



### Höchstzulässige Werte / maximum rated values

#### Elektrische Eigenschaften / electrical properties

Kollektor Emitter Sperrspannung collector emitter voltage	$T_{vj} = 25^{\circ}\text{C}$	$V_{CES}$	1200	V
Kollektor Dauergleichstrom DC collector current	$T_c = 80^{\circ}\text{C}$	$I_{C, nom}$	400	A
	$T_c = 25^{\circ}\text{C}$	$I_C$	650	A
Periodischer Kollektor Spitzenstrom repetitive peak collector current	$t_p = 1\text{ms}, T_c = 80^{\circ}\text{C}$	$I_{CRM}$	800	A
Gesamt Verlustleistung total power dissipation	$T_c = 25^{\circ}\text{C}$	$P_{tot}$	2250	W
Gate Emitter Spitzenspannung gate emitter peak voltage		$V_{GES}$	+/- 20	V
Dauergleichstrom DC forward current		$I_F$	400	A
Periodischer Spitzenstrom repetitive peak forward current	$t_p = 1\text{ms}$	$I_{FRM}$	800	A
Grenzlastintegral $I^2t$ value	$V_R = 0\text{V}, t_p = 10\text{ms}, T_{vj} = 125^{\circ}\text{C}$	$I^2t$	31	$\text{kA}^2\text{s}$
Isolations Prüfspannung insulation test voltage	RMS, $f = 50\text{Hz}, t = 1\text{min}$	$V_{ISOL}$	2,5	kV

### Charakteristische Werte / characteristic values

#### Transistor Wechselrichter / transistor inverter

			min.	typ.	max.	
Kollektor Emitter Sättigungsspannung collector emitter saturation voltage	$V_{GE} = 15\text{V}, T_{vj} = 25^{\circ}\text{C}, I_C = I_{C, nom}$	$V_{CESat}$	-	1,7	2,15	V
	$V_{GE} = 15\text{V}, T_{vj} = 125^{\circ}\text{C}, I_C = I_{C, nom}$		-	2	-	V
Gate Schwellenspannung gate threshold voltage	$V_{CE} = V_{GE}, T_{vj} = 25^{\circ}\text{C}, I_C = 16\text{mA}$	$V_{GE(th)}$	5	5,8	6,5	V
Gateladung gate charge	$V_{GE} = -15\text{V} \dots +15\text{V}$	$Q_G$	-	3,7	-	$\mu\text{C}$
Eingangskapazität input capacitance	$f = 1\text{MHz}, T_{vj} = 25^{\circ}\text{C}, V_{CE} = 25\text{V}, V_{GE} = 0\text{V}$	$C_{ies}$	-	28	-	nF
Rückwirkungskapazität reverse transfer capacitance	$f = 1\text{MHz}, T_{vj} = 25^{\circ}\text{C}, V_{CE} = 25\text{V}, V_{GE} = 0\text{V}$	$C_{res}$	-	1,1	-	nF
Kollektor Emitter Reststrom collector emitter cut off current	$V_{CE} = 1200\text{V}, V_{GE} = 0\text{V}, T_{vj} = 25^{\circ}\text{C}$	$I_{CES}$	-	-	5	mA
Gate Emitter Reststrom 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 Wechselrichter / transistor inverter

			min.	typ.	max.	
Einschaltverzögerungszeit (induktive Last) turn on delay time (inductive load)	$I_C = I_{C, nom}, V_{CC} = 600V$ $V_{GE} = \pm 15V, R_G = 1,8\Omega, T_{vj} = 25^\circ C$	$t_{d,on}$	-	250	-	ns
	$V_{GE} = \pm 15V, R_G = 1,8\Omega, T_{vj} = 125^\circ C$		-	300	-	ns
Anstiegszeit (induktive Last) rise time (inductive load)	$I_C = I_{C, nom}, V_{CC} = 600V$ $V_{GE} = \pm 15V, R_G = 1,8\Omega, T_{vj} = 25^\circ C$	$t_r$	-	90	-	ns
	$V_{GE} = \pm 15V, R_G = 1,8\Omega, T_{vj} = 125^\circ C$		-	95	-	ns
Abschaltverzögerungszeit (induktive Last) turn off delay time (inductive load)	$I_C = I_{C, nom}, V_{CC} = 600V$ $V_{GE} = \pm 15V, R_G = 1,8\Omega, T_{vj} = 25^\circ C$	$t_{d,off}$	-	550	-	ns
	$V_{GE} = \pm 15V, R_G = 1,8\Omega, T_{vj} = 125^\circ C$		-	650	-	ns
Fallzeit (induktive Last) fall time (inductive load)	$I_C = I_{C, nom}, V_{CC} = 600V$ $V_{GE} = \pm 15V, R_G = 1,8\Omega, T_{vj} = 25^\circ C$	$t_f$	-	130	-	ns
	$V_{GE} = \pm 15V, R_G = 1,8\Omega, T_{vj} = 125^\circ C$		-	180	-	ns
Einschaltverlustenergie pro Puls turn on energy loss per pulse	$I_C = I_{C, nom}, V_{CC} = 600V, L_\sigma = 85nH$ $V_{GE} = \pm 15V, R_G = 1,8\Omega, T_{vj} = 125^\circ C$	$E_{on}$	-	33	-	mJ
Ausschaltverlustenergie pro Puls turn off energy loss per pulse	$I_C = I_{C, nom}, V_{CC} = 600V, L_\sigma = 85nH$ $V_{GE} = \pm 15V, R_G = 1,8\Omega, T_{vj} = 125^\circ C$	$E_{off}$	-	59	-	mJ
Kurzschlussverhalten SC data	$t_p \leq 10\mu sec, V_{GE} \leq 15V, T_{vj} \leq 125^\circ C$ $V_{CC} = 900V, V_{CEmax} = V_{CES} - L_{\sigma CE} \cdot di/dt$	$I_{SC}$	-	1600	-	A
Modulinduktivität stray inductance module		$L_{\sigma CE}$	-	16	-	nH
Leitungswiderstand, Anschluss-Chip lead resistance, terminal-chip	$T_c = 25^\circ C$	$R_{CC/EE}$	-	0,5	-	mΩ

### Charakteristische Werte / characteristic values

#### Diode Wechselrichter / diode inverter

Durchlassspannung forward voltage	$I_F = I_{C, nom}, V_{GE} = 0V, T_{vj} = 25^\circ C$	$V_F$	-	1,65	2,15	V
	$I_F = I_{C, nom}, V_{GE} = 0V, T_{vj} = 125^\circ C$		-	1,65	-	V
Rückstromspitze peak reverse recovery current	$I_F = I_{C, nom}, -di_F/dt = 4000A/\mu s$ $V_R = 600V, V_{GE} = -15V, T_{vj} = 25^\circ C$	$I_{RM}$	-	280	-	A
	$V_R = 600V, V_{GE} = -15V, T_{vj} = 125^\circ C$		-	360	-	A
Sperrverzögerungsladung recovered charge	$I_F = I_{C, nom}, -di_F/dt = 4000A/\mu s$ $V_R = 600V, V_{GE} = -15V, T_{vj} = 25^\circ C$	$Q_r$	-	40	-	μC
	$V_R = 600V, V_{GE} = -15V, T_{vj} = 125^\circ C$		-	75	-	μC
Ausschaltenergie pro Puls reverse recovery energy	$I_F = I_{C, nom}, -di_F/dt = 4000A/\mu s$ $V_R = 600V, V_{GE} = -15V, T_{vj} = 25^\circ C$	$E_{rec}$	-	18	-	mJ
	$V_R = 600V, V_{GE} = -15V, T_{vj} = 125^\circ C$		-	34	-	mJ

# Technische Information / technical information

eupec

IGBT-Module  
IGBT-Modules

FZ400R12KE3



## Thermische Eigenschaften / thermal properties

Innerer Wärmewiderstand; DC thermal resistance, junction to case; DC	Transistor Wechselr. / transistor inverter	$R_{thJC}$	-	-	0,055	K/W
	Diode Wechselrichter / diode inverter		-	-	0,125	K/W
Übergangs Wärmewiderstand thermal resistance, case to heatsink	pro Modul / per module $\lambda_{paste} = 1W/m^2K$ / $\lambda_{grease} = 1W/m^2K$	$R_{thCK}$	-	0,01	-	K/W
Höchstzulässige Sperrschichttemp. maximum junction temperature		$T_{vjmax}$	-	-	150	°C
Betriebstemperatur operation temperature		$T_{vjop}$	-40	-	125	°C
Lagertemperatur storage temperature		$T_{stg}$	-40	-	125	°C

## Mechanische Eigenschaften / mechanical properties

Gehäuse, siehe Anlage case, see appendix						
Innere Isolation internal insulation					Al <sub>2</sub> O <sub>3</sub>	
Kriechstrecke creepage distance					20	mm
Luftstrecke clearance					11	mm
CTI comperative tracking index					225	
Anzugsdrehmoment, mech. Befestigung mounting torque	Schraube M5 screw M5	M	3	-	6	Nm
Anzugsdrehmoment, elektr. Anschlüsse terminal connection torque	terminals M6 terminals M4	M	2,5 1,1	-	5 2	Nm
Gewicht weight		G			420	g

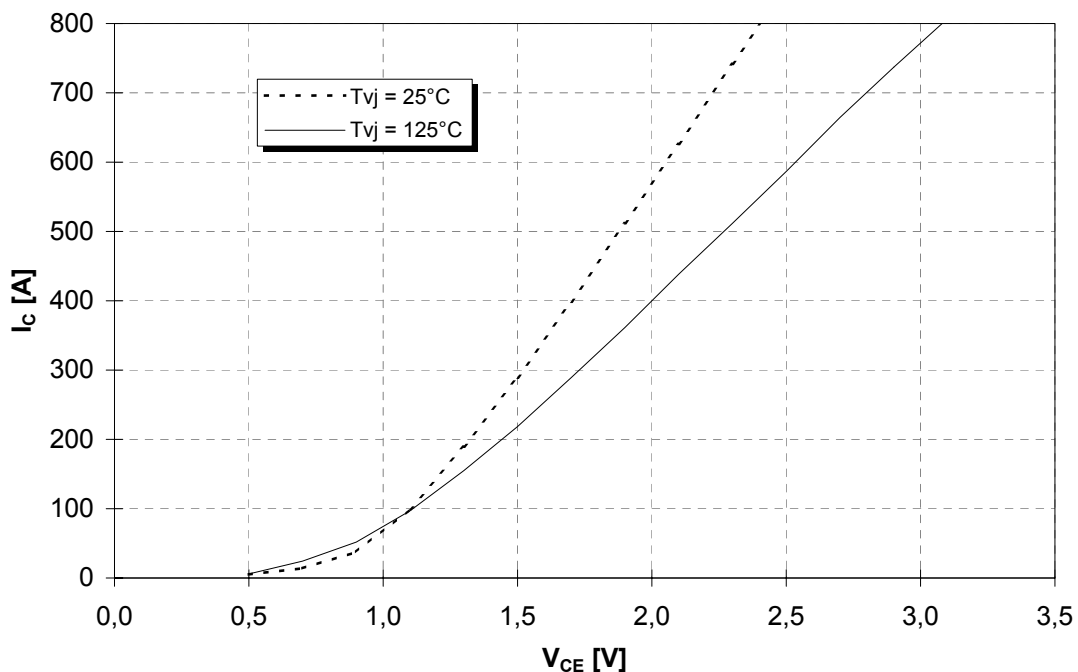
Mit dieser technischen Information werden Halbleiterbauelemente spezifiziert, jedoch keine Eigenschaften zugesichert. Sie gilt in Verbindung mit den zugehörigen technischen Erläuterungen.

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



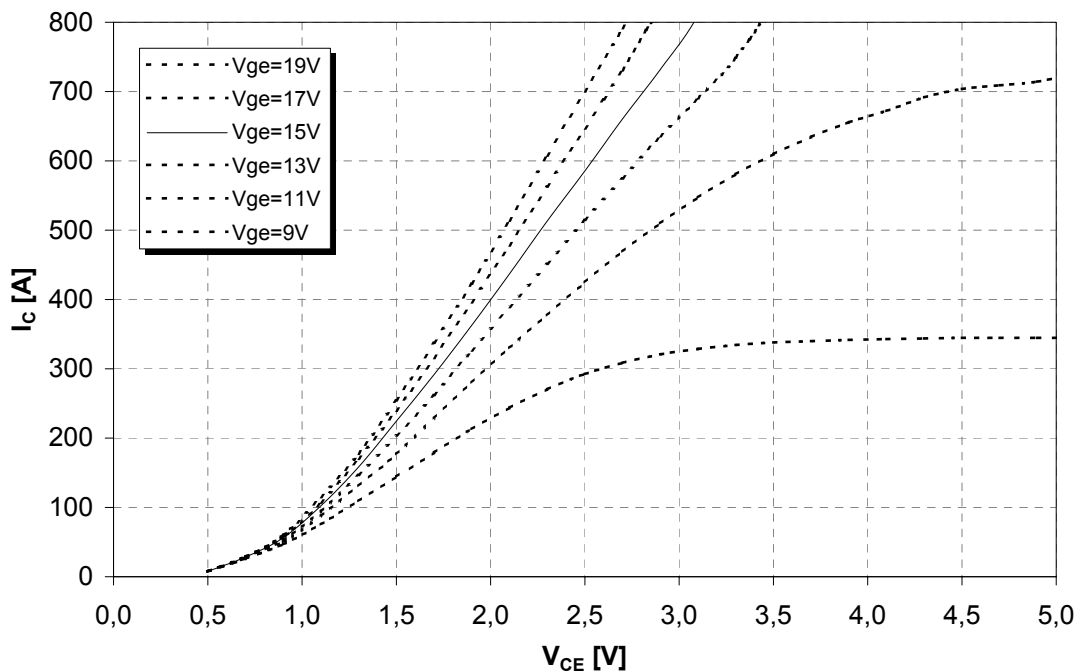
Ausgangskennlinie (typisch)  
output characteristic (typical)

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



Ausgangskennlinienfeld (typisch)  
output characteristic (typical)

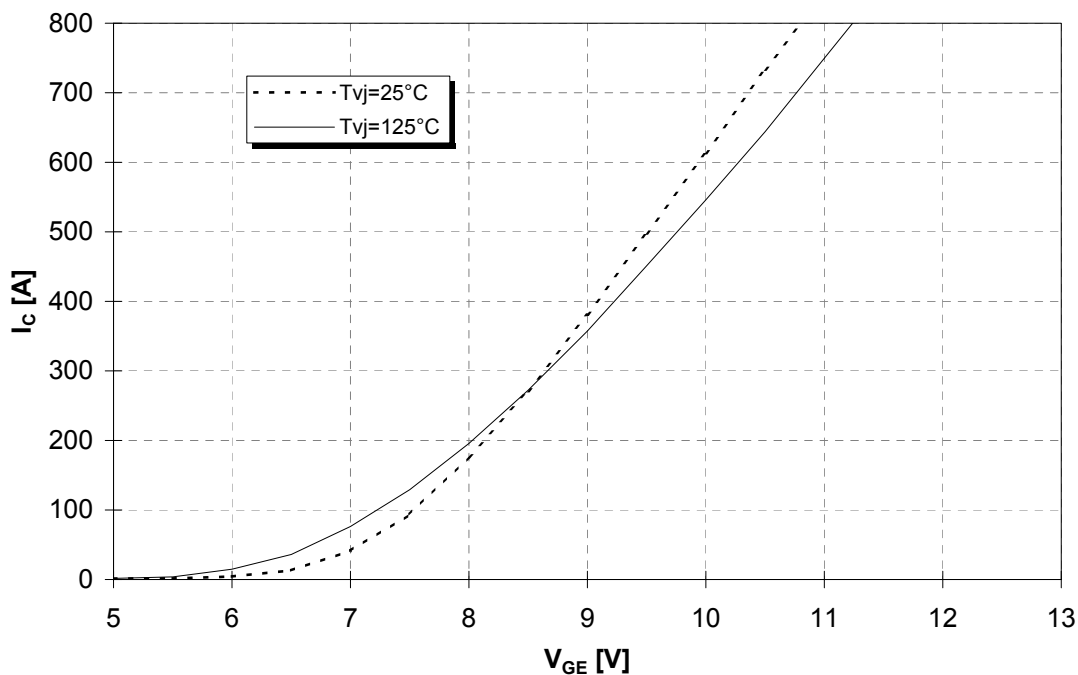
$I_C = f(V_{CE})$   
 $T_{vj} = 125^\circ C$





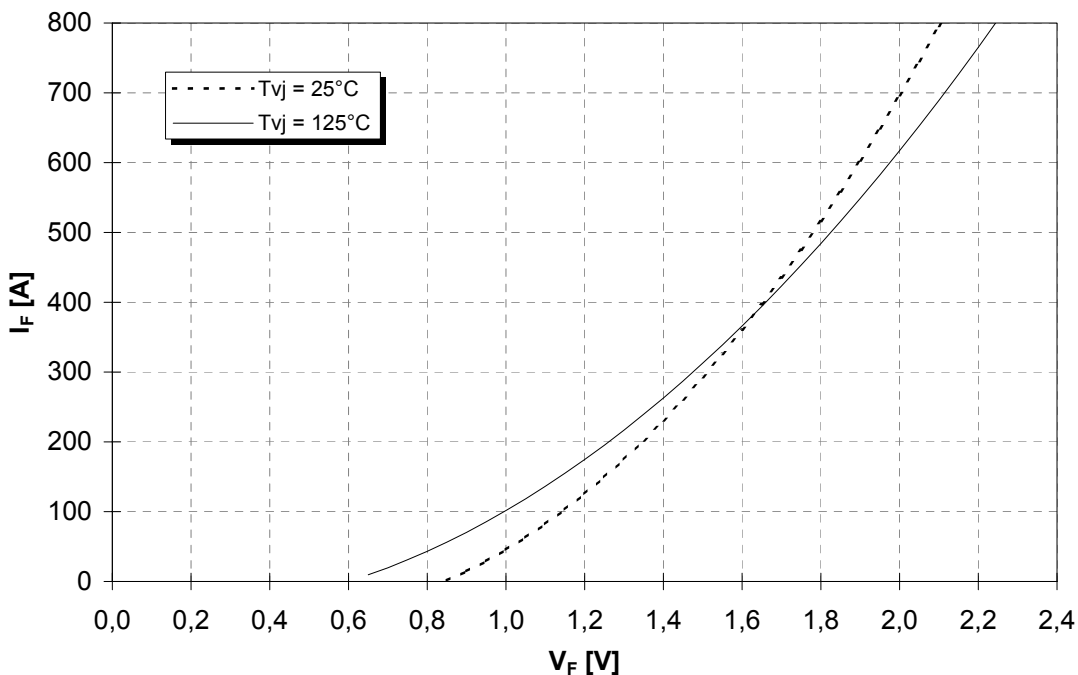
**Übertragungscharakteristik (typisch)**  
**transfer characteristic (typical)**

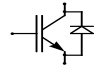
$I_C = f(V_{GE})$   
 $V_{CE} = 20V$



**Durchlasskennlinie der Inversdiode (typisch)**  
**forward characteristic of inverse diode (typical)**

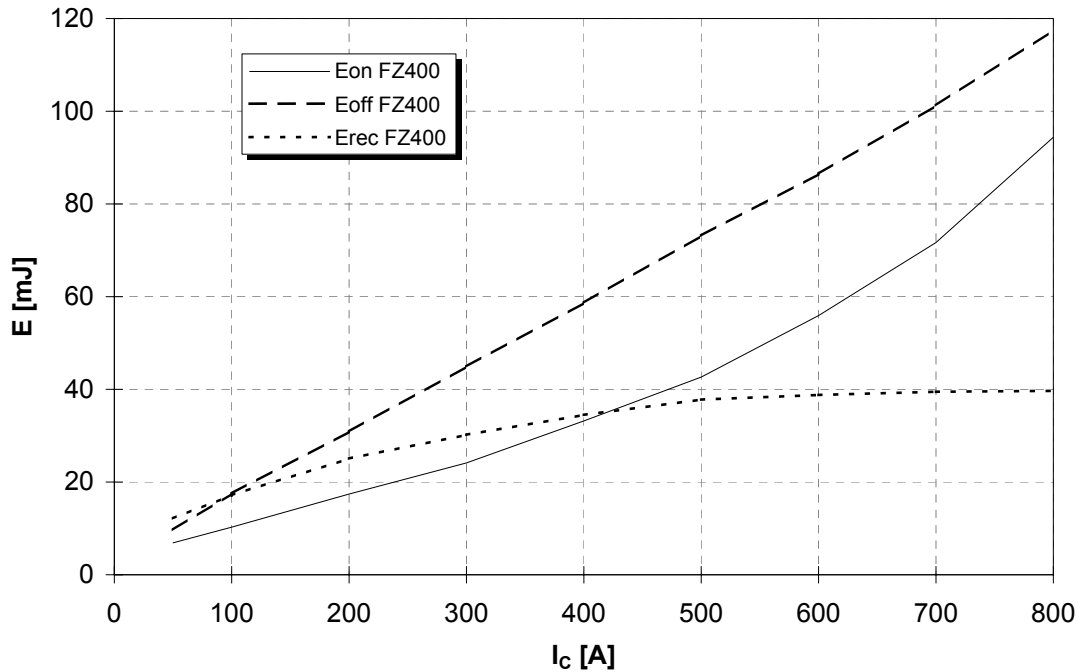
$I_F = f(V_F)$





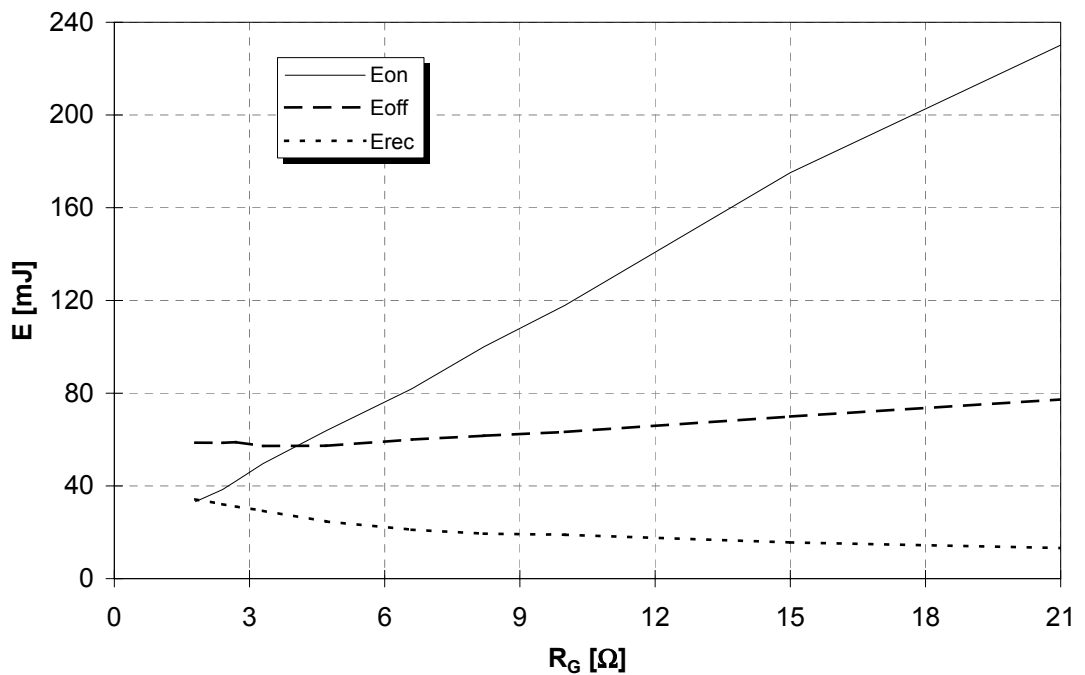
Schaltverluste (typisch)  
Switching losses (typical)

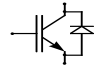
$E_{on} = f(I_C)$ ,  $E_{off} = f(I_C)$ ,  $E_{rec} = f(I_C)$   
 $V_{GE}=15V$ ,  $R_{gon}=R_{goff}=1,8\Omega$ ,  $V_{CE}=600V$ ,  $T_{vj}=125^\circ C$



Schaltverluste (typisch)  
Switching losses (typical)

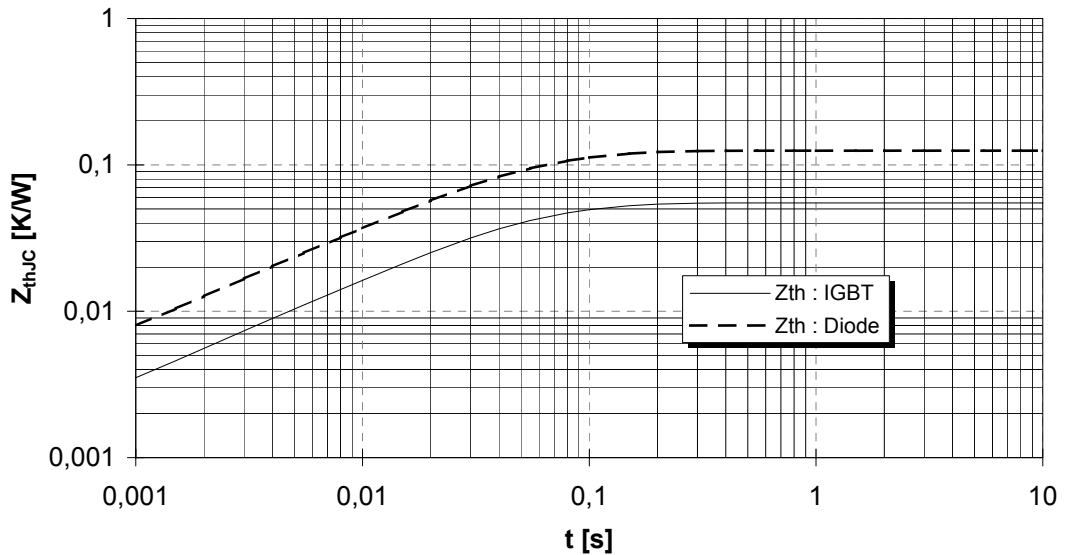
$E_{on} = f(R_G)$ ,  $E_{off} = f(R_G)$ ,  $E_{rec} = f(R_G)$   
 $V_{GE}=15V$ ,  $I_C=400A$ ,  $V_{CE}=600V$ ,  $T_{vj}=125^\circ C$





Transienter Wärmewiderstand  
Transient thermal impedance

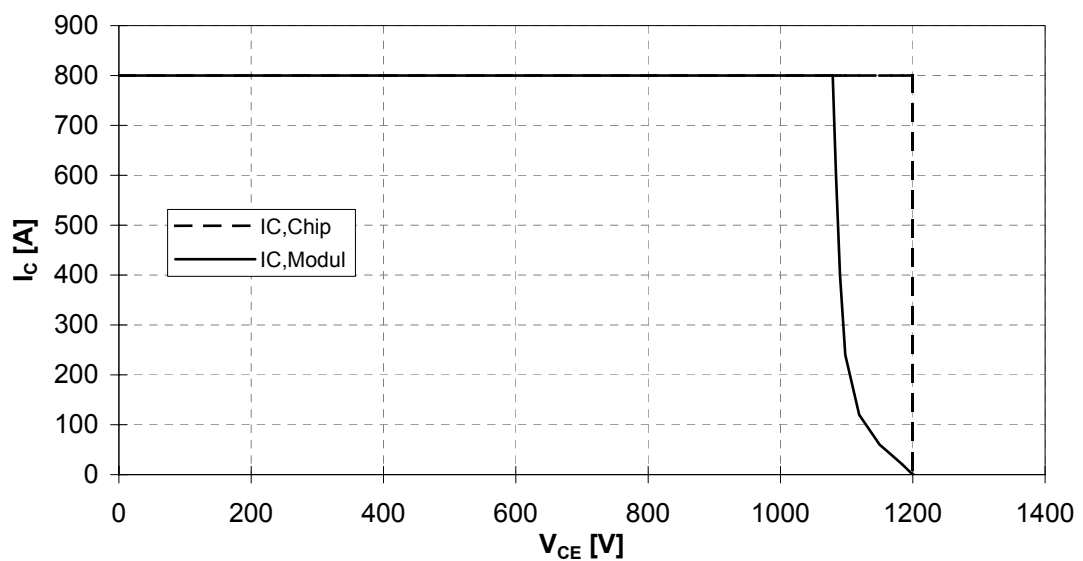
$$Z_{thJC} = f(t)$$

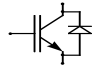


i	1	2	3	4
$r_i$ [K/kW] : IGBT	23,12	27,71	3,13	1,04
$\tau_i$ [s] : IGBT	6,499E-02	2,601E-02	2,364E-03	1,187E-05
$r_i$ [K/kW] : Diode	52,56	62,98	7,10	2,36
$\tau_i$ [s] : Diode	6,499E-02	2,601E-02	2,364E-03	1,187E-05

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

$$V_{GE}=15V, T_j=125^{\circ}C, R_G=1,8\Omega$$





Gehäusemaße / Schaltbild  
Package outline / Circuit diagram

