

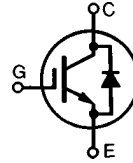
## IGBT with Diode

**IXSX50N60AU1**  
**IXSX50N60AU1S**

$$\begin{aligned} V_{CES} &= 600 \text{ V} \\ I_{C25} &= 75 \text{ A} \\ V_{CE(sat)} &= 2.7 \text{ V} \end{aligned}$$

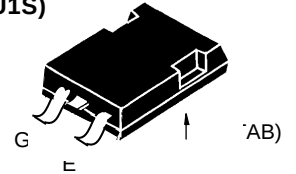
## Combi Pack

## Short Circuit SOA Capability

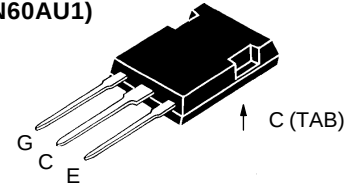


| Symbol                                                                          | Test Conditions                                                                                                            | Maximum Ratings                   |                  |
|---------------------------------------------------------------------------------|-----------------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

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



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



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

## 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  $I_{RM}$

## 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

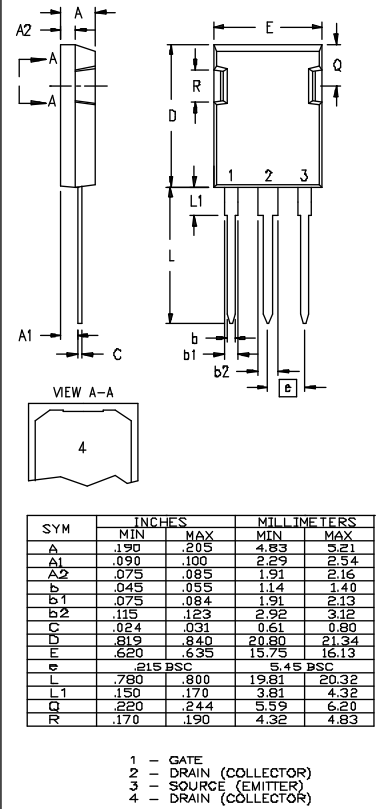
| Symbol        | Test Conditions                                        | Characteristic Values<br>( $T_J = 25^\circ\text{C}$ , unless otherwise specified) |      |                            |
|---------------|--------------------------------------------------------|-----------------------------------------------------------------------------------|------|----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

| Symbol       | Test Conditions                                                                                                                                                                                                                                                                                                                       | Characteristic Values<br>( $T_J = 25^\circ\text{C}$ , unless otherwise specified) |      |          |
|--------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|------|----------|
|              |                                                                                                                                                                                                                                                                                                                                       | min.                                                                              | typ. | max.     |
| $g_{fs}$     | $I_C = I_{C90}$ ; $V_{CE} = 10\text{ V}$ ,<br>Pulse test, $t \leq 300\text{ }\mu\text{s}$ , duty cycle $\leq 2\%$                                                                                                                                                                                                                     | 20                                                                                | 23   | S        |
| $Q_g$        | $I_C = I_{C90}$ ; $V_{GE} = 15\text{ V}$ , $V_{CE} = 0.5\text{ V}_{CES}$                                                                                                                                                                                                                                                              |                                                                                   | 190  | 250 nC   |
| $Q_{ge}$     |                                                                                                                                                                                                                                                                                                                                       |                                                                                   | 45   | 60 nC    |
| $Q_{gc}$     |                                                                                                                                                                                                                                                                                                                                       |                                                                                   | 88   | 120 nC   |
| $t_{d(on)}$  | <b>Inductive load, <math>T_J = 25^\circ\text{C}</math></b><br>$I_C = I_{C90}$ , $V_{GE} = 15\text{ V}$ , $L = 100\text{ }\mu\text{H}$ ,<br>$V_{CE} = 0.8\text{ V}_{CES}$ , $R_G = 2.7\text{ }\Omega$<br>Remarks: Switching times may increase<br>for $V_{CE}(\text{Clamp}) > 0.8 \cdot V_{CES}$ , higher $T_J$ or<br>increased $R_G$  |                                                                                   | 70   | ns       |
| $t_{ri}$     |                                                                                                                                                                                                                                                                                                                                       |                                                                                   | 220  | ns       |
| $t_{d(off)}$ |                                                                                                                                                                                                                                                                                                                                       |                                                                                   | 200  | ns       |
| $t_{fi}$     |                                                                                                                                                                                                                                                                                                                                       |                                                                                   | 400  | 600 ns   |
| $E_{off}$    |                                                                                                                                                                                                                                                                                                                                       |                                                                                   | 6    | mJ       |
| $t_{d(on)}$  | <b>Inductive load, <math>T_J = 125^\circ\text{C}</math></b><br>$I_C = I_{C90}$ , $V_{GE} = 15\text{ V}$ , $L = 100\text{ }\mu\text{H}$ ,<br>$V_{CE} = 0.8\text{ V}_{CES}$ , $R_G = 2.7\text{ }\Omega$<br>Remarks: Switching times may increase<br>for $V_{CE}(\text{Clamp}) > 0.8 \cdot V_{CES}$ , higher $T_J$ or<br>increased $R_G$ |                                                                                   | 70   | ns       |
| $t_{ri}$     |                                                                                                                                                                                                                                                                                                                                       |                                                                                   | 230  | ns       |
| $E_{on}$     |                                                                                                                                                                                                                                                                                                                                       |                                                                                   | 4.5  | mJ       |
| $t_{d(off)}$ |                                                                                                                                                                                                                                                                                                                                       |                                                                                   | 340  | ns       |
| $t_{fi}$     |                                                                                                                                                                                                                                                                                                                                       |                                                                                   | 400  | ns       |
| $E_{off}$    |                                                                                                                                                                                                                                                                                                                                       |                                                                                   | 7    | mJ       |
| $R_{thJC}$   |                                                                                                                                                                                                                                                                                                                                       |                                                                                   |      | 0.42 K/W |
| $R_{thCK}$   |                                                                                                                                                                                                                                                                                                                                       |                                                                                   | 0.15 | K/W      |

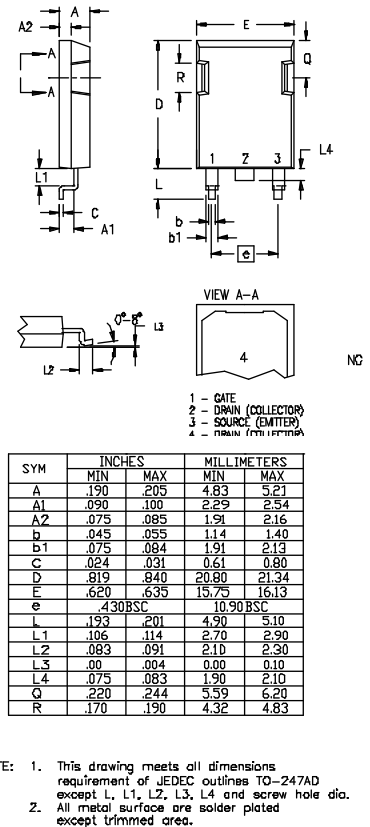
## Reverse Diode (FRED)

| Symbol     | Test Conditions                                                                                                                                                                                                                              | Characteristic Values<br>( $T_J = 25^\circ\text{C}$ , unless otherwise specified) |      |          |
|------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|------|----------|
|            |                                                                                                                                                                                                                                              | min.                                                                              | typ. | max.     |
| $V_F$      | $I_F = I_{C90}$ ; $V_{GE} = 0\text{ V}$ ,<br>Pulse test, $t \leq 300\text{ }\mu\text{s}$ , duty cycle $d \leq 2\%$                                                                                                                           |                                                                                   |      | 1.8 V    |
| $I_{RM}$   | $I_F = I_{C90}$ ; $V_{GE} = 0\text{ V}$ , $-di_F/dt = 480\text{ A}/\mu\text{s}$<br>$V_R = 360\text{ V}$ $T_J = 125^\circ\text{C}$<br>$I_F = 1\text{ A}$ ; $-di/dt = 200\text{ A}/\mu\text{s}$ ; $V_R = 30\text{ V}$ $T_J = 25^\circ\text{C}$ |                                                                                   | 19   | 33 A     |
| $t_{rr}$   |                                                                                                                                                                                                                                              |                                                                                   | 175  | ns       |
|            |                                                                                                                                                                                                                                              |                                                                                   | 35   | 50 ns    |
| $R_{thJC}$ |                                                                                                                                                                                                                                              |                                                                                   |      | 0.75 K/W |

## TO-247 HOLE-LESS



## TO-247 HOLE-LESS SMD



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

IXYS MOSFETS and IGBTs are covered by one or more of the following U.S. patents: 4,835,592 4,881,106 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

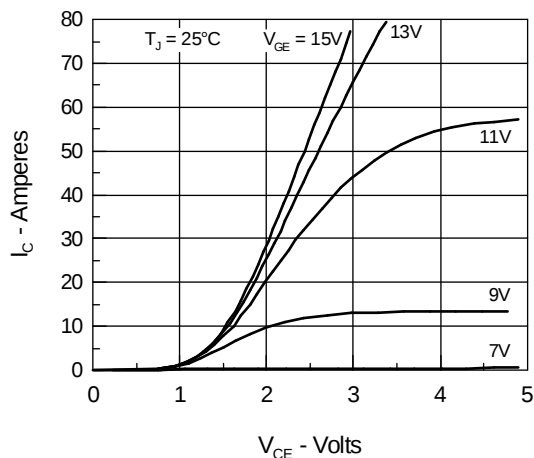


Fig.2 Output Characteristics

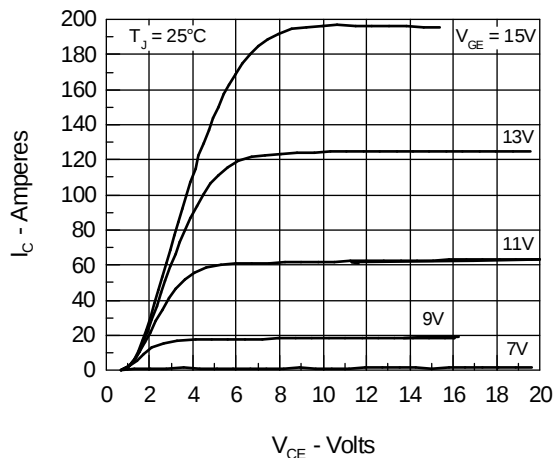


Fig. 3 Collector-Emitter Voltage vs. Gate-Emitter Voltage

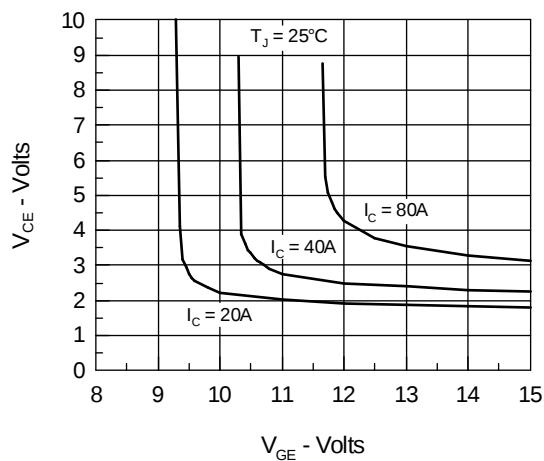


Fig. 4 Temperature Dependence of Output Saturation Voltage

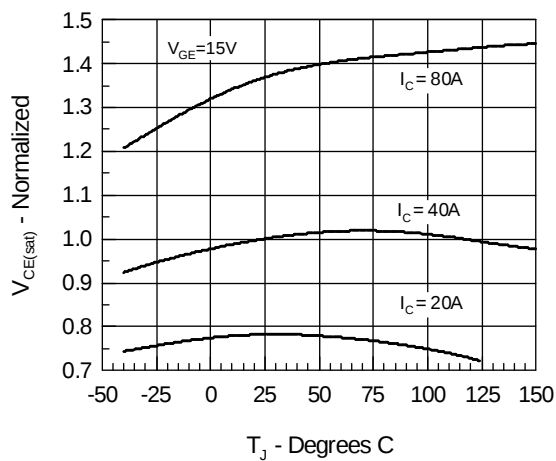


Fig.5 Input Admittance

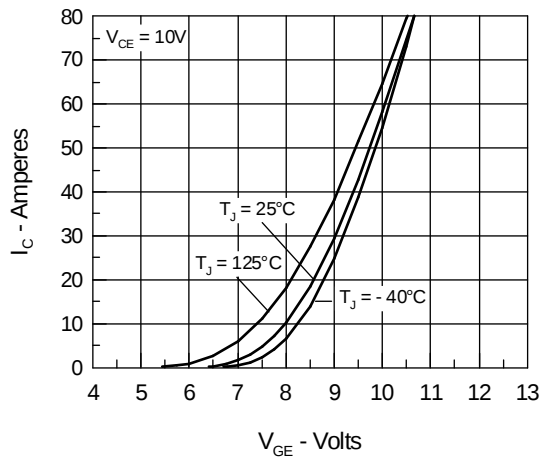


Fig.6 Temperature Dependence of Breakdown and Threshold Voltage

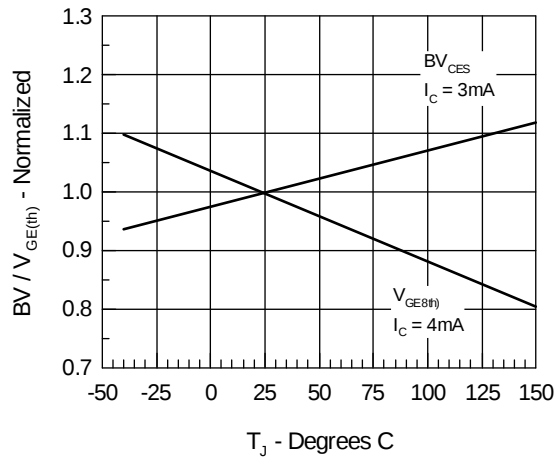


Fig.7 Turn-Off Energy per Pulse and Fall Time on Collector Current

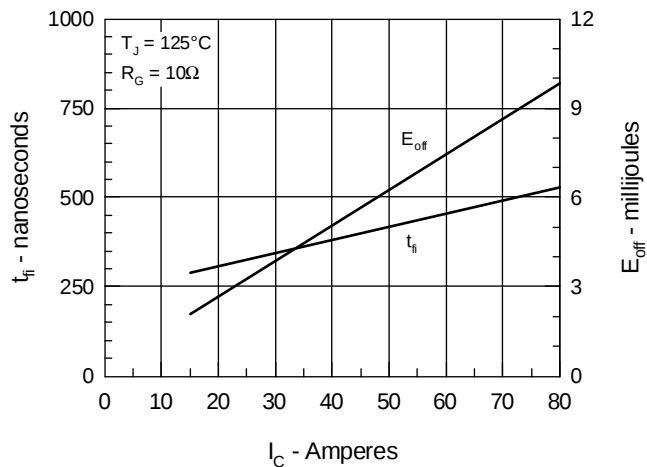


Fig.8 Dependence of Turn-Off Energy Per Pulse and Fall Time on  $R_G$

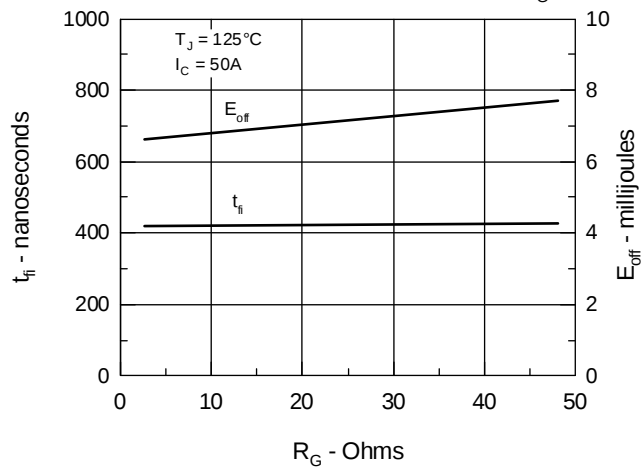


Fig.9 Gate Charge Characteristic Curve

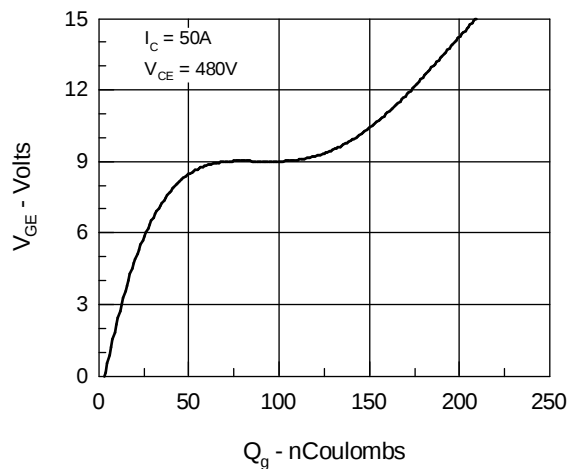


Fig.10 Turn-Off Safe Operating Area

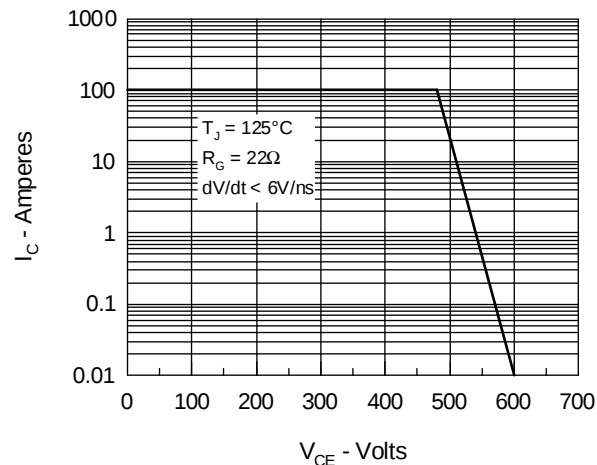


Fig.11 Transient Thermal Impedance

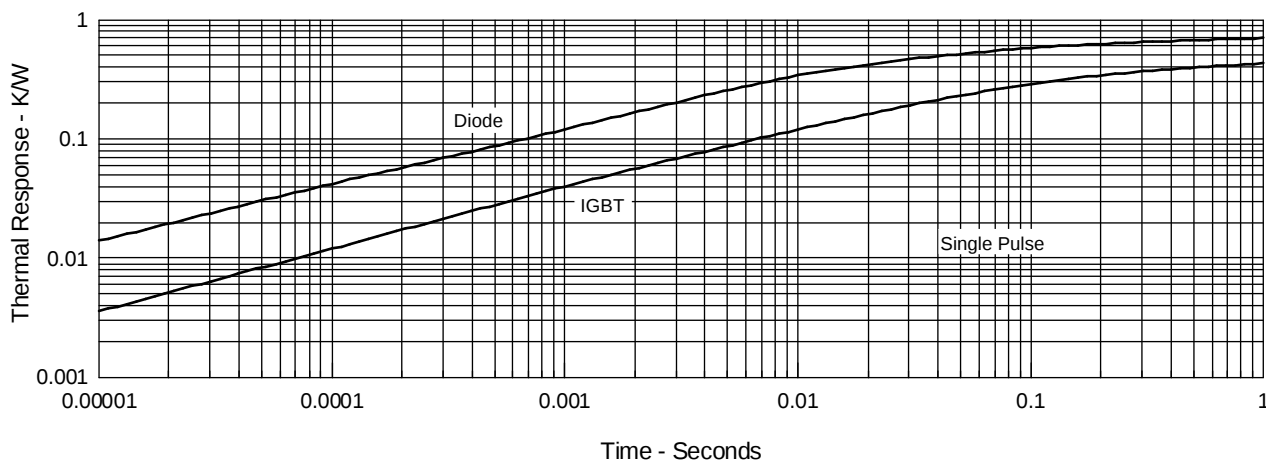


Fig.12 Typical Forward Voltage Drop

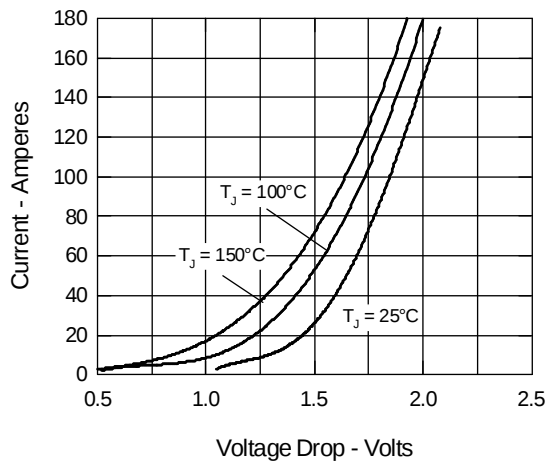
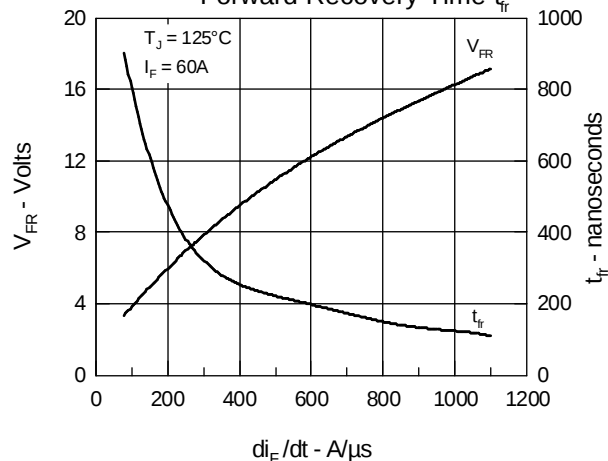
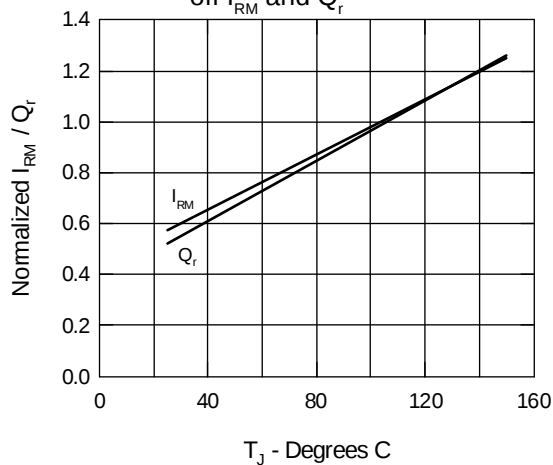
Fig.13 Peak Forward Voltage  $V_{FR}$  and Forward Recovery Time  $t_{fr}$ Fig.14 Junction Temperature Dependence of  $I_{RM}$  and  $Q_r$ 

Fig.15 Reverse Recovery Charge

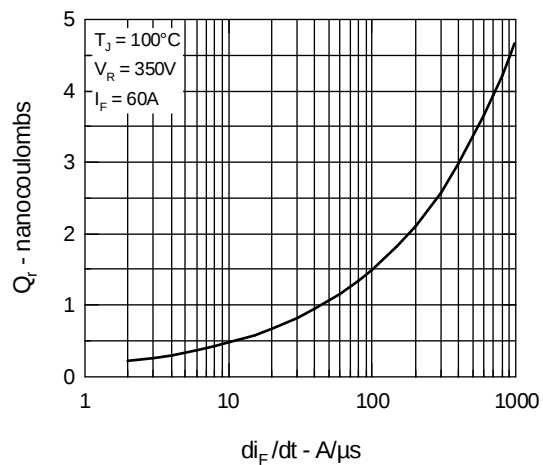


Fig.16 Peak Reverse Recovery Current

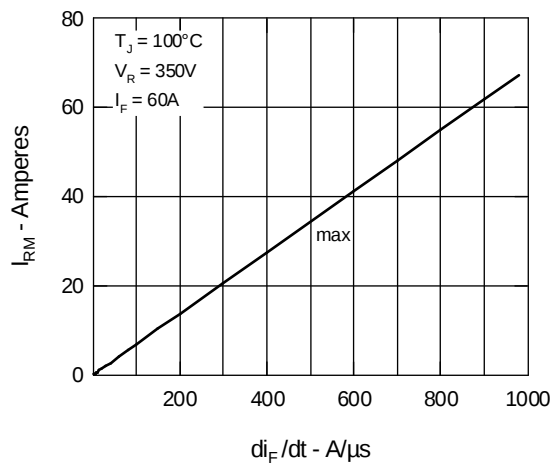


Fig.17 Reverse Recovery Time

