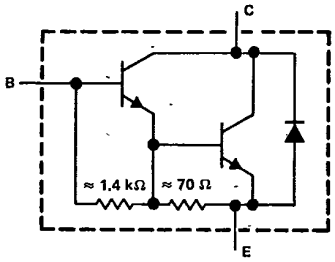
TIP100, TIP101, TIP102
N-P-N DARLINGTON-CONNECTED SILICON POWER TRANSISTORS

JANUARY 1977 – REVISED OCTOBER 1984

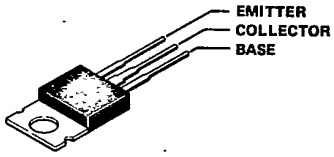
T-33-29

- Designed for Complementary Use with TIP105, TIP106, TIP107
- 80 W at 25°C Case Temperature
- 8 A Continuous Collector Current
- Min h_{FE} of 200 at 4 V, 8 A
- MAX I_{CEO} of 50 μA
- MAX $V_{CE(sat)}$ of 2.5 V at I_C = 8 A
- Reverse Energy Rating . . . 10 mJ
- Designed for Ignition Systems, Motor Control, and Solenoid Driver Applications
- Designed to Replace:
  2N6045 Series 2N6388 Series
  MJE6045 Series SE9302 Series

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)

	TIP100	TIP101	TIP102
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	8 A		
Peak collector current (see Note 1)	15 A		
Continuous base current	1 A		
Safe operating areas at (or below) 25°C case temperature	See Figures 7 and 8		
Continuous device dissipation at (or below) 25°C case temperature (see Note 2)	80 W		
Continuous device dissipation at (or below) 25°C free-air temperature (see Note 3)	2 W		
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 0.64 °C/W or refer to Dissipation Derating Curve, Figure 9.
3. Derate linearly to 150°C free-air temperature at the rate of 16 °C/mW or refer to Dissipation Derating Curve, Figure 10.

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electrical characteristics at 25°C case temperature

PARAMETER	TEST CONDITIONS		TIP100			TIP101			TIP102			UNIT
			MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX	
$V_{(BR)CEO}$	I_C = 30 mA, See Note 4	I_B = 0,	60			80			100			V
I_{CEO}	V_{CE} = 30 V,	I_B = 0			50							μA
	V_{CE} = 40 V,	I_B = 0						50				
	V_{CE} = 50 V,	I_B = 0									50	
I_{CBO}	V_{CB} = 60 V,	I_E = 0			50							μA
	V_{CB} = 80 V,	I_E = 0						50				
	V_{CB} = 100 V,	I_E = 0									50	
I_{EBO}	V_{EB} = 5 V,	I_C = 0			8			8			8	mA
h_{FE}	V_{CE} = 4 V, See Notes 4 and 5	I_C = 3 A,	1000		20 000	1000		20 000	1000		20 000	
	V_{CE} = 4 V, See Notes 4 and 5	I_C = 8 A,	200			200			200			
V_{BE}	V_{CE} = 4 V, See Notes 4 and 5	I_C = 8 A,			2.8			2.8			2.8	V
$V_{CE(sat)}$	I_B = 6 mA, See Notes 4 and 5	I_C = 3 A,			2			2			2	V
	I_B = 80 mA, See Notes 4 and 5	I_C = 8 A,			2.5			2.5			2.5	
V_F	I_F = 8 A, See Notes 4 and 5	I_B = 0,			2.8			2.8			2.8	V

NOTES: 4. These parameters must be measured using pulse techniques, t_w = 300 μs, duty cycle ≤ 2%.
5. These parameters are measured with voltage-sensing contacts separate from the current-carrying contacts and located within 3,2 mm (0.125 inch) from the device body.

thermal characteristics

PARAMETER		MIN	TYP	MAX	UNIT
$R_{\theta JC}$				1.56	°C/W
$R_{\theta JA}$				62.5	
$R_{\theta CHS}$	See Note 6		0.7		
$R_{\theta C}$			0.9		J/°C

NOTE 6: This parameter is measured using a 0,08 mm (0.003 inch) mica insulator with Dow-Corning 11 compound or both sides of the insulator, a 0.138-32 (formerly 6-32) mounting screw with bushing, and a mounting torque of 0,9 newton-meter (8 inch-pounds).

resistive-load switching characteristics at 25°C case temperature

PARAMETER	TEST CONDITIONS†			MIN	TYP	MAX	UNIT
t_d	I_C = 8 A,	I_{B1} = 80 mA,	I_{B2} = −80 mA,		0.035		μs
t_r	$V_{BE(off)}$ = −5 V,	R_L = 5 Ω,	See Figure 1		0.35		
t_s					1.8		
t_f					2.45		

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

functional tests at 25°C free-air temperature

TEST	CONDITIONS			LEVEL
Power (V_{CE} • I_C)	V_{CE} = 40 V,	I_C = 2 A,	t_{test} = 0.15 s	80 W
Reverse Pulse Energy $\left(\frac{I_C^2 L}{2}\right)$	I_{CM} = 1 A, t_{test} = 0.5 s,	L = 20 mH, See Figure 2	f = 10 Hz,	10 mJ

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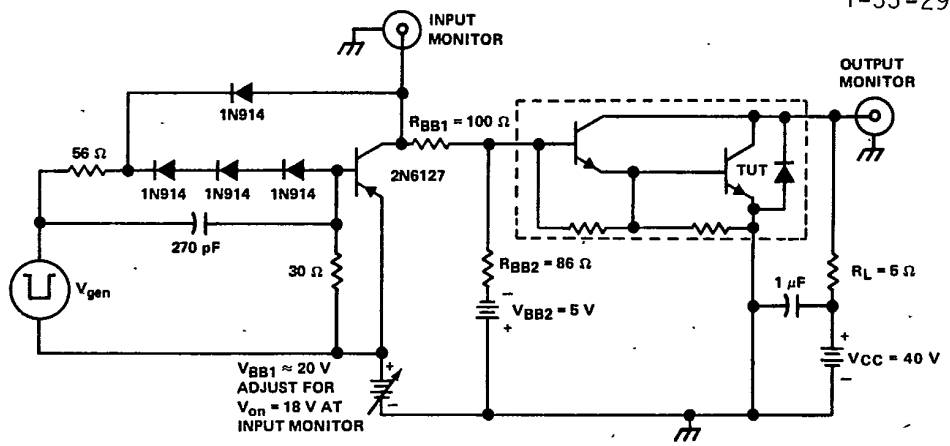
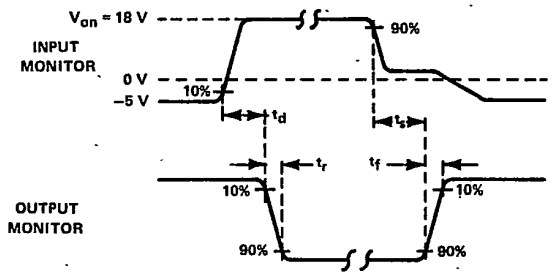
PARAMETER MEASUREMENT INFORMATION



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

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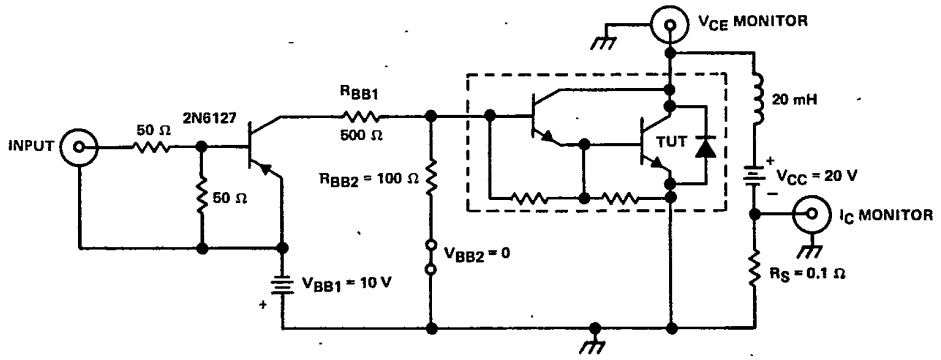
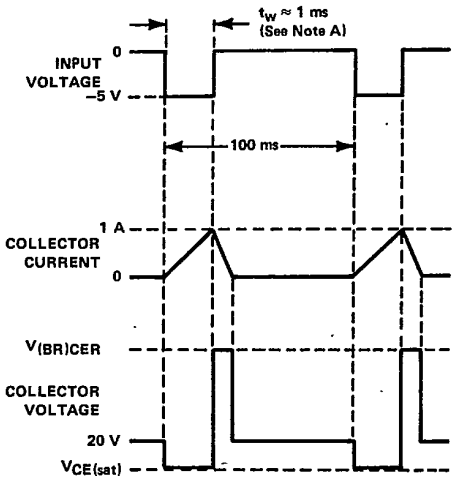
FUNCTIONAL TEST INFORMATION



TEST CIRCUIT



VOLTAGE AND CURRENT WAVEFORMS

NOTE A: Input pulse duration is increased until I_{CM} = 1 A.

FIGURE 2. REVERSE PULSE ENERGY TEST

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TYPICAL CHARACTERISTICS

STATIC FORWARD CURRENT TRANSFER RATIO vs COLLECTOR CURRENT

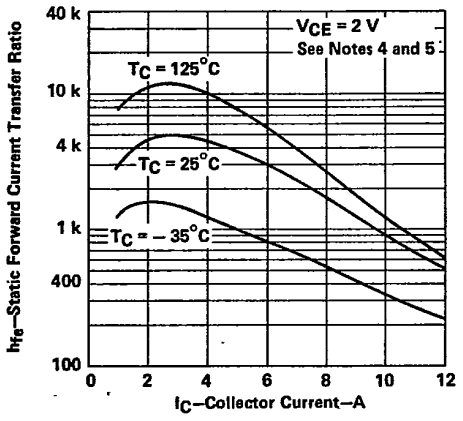

FIGURE 3

STATIC FORWARD CURRENT TRANSFER RATIO vs COLLECTOR CURRENT

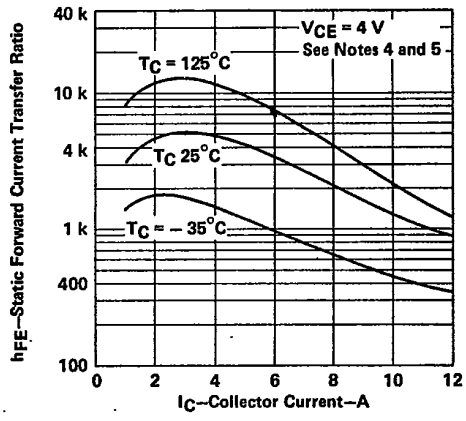

FIGURE 4

COLLECTOR-EMITTER SATURATION VOLTAGE vs COLLECTOR CURRENT

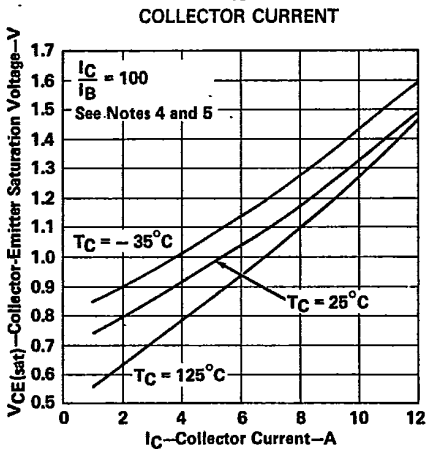

FIGURE 5

BASE-EMITTER VOLTAGE vs COLLECTOR CURRENT

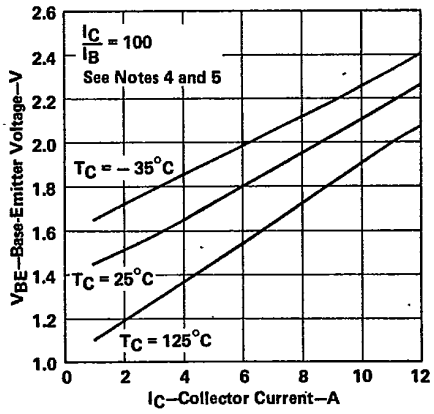

FIGURE 6

NOTES: 4. These parameters must be measured using pulse techniques, t_w = 300 μs, duty cycle ≤ 2 %.
5. 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

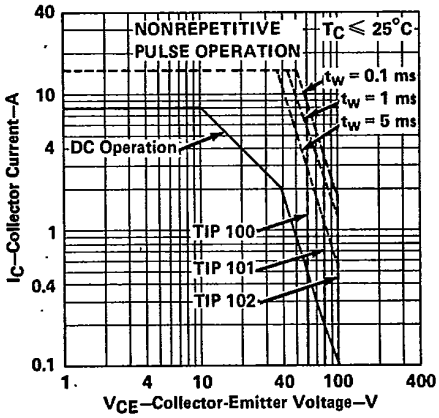

FIGURE 7

MAXIMUM COLLECTOR CURRENT
vs
UNCLAMPED INDUCTIVE LOAD

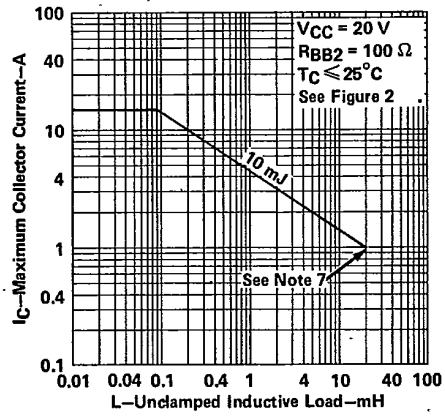

FIGURE 8

NOTE 7: Above this point the safe operating area has not been defined.

THERMAL INFORMATION

CASE TEMPERATURE
DISSIPATION DERATING CURVE

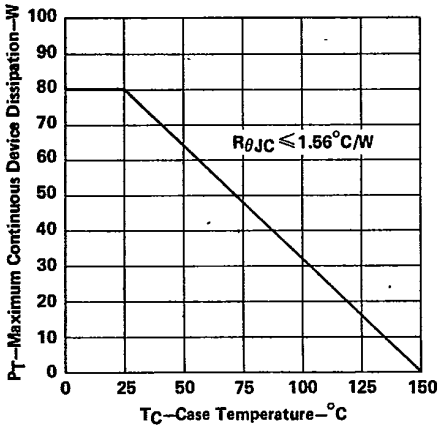

FIGURE 9

FREE-AIR TEMPERATURE
DISSIPATION DERATING CURVE

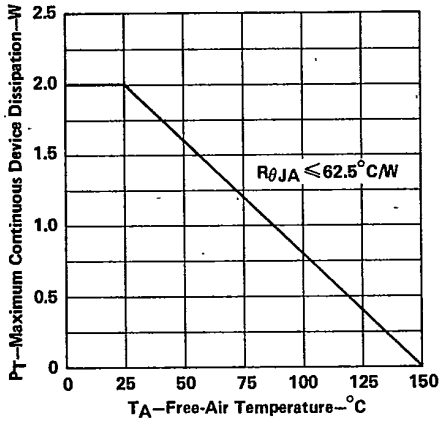

FIGURE 10

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