V23990-P840-A48/A49/C48/C49-PM

preliminary datasheet

flowPIM0 3rd Gen — 1200V/15A

Features

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

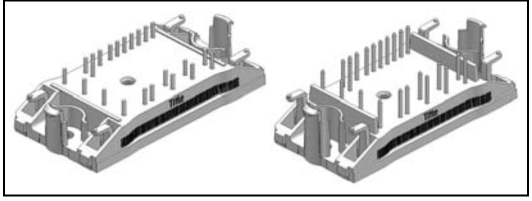
Target Applications

- Industrial Drives
- Embedded Generation

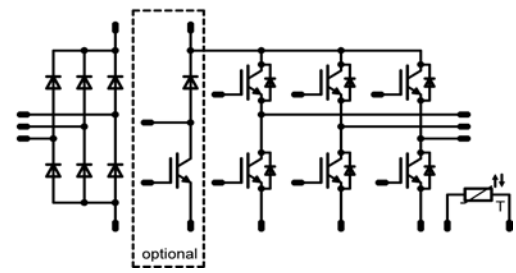
Types

- V23990-P840-A48-PM 12mm height
- V23990-P840-A49-PM 17mm height
- V23990-P840-C48-PM 12mm height; w/o BRC
- V23990-P840-C49-PM 17mm height; w/o BRC

flow0 Housing



Schematics



Maximum Ratings

Tj=25°C, unless otherwise specified

Parameter	Symbol	Condition		Value	Unit
Input Rectifier Diode					
Repetitive peak reverse voltage	V_{RRM}			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		220	A
I2t-value	I^2t			220	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_{jmax}			175	°C
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	18	A
Repetitive peak collector current	I_{Cpuls}	tp limited by $T_j$max		45	A
Power dissipation per IGBT	P_{tot}	T_j=$T_j$max	T_h=80°C T_c=80°C	52	W
Gate-emitter peak voltage	V_{GE}			±20	V
Short circuit ratings	t_{SC}	T_j≤150°C		10	us
	V_{CC}	V_{GE}=15V		800	V
Maximum Junction Temperature	T_{jmax}			175	°C

Maximum Ratings

Tj=25°C, 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°C T_c=80°C	18	A
Repetitive peak forward current	I_{FRM}	tp limited by $T_j$max		30	A
Power dissipation per Diode	P_{tot}	T_j=$T_j$max	T_h=80°C T_c=80°C	38	W
Maximum Junction Temperature	T_{jmax}			175	°C
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	10	A
Repetitive peak collector current	I_{cpuls}	tp limited by $T_j$max	T_h=80°C	24	A
Power dissipation per IGBT	P_{tot}	T_j=$T_j$max	T_h=80°C T_c=80°C	30	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	us V
Maximum Junction Temperature	T_{jmax}			150	°C
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	10	A
Repetitive peak forward current	I_{FRM}	tp limited by $T_j$max	T_h=80°C	15	A
Power dissipation per Diode	P_{tot}	T_j=$T_j$max	T_h=80°C T_c=80°C	22	W
Maximum Junction Temperature	T_{jmax}			150	°C
Thermal properties					
Storage temperature	T_{stg}			-40…+125	°C
Operation temperature	T_{jop}			-40…+150	°C
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(°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}				30	Tj=25°C Tj=125°C		0,93 0,81		V
Slope resistance (for power loss calc. only)	r_t					Tj=25°C Tj=125°C		0,010 0,013		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 thickness≤50um λ = 1 W/mK						2,16		K/W
Transistor Inverter										
Gate emitter threshold voltage	$V_{GE(th)}$	VCE=VGE			0,0005	Tj=25°C Tj=125°C	5	5,8	6,5	V
Collector-emitter saturation voltage	$V_{CE(sat)}$				15	Tj=25°C Tj=125°C		1,94 2,26		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		Ω
Turn-on delay time	$t_{d(on)}$	Rgon=16 Ohm Rgoff=16 Ohm	±15	600	15	Tj=25°C Tj=125°C		60		ns
Rise time	t_r					Tj=25°C Tj=125°C		19		ns
Turn-off delay time	$t_{d(off)}$					Tj=25°C Tj=125°C		239		ns
Fall time	t_f					Tj=25°C Tj=125°C		106		ns
Turn-on energy loss per pulse	E_{on}					Tj=25°C Tj=125°C		1,25		mWs
Turn-off energy loss per pulse	E_{off}					Tj=25°C Tj=125°C		1,24		mWs
Input capacitance	C_{ies}	f=1MHz	0	25		Tj=25°C		1000		pF
Output capacitance	C_{oss}							100		pF
Reverse transfer capacitance	C_{rss}							56		pF
Gate charge	Q_{Gate}	Vcc=960V	±15		15	Tj=25°C		93		nC
Thermal resistance chip to heatsink per chip	R_{thJH}	Thermal grease thickness≤50um λ = 1 W/mK						1,83		K/W
Diode Inverter										
Diode forward voltage	V_F				10	Tj=25°C Tj=125°C	1,35	1,90 1,91	2,35	V
Reverse leakage current	I_{rm}			1200		Tj=25°C Tj=125°C		2,7		mA
Peak reverse recovery current	I_{RRM}	Rgon=16 Ohm	±15	600	15	Tj=25°C Tj=125°C		16		A
Reverse recovery time	t_{rr}					Tj=25°C Tj=125°C		433		ns
Reverse recovered charge	Q_{rr}					Tj=25°C Tj=125°C		2,75		uC
Peak rate of fall of recovery current	di(rec)max /dt					Tj=25°C Tj=125°C		109		A/ms
Reverse recovered energy	Erec					Tj=25°C Tj=125°C		1,16		mWs
Thermal resistance chip to heatsink per chip	R_{thJH}	Thermal grease thickness≤50um λ = 1 W/mK						2,52		K/W

Characteristic Values

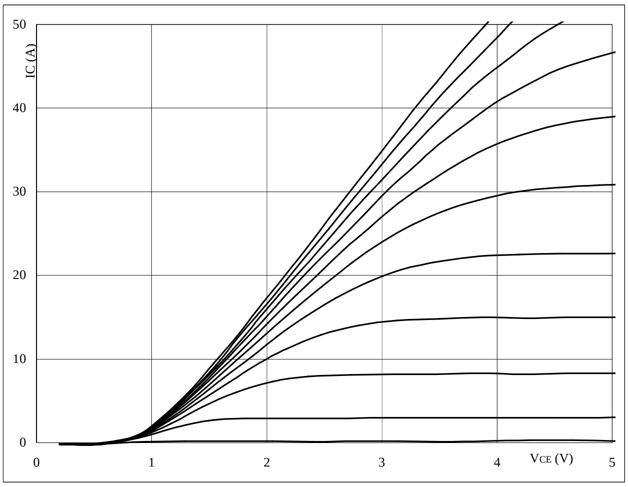
Parameter	Symbol	Conditions	V_{GE}(V) or V_{GS}(V)	V_r(V) or V_{CE}(V) or V_{DS}(V)	I_C(A) or I_F(A) or I_D(A)	T(°C)	Value Min	Typ	Max	Unit
Transistor BRC										
Gate emitter threshold voltage	$V_{GE(th)}$	VCE=VGE			0,0003	Tj=25°C Tj=125°C	5	5,8	6,5	V
Collector-emitter saturation voltage	$V_{CE(sat)}$				8	Tj=25°C Tj=125°C	1,6	1,87 2,22	2,1	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=125°C			200	nA
Integrated Gate resistor	R_{gint}							none		Ω
Turn-on delay time	$t_{d(on)}$	Rgon=32Ohm Rgoff=32Ohm	15	600	8	Tj=25°C Tj=125°C		72		ns
Rise time	t_r					Tj=25°C Tj=125°C		24		ns
Turn-off delay time	$t_{d(off)}$					Tj=25°C Tj=125°C		228		ns
Fall time	t_f					Tj=25°C Tj=125°C		104		ns
Turn-on energy loss per pulse	E_{on}					Tj=25°C Tj=125°C		0,71		mWs
Turn-off energy loss per pulse	E_{off}					Tj=25°C Tj=125°C		0,62		mWs
Input capacitance	C_{ies}	f=1MHz	0	25		Tj=25°C		490		pF
Output capacitance	C_{oss}							50		pF
Reverse transfer capacitance	C_{rss}							30		pF
Gate charge	Q_{Gate}	Vcc=960V	±15		8	Tj=25°C		50		nC
Thermal resistance chip to heatsink per chip	R_{thJH}	Thermal grease thickness≤50um λ = 1 W/mK						2,36		K/W
Diode BRC										
Diode forward voltage	V_F				7,5	Tj=25°C Tj=125°C	0,8	1,67 1,61	2,2	V
Reverse leakage current	I_r			1200		Tj=25°C Tj=125°C			250	mA
Peak reverse recovery current	I_{RRM}	Rgon=32Ohm	15	600	8	Tj=25°C Tj=125°C		10		A
Reverse recovery time	t_{rr}					Tj=25°C Tj=125°C		427		ns
Reverse recovered charge	Q_{rr}					Tj=25°C Tj=125°C		1,64		mC
Peak rate of fall of recovery current	di(rec)max /dt					Tj=25°C Tj=125°C		73		A/ms
Reverse recovery energy	E_{rec}					Tj=25°C Tj=125°C		0,69		mWs
Thermal resistance chip to heatsink per chip	R_{thJH}	Thermal grease thickness≤50um λ = 1 W/mK						3,15		K/W
Thermistor										
Rated resistance	R_{25}	Tol. ±13%				Tj=25°C	19,1	22	24,9	kΩ
	R_{100}	Tol. ±5%				Tj=100°C	1411	1486	1560	
Power dissipation given Epcos-Typ	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

$I_C = f(V_{CE})$



At

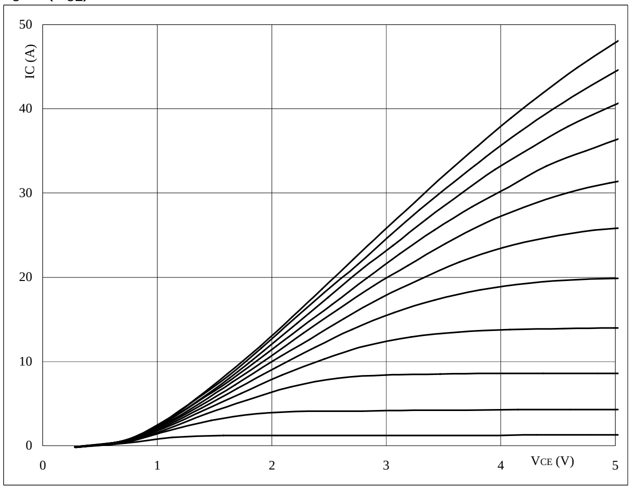
t_p =	250	μs
T_j =	25	°C

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

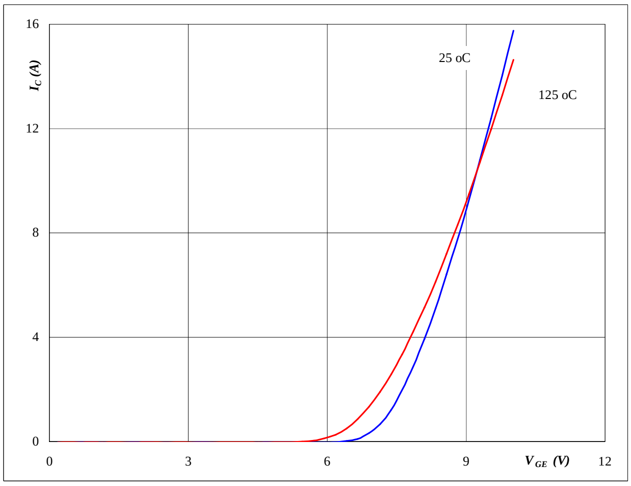
t_p =	250	μs
T_j =	125	°C

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

Figure 3	Output inverter IGBT

Typical transfer characteristics

$Ic = f(V_{GE})$



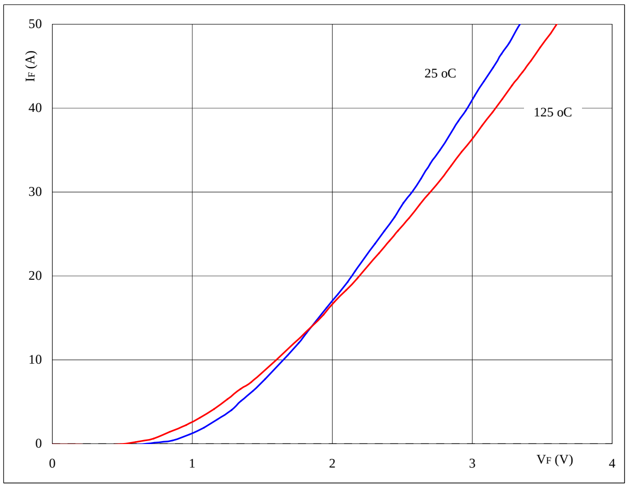
At

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

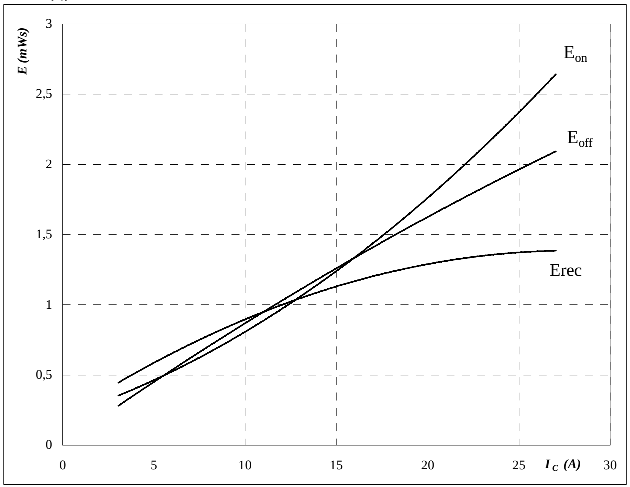
t_p =	250	μs

Output Inverter

Figure 5 Output inverter IGBT

Typical switching energy losses as a function of collector current

E = f(I_c)



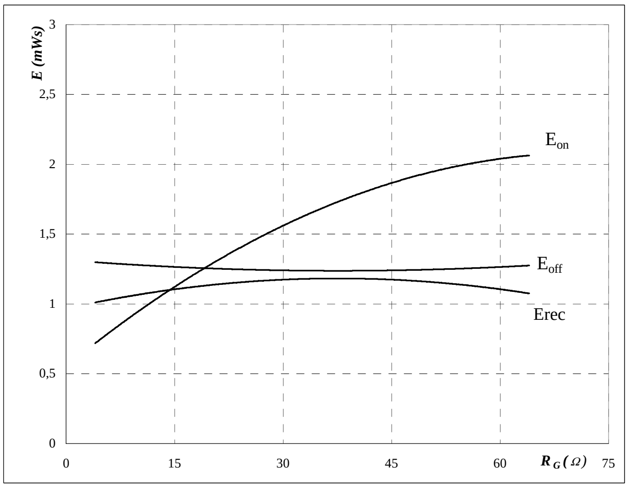
With an inductive load at

T_j =	125	°C
V_{CE} =	600	V
V_{GE} =	±15	V
R_{gon} =	16	Ω
R_{goff} =	16	Ω

Figure 6 Output inverter IGBT

Typical switching energy losses as a function of gate resistor

E = f(R_G)



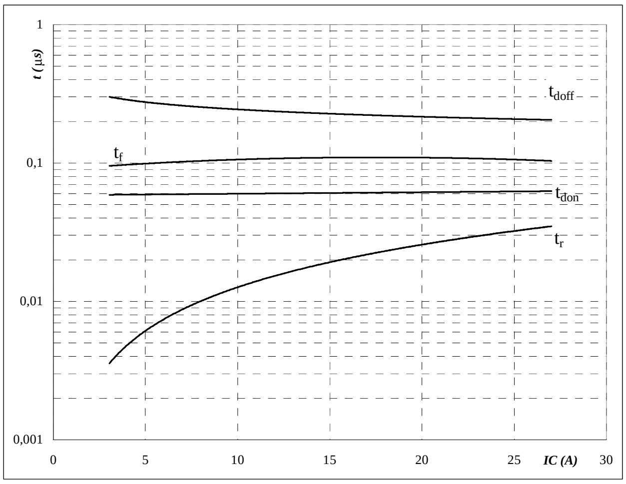
With an inductive load at

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

Figure 7 Output inverter IGBT

Typical switching times as a function of collector current

t = f(I_C)



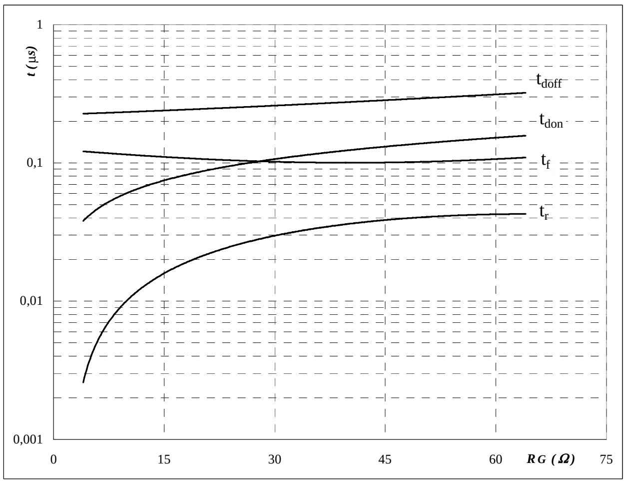
With an inductive load at

T_j =	125	°C
V_{CE} =	600	V
V_{GE} =	±15	V
R_{gon} =	16	Ω
R_{goff} =	16	Ω

Figure 8 Output inverter IGBT

Typical switching times as a function of gate resistor

t = f(R_G)



With an inductive load at

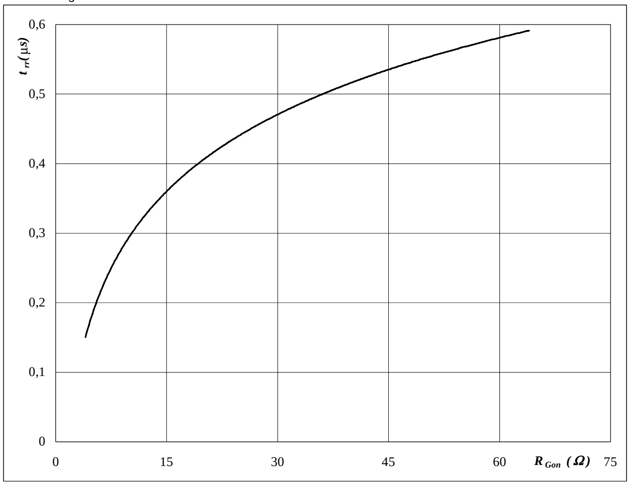
T_j =	125	°C
V_{CE} =	600	V
V_{GE} =	±15	V
I_C =	15	A

Output Inverter

Figure 9 Output inverter FRED diode

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

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



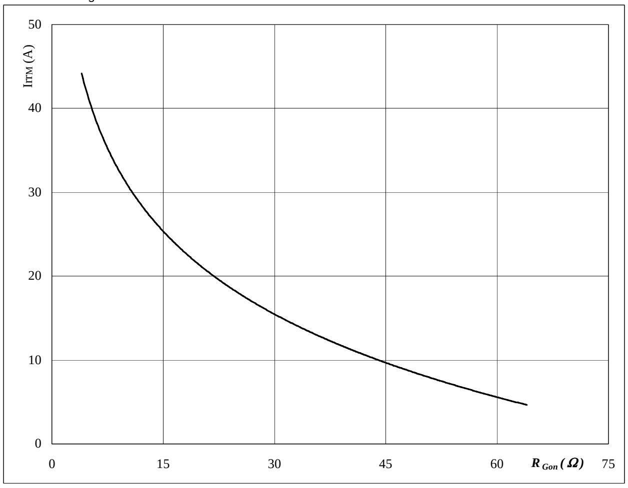
At

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

Figure 10 Output inverter FRED diode

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

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



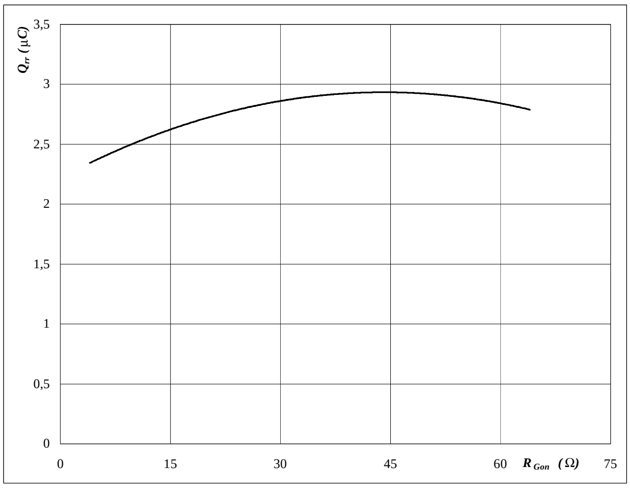
At

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

Figure 11 Output inverter FRED diode

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

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



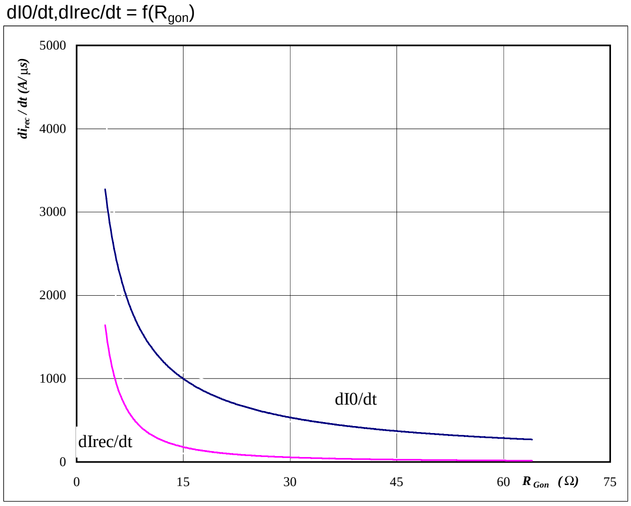
At

T_j =	125	°C
V_R =	600	V
I_F =	15	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

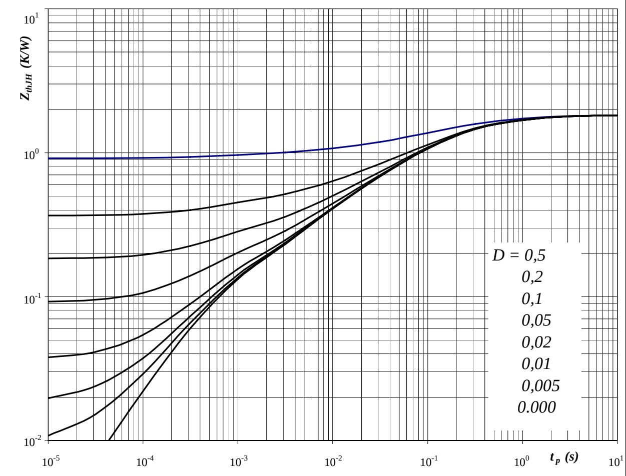
T_j =	125	°C
V_R =	600	V
I_F =	15	A
V_{GE} =	±15	V

Output Inverter

Figure 13

IGBT transient thermal impedance as a function of pulse width

$Z_{thJH} = f(tp)$



With

D = tp / T

R_{thJH} = 1,83 K/W

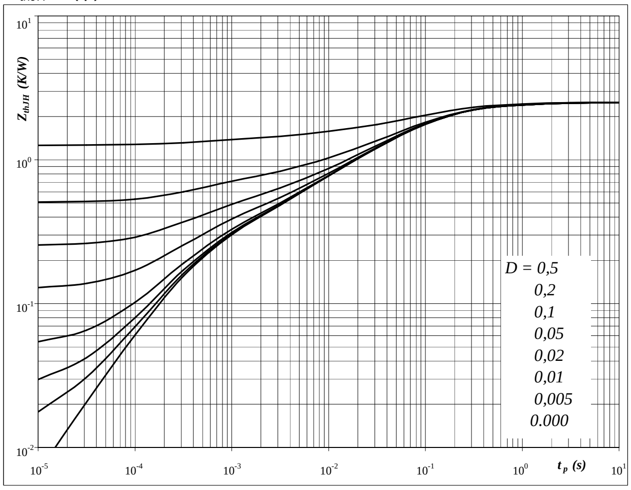
IGBT thermal model values

R (C/W)	Tau (s)
0,06	5,6E+00
0,28	8,7E-01
0,77	1,7E-01
0,42	3,4E-02
0,19	6,2E-03
0,10	5,5E-04

Figure 14

FRED transient thermal impedance as a function of pulse width

$Z_{thJH} = f(tp)$



With

D = tp / T

R_{thJH} = 2,52 K/W

FRED thermal model values

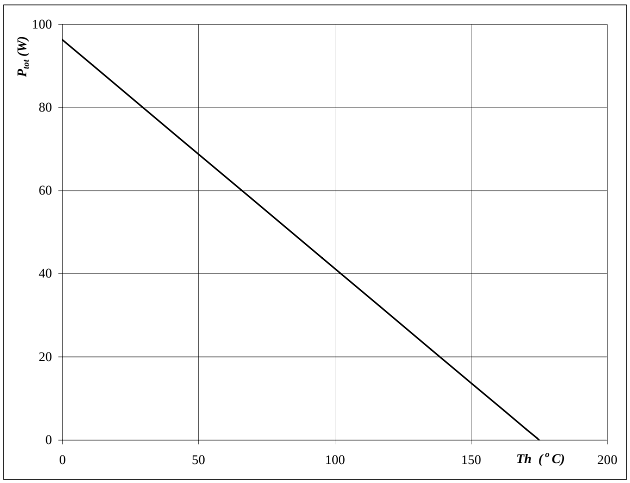
R (C/W)	Tau (s)
0,05	9,6E+00
0,26	8,2E-01
1,04	1,2E-01
0,69	2,6E-02
0,27	3,4E-03
0,21	3,8E-04

Output Inverter

Figure 15 Output inverter IGBT

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_h)$

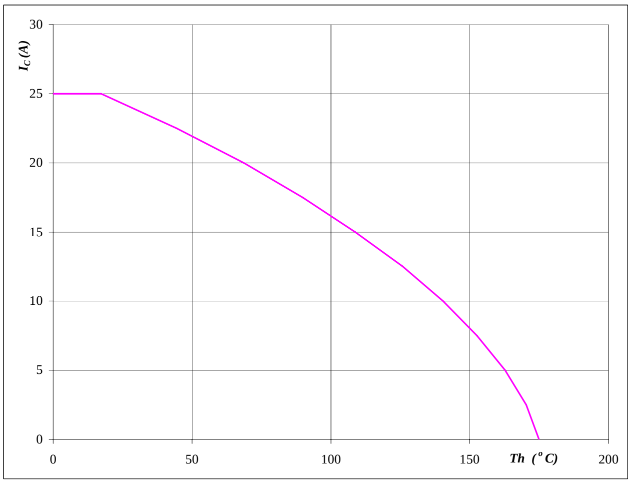


At
T_j = 175 °C

Figure 16 Output inverter IGBT

Collector current as a function of heatsink temperature

$I_C = f(T_h)$

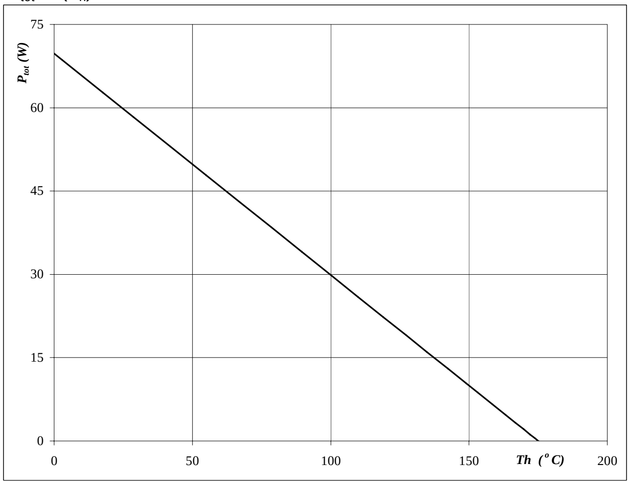


At
T_j = 175 °C
V_{GE} = 15 V

Figure 17 Output inverter FRED

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_h)$

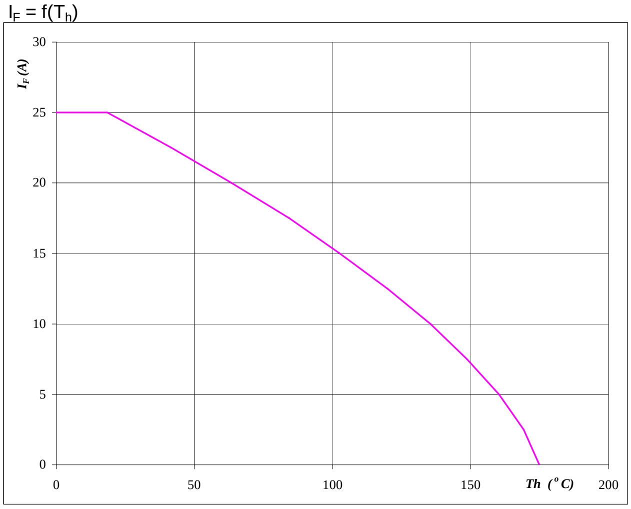


At
T_j = 175 °C

Figure 18 Output inverter FRED

Forward current as a function of heatsink temperature

$I_F = f(T_h)$



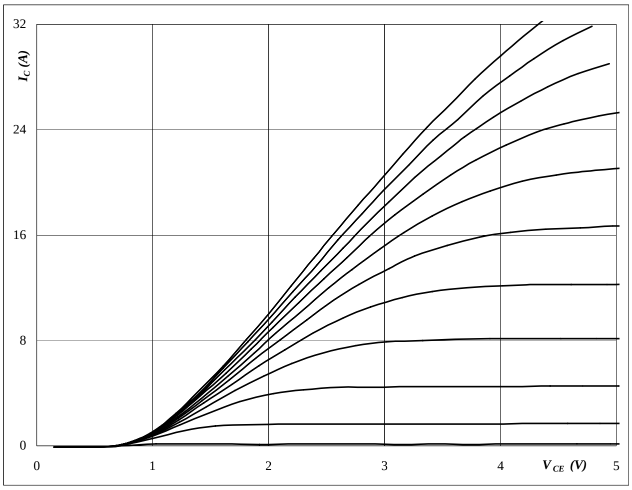
At
T_j = 175 °C

Brake

Figure 1 Brake IGBT

Typical output characteristics

$I_C = f(V_{CE})$



At

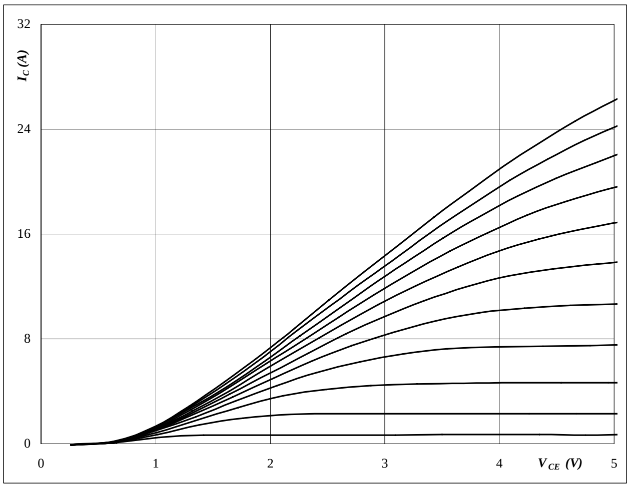
t_p =	250	μs
T_j =	25	°C

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

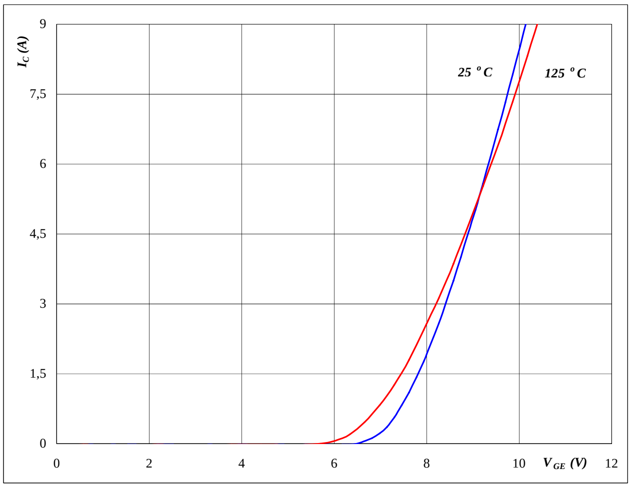
t_p =	250	μs
T_j =	125	°C

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

Figure 3 Brake IGBT

Typical transfer characteristics

$I_C = f(V_{GE})$



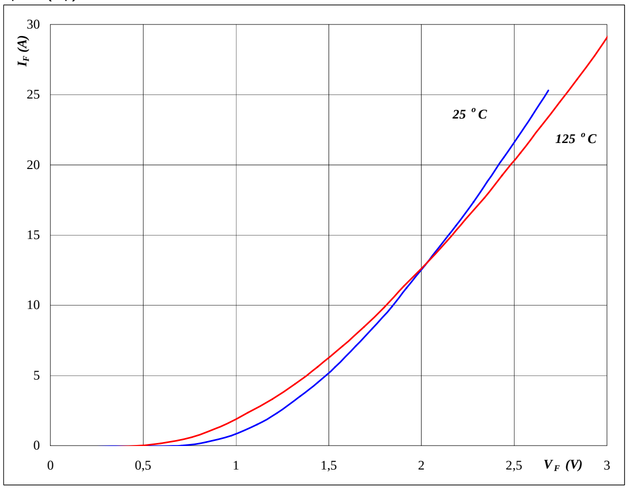
At

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

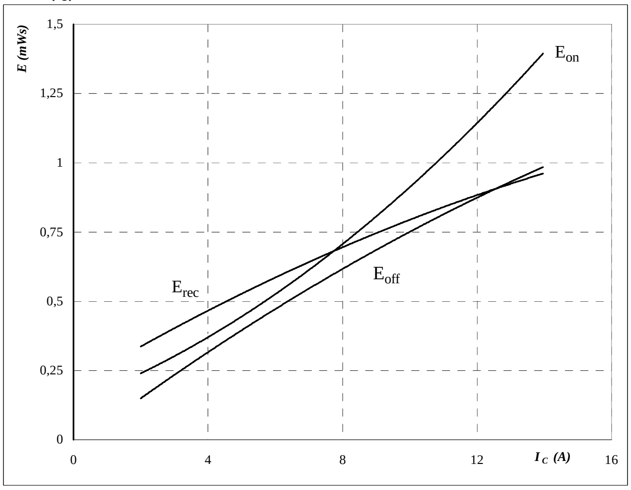
t_p =	250	μs

Brake

Figure 5 Brake IGBT

Typical switching energy losses as a function of collector current

$E = f(I_C)$



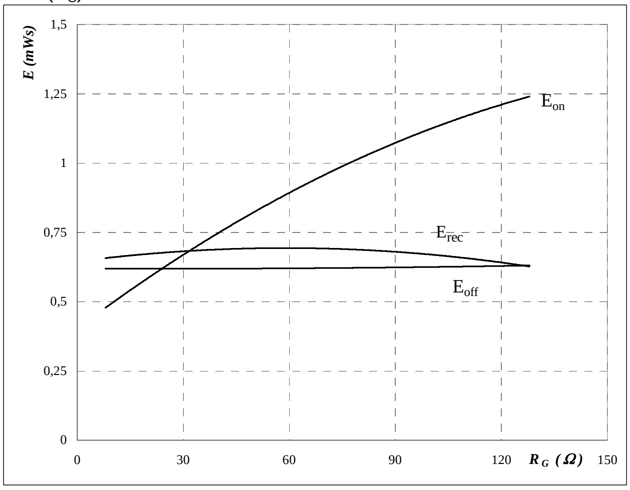
With an inductive load at

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

Figure 6 Brake IGBT

Typical switching energy losses as a function of gate resistor

$E = f(R_G)$



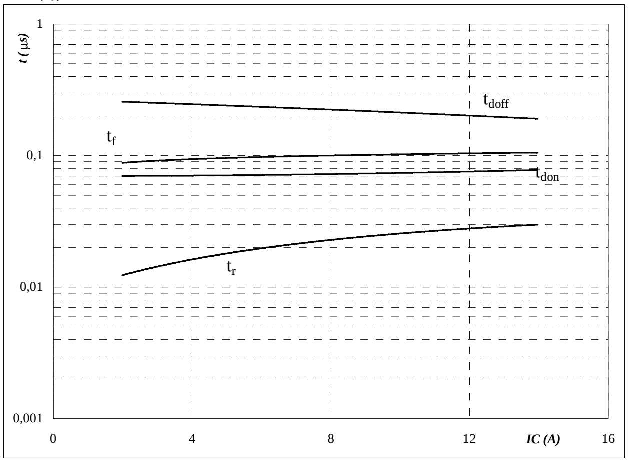
With an inductive load at

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

Figure 7 Brake IGBT

Typical switching times as a function of collector current

$t = f(I_C)$



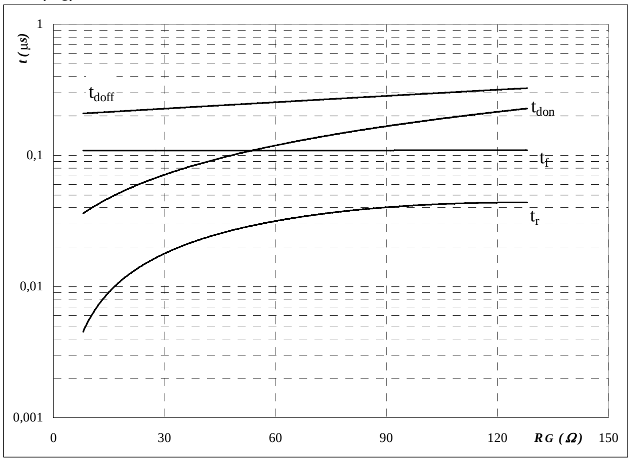
With an inductive load at

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

Figure 8 Brake IGBT

Typical switching times as a function of gate resistor

$t = f(R_G)$



With an inductive load at

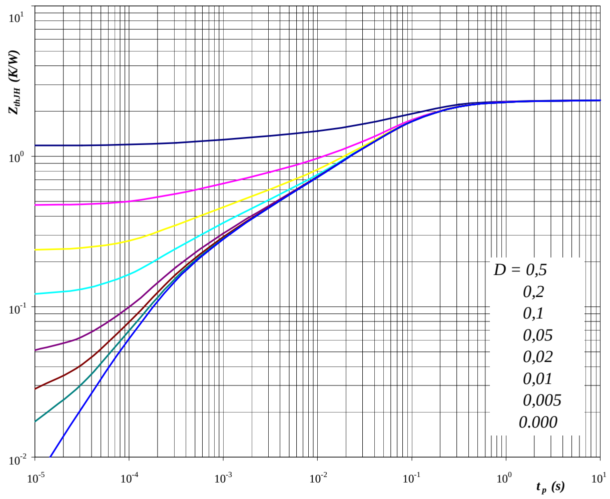
T_j =	125	°C
V_{CE} =	600	V
V_{GE} =	±15	V
I_C =	8	A

Brake

Figure 9

IGBT transient thermal impedance as a function of pulse width

$Z_{thJH} = f(t_p)$



With

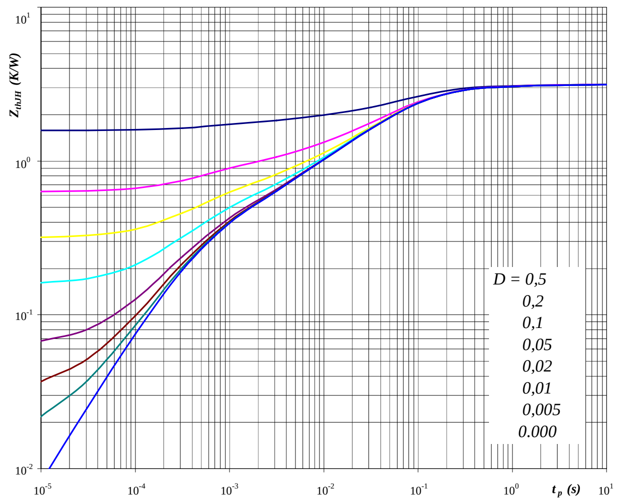
D = tp / T

R_{thJH} = 2,36 K/W

Figure 10

FRED transient thermal impedance as a function of pulse width

$Z_{thJH} = f(t_p)$



With

D = tp / T

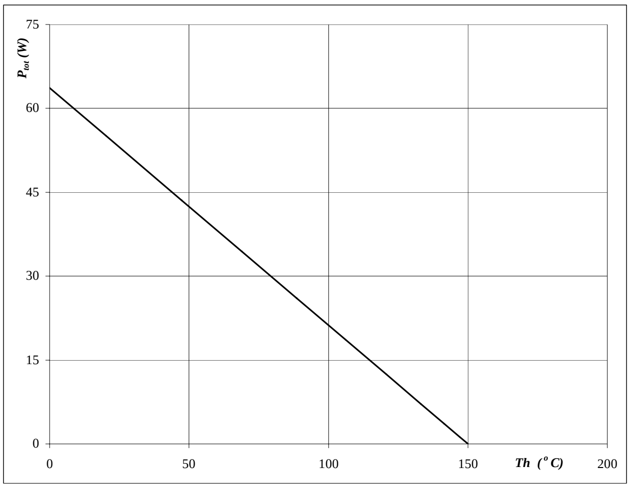
R_{thJH} = 3,15 K/W

Brake

Figure 11 Brake IGBT

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_h)$



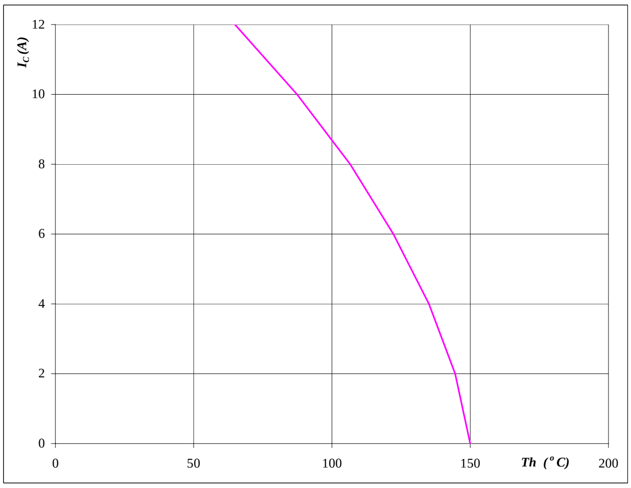
At

T_j = 150 ºC

Figure 12 Brake IGBT

Collector current as a function of heatsink temperature

$I_C = f(T_h)$



At

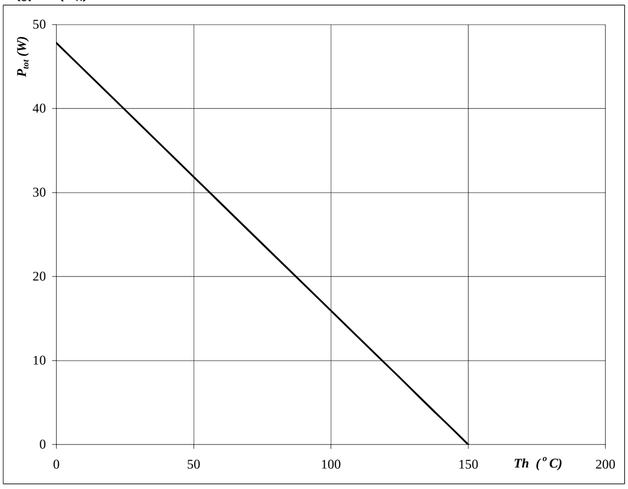
T_j = 150 ºC

V_{GE} = 15 V

Figure 13 Brake FRED

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_h)$



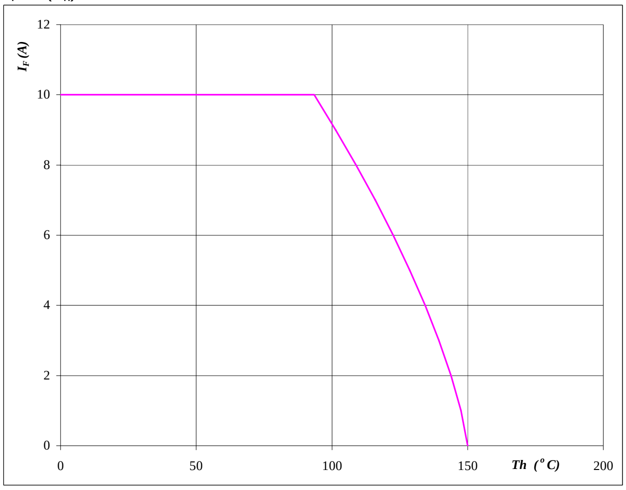
At

T_j = 150 ºC

Figure 14 Brake FRED

Forward current as a function of heatsink temperature

$I_F = f(T_h)$



At

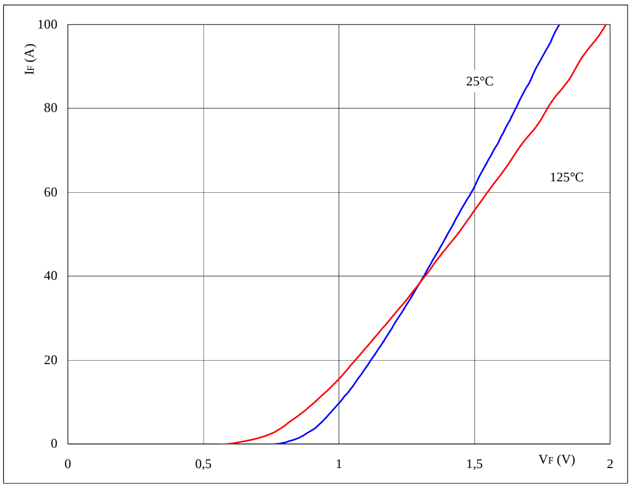
T_j = 150 ºC

Input Rectifier Bridge

Figure 1 Rectifier diode

Typical diode forward current as a function of forward voltage

$I_F = f(V_F)$



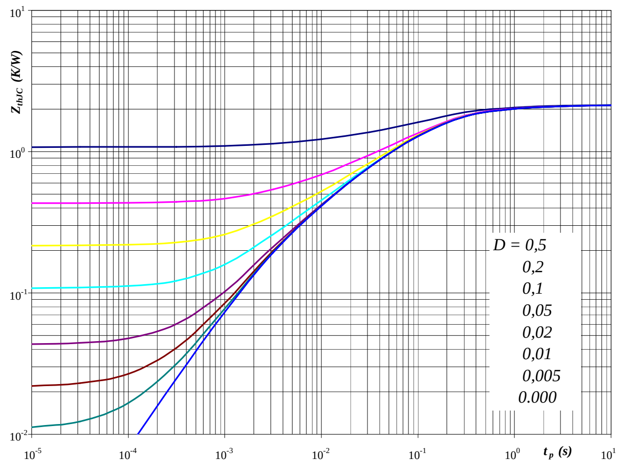
At

t_p = 250 µs

Figure 2 Rectifier diode

Diode transient thermal impedance as a function of pulse width

$Z_{thJH} = f(t_p)$



With

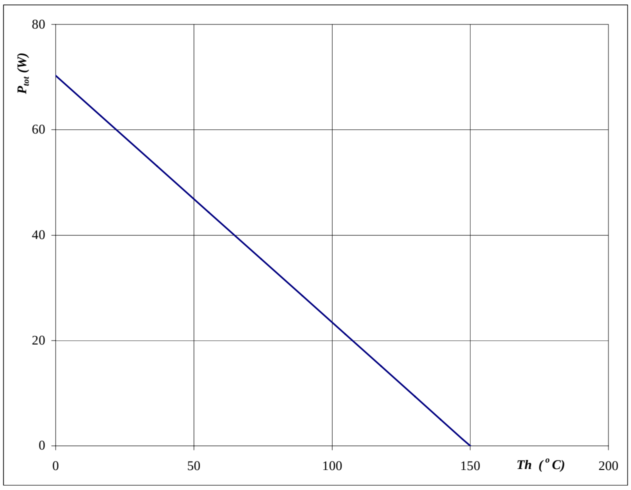
D = tp / T

R_{thJH} = 2,16 K/W

Figure 3 Rectifier diode

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_h)$



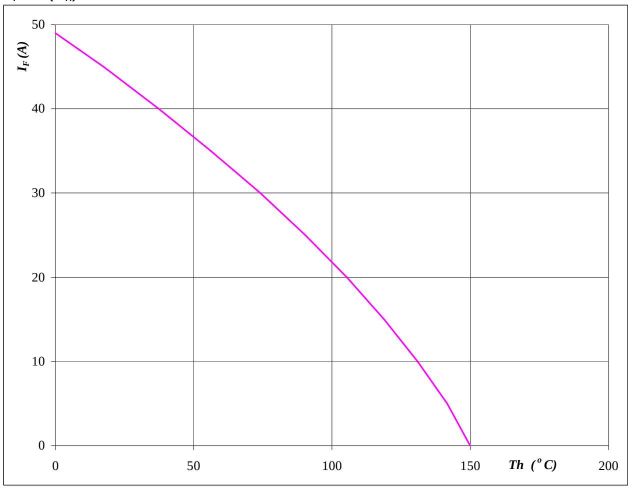
At

T_j = 150 ºC

Figure 4 Rectifier diode

Forward current as a function of heatsink temperature

$I_F = f(T_h)$



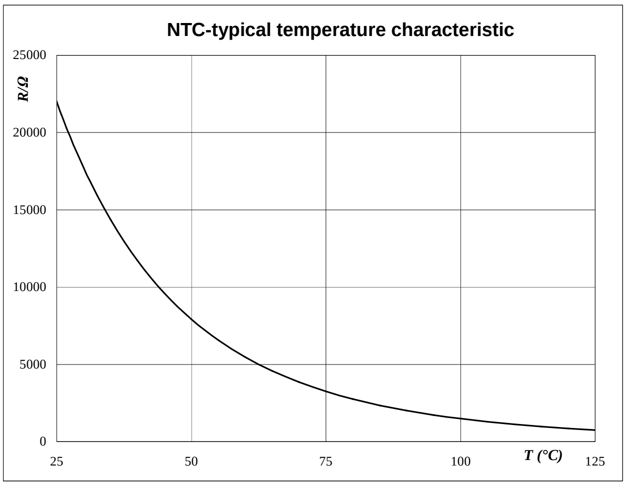
At

T_j = 150 ºC

Thermistor

Figure 1	Thermistor

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



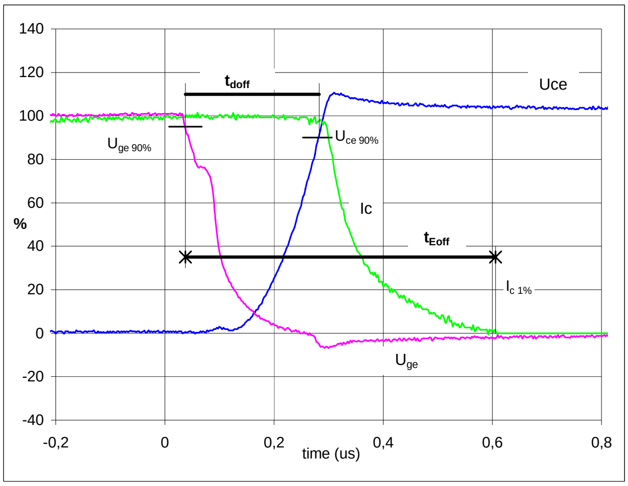
Switching Definitions Output Inverter

General conditions

T_j	=	125 °C
R_{gon}	=	16 Ω
R_{goff}	=	19 Ω

Figure 1 Output inverter IGBT

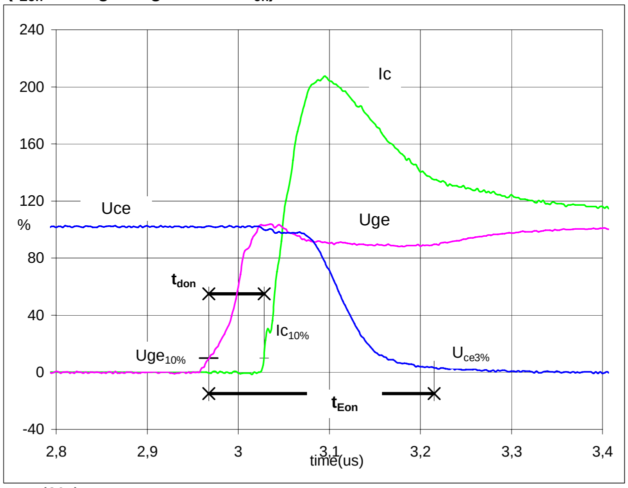
Turn-off Switching Waveforms & definition of tdoff, tEoff
(t_{Eoff} = integrating time for E_{off})



V_{GE} (0%) =	-15	V
V_{GE} (100%) =	15	V
V_C (100%) =	600	V
I_C (100%) =	15	A
t_{doff} =	0,24	μs
t_{Eoff} =	0,57	μs

Figure 2 Output inverter IGBT

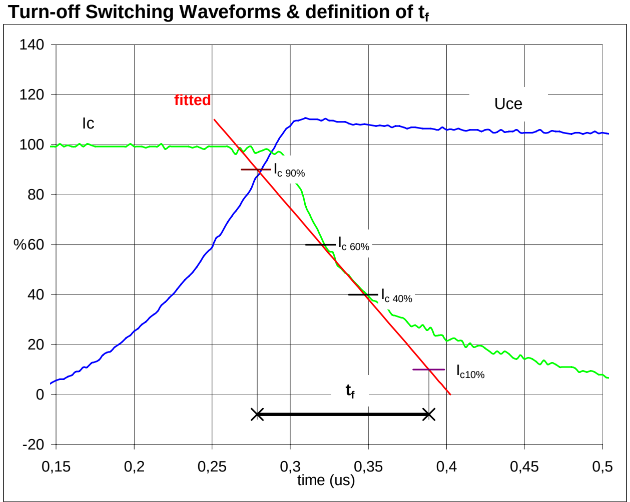
Turn-on Switching Waveforms & definition of tdon, tEon
(t_{Eon} = integrating time for E_{on})



V_{GE} (0%) =	-15	V
V_{GE} (100%) =	15	V
V_C (100%) =	600	V
I_C (100%) =	15	A
t_{don} =	0,06	μs
t_{Eon} =	0,25	μs

Figure 3 Output inverter IGBT

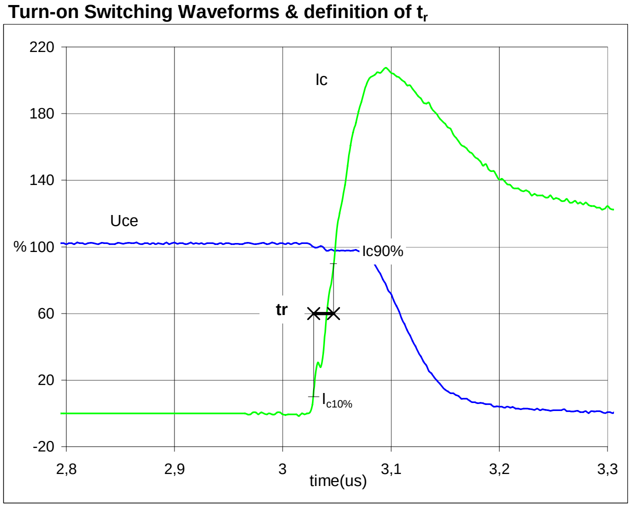
Turn-off Switching Waveforms & definition of t_f



V_C (100%) =	600	V
I_C (100%) =	15	A
t_f =	0,106	μs

Figure 4 Output inverter IGBT

Turn-on Switching Waveforms & definition of t_r

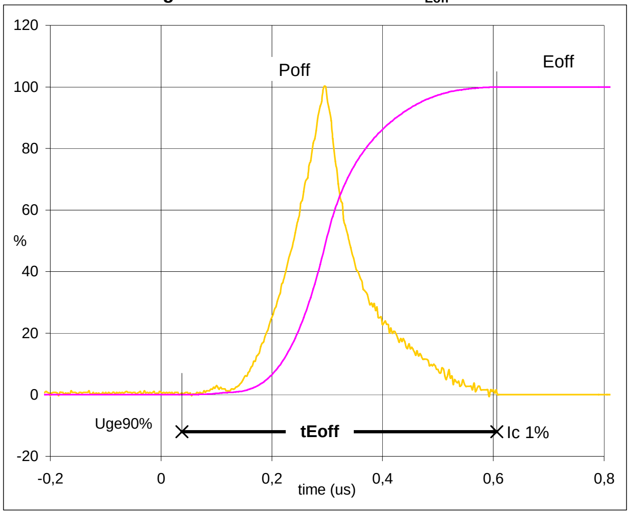


V_C (100%) =	600	V
I_C (100%) =	15	A
t_r =	0,019	μs

Switching Definitions Output Inverter

Figure 5 Output inverter IGBT

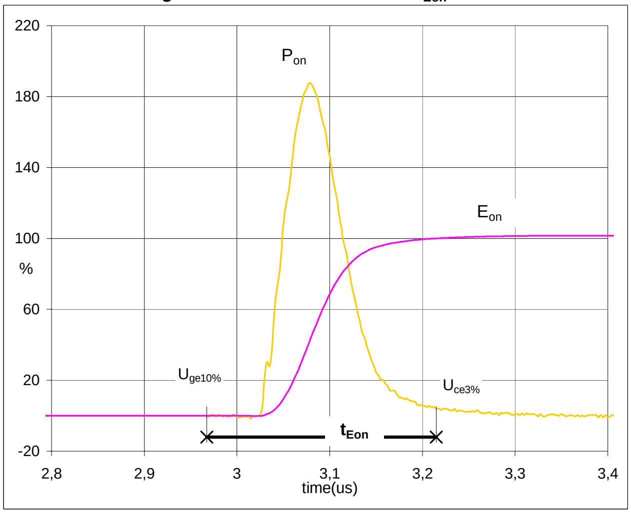
Turn-off Switching Waveforms & definition of t_{Eoff}



P_{off} (100%) =	9,00	kW
E_{off} (100%) =	1,24	mJ
t_{Eoff} =	0,57	μs

Figure 6 Output inverter IGBT

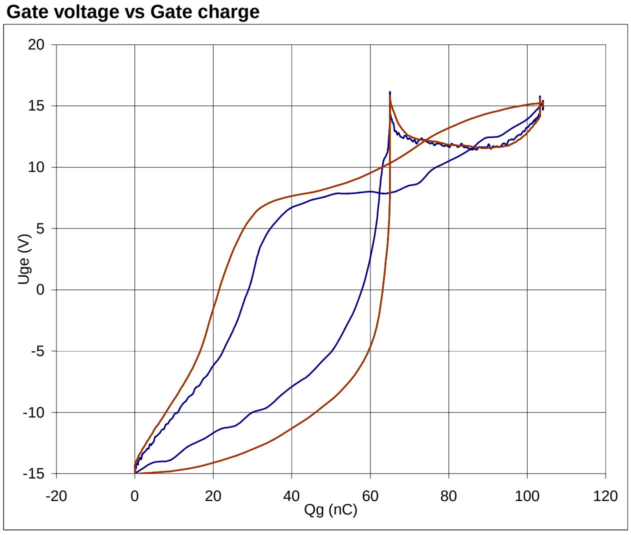
Turn-on Switching Waveforms & definition of t_{Eon}



P_{on} (100%) =	9,00	kW
E_{on} (100%) =	1,25	mJ
t_{Eon} =	0,25	μs

Figure 7 Output inverter IGBT

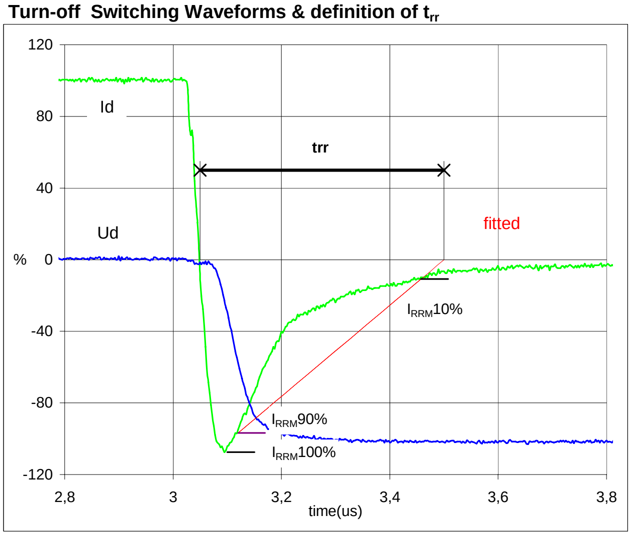
Gate voltage vs Gate charge



V_{GEoff} =	-15	V
V_{GEon} =	15	V
V_C (100%) =	600	V
I_C (100%) =	15	A
Q_g =	104,04	nC

Figure 8 Output inverter FRED

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

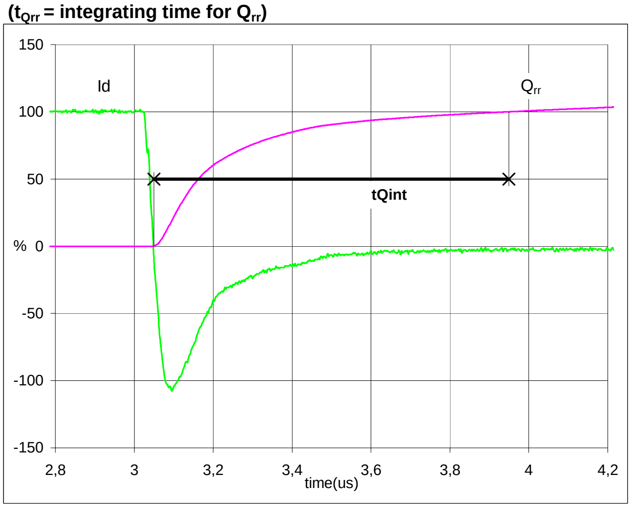


V_d (100%) =	600	V
I_d (100%) =	15	A
I_{RRM} (100%) =	-16	A
t_{rr} =	0,43	μs

Switching Definitions Output Inverter

Figure 9 Output inverter FRED

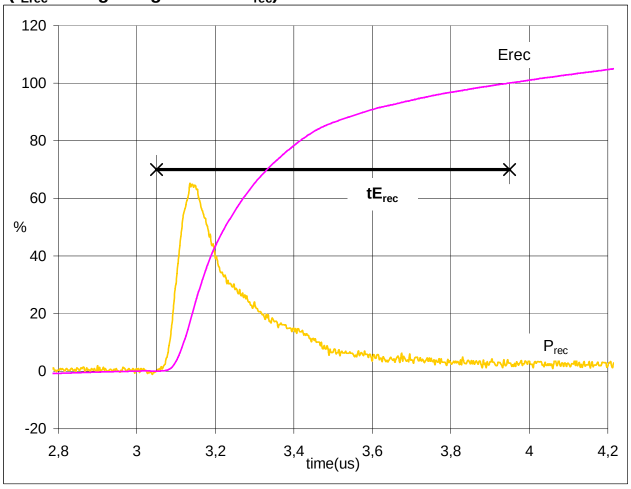
Turn-on Switching Waveforms & definition of t_{Qrr}
(t_{Qrr} = integrating time for Q_{rr})



I_d (100%) =	15	A
Q_{rr} (100%) =	2,75	μC
t_{Qint} =	0,90	μs

Figure 10 Output inverter FRED

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

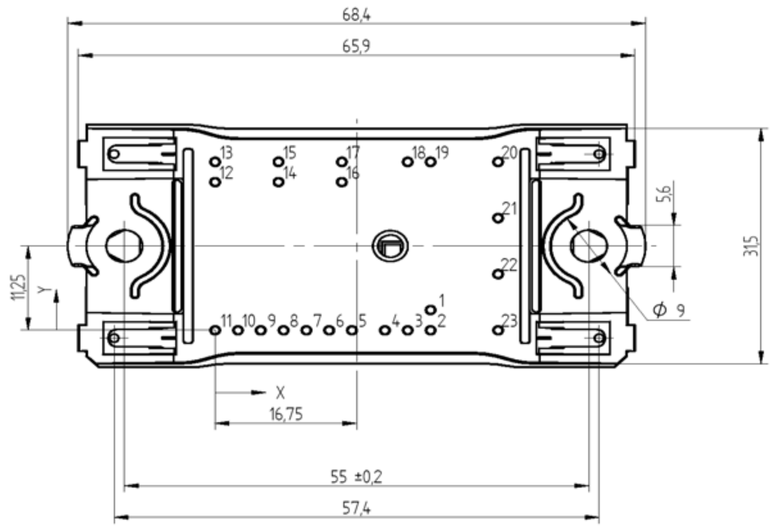


P_{rec} (100%) =	9,00	kW
E_{rec} (100%) =	1,157	mJ
t_{Erec} =	0,90	μs

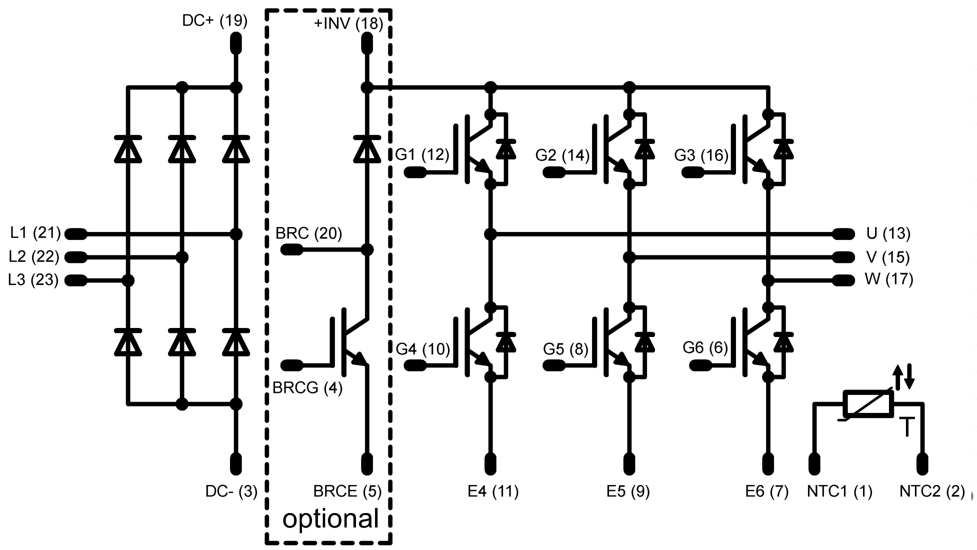
Package Outline and Pinout

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



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Datasheet Status	Product Status	Definition
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