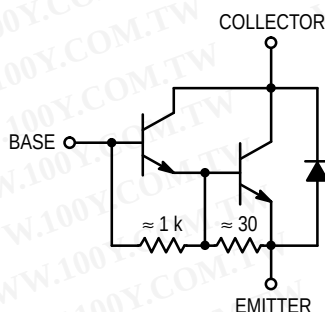


NPN Silicon Power Darlington Transistor

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

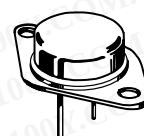
- Collector-Emitter Sustaining Voltage —
 $V_{CEO(sus)} = 400 \text{ Vdc (Min)}$
- 175 Watts Capability at 50 Volts
- Automotive Functional Tests

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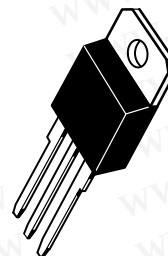


MJ10012
MJH10012

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°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 $\leq 10\%$.



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

Characteristic	Symbol	Min	Typ	Max	Unit
OFF CHARACTERISTICS (1)					
Collector–Emitter Sustaining Voltage (Figure 1) ($I_C = 200\text{ mA}$, $I_B = 0$, $V_{\text{clamp}} = \text{Rated } V_{\text{CEO}}$)	$V_{\text{CEO(sus)}}$	400	—	—	Vdc
Collector–Emitter Sustaining Voltage (Figure 1) ($I_C = 200\text{ mA}$, $R_{\text{BE}} = 27\text{ Ohms}$, $V_{\text{clamp}} = \text{Rated } V_{\text{CER}}$)	$V_{\text{CER(sus)}}$	425	—	—	Vdc
Collector Cutoff Current (Rated V_{CER} , $R_{\text{BE}} = 27\text{ Ohms}$)	I_{CER}	—	—	1.0	mA
Collector Cutoff Current (Rated V_{CBO} , $I_E = 0$)	I_{CBO}	—	—	1.0	mA
Emitter Cutoff Current ($V_{\text{EB}} = 6.0\text{ Vdc}$, $I_C = 0$)	I_{EBO}	—	—	40	mA

ON CHARACTERISTICS (1)

DC Current Gain ($I_C = 3.0\text{ A}$, $V_{\text{CE}} = 6.0\text{ Vdc}$) ($I_C = 6.0\text{ A}$, $V_{\text{CE}} = 6.0\text{ Vdc}$) ($I_C = 10\text{ A}$, $V_{\text{CE}} = 6.0\text{ Vdc}$)	h_{FE}	300 100 20	550 350 150	— 2000 —	—
Collector–Emitter Saturation Voltage ($I_C = 3.0\text{ A}$, $I_B = 0.6\text{ A}$) ($I_C = 6.0\text{ A}$, $I_B = 0.6\text{ A}$) ($I_C = 10\text{ A}$, $I_B = 2.0\text{ A}$)	$V_{\text{CE(sat)}}$	— — —	— — —	1.5 2.0 2.5	Vdc
Base Emitter Saturation Voltage ($I_C = 6.0\text{ A}$, $I_B = 0.6\text{ A}$) ($I_C = 10\text{ A}$, $I_B = 2.0\text{ A}$)	$V_{\text{BE(sat)}}$	— —	— —	2.5 3.0	Vdc
Base Emitter On Voltage ($I_C = 10\text{ A}$, $V_{\text{CE}} = 6.0\text{ Vdc}$)	$V_{\text{BE(on)}}$	—	—	2.8	Vdc
Diode Forward Voltage ($I_F = 10\text{ A}$)	V_f	—	2.0	3.5	Vdc

DYNAMIC CHARACTERISTICS

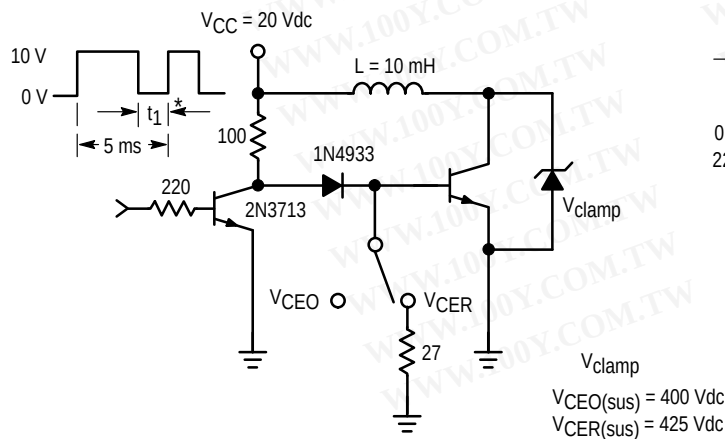
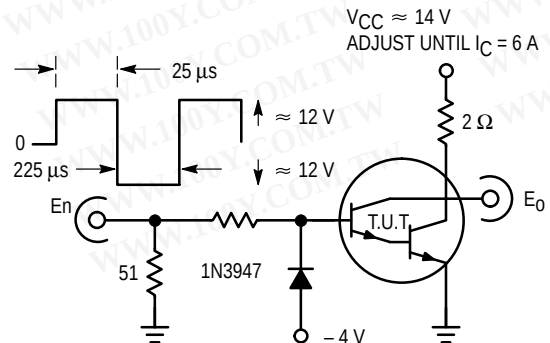
Output Capacitance ($V_{\text{CB}} = 10\text{ Vdc}$, $I_E = 0$, $f_{\text{test}} = 100\text{ kHz}$)	C_{ob}	—	165	350	pF
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SWITCHING CHARACTERISTICS

Storage Time	($V_{\text{CC}} = 12\text{ Vdc}$, $I_C = 6.0\text{ A}$, $I_{\text{B1}} = I_{\text{B2}} = 0.3\text{ A}$) Figure 2	t_s	—	7.5	15	μs
Fall Time		t_f	—	5.2	15	μs

FUNCTIONAL TESTS

Second Breakdown Collector Current with Base–Forward Biased	$I_{\text{S/B}}$	See Figure 10			—
Pulsed Energy Test (See Figure 12)	$I_{\text{C2L/2}}$	—	—	180	mJ

(1) Pulse Test: Pulse Width = 300 μs , Duty Cycle = 2%.* Adjust t_1 such that I_C reaches 200 mA at $V_{\text{CE}} = V_{\text{clamp}}$ Figure 1. Sustaining Voltage
Test CircuitFigure 2. Switching Times
Test Circuit

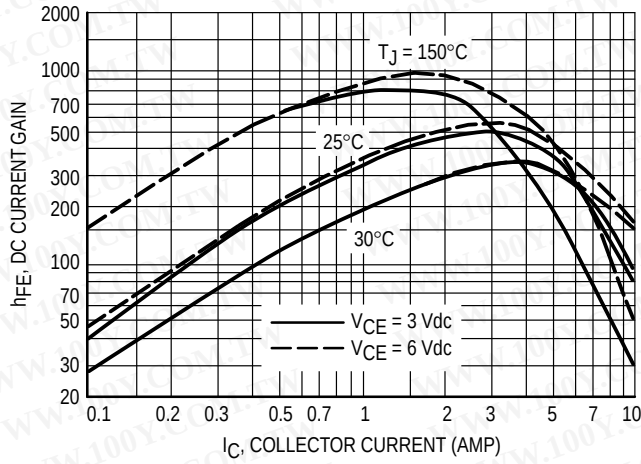


Figure 3. DC Current Gain

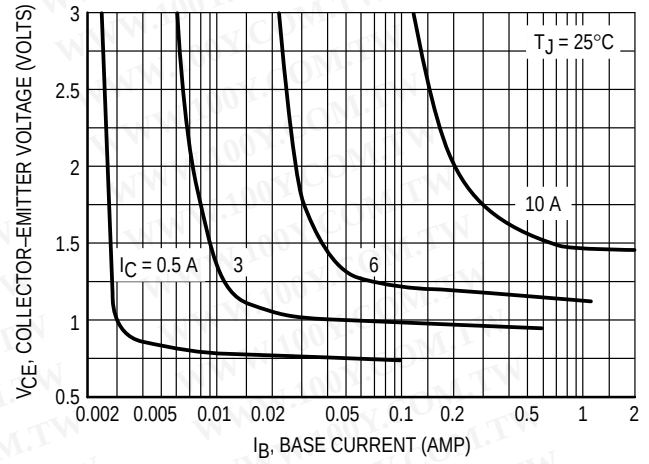


Figure 4. Collector Saturation Region

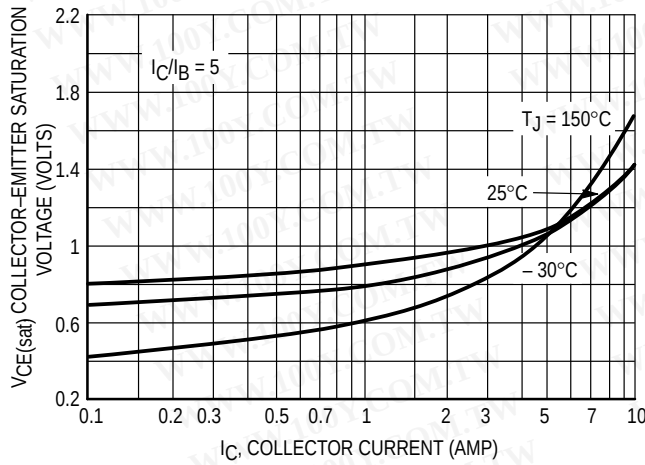


Figure 5. Collector-Emitter Saturation Voltage

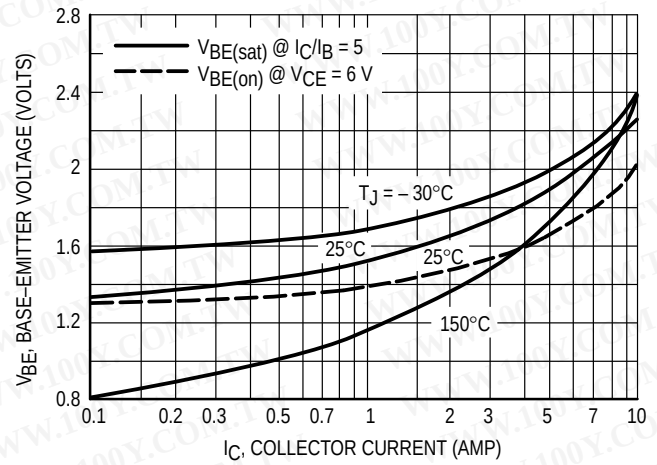


Figure 6. Base-Emitter Voltage

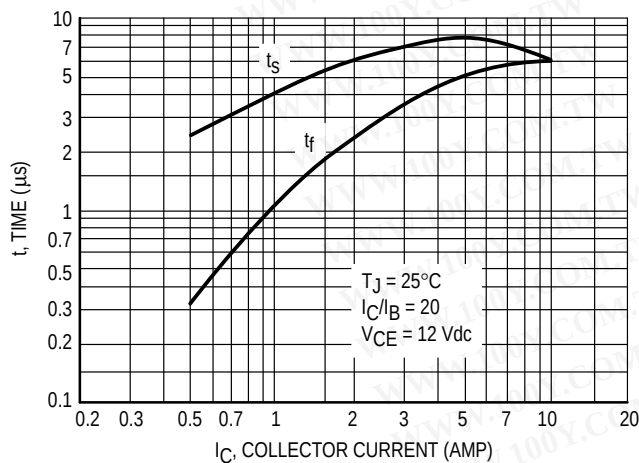


Figure 7. Turn-Off Switching Time

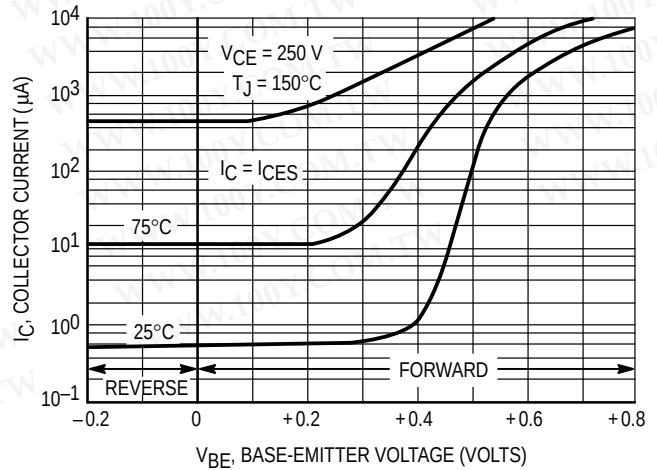


Figure 8. Collector Cutoff Region

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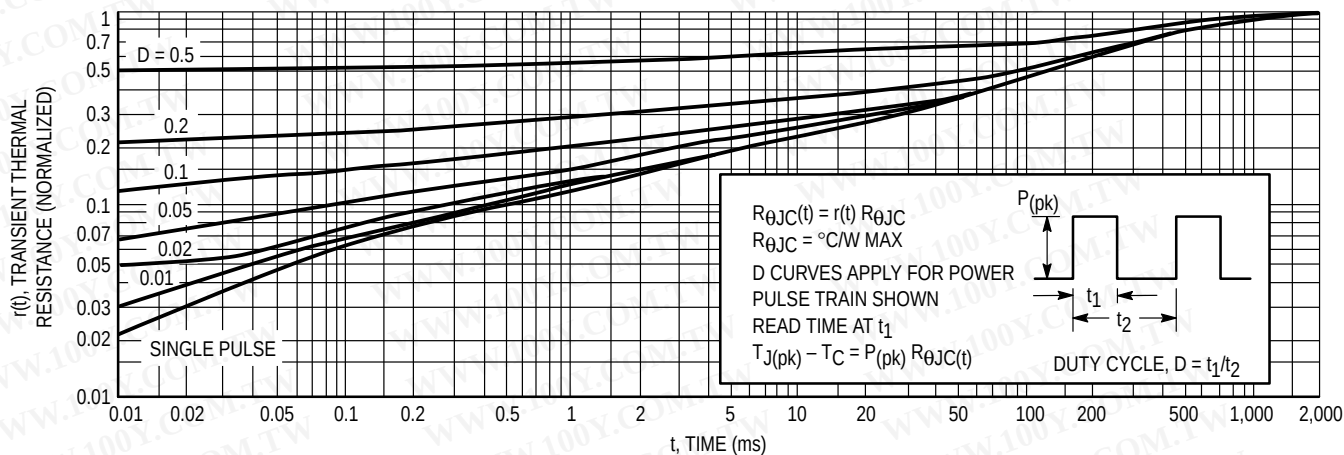


Figure 9. Thermal Response

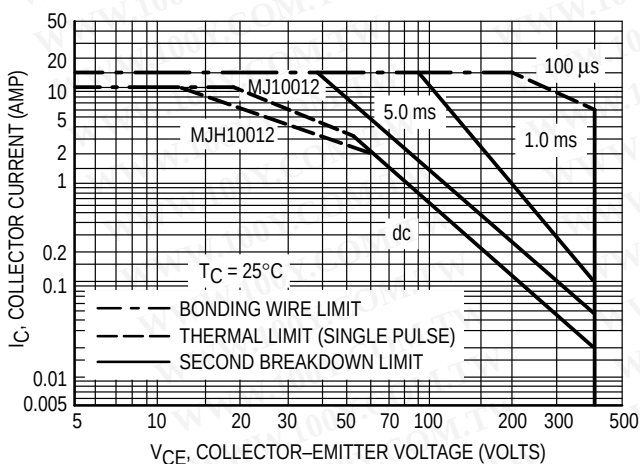


Figure 10. Forward Bias Safe Operating Area

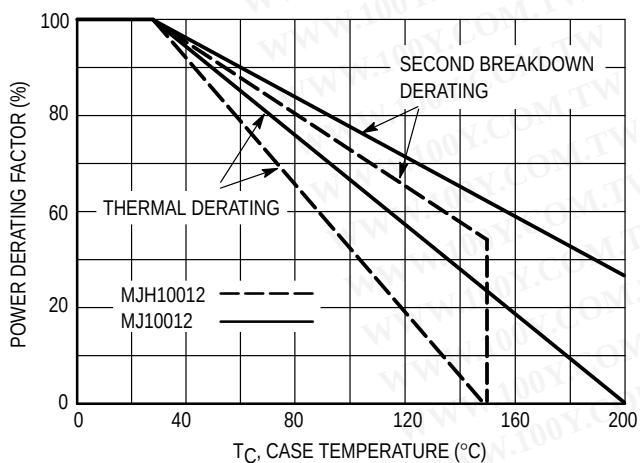
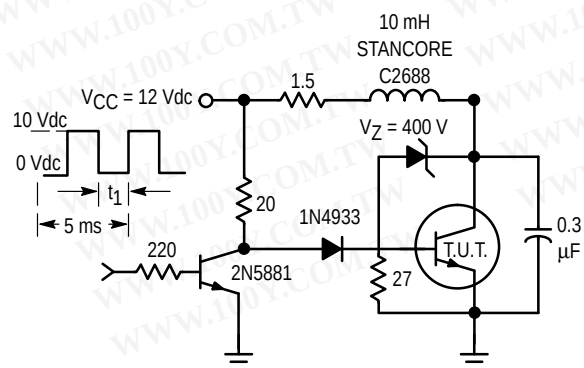


Figure 11. Power Derating

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.



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

