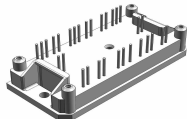
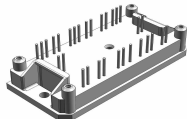
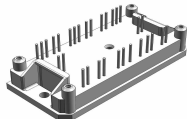
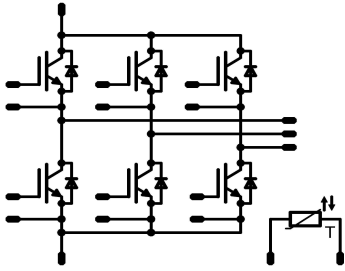
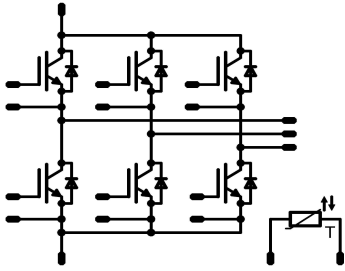
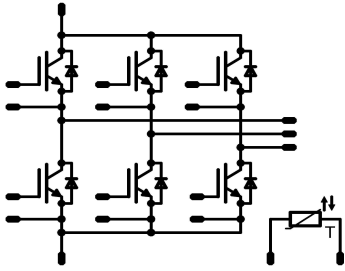




flow PACK 1 3rd gen		600 V / 50 A			
<table border="1" style="width:100%; border-collapse: collapse;"> <tr> <th style="background-color: #cccccc;">Features</th> </tr> <tr> <td> <ul style="list-style-type: none"> Compact flow1 housing Compact and Low Inductance Design Built-in NTC </td> </tr> </table>	Features	<ul style="list-style-type: none"> Compact flow1 housing Compact and Low Inductance Design Built-in NTC 	<table border="1" style="width:100%; border-collapse: collapse;"> <tr> <th style="background-color: #cccccc;">flow1 housing</th> </tr> <tr> <td style="text-align: center;">  </td> </tr> </table>	flow1 housing	
Features					
<ul style="list-style-type: none"> Compact flow1 housing Compact and Low Inductance Design Built-in NTC 					
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<table border="1" style="width:100%; border-collapse: collapse;"> <tr> <th style="background-color: #cccccc;">Target Applications</th> </tr> <tr> <td> <ul style="list-style-type: none"> Motor Drive Power Generation UPS </td> </tr> </table>	Target Applications	<ul style="list-style-type: none"> Motor Drive Power Generation UPS 	<table border="1" style="width:100%; border-collapse: collapse;"> <tr> <th style="background-color: #cccccc;">Schematic</th> </tr> <tr> <td style="text-align: center;">  </td> </tr> </table>	Schematic	
Target Applications					
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Schematic					
					
<table border="1" style="width:100%; border-collapse: collapse;"> <tr> <th style="background-color: #cccccc;">Types</th> </tr> <tr> <td> <ul style="list-style-type: none"> V23990-P823-F10-PM </td> </tr> </table>	Types	<ul style="list-style-type: none"> V23990-P823-F10-PM 			
Types					
<ul style="list-style-type: none"> V23990-P823-F10-PM 					

Maximum Ratings

$T_J=25^{\circ}\text{C}$, unless otherwise specified

Parameter	Symbol	Condition	Value	Unit
Inverter Transistor				
Collector-emitter break down voltage	V_{CE}		600	V
DC collector current	I_C	$T_J=T_{Jmax}$	44	A
Repetitive peak collector current	I_{CRM}	t_p limited by T_{Jmax}	150	A
Power dissipation	P_{tot}	$T_J=T_{Jmax}$	77	W
Gate-emitter peak voltage	V_{GE}		± 20	V
Short circuit ratings	t_{SC}	$T_J \leq 150^{\circ}\text{C}$	6	μs
	V_{CC}	$V_{GE} = 15\text{V}$	360	V
Maximum Junction Temperature	T_{Jmax}		175	$^{\circ}\text{C}$

Inverter Diode

Peak Repetitive Reverse Voltage	V_{RRM}	$T_J=25^{\circ}\text{C}$	600	V
DC forward current	I_F	$T_J=T_{Jmax}$	40	A
Repetitive peak forward current	I_{FRM}	t_p limited by T_{Jmax}	100	A
Power dissipation	P_{tot}	$T_J=T_{Jmax}$	57	W
Maximum Junction Temperature	T_{Jmax}		175	$^{\circ}\text{C}$

Thermal Properties

Storage temperature	T_{stg}		-40...+125	$^{\circ}\text{C}$
Operation temperature under switching condition	T_{op}		-40...+150	$^{\circ}\text{C}$

Insulation Properties

Insulation voltage	V_{is}	$t=1\text{min}$	4000	V_{DC}
Creepage distance			min 12,7	mm
Clearance			min 12,7	mm



Characteristic Values

Parameter	Symbol	Conditions					Value			Unit
		V_{GE} [V] or V_{GS} [V]	V_{r} [V] or V_{CE} [V] or V_{DS} [V]	I_C [A] or I_F [A] or I_D [A]	T_j	Min	Typ	Max		

Inverter Transistor

Gate emitter threshold voltage	$V_{GE(th)}$	VCE=VGE			0,0008	Tj=25°C Tj=150°C	5	5,8	6,5	V
Collector-emitter saturation voltage	V_{CESat}		15		50	Tj=25°C Tj=150°C	1,1	1,56 1,79	2,1	V
Collector-emitter cut-off current incl. Diode	I_{CES}		0	600		Tj=25°C Tj=150°C			0,35	mA
Gate-emitter leakage current	I_{GES}		20	0		Tj=25°C Tj=150°C			650	nA
Integrated Gate resistor	R_{gint}							none		Ω
Turn-on delay time	$t_{d(on)}$	Rgoff=8 Ω Rgon=8 Ω	±15	300	50	Tj=25°C Tj=150°C		106 98		ns
Rise time	t_r					Tj=25°C Tj=150°C		19 16		
Turn-off delay time	$t_{d(off)}$					Tj=25°C Tj=150°C		150 173		
Fall time	t_f					Tj=25°C Tj=150°C		89 115		
Turn-on energy loss per pulse	E_{on}					Tj=25°C Tj=150°C		0,50 0,75		
Turn-off energy loss per pulse	E_{off}					Tj=25°C Tj=150°C		1,18 1,63		
Input capacitance	C_{ies}							3140		pF
Output capacitance	C_{oss}	f=1MHz	0	25		Tj=25°C		200		
Reverse transfer capacitance	C_{rss}							93		
Gate charge	Q_G	Vcc=480	±15		50	Tj=25°C		310		nC
Thermal resistance chip to heatsink	$R_{th(j-s)}$	Thermal grease thickness≤50um λ = 1 W/mK						1,24		K/W

Inverter Diode

Diode forward voltage	V_F				50	Tj=25°C Tj=150°C	1,2	1,63 1,60	2,1	V				
Peak reverse recovery current	I_{RRM}					Tj=25°C Tj=150°C		28 79		A				
Reverse recovery time	t_{rr}	Rgon=8 Ω	±15	300	50	Tj=25°C Tj=150°C		144 147		ns				
Reverse recovered charge	Q_{rr}					Tj=25°C Tj=150°C		1,91 4,71						
Peak rate of fall of recovery current	$(di_{rr}/dt)_{max}$					Tj=25°C Tj=150°C		1357 4135						
Reverse recovered energy	E_{rec}					Tj=25°C Tj=150°C		0,55 1,09						
Thermal resistance chip to heatsink	$R_{th(j-s)}$					Thermal grease thickness≤50um λ = 1 W/mK						1,65		K/W

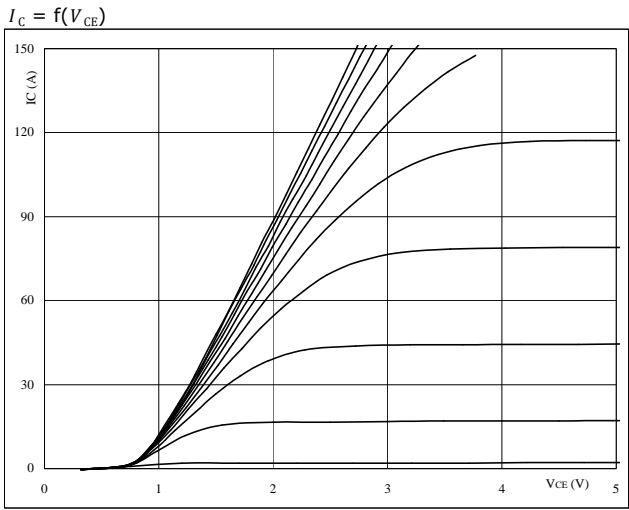
Thermistor

Rated resistance	R_{25}	Tol. ±5%				Tj=25°C	4,46	4,7	4,94	kΩ
Deviation of R100	$D_{R/R}$	R100=435Ω				Tc=100°C		2,6		%/K
Power dissipation given Epcos-Typ	P					Tj=25°C		210		mW
B-value	$B_{(25/100)}$	Tol. ±3%				Tj=25°C		3530		K



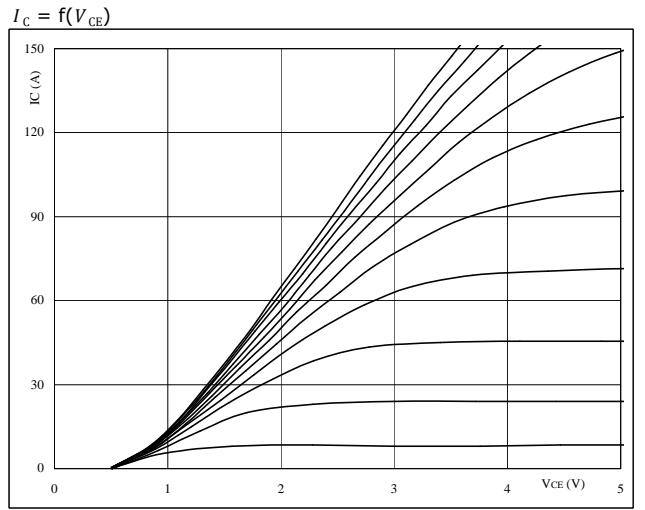
Output Inverter

Figure 1 Output inverter IGBT
Typical output characteristics



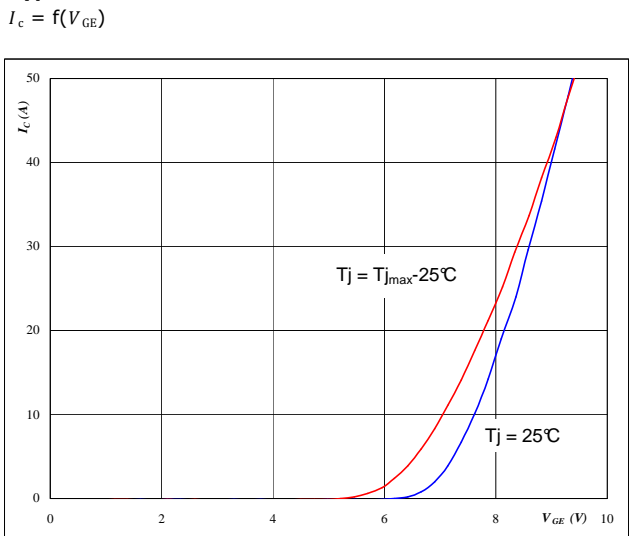
At
 $t_p = 250 \mu s$
 $T_j = 25 \text{ }^\circ C$
 VGE from 7 V to 17 V in steps of 1 V

Figure 2 Output inverter IGBT
Typical output characteristics



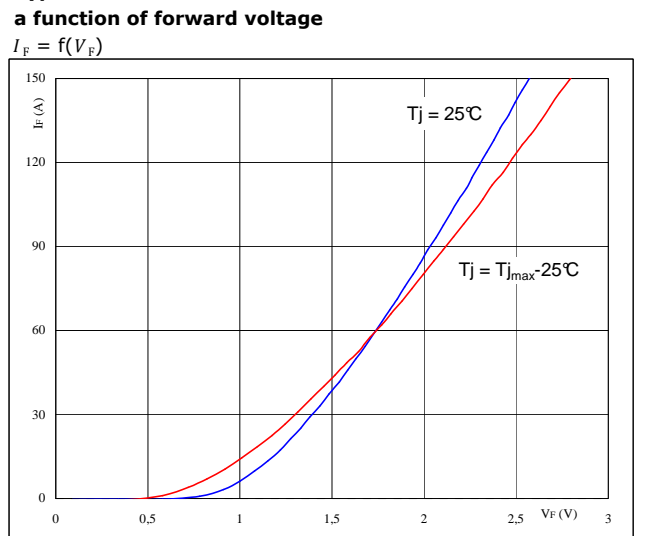
At
 $t_p = 250 \mu s$
 $T_j = 150 \text{ }^\circ C$
 VGE from 7 V to 17 V in steps of 1 V

Figure 3 Output inverter IGBT
Typical transfer characteristics



At
 $t_p = 250 \mu s$
 $V_{CE} = 10 V$

Figure 4 Output inverter FWD
Typical diode forward current as a function of forward voltage



At
 $t_p = 250 \mu s$

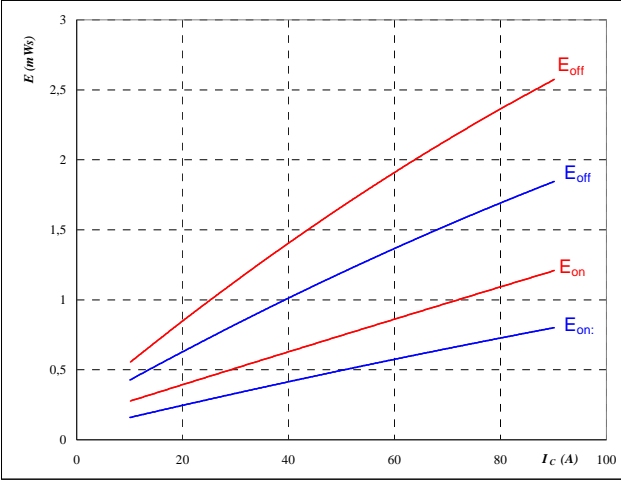


Output Inverter

Figure 5 Output inverter IGBT

Typical switching energy losses as a function of collector current

$E = f(I_c)$



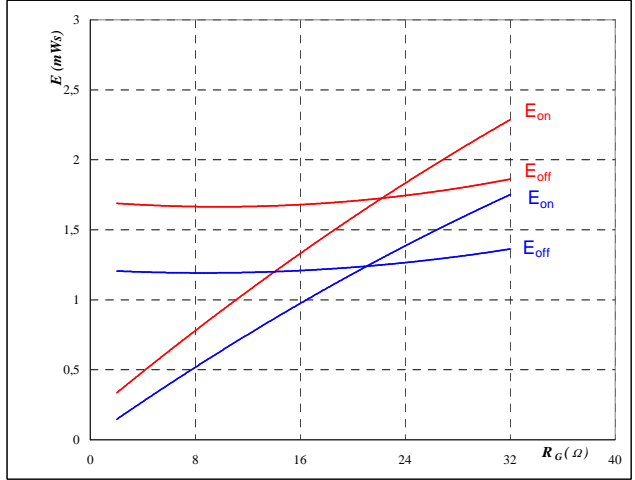
With an inductive load at

- $T_j = 25/150 \text{ } ^\circ\text{C}$
- $V_{CE} = 300 \text{ V}$
- $V_{GE} = \pm 15 \text{ V}$
- $R_{gon} = 8 \text{ } \Omega$
- $R_{goff} = 8 \text{ } \Omega$

Figure 6 Output inverter IGBT

Typical switching energy losses as a function of gate resistor

$E = f(R_g)$



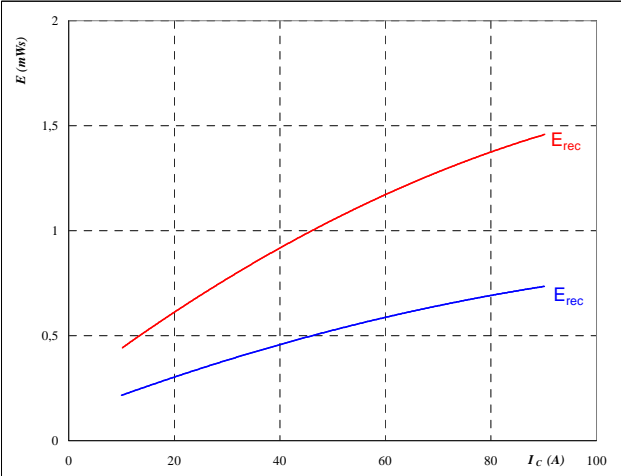
With an inductive load at

- $T_j = 25/150 \text{ } ^\circ\text{C}$
- $V_{CE} = 300 \text{ V}$
- $V_{GE} = \pm 15 \text{ V}$
- $I_c = 50 \text{ A}$

Figure 7 Output inverter IGBT

Typical reverse recovery energy loss as a function of collector current

$E_{rec} = f(I_c)$



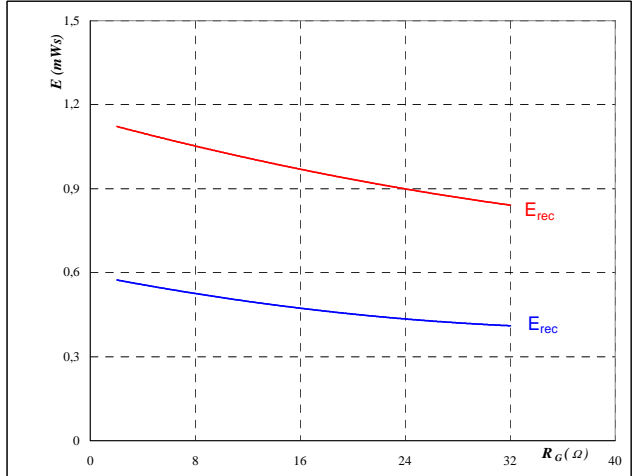
With an inductive load at

- $T_j = 25/150 \text{ } ^\circ\text{C}$
- $V_{CE} = 300 \text{ V}$
- $V_{GE} = \pm 15 \text{ V}$
- $R_{gon} = 8 \text{ } \Omega$

Figure 8 Output inverter IGBT

Typical reverse recovery energy loss as a function of gate resistor

$E_{rec} = f(R_g)$



With an inductive load at

- $T_j = 25/150 \text{ } ^\circ\text{C}$
- $V_{CE} = 300 \text{ V}$
- $V_{GE} = \pm 15 \text{ V}$
- $I_c = 50 \text{ A}$

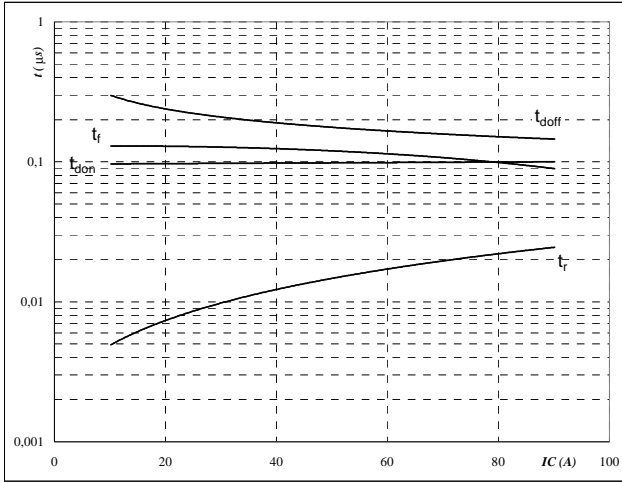


Output Inverter

Figure 9 Output inverter IGBT

Typical switching times as a function of collector current

$$t = f(I_C)$$



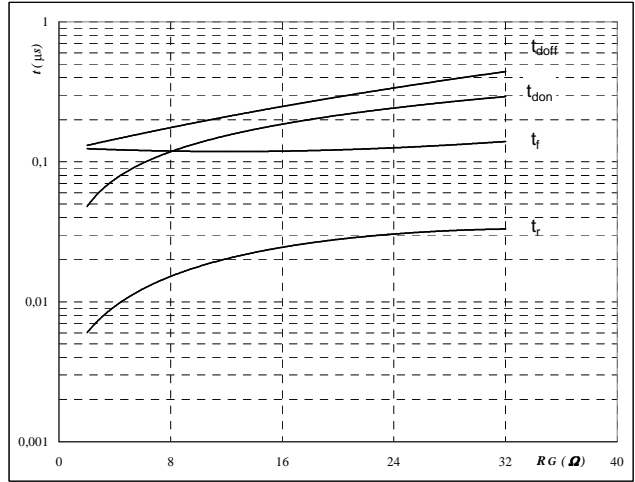
With an inductive load at

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

Figure 10 Output inverter IGBT

Typical switching times as a function of gate resistor

$$t = f(R_G)$$



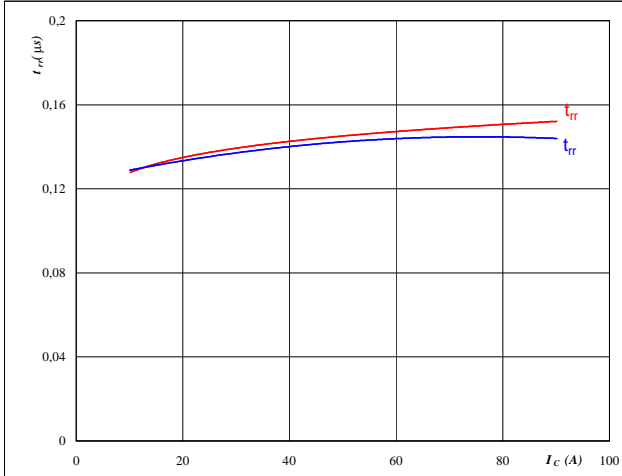
With an inductive load at

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

Figure 11 Output inverter FWD

Typical reverse recovery time as a function of collector current

$$t_{rr} = f(I_C)$$



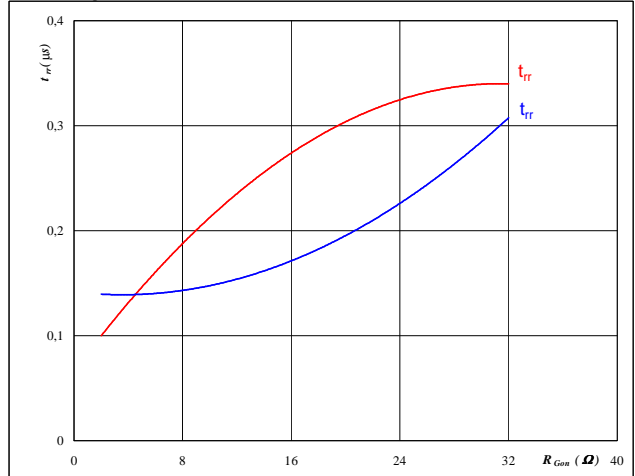
At

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

Figure 12 Output inverter FWD

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

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



At

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

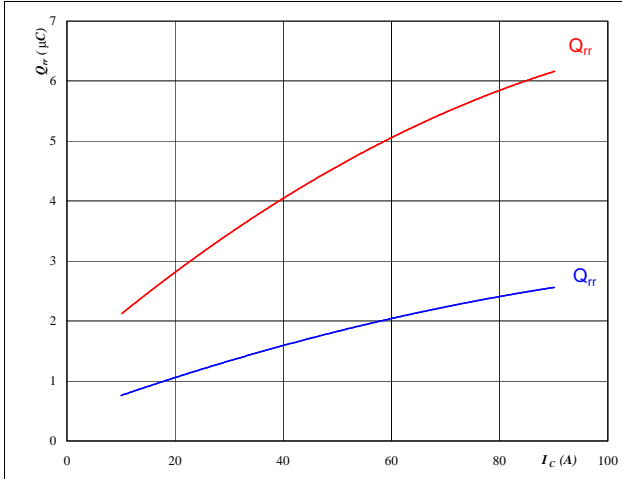


Output Inverter

Figure 13 Output inverter FWD

Typical reverse recovery charge as a function of collector current

$$Q_{rr} = f(I_c)$$

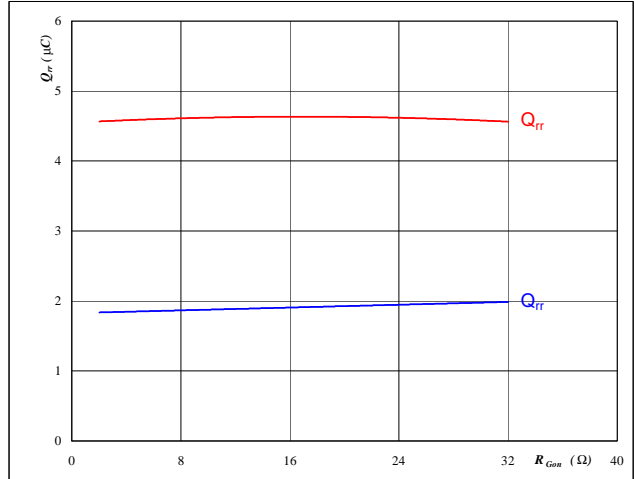


At
 $T_j = 25/150$ °C
 $V_{CE} = 300$ V
 $V_{GE} = \pm 15$ V
 $R_{gon} = 8$ Ω

Figure 14 Output inverter FWD

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

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

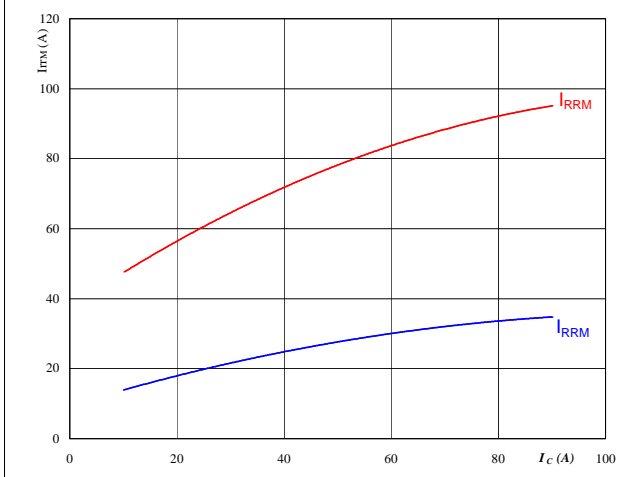


At
 $T_j = 25/150$ °C
 $V_R = 300$ V
 $I_F = 50$ A
 $V_{GE} = \pm 15$ V

Figure 15 Output inverter FWD

Typical reverse recovery current as a function of collector current

$$I_{RRM} = f(I_c)$$

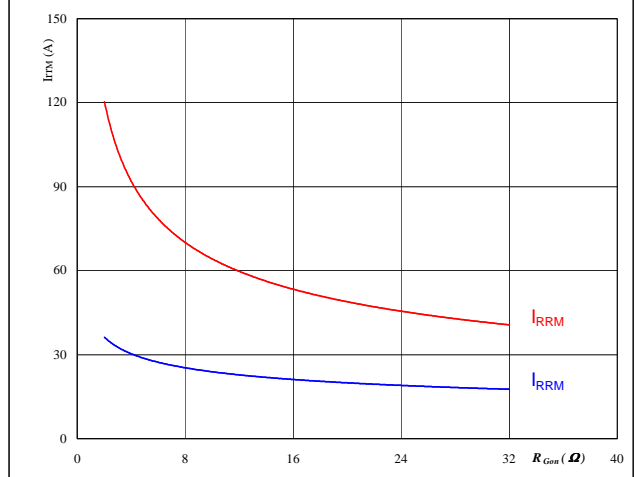


At
 $T_j = 25/150$ °C
 $V_{CE} = 300$ V
 $V_{GE} = \pm 15$ V
 $R_{gon} = 8$ Ω

Figure 16 Output inverter FWD

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

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



At
 $T_j = 25/150$ °C
 $V_R = 300$ V
 $I_F = 50$ A
 $V_{GE} = \pm 15$ V

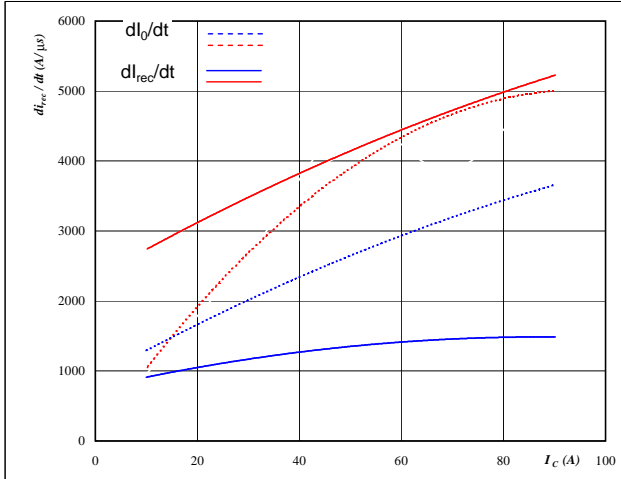


Output Inverter

Figure 17 Output inverter FWD

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

$$dI_0/dt, dI_{rec}/dt = f(I_c)$$

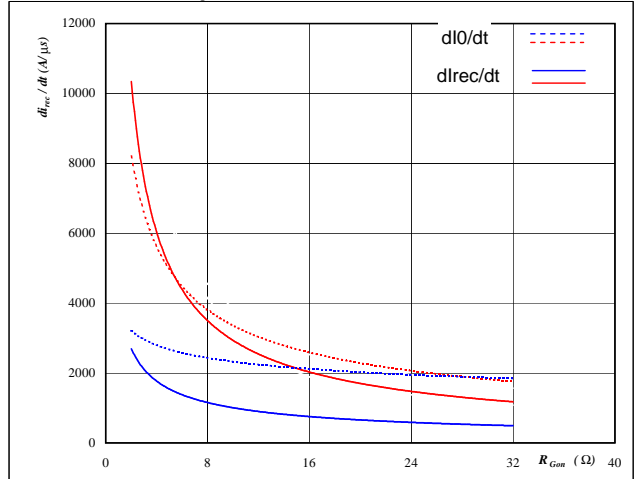


At
 $T_j = 25/150 \text{ } ^\circ\text{C}$
 $V_{CE} = 300 \text{ V}$
 $V_{GE} = \pm 15 \text{ V}$
 $R_{gon} = 8 \text{ } \Omega$

Figure 18 Output inverter FWD

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

$$dI_0/dt, dI_{rec}/dt = f(R_{gon})$$

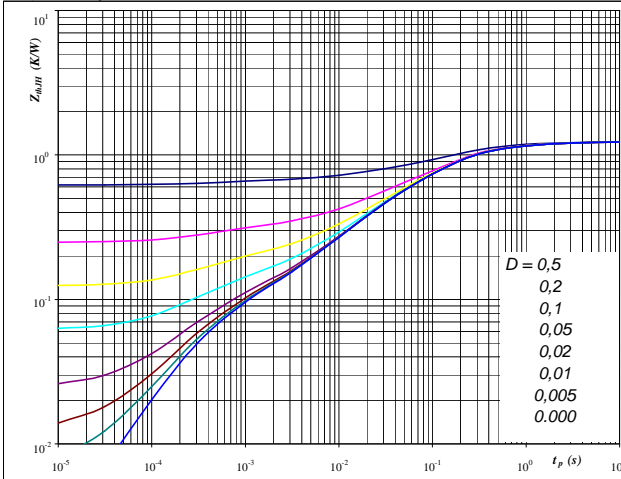


At
 $T_j = 25/150 \text{ } ^\circ\text{C}$
 $V_R = 300 \text{ V}$
 $I_F = 50 \text{ A}$
 $V_{GE} = \pm 15 \text{ V}$

Figure 19 Output inverter IGBT

IGBT transient thermal impedance as a function of pulse width

$$Z_{thjH} = f(t_p)$$



At
 $D = t_p / T$
 $R_{thjH} = 1,24 \text{ K/W}$

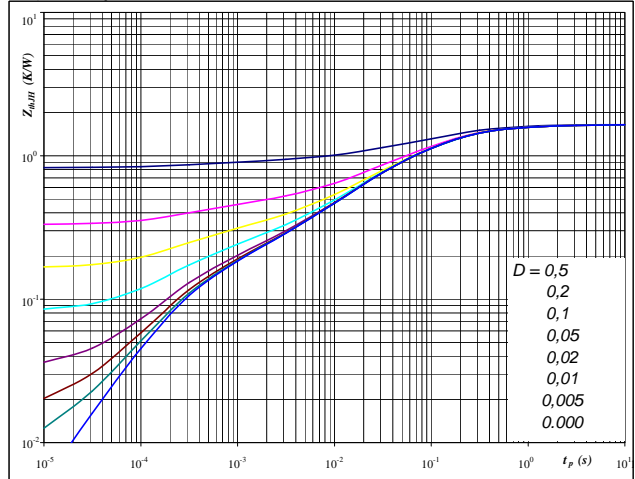
IGBT thermal model values

R (K/W)	Tau (s)
0,02	1,3E+01
0,10	1,7E+00
0,30	3,0E-01
0,49	9,8E-02
0,23	1,6E-02
0,04	2,2E-03
0,06	3,4E-04

Figure 20 Output inverter FWD

FWD transient thermal impedance as a function of pulse width

$$Z_{thjH} = f(t_p)$$



At
 $D = t_p / T$
 $R_{thjH} = 1,65 \text{ K/W}$

FWD thermal model values

R (K/W)	Tau (s)
0,02	1,5E+01
0,09	1,7E+00
0,27	3,1E-01
0,72	8,9E-02
0,36	1,4E-02
0,09	1,3E-03
0,10	2,4E-04

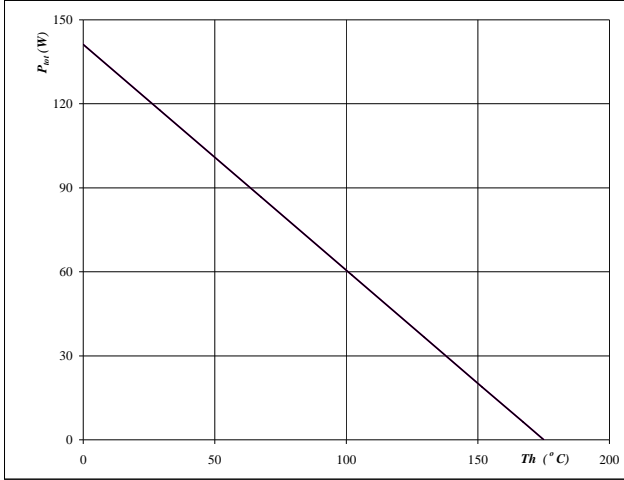


Output Inverter

Figure 21 Output inverter IGBT

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_h)$

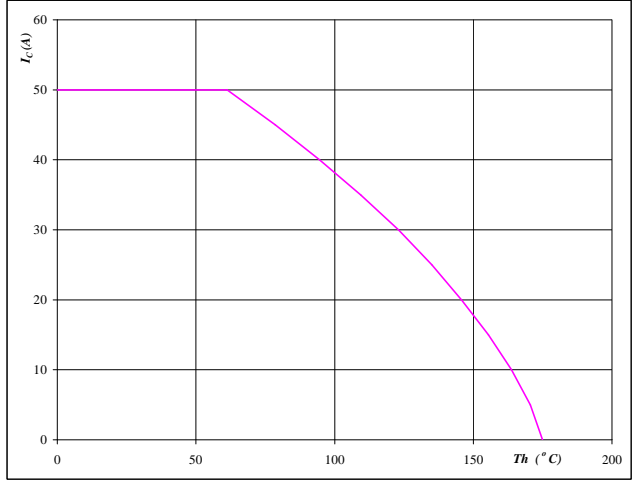


At
 $T_j = 175 \text{ } ^\circ\text{C}$
— single heating
— overall heating

Figure 22 Output inverter IGBT

Collector current as a function of heatsink temperature

$I_c = f(T_h)$

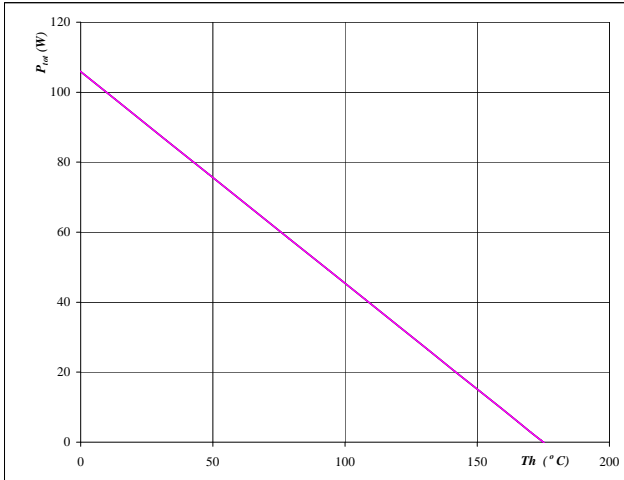


At
 $T_j = 175 \text{ } ^\circ\text{C}$
 $V_{ce} = 15 \text{ V}$

Figure 23 Output inverter FWD

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_h)$

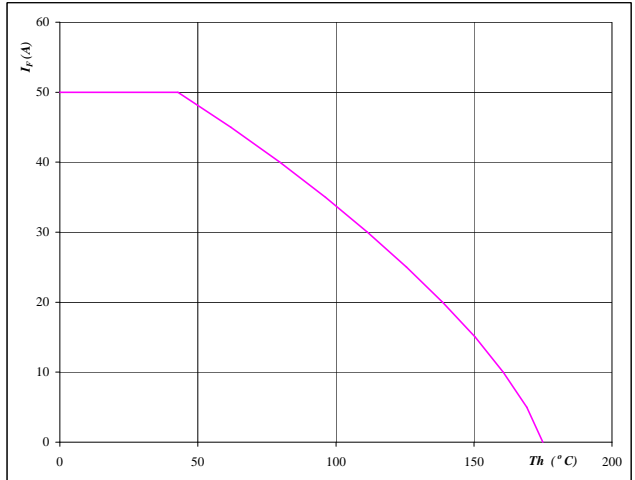


At
 $T_j = 175 \text{ } ^\circ\text{C}$
— single heating
— overall heating

Figure 24 Output inverter FWD

Forward current as a function of heatsink temperature

$I_F = f(T_h)$



At
 $T_j = 175 \text{ } ^\circ\text{C}$

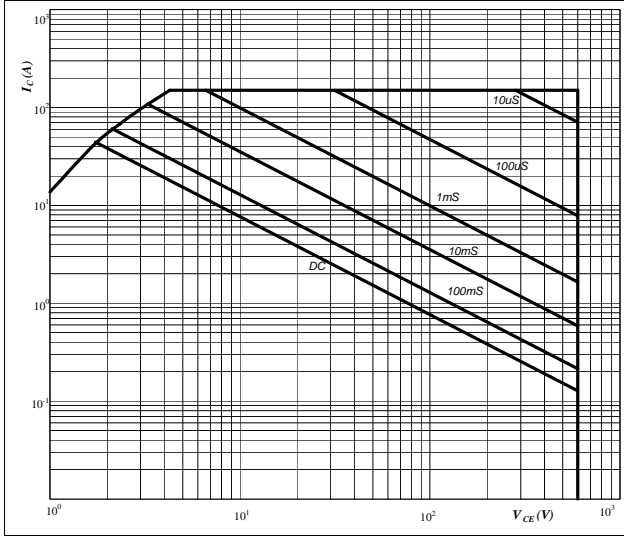


Output Inverter

Figure 25 Output inverter IGBT

Safe operating area as a function of collector-emitter voltage

$I_C = f(V_{CE})$

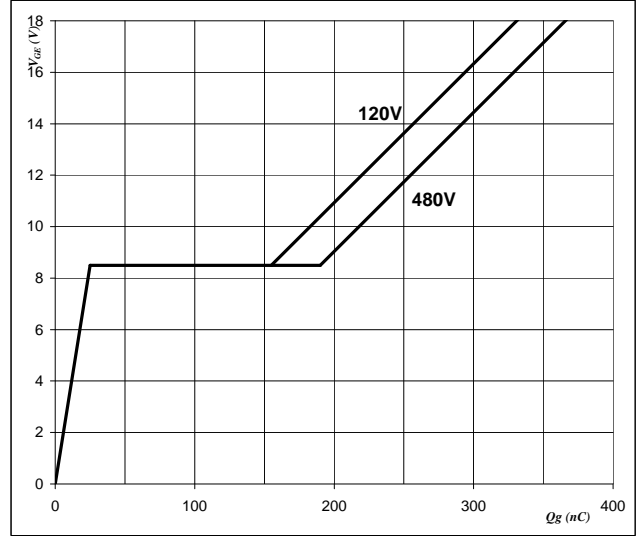


At
 $D =$ single pulse
 $T_h =$ 80 °C
 $V_{GE} =$ ±15 V
 $T_j =$ T_{jmax} °C

Figure 26 Output inverter IGBT

Gate voltage vs Gate charge

$V_{GE} = f(Q_g)$



At
 $I_C =$ 50 A

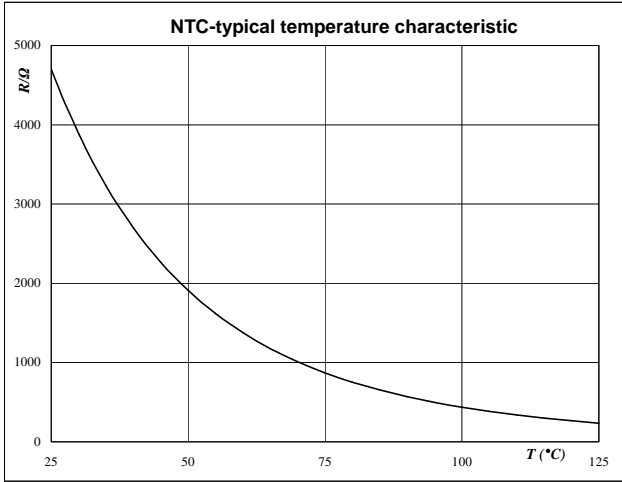


Thermistor

Figure 1 Thermistor

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

$$R_T = f(T)$$





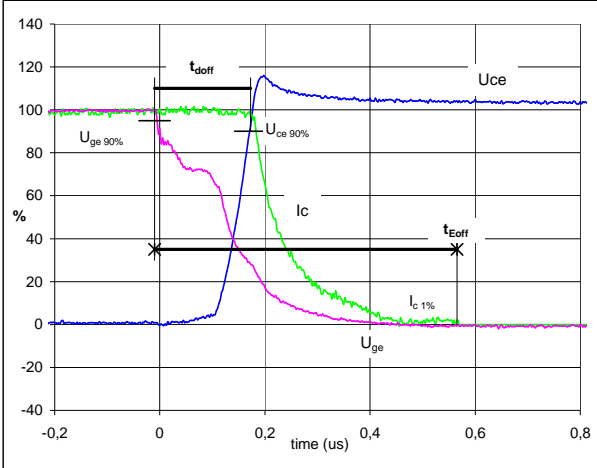
Switching Definitions Output Inverter

General conditions

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

Figure 1 Output inverter IGBT

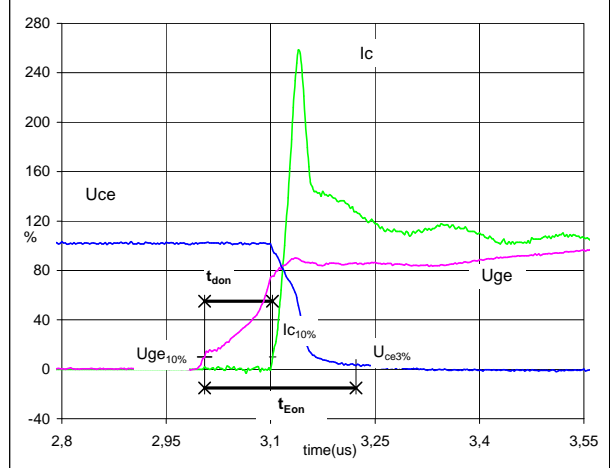
Turn-off Switching Waveforms & definition of t_{doff} , t_{Eoff}
 (t_{Eoff} = integrating time for E_{off})



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

Figure 2 Output inverter IGBT

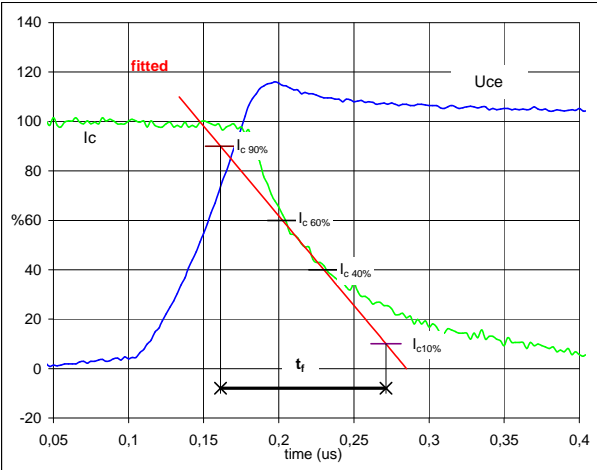
Turn-on Switching Waveforms & definition of t_{don} , t_{Eon}
 (t_{Eon} = integrating time for E_{on})



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

Figure 3 Output inverter IGBT

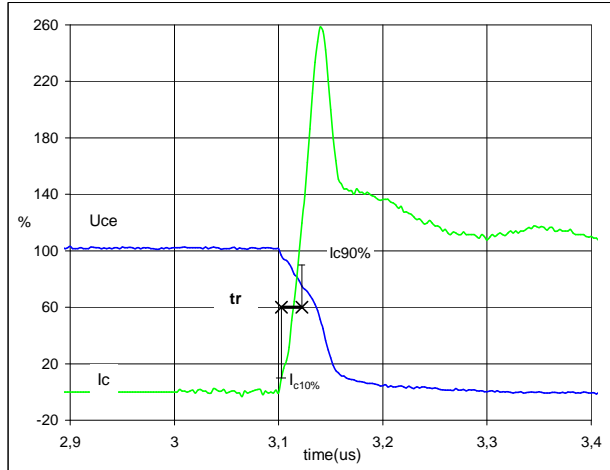
Turn-off Switching Waveforms & definition of t_f



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

Figure 4 Output inverter IGBT

Turn-on Switching Waveforms & definition of t_r



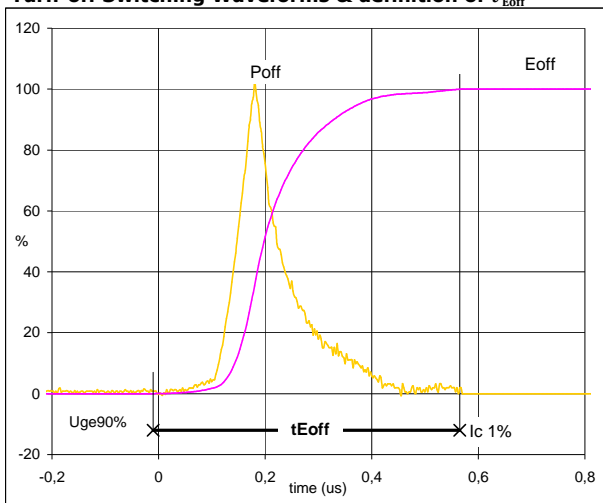
V_C (100%) =	300	V
I_C (100%) =	50	A
t_r =	0,02	μs



Switching Definitions Output Inverter

Figure 5 Output inverter IGBT

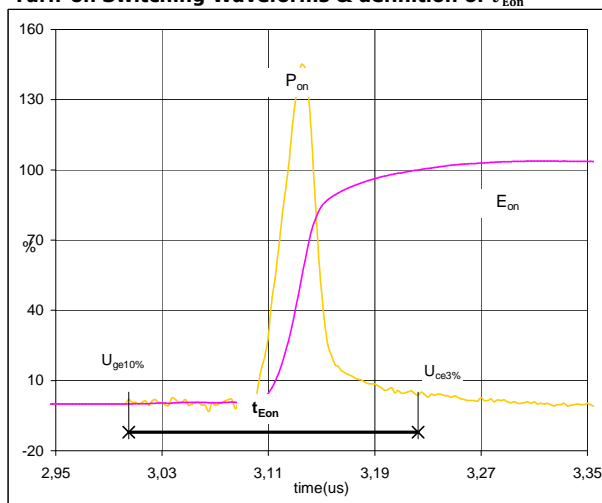
Turn-off Switching Waveforms & definition of t_{Eoff}



$P_{off} (100\%) = 15,03 \text{ kW}$
 $E_{off} (100\%) = 1,63 \text{ mJ}$
 $t_{Eoff} = 0,58 \text{ } \mu\text{s}$

Figure 6 Output inverter IGBT

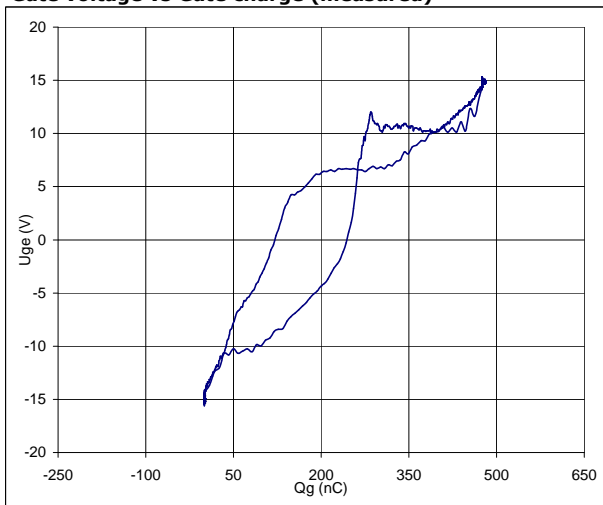
Turn-on Switching Waveforms & definition of t_{Eon}



$P_{on} (100\%) = 15,03 \text{ kW}$
 $E_{on} (100\%) = 0,75 \text{ mJ}$
 $t_{Eon} = 0,22 \text{ } \mu\text{s}$

Figure 7 Output inverter FRED

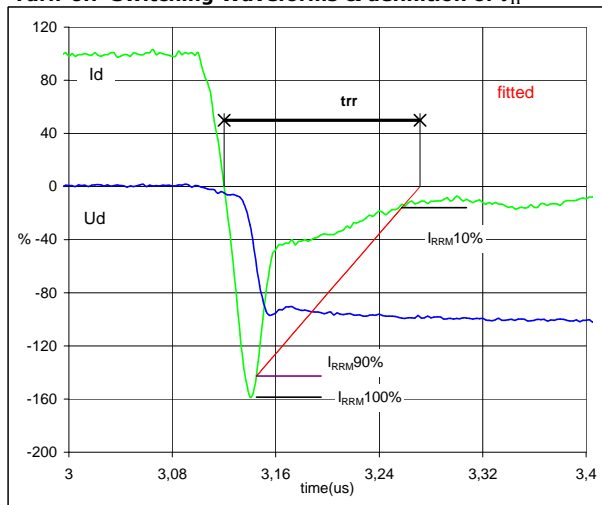
Gate voltage vs Gate charge (measured)



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

Figure 8 Output inverter IGBT

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



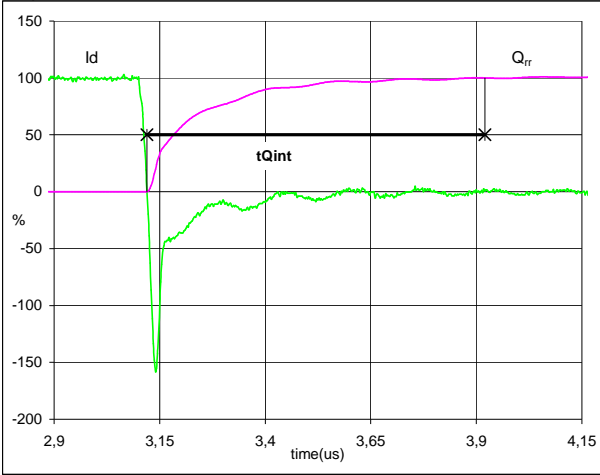
$V_d (100\%) = 300 \text{ V}$
 $I_d (100\%) = 50 \text{ A}$
 $I_{RRM} (100\%) = -79 \text{ A}$
 $t_{tr} = 0,15 \text{ } \mu\text{s}$



Switching Definitions Output Inverter

Figure 9 Output inverter FRED

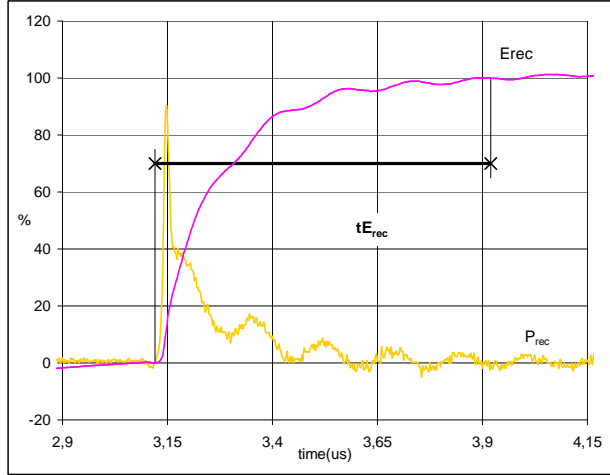
Turn-on Switching Waveforms & definition of t_{Qrr}
(t_{Qrr} = integrating time for Q_{rr})



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

Figure 10 Output inverter FRED

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



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

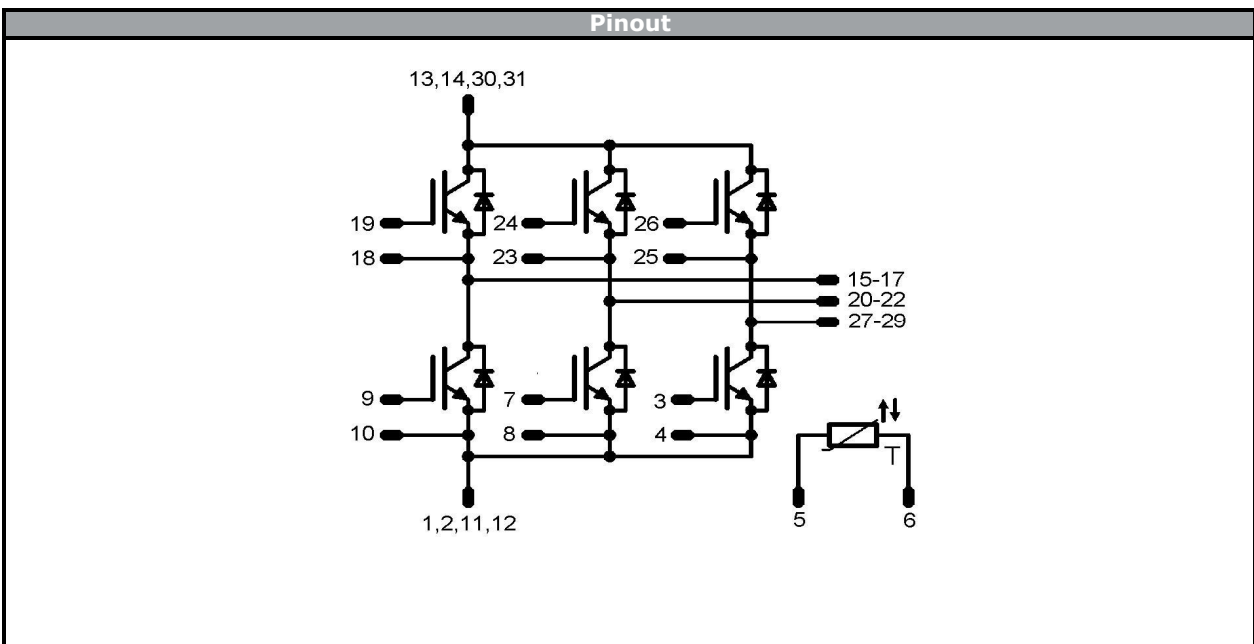


Ordering Code and Marking - Outline - Pinout

Ordering Code & Marking			
Version	Ordering Code	in DataMatrix as	in packaging barcode as
without thermal paste 17mm housing	V23990-P823-F10-PM	P823-F10	P823-F10

Outline

Pin table			
Pin	X	Y	
1	52,6	0	
2	49,9	0	
3	42,65	0	
4	39,65	0	
5	35,15	2,8	
6	28,4	0	
7	24	2,8	
8	21	0	
9	12,2	0	
10	9,2	0	
11	2,7	0	
12	0	0	
13	0	14,65	
14	2,7	14,65	
15	0	28,6	
16	2,7	28,6	
17	5,4	28,6	
18	9,6	28,6	
19	12,6	28,6	
20	19,6	28,6	
21	22,3	28,6	
22	25	28,6	
23	29,7	28,6	
24	32,7	28,6	
25	39,7	28,6	
26	42,7	28,6	
27	42,2	28,6	
28	49,9	28,6	
29	52,6	28,6	
30	52,6	14,56	
31	49,9	14,56	





Packaging instruction					
Standard packaging quantity (SPQ)	100	>SPQ	Standard	<SPQ	Sample

Handling instruction
Handling instructions for <i>flow 1</i> packages see vincotech.com website.

Package data
Package data for <i>flow 1</i> packages see vincotech.com website.

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