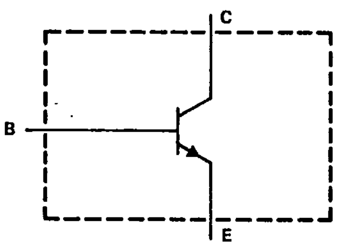
TIP47, TIP48, TIP49, TIP50
N-P-N SILICON POWER TRANSISTORS

REVISED OCTOBER 1984

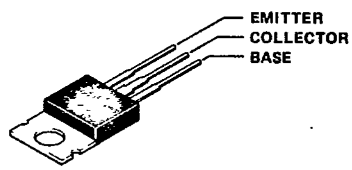
T-33-11

- 40 W at 25°C Case Temperature
- 1 A Continuous Collector Current
- 2 A Peak Collector Current
- Minimum 10 MHz f_t at 10 V, 0.2 A
- 20 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



TO-220AB PACKAGE



THE COLLECTOR IS IN ELECTRICAL CONTACT WITH THE MOUNTING TAB

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

	TIP47	TIP48	TIP49	TIP50
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	1 A			
Peak collector current (see Note 1)	2 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)	40 W			
Continuous device dissipation at (or below) 25°C free-air temperature (see Note 3)	2 W			
Unclamped inductive load energy (see Note 4)	20 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 $t_w \leq 1$ ms, duty cycle ≤ 10 %.
2. For operation above 25°C case temperature, refer to Dissipation Derating Curve, Figure 8.
3. For operation above 25°C free-air temperature, 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, $R_{BB2} = 100\,\Omega$, $V_{BB2} = 0$ V, $R_s = 0.1\,\Omega$, $V_{CC} = 20$ V, Energy $\approx I_C{}^2L/2$.

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electrical characteristics at 25°C case temperature

PARAMETER	TEST CONDITIONS	TIP47 MIN	TIP47 TYP	TIP47 MAX	TIP48 MIN	TIP48 TYP	TIP48 MAX	TIP49 MIN	TIP49 TYP	TIP49 MAX	TIP50 MIN	TIP50 TYP	TIP50 MAX	UNIT
$V_{(BR)CEO}$	$I_C = 30$ mA, $I_B = 0$, See Note 5	250			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, $I_C = 1$ A, See Notes 5 and 6	10			10			10			10			
V_{BE}	$V_{CE} = 10$ V, $I_C = 1$ A, See Notes 5 and 6			1.5			1.5			1.5			1.5	V
$V_{CE(sat)}$	$I_B = 0.2$ A, $I_C = 1$ 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	25			25			25			25			
$\|h_{fe}\|$	$V_{CE} = 10$ V, $I_C = 0.2$ A, f = 2 MHz	5			5			5			5			

NOTES: 5. These parameters must be measured using pulse techniques, $t_W = 300\ \mu s$, 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 characteristic at 25°C case temperature

PARAMETER	TEST CONDITIONS†	MIN	TYP	MAX	UNIT
t_{on}	$I_C = 1$ A, $I_{B1} = 100$ mA, $I_{B2} = -100$ mA,		0.2		μs
t_{off}	$V_{BE(off)} = -5$ V, $R_L = 200\ \Omega$, See Figure 1		2		μs

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

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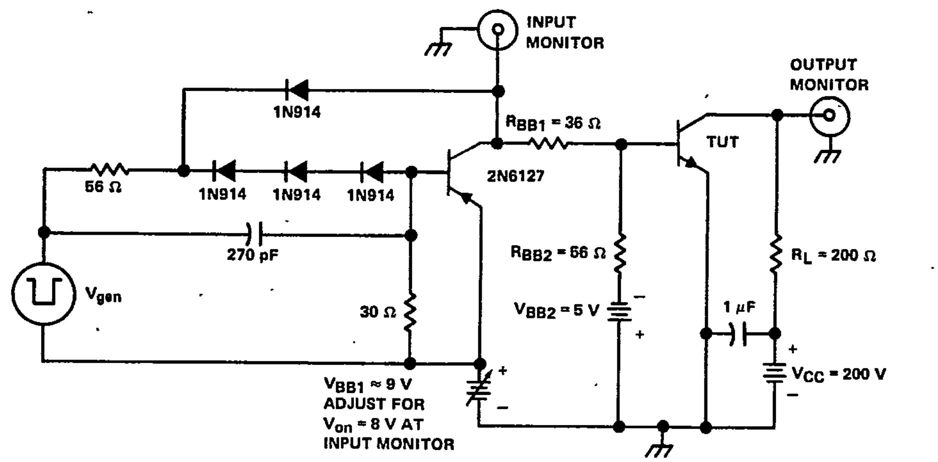
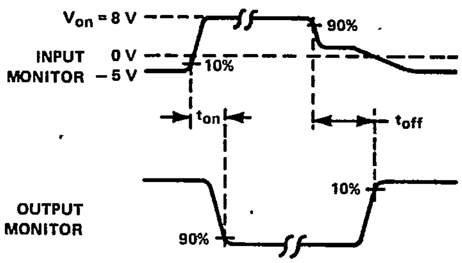
PARAMETER MEASUREMENT INFORMATION



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, $R_{in} \geq 10$ MΩ, $C_{in} \leq 11.5$ 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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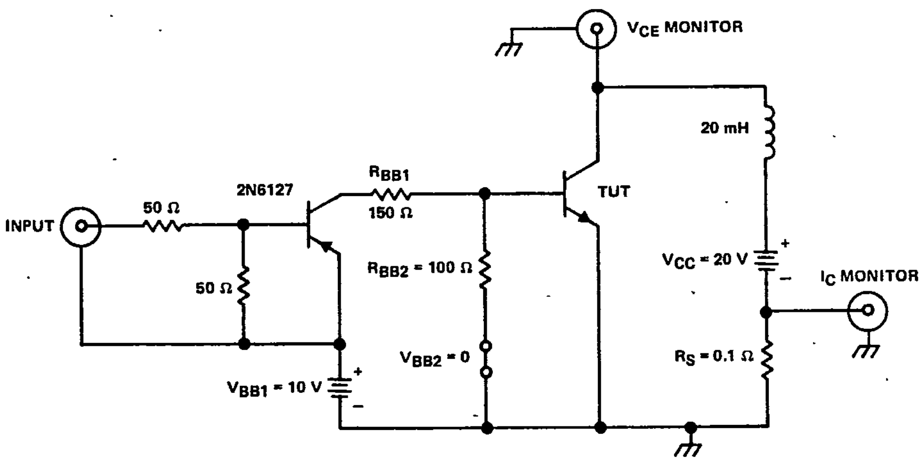
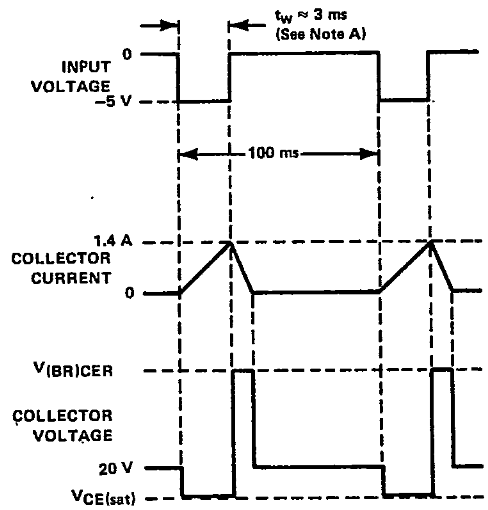
PARAMETER MEASUREMENT INFORMATION



TEST CIRCUIT



VOLTAGE AND CURRENT WAVEFORMS

NOTE A: Input pulse duration is increased until I_{CM} = 1.4 A.

FIGURE 2. INDUCTIVE-LOAD SWITCHING

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TYPICAL CHARACTERISTICS

STATIC FORWARD CURRENT TRANSFER RATIO
vs
COLLECTOR CURRENT

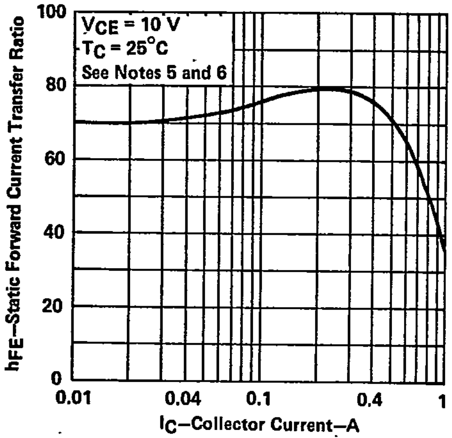

FIGURE 3

BASE-EMITTER VOLTAGE
vs
COLLECTOR CURRENT

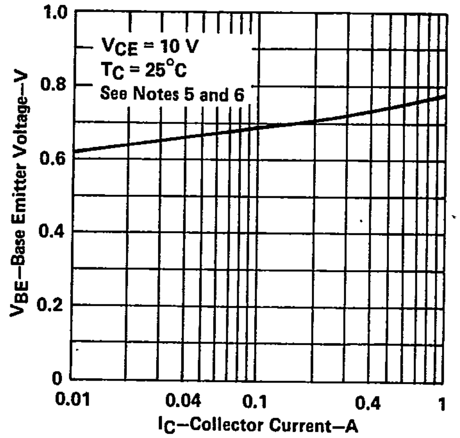

FIGURE 4

COLLECTOR-EMITTER
SATURATION VOLTAGE
vs
COLLECTOR CURRENT

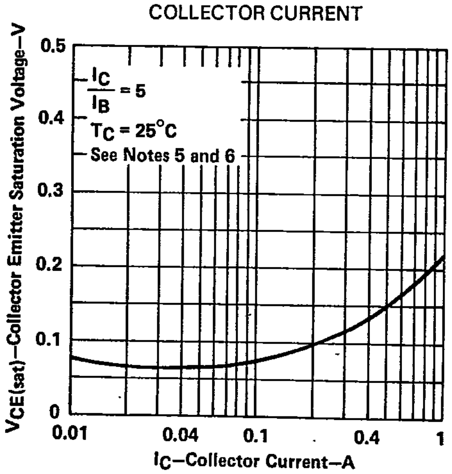

FIGURE 5

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

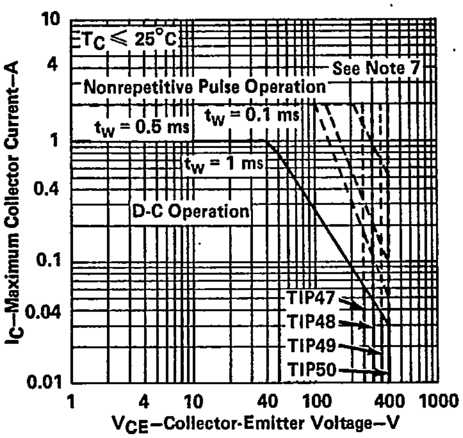

FIGURE 6

MAXIMUM COLLECTOR CURRENT
vs
UNCLAMPED INDUCTIVE LOAD

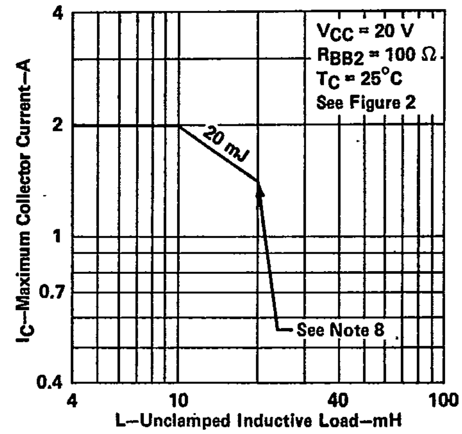

FIGURE 7

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

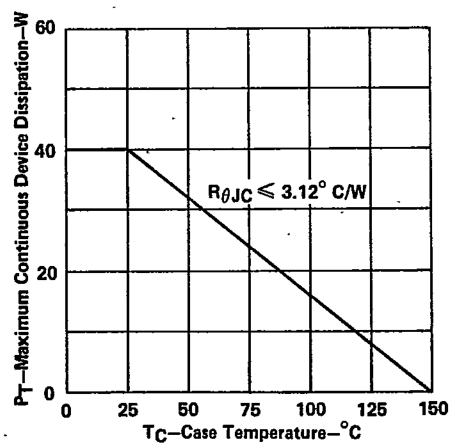

FIGURE 8

FREE-AIR TEMPERATURE
DISSIPATION DERATING CURVE

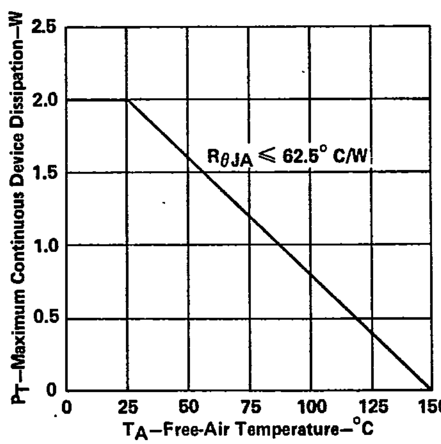

FIGURE 9

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