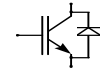


Technische Information / Technical Information

IGBT-Module
IGBT-Modules

FZ 1200 R 33 KL2

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Höchstzulässige Werte / Maximum rated values

Elektrische Eigenschaften / Electrical properties

Kollektor-Emitter-Sperrspannung collector-emitter voltage	$T_J = 25^\circ\text{C}$ $T_J = -25^\circ\text{C}$	V_{CES}	3300 3300	V
Kollektor-Dauerstrom DC-collector current	$T_C = 80^\circ\text{C}$ $T_C = 25^\circ\text{C}$	$I_{C,nom.}$ I_C	1200 2300	A A
Periodischer Kollektor Spitzenstrom repetitive peak collector current	$t_p = 1 \text{ ms}, T_C = 80^\circ\text{C}$	I_{CRM}	2400	A
Gesamt-Verlustleistung total power dissipation	$T_C = 25^\circ\text{C}$, Transistor	P_{tot}	14,7	kW
Gate-Emitter-Spitzenspannung gate-emitter peak voltage		V_{GES}	+/- 20V	V
Dauerstrom DC forward current		I_F	1200	A
Periodischer Spitzenstrom repetitive peak forw. current	$t_p = 1 \text{ ms}$	I_{FRM}	2400	A
Grenzlastintegral der Diode I^2t - value, Diode	$V_R = 0V, t_p = 10\text{ms}, T_{vj} = 125^\circ\text{C}$	I^2t	440.000	A^2s
Spitzenverlustleistung der Diode maximum power dissipation diode	$T_J = 125^\circ\text{C}$	P_{RQM}	1.500	kW
Isolations-Prüfspannung insulation test voltage	RMS, $f = 50 \text{ Hz}, t = 1 \text{ min.}$	V_{ISOL}	6.000	V
Teilentladungs-Aussetzspannung partial discharge extinction voltage	RMS, $f = 50 \text{ Hz}, Q_{PD} \leq 10 \text{ pC}$ (acc. to IEC 1287)	V_{ISOL}	2.600	V

Charakteristische Werte / Characteristic values

Transistor / Transistor

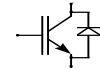
			min.	typ.	max.	
Kollektor-Emitter Sättigungsspannung collector-emitter saturation voltage	$I_C = 1200\text{A}, V_{GE} = 15\text{V}, T_{vj} = 25^\circ\text{C}$	$V_{CE \text{ sat}}$	-	3,00	3,65	V
	$I_C = 1200\text{A}, V_{GE} = 15\text{V}, T_{vj} = 125^\circ\text{C}$		-	3,70	4,45	V
Gate-Schwellenspannung 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 input capacitance	$f = 1\text{MHz}, T_{vj} = 25^\circ\text{C}, V_{CE} = 25\text{V}, V_{GE} = 0\text{V}$	C_{ies}	-	145	-	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}	-	8	-	nF
Gateladung gate charge	$V_{GE} = -15\text{V} \dots +15\text{V}, V_{CE} = 1800\text{V}$	Q_G	-	22	-	μC
Kollektor-Emitter Reststrom 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 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: J. Biermann

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approved by: Christoh Lübke; 2002-04-30

revision: 3



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Charakteristische Werte / Characteristic values

Transistor / Transistor

min. typ. max.

			min.	typ.	max.	
Einschaltverzögerungszeit (ind. Last) turn on delay time (inductive load)	$I_C = 1200\text{ A}, V_{CC} = 1800\text{ V}$	$t_{d,on}$	-	700		ns
	$V_{GE} = \pm 15\text{ V}, R_G = 2,7\Omega, C_{GE} = 330\text{ nF}, T_{vj} = 25^\circ\text{ C}$					
	$V_{GE} = \pm 15\text{ V}, R_G = 2,7\Omega, C_{GE} = 330\text{ nF}, T_{vj} = 125^\circ\text{ C}$					
Anstiegszeit (induktive Last) rise time (inductive load)	$I_C = 1200\text{ A}, V_{CC} = 1800\text{ V}$	t_r	-	450		ns
	$V_{GE} = \pm 15\text{ V}, R_G = 2,7\Omega, C_{GE} = 330\text{ nF}, T_{vj} = 25^\circ\text{ C}$					
	$V_{GE} = \pm 15\text{ V}, R_G = 2,7\Omega, C_{GE} = 330\text{ nF}, T_{vj} = 125^\circ\text{ C}$					
Abschaltverzögerungszeit (ind. Last) turn off delay time (inductive load)	$I_C = 1200\text{ A}, V_{CC} = 1800\text{ V}$	$t_{d,off}$	-	2500	-	ns
	$V_{GE} = \pm 15\text{ V}, R_G = 2,7\Omega, C_{GE} = 330\text{ nF}, T_{vj} = 25^\circ\text{ C}$					
	$V_{GE} = \pm 15\text{ V}, R_G = 2,7\Omega, C_{GE} = 330\text{ nF}, T_{vj} = 125^\circ\text{ C}$					
Fallzeit (induktive Last) fall time (inductive load)	$I_C = 1200\text{ A}, V_{CC} = 1800\text{ V}$	t_f	-	220	-	ns
	$V_{GE} = \pm 15\text{ V}, R_G = 2,7\Omega, C_{GE} = 330\text{ nF}, T_{vj} = 25^\circ\text{ C}$					
	$V_{GE} = \pm 15\text{ V}, R_G = 2,7\Omega, C_{GE} = 330\text{ nF}, T_{vj} = 125^\circ\text{ C}$					
Einschaltverlustenergie pro Puls turn-on energy loss per pulse	$I_C = 1200\text{ A}, V_{CC} = 1800\text{ V}, V_{GE} = 15\text{ V}$ $R_G = 1,2\Omega, C_{GE} = 330\text{ nF}, T_{vj} = 125^\circ\text{ C}, L_S = 40\text{ nH}$	E_{on}	-	2700	-	mWs
Abschaltverlustenergie pro Puls turn-off energy loss per pulse	$I_C = 1200\text{ A}, V_{CC} = 1800\text{ V}, V_{GE} = 15\text{ V}$ $R_G = 2,7\Omega, C_{GE} = 330\text{ nF}, T_{vj} = 125^\circ\text{ C}, L_S = 40\text{ nH}$	E_{off}	-	1590	-	mWs
Kurzschlußverhalten SC Data	$t_P \leq 10\mu\text{sec}, V_{GE} \leq 15\text{ V}$	I_{SC}	-	5200	-	A
	$T_{vj} \leq 125^\circ\text{ C}, V_{CC} = 2500\text{ V}, V_{CEmax} = V_{CES} - L_{sCE} \cdot di/dt$					
Modulinduktivität stray inductance module		L_{sCE}	-	10	-	nH
Modul-Leitungswiderstand, Anschlüsse - Chip lead resistance, terminals - chip	$T = 25^\circ\text{ C}$	R_{CC+EE}	-	0,12	-	mΩ

Charakteristische Werte / Characteristic values

Diode / Diode

min. typ. max.

			min.	typ.	max.	
Durchlaßspannung forward voltage	$I_F = 1200\text{ A}, V_{GE} = 0\text{ V}, T_{vj} = 25^\circ\text{ C}$	V_F	-	2,60	3,35	V
	$I_F = 1200\text{ A}, V_{GE} = 0\text{ V}, T_{vj} = 125^\circ\text{ C}$					
Rückstromspitze peak reverse recovery current	$I_F = 1200\text{ A}, -di_F/dt = 4900\text{ A}/\mu\text{sec}$	I_{RM}	-	1180	-	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 recovered charge	$I_F = 1200\text{ A}, -di_F/dt = 4900\text{ A}/\mu\text{sec}$	Q_r	-	650	-	μAs
	$V_R = 1800\text{ V}, V_{GE} = -10\text{ V}, T_{vj} = 25^\circ\text{ C}$					
	$V_R = 1800\text{ V}, V_{GE} = -10\text{ V}, T_{vj} = 125^\circ\text{ C}$					
Abschaltenergie pro Puls reverse recovery energy	$I_F = 1200\text{ A}, -di_F/dt = 4900\text{ A}/\mu\text{sec}$	E_{rec}	-	430	-	mWs
	$V_R = 1800\text{ V}, V_{GE} = -10\text{ V}, T_{vj} = 25^\circ\text{ C}$					
	$V_R = 1800\text{ V}, V_{GE} = -10\text{ V}, T_{vj} = 125^\circ\text{ C}$					

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Thermische Eigenschaften / Thermal properties

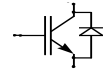
			min.	typ.	max.	
Innerer Wärmewiderstand thermal resistance, junction to case	Transistor / transistor, DC	R_{thJC}	-	-	0,0085	K/W
	Diode/Diode, DC		-	-	0,0170	K/W
Übergangs-Wärmewiderstand thermal resistance, case to heatsink	pro Modul / per module $\lambda_{paste} = 1 \text{ W/m}^2\text{K} / \lambda_{grease} = 1 \text{ W/m}^2\text{K}$	R_{thCK}	-	0,006	-	K/W
Höchstzulässige Sperrschichttemperatur maximum junction temperature		T_{vj}	-	-	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				AISiC	
Innere Isolation internal insulation				AlN	
Kriechstrecke creepage distance				32,2	mm
Luftstrecke clearance				19,1	mm
CTI comperative tracking index				> 400	
Anzugsdrehmoment f. mech. Befestigung mounting torque		M1		5	Nm
Anzugsdrehmoment f. elektr. Anschlüsse terminal connection torque		M2		2	Nm
	terminals M4 terminals M8			8 .. 10	Nm
Gewicht weight		G		1500	g

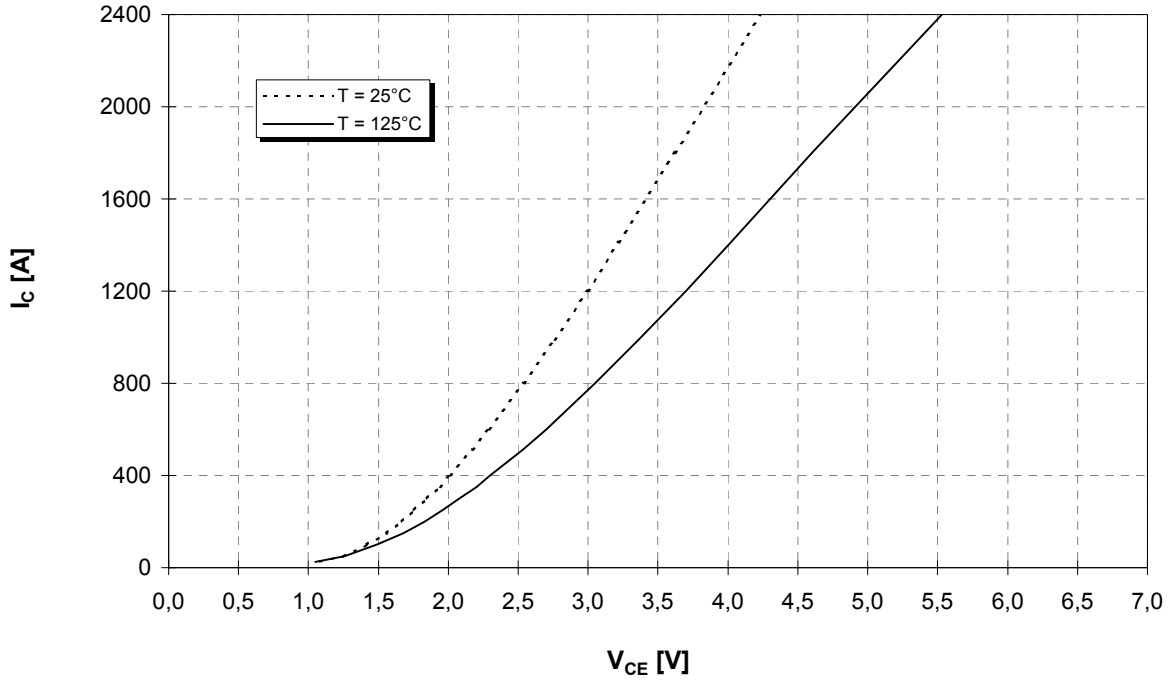
Mit dieser technischen Information werden Halbleiterbauelemente spezifiziert, jedoch keine Eigenschaften zugesichert.
Sie gilt in Verbindung mit den zugehörigen Technischen Erläuterungen.

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



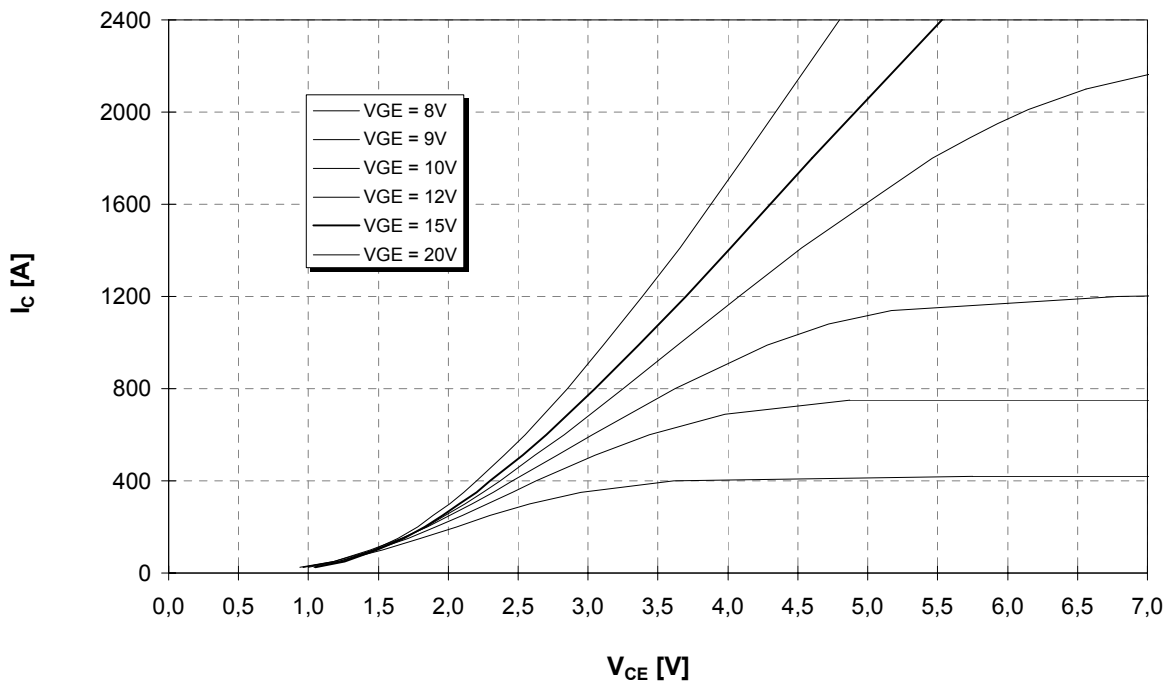
Ausgangskennlinie (typisch)
Output characteristic (typical)

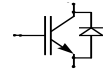
$I_c = f(V_{CE})$
 $V_{GE} = 15V$



Ausgangskennlinienfeld (typisch)
Output characteristic (typical)

$I_c = f(V_{CE})$
 $T_{vj} = 125°C$

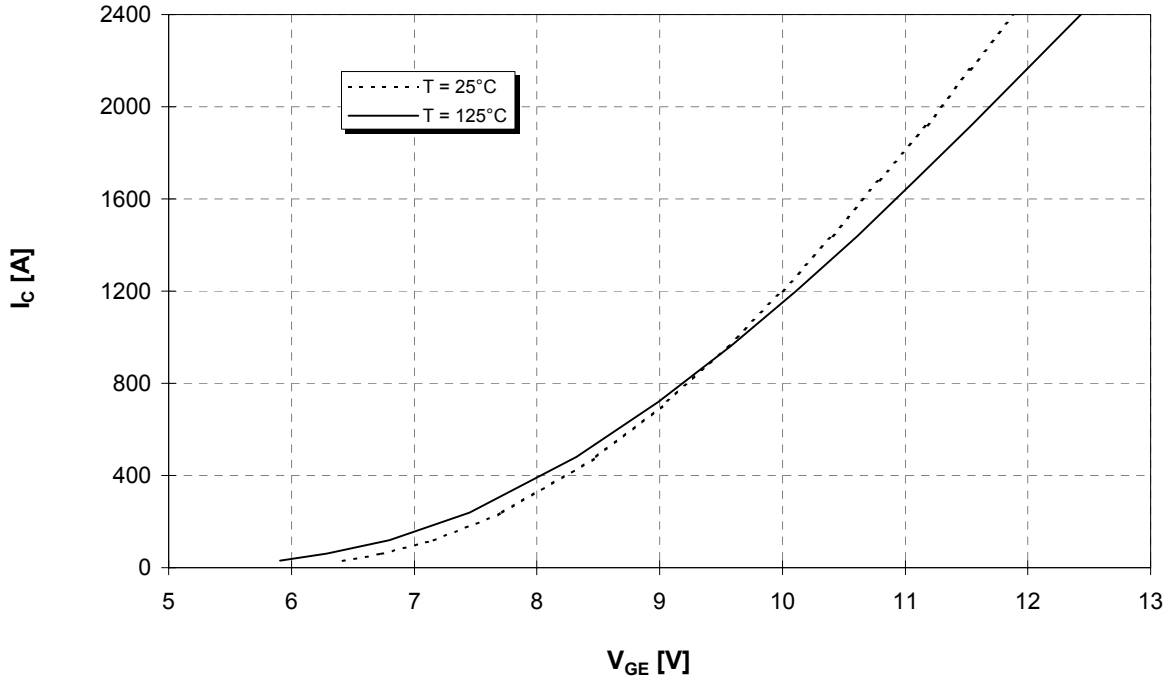




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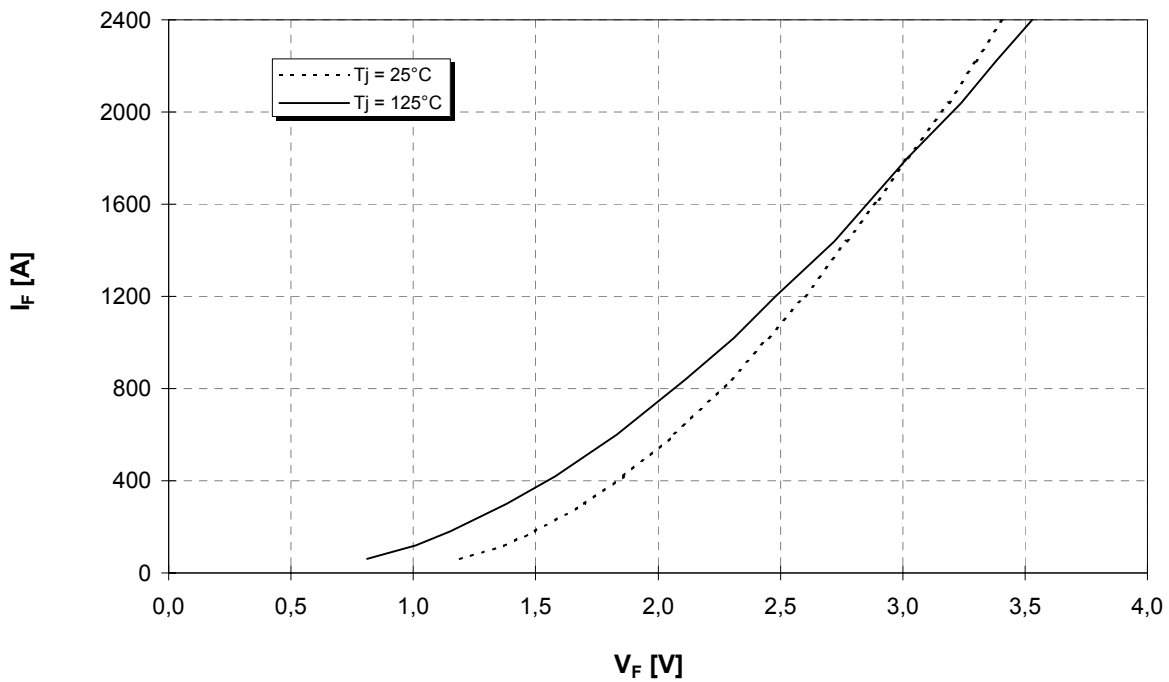
Übertragungscharakteristik (typisch)
Transfer characteristic (typical)

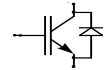
$I_c = f(V_{GE})$
 $V_{CE} = 20V$



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

$I_F = f(V_F)$

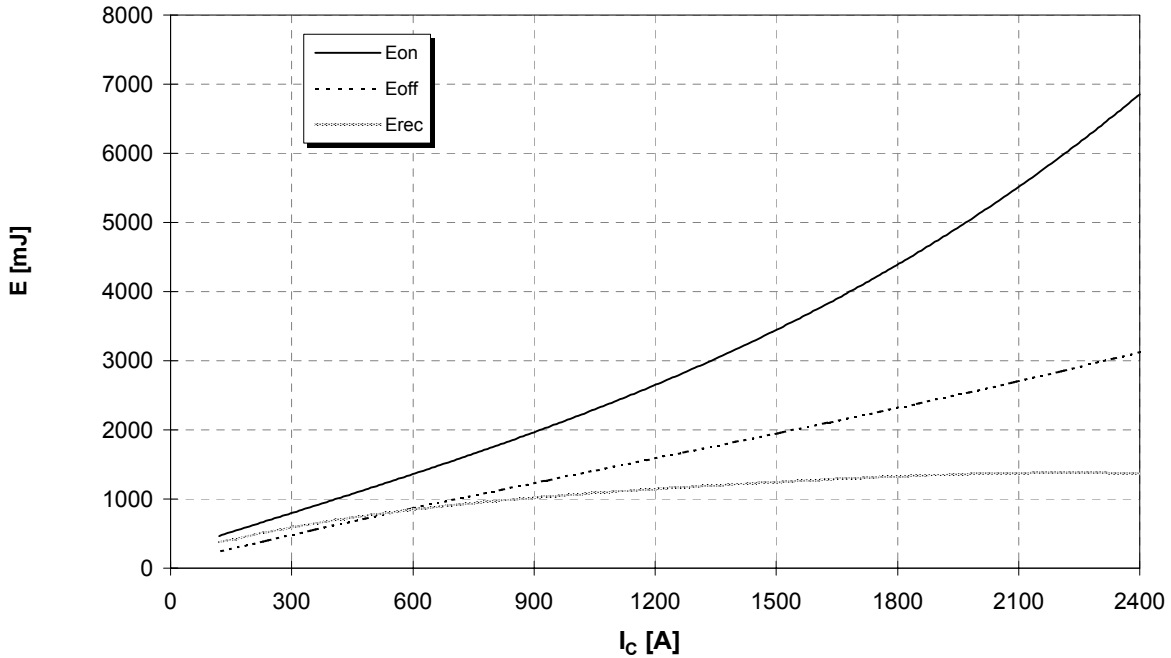




Schaltverluste (typisch)
Switching losses (typical)

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

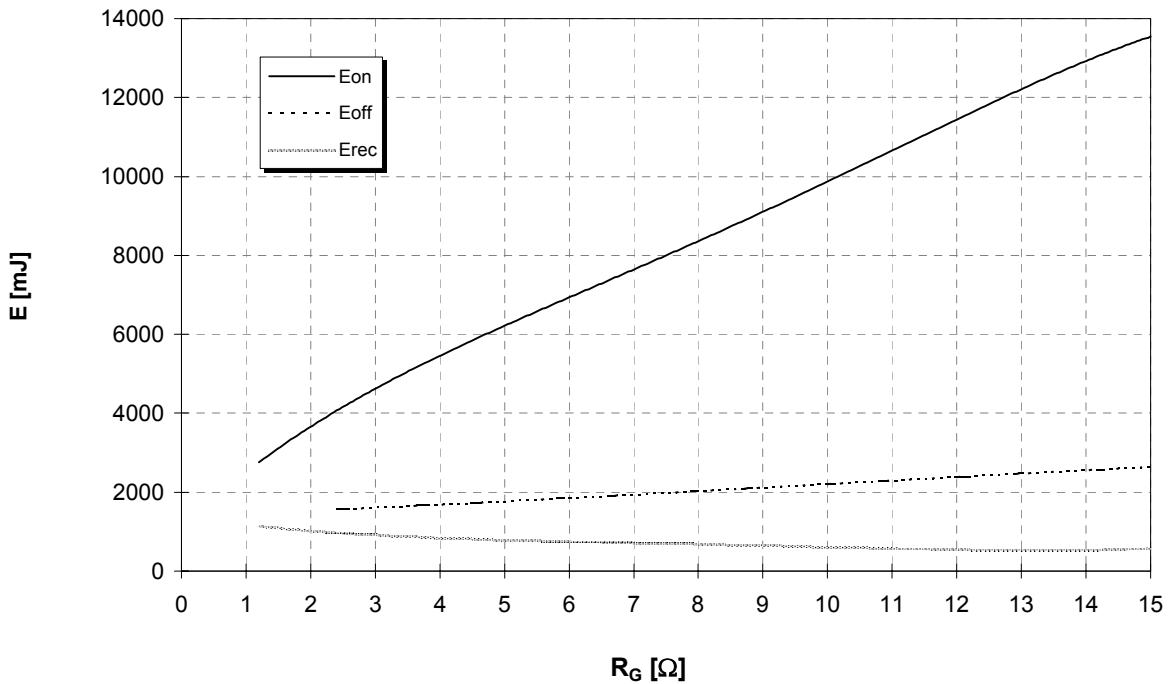
$R_{Gon} = 1,2 \Omega$, $R_{Goff} = 2,7 \Omega$, $C_{GE} = 330 \text{ nF}$, $V_{CE} = 1800\text{V}$, $T_J = 125^\circ\text{C}$

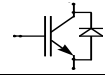


Schaltverluste (typisch)
Switching losses (typical)

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

$I_C = 1200 \text{ A}$, $C_{GE} = 330 \text{ nF}$, $V_{CE} = 1800\text{V}$, $T_J = 125^\circ\text{C}$





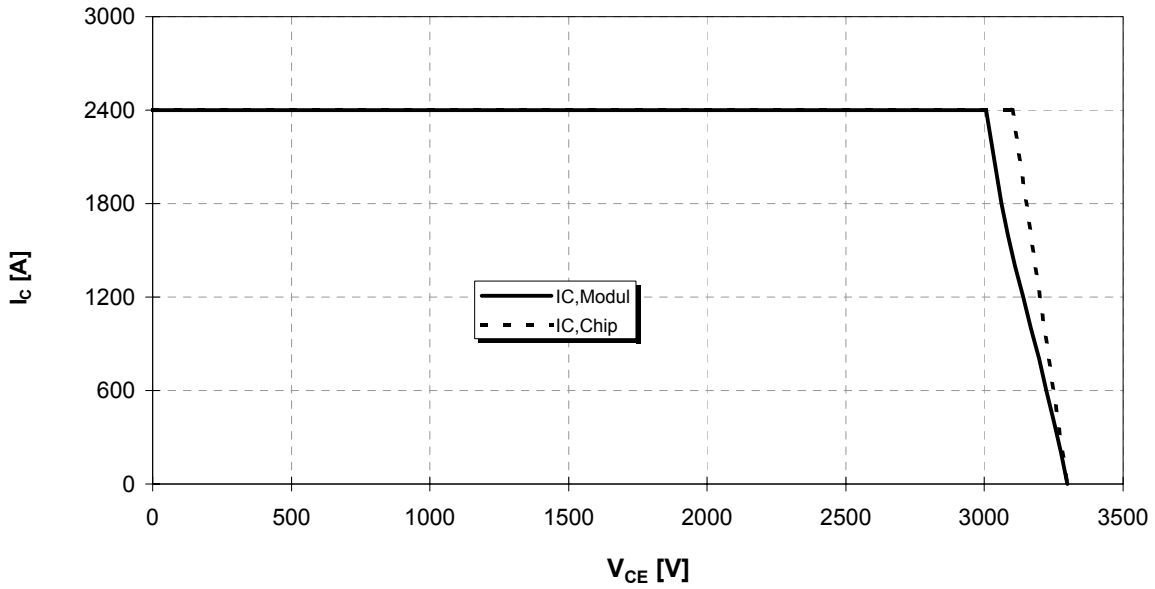
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Sicherer Arbeitsbereich IGBT (RBSOA)

Reverse bias safe operation area IGBT (RBSOA)

$R_{G,off} = 2,7\Omega$, $C_{GE} = 330\text{ nF}$

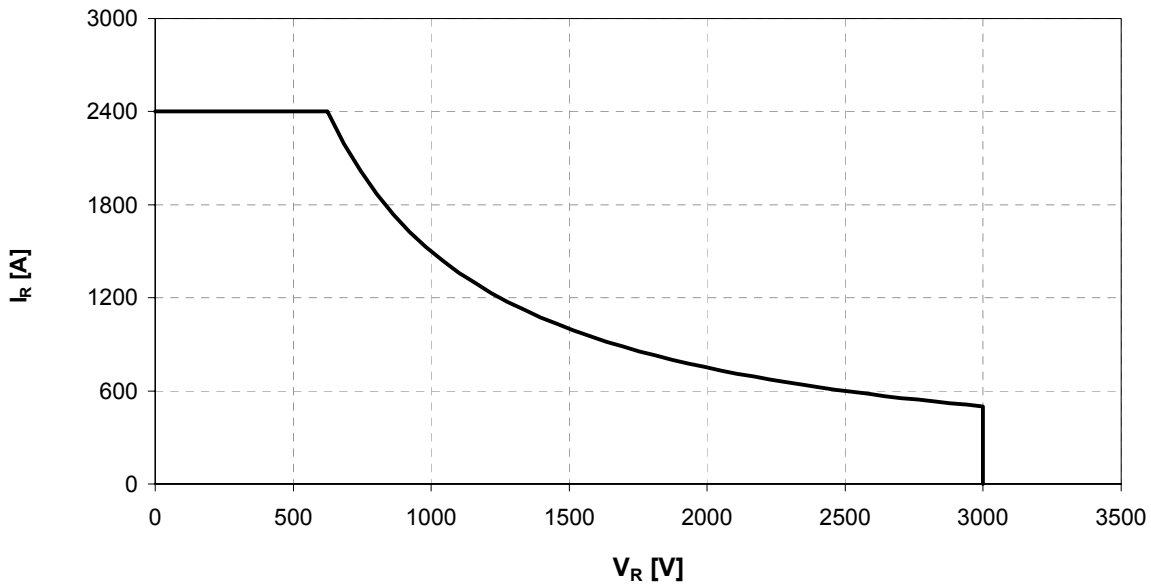
$T_{vj} = 125^\circ\text{C}$

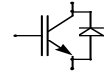


Sicherer Arbeitsbereich Diode (SOA)

safe operation area Diode (SOA)

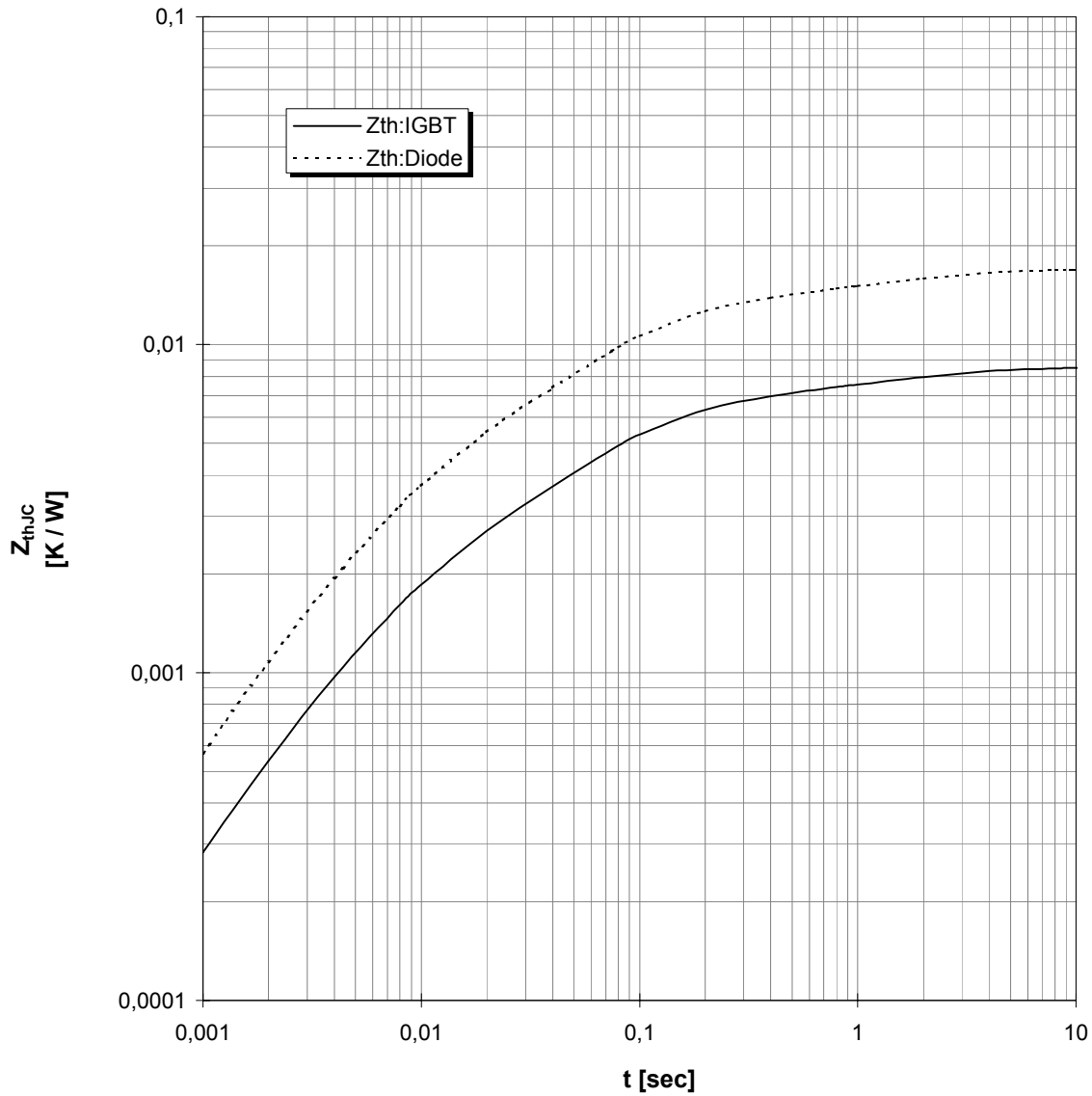
$T_{vj} = 125^\circ\text{C}$



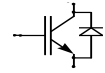


Transienter Wärmewiderstand
Transient thermal impedance

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



i	1	2	3	4
r_i [K/kW] : IGBT	1,56	4,25	1,26	1,44
τ_i [sec] : IGBT	0,0068	0,0642	0,3209	2,0212
r_i [K/kW] : Diode	3,11	8,49	2,52	2,88
τ_i [sec] : Diode	0,0068	0,0642	0,3209	2,0212



Gehäusemaße / Schaltbild
Package outline / Circuit diagram

