

Maximum Ratings / Höchstzulässige Werte

Parameter	Condition	Symbol	Datasheet values	Unit
			max.	

Input Rectifier Bridge
Gleichrichter

Repetitive peak reverse voltage Periodische Rückw. Spitzensperrspannung		V_{RRM}	1600	V
Forward current per diode Dauergrenzstrom	DC current $T_h=80^\circ\text{C}$;	I_{FAV}	50	A
Surge forward current Stoßstrom Grenzwert	$t_p=10\text{ms}$ $T_j=25^\circ\text{C}$	I_{FSM}	300	A
I^2t -value Grenzlastintegral	$t_p=10\text{ms}$ $T_j=25^\circ\text{C}$	I^2t	450	A^2s
Power dissipation per Diode Verlustleistung pro Diode	$T_j=150^\circ\text{C}$ $T_h=80^\circ\text{C}$	P_{tot}	90	W

Transistor Inverter
Transistor Wechselrichter

Collector-emitter break down voltage Kollektor-Emitter-Sperrspannung		V_{CE}	600	V
DC collector current Kollektor-Dauergleichstrom	$T_j=150^\circ\text{C}$ $T_h=80^\circ\text{C}$,	I_C	40	A
Repetitive peak collector current Periodischer Kollektorspitzenstrom	$t_p=1\text{ms}$ $T_h=80^\circ\text{C}$	I_{cpuls}	80	A
Power dissipation per IGBT Verlustleistung pro IGBT	$T_j=150^\circ\text{C}$ $T_h=80^\circ\text{C}$	P_{tot}	129	W
Gate-emitter peak voltage Gate-Emitter-Spitzenspannung		V_{GE}	± 20	V
SC withstand time Kurzschlußverhalten	$T_j=125^\circ\text{C}$ $V_{GE}=15\text{V}$ $V_{ce}=390\text{V}$	t_{SC}	3,5	us

Diode Inverter
Diode Wechselrichter

DC forward current Dauergleichstrom	$T_j=150^\circ\text{C}$ $T_h=80^\circ\text{C}$,	I_F	40	A
Repetitive peak forward current Periodischer Spitzenstrom	$t_p=1\text{ms}$ $T_h=80^\circ\text{C}$	I_{FRM}	80	A
Power dissipation per Diode Verlustleistung pro Diode	$T_j=150^\circ\text{C}$ $T_h=80^\circ\text{C}$	P_{tot}	63	W

Thermal properties
Thermische Eigenschaften

max. Chip temperature max. Chiptemperatur		T_{jmax}	150	$^\circ\text{C}$
Storage temperature Lagertemperatur		T_{stg}	-40...+125	$^\circ\text{C}$
Operation temperature Betriebstemperatur		T_{op}	-40...+125	$^\circ\text{C}$

Insulation properties
Modulisation

Insulation voltage Isolationsspannung	$t=1\text{min}$	V_{is}	4000	Vdc
Creepage distance Kriechstrecke			min 12,7	mm
Clearance Luftstrecke			min 12,7	mm

fastPIM 1H, 600V, 40A

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	

Input Rectifier Bridge

Gleichrichter

Forward voltage Durchlaßspannung	V_F	$T_J=25^{\circ}\text{C}$ $T_J=125^{\circ}\text{C}$				80		1,32 1,33	1,5	V
Threshold voltage (for power loss calc. only) Schleusenspannung	V_{to}	$T_J=25^{\circ}\text{C}$ $T_J=125^{\circ}\text{C}$				80		0,94 0,82		V
Slope resistance (for power loss calc. only) Ersatzwiderstand	r_t	$T_J=25^{\circ}\text{C}$ $T_J=125^{\circ}\text{C}$				80		0,005 0,006		Ohm
Reverse current Sperrstrom	I_r	$T_J=25^{\circ}\text{C}$ $T_J=150^{\circ}\text{C}$			1200			3	0,01 4	mA
Thermal resistance chip to heatsink per chip Wärmewiderstand Chip-Kühlkörper pro Chip	R_{thJH}		Thermal grease thickness≤50um Wärmeleitpaste Dicke≤50um $\lambda =$ 0,61 W/mK					0,78		K/W

Transistor Inverter, inductive load

Transistor Wechselrichter

Gate emitter threshold voltage Gate-Schwellenspannung	$V_{GE(th)}$	$T_J=25^{\circ}\text{C}$ $T_J=125^{\circ}\text{C}$	VCE=VGE			0,00025	4,5	5,6	7	V
Collector-emitter saturation voltage Kollektor-Emitter Sättigungsspannung	$V_{CE(sat)}$	$T_J=25^{\circ}\text{C}$ $T_J=125^{\circ}\text{C}$		15		40		1,98 1,45	2,85	V
Collector-emitter cut-off Kollektor-Emitter Reststrom	I_{CES}	$T_J=25^{\circ}\text{C}$ $T_J=125^{\circ}\text{C}$		0	600				0,25 3	mA
Gate-emitter leakage current Gate-Emitter Reststrom	I_{GES}	$T_J=25^{\circ}\text{C}$ $T_J=125^{\circ}\text{C}$		25	0				300	nA
Turn-on delay time Einschaltverzögerungszeit	$t_{d(on)}$	$T_J=25^{\circ}\text{C}$ $T_J=125^{\circ}\text{C}$	Rgon=6 Ohm Rgoff=1 Ohm	15	300	40		40		ns
Rise time Anstiegszeit	t_r	$T_J=25^{\circ}\text{C}$ $T_J=125^{\circ}\text{C}$	Rgon=6 Ohm Rgoff=1 Ohm	15	300	40		12		ns
Turn-off delay time Abschaltverzögerungszeit	$t_{d(off)}$	$T_J=25^{\circ}\text{C}$ $T_J=125^{\circ}\text{C}$	Rgon=6 Ohm Rgoff=1 Ohm	15	300	40		186		ns
Fall time Fallzeit	t_f	$T_J=25^{\circ}\text{C}$ $T_J=125^{\circ}\text{C}$	Rgon=6 Ohm Rgoff=1 Ohm	15	300	40		15		ns
Turn-on energy loss per pulse Einschaltverlustenergie pro Puls	E_{on}	$T_J=25^{\circ}\text{C}$ $T_J=125^{\circ}\text{C}$	Rgon=6 Ohm Rgoff=1 Ohm	15	300	40		0,691		mWs
Turn-off energy loss per pulse Abschaltverlustenergie pro Puls	E_{off}	$T_J=25^{\circ}\text{C}$ $T_J=125^{\circ}\text{C}$	Rgon=6 Ohm Rgoff=1 Ohm	15	300	40		0,495		mWs
Input capacitance Eingangskapazität	C_{ies}	$T_J=25^{\circ}\text{C}$ $T_J=125^{\circ}\text{C}$	f=1MHz	0	25			6,2		nF
Output capacitance Ausgangskapazität	C_{oss}	$T_J=25^{\circ}\text{C}$ $T_J=125^{\circ}\text{C}$	f=1MHz	0	25			0,4		nF
Reverse transfer capacitance Rückwirkungskapazität	C_{rss}	$T_J=25^{\circ}\text{C}$ $T_J=125^{\circ}\text{C}$	f=1MHz	0	25			0,2		nF
Gate charge Gate Ladung	Q_{Gate}	$T_J=25^{\circ}\text{C}$ $T_J=125^{\circ}\text{C}$		15	300	40		350	405	nC
Thermal resistance chip to heatsink per chip Wärmewiderstand Chip-Kühlkörper pro Chip	R_{thJH}		Thermal grease thickness≤50um Wärmeleitpaste Dicke≤50um $\lambda =$ 0,61 W/mK					0,54		K/W

fastPIM 1H, 600V, 40A

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				40		1,49 1,27	2,2	V
Peak reverse recovery current Rückstromspitze	I_{RM}	Tj=25°C Tj=125°C	Rgon=6 Ohm	15	300	40		101		A
Reverse recovery time Sperrverzögerungszeit	t_{rr}	Tj=25°C Tj=125°C	Rgon=6 Ohm	15	300	40		64		ns
Reverse recovered charge Sperrverzögerungsladung	Q_{rr}	Tj=25°C Tj=125°C	Rgon=6 Ohm	15	300	40		3,87		uC
Reverse recovered energy Sperrverzögerungsenergie	Erec	Tj=25°C Tj=125°C	Rgon=6 Ohm	15	300	40		0,726		mWs
Thermal resistance chip to heatsink per chip Wärmewiderstand Chip-Kühlkörper pro Chip	R_{thJH}		Thermal grease thickness≤50um Wärmeleitpaste Dicke≤50um $\lambda = 0,61 \text{ W/mK}$					1,11		K/W

NTC-Thermistor

NTC-Widerstand

Rated resistance Nennwiderstand	R_{25}	Tj=25°C	Tol. ±5%				9,5	10	10,5	kOhm
Deviation of R100 Abweichung von R100	$D_{R/R}$	Tc=100°C	R100=809Ohm					2,8		%/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%					3730		K

Output inverter

Figure 1. Typical output characteristics

Output inverter IGBT

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

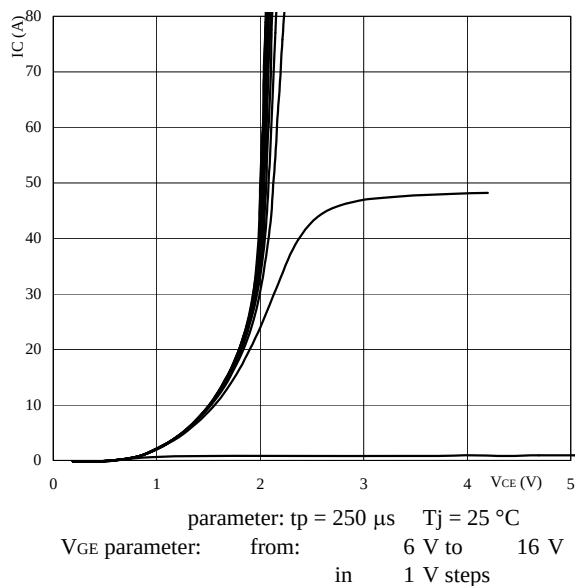


Figure 2. Typical output characteristics

Output inverter IGBT

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

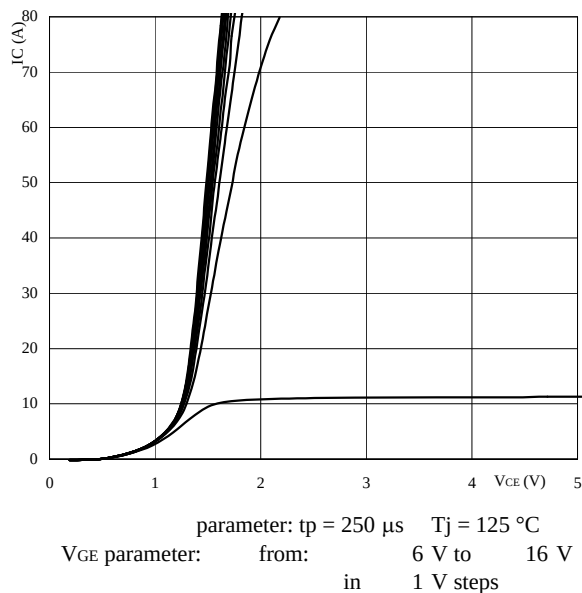


Figure 3. Typical transfer characteristics

Output inverter IGBT

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

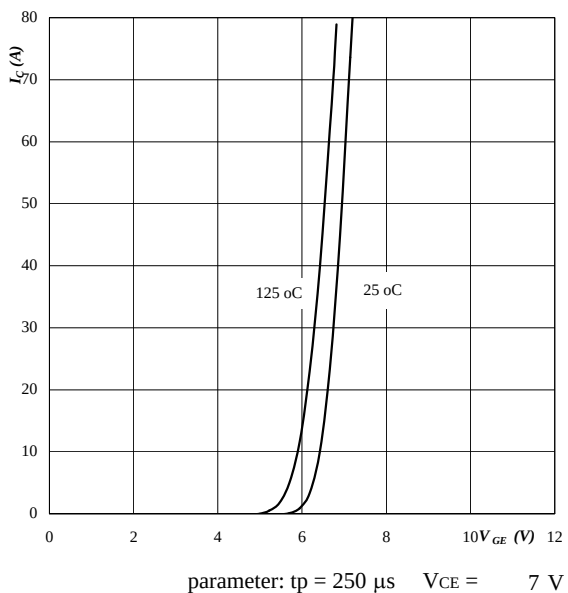
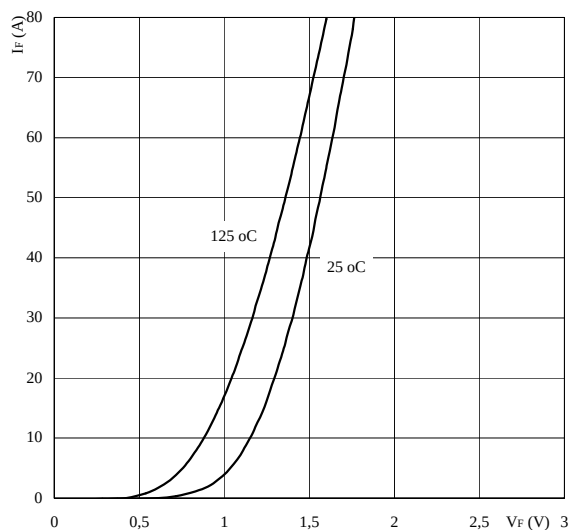


Figure 4. Typical diode forward current as a function of forward voltage

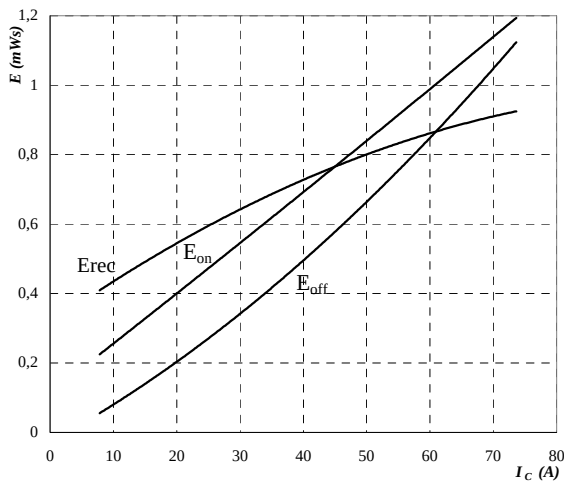
Output inverter FRED

$$I_F = f(V_F)$$



Output inverter

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



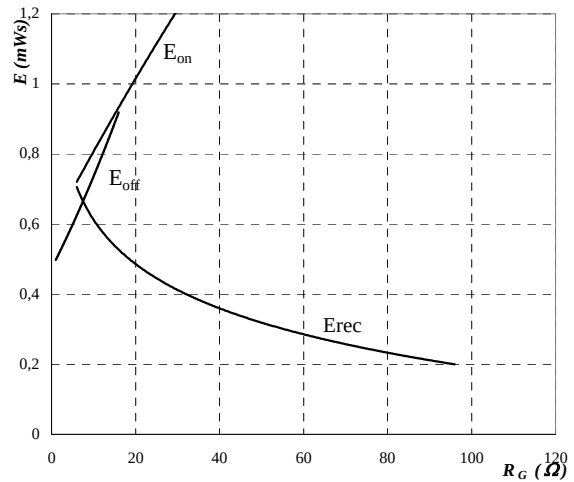
inductive load, $T_j = 125^\circ\text{C}$

$V_{CE} = 300\text{ V}$

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

$R_{Gon} = 6 \cdot R_{Goff} = 6\ \Omega$

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



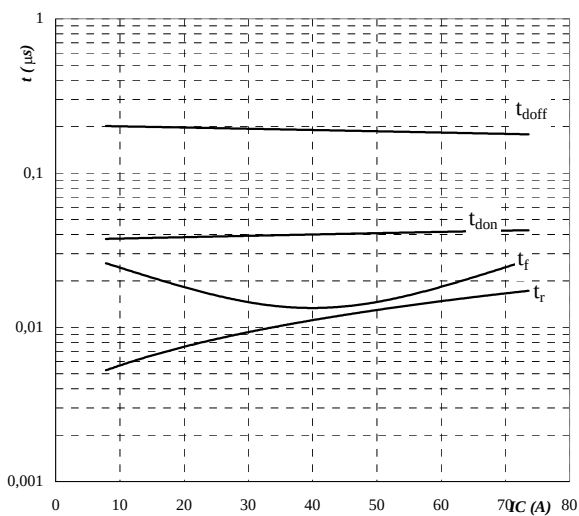
inductive load, $T_j = 125^\circ\text{C}$

$V_{CE} = 300\text{ V}$

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

$I_c = 40\text{ A}$

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



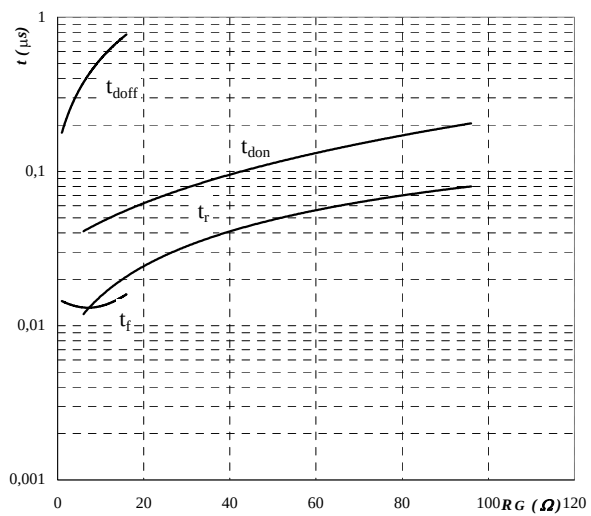
inductive load, $T_j = 125^\circ\text{C}$

$V_{CE} = 300\text{ V}$

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

$R_{Gon} = 6 \cdot R_{Goff} = 6\ \Omega$

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



inductive load, $T_j = 125^\circ\text{C}$

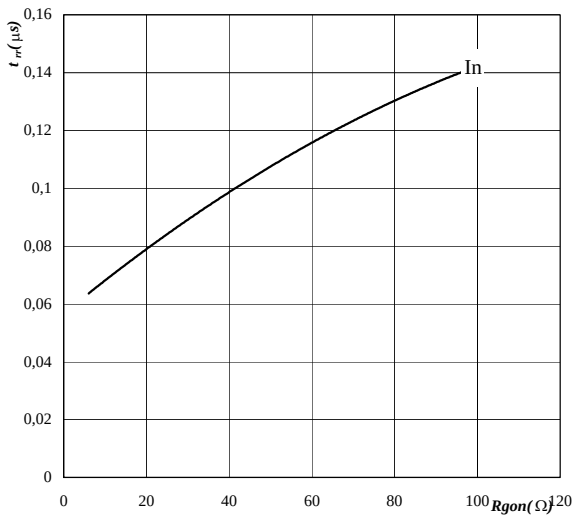
$V_{CE} = 300\text{ V}$

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

$I_c = 40\text{ A}$

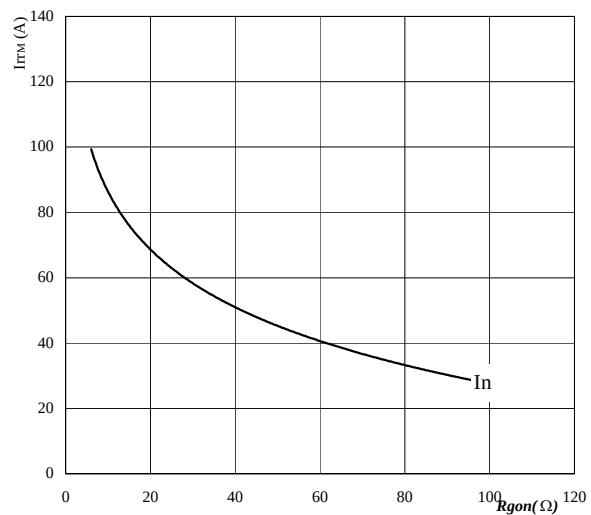
Output inverter

Figure 9. Typical reverse recovery time as a function of gate resistor
Output inverter FRED diode
 $t_{rr} = f(R_{gon})$



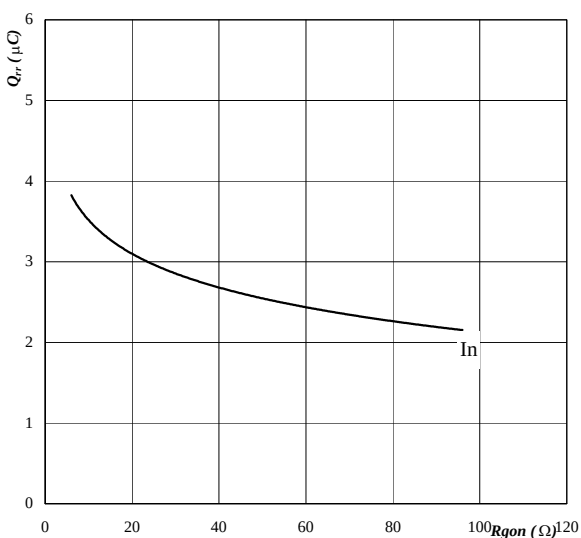
$T_j = 125^\circ C$
 $V_R = 300 V$
 $I_n = 40 A$

Figure 10. Typical reverse recovery current as a function of gate resistor
Output inverter FRED diode
 $I_{RRM} = f(R_{gon})$



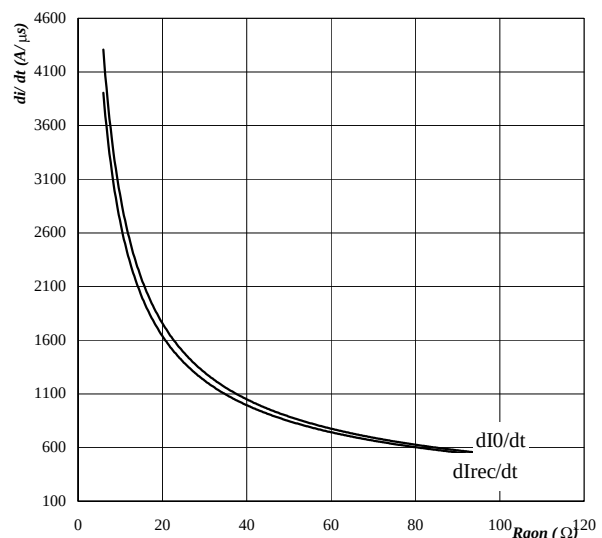
$T_j = 125^\circ C$
 $V_R = 300 V$
 $I_n = 40 A$

Figure 11. Typical reverse recovery charge as a function of gate resistor
Output inverter FRED diode
 $Q_{rr} = f(R_{gon})$



$T_j = 125^\circ C$
 $V_R = 300 V$
 $I_n = 40 A$

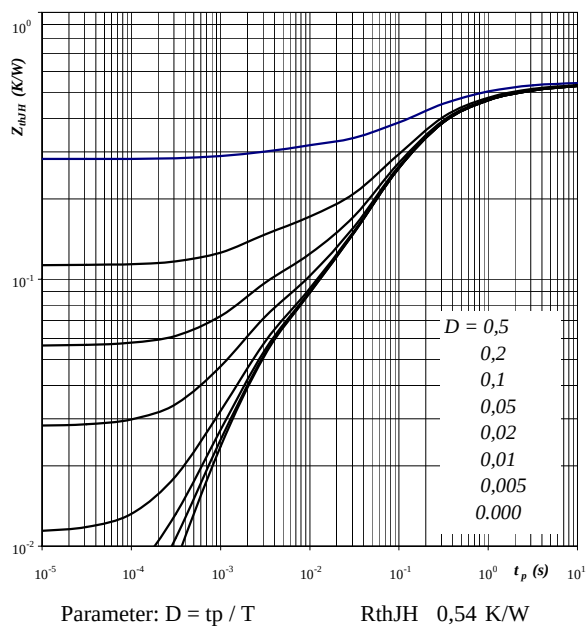
Figure 12. Typical diode peak rate of fall of forward and reverse recovery current as a function of gate resistor
Output inverter FRED diode
 $di_0/dt, dI_{rec}/dt = f(R_{gon})$



$T_j = 125^\circ C$
 $V_R = 300 V$
 $I_F = 40 A$

Output inverter

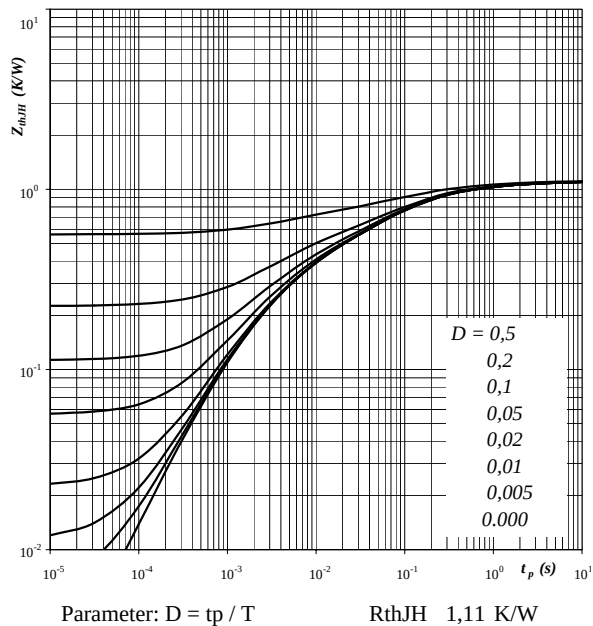
Figure 13. IGBT transient thermal impedance
as a function of pulse width
 $Z_{thJH} = f(t_p)$



IGBT thermal model values

R (C/W)	Tau (s)
0,03	1,5E+02
0,04	6,7E+00
0,10	9,4E-01
0,24	1,7E-01
0,10	4,3E-02

Figure 14. FRED transient thermal impedance
as a function of pulse width
 $Z_{thJH} = f(t_p)$



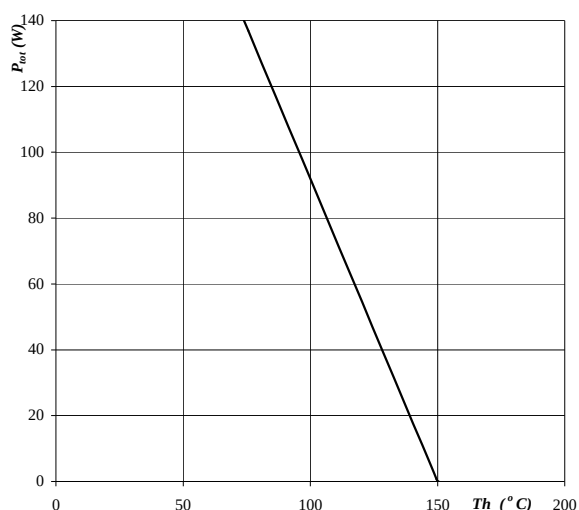
FRED thermal model values

R (C/W)	Tau (s)
0,01	-2,5E+02
0,05	8,9E+00
0,12	9,0E-01
0,33	1,6E-01
0,27	3,8E-02

Output inverter

Figure 15. Power dissipation as a function of heatsink temperature

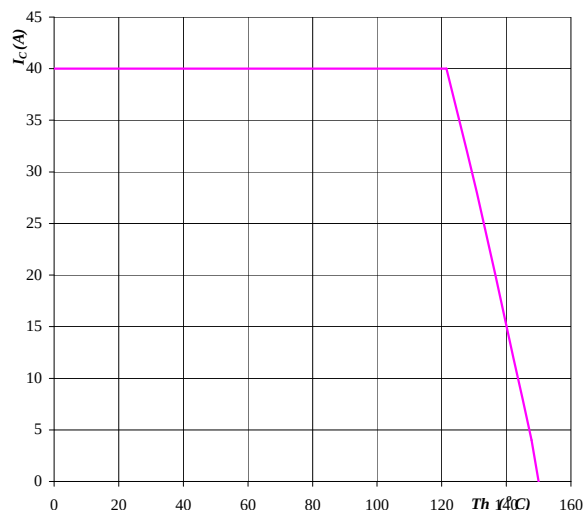
Output inverter IGBT
 $P_{tot} = f(T_h)$



parameter: $T_j = 150^\circ\text{C}$

Figure 16. Collector current as a function of heatsink temperature

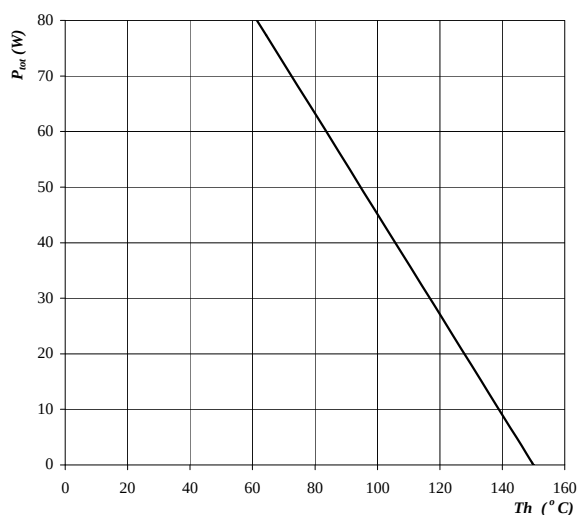
Output inverter IGBT
 $I_c = f(T_h)$



parameter: $T_j = 150^\circ\text{C}$
 $V_{GE} = 0$ V

Figure 17. Power dissipation as a function of heatsink temperature

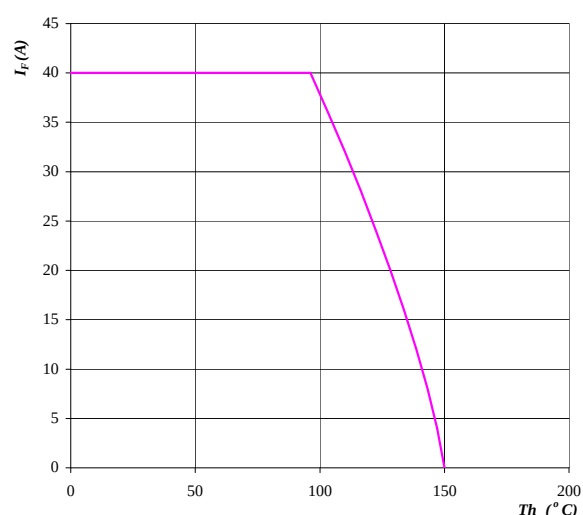
Output inverter FRED
 $P_{tot} = f(T_h)$



parameter: $T_j = 150^\circ\text{C}$

Figure 18. Forward current as a function of heatsink temperature

Output inverter FRED
 $I_F = f(T_h)$



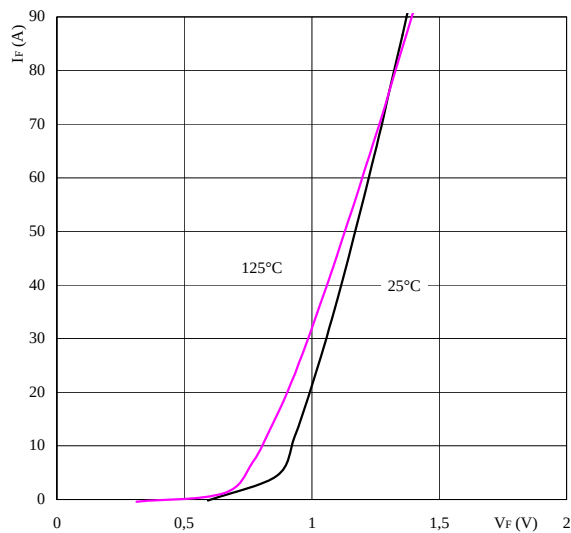
parameter: $T_j = 150^\circ\text{C}$

Input rectifier bridge

Figure 19. Typical diode forward current as a function of forward voltage

Rectifier diode

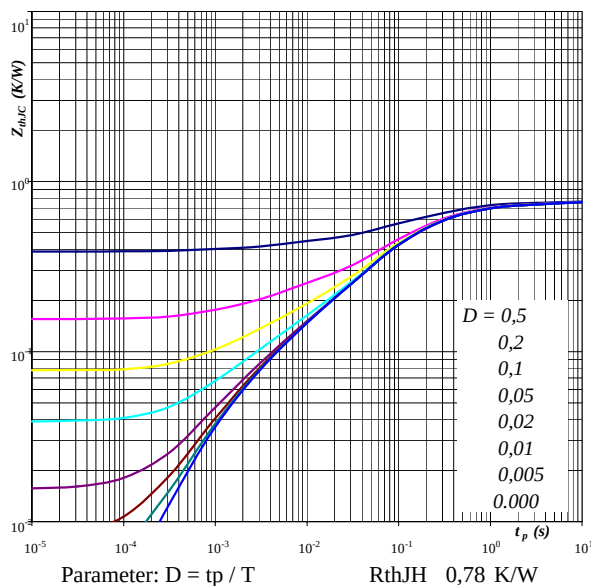
$$I_F = f(V_F)$$



parameter: $t_p = 250 \mu s$

Figure 20. Diode transient thermal impedance as a function of pulse width

$Z_{thJH} = f(t_p)$



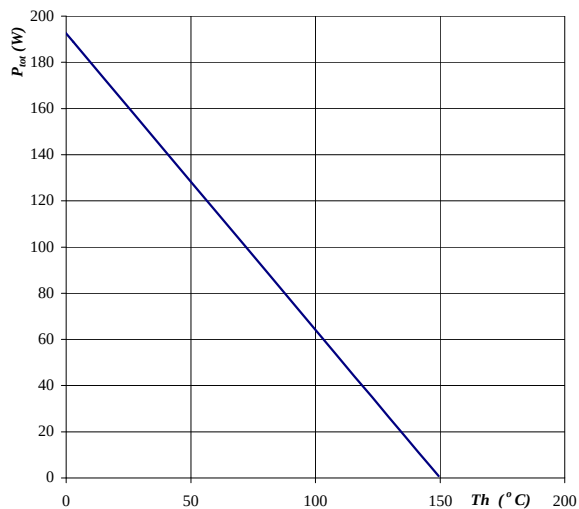
Parameter: $D = t_p / T$

$R_{thJH} = 0.78 \text{ K/W}$

Figure 21. Power dissipation as a function of heatsink temperature

Rectifier diode

$$P_{tot} = f(T_h)$$

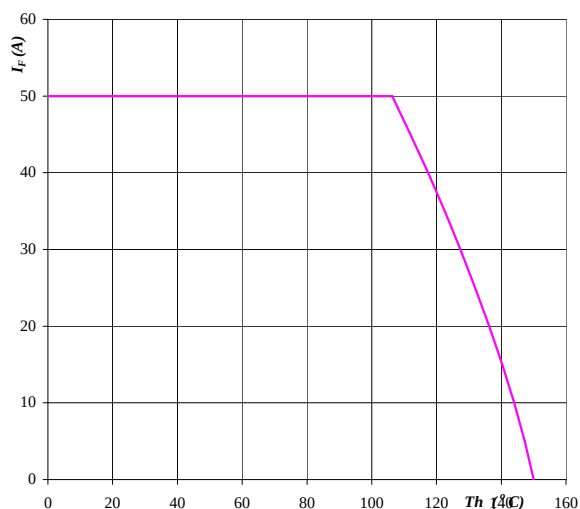


parameter: $T_j = 150^\circ\text{C}$

Figure 22. Forward current as a function of heatsink temperature

Rectifier diode

$$I_F = f(T_h)$$



parameter: $T_j = 150^\circ\text{C}$

Thermistor

**Figure 23. Typical NTC characteristic
as a function of temperature**

NTC

$$R_T / R_{25} = f(T)$$

