

**Höchstzulässige Werte / Maximum rated values****Elektrische Eigenschaften / Electrical properties**

Kollektor-Emitter-Sperrspannung collector-emitter voltage		V_{CES}	1200	V
Kollektor-Dauergleichstrom DC-collector current	$T_C = 80^\circ\text{C}$	$I_{C,nom.}$	400	A
	$T_C = 25^\circ\text{C}$	I_C	570	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}	3000	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	$V_R = 0V, t_p = 10\text{ms}, T_{vj} = 125^\circ\text{C}$	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	$I_C = 400\text{A}, V_{GE} = 15\text{V}, T_{vj} = 25^\circ\text{C}$	$V_{CE\text{ sat}}$	-	3,20	3,70	V
	$I_C = 400\text{A}, V_{GE} = 15\text{V}, T_{vj} = 125^\circ\text{C}$		-	3,85	-	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}	-	1,7	-	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}	-	-	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

prepared by: A.Schulz

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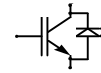
revision: 3

Technische Information / Technical Information

IGBT-Module
IGBT-Modules

F4-400R12KS4 B2

eupec



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
	$V_{GE} = \pm 15\text{ V}, R_G = 2,2\ \Omega, T_{vj} = 25^\circ\text{C}$					
	$V_{GE} = \pm 15\text{ V}, R_G = 2,2\ \Omega, T_{vj} = 125^\circ\text{C}$					
Anstiegszeit (induktive Last) rise time (inductive load)	$I_C = 400\text{ A}, V_{CC} = 600\text{ V}$	t_r	-	90	-	ns
	$V_{GE} = \pm 15\text{ V}, R_G = 2,2\ \Omega, T_{vj} = 25^\circ\text{C}$					
	$V_{GE} = \pm 15\text{ V}, R_G = 2,2\ \Omega, T_{vj} = 125^\circ\text{C}$					
Abschaltverzögerungszeit (ind. Last) turn off delay time (inductive load)	$I_C = 400\text{ A}, V_{CC} = 600\text{ V}$	$t_{d,off}$	-	530	-	ns
	$V_{GE} = \pm 15\text{ V}, R_G = 2,2\ \Omega, T_{vj} = 25^\circ\text{C}$					
	$V_{GE} = \pm 15\text{ V}, R_G = 2,2\ \Omega, T_{vj} = 125^\circ\text{C}$					
Fallzeit (induktive Last) fall time (inductive load)	$I_C = 400\text{ A}, V_{CC} = 600\text{ V}$	t_f	-	60	-	ns
	$V_{GE} = \pm 15\text{ V}, R_G = 2,2\ \Omega, T_{vj} = 25^\circ\text{C}$					
	$V_{GE} = \pm 15\text{ V}, R_G = 2,2\ \Omega, T_{vj} = 125^\circ\text{C}$					
Einschaltverlustenergie pro Puls turn-on energy loss per pulse	$I_C = 400\text{ A}, V_{CC} = 600\text{ V}, V_{GE} = 15\text{ V}$	E_{on}	-	38	-	mWs
	$R_G = 2,2\ \Omega, T_{vj} = 125^\circ\text{C}, L_S = 85\text{ nH}$					
Abschaltverlustenergie pro Puls turn-off energy loss per pulse	$I_C = 400\text{ A}, V_{CC} = 600\text{ V}, V_{GE} = 15\text{ V}$	E_{off}	-	29	-	mWs
	$R_G = 2,2\ \Omega, T_{vj} = 125^\circ\text{C}, L_S = 85\text{ nH}$					
Kurzschlußverhalten SC Data	$t_p \leq 10\ \mu\text{sec}, V_{GE} \leq 15\text{ V}$	I_{SC}	-	2600	-	A
	$T_{vj} \leq 125^\circ\text{C}, V_{CC} = 900\text{ V}, V_{CEmax} = V_{CES} - L_{SCE} \cdot di/dt$					
Modulinduktivität stray inductance module		L_{SCE}	-	54	-	nH
Modul-Leitungswiderstand, Anschlüsse - Chip lead resistance, terminals - chip		R_{CC+EE}	-	0,2	-	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	2,40	V
	$I_F = 400\text{ A}, V_{GE} = 0\text{ V}, T_{vj} = 125^\circ\text{C}$					
Rückstromspitze peak reverse recovery current	$I_F = 400\text{ A}, -di_F/dt = 4100\text{ A}/\mu\text{sec}$	I_{RM}	-	270	-	A
	$V_R = 600\text{ V}, V_{GE} = -10\text{ V}, T_{vj} = 25^\circ\text{C}$					
	$V_R = 600\text{ V}, V_{GE} = -10\text{ V}, T_{vj} = 125^\circ\text{C}$					
Sperrverzögerungsladung recovered charge	$I_F = 400\text{ A}, -di_F/dt = 4100\text{ A}/\mu\text{sec}$	Q_r	-	30	-	μAs
	$V_R = 600\text{ V}, V_{GE} = -10\text{ V}, T_{vj} = 25^\circ\text{C}$					
	$V_R = 600\text{ V}, V_{GE} = -10\text{ V}, T_{vj} = 125^\circ\text{C}$					
Abschaltenergie pro Puls reverse recovery energy	$I_F = 400\text{ A}, -di_F/dt = 4100\text{ A}/\mu\text{sec}$	E_{rec}	-	16	-	mWs
	$V_R = 600\text{ V}, V_{GE} = -10\text{ V}, T_{vj} = 25^\circ\text{C}$					
	$V_R = 600\text{ V}, V_{GE} = -10\text{ V}, T_{vj} = 125^\circ\text{C}$					

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Thermische Eigenschaften / Thermal properties

			min.	typ.	max.	
Innerer Wärmewiderstand thermal resistance, junction to case	Transistor / transistor, DC, pro Modul / per module	R_{thJC}	-	-	10,5	K/kW
	Transistor / transistor, DC, pro Zweig / per arm		-	-	42,0	K/kW
	Diode / Diode, DC, pro Modul / per module		-	-	17,5	K/kW
	Diode / Diode, DC, pro Zweig / per arm		-	-	70,0	K/kW
Übergangs-Wärmewiderstand thermal resistance, case to heatsink	pro Modul / per module	R_{thCK}	-	8,0	-	K/kW
	pro Zweig / per arm		-	32,0	-	K/kW
	$\lambda_{Paste} = 1 \text{ W/m}^2\text{K} / \lambda_{grease} = 1 \text{ W/m}^2\text{K}$					
Höchstzulässige Sperrschichttemperatur maximum junction temperature		$T_{vj\ max}$	-	-	150	°C
Betriebstemperatur operation temperature		$T_{vj\ op}$	-40	-	125	°C
Lagertemperatur storage temperature		T_{stg}	-40	-	125	°C

Mechanische Eigenschaften / Mechanical properties

Gehäuse, siehe Anlage case, see appendix					
Material Modulgrundplatte material of module baseplate			AlSiC		
Innere Isolation internal insulation			AlN		
Kriechstrecke creepage distance			12		mm
Luftstrecke clearance			12 ¹⁾		mm
CTI comperative tracking index			> 400		
Anzugsdrehmoment f. mech. Befestigung mounting torque	Schraube / screw M6	M1	4,25	5,75	Nm
Anzugsdrehmoment f. elektr. Anschlüsse terminal connection torque	terminals M6	M2	5	6	Nm Nm
Gewicht weight		G	1500		g

¹⁾ Luftstrecke nur gültig bei Verwendung des eupec-Steckergehäuses / Clearance only valid with usage the eupec terminal housing

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

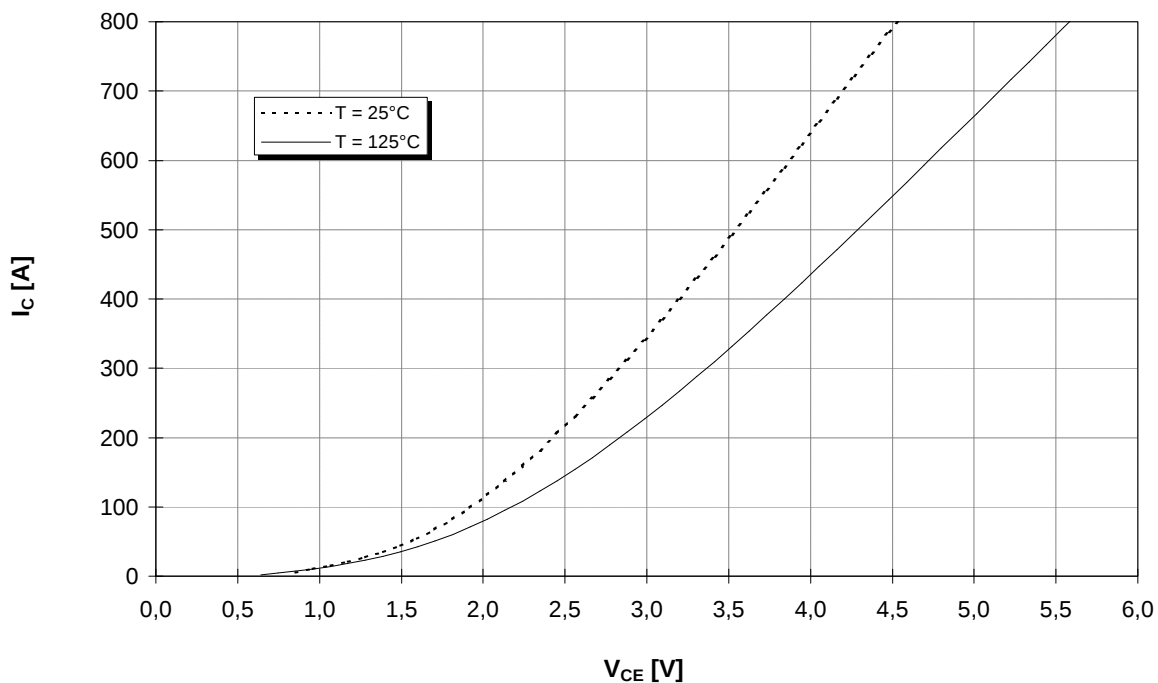
This technical information specifies semiconductor devices but promises no characteristics. It is
valid in combination with the belonging technical notes.



Ausgangskennlinie (typisch)
Output characteristic (typical)

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

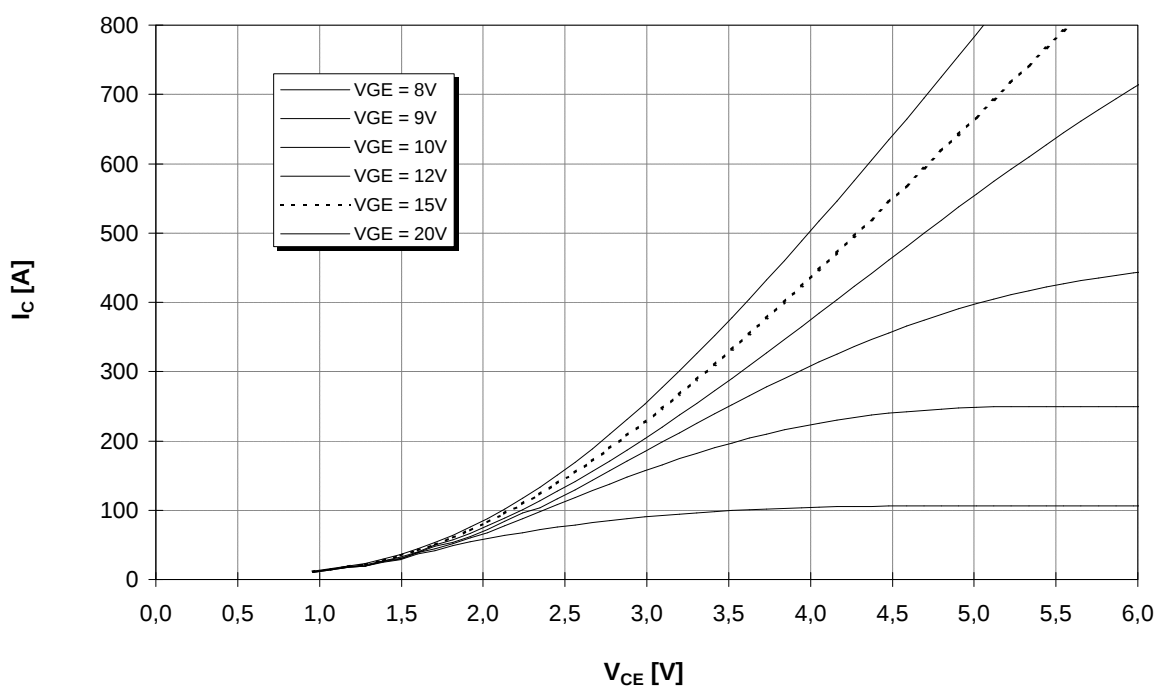
$V_{GE} = 15V$



Ausgangskennlinienfeld (typisch)
Output characteristic (typical)

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

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

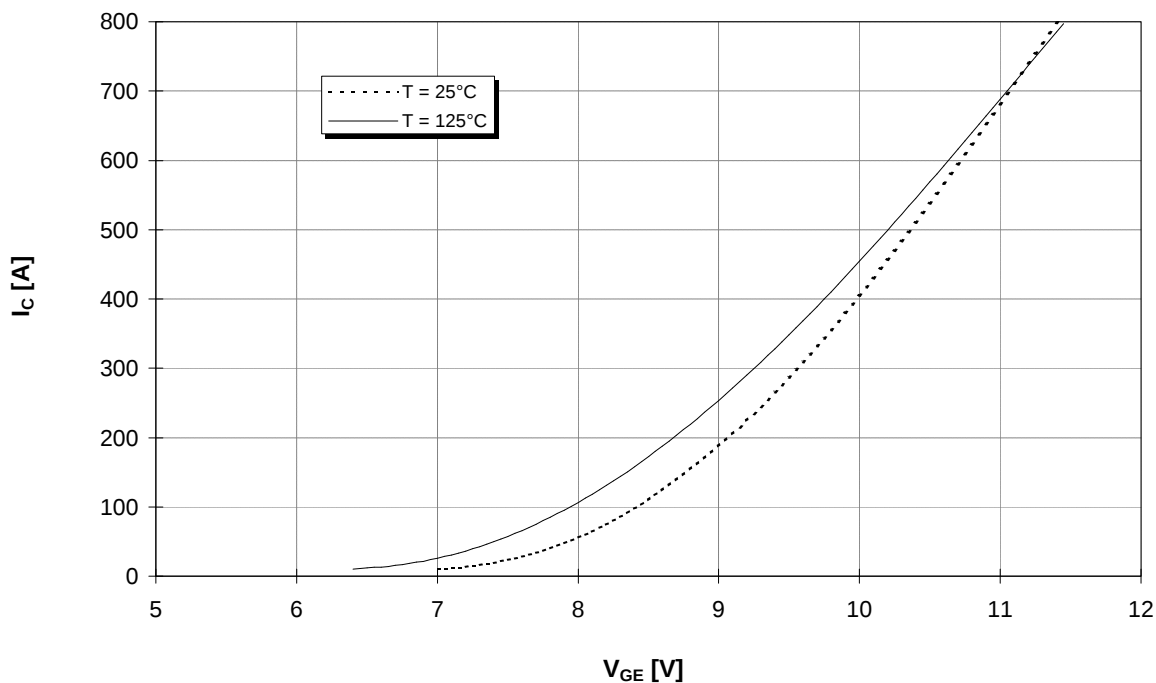




Übertragungscharakteristik (typisch)
Transfer characteristic (typical)

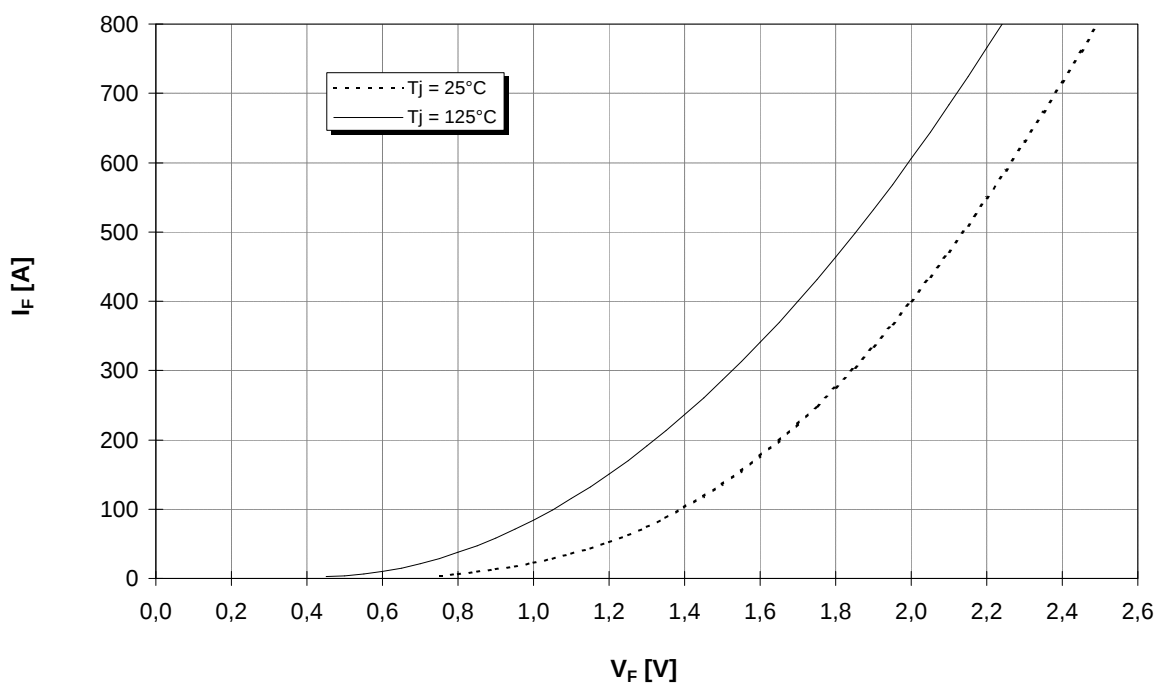
$$I_C = f(V_{GE})$$

$$V_{CE} = 20V$$



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

$$I_F = f(V_F)$$

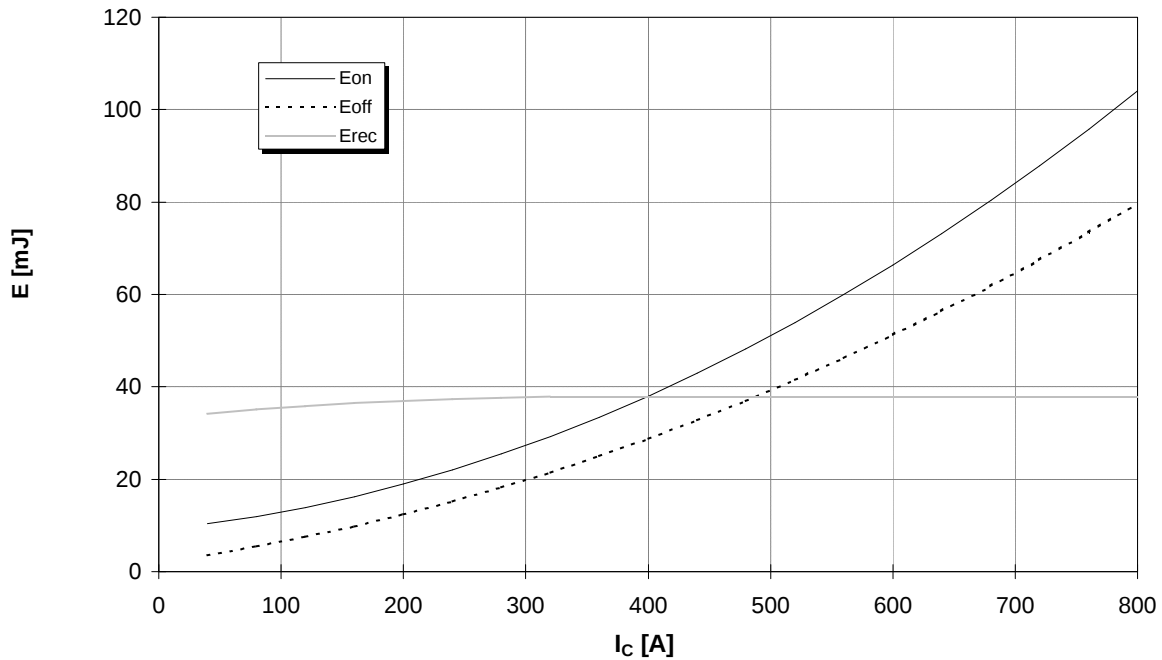




Schaltverluste (typisch)
Switching losses (typical)

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

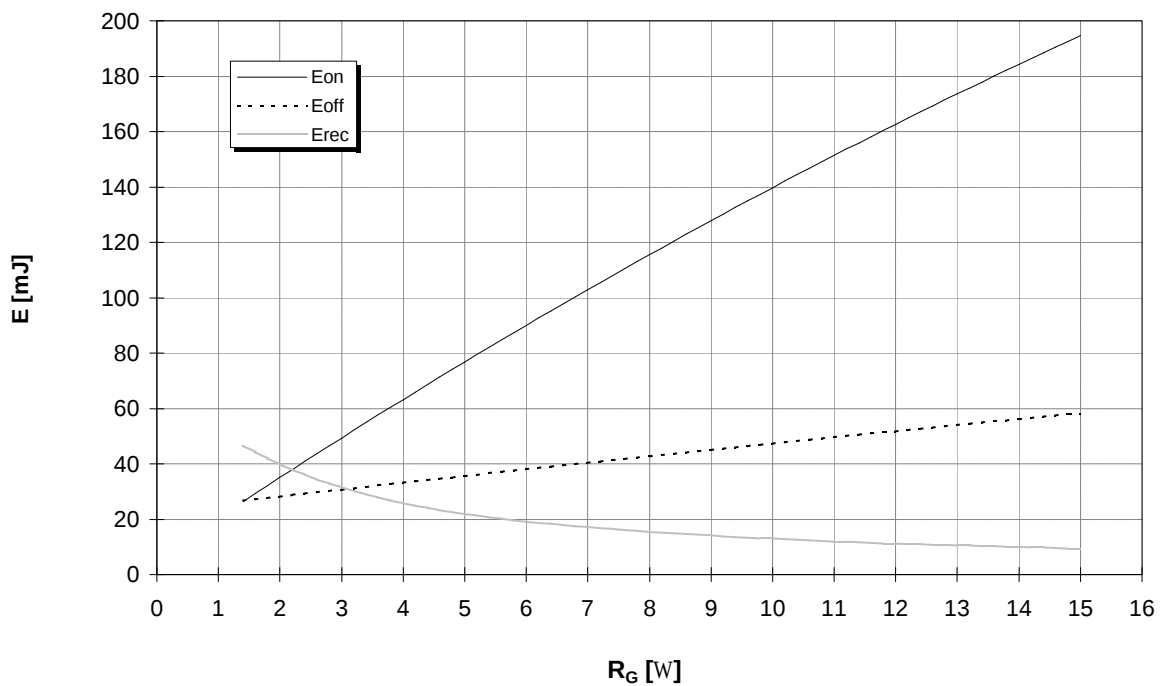
$$R_{G,on} = R_{G,off} = 2,2 \text{ W}, V_{CE} = 600\text{V}, T_J = 125^\circ\text{C}$$

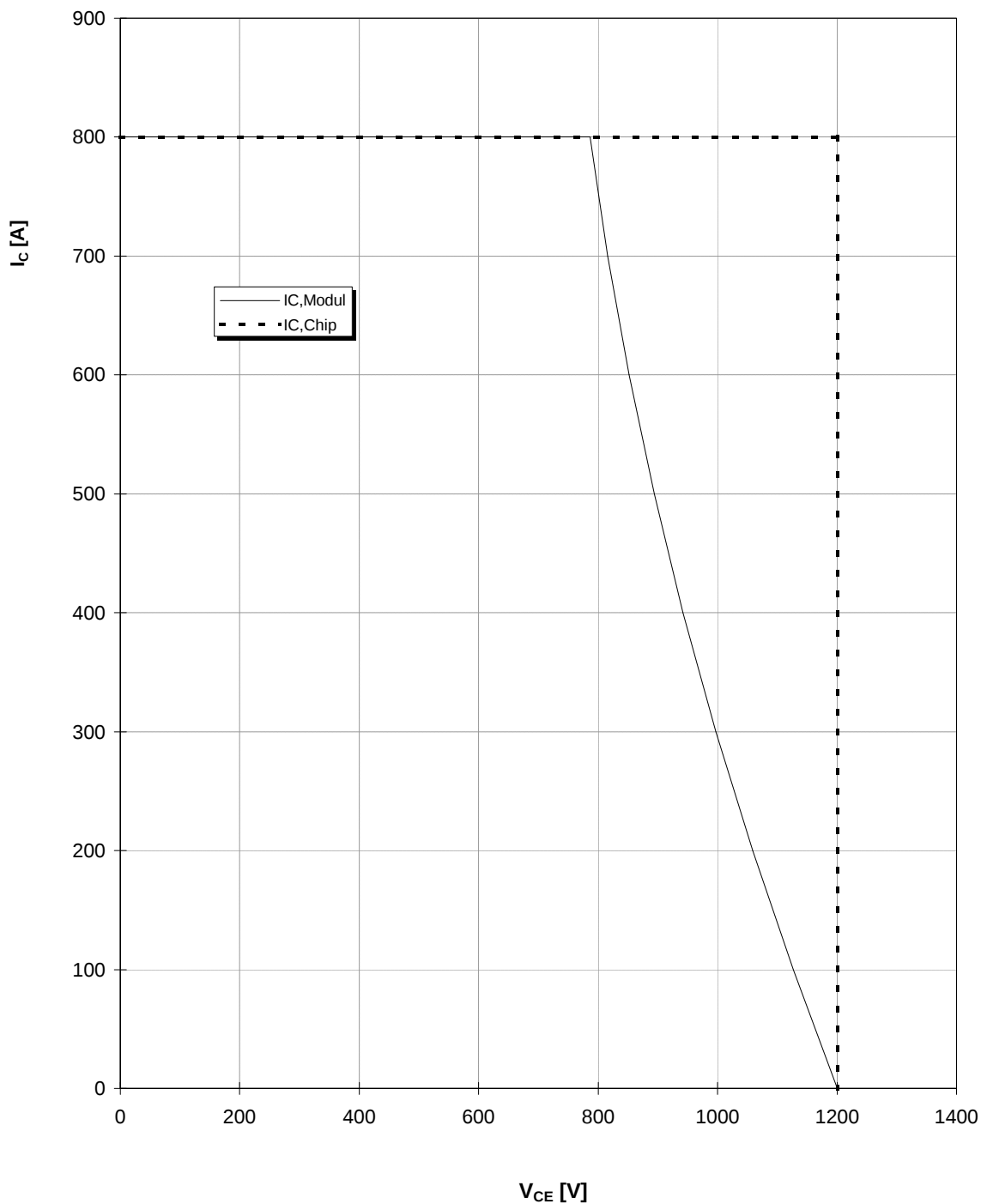


Schaltverluste (typisch)
Switching losses (typical)

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

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

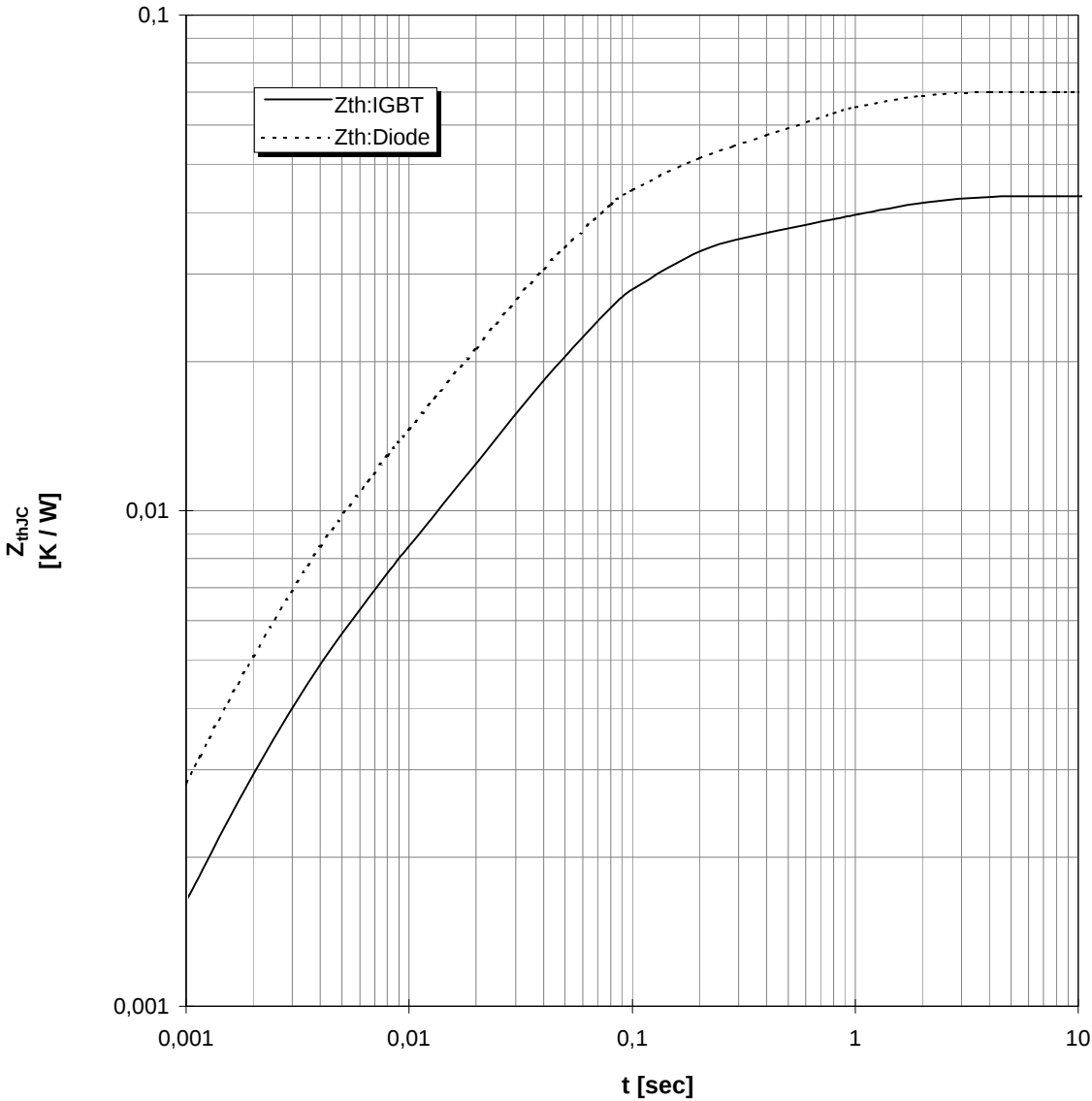


**Sicherer Arbeitsbereich IGBT (RBSOA)**
Reverse bias safe operation area IGBT (RBSOA) $R_{G,off} = 2,2 \text{ W}$, $T_{vj} = 125^\circ\text{C}$ 



Transienter Wärmewiderstand
Transient thermal impedance

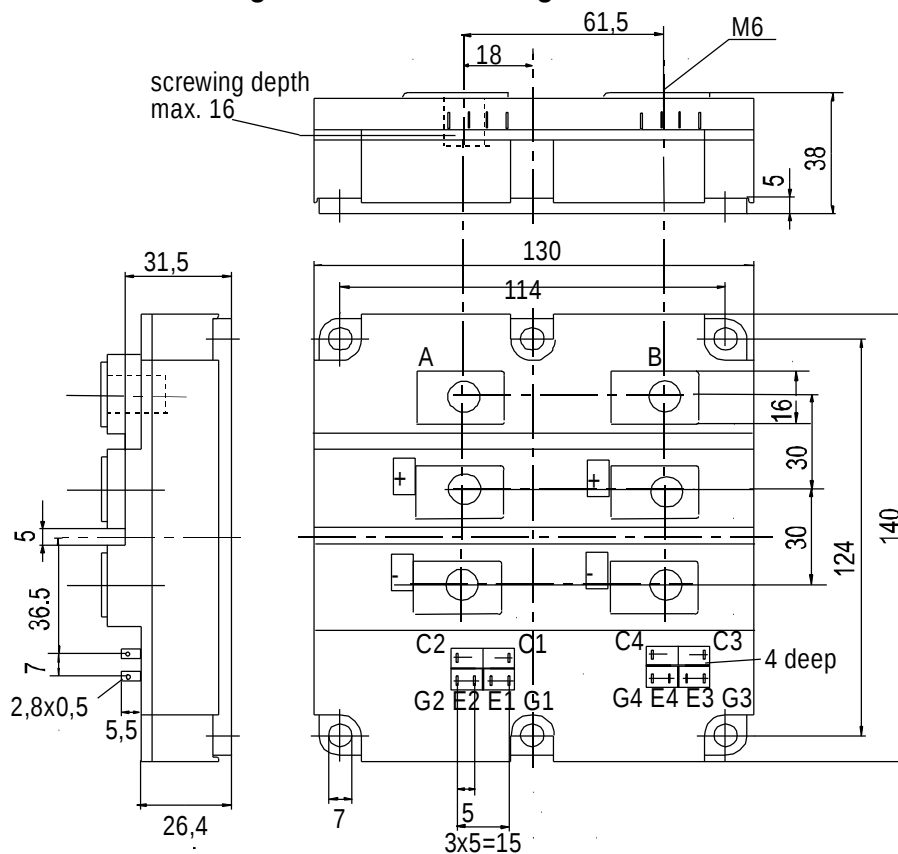
$Z_{thJC} = f(t)$



i	1	2	3	4
r_i [K/kW] : IGBT	4,03	19,86	8,40	9,71
τ_i [sec] : IGBT	0,0030	0,0500	0,1000	0,9500
r_i [K/kW] : Diode	6,90	37,51	12,81	12,79
τ_i [sec] : Diode	0,0030	0,0450	0,4500	0,7500



Gehäusemaße / Schaltbild
Package outline / Circuit diagram



IH5

external connection
(to be done)

