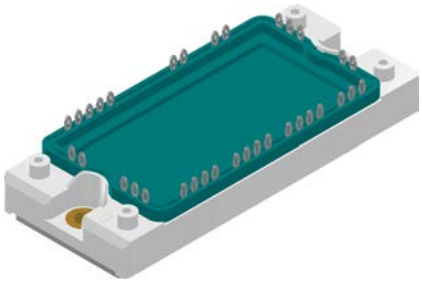
# Standard Rectifier Module

| 3~ Rectifier | | Brake Chopper | |
|---|---|---|---|
| $V_{RRM}$ = | 1600 V | $V_{CES}$ = | 1200 V |
| $I_{DAV}$ = | 450 A | $I_{C25}$ = | 250 A |
| $I_{FSM}$ = | 2400 A | $V_{CE(sat)}$ = | 1,7 V |

## 3~ Rectifier Bridge + Brake Unit + NTC

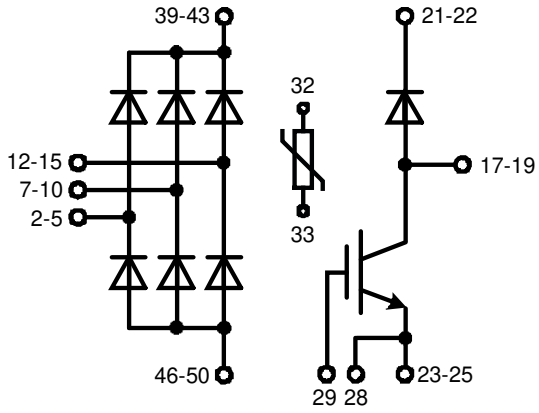
**Part number**

**MDMA450UB1600PTED**



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

X2PT Features:
- very low Eoff
- reduced Vce(sat)
- Tjmax = 175°C
- reduced Rth
- very low gate charge
- easy paralleling
- square RBSOA @ 3x Inom

**Applications:**

- 3~ Rectifier with brake unit for drive inverters

**Package:** E2-Pack

- Isolation Voltage: 4300 V~
- Industry standard outline
- RoHS compliant
- PressFit-Pins for PCB mounting
- Height: 17 mm
- Base plate: Copper internally DCB isolated
- Advanced power cycling
- Phase Change Material available

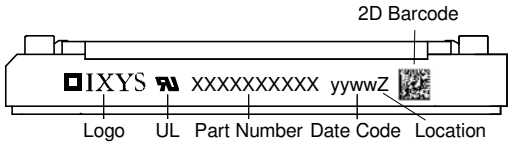
## Rectifier

| 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 | | | 3 | mA |
| $V_F$ | *forward voltage drop* | $I_F$ = 150 A | $T_{VJ}$ = 25°C | | | 1,26 | V |
| | | $I_F$ = 450 A | | | | 1,81 | V |
| | | $I_F$ = 150 A | $T_{VJ}$ = 125°C | | | 1,23 | V |
| | | $I_F$ = 450 A | | | | 1,99 | V |
| $I_{DAV}$ | *bridge output current* | $T_C$ = 85°C | $T_{VJ}$ = 150°C | | | 450 | A |
| | | rectangular d = ⅓ | | | | | |
| $V_{F0}$ | *threshold voltage* } *for power loss calculation only* | | $T_{VJ}$ = 150°C | | | 0,82 | V |
| $r_F$ | *slope resistance* } | | | | | 2,7 | mΩ |
| $R_{thJC}$ | *thermal resistance junction to case* | | | | | 0,2 | K/W |
| $R_{thCH}$ | *thermal resistance case to heatsink* | | | | 0,1 | | K/W |
| $P_{tot}$ | *total power dissipation* | | $T_C$ = 25°C | | | 625 | W |
| $I_{FSM}$ | *max. forward surge current* | t = 10 ms; (50 Hz), sine | $T_{VJ}$ = 45°C | | | 2,40 | kA |
| | | t = 8,3 ms; (60 Hz), sine | $V_R$ = 0 V | | | 2,59 | kA |
| | | t = 10 ms; (50 Hz), sine | $T_{VJ}$ = 150°C | | | 2,04 | kA |
| | | t = 8,3 ms; (60 Hz), sine | $V_R$ = 0 V | | | 2,21 | kA |
| $I^2t$ | *value for fusing* | t = 10 ms; (50 Hz), sine | $T_{VJ}$ = 45°C | | | 28,8 | kA²s |
| | | t = 8,3 ms; (60 Hz), sine | $V_R$ = 0 V | | | 27,9 | kA²s |
| | | t = 10 ms; (50 Hz), sine | $T_{VJ}$ = 150°C | | | 20,8 | kA²s |
| | | t = 8,3 ms; (60 Hz), sine | $V_R$ = 0 V | | | 20,2 | kA²s |
| $C_J$ | *junction capacitance* | $V_R$ = 400 V; f = 1 MHz | $T_{VJ}$ = 25°C | | 91 | | pF |

| Brake IGBT + Diode | | | | 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 | | | 250 | A |
| $I_{C80}$ | | | $T_C$ = 80°C | | | 175 | A |
| $P_{tot}$ | *total power dissipation* | | $T_C$ = 25°C | | | 780 | W |
| $V_{CE(sat)}$ | *collector emitter saturation voltage* | $I_C$ = 150 A; $V_{GE}$ = 15 V | $T_{VJ}$ = 25°C | | 1,7 | 2,1 | V |
| | | | $T_{VJ}$ = 125°C | | 1,9 | | V |
| $V_{GE(th)}$ | *gate emitter threshold voltage* | $I_C$ = 6 mA; $V_{GE}$ = $V_{CE}$ | $T_{VJ}$ = 25°C | 6 | 6,8 | 7,5 | V |
| $I_{CES}$ | *collector emitter leakage current* | $V_{CE}$ = $V_{CES}$; $V_{GE}$ = 0 V | $T_{VJ}$ = 25°C | | | 0,1 | mA |
| | | | $T_{VJ}$ = 125°C | | 1 | | 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; $I_C$ = 150 A | | | 510 | | nC |
| $t_{d(on)}$ | *turn-on delay time* | inductive load<br>$V_{CE}$ = 600 V; $I_C$ = 150 A<br>$V_{GE}$ = ±15 V; $R_G$ = 4,7 Ω | $T_{VJ}$ = 125°C | | 280 | | ns |
| $t_r$ | *current rise time* | | | | 80 | | ns |
| $t_{d(off)}$ | *turn-off delay time* | | | | 440 | | ns |
| $t_f$ | *current fall time* | | | | 230 | | ns |
| $E_{on}$ | *turn-on energy per pulse* | | | | 26 | | mJ |
| $E_{off}$ | *turn-off energy per pulse* | | | | 15 | | mJ |
| **RBSOA** | *reverse bias safe operating area* | $V_{GE}$ = ±15 V; $R_G$ = 4,7 Ω | $T_{VJ}$ = 125°C | | | | |
| $I_{CM}$ | | $V_{CEK}$ = 1200 V | | | | 450 | 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* | $R_G$ = 4,7 Ω; non-repetitive | | | 600 | | A |
| $R_{thJC}$ | *thermal resistance junction to case* | | | | | 0,16 | K/W |
| $R_{thCH}$ | *thermal resistance case to heatsink* | | | | 0,10 | | K/W |

| Brake Diode | | | | | | | |
|---|---|---|---|---|---|---|---|
| $V_{RRM}$ | *max. repetitive reverse voltage* | | $T_{VJ}$ = 25°C | | | 1200 | V |
| $I_{F25}$ | *forward current* | | $T_C$ = 25°C | | | 135 | A |
| $I_{F80}$ | | | $T_C$ = 80°C | | | 90 | A |
| $V_F$ | *forward voltage* | $I_F$ = 100 A | $T_{VJ}$ = 25°C | | | 2,20 | V |
| | | | $T_{VJ}$ = 125°C | | 1,95 | | V |
| $I_R$ | *reverse current* | $V_R$ = $V_{RRM}$ | $T_{VJ}$ = 25°C | | | 0,1 | mA |
| | | | $T_{VJ}$ = 125°C | | | 1,2 | mA |
| $Q_{rr}$ | *reverse recovery charge* | $V_R$ = 600 V<br>$-di_F/dt$ = 1600 A/µs<br>$I_F$ = 100 A; $V_{GE}$ = 0 V | $T_{VJ}$ = 125°C | | 12,5 | | µC |
| $I_{RM}$ | *max. reverse recovery current* | | | | 100 | | A |
| $t_{rr}$ | *reverse recovery time* | | | | 350 | | ns |
| $E_{rec}$ | *reverse recovery energy* | | | | 4 | | mJ |
| $R_{thJC}$ | *thermal resistance junction to case* | | | | | 0,4 | K/W |
| $R_{thCH}$ | *thermal resistance case to heatsink* | | | | 0,1 | | K/W |

| Package E2-Pack | | | | Ratings | | | |
|---|---|---|---|---|---|---|---|
| **Symbol** | **Definition** | **Conditions** | | **min.** | **typ.** | **max.** | **Unit** |
| $I_{RMS}$ | *RMS current* | per terminal | | | | 30 | 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 | 4300 | | | V |
| | | t = 1 minute | | 3600 | | | V |



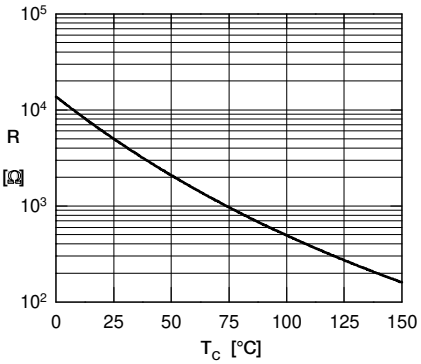

**Part description**

M = Module
D = Diode
M = Standard Rectifier
A = (up to 1800V)
450 = Current Rating [A]
UB = 3~ Rectifier Bridge + Brake Unit
1600 = Reverse Voltage [V]
PT = PressFit-Pin, Thermistor
ED = E2-Pack
- = Hyphen
PC = Phase Change Material

| Ordering | Ordering Number | Marking on Product | Delivery Mode | Quantity | Code No. |
|---|---|---|---|---|---|
| Standard | MDMA450UB1600PTED | MDMA450UB1600PTED | Blister | 28 | 517598 |
| Alternative | MDMA450UB1600PTED-PC | MDMA450UB1600PTED | Blister | 28 | 517605 |

## Temperature Sensor NTC

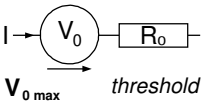
| **Symbol** | **Definition** | **Conditions** | **min.** | **typ.** | **max.** | **Unit** |
|---|---|---|---|---|---|---|
| $R_{25}$ | *resistance* | $T_{VJ}$ = 25° | 4,85 | 5 | 5,15 | kΩ |
| $B_{25/50}$ | *temperature coefficient* | | | 3375 | | K |




Typ. NTC resistance vs. temperature

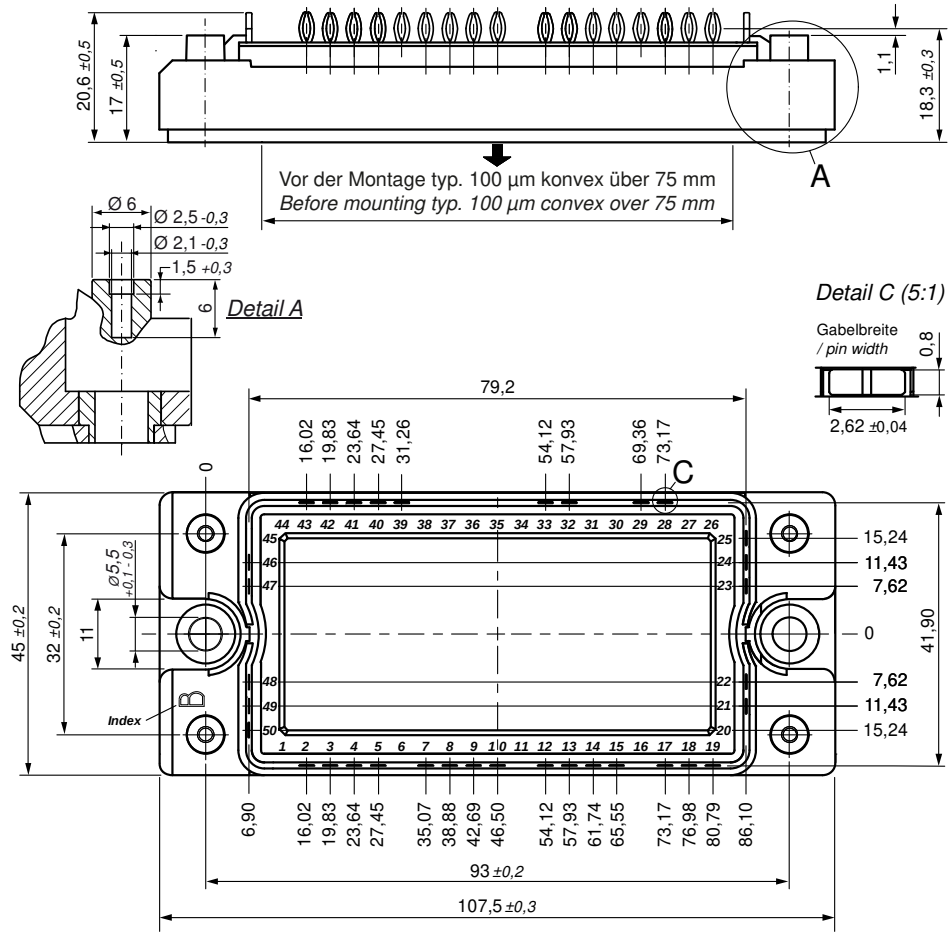
## Equivalent Circuits for Simulation

** on die level* $T_{VJ}$ = 150°C




| | | **Rectifier** | **Brake IGBT +** | **Brake Diode** | |
|---|---|---|---|---|---|
| $V_{0\ max}$ | *threshold voltage* | 0,82 | 1,1 | 1,25 | V |
| $R_{0\ max}$ | *slope resistance ** | 1,2 | 9,2 | 8,5 | mΩ |

## Outlines E2-Pack

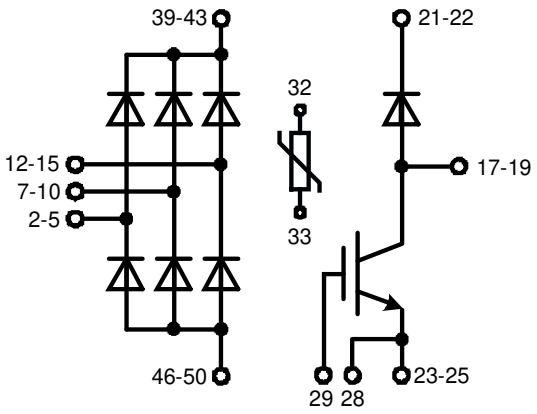



**Bemerkung** / ***Note:***

- Nicht tolerierte 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**
- Bohrlochdurchmesser / *Diameter of drill:* **Ø 2.35 mm**
- Endlochdurchmesser / *Diameter of plated holes:* **Ø 2.14 - 2.29 mm** (Cu thickness in via typ. 50 µm)
- Beschichtung / *Plating:* **chem. Sn max. 15 µm**
- Einpresskraft / *Insert Force:* per terminal with a typ. insert speed of 7 mm/s: **typ. 90 N**
- Weitere Angaben / *Further information:* www.ixys.com **Application note IXAN0077**
- 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

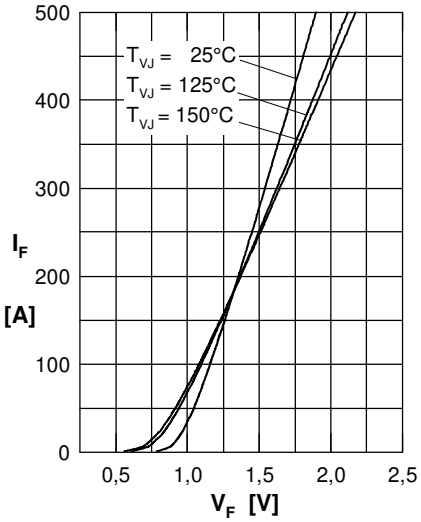



Fig. 1 Forward current versus voltage drop per diode

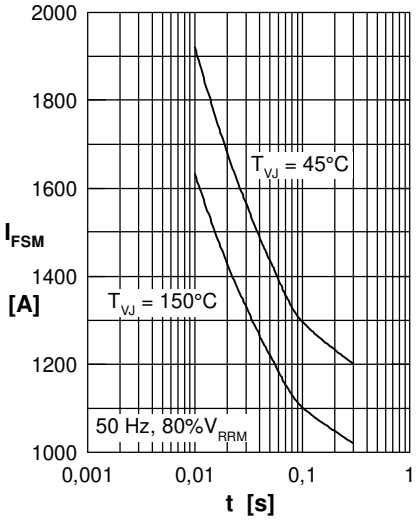



Fig. 2 Surge overload current vs. time per diode

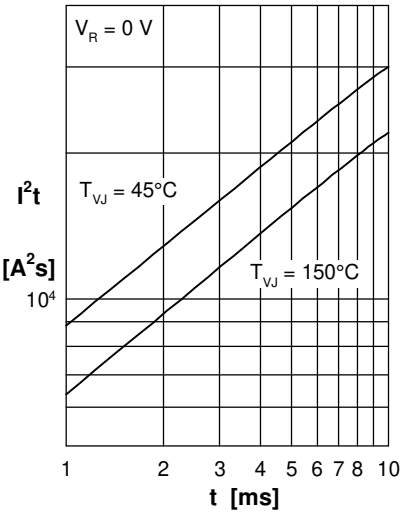



Fig. 3 $I^2t$ versus time per diode

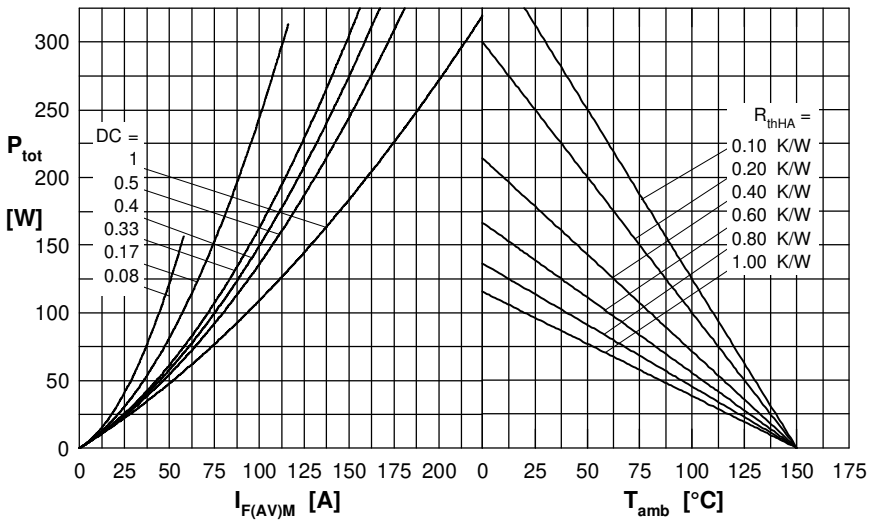



Fig. 4 Power dissipation vs. forward current and ambient temperature per diode

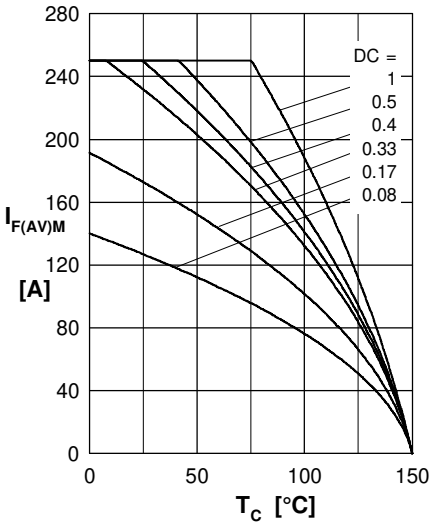



Fig. 5 Max. forward current vs. case temperature per diode

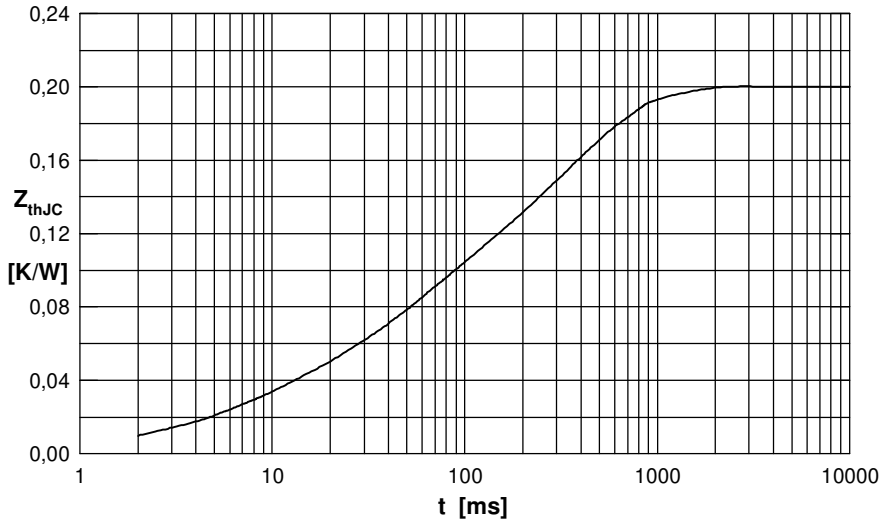



Fig. 6 Transient thermal impedance junction to case vs. time per diode

Constants for $Z_{thJC}$ calculation:

| i | $R_{thi}$ (K/W) | $t_i$ (s) |
|---|---|---|
| 1 | 0.020 | 0.006 |
| 2 | 0.003 | 0.007 |
| 3 | 0.057 | 0.042 |
| 4 | 0.120 | 0.350 |

## Brake IGBT + Diode

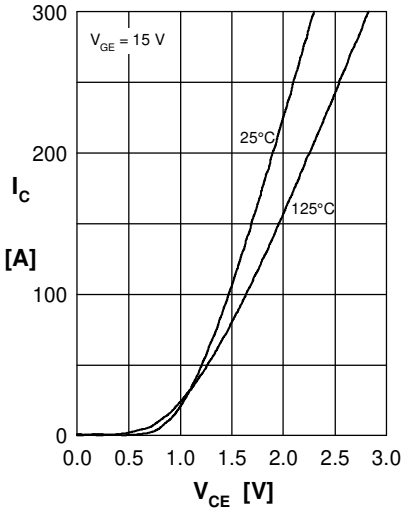



Fig.1 Output characteristics IGBT

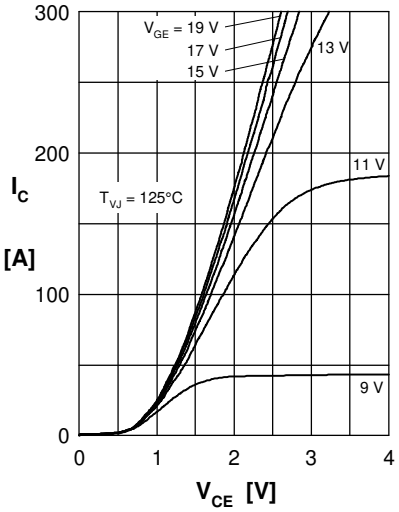



Fig.2 Typ. output characteristics IGBT

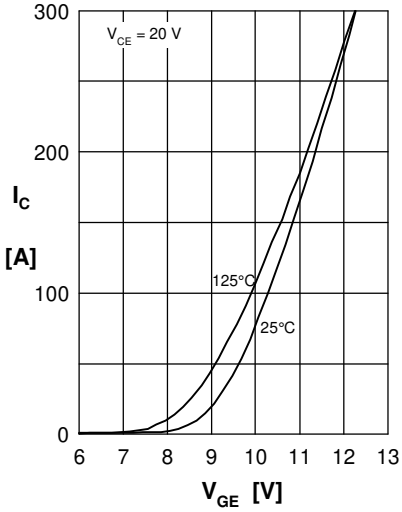



Fig. 3 Typ. transfer charact. IGBT

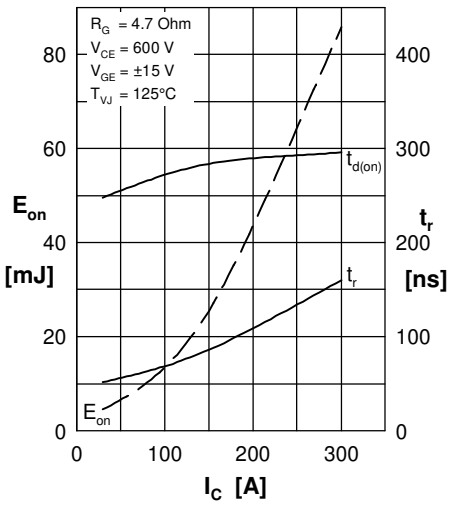



Fig. 4 Typ. turn-on energy & switch. times vs. collector current

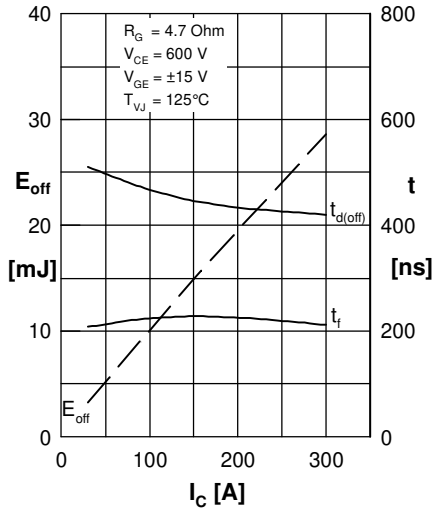



Fig. 5 Typ. turn-off energy & switch. times vs. collector current

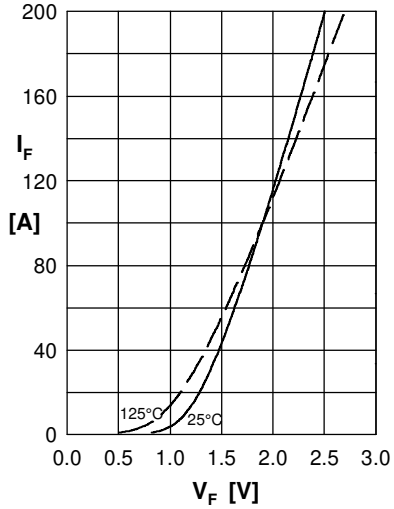



Fig. 6 Typ. forward characteristics Diode

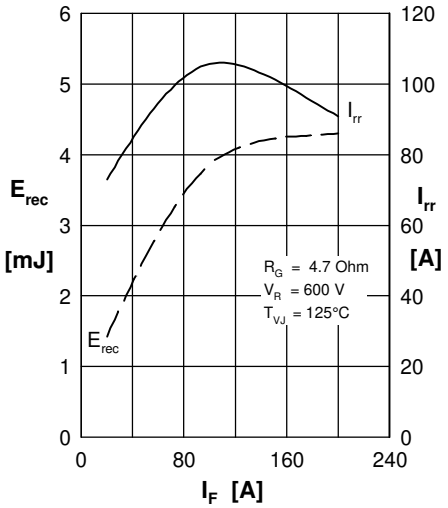



Fig. 7 Typ. reverse recovery characteristics Diode

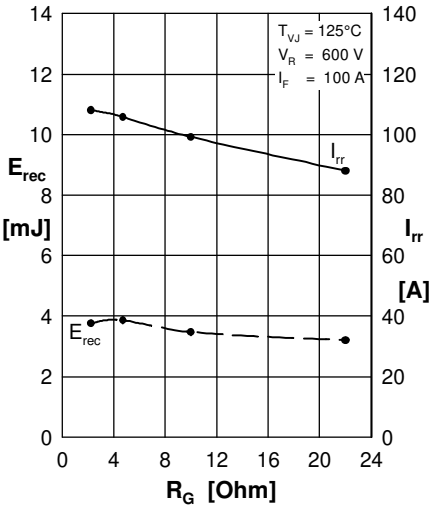



Fig. 8 Typ. reverse recovery characteristics Diode

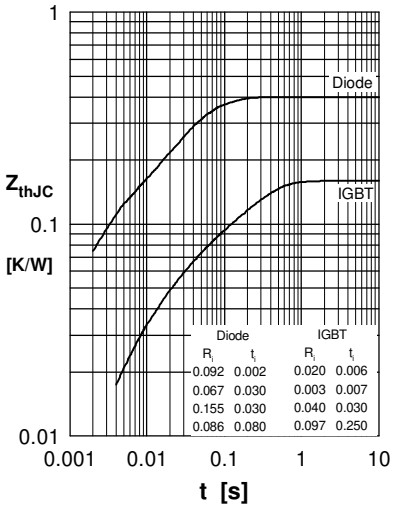



Fig. 9 Transient thermal resistance junction to case