Vincotech

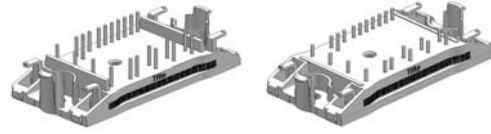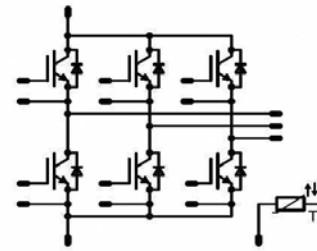| flowPACK 0 3rd gen	1200V/15A

Features

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

Target Applications

- Motor Drives
- Power Generation
- UPS

Types

- V23990-P868-F49-PM: 17mm height
- V23990-P868-F48-PM: 12mm height

flow0 housing

Schematic

Maximum Ratings

Tj=25°C, unless otherwise specified

Parameter	Symbol	Condition		Value	Unit
Inverter Transistor					
Collector-emitter voltage	V_{CE}			1200	V
DC collector current	I_C	$T_j=T_{jmax}$	$T_h=80°C$ $T_c=80°C$	22	A
Repetitive peak collector current	I_{Cpulse}	t_p limited by T_{jmax}		45	A
Power dissipation per IGBT	P_{tot}	$T_j=T_{jmax}$	$T_h=80°C$ $T_c=80°C$	64	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	$T_j=T_{jmax}$	$T_h=80°C$ $T_c=80°C$	21	A
Repetitive peak forward current	I_{FRM}	t_p limited by T_{jmax}		30	A
Power dissipation per Diode	P_{tot}	$T_j=T_{jmax}$	$T_h=80°C$ $T_c=80°C$	45	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

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		0,0005	Tj=25°C Tj=150°C	5	5,8	6,5	V
Collector-emitter saturation voltage	$V_{CE(sat)}$	15		15	Tj=25°C Tj=150°C		1,84 2,23	2,3	V
Collector-emitter cut-off current incl. Diode	I_{CES}	0	1200		Tj=25°C Tj=150°C			5	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	15	Tj=25°C Tj=150°C	86 84		ns
Rise time	t_r					Tj=25°C Tj=150°C	17,8 23,6		
Turn-off delay time	$t_{d(off)}$					Tj=25°C Tj=150°C	201 264		
Fall time	t_f					Tj=25°C Tj=150°C	81 130		
Turn-on energy loss per pulse	E_{on}					Tj=25°C Tj=150°C	0,95 1,40		mWs
Turn-off energy loss per pulse	E_{off}					Tj=25°C Tj=150°C	0,83 1,37		
Input capacitance	C_{ies}	f=1MHz	0	25		Tj=25°C	900		pF
Output capacitance	C_{oss}						80		
Reverse transfer capacitance	C_{rss}						55		
Gate charge	Q_{Gate}		15	960	15	Tj=25°C	93		nC
Thermal resistance chip to heatsink per chip	R_{thJH}	Thermal grease thickness≤50um λ = 0,61 W/mK					1,47		K/W
Inverter Diode									
Diode forward voltage	V_F			15	Tj=25°C Tj=150°C		1,84 1,77	2,4	V
Peak reverse recovery current	I_{RRM}	Rgon=32Ω	±15	600	15	Tj=25°C Tj=150°C	14,8 16,2		A
Reverse recovery time	t_{rr}					Tj=25°C Tj=150°C	289 447		ns
Reverse recovered charge	Q_{rr}					Tj=25°C Tj=150°C	1,54 2,68		µC
Peak rate of fall of recovery current	di(rec)max /dt					Tj=25°C Tj=150°C	92 59		A/µs
Reverse recovered energy	E_{rec}					Tj=150°C	1,08		mWs
Thermal resistance chip to heatsink per chip	R_{thJH}	Thermal grease thickness≤50um λ = 0,61 W/mK					2,13		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
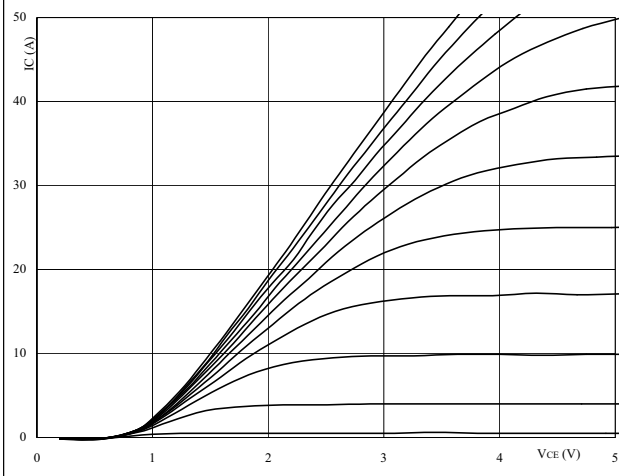
$I_C = f(V_{CE})$

$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

$I_C = f(V_{CE})$
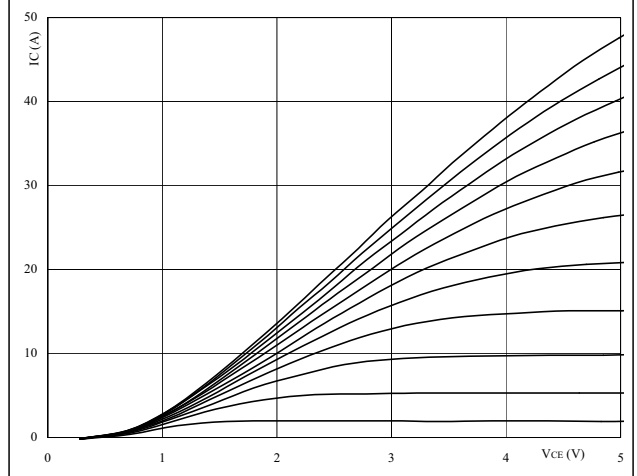
$t_p = $ 250 µs

$T_j = $ 150 °C

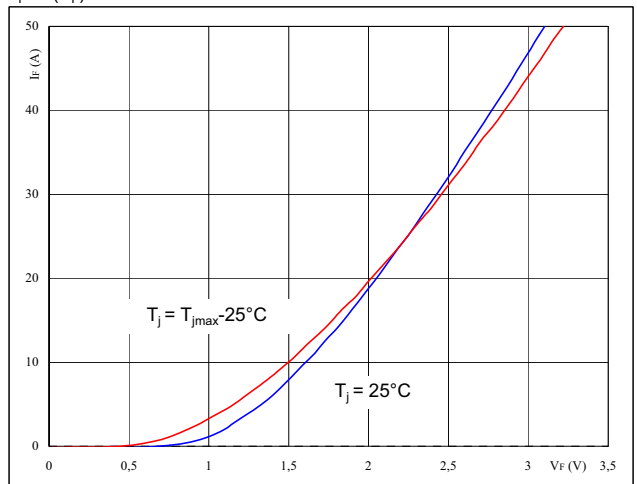V_{GE} from 7 V to 17 V in steps of 1 V

Figure 3	Output inverter IGBT

Typical transfer characteristics

$I_C = f(V_{GE})$

$T_j = 25°C$

$T_j = T_{jmax}-25°C$
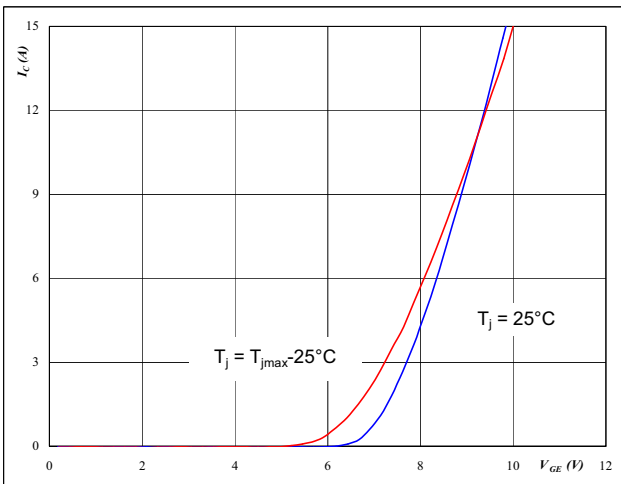
$t_p = $ 250 µs

$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

Revision: 1

Output Inverter

Figure 5 — Output inverter IGBT

Typical switching energy losses as a function of collector current

$E = f(I_C)$
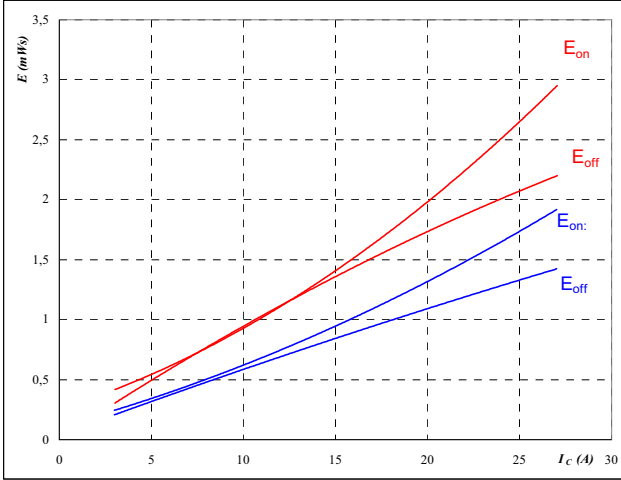
inductive load

$T_j =$	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

$E = f(R_G)$
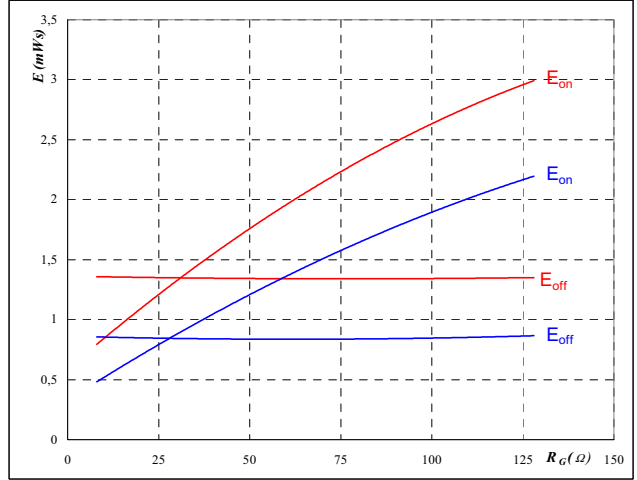
inductive load

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

Figure 7 — Output inverter IGBT

Typical reverse recovery energy loss as a function of collector current

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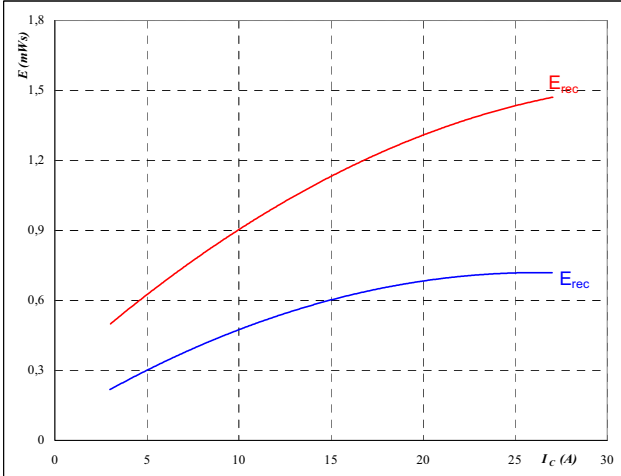
inductive load

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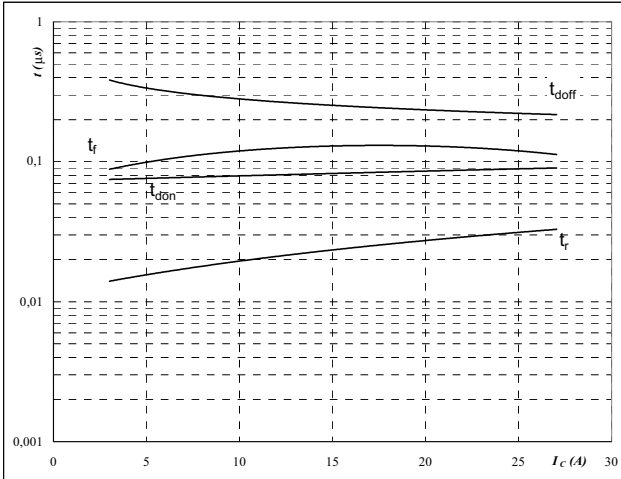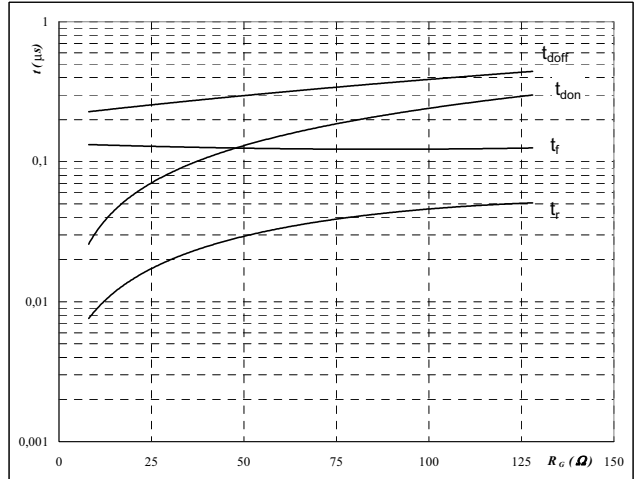
$E_{rec} = f(R_G)$
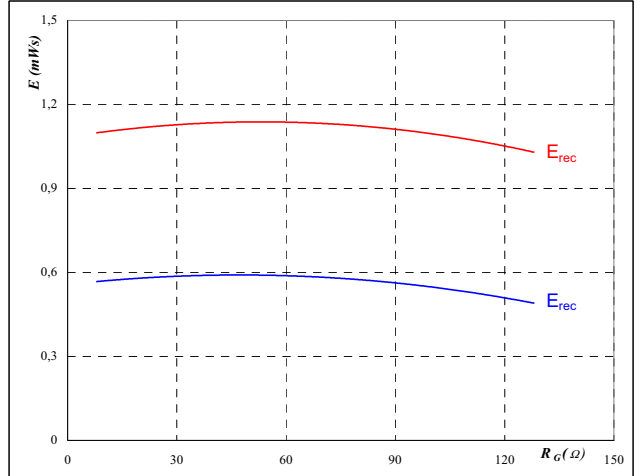
inductive load

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

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 =	15	A

Figure 11	Output inverter FRED

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

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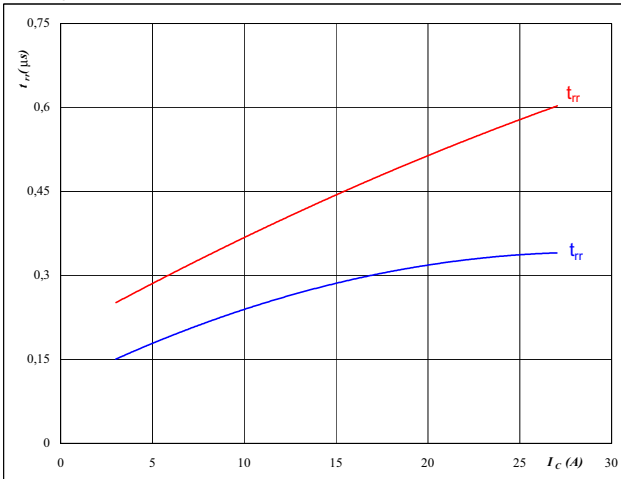
T_j =	25/150	°C
V_{CE} =	600	V
V_{GE} =	±15	V
R_{gon} =	32	Ω

Figure 12	Output inverter FRED

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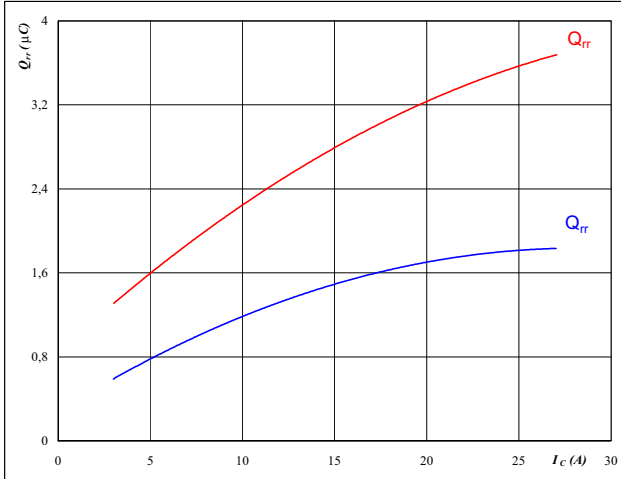function of IGBT turn on gate resistor**

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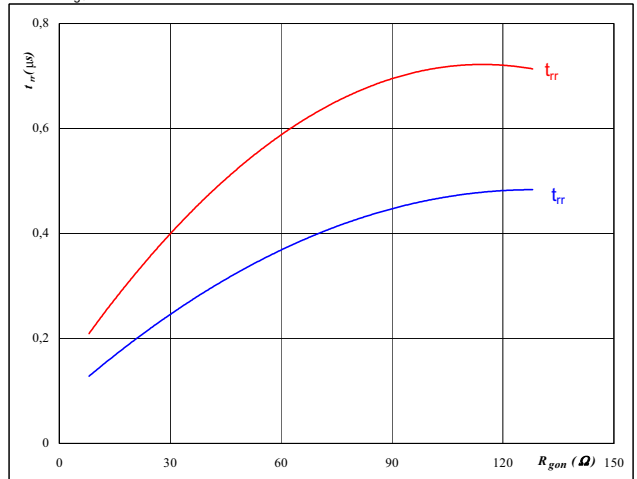
T_j =	25/150	°C
V_R =	600	V
I_F =	15	A
V_{GE} =	±15	V

Output Inverter

Figure 13 — Output inverter FRED

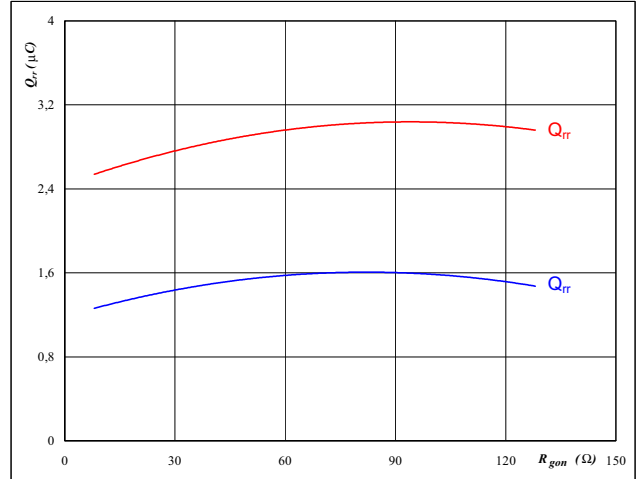**Typical reverse recovery charge as a function of collector current**

$Q_{rr} = f(I_C)$

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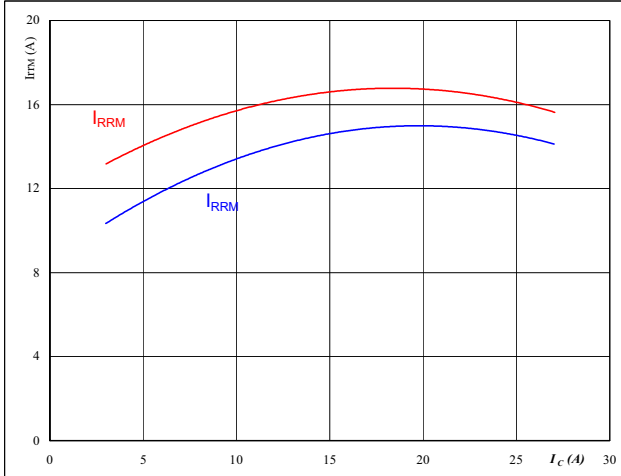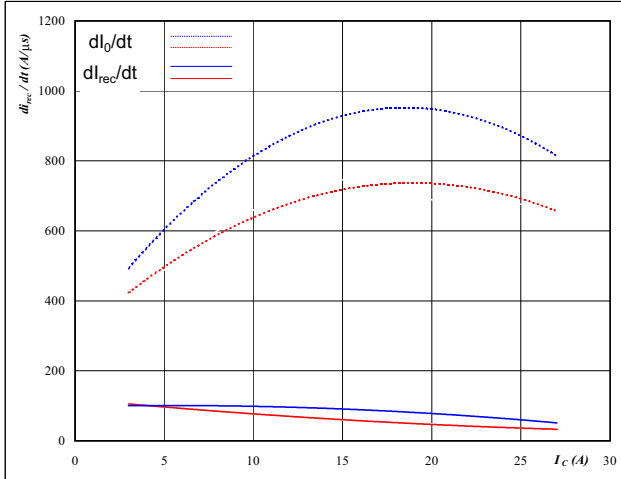
$Q_{rr} = f(R_{gon})$

T_j =	25/150	°C
V_R =	600	V
I_F =	15	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

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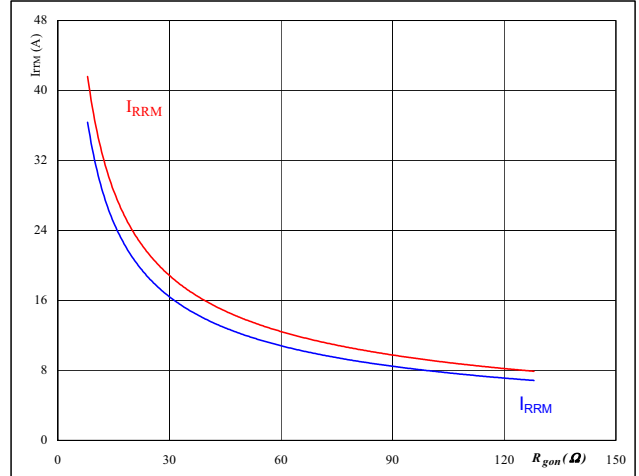
T_j =	25/150	°C
V_R =	600	V
I_F =	15	A
V_{GE} =	±15	V

Output Inverter

Figure 17	Output inverter FRED

Typical rate of fall of forward and reverse recovery current as a function of collector current
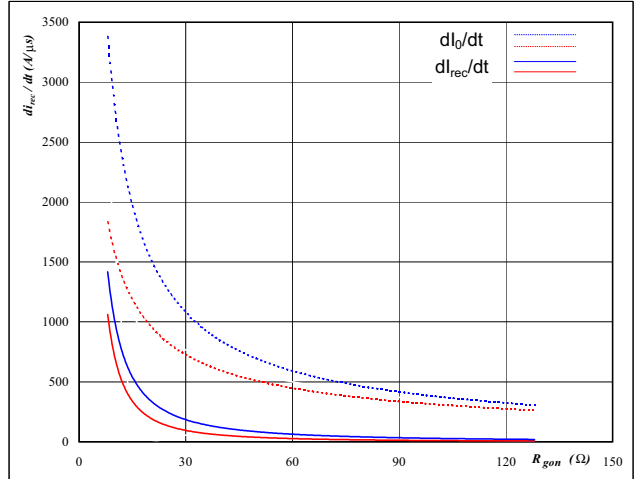
$dI_0/dt, dI_{rec}/dt = f(I_C)$

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 =	15	A
V_{GE} =	±15	V

Figure 19	Output inverter IGBT

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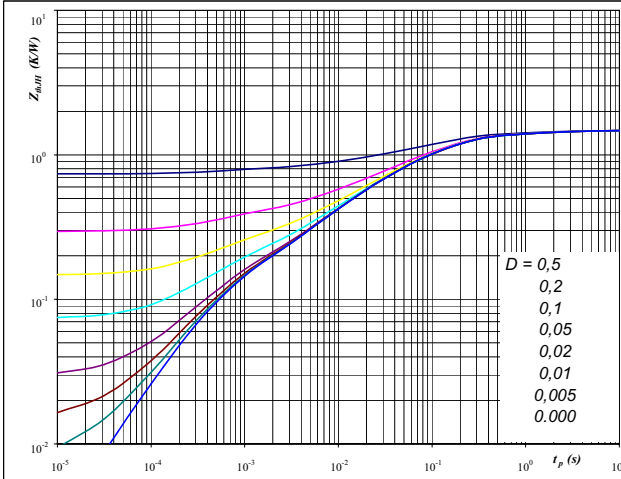
$Z_{thJH} = f(t_p)$

D =	t_p / T	
R_{thJH} =	1,47	K/W

IGBT thermal model values

R (C/W)	Tau (s)
0,03	6,2E+00
0,15	8,8E-01
0,65	1,2E-01
0,38	2,5E-02
0,15	4,5E-03
0,11	4,6E-04

Figure 20	Output inverter FRED

FRED transient thermal impedance as a function of pulse width

$Z_{thJH} = f(t_p)$
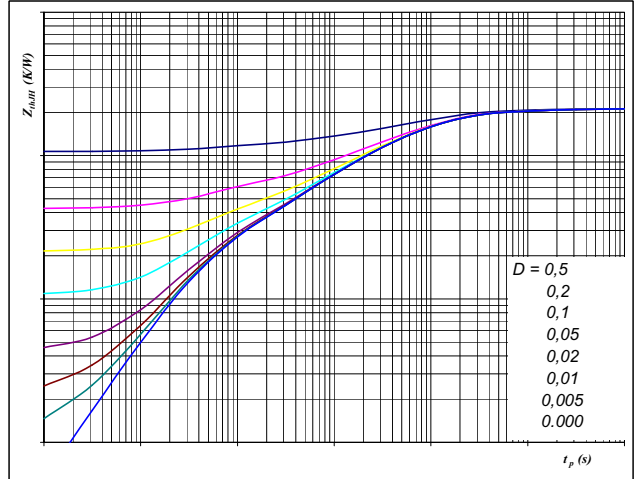
D =	t_p / T	
R_{thJH} =	2,13	K/W

FRED thermal model values

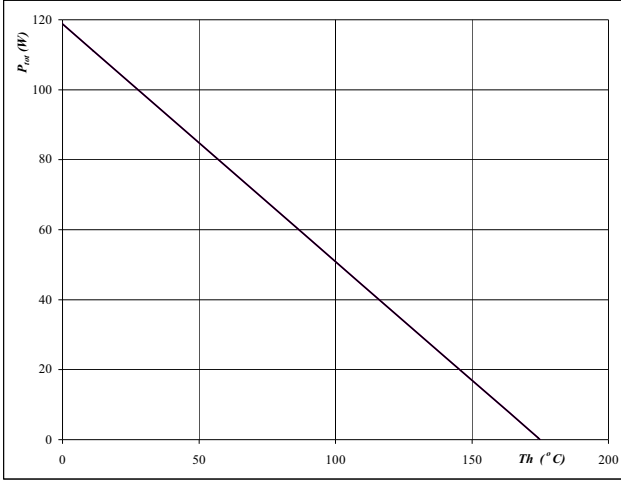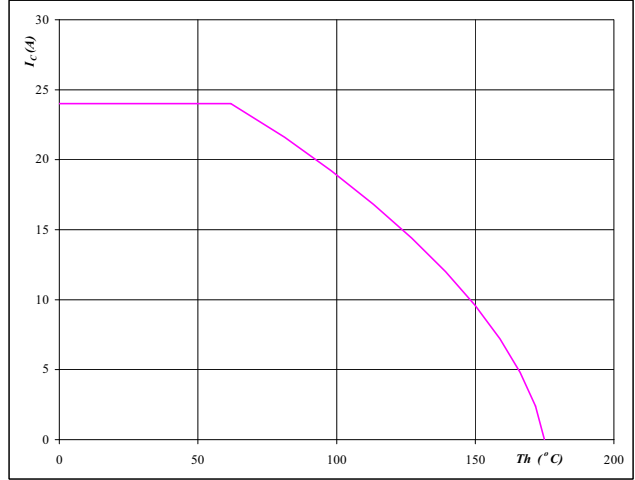| R (C/W)	Tau (s)
0,04	8,9E+00
0,17	8,9E-01
0,81	1,2E-01
0,64	2,4E-02
0,28	3,9E-03
0,20	4,4E-04

Output Inverter

Figure 21	Output inverter IGBT

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_h)$
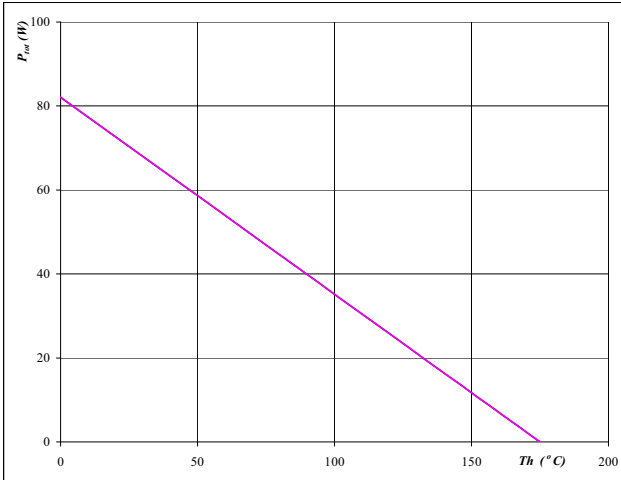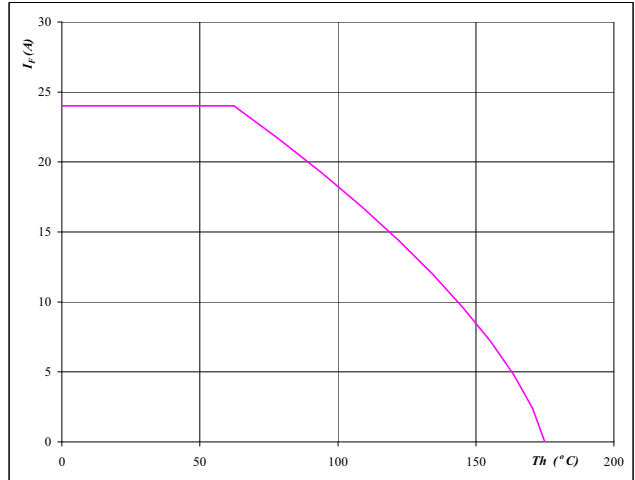

$T_j =$ 175 °C

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

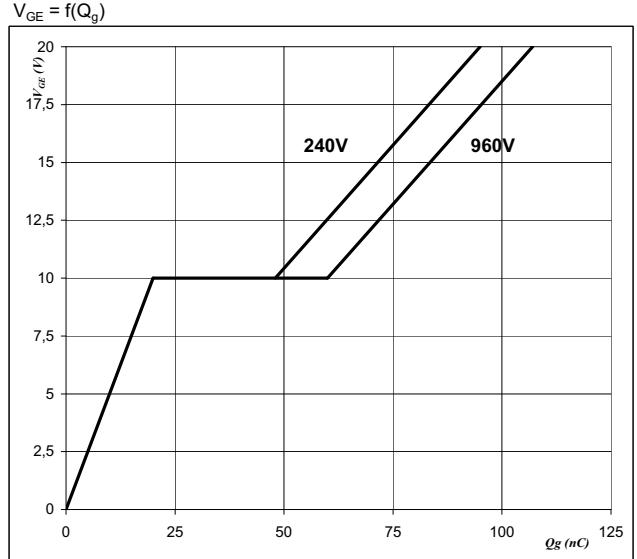**Safe operating area as a function
of collector-emitter voltage**

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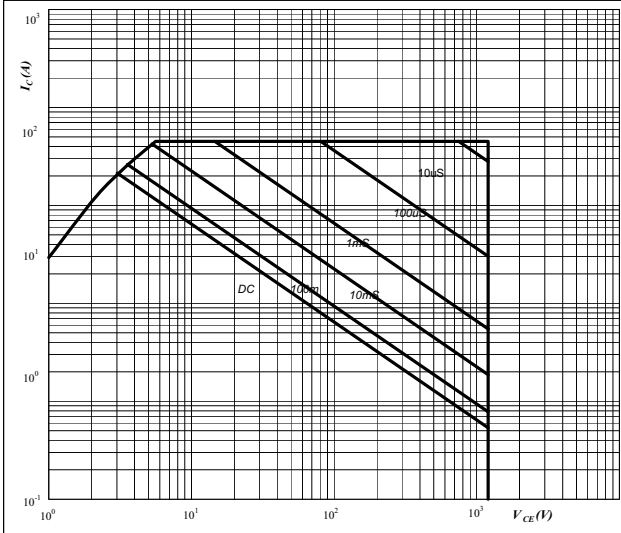
D =   single pulse
T_h =   80   °C
V_{GE} =   ±15   V
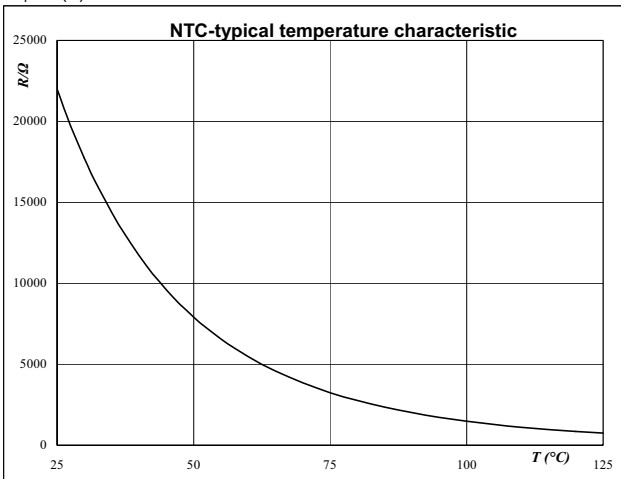T_j = T_{jmax} °C

Figure 26	Output inverter IGBT

Gate voltage vs Gate charge

$V_{GE} = f(Q_g)$

I_C =   15   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

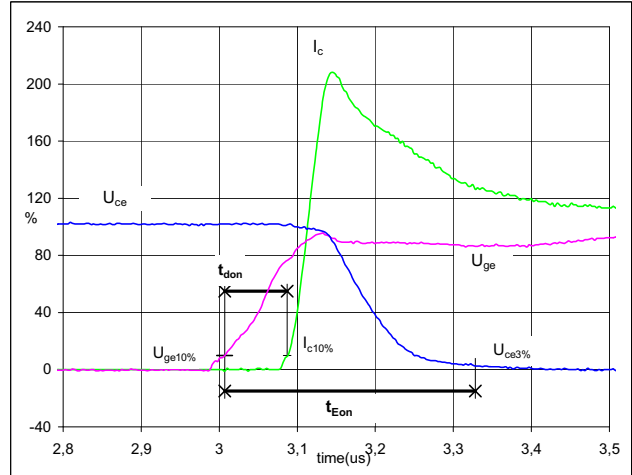### General conditions

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}
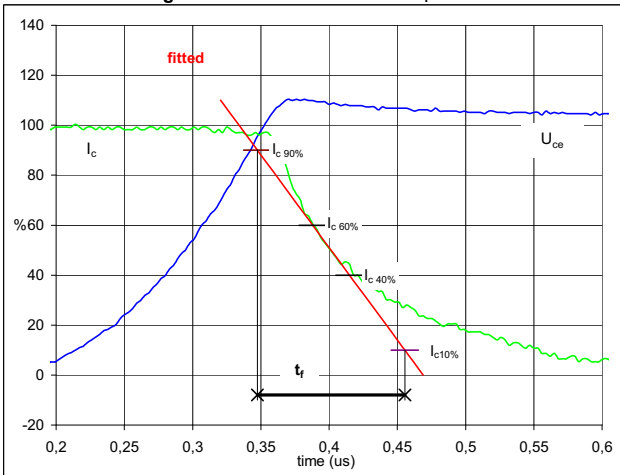**(t_{Eoff} = integrating time for E_{off})**
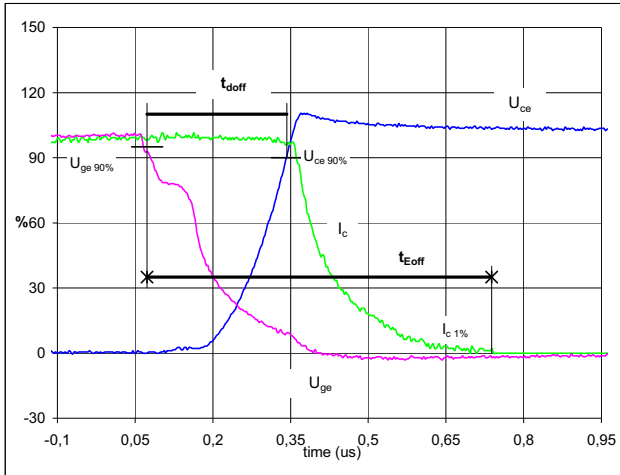
V_{GE} (0%) =	-15	V
V_{GE} (100%) =	15	V
V_C (100%) =	600	V
I_C (100%) =	15	A
t_{doff} =	0,26	µs
t_{Eoff} =	0,67	µs

Figure 2 Output inverter IGBT

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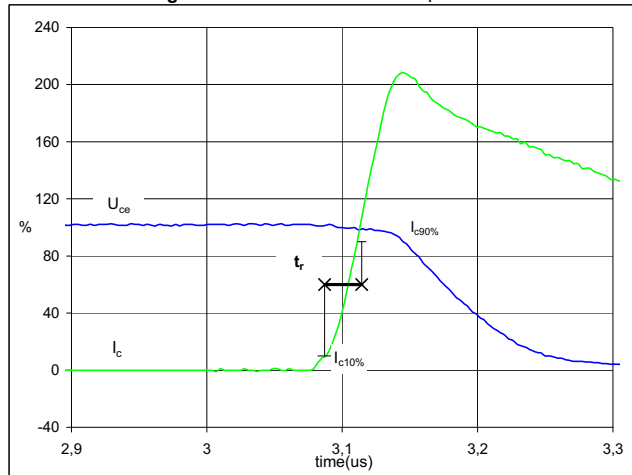**(t_{Eon} = integrating time for E_{on})**

V_{GE} (0%) =	-15	V
V_{GE} (100%) =	15	V
V_C (100%) =	600	V
I_C (100%) =	15	A
t_{don} =	0,08	µs
t_{Eon} =	0,32	µs

Figure 3 Output inverter IGBT

Turn-off Switching Waveforms & definition of t_f

V_C (100%) =	600	V
I_C (100%) =	15	A
t_f =	0,13	µs

Figure 4 Output inverter IGBT

Turn-on Switching Waveforms & definition of t_r

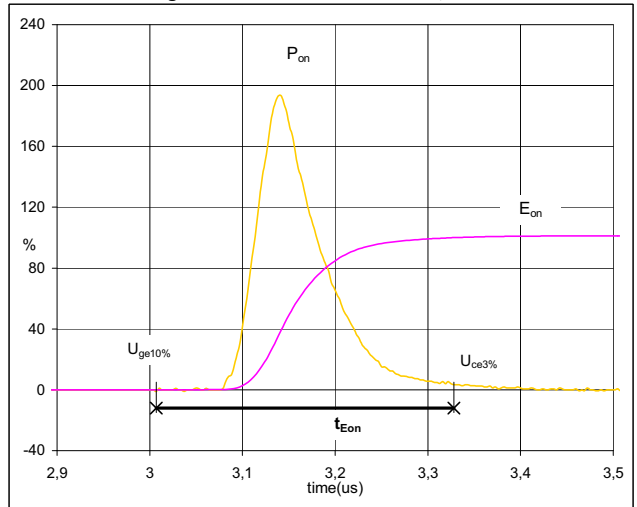|		
V_C (100%) =	600	V
I_C (100%) =	15	A
t_r =	0,02	µs

Switching Definitions Output Inverter

Figure 5	Output inverter IGBT

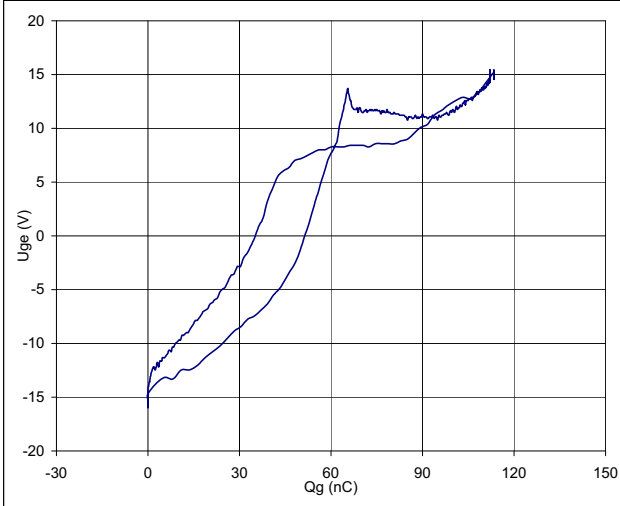**Turn-off Switching Waveforms & definition of t_{Eoff}**
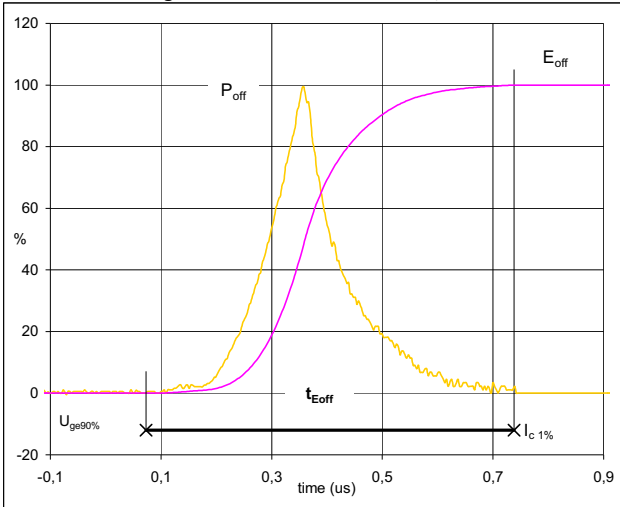
P_{off} (100%) =	9,03	kW
E_{off} (100%) =	1,37	mJ
t_{Eoff} =	0,67	µs

Figure 6	Output inverter IGBT

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

P_{on} (100%) =	9,03	kW
E_{on} (100%) =	1,40	mJ
t_{Eon} =	0,32	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%) =	15	A
Q_g =	113	nC

Figure 8	Output inverter IGBT

Turn-off Switching Waveforms & definition of t_{rr}
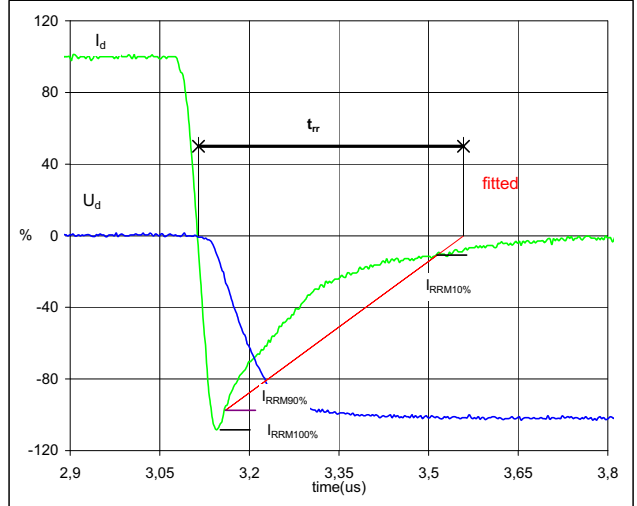
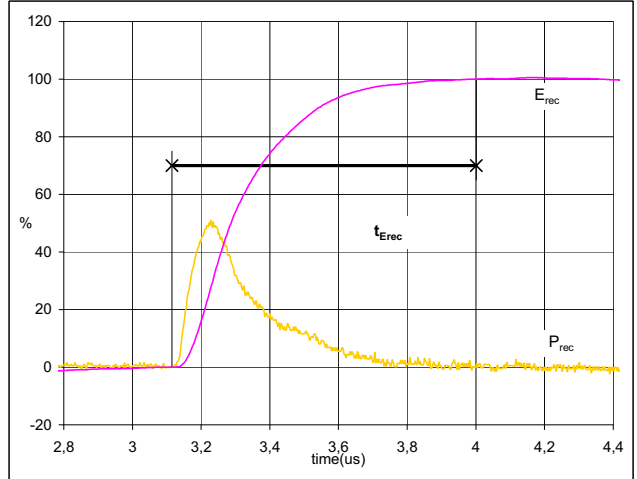|		
V_d (100%) =	600	V
I_d (100%) =	15	A
I_{RRM} (100%) =	-16	A
t_{rr} =	0,45	µs

Switching Definitions Output Inverter

Figure 9	Output inverter FRED

Turn-on Switching Waveforms & definition of t_{Qrr}
(t_{Qrr} = integrating time for Q_{rr})
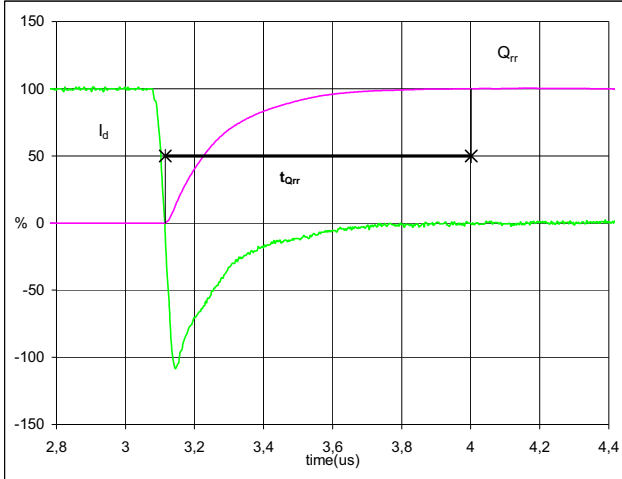
I_d (100%) =	15	A
Q_{rr} (100%) =	2,68	µC
t_{Qrr} =	0,89	µs

Figure 10	Output inverter FRED

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

P_{rec} (100%) =	9,03	kW
E_{rec} (100%) =	1,08	mJ
t_{Erec} =	0,89	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
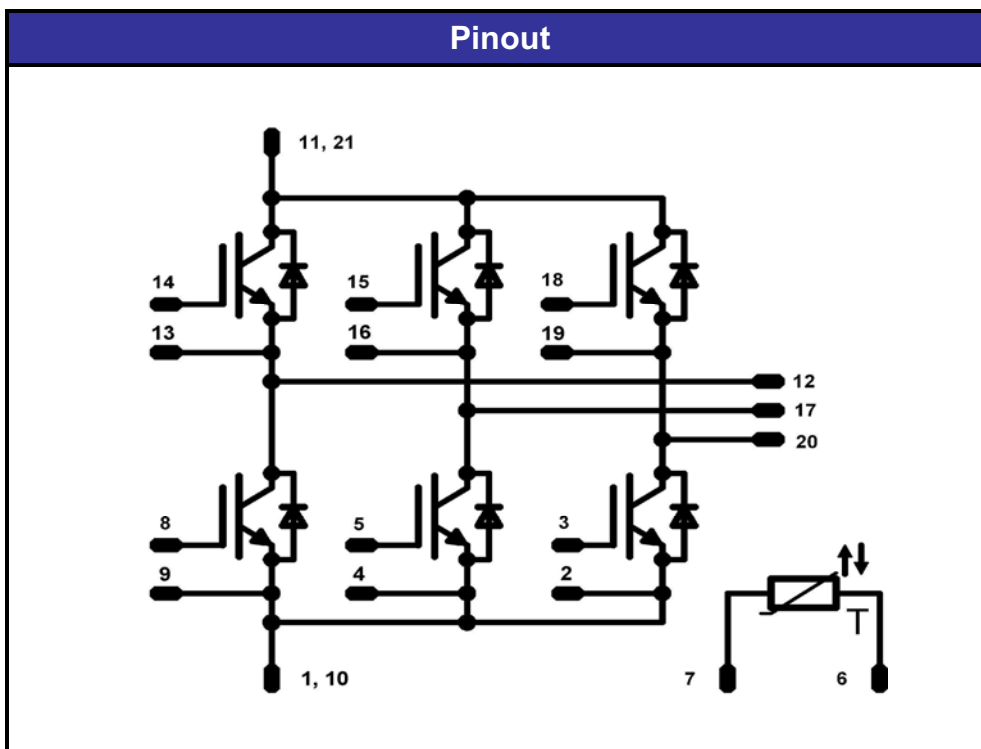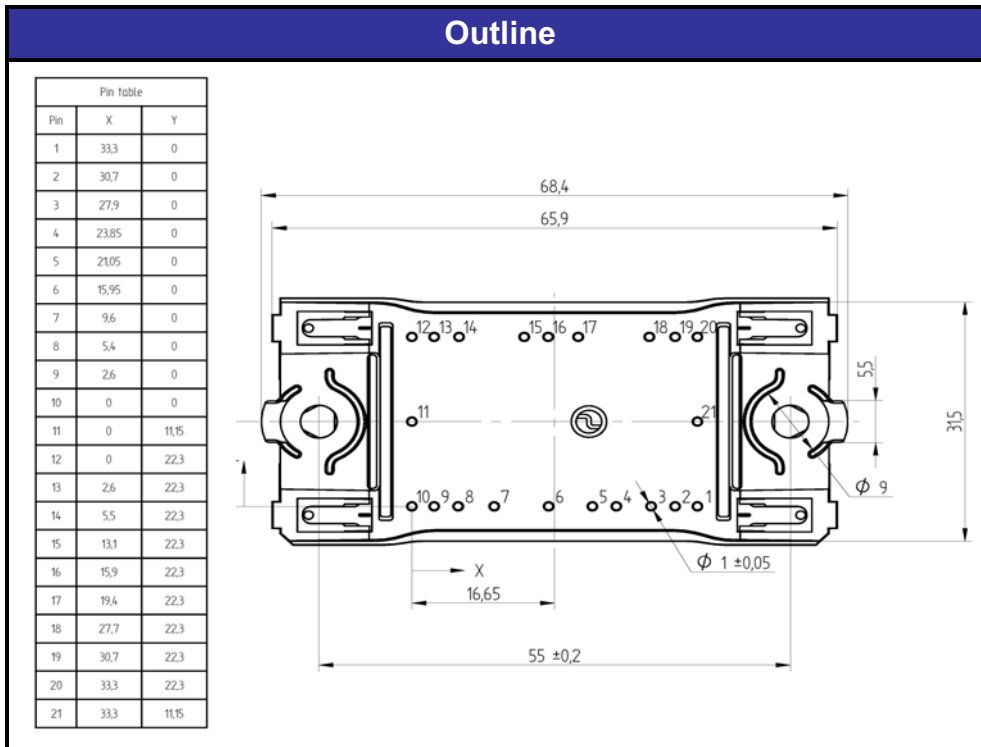
PRODUCT STATUS DEFINITIONS

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.