

8961726 TEXAS INSTR (OPTO)

62C 36808

D

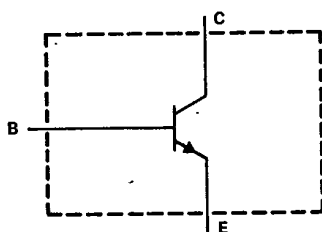
TIP41, TIP41A, TIP41B, TIP41C,  
TIP41D, TIP41E, TIP41F  
N-P-N SILICON POWER TRANSISTORS

JULY 1968 - REVISED OCTOBER 1984

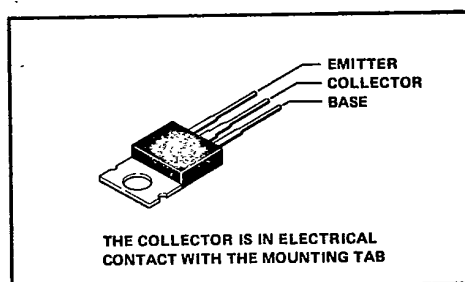
- Designed for Complementary Use With TIP42 Series
- 65 W at 25°C Case Temperature
- 6 A Continuous Collector Current
- 10 A Peak Collector Current
- Minimum  $f_T$  of 3 MHz at 10 V, 0.5 A
- Customer-Specified Selections Available

T-33-11

## device schematic



## TO-220AB PACKAGE



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

|                                                                                    | TIP41           | TIP41A | TIP41B | TIP41C |
|------------------------------------------------------------------------------------|-----------------|--------|--------|--------|
| Collector-base voltage                                                             | 80 V            | 100 V  | 120 V  | 140 V  |
| Collector-emitter voltage ( $I_B = 0$ )                                            | 40 V            | 60 V   | 80 V   | 100 V  |
| Emitter-base voltage                                                               | 5 V             |        |        |        |
| Continuous collector current                                                       | 6 A             |        |        |        |
| Peak collector current (see Note 1)                                                | 10 A            |        |        |        |
| Continuous base current                                                            | 3 A             |        |        |        |
| Safe operating area at 25°C case temperature                                       | See Figure 4    |        |        |        |
| Continuous device dissipation at 25°C case temperature (see Note 2)                | 65 W            |        |        |        |
| Continuous device dissipation at (or below) 25°C free-air temperature (see Note 3) | 2 W             |        |        |        |
| Unclamped inductive load energy (see Note 4)                                       | 62.5 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                      | 250°C           |        |        |        |

- NOTES: 1. This value applies for  $t_W = 0.3$  ms, duty cycle  $\leq 10\%$ .  
 2. Derate linearly to 150°C case temperature at the rate of 0.62 W/°C.  
 3. Derate linearly to 150°C free-air temperature at the rate of 16 mW/°C.  
 4. This rating is based on the capability of the transistor to operate safely in the circuit in Figure 2.

5

TIP Devices

8961726 TEXAS INSTR (OPT0)

62C 36809 D

T-33-11

TIP41, TIP41A, TIP41B, TIP41C,  
TIP41D, TIP41E, TIP41F  
N-P-N SILICON POWER TRANSISTORS

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

|                                                                                    | TIP41D          | TIP41E | TIP41F |
|------------------------------------------------------------------------------------|-----------------|--------|--------|
| Collector-base voltage                                                             | 160 V           | 180 V  | 200 V  |
| Collector-emitter voltage ( $I_B = 0$ )                                            | 120 V           | 140 V  | 160 V  |
| Emitter-base voltage                                                               | 5 V             |        |        |
| Continuous collector current                                                       | 6 A             |        |        |
| Peak collector current (see Note 1)                                                | 10 A            |        |        |
| Continuous base current                                                            | 3 A             |        |        |
| Safe operating area at 25°C case temperature                                       | See Figure 4    |        |        |
| Continuous device dissipation at 25°C case temperature (see Note 2)                | 65 W            |        |        |
| Continuous device dissipation at (or below) 25°C free-air temperature (see Note 3) | 2 W             |        |        |
| Unclamped inductive load energy (see Note 4)                                       | 62.5 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                      | 250°C           |        |        |

- NOTES: 1. This value applies for  $t_W = 0.3$  ms, duty cycle  $\leq 10\%$ .  
2. Derate linearly to 150°C case temperature at the rate of 0.52 W/°C.  
3. Derate linearly to 150°C free-air temperature at the rate of 16 mW/°C.  
4. This rating is based on the capability of the transistor to operate safely in the circuit in Figure 2.

electrical characteristics at 25°C case temperature

| PARAMETER     | TEST CONDITIONS                      |                | TIP41 |     | TIP41A |     | TIP41B |     | TIP41C |     | UNIT |
|---------------|--------------------------------------|----------------|-------|-----|--------|-----|--------|-----|--------|-----|------|
|               |                                      |                | MIN   | TYP | MAX    | MIN | TYP    | MAX | MIN    | TYP |      |
| $V_{(BR)CEO}$ | $I_C = 30$ mA,<br>See Note 5         | $I_B = 0$ ,    | 40    |     | 60     |     | 80     |     | 100    |     | V    |
| $I_{CEO}$     | $V_{CE} = 30$ V,                     | $I_B = 0$      | 0.7   |     | 0.7    |     |        |     |        |     | mA   |
|               | $V_{CE} = 60$ V,                     | $I_B = 0$      |       |     |        |     | 0.7    |     | 0.7    |     |      |
| $I_{CES}$     | $V_{CE} = 80$ V,                     | $V_{BE} = 0$   | 0.4   |     |        |     |        |     |        |     | mA   |
|               | $V_{CE} = 100$ V,                    | $V_{BE} = 0$   |       |     | 0.4    |     |        |     |        |     |      |
|               | $V_{CE} = 120$ V,                    | $V_{BE} = 0$   |       |     |        |     | 0.4    |     |        |     |      |
|               | $V_{CE} = 140$ V,                    | $V_{BE} = 0$   |       |     |        |     |        |     | 0.4    |     |      |
| $I_{EBO}$     | $V_{EB} = 5$ V,                      | $I_C = 0$      | 1     |     | 1      |     | 1      |     | 1      |     | mA   |
| $h_{FE}$      | $V_{CE} = 4$ V,<br>See Notes 5 and 6 | $I_C = 0.3$ A, | 30    |     | 30     |     | 30     |     | 30     |     |      |
|               | $V_{CE} = 4$ V,<br>See Notes 5 and 6 | $I_C = 3$ A,   | 15 75 |     | 15 75  |     | 15 75  |     | 15 75  |     |      |
| $V_{BE}$      | $V_{CE} = 4$ V,<br>See Notes 5 and 6 | $I_C = 6$ A,   | 2     |     | 2      |     | 2      |     | 2      |     | V    |
| $V_{CE(sat)}$ | $I_B = 0.6$ A,<br>See Notes 5 and 6  | $I_C = 6$ A,   | 1.5   |     | 1.5    |     | 1.5    |     | 1.5    |     | V    |
| $h_{fe}$      | $V_{CE} = 10$ V,<br>$f = 1$ kHz      | $I_C = 0.5$ A, | 20    |     | 20     |     | 20     |     | 20     |     |      |
| $ h_{fe} $    | $V_{CE} = 10$ V,<br>$f = 1$ MHz      | $I_C = 0.5$ A, | 3     |     | 3      |     | 3      |     | 3      |     |      |

- 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.



TIP Devices

8961726 TEXAS INSTR (OPTO)

62C 36810 D

TIP41, TIP41A, TIP41B, TIP41C,  
TIP41D, TIP41E, TIP41F  
N-P-N SILICON POWER TRANSISTORS

## electrical characteristics at 25°C case temperature

7-33-11

| PARAMETER     | TEST CONDITIONS                                                          | TIP41D |     | TIP41E |     | TIP41F |     | UNIT |
|---------------|--------------------------------------------------------------------------|--------|-----|--------|-----|--------|-----|------|
|               |                                                                          | MIN    | TYP | MAX    | MIN | TYP    | MAX |      |
| $V_{(BR)CEO}$ | $I_C = 30 \text{ mA}$ ,<br>See Note 5                                    | 120    |     |        | 140 |        | 160 | V    |
| $I_{CEO}$     | $V_{CE} = 90 \text{ V}$ ,<br>$I_B = 0$                                   |        | 0.7 |        | 0.7 |        | 0.7 | mA   |
| $I_{CES}$     | $V_{CE} = 160 \text{ V}$ ,<br>$V_{BE} = 0$                               |        | 0.4 |        |     |        |     | mA   |
|               | $V_{CE} = 180 \text{ V}$ ,<br>$V_{BE} = 0$                               |        |     |        | 0.4 |        |     |      |
|               | $V_{CE} = 200 \text{ V}$ ,<br>$V_{BE} = 0$                               |        |     |        |     |        | 0.4 |      |
| $I_{EBO}$     | $V_{EB} = 5 \text{ V}$ ,<br>$I_C = 0$                                    |        | 1   |        | 1   |        | 1   | mA   |
| $h_{FE}$      | $V_{CE} = 4 \text{ V}$ ,<br>$I_C = 0.3 \text{ A}$ ,<br>See Notes 5 and 6 | 30     |     |        | 30  |        | 30  |      |
|               | $V_{CE} = 4 \text{ V}$ ,<br>$I_C = 3 \text{ A}$ ,<br>See Notes 5 and 6   | 15     |     |        | 15  |        | 15  |      |
| $V_{BE}$      | $V_{CE} = 4 \text{ V}$ ,<br>See Notes 5 and 6                            |        | 2   |        | 2   |        | 2   | V    |
| $V_{CE(sat)}$ | $I_B = 1.5 \text{ A}$ ,<br>$I_C = 6 \text{ A}$ ,<br>See Notes 5 and 6    |        | 1.5 |        | 1.5 |        | 1.5 | V    |
| $h_{fe}$      | $V_{CE} = 10 \text{ V}$ ,<br>$f = 1 \text{ kHz}$                         | 20     |     |        | 20  |        | 20  |      |
| $ h_{fe} $    | $V_{CE} = 10 \text{ V}$ ,<br>$f = 1 \text{ MHz}$                         | 3      |     |        | 3   |        | 3   |      |

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.

## thermal characteristics

| PARAMETER       | MIN | TYP | MAX  | UNIT |
|-----------------|-----|-----|------|------|
| $R_{\theta JC}$ |     |     | 1.92 | °C/W |
| $R_{\theta JA}$ |     |     | 62.5 |      |

## resistive-load switching characteristics at 25°C case temperature

| PARAMETER | TEST CONDITIONS †                                                                  |  |  | MIN | TYP | MAX | UNIT          |
|-----------|------------------------------------------------------------------------------------|--|--|-----|-----|-----|---------------|
| $t_{on}$  | $I_C = 6 \text{ A}$ ,<br>$I_{B1} = 0.6 \text{ A}$ ,<br>$I_{B2} = -0.6 \text{ A}$ , |  |  |     | 0.6 |     | $\mu\text{s}$ |
| $t_{off}$ | $V_{BE(off)} = -4 \text{ V}$ ,<br>$R_L = 5 \Omega$ ,<br>See Figure 1               |  |  |     | 1   |     |               |

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

TIP Devices

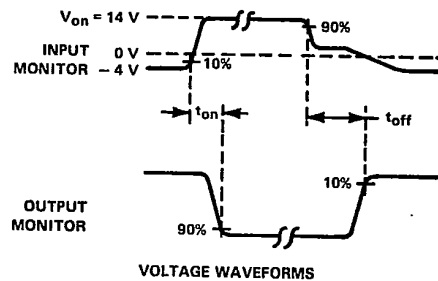
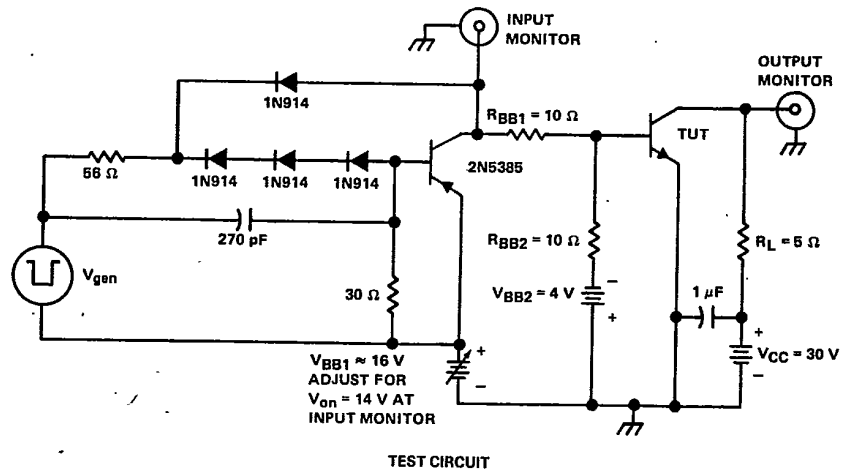
8961726 TEXAS INSTR (OPTO)

62C 36811 D 1

TIP41, TIP41A, TIP41B, TIP41C,  
TIP41D, TIP41E, TIP41F  
N-P-N SILICON POWER TRANSISTORS

T-33-11

## PARAMETER MEASUREMENT INFORMATION



- NOTES:
- A.  $V_{gen}$  is a  $\sim 30$ -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

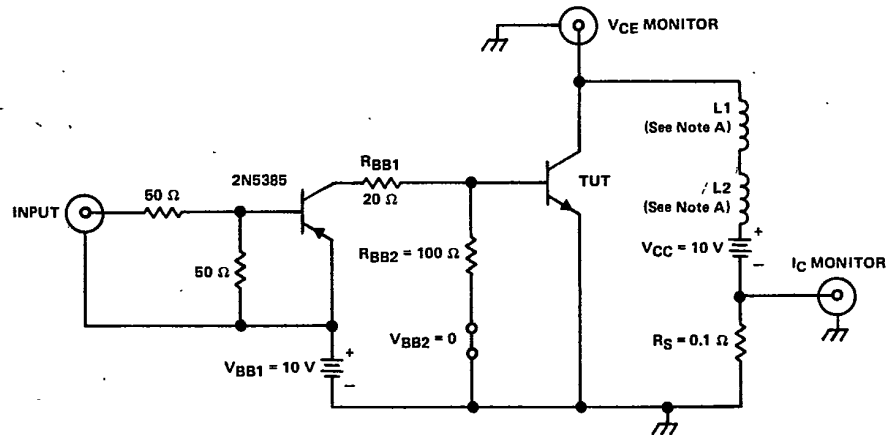
8961726 TEXAS INSTR (OPTO)

62C 36812 D

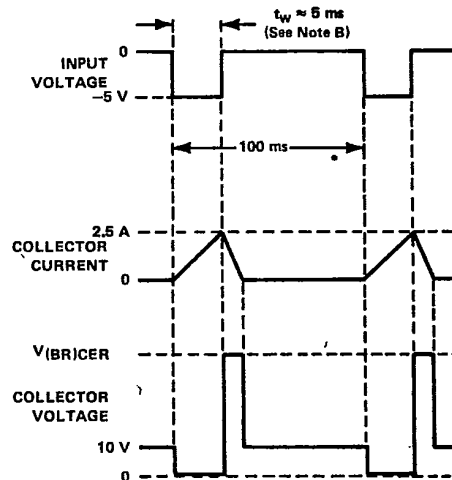
TIP41, TIP41A, TIP41B, TIP41C,  
TIP41D, TIP41E, TIP41F  
N-P-N SILICON POWER TRANSISTORS

## PARAMETER MEASUREMENT INFORMATION

T-33-11



TEST CIRCUIT



VOLTAGE AND CURRENT WAVEFORMS

NOTES: A. L1 and L2 are 10 mH, 0.11  $\Omega$ , Chicago Standard Transformer Corporation C-2688, or equivalent.  
B. Input pulse duration is increased until  $I_{CM} = -2.5$  A.

FIGURE 2. INDUCTIVE-LOAD SWITCHING

5

TIP Devices

8961726 TEXAS INSTR (OPTO)

62C 36813 D

TIP41, TIP41A, TIP41B, TIP41C,  
TIP41D, TIP41E, TIP41F  
N-P-N SILICON POWER TRANSISTORS

T-33-11

TYPICAL CHARACTERISTICS  
STATIC FORWARD CURRENT TRANSFER RATIO  
VS  
COLLECTOR CURRENT

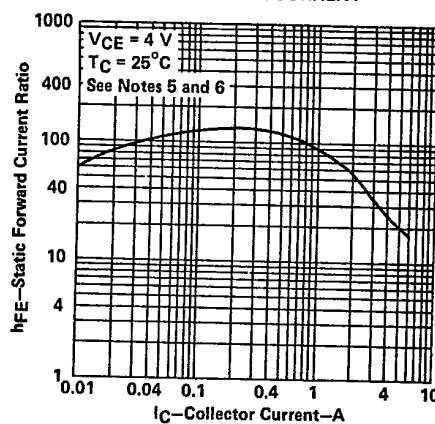


FIGURE 3

- 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.

MAXIMUM SAFE OPERATING AREA  
FORWARD-BIAS SAFE OPERATING AREA

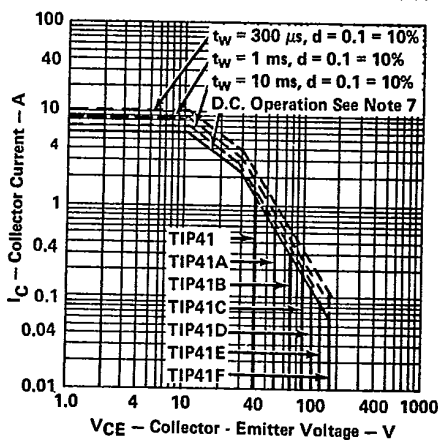


FIGURE 4

- NOTES: 7. This combination of maximum voltage and current may be achieved only when switching from saturation to cutoff with a clamped inductive load.

TIP Devices

8961726 TEXAS INSTR (OPTO)

62C 36814 D

TIP41, TIP41A, TIP41B, TIP41C,  
TIP41D, TIP41E, TIP41F  
N-P-N SILICON POWER TRANSISTORS

## THERMAL INFORMATION

T-33-11

## DISSIPATION DERATING CURVE

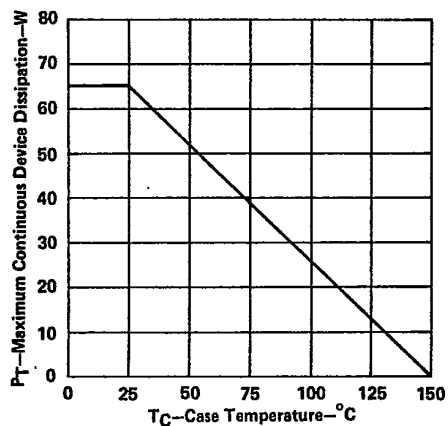


FIGURE 5

5

TIP Devices