

**Vorläufige Daten  
preliminary data**

**IGBT-Wechselrichter / IGBT-inverter**

**Höchstzulässige Werte / maximum rated values**

Kollektor-Emitter-Sperrspannung collector-emitter voltage	$T_{vj} = 25^{\circ}\text{C}$	$V_{CES}$	1200	V
Kollektor-Dauergleichstrom DC-collector current	$T_C = 70^{\circ}\text{C}$ $T_C = 25^{\circ}\text{C}$	$I_{C\text{ nom}}$ $I_C$	50 70	A A
Periodischer Kollektor Spitzenstrom repetitive peak collector current	$t_p = 1\text{ ms}, T_C = 70^{\circ}\text{C}$	$I_{CRM}$	100	A
Gesamt-Verlustleistung total power dissipation	$T_C = 25^{\circ}\text{C}$	$P_{tot}$	355	W
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	$I_C = 50\text{ A}, V_{GE} = 15\text{ V}, T_{vj} = 25^{\circ}\text{C}$ $I_C = 50\text{ A}, V_{GE} = 15\text{ V}, T_{vj} = 125^{\circ}\text{C}$	$V_{CE\text{ sat}}$		3,20 3,85	3,75	V V
Gate-Schwellenspannung gate threshold voltage	$I_C = 2,00\text{ mA}, V_{CE} = V_{GE}, T_{vj} = 25^{\circ}\text{C}$	$V_{GEth}$	4,5	5,5	6,5	V
Gateladung gate charge	$V_{GE} = -15\text{ V} \dots +15\text{ V}$	$Q_G$		0,60		$\mu\text{C}$
Interner Gatewiderstand internal gate resistor	$T_{vj} = 25^{\circ}\text{C}$	$R_{Gint}$		5,0		$\Omega$
Eingangskapazität input capacitance	$f = 1\text{ MHz}, T_{vj} = 25^{\circ}\text{C}, V_{CE} = 25\text{ V}, V_{GE} = 0\text{ V}$	$C_{ies}$		3,40		nF
Rückwirkungskapazität reverse transfer capacitance	$f = 1\text{ MHz}, T_{vj} = 25^{\circ}\text{C}, V_{CE} = 25\text{ V}, V_{GE} = 0\text{ V}$	$C_{res}$		0,21		nF
Kollektor-Emitter Reststrom collector-emitter cut-off current	$V_{CE} = 1200\text{ V}, V_{GE} = 0\text{ V}, T_{vj} = 25^{\circ}\text{C}$	$I_{CES}$			5,0	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)	$I_C = 50\text{ A}, V_{CE} = 600\text{ V}$ $V_{GE} = \pm 15\text{ V}, R_{Gon} = 13\ \Omega, T_{vj} = 25^{\circ}\text{C}$ $V_{GE} = \pm 15\text{ V}, R_{Gon} = 13\ \Omega, T_{vj} = 125^{\circ}\text{C}$	$t_{d\text{ on}}$		0,12 0,13		$\mu\text{s}$ $\mu\text{s}$
Anstiegszeit (induktive Last) rise time (inductive load)	$I_C = 50\text{ A}, V_{CE} = 600\text{ V}$ $V_{GE} = \pm 15\text{ V}, R_{Gon} = 13\ \Omega, T_{vj} = 25^{\circ}\text{C}$ $V_{GE} = \pm 15\text{ V}, R_{Gon} = 13\ \Omega, T_{vj} = 125^{\circ}\text{C}$	$t_r$		0,05 0,06		$\mu\text{s}$ $\mu\text{s}$
Abschaltverzögerungszeit (ind. Last) turn-off delay time (inductive load)	$I_C = 50\text{ A}, V_{CE} = 600\text{ V}$ $V_{GE} = \pm 15\text{ V}, R_{Goff} = 13\ \Omega, T_{vj} = 25^{\circ}\text{C}$ $V_{GE} = \pm 15\text{ V}, R_{Goff} = 13\ \Omega, T_{vj} = 125^{\circ}\text{C}$	$t_{d\text{ off}}$		0,31 0,36		$\mu\text{s}$ $\mu\text{s}$
Fallzeit (induktive Last) fall time (inductive load)	$I_C = 50\text{ A}, V_{CE} = 600\text{ V}$ $V_{GE} = \pm 15\text{ V}, R_{Goff} = 13\ \Omega, T_{vj} = 25^{\circ}\text{C}$ $V_{GE} = \pm 15\text{ V}, R_{Goff} = 13\ \Omega, T_{vj} = 125^{\circ}\text{C}$	$t_f$		0,02 0,03		$\mu\text{s}$ $\mu\text{s}$
Einschaltverlustenergie pro Puls turn-on energy loss per pulse	$I_C = 50\text{ A}, V_{CE} = 600\text{ V}, L_s = 30\text{ nH}$ $V_{GE} = \pm 15\text{ V}, R_{Gon} = 13\ \Omega, T_{vj} = 25^{\circ}\text{C}$ $V_{GE} = \pm 15\text{ V}, R_{Gon} = 13\ \Omega, T_{vj} = 125^{\circ}\text{C}$	$E_{on}$		6,00		mJ mJ
Abschaltverlustenergie pro Puls turn-off energy loss per pulse	$I_C = 50\text{ A}, V_{CE} = 600\text{ V}, L_s = 30\text{ nH}$ $V_{GE} = \pm 15\text{ V}, R_{Goff} = 13\ \Omega, T_{vj} = 25^{\circ}\text{C}$ $V_{GE} = \pm 15\text{ V}, R_{Goff} = 13\ \Omega, T_{vj} = 125^{\circ}\text{C}$	$E_{off}$		2,50		mJ mJ
Kurzschlußverhalten SC data	$t_p \leq 10\ \mu\text{s}, V_{GE} \leq 15\text{ V}$ $T_{vj} \leq 125^{\circ}\text{C}, V_{CC} = 900\text{ V}, V_{CEmax} = V_{CES} - L_{sCE} \cdot di/dt$	$I_{SC}$		300		A
Innerer Wärmewiderstand thermal resistance, junction to case	pro IGBT per IGBT	$R_{thJC}$			0,35	K/W

prepared by: Martin Knecht	date of publication: 2003-9-24
approved by: Robert Severin	revision: 2.0

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**Diode-Wechselrichter / diode-inverter**

**Höchstzulässige Werte / maximum rated values**

Periodische Spitzensperrspannung repetitive peak reverse voltage	$T_{vj} = 25^{\circ}\text{C}$	$V_{RRM}$	1200	V
Dauergleichstrom DC forward current		$I_F$	50	A
Periodischer Spitzenstrom repetitive peak forward current	$t_p = 1\text{ ms}$	$I_{FRM}$	100	A
Grenzlastintegral $I^2t$ - value	$V_R = 0\text{ V}, t_p = 10\text{ ms}, T_{vj} = 125^{\circ}\text{C}$	$I^2t$	1250	A <sup>2</sup> s

**Charakteristische Werte / characteristic values**

			min.	typ.	max.	
Durchlassspannung forward voltage	$I_F = 50\text{ A}, V_{GE} = 0\text{ V}, T_{vj} = 25^{\circ}\text{C}$ $I_F = 50\text{ A}, V_{GE} = 0\text{ V}, T_{vj} = 125^{\circ}\text{C}$	$V_F$		2,00 1,70	2,55	V V
Rückstromspitze peak reverse recovery current	$I_F = 50\text{ A}, -di_F/dt = 1300\text{ A}/\mu\text{s}$ $V_R = 600\text{ V}, V_{GE} = -15\text{ V}, T_{vj} = 25^{\circ}\text{C}$ $V_R = 600\text{ V}, V_{GE} = -15\text{ V}, T_{vj} = 125^{\circ}\text{C}$	$I_{RM}$		28,0 41,0		A A
Sperrverzögerungsladung recovered charge	$I_F = 50\text{ A}, -di_F/dt = 1300\text{ A}/\mu\text{s}$ $V_R = 600\text{ V}, V_{GE} = -15\text{ V}, T_{vj} = 25^{\circ}\text{C}$ $V_R = 600\text{ V}, V_{GE} = -15\text{ V}, T_{vj} = 125^{\circ}\text{C}$	$Q_r$		3,00 8,50		$\mu\text{C}$ $\mu\text{C}$
Abschaltenergie pro Puls reverse recovery energy	$I_F = 50\text{ A}, -di_F/dt = 1300\text{ A}/\mu\text{s}$ $V_R = 600\text{ V}, V_{GE} = -15\text{ V}, T_{vj} = 25^{\circ}\text{C}$ $V_R = 600\text{ V}, V_{GE} = -15\text{ V}, T_{vj} = 125^{\circ}\text{C}$	$E_{rec}$		1,10 3,10		mJ mJ
Innerer Wärmewiderstand thermal resistance, junction to case	pro Diode per diode	$R_{thJC}$			0,70	K/W

**NTC-Widerstand / NTC-thermistor**

**Charakteristische Werte / characteristic values**

			min.	typ.	max.	
Nennwiderstand rated resistance	$T_C = 25^{\circ}\text{C}$	$R_{25}$		5,00		k $\Omega$
Abweichung von $R_{100}$ deviation of $R_{100}$	$T_C = 100^{\circ}\text{C}, R_{100} = 493\ \Omega$	$\Delta R/R$	-5		5	%
Verlustleistung power dissipation	$T_C = 25^{\circ}\text{C}$	$P_{25}$			20,0	mW
B-Wert B-value	$R_2 = R_{25} \exp [B_{25}/50(1/T_2 - 1/(298,15\text{ K}))]$	$B_{25}/50$		3375		K

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# Technische Information / technical information

IGBT-Module  
IGBT-modules

## F4-50R12KS4



### Vorläufige Daten preliminary data

#### Modul / module

Isolations-Prüfspannung insulation test voltage	RMS, f = 50 Hz, t = 1 min.	V <sub>ISO</sub>	2,5		kV
Material Modulgrundplatte material of module baseplate			Cu		
Material für innere Isolation material for internal insulation			Al <sub>2</sub> O <sub>3</sub>		
Kriechstrecke creepage distance	Kontakt - Kühlkörper / terminal to heatsink Kontakt - Kontakt / terminal to terminal		10,0		mm
Luftstrecke clearance distance	Kontakt - Kühlkörper / terminal to heatsink Kontakt - Kontakt / terminal to terminal		7,50		mm
Vergleichszahl der Kriechwegbildung comparative tracking index		CTI	> 225		
			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 <sub>thCH</sub>		0,02	K/W
Modulinduktivität stray inductance module		L <sub>sCE</sub>		30	nH
Modulleitungswiderstand, Anschlüsse - Chip module lead resistance, terminals - chip	T <sub>C</sub> = 25°C, pro Schalter / per switch	R <sub>CC'+EE'</sub>		2,20	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 M5	M	3,00	-	6,00 Nm
Gewicht weight		G		180	g

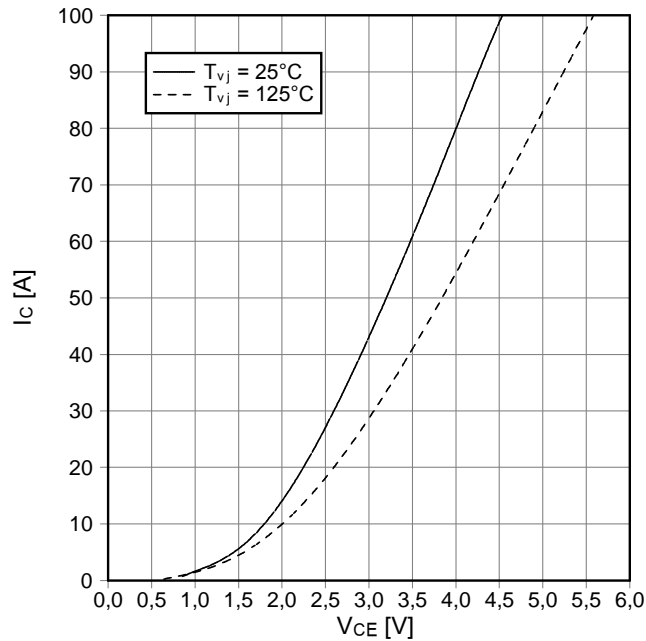
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**This technical information specifies semiconductor devices but guarantees no characteristics. It is valid with the appropriate technical explanations.**

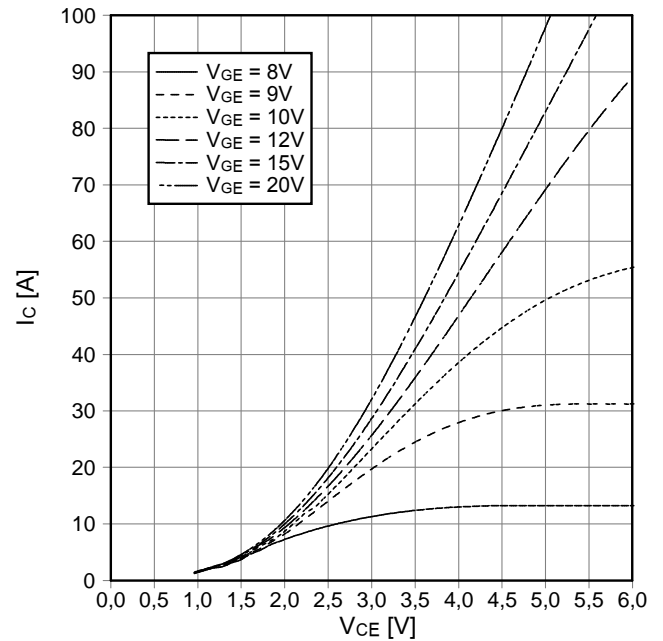
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approved by: Robert Severin	revision: 2.0

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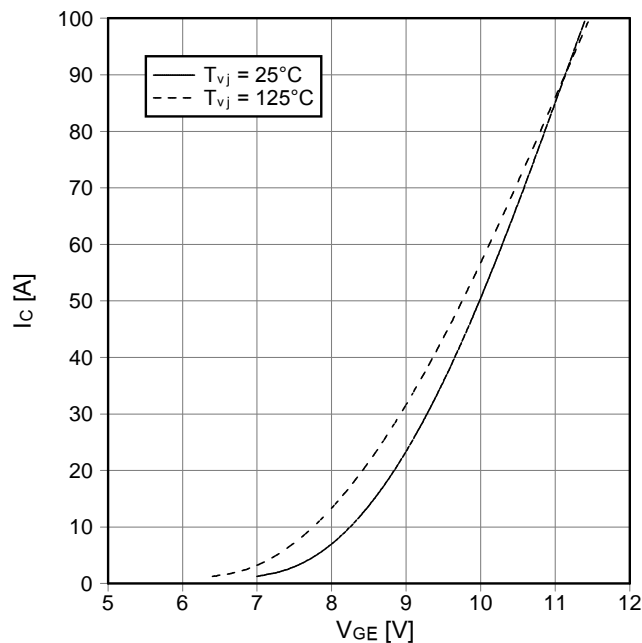
**Ausgangskennlinie IGBT-Wechselr. (typisch)**  
output characteristic IGBT-inverter (typical)  
 $I_c = f(V_{CE})$   
 $V_{GE} = 15\text{ V}$



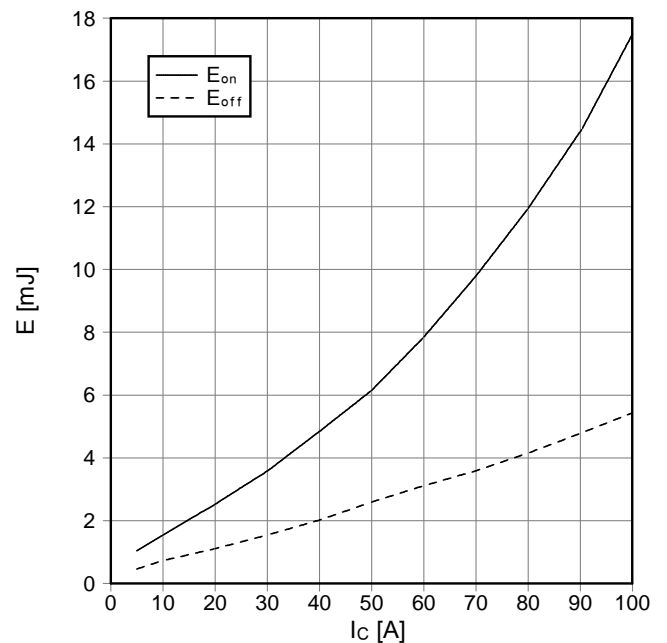
**Ausgangskennlinienfeld IGBT-Wechselr. (typisch)**  
output characteristic IGBT-inverter (typical)  
 $I_c = f(V_{CE})$   
 $T_{vj} = 125^\circ\text{C}$



**Übertragungscharakteristik IGBT-Wechselr. (typisch)**  
transfer characteristic IGBT-inverter (typical)  
 $I_c = f(V_{GE})$   
 $V_{CE} = 20\text{ V}$



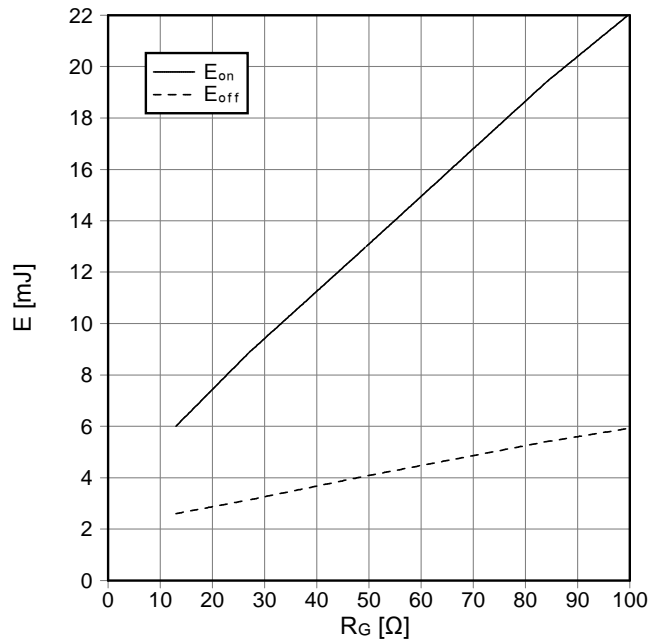
**Schaltverluste IGBT-Wechselr. (typisch)**  
switching losses IGBT-inverter (typical)  
 $E_{on} = f(I_c)$ ,  $E_{off} = f(I_c)$   
 $V_{GE} = \pm 15\text{ V}$ ,  $R_{Gon} = 13\ \Omega$ ,  $R_{Goff} = 13\ \Omega$ ,  $V_{CE} = 600\text{ V}$ ,  
 $T_{vj} = 125^\circ\text{C}$



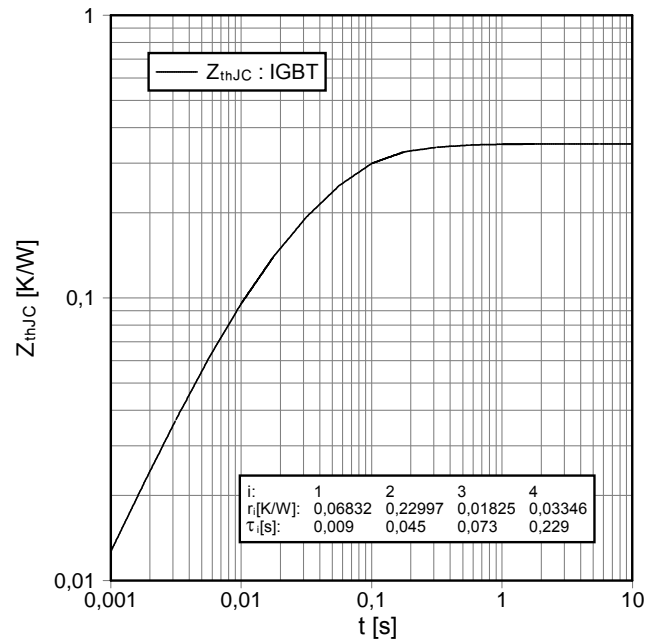
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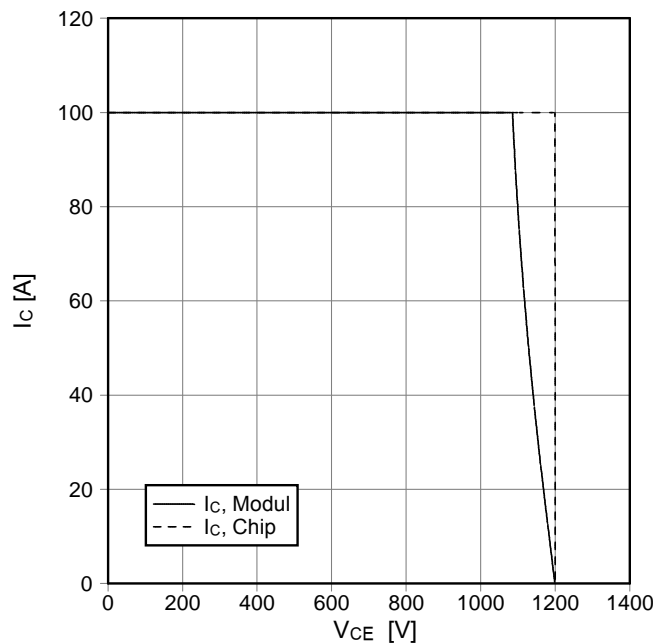
**Schaltverluste IGBT-Wechselr. (typisch)**  
switching losses IGBT-inverter (typical)  
 $E_{on} = f(R_G)$ ,  $E_{off} = f(R_G)$   
 $V_{GE} = \pm 15\text{ V}$ ,  $I_C = 50\text{ A}$ ,  $V_{CE} = 600\text{ V}$ ,  $T_{vj} = 125^\circ\text{C}$



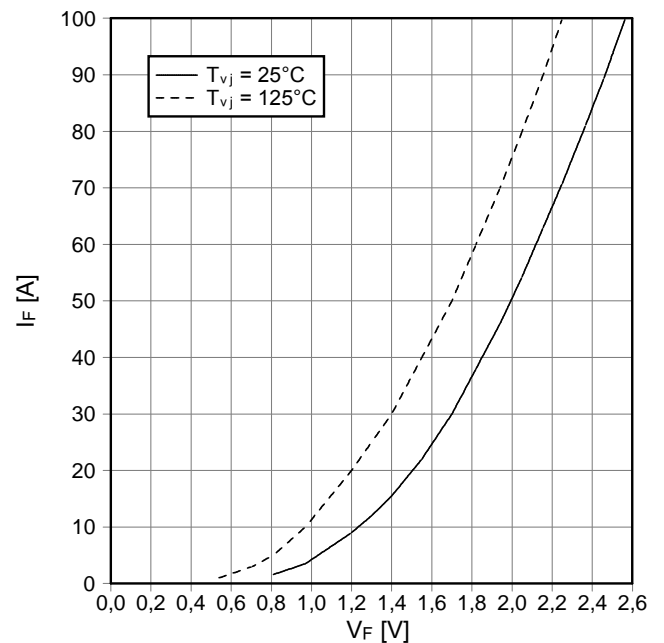
**Transienter Wärmewiderstand IGBT-Wechselr.**  
transient thermal impedance IGBT-inverter  
 $Z_{thJC} = f(t)$



**Sicherer Rückwärts-Arbeitsbereich IGBT-Wr. (RBSOA)**  
reverse bias safe operating area IGBT-inv. (RBSOA)  
 $I_C = f(V_{CE})$   
 $V_{GE} = \pm 15\text{ V}$ ,  $R_{Goff} = 13\ \Omega$ ,  $T_{vj} = 125^\circ\text{C}$



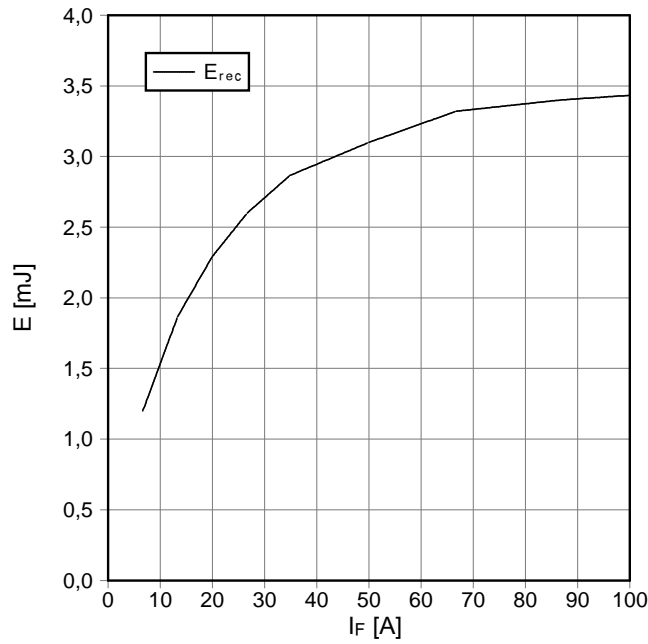
**Durchlaßkennlinie der Diode-Wechselr. (typisch)**  
forward characteristic of diode-inverter (typical)  
 $I_F = f(V_F)$



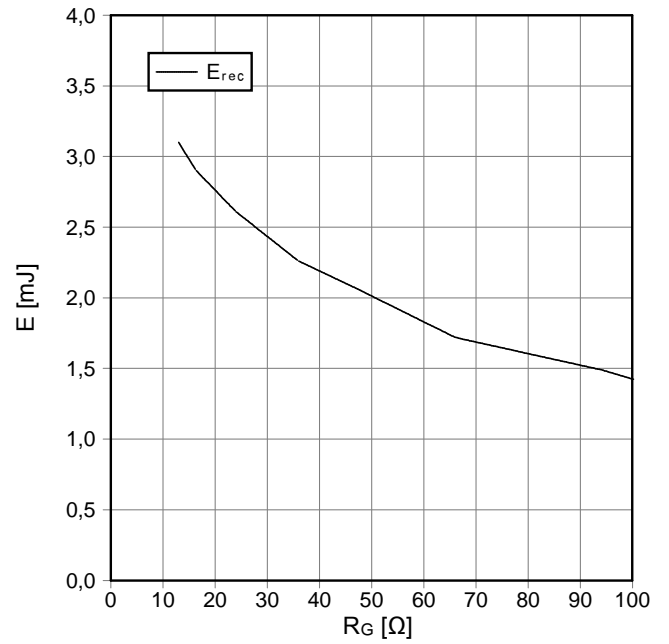
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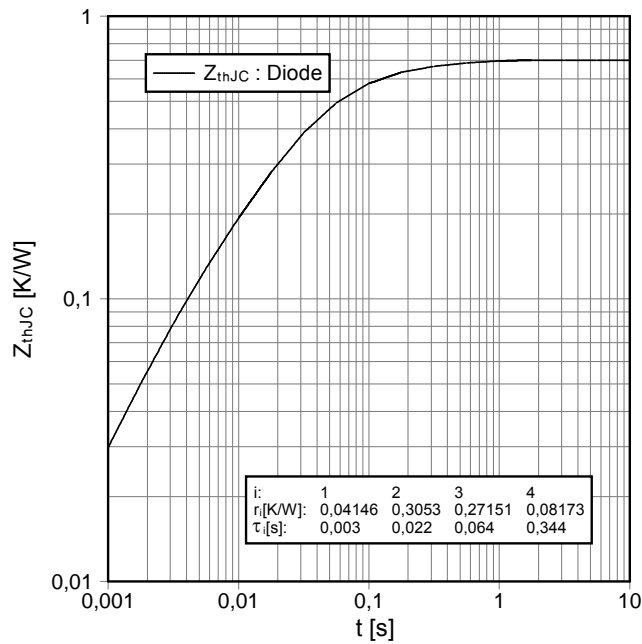
Schaltverluste Diode-Wechselr. (typisch)  
switching losses diode-inverter (typical)  
 $E_{rec} = f(I_F)$   
 $R_{Gon} = 13 \Omega$ ,  $V_{CE} = 600 V$ ,  $T_{vj} = 125^\circ C$



Schaltverluste Diode-Wechselr. (typisch)  
switching losses diode-inverter (typical)  
 $E_{rec} = f(R_G)$   
 $I_F = 50 A$ ,  $V_{CE} = 600 V$ ,  $T_{vj} = 125^\circ C$

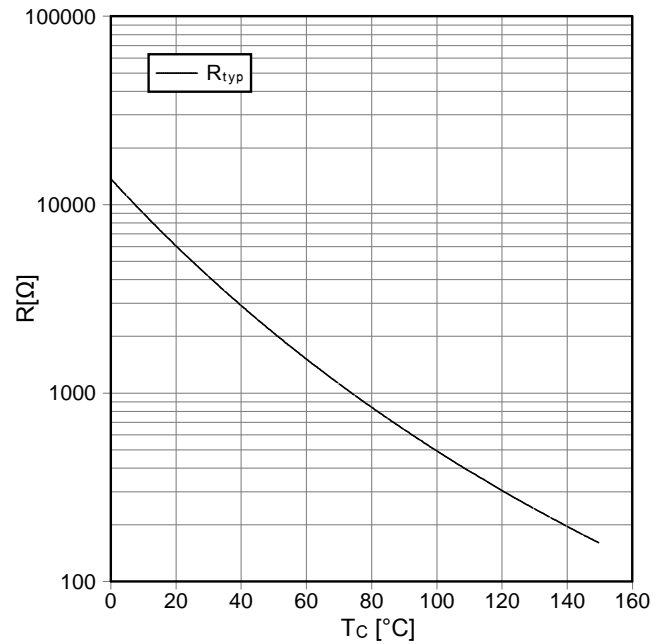


Transienter Wärmewiderstand Diode-Wechselr.  
transient thermal impedance diode-inverter  
 $Z_{thJC} = f(t)$



i:	1	2	3	4
$r_i$ [K/W]:	0,04146	0,3053	0,27151	0,08173
$\tau_i$ [s]:	0,003	0,022	0,064	0,344

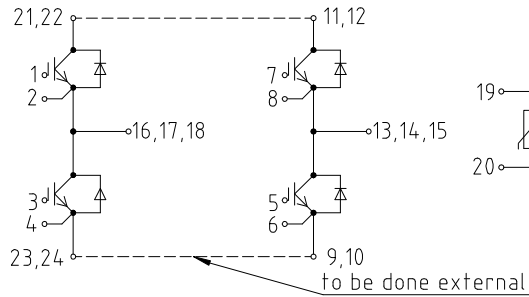
NTC-Temperaturkennlinie (typisch)  
NTC-temperature characteristic (typical)  
 $R = f(T)$



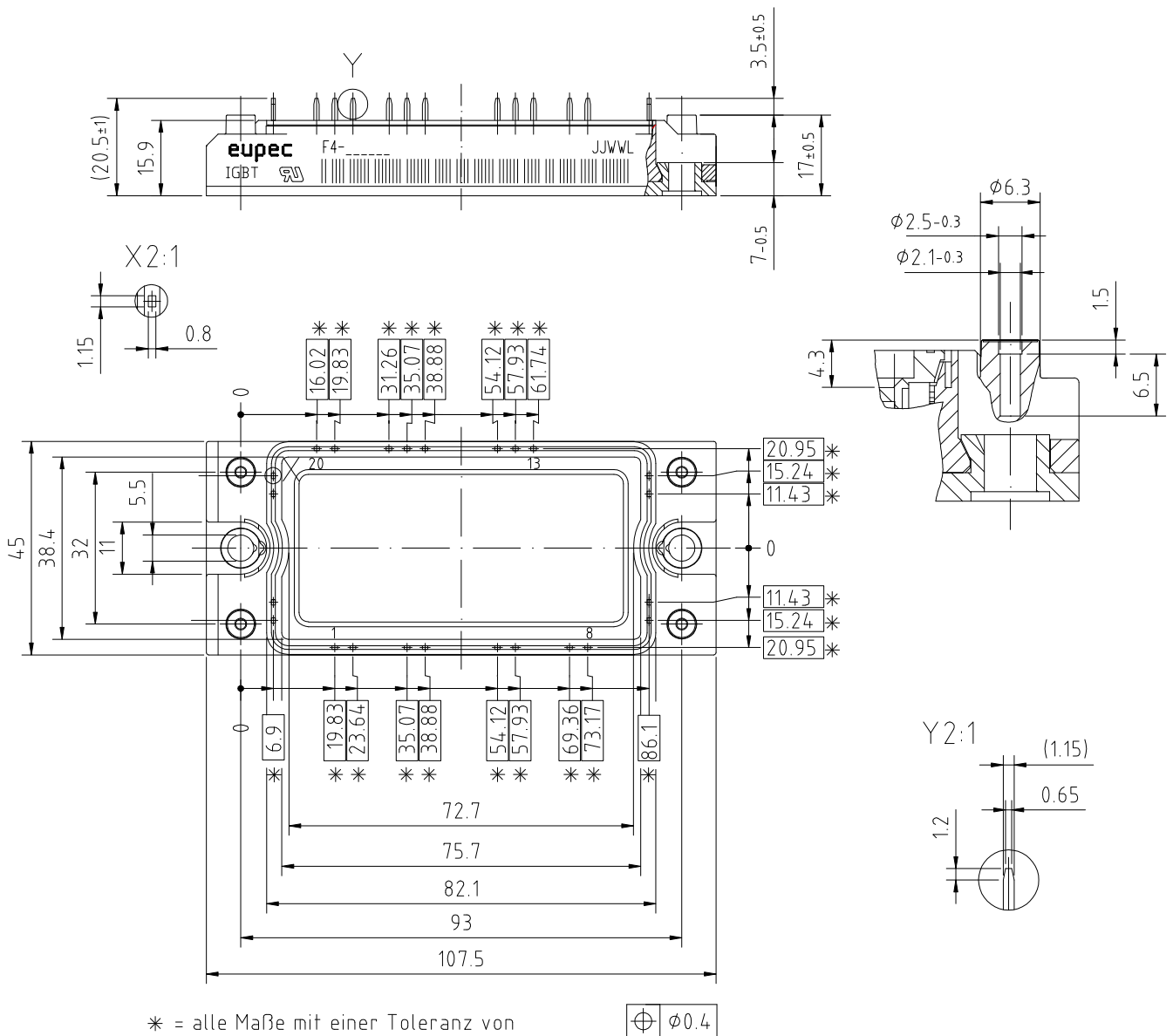
prepared by: Martin Knecht	date of publication: 2003-9-24
approved by: Robert Severin	revision: 2.0

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### Schaltplan / circuit diagram



### Gehäuseabmessungen / package outlines



prepared by: Martin Knecht	date of publication: 2003-9-24
approved by: Robert Severin	revision: 2.0

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