Vincotech

flowPIM0 3rd Gen	1200V/8A

Features
- 2 Clips housing in 12 and 17mm height
- Trench Fieldstop Technology IGBT4
- Enhenced Rectifier
- Optional w/o BRC

Target Applications
- Industrial Drives
- Embedded Generation

Types
- V23990-P849-A58-PM 12mm height
- V23990-P849-A59-PM 17mm height
- V23990-P849-C58-PM 12mm height; w/o BRC
- V23990-P849-C59-PM 17mm height; w/o BRC

flow0 Housing

Schematics

Maximum Ratings

T_j=25℃, unless otherwise specified

Parameter	Symbol	Condition		Value	Unit
Input Rectifier Doide					
Repetitive peak reverse voltage	V_{RRM}			1600	V
Forward current per diode	I_{FAV}	DC current	T_h=80℃ T_c=80℃	36	A
Surge forward current	I_{FSM}	t_p=10ms	T_j=25℃	370	A
I2t-value	I^2t			680	A^2s
Power dissipation per Diode	P_{tot}	T_j=$T_j$max	T_h=80℃ T_c=80℃	43	W
Maximum Junction Temperature	T_{jmax}			150	℃
Transistor Inverter					
Collector-emitter voltage	V_{CE}			1200	V
DC collector current	I_C	T_j=$T_j$max	T_h=80℃ T_c=80℃	13	A
Repetitive peak collector current	I_{Cpuls}	T_j≤150℃		24	A
Power dissipation per IGBT	P_{tot}	T_j=$T_j$max	T_h=80℃ T_c=80℃	44	W
Gate-emitter peak voltage	V_{GE}			±20	V
Short circuit ratings	t_{SC}	T_j≤150℃		10	µs
	V_{CC}	V_{GE}=15V		800	V
Maximum Junction Temperature	T_{jmax}			175	℃

Maximum Ratings

T_j=25℃, unless otherwise specified

Parameter	Symbol	Condition		Value	Unit
Diode Inverter					
Peak Repetitive Reverse Voltage	V_{RRM}			1200	V
DC forward current	I_F	T_j=$T_j$max	T_h=80℃ T_c=80℃	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℃ T_c=80℃	36	W
Maximum Junction Temperature	T_{jmax}			175	℃
Transistor BRC					
Collector-emitter voltage	V_{CE}			1200	V
DC collector current	I_C	T_j=$T_j$max	T_h=80℃ T_c=80℃	8	A
Repetitive peak collector current	I_{cpuls}	tp limited by $T_j$max		12	A
Power dissipation per IGBT	P_{tot}	T_j=$T_j$max	T_h=80℃ T_c=80℃	32	W
Gate-emitter peak voltage	V_{GE}			±20	V
Short circuit ratings	t_{SC} V_{CC}	T_j≤150℃ V_{GE}=15V		10 800	μs V
Maximum Junction Temperature	T_{jmax}			175	℃
Diode BRC					
Peak Repetitive Reverse Voltage	V_{RRM}			1200	V
DC forward current	I_F	T_j=$T_j$max	T_h=80℃ T_c=80℃	7	A
Repetitive peak forward current	I_{FRM}	tp limited by $T_j$max		6	A
Power dissipation per Diode	P_{tot}	T_j=$T_j$max	T_h=80℃ T_c=80℃	18	W
Maximum Junction Temperature	T_{jmax}			150	℃
Thermal properties					
Storage temperature	T_{stg}			-40…+125	℃
Operation temperature	T_{jop}			-40…+125	℃
Insulation properties					
Insulation voltage	V_{is}	t=2s	DC voltage	4000	V
Creepage distance				min 12,7	mm
Clearance				min 12,7	mm

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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	1,15 / 1,11	1,6	V
Threshold voltage (for power loss calc. only)	V_{to}			30	Tj=25°C / Tj=125°C		0,91 / 0,77		V
Slope resistance (for power loss calc. only)	r_t				Tj=25°C / Tj=125°C		0,008 / 0,011		Ω
Reverse current	I_r		1600		Tj=25°C / Tj=150°C			0,1	mA
Thermal resistance chip to heatsink per chip	R_{thJH}	Thermal grease thicknes≤50um λ = 1 W/mK					1,66		K/W
Transistor Inverter									
Gate emitter threshold voltage	$V_{GE(th)}$	VCE=VGE		0,0003	Tj=25°C / Tj=125°C	5	5,8	6,5	V
Collector-emitter saturation voltage	$V_{CE(sat)}$			8	Tj=25°C / Tj=125°C	1,6	1,87 / 2,20	2,35	V
Collector-emitter cut-off current incl. Diode	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=125°C			200	nA
Integrated Gate resistor	R_{gint}						none		Ω
Turn-on delay time	$t_{d(on)}$	Rgon=32Ohm Rgoff=32Ohm	600	8	Tj=25°C / Tj=125°C		71		ns
Rise time	t_r				Tj=25°C / Tj=125°C		23		ns
Turn-off delay time	$t_{d(off)}$	15			Tj=25°C / Tj=125°C		236		ns
Fall time	t_f				Tj=25°C / Tj=125°C		108		ns
Turn-on energy loss per pulse	E_{on}				Tj=25°C / Tj=125°C		0,75		mWs
Turn-off energy loss per pulse	E_{off}				Tj=25°C / Tj=125°C		0,62		mWs
Input capacitance	C_{ies}						490		pF
Output capacitance	C_{oss}	f=1MHz / 0	25		Tj=25°C		50		pF
Reverse transfer capacitance	C_{rss}						30		pF
Gate charge	Q_{Gate}	Vcc=600V / ±15		8	Tj=25°C		53		nC
Thermal resistance chip to heatsink per chip	R_{thJH}	Thermal grease thicknes≤50um λ = 1 W/mK					2,16		K/W
Diode Inverter									
Diode forward voltage	V_F			10	Tj=25°C / Tj=125°C	1,35	1,70 / 1,66	2,2	V
Reverse leakage current	I_{rm}		1200		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		10		A
Reverse recovery time	t_{rr}				Tj=25°C / Tj=125°C		383		ns
Reverse recovered charge	Q_{rr}				Tj=25°C / Tj=125°C		1,57		uC
Peak rate of fall of recovery current	di(rec)max /dt				Tj=25°C / Tj=125°C		69		A/ms
Reverse recovered energy	Erec				Tj=25°C / Tj=125°C		0,63		mWs
Thermal resistance chip to heatsink per chip	R_{thJH}	Thermal grease thicknes≤50um λ = 1 W/mK					2,68		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(℃)	Min	Typ	Max	
Transistor BRC									
Gate emitter threshold voltage	$V_{GE(th)}$	VCE=VGE			0,00015	Tj=25℃ Tj=125℃	5	5,8	6,5	V
Collector-emitter saturation voltage	$V_{CE(sat)}$		15		4	Tj=25℃ Tj=125℃		1,96 2,17		V
Collector-emitter cut-off	I_{CES}		0	1200		Tj=25℃ Tj=125℃			0,05	mA
Gate-emitter leakage current	I_{GES}		20	0		Tj=25℃ Tj=125℃			200	nA
Integrated Gate resistor	R_{gint}							none		Ω
Turn-on delay time	$t_{d(on)}$	Rgon=64Ohm Rgoff=64Ohm	15	600	4	Tj=25℃ Tj=125℃		90		ns
Rise time	t_r					Tj=25℃ Tj=125℃		24		ns
Turn-off delay time	$t_{d(off)}$					Tj=25℃ Tj=125℃		226		ns
Fall time	t_f					Tj=25℃ Tj=125℃		99		ns
Turn-on energy loss per pulse	E_{on}					Tj=25℃ Tj=125℃		0,34		mWs
Turn-off energy loss per pulse	E_{off}					Tj=25℃ Tj=125℃		0,30		mWs
Input capacitance	C_{ies}	f=1MHz	0	25		Tj=25℃		250		pF
Output capacitance	C_{oss}							25		pF
Reverse transfer capacitance	C_{rss}							15		pF
Gate charge	Q_{Gate}		15	960	4	Tj=25℃		25		nC
Thermal resistance chip to heatsink per chip	R_{thJH}	Thermal grease thickness≤50um λ = 1 W/mK						2,93		K/W
Diode BRC									
Diode forward voltage	V_F				4	Tj=25℃ Tj=125℃	1	1,91 1,84	2,35	V
Reverse leakage current	I_r		15	600	4	Tj=25℃ Tj=125℃			250	mA
Peak reverse recovery current	I_{RRM}	Rgon=64Ohm	15	600	4	Tj=25℃ Tj=125℃		5		A
Reverse recovery time	t_{rr}					Tj=25℃ Tj=125℃		446		ns
Reverse recovered charge	Q_{rr}					Tj=25℃ Tj=125℃		0,76		uC
Peak rate of fall of recovery current	di(rec)max /dt					Tj=25℃ Tj=125℃		40		A/ms
Reverse recovery energy	E_{rec}					Tj=25℃ Tj=125℃		0,32		mWs
Thermal resistance chip to heatsink per chip	R_{thJH}	Thermal grease thickness≤50um λ = 1 W/mK						3,98		K/W
Thermistor									
Rated resistance	R_{25}	Tol. ±13%				Tj=25℃	19,1	22	24,9	kΩ
	R_{100}	Tol. ±5%				Tj=100℃	1411	1486	1560	Ω
Power dissipation given Epcos-Typ	P					Tj=25℃		210		mW
B-value	$B_{(25/100)}$	Tol. ±3%				Tj=25℃		4000		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
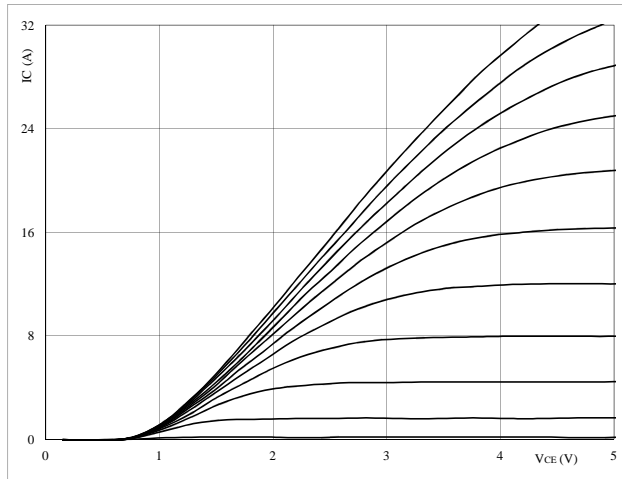
VGE from 7 V to 17 V in steps of 1 V

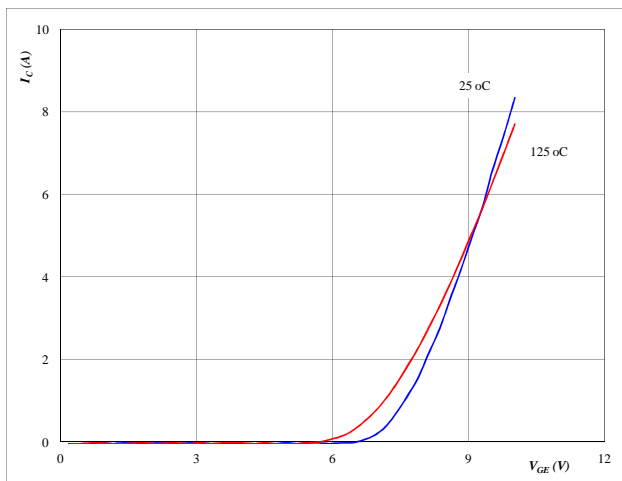| Figure 2	Output inverter IGBT

Typical output characteristics

$I_C = f(V_{CE})$

At

t_p = 250 µs
T_j = 125 °C
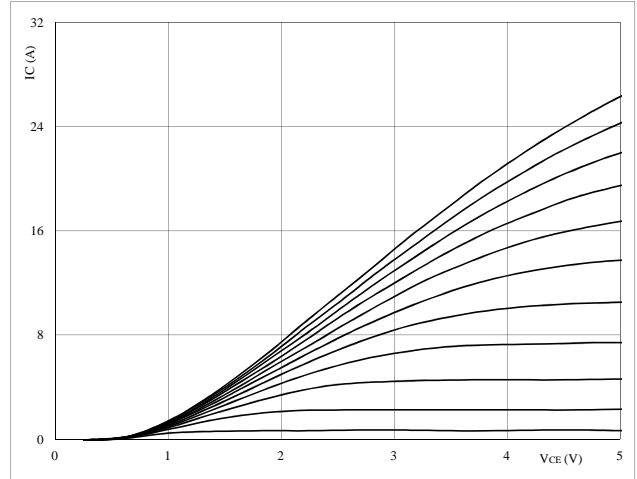
VGE from 7 V to 17 V in steps of 1 V

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**
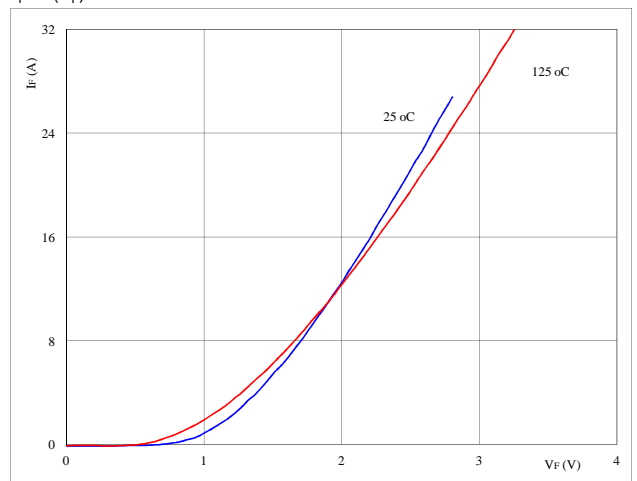
$I_F = f(V_F)$

At

t_p = 250 µs

Output Inverter

Figure 5	Output inverter IGBT

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

$E = f(I_C)$
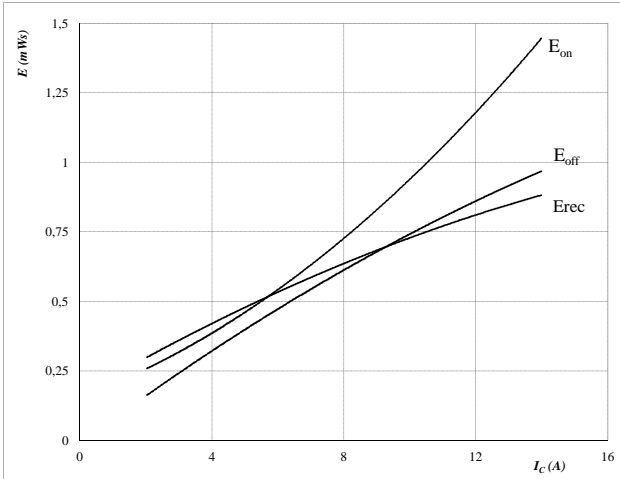
With an inductive load at

$T_j =$	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**

$E = f(R_G)$
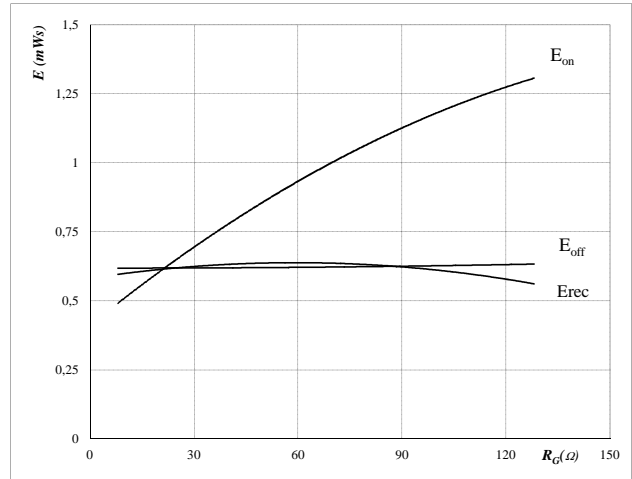
With an inductive load at

$T_j =$	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**

$t = f(I_C)$
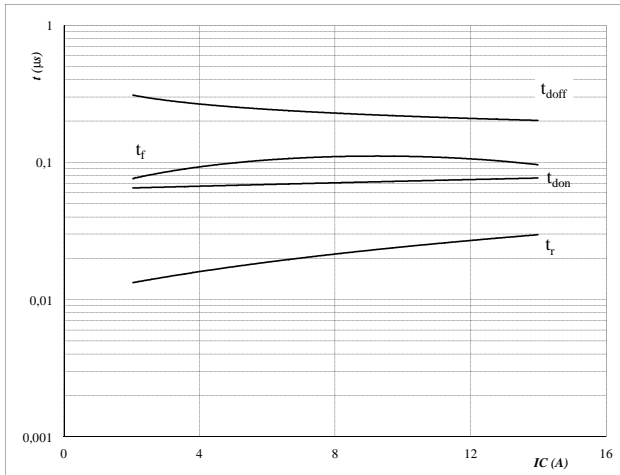
With an inductive load at

$T_j =$	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**

$t = f(R_G)$
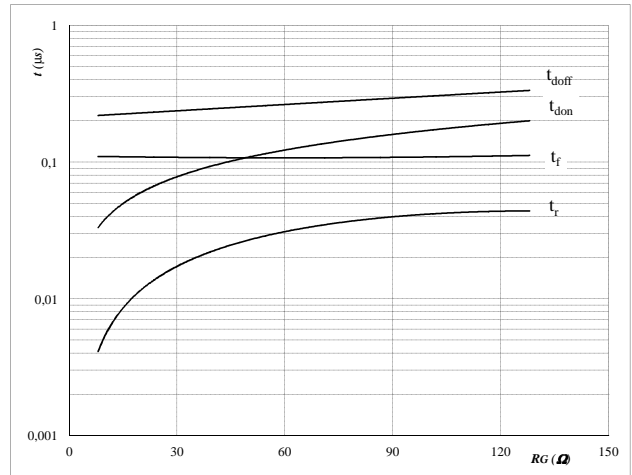
With an inductive load at

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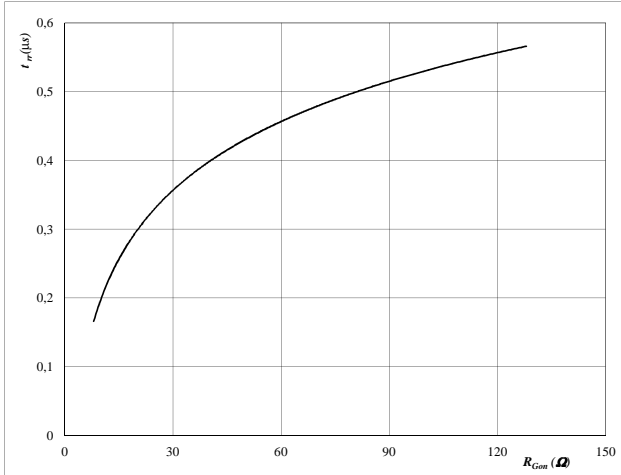
$T_j =$	125	°C
$V_R =$	600	V
$I_F =$	8	A
$V_{GE} =$	±15	V

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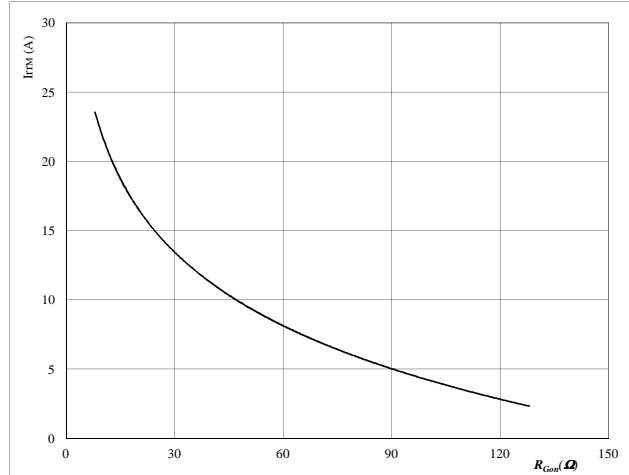
$T_j =$	125	°C
$V_R =$	600	V
$I_F =$	8	A
$V_{GE} =$	±15	V

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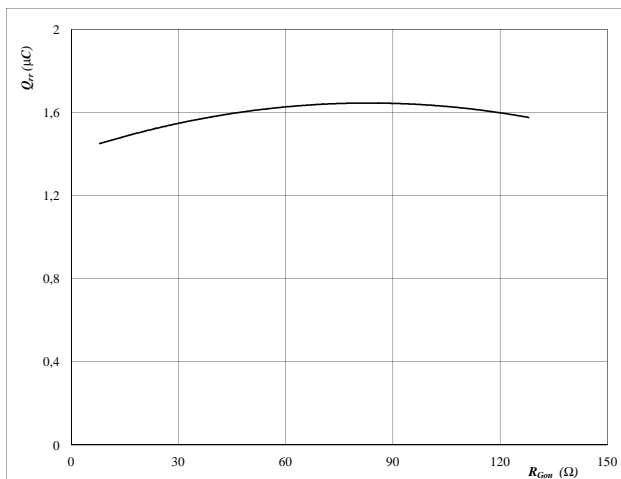
$T_j =$	125	°C
$V_R =$	600	V
$I_F =$	8	A
$V_{GE} =$	±15	V

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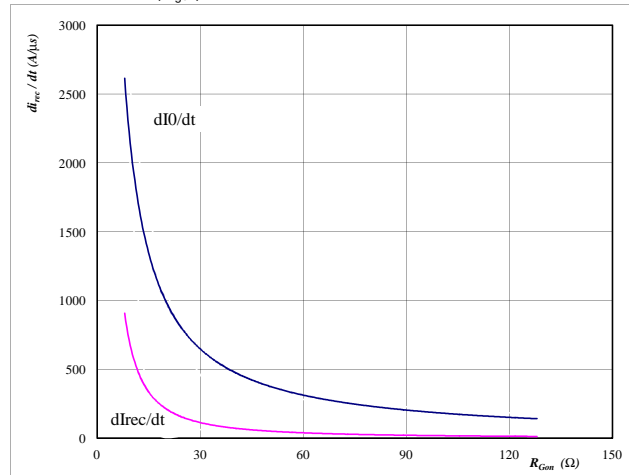
$T_j =$	125	°C
$V_R =$	600	V
$I_F =$	8	A
$V_{GE} =$	±15	V

Output Inverter

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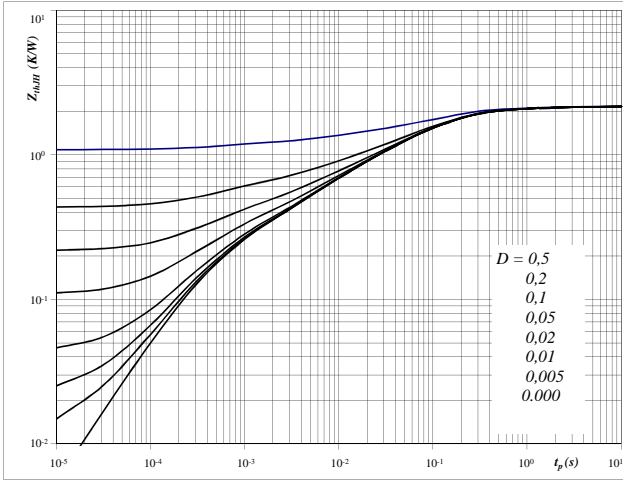
$Z_{thJH} = f(tp)$

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

**FRED transient thermal impedance
as a function of pulse width**

$Z_{thJH} = f(tp)$
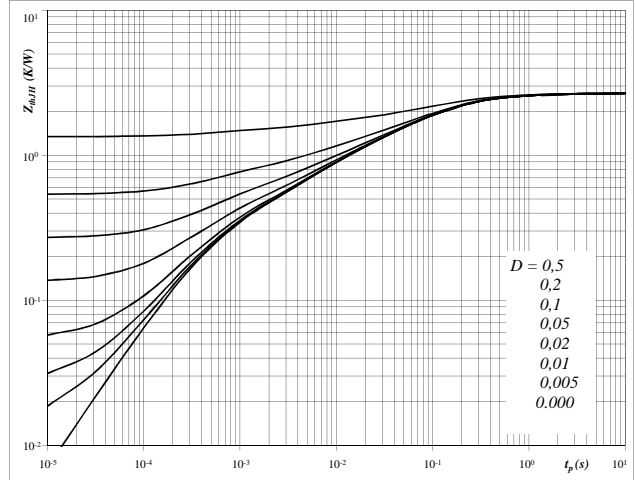
With

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

Output Inverter

Figure 15   Output inverter IGBT

**Power dissipation as a
function of heatsink temperature**
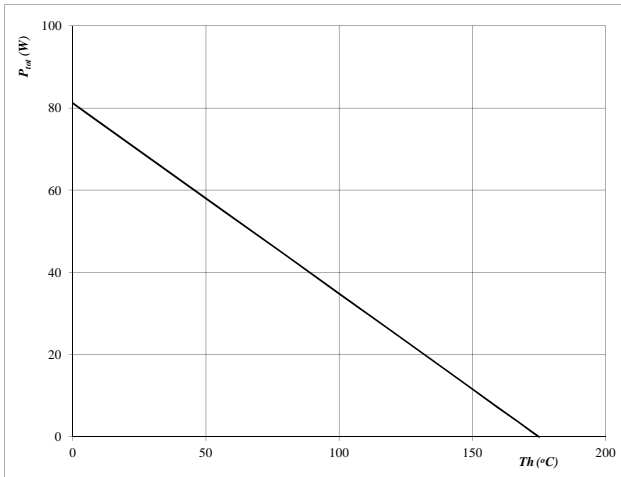
$P_{tot} = f(T_h)$

At
$T_j =$ 175   °C

Figure 16   Output inverter IGBT

**Collector current as a
function of heatsink temperature**

$I_C = f(T_h)$
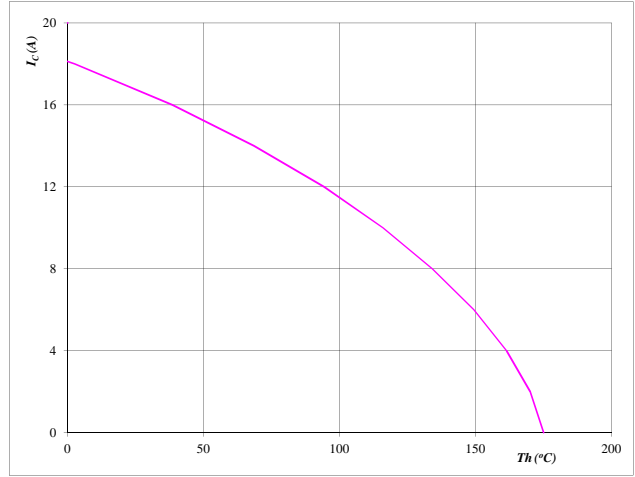
At
$T_j =$ 175   °C
$V_{GE} =$ 15   V

Figure 17   Output inverter FRED

**Power dissipation as a
function of heatsink temperature**

$P_{tot} = f(T_h)$
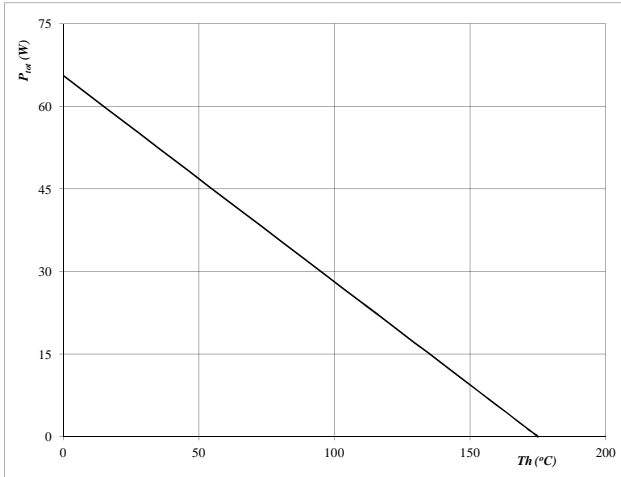
At
$T_j =$ 175   °C

Figure 18   Output inverter FRED

**Forward current as a
function of heatsink temperature**

$I_F = f(T_h)$
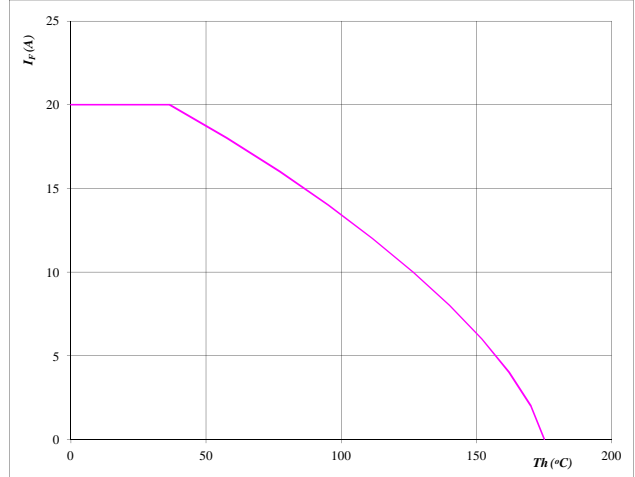
At
$T_j =$ 175   °C

Brake

Figure 1	Brake IGBT

Typical output characteristics

$I_C = f(V_{CE})$

At

t_p =	250	µs
T_j =	25	°C
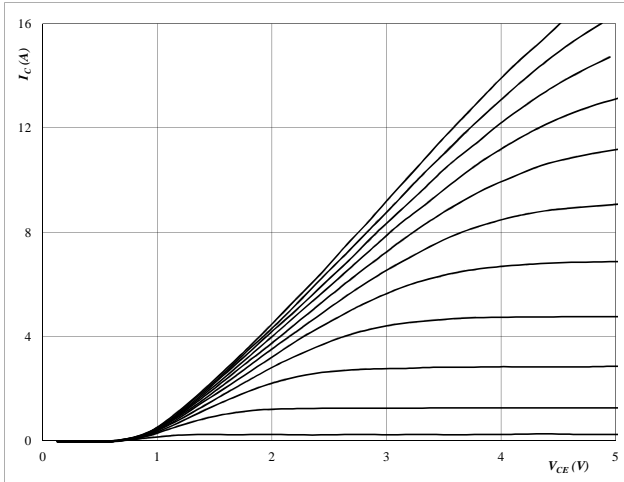
VGE from 7 V to 17 V in steps of 1 V

Figure 2	Brake IGBT

Typical output characteristics

$I_C = f(V_{CE})$

At

t_p =	250	µs
T_j =	125	°C
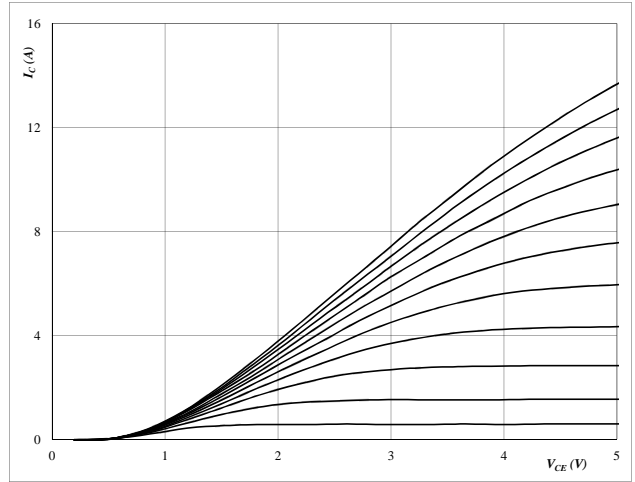
VGE from 7 V to 17 V in steps of 1 V

Figure 3	Brake IGBT

Typical transfer characteristics

$I_C = f(V_{GE})$

At
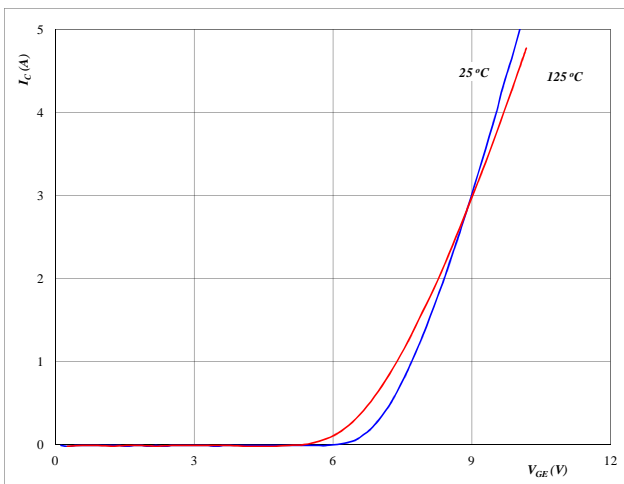
t_p =	250	µs
V_{CE} =	10	V

Figure 4	Brake FRED

Typical diode forward current as a function of forward voltage

$I_F = f(V_F)$

At
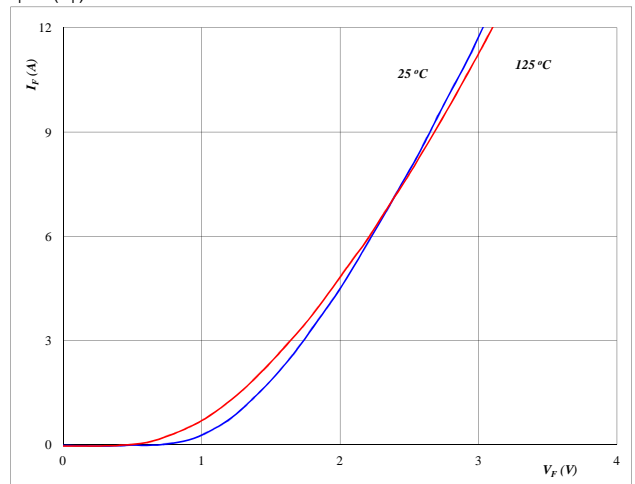
t_p =	250	µs

Brake

Figure 5	Brake IGBT

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

$E = f(I_C)$
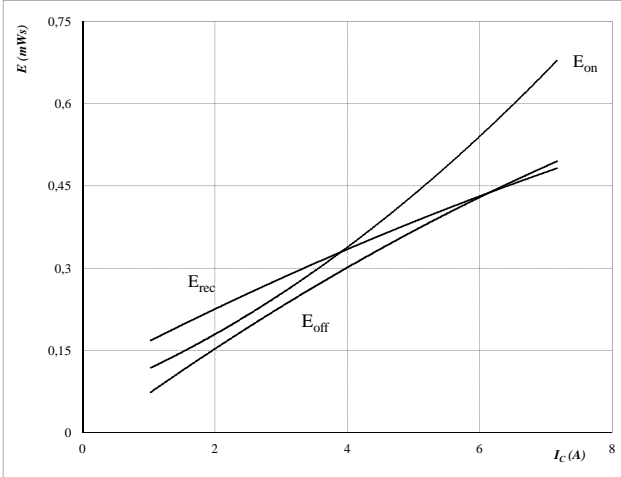
With an inductive load at

$T_j =$	125	℃
$V_{CE} =$	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**

$E = f(R_G)$
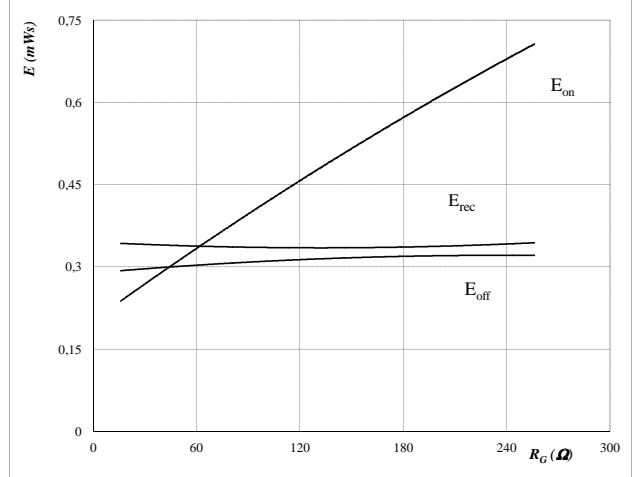
With an inductive load at

$T_j =$	125	℃
$V_{CE} =$	600	V
$V_{GE} =$	±15	V
$I_C =$	4	A

Figure 7	Brake IGBT

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

$t = f(I_C)$
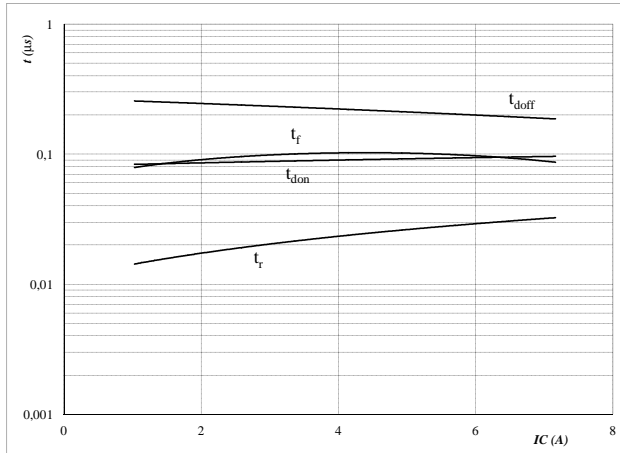
With an inductive load at

$T_j =$	125	℃
$V_{CE} =$	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**

$t = f(R_G)$
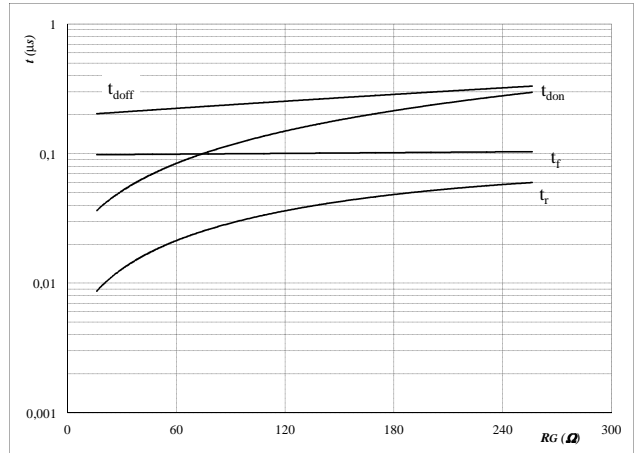
With an inductive load at

$T_j =$	125	℃
$V_{CE} =$	600	V
$V_{GE} =$	±15	V
$I_C =$	4	A

Brake

Figure 9

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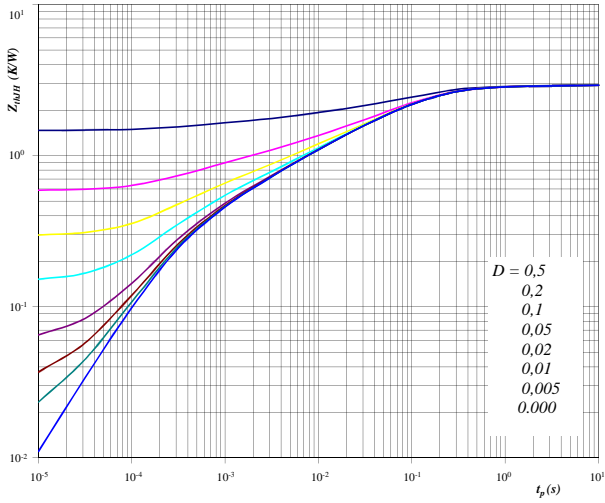
$Z_{thJH} = f(t_p)$
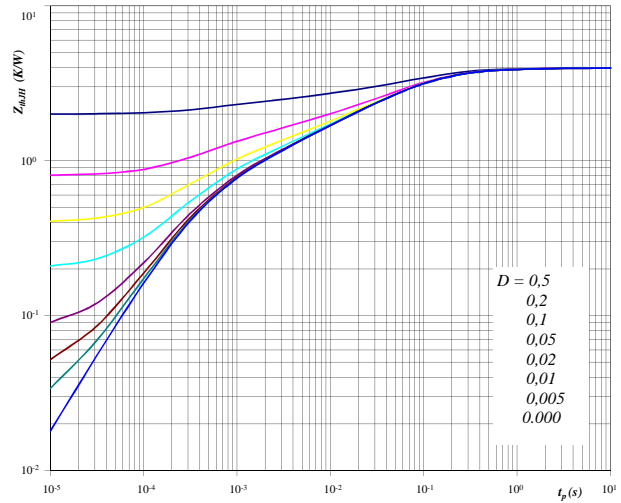

With

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
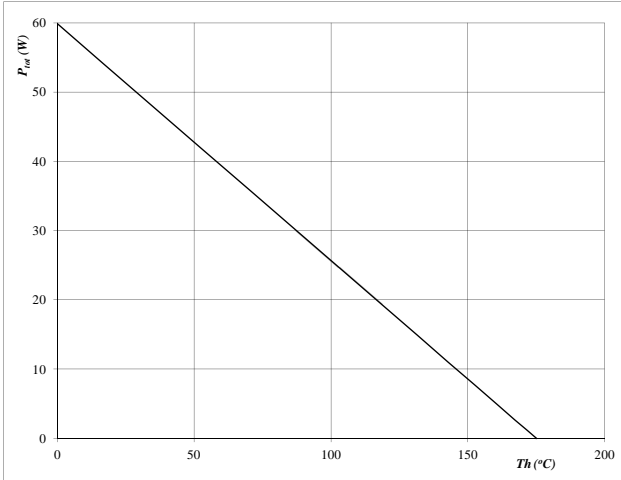
D = tp / T

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
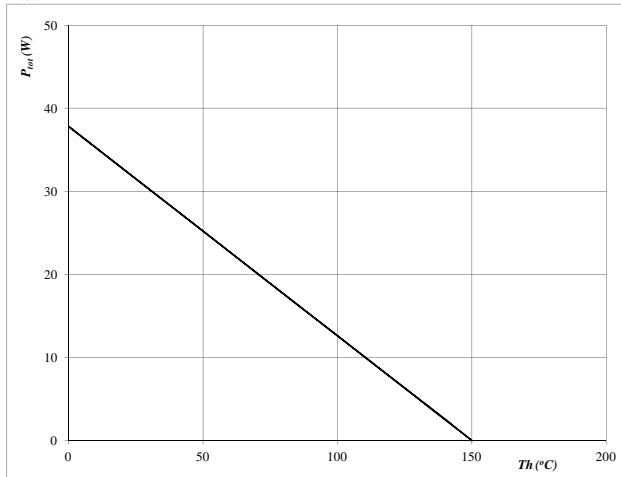
$T_j = $ 150   ºC

Figure 14	Brake FRED

Forward current as a
function of heatsink temperature

$I_F = f(T_h)$

At
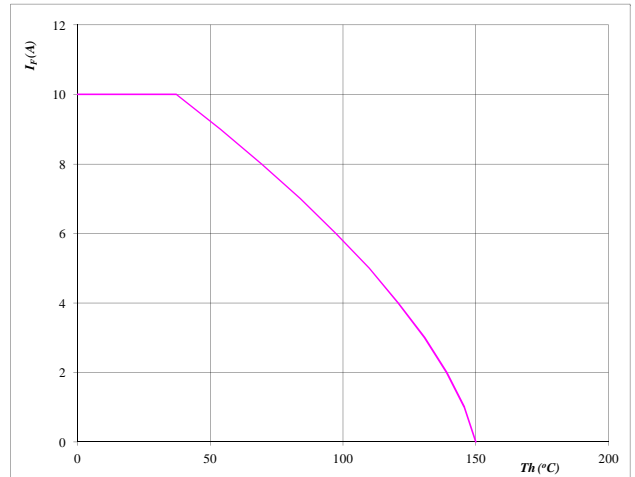
$T_j = $ 150   ºC

Input Rectifier Bridge

Figure 1	Rectifier diode

Typical diode forward current as a function of forward voltage
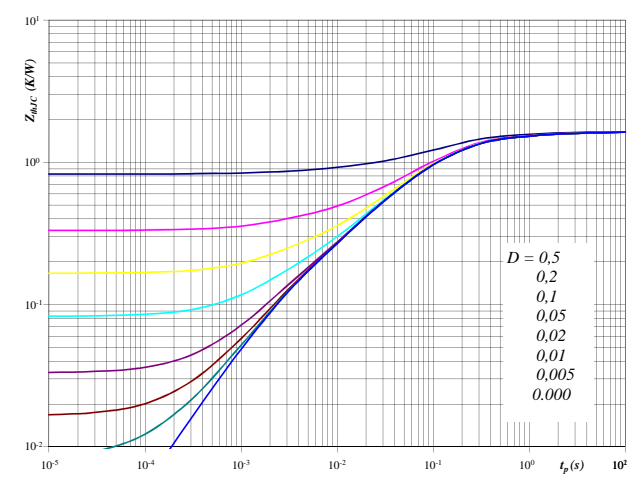
$I_F = f(V_F)$

At
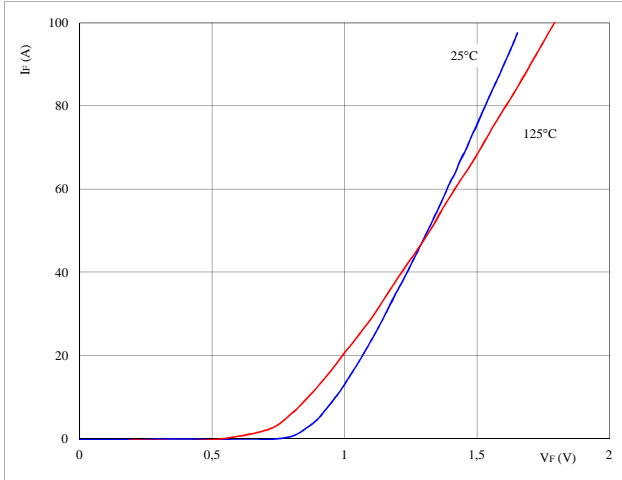
$t_p =$ 250   µs

Figure 2	Rectifier diode

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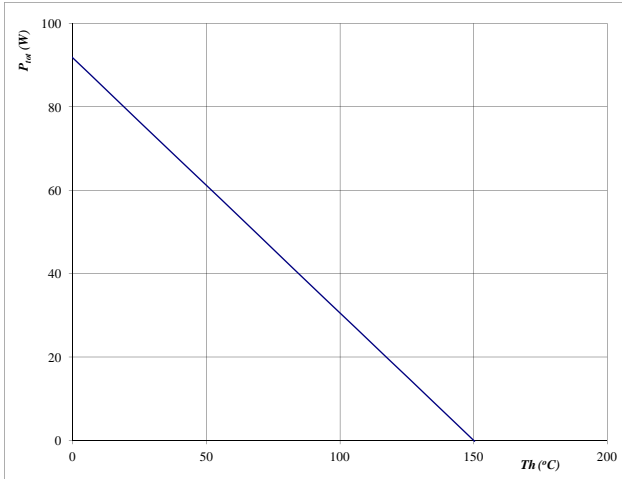
$Z_{thJH} = f(t_p)$

With

D =   tp / T

$R_{thJH} =$ 1,66   K/W

Figure 3	Rectifier diode

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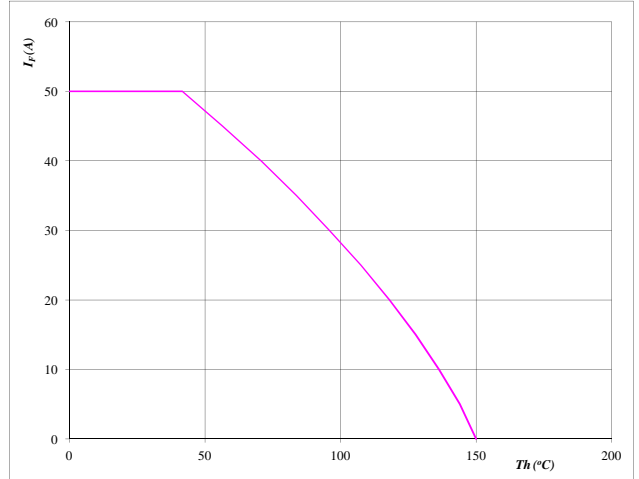
$P_{tot} = f(T_h)$

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)
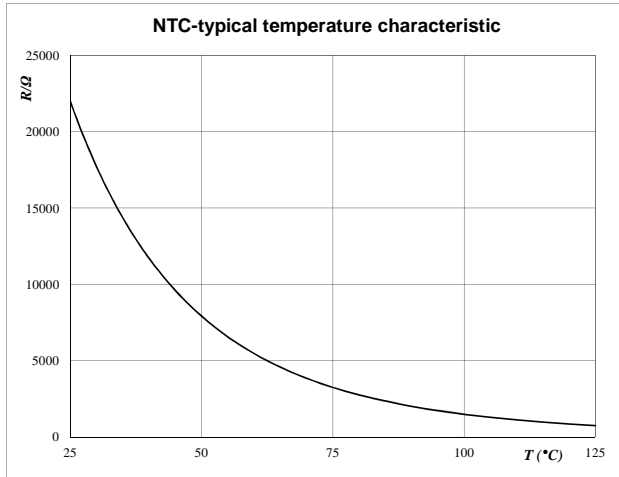
Switching Definitions Output Inverter

General conditions

T_j	=	125,3 ℃
R_{gon}	=	32 Ω
R_{goff}	=	36 Ω

Figure 1 Output inverter IGBT

Turn-off Switching Waveforms & definition of tdoff, tEoff
(t_{Eoff} = integrating time for E_{off})
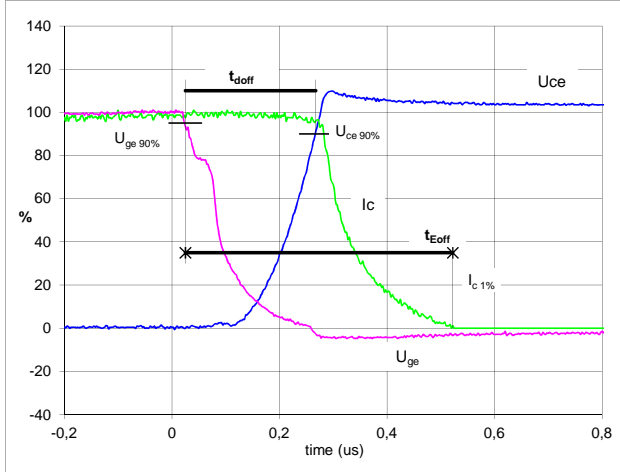
V_{GE} (0%) =	-15	V
V_{GE} (100%) =	15	V
V_C (100%) =	600	V
I_C (100%) =	8	A
t_{doff} =	0,24	µs
t_{Eoff} =	0,50	µs

Figure 2 Output inverter IGBT

Turn-on Switching Waveforms & definition of tdon, tEon
(t_{Eon} = integrating time for E_{on})
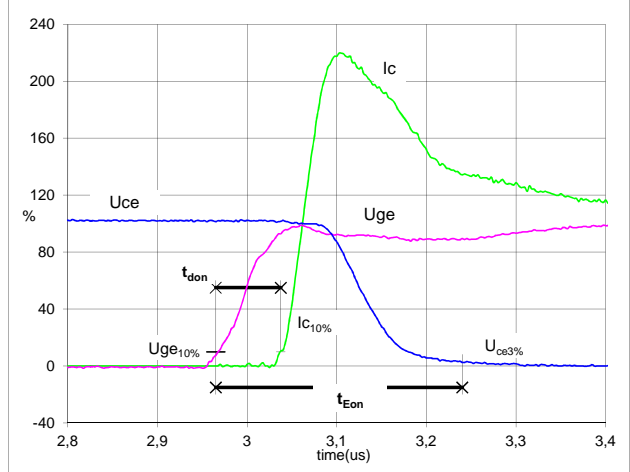
V_{GE} (0%) =	-15	V
V_{GE} (100%) =	15	V
V_C (100%) =	600	V
I_C (100%) =	8	A
t_{don} =	0,07	µs
t_{Eon} =	0,275	µs

Figure 3 Output inverter IGBT

Turn-off Switching Waveforms & definition of t_f
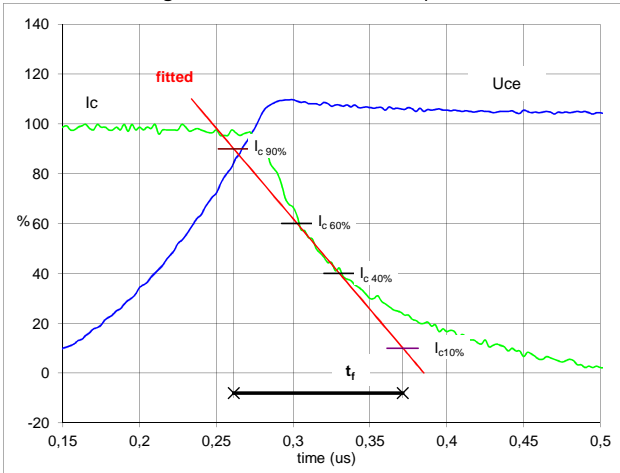
V_C (100%) =	600	V
I_C (100%) =	8	A
t_f =	0,108	µs

Figure 4 Output inverter IGBT

Turn-on Switching Waveforms & definition of t_r
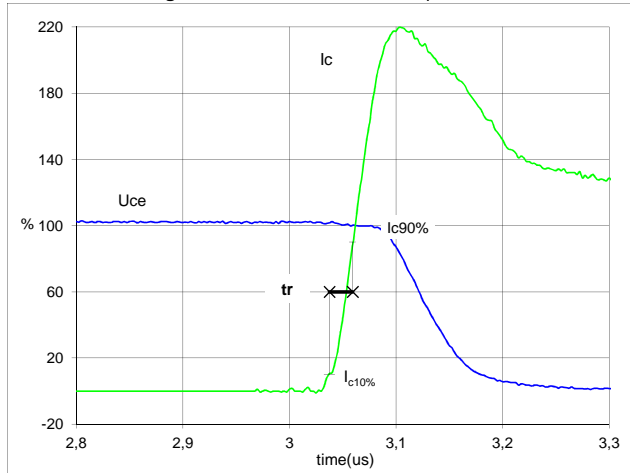
V_C (100%) =	600	V
I_C (100%) =	8	A
t_r =	0,023	µs

Switching Definitions Output Inverter

Figure 5	Output inverter IGBT

Turn-off Switching Waveforms & definition of t$_{Eoff}$
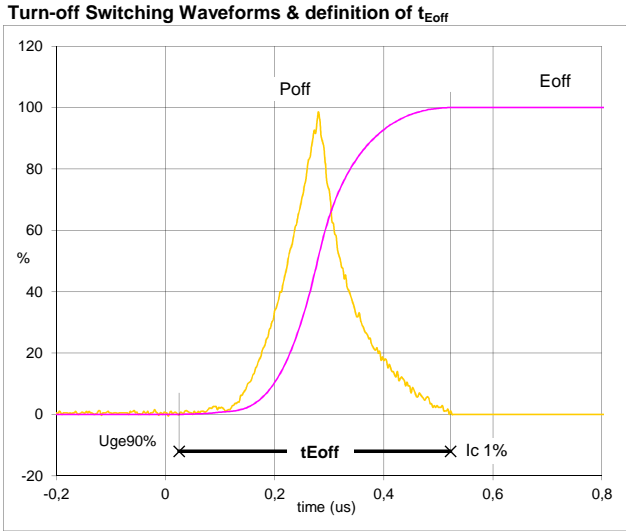
P$_{off}$ (100%) =	4,93	kW
E$_{off}$ (100%) =	0,62	mJ
t$_{Eoff}$ =	0,50	μs

Figure 6	Output inverter IGBT

Turn-on Switching Waveforms & definition of t$_{Eon}$
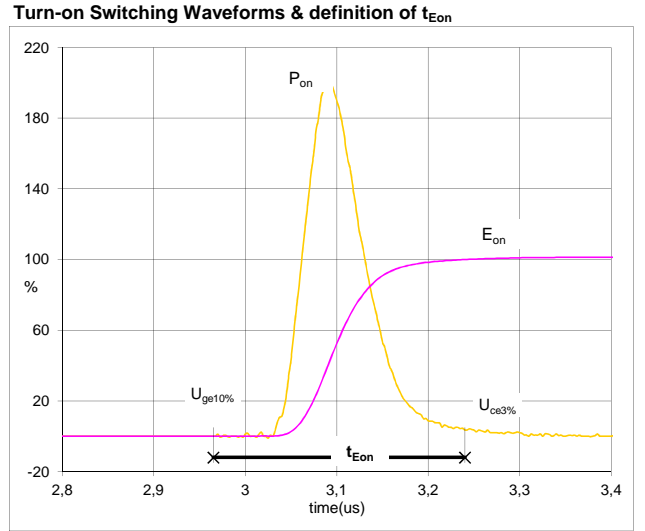
P$_{on}$ (100%) =	4,932	kW
E$_{on}$ (100%) =	0,75	mJ
t$_{Eon}$ =	0,275	μs

Figure 7	Output inverter IGBT

Gate voltage vs Gate charge
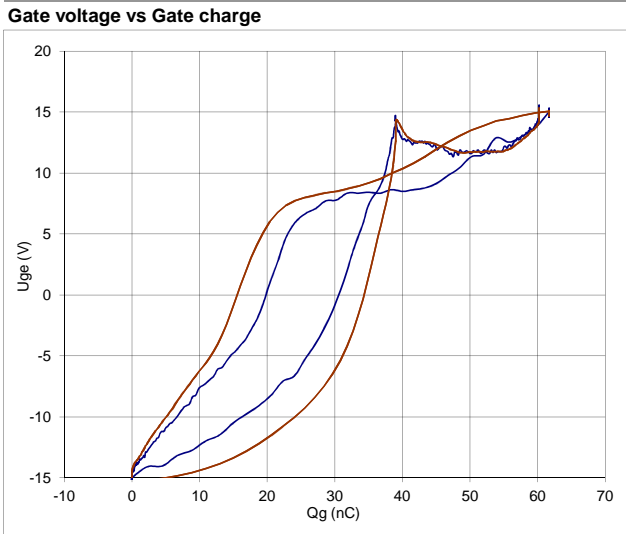
V$_{GEoff}$ =	-15	V
V$_{GEon}$ =	15	V
V$_C$ (100%) =	600	V
I$_C$ (100%) =	8	A
Q$_g$ =	61,714	nC

Figure 8	Output inverter FRED

Turn-off Switching Waveforms & definition of t$_{rr}$
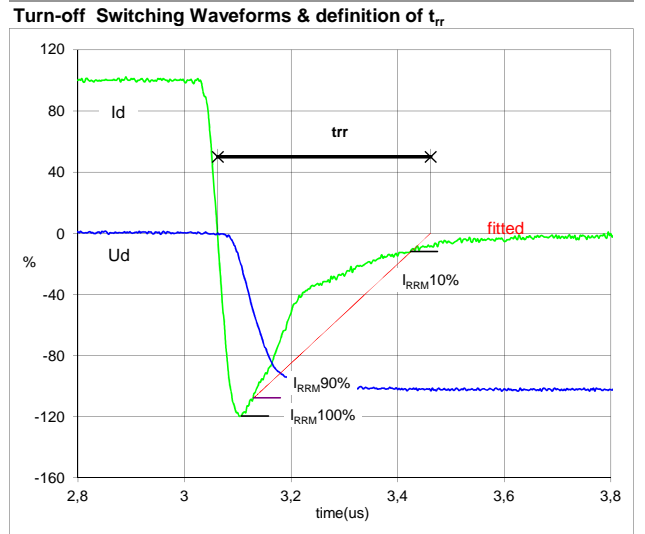
V$_d$ (100%) =	600	V
I$_d$ (100%) =	8	A
I$_{RRM}$ (100%) =	-10	A
t$_{rr}$ =	0,383	μs

Switching Definitions Output Inverter

Figure 9	Output inverter FRED

Turn-on Switching Waveforms & definition of t_{Qrr}
(t_{Qrr} = integrating time for Q_{rr})
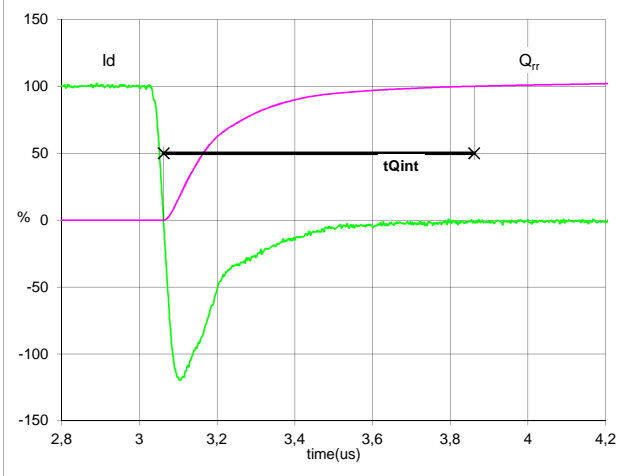
I_d (100%) =	8	A
Q_{rr} (100%) =	1,569	µC
t_{Qint} =	0,80	µs

Figure 10	Output inverter FRED

Turn-on Switching Waveforms & definition of t_{Erec}
(t_{Erec}= integrating time for E_{rec})
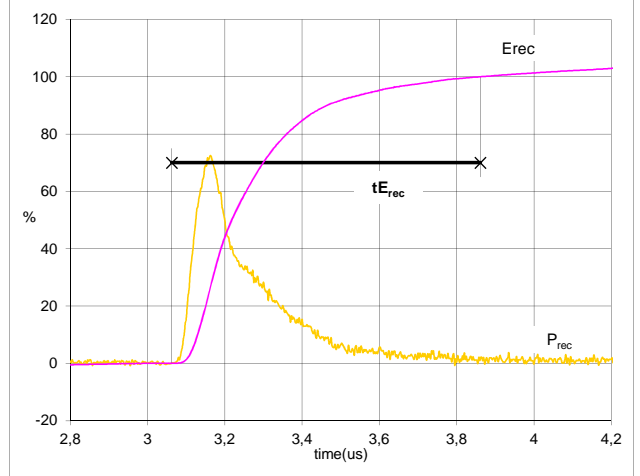
P_{rec} (100%) =	4,932	kW
E_{rec} (100%) =	0,634	mJ
t_{Erec} =	0,80	µs

Package Outline and Pinout

Outline

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
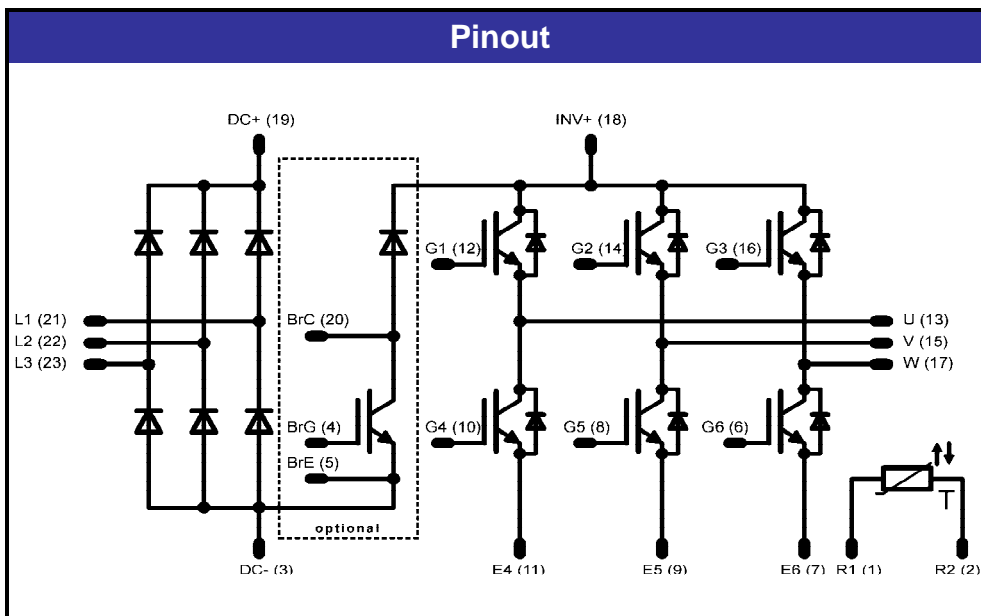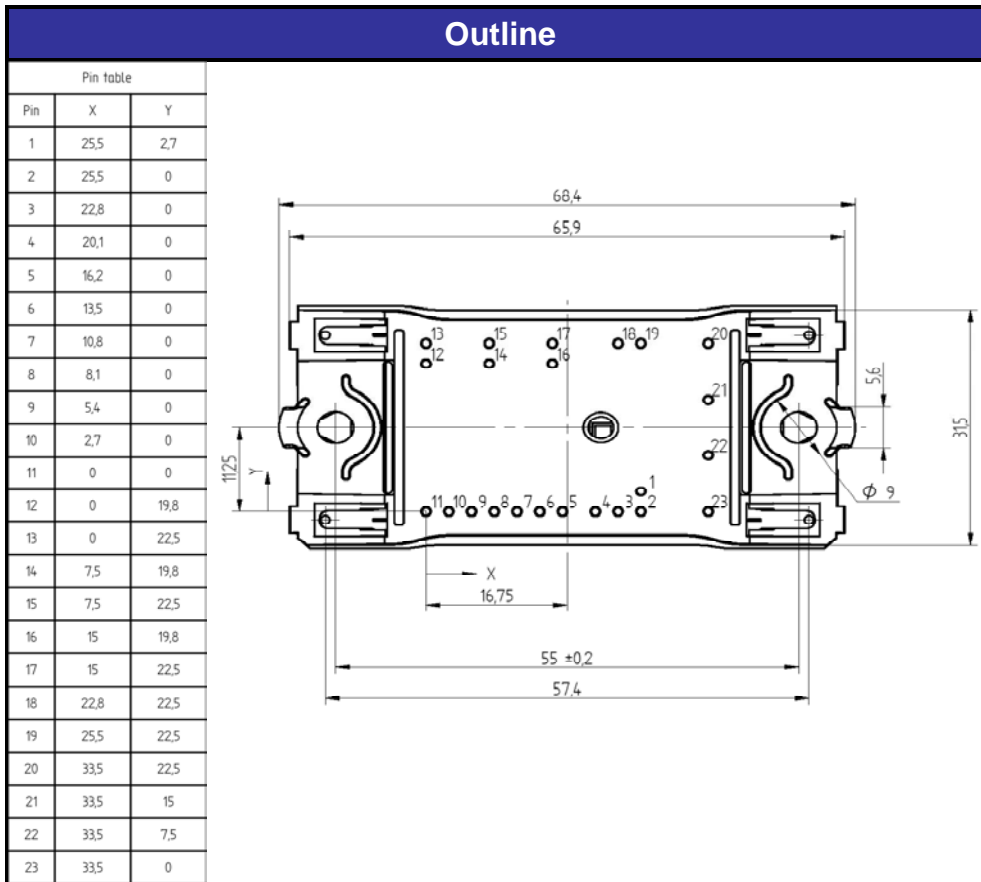
PRODUCT STATUS DEFINITIONS

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.