

8961726 TEXAS INSTR (OPTO)

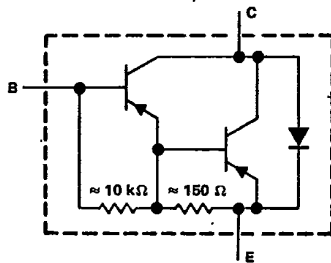
62C 36976 D

TIP645, TIP646, TIP647
P-N-P DARLINGTON-CONNECTED
SILICON POWER TRANSISTORS
 REVISED OCTOBER 1984

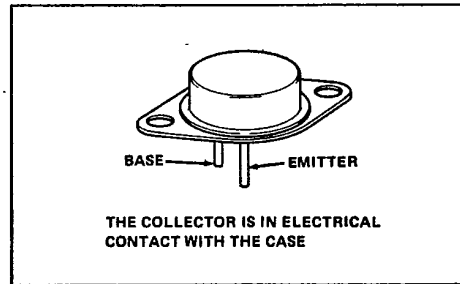
T-33-31

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

device schematic



TO-3 PACKAGE



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 $\approx I_C^2 L / 2$.



TIP Devices

8961726 TEXAS INSTR (OPTO)

62C 36977 D

T-33-31

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

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
hFE	$V_{CE} = -4 \text{ V}$, 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}	$I_C = -10 \text{ A}$, $I_{B1} = -40 \text{ mA}$, $I_{B2} = 40 \text{ mA}$		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

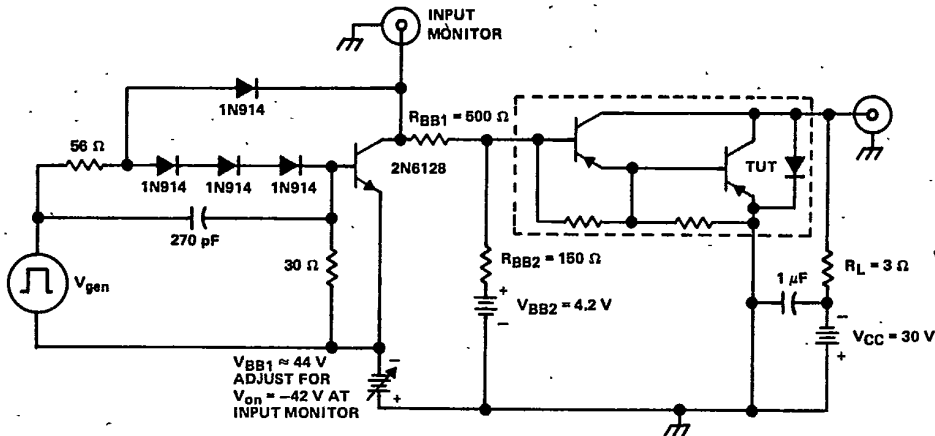
8961726 TEXAS INSTR (OPTO)

62C 36978 D

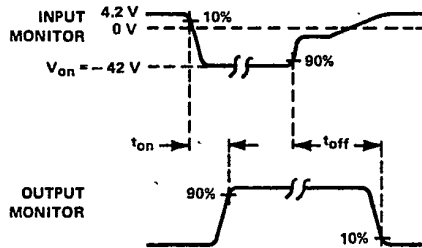
TIP645, TIP646, TIP647
P-N-P DARLINGTON-CONNECTED
SILICON POWER TRANSISTORS

PARAMETER MEASUREMENT INFORMATION

T-33-31



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: $t_r < 15$ ns, $t_f < 15$ 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: $t_r < 15$ ns, $R_{in} \geq 10 M\Omega$, $C_{in} < 11.6$ 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



TIP Devices

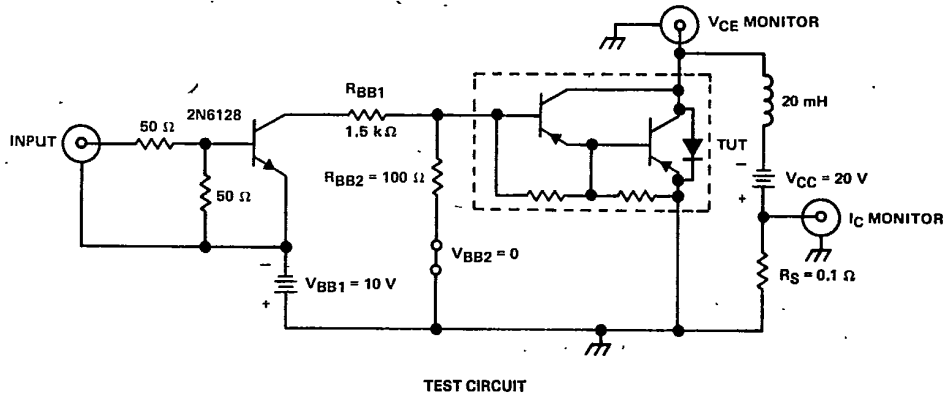
8961726 TEXAS INSTR (OPT0)

62C 36979 D

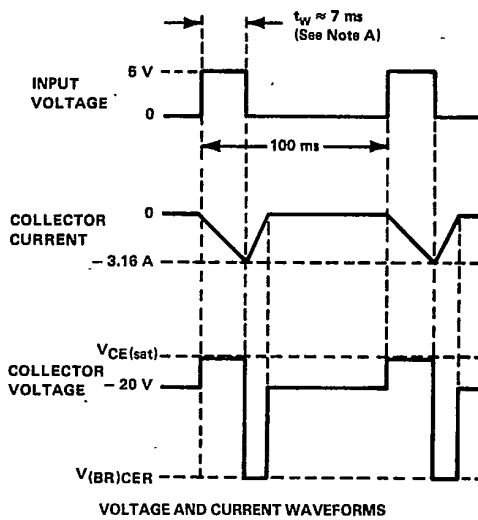
T-33-31

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

PARAMETER MEASUREMENT INFORMATION



TEST CIRCUIT



VOLTAGE AND CURRENT WAVEFORMS

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

FIGURE 2. INDUCTIVE-LOAD SWITCHING

5
TIP Devices

8961726 TEXAS INSTR (OPTO)

62C 36980 D

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

TYPICAL CHARACTERISTICS

T-33-31

STATIC FORWARD CURRENT TRANSFER RATIO
vs
COLLECTOR CURRENT

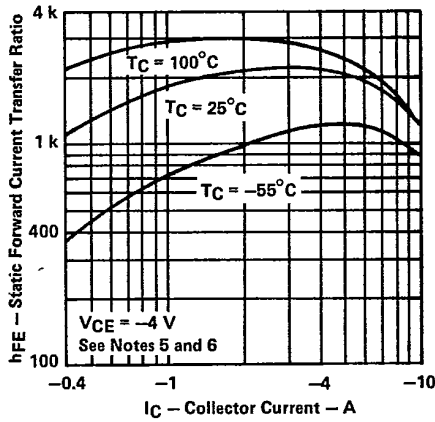


FIGURE 3

BASE-EMITTER VOLTAGE
vs
CASE TEMPERATURE

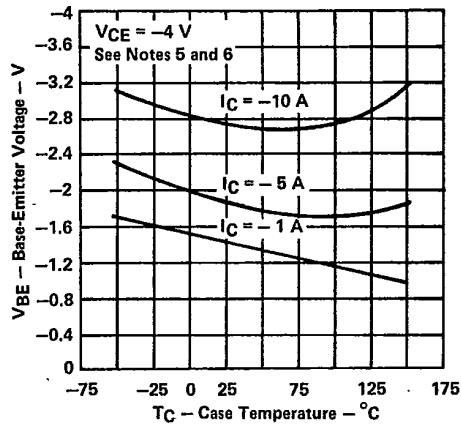


FIGURE 4

COLLECTOR-EMITTER SATURATION VOLTAGE
vs
CASE TEMPERATURE

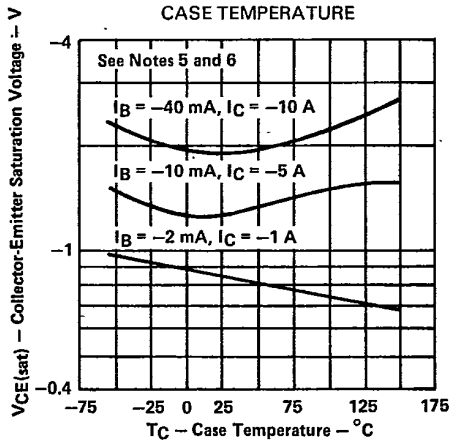


FIGURE 5

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

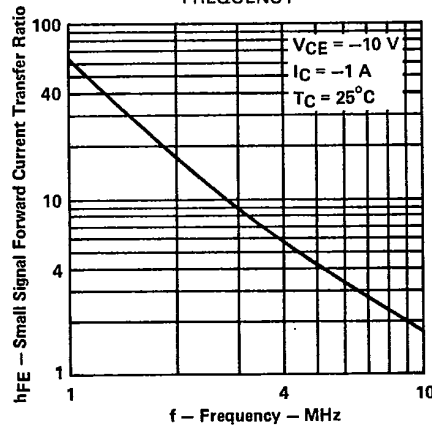


FIGURE 6

- 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.

5
TIP Devices

8961726 TEXAS INSTR (OPT0)

62C 36981 D

T-33-31

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

MAXIMUM SAFE OPERATING AREA

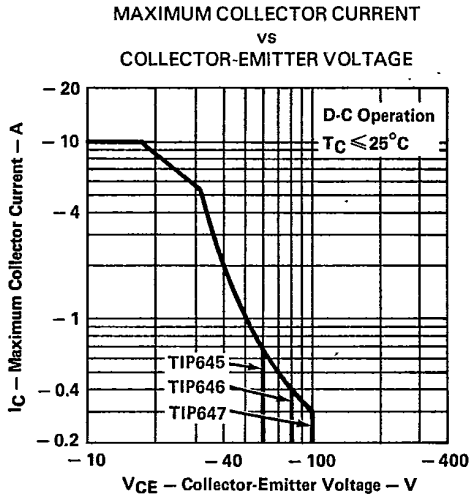


FIGURE 7

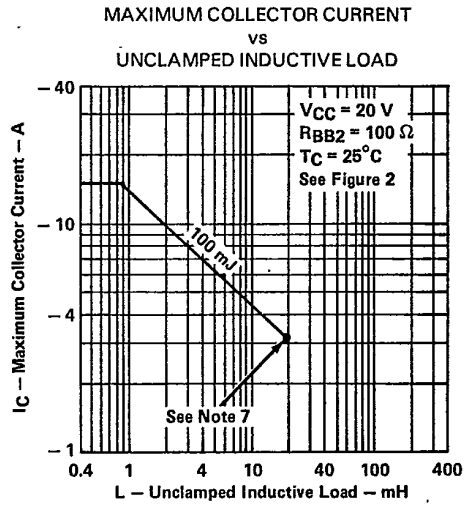


FIGURE 8

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

THERMAL INFORMATION

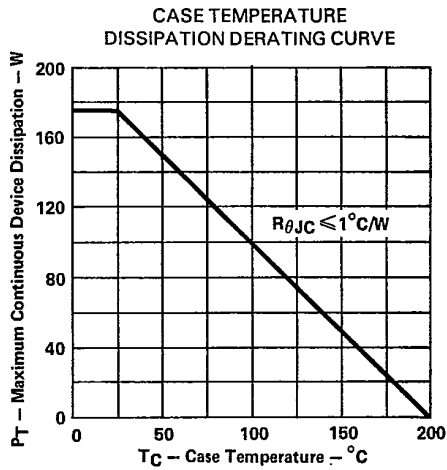


FIGURE 9

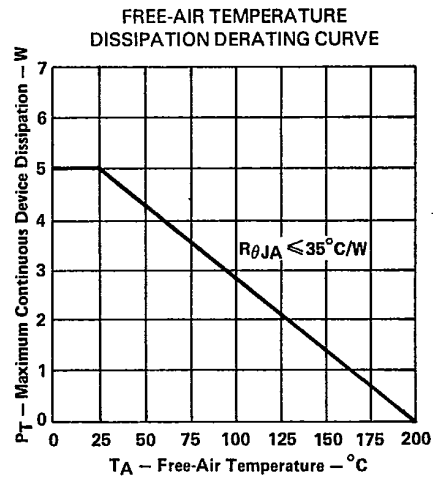


FIGURE 10

TIP Devices