***flow* PIM® 1, 1200V (trench)**

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 Tc=80°C	I_{FAV}	36 40,limited by nr.of wires	A
Surge forward current Stoßstrom Grenzwert	t_p=10ms	T_j=25°C	I_{FSM}	250	A
I^2t-value Grenzlastintegral	t_p=10ms	T_j=25°C	I^2t	310	A^2s
Power dissipation per Diode Verlustleistung pro Diode	T_j=150°C	T_h=80°C Tc=80°C	P_{tot}	42,5 64	W
Transistor Inverter **Transistor Wechselrichter**					
Collector-emitter break down voltage Kollektor-Emitter-Sperrspannung			V_{CE}	1200	V
DC collector current Kollektor-Dauergleichstrom	T_j=150°C	T_h=80°C Tc=80°C	I_C	23 24,limited by nr. of wires	A
Repetitive peak collector current Periodischer Kollektorspitzenstrom	t_p=1ms	T_h=80°C	I_{cpuls}	46	A
Power dissipation per IGBT Verlustleistung pro IGBT	T_j=150°C	T_h=80°C Tc=80°C	P_{tot}	50,3 76	W
Gate-emitter peak voltage Gate-Emitter-Spitzenspannung			V_{GE}	±20	V
SC withstand time	Tj≤150°C	V_{GE}=15V	t_{SC}	10	us
Diode Inverter **Diode Wechselrichter**					
DC forward current Dauergleichstrom	T_j=150°C	T_h=80°C Tc=80°C	I_F	21,7 24,limited by nr. of wires	A
Repetitive peak forward current Periodischer Spitzenstrom	t_p=1ms	T_h=80°C	I_{FRM}	43,4	A
Power dissipation per Diode Verlustleistung pro Diode	T_j=150°C	T_h=80°C Tc=80°C	P_{tot}	36,4 56,0	W
Transistor BRC **Transistor BRC**					
Collector-emitter break down voltage Kollektor-Emitter-Sperrspannung			V_{CE}	1200	V
DC collector current Kollektor-Dauergleichstrom	T_j=150°C	T_h=80°C Tc=80°C	I_C	16 16,limited by bond wires	A
Repetitive peak collector current Periodischer Kollektorspitzenstrom	t_p=1ms	T_h=80°C	I_{cpuls}	32	A
Power dissipation per IGBT Verlustleistung pro IGBT	T_j=150°C	T_h=80°C Tc=80°C	P_{tot}	42 63,5	W
Gate-emitter peak voltage Gate-Emitter-Spitzenspannung			V_{GE}	±20	V
SC withstand time Kurzschlußverhalten	Tj≤150°C VCE=1200 V	VGE=15V	t_{SC}	10	us

***flow* PIM® 1, 1200V (trench)**

Maximum Ratings / Höchstzulässige Werte

Parameter	Condition		Symbol	Datasheet values	Unit
				max.	
Diode BRC					
Diode BRC					
DC forward current Dauergleichstrom	T_j=150°C	T_h=80°C Tc=80°C	I_F	16,limited by nr. of wires 16,limited by nr. of wires	A
Repetitive peak forward current Periodischer Spitzenstrom	t_p=1ms	T_h=80°C	I_{FRM}	33	A
Power dissipation per Diode Verlustleistung pro Diode	T_j=150°C	T_h=80°C Tc=80°C	P_{tot}	30 46	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

***flow*PIM® 1, 1200V (trench)**

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	V_F	Tj=25°C				30	0,8	1,16	1,35	V
Durchlaßpannung								1,12		
Threshold voltage (for power loss calc. only)	V_{to}	Tj=25°C				30				V
Schleusenspannung								0,91		
Slope resistance (for power loss calc. only)	r_t	Tj=25°C				30				mOhm
Ersatzwiderstand								9		
Reverse current	I_r	Tj=25°C			1500				0,02	mA
Sperrstrom										
Thermal resistance chip to heatsink per chip			Thermal grease							
Wärmewiderstand Chip-Kühlkörper pro Chip	R_{thJH}		thikness≤50um					1,7		K/W
Thermal resistance chip to case per chip			Warmeleitpaste							
Wärmewiderstand Chip-Gehause pro Chip	R_{thJC}		Dicke≤50um λ = 0,61 W/mK					1,1		K/W
Transistor Inverter, inductive load										
Transistor Wechselrichter										
Gate emitter threshold voltage	$V_{GE(th)}$	Tj=25°C	VCE=VGE			0,001	5	5,8	6,5	V
Gate-Schwellenspannung		Tj=125°C								
Collector-emitter saturation voltage	$V_{CE(sat)}$	Tj=25°C		15		25	1,3	1,80	2,25	V
Kollektor-Emitter Sättigungsspannung		Tj=125°C						2,20		
Collector-emitter cut-off incl.FRED	I_{CES}	Tj=25°C		0	1200				0,25	mA
Kollektor-Emitter Reststrom inkl.FRED		Tj=125°C								
Gate-emitter leakage current	I_{GES}	Tj=25°C		25	0				680	nA
Gate-Emitter Reststrom		Tj=150°C								
Integrated Gate resistor	R_{gint}							8		Ohm
Integrirter Gate Widerstand										
Turn-on delay time	$t_{d(on)}$	Tj=25°C		15	600	25				ns
Einschaltverzögerungszeit		Tj=125°C	Rgon=40 Ohm					63		
Rise time	t_r	Tj=25°C		15	600	25				ns
Anstiegszeit		Tj=125°C	Rgon=40 Ohm					28		
Turn-off delay time	$t_{d(off)}$	Tj=25°C		15	600	25				ns
Abschaltverzögerungszeit		Tj=125°C	Rgoff=20 Ohm					722		
Fall time	t_f	Tj=25°C		15	600	25				ns
Fallzeit		Tj=125°C	Rgoff=20 Ohm					258		
Turn-on energy loss per pulse	E_{on}	Tj=25°C		15	600	25				mWs
Einschaltverlustenergie pro Puls		Tj=125°C	Rgon=40 Ohm					2,94		
Turn-off energy loss per pulse	E_{off}	Tj=25°C		15	600	25				mWs
Abschaltverlustenergie pro Puls		Tj=125°C	Rgoff=20 Ohm					3,5		
Input capacitance	C_{ies}	Tj=25°C	f=1MHz	0	25			1,86		nF
Eingangskapazität		Tj=125°C								
Output capacitance	C_{oss}	Tj=25°C	f=1MHz	0	25			0,096		nF
Ausgangskapazität		Tj=125°C								
Reverse transfer capacitance	C_{rss}	Tj=25°C	f=1MHz	0	25			0,082		nF
Rückwirkungskapazität		Tj=125°C								
Gate charge	Q_{Gate}	Tj=25°C		15	960	25		155		nC
Gate Ladung		Tj=125°C								
Thermal resistance chip to heatsink per chip			Thermal grease							
Wärmewiderstand Chip-Kühlkörper pro Chip	R_{thJH}		thikness≤50um					1,4		K/W
Thermal resistance chip to case per chip			Warmeleitpaste							
Wärmewiderstand Chip-Gehause pro Chip	R_{thJC}		Dicke≤50um λ = 0,61 W/mK					0,9		K/W

***flow*PIM® 1, 1200V (trench)**

Characteristic values

Description	Symbol	Conditions					Datasheet values			Unit
		T(C°)	Other conditions (Rgon-Rgoff)	VGE(V) VGS(V)	V_R(V) VCE(V) VDS(V)	Ic(A) IF(A) Id(A)	Min	Typ	Max	
Diode Inverter										
Diode Wechselrichter										
Diode forward voltage	V_F	Tj=25°C				25	1	1,8	2,25	V
Durchlaßspannung		Tj=125°C						1,78		
Peak reverse recovery current	I_{RRM}	Tj=25°C		15	600	25				A
Rückstromspitze		Tj=125°C	Rgon=40 Ohm					35		
Reverse recovery time	t_{rr}	Tj=25°C		15	600	25				ns
Sperreverzögerungszeit		Tj=125°C	Rgon=40 Ohm					448		
Reverse recovered charge	Q_{rr}	Tj=25°C		15	600	25				uC
Sperrverzögerungsladung		Tj=125°C	Rgon=40 Ohm					5,2		
Reverse recovered energy	E_{rec}	Tj=25°C		15	600	25				mWs
Sperrverzögerungsenergie		Tj=125°C	Rgon=40 Ohm					2,04		
Thermal resistance chip to heatsink per chip			Thermal grease							
Wärmewiderstand Chip-Kühlkörper pro Chip	R_{thJH}		thikness≤50um					1,9		K/W
Thermal resistance chip to case per chip			Warmeleitpaste Dicke≤50um λ = 0,61							
Wärmewiderstand Chip-Gehause pro Chip	R_{thJC}		W/mK					1,3		K/W
Transistor BRC										
Transistor BRC										
Gate emitter threshold voltage	$V_{GE(th)}$	Tj=25°C	VCE=VGE			0,0006	5	5,8	6,5	V
Gate-Schwellenspannung		Tj=125°C								
Collector-emitter saturation voltage	$V_{CE(sat)}$	Tj=25°C		15		15	1,3	1,8	2,15	V
Kollektor-Emitter Sättigungsspannung		Tj=125°C						2,1		
Collector-emitter cut-off	I_{CES}	Tj=25°C		0	600				0,1	mA
Kollektor-Emitter Reststrom		Tj=125°C								
Gate-emitter leakage current	I_{GES}	Tj=25°C		25	0				180	nA
Gate-Emitter Reststrom		Tj=150°C								
Turn-on delay time	$t_{d(on)}$	Tj=25°C		15	600	15				ns
Einschaltverzögerungszeit		Tj=125°C	Rgon=46,7 Ohm					33		
Rise time	t_r	Tj=25°C		15	600	15				ns
Anstiegszeit		Tj=125°C	Rgon=46,7 Ohm					21		
Turn-off delay time	$t_{d(off)}$	Tj=25°C		15	600	15				ns
Abschaltverzögerungszeit		Tj=125°C	Rgoff=23,3 Ohm					403		
Fall time	t_f	Tj=25°C		15	600					ns
Fallzeit		Tj=125°C	Rgoff=23,3 Ohm					241		
Turn-on energy loss per pulse	E_{on}	Tj=25°C		15	600					uWs
Einschaltverlustenergie pro Puls		Tj=125°C	Rgon=46,7 Ohm			15		1,3		
Turn-off energy loss per pulse	E_{off}	Tj=25°C		15	600					uWs
Abschaltverlustenergie pro Puls		Tj=125°C	Rgoff=23,3 Ohm			15		1,96		
Input capacitance	C_{iss}	Tj=25°C	f=1MHz	0	25			1,09		nF
Eingangskapazität		Tj=125°C				15				
Output capacitance	C_{oss}	Tj=25°C	f=1MHz	0	25			0,058		nF
Ausgangskapazität		Tj=125°C								
Reverse transfer capacitance	C_{rss}	Tj=25°C	f=1MHz	0	25			0,048		nF
Rückwirkungskapazität		Tj=125°C								
Gate charge	Q_{Gate}	Tj=25°C		15	960	15		85		nC
Gate Ladung		Tj=125°C								
Thermal resistance chip to heatsink per chip			Thermal grease							
Wärmewiderstand Chip-Kühlkörper pro Chip	R_{thJH}		thikness≤50um					1,7		K/W
Thermal resistance chip to case per chip			Warmeleitpaste Dicke≤50um λ = 0,61							
Wärmewiderstand Chip-Gehause pro Chip	R_{thJC}		W/mK					1,1		K/W

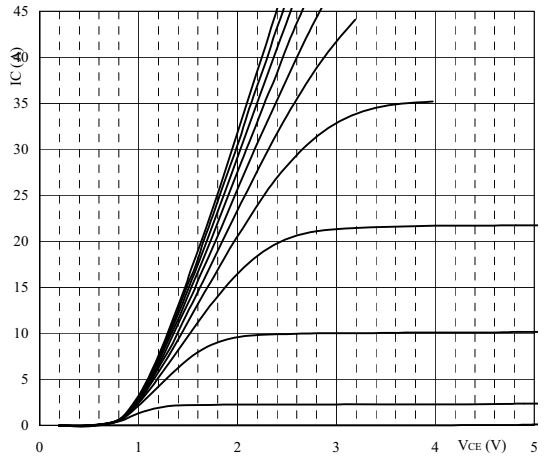
***flow*PIM® 1, 1200V (trench)**

Characteristic values

Description	Symbol	Conditions					Datasheet values			Unit
		T(C°)	Other conditions (Rgon-Rgoff)	VGE(V) VGS(V)	V_R(V) VCE(V) VDS(V)	Ic(A) IF(A) Id(A)	Min	Typ	Max	
Diode BRC										
Diode BRC										
Diode forward voltage Durchlaßspannung	V_F	Tj=25°C Tj=125°C				15	1	1,75 1,75	2,15	V
Reverse current Sperrstrom	I_r	Tj=25°C			1200				250	uA
Peak reverse recovery current Rückstromspitze	I_{RRM}	Tj=25°C Tj=125°C	Rgon=46,7 Ohm	15	600	15		17,5		A
Reverse recovery time Sperreverzögerungszeit	trr	Tj=25°C Tj=125°C	Rgon=46,7 Ohm	15	600	15		400		ns
Reverse recovered charge Sperrverzögerungsladung	Qrr	Tj=25°C Tj=125°C	Rgon=46,7 Ohm	15	600	15		2,5		uC
Reverse recovered energy Sperrverzögerungsenergie	Erec	Tj=25°C Tj=125°C	Rgon=46,7 Ohm	15	600	15		1,0		mWs
Thermal resistance chip to heatsink per chip Wärmewiderstand Chip-Kühlkörper pro Chip	R_{thJH}		Thermal grease thikness≤50um Warmeleitpaste					2,3		K/W
Thermal resistance chip to case per chip Wärmewiderstand Chip-Gehause pro Chip	R_{thJC}		Dicke≤50um λ = 0,61 W/mK					1,5		K/W
NTC-Thermistor										
NTC-Widerstand										
Rated resistance Nennwiderstand	R_{25}	TC=25°C	Tol. ±5%				4,2	4,7	5,3	kOhm
Deviation of R100 Abweichung von R100	$D_{R/R}$	TC=100°C						2,56		%/K
Power dissipation given Epcos-Typ Verlustleistung Epcos-Typ angeben	P	TC=25°C						210		mW
B-value B-Wert	$B_{(25/100)}$		Tol. ±3%					3530		K

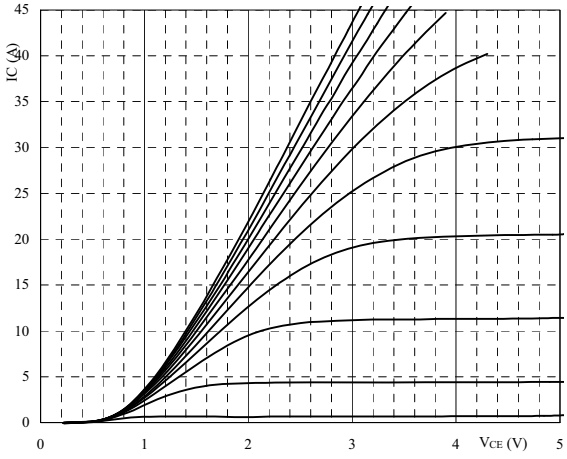
Output inverter

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



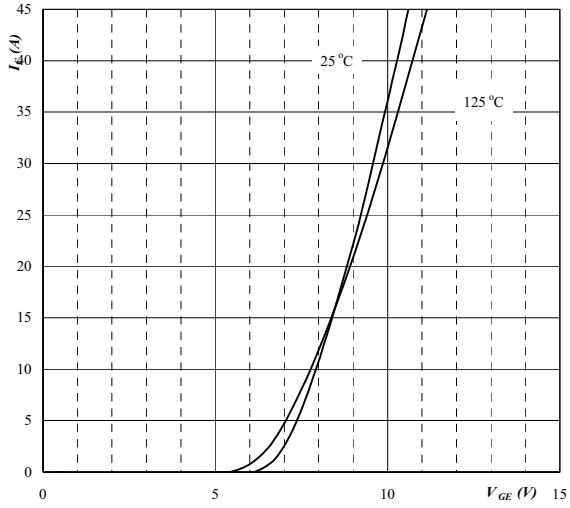
parameter: tp = 250 ms Tj = 25 °C
V_{GE} parameter: from: 6 V to 16 V
in 1 V steps

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



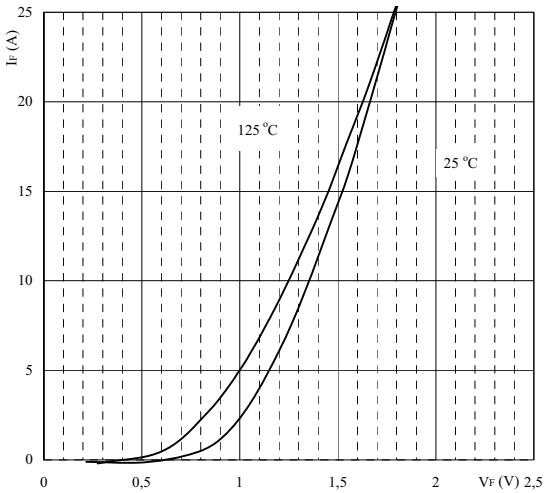
parameter: tp = 250 ms Tj = 125 °C
V_{GE} parameter: from: 6 V to 16 V
in 1 V steps

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



parameter: tp = 250 ms V_{CE} = 7 V

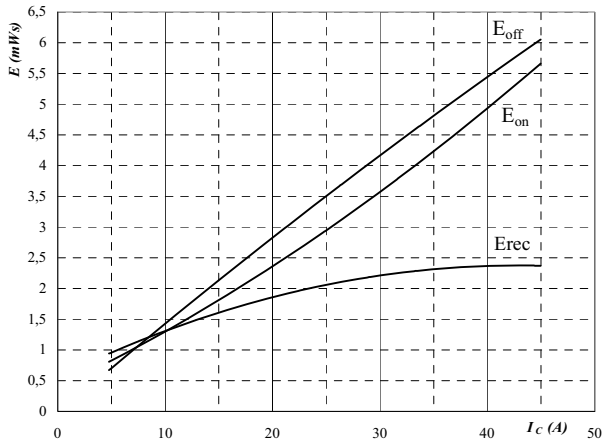
Figure 4. Typical diode forward current as a function of forward voltage
Output inverter FRED IF=f(VF)



parameter: tp = 250 ms

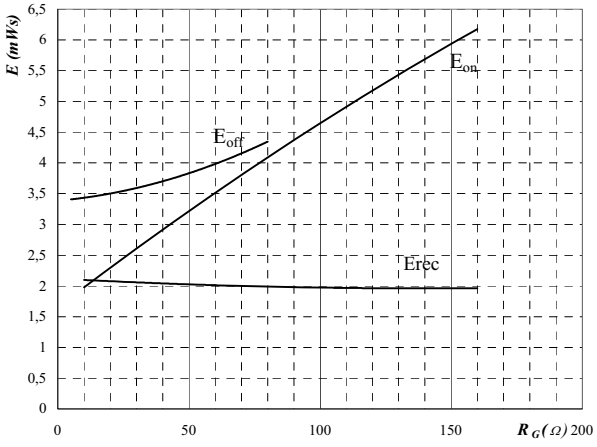
Output inverter

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



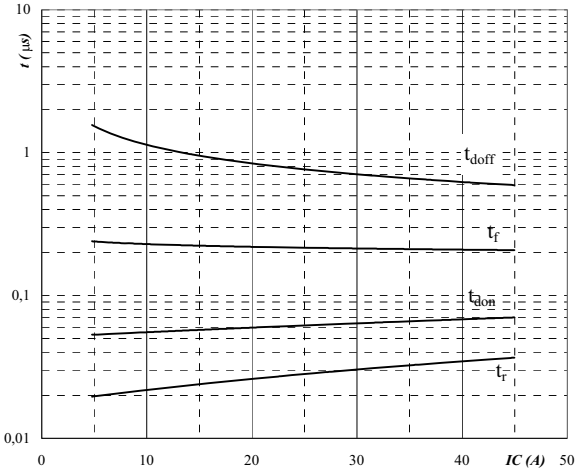
inductive load, Tj = 125 °C
V_{CE} = 600 V
V_{GE} = 15 V
$R_{Gon} = 2*R_{Goff}$ = 40 Ohm

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



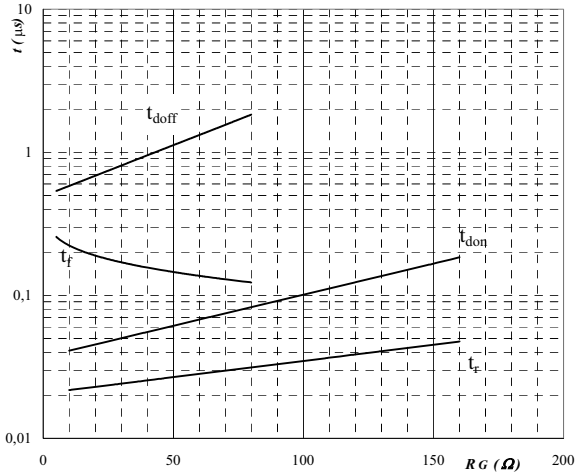
inductive load, Tj = 125 °C
V_{CE} = 600 V
V_{GE} = 15 V
Ic = 25 A

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



inductive load, Tj = 125 °C
V_{CE} = 600 V
V_{GE} = 15 V
$R_{Gon} = 2*R_{Goff}$ = 40 Ohm

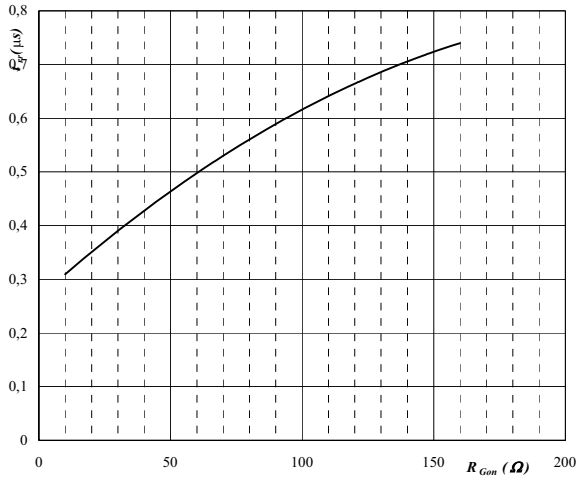
Figure 8. Typical switching times as a function of gate resistor
Output inverter IGBT
t = f (RG)



inductive load, Tj = 125 °C
V_{CE} = 600 V
V_{GE} = 15 V
Ic = 25 A

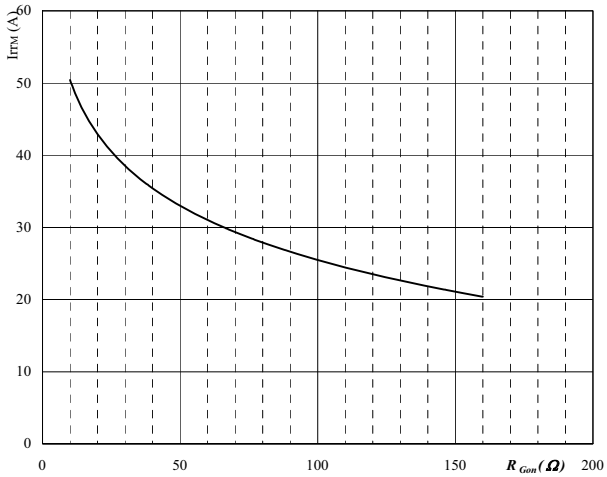
Output inverter

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



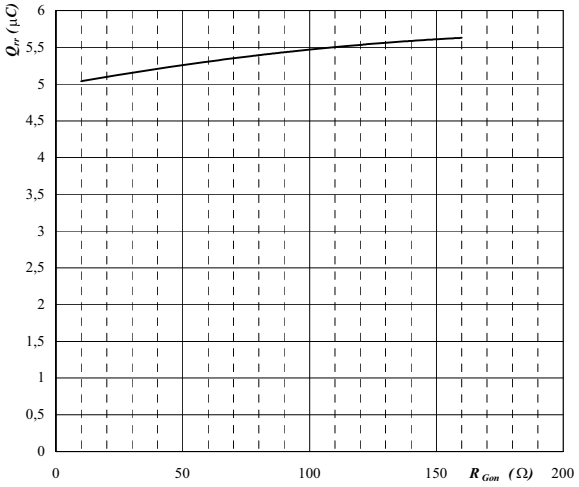
Tj = 125 °C
VR = 600 V
IF= 25 A

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



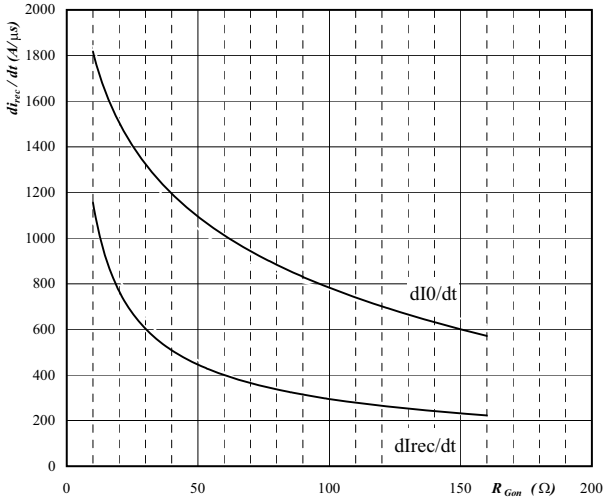
Tj = 125 °C
VR = 600 V
IF= 25 A

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



Tj = 125 °C
VR = 600 V
IF= 25 A

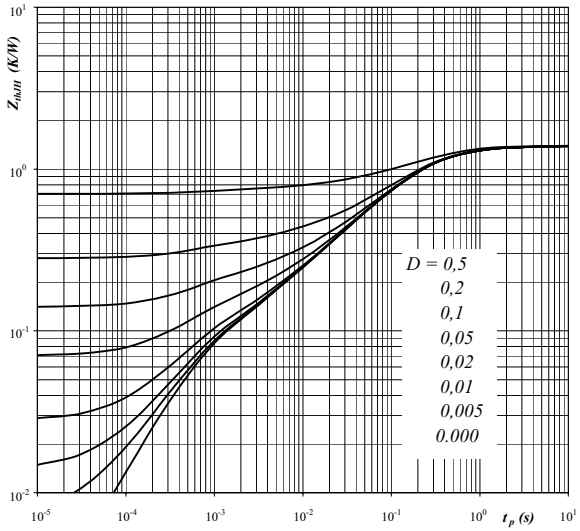
Figure 12. Typical rate of fall of forward and reverse recovery current as a function of IGBT turn on gate resistor
Output inverter FRED diode
dI0/dt,dIrec/dt= f (Rgon)



Tj = 125 °C
VR = 600 V
IF= 25 A

Output inverter

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

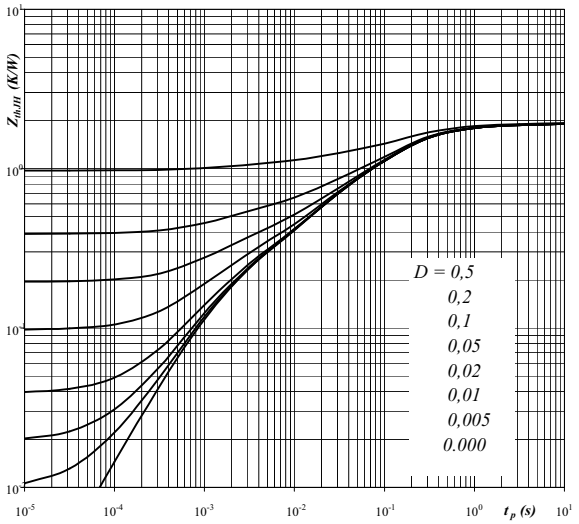


Parameter: D = tp / T RthJH= 1,4 K/W

IGBT thermal model values

R (C/W)	Tau (s)
0,04	1,1E+01
0,15	1,1E+00
0,71	2,1E-01

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



Parameter: D = tp / T RthJH= 1,9 K/W

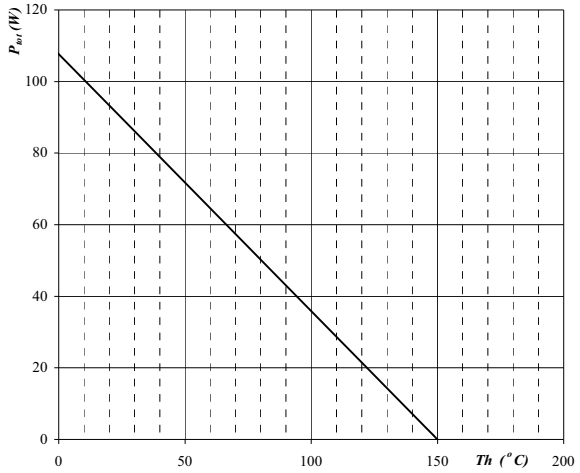
FRED thermal model values

R (C/W)	Tau (s)
0,03	6,2E+01
0,09	3,7E+00
0,41	4,6E-01

Output inverter

Figure 15. Power dissipation as a function of heatsink temperature

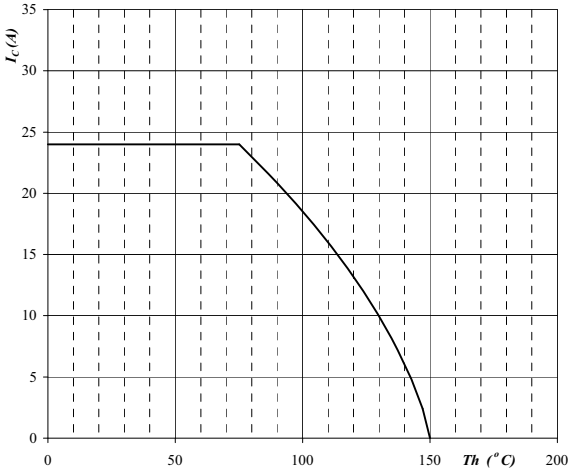
Output inverter IGBT
Ptot = f (Th)



parameter: Tj = 150°C

Figure 16. Collector current as a function of heatsink temperature

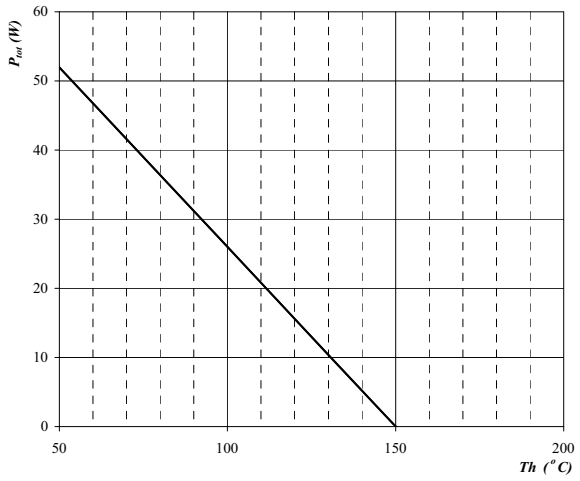
Output inverter IGBT
Ic = f (Th)



parameter: Tj = 150°C
V_{GE}= 15 V

Figure 17. Power dissipation as a function of heatsink temperature

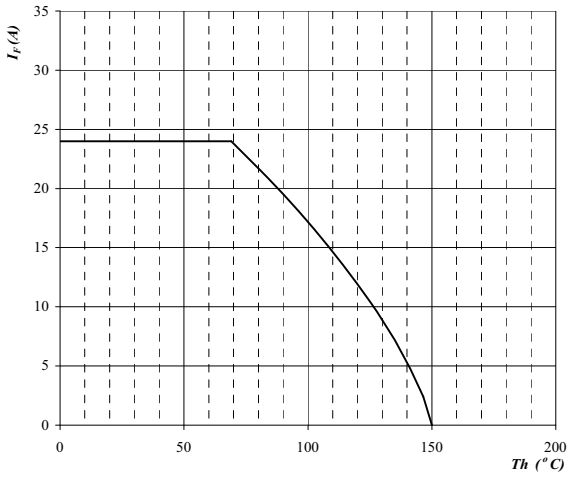
Output inverter FRED
Ptot = f (Th)



parameter: Tj = 150°C

Figure 18. Forward current as a function of heatsink temperature

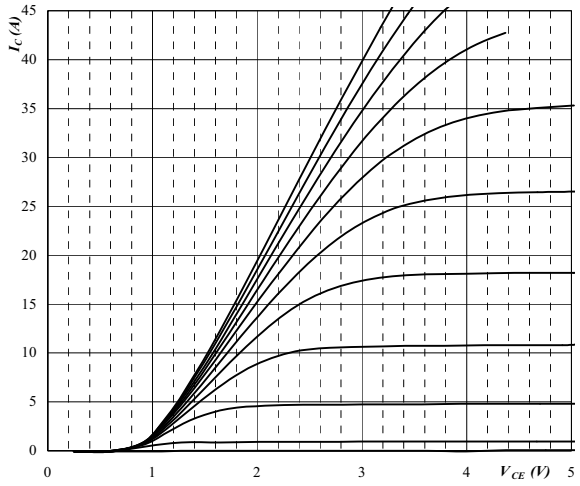
Output inverter FRED
IF = f (Th)



parameter: Tj = 150°C

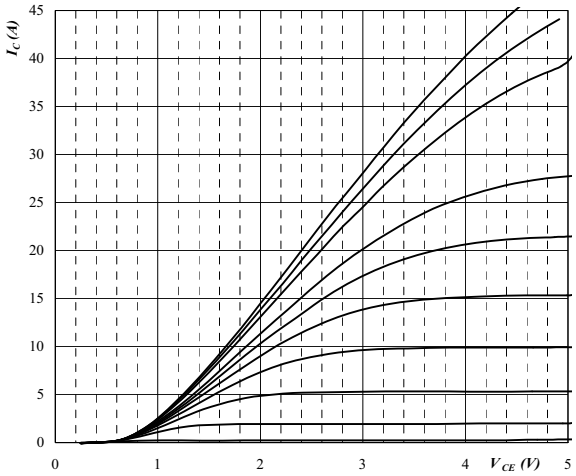
Brake

Figure 19. Typical output characteristics
Brake IGBT
Ic= f(VCE)



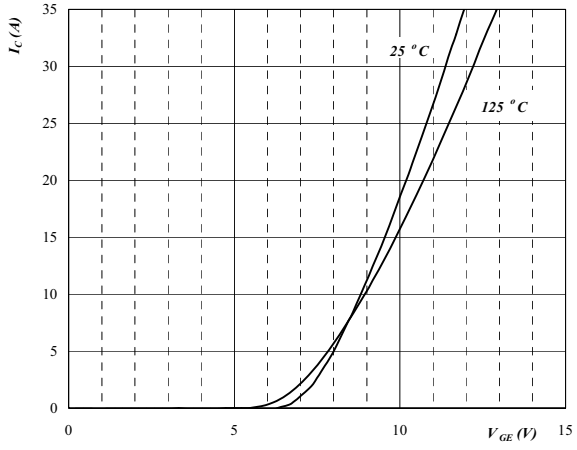
parameter: tp = 250 ms Tj = 25 °C
VGE parameter: from: 6 V to 16 V
in 1 V steps

Figure 20. Typical output characteristics
Brake IGBT
Ic= f(VCE)



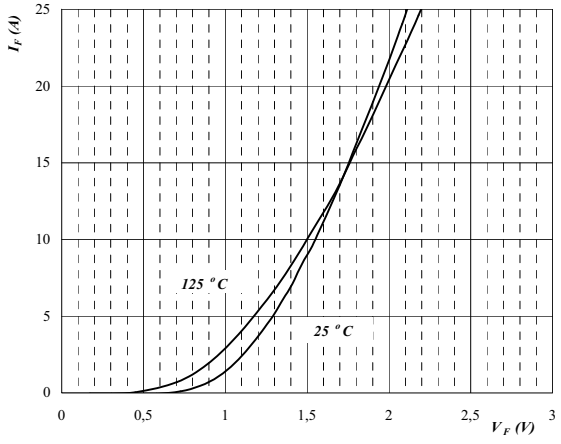
parameter: tp = 250 ms Tj = 125 °C
VGE parameter: from: 6 V to 16 V
in 1 V steps

Figure 21. Typical transfer characteristics
Brake IGBT
Ic= f(VGE)



parameter: tp = 250 ms VCE = 10 V

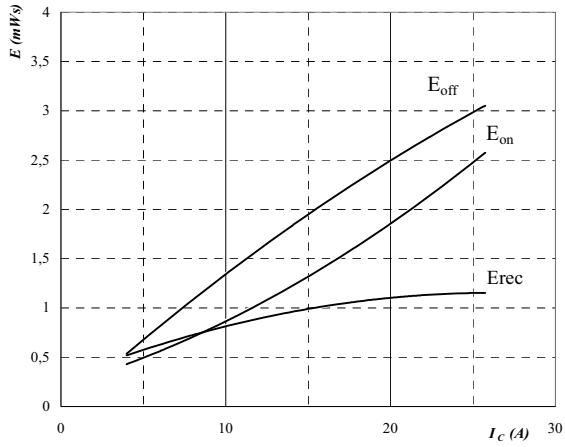
Figure 22. Typical diode forward current as a function of forward voltage
Brake FRED IF=f(VF)



parameter: tp = 250 ms

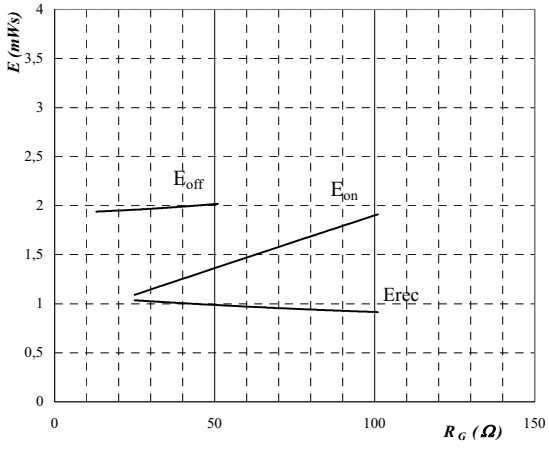
Brake

Figure 23. Typical switching energy losses as a function of collector current
Brake IGBT
E = f (Ic)



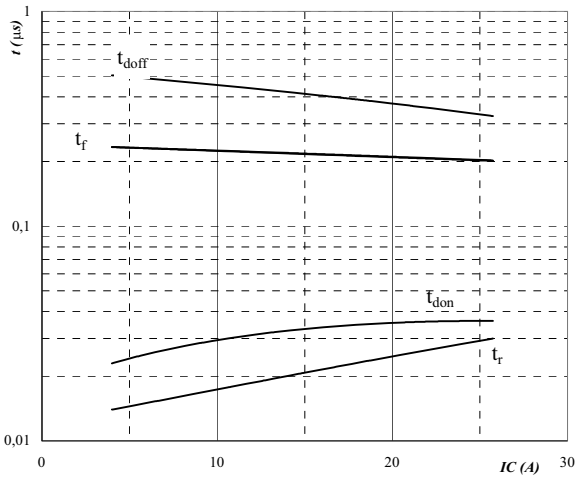
inductive load, Tj = 125 °C
V_{CE} = 600 V
V_{GE} = 15 V
$R_{Gon} = 2*R_{Goff}$ = 46,7 Ohm

Figure 24. Typical switching energy losses as a function of gate resistor
Brake IGBT
E = f (RG)



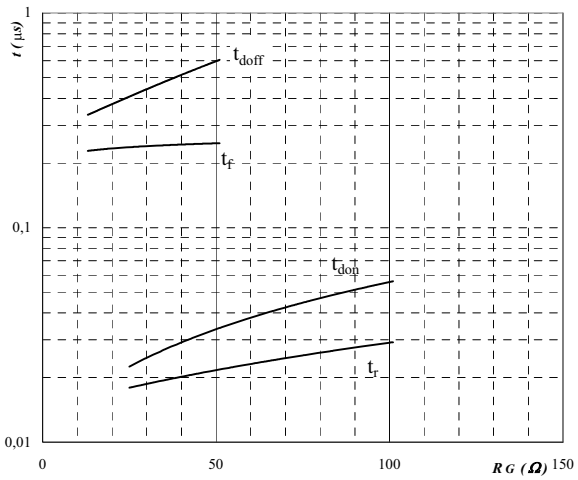
inductive load, Tj = 125 °C
V_{CE} = 600 V
V_{GE} = 15 V
Ic = 15 A

Figure 25. Typical switching times as a function of collector current
Brake IGBT
t = f (Ic)



inductive load, Tj = 125 °C
V_{CE} = 600 V
V_{GE} = 15 V
$R_{Gon} = 2*R_{Goff}$ = 46,7 Ohm

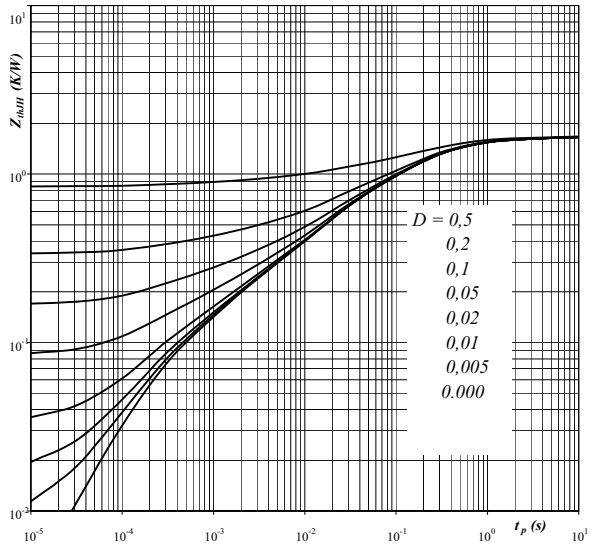
Figure 26. Typical switching times as a function of gate resistor
Brake IGBT
t = f (RG)



inductive load, Tj = 125 °C
V_{CE} = 600 V
V_{GE} = 15 V
Ic = 15 A

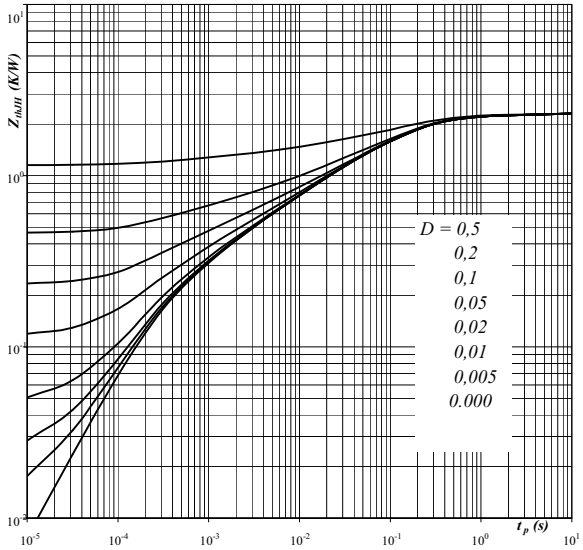
Brake

Figure 27. IGBT transient thermal impedance as a function of pulse width
ZthJH = f(tp)



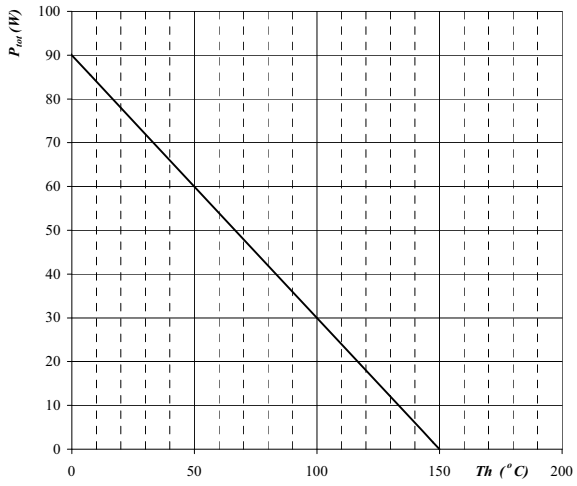
Parameter: D = tp / T RthJH= 1,7 K/W

Figure 28. FRED transient thermal impedance as a function of pulse width
ZthJH = f(tp)



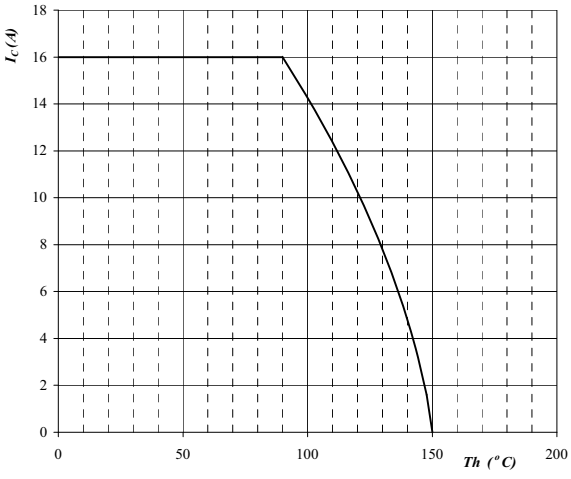
Parameter: D = tp / T RthJH= 2,3 K/W

Figure 29. Power dissipation as a function of heatsink temperature
Brake IGBT
Ptot = f (Th)



parameter: Tj = 150°C

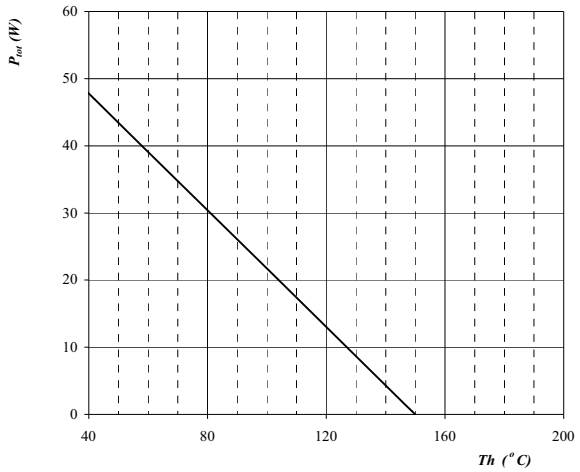
Figure 30. Collector current as a function of heatsink temperature
Brake IGBT
Ic = f (Th)



parameter: Tj = 150°C
V_{GE}= 15 V

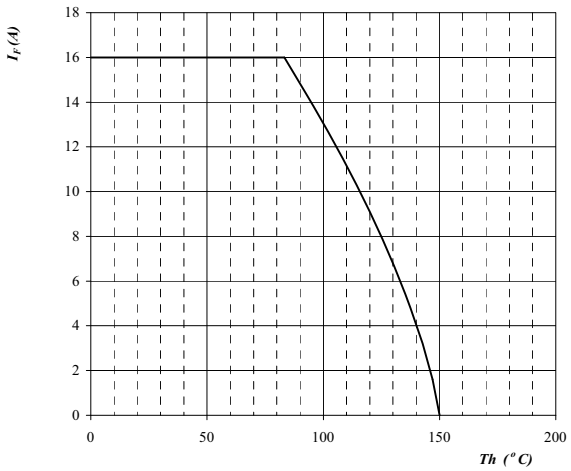
Brake

Figure 31. Power dissipation as a function of heatsink temperature
Brake FRED
Ptot = f (Th)



parameter: Tj = 150°C

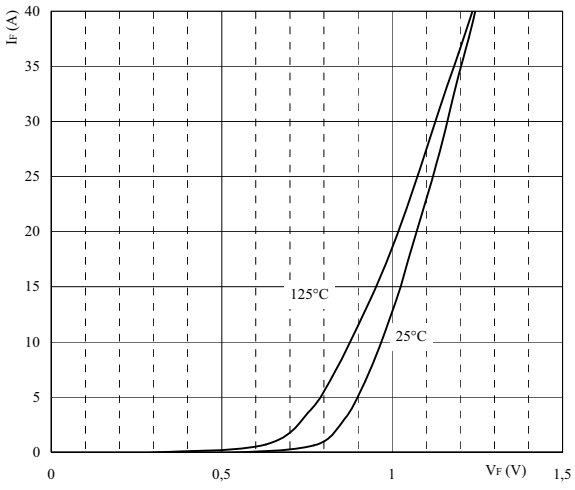
Figure 32. Forward current as a function of heatsink temperature
Brake FRED
IF = f (Th)



parameter: Tj = 150°C

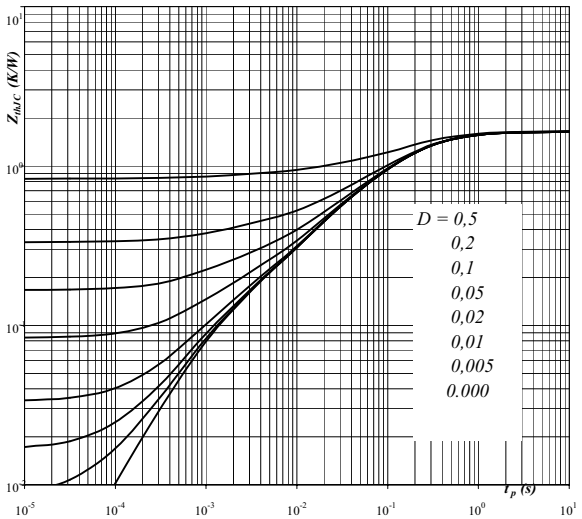
Input rectifier bridge

Figure 33. Typical diode forward current as a function of forward voltage
Rectifier diode IF=f(VF)



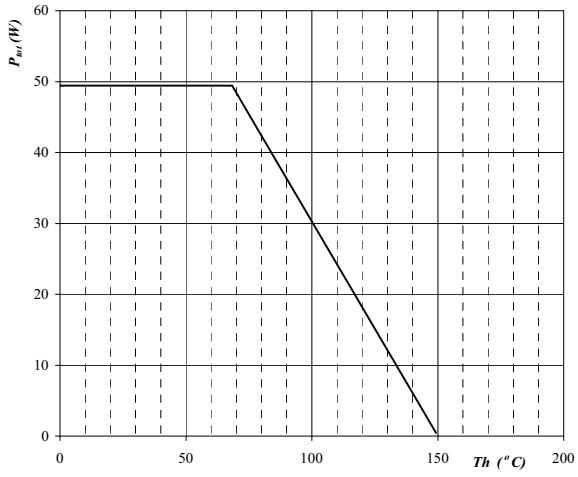
parameter: tp = 250 ms

Figure 34. Diode transient thermal impedance as a function of pulse width
ZthJH = f(tp)



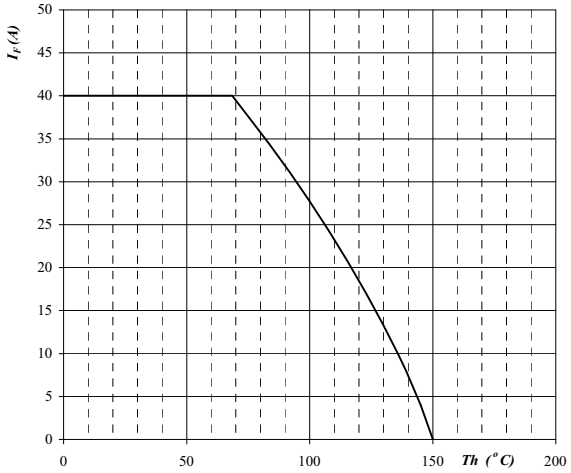
Parameter: D = tp / T RthJH= 1,7 K/W

Figure 35. Power dissipation as a function of heatsink temperature
Rectifier diode
Ptot = f (Th)



parameter: Tj = 150°C

Figure 36. Forward current as a function of heatsink temperature
Rectifier diode
IF = f (Th)



parameter: Tj = 150°C

Thermistor

Figure 37. Typical NTC characteristic as a function of temperature

$R_T = f(T)$