

| Symbol       | Test Conditions<br>( $T_J = 25^\circ\text{C}$ , Unless Otherwise Specified)                                                                   | Characteristic Values |      |                         |
|--------------|-----------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|------|-------------------------|
|              |                                                                                                                                               | Min.                  | Typ. | Max.                    |
| $g_{fs}$     | $I_C = 20\text{A}$ , $V_{CE} = 10\text{V}$ , Note 1                                                                                           | 9                     | 30   | S                       |
| $C_{ies}$    | $V_{CE} = 25\text{V}$ , $V_{GE} = 0\text{V}$ , $f = 1\text{MHz}$                                                                              |                       | 915  | pF                      |
| $C_{oes}$    |                                                                                                                                               |                       | 78   | pF                      |
| $C_{res}$    |                                                                                                                                               |                       | 32   | pF                      |
| $Q_g$        | $I_C = 20\text{A}$ , $V_{GE} = 15\text{V}$ , $V_{CE} = 0.5 \cdot V_{CES}$                                                                     |                       | 38   | nC                      |
| $Q_{ge}$     |                                                                                                                                               |                       | 8    | nC                      |
| $Q_{gc}$     |                                                                                                                                               |                       | 17   | nC                      |
| $t_{d(on)}$  | Inductive load, $T_J = 25^\circ\text{C}$<br>$I_C = 20\text{A}$ , $V_{GE} = 15\text{V}$<br>$V_{CE} = 300\text{V}$ , $R_G = 5\Omega$<br>Note 2  |                       | 16   | ns                      |
| $t_{ri}$     |                                                                                                                                               |                       | 26   | ns                      |
| $E_{on}$     |                                                                                                                                               |                       | 0.27 | mJ                      |
| $t_{d(off)}$ |                                                                                                                                               |                       | 42   | ns                      |
| $t_{fi}$     |                                                                                                                                               |                       | 47   | ns                      |
| $E_{off}$    |                                                                                                                                               |                       | 0.09 | mJ                      |
| $t_{d(on)}$  | Inductive load, $T_J = 125^\circ\text{C}$<br>$I_C = 20\text{A}$ , $V_{GE} = 15\text{V}$<br>$V_{CE} = 300\text{V}$ , $R_G = 5\Omega$<br>Note 2 |                       | 17   | ns                      |
| $t_{ri}$     |                                                                                                                                               |                       | 28   | ns                      |
| $E_{on}$     |                                                                                                                                               |                       | 0.44 | mJ                      |
| $t_{d(off)}$ |                                                                                                                                               |                       | 70   | ns                      |
| $t_{fi}$     |                                                                                                                                               |                       | 90   | ns                      |
| $E_{off}$    |                                                                                                                                               |                       | 0.33 | mJ                      |
| $R_{thJC}$   | TO-247                                                                                                                                        |                       |      | 0.56 $^\circ\text{C/W}$ |
| $R_{thCS}$   |                                                                                                                                               |                       | 0.21 | $^\circ\text{C/W}$      |

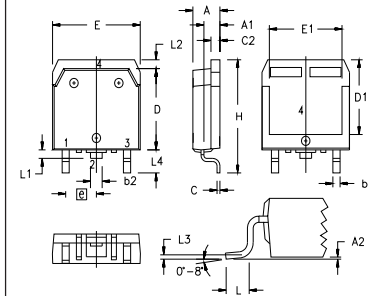
## Reverse Diode (FRED)

| Symbol     | Test Conditions<br>( $T_J = 25^\circ\text{C}$ , Unless Otherwise Specified)                                                    | Characteristic Values |           |                        |
|------------|--------------------------------------------------------------------------------------------------------------------------------|-----------------------|-----------|------------------------|
|            |                                                                                                                                | Min.                  | Typ.      | Max.                   |
| $V_F$      | $I_F = 30\text{A}$ , $V_{GE} = 0\text{V}$ , Note 1<br>$T_J = 150^\circ\text{C}$                                                |                       | 1.6       | 2.7 V                  |
| $I_{RM}$   | $I_F = 30\text{A}$ , $V_{GE} = 0\text{V}$ , $-di_F/dt = 100\text{A}/\mu\text{s}$ , $T_J = 100^\circ\text{C}$                   |                       |           | 4 A                    |
| $t_{rr}$   | $V_R = 100\text{V}$ , $T_J = 100^\circ\text{C}$<br>$I_F = 1\text{A}$ , $-di/dt = 100\text{A}/\mu\text{s}$ , $V_R = 30\text{V}$ |                       | 100<br>25 | ns<br>ns               |
| $R_{thJC}$ |                                                                                                                                |                       |           | 0.9 $^\circ\text{C/W}$ |

## Notes:

1. Pulse test,  $t \leq 300\mu\text{s}$ , duty cycle,  $d \leq 2\%$ .
2. Switching times & energy losses may increase for higher  $V_{CE}$  (Clamp),  $T_J$  or  $R_G$ .

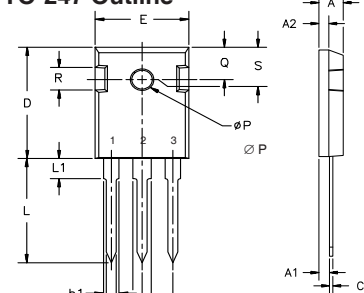
## TO-268 Outline



Terminals: 1 - Gate, 2,4 - Collector  
3 - Emitter

| SYM | INCHES   |      | MILLIMETERS |       |
|-----|----------|------|-------------|-------|
|     | MIN      | MAX  | MIN         | MAX   |
| A   | .193     | .201 | 4.90        | 5.10  |
| A1  | .106     | .114 | 2.70        | 2.90  |
| A2  | .001     | .010 | 0.02        | 0.25  |
| b   | .045     | .057 | 1.15        | 1.45  |
| b2  | .075     | .083 | 1.90        | 2.10  |
| C   | .016     | .026 | 0.40        | 0.65  |
| C2  | .057     | .063 | 1.45        | 1.60  |
| D   | .543     | .551 | 13.80       | 14.00 |
| D1  | .488     | .500 | 12.40       | 12.70 |
| E   | .624     | .632 | 15.85       | 16.05 |
| E1  | .524     | .535 | 13.30       | 13.60 |
| e   | .215 BSC |      | 5.45 BSC    |       |
| H   | .736     | .752 | 18.70       | 19.10 |
| L   | .094     | .106 | 2.40        | 2.70  |
| L1  | .047     | .055 | 1.20        | 1.40  |
| L2  | .039     | .045 | 1.00        | 1.15  |
| L3  | .010 BSC |      | 0.25 BSC    |       |
| L4  | .150     | .161 | 3.80        | 4.10  |

## TO-247 Outline



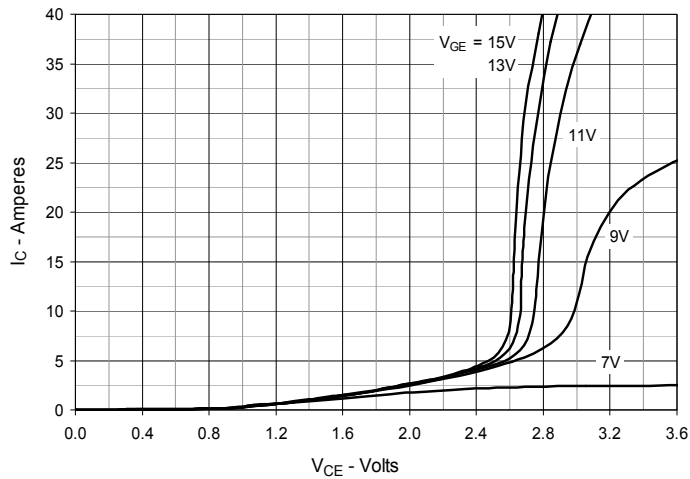
Terminals: 1 - Gate, 2 - Collector  
3 - Emitter

| Dim. | Millimeter |       | Inches |       |
|------|------------|-------|--------|-------|
|      | Min.       | Max.  | Min.   | Max.  |
| A    | 4.7        | 5.3   | .185   | .209  |
| A1   | 2.2        | 2.54  | .087   | .102  |
| A2   | 2.2        | 2.6   | .059   | .098  |
| b    | 1.0        | 1.4   | .040   | .055  |
| b1   | 1.65       | 2.13  | .065   | .084  |
| b2   | 2.87       | 3.12  | .113   | .123  |
| C    | .4         | .8    | .016   | .031  |
| D    | 20.80      | 21.46 | .819   | .845  |
| E    | 15.75      | 16.26 | .610   | .640  |
| e    | 5.20       | 5.72  | 0.205  | 0.225 |
| L    | 19.81      | 20.32 | .780   | .800  |
| L1   |            | 4.50  |        | .177  |
| ØP   | 3.55       | 3.65  | .140   | .144  |
| Q    | 5.89       | 6.40  | 0.232  | 0.252 |
| R    | 4.32       | 5.49  | .170   | .216  |
| S    | 6.15       | BSC   | 242    | BSC   |

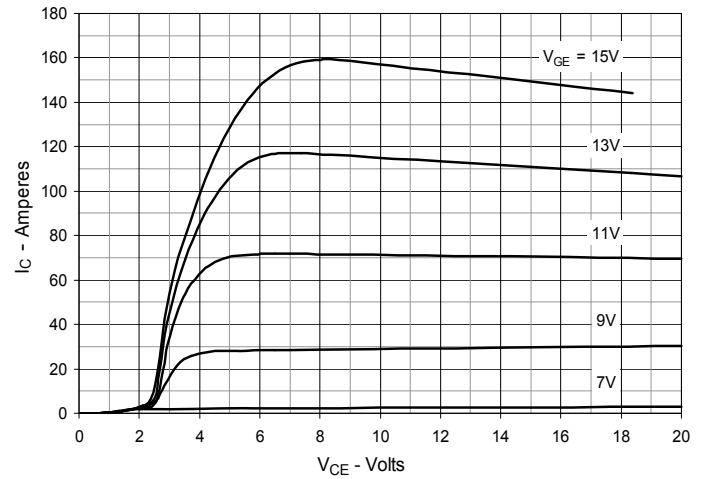
IXYS Reserves the Right to Change Limits, Test Conditions, and Dimensions.

|                                                                                  |           |           |           |           |              |              |              |              |              |             |
|----------------------------------------------------------------------------------|-----------|-----------|-----------|-----------|--------------|--------------|--------------|--------------|--------------|-------------|
| IXYS MOSFETs and IGBTs are covered by one or more of the following U.S. patents: | 4,835,592 | 4,931,844 | 5,049,961 | 5,237,481 | 6,162,665    | 6,404,065 B1 | 6,683,344    | 6,727,585    | 7,005,734 B2 | 7,157,338B2 |
|                                                                                  | 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    | 7,063,975 B2 |             |
|                                                                                  | 4,881,106 | 5,034,796 | 5,187,117 | 5,486,715 | 6,306,728 B1 | 6,583,505    | 6,710,463    | 6,771,478 B2 | 7,071,537    |             |

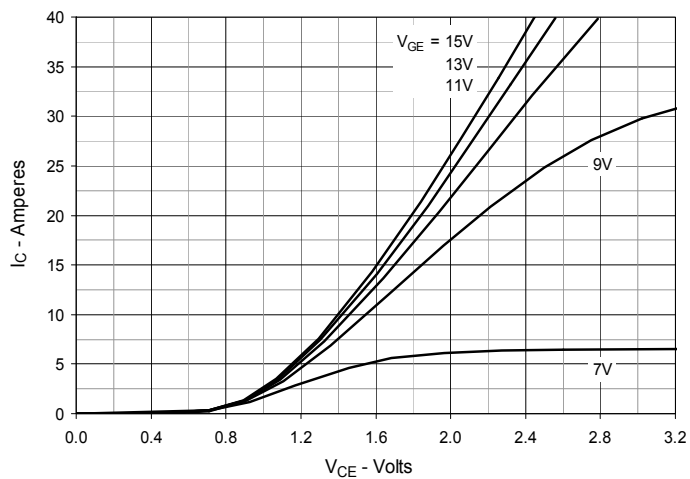
**Fig. 1. Output Characteristics @  $T_J = 25^\circ\text{C}$**



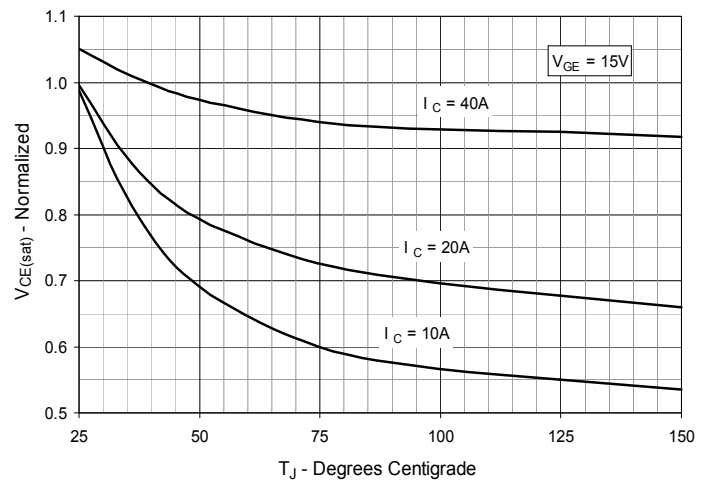
**Fig. 2. Extended Output Characteristics @  $T_J = 25^\circ\text{C}$**



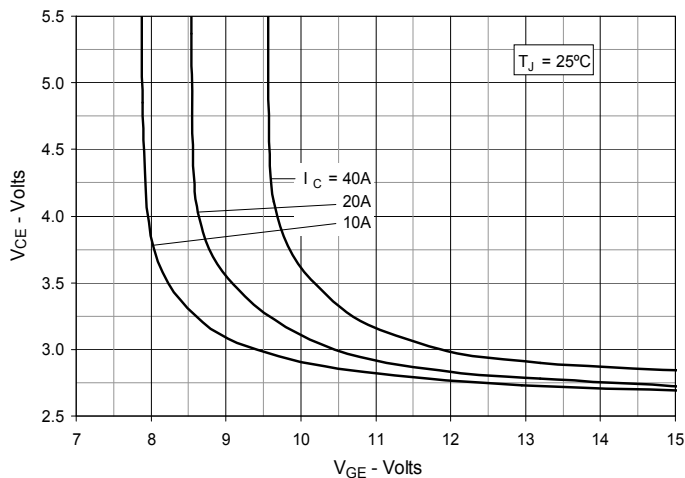
**Fig. 3. Output Characteristics @  $T_J = 125^\circ\text{C}$**



**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**

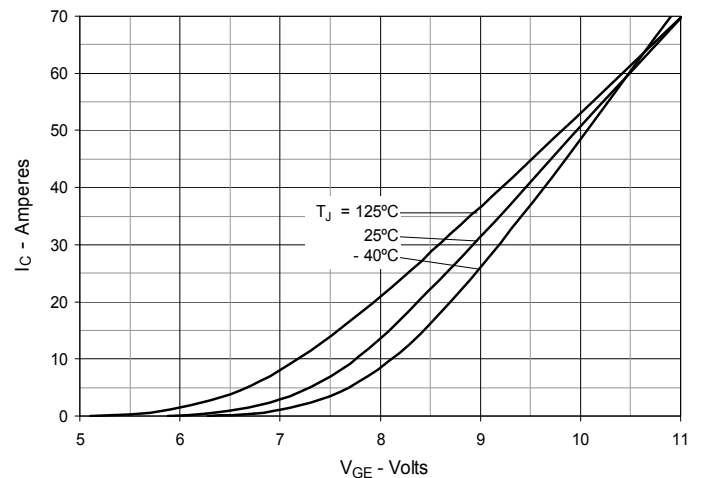


Fig. 7. Transconductance

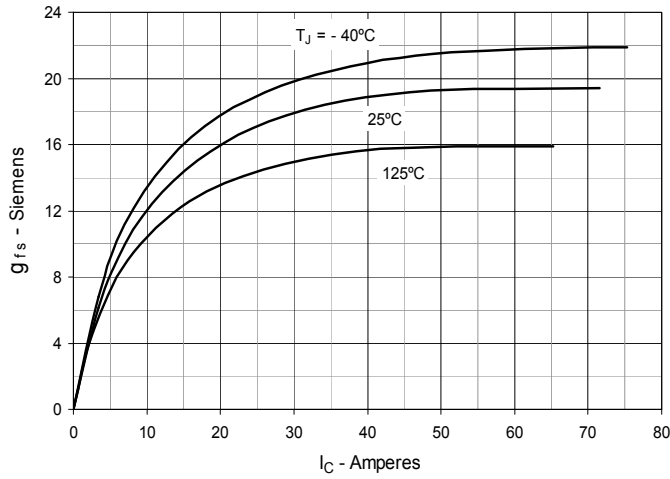


Fig. 8. Gate Charge

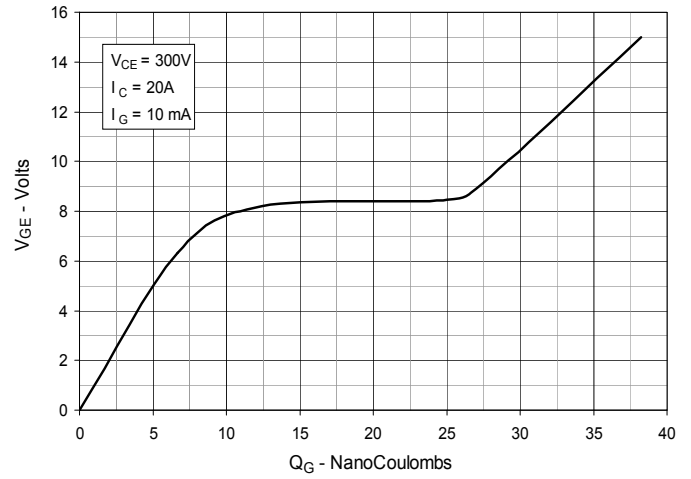


Fig. 9. Capacitance

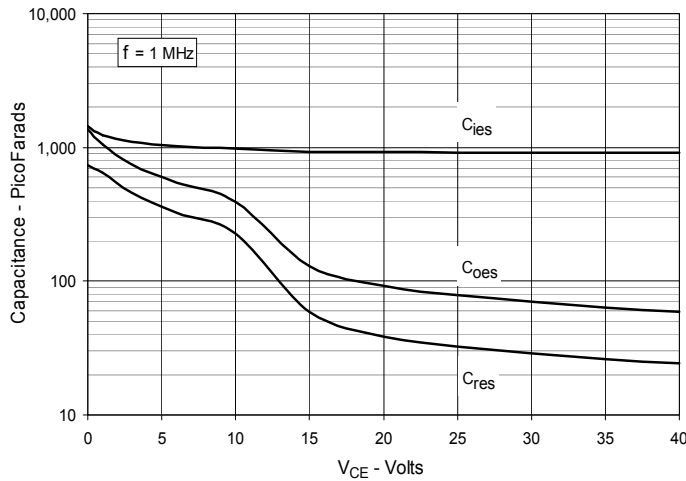


Fig. 10. Reverse-Bias Safe Operating Area

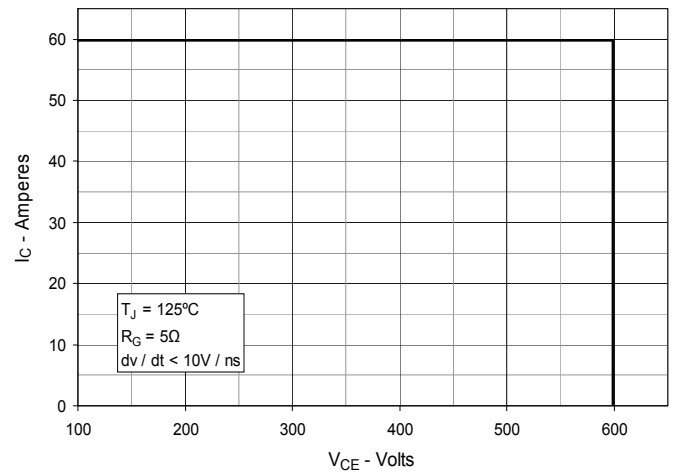
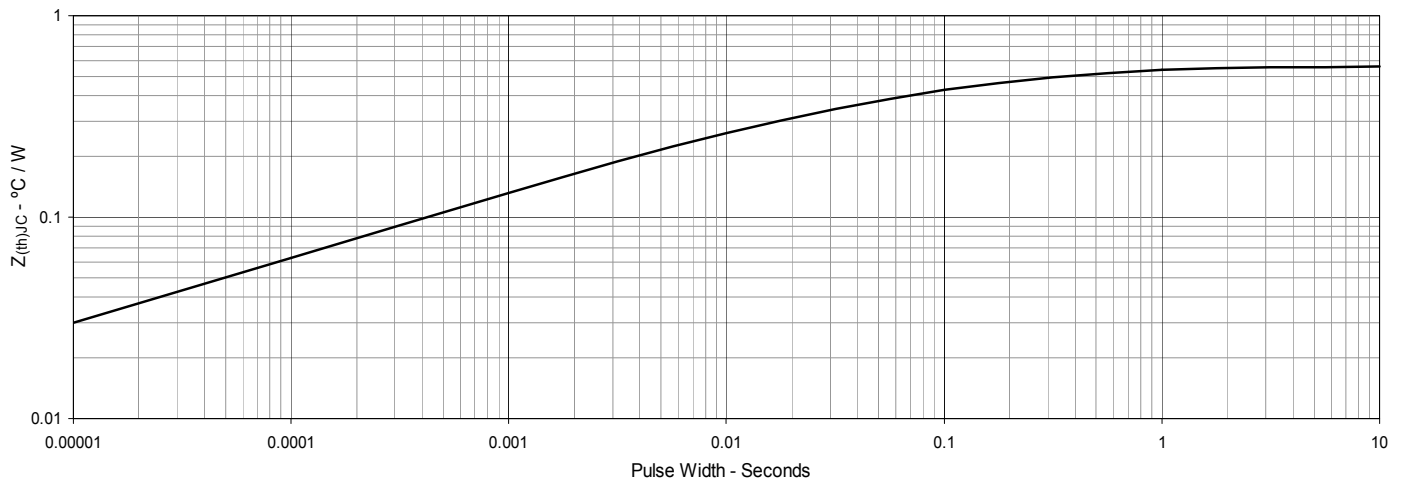


Fig. 11. Maximum Transient Thermal Impedance



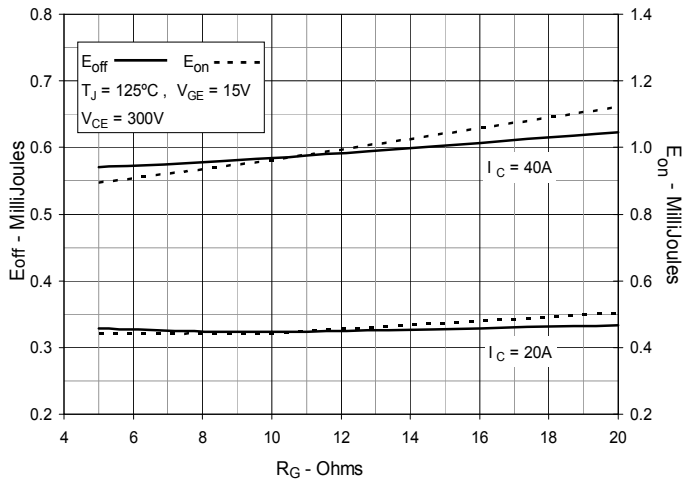
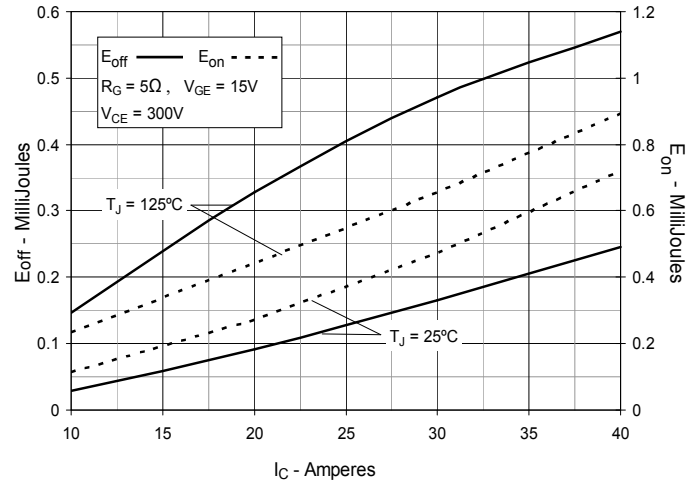
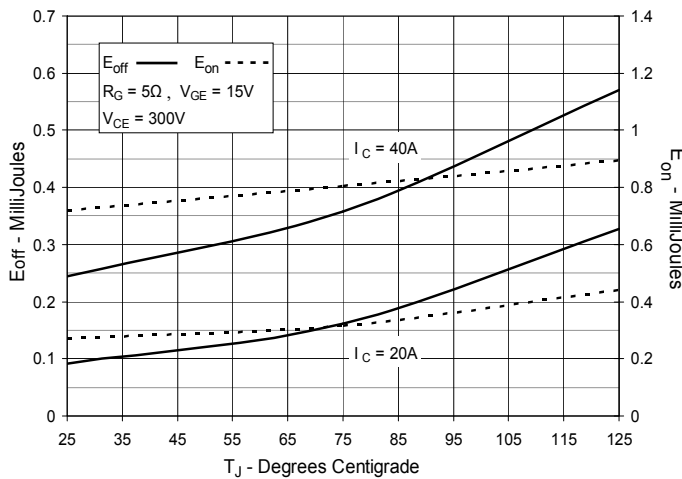
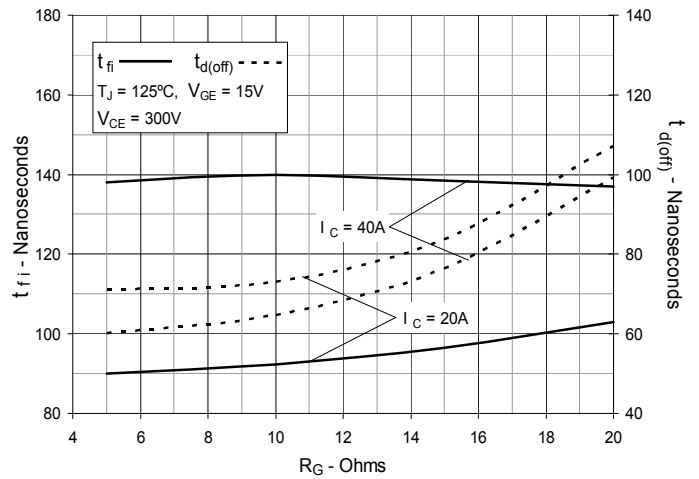
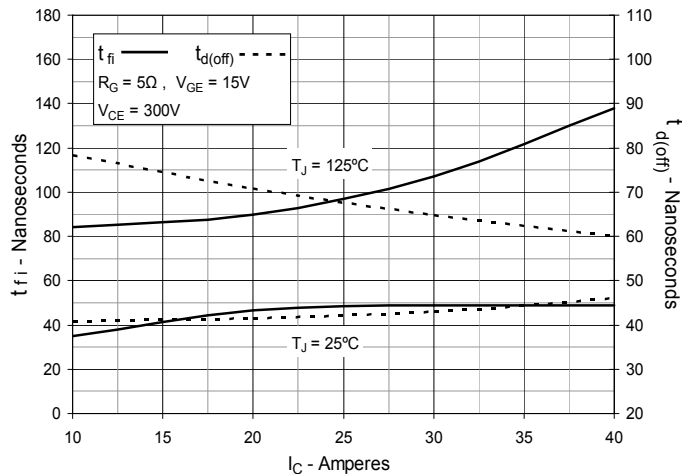
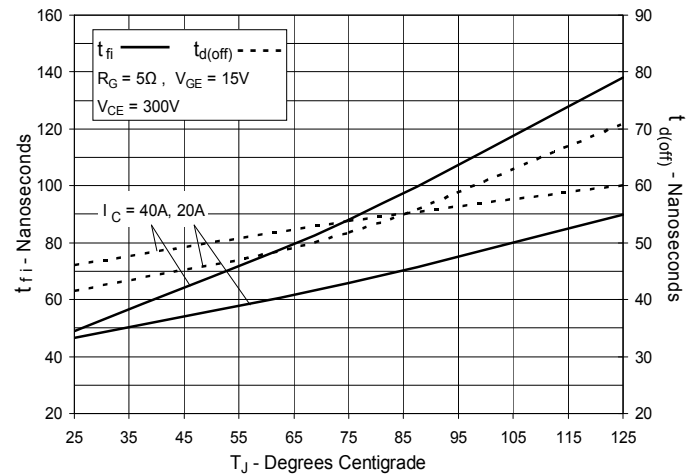
**Fig. 12. Inductive Switching Energy Loss vs. Gate Resistance**

**Fig. 13. Inductive Switching Energy Loss vs. Collector Current**

**Fig. 14. Inductive Switching Energy Loss vs. Junction Temperature**

**Fig. 15. Inductive Turn-off Switching Times vs. Gate Resistance**

**Fig. 16. Inductive Turn-off Switching Times vs. Collector Current**

**Fig. 17. Inductive Turn-off Switching Times vs. Junction Temperature**


Fig. 18. Inductive Turn-on Switching Times vs. Gate Resistance

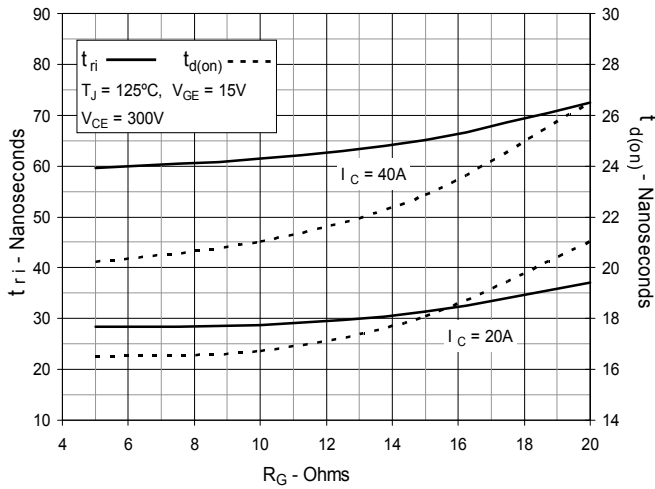


Fig. 19. Inductive Turn-on Switching Times vs. Collector Current

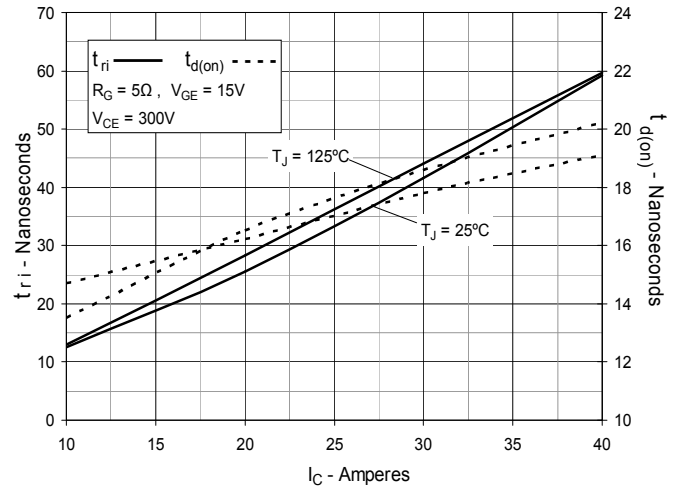
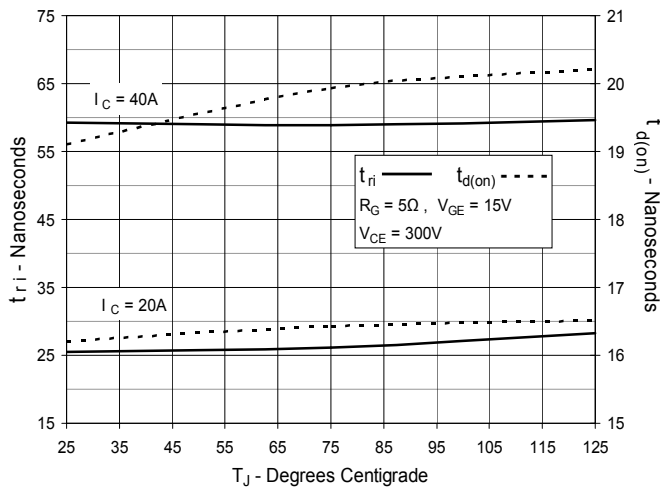


Fig. 20. Inductive Turn-on Switching Times vs. Junction Temperature



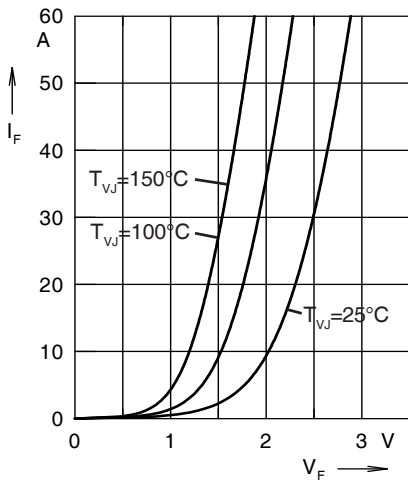


Fig. 21. Forward current  $I_F$  versus  $V_F$

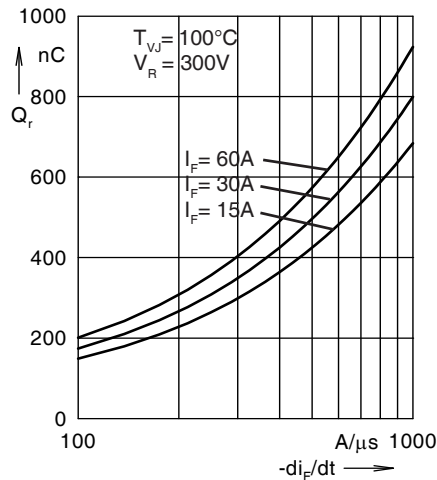


Fig. 22. Reverse recovery charge  $Q_r$  versus  $-di_F/dt$

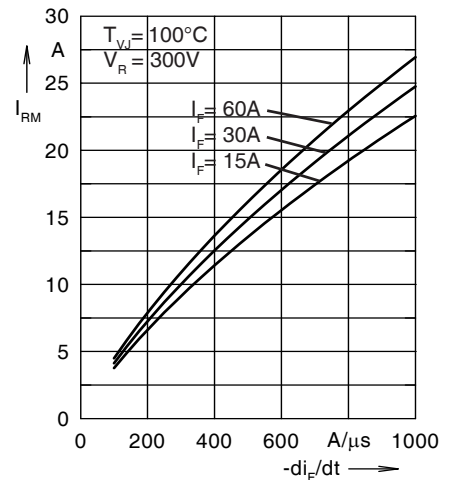


Fig. 23. Peak reverse current  $I_{RM}$  versus  $-di_F/dt$

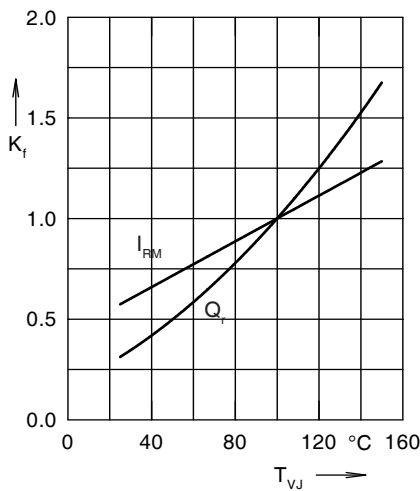


Fig. 24. Dynamic parameters  $Q_r$ ,  $I_{RM}$  versus  $T_{VJ}$

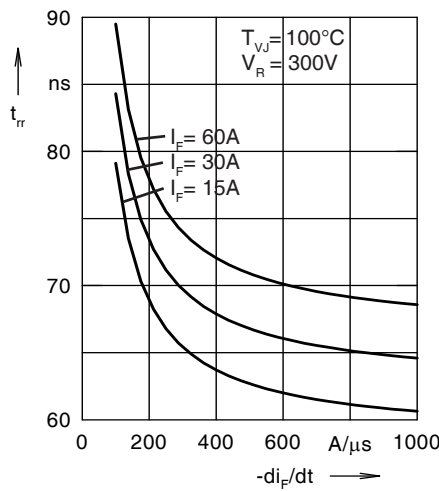


Fig. 25. Recovery time  $t_{rr}$  versus  $-di_F/dt$

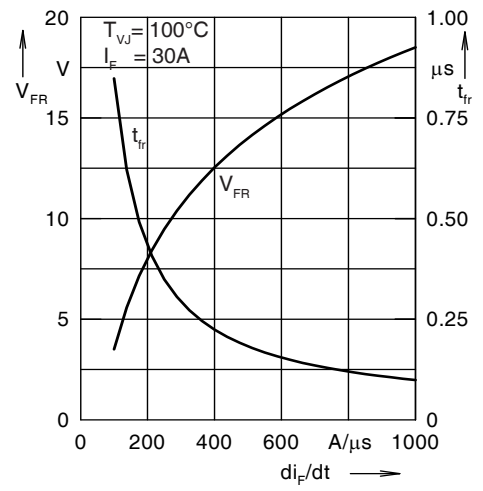


Fig. 26. Peak forward voltage  $V_{FR}$  and  $t_{fr}$  versus  $di_F/dt$

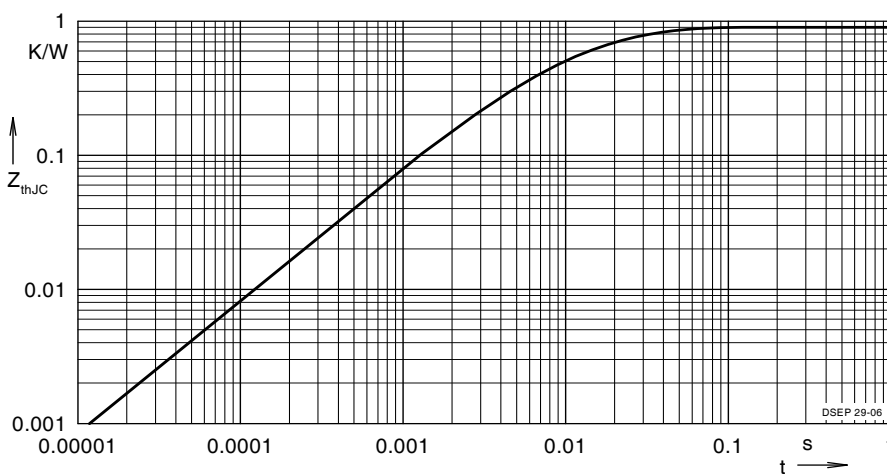


Fig. 27. Transient thermal resistance junction to case

Constants for  $Z_{thJC}$  calculation:

| i | $R_{thi}$ (K/W) | $t_i$ (s) |
|---|-----------------|-----------|
| 1 | 0.502           | 0.0052    |
| 2 | 0.193           | 0.0003    |
| 3 | 0.205           | 0.0162    |



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