

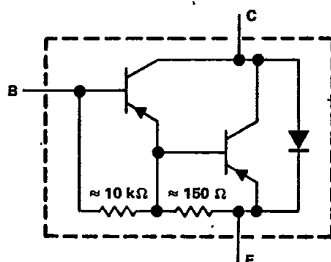
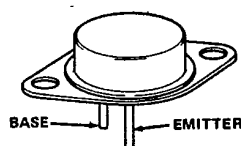
8961726 TEXAS INSTR (OPTO)

62C 36976 D

TIP645, TIP646, TIP647
P-N-P DARLINGTON-CONNECTED
SILICON POWER TRANSISTORS

REVISED OCTOBER 1984

- Designed For Complementary Use With TIP640, TIP641, TIP642 T-33-31
- 175 W at 25°C Case Temperature
- 10 A Rated Collector Current
- Min h_{FE} of 1000 at 4 V, 5 A
- 100 mJ Reverse Energy Rating

device schematic**TO-3 PACKAGE**

THE COLLECTOR IS IN ELECTRICAL
CONTACT WITH THE CASE

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

	TIP645	TIP646	TIP647
Collector-base voltage	-60 V	-80 V	-100 V
Collector-emitter voltage ($I_B = 0$)	-60 V	-80 V	-100 V
Emitter-base voltage		-5 V	
Continuous collector current		-10 A	
Peak collector current (see Note 1)		-15 A	
Continuous base current		-0.5 A	
Safe operating areas at (or below) 25°C case temperature	See Figures 7 and 8		
Continuous device dissipation at (or below) 25°C case temperature (see Note 2)		175 W	
Continuous device dissipation at (or below) 25°C free-air temperature (see Note 3)		5 W	
Unclamped inductive load energy (see Note 4)		100 mJ	
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		260°C	

- NOTES: 1. This value applies for $t_W \leq 0.3$ ms, duty cycle $\leq 10\%$.
 2. Derate linearly to 200°C case temperature at the rate of 1 W/°C or refer to Dissipation Derating Curve, Figure 9.
 3. Derate linearly to 200°C free-air temperature at the rate of 28.6 mW/°C or refer to Dissipation Derating Curve, Figure 10.
 4. This rating is based on the capability of the transistors to operate safely in the circuit of 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	TIP645			TIP646			TIP647			UNIT
		MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX	
$V_{(BR)CEO}$	$I_C = -30 \text{ mA}$, See Note 5 $I_B = 0$	-60			-80			-100			V
I_{CEO}	$V_{CE} = -30 \text{ V}$, $I_B = 0$		-2								mA
	$V_{CE} = -40 \text{ V}$, $I_B = 0$					-2					
	$V_{CE} = -60 \text{ V}$, $I_B = 0$								-2		
I_{CBO}	$V_{CB} = -60 \text{ V}$, $I_E = 0$		-1								mA
	$V_{CB} = -80 \text{ V}$, $I_E = 0$					-1					
	$V_{CB} = -100 \text{ V}$, $I_E = 0$								-1		
I_{EBO}	$V_{EB} = -5 \text{ V}$, $I_C = 0$		-2			-2			-2		mA
h_{FE}	$V_{CE} = -4 \text{ V}$, See Notes 5 and 6 $I_C = -5 \text{ A}$	1000			1000			1000			
	$V_{CE} = -4 \text{ V}$, See Notes 5 and 6 $I_C = -10 \text{ A}$	500			500			500			
V_{BE}	$V_{CE} = -4 \text{ V}$, See Notes 5 and 6 $I_C = -10 \text{ A}$		-3			-3			-3		V
$V_{CE(sat)}$	$I_B = -10 \text{ mA}$, See Notes 5 and 6 $I_C = -5 \text{ A}$		-2			-2			-2		V
	$I_B = -40 \text{ mA}$, See Notes 5 and 6 $I_C = -10 \text{ A}$		-3			-3			-3		
V_F	$I_F = 10 \text{ A}$, See Notes 5 and 6		3.5			3.5			3.5		V

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}	$I_C = -10 \text{ A}$, $I_B = -40 \text{ mA}$	$I_B = -40 \text{ mA}$			0.9		μs
t_{off}	$V_{BE(off)} = 4.2 \text{ V}$, $R_L = 3 \Omega$	See Figure 1			11		

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

TIP Devices

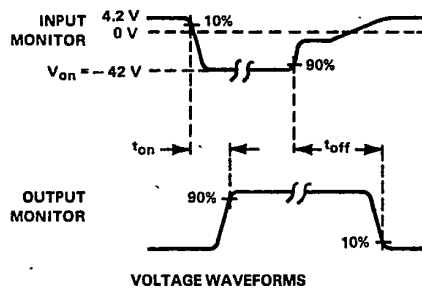
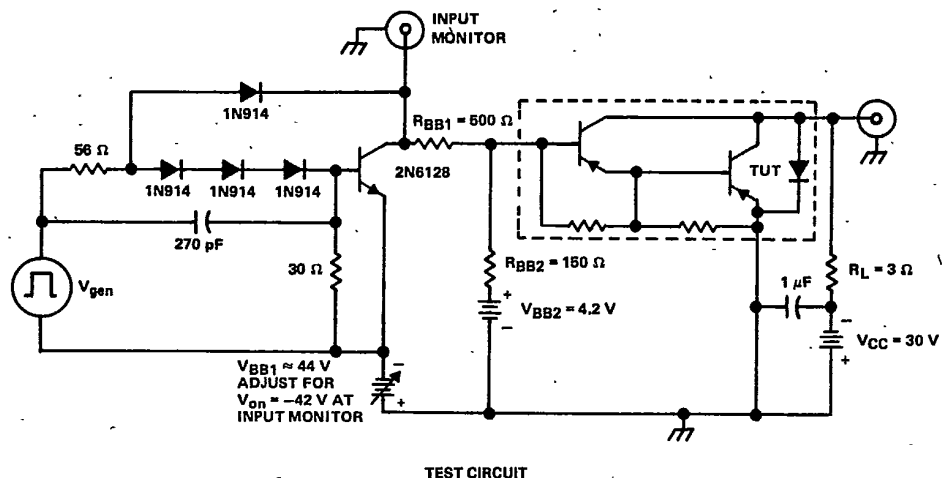
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PARAMETER MEASUREMENT INFORMATION

T-33-31



- 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: $t_f \leq 15\ \text{ns}$, $t_r \leq 15\ \text{ns}$, $Z_{\text{out}} = 50\ \Omega$, $t_W = 20\ \mu\text{s}$, duty cycle $\leq 2\%$.
 - C. Waveforms are monitored on an oscilloscope with the following characteristics: $t_r \leq 15\ \text{ns}$, $R_{\text{in}} \geq 10\ \text{M}\Omega$, $C_{\text{in}} \leq 11.5\ \text{pF}$.
 - D. Resistors must be noninductive types.
 - E. The d-c power supplies may require additional bypassing in order to minimize ringing.

FIGURE 1. RESISTIVE-LOAD SWITCHING

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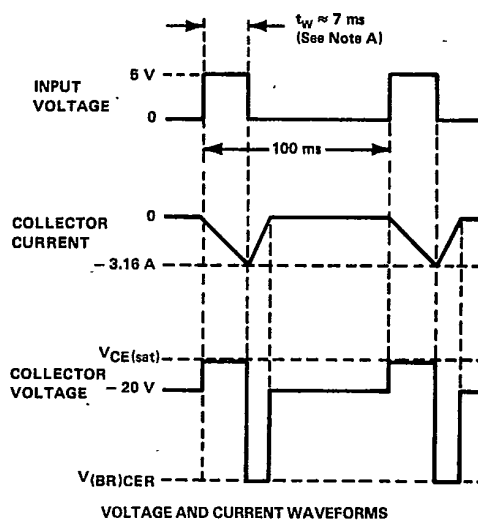
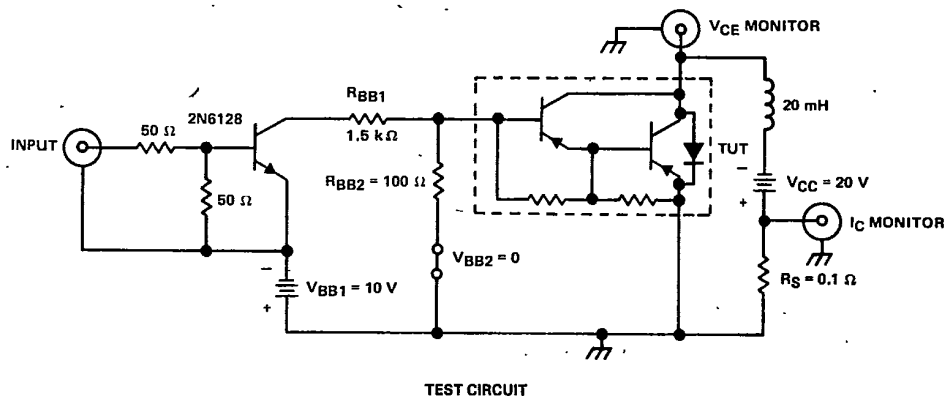
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PARAMETER MEASUREMENT INFORMATION



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

FIGURE 2. INDUCTIVE-LOAD SWITCHING

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TYPICAL CHARACTERISTICS

T-33-31

STATIC FORWARD CURRENT TRANSFER RATIO
vs
COLLECTOR CURRENT

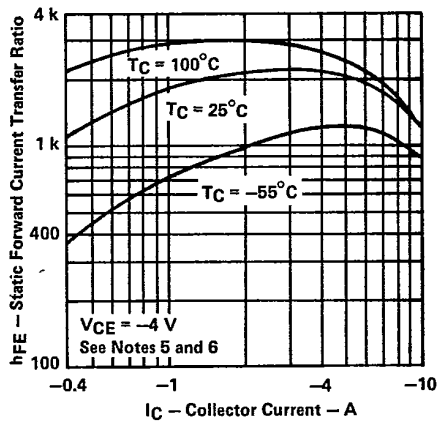


FIGURE 3

BASE-EMITTER VOLTAGE
vs
CASE TEMPERATURE

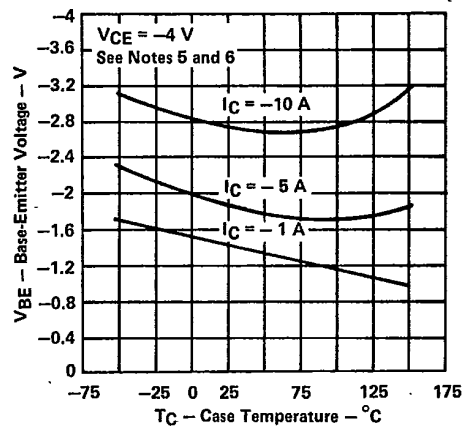


FIGURE 4

COLLECTOR-EMITTER SATURATION VOLTAGE
vs
CASE TEMPERATURE

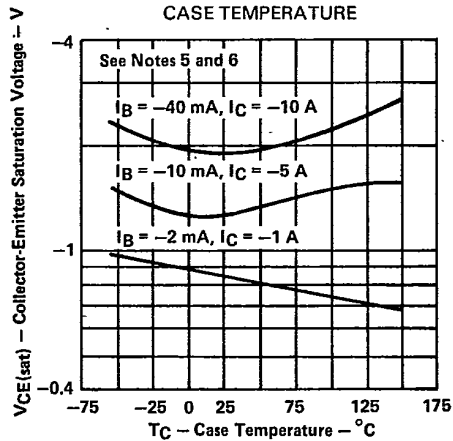


FIGURE 5

SMALL-SIGNAL COMMON-EMITTER
FORWARD CURRENT TRANSFER RATIO
vs
FREQUENCY

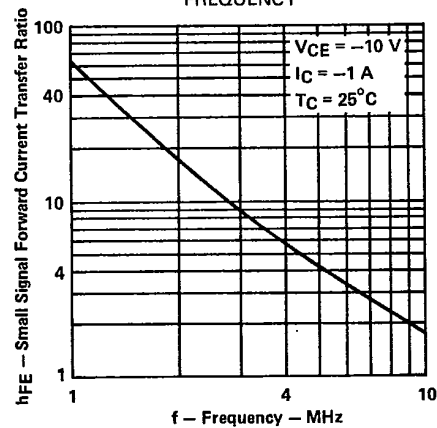


FIGURE 6

- 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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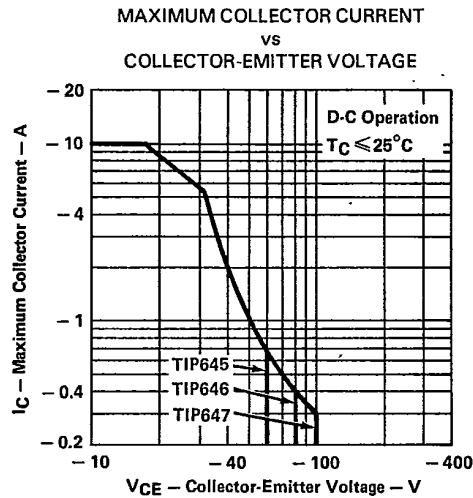
MAXIMUM SAFE OPERATING AREA

FIGURE 7

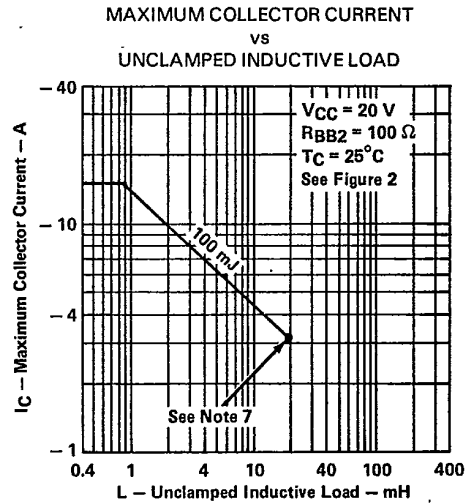


FIGURE 8

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

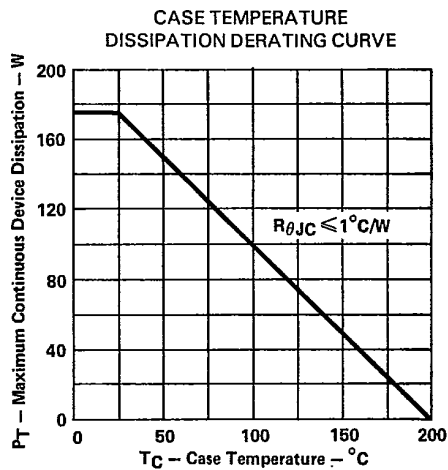
THERMAL INFORMATION

FIGURE 9

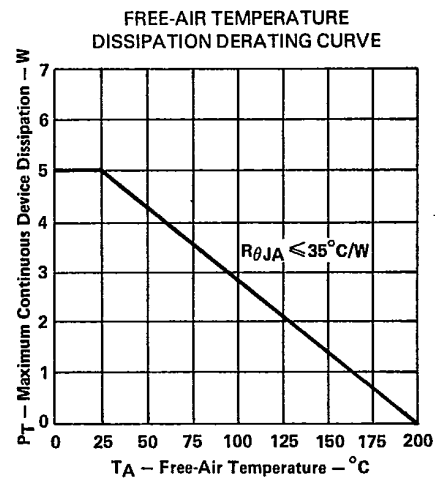


FIGURE 10

TIP Devices