HARRIS SEMICONDUCTOR

# HGTP3N60B3D, HGT1S3N60B3D, HGT1S3N60B3DS

## ADVANCE INFORMATION

September 1997

## 7A, 600V, UFS Series N-Channel IGBT with Anti-Parallel Hyperfast Diode

### Features

- 7A, 600V, $T_C = 25^oC$
- 600V Switching SOA Capability
- Typical Fall Time . . . . . 115ns at $T_J = 150^oC$
- Short Circuit Rating
- Low Conduction Loss
- Hyperfast Anti-Parallel Diode

### Ordering Information

| PART NUMBER | PACKAGE | BRAND |
|---|---|---|
| HGTP3N60B3D | TO-220AB | G3N60B3D |
| HGT1S3N60B3D | TO-262AA | G3N60B3D |
| HGT1S3N60B3DS | TO-263AB | G3N60B3D |

NOTE: When ordering, use the entire part number. Add the suffix 9A to obtain the TO-263AB variant in tape and reel, i.e., HGT1S3N60B3DS9A

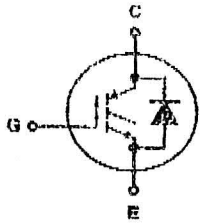
### Description

The HGTP3N60B3D, HGT1S3N60B3D, and HGT1S3N60B3DS are MOS gated high voltage switching devices combining the best features of MOSFETs and bipolar transistors. These devices have the high input impedance of a MOSFET and the low on-state conduction loss of a bipolar transistor. The much lower on-state voltage drop varies only moderately between 25C and 150°C. The diode used in anti-parallel with the IGBT is the RHRD460.

The IGBT is ideal for many high voltage switching applications operating at moderate frequencies where low conduction losses are essential, such as: AC and DC motor controls, power supplies and drivers for solenoids, relays and contactors.

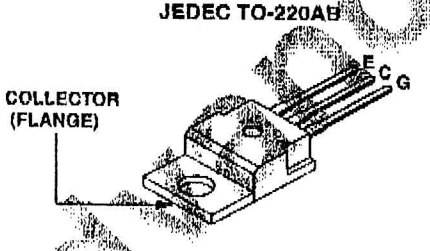
Formerly Developmental Type TA49193.

### Symbol

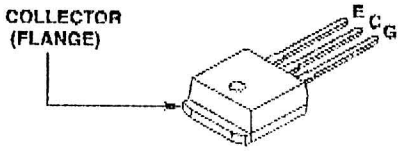



### Packaging

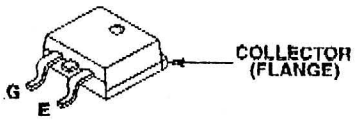
JEDEC TO-220AB




JEDEC TO-262AA




JEDEC TO-263AB






File Number 4414

**Electrical Specifications** $T_C = 25^oC$, Unless Otherwise Specified (Continued)

| PARAMETER | SYMBOL | TEST CONDITIONS | MIN | TYP | MAX | UNITS |
|---|---|---|---|---|---|---|
| Current Turn-On Delay Time | $t_{d(ON)I}$ | IGBT and Diode at $T_J = 25^oC$ | - | 18 | - | ns |
| Current Rise Time | $t_{rI}$ | $I_{CE} = I_{C110}$ | - | 16 | - | ns |
| Current Turn-Off Delay Time | $t_{d(OFF)I}$ | $V_{CE} = 0.8\ BV_{CES}$ | - | 105 | - | ns |
| Current Fall Time | $t_{fI}$ | $V_{GE} = 15V$ | - | 70 | - | ns |
| Turn-On Energy | $E_{ON}$ | $R_G = 82\Omega$ | - | 66 | 75 | µJ |
| Turn-Off Energy (Note 1) | $E_{OFF}$ | L = 1mH | - | 88 | 160 | µJ |
| Current Turn-On Delay Time | $t_{d(ON)I}$ | Test Circuit - (Figure 19) | - | 16 | - | ns |
| Current Rise Time | $t_{rI}$ | IGBT and Diode at $T_J = 150^oC$ | - | 18 | - | ns |
| Current Turn-Off Delay Time | $t_{d(OFF)I}$ | $I_{CE} = I_{C110}$ | - | 220 | 295 | ns |
| Current Fall Time | $t_{fI}$ | $V_{CE} = 0.8\ BV_{CES}$ | - | 115 | 175 | ns |
| Turn-On Energy | $E_{ON}$ | $V_{GE} = 15V$ | - | 130 | 140 | µJ |
| Turn-Off Energy (Note 1) | $E_{OFF}$ | $R_G = 82\Omega$ | - | 210 | 325 | µJ |
| Diode Foward Voltage | $V_{EC}$ | L = 1mH | - | 2.0 | 2.5 | V |
| Diode Reverse Recovery Time | $t_{RR}$ | Test Circuit - (Figure 19) | - | - | 22 | ns |
| | | $I_{EC} = 1A,\ dI_{EC}/dt = 200A/\mu s$ | - | - | 28 | ns |
| | | $I_{EC} = 3A,\ dI_{EC}/dt = 200A/\mu s$ | - | - | 3.75 | °C/W |
| Thermal Resistance Junction To Case | $R_{\theta JC}$ | IGBT | | | 3.0 | °C/W |
| | | Diode | | | | |

NOTE:

1. Turn-Off Energy Loss ($E_{OFF}$) is defined as the integral of the instantaneous power loss starting at the trailing edge of the input pulse and ending at the point where the collector current equals zero ($I_{CE}$ = 0A). All devices were tested per JEDEC Standard No. 24-1 Method for Measurement of Power Device Turn-Off Switching Loss. This test method produces the true total Turn-Off Energy Loss. Turn-On losses include losses due to diode recovery.

## Typical Performance Curves (Unless Otherwise Specified)

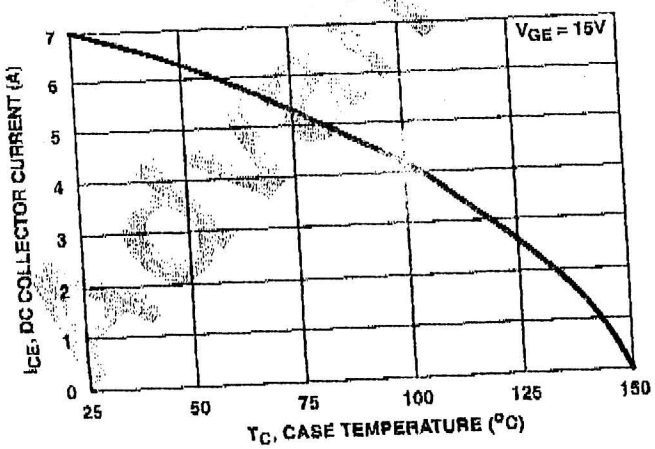



FIGURE 1. DC COLLECTOR CURRENT AS A FUNCTION OF CASE TEMPERATURE

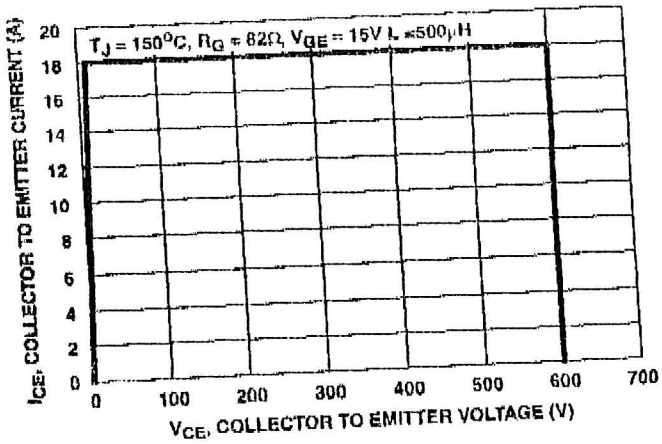



FIGURE 2. MINIMUM SWITCHING SAFE OPERATING AREA

## Typical Performance Curves (Unless Otherwise Specified) (Continued)

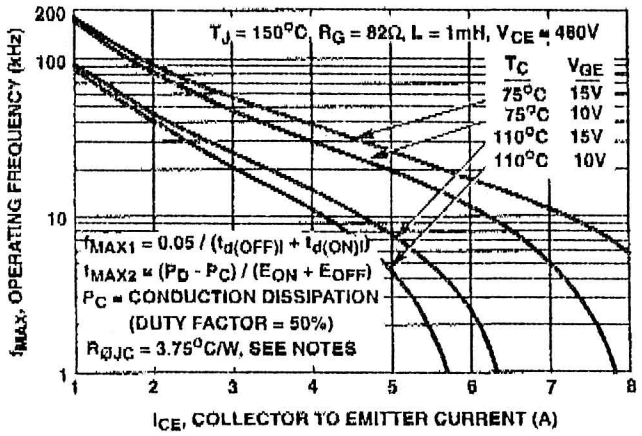



FIGURE 3. OPERATING FREQUENCY AS A FUNCTION OF COLLECTOR TO EMITTER CURRENT

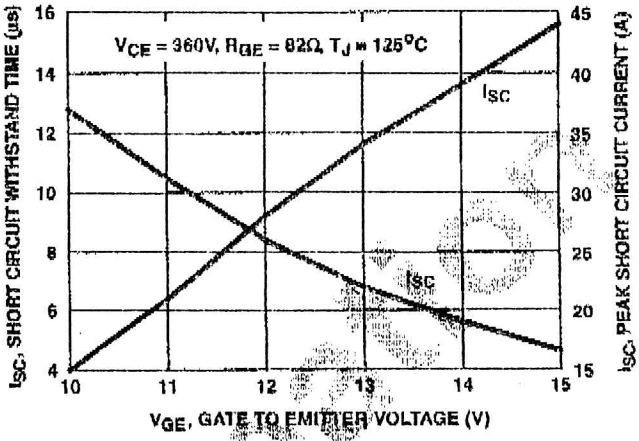



FIGURE 4. SHORT CIRCUIT WITHSTAND TIME

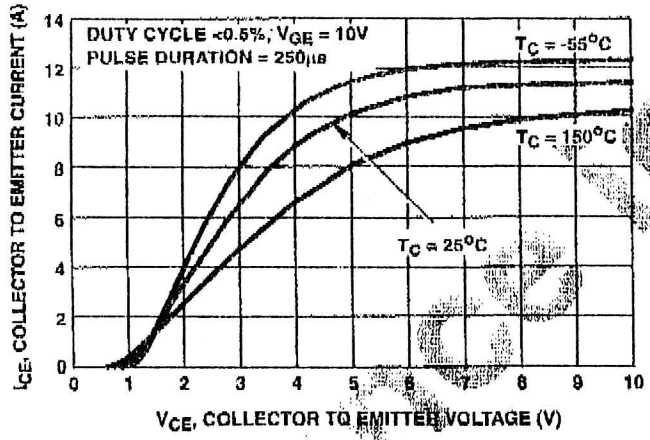



FIGURE 5. COLLECTOR TO EMITTER ON-STATE VOLTAGE

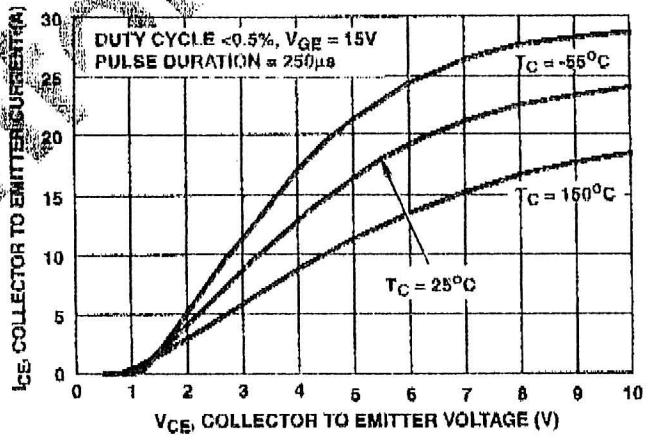



FIGURE 6. COLLECTOR TO EMITTER ON-STATE VOLTAGE

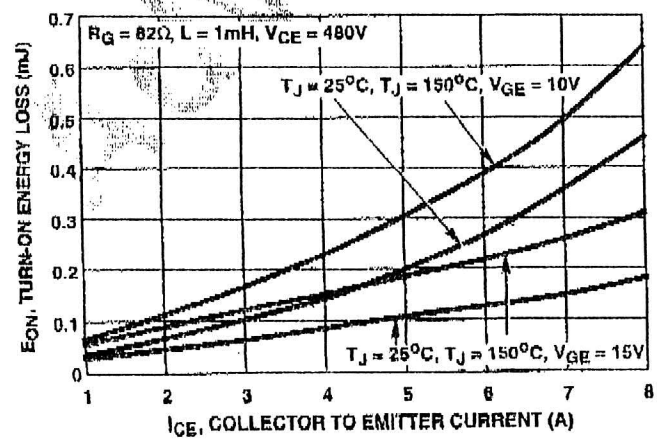



FIGURE 7. TURN-ON ENERGY LOSS AS A FUNCTION OF COLLECTOR TO EMITTER CURRENT

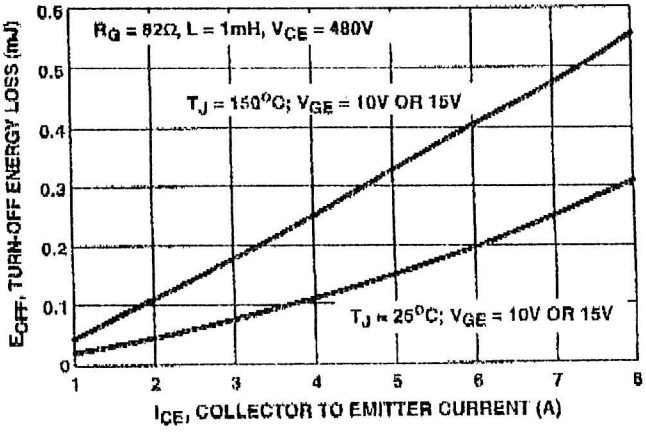



FIGURE 8. TURN-OFF ENERGY LOSS AS A FUNCTION OF COLLECTOR TO EMITTER CURRENT

## Typical Performance Curves (Unless Otherwise Specified) (Continued)

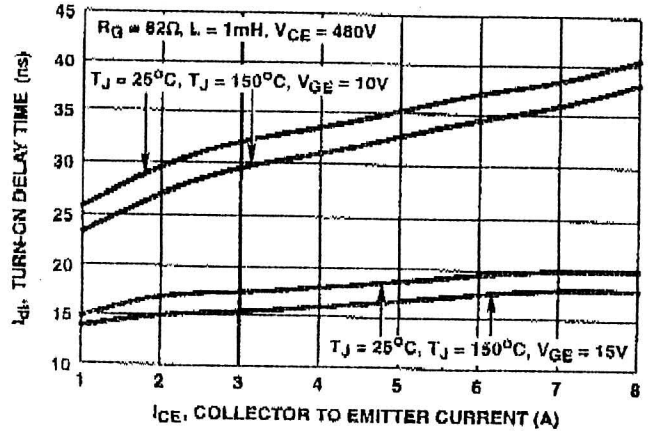



FIGURE 9. TURN-ON DELAY TIME AS A FUNCTION OF COLLECTOR TO EMITTER CURRENT

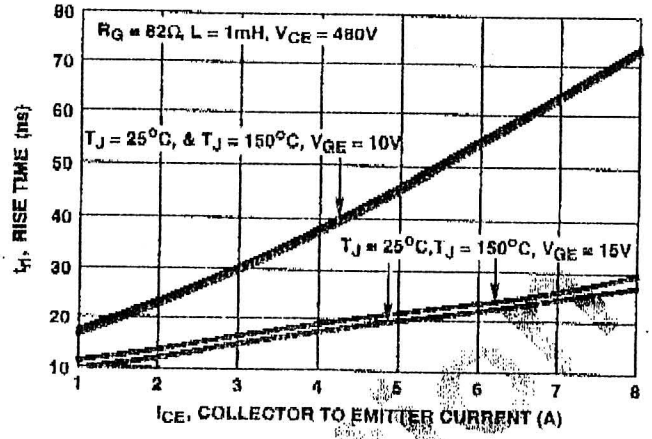



FIGURE 10. TURN-ON RISE TIME AS A FUNCTION OF COLLECTOR TO EMITTER CURRENT

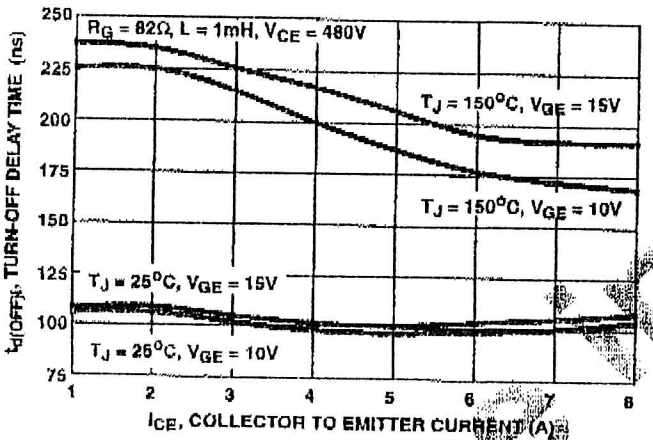



FIGURE 11. TURN-OFF DELAY TIME AS A FUNCTION OF COLLECTOR TO EMITTER CURRENT

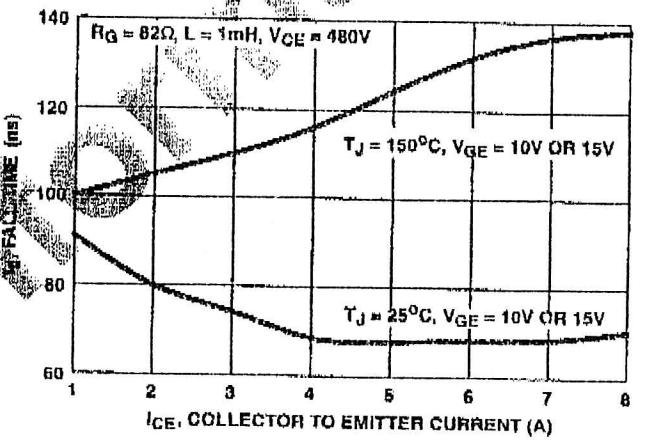



FIGURE 12. FALL TIME AS A FUNCTION OF COLLECTOR TO EMITTER CURRENT

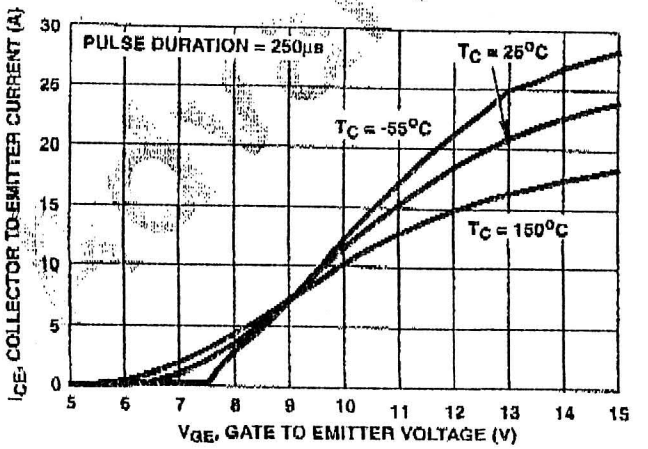



FIGURE 13. TRANSFER CHARACTERISTIC

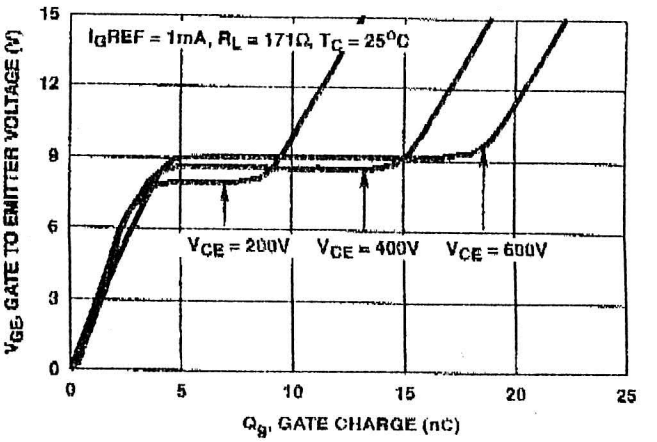



FIGURE 14. GATE CHARGE WAVEFORMS

## Typical Performance Curves (Unless Otherwise Specified) (Continued)

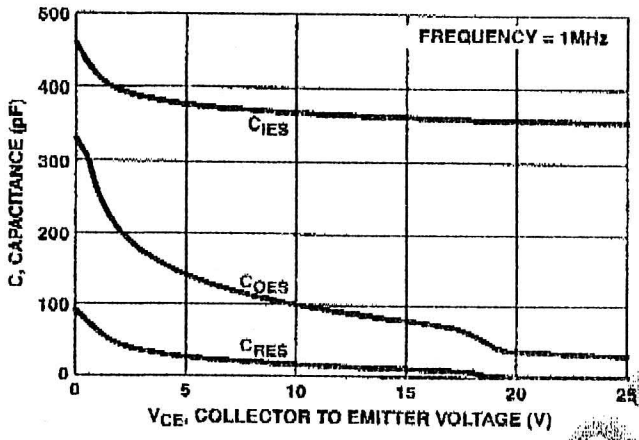



FIGURE 15. CAPACITANCE AS A FUNCTION OF COLLECTOR TO EMITTER VOLTAGE

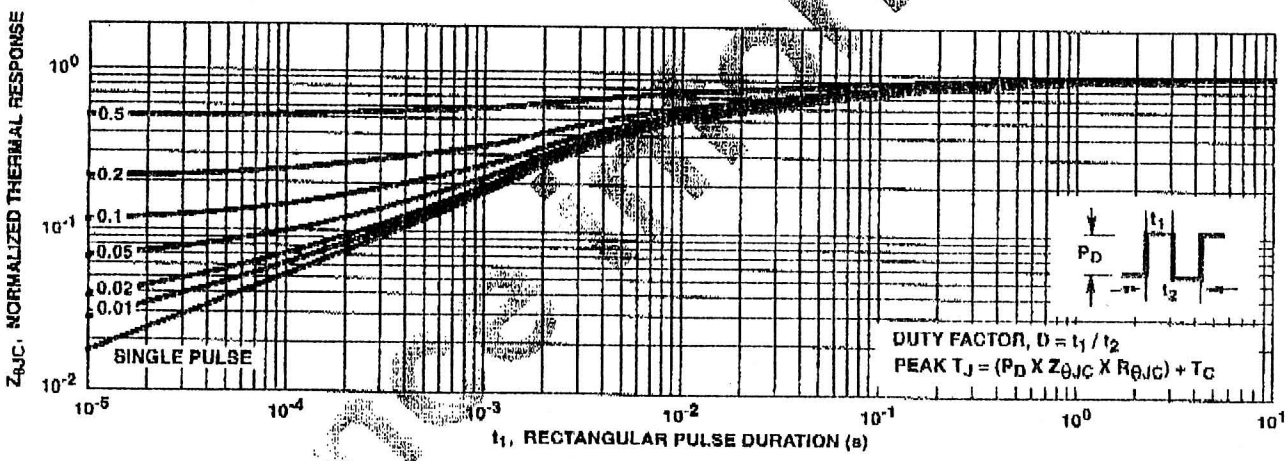



FIGURE 16. NORMALIZED TRANSIENT THERMAL RESPONSE, JUNCTION TO CASE

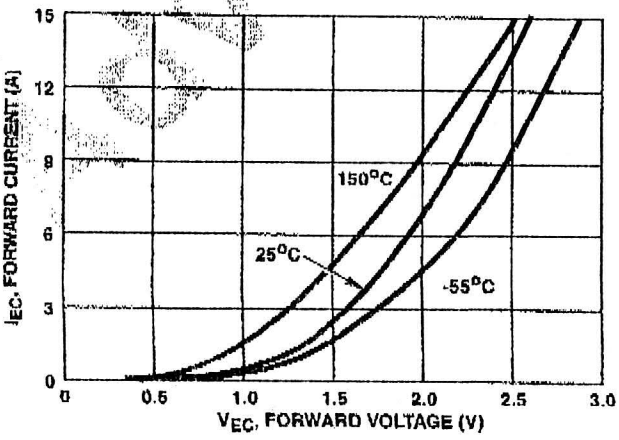



FIGURE 17. DIODE FORWARD CURRENT AS A FUNCTION OF FORWARD VOLTAGE DROP

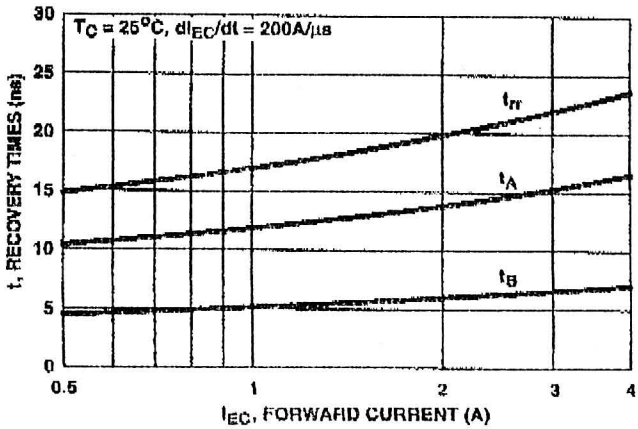



FIGURE 18. RECOVERY TIME AS A FUNCTION OF FORWARD CURRENT