

Technische Information / technical information**eupec**IGBT-Module
IGBT-Modules**FZ1600R12KE3****vorläufige Daten**
preliminary data**Höchstzulässige Werte / maximum rated values****Elektrische Eigenschaften / electrical properties**

Kollektor Emitter Sperrspannung collector emitter voltage	$T_{vj} = 25^{\circ}\text{C}$	V_{CES}	1200	V
Kollektor Dauergleichstrom DC collector current	$T_c = 80^{\circ}\text{C}$ $T_c = 25^{\circ}\text{C}$	$I_{C, \text{nom}}$ I_C	1600 2300	A A
Periodischer Kollektor Spitzenstrom repetitive peak collector current	$t_p = 1\text{ms}$, $T_c = 80^{\circ}\text{C}$	I_{CRM}	3200	A
Gesamt Verlustleistung total power dissipation	$T_c = 25^{\circ}\text{C}$; Transistor	P_{tot}	7,8	kW
Gate Emitter Spitzenspannung gate emitter peak voltage		V_{GES}	+/- 20	V
Dauergleichstrom DC forward current		I_F	1600	A
Periodischer Spitzenstrom repetitive peak forward current	$t_p = 1\text{ms}$	I_{FRM}	3200	A
Grenzlastintegral I^2t value	$V_R = 0\text{V}$, $t_p = 10\text{ms}$, $T_{vj} = 125^{\circ}\text{C}$	I^2t	300	k A ² 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	$I_C = 1600\text{A}$, $V_{GE} = 15\text{V}$, $T_{vj} = 25^{\circ}\text{C}$, $I_C = 1600\text{A}$, $V_{GE} = 15\text{V}$, $T_{vj} = 125^{\circ}\text{C}$,	V_{CESat}	- -	1,7 2	2,15 t.b.d.	V V
Gate Schwellenspannung gate threshold voltage	$I_C = 64\text{mA}$, $V_{CE} = V_{GE}$, $T_{vj} = 25^{\circ}\text{C}$,	$V_{GE(th)}$	5	5,8	6,5	V
Gateladung gate charge	$V_{GE} = -15\text{V} \dots +15\text{V}$; $V_{CE} = \dots\text{V}$	Q_G	-	15,4	-	μC
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}	-	115	-	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}	-	5,4	-	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

prepared by: MOD-D2; Mark Münzer

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Charakteristische Werte / characteristic values

Transistor Wechselrichter / transistor inverter

			min.	typ.	max.	
Einschaltverzögerungszeit (ind. Last) turn on delay time (inductive load)	$I_C = 1600A, V_{CC} = 600V$	$t_{d,on}$	-	0,60	-	μs
	$V_{GE} = \pm 15V, R_{Gon} = 1,6\Omega, T_{vj} = 25^\circ C$					
	$V_{GE} = \pm 15V, R_{Gon} = 1,6\Omega, T_{vj} = 125^\circ C$					
Anstiegszeit (induktive Last) rise time (inductive load)	$I_C = 1600A, V_{CC} = 600V$	t_r	-	0,23	-	μs
	$V_{GE} = \pm 15V, R_{Gon} = 1,6\Omega, T_{vj} = 25^\circ C$					
	$V_{GE} = \pm 15V, R_{Gon} = 1,6\Omega, T_{vj} = 125^\circ C$					
Abschaltverzögerungszeit (ind. Last) turn off delay time (inductive load)	$I_C = 1600A, V_{CC} = 600V$	$t_{d,off}$	-	0,82	-	μs
	$V_{GE} = \pm 15V, R_{Goff} = 0,2\Omega, T_{vj} = 25^\circ C$					
	$V_{GE} = \pm 15V, R_{Goff} = 0,2\Omega, T_{vj} = 125^\circ C$					
Fallzeit (induktive Last) fall time (inductive load)	$I_C = 1600A, V_{CC} = 600V$	t_f	-	0,15	-	μs
	$V_{GE} = \pm 15V, R_{Goff} = 0,2\Omega, T_{vj} = 25^\circ C$					
	$V_{GE} = \pm 15V, R_{Goff} = 0,2\Omega, T_{vj} = 125^\circ C$					
Einschaltverlustenergie pro Puls turn on energy loss per pulse	$I_C = 1600A, V_{CC} = 600V, L_\sigma = 45nH$ $V_{GE} = \pm 15V, R_{Gon} = 1,6\Omega, T_{vj} = 125^\circ C$	E_{on}	-	325	-	mJ
Ausschaltverlustenergie pro Puls turn off energy loss per pulse	$I_C = 1600A, V_{CC} = 600V, L_\sigma = 45nH$ $V_{GE} = \pm 15V, R_{Goff} = 0,2\Omega, T_{vj} = 125^\circ C$	E_{off}	-	250	-	mJ
Kurzschlussverhalten SC data	$t_p \leq 10\mu s, V_{GE} \leq 15V, T_{vj} \leq 125^\circ C$ $V_{CC} = 900V, V_{CEmax} = V_{CES} - L_{\sigma CE} \cdot di/dt $	I_{SC}	-	6400	-	A
Modulinduktivität stray inductance module		$L_{\sigma CE}$	-	12	-	nH
Leitungswiderstand, Anschluss-Chip lead resistance, terminal-chip	$T_c = 25^\circ C$	$R_{CC'/EE'}$	-	0,19	-	m Ω

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	-	2,2	2,8	V
	$I_F = I_{C, nom}, V_{GE} = 0V, T_{vj} = 125^\circ C$		-	2	-	V
Rückstromspitze peak reverse recovery current	$I_F = I_{C, nom}, -di_F/dt = 7200A/\mu s$	I_{RM}	-	515	-	A
	$V_R = 600V, V_{GE} = -15V, T_{vj} = 25^\circ C$					
	$V_R = 600V, V_{GE} = -15V, T_{vj} = 125^\circ C$					
Sperrverzögerungsladung recovered charge	$I_F = I_{C, nom}, -di_F/dt = 7200A/\mu s$	Q_r	-	75	-	μC
	$V_R = 600V, V_{GE} = -15V, T_{vj} = 25^\circ C$					
	$V_R = 600V, V_{GE} = -15V, T_{vj} = 125^\circ C$					
Ausschaltenergie pro Puls reverse recovery energy	$I_F = I_{C, nom}, -di_F/dt = 7200A/\mu s$	E_{rec}	-	18	-	mJ
	$V_R = 600V, V_{GE} = -15V, T_{vj} = 25^\circ C$					
	$V_R = 600V, V_{GE} = -15V, T_{vj} = 125^\circ C$					



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Thermische Eigenschaften / thermal properties

			min.	typ.	max.	
Innerer Wärmewiderstand thermal resistance, junction to case	pro Transistor /per transistor, DC pro Diode/per Diode, DC	R_{thJC} R_{thJC}	-	-	0,016 0,032	K/W K/W
Übergangs Wärmewiderstand thermal resistance, case to heatsink	pro Modul / per module $\lambda_{Paste}/\lambda_{grease} = 1W/m^2K$	R_{thCK}	-	0,006	-	K/W
Höchstzulässige Sperrschichttemp. 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						
Innere Isolation internal insulation			Al ₂ O ₃			
Kriechstrecke creepage distance			32			mm
Luftstrecke clearance			20			mm
CTI comperative tracking index			>400			
Anzugsdrehmoment, mech. Befestigung mounting torque	Schraube / screw M5	M	4,25	-	5,75	Nm
Anzugsdrehmoment, elektr. Anschlüsse terminal connection torque	Anschlüsse / terminal M4	M	1,7	-	2,3	Nm
	Anschlüsse / terminal M8	M	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.

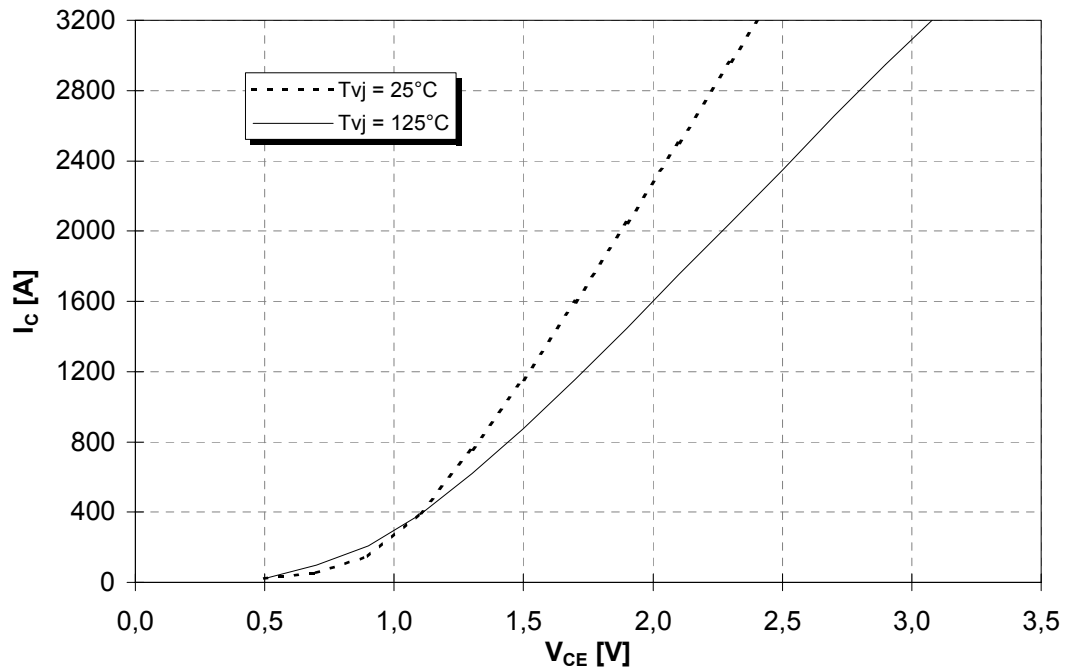
This technical information specifies semiconductor devices but promises no characteristics. It is valid with the belonging technical notes.



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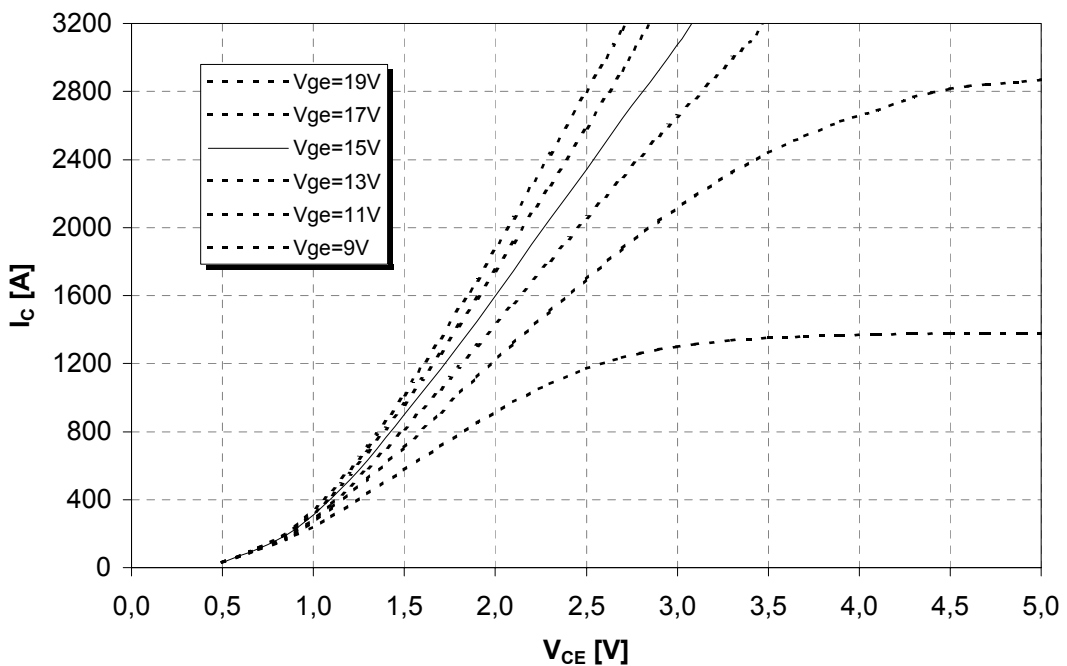
Ausgangskennlinie (typisch)
output characteristic (typical)

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



Ausgangskennlinienfeld (typisch)
output characteristic (typical)

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



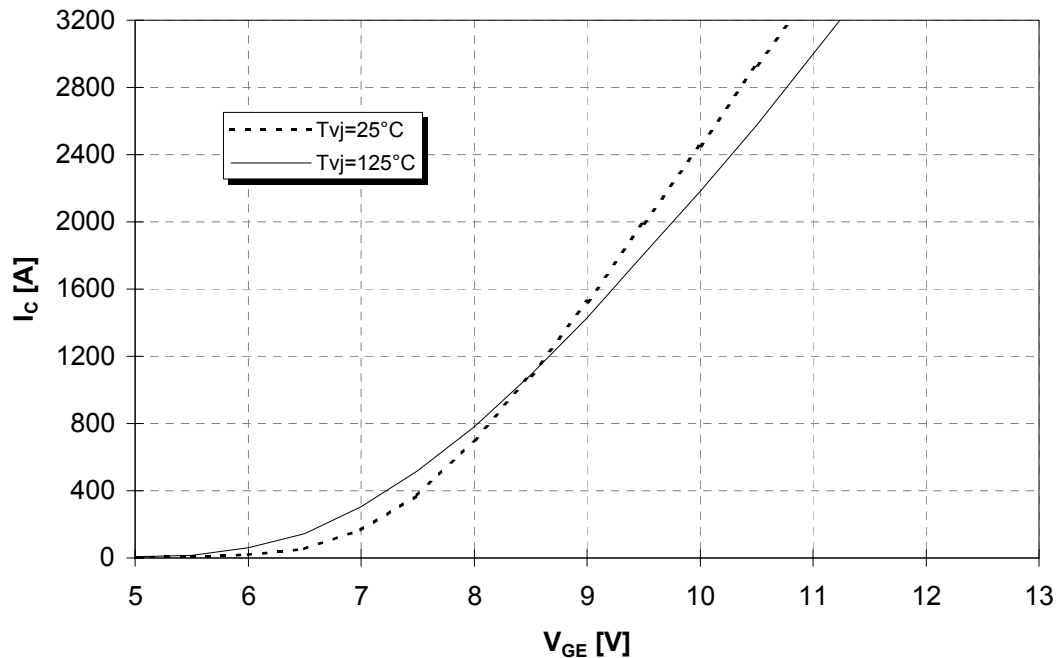


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Übertragungscharakteristik (typisch) transfer characteristic (typical)

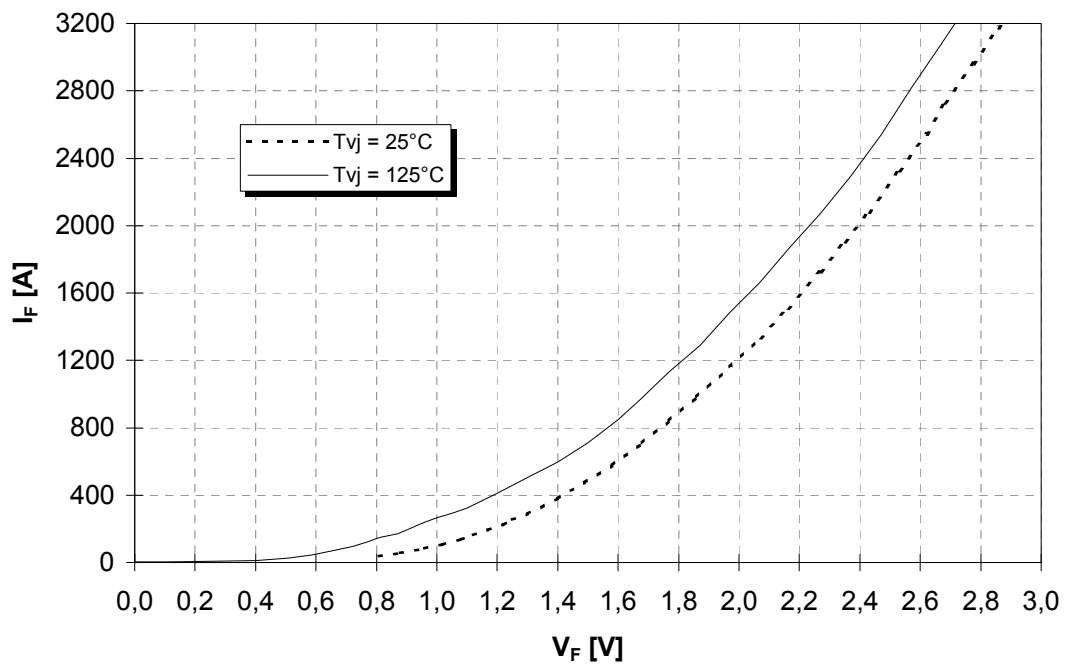
$$I_C = f(V_{GE})$$

$$V_{CE} = 20V$$



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

$$I_F = f(V_F)$$



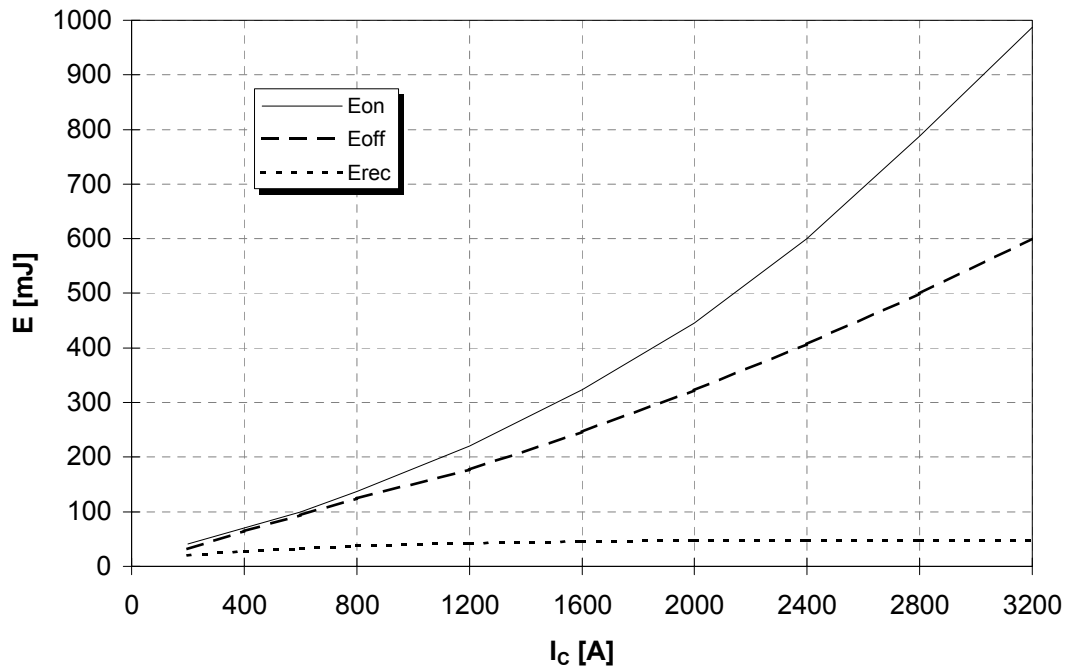


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Schaltverluste (typisch) Switching losses (typical)

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

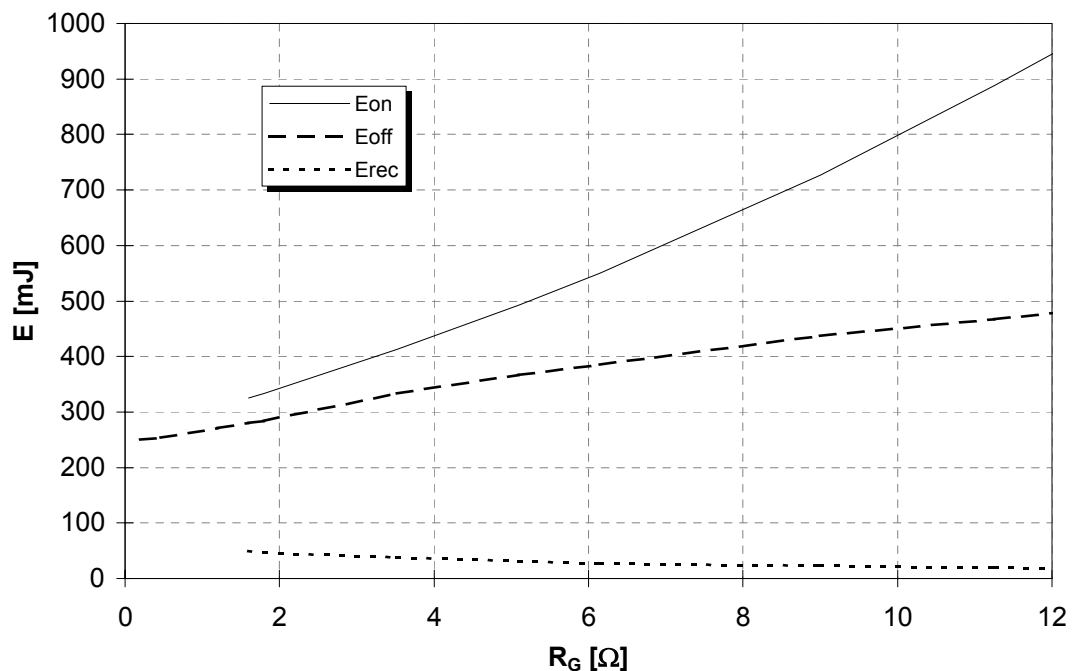
$V_{GE} = \pm 15V, R_{qon} = 1,6\Omega, R_{qoff} = 0,2\Omega, V_{CE} = 600V, T_{vj} = 125^\circ C$



Schaltverluste (typisch) Switching losses (typical)

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

$V_{GE} = \pm 15V, I_C = 1600A, V_{CE} = 600V, T_{vj} = 125^\circ C$

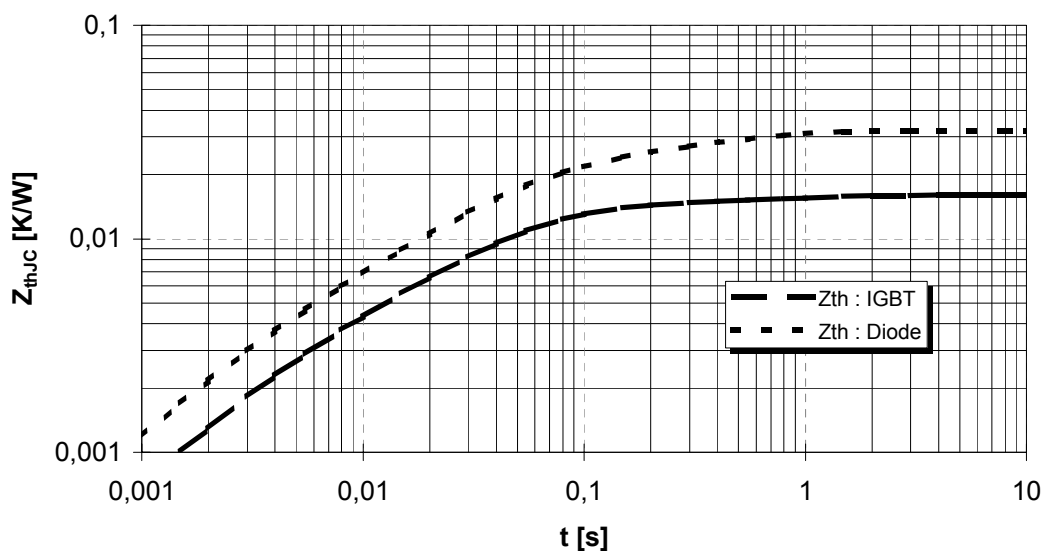




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Transienter Wärmewiderstand Transient thermal impedance

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

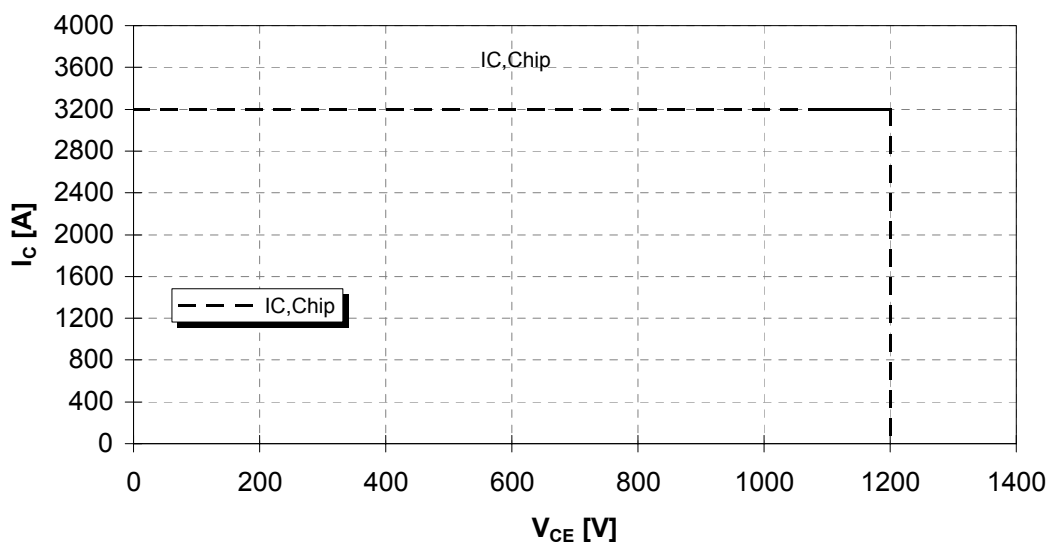


i	1	2	3	4
r_i [K/kW] : IGBT	1,91	6,27	6,17	1,65
τ_i [s] : IGBT	6,897E-01	5,634E-02	2,997E-02	3,820E-03
r_i [K/kW] : Diode	9,18	10,08	10,58	2,16
τ_i [s] : Diode	4,452E-01	7,451E-02	2,647E-02	2,850E-03

Sicherer Arbeitsbereich (RBSOA)

Reverse bias safe operation area (RBSOA)

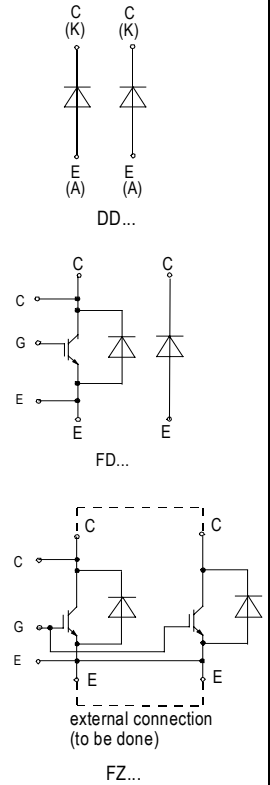
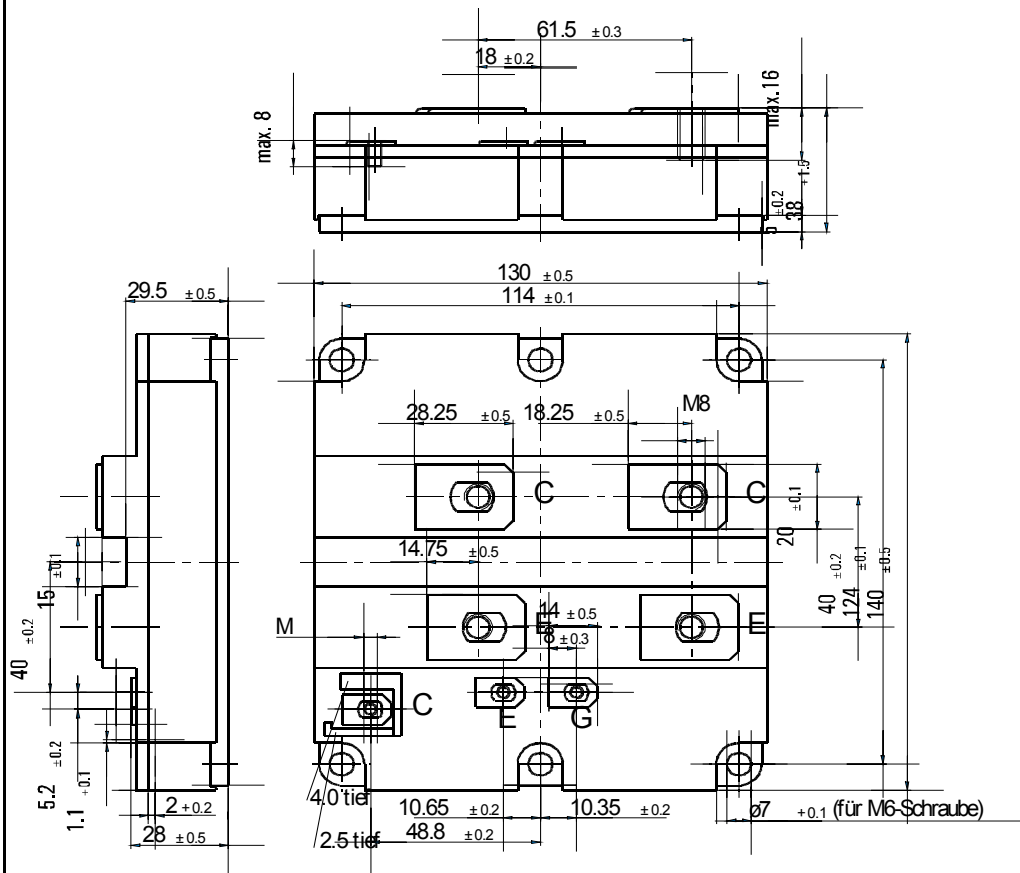
$$V_{GE}=15V, T_j=125^\circ C$$





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Gehäusemaße / Schaltbild Package outline / Circuit diagram



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