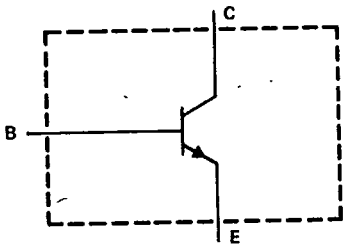
TIP31, TIP31A, TIP31B, TIP31C, TIP31D, TIP31E, TIP31F
N-P-N SILICON POWER TRANSISTORS

DECEMBER 1970 – REVISED OCTOBER 1984

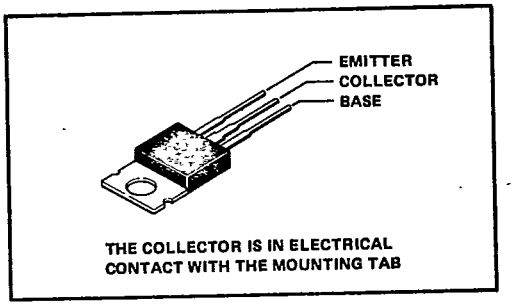
T-33-11

- 40 W at 25°C Case Temperature
- 3 A Continuous Collector Current
- 5 A Peak Collector Current
- Minimum f_T of 3 MHz at 10 V, 0.5 mA
- Customer-Specified Selections Available

device schematic



TO-220AB PACKAGE



THE COLLECTOR IS IN ELECTRICAL CONTACT WITH THE MOUNTING TAB

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

	TIP31	TIP31A	TIP31B	TIP31C
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	3 A			
Peak collector current (see Note 1)	5 A			
Continuous base current	1 A			
Safe operating area at 25°C case temperature	See Figure 4			
Continuous device dissipation at (or below) 25°C case temperature (see Note 2)	40 W			
Continuous device dissipation at (or below) 25°C free-air temperature (see Note 3)	2 W			
Unclamped inductive load energy (see Note 4)	32 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 $t_w \leq 0.3$ ms, duty cycle ≤ 10%.
2. Derate linearly to 150°C case temperature at the rate of 0.32 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.

TIP31, TIP31A, TIP31B, TIP31C, TIP31D, TIP31E, TIP31F
N-P-N SILICON POWER TRANSISTORS

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

	TIP31D	TIP31E	TIP31F
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	3 A		
Peak collector current (see Note 1)	5 A		
Continuous base current	1 A		
Safe operating area at 25°C case temperature	See Figure 4		
Continuous device dissipation at (or below) 25°C case temperature (see Note 2)	40 W		
Continuous device dissipation at (or below) 25°C free-air temperature (see Note 3)	2 W		
Unclamped inductive load energy (see Note 4)	32 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 $t_w \leq 0.3$ ms, duty cycle ≤ 10%.
2. Derate linearly to 150°C case temperature at the rate of 0.32 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 (unless otherwise noted)

PARAMETER	TEST CONDITIONS	TIP31		TIP31A		TIP31B		TIP31C		UNIT
		MIN	TYP MAX	MIN	TYP MAX	MIN	TYP MAX	MIN	TYP MAX	
$V_{(BR)CEO}$	I_C = 30 mA, I_B = 0, See Note 5	40		60		80		100		V
I_{CEO}	V_{CE} = 30 V, I_B = 0		0.3		0.3					mA
	V_{CE} = 60 V, I_B = 0						0.3		0.3	
I_{CES}	V_{CE} = 80 V, V_{BE} = 0		0.2							mA
	V_{CE} = 100 V, V_{BE} = 0				0.2					
	V_{CE} = 120 V, V_{BE} = 0						0.2			
	V_{CE} = 140 V, V_{BE} = 0								0.2	
I_{EBO}	V_{EB} = 5 V, I_C = 0		1		1		1		1	mA
h_{FE}	V_{CE} = 4 V, I_C = 1 A, See Notes 5 and 6	25		25		25		25		
	V_{CE} = 4 V, I_C = 3 A, See Notes 5 and 6	10	50	10	50	10	50	10	50	
V_{BE}	V_{CE} = 4 V, I_C = 3 A, See Notes 5 and 6		1.8		1.8		1.8		1.8	V
$V_{CE(sat)}$	I_B = 375 mA, I_C = 3 A, See Notes 5 and 6		1.2		1.2		1.2		1.2	V
h_{fe}	V_{CE} = 10 V, I_C = 0.5 A, f = 1 kHz	20		20		20		20		
h_{fe}	V_{CE} = 10 V, I_C = 0.5 A, f = 1 MHz	3		3		3		3		

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.

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N-P-N SILICON POWER TRANSISTORS

T-33-11

electrical characteristics at 25°C case temperature (unless otherwise noted)

PARAMETER	TEST CONDITIONS	TIP31D			TIP31E			TIP31F			UNIT
		MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX	
$V_{(BR)CEO}$	I_C = 30 mA, I_B = 0, See Note 5	120			140			160			V
I_{CEO}	V_{CE} = 90 V, I_B = 0			0.3			0.3			0.3	mA
I_{CES}	V_{CE} = 160 V, V_{BE} = 0			0.2							mA
	V_{CE} = 180 V, V_{BE} = 0						0.2				
	V_{CE} = 200 V, V_{BE} = 0									0.2	
I_{EBO}	V_{EB} = 5 V, I_C = 0			1			1			1	mA
h_{FE}	V_{CE} = 4 V, I_C = 1 A, See Notes 5 and 6	25			25			25			
	V_{CE} = 4 V, I_C = 3 A, See Notes 5 and 6	5			5			5			
V_{BE}	V_{CE} = 4 V, I_C = 3 A, See Notes 5 and 6			1.8			1.8			1.8	V
$V_{CE(sat)}$	I_B = 750 mA, I_C = 3 A, See Notes 5 and 6			2.5			2.5			2.5	V
h_{fe}	V_{CE} = 10 V, I_C = 0.5 A, f = 1 kHz	20			20			20			
h_{fe}	V_{CE} = 10 V, I_C = 0.5 A, f = 1 MHz	3			3			3			

NOTES: 5. These parameters must be measured using pulse techniques, t_w = 300 μs, duty cycle ≤ 2%.
6. These parameters are measured using voltage-sensing contacts separate from the current-carrying contacts.

thermal characteristics

PARAMETER	MIN	TYP	MAX	UNIT
$R_{\theta JC}$			3.125	°C/W
$R_{\theta JA}$			62.5	

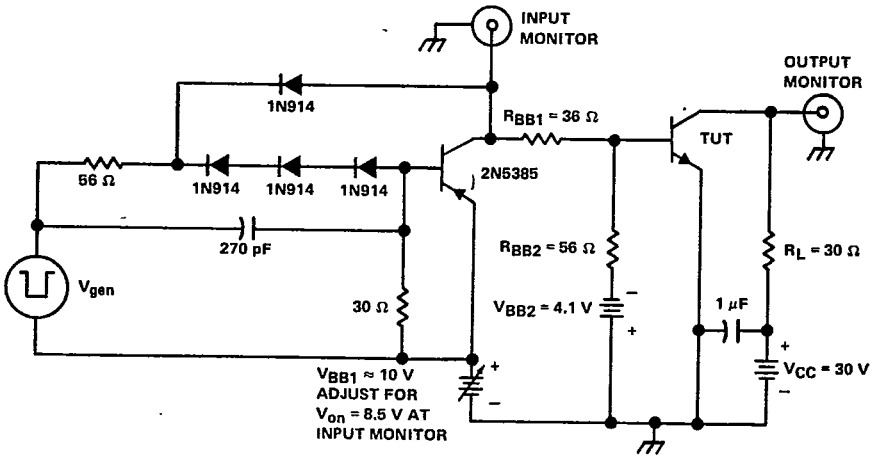
resistive-load switching characteristic at 25°C case temperature (unless otherwise noted)

PARAMETER	TEST CONDITIONS†	MIN	TYP	MAX	UNIT
t_{on}	I_C = 1 A, I_{B1} = 0.1 A, I_{B2} = −0.1 A,			0.5	μs
t_{off}	$V_{BE(off)}$ = −4.3 V, R_L = 30 Ω, See Figure 1			2	

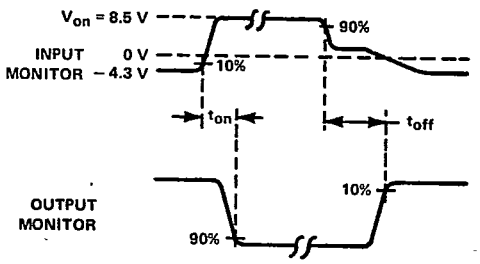
† Voltage and current values shown are nominal; exact values vary slightly with transistor parameters.

TIP31, TIP31A, TIP31B, TIP31C,
TIP31D, TIP31E, TIP31F
N-P-N SILICON POWER TRANSISTORS

PARAMETER MEASUREMENT INFORMATION



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 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

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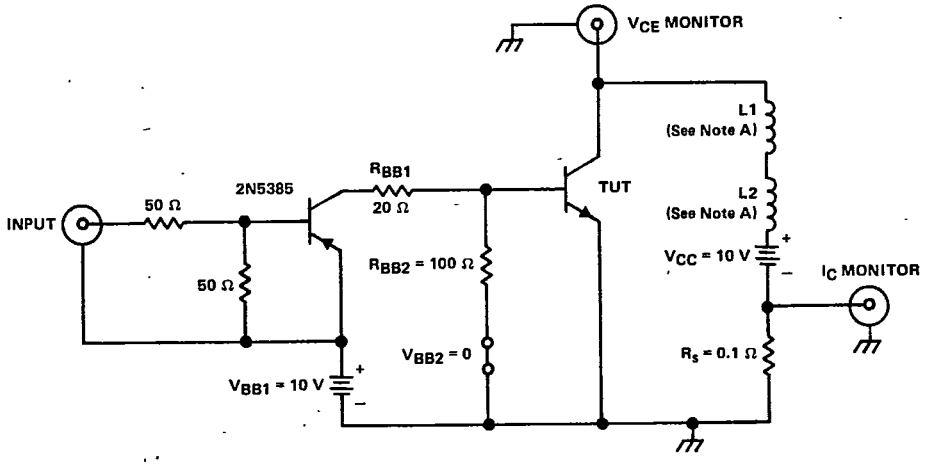
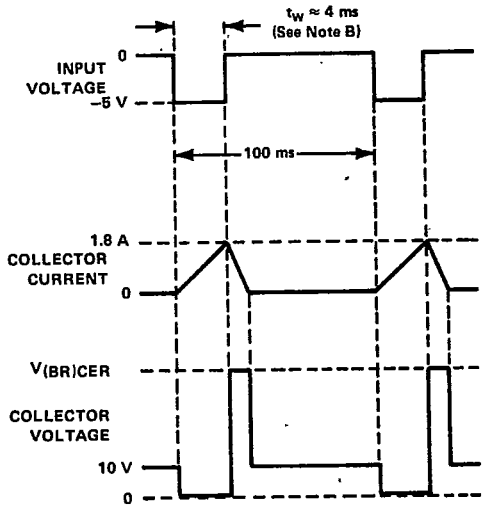
PARAMETER MEASUREMENT INFORMATION



TEST CIRCUIT



VOLTAGE AND CURRENT WAVEFORMS

NOTES: A. L1 and L2 are 10 mH, 0.11 Ω, Chicago Standard Transformer Corporation C-2688, or equivalent.
B. Input pulse duration is increased until I_{CM} = 1.8 A.

FIGURE 2. INDUCTIVE-LOAD SWITCHING

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TYPICAL CHARACTERISTICS

STATIC FORWARD CURRENT TRANSFER RATIO
vs
COLLECTOR CURRENT

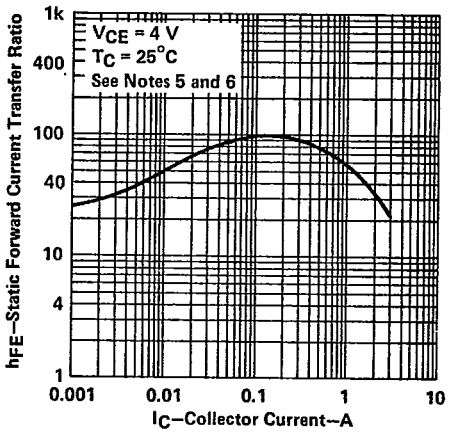

FIGURE 3

NOTES: 5. These parameters must be measured using pulse techniques, t_w = 300 μs, duty cycle ≤ 2%.
6. These parameters are measured with voltage-sensing contacts separate from the current-carrying contacts.

MAXIMUM SAFE OPERATING AREA

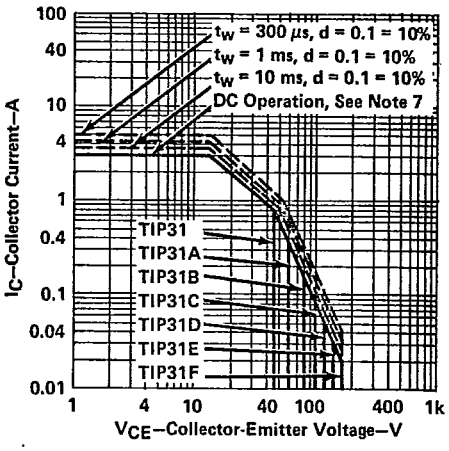

FIGURE 4

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

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THERMAL INFORMATION

DISSIPATION DERATING CURVE

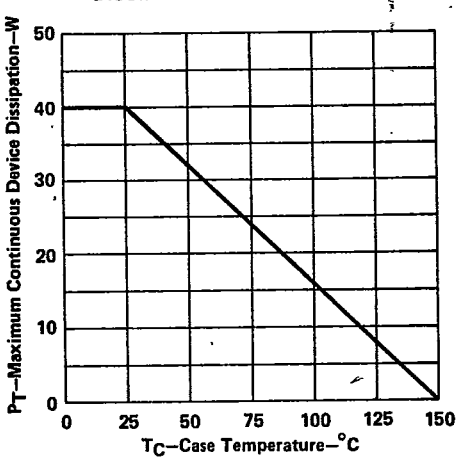

FIGURE 5