

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

Kollektor-Emitter-Sperrspannung collector-emitter voltage		V_{CES}	1200	V
Kollektor-Dauergleichstrom DC-collector current	$T_C = 80^\circ\text{C}$	$I_{C,nom.}$	1600	A
	$T_C = 25^\circ\text{C}$	I_C	2450	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}	10,0	kW
Gate-Emitter-Spitzenspannung gate-emitter peak voltage		V_{GES}	+/- 20V	V
Dauergleichstrom DC forward current		I_F	1600	A
Periodischer Spitzenstrom repetitive peak forw. current	$t_p = 1\text{ ms}$	I_{FRM}	3200	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	590	kA^2s
Isolations-Prüfspannung insulation test voltage	RMS, $f = 50\text{ Hz}, t = 1\text{ min.}$	V_{ISOL}	2,5	kV

Charakteristische Werte / Characteristic values**Transistor / Transistor**

min. typ. max.

Kollektor-Emitter Sättigungsspannung collector-emitter saturation voltage	$I_C = 1600\text{A}, V_{GE} = 15\text{V}, T_{vj} = 25^\circ\text{C}$	$V_{CE\text{ sat}}$	-	2,1	2,6	V
	$I_C = 1600\text{A}, V_{GE} = 15\text{V}, T_{vj} = 125^\circ\text{C}$		-	2,4	2,9	V
Gate-Schwellenspannung gate threshold voltage	$I_C = 64\text{mA}, V_{CE} = V_{GE}, T_{vj} = 25^\circ\text{C}$	$V_{GE(th)}$	4,5	5,5	6,5	V
Gateladung gate charge	$V_{GE} = -15\text{V} \dots +15\text{V}$	Q_G	-	17	-	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}	-	110	-	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}	-	7	-	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}	-	0,04	1,5	mA
	$V_{CE} = 1200\text{V}, V_{GE} = 0\text{V}, T_{vj} = 125^\circ\text{C}$		-	3,5	-	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}	-	-	600	nA

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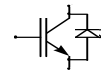
revision: 3

Technische Information / Technical Information

IGBT-Module
IGBT-Modules

FZ 1600 R 12 KL4C

eupec



Charakteristische Werte / Characteristic values

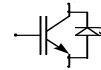
Transistor / Transistor

			min.	typ.	max.	
Einschaltverzögerungszeit (ind. Last) turn on delay time (inductive load)	$I_C = 1600A, V_{CE} = 600V$	$t_{d,on}$	-	0,28	-	μs
	$V_{GE} = \pm 15V, R_G = 0,91\Omega, T_{vj} = 25^\circ C$					
	$V_{GE} = \pm 15V, R_G = 0,91\Omega, T_{vj} = 125^\circ C$					
Anstiegszeit (induktive Last) rise time (inductive load)	$I_C = 1600A, V_{CE} = 600V$	t_r	-	0,19	-	μs
	$V_{GE} = \pm 15V, R_G = 0,91\Omega, T_{vj} = 25^\circ C$					
	$V_{GE} = \pm 15V, R_G = 0,91\Omega, T_{vj} = 125^\circ C$					
Abschaltverzögerungszeit (ind. Last) turn off delay time (inductive load)	$I_C = 1600A, V_{CE} = 600V$	$t_{d,off}$	-	1,06	-	μs
	$V_{GE} = \pm 15V, R_G = 0,91\Omega, T_{vj} = 25^\circ C$					
	$V_{GE} = \pm 15V, R_G = 0,91\Omega, T_{vj} = 125^\circ C$					
Fallzeit (induktive Last) fall time (inductive load)	$I_C = 1600A, V_{CE} = 600V$	t_f	-	0,14	-	μs
	$V_{GE} = \pm 15V, R_G = 0,91\Omega, T_{vj} = 25^\circ C$					
	$V_{GE} = \pm 15V, R_G = 0,91\Omega, T_{vj} = 125^\circ C$					
Einschaltverlustenergie pro Puls turn-on energy loss per pulse	$I_C = 1600A, V_{CE} = 600V, V_{GE} = 15V$	E_{on}	-	210	-	mWs
	$R_G = 0,91\Omega, T_{vj} = 125^\circ C, L_S = 70nH$					
Abschaltverlustenergie pro Puls turn-off energy loss per pulse	$I_C = 1600A, V_{CE} = 600V, V_{GE} = 15V$	E_{off}	-	260	-	mWs
	$R_G = 0,91\Omega, T_{vj} = 125^\circ C, L_S = 70nH$					
Kurzschlußverhalten SC Data	$t_p \leq 10\mu sec, V_{GE} \leq 15V, R_G = 0,91\Omega$	I_{SC}	-	12000	-	A
	$T_{vj} \leq 125^\circ C, V_{CC} = 900V, V_{CEmax} = V_{CES} - L_{sCE} \cdot di/dt$					
Modulinduktivität stray inductance module		L_{sCE}	-	15	-	nH
Modul Leitungswiderstand, Anschlüsse – Chip module lead resistance, terminals – chip	$T_C = 25^\circ C$	$R_{CC'+EE'}$	-	0,10	-	m Ω

Charakteristische Werte / Characteristic values

Diode / Diode

			min.	typ.	max.	
Durchlaßspannung forward voltage	$I_F = 1600A, V_{GE} = 0V, T_{vj} = 25^\circ C$	V_F	-	1,8	2,3	V
	$I_F = 1600A, V_{GE} = 0V, T_{vj} = 125^\circ C$					
Rückstromspitze peak reverse recovery current	$I_F = 1600A, -di_F/dt = 9000A/\mu sec$	I_{RM}	-	900	-	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	$I_F = 1600A, -di_F/dt = 9000A/\mu sec$	Q_r	-	150	-	μAs
	$V_R = 600V, V_{GE} = -15V, T_{vj} = 25^\circ C$					
	$V_R = 600V, V_{GE} = -15V, T_{vj} = 125^\circ C$					
Abschaltenergie pro Puls reverse recovery energy	$I_F = 1600A, -di_F/dt = 9000A/\mu sec$	E_{rec}	-	60	-	mWs
	$V_R = 600V, V_{GE} = -15V, T_{vj} = 25^\circ C$					
	$V_R = 600V, V_{GE} = -15V, T_{vj} = 125^\circ C$					

**Thermische Eigenschaften / Thermal properties**

			min.	typ.	max.	
Innerer Wärmewiderstand thermal resistance, junction to case	Transistor / transistor, DC	R_{thJC}	-	-	0,0125	K/W
	Diode/Diode, DC		-	-	0,0210	K/W
Übergangs-Wärmewiderstand thermal resistance, case to heatsink	pro Modul / per module $\lambda_{paste} = 1 \text{ W/m} \cdot \text{K}$ / $\lambda_{grease} = 1 \text{ W/m} \cdot \text{K}$	R_{thCK}	-	0,006	-	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	-	125	°C

Mechanische Eigenschaften / Mechanical properties

Gehäuse, siehe Anlage case, see appendix						
Innere Isolation internal insulation			Al ₂ O ₃			
Kriechstrecke creepage distance			17			mm
Luftstrecke clearance			10			mm
CTI comperative tracking index			275			
Anzugsdrehmoment f. mech. Befestigung mounting torque		M1	4,25	5	5,75	Nm
Anzugsdrehmoment f. elektr. Anschlüsse terminal connection torque	terminals M4	M2	1,7	2	2,3	Nm
	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.

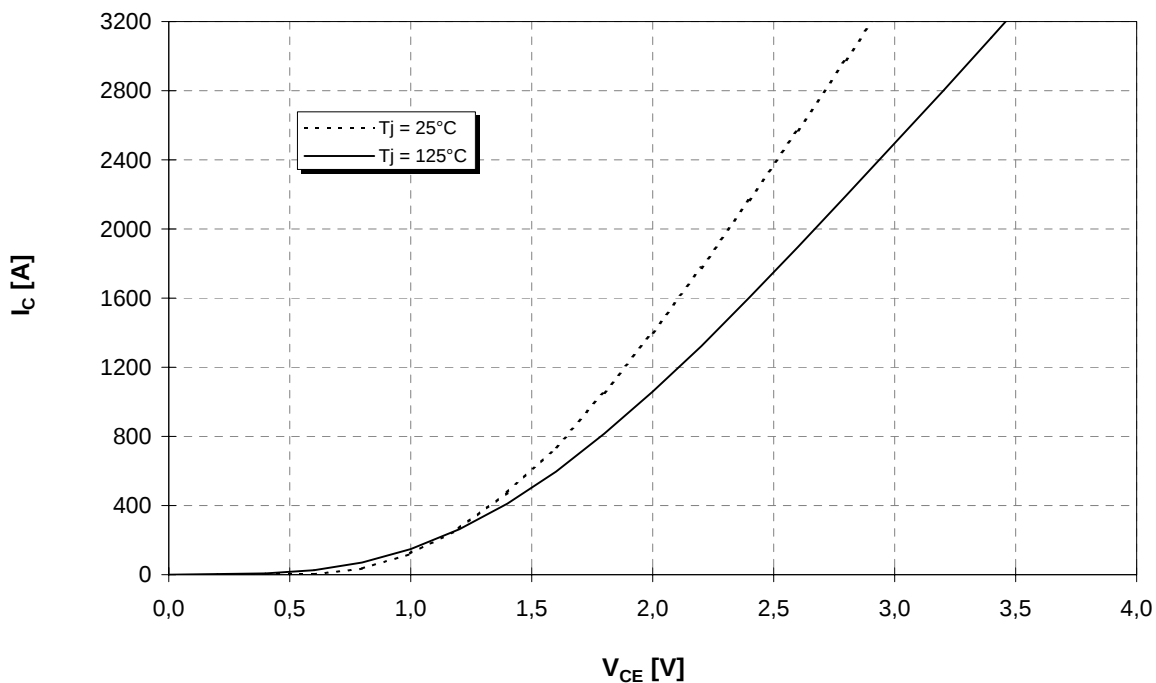
This technical information specifies semiconductor devices but promises no characteristics. It is
valid in combination with the belonging technical notes.



Ausgangskennlinie (typisch)
Output characteristic (typical)

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

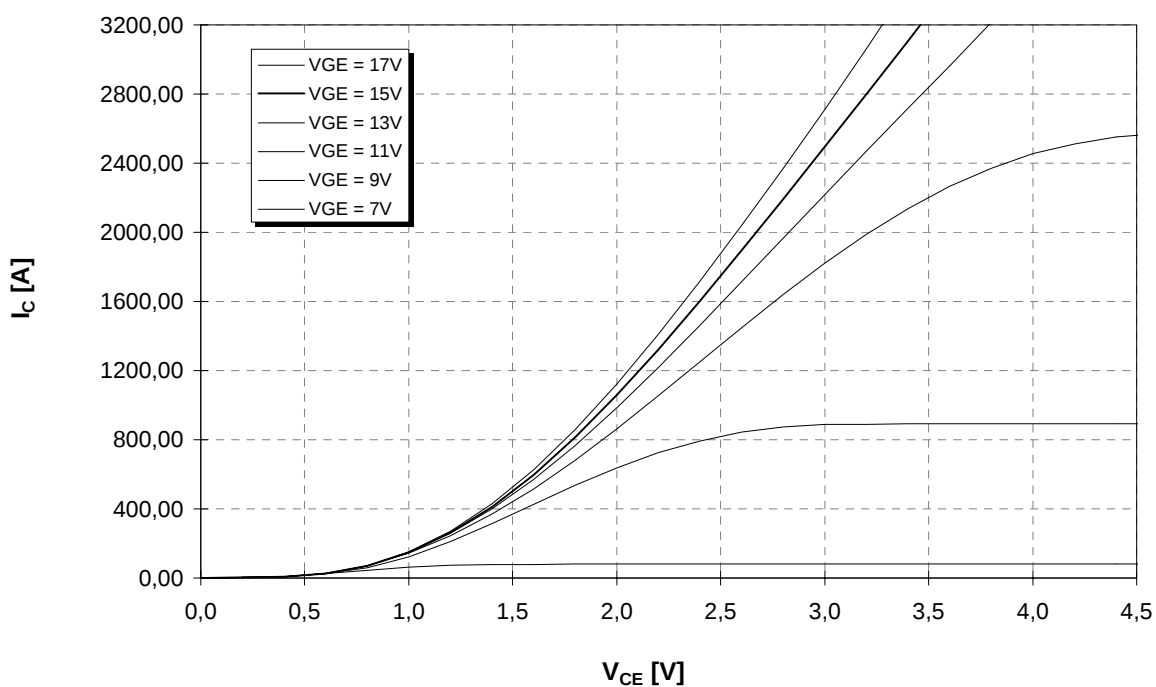
$V_{GE} = 15V$

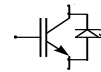


Ausgangskennlinienfeld (typisch)
Output characteristic (typical)

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

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

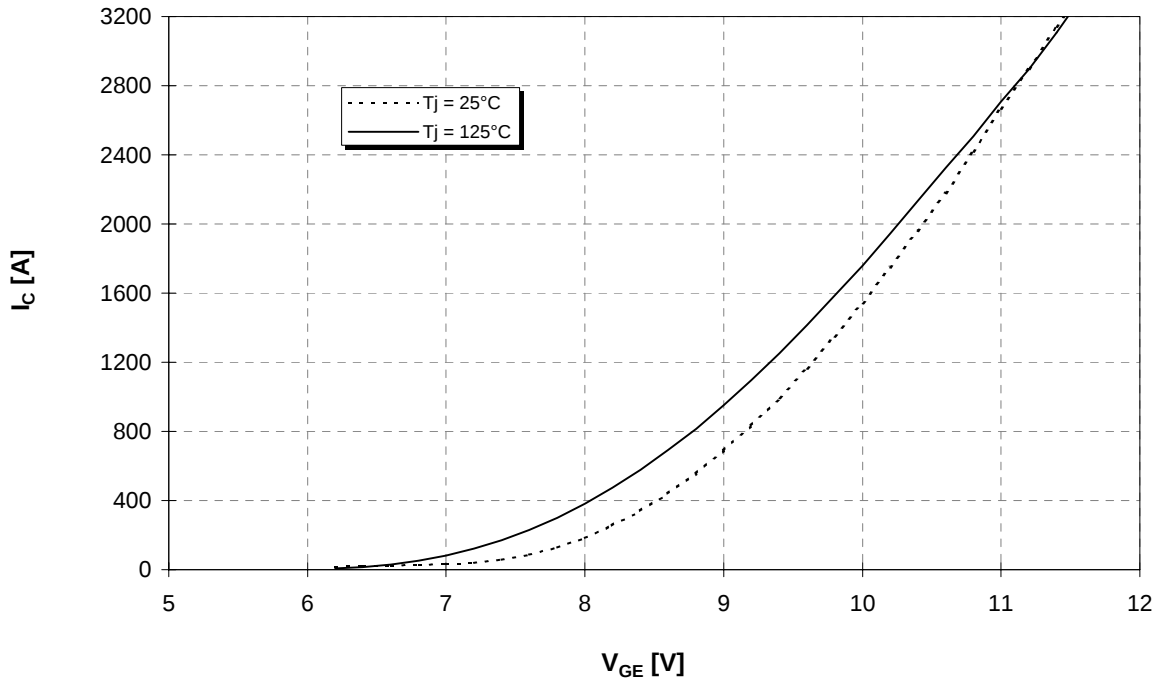




Übertragungscharakteristik (typisch)
Transfer characteristic (typical)

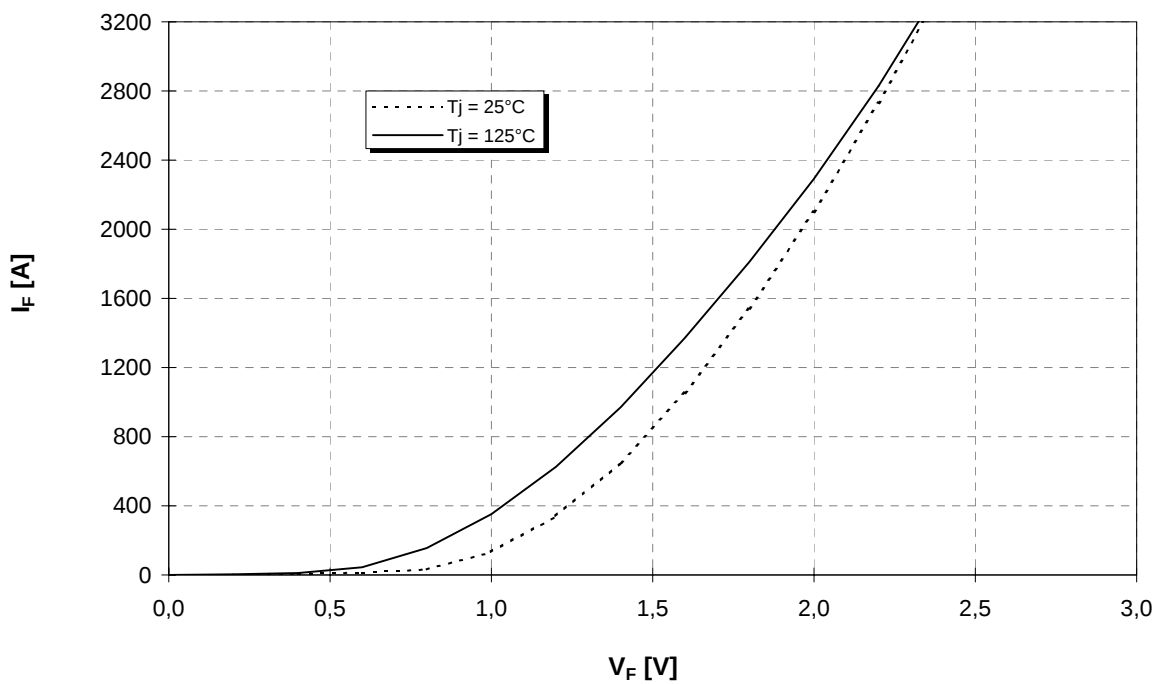
$$I_C = f(V_{GE})$$

$V_{CE} = 20V$



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

$$I_F = f(V_F)$$

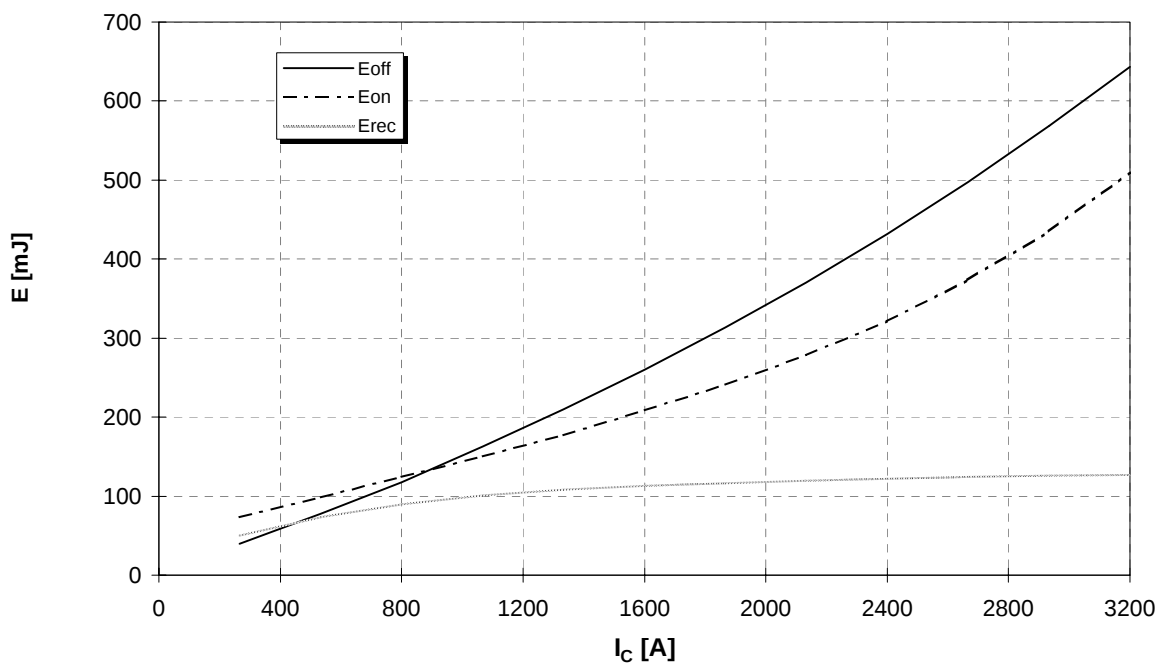




Schaltverluste (typisch)
Switching losses (typical)

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

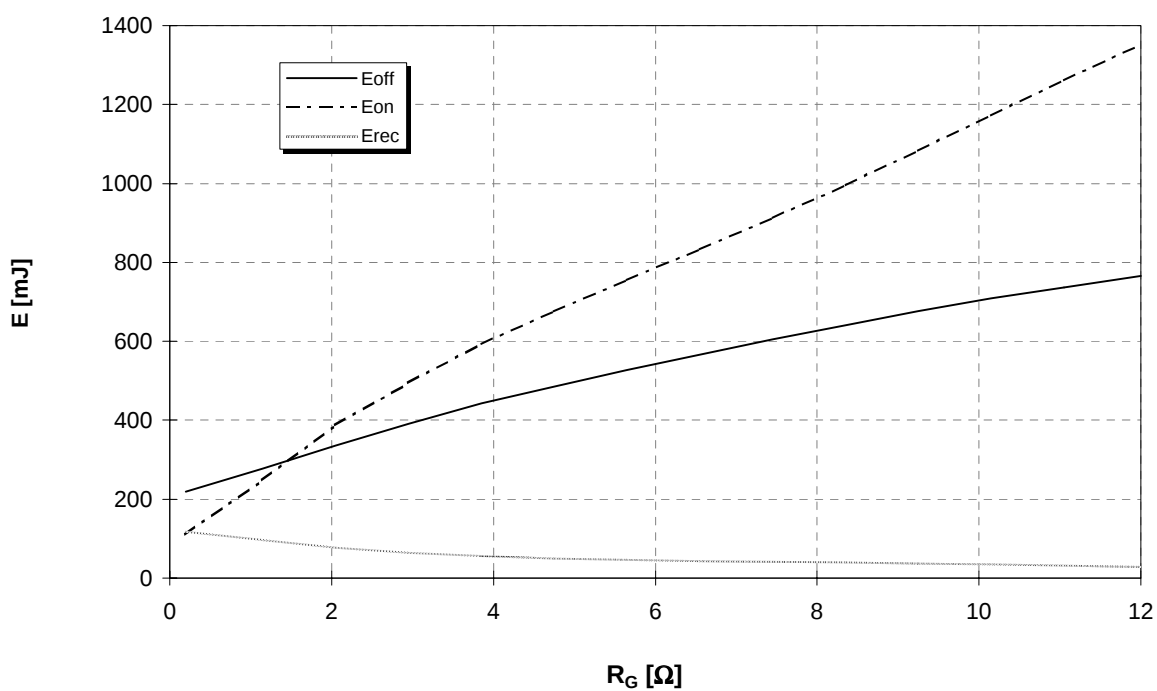
$R_{gon} = R_{goff} = 0,91 \, \Omega, V_{CE} = 600V, T_J = 125^\circ C$



Schaltverluste (typisch)
Switching losses (typical)

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

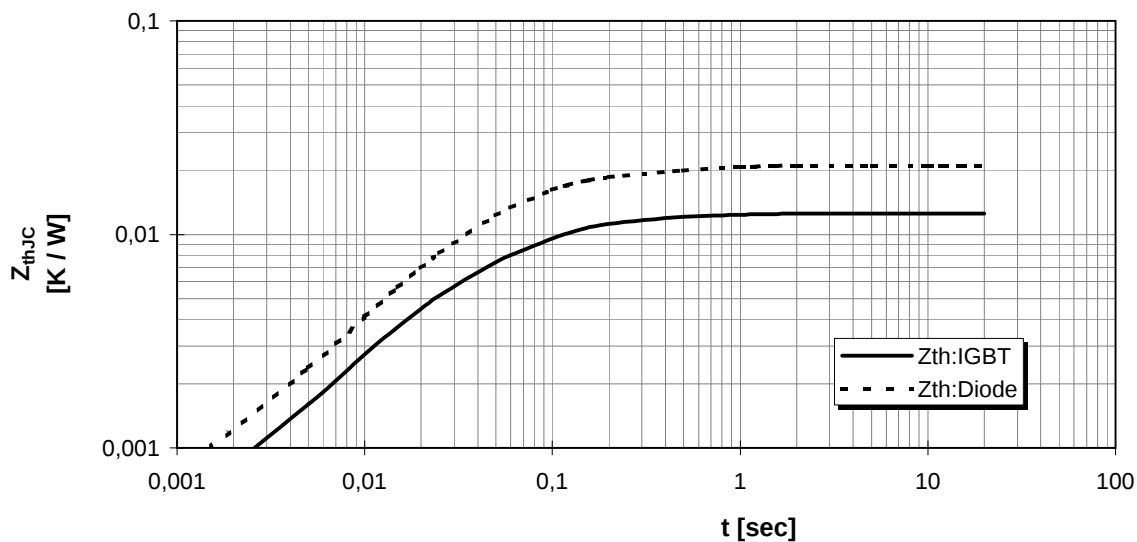
$I_C = 1600A, V_{CE} = 600V, T_J = 125^\circ C$





Transienter Wärmewiderstand Transient thermal impedance

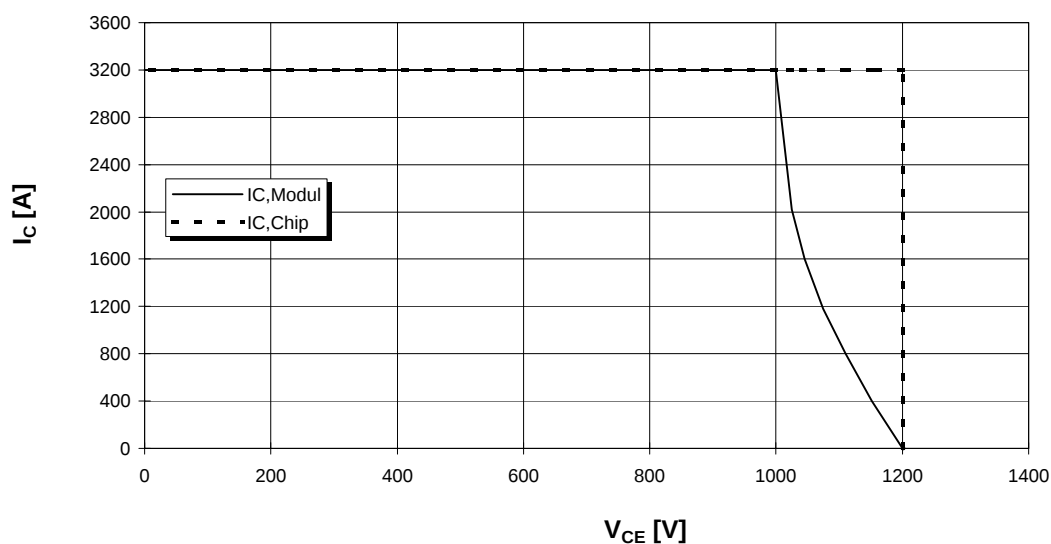
$$Z_{thJC} = f(t)$$

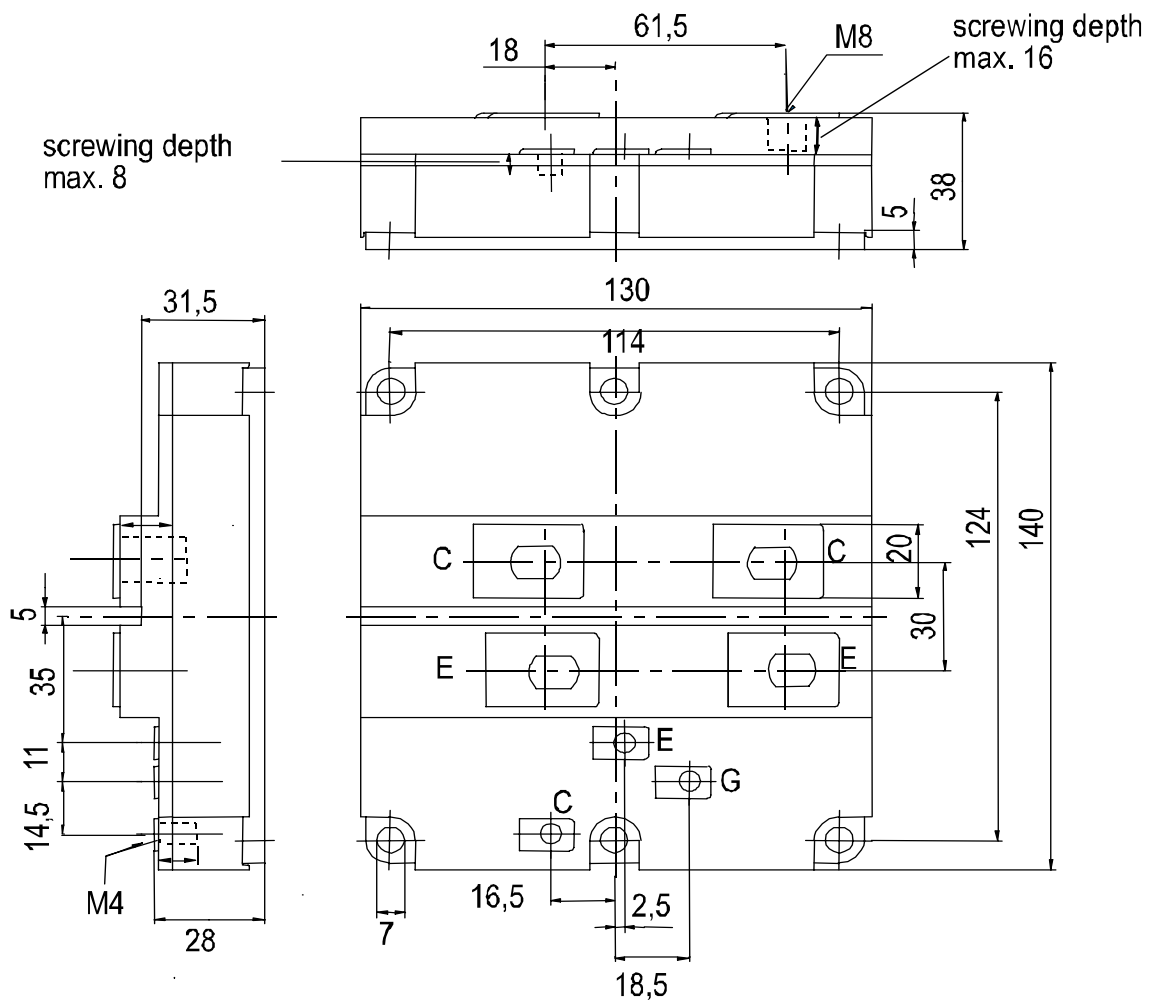
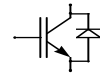


i	1	2	3	4
r_i [K/kW] : IGBT	0,21	3,98	7,32	0,99
τ_i [sec] : IGBT	0,00006	0,0187	0,080	0,50
r_i [K/kW] : Diode	0,32	4,70	2,93	13,05
τ_i [sec] : Diode	0,00014	0,0218	0,060	0,50

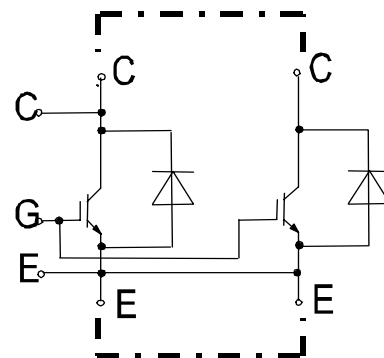
Sicherer Arbeitsbereich (RBSOA)

Reverse bias safe operation area (RBSOA) $R_g = 0,91\Omega$, $T_{vj} = 125^\circ\text{C}$





external connections (to be done)



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