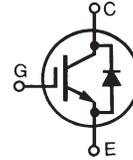


HiPerFAST™ IGBT with Diode

Optimized for 10-25 kHz
hard switching and up to
100 kHz resonant switching

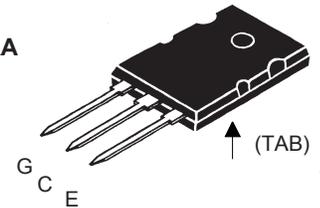
IXGK 60N60B2D1
IXGX 60N60B2D1

$V_{CES} = 600 \text{ V}$
 $I_{C25} = 75 \text{ A}$
 $V_{CE(sat)} < 1.8 \text{ V}$
 $t_{fi(typ)} = 100 \text{ ns}$

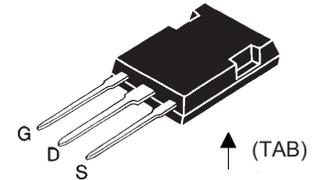


| Symbol | Test Conditions | Maximum Ratings | |
|---|--|-------------------|------------------|
| V_{CES} | $T_J = 25^\circ\text{C to } 150^\circ\text{C}$ | 600 | V |
| V_{CGR} | $T_J = 25^\circ\text{C to } 150^\circ\text{C}; R_{GE} = 1 \text{ M}\Omega$ | 600 | V |
| V_{GES} | Continuous | ± 20 | V |
| V_{GEM} | Transient | ± 30 | V |
| I_{C25} | $T_C = 25^\circ\text{C}$ (limited by leads) | 75 | A |
| I_{C110} | $T_C = 110^\circ\text{C}$ | 60 | A |
| I_{CM} | $T_C = 25^\circ\text{C}, 1 \text{ ms}$ | 300 | A |
| SSOA (RBSOA) | $V_{GE} = 15 \text{ V}, T_{VJ} = 125^\circ\text{C}, R_G = 10 \Omega$ Clamped inductive load @ $V_{CE} \leq 600 \text{ V}$ | $I_{CM} = 150$ | A |
| P_C | $T_C = 25^\circ\text{C}$ | 500 | W |
| T_J | | -55 ... +150 | $^\circ\text{C}$ |
| T_{JM} | | 150 | $^\circ\text{C}$ |
| T_{stg} | | -55 ... +150 | $^\circ\text{C}$ |
| M_d | Mounting torque, TO-264 | 1.13/10 Nm/lb.in. | |
| Weight | TO-264 | 10 | g |
| | PLUS247 | 6 | g |
| Maximum lead temperature for soldering 1.6 mm (0.062 in.) from case for 10 s | | 300 | $^\circ\text{C}$ |

TO-264 AA
(IXGK)



PLUS247
(IXGX)



G = Gate C = Collector
E = Emitter Tab = Collector

Features

- Square RBSOA
- High current handling capability
- MOS Gate turn-on for drive simplicity
- Fast Recovery Epitaxial Diode (FRED) with soft recovery and low I_{RM}

Applications

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

Advantages

- Space savings (two devices in one package)
- Easy to mount with 1 screw

| Symbol | Test Conditions | Characteristic Values ($T_J = 25^\circ\text{C}$, unless otherwise specified) | | |
|---------------|---|---|------|---------------------------|
| | | Min. | Typ. | Max. |
| $V_{GE(th)}$ | $I_C = 250 \mu\text{A}, V_{CE} = V_{GE}$ | 3.0 | | 5.0 V |
| I_{CES} | $V_{CE} = V_{CES}$ $V_{GE} = 0 \text{ V}$ $T_J = 125^\circ\text{C}$ | | | 300 μA 5 mA |
| I_{GES} | $V_{CE} = 0 \text{ V}, V_{GE} = \pm 20 \text{ V}$ | | | $\pm 100 \text{ nA}$ |
| $V_{CE(sat)}$ | $I_C = 50 \text{ A}, V_{GE} = 15 \text{ V}$ Note 1 | | | 1.8 V |

| Symbol | Test Conditions | Characteristic Values ($T_J = 25^\circ\text{C}$, unless otherwise specified) | | | |
|--------------|--|---|------|------|----|
| | | Min. | Typ. | Max. | |
| g_{fs} | $I_C = 50\text{ A}$; $V_{CE} = 10\text{ V}$, Note 1 | 40 | 58 | S | |
| C_{ies} | $V_{CE} = 25\text{ V}$, $V_{GE} = 0\text{ V}$, $f = 1\text{ MHz}$ | | 3900 | pF | |
| C_{oes} | | | 340 | pF | |
| C_{res} | | | 100 | pF | |
| Q_g | $I_C = 50\text{ A}$, $V_{GE} = 15\text{ V}$, $V_{CE} = 0.5 V_{CES}$ | | 170 | nC | |
| Q_{ge} | | | 25 | nC | |
| Q_{gc} | | | 57 | nC | |
| $t_{d(on)}$ | Inductive load, $T_J = 25^\circ\text{C}$ $I_C = 50\text{ A}$, $V_{GE} = 15\text{ V}$ $V_{CE} = 400\text{ V}$, $R_G = R_{off} = 3.3\ \Omega$ | | 28 | ns | |
| t_{ri} | | | 30 | ns | |
| $t_{d(off)}$ | | | 160 | 270 | ns |
| t_{fi} | | | 100 | 170 | ns |
| E_{off} | | | 1.0 | 2.5 | mJ |
| $t_{d(on)}$ | Inductive load, $T_J = 125^\circ\text{C}$ $I_C = 50\text{ A}$, $V_{GE} = 15\text{ V}$ $V_{CE} = 400\text{ V}$, $R_G = R_{off} = 2.0\ \Omega$ | | 28 | ns | |
| t_{ri} | | | 36 | ns | |
| E_{on} | | | 1.5 | mJ | |
| $t_{d(off)}$ | | | 310 | ns | |
| t_{fi} | | | 240 | ns | |
| E_{off} | | 2.8 | mJ | | |
| R_{thJC} | | | 0.25 | K/W | |
| R_{thCK} | | 0.15 | | K/W | |

| Reverse Diode (FRED) | | Characteristic Values ($T_J = 25^\circ\text{C}$, unless otherwise specified) | | |
|----------------------|---|---|------|----------|
| Symbol | Test Conditions | min. | typ. | max. |
| V_F | $I_F = 60\text{ A}$, $V_{GE} = 0\text{ V}$, Note 1 | | | 2.1 V |
| | | | | 1.4 V |
| I_{RM} | $I_F = 60\text{ A}$, $V_{GE} = 0\text{ V}$, $-di_F/dt = 100\text{ A}/\mu\text{s}$, $T_J = 100^\circ\text{C}$ $V_R = 100\text{ V}$ | | | 8.3 A |
| t_{rr} | $I_F = 1\text{ A}$; $-di/dt = 200\text{ A/ms}$; $V_R = 30\text{ V}$ | | 35 | ns |
| R_{thJC} | | | | 0.85 K/W |

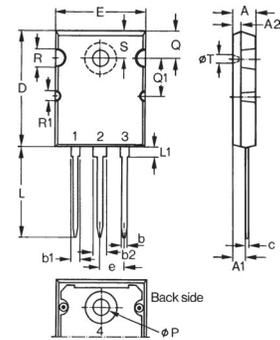
Note 1: Pulse test, $t \leq 300\ \mu\text{s}$, duty cycle $\leq 2\%$

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:

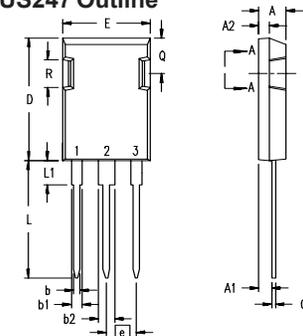
4,835,592 4,881,106 5,017,508 5,049,961 5,187,117 5,486,715 6,306,728B1 6,259,123B1 6,306,728B1
4,850,072 4,931,844 5,034,796 5,063,307 5,237,481 5,381,025 6,404,065B1 6,162,665 6,534,343

TO-264 AA Outline



| Dim. | Millimeter | | Inches | |
|------|------------|-------|----------|-------|
| | Min. | Max. | Min. | Max. |
| A | 4.82 | 5.13 | .190 | .202 |
| A1 | 2.54 | 2.89 | .100 | .114 |
| A2 | 2.00 | 2.10 | .079 | .083 |
| b | 1.12 | 1.42 | .044 | .056 |
| b1 | 2.39 | 2.69 | .094 | .106 |
| b2 | 2.90 | 3.09 | .114 | .122 |
| c | 0.53 | 0.83 | .021 | .033 |
| D | 25.91 | 26.16 | 1.020 | 1.030 |
| E | 19.81 | 19.96 | .780 | .786 |
| e | 5.46 BSC | | .215 BSC | |
| J | 0.00 | 0.25 | .000 | .010 |
| K | 0.00 | 0.25 | .000 | .010 |
| L | 20.32 | 20.83 | .800 | .820 |
| L1 | 2.29 | 2.59 | .090 | .102 |
| P | 3.17 | 3.66 | .125 | .144 |
| Q | 6.07 | 6.27 | .239 | .247 |
| Q1 | 8.38 | 8.69 | .330 | .342 |
| R | 3.81 | 4.32 | .150 | .170 |
| R1 | 1.78 | 2.29 | .070 | .090 |
| S | 6.04 | 6.30 | .238 | .248 |
| T | 1.57 | 1.83 | .062 | .072 |

PLUS247 Outline



Terminals: 1 - Gate
2 - Drain (Collector)
3 - Source (Emitter)
4 - Drain (Collector)

| Dim. | Millimeter | | Inches | |
|----------------|------------|-------|----------|-------|
| | Min. | Max. | Min. | Max. |
| A | 4.83 | 5.21 | .190 | .205 |
| A ₁ | 2.29 | 2.54 | .090 | .100 |
| A ₂ | 1.91 | 2.16 | .075 | .085 |
| b | 1.14 | 1.40 | .045 | .055 |
| b ₁ | 1.91 | 2.13 | .075 | .084 |
| b ₂ | 2.92 | 3.12 | .115 | .123 |
| 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 | 19.81 | 20.32 | .780 | .800 |
| L1 | 3.81 | 4.32 | .150 | .170 |
| Q | 5.59 | 6.20 | .220 | 0.244 |
| R | 4.32 | 4.83 | .170 | .190 |

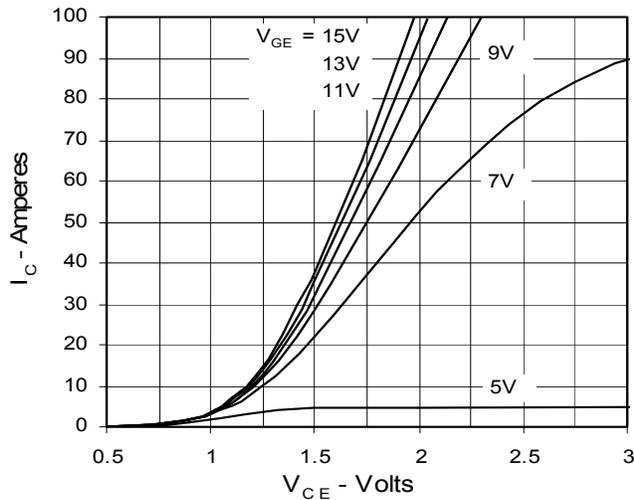
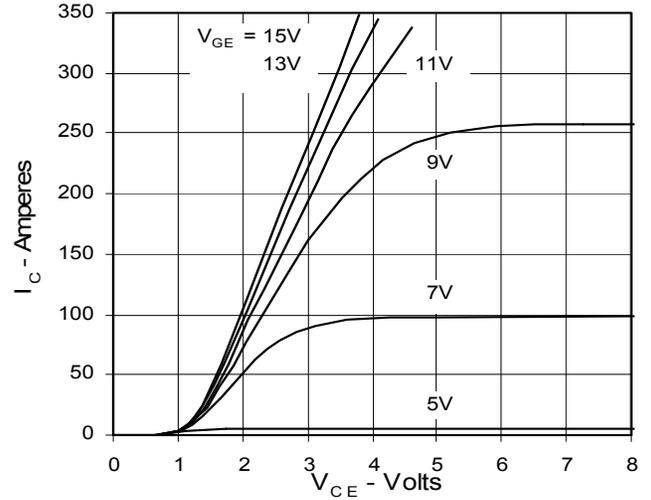
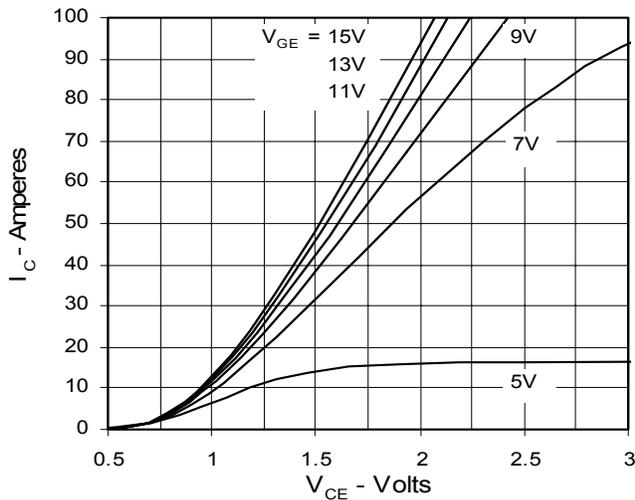
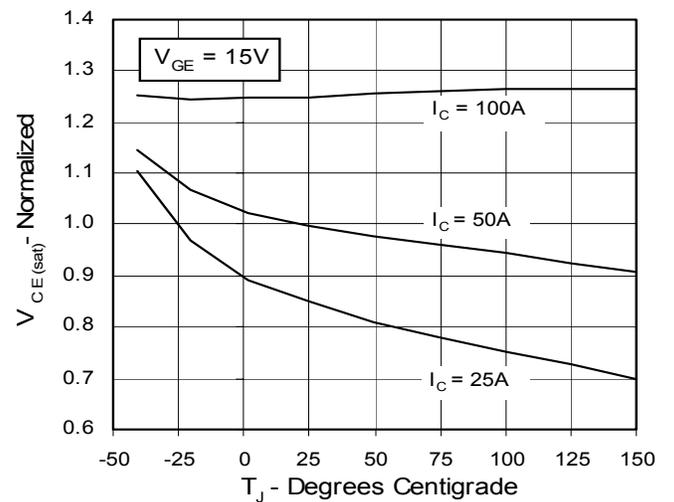
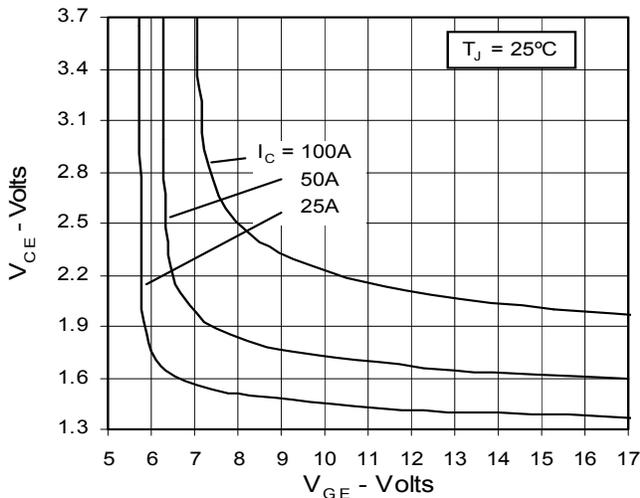
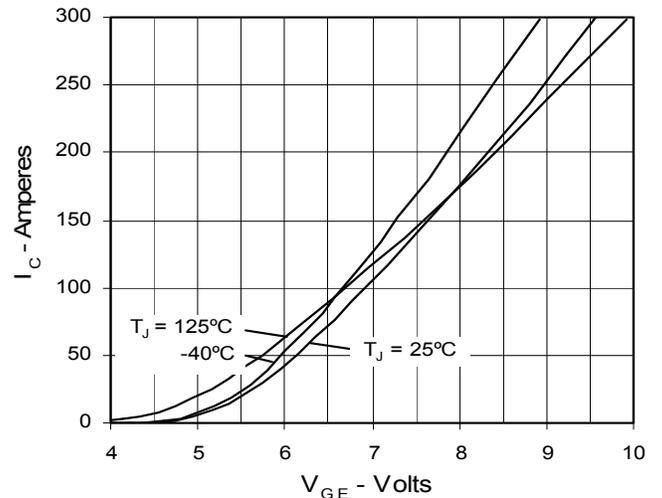
Fig. 1. Output Characteristics
@ 25 Deg. C

Fig. 2. Extended Output Characteristics
@ 25 deg. C

Fig. 3. Output Characteristics
@ 125 Deg. C

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

Fig. 5. Collector-to-Emitter Voltage vs. Gate-to-Emitter voltage

Fig. 6. Input Admittance


Fig. 7. Transconductance

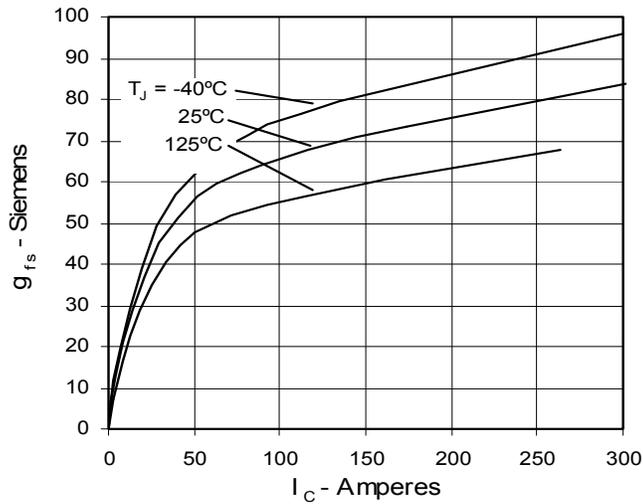


Fig. 8. Dependence of Turn-Off Energy on R_G

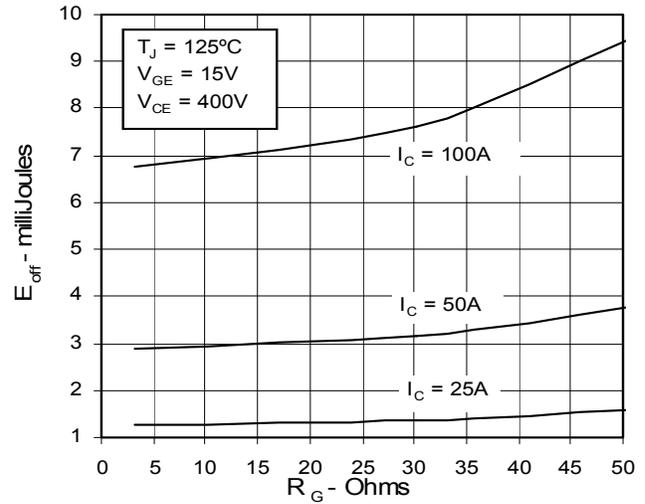


Fig. 9. Dependence of Turn-Off Energy on I_C

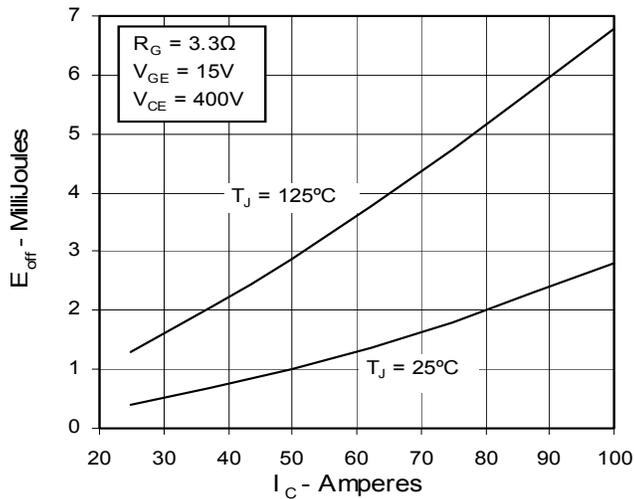


Fig. 10. Dependence of Turn-Off Energy on Temperature

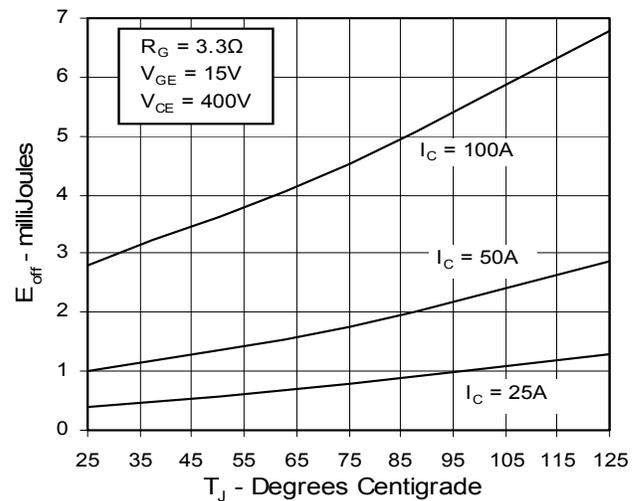


Fig. 11. Dependence of Turn-Off Switching Time on R_G

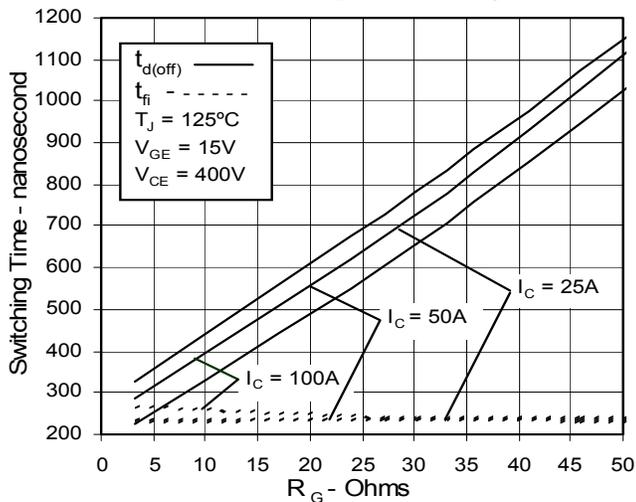


Fig. 12. Dependence of Turn-Off Switching Time on I_C

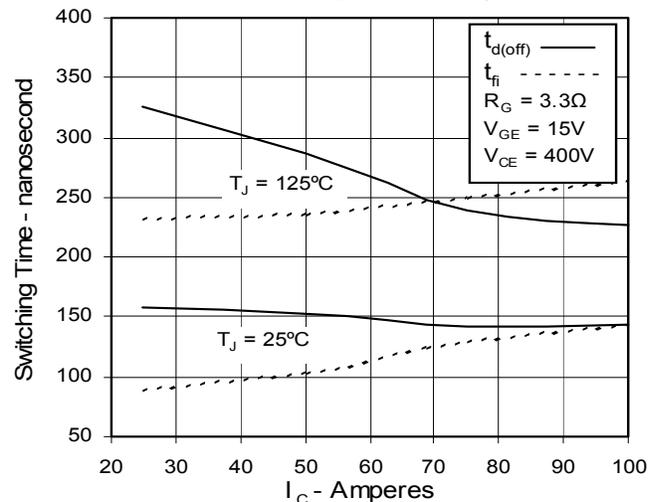


Fig. 13. Dependence of Turn-Off Switching Time on Temperature

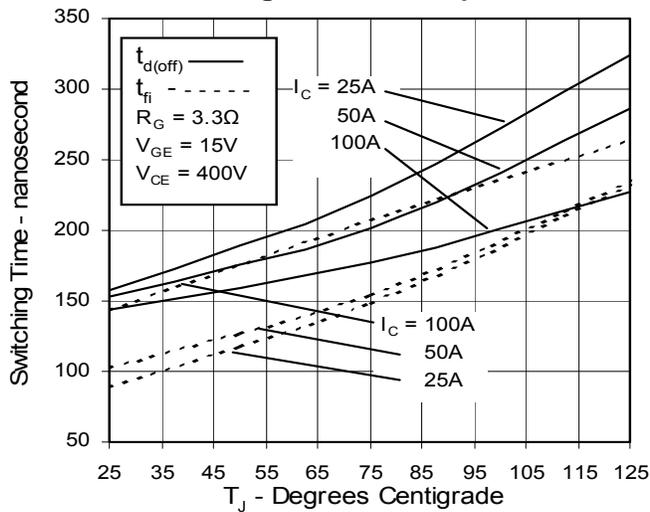


Fig. 14. Gate Charge

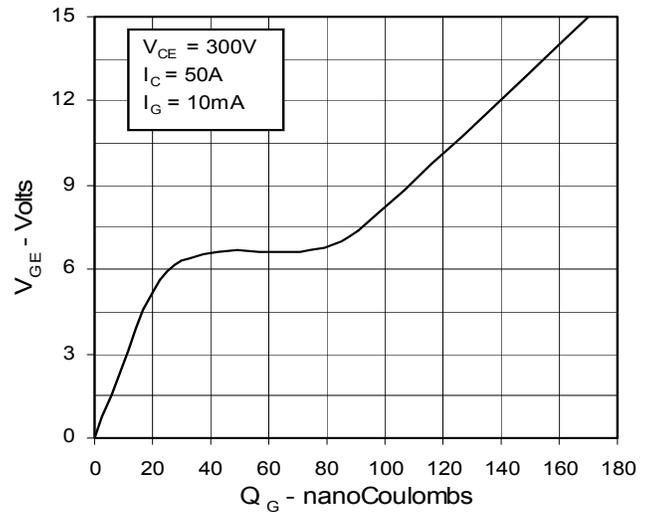


Fig. 15. Capacitance

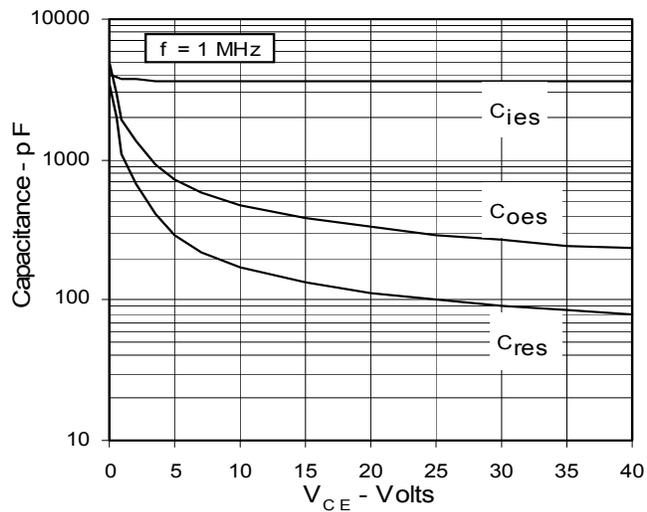
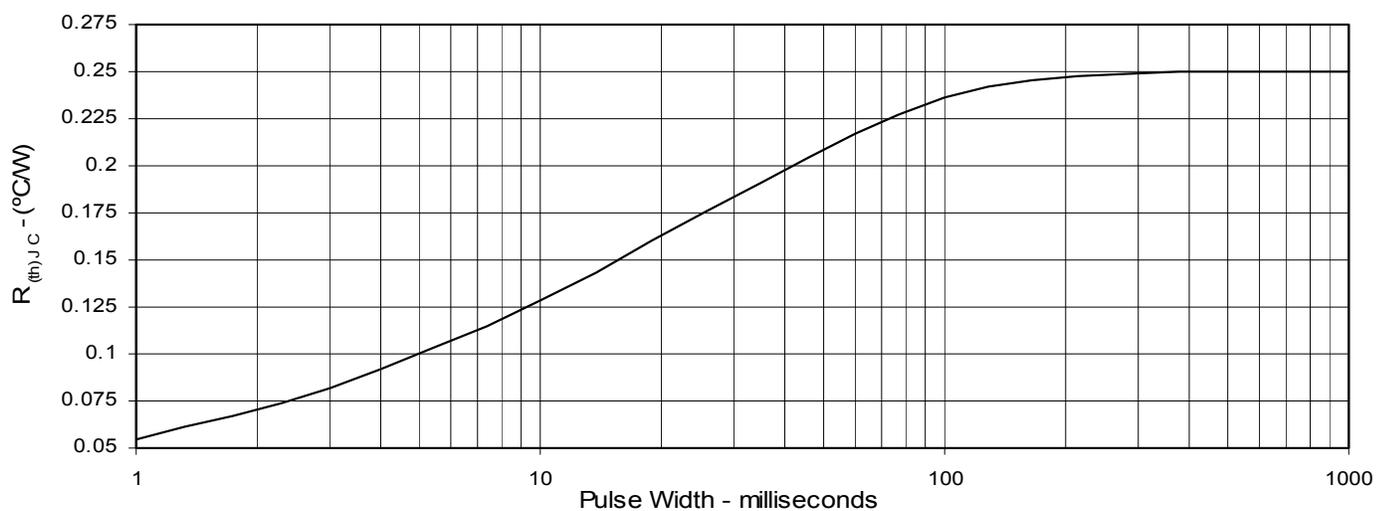


Fig. 16. Maximum Transient Thermal Resistance



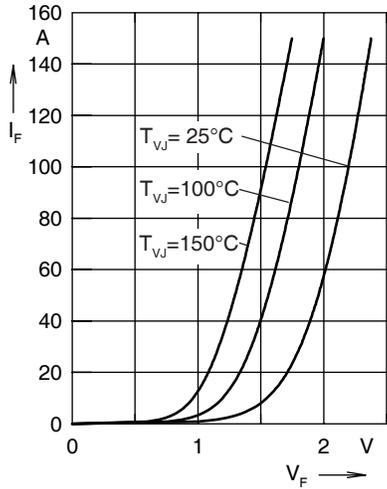


Fig. 17. Forward current I_F versus V_F

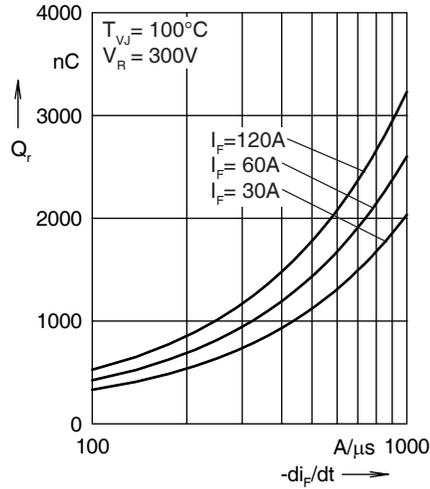


Fig. 18. Reverse recovery charge Q_r versus $-di_F/dt$

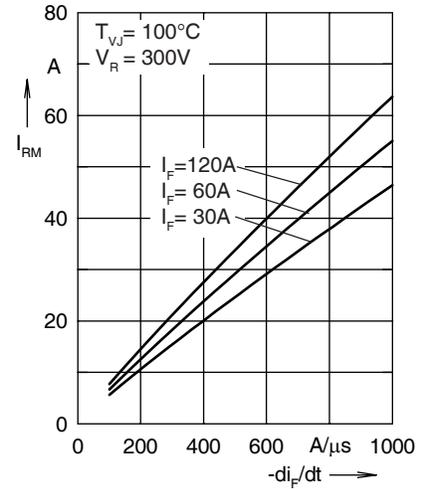


Fig. 19. Peak reverse current I_{RM} versus $-di_F/dt$

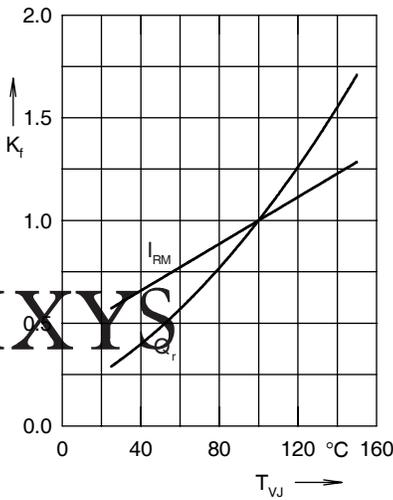


Fig. 20. Dynamic parameters Q_r , I_{RM} versus T_{VJ}

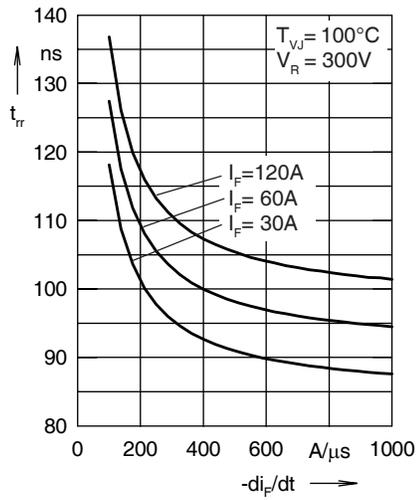


Fig. 21. Recovery time t_{rr} versus $-di_F/dt$

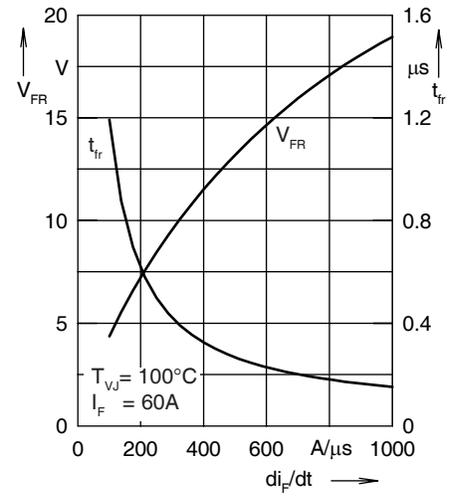


Fig. 22. Peak forward voltage V_{FR} and t_{rr} versus di_F/dt

Constants for Z_{thJC} calculation:

| i | R_{thi} (K/W) | t_i (s) |
|---|-----------------|-----------|
| 1 | 0.3073 | 0.0055 |
| 2 | 0.3533 | 0.0092 |
| 3 | 0.0887 | 0.0007 |
| 4 | 0.1008 | 0.0399 |

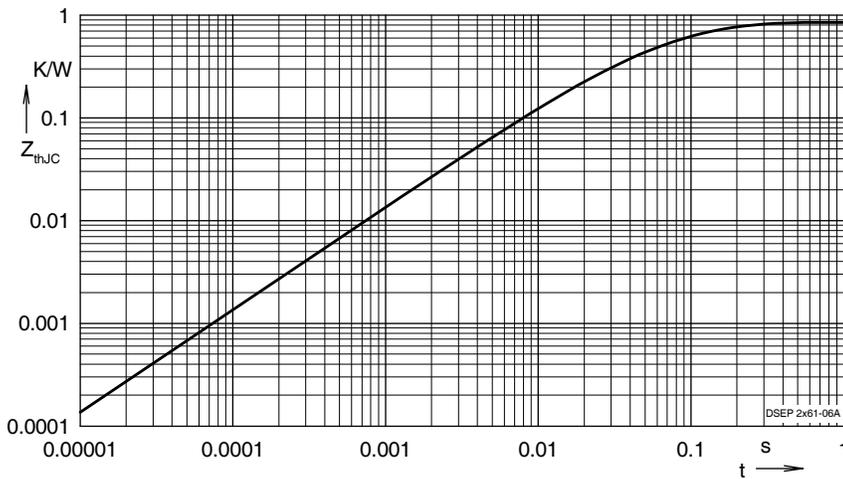


Fig. 23. Transient thermal resistance junction to case