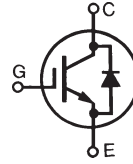


## High Voltage IGBT with Diode

**IXGH 28N120BD1**  
**IXGT 28N120BD1**

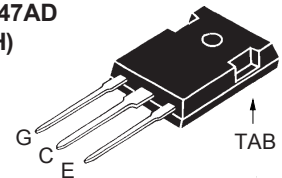
### Preliminary Data Sheet



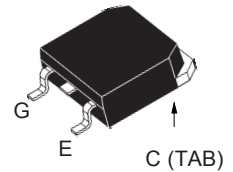
$$\begin{aligned} V_{CES} &= 1200 \text{ V} \\ I_{C25} &= 50 \text{ A} \\ V_{CE(sat)} &= 3.5 \text{ V} \\ t_{fi(typ)} &= 160 \text{ ns} \end{aligned}$$

| Symbol                                                                          | Test Conditions                                                                                   | Maximum Ratings                   |                  |
|---------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------|-----------------------------------|------------------|
| $V_{CES}$                                                                       | $T_J = 25^\circ\text{C}$ to $150^\circ\text{C}$                                                   | 1200                              | V                |
| $V_{CGR}$                                                                       | $T_J = 25^\circ\text{C}$ to $150^\circ\text{C}$ ; $R_{GE} = 1 \text{ M}\Omega$                    | 1200                              | V                |
| $V_{GES}$                                                                       | Continuous                                                                                        | $\pm 20$                          | V                |
| $V_{GEM}$                                                                       | Transient                                                                                         | $\pm 30$                          | V                |
| $I_{C25}$                                                                       | $T_C = 25^\circ\text{C}$                                                                          | 50                                | A                |
| $I_{C110}$                                                                      | $T_C = 110^\circ\text{C}$                                                                         | 28                                | A                |
| $I_{CM}$                                                                        | $T_C = 25^\circ\text{C}$ , 1 ms                                                                   | 150                               | A                |
| <b>SSOA</b><br><b>(RBSOA)</b>                                                   | $V_{GE} = 15 \text{ V}$ , $T_J = 125^\circ\text{C}$ , $R_G = 10 \Omega$<br>Clamped inductive load | $I_{CM} = 120$<br>@ $0.8 V_{CES}$ | A                |
| $P_C$                                                                           | $T_C = 25^\circ\text{C}$                                                                          | 250                               | 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-247)                                                                          | 1.13/10 Nm/lb.in.                 |                  |
| Maximum lead temperature for soldering<br>1.6 mm (0.062 in.) from case for 10 s |                                                                                                   | 300                               | $^\circ\text{C}$ |
| Maximum tab temperature<br>soldering SMD devices for 10s                        |                                                                                                   | 260                               | $^\circ\text{C}$ |
| <b>Weight</b>                                                                   | TO-247AD/TO-268                                                                                   | 6/4                               | g                |

**TO-247AD**  
**(IXGH)**



**TO-268**  
**(IXGT)**



G = Gate  
E = Emitter

C = Collector  
TAB = Collector

### Features

- International standard packages: JEDEC TO-247AD & TO-268
- IGBT and anti-parallel FRED for resonant power supplies
  - Induction heating
  - Rice cookers
- MOS Gate turn-on
  - drive simplicity
- Fast Recovery Exptaxial Diode (FRED)
  - soft recovery with low  $I_{RM}$

### Advantages

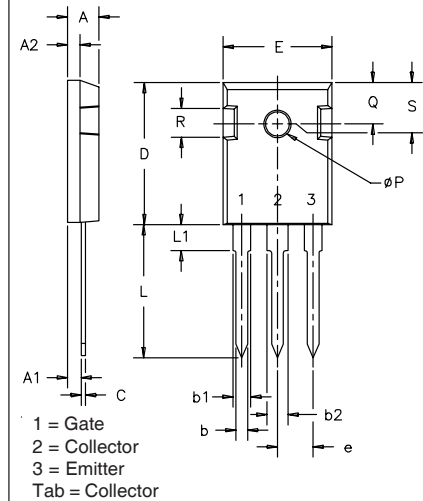
- Saves space (two devices in one package)
- Easy to mount with 1 screw (isolated mounting screw hole)
- Reduces assembly time and cost

| Symbol        | Test Conditions                                                                                       | Characteristic Values<br>( $T_J = 25^\circ\text{C}$ , unless otherwise specified) |            |                                   |
|---------------|-------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|------------|-----------------------------------|
|               |                                                                                                       | min.                                                                              | typ.       | max.                              |
| $BV_{CES}$    | $I_C = 1 \mu\text{A}$ , $V_{GE} = 0 \text{ V}$                                                        | 1200                                                                              |            | V                                 |
| $V_{GE(th)}$  | $I_C = 250 \mu\text{A}$ , $V_{CE} = V_{GE}$                                                           | 2.5                                                                               |            | 5.0 V                             |
| $I_{CES}$     | $V_{CE} = V_{CES}$<br>$V_{GE} = 0 \text{ V}$<br>$T_J = 25^\circ\text{C}$<br>$T_J = 125^\circ\text{C}$ |                                                                                   | 50         | 50 $\mu\text{A}$<br>$\mu\text{A}$ |
| $I_{GES}$     | $V_{CE} = 0 \text{ V}$ , $V_{GE} = \pm 20 \text{ V}$                                                  |                                                                                   |            | $\pm 100 \text{ nA}$              |
| $V_{CE(sat)}$ | $I_C = 28 \text{ A}$ , $V_{GE} = 15 \text{ V}$<br>Note 2<br>$T = 125^\circ\text{C}$                   |                                                                                   | 2.9<br>2.8 | 3.5 V                             |

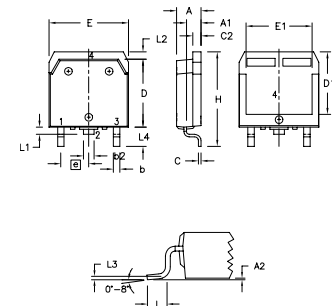
| Symbol       | Test Conditions                                                     | Characteristic Values<br>( $T_J = 25^\circ\text{C}$ , unless otherwise specified) |      |         |
|--------------|---------------------------------------------------------------------|-----------------------------------------------------------------------------------|------|---------|
|              |                                                                     | min.                                                                              | typ. | max.    |
| $g_{fs}$     | $I_C = 28\text{A}$ ; $V_{CE} = 10\text{V}$ ,<br>Note 2.             | 20                                                                                | 30   | S       |
| $C_{ies}$    | $V_{CE} = 25\text{V}$ , $V_{GE} = 0\text{V}$ , $f = 1\text{MHz}$    |                                                                                   | 2700 | pF      |
| $C_{oes}$    |                                                                     |                                                                                   | 180  | pF      |
| $C_{res}$    |                                                                     |                                                                                   | 60   | pF      |
| $Q_g$        | $I_C = 28\text{A}$ , $V_{GE} = 15\text{V}$ , $V_{CE} = 0.5 V_{CES}$ |                                                                                   | 112  | nC      |
| $Q_{ge}$     |                                                                     |                                                                                   | 17   | nC      |
| $Q_{gc}$     |                                                                     |                                                                                   | 37   | nC      |
| $t_{d(on)}$  | <b>Inductive load, <math>T_J = 25^\circ\text{C}</math></b>          |                                                                                   | 30   | ns      |
| $t_{ri}$     | $I_C = 28\text{A}$ ; $V_{GE} = 15\text{V}$                          |                                                                                   | 20   | ns      |
| $t_{d(off)}$ | $V_{CE} = 0.8 V_{CES}$ ; $R_G = R_{off} = 5\ \Omega$<br>Note 1.     |                                                                                   | 180  | 280 ns  |
| $t_{fi}$     | <b>Inductive load, <math>T_J = 125^\circ\text{C}</math></b>         |                                                                                   | 160  | 320 ns  |
| $E_{off}$    |                                                                     |                                                                                   | 2.8  | 5.0 mJ  |
| $t_{d(on)}$  |                                                                     |                                                                                   | 35   | ns      |
| $t_{ri}$     | $I_C = 28\text{A}$ ; $V_{GE} = 15\text{V}$                          |                                                                                   | 28   | ns      |
| $E_{on}$     | $V_{CE} = 0.8 V_{CES}$ ; $R_G = R_{off} = 5\ \Omega$                |                                                                                   | 2.5  | mJ      |
| $t_{d(off)}$ | Note 1                                                              |                                                                                   | 250  | ns      |
| $t_{fi}$     |                                                                     |                                                                                   | 300  | ns      |
| $E_{off}$    |                                                                     |                                                                                   | 5.0  | mJ      |
| $R_{thJC}$   | (TO-247)                                                            |                                                                                   | 0.25 | 0.5 K/W |
| $R_{thCK}$   |                                                                     |                                                                                   |      |         |

| Symbol     | Test Conditions                                                                                      | Characteristic Values<br>( $T_J = 25^\circ\text{C}$ , unless otherwise specified) |      |         |
|------------|------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|------|---------|
|            |                                                                                                      | min.                                                                              | typ. | max.    |
| $V_F$      | $I_F = 10\text{A}$ , $V_{GE} = 0\text{V}$                                                            |                                                                                   |      | 3.3 V   |
| $I_F$      | $T_C = 90^\circ\text{C}$                                                                             |                                                                                   |      | 10 A    |
| $I_{RM}$   | $I_F = 10\text{A}$ ; $-di_F/dt = 400\text{A}/\mu\text{s}$ , $V_R = 600\text{V}$                      |                                                                                   | 14   | A       |
| $t_{rr}$   | $V_{GE} = 0\text{V}$ ; $T_J = 125^\circ\text{C}$                                                     |                                                                                   | 120  | ns      |
| $t_{rr}$   | $I_F = 1\text{A}$ ; $-di_F/dt = 100\text{A}/\mu\text{s}$ ; $V_R = 30\text{V}$ , $V_{GE} = 0\text{V}$ |                                                                                   | 40   | ns      |
| $R_{thJC}$ |                                                                                                      |                                                                                   |      | 2.5 K/W |

- Notes: 1. Switching times may increase for  $V_{CE}(\text{Clamp}) > 0.8 \cdot V_{CES}$ , higher  $T_J$  or increased  $R_G$ .
2. Pulse test,  $t \leq 300\ \mu\text{s}$ , duty cycle  $d \leq 2\%$

**TO-247 AD Outline**


| SYM | INCHES   |      | MILLIMETERS |       |
|-----|----------|------|-------------|-------|
|     | MIN      | MAX  | MIN         | MAX   |
| A   | .185     | .209 | 4.7         | 5.3   |
| A1  | .087     | .102 | 2.2         | 2.54  |
| A2  | .059     | .098 | 2.2         | 2.6   |
| b   | .040     | .055 | 1.0         | 1.4   |
| b1  | .065     | .084 | 1.65        | 2.13  |
| b2  | .113     | .123 | 2.87        | 3.12  |
| C   | .016     | .031 | .4          | .8    |
| D   | .819     | .845 | 20.80       | 21.46 |
| E   | .610     | .640 | 15.75       | 16.26 |
| e   | .215 BSC |      | 5.45 BSC    |       |
| L   | .780     | .800 | 19.81       | 20.32 |
| L1  |          | .177 |             | 4.50  |
| ØP  | .140     | .144 | 3.55        | 3.65  |
| Q   | .212     | .244 | 5.4         | 6.2   |
| R   | .170     | .216 | 4.32        | 5.49  |
| S   | .242 BSC |      | 6.15 BSC    |       |

**TO-268 Outline**


| Dim. | Millimeter |       | Inches   |      |
|------|------------|-------|----------|------|
|      | Min.       | Max.  | Min.     | Max. |
| A    | 4.9        | 5.1   | .193     | .201 |
| A1   | 2.7        | 2.9   | .106     | .114 |
| A2   | .02        | .25   | .001     | .010 |
| b    | 1.15       | 1.45  | .045     | .057 |
| b2   | 1.9        | 2.1   | .075     | .083 |
| C    | .4         | .65   | .016     | .026 |
| D    | 13.80      | 14.00 | .543     | .551 |
| E    | 15.85      | 16.05 | .624     | .632 |
| E1   | 13.3       | 13.6  | .524     | .535 |
| e    | 5.45 BSC   |       | .215 BSC |      |
| H    | 18.70      | 19.10 | .736     | .752 |
| L    | 2.40       | 2.70  | .094     | .106 |
| L1   | 1.20       | 1.40  | .047     | .055 |
| L2   | 1.00       | 1.15  | .039     | .045 |
| L3   | 0.25 BSC   |       | .010 BSC |      |
| L4   | 3.80       | 4.10  | .150     | .161 |

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

Fig. 1. Output Characteristics  
@ 25 Deg. C

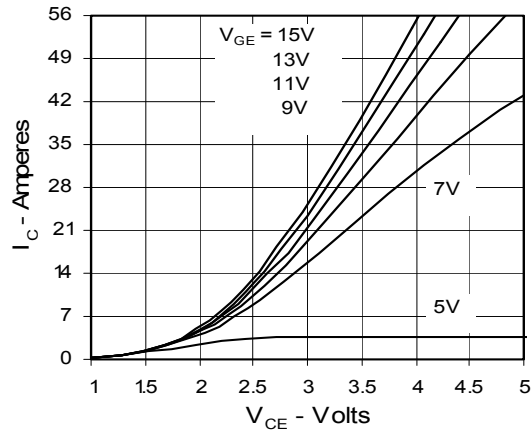


Fig. 2. Extended Output Characteristics  
@ 25 deg. C

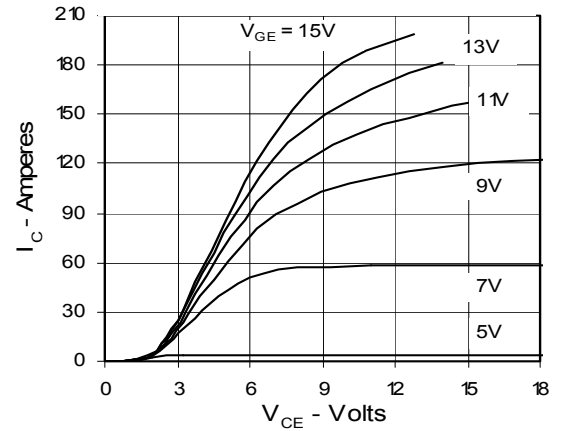


Fig. 3. Output Characteristics  
@ 125 Deg. C

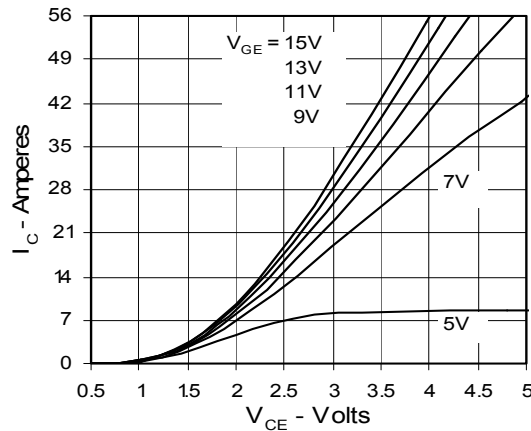


Fig. 4. Temperature Dependence of  $V_{CE(sat)}$

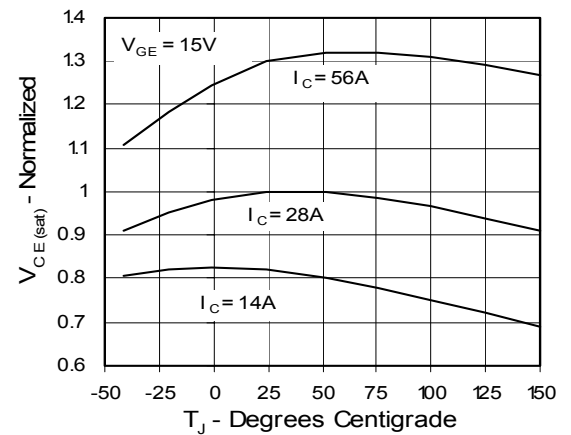


Fig. 5. Input Admittance

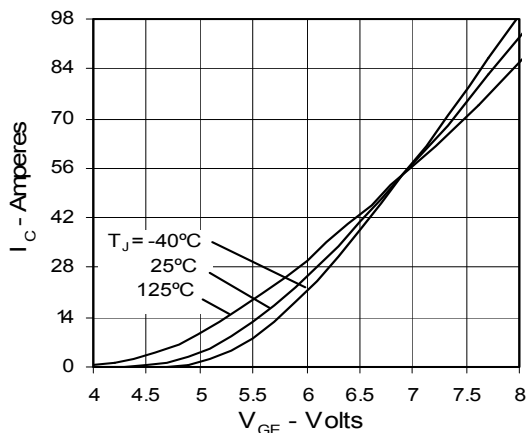


Fig. 6. Transconductance

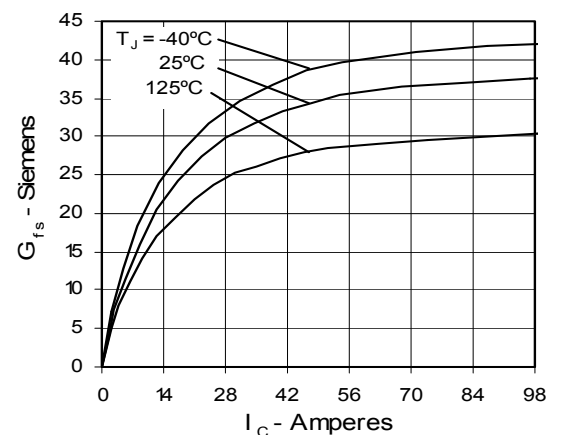


Fig. 7. Dependence of  $E_{off}$  on  $R_G$

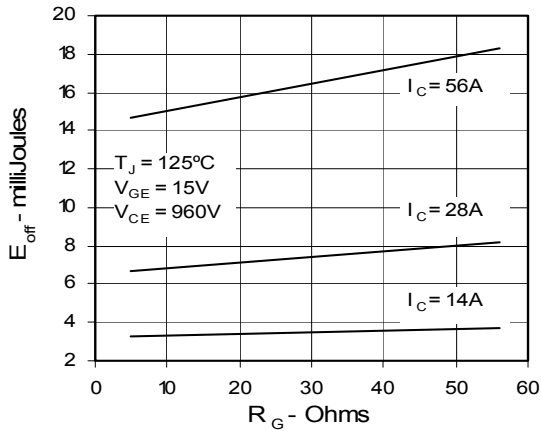


Fig. 8. Dependence of  $E_{off}$  on  $I_C$

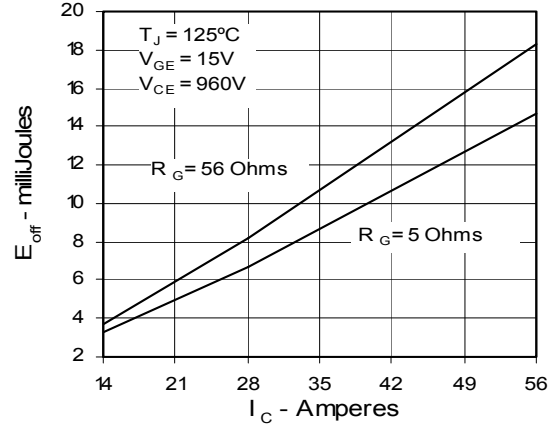


Fig. 9. Dependence of  $E_{off}$  on Temperature

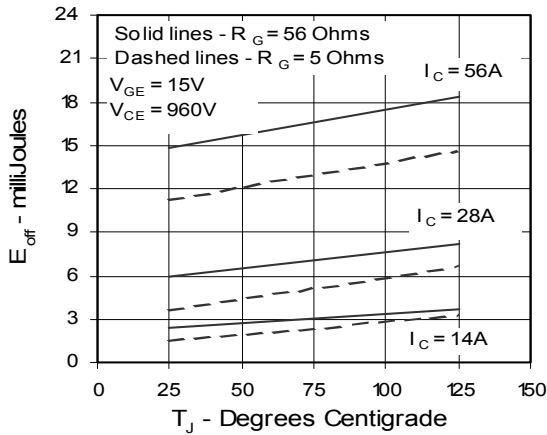


Fig. 10. Gate Charge

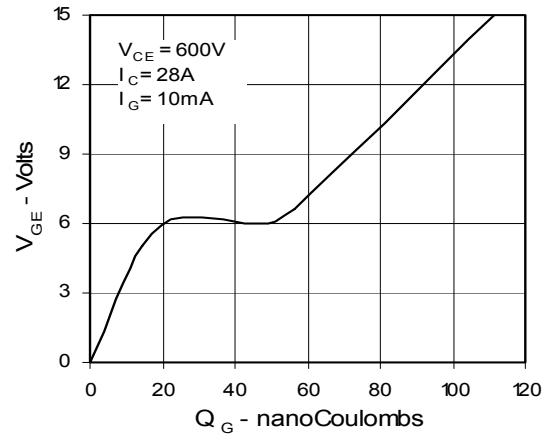


Fig. 11. Reverse-Bias Safe Operating Area

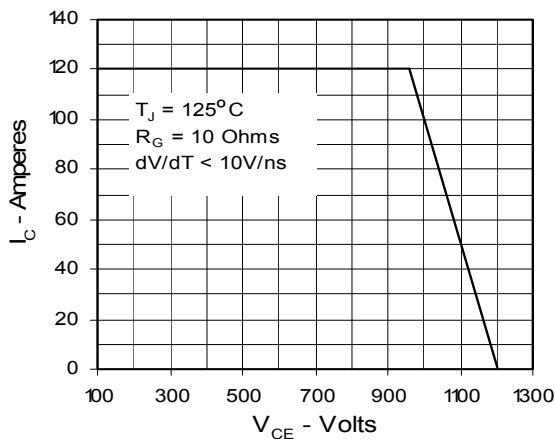
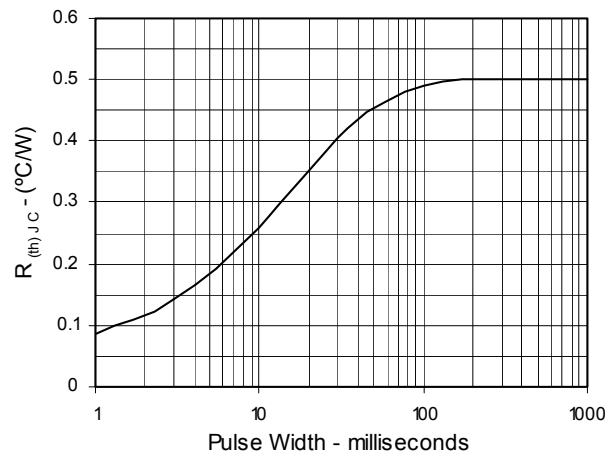


Fig. 12. Maximum Transient Thermal Resistance



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

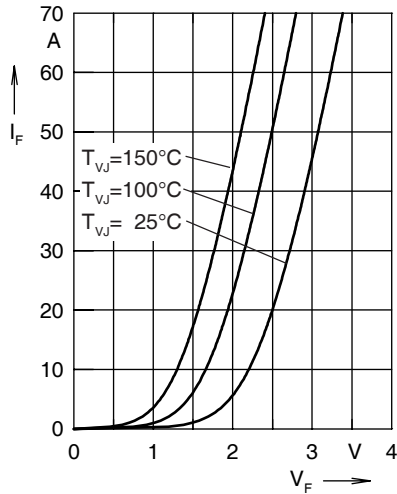


Fig. 13. Forward current  $I_F$  versus  $V_F$

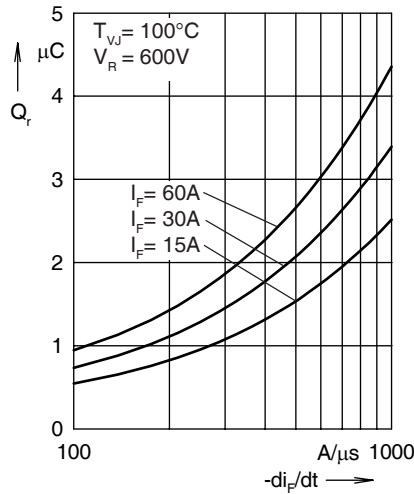


Fig. 14. Reverse recovery charge  $Q_r$  versus  $-di_F/dt$

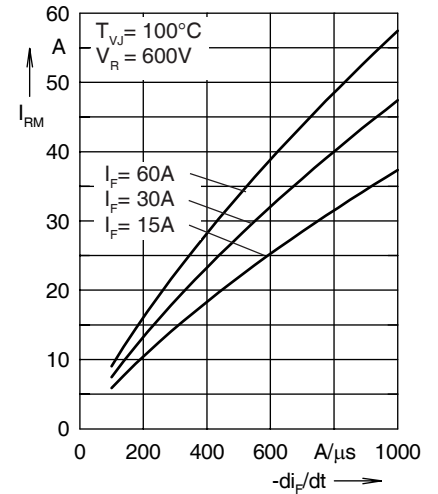


Fig. 15. Peak reverse current  $I_{RM}$  versus  $-di_F/dt$

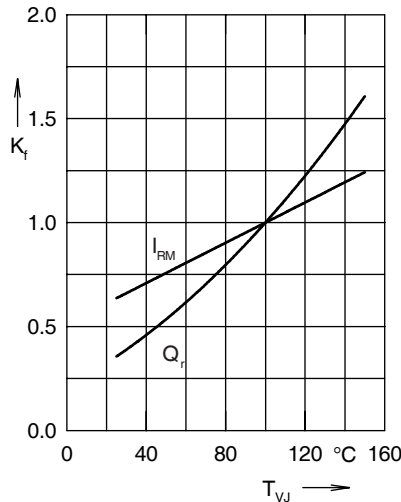


Fig. 16. Dynamic parameters  $Q_r$ ,  $I_{RM}$  versus  $T_{VJ}$

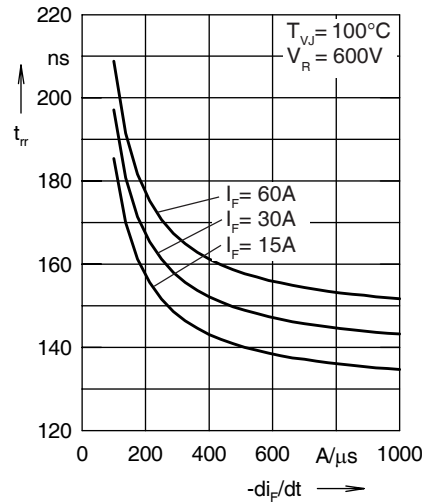


Fig. 17. Recovery time  $t_{rr}$  versus  $-di_F/dt$

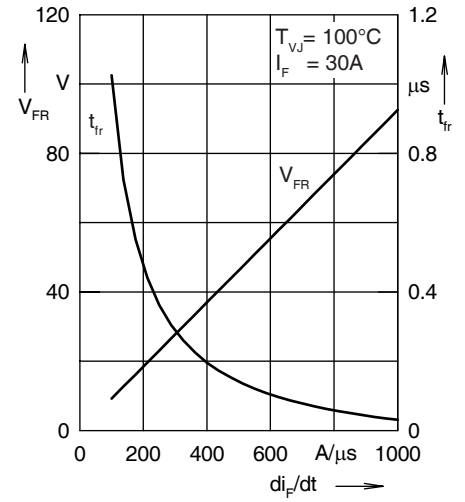


Fig. 18. Peak forward voltage  $V_{FR}$  and  $t_{fr}$  versus  $di_F/dt$

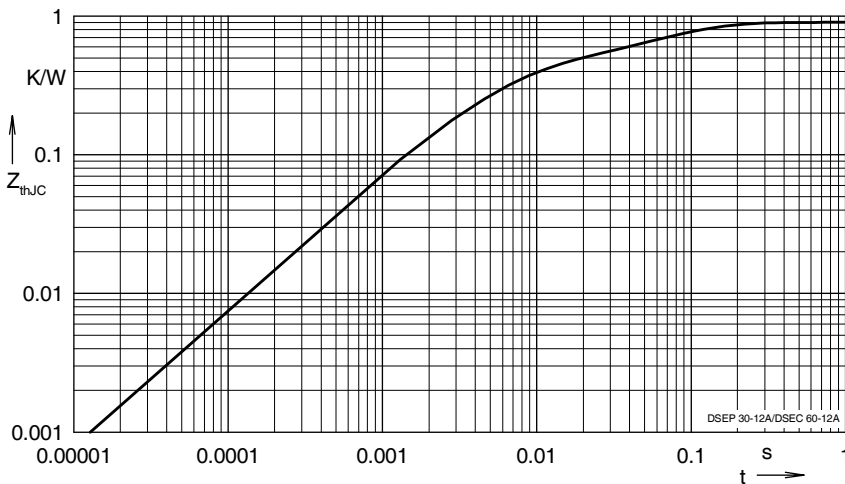


Fig. 19. Transient thermal resistance junction to case

Constants for  $Z_{thJC}$  calculation:

| i | $R_{thi}$ (K/W) | $t_i$ (s) |
|---|-----------------|-----------|
| 1 | 0.465           | 0.0052    |
| 2 | 0.179           | 0.0003    |
| 3 | 0.256           | 0.0397    |