

vorläufige Daten  
preliminary data

## Höchstzulässige Werte / Maximum rated values

## Elektrische Eigenschaften / Electrical properties

|                                                                          |                                                                          |                       |            |                       |
|--------------------------------------------------------------------------|--------------------------------------------------------------------------|-----------------------|------------|-----------------------|
| Kollektor-Emitter-Sperrspannung<br>collector-emitter voltage             | $T_{vj} = 25^{\circ}\text{C}$                                            | $V_{CES}$             | 1700       | V                     |
| Kollektor-Dauergleichstrom<br>DC-collector current                       | $T_C = 80^{\circ}\text{C}$<br>$T_C = 25^{\circ}\text{C}$                 | $I_{C,nom.}$<br>$I_C$ | 400<br>650 | A<br>A                |
| Periodischer Kollektor Spitzenstrom<br>repetitive peak collector current | $t_p = 1\text{ ms}$ , $T_C = 80^{\circ}\text{C}$                         | $I_{CRM}$             | 800        | A                     |
| Gesamt-Verlustleistung<br>total power dissipation                        | $T_C = 25^{\circ}\text{C}$ , Transistor                                  | $P_{tot}$             | 3,1        | kW                    |
| Gate-Emitter-Spitzenspannung<br>gate-emitter peak voltage                |                                                                          | $V_{GES}$             | +/- 20V    | V                     |
| Dauergleichstrom<br>DC forward current                                   |                                                                          | $I_F$                 | 400        | A                     |
| Periodischer Spitzenstrom<br>repetitive peak forw. current               | $t_p = 1\text{ ms}$                                                      | $I_{FRM}$             | 800        | A                     |
| Grenzlastintegral der Diode<br>$I^2t$ - value, Diode                     | $V_R = 0\text{V}$ , $t_p = 10\text{ms}$ , $T_{vj} = 125^{\circ}\text{C}$ | $I^2t$                | 45         | $\text{kA}^2\text{s}$ |
| Isolations-Prüfspannung<br>insulation test voltage                       | RMS, $f = 50\text{ Hz}$ , $t = 1\text{ min.}$                            | $V_{ISOL}$            | 4          | kV                    |

## Charakteristische Werte / Characteristic values

## Transistor / Transistor

|                                                                              |                                                                                                                                                             |                     | min.   | typ.       | max.       |               |
|------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|--------|------------|------------|---------------|
| Kollektor-Emitter Sättigungsspannung<br>collector-emitter saturation voltage | $I_C = 400\text{A}$ , $V_{GE} = 15\text{V}$ , $T_{vj} = 25^{\circ}\text{C}$<br>$I_C = 400\text{A}$ , $V_{GE} = 15\text{V}$ , $T_{vj} = 125^{\circ}\text{C}$ | $V_{CE\text{ sat}}$ | -<br>- | 2,6<br>3,1 | 3,1<br>3,6 | V<br>V        |
| Gate-Schwellenspannung<br>gate threshold voltage                             | $I_C = 30\text{mA}$ , $V_{CE} = V_{GE}$ , $T_{vj} = 25^{\circ}\text{C}$                                                                                     | $V_{GE(th)}$        | 4,5    | 5,5        | 6,5        | V             |
| Gateladung<br>gate charge                                                    | $V_{GE} = -15\text{V} \dots +15\text{V}$                                                                                                                    | $Q_G$               | -      | 4,8        | -          | $\mu\text{C}$ |
| Eingangskapazität<br>input capacitance                                       | $f = 1\text{MHz}$ , $T_{vj} = 25^{\circ}\text{C}$ , $V_{CE} = 25\text{V}$ , $V_{GE} = 0\text{V}$                                                            | $C_{ies}$           | -      | 27         | -          | nF            |
| Rückwirkungskapazität<br>reverse transfer capacitance                        | $f = 1\text{MHz}$ , $T_{vj} = 25^{\circ}\text{C}$ , $V_{CE} = 25\text{V}$ , $V_{GE} = 0\text{V}$                                                            | $C_{res}$           | -      | 1,3        | -          | nF            |
| Kollektor-Emitter Reststrom<br>collector-emitter cut-off current             | $V_{CE} = 1700\text{V}$ , $V_{GE} = 0\text{V}$ , $T_{vj} = 25^{\circ}\text{C}$                                                                              | $I_{CES}$           | -      | -          | 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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# Technische Information / Technical Information

IGBT-Module  
IGBT-Modules

## FD 401 R 17 KF6C B2

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

### Charakteristische Werte / Characteristic values

#### Transistor / Transistor

|                                                                                        |                                                                                                                               |               | min. | typ. | max. |            |
|----------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------|---------------|------|------|------|------------|
| Einschaltverzögerungszeit (ind. Last)<br>turn on delay time (inductive load)           | $I_C = 400A, V_{CE} = 900V$                                                                                                   | $t_{d,on}$    | -    | 0,4  | -    | $\mu s$    |
|                                                                                        | $V_{GE} = \pm 15V, R_G = 1,8 \Omega, T_{vj} = 25^\circ C$                                                                     |               |      |      |      |            |
|                                                                                        | $V_{GE} = \pm 15V, R_G = 1,8 \Omega, T_{vj} = 125^\circ C$                                                                    |               |      |      |      |            |
| Anstiegszeit (induktive Last)<br>rise time (inductive load)                            | $I_C = 400A, V_{CE} = 900V$                                                                                                   | $t_r$         | -    | 0,15 | -    | $\mu s$    |
|                                                                                        | $V_{GE} = \pm 15V, R_G = 1,8 \Omega, T_{vj} = 25^\circ C$                                                                     |               |      |      |      |            |
|                                                                                        | $V_{GE} = \pm 15V, R_G = 1,8 \Omega, T_{vj} = 125^\circ C$                                                                    |               |      |      |      |            |
| Abschaltverzögerungszeit (ind. Last)<br>turn off delay time (inductive load)           | $I_C = 400A, V_{CE} = 900V$                                                                                                   | $t_{d,off}$   | -    | 1,1  | -    | $\mu s$    |
|                                                                                        | $V_{GE} = \pm 15V, R_G = 3,6 \Omega, T_{vj} = 25^\circ C$                                                                     |               |      |      |      |            |
|                                                                                        | $V_{GE} = \pm 15V, R_G = 3,6 \Omega, T_{vj} = 125^\circ C$                                                                    |               |      |      |      |            |
| Fallzeit (induktive Last)<br>fall time (inductive load)                                | $I_C = 400A, V_{CE} = 900V$                                                                                                   | $t_f$         | -    | 0,1  | -    | $\mu s$    |
|                                                                                        | $V_{GE} = \pm 15V, R_G = 3,6 \Omega, T_{vj} = 25^\circ C$                                                                     |               |      |      |      |            |
|                                                                                        | $V_{GE} = \pm 15V, R_G = 3,6 \Omega, T_{vj} = 125^\circ C$                                                                    |               |      |      |      |            |
| Einschaltverlustenergie pro Puls<br>turn-on energy loss per pulse                      | $I_C = 400A, V_{CE} = 900V, V_{GE} = 15V$<br>$R_{G,on} = 1,8 \Omega, T_{vj} = 125^\circ C, L_S = 60nH$                        | $E_{on}$      | -    | 190  | -    | mWs        |
| Abschaltverlustenergie pro Puls<br>turn-off energy loss per pulse                      | $I_C = 400A, V_{CE} = 900V, V_{GE} = 15V$<br>$R_G = 3,6 \Omega, T_{vj} = 125^\circ C, L_S = 60nH$                             | $E_{off}$     | -    | 150  | -    | mWs        |
| Kurzschlußverhalten<br>SC Data                                                         | $t_P \leq 10\mu sec, V_{GE} \leq 15V$<br>$T_{vj} \leq 125^\circ C, V_{CC} = 1000V, V_{CEmax} = V_{CES} - L_{SCE} \cdot di/dt$ | $I_{SC}$      | -    | 1600 | -    | A          |
| Modulinduktivität<br>stray inductance module                                           |                                                                                                                               | $L_{SCE}$     | -    | 58   | -    | nH         |
| Modulleitungswiderstand, Anschlüsse - Chip<br>module lead resistance, terminals - chip | pro Zweig / per arm                                                                                                           | $R_{CC'+EE'}$ | -    | 0,78 | -    | m $\Omega$ |

### Charakteristische Werte / Characteristic values

#### Diode / Diode

|                                                     |                                                   |           | min. | typ. | max. |          |
|-----------------------------------------------------|---------------------------------------------------|-----------|------|------|------|----------|
| Durchlaßspannung<br>forward voltage                 | $I_F = 400A, V_{GE} = 0V, T_{vj} = 25^\circ C$    | $V_F$     | -    | 2,1  | 2,5  | V        |
|                                                     | $I_F = 400A, V_{GE} = 0V, T_{vj} = 125^\circ C$   |           |      |      |      |          |
| Rückstromspitze<br>peak reverse recovery current    | $I_F = 400A, -di_F/dt = 2400 A/\mu sec$           | $I_{RM}$  | -    | 270  | -    | A        |
|                                                     | $V_R = 900V, V_{GE} = -10V, T_{vj} = 25^\circ C$  |           |      |      |      |          |
|                                                     | $V_R = 900V, V_{GE} = -10V, T_{vj} = 125^\circ C$ |           |      |      |      |          |
| Sperrverzögerungsladung<br>recovered charge         | $I_F = 400A, -di_F/dt = 2400 A/\mu sec$           | $Q_r$     | -    | 75   | -    | $\mu As$ |
|                                                     | $V_R = 900V, V_{GE} = -10V, T_{vj} = 25^\circ C$  |           |      |      |      |          |
|                                                     | $V_R = 900V, V_{GE} = -10V, T_{vj} = 125^\circ C$ |           |      |      |      |          |
| Abschaltenergie pro Puls<br>reverse recovery energy | $I_F = 400A, -di_F/dt = 2400 A/\mu sec$           | $E_{rec}$ | -    | 35   | -    | mWs      |
|                                                     | $V_R = 900V, V_{GE} = -10V, T_{vj} = 25^\circ C$  |           |      |      |      |          |
|                                                     | $V_R = 900V, V_{GE} = -10V, T_{vj} = 125^\circ C$ |           |      |      |      |          |

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## Thermische Eigenschaften / Thermal properties

|                                                                        |                                                                                                          |            | min. | typ.         | max.  |     |
|------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------|------------|------|--------------|-------|-----|
| Innerer Wärmewiderstand<br>thermal resistance, junction to case        | Transistor / transistor, DC                                                                              | $R_{thJC}$ | -    | -            | 0,04  | K/W |
|                                                                        | Diode/Diode, DC                                                                                          |            | -    | -            | 0,068 | K/W |
| Übergangs-Wärmewiderstand<br>thermal resistance, case to heatsink      | pro Zweig / per arm<br>pro Modul / per module                                                            | $R_{thCK}$ | -    | 0,04<br>0,02 |       | K/W |
|                                                                        | $\lambda_{\text{Paste}} = 1 \text{ W/m}^2\text{K}$ / $\lambda_{\text{grease}} = 1 \text{ W/m}^2\text{K}$ |            |      |              |       |     |
| Höchstzulässige Sperrschichttemperatur<br>maximum junction temperature |                                                                                                          | $T_{vj}$   | -    | -            | 150   | °C  |
| Betriebstemperatur<br>operation temperature                            |                                                                                                          | $T_{op}$   | -40  | -            | 125   | °C  |
| Lagertemperatur<br>storage temperature                                 |                                                                                                          | $T_{stg}$  | -40  | -            | 125   | °C  |

## Mechanische Eigenschaften / Mechanical properties

|                                                                      |              |    |      |          |
|----------------------------------------------------------------------|--------------|----|------|----------|
| Gehäuse, siehe Anlage<br>case, see appendix                          |              |    |      |          |
| Innere Isolation<br>internal insulation                              |              |    | AlN  |          |
| Kriechstrecke<br>creepage distance                                   |              |    | 32   | mm       |
| Luftstrecke<br>clearance                                             |              |    | 19   | mm       |
| CTI<br>comperative tracking index                                    |              |    | >400 |          |
| Anzugsdrehmoment f. mech. Befestigung<br>mounting torque             |              | M1 | 5    | Nm       |
| Anzugsdrehmoment f. elektr. Anschlüsse<br>terminal connection torque | terminals M5 | M2 | 4    | Nm<br>Nm |
| Gewicht<br>weight                                                    |              | G  | 500  | g        |

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

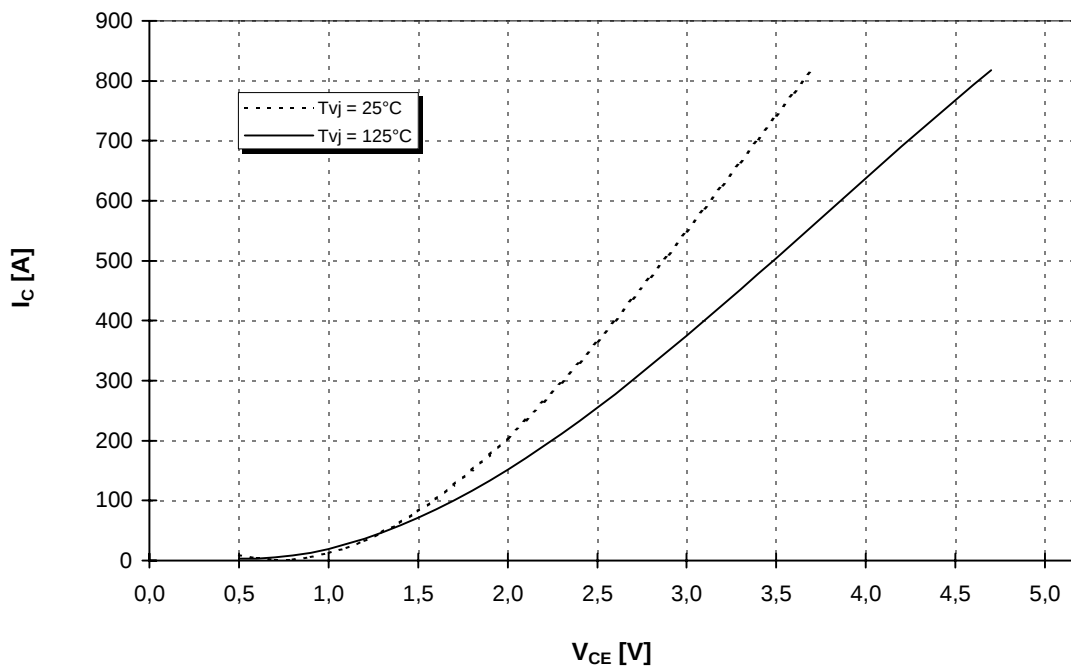
This technical information specifies semiconductor devices but promises no characteristics. It is  
valid in combination with the belonging technical notes.


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Ausgangskennlinie (typisch)  
Output characteristic (typical)

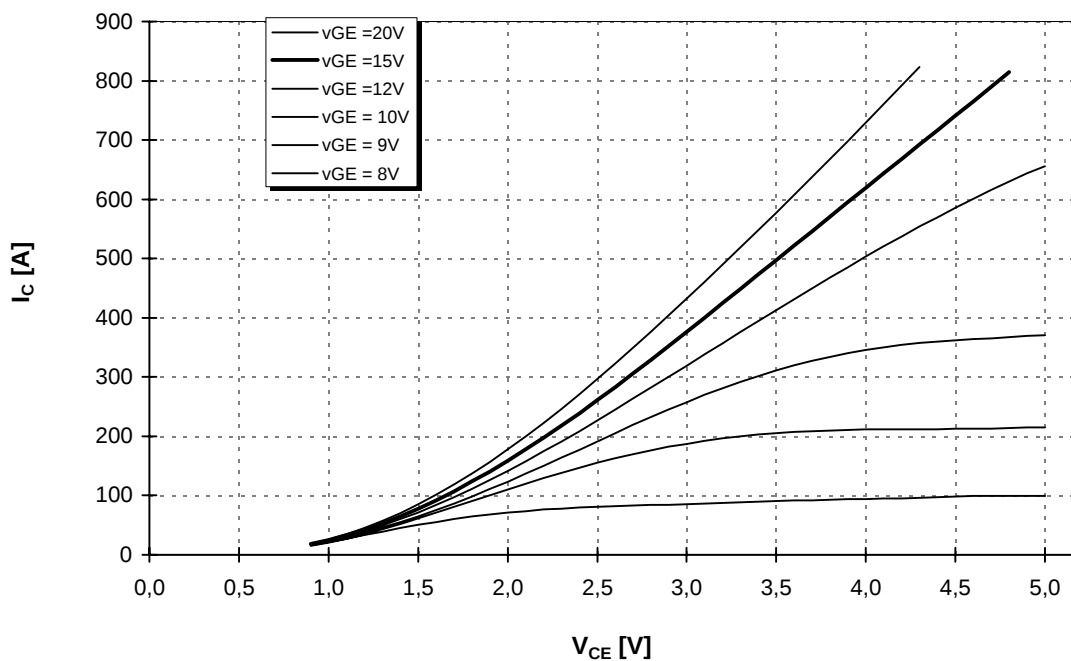
$$I_C = f(V_{CE})$$

$$V_{GE} = 15V$$


Ausgangskennlinienfeld (typisch)  
Output characteristic (typical)

$$I_C = f(V_{CE})$$

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



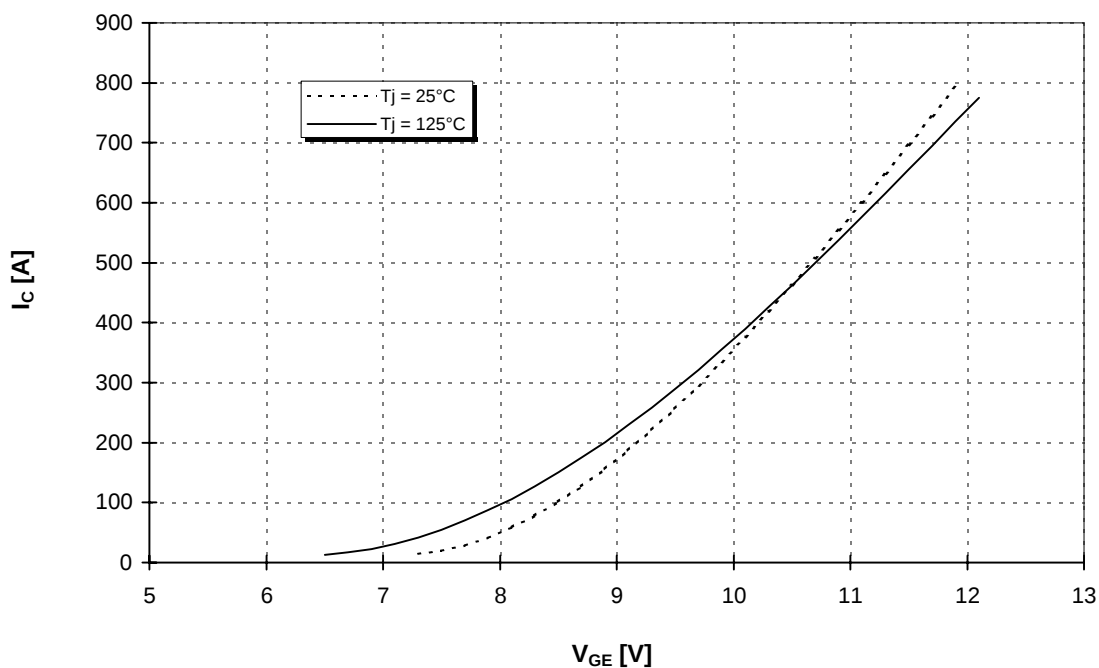


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Übertragungscharakteristik (typisch)  
Transfer characteristic (typical)

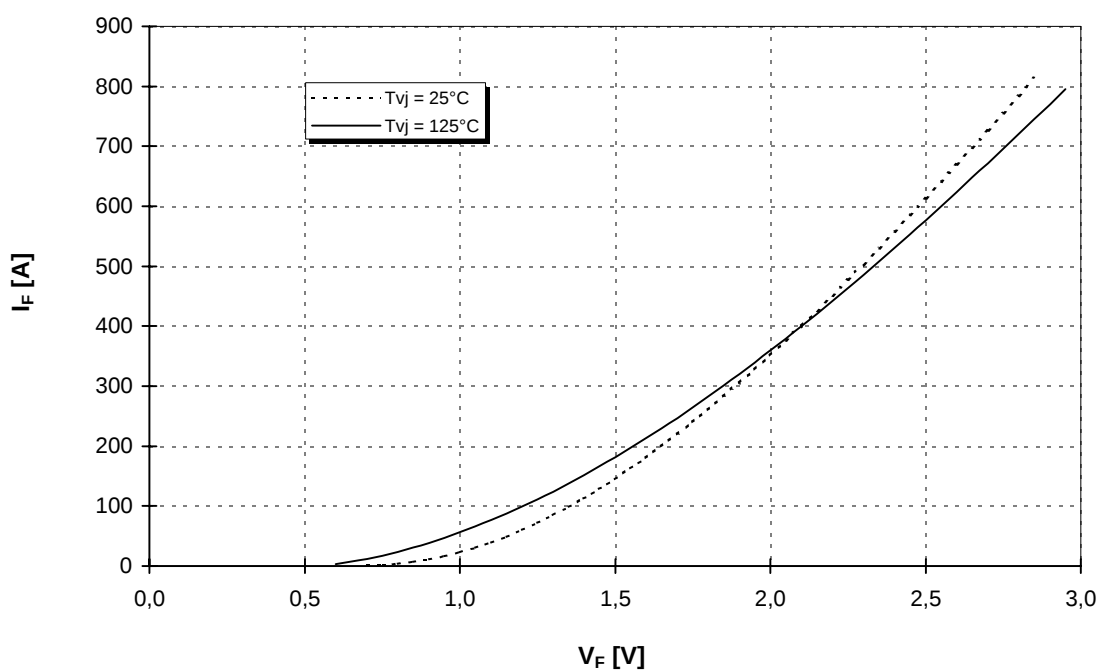
$$I_C = f(V_{GE})$$

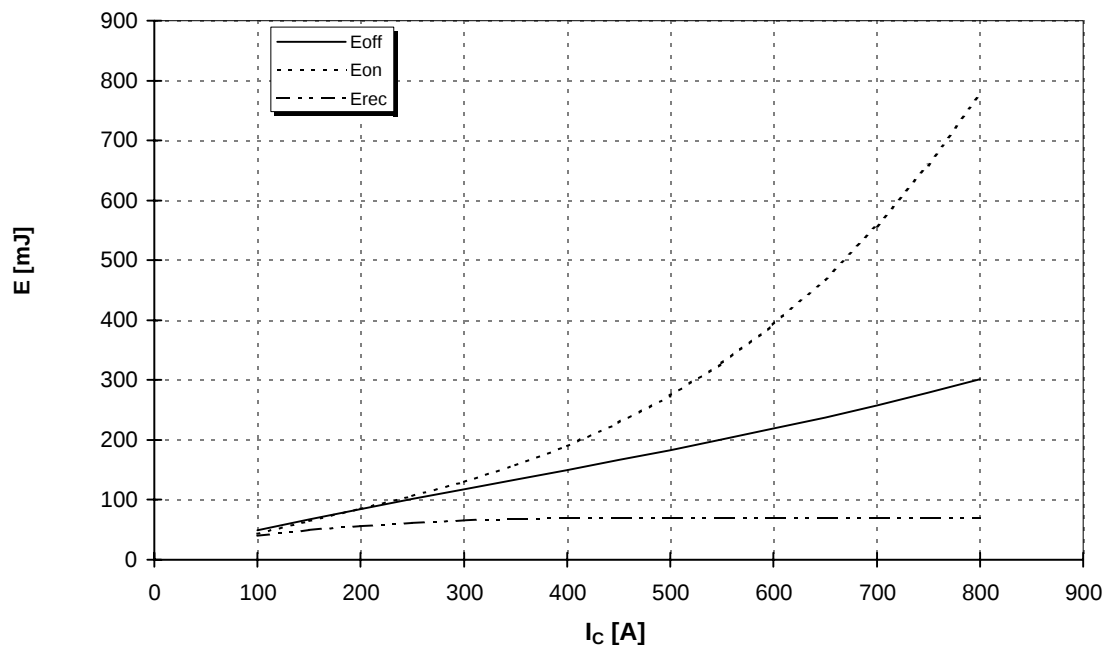
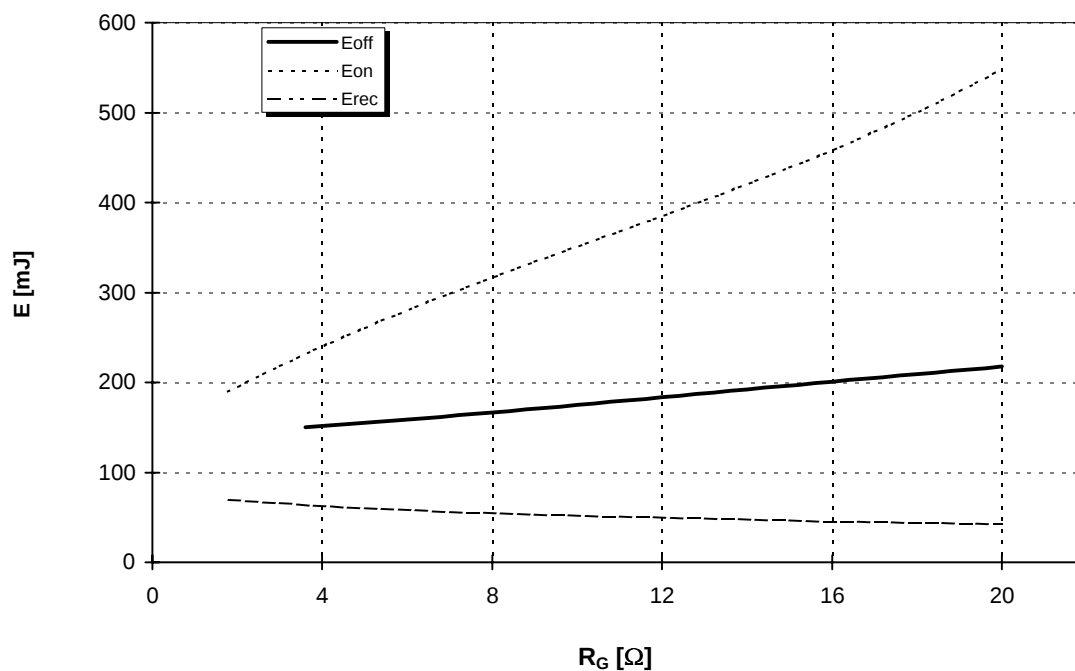
$V_{CE} = 20V$



Durchlaßkennlinie der Inversdiode (typisch)  
Forward characteristic of inverse diode (typical)

$$I_F = f(V_F)$$



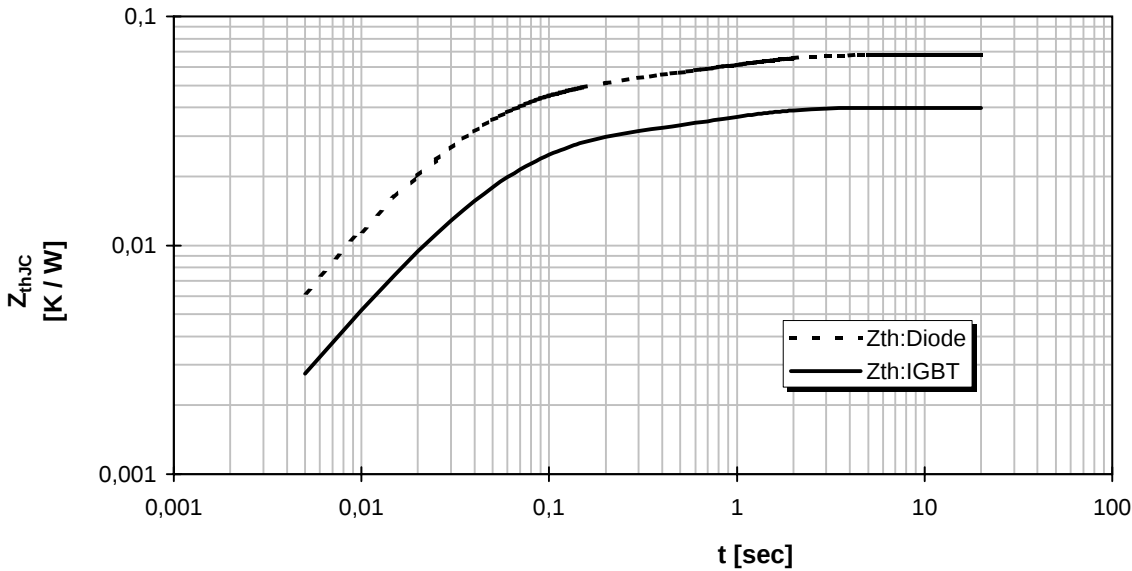
vorläufige Daten  
preliminary dataSchaltverluste (typisch)  
Switching losses (typical) $E_{on} = f(I_C)$ ,  $E_{off} = f(I_C)$ ,  $E_{rec} = f(I_C)$  $R_{gon} = 1,8\Omega$ ,  $R_{goff} = 3,6\Omega$ ,  $V_{CE} = 900V$ ,  $T_j = 125^\circ C$ ,  $V_{GE} = \pm 15V$ Schaltverluste (typisch)  
Switching losses (typical) $E_{on} = f(R_G)$ ,  $E_{off} = f(R_G)$ ,  $E_{rec} = f(R_G)$  $I_C = 400A$ ,  $V_{CE} = 900V$ ,  $T_j = 125^\circ C$ ,  $V_{GE} = \pm 15V$ 



vorläufige Daten  
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Transienter Wärmewiderstand  
Transient thermal impedance

$Z_{thJC} = f(t)$



| i                      | 1      | 2      | 3     | 4     |
|------------------------|--------|--------|-------|-------|
| $r_i$ [K/kW] : IGBT    | 3,76   | 18,86  | 5,7   | 11,6  |
| $\tau_i$ [sec] : IGBT  | 0,027  | 0,052  | 0,09  | 0,838 |
| $r_i$ [K/kW] : Diode   | 31,39  | 14,05  | 4,477 | 18,08 |
| $\tau_i$ [sec] : Diode | 0,0287 | 0,0705 | 0,153 | 0,988 |

Sicherer Arbeitsbereich (RBSOA)

Reverse bias safe operation area (RBSOA)  $R_g = 3,6 \text{ Ohm}$ ,  $T_{vj} = 125^\circ\text{C}$

