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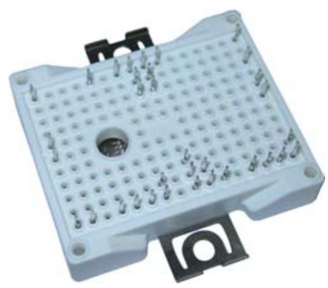
# XPT IGBT Module

| 3~ Rectifier | | Brake Chopper | | 3~ Inverter | |
|---|---|---|---|---|---|
| $V_{RRM}$ = | 1600 V | $V_{CES}$ = | 1200 V | $V_{CES}$ = | 1200 V |
| $I_{DAV}$ = | 70 A | $I_{C25}$ = | 28 A | $I_{C25}$ = | 28 A |
| $I_{FSM}$ = | 270 A | $V_{CE(sat)}$ = | 1.8 V | $V_{CE(sat)}$ = | 1.8 V |

## 6-Pack + 3~ Rectifier Bridge & Brake Unit + NTC

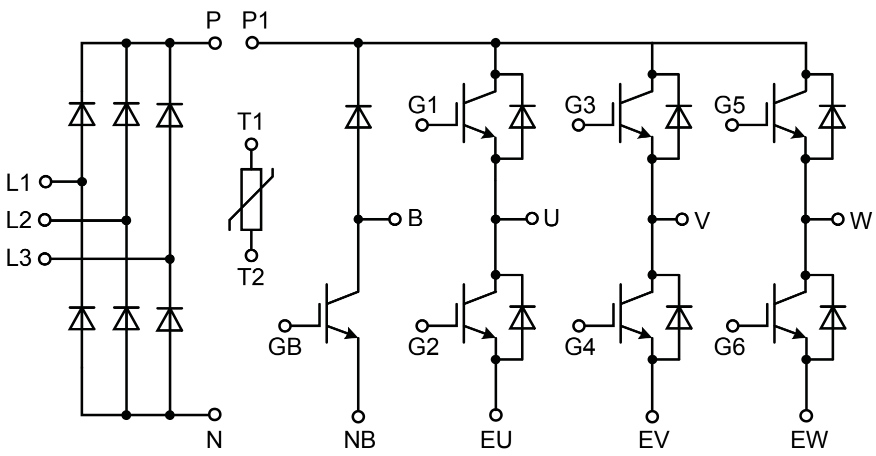
**Part number**

MIXA20WB1200TMI



Backside: isolated

UL pending




**Features / Advantages:**

- Easy paralleling due to the positive temperature coefficient of the on-state voltage
- Rugged XPT design (Xtreme light Punch Through) results in:
  - short circuit rated for 10 µsec.
  - very low gate charge
  - low EMI
  - square RBSOA @ 3x Ic
- Thin wafer technology combined with the XPT design results in a competitive low VCE(sat)
- SONIC™ diode
  - fast and soft reverse recovery
  - low operating forward voltage

**Applications:**

- AC motor drives
- Solar inverter
- Medical equipment
- Uninterruptible power supply
- Air-conditioning systems
- Welding equipment
- Switched-mode and resonant-mode power supplies
- Inductive heating, cookers
- Pumps, Fans

**Package:** MiniPack2B

- Isolation Voltage: 3000 V~
- Industry standard outline
- RoHS compliant
- Epoxy meets UL 94V-0

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| Rectifier | | | | Ratings | | | |
|---|---|---|---|---|---|---|---|
| Symbol | Definition | Conditions | | 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 | | | 10 | µA |
| | | $V_R$ = 1600 V | $T_{VJ}$ = 125°C | | | 1 | mA |
| $V_F$ | *forward voltage drop* | $I_F$ = 20 A | $T_{VJ}$ = 25°C | | | 1.19 | V |
| | | $I_F$ = 40 A | | | | 1.54 | V |
| | | $I_F$ = 20 A | $T_{VJ}$ = 125 °C | | | 1.12 | V |
| | | $I_F$ = 40 A | | | | 1.59 | V |
| $I_{DAV}$ | *bridge output current* | $T_C$ = 80°C | $T_{VJ}$ = 150°C | | | 70 | A |
| | | rectangular d = ⅓ | | | | | |
| $V_{F0}$ | *threshold voltage* | *for power loss calculation only* | $T_{VJ}$ = 150°C | | | 0.86 | V |
| $r_F$ | *slope resistance* | | | | | 12.3 | mΩ |
| $R_{thJC}$ | *thermal resistance junction to case* | | | | | 1.8 | K/W |
| $R_{thCH}$ | *thermal resistance case to heatsink* | | | | 0.35 | | K/W |
| $P_{tot}$ | *total power dissipation* | | $T_C$ = 25°C | | | 70 | W |
| $I_{FSM}$ | *max. forward surge current* | t = 10 ms; (50 Hz), sine | $T_{VJ}$ = 45°C | | | 270 | A |
| | | t = 8,3 ms; (60 Hz), sine | $V_R$ = 0 V | | | 290 | A |
| | | t = 10 ms; (50 Hz), sine | $T_{VJ}$ = 150°C | | | 230 | A |
| | | t = 8,3 ms; (60 Hz), sine | $V_R$ = 0 V | | | 250 | A |
| $I^2t$ | *value for fusing* | t = 10 ms; (50 Hz), sine | $T_{VJ}$ = 45°C | | | 365 | A²s |
| | | t = 8,3 ms; (60 Hz), sine | $V_R$ = 0 V | | | 350 | A²s |
| | | t = 10 ms; (50 Hz), sine | $T_{VJ}$ = 150°C | | | 265 | A²s |
| | | t = 8,3 ms; (60 Hz), sine | $V_R$ = 0 V | | | 260 | A²s |
| $C_J$ | *junction capacitance* | $V_R$ = 400 V; f = 1 MHz | $T_{VJ}$ = 25°C | | 10 | | pF |

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## Brake IGBT

| Symbol | Definition | Conditions | | Ratings 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 | | | 28 | A |
| $I_{C80}$ | | | $T_C$ = 80°C | | | 20 | A |
| $P_{tot}$ | *total power dissipation* | | $T_C$ = 25°C | | | 100 | W |
| $V_{CE(sat)}$ | *collector emitter saturation voltage* | $I_C$ = 15 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* | $I_C$ = 0.6 mA; $V_{GE}$ = $V_{CE}$ | $T_{VJ}$ = 25°C | 5.4 | 5.9 | 6.5 | 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 | | 0.1 | | 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; $I_C$ = 15 A | | | 48 | | nC |
| $t_{d(on)}$ | *turn-on delay time* | inductive load | $T_{VJ}$ = 125°C | | 70 | | ns |
| $t_r$ | *current rise time* | $V_{CE}$ = 600 V; $I_C$ = 15 A | | | 40 | | ns |
| $t_{d(off)}$ | *turn-off delay time* | $V_{GE}$ = ±15 V; $R_G$ = 56 Ω | | | 250 | | ns |
| $t_f$ | *current fall time* | | | | 100 | | ns |
| $E_{on}$ | *turn-on energy per pulse* | | | | 1.6 | | mJ |
| $E_{off}$ | *turn-off energy per pulse* | | | | 1.7 | | mJ |
| RBSOA | *reverse bias safe operating area* | $V_{GE}$ = ±15 V; $R_G$ = 56 Ω | $T_{VJ}$ = 125°C | | | | |
| $I_{CM}$ | | $V_{CEK}$ = 1200 V | | | | 45 | A |
| SCSOA | *short circuit safe operating area* | | | | | | |
| $t_{SC}$ | *short circuit duration* | $V_{CE}$ = 900 V; $V_{GE}$ = ±15 V | $T_{VJ}$ = 125°C | | | 10 | µs |
| $I_{SC}$ | *short circuit current* | $R_G$ = 56 Ω; non-repetitive | | | 60 | | A |
| $R_{thJC}$ | *thermal resistance junction to case* | | | | | 1.26 | K/W |
| $R_{thCH}$ | *thermal resistance case to heatsink* | | | | 0.42 | | K/W |

## Brake Diode

| Symbol | Definition | Conditions | | min. | typ. | max. | Unit |
|---|---|---|---|---|---|---|---|
| $V_{RRM}$ | *max. repetitive reverse voltage* | | $T_{VJ}$ = 25°C | | | 1200 | V |
| $I_{F25}$ | *forward current* | | $T_C$ = 25°C | | | 18 | A |
| $I_{F80}$ | | | $T_C$ = 80°C | | | 12 | A |
| $V_F$ | *forward voltage* | $I_F$ = 10 A | $T_{VJ}$ = 25°C | | | 2.20 | V |
| | | | $T_{VJ}$ = 125°C | | 2.20 | | V |
| $I_R$ | *reverse current* | $V_R$ = $V_{RRM}$ | $T_{VJ}$ = 25°C | | | 0.1 | mA |
| | | | $T_{VJ}$ = 125°C | | | 0.2 | mA |
| $Q_{rr}$ | *reverse recovery charge* | $V_R$ = 600 V | | | 1.3 | | µC |
| $I_{RM}$ | *max. reverse recovery current* | $-di_F/dt$ = 250 A/µs | $T_{VJ}$ = 125°C | | 10.5 | | A |
| $t_{rr}$ | *reverse recovery time* | $I_F$ = 10 A | | | 350 | | ns |
| $E_{rec}$ | *reverse recovery energy* | | | | 0.4 | | mJ |
| $R_{thJC}$ | *thermal resistance junction to case* | | | | | 2.5 | K/W |
| $R_{thCH}$ | *thermal resistance case to heatsink* | | | | 0.83 | | K/W |

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## Inverter IGBT

| 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 | | | 28 | A |
| $I_{C80}$ | | | $T_C$ = 80°C | | | 20 | A |
| $P_{tot}$ | *total power dissipation* | | $T_C$ = 25°C | | | 100 | W |
| $V_{CE(sat)}$ | *collector emitter saturation voltage* | $I_C$ = 15A; $V_{GE}$ = 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* | $I_C$ = 0.6mA; $V_{GE}$ = $V_{CE}$ | $T_{VJ}$ = 25°C | 5.4 | 5.9 | 6.5 | 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 | | 0.1 | | 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; $I_C$ = 15 A | | | 48 | | nC |
| $t_{d(on)}$ | *turn-on delay time* | inductive load<br>$V_{CE}$ = 600V; $I_C$ = 15A<br>$V_{GE}$ = ±15 V; $R_G$ = 56 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* | | | | 1.6 | | mJ |
| $E_{off}$ | *turn-off energy per pulse* | | | | 1.7 | | mJ |
| RBSOA | *reverse bias safe operating area* | $V_{GE}$ = ±15 V; $R_G$ = 56 Ω | $T_{VJ}$ = 125°C | | | | |
| $I_{CM}$ | | $V_{CEmax}$ = 1200V | | | | 45 | A |
| SCSOA | *short circuit safe operating area* | $V_{CEmax}$ = 900V | | | | | |
| $t_{SC}$ | *short circuit duration* | $V_{CE}$ = 900V; $V_{GE}$ = ±15 V | $T_{VJ}$ = 125°C | | | 10 | µs |
| $I_{SC}$ | *short circuit current* | $R_G$ = 56Ω; non-repetitive | | | 60 | | A |
| $R_{thJC}$ | *thermal resistance junction to case* | | | | | 1.26 | K/W |
| $R_{thCH}$ | *thermal resistance case to heatsink* | | | | 0.42 | | K/W |

## Inverter Diode

| Symbol | Definition | Conditions | | min. | typ. | max. | Unit |
|---|---|---|---|---|---|---|---|
| $V_{RRM}$ | *max. repetitive reverse voltage* | | $T_{VJ}$ = 25°C | | | 1200 | V |
| $I_{F25}$ | *forward current* | | $T_C$ = 25°C | | | 18 | A |
| $I_{F80}$ | | | $T_C$ = 80°C | | | 12 | A |
| $V_F$ | *forward voltage* | $I_F$ = 10A | $T_{VJ}$ = 25°C | | | 2.20 | V |
| | | | $T_{VJ}$ = 125°C | | 2.20 | | V |
| $I_R$ | *reverse current* | $V_R$ = $V_{RRM}$ | $T_{VJ}$ = 25°C | | | 0.1 | mA |
| | | | $T_{VJ}$ = 125°C | | 0.2 | | mA |
| $Q_{rr}$ | *reverse recovery charge* | $V_R$ = 600 V<br>$-di_F/dt$ = 250 A/µs<br>$I_F$ = 10A; $V_{GE}$ = 0 V | $T_{VJ}$ = 125°C | | 1.3 | | µC |
| $I_{RM}$ | *max. reverse recovery current* | | | | 10.5 | | A |
| $t_{rr}$ | *reverse recovery time* | | | | 350 | | ns |
| $E_{rec}$ | *reverse recovery energy* | | | | 0.4 | | mJ |
| $R_{thJC}$ | *thermal resistance junction to case* | | | | | 2.5 | K/W |
| $R_{thCH}$ | *thermal resistance case to heatsink* | | | | 0.83 | | K/W |

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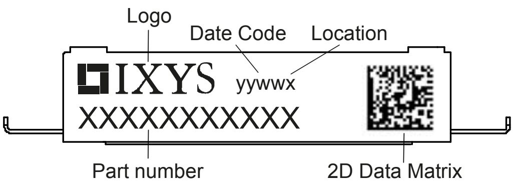
| Package MiniPack2B | | | | Ratings | | | |
|---|---|---|---|---|---|---|---|
| **Symbol** | **Definition** | **Conditions** | | **min.** | **typ.** | **max.** | **Unit** |
| $I_{RMS}$ | *RMS current* | per terminal | | | | | A |
| $T_{VJ}$ | *virtual junction temperature* | | | -40 | | 150 | °C |
| $T_{op}$ | *operation temperature* | | | -40 | | 125 | °C |
| $T_{stg}$ | *storage temperature* | | | -40 | | 125 | °C |
| Weight | | | | | 39 | | g |
| $M_D$ | *mounting torque* | | | 2 | | 2.2 | Nm |
| $d_{Spp/App}$ | *creepage distance on surface \| striking distance through air* | *terminal to terminal* | 6.3 | 5.0 | | | mm |
| $d_{Spb/Apb}$ | | *terminal to backside* | 11.5 | 10.0 | | | mm |
| $V_{ISOL}$ | *isolation voltage* | t = 1 second; 50/60 Hz, RMS; $I_{ISOL}$ ≤ 1 mA | | 3000 | | | V |
| | | t = 1 minute | | 2500 | | | V |
| $R_{pin-chip}$ | *resistance pin to chip* | $V = V_{CEsat} + 2{\cdot}R{\cdot}I_C$ resp. $V = V_F + 2{\cdot}R{\cdot}I_F$ | | | 6 | | mΩ |
| $T_{vjm}$ | *max. virtual junction temperature* | | | | | 175 | °C |

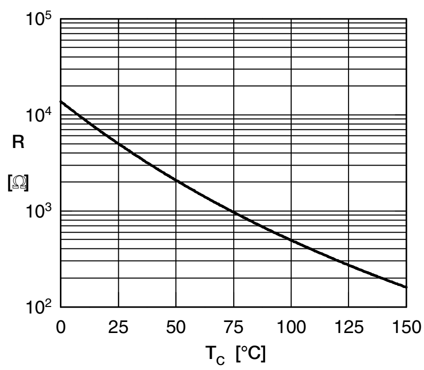



**Part number**

M = Module
I = IGBT
X = XPT IGBT
A = Gen 1 / std
20 = Current Rating [A]
WB = 6-Pack + 3~ Rectifier Bridge & Brake Unit
1200 = Reverse Voltage [V]
T = Thermistor \ Temperature sensor
MI = MiniPack2B

| Ordering | Part Number | Marking on Product | Delivery Mode | Quantity | Code No. |
|---|---|---|---|---|---|
| Standard | MIXA20WB1200TMI | MIXA20WB1200TMI | Blister | 20 | 514795 |

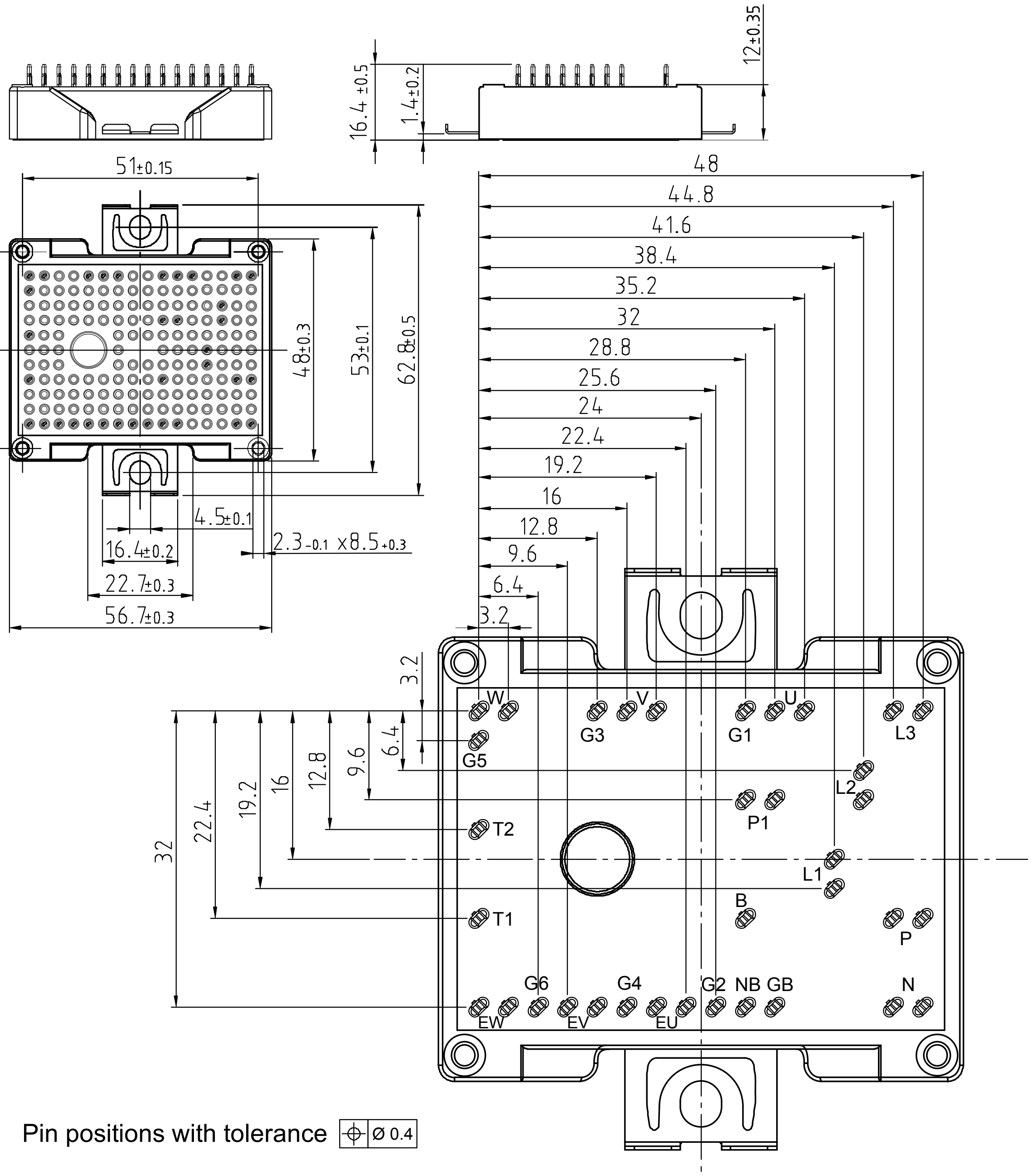
| Temperature Sensor NTC | | | | | | |
|---|---|---|---|---|---|---|
| **Symbol** | **Definition** | **Conditions** | **min.** | **typ.** | **max.** | **Unit** |
| $R_{25}$ | *resistance* | $T_{VJ}$ = 25° | 4.75 | 5 | 5.25 | kΩ |
| $B_{25/50}$ | *temperature coefficient* | | | 3375 | | K |

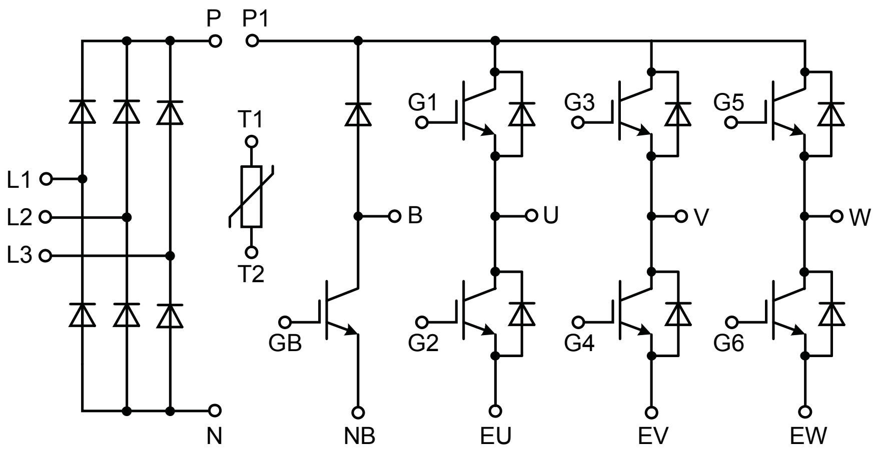



Typ. NTC resistance vs. temperature

| Equivalent Circuits for Simulation ** on die level* | | $T_{VJ}$ = 150 °C | | | | | |
|---|---|---|---|---|---|---|---|
| I → $V_0$ — $R_0$ | | **Rectifier** | **Brake IGBT** | **Brake Diode** | **Inverter IGBT** | **Inverter Diode** | |
| $V_{0\,max}$ | *threshold voltage* | 0.86 | 1.1 | 1.25 | 1.1 | 1.25 | V |
| $R_{0\,max}$ | *slope resistance ** | 10 | 86 | 90 | 86 | 90 | mΩ |

## Outlines MiniPack2B



## Rectifier

$V_F$ [V]

Fig. 1 Forward current versus voltage drop per diode

t [s]

Fig. 2 Surge overload current

t [ms]

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

Fig. 4 Power dissipation versus direct output current and ambient temperature, sine 180°

Fig. 5 Max. forward current versus case temperature

Fig. 6 Transient thermal impedance junction to case

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## Brake IGBT

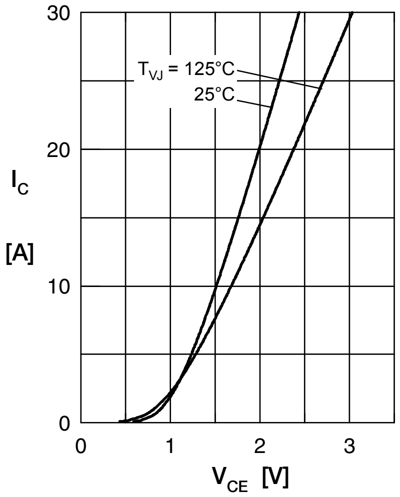


Fig. 1 Typ. output characteristics

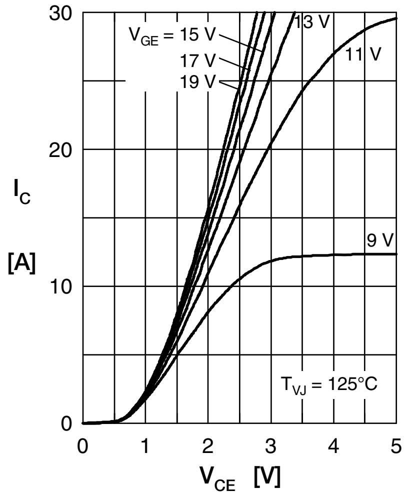


Fig. 2 Typ. output characteristics

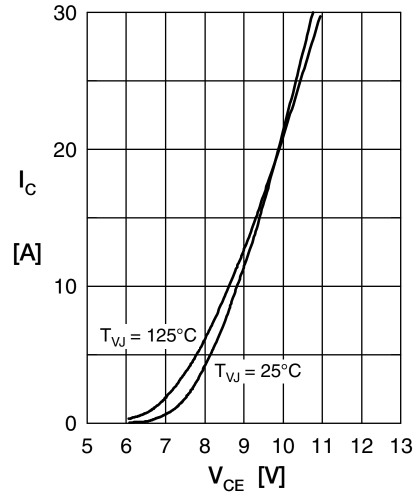


Fig. 3 Typ. transfer characteristics

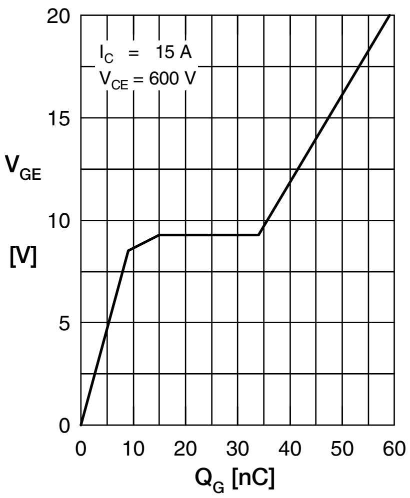


Fig. 4 Typ. turn-on gate charge

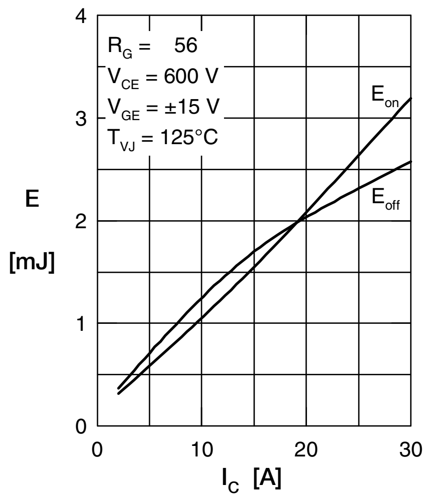


Fig. 5 Typ. switching energy vs. collector current

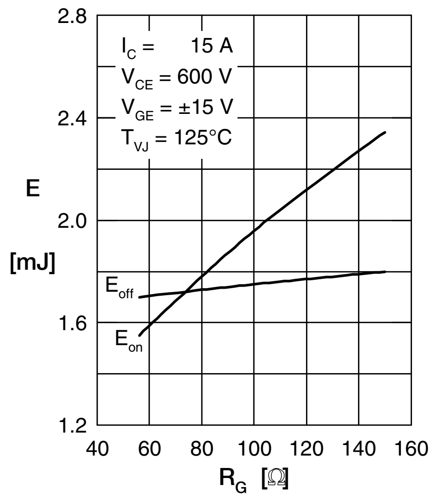


Fig. 6 Typ. switching energy versus gate resistance

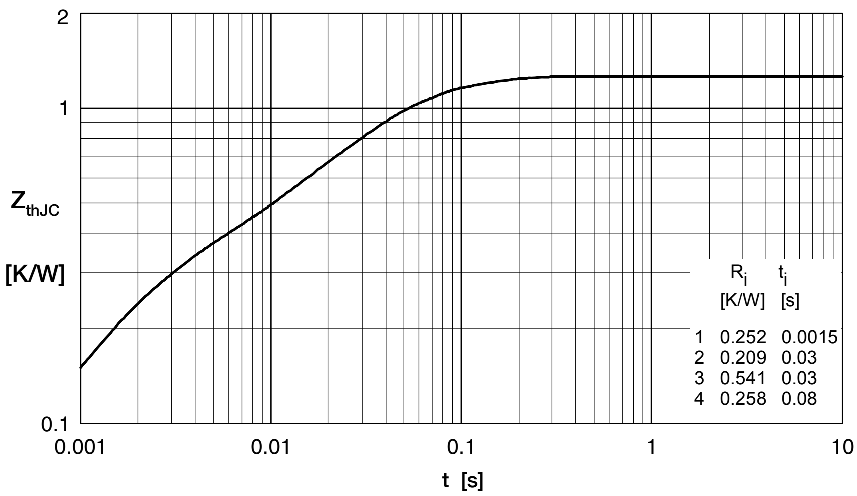


Fig. 7 Transient thermal impedance junction to case

## Brake Diode

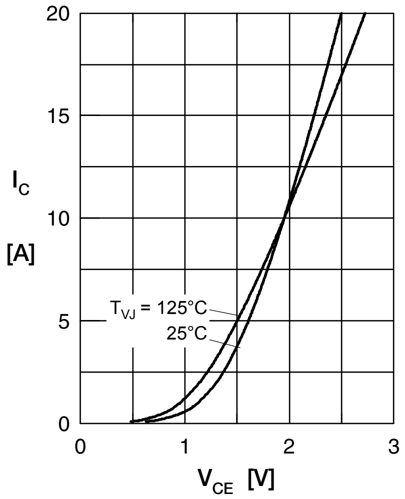


Fig. 1 Typ. Forward current versus $V_F$

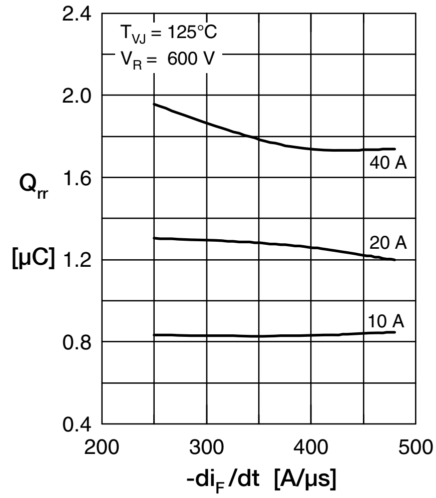


Fig. 2 Typ. reverse recovery charge $Q_{rr}$ versus di/dt

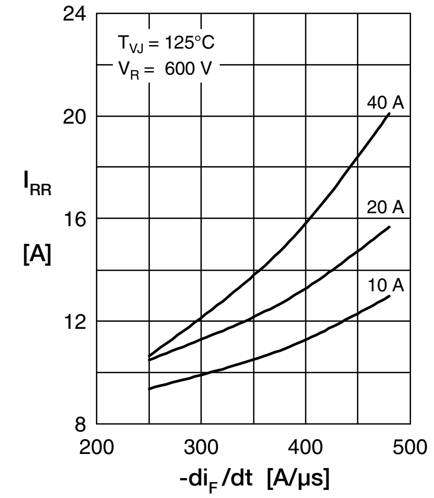


Fig. 3 Typ. peak reverse current $I_{RM}$ versus di/dt

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

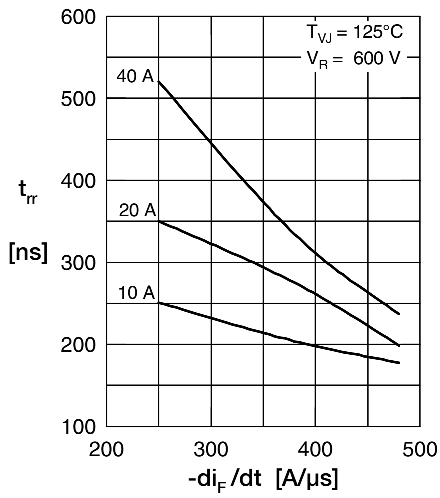


Fig. 5 Typ. recovery time $t_{rr}$ versus $-di_F/dt$

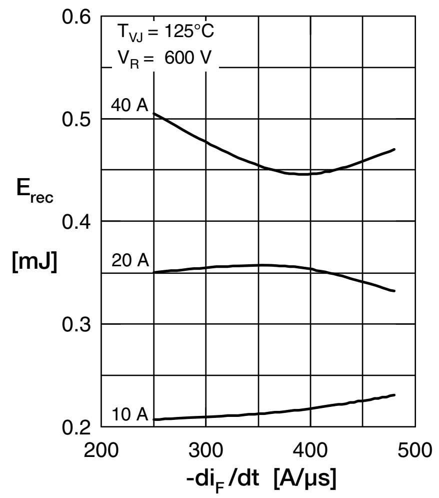


Fig. 6 Typ. recovery energy $E_{rec}$ versus -di/dt

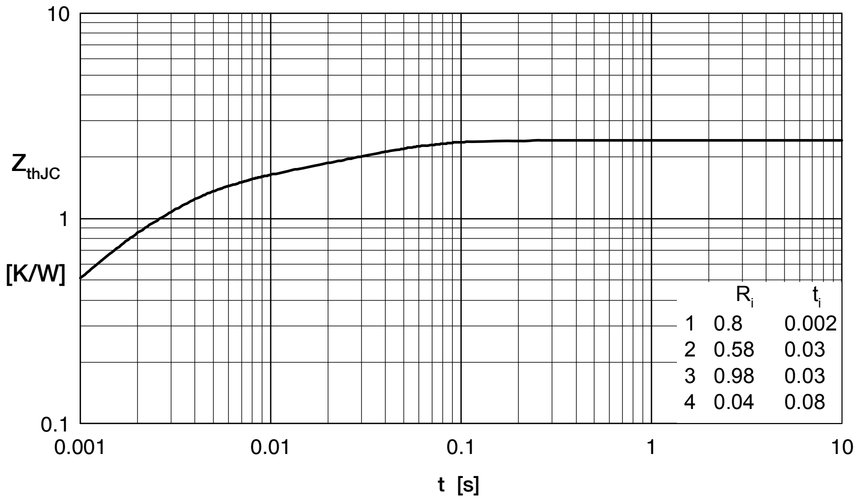


Fig. 7 Transient thermal impedance junction to case

## Inverter IGBT

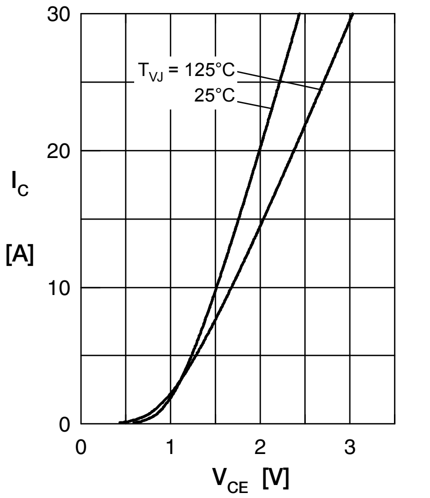


Fig. 1 Typ. output characteristics

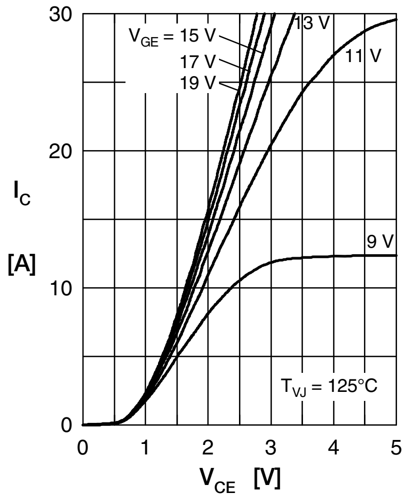


Fig. 2 Typ. output characteristics

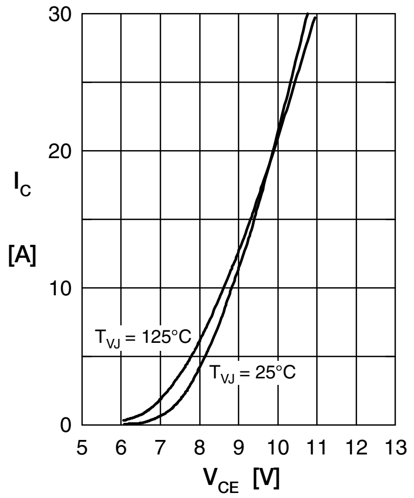


Fig. 3 Typ. transfer characteristics

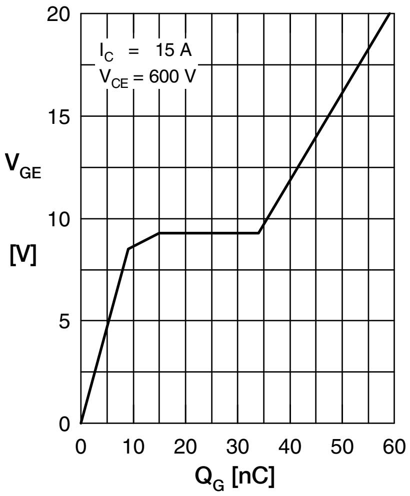


Fig. 4 Typ. turn-on gate charge

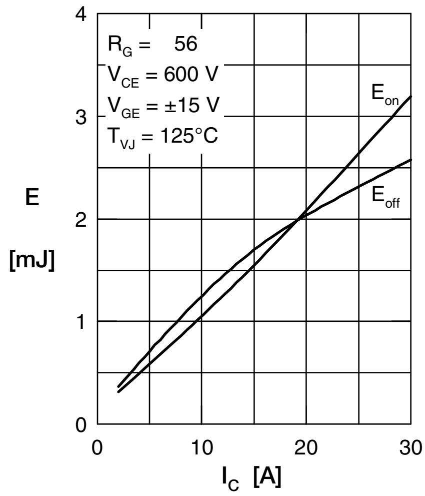


Fig. 5 Typ. switching energy vs. collector current

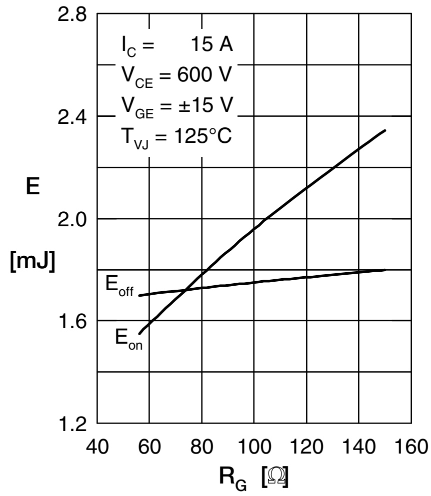


Fig. 6 Typ. switching energy versus gate resistance

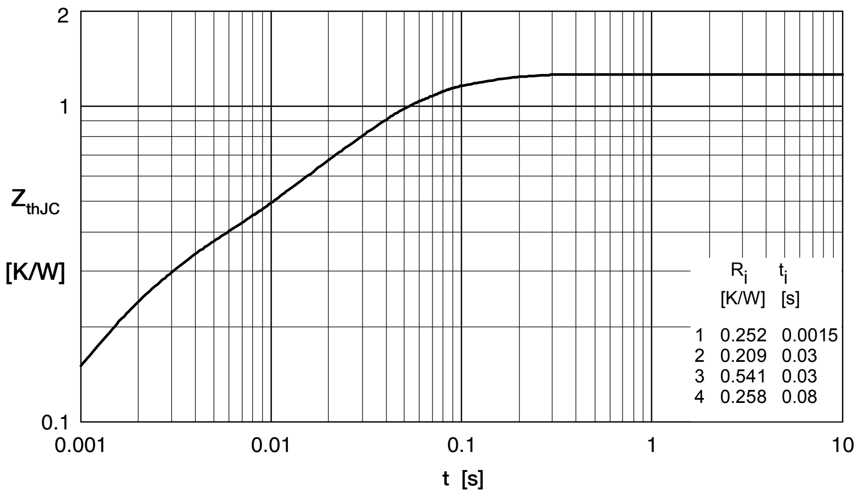


Fig. 7 Transient thermal impedance junction to case

## Inverter Diode

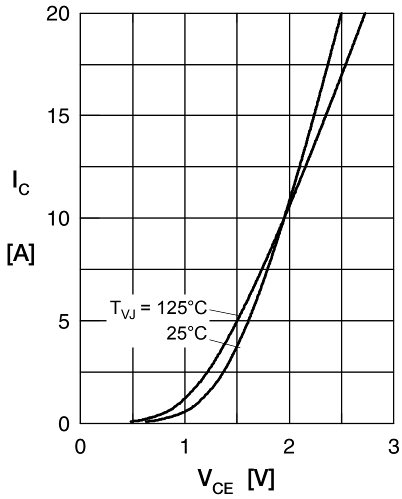


Fig. 1 Typ. Forward current versus $V_F$

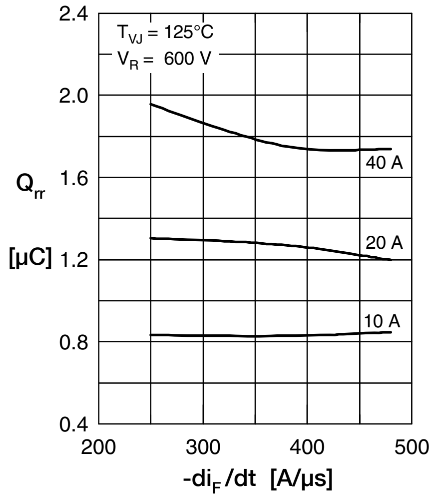


Fig. 2 Typ. reverse recovery charge $Q_{rr}$ versus di/dt

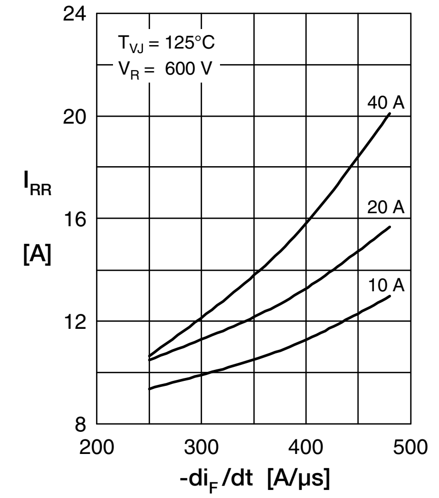


Fig. 3 Typ. peak reverse current $I_{RM}$ versus di/dt

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

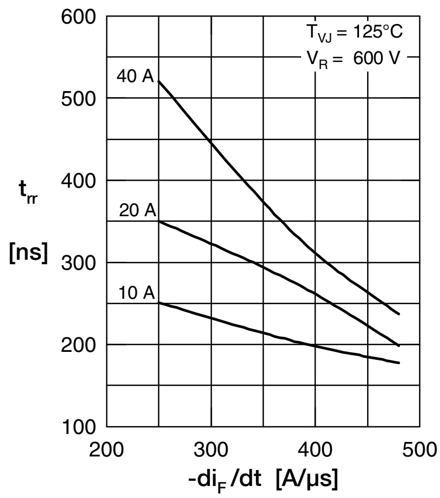


Fig. 5 Typ. recovery time $t_{rr}$ versus $-di_F/dt$

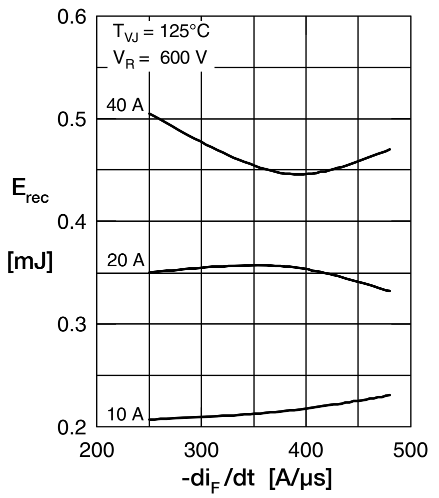


Fig. 6 Typ. recovery energy $E_{rec}$ versus -di/dt

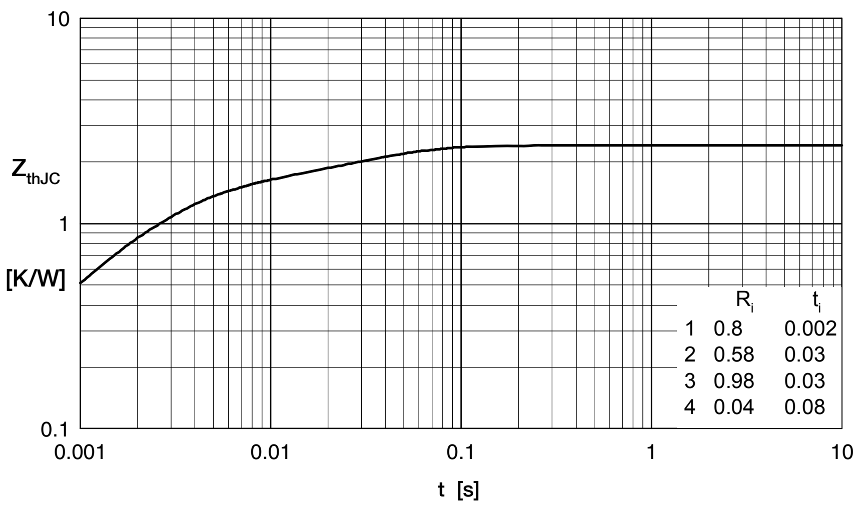


Fig. 7 Transient thermal impedance junction to case