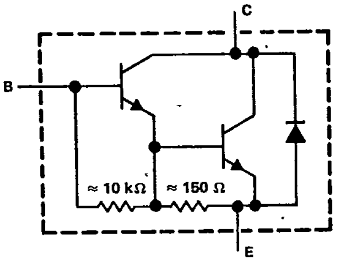
TIP120, TIP121, TIP122
N-P-N DARLINGTON-CONNECTED SILICON POWER TRANSISTORS

REVISED OCTOBER 1984

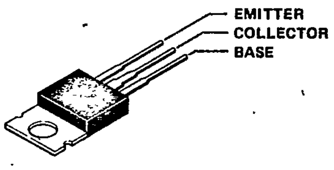
T-33-29

- Designed For Complementary use with TIP125, TIP126, TIP127
- 65 W at 25°C Case Temperature
- 5 A Rated Collector Current
- Min h_{FE} of 1000 at 3 V, 3 A
- 50 mJ Reverse Energy Rating

device schematic



TO-220AB PACKAGE



THE COLLECTOR IS IN ELECTRICAL CONTACT WITH THE MOUNTING TAB

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

	TIP120	TIP121	TIP122
Collector-base voltage	60 V	80 V	100 V
Collector-emitter voltage ($I_B = 0$)	60 V	80 V	100 V
Emitter-base voltage	5 V		
Continuous collector current	5 A		
Peak collector current (see Note 1)	8 A		
Continuous base current	0.1 A		
Continuous device dissipation at (or below) 25°C case temperature (see Note 2)	65 W		
Continuous device dissipation at (or below) 25°C free-air temperature (see Note 3)	2 W		
Safe operating area at (or below) 25°C case temperature	See Figures 7 and 8		
Unclamped inductive load energy (see Note 4)	50 mJ		
Operating collector junction and storage temperature range	−65°C to 150°C		
Lead temperature 3,2 mm (0.125 inch) from case for 10 seconds	260°C		

NOTES:
1. This value applies for $t_w \leq 0.3$ ms, duty cycle ≤ 10%.
2. Derate linearly to 150°C case temperature at the rate of 0.52 W/°C or refer to Dissipation Derating Curve, Figure 9.
3. Derate linearly to 150°C free-air temperature at the rate of 16 mW/°C or refer to Dissipation Derating Curve, Figure 10.
4. This rating is based on the capability of the transistor to operate safely in the circuit in Figure 2. $L = 20$ mH, $R_{BB2} = 100\ \Omega$, $V_{BB2} = 0$ V, $R_S = 0.1\ \Omega$, $V_{CC} = 20$ V. Energy $\approx I_C{}^2 L/2$.

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electrical characteristics at 25°C case temperature

PARAMETER	TEST CONDITIONS	TIP120			TIP121			TIP122			UNIT
		MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX	
$V_{(BR)CEO}$	I_C = 30 mA, I_B = 0, See Note 5	60			80			100			V
I_{CEO}	V_{CE} = 30 V, I_B = 0			0.5							mA
	V_{CE} = 40 V, I_B = 0						0.5				
	V_{CE} = 50 V, I_B = 0									0.5	
I_{CBO}	V_{CB} = 60 V, I_E = 0			0.2							mA
	V_{CB} = 80 V, I_E = 0						0.2				
	V_{CB} = 100 V, I_E = 0									0.2	
I_{EBO}	V_{EB} = 5 V, I_C = 0			2			2			2	mA
h_{FE}	V_{CE} = 3 V, I_C = 0.5 A, See Notes 5 and 6	1000			1000			1000			
	V_{CE} = 3 V, I_C = 3 A, See Notes 5 and 6	1000			1000			1000			
$V_{CE(sat)}$	I_B = 12 mA, I_C = 3 A, See Notes 5 and 6			2			2			2	V
	I_B = 20 mA, I_C = 5 A, See Notes 5 and 6			4			4			4	
V_{BE}	V_{CE} = 3 V, I_C = 3 A, See Notes 5 and 6			2.5			2.5			2.5	V
V_F	I_F = 5 A, See Notes 5 and 6			3.5			3.5			3.5	V

NOTES: 5. These parameters must be measured using pulse techniques, t_w = 300 µs, duty cycle ≤ 2 %.

6. These parameters are measured with voltage-sensing contacts separate from the current-carrying contacts located within 3,2 mm (0.125 inch) from the device body.

thermal characteristics

PARAMETER	MIN	TYP	MAX	UNIT
$R_{\theta JC}$			1.92	°C/W
$R_{\theta JA}$			62.5	

resistive-load switching characteristics at 25°C case temperature

PARAMETER	TEST CONDITIONS†	MIN	TYP	MAX	UNIT
t_{on}	I_C = 3 A, I_{B1} = 12 mA, I_{B2} = − 12 mA,		1.5		µs
t_{off}	$V_{BE(off)}$ = − 5 V, R_L = 10 Ω, See Figure 1		8.5		

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

PARAMETER MEASUREMENT INFORMATION

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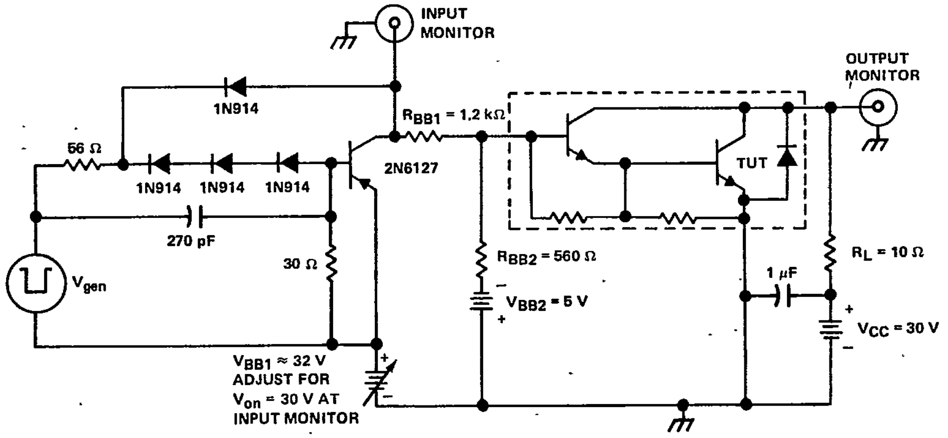
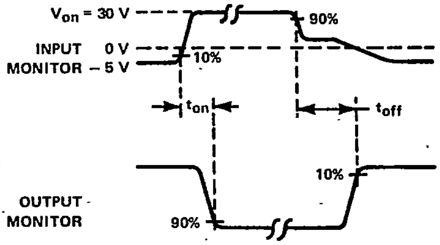


TEST CIRCUIT

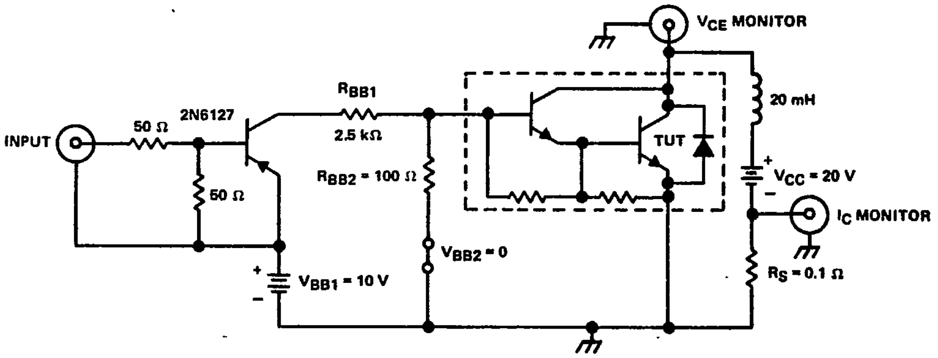


VOLTAGE WAVEFORMS

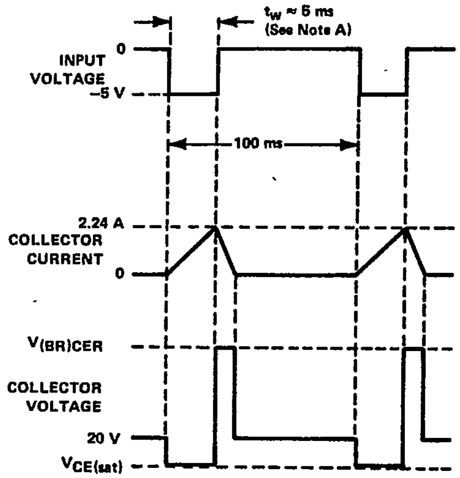
NOTES:
- A. V_{gen} is a − 30-V pulse into a 50 Ω termination.
- B. The V_{gen} waveform is supplied by a generator with the following characteristics: $t_r \leq 15$ ns, $t_f \leq 15$ ns, $Z_{out} = 50\ \Omega$, $t_w = 20\ \mu s$, duty cycle ≤ 2 %.
- C. Waveforms are monitored on an oscilloscope with the following characteristics: $t_r \leq 15$ ns, $R_{in} \geq 10\ M\Omega$, $C_{in} \leq 11.5$ pF.
- D. Resistors must be noninductive types.
- E. The d-c power supplies may require additional bypassing in order to minimize ringing.

FIGURE 1. RESISTIVE-LOAD SWITCHING

PARAMETER MEASUREMENT INFORMATION



TEST CIRCUIT



VOLTAGE AND CURRENT WAVEFORMS

NOTE A: Input pulse duration is increased until I_{CM} = 2.24 A.

FIGURE 2. INDUCTIVE-LOAD SWITCHING

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TYPICAL CHARACTERISTICS

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STATIC FORWARD CURRENT TRANSFER RATIO
vs
COLLECTOR CURRENT

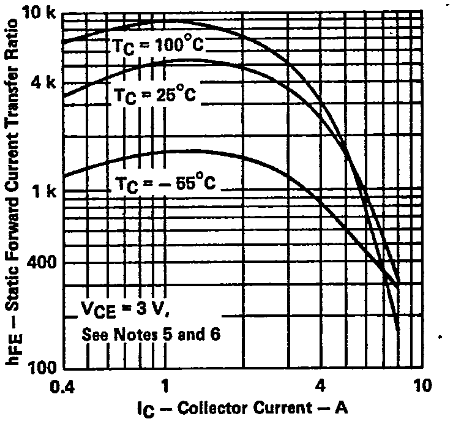

FIGURE 3

BASE-EMITTER VOLTAGE
vs
CASE TEMPERATURE

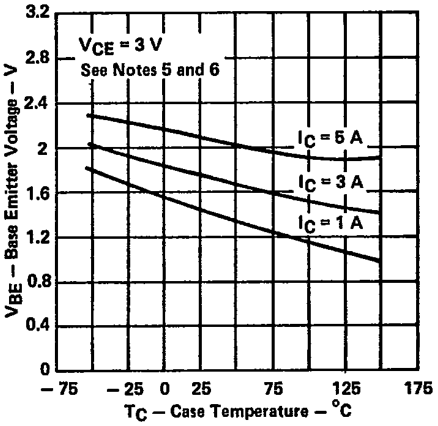

FIGURE 4

COLLECTOR-EMITTER SATURATION VOLTAGE
vs
CASE TEMPERATURE

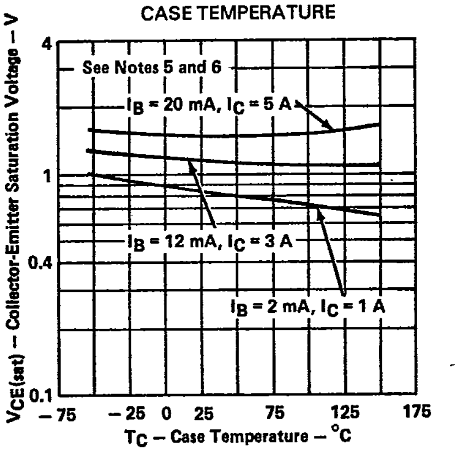

FIGURE 5

SMALL-SIGNAL COMMON-EMITTER
FORWARD CURRENT TRANSFER RATIO
vs
FREQUENCY

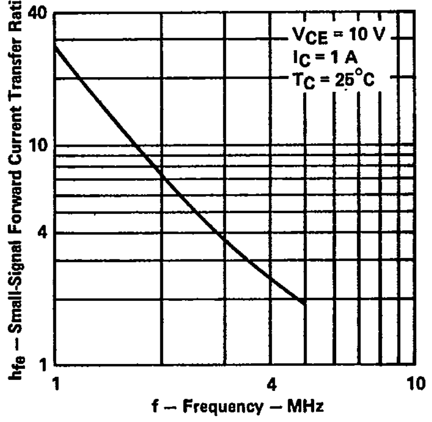

FIGURE 6

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TIP Devices

NOTES: 5. These parameters must be measured using pulse techniques, t_w = 300 μs, duty cycle ≤ 2 %.
6. These parameters are measured with voltage-sensing contacts separate from the current-carrying contacts located within 3,2 mm (0.125 inch) from the device body.

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MAXIMUM SAFE OPERATING AREA

MAXIMUM COLLECTOR CURRENT vs COLLECTOR-EMITTER VOLTAGE

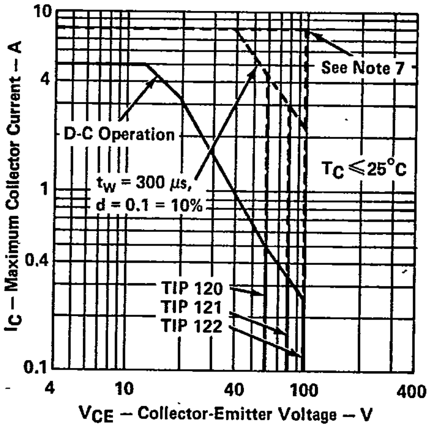

FIGURE 7

MAXIMUM COLLECTOR CURRENT vs UNCLAMPED INDUCTIVE LOAD

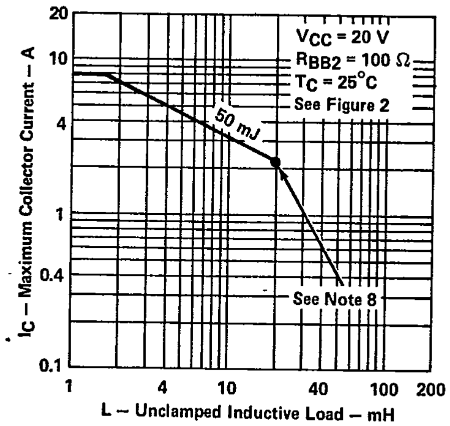

FIGURE 8

NOTES: 7. This combination of maximum voltage and current may be achieved only when switching from saturation to cutoff with a clamped inductive load.

8. Above this point the safe operating area has not been defined.

THERMAL INFORMATION

CASE TEMPERATURE DISSIPATION DERATING CURVE

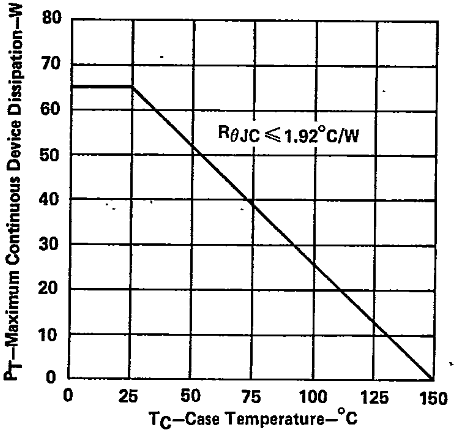

FIGURE 9

FREE-AIR TEMPERATURE DISSIPATION DERATING CURVE

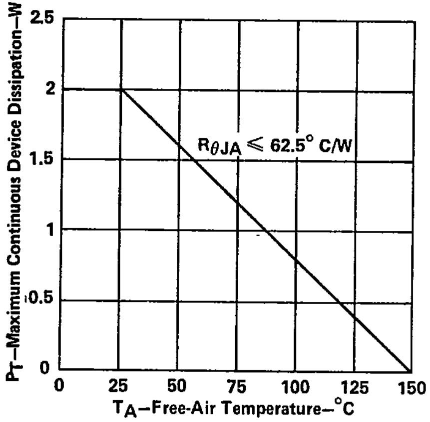

FIGURE 10

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