IXYS

Preliminary data

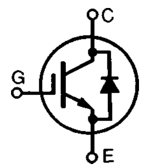
# IGBT with Diode

## Combi Pack

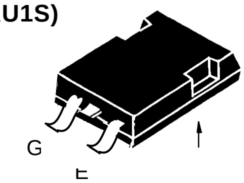
**IXSX50N60AU1**
**IXSX50N60AU1S**

$V_{CES}$ = 600 V
$I_{C25}$ = 75 A
$V_{CE(sat)}$ = 2.7 V

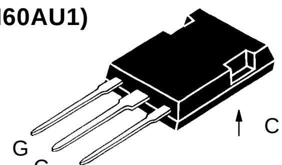
Short Circuit SOA Capability




**TO-247 Hole-less SMD (50N60AU1S)**




**TO-247 Hole-less (50N60AU1)**




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

| Symbol | Test Conditions | Maximum Ratings | |
|---|---|---|---|
| $V_{CES}$ | $T_J$ = 25°C to 150°C | 600 | V |
| $V_{CGR}$ | $T_J$ = 25°C to 150°C; $R_{GE}$ = 1 MΩ | 600 | V |
| $V_{GES}$ | Continuous | ±20 | V |
| $V_{GEM}$ | Transient | ±30 | V |
| $I_{C25}$ | $T_C$ = 25°C, limited by leads | 75 | A |
| $I_{C90}$ | $T_C$ = 90°C | 50 | A |
| $I_{CM}$ | $T_C$ = 25°C, 1 ms | 200 | A |
| **SSOA (RBSOA)** | $V_{GE}$ = 15 V, $T_{VJ}$ = 125°C, $R_G$ = 22 Ω<br>Clamped inductive load, L = 30 µH | $I_{CM}$ = 100<br>@ 0.8 $V_{CES}$ | A |
| $t_{SC}$ **(SCSOA)** | $V_{GE}$ = 15 V, $V_{CE}$ = 360 V, $T_J$ = 125°C<br>$R_G$ = 22 Ω, non repetitive | 10 | µs |
| $P_C$ | $T_C$ = 25°C | 300 | W |
| $T_J$ | | -55 ... +150 | °C |
| $T_{JM}$ | | 150 | °C |
| $T_{stg}$ | | -55 ... +150 | °C |
| **Weight** | | 6 | g |
| Maximum lead temperature for soldering<br>1.6 mm (0.062 in.) from case for 10 s | | 300 | °C |

### Features

- Hole-less TO-247 package for clip mounting
- High current rating
- Guaranteed Short Circuit SOA capability
- High frequency IGBT and anti-parallel FRED in one package
- Low $V_{CE(sat)}$
  - for minimum on-state conduction losses
- MOS Gate turn-on
  - drive simplicity
- Fast Recovery Epitaxial Diode (FRED)
  - soft recovery with low $I_{RM}$

| Symbol | Test Conditions | | Characteristic Values ($T_J$ = 25°C, unless otherwise specified) min. | typ. | max. | |
|---|---|---|---|---|---|---|
| $BV_{CES}$ | $I_C$ = 3 mA, $V_{GE}$ = 0 V | | 600 | | | V |
| $V_{GE(th)}$ | $I_C$ = 4 mA, $V_{CE}$ = $V_{GE}$ | | 4 | | 8 | V |
| $I_{CES}$ | $V_{CE}$ = 0.8 • $V_{CES}$<br>$V_{GE}$ = 0 V | $T_J$ = 25°C<br>$T_J$ = 125°C | | | 750<br>15 | µA<br>mA |
| $I_{GES}$ | $V_{CE}$ = 0 V, $V_{GE}$ = ±20 V | | | | ±100 | nA |
| $V_{CE(sat)}$ | $I_C$ = $I_{C90}$, $V_{GE}$ = 15 V | | | | 2.7 | V |

### Applications

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

### Advantages

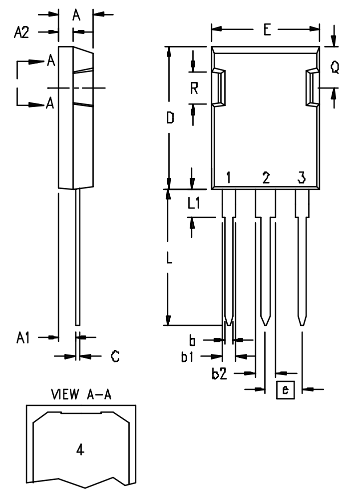
- Space savings (two devices in one package)
- High power density

| 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 % | 20 | 23 | | S |
| $Q_g$ | $I_C = I_{C90}$, $V_{GE}$ = 15 V, $V_{CE}$ = 0.5 $V_{CES}$ | | 190 | 250 | nC |
| $Q_{ge}$ | | | 45 | 60 | nC |
| $Q_{gc}$ | | | 88 | 120 | nC |
| $t_{d(on)}$ | **Inductive load, $T_J$ = 25°C** | | 70 | | ns |
| $t_{ri}$ | $I_C = I_{C90}$, $V_{GE}$ = 15 V, L = 100 µH, $V_{CE}$ = 0.8 $V_{CES}$, $R_G$ = 2.7 Ω | | 220 | | ns |
| $t_{d(off)}$ | Remarks: Switching times may increase for $V_{CE}$ (Clamp) > 0.8 • $V_{CES}$, higher $T_J$ or increased $R_G$ | | 200 | | ns |
| $t_{fi}$ | | | 400 | 600 | ns |
| $E_{off}$ | | | 6 | | mJ |
| $t_{d(on)}$ | **Inductive load, $T_J$ = 125°C** | | 70 | | ns |
| $t_{ri}$ | $I_C = I_{C90}$, $V_{GE}$ = 15 V, L = 100 µH | | 230 | | ns |
| $E_{on}$ | $V_{CE}$ = 0.8 $V_{CES}$, $R_G$ = 2.7 Ω | | 4.5 | | mJ |
| $t_{d(off)}$ | Remarks: Switching times may increase for $V_{CE}$ (Clamp) > 0.8 • $V_{CES}$, higher $T_J$ or increased $R_G$ | | 340 | | ns |
| $t_{fi}$ | | | 400 | | ns |
| $E_{off}$ | | | 7 | | mJ |
| $R_{thJC}$ | | | | 0.42 | K/W |
| $R_{thCK}$ | | | 0.15 | | 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 % | | | 1.8 | V |
| $I_{RM}$ | $I_F = I_{C90}$, $V_{GE}$ = 0 V, -$di_F$/dt = 480 A/µs | | 19 | 33 | A |
| $t_{rr}$ | $V_R$ = 360 V $T_J$ = 125°C | | 175 | | ns |
| | $I_F$ = 1 A; -di/dt = 200 A/µs; $V_R$ = 30 V $T_J$ = 25°C | | 35 | 50 | ns |
| $R_{thJC}$ | | | | 0.75 | K/W |

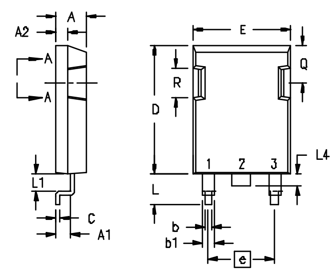
TO-247 HOLE-LESS

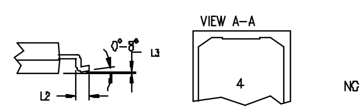



| SYM | INCHES MIN | INCHES MAX | MILLIMETERS MIN | MILLIMETERS MAX |
|---|---|---|---|---|
| A | .190 | .205 | 4.83 | 5.21 |
| A1 | .090 | .100 | 2.29 | 2.54 |
| A2 | .075 | .085 | 1.91 | 2.16 |
| b | .045 | .055 | 1.14 | 1.40 |
| b1 | .075 | .084 | 1.91 | 2.13 |
| b2 | .115 | .123 | 2.92 | 3.12 |
| C | .024 | .031 | 0.61 | 0.80 |
| D | .819 | .840 | 20.80 | 21.34 |
| E | .620 | .635 | 15.75 | 16.13 |
| e | .215 BSC | | 5.45 BSC | |
| L | .780 | .800 | 19.81 | 20.32 |
| L1 | .150 | .170 | 3.81 | 4.32 |
| Q | .220 | .244 | 5.59 | 6.20 |
| R | .170 | .190 | 4.32 | 4.83 |

1 – GATE
2 – DRAIN (COLLECTOR)
3 – SOURCE (EMITTER)
4 – DRAIN (COLLECTOR)

TO-247 HOLE-LESS SMD




1 – GATE
2 – DRAIN (COLLECTOR)
3 – SOURCE (EMITTER)
4 – DRAIN (COLLECTOR)

| SYM | INCHES MIN | INCHES MAX | MILLIMETERS MIN | MILLIMETERS MAX |
|---|---|---|---|---|
| A | .190 | .205 | 4.83 | 5.21 |
| A1 | .090 | .100 | 2.29 | 2.54 |
| A2 | .075 | .085 | 1.91 | 2.16 |
| b | .045 | .055 | 1.14 | 1.40 |
| b1 | .075 | .084 | 1.91 | 2.13 |
| C | .024 | .031 | 0.61 | 0.80 |
| D | .819 | .840 | 20.80 | 21.34 |
| E | .620 | .635 | 15.75 | 16.13 |
| e | .430BSC | | 10.90BSC | |
| L | .193 | .201 | 4.90 | 5.10 |
| L1 | .106 | .114 | 2.70 | 2.90 |
| L2 | .083 | .091 | 2.10 | 2.30 |
| L3 | .00 | .004 | 0.00 | 0.10 |
| L4 | .075 | .083 | 1.90 | 2.10 |
| Q | .220 | .244 | 5.59 | 6.20 |
| R | .170 | .190 | 4.32 | 4.83 |

NOTE:
1. This drawing meets all dimensions requirement of JEDEC outlines TO-247AD except L, L1, L2, L3, L4 and screw hole dia.
2. All metal surface are solder plated except trimmed area.

Fig.1 Saturation Characteristics

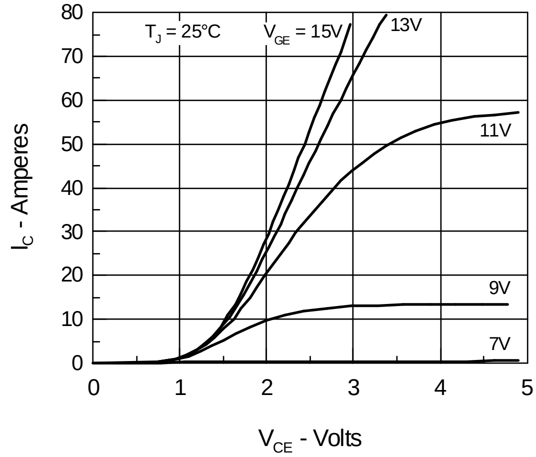



Fig.2 Output Characterstics

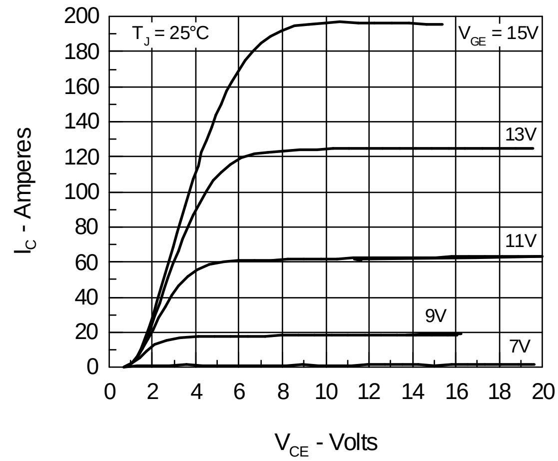



Fig. 3 Collector-Emitter Voltage vs. Gate-Emitter Voltage

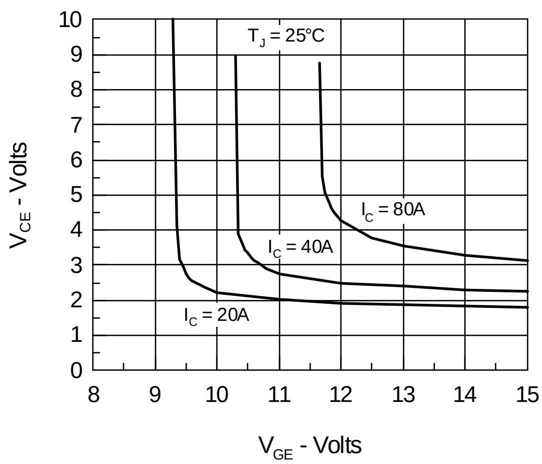



Fig. 4 Temperature Dependence of Output Saturation Voltage

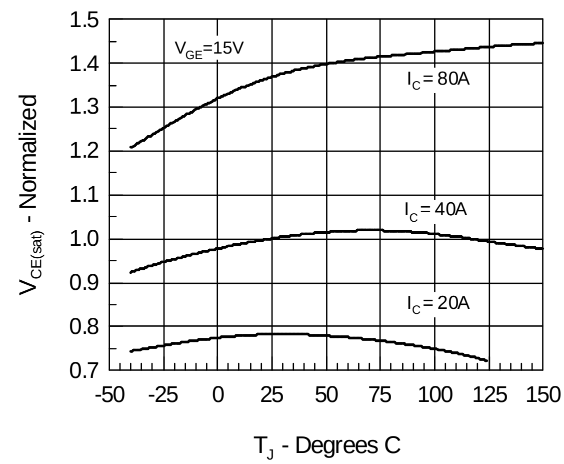



Fig.5 Input Admittance

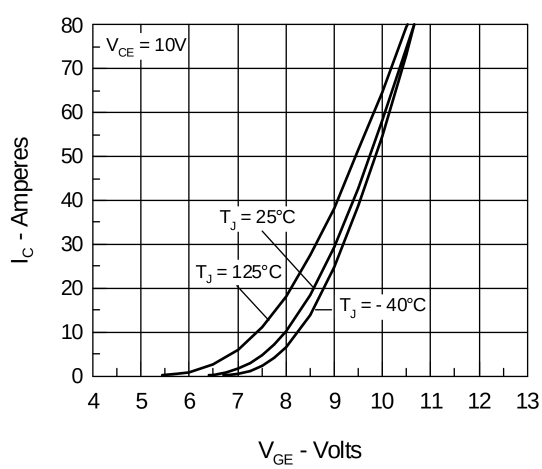



Fig.6 Temperature Dependence of Breakdown and Threshold Voltage

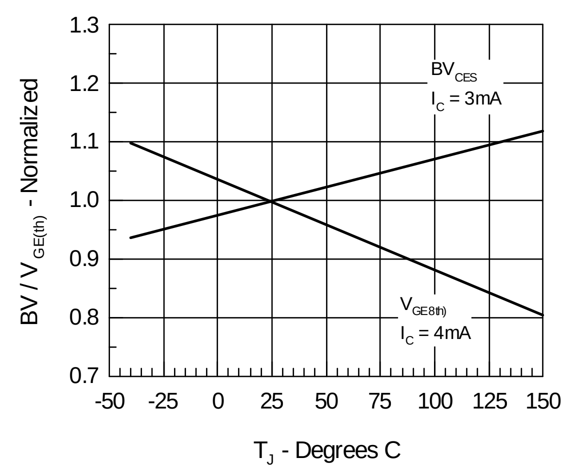


Fig.7 Turn-Off Energy per Pulse and Fall Time on Collector Current

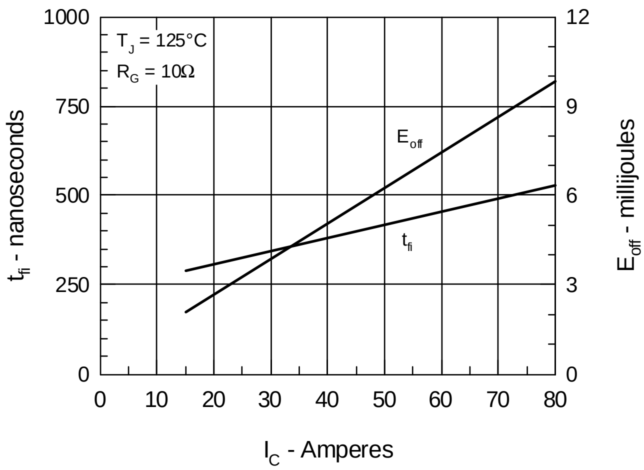



Fig.8 Dependence of Turn-Off Energy Per Pulse and Fall Time on $R_G$

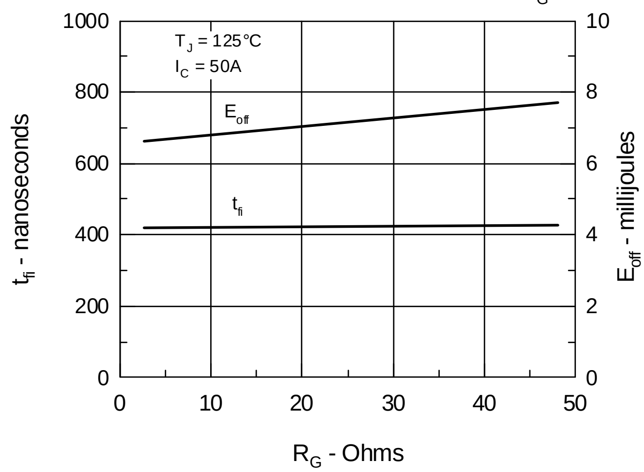



Fig.9 Gate Charge Characteristic Curve

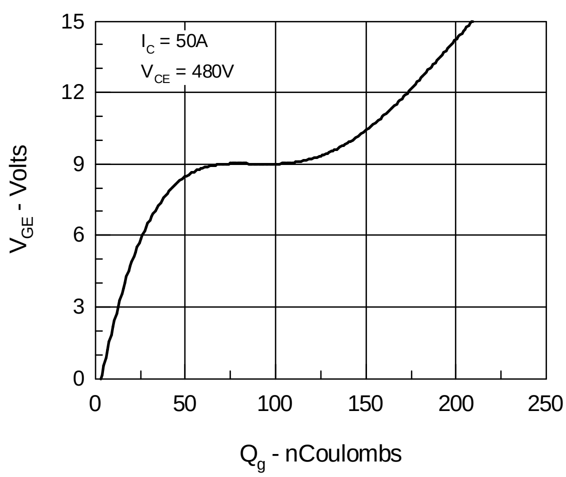



Fig.10 Turn-Off Safe Operating Area

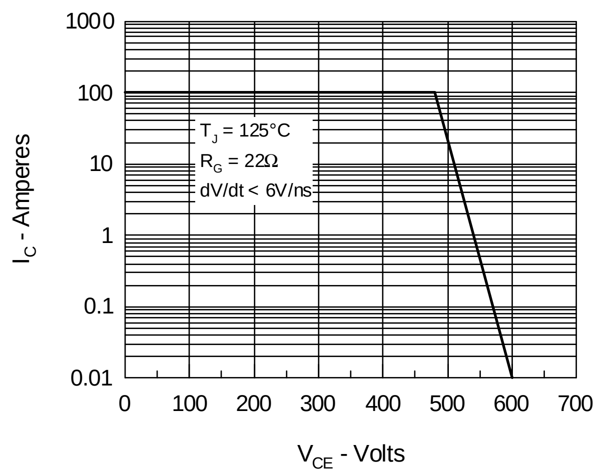



Fig.11 Transient Thermal Impedance

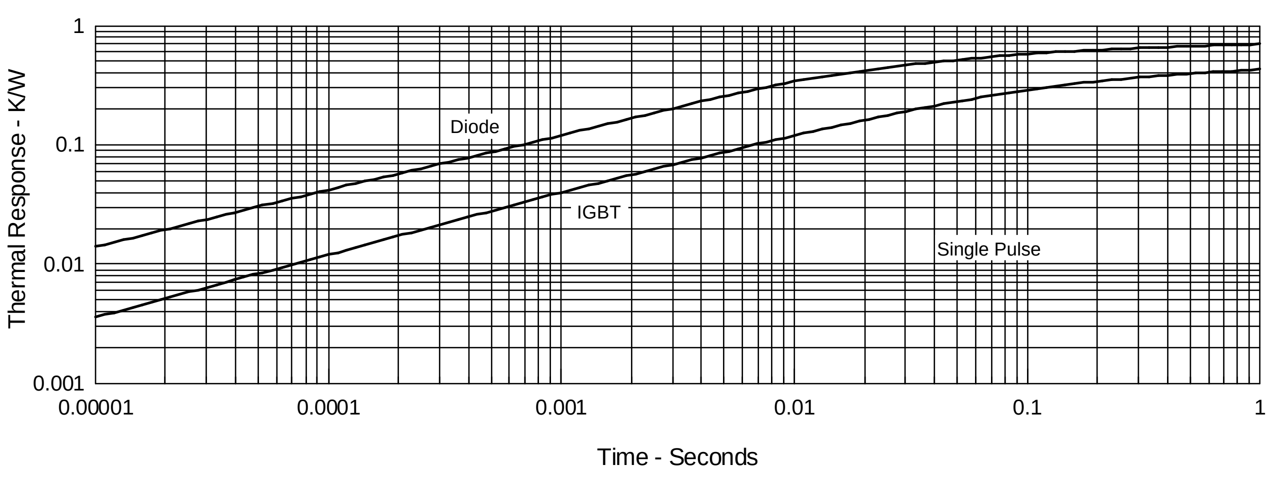


Fig.12 Typical Forward Voltage Drop

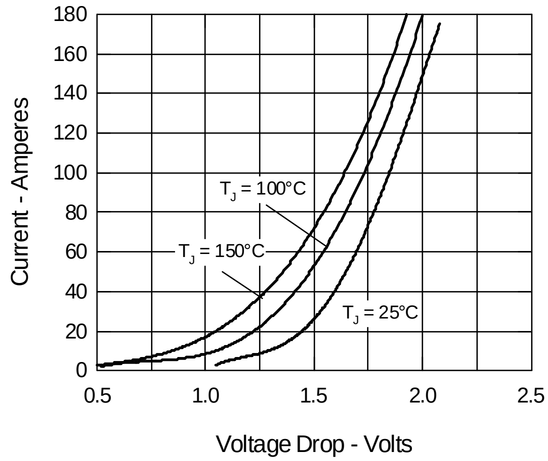



Fig.13 Peak Forward Voltage $V_{FR}$ and Forward Recovery Time $t_{fr}$

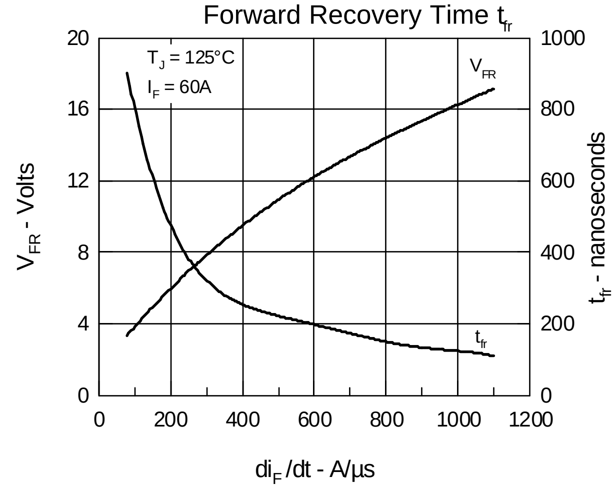



Fig.14 Junction Temperature Dependence off $I_{RM}$ and $Q_r$

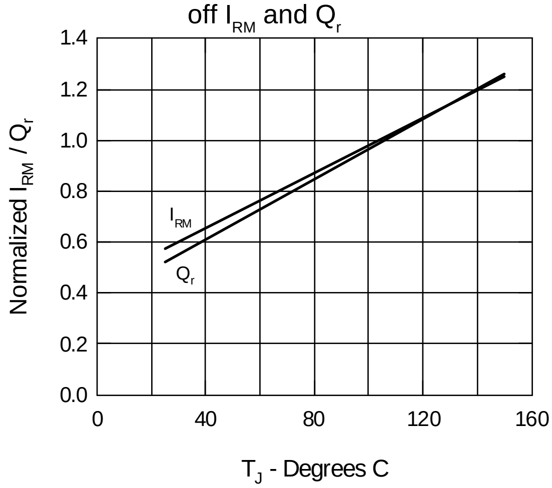



Fig.15 Reverse Recovery Chargee

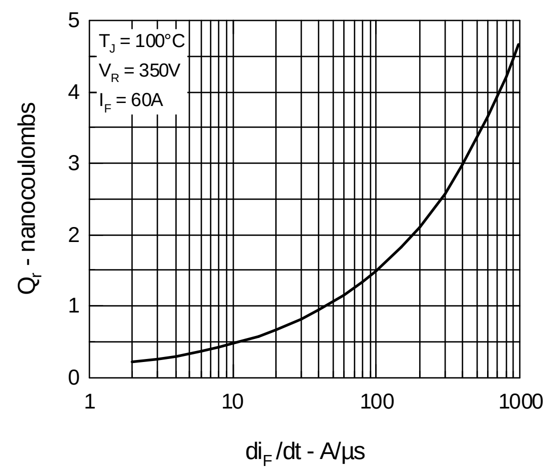



Fig.16 Peak Reverse Recovery Current

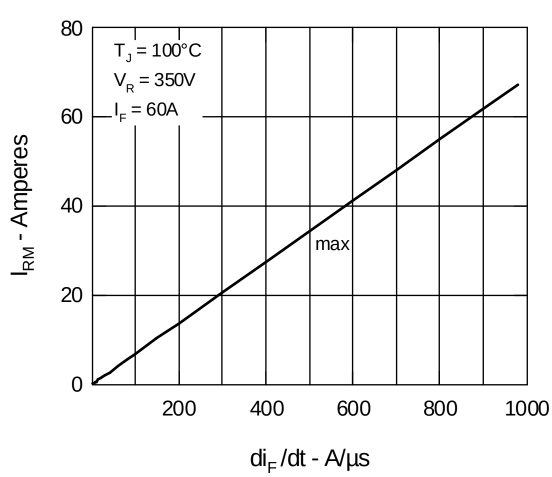



Fig.17 Reverse Recovery Time