# Technische Information / technical information

IGBT-Module
IGBT-modules

# FZ1200R33KL2C_B5

power electronics in motion
eupec

**Vorläufige Daten**
**preliminary data**

## IGBT-Wechselrichter / IGBT-inverter

### Höchstzulässige Werte / maximum rated values

| | | | | |
|---|---|---|---|---|
| Kollektor-Emitter-Sperrspannung<br>collector-emitter voltage | $T_{vj}$ = 25°C<br>$T_{vj}$ = -25°C | $V_{CES}$ | 3300<br>3300 | V |
| Kollektor-Dauergleichstrom<br>DC-collector current | $T_C$ = 80°C, $T_{vj}$ = 150°C<br>$T_C$ = 25°C, $T_{vj}$ = 150°C | $I_{C\ nom}$<br>$I_C$ | 1200<br>2300 | A<br>A |
| Periodischer Kollektor Spitzenstrom<br>repetitive peak collector current | $t_P$ = 1 ms, $T_C$ = 80°C | $I_{CRM}$ | 2400 | A |
| Gesamt-Verlustleistung<br>total power dissipation | $T_C$ = 25°C, $T_{vj}$ = 150°C | $P_{tot}$ | 14,5 | kW |
| Gate-Emitter-Spitzenspannung<br>gate-emitter peak voltage | | $V_{GES}$ | +/-20 | V |

### Charakteristische Werte / characteristic values

| | | | | min. | typ. | max. | |
|---|---|---|---|---|---|---|---|
| Kollektor-Emitter Sättigungsspannung<br>collector-emitter saturation voltage | $I_C$ = 1200 A, $V_{GE}$ = 15 V<br>$I_C$ = 1200 A, $V_{GE}$ = 15 V | $T_{vj}$ = 25°C<br>$T_{vj}$ = 125°C | $V_{CE\ sat}$ | | 3,00<br>3,70 | 3,65<br>4,45 | V<br>V |
| Gate-Schwellenspannung<br>gate threshold voltage | $I_C$ = 120 mA, $V_{CE}$ = $V_{GE}$, $T_{vj}$ = 25°C | | $V_{GEth}$ | 4,2 | 5,1 | 6,0 | V |
| Gateladung<br>gate charge | $V_{GE}$ = -15 V ... +15 V, $V_{CE}$ = 1800V | | $Q_G$ | | 22,0 | | µC |
| Interner Gatewiderstand<br>internal gate resistor | $T_{vj}$ = 25°C | | $R_{Gint}$ | | 0,42 | | Ω |
| Eingangskapazität<br>input capacitance | f = 1 MHz, $T_{vj}$ = 25°C, $V_{CE}$ = 25 V, $V_{GE}$ = 0 V | | $C_{ies}$ | | 145 | | nF |
| Rückwirkungskapazität<br>reverse transfer capacitance | f = 1 MHz, $T_{vj}$ = 25°C, $V_{CE}$ = 25 V, $V_{GE}$ = 0 V | | $C_{res}$ | | 8,00 | | nF |
| Kollektor-Emitter Reststrom<br>collector-emitter cut-off current | $V_{CE}$ = 3300 V, $V_{GE}$ = 0 V, $T_{vj}$ = 25°C | | $I_{CES}$ | | | 5,0 | mA |
| Gate-Emitter Reststrom<br>gate-emitter leakage current | $V_{CE}$ = 0 V, $V_{GE}$ = 20 V, $T_{vj}$ = 25°C | | $I_{GES}$ | | | 400 | nA |
| Einschaltverzögerungszeit (ind. Last)<br>turn-on delay time (inductive load) | $I_C$ = 1200 A, $V_{CE}$ = 1800 V<br>$V_{GE}$ = ±15 V<br>$R_{Gon}$ = 4,7 Ω, $C_{GE}$ = 330 nF | $T_{vj}$ = 25°C<br>$T_{vj}$ = 125°C | $t_{d\ on}$ | | 1,00<br>1,00 | | µs<br>µs |
| Anstiegszeit (induktive Last)<br>rise time (inductive load) | $I_C$ = 1200 A, $V_{CE}$ = 1800 V<br>$V_{GE}$ = ±15 V<br>$R_{Gon}$ = 4,7 Ω, $C_{GE}$ = 330 nF | $T_{vj}$ = 25°C<br>$T_{vj}$ = 125°C | $t_r$ | | 0,40<br>0,40 | | µs<br>µs |
| Abschaltverzögerungszeit (ind. Last)<br>turn-off delay time (inductive load) | $I_C$ = 1200 A, $V_{CE}$ = 1800 V<br>$V_{GE}$ = ±15 V<br>$R_{Goff}$ = 4,7 Ω, $C_{GE}$ = 330 nF | $T_{vj}$ = 25°C<br>$T_{vj}$ = 125°C | $t_{d\ off}$ | | 3,70<br>3,90 | | µs<br>µs |
| Fallzeit (induktive Last)<br>fall time (inductive load) | $I_C$ = 1200 A, $V_{CE}$ = 1800 V<br>$V_{GE}$ = ±15 V<br>$R_{Goff}$ = 4,7 Ω, $C_{GE}$ = 330 nF | $T_{vj}$ = 25°C<br>$T_{vj}$ = 125°C | $t_f$ | | 0,25<br>0,35 | | µs<br>µs |
| Einschaltverlustenergie pro Puls<br>turn-on energy loss per pulse | $I_C$ = 1200 A, $V_{CE}$ = 1800 V, dI/dt = 5400 A/µs<br>$V_{GE}$ = ±15 V, $L_S$ = 60 nH<br>$R_{Gon}$ = 2,0 Ω, $C_{GE}$ = 330 nF | $T_{vj}$ = 25°C<br>$T_{vj}$ = 125°C | $E_{on}$ | | 2400<br>3150 | | mJ<br>mJ |
| Abschaltverlustenergie pro Puls<br>turn-off energy loss per pulse | $I_C$ = 1200 A, $V_{CE}$ = 1800 V<br>$V_{GE}$ = ±15 V, $L_S$ = 60 nH<br>$R_{Goff}$ = 4,7 Ω, $C_{GE}$ = 330 nF | $T_{vj}$ = 25°C<br>$T_{vj}$ = 125°C | $E_{off}$ | | 1400<br>1900 | | mJ<br>mJ |
| Kurzschlußverhalten<br>SC data | $t_P$ ≤ 10 µs, $V_{GE}$ ≤ 15 V<br>$T_{vj}$ = 125°C, $V_{CC}$ = 2500 V, $V_{CEmax}$ = $V_{CES}$ -$L_{sCE}$ ·di/dt | | $I_{SC}$ | | 5200 | | A |
| Innerer Wärmewiderstand<br>thermal resistance, junction to case | pro IGBT<br>per IGBT | | $R_{thJC}$ | | | 8,50 | K/kW |
| Übergangs-Wärmewiderstand<br>thermal resistance, case to heatsink | pro IGBT / per IGBT<br>$\lambda_{Paste}$ = 1 W/(m·K) / $\lambda_{grease}$ = 1 W/(m·K) | | $R_{thCH}$ | | 9,00 | | K/kW |

| | |
|---|---|
| prepared by: Karl-Heinz Hoppe | date of publication: 2004-4-8 |
| approved by: Thomas Schütze | revision: 2.1 |

# Technische Information / technical information

IGBT-Module
IGBT-modules

# FZ1200R33KL2C_B5

power electronics in motion
eupec

**Vorläufige Daten**
**preliminary data**

## Diode-Wechselrichter / diode-inverter

### Höchstzulässige Werte / maximum rated values

| | | | | |
|---|---|---|---|---|
| Periodische Spitzensperrspannung<br>repetitive peak reverse voltage | $T_{vj}$ = 25°C<br>$T_{vj}$ = -25°C | $V_{RRM}$ | 3300<br>3300 | V |
| Dauergleichstrom<br>DC forward current | | $I_F$ | 1200 | A |
| Periodischer Spitzenstrom<br>repetitive peak forward current | $t_P$ = 1 ms | $I_{FRM}$ | 2400 | A |
| Grenzlastintegral<br>$I^2t$ - value | $V_R$ = 0 V, $t_P$ = 10 ms, $T_{vj}$ = 125°C | $I^2t$ | 440 | kA²s |
| Spitzenverlustleistung<br>maximum power dissipation | $T_{vj}$ = 125°C | $P_{RQM}$ | 1800 | kW |
| Mindesteinschaltdauer<br>minimum turn-on time | | $t_{Fon\ min}$ | 10,0 | µs |

### Charakteristische Werte / characteristic values

| | | | | min. | typ. | max. | |
|---|---|---|---|---|---|---|---|
| Durchlassspannung<br>forward voltage | $I_F$ = 1200 A, $V_{GE}$ = 0 V<br>$I_F$ = 1200 A, $V_{GE}$ = 0 V | $T_{vj}$ = 25°C<br>$T_{vj}$ = 125°C | $V_F$ | | 2,60<br>2,55 | t.b.d. | V<br>V |
| Rückstromspitze<br>peak reverse recovery current | $I_F$ = 1200 A, - $di_F/dt$ = 5400 A/µs<br>$V_R$ = 1800 V<br>$V_{GE}$ = -15 V | $T_{vj}$ = 25°C<br>$T_{vj}$ = 125°C | $I_{RM}$ | | 1400<br>1600 | | A<br>A |
| Sperrverzögerungsladung<br>recovered charge | $I_F$ = 1200 A, - $di_F/dt$ = 5400 A/µs<br>$V_R$ = 1800 V<br>$V_{GE}$ = -15 V | $T_{vj}$ = 25°C<br>$T_{vj}$ = 125°C | $Q_r$ | | 810<br>1450 | | µC<br>µC |
| Abschaltenergie pro Puls<br>reverse recovery energy | $I_F$ = 1200 A, - $di_F/dt$ = 5400 A/µs<br>$V_R$ = 1800 V<br>$V_{GE}$ = -15 V | $T_{vj}$ = 25°C<br>$T_{vj}$ = 125°C | $E_{rec}$ | | 750<br>1500 | | mJ<br>mJ |
| Innerer Wärmewiderstand<br>thermal resistance, junction to case | pro Diode<br>per diode | | $R_{thJC}$ | | | 17,0 | K/kW |
| Übergangs-Wärmewiderstand<br>thermal resistance, case to heatsink | pro Diode / per diode<br>$\lambda_{Paste}$ = 1 W/(m·K) / $\lambda_{grease}$ = 1 W/(m·K) | | $R_{thCH}$ | | 18,0 | | K/kW |

| | |
|---|---|
| prepared by: Karl-Heinz Hoppe | date of publication: 2004-4-8 |
| approved by: Thomas Schütze | revision: 2.1 |

**Vorläufige Daten**
**preliminary data**

## Modul / module

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Isolations-Prüfspannung<br>insulation test voltage | RMS, f = 50 Hz, t = 1 min. | $V_{ISOL}$ | 10,2 | | | kV |
| Teilentladungs Aussetzspannung<br>partial discharge extinction voltage | RMS, f = 50 Hz, $Q_{PD}$ typ 10 pC (acc. to IEC 1287) | $V_{ISOL}$ | 5,1 | | | kV |
| Kollektor-Emitter-Gleichsperrspannung<br>DC stability | $T_{vj}$ = 25°C, 100 fit | $V_{CE\,D}$ | 2150 | | | V |
| Material Modulgrundplatte<br>material of module baseplate | | | AlSiC | | | |
| Material für innere Isolation<br>material for internal insulation | | | AlN | | | |
| Kriechstrecke<br>creepage distance | Kontakt - Kühlkörper / terminal to heatsink<br>Kontakt - Kontakt / terminal to terminal | | 64,0<br>56,0 | | | mm |
| Luftstrecke<br>clearance distance | Kontakt - Kühlkörper / terminal to heatsink<br>Kontakt - Kontakt / terminal to terminal | | 40,0<br>26,0 | | | mm |
| Vergleichszahl der Kriechwegbildung<br>comparative tracking index | | CTI | > 600 | | | |

| | | | min. | typ. | max. | |
|---|---|---|---|---|---|---|
| Übergangs-Wärmewiderstand<br>thermal resistance, case to heatsink | pro Modul / per module<br>$\lambda_{Paste}$ = 1 W/(m·K) / $\lambda_{grease}$ = 1 W/(m·K) | $R_{thCH}$ | | 6,00 | | K/kW |
| Modulinduktivität<br>stray inductance module | | $L_{sCE}$ | | 18 | | nH |
| Modulleitungswiderstand,<br>Anschlüsse - Chip<br>module lead resistance,<br>terminals - chip | $T_C$ = 25°C, pro Schalter / per switch | $R_{CC'+EE'}$ | | 0,12 | | mΩ |
| Höchstzulässige Sperrschichttemperatur<br>maximum junction temperature | Wechselrichter / inverter | $T_{vj\,max}$ | | | 150 | °C |
| Temperatur im Schaltbetrieb<br>temperature under switching conditions | Wechselrichter / inverter | $T_{vj\,op}$ | -40 | | 125 | °C |
| Lagertemperatur<br>storage temperature | | $T_{stg}$ | -40 | | 125 | °C |
| Anzugsdrehmoment f. mech. Befestigung<br>mounting torque | Schraube / screw M6 | M | 4,25 | - | 5,75 | Nm |
| Anzugsdrehmoment f. elektr. Anschlüsse<br>terminal connection torque | Schraube / screw M4<br>Schraube / screw M8 | M | 1,8<br>8,0 | -<br>- | 2,1<br>10 | Nm<br>Nm |
| Gewicht<br>weight | | G | | 1400 | | g |

**Mit dieser technischen Information werden Halbleiterbauelemente spezifiziert, jedoch keine Eigenschaften zugesichert. Sie gilt in Verbindung mit den zugehörigen technischen Erläuterungen.**

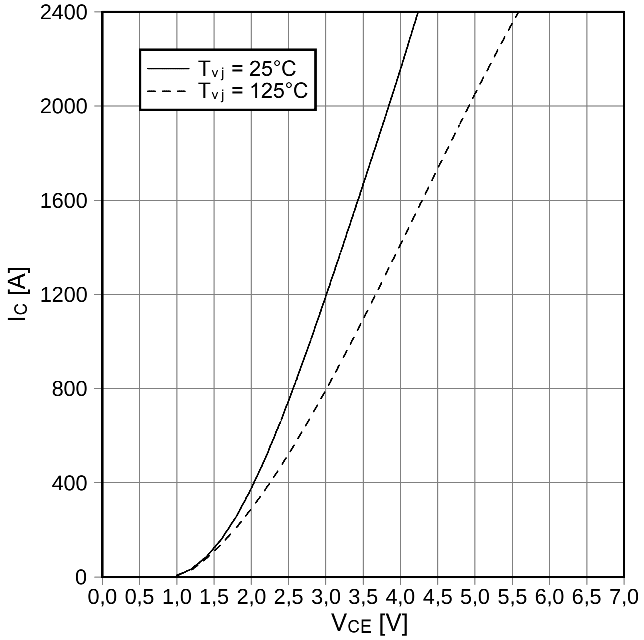
**This technical information specifies semiconductor devices but guarantees no characteristics. It is valid with the appropriate technical explanations.**



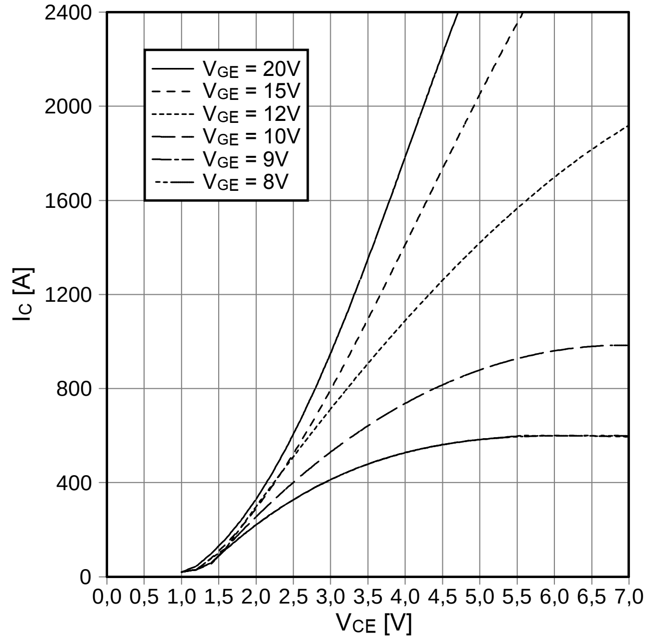
| | |
|---|---|
| prepared by: Karl-Heinz Hoppe | date of publication: 2004-4-8 |
| approved by: Thomas Schütze | revision: 2.1 |

**Vorläufige Daten**
**preliminary data**

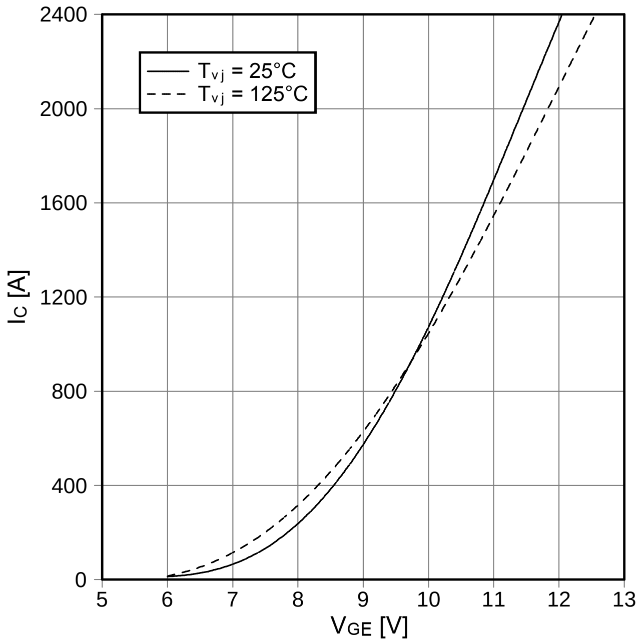
**Ausgangskennlinie IGBT-Wechselr. (typisch)**
**output characteristic IGBT-inverter (typical)**
**$I_C$ = f ($V_{CE}$)**
**$V_{GE}$ = 15 V**



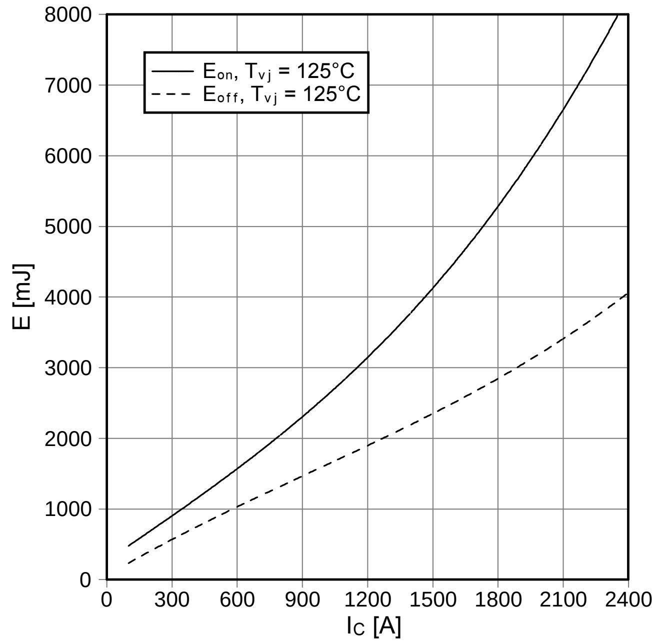

**Ausgangskennlinienfeld IGBT-Wechselr. (typisch)**
**output characteristic IGBT-inverter (typical)**
**$I_C$ = f ($V_{CE}$)**
**$T_{vj}$ = 125°C**




**Übertragungscharakteristik IGBT-Wechselr. (typisch)**
**transfer characteristic IGBT-inverter (typical)**
**$I_C$ = f ($V_{GE}$)**
**$V_{CE}$ = 20 V**



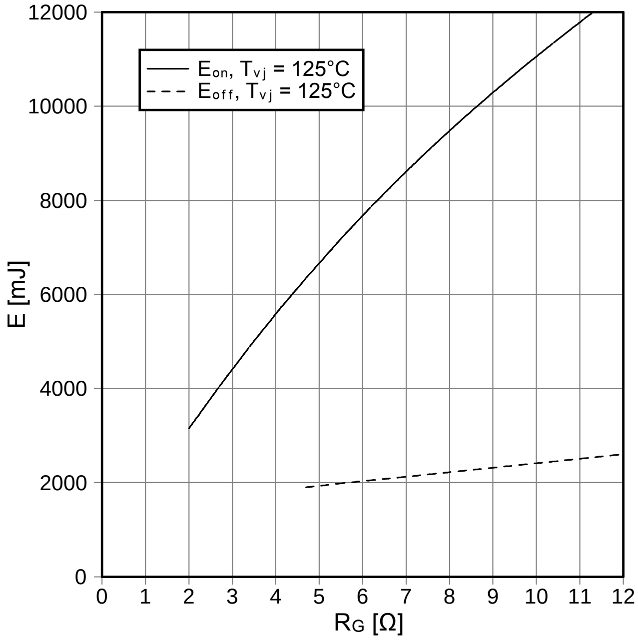

**Schaltverluste IGBT-Wechselr. (typisch)**
**switching losses IGBT-inverter (typical)**
**$E_{on}$ = f ($I_C$), $E_{off}$ = f ($I_C$)**
**$V_{GE}$ = ±15 V, $R_{Gon}$ = 2 Ω, $R_{Goff}$ = 4,7 Ω, $V_{CE}$ = 1800 V,**
**$C_{GE}$ = 330 nF**



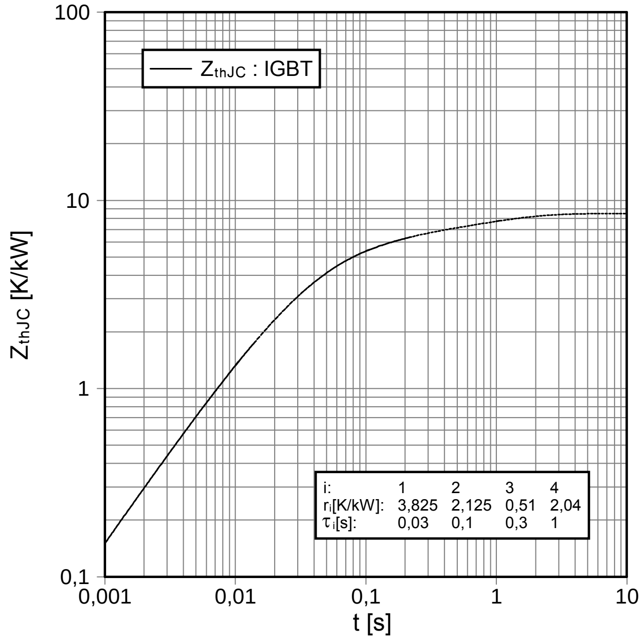

| | |
|---|---|
| prepared by: Karl-Heinz Hoppe | date of publication: 2004-4-8 |
| approved by: Thomas Schütze | revision: 2.1 |

**Vorläufige Daten**
**preliminary data**

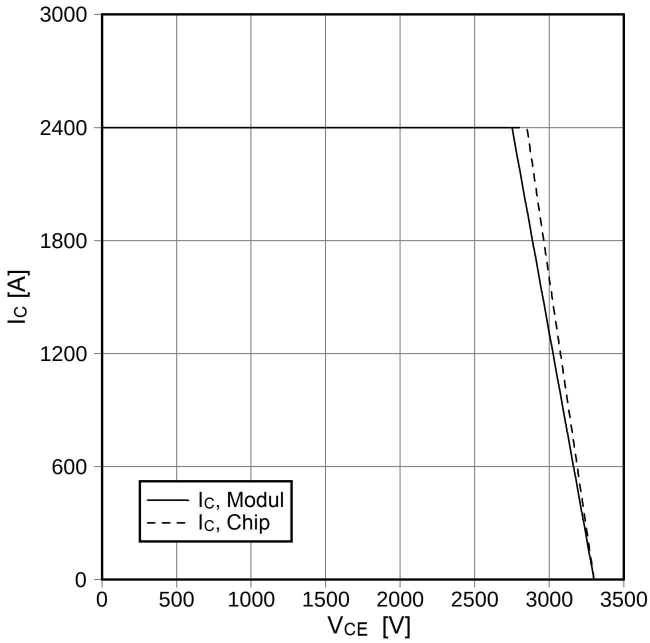
**Schaltverluste IGBT-Wechselr. (typisch)**
**switching losses IGBT-Inverter (typical)**
**$E_{on}$ = f ($R_G$), $E_{off}$ = f ($R_G$)**
**$V_{GE}$ = ±15 V, $I_C$ = 1200 A, $V_{CE}$ = 1800 V, $C_{GE}$ = 330 nF**



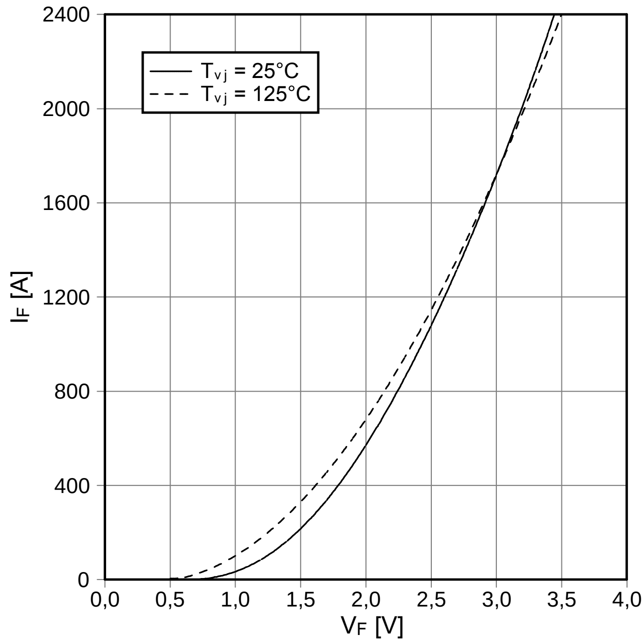

**Transienter Wärmewiderstand IGBT-Wechselr.**
**transient thermal impedance IGBT-inverter**
**$Z_{thJC}$ = f (t)**




**Sicherer Rückwärts-Arbeitsbereich IGBT-Wr. (RBSOA)**
**reverse bias safe operating area IGBT-inv. (RBSOA)**
**$I_C$ = f ($V_{CE}$)**
**$V_{GE}$ = ±15 V, $R_{Goff}$ = 4,7 Ω, $T_{vj}$ = 125°C, $C_{GE}$ = 330 nF**



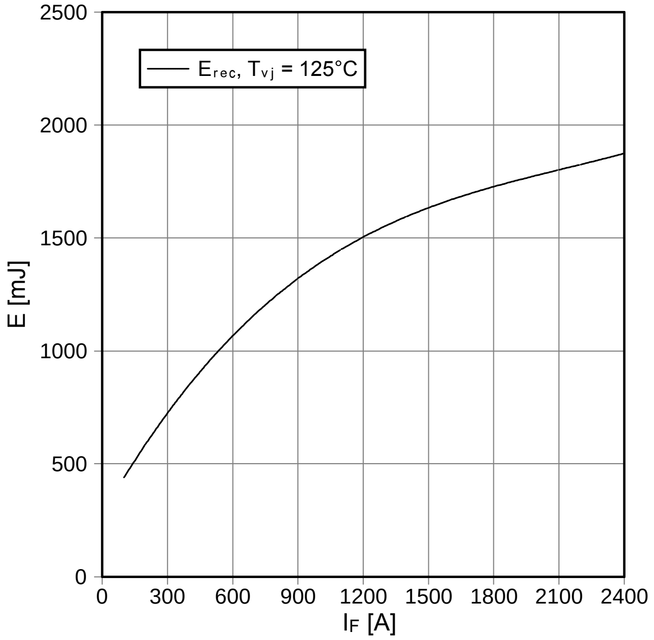

**Durchlaßkennlinie der Diode-Wechselr. (typisch)**
**forward characteristic of diode-inverter (typical)**
**$I_F$ = f ($V_F$)**



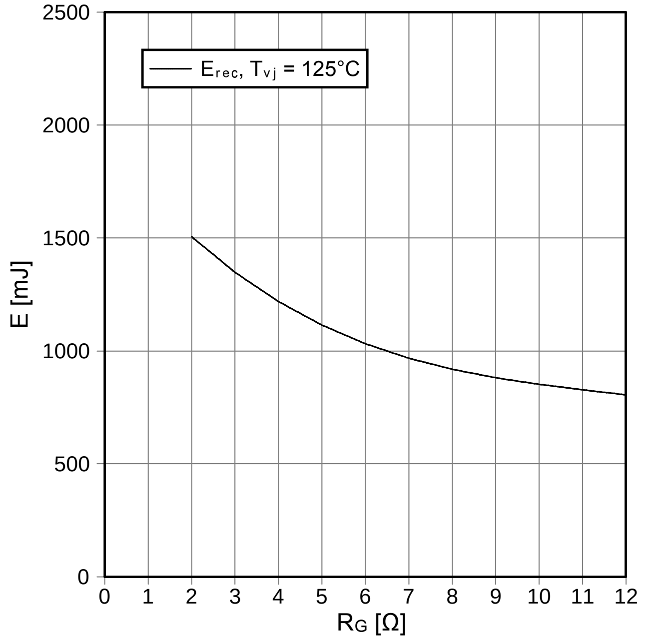

| | |
|---|---|
| prepared by: Karl-Heinz Hoppe | date of publication: 2004-4-8 |
| approved by: Thomas Schütze | revision: 2.1 |

**Vorläufige Daten**
**preliminary data**

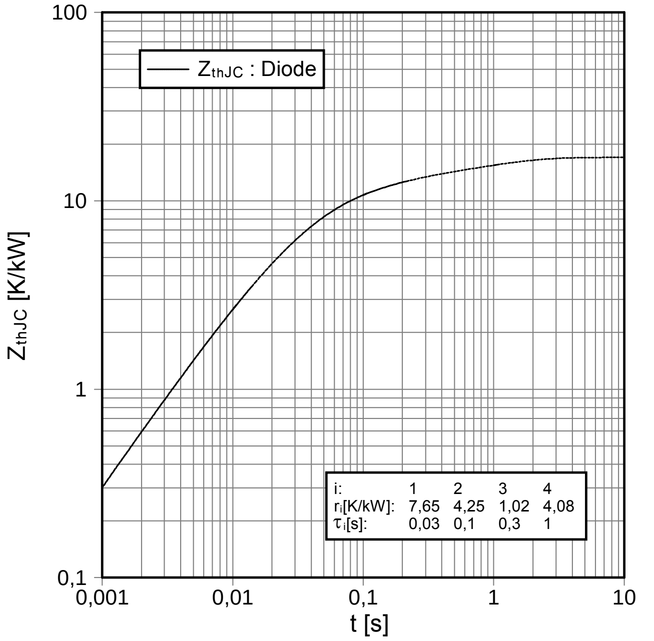
**Schaltverluste Diode-Wechselr. (typisch)**
**switching losses diode-inverter (typical)**
**$E_{rec} = f\ (I_F)$**
**$R_{Gon} = 2\ \Omega$, $V_{CE} = 1800$ V**



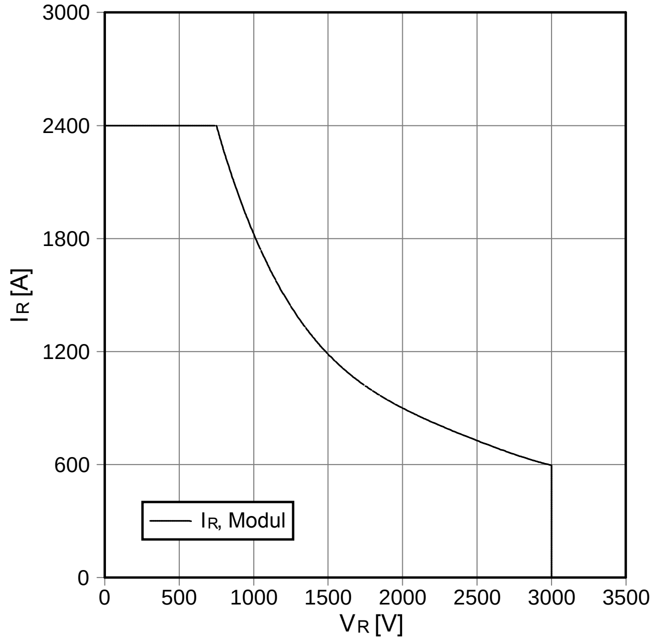

**Schaltverluste Diode-Wechselr. (typisch)**
**switching losses diode-inverter (typical)**
**$E_{rec} = f\ (R_G)$**
**$I_F = 1200$ A, $V_{CE} = 1800$ V**




**Transienter Wärmewiderstand Diode-Wechselr.**
**transient thermal impedance diode-inverter**
**$Z_{thJC} = f\ (t)$**



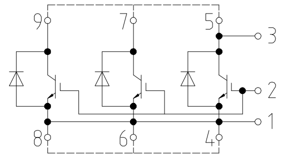

**Sicherer Arbeitsbereich Diode-Wechselr. (SOA)**
**save operation area diode-inverter (SOA)**
**$I_R = f(V_R)$**
**$T_{vj} = 125°C$**



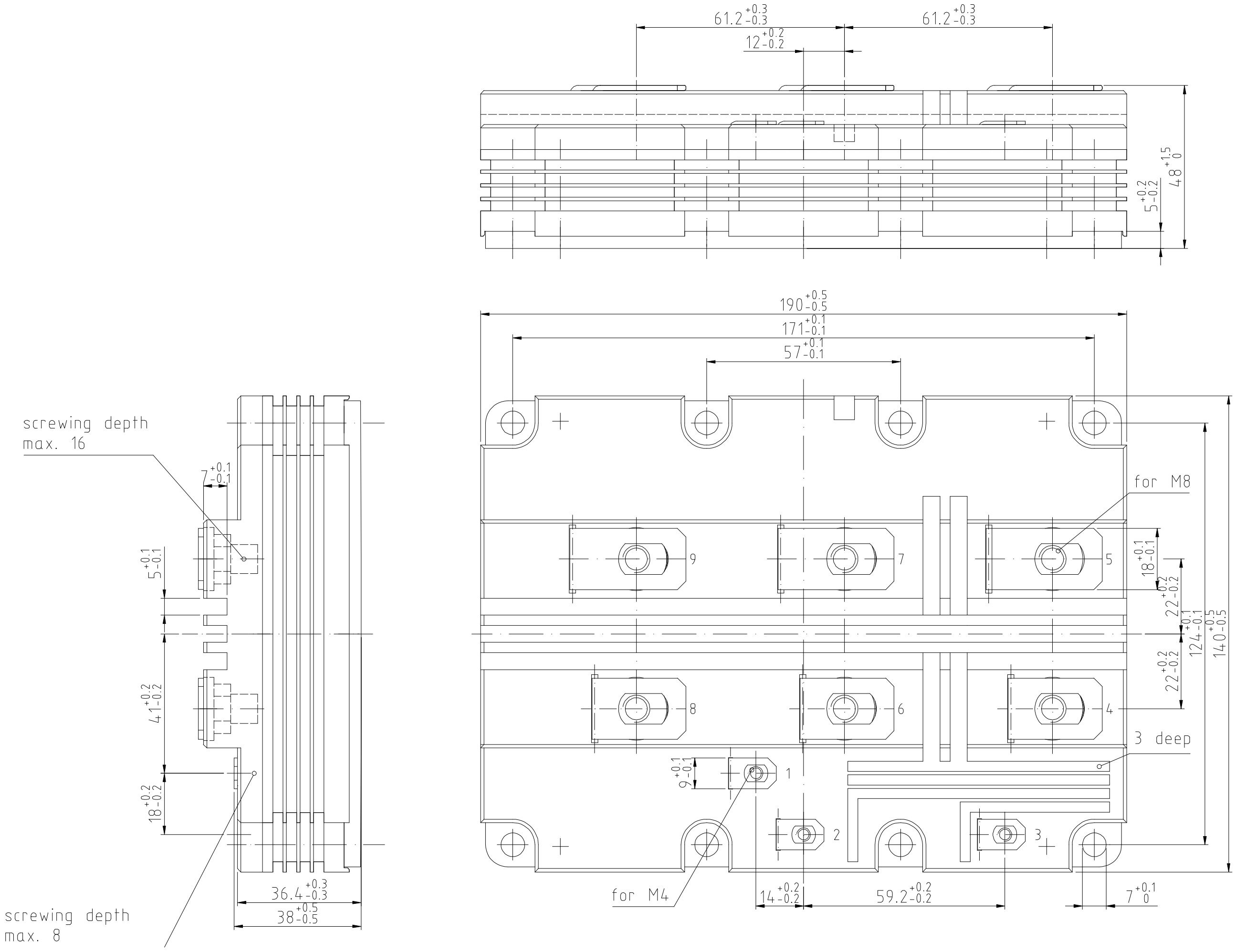

| | |
|---|---|
| prepared by: Karl-Heinz Hoppe | date of publication: 2004-4-8 |
| approved by: Thomas Schütze | revision: 2.1 |

**Vorläufige Daten**
**preliminary data**

## Schaltplan / circuit diagram




## Gehäuseabmessungen / package outlines




| | |
|---|---|
| prepared by: Karl-Heinz Hoppe | date of publication: 2004-4-8 |
| approved by: Thomas Schütze | revision: 2.1 |

# Terms & Conditions of Usage

**Attention**
The present product data is exclusively subscribed to technically experienced staff. This Data Sheet is describing the specification of the products for which a warranty is granted exclusively pursuant the terms and conditions of the supply agreement. There will be no guarantee of any kind for the product and its specifications. Changes to the Data Sheet are reserved.

You and your technical departments will have to evaluate the suitability of the product for the intended application and the completeness of the product data with respect to such application. Should you require product information in excess of the data given in the Data Sheet, please contact your local Sales Office via “www.eupec.com / sales & contact”.

**Warning**
Due to technical requirements the products may contain dangerous substances. For information on the types in question please contact your local Sales Office via “www.eupec.com / sales & contact”.