Vincotech

flowPACK 0 3rd gen	1200V/25A

Features

- 2 clip housing in 12mm and 17mm height
- Trench Fieldstop IGBT[4] technology
- Compact and low inductance design
- Built-in NTC

flow0 housing

Target Applications

- Motor Drives
- Power Generation
- UPS

Schematic

Types

- V23990-P869-F49-PM: 17mm height
- V23990-P869-F48-PM: 12mm height
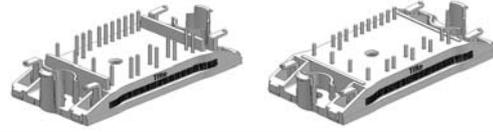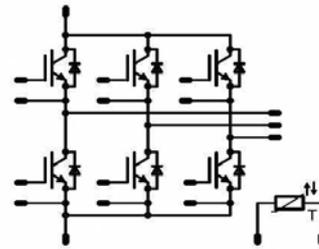
Maximum Ratings

T_j=25°C, unless otherwise specified

Parameter	Symbol	Condition		Value	Unit
Inverter Transistor					
Collector-emitter voltage	V_{CE}			1200	V
DC collector current	I_C	$T_j=T_{jmax}$	T_h=80°C T_c=80°C	28	A
Repetitive peak collector current	I_{Cpulse}	t_p limited by T_{jmax}		75	A
Power dissipation per IGBT	P_{tot}	$T_j=T_{jmax}$	T_h=80°C T_c=80°C	73	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_{jmax}			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
Inverter Diode					
Peak Repetitive Reverse Voltage	V_{RRM}	T_j=25°C		1200	V
DC forward current	I_F	$T_j=T_{jmax}$	T_h=80°C T_c=80°C	27	A
Repetitive peak forward current	I_{FRM}	t_p limited by T_{jmax}		50	A
Power dissipation per Diode	P_{tot}	$T_j=T_{jmax}$	T_h=80°C T_c=80°C	51	W
Maximum Junction Temperature	T_{jmax}			175	°C

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

Maximum Ratings

Tj=25°C, unless otherwise specified

Parameter	Symbol	Condition		Value	Unit
Insulation properties					
Insulation voltage	V_{is}	t=2s	DC voltage	4000	V
Creepage distance				min.12,7	mm
Clearance				min.12,7	mm

2

Revision: 1

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		0,00085	Tj=25°C Tj=150°C	5	5,8	6,5	V
Collector-emitter saturation voltage	$V_{CE(sat)}$	15		25	Tj=25°C Tj=150°C		1,91 2,33	2,4	V
Collector-emitter cut-off current incl. Diode	I_{CES}	0	1200		Tj=25°C Tj=150°C			10	µA
Gate-emitter leakage current	I_{GES}	20	0		Tj=25°C Tj=150°C			200	nA
Integrated Gate resistor	R_{gint}						none		Ω
Turn-on delay time	$t_{d(on)}$	Rgon=32Ω Rgoff=32Ω	±15	600	25	Tj=25°C Tj=150°C	130 127		ns
Rise time	t_r					Tj=25°C Tj=150°C	26 32		
Turn-off delay time	$t_{d(off)}$					Tj=25°C Tj=150°C	220 286		
Fall time	t_f					Tj=25°C Tj=150°C	77 118		
Turn-on energy loss per pulse	E_{on}					Tj=25°C Tj=150°C	2,001 3,002		mWs
Turn-off energy loss per pulse	E_{off}					Tj=25°C Tj=150°C	1,32 2,16		
Input capacitance	C_{ies}	f=1MHz	0	25		Tj=25°C	1430		pF
Output capacitance	C_{oss}						115		
Reverse transfer capacitance	C_{rss}						85		
Gate charge	Q_{Gate}	15	960	25	Tj=25°C		120		nC
Thermal resistance chip to heatsink per chip	R_{thJH}	Thermal grease thickness≤50um λ = 0,61 W/mK					1,305		K/W
Inverter Diode									
Diode forward voltage	V_F			25	Tj=25°C Tj=150°C		1,87 1,80	2,35	V
Reverse leakage current	I_R				Tj=25°C Tj=150°C			10	µA
Peak reverse recovery current	I_{RRM}				Tj=25°C Tj=150°C		18,3 21,7		A
Reverse recovery time	t_{rr}	Rgon=32Ω	±15	600	25	Tj=25°C Tj=150°C	360 588		ns
Reverse recovered charge	Q_{rr}				Tj=25°C Tj=150°C		2,41 4,94		µC
Peak rate of fall of recovery current	di(rec)max/dt				Tj=25°C Tj=150°C		75 48		A/µs
Reverse recovered energy	E_{rec}				Tj=150°C		1,971		mWs
Thermal resistance chip to heatsink per chip	R_{thJH}	Thermal grease thickness≤50um λ = 0,61 W/mK					1,851		K/W
Thermistor									
Rated resistance	R_{25}	Tol. ±5%			Tj=25°C	20,9	22	23,1	kΩ
Deviation of R100	ΔR/R	R100=1486Ω			Tj=100°C		2,9		%/K
Power dissipation	P				Tj=25°C		210		mW
B-value	$B_{(25/100)}$	Tol. ±3%			Tj=25°C		4000		K

Output Inverter

Figure 1	Output inverter IGBT

Typical output characteristics
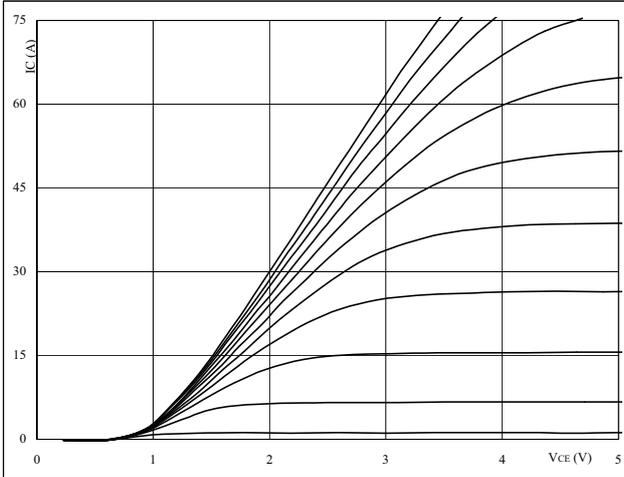
$I_C = f(V_{CE})$

$t_p =$	250	µs
$T_j =$	25	°C
V_{GE} from	7 V to 17 V in steps of 1 V	

Figure 2	Output inverter IGBT

Typical output characteristics

$I_C = f(V_{CE})$
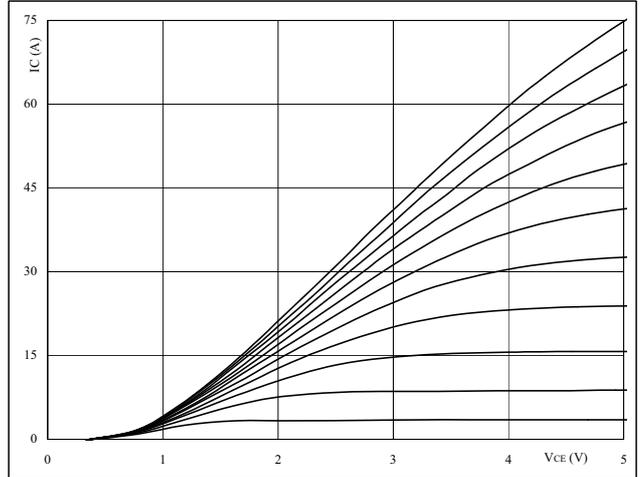
$t_p =$	250	µs
$T_j =$	150	°C
V_{GE} from	7 V to 17 V in steps of 1 V	

Figure 3	Output inverter IGBT

Typical transfer characteristics

$I_C = f(V_{GE})$

$T_j = T_{jmax}-25°C$

$T_j = 25°C$
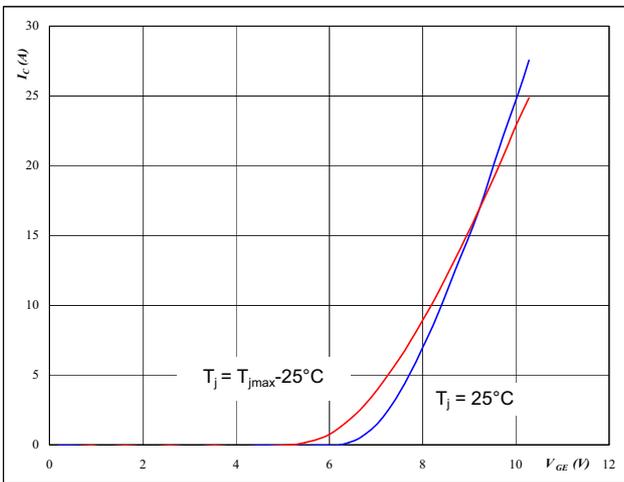
$t_p =$	250	µs
$V_{CE} =$	10	V

Figure 4	Output inverter FRED

**Typical diode forward current as
a function of forward voltage**

$I_F = f(V_F)$
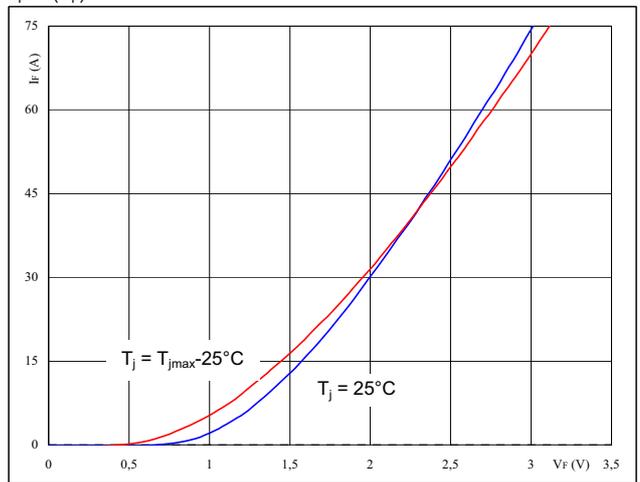
$T_j = T_{jmax}-25°C$

$T_j = 25°C$

$t_p =$	250	µs

Output Inverter

Figure 5 — Output inverter IGBT

**Typical switching energy losses
as a function of collector current**

$E = f(I_C)$
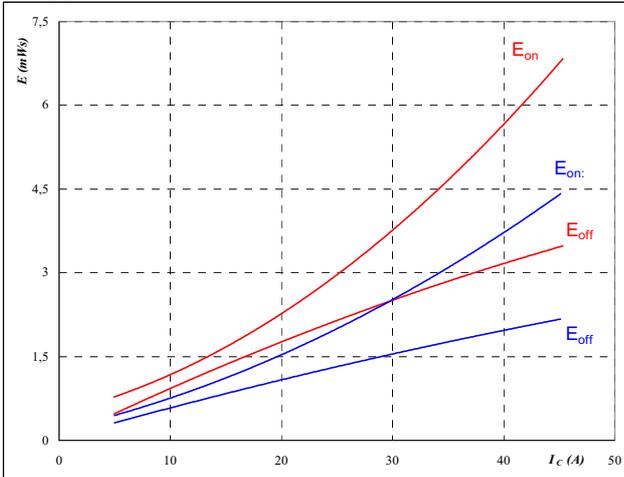
inductive load

T_j =	25/150	°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**

$E = f(R_G)$
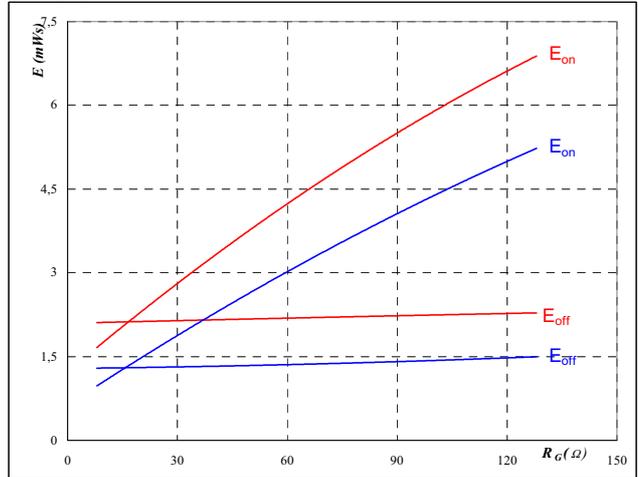
inductive load

T_j =	25/150	°C
V_{CE} =	600	V
V_{GE} =	±15	V
I_C =	25	A

Figure 7 — Output inverter IGBT

**Typical reverse recovery energy loss
as a function of collector current**

$E_{rec} = f(I_C)$
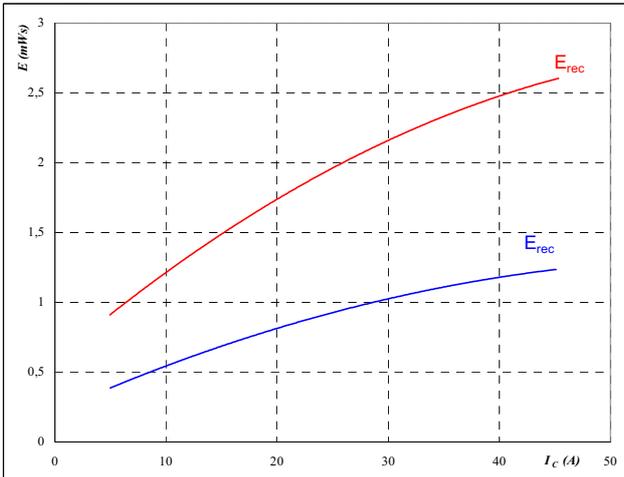
inductive load

T_j =	25/150	°C
V_{CE} =	600	V
V_{GE} =	±15	V
R_{gon} =	32	Ω

Figure 8 — Output inverter IGBT

**Typical reverse recovery energy loss
as a function of gate resistor**

$E_{rec} = f(R_G)$
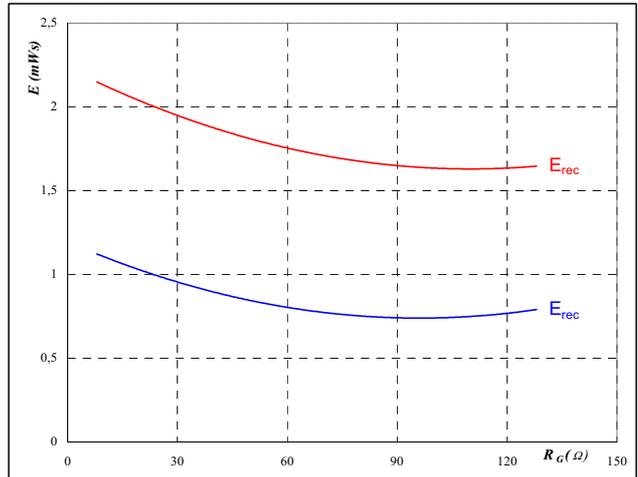
inductive load

T_j =	25/150	°C
V_{CE} =	600	V
V_{GE} =	±15	V
I_C =	25	A

![Vincotech logo]

Output Inverter

Figure 9	Output inverter IGBT

**Typical switching times as a
function of collector current**

$t = f(I_C)$
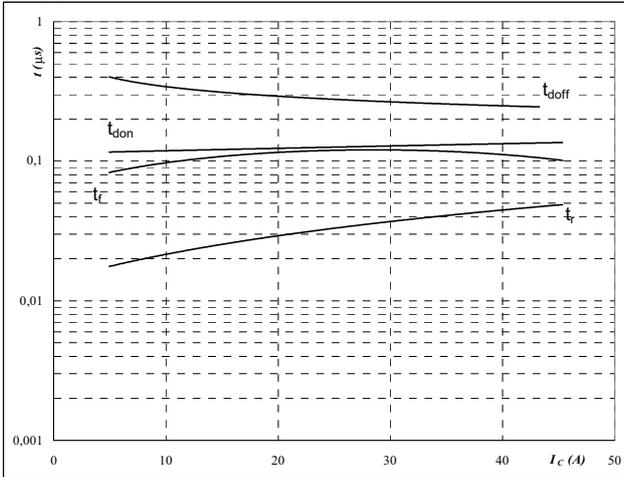
inductive load

T_j =	150	°C
V_{CE} =	600	V
V_{GE} =	±15	V
R_{gon} =	32	Ω
R_{goff} =	32	Ω

Figure 10	Output inverter IGBT

**Typical switching times as a
function of gate resistor**

$t = f(R_G)$
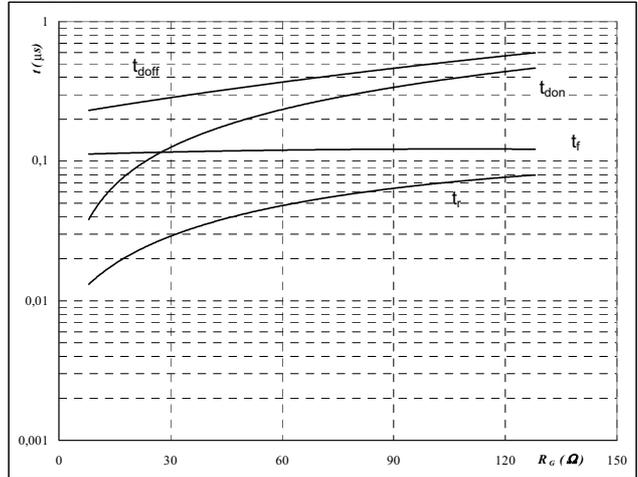
inductive load

T_j =	150	°C
V_{CE} =	600	V
V_{GE} =	±15	V
I_C =	25	A

Figure 11	Output inverter FRED

**Typical reverse recovery time as a
function of collector current**

$t_{rr} = f(I_C)$
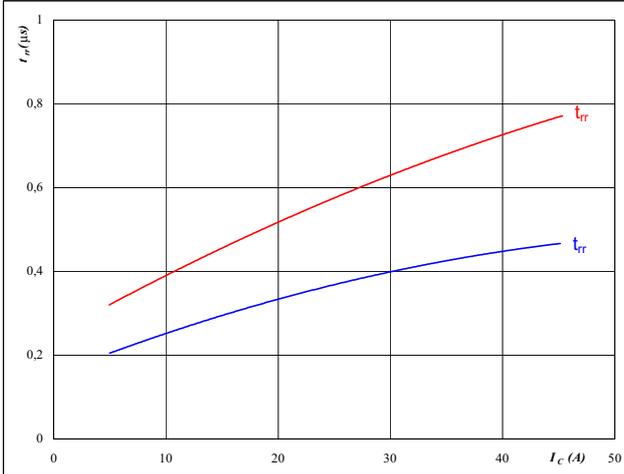
T_j =	25/150	°C
V_{CE} =	600	V
V_{GE} =	±15	V
R_{gon} =	32	Ω

Figure 12	Output inverter FRED

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

$t_{rr} = f(R_{gon})$
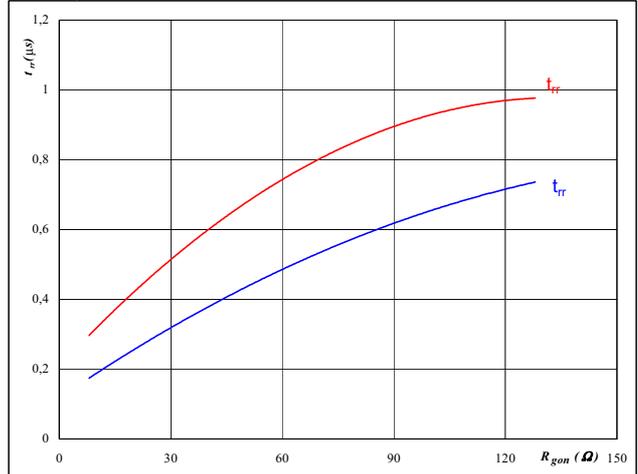
T_j =	25/150	°C
V_R =	600	V
I_F =	25	A
V_{GE} =	±15	V

Output Inverter

Figure 13	Output inverter FRED

**Typical reverse recovery charge as a
function of collector current**

$Q_{rr} = f(I_C)$
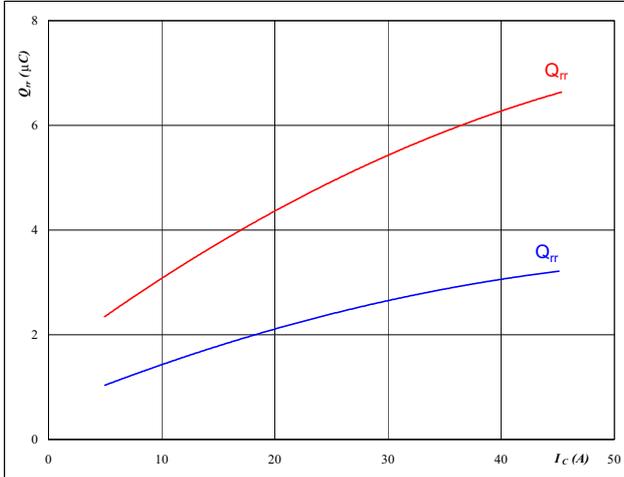
T_j =	25/150	°C
V_{CE} =	600	V
V_{GE} =	±15	V
R_{gon} =	32	Ω

Figure 14	Output inverter FRED

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

$Q_{rr} = f(R_{gon})$
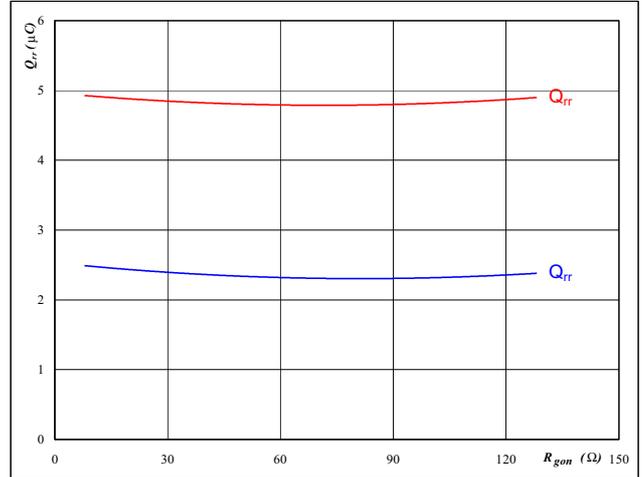
T_j =	25/150	°C
V_R =	600	V
I_F =	25	A
V_{GE} =	±15	V

Figure 15	Output inverter FRED

**Typical reverse recovery current as a
function of collector current**

$I_{RRM} = f(I_C)$
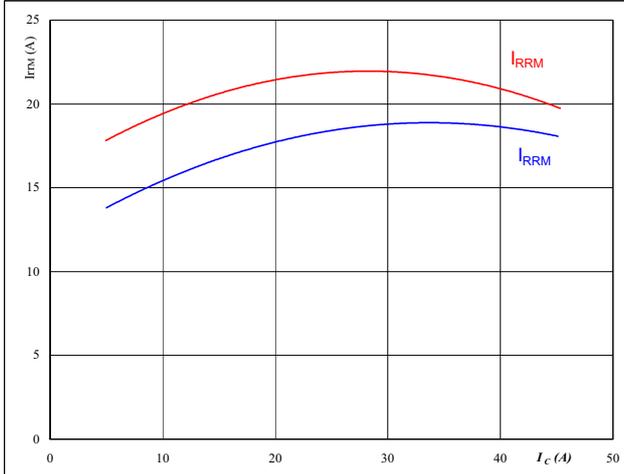
T_j =	25/150	°C
V_{CE} =	600	V
V_{GE} =	±15	V
R_{gon} =	32	Ω

Figure 16	Output inverter FRED

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

$I_{RRM} = f(R_{gon})$
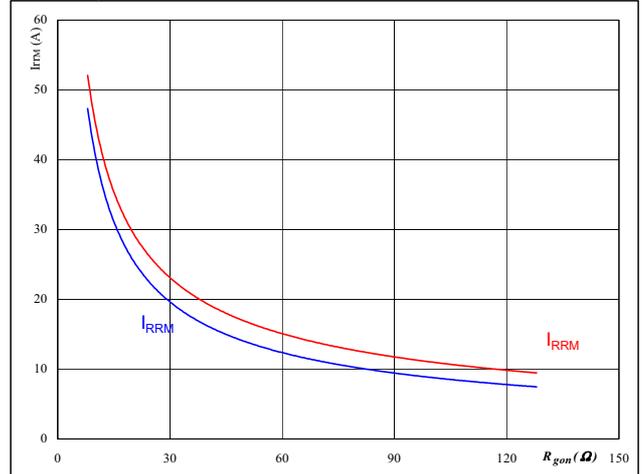
T_j =	25/150	°C
V_R =	600	V
I_F =	25	A
V_{GE} =	±15	V

Output Inverter

Figure 17	Output inverter FRED

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

$dI_0/dt, dI_{rec}/dt = f(I_C)$
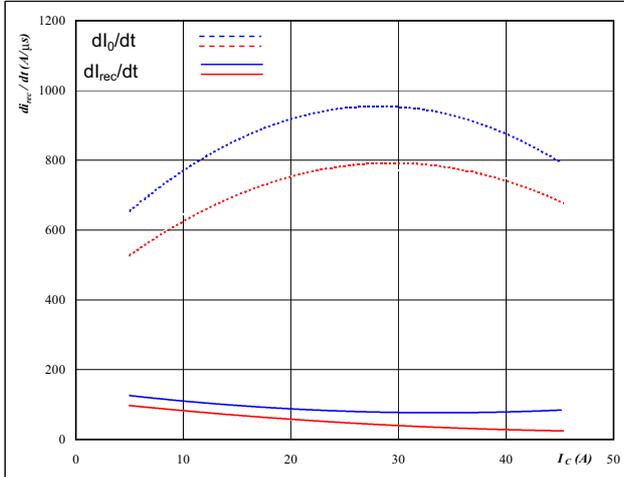
|		
T_j =	25/150	°C
V_{CE} =	600	V
V_{GE} =	±15	V
R_{gon} =	32	Ω

Figure 18	Output inverter FRED

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

$dI_0/dt, dI_{rec}/dt = f(R_{gon})$
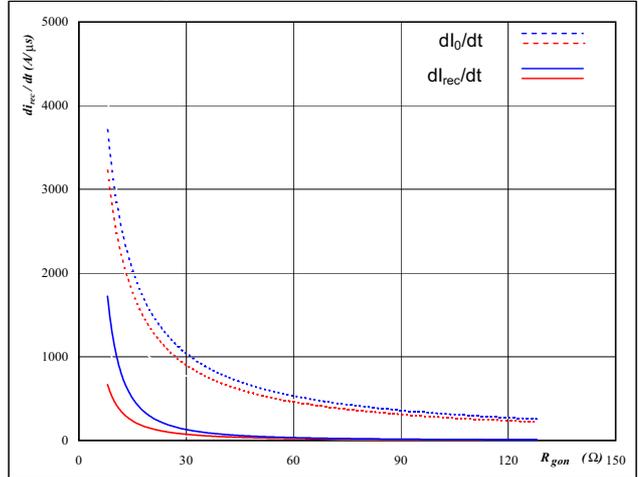
T_j =	25/150	°C
V_R =	600	V
I_F =	25	A
V_{GE} =	±15	V

Figure 19	Output inverter IGBT

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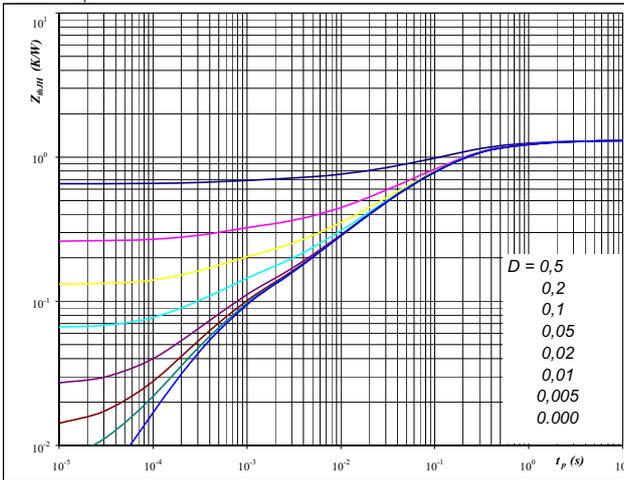
$Z_{thJH} = f(t_p)$

D =	t_p / T	
R_{thJH} =	1,31	K/W

IGBT thermal model values

R (C/W)	Tau (s)
0,06	3,5E+00
0,18	6,2E-01
0,65	1,3E-01
0,27	2,3E-02
0,08	3,9E-03
0,07	4,6E-04

Figure 20	Output inverter FRED

FRED transient thermal impedance as a function of pulse width

$Z_{thJH} = f(t_p)$
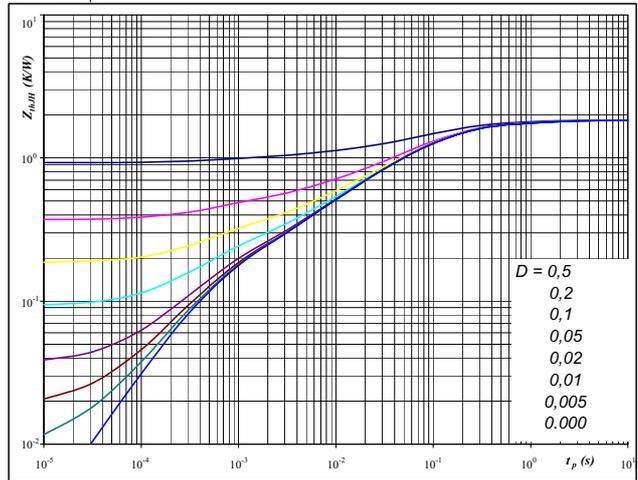
D =	t_p / T	
R_{thJH} =	1,85	K/W

FRED thermal model values

R (C/W)	Tau (s)
0,04	9,4E+00
0,19	8,3E-01
0,80	1,3E-01
0,50	2,9E-02
0,19	4,5E-03
0,13	4,9E-04

Output Inverter

Figure 21	Output inverter IGBT

Power dissipation as a
function of heatsink temperature
$P_{tot} = f(T_h)$
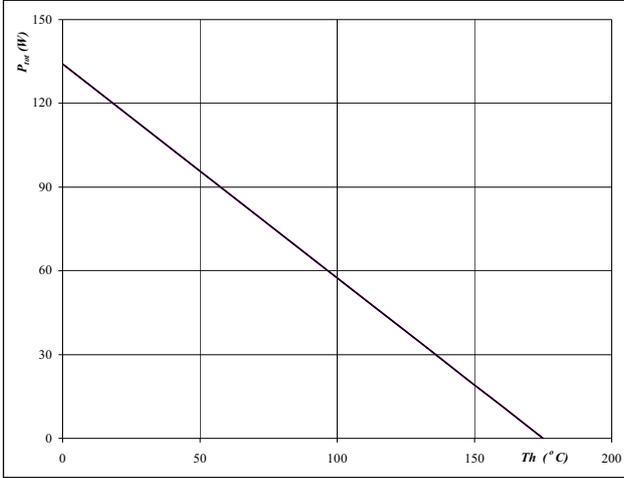
$T_j =$ 175 °C

Figure 22	Output inverter IGBT

Collector current as a
function of heatsink temperature
$I_C = f(T_h)$
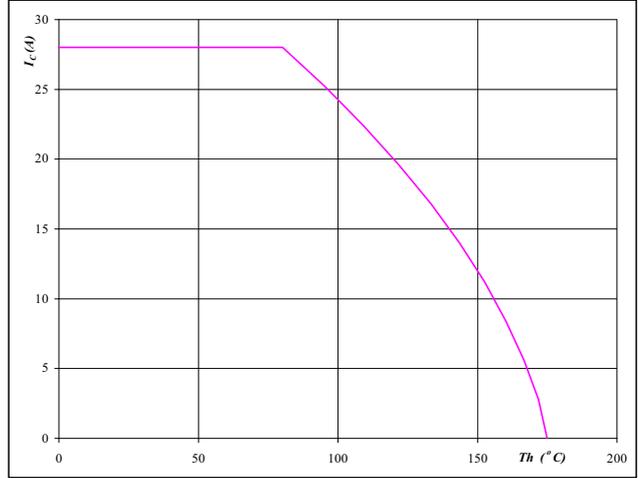
$T_j =$ 175 °C
$V_{GE} =$ 15 V

Figure 23	Output inverter FRED

Power dissipation as a
function of heatsink temperature
$P_{tot} = f(T_h)$
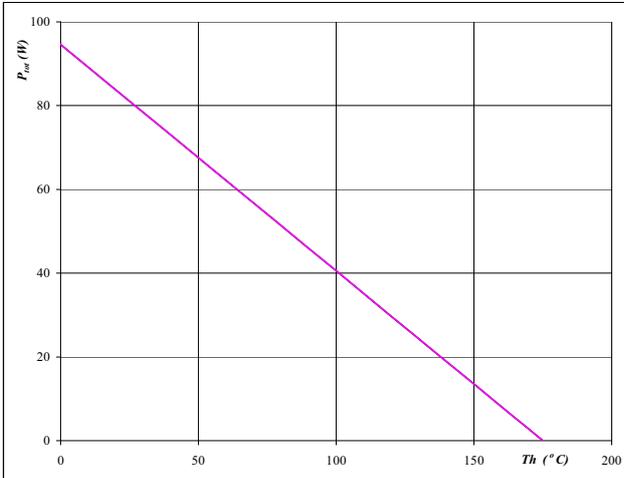
$T_j =$ 175 °C

Figure 24	Output inverter FRED

Forward current as a
function of heatsink temperature
$I_F = f(T_h)$
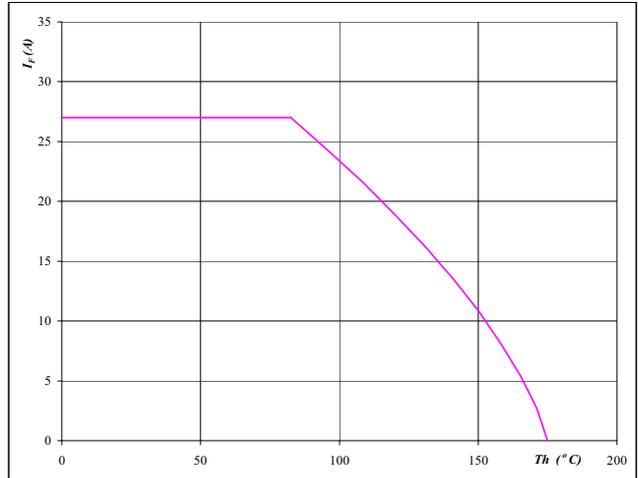
$T_j =$ 175 °C

Output Inverter

Figure 25 — Output inverter IGBT

**Safe operating area as a function
of collector-emitter voltage**

$I_C = f(V_{CE})$
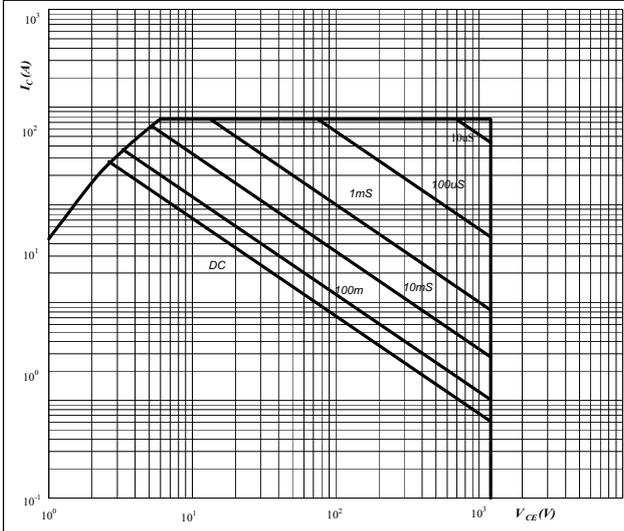
D = single pulse
T_h = 80 ºC
V_{GE} = ±15 V
T_j = T_{jmax} ºC

Figure 26 — Output inverter IGBT

**Gate voltage vs Gate charge**

$V_{GE} = f(Q_g)$
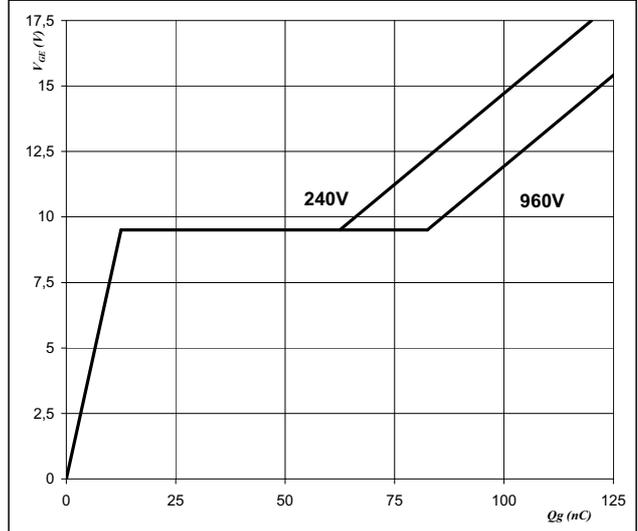
I_C = 25 A

Thermistor

Figure 1 — Thermistor

**Typical NTC characteristic
as a function of temperature**

$R_T = f(T)$

NTC-typical temperature characteristic
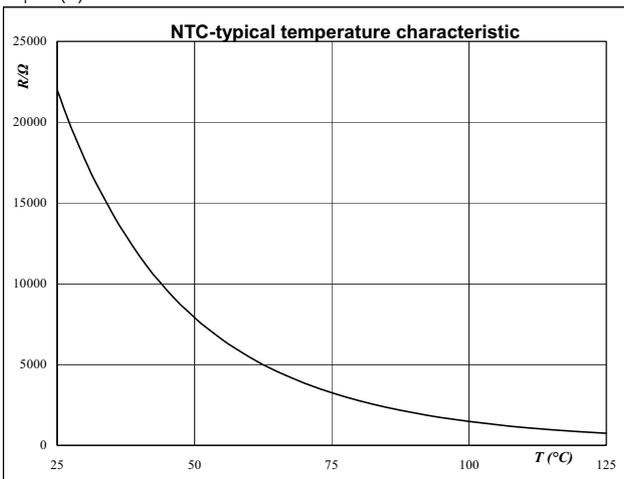
Switching Definitions Output Inverter

General conditions

T_j	=	150 °C
R_{gon}	=	32 Ω
R_{goff}	=	32 Ω

Figure 1 — Output inverter IGBT

Turn-off Switching Waveforms & definition of t_{doff}, t_{Eoff}
**(t_{Eoff} = integrating time for E_{off})**
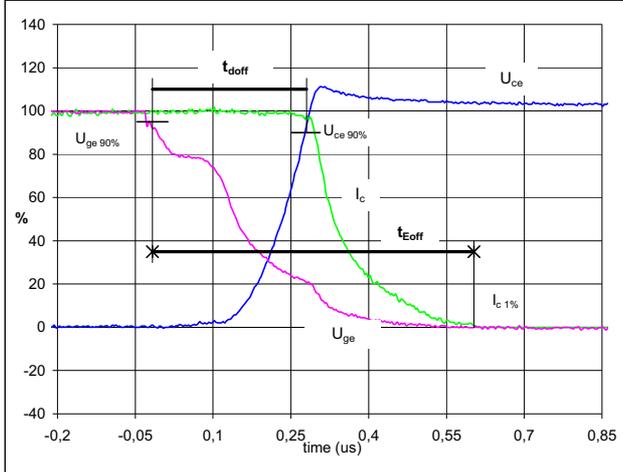
V_{GE} (0%) =	-15	V
V_{GE} (100%) =	15	V
V_C (100%) =	600	V
I_C (100%) =	25	A
t_{doff} =	0,29	µs
t_{Eoff} =	0,62	µs

Figure 2 — Output inverter IGBT

Turn-on Switching Waveforms & definition of t_{don}, t_{Eon}
**(t_{Eon} = integrating time for E_{on})**
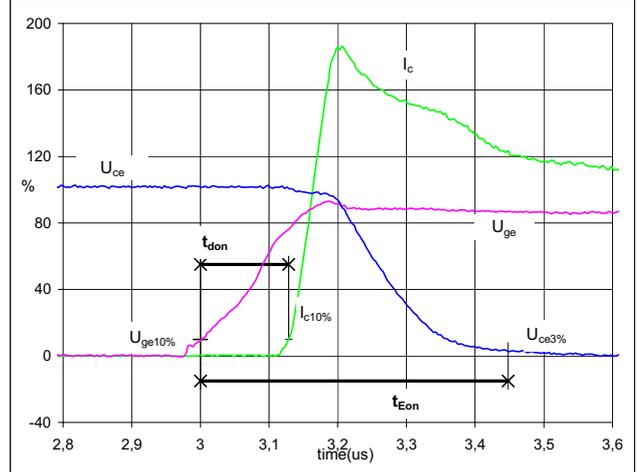
V_{GE} (0%) =	-15	V
V_{GE} (100%) =	15	V
V_C (100%) =	600	V
I_C (100%) =	25	A
t_{don} =	0,13	µs
t_{Eon} =	0,45	µs

Figure 3 — Output inverter IGBT

Turn-off Switching Waveforms & definition of t_f
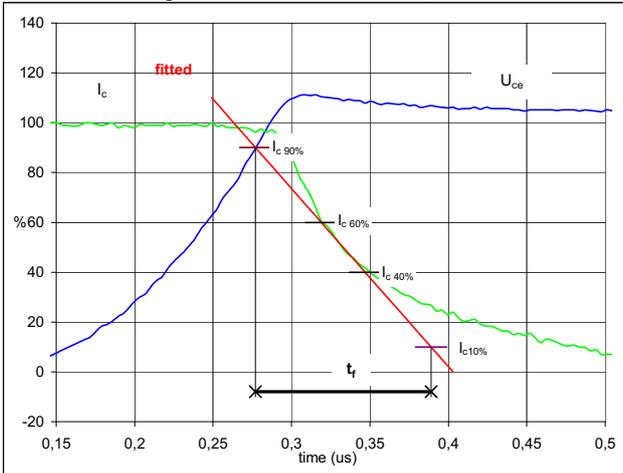
V_C (100%) =	600	V
I_C (100%) =	25	A
t_f =	0,12	µs

Figure 4 — Output inverter IGBT

Turn-on Switching Waveforms & definition of t_r
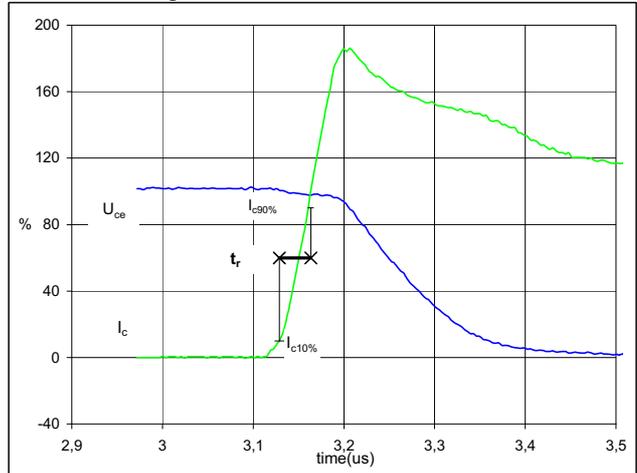
V_C (100%) =	600	V
I_C (100%) =	25	A
t_r =	0,03	µs

Switching Definitions Output Inverter

Figure 5	Output inverter IGBT
Turn-off Switching Waveforms & definition of t_{Eoff}	
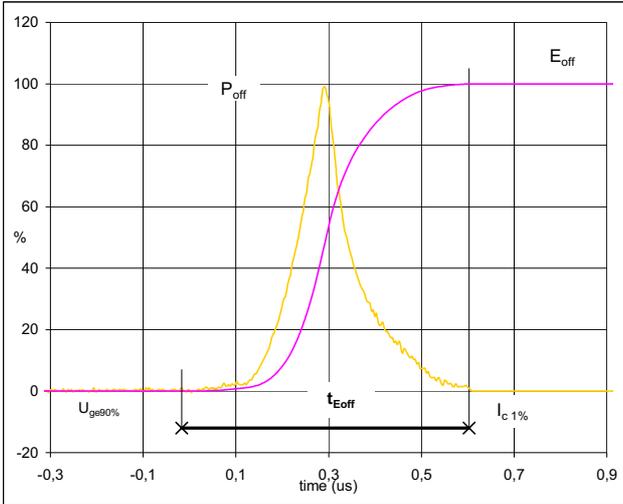
P_{off} (100%) =	15,10	kW
E_{off} (100%) =	2,16	mJ
t_{Eoff} =	0,62	µs

Figure 6	Output inverter IGBT
Turn-on Switching Waveforms & definition of t_{Eon}	
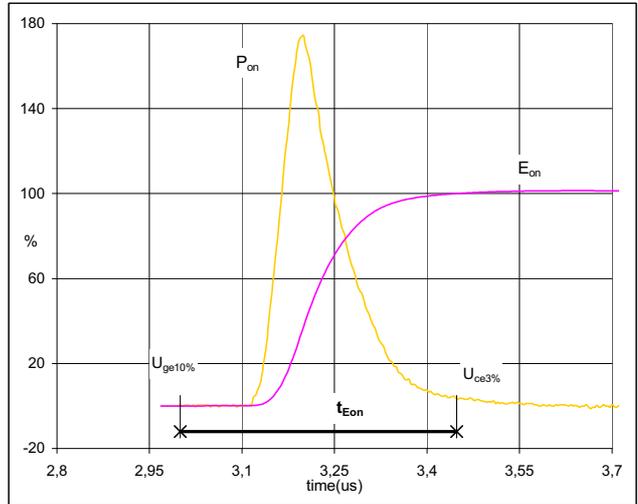
P_{on} (100%) =	15,10	kW
E_{on} (100%) =	3,00	mJ
t_{Eon} =	0,45	µs

Figure 7	Output inverter FRED
Gate voltage vs Gate charge (measured)	
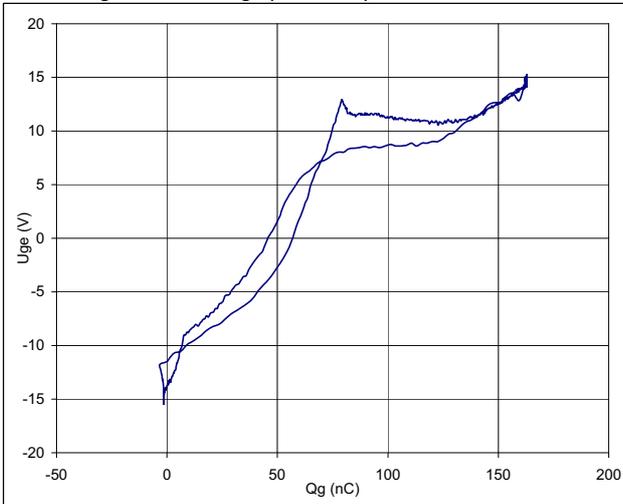
V_{GEoff} =	-15	V
V_{GEon} =	15	V
V_C (100%) =	600	V
I_C (100%) =	25	A
Q_g =	678	nC

Figure 8	Output inverter IGBT
Turn-off Switching Waveforms & definition of t_{rr}	
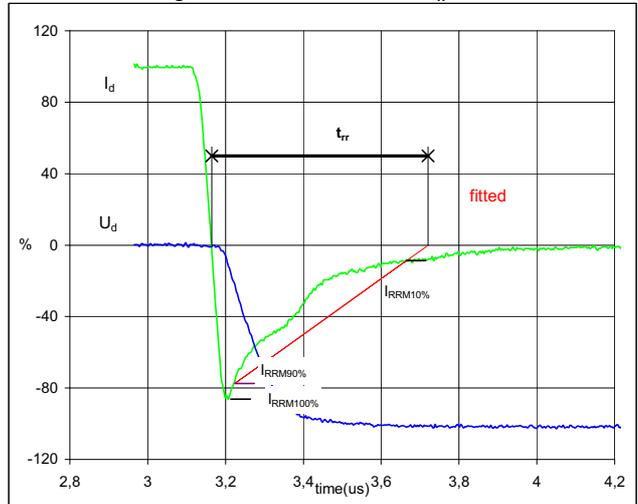
V_d (100%) =	600	V
I_d (100%) =	25	A
I_{RRM} (100%) =	-22	A
t_{rr} =	0,59	µs

Switching Definitions Output Inverter

Figure 9	Output inverter FRED

Turn-on Switching Waveforms & definition of t_{Qrr}
(t_{Qrr} = integrating time for Q_{rr})
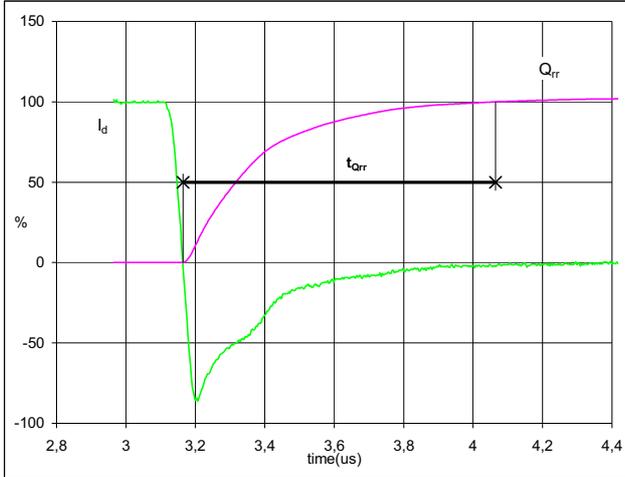
I_d (100%) =	25	A
Q_{rr} (100%) =	4,94	µC
t_{Qrr} =	0,90	µs

Figure 10	Output inverter FRED

Turn-on Switching Waveforms & definition of t_{Erec}
(t_{Erec}= integrating time for E_{rec})
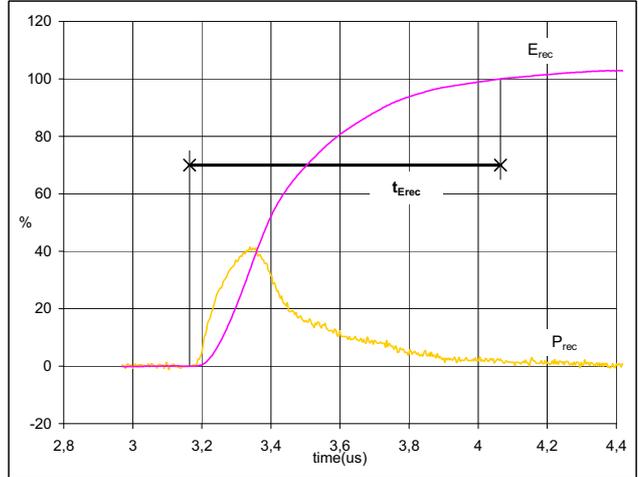
P_{rec} (100%) =	15,10	kW
E_{rec} (100%) =	1,97	mJ
t_{Erec} =	0,90	µs

Package Outline and Pinout

Outline

Pin table		
Pin	X	Y
1	33,3	0
2	30,7	0
3	27,9	0
4	23,85	0
5	21,05	0
6	15,95	0
7	9,6	0
8	5,4	0
9	2,6	0
10	0	0
11	0	11,15
12	0	22,3
13	2,6	22,3
14	5,5	22,3
15	13,1	22,3
16	15,9	22,3
17	19,4	22,3
18	27,7	22,3
19	30,7	22,3
20	33,3	22,3
21	33,3	11,15

Pinout
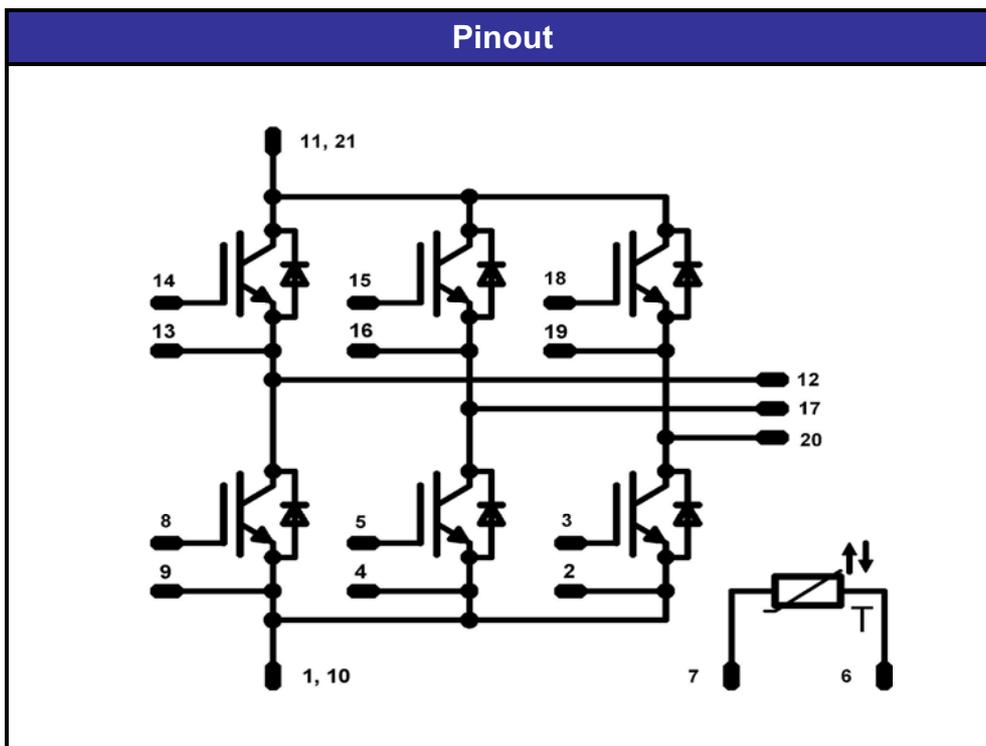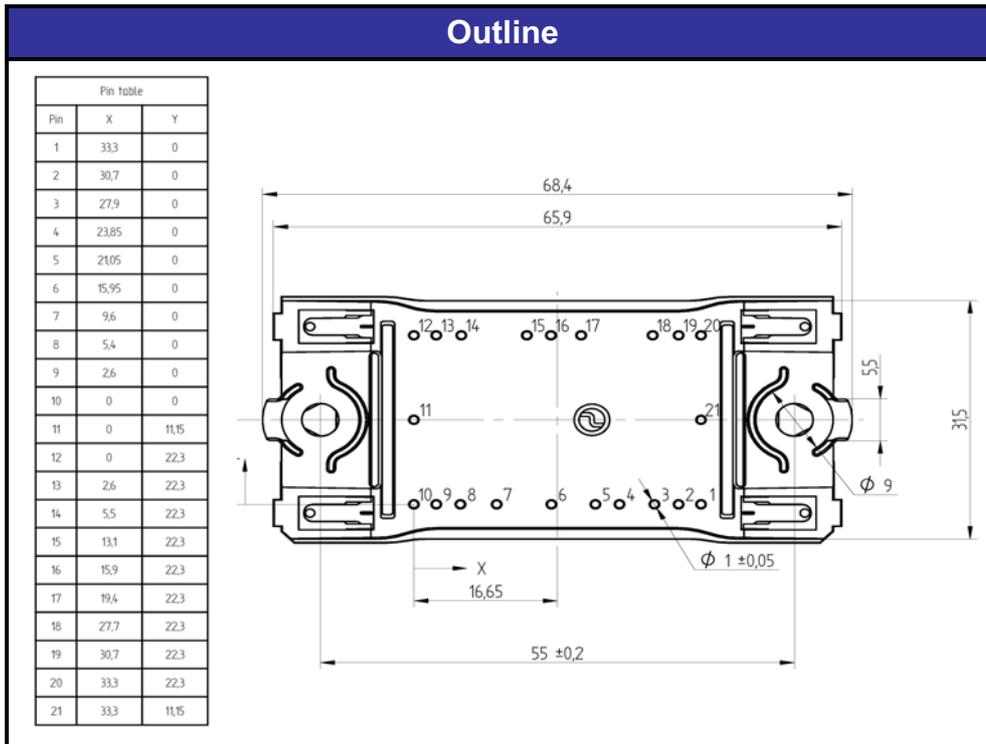
PRODUCT STATUS DEFINITIONS

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.