

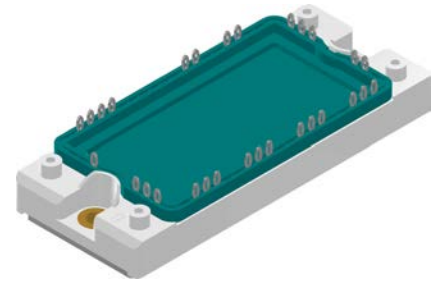
Standard Rectifier Module

| 3~ Rectifier | Brake Chopper |
|----------------------------|-------------------------------|
| $V_{RRM} = 1600 \text{ V}$ | $V_{CES} = 1200 \text{ V}$ |
| $I_{DAV} = 360 \text{ A}$ | $I_{C25} = 250 \text{ A}$ |
| $I_{FSM} = 1900 \text{ A}$ | $V_{CE(sat)} = 1,7 \text{ V}$ |


3~ Rectifier Bridge + Brake Unit + NTC

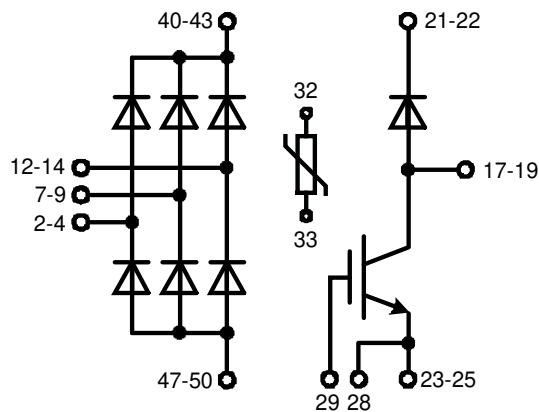
Part number

MDMA360UB1600PTED



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: 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

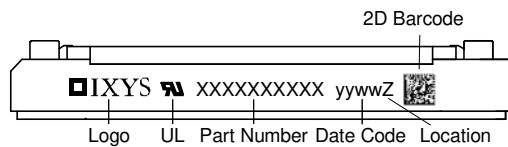
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| Rectifier | | | | Ratings | | | |
|------------|--|-----------------------------|-------------------|------------------------------|------|-----------------------------------|-------------------|
| Symbol | Definition | Conditions | | min. | typ. | max. | Unit |
| V_{RSM} | max. non-repetitive reverse blocking voltage | | | | | 1700 | V |
| V_{RRM} | max. repetitive reverse blocking voltage | | | | | 1600 | V |
| I_R | reverse current | $V_R = 1600$ V | | $T_{VJ} = 25^\circ\text{C}$ | | 100 | μA |
| | | $V_R = 1600$ V | | $T_{VJ} = 150^\circ\text{C}$ | | 3 | mA |
| V_F | forward voltage drop | $I_F = 120$ A | | $T_{VJ} = 25^\circ\text{C}$ | | 1,25 | V |
| | | $I_F = 360$ A | | | | 1,80 | V |
| | | $I_F = 120$ A | | $T_{VJ} = 125^\circ\text{C}$ | | 1,23 | V |
| | | $I_F = 360$ A | | | | 1,98 | V |
| I_{DAV} | bridge output current | $T_C = 85^\circ\text{C}$ | | $T_{VJ} = 150^\circ\text{C}$ | | 360 | A |
| | | rectangular | $d = \frac{1}{3}$ | | | | |
| V_{FO} | threshold voltage | | | $T_{VJ} = 150^\circ\text{C}$ | | 0,82 | V |
| r_F | slope resistance | | | | | 3,4 | m Ω |
| | | | | | | } for power loss calculation only | |
| R_{thJC} | thermal resistance junction to case | | | | | 0,25 | K/W |
| R_{thCH} | thermal resistance case to heatsink | | | | 0,1 | | K/W |
| P_{tot} | total power dissipation | | | $T_C = 25^\circ\text{C}$ | | 500 | W |
| I_{FSM} | max. forward surge current | $t = 10$ ms; (50 Hz), sine | | $T_{VJ} = 45^\circ\text{C}$ | | 1,90 | kA |
| | | $t = 8,3$ ms; (60 Hz), sine | | $V_R = 0$ V | | 2,05 | kA |
| | | $t = 10$ ms; (50 Hz), sine | | $T_{VJ} = 150^\circ\text{C}$ | | 1,62 | kA |
| | | $t = 8,3$ ms; (60 Hz), sine | | $V_R = 0$ V | | 1,75 | kA |
| I^2t | value for fusing | $t = 10$ ms; (50 Hz), sine | | $T_{VJ} = 45^\circ\text{C}$ | | 18,1 | kA ² s |
| | | $t = 8,3$ ms; (60 Hz), sine | | $V_R = 0$ V | | 17,5 | kA ² s |
| | | $t = 10$ ms; (50 Hz), sine | | $T_{VJ} = 150^\circ\text{C}$ | | 13,0 | kA ² s |
| | | $t = 8,3$ ms; (60 Hz), sine | | $V_R = 0$ V | | 12,7 | kA ² s |
| C_J | junction capacitance | $V_R = 400$ V; $f = 1$ MHz | | $T_{VJ} = 25^\circ\text{C}$ | | 73 | pF |

| Brake IGBT + Diode | | | | Ratings | | | |
|--------------------|--------------------------------------|--|-------------------------|---------|----------|---------|--|
| Symbol | Definition | Conditions | min. | typ. | max. | Unit | |
| V_{CES} | collector emitter voltage | $T_{VJ} = 25^{\circ}C$ | | | 1200 | V | |
| V_{GES} | max. DC gate voltage | | | | ± 20 | V | |
| V_{GEM} | max. transient gate emitter voltage | | | | ± 30 | V | |
| I_{C25} | collector current | $T_C = 25^{\circ}C$ | | | 250 | A | |
| I_{C80} | | $T_C = 80^{\circ}C$ | | | 175 | A | |
| P_{tot} | total power dissipation | $T_C = 25^{\circ}C$ | | | 780 | W | |
| $V_{CE(sat)}$ | collector emitter saturation voltage | $I_C = 150\text{ A}; V_{GE} = 15\text{ V}$ | | | 1,7 | V | |
| | | | | | 1,9 | V | |
| $V_{GE(th)}$ | gate emitter threshold voltage | $I_C = 6\text{ mA}; V_{GE} = V_{CE}$ | 6 | 6,8 | 7,5 | V | |
| I_{CES} | collector emitter leakage current | $V_{CE} = V_{CES}; V_{GE} = 0\text{ V}$ | | | 0,1 | mA | |
| | | | | 1 | | mA | |
| I_{GES} | gate emitter leakage current | $V_{GE} = \pm 20\text{ V}$ | | | 500 | nA | |
| $Q_{G(on)}$ | total gate charge | $V_{CE} = 600\text{ V}; V_{GE} = 15\text{ V}; I_C = 150\text{ A}$ | | 510 | | nC | |
| $t_{d(on)}$ | turn-on delay time | inductive load $V_{CE} = 600\text{ V}; I_C = 150\text{ A}$ $V_{GE} = \pm 15\text{ V}; R_G = 4,7\ \Omega$ | $T_{VJ} = 125^{\circ}C$ | | 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 | $V_{GE} = \pm 15\text{ V}; R_G = 4,7\ \Omega$ | | | | | |
| I_{CM} | | $V_{CEK} = 1200\text{ V}$ | | | 400 | A | |
| SCSOA | short circuit safe operating area | $V_{CEK} = 1200\text{ V}$ | | | | | |
| t_{SC} | short circuit duration | $V_{CE} = 900\text{ V}; V_{GE} = \pm 15$ | | | 10 | μs | |
| I_{SC} | short circuit current | $R_G = 4,7\ \Omega$; 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 | $T_{VJ} = 25^{\circ}C$ | | | 1200 | V | |
| I_{F25} | forward current | $T_C = 25^{\circ}C$ | | | 135 | A | |
| I_{F80} | | $T_C = 80^{\circ}C$ | | | 90 | A | |
| V_F | forward voltage | $I_F = 100\text{ A}$ | | | 2,20 | V | |
| | | | | | 1,95 | V | |
| I_R | reverse current | $V_R = V_{RRM}$ | | | 0,1 | mA | |
| | | | | | 1,2 | mA | |
| Q_{rr} | reverse recovery charge | $V_R = 600\text{ V}$ $-di_F/dt = 1600\text{ A}/\mu s$ $I_F = 100\text{ A}; V_{GE} = 0\text{ V}$ | $T_{VJ} = 125^{\circ}C$ | | 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 t = 1 minute | 4300 | | | V |
| | | 50/60 Hz, RMS; $I_{ISOL} \leq 1$ mA | 3600 | | | V |


Part description

M = Module
 D = Diode
 M = Standard Rectifier
 A = (up to 1800V)
 360 = 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 | MDMA360UB1600PTED | MDMA360UB1600PTED | Blister | 28 | 516620 |
| Alternative | MDMA360UB1600PTED-PC | MDMA360UB1600PTED | Blister | 28 | 515423 |

Temperature Sensor NTC

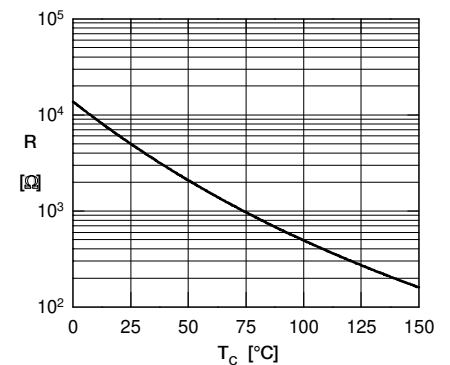
| Symbol | Definition | Conditions | min. | typ. | max. | Unit |
|-------------|-------------------------|---------------------|------|------|------|------------|
| R_{25} | resistance | $T_{VJ} = 25^\circ$ | 4,85 | 5 | 5,15 | k Ω |
| $B_{25/50}$ | temperature coefficient | | | 3375 | | K |

Equivalent Circuits for Simulation

* on die level

 $T_{VJ} = 150^\circ\text{C}$

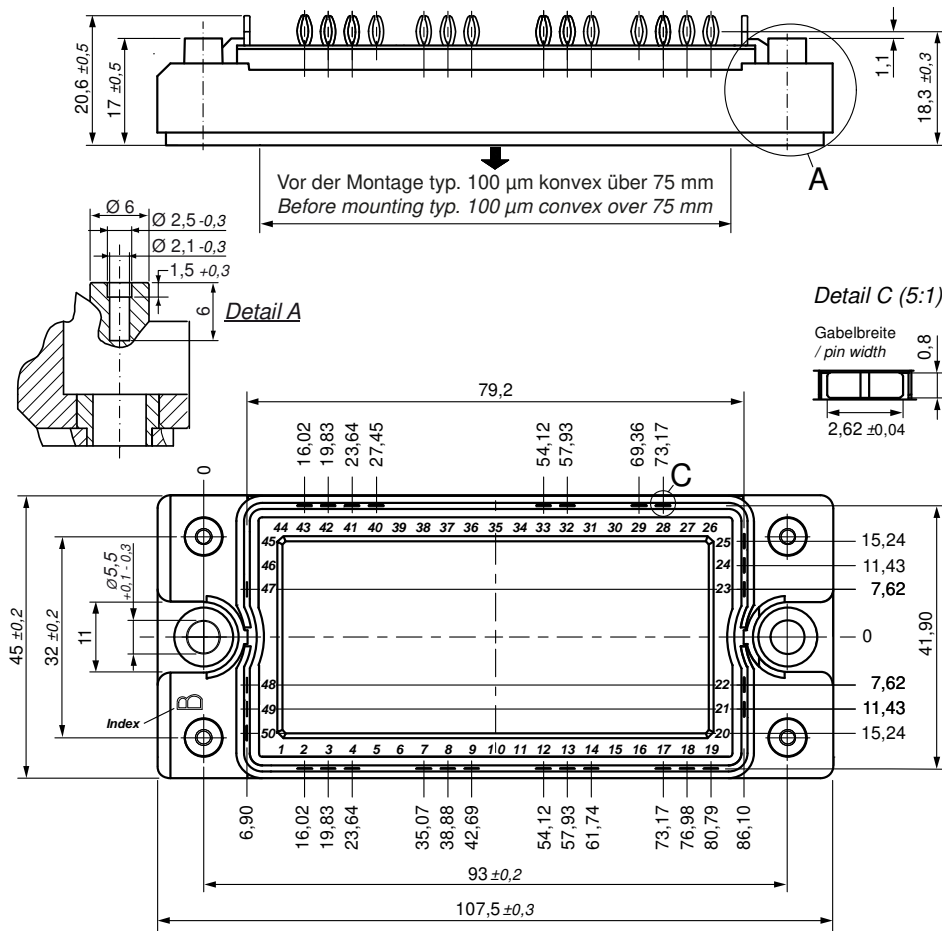
| | Rectifier | Brake IGBT + | Brake Diode | |
|-------|-----------|--------------|-------------|------------|
| V_0 | 0,82 | 1,1 | 1,25 | V |
| R_0 | 1,5 | 9,2 | 8,5 | m Ω |



Typ. NTC resistance vs. temperature



Outlines E2-Pack

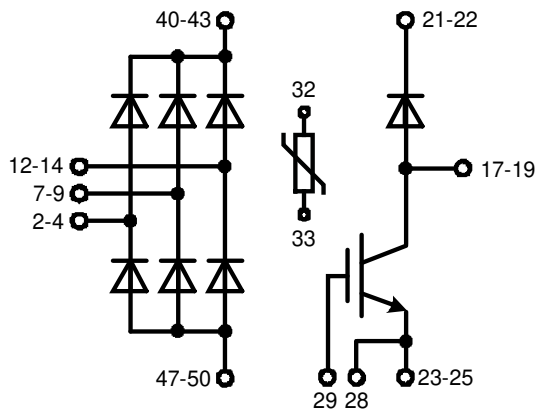


Bemerkung / Note:

- 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: $\oplus 0,1$
- 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**



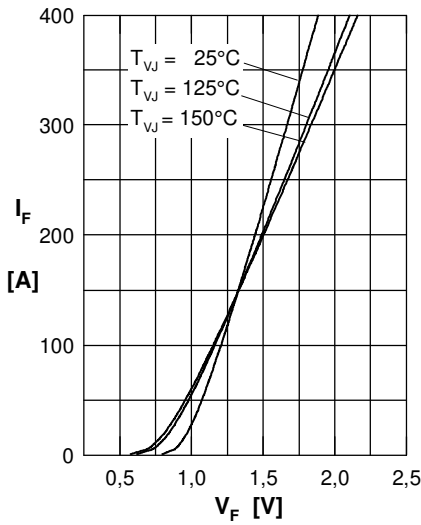
Rectifier


Fig. 1 Forward current versus voltage drop per diode

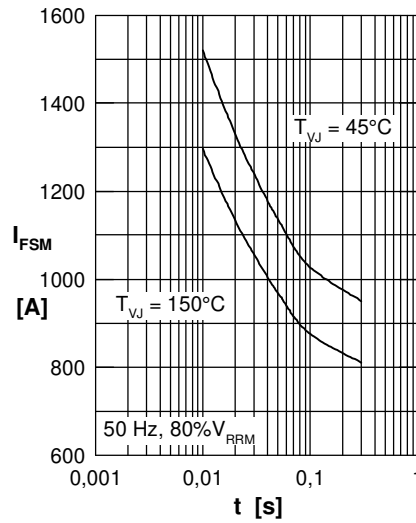


Fig. 2 Surge overload current vs. time per diode

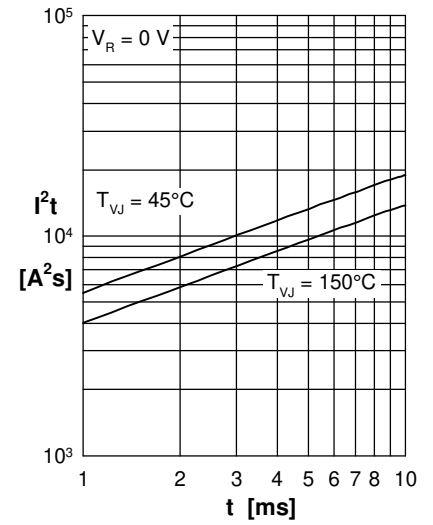
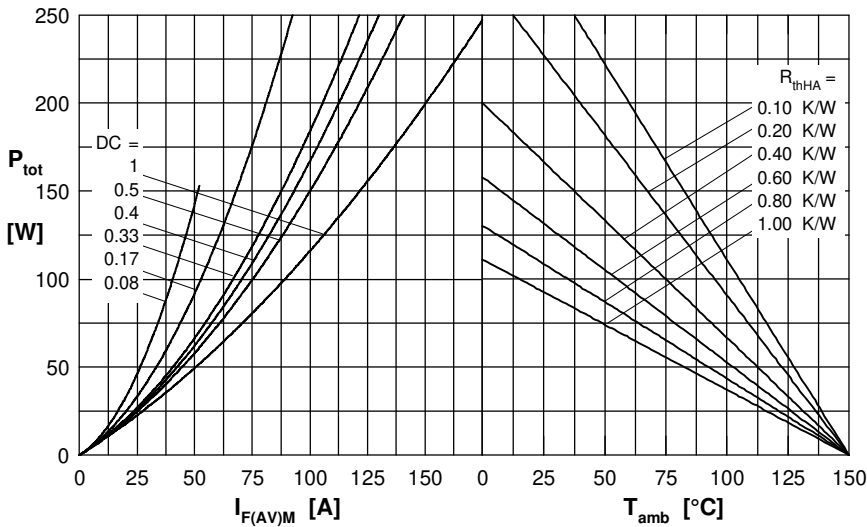

 Fig. 3 I^2t versus time per diode


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

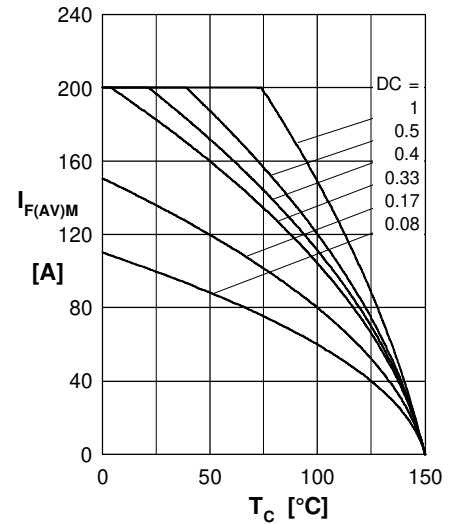


Fig. 5 Max. forward current vs. case temperature per diode

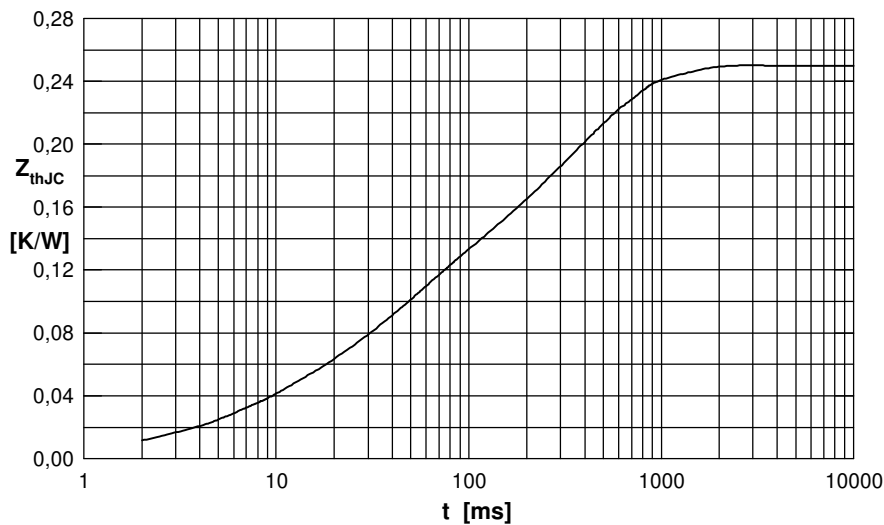


Fig. 6 Transient thermal impedance junction to case vs. time per diode

 Constants for Z_{thJC} calculation:

| i | R_{thi} (K/W) | t_i (s) |
|---|-----------------|-----------|
| 1 | 0.020 | 0.006 |
| 2 | 0.003 | 0.007 |
| 3 | 0.080 | 0.037 |
| 4 | 0.147 | 0.360 |

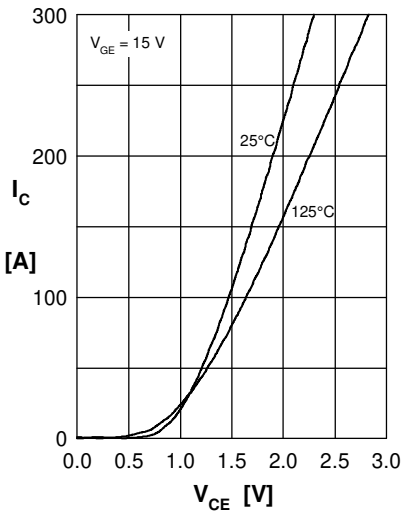
Brake IGBT + Diode


Fig.1 Output characteristics IGBT

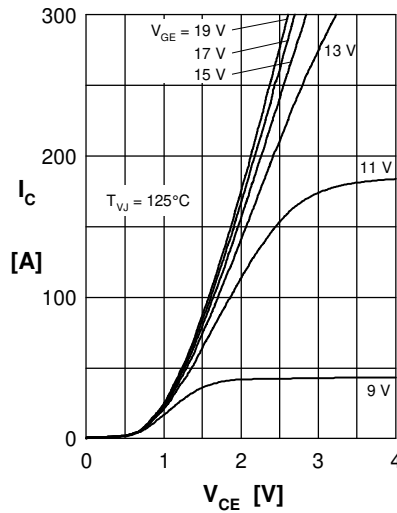


Fig.2 Typ. output characteristics IGBT

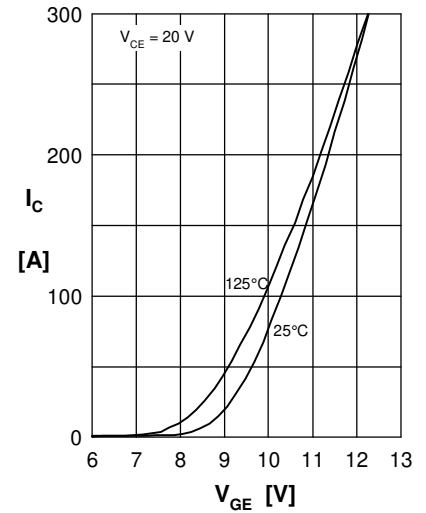


Fig. 3 Typ. transfer charact. IGBT

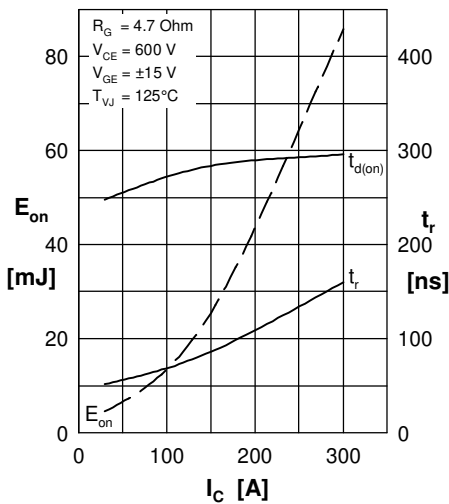


Fig. 4 Typ. turn-on energy & switch. times vs. collector current

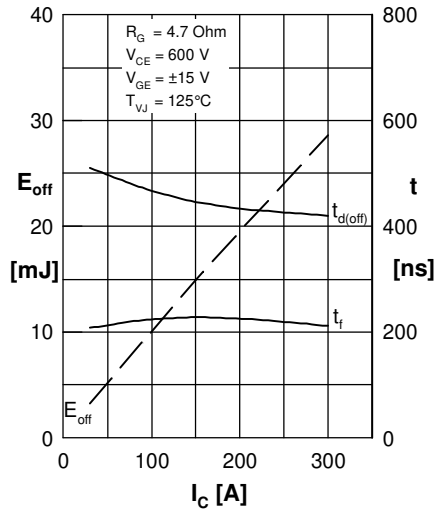


Fig. 5 Typ. turn-off energy & switch. times vs. collector current

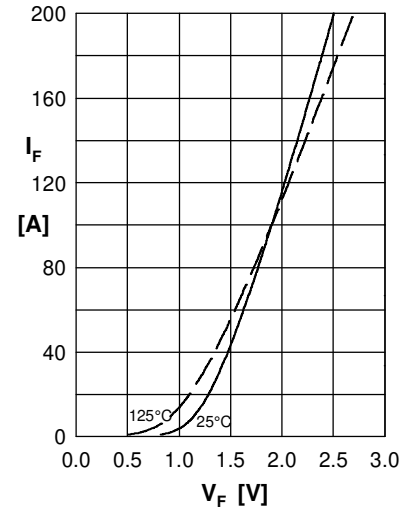


Fig. 6 Typ. forward characteristics Diode

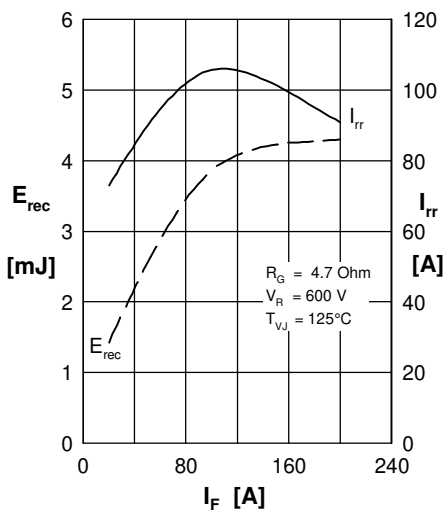


Fig. 7 Typ. reverse recovery characteristics Diode

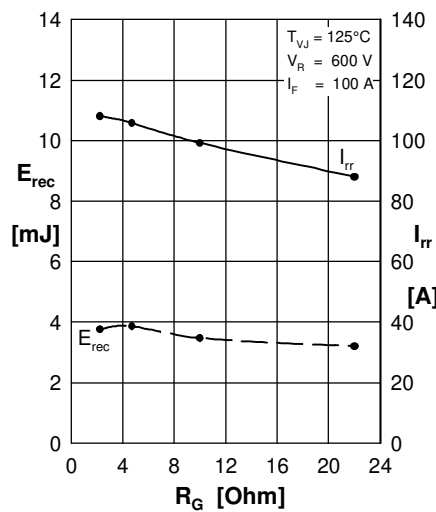


Fig. 8 Typ. reverse recovery characteristics Diode

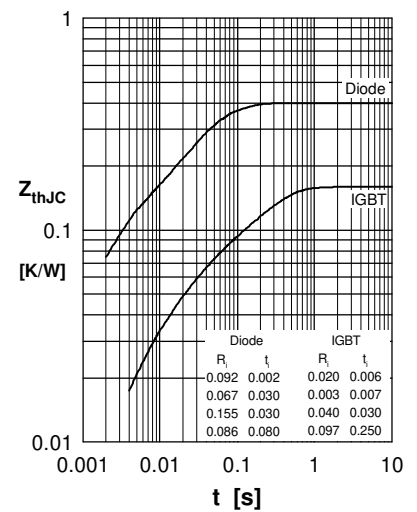


Fig. 9 Transient thermal resistance junction to case