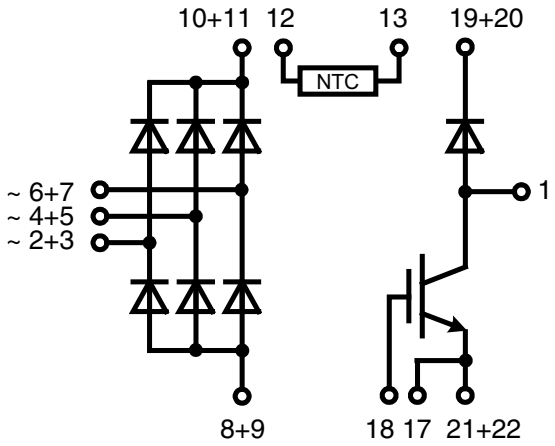
# Three Phase Rectifier Bridge

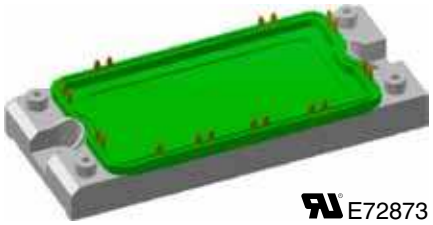
with IGBT and Fast Recovery Diode
for Braking System

| Rectifier Diode | Fast Recov. Diode | IGBT |
|---|---|---|
| $V_{RRM}$ = 1600 V | $V_{CES}$ = 1200 V | $V_{CES}$ = 1200 V |
| $I_{dAVM}$ = 145 A | $V_F$ = 2.75 V | $I_{C80}$ = 108 A |
| $I_{FSM}$ = 1100 A | $I_{FSM}$ = 200 A | $V_{CEsat}$ = 2.35 V |

**Part name** (Marking on product)

VUB145-16NOXT




**Features:**

- Soldering connections for PCB mounting
- Convenient package outline
- NTC

**Application:**

- Drive Inverters with brake system

**Package:**

- Two functions in one package
- Easy to mount with two screws
- Suitable for wave soldering
- High temperature and power cycling capability
- UL registered, E72873

## IGBT

| Symbol | Definitions | Conditions | | Ratings min. | typ. | max. | Unit |
|---|---|---|---|---|---|---|---|
| $V_{CES}$ | *collector emitter voltage* | | $T_{VJ}$ = 25°C to 150°C | | | 1200 | V |
| $V_{GES}$ | *max. DC gate voltage* | continuous | | -20 | | +20 | V |
| $V_{GEM}$ | *max. transient collector gate voltage* | transient | | -30 | | +30 | V |
| $I_{C25}$ | *collector current* | DC | $T_C$ = 25°C | | | 155 | A |
| $I_{C80}$ | | DC | $T_C$ = 80°C | | | 108 | A |
| $P_{tot}$ | *total power dissipation* | | $T_C$ = 25°C | | | 500 | W |
| $V_{CE(sat)}$ | *collector emitter saturation voltage* | $I_C$ = 100 A; $V_{GE}$ = 15 V | $T_{VJ}$ = 25°C | | 2.05 | 2.35 | V |
| $V_{GE(th)}$ | *gate emitter threshold voltage* | $I_C$ = 4 mA | $T_{VJ}$ = 25°C | 5.4 | | 6.5 | V |
| $I_{CES}$ | *collector emitter leakage current* | $V_{CE}$ = $V_{CES}$; $V_{GE}$ = 0 V | $T_{VJ}$ = 25°C | | 0.01 | 0.1 | mA |
| | | | $T_{VJ}$ = 125°C | | 0.1 | | mA |
| $I_{GES}$ | *gate emitter leakage current* | $V_{CE}$ = 0 V; $V_{GE}$ = ±20 V | | | | 500 | nA |
| $Q_{G(on)}$ | *total gate charge* | $V_{CE}$ = 600 V; $V_{GE}$ = 15 V; $I_C$ = 100 A | | | 295 | | nC |
| $t_{d(on)}$ | *turn-on delay time* | inductive load | $T_{VJ}$ = 125°C | | 70 | | ns |
| $t_{d(off)}$ | *turn-off delay time* | $V_{CE}$ = 600 V; $I_C$ = 100 A | | | 250 | | ns |
| $t_r$ | *current rise time* | $V_{GE}$ = ±15 V; $R_G$ = 6.8 Ω; L = 100 µH | | | 40 | | ns |
| $t_f$ | *current fall time* | | | | 100 | | ns |
| $E_{on}$ | *turn-on energy per pulse* | | | | 8.5 | | mJ |
| $E_{off}$ | *turn-off energy per pulse* | | | | 11.5 | | mJ |
| $I_{CM}$ | *reverse bias safe operating area* | RBSOA; $V_{GE}$ = ±15 V; $R_G$ = 6.8 Ω; L = 100 µH | | | 200 | | A |
| $V_{CEK}$ | | clamped inductive load; | $T_{VJ}$ = 125°C | | ≤ $V_{CES}$-$L_S$·$d_i$/dt | | V |
| **SCSOA** | *short circuit safe operating area* | $V_{CE}$ = 720 V; $V_{GE}$ = ±15 V; | $T_{VJ}$ = 125°C | | | | |
| $t_{SC}$ | | $R_G$ = 6.8 Ω; non-repetitive | | | | 10 | µs |
| $I_{SC}$ | | | | | | 400 | A |
| **RBSOA** | *reverse bias safe operating area* | $V_{CE}$ = 1200 V; $V_{GE}$ = ±15 V; | $T_{VJ}$ = 125°C | | | 300 | A |
| | | $R_G$ = 6.8 Ω; L = 100 µH; clamped inductive load | | | | | |
| $R_{thJC}$ | *thermal resistance junction to case* | | | | | 0.25 | K/W |
| $R_{thCH}$ | *thermal resistance case to heatsink* | | | | 0.1 | | K/W |

## Fast Recovery Diode

| Symbol | Definitions | Conditions | | Ratings min. | typ. | max. | Unit |
|---|---|---|---|---|---|---|---|
| $V_{RRM}$ | *max. repetitive reverse voltage* | | $T_{VJ}$ = 150°C | | | 1200 | V |
| $I_{FAV}$ | *average forward current* | rect.; d = 0.5 | $T_C$ = 80°C | | | 32 | A |
| $I_{FRMS}$ | *rms forward current* | rect.; d = 0.5 | $T_C$ = 80°C | | | 45 | A |
| $I_{FSM}$ | *max. surge forward current* | t = 10 ms | $T_{VJ}$ = 45°C | | | 200 | A |
| $P_{tot}$ | *total power dissipation* | | $T_C$ = 25°C | | | 130 | W |
| $V_{F0}$ | *threshold voltage* | | $T_{VJ}$ = 150°C | | | 1.3 | V |
| $r_F$ | *slope resistance* | for power loss calculation only | | | | 17 | mΩ |
| $V_F$ | *forward voltage* | $I_F$ = 30 A | $T_{VJ}$ = 25°C | | | 2.75 | V |
| $I_R$ | *reverse current* | $V_R$ = $V_{RRM}$ | $T_{VJ}$ = 25°C | | | 0.25 | mA |
| | | | $T_{VJ}$ = 125°C | | 1 | | mA |
| $I_{RM}$ | *reverse recovery current* | $I_F$ = 50 A; $V_R$ = 100 V; $di_F$/dt = -100 A/µs | | | 8 | 11 | A |
| $t_{rr}$ | *reverse recovery time* | $I_F$ = 1 A; $V_R$ = 30 V; $di_F$/dt = -200 A/µs | | | 40 | | ns |
| $R_{thJC}$ | *thermal resistance junction to case* | | | | | 0.9 | K/W |
| $R_{thCH}$ | *thermal resistance case to heatsink* | | | | 0.3 | | K/W |

$T_C$ = 25°C unless otherwise stated

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

20110907b

## Rectifier Diode

| Symbol | Conditions | | | Ratings min. | typ. | max. | |
|---|---|---|---|---|---|---|---|
| $V_{RRM}$ | *max. repetitive reverse voltage* | | $T_{VJ}$ = 25°C | | | 1600 | V |
| $I_R$ | *reverse current* | $V_R = V_{RRM}$ | $T_{VJ}$ = 25°C | | | 0.05 | mA |
| | | | $T_{VJ}$ = 150°C | | | 2 | mA |
| $V_F$ | *forward voltage* | $I_F$ = 150 A | $T_{VJ}$ = 25°C | | | 1.68 | V |
| $I_{D(AV)M}$ | *max. average DC output current* | sine; d = $^1/_3$; bridge | $T_C$ = 95°C | | | 145 | A |
| $V_{F0}$ | *threshold voltage* | | $T_{VJ}$ = 150°C | | | 0.87 | V |
| $r_F$ | *slope resistance* | *for power loss calculation only* | | | | 5.9 | mΩ |
| $R_{thJC}$ | *thermal resistance junction to case* | per diode | $T_{VJ}$ = 25°C | | | 0.5 | K/W |
| $R_{thCH}$ | *thermal resistance case to heatsink* | | $T_{VJ}$ = 25°C | | | 0.1 | K/W |
| $P_{tot}$ | *total power dissipation* | | $T_{VJ}$ = 25°C | | | 250 | W |
| $I_{FSM}$ | *max. forward surge current* | t = 10 ms (50Hz) | $T_{VJ}$ = 45°C | | | 1100 | A |
| | | $V_R$ = 0 V | $T_{VJ}$ = 150°C | | | 960 | A |
| $I^2t$ | *value for fusing* | t = 10 ms (50Hz) | $T_{VJ}$ = 45°C | | | 6050 | $A^2s$ |
| | | $V_R$ = 0 V | $T_{VJ}$ = 150°C | | | 4610 | $A^2s$ |

## Temperature Sensor NTC

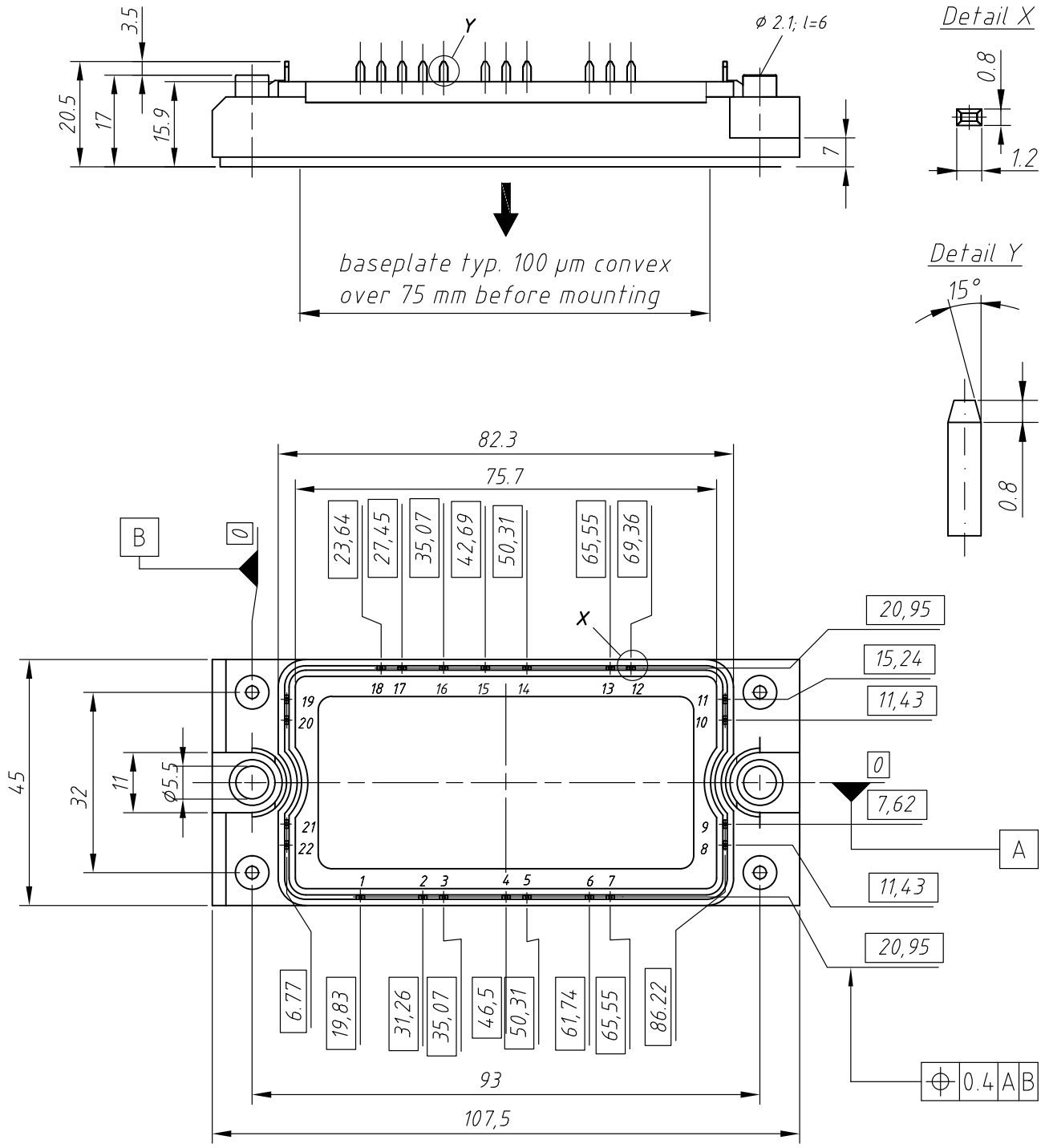
| Symbol | Definitions | Conditions | | Ratings min. | typ. | max. | Unit |
|---|---|---|---|---|---|---|---|
| $R_{25}$ | *resistance* | | $T_C$ = 25°C | 4.75 | 5.0 | 5.25 | kΩ |
| $B_{25/85}$ | | | | | 3375 | | K |

## Module

| Symbol | Definitions | Conditions | | Ratings min. | typ. | max. | Unit |
|---|---|---|---|---|---|---|---|
| $T_{VJ}$ | *operating temperature* | | | -40 | | 125 | °C |
| $T_{VJM}$ | *max. virtual junction temperature* | | | | | 150 | °C |
| $T_{stg}$ | *storage temperature* | | | -40 | | 125 | °C |
| $V_{ISOL}$ | *isolation voltage* | $I_{ISOL} \leq$ 1 mA; 50/60 Hz; | t = 1 min. | | | 3000 | V~ |
| | | | t = 1 s | | | 3600 | V~ |
| $M_d$ | *mounting torque* | (M5) | | 3 | | 6 | Nm |
| $d_S$ | *creep distance on surface* | | | 12.7 | | | mm |
| $d_A$ | *strike distance through air* | | | 9.6 | | | mm |
| a | *maximum allowable acceleration* | | | | | 50 | $m/s^2$ |
| $R_{pin\text{-}chip}$ | *thermal resistance pin to chip* | | $T_{VJ}$ = 25°C | | 2 | | mΩ |
| **Weight** | | | | | 180 | | g |

$T_C$ = 25°C unless otherwise stated

**Outline Drawing** Dimensions in mm (1 mm = 0.0394“)




**Product Marking**

| Ordering | Part Name | Marking on Product | Delivering Mode | Base Qty | Ordering Code |
|---|---|---|---|---|---|
| Standard | VUB 145-16NOXT | VUB145-16NOXT | Box | 6 | 510475 |

## Rectifier Diode

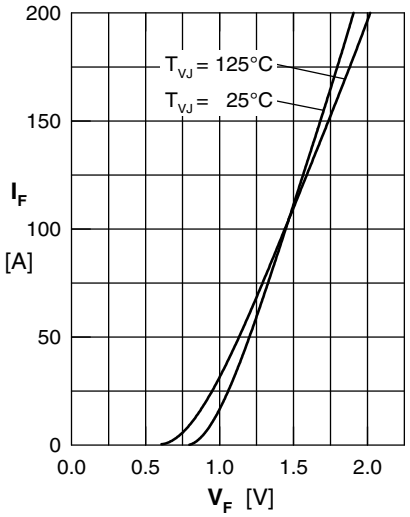



Fig. 1 Typ. forward current vs. voltage drop per diode

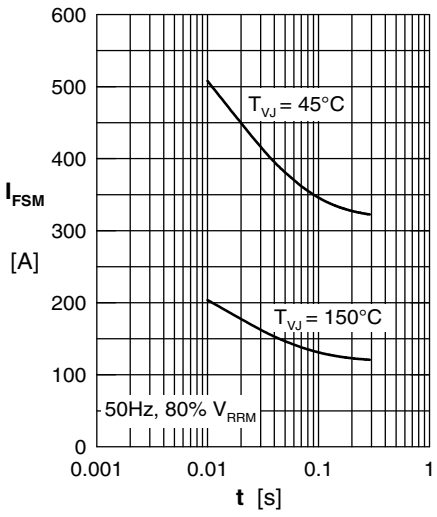



Fig. 2 Surge overload current

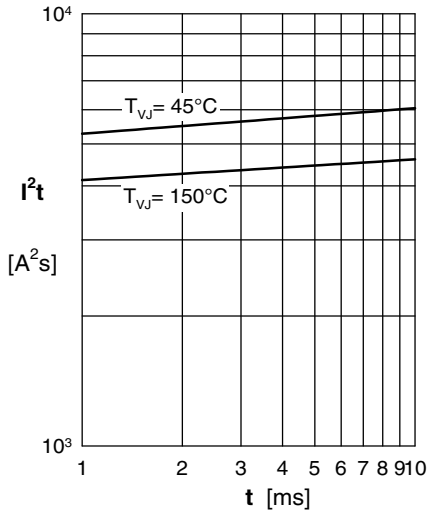



Fig. 3 $I^2t$ versus time per diode

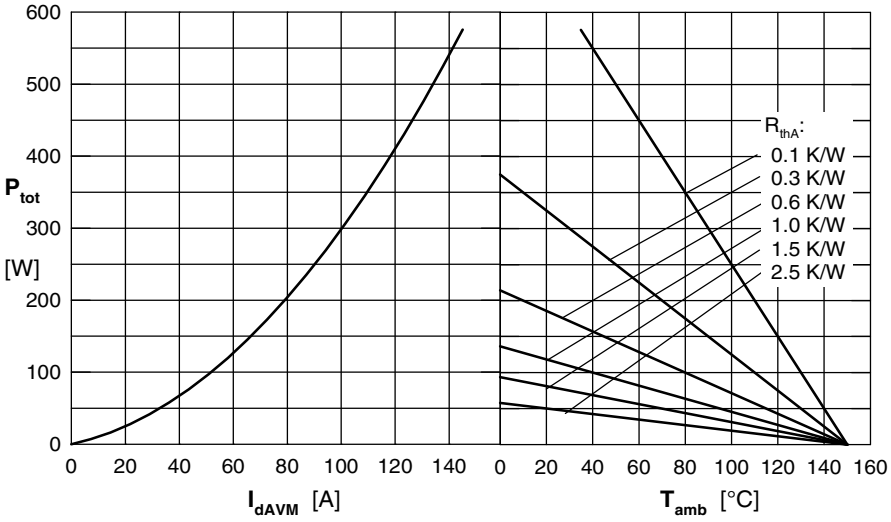



Fig. 4 Typ. power dissipation versus direct output current and ambient temperature, sine 120°

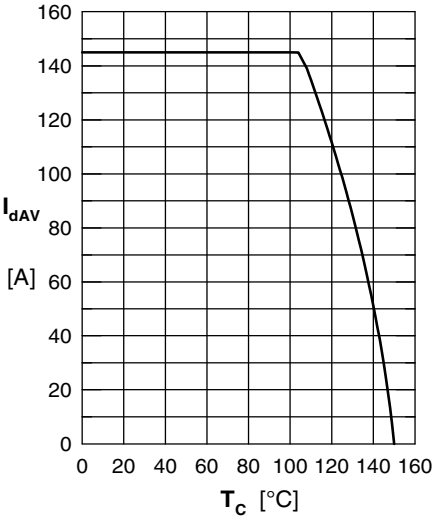



Fig. 5 Max. forward current vs. case temperature

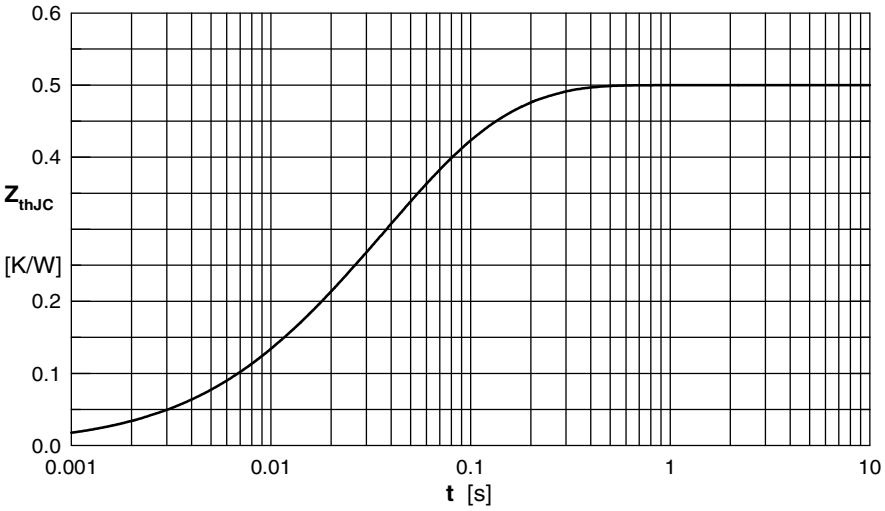



Fig. 6 Typ. transient thermal impedance junction to case

## IGBT

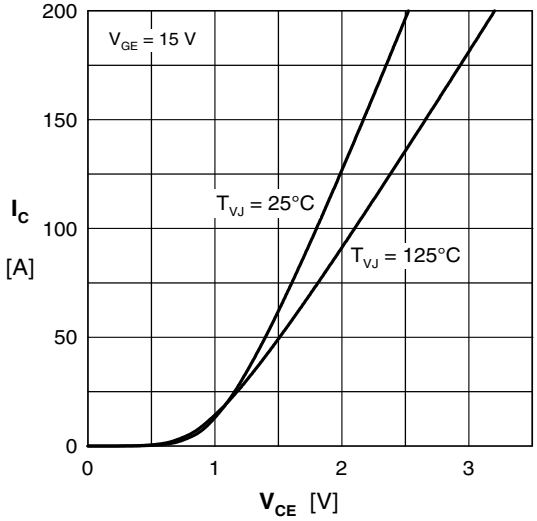



Fig. 1 Typ. output characteristics on die level

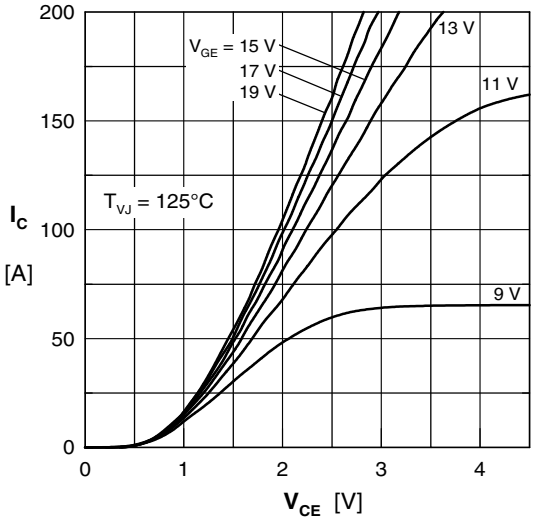



Fig. 2 Typ. output characteristics on die level

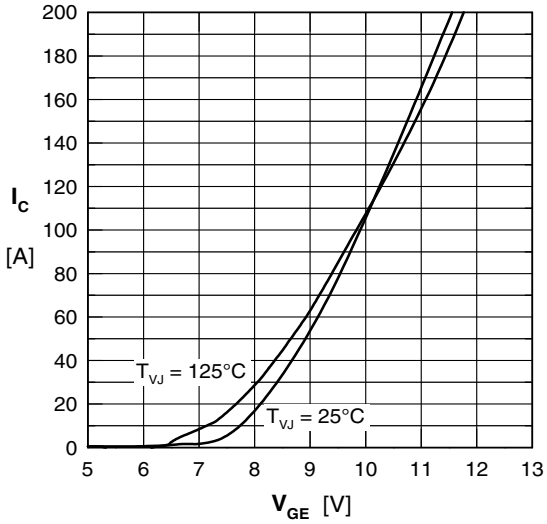



Fig. 3 Typ. tranfer characteristics

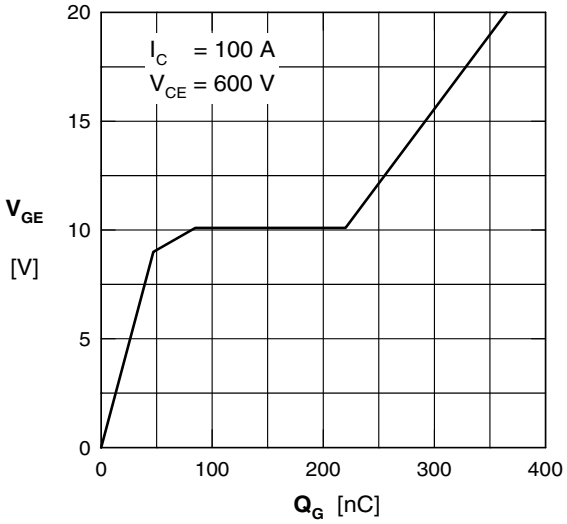



Fig. 4 Typ. turn-on gate charge

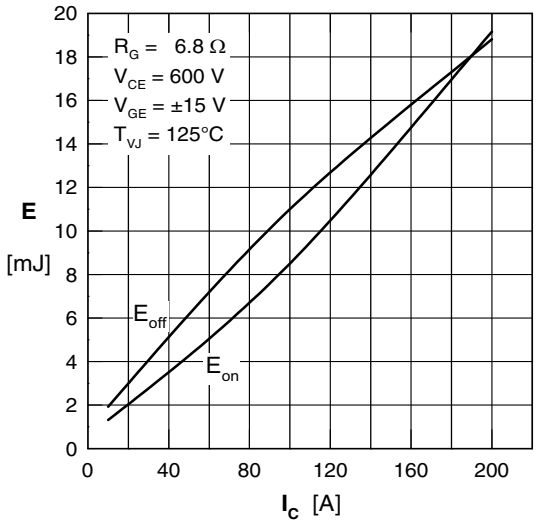



Fig. 5 Typ. switching energy vs. collector current

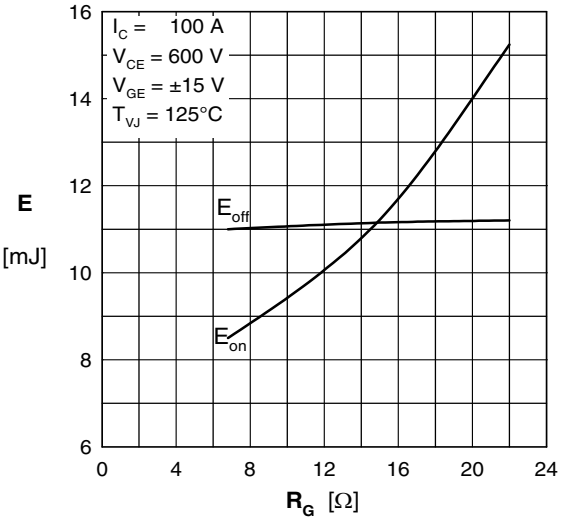



Fig. 6 Typ. switching energy vs. gate resistance

## Fast Recovery Diode

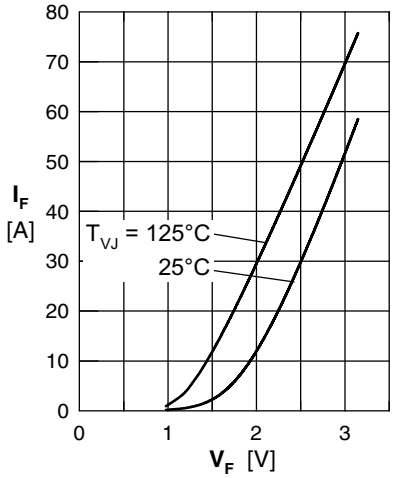



Fig. 1 Typ. forward current $I_F$ vs. $V_F$

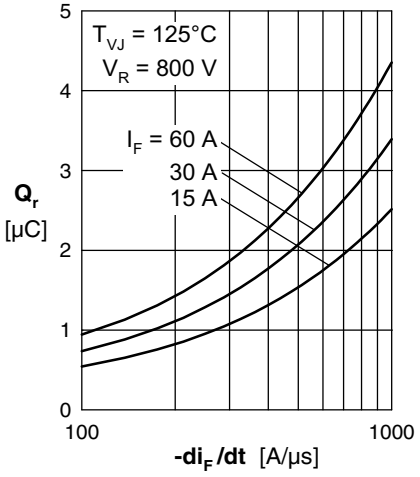



Fig. 2 Typ. reverse recovery charge $Q_r$ versus -di$_F$/dt

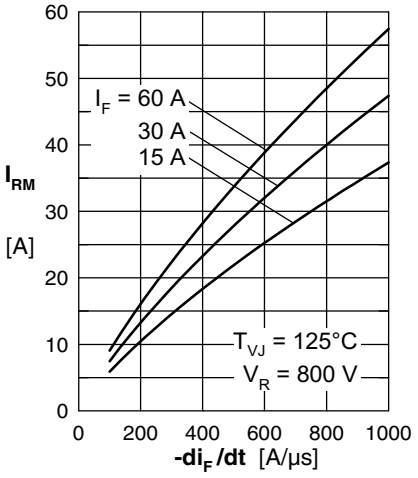



Fig. 3 Typ. peak reverse current $I_{RM}$ versus -di$_F$/dt

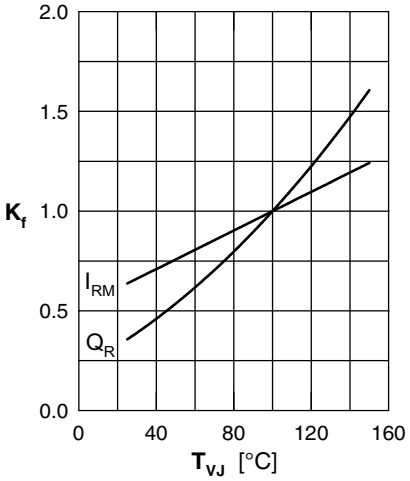



Fig. 4 Typ. dynamic parameters $Q_r$, $I_{RM}$, versus $T_{VJ}$

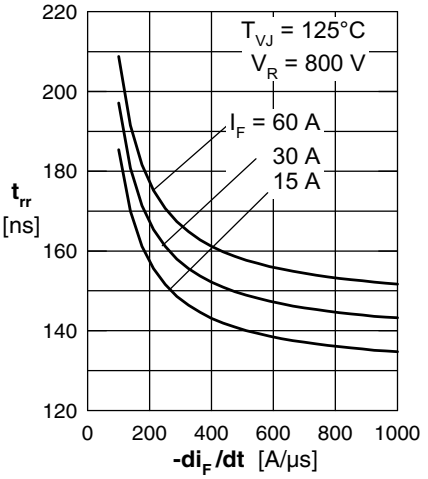



Fig. 5 Typ. recovery time $t_{rr}$ vs. -di$_F$/dt

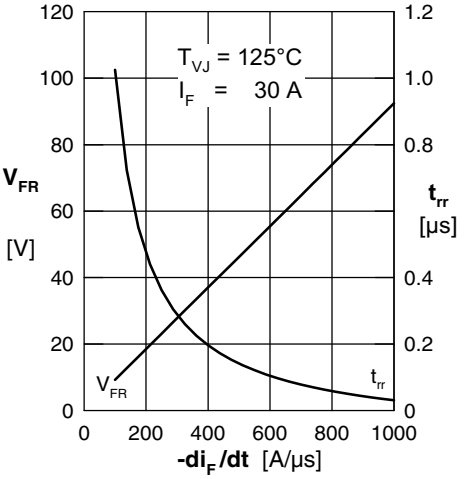



Fig. 6 Typ. peak forward voltage $V_{FR}$ and $t_{fr}$ versus di$_F$/dt

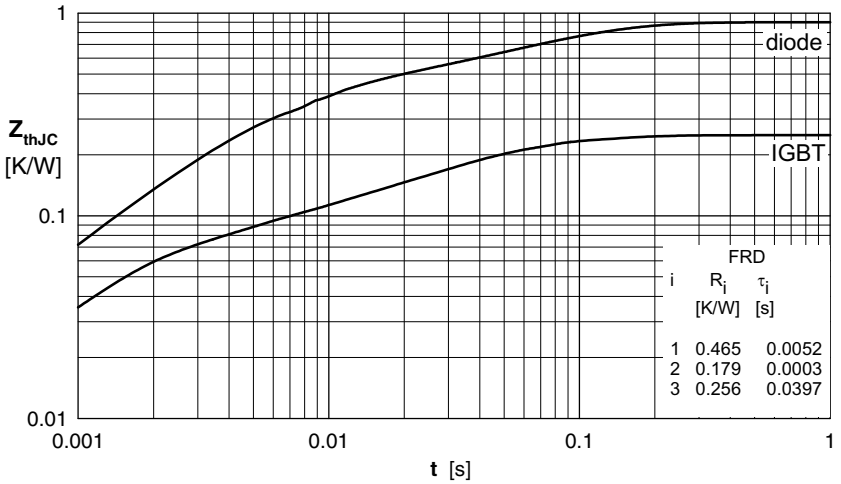



Fig. 7 Typ. transient thermal impedance junction to case

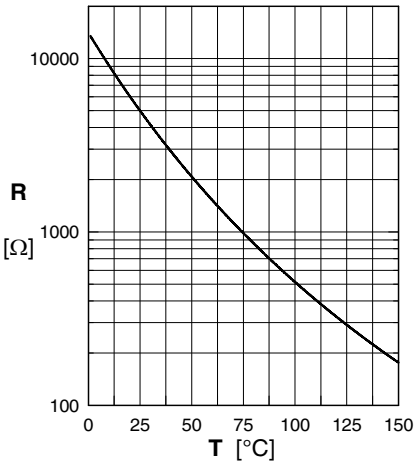



Fig. 8 Typ. thermistor resistance versus temperature