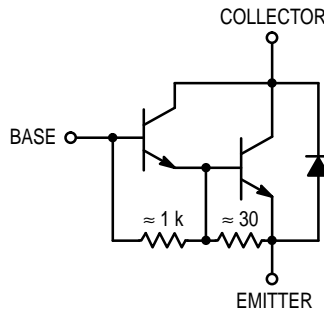


# NPN Silicon Power Darlington Transistor

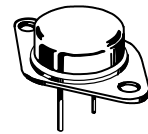
The MJ10012 and MJH10012 are high-voltage, high-current Darlington transistors designed for automotive ignition, switching regulator and motor control applications.

- Collector-Emitter Sustaining Voltage —  
 $V_{CEO(sus)} = 400 \text{ Vdc (Min)}$
- 175 Watts Capability at 50 Volts
- Automotive Functional Tests

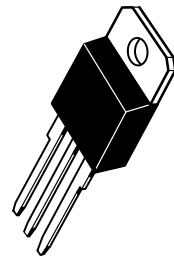


**MJ10012**  
**MJH10012**

**10 AMPERE**  
**POWER TRANSISTORS**  
**DARLINGTON NPN**  
**SILICON**  
**400 VOLTS**  
**175 AND 118 WATTS**



**CASE 1-07**  
**TO-204AA**  
**(TO-3)**  
**MJ10012**



**CASE 340D-01**  
**TO-218 TYPE**  
**MJH10012**

## MAXIMUM RATINGS

Rating	Symbol	MJ10012	MJH10012	Unit
Collector-Emitter Voltage	$V_{CEO}$	400		Vdc
Collector-Emitter Voltage ( $R_{BE} = 27 \Omega$ )	$V_{CER}$	550		Vdc
Collector-Base Voltage	$V_{CBO}$	600		Vdc
Emitter-Base Voltage	$V_{EBO}$	8.0		Vdc
Collector Current — Continuous — Peak (1)	$I_C$	10 15		Adc
Base Current	$I_B$	2.0		Adc
Total Power Dissipation @ $T_C = 25^\circ\text{C}$ @ $T_C = 100^\circ\text{C}$ Derate above $25^\circ\text{C}$	$P_D$	175 100 1.0	118 47.5 1.05	Watts Watts W/ $^\circ\text{C}$
Operating and Storage Junction Temperature Range	$T_J, T_{stg}$	-65 to +200	-55 to +150	$^\circ\text{C}$

## THERMAL CHARACTERISTICS

Characteristic	Symbol	Max		Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	1.0	0.95	$^\circ\text{C/W}$
Maximum Lead Temperature for Soldering Purposes: 1/8" from Case for 5 Seconds	$T_L$	275	275	$^\circ\text{C}$

(1) Pulse Test: Pulse Width = 5.0 ms, Duty Cycle  $\leq 10\%$ .

# MJ10012 MJH10012

## ELECTRICAL CHARACTERISTICS (T<sub>C</sub> = 25°C unless otherwise noted)

Characteristic	Symbol	Min	Typ	Max	Unit
<b>OFF CHARACTERISTICS (1)</b>					
Collector–Emitter Sustaining Voltage (Figure 1) (I <sub>C</sub> = 200 mA, I <sub>B</sub> = 0, V <sub>clamp</sub> = Rated V <sub>CEO</sub> )	V <sub>CEO(sus)</sub>	400	—	—	Vdc
Collector–Emitter Sustaining Voltage (Figure 1) (I <sub>C</sub> = 200 mA, R <sub>BE</sub> = 27 Ohms, V <sub>clamp</sub> = Rated V <sub>CER</sub> )	V <sub>CER(sus)</sub>	425	—	—	Vdc
Collector Cutoff Current (Rated V <sub>CER</sub> , R <sub>BE</sub> = 27 Ohms)	I <sub>CER</sub>	—	—	1.0	mA
Collector Cutoff Current (Rated V <sub>CBO</sub> , I <sub>E</sub> = 0)	I <sub>CBO</sub>	—	—	1.0	mA
Emitter Cutoff Current (V <sub>EB</sub> = 6.0 Vdc, I <sub>C</sub> = 0)	I <sub>EBO</sub>	—	—	40	mA

## ON CHARACTERISTICS (1)

DC Current Gain (I <sub>C</sub> = 3.0 A, V <sub>CE</sub> = 6.0 Vdc) (I <sub>C</sub> = 6.0 A, V <sub>CE</sub> = 6.0 Vdc) (I <sub>C</sub> = 10 A, V <sub>CE</sub> = 6.0 Vdc)	h <sub>FE</sub>	300 100 20	550 350 150	— 2000 —	—
Collector–Emitter Saturation Voltage (I <sub>C</sub> = 3.0 A, I <sub>B</sub> = 0.6 A) (I <sub>C</sub> = 6.0 A, I <sub>B</sub> = 0.6 A) (I <sub>C</sub> = 10 A, I <sub>B</sub> = 2.0 A)	V <sub>CE(sat)</sub>	— — —	— — —	1.5 2.0 2.5	Vdc
Base Emitter Saturation Voltage (I <sub>C</sub> = 6.0 A, I <sub>B</sub> = 0.6 A) (I <sub>C</sub> = 10 A, I <sub>B</sub> = 2.0 A)	V <sub>BE(sat)</sub>	— —	— —	2.5 3.0	Vdc
Base Emitter On Voltage (I <sub>C</sub> = 10 A, V <sub>CE</sub> = 6.0 Vdc)	V <sub>BE(on)</sub>	—	—	2.8	Vdc
Diode Forward Voltage (I <sub>F</sub> = 10 A)	V <sub>f</sub>	—	2.0	3.5	Vdc

## DYNAMIC CHARACTERISTICS

Output Capacitance (V <sub>CB</sub> = 10 Vdc, I <sub>E</sub> = 0, f <sub>test</sub> = 100 kHz)	C <sub>ob</sub>	—	165	350	pF
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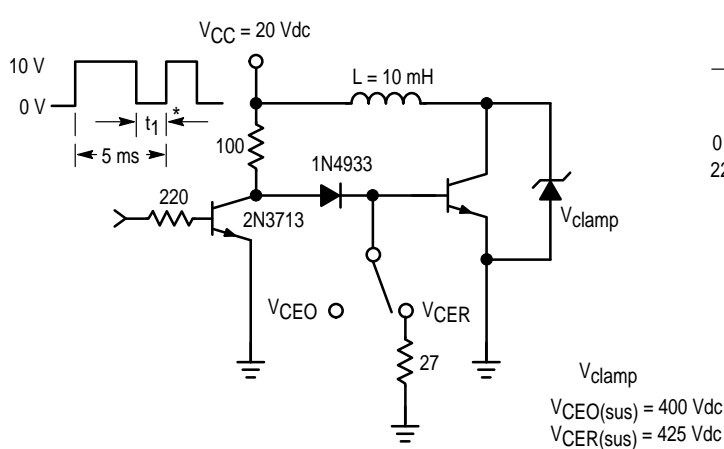
## SWITCHING CHARACTERISTICS

Storage Time	(V <sub>CC</sub> = 12 Vdc, I <sub>C</sub> = 6.0 A, I <sub>B1</sub> = I <sub>B2</sub> = 0.3 A) Figure 2	t <sub>s</sub>	—	7.5	15	μs
Fall Time		t <sub>f</sub>	—	5.2	15	μs

## FUNCTIONAL TESTS

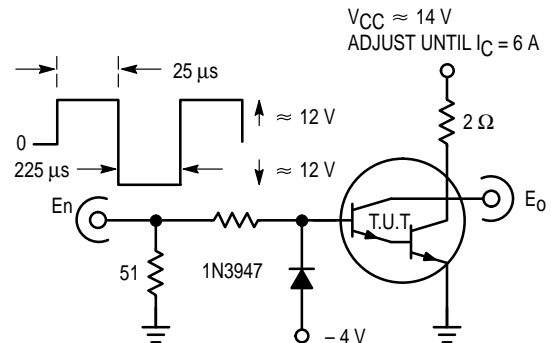
Second Breakdown Collector Current with Base–Forward Biased	I <sub>S/B</sub>	See Figure 10			—
Pulsed Energy Test (See Figure 12)	I <sub>C2L/2</sub>	—	—	180	mJ

(1) Pulse Test: Pulse Width = 300 μs, Duty Cycle = 2%.



\* Adjust t<sub>1</sub> such that I<sub>C</sub> reaches 200 mA at V<sub>CE</sub> = V<sub>clamp</sub>

**Figure 1. Sustaining Voltage Test Circuit**



**Figure 2. Switching Times Test Circuit**

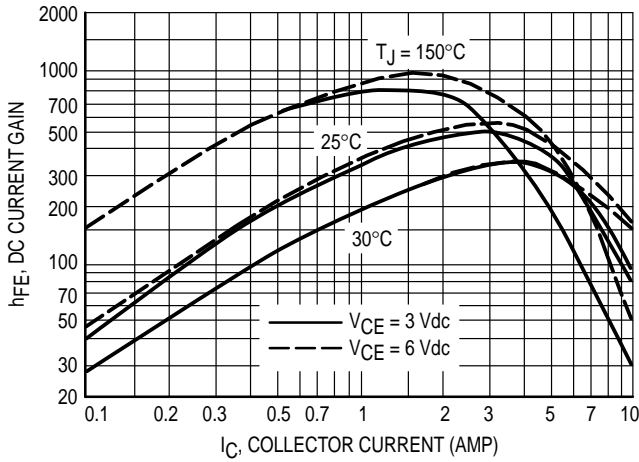


Figure 3. DC Current Gain

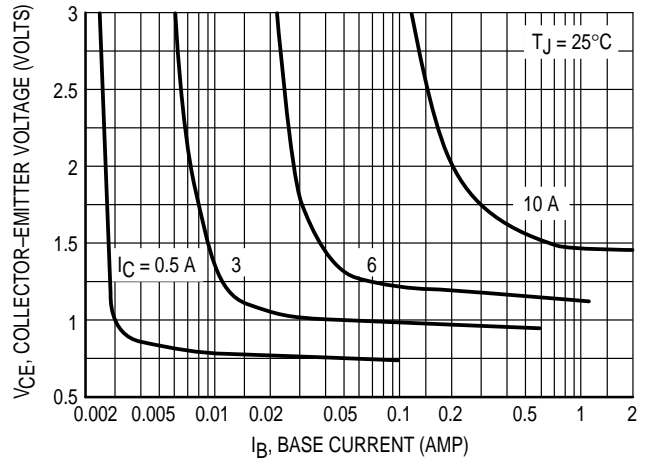


Figure 4. Collector Saturation Region

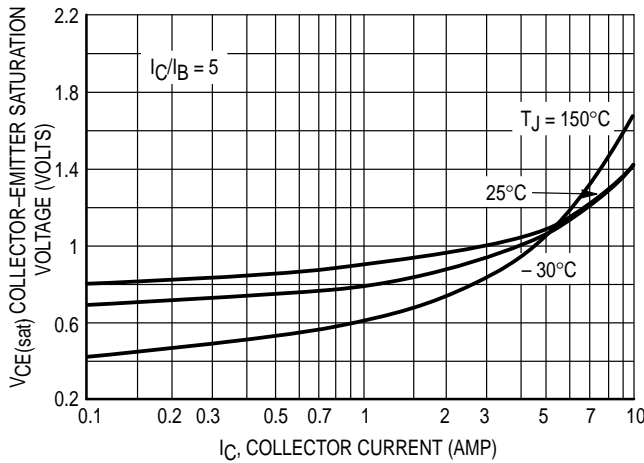


Figure 5. Collector-Emitter Saturation Voltage

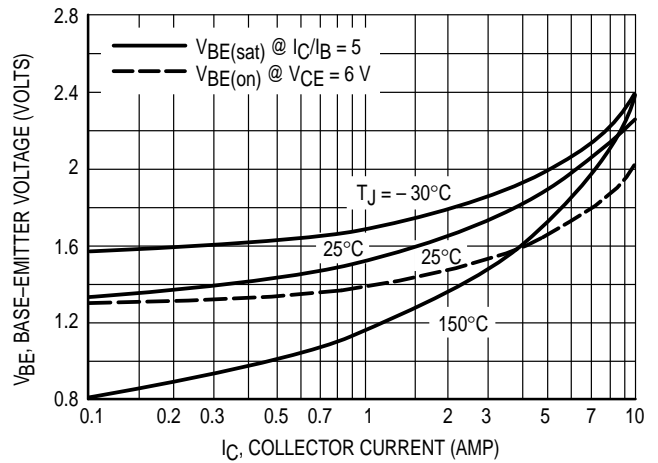


Figure 6. Base-Emitter Voltage

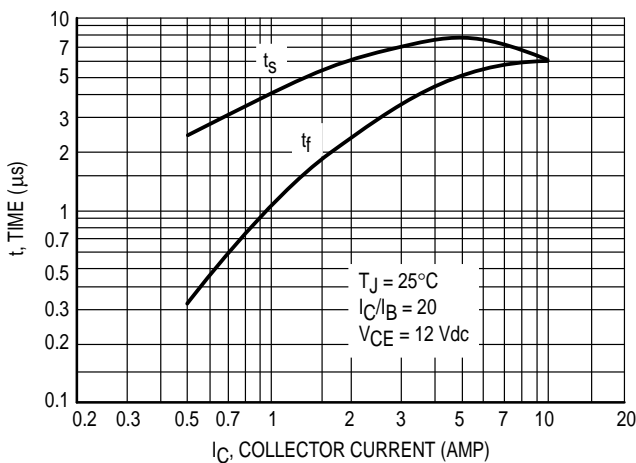


Figure 7. Turn-Off Switching Time

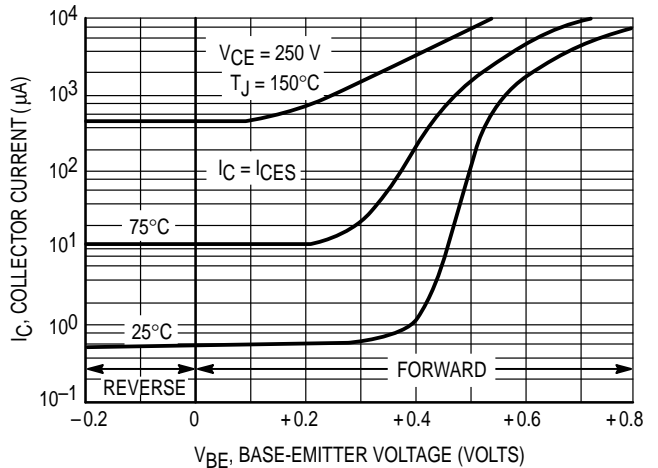


Figure 8. Collector Cutoff Region

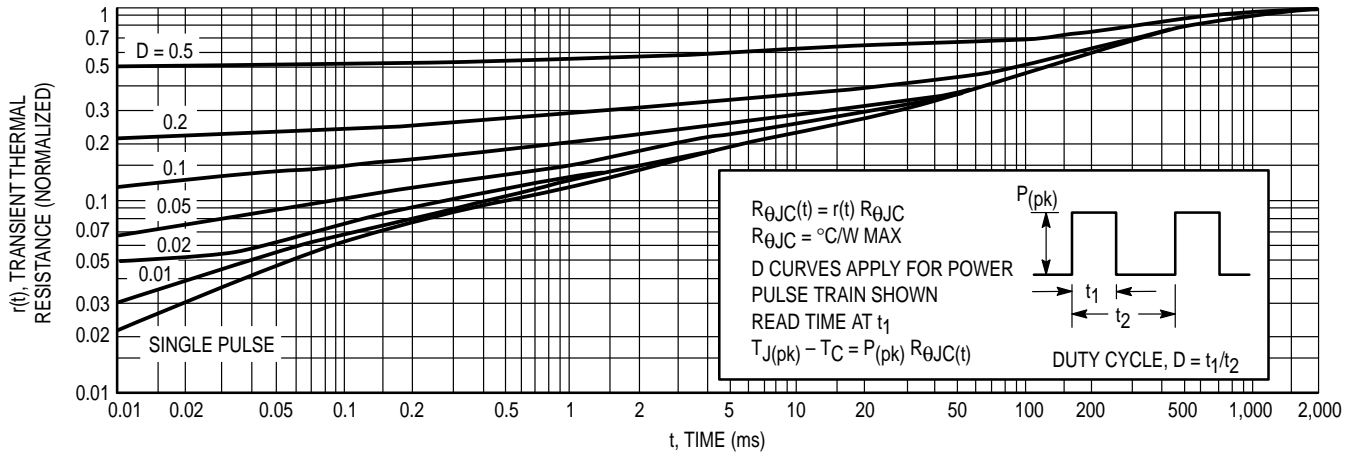


Figure 9. Thermal Response

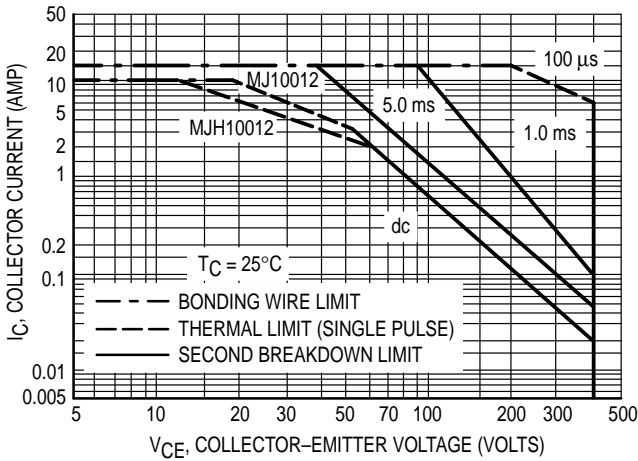


Figure 10. Forward Bias Safe Operating Area

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 10 is based on  $T_C = 25^\circ\text{C}$ ,  $T_{J(pk)}$  is variable depending on power level. Second breakdown pulse limits are valid for duty cycles to 10% but must be derated when  $T_C \geq 25^\circ\text{C}$ . Second breakdown limitations do not derate the same as thermal limitations. Allowable current at the voltages shown on Figure 10 may be found at any case temperature by using the appropriate curve on Figure 11.

$T_{J(pk)}$  may be calculated from the data in Figure 11. At high case temperatures, thermal limitations will reduce the power that can be handled to values less than the limitations imposed by second breakdown.

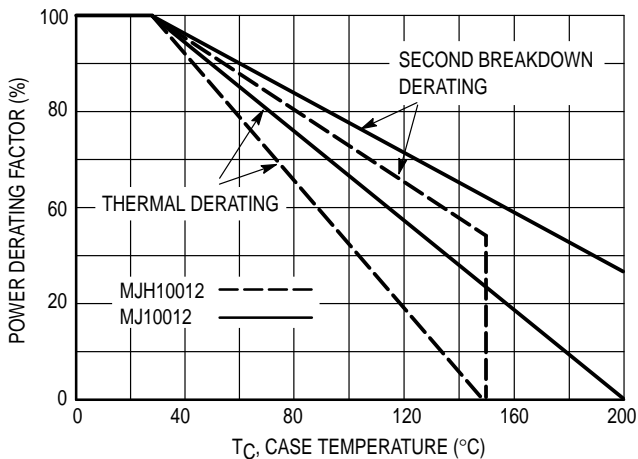
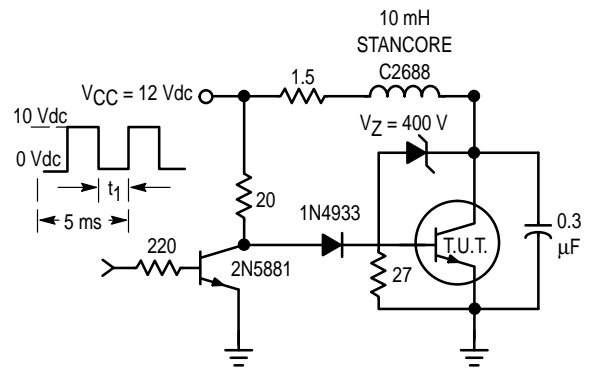


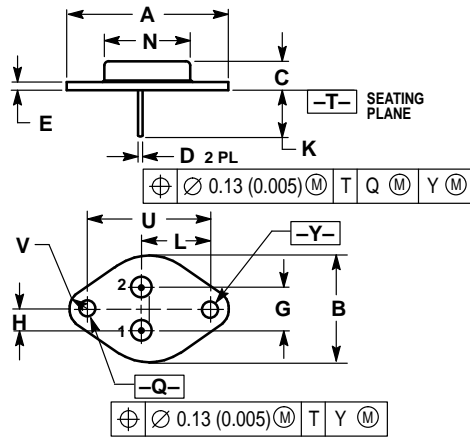
Figure 11. Power Derating



$t_1$  to be selected such that  $I_C$  reaches 6 Adc before switch-off.  
 NOTE: "Usage Test," Figure 12 specifies energy handling capabilities in an automotive ignition circuit.

Figure 12. Usage Test Circuit

PACKAGE DIMENSIONS

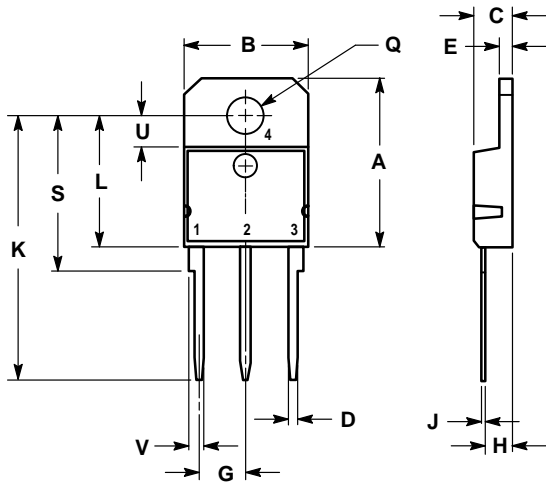


- NOTES:  
 1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.  
 2. CONTROLLING DIMENSION: INCH.  
 3. ALL RULES AND NOTES ASSOCIATED WITH REFERENCED TO-204AA OUTLINE SHALL APPLY.

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	1.550 REF	—	39.37 REF	—
B	—	1.050	—	26.67
C	0.250	0.335	6.35	8.51
D	0.038	0.043	0.97	1.09
E	0.055	0.070	1.40	1.77
G	0.430 BSC	—	10.92 BSC	—
H	0.215 BSC	—	5.46 BSC	—
K	0.440	0.480	11.18	12.19
L	0.665 BSC	—	16.89 BSC	—
N	—	0.830	—	21.08
Q	0.151	0.165	3.84	4.19
U	1.187 BSC	—	30.15 BSC	—
V	0.131	0.188	3.33	4.77

STYLE 1:  
 PIN 1: BASE  
 2: EMITTER  
 CASE: COLLECTOR

CASE 1-07  
 TO-204AA (TO-3)  
 ISSUE Z




- NOTES:  
 1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.  
 2. CONTROLLING DIMENSION: MILLIMETER.

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	19.00	19.60	0.749	0.771
B	14.00	14.50	0.551	0.570
C	4.20	4.70	0.165	0.185
D	1.00	1.30	0.040	0.051
E	1.45	1.65	0.058	0.064
G	5.21	5.72	0.206	0.225
H	2.60	3.00	0.103	0.118
J	0.40	0.60	0.016	0.023
K	28.50	32.00	1.123	1.259
L	14.70	15.30	0.579	0.602
Q	4.00	4.25	0.158	0.167
S	17.50	18.10	0.689	0.712
U	3.40	3.80	0.134	0.149
V	1.50	2.00	0.060	0.078

STYLE 1:  
 PIN 1: BASE  
 2: COLLECTOR  
 3: EMITTER  
 4: COLLECTOR

CASE 340D-01  
 SOT 93, TO-218 TYPE  
 ISSUE A

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