V23990-P585-A20 / C20-PM

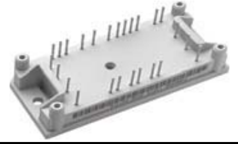
final datasheet

flow PIM 1 600V / 30A

Features

- Trench Fieldstop technology IGBTs for low saturation losses
- Compact design with enhanced rectifier
- Optional with brake chopper

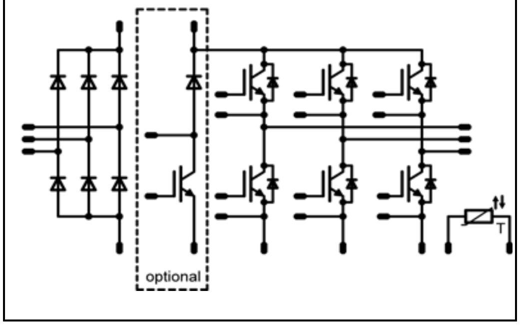
flow 1 housing



Target Applications

- Motor Drives
- Power Generation

Schematic



Types

- V23990-P585-A20-PM with BRC
- V23990-P585-C20-PM without BRC

Maximum Ratings

Parameter	Symbol	Condition		Value	Unit
Input Rectifier Bridge					
Repetitive peak reverse voltage	V_{RRM}			1600	V
Forward current per diode	I_{FAV}	DC current	T_h=80°C	31	A
			T_c=80°C	42	
Surge forward current	I_{FSM}	t_p=10ms	T_j=25°C	250	A
I^2t-value	I^2t		T_j=25°C	310	A2s
Power dissipation per Diode	P_{tot}	$T_j=T_j$max	T_h=80°C	36	W
			T_c=80°C	55	
Maximum junction temperature	$T_j$max			150	°C
Transistor Inverter					
Collector-emitter break down voltage	V_{CE}			600	V
DC collector current	I_C	$T_j=T_j$max	T_h=80°C	30	A
			T_c=80°C	38	
Repetitive peak collector current	I_{cpuls}	tp limited by $T_j$max		90	A
Power dissipation per IGBT	P_{tot}	$T_j=T_j$max	T_h=80°C	55	W
			T_c=80°C	84	
Gate-emitter peak voltage	V_{GE}			±20	V
SC withstand time*	t_{SC}	Tj≤150°C VCC=360V VGE=15V		6	µs
Maximum junction temperature	$T_j$max			175	°C

* It is recommended to not exceed 1000 short circuit situations in the lifetime of the module and to allow at least 1s between short circuits

Maximum Ratings

Parameter	Symbol	Condition		Value	Unit
Diode Inverter					
DC forward current	I_F	$T_j=T_j$max	T_h=80°C	27	A
			T_c=80°C	37	
Repetitive peak forward current	I_{FRM}	tp limited by $T_j$max		60	A
Power dissipation per Diode	P_{tot}	$T_j=T_j$max	T_h=80°C	46	W
			T_c=80°C	69	
Maximum junction temperature	$T_j$max			175	°C
				#BEZUG!	#BEZUG!
Transistor BRC					
Collector-emitter break down voltage	V_{CE}			600	V
DC collector current	I_C	$T_j=T_j$max	T_h=80°C	22	A
			T_c=80°C	28	
Repetitive peak collector current	I_{cpuls}	tp limited by $T_j$max	T_h=80°C	60	A
Power dissipation per IGBT	P_{tot}	$T_j=T_j$max	T_h=80°C	46	W
			T_c=80°C	68	
Gate-emitter peak voltage	V_{GE}			±20	V
SC withstand time*	t_{SC}	Tj≤150°C VCE=600 VGE=15V		6	µs
Maximum junction temperature	$T_j$max			175	°C

* It is recommended to not exceed 1000 short circuit situations in the lifetime of the module and to allow at least 1s between short circuits

Diode BRC					
DC forward current	I_F	$T_j=T_j$max	T_h=80°C	17	A
			T_c=80°C	20	
Repetitive peak forward current	I_{FRM}	tp limited by $T_j$max	T_h=80°C	40	A
Power dissipation per Diode	P_{tot}	$T_j=T_j$max	T_h=80°C	27	W
			T_c=80°C	41	
Maximum junction temperature	$T_j$max			175	°C
Thermal properties					
Storage temperature	T_{stg}			-40…+125	°C
Operation temperature	T_{op}			-40…+125	°C
Insulation properties					
Insulation voltage	V_{is}	t=1min		4000	Vdc
Creepage distance				min 12,7	mm
Clearance				min 12,7	mm

Characteristic Values

Parameter	**Symbol**	**Conditions**					**Value**			**Unit**
			V_{GE}(V) or V_{GS}(V)	**V_r(V) or V_{CE}(V) or V_{DS}(V)**	**I_C(A) or I_F(A) or I_D(A)**	**T(C°)**	**Min**	**Typ**	**Max**	
Input Rectifier Bridge										
Forward voltage	V_F				50	Tj=25°C Tj=125°C		1,32 1,37	1,6	V
Threshold voltage (for power loss calc. only)	V_{to}				30	Tj=25°C Tj=125°C		0,96 0,84		V
Slope resistance (for power loss calc. only)	r_t				30	Tj=25°C Tj=125°C		0,007 0,011		Ohm
Reverse leakage current	I_r			1500		Tj=25°C Tj=150°C			0,023	mA
Thermal resistance chip to heatsink per chip	R_{thJH}	Thermal grease thickness≤50um λ = 0,61 W/mK						1,94		K/W
Thermal resistance chip to case per chip	R_{thJC}							1,2804		K/W
Transistor Inverter										
Gate emitter threshold voltage	$V_{GE(th)}$	VCE=VGE			0,00043	Tj=25°C Tj=125°C	5	5,8	6,5	V
Collector-emitter saturation voltage	$V_{CE(sat)}$		15		30	Tj=25°C Tj=125°C		1,61 1,77	2,1	V
Collector-emitter cut-off	I_{CES}		0	600		Tj=25°C Tj=125°C			0,2	mA
Gate-emitter leakage current	I_{GES}		20	0		Tj=25°C Tj=125°C			350	nA
Integrated Gate resistor	R_{gint}							none		Ohm
Turn-on delay time	$t_{d(on)}$	Rgoff=8 Ω Rgon=8 Ω	±15	300	50	Tj=25°C Tj=125°C		94		ns
Rise time	t_r					Tj=25°C Tj=125°C		18		ns
Turn-off delay time	$t_{d(off)}$					Tj=25°C Tj=125°C		160		ns
Fall time	t_f					Tj=25°C Tj=125°C		87		ns
Turn-on energy loss per pulse	E_{on}					Tj=25°C Tj=125°C		0,633		mWs
Turn-off energy loss per pulse	E_{off}					Tj=25°C Tj=125°C		0,797		mWs
Input capacitance	C_{ies}	f=1MHz	0	25		Tj=25°C Tj=125°C		1,63		nF
Output capacitance	C_{oss}		0	25		Tj=25°C Tj=125°C		0,108		nF
Reverse transfer capacitance	C_{rss}		0	25		Tj=25°C Tj=125°C		0,05		nF
Gate charge	Q_{Gate}					Tj=25°C Tj=125°C		tbd		nC
Thermal resistance chip to heatsink per chip	R_{thJH}	Thermal foil thickness=76um Kunze foil KU-ALF5						1,72		K/W
Thermal resistance chip to case per chip	R_{thJC}							1,1352		K/W
Diode Inverter										
Diode forward voltage	V_F				30	Tj=25°C Tj=125°C		1,75 1,7	2,15	V
Peak reverse recovery current	I_{RM}		±15	300	30	Tj=25°C Tj=125°C		34,29		A
Reverse recovery time	t_{rr}		±15	300	30	Tj=25°C Tj=125°C		183,2		ns
Reverse recovery charge	Q_{rr}		±15	300	30	Tj=25°C Tj=125°C		2,16		μC
Reverse recovery energy	Erec		±15	300	30	Tj=25°C Tj=125°C		0,446		mWs
Thermal resistance chip to heatsink per chip	R_{thJH}	Thermal grease thickness≤50um λ = 0,61 W/mK						2,07		K/W
Thermal resistance chip to case per chip	R_{thJC}							1,242		K/W

Characteristic Values

Parameter	Symbol	Conditions					Value			Unit
			V_{GE}(V) or V_{GS}(V)	V_r(V) or V_{CE}(V) or V_{DS}(V)	I_C(A) or I_F(A) or I_D(A)	T(C°)	Min	Typ	Max	
Transistor BRC										
Gate emitter threshold voltage	$V_{GE(th)}$	VCE=VGE			0,00029	Tj=25°C Tj=125°C	5	5,8	6,5	V
Collector-emitter saturation voltage	$V_{CE(sat)}$		15		20	Tj=25°C Tj=125°C		1,55 1,75	2	V
Collector-emitter cut-off	I_{CES}		0	600		Tj=25°C Tj=125°C			0,05	mA
Gate-emitter leakage current	I_{GES}		20	0		Tj=25°C Tj=125°C			350	nA
Integrated Gate resistor	R_{gint}							none		Ohm
Turn-on delay time	$t_{d(on)}$	Rgoff=20Ω Rgon=40Ω	±15	300	20	Tj=25°C Tj=125°C		128,2		ns
Rise time	t_r					Tj=25°C Tj=125°C		21,3		ns
Turn-off delay time	$t_{d(off)}$					Tj=25°C Tj=125°C		178,5		ns
Fall time	t_f					Tj=25°C Tj=125°C		114,3		ns
Turn-on energy loss per pulse	E_{on}					Tj=25°C Tj=125°C		0,59		µWs
Turn-off energy loss per pulse	E_{off}					Tj=25°C Tj=125°C		0,63		µWs
Input capacitance	C_{ies}	f=1MHz	0	25		Tj=25°C Tj=125°C		1,1		nF
Output capacitance	C_{oss}					Tj=25°C Tj=125°C		0,071		nF
Reverse transfer capacitance	C_{rss}					Tj=25°C Tj=125°C		0,032		nF
Gate charge	Q_{Gate}					Tj=25°C Tj=125°C		tbd		nC
Thermal resistance chip to heatsink per chip	R_{thJH}	Thermal foil thickness=76um Kunze foil KU-ALF5						2,12		K/W
Thermal resistance chip to case per chip	R_{thJC}							1,3992		K/W
Diode BRC										
Diode forward voltage	V_F				20	Tj=25°C Tj=125°C		1,77 1,67	2,1	V
Reverse leakage current	I_r			600		Tj=25°C Tj=125°C			140	µA
Reverse recovery time	t_{rr}	Rgon=40Ω	±15	300		Tj=25°C Tj=125°C		239,7		ns
Reverse recovered charge	Q_{rr}	Rgon=40Ω	±15	300		Tj=25°C Tj=125°C		1,277		µC
Reverse recovery energy	E_{rec}	Rgon=40Ω	±15	300		Tj=25°C Tj=125°C		0,24		µWs
Thermal resistance chip to heatsink per chip	R_{thJH}	Thermal foil thickness=76um Kunze foil KU-ALF5						3,53		K/W
Thermal resistance chip to case per chip	R_{thJC}							2,3298		K/W
NTC Thermistor										
Rated resistance	R_{25}					Tj=25°C	20,9	22	23,1	kOhm
Deviation of R100	$D_{R/R}$	R100=1503Ω				Tc=100°C		2,9		%/K
Power dissipation given Epcos-Type	P					Tj=25°C		210		mW
B-value	$B_{(25/100)}$	Tol. ±3%				Tj=25°C		3980		K

Package Outline and Pinout

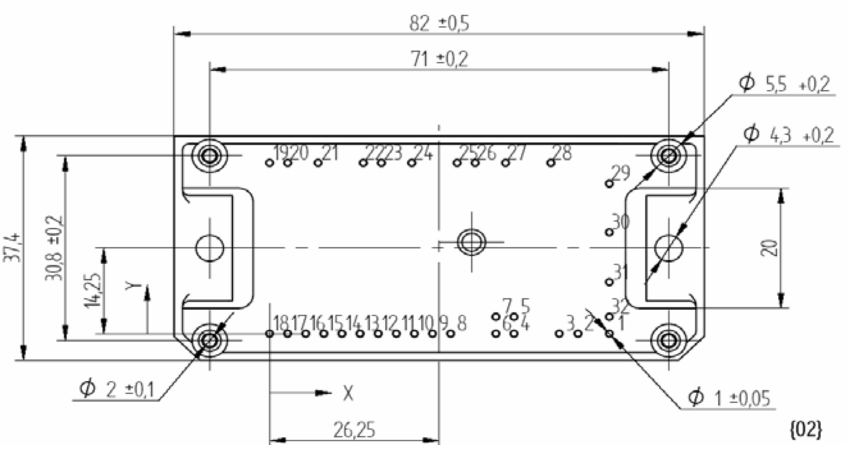
Outline

Pin table

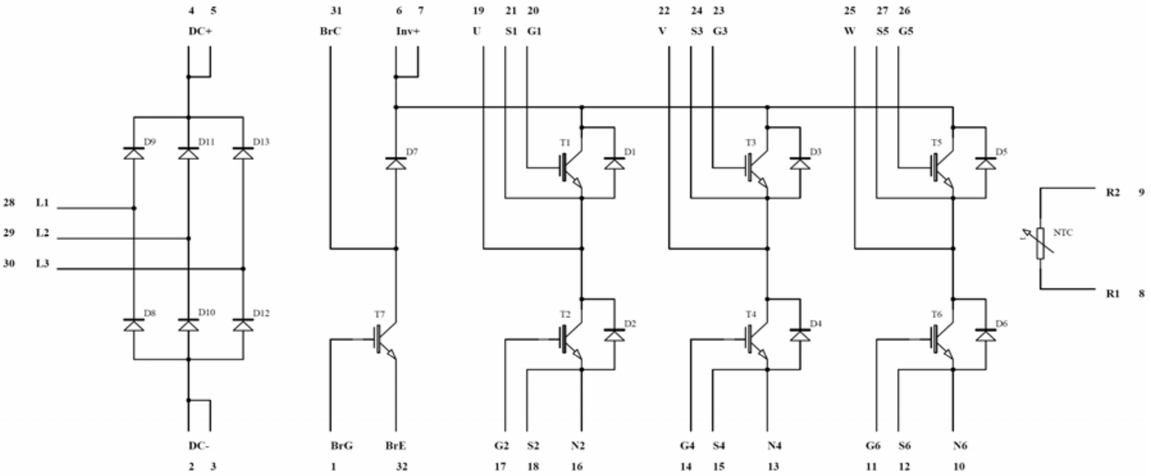
Pin	X	Y
1	52,55	0
2	47,7	0
3	44,8	0
4	37,8	0
5	37,8	2,8
6	35	0
7	35	2,8
8	28	0
9	25,2	0
10	22,4	0
11	19,6	0
12	16,8	0
13	14	0
14	11,2	0
15	8,4	0
16	5,6	0
17	2,8	0
18	0	0
19	0	28,5
20	2,8	28,5
21	7,5	28,5
22	14,5	28,5
23	17,3	28,5
24	22	28,5
25	29	28,5
26	31,8	28,5
27	36,5	28,5
28	43,5	28,5

Pin table

Pin	X	Y
29	52,55	25
30	52,55	16,9
31	52,55	8,6
32	52,55	2,8



Pinout



PRODUCT STATUS DEFINITIONS

Datasheet Status	Product Status	Definition
Target	Formative or In Design	This datasheet contains the design specifications for product development. Specifications may change in any manner without notice. The data contained is exclusively intended for technically trained staff.
Preliminary	First Production	This datasheet contains preliminary data, and supplementary data may be published at a later date. Vincotech reserves the right to make changes at any time without notice in order to improve design. The data contained is exclusively intended for technically trained staff.
Final	Full Production	This datasheet contains final specifications. Vincotech reserves the right to make changes at any time without notice in order to improve design. The data contained is exclusively intended for technically trained staff.

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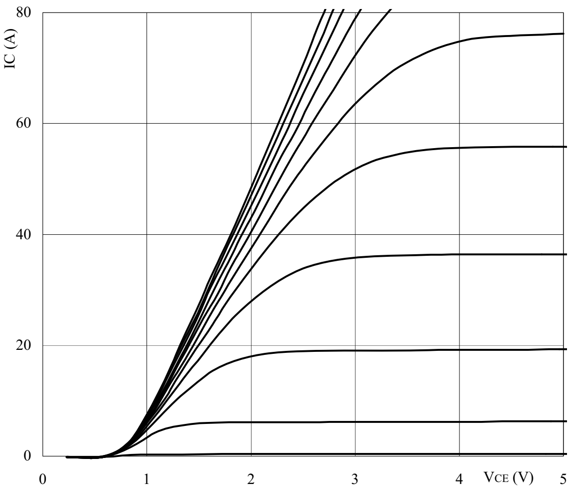
As used herein:

1. Life support devices or systems are devices or systems which, (a) are intended for surgical implant into the body, or (b) support or sustain life, or (c) whose failure to perform when properly used in accordance with instructions for use provided in labelling can be reasonably expected to result in significant injury to the user.
2. A critical component is any component of a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.

Output inverter

Figure 1. Typical output characteristics

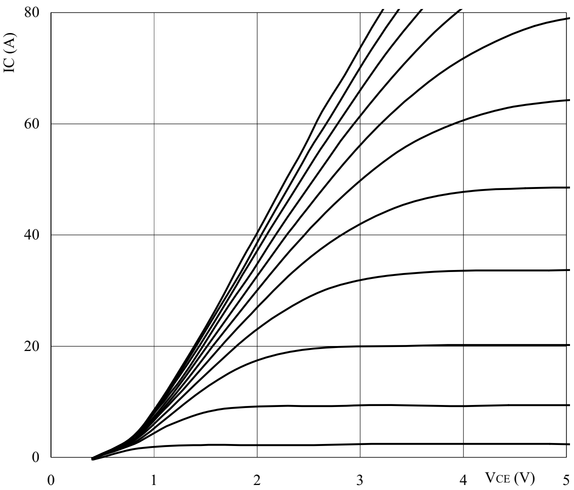
Output inverter IGBT
$I_C = f(V_{CE})$



parameter: t_p = 250 us T_j = 25 °C
V_{GE} parameter: from: 7 V to 17 V
in 1 V steps

Figure 2. Typical output characteristics

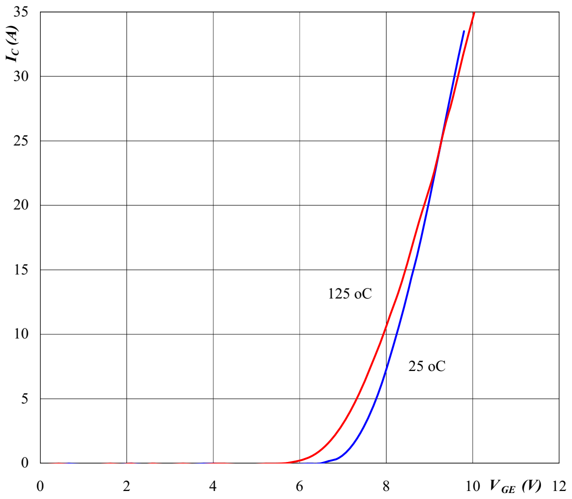
Output inverter IGBT
$I_C = f(V_{CE})$



parameter: t_p = 250 us T_j = 125 °C
V_{GE} parameter: from: 7 V to 17 V
in 1 V steps

Figure 3. Typical transfer characteristics

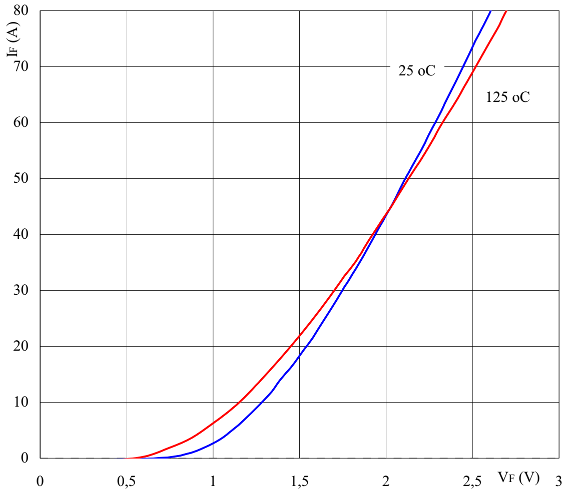
Output inverter IGBT
$I_C = f(V_{GE})$



parameter: t_p = 250 us V_{CE} = 10 V

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

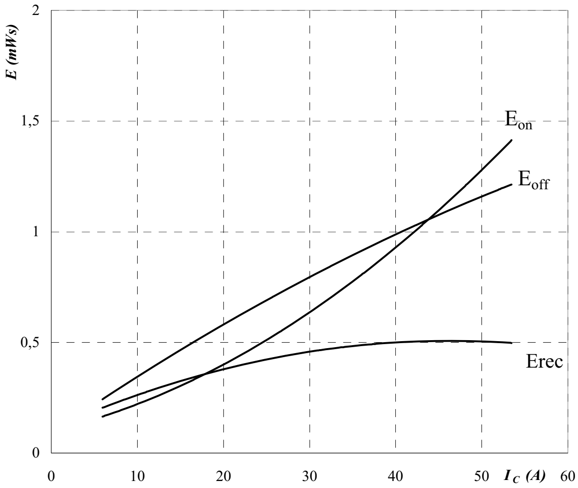
Output inverter FRED $I_F = f(V_F)$



parameter: t_p = 250 us

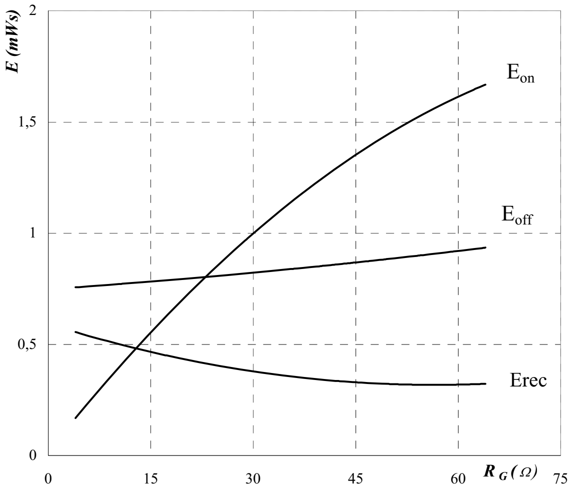
Output inverter

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



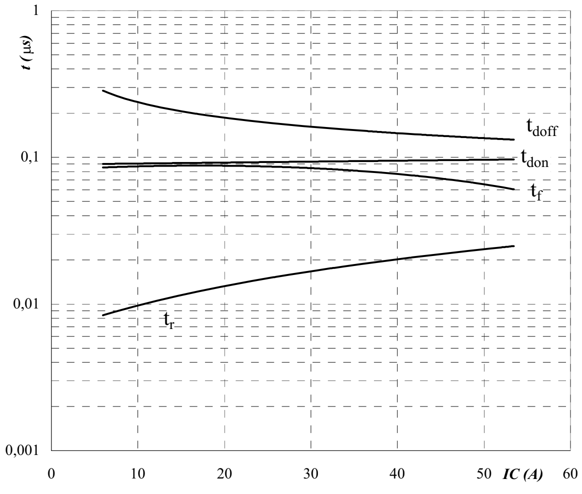
inductive load, Tj = 125 °C
V_{CE} = 300 V
V_{GE}= ±15 V
Rgon= 16 Ω
Rgoff= 16 Ω

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



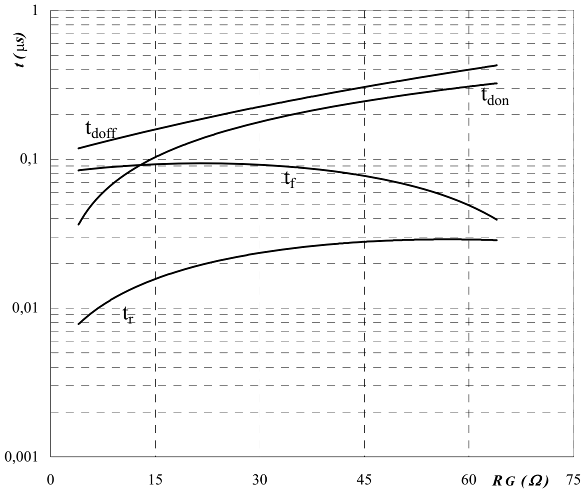
inductive load, Tj = 125 °C
V_{CE} = 300 V
V_{GE}= ±15 V
Ic = 30 A

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= 16 Ω

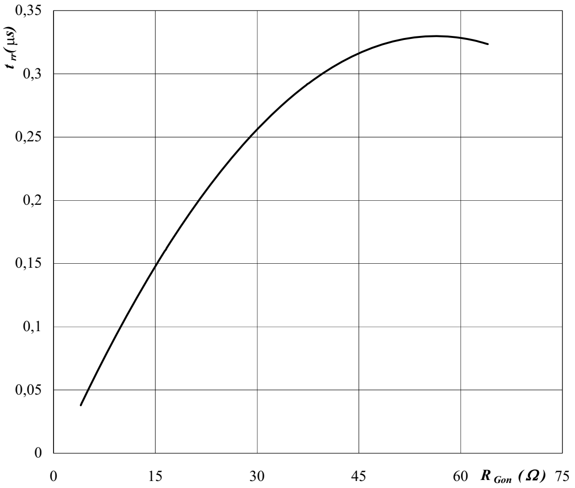
Figure 8. Typical switching times as a function of gate resistor
Output inverter IGBT
t = f (RG)



inductive load, Tj = 125 °C
V_{CE} = 300 V
V_{GE}= ±15 V
Ic = 30 A

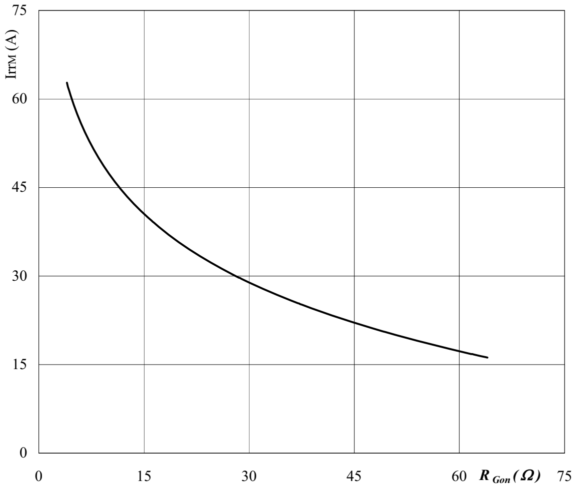
Output inverter

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



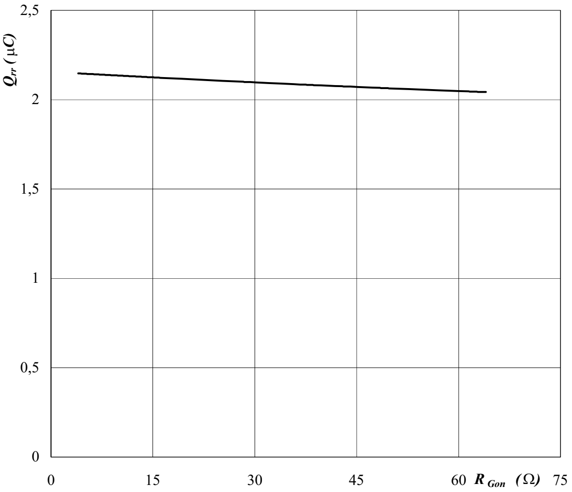
Tj = 125 °C
V_R = 300 V
I_F= 30 A
V_{GE}= ±15 V

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



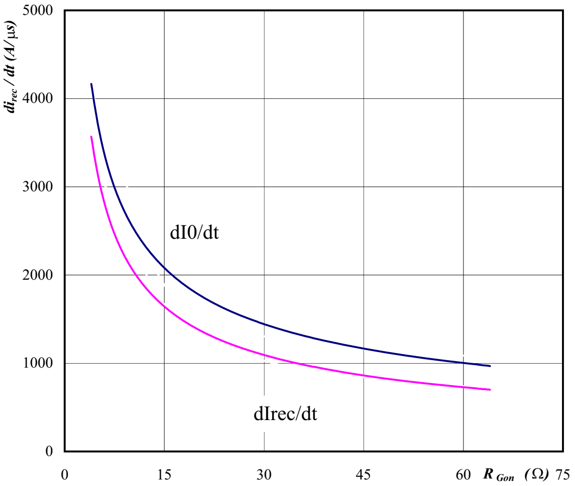
Tj = 125 °C
V_R = 300 V
I_F= 30 A
V_{GE}= ±15 V

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= 30 A
V_{GE}= ±15 V

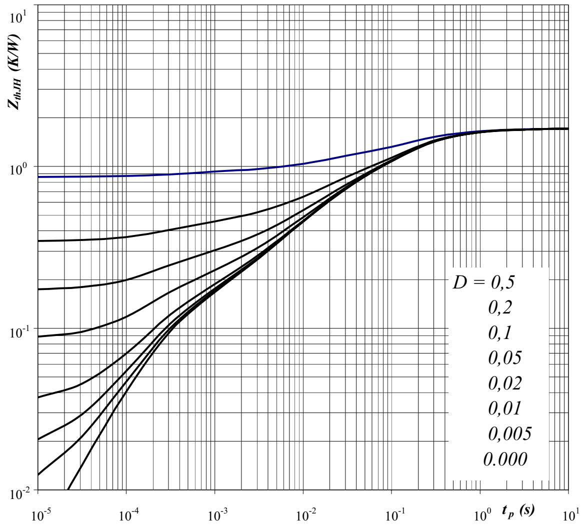
Figure 12. **Typical rate of fall of forward and reverse recovery current as a function of IGBT turn on gate resistor**
Output inverter FRED diode
dI0/dt,dIrec/dt= f (Rgon)



Tj = 125 °C
V_R = 300 V
I_F= 30 A
V_{GE}= ±15 V

Output inverter

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

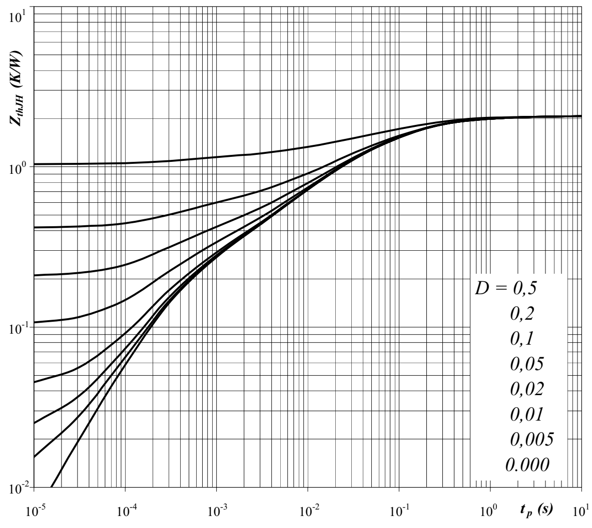


Parameter: D = tp / T RthJH= 1,72 K/W

IGBT thermal model values

R (C/W)	Tau (s)
0,09	3,0E+00
0,36	4,1E-01
0,67	1,1E-01
0,39	1,7E-02
0,11	2,8E-03
0,11	2,7E-04

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



Parameter: D = tp / T RthJH= 2,07 K/W

FRED thermal model values

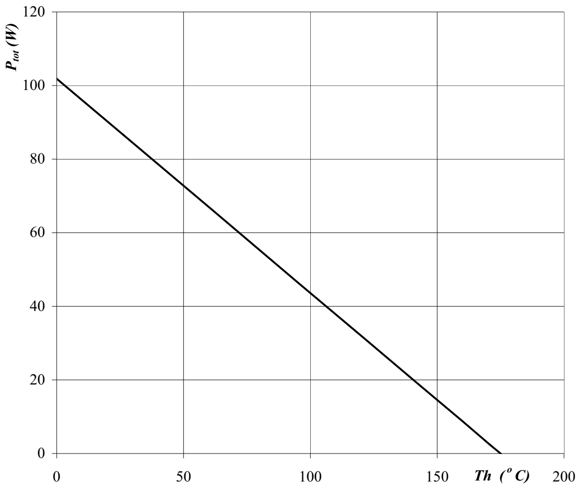
R (C/W)	Tau (s)
0,09	2,7E+00
0,36	3,1E-01
0,72	7,9E-02
0,52	1,6E-02
0,21	2,8E-03
0,18	3,3E-04

Output inverter

Figure 15. Power dissipation as a function of heatsink temperature

Output inverter IGBT

P_{tot} = f (Th)

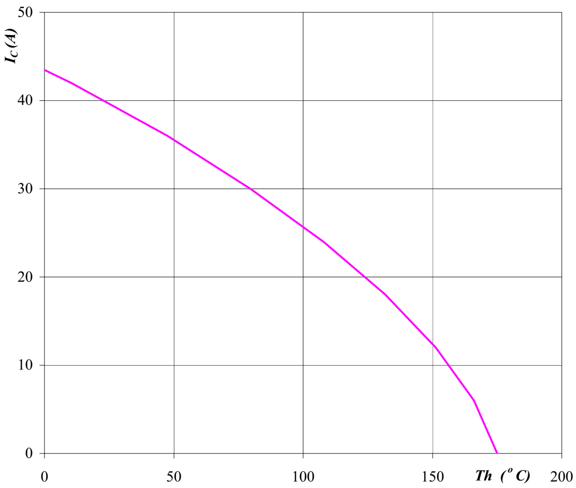


parameter: Tj= 175 ºC

Figure 16. Collector current as a function of heatsink temperature

Output inverter IGBT

I_C = f (Th)

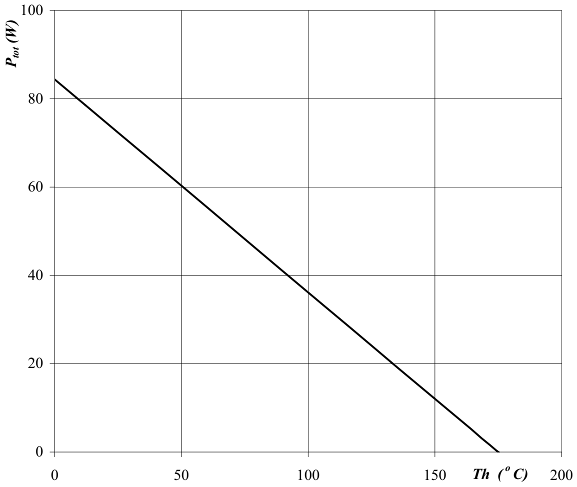


parameter: Tj= 175 ºC
V_{GE}= 15 V

Figure 17. Power dissipation as a function of heatsink temperature

Output inverter FRED

P_{tot} = f (Th)

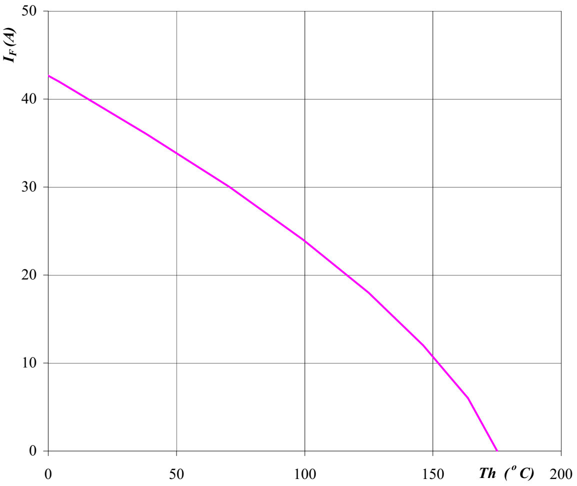


parameter: Tj= 175 ºC

Figure 18. Forward current as a function of heatsink temperature

Output inverter FRED

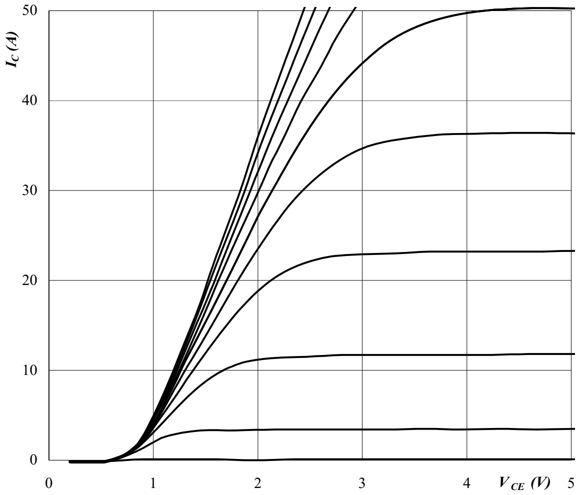
I_F = f (Th)



parameter: Tj= 175 ºC

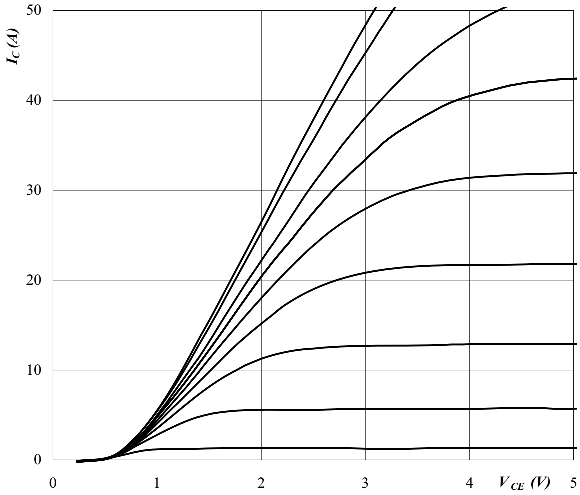
Brake

Figure 1. **Typical output characteristics**
Brake IGBT
$I_c = f(V_{CE})$



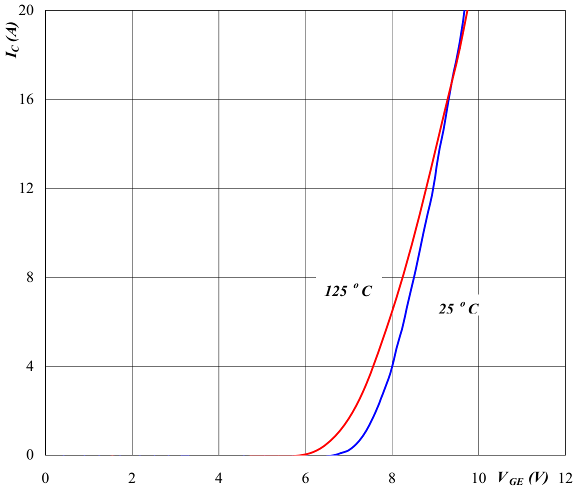
parameter: tp = 250 us Tj = 25 °C
V_{GE} parameter: from: 7 V to 17 V
in 1 V steps

Figure 2. **Typical output characteristics**
Brake IGBT
$I_c = f(V_{CE})$



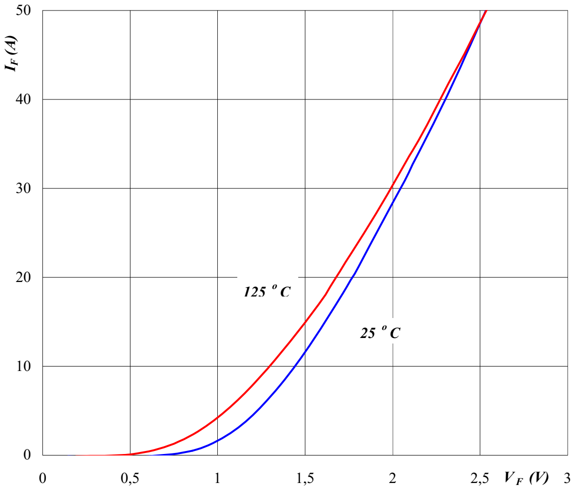
parameter: tp = 250 us Tj = 125 °C
V_{GE} parameter: from: 7 V to 17 V
in 1 V steps

Figure 3. **Typical transfer characteristics**
Brake IGBT
$I_c = f(V_{GE})$



parameter: tp = 250 us V_{CE} = 10 V

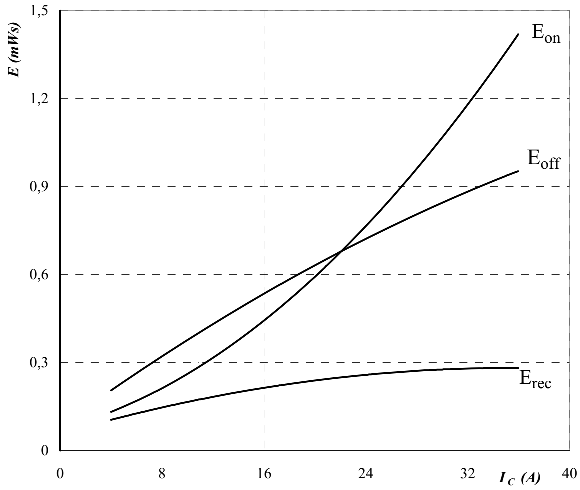
Figure 4. **Typical diode forward current as a function of forward voltage**
Brake FRED $I_F = f(V_F)$



parameter: tp = 250 us

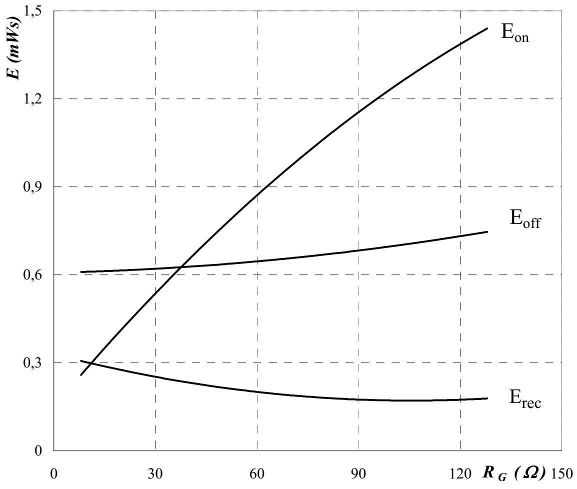
Brake

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



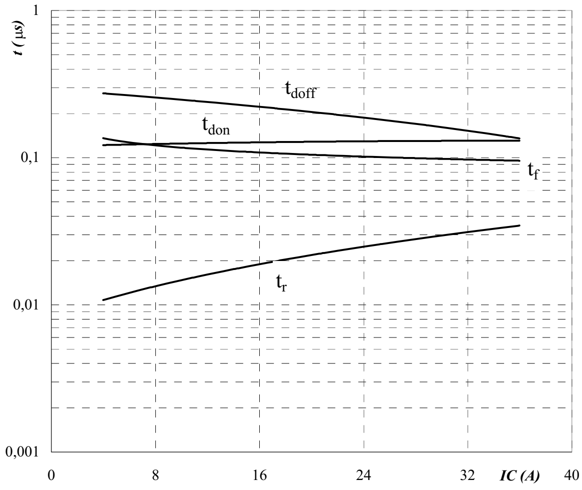
inductive load, Tj = 125 °C
V_{CE} = 300 V
V_{GE}= ±15 V
Rgon = 32 Ω
Rgoff = 32 Ω

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



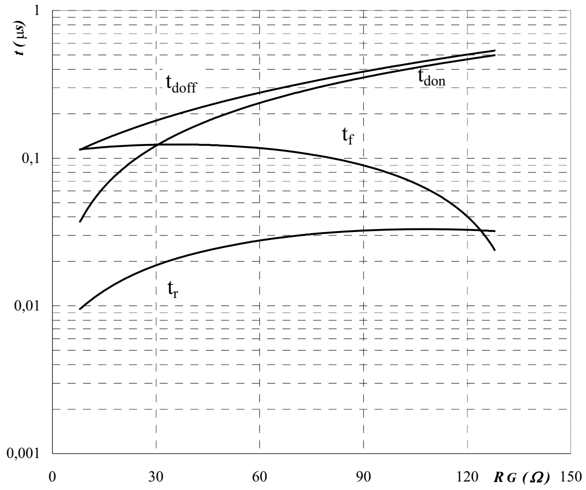
inductive load, Tj = 125 °C
V_{CE} = 300 V
V_{GE}= ±15 V
Ic = 20 A

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



inductive load, Tj = 125 °C
V_{CE} = 300 V
V_{GE}= ±15 V
Rgon = 32 Ω
Rgoff = 32 Ω

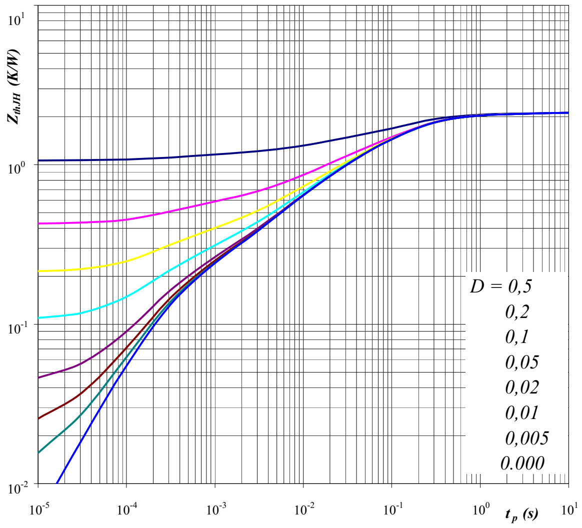
Figure 8. Typical switching times as a function of gate resistor
Brake IGBT
t = f (R_G)



inductive load, Tj = 125 °C
V_{CE} = 300 V
V_{GE}= ±15 V
Ic = 20 A

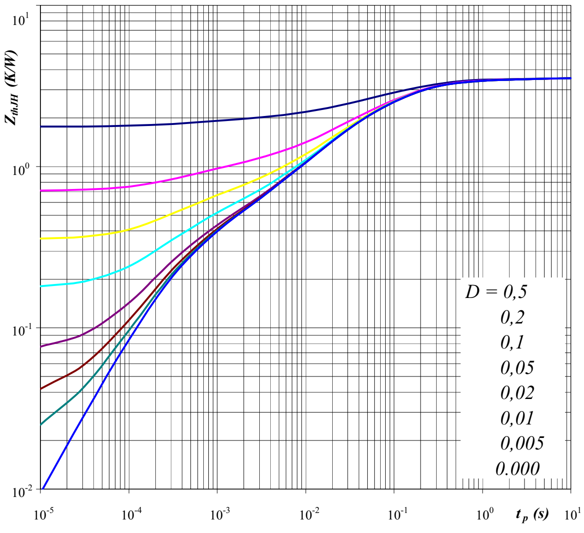
Brake

Figure 9. IGBT transient thermal impedance as a function of pulse width
ZthJH = f(tp)



Parameter: D = tp / T RthJH= 2,12 K/W

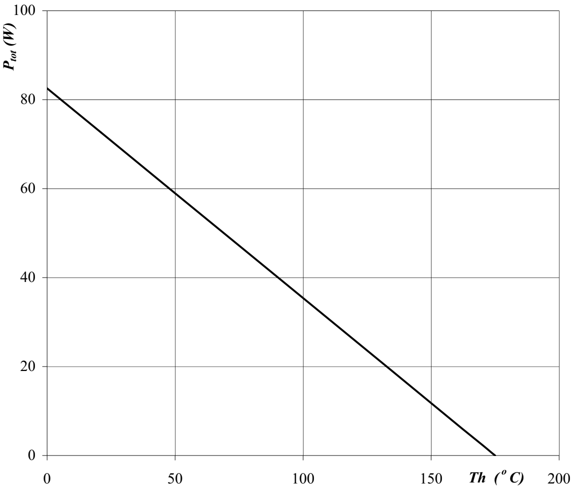
Figure 10. FRED transient thermal impedance as a function of pulse width
ZthJH = f(tp)



Parameter: D = tp / T RthJH= 3,53 K/W

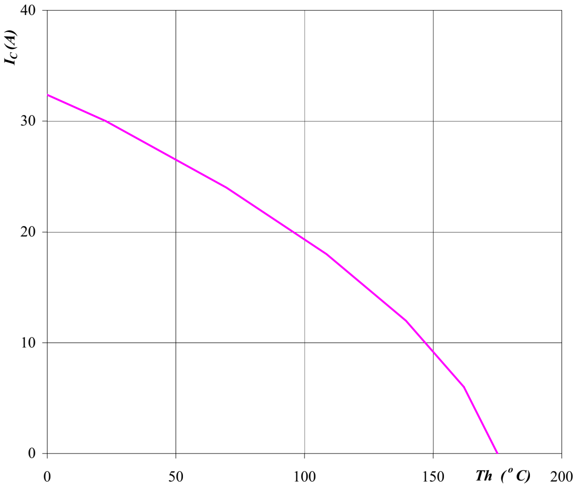
Brake

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



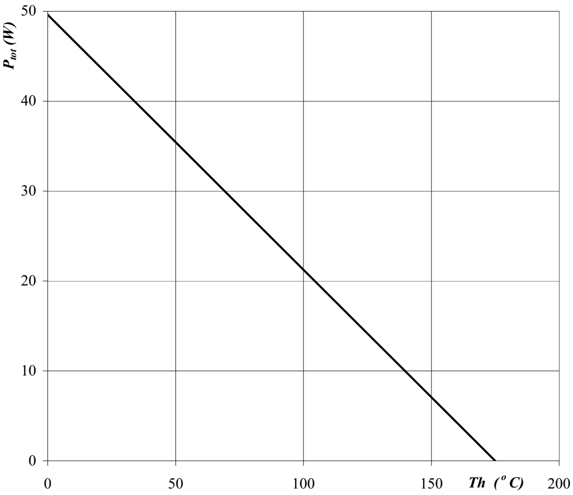
parameter: Tj= 175 ºC

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



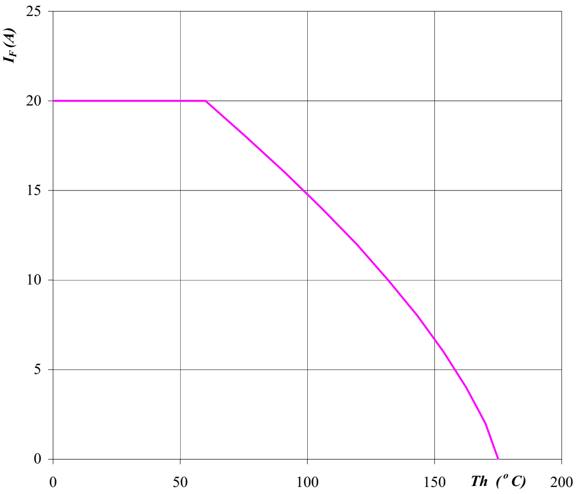
parameter: Tj= 175 ºC
V_{GE}= 15 V

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
$I_F = f(Th)$

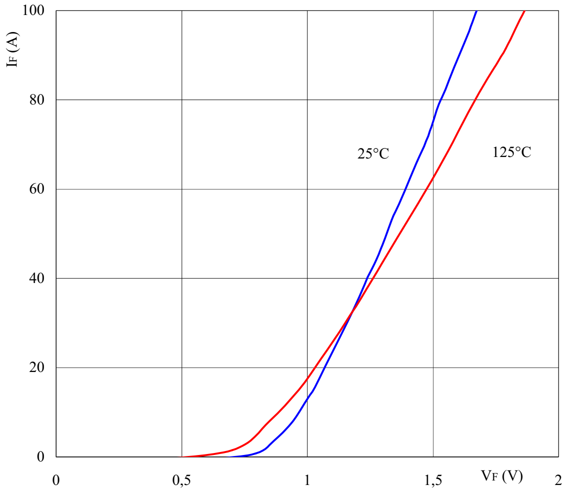


parameter: Tj= 175 ºC

Input rectifier bridge

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

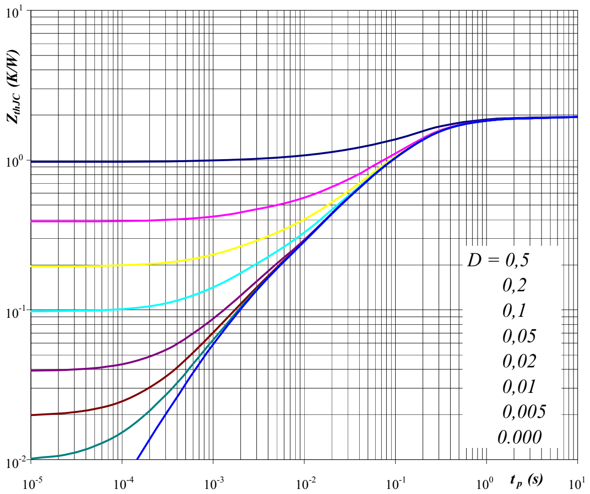
Rectifier diode $I_F = f(V_F)$



parameter: tp = 250 us

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

$Z_{thJH} = f(t_p)$

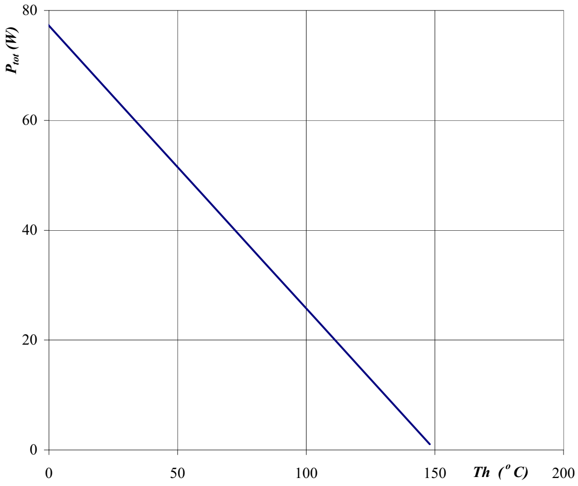


Parameter: D = tp / T RthJH= 1,94 K/W

Figure 3. Power dissipation as a function of heatsink temperature

Rectifier diode

$P_{tot} = f(T_h)$

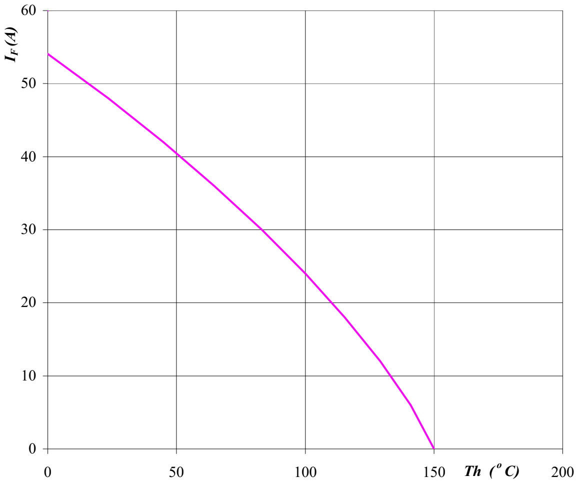


parameter: Tj= 150 ºC

Figure 4. Forward current as a function of heatsink temperature

Rectifier diode

$I_F = f(T_h)$

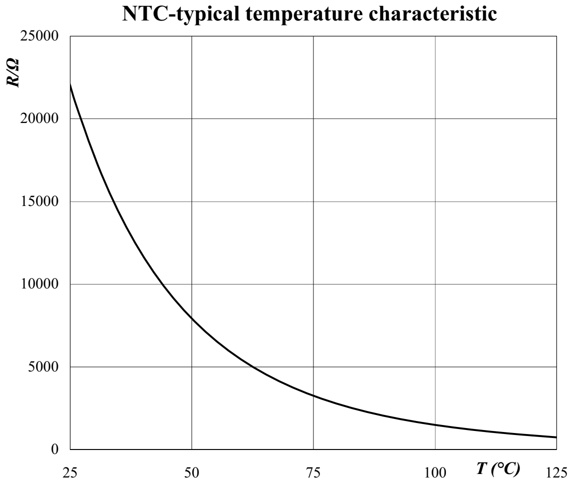


parameter: Tj= 150 ºC

Thermistor

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

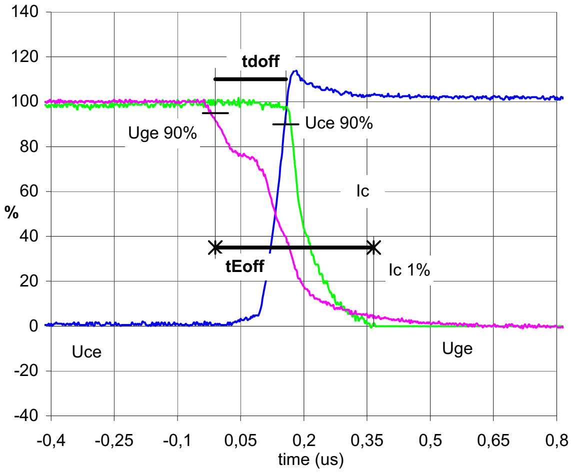
$R_T = f(T)$



Switching definitions

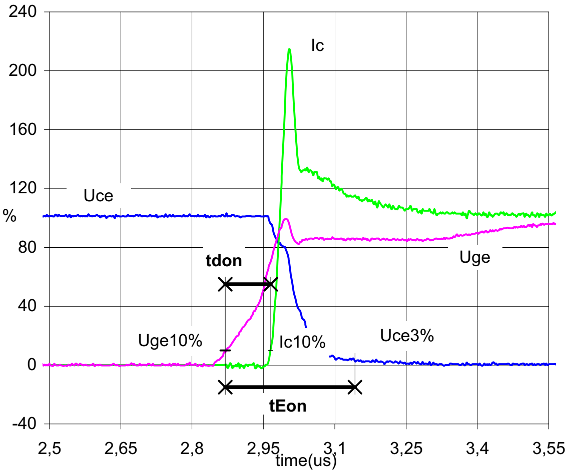
General conditions: Tj= 125 °C Rgon= 16 Ω Rgoff= 16,0 Ω

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



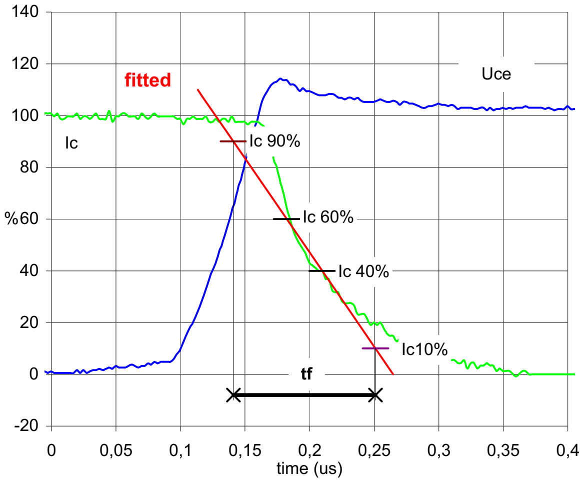
Uge(0%)= -15 V
Uge(100%)= 15 V
Uc(100%)= 300 V
Ic(100%)= 30 A
tdoff= 0,16 us
t_{Eoff}= 0,38 us

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



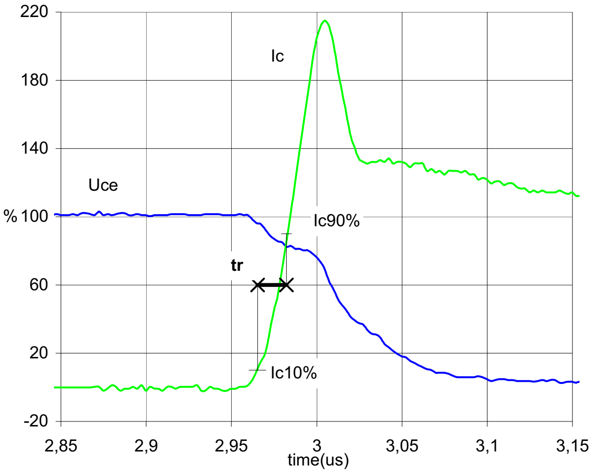
Uge(0%)= -15 V
Uge(100%)= 15 V
Uc(100%)= 300 V
Ic(100%)= 30 A
tdon= 0,09 us
t_{Eon}= 0,27 us

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



Uc(100%)= 300 V
Ic(100%)= 30 A
t_f= 0,087 us

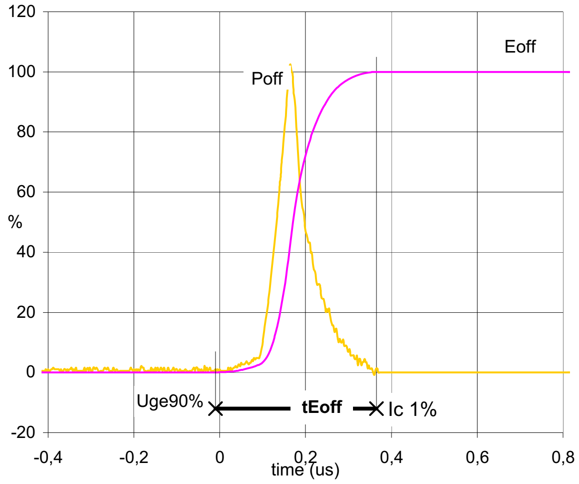
Figure 4. Turn-on Switching Waveforms & definition of t_r
Output inverter IGBT



Uc(100%)= 300 V
Ic(100%)= 30 A
t_r= 0,018 us

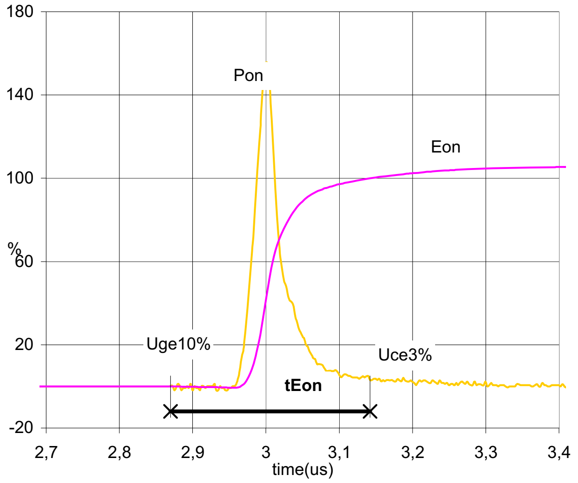
Switching definitions

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



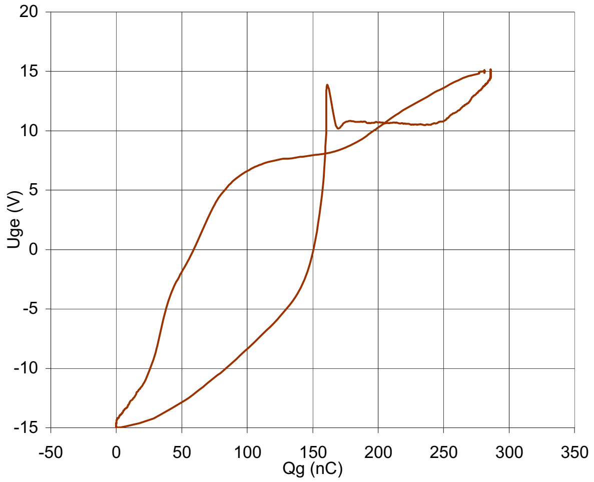
Poff(100%)= 8,95 kW
Eoff(100%)= 0,80 mJ
t_{Eoff}= 0,38 us

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



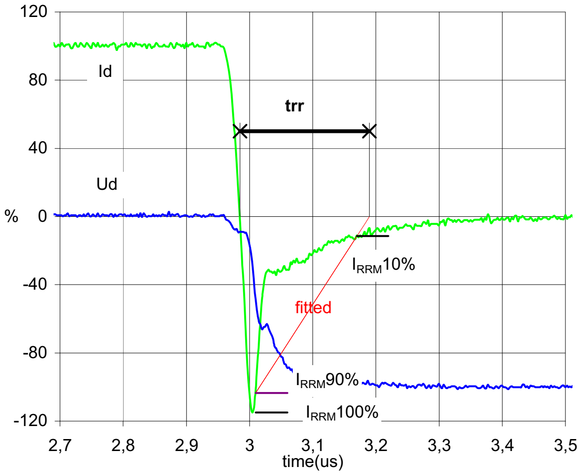
Pon(100%)= 8,95 kW
Eon(100%)= 0,63 mJ
t_{Eon}= 0,27 us

Figure 7. Gate voltage vs Gate charge
Output inverter IGBT



Ugeoff= -15 V
Ugeon= 15 V
Uc(100%)= 300 V
Ic(100%)= 30 A
Qg= 285,8 nC

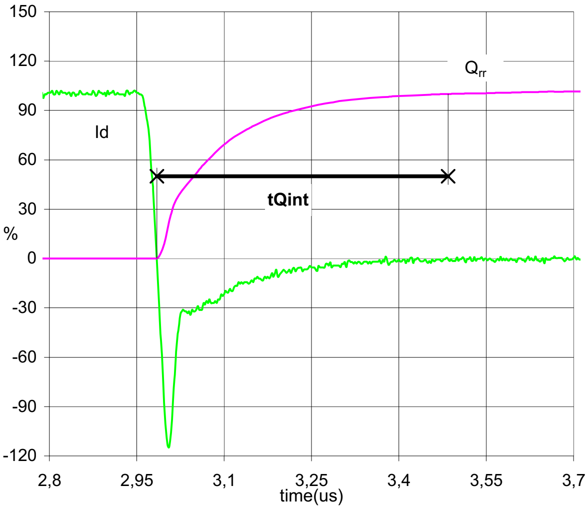
Figure 8. Turn-off Switching Waveforms & definition of t_{rr}
Output inverter FRED



Ud(100%)= 300 V
Id(100%)= 30 A
I_{RRM}(100%)= 34 A
trr= 0,18 us

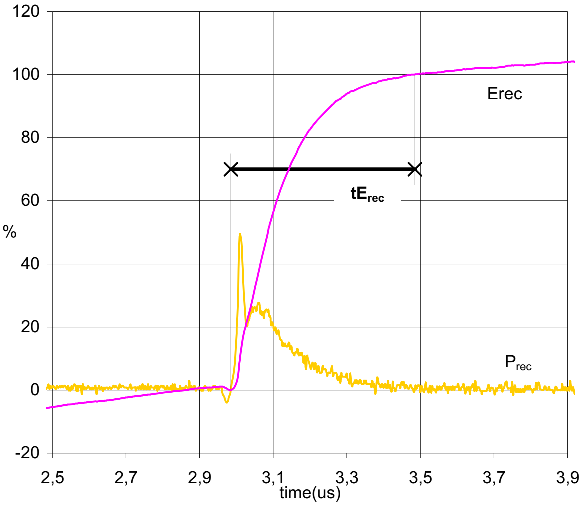
Switching definitions

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



Id(100%)= 30 A
Qrr(100%)= 2,161 uC
tQint= 0,50 us

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



Prec(100%)= 8,95 kW
Erec(100%)= 0,45 mJ
tErec= 0,50 us