

8961726 TEXAS INSTR (OPTO)

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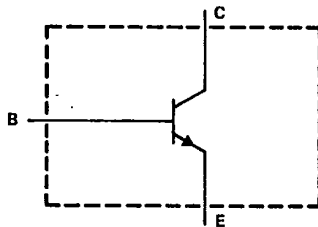
TIP47, TIP48, TIP49, TIP50
N-P-N SILICON POWER TRANSISTORS

REVISED OCTOBER 1984

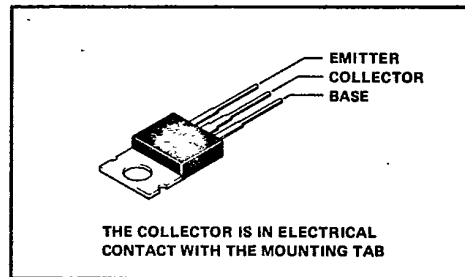
- 40 W at 25°C Case Temperature
- 1 A Continuous Collector Current
- 2 A Peak Collector Current
- Minimum 10 MHz f_t at 10 V, 0.2 A
- 20 mJ Reverse-Energy Rating
- 250 V to 400 V Minimum $V_{(BR)CEO}$
- Designed for Industrial and Consumer Applications
- Designed for High Voltage, High Forward, and Reverse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

F-33-11

device schematic



TO-220AB PACKAGE



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 $\leq 10\%$.
 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 $\approx I_C^2 L/2$.

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electrical characteristics at 25°C case temperature

PARAMETER	TEST CONDITIONS	TIP47			TIP48			TIP49			TIP50			UNIT
		MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX	
$V_{(BR)CEO}$	$I_C = 30 \text{ mA}$, See Note 5	250			300			350			400			V
I_{CEO}	$V_{CE} = 150 \text{ V}$, $I_B = 0$	1												mA
	$V_{CE} = 200 \text{ V}$, $I_B = 0$				1									
	$V_{CE} = 250 \text{ V}$, $I_B = 0$							1						
	$V_{CE} = 300 \text{ V}$, $I_B = 0$										1			
I_{CES}	$V_{CE} = 350 \text{ V}$, $V_{BE} = 0$	1												mA
	$V_{CE} = 400 \text{ V}$, $V_{BE} = 0$				1									
	$V_{CE} = 450 \text{ V}$, $V_{BE} = 0$							1						
	$V_{CE} = 500 \text{ V}$, $V_{BE} = 0$										1			
I_{EBO}	$V_{EB} = 5 \text{ V}$, $I_C = 0$	1			1			1			1			mA
h_{FE}	$V_{CE} = 10 \text{ V}$, $I_C = 0.3 \text{ A}$, See Notes 5 and 6	30	150		30	150		30	150		30	150		
	$V_{CE} = 10 \text{ V}$, $I_C = 1 \text{ A}$, See Notes 5 and 6	10			10			10			10			
V_{BE}	$V_{CE} = 10 \text{ V}$, $I_C = 1 \text{ A}$, See Notes 5 and 6	1.5			1.5			1.5			1.5			V
$V_{CE(sat)}$	$I_B = 0.2 \text{ A}$, $I_C = 1 \text{ A}$, See Notes 5 and 6	1.5			1.5			1.5			1.5			V
h_{fe}	$V_{CE} = 10 \text{ V}$, $I_C = 0.2 \text{ A}$, $f = 1 \text{ kHz}$	25			25			25			25			
$ h_{fe} $	$V_{CE} = 10 \text{ V}$, $I_C = 0.2 \text{ A}$, $f = 2 \text{ MHz}$	5			5			5			5			

NOTES: 5. These parameters must be measured using pulse techniques, $t_W = 300 \mu\text{s}$, duty cycle $\leq 2\%$.

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}	$I_C = 1\text{ A}$, $I_{B1} = 100\text{ mA}$, $I_{B2} = -100\text{ mA}$, $V_{BE(off)} = -5\text{ V}$, $R_L = 200\ \Omega$, See Figure 1	0.2			μs
t_{off}		2			

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

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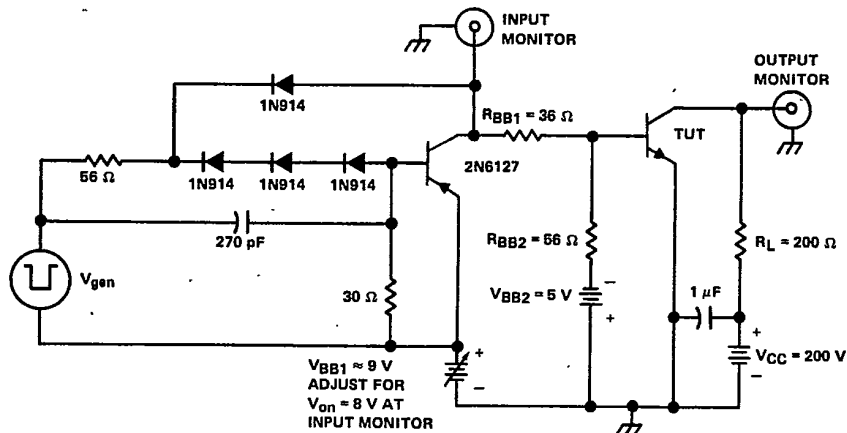
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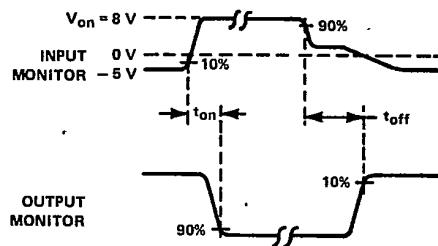
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PARAMETER MEASUREMENT INFORMATION



TEST CIRCUIT



VOLTAGE WAVEFORMS

- NOTES:
- V_{gen} is a - 30-V pulse into a 50 Ω termination.
 - 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 $\leq 2\%$.
 - 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.
 - Resistors must be noninductive types.
 - The d-c power supplies may require additional bypassing in order to minimize ringing.

FIGURE 1. RESISTIVE-LOAD SWITCHING

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TIP Devices

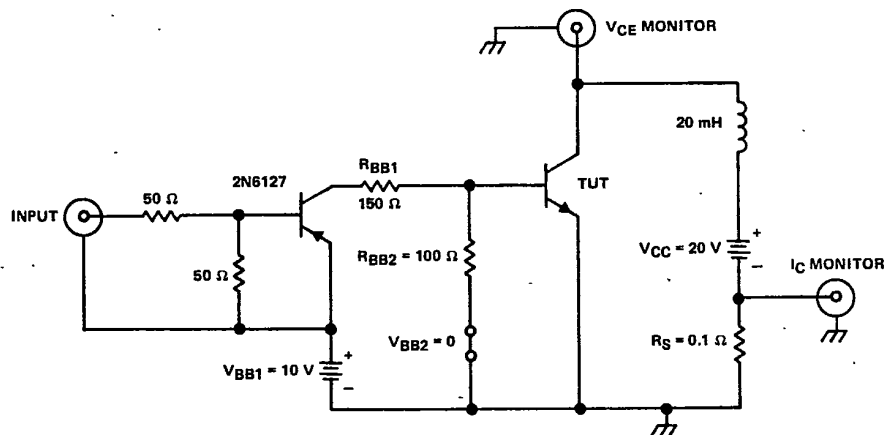
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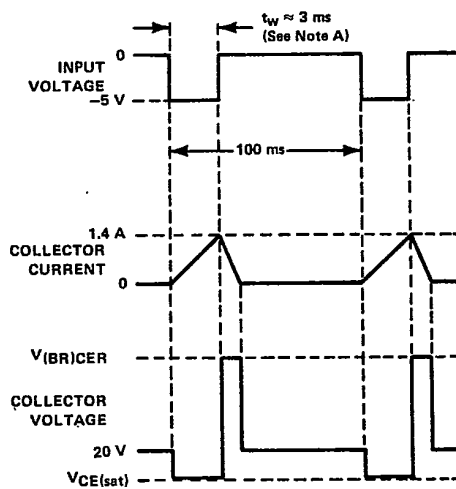
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PARAMETER MEASUREMENT INFORMATION



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

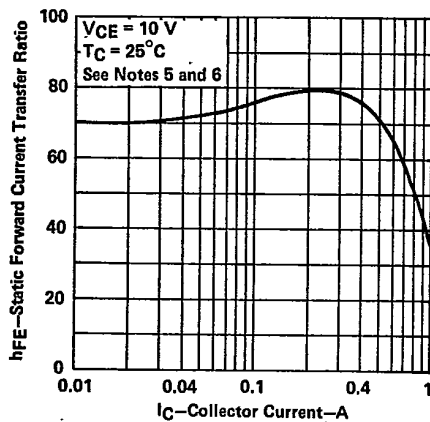
STATIC FORWARD CURRENT TRANSFER RATIO
vs
COLLECTOR CURRENT

FIGURE 3

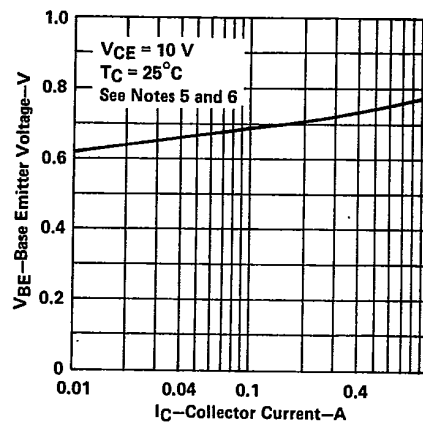
BASE-EMITTER VOLTAGE
vs
COLLECTOR CURRENT

FIGURE 4

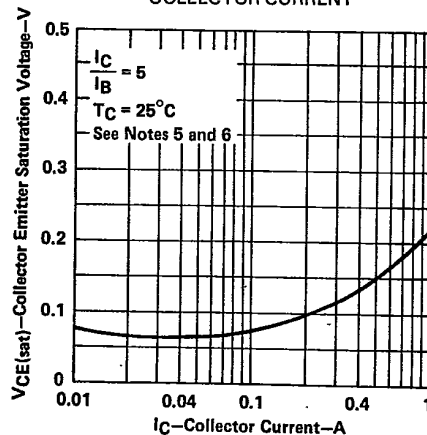
COLLECTOR-EMITTER
SATURATION VOLTAGE
vs
COLLECTOR CURRENT

FIGURE 5

- NOTES: 5. These parameters must be measured using pulse techniques, $t_W = 300 \mu s$, duty cycle $\leq 2\%$.
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.

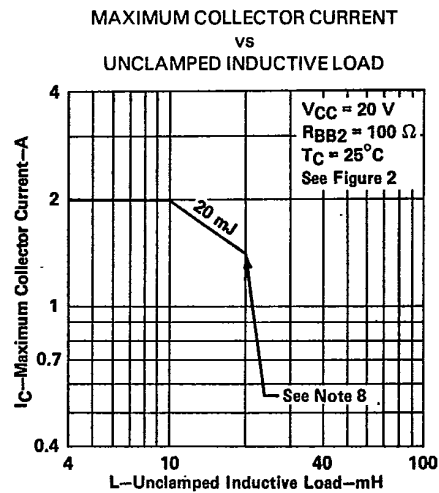
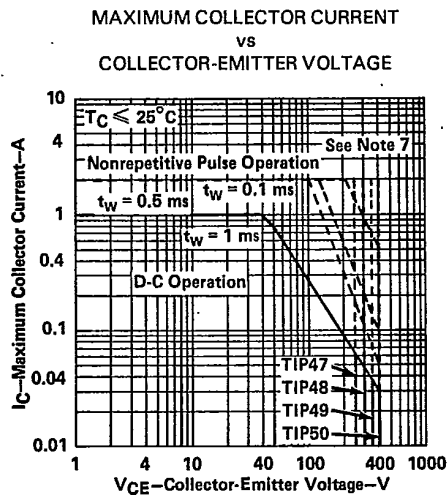
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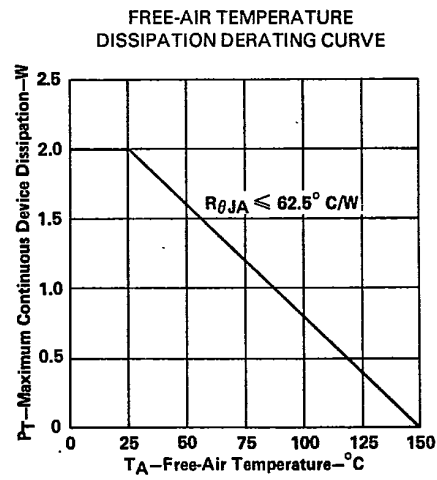
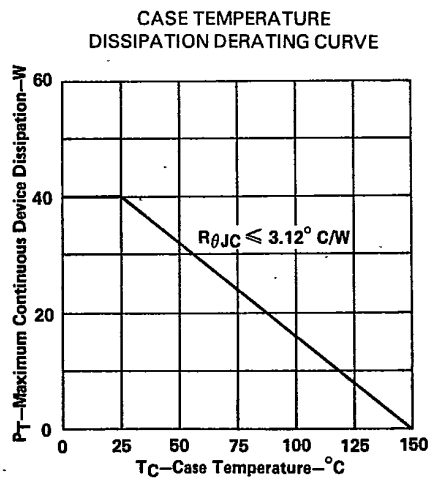
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MAXIMUM SAFE OPERATING AREA



- 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



TIP Devices