Elektrische Eigenschaften / Electrical properties

Höchstzulässige Werte / Maximum rated values

Diode Gleichrichter/ Diode Rectifier

Periodische Rückw. Spitzensperrspannung repetitive peak reverse voltage	T_{vj} = 25°C	V_{RRM}	1600	V
Gleichrichter Ausgang Grenzeffektivstrom maximum RMS current at Rectifier output	T_C = 80°C	I_{RMSmax}	60	A
Durchlaßstrom Grenzeffektivwert proChip Forward current RMS maximum per Chip	T_C = 80°C	I_{FRMSM}	50	A
Stoßstrom Grenzwert surge forward current	t_P = 10 ms, T_{vj} = 25°C t_P = 10 ms, T_{vj} = 150°C	I_{FSM}	315 260	A A
Grenzlastintegral I^2t - value	t_P = 10 ms, T_{vj} = 25°C t_P = 10 ms, T_{vj} = 150°C	I^2t	500 340	A^2s A^2s

Transistor Wechselrichter/ Transistor Inverter

Kollektor-Emitter-Sperrspannung collector-emitter voltage	T_{vj} = 25°C	V_{CES}	1200	V
Kollektor-Dauergleichstrom DC-collector current	Tc = 80 °C T_C = 25 °C	$I_{C,nom.}$ I_C	40 55	A A
Periodischer Kollektor Spitzenstrom repetitive peak collector current	t_P = 1 ms, T_C = 80 °C	I_{CRM}	80	A
Gesamt-Verlustleistung total power dissipation	T_C = 25°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 ms	I_{FRM}	80	A
Grenzlastintegral I^2t - value	V_R = 0V, t_p = 10ms, T_{vj} = 125°C	I^2t	320	A^2s

Transistor Brems-Chopper/ Transistor Brake-Chopper

Kollektor-Emitter-Sperrspannung collector-emitter voltage	T_{vj} = 25°C	V_{CES}	1200	V
Kollektor-Dauergleichstrom DC-collector current	T_C = 80 °C T_C = 25 °C	$I_{C,nom.}$ I_C	15 25	A A
Periodischer Kollektor Spitzenstrom repetitive peak collector current	t_P = 1 ms, T_C = 80°C	I_{CRM}	30	A
Gesamt-Verlustleistung total power dissipation	T_C = 25°C	P_{tot}	100	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 ms	I_{FRM}	20	A

prepared by: Andreas Schulz	date of publication:23.04.2002
approved by: Robert Severin	revision: 2

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

Elektrische Eigenschaften / Electrical properties

Charakteristische Werte / Characteristic values

Diode Gleichrichter/ Diode Rectifier			**min.**	**typ.**	**max.**	
Durchlaßspannung forward voltage	T_{vj} = 150°C, I_F = 40 A	V_F	-	1,2	-	V
Schleusenspannung threshold voltage	T_{vj} = 150°C	$V_{(TO)}$	-	-	0,8	V
Ersatzwiderstand slope resistance	T_{vj} = 150°C	r_T	-	-	10,5	mΩ
Sperrstrom reverse current	T_{vj} = 150°C, V_R = 1600 V	I_R	-	2	-	mA
Modul Leitungswiderstand, Anschlüsse-Chip lead resistance, terminals-chip	T_C = 25°C	$R_{AA'+CC'}$	-	5	-	mΩ

Transistor Wechselrichter/ Transistor Inverter			**min.**	**typ.**	**max.**	
Kollektor-Emitter Sättigungsspannung collector-emitter saturation voltage	V_{GE} = 15V, T_{vj} = 25°C, I_C = 40 A V_{GE} = 15V, T_{vj} = 125°C, I_C = 40 A	$V_{CE\ sat}$	- -	1,8 2,15	2,3 -	V V
Gate-Schwellenspannung gate threshold voltage	V_{CE} = V_{GE}, T_{vj} = 25°C, I_C = 1,5 mA	$V_{GE(TO)}$	5,0	5,8	6,5	V
Eingangskapazität input capacitance	f = 1MHz, T_{vj} = 25°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°C, V_{CE} = 1200 V	I_{CES}	-	-	5	mA
Gate-Emitter Reststrom gate-emitter leakage current	V_{CE} = 0V, V_{GE} =20V, T_{vj} =25°C	I_{GES}	-	-	400	nA
Einschaltverzögerungszeit (ind. Last) turn on delay time (inductive load)	I_C = I_{Nenn}, V_{CC} = 600 V V_{GE} = ±15V, T_{vj} = 25°C, R_G = 27 Ohm V_{GE} = ±15V, T_{vj} = 125°C, R_G = 27 Ohm	$t_{d,on}$	- -	85 90	- -	ns ns
Anstiegszeit (induktive Last) rise time (inductive load)	I_C = I_{Nenn}, V_{CC} = 600 V V_{GE} = ±15V, T_{vj} = 25°C, R_G = 27 Ohm V_{GE} = ±15V, T_{vj} = 125°C, R_G = 27 Ohm	t_r	- -	30 45	- -	ns ns
Abschaltverzögerungszeit (ind. Last) turn off delay time (inductive load)	I_C = I_{Nenn}, V_{CC} = 600 V V_{GE} = ±15V, T_{vj} = 25°C, R_G = 27 Ohm V_{GE} = ±15V, T_{vj} = 125°C, R_G = 27 Ohm	$t_{d,off}$	- -	420 520	- -	ns ns
Fallzeit (induktive Last) fall time (inductive load)	I_C = I_{Nenn}, V_{CC} = 600 V V_{GE} = ±15V, T_{vj} = 25°C, R_G = 27 Ohm V_{GE} = ±15V, T_{vj} = 125°C, R_G = 27 Ohm	t_f	- -	65 90	- -	ns ns
Einschaltverlustenergie pro Puls turn-on energy loss per pulse	I_C = I_{Nenn}, V_{CC} = 600 V V_{GE} = ±15V, T_{vj} = 125°C, R_G = 27 Ohm Lσ = 45 nH	E_{on}	-	5,8	-	mWs
Abschaltverlustenergie pro Puls turn-off energy loss per pulse	I_C = I_{Nenn}, V_{CC} = 600 V V_{GE} = ±15V, T_{vj} = 125°C, R_G = 27 Ohm Lσ = 45 nH	E_{off}	-	4,9	-	mWs
Kurzschlußverhalten SC Data	t_P ≤ 10µs, V_{GE} ≤ 15V, R_G = 27 Ohm T_{vj}≤125°C, V_{CC} = 720 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°C	$R_{CC'+EE'}$	-	7	-	mΩ
Diode Wechselrichter/ Diode Inverter			**min.**	**typ.**	**max.**	
Durchlaßspannung forward voltage	V_{GE} = 0V, T_{vj} = 25°C, I_F = 40 A	V_F	-	1,75	2,3	V
	V_{GE} = 0V, T_{vj} = 125°C, I_F = 40 A		-	1,75	-	V
Rückstromspitze peak reverse recovery current	I_F=I_{Nenn}, - di_F/dt = 1000 A/µs					
	V_{GE} = -10V, T_{vj} = 25°C, V_R = 600 V	I_{RM}	-	45	-	A
	V_{GE} = -10V, T_{vj} = 125°C, V_R = 600 V		-	46	-	A
Sperrverzögerungsladung recovered charge	I_F=I_{Nenn}, - di_F/dt = 1000 A/µs					
	V_{GE} = -10V, T_{vj} = 25°C, V_R = 600 V	Q_r	-	4,4	-	µAs
	V_{GE} = -10V, T_{vj} = 125°C, V_R = 600 V		-	8,4	-	µAs
Abschaltenergie pro Puls reverse recovery energy	I_F=I_{Nenn}, - di_F/dt = 1000 A/µs					
	V_{GE} = -10V, T_{vj} = 25°C, V_R = 600 V	E_{rec}	-	1,55	-	mWs
	V_{GE} = -10V, T_{vj} = 125°C, V_R = 600 V		-	3,1	-	mWs
Transistor Brems-Chopper/ Transistor Brake-Chopper			**min.**	**typ.**	**max.**	
Kollektor-Emitter Sättigungsspannung collector-emitter saturation voltage	V_{GE} = 15V, T_{vj} = 25°C, I_C = 15 A	$V_{CE\,sat}$	-	1,7	2,15	V
	V_{GE} = 15V, T_{vj} = 125°C, I_C = 15 A		-	2	-	V
Gate-Schwellenspannung gate threshold voltage	V_{CE} = V_{GE}, T_{vj} = 25°C, I_C = 0,5 mA	$V_{GE(TO)}$	5,0	5,8	6,5	V
Eingangskapazität input capacitance	f = 1MHz, T_{vj} = 25°C V_{CE} = 25 V, V_{GE} = 0 V	C_{ies}	-	1,1	-	nF
Kollektor-Emitter Reststrom collector-emitter cut off current	V_{GE} = 0V, T_{vj} = 25°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°C	I_{GES}	-	-	400	nA
Schaltverluste und -bedingungen Switching losses and conditions	siehe Wechselrichter in Dbl FP15R12KE3 see inverter in datasheet FP15R12KE3					
Diode Brems-Chopper/ Diode Brake-Chopper			**min.**	**typ.**	**max.**	
Durchlaßspannung forward voltage	T_{vj} = 25°C, I_F = 15 A	V_F	-	2,05	2,5	V
	T_{vj} = 125°C, I_F = 15 A		-	2,2	-	V
Schaltverluste und -bedingungen Switching losses and conditions	siehe Wechselrichter in Dbl FB10R12KE3 see inverter in datasheet FB10R12KE3					
NTC-Widerstand/ NTC-Thermistor			**min.**	**typ.**	**max.**	
Nennwiderstand rated resistance	T_C = 25°C	R_{25}	-	5	-	kΩ
Abweichung von R_{100} deviation of R_{100}	T_C = 100°C, R_{100} = 493 Ω	ΔR/R	-5		5	%
Verlustleistung power dissipation	T_C = 25°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	Gleichr. Diode/ Rectif. Diode		R_{thJC}	-	-	1	K/W
	Trans. Wechsr./ Trans. Inverter			-	-	0,6	K/W
	Diode Wechsr./ Diode Inverter			-	-	0,95	K/W
	Trans. Bremse/ Trans. Brake			-	-	1,2	K/W
	Diode Bremse/ Diode Brake			-	-	2,3	K/W
Übergangs-Wärmewiderstand thermal resistance, case to heatsink	Gleichr. Diode/ Rectif. Diode	λ_{Paste}=1W/m*K	R_{thCK}	-	0,08	-	K/W
	Trans. Wechsr./ Trans. Inverter	λ_{grease}=1W/m*K		-	0,04	-	K/W
	Diode Wechsr./ Diode Inverter			-	0,08	-	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

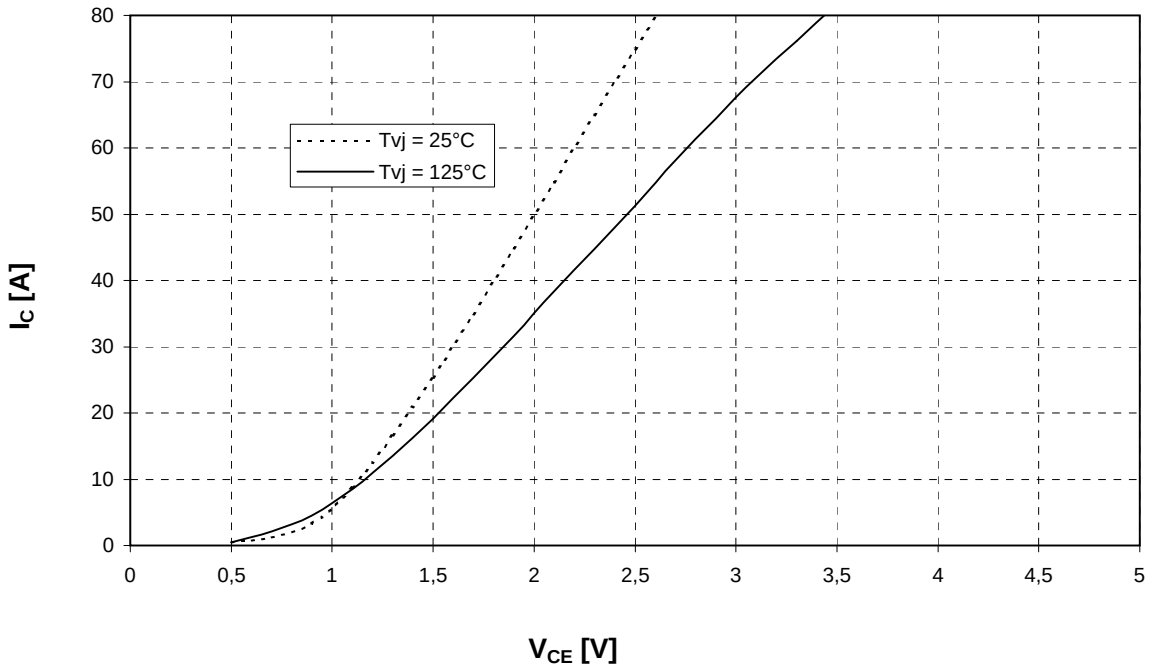
Innere Isolation internal insulation			Al_2O_3			
CTI comperative tracking index			225			
Anzugsdrehmoment f. mech. Befestigung mounting torque	Schraube M 5 screw M 5	M	3	-	6	Nm
Gewicht weight		G	180			g
Luftstrecke clearance	Pin-Erde Pin-GND		7,5			mm
Kriechstrecke creeping distance	Pin-Erde Pin-GND		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

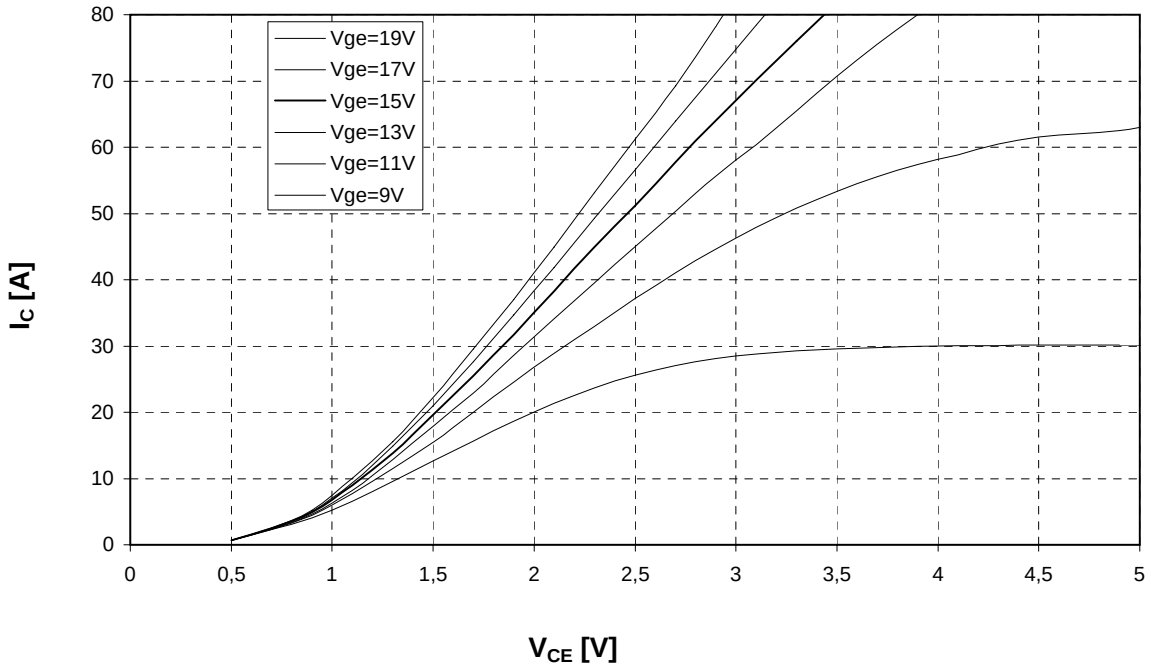
Ausgangskennlinienfeld Wechselr. (typisch) $I_C = f(V_{CE})$

Output characteristic Inverter (typical) $V_{GE} = 15\ V$

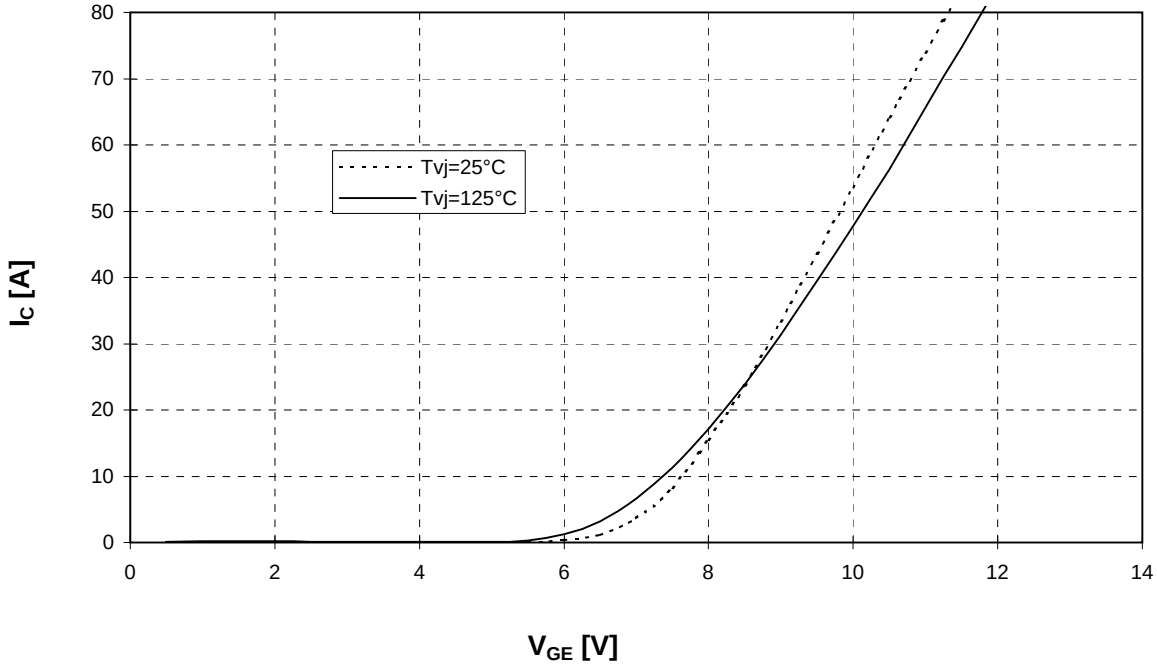


Ausgangskennlinienfeld Wechselr. (typisch) $I_C = f(V_{CE})$

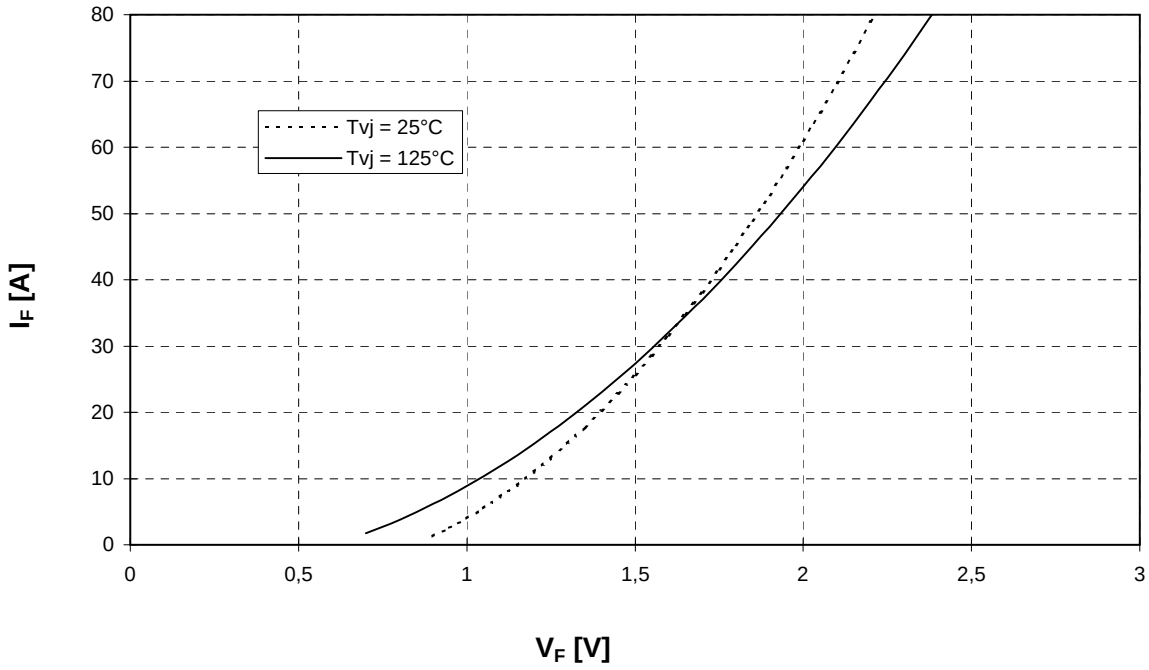
Output characteristic Inverter (typical) $T_{vj} = 125°C$



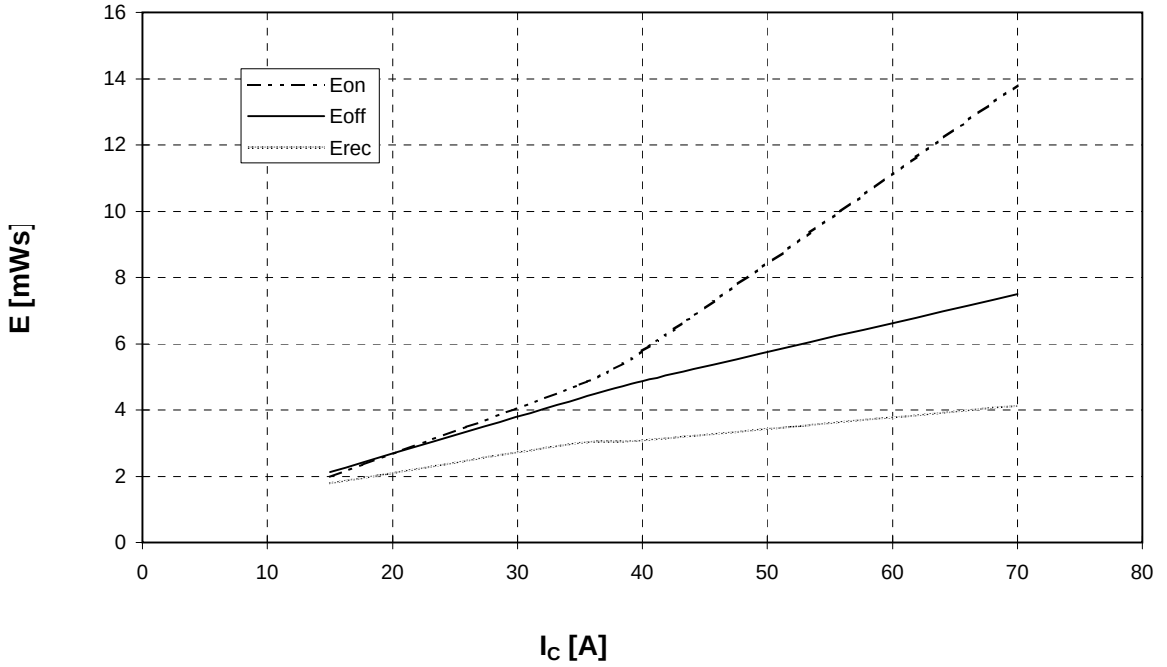
Übertragungscharakteristik Wechselr. (typisch) $I_C = f(V_{GE})$
Transfer characteristic Inverter (typical) $V_{CE} = 20\ V$



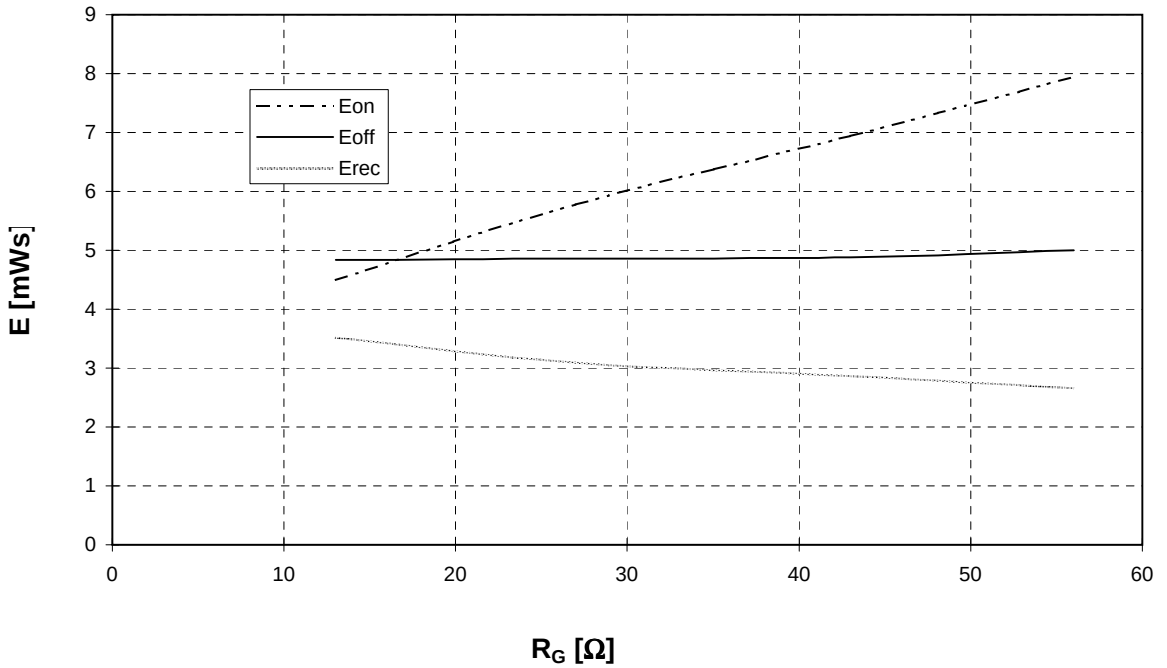
Durchlaßkennlinie der Freilaufdiode Wechselr. (typisch) $I_F = f(V_F)$
Forward characteristic of FWD Inverter (typical)



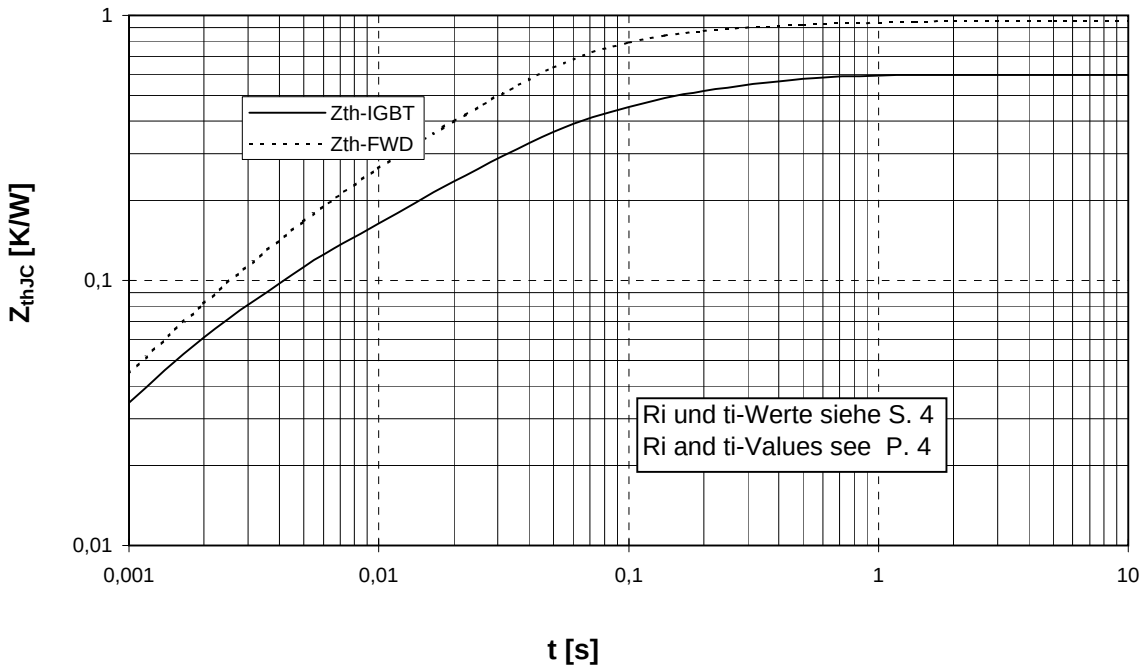
Schaltverluste Wechselr. (typisch) $E_{on} = f(I_C)$, $E_{off} = f(I_C)$, $E_{rec} = f(I_C)$ V_{CC} = **600 V**
Switching losses Inverter (typical) T_j = 125°C, V_{GE} = ±15 V, R_{Gon} = R_{Goff} = **27 Ohm**



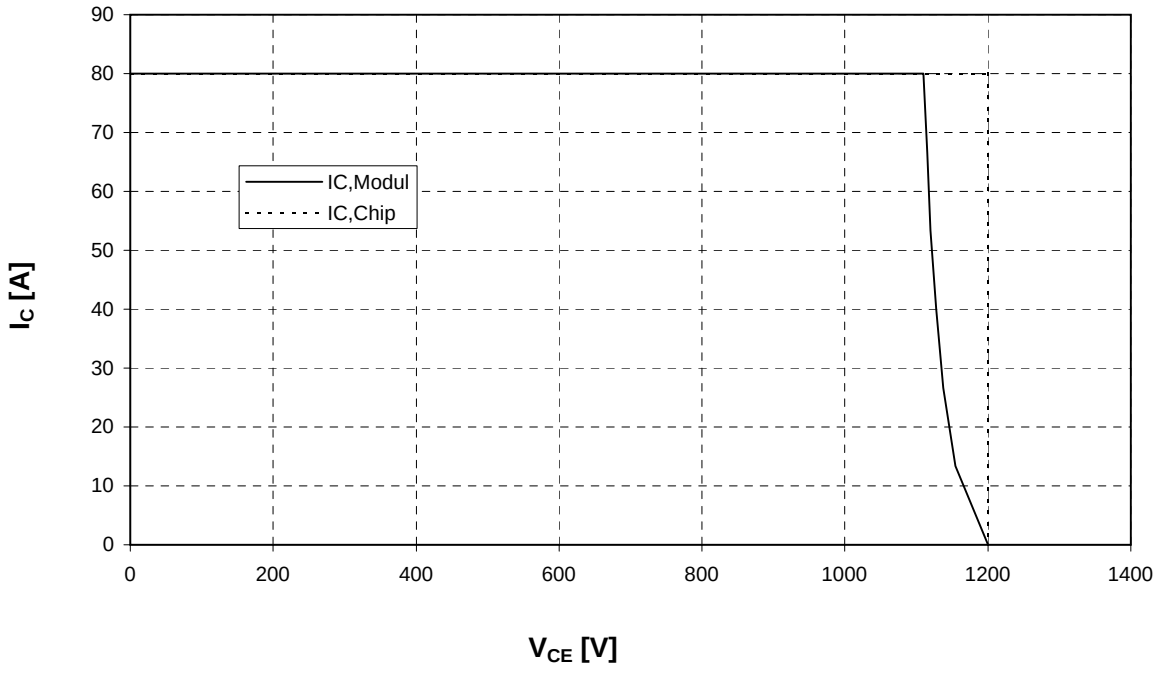
Schaltverluste Wechselr. (typisch) $E_{on} = f(R_G)$, $E_{off} = f(R_G)$, $E_{rec} = f(R_G)$
Switching losses Inverter (typical) T_j = 125°C, V_{GE} = +-15 V , $I_c = I_{nenn}$, V_{CC} = **600 V**



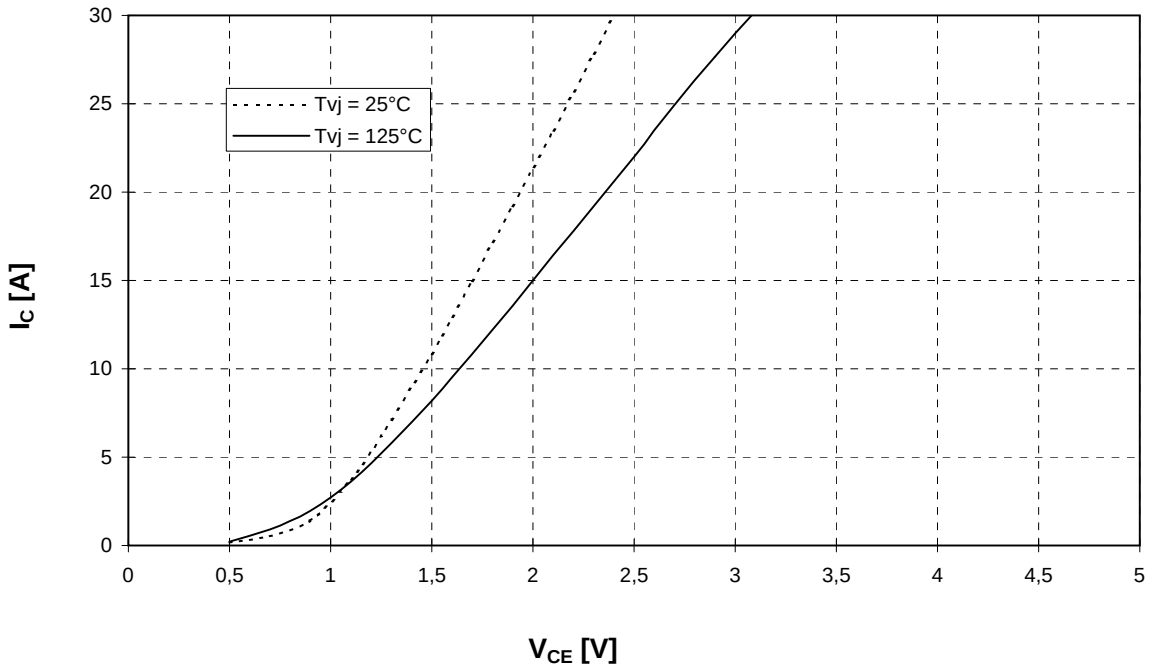
Transienter Wärmewiderstand Wechselr. $Z_{thJC} = f(t)$
Transient thermal impedance Inverter



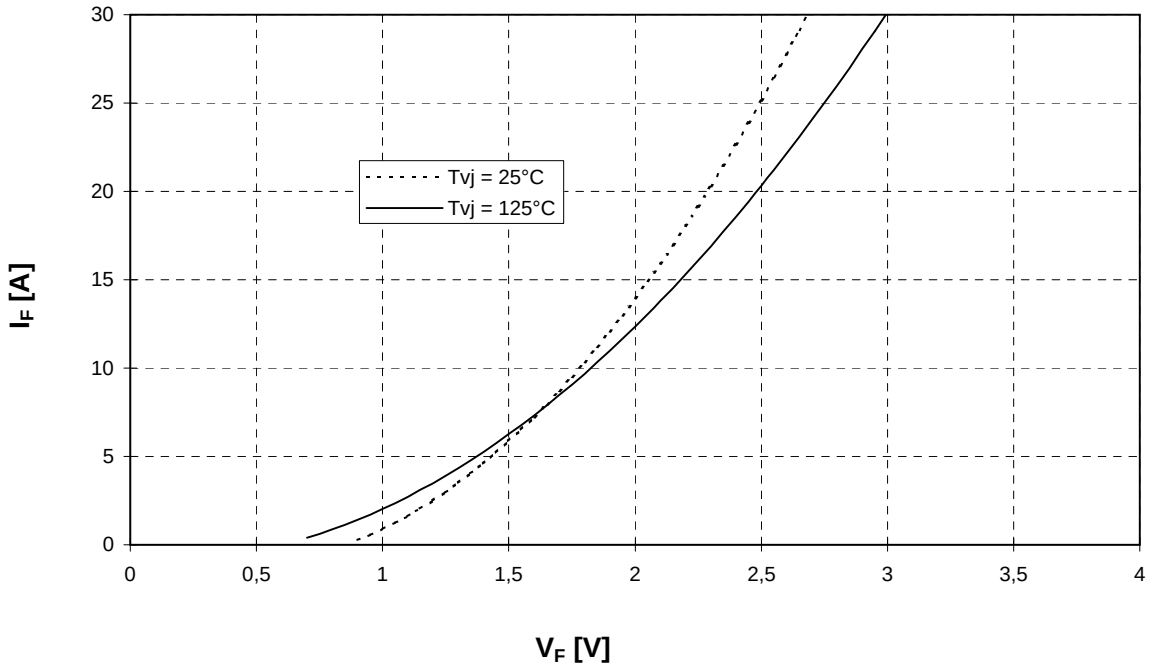
Sicherer Arbeitsbereich IGBT-Wechselr. (RBSOA)
Reverse bias save operating area (RBSOA) $V_{GE} = 15V$, $T_j = 125°C$



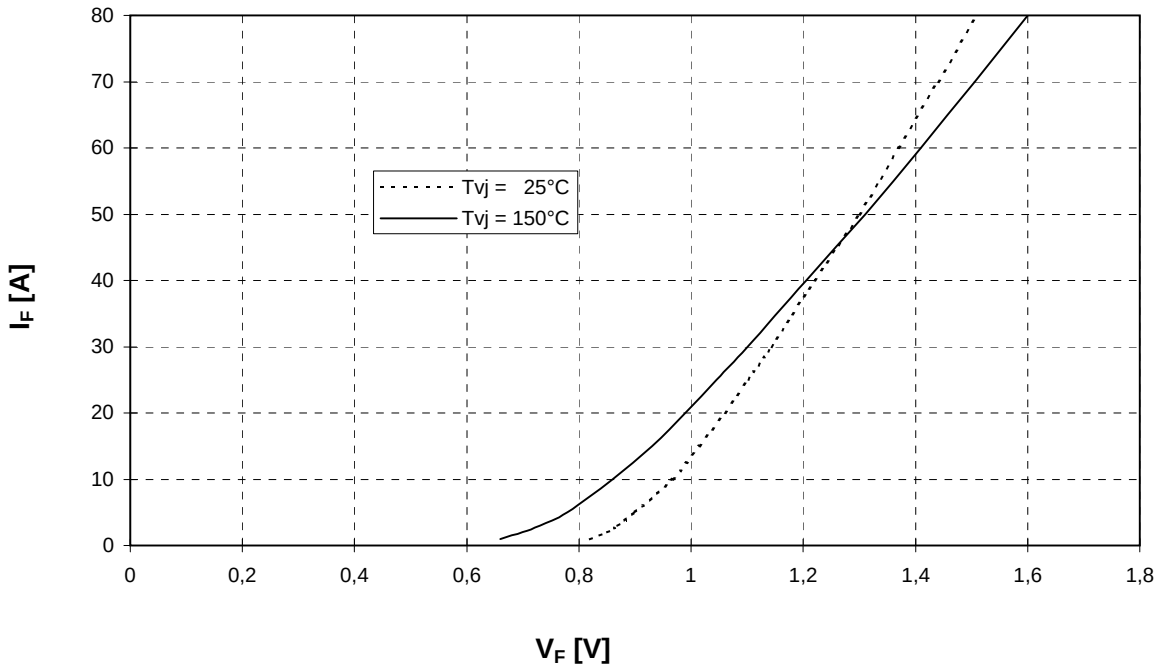
Ausgangskennlinienfeld Brems-Chopper-IGBT (typisch) $I_C = f(V_{CE})$
Output characteristic brake-chopper-IGBT (typical) $V_{GE} = 15$ V



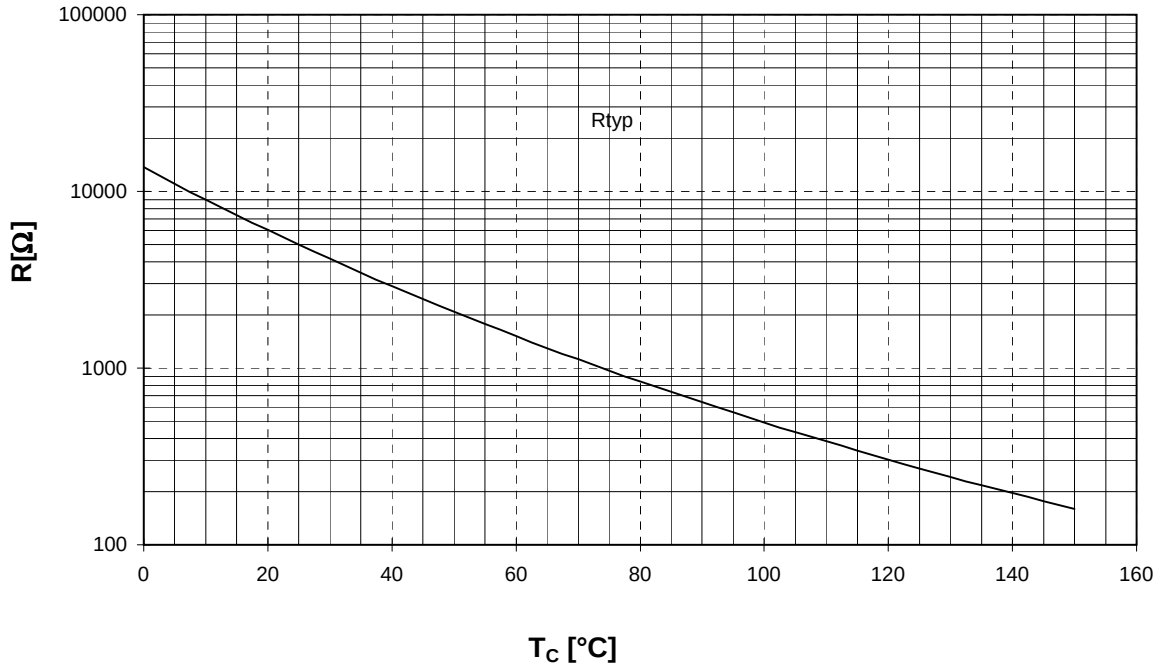
Durchlaßkennlinie der Brems-Chopper-Diode (typisch) $I_F = f(V_F)$
Forward characteristic of brake-chopper-FWD (typical)



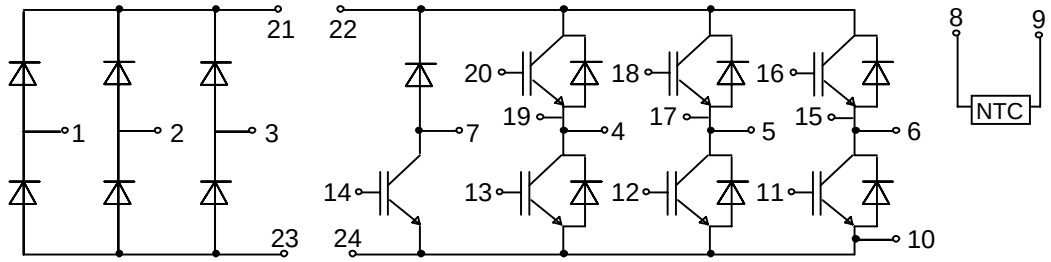
Durchlaßkennlinie der Gleichrichterdiode (typisch) $I_F = f(V_F)$
Forward characteristic of Rectifier Diode (typical)



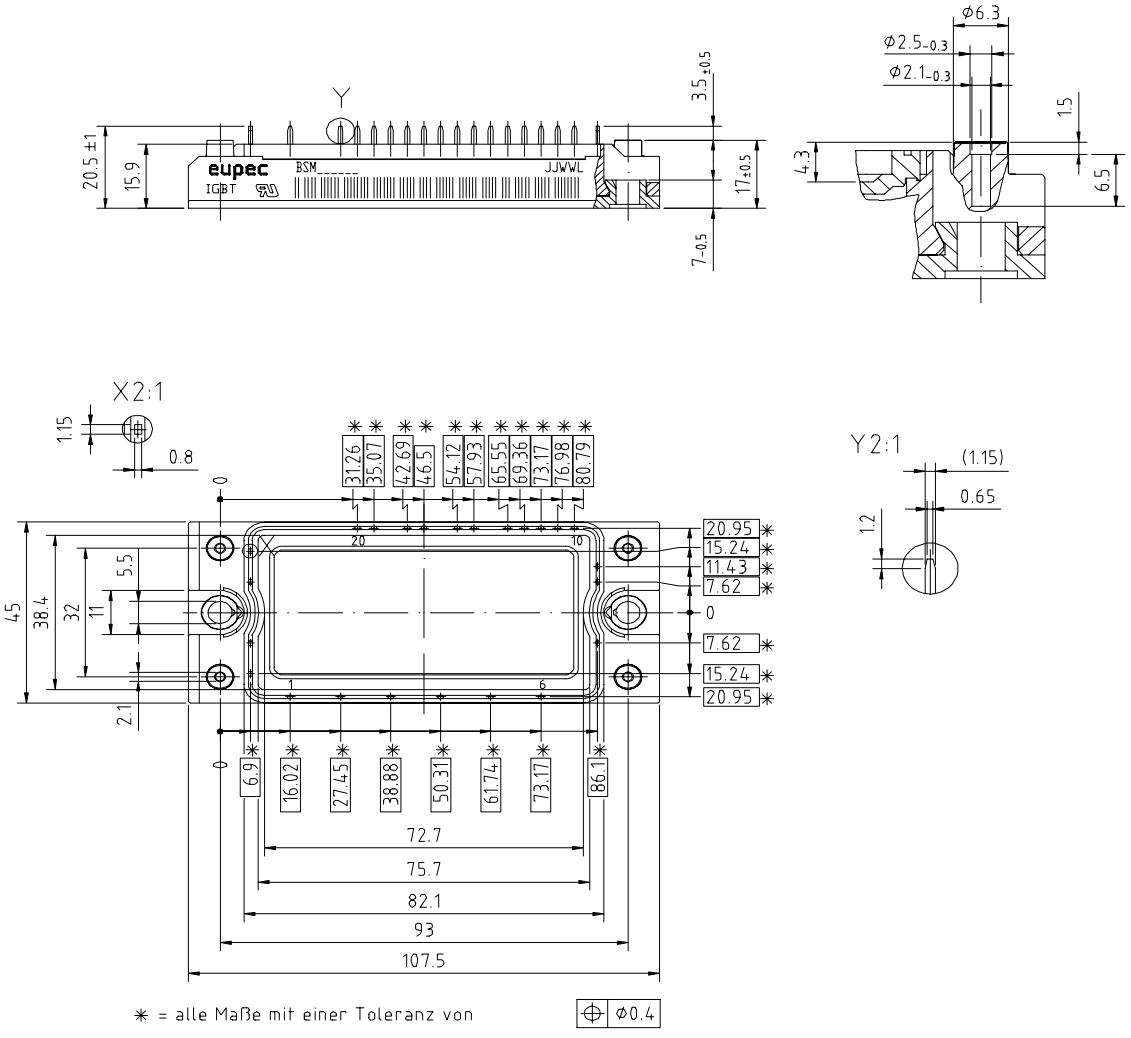
NTC- Temperaturkennlinie (typisch) **R = f (T)**
NTC- temperature characteristic (typical)



Schaltplan/ Circuit diagram



Gehäuseabmessungen/ Package outlines



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 promises no characteristics. It is valid in combination with the belonging technical notes.