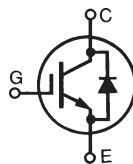


HiPerFAST™ IGBT with Diode

C2-Class High Speed IGBTs

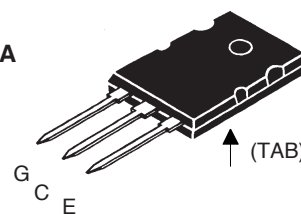
IXGK 60N60C2D1
IXGX 60N60C2D1

V_{CES} = 600 V
I_{C25} = 75 A
V_{CE(sat)} = 2.5 V
t_{fi(typ)} = 35 ns

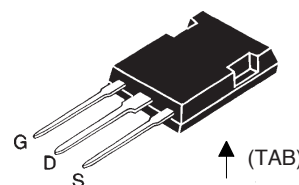


| Symbol | Test Conditions | Maximum Ratings | |
|---|--|-----------------------|-----------|
| V _{CES} | T _J = 25°C to 150°C | 600 | V |
| V _{CGR} | T _J = 25°C to 150°C; R _{GE} = 1 MΩ | 600 | V |
| V _{GES} | Continuous | ±20 | V |
| V _{GEM} | Transient | ±30 | V |
| I _{C25} | T _C = 25°C (limited by leads) | 75 | A |
| I _{C110} | T _C = 110°C | 60 | A |
| I _{F110} | T _C = 110°C | 48 | A |
| I _{CM} | T _C = 25°C, 1 ms | 300 | A |
| SSOA (RBSOA) | V _{GE} = 15 V, T _{VJ} = 125°C, R _G = 10 Ω Clamped inductive load @ V _{CE} ≤ 600 V | I _{CM} = 100 | A |
| P _C | T _C = 25°C | 480 | W |
| T _J | | -55 ... +150 | °C |
| T _{JM} | | 150 | °C |
| T _{stg} | | -55 ... +150 | °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 | °C |

**TO-264 AA
(IXGK)**



**PLUS247
(IXGX)**



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

Features

- Very high frequency IGBT and anti-parallel FRED in one package
- 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°C unless otherwise specified) | | |
|----------------------|---|---|------|---------|
| | | Min. | Typ. | Max. |
| V _{GE(th)} | I _C = 250 μA, V _{CE} = V _{GE} | 3.0 | | 5.0 V |
| I _{CES} | V _{CE} = V _{CES} V _{GE} = 0 V | T _J = 25°C | | 650 μA |
| | | T _J = 125°C | | 5 mA |
| I _{GES} | V _{CE} = 0 V, V _{GE} = ±20 V | | | ±100 nA |
| V _{CE(sat)} | I _C = 50 A, V _{GE} = 15 V Note 1 | T _J = 25°C | | 2.1 V |
| | | T _J = 125°C | | 1.8 V |

| Symbol | Test Conditions | Characteristic Values | | |
|--------------|--|-----------------------|------|--------|
| | | 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} | | | 280 | pF |
| C_{res} | | | 97 | pF |
| Q_g | $I_C = 50 \text{ A}, V_{GE} = 15 \text{ V}, V_{CE} = 0.5 V_{CES}$ | | 146 | nC |
| Q_{ge} | | | 28 | nC |
| Q_{gc} | | | 50 | nC |
| $t_{d(on)}$ | Inductive load, $T_J = 25^\circ\text{C}$ $I_C = 50 \text{ A}, V_{GE} = 15 \text{ V}$ $V_{CE} = 400 \text{ V}, R_G = R_{off} = 2.0 \Omega$ | | 18 | ns |
| E_{on} | | | 0.4 | mJ |
| t_{ri} | | | 25 | ns |
| $t_{d(off)}$ | | | 95 | 150 ns |
| t_{fi} | | | 35 | ns |
| E_{off} | | 0.48 | 0.8 | mJ |
| $t_{d(on)}$ | Inductive load, $T_J = 125^\circ\text{C}$ $I_C = 50 \text{ A}, V_{GE} = 15 \text{ V}$ $V_{CE} = 400 \text{ V}, R_G = R_{off} = 2.0 \Omega$ | | 18 | ns |
| t_{ri} | | | 25 | ns |
| E_{on} | | | 0.9 | mJ |
| $t_{d(off)}$ | | | 130 | ns |
| t_{fi} | | | 80 | ns |
| E_{off} | | 1.2 | mJ | |
| R_{thJC} | | | 0.26 | K/W |
| R_{thCK} | | 0.15 | | K/W |

Reverse Diode (FRED)

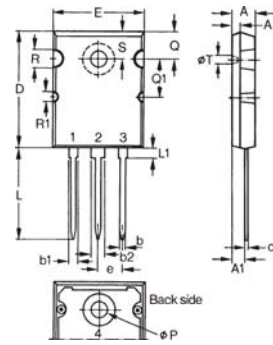
| Symbol | Test Conditions | Characteristic Values | | |
|------------|---|---------------------------|------|----------|
| | | min. | typ. | max. |
| V_F | $I_F = 60 \text{ A}, V_{GE} = 0 \text{ V}$, Note 1 | | | 2.1 V |
| | | $T_J = 150^\circ\text{C}$ | | 1.4 |
| I_{RM} | $I_F = 60 \text{ A}, V_{GE} = 0 \text{ V}, -di_F/dt = 100 \text{ A}/\mu\text{s}$ $V_R = 100 \text{ V}$ | | | 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} | | | | 0.65 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.

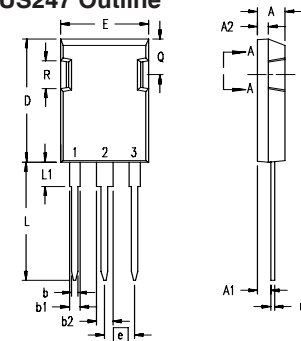
IXYS MOSFETs and IGBTs are covered by 4,835,592 4,931,844 5,049,961 5,237,481 6,162,665 6,404,065 B1 6,683,344 6,727,585
one or more of the following U.S. patents: 4,850,072 5,017,508 5,063,307 5,381,025 6,259,123 B1 6,534,343 6,710,405 B2 6,759,692
4,881,106 5,034,796 5,187,117 5,486,715 6,306,728 B1 6,583,505 6,710,463 6771478 B2

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°C

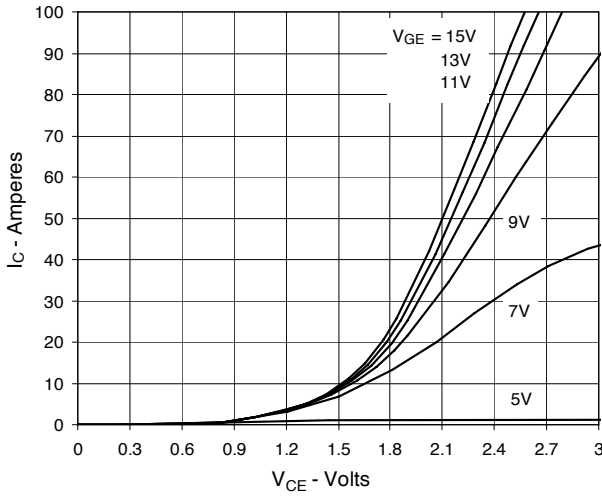


Fig. 2. Extended Output Characteristics @ 25°C

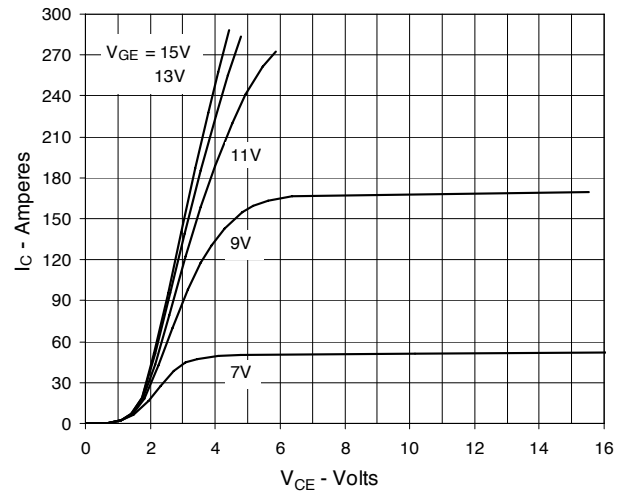


Fig. 3. Output Characteristics @ 125°C

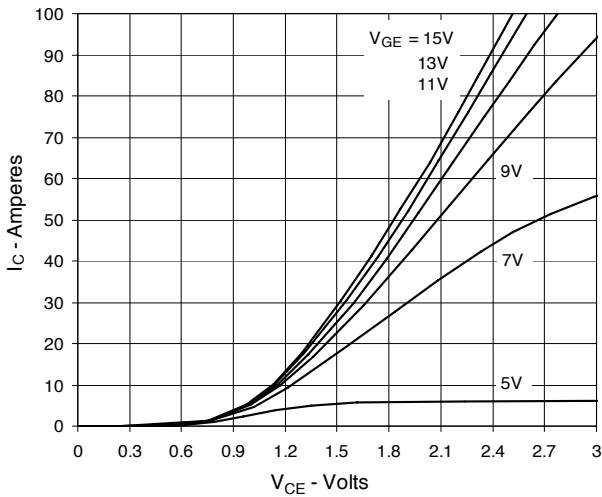


Fig. 4. Dependence of $V_{CE(sat)}$ on Junction Temperature

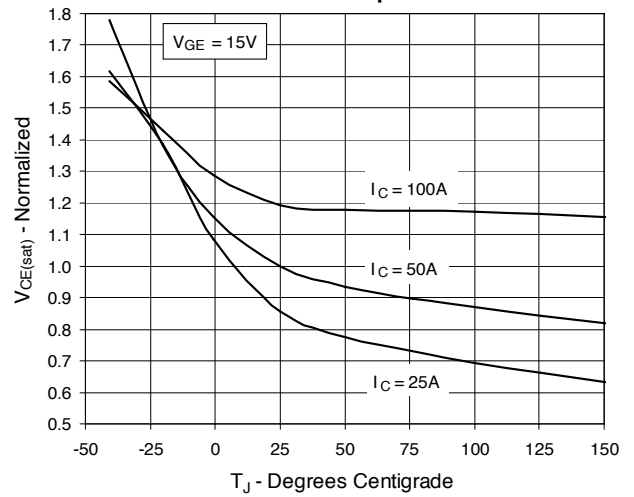


Fig. 5. Collector-to-Emitter Voltage vs. Gate-to-Emitter Voltage

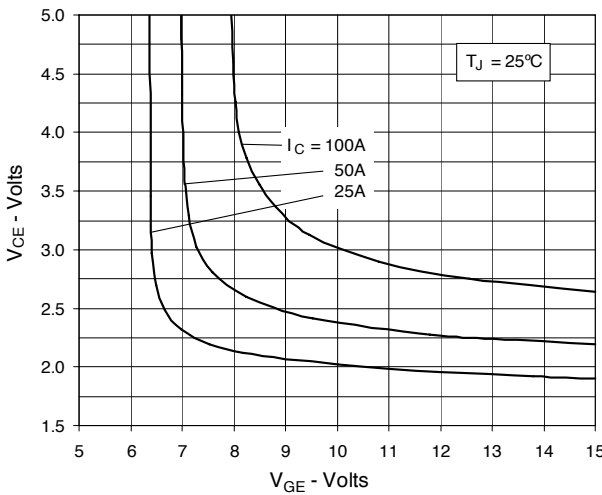


Fig. 6. Input Admittance

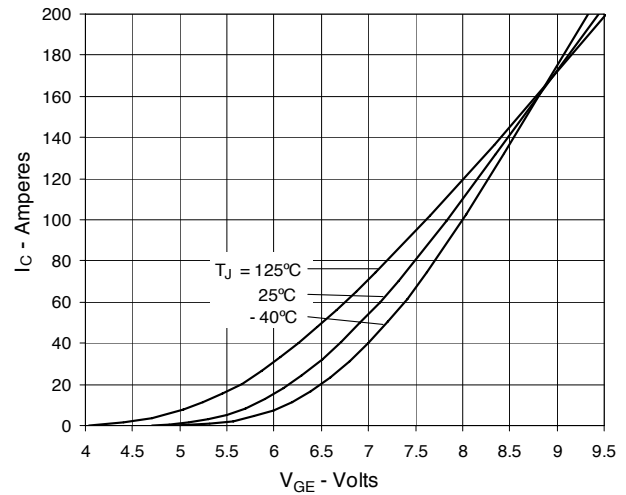


Fig. 7. Transconductance

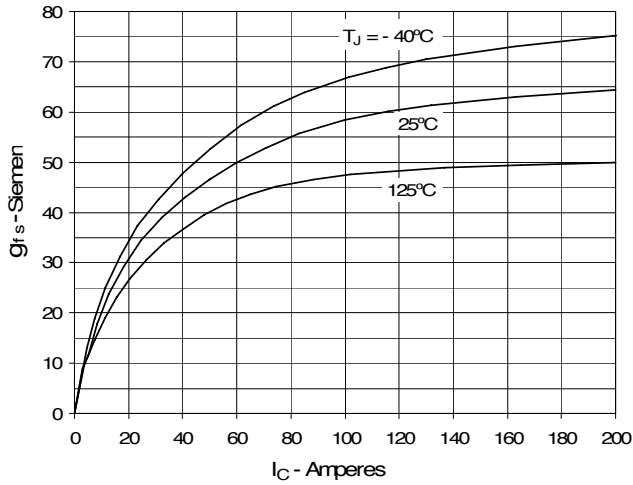


Fig. 8. Inductive Switching Energy Loss vs. Gate Resistance

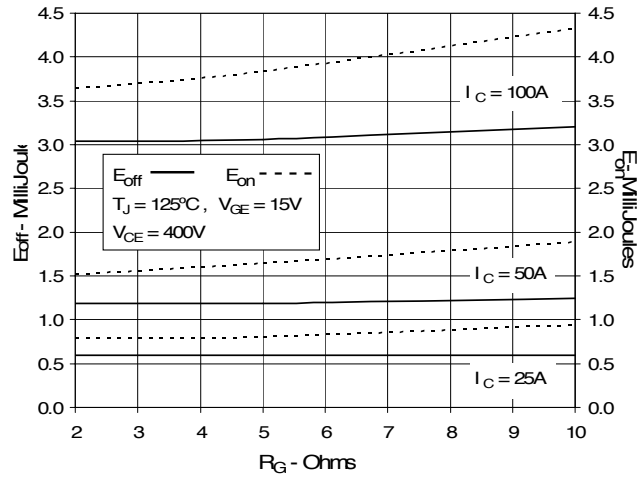


Fig. 9. Inductive Switching Energy Loss vs. Collector Current

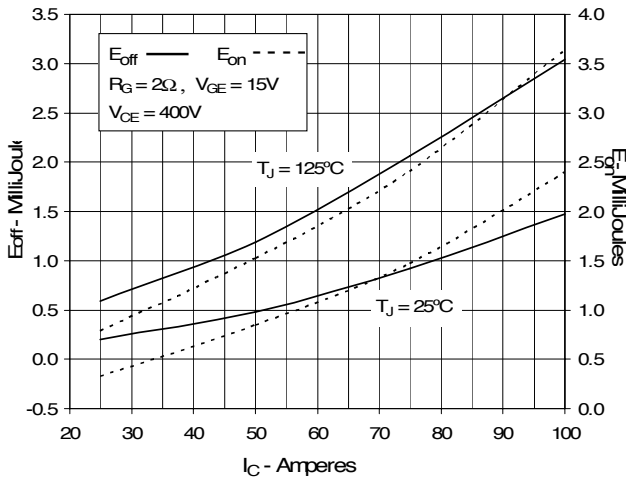


Fig. 10. Inductive Switching Energy Loss vs. Junction Temperature

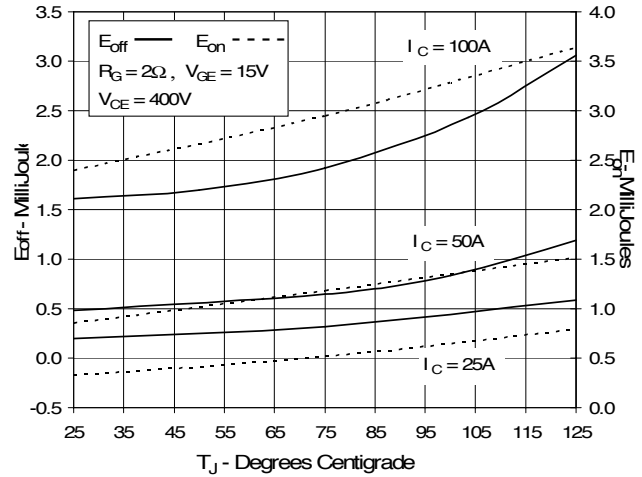


Fig. 11. Inductive Turn-off Switching Times vs. Gate Resistance

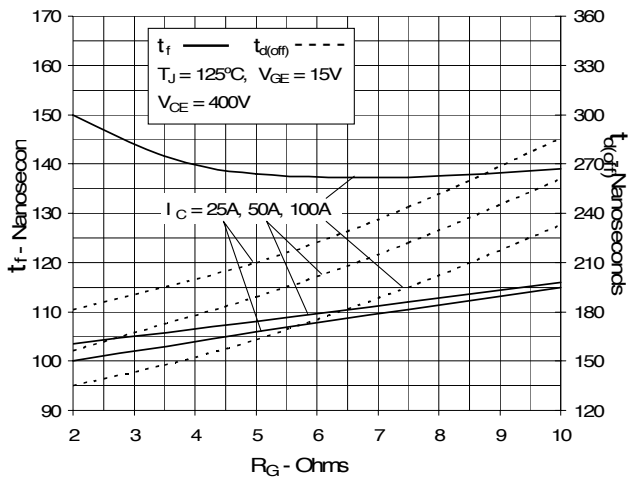
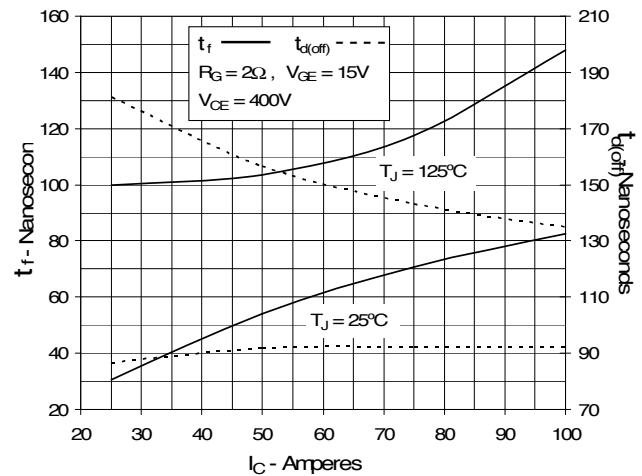
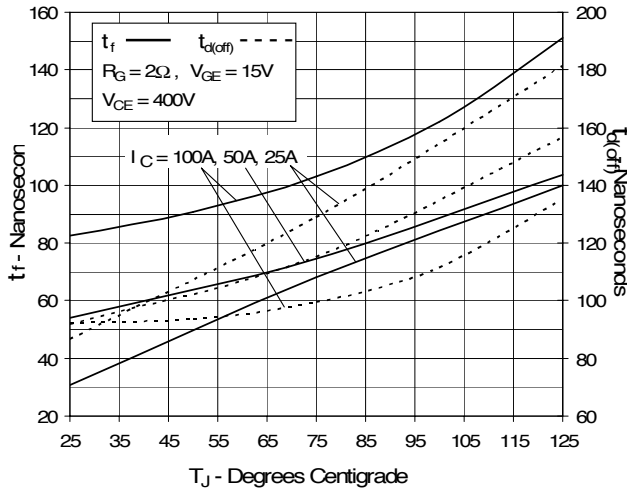


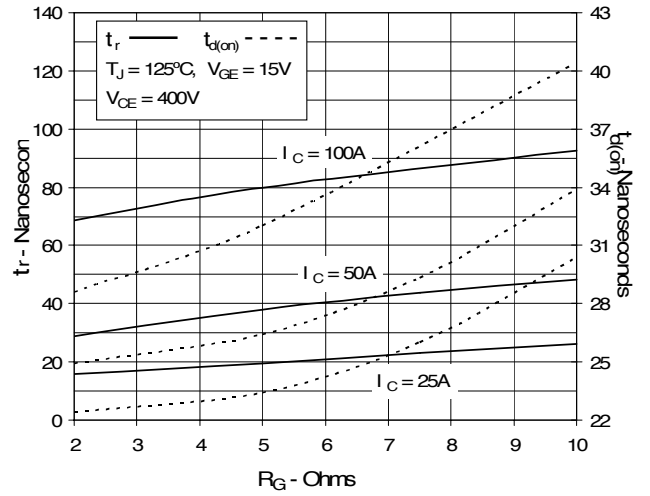
Fig. 12. Inductive Turn-off Switching Times vs. Collector Current



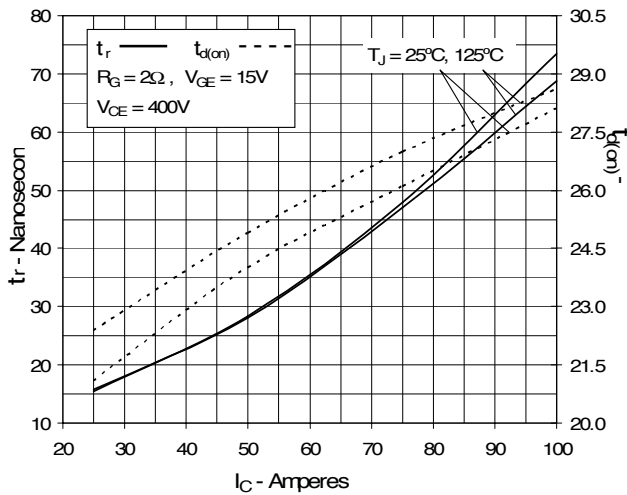
**Fig. 13. Inductive Turn-off
Switching Times vs. Junction Temperature**



**Fig. 14. Inductive Turn-on
Switching Times vs. Gate Resistance**



**Fig. 15. Inductive Turn-on
Switching Times vs. Collector Current**



**Fig. 16. Inductive Turn-on
Switching Times vs. Junction Temperature**

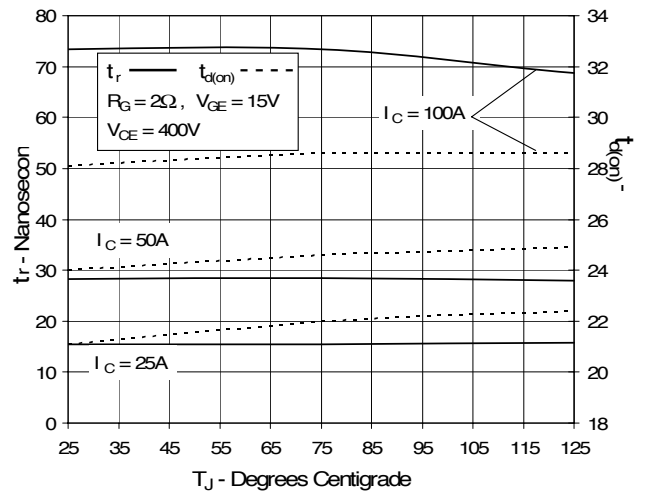


Fig. 17. Gate Charge

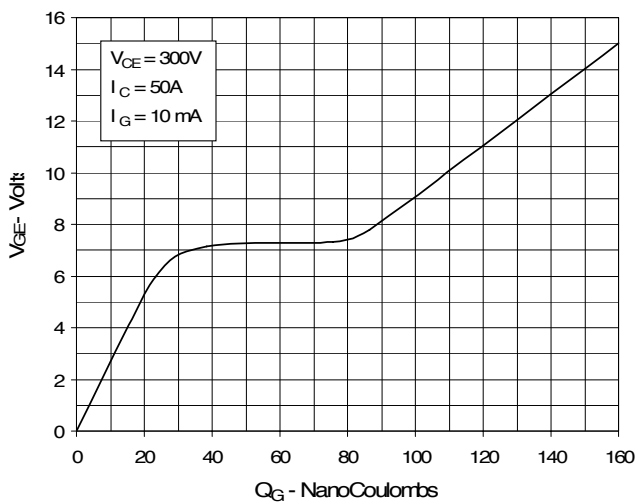


Fig. 18. Capacitance

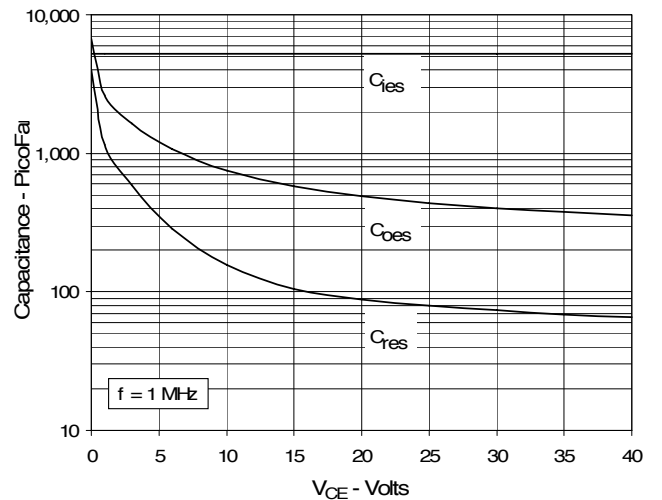


Fig. 19. Reverse-Bias Safe Operating Area

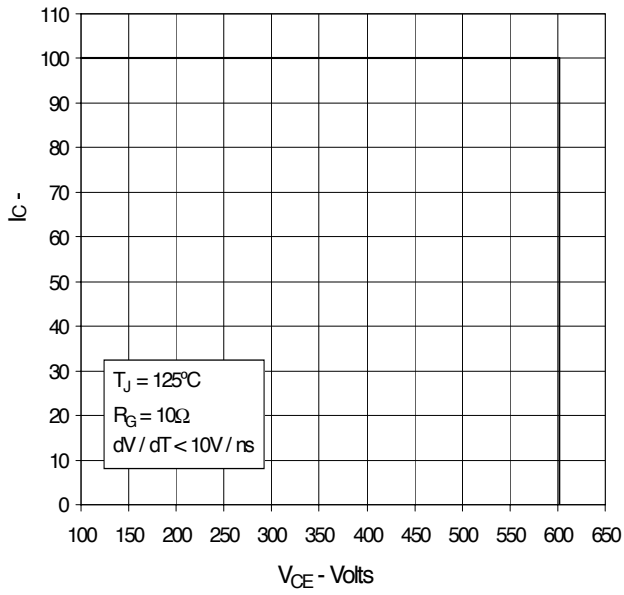
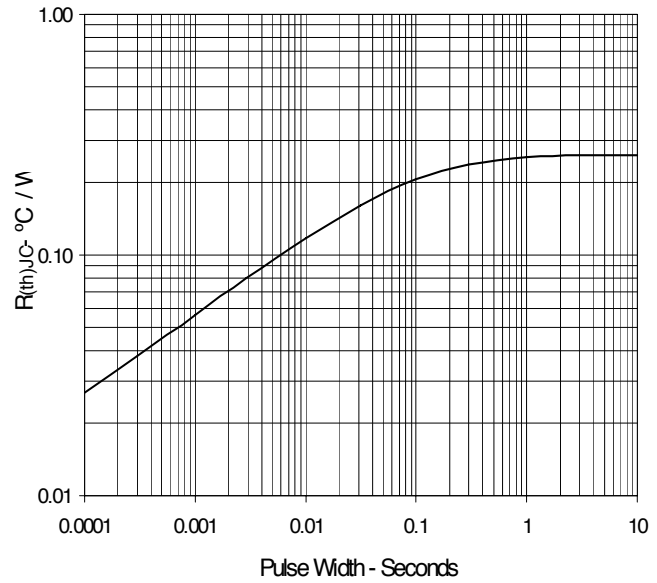


Fig. 20. Maximum Transient Thermal Resistance



Diode's Curves

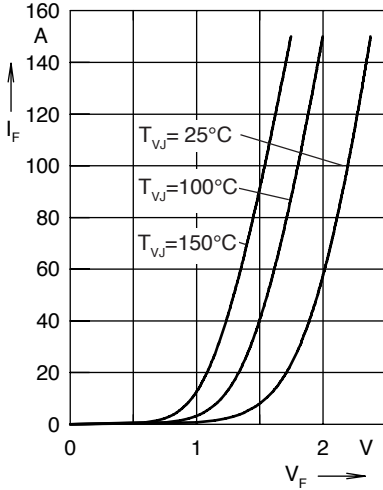


Fig. 21. Forward current I_F versus V_F

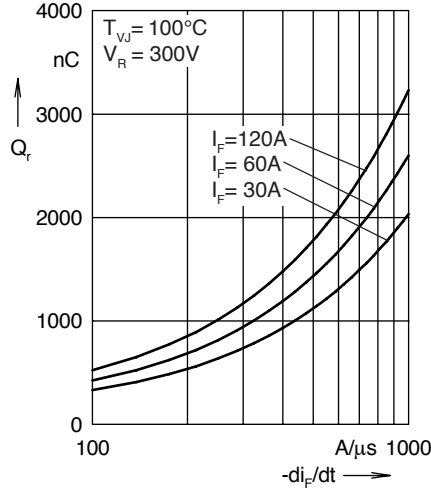


Fig. 22. Reverse recovery charge Q_r versus $-di_F/dt$

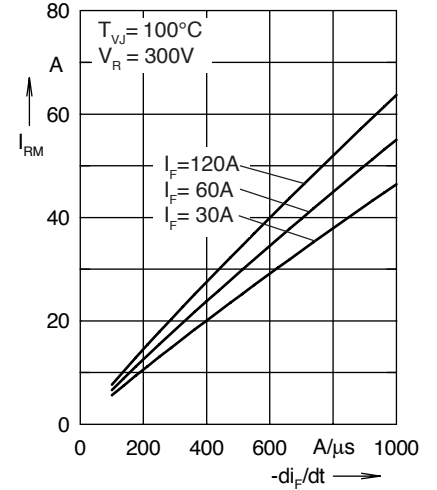


Fig. 23. Peak reverse current I_{RM} versus $-di_F/dt$

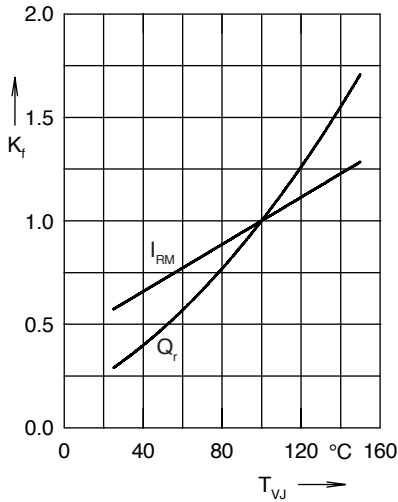


Fig. 24. Dynamic parameters Q_r , I_{RM} versus T_{VJ}

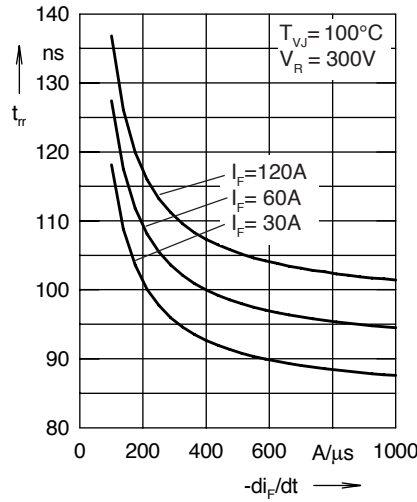


Fig. 25. Recovery time t_{rr} versus $-di_F/dt$

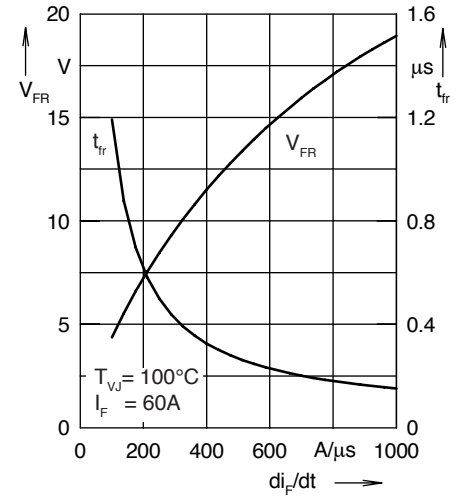


Fig. 26. Peak forward voltage V_{FR} and t_{fr} versus di_F/dt

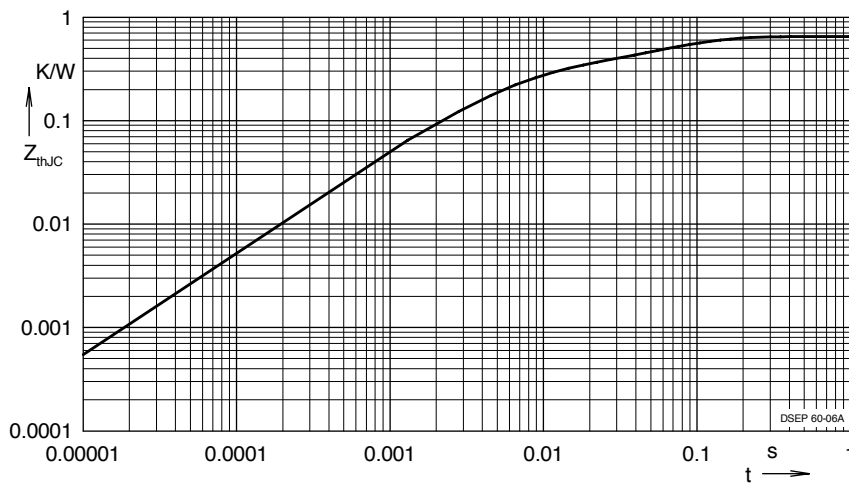


Fig. 27. Transient thermal resistance junction to case

Constants for Z_{thJC} calculation:

| i | R_{thi} (K/W) | t_i (s) |
|---|-----------------|-----------|
| 1 | 0.324 | 0.0052 |
| 2 | 0.125 | 0.0003 |
| 3 | 0.201 | 0.0385 |

Note: Fig. 15 through Fig. 20 show typical values