

8961726 TEXAS INSTR (OPT0)

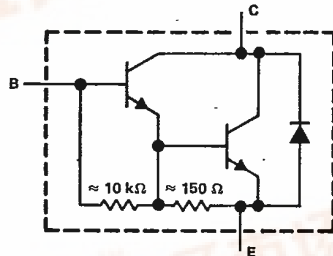
62C 36970 D

**TIP640, TIP641, TIP642**  
**N-P-N DARLINGTON-CONNECTED**  
**SILICON POWER TRANSISTORS**  
 REVISED OCTOBER 1984

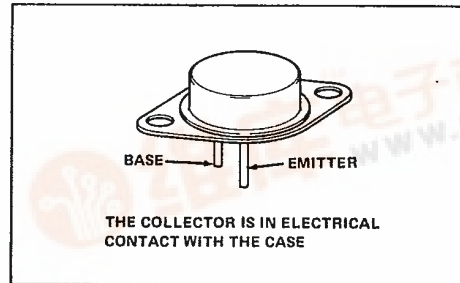
T-33-29

- Designed For Complementary use with TIP645, TIP646, TIP647
- 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



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

|  | TIP640              | TIP641 | TIP642 |
|--|---------------------|--------|--------|
| 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 area 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 transistor to operate safely in the circuit in 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 36971 D

T-33-29

**TIP640, TIP641, TIP642  
N-P-N DARLINGTON-CONNECTED  
SILICON POWER TRANSISTORS**

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

| PARAMETER            | TEST CONDITIONS  | TIP640 |     |     | TIP641 |     |     | TIP642 |     |     | UNIT |
|----------------------|--|--------|-----|-----|--------|-----|-----|--------|-----|-----|------|
|                      |  | MIN    | TYP | MAX | MIN    | TYP | MAX | MIN    | TYP | MAX |      |
| V <sub>(BR)CEO</sub> | I <sub>C</sub> = 30 mA,<br>See Note 5<br>I <sub>B</sub> = 0,           | 60     |     |     | 80     |     |     | 100    |     |     | V    |
| I <sub>CEO</sub>     | V <sub>CE</sub> = 30 V,<br>I <sub>B</sub> = 0                          |        | 2   |     |        | 2   |     |        |     |     | mA   |
|                      | V <sub>CE</sub> = 40 V,<br>I <sub>B</sub> = 0                          |        |     |     |        |     |     |        |     |     |      |
|                      | V <sub>CE</sub> = 50 V,<br>I <sub>B</sub> = 0                          |        |     |     |        |     |     |        | 2   |     |      |
| I <sub>CBO</sub>     | V <sub>CB</sub> = 60 V,<br>I <sub>E</sub> = 0                          |        | 1   |     |        |     |     |        |     |     | mA   |
|                      | V <sub>CB</sub> = 80 V,<br>I <sub>E</sub> = 0                          |        |     |     |        | 1   |     |        |     |     |      |
|                      | V <sub>CB</sub> = 100 V,<br>I <sub>E</sub> = 0                         |        |     |     |        |     |     |        | 1   |     |      |
| I <sub>EBO</sub>     | V <sub>EB</sub> = 5 V,<br>I <sub>C</sub> = 0                           |        | 2   |     |        | 2   |     |        | 2   |     | mA   |
| h <sub>FE</sub>      | V <sub>CE</sub> = 4 V,<br>See Notes 5 and 6<br>I <sub>C</sub> = 5 A,   | 1000   |     |     | 1000   |     |     | 1000   |     |     |      |
|                      | V <sub>CE</sub> = 4 V,<br>See Notes 5 and 6<br>I <sub>C</sub> = 10 A,  | 500    |     |     | 500    |     |     | 500    |     |     |      |
| V <sub>BE</sub>      | V <sub>CE</sub> = 4 V,<br>See Notes 5 and 6<br>I <sub>C</sub> = 10 A,  |        | 3   |     |        | 3   |     |        | 3   |     | V    |
| V <sub>CE(sat)</sub> | I <sub>B</sub> = 10 mA,<br>See Notes 5 and 6<br>I <sub>C</sub> = 5 A,  |        | 2   |     |        | 2   |     |        | 2   |     | V    |
|                      | I <sub>B</sub> = 40 mA,<br>See Notes 5 and 6<br>I <sub>C</sub> = 10 A, |        | 3   |     |        | 3   |     |        | 3   |     |      |
| V <sub>F</sub>       | I <sub>F</sub> = 10 A,<br>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  $\leq 2\%$ .  
6. 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.

**resistive-load switching characteristic at 25°C case temperature**

| PARAMETER        | TEST CONDITIONS†  | MIN | TYP | MAX | UNIT |
|------------------|---|-----|-----|-----|------|
| t <sub>on</sub>  | I <sub>C</sub> = 10 A, I <sub>B1</sub> = 40 mA, I <sub>B2</sub> = -40 mA, |     | 0.9 |     | μs   |
| t <sub>off</sub> | V <sub>BE(off)</sub> = -4.2 V, R <sub>L</sub> = 3 Ω, See Figure 1         |     | 11  |     |      |

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



TIP Devices

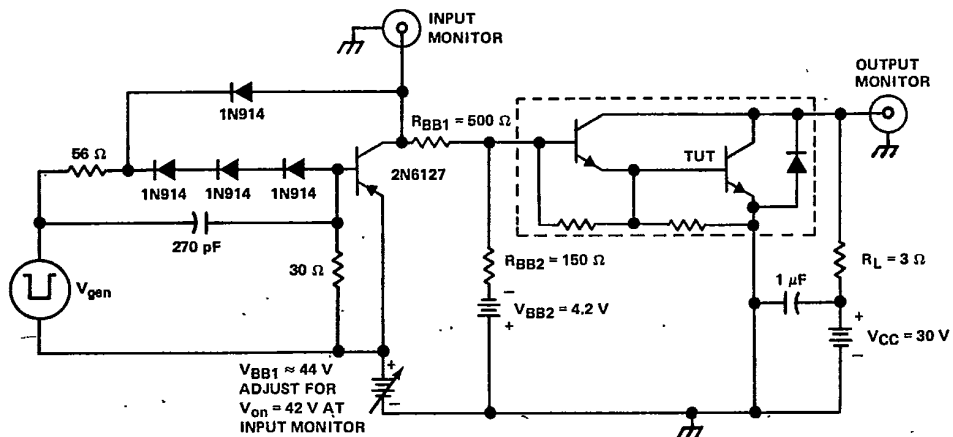
8961726 TEXAS INSTR (OPTO)

62C 36972 D

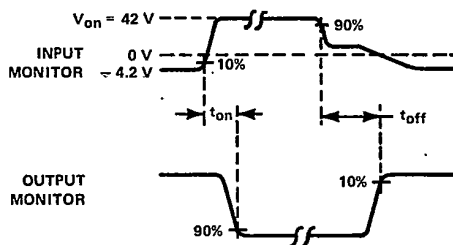
TIP640, TIP641, TIP642  
N-P-N DARLINGTON-CONNECTED  
SILICON POWER TRANSISTORS

PARAMETER MEASUREMENT INFORMATION

T-33-29



TEST CIRCUIT



VOLTAGE WAVEFORMS

- NOTES: A.  $V_{gen}$  is a  $-30\text{-V}$  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 1. RESISTIVE-LOAD SWITCHING



TIP Devices

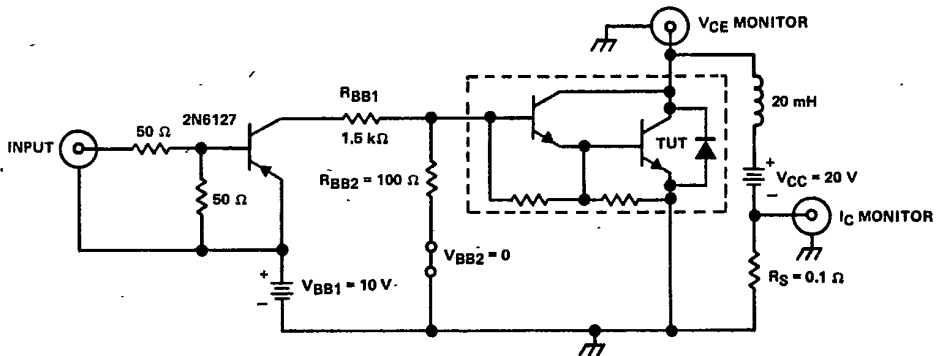
8961726 TEXAS INSTR (OPT0)

62C 36973 D

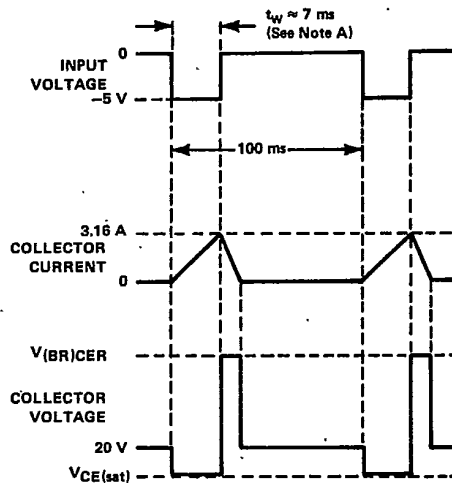
TIP640, TIP641, TIP642  
N-P-N DARLINGTON-CONNECTED  
SILICON POWER TRANSISTORS

T-33-29

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

TIP Devices

8961726 TEXAS INSTR (OPTO)

62C 36974 D

TIP640, TIP641, TIP642  
N-P-N DARLINGTON-CONNECTED  
SILICON POWER TRANSISTORS

TYPICAL CHARACTERISTICS

T-33-29

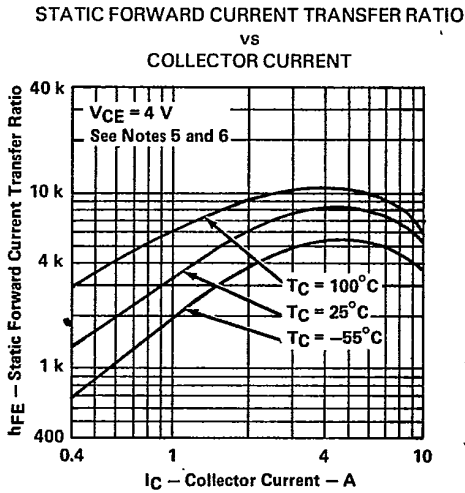


FIGURE 3

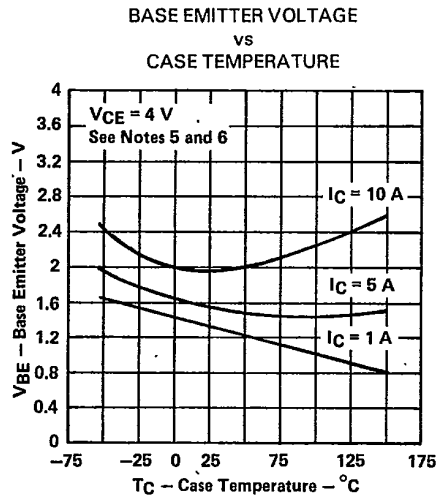


FIGURE 4

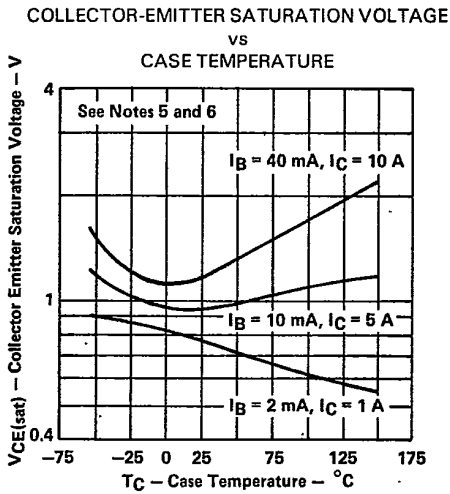


FIGURE 5

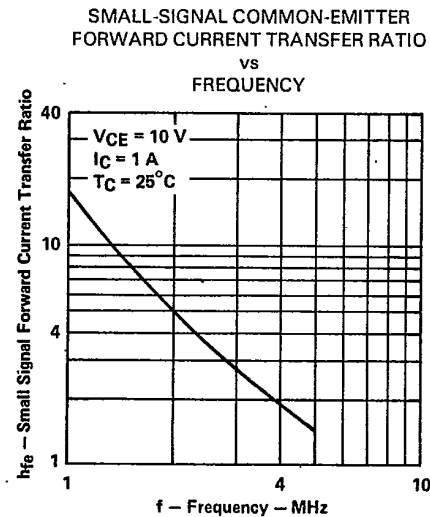


FIGURE 6

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



TIP Devices

8961726 TEXAS INSTR (OPTO)

62C 36975 D

T-33-29

**TIP640, TIP641, TIP642  
N-P-N DARLINGTON-CONNECTED  
SILICON POWER TRANSISTORS**

**MAXIMUM SAFE OPERATING AREA**

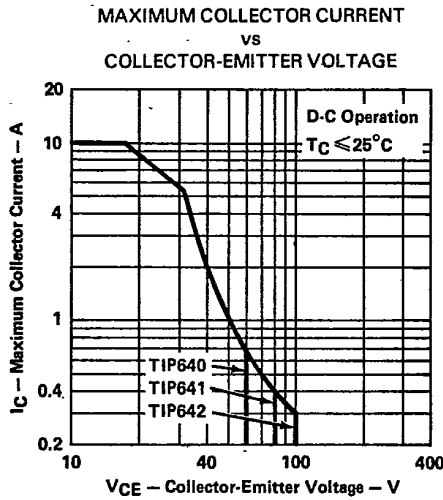


FIGURE 7

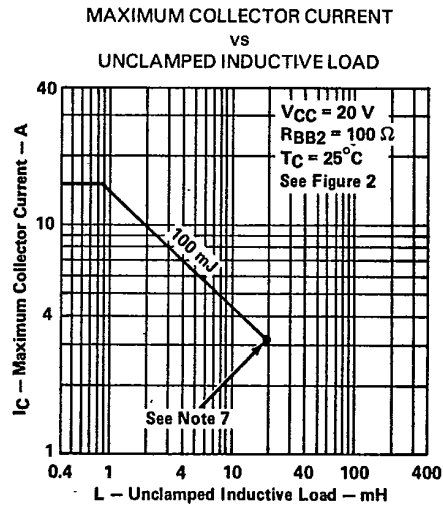


FIGURE 8

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

**THERMAL INFORMATION**

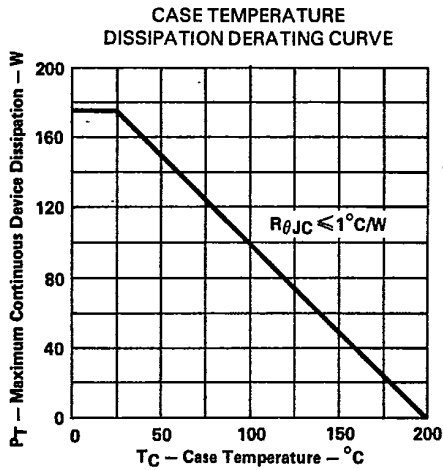


FIGURE 9

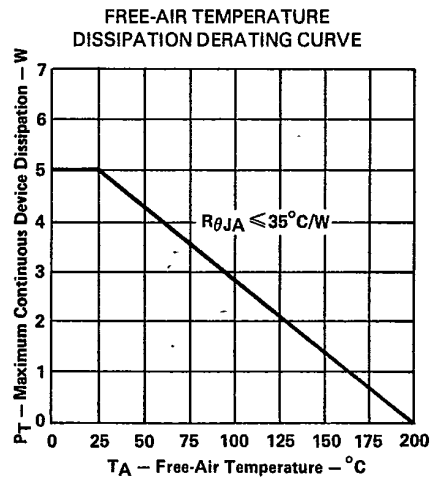


FIGURE 10

TIP Devices