

# Technische Information / Technical Information

IGBT-Module  
IGBT-Modules

## BSM50GX120DN2

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### Elektrische Eigenschaften / Electrical properties

#### Höchstzulässige Werte / Maximum rated values

##### Diode Gleichrichter/ Diode Rectifier

Periodische Rückw. Spitzenspannung repetitive peak reverse voltage		$V_{RRM}$	1600	V
Durchlaßstrom Grenzeffektivwert RMS forward current per chip		$I_{FRMSM}$	40	A
Dauergleichstrom DC forward current	$T_c = 80^\circ\text{C}$	$I_d$	50	A
Stoßstrom Grenzwert surge forward current	$t_p = 10\text{ ms}, T_{vj} = 25^\circ\text{C}$ $t_p = 10\text{ ms}, T_{vj} = 150^\circ\text{C}$	$I_{FSM}$	500 400	A A
Grenzlastintegral $I^2t$ - value	$t_p = 10\text{ ms}, T_{vj} = 25^\circ\text{C}$ $t_p = 10\text{ ms}, T_{vj} = 150^\circ\text{C}$	$I^2t$	1250 800	$\text{A}^2\text{s}$ $\text{A}^2\text{s}$

##### Transistor Wechselrichter/ Transistor Inverter

Kollektor-Emitter-Sperrspannung collector-emitter voltage		$V_{CES}$	1200	V
Kollektor-Dauergleichstrom DC-collector current	$T_c = 80^\circ\text{C}$ $T_c = 25^\circ\text{C}$	$I_{c,nom.}$ $I_c$	50 80	A A
Periodischer Kollektor Spitzenstrom repetitive peak collector current	$t_p = 1\text{ ms}, T_c = 80^\circ\text{C}$	$I_{CRM}$	100	A
Gesamt-Verlustleistung total power dissipation	$T_c = 25^\circ\text{C}$	$P_{tot}$	360	W
Gate-Emitter-Spitzenspannung gate-emitter peak voltage		$V_{GES}$	+/- 20V	V

##### Diode Wechselrichter/ Diode Inverter

Dauergleichstrom DC forward current	$T_c = 80^\circ\text{C}$	$I_F$	50	A
Periodischer Spitzenstrom repetitive peak forw. current	$t_p = 1\text{ ms}$	$I_{FRM}$	100	A
Grenzlastintegral $I^2t$ - value	$V_R = 0\text{V}, t_p = 10\text{ms}, T_{vj} = 125^\circ\text{C}$	$I^2t$	1.200	$\text{A}^2\text{s}$

##### Transistor Brems-Chopper/ Transistor Brake-Chopper

Kollektor-Emitter-Sperrspannung collector-emitter voltage		$V_{CES}$	1200	V
Kollektor-Dauergleichstrom DC-collector current	$T_c = 80^\circ\text{C}$ $T_c = 25^\circ\text{C}$	$I_{c,nom.}$ $I_c$	25 45	A A
Periodischer Kollektor Spitzenstrom repetitive peak collector current	$t_p = 1\text{ ms}, T_c = 80^\circ\text{C}$	$I_{CRM}$	50	A
Gesamt-Verlustleistung total power dissipation	$T_c = 25^\circ\text{C}$	$P_{tot}$	230	W
Gate-Emitter-Spitzenspannung gate-emitter peak voltage		$V_{GES}$	+/- 20V	V

##### Diode Brems-Chopper/ Diode Brake-Chopper

Dauergleichstrom DC forward current	$T_c = 80^\circ\text{C}$	$I_F$	15	A
Periodischer Spitzenstrom repetitive peak forw. current	$t_p = 1\text{ ms}$	$I_{FRM}$	30	A

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### 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	$T_{vj} = 150^{\circ}\text{C}$ , $I_F = 50 \text{ A}$	$V_F$	-	1,05	-	V
Schleusenspannung threshold voltage	$T_{vj} = 150^{\circ}\text{C}$	$V_{(TO)}$	-	-	0,8	V
Ersatzwiderstand slope resistance	$T_{vj} = 150^{\circ}\text{C}$	$r_T$	-	-	6,5	m $\Omega$
Sperrstrom reverse current	$T_{vj} = 150^{\circ}\text{C}$ , $V_R = 1600 \text{ V}$	$I_R$	-	3	-	mA
Modul Leitungswiderstand, Anschlüsse-Chip lead resistance, terminals-chip	$T_C = 25^{\circ}\text{C}$	$R_{AA+CC}$	-	4	-	m $\Omega$

##### Transistor Wechselrichter/ Transistor Inverter

			min.	typ.	max.	
Kollektor-Emitter Sättigungsspannung collector-emitter saturation voltage	$V_{GE} = 15\text{V}$ , $T_{vj} = 25^{\circ}\text{C}$ , $I_C = 50 \text{ A}$	$V_{CE\text{ sat}}$	-	2,2	2,55	V
	$V_{GE} = 15\text{V}$ , $T_{vj} = 125^{\circ}\text{C}$ , $I_C = 50 \text{ A}$		-	2,5	-	V
Gate-Schwellenspannung gate threshold voltage	$V_{CE} = V_{GE}$ , $T_{vj} = 25^{\circ}\text{C}$ , $I_C = 2 \text{ mA}$	$V_{GE(TO)}$	4,5	5,5	6,5	V
Eingangskapazität input capacitance	$f = 1\text{MHz}$ , $T_{vj} = 25^{\circ}\text{C}$ $V_{CE} = 25 \text{ V}$ , $V_{GE} = 0 \text{ V}$	$C_{ies}$	-	3,3	-	nF
Kollektor-Emitter Reststrom collector-emitter cut-off current	$V_{GE} = 0\text{V}$ , $T_{vj} = 25^{\circ}\text{C}$ , $V_{CE} = 1200 \text{ V}$	$I_{CES}$	-	3,0	500	$\mu\text{A}$
	$V_{GE} = 0\text{V}$ , $T_{vj} = 125^{\circ}\text{C}$ , $V_{CE} = 1200 \text{ V}$		-	4,0	-	mA
Gate-Emitter Reststrom gate-emitter leakage current	$V_{CE} = 0\text{V}$ , $V_{GE} = 20\text{V}$ , $T_{vj} = 25^{\circ}\text{C}$	$I_{GESS}$	-	-	300	nA
Einschaltverzögerungszeit (ind. Last) turn on delay time (inductive load)	$I_C = I_{Nenn}$ , $V_{CC} = 600 \text{ V}$	$t_{c,on}$	-	65	-	ns
	$V_{GE} = \pm 15\text{V}$ , $T_{vj} = 25^{\circ}\text{C}$ , $R_G = 15 \text{ Ohm}$					
	$V_{GE} = \pm 15\text{V}$ , $T_{vj} = 125^{\circ}\text{C}$ , $R_G = 15 \text{ Ohm}$					
Anstiegszeit (induktive Last) rise time (inductive load)	$I_C = I_{Nenn}$ , $V_{CC} = 600 \text{ V}$	$t_r$	-	45	-	ns
	$V_{GE} = \pm 15\text{V}$ , $T_{vj} = 25^{\circ}\text{C}$ , $R_G = 15 \text{ Ohm}$					
	$V_{GE} = \pm 15\text{V}$ , $T_{vj} = 125^{\circ}\text{C}$ , $R_G = 15 \text{ Ohm}$					
Abschaltverzögerungszeit (ind. Last) turn off delay time (inductive load)	$I_C = I_{Nenn}$ , $V_{CC} = 600 \text{ V}$	$t_{d,off}$	-	380	-	ns
	$V_{GE} = \pm 15\text{V}$ , $T_{vj} = 25^{\circ}\text{C}$ , $R_G = 15 \text{ Ohm}$					
	$V_{GE} = \pm 15\text{V}$ , $T_{vj} = 125^{\circ}\text{C}$ , $R_G = 15 \text{ Ohm}$					
Fallzeit (induktive Last) fall time (inductive load)	$I_C = I_{Nenn}$ , $V_{CC} = 600 \text{ V}$	$t_f$	-	10	-	ns
	$V_{GE} = \pm 15\text{V}$ , $T_{vj} = 25^{\circ}\text{C}$ , $R_G = 15 \text{ Ohm}$					
	$V_{GE} = \pm 15\text{V}$ , $T_{vj} = 125^{\circ}\text{C}$ , $R_G = 15 \text{ Ohm}$					
Einschaltverlustenergie pro Puls turn-on energy loss per pulse	$I_C = I_{Nenn}$ , $V_{CC} = 600 \text{ V}$ $V_{GE} = \pm 15\text{V}$ , $T_{vj} = 125^{\circ}\text{C}$ , $R_G = 15 \text{ Ohm}$ $L_B = 50 \text{ nH}$	$E_{on}$	-	6,5	-	mWs
Abschaltverlustenergie pro Puls turn-off energy loss per pulse	$I_C = I_{Nenn}$ , $V_{CC} = 600 \text{ V}$ $V_{GE} = \pm 15\text{V}$ , $T_{vj} = 125^{\circ}\text{C}$ , $R_G = 15 \text{ Ohm}$ $L_B = 50 \text{ nH}$	$E_{off}$	-	6	-	mWs
Kurzschlußverhalten SC Data	$t_F \leq 10\mu\text{s}$ , $V_{GE} \leq 15\text{V}$ , $R_G = 15 \text{ Ohm}$ $T_{vj} \leq 125^{\circ}\text{C}$ , $V_{CC} = 720 \text{ V}$ $dI/dt = 4000 \text{ A}/\mu\text{s}$	$I_{sc}$	-	300	-	A

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### Elektrische Eigenschaften / Electrical properties

#### Charakteristische Werte / Characteristic values

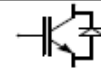
		min.	typ.	max.			
Modulinduktivität stray inductance module		$L_{\text{CE}}$	-	-	100 nH		
Modul Leitungswiderstand, Anschlüsse-Chip lead resistance, terminals-chip	$T_C = 25^\circ\text{C}$	$R_{\text{CC-EE}}$	-	7	- mΩ		
<b>Diode Wechselrichter/ Diode Inverter</b>		<b>min.</b>		<b>typ.</b>		<b>max.</b>	
Durchlaßspannung forward voltage	$V_{\text{GE}} = 0\text{V}, T_{\text{vj}} = 25^\circ\text{C}, I_{\text{F}} = 50\text{A}$ $V_{\text{GE}} = 0\text{V}, T_{\text{vj}} = 125^\circ\text{C}, I_{\text{F}} = 50\text{A}$	$V_{\text{F}}$	-	1,75	2,2	V	
Rückstromspitze peak reverse recovery current	$I_{\text{F}} = I_{\text{Nenn}}, -di_{\text{F}}/dt = 1800\text{A}/\mu\text{s}$ $V_{\text{GE}} = -10\text{V}, T_{\text{vj}} = 25^\circ\text{C}, V_{\text{R}} = 600\text{V}$ $V_{\text{GE}} = -10\text{V}, T_{\text{vj}} = 125^\circ\text{C}, V_{\text{R}} = 600\text{V}$	$I_{\text{RM}}$	-	75	-	A	
Sperrverzögerungsladung recovered charge	$I_{\text{F}} = I_{\text{Nenn}}, -di_{\text{F}}/dt = 1800\text{A}/\mu\text{s}$ $V_{\text{GE}} = -10\text{V}, T_{\text{vj}} = 25^\circ\text{C}, V_{\text{R}} = 600\text{V}$ $V_{\text{GE}} = -10\text{V}, T_{\text{vj}} = 125^\circ\text{C}, V_{\text{R}} = 600\text{V}$	$Q_{\text{r}}$	-	5,5	-	μAs	
Abschaltenergie pro Puls reverse recovery energy	$I_{\text{F}} = I_{\text{Nenn}}, -di_{\text{F}}/dt = 1800\text{A}/\mu\text{s}$ $V_{\text{GE}} = -10\text{V}, T_{\text{vj}} = 25^\circ\text{C}, V_{\text{R}} = 600\text{V}$ $V_{\text{GE}} = -10\text{V}, T_{\text{vj}} = 125^\circ\text{C}, V_{\text{R}} = 600\text{V}$	$E_{\text{RO}}$	-	1,8	-	mWs	
<b>Transistor Brems-Chopper/ Transistor Brake-Chopper</b>		<b>min.</b>		<b>typ.</b>		<b>max.</b>	
Kollektor-Emitter Sättigungsspannung collector-emitter saturation voltage	$V_{\text{GE}} = 15\text{V}, T_{\text{vj}} = 25^\circ\text{C}, I_{\text{C}} = 25,0\text{A}$ $V_{\text{GE}} = 15\text{V}, T_{\text{vj}} = 125^\circ\text{C}, I_{\text{C}} = 25,0\text{A}$	$V_{\text{CE sat}}$	-	2,2	2,55	V	
Gate-Schwellenspannung gate threshold voltage	$V_{\text{CE}} = V_{\text{GE}}, T_{\text{vj}} = 25^\circ\text{C}, I_{\text{C}} = 1\text{mA}$	$V_{\text{GE(TH)}}$	4,5	5,5	6,5	V	
Eingangskapazität input capacitance	$f = 1\text{MHz}, T_{\text{vj}} = 25^\circ\text{C}$ $V_{\text{CE}} = 25\text{V}, V_{\text{GE}} = 0\text{V}$	$C_{\text{ies}}$	-	1,5	-	nF	
Kollektor-Emitter Reststrom collector-emitter out-off current	$V_{\text{GE}} = 0\text{V}, T_{\text{vj}} = 25^\circ\text{C}, V_{\text{CE}} = 1200\text{V}$ $V_{\text{GE}} = 0\text{V}, T_{\text{vj}} = 125^\circ\text{C}, V_{\text{CE}} = 1200\text{V}$	$I_{\text{CES}}$	-	1,5	500	μA	
Gate-Emitter Reststrom gate-emitter leakage current	$V_{\text{CE}} = 0\text{V}, V_{\text{GE}} = 20\text{V}, T_{\text{vj}} = 25^\circ\text{C}$	$I_{\text{GES}}$	-	-	300	nA	
<b>Diode Brems-Chopper/ Diode Brake-Chopper</b>		<b>min.</b>		<b>typ.</b>		<b>max.</b>	
Durchlaßspannung forward voltage	$T_{\text{vj}} = 25^\circ\text{C}, I_{\text{F}} = 25,0\text{A}$ $T_{\text{vj}} = 125^\circ\text{C}, I_{\text{F}} = 25,0\text{A}$	$V_{\text{F}}$	-	2,1	2,4	V	
<b>NTC-Widerstand/ NTC-Thermistor</b>		<b>min.</b>		<b>typ.</b>		<b>max.</b>	
Nennwiderstand rated resistance	$T_C = 25^\circ\text{C}$	$R_{25}$	-	5	-	kΩ	
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	mW	
B-Wert B-value	$R_2 = R_1 \exp [B(1/T_2 - 1/T_1)]$	$B_{25/50}$		3375		K	

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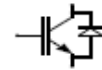


### Thermische Eigenschaften / Thermal properties

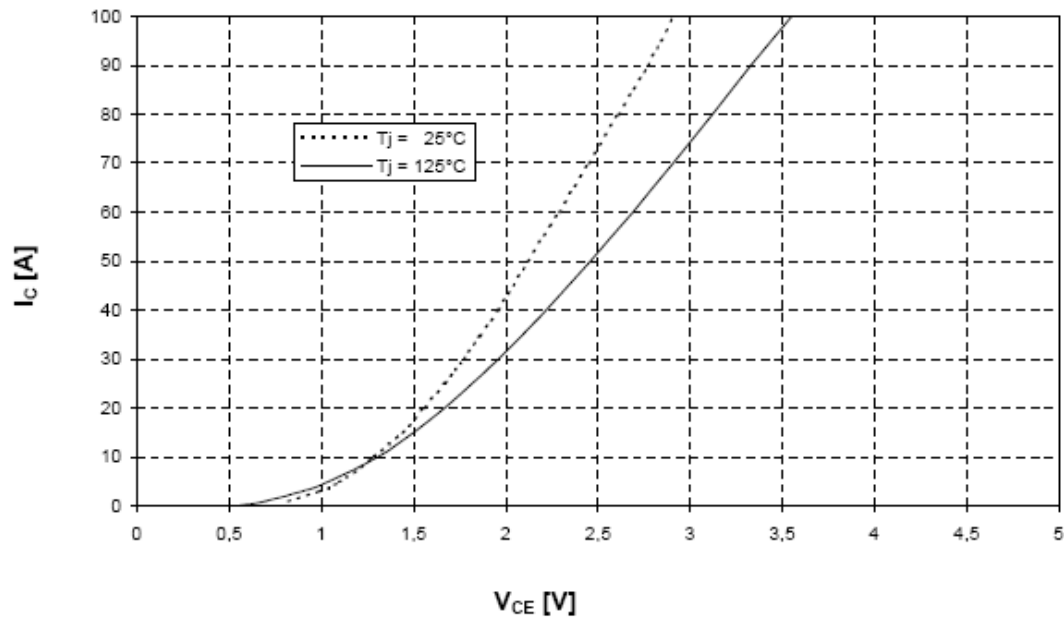
		min.		typ.	max.		
Innerer Wärmewiderstand thermal resistance, junction to case	Gleichr. Diode/ Rectif. Diode	$R_{thJC}$	-	-	0,65	K/W	
	Trans. Wechsr./ Trans. Inverter		-	-	0,35	K/W	
	Diode Wechsr./ Diode Inverter		-	-	0,55	K/W	
	Trans. Bremse/ Trans. Brake		-	-	0,55	K/W	
	Diode Bremse/ Diode Brake		-	-	1,2	K/W	
Übergangs-Wärmewiderstand thermal resistance, case to heatsink	Gleichr. Diode/ Rectif. Diode	$\lambda_{Pulse}=1W/m^2K$	$R_{thCK}$	-	0,04	-	K/W
	Trans. Wechsr./ Trans. Inverter	$\lambda_{Pulse}=1W/m^2K$		-	0,02	-	K/W
	Diode Wechsr./ 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

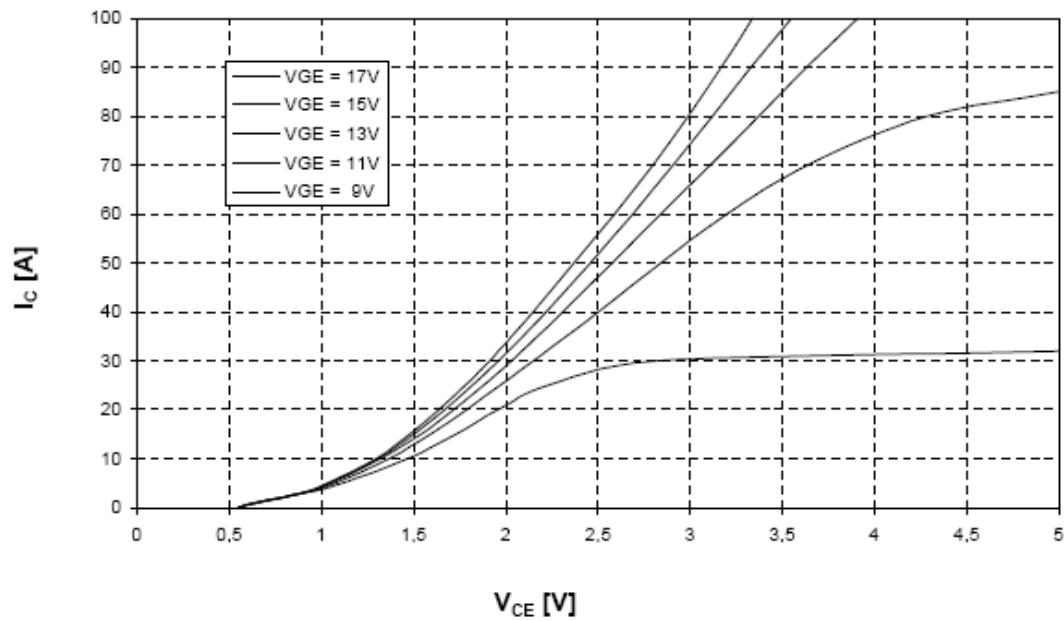
Innere Isolation internal insulation				$Al_2O_3$	
CTI comperative tracking index				225	
Anzugsdrehmoment f. mech. Befestigung mounting torque		M		3 $\pm 10\%$	Nm
Gewicht weight		G		300	g

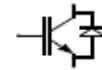


Ausgangskennlinienfeld Wechselr. (typisch)  $d = f(V_{CE})$   
Output characteristic Inverter (typical)  $V_{GE} = 15\text{ V}$



Ausgangskennlinienfeld Wechselr. (typisch)  $d = f(V_{CE})$   
Output characteristic Inverter (typical)  $T_j = 125^\circ\text{C}$

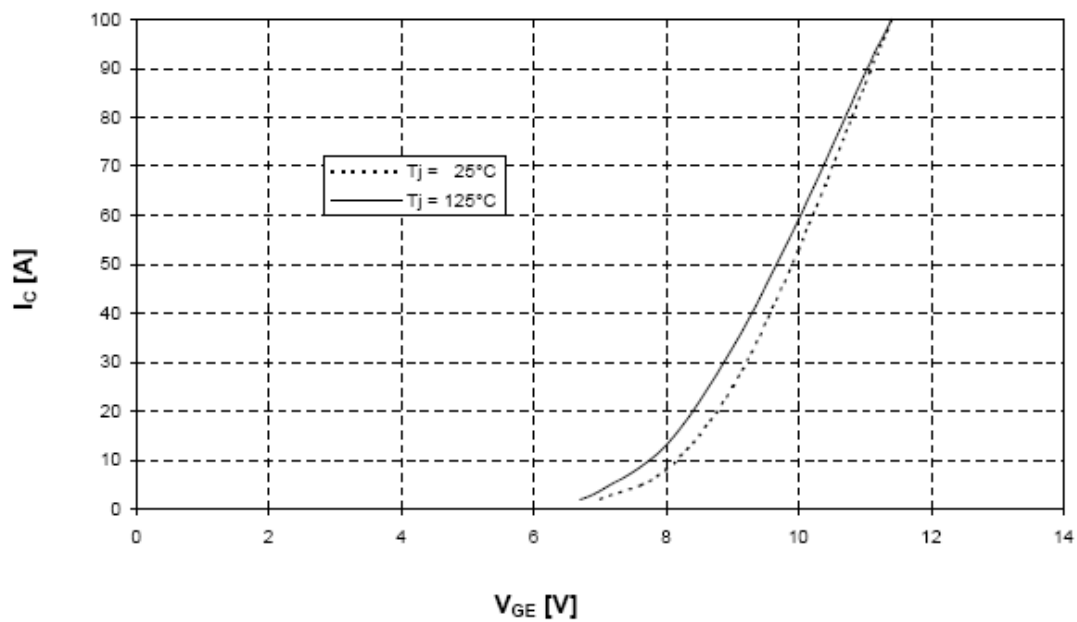




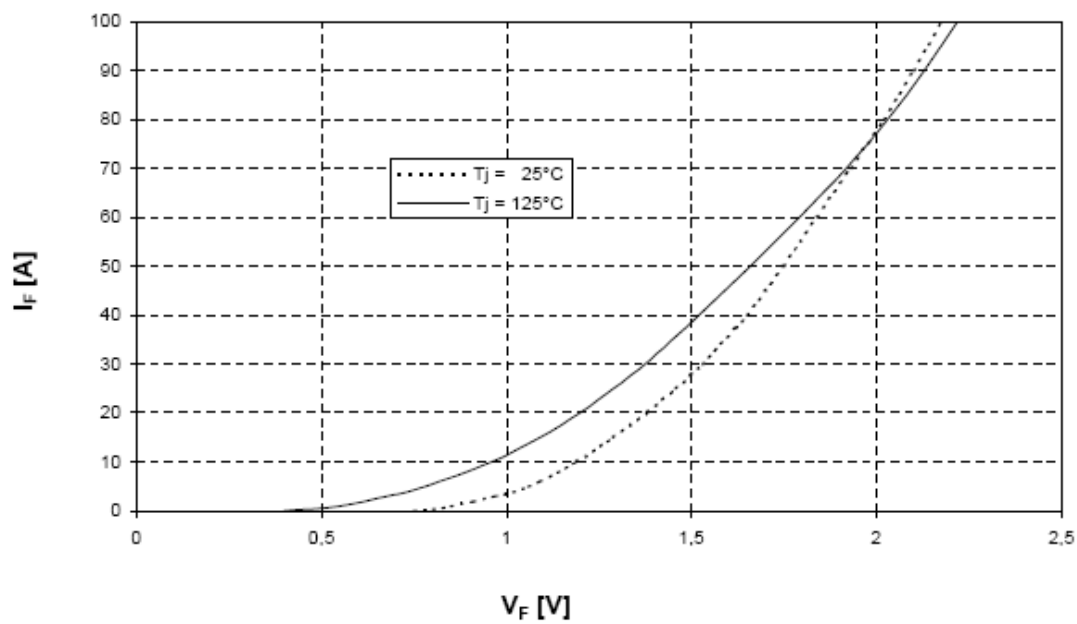
Übertragungscharakteristik Wechselr. (typisch)  
Transfer characteristic Inverter (typical)

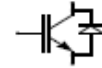
$$i_c = f(V_{GE})$$

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

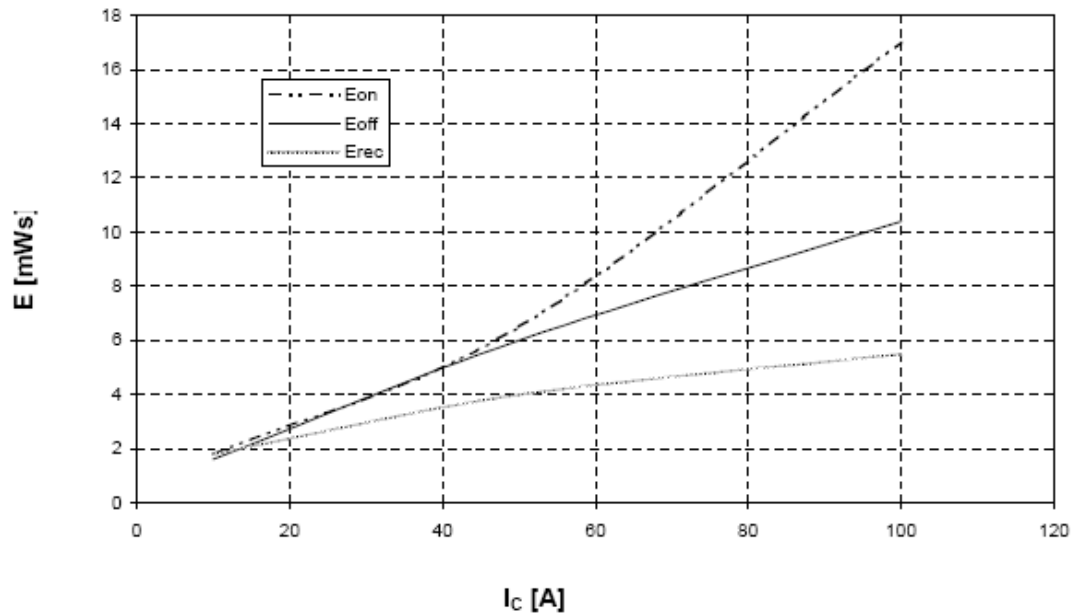


Durchlaßkennlinie der Freilaufdiode Wechselr. (typisch)  $i_F = f(V_F)$   
Forward characteristic of FWD Inverter (typical)

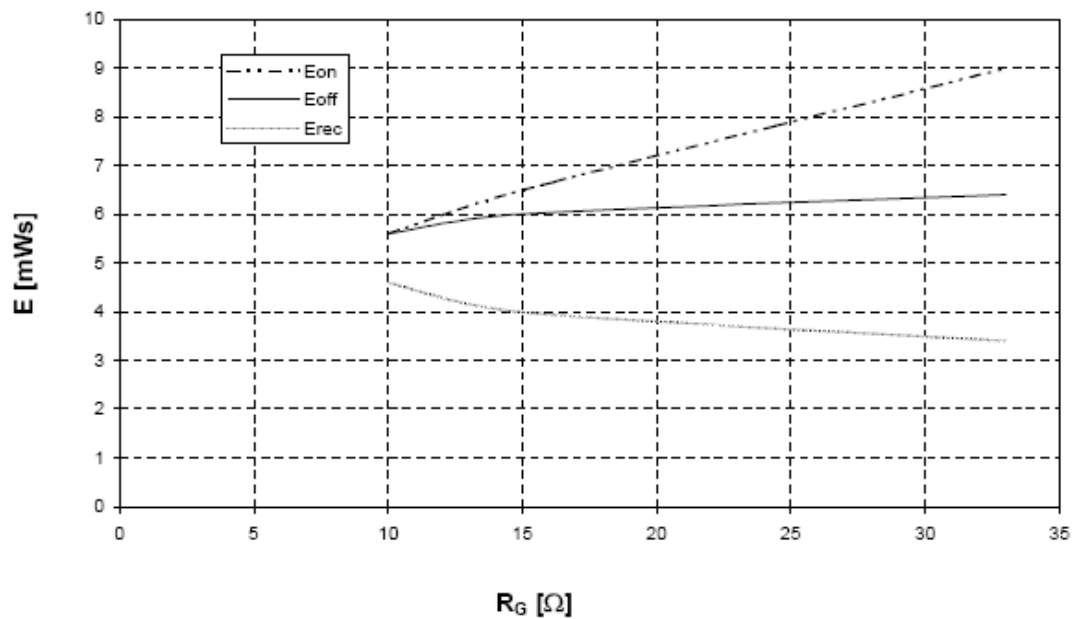


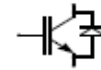


Schaltverluste Wechselr. (typisch)  $E_{on} = f(I_C), E_{off} = f(I_C), E_{rec} = f(I_C)$   $V_{CC} = 600\text{ V}$   
 Switching losses Inverter (typical)  $T_J = 125^\circ\text{C}, V_{GE} = \pm 15\text{ V}, R_{Gon} = R_{Goff} = 15\text{ Ohm}$



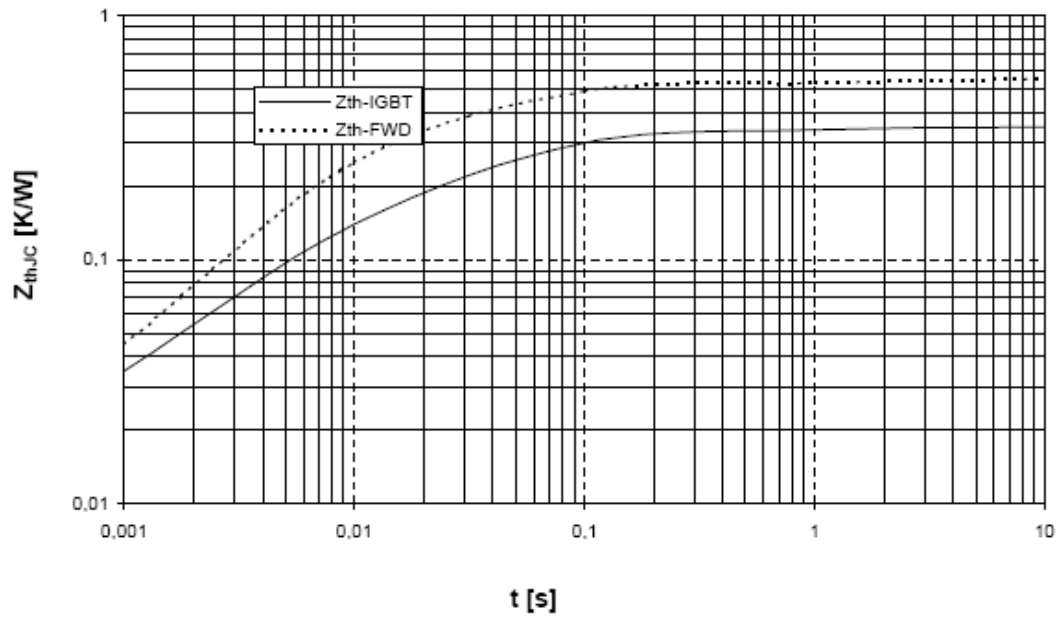
Schaltverluste Wechselr. (typisch)  $E_{on} = f(R_G), E_{off} = f(R_G), E_{rec} = f(R_G)$   
 Switching losses Inverter (typical)  $T_J = 125^\circ\text{C}, V_{GE} = +15\text{ V}, I_o = I_{nenn}, V_{CC} = 600\text{ V}$





Transienter Wärmewiderstand Wechsler.  
Transient thermal impedance Inverter

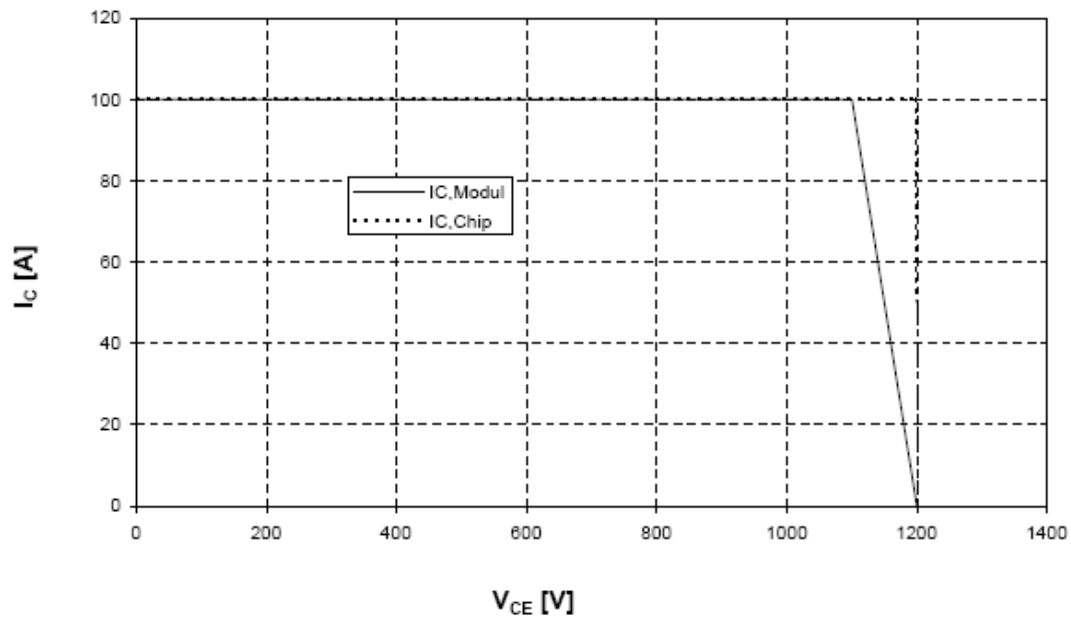
$$Z_{thJC} = f(t)$$



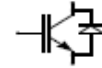
Sicherer Arbeitsbereich Wechsler. (RBSOA)

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

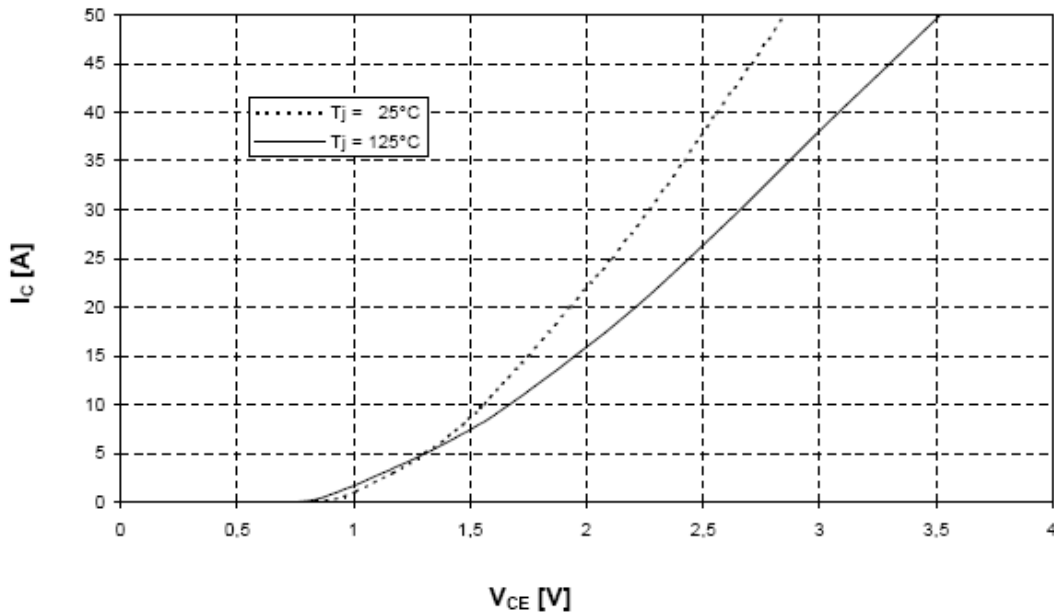
Reverse bias safe operating area Inverter (RBSOA)<sub>T<sub>vj</sub> = 125°C, V<sub>GE</sub> = ±15V, R<sub>Θ</sub> = 15 Ohm</sub>



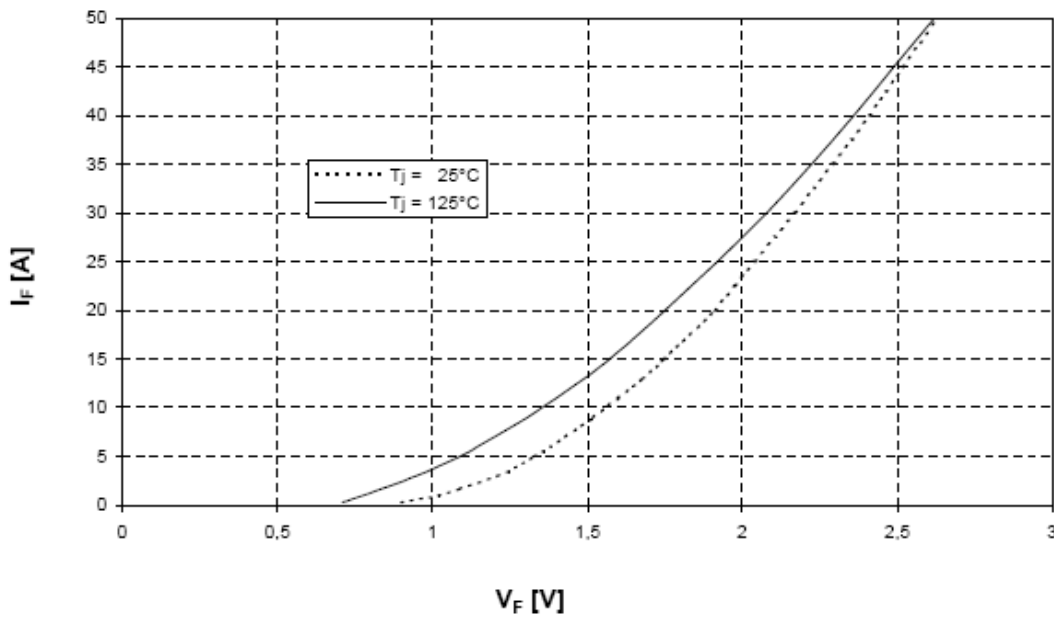


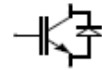


Ausgangskennlinienfeld Brems-Chopper-IGBT (typisch)  $d = f(V_{CE})$   
Output characteristic brake-chopper-IGBT (typical)  $V_{OE} = 15\text{ V}$

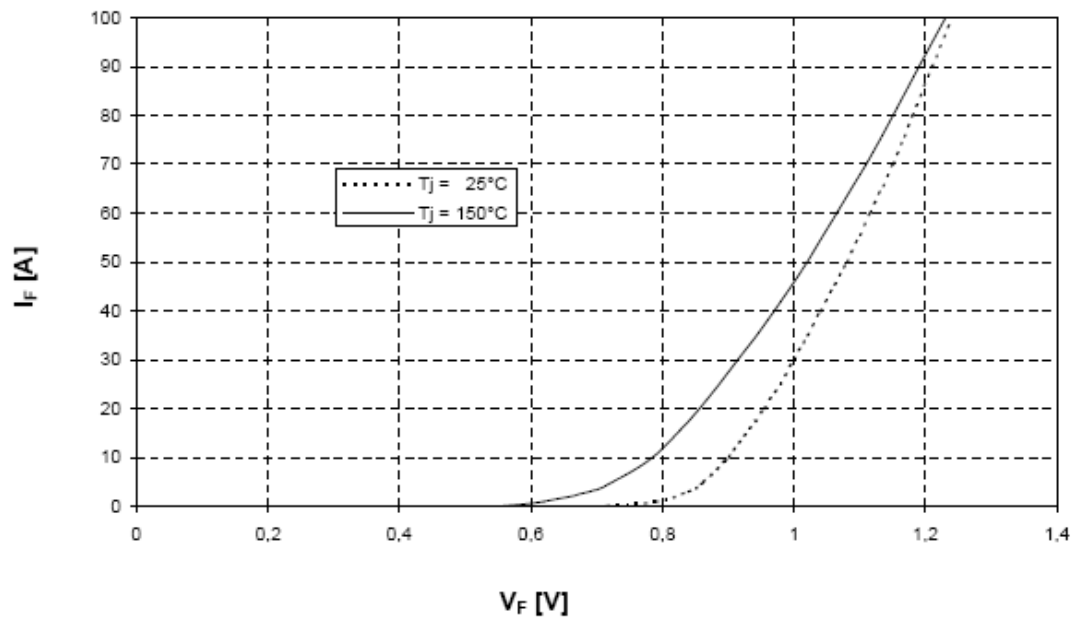


Durchlaßkennlinie der Brems-Chopper-Diode (typisch)  $d = f(V_F)$   
Forward characteristic of brake-chopper-FWD (typical)

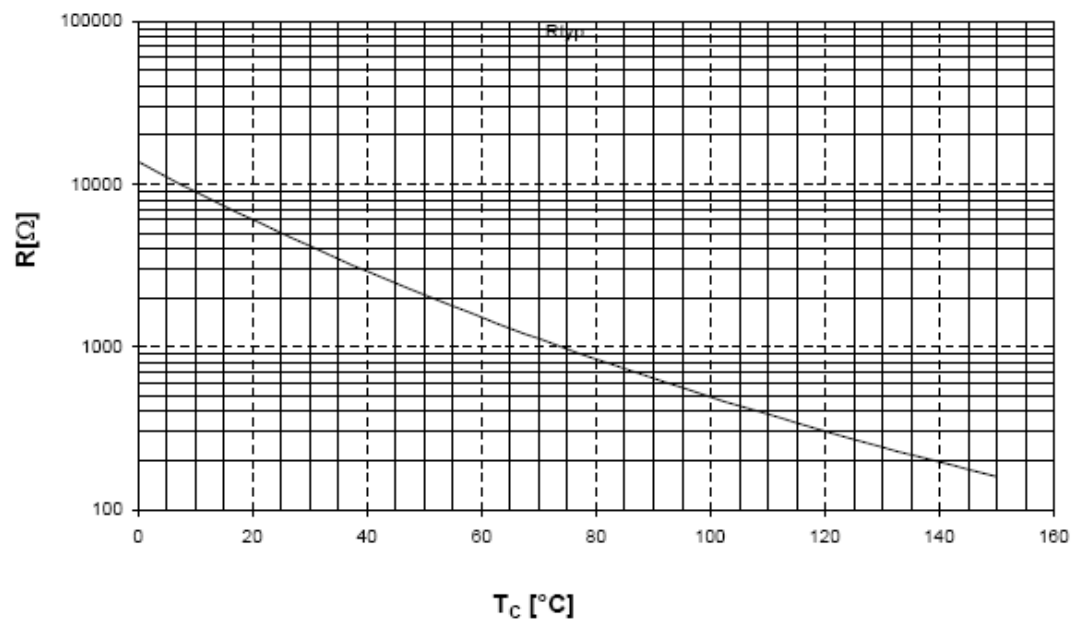




Durchlaßkennlinie der Gleichrichterdiode (typisch)  $i_F = f(V_F)$   
Forward characteristic of Rectifier Diode (typical)

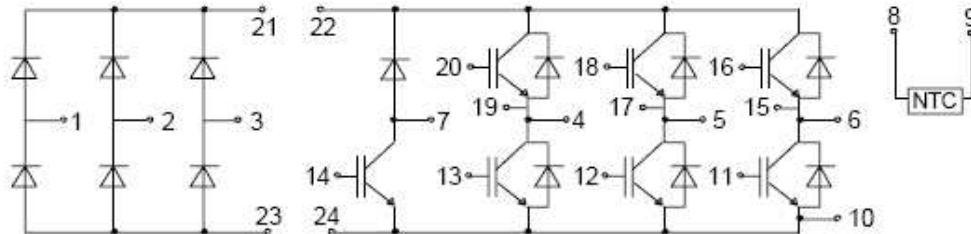


NTC- Temperaturkennlinie (typisch)  $R = f(T)$   
NTC- temperature characteristic (typical)

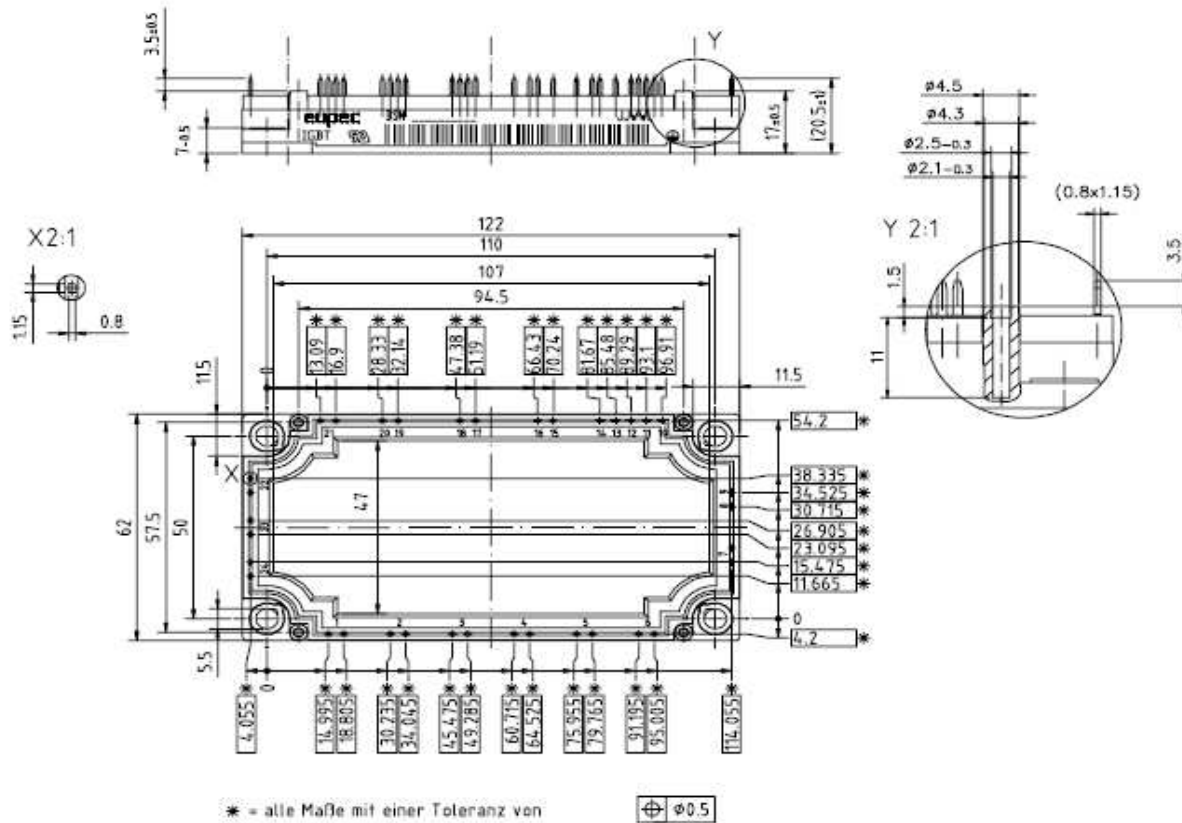




**Schaltplan/ Circuit diagram**



**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.