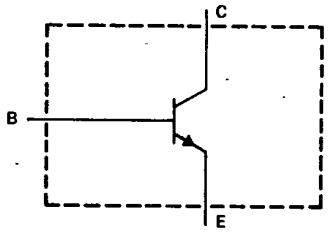
TIP55A, TIP56A, TIP57A, TIP58A
N-P-N SILICON POWER TRANSISTORS

T-33-11

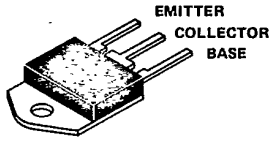
REVISED OCTOBER 1984

- Min $V_{(BR)CEO}$ of 250 V to 400 V
- 50 W at 100°C Case Temperature
- 10 A Peak Collector Current
- Designed for Automotive Ignition and Switching Regulator Applications
- Characterized For Operation In Ignition and Switching Regulator Applications
- High-Voltage, High Forward and Reverse Energy

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)

	TIP55A	TIP56A	TIP57A	TIP58A
Collector-base voltage	350 V	400 V	450 V	500 V
Collector-emitter voltage (I_B = 0)	250 V	300 V	350 V	400 V
Emitter-base voltage	8 V	8 V	8 V	8 V
Continuous collector current	7.5 A			
Peak collector current (see Note 1)	10 A			
Continuous base current	4 A			
Safe operating area	See Figure 8			
Continuous device dissipation at (or below) 100°C case temperature (see Note 2)	50 W			
Continuous device dissipation at (or below) 25°C free-air temperature (see Note 3)	3 W			
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	300°C			

NOTES: 1. This value applies for $t_w \leq 10$ 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 24 mW/°C or refer to Dissipation Derating Curve, Figure 10.

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electrical characteristics at 25°C case temperature

PARAMETER	TEST CONDITIONS	TIP55A			TIP56A			TIP57A			TIP58A			UNIT
		MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX	
$V_{(BR)CEO}$	I_C = 20 mA, I_B = 0, See Note 4	250			300			350			400			V
I_{CER}	V_{CE} = 350 V, R_{BE} = 27 Ω			100										μA
	V_{CE} = 400 V, R_{BE} = 27 Ω						100							
	V_{CE} = 450 V, R_{BE} = 27 Ω									100				
	V_{CE} = 500 V, R_{BE} = 27 Ω												100	
I_{EBO}	V_{EB} = 8 V, I_C = 0			100			100			100			100	μA
h_{FE}	V_{CE} = 2 V, I_C = 1 A, See Notes 4 and 5	10		100	10		100	10		100	10		100	
	V_{CE} = 2 V, I_C = 5 A, See Notes 4 and 5	6			6			6			6			
$V_{BE(sat)}$	I_B = 1 A, I_C = 5 A, See Notes 4 and 5			1.5			1.5			1.5			1.5	V
$V_{CE(sat)}$	I_B = 1 A, I_C = 5 A, See Notes 4 and 5			1.2			1.2			1.2			1.2	V
	I_B = 4 A, I_C = 10 A, See Notes 4 and 5			2.5			2.5			2.5			2.5	

NOTES: 4. These parameters must be measured using pulse techniques, t_w = 300 μs, duty cycle ≤ 2 %.
5. 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.

thermal characteristics

PARAMETER	MIN	TYP	MAX	UNIT
$R_{\theta JC}$			1	°C/W
$R_{\theta JA}$			41.7	
$R_{\theta CHS}$ (see Note 6)		0.6		
$C_{\theta C}$		1.4		J/°C

NOTE 6: This parameter must be measured using a (0.003 inch) mica insulator with Dow-Corning 11 compound on both sides of the insulator, 6-32 mounting screws with bushing, and a mounting torque of 8 inch-pounds.

resistive-load switching characteristics at 25°C case temperature

PARAMETER	TEST CONDITIONS†	MIN	TYP	MAX	UNIT
t_d	I_C = 5 A, I_{B1} = 1 A, I_{B2} = −1 A, $V_{BE(off)}$ = −4 V, R_L = 40 Ω, See Figure 1			0.04	μs
t_r				0.13	
t_s				1.5	
t_f				0.2	

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

functional tests at 25°C free-air temperature

TEST	TEST CONDITIONS	LEVEL
Power (V_{CE} • I_C)	V_{CE} = 50 V, I_C = 2 A, t_{test} = 0.15 s	100 W
Reverse Pulse Energy $\left(\frac{I_C^2 L}{2}\right)$	I_{CM} = 5 A, L = 2 mH, f = 10 Hz, t_{test} = 0.5 s, See Figure 2	25 mJ
Forward Pulse Energy $\left(\frac{I_C^2 L}{2}\right)$	I_{CM} = 10 A, L = 5 mH, V_{clamp} = V_{CEO}max rating, f = 60 Hz, t_{test} = 0.5 s, See Figure 3	250 mJ
Operation as Commutating Switch	I_{load} = 5 A, V_{CC} = 0.8 V_{CEO} max rating, f = 20 kHz, t_{test} = 0.5 s, See Figure 4	

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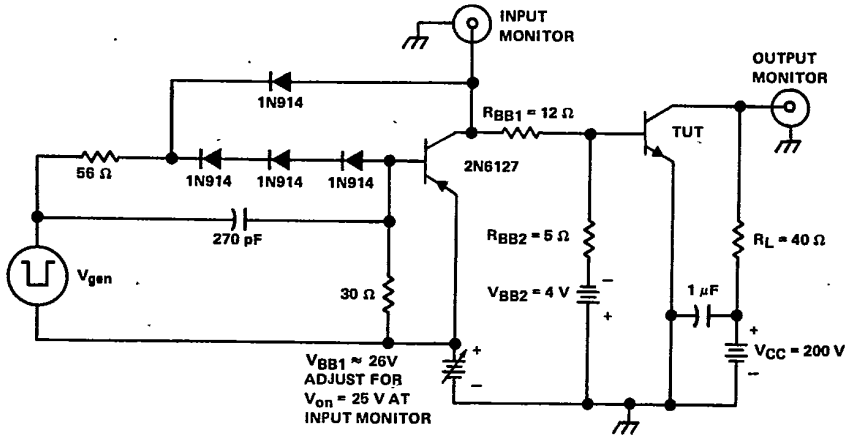
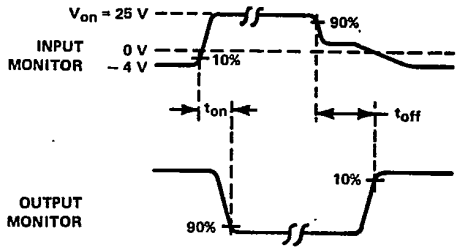
PARAMETER MEASUREMENT INFORMATION



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 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

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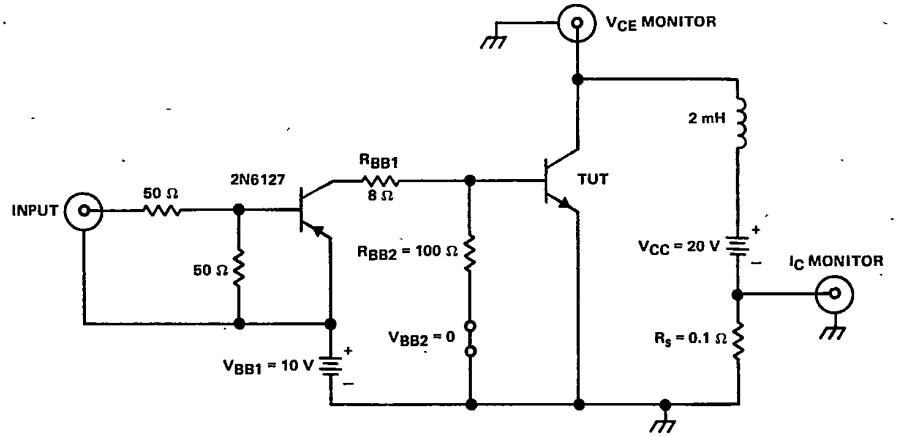
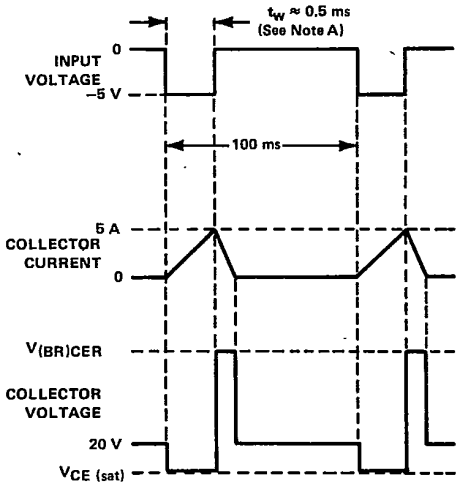
FUNCTIONAL TEST INFORMATION



TEST CIRCUIT



VOLTAGE AND CURRENT WAVEFORMS

NOTE A: Input pulse duration is increased until I_{CM} = 5 A.

FIGURE 2. REVERSE PULSE ENERGY

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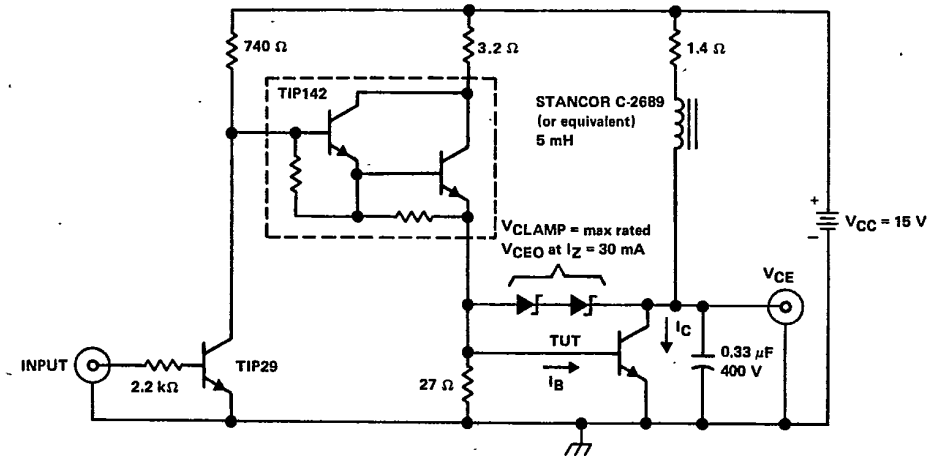
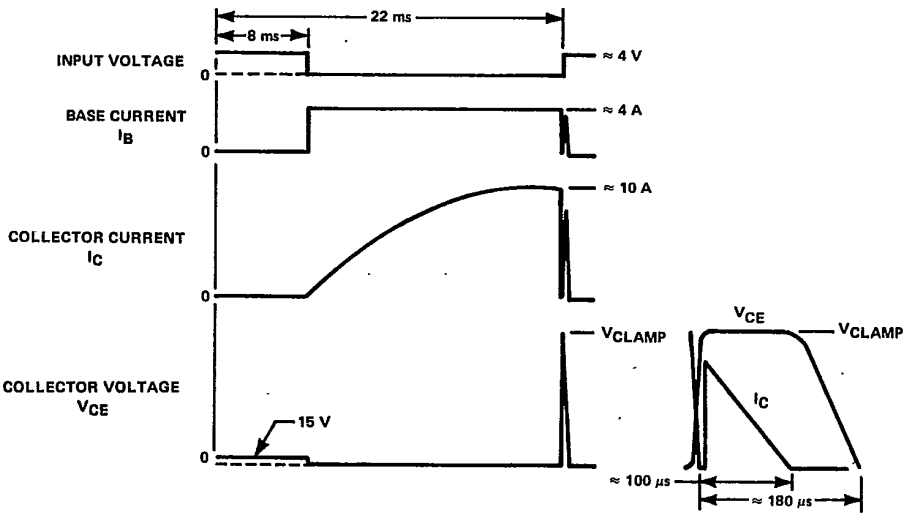
FUNCTIONAL TEST INFORMATION



TEST CIRCUIT



WAVEFORMS

COLLECTOR VOLTAGE AND COLLECTOR CURRENT WAVEFORM DETAIL

NOTES: A. Base and collector currents are measured using current probes such as Tektronix types P6019, P6020, P6021, P6042 or the equivalent.

B. Waveforms are monitored on an oscilloscope with the following characteristics: $t_r \leq 20$ ns, $R_{in} \geq 10$ MΩ, $C_{in} \leq 11.5$ pF.

FIGURE 3. FORWARD PULSE ENERGY

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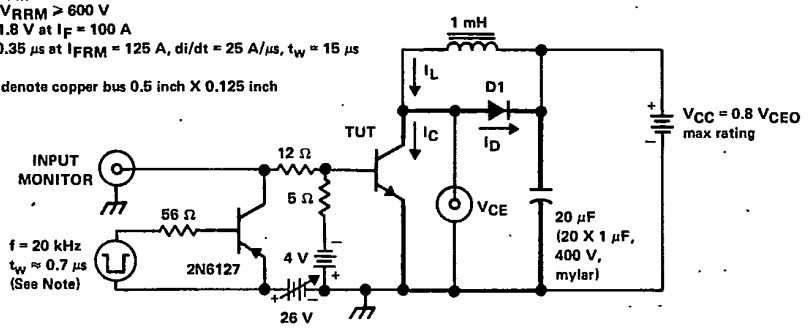
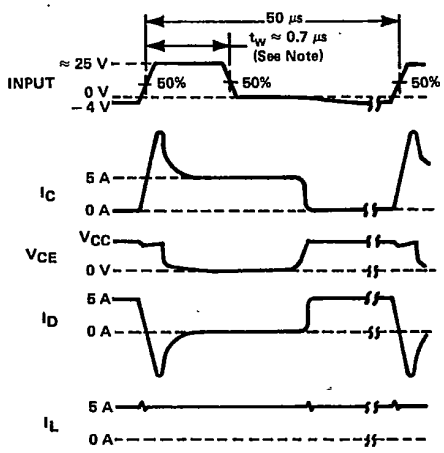
FUNCTIONAL TEST INFORMATION

D1: RCA 40960 (or equivalent)
Rated $I_{FM} \geq 125$ A
Rated $V_{RRM} \geq 600$ V
$V_F \leq 1.8$ V at $I_F = 100$ A
$t_{rr} \leq 0.35\ \mu s$ at $I_{FRM} = 125$ A, $di/dt = 25$ A/μs, $t_w = 15\ \mu s$

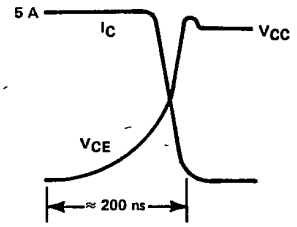
Heavy lines denote copper bus 0.5 inch X 0.125 inch



TEST CIRCUIT



WAVEFORMS



COLLECTOR VOLTAGE AND COLLECTOR CURRENT WAVEFORM DETAIL

NOTE: Increase pulse duration until $I_C = 5$ A following its peak.

FIGURE 4. OPERATION AS COMMUTATING SWITCH

TYPICAL CHARACTERISTICS

STATIC FORWARD CURRENT TRANSFER RATIO
vs
COLLECTOR CURRENT

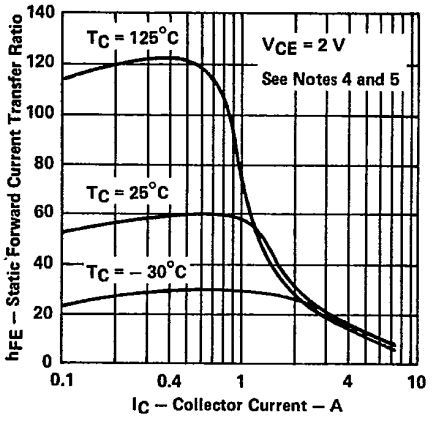


FIGURE 5

BASE-EMITTER VOLTAGE
vs
COLLECTOR CURRENT

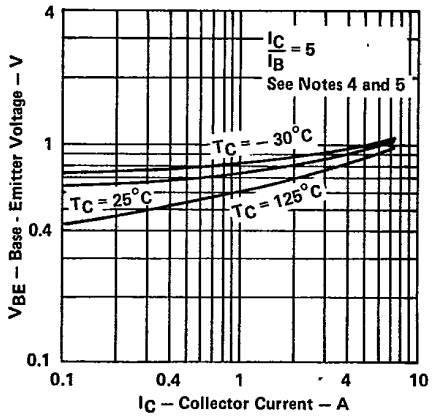


FIGURE 6

COLLECTOR-EMITTER SATURATION VOLTAGE
vs
COLLECTOR CURRENT

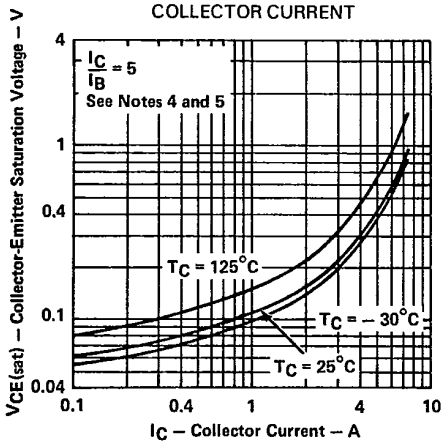


FIGURE 7

NOTES: 4. These parameters must be measured using pulse techniques, t_w = 300 μs, duty cycle ≤ 2 %.
5. 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.

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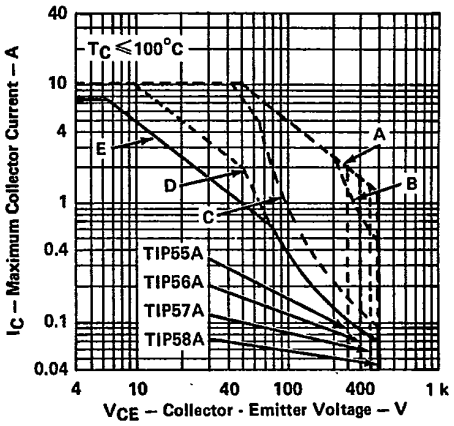
MAXIMUM SAFE OPERATING AREA

MAXIMUM COLLECTOR CURRENT
vs
COLLECTOR-EMITTER VOLTAGE



CURVE	CONDITIONS
A	t_w = 100 μs, d = 0.1 = 10 %
B	t_w = 1 ms, d = 0.1 = 10 %
C	t_w = 10 ms, d = 0.1 = 10 %
D	t_w = 150 ms, d = 0.01 = 1 %
E	D C OPERATION

FIGURE 8

THERMAL INFORMATION

CASE TEMPERATURE
DISSIPATION DERATING CURVE

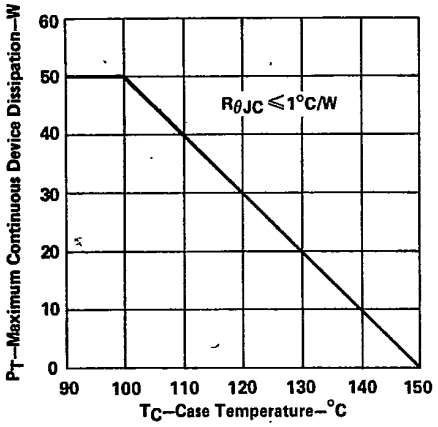


FIGURE 9

FREE-AIR TEMPERATURE
DISSIPATION DERATING CURVE

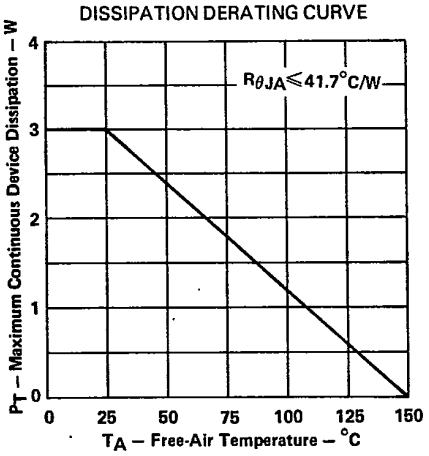


FIGURE 10

TI Devices

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