

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}	1600	V
Gleichrichter Ausgang Grenzeffektivstrom maximum RMS current at Rectifier output	$T_C = 80^{\circ}\text{C}$	I_{RMSmax}	75	A
Durchlaßstrom Grenzeffektivwert proChip Forward current RMS maximum per Chip	$T_C = 80^{\circ}\text{C}$	I_{FRMSM}	50	A
Stoßstrom Grenzwert surge forward current	$t_p = 10\text{ ms}, T_{vj} = 25^{\circ}\text{C}$	I_{FSM}	315	A
	$t_p = 10\text{ ms}, T_{vj} = 150^{\circ}\text{C}$		260	A
Grenzlastintegral I^2t - value	$t_p = 10\text{ ms}, T_{vj} = 25^{\circ}\text{C}$	I^2t	500	A^2s
	$t_p = 10\text{ ms}, T_{vj} = 150^{\circ}\text{C}$		340	A^2s

Transistor Wechselrichter/ Transistor Inverter

Kollektor-Emitter-Sperrspannung collector-emitter voltage	$T_{vj} = 25^{\circ}\text{C}$	V_{CES}	1200	V
Kollektor-Dauergleichstrom DC-collector current	$T_C = 80^{\circ}\text{C}$	$I_{C,nom.}$	40	A
	$T_C = 25^{\circ}\text{C}$	I_C	55	A
Periodischer Kollektor Spitzenstrom repetitive peak collector current	$t_p = 1\text{ ms}, T_C = 80^{\circ}\text{C}$	I_{CRM}	80	A
Gesamt-Verlustleistung total power dissipation	$T_C = 25^{\circ}\text{C}$	P_{tot}	200	W
Gate-Emitter-Spitzenspannung gate-emitter peak voltage		V_{GES}	+/- 20V	V

Diode Wechselrichter/ Diode Inverter

Dauergleichstrom DC forward current		I_F	40	A
Periodischer Spitzenstrom repetitive peak forw. current	$t_p = 1\text{ ms}$	I_{FRM}	80	A
Grenzlastintegral I^2t - value	$V_R = 0\text{V}, t_p = 10\text{ms}, T_{vj} = 125^{\circ}\text{C}$	I^2t	320	A^2s

Transistor Brems-Chopper/ Transistor Brake-Chopper

Kollektor-Emitter-Sperrspannung collector-emitter voltage	$T_{vj} = 25^{\circ}\text{C}$	V_{CES}	1200	V
Kollektor-Dauergleichstrom DC-collector current	$T_C = 80^{\circ}\text{C}$	$I_{C,nom.}$	40	A
	$T_C = 25^{\circ}\text{C}$	I_C	55	A
Periodischer Kollektor Spitzenstrom repetitive peak collector current	$t_p = 1\text{ ms}, T_C = 80^{\circ}\text{C}$	I_{CRM}	80	A
Gesamt-Verlustleistung total power dissipation	$T_C = 25^{\circ}\text{C}$	P_{tot}	200	W
Gate-Emitter-Spitzenspannung gate-emitter peak voltage		V_{GES}	+/- 20V	V

Diode Brems-Chopper/ Diode Brake-Chopper

Dauergleichstrom DC forward current		I_F	15	A
Periodischer Spitzenstrom repetitive peak forw. current	$t_p = 1\text{ ms}$	I_{FRM}	30	A

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Technische Information / Technical Information

eupec

IGBT-Module
IGBT-Modules

FP40R12KE3G

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	$T_{vj} = 150^{\circ}\text{C}$, $I_F = 40 \text{ A}$	V_F	-	1,2	-	V
Schleusenspannung threshold voltage	$T_{vj} = 150^{\circ}\text{C}$	$V_{(TO)}$	-	-	0,8	V
Ersatzwiderstand slope resistance	$T_{vj} = 150^{\circ}\text{C}$	r_T	-	-	10,5	m Ω
Sperrstrom reverse current	$T_{vj} = 150^{\circ}\text{C}$, $V_R = 1600 \text{ V}$	I_R	-	2	-	mA
Modul Leitungswiderstand, Anschlüsse-Chip lead resistance, terminals-chip	$T_C = 25^{\circ}\text{C}$	R_{AA+CC}	-	4	-	m Ω

Transistor Wechselrichter/ Transistor Inverter

			min.	typ.	max.	
Kollektor-Emitter Sättigungsspannung collector-emitter saturation voltage	$V_{GE} = 15\text{V}$, $T_{vj} = 25^{\circ}\text{C}$, $I_C = 40 \text{ A}$	$V_{CE\text{ sat}}$	-	1,8	2,3	V
	$V_{GE} = 15\text{V}$, $T_{vj} = 125^{\circ}\text{C}$, $I_C = 40 \text{ A}$		-	2,15	-	V
Gate-Schwellenspannung gate threshold voltage	$V_{CE} = V_{GE}$, $T_{vj} = 25^{\circ}\text{C}$, $I_C = 1,5 \text{ mA}$	$V_{GE(TO)}$	5,0	5,8	6,5	V
Eingangskapazität input capacitance	f = 1MHz, $T_{vj} = 25^{\circ}\text{C}$ $V_{CE} = 25 \text{ V}$, $V_{GE} = 0 \text{ V}$	C_{ies}	-	2,5	-	nF
Kollektor-Emitter Reststrom collector-emitter cut off current	$V_{GE} = 0\text{V}$, $T_{vj} = 25^{\circ}\text{C}$, $V_{CE} = 1200 \text{ V}$	I_{CES}	-	-	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}	-	-	400	nA
Einschaltverzögerungszeit (ind. Last) turn on delay time (inductive load)	$I_C = I_{Nenn}$, $V_{CC} = 600 \text{ V}$	$t_{d,on}$	-	85	-	ns
	$V_{GE} = \pm 15\text{V}$, $T_{vj} = 25^{\circ}\text{C}$, $R_G = 27 \text{ Ohm}$					
	$V_{GE} = \pm 15\text{V}$, $T_{vj} = 125^{\circ}\text{C}$, $R_G = 27 \text{ Ohm}$					
Anstiegszeit (induktive Last) rise time (inductive load)	$I_C = I_{Nenn}$, $V_{CC} = 600 \text{ V}$	t_r	-	30	-	ns
	$V_{GE} = \pm 15\text{V}$, $T_{vj} = 25^{\circ}\text{C}$, $R_G = 27 \text{ Ohm}$					
	$V_{GE} = \pm 15\text{V}$, $T_{vj} = 125^{\circ}\text{C}$, $R_G = 27 \text{ Ohm}$					
Abschaltverzögerungszeit (ind. Last) turn off delay time (inductive load)	$I_C = I_{Nenn}$, $V_{CC} = 600 \text{ V}$	$t_{d,off}$	-	420	-	ns
	$V_{GE} = \pm 15\text{V}$, $T_{vj} = 25^{\circ}\text{C}$, $R_G = 27 \text{ Ohm}$					
	$V_{GE} = \pm 15\text{V}$, $T_{vj} = 125^{\circ}\text{C}$, $R_G = 27 \text{ Ohm}$					
Fallzeit (induktive Last) fall time (inductive load)	$I_C = I_{Nenn}$, $V_{CC} = 600 \text{ V}$	t_f	-	65	-	ns
	$V_{GE} = \pm 15\text{V}$, $T_{vj} = 25^{\circ}\text{C}$, $R_G = 27 \text{ Ohm}$					
	$V_{GE} = \pm 15\text{V}$, $T_{vj} = 125^{\circ}\text{C}$, $R_G = 27 \text{ Ohm}$					
Einschaltverlustenergie pro Puls turn-on energy loss per pulse	$I_C = I_{Nenn}$, $V_{CC} = 600 \text{ V}$	E_{on}	-	6	-	mWs
	$V_{GE} = \pm 15\text{V}$, $T_{vj} = 125^{\circ}\text{C}$, $R_G = 27 \text{ Ohm}$ $L\sigma = 45 \text{ nH}$					
Abschaltverlustenergie pro Puls turn-off energy loss per pulse	$I_C = I_{Nenn}$, $V_{CC} = 600 \text{ V}$	E_{off}	-	4,2	-	mWs
	$V_{GE} = \pm 15\text{V}$, $T_{vj} = 125^{\circ}\text{C}$, $R_G = 27 \text{ Ohm}$ $L\sigma = 45 \text{ nH}$					
Kurzschlußverhalten SC Data	$t_P \leq 10\mu\text{s}$, $V_{GE} \leq 15\text{V}$, $R_G = 27 \text{ Ohm}$ $T_{vj} \leq 125^{\circ}\text{C}$, $V_{CC} = 720 \text{ V}$	I_{SC}	-	160	-	A

Elektrische Eigenschaften / Electrical properties

Charakteristische Werte / Characteristic values

		min.	typ.	max.		
Modulinduktivität stray inductance module		$L_{\sigma CE}$	-	-	60	nH
Modul Leitungswiderstand, Anschlüsse-Chip lead resistance, terminals-chip	$T_C = 25^\circ C$	R_{CC+EE}	-	7	-	m Ω
Diode Wechselrichter/ Diode Inverter			min.	typ.	max.	
Durchlaßspannung forward voltage	$V_{GE} = 0V, T_{vj} = 25^\circ C, I_F = 40 A$ $V_{GE} = 0V, T_{vj} = 125^\circ C, I_F = 40 A$	V_F	-	1,75	2,3	V
Rückstromspitze peak reverse recovery current	$I_F = I_{Nenn}, -di_F/dt = 900 A/\mu s$ $V_{GE} = -10V, T_{vj} = 25^\circ C, V_R = 600 V$ $V_{GE} = -10V, T_{vj} = 125^\circ C, V_R = 600 V$	I_{RM}	-	39	-	A
Sperrverzögerungsladung recovered charge	$I_F = I_{Nenn}, -di_F/dt = 900 A/\mu s$ $V_{GE} = -10V, T_{vj} = 25^\circ C, V_R = 600 V$ $V_{GE} = -10V, T_{vj} = 125^\circ C, V_R = 600 V$	Q_r	-	4,2	-	μAs
Abschaltenergie pro Puls reverse recovery energy	$I_F = I_{Nenn}, -di_F/dt = 900 A/\mu s$ $V_{GE} = -10V, T_{vj} = 25^\circ C, V_R = 600 V$ $V_{GE} = -10V, T_{vj} = 125^\circ C, V_R = 600 V$	E_{rec}	-	1,35	-	mWs
Transistor Brems-Chopper/ Transistor Brake-Chopper			min.	typ.	max.	
Kollektor-Emitter Sättigungsspannung collector-emitter saturation voltage	$V_{GE} = 15V, T_{vj} = 25^\circ C, I_C = 40 A$ $V_{GE} = 15V, T_{vj} = 125^\circ C, I_C = 40 A$	$V_{CE sat}$	-	1,8	2,3	V
Gate-Schwellenspannung gate threshold voltage	$V_{CE} = V_{GE}, T_{vj} = 25^\circ C, I_C = 1,5 mA$	$V_{GE(TO)}$	5,0	5,8	6,5	V
Eingangskapazität input capacitance	$f = 1MHz, T_{vj} = 25^\circ C$ $V_{CE} = 25 V, V_{GE} = 0 V$	C_{ies}	-	2,5	-	nF
Kollektor-Emitter Reststrom collector-emitter cut off current	$V_{GE} = 0V, T_{vj} = 25^\circ C, V_{CE} = 1200 V$	I_{CES}	-	5,0	500	mA
Gate-Emitter Reststrom gate-emitter leakage current	$V_{CE} = 0V, V_{GE} = 20V, T_{vj} = 25^\circ C$	I_{GES}	-	-	400	nA
Schaltverluste und -bedingungen Switching losses and conditions	siehe Wechselrichter in diesem Datenblatt see inverter in this datasheet					
Diode Brems-Chopper/ Diode Brake-Chopper			min.	typ.	max.	
Durchlaßspannung forward voltage	$T_{vj} = 25^\circ C, I_F = 40 A$ $T_{vj} = 125^\circ C, I_F = 40 A$	V_F	-	2,35	2,8	V
Schaltverluste und -bedingungen Switching losses and conditions	siehe Wechselrichter in Dbl FP15R12KE3 see inverter in datasheet FP15R12KE3					
NTC-Widerstand/ NTC-Thermistor			min.	typ.	max.	
Nennwiderstand rated resistance	$T_C = 25^\circ C$	R_{25}	-	5	-	k Ω
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

Thermische Eigenschaften / Thermal properties

		min.	typ.	max.		
Innerer Wärmewiderstand thermal resistance, junction to case	Glechr. Diode/ Rectif. Diode	R_{thJC}	-	-	1	K/W
	Trans. Wechr./ Trans. Inverter		-	-	0,6	K/W
	Diode Wechr./ Diode Inverter		-	-	0,95	K/W
	Trans. Bremse/ Trans. Brake		-	-	0,6	K/W
	Diode Bremse/ Diode Brake		-	-	1,5	K/W
Übergangs-Wärmewiderstand thermal resistance, case to heatsink	Glechr. Diode/ Rectif. Diode	R_{thCK}	-	0,04	-	K/W
	Trans. Wechr./ Trans. Inverter		-	0,02	-	K/W
	Diode Wechr./ Diode Inverter		-	0,04	-	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	
Anzugsdrehmoment f. mech. Befestigung mounting torque	Schraube M 5 screw M 5	M	3	-	6 Nm
Gewicht weight		G		300	g
Luftstrecke clearance	Pin-Erde Pin-GND			7,5	mm
Kriechstrecke creeping distance	Pin-Erde Pin-GND			10	mm

Transiente Thermische Eigenschaften / Transient Thermal properties

	IGBT-Wechselrichter IGBT-Inverter		Diode-Wechselrichter Diode-Inverter	
	r_i [K/W]	τ_i [s]	r_i [K/W]	τ_i [s]
1	6,769E-02	2,345E-03	9,674E-02	3,333E-03
2	1,052E-01	2,820E-01	6,249E-01	3,429E-02
3	2,709E-01	2,820E-02	1,800E-01	1,294E-01
4	1,523E-01	1,128E-01	5,701E-02	7,662E-01

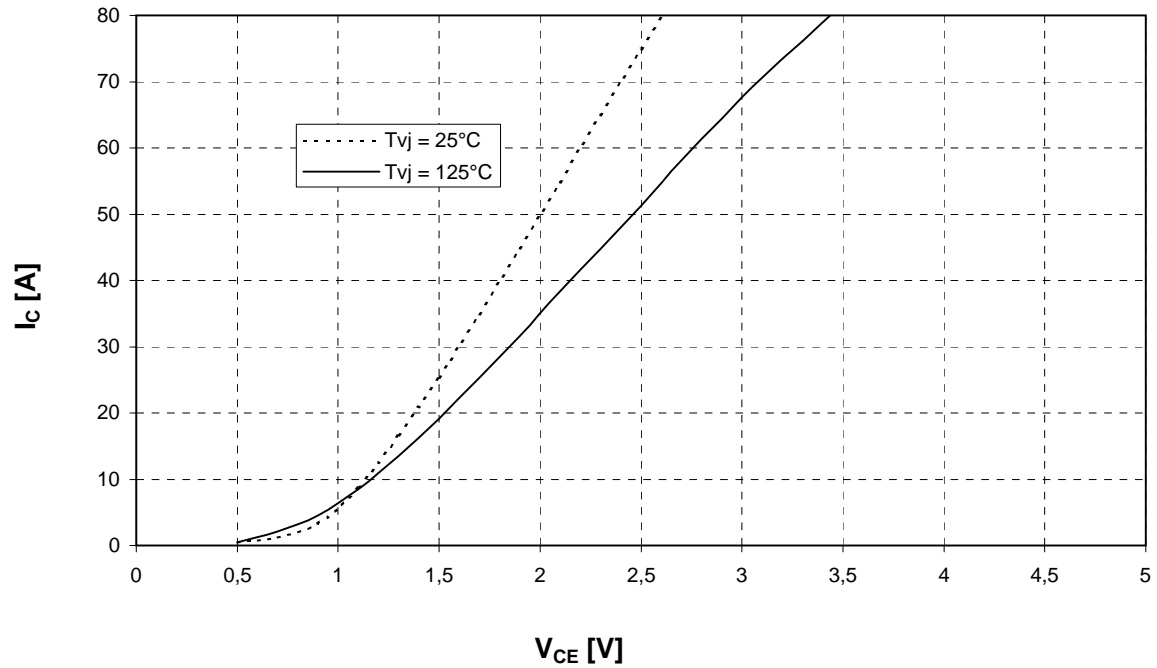
FP40R12KE3G

Ausgangskennlinienfeld Wechselr. (typisch)

$I_C = f(V_{CE})$

Output characteristic Inverter (typical)

$V_{GE} = 15\text{ V}$

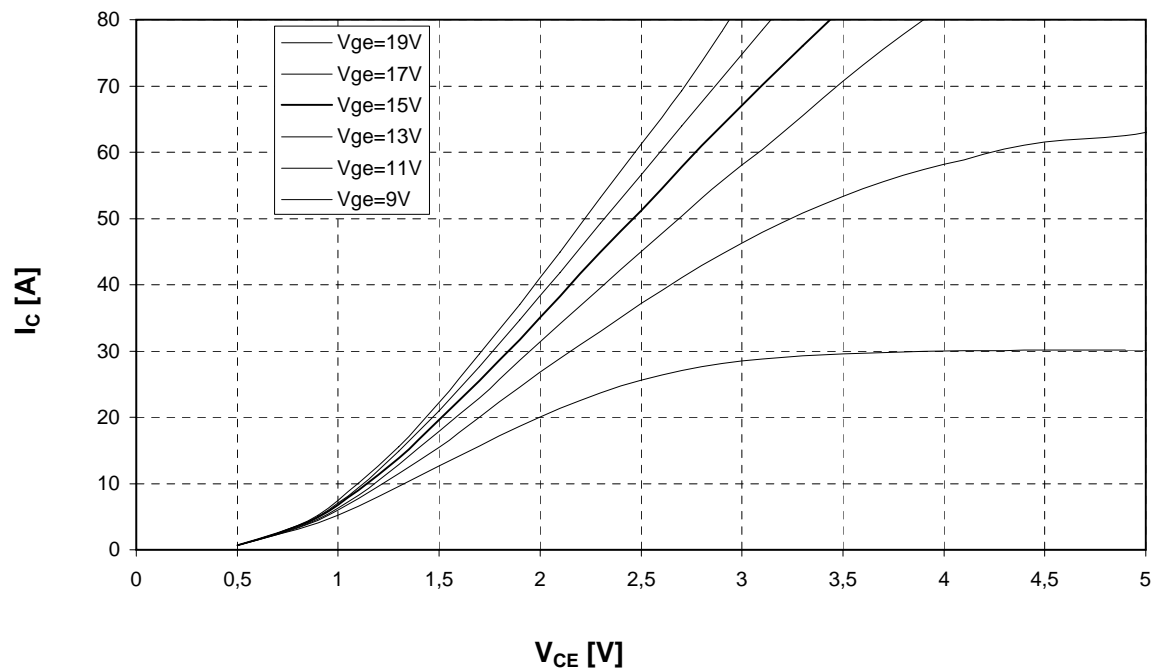


Ausgangskennlinienfeld Wechselr. (typisch)

$I_C = f(V_{CE})$

Output characteristic Inverter (typical)

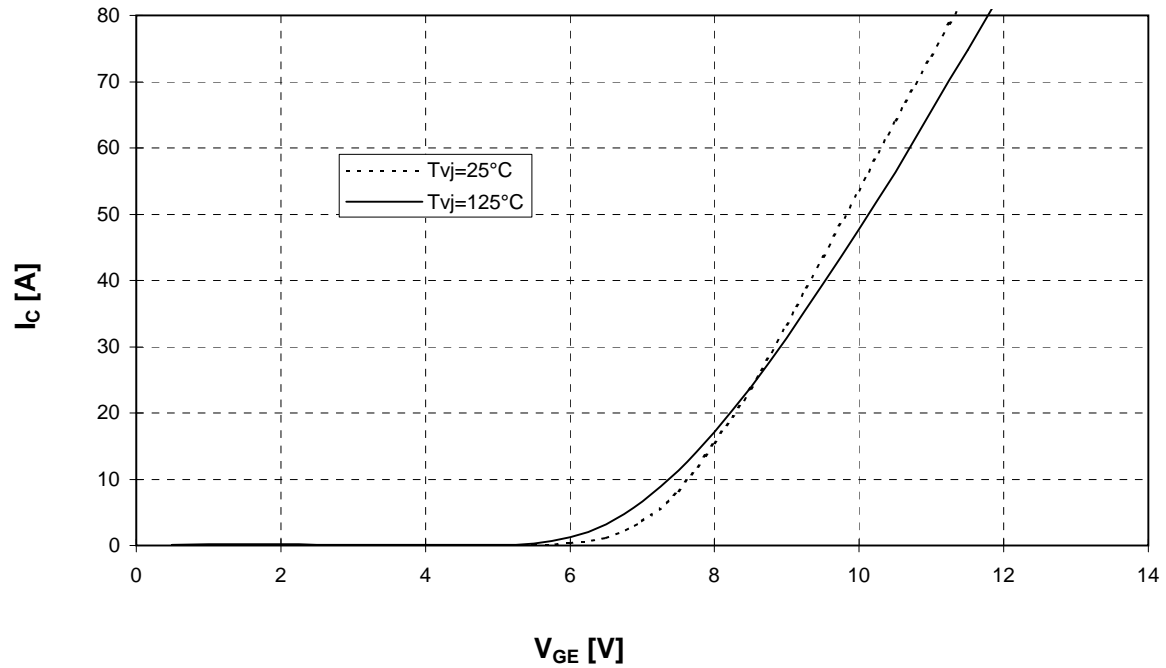
$T_{vj} = 125^\circ\text{C}$



Übertragungscharakteristik Wechselr. (typisch)
Transfer characteristic Inverter (typical)

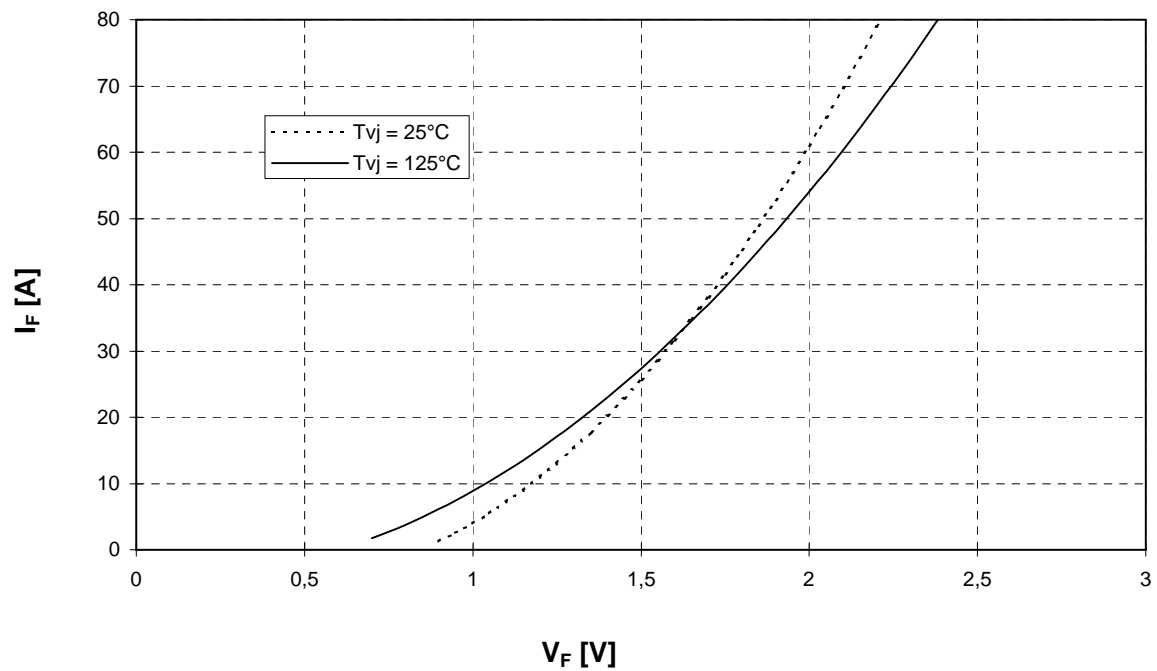
$$I_C = f(V_{GE})$$

$$V_{CE} = 20 \text{ V}$$



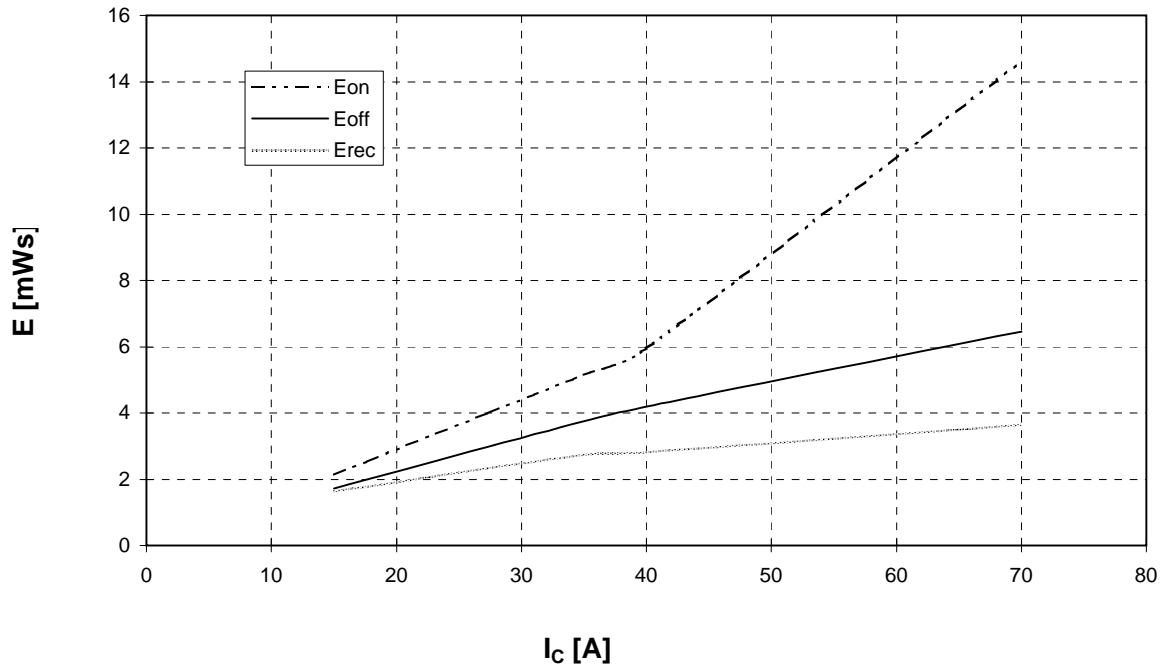
Durchlaßkennlinie der Freilaufdiode Wechselr. (typisch)
Forward characteristic of FWD Inverter (typical)

$$I_F = f(V_F)$$

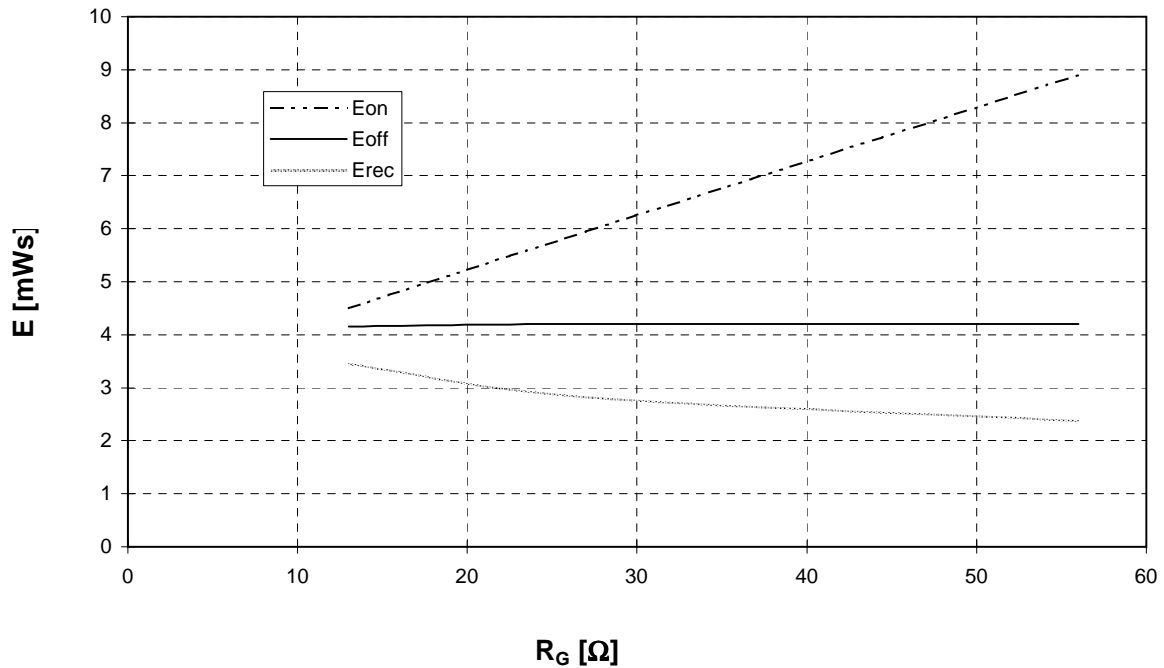


FP40R12KE3G

Schaltverluste Wechselr. (typisch) $E_{on} = f(I_C)$, $E_{off} = f(I_C)$, $E_{rec} = f(I_C)$ $V_{CC} = 600\text{ V}$
 Switching losses Inverter (typical) $T_j = 125^\circ\text{C}$, $V_{GE} = \pm 15\text{ V}$, $R_{Gon} = R_{Goff} = 27\text{ Ohm}$

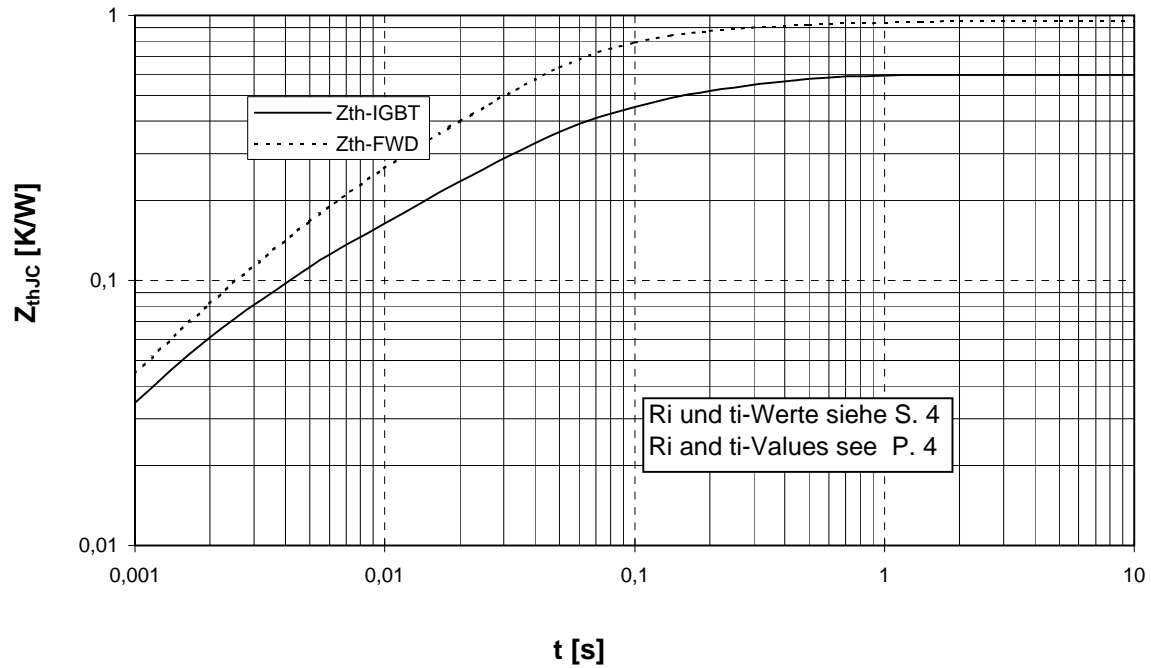


Schaltverluste Wechselr. (typisch) $E_{on} = f(R_G)$, $E_{off} = f(R_G)$, $E_{rec} = f(R_G)$
 Switching losses Inverter (typical) $T_j = 125^\circ\text{C}$, $V_{GE} = \pm 15\text{ V}$, $I_C = I_{nenn}$, $V_{CC} = 600\text{ V}$



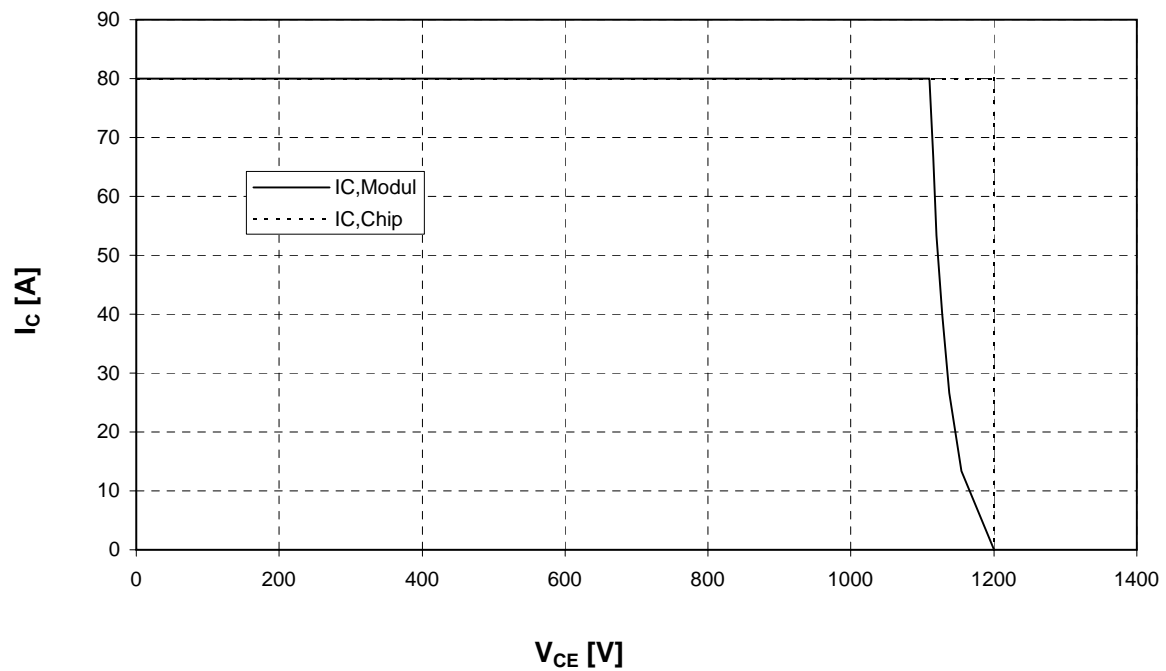
Transienter Wärmewiderstand Wechsler.
Transient thermal impedance Inverter

$Z_{thJC} = f(t)$



Sicherer Arbeitsbereich IGBT-Wechsler. (RBSOA)
Reverse bias safe operating area (RBSOA)

$V_{GE} = 15V, T_j = 125^\circ C$

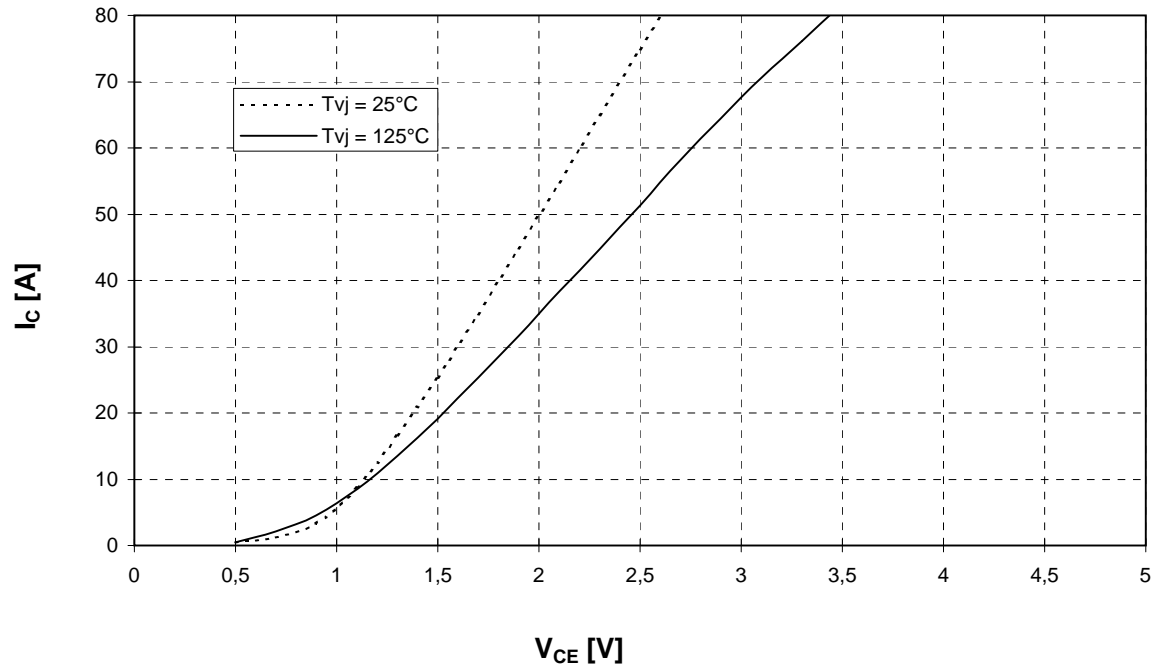


Ausgangskennlinienfeld Brems-Chopper-IGBT (typisch)

$I_C = f(V_{CE})$

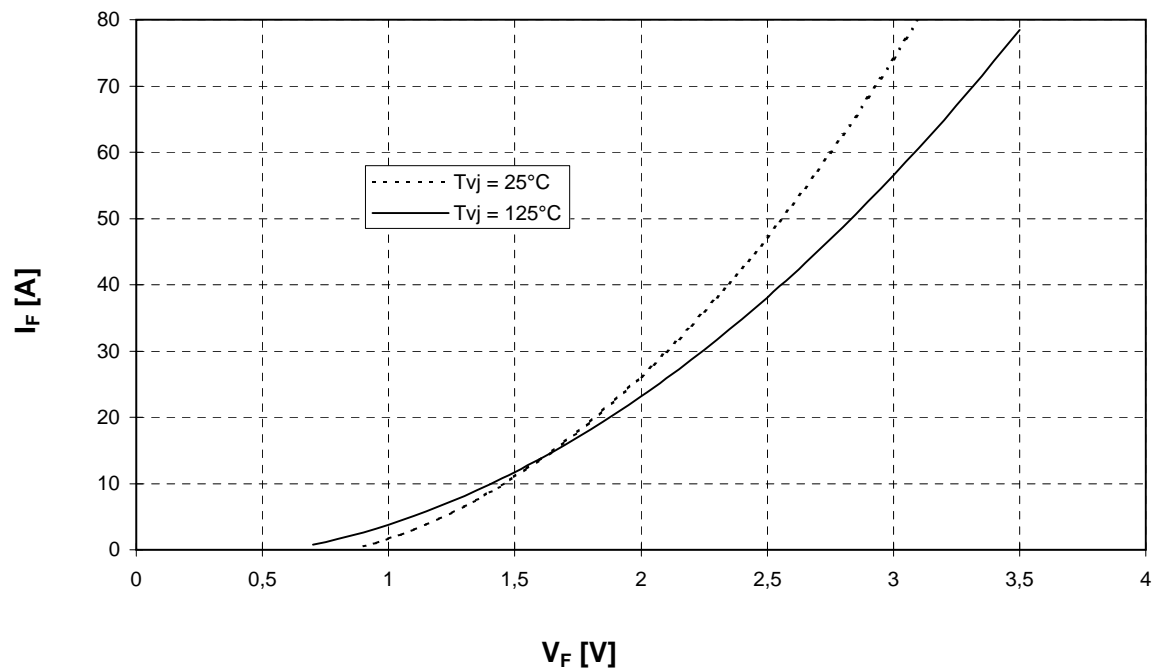
Output characteristic brake-chopper-IGBT (typical)

$V_{GE} = 15\text{ V}$

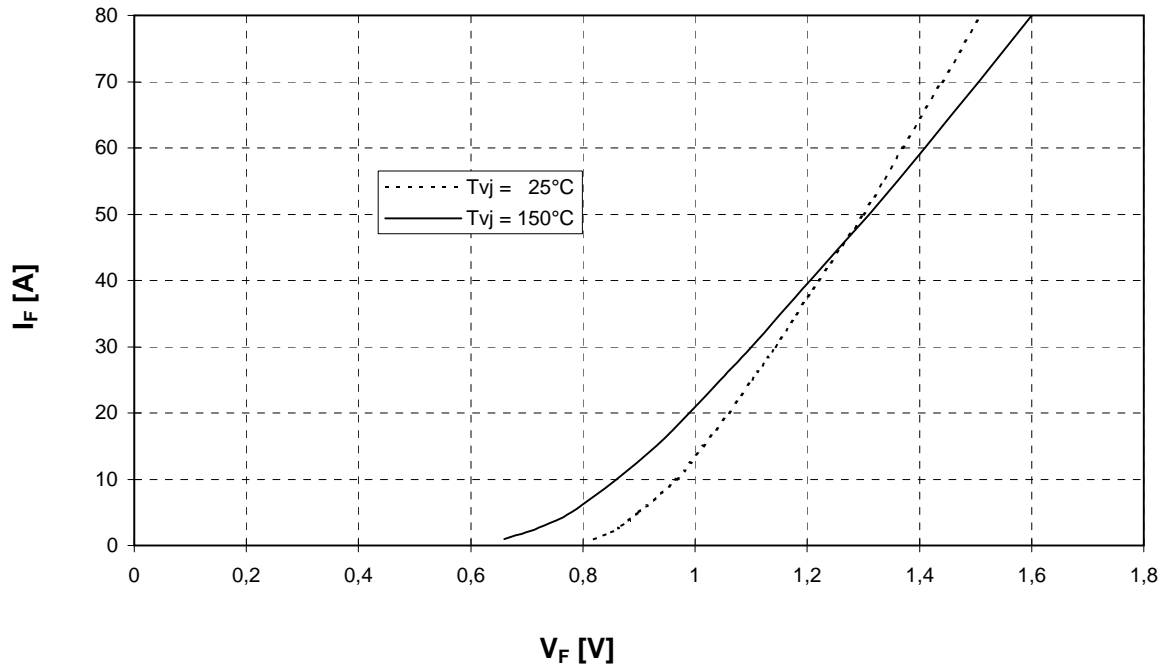


Durchlaßkennlinie der Brems-Chopper-Diode (typisch) $I_F = f(V_F)$

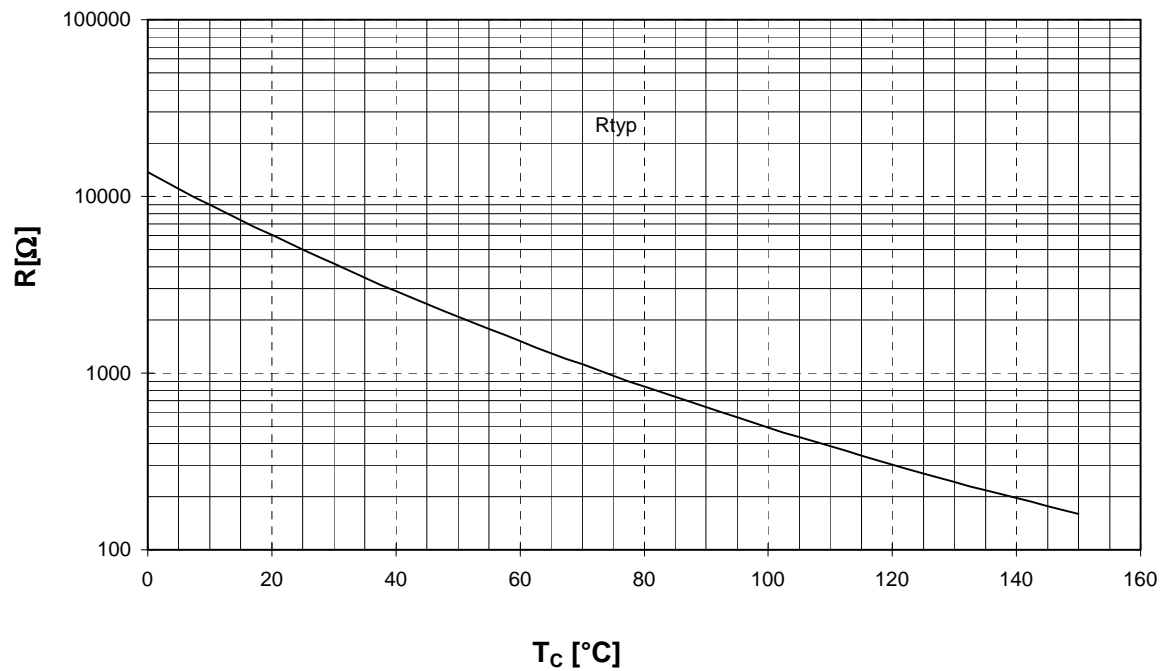
Forward characteristic of brake-chopper-FWD (typical)



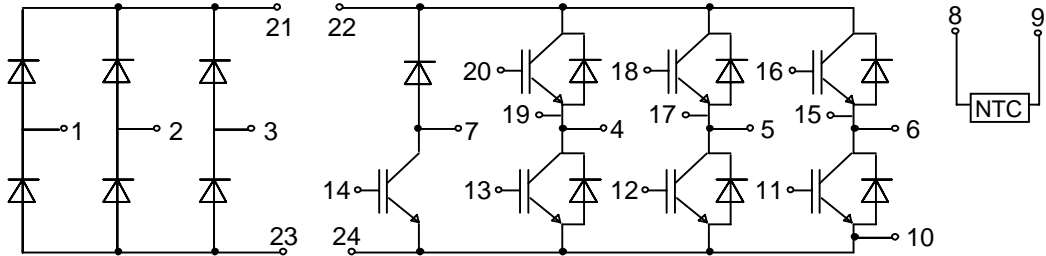
Durchlaßkennlinie der Gleichrichterdiode (typisch) $I_F = f(V_F)$
Forward characteristic of Rectifier Diode (typical)



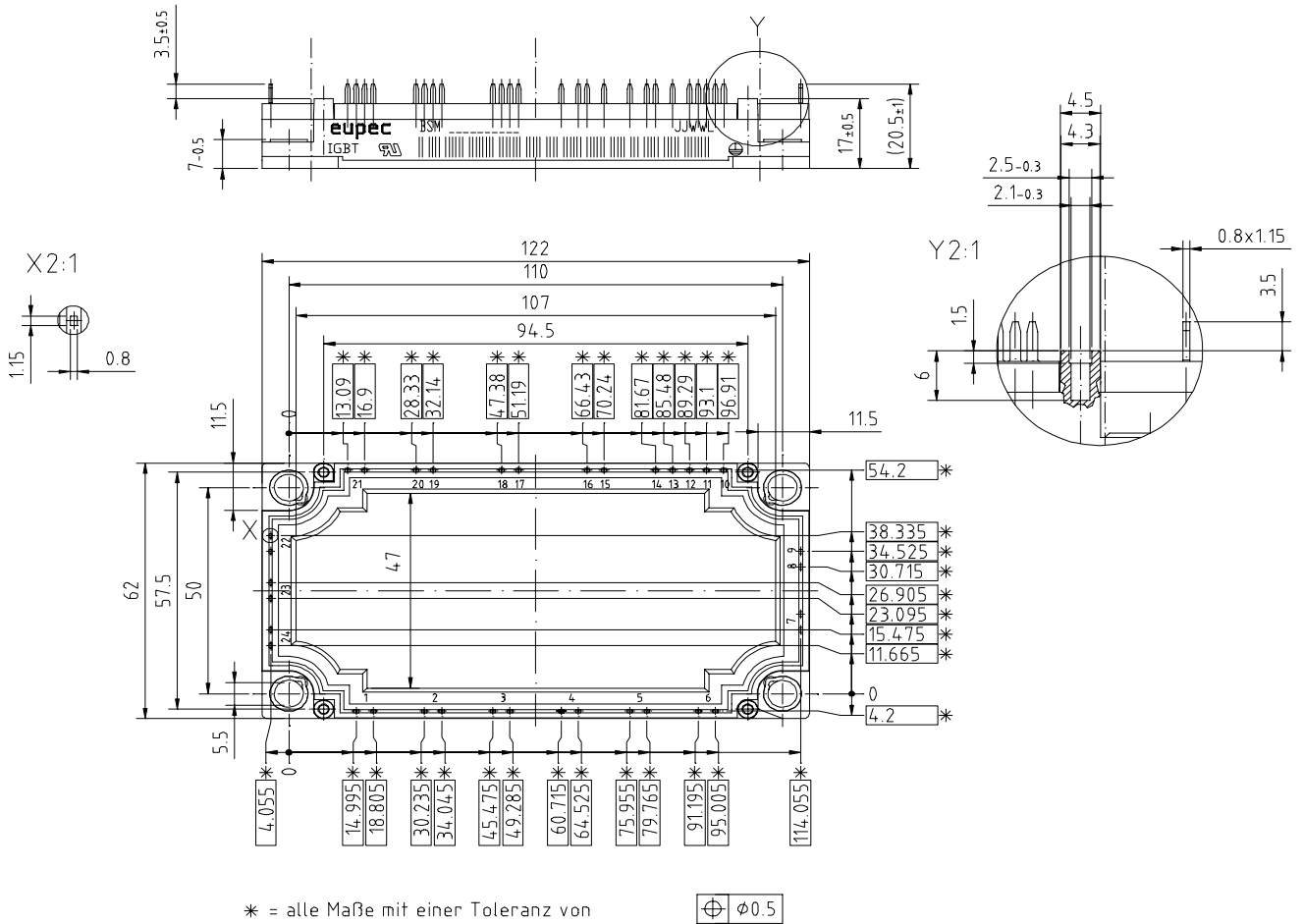
NTC- Temperaturkennlinie (typisch) $R = f(T)$
NTC- temperature characteristic (typical)



Schaltplan/ Circuit diagram



Gehäuseabmessungen/ Package outlines



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