

8961726 TEXAS INSTR (OPTO)

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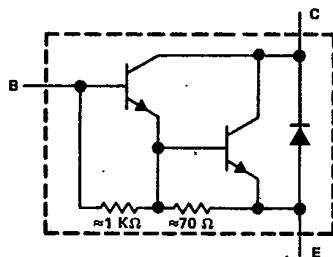
TIP150, TIP151, TIP152
N-P-N DARLINGTON-CONNECTED
SILICON POWER TRANSISTORS

REVISÉ OCTOBER 1984

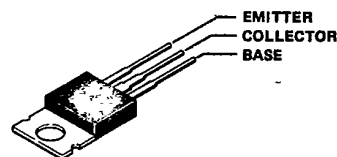
- **High Voltage, High Forward and Clamped Reverse Energy**
- **10 A Peak Collector Current**
- **80 W at 25°C Case Temperature**
- **Reverse-Bias SOA . . . 300 V to 400 V at 7 A**
- **V_{CEX(sus)} . . . 300 V to 400 V Min at 7 A**

T-33-29

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)

	TIP150	TIP151	TIP152
Collector-base voltage	300 V	350 V	400 V
Collector-emitter voltage ($I_B = 0$)	300 V	350 V	400 V
Emitter-base voltage		8 V	
Continuous collector current		7 A	
Peak collector current (see Note 1)		10 A	
Continuous base current		1.5 A	
Safe operating area at (or below) 25°C case temperature	See Figures 8 and 9		
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 $t_{\text{W}} \leq 5$ ms, duty cycle $\leq 10\%$.
 2. Derate linearly to 150°C case temperature at the rate of $0.64\text{ W}/^{\circ}\text{C}$ or refer to Dissipation Derating Curve, Figure 10.
 3. Derate linearly to 150°C free-air temperature at the rate of $16\text{ mW}/^{\circ}\text{C}$ or refer to Dissipation Derating Curve, Figure 11.



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TIP150, TIP151, TIP152
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SILICON POWER TRANSISTORS

electrical characteristics at 25°C case temperature

PARAMETER	TEST CONDITIONS	TIP150			TIP151			TIP152			UNIT
		MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX	
$V_{(BR)CBO}$	$I_C = 1 \text{ mA}$, See Note 4 $I_E = 0$,	300			350			400			V
$V_{(BR)CEO}$	$I_C = 10 \text{ mA}$, See Note 4 $I_B = 0$,	300			350			400			V
$V_{CEX(sus)}$	$I_C = 7 \text{ A}$, See Figure 1 $I_E = 0$,	300			350			400			V
I_{CEO}	$V_{CE} = 300 \text{ V}$, $I_B = 0$			250							μA
	$V_{CE} = 350 \text{ V}$, $I_B = 0$						250				
	$V_{CE} = 400 \text{ V}$, $I_B = 0$									250	
I_{EBO}	$V_{EB} = 8 \text{ V}$, $I_C = 0$			15			15			15	mA
h_{FE}	$V_{CE} = 5 \text{ V}$, See Notes 4 and 5 $I_C = 2.5 \text{ A}$,	150			150			150			
	$V_{CE} = 5 \text{ V}$, See Notes 4 and 5 $I_C = 5 \text{ A}$,	50			50			50			
	$V_{CE} = 5 \text{ V}$, See Notes 4 and 5 $I_C = 7 \text{ A}$,	15			15			15			
	$I_B = 100 \text{ mA}$, See Notes 4 and 5 $I_C = 2 \text{ A}$,		2.2			2.2			2.2		V
V_{BE}	$I_B = 250 \text{ mA}$, See Notes 4 and 5 $I_C = 5 \text{ A}$,		2.3			2.3			2.3		
	$I_B = 10 \text{ mA}$, See Notes 4 and 5 $I_C = 1 \text{ A}$,		1.5			1.5			1.5		V
$V_{CE(sat)}$	$I_B = 100 \text{ mA}$, See Notes 4 and 5 $I_C = 2 \text{ A}$,		1.5			1.5			1.5		
	$I_B = 250 \text{ mA}$, See Notes 4 and 5 $I_C = 5 \text{ A}$,		2			2			2		
	$I_F = 7 \text{ A}$, See Notes 4 and 5		3.5			3.5			3.5		V
h_{fe}	$V_{CE} = 5 \text{ V}$, $f = 1 \text{ kHz}$ $I_C = 0.5 \text{ A}$,	200			200			200			
$ h_{fe} $	$V_{CE} = 5 \text{ V}$, $f = 1 \text{ MHz}$ $I_C = 0.5 \text{ A}$,	10			10			10			
C_{obo}	$V_{CB} = 10 \text{ V}$, $f = 1 \text{ MHz}$ $I_E = 0$,		100			100			100		pF

NOTES: 4. These parameters must be measured using pulse techniques, $t_w = 300 \mu\text{s}$, duty cycle $\leq 2\%$.

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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thermal characteristics

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

NOTE 6: This parameter is measured using 0.08 mm (0.003-inch) mica insulator with Dow-Corning 11 compound on 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	$I_C = 5\text{ A}, \quad I_{B1} = 250\text{ mA}, \quad I_{B2} = -250\text{ mA},$ $V_{BE(\text{off})} = -7.3\text{ V}, \quad R_L = 50\ \Omega, \quad \text{See Figure 2}$		20		ns
t_r			160		
t_s			3400		
t_f			1520		

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

inductive-load switching characteristics at 25°C case temperature

PARAMETER	TEST CONDITIONS†	MIN	TYP	MAX	UNIT
t_{sv}	$V_{(\text{clamp})} = \text{Min } V_{CEX(\text{sus})}, \quad I_{CM} = 5\text{ A},$ $I_{B1} = 250\text{ mA}, \quad I_{B2} = -250\text{ mA}, \quad \text{See Figure 3}$		3900		ns
t_{sj}			4700		
t_{tv}			1200		
t_{tj}			1200		
t_{xo}			2000		

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

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TIP Devices

TEXAS
INSTRUMENTS

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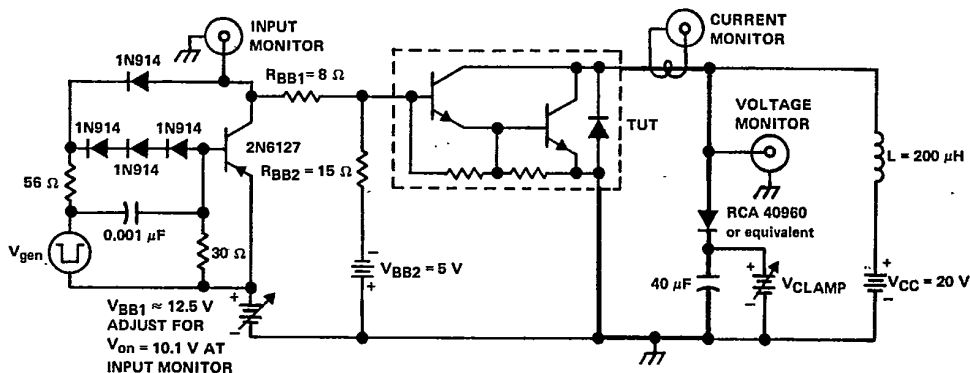
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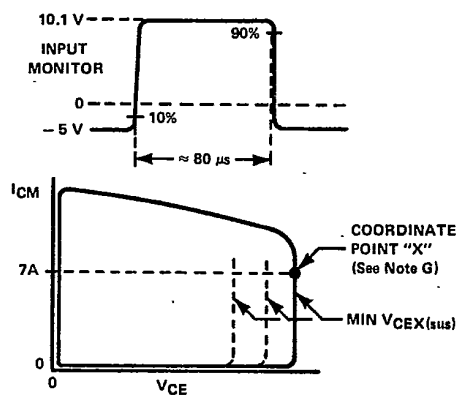
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SILICON POWER TRANSISTORS

PARAMETER MEASUREMENT INFORMATION



TEST CIRCUIT



INPUT WAVEFORM AND X-Y DISPLAY

- NOTES: A. V_{gen} is a -20-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, $Z_{out} = 50$ Ω , $t_w = 40$ μ s, duty cycle $\leq 2\%$.
C. Waveforms are monitored on an X-Y oscilloscope with the following characteristics: $t_r \leq 15$ ns, $R_{in} \geq 10$ M Ω , $C_{in} \leq 11.5$ pF.
D. Resistors must be noninductive types.
E. The d-c power supplies may require additional bypassing in order to minimize ringing.
F. Heavy lines denote copper bus 0.5 inch by 0.125 inch (12.7 mm by 3.2 mm) fabricated to have minimum inductance.
G. Adjust input pulse duration until collector current is 7 A at point "X". I_{CM} must not exceed 10 A.

FIGURE 1. COLLECTOR-EMITTER SUSTAINING VOLTAGE TEST

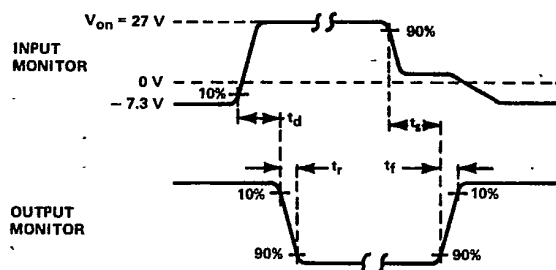
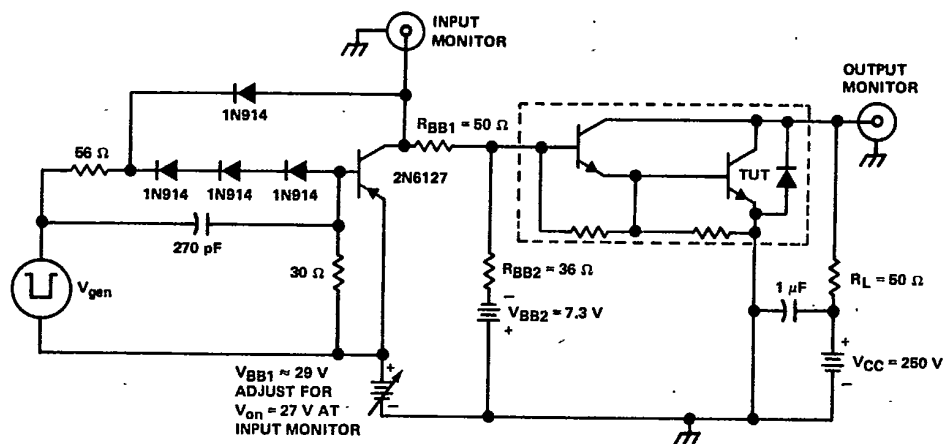
TIP Devices

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PARAMETER MEASUREMENT INFORMATION T-33-29



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

FIGURE 2. RESISTIVE-LOAD SWITCHING TIMES

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TIP Devices

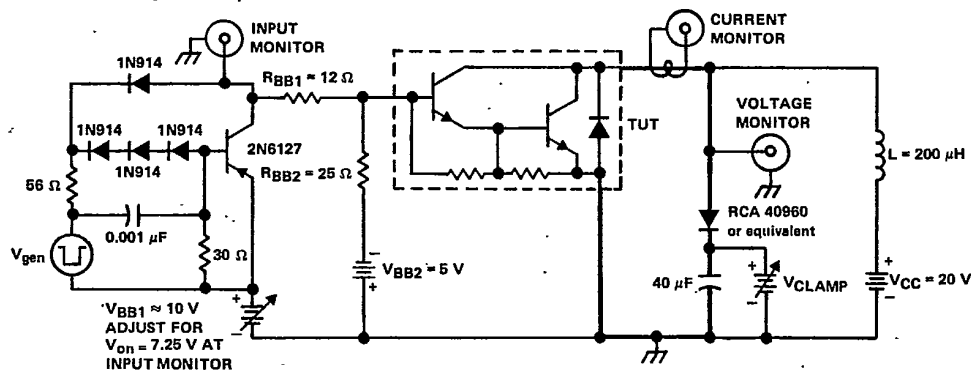
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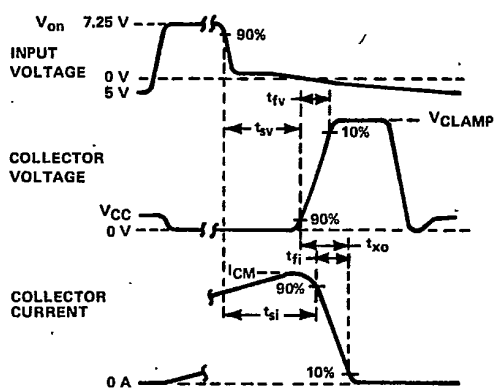
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PARAMETER MEASUREMENT INFORMATION



TEST CIRCUIT



WAVEFORMS

- NOTES: A. V_{gen} is a $\sim 30\text{-V}$ pulse into a 50Ω termination.
B. The V_{gen} waveform is supplied by a generator with the following characteristics: $t_f \leq 15 \text{ ns}$, $t_r \leq 15 \text{ ns}$, $Z_{out} = 50 \Omega$, $t_w \approx 25 \mu\text{s}$, duty cycle $\leq 2\%$. Pulse duration is adjusted for $I_{CM} = 3 \text{ A}$.
C. Waveforms are monitored on an oscilloscope with the following characteristics: $t_r \leq 15 \text{ ns}$, $R_{in} \geq 10 \text{ M}\Omega$, $C_{in} \leq 11.5 \text{ pF}$.
D. Resistors must be noninductive types.
E. The d-c power supplies may require additional bypassing in order to minimize ringing.
F. Heavy lines denote copper bus 0.5 inch by 0.125 (12,7 mm by 3,2 mm) fabricated to have minimum inductance.

FIGURE 3. INDUCTIVE-LOAD SWITCHING TIMES

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TYPICAL CHARACTERISTICS

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COLLECTOR CUTOFF CURRENT
vs
CASE TEMPERATURE

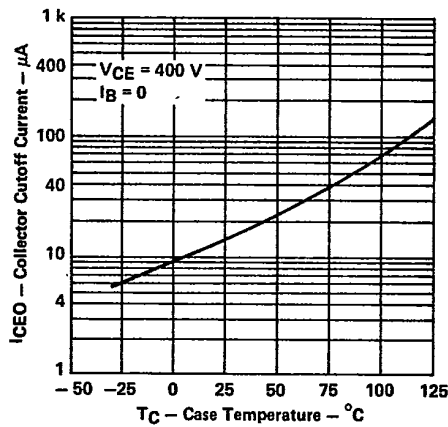


FIGURE 4

STATIC FORWARD CURRENT TRANSFER RATIO
vs
COLLECTOR CURRENT

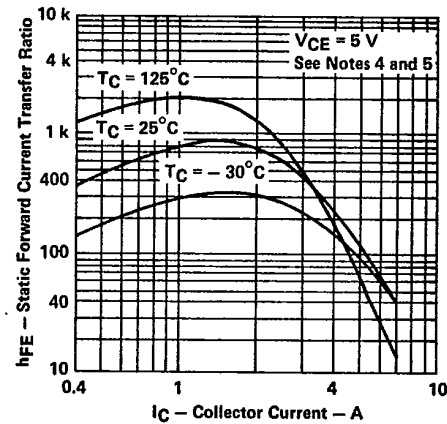


FIGURE 5

BASE-EMITTER VOLTAGE
vs
COLLECTOR CURRENT

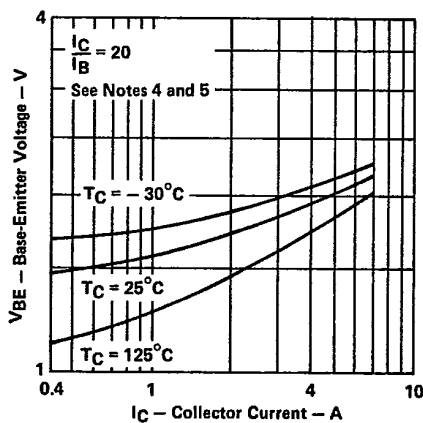


FIGURE 6

COLLECTOR-EMITTER SATURATION VOLTAGE
vs
COLLECTOR CURRENT

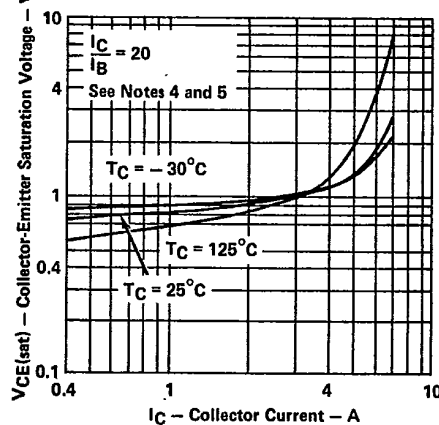


FIGURE 7

- NOTES: 4. These parameters must be measured using pulse techniques, $t_W = 300 \mu s$, duty cycle $\leq 2\%$.
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.

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MAXIMUM SAFE OPERATING AREA

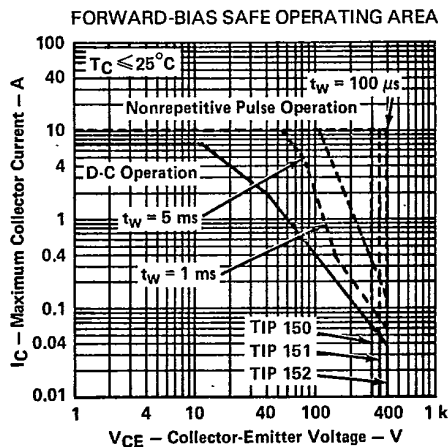


FIGURE 8

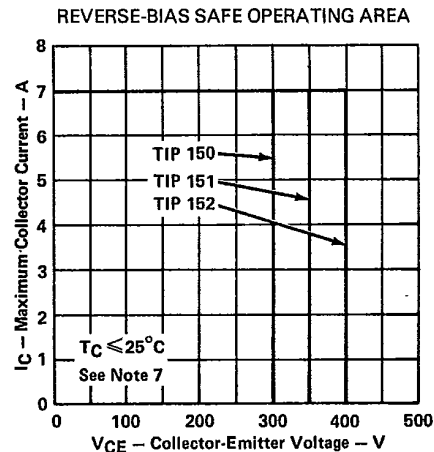


FIGURE 9

NOTE 7: This combination of maximum voltage and current may be achieved only when switching from saturation to cutoff with a clamped inductive load as in Figure 1.

THERMAL INFORMATION

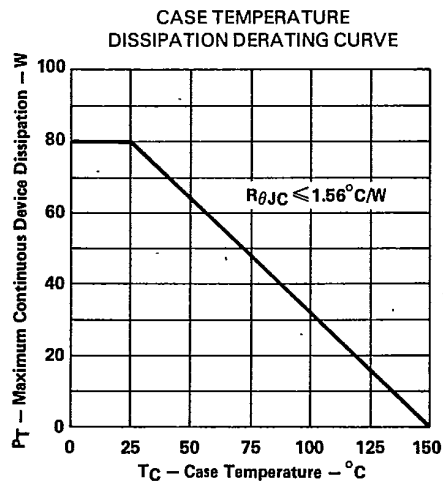


FIGURE 10

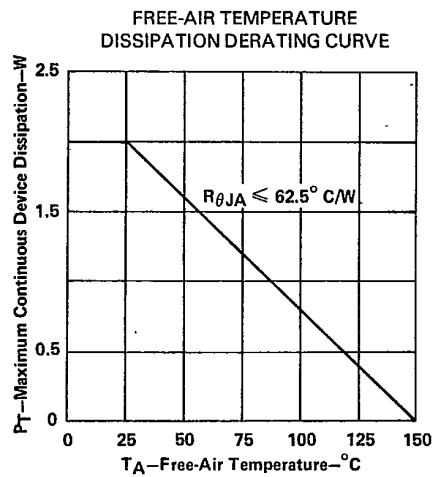


FIGURE 11

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