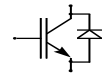


Technische Information / Technical Information

IGBT-Module
IGBT-Modules

FZ 400 R12 KS4

eupec



Vorläufige Daten
Preliminary data

Höchstzulässige Werte / Maximum rated values

Elektrische Eigenschaften / Electrical properties

Kollektor-Emitter-Sperrspannung collector-emitter voltage		V_{CES}	1200	V
Kollektor-Dauergleichstrom DC-collector current	$T_C = 70^\circ\text{C}$	$I_{C, \text{nom.}}$	400	A
	$T_C = 25^\circ\text{C}$	I_C	510	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	$T_C = 25^\circ\text{C}$, Transistor	P_{tot}	2500	W
Gate-Emitter-Spitzenspannung gate-emitter peak voltage		V_{GES}	+/- 20V	V
Dauergleichstrom DC forward current		I_F	400	A
Periodischer Spitzenstrom repetitive peak forw. current	$t_p = 1 \text{ ms}$	I_{FRM}	800	A
Grenzlastintegral der Diode I^2t - value, Diode	$V_R = 0\text{V}, t_p = 10\text{ms}, T_{vj} = 125^\circ\text{C}$	I^2t	65.000	A^2s
Isolations-Prüfspannung insulation test voltage	RMS, $f = 50 \text{ Hz}, t = 1 \text{ min.}$	V_{ISOL}	2.500	V

Charakteristische Werte / Characteristic values

Transistor / Transistor

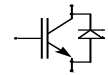
			min.	typ.	max.	
Kollektor-Emitter Sättigungsspannung collector-emitter saturation voltage	$I_C = 400\text{A}, V_{GE} = 15\text{V}, T_{vj} = 25^\circ\text{C}$	$V_{CE \text{ sat}}$	-	3,00	-	V
	$I_C = 400\text{A}, V_{GE} = 15\text{V}, T_{vj} = 125^\circ\text{C}$		-	3,60	-	V
Gate-Schwellenspannung gate threshold voltage	$I_C = 16 \text{ mA}, V_{CE} = V_{GE}, T_{vj} = 25^\circ\text{C}$	$V_{GE(th)}$	4,5	5,5	6,5	V
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}	-	26	-	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}	-	t.b.d.	-	nF
Gateladung gate charge	$V_{GE} = -15\text{V} \dots + 15\text{V}, V_{CE} = 600\text{V}$	Q_G	-	4,2	-	μC
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}	-	0,4	-	mA
	$V_{CE} = 1200\text{V}, V_{GE} = 0\text{V}, T_{vj} = 125^\circ\text{C}$		-	24	-	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

prepared by: R. Jörke

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approved by: Jens Thureau

revision: 1



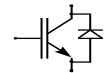
Vorläufige Daten Preliminary data

Charakteristische Werte / Characteristic values

Transistor / Transistor		min.	typ.	max.		
Einschaltverzögerungszeit (ind. Last) turn on delay time (inductive load)	$I_C = 400\text{ A}, V_{CC} = 600\text{ V}$	$t_{d,on}$	-	100	-	ns
	$V_{GE} = \pm 15\text{ V}, R_G = 2,2\ \Omega, T_{vj} = 25^\circ\text{C}$			125		ns
Anstiegszeit (induktive Last) rise time (inductive load)	$I_C = 400\text{ A}, V_{CC} = 600\text{ V}$	t_r	-	90	-	ns
	$V_{GE} = \pm 15\text{ V}, R_G = 2,2\ \Omega, T_{vj} = 25^\circ\text{C}$			100		ns
Abschaltverzögerungszeit (ind. Last) turn off delay time (inductive load)	$I_C = 400\text{ A}, V_{CC} = 600\text{ V}$	$t_{d,off}$	-	530	-	ns
	$V_{GE} = \pm 15\text{ V}, R_G = 2,2\ \Omega, T_{vj} = 25^\circ\text{C}$			590		ns
Fallzeit (induktive Last) fall time (inductive load)	$I_C = 400\text{ A}, V_{CC} = 600\text{ V}$	t_f	-	60	-	ns
	$V_{GE} = \pm 15\text{ V}, R_G = 2,2\ \Omega, T_{vj} = 25^\circ\text{C}$			70		ns
Einschaltverlustenergie pro Puls turn-on energy loss per pulse	$I_C = 400\text{ A}, V_{CC} = 600\text{ V}, V_{GE} = 15\text{ V}$ $R_G = 2,2\ \Omega, T_{vj} = 125^\circ\text{C}, L_S = 85\text{ nH}$	E_{on}	-	38	-	mWs
Abschaltverlustenergie pro Puls turn-off energy loss per pulse	$I_C = 400\text{ A}, V_{CC} = 600\text{ V}, V_{GE} = 15\text{ V}$ $R_G = 2,2\ \Omega, T_{vj} = 125^\circ\text{C}, L_S = 85\text{ nH}$	E_{off}	-	32	-	mWs
Kurzschlußverhalten SC Data	$t_P \leq 10\ \mu\text{sec}, V_{GE} \leq 15\text{ V}$ $T_{vj} \leq 125^\circ\text{C}, V_{CC} = 900\text{ V}, V_{CEmax} = V_{CES} - L_{sCE} \cdot di/dt$	I_{SC}	-	2600	-	A
Modulinduktivität stray inductance module		L_{sCE}	-	16	-	nH
Modul-Leitungswiderstand, Anschlüsse - Chip lead resistance, terminals - chip		R_{CC+EE}	-	0,4	-	mΩ

Charakteristische Werte / Characteristic values

Diode / Diode		min.	typ.	max.		
Durchlaßspannung forward voltage	$I_F = 400\text{ A}, V_{GE} = 0\text{ V}, T_{vj} = 25^\circ\text{C}$	V_F	-	2,00	-	V
	$I_F = 400\text{ A}, V_{GE} = 0\text{ V}, T_{vj} = 125^\circ\text{C}$			1,70		V
Rückstromspitze peak reverse recovery current	$I_F = 400\text{ A}, -di_F/dt = 4100\text{ A}/\mu\text{sec}$	I_{RM}	-	270	-	A
	$V_R = 600\text{ V}, V_{GE} = -10\text{ V}, T_{vj} = 25^\circ\text{C}$			450		A
Sperrverzögerungsladung recovered charge	$I_F = 400\text{ A}, -di_F/dt = 4100\text{ A}/\mu\text{sec}$	Q_r	-	30	-	μAs
	$V_R = 600\text{ V}, V_{GE} = -10\text{ V}, T_{vj} = 25^\circ\text{C}$			80		μAs
Abschaltenergie pro Puls reverse recovery energy	$I_F = 400\text{ A}, -di_F/dt = 4100\text{ A}/\mu\text{sec}$	E_{rec}	-	16	-	mWs
	$V_R = 600\text{ V}, V_{GE} = -10\text{ V}, T_{vj} = 25^\circ\text{C}$			38		mWs



Vorläufige Daten Preliminary data

Thermische Eigenschaften / Thermal properties

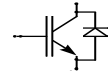
			min.	typ.	max.	
Innerer Wärmewiderstand thermal resistance, junction to case	Transistor / transistor, DC	R_{thJC}	-	-	0,050	K/W
	Diode/Diode, DC		-	-	0,085	K/W
Übergangs-Wärmewiderstand thermal resistance, case to heatsink	pro Modul / per module $\lambda_{Paste} = 1 \text{ W/m}^2\text{K} / \lambda_{grease} = 1 \text{ W/m}^2\text{K}$	R_{thCK}	-	0,010	-	K/W
Höchstzulässige Sperrschichttemperatur maximum junction temperature		T_{vj}	-	-	150	°C
Betriebstemperatur operation temperature		T_{op}	-40	-	125	°C
Lagertemperatur storage temperature		T_{stg}	-40	-	150	°C

Mechanische Eigenschaften / Mechanical properties

Gehäuse, siehe Anlage case, see appendix					
Material Modulgrundplatte material of module baseplate				Cu	
Innere Isolation internal insulation				Al ₂ O ₃	
Kriechstrecke creepage distance				20	mm
Luftstrecke clearance				11	mm
CTI comperative tracking index				225	
Anzugsdrehmoment f. mech. Befestigung mounting torque	Schraube / screw M5	M1		3,0 - 6,0	Nm
Anzugsdrehmoment f. elektr. Anschlüsse terminal connection torque	terminals M6	M2		2,5 - 5,0	Nm
	terminals M4			1,1 - 2,0	Nm
Gewicht weight		G		300	g

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

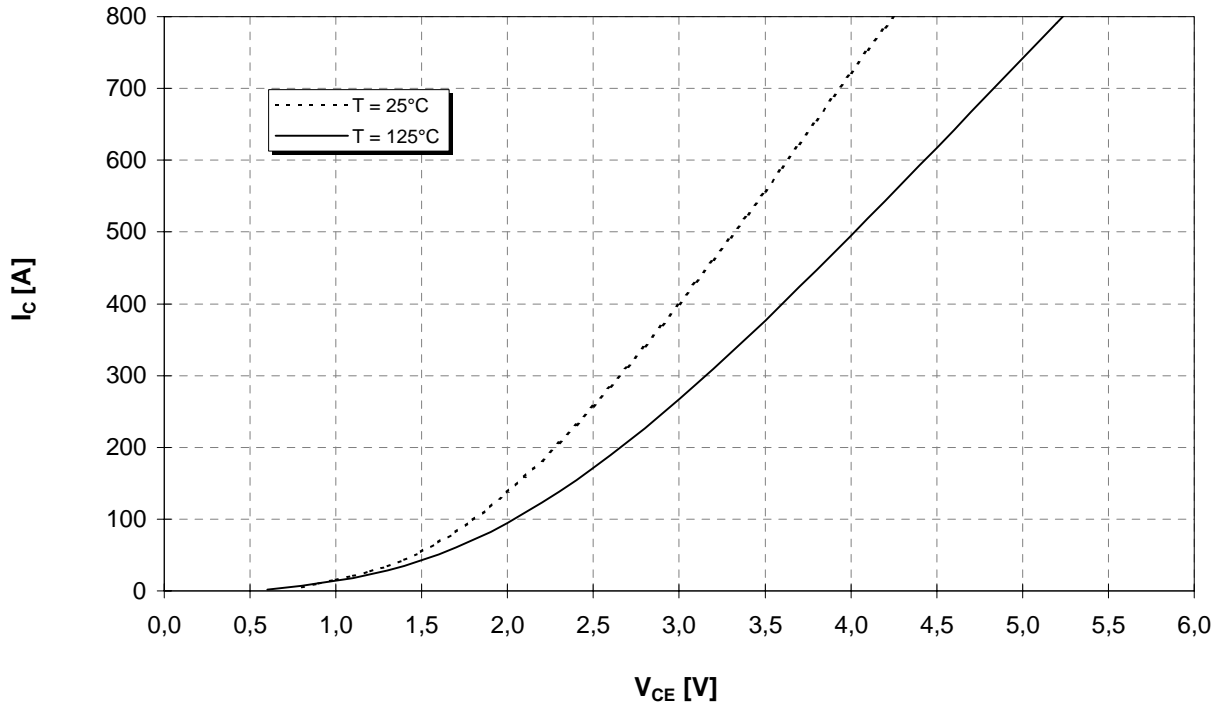
This technical information specifies semiconductor devices but promises no characteristics. It is valid in combination with the belonging technical notes.



Vorläufige Daten
Preliminary data

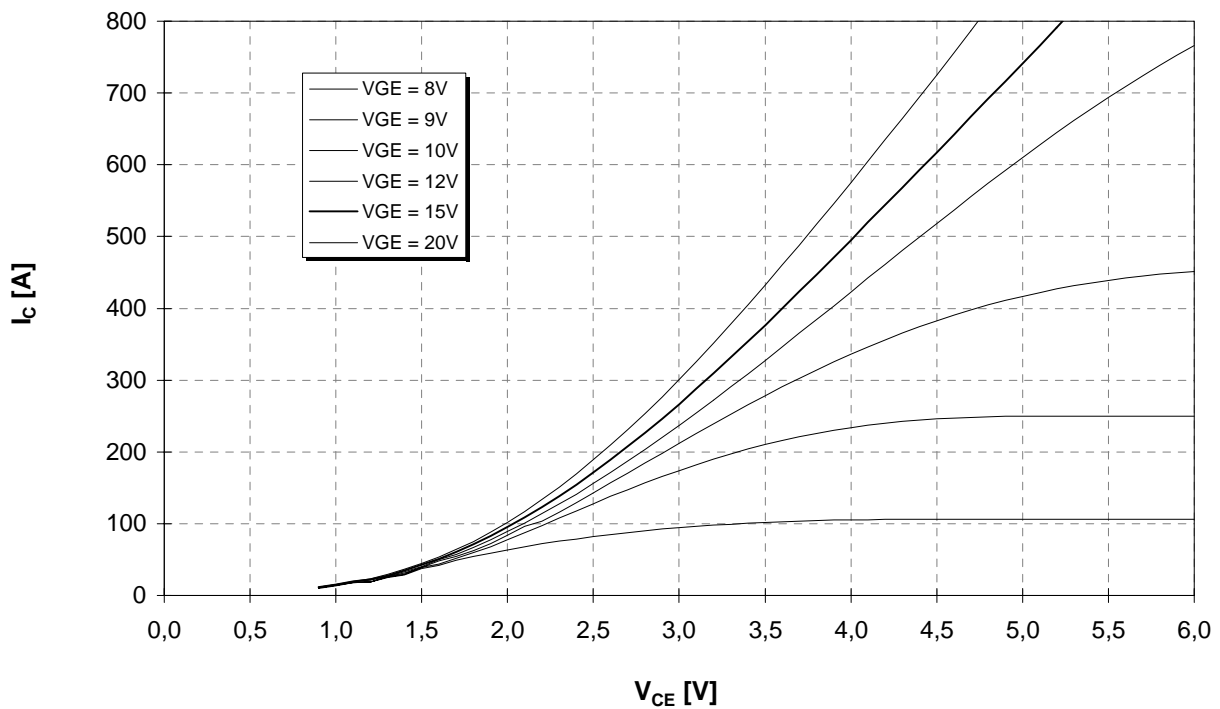
Ausgangskennlinie (typisch)
Output characteristic (typical)

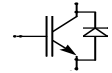
$I_C = f(V_{CE})$
 $V_{GE} = 15V$



Ausgangskennlinienfeld (typisch)
Output characteristic (typical)

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

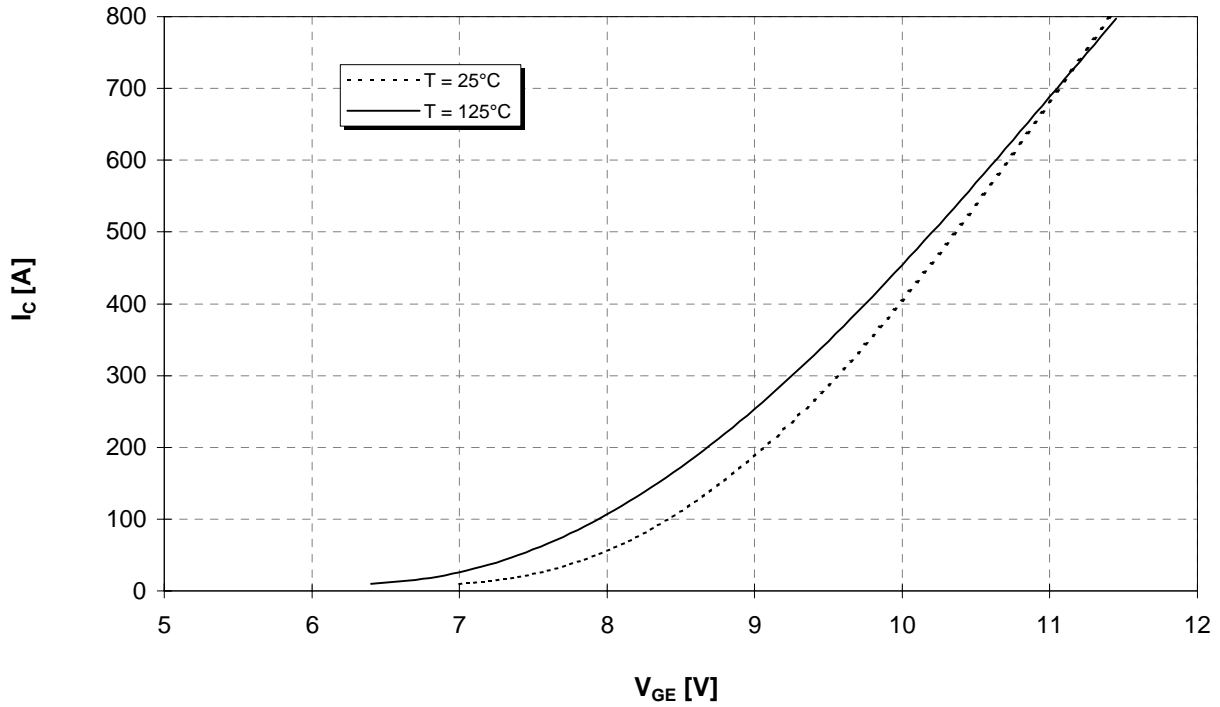




Vorläufige Daten
Preliminary data

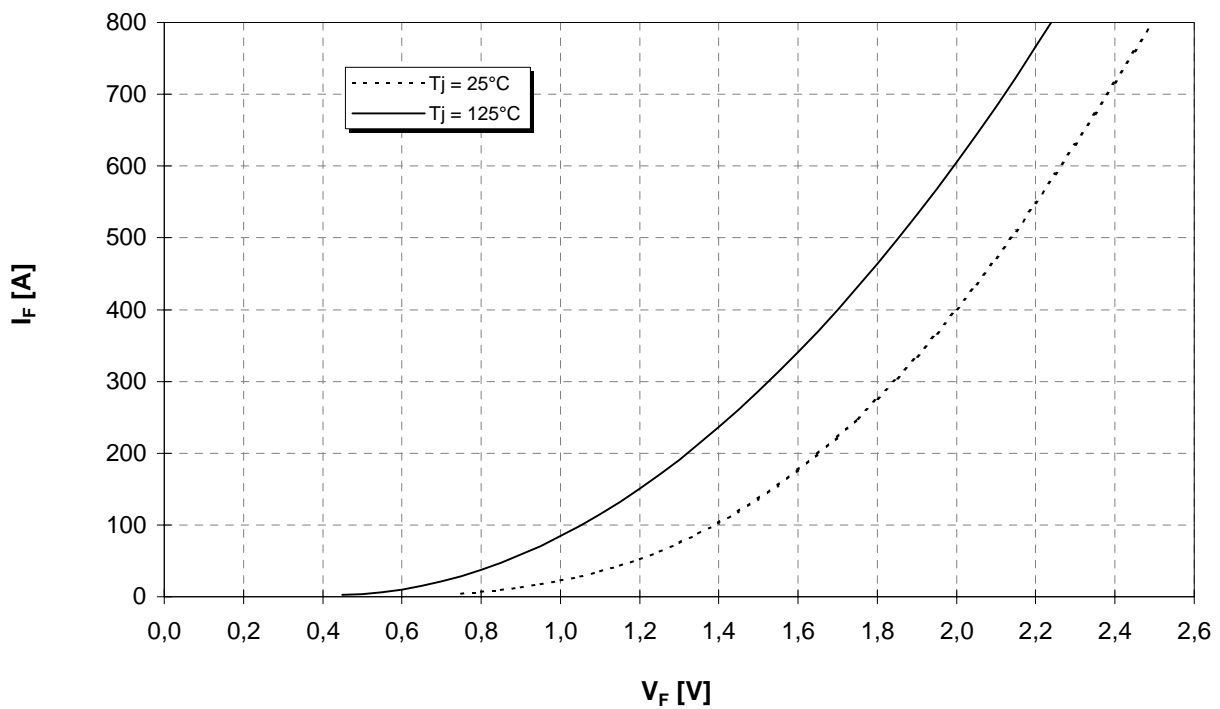
Übertragungscharakteristik (typisch)
Transfer characteristic (typical)

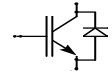
$I_C = f(V_{GE})$
 $V_{CE} = 20V$



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

$I_F = f(V_F)$



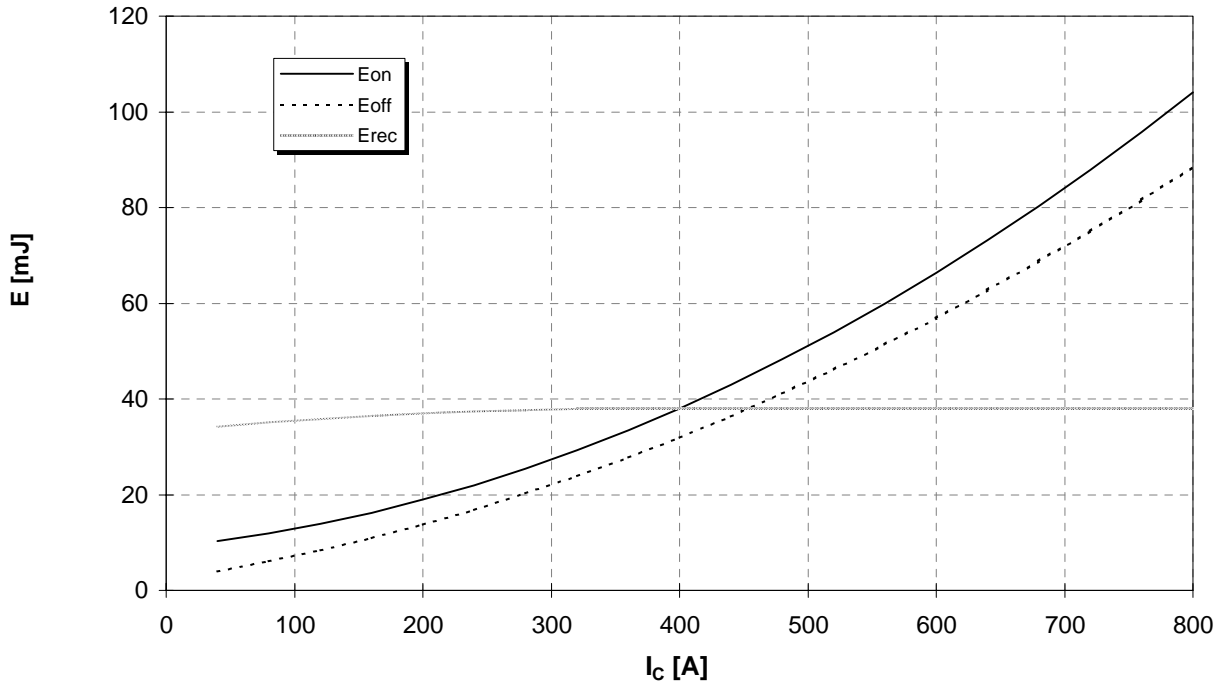


Vorläufige Daten
Preliminary data

Schaltverluste (typisch)
Switching losses (typical)

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

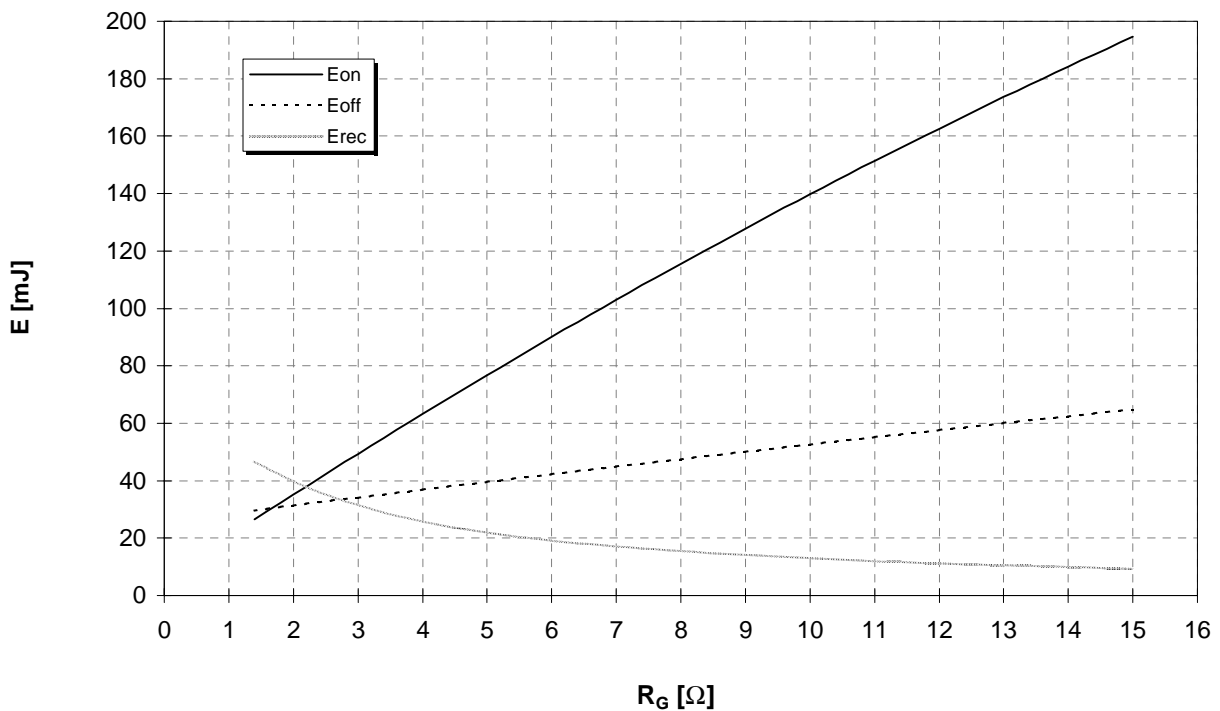
$$R_{G,on} = R_{G,off} = 2,2 \Omega, V_{CE} = 600V, T_j = 125^\circ C$$

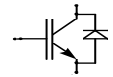


Schaltverluste (typisch)
Switching losses (typical)

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

$$I_C = 400 A, V_{CE} = 600V, T_j = 125^\circ C$$

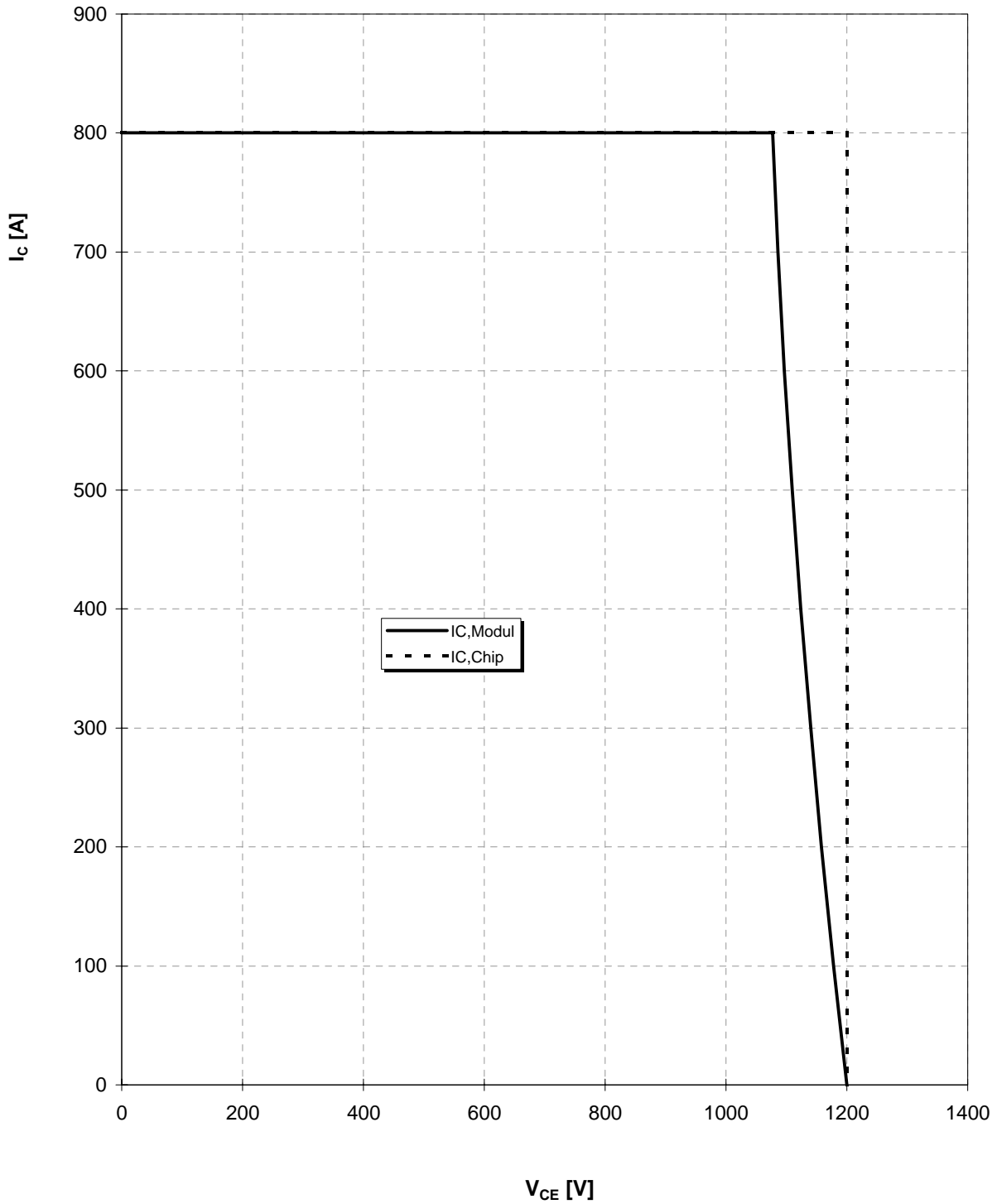


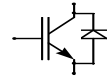


Vorläufige Daten
Preliminary data

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

$R_{G,off} = 2,2 \Omega$, $T_{vj} = 125^\circ\text{C}$

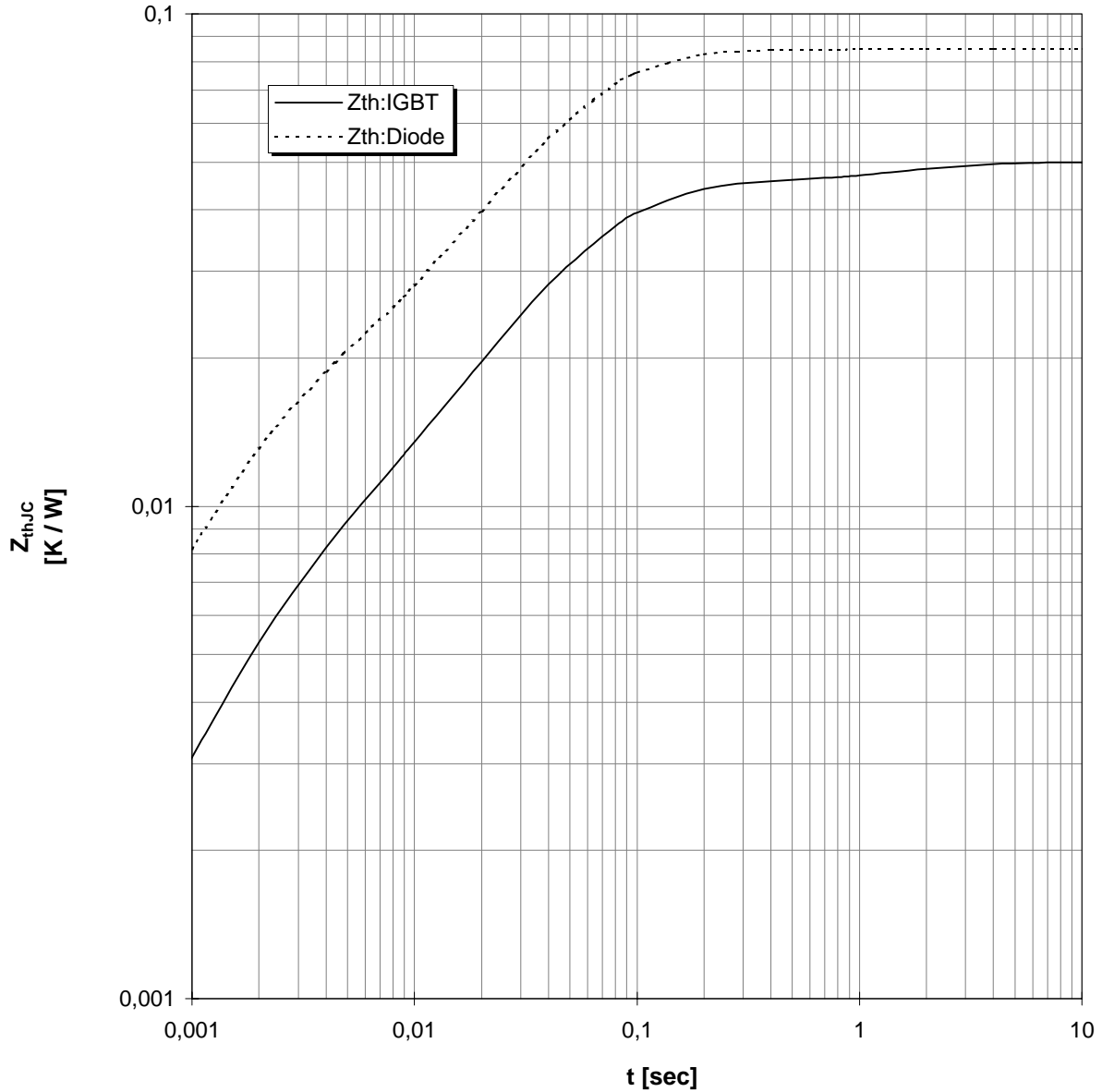




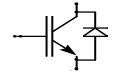
Vorläufige Daten
Preliminary data

Transienter Wärmewiderstand
Transient thermal impedance

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



i	1	2	3	4
r_i [K/kW] : IGBT	5,59	16,93	22,06	5,43
τ_i [sec] : IGBT	0,0020	0,0300	0,0660	1,6550
r_i [K/kW] : Diode	13,15	34,56	35,61	1,68
τ_i [sec] : Diode	0,0015	0,0327	0,0561	0,3872



Vorläufige Daten
Preliminary data

Gehäusemaße / Schaltbild
Package outline / Circuit diagram

