

# Technische Information / Technical Information

IGBT-Module  
IGBT-Modules

## FZ 1200 R 33 KF2\_B5

**eupec**



**vorläufige Daten**  
**preliminary data**

### Höchstzulässige Werte / Maximum rated values

#### Elektrische Eigenschaften / Electrical properties

|  |   |                        |              |                        |
|--|---|------------------------|--------------|------------------------|
| Kollektor-Emitter-Sperrspannung<br>collector-emitter voltage             | $T_{vj} = 25^{\circ}\text{C}$<br>$T_{vj} = -25^{\circ}\text{C}$               | $V_{CES}$<br>$V_{CES}$ | 3300<br>3300 | V<br>V                 |
| Kollektor-Dauerstrom<br>DC-collector current                             | $T_C = 80^{\circ}\text{C}$<br>$T_C = 25^{\circ}\text{C}$                      | $I_{C,nom.}$<br>$I_C$  | 1200<br>2000 | A<br>A                 |
| Periodischer Kollektor Spitzenstrom<br>repetitive peak collector current | $t_p = 1 \text{ ms}, T_C = 80^{\circ}\text{C}$                                | $I_{CRM}$              | 2400         | A                      |
| Gesamt-Verlustleistung<br>total power dissipation                        | $T_C = 25^{\circ}\text{C}$ , Transistor                                       | $P_{tot}$              | 14,7         | kW                     |
| Gate-Emitter-Spitzenspannung<br>gate-emitter peak voltage                |   | $V_{GES}$              | +/- 20V      | V                      |
| Dauerstrom<br>DC forward current   |   | $I_F$                  | 1200         | A                      |
| Periodischer Spitzenstrom<br>repetitive peak forw. current               | $t_p = 1 \text{ ms}$  | $I_{FRM}$              | 2400         | A                      |
| Grenzlastintegral der Diode<br>$I^2t$ - value, Diode                     | $V_R = 0V, t_p = 10\text{ms}, T_{vj} = 125^{\circ}\text{C}$                   | $I^2t$                 | 444          | $\text{k A}^2\text{s}$ |
| Spitzenverlustleistung der Diode<br>maximum power dissipation diode      | $T_{vj} = 125^{\circ}\text{C}$  | $P_{RQM}$              | 1200         | kW                     |
| Isolations-Prüfspannung<br>insulation test voltage                       | RMS, $f = 50 \text{ Hz}, t = 1 \text{ min.}$                                  | $V_{ISOL}$             | 10,2         | kV                     |
| Teilentladungs-Aussetzspannung<br>partial discharge extinction voltage   | RMS, $f = 50 \text{ Hz}, Q_{pD} \text{ typ. } 10\text{pC (acc. To IEC 1287)}$ | $V_{ISOL}$             | 5,1          | kV                     |

### Charakteristische Werte / Characteristic values

#### Transistor / Transistor

|  |   |                      | min. | typ. | max. |               |
|--|---|----------------------|------|------|------|---------------|
| Kollektor-Emitter Sättigungsspannung<br>collector-emitter saturation voltage | $I_C = 1200\text{A}, V_{GE} = 15\text{V}, T_{vj} = 25^{\circ}\text{C}$                  | $V_{CE \text{ sat}}$ | -    | 3,40 | 4,25 | V             |
|  | $I_C = 1200\text{A}, V_{GE} = 15\text{V}, T_{vj} = 125^{\circ}\text{C}$                 |                      | -    | 4,30 | 5,00 | V             |
| Gate-Schwellenspannung<br>gate threshold voltage                             | $I_C = 120 \text{ mA}, V_{CE} = V_{GE}, T_{vj} = 25^{\circ}\text{C}$                    | $V_{GE(th)}$         | 4,2  | 5,1  | 6,0  | V             |
| Eingangskapazität<br>input capacitance                                       | $f = 1\text{MHz}, T_{vj} = 25^{\circ}\text{C}, V_{CE} = 25\text{V}, V_{GE} = 0\text{V}$ | $C_{res}$            | -    | 150  | -    | nF            |
| Rückwirkungskapazität<br>reverse transfer capacitance                        | $f = 1\text{MHz}, T_{vj} = 25^{\circ}\text{C}, V_{CE} = 25\text{V}, V_{GE} = 0\text{V}$ | $C_{res}$            | -    | 8    | -    | nF            |
| Gateladung<br>gate charge  | $V_{GE} = -15\text{V} \dots +15\text{V}$  | $Q_G$                | -    | 22   | -    | $\mu\text{C}$ |
| Kollektor-Emitter Reststrom<br>collector-emitter cut-off current             | $V_{CE} = 3300\text{V}, V_{GE} = 0\text{V}, T_{vj} = 25^{\circ}\text{C}$                | $I_{CES}$            | -    | -    | 5    | mA            |
| Gate-Emitter Reststrom<br>gate-emitter leakage current                       | $V_{CE} = 0\text{V}, V_{GE} = 20\text{V}, T_{vj} = 25^{\circ}\text{C}$                  | $I_{GES}$            | -    | -    | 400  | nA            |

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### Charakteristische Werte / Characteristic values

#### Transistor / Transistor

|  |  |             | min. | typ. | max. |               |
|--|--|-------------|------|------|------|---------------|
| Einschaltverzögerungszeit (ind. Last)<br>turn on delay time (inductive load)     | $I_C = 1200 \text{ A}, V_{CE} = 1800 \text{ V}$  | $t_{d,on}$  | -    | 0,70 | -    | $\mu\text{s}$ |
|  | $V_{GE} = \pm 15 \text{ V}, R_G = 2,7 \Omega, C_{GE} = 220 \text{ nF}, T_{vj} = 25^\circ\text{C}$  |             |      |      |      |               |
|  | $V_{GE} = \pm 15 \text{ V}, R_G = 2,7 \Omega, C_{GE} = 220 \text{ nF}, T_{vj} = 125^\circ\text{C}$   |             |      |      |      |               |
| Anstiegszeit (induktive Last)<br>rise time (inductive load)                      | $I_C = 1200 \text{ A}, V_{CE} = 1800 \text{ V}$  | $t_r$       | -    | 0,45 | -    | $\mu\text{s}$ |
|  | $V_{GE} = \pm 15 \text{ V}, R_G = 2,7 \Omega, C_{GE} = 220 \text{ nF}, T_{vj} = 25^\circ\text{C}$  |             |      |      |      |               |
|  | $V_{GE} = \pm 15 \text{ V}, R_G = 2,7 \Omega, C_{GE} = 220 \text{ nF}, T_{vj} = 125^\circ\text{C}$   |             |      |      |      |               |
| Abschaltverzögerungszeit (ind. Last)<br>turn off delay time (inductive load)     | $I_C = 1200 \text{ A}, V_{CE} = 1800 \text{ V}$  | $t_{d,off}$ | -    | 1,90 | -    | $\mu\text{s}$ |
|  | $V_{GE} = \pm 15 \text{ V}, R_G = 1,8 \Omega, C_{GE} = 220 \text{ nF}, T_{vj} = 25^\circ\text{C}$  |             |      |      |      |               |
|  | $V_{GE} = \pm 15 \text{ V}, R_G = 1,8 \Omega, C_{GE} = 220 \text{ nF}, T_{vj} = 125^\circ\text{C}$   |             |      |      |      |               |
| Fallzeit (induktive Last)<br>fall time (inductive load)                          | $I_C = 1200 \text{ A}, V_{CE} = 1800 \text{ V}$  | $t_f$       | -    | 0,20 | -    | $\mu\text{s}$ |
|  | $V_{GE} = \pm 15 \text{ V}, R_G = 1,8 \Omega, C_{GE} = 220 \text{ nF}, T_{vj} = 25^\circ\text{C}$  |             |      |      |      |               |
|  | $V_{GE} = \pm 15 \text{ V}, R_G = 1,8 \Omega, C_{GE} = 220 \text{ nF}, T_{vj} = 125^\circ\text{C}$   |             |      |      |      |               |
| Einschaltverlustenergie pro Puls<br>turn-on energy loss per pulse                | $I_C = 1200 \text{ A}, V_{CE} = 1800 \text{ V}, V_{GE} = 15 \text{ V}$<br>$R_G = 1,5 \Omega, C_{GE} = 220 \text{ nF}, T_{vj} = 125^\circ\text{C}, L_S = 40 \text{ nH}$ | $E_{on}$    | -    | 2900 | -    | mWs           |
| Abschaltverlustenergie pro Puls<br>turn-off energy loss per pulse                | $I_C = 1200 \text{ A}, V_{CE} = 1800 \text{ V}, V_{GE} = 15 \text{ V}$<br>$R_G = 1,8 \Omega, C_{GE} = 220 \text{ nF}, T_{vj} = 125^\circ\text{C}, L_S = 40 \text{ nH}$ | $E_{off}$   | -    | 1600 | -    | mWs           |
| Kurzschlußverhalten<br>SC Data   | $t_p \leq 10 \mu\text{sec}, V_{GE} \leq 15 \text{ V}$  | $I_{SC}$    | -    | 6000 | -    | A             |
|  | $T_{vj} \leq 125^\circ\text{C}, V_{CC} = 2500 \text{ V}, V_{CEmax} = V_{CES} - L_{sCE} \cdot di/dt$  |             |      |      |      |               |
| Modulinduktivität<br>stray inductance module                                     |  | $L_{sCE}$   | -    | 18   | -    | nH            |
| Modul-Leitungswiderstand, Anschlüsse - Chip<br>lead resistance, terminals - chip | $T_C = 25^\circ\text{C}$   | $R_{CC+EE}$ | -    | 0,12 | -    | m $\Omega$    |

### Charakteristische Werte / Characteristic values

#### Diode / Diode

|   |   |           | min. | typ. | max. |                |
|---|---|-----------|------|------|------|----------------|
| Durchlaßspannung<br>forward voltage                 | $I_F = 1200 \text{ A}, V_{GE} = 0 \text{ V}, T_{vj} = 25^\circ\text{C}$   | $V_F$     | -    | 2,80 | 3,50 | V              |
|   | $I_F = 1200 \text{ A}, V_{GE} = 0 \text{ V}, T_{vj} = 125^\circ\text{C}$  |           |      |      |      |                |
| Rückstromspitze<br>peak reverse recovery current    | $I_F = 1200 \text{ A}, -di_F/dt = 4600 \text{ A}/\mu\text{sec}$   | $I_{RM}$  | -    | 1250 | -    | A              |
|   | $V_R = 1800 \text{ V}, V_{GE} = -10 \text{ V}, T_{vj} = 25^\circ\text{C}$   |           |      |      |      |                |
|   | $V_R = 1800 \text{ V}, V_{GE} = -10 \text{ V}, T_{vj} = 125^\circ\text{C}$  |           |      |      |      |                |
| Sperrverzögerungsladung<br>recovered charge         | $I_F = 1200 \text{ A}, -di_F/dt = 4600 \text{ A}/\mu\text{sec}$   | $Q_r$     | -    | 710  | -    | $\mu\text{As}$ |
|   | $V_R = 1800 \text{ V}, V_{GE} = -10 \text{ V}, T_{vj} = 25^\circ\text{C}$   |           |      |      |      |                |
|   | $V_R = 1800 \text{ V}, V_{GE} = -10 \text{ V}, T_{vj} = 125^\circ\text{C}$  |           |      |      |      |                |
| Abschaltenergie pro Puls<br>reverse recovery energy | $I_F = 1200 \text{ A}, -di_F/dt = 4600 \text{ A}/\mu\text{sec}$   | $E_{rec}$ | -    | 680  | -    | mWs            |
|   | $V_R = 1800 \text{ V}, V_{GE} = -10 \text{ V}, T_{vj} = 25^\circ\text{C}$<br>$V_R = 1800 \text{ V}, V_{GE} = -10 \text{ V}, T_{vj} = 125^\circ\text{C}$ |           |      |      |      |                |

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**vorläufige Daten**  
**preliminary data**

### Thermische Eigenschaften / Thermal properties

|  |  | min. typ. max. |     |       |        |     |
|--|--|----------------|-----|-------|--------|-----|
| Innerer Wärmewiderstand<br>thermal resistance, junction to case        | Transistor / transistor, DC  | $R_{thJC}$     | -   | -     | 0,0085 | K/W |
|  | Diode/Diode, DC  |                | -   | -     | 0,0170 | K/W |
| Übergangs-Wärmewiderstand<br>thermal resistance, case to heatsink      | pro Modul / per module<br>$\lambda_{paste} = 1 \text{ W/m}^2\text{K} / \lambda_{grease} = 1 \text{ W/m}^2\text{K}$ | $R_{thCK}$     | -   | 0,006 | -      | K/W |
| Höchstzulässige Sperrschichttemperatur<br>maximum junction temperature |  | $T_{vj\ max}$  | -   | -     | 150    | °C  |
| Betriebstemperatur<br>operation temperature                            |  | $T_{vj\ op}$   | -40 | -     | 125    | °C  |
| Lagertemperatur<br>storage temperature                                 |  | $T_{stg}$      | -40 | -     | 125    | °C  |

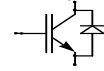
### Mechanische Eigenschaften / Mechanical properties

|  |                           |   |      |       |      |    |
|--|---------------------------|---|------|-------|------|----|
| Gehäuse, siehe Anlage<br>case, see appendix                          |                           |   |      |       |      |    |
| Material Modulgrundplatte<br>material of module baseplate            |                           |   |      | AlSiC |      |    |
| Innere Isolation<br>internal insulation                              |                           |   |      | AlN   |      |    |
| Kriechstrecke<br>creepage distance                                   |                           |   |      | 56    |      | mm |
| Luftstrecke<br>clearance   |                           |   |      | 26    |      | mm |
| CTI<br>comperative tracking index                                    |                           |   |      | > 600 |      |    |
| Anzugsdrehmoment f. mech. Befestigung<br>mounting torque             | Schraube M6 / screw M6    | M | 4,25 | -     | 5,75 | Nm |
| Anzugsdrehmoment f. elektr. Anschlüsse<br>terminal connection torque | Anschlüsse / terminals M4 | M | 1,8  |       | 2,1  | Nm |
|  | Anschlüsse / terminals M8 | M | 8    |       | 10   | 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.

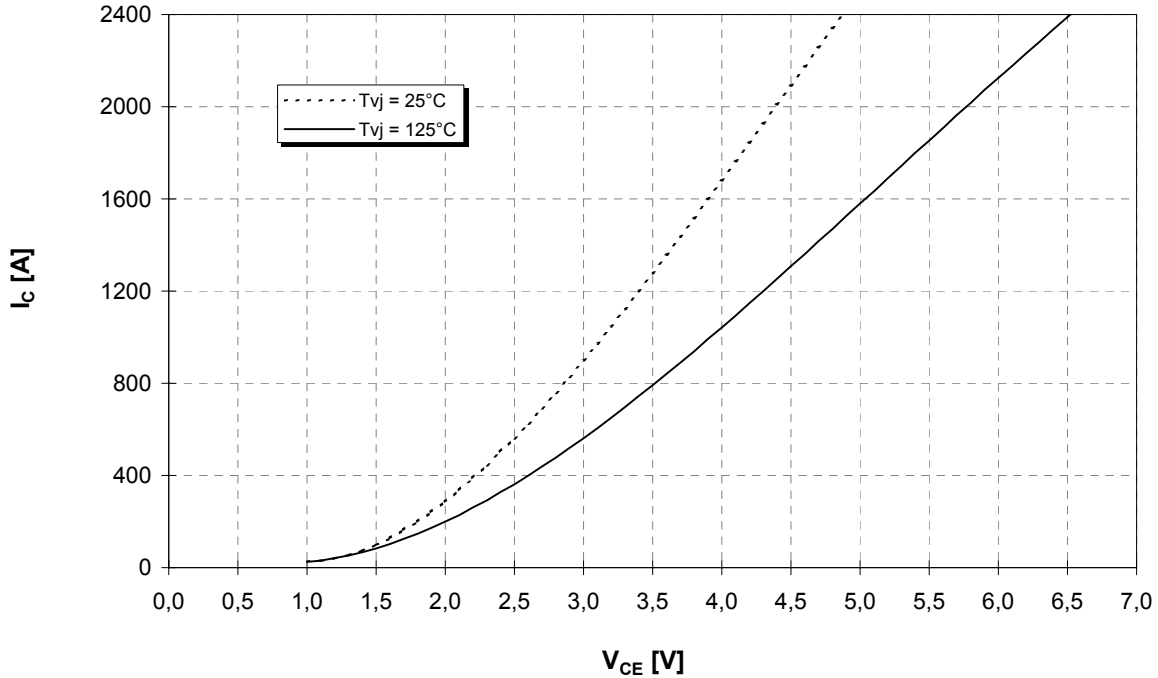
This technical information specifies semiconductor devices but promises no characteristics. It is valid in combination with the belonging technical notes.



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preliminary data

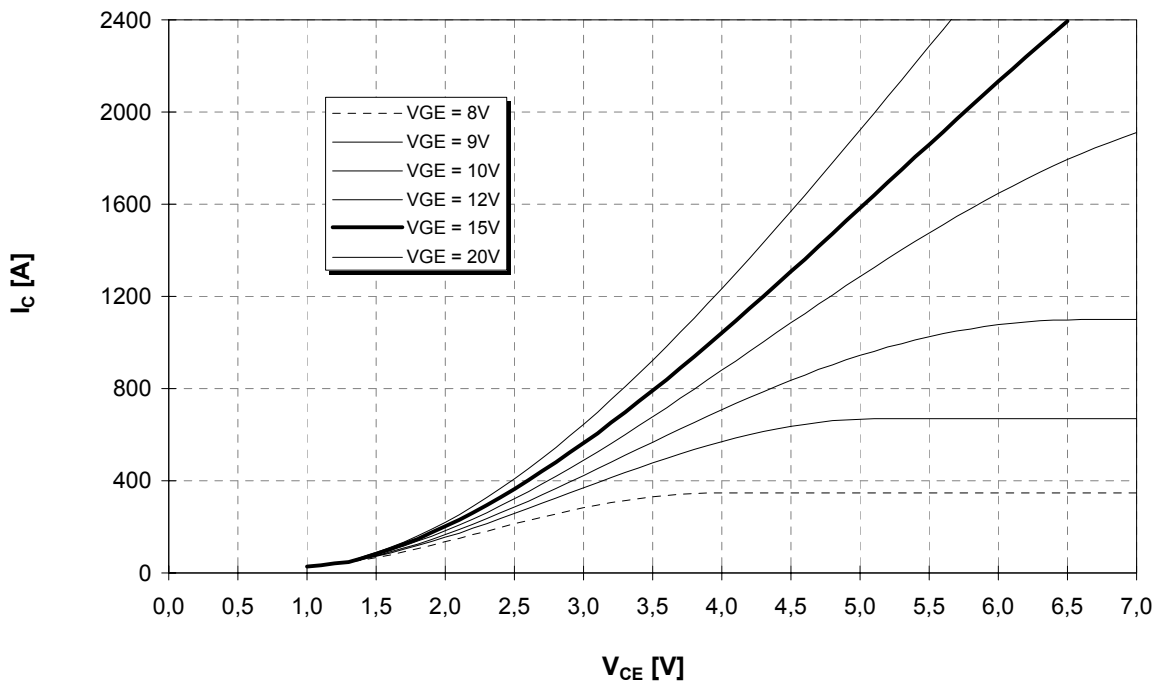
Ausgangskennlinie (typisch)  
Output characteristic (typical)

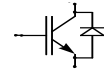
$I_c = f(V_{CE})$   
 $V_{GE} = 15V$



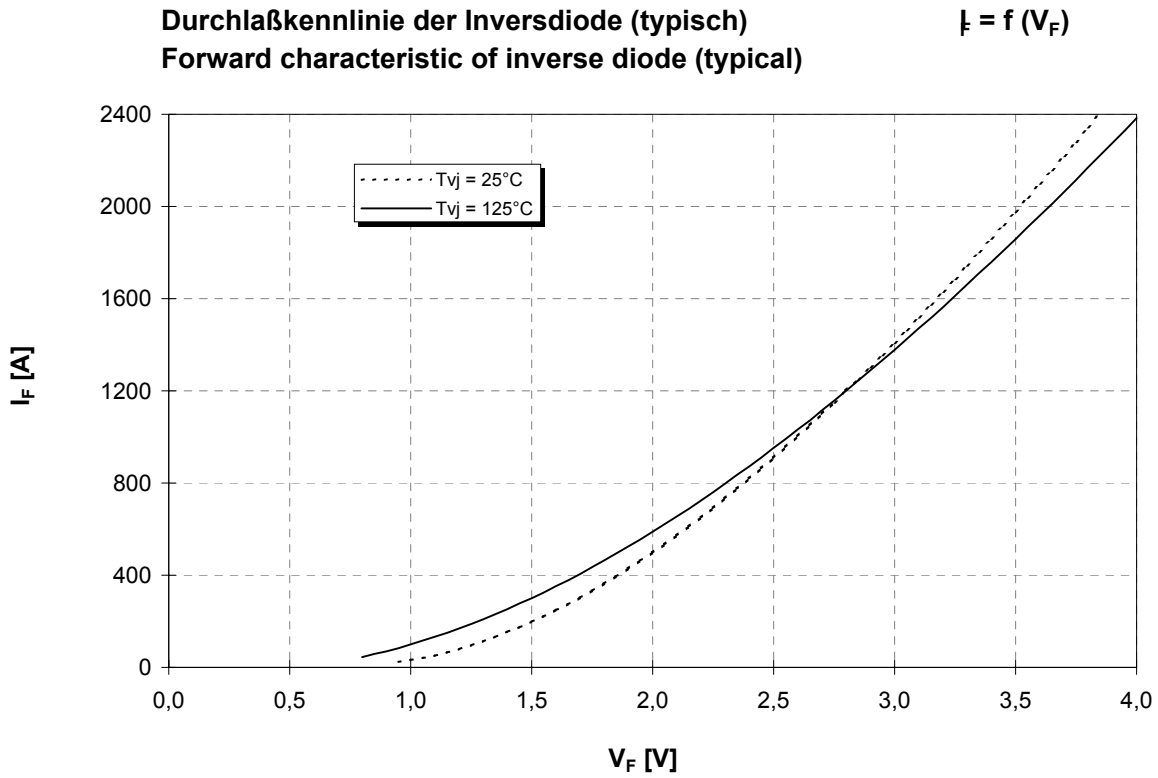
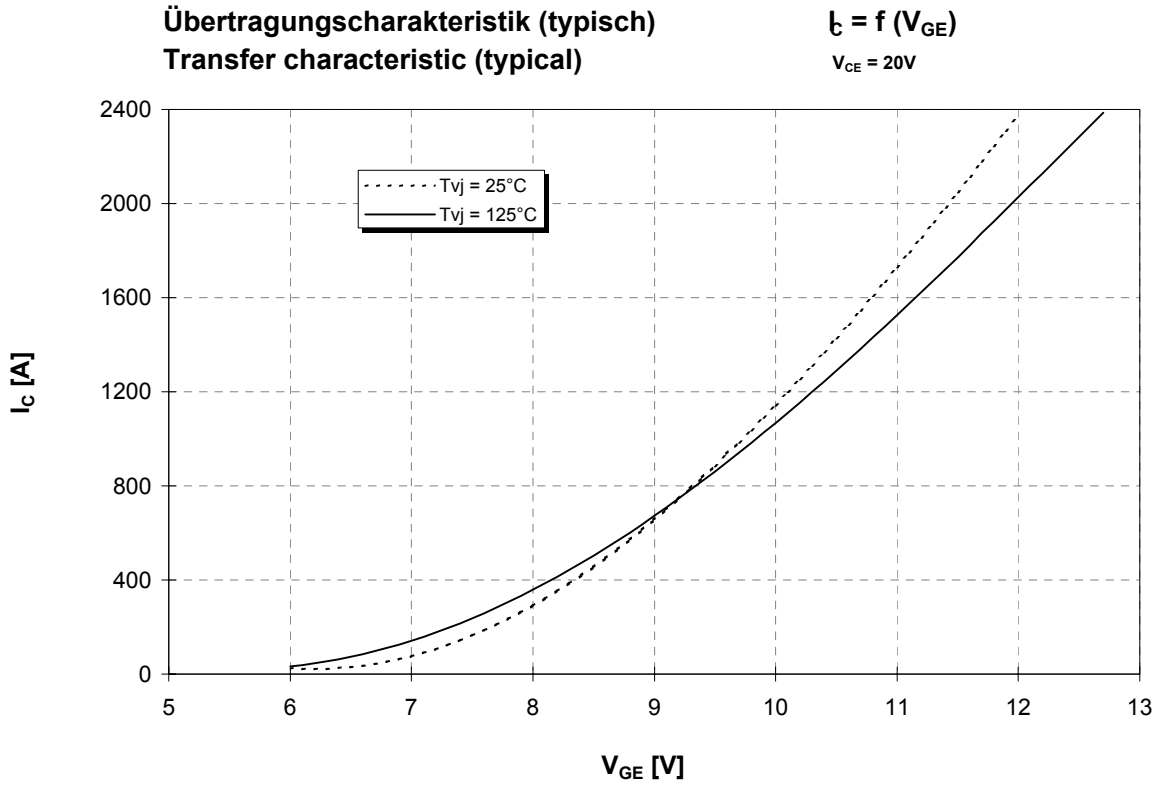
Ausgangskennlinienfeld (typisch)  
Output characteristic (typical)

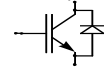
$I_c = f(V_{CE})$   
 $T_j = 125^\circ C$





vorläufige Daten  
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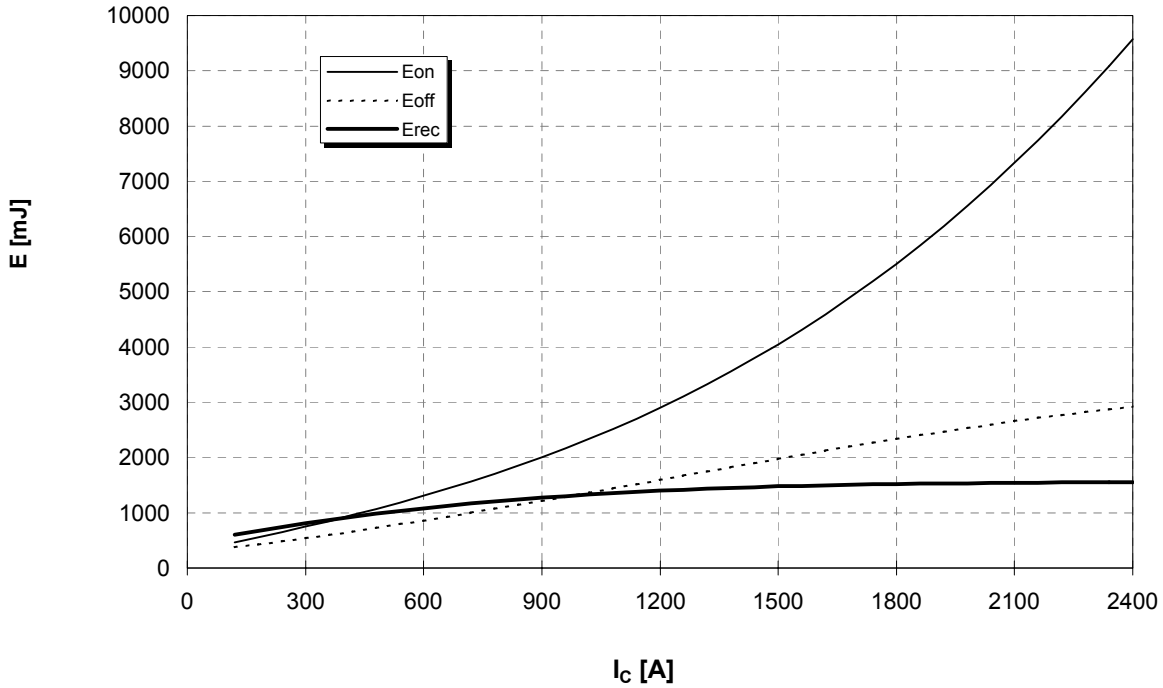


vorläufige Daten  
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Schaltverluste (typisch)  
Switching losses (typical)

$$E_{on} = f(I_C), E_{off} = f(I_C), E_{rec} = f(I_C)$$

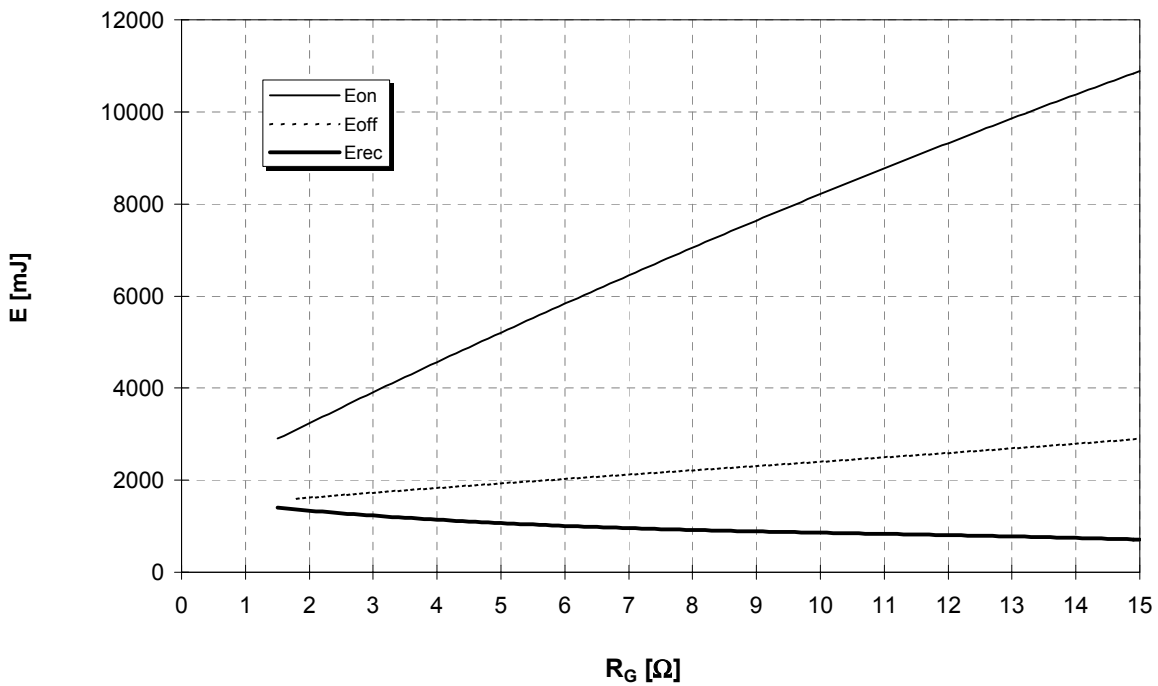
$T_{vj}=125^{\circ}\text{C}, V_{CE} = 1800\text{V}, V_{GE}=\pm 15\text{V}, R_{Gon} = 1,5 \Omega, R_{Goff} = 1,8 \Omega, C_{GE} = 220 \text{ nF}$

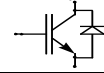


Schaltverluste (typisch)  
Switching losses (typical)

$$E_{on} = f(R_G), E_{off} = f(R_G), E_{rec} = f(R_G)$$

$T_{vj} = 125^{\circ}\text{C}, I_C = 1200 \text{ A}, V_{CE} = 1800\text{V}, V_{GE} = \pm 15\text{V}, C_{GE} = 220 \text{ nF}$

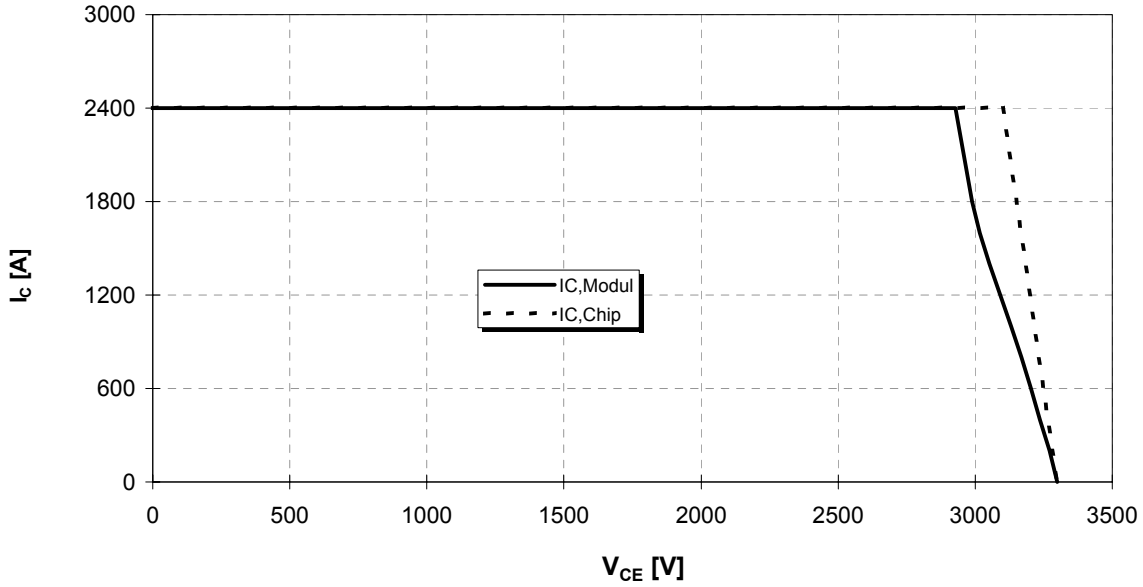




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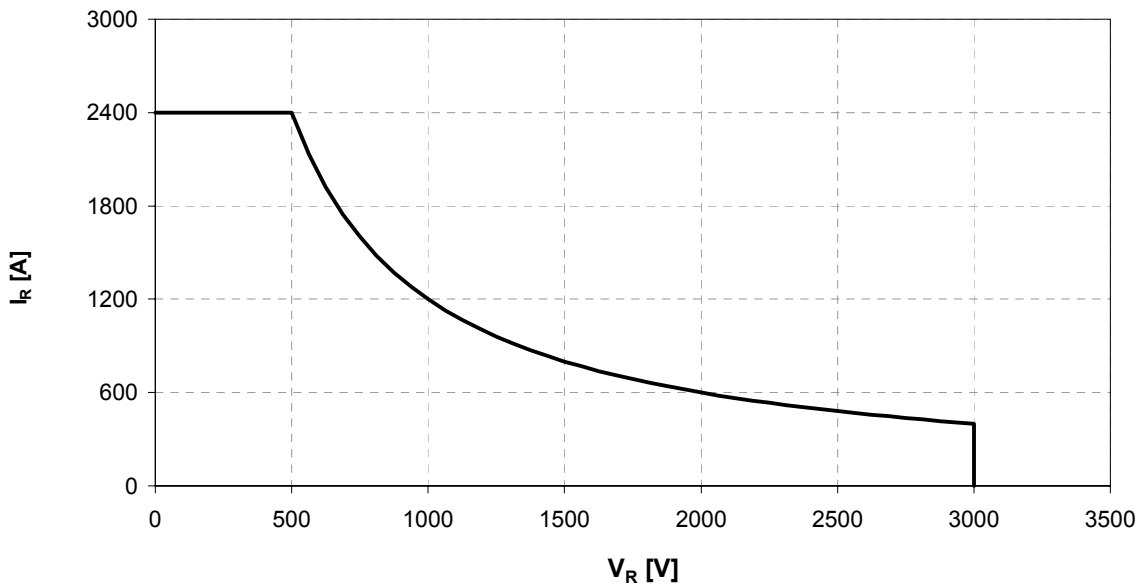
**Sicherer Arbeitsbereich IGBT (RBSOA)**  
**Reverse bias safe operation area IGBT (RBSOA)**

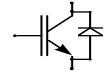
$V_{GE} = \pm 15V, R_{G,off} = 1,8\Omega, C_{GE} = 220 \text{ nF}$   
 $T_{vj} = 125^\circ\text{C}$



**Sicherer Arbeitsbereich Diode (SOA)**  
**safe operation area Diode (SOA)**

$T_{vj} = 125^\circ\text{C}$

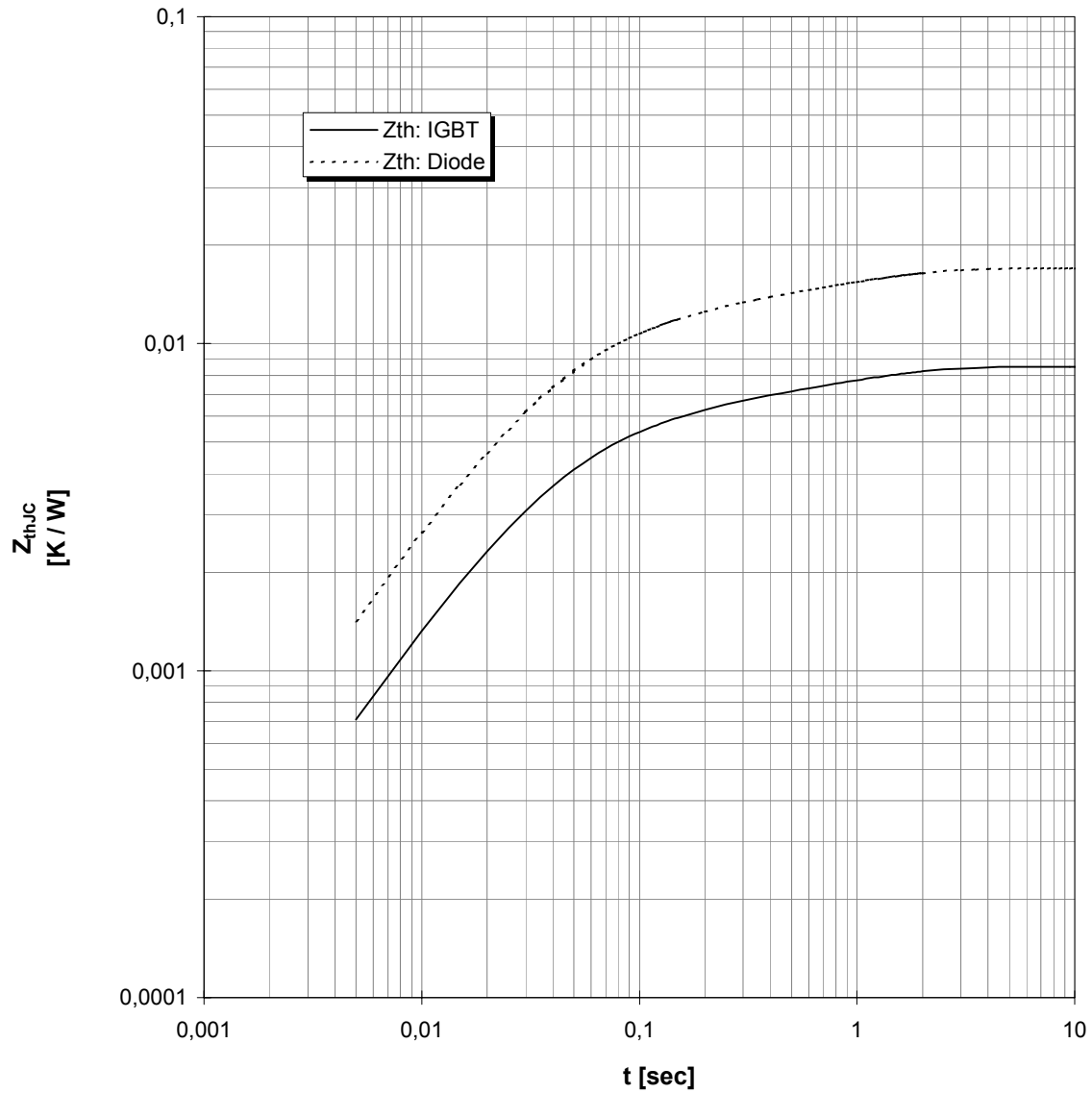




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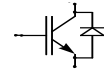
**Transienter Wärmewiderstand**  
**Transient thermal impedance**

$$Z_{thJC} = f(t)$$



| i                      | 1    | 2    | 3    | 4    |
|------------------------|------|------|------|------|
| $r_i$ [K/kW] : IGBT    | 3,83 | 2,13 | 0,51 | 2,04 |
| $\tau_i$ [sec] : IGBT  | 0,03 | 0,10 | 0,30 | 1,00 |
| $r_i$ [K/kW] : Diode   | 7,65 | 4,25 | 1,02 | 4,08 |
| $\tau_i$ [sec] : Diode | 0,03 | 0,10 | 0,30 | 1,00 |





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Äußere Abmessungen /  
external dimensions

