

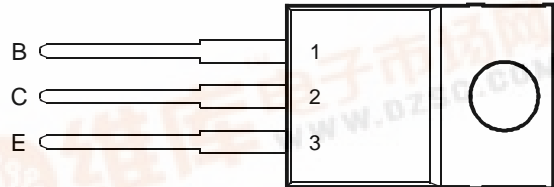
## BD239D, BD239E, BD239F NPN SILICON POWER TRANSISTORS

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SEPTEMBER 1981 - REVISED MARCH 1997

- 30 W at 25°C Case Temperature
- 2 A Continuous Collector Current
- 4 A Peak Collector Current
- Customer-Specified Selections Available

TO-220 PACKAGE  
(TOP VIEW)



Pin 2 is in electrical contact with the mounting base.

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### absolute maximum ratings at 25°C case temperature (unless otherwise noted)

RATING		SYMBOL	VALUE	UNIT
Collector-emitter voltage ( $R_{BE} = 100 \Omega$ )	BD239D	$V_{CER}$	160	V
	BD239E		180	
	BD239F		200	
Collector-emitter voltage ( $I_B = 0$ )	BD239D	$V_{CEO}$	120	V
	BD239E		140	
	BD239F		160	
Emitter-base voltage		$V_{EBO}$	5	V
Continuous collector current		$I_C$	2	A
Peak collector current (see Note 1)		$I_{CM}$	4	A
Continuous base current		$I_B$	0.6	A
Continuous device dissipation at (or below) 25°C case temperature (see Note 2)		$P_{tot}$	30	W
Continuous device dissipation at (or below) 25°C free air temperature (see Note 3)		$P_{tot}$	2	W
Unclamped inductive load energy (see Note 4)		$\frac{1}{2}LI_C^2$	32	mJ
Operating junction temperature range		$T_j$	-65 to +150	°C
Storage temperature range		$T_{stg}$	-65 to +150	°C
Lead temperature 3.2 mm from case for 10 seconds		$T_L$	250	°C

- NOTES: 1. This value applies for  $t_p \leq 0.3$  ms, duty cycle  $\leq 10\%$ .  
 2. Derate linearly to 150°C case temperature at the rate of 0.24 W/°C.  
 3. Derate linearly to 150°C free air temperature at the rate of 16 mW/°C.  
 4. This rating is based on the capability of the transistor to operate safely in a circuit of:  $L = 20$  mH,  $I_{B(on)} = 0.4$  A,  $R_{BE} = 100 \Omega$ ,  $V_{BE(off)} = 0$ ,  $R_S = 0.1 \Omega$ ,  $V_{CC} = 20$  V.



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## NPN SILICON POWER TRANSISTORS

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### electrical characteristics at 25°C case temperature

PARAMETER	TEST CONDITIONS			MIN	TYP	MAX	UNIT
$V_{(BR)CEO}$ Collector-emitter breakdown voltage	$I_C = 30 \text{ mA}$ (see Note 5)	$I_B = 0$	BD239D BD239E BD239F	120 140 160			V
$I_{CES}$ Collector-emitter cut-off current	$V_{CE} = 160 \text{ V}$ $V_{CE} = 180 \text{ V}$ $V_{CE} = 200 \text{ V}$	$V_{BE} = 0$ $V_{BE} = 0$ $V_{BE} = 0$	BD239D BD239E BD239F			0.2 0.2 0.2	mA
$I_{CEO}$ Collector cut-off current	$V_{CE} = 90 \text{ V}$	$I_B = 0$				0.3	mA
$I_{EBO}$ Emitter cut-off current	$V_{EB} = 5 \text{ V}$	$I_C = 0$				1	$\mu\text{A}$
$h_{FE}$ Forward current transfer ratio	$V_{CE} = 4 \text{ V}$ $V_{CE} = 4 \text{ V}$	$I_C = 0.2 \text{ A}$ $I_C = 1 \text{ A}$	(see Notes 5 and 6)	40 15			
$V_{CE(sat)}$ Collector-emitter saturation voltage	$I_B = 0.2 \text{ A}$	$I_C = 1 \text{ A}$	(see Notes 5 and 6)			0.7	V
$V_{BE}$ Base-emitter voltage	$V_{CE} = 4 \text{ V}$	$I_C = 1 \text{ A}$	(see Notes 5 and 6)			1.3	V
$h_{fe}$ Small signal forward current transfer ratio	$V_{CE} = 10 \text{ V}$	$I_C = 0.2 \text{ A}$	$f = 1 \text{ kHz}$	20			
$ h_{fe} $ Small signal forward current transfer ratio	$V_{CE} = 10 \text{ V}$	$I_C = 0.2 \text{ A}$	$f = 1 \text{ MHz}$	3			

NOTES: 5. These parameters must be measured using pulse techniques,  $t_p = 300 \mu\text{s}$ , duty cycle  $\leq 2\%$ .

6. These parameters must be measured using voltage-sensing contacts, separate from the current carrying contacts.

### thermal characteristics

PARAMETER	MIN	TYP	MAX	UNIT
$R_{\theta JC}$ Junction to case thermal resistance			4.17	$^{\circ}\text{C}/\text{W}$
$R_{\theta JA}$ Junction to free air thermal resistance			62.5	$^{\circ}\text{C}/\text{W}$

### resistive-load-switching characteristics at 25°C case temperature

PARAMETER	TEST CONDITIONS †			MIN	TYP	MAX	UNIT
$t_{on}$ Turn-on time	$I_C = 200 \text{ mA}$	$I_{B(on)} = 20 \text{ mA}$	$I_{B(off)} = -20 \text{ mA}$		0.3		$\mu\text{s}$
$t_{off}$ Turn-off time	$V_{BE(off)} = -3.4 \text{ V}$	$R_L = 150 \Omega$	$t_p = 20 \mu\text{s}$ , dc $\leq 2\%$		0.8		$\mu\text{s}$

† Voltage and current values shown are nominal; exact values vary slightly with transistor parameters.

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## TYPICAL CHARACTERISTICS

**TYPICAL DC CURRENT GAIN  
VS  
COLLECTOR CURRENT**

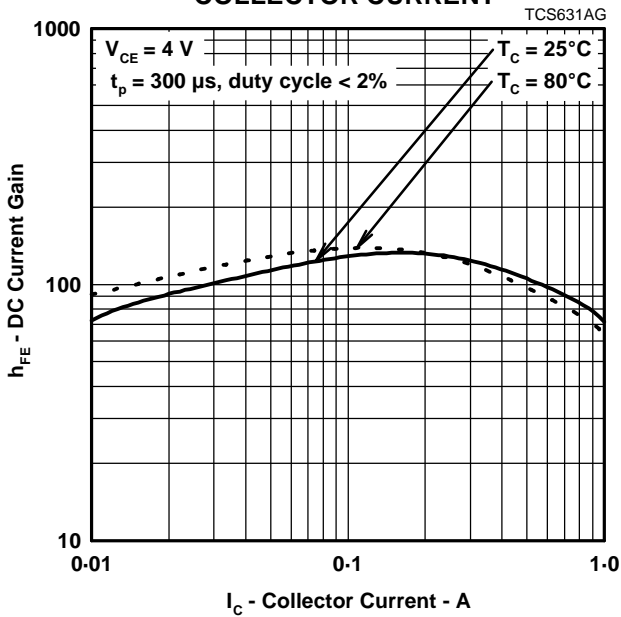


Figure 1.

**COLLECTOR-EMITTER SATURATION VOLTAGE  
VS  
BASE CURRENT**

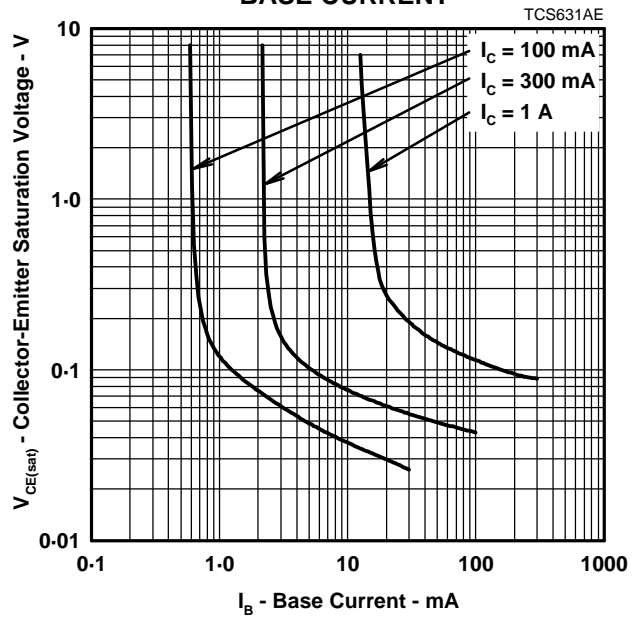


Figure 2.

**BASE-EMITTER VOLTAGE  
VS  
COLLECTOR CURRENT**

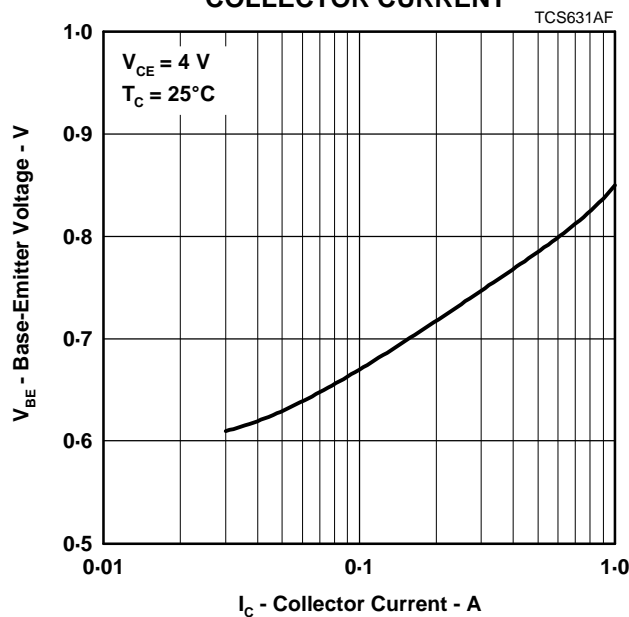


Figure 3.

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## MAXIMUM SAFE OPERATING REGIONS

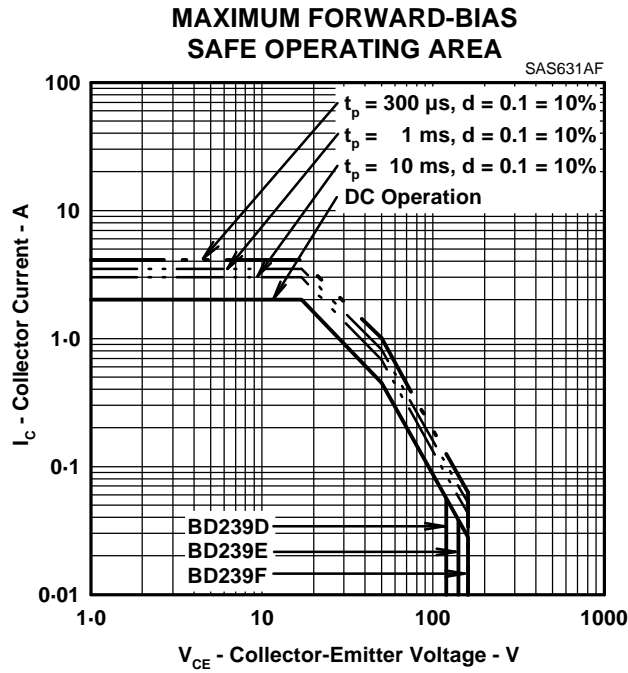


Figure 4.

## THERMAL INFORMATION

### MAXIMUM POWER DISSIPATION VS CASE TEMPERATURE

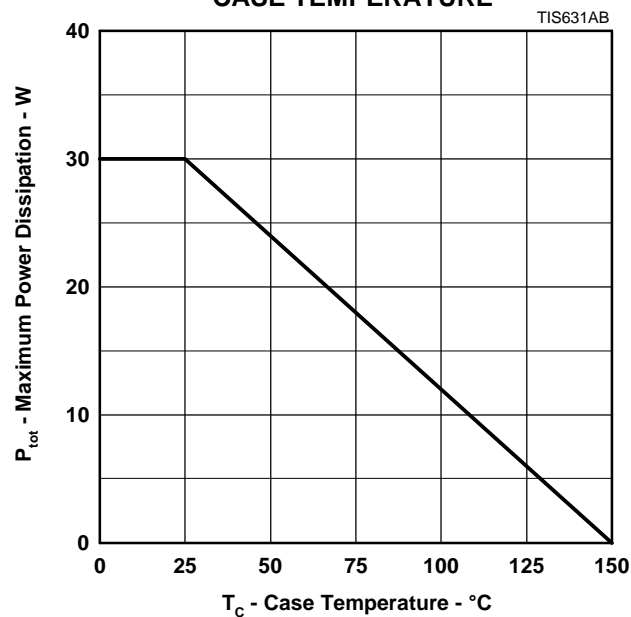


Figure 5.

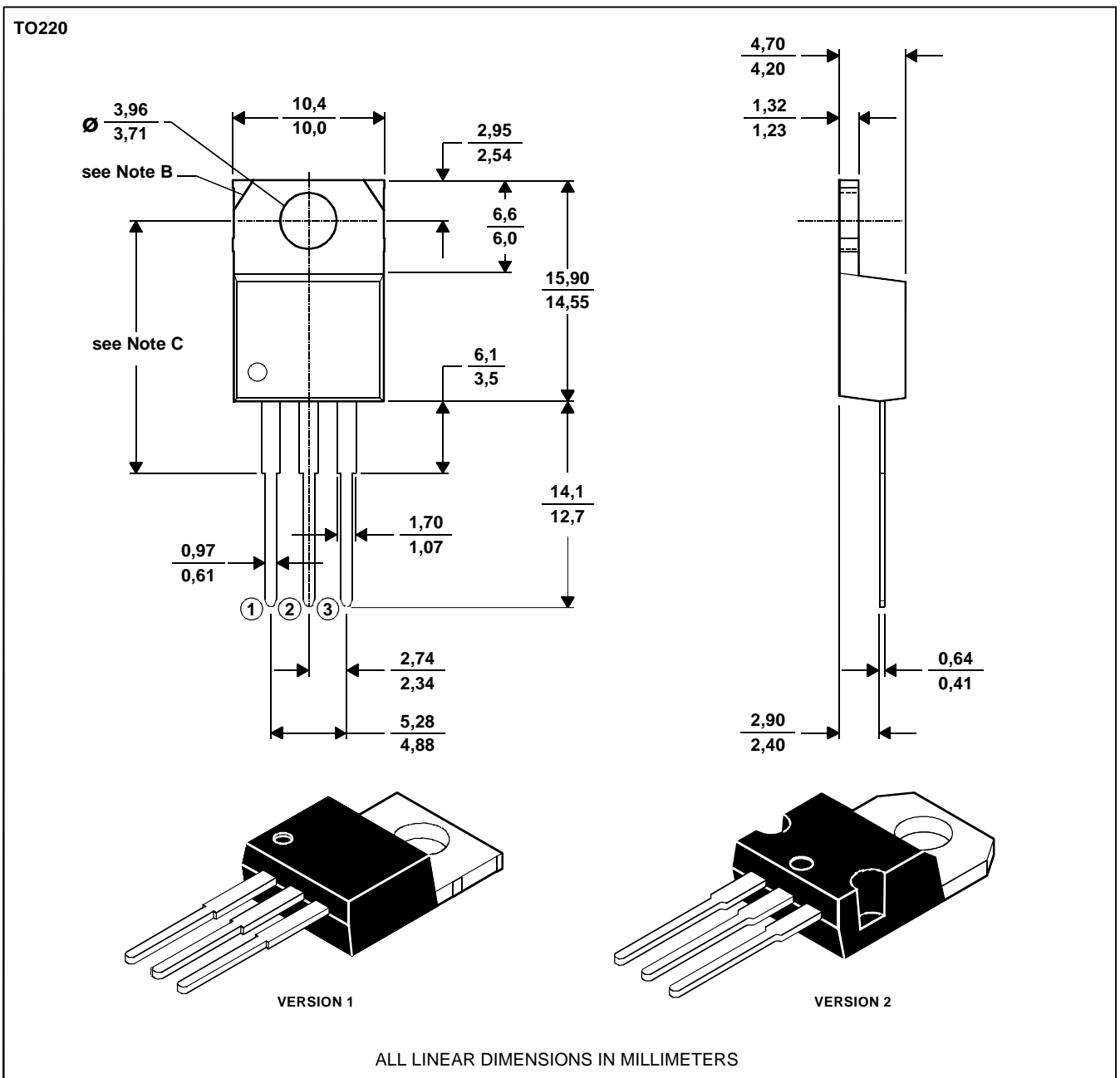
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## MECHANICAL DATA

### TO-220 3-pin plastic flange-mount package

This single-in-line package consists of a circuit mounted on a lead frame and encapsulated within a plastic compound. The compound will withstand soldering temperature with no deformation, and circuit performance characteristics will remain stable when operated in high humidity conditions. Leads require no additional cleaning or processing when used in soldered assembly.



- NOTES: A. The centre pin is in electrical contact with the mounting tab.  
 B. Mounting tab corner profile according to package version.  
 C. Typical fixing hole centre stand off height according to package version.  
 Version 1, 18.0 mm. Version 2, 17.6 mm.

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