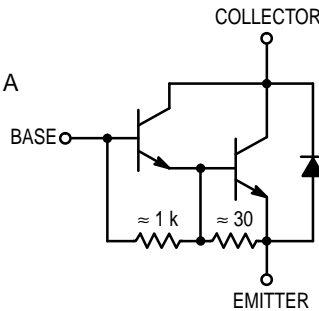


**BU323AP**

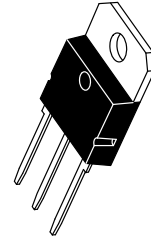
**NPN Silicon Darlington Power Transistor**

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

- Collector–Emitter Sustaining Voltage —  
 $V_{CE(sus)} = 475 \text{ Vdc}$
- 125 Watts Capability at 50 Volts
- $V_{CE}$  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



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



**CASE 340D-02  
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  $\leq 10\%$ .

# BU323AP

## 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 ( $I_C = 3\text{ Adc}$ , $I_B = 60\text{ mAdc}$ ) ( $I_C = 6\text{ Adc}$ , $I_B = 120\text{ mAdc}$ ) ( $I_C = 10\text{ Adc}$ , $I_B = 300\text{ mAdc}$ ) ( $I_C = 6\text{ Adc}$ , $I_B = 120\text{ mAdc}$ , $T_C = -40^\circ\text{C}$ )	$V_{\text{CE(sat)}}$			1.5 1.7 2.7 2.0	Vdc
Base–Emitter Saturation Voltage ( $I_C = 6\text{ Adc}$ , $I_B = 120\text{ mAdc}$ ) ( $I_C = 10\text{ Adc}$ , $I_B = 300\text{ mAdc}$ ) ( $I_C = 6\text{ Adc}$ , $I_B = 120\text{ mAdc}$ , $T_C = -40^\circ\text{C}$ )	$V_{\text{BE(sat)}}$			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
---	-----------------	--	-----	-----	----

## 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)	$I_{\text{C}2\text{L}/2}$	550			mJ

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

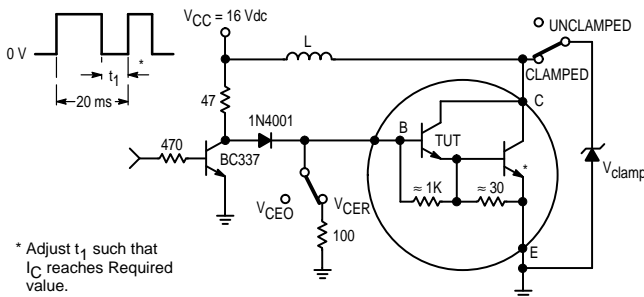


Figure 1. Sustaining Voltage Test Circuit

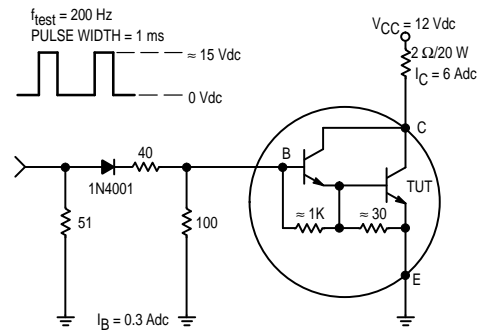


Figure 2. Switching Times Test Circuit

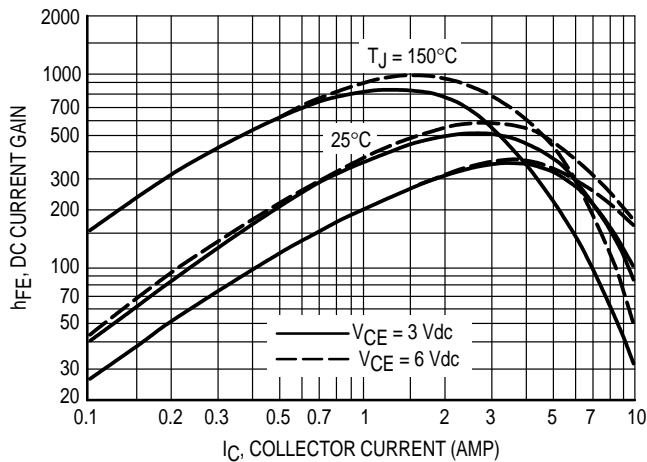


Figure 3. DC Current Gain

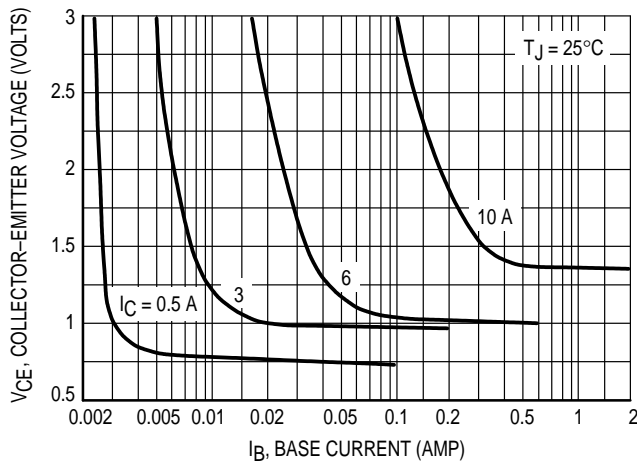


Figure 4. Collector Saturation Region

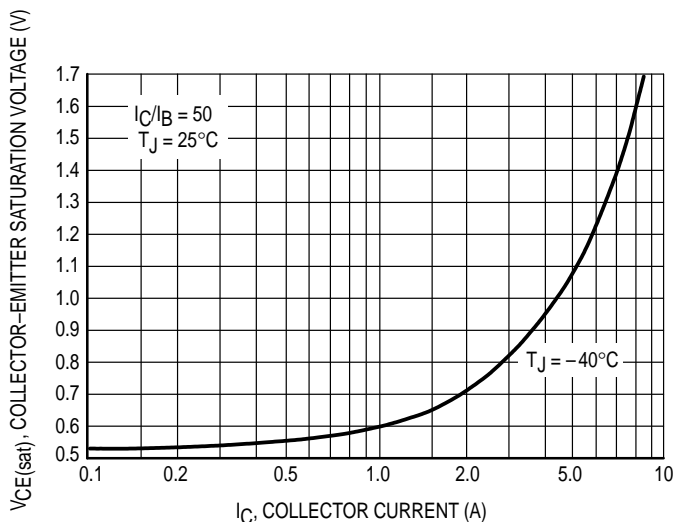


Figure 5. Collector-Emitter Saturation Voltage

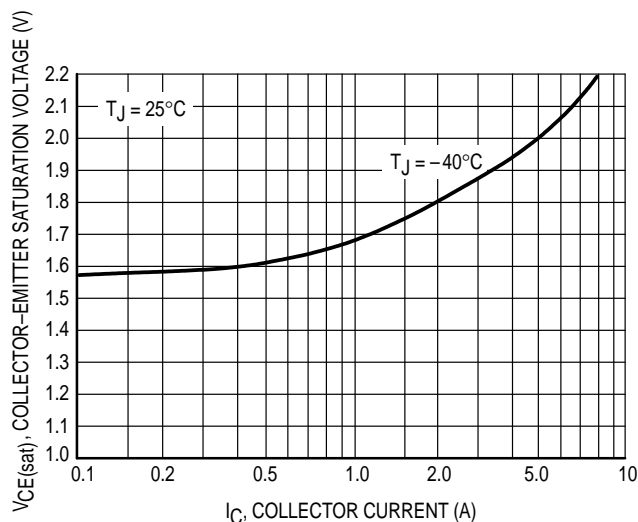


Figure 6. Base-Emitter Voltage

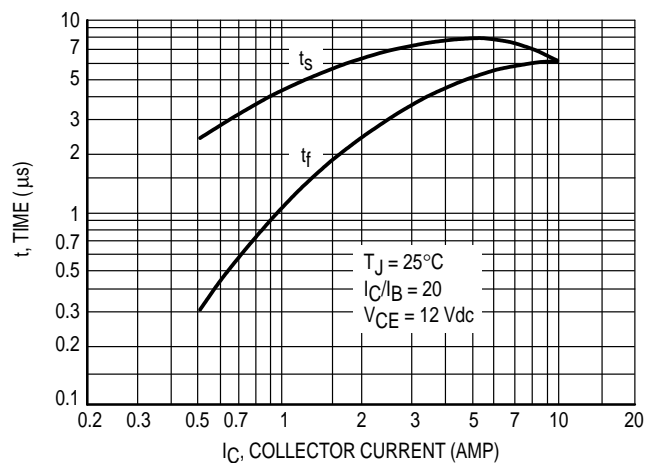


Figure 7. Turn-Off Switching Time

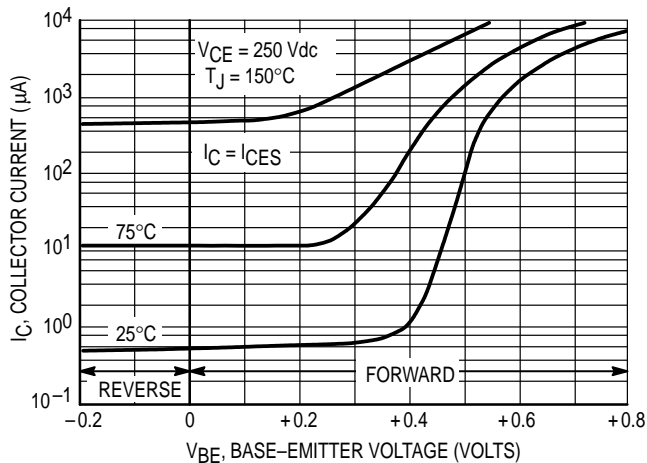


Figure 8. Collector Cutoff Region

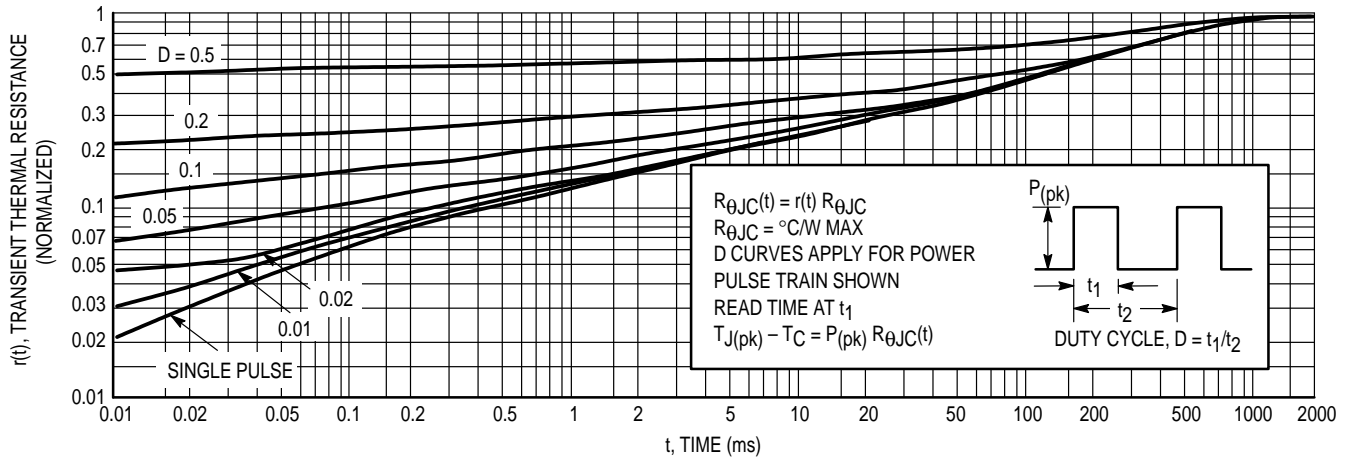


Figure 9. Thermal Response

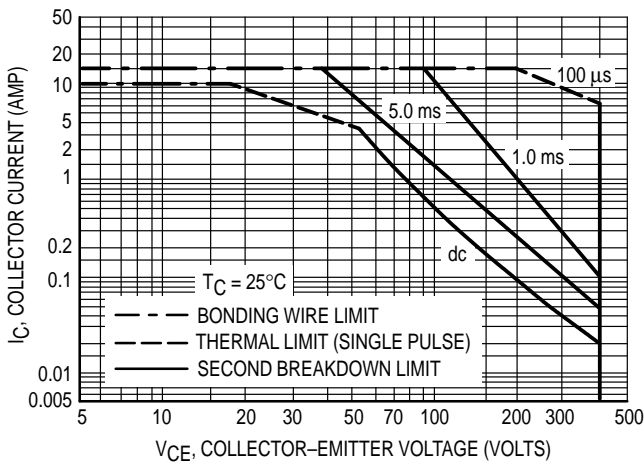


Figure 10. Forward Bias Safe Operating Area

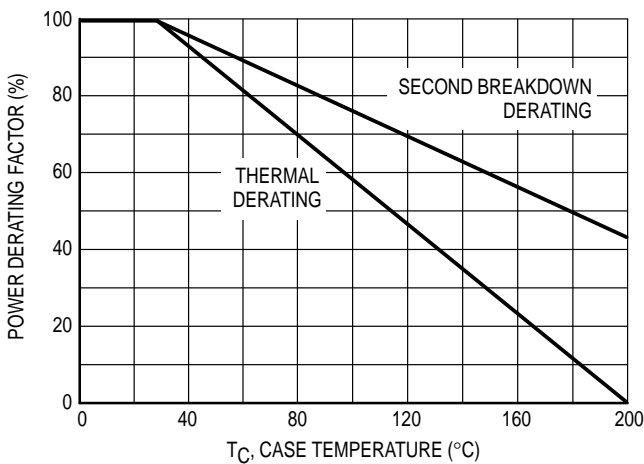
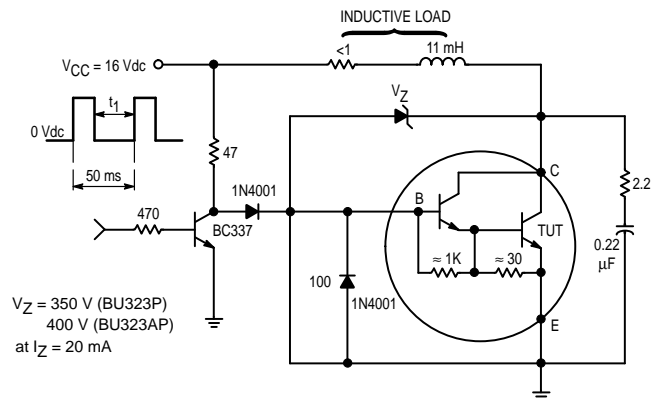


Figure 11. Power Derating

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.

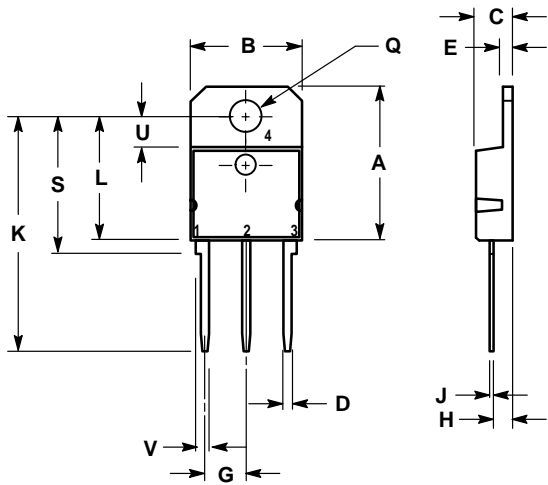


$t_1$  to be selected such that  $I_C$  reaches 10 Adc before switch-off.

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	—	20.35	—	0.801
B	14.70	15.20	0.579	0.598
C	4.70	4.90	0.185	0.193
D	1.10	1.30	0.043	0.051
E	1.17	1.37	0.046	0.054
G	5.40	5.55	0.213	0.219
H	2.00	3.00	0.079	0.118
J	0.50	0.78	0.020	0.031
K	31.00 REF		1.220 REF	
L	—	16.20	—	0.638
Q	4.00	4.10	0.158	0.161
S	17.80	18.20	0.701	0.717
U	4.00 REF		0.157 REF	
V	1.75 REF		0.069	

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

CASE 340D-02  
 TO-218 TYPE  
 ISSUE B

Motorola reserves the right to make changes without further notice to any products herein. Motorola makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does Motorola assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation consequential or incidental damages. "Typical" parameters which may be provided in Motorola data sheets and/or specifications can and do vary in different applications and actual performance may vary over time. All operating parameters, including "Typicals" must be validated for each customer application by customer's technical experts. Motorola does not convey any license under its patent rights nor the rights of others. Motorola products are not designed, intended, or authorized for use as components in systems intended for surgical implant into the body, or other applications intended to support or sustain life, or for any other application in which the failure of the Motorola product could create a situation where personal injury or death may occur. Should Buyer purchase or use Motorola products for any such unintended or unauthorized application, Buyer shall indemnify and hold Motorola and its officers, employees, subsidiaries, affiliates, and distributors harmless against all claims, costs, damages, and expenses, and reasonable attorney fees arising out of, directly or indirectly, any claim of personal injury or death associated with such unintended or unauthorized use, even if such claim alleges that Motorola was negligent regarding the design or manufacture of the part. Motorola and  are registered trademarks of Motorola, Inc. Motorola, Inc. is an Equal Opportunity/Affirmative Action Employer.

**How to reach us:**

**USA/EUROPE/Locations Not Listed:** Motorola Literature Distribution;  
P.O. Box 20912; Phoenix, Arizona 85036. 1-800-441-2447 or 602-303-5454

**MFAX:** RMFAX0@email.sps.mot.com – TOUCHTONE 602-244-6609  
**INTERNET:** <http://Design-NET.com>

**JAPAN:** Nippon Motorola Ltd.; Tatsumi-SPD-JLDC, 6F Seibu-Butsuryu-Center,  
3-14-2 Tatsumi Koto-Ku, Tokyo 135, Japan. 03-81-3521-8315

**ASIA/PACIFIC:** Motorola Semiconductors H.K. Ltd.; 8B Tai Ping Industrial Park,  
51 Ting Kok Road, Tai Po, N.T., Hong Kong. 852-26629298



BU323AP/D

