flow 90PIM 1 600V/15A V23990-P633-A-02-14

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; Tc=80°C	I_{FAV}	30 30	A
Surge forward current Stoßstrom Grenzwert	t_p=10ms	T_j=25°C	I_{FSM}	200	A
I^2t-value Grenzlastintegral	t_p=10ms	T_j=25°C	I^2t	200	A2s
Power dissipation per Diode Verlustleistung pro Diode	T_j=150°C	T_h=80°C T_c=80°C	P_{tot}	40 60	W
max. Chip temperature max. Chiptemperatur			T_{jmax}	**150**	°C
Transistor Inverter **Transistor Wechselrichter**					
Collector-emitter break down voltage Kollektor-Emitter-Sperrspannung			V_{CE}	600	V
DC collector current Kollektor-Dauergleichstrom	T_j=175°C	T_h=80°C, T_c=80°C	I_C	19 20	A
Repetitive peak collector current Periodischer Kollektorspitzenstrom	tp limited by Tj max		I_{cpuls}	45	A
Power dissipation per IGBT Verlustleistung pro IGBT	T_j=175°C	T_h=80°C T_c=80°C	P_{tot}	40 60	W
Gate-emitter peak voltage Gate-Emitter-Spitzenspannung			V_{GE}	±20	V
SC withstand time* Kurzschlußverhalten*	Tj≤150°C V_{CC}=360V	V_{GE}=15V	t_{SC}	6	us
max. Chip temperature max. Chiptemperatur			T_{jmax}		
Diode Inverter **Diode Wechselrichter**					
DC forward current Dauergleichstrom	T_j=175°C	T_h=80°C, T_c=80°C	I_F	18 20	A
Repetitive peak forward current Periodischer Spitzenstrom	tp limited by Tj max		I_{FRM}	45	A
Power dissipation per Diode Verlustleistung pro Diode	T_j=175°C	T_h=80°C T_c=80°C	P_{tot}	32 49	W
max. Chip temperature max. Chiptemperatur			T_{jmax}	**175**	°C

***flow* 90PIM 1 600V/15A**

V23990-P633-A-02-14

Maximum Ratings / Höchstzulässige Werte

Parameter	Condition		Symbol	Datasheet values max.	Unit
Transistor BRC **Transistor Wechselrichter**					
Collector-emitter break down voltage Kollektor-Emitter-Sperrspannung			V_{CE}	600	V
DC collector current Kollektor-Dauergleichstrom	T_j=150°C T_j=150°C	T_h=80°C	I_C	10 10	A
Repetitive peak collector current Periodischer Kollektorspitzenstrom	t_p=1ms	T_h=80°C	I_{cpuls}	30	A
Power dissipation per IGBT Verlustleistung pro IGBT	T_j=150°C	T_h=80°C	P_{tot}	35 42	W
Gate-emitter peak voltage Gate-Emitter-Spitzenspannung			V_{GE}	±20	V
SC withstand time Kurzschlußverhalten	Tj≤150°C VCE=600/1200 V	VGE=15V	t_{SC}	6	us
max. Chip temperature max. Chiptemperatur			T_{jmax}	**175**	°C
Diode BRC **Diode BRC**					
DC forward current Dauergleichstrom	T_j=150°C T_j=150°C	T_h=80°C	I_F	10 10	A
Repetitive peak forward current Periodischer Spitzenstrom	t_p=1ms	T_h=80°C	I_{FRM}	30	A
Power dissipation per Diode Verlustleistung pro Diode	T_j=150°C	T_h=80°C	P_{tot}	31 36	W
max. Chip temperature max. Chiptemperatur			T_{jmax}	**175**	°C
Thermal properties **Thermische Eigenschaften**					
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

Additional notes and remarks: ** Allowed number of short circuits must be less than 1000 times, and time duration between short circuits should be more than 1 second!*

Characteristic values/ Charateristische Werte

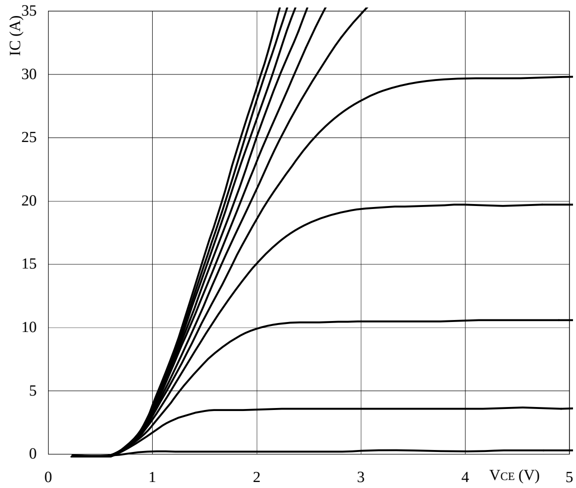
Description	Symbol	Conditions T(C°)	Other conditions (Rgon-Rgoff)	VGE(V) VGS(V)	VCE(V) VDS(V)	IC(A) IF(A) Id(A)	Datasheet values Min	Typ	Max	Unit
Input Rectifier Bridge Gleichrichter										
Forward voltage Durchlaßpannung	V_F	Tj=25°C Tj=125°C				30		1,22 1,18	1,5	V
Threshold voltage (for power loss calc. only) Schleusenspannung	V_{to}	Tj=25°C Tj=125°C				30		0,91 0,81		V
Slope resistance (for power loss calc. only) Ersatzwiderstand	r_t	Tj=25°C Tj=125°C				30		0,011 0,012		Ohm
Reverse current Sperrstrom	I_r	Tj=25°C Tj=150°C			1500				0,01	mA
Thermal resistance chip to heatsink per chip Wärmewiderstand Chip-Kühlkörper pro Chip	R_{thJH}		Thermal grease thickness≤50um					1,75		K/W
Thermal resistance chip to case per chip Wärmewiderstand Chip-Gehause pro Chip	R_{thJC}		Warmeleitpaste Dicke≤50um λ = 0,61 W/mK					1,155		
Transistor Inverter Transistor Wechselrichter										
Gate emitter threshold voltage Gate-Schwellenspannung	$V_{GE(th)}$	Tj=25°C Tj=125°C	VCE=VGE			0,00021	4,5	5,8	7	
Collector-emitter saturation voltage Kollektor-Emitter Sättigungsspannung	$V_{CE(sat)}$	Tj=25°C Tj=125°C		15		15		1,52 1,7	2,1	V
Collector-emitter cut-off Kollektor-Emitter Reststrom	I_{CES}	Tj=25°C Tj=125°C		0	600				0,11	mA
Gate-emitter leakage current Gate-Emitter Reststrom	I_{GES}	Tj=25°C Tj=125°C		20	0				350	nA
Integrated Gate resistor Integrirter Gate Widerstand	R_{gint}							none		Ohm
Turn-on delay time Einschaltverzögerungszeit	$t_{d(on)}$	Tj=25°C Tj=125°C	Rgoff=8 Ω Rgon=16 Ω	15	300	15		15		ns
Rise time Anstiegszeit	t_r	Tj=25°C Tj=125°C	Rgoff=8 Ω Rgon=16 Ω	15	300	15		15		ns
Turn-off delay time Abschaltverzögerungszeit	$t_{d(off)}$	Tj=25°C Tj=125°C	Rgoff=8 Ω Rgon=16 Ω	15	300	15		156		ns
Fall time Fallzeit	t_f	Tj=25°C Tj=125°C	Rgoff=8 Ω Rgon=16 Ω	15	300	15		91		ns
Turn-on energy loss per pulse Einschaltverlustenergie pro Puls	E_{on}	Tj=25°C Tj=125°C	Rgoff=8 Ω Rgon=16 Ω	15	300	15		0,318		mWs
Turn-off energy loss per pulse Abschaltverlustenergie pro Puls	E_{off}	Tj=25°C Tj=125°C	Rgoff=8 Ω Rgon=16 Ω	15	300	15		0,41		mWs
SC withstand time Kurzschlußverhalten	t_{SC}									us
Input capacitance Eingangskapazität	C_{ies}	Tj=25°C Tj=125°C	f=1MHz	0	25			0,86		nF
Output capacitance Ausgangskapazität	C_{oss}	Tj=25°C Tj=125°C	f=1MHz	0	25			0,055		nF
Reverse transfer capacitance Rückwirkungskapazität	C_{rss}	Tj=25°C Tj=125°C	f=1MHz	0	25			0,024		nF
Gate charge Gate Ladung	Q_{Gate}	Tj=25°C Tj=125°C						tbd		nC
Thermal resistance chip to heatsink per chip Wärmewiderstand Chip-Kühlkörper pro Chip	R_{thJH}		Thermal grease thickness≤50um					2,4		K/W
Thermal resistance chip to case per chip Wärmewiderstand Chip-Gehause pro Chip	R_{thJC}		Warmeleitpaste Dicke≤50um λ = 0,61 W/mK					0,63		K/W
Diode Inverter Diode Wechselrichter										
Diode forward voltage Durchlaßpannung	V_F	Tj=25°C Tj=125°C				10		1,79 1,68	2,1	V
Peak reverse recovery current Rückstromspitze	I_{RM}	Tj=25°C Tj=125°C	diF/dt = 436 A/us	0	300	10		13,25		A
Reverse recovery time Sperreverzögerungszeit	t_{rr}	Tj=25°C Tj=125°C	diF/dt = 436 A/us	0	300	10		231		ns
Reverse recovered charge Sperrverzögerungsladung	Q_{rr}	Tj=25°C Tj=125°C	diF/dt = 436 A/us	0	300	10		1,05		uC
Reverse recovered energy Sperrverzögerungsenergie	Erec	Tj=25°C Tj=125°C	diF/dt = 436 A/us	0	300	10		0,222		mWs
Thermal resistance chip to heatsink per chip Wärmewiderstand Chip-Kühlkörper pro Chip	R_{thJH}		Thermal grease thickness≤50um					2,94		K/W
Thermal resistance chip to case per chip Wärmewiderstand Chip-Gehause pro Chip	R_{thJC}		Warmeleitpaste Dicke≤50um λ = 0,61 W/mK					1,03		K/W

Characteristic values/ Charateristische Werte

Description	Symbol	Conditions T(C°)	Other conditions (Rgon-Rgoff)	VGE(V) VGS(V)	VCE(V) VDS(V)	IC(A) IF(A) Id(A)	Datasheet values Min	Typ	Max	Unit
Transistor BRC **Transistor BRC**										
Gate emitter threshold voltage Gate-Schwellenspannung	$V_{GE(th)}$	Tj=25°C Tj=125°C	VCE=VGE			0,00015	4,5	5,8	7	V
Collector-emitter saturation voltage Kollektor-Emitter Sättigungsspannung	$V_{CE(sat)}$	Tj=25°C Tj=125°C		15		10		1,52 1,7	2,1	V
Collector-emitter cut-off Kollektor-Emitter Reststrom	I_{CES}	Tj=25°C Tj=125°C		0	600				0,03	mA
Gate-emitter leakage current Gate-Emitter Reststrom	I_{GES}	Tj=25°C Tj=125°C		20	0				350	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=32Ω Rgoff=16Ω	15	300	10		 16,3		ns
Rise time Anstiegszeit	t_r	Tj=25°C Tj=125°C	Rgon=32Ω Rgoff=16Ω	15	300	10		 16,7		ns
Turn-off delay time Abschaltverzögerungszeit	$t_{d(off)}$	Tj=25°C Tj=125°C	Rgon=32Ω Rgoff=16Ω	15	300	10		 172,5		ns
Fall time Fallzeit	t_f	Tj=25°C Tj=125°C	Rgon=32Ω Rgoff=16Ω	15	300	10		 115,2		ns
Turn-on energy loss per pulse Einschaltverlustenergie pro Puls	E_{on}	Tj=25°C Tj=125°C	Rgon=32Ω Rgoff=16Ω	15	300	10		 0,25		uWs
Turn-off energy loss per pulse Abschaltverlustenergie pro Puls	E_{off}	Tj=25°C Tj=125°C	Rgon=32Ω Rgoff=16Ω	15	300	10		 0,3		uWs
SC withstand time Kurzschlußverhalten	t_{SC}									us
Input capacitance Eingangskapazität	C_{iss}	Tj=25°C Tj=125°C	f=1MHz	0	25			0,551		nF
Output capacitance Ausgangskapazität	C_{oss}	Tj=25°C Tj=125°C	f=1MHz	0	25			0,04		nF
Reverse transfer capacitance Rückwirkungskapazität	Cies	Tj=25°C Tj=125°C	f=1MHz	0	25			0,017		nF
Gate charge Gate Ladung	Qgate	Tj=25°C Tj=125°C						tbd		nC
Thermal resistance chip to heatsink per chip	R_{thJH}		Thermal grease thickness≤50um					2,74		K/W
Wärmewiderstand Chip-Kühlkörper pro Chip			Warmeleitpaste Dicke≤50um λ = 0,61 W/mK					1,8084		
Diode BRC **Diode BRC**										
Diode forward voltage Durchlaßspannung	V_F	Tj=25°C Tj=125°C				10		1,61 1,53	2,2	V
Reverse current Sperrstrom	I_r	Tj=25°C Tj=125°C	Rgon=32Ω	15	600	10			0,06	uA
Reverse recovery time Sperreverzögerungszeit	t_{rr}	Tj=25°C Tj=125°C	Rgon=32Ω	15	300	10		 265,8		ns
Reverse recovered charge Sperrverzögerungsladung	Q_{rr}	Tj=25°C Tj=125°C	Rgon=32Ω	15	300	10		 0,8		uC
Reverse recovery energy Sperrverzögerungsenergie	E_{rec}	Tj=25°C Tj=125°C	Rgon=32Ω	15	300	10				uWs
Thermal resistance chip to heatsink per chip	R_{thJH}		Thermal grease thickness≤50um					3,07		K/W
Wärmewiderstand Chip-Kühlkörper pro Chip			Warmeleitpaste Dicke≤50um λ = 0,61 W/mK							
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=1503Ω					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

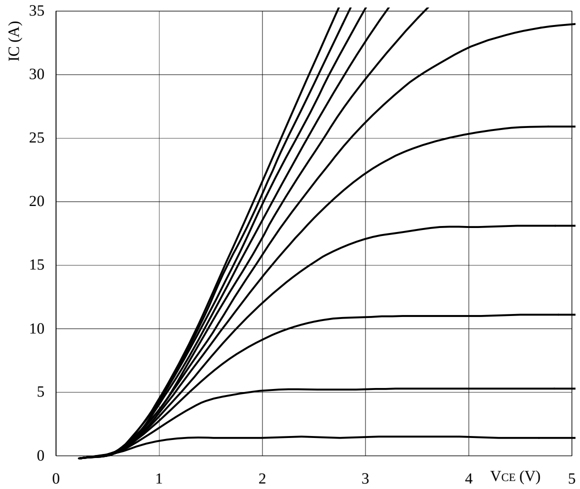
Output inverter

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



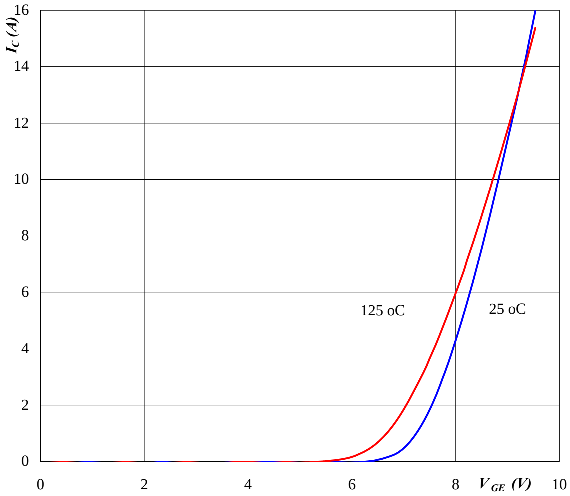
parameter: tp = 250 us Tj = 25 °C
VGE parameter: from: 7 V to 17 V
in 1 V steps

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



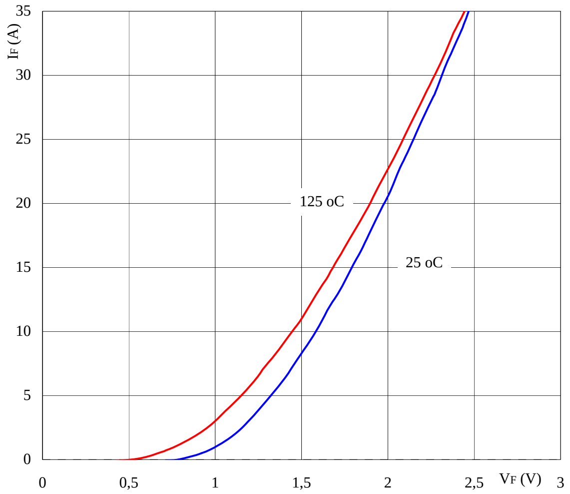
parameter: tp = 250 us Tj = 125 °C
VGE parameter: from: 7 V to 17 V
in 1 V steps

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



parameter: tp = 250 us VCE = 10 V

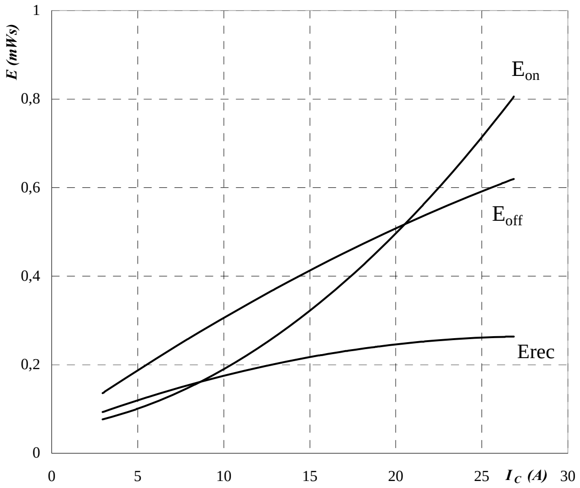
Figure 4. Typical diode forward current as a function of forward voltage
Output inverter FRED IF=f(VF)



parameter: tp = 250 us

Output inverter

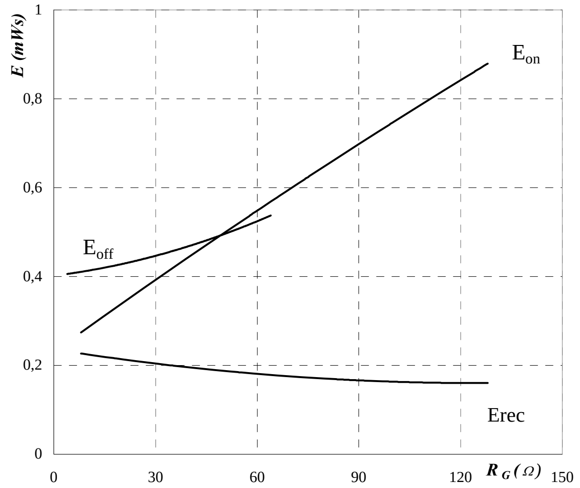
Figure 5. Typical switching energy losses as a function of collector current
Output inverter IGBT
E = f (Ic)



inductive load, Tj = 125 °C

V_{CE} =	300 V
V_{GE}=	15 V
Rgon=	16 Ω
Rgoff=	8 Ω

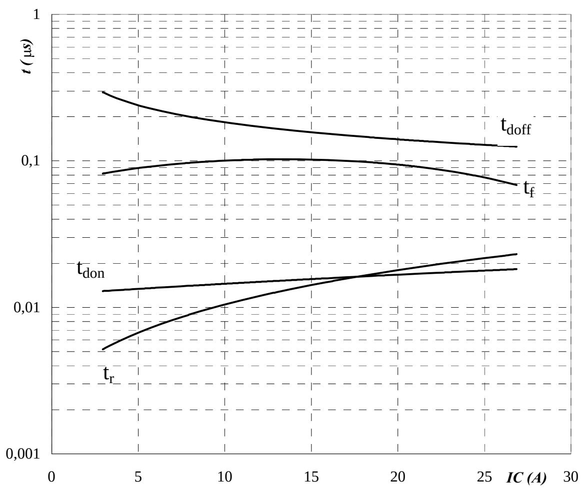
Figure 6. Typical switching energy losses as a function of gate resistor
Output inverter IGBT
E = f (R_G)



inductive load, Tj = 125 °C

V_{CE} =	300 V
V_{GE}=	15 V
Ic =	15 A

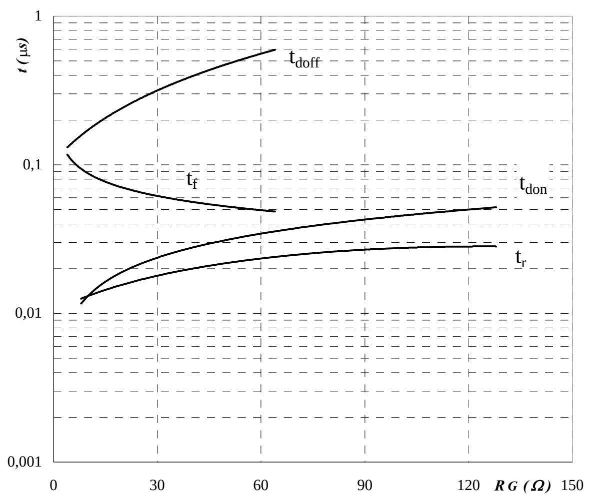
Figure 7. Typical switching times as a function of collector current
Output inverter IGBT
t = f (Ic)



inductive load, Tj = 125 °C

V_{CE} =	300 V
V_{GE}=	15 V
Rgon=	16 Ω
Rgoff=	8 Ω

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

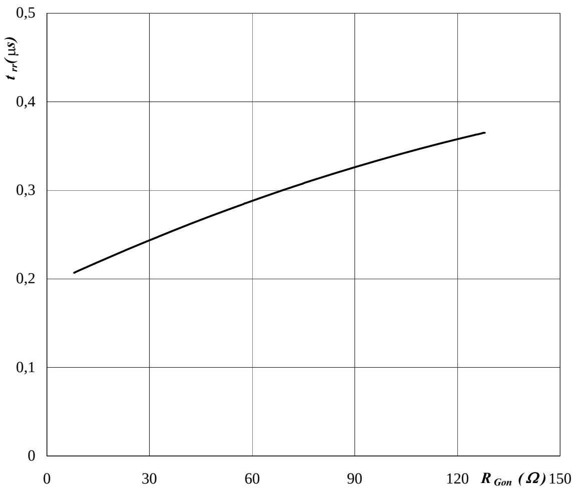


inductive load, Tj = 125 °C

V_{CE} =	300 V
V_{GE}=	15 V
Ic =	15 A

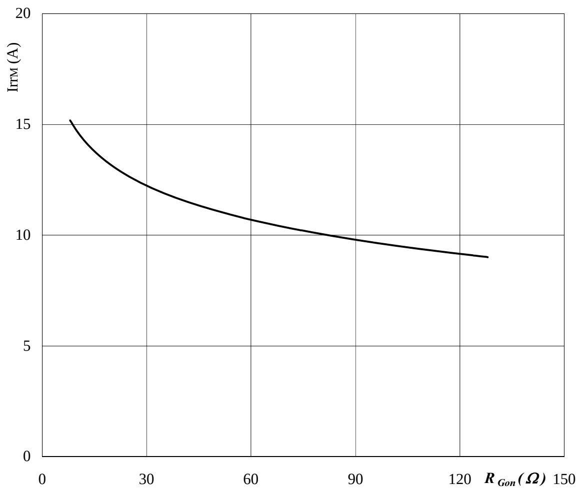
Output inverter

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



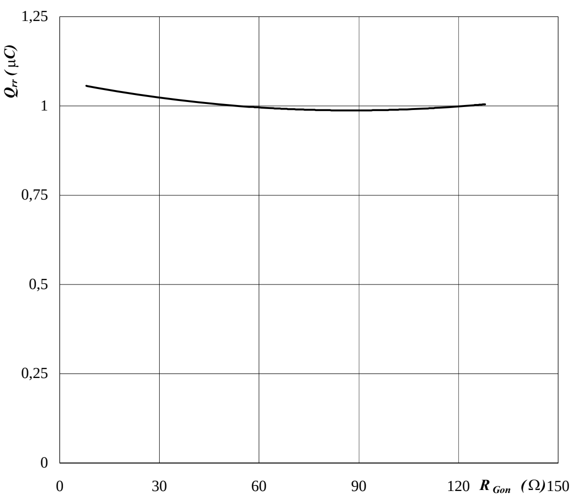
Tj =	125 °C
V_R =	300 V
I_F=	15 A
V_{GE}=	15 V

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



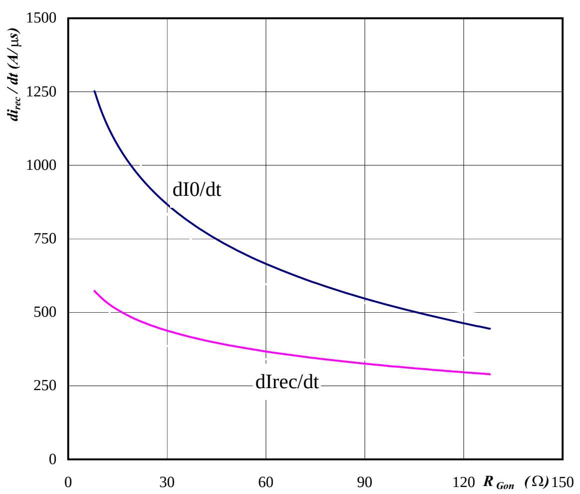
Tj =	125 °C
V_R =	300 V
I_F=	15 A
V_{GE}=	15 V

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



Tj =	125 °C
V_R =	300 V
I_F=	15 A
V_{GE}=	15 V

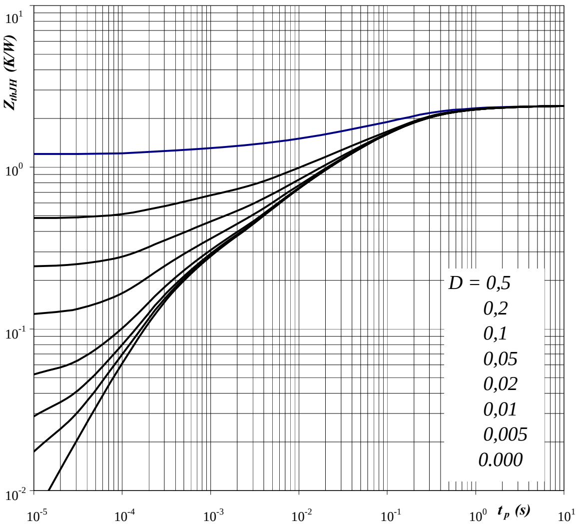
Figure 12. Typical rate of fall of forward and reverse recovery current as a function of IGBT turn on gate resistor
Output inverter FRED diode
dI0/dt,dIrec/dt= f (Rgon)



Tj =	125 °C
V_R =	300 V
I_F=	15 A
V_{GE}=	15 V

Output inverter

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

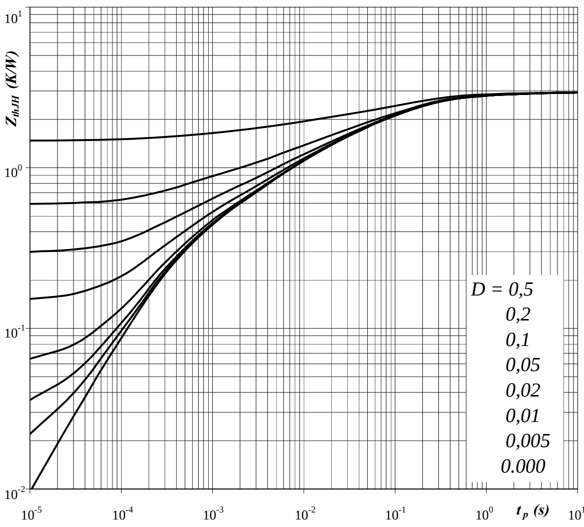


Parameter: D = tp / T RthJH= 2,40 K/W

IGBT thermal model values

R (C/W)	Tau (s)
0,10	5,1E+00
0,36	5,4E-01
0,97	1,2E-01
0,53	1,9E-02
0,26	3,4E-03
0,19	3,2E-04

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



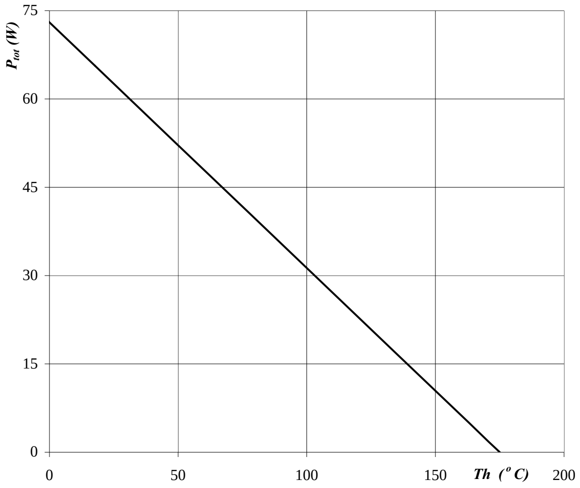
Parameter: D = tp / T RthJH= 2,94 K/W

FRED thermal model values

R (C/W)	Tau (s)
0,10	5,5E+00
0,38	5,4E-01
1,04	1,1E-01
0,69	1,9E-02
0,45	3,3E-03
0,30	3,8E-04

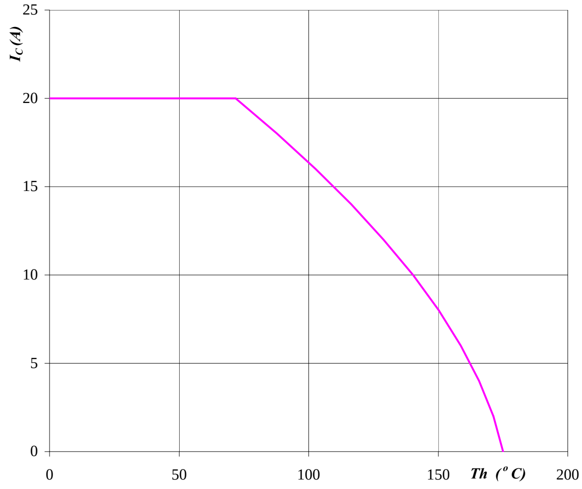
Output inverter

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



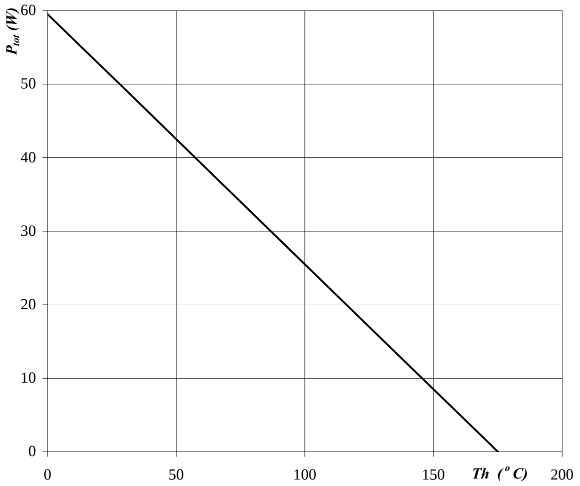
parameter: Tj= 175 ºC

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



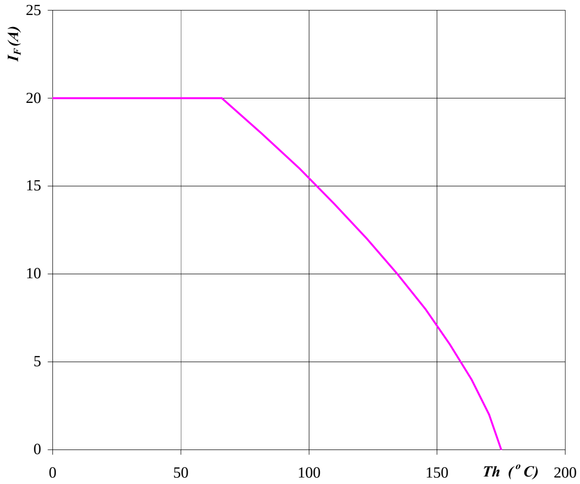
parameter: Tj= 175 ºC
V_{GE}= 15 V

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



parameter: Tj= 175 ºC

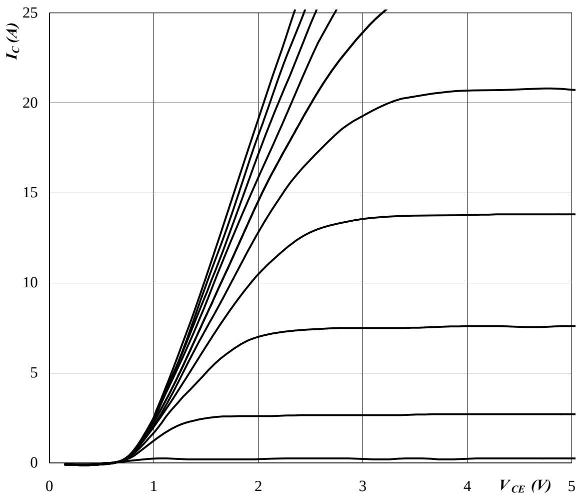
Figure 18. Forward current as a function of heatsink temperature
Output inverter FRED
$I_F = f(T_h)$



parameter: Tj= 175 ºC

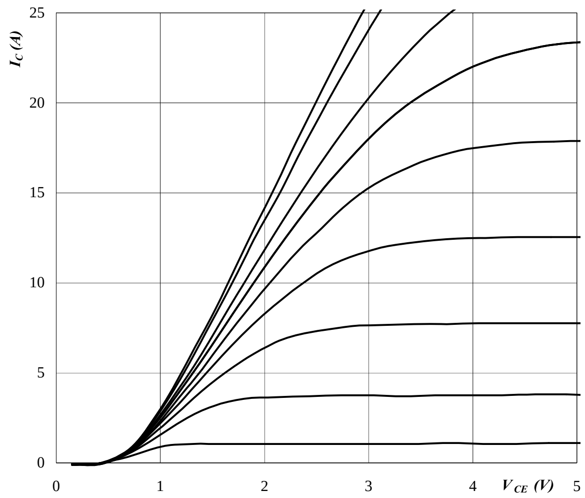
Brake

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



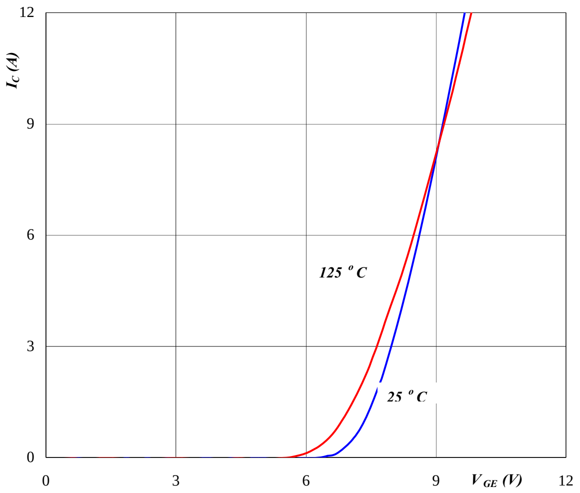
parameter: tp = 250 us   Tj = 25 °C
VGE parameter: from: 7 V to 17 V
in 1 V steps

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



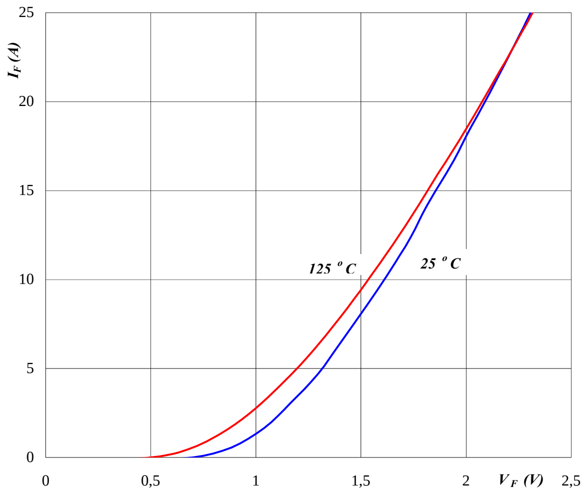
parameter: tp = 250 us   Tj = 125 °C
VGE parameter: from: 7 V to 17 V
in 1 V steps

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



parameter: tp = 250 us   VCE = 10 V

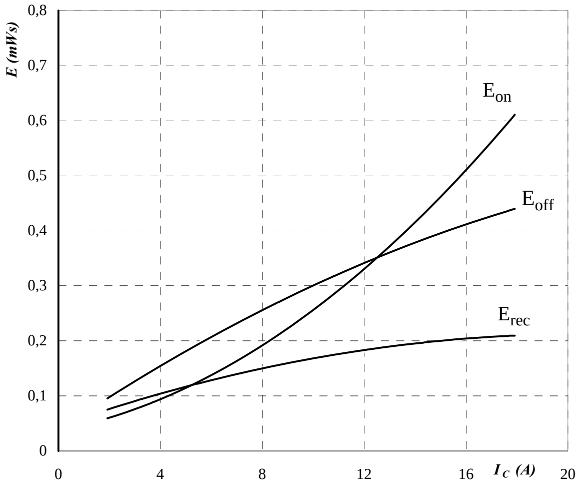
Figure 4. Typical diode forward current as a function of forward voltage
Brake FRED   IF=f(VF)



parameter: tp = 250 us

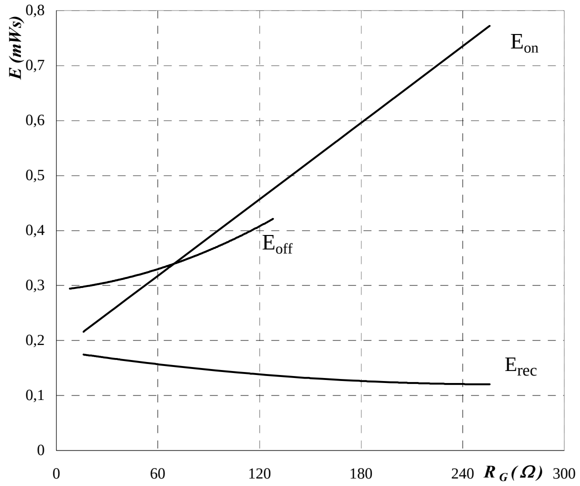
Brake

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



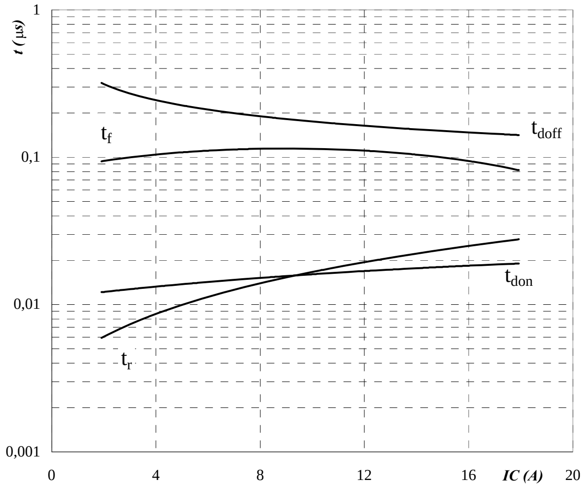
inductive load, Tj = 125 °C
VCE = 300 V
VGE= 15 V
Rgon = 32 Ω
Rgoff = 16 Ω

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



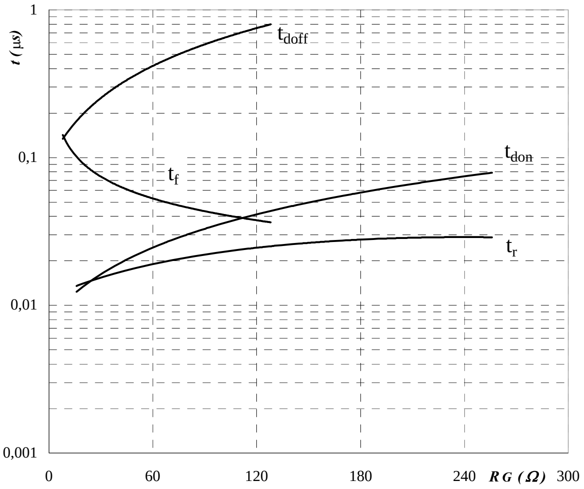
inductive load, Tj = 125 °C
VCE = 300 V
VGE= 15 V
Ic = 10 A

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



inductive load, Tj = 125 °C
VCE = 300 V
VGE= 15 V
Rgon = 32 Ω
Rgoff = 16 Ω

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

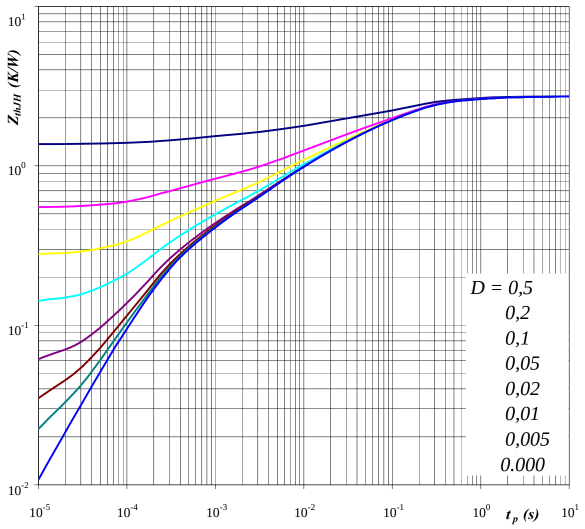


inductive load, Tj = 125 °C
VCE = 300 V
VGE= 15 V
Ic = 10 A

Brake

Figure9. IGBT transient thermal impedance as a function of pulse width

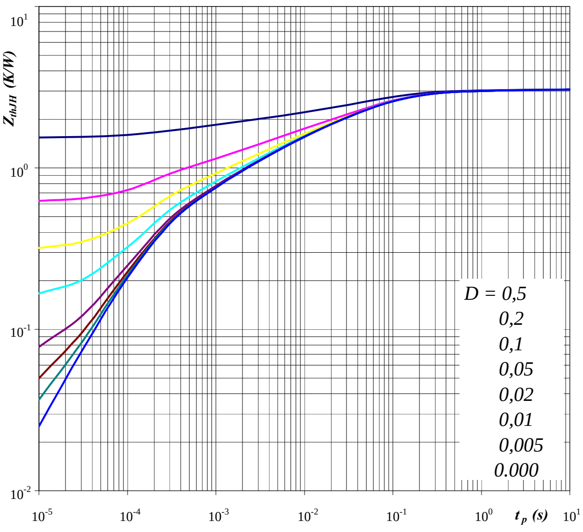
ZthJH = f(tp)



Parameter: D = tp / T   RthJH= 2,74 K/W

Figure 10. FRED transient thermal impedance as a function of pulse width

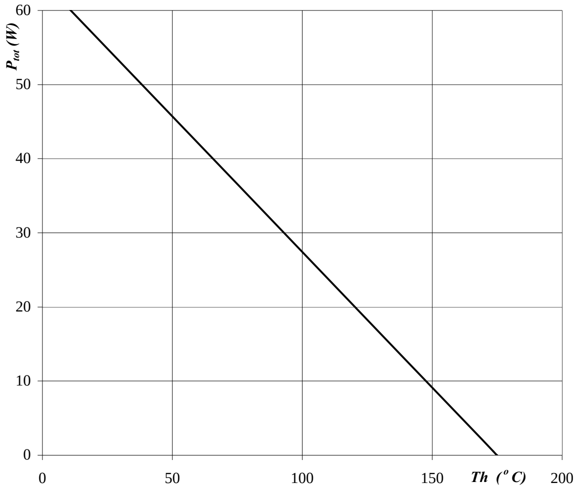
ZthJH = f(tp)



Parameter: D = tp / T   RthJH= 3,07 K/W

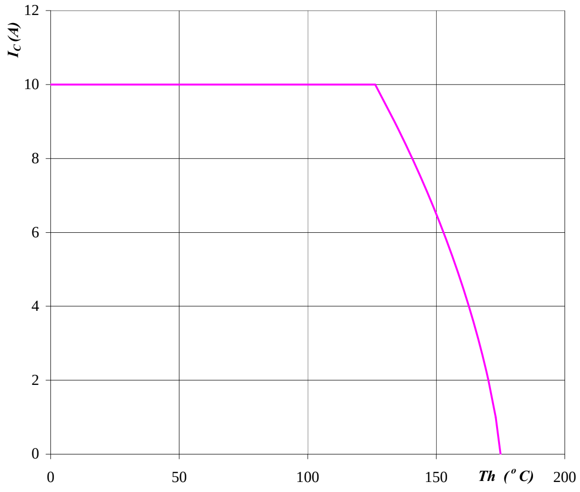
Brake

Figure 11. Power dissipation as a function of heatsink temperature
Brake IGBT
P_{tot} = f (Th)



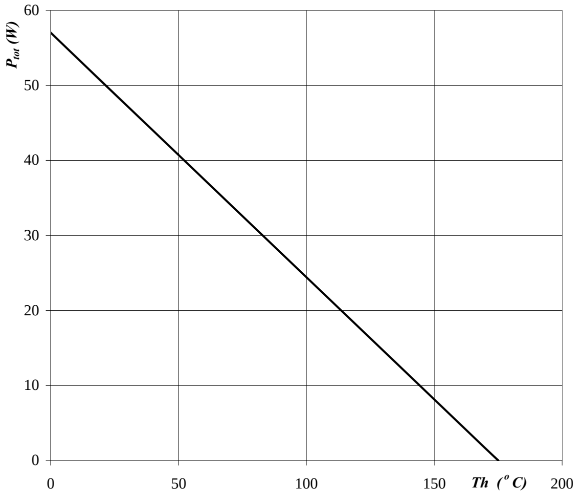
parameter: Tj= 175 ºC

Figure 12. Collector current as a function of heatsink temperature
Brake IGBT
I_C = f (Th)



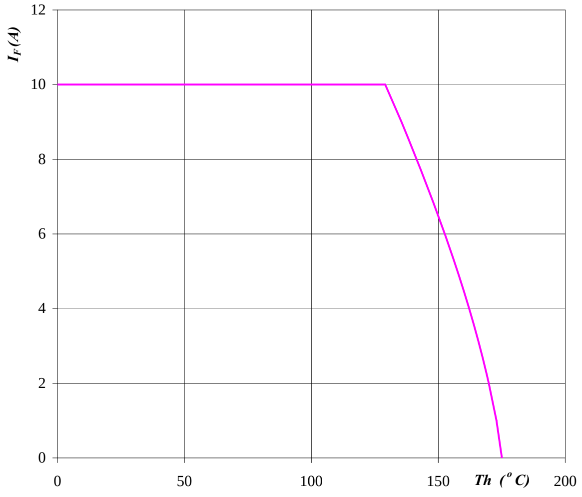
parameter: Tj= 175 ºC
V_{GE}= 15 V

Figure 13. Power dissipation as a function of heatsink temperature
Brake FRED
P_{tot} = f (Th)



parameter: Tj= 175 ºC

Figure 14. Forward current as a function of heatsink temperature
Brake FRED
I_F = f (Th)

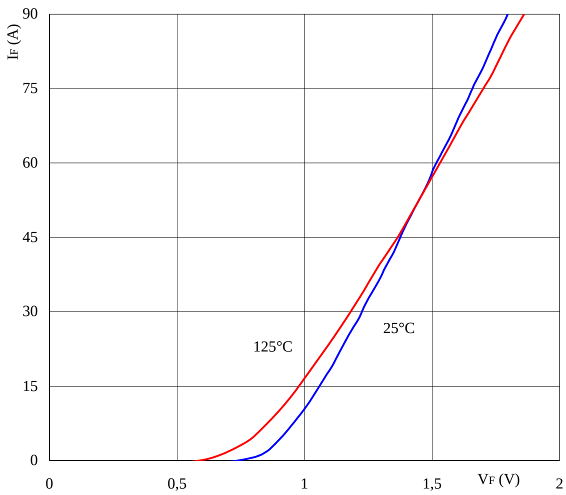


parameter: Tj= 175 ºC

Input rectifier bridge

Figure 1. Typical diode forward current as a function of forward voltage

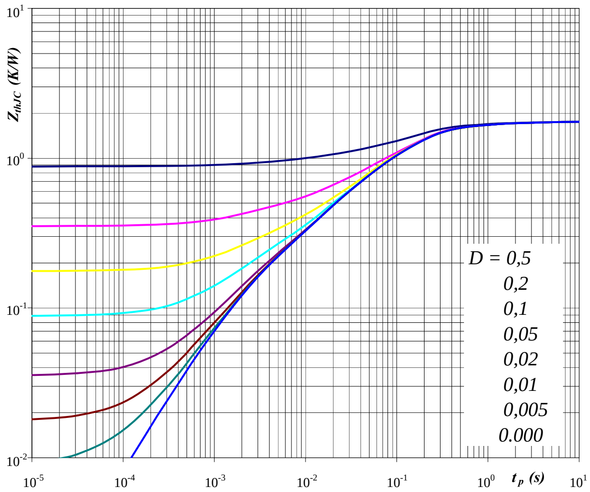
Rectifier diode $I_F=f(V_F)$



parameter: tp = 250 us

Figure 2. Diode transient thermal impedance as a function of pulse width

$Z_{thJH} = f(t_p)$

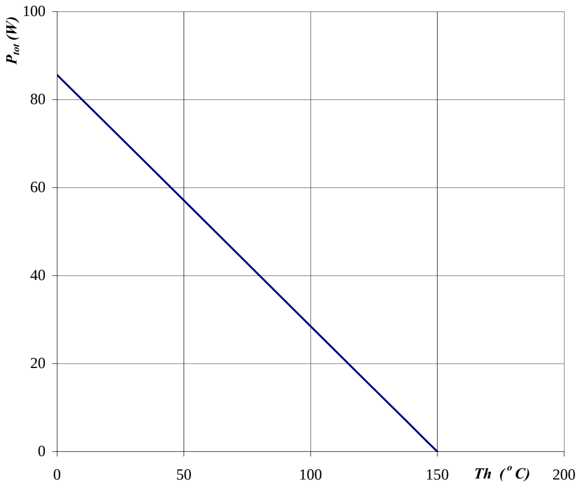


Parameter: D = tp / T RthJH= 1,75 K/W

Figure 3. Power dissipation as a function of heatsink temperature

Rectifier diode

$P_{tot} = f(T_h)$

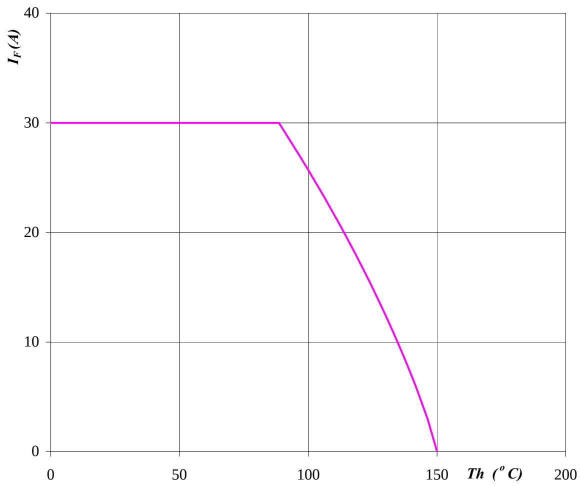


parameter: Tj= 150 ºC

Figure 4. Forward current as a function of heatsink temperature

Rectifier diode

$I_F = f(T_h)$

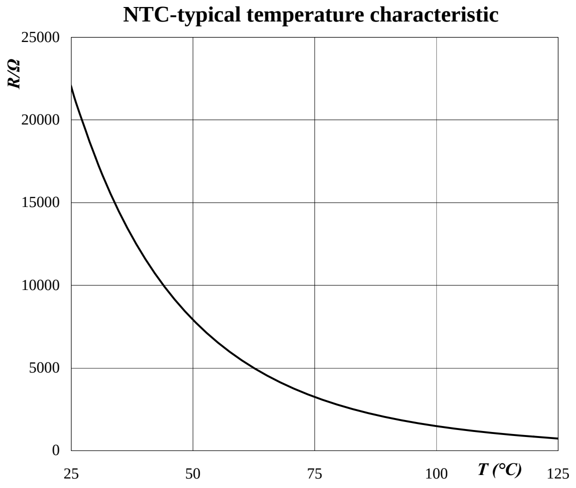


parameter: Tj= 150 ºC

Thermistor

Figure 1. **Typical NTC characteristic as afunction of temperature**

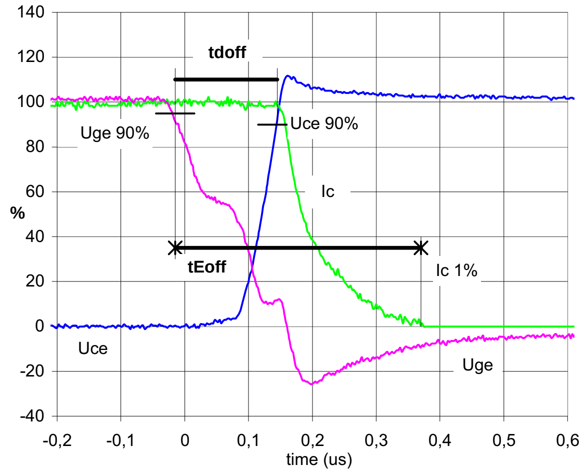
$R_T = f(T)$



Switching definitions

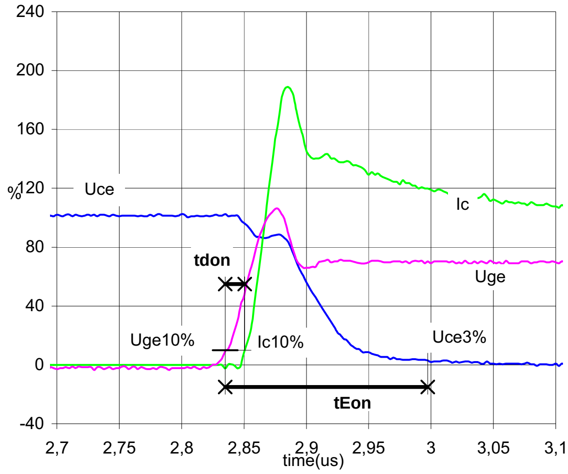
General conditions: Tj= 125 °C Rgon= 16 Ω Rgoff= 8,0 Ω

Figure 1. Turn-off Switching Waveforms & definition of tdoff, t_{Eoff}
(t_{Eoff} = integrating time for E_{off})
Output inverter IGBT



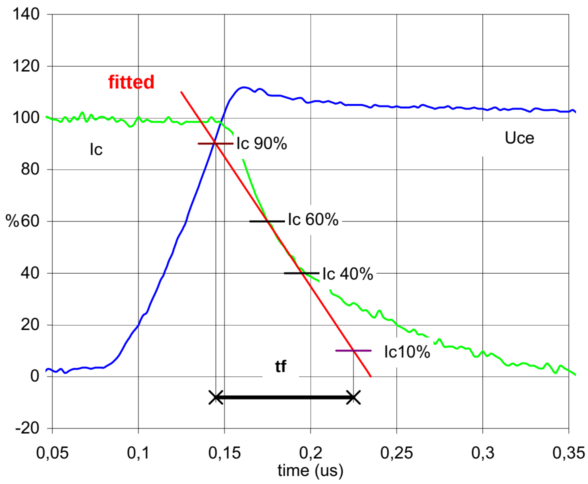
Uge(0%)= 0 V
Uge(100%)= 15 V
Uc(100%)= 300 V
Ic(100%)= 15 A
tdoff= 0,16 us
t_{Eoff}= 0,39 us

Figure 2. Turn-on Switching Waveforms & definition of t_{don}, t_{Eon}
(t_{Eon} = integrating time for E_{on})
Output inverter IGBT



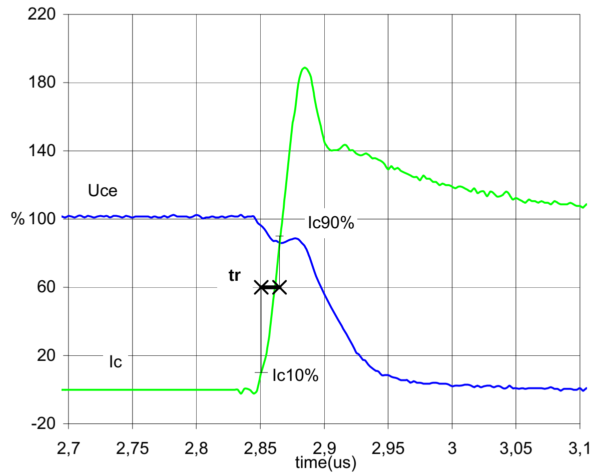
Uge(0%)= 0 V
Uge(100%)= 15 V
Uc(100%)= 300 V
Ic(100%)= 14,9 A
tdon= 0,01 us
t_{Eon}= 0,16 us

Figure 3. Turn-off Switching Waveforms & definition of t_f
Output inverter IGBT



Uc(100%)= 300 V
Ic(100%)= 15 A
t_f= 0,091 us

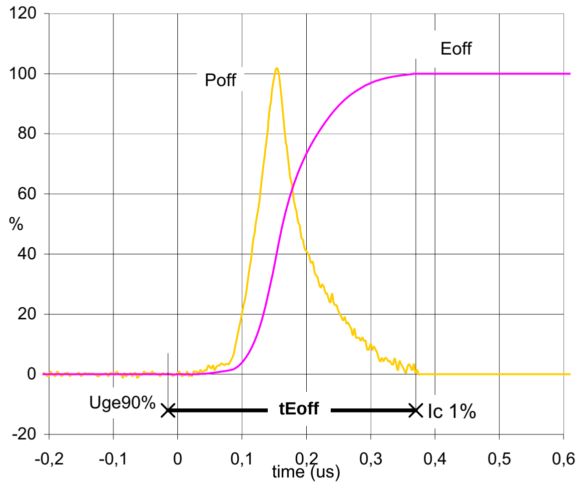
Figure 4. Turn-on Switching Waveforms & definition of t_r
Output inverter IGBT



Uc(100%)= 300 V
Ic(100%)= 14,9 A
t_r= 0,015 us

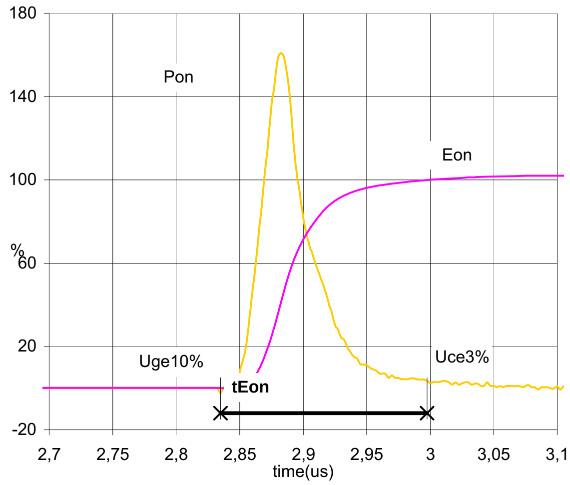
Switching definitions

Figure 5. Turn-off Switching Waveforms & definition of t_{Eoff}
Output inverter IGBT



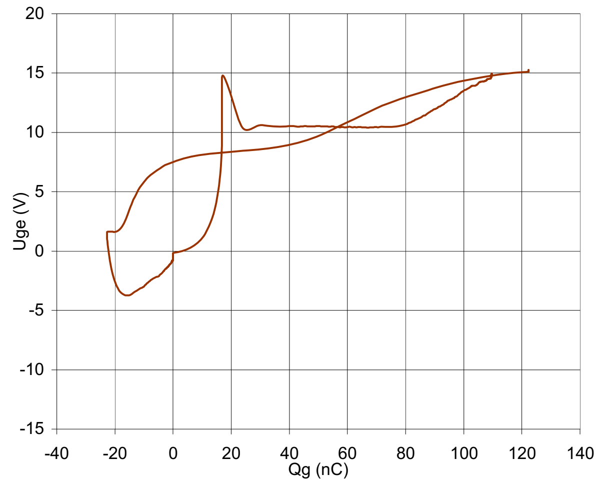
Poff(100%)= 4,47 kW
Eoff(100%)= 0,41 mJ
t_{Eoff}= 0,39 us

Figure 6. Turn-on Switching Waveforms & definition of t_{Eon}
Output inverter IGBT



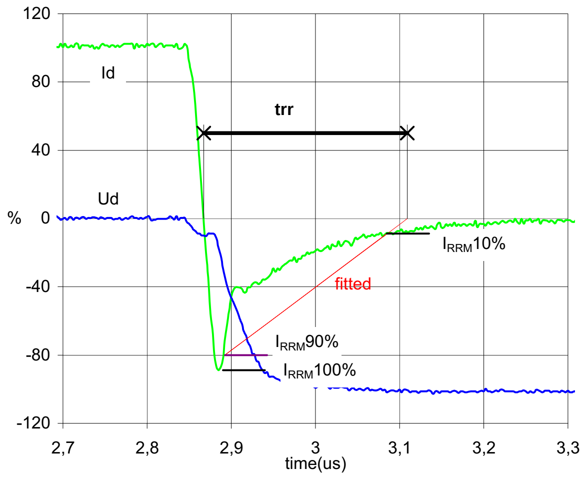
Pon(100%)= 4,47 kW
Eon(100%)= 0,32 mJ
t_{Eon}= 0,16 us

Figure 7. Gate voltage vs Gate charge
Output inverter IGBT



Ugeoff= 0 V
Ugeon= 15 V
Uc(100%)= 300 V
Ic(100%)= 15 A
Qg= 122,3 nC

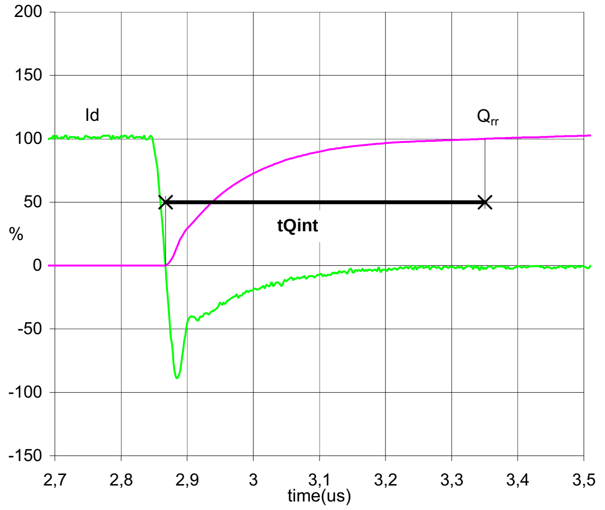
Figure 8. Turn-off Switching Waveforms & definition of t_{rr}
Output inverter FRED



Ud(100%)= 300 V
Id(100%)= 14,9 A
I_{RRM}(100%)= 13,3 A
trr= 0,23 us

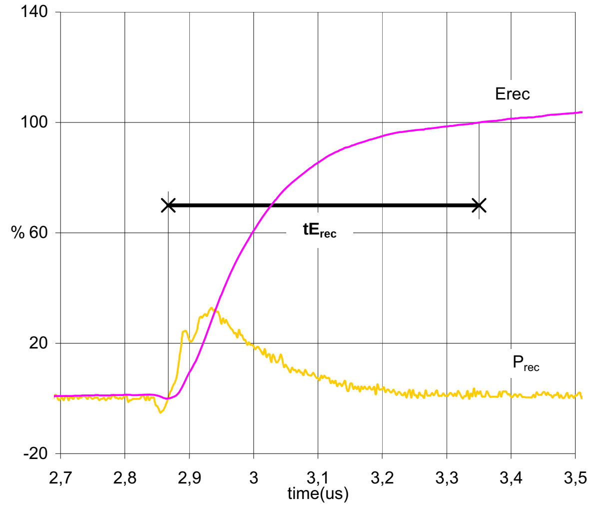
Switching definitions

Figure 9. Turn-on Switching Waveforms & definition of t_{Qrr}
(tQrr= integrating time for Qrr)
Output inverter FRED



Id(100%)= 15 A
Qrr(100%)= 1,055 uC
tQint= 0,48 us

Figure 10. Turn-on Switching Waveforms & definition of t_{Erec}
(t_{Erec}= integrating time for E_{rec})
Output inverter FRED



Prec(100%)= 4,47 kW
Erec(100%)= 0,22 mJ
tErec= 0,48 us