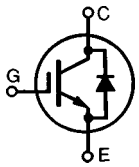
IXYS

***Not for new designs***

| | | $V_{CES}$ | $I_{C25}$ | $V_{CE(sat)}$ |
|---|---|---|---|---|
| **Low $V_{CE(sat)}$ IGBT with Diode** | **IXSH 20 N60U1** | **600 V** | **40 A** | **2.5 V** |
| **High Speed IGBT with Diode** | **IXSH 20 N60AU1** | **600 V** | **40 A** | **3.0 V** |

## Combi Packs

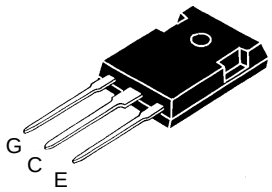
Short Circuit SOA Capability




| 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 | 40 | A |
| $I_{C90}$ | $T_C$ = 90°C | 20 | A |
| $I_{CM}$ | $T_C$ = 25°C, 1 ms | 80 | A |
| **SSOA (RBSOA)** | $V_{GE}$= 15 V, $T_J$ = 125°C, $R_G$ = 82 Ω<br>Clamped inductive load, L = 100 µH | $I_{CM}$ = 40<br>@ 0.8 $V_{CES}$ | A |
| $t_{SC}$ **(SCSOA)** | $V_{GE}$= 15 V, $V_{CE}$ = 360 V, $T_J$ = 125°C<br>$R_G$ = 82 Ω, non repetitive | 10 | µs |
| $P_C$ | $T_C$ = 25°C | 150 | W |
| $T_J$ | | -55 ... +150 | °C |
| $T_{JM}$ | | 150 | °C |
| $T_{stg}$ | | -55 ... +150 | °C |
| $M_d$ | Mounting torque | 1.13/10 | Nm/lb.in. |
| **Weight** | | 6 | g |
| Maximum lead temperature for soldering 1.6 mm (0.062 in.) from case for 10 s | | 300 | °C |

| Symbol | Test Conditions | | Characteristic Values ($T_J$ = 25°C, unless otherwise specified) min. | typ. | max. | |
|---|---|---|---|---|---|---|
| $BV_{CES}$ | $I_C$ = 1.75 mA, $V_{GE}$ = 0 V | | 600 | | | V |
| $V_{GE(th)}$ | $I_C$ = 1.5 mA, $V_{CE}$ = $V_{GE}$ | | 3.5 | | 6.5 | V |
| $I_{CES}$ | $V_{CE}$ = 0.8 • $V_{CES}$ | $T_J$ = 25°C | | | 500 | µA |
| | $V_{GE}$ = 0 V | $T_J$ = 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 | 20N60U1 | | | 2.5 | V |
| | | 20N60AU1 | | | 3.0 | V |

**TO-247 AD**




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

### Features

- International standard package JEDEC TO-247 AD
- High frequency IGBT with guaranteed Short Circuit SOA capability
- IGBT and anti-parallel FRED in one package
- 2nd generation HDMOS™ process
- Low $V_{CE(sat)}$
  - for low on-state conduction losses
- MOS Gate turn-on
  - drive simplicity

### 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)
- Easy to mount with 1 screw (isolated mounting screw hole)
- Reduces assembly time and cost
- High power density

91770D (4/96)

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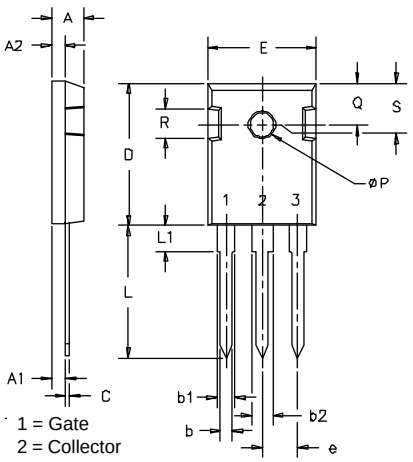
| Symbol | Test Conditions | | Characteristic Values ($T_J$ = 25°C, unless otherwise specified) min. | typ. | max. | |
|---|---|---|---|---|---|---|
| $g_{fs}$ | $I_C = I_{C90}$; $V_{CE}$ = 10 V, Pulse test, t ≤ 300 µs, duty cycle ≤ 2 % | | 6 | 7 | | S |
| $I_{C(on)}$ | $V_{GE}$ = 15 V, $V_{CE}$ = 10 V | | | 65 | | A |
| $C_{ies}$ | $V_{CE}$ = 25 V, $V_{GE}$ = 0 V, f = 1 MHz | | | 1800 | | pF |
| $C_{oes}$ | | | | 250 | | pF |
| $C_{res}$ | | | | 45 | | pF |
| $Q_g$ | $I_C = I_{C90}$, $V_{GE}$ = 15 V, $V_{CE}$ = 0.5 $V_{CES}$ | | | 90 | 120 | nC |
| $Q_{ge}$ | | | | 40 | 55 | nC |
| $Q_{gc}$ | | | | 65 | 80 | nC |
| $t_{d(on)}$ | **Inductive load, $T_J$ = 25°C** | | | 100 | | ns |
| $t_{ri}$ | $I_C = I_{C90}$, $V_{GE}$ = 15 V, | | | 200 | | ns |
| $t_{d(off)}$ | L = 100 µH, $V_{CE}$ = 0.8 $V_{CES}$, $R_G$ = 39 Ω | | | 450 | | ns |
| $t_{fi}$ | Remarks: Switching times may increase for $V_{CE}$ (Clamp) > 0.8 • $V_{CES}$, higher $T_J$ or increased $R_G$ | 20N60U1 | | | | ns |
| | | 20N60AU1 | | 350 | | ns |
| $E_{off}$ | | | | 2.5 | | mJ |
| $t_{d(on)}$ | **Inductive load, $T_J$ = 125°C** | | | 100 | | ns |
| $t_{ri}$ | $I_C = I_{C90}$, $V_{GE}$ = 15 V, | | | 200 | | ns |
| $E_{on}$ | L = 100 µH | | | 1 | | mJ |
| $t_{d(off)}$ | $V_{CE}$ = 0.8 $V_{CES}$, $R_G$ = 39 Ω | | | | 1000 | ns |
| $t_{fi}$ | Remarks: Switching times may increase for $V_{CE}$ (Clamp) > 0.8 • $V_{CES}$, higher $T_J$ or increased $R_G$ | 20N60U1 | | | 1000 | ns |
| | | 20N60AU1 | | | 600 | ns |
| $E_{off}$ | | 20N60U1 | | 9 | | mJ |
| | | 20N60AU1 | | 3 | 5 | mJ |
| $R_{thJC}$ | | | | | 0.83 | K/W |
| $R_{thCK}$ | | | | 0.25 | | K/W |

**TO-247 AD Outline**




1 = Gate
2 = Collector
3 = Emitter
Tab = Collector

| SYM | INCHES MIN | INCHES MAX | MILLIMETERS MIN | MILLIMETERS MAX |
|---|---|---|---|---|
| A | .185 | .209 | 4.7 | 5.3 |
| $A_1$ | .087 | .102 | 2.2 | 2.54 |
| $A_2$ | .059 | .098 | 2.2 | 2.6 |
| b | .040 | .055 | 1.0 | 1.4 |
| $b_1$ | .065 | .084 | 1.65 | 2.13 |
| $b_2$ | .113 | .123 | 2.87 | 3.12 |
| C | .016 | .031 | .4 | .8 |
| D | .819 | .845 | 20.80 | 21.46 |
| E | .610 | .640 | 15.75 | 16.26 |
| e | .215 BSC | | 5.45 BSC | |
| L | .780 | .800 | 19.81 | 20.32 |
| L1 | | .177 | | 4.50 |
| øP | .140 | .144 | 3.55 | 3.65 |
| Q | .212 | .244 | 5.4 | 6.2 |
| R | .170 | .216 | 4.32 | 5.49 |
| S | .242 BSC | | 6.15 BSC | |

**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 | | 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 |

IXYS MOSFETs and IGBTs are covered by one of the following U.S.patents: 4,835,592 4,881,108 5,017,508 5,049,961 5,187,117 5,486,715 4,850,072 4,931,844 5,034,796 5,063,307 5,237,481 5,381,025

Fig. 1 Saturation Characteristics

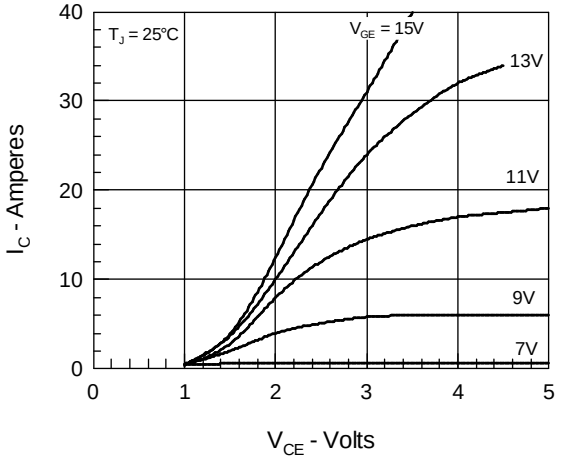



Fig. 2 Output Characterstics

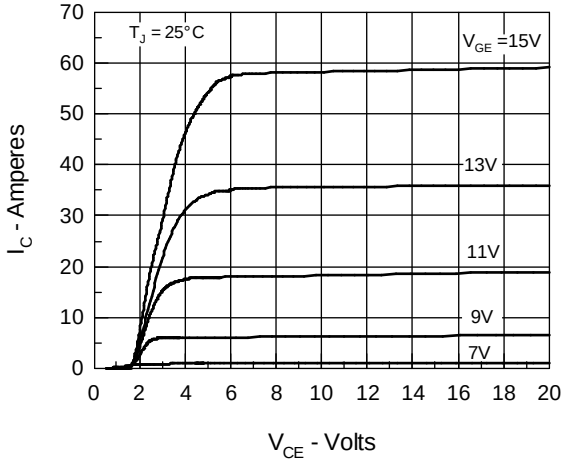



Fig. 3 Collector-Emitter Voltage vs. Gate-Emitter Voltage

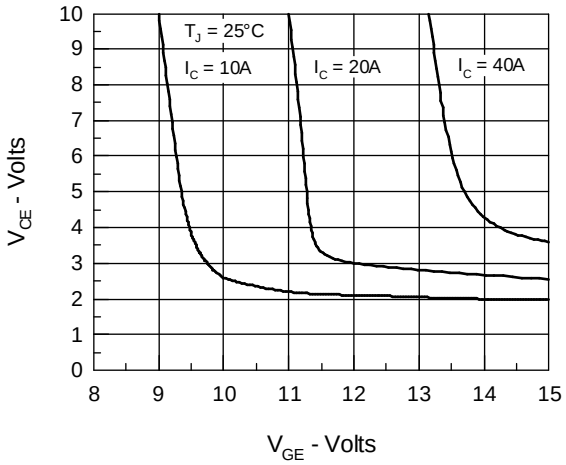



Fig. 4 Temperature Dependence of Output Saturation Voltage

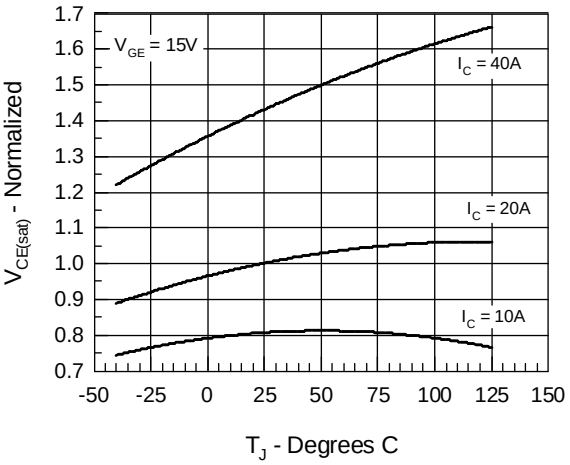



Fig. 5 Input Admittance

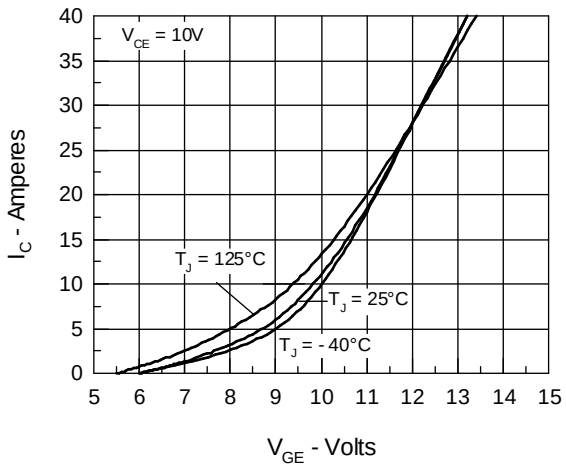



Fig. 6 Temperature Dependence of Breakdown and Threshold Volt.

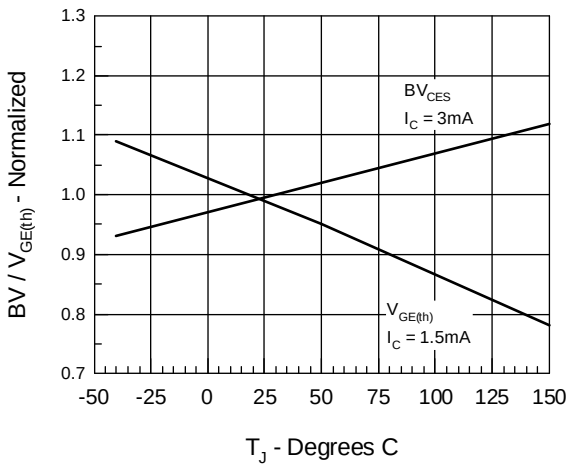



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Fig.7 Turn-Off Energy per Pulse and Fall Time on Collector Current

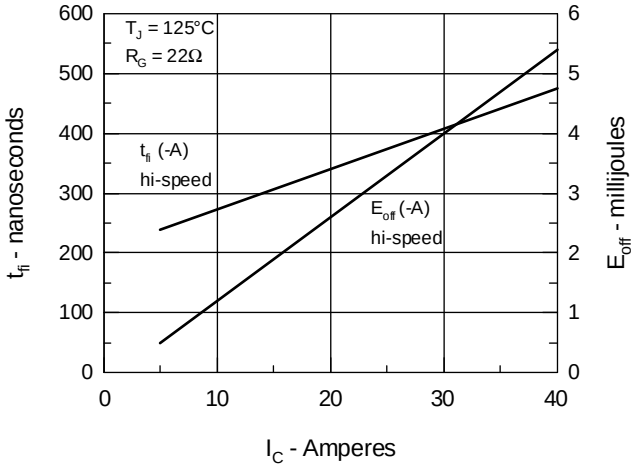


Fig.8 Dependence of Turn-Off Energy Per Pulse and Fall Time on $R_G$

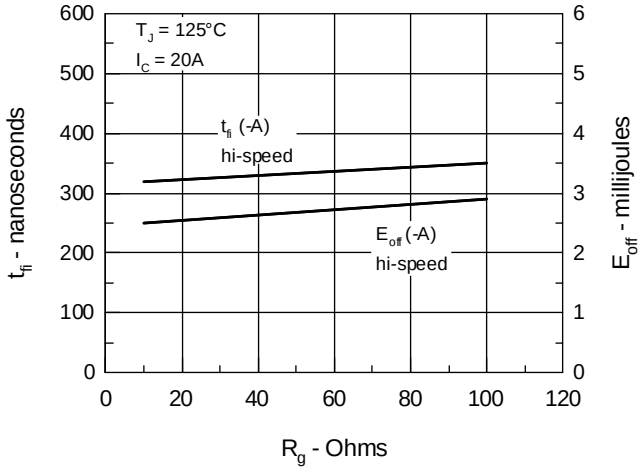


Fig.9 Gate Charge Characteristic Curve

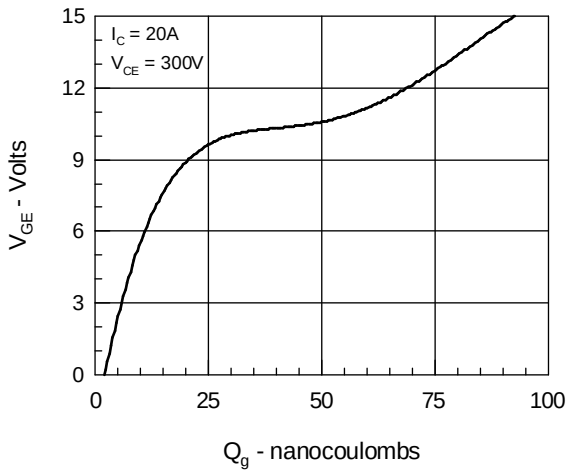


Fig.10 Turn-Off Safe Operating Area

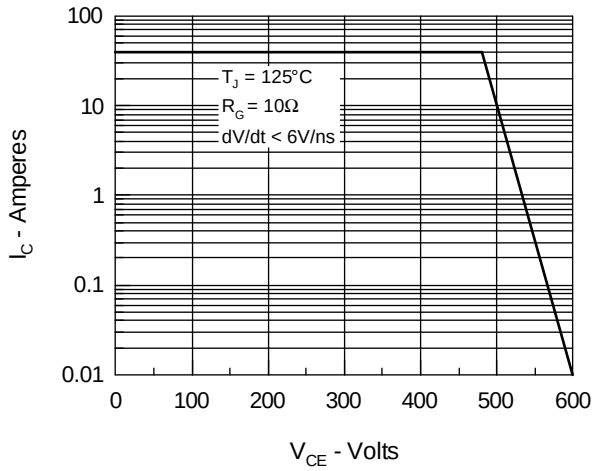


Fig.11 Transient Thermal Impedance

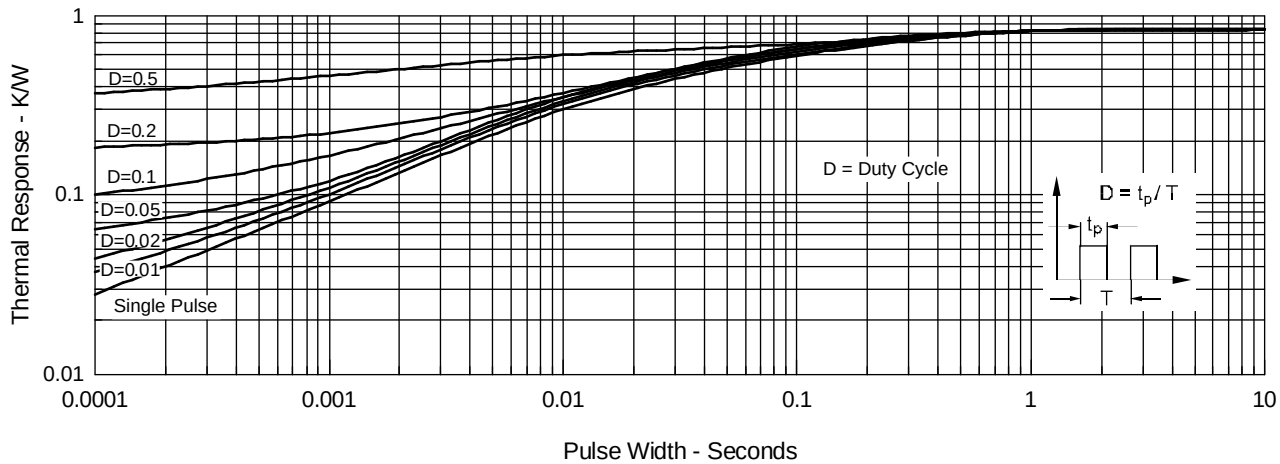

Fig.12 Maximum Forward Voltage Drop Recovery Time $t_{fr}$

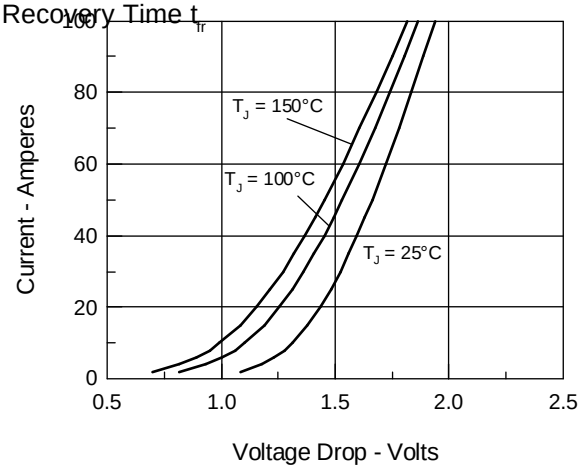


Fig.13 Peak Forward Voltage $V_{FR}$ and Forward

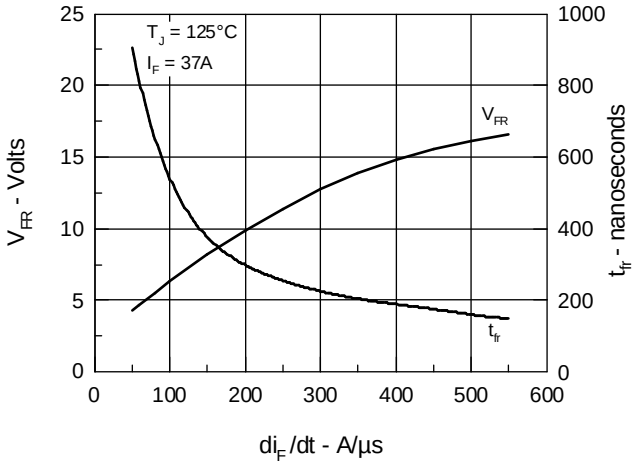


Fig.14 Junction Temperature Dependence off $I_{RM}$ and $Q_r$

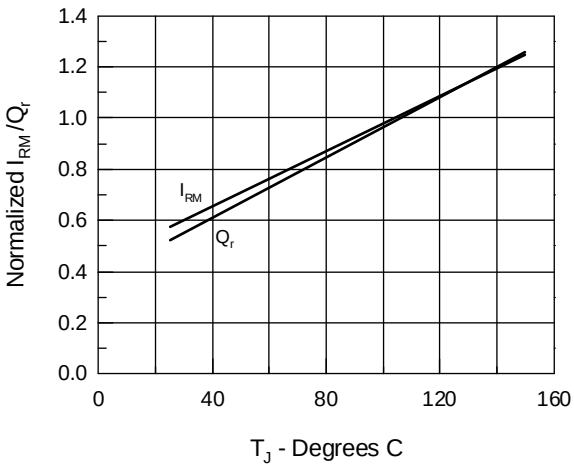


Fig.15 Reverse Recovery Chargee

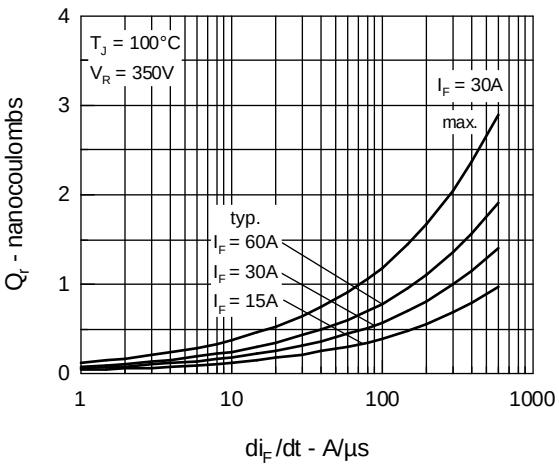


Fig.16 Peak Reverse Recovery Current

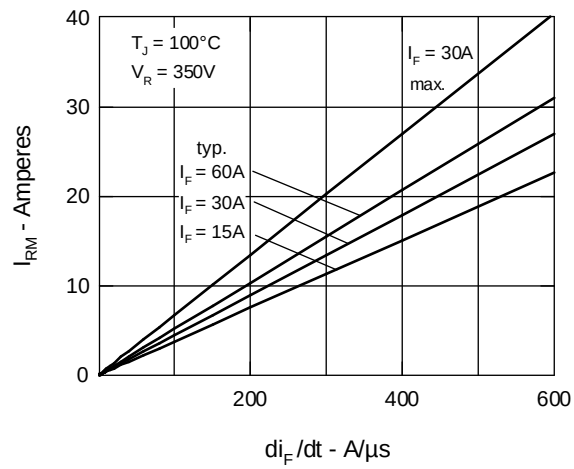


Fig.17 Reverse Recovery Time

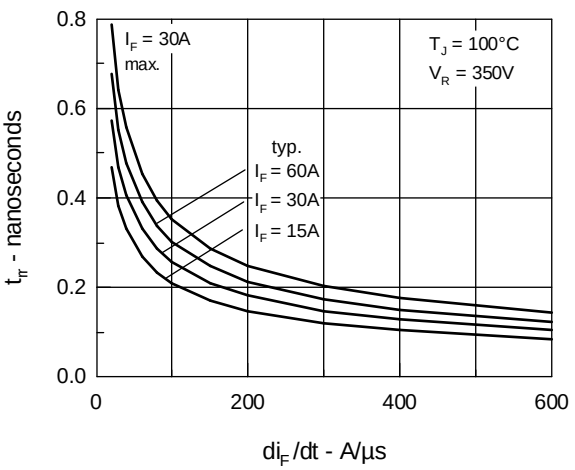


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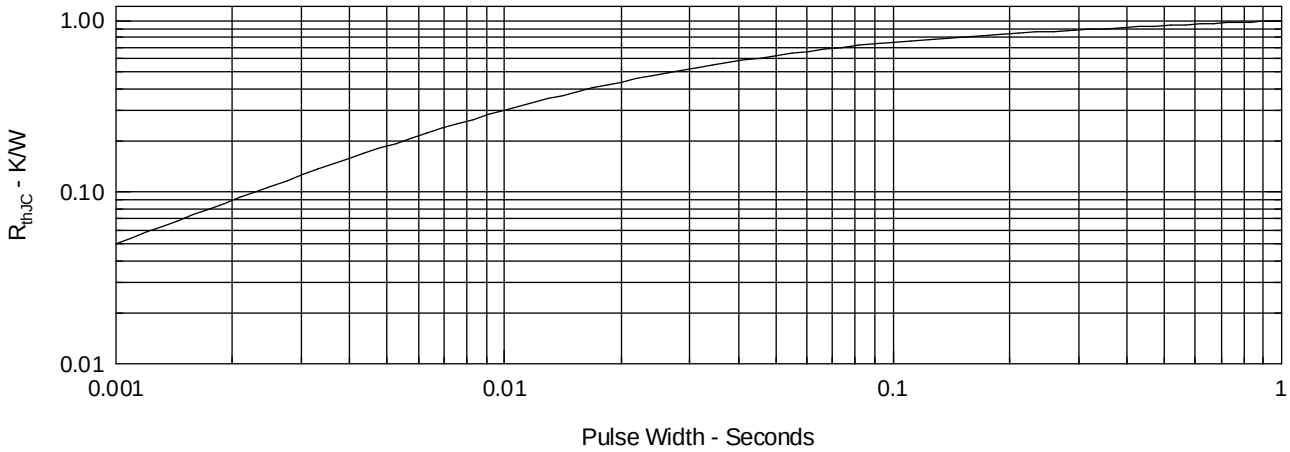
Fig.18 Diode Transient Thermal resistance junction to case



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