

8961726 TEXAS INSTR (OPTO)

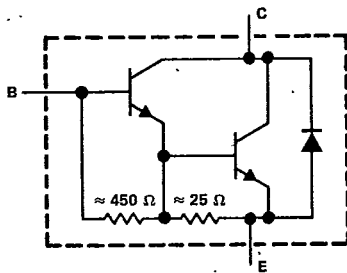
62C 36990 D

**TIP663, TIP664, TIP665**  
**N-P-N DARLINGTON-CONNECTED**  
**SILICON POWER TRANSISTORS**  
 REVISED OCTOBER 1984

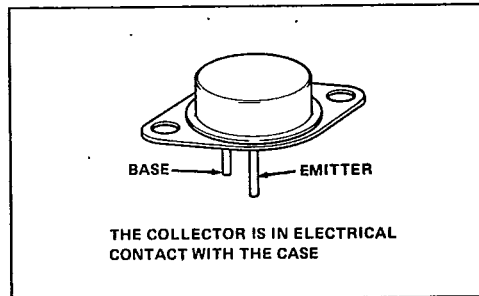
T-33-29

- 150 W at 100°C Case Temperature
- 20 A Continuous Collector Current
- Min  $h_{FE}$ ...250 at 5 V, 10 A
- Forward-Bias SOA...30 V, 5 A
- Reverse-Bias SOA...300 V to 400 V, 10 A
- High-Voltage, High Forward and Clamped Reverse Energy
- Designed for Ignition Systems, Motor Controls, and Solenoid Driver Applications

device schematic



TO-3 PACKAGE



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

	TIP663	TIP664	TIP665
Collector-base voltage	400 V	450 V	600 V
Collector-emitter voltage ( $I_B = 0$ )	300 V	350 V	400 V
Emitter-base voltage	8 V		
Continuous collector current	20 A		
Peak collector current (see Note 1)	30 A		
Continuous base current	5 A		
Safe operating area at (or below) 25°C case temperature	See Figures 9 and 10		
Continuous device dissipation at (or below) 100°C case temperature (see Note 2)	150 W		
Continuous device dissipation at (or below) 25°C free-air temperature (see Note 3)	5.5 W		
Operating collector junction and storage temperature range	- 65°C to 200°C		
Lead temperature 3,2 mm (0.125 inch) from case for 10 seconds	300°C		

- NOTES: 1. This value applies for  $t_w \leq 5$  ms, duty cycle  $\leq 10\%$ .  
 2. Derate linearly to 200°C case temperature at the rate of 1.5 W/°C or refer to Dissipation Derating Curve, Figure 9.  
 3. Derate linearly to 200°C free-air temperature at the rate of 31.4 mW/°C or refer to Dissipation Derating Curve, Figure 10.

**TIP Devices**

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**electrical characteristics at 25°C case temperature**

PARAMETER	TEST CONDITIONS	TIP663			TIP664			TIP665			UNIT
		MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX	
V(BR)CBO	I <sub>C</sub> = 1 mA, See Note 4 I <sub>E</sub> = 0,	400			450			500			V
V(BR)CEO	I <sub>C</sub> = 10 mA, See Note 4 I <sub>B</sub> = 0,	300			350			400			V
V <sub>CEX(sus)</sub>	I <sub>C</sub> = 20 A, See Figure 1	300			350			400			V
I <sub>CEO</sub>	V <sub>CE</sub> = 250 V, I <sub>B</sub> = 0			250							μA
	V <sub>CE</sub> = 300 V, I <sub>B</sub> = 0					250					
	V <sub>CE</sub> = 350 V, I <sub>B</sub> = 0								250		
I <sub>CES</sub>	V <sub>CE</sub> = 350 V, V <sub>BE</sub> = 0			250							μA
	V <sub>CE</sub> = 400 V, V <sub>BE</sub> = 0					250					
	V <sub>CE</sub> = 450 V, V <sub>BE</sub> = 0								250		
I <sub>EBO</sub>	V <sub>EB</sub> = 8 V, I <sub>C</sub> = 0			50		50			50		mA
h <sub>FE</sub>	V <sub>CE</sub> = 5 V, See Notes 4 and 5 I <sub>C</sub> = 5 A,	500	10000		500	10000		500	10000		
	V <sub>CE</sub> = 5 V, See Notes 4 and 5 I <sub>C</sub> = 10 A,	250			250			250			
	V <sub>CE</sub> = 5 V, See Notes 4 and 5 I <sub>C</sub> = 20 A,	25			25			25			
V <sub>BE(sat)</sub>	I <sub>B</sub> = 1 A, See Notes 4 and 5 I <sub>C</sub> = 10 A,			2.1		2.1			2.1		V
	I <sub>B</sub> = 1 A, See Notes 4 and 5 I <sub>C</sub> = 20 A,			2.5		2.5			2.5		
V <sub>CE(sat)</sub>	I <sub>B</sub> = 400 mA, See Notes 4 and 5 I <sub>C</sub> = 10 A,			1.3		1.3			1.3		V
	I <sub>B</sub> = 1 A, See Notes 4 and 5 I <sub>C</sub> = 20 A,			3		3			3		
V <sub>F</sub>	I <sub>F</sub> = 20 A, See Notes 4 and 5			3.5		3.5			3.5		V
h <sub>fe</sub>	V <sub>CE</sub> = 5 V, f = 1 kHz I <sub>C</sub> = 1 A,	1000			1000			1000			
h <sub>fe</sub>	V <sub>CE</sub> = 5 V, f = 5 MHz I <sub>C</sub> = 1 A,	2			2			2			
C <sub>obo</sub>	V <sub>CB</sub> = 10 V, f = 1 MHz I <sub>E</sub> = 0,			250		250			250		pF

NOTES: 4. These parameters must be measured using pulse techniques, t<sub>w</sub> = 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.

**thermal characteristics**

PARAMETER	MIN	TYP	MAX	UNIT
R <sub>θJC</sub>		0.67		°C/W
R <sub>θJA</sub>		31.8		
R <sub>θCHS</sub> See Note 6	0.4			

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 characteristic at 25°C case temperature**

PARAMETER	TEST CONDITIONS†	MIN	TYP	MAX	UNIT
t <sub>d</sub>			0.05		μs
t <sub>r</sub>	I <sub>C</sub> = 10 A, I <sub>B1</sub> = 400 mA, I <sub>B2</sub> = -440 mA,		0.22		
t <sub>s</sub>	V <sub>BE(off)</sub> = -7.1 V, R <sub>L</sub> = 25 Ω, See Figure 2		6.5		
t <sub>f</sub>			1.3		

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

TIP Devices



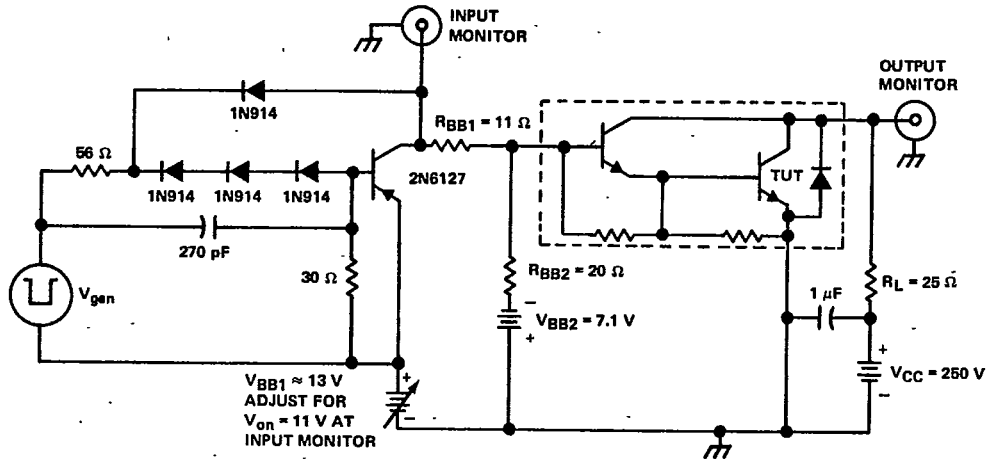
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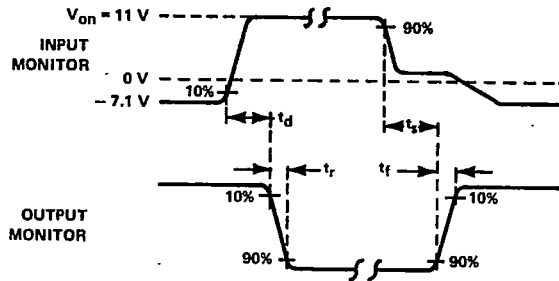
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**PARAMETER MEASUREMENT INFORMATION**



TEST CIRCUIT



VOLTAGE WAVEFORMS

- NOTES: A.  $V_{gen}$  is a -30-V pulse into a 50Ω 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  $\leq 2\%$ .  
 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 2. RESISTIVE-LOAD SWITCHING



TIP Devices

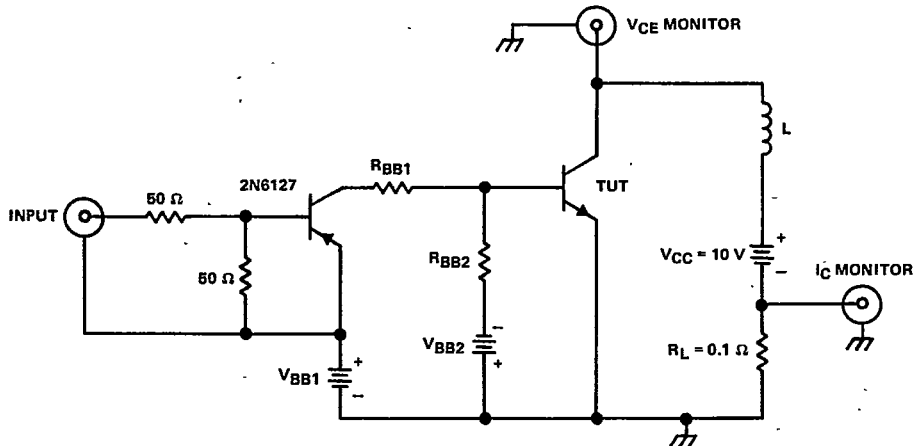
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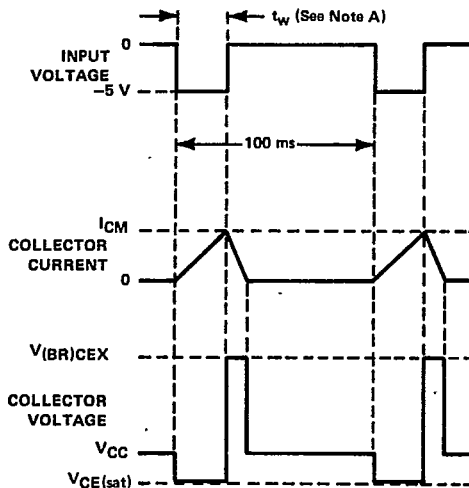
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SILICON POWER TRANSISTORS

FUNCTIONAL TEST INFORMATION

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TEST CIRCUIT



VOLTAGE AND CURRENT WAVEFORMS

- NOTES: A. Input pulse duration is increased until the peak collector current reaches the specified value of  $I_{CM}$ .  
B. Circuit shown is for testing n-p-n transistors. For p-n-p transistors, all voltage supplies and waveforms are reversed and the driver transistor is type 2N6128.

FIGURE 3. REVERSE PULSE ENERGY TEST

5  
TIP Devices

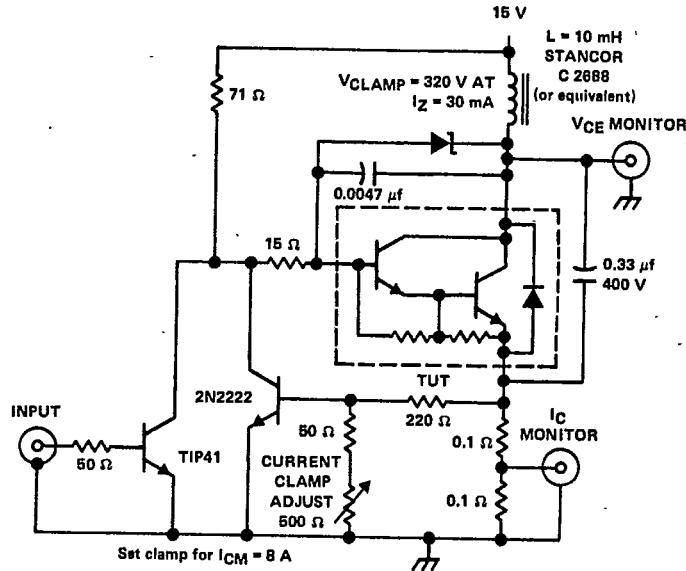
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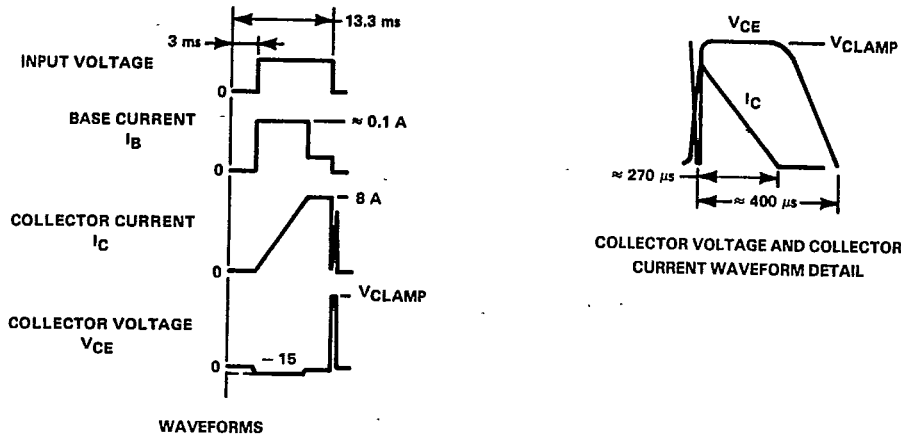
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FUNCTIONAL TEST INFORMATION



TEST CIRCUIT



WAVEFORMS

- NOTES: A. Base and collector currents are measured using current probes such as Tektronix types P6019, P6020, P6021, P6042 or the equivalent.  
B. Waveforms are monitored on an oscilloscope with the following characteristics:  $t_r \leq 20$  ns,  $R_{in} \geq 10$  M $\Omega$ ,  $C_{in} \leq 11.5$  pF.

FIGURE 4. FORWARD PULSE ENERGY TEST

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TYPICAL CHARACTERISTICS

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TIP665  
COLLECTOR CUTOFF CURRENT  
vs  
CASE TEMPERATURE

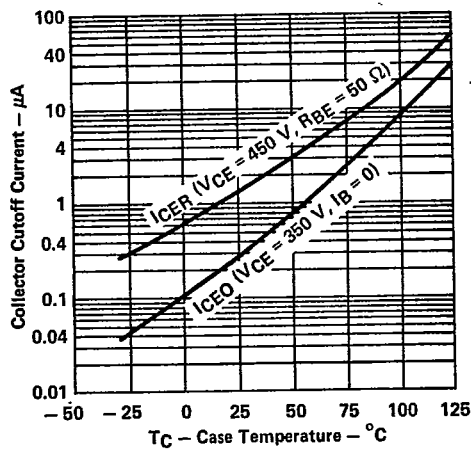


FIGURE 5

STATIC FORWARD CURRENT TRANSFER RATIO  
vs  
COLLECTOR CURRENT

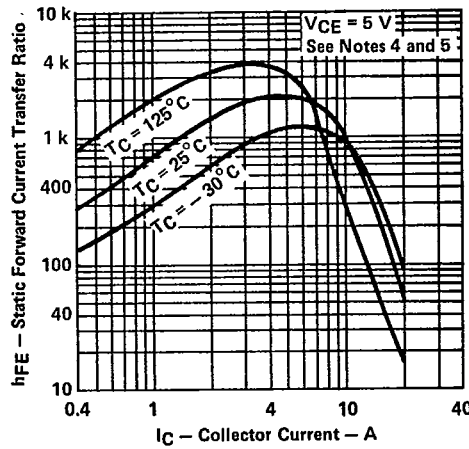


FIGURE 6

BASE-EMITTER VOLTAGE  
vs  
COLLECTOR CURRENT

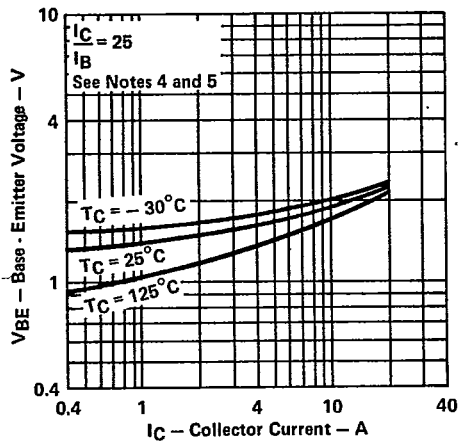


FIGURE 7

COLLECTOR-EMITTER SATURATION VOLTAGE  
vs  
COLLECTOR CURRENT

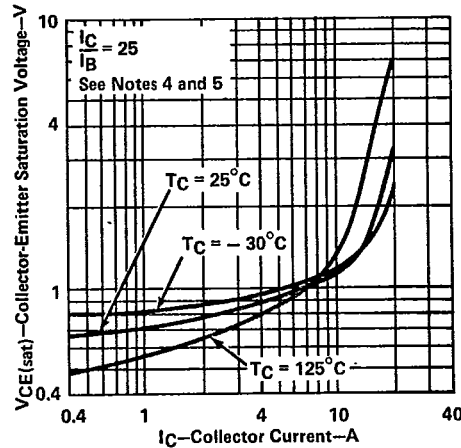


FIGURE 8

- 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 located within 3.2 mm (0.125 inch) from the device body.

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**MAXIMUM SAFE OPERATING AREA**

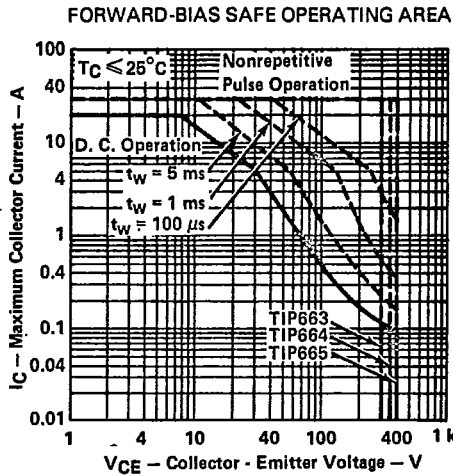


FIGURE 9

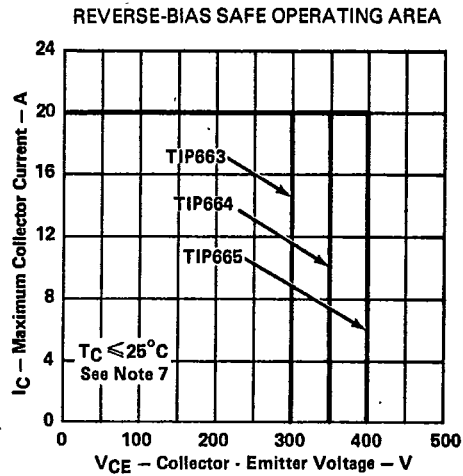


FIGURE 10

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**

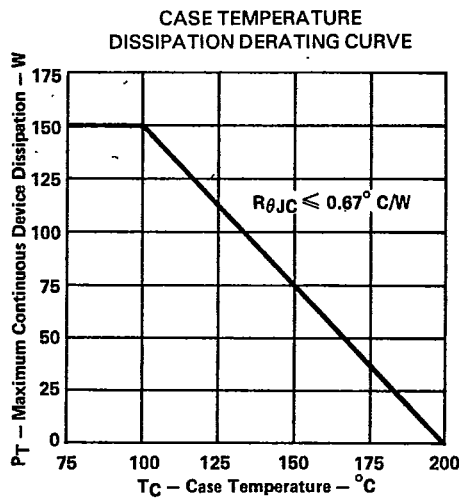


FIGURE 11

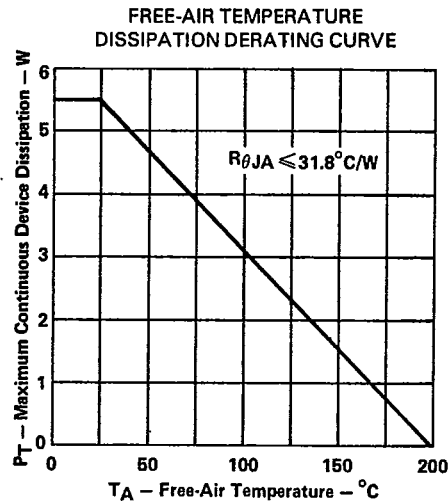


FIGURE 12



TIP Devices