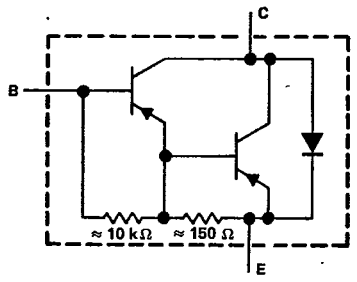
TIP145, TIP146, TIP147
P-N-P DARLINGTON-CONNECTED SILICON POWER TRANSISTORS

REVISED OCTOBER 1984

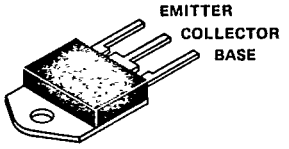
T-33-31

- Designed for Complementary Use With TIP140, TIP141, TIP142
- 125 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-218AA PACKAGE



THE COLLECTOR IS IN ELECTRICAL CONTACT WITH THE MOUNTING TAB

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

	TIP145	TIP146	TIP147
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)	125 W		
Continuous device dissipation at (or below) 25°C free-air temperature (see Note 3)	3.5 W		
Unclamped inductive load energy (see Note 4)	100 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 $t_w \leq 0.3$ ms, duty cycle ≤ 10%.
2. Derate linearly to 150°C case temperature at the rate of 1 W/°C or refer to Dissipation Derating Curve, Figure 9.
3. Derate linearly to 150°C free-air temperature at the rate of 28 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 Ω, V_{BB2} = 0 V, R_S = 0.1 Ω, V_{CC} = 20 V, Energy ≈ $I_C^2 L/2$.

TIP145, TIP146, TIP147
P-N-P DARLINGTON-CONNECTED SILICON POWER TRANSISTORS

electrical characteristics at 25°C case temperature

PARAMETER	TEST CONDITIONS			TIP145			TIP146			TIP147			UNIT
				MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX	
$V_{(BR)CEO}$	$I_C = -30$ mA,	$I_B = 0$,	See Note 5	−60			−80			−100			V
I_{CEO}	$V_{CE} = -30$ V,	$I_B = 0$				−2							mA
	$V_{CE} = -40$ V,	$I_B = 0$							−2				
	$V_{CE} = -50$ V,	$I_B = 0$										−2	
I_{CBO}	$V_{CB} = -60$ V,	$I_E = 0$				−1							mA
	$V_{CB} = -80$ V,	$I_E = 0$							−1				
	$V_{CB} = -100$ V,	$I_E = 0$										−1	
I_{EBO}	$V_{EB} = -5$ V,	$I_C = 0$				−2			−2			−2	mA
h_{FE}	$V_{CE} = -4$ V,	$I_C = -5$ A,	See Notes 5 and 6	1000			1000			1000			
	$V_{CE} = -4$ V,	$I_C = -10$ A,	See Notes 5 and 6	500			500			500			
V_{BE}	$V_{CE} = -4$ V,	$I_C = -10$ A,	See Notes 5 and 6			−3			−3			−3	V
$V_{CE(sat)}$	$I_B = -10$ mA,	$I_C = -5$ A,	See Notes 5 and 6			−2			−2			−2	V
	$I_B = -40$ mA,	$I_C = -10$ A,	See Notes 5 and 6			−3			−3			−3	
V_F	$I_F = 10$ A,	See Notes 5 and 6				3.5			3.5			3.5	V

NOTES: 5. These parameters must be measured using pulse techniques, $t_w = 300\ \mu s$, duty cycle ≤ 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 characteristics at 25° case temperature

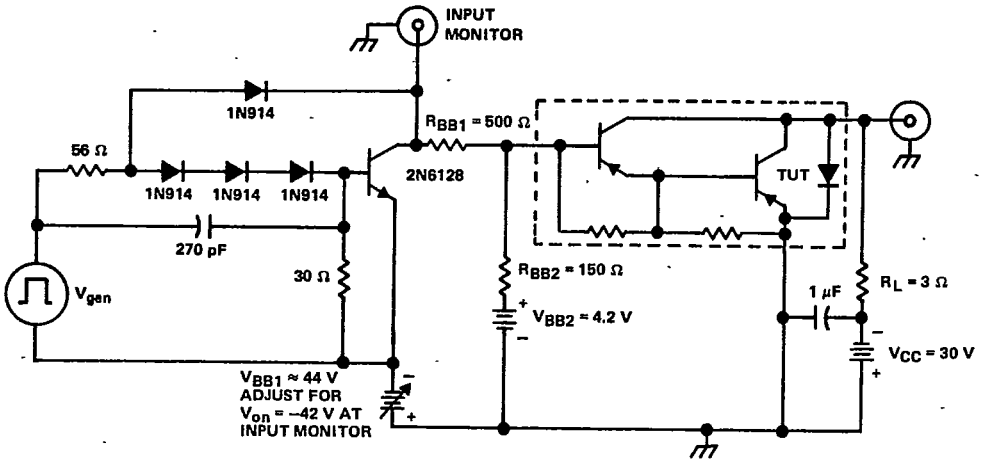
PARAMETER	TEST CONDITIONS †				MIN	TYP	MAX	UNIT
t_{on}	$I_C = -10$A,	$I_{B1} = -40$ mA,	$I_{B2} = 40$ mA,			0.9		μs
t_{off}	$V_{BE(off)} = 4.2$ V,	$R_L = 3\ \Omega$,	See Figure 1			11		

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

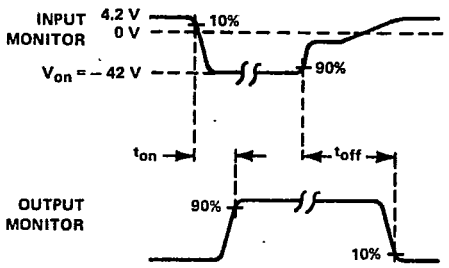
TEXAS INSTRUMENTS
POST OFFICE BOX 225012 • DALLAS, TEXAS 75265

PARAMETER MEASUREMENT INFORMATION

T-33-31



TEST CIRCUIT



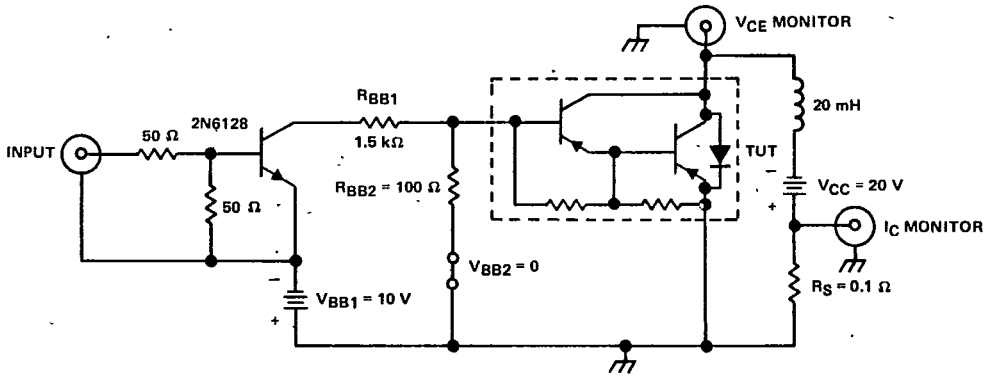
VOLTAGE WAVEFORMS

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: $t_r \leq 15$ ns, $t_f \leq 15$ ns, $Z_{out} = 50\ \Omega$, $t_w = 20\ \mu s$, duty cycle ≤ 2%.
C. 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.
D. Resistors must be noninductive types.
E. The d-c power supplies may require additional bypassing in order to minimize ringing.

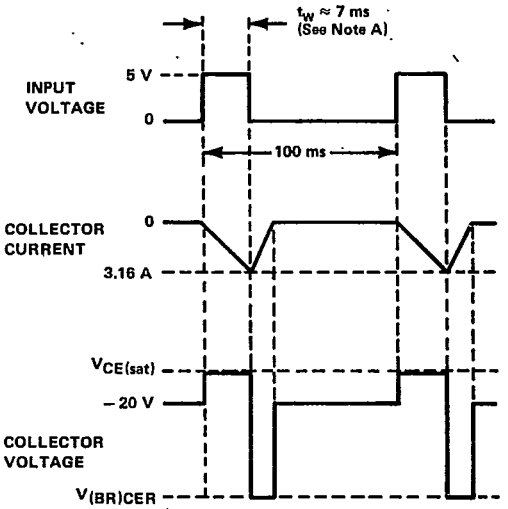
FIGURE 1. RESISTIVE-LOAD SWITCHING

TIP145, TIP146, TIP147
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

TEXAS INSTRUMENTS
POST OFFICE BOX 225012 • DALLAS, TEXAS 75265

TIP145, TIP146, TIP147
P-N-P DARLINGTON-CONNECTED
SILICON POWER TRANSISTORS

T-33-31

TYPICAL CHARACTERISTICS

STATIC FORWARD CURRENT TRANSFER RATIO
vs
COLLECTOR CURRENT

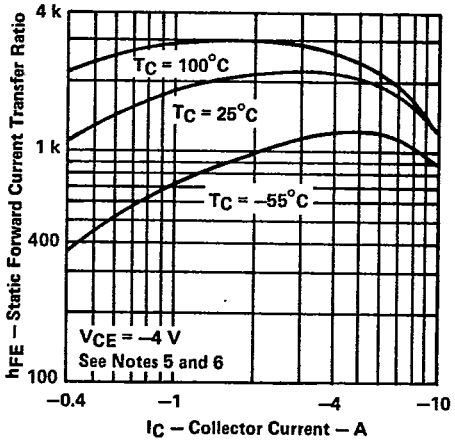


FIGURE 3

BASE-EMITTER VOLTAGE
vs
CASE TEMPERATURE

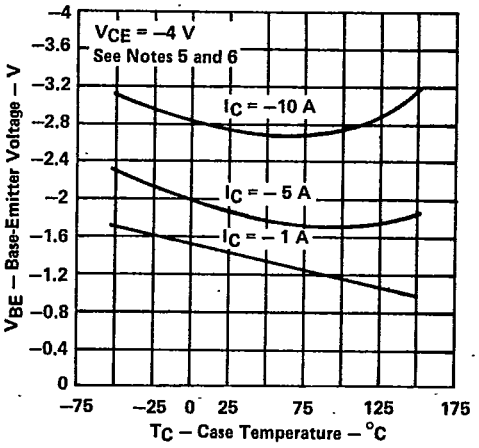


FIGURE 4

COLLECTOR-EMITTER SATURATION VOLTAGE
vs
CASE TEMPERATURE

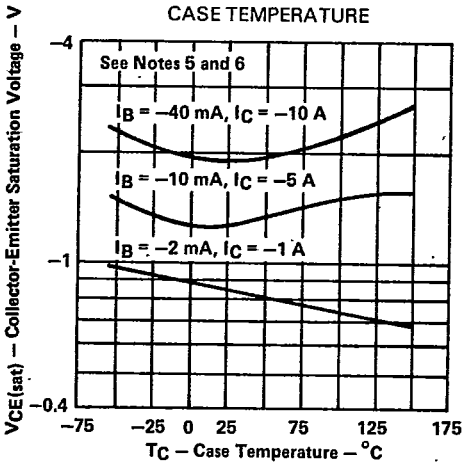


FIGURE 5

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

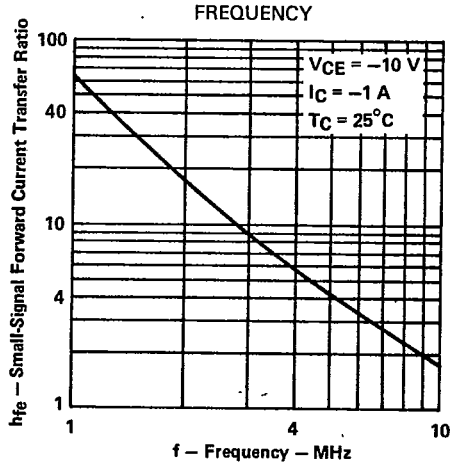


FIGURE 6

NOTES: 5. These parameters must be measured using pulse techniques, t_w = 300 μs, duty cycle ≤ 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.

TIP145, TIP146, TIP147
P-N-P DARLINGTON-CONNECTED SILICON POWER TRANSISTORS

MAXIMUM SAFE OPERATING AREA

MAXIMUM COLLECTOR CURRENT
vs
COLLECTOR-EMITTER VOLTAGE

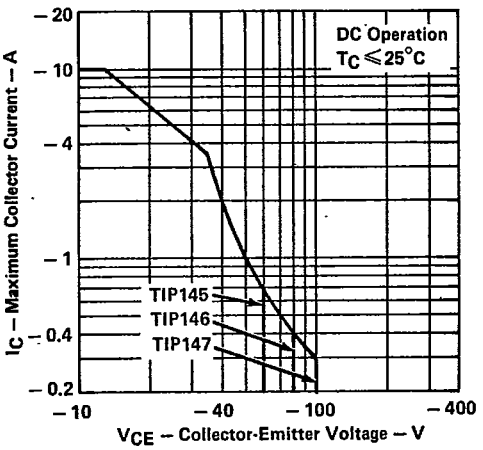


FIGURE 7

MAXIMUM COLLECTOR CURRENT
vs
UNCLAMPED INDUCTIVE LOAD

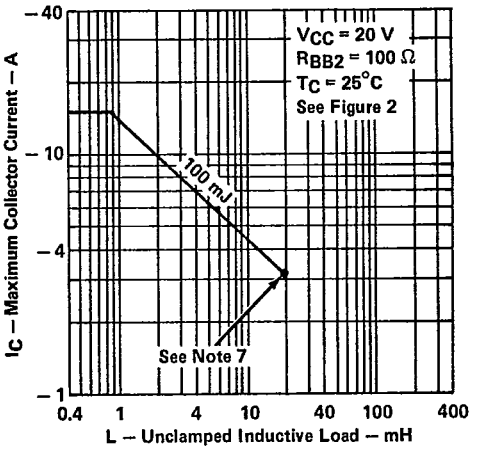


FIGURE 8

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

THERMAL INFORMATION

CASE TEMPERATURE
DISSIPATION DERATING CURVE

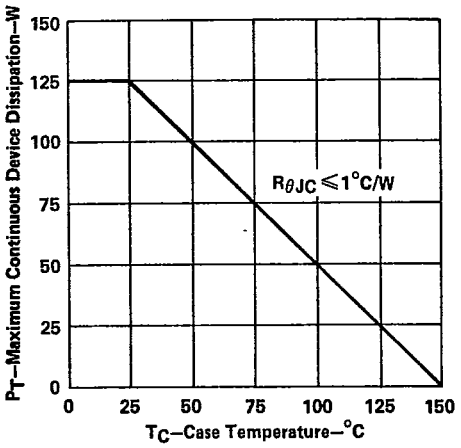


FIGURE 9

FREE-AIR TEMPERATURE
DISSIPATION DERATING CURVE

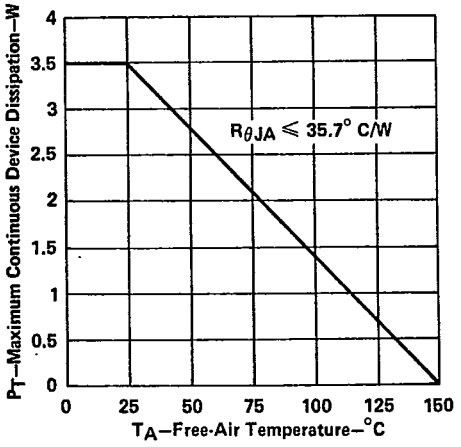


FIGURE 10

TEXAS INSTRUMENTS
POST OFFICE BOX 225012 • DALLAS, TEXAS 75265