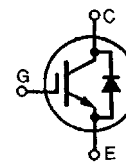
IXYS

Preliminary data

# HiPerFAST™ IGBT with Diode
## Combi Pack

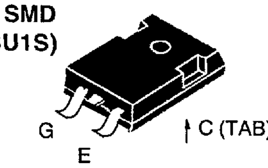
| | $V_{CES}$ | $I_{C(25)}$ | $V_{CE(sat)}$ | $t_{fi}$ |
|---|---|---|---|---|
| **IXGH24N50BU1** | 500 V | 48 A | 2.3 V | 80 ns |
| **IXGH24N60BU1** | 600 V | 48 A | 2.5 V | 80 ns |



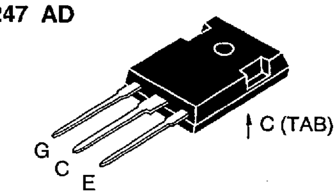

| Symbol | Test Conditions | Maximum Ratings 24N50 | 24N60 | |
|---|---|---|---|---|
| $V_{CES}$ | $T_J$ = 25°C to 150°C | 500 | 600 | V |
| $V_{CGR}$ | $T_J$ = 25°C to 150°C; $R_{GE}$ = 1 MΩ | 500 | 600 | V |
| $V_{GES}$ | Continuous | | ±20 | V |
| $V_{GEM}$ | Transient | | ±30 | V |
| $I_{C25}$ | $T_C$ = 25°C | | 48 | A |
| $I_{C90}$ | $T_C$ = 90°C | | 24 | A |
| $I_{CM}$ | $T_C$ = 25°C, 1 ms | | 96 | A |
| **SSOA (RBSOA)** | $V_{GE}$= 15 V, $T_{VJ}$ = 125°C, $R_G$ = 22 Ω<br>Clamped inductive load, L = 100 µH | | $I_{CM}$ = 48<br>@ 0.8 $V_{CES}$ | A |
| $P_C$ | $T_C$ = 25°C | | 150 | W |
| $T_J$ | | | -55 ... +150 | °C |
| $T_{JM}$ | | | 150 | °C |
| $T_{stg}$ | | | -55 ... +150 | °C |
| Maximum Lead and Tab temperature for soldering 1.6 mm (0.062 in.) from case for 10 s | | | 300 | °C |
| $M_d$ | Mounting torque | | 1.13/10 | Nm/lb.in. |
| **Weight** | | | 6 | g |

| Symbol | Test Conditions | | Characteristic Values ($T_J$ = 25°C, unless otherwise specified) min. | typ. | max. | |
|---|---|---|---|---|---|---|
| $BV_{CES}$ | $I_C$ = 750 µA, $V_{GE}$ = 0 V | 24N50 | 500 | | | V |
| | | 24N60 | 600 | | | V |
| $V_{GE(th)}$ | $I_C$ = 250 µA, $V_{CE}$ = $V_{GE}$ | | 2.5 | | 5.5 | V |
| $I_{CES}$ | $V_{CE}$ = 0.8 • $V_{CES}$<br>$V_{GE}$ = 0 V | $T_J$ = 25°C | | | 500 | µA |
| | | $T_J$ = 125°C | | | 8 | mA |
| $I_{GES}$ | $V_{CE}$ = 0 V, $V_{GE}$ = ±20 V | | | | ±100 | nA |
| $V_{CE(sat)}$ | $I_C$ = $I_{C90}$, $V_{GE}$ = 15 V | 24N50 | | | 2.3 | V |
| $V_{CE(sat)}$ | $I_C$ = $I_{C90}$, $V_{GE}$ = 15 V | 24N60 | | | 2.5 | V |

**TO-247 SMD (24N**BU1S)**




**TO-247 AD**




G = Gate, C = Collector,
E = Emitter, TAB = Collector

### Features

- International standard packages JEDEC TO-247 SMD surface mountable and JEDEC TO-247 AD
- High frequency IGBT and antiparallel FRED in one package
- High current handling capability
- 3rd generation HDMOS™ process
- MOS Gate turn-on
  - drive simplicity

### Applications

- AC motor speed control
- DC servo and robot drives
- DC choppers
- Uninterruptible power supplies (UPS)
- Switched-mode and resonant-mode power supplies

### Advantages

- Space savings (two devices in one package)
- High power density
- Suitable for surface mounting
- Switching speed for high frequency applications
- Easy to mount with 1 screw (insulated mounting screw hole)





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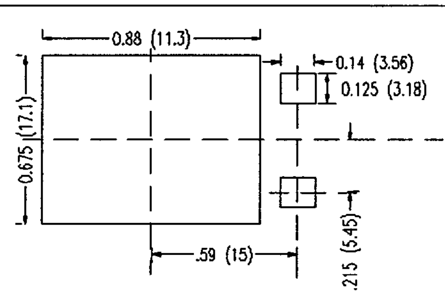
| Symbol | Test Conditions | Characteristic Values ($T_J$ = 25°C, unless otherwise specified) min. | typ. | max. | |
|---|---|---|---|---|---|
| $g_{fs}$ | $I_C = I_{C90}$; $V_{CE}$ = 10 V, Pulse test, t ≤ 300 µs, duty cycle ≤ 2 % | 9 | 13 | | S |
| $C_{ies}$ | $V_{CE}$ = 25 V, $V_{GE}$ = 0 V, f = 1 MHz | | 1500 | | pF |
| $C_{oes}$ | | | 175 | | pF |
| $C_{res}$ | | | 40 | | pF |
| $Q_g$ | $I_C = I_{C90}$, $V_{GE}$ = 15 V, $V_{CE}$ = 0.5 $V_{CES}$ | | 90 | 120 | nC |
| $Q_{ge}$ | | 11 | 15 | | nC |
| $Q_{gc}$ | | | 30 | 40 | nC |
| $t_{d(on)}$ | **Inductive load, $T_J$ = 25°C** | | 25 | | ns |
| $t_{ri}$ | $I_C = I_{C90}$, $V_{GE}$ = 15 V, L = 100 µH, | | 15 | | ns |
| $E_{on}$ | $V_{CE}$ = 0.8 $V_{CES}$, $R_G = R_{off}$ = 10 Ω | | 0.6 | | mJ |
| $t_{d(off)}$ | Remarks: Switching times may | | 150 | 200 | ns |
| $t_{fi}$ | increase for $V_{CE}$ (Clamp) > 0.8 • $V_{CES}$, | | 80 | 150 | ns |
| $E_{off}$ | higher $T_J$ or increased $R_G$ | 24N50BU1 | 0.62 | | mJ |
| | | 24N60BU1 | 0.8 | | mJ |
| $t_{d(on)}$ | **Inductive load, $T_J$ = 125°C** | | 25 | | ns |
| $t_{ri}$ | $I_C = I_{C90}$, $V_{GE}$ = 15 V, L = 100 µH | | 15 | | ns |
| $E_{on}$ | $V_{CE}$ = 0.8 $V_{CES}$, $R_G = R_{off}$ = 10 Ω | | 0.8 | | mJ |
| $t_{d(off)}$ | Remarks: Switching times may | | 250 | | ns |
| $t_{fi}$ | increase for $V_{CE}$ (Clamp) > 0.8 • $V_{CES}$, | | 100 | | ns |
| $E_{off}$ | higher $T_J$ or increased $R_G$ | 24N50BU1 | 0.9 | | mJ |
| | | 24N60BU1 | 1.4 | | mJ |
| $R_{thJC}$ | | | | 0.83 | K/W |
| $R_{thCK}$ | | | 0.25 | | K/W |

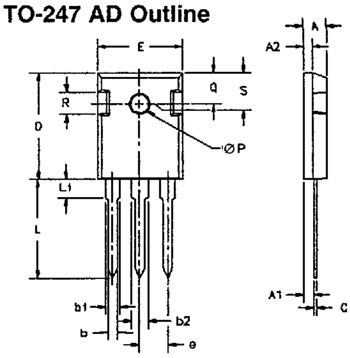
**Reverse Diode (FRED)**

| Symbol | Test Conditions | Characteristic Values ($T_J$ = 25°C, unless otherwise specified) min. | typ. | max. | |
|---|---|---|---|---|---|
| $V_F$ | $I_F = I_{C90}$, $V_{GE}$ = 0 V, Pulse test, t ≤ 300 µs, duty cycle d ≤ 2 % | | | 1.6 | V |
| $I_{RM}$ | $I_F = I_{C90}$, $V_{GE}$ = 0 V, $-di_F/dt$ = 240 A/µs | | 10 | 15 | A |
| $t_{rr}$ | $V_R$ = 360 V, $T_J$ = 125°C | | 150 | | ns |
| | $I_F$ = 1 A; -di/dt = 100 A/µs; $V_R$ = 30 V $T_J$ = 25°C | | 35 | 50 | ns |
| $R_{thJC}$ | | | | 1 | K/W |

**Min. Recommended Footprint** (Dimensions in inches and (mm))

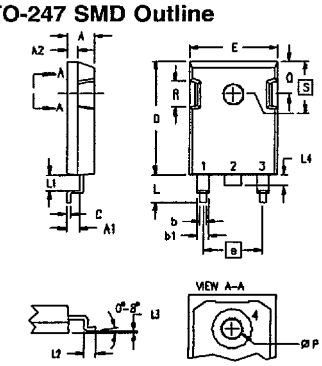



**TO-247 AD Outline**




| Dim. | Millimeter Min. | Max. | Inches Min. | Max. |
|---|---|---|---|---|
| A | 4.7 | 5.3 | .185 | .209 |
| $A_1$ | 2.2 | 2.54 | .087 | .102 |
| $A_2$ | 2.2 | 2.6 | .059 | .098 |
| b | 1.0 | 1.4 | .040 | .055 |
| $b_1$ | 1.65 | 2.13 | .065 | .084 |
| $b_2$ | 2.87 | 3.12 | .113 | .123 |
| C | .4 | .8 | .016 | .031 |
| D | 20.80 | 21.46 | .819 | .845 |
| E | 15.75 | 16.26 | .610 | .640 |
| e | 5.20 | 5.72 | 0.205 | 0.225 |
| L | 19.81 | 20.32 | .780 | .800 |
| L1 | | 4.50 | | .177 |
| ØP | 3.55 | 3.65 | .140 | .144 |
| Q | 5.89 | 6.40 | 0.232 | 0.252 |
| R | 4.32 | 5.49 | .170 | .216 |
| S | 6.15 | BSC | 242 | BSC |

**TO-247 SMD Outline**




1. Gate
2. Collector
3. Emitter
4. Collector

| Dim. | Millimeter Min. | Max. | Inches Min. | Max. |
|---|---|---|---|---|
| A | 4.83 | 5.21 | .190 | .205 |
| A1 | 2.29 | 2.54 | .090 | .100 |
| A2 | 1.91 | 2.16 | .075 | .085 |
| b | 1.14 | 1.40 | .045 | .055 |
| b1 | 1.91 | 2.13 | .075 | .084 |
| C | 0.61 | 0.80 | .024 | .031 |
| D | 20.80 | 21.34 | .819 | .840 |
| E | 15.75 | 16.13 | .620 | .635 |
| e | 5.45 | BSC | .215 | BSC |
| L | 4.90 | 5.10 | .193 | .201 |
| L1 | 2.70 | 2.90 | .106 | .114 |
| L2 | 2.10 | 2.30 | .083 | .091 |
| L3 | 0.00 | 0.10 | .00 | .004 |
| L4 | 1.90 | 2.10 | .075 | .083 |
| ØP | 3.55 | 3.65 | .140 | .144 |
| Q | 5.59 | 6.20 | .220 | .244 |
| R | 4.32 | 4.83 | .170 | .190 |
| S | 6.15 | BSC | .242 | BSC |

IXYS reserves the right to change limits, test conditions, and dimensions.

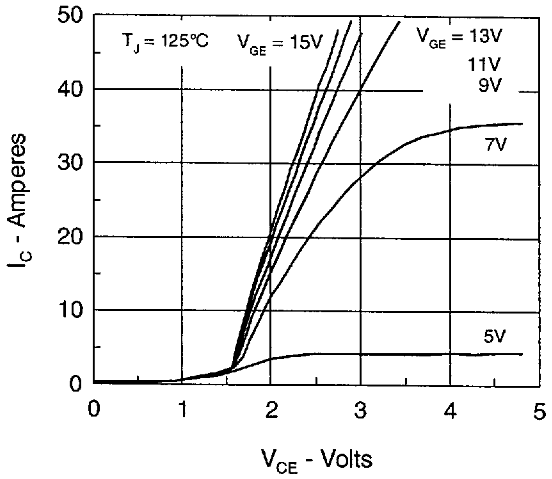



Fig. 1. Saturation Voltage Characteristics

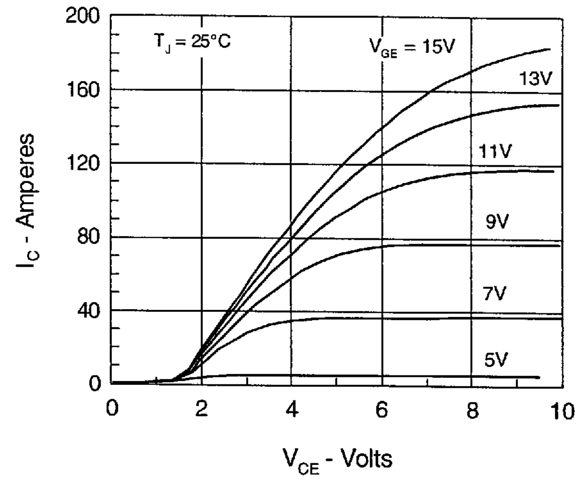



Fig. 2. Extended Output Characteristics

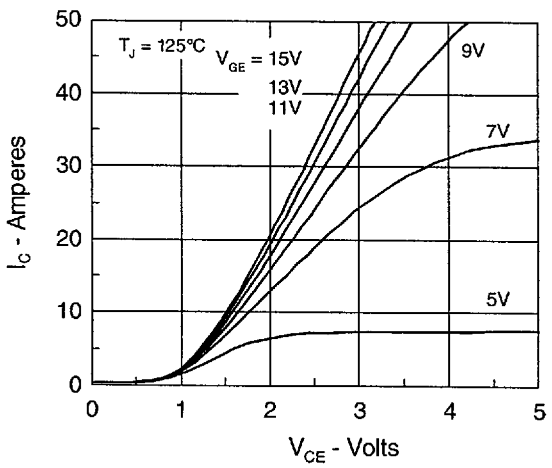



Fig. 3. Saturation Voltage Characteristics

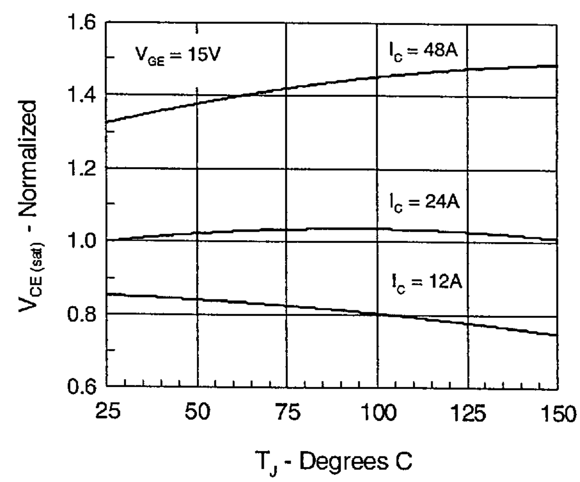



Fig. 4. Temperature Dependence of $V_{CE(sat)}$

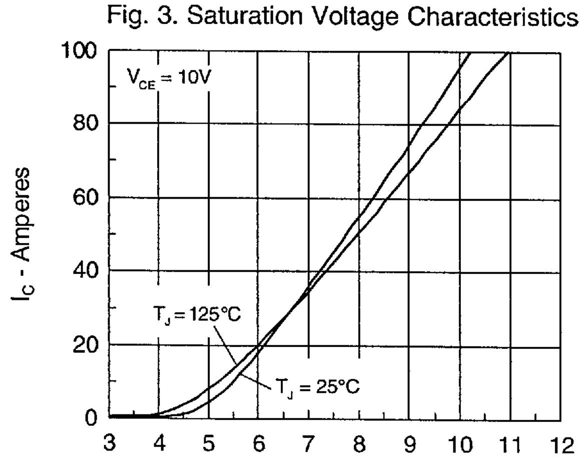



Fig. 5. Admittance Curves

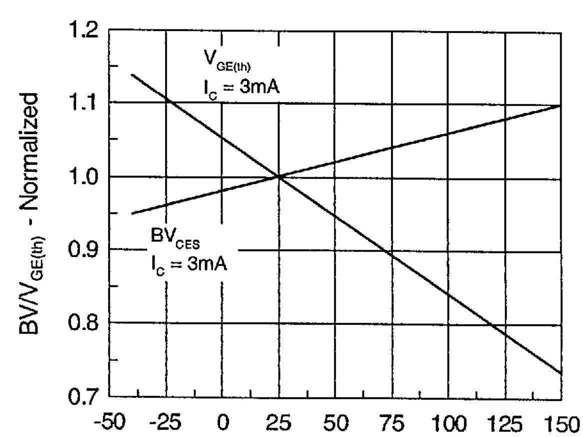



Fig. 6. Temperature Dependence of $BV_{DSS}$ & $V_{GE(th)}$

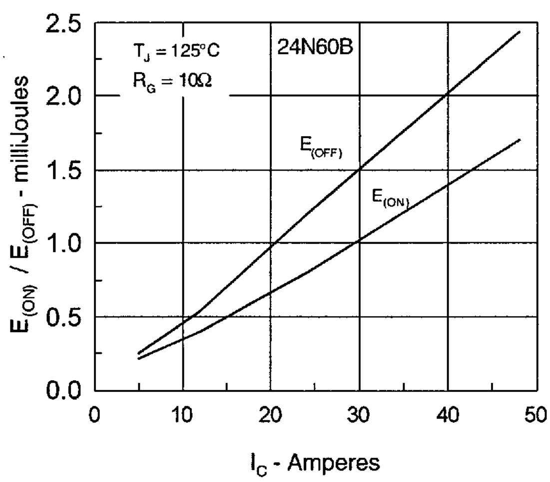



Fig. 7. Dependence of tfi and $E_{OFF}$ on $I_C$.

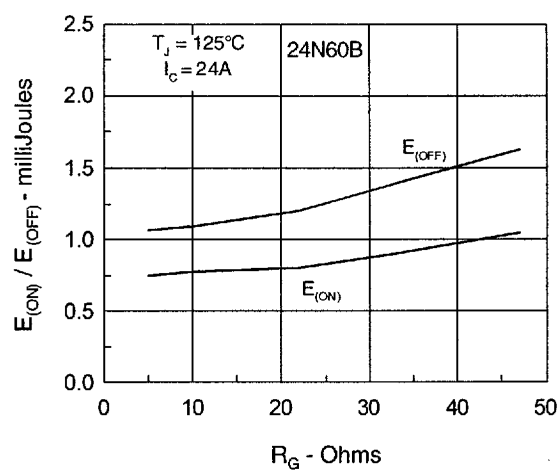



Fig. 8. Dependence of tfi and $E_{OFF}$ on $R_G$.

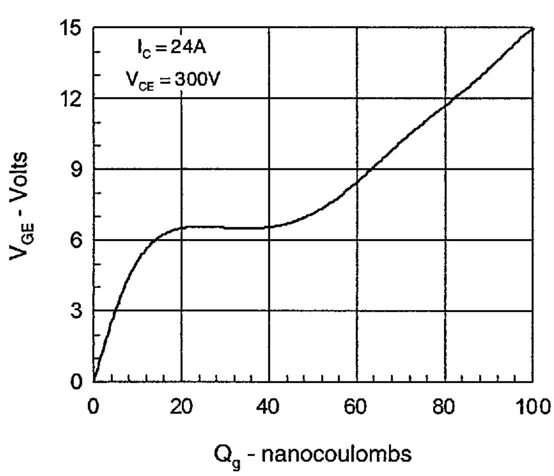



Fig. 9. Gate Charge

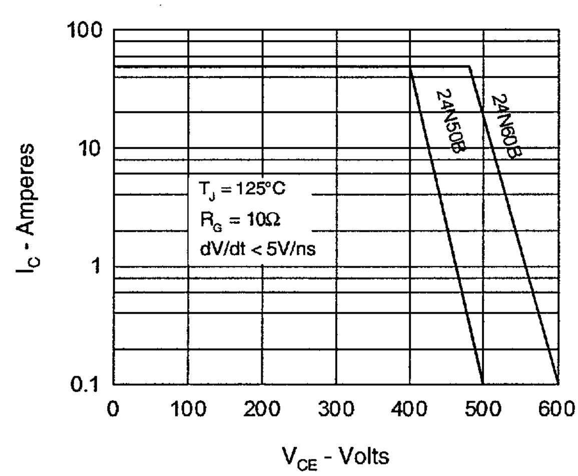



Fig. 10. Turn-off Safe Operating Area

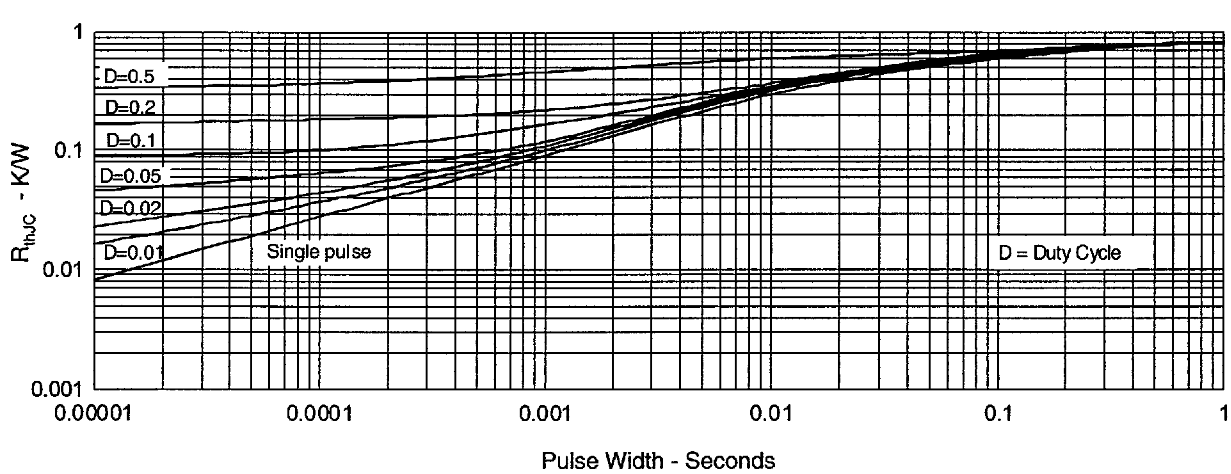



Fig. 11. Transient Thermal Resistance

Fig.12 Maximum Forward Voltage Drop

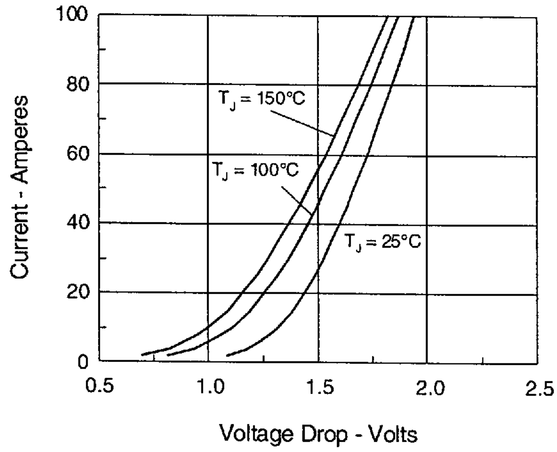



Fig.13 Peak Forward Voltage $V_{FR}$ and Forward Recovery Time $t_{FR}$

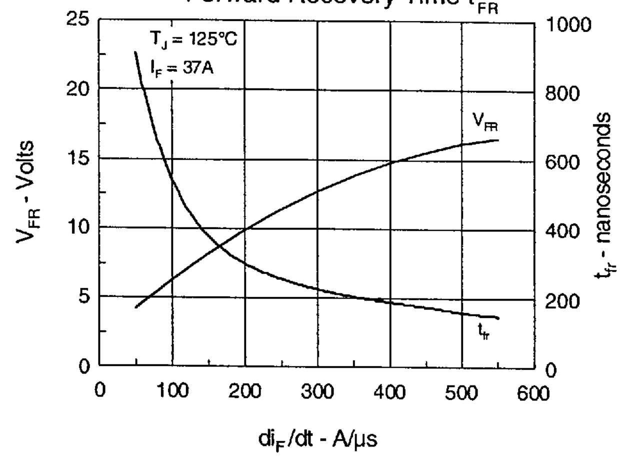



Fig.14 Junction Temperature Dependence off $I_{RM}$ and $Q_r$

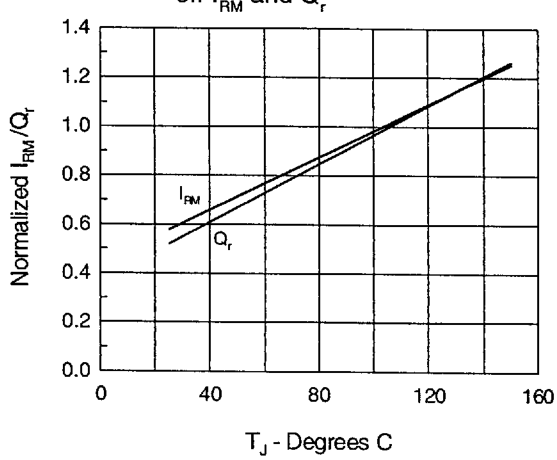



Fig.15 Reverse Recovery Chargee

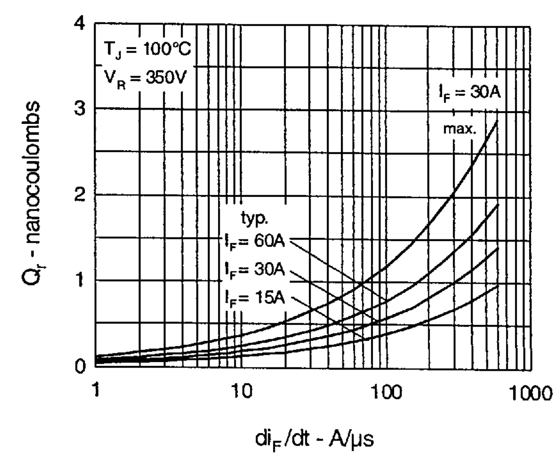



Fig.16 Peak Reverse Recovery Current

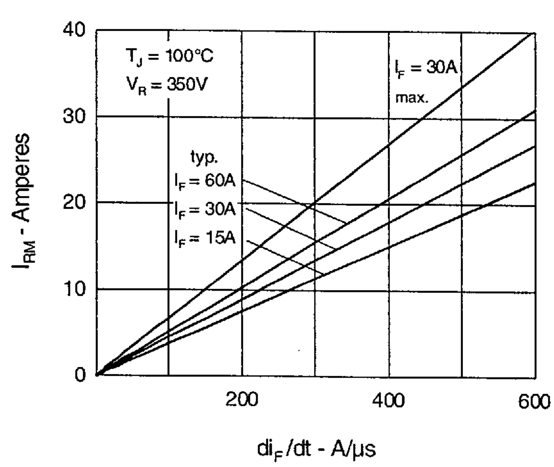



Fig.17 Reverse Recovery Time

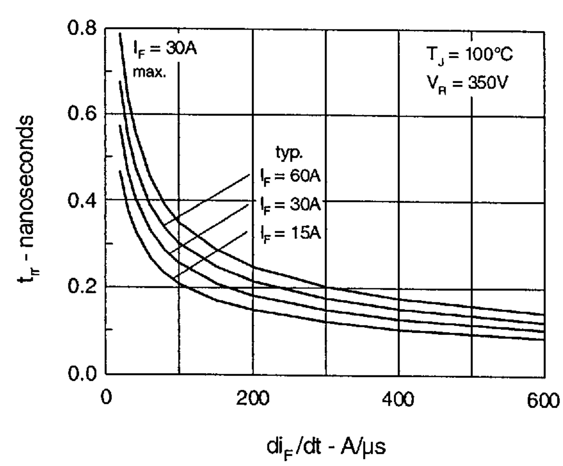


Fig.17 Diode Transient Thermal resistance junction to case