

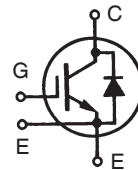
# IGBT with Diode

Short Circuit SOA Capability

## IXSN 80N60BD1

$V_{CES} = 600 \text{ V}$   
 $I_{C25} = 160 \text{ A}$   
 $V_{CE(sat)} = 2.5 \text{ V}$   
 $t_{fi} = 180 \text{ ns}$

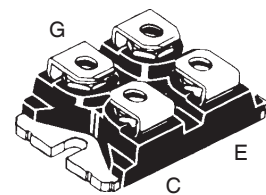
Preliminary Data Sheet



| 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 A                                      |
| $V_{GES}$                          | Continuous                                                                                                           | $\pm 20$ V                                 |
| $V_{GEM}$                          | Transient                                                                                                            | $\pm 30$ V                                 |
| $I_{C25}$                          | $T_C = 25^\circ\text{C}$ (Silicon chip capability)                                                                   | 160 A                                      |
| $I_L$                              | Lead current limit (RMS)                                                                                             | 100 A                                      |
| $I_{C90}$                          | $T_C = 90^\circ\text{C}$                                                                                             | 80 A                                       |
| $I_{CM}$                           | $T_C = 25^\circ\text{C}$ , 1 ms                                                                                      | 300 A                                      |
| <b>SSOA (RBSOA)</b>                | $V_{GE} = 15 \text{ V}$ , $T_{VJ} = 125^\circ\text{C}$ , $R_G = 5 \Omega$<br>Clamped inductive load                  | $I_{CM} = 160$<br>@ $0.8 V_{CES}$          |
| <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 $\mu\text{s}$                           |
| $P_C$                              | $T_C = 25^\circ\text{C}$                                                                                             | 420 W                                      |
| $V_{ISOL}$                         | 50/60 Hz<br>$I_{ISOL} \leq 1 \text{ mA}$                                                                             | t = 1 min<br>2500 V~<br>t = 1 s<br>3000 V~ |
| $T_J$                              |                                                                                                                      | -55 ... +150 $^\circ\text{C}$              |
| $T_{JM}$                           |                                                                                                                      | 150 $^\circ\text{C}$                       |
| $T_{stg}$                          |                                                                                                                      | -55 ... +150 $^\circ\text{C}$              |
| $M_d$                              | Mounting torque                                                                                                      | 0.4/6 Nm/lb.in.                            |
| <b>Weight</b>                      |                                                                                                                      | 30 g                                       |

miniBLOC, SOT-227 B

E153432 E



E = Emitter ①, C = Collector  
G = Gate, E = Emitter ②

① Either Emitter terminal can be used as Main or Kelvin Emitter

### Features

- International standard package
- Aluminium-nitride isolation
  - high power dissipation
- Isolation voltage 3000 V~
- UL registered E 153432
- Low  $V_{CE(sat)}$ 
  - for minimum on-state conduction losses
- Fast Recovery Epitaxial Diode
  - short  $t_{tr}$  and  $I_{RM}$
- Low collector-to-case capacitance (< 60 pF)
  - reduced RFI
- Low package inductance (< 10 nH)
  - easy to drive and to protect

### Applications

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

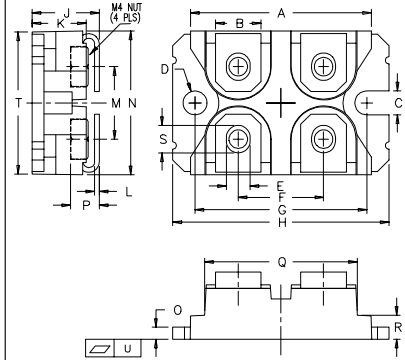
### Advantages

- Space savings
- Easy to mount with 2 screws
- High power density

| Symbol        | Test Conditions                                      | Characteristic Values<br>( $T_J = 25^\circ\text{C}$ , unless otherwise specified) |                                                       |                           |
|---------------|------------------------------------------------------|-----------------------------------------------------------------------------------|-------------------------------------------------------|---------------------------|
|               |                                                      | min.                                                                              | typ.                                                  | max.                      |
| $BV_{CES}$    | $I_C = 500 \mu\text{A}$ , $V_{GE} = 0 \text{ V}$     | 600                                                                               |                                                       | V                         |
| $V_{GE(th)}$  | $I_C = 8 \text{ mA}$ , $V_{CE} = V_{GE}$             | 4                                                                                 |                                                       | V                         |
| $I_{CES}$     | $V_{CE} = V_{CES}$<br>$V_{GE} = 0 \text{ V}$         |                                                                                   | $T_J = 25^\circ\text{C}$<br>$T_J = 125^\circ\text{C}$ | 200 $\mu\text{A}$<br>2 mA |
| $I_{GES}$     | $V_{CE} = 0 \text{ V}$ , $V_{GE} = \pm 20 \text{ V}$ |                                                                                   |                                                       | $\pm 200$ nA              |
| $V_{CE(sat)}$ | $I_C = I_{C90}$ , $V_{GE} = 15 \text{ V}$ ; Note 1   |                                                                                   |                                                       | 2.5 V                     |

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

| Symbol       | Test Conditions                                                                                                                                                                             | Characteristic Values<br>( $T_J = 25^\circ\text{C}$ , unless otherwise specified) |      |      |    |
|--------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|------|------|----|
|              |                                                                                                                                                                                             | min.                                                                              | typ. | max. |    |
| $g_{fs}$     | $I_C = 60\text{ A}$ ; $V_{CE} = 10\text{ V}$ ,<br>Note1                                                                                                                                     | 52                                                                                |      | S    |    |
| $C_{ies}$    | $V_{CE} = 25\text{ V}$ , $V_{GE} = 0\text{ V}$ , $f = 1\text{ MHz}$                                                                                                                         |                                                                                   | 6600 | pF   |    |
| $C_{oes}$    |                                                                                                                                                                                             |                                                                                   | 720  | pF   |    |
| $C_{res}$    |                                                                                                                                                                                             |                                                                                   | 196  | pF   |    |
| $Q_g$        | $I_C = I_{C90}$ , $V_{GE} = 15\text{ V}$ , $V_{CE} = 0.5 V_{CES}$                                                                                                                           |                                                                                   | 200  | nC   |    |
| $Q_{ge}$     |                                                                                                                                                                                             |                                                                                   | 70   | nC   |    |
| $Q_{gc}$     |                                                                                                                                                                                             |                                                                                   | 60   | nC   |    |
| $t_{d(on)}$  | <b>Inductive load, <math>T_J = 25^\circ\text{C}</math></b><br>$I_C = I_{C90}$ , $V_{GE} = 15\text{ V}$ , $L = 100\ \mu\text{H}$ ,<br>$V_{CE} = 0.8 V_{CES}$ , $R_G = 2.7\ \Omega$<br>Note 2 |                                                                                   | 60   | ns   |    |
| $t_{ri}$     |                                                                                                                                                                                             |                                                                                   | 50   | ns   |    |
| $t_{d(off)}$ |                                                                                                                                                                                             |                                                                                   | 140  | 280  | ns |
| $t_{fi}$     |                                                                                                                                                                                             |                                                                                   | 120  | 200  | ns |
| $E_{off}$    |                                                                                                                                                                                             |                                                                                   | 1.8  | 3.5  | mJ |
| $t_{d(on)}$  | <b>Inductive load, <math>T_J = 125^\circ\text{C}</math></b><br>$I_C = I_{C90}$ , $V_{GE} = 15\text{ V}$ , $L = 100\ \mu\text{H}$<br>$V_{CE} = 0.8 V_{CES}$ , $R_G = 2.7\ \Omega$<br>Note 2  |                                                                                   | 60   | ns   |    |
| $t_{ri}$     |                                                                                                                                                                                             |                                                                                   | 60   | ns   |    |
| $E_{on}$     |                                                                                                                                                                                             |                                                                                   | 4.8  | mJ   |    |
| $t_{d(off)}$ |                                                                                                                                                                                             |                                                                                   | 190  | ns   |    |
| $t_{fi}$     |                                                                                                                                                                                             |                                                                                   | 160  | ns   |    |
| $E_{off}$    |                                                                                                                                                                                             | 3.3                                                                               | mJ   |      |    |
| $R_{thJC}$   |                                                                                                                                                                                             |                                                                                   | 0.30 | K/W  |    |
| $R_{thCK}$   |                                                                                                                                                                                             | 0.05                                                                              |      | K/W  |    |

**miniBLOC, SOT-227 B**


M4 screws (4x) supplied

| Dim. | Millimeter |       | Inches |       |
|------|------------|-------|--------|-------|
|      | Min.       | Max.  | Min.   | Max.  |
| A    | 31.50      | 31.88 | 1.240  | 1.255 |
| B    | 7.80       | 8.20  | 0.307  | 0.323 |
| C    | 4.09       | 4.29  | 0.161  | 0.169 |
| D    | 4.09       | 4.29  | 0.161  | 0.169 |
| E    | 4.09       | 4.29  | 0.161  | 0.169 |
| F    | 14.91      | 15.11 | 0.587  | 0.595 |
| G    | 30.12      | 30.30 | 1.186  | 1.193 |
| H    | 38.00      | 38.23 | 1.496  | 1.505 |
| J    | 11.68      | 12.22 | 0.460  | 0.481 |
| K    | 8.92       | 9.60  | 0.351  | 0.378 |
| L    | 0.76       | 0.84  | 0.030  | 0.033 |
| M    | 12.60      | 12.85 | 0.496  | 0.506 |
| N    | 25.15      | 25.42 | 0.990  | 1.001 |
| O    | 1.98       | 2.13  | 0.078  | 0.084 |
| P    | 4.95       | 5.97  | 0.195  | 0.235 |
| Q    | 26.54      | 26.90 | 1.045  | 1.059 |
| R    | 3.94       | 4.42  | 0.155  | 0.174 |
| S    | 4.72       | 4.85  | 0.186  | 0.191 |
| T    | 24.59      | 25.07 | 0.968  | 0.987 |
| U    | -0.05      | 0.1   | -0.002 | 0.004 |

**Reverse Diode (FRED)**
**Characteristic Values**  
( $T_J = 25^\circ\text{C}$ , unless otherwise specified)

| Symbol     | Test Conditions                                                                                                                     | typ. | max.            |
|------------|-------------------------------------------------------------------------------------------------------------------------------------|------|-----------------|
| $V_F$      | $I_F = 60\text{ A}$ , Note 1<br>$T_J = 150^\circ\text{C}$                                                                           |      | 2.05 V<br>1.4 V |
| $I_{RM}$   | $I_F = I_{C90}$ , $V_{GE} = 0\text{ V}$ , $-di_F/dt = 100\text{ A}/\mu\text{s}$<br>$V_R = 100\text{ V}$ , $T_J = 100^\circ\text{C}$ |      | 8.0 A           |
| $t_{rr}$   | $I_F = 1\text{ A}$ , $-di/dt = 50\text{ A}/\mu\text{s}$ , $V_R = 30\text{ V}$                                                       | 35   | ns              |
| $R_{thJC}$ |                                                                                                                                     |      | 0.85 K/W        |

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

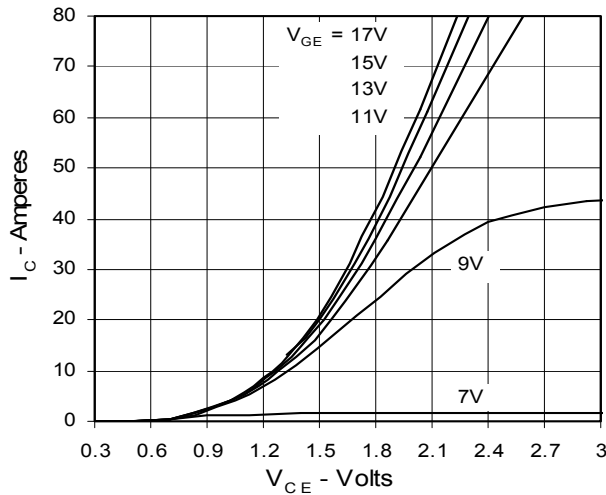
Note: 2. Remarks: Switching times may increase for

 $V_{CE}(\text{Clamp}) > 0.8 \cdot V_{CES}$ , higher  $T_J$  or increased  $R_G$ 

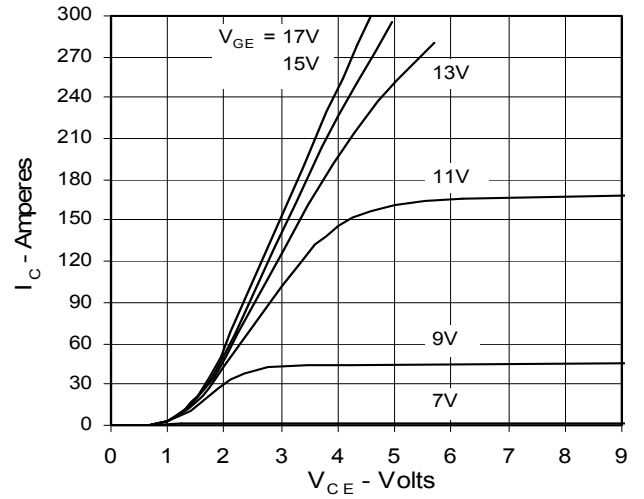
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|                                                                                  |           |           |           |           |           |           |             |             |             |           |
|----------------------------------------------------------------------------------|-----------|-----------|-----------|-----------|-----------|-----------|-------------|-------------|-------------|-----------|
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|                                                                                  | 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 | 6,683,344 |

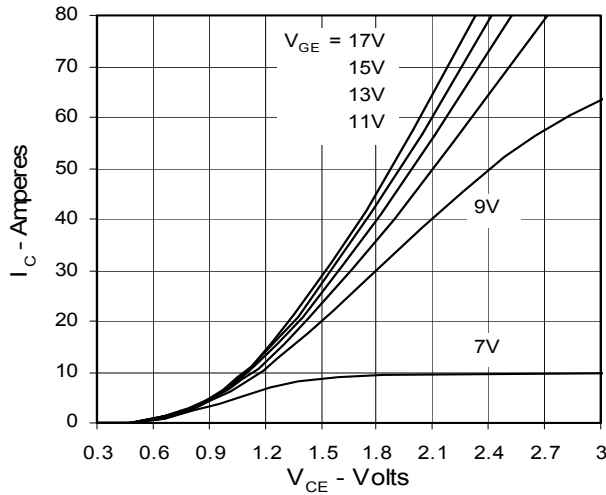
**Fig. 1. Output Characteristics @ 25 Deg. C**



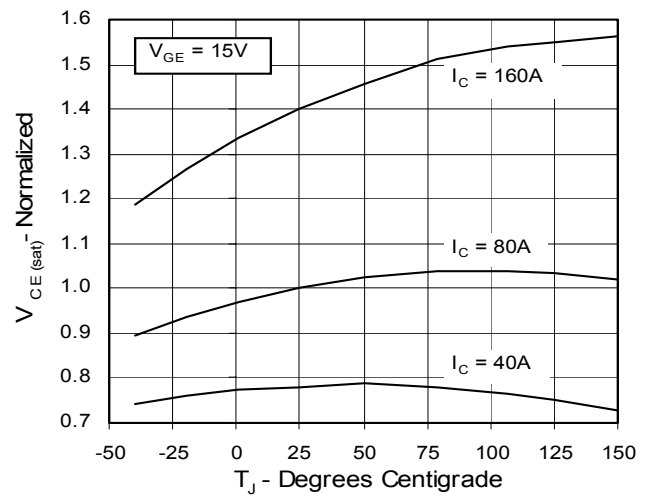
**Fig. 2. Extended Output Characteristics @ 25 deg. C**



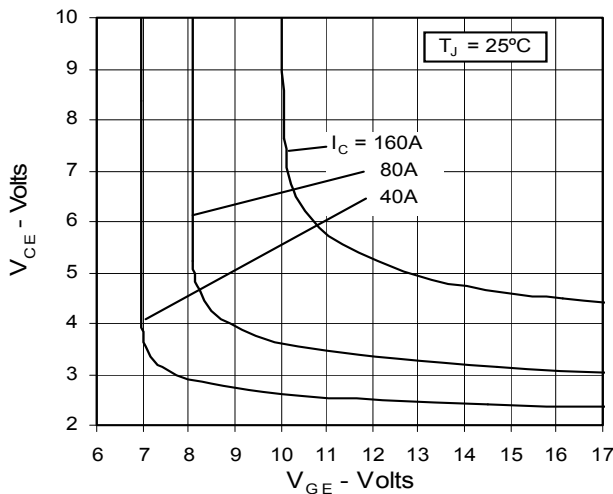
**Fig. 3. Output Characteristics @ 125 Deg. C**



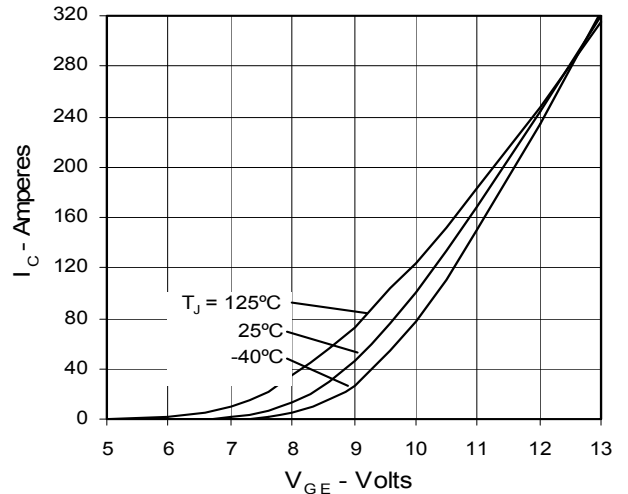
**Fig. 4. Dependence of  $V_{CE(sat)}$  on Temperature**



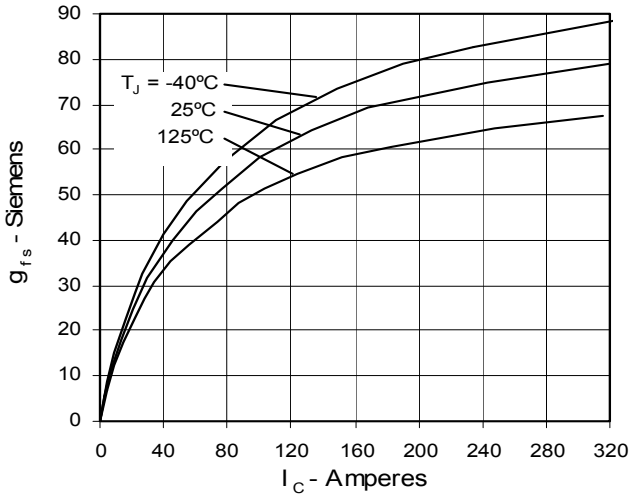
**Fig. 5. Collector-to-Emitter Voltage vs. Gate-to-Emitter voltage**



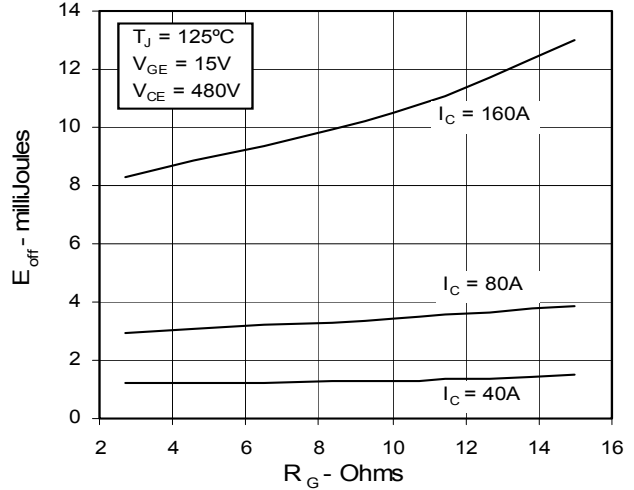
**Fig. 6. Input Admittance**



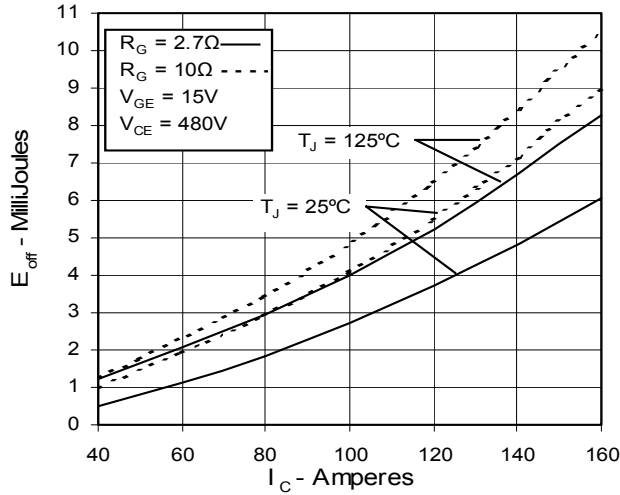
**Fig. 7. Transconductance**



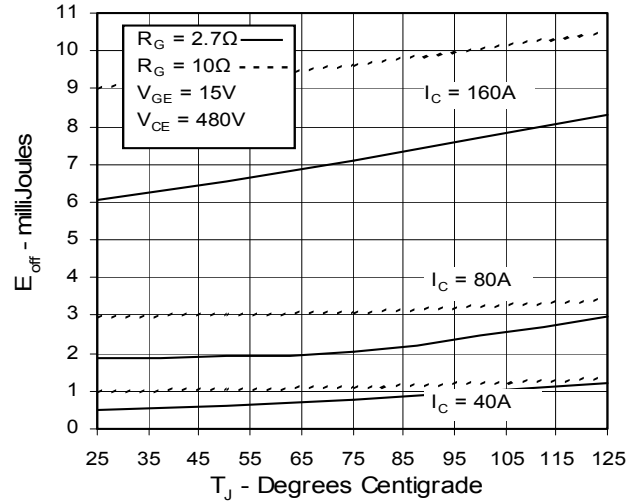
**Fig. 8. Dependence of Turn-off Energy Loss on  $R_G$**



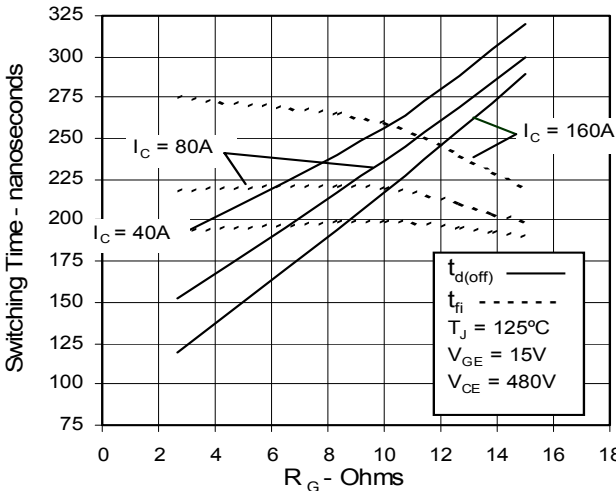
**Fig. 9. Dependence of Turn-Off Energy Loss on  $I_C$**



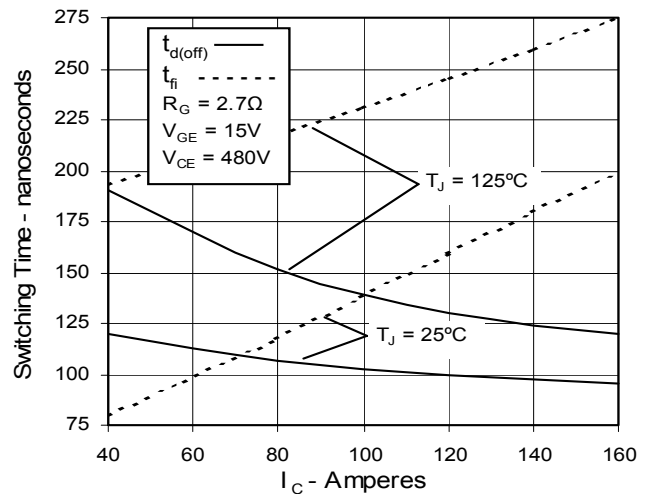
**Fig. 10. Dependence of Turn-off Energy Loss on Temperature**



**Fig. 11. Dependence of Turn-off Switching Time on  $R_G$**



**Fig. 12. Dependence of Turn-off Switching Time on  $I_C$**

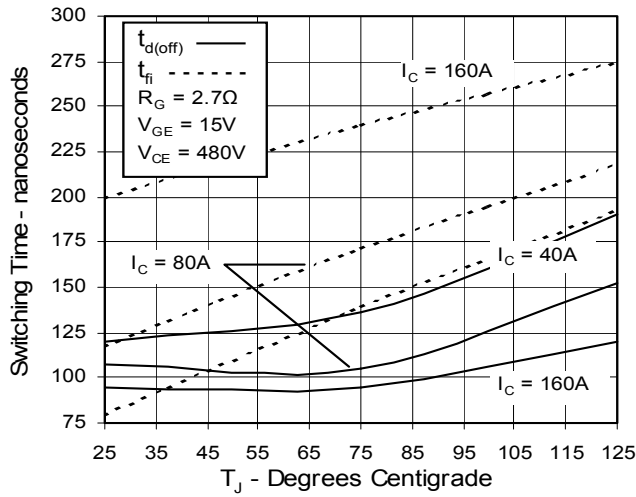


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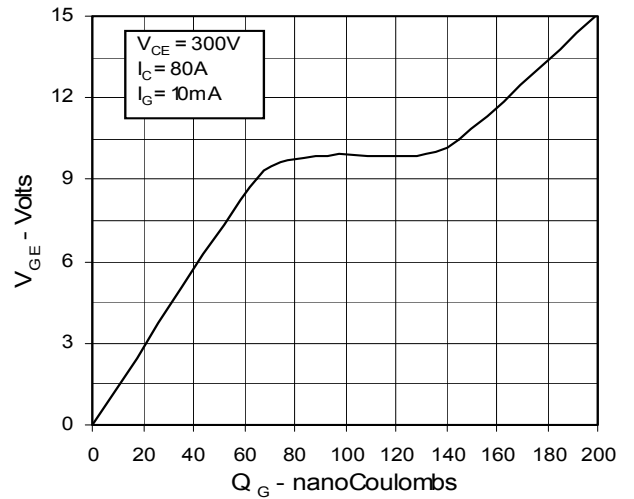
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|           |           |           |           |           |           |             |             |             |           |
|-----------|-----------|-----------|-----------|-----------|-----------|-------------|-------------|-------------|-----------|
| 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   | 6,583,505 |
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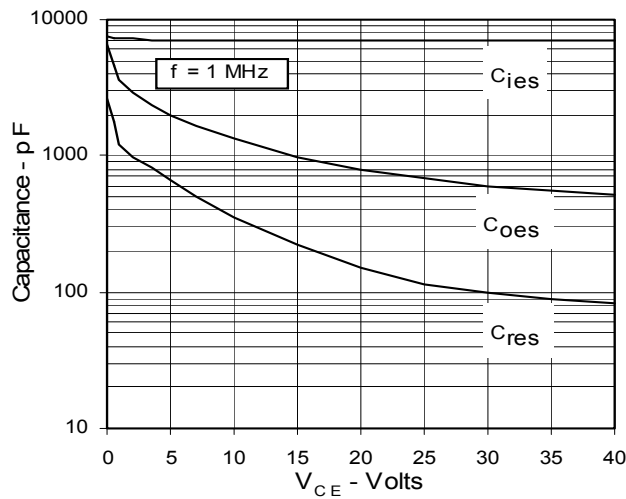
**Fig. 13. Dependence of Turn-off Switching Time on Temperature**



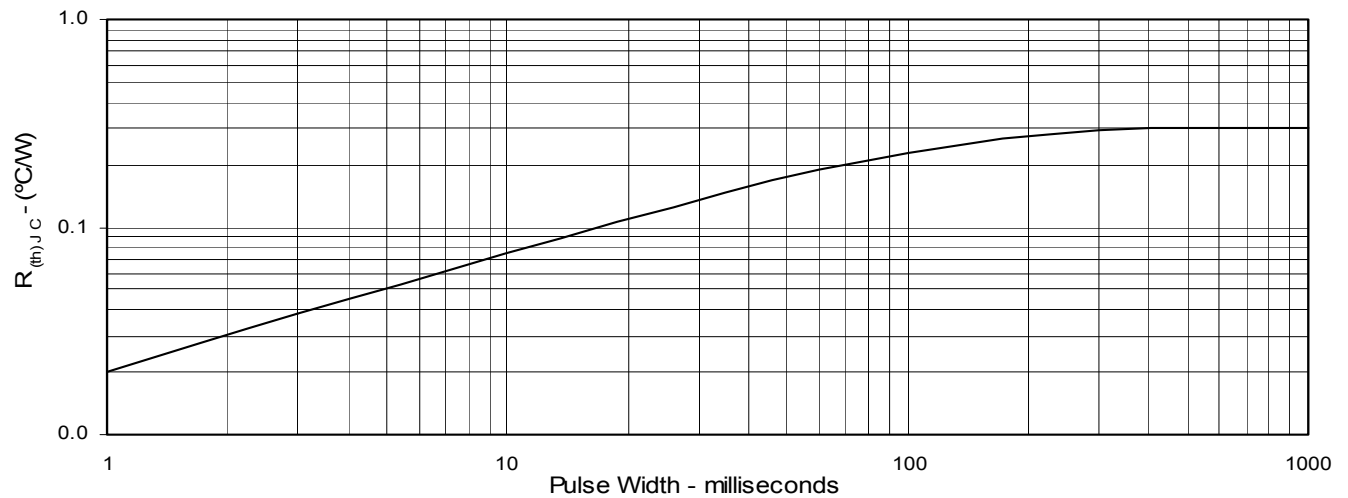
**Fig. 14. Gate Charge**



**Fig. 15. Capacitance**



**Fig. 16. Maximum Transient Thermal Resistance**



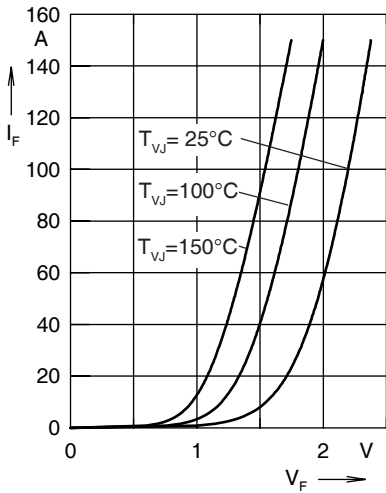


Fig. 17. Forward current  $I_F$  versus  $V_F$

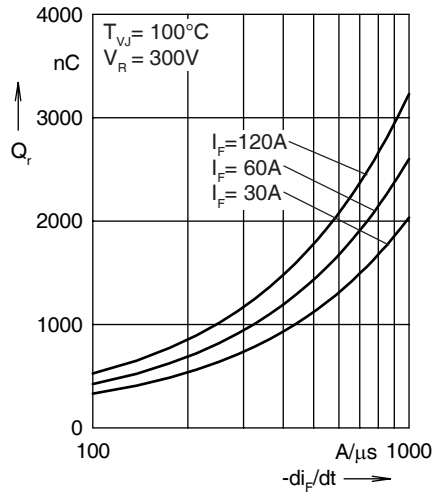


Fig. 18. Reverse recovery charge  $Q_r$  versus  $-di_F/dt$

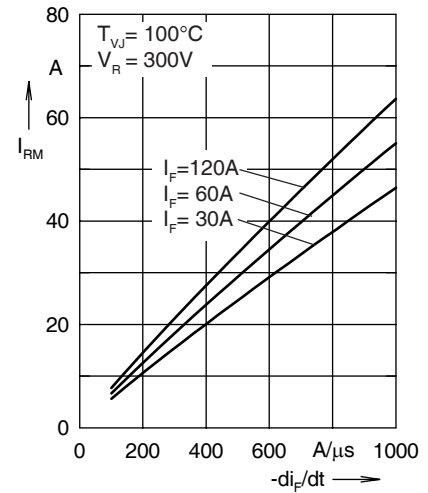


Fig. 19. Peak reverse current  $I_{RM}$  versus  $-di_F/dt$

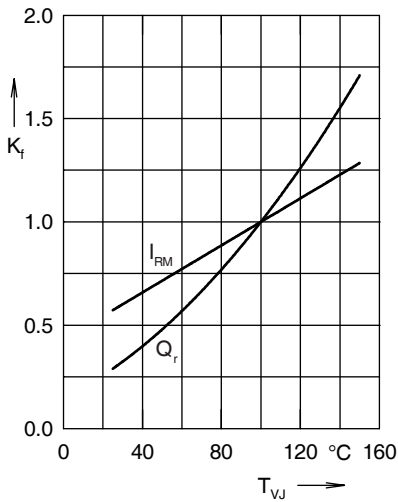


Fig. 20. Dynamic parameters  $Q_r$ ,  $I_{RM}$  versus  $T_{VJ}$

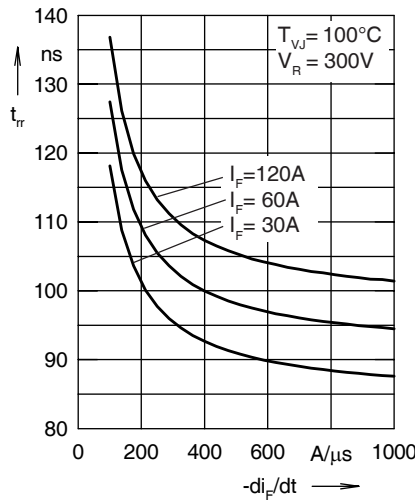


Fig. 21. Recovery time  $t_{tr}$  versus  $-di_F/dt$

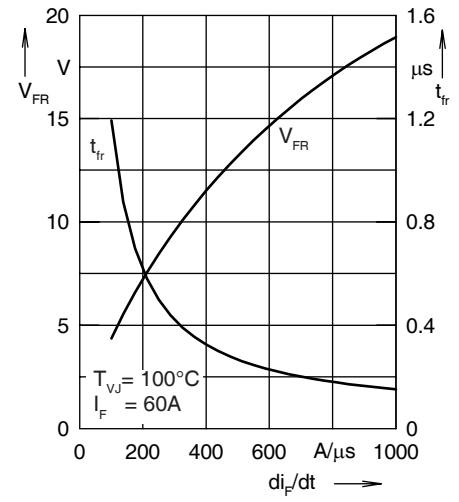


Fig. 22. Peak forward voltage  $V_{FR}$  and  $t_{tr}$  versus  $di_F/dt$

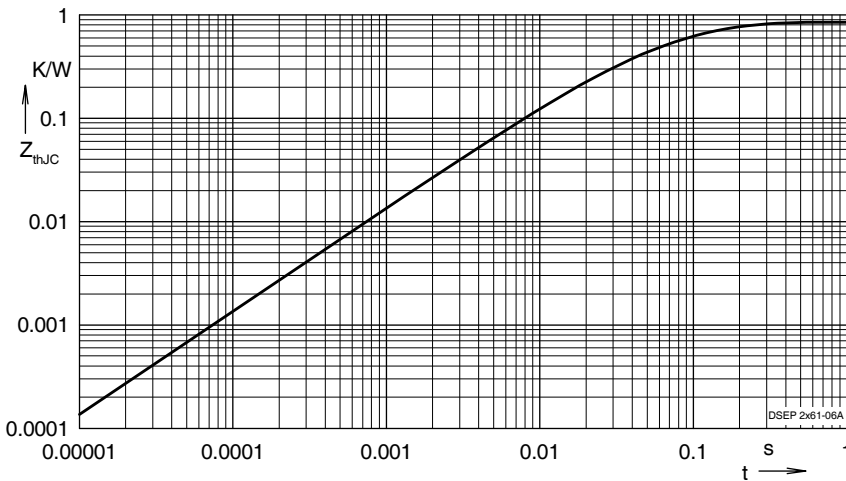


Fig. 7 Transient thermal resistance junction to case

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    |

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