

Gehäuse vom 6,5kV Modul  
housing from 6,5kV Module

**Vorläufige Daten**  
**preliminary data**

**IGBT-Wechselrichter/IGBT-inverter**  
**Höchstzulässige Werte/maximum rated values**

Kollektor-Emitter-Sperrspannung collector-emitter voltage	$T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = -25^{\circ}\text{C}$	$V_{CES}$	3300 3300	V
Kollektor-Dauergleichstrom DC-collector current	$T_C = 80^{\circ}\text{C}$ $T_C = 25^{\circ}\text{C}$	$I_{C\ nom}$ $I_C$	1200 2000	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	$T_C = 25^{\circ}\text{C}$	$P_{tot}$	14,5	kW
Gate-Emitter-Spitzenspannung gate-emitter peak voltage		$V_{GES}$	+/-20	V

**Charakteristische Werte/characteristic values**

			min.	typ.	max.	
Kollektor-Emitter Sättigungsspannung collector-emitter saturation voltage	$I_C = 1200\ \text{A}$ , $V_{GE} = 15\ \text{V}$ , $T_{vj} = 25^{\circ}\text{C}$ $I_C = 1200\ \text{A}$ , $V_{GE} = 15\ \text{V}$ , $T_{vj} = 125^{\circ}\text{C}$	$V_{CE\ sat}$		3,40 4,30	4,25 5,00	V V
Gate-Schwellenspannung gate threshold voltage	$I_C = 120\ \text{mA}$ , $V_{CE} = V_{GE}$ , $T_{vj} = 25^{\circ}\text{C}$	$V_{GEth}$	4,2	5,1	6,0	V
Gateladung gate charge	$V_{GE} = -15\ \text{V} \dots +15\ \text{V}$ , $V_{CE} = 1800\ \text{V}$	$Q_G$		22,0		$\mu\text{C}$
Interner Gatewiderstand internal gate resistor	$T_{vj} = 25^{\circ}\text{C}$	$R_{Gint}$		0,42		$\Omega$
Eingangskapazität input capacitance	$f = 1\ \text{MHz}$ , $T_{vj} = 25^{\circ}\text{C}$ , $V_{CE} = 25\ \text{V}$ , $V_{GE} = 0\ \text{V}$	$C_{ies}$		150		nF
Rückwirkungskapazität reverse transfer capacitance	$f = 1\ \text{MHz}$ , $T_{vj} = 25^{\circ}\text{C}$ , $V_{CE} = 25\ \text{V}$ , $V_{GE} = 0\ \text{V}$	$C_{res}$		8,00		nF
Kollektor-Emitter Reststrom collector-emitter cut-off current	$V_{CE} = 3300\ \text{V}$ , $V_{GE} = 0\ \text{V}$ , $T_{vj} = 25^{\circ}\text{C}$	$I_{CES}$			5,0	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
Einschaltverzögerungszeit (ind. Last) turn-on delay time (inductive load)	$I_C = 1200\ \text{A}$ , $V_{CE} = 1800\ \text{V}$ $V_{GE} = \pm 15\ \text{V}$ , $R_{Gon} = 2,7\ \Omega$ , $C_{GE} = 220\ \text{nF}$ , $T_{vj} = 25^{\circ}\text{C}$ $V_{GE} = \pm 15\ \text{V}$ , $R_{Gon} = 2,7\ \Omega$ , $C_{GE} = 220\ \text{nF}$ , $T_{vj} = 125^{\circ}\text{C}$	$t_{d\ on}$		0,70 0,65		$\mu\text{s}$ $\mu\text{s}$
Anstiegszeit (induktive Last) rise time (inductive load)	$I_C = 1200\ \text{A}$ , $V_{CE} = 1800\ \text{V}$ $V_{GE} = \pm 15\ \text{V}$ , $R_{Gon} = 2,7\ \Omega$ , $C_{GE} = 220\ \text{nF}$ , $T_{vj} = 25^{\circ}\text{C}$ $V_{GE} = \pm 15\ \text{V}$ , $R_{Gon} = 2,7\ \Omega$ , $C_{GE} = 220\ \text{nF}$ , $T_{vj} = 125^{\circ}\text{C}$	$t_r$		0,45 0,48		$\mu\text{s}$ $\mu\text{s}$
Abschaltverzögerungszeit (ind. Last) turn-off delay time (inductive load)	$I_C = 1200\ \text{A}$ , $V_{CE} = 1800\ \text{V}$ $V_{GE} = \pm 15\ \text{V}$ , $R_{Goff} = 1,8\ \Omega$ , $C_{GE} = 220\ \text{nF}$ , $T_{vj} = 25^{\circ}\text{C}$ $V_{GE} = \pm 15\ \text{V}$ , $R_{Goff} = 1,8\ \Omega$ , $C_{GE} = 220\ \text{nF}$ , $T_{vj} = 125^{\circ}\text{C}$	$t_{d\ off}$		1,90 2,10		$\mu\text{s}$ $\mu\text{s}$
Fallzeit (induktive Last) fall time (inductive load)	$I_C = 1200\ \text{A}$ , $V_{CE} = 1800\ \text{V}$ $V_{GE} = \pm 15\ \text{V}$ , $R_{Goff} = 1,8\ \Omega$ , $C_{GE} = 220\ \text{nF}$ , $T_{vj} = 25^{\circ}\text{C}$ $V_{GE} = \pm 15\ \text{V}$ , $R_{Goff} = 1,8\ \Omega$ , $C_{GE} = 220\ \text{nF}$ , $T_{vj} = 125^{\circ}\text{C}$	$t_f$		0,20 0,20		$\mu\text{s}$ $\mu\text{s}$
Einschaltverlustenergie pro Puls turn-on energy loss per pulse	$I_C = 1200\ \text{A}$ , $V_{CE} = 1800\ \text{V}$ , $L_S = 60\ \text{nH}$ $V_{GE} = \pm 15\ \text{V}$ , $R_{Gon} = 1,2\ \Omega$ , $C_{GE} = 220\ \text{nF}$ , $T_{vj} = 25^{\circ}\text{C}$ $V_{GE} = \pm 15\ \text{V}$ , $R_{Gon} = 1,2\ \Omega$ , $C_{GE} = 220\ \text{nF}$ , $T_{vj} = 125^{\circ}\text{C}$	$E_{on}$		1500 2300		mJ mJ
Abschaltverlustenergie pro Puls turn-off energy loss per pulse	$I_C = 1200\ \text{A}$ , $V_{CE} = 1800\ \text{V}$ , $L_S = 60\ \text{nH}$ $V_{GE} = \pm 15\ \text{V}$ , $R_{Goff} = 1,8\ \Omega$ , $C_{GE} = 220\ \text{nF}$ , $T_{vj} = 25^{\circ}\text{C}$ $V_{GE} = \pm 15\ \text{V}$ , $R_{Goff} = 1,8\ \Omega$ , $C_{GE} = 220\ \text{nF}$ , $T_{vj} = 125^{\circ}\text{C}$	$E_{off}$		1500 1800		mJ mJ
Kurzschlußverhalten SC data	$t_P \leq 10\ \mu\text{s}$ , $V_{GE} \leq 15\ \text{V}$ $T_{vj} \leq 125^{\circ}\text{C}$ , $V_{CC} = 2500\ \text{V}$ , $V_{CEmax} = V_{CES} - L_{sCE} \cdot di/dt$	$I_{SC}$		6000		A
Innerer Wärmewiderstand thermal resistance, junction to case	pro IGBT per IGBT	$R_{thJC}$			8,50	K/kW
Übergangs-Wärmewiderstand thermal resistance, case to heatsink	pro IGBT / per IGBT $\lambda_{paste} = 1\ \text{W}/(\text{m}\cdot\text{K})$ / $\lambda_{grease} = 1\ \text{W}/(\text{m}\cdot\text{K})$	$R_{thCH}$		9,00		K/kW

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**Vorläufige Daten**  
**preliminary data**

**Diode-Wechselrichter/diode-inverter**  
**Höchstzulässige Werte/maximum rated values**

Periodische Spitzensperrspannung repetitive peak reverse voltage	$T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = -25^{\circ}\text{C}$	$V_{RRM}$	3300 3300	V
Dauergleichstrom DC forward current		$I_F$	1200	A
Periodischer Spitzenstrom repetitive peak forward current	$t_P = 1 \text{ ms}$	$I_{FRM}$	2400	A
Grenzlastintegral $I^2t$ - value	$V_R = 0 \text{ V}, t_P = 10 \text{ ms}, T_{vj} = 125^{\circ}\text{C}$	$I^2t$	500	$\text{kA}^2\text{s}$
Spitzenverlustleistung maximum power dissipation	$T_{vj} = 125^{\circ}\text{C}$	$P_{RQM}$	2400	kW
Mindesteinschaltdauer minimum turn-on time		$t_{Fon \text{ min}}$	10,0	$\mu\text{s}$

**Charakteristische Werte/characteristic values**

			min.	typ.	max.	
Durchlassspannung forward voltage	$I_F = 1200 \text{ A}, V_{GE} = 0 \text{ V}, T_{vj} = 25^{\circ}\text{C}$	$V_F$		2,80	3,50	V
	$I_F = 1200 \text{ A}, V_{GE} = 0 \text{ V}, T_{vj} = 125^{\circ}\text{C}$			2,80	3,50	V
Rückstromspitze peak reverse recovery current	$I_F = 1200 \text{ A}, -di_F/dt = 5500 \text{ A}/\mu\text{s}$	$I_{RM}$		1500		A
	$V_R = 1800 \text{ V}, V_{GE} = -15 \text{ V}, T_{vj} = 25^{\circ}\text{C}$ $V_R = 1800 \text{ V}, V_{GE} = -15 \text{ V}, T_{vj} = 125^{\circ}\text{C}$			1650		A
Sperrverzögerungsladung recovered charge	$I_F = 1200 \text{ A}, -di_F/dt = 5500 \text{ A}/\mu\text{s}$	$Q_r$		710		$\mu\text{C}$
	$V_R = 1800 \text{ V}, V_{GE} = -15 \text{ V}, T_{vj} = 25^{\circ}\text{C}$ $V_R = 1800 \text{ V}, V_{GE} = -15 \text{ V}, T_{vj} = 125^{\circ}\text{C}$			1300		$\mu\text{C}$
Abschaltenergie pro Puls reverse recovery energy	$I_F = 1200 \text{ A}, -di_F/dt = 5500 \text{ A}/\mu\text{s}$	$E_{rec}$		780		mJ
	$V_R = 1800 \text{ V}, V_{GE} = -15 \text{ V}, T_{vj} = 25^{\circ}\text{C}$ $V_R = 1800 \text{ V}, V_{GE} = -15 \text{ V}, T_{vj} = 125^{\circ}\text{C}$			1600		mJ
Innerer Wärmewiderstand thermal resistance, junction to case	pro Diode per diode	$R_{thJC}$			17,0	K/kW
Übergangs-Wärmewiderstand thermal resistance, case to heatsink	pro Diode / per diode $\lambda_{\text{Paste}} = 1 \text{ W}/(\text{m}\cdot\text{K})$ / $\lambda_{\text{grease}} = 1 \text{ W}/(\text{m}\cdot\text{K})$	$R_{thCH}$		18,0		K/kW

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**Modul/module**

Isolations-Prüfspannung insulation test voltage	RMS, f = 50 Hz, t = 1 min	V <sub>ISO</sub>	10		kV
Teilentladungs Aussetzspannung partial discharge extinction voltage	RMS, f = 50 Hz, Q <sub>PD</sub> typ. 10 pC (acc. to IEC 1287)	V <sub>ISO</sub>	5,1		kV
Material Modulgrundplatte material of module baseplate			AlSiC		
Material für innere Isolation material for internal insulation			AlN		
Kriechstrecke creepage distance	Kontakt - Kühlkörper / terminal to heatsink Kontakt - Kontakt / terminal to terminal		64,0 56,0		mm
Luftstrecke clearance distance	Kontakt - Kühlkörper / terminal to heatsink Kontakt - Kontakt / terminal to terminal		40,0 26,0		mm
Vergleichszahl der Kriechwegbildung comparative tracking index		CTI	> 600		
			min.	typ.	max.
Übergangs-Wärmewiderstand thermal resistance, case to heatsink	pro Modul / per module $\lambda_{\text{Paste}} = 1 \text{ W/(m}\cdot\text{K)} / \lambda_{\text{grease}} = 1 \text{ W/(m}\cdot\text{K)}$	R <sub>thCH</sub>		6,00	K/kW
Modulinduktivität stray inductance module		L <sub>sCE</sub>		18	nH
Modulleitungswiderstand, Anschlüsse - Chip module lead resistance, terminals - chip	T <sub>C</sub> = 25°C, pro Schalter / per switch	R <sub>CC+EE'</sub>		0,12	mΩ
Höchstzulässige Sperrschichttemperatur maximum junction temperature		T <sub>vj max</sub>			150 °C
Temperatur im Schaltbetrieb temperature under switching conditions		T <sub>vj op</sub>	-40		125 °C
Lagertemperatur storage temperature		T <sub>stg</sub>	-40		125 °C
Anzugsdrehmoment f. mech. Befestigung mounting torque	Schraube / screw M6	M	4,25	-	5,75 Nm
Anzugsdrehmoment f. elektr. Anschlüsse terminal connection torque	Schraube / screw M4 Schraube / screw M8	M	1,8 8,0	- -	2,1 10 Nm
Gewicht weight		G		1400	g

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

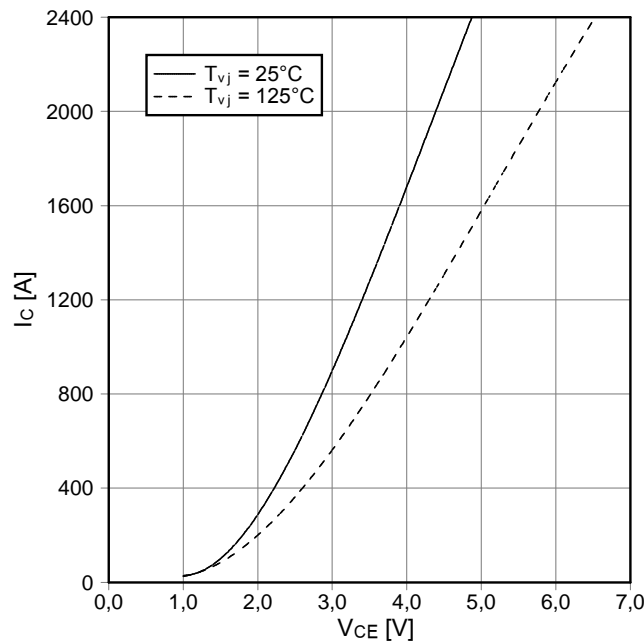
**This technical information specifies semiconductor devices but guarantees no characteristics. It is valid with the appropriate technical explanations.**

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**Vorläufige Daten**  
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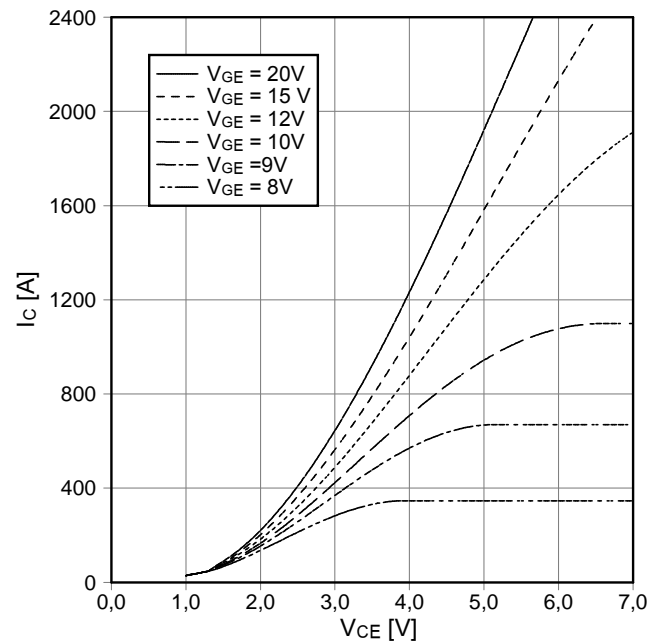
**Ausgangskennlinie IGBT-Wechselr. (typisch)**  
**output characteristic IGBT-inverter (typical)**

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



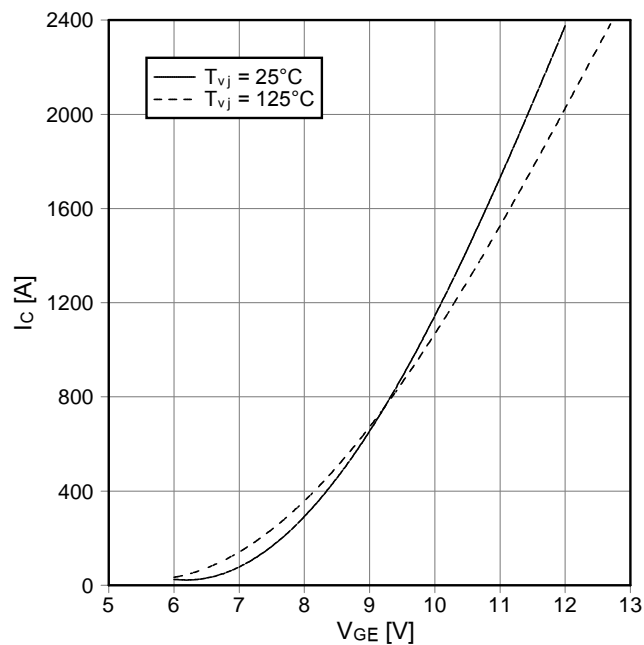
**Ausgangskennlinienfeld IGBT-Wechselr. (typisch)**  
**output characteristic IGBT-inverter (typical)**

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



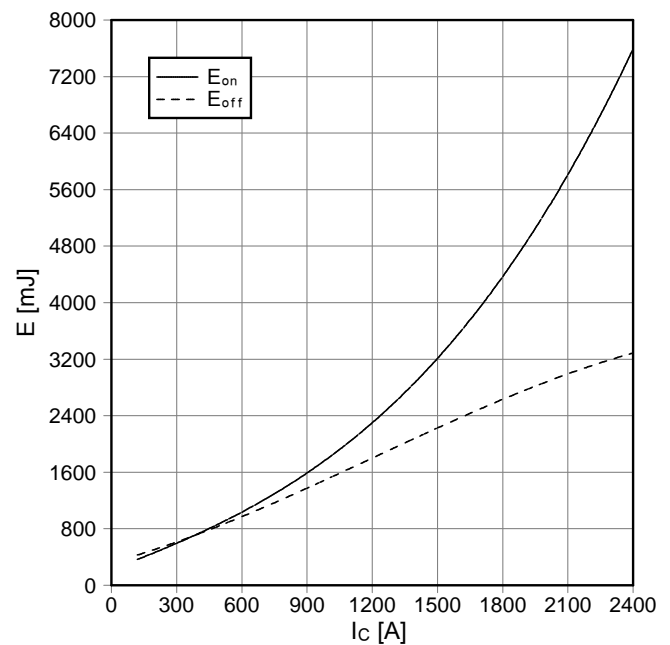
**Übertragungscharakteristik IGBT-Wechselr. (typisch)**  
**transfer characteristic IGBT-inverter (typical)**

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



**Schaltverluste IGBT-Wechselr. (typisch)**  
**switching losses IGBT-inverter (typical)**

$E_{on} = f(I_c)$ ,  $E_{off} = f(I_c)$   
 $V_{GE} = \pm 15\text{ V}$ ,  $R_{Gon} = 1,2\ \Omega$ ,  $R_{Goff} = 1,8\ \Omega$ ,  $V_{CE} = 1800\text{ V}$ ,  
 $T_{vj} = 125^\circ\text{C}$ ,  $C_{GE} = 220\text{ nF}$

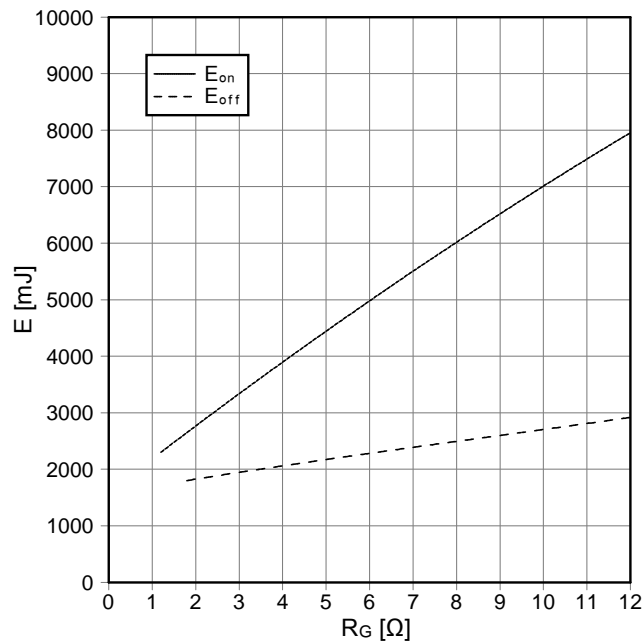


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**Vorläufige Daten**  
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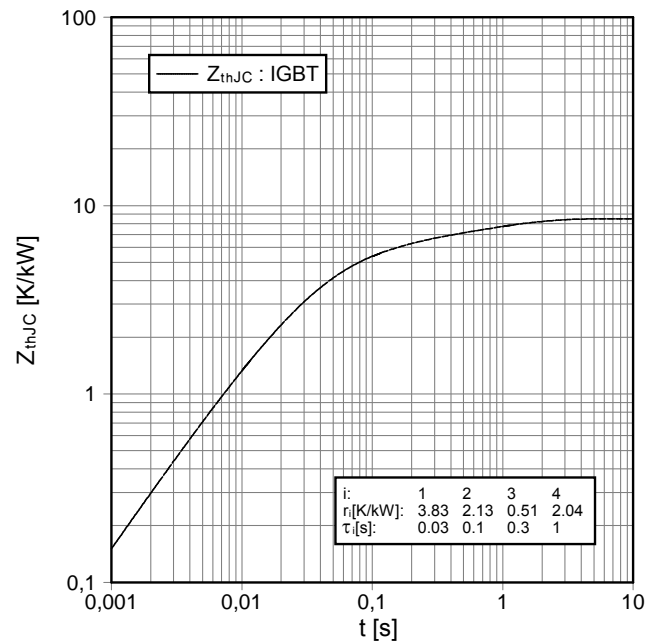
**Schaltverluste IGBT-Wechselr. (typisch)**  
**switching losses IGBT-inverter (typical)**

$E_{on} = f(R_G)$ ,  $E_{off} = f(R_G)$   
 $V_{GE} = \pm 15 \text{ V}$ ,  $I_C = 1200 \text{ A}$ ,  $V_{CE} = 1800 \text{ V}$ ,  $T_{vj} = 125^\circ\text{C}$ ,  
 $C_{GE} = 220 \text{ nF}$



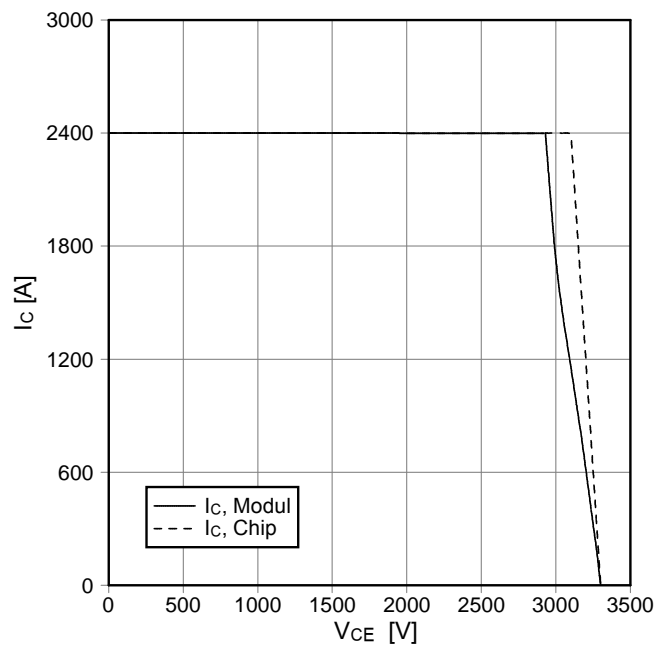
**Transienter Wärmewiderstand IGBT-Wechselr.**  
**transient thermal impedance IGBT-inverter**

$Z_{thJC} = f(t)$



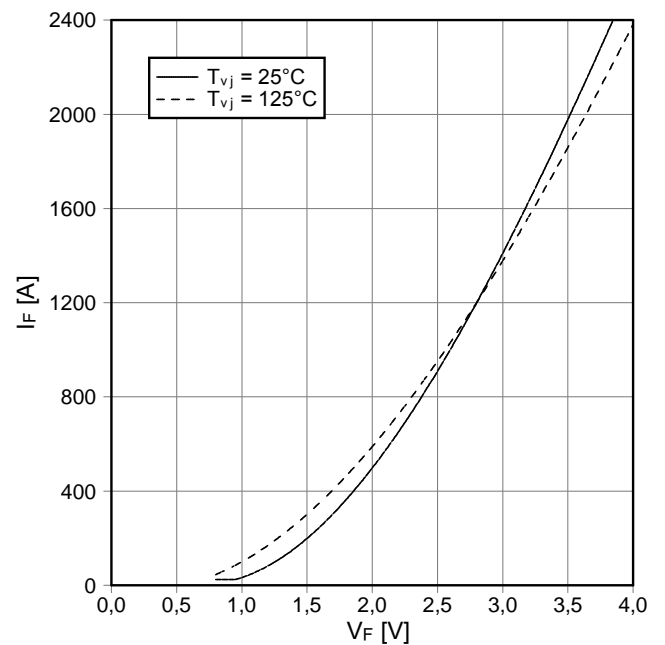
**Sicherer Rückwärts-Arbeitsbereich IGBT-Wr. (RBSOA)**  
**reverse bias safe operating area IGBT-inv. (RBSOA)**

$I_C = f(V_{CE})$   
 $V_{GE} = \pm 15 \text{ V}$ ,  $R_{Goff} = 1,8 \text{ } \Omega$ ,  $T_{vj} = 125^\circ\text{C}$ ,  $C_{GE} = 220 \text{ nF}$



**Durchlaßkennlinie der Diode-Wechselr. (typisch)**  
**forward characteristic of diode-inverter (typical)**

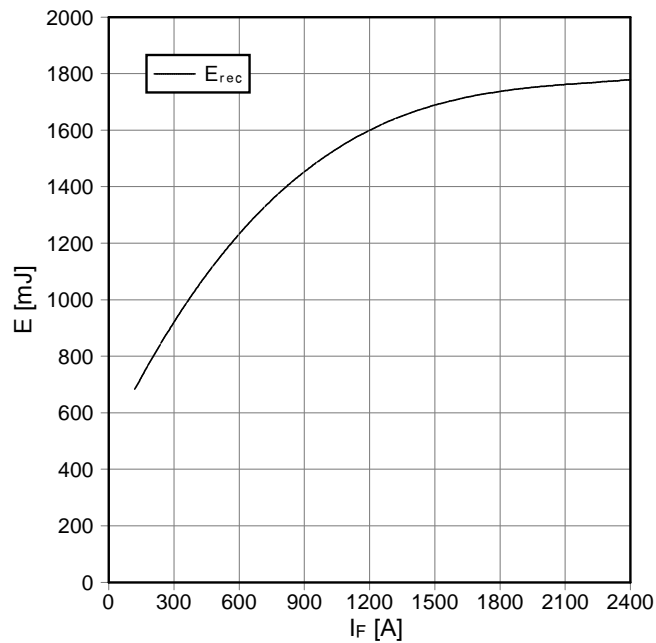
$I_F = f(V_F)$



**Vorläufige Daten**  
**preliminary data**

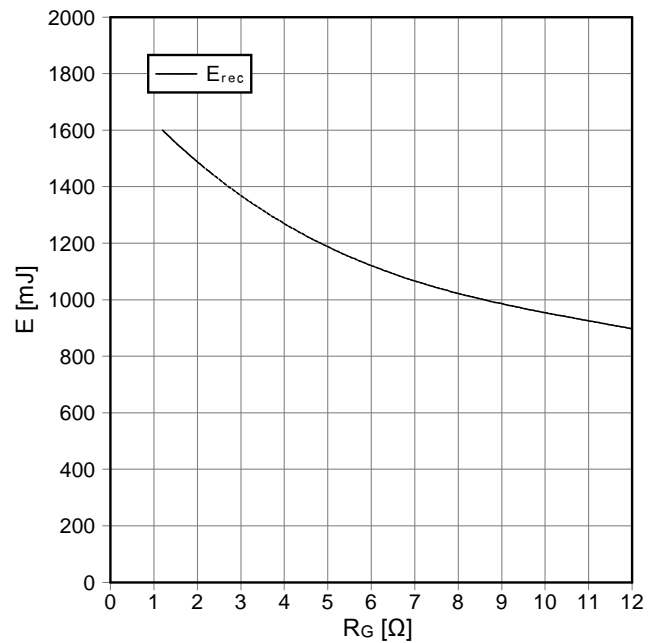
**Schaltverluste Diode-Wechselr. (typisch)**  
**switching losses diode-inverter (typical)**

$E_{rec} = f(I_C)$   
 $R_{Gon} = 1,2 \Omega, V_{CE} = 1800 V, T_{vj} = 125^\circ C$



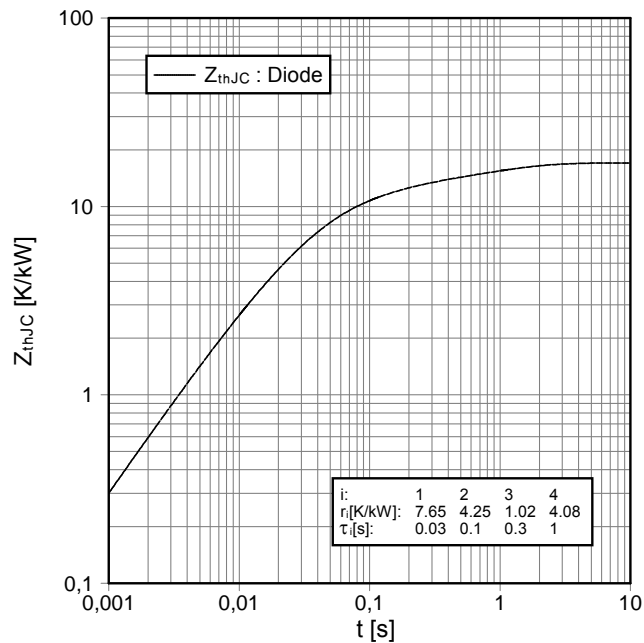
**Schaltverluste Diode-Wechselr. (typisch)**  
**switching losses diode-inverter (typical)**

$E_{rec} = f(R_G)$   
 $I_F = 1200 A, V_{CE} = 1800 V, T_{vj} = 125^\circ C$



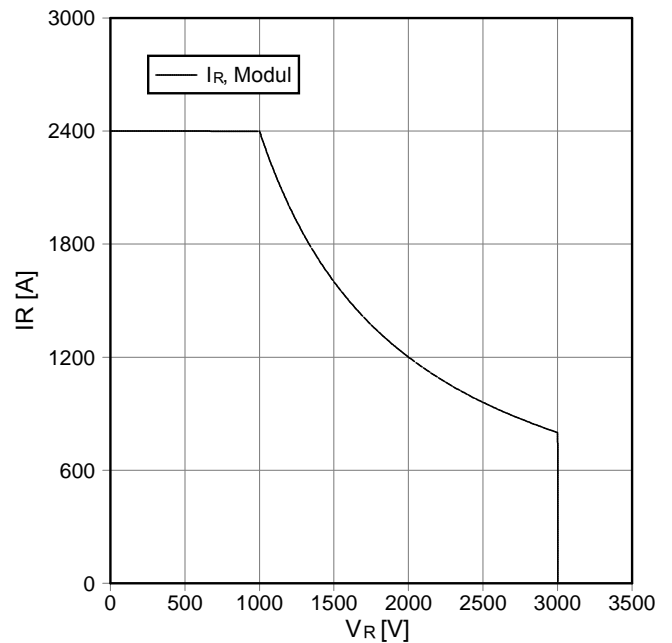
**Transienter Wärmewiderstand Diode-Wechselr.**  
**transient thermal impedance diode-inverter**

$Z_{thJC} = f(t)$



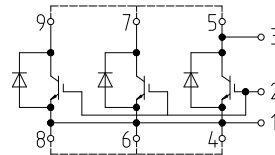
**Sicherer Arbeitsbereich Diode-Wechselr. (SOA)**  
**safe operation area diode-inverter (SOA)**

$I_R = f(V_R)$   
 $T_{vj} = 125^\circ C$



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Schaltplan/circuit diagram



Gehäuseabmessungen/package outlines

