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final datasheet

fastPIM 1H, 600V, 40A — V23990-P387-A11-01-14

Maximum Ratings / Höchstzulässige Werte

Parameter	Condition		Symbol	Datasheet values max.	Unit
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°C;	I_{FAV}	50	A
Surge forward current Stoßstrom Grenzwert	t_p=10ms	T_j=25°C	I_{FSM}	300	A
I^2t-value Grenzlastintegral	t_p=10ms	T_j=25°C	I^2t	450	A^2s
Power dissipation per Diode Verlustleistung pro Diode	T_j=150°C	T_h=80°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°C	T_h=80°C,	I_C	40	A
Repetitive peak collector current Periodischer Kollektorspitzenstrom	t_p=1ms	T_h=80°C	I_{cpuls}	80	A
Power dissipation per IGBT Verlustleistung pro IGBT	T_j=150°C	T_h=80°C	P_{tot}	129	W
Gate-emitter peak voltage Gate-Emitter-Spitzenspannung			V_{GE}	±20	V
SC withstand time Kurzschlußverhalten	Tj=125°C Vce=390V	V_{GE}=15V	t_{SC}	3,5	us
Diode Inverter **Diode Wechselrichter**					
DC forward current Dauergleichstrom	T_j=150°C	T_h=80°C,	I_F	40	A
Repetitive peak forward current Periodischer Spitzenstrom	t_p=1ms	T_h=80°C	I_{FRM}	80	A
Power dissipation per Diode Verlustleistung pro Diode	T_j=150°C	T_h=80°C	P_{tot}	63	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

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Characteristic values

Description	Symbol	Conditions T(C°)	Other conditions (Rgon-Rgoff)	VGE(V) VGS(V)	VR(V) VCE(V) VDS(V)	IC(A) IF(A) Id(A)	Datasheet values Min	Typ	Max	Unit
Input Rectifier Bridge **Gleichrichter**										
Forward voltage Durchlaßpannung	V_F	Tj=25°C Tj=125°C				80		1,32 1,33	1,5	V
Threshold voltage (for power loss calc. only) Schleusenspannung	V_{to}	Tj=25°C Tj=125°C				80		0,94 0,82		V
Slope resistance (for power loss calc. only) Ersatzwiderstand	r_t	Tj=25°C Tj=125°C				80		0,005 0,006		Ohm
Reverse current Sperrstrom	I_r	Tj=25°C Tj=150°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 Warmeleitpaste Dicke≤50um λ = 0,61 W/mK					0,78		K/W
Transistor Inverter, inductive load **Transistor Wechselrichter**										
Gate emitter threshold voltage Gate-Schwellenspannung	$V_{GE(th)}$	Tj=25°C Tj=125°C	VCE=VGE			0,00025	4,5	5,6	7	V
Collector-emitter saturation voltage Kollektor-Emitter Sättigungsspannung	$V_{CE(sat)}$	Tj=25°C Tj=125°C		15		40		1,98 1,45	2,85	V
Collector-emitter cut-off Kollektor-Emitter Reststrom	I_{CES}	Tj=25°C Tj=125°C		0	600				0,25 3	mA
Gate-emitter leakage current Gate-Emitter Reststrom	I_{GES}	Tj=25°C Tj=125°C		25	0				300	nA
Turn-on delay time Einschaltverzögerungszeit	$t_{d(on)}$	Tj=25°C Tj=125°C	Rgon=6 Ohm Rgoff=1 Ohm	15	300	40		 40		ns
Rise time Anstiegszeit	t_r	Tj=25°C Tj=125°C	Rgon=6 Ohm Rgoff=1 Ohm	15	300	40		 12		ns
Turn-off delay time Abschaltverzögerungszeit	$t_{d(off)}$	Tj=25°C Tj=125°C	Rgon=6 Ohm Rgoff=1 Ohm	15	300	40		 186		ns
Fall time Fallzeit	t_f	Tj=25°C Tj=125°C	Rgon=6 Ohm Rgoff=1 Ohm	15	300	40		 15		ns
Turn-on energy loss per pulse Einschaltverlustenergie pro Puls	E_{on}	Tj=25°C Tj=125°C	Rgon=6 Ohm Rgoff=1 Ohm	15	300	40		 0,691		mWs
Turn-off energy loss per pulse Abschaltverlustenergie pro Puls	E_{off}	Tj=25°C Tj=125°C	Rgon=6 Ohm Rgoff=1 Ohm	15	300	40		 0,495		mWs
Input capacitance Eingangskapazität	C_{ies}	Tj=25°C Tj=125°C	f=1MHz	0	25			6,2		nF
Output capacitance Ausgangskapazität	C_{oss}	Tj=25°C Tj=125°C	f=1MHz	0	25			0,4		nF
Reverse transfer capacitance Rückwirkungskapazität	C_{rss}	Tj=25°C Tj=125°C	f=1MHz	0	25			0,2		nF
Gate charge Gate Ladung	Q_{Gate}	Tj=25°C Tj=125°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 Warmeleitpaste Dicke≤50um λ = 0,61 W/mK					0,54		K/W

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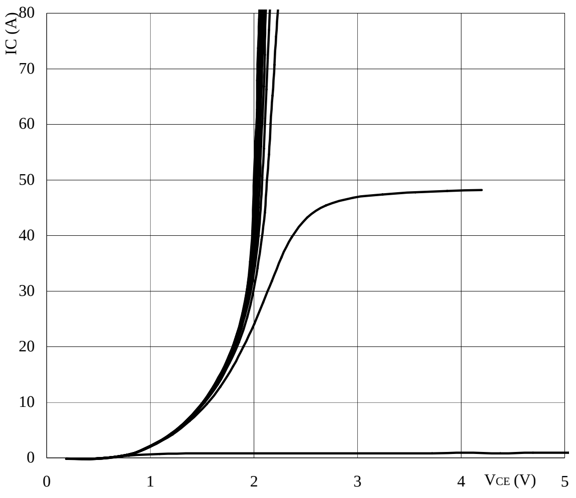
Characteristic values

Description	Symbol	Conditions T(C°)	Other conditions (Rgon-Rgoff)	VGE(V) VGS(V)	VR(V) VCE(V) VDS(V)	IC(A) IF(A) Id(A)	Datasheet values Min	Typ	Max	Unit
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 Sperreverzögerungszeit	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 Warmeleitpaste Dicke≤50um λ = 0,61 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

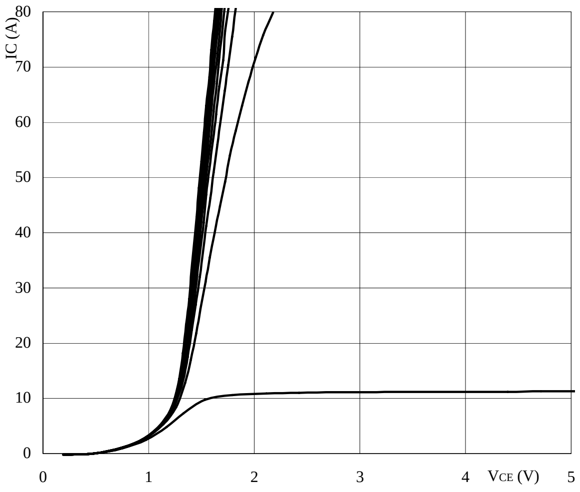
Output inverter

Figure 1. Typical output characteristics
Output inverter IGBT
$I_C = f(V_{CE})$



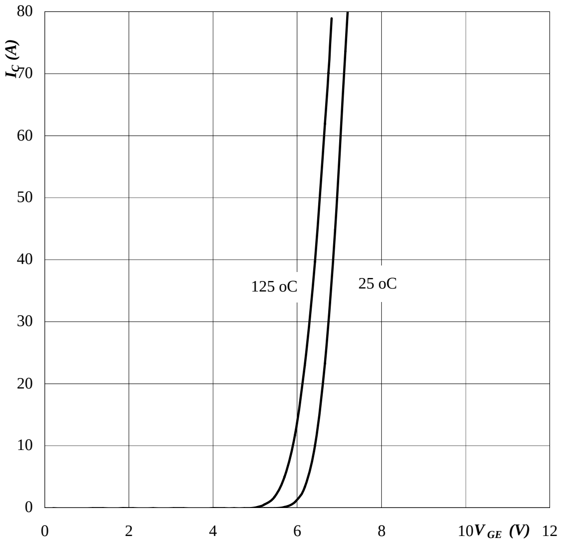
parameter: tp = 250 µs Tj = 25 °C
VGE parameter: from: 6 V to 16 V in 1 V steps

Figure 2. Typical output characteristics
Output inverter IGBT
$I_C = f(V_{CE})$



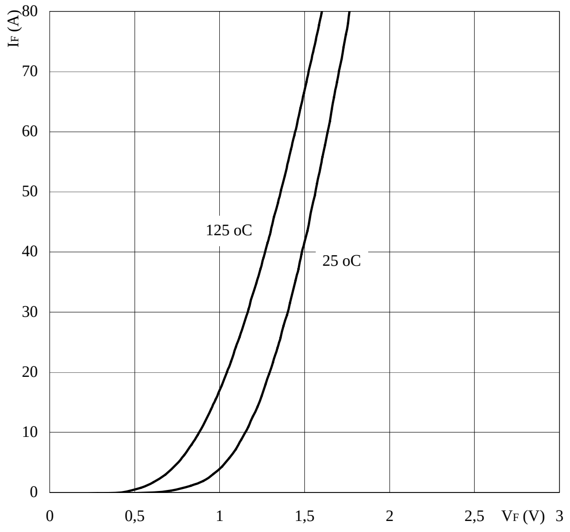
parameter: tp = 250 µs Tj = 125 °C
VGE parameter: from: 6 V to 16 V in 1 V steps

Figure 3. Typical transfer characteristics
Output inverter IGBT
$I_C = f(V_{GE})$



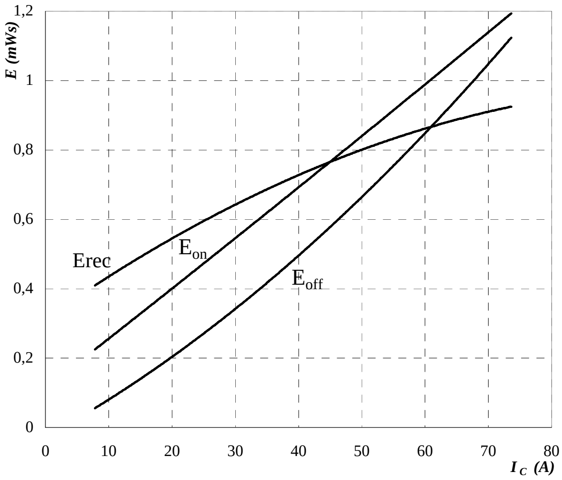
parameter: tp = 250 µs VCE = 7 V

Figure 4. Typical diode forward current as a function of forward voltage
Output inverter FRED $I_F = f(V_F)$



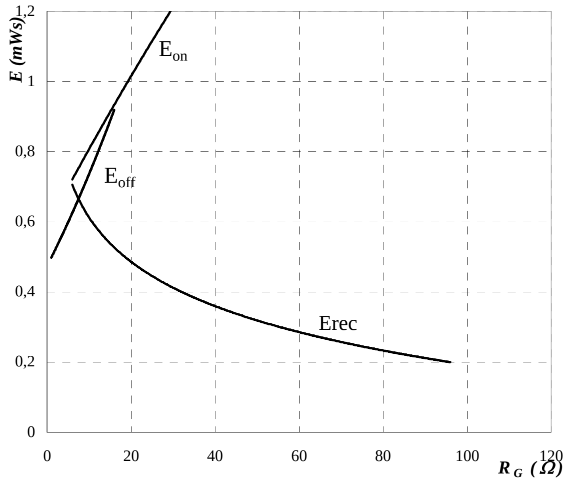
Output inverter

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



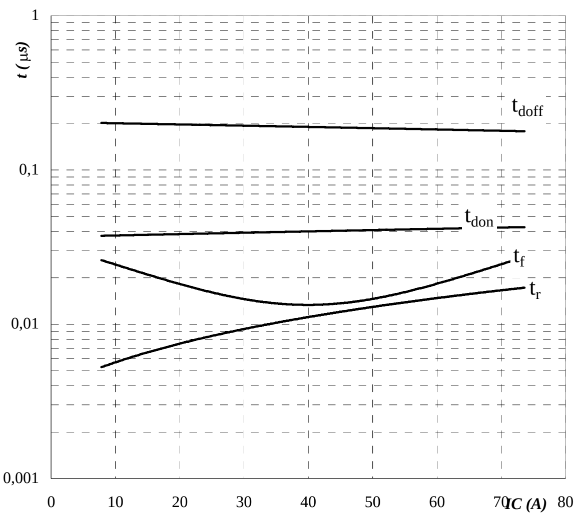
inductive load, Tj = 125 °C
V_{CE} = 300 V
V_{GE} = 15 V
R_{Gon} = 6* R_{Goff} = 6 Ω

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



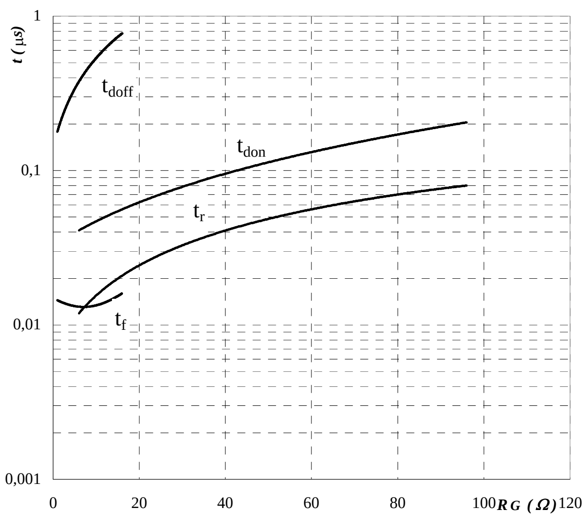
inductive load, Tj = 125 °C
V_{CE} = 300 V
V_{GE} = 15 V
Ic = 40 A

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



inductive load, Tj = 125 °C
V_{CE} = 300 V
V_{GE} = 15 V
R_{Gon} = 6*R_{Goff} = 6 Ω

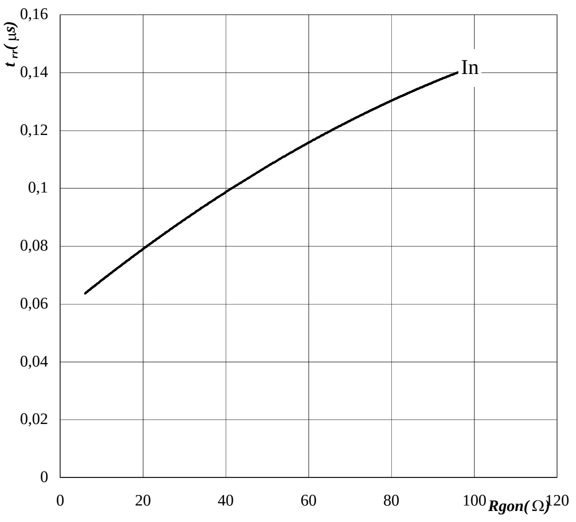
Figure 8. **Typical switching times as a function of gate resistor**
Output inverter IGBT
t = f (R_G)



inductive load, Tj = 125 °C
V_{CE} = 300 V
V_{GE} = 15 V
Ic = 40 A

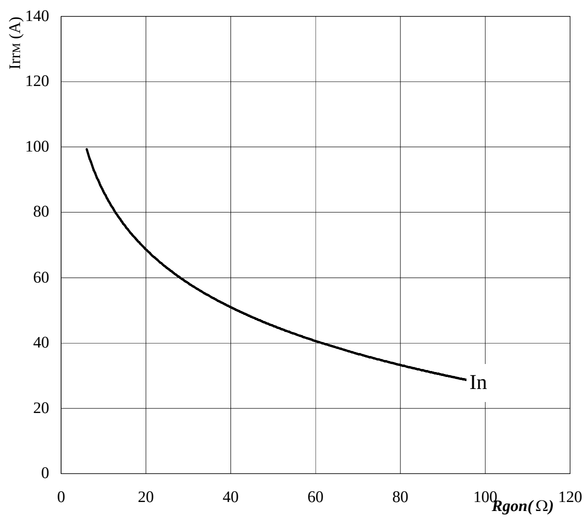
Output inverter

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



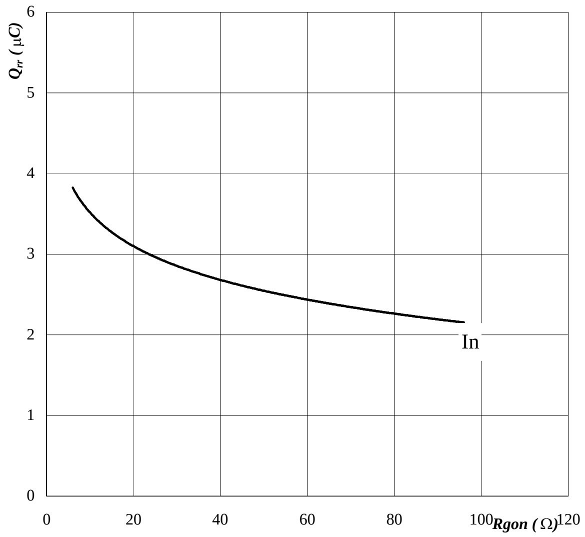
Tj = 125 °C
V_R = 300 V
In= 40 A

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



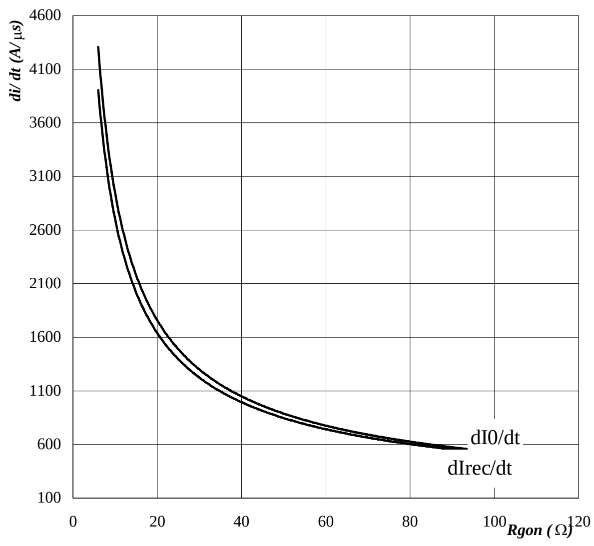
Tj = 125 °C
V_R = 300 V
In= 40 A

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



Tj = 125 °C
V_R = 300 V
In= 40 A

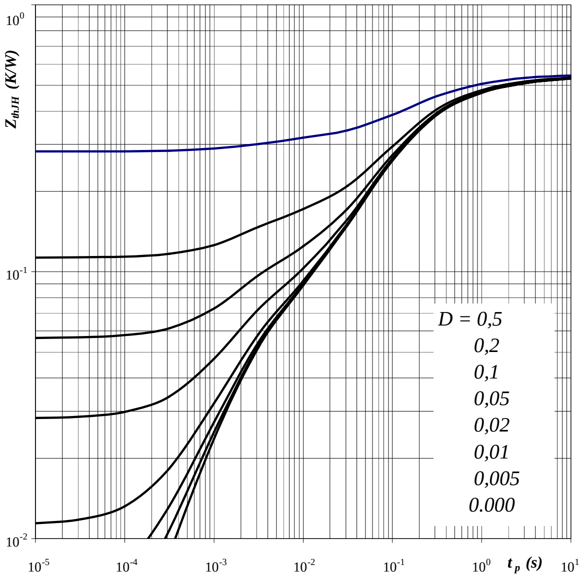
Figure 12. Typical diode peak rate of fall of forward and reverse recovery current as a function of gate resistor
Output inverter FRED diode
di0/dt,dIrec/dt= f (Rgon)



Tj = 125 °C
V_R = 300 V
I_F= 40 A

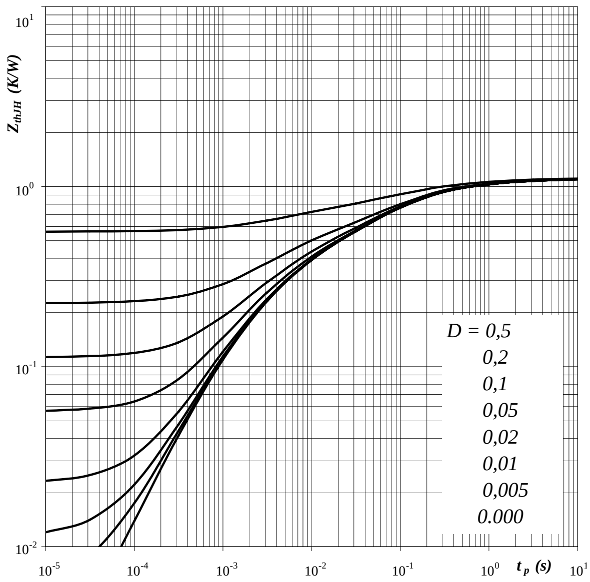
Output inverter

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



Parameter: D = tp / T RthJH 0,54 K/W

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



Parameter: D = tp / T RthJH 1,11 K/W

IGBT thermal model values

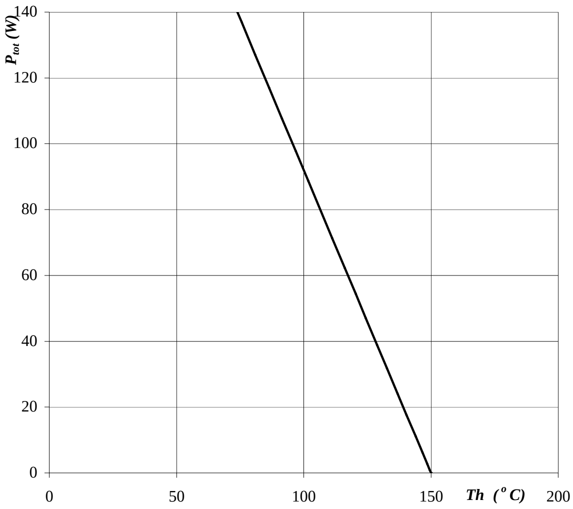
R (C/W)	Tau (s)
0,03	1,5E+02
0,04	6,7E+00
0,10	9,4E-01
0,24	1,7E-01
0,10	4,3E-02

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

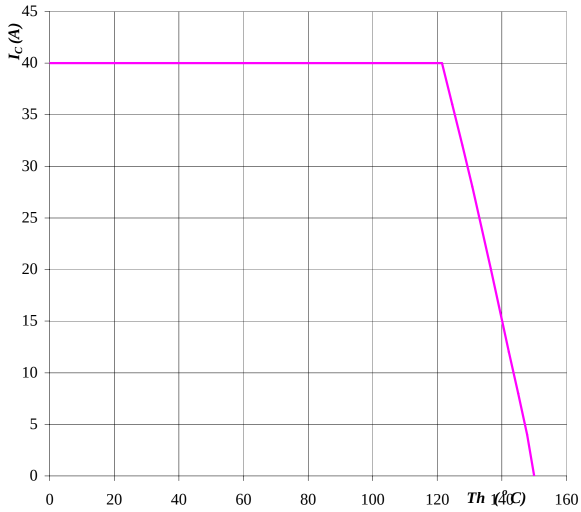
Output inverter

Figure 15. Power dissipation as a function of heatsink temperature
Output inverter IGBT
P_{tot} = f (Th)



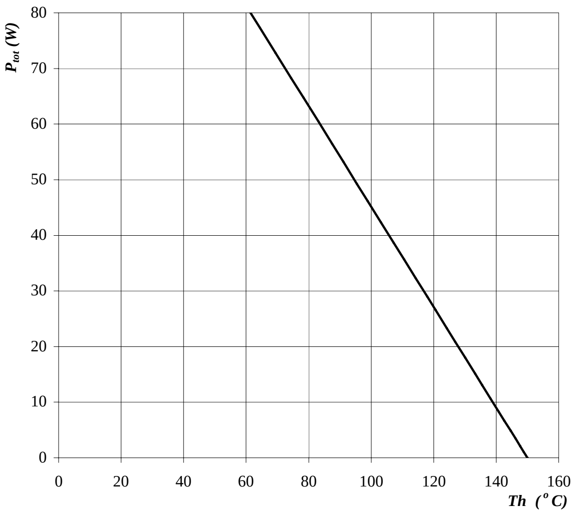
parameter: Tj = 150°C

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



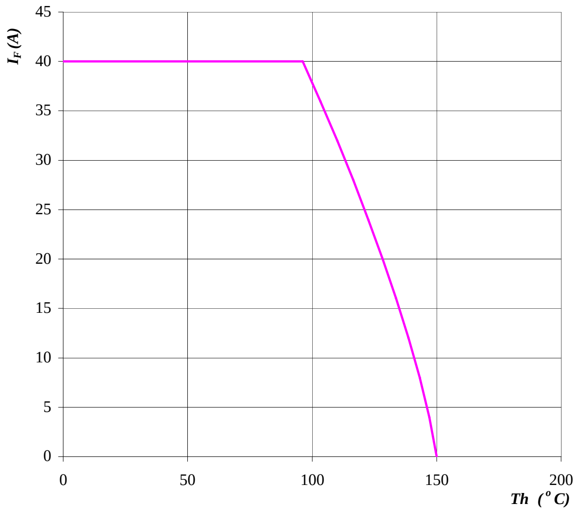
parameter: Tj = 150°C
V_{GE}= 0 V

Figure 17. Power dissipation as a function of heatsink temperature
Output inverter FRED
P_{tot} = f (Th)



parameter: Tj = 150°C

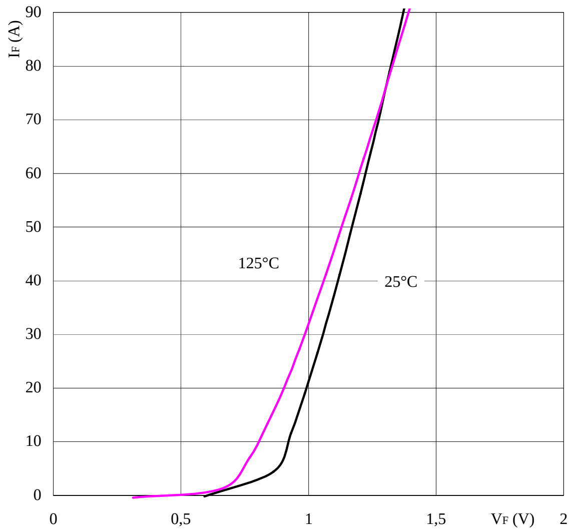
Figure 18. Forward current as a function of heatsink temperature
Output inverter FRED
I_F = f (Th)



parameter: Tj = 150°C

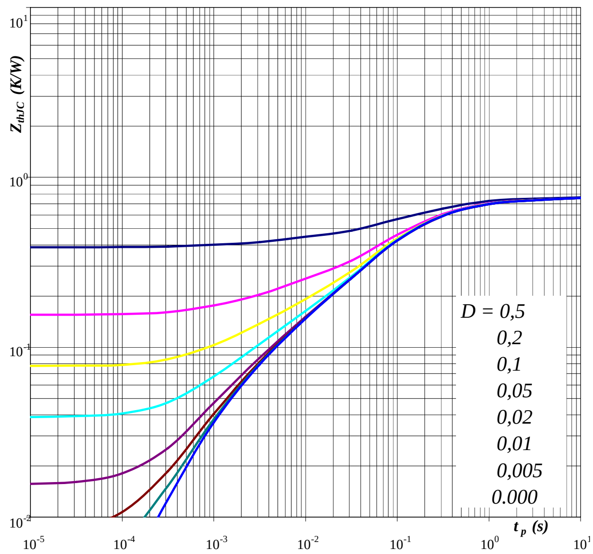
Input rectifier bridge

Figure 19. Typical diode forward current as a function of forward voltage
Rectifier diode $I_F = f(V_F)$



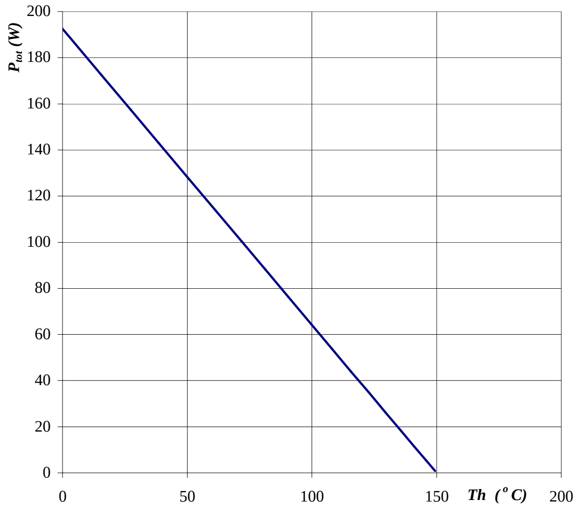
parameter: tp = 250 µs

Figure 20. Diode transient thermal impedance as a function of pulse width
$Z_{thJH} = f(tp)$



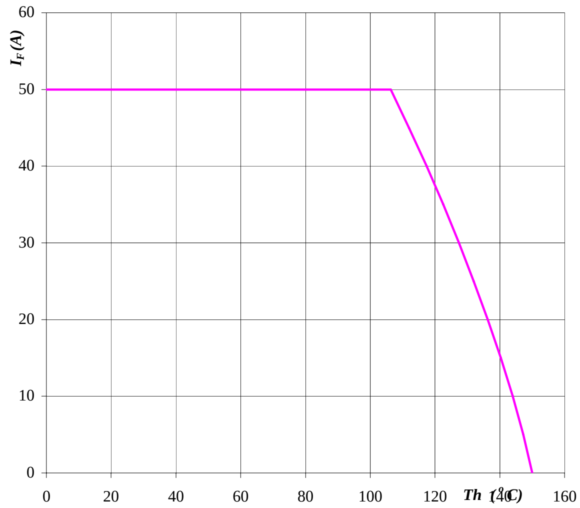
Parameter: D = tp / T RthJH 0,78 K/W

Figure 21. Power dissipation as a function of heatsink temperature
Rectifier diode
$P_{tot} = f\ (Th)$



parameter: Tj = 150°C

Figure 22. Forward current as a function of heatsink temperature
Rectifier diode
$I_F = f\ (Th)$



parameter: Tj = 150°C

Thermistor

Figure 23. **Typical NTC characteristic as a function of temperature**
NTC
$R_T / R_{25} = f(T)$