

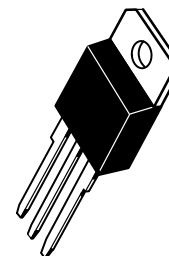
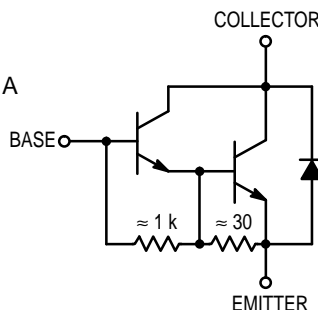
**BU323AP**

**DARLINGTON  
NPN SILICON  
POWER TRANSISTOR  
400 VOLTS  
125 WATTS**

# NPN Silicon Darlington Power Transistor

The BU323AP is a monolithic darlington transistor designed for automotive ignition, switching regulator and motor control applications.

- Collector–Emitter Sustaining Voltage —  
 $V_{CER(sus)} = 475 \text{ Vdc}$
- 125 Watts Capability at 50 Volts
- $V_{CE \text{ Sat}}$  Specified at  $-40^\circ\text{C} = 2.0 \text{ V Max.}$  at  $I_C = 6.0 \text{ A}$
- Photoglass Passivation for Reliability and Stability



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

## MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Collector–Emitter Voltage	$V_{CEO(sus)}$	400	Vdc
Collector–Emitter Voltage	$V_{CEV}$	475	Vdc
Emitter–Base Voltage	$V_{EB}$	6.0	Vdc
Collector Current — Continuous	$I_C$	10	Adc
— Peak (1)	$I_{CM}$	16	
Base Current — Continuous	$I_B$	3.0	Adc
— Peak (1)	$I_{BM}$		
Total Power Dissipation — $T_C = 25^\circ\text{C}$	$P_D$	125	Watts
— $T_C = 100^\circ\text{C}$		100	Watts
Derate above $25^\circ\text{C}$		1.0	W/ $^\circ\text{C}$
Operating and Storage Junction Temperature Range	$T_J, T_{stg}$	-65 to +200	$^\circ\text{C}$

## THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	1.0	$^\circ\text{C/W}$
Maximum Lead Temperature for Soldering Purposes: 1/8" from Case for 5 Seconds	$T_L$	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
<b>OFF CHARACTERISTICS<sup>1</sup></b>					
Collector–Emitter Sustaining Voltage (Figure 1) L = 10 mH ( $I_C = 200\text{ mA}$ , $I_B = 0$ , $V_{\text{clamp}} = \text{Rated } V_{\text{CEO}}$ )	$V_{\text{CEO(sus)}}$	400			Vdc
Collector–Emitter Sustaining Voltage (Figure 1) ( $I_C = 3\text{ A}$ , $R_{\text{BE}} = 100\text{ Ohms}$ , L = 500 $\mu\text{H}$ ) Unclamped	$V_{\text{CER(sus)}}$	475			Vdc
Collector Cutoff Current (Rated $V_{\text{CER}}$ , $R_{\text{BE}} = 100\text{ Ohms}$ )	$I_{\text{CER}}$			1	mAdc
Collector Cutoff Current (Rated $V_{\text{CBO}}$ , $I_E = 0$ )	$I_{\text{CBO}}$			1	mAdc
Emitter Cutoff Current ( $V_{\text{EB}} = 6\text{ Vdc}$ , $I_C = 0$ )	$I_{\text{EBO}}$			40	mAdc

**ON CHARACTERISTICS<sup>1</sup>**

DC Current Gain ( $I_C = 3\text{ Adc}$ , $V_{\text{CE}} = 6\text{ Vdc}$ ) ( $I_C = 6\text{ Adc}$ , $V_{\text{CE}} = 6\text{ Vdc}$ ) ( $I_C = 10\text{ Adc}$ , $V_{\text{CE}} = 6\text{ Vdc}$ )	hFE	300 150 50	550 350 150	2000	
Collector–Emitter Saturation Voltage ( $I_C = 3\text{ Adc}$ , $I_B = 60\text{ mA}$ ) ( $I_C = 6\text{ Adc}$ , $I_B = 120\text{ mA}$ ) ( $I_C = 10\text{ Adc}$ , $I_B = 300\text{ mA}$ ) ( $I_C = 6\text{ Adc}$ , $I_B = 120\text{ mA}$ , $T_C = -40^\circ\text{C}$ )	$V_{\text{CE(sat)}}$			1.5 1.7 2.7 2.0	Vdc
Base–Emitter Saturation Voltage ( $I_C = 6\text{ Adc}$ , $I_B = 120\text{ mA}$ ) ( $I_C = 10\text{ Adc}$ , $I_B = 300\text{ mA}$ ) ( $I_C = 6\text{ Adc}$ , $I_B = 120\text{ mA}$ , $T_C = -40^\circ\text{C}$ )	$V_{\text{BE(sat)}}$			2.2 3 2.4	Vdc
Base–Emitter On Voltage ( $I_C = 10\text{ Adc}$ , $V_{\text{CE}} = 6\text{ Vdc}$ )	$V_{\text{BE(on)}}$			2.5	Vdc
Diode Forward Voltage ( $I_F = 10\text{ Adc}$ )	$V_f$		2	3.5	Vdc

**DYNAMIC CHARACTERISTICS**

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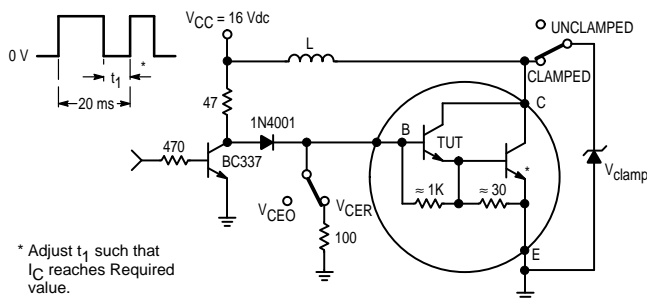
**SWITCHING CHARACTERISTICS**

Storage Time	$(V_{\text{CC}} = 12\text{ Vdc}$ , $I_C = 6\text{ Adc}$ , $I_{\text{B1}} = I_{\text{B2}} = 0.3\text{ Adc}$ ) Fig. 2	$t_s$	7.5	15	$\mu\text{s}$
Fall Time		$t_f$	5.2	15	$\mu\text{s}$

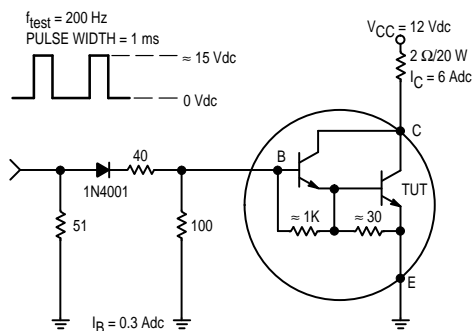
**FUNCTIONAL TESTS**

Second Breakdown Collector Current with Base–Forward Biased	$I_{\text{S/B}}$		See Figure 10		
Pulsed Energy Test (See Figure 12)	$I_{\text{C2L/2}}$	550			mJ

<sup>1</sup>Pulse Test: Pulse Width = 300  $\mu\text{s}$ , Duty Cycle = 2%.



**Figure 1. Sustaining Voltage Test Circuit**



**Figure 2. Switching Times Test Circuit**

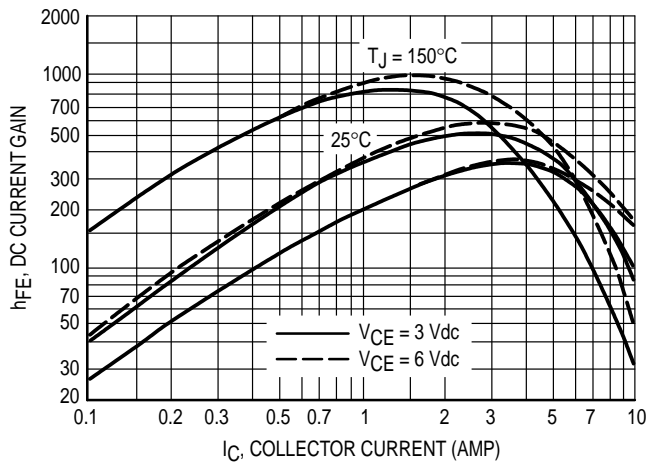


Figure 3. DC Current Gain

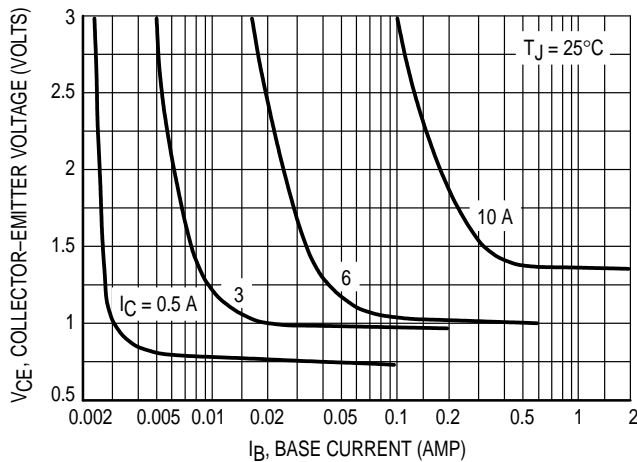


Figure 4. Collector Saturation Region

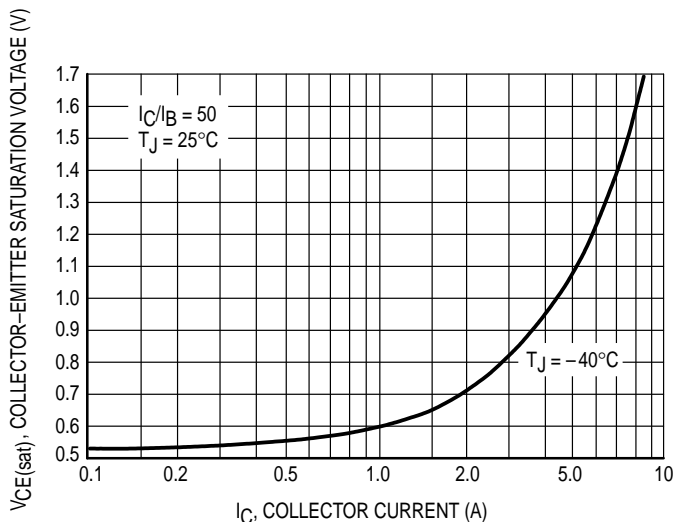


Figure 5. Collector-Emitter Saturation Voltage

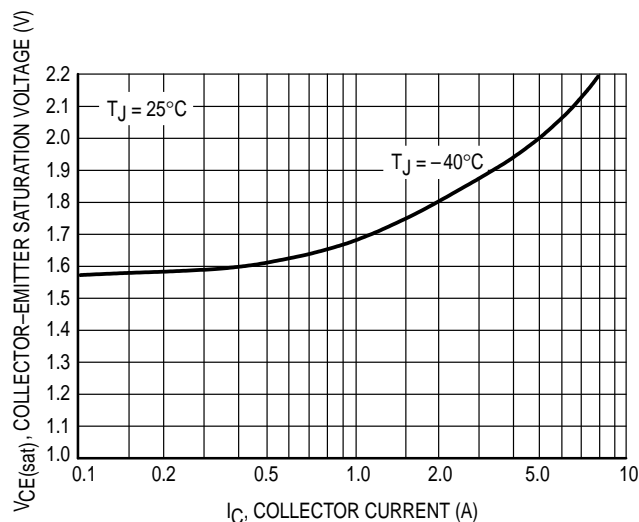


Figure 6. Base-Emitter Voltage

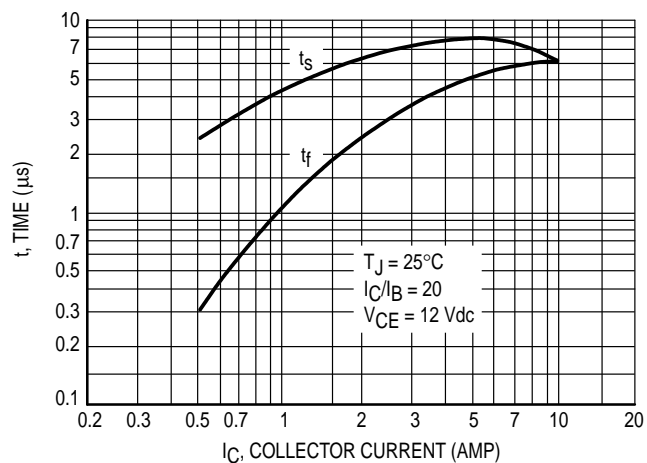


Figure 7. Turn-Off Switching Time

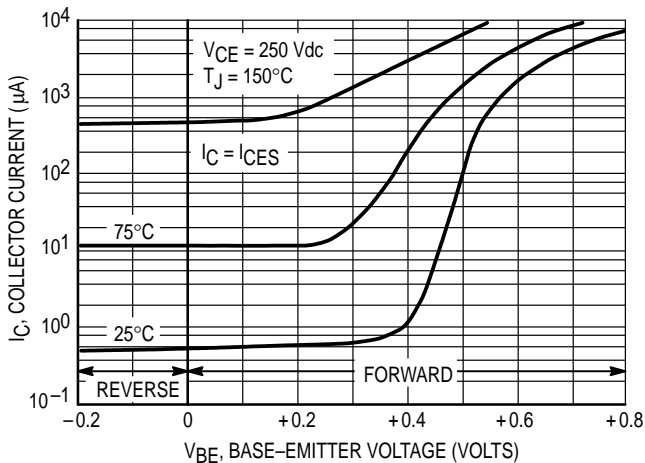
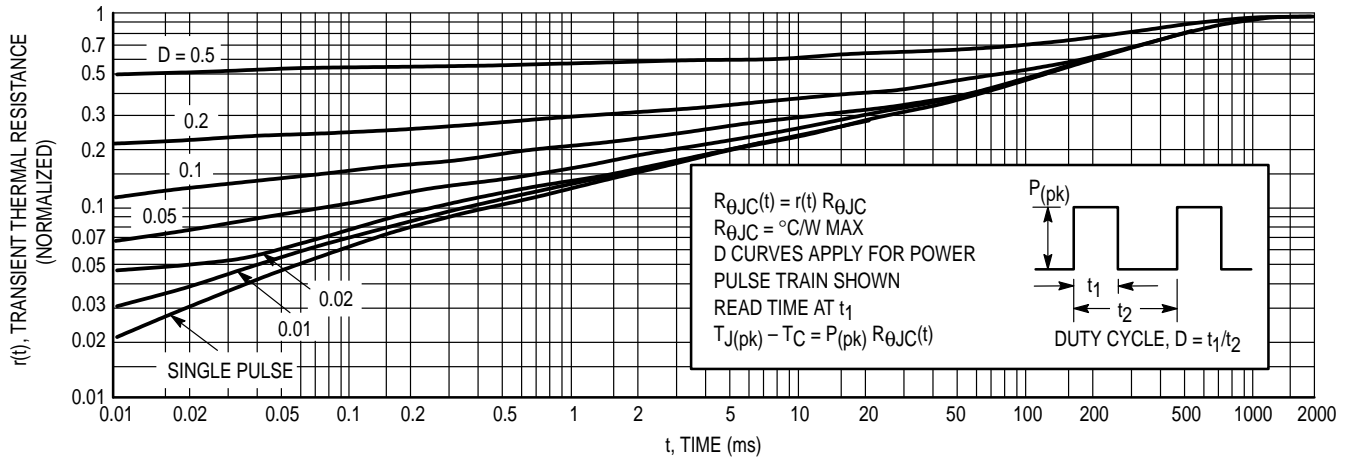
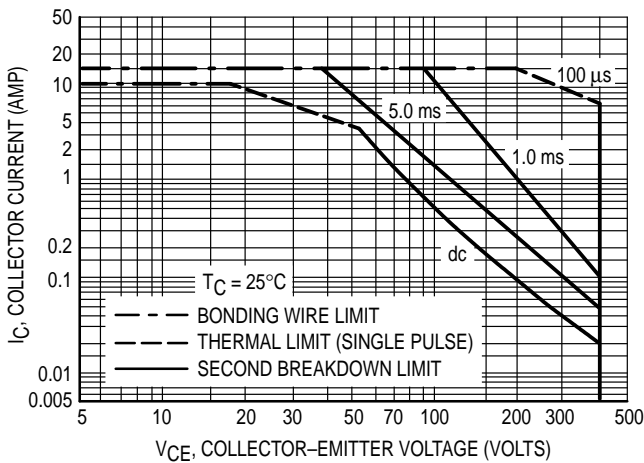


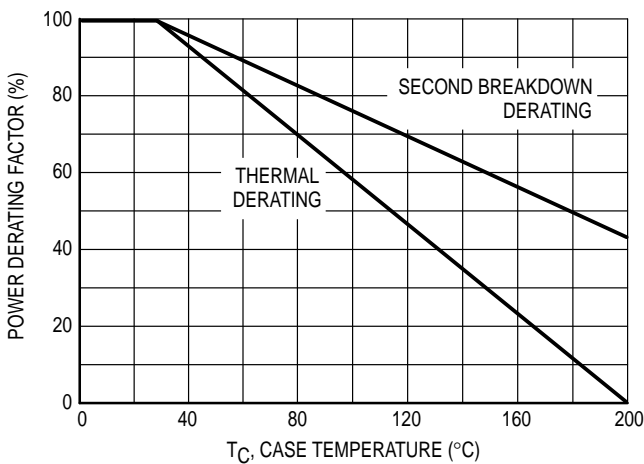
Figure 8. Collector Cutoff Region



**Figure 9. Thermal Response**



**Figure 10. Forward Bias Safe Operating Area**

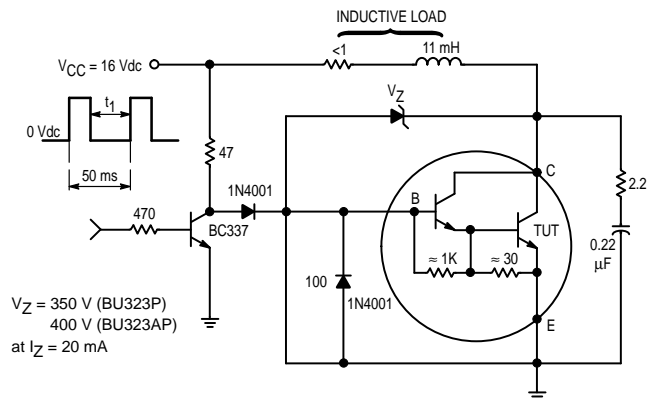


**Figure 11. Power Derating**

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.

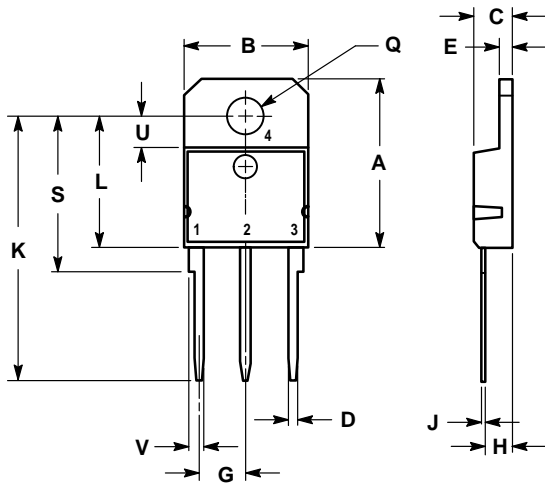


$t_1$  to be selected such that  $I_C$  reaches 10 Adc before switch-off.

NOTE: Figure 12 specifies energy handling capabilities in an automotive ignition circuit.

**Figure 12. Ignition Test Circuit**

PACKAGE DIMENSIONS



- 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  
 TO-218 TYPE  
 ISSUE A

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