

# TIP120, TIP121, TIP122 NPN SILICON POWER DARLINGTONS

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DECEMBER 1971 - REVISED MARCH 1997

- Designed for Complementary Use with TIP125, TIP126 and TIP127
- 65 W at 25°C Case Temperature
- 5 A Continuous Collector Current
- Minimum  $h_{FE}$  of 1000 at 3 V, 3 A

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-base voltage ( $I_E = 0$ )	TIP120	$V_{CBO}$	60	V
	TIP121		80	
	TIP122		100	
Collector-emitter voltage ( $I_B = 0$ )	TIP120	$V_{CEO}$	60	V
	TIP121		80	
	TIP122		100	
Emitter-base voltage		$V_{EBO}$	5	V
Continuous collector current		$I_C$	5	A
Peak collector current (see Note 1)		$I_{CM}$	8	A
Continuous base current		$I_B$	0.1	A
Continuous device dissipation at (or below) 25°C case temperature (see Note 2)		$P_{tot}$	65	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)		$\frac{1}{2}LI_C^2$	50	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		$T_L$	260	°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 0.52 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,  $I_{B(on)} = 5$  mA,  $R_{BE} = 100 \Omega$ ,  $V_{BE(off)} = 0$ ,  $R_S = 0.1 \Omega$ ,  $V_{CC} = 20$  V.

## PRODUCT INFORMATION

Information is current as of publication date. Products conform to specifications in accordance with the terms of Power Innovations standard warranty. Production processing does not necessarily include testing of all parameters.

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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)	$I_B = 0$	TIP120 TIP121 TIP122	60 80 100		V
$I_{CEO}$	Collector-emitter cut-off current	$V_{CE} = 30 \text{ V}$ $V_{CE} = 40 \text{ V}$ $V_{CE} = 50 \text{ V}$	$I_B = 0$ $I_B = 0$ $I_B = 0$	TIP120 TIP121 TIP122		0.5 0.5 0.5	mA
$I_{CBO}$	Collector cut-off current	$V_{CB} = 60 \text{ V}$ $V_{CB} = 80 \text{ V}$ $V_{CB} = 100 \text{ V}$	$I_E = 0$ $I_E = 0$ $I_E = 0$	TIP120 TIP121 TIP122		0.2 0.2 0.2	mA
$I_{EBO}$	Emitter cut-off current	$V_{EB} = 5 \text{ V}$	$I_C = 0$			2	mA
$h_{FE}$	Forward current transfer ratio	$V_{CE} = 3 \text{ V}$ $V_{CE} = 3 \text{ V}$	$I_C = 0.5 \text{ A}$ $I_C = 3 \text{ A}$	(see Notes 5 and 6)	1000 1000		
$V_{CE(sat)}$	Collector-emitter saturation voltage	$I_B = 12 \text{ mA}$ $I_B = 20 \text{ mA}$	$I_C = 3 \text{ A}$ $I_C = 5 \text{ A}$	(see Notes 5 and 6)		2 4	V
$V_{BE}$	Base-emitter voltage	$V_{CE} = 3 \text{ V}$	$I_C = 3 \text{ A}$	(see Notes 5 and 6)		2.5	V
$V_{EC}$	Parallel diode forward voltage	$I_E = 5 \text{ A}$	$I_B = 0$	(see Notes 5 and 6)		3.5	V

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			1.92	°C/W
$R_{\theta JA}$ Junction to free air thermal resistance			62.5	°C/W

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

PARAMETER	TEST CONDITIONS †			MIN	TYP	MAX	UNIT
$t_{on}$ Turn-on time	$I_C = 3 \text{ A}$	$I_{B(on)} = 12 \text{ mA}$	$I_{B(off)} = -12 \text{ mA}$		1.5		$\mu\text{s}$
$t_{off}$ Turn-off time	$V_{BE(off)} = -5 \text{ V}$	$R_L = 10 \Omega$	$t_p = 20 \mu\text{s}$ , dc $\leq 2\%$		8.5		$\mu\text{s}$

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

TYPICAL CHARACTERISTICS

TYPICAL DC CURRENT GAIN  
 VS  
 COLLECTOR CURRENT

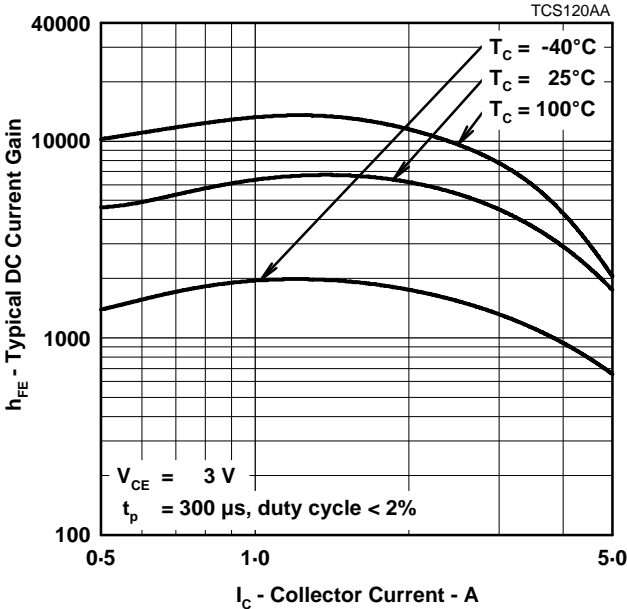


Figure 1.

COLLECTOR-EMITTER SATURATION VOLTAGE  
 VS  
 COLLECTOR CURRENT

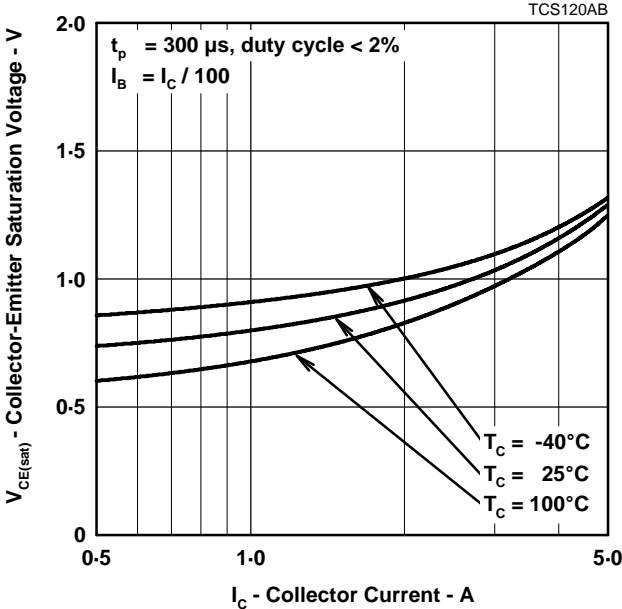


Figure 2.

BASE-EMITTER SATURATION VOLTAGE  
 VS  
 COLLECTOR CURRENT

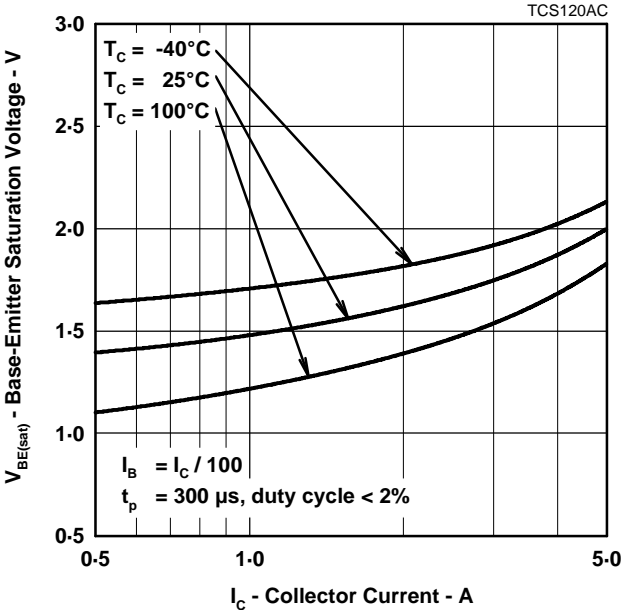


Figure 3.

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## MAXIMUM SAFE OPERATING REGIONS

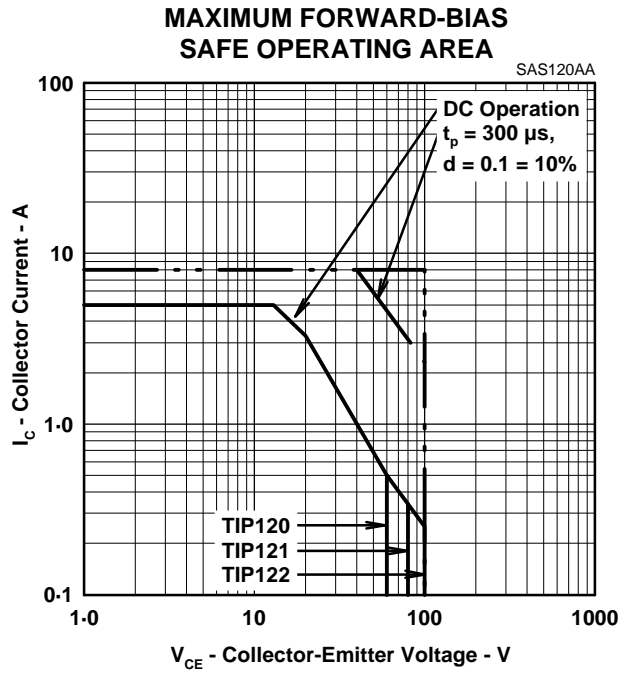


Figure 4.

## THERMAL INFORMATION

### MAXIMUM POWER DISSIPATION VS CASE TEMPERATURE

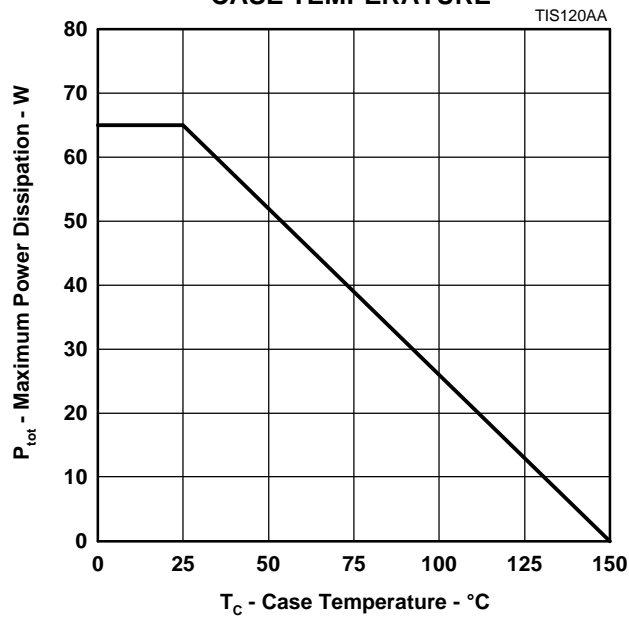


Figure 5.

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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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