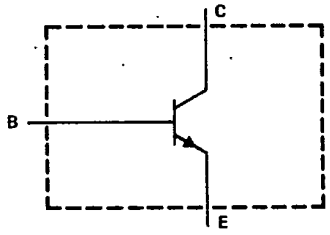
TIP51, TIP52, TIP53, TIP54
N-P-N SILICON POWER TRANSISTORS

T-33-13

REVISED OCTOBER 1984

- 100 W at 25°C Case Temperature
- 3 A Continuous Collector Current
- 5 A Peak Collector Current
- Minimum 2.5 MHz f_T at 10 V, 0.2 A
- 100 mJ Reverse-Energy Rating
- 250 V to 400 V Minimum $V_{(BR)CEO}$
- Designed for Industrial and Consumer Applications
- Designed for High Voltage, High Forward, and Reverse Energy Applications

device schematic



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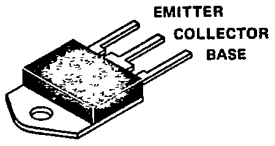

THE COLLECTOR IS IN ELECTRICAL CONTACT WITH THE MOUNTING TAB

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

	TIP51	TIP52	TIP53	TIP54
Collector-base voltage	350 V	400 V	450 V	500 V
Collector-emitter voltage (I_B = 0)	250 V	300 V	350 V	400 V
Emitter-base voltage	5 V			
Continuous collector current	3 A			
Peak collector current (see Note 1)	5 A			
Continuous base current	0.6 A			
Safe operating areas at (or below) 25°C case temperature	See Figures 6 and 7			
Continuous device dissipation at (or below) 25°C case temperature (see Note 2)	100 W			
Continuous device dissipation at (or below) 25°C free-air temperature (see Note 3)	3.5 W			
Unclamped inductive load energy (see Note 4)	100 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 1.25°C/W, refer to Dissipation Derating Curve, Figure 8.
3. Derate linearly to 150°C free-air temperature at the rate of 35.7°C/W, refer to Dissipation Derating Curve, Figure 9.
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 Ω, V_{BB2} = 0 V, R_S = 0.1 Ω, V_{CC} = 20 V. Energy ≈ $I_C^2L/2$.

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electrical characteristics at 25°C case temperature (unless otherwise noted)

PARAMETER	TEST CONDITIONS	TIP51			TIP52			TIP53			TIP54			UNIT
		MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX	
$V_{(BR)CEO}$	I_C = 30 mA, I_B = 0, See Note 5	200			300			350			400			V
I_{CEO}	V_{CE} = 150 V, I_B = 0			1										mA
	V_{CE} = 200 V, I_B = 0						1							
	V_{CE} = 250 V, I_B = 0									1				
	V_{CE} = 300 V, I_B = 0												1	
I_{CES}	V_{CE} = 350 V, V_{BE} = 0			1										mA
	V_{CE} = 400 V, V_{BE} = 0						1							
	V_{CE} = 450 V, V_{BE} = 0									1				
	V_{CE} = 500 V, V_{BE} = 0												1	
I_{EBO}	V_{EB} = 5 V, I_C = 0			1			1			1			1	mA
h_{FE}	V_{CE} = 10 V, I_C = 0.3 A, See Notes 5 and 6	30		150	30		150	30		150	30		150	
	V_{CE} = 10 V, I_C = 3 A, See Notes 5 and 6	10			10			10			10			
V_{BE}	V_{CE} = 10 V, I_C = 3 A, See Notes 5 and 6			1.5			1.5			1.5			1.5	V
$V_{CE(sat)}$	I_B = 0.6 A, I_C = 3 A, See Notes 5 and 6			1.5			1.5			1.5			1.5	V
h_{fe}	V_{CE} = 10 V, I_C = 0.2 A, f = 1 kHz	30			30			30			30			
$\|h_{fe}\|$	V_{CE} = 10 V, I_C = 0.2 A, f = 1 MHz	2.5			2.5			2.5			2.5			

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 and located within 3,2 mm (0.125 inch) from the device body.

resistive-load switching characteristics at 25°C case temperature (unless otherwise noted)

PARAMETER	TEST CONDITIONS†			MIN	TYP	MAX	UNIT
t_{on}	I_C = 1 A,	I_{B1} = 0.1 A,	I_{B2} = −0.1 A,		0.25		μs
t_{off}	$V_{BE(off)}$ = −5 V,	R_L = 200 Ω,	See Figure 1		5		

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

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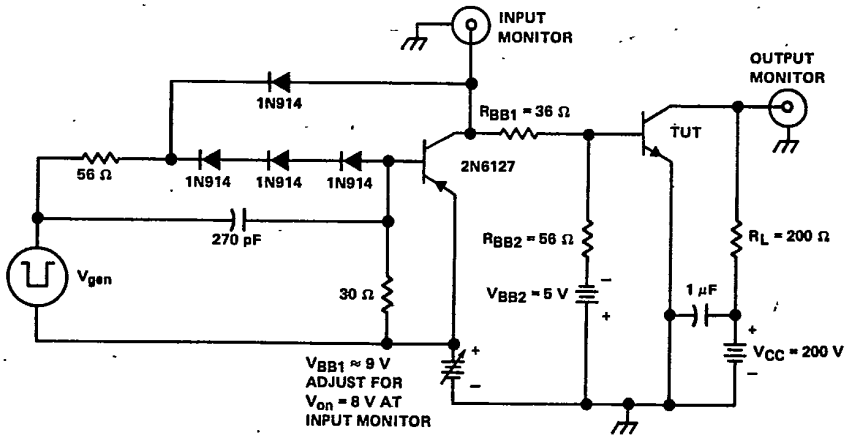
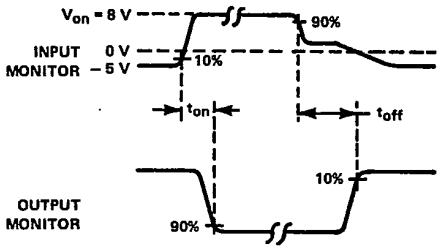
PARAMETER MEASUREMENT INFORMATION



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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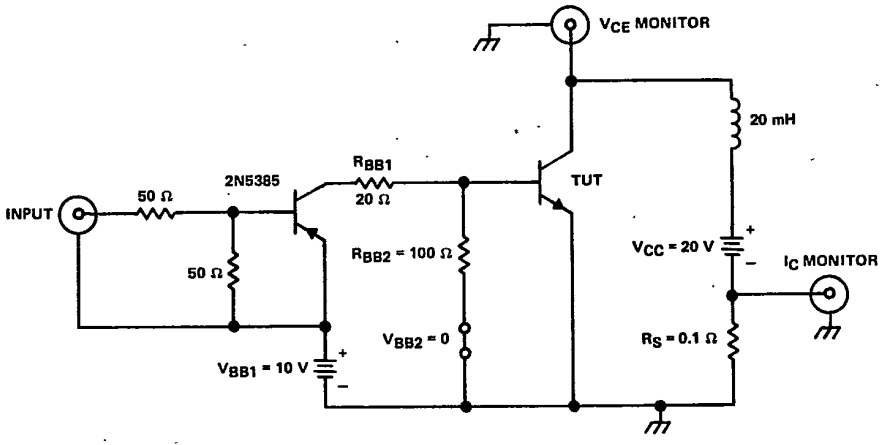
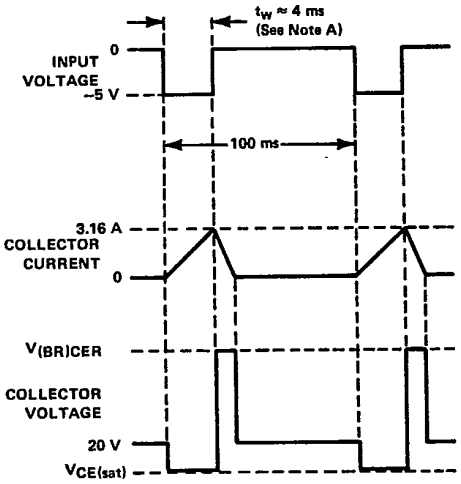
PARAMETER MEASUREMENT INFORMATION



TEST CIRCUIT



VOLTAGE AND CURRENT WAVEFORMS

NOTE A: Input pulse duration is increased until I_{CM} = 3.16 A.

FIGURE 2. INDUCTIVE-LOAD SWITCHING

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TYPICAL CHARACTERISTICS

STATIC FORWARD CURRENT TRANSFER RATIO
vs
COLLECTOR CURRENT

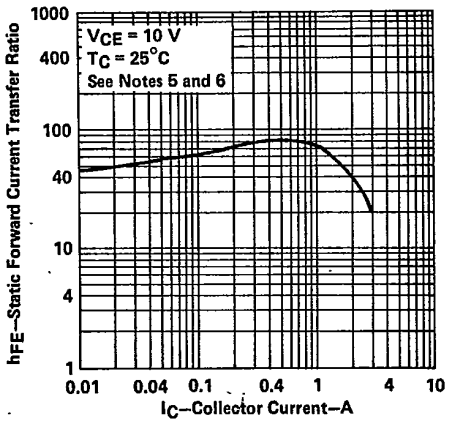

FIGURE 3

BASE-EMITTER VOLTAGE
vs
COLLECTOR CURRENT

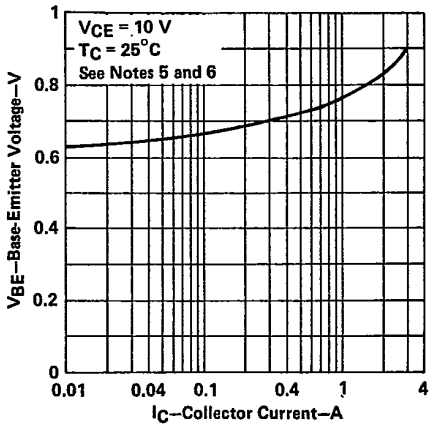

FIGURE 4

COLLECTOR-EMITTER SATURATION VOLTAGE
vs
COLLECTOR CURRENT

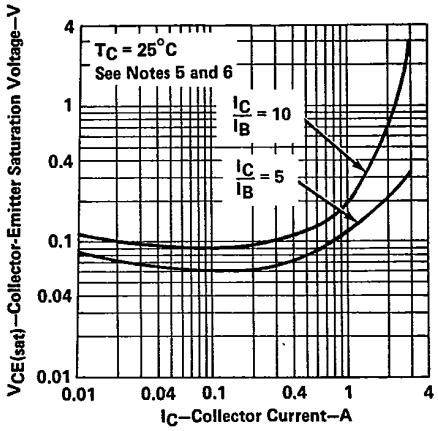

FIGURE 5

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 and 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

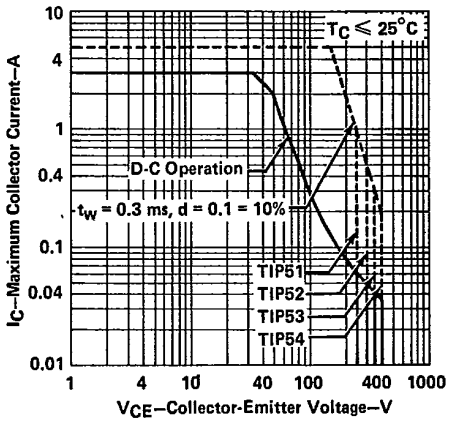

FIGURE 6

MAXIMUM COLLECTOR CURRENT
vs
UNCLAMPED INDUCTIVE LOAD

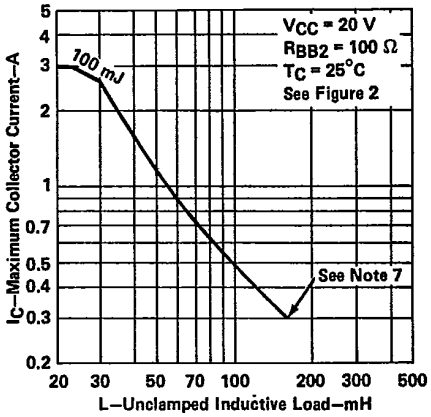

FIGURE 7

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

THERMAL INFORMATION

CASE TEMPERATURE
DISSIPATION DERATING CURVE

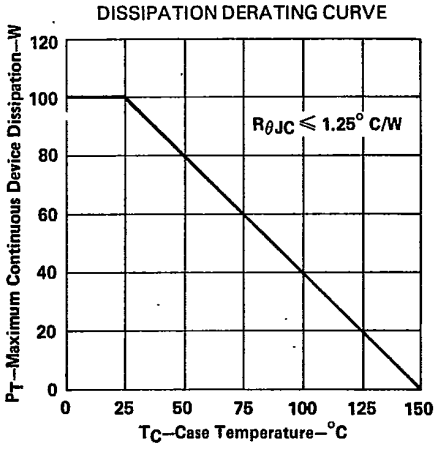

FIGURE 8

FREE-AIR TEMPERATURE
DISSIPATION DERATING CURVE

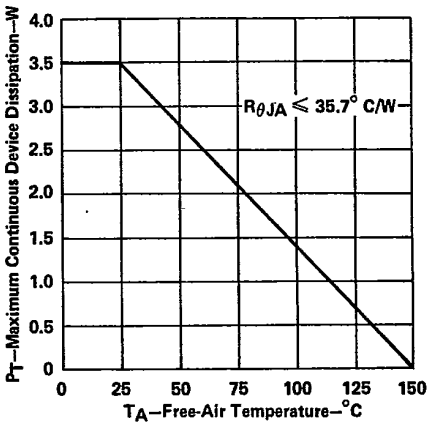

FIGURE 9

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