

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		μC
Interner Gatewiderstand internal gate resistor	$T_{vj} = 25^{\circ}\text{C}$	R_{Gint}		0,42		Ω
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		μs μs
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		μs μs
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		μs μs
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		μs μs
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

prepared by: Alfons Wiesenthal	date of publication: 2003-7-8
approved by: Thomas Schütze	revision: 2.0

Vorläufige Daten
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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	kA^2s
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	μs

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		μC
	$V_R = 1800 \text{ V}, V_{GE} = -15 \text{ V}, T_{vj} = 25^{\circ}\text{C}$ $V_R = 1800 \text{ V}, V_{GE} = -15 \text{ V}, T_{vj} = 125^{\circ}\text{C}$			1300		μC
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 _{ISO}	10		kV
Teilentladungs Aussetzspannung partial discharge extinction voltage	RMS, f = 50 Hz, Q _{PD} typ. 10 pC (acc. to IEC 1287)	V _{ISO}	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 $\lambda_{\text{Paste}} = 1 \text{ W}/(\text{m}\cdot\text{K}) / \lambda_{\text{Grease}} = 1 \text{ W}/(\text{m}\cdot\text{K})$	R _{thCH}	6,00		K/kW
Modulinduktivität stray inductance module		L _{sCE}	18		nH
Modulleitungswiderstand, Anschlüsse - Chip module lead resistance, terminals - chip	T _C = 25°C, pro Schalter / per switch	R _{CC+EE'}	0,12		mΩ
Höchstzulässige Sperrschichttemperatur maximum junction temperature		T _{vj max}		150	°C
Temperatur im Schaltbetrieb temperature under switching conditions		T _{vj op}	-40	125	°C
Lagertemperatur storage temperature		T _{stg}	-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.

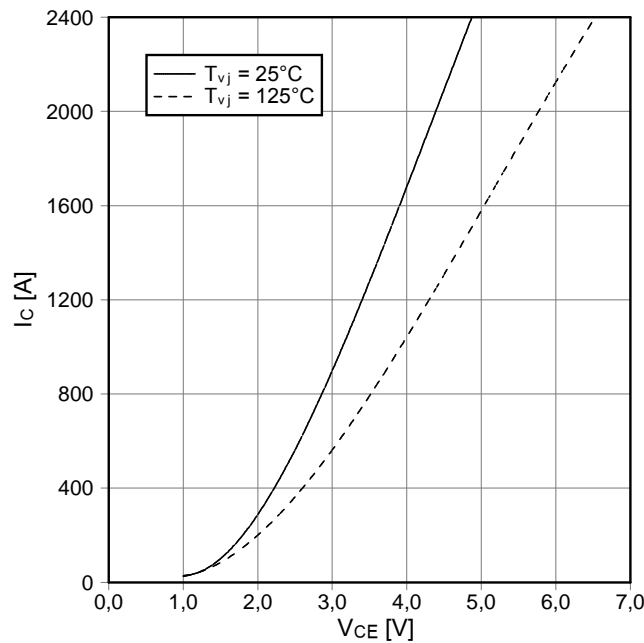
This technical information specifies semiconductor devices but guarantees no characteristics. It is valid with the appropriate technical explanations.

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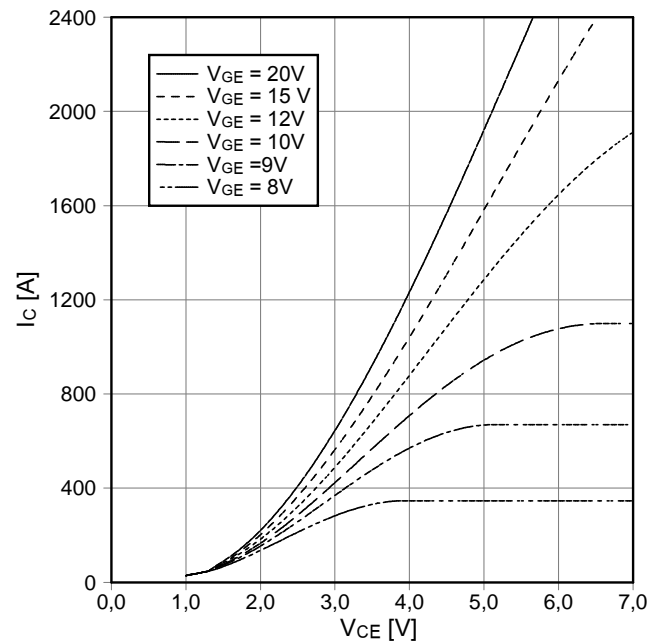
Ausgangskennlinie IGBT-Wechselr. (typisch)
output characteristic IGBT-inverter (typical)

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



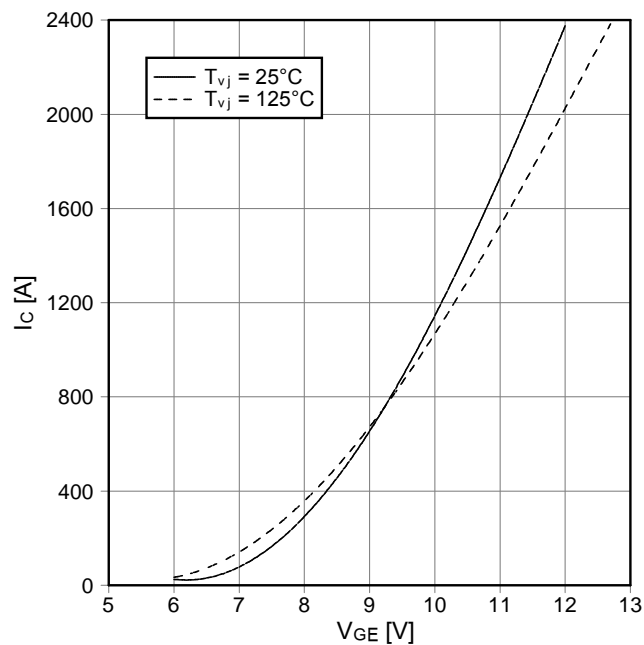
Ausgangskennlinienfeld IGBT-Wechselr. (typisch)
output characteristic IGBT-inverter (typical)

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



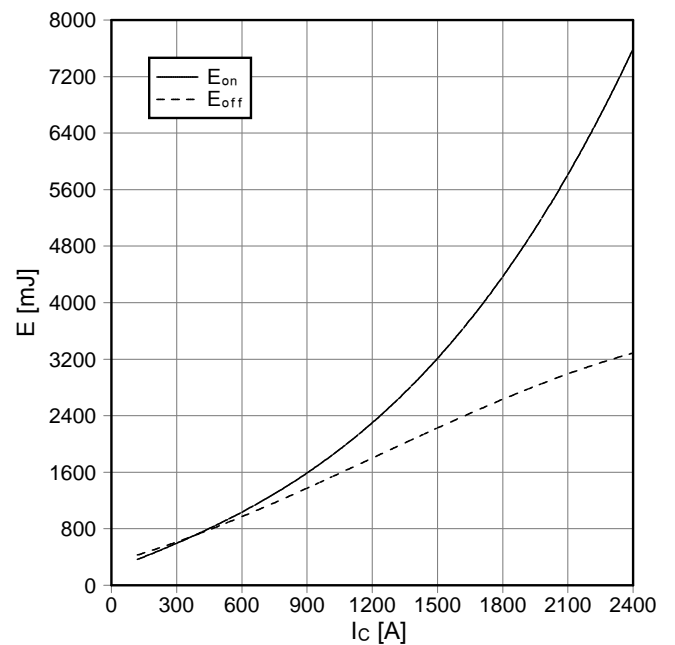
Übertragungscharakteristik IGBT-Wechselr. (typisch)
transfer characteristic IGBT-inverter (typical)

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



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

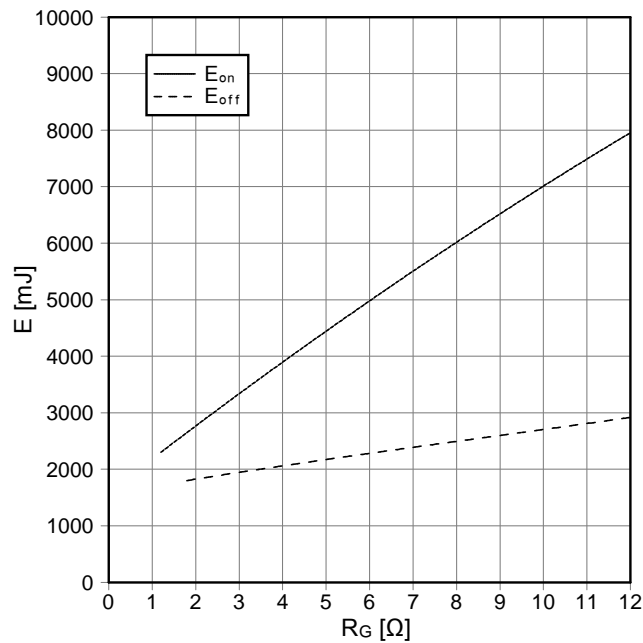
$E_{on} = f(I_c)$, $E_{off} = f(I_c)$
 $V_{GE} = \pm 15\text{ V}$, $R_{Gon} = 1,2\ \Omega$, $R_{Goff} = 1,8\ \Omega$, $V_{CE} = 1800\text{ V}$,
 $T_{vj} = 125^\circ\text{C}$, $C_{GE} = 220\text{ nF}$



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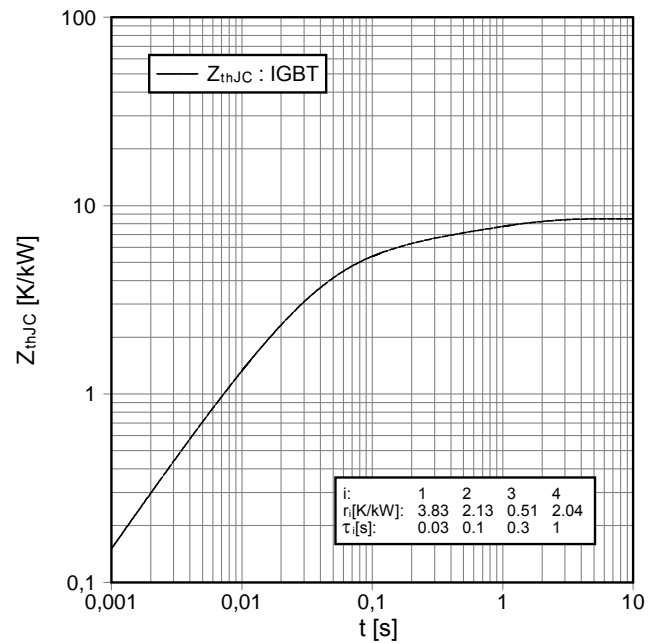
Schaltverluste IGBT-Wechselr. (typisch)
switching losses IGBT-inverter (typical)

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



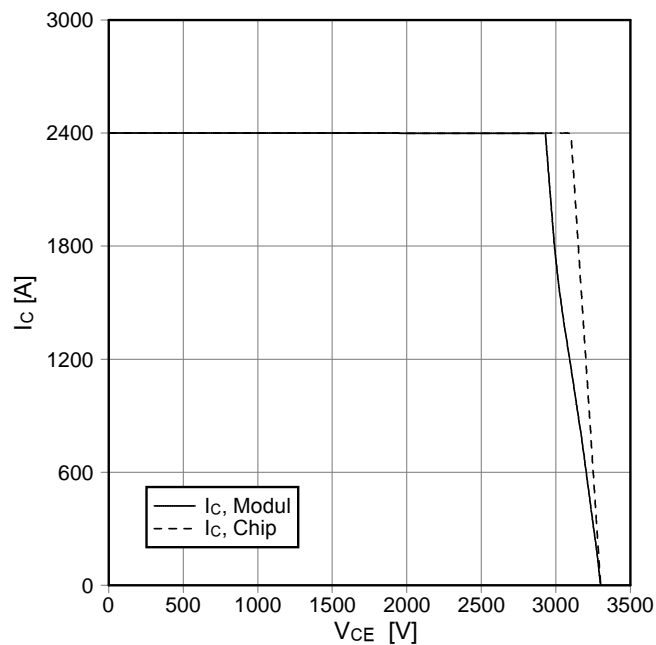
Transienter Wärmewiderstand IGBT-Wechselr.
transient thermal impedance IGBT-inverter

$Z_{thJC} = f(t)$



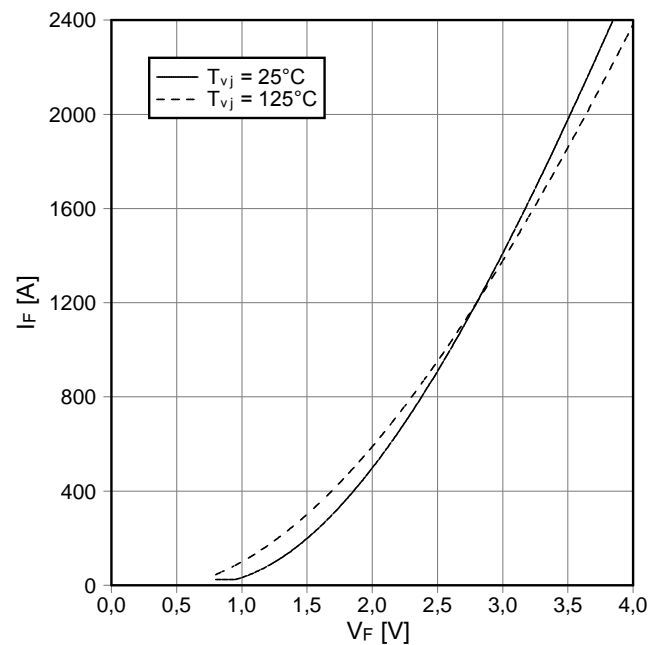
Sicherer Rückwärts-Arbeitsbereich IGBT-Wr. (RBSOA)
reverse bias safe operating area IGBT-inv. (RBSOA)

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



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

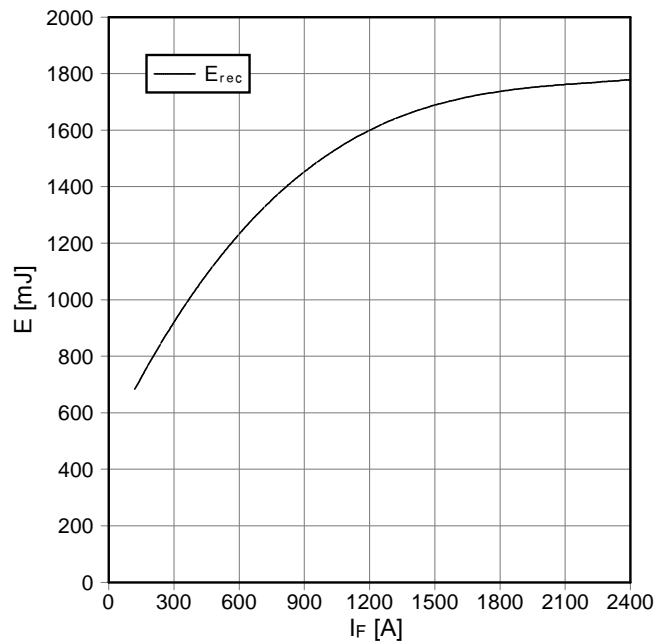
$I_F = f(V_F)$



Vorläufige Daten
preliminary data

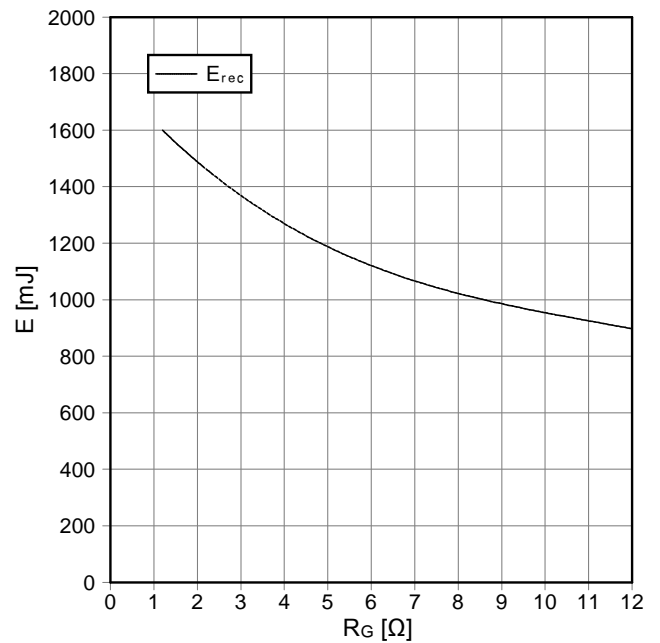
Schaltverluste Diode-Wechselr. (typisch)
switching losses diode-inverter (typical)

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



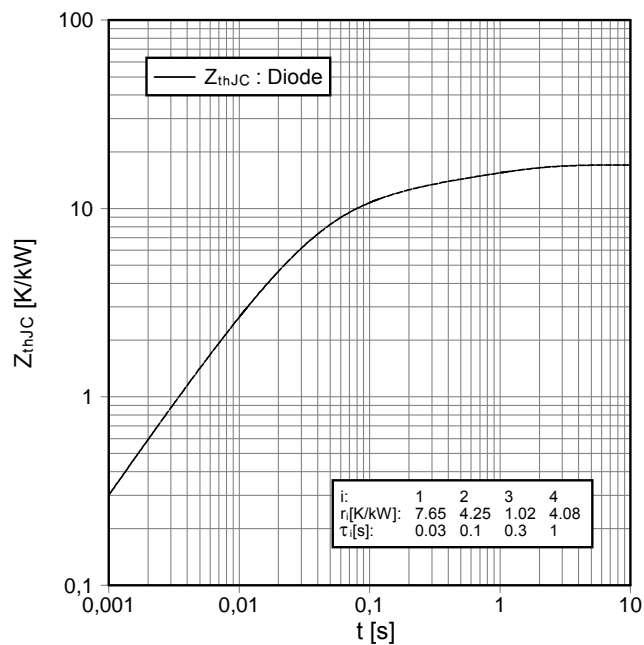
Schaltverluste Diode-Wechselr. (typisch)
switching losses diode-inverter (typical)

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



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

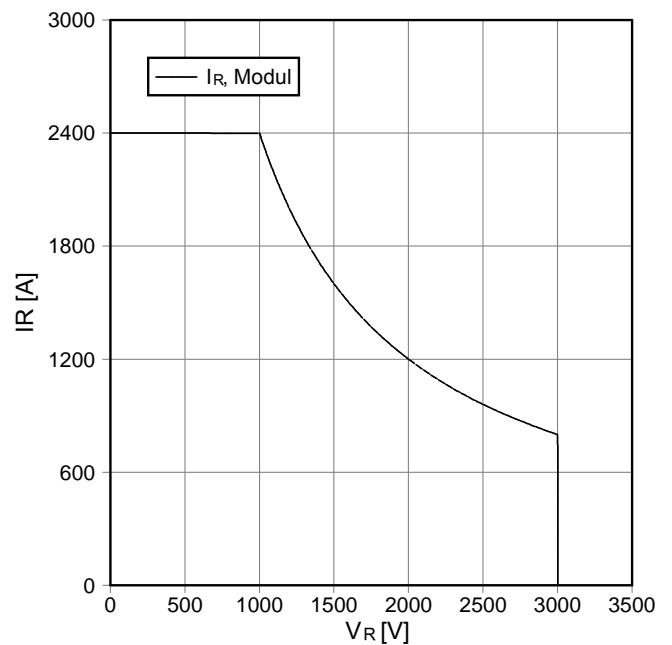
$Z_{thJC} = f(t)$



i:	1	2	3	4
r_i [K/kW]:	7.65	4.25	1.02	4.08
τ [s]:	0.03	0.1	0.3	1

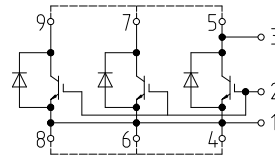
Sicherer Arbeitsbereich Diode-Wechselr. (SOA)
safe operation area diode-inverter (SOA)

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



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Schaltplan/circuit diagram



Gehäuseabmessungen/package outlines

