flow PIM 0 3rd Gen — 1200V / 8A

Features

- Tyco 2 clip-in housing in 12 and 17mm height
- Trench Fieldstop IGBT's 4 technology
- Optional w/o BRC

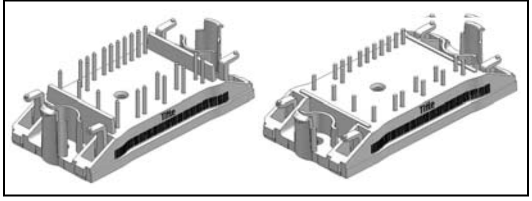
Target Applications

- Industrial Drives
- Embedded Generation

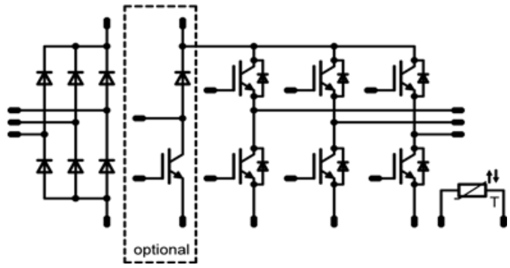
Types

- V23990-P849-A49-PM 17mm height
- V23990-P849-A48-PM 12mm height
- V23990-P849-C49-PM 17mm height; w/o BRC
- V23990-P849-C48-PM 12mm height; w/o BRC

***flow* 0 housing**



Schematic



Maximum Ratings

Tj=25°C, unless otherwise specified

Parameter	Symbol	Condition			Value	Unit
Input Rectifier Diode						
Repetitive peak reverse voltage	V_{RRM}		I_R=0.05mA	T_j=25°C	1600	V
Forward current per diode	I_{FAV}	DC current		T_h=80°C T_c=80°C	28	A
Surge forward current	I_{FSM}	t_p=10ms	180°sine	T_j=$T_j$max	220	A
I2t-value	I^2t				200	A2s
Power dissipation per Diode	P_{tot}	T_j=$T_j$max		T_h=80°C T_c=80°C	33	W
Maximum Junction Temperature	$T_j$max				150	°C

Maximum Ratings

Tj=25°C, unless otherwise specified

Parameter	Symbol	Condition		Value	Unit
Transistor Inverter					
Collector-emitter voltage	V_{CE}			1200	V
DC collector current	I_C	$T_j=T_j$max	T_h=80°C T_c=80°C	13	A
Repetitive peak collector current	I_{Cpuls}	tp limited by $T_j$max		24	A
Power dissipation per IGBT	P_{tot}	$T_j=T_j$max	T_h=80°C T_c=80°C	44	W
Gate-emitter peak voltage	V_{GE}			±20	V
Short circuit ratings*	t_{SC} V_{CC}	T_j=150°C	V_{GE}=15V	10 800	μs V
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

Parameter	Symbol	Condition		Value	Unit
Diode Inverter					
Peak Repetitive Reverse Voltage	VRRM			1200	V
DC forward current	I_F	$T_j=T_j$max	T_h=80°C T_c=80°C	16	A
Repetitive peak forward current	I_{FRM}	tp limited by $T_j$max		20	A
Power dissipation per Diode	P_{tot}	$T_j=T_j$max	T_h=80°C T_c=80°C	36	W
Maximum Junction Temperature	$T_j$max			175	°C

Maximum Ratings

Tj=25°C, unless otherwise specified

Parameter	Symbol	Condition		Value	Unit
Transistor BRC					
Collector-emitter voltage	V_{CE}			1200	V
DC collector current	I_C	T_j=$T_j$max	T_h=80°C T_c=80°C	8	A
Repetitive peak collector current	I_{cpuls}	tp limited by $T_j$max	T_h=80°C	12	A
Power dissipation per IGBT	P_{tot}	T_j=$T_j$max	T_h=80°C T_c=80°C	32	W
Gate-emitter peak voltage	V_{GE}			±20	V
Short circuit ratings*	t_{SC} V_{CC}	T_j=150°C	V_{GE}=15V	10 800	μs V
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

Parameter	Symbol	Condition		Value	Unit
Diode BRC					
Peak Repetitive Reverse Voltage	V_{RRM}			1200	V
DC forward current	I_F	T_j=$T_j$max	T_h=80°C T_c=80°C	7	A
Repetitive peak forward current	I_{FRM}	tp limited by $T_j$max	T_h=80°C	8	A
Power dissipation per Diode	P_{tot}	T_j=$T_j$max	T_h=80°C T_c=80°C	18	W
Maximum Junction Temperature	$T_j$max			150	°C

Parameter	Symbol	Condition	Value	Unit
Thermal properties				
Storage temperature	T_{stg}		-40…+125	°C
Operation junction temperature	T_{jop}		-40…Tjmax-25°C	°C

Parameter	Symbol	Condition	Value	Unit
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 Diode										
Forward voltage	V_F				30	Tj=25°C Tj=125°C	1	1,22 1,19	1,9	V
Threshold voltage (for power loss calc. only)	V_{to}					Tj=25°C Tj=125°C		0,93 0,81	0,83	V
Slope resistance (for power loss calc. only)	r_t					Tj=25°C Tj=125°C		0,01 0,01	0,02	Ohm
Reverse current	I_r			1500		Tj=25°C Tj=125°C			0,01	mA
Thermal resistance chip to heatsink per chip	R_{thJH}	Thermal grease thickness≤50um λ = 0,61 W/mK						2,12		K/W
Thermal resistance chip to case per chip	R_{thJC}									
Transistor Inverter										
Gate emitter threshold voltage	$V_{GE(th)}$	VCE=VGE			0.3m	Tj=25°C Tj=125°C	5	5,8	6,5	V
Collector-emitter saturation voltage	$V_{CE(sat)}$		15		8	Tj=25°C Tj=125°C		1,87 2,2	2,25	V
Collector-emitter cut-off current incl. Diode	I_{CES}		0	1200		Tj=25°C Tj=125°C			0,01	mA
Gate-emitter leakage current	I_{GES}		20	0		Tj=25°C Tj=125°C			200	nA
Integrated Gate resistor	R_{gint}							none		Ohm
Turn-on delay time	$t_{d(on)}$	Rgon=32Ohm Rgoff=32Ohm	±15	600	10			70,6		ns
Rise time	t_r							22,8		ns
Turn-off delay time	$t_{d(off)}$							236		ns
Fall time	t_f							108,2		ns
Turn-on energy loss per pulse	E_{on}							0,75		mWs
Turn-off energy loss per pulse	E_{off}							0,62		mWs
Input capacitance	C_{ies}	f=1MHz	0	25		Tj=25°C		0,49		nF
Output capacitance	C_{oss}							0,05		nF
Reverse transfer capacitance	C_{rss}							0,03		nF
Gate charge	Q_{Gate}		±15			Tj=25°C		69		nC
Thermal resistance chip to heatsink per chip	R_{thJH}	Thermal grease thickness≤50um λ = 0,61 W/mK						2,16		K/W
Thermal resistance chip to case per chip	R_{thJC}									K/W
Diode Inverter										
Diode forward voltage	V_F				10	Tj=25°C Tj=125°C	1,35	1,7 1,66	2,2	V
Reverse leakage current	I_{rm}					Tj=25°C Tj=125°C			2,7	mA
Peak reverse recovery current	I_{RRM}	Rgon=32Ohm	±15	600	10	Tj=25°C Tj=125°C		9,88		A
Reverse recovery time	t_{rr}					Tj=25°C Tj=125°C		382		ns
Reverse recovered charge	Q_{rr}					Tj=25°C Tj=125°C		1,57		mC
Peak rate of fall of recovery current	di(rec)max /dt							69		A/ms
Reverse recovered energy	Erec					Tj=25°C Tj=125°C		0,64		mWs
Thermal resistance chip to heatsink per chip	R_{thJH}	Thermal grease thickness≤50um λ = 0,61 W/mK						2,68		K/W
Thermal resistance chip to case per chip	R_{thJC}									K/W

Characteristic Values

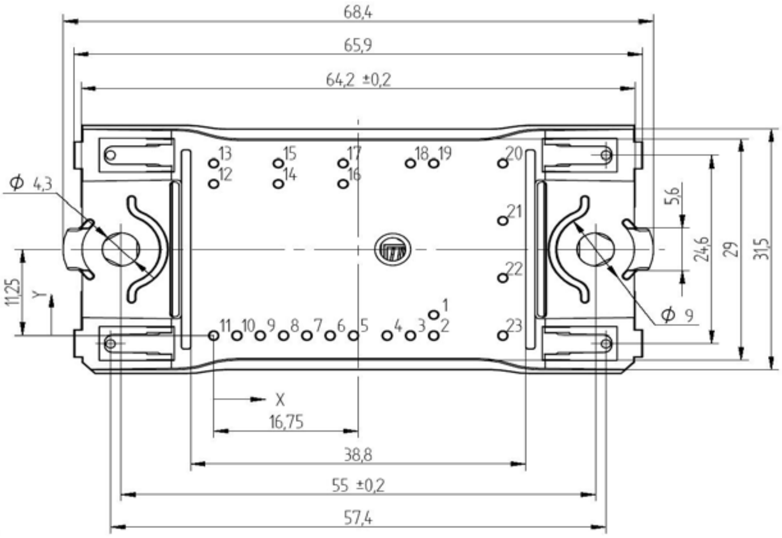
Parameter	Symbol	Conditions					Value			Unit
			V_{GE}(V) or V_{GS}(V)	V_r(V) or V_{CE}(V) or V_{DS}(V)	I_C(A) or I_F(A) or I_D(A)	T(°C)	Min	Typ	Max	
Transistor BRC										
Gate emitter threshold voltage	$V_{GE(th)}$	VCE=VGE			0.15m	Tj=25°C Tj=150°C	5	5,8	6,5	V
Collector-emitter saturation voltage	$V_{CE(sat)}$		15		4	Tj=25°C Tj=125°C		1,96 2,17	2,2	V
Collector-emitter cut-off	I_{CES}		0	1200		Tj=25°C Tj=125°C			0,05	mA
Gate-emitter leakage current	I_{GES}		20	0		Tj=25°C Tj=150°C			200	nA
Integrated Gate resistor	R_{gint}							none		Ohm
Turn-on delay time	$t_{d(on)}$	Rgon=64Ohm Rgoff=64Ohm	±15	600	4	Tj=25°C Tj=150°C		90		ns
Rise time	t_r					Tj=25°C Tj=150°C		24		ns
Turn-off delay time	$t_{d(off)}$					Tj=25°C Tj=150°C		226		ns
Fall time	t_f					Tj=25°C Tj=150°C		99		ns
Turn-on energy loss per pulse	E_{on}					Tj=25°C Tj=150°C		0,34		mWs
Turn-off energy loss per pulse	E_{off}					Tj=25°C Tj=150°C		0,3		mWs
Input capacitance	C_{ies}	f=1MHz	0	25		Tj=25°C		0,25		nF
Output capacitance	C_{oss}							0,025		nF
Reverse transfer capacitance	C_{rss}							0,015		nF
Gate charge	Q_{Gate}		±15	600	4	Tj=25°C				nC
Thermal resistance chip to heatsink per chip	R_{thJH}	Thermal grease thickness≤50um λ = 0,61 W/mK						2,93		K/W
Thermal resistance chip to case per chip	R_{thJC}									K/W
Diode BRC										
Diode forward voltage	V_F				4	Tj=25°C Tj=125°C	1	1,91 1,84	2,35	V
Reverse leakage current	I_r					Tj=25°C Tj=125°C			250	mA
Peak reverse recovery current	I_{RRM}	Rgon=64Ohm	±15	600	4	Tj=25°C Tj=125°C		4,65		A
Reverse recovery time	t_{rr}					Tj=25°C Tj=125°C		446		ns
Reverse recovered charge	Q_{rr}					Tj=25°C Tj=125°C		0,76		mC
Peak rate of fall of recovery current	di(rec)max /dt					Tj=25°C Tj=125°C		40		A/ms
Reverse recovery energy	E_{rec}					Tj=25°C Tj=125°C		0,32		mWs
Thermal resistance chip to heatsink per chip	R_{thJH}	Thermal grease thickness≤50um λ = 0,61 W/mK						3,98		K/W
Thermal resistance chip to case per chip	R_{thJC}									K/W
Thermistor										
Rated resistance	R_{25}	Tol. ±5%				Tj=25°C	20,9	22	23,1	kOhm
Deviation of R100	$D_{R/R}$	R100=1503Ohm				Tc=100°C		2,9		%/K
Power dissipation given Epcos-Typ	P					Tj=25°C		210		mW
B-value	$B_{(25/100)}$	Tol. ±3%				Tj=25°C		3980		K

Package Outline and Pinout

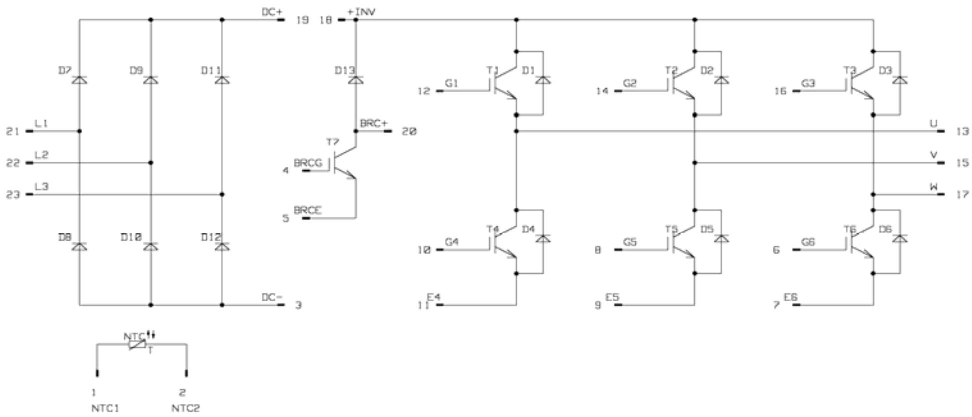
Outline

Pin table

Pin	X	Y
1	25,5	2,7
2	25,5	0
3	22,8	0
4	20,1	0
5	16,2	0
6	13,5	0
7	10,8	0
8	8,1	0
9	5,4	0
10	2,7	0
11	0	0
12	0	19,8
13	0	22,5
14	7,5	19,8
15	7,5	22,5
16	15	19,8
17	15	22,5
18	22,8	22,5
19	25,5	22,5
20	33,5	22,5
21	33,5	15
22	33,5	7,5
23	33,5	0



Pinout



This drawing contains the maximum configuration.
Depending upon types, some components may be left. See in part list.

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. Tyco Electronics 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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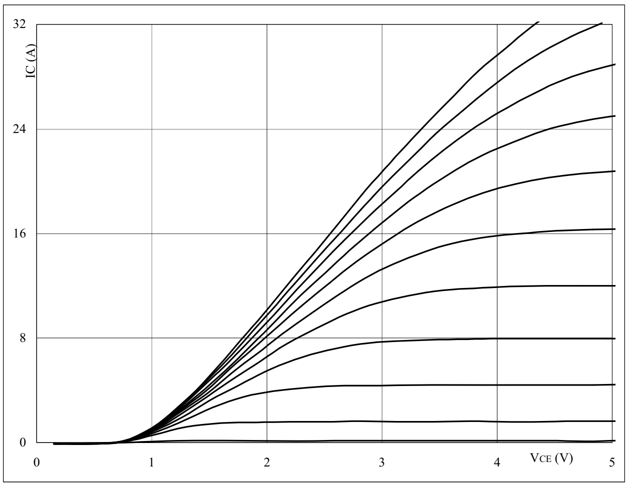
2. A critical component is any component of a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.

Output Inverter

Figure 1 Output inverter IGBT

Typical output characteristics

$I_C = f(V_{CE})$



At

t_p = 250 µs

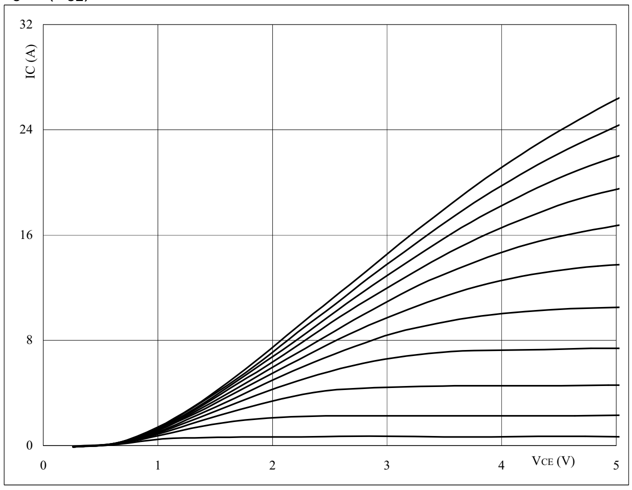
T_j = 25 °C

VGE from 7 V to 17 V in steps of 1 V

Figure 2 Output inverter IGBT

Typical output characteristics

$I_C = f(V_{CE})$



At

t_p = 250 µs

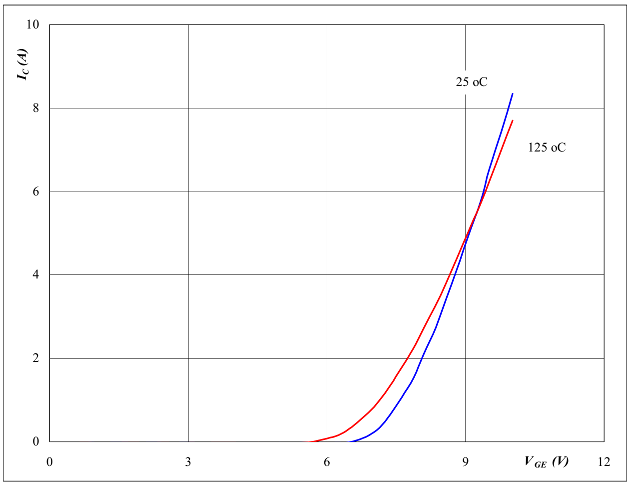
T_j = 125 °C

VGE from 7 V to 17 V in steps of 1 V

Figure 3 Output inverter IGBT

Typical transfer characteristics

$I_c = f(V_{GE})$



At

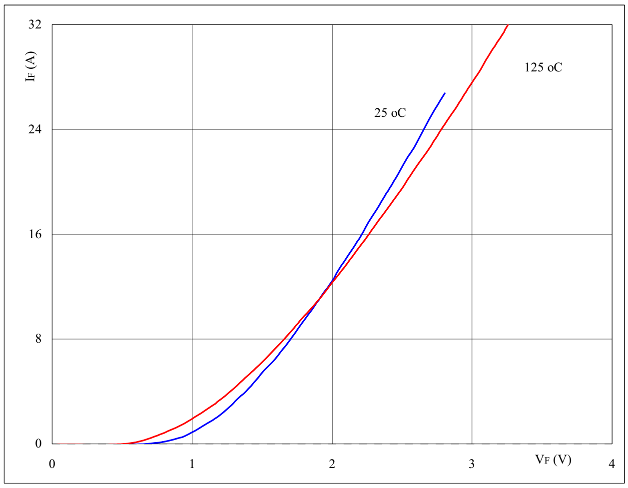
t_p = 250 µs

V_{CE} = 10 V

Figure 4 Output inverter FRED

Typical diode forward current as a function of forward voltage

$I_F = f(V_F)$



At

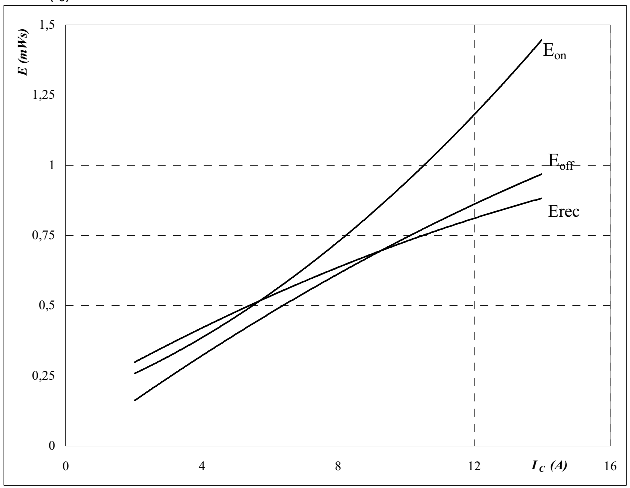
t_p = 250 µs

Output Inverter

Figure 5 Output inverter IGBT

Typical switching energy losses as a function of collector current

E = f(I_c)



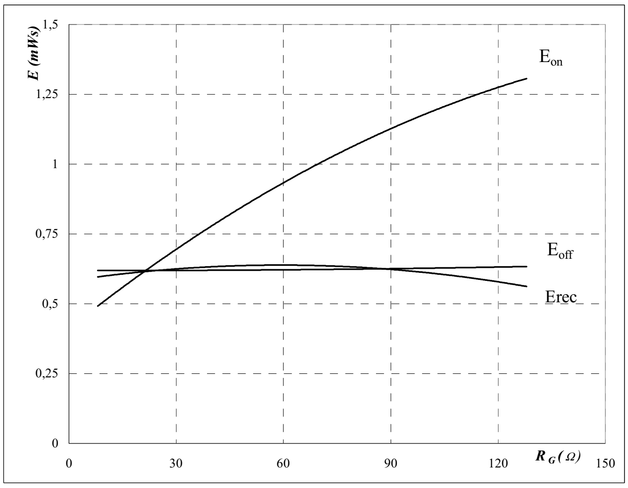
With an inductive load at

T_j =	125	°C
V_{CE} =	600	V
V_{GE} =	±15	V
R_{gon} =	32	Ω
R_{goff} =	32	Ω

Figure 6 Output inverter IGBT

Typical switching energy losses as a function of gate resistor

E = f(R_G)



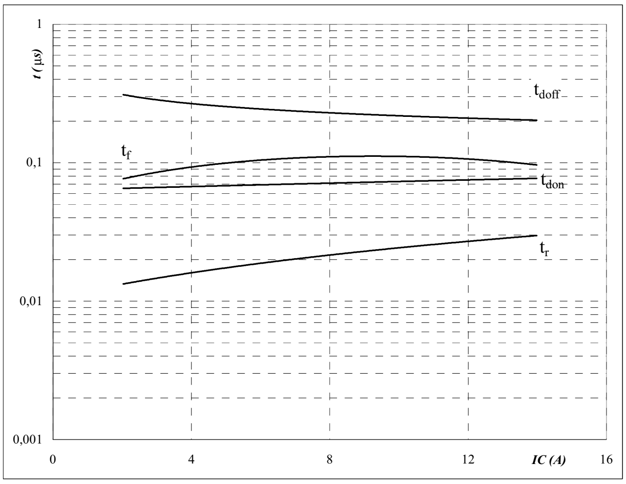
With an inductive load at

T_j =	125	°C
V_{CE} =	600	V
V_{GE} =	±15	V
I_C =	8	A

Figure 7 Output inverter IGBT

Typical switching times as a function of collector current

t = f(I_C)



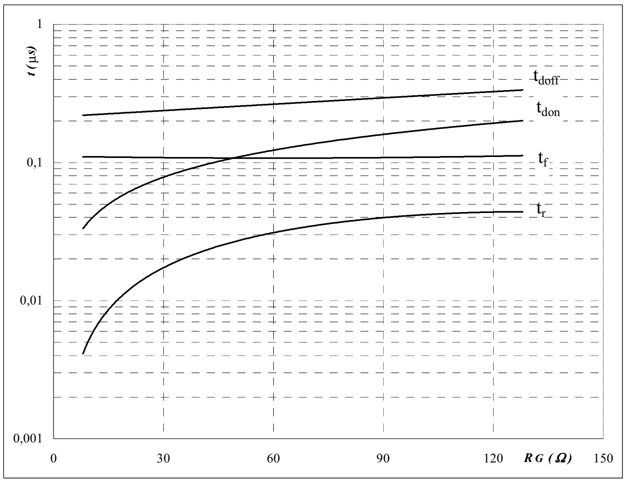
With an inductive load at

T_j =	125	°C
V_{CE} =	600	V
V_{GE} =	±15	V
R_{gon} =	32	Ω
R_{goff} =	32	Ω

Figure 8 Output inverter IGBT

Typical switching times as a function of gate resistor

t = f(R_G)



With an inductive load at

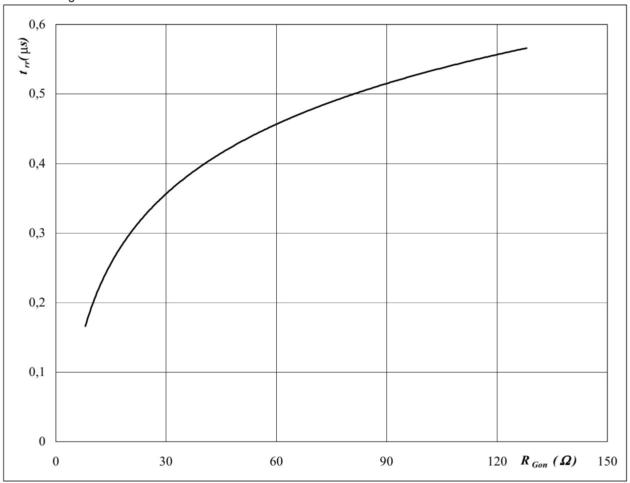
T_j =	125	°C
V_{CE} =	600	V
V_{GE} =	±15	V
I_C =	8	A

Output Inverter

Figure 9 Output inverter FRED diode

Typical reverse recovery time as a function of IGBT turn on gate resistor

$t_{rr} = f(R_{gon})$



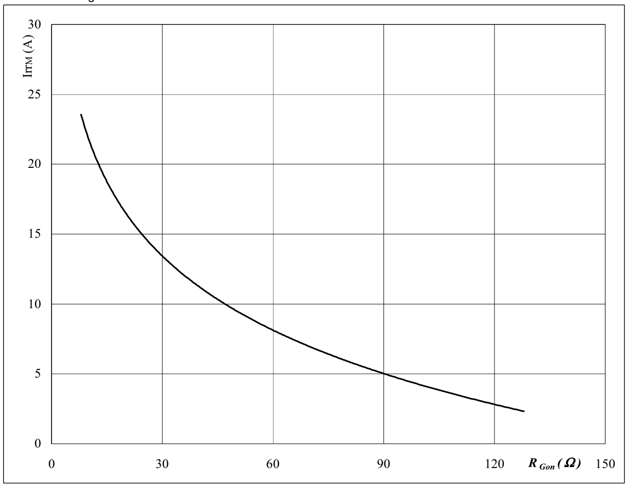
At

T_j =	125	°C
V_R =	600	V
I_F =	8	A
V_{GE} =	±15	V

Figure 10 Output inverter FRED diode

Typical reverse recovery current as a function of IGBT turn on gate resistor

$I_{RRM} = f(R_{gon})$



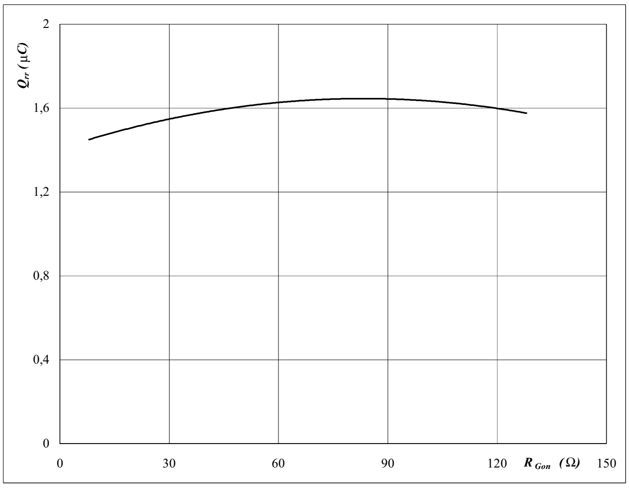
At

T_j =	125	°C
V_R =	600	V
I_F =	8	A
V_{GE} =	±15	V

Figure 11 Output inverter FRED diode

Typical reverse recovery charge as a function of IGBT turn on gate resistor

$Q_{rr} = f(R_{gon})$



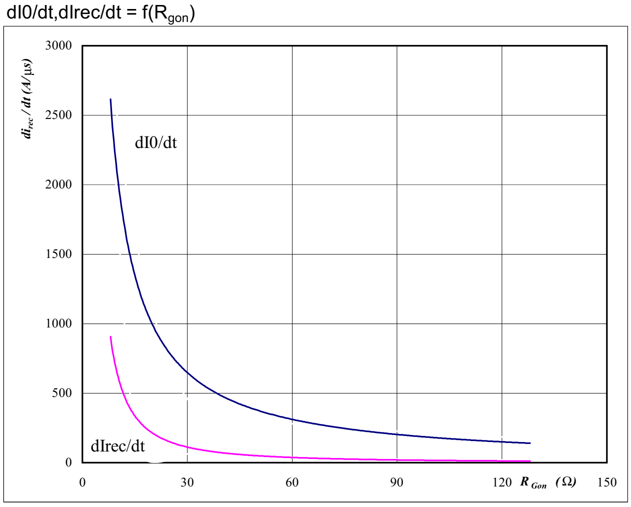
At

T_j =	125	°C
V_R =	600	V
I_F =	8	A
V_{GE} =	±15	V

Figure 12 Output inverter FRED diode

Typical rate of fall of forward and reverse recovery current as a function of IGBT turn on gate resistor

$dI0/dt, dIrec/dt = f(R_{gon})$



At

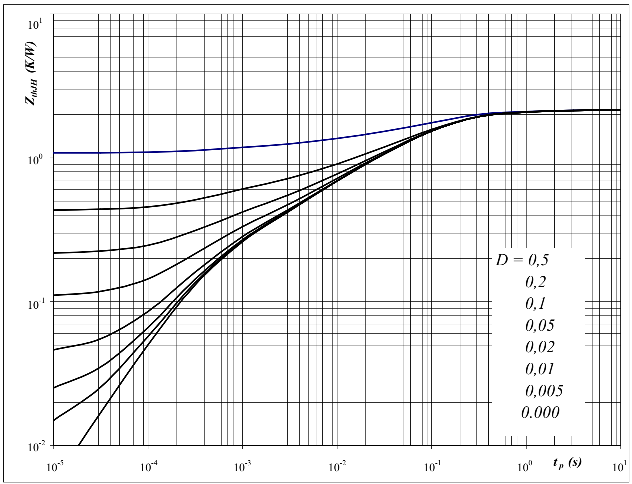
T_j =	125	°C
V_R =	600	V
I_F =	8	A
V_{GE} =	±15	V

Output Inverter

Figure 13 Output inverter IGBT

IGBT transient thermal impedance
as a function of pulse width

$Z_{thJH} = f(tp)$



With

D =	tp / T	
R_{thJH} =	2,16	K/W

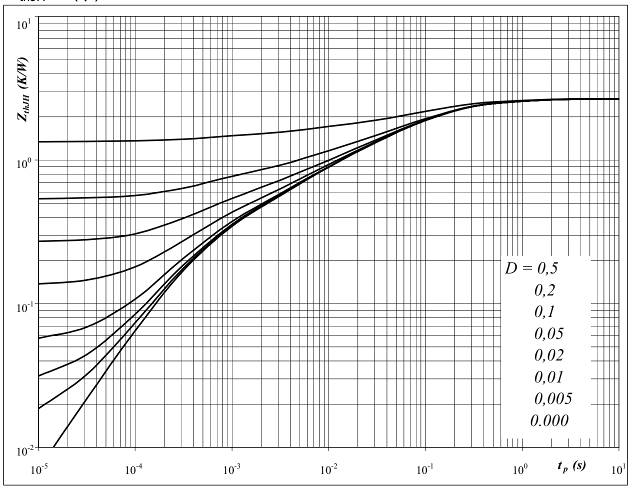
IGBT thermal model values

R (C/W)	Tau (s)
0,05	4,1E+00
0,25	5,5E-01
0,99	1,0E-01
0,45	1,9E-02
0,24	3,3E-03
0,18	4,0E-04

Figure 14 Output inverter FRED diode

FRED transient thermal impedance
as a function of pulse width

$Z_{thJH} = f(tp)$



With

D =	tp / T	
R_{thJH} =	2,68	K/W

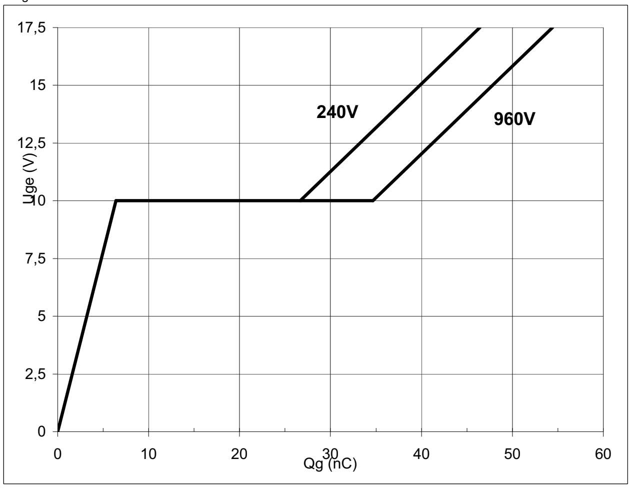
FRED thermal model values

R (C/W)	Tau (s)
0,05	7,9E+00
0,27	7,3E-01
1,07	1,3E-01
0,69	2,5E-02
0,36	3,6E-03
0,25	4,3E-04

Figure 15 Output inverter IGBT

Gate voltage vs Gate charge
Output inverter IGBT

$U_{ge} = f(Qg)$



At

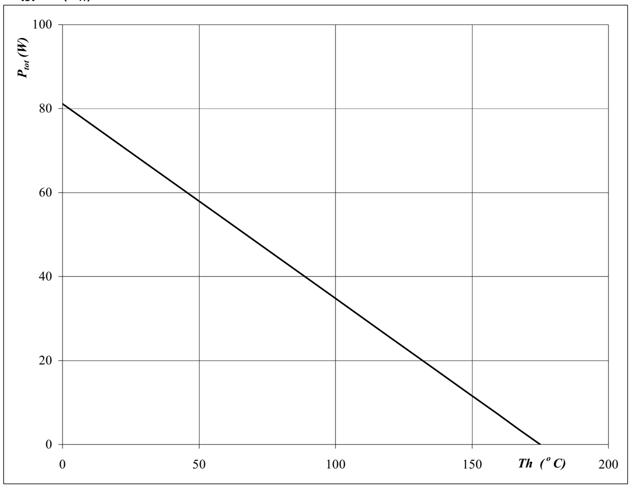
V_{CE} (80%) =	960	V
V_{CE} (20%) =	240	V
V_{GE} =	15	V
I_C (100%) =	8	A
Q_g =	50	nC

Output Inverter

Figure 16 Output inverter IGBT

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_h)$

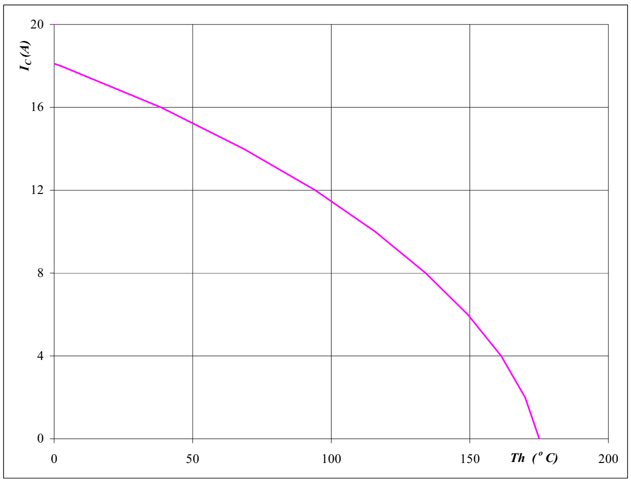


At
T_j = 175 °C

Figure 17 Output inverter IGBT

Collector current as a function of heatsink temperature

$I_C = f(T_h)$

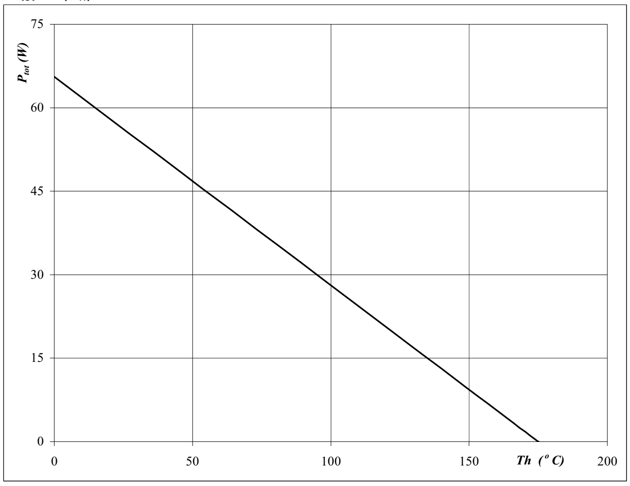


At
T_j = 175 °C
V_{GE} = 15 V

Figure 18 Output inverter FRED

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_h)$

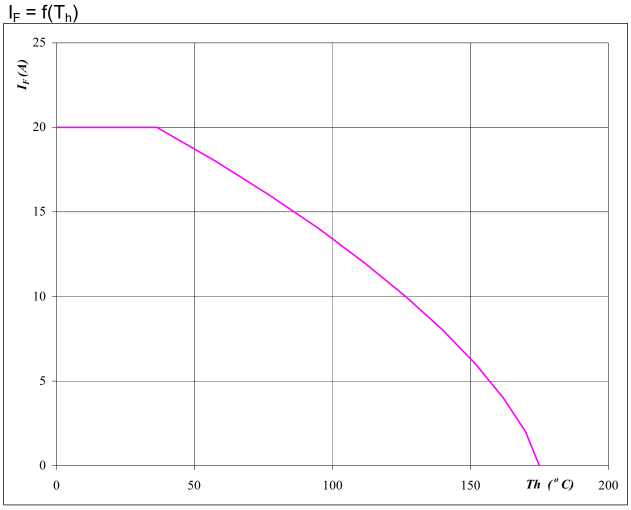


At
T_j = 175 °C

Figure 19 Output inverter FRED

Forward current as a function of heatsink temperature

$I_F = f(T_h)$



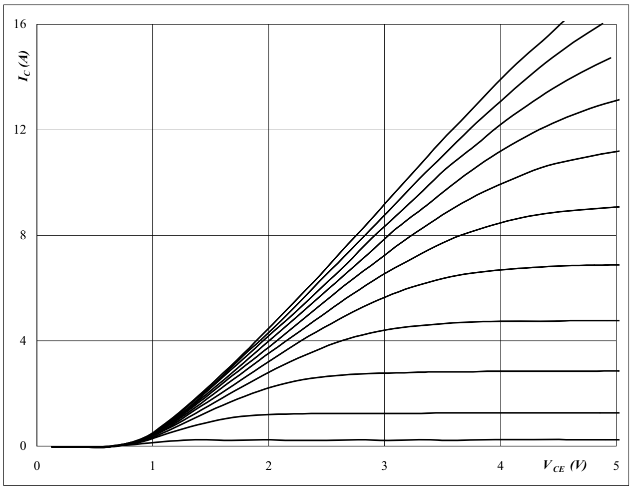
At
T_j = 175 °C

Brake

Figure 1 Brake IGBT

Typical output characteristics

$I_C = f(V_{CE})$



At

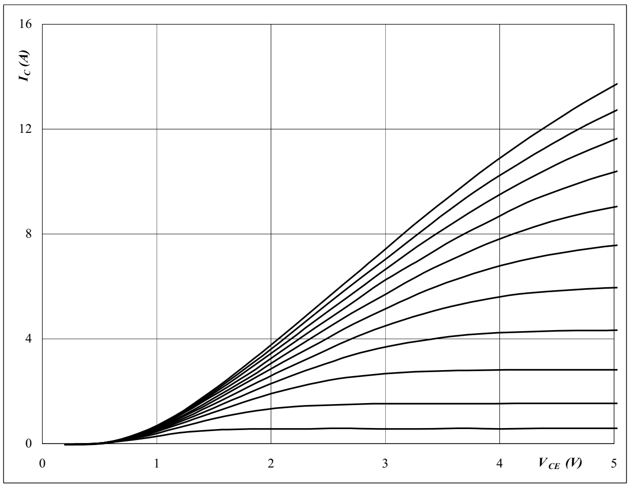
t_p =	250	μs
T_j =	25	°C

VGE from 7 V to 17 V in steps of 1 V

Figure 2 Brake IGBT

Typical output characteristics

$I_C = f(V_{CE})$



At

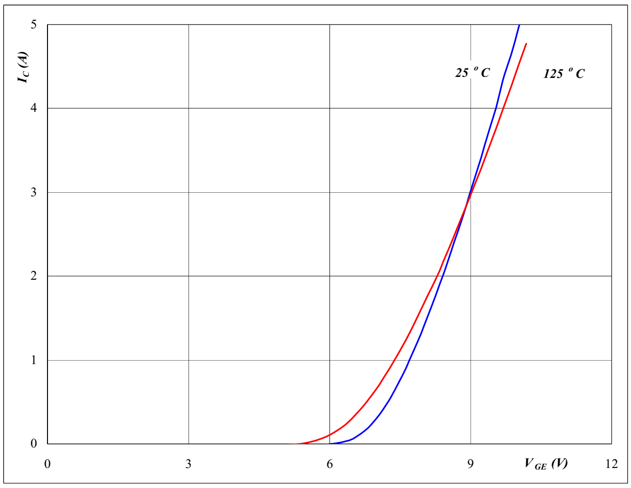
t_p =	250	μs
T_j =	125	°C

VGE from 7 V to 17 V in steps of 1 V

Figure 3 Brake IGBT

Typical transfer characteristics

$I_C = f(V_{GE})$



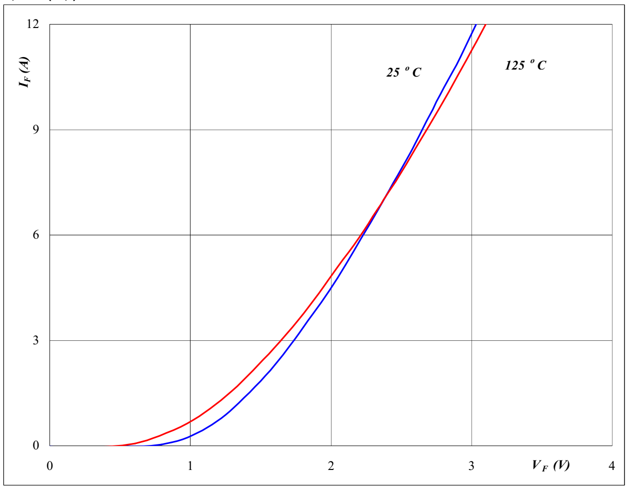
At

t_p =	250	μs
V_{CE} =	10	V

Figure 4 Brake FRED

Typical diode forward current as a function of forward voltage

$I_F = f(V_F)$



At

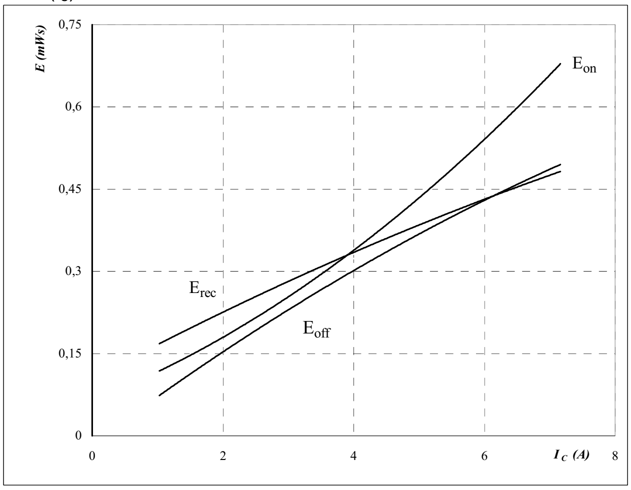
t_p =	250	μs

Brake

Figure 5 Brake IGBT

Typical switching energy losses as a function of collector current

$E = f(I_C)$



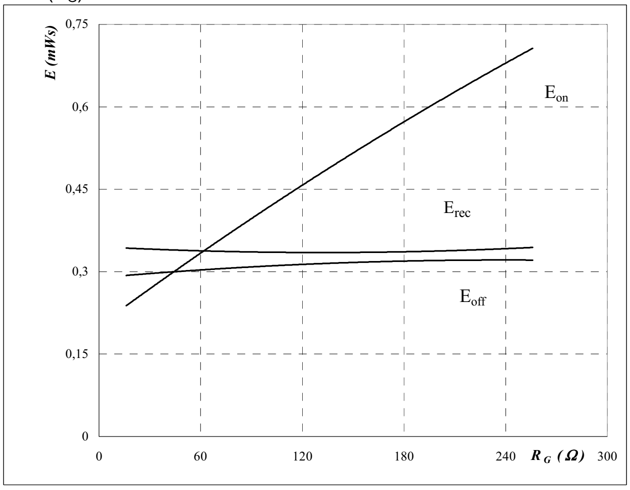
With an inductive load at

T_j =	125	°C
V_{CE} =	600	V
V_{GE} =	±15	V
R_{gon} =	64	Ω
R_{goff} =	64	Ω

Figure 6 Brake IGBT

Typical switching energy losses as a function of gate resistor

$E = f(R_G)$



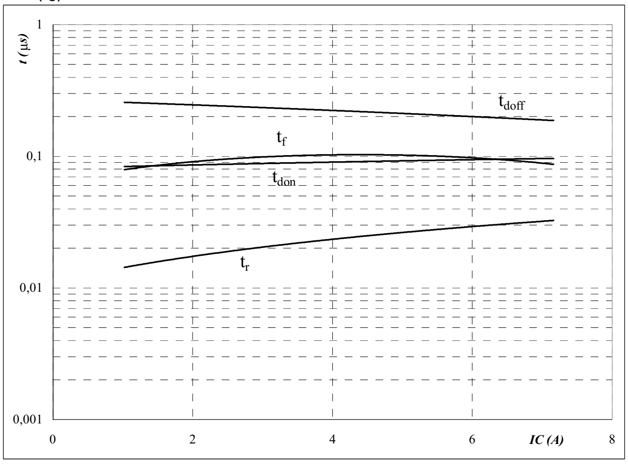
With an inductive load at

T_j =	125	°C
V_{CE} =	600	V
V_{GE} =	±15	V
I_C =	4	A

Figure 7 Brake IGBT

Typical switching times as a function of collector current

$t = f(I_C)$



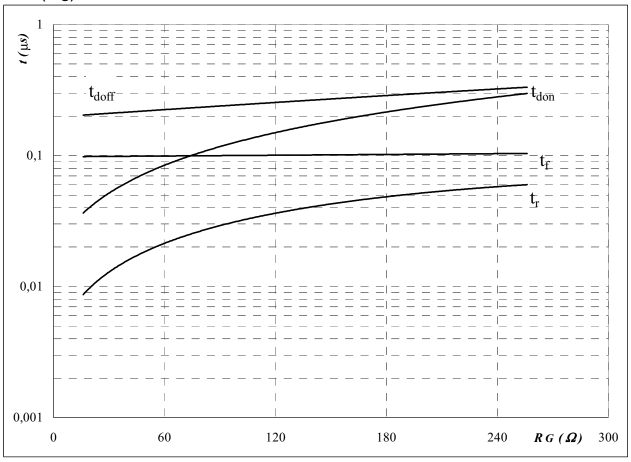
With an inductive load at

T_j =	125	°C
V_{CE} =	600	V
V_{GE} =	±15	V
R_{gon} =	64	Ω
R_{goff} =	64	Ω

Figure 8 Brake IGBT

Typical switching times as a function of gate resistor

$t = f(R_G)$



With an inductive load at

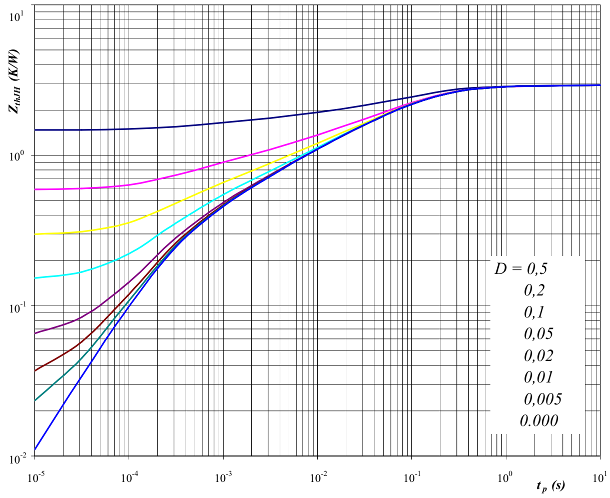
T_j =	125	°C
V_{CE} =	600	V
V_{GE} =	±15	V
I_C =	4	A

Brake

Figure 9

IGBT transient thermal impedance
as a function of pulse width

$Z_{thJH} = f(t_p)$

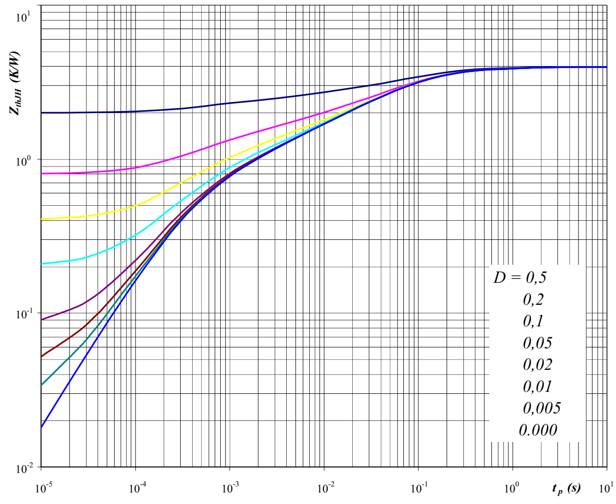


With
D = tp / T
R_{thJH} = 2,93 K/W

Figure 10

FRED transient thermal impedance
as a function of pulse width

$Z_{thJH} = f(t_p)$



With
D = tp / T
R_{thJH} = 3,98 K/W

Brake

Figure 11 Brake IGBT

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_h)$

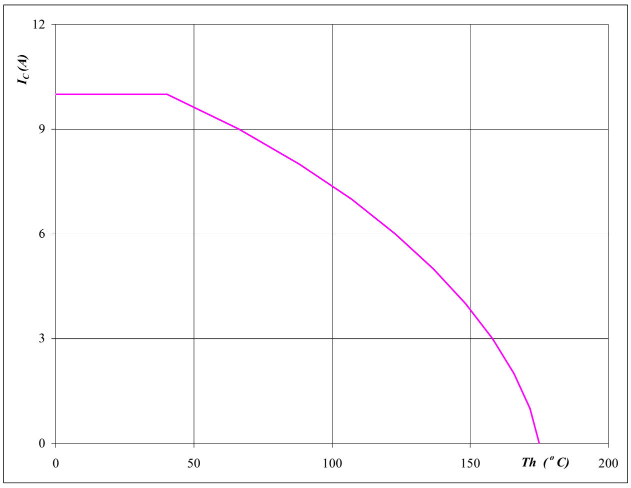
At

T_j = 175 ºC

Figure 12 Brake IGBT

Collector current as a function of heatsink temperature

$I_C = f(T_h)$



At

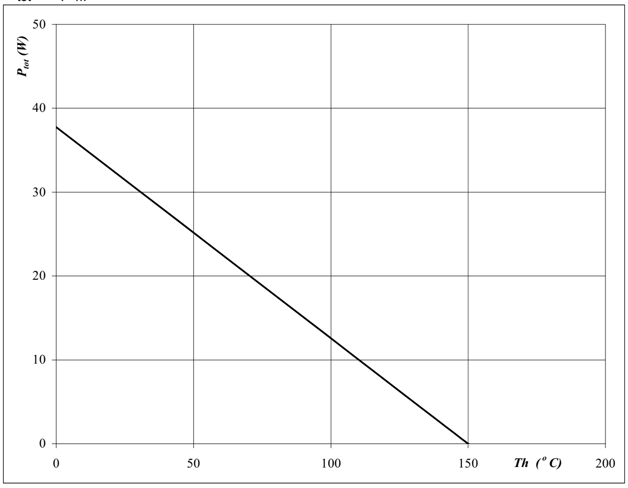
T_j = 175 ºC

V_{GE} = 15 V

Figure 13 Brake FRED

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_h)$



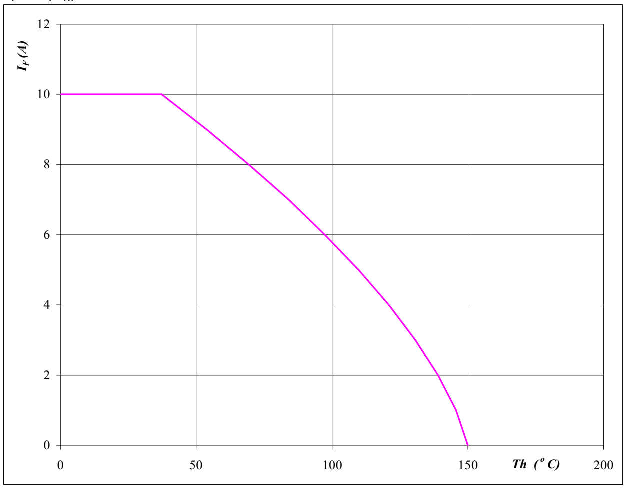
At

T_j = 150 ºC

Figure 14 Brake FRED

Forward current as a function of heatsink temperature

$I_F = f(T_h)$



At

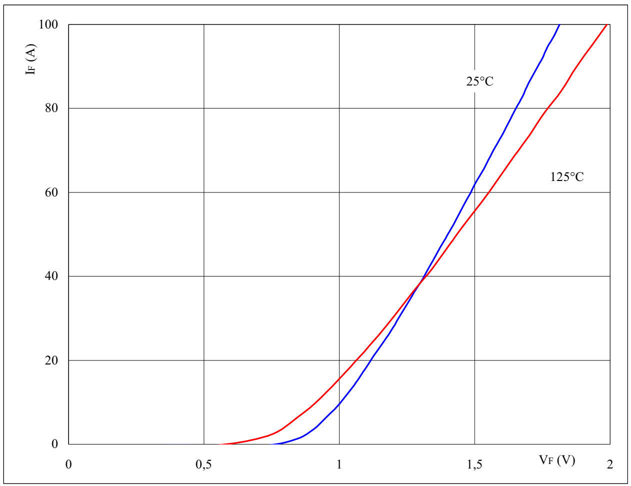
T_j = 150 ºC

Input Rectifier Bridge

Figure 1 Rectifier diode

Typical diode forward current as a function of forward voltage

$I_F = f(V_F)$



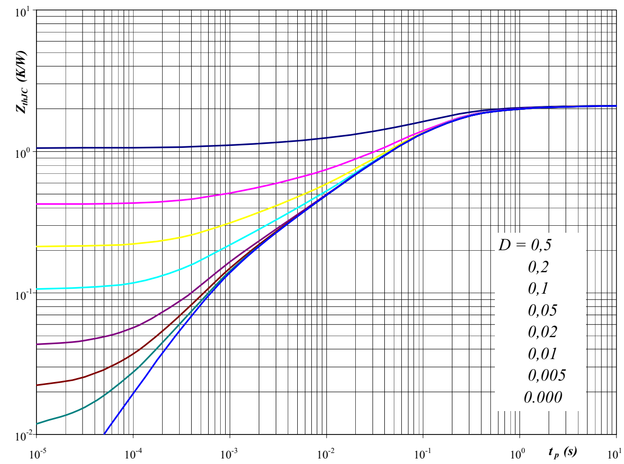
At

t_p = 250 µs

Figure 2 Rectifier diode

Diode transient thermal impedance as a function of pulse width

$Z_{thJH} = f(t_p)$



With

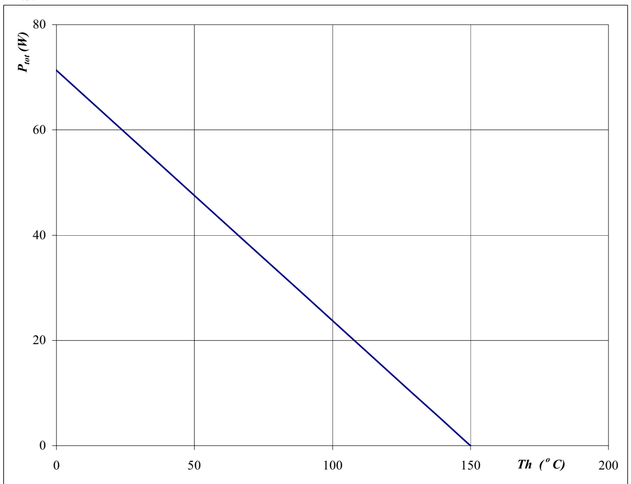
D = tp / T

R_{thJH} = 2,12 K/W

Figure 3 Rectifier diode

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_h)$



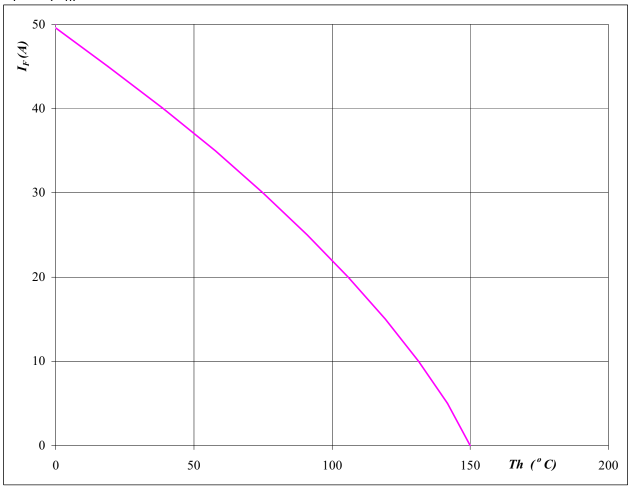
At

T_j = 150 ºC

Figure 4 Rectifier diode

Forward current as a function of heatsink temperature

$I_F = f(T_h)$



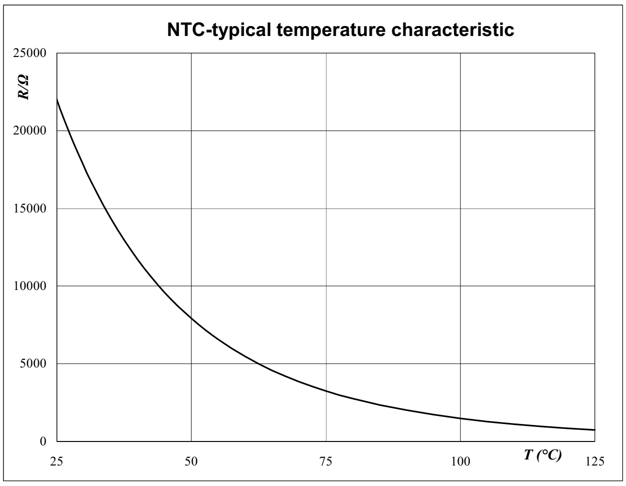
At

T_j = 150 ºC

Thermistor

Figure 1	Thermistor

Typical NTC characteristic
as a function of temperature
$R_T = f(T)$



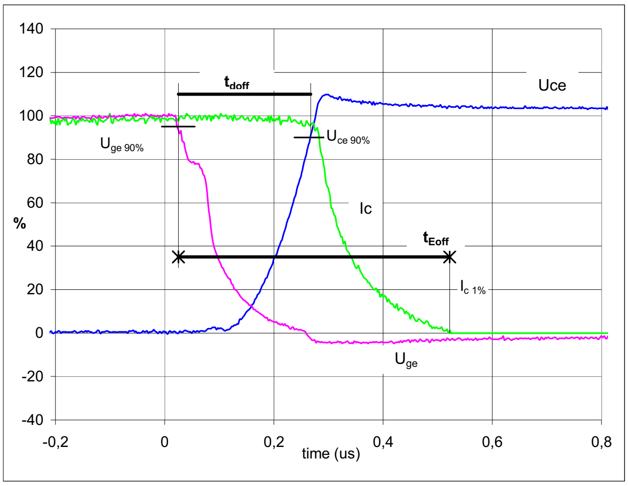
Switching Definitions Output Inverter

General conditions

T_j	=	125,3 °C
R_{gon}	=	32 Ω
R_{goff}	=	32 Ω

Figure 1 Output inverter IGBT

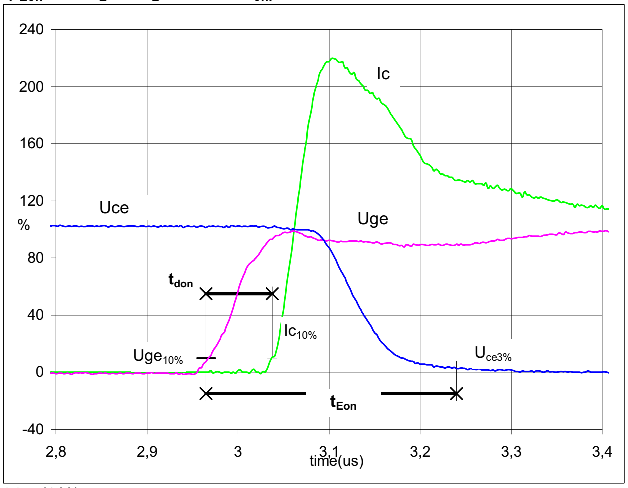
Turn-off Switching Waveforms & definition of tdoff, tEoff
(t_{Eoff} = integrating time for E_{off})



V_{GE} (0%) =	-15	V
V_{GE} (100%) =	15	V
V_C (100%) =	600	V
I_C (100%) =	8	A
t_{doff} =	0,24	μs
t_{Eoff} =	0,50	μs

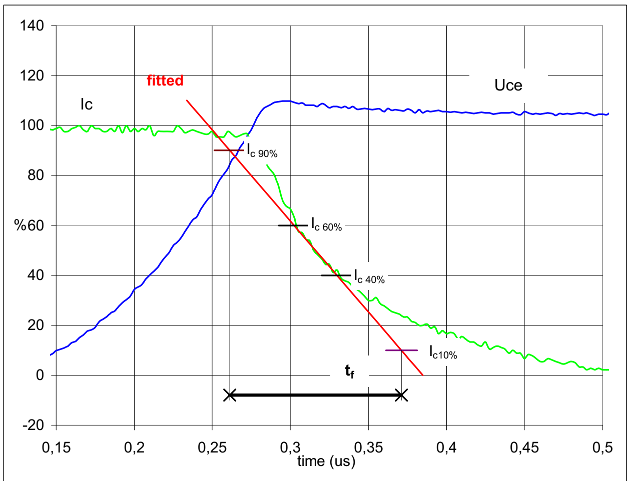
Figure 2 Output inverter IGBT

Turn-on Switching Waveforms & definition of tdon, tEon
(t_{Eon} = integrating time for E_{on})



V_{GE} (0%) =	-15	V
V_{GE} (100%) =	15	V
V_C (100%) =	600	V
I_C (100%) =	8	A
t_{don} =	0,07	μs
t_{Eon} =	0,275	μs

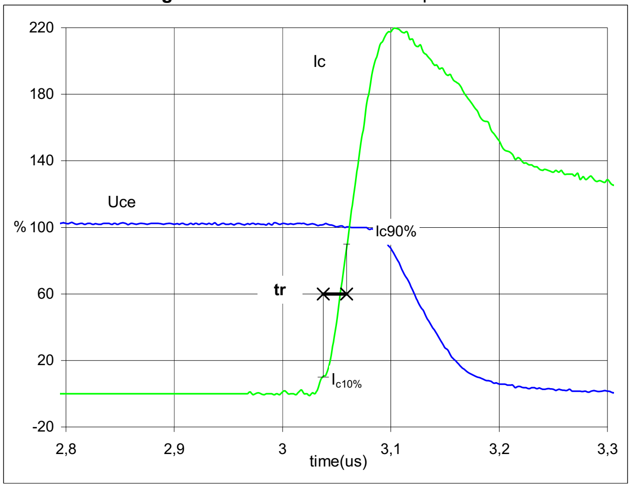
Figure 3 Output inverter I



V_C (100%) =	600	V
I_C (100%) =	8	A
t_f =	0,108	μs

Figure 4 Output inverter IGBT

Turn-on Switching Waveforms & definition of t_r

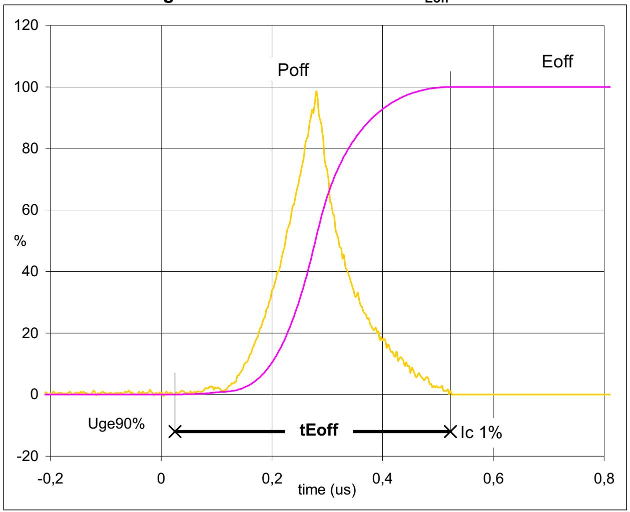


V_C (100%) =	600	V
I_C (100%) =	8	A
t_r =	0,023	μs

Switching Definitions Output Inverter

Figure 5 Output inverter IGBT

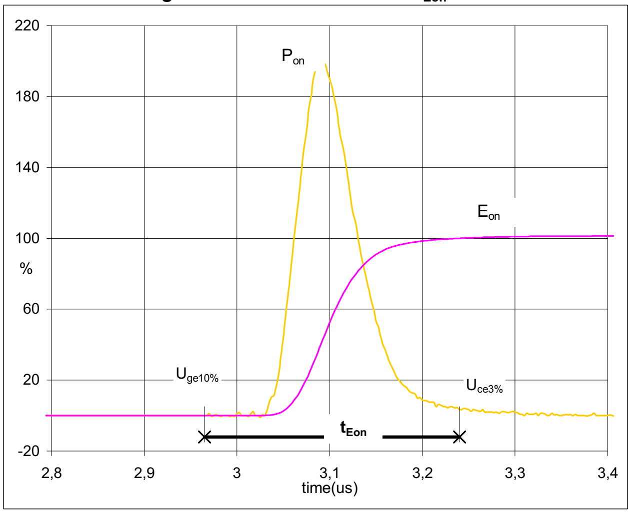
Turn-off Switching Waveforms & definition of t_{Eoff}



P_{off} (100%) =	4,93	kW
E_{off} (100%) =	0,62	mJ
t_{Eoff} =	0,50	µs

Figure 6 Output inverter IGBT

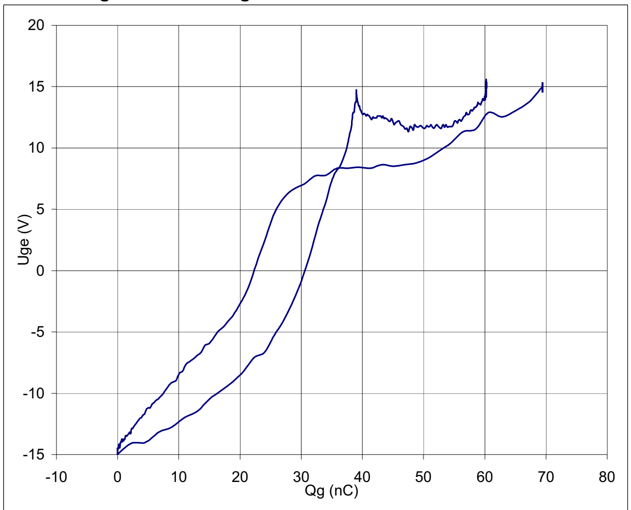
Turn-on Switching Waveforms & definition of t_{Eon}



P_{on} (100%) =	4,932	kW
E_{on} (100%) =	0,75	mJ
t_{Eon} =	0,275	µs

Figure 7 Output inverter IGBT

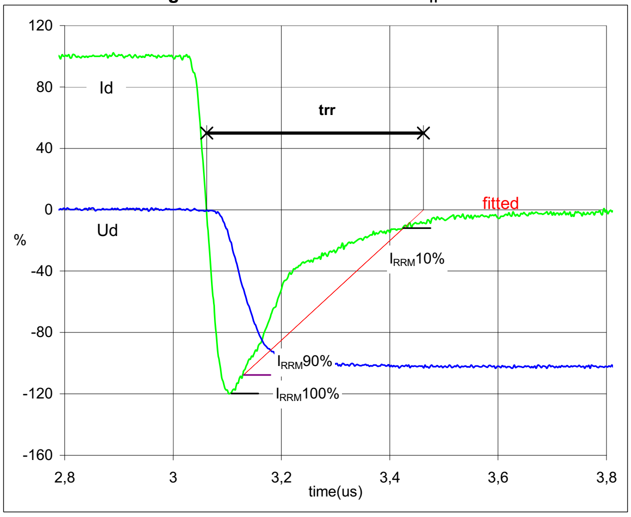
Gate voltage vs Gate charge



V_{GEoff} =	-15	V
V_{GEon} =	15	V
V_C (100%) =	600	V
I_C (100%) =	8	A
Q_g =	69,42825	nC

Figure 8 Output inverter FRED

Turn-off Switching Waveforms & definition of t_{rr}

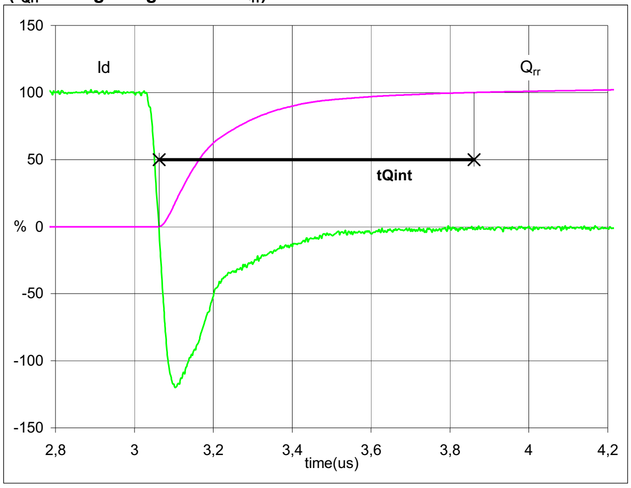


V_d (100%) =	600	V
I_d (100%) =	8	A
I_{RRM} (100%) =	-10	A
t_{rr} =	0,383	µs

Switching Definitions Output Inverter

Figure 9 Output inverter FRED

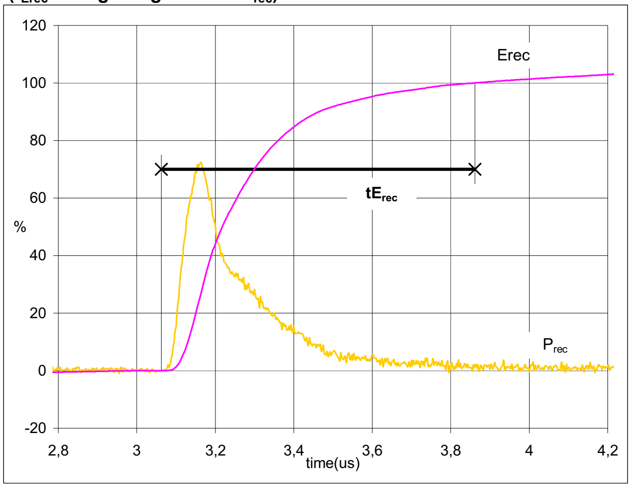
Turn-on Switching Waveforms & definition of t_{Qrr}
(t_{Qrr} = integrating time for Q_{rr})



I_d (100%) =	8	A
Q_{rr} (100%) =	1,569	µC
t_{Qint} =	0,80	µs

Figure 10 Output inverter FRED

Turn-on Switching Waveforms & definition of t_{Erec}
(t_{Erec} = integrating time for E_{rec})



P_{rec} (100%) =	4,932	kW
E_{rec} (100%) =	0,634	mJ
t_{Erec} =	0,80	µs