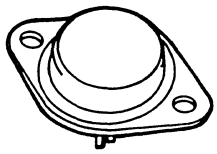
HIGH SPEED
NPN POWER DARLINGTON TRANSISTORS

GE10000-GE10009

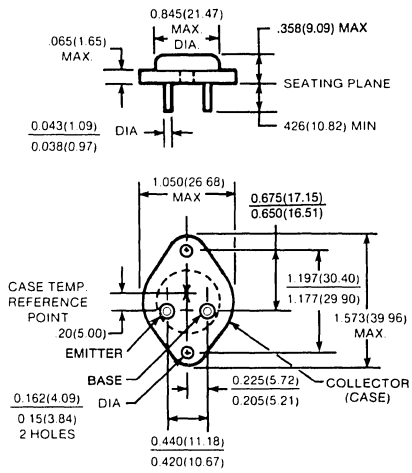
500 VOLTS
10-20 AMPS, 175 WATTS

These devices are designed for use in high speed switching applications, such as off-line switching power supplies, AC & DC motor control, UPS systems, ultrasonic equipment and other high frequency power conversion equipment.

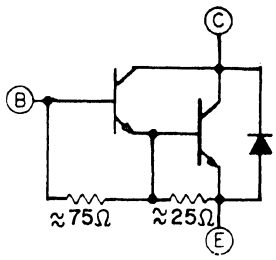


CASE STYLE TO-204AA (TO-3)

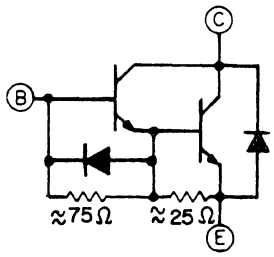
DIMENSIONS ARE IN INCHES AND (MILLIMETERS)



GE10000 THRU GE10003



GE10004 THRU GE10009



DEVICE CIRCUIT

absolute maximum ratings (25° C)

(unless otherwise specified)

Voltages	GE 10000	GE 10001	GE 10002	GE 10003	GE 10004	GE 10005	GE 10006	GE 10007	GE 10008	GE 10009	Units
$V_{CEO(SUS)}$	350	400	350	400	350	400	350	400	450	500	Volts
V_{CEX}, (T_C = 100° C)	400	450	400	450	400	450	400	450	450	500	
V_{CEV}	450	500	450	500	450	500	450	500	650	700	Volts
V_{EBO}	8	8	8	8	8	8	8	8	8	8	Volts
Currents											
I_C	20	20	10	10	20	20	10	10	20	20	Amps
I_{CM}	30	30	20	20	30	30	20	20	30	30	Amps
I_B	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	Amps
I_{BM}	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	Amps
Power Dissipation											
P_D(T_C = 25° C)	175	175	150	150	175	175	150	150	175	175	Watts
P_D(T_C = 100° C)	100	100	85	85	100	100	85	85	100	100	Watts
Derate above 25° C	1.0	1.0	.86	.86	1.0	1.0	.86	.86	1.0	1.0	W/° C
Temperatures											
T_{stg} and T_J	-65 to +200	-65 to +200	-65 to +200	-65 to +200	-65 to +200	-65 to +200	-65 to +200	-65 to +200	-65 to +200	-65 to +200	°C
T_L[1]	+275	+275	+275	+275	+275	+275	+275	+275	+275	+275	°C
Thermal Resistance	1.0	1.0	1.17	1.17	1.0	1.0	1.17	1.17	1.0	1.0	°C/Watt

1) Max. Lead Temperature for soldering purposes 1/8" from case for 5 seconds.

device electrical characteristics

(Test Conditions in Next Section; T_C = 25°C Except as Notes)

STATIC		GE 10000	GE 10001	GE 10002	GE 10003	GE 10004	GE 10005	GE 10006	GE 10007	GE 10008	GE 10009	Units
(1) $V_{CEO(SUS)}$	Min.	350	400	350	400	350	400	350	400	450	500	Volts
(2) $V_{CEX(SUS)}$, (T_C = 100°C)	Min.	400	450	400	450	400	450	400	450	450	500	Volts
(3) $V_{CEX(SUS)}$, (T_C = 100°C)	Min.	295	345	315	365	295	345	315	365	295	345	Volts
(4) I_{CEV}	Max.	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	mA
I_{CEV}, (T_C = 150°C)	Max.	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	mA
(5) I_{CER}, (T_C = 100°C)	Max.	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	mA
(6) I_{EBO}	Max.	200	200	200	200	200	200	200	200	200	200	mA
(7) $I_{s/b}$	See Figure	15	15	16	16	15	15	16	16	17	17	
(8) h_{FE}	Min. Max.	50 600	50 600	40 500	40 500	50 600	50 600	40 500	40 500	40 400	40 400	
(9) h_{FE}	Min. Max.	40 400	40 400	30 300	30 300	40 400	40 400	30 300	30 300	30 300	30 300	
(10) $V_{CE(SAT)}$	Max.	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	2.0	2.0	Volts
(11) $V_{CE(SAT)}$	Max.	3.0	3.0	2.9	2.9	3.0	3.0	2.9	2.9	3.5	3.5	Volts
(12) $V_{CE(SAT)}$, (T_C = 100°C)	Max.	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.5	2.5	Volts
(13) $V_{BE(SAT)}$	Max.	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	Volts
$V_{BE(SAT)}$, (T_C = 100°C)	Max.	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	Volts
(14) DIODE V_F	Typ. Max.	1.95 5.0	1.95 5.0	1.5 5.0	1.5 5.0	1.95 5.0	1.95 5.0	1.5 5.0	1.5 5.0	1.95 5.0	1.95 5.0	Volts Volts
DYNAMIC												
Output Capacitance (V_{CB} = 10V, I_E = 0, f_{TEST} = 1MHz)	Typ.	175	175	175	175	175	175	175	175	175	175	pF
	Max.	325	325	325	325	325	325	325	325	325	325	pF
SWITCHING												
(1) Resistive t_d	Typ. Max.	.045 .200	.045 .200	.045 .200	.045 .200	.045 .200	.045 .200	.045 .200	.045 .200	.04 .25	.04 .25	μs μs
t_r	Typ. Max.	.23 .60	.23 .60	.14 .40	.14 .40	.22 .60	.22 .60	.11 .40	.11 .40	.18 1.0	.18 1.0	μs μs
t_s	Typ. Max.	1.7 3.5	1.7 3.5	1.5 3.0	1.5 3.0	1.2 1.5	1.2 1.5	1.3 1.5	1.3 1.5	1.2 2.0	1.2 2.0	μs μs
t_f	Typ. Max.	.85 2.4	.85 2.4	.40 1.5	.40 1.5	.25 .50	.25 .50	.15 .50	.15 .50	.20 .60	.20 .60	μs μs
(2) Inductive t_s (T_C = 100°C)	Typ. Max.	4.4 6.5	4.4 6.5	4.2 6.0	4.2 6.0	2.9 4.0	2.9 4.0	3.2 4.0	3.2 4.0	3.0 4.0	3.0 4.0	μs μs
t_f	Typ. Max.	.54 1.5	.54 1.5	.39 1.5	.39 1.5	.19 1.0	.19 1.0	.18 1.0	.18 1.0	.20 1.0	.20 1.0	μs μs
t_c	Typ. Max.	1.7 3.0	1.7 3.0	1.0 2.5	1.0 2.5	.62 1.5	.62 1.5	.46 1.5	.46 1.5	.60 1.5	.60 1.5	μs μs
(3) Inductive t_s	Typ.	2.2	2.2	2.0	2.0	1.5	1.5	1.5	1.5	1.5	1.5	μs
t_f	Typ.	.30	.30	.20	.20	.10	.10	.10	.10	.10	.10	μs
t_c	Typ.	1.0	1.0	.50	.50	.30	.30	.22	.22	.30	.30	μs

STATIC TEST CONDITIONS

(1) $V_{CEX(SUS)}$ a) I_C = 250mA, I_B = 0, V_{CLAMP} = V_{CEO} Rated b) I_C = 100mA, I_B = 0, V_{CLAMP} = V_{CEO} Rated	APPLIES TO GE10000 Thru GE10007 GE10008, 9
(2) $V_{CEX(SUS)}$ a) I_C = 2A, V_{CLAMP} = V_{CEX} Rated b) I_C = 1A, V_{CLAMP} = V_{CEX} Rated	APPLIES TO GE10000, 1, 4, 5, 8, 9 GE10002, 3, 6, 7
(3) $V_{CEX(SUS)}$ a) I_C = 10A, V_{CLAMP} = V_{CEX} Rated b) I_C = 5A, V_{CLAMP} = V_{CEX} Rated	APPLIES TO GE10000, 1, 4, 5, 8, 9 GE10002, 3, 6, 7
(4) I_{CEV} V_{CEV} = Rated Valve, V_{BE} = 1.5V	APPLIES TO All
(5) I_{CER} V_{CE} = Rated Valve, R_{BE} = 50Ω	APPLIES TO All
(6) I_{EBO} V_{EB} = 8V, I_C = 0 V_{EB} = 2V, I_C = 0	APPLIES TO GE10000, 1, 2, 3 GE10004, 5, 6, 7, 8, 9
(7) $I_{s/b}$ SEE APPROPRIATE FORWARD BIAS SECOND BREAKDOWN FIGURE	
(8) h_{FE} (a) I_C = 5A, V_{CE} = 5V (b) I_C = 2.5A, V_{CE} = 5V	APPLIES TO GE10000, 1, 4, 5, 8, 9 GE10002, 3, 6, 7
(9) h_{FE} I_C = 10A, V_{CE} = 5V I_C = 5A, V_{CE} = 5V	APPLIES TO GE10000, 4, 5, 8, 9 GE10002, 3, 6, 7
(10) $V_{CE(SAT)}$ a) I_C = 10A, I_B = .4A b) I_C = 5A, I_B = .25A c) I_C = 5A, I_B = .5A	APPLIES TO GE10000, 1, 4, 5 GE10002, 3, 6, 7 GE10008, 9
(11) $V_{CE(SAT)}$ a) I_C = 20A, I_B = 1A b) I_C = 10A, I_B = 1A c) I_C = 20A, i_B = 2A	APPLIES TO GE10000, 1, 4, 5 GE10002, 3, 6, 7 GE10008, 9
(12) $V_{CE(SAT)}$ SAME AS (10) BUT T_C = 100°C	
(13) $V_{BE(SAT)}$ a) I_C = 10A, I_B = .4A b) I_C = 5A, I_B = .25A c) I_C = 10A, I_B = .5A	APPLIES TO GE10000, 1, 4, 5 GE10002, 3, 6, 7 GE10008, 9
(14) DIODE V_F a) I_F = 10A b) I_F = 5A	APPLIES TO GE10000, 4, 5, 8, 9 GE10002, 3, 6, 7

SWITCHING TEST CONDITIONS

(1) RESISTIVE	APPLIES TO	(2) INDUCTIVE	APPLIES TO	(3) INDUCTIVE
V_{CC}=250V, t_p=50μs, Duty ≤ 2%	GE10000, 1, 4, 5	V_{CLAMP} = 250V, L = 100μh, T_C = 100°C		SAME AS (2), BUT T_C = 25°C
a) I_C = 10A, I_{B1} = .4A, I_{B2} = 1.6A		a) I_C = 10A, I_{B1} = .4A, I_{B2} = 1.6A	GE10000, 1, 4, 5	
b) I_C = 5A, I_{B1} = .25A, I_{B2} = 1A	GE10002, 3, 6, 7	b) I_C = 5A, I_B = .25A, I_{B2} = 1A	GE10002, 3, 6, 7	
c) I_C = 10A, I_{B1} = .5A, I_{B2} = 2A	GE10008, 9	c) I_C = 10A, I_B = .5A, I_{B2} = 2A	GE10008, 9	

NOTE: See FIGURE 24 for Switching Time Test Circuit.

TYPICAL CHARACTERISTICS

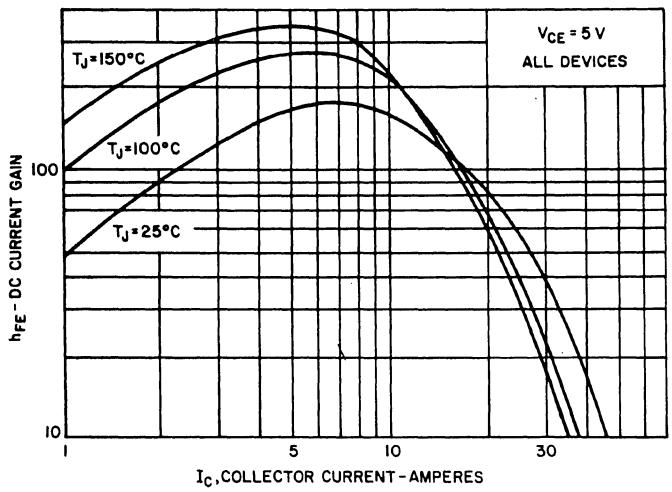


FIGURE 1. DC CURRENT GAIN (V_{CE} = 5V)

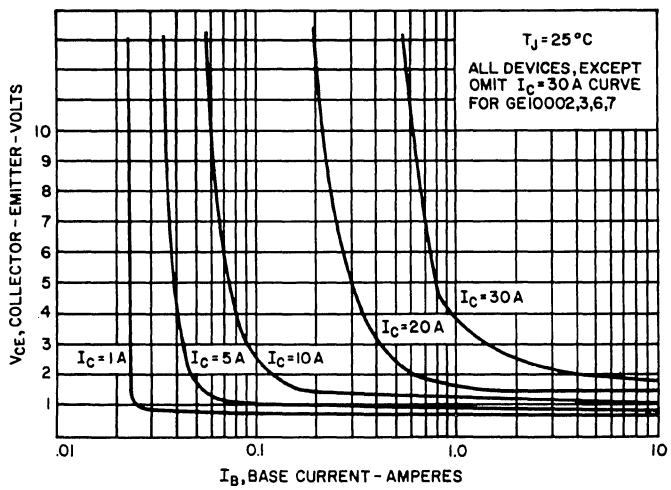


FIGURE 2. COLLECTOR SATURATION REGION

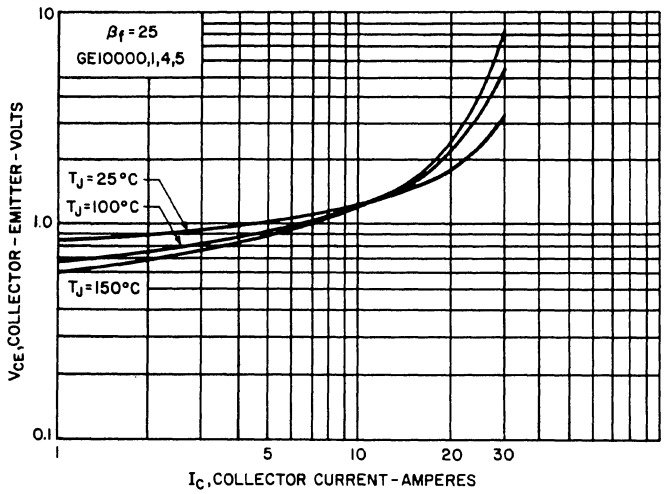


FIGURE 3. $V_{CE\ (SAT)}$ VS I_C

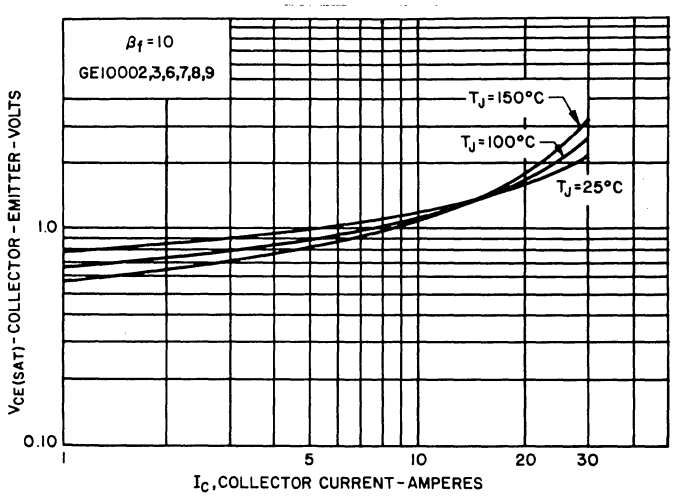


FIGURE 4. I_C COLLECTOR CURRENT (AMPERES)

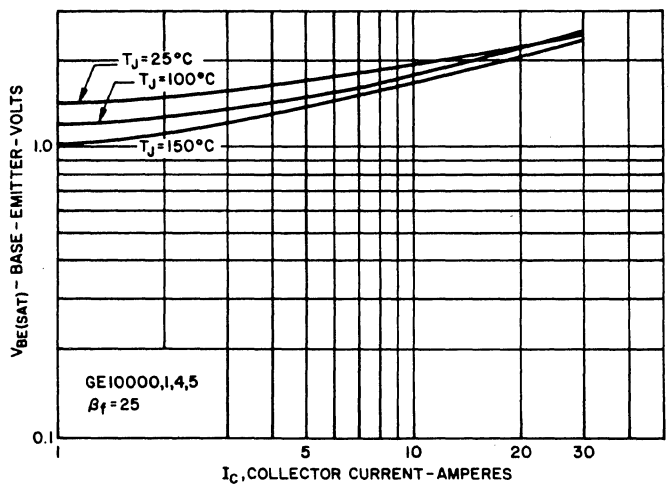


FIGURE 5. $V_{BE\ (SAT)}$ VS I_C

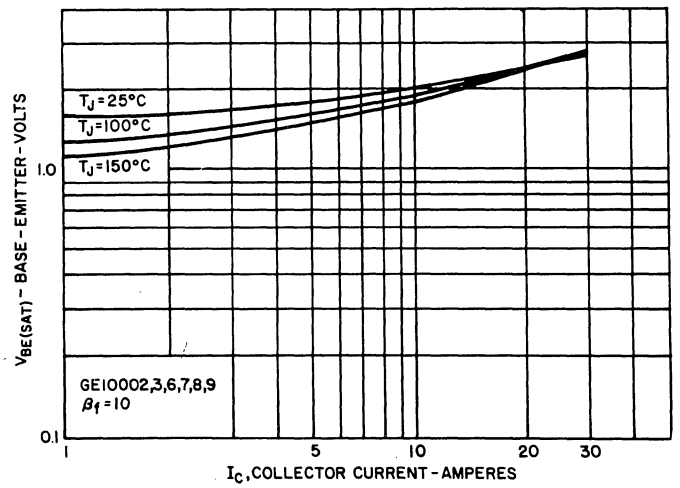


FIGURE 6. $V_{BE\ (SAT)}$ VS I_C

TYPICAL CHARACTERISTICS

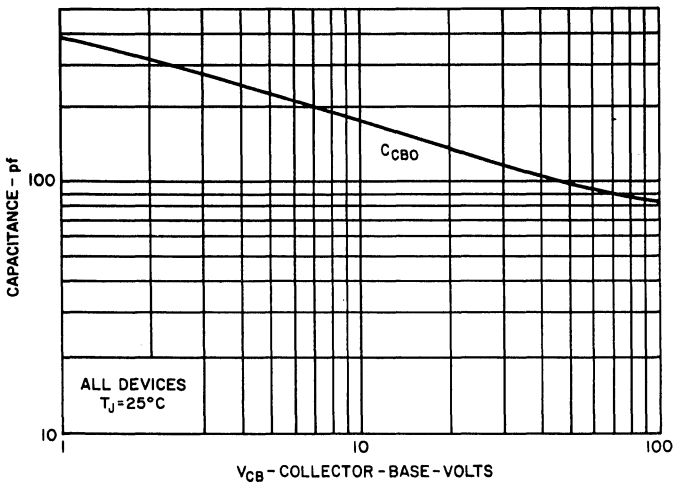


FIGURE 7. CAPACITANCE (C_{CBO})

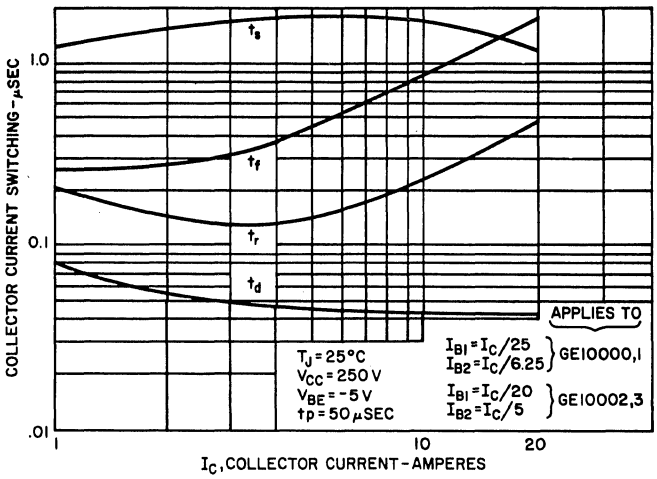


FIGURE 8. RESISTIVE SWITCHING PERFORMANCE

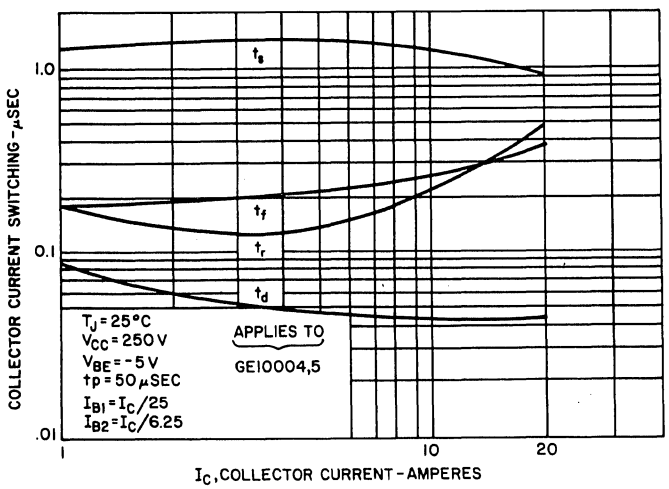


FIGURE 9. RESISTIVE SWITCHING PERFORMANCE

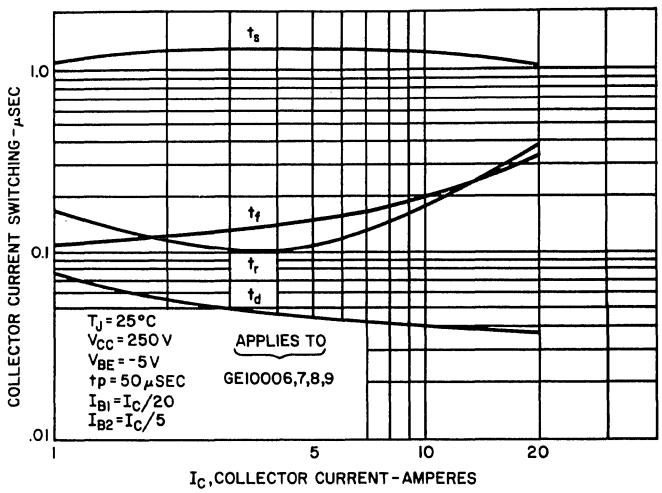


FIGURE 10. RESISTIVE SWITCHING PERFORMANCE

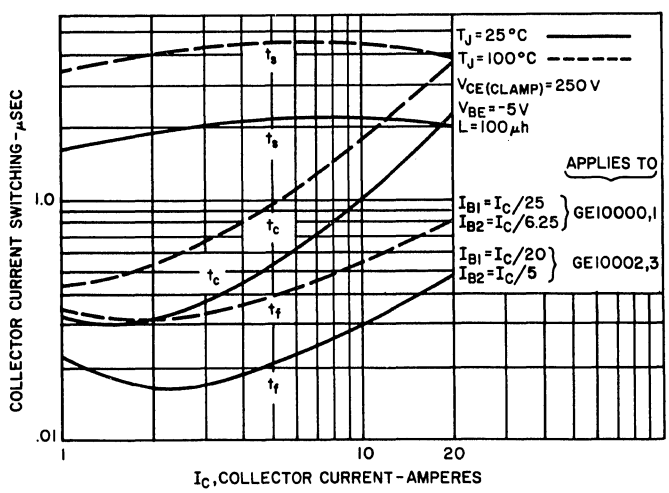


FIGURE 11. INDUCTIVE SWITCHING PERFORMANCE (CLAMPED)

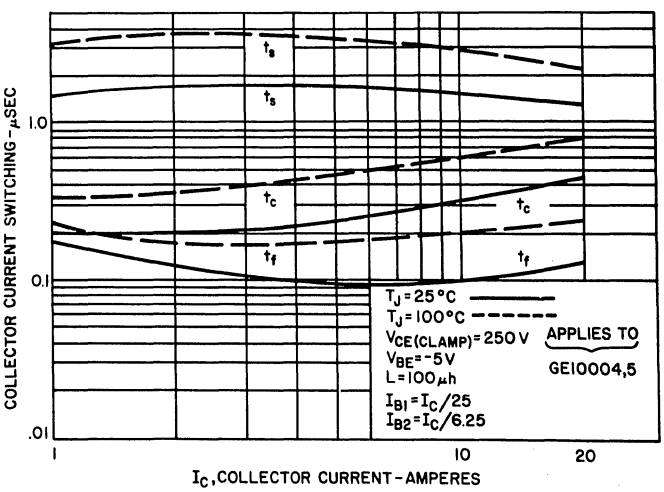


FIGURE 12. INDUCTIVE SWITCHING PERFORMANCE

TYPICAL CHARACTERISTICS

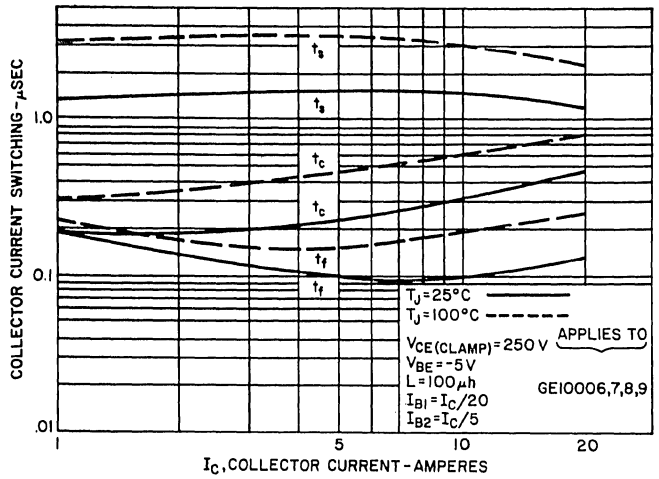


FIGURE 13. INDUCTIVE SWITCHING PERFORMANCE (CLAMPED)

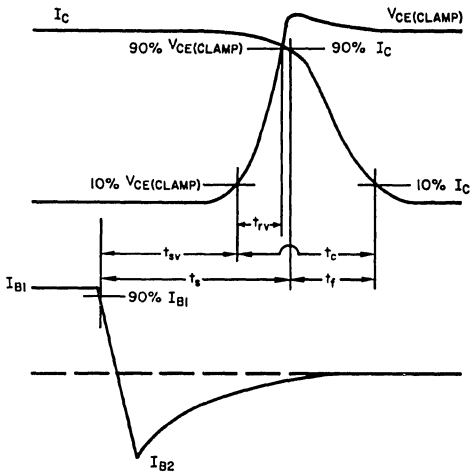


FIGURE 14. INDUCTIVE SWITCHING TURN-OFF WAVEFORMS

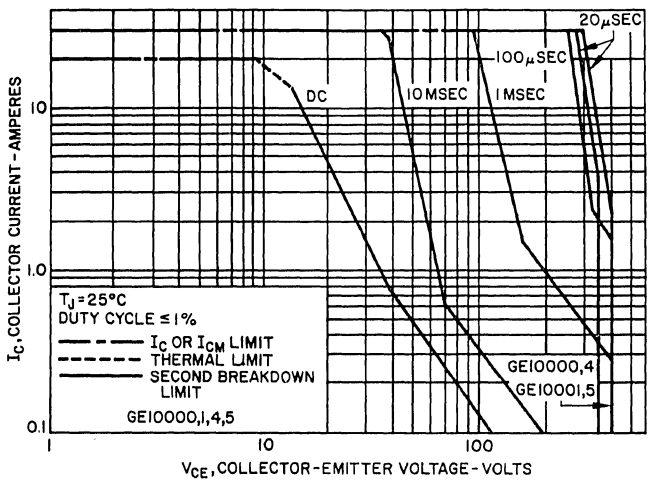


FIGURE 15. FORWARD BIAS SAFE OPERATING AREA

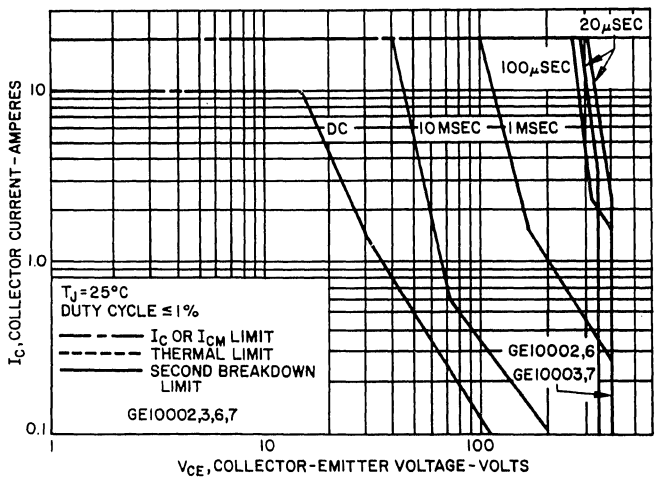


FIGURE 16. FORWARD BIAS SAFE OPERATING AREA

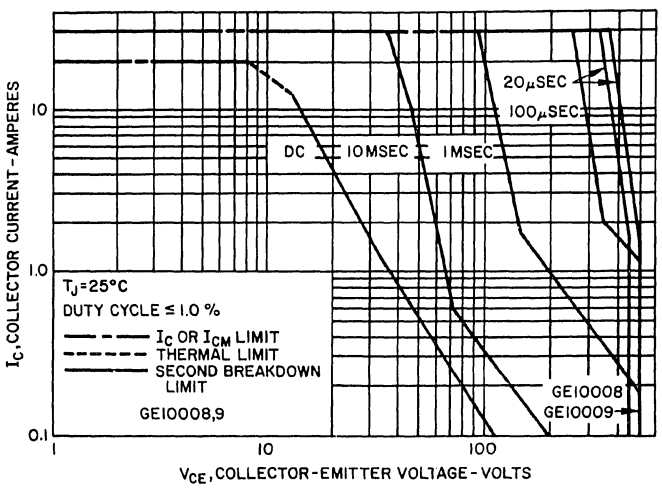


FIGURE 17. FORWARD BIAS SAFE OPERATING AREA

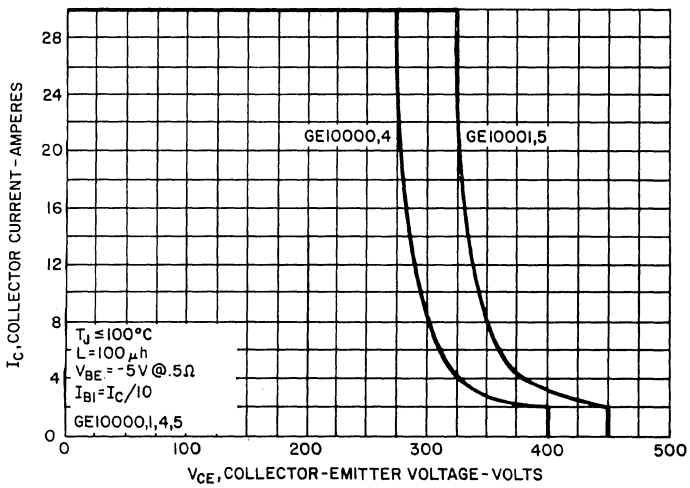


FIGURE 18. REVERSE BIAS SAFE OPERATING AREA (CLAMPED)

TYPICAL CHARACTERISTICS

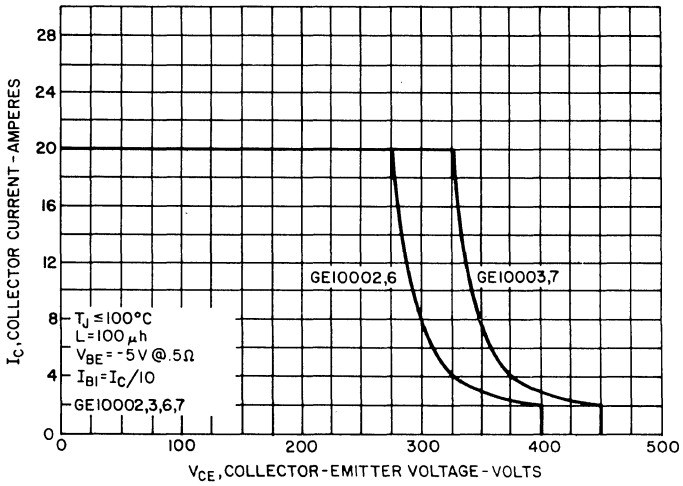


FIGURE 19. REVERSE BIAS SAFE OPERATING AREA (CLAMPED)

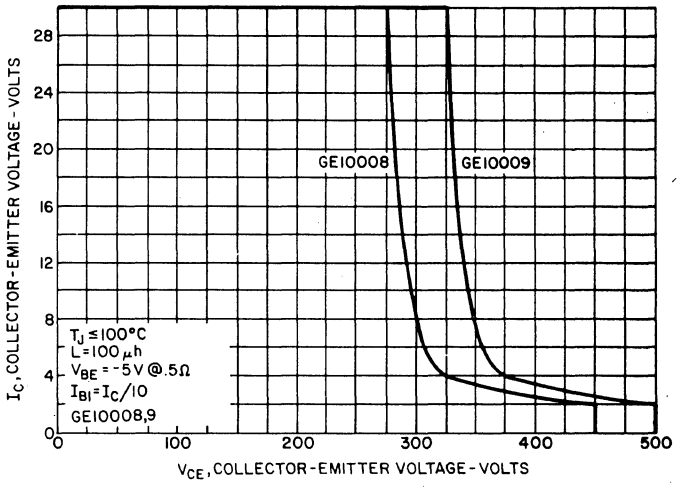


FIGURE 20. REVERSE BIAS SAFE OPERATING AREA (CLAMPED)

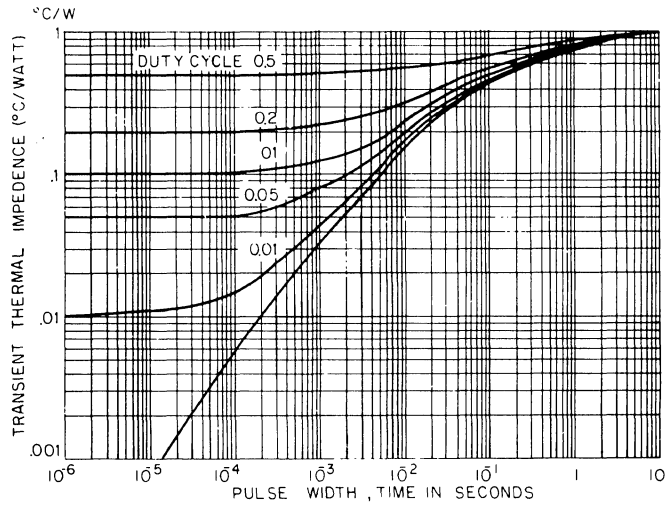


FIGURE 21. TRANSIENT THERMAL RESPONSE

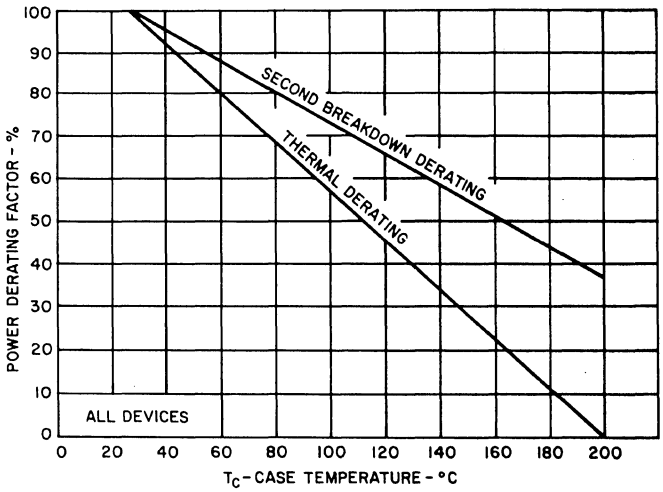


FIGURE 22. POWER DERATING

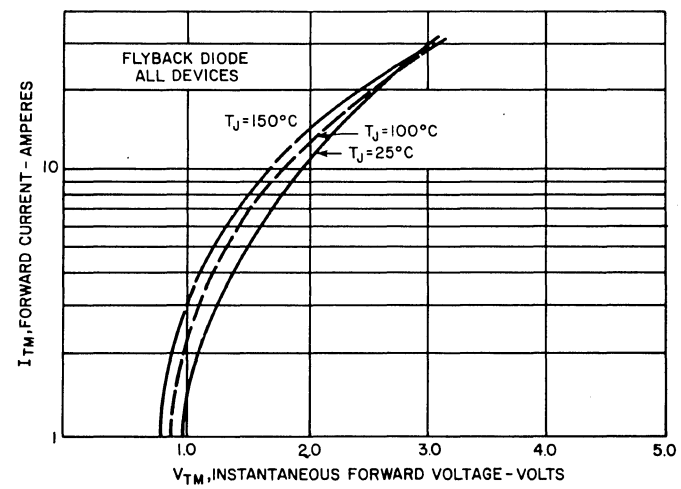


FIGURE 23. FORWARD CHARACTERISTICS

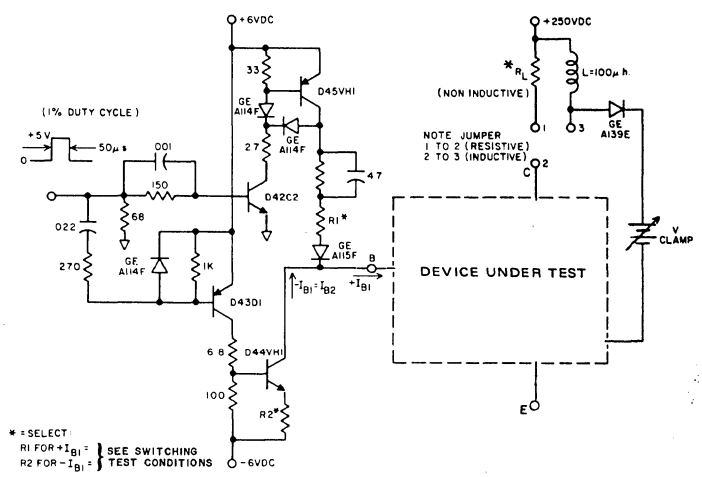


FIGURE 24. SWITCHING TIME TEST CIRCUIT