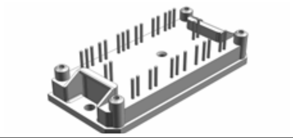
Vincotech

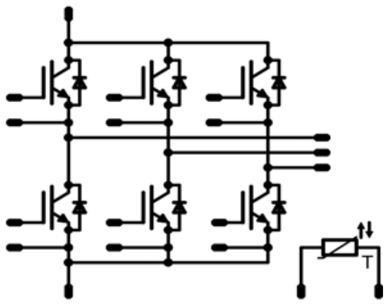
V23990-P823-F-PM
preliminary datasheet

flowPACK 1 3rd gen **600V/50A**

Features
- Compact flow1 housing
- Trench Fieldstop IGBT3 Technology
- Compact and Low Inductance Design
- AlN substrate for improved performance
- Built-in NTC

flow1 housing


Target Applications
- Motor Drive
- Power Generation
- UPS

Schematic


Types
- V23990-P823-F

Maximum Ratings

Tj=25°C, unless otherwise specified

Parameter	Symbol	Condition		Value	Unit
Inverter Transistor					
Collector-emitter break down voltage	V_{CE}			600	V
DC collector current	I_C	$T_j=T_j$max	$T_h=80°C$ $T_c=80°C$	50	A
Repetitive peak collector current	I_{Cpulse}	t_p limited by $T_j$max	$T_h=80°C$ $T_c=80°C$	150	A
Power dissipation per IGBT	P_{tot}	$T_j=T_j$max	$T_h=80°C$ $T_c=80°C$	139	W
Gate-emitter peak voltage	V_{GE}			±20	V
Short circuit ratings	t_{SC} V_{CC}	$T_j≤150°C$ $V_{GE}=15V$		6 360	μs V
Maximum Junction Temperature	$T_j$max			175	°C
Inverter Diode					
Peak Repetitive Reverse Voltage	V_{RRM}	$T_j=25°C$		600	V
DC forward current	I_F	$T_j=T_j$max	$T_h=80°C$ $T_c=80°C$	50	A
Repetitive peak forward current	I_{FRM}	t_p limited by $T_j$max	$T_h=80°C$ $T_c=80°C$	100	A
Power dissipation per Diode	P_{tot}	$T_j=T_j$max	$T_h=80°C$ $T_c=80°C$	109	W
Maximum Junction Temperature	$T_j$max			175	°C

Maximum Ratings

Tj=25°C, unless otherwise specified

Parameter	Symbol	Condition	Value	Unit
Thermal Properties				
Storage temperature	T_{stg}		-40…+125	°C
Operation temperature under switching condition	T_{op}		-40…+150	°C
Insulation Properties				
Insulation voltage	V_{is}	t=1min	4000	V_{DC}
Creepage distance			min 12,7	mm
Clearance			min 12,7	mm

Characteristic Values

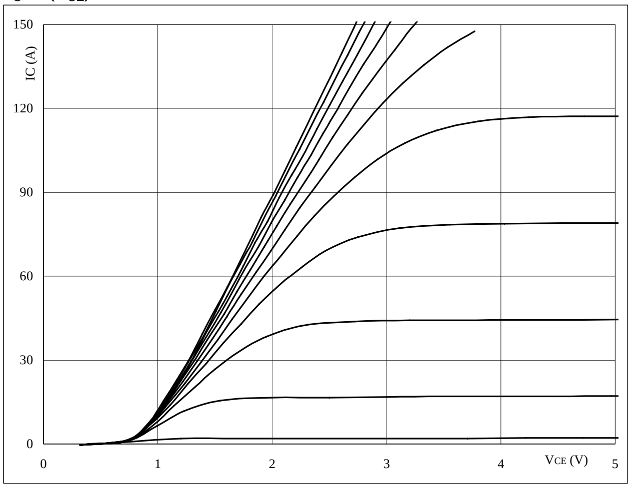
Parameter	Symbol	Conditions					Value			Unit
			V_{GE} [V] or V_{GS} [V]	V_r [V] or V_{CE} [V] or V_{DS} [V]	I_C [A] or I_F [A] or I_D [A]	T_j	Min	Typ	Max	
Inverter Transistor										
Gate emitter threshold voltage	$V_{GE(th)}$	VCE=VGE			0,0008	Tj=25°C Tj=150°C	5	5,8	6,5	V
Collector-emitter saturation voltage	$V_{CE(sat)}$		15		50	Tj=25°C Tj=150°C	1,1	1,56 1,79	2,1	V
Collector-emitter cut-off current incl. Diode	I_{CES}		0	600		Tj=25°C Tj=150°C			0,35	mA
Gate-emitter leakage current	I_{GES}		20	0		Tj=25°C Tj=150°C			650	nA
Integrated Gate resistor	R_{gint}							none		Ω
Turn-on delay time	$t_{d(on)}$	Rgoff=8 Ω Rgon=8 Ω	±15	300	50	Tj=25°C Tj=150°C		106 98		ns
Rise time	t_r					Tj=25°C Tj=150°C		19 16		
Turn-off delay time	$t_{d(off)}$					Tj=25°C Tj=150°C		150 173		
Fall time	t_f					Tj=25°C Tj=150°C		89 115		
Turn-on energy loss per pulse	E_{on}					Tj=25°C Tj=150°C		0,50 0,75		mWs
Turn-off energy loss per pulse	E_{off}					Tj=25°C Tj=150°C		1,18 1,63		
Input capacitance	C_{ies}	f=1MHz	0	25		Tj=25°C		3140		pF
Output capacitance	C_{oss}							200		
Reverse transfer capacitance	C_{rss}							93		
Gate charge	Q_{Gate}	Vcc=480	±15		50	Tj=25°C		310		nC
Thermal resistance chip to heatsink per chip	R_{thJH}	Thermal foil thickness=76um Kunze foil KU-ALF5						0,68		K/W
Inverter Diode										
Diode forward voltage	V_F				50	Tj=25°C Tj=150°C	1,2	1,63 1,60	2,1	V
Peak reverse recovery current	I_{RRM}	Rgon=8 Ω	±15	300	50	Tj=25°C Tj=150°C		28 79		A
Reverse recovery time	t_{rr}					Tj=25°C Tj=150°C		144 147		ns
Reverse recovered charge	Q_{rr}					Tj=25°C Tj=150°C		1,91 4,71		µC
Peak rate of fall of recovery current	di(rec)max /dt					Tj=25°C Tj=150°C		1357 4135		A/µs
Reverse recovered energy	Erec					Tj=25°C Tj=150°C		0,55 1,09		mWs
Thermal resistance chip to heatsink per chip	R_{thJH}	Thermal foil thickness=76um Kunze foil KU-ALF5						0,87		K/W
Thermistor										
Rated resistance	R_{25}	Tol. ±5%				Tj=25°C	4,46	4,7	4,94	kΩ
Deviation of R100	$D_{R/R}$	R100=435Ω				Tc=100°C		2,6		%/K
Power dissipation given Epcos-Typ	P					Tj=25°C		210		mW
B-value	$B_{(25/100)}$	Tol. ±3%				Tj=25°C		3530		K

Output Inverter

Figure 1 Output inverter IGBT

Typical output characteristics

$I_C = f(V_{CE})$



At

t_p = 250 µs

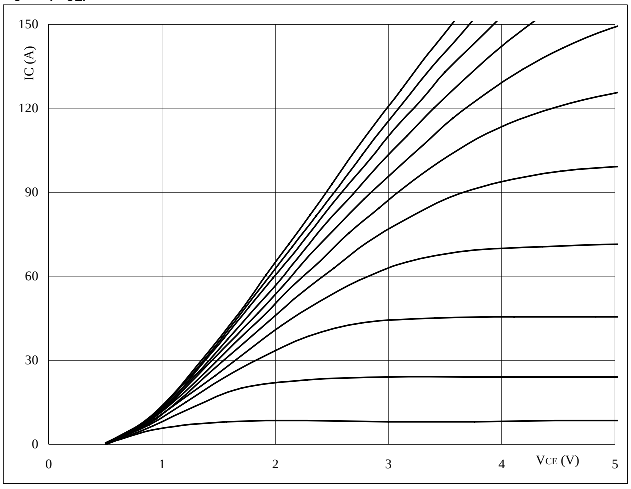
T_j = 25 °C

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

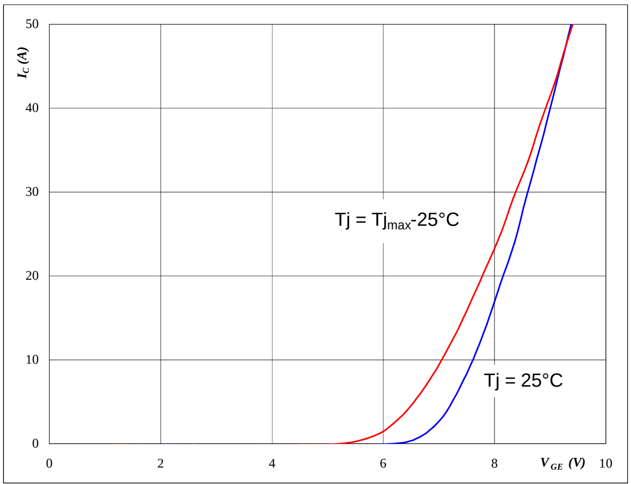
T_j = 150 °C

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

Figure 3 Output inverter IGBT

Typical transfer characteristics

$Ic = f(V_{GE})$



At

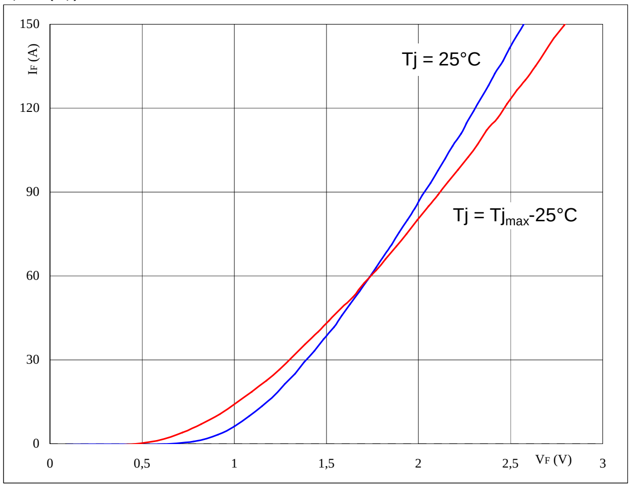
t_p = 250 µs

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

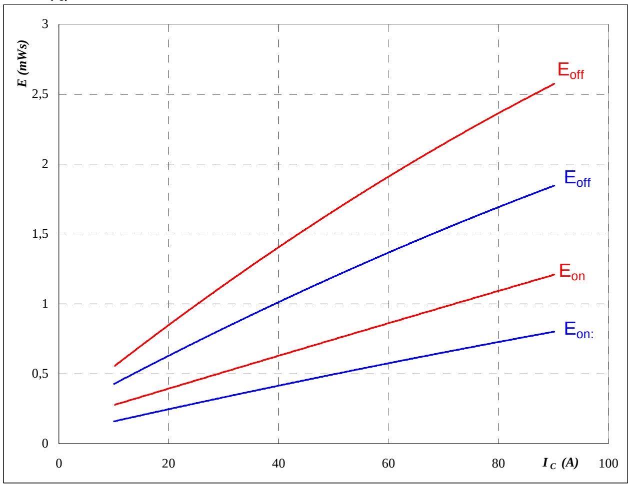
t_p = 250 µs

Output Inverter

Figure 5 Output inverter IGBT

Typical switching energy losses as a function of collector current

$E = f(I_c)$



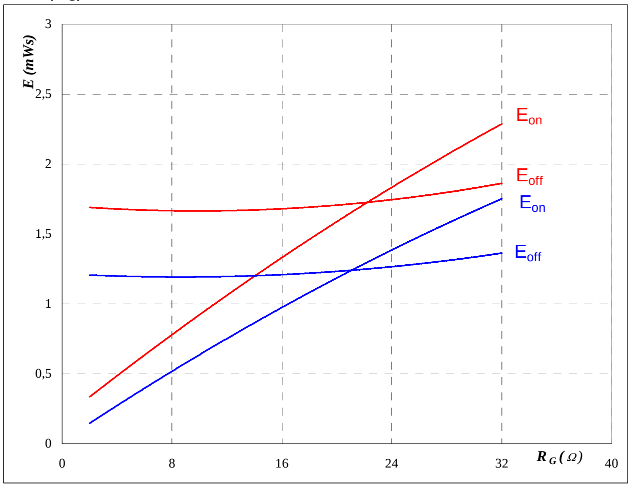
With an inductive load at

T_j =	25/150	°C
V_{CE} =	300	V
V_{GE} =	±15	V
R_{gon} =	8	Ω
R_{goff} =	8	Ω

Figure 6 Output inverter IGBT

Typical switching energy losses as a function of gate resistor

$E = f(R_G)$



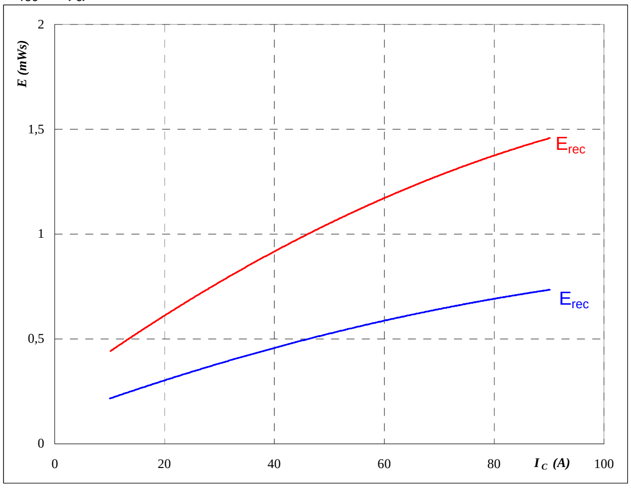
With an inductive load at

T_j =	25/150	°C
V_{CE} =	300	V
V_{GE} =	±15	V
I_C =	50	A

Figure 7 Output inverter IGBT

Typical reverse recovery energy loss as a function of collector current

$E_{rec} = f(I_c)$



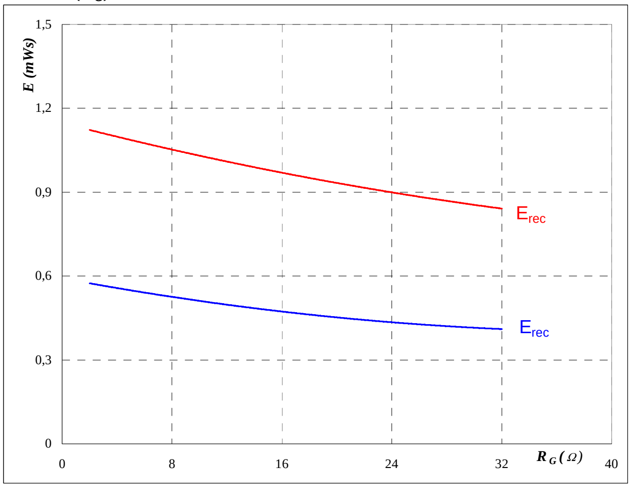
With an inductive load at

T_j =	25/150	°C
V_{CE} =	300	V
V_{GE} =	±15	V
R_{gon} =	8	Ω

Figure 8 Output inverter IGBT

Typical reverse recovery energy loss as a function of gate resistor

$Erec = f(R_G)$



With an inductive load at

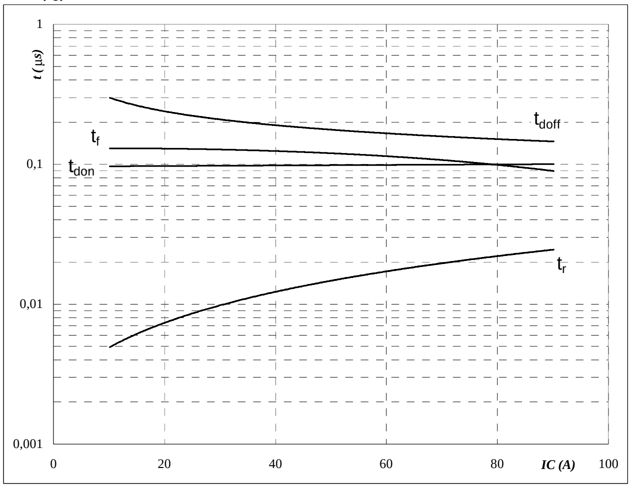
T_j =	25/150	°C
V_{CE} =	300	V
V_{GE} =	±15	V
I_C =	50	A

Output Inverter

Figure 9 Output inverter IGBT

Typical switching times as a function of collector current

t = f(I_C)



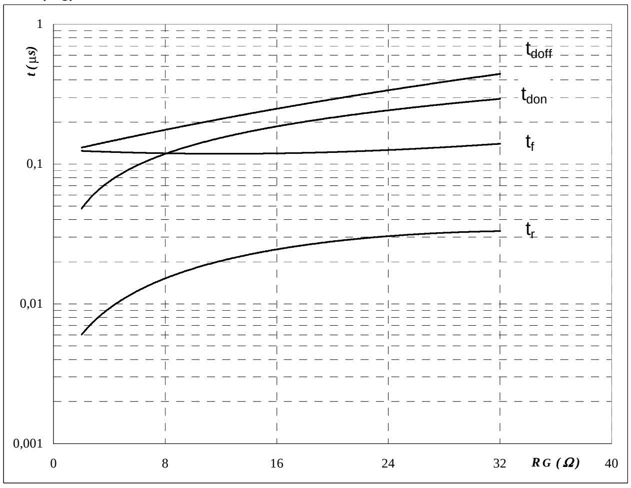
With an inductive load at

T_j =	150	°C
V_{CE} =	300	V
V_{GE} =	±15	V
R_{gon} =	8	Ω
R_{goff} =	8	Ω

Figure 10 Output inverter IGBT

Typical switching times as a function of gate resistor

t = f(R_G)



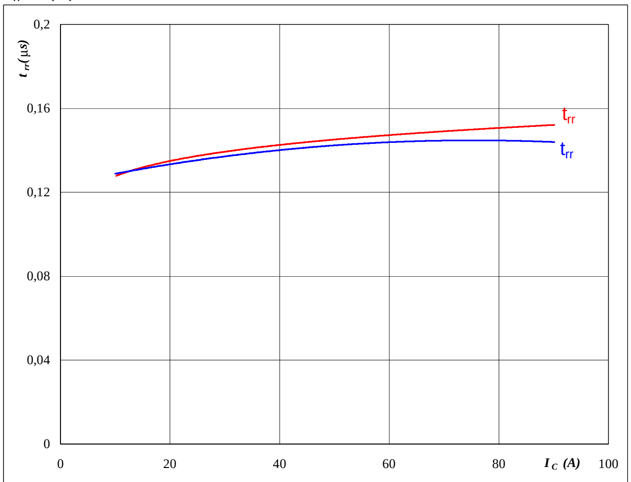
With an inductive load at

T_j =	150	°C
V_{CE} =	300	V
V_{GE} =	±15	V
I_C =	50	A

Figure 11 Output inverter FRED

Typical reverse recovery time as a function of collector current

t_{rr} = f(Ic)



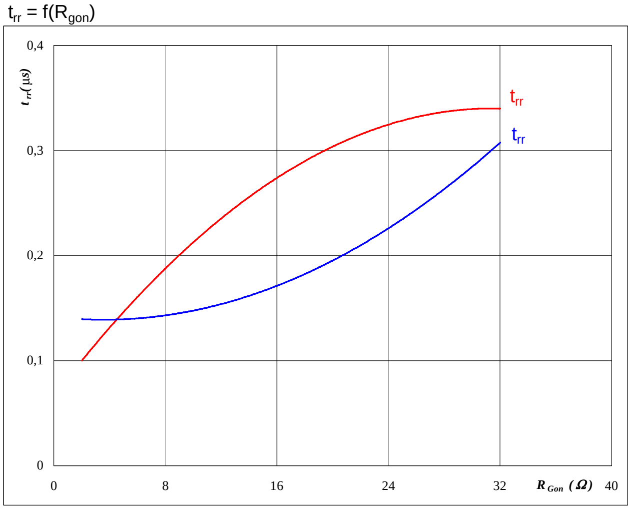
At

T_j =	25/150	°C
V_{CE} =	300	V
V_{GE} =	±15	V
R_{gon} =	8	Ω

Figure 12 Output inverter FRED

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

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



At

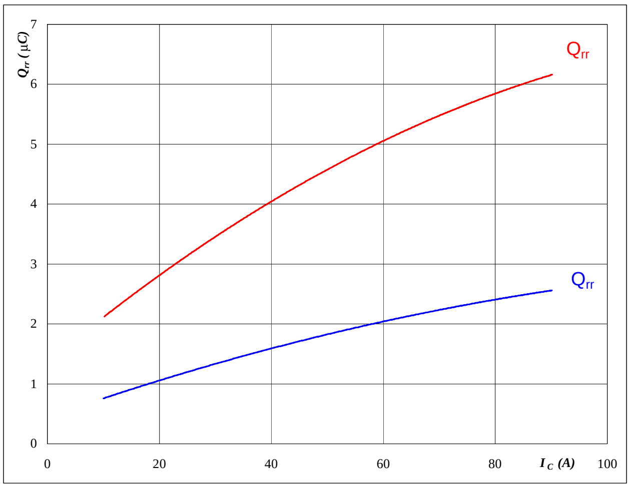
T_j =	25/150	°C
V_R =	300	V
I_F =	50	A
V_{GE} =	±15	V

Output Inverter

Figure 13 Output inverter FRED

Typical reverse recovery charge as a function of collector current

$Q_{rr} = f(Ic)$



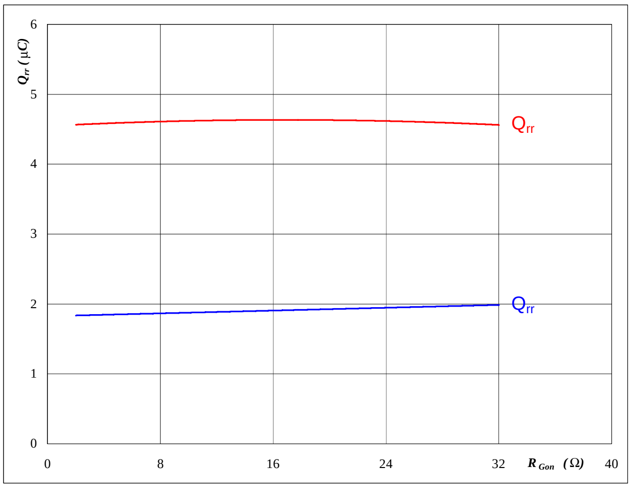
At

T_j =	25/150	°C
V_{CE} =	300	V
V_{GE} =	±15	V
R_{gon} =	8	Ω

Figure 14 Output inverter FRED

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

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



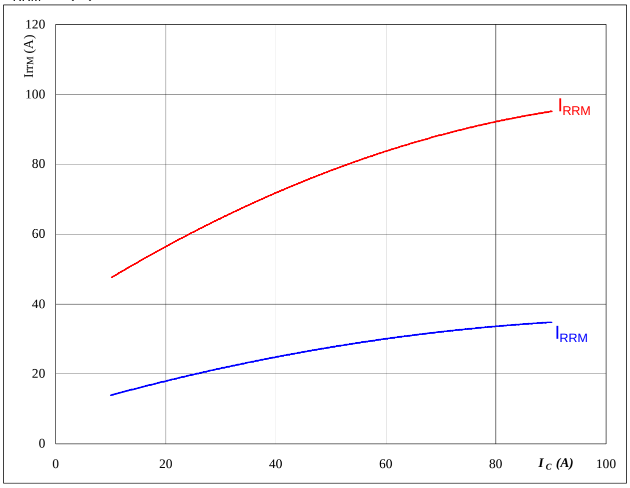
At

T_j =	25/150	°C
V_R =	300	V
I_F =	50	A
V_{GE} =	±15	V

Figure 15 Output inverter FRED

Typical reverse recovery current as a function of collector current

$I_{RRM} = f(Ic)$



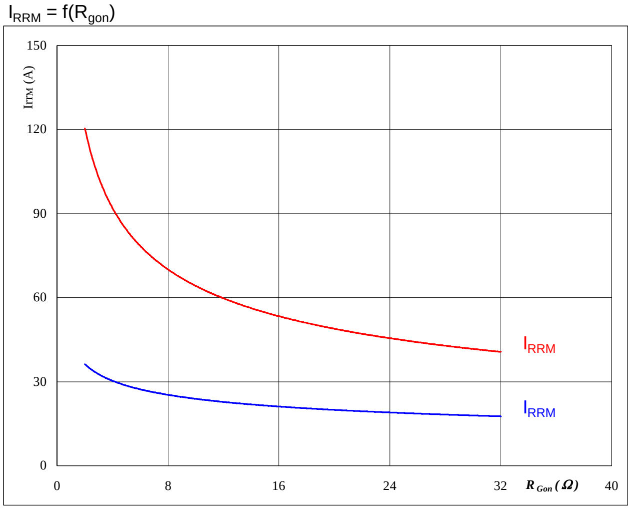
At

T_j =	25/150	°C
V_{CE} =	300	V
V_{GE} =	±15	V
R_{gon} =	8	Ω

Figure 16 Output inverter FRED

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

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



At

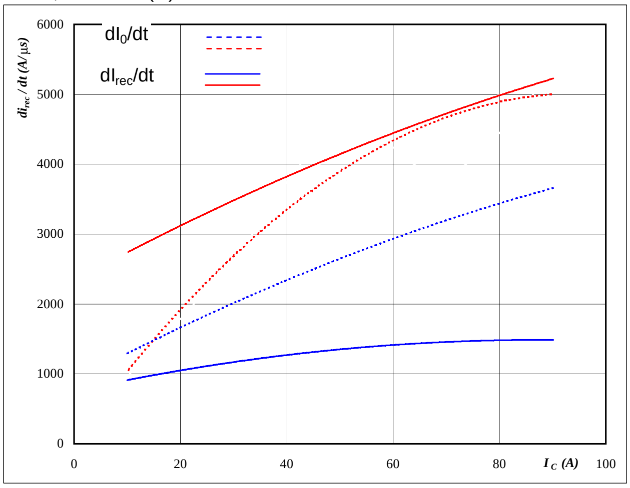
T_j =	25/150	°C
V_R =	300	V
I_F =	50	A
V_{GE} =	±15	V

Output Inverter

Figure 17 Output inverter FRED

Typical rate of fall of forward and reverse recovery current as a function of collector current

dI0/dt,dIrec/dt = f(Ic)



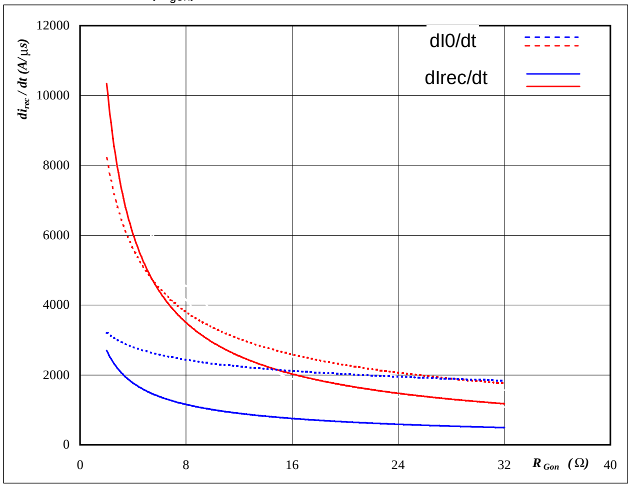
At

T_j =	25/150	°C
V_{CE} =	300	V
V_{GE} =	±15	V
R_{gon} =	8	Ω

Figure 18 Output inverter FRED

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})



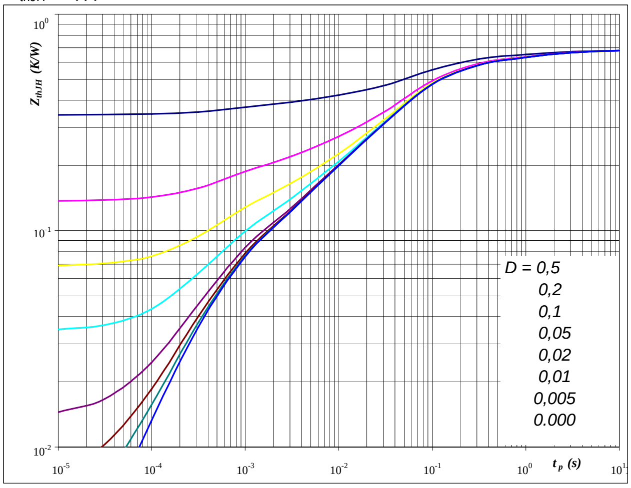
At

T_j =	25/150	°C
V_R =	300	V
I_F =	50	A
V_{GE} =	±15	V

Figure 19 Output inverter IGBT

IGBT transient thermal impedance as a function of pulse width

Z_{thJH} = f(tp)



At

D =	tp / T	
R_{thJH} =	0,68	K/W

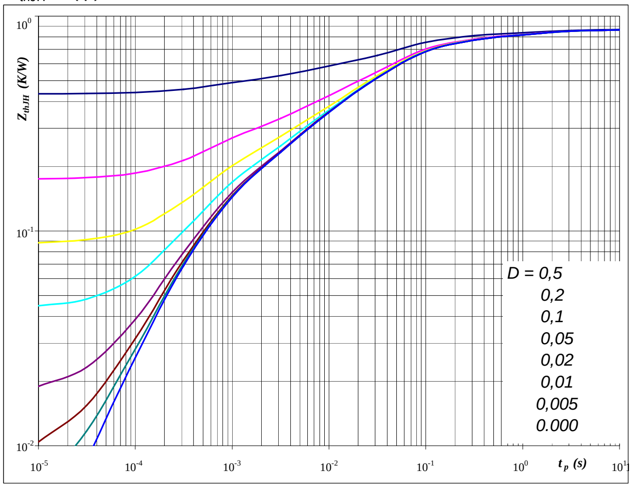
IGBT thermal model values

R (C/W)	Tau (s)
0,02	9,9E+00
0,08	1,2E+00
0,18	1,5E-01
0,26	4,2E-02
0,08	4,6E-03
0,06	5,2E-04

Figure 20 Output inverter FRED

FRED transient thermal impedance as a function of pulse width

Z_{thJH} = f(tp)



At

D =	tp / T	
R_{thJH} =	0,87	K/W

FRED thermal model values

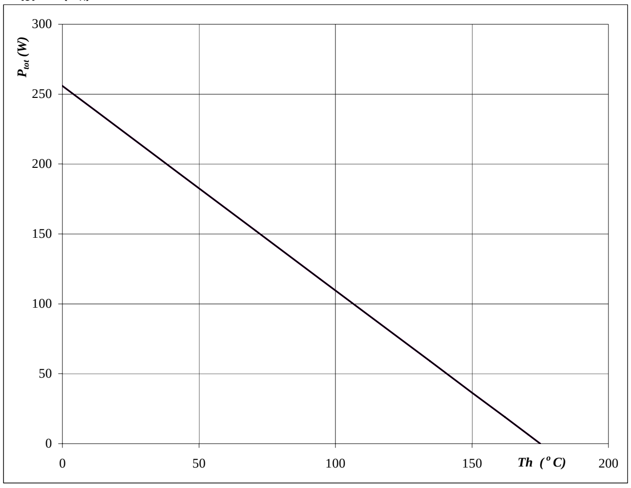
R (C/W)	Tau (s)
0,02	9,5E+00
0,08	1,1E+00
0,15	1,4E-01
0,35	3,2E-02
0,15	4,1E-03
0,11	5,0E-04

Output Inverter

Figure 21	Output inverter IGBT

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_h)$



At

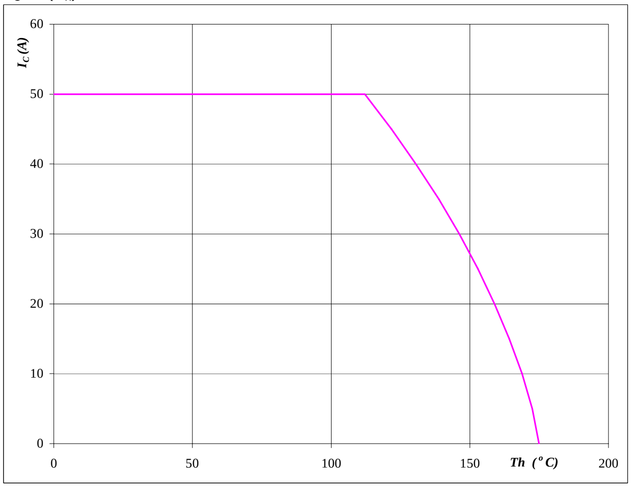
T_j = 175 °C

single heating
overall heating

Figure 22	Output inverter IGBT

Collector current as a function of heatsink temperature

$I_C = f(T_h)$



At

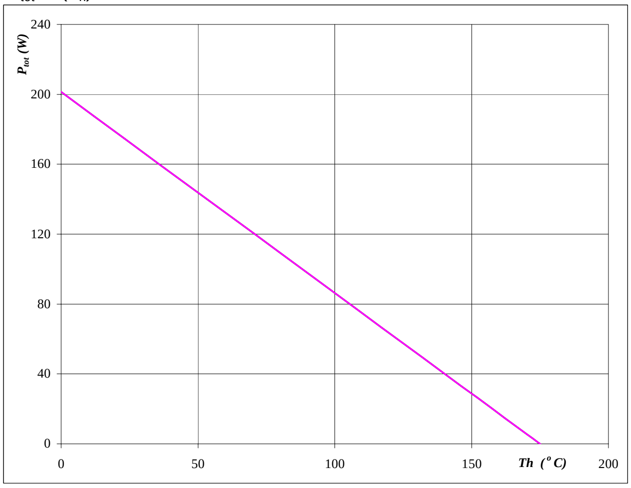
T_j = 175 °C

V_{GE} = 15 V

Figure 23	Output inverter FRED

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_h)$



At

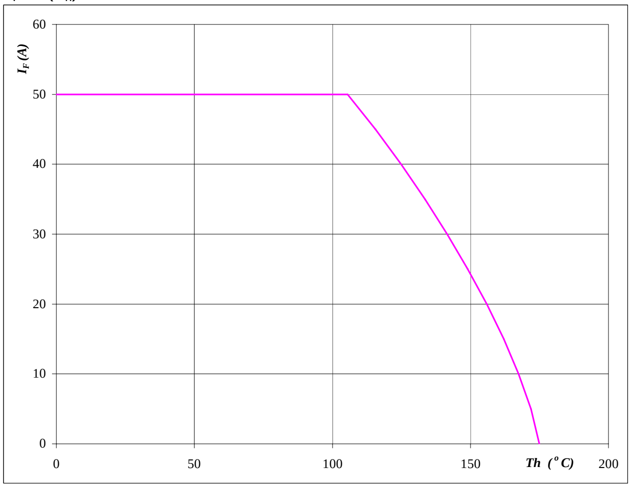
T_j = 175 °C

single heating
overall heating

Figure 24	Output inverter FRED

Forward current as a function of heatsink temperature

$I_F = f(T_h)$



At

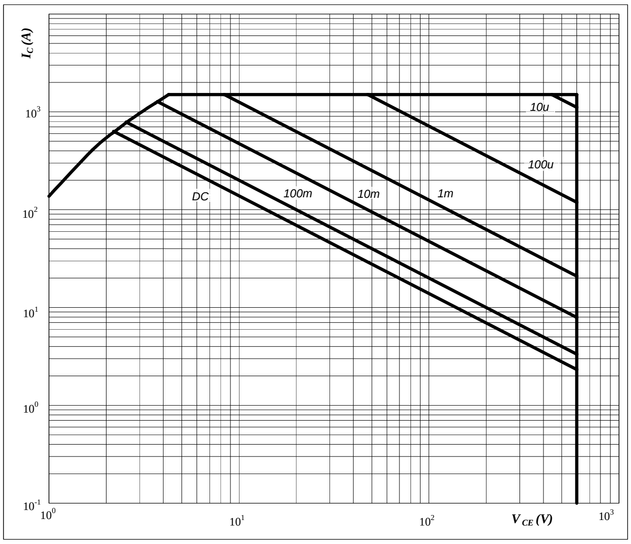
T_j = 175 °C

Output Inverter

Figure 25 Output inverter IGBT

Safe operating area as a function of collector-emitter voltage

$I_C = f(V_{CE})$



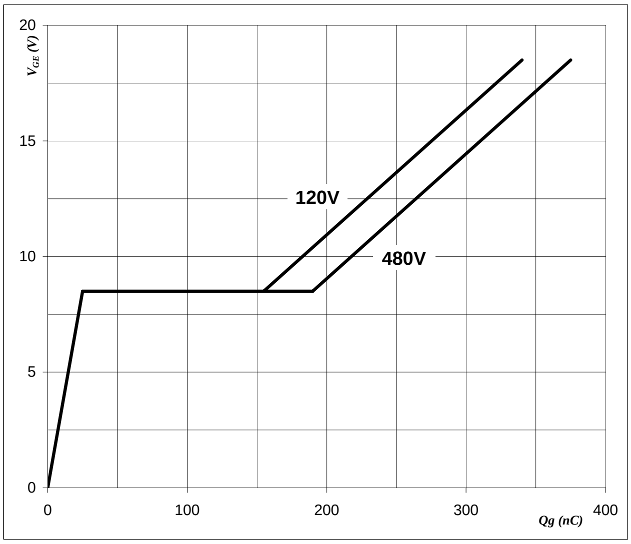
At

D =	single pulse	
Th =	80	ºC
V_{GE} =	±15	V
Tj =	T_{jmax}	ºC

Figure 26 Output inverter IGBT

Gate voltage vs Gate charge

$V_{GE} = f(Qg)$



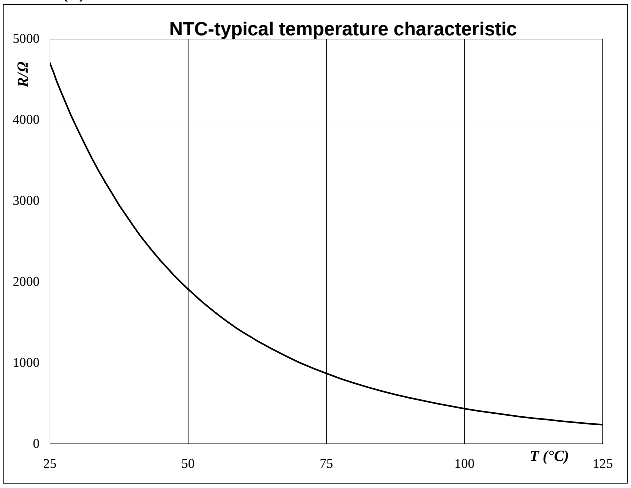
At

I_C =	50	A

Thermistor

Figure 1	Thermistor

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



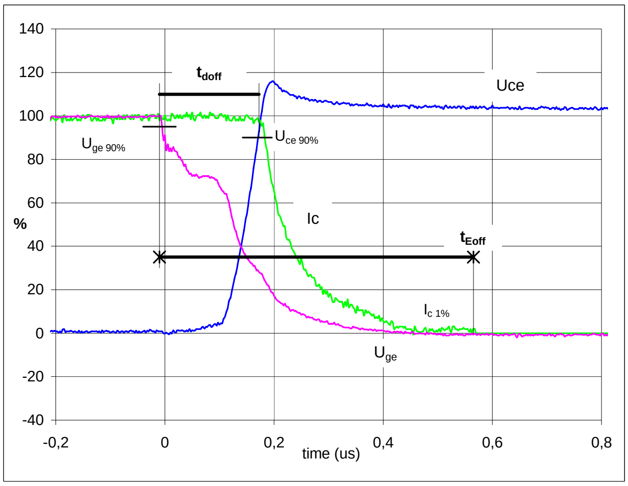
Switching Definitions Output Inverter

General conditions

T_j	=	150 °C
R_{gon}	=	8 Ω
R_{goff}	=	8 Ω

Figure 1 Output inverter IGBT

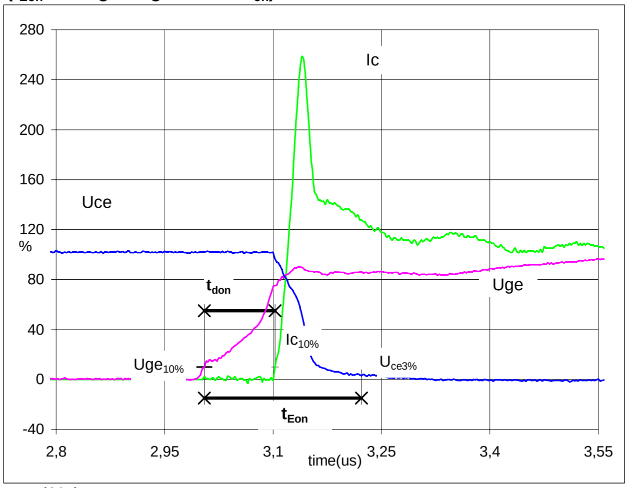
Turn-off Switching Waveforms & definition of tdoff, tEoff
(t_{Eoff} = integrating time for E_{off})



V_{GE} (0%) =	-15	V
V_{GE} (100%) =	15	V
V_C (100%) =	300	V
I_C (100%) =	50	A
t_{doff} =	0,17	µs
t_{Eoff} =	0,58	µs

Figure 2 Output inverter IGBT

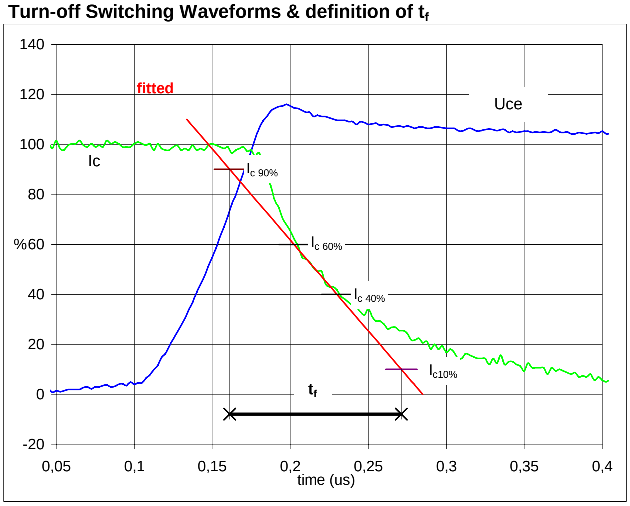
Turn-on Switching Waveforms & definition of tdon, tEon
(t_{Eon} = integrating time for E_{on})



V_{GE} (0%) =	-15	V
V_{GE} (100%) =	15	V
V_C (100%) =	300	V
I_C (100%) =	50	A
t_{don} =	0,10	µs
t_{Eon} =	0,22	µs

Figure 3 Output inverter IGBT

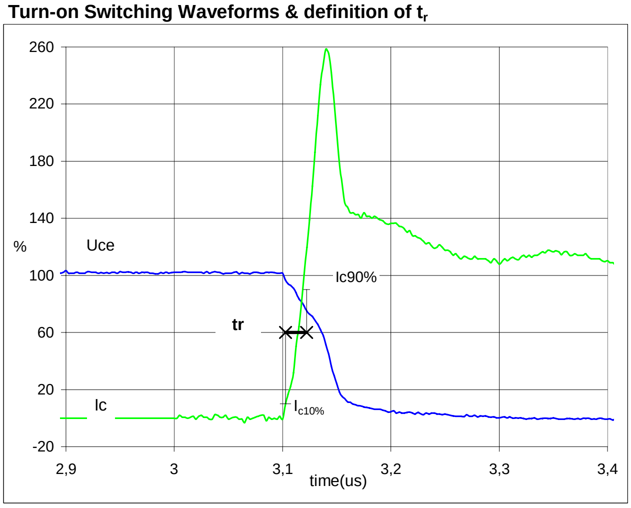
Turn-off Switching Waveforms & definition of t_f



V_C (100%) =	300	V
I_C (100%) =	50	A
t_f =	0,12	µs

Figure 4 Output inverter IGBT

Turn-on Switching Waveforms & definition of t_r

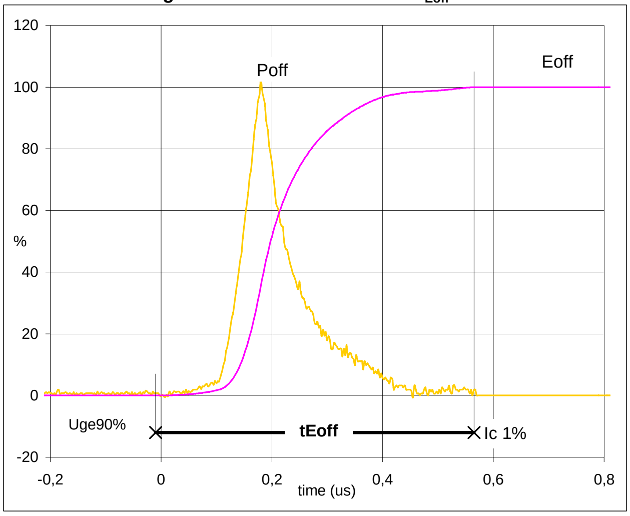


V_C (100%) =	300	V
I_C (100%) =	50	A
t_r =	0,02	µs

Switching Definitions Output Inverter

Figure 5 — Output inverter IGBT

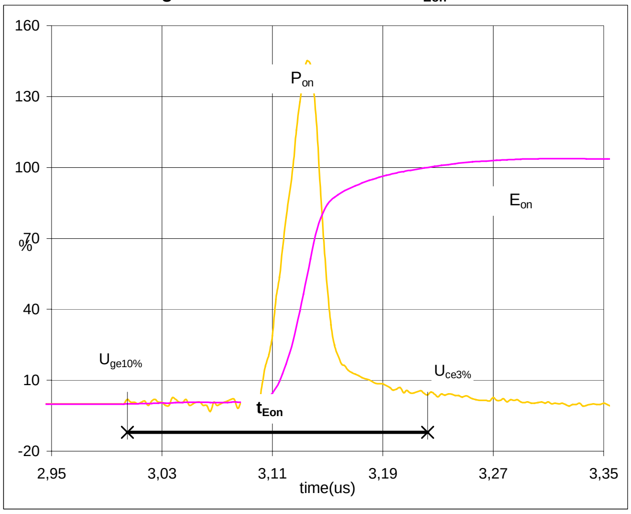
Turn-off Switching Waveforms & definition of t_{Eoff}



P_{off} (100%) = 15,03 kW
E_{off} (100%) = 1,63 mJ
t_{Eoff} = 0,58 μs

Figure 6 — Output inverter IGBT

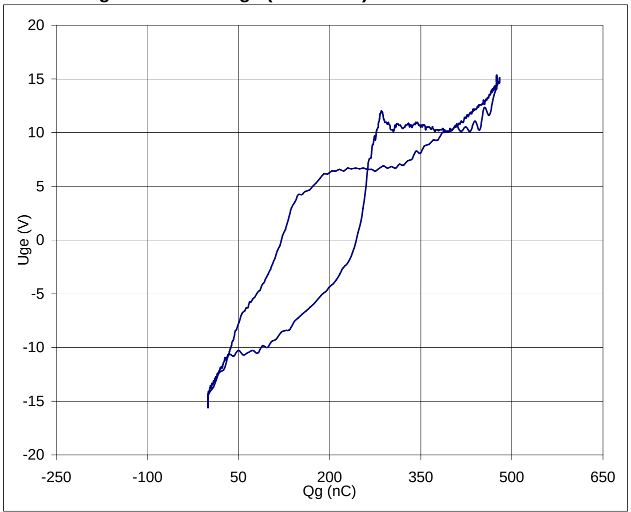
Turn-on Switching Waveforms & definition of t_{Eon}



P_{on} (100%) = 15,03 kW
E_{on} (100%) = 0,75 mJ
t_{Eon} = 0,22 μs

Figure 7 — Output inverter FRED

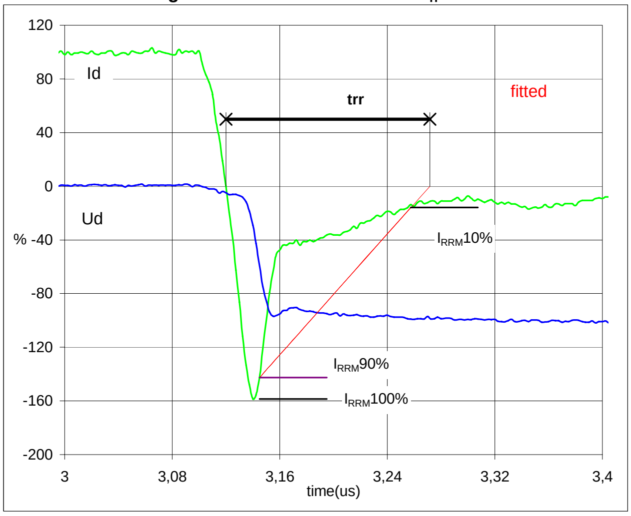
Gate voltage vs Gate charge (measured)



V_{GEoff} = -15 V
V_{GEon} = 15 V
V_C (100%) = 300 V
I_C (100%) = 50 A
Q_g = 479,76 nC

Figure 8 — Output inverter IGBT

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

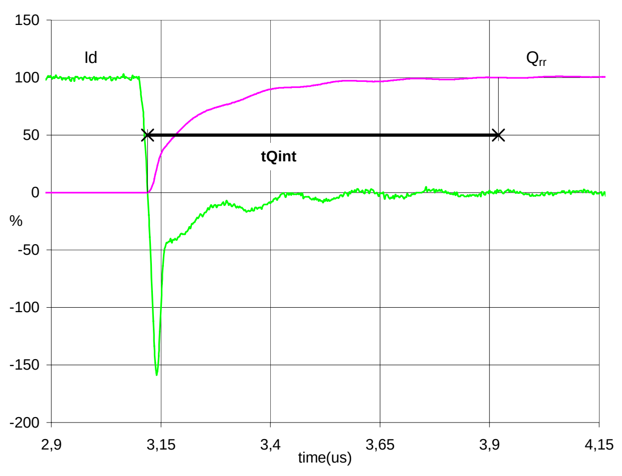


V_d (100%) = 300 V
I_d (100%) = 50 A
I_{RRM} (100%) = -79 A
t_{rr} = 0,15 μs

Switching Definitions Output Inverter

Figure 9 Output inverter FRED

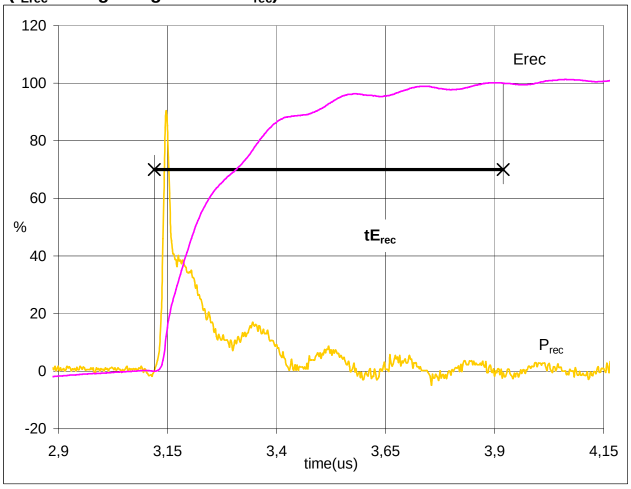
Turn-on Switching Waveforms & definition of t_{Qrr}
(t_{Qrr} = integrating time for Q_{rr})



I_d (100%) =	50	A
Q_{rr} (100%) =	4,71	μC
t_{Qint} =	0,80	μs

Figure 10 Output inverter FRED

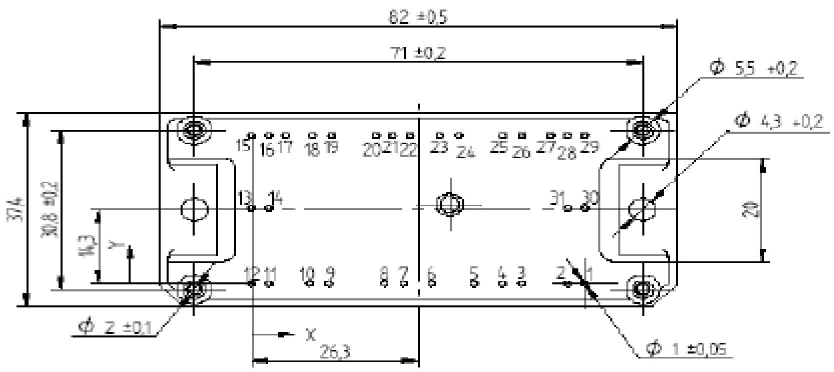
Turn-on Switching Waveforms & definition of t_{Erec}
(t_{Erec}= integrating time for E_{rec})



P_{rec} (100%) =	15,03	kW
E_{rec} (100%) =	1,09	mJ
t_{Erec} =	0,80	μs

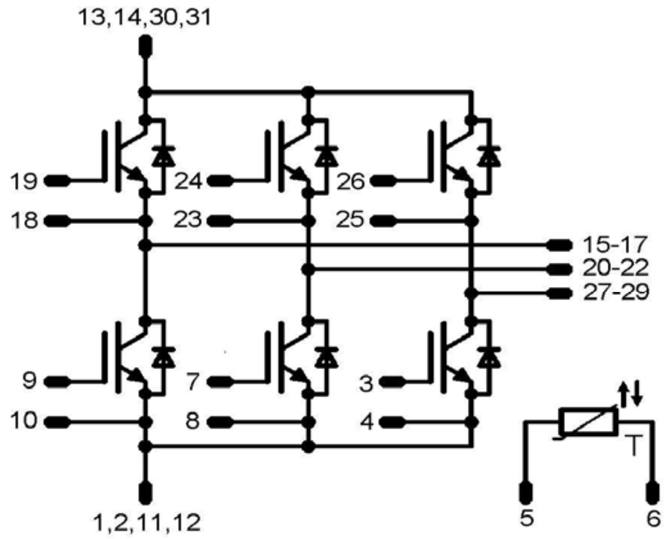
Package Outline and Pinout

Outline



Pin Table											
Pin	X	Y	Pin	X	Y	Pin	X	Y	Pin	X	Y
1	52,6	0	9	12,2	0	17	5,4	28,6	25	39,7	28,6
2	49,9	0	10	9,2	0	18	9,6	28,6	26	42,7	28,6
3	42,65	0	11	2,7	0	19	12,6	28,6	27	47,2	28,6
4	39,65	0	12	0	0	20	19,6	28,6	28	49,9	28,6
5	35,15	0	13	0	14,65	21	22,3	28,6	29	52,6	28,6
6	28,4	0	14	2,7	14,65	22	25	28,6	30	52,6	14,65
7	24	0	15	0	28,6	23	29,7	28,6	31	49,9	14,65
8	21	0	16	2,7	28,6	24	32,7	28,6			

Pinout



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