# 50-Ampere N-P-N Darlington Power Transistors

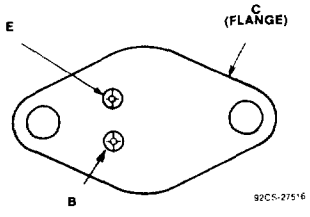
**Features:**

- *High speed $t_s < 5.0$ μsec., $t_f < 3.0$ μsec.*
- *High voltage: 400-500 $V_{CEO}$*
- *High gain: $h_{FE}$ 50 minimum @ 50 amperes, $I_C$*
- *High current: 75 amperes, $I_C$ (Peak)*

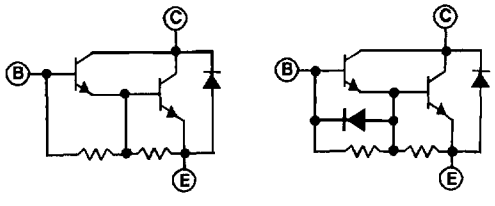
The D64DV and D64EV series of silicon n-p-n power Darlington transistors are designed for use in high-speed switching applications. These applications include off-line switching power supplies, PWM ac and dc motor controls, UPS systems, ultrasonic equipment, and other high-frequency power conversion equipment.

These devices are supplied in the JEDEC TO-204AE hermetic steel package.

**TERMINAL DESIGNATIONS**




**JEDEC TO-204AE**




**D64DV** **D64EV**

**DEVICE CIRCUIT**



**MAXIMUM RATINGS ($T_A$ = 25° C)** (unless otherwise specified)

| RATING | SYMBOL | D64DV5/EV5 | D64DV6/EV6 | D64DV7/EV7 | UNITS |
|---|---|---|---|---|---|
| Collector-Emitter Voltage | $V_{CEO}$ | 400 | 450 | 500 | Volts |
| Collector-Base Voltage | $V_{CBO}$ | 500 | 600 | 700 | Volts |
| Emitter Base Voltage D64DV<br>D64EV | $V_{EBO}$ | 8<br>5 | 8<br>5 | 8<br>5 | Volts |
| Collector Current — Continuous<br>Peak (Repetitive)<br>Peak (Non-Repetitive) | $I_C$<br>$I_{CM}$<br>$I_{CSM}$ | 50<br>75<br>125 | 50<br>75<br>125 | 50<br>75<br>125 | A |
| Base Current — Continuous<br>Peak (Non-Repetitive) | $I_B$<br>$I_{BM}$ | 10<br>20 | 10<br>20 | 10<br>20 | A |
| Total Power Dissipation @ $T_C$ = 25°C | $P_D$ | 180 | 180 | 180 | Watts |
| Operating and Storage Junction Temperature Range | $T_J$, $T_{STG}$ | −65 to +150 | −65 to +150 | −65 to +150 | °C |

**THERMAL CHARACTERISTICS**

| | | | | | |
|---|---|---|---|---|---|
| Thermal Resistance, Junction to Case | $R_{\theta JC}$ | 0.7 | 0.7 | 0.7 | °C/W |
| Maximum Lead Temperature for Soldering Purposes: ⅛" from Case for 5 Seconds | $T_L$ | 300 | 300 | 300 | °C |

**ELECTRICAL CHARACTERISTICS ($T_C$ = 25° C)** (unless otherwise specified)

| CHARACTERISTIC | | SYMBOL | MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|---|
| **OFF CHARACTERISTICS** | | | | | | |
| Collector-Emitter Sustaining Voltage ($I_C$ = 0.5A) ($V_{clamp}$ = $V_{CEO}$ Rated) | D64DV5/EV5<br>D64DV6/EV6<br>D64DV6/EV7 | $V_{CEO(sus)}$ | 400<br>450<br>500 | —<br>—<br>— | —<br>—<br>— | Volts |
| Collector Cutoff Current ($V_{CE}$ = Rated Value, $V_{BE}$ = -1.5V) | $T_J$ = 25°C<br>$T_J$ = 150°C | $I_{CEV}$ | —<br>— | —<br>— | 1.0<br>2.5 | mA |
| Emitter Cutoff Current ($V_{EB}$ = 4.5V, $I_C$ = 0)<br>($V_{EB}$ = 1.5V, $I_C$ = 0) | D64DV<br>D64EV | $I_{EBO}$ | —<br>— | —<br>— | 350<br>350 | mA |
| **SECOND BREAKDOWN** | | | | | | |
| Second Breakdown with Base Forward Biased | | FBSOA | SEE FIGURE 23 | | | |
| **ON CHARACTERISTICS** | | | | | | |
| DC Current Gain ($I_C$ = 75A, $V_{CE}$ = 5V)<br>($I_C$ = 50A, $V_{CE}$ = 5V)<br>($I_C$ = 20A, $V_{CE}$ = 5V) | | $h_{FE}$ | 25<br>50<br>100 | 60<br>135<br>250 | —<br>—<br>— | — |
| Collector-Emitter Saturation Voltage ($I_C$ = 75A, $I_B$ = 5A)<br>($I_C$ = 50A, $I_B$ = 4A)<br>($I_C$ = 20A, $I_B$ = 2A) | | $V_{CE(sat)}$ | —<br>—<br>— | 2.2<br>1.7<br>1.15 | 3.0<br>2.0<br>1.5 | V |
| Base-Emitter Saturation Voltage ($I_C$ = 75A, $I_B$ = 5A)<br>($I_C$ = 50A, $I_B$ = 4A)<br>($I_C$ = 20A, $I_B$ = 2A) | | $V_{BE(sat)}$ | —<br>—<br>— | 2.8<br>2.45<br>1.95 | 3.5<br>3.0<br>2.5 | V |

**SWITCHING CHARACTERISTICS**

| Resistive Load | | | | TYP. DV | TYP. EV | MAX. DV | MAX. EV | |
|---|---|---|---|---|---|---|---|---|
| Delay Time | $V_{CC}$ = 250V | $t_d$ | — | 0.09 | 0.09 | 0.5 | 0.5 | μs |
| Rise Time | $I_C$ = 50A | $t_r$ | — | 0.5 | 0.5 | 1 | 1 | |
| Storage Time | $I_{B1}$ = 2.5A, $I_{B2}$ = -5A | $t_s$ | — | 2.55 | 2 | 5 | 3 | |
| Fall Time | $t_p$ = 50 μsec | $t_f$ | — | 1.4 | 0.64 | 3 | 1 | |

**EMITTER-COLLECTOR DIODE CHARACTERISTICS**

| | | | | | |
|---|---|---|---|---|---|
| Power Dissipation | $P_D$ | — | — | 125 | Watts |
| Forward Voltage ($I_F$ = 25A)<br>($I_P$ = 50A)<br>($I_F$ = 50A, $T_J$ = 150°C) | $V_F$<br>$V_F$<br>$V_F$ | —<br>—<br>— | 1.95<br>2.60<br>2.30 | 3.20<br>3.80<br>3.50 | Volts<br>Volts<br>Volts |
| Reverse Recovery Time ($I_F$ = 50A, $di/_{dt}$ = 25A/μsec, $R_{B1E}$ = 0.25Ω) | $T_{rr}$ | — | 3.85 | 10.0 | μsec |
| Forward Turn-On Time ($I_F$ = 100A, $di/_{dt}$ = 100A/μsec) | $T_{ON}$ | — | 0.75 | 1.5 | μsec |
| Single Cycle Surge Current (60Hz) | $I_{FSM}$ | — | — | 150 | Amps |
| Thermal Resistance | $R_{\theta JC}$ | — | — | 1.0 | °C/Watt |

## TYPICAL CHARACTERISTICS

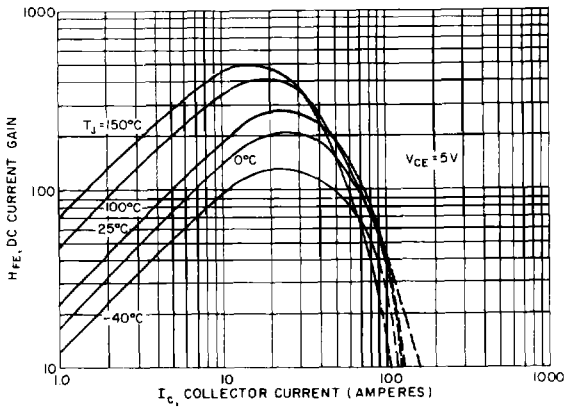



FIGURE 1. DC CURRENT GAIN ($V_{CE}$ = 5V)

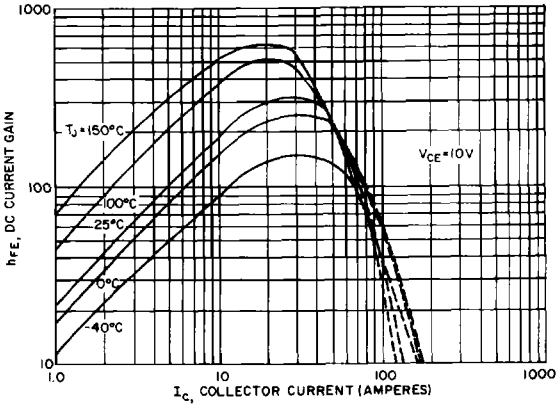



FIGURE 2. DC CURRENT GAIN ($V_{CE}$ = 10V)

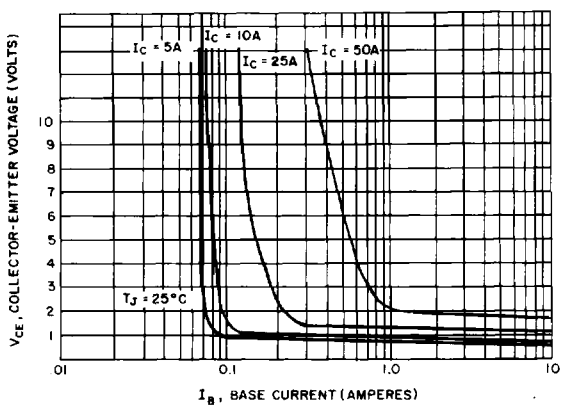



FIGURE 3. COLLECTOR SATURATION REGION

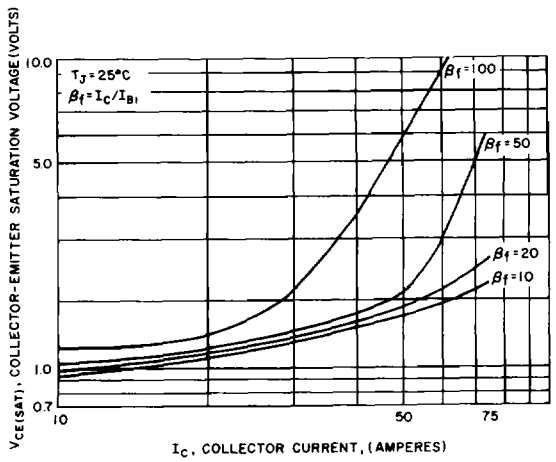



FIGURE 4. $V_{CE\ (SAT)}$ VS $I_C$, $T_J$ = 25°C

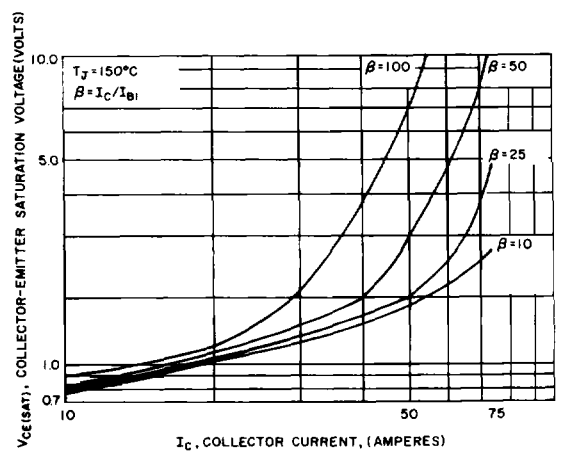



FIGURE 5. $V_{CE\ (SAT)}$ VS $I_C$, $T_J$ = 150°C

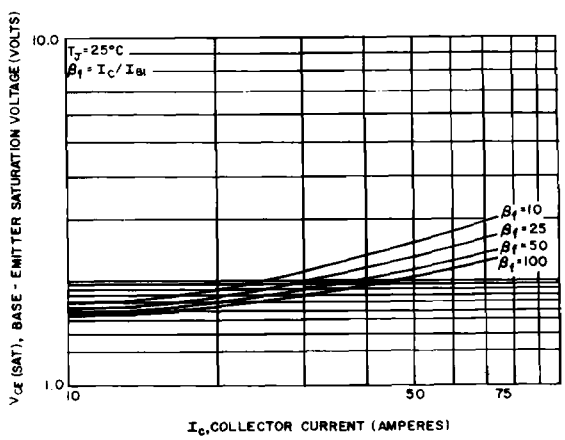



FIGURE 6. $V_{BE\ (SAT)}$ VS $I_C$, $T_J$ = 25°C

2 POWER TRANSISTORS

## TYPICAL CHARACTERISTICS

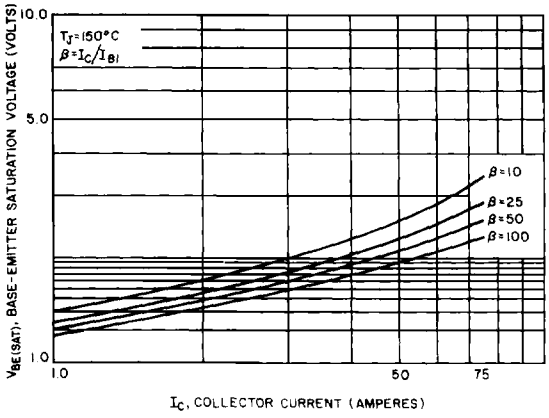



FIGURE 7. $V_{BE\ (SAT)}$ VS $I_C$, $T_J$ = 150°C

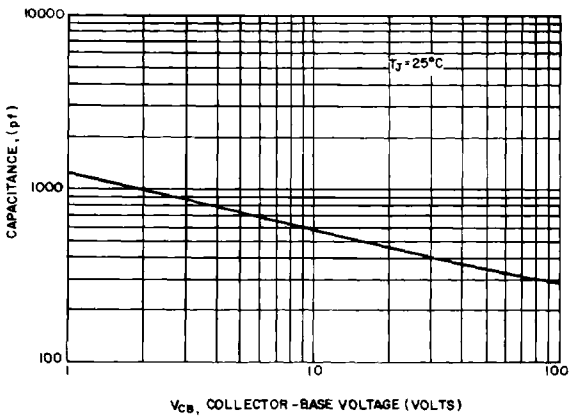



FIGURE 8. CAPACITANCE ($C_{CBO}$)

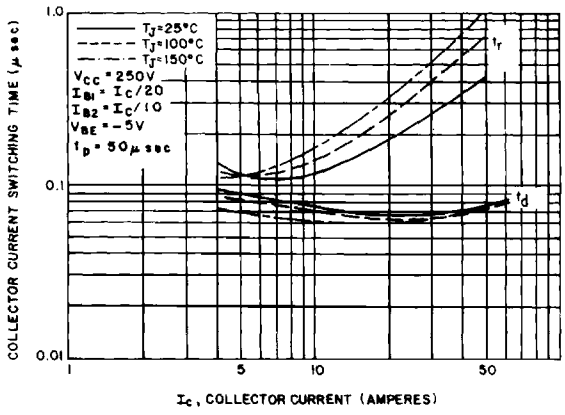



FIGURE 9. TURN-ON TIME (RESISTIVE LOAD) (D64DV ONLY)

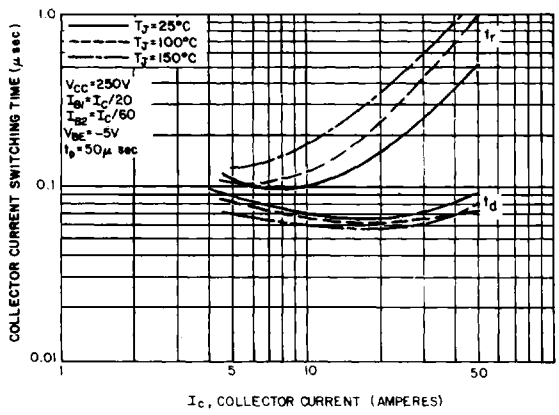



FIGURE 10. TURN-ON TIME (RESISTIVE LOAD) (D64EV ONLY)

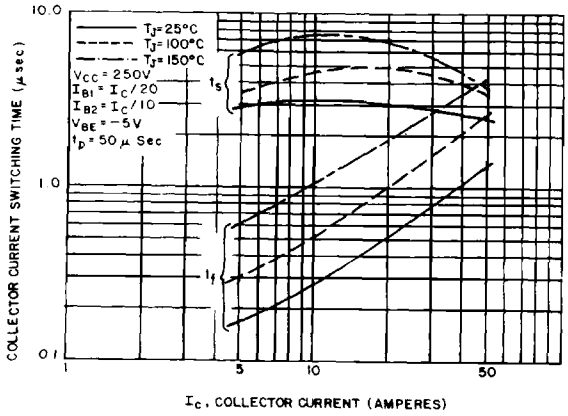



FIGURE 11. TURN-OFF TIME (RESISTIVE LOAD) (D64DV ONLY)

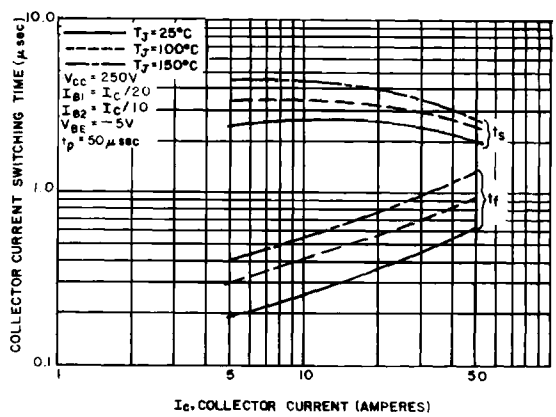



FIGURE 12. TURN-OFF TIME (RESISTIVE LOAD) (D64EV ONLY)

## TYPICAL CHARACTERISTICS

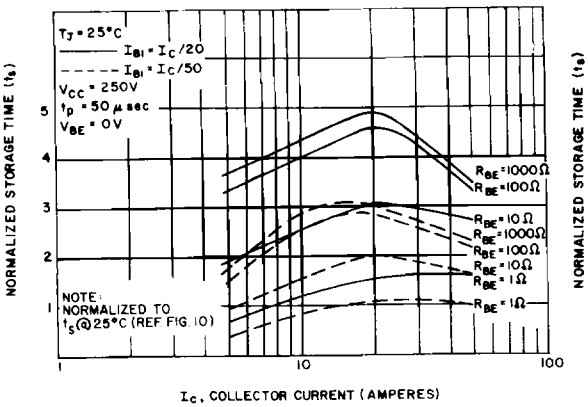



FIGURE 13. NORMALIZED RESISTIVE SWITCHING STORAGE TIME ($R_{BE}$ VARATIONS) VS COLLECTOR CURRENT (D64DV ONLY)

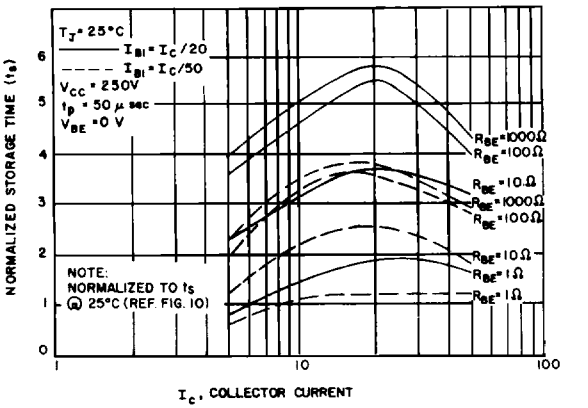



FIGURE 14. NORMALIZED RESISTIVE SWITCHING STORAGE TIME ($R_{BE}$ VARATIONS) VS COLLECTOR CURRENT (D64EV ONLY)



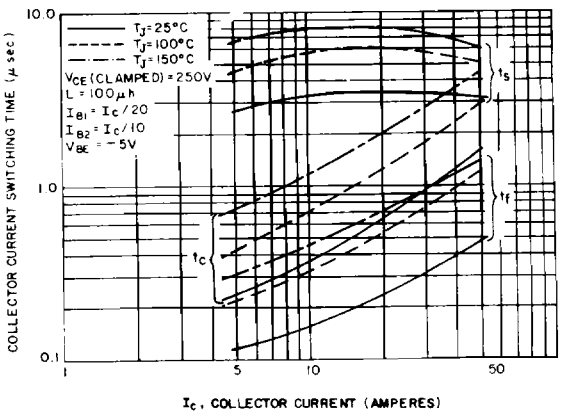



FIGURE 15. CLAMPING INDUCTIVE TURN-OFF TIME (D64DV ONLY)

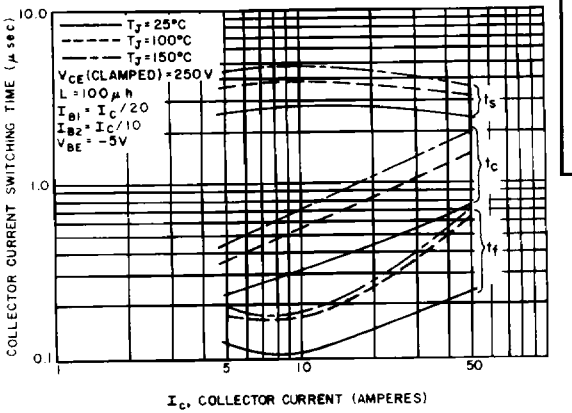



FIGURE 16. CLAMPING INDUCTIVE TURN-OFF TIME (D64EV ONLY)

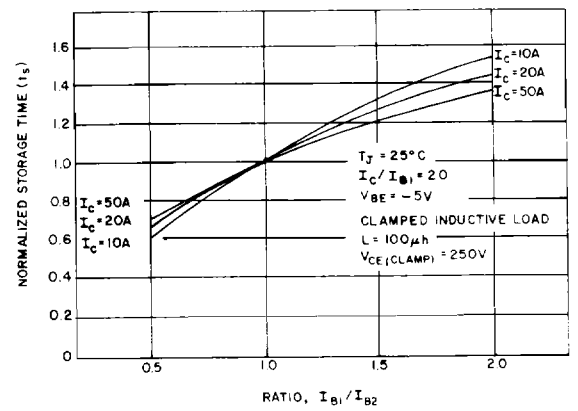



FIGURE 17. STORAGE TIME VARIATION WITH $I_{B2}$ (D64DV ONLY)

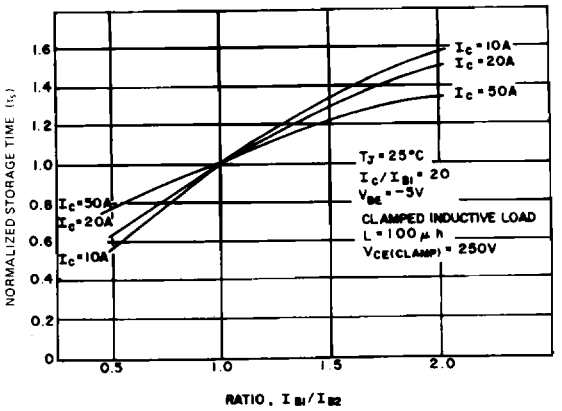



FIGURE 18. STORAGE TIME VARIATION WITH $I_{B2}$ (D64EV ONLY)

## TYPICAL CHARACTERISTICS

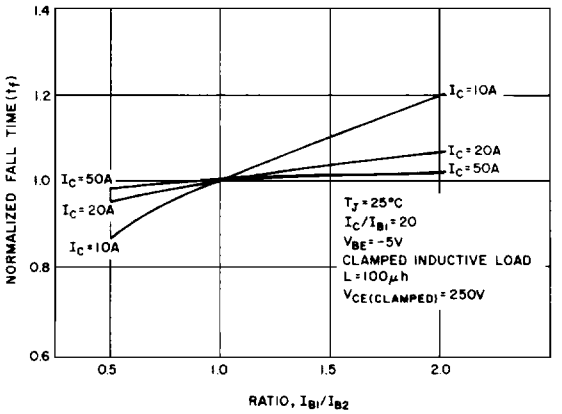



**FIGURE 19. FALL TIME VARIATION WITH $I_{B2}$ (D64DV ONLY)**

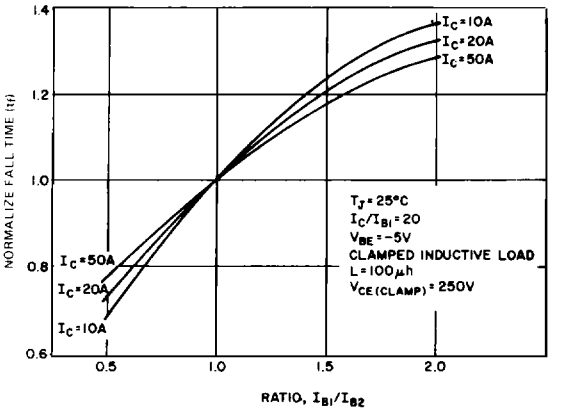



**FIGURE 20. FALL TIME VARIATION WITH $I_{B2}$ (D64EV ONLY)**

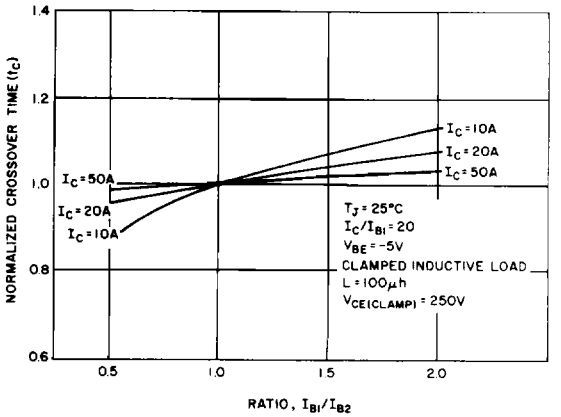



**FIGURE 21. CROSSOVER TIME VARIATION WITH $I_{B2}$ (D64DV ONLY)**

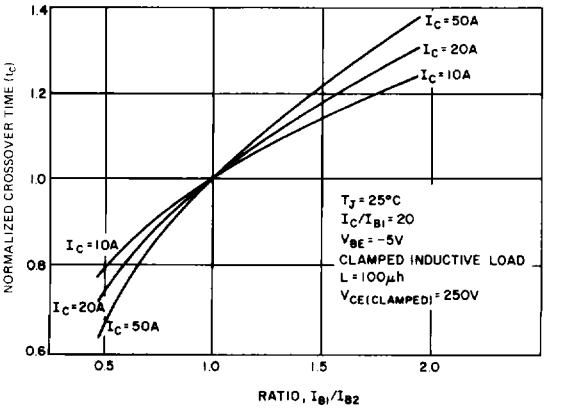



**FIGURE 22. CROSSOVER TIME VARIATION WITH $I_{B2}$ (D64EV ONLY)**

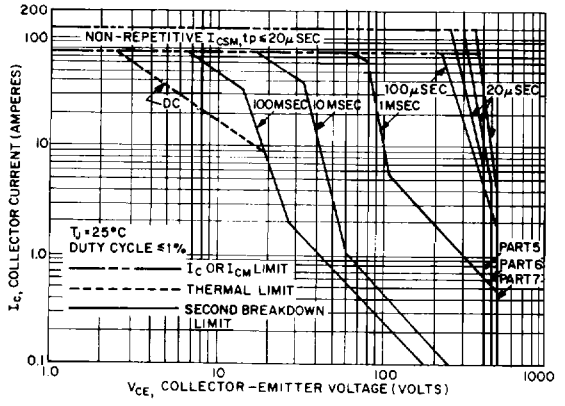



**FIGURE 23. FORWARD BIAS SAFE OPERATING AREA**

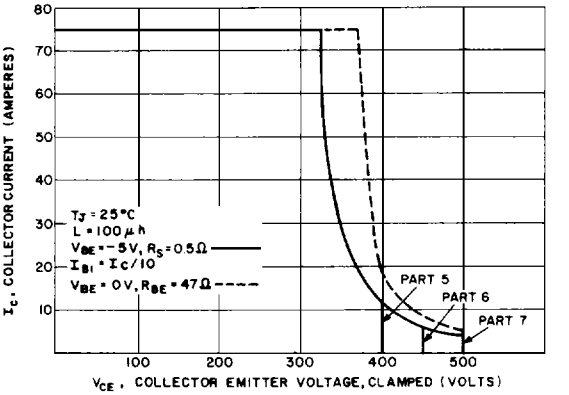



**FIGURE 24. REVERSE BIAS SAFE OPERATING AREA (CLAMPED)**

## TYPICAL CHARACTERISTICS

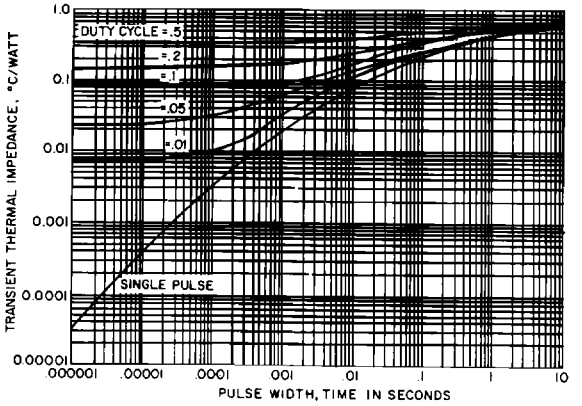



FIGURE 25. TRANSIENT THERMAL RESPONSE

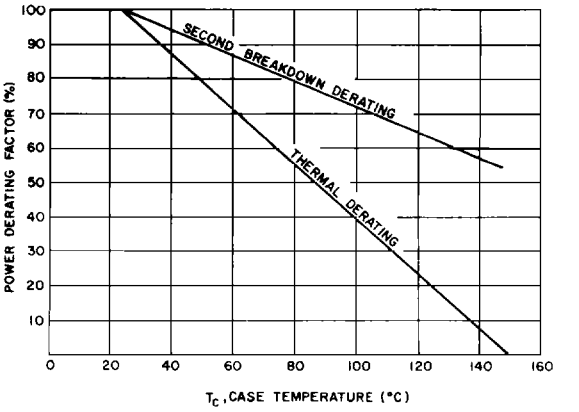



FIGURE 26. POWER DERATING

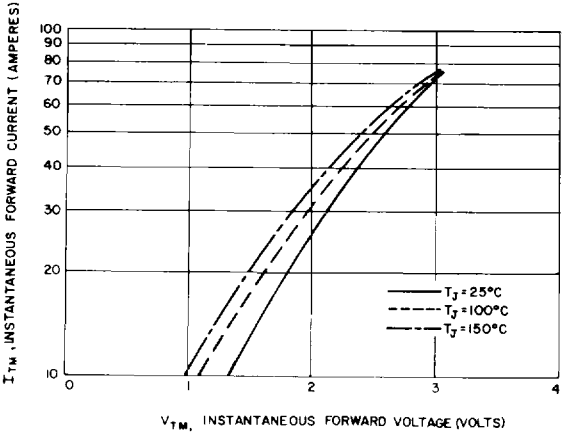



FIGURE 27. FORWARD CHARACTERISTICS

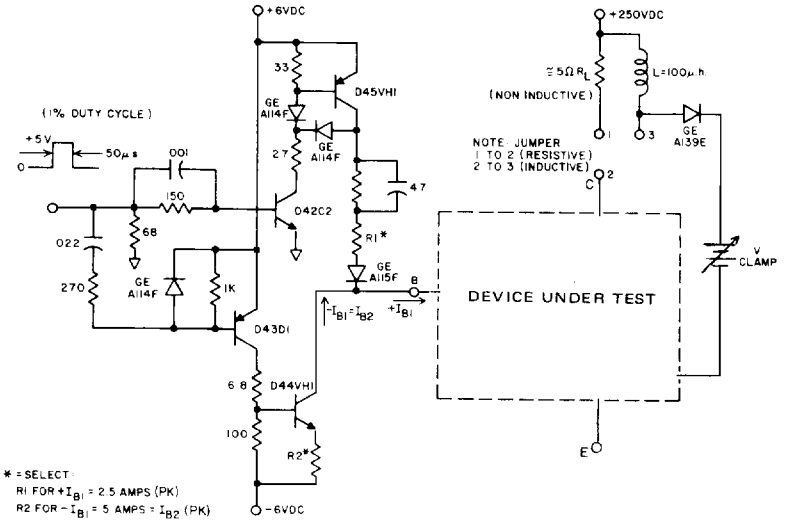



FIGURE 28.
SWITCHING TIME
TEST CIRCUIT