

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

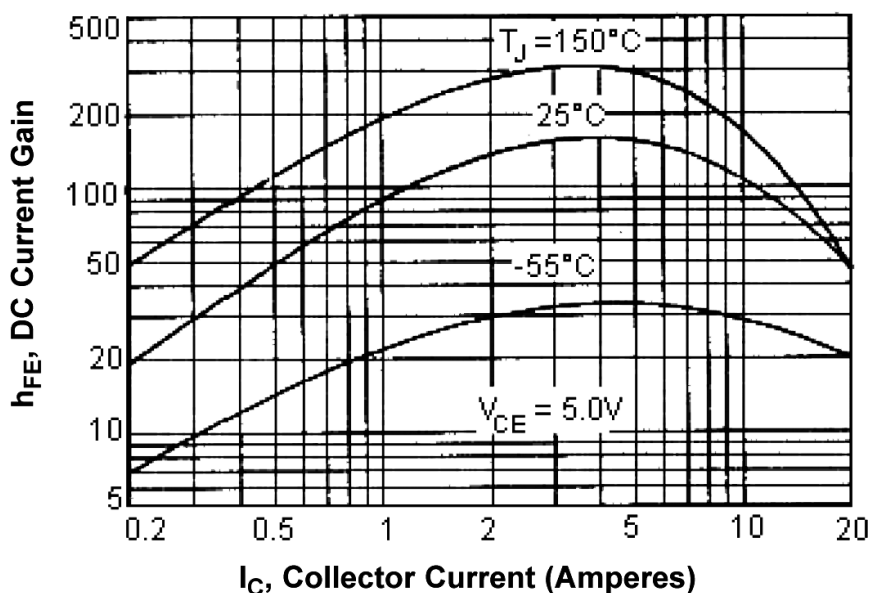
# Darlington Transistor T0-3



### Power Derating



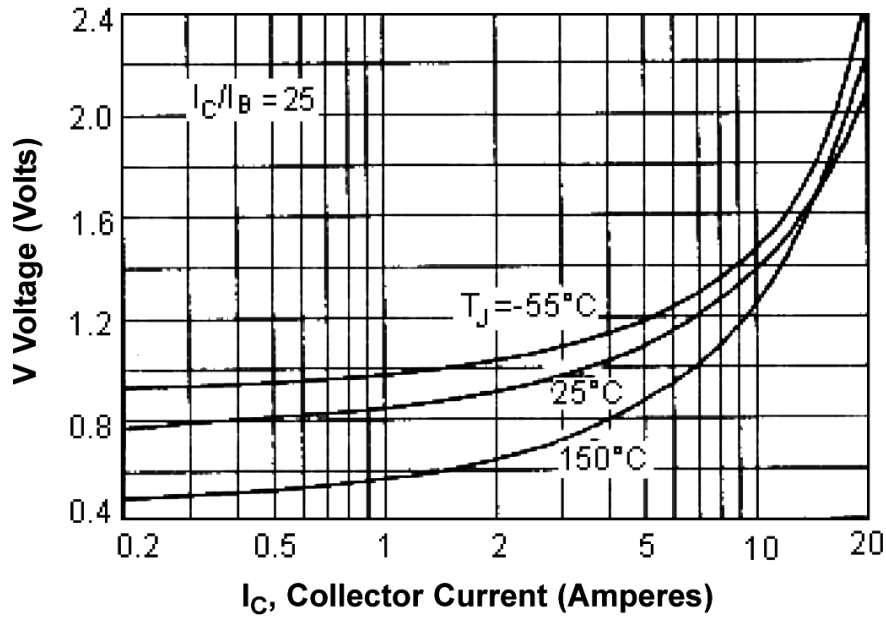
### DC Current Gain



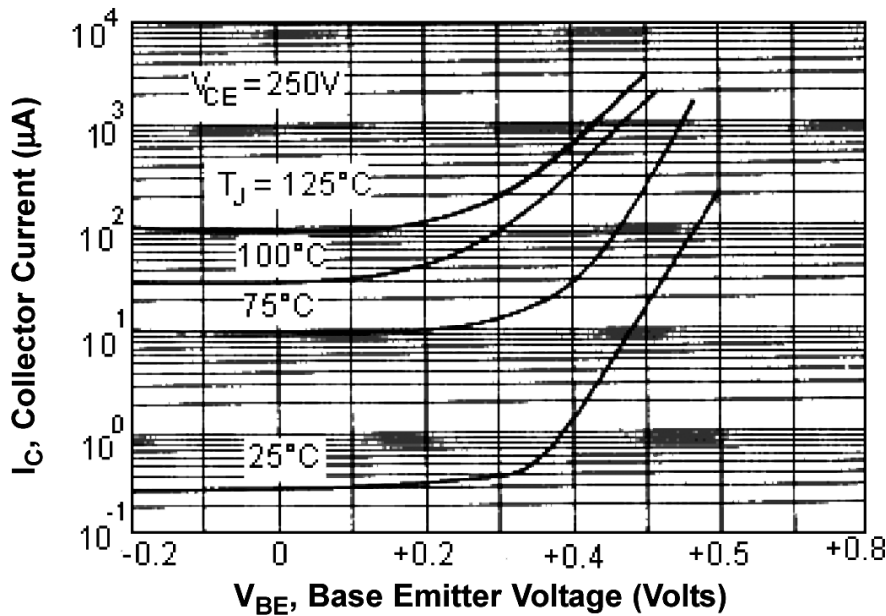
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### Collector Emitter Saturation Voltage



### Collector Cut-Off Region

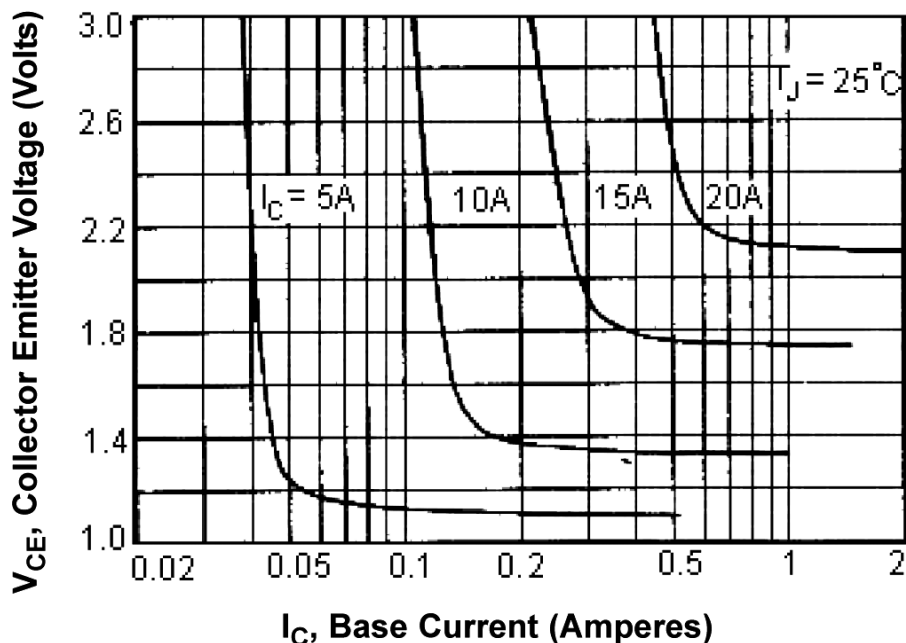


# Darlington Transistor

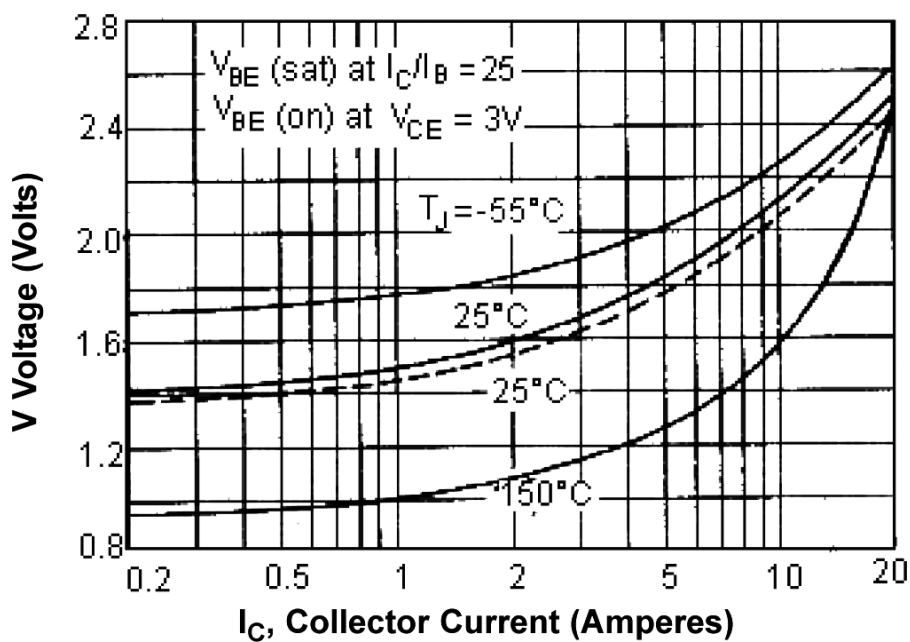
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Collector Saturation Region



Base Emitter Voltage

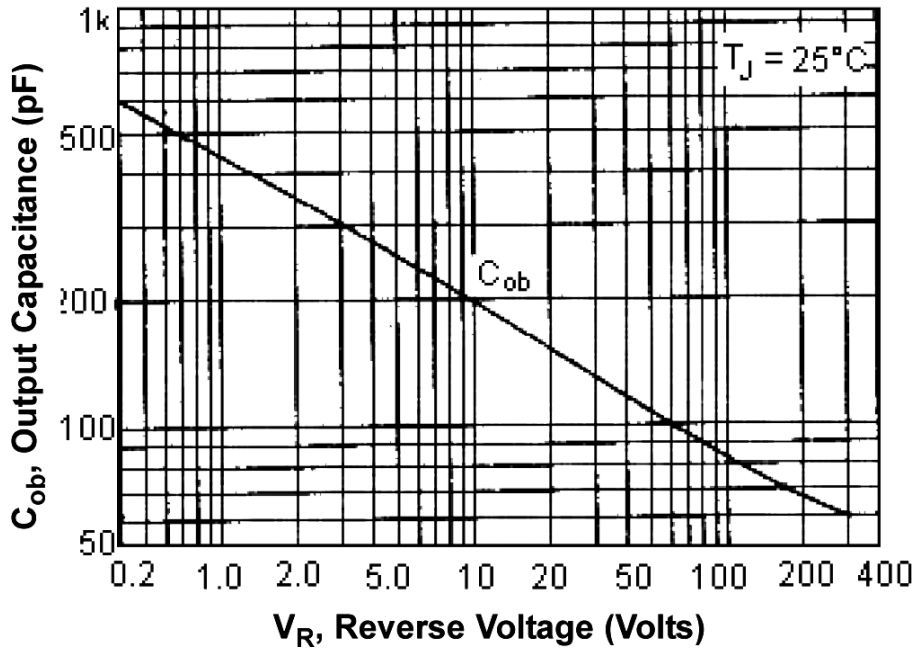


# Darlington Transistor

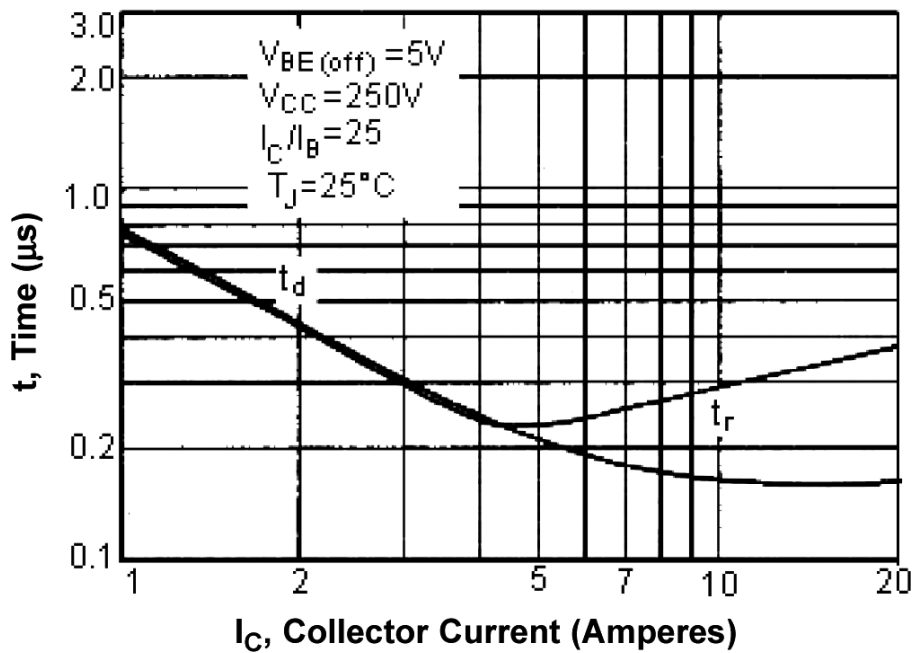
## T0-3



### Output Capacitances



### Turn-On Time

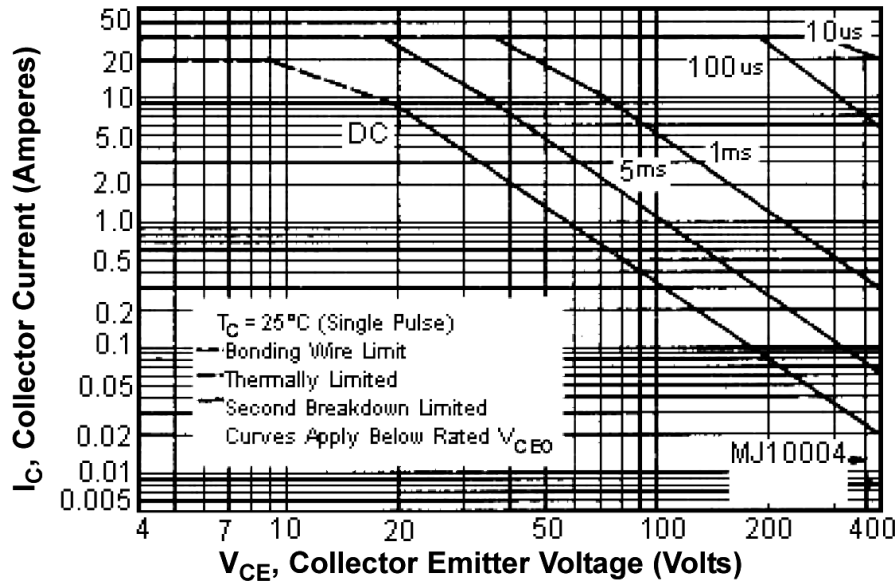


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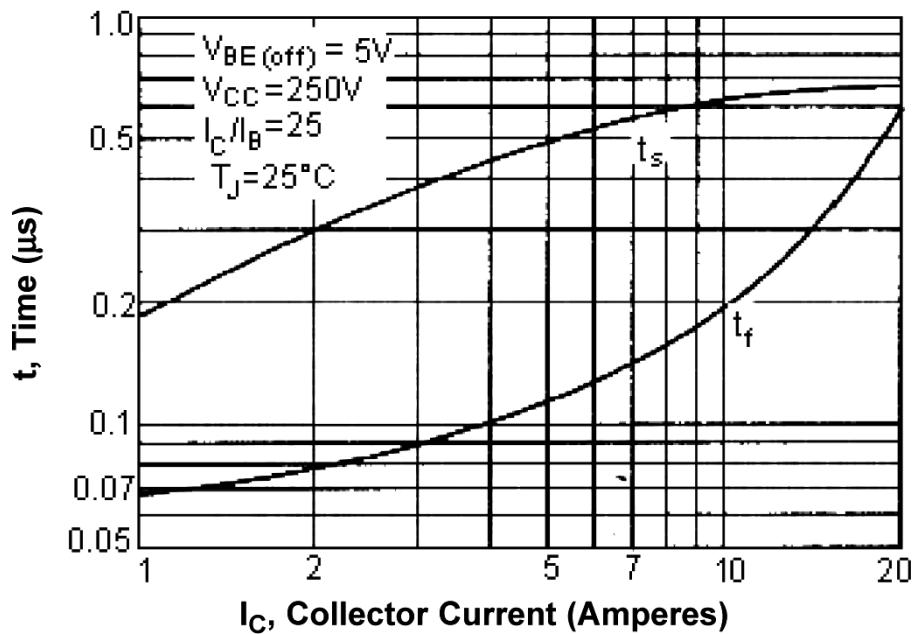
## T0-3



Active Region Safe Operating Area



Turn-Off Time

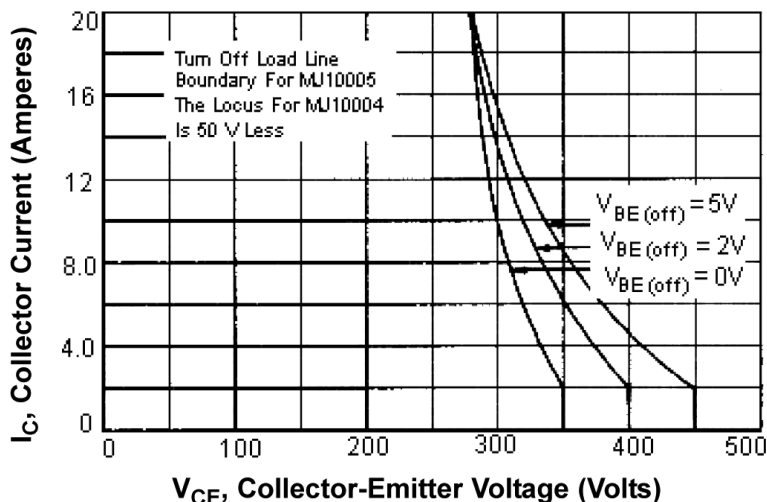


# Darlington Transistor

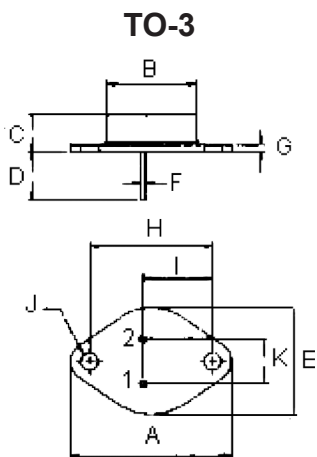
## TO-3



### Reverse Bias Switching Safe Operating Area



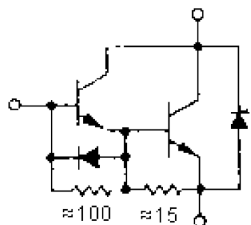
### Dimensions



**Pin Configuration**  
 Pin 1. Base  
 2. Emitter  
 3. Collector (Case)

Dimensions	Min.	Max.
A	38.75	39.96
B	19.28	22.23
C	7.96	9.28
D	11.18	12.19
E	25.2	26.67
F	0.92	1.09
G	1.38	1.62
H	29.9	30.4
I	16.64	17.3
J	3.88	4.36
K	10.67	11.18

Dimensions : Millimetres



### Part Number Table

Description	Part Number
Darlington Transistor, TO-3	MJ10004

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