

Technische Information / Technical Information

IGBT-Module
IGBT-Modules

FZ 400 R 33 KF2 B5

eupec



vorläufige Daten
preliminary data

Höchstzulässige Werte / Maximum rated values

Elektrische Eigenschaften / Electrical properties

Kollektor-Emitter-Sperrspannung collector-emitter voltage	$T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = -25^{\circ}\text{C}$	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	400 660	A 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}	4,8	kW
Gate-Emitter-Spitzenspannung gate-emitter peak voltage		V_{GES}	+/- 20V	V
Dauerstrom 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	70	$\text{k A}^2\text{s}$
Spitzenverlustleistung der Diode maximum power dissipation diode	$T_{vj} = 125^{\circ}\text{C}$	P_{RQM}	400	kW
Isolations-Prüfspannung insulation test voltage	RMS, $f = 50 \text{ Hz}, t = 1 \text{ min.}$	V_{ISOL}	10,2	kV
Teilentladungs-Aussetzspannung partial discharge extinction voltage	RMS, $f = 50 \text{ Hz}, Q_{pD} \text{ typ. } 10\text{pC (acc. To IEC 1287)}$	V_{ISOL}	5,1	kV

Charakteristische Werte / Characteristic values

Transistor / Transistor

			min.	typ.	max.	
Kollektor-Emitter Sättigungsspannung collector-emitter saturation voltage	$I_C = 400\text{A}, V_{GE} = 15\text{V}, T_{vj} = 25^{\circ}\text{C}$	$V_{CE \text{ sat}}$	-	3,40	4,25	V
	$I_C = 400\text{A}, V_{GE} = 15\text{V}, T_{vj} = 125^{\circ}\text{C}$		-	4,30	5,00	V
Gate-Schwellenspannung gate threshold voltage	$I_C = 40 \text{ mA}, V_{CE} = V_{GE}, T_{vj} = 25^{\circ}\text{C}$	$V_{GE(th)}$	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}	-	50	-	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}	-	2,7	-	nF
Gateladung gate charge	$V_{GE} = -15\text{V} \dots +15\text{V}$	Q_G	-	8	-	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: Alfons Wiesenthal

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Transistor / Transistor

			min.	typ.	max.	
Einschaltverzögerungszeit (ind. Last) turn on delay time (inductive load)	$I_C = 400 \text{ A}, V_{CE} = 1800 \text{ V}$	$t_{d,on}$	-	0,75	-	μs
	$V_{GE} = \pm 15 \text{ V}, R_G = 8,2 \Omega, C_{GE} = 68 \text{ nF}, T_{vj} = 25^\circ\text{C}$		-	0,70	-	μs
	$V_{GE} = \pm 15 \text{ V}, R_G = 8,2 \Omega, C_{GE} = 68 \text{ nF}, T_{vj} = 125^\circ\text{C}$		-	0,70	-	μs
Anstiegszeit (induktive Last) rise time (inductive load)	$I_C = 400 \text{ A}, V_{CE} = 1800 \text{ V}$	t_r	-	0,45	-	μs
	$V_{GE} = \pm 15 \text{ V}, R_G = 8,2 \Omega, C_{GE} = 68 \text{ nF}, T_{vj} = 25^\circ\text{C}$		-	0,48	-	μs
	$V_{GE} = \pm 15 \text{ V}, R_G = 8,2 \Omega, C_{GE} = 68 \text{ nF}, T_{vj} = 125^\circ\text{C}$		-	0,48	-	μs
Abschaltverzögerungszeit (ind. Last) turn off delay time (inductive load)	$I_C = 400 \text{ A}, V_{CE} = 1800 \text{ V}$	$t_{d,off}$	-	1,55	-	μs
	$V_{GE} = \pm 15 \text{ V}, R_G = 4,3 \Omega, C_{GE} = 68 \text{ nF}, T_{vj} = 25^\circ\text{C}$		-	1,70	-	μs
	$V_{GE} = \pm 15 \text{ V}, R_G = 4,3 \Omega, C_{GE} = 68 \text{ nF}, T_{vj} = 125^\circ\text{C}$		-	1,70	-	μs
Fallzeit (induktive Last) fall time (inductive load)	$I_C = 400 \text{ A}, V_{CE} = 1800 \text{ V}$	t_f	-	0,20	-	μs
	$V_{GE} = \pm 15 \text{ V}, R_G = 4,3 \Omega, C_{GE} = 68 \text{ nF}, T_{vj} = 25^\circ\text{C}$		-	0,20	-	μs
	$V_{GE} = \pm 15 \text{ V}, R_G = 4,3 \Omega, C_{GE} = 68 \text{ nF}, T_{vj} = 125^\circ\text{C}$		-	0,20	-	μs
Einschaltverlustenergie pro Puls turn-on energy loss per pulse	$I_C = 400 \text{ A}, V_{CC} = 1800 \text{ V}, V_{GE} = \pm 15 \text{ V}$ $R_G = 3,6 \Omega, C_{GE} = 68 \text{ nF}, T_{vj} = 125^\circ\text{C}, L_G = 60 \text{ nH}$	E_{on}	-	960	-	mWs
Abschaltverlustenergie pro Puls turn-off energy loss per pulse	$I_C = 400 \text{ A}, V_{CC} = 1800 \text{ V}, V_{GE} = \pm 15 \text{ V}$ $R_G = 4,3 \Omega, C_{GE} = 68 \text{ nF}, T_{vj} = 125^\circ\text{C}, L_G = 60 \text{ nH}$	E_{off}	-	530	-	mWs
Kurzschlußverhalten SC Data	$t_p \leq 10 \mu\text{sec}, V_{GE} \leq 15 \text{ V}$ $T_{vj} \leq 125^\circ\text{C}, V_{CC} = 2500 \text{ V}, V_{CEmax} = V_{CES} - L_{\sigma CE} \cdot di/dt$	I_{SC}	-	2000	-	A
Modulinduktivität stray inductance module		$L_{\sigma CE}$	-	25	-	nH
Modul-Leitungswiderstand, Anschlüsse - Chip lead resistance, terminals - chip	$T = 25^\circ\text{C}$	R_{CC+EE}	-	0,37	-	m Ω

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	-	2,80	3,50	V
	$I_F = 400 \text{ A}, V_{GE} = 0 \text{ V}, T_{vj} = 125^\circ\text{C}$		-	2,80	3,50	V
Rückstromspitze peak reverse recovery current	$I_F = 400 \text{ A}, -di_F/dt = 2100 \text{ A}/\mu\text{s}$	I_{RM}	-	480	-	A
	$V_R = 1800 \text{ V}, V_{GE} = -10 \text{ V}, T_{vj} = 25^\circ\text{C}$		-	500	-	A
	$V_R = 1800 \text{ V}, V_{GE} = -10 \text{ V}, T_{vj} = 125^\circ\text{C}$		-	500	-	A
Sperrverzögerungsladung recovered charge	$I_F = 400 \text{ A}, -di_F/dt = 2100 \text{ A}/\mu\text{s}$	Q_r	-	235	-	μAs
	$V_R = 1800 \text{ V}, V_{GE} = -10 \text{ V}, T_{vj} = 25^\circ\text{C}$		-	440	-	μAs
	$V_R = 1800 \text{ V}, V_{GE} = -10 \text{ V}, T_{vj} = 125^\circ\text{C}$		-	440	-	μAs
Abschaltenergie pro Puls reverse recovery energy	$I_F = 400 \text{ A}, -di_F/dt = 2100 \text{ A}/\mu\text{s}$	E_{rec}	-	225	-	mWs
	$V_R = 1800 \text{ V}, V_{GE} = -10 \text{ V}, T_{vj} = 25^\circ\text{C}$		-	460	-	mWs
	$V_R = 1800 \text{ V}, V_{GE} = -10 \text{ V}, T_{vj} = 125^\circ\text{C}$		-	460	-	mWs

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Thermische Eigenschaften / Thermal properties

		min. typ. max.				
Innerer Wärmewiderstand thermal resistance, junction to case	Transistor / transistor, DC	R_{thJC}	-	-	0,026	K/W
	Diode/Diode, DC		-	-	0,051	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}	-	0,016	-	K/W
Höchstzulässige Sperrschichttemperatur maximum junction temperature		$T_{vj \max}$	-	-	150	°C
Betriebstemperatur operation temperature		$T_{vj \text{ op}}$	-40	-	125	°C
Lagertemperatur storage temperature		T_{stg}	-40	-	125	°C

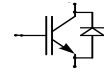
Mechanische Eigenschaften / Mechanical properties

Gehäuse, siehe Anlage case, see appendix						
Material Modulgrundplatte material of module baseplate				AlSiC		
Innere Isolation internal insulation				AlN		
Kriechstrecke creepage distance				56		mm
Luftstrecke clearance				26		mm
CTI comperative tracking index				> 600		
Anzugsdrehmoment f. mech. Befestigung mounting torque	Schraube / screw M6	M	4,25	-	5,75	Nm
Anzugsdrehmoment f. elektr. Anschlüsse terminal connection torque	Anschlüsse / terminals M8	M	8	-	10	Nm
Gewicht weight		G	500			g

Mit dieser technischen Information werden Halbleiterbauelemente spezifiziert, jedoch keine Eigenschaften zugesichert.

Sie gilt in Verbindung mit den zugehörigen Technischen Erläuterungen.

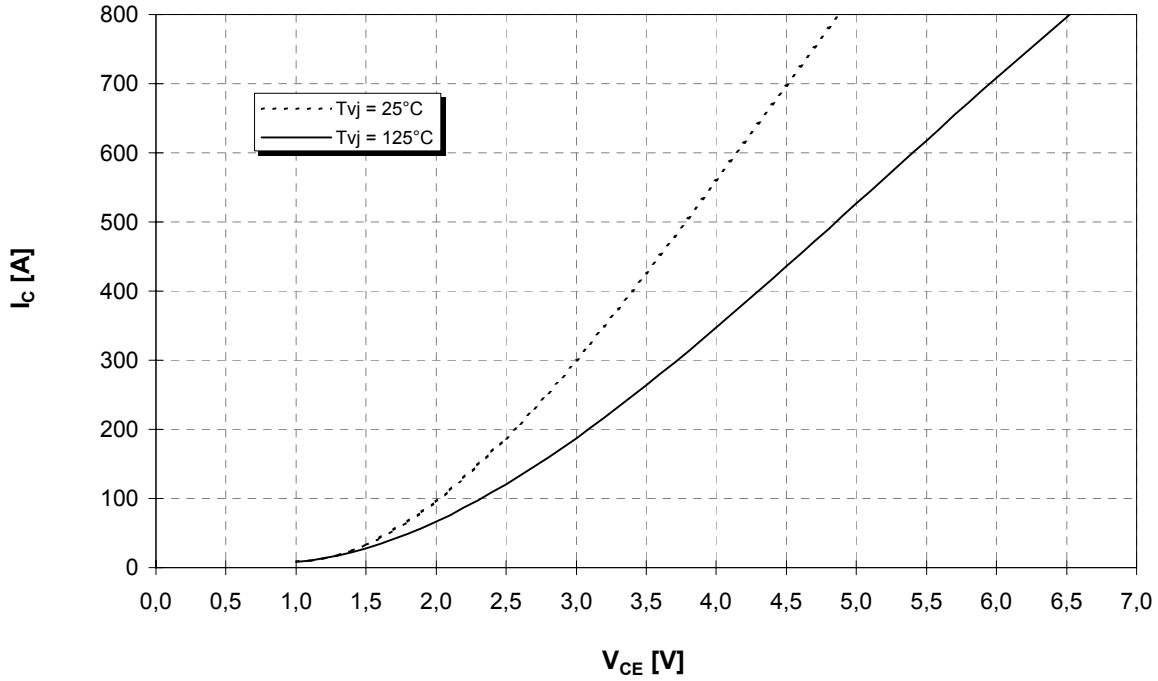
This technical information specifies semiconductor devices but promises no characteristics. It is valid in combination with the belonging technical notes.



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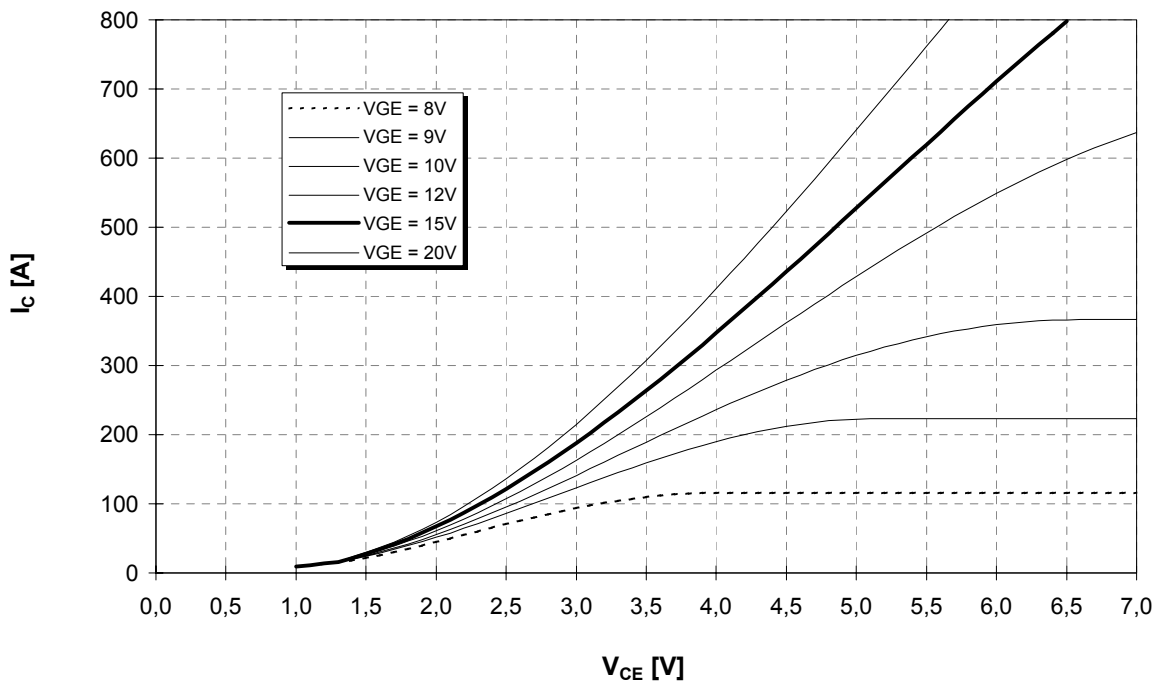
Ausgangskennlinie (typisch)
Output characteristic (typical)

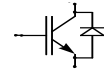
$I_c = f(V_{CE})$
 $V_{GE} = 15V$



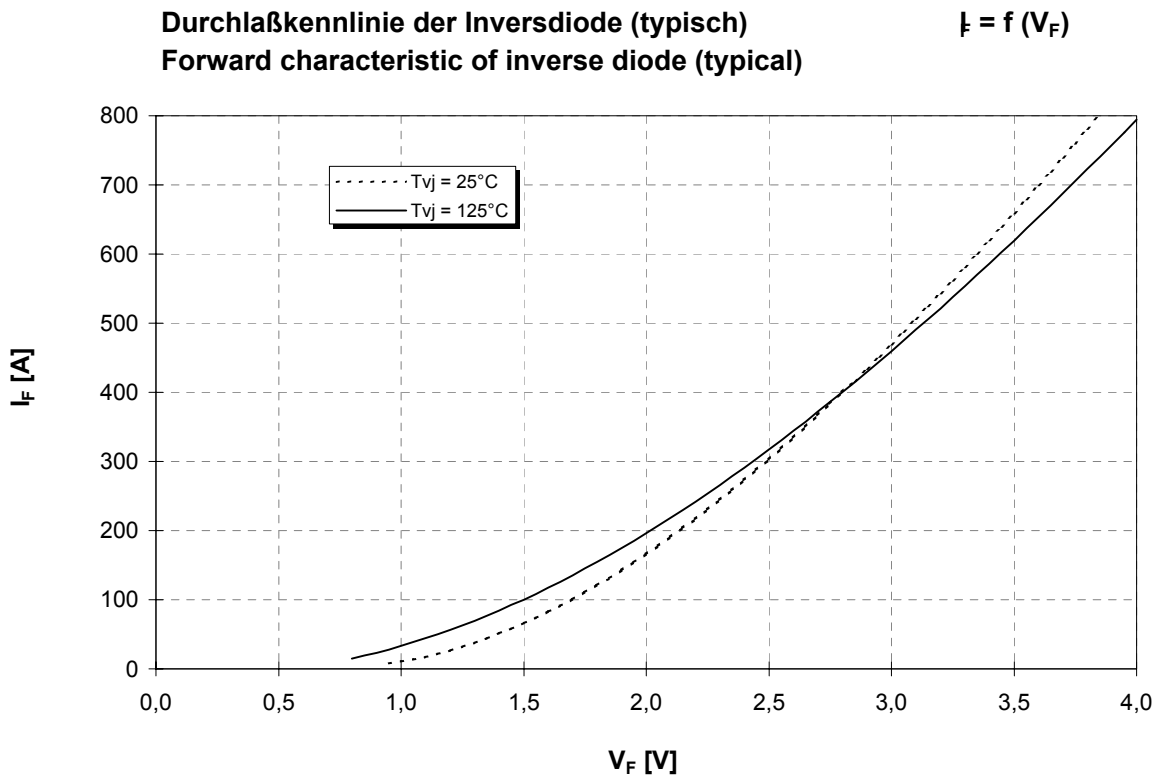
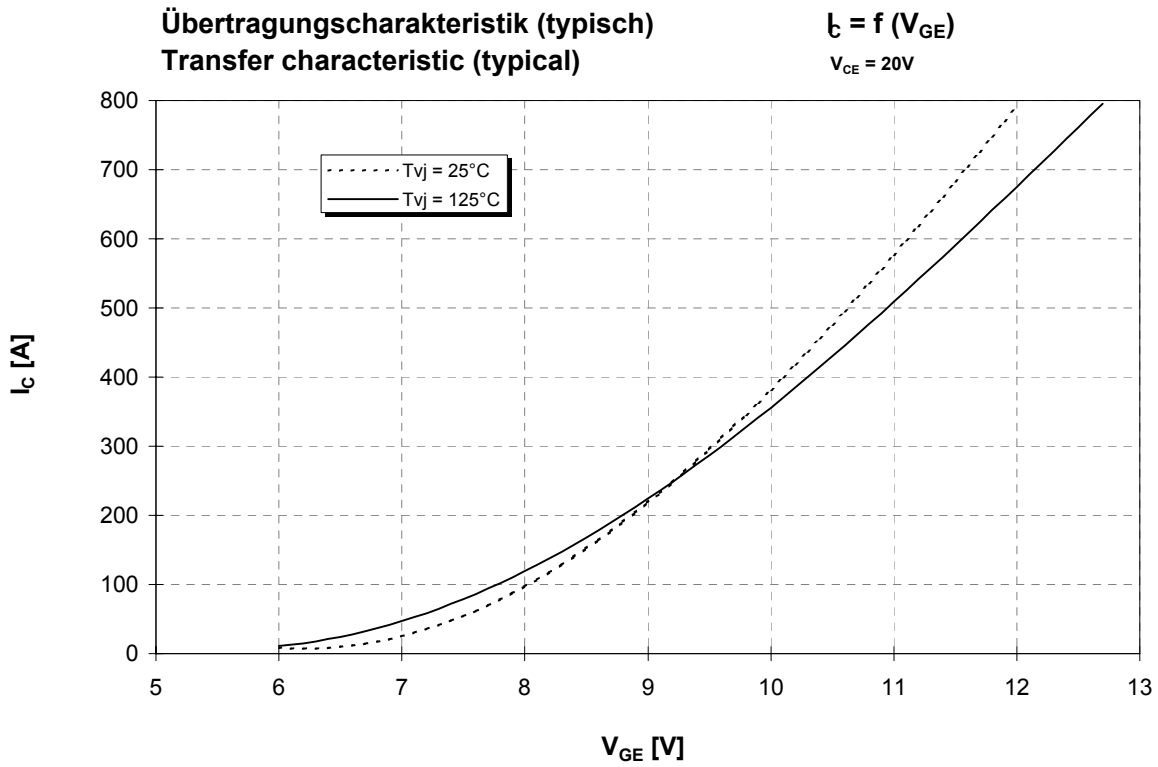
Ausgangskennlinienfeld (typisch)
Output characteristic (typical)

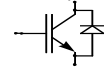
$I_c = f(V_{CE})$
 $T_{vj} = 125°C$





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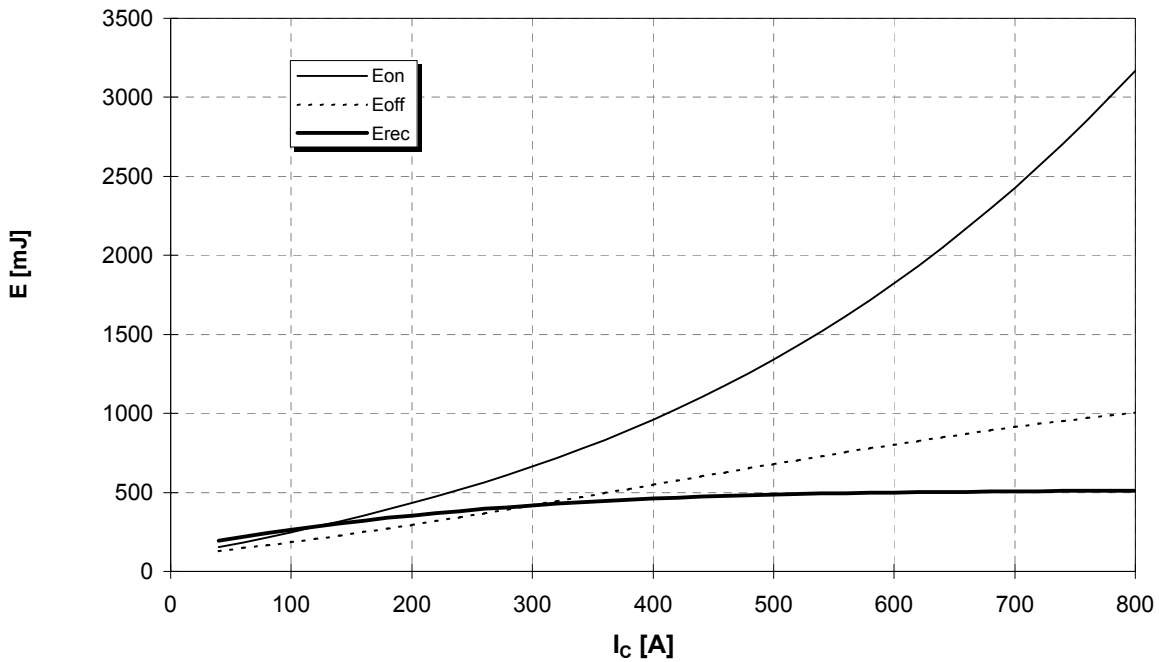


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Schaltverluste (typisch)
Switching losses (typical)

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

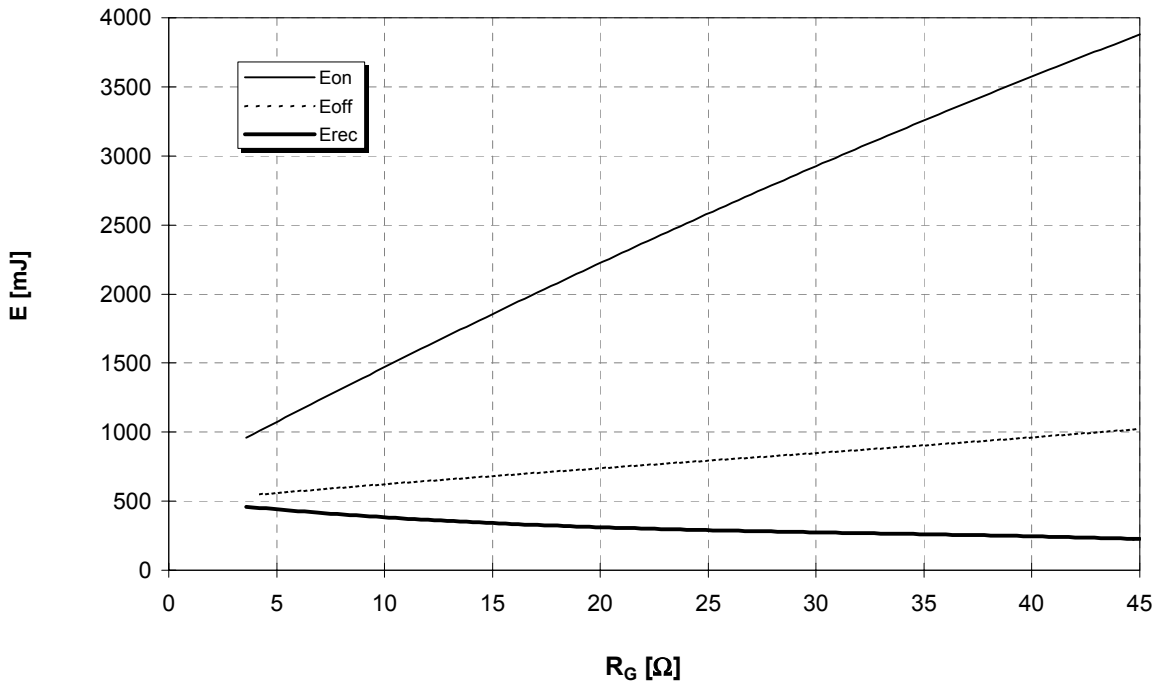
$T_{vj} = 125^\circ\text{C}$, $V_{CE} = 1800\text{V}$, $V_{GE} = \pm 15\text{V}$, $R_{G,on} = 3,6 \Omega$, $R_{G,off} = 4,3 \Omega$, $C_{GE} = 68 \text{ nF}$,

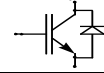


Schaltverluste (typisch)
Switching losses (typical)

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

$T_{vj} = 125^\circ\text{C}$, $V_{CE} = 1800\text{V}$, $I_C = 400 \text{ A}$, $C_{GE} = 68 \text{ nF}$,



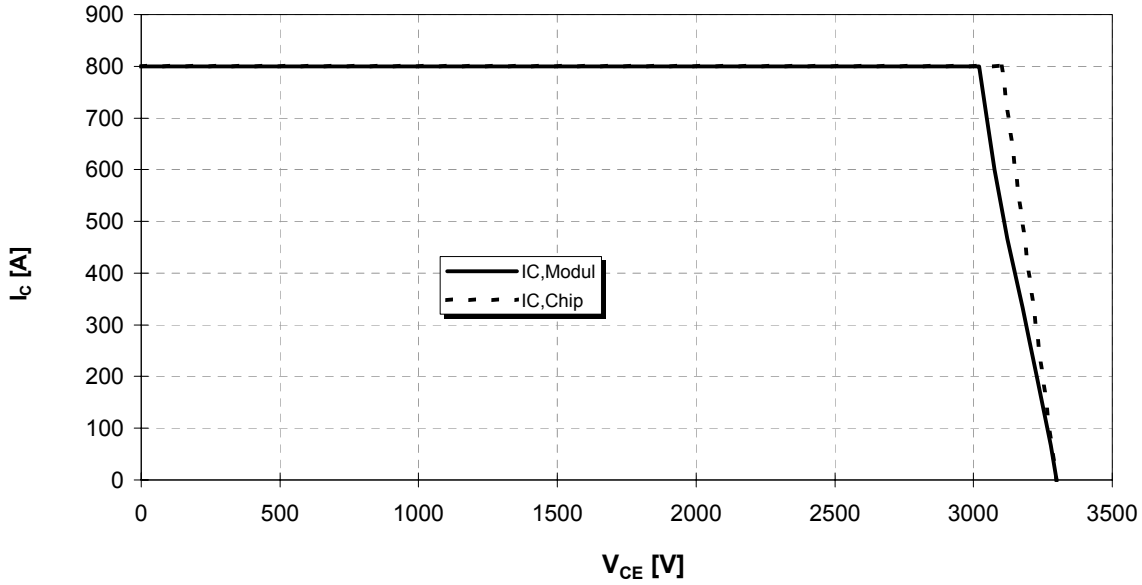


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Sicherer Arbeitsbereich IGBT (RBSOA)

Reverse bias safe operation area IGBT (RBSOA)

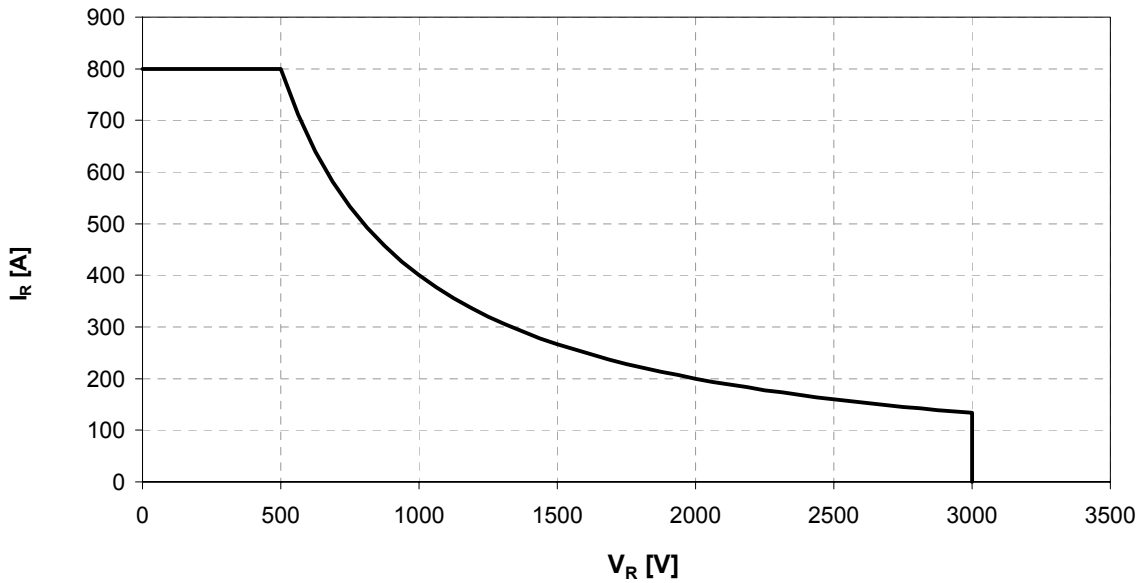
$T_{vj} = 125^{\circ}\text{C}$, $V_{GE} = \pm 15\text{V}$, $R_{Goff} = 4,3 \Omega$, $C_{GE} = 68 \text{ nF}$

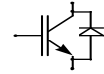


Sicherer Arbeitsbereich Diode (SOA)

safe operation area Diode (SOA)

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

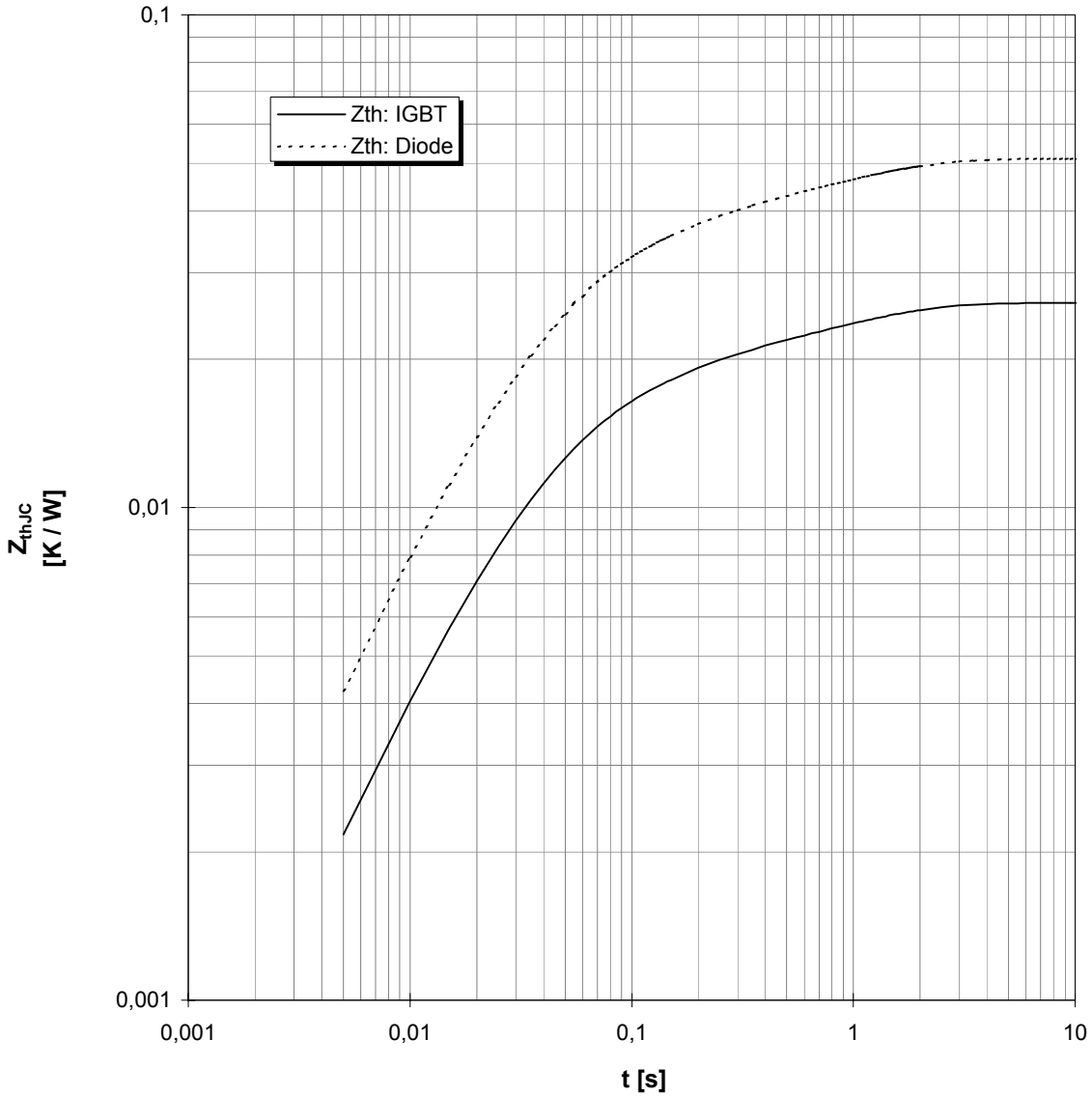




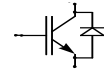
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Transienter Wärmewiderstand
Transient thermal impedance

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

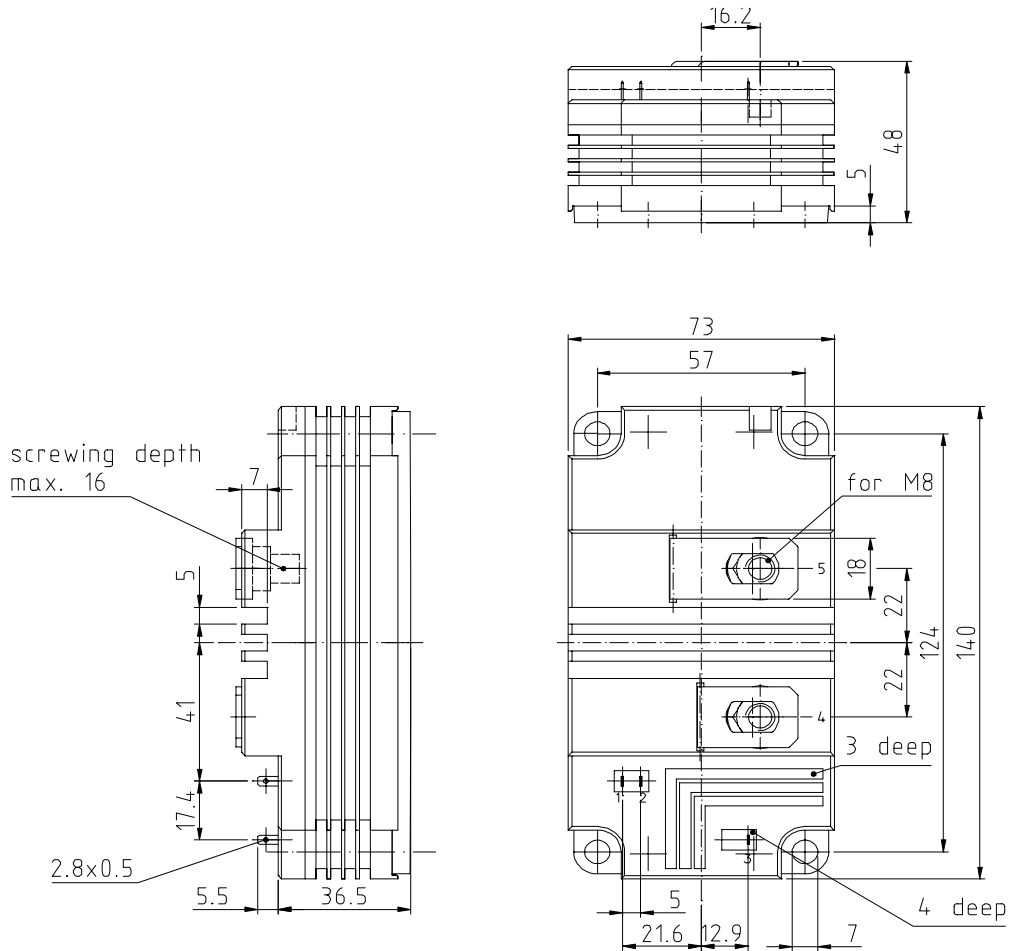


i	1	2	3	4
r_i [K/kW] : IGBT	11,70	6,50	1,56	6,24
τ_i [s] : IGBT	0,03	0,10	0,30	1,00
r_i [K/kW] : Diode	22,95	12,75	3,06	12,24
τ_i [s] : Diode	0,03	0,10	0,30	1,00



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Gehäusemaße / Schaltbild
Package outline / Circuit diagram



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