Maximum Ratings / Höchstzulässige Werte

Parameter	Condition		Symbol	Datasheet values max.	Unit
Transistor Inverter Transistor Wechselrichter					
Collector-emitter break down voltage Kollektor-Emitter-Sperrspannung			V_{CE}	600	V
DC collector current Kollektor-Dauergleichstrom	T_j=150°C	T_h=80°C, T_c=80°C	I_C	7 10, limited by wires	A
Repetitive peak collector current Periodischer Kollektorspitzenstrom	t_p=1ms	T_h=80°C	I_{cpuls}	19	A
Power dissipation per IGBT Verlustleistung pro IGBT	T_j=150°C	T_h=80°C T_c=80°C	P_{tot}	24 37	W
Gate-emitter peak voltage Gate-Emitter-Spitzenspannung			V_{GE}	±20	V
SC withstand time Kurzschlußverhalten	Tj≤150°C V_{CE}=V_{CEBR}	V_{GE}=15V	t_{SC}	10	us
Diode Inverter Diode Wechselrichter					
DC forward current Dauergleichstrom	T_j=150°C	T_h=80°C, T_c=80°C	I_F	10, limited by wires 10, limited by wires	A
Repetitive peak forward current Periodischer Spitzenstrom	t_p=1ms	T_h=80°C	I_{FRM}	32	A
Power dissipation per Diode Verlustleistung pro Diode	T_j=150°C	T_h=80°C T_c=80°C	P_{tot}	23 35	W
Thermal properties Thermische Eigenschaften					
max. Chip temperature max. Chiptemperatur			T_{jmax}	150	°C
Storage temperature Lagertemperatur			T_{stg}	-40…+125	°C
Operation temperature Betriebstemperatur			T_{op}	-40…+125	°C
Insulation properties Modulisolation					
Insulation voltage Isolationsspannung		t=1min	V_{is}	4000	Vdc
Creepage distance Kriechstrecke				min 12,7	mm
Clearance Luftstrecke				min 12,7	mm

Characteristic values

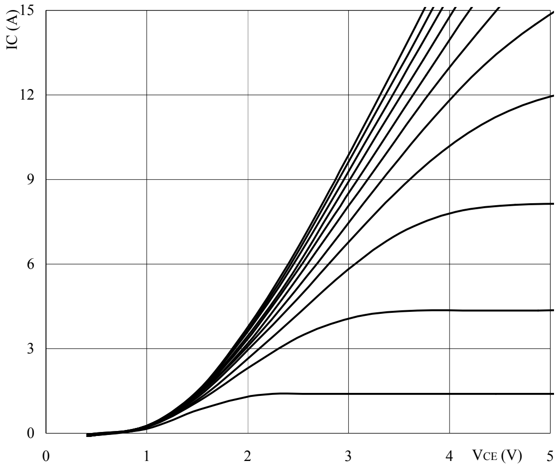
Description	Symbol	T(C°)	Other conditions (Rgon-Rgoff)	VGE(V) VGS(V)	VR(V) VCE(V) VDS(V)	IC(A) IF(A) Id(A)	Min	Typ	Max	Unit
Transistor Inverter, inductive load **Transistor Wechselrichter**										
Gate emitter threshold voltage Gate-Schwellenspannung	$V_{GE(th)}$	Tj=25°C Tj=125°C	VCE=VGE			2E-04	3	4	5	V
Collector-emitter saturation voltage Kollektor-Emitter Sättigungsspannung	$V_{CE(sat)}$	Tj=25°C Tj=125°C		15		5		2,21 2,61	2,9	V
Collector-emitter cut-off Kollektor-Emitter Reststrom	I_{CES}	Tj=25°C Tj=125°C		0	600				0,06 0,5	mA
Gate-emitter leakage current Gate-Emitter Reststrom	I_{GES}	Tj=25°C Tj=125°C		25	0				200	nA
Integrated Gate resistor Integrirter Gate Widerstand	R_{gint}							-		Ohm
Turn-on delay time Einschaltverzögerungszeit	$t_{d(on)}$	Tj=25°C Tj=125°C	Rgon=137 Ohm Rgoff=68,5 Ohm	15	300	5		 18		ns
Rise time Anstiegszeit	t_r	Tj=25°C Tj=125°C	Rgon=137 Ohm Rgoff=68,5 Ohm	15	300	5		 16		ns
Turn-off delay time Abschaltverzögerungszeit	$t_{d(off)}$	Tj=25°C Tj=125°C	Rgon=137 Ohm Rgoff=68,5 Ohm	15	300	5		 245		ns
Fall time Fallzeit	t_f	Tj=25°C Tj=125°C	Rgon=137 Ohm Rgoff=68,5 Ohm	15	300	5		 25		ns
Turn-on energy loss per pulse Einschaltverlustenergie pro Puls	E_{on}	Tj=25°C Tj=125°C	Rgon=137 Ohm Rgoff=68,5 Ohm	15	300	5		 0,114		mWs
Turn-off energy loss per pulse Abschaltverlustenergie pro Puls	E_{off}	Tj=25°C Tj=125°C	Rgon=137 Ohm Rgoff=68,5 Ohm	15	300	5		 0,112		mWs
Input capacitance Eingangskapazität	C_{ies}	Tj=25°C Tj=125°C	f=1MHz	0	25			0,264	0,317	nF
Output capacitance Ausgangskapazität	C_{oss}	Tj=25°C Tj=125°C	f=1MHz	0	25			0,029	0,035	nF
Reverse transfer capacitance Rückwirkungskapazität	C_{rss}	Tj=25°C Tj=125°C	f=1MHz	0	25			0,017	0,02	nF
Gate charge Gate Ladung	Q_{Gate}	Tj=25°C Tj=125°C		15	480	4		24	31	nC
Thermal resistance chip to heatsink per chip Wärmewiderstand Chip-Kühlkörper pro Chip	R_{thJH}		Thermal grease thickness≤50um Warmeleitpaste Dicke≤50um λ = 0,61 W/mK					2,87 1,894		K/W
Coupled thermal resistance inverter diode-transistor Gekoppelte Wärmewiderstand Wechselrichter Diode-Transistor	R_{thJH}		Thermal grease thickness≤50um Warmeleitpaste Dicke≤50um λ = 0,61 W/mK					TBD		K/W

Characteristic values

Description	Symbol	Conditions					Datasheet values			Unit
		T(C°)	Other conditions (Rgon-Rgoff)	VGE(V) VGS(V)	VR(V) VCE(V) VDS(V)	IC(A) IF(A) Id(A)	Min	Typ	Max	
Diode Inverter **Diode Wechselrichter**										
Diode forward voltage Durchlaßspannung	V_F	Tj=25°C Tj=125°C				5		1,38 1,08	2,1	V
Peak reverse recovery current Rückstromspitze	I_{RRM}	Tj=25°C Tj=125°C	Rgon=137 Ohm	15	300	5		8,2		A
Reverse recovery time Sperreverzögerungszeit	t_{rr}	Tj=25°C Tj=125°C	Rgon=137 Ohm	15	300	5		60		ns
Reverse recovered charge Sperrverzögerungsladung	Q_{rr}	Tj=25°C Tj=125°C	Rgon=137 Ohm	15	300	5		0,27		uC
Reverse recovered energy Sperrverzögerungsenergie	Erec	Tj=25°C Tj=125°C	Rgon=137 Ohm	15	300	5		0,034		mWs
Thermal resistance chip to heatsink per chip Wärmewiderstand Chip-Kühlkörper pro Chip	R_{thJH}		Thermal grease thickness≤50um Warmeleitpaste Dicke≤50um λ = 0,61 W/mK					3,03 2		K/W
Coupled thermal resistance inverter transistor-diode Gekoppelte Wärmewiderstand Wechselrichter Transistor-Diode	R_{thJH}		Thermal grease thickness≤50um Warmeleitpaste Dicke≤50um λ = 0,61 W/mK					TBD		K/W
NTC-Thermistor **NTC-Widerstand**										
Rated resistance Nennwiderstand	R_{25}	Tj=25°C	Tol. ±5%				20,9	22	23,1	kOhm
Deviation of R100 Abweichung von R100	$D_{R/R}$	Tc=100°C	R100=1503Ohm					2,9		%/K
Power dissipation given Epcos-Typ Verlustleistung Epcos-Typ angeben	P	Tj=25°C						210		mW
B-value B-Wert	$B_{(25/100)}$	Tj=25°C	Tol. ±3%					3980		K

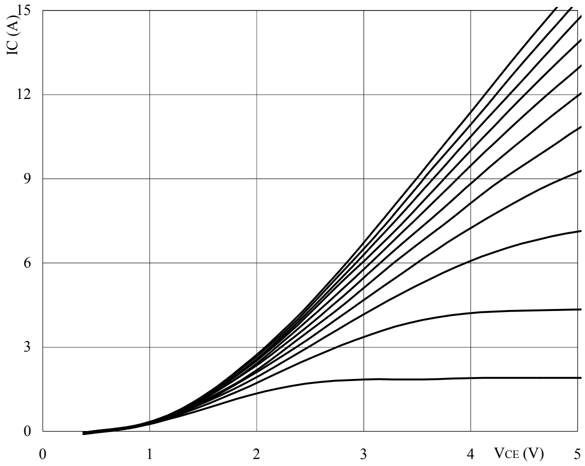
Output inverter

Figure 1. Typical output characteristics
Output inverter IGBT
Ic= f(VCE)



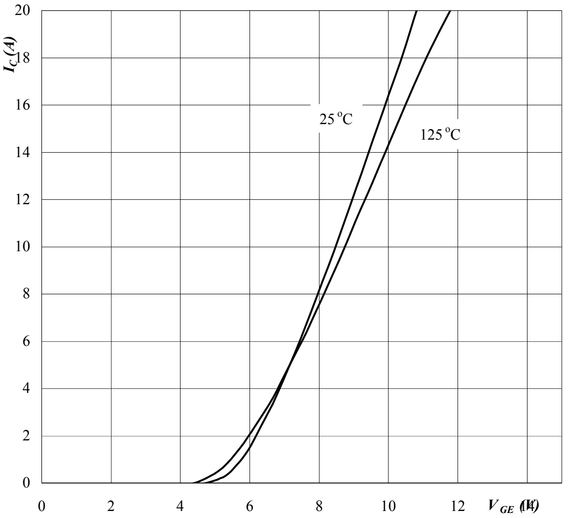
parameter: tp = 250 ms Tj = 25 °C
VGE parameter: from: 6 V to 16 V
in 1 V steps

Figure 2. Typical output characteristics
Output inverter IGBT
Ic= f(VCE)



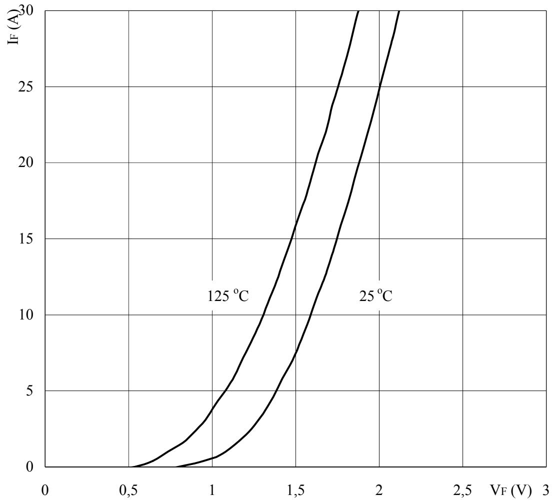
parameter: tp = 250 ms Tj = 125 °C
VGE parameter: from: 6 V to 16 V
in 1 V steps

Figure 3. Typical transfer characteristics
Output inverter IGBT
Ic= f(VGE)



parameter: tp = 250 ms VCE = 12 V

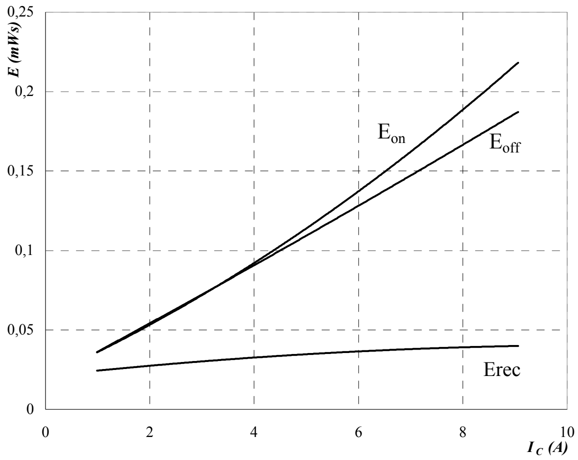
Figure 4. Typical diode forward current as a function of forward voltage
Output inverter FRED IF=f(VF)



parameter: tp = 250 ms

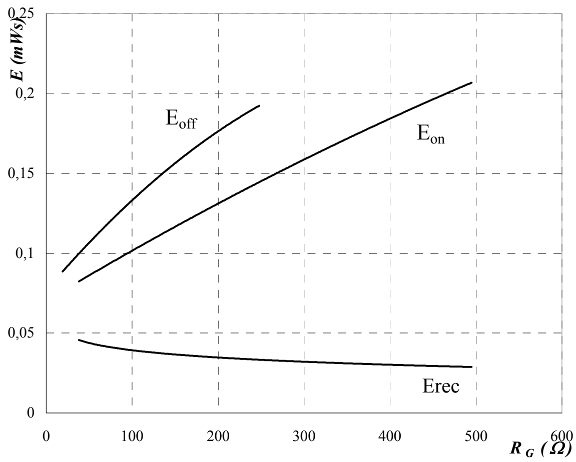
Output inverter

Figure 5. Typical switching energy losses as a function of collector current
Output inverter IGBT
E = f (Ic)



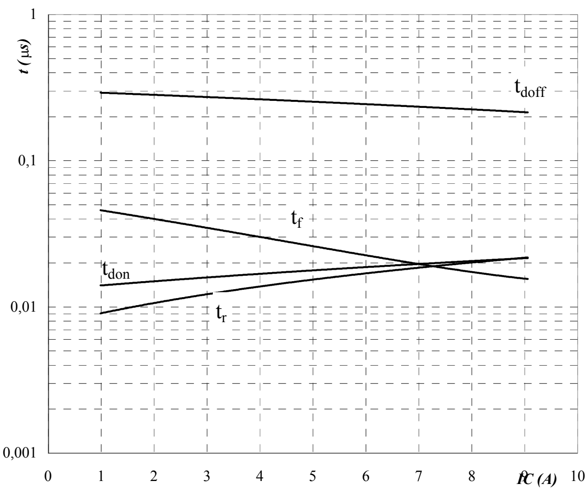
inductive load, Tj = 125 °C
VCE = 300 V
VGE= 15 V
RGon = 2*RGoff = 137 Ohm

Figure 6. Typical switching energy losses as a function of gate resistor
Output inverter IGBT
E = f (RG)



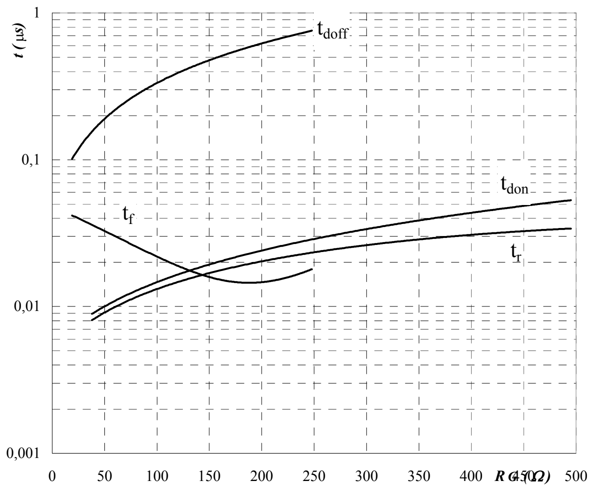
inductive load, Tj = 125 °C
VCE = 300 V
VGE= 15 V
Ic = 5 A

Figure 7. Typical switching times as a function of collector current
Output inverter IGBT
t = f (Ic)



inductive load, Tj = 125 °C
VCE = 300 V
VGE= 15 V
RGon = 2*RGoff = 137 Ohm

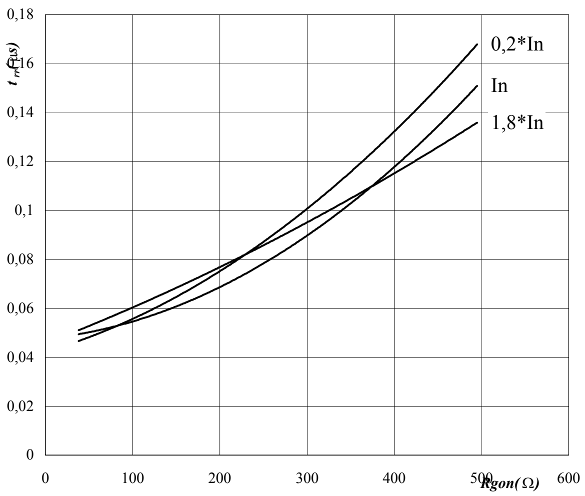
Figure 8. Typical switching times as a function of gate resistor
Output inverter IGBT
t = f (RG)



inductive load, Tj = 125 °C
VCE = 300 V
VGE= 15 V
Ic = 5 A

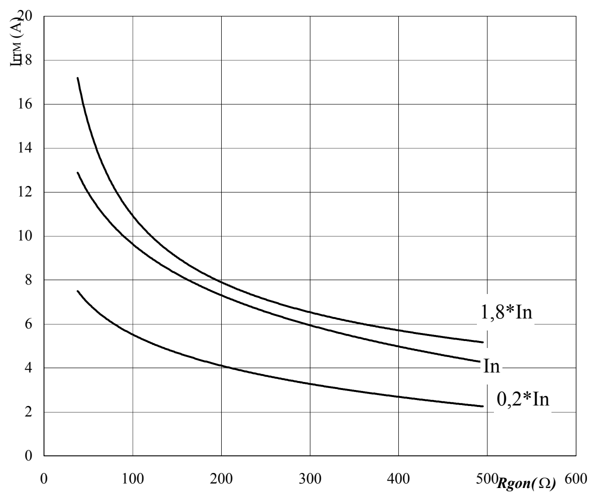
Output inverter

Figure 9. Typical reverse recovery time as a function of gate resistor
Output inverter FRED diode
trr = f (Rgon)



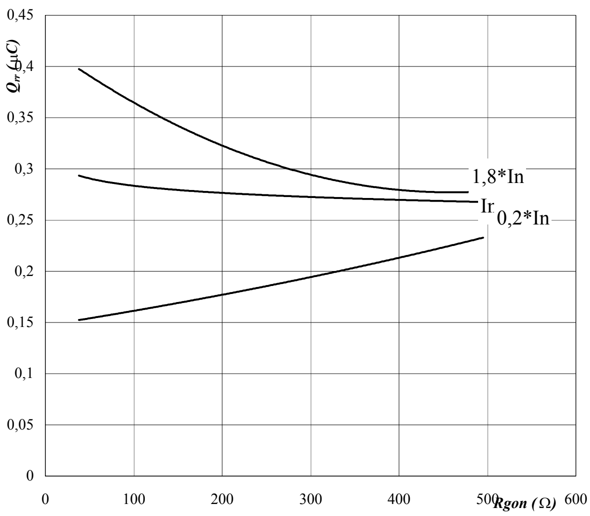
Tj = 125 °C
V_R = 300 V
In= 5 A

Figure 10. Typical reverse recovery current as a function of gate resistor
Output inverter FRED diode
IRRM = f (Rgon)



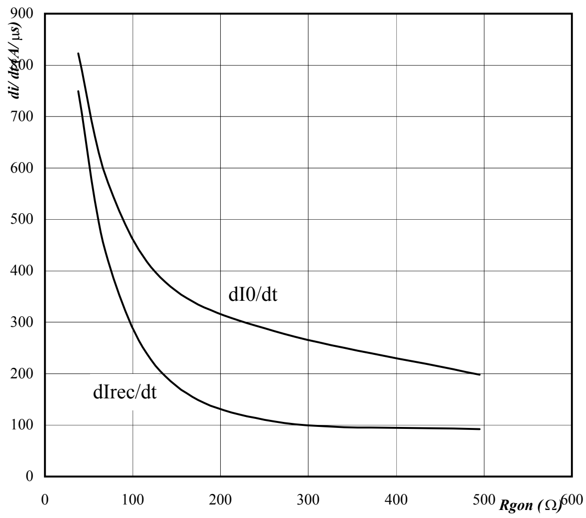
Tj = 125 °C
V_R = 300 V
In= 5 A

Figure 11. Typical reverse recovery charge as a function of gate resistor
Output inverter FRED diode
Qrr = f (Rgon)



Tj = 125 °C
V_R = 300 V
In= 5 A

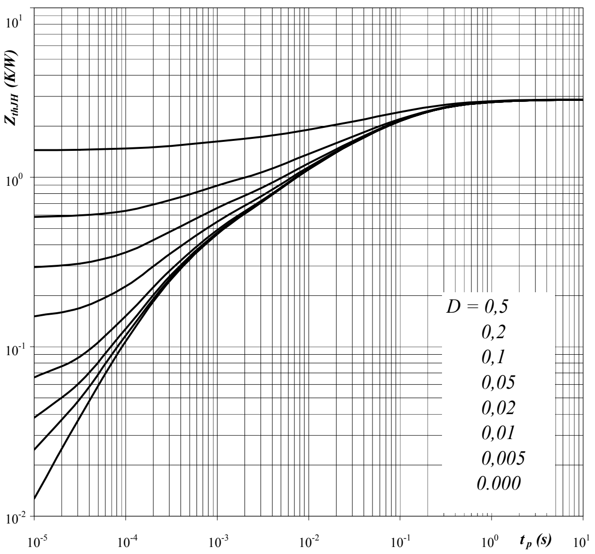
Figure 12. Typical diode peak rate of fall of forward and reverse recovery current as a function of gate resistor
Output inverter FRED diode
di0/dt,dIrec/dt= f (Rgon)



Tj = 125 °C
V_R = 300 V
I_F= 5 A

Output inverter

Figure 13. IGBT transient thermal impedance as a function of pulse width
ZthJH = f(tp)

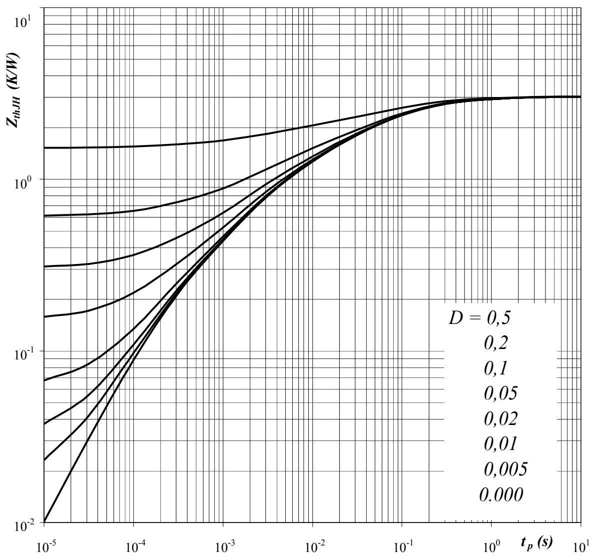


Parameter: D = tp / T RthJH= 2,87 K/W

IGBT thermal model values

R (C/W)	Tau (s)
0,05	1,3E+01
0,31	6,6E-01
0,93	1,2E-01
0,73	2,7E-02
0,49	4,8E-03

Figure 14. FRED transient thermal impedance as a function of pulse width
ZthJH = f(tp)



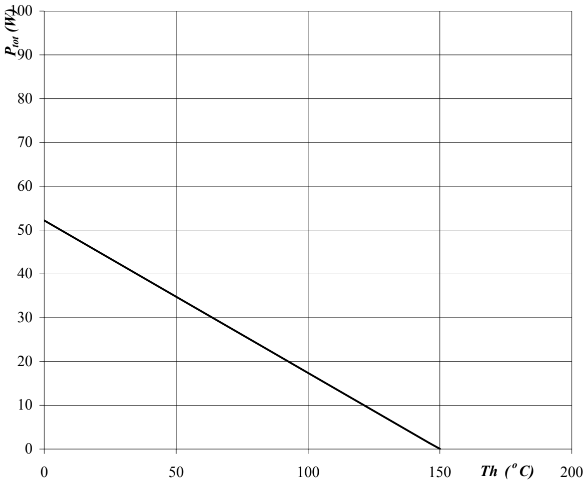
Parameter: D = tp / T RthJH= 3,0 K/W

FRED thermal model values

R (C/W)	Tau (s)
0,04	4,2E+01
0,22	1,0E+00
0,84	1,4E-01
0,78	3,4E-02
0,61	7,4E-03

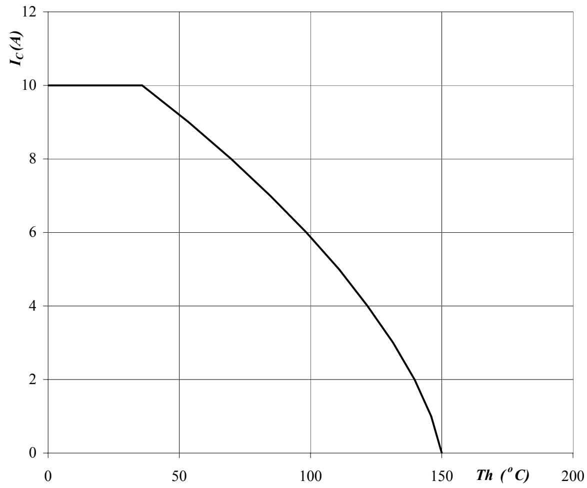
Output inverter

Figure 15. Power dissipation as a function of heatsink temperature
Output inverter IGBT
Ptot = f (Th)



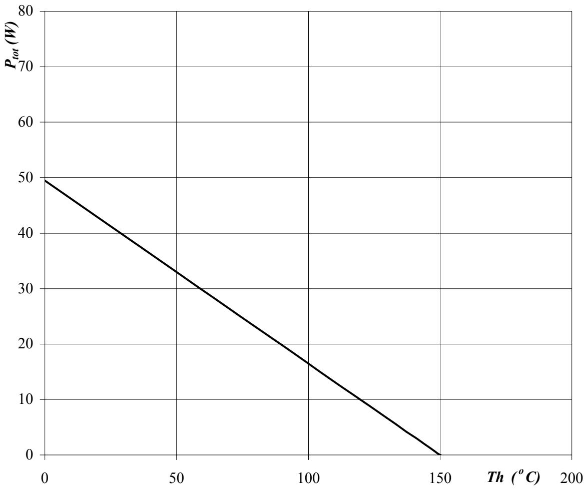
parameter: Tj = 150°C

Figure 16. Collector current as a function of heatsink temperature
Output inverter IGBT
Ic = f (Th)



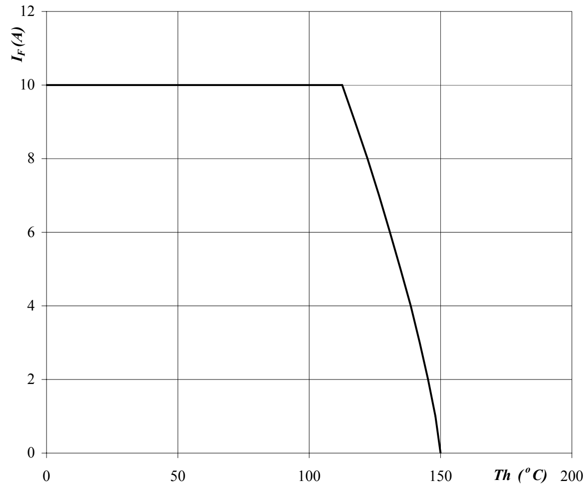
parameter: Tj = 150°C
V_{GE}= 15 V

Figure 17. Power dissipation as a function of heatsink temperature
Output inverter FRED
Ptot = f (Th)



parameter: Tj = 150°C

Figure 18. Forward current as a function of heatsink temperature
Output inverter FRED
IF = f (Th)



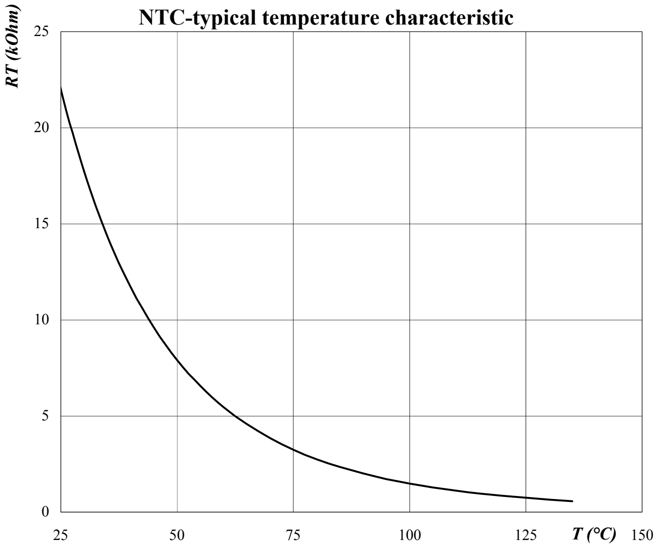
parameter: Tj = 150°C

Thermistor

Figure 23. Typical NTC characteristic as afunction of temperature

NTC

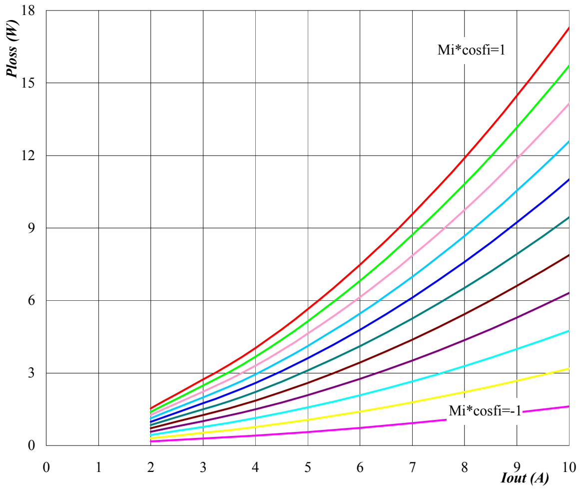
$R_T = f(T)$



Output inverter application

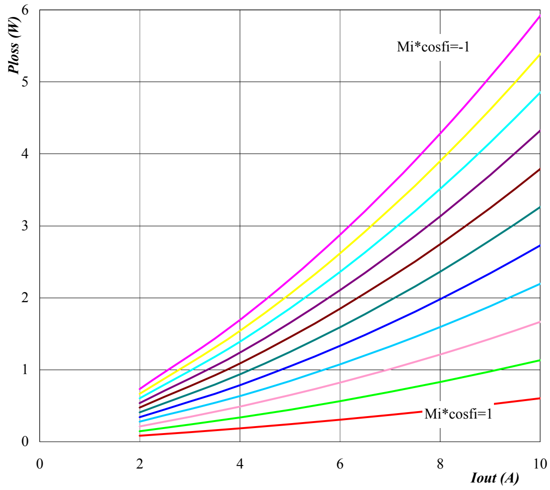
General conditions: 3 phase SPWM, Vgeon= 15 V Vgeoff=0V Rgon= 137 ohms Rgoff= 68,5 ohms

Figure 1. Typical avarage static loss as a function of output current
IGBT Ploss=f(Iout)



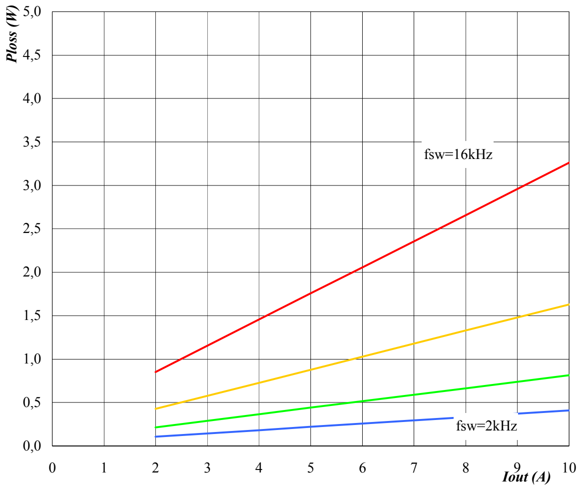
Conditions: Tj=125°C
Modulation index * cosfi
parameter Mi*cosfi from -1,00 to 1,00
in 0,20 steps

Figure 2. Typical avarage static loss as a function of output current
FRED Ploss=f(Iout)



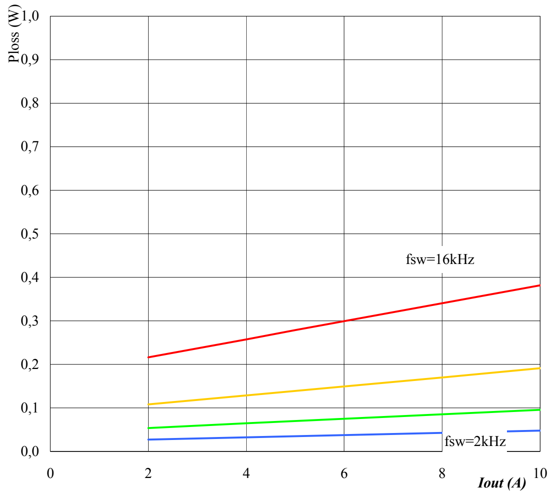
Conditions: Tj=125°C
Modulation index * cosfi
parameter Mi*cosfi from -1,00 to 1,00
in 0,20 steps

Figure 3. Typical avarage switching loss as a function of output current
IGBT Ploss=f(Iout)



Conditions: Tj=125C
DC link= 320 V
Switching freq. fsw from 2 kHz to 16 kHz
parameter in * 2 steps

Figure 4. Typical avarage switching loss as a function of output current
FRED Ploss=f(Iout)

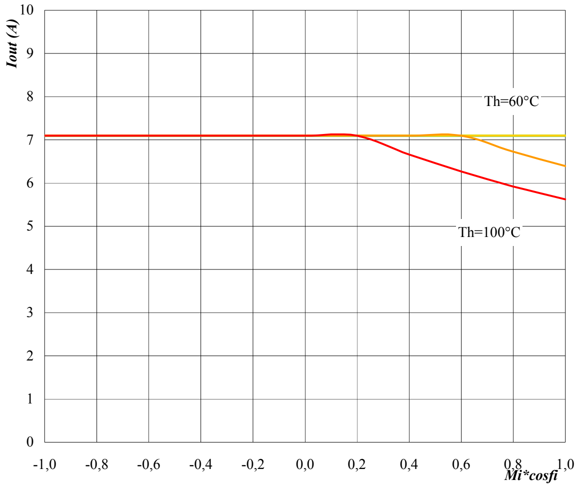


Conditions: Tj=125C
DC link= 320 V
Switching freq. fsw from 2 kHz to 16 kHz
parameter in * 2 steps

Output inverter application

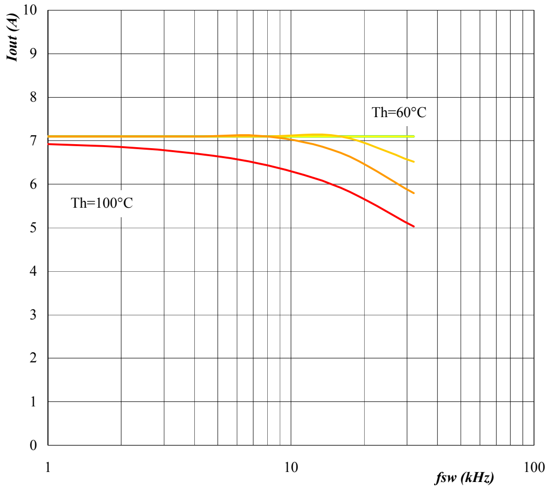
General conditions: 3 phase SPWM, Vgeon= 15 V Vgeoff=0V Rgon= 137 ohms Rgoff= 68,5 ohms

Figure 5. Typical available 50Hz output current as a function of Mi*cosfi
Phase Iout=f(Mi*cosfi)



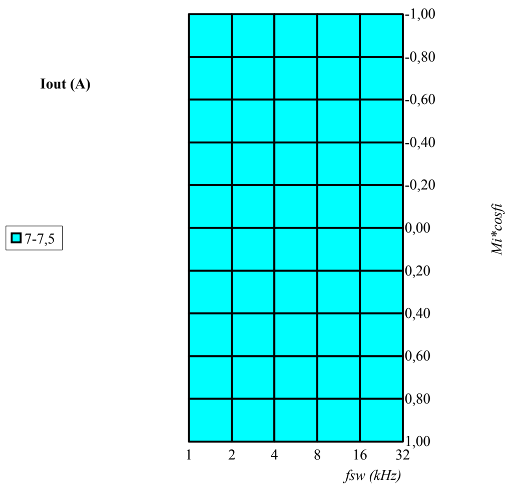
Conditions:	Tj=125C			
	DC link=	320 V		
	fsw=	16 kHz		
Heatsink temp.	Th from	60 °C to	100 °C	
parameter	in	5 °C	steps	

Figure 6. Typical available 50Hz output current as a function of switching frequency
Phase Iout=f(fsw)



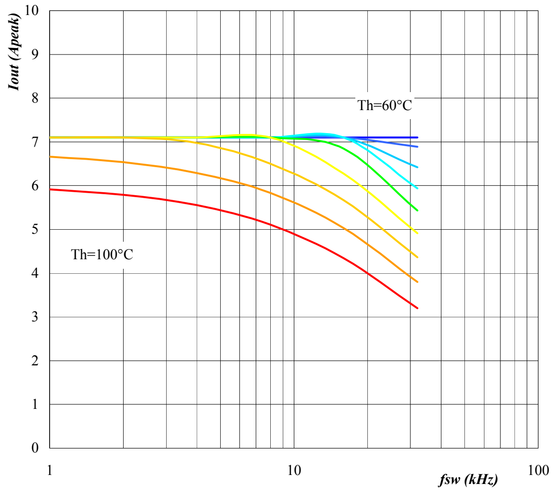
Conditions:	Tj=125C			
	DC link=	320 V		
	Mi*cosfi=	0,8		
Heatsink temp.	Th from	60 °C to	100 °C	
parameter	in	5 °C	steps	

Figure 7. Typical available 50Hz output current as a function of Mi*cosfi and fsw
Phase Iout=f(fsw,Mi*cosfi)



Conditions:	Tj=125C	
	DC link=	320 V
	Th=	80 °C

Figure 8. Typical available 0Hz output current as a function of switching frequency
Phase Ioutpeak=f(fsw)



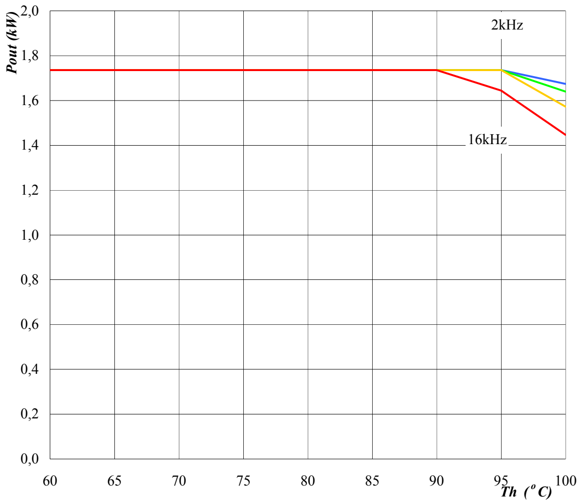
Conditions:	Tj=125C			
	DC link=	320 V		
Heatsink temp.	Th from	60 °C to	100 °C	
parameter	in	5 °C	steps	

Output inverter application

General conditions: 3 phase SPWM, Vgeon= 15 V Vgeoff=0V Rgon= 137 ohms Rgoff= 68,5 ohms

Figure 9. Typical available electric peak output power as a function of heatsink temperature

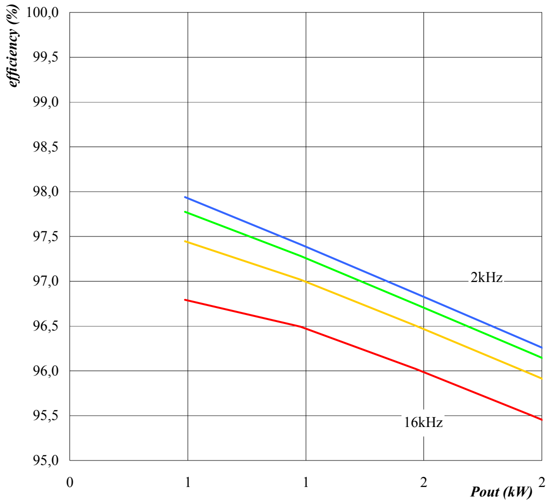
Inverter Pout=f(Th)



Conditions: Tj=125C
DC link= 320 V
Modulation index Mi= 1
cosfi= 0,80
Switching freq. parameter fsw from 2 kHz to 16 kHz in * 2 steps

Figure 10. Typical efficiency as a function of output power

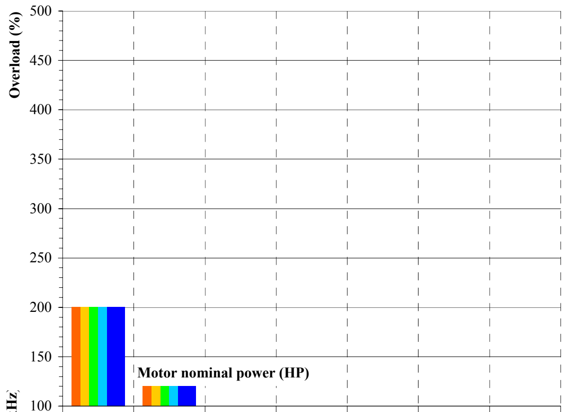
Inverter efficiency=f(Pout)



Conditions: Tj=125C
DC link= 320 V
Modulation index Mi= 1
cosfi= 0,80
Switching freq. parameter fsw from 2 kHz to 16 kHz in * 2 steps

Figure 11. Typical available overload factor as a function of motor power and switching frequency

Inverter Ppeak/Pnom=f(Pnom,fsw)



Switching frequency (kHz)	1	1,5	2	3	5	7,5	10
1	200	134	0	0	0	0	0
2	200	134	0	0	0	0	0
4	200	134	0	0	0	0	0
8	200	134	0	0	0	0	0
16	200	134	0	0	0	0	0

Conditions: Tj=125C
DC link= 320 V
Modulation index Mi= 1
cosfi= 0,8
Switching freq. parameter fsw from 1 kHz to 16 kHz in * 2 steps
Heatsink temperature= 80 °C
Motor efficiency= 0,85