

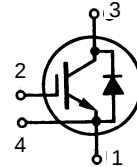
# IGBT with Diode

# IXSN 52N60AU1

## Combi Pack

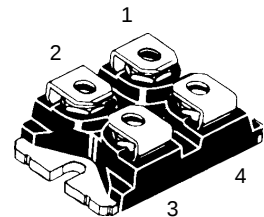
$$\begin{aligned} V_{CES} &= 600 \text{ V} \\ I_{C25} &= 80 \text{ A} \\ V_{CE(sat)} &= 3 \text{ V} \end{aligned}$$

## Short Circuit SOA Capability



| 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                |
| $I_{C25}$                          | $T_C = 25^\circ\text{C}$                                                                                                   | 80                               | A                |
| $I_{C90}$                          | $T_C = 90^\circ\text{C}$                                                                                                   | 40                               | A                |
| $I_{CM}$                           | $T_C = 25^\circ\text{C}$ , 1 ms                                                                                            | 160                              | A                |
| <b>SSOA (RBSOA)</b>                | $V_{GE} = 15 \text{ V}$ , $T_{VJ} = 125^\circ\text{C}$ , $R_G = 22 \Omega$<br>Clamped inductive load, $L = 30 \mu\text{H}$ | $I_{CM} = 80$<br>@ $0.8 V_{CES}$ | A                |
| <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                               | $\mu\text{s}$    |
| $P_C$                              | $T_C = 25^\circ\text{C}$                                                                                                   | 250                              | W                |
| $V_{ISOL}$                         | 50/60 Hz                                                                                                                   | $t = 1 \text{ min}$              | 2500 V~          |
|                                    | $I_{ISOL} \leq 1 \text{ mA}$                                                                                               | $t = 1 \text{ s}$                | 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                                                                                                            | 1.5/13                           | Nm/lb.in.        |
|                                    | Terminal connection torque (M4)                                                                                            | 1.5/13                           | Nm/lb.in.        |
| <b>Weight</b>                      |                                                                                                                            | 30                               | g                |

## miniBLOC, SOT-227 B



1 = Emitter ①, 3 = Collector  
2 = Gate, 4 = Emitter ①

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

### Features

- International standard package miniBLOC
- Aluminium-nitride isolation
  - high power dissipation
- Isolation voltage 3000 V~
- Low  $V_{CE(sat)}$ 
  - for minimum on-state conduction losses
- Fast Recovery Epitaxial Diode
  - short  $t_{rr}$  and  $I_{RM}$
- Low collector-to-case capacitance (< 50 pF)
  - reduces 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

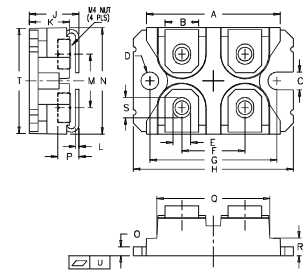
### Advantages

- 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.                 |
| $BV_{CES}$    | $I_C = 3 \text{ mA}$ , $V_{GE} = 0 \text{ V}$          | 600                                                                               |      | V                    |
| $V_{GE(th)}$  | $I_C = 4 \text{ mA}$ , $V_{CE} = V_{GE}$               | 4                                                                                 |      | V                    |
| $I_{CES}$     | $V_{CE} = 0.8 \cdot V_{CES}$<br>$V_{GE} = 0 \text{ V}$ | $T_J = 25^\circ\text{C}$<br>$T_J = 125^\circ\text{C}$                             |      | 750 $\mu\text{A}$    |
|               |                                                        |                                                                                   |      | 15 mA                |
| $I_{GES}$     | $V_{CE} = 0 \text{ V}$ , $V_{GE} = \pm 20 \text{ V}$   |                                                                                   |      | $\pm 100 \text{ nA}$ |
| $V_{CE(sat)}$ | $I_C = I_{C90}$ , $V_{GE} = 15 \text{ V}$              |                                                                                   |      | 3 V                  |

| Symbol       | Test Conditions                                                                                                                                                                                                                                                                                                             | Characteristic Values<br>( $T_J = 25^\circ\text{C}$ , unless otherwise specified) |      |          |
|--------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|------|----------|
|              |                                                                                                                                                                                                                                                                                                                             | min.                                                                              | typ. | max.     |
| $g_{fs}$     | $I_C = I_{C90}, V_{CE} = 10\text{ V}$ ,<br>Pulse test, $t \leq 300\text{ }\mu\text{s}$ , duty cycle $d \leq 2\%$                                                                                                                                                                                                            | 20                                                                                | 23   | S        |
| $C_{ies}$    | $V_{CE} = 25\text{ V}$ , $V_{GE} = 0\text{ V}$ , $f = 1\text{ MHz}$                                                                                                                                                                                                                                                         |                                                                                   | 4500 | pF       |
| $C_{oes}$    |                                                                                                                                                                                                                                                                                                                             |                                                                                   | 400  | pF       |
| $C_{res}$    |                                                                                                                                                                                                                                                                                                                             |                                                                                   | 90   | pF       |
| $Q_g$        | $I_C = I_{C90}, V_{GE} = 15\text{ V}$ , $V_{CE} = 0.5 V_{CES}$                                                                                                                                                                                                                                                              |                                                                                   | 190  | 250 nC   |
| $Q_{ge}$     |                                                                                                                                                                                                                                                                                                                             |                                                                                   | 45   | 60 nC    |
| $Q_{gc}$     |                                                                                                                                                                                                                                                                                                                             |                                                                                   | 88   | 120 nC   |
| $t_{d(on)}$  | <b>Inductive load, <math>T_J = 25^\circ\text{C}</math></b><br>$I_C = I_{C90}, V_{GE} = 15\text{ V}$ , $L = 100\text{ }\mu\text{H}$ ,<br>$V_{CE} = 0.8 V_{CES}$ , $R_G = 2.7\text{ }\Omega$<br>Remarks: Switching times may increase<br>for $V_{CE}(\text{Clamp}) > 0.8 \cdot V_{CES}$ , higher $T_J$ or<br>increased $R_G$  |                                                                                   | 70   | ns       |
| $t_{ri}$     |                                                                                                                                                                                                                                                                                                                             |                                                                                   | 220  | ns       |
| $t_{d(off)}$ |                                                                                                                                                                                                                                                                                                                             |                                                                                   | 200  | ns       |
| $t_{fi}$     |                                                                                                                                                                                                                                                                                                                             |                                                                                   | 200  | ns       |
| $E_{off}$    |                                                                                                                                                                                                                                                                                                                             |                                                                                   | 3.5  | mJ       |
| $t_{d(on)}$  |                                                                                                                                                                                                                                                                                                                             |                                                                                   | 70   | ns       |
| $t_{ri}$     | <b>Inductive load, <math>T_J = 125^\circ\text{C}</math></b><br>$I_C = I_{C90}, V_{GE} = 15\text{ V}$ , $L = 100\text{ }\mu\text{H}$ ,<br>$V_{CE} = 0.8 V_{CES}$ , $R_G = 2.7\text{ }\Omega$<br>Remarks: Switching times may increase<br>for $V_{CE}(\text{Clamp}) > 0.8 \cdot V_{CES}$ , higher $T_J$ or<br>increased $R_G$ |                                                                                   | 220  | ns       |
| $E_{on}$     |                                                                                                                                                                                                                                                                                                                             |                                                                                   | 4.7  | mJ       |
| $t_{d(off)}$ |                                                                                                                                                                                                                                                                                                                             |                                                                                   | 450  | ns       |
| $t_{fi}$     |                                                                                                                                                                                                                                                                                                                             |                                                                                   | 340  | 600 ns   |
| $E_{off}$    |                                                                                                                                                                                                                                                                                                                             |                                                                                   | 6    | mJ       |
| $R_{thJC}$   |                                                                                                                                                                                                                                                                                                                             |                                                                                   |      | 0.50 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 |

| Symbol     | Test Conditions                                                                                                                                                                          | Characteristic Values<br>( $T_J = 25^\circ\text{C}$ , unless otherwise specified) |      |          |
|------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|------|----------|
|            |                                                                                                                                                                                          | min.                                                                              | typ. | max.     |
| $V_F$      | $I_F = I_{C90}, V_{GE} = 0\text{ V}$ ,<br>Pulse test, $t \leq 300\text{ }\mu\text{s}$ , duty cycle $d \leq 2\%$                                                                          |                                                                                   |      | 1.8 V    |
| $I_{RM}$   | $I_F = I_{C90}, V_{GE} = 0\text{ V}$ , $-di_F/dt = 480\text{ A}/\mu\text{s}$<br>$V_R = 360\text{ V}$<br>$I_F = 1\text{ A}$ , $-di_F/dt = 200\text{ A}/\mu\text{s}$ ; $V_R = 30\text{ V}$ |                                                                                   | 19   | A        |
| $t_{rr}$   |                                                                                                                                                                                          |                                                                                   | 175  | ns       |
|            |                                                                                                                                                                                          |                                                                                   | 35   | 50 ns    |
| $R_{thJC}$ |                                                                                                                                                                                          |                                                                                   |      | 0.80 K/W |

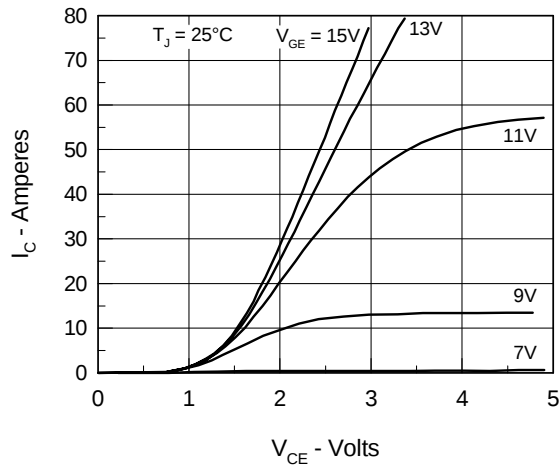
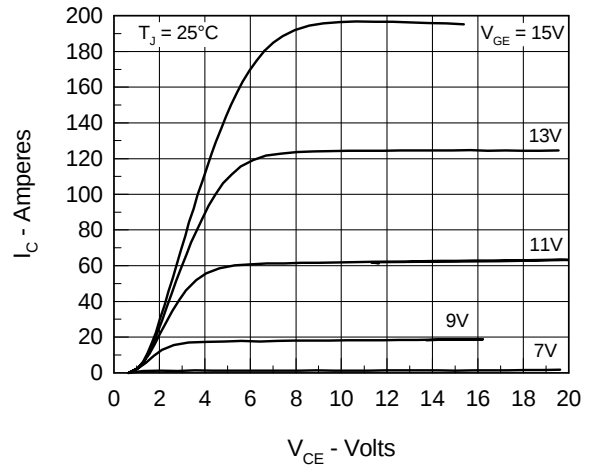
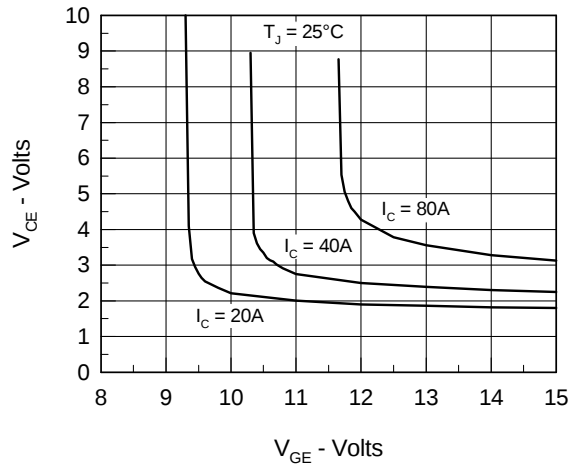
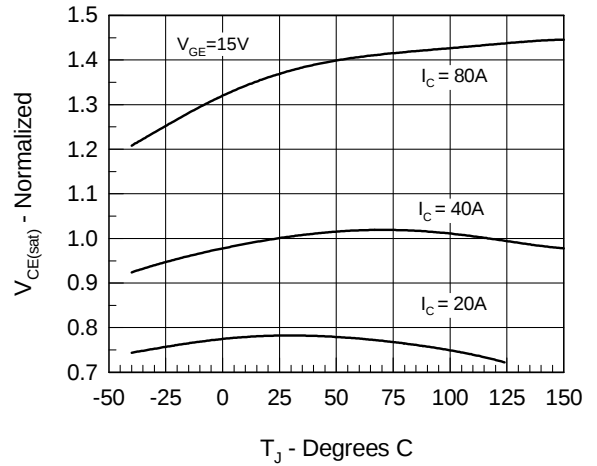
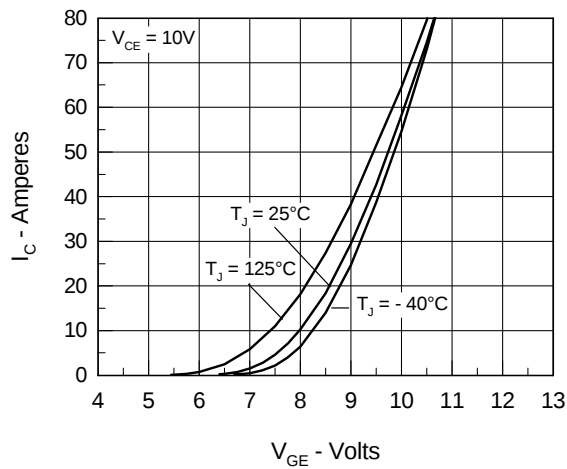
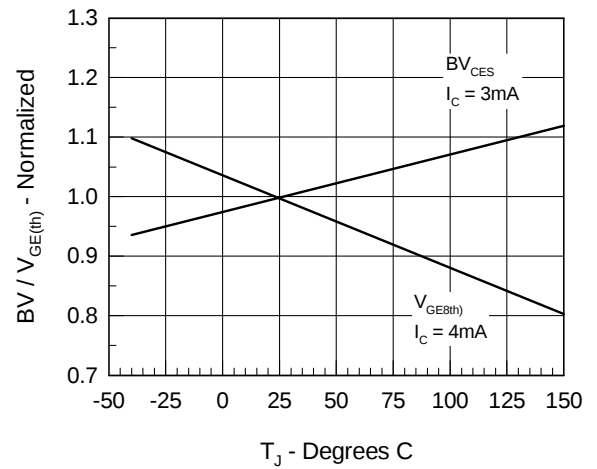
**Fig.1 Saturation Characteristics**

**Fig.2 Output Characteristics**

**Fig.3 Collector-Emitter Voltage vs. Gate-Emitter Voltage**

**Fig.4 Temperature Dependence of Output Saturation Voltage**

**Fig.5 Input Admittance**

**Fig.6 Temperature Dependence of Breakdown and Threshold Voltage**


Fig.7 Turn-Off Energy per Pulse and Fall Time on Collector Current

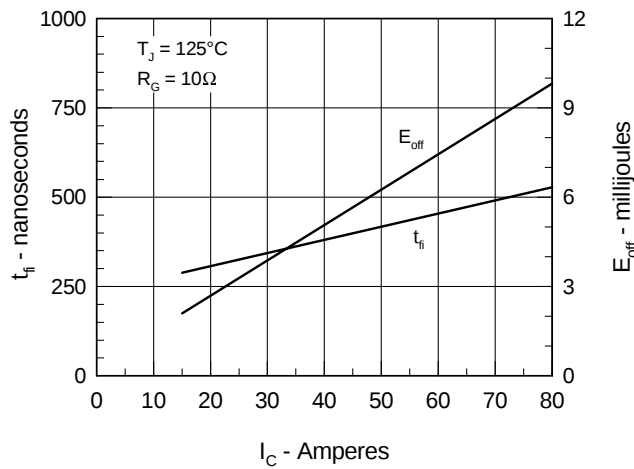


Fig.8 Dependence of Turn-Off Energy Per Pulse and Fall Time on  $R_G$

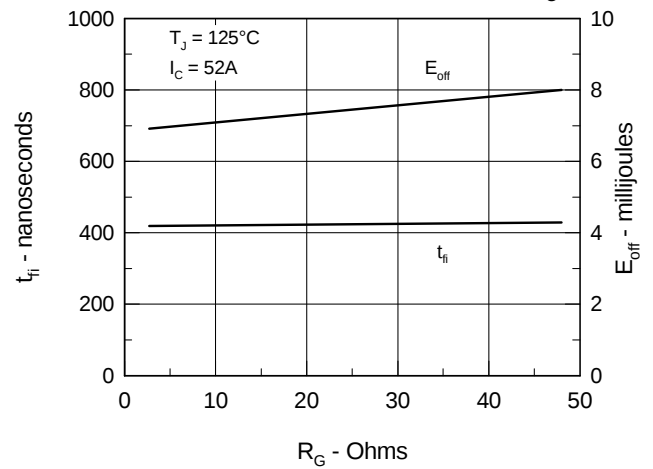


Fig.9 Gate Charge Characteristic Curve

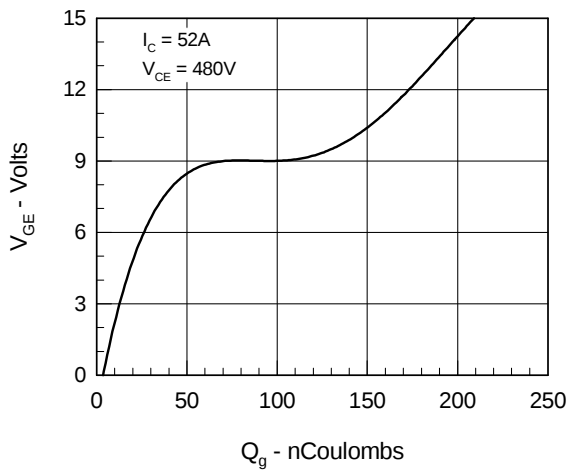


Fig.10 Turn-Off Safe Operating Area

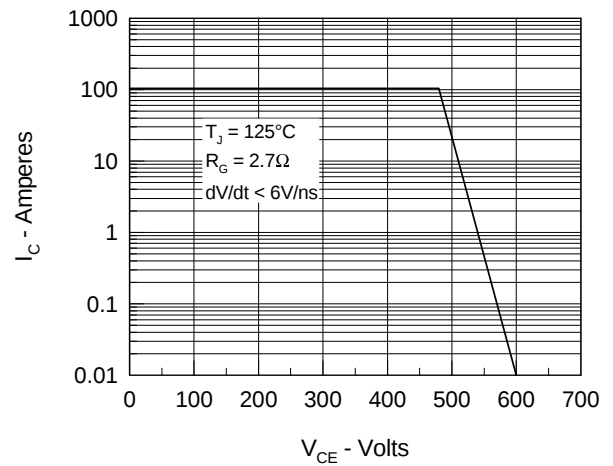
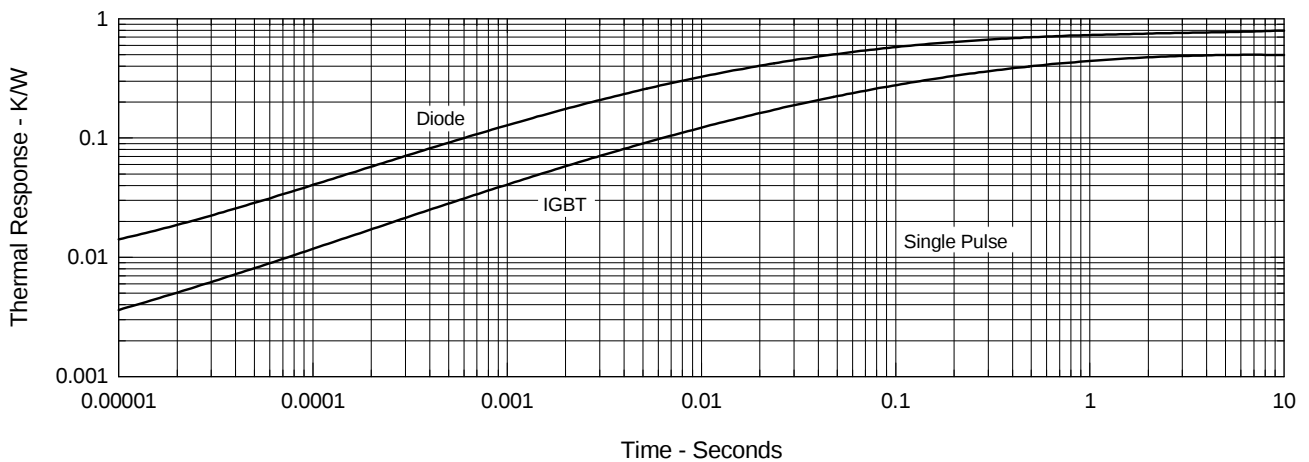


Fig.11 Transient Thermal Impedance



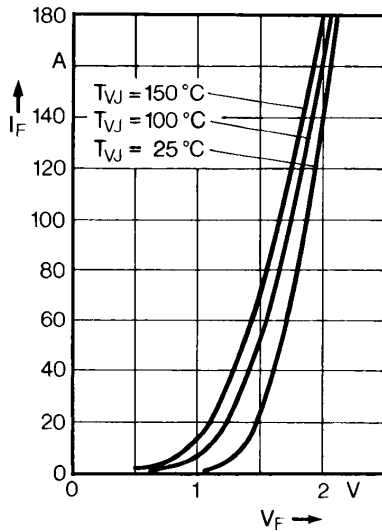


Fig. 12 Forward current versus voltage drop.

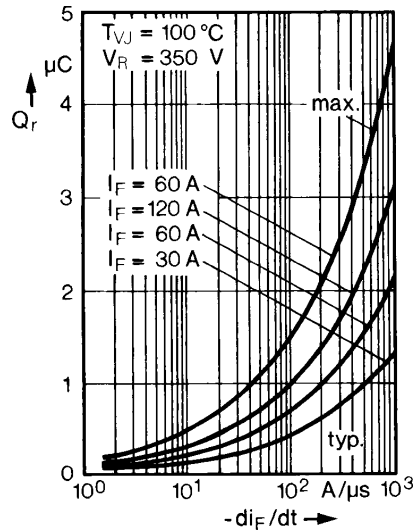


Fig. 13 Recovery charge versus  $-di_F/dt$ .

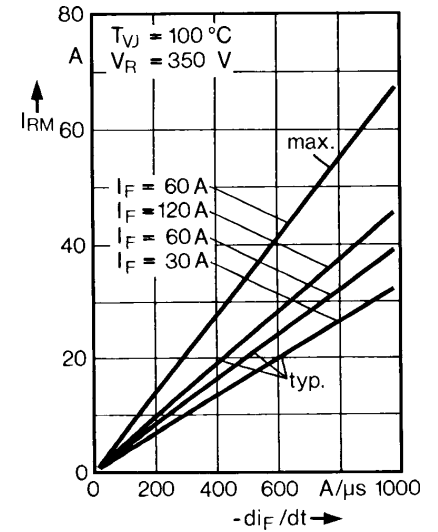


Fig. 14 Peak reverse current versus  $-di_F/dt$ .

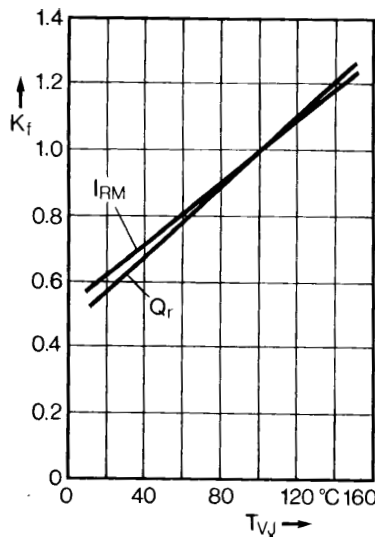


Fig. 15 Dynamic parameters versus junction temperature.

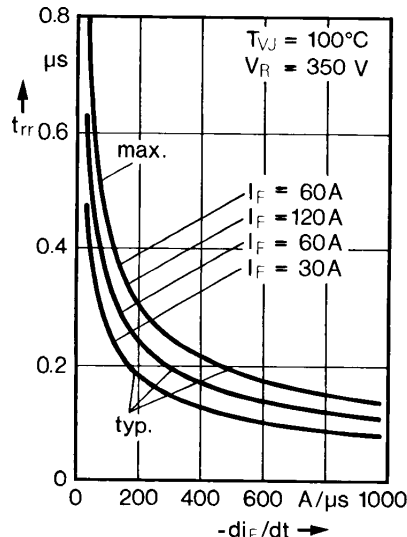


Fig. 16 Recovery time versus  $-di_F/dt$ .

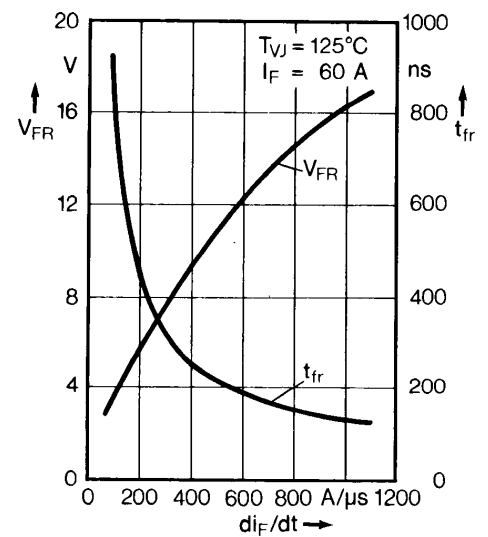


Fig. 17 Peak forward voltage vs.  $di_F/dt$ .

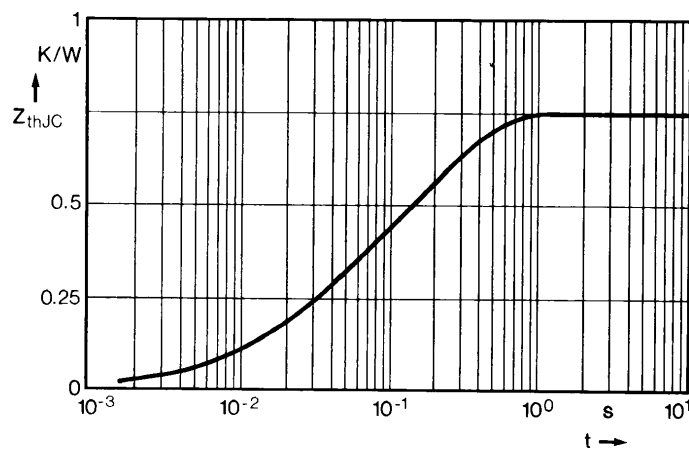


Fig. 18 Transient thermal impedance junction to case.

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