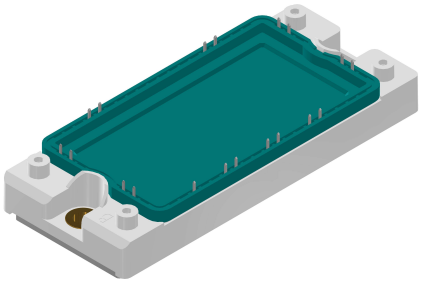
# Standard Rectifier Module

| 3~ Rectifier | | | Brake Chopper | | |
|---|---|---|---|---|---|
| $V_{RRM}$ | = | 1600 V | $V_{CES}$ | = | 1200 V |
| $I_{DAV}$ | = | 120 A | $I_{C25}$ | = | 120 A |
| $I_{FSM}$ | = | 700 A | $V_{CE(sat)}$ | = | 1.8 V |

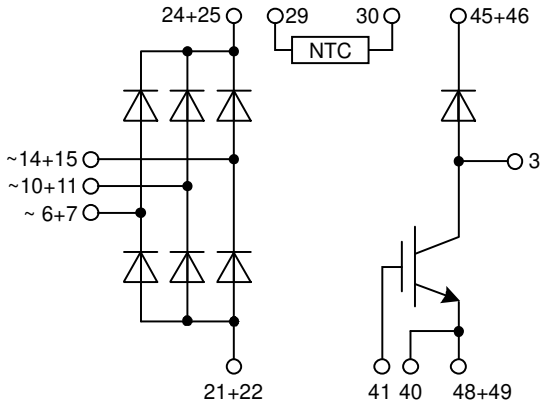
## 3~ Rectifier Bridge + Brake Unit + NTC

**Part number**

**VUB116-16NOXT**



Backside: isolated




E72873

**Features / Advantages:**

- Package with DCB ceramic
- Improved temperature and power cycling
- Planar passivated chips
- Very low forward voltage drop
- Very low leakage current
- NTC

**Applications:**

- 3~ Rectifier with brake unit for drive inverters

**Package:** E2-Pack

- Isolation Voltage: 3600 V~
- Industry standard outline
- RoHS compliant
- Soldering pins for PCB mounting
- Height: 17 mm
- Base plate: Copper internally DCB isolated
- Advanced power cycling
- Phase Change Material available

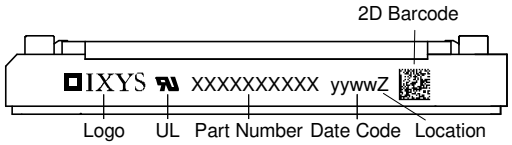
## Rectifier

| Symbol | Definition | Conditions | | Ratings min. | typ. | max. | Unit |
|---|---|---|---|---|---|---|---|
| $V_{RSM}$ | *max. non-repetitive reverse blocking voltage* | | $T_{VJ}$ = 25°C | | | 1700 | V |
| $V_{RRM}$ | *max. repetitive reverse blocking voltage* | | $T_{VJ}$ = 25°C | | | 1600 | V |
| $I_R$ | *reverse current* | $V_R$ = 1600 V | $T_{VJ}$ = 25°C | | | 100 | µA |
| | | $V_R$ = 1600 V | $T_{VJ}$ = 150°C | | | 1.5 | mA |
| $V_F$ | *forward voltage drop* | $I_F$ = 40 A | $T_{VJ}$ = 25°C | | | 1.19 | V |
| | | $I_F$ = 120 A | | | | 1.64 | V |
| | | $I_F$ = 40 A | $T_{VJ}$ = 125°C | | | 1.12 | V |
| | | $I_F$ = 120 A | | | | 1.70 | V |
| $I_{DAV}$ | *bridge output current* | $T_C$ = 105°C | $T_{VJ}$ = 150°C | | | 120 | A |
| | | rectangular d = ⅓ | | | | | |
| $V_{F0}$ | *threshold voltage* } *for power loss calculation only* | | $T_{VJ}$ = 150°C | | | 0.80 | V |
| $r_F$ | *slope resistance* } | | | | | 7.6 | mΩ |
| $R_{thJC}$ | *thermal resistance junction to case* | | | | | 0.65 | K/W |
| $R_{thCH}$ | *thermal resistance case to heatsink* | | | | 0.1 | | K/W |
| $P_{tot}$ | *total power dissipation* | | $T_C$ = 25°C | | | 190 | W |
| $I_{FSM}$ | *max. forward surge current* | t = 10 ms; (50 Hz), sine | $T_{VJ}$ = 45°C | | | 700 | A |
| | | t = 8,3 ms; (60 Hz), sine | $V_R$ = 0 V | | | 755 | A |
| | | t = 10 ms; (50 Hz), sine | $T_{VJ}$ = 150°C | | | 595 | A |
| | | t = 8,3 ms; (60 Hz), sine | $V_R$ = 0 V | | | 645 | A |
| $I^2t$ | *value for fusing* | t = 10 ms; (50 Hz), sine | $T_{VJ}$ = 45°C | | | 2.45 | kA²s |
| | | t = 8,3 ms; (60 Hz), sine | $V_R$ = 0 V | | | 2.37 | kA²s |
| | | t = 10 ms; (50 Hz), sine | $T_{VJ}$ = 150°C | | | 1.77 | kA²s |
| | | t = 8,3 ms; (60 Hz), sine | $V_R$ = 0 V | | | 1.73 | kA²s |
| $C_J$ | *junction capacitance* | $V_R$ = 400 V; f = 1 MHz | $T_{VJ}$ = 25°C | | 27 | | pF |

| Brake IGBT | | | | Ratings | | | |
|---|---|---|---|---|---|---|---|
| Symbol | Definition | Conditions | | min. | typ. | max. | Unit |
| $V_{CES}$ | *collector emitter voltage* | | $T_{VJ}$ = 25°C | | | 1200 | V |
| $V_{GES}$ | *max. DC gate voltage* | | | | | ±20 | V |
| $V_{GEM}$ | *max. transient gate emitter voltage* | | | | | ±30 | V |
| $I_{C25}$ | *collector current* | | $T_C$ = 25°C | | | 120 | A |
| $I_{C80}$ | | | $T_C$ = 80°C | | | 84 | A |
| $P_{tot}$ | *total power dissipation* | | $T_C$ = 25°C | | | 390 | W |
| $V_{CE(sat)}$ | *collector emitter saturation voltage* | $I_C$ = 75 A; $V_{GE}$ = 15 V | $T_{VJ}$ = 25°C | | 1.8 | 2.1 | V |
| | | | $T_{VJ}$ = 125°C | | 2.1 | | V |
| $V_{GE(th)}$ | *gate emitter threshold voltage* | $I_C$ = 3 mA; $V_{GE}$ = $V_{CE}$ | $T_{VJ}$ = 25°C | 5.5 | 6.0 | 6.5 | V |
| $I_{CES}$ | *collector emitter leakage current* | $V_{CE}$ = $V_{CES}$; $V_{GE}$ = 0 V | $T_{VJ}$ = 25°C | | | 0.2 | mA |
| | | | $T_{VJ}$ = 125°C | | 0.6 | | mA |
| $I_{GES}$ | *gate emitter leakage current* | $V_{GE}$ = ±20 V | | | | 500 | nA |
| $Q_{G(on)}$ | *total gate charge* | $V_{CE}$ = 600 V; $V_{GE}$ = 15 V; $I_C$ = 75 A | | | 230 | | nC |
| $t_{d(on)}$ | *turn-on delay time* | inductive load<br>$V_{CE}$ = 600 V; $I_C$ = 75 A<br>$V_{GE}$ = ±15 V; $R_G$ = 10 Ω | $T_{VJ}$ = 125°C | | 70 | | ns |
| $t_r$ | *current rise time* | | | | 40 | | ns |
| $t_{d(off)}$ | *turn-off delay time* | | | | 250 | | ns |
| $t_f$ | *current fall time* | | | | 100 | | ns |
| $E_{on}$ | *turn-on energy per pulse* | | | | 6.8 | | mJ |
| $E_{off}$ | *turn-off energy per pulse* | | | | 8.3 | | mJ |
| **RBSOA** | *reverse bias safe operating area* | $V_{GE}$ = ±15 V; $R_G$ = 10 Ω | $T_{VJ}$ = 125°C | | | | |
| $I_{CM}$ | | $V_{CEK}$ = 1200 V | | | | 225 | A |
| **SCSOA** | *short circuit safe operating area* | $V_{CEK}$ = 1200 V | | | | | |
| $t_{SC}$ | *short circuit duration* | $V_{CE}$ = 900 V; $V_{GE}$ = ±15 | $T_{VJ}$ = 125°C | | | 10 | µs |
| $I_{SC}$ | *short circuit current* | $R_G$ = 10 Ω; non-repetitive | | | 300 | | A |
| $R_{thJC}$ | *thermal resistance junction to case* | | | | | 0.32 | K/W |
| $R_{thCH}$ | *thermal resistance case to heatsink* | | | | 0.15 | | K/W |

| Brake Diode | | | | | | | |
|---|---|---|---|---|---|---|---|
| $V_{RRM}$ | *max. repetitive reverse voltage* | | $T_{VJ}$ = 25°C | | | 1200 | V |
| $I_{F25}$ | *forward current* | | $T_C$ = 25°C | | | 48 | A |
| $I_{F80}$ | | | $T_C$ = 80°C | | | 32 | A |
| $V_F$ | *forward voltage* | $I_F$ = 30 A | $T_{VJ}$ = 25°C | | | 2.75 | V |
| | | | $T_{VJ}$ = 125°C | | 1.99 | | V |
| $I_R$ | *reverse current* | $V_R$ = $V_{RRM}$ | $T_{VJ}$ = 25°C | | | 0.25 | mA |
| | | | $T_{VJ}$ = 125°C | | | 1 | mA |
| $Q_{rr}$ | *reverse recovery charge* | $V_R$ = 600 V<br>$-di_F/dt$ = 400 A/µs<br>$I_F$ = 30 A; $V_{GE}$ = 0 V | $T_{VJ}$ = 125°C | | 1.8 | | µC |
| $I_{RM}$ | *max. reverse recovery current* | | | | 23 | | A |
| $t_{rr}$ | *reverse recovery time* | | | | 150 | | ns |
| $R_{thJC}$ | *thermal resistance junction to case* | | | | | 0.9 | K/W |
| $R_{thCH}$ | *thermal resistance case to heatsink* | | | | 0.3 | | K/W |

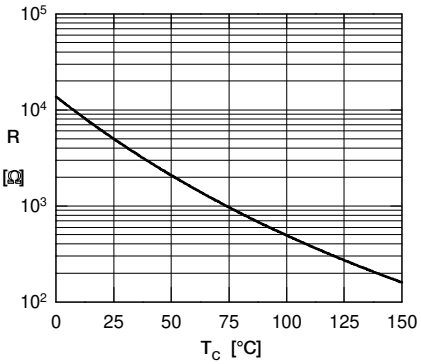
| Package E2-Pack | | | | Ratings | | | |
|---|---|---|---|---|---|---|---|
| **Symbol** | **Definition** | **Conditions** | | **min.** | **typ.** | **max.** | **Unit** |
| $I_{RMS}$ | *RMS current* | per terminal | | | | 50 | A |
| $T_{VJ}$ | *virtual junction temperature* | | | -40 | | 150 | °C |
| $T_{op}$ | *operation temperature* | | | -40 | | 125 | °C |
| $T_{stg}$ | *storage temperature* | | | -40 | | 125 | °C |
| **Weight** | | | | | 176 | | g |
| $M_D$ | *mounting torque* | | | 3 | | 6 | Nm |
| $d_{Spp/App}$ | *creepage distance on surface \| striking distance through air* | | *terminal to terminal* | 6.0 | | | mm |
| $d_{Spb/Apb}$ | | | *terminal to backside* | 12.0 | | | mm |
| $V_{ISOL}$ | *isolation voltage* | t = 1 second | 50/60 Hz, RMS; $I_{ISOL}$ ≤ 1 mA | 3600 | | | V |
| | | t = 1 minute | | 3000 | | | V |




| Ordering | Ordering Number | Marking on Product | Delivery Mode | Quantity | Code No. |
|---|---|---|---|---|---|
| Standard | VUB116-16NOXT | VUB116-16NOXT | Box | 6 | 510755 |

## Temperature Sensor NTC

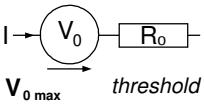
| Symbol | Definition | Conditions | min. | typ. | max. | Unit |
|---|---|---|---|---|---|---|
| $R_{25}$ | *resistance* | $T_{VJ}$ = 25° | 4.75 | 5 | 5.25 | kΩ |
| $B_{25/50}$ | *temperature coefficient* | | | 3375 | | K |



Typ. NTC resistance vs. temperature

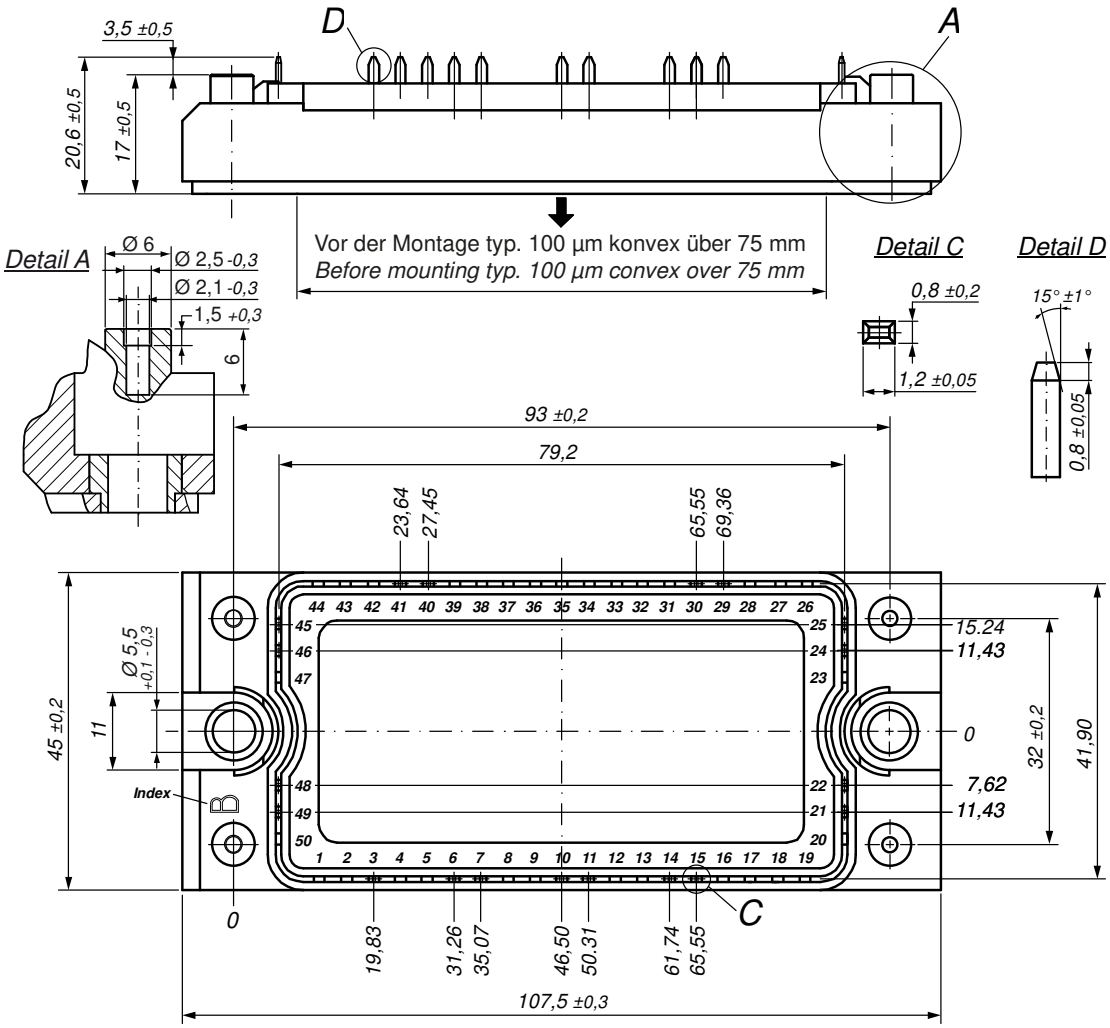
## Equivalent Circuits for Simulation

** on die level* $T_{VJ}$ = 150°C




| | | Rectifier | Brake IGBT | Brake Diode | |
|---|---|---|---|---|---|
| $V_{0\ max}$ | *threshold voltage* | 0.8 | 1.1 | 1.31 | V |
| $R_{0\ max}$ | *slope resistance ** | 4.5 | 17.9 | 8 | mΩ |

## Outlines E2-Pack

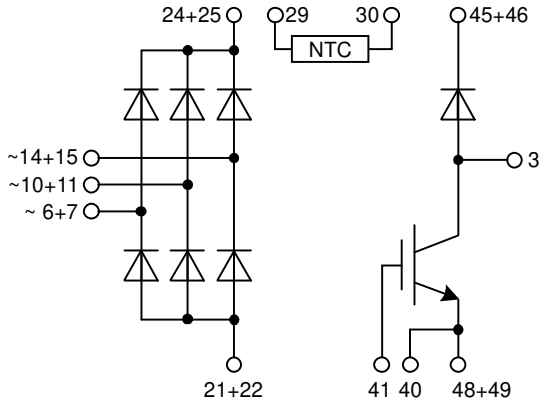



**Bemerkung** / ***Note:***

- Nichttolerierte Maße nach / *Measure without tolerances according DIN ISO 2768-T1-m*
- PCB-Lochmuster / *PCB hole pattern:* **see pin position**
- Toleranz Pin-Position und PCB-Lochmuster / *Tolerance of pin position and PCB hole pattern:* ⌖ **0.1**
- Montageanleitung / *Mounting instruction:* www.ixys.com **Application note IXAN0024**

***Detail A*:** PCB-Montage / *Mounting on PCB*

- Empfohlene, selbstschneidende Schraube / *Recommended, self-tapping screw:* **EJOT PT®** (Größe / *size:* **K25**)
- Max. Schraubenlänge / *Max. screw length:* **PCB-Dicke** / **thickness + 6 mm** *(*max. Lochtiefe / *hole depth)*
- Empfohlenes Drehmoment / *Recommended mounting torque:* **1.5 Nm**



## Rectifier

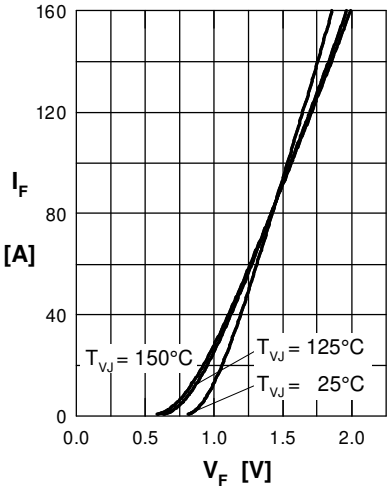



Fig. 1 Forward current versus voltage drop per diode

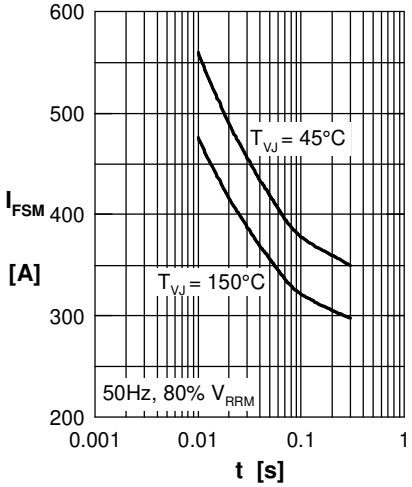



Fig. 2 Surge overload current vs. time per diode

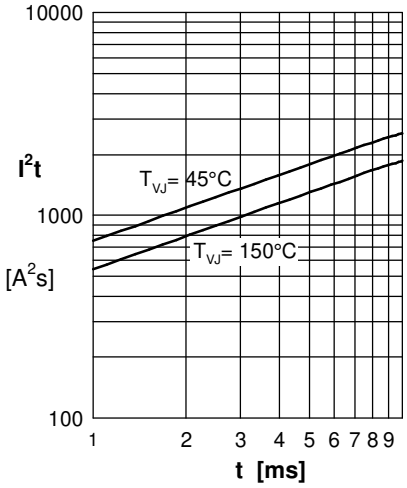



Fig. 3 $I^2t$ versus time per diode

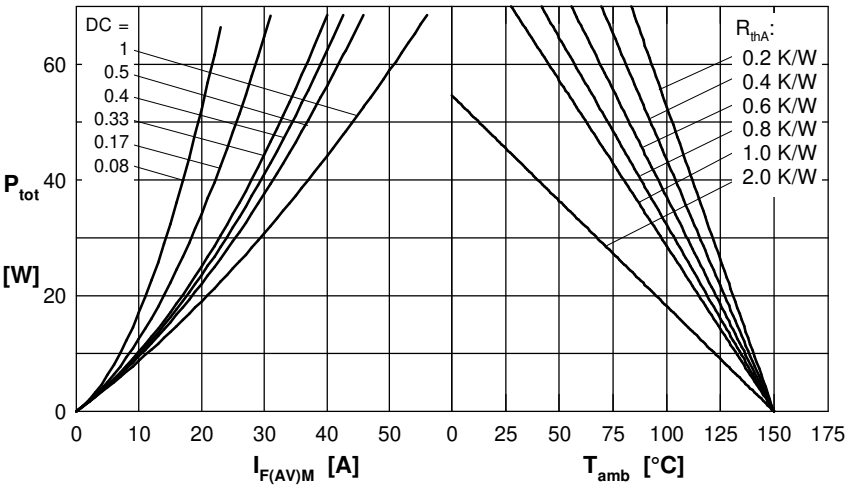



Fig. 4 Power dissipation vs. forward current and ambient temperature per diode

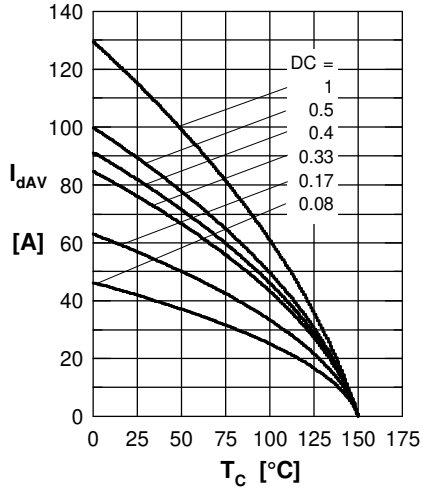
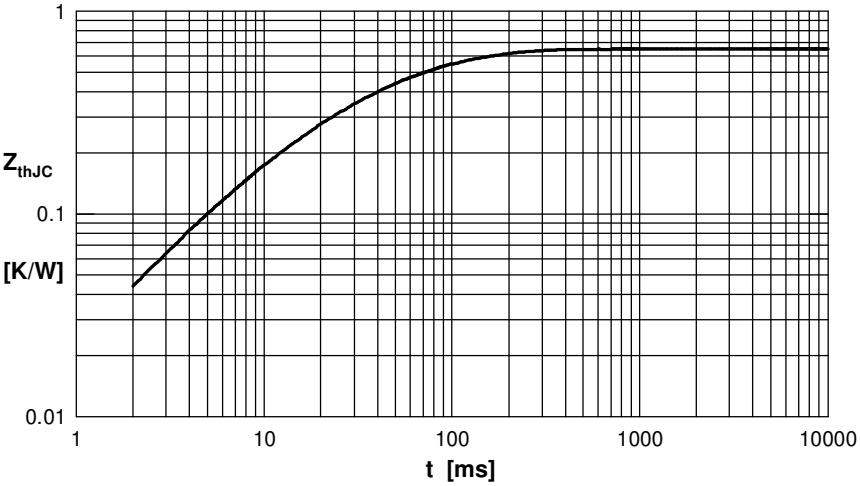



Fig. 5 Max. forward current vs. case temperature per diode




| $R_i$ | $t_i$ |
|---|---|
| 0.085 | 0.012 |
| 0.041 | 0.007 |
| 0.309 | 0.036 |
| 0.215 | 0.102 |

Fig. 6 Transient thermal impedance junction to case vs. time per diode

## Brake IGBT

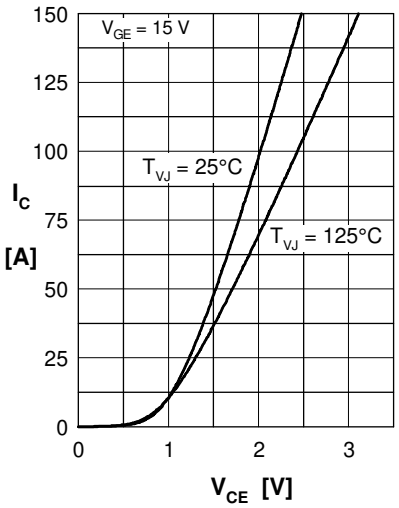



Fig. 1 Typ. output characteristics

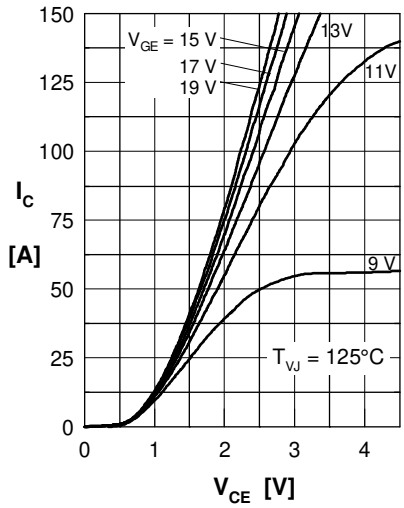



Fig. 2 Typ. output characteristics

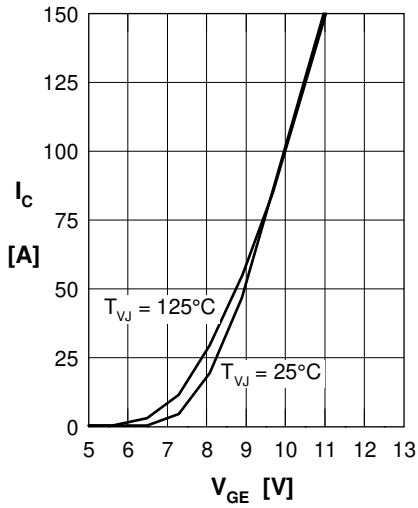



Fig. 3 Typ. tranfer characteristics

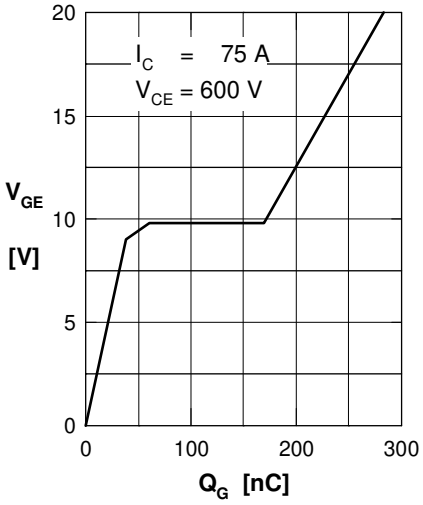



Fig. 4 Typ. turn-on gate charge

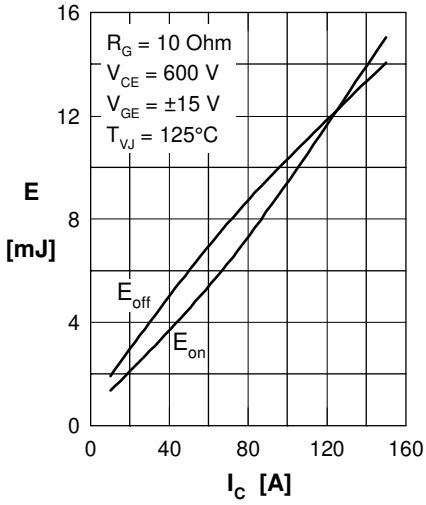



Fig. 5 Typ. switching energy versus collector current

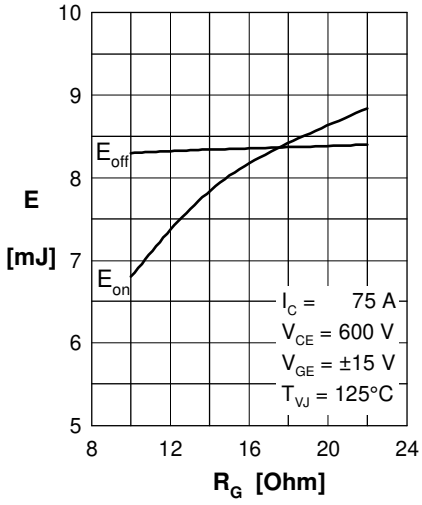



Fig. 6 Typ. switching energy versus gate resistance

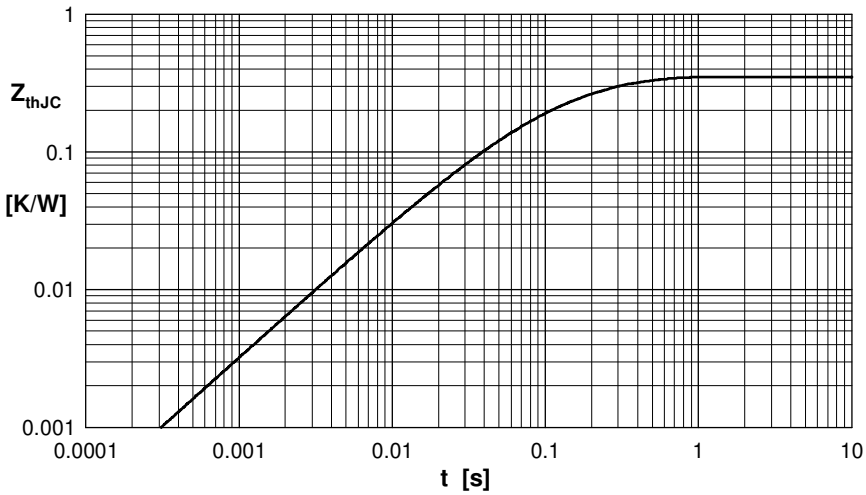



Fig. 7 Typ. transient thermal impedance junction to case

## Brake Diode

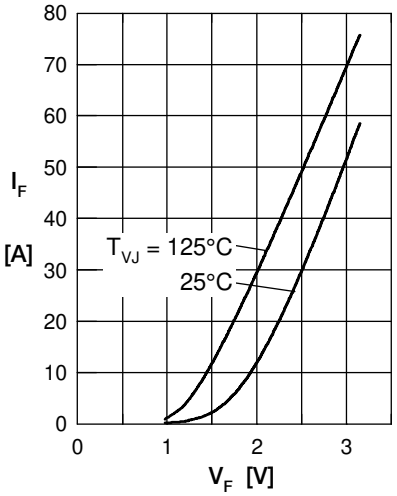



Fig. 1 Forward current $I_F$ vs. $V_F$

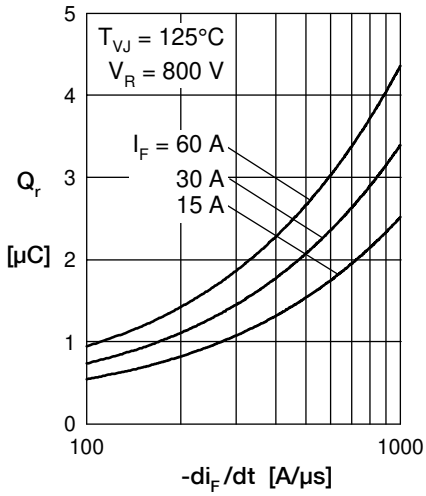



Fig. 2 Typ. reverse recovery charge $Q_r$ versus $-di_F/dt$

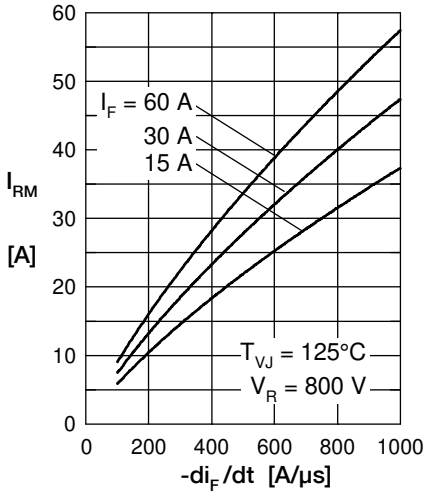



Fig. 3 Typ. peak reverse current $I_{RM}$ versus $-di_F/dt$

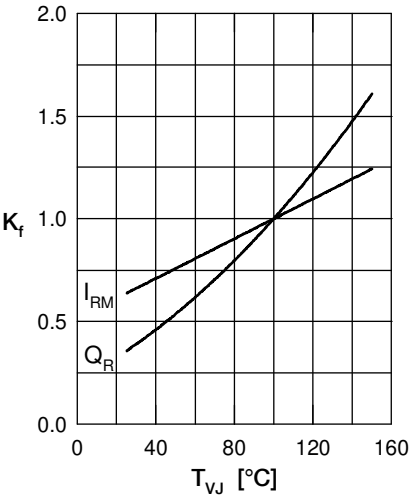



Fig. 4 Dynamic parameters $Q_r$, $I_{RM}$ versus $T_{VJ}$

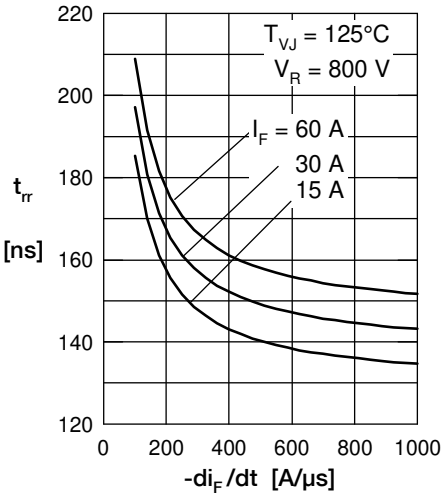



Fig. 5 Typ. recovery time $t_{rr}$ versus $-di_F/dt$

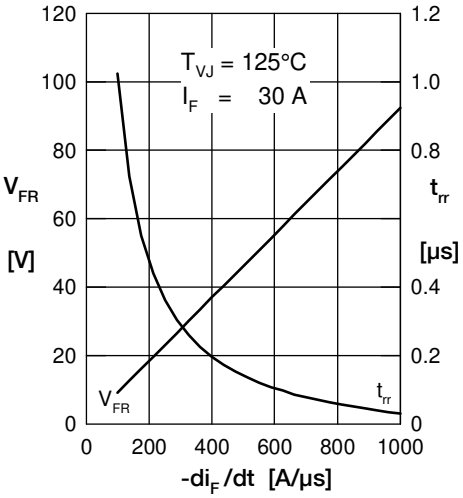



Fig. 6 Typ. peak forward voltage $V_{FR}$ and $t_{fr}$ versus $di_F/dt$

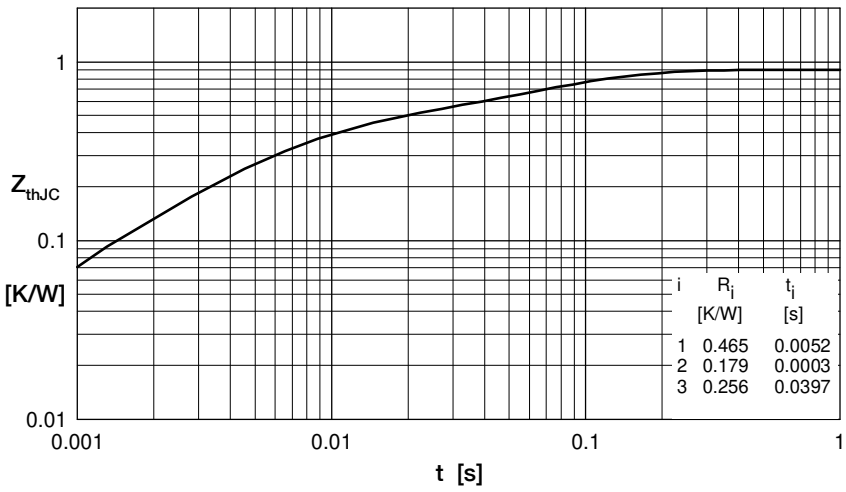



Fig. 7 Transient thermal impedance junction to case