Vorläufig
preliminary**Elektrische Eigenschaften / electrical properties****Höchstzulässige Werte / maximum rated values****Diode Gleichrichter / diode rectifier**

Periodische Rückw. Spitzensperrspannung repetitive peak reverse voltage	$T_{vj} = 25^{\circ}\text{C}$	V_{RRM}	800	V
Durchlaßstrom Grenzeffektivwert pro Chip RMS forward current per chip	$T_C = 80^{\circ}\text{C}$	I_{FRMSM}	23	A
Gleichrichter Ausgang Grenzeffektivstrom maximum RMS current at Rectifier output	$T_C = 80^{\circ}\text{C}$	I_{RMSmax}	25	A
Stoßstrom Grenzwert surge forward current	$t_p = 10\text{ ms}, T_{vj} = 25^{\circ}\text{C}$ $t_p = 10\text{ ms}, T_{vj} = 150^{\circ}\text{C}$	I_{FSM}	197 158	A A
Grenzlastintegral I^2t - value	$t_p = 10\text{ ms}, T_{vj} = 25^{\circ}\text{C}$ $t_p = 10\text{ ms}, T_{vj} = 150^{\circ}\text{C}$	I^2t	194 125	A^2s A^2s

Transistor Wechselrichter / transistor inverter

Kollektor-Emitter-Sperrspannung collector-emitter voltage	$T_{vj} = 25^{\circ}\text{C}$	V_{CES}	600	V
Kollektor-Dauergleichstrom DC-collector current	$T_C = 80^{\circ}\text{C}$ $T_C = 25^{\circ}\text{C}$	$I_{C,nom.}$ I_C	10 15	A A
Periodischer Kollektor Spitzenstrom repetitive peak collector current	$t_p = 1\text{ ms}, T_C = 80^{\circ}\text{C}$	I_{CRM}	20	A
Gesamt-Verlustleistung total power dissipation	$T_C = 25^{\circ}\text{C}$	P_{tot}	55	W
Gate-Emitter-Spitzenspannung gate-emitter peak voltage		V_{GES}	+/- 20V	V

Diode Wechselrichter / diode inverter

Dauergleichstrom DC forward current		I_F	10	A
Periodischer Spitzenstrom repetitive peak forw. current	$t_p = 1\text{ ms}$	I_{FRM}	20	A
Grenzlastintegral I^2t - value	$V_R = 0\text{V}, t_p = 10\text{ms}, T_{vj} = 125^{\circ}\text{C}$	I^2t	12	A^2s

Transistor Brems-Chopper / transistor brake-chopper

Kollektor-Emitter-Sperrspannung collector-emitter voltage	$T_{vj} = 25^{\circ}\text{C}$	V_{CES}	600	V
Kollektor-Dauergleichstrom DC-collector current	$T_C = 80^{\circ}\text{C}$ $T_C = 25^{\circ}\text{C}$	$I_{C,nom.}$ I_C	10 15	A A
Periodischer Kollektor Spitzenstrom repetitive peak collector current	$t_p = 1\text{ ms}, T_C = 80^{\circ}\text{C}$	I_{CRM}	20	A
Gesamt-Verlustleistung total power dissipation	$T_C = 25^{\circ}\text{C}$	P_{tot}	55	W
Gate-Emitter-Spitzenspannung gate-emitter peak voltage		V_{GES}	+/- 20V	V

Diode Brems-Chopper / diode brake-chopper

Dauergleichstrom DC forward current		I_F	10	A
Periodischer Spitzenstrom repetitive peak forw. current	$t_p = 1\text{ ms}$	I_{FRM}	20	A

prepared by: Thomas Passe

date of publication: 2003-03-26

approved by: R. Keggenhoff

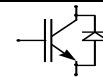
revision: 2.1

Technische Information / technical information

IGBT-Module
IGBT-Modules

FB10R06KL4GB1

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**Vorläufig
preliminary**

Modul Isolation / module isolation

Isolations-Prüfspannung insulation test voltage	RMS, f = 50 Hz, t = 1 min. NTC connected to baseplate	V _{ISOL}	2,5	kV
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Elektrische Eigenschaften / electrical properties

Charakteristische Werte / characteristic values

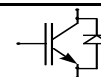
Diode Gleichrichter / diode rectifier			min.	typ.	max.	
Durchlaßspannung forward voltage	$T_{vj} = 150^{\circ}\text{C},$ $I_F = 10\text{ A}$	V_F	-	0,9	-	V
Schleusenspannung threshold voltage	$T_{vj} = 150^{\circ}\text{C}$	$V_{(TO)}$	-	0,67	-	V
Ersatzwiderstand slope resistance	$T_{vj} = 150^{\circ}\text{C}$	r_T	-	21	-	mΩ
Sperrstrom reverse current	$T_{vj} = 150^{\circ}\text{C},$ $V_R = 800\text{ V}$	I_R	-	5	-	mA
Modul Leitungswiderstand, Anschlüsse-Chip lead resistance, terminals-chip	$T_C = 25^{\circ}\text{C}$	$R_{AA'+CC'}$	-	11	-	mΩ
Transistor Wechselrichter / transistor inverter			min.	typ.	max.	
Kollektor-Emitter Sättigungsspannung collector-emitter saturation voltage	$V_{GE} = 15\text{V}, T_{vj} = 25^{\circ}\text{C}, I_C = 10\text{ A}$	$V_{CE\text{ sat}}$	-	1,95	2,55	V
	$V_{GE} = 15\text{V}, T_{vj} = 125^{\circ}\text{C}, I_C = 10\text{ A}$		-	2,2	-	V
Gate-Schwellenspannung gate threshold voltage	$V_{CE} = V_{GE}, T_{vj} = 25^{\circ}\text{C}, I_C = 0,35\text{mA}$	$V_{GE(TO)}$	4,5	5,5	6,5	V
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}	-	0,8	-	nF
Kollektor-Emitter Reststrom collector-emitter cut-off current	$V_{GE} = 0\text{V}, T_{vj} = 25^{\circ}\text{C}, V_{CE} = 600\text{V}$	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)	$I_C = I_{Nenn}, V_{CC} = 300\text{ V}$	$t_{d,on}$	-	32	-	ns
	$V_{GE} = \pm 15\text{V}, T_{vj} = 25^{\circ}\text{C}, R_G = 82\text{ Ohm}$		-			
	$V_{GE} = \pm 15\text{V}, T_{vj} = 125^{\circ}\text{C}, R_G = 82\text{ Ohm}$		-			
Anstiegszeit (induktive Last) rise time (inductive load)	$I_C = I_{Nenn}, V_{CC} = 300\text{ V}$	t_r	-	26	-	ns
	$V_{GE} = \pm 15\text{V}, T_{vj} = 25^{\circ}\text{C}, R_G = 82\text{ Ohm}$		-			
	$V_{GE} = \pm 15\text{V}, T_{vj} = 125^{\circ}\text{C}, R_G = 82\text{ Ohm}$		-			
Abschaltverzögerungszeit (ind. Last) turn off delay time (inductive load)	$I_C = I_{Nenn}, V_{CC} = 300\text{ V}$	$t_{d,off}$	-	234	-	ns
	$V_{GE} = \pm 15\text{V}, T_{vj} = 25^{\circ}\text{C}, R_G = 82\text{ Ohm}$		-			
	$V_{GE} = \pm 15\text{V}, T_{vj} = 125^{\circ}\text{C}, R_G = 82\text{ Ohm}$		-			
Fallzeit (induktive Last) fall time (inductive load)	$I_C = I_{Nenn}, V_{CC} = 300\text{ V}$	t_f	-	10	-	ns
	$V_{GE} = \pm 15\text{V}, T_{vj} = 25^{\circ}\text{C}, R_G = 82\text{ Ohm}$		-			
	$V_{GE} = \pm 15\text{V}, T_{vj} = 125^{\circ}\text{C}, R_G = 82\text{ Ohm}$		-			
Einschaltverlustenergie pro Puls turn-on energy loss per pulse	$I_C = I_{Nenn}, V_{CC} = 300\text{ V}$ $V_{GE} = \pm 15\text{V}, T_{vj} = 125^{\circ}\text{C}, R_G = 82\text{ Ohm}$ $L_S = 80\text{ nH}$	E_{on}	-	0,36	-	mJ
Abschaltverlustenergie pro Puls turn-off energy loss per pulse	$I_C = I_{Nenn}, V_{CC} = 300\text{ V}$ $V_{GE} = \pm 15\text{V}, T_{vj} = 125^{\circ}\text{C}, R_G = 82\text{ Ohm}$ $L_S = 80\text{ nH}$	E_{off}	-	0,44	-	mJ
Kurzschlußverhalten SC Data	$t_P \leq 10\mu\text{s}, V_{GE} \leq 15\text{V}, R_G = 82\text{ Ohm}$ $T_{vj} \leq 125^{\circ}\text{C}, V_{CC} = 360\text{ V}$ $dI/dt = 400\text{ A}/\mu\text{s}$	I_{SC}	-	40	-	A

Technische Information / technical information

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**Vorläufig
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Elektrische Eigenschaften / electrical properties

Charakteristische Werte / characteristic values

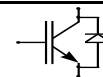
			min.	typ.	max.	
Modulinduktivität stray inductance module		$L_{\sigma CE}$	-	-	40	nH
Modul Leitungswiderstand, Anschlüsse-Chip lead resistance, terminals-chip	$T_C = 25^\circ C$	$R_{CC'+EE'}$	-	10	-	mΩ
Diode Wechselrichter / diode inverter			min.	typ.	max.	
Durchlaßspannung forward voltage	$V_{GE} = 0V, T_{vj} = 25^\circ C, I_F = 10 A$ $V_{GE} = 0V, T_{vj} = 125^\circ C, I_F = 10 A$	V_F	-	1,85 1,9	2,25 -	V V
Rückstromspitze peak reverse recovery current	$I_F = I_{Nenn}, -di_F/dt = 600 A/us$ $V_{GE} = -10V, T_{vj} = 25^\circ C, V_R = 300 V$ $V_{GE} = -10V, T_{vj} = 125^\circ C, V_R = 300 V$	I_{RM}	-	11 12	- -	A A
Sperrverzögerungsladung recovered charge	$I_F = I_{Nenn}, -di_F/dt = 600 A/us$ $V_{GE} = -10V, T_{vj} = 25^\circ C, V_R = 300 V$ $V_{GE} = -10V, T_{vj} = 125^\circ C, V_R = 300 V$	Q_r	-	0,35 0,71	- -	μAs μAs
Abschaltenergie pro Puls reverse recovery energy	$I_F = I_{Nenn}, -di_F/dt = 600 A/us$ $V_{GE} = -10V, T_{vj} = 25^\circ C, V_R = 300 V$ $V_{GE} = -10V, T_{vj} = 125^\circ C, V_R = 300 V$	E_{rec}	-	0,05 0,12	- -	mJ mJ
Transistor Brems-Chopper / transistor brake-chopper			min.	typ.	max.	
Kollektor-Emitter Sättigungsspannung collector-emitter saturation voltage	$V_{GE} = 15V, T_{vj} = 25^\circ C, I_C = 10,0 A$ $V_{GE} = 15V, T_{vj} = 125^\circ C, I_C = 10,0 A$	$V_{CE sat}$	-	1,95 2,2	2,55 -	V V
Gate-Schwellenspannung gate threshold voltage	$V_{CE} = V_{GE}, T_{vj} = 25^\circ C, I_C = 0,35mA$	$V_{GE(TO)}$	4,5	5,5	6,5	V
Eingangskapazität input capacitance	$f = 1MHz, T_{vj} = 25^\circ C$ $V_{CE} = 25 V, V_{GE} = 0 V$	C_{ies}	-	0,8	-	nF
Kollektor-Emitter Reststrom collector-emitter cut-off current	$V_{GE} = 0V, T_{vj} = 25^\circ C, V_{CE} = 600V$		-	-	5,0	mA
Gate-Emitter Reststrom gate-emitter leakage current	$V_{CE} = 0V, V_{GE} = 20V, T_{vj} = 25^\circ C$	I_{GES}	-	-	400	nA
Diode Brems-Chopper / diode brake-chopper			min.	typ.	max.	
Durchlaßspannung forward voltage	$T_{vj} = 25^\circ C, I_F = 10,0 A$ $T_{vj} = 125^\circ C, I_F = 10,0 A$	V_F	-	1,85 1,9	2,25 -	V V
NTC-Widerstand / NTC-thermistor			min.	typ.	max.	
Nennwiderstand rated resistance	$T_C = 25^\circ C$	R_{25}	-	5	-	kΩ
Abweichung von R_{100} deviation of R_{100}	$T_C = 100^\circ C, R_{100} = 493 \Omega$	$\Delta R/R$	-5		5	%
Verlustleistung power dissipation	$T_C = 25^\circ C$	P_{25}			20	mW
B-Wert B-value	$R_2 = R_1 \exp [B(1/T_2 - 1/T_1)]$	$B_{25/50}$		3375		K

Technische Information / technical information

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IGBT-Modules

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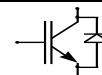
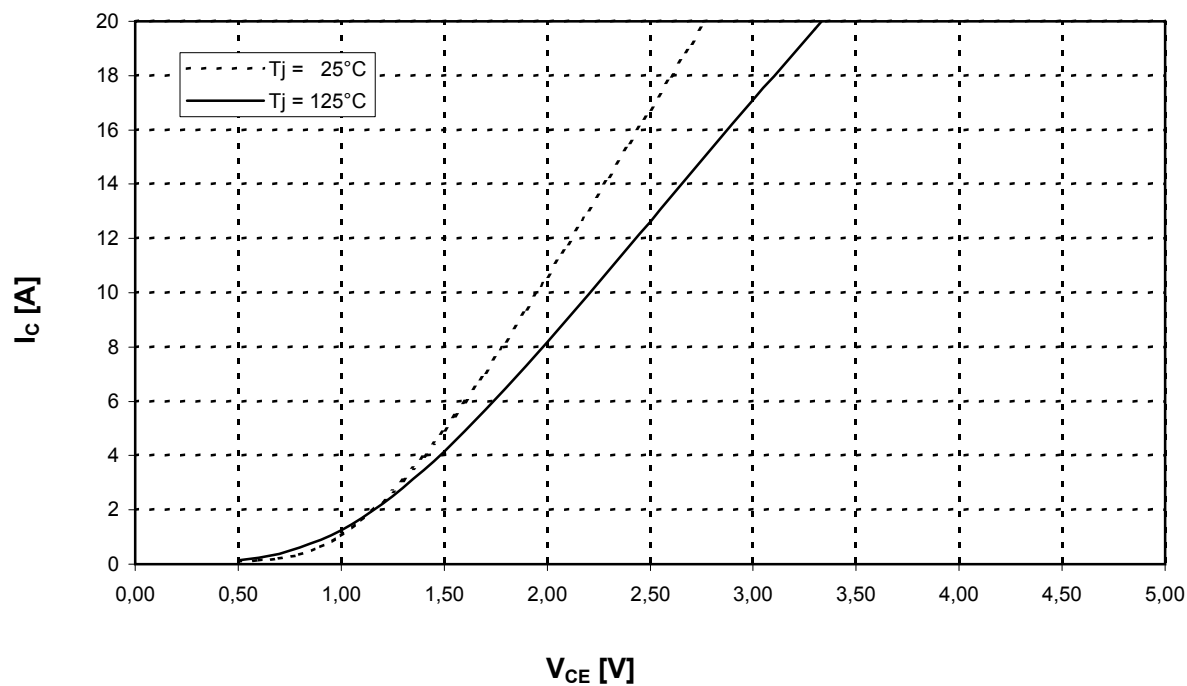
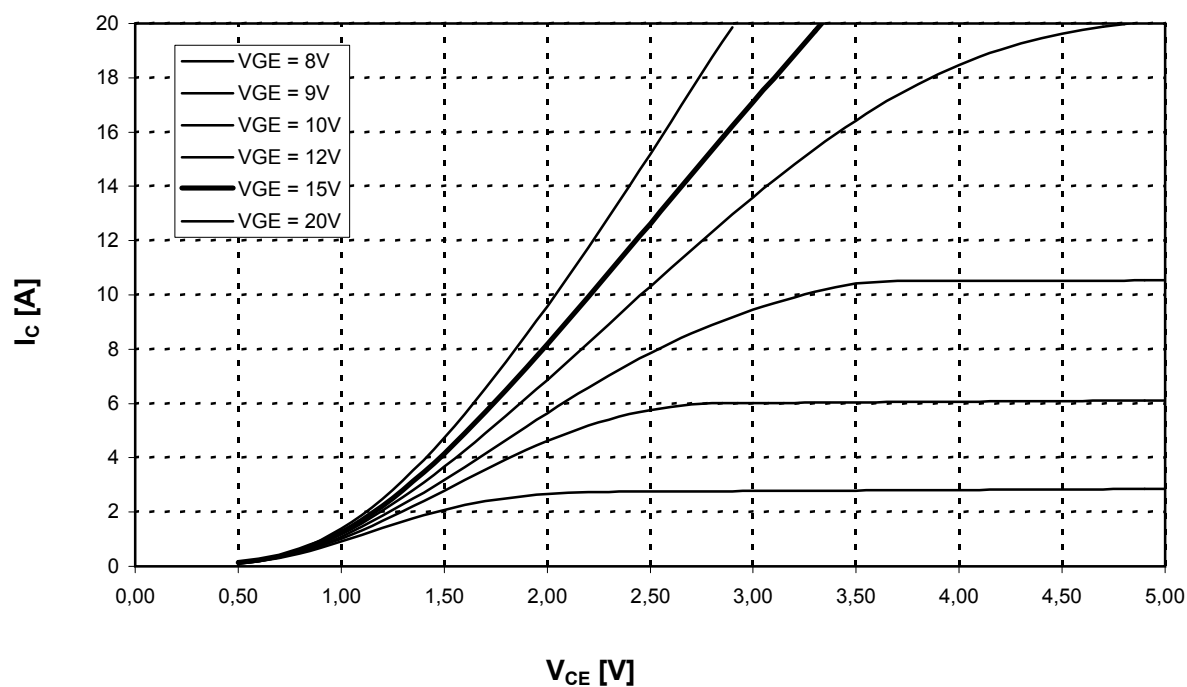
**Vorläufig
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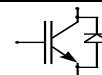
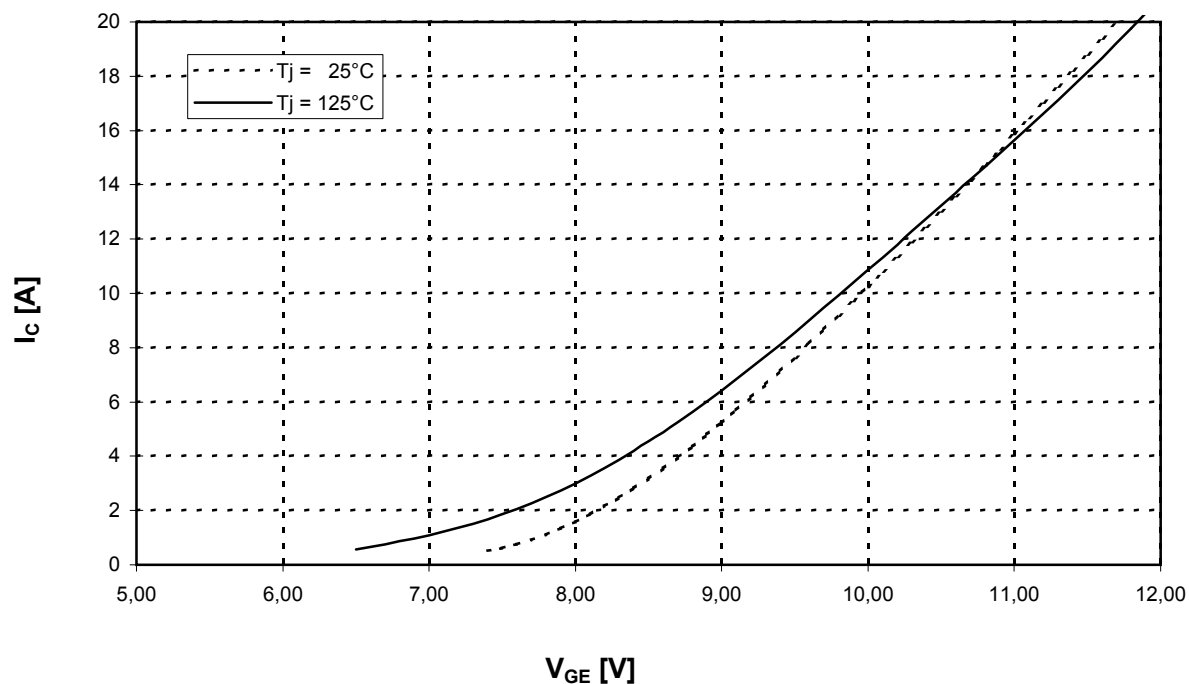
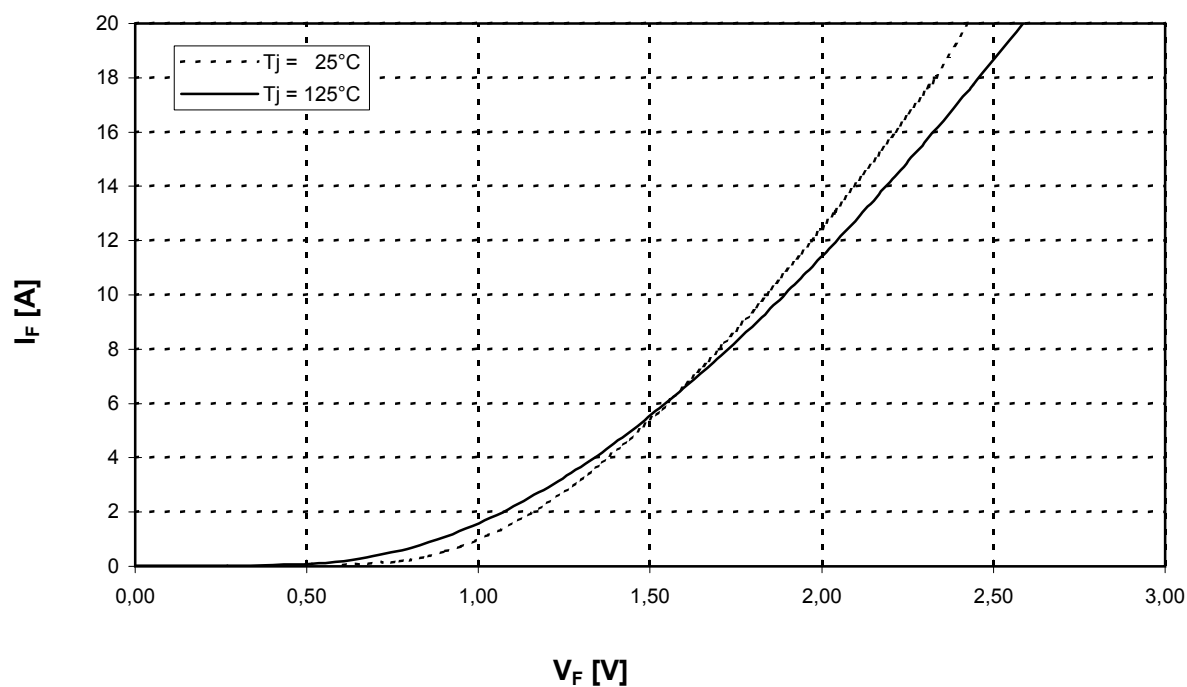
Thermische Eigenschaften / thermal properties

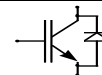
			min.	typ.	max.	
Innerer Wärmewiderstand thermal resistance, junction to heatsink	Gleichr. Diode/ rectif. diode $\lambda_{\text{Paste}}=1\text{W/m}^2\text{K}$	R_{thJH}	-	2,6	-	K/W
	Trans. Wechselr./ trans. inverter $\lambda_{\text{grease}}=1\text{W/m}^2\text{K}$		-	2,8	-	K/W
	Diode Wechselr./ diode inverter		-	4,3	-	K/W
	Trans. Bremse/ trans. brake		-	2,8	-	K/W
	Diode Bremse/ diode brake		-	4,3	-	K/W
Innerer Wärmewiderstand thermal resistance, junction to case	Gleichr. Diode/ rectif. diode	R_{thJC}	-	-	2,4	K/W
	Trans. Wechselr./ trans.inverter		-	-	2,2	K/W
	Diode Wechselr./ diode inverter		-	-	3,1	K/W
	Trans. Bremse/ trans. brake		-	-	2,2	K/W
	Diode Bremse/ diode brake		-	-	3,1	K/W
Übergangs-Wärmewiderstand thermal resistance, case to heatsink	Gleichr. Diode/ rectif. diode $\lambda_{\text{Paste}}=1\text{W/m}^2\text{K}$	R_{thCH}	-	0,4	-	K/W
	Trans. Wechselr./ trans. inverter $\lambda_{\text{grease}}=1\text{W/m}^2\text{K}$		-	0,8	-	K/W
	Diode Wechselr./ diode inverter		-	1,5	-	K/W
	Trans. Bremse/ trans. brake		-	0,8	-	K/W
	Diode Bremse/ diode brake		-	1,5	-	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

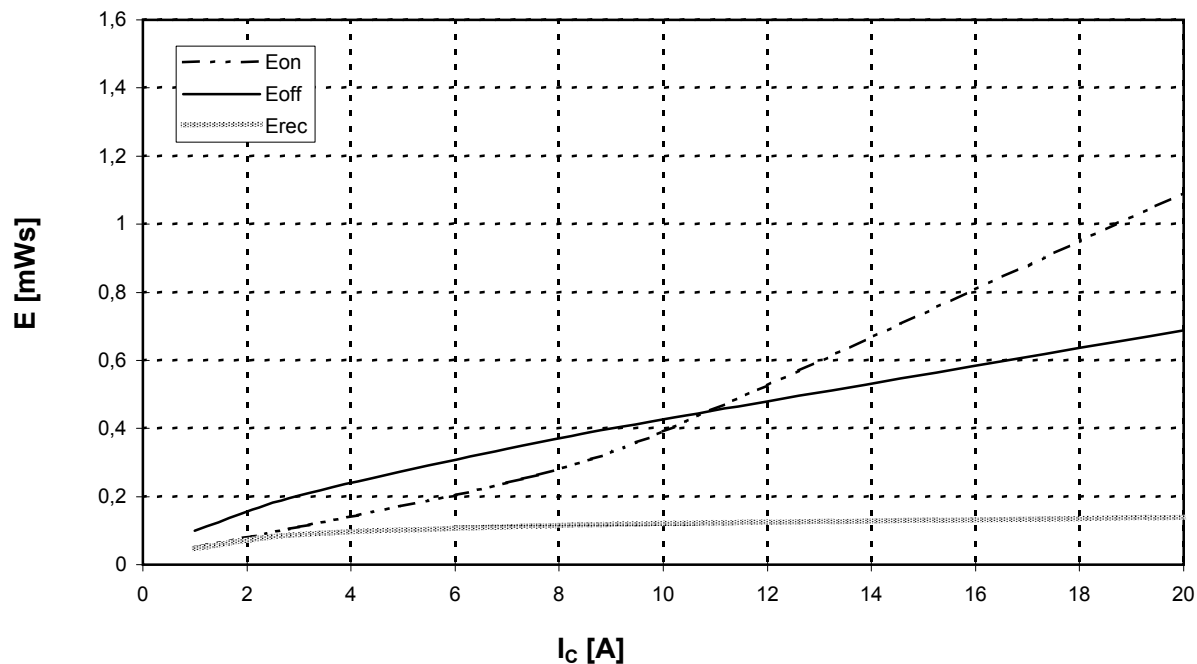
Innere Isolation internal insulation			Al_2O_3	
CTI comperative tracking index			225	
Anpreßkraft f. mech. Befestigung pro Feder mounting force per clamp		F	40...80	N
Gewicht weight		G	36	g
Kontakt - Kühlkörper terminal to heatsink	Kriechstrecke creepage distance		13,5	mm
	Luftstrecke clearance distance		12	mm
Terminal - Terminal terminal to terminal	Kriechstrecke creepage distance		7,5	mm
	Luftstrecke clearance distance		7,5	mm

Vorläufig
preliminaryAusgangskennlinienfeld Wechselr. (typisch)
output characteristic inverter (typical) $I_C = f(V_{CE})$
 $V_{GE} = 15\text{ V}$ Ausgangskennlinienfeld Wechselr. (typisch)
output characteristic inverter (typical) $I_C = f(V_{CE})$
 $T_{vj} = 125^\circ\text{C}$ 

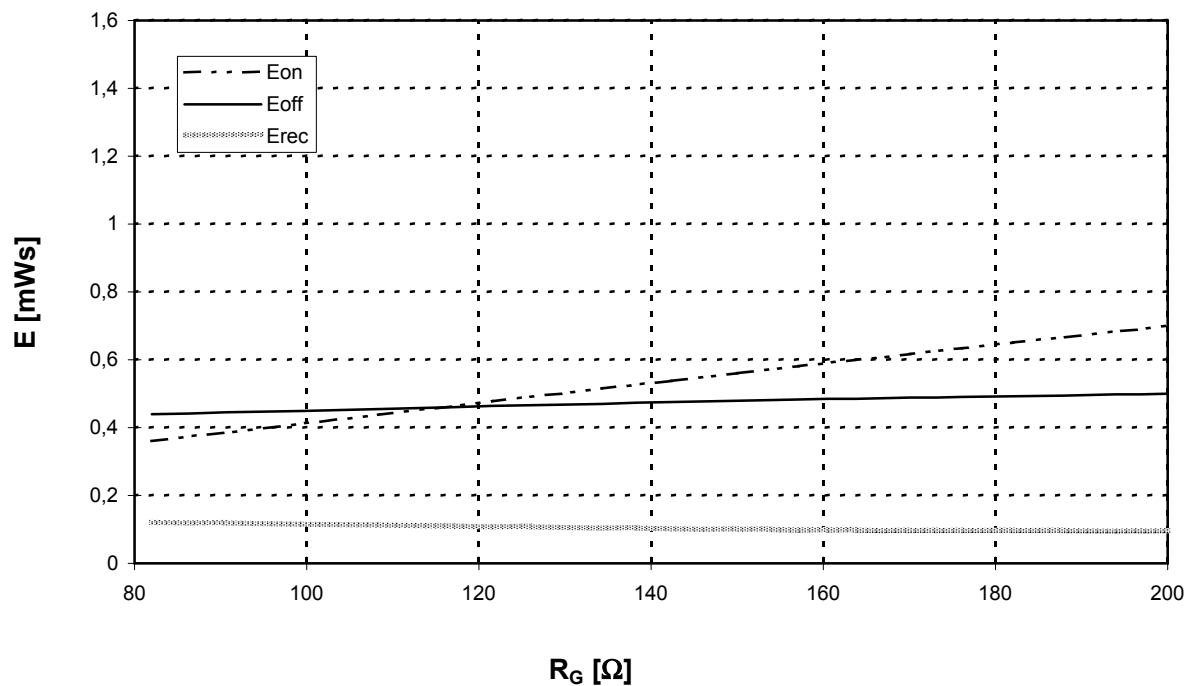
Vorläufig
preliminaryÜbertragungscharakteristik Wechsele. (typisch)
transfer characteristic inverter (typical) $I_C = f(V_{GE})$
 $V_{CE} = 20\text{ V}$ Durchlaßkennlinie der Freilaufdiode Wechsele. (typisch) $I_F = f(V_F)$
forward characteristic of FWD inverter (typical)

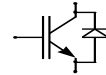
Vorläufig
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Schaltverluste Wechselr. (typisch) $E_{on} = f(I_c)$, $E_{off} = f(I_c)$, $E_{rec} = f(I_c)$ $V_{CC} = 300\text{ V}$
 switching losses inverter (typical) $T_j = 125^\circ\text{C}$, $V_{GE} = \pm 15\text{ V}$, $R_{Gon} = R_{Goff} = 82\text{ Ohm}$



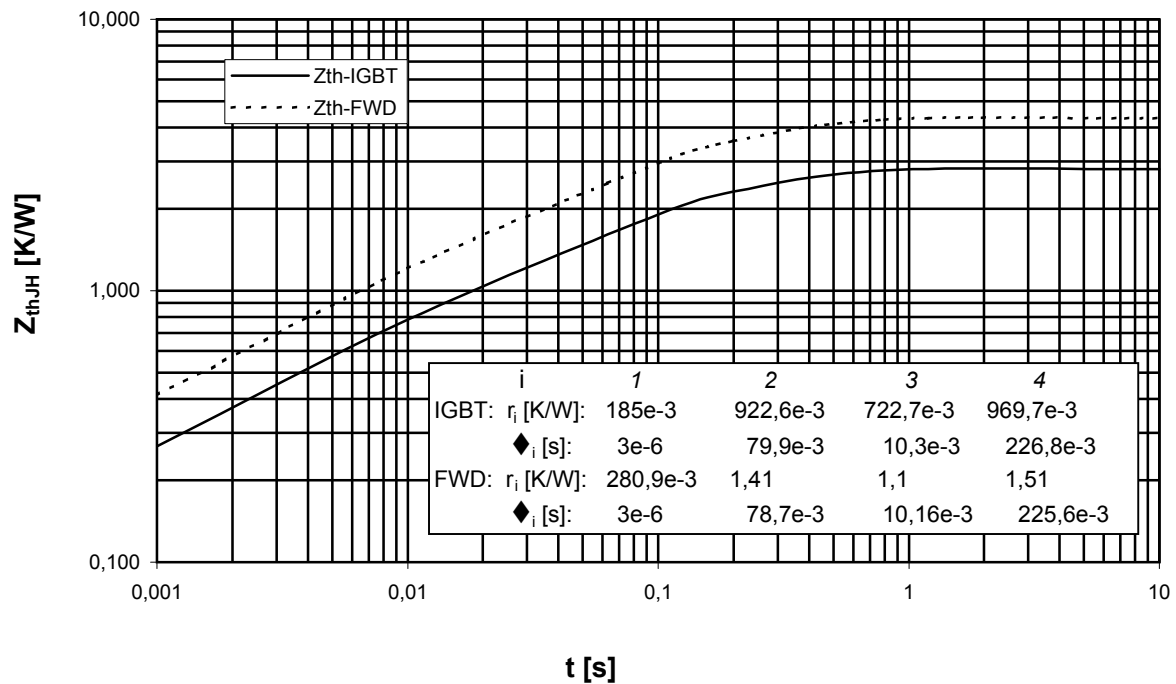
Schaltverluste Wechselr. (typisch) $E_{on} = f(R_G)$, $E_{off} = f(R_G)$, $E_{rec} = f(R_G)$
 switching losses inverter (typical) $T_j = 125^\circ\text{C}$, $V_{GE} = +15\text{ V}$, $I_c = I_{nenn}$, $V_{CC} = 300\text{ V}$



Vorläufig
preliminary

Transienter Wärmewiderstand Wechsele
transient thermal impedance inverter

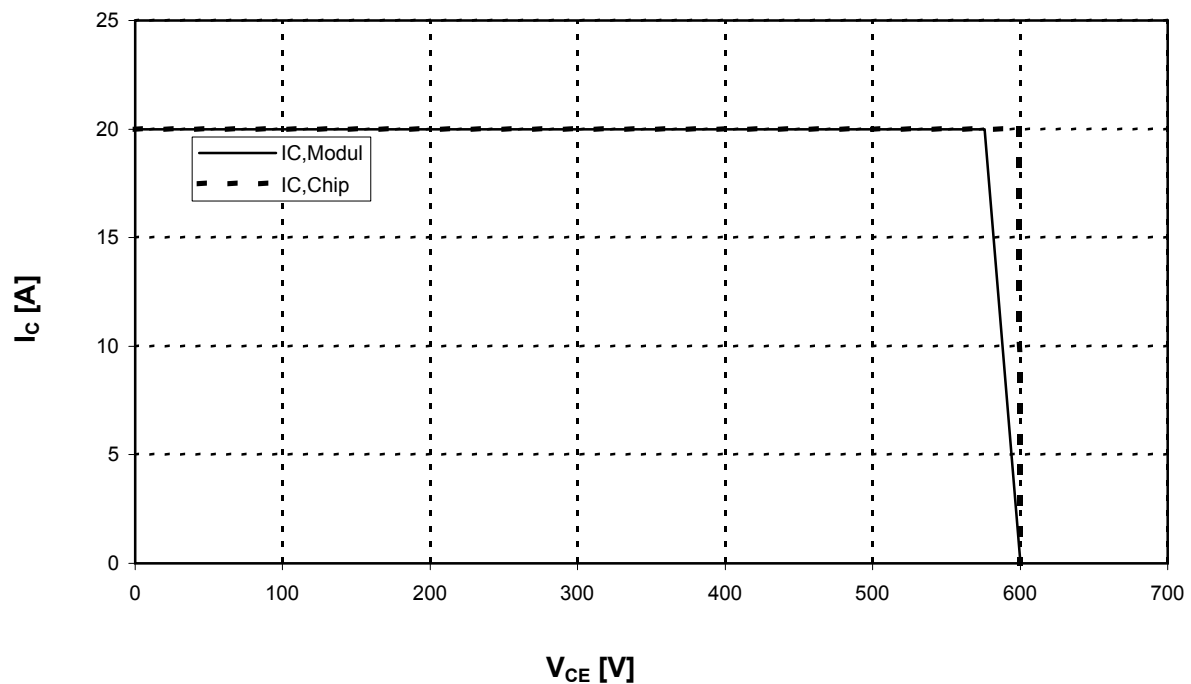
$$Z_{thJH} = f(t)$$

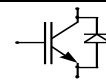


Sicherer Arbeitsbereich Wechsele (RBSOA)

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

reverse bias safe operating area inverter (RBSOA) $T_{vj} = 125^\circ\text{C}$, $V_{GE} = \pm 15\text{V}$, $R_G = 82\ \Omega$

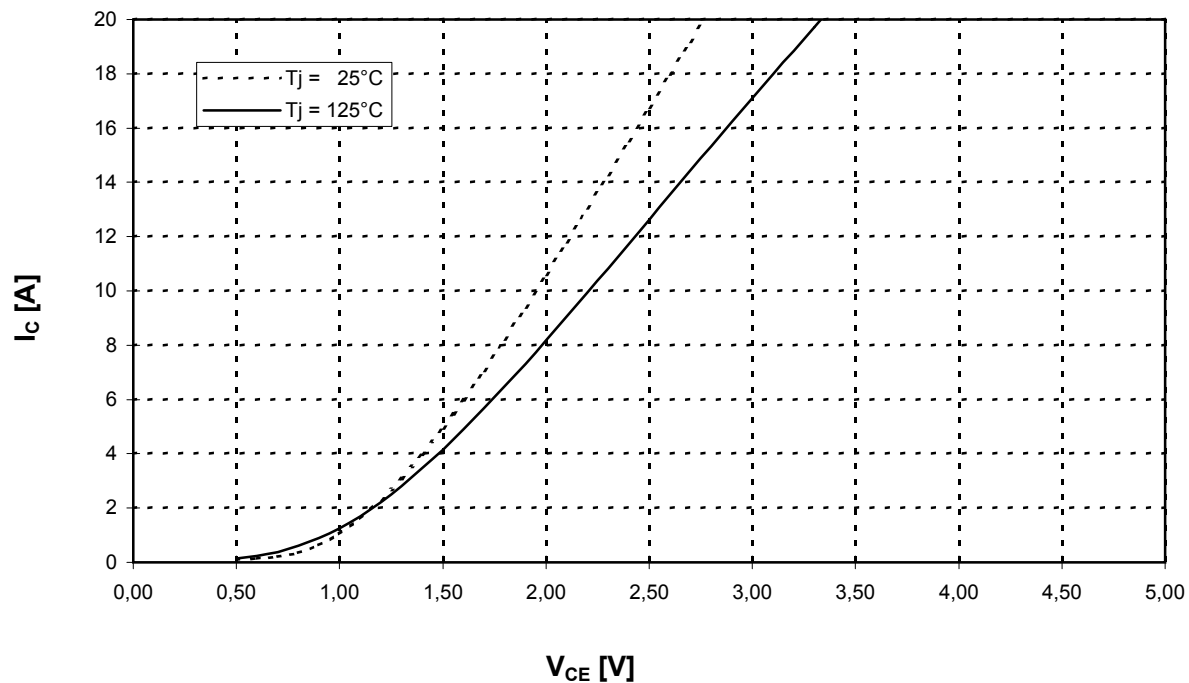




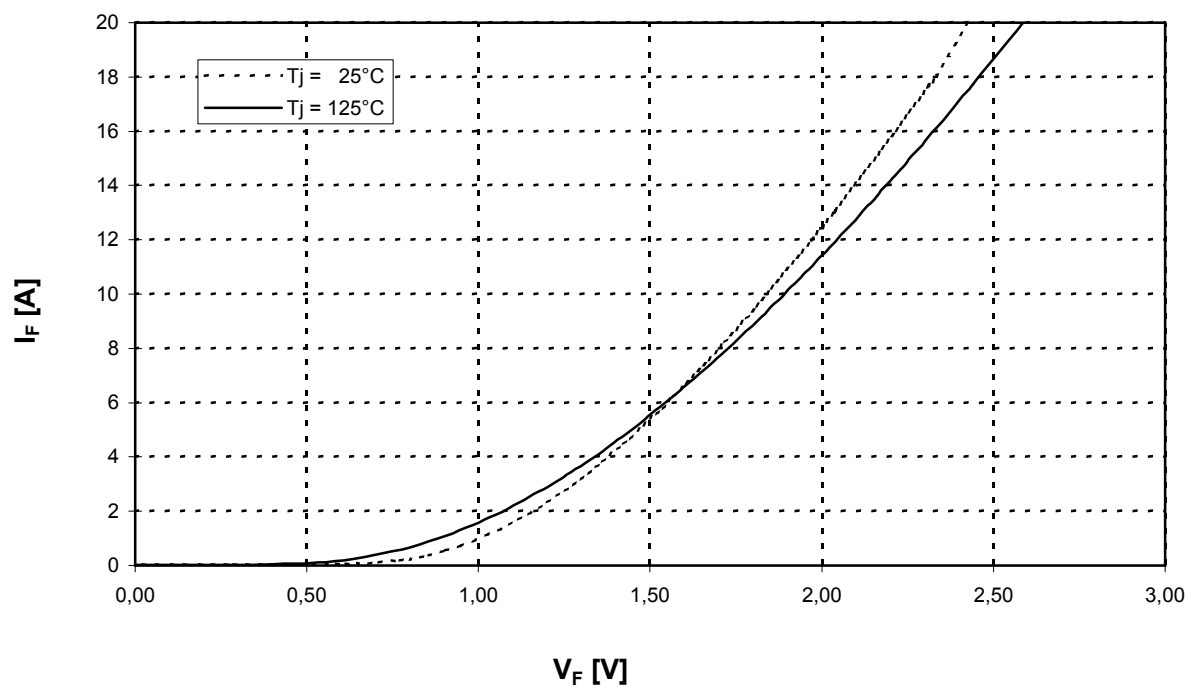
Vorläufig
preliminary

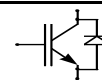
Ausgangskennlinienfeld Brems-Chopper-IGBT (typisch)
output characteristic brake-chopper-IGBT (typical)

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



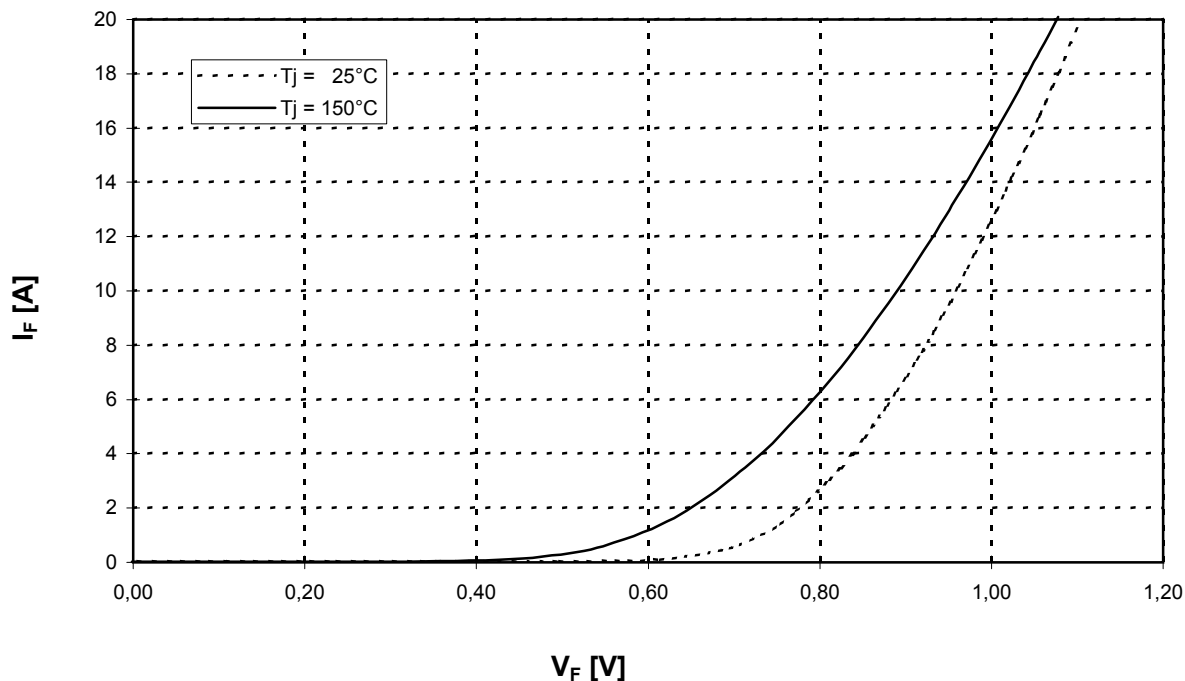
Durchlaßkennlinie der Brems-Chopper-Diode (typisch) $I_F = f(V_F)$
forward characteristic of brake-chopper-FWD (typical)



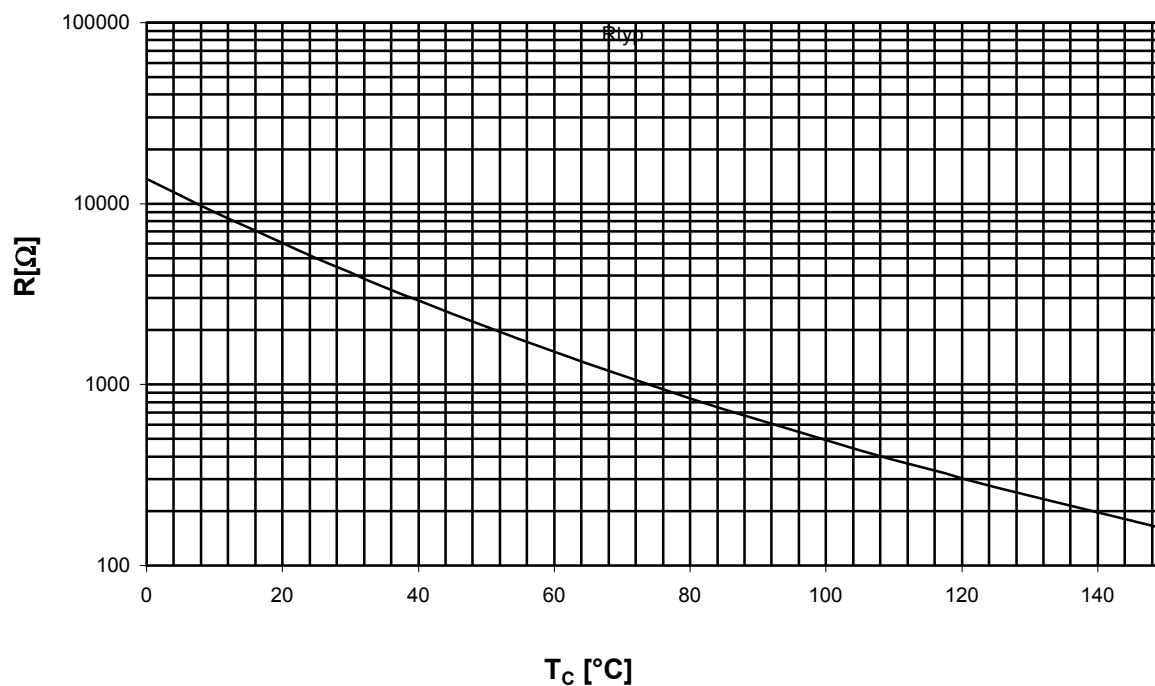


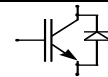
Vorläufig
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Durchlaßkennlinie der Gleichrichterdiode (typisch) $I_F = f(V_F)$
forward characteristic of rectifier diode (typical)



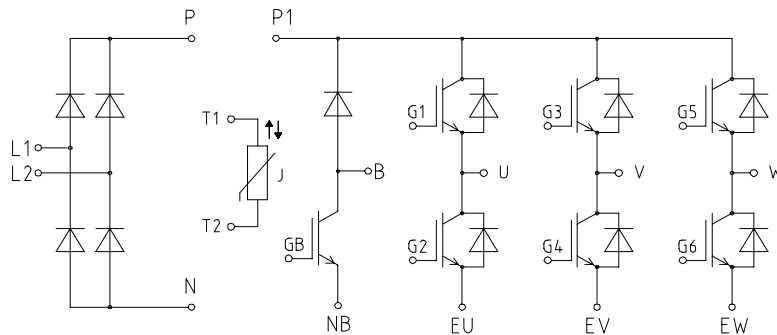
NTC- Temperaturkennlinie (typisch) $R = f(T)$
NTC- temperature characteristic (typical)





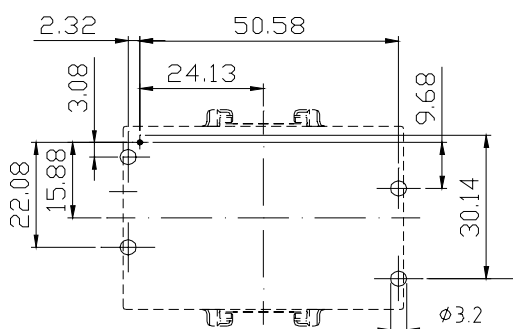
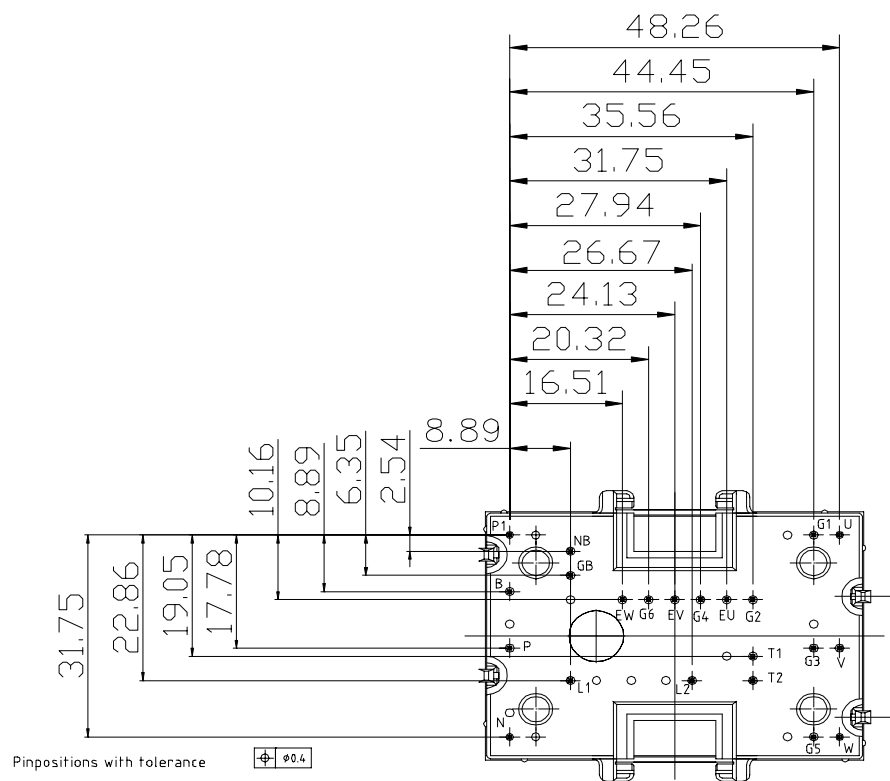
Vorläufig
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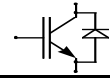
Schaltplan/ circuit diagram



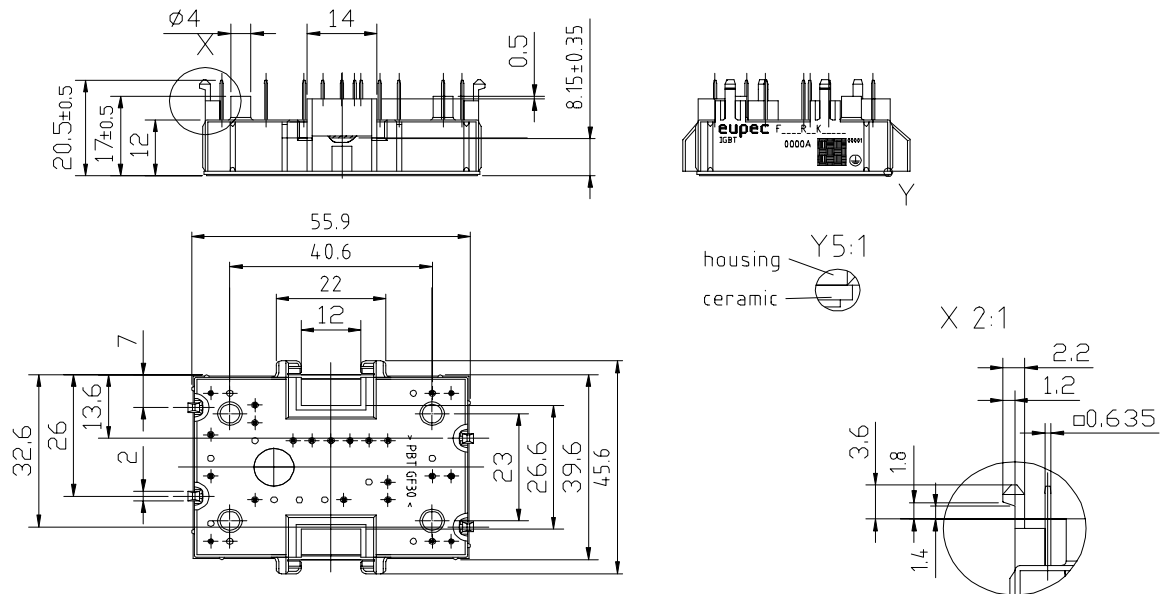
Gehäuseabmessungen/ package outlines

**Bohrplan /
drilling layout**





Gehäuseabmessungen Forts. / package outlines contd.



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