



<i>flow</i> PACK 2	1200V/100A
<div style="border: 1px solid black; padding: 5px; margin-bottom: 5px;"> <p style="text-align: center; background-color: #ccc; margin: 0;">Features</p> <ul style="list-style-type: none"> High power flow2 housing Trench Fieldstop Technology IGBT4 Compact and low inductive design </div> <div style="border: 1px solid black; padding: 5px; margin-bottom: 5px;"> <p style="text-align: center; background-color: #ccc; margin: 0;">Target Applications</p> <ul style="list-style-type: none"> Motor Drive Power Generation UPS </div> <div style="border: 1px solid black; padding: 5px;"> <p style="text-align: center; background-color: #ccc; margin: 0;">Types</p> <ul style="list-style-type: none"> V23990-P689-F </div>	<div style="border: 1px solid black; padding: 5px; margin-bottom: 5px;"> <p style="text-align: center; background-color: #ccc; margin: 0;"><i>flow</i> 2 17mm housing</p> </div> <div style="border: 1px solid black; padding: 5px;"> <p style="text-align: center; background-color: #ccc; margin: 0;">Schematic</p> </div>

Maximum Ratings

$T_j = 25\text{ °C}$, unless otherwise specified

Parameter	Symbol	Condition	Value	Unit
Inverter Switch				
Collector-emitter break down voltage	V_{CE}		1200	V
DC collector current	I_C	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	100	A
Repetitive peak collector current	I_{CRM}	t_p limited by T_{jmax}	300	A
Power dissipation per IGBT	P_{tot}	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	270	W
Gate-emitter peak voltage	V_{GE}		±20	V
Short circuit ratings	t_{SC} V_{CC}	$T_j \leq 150\text{ °C}$ $V_{GE} = 15\text{ V}$	10 900	μs V
Maximum Junction Temperature	T_{jmax}		175	°C
Inverter Diode				
Peak Repetitive Reverse Voltage	V_{RRM}		1200	V
DC forward current	I_F	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	85	A
Repetitive peak forward current	I_{FRM}	t_p limited by T_{jmax}	200	A
Power dissipation per Diode	P_{tot}	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	160	W
Maximum Junction Temperature	T_{jmax}		175	°C



Maximum Ratings

$T_i = 25\text{ °C}$, unless otherwise specified

Parameter	Symbol	Condition	Value	Unit
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Modul Properties

Thermal Properties

Storage temperature	T_{stg}		-40...+125	°C
Operation temperature under switching condition	T_{op}		-40...+($T_{jmax} - 25$)	°C

Insulation Properties

Insulation voltage	V_{is}	DC Test Voltage* $t_p = 2\text{ s}$	4000	V
		AC Voltage $t_p = 1\text{ min}$	2500	V
Creepage distance			min 12,7	mm
Clearance			min 12,7	mm
Competative tracking index	CTI		>200	

* 100 % tested in production



Characteristic Values

Parameter	Symbol	Conditions					Value			Unit	
		V_{GE} [V]	V_{GS} [V]	V_r [V]	V_{CE} [V]	V_{DS} [V]	I_C [A]	I_F [A]	I_D [A]		T_j [°C]

Inverter Switch

Gate emitter threshold voltage	$V_{GE(th)}$	$V_{CE} = V_{GE}$				0,0034	25		5	5,8	6,5	V
Collector-emitter saturation voltage	V_{CEsat}		15			100	25 150		1,5	1,94 2,35	2,5	V
Collector-emitter cut-off current incl. Diode	I_{CES}		0	1200			25				0,025	mA
Gate-emitter leakage current	I_{GES}		20	0			25				700	nA
Integrated Gate resistor	R_{gint}									2		Ω
Turn-on delay time	$t_{d(on)}$						25 150			104 108		ns
Rise time	t_r						25 150			18 23		
Turn-off delay time	$t_{d(off)}$	$R_{gon} = 8 \Omega$	± 15	600	100		25 150			219 293		
Fall time	t_f	$R_{goff} = 8 \Omega$					25 150			72 111		
Turn-on energy loss per pulse	E_{on}						25 150			4,04 6,73		mWs
Turn-off energy loss per pulse	E_{off}						25 150			5,25 8,77		
Input capacitance	C_{ies}									5540		pF
Output capacitance	C_{oss}	$f = 1 \text{ MHz}$	0	25			25			410		
Reverse transfer capacitance	C_{rss}									320		
Gate charge	Q_G	$V_{CC}=960$	± 15			100	25			480		nC
Thermal resistance chip to heatsink per chip	$R_{th(j-s)}$	Thermal grease thickness $\leq 50\mu\text{m}$ $\lambda = 1 \text{ W/mK}$								0,35		K/W

Inverter Diode

Diode forward voltage	V_F					100	25 150		1	1,99 2,01	2,5	V
Peak reverse recovery current	I_{RRM}						25 150			164 187		A
Reverse recovery time	t_{rr}						25 150			130 294		ns
Reverse recovered charge	Q_{rr}	$R_{gon} = 8 \Omega$	± 15	600	100		25 150			9,32 18,66		μC
Peak rate of fall of recovery current	$(di_{rr}/dt)_{max}$						25 150			8743 3702		A/ μs
Reverse recovered energy	E_{rec}						25 150			3,87 7,96		mWs
Thermal resistance chip to heatsink per chip	$R_{th(j-s)}$	Thermal grease thickness $\leq 50\mu\text{m}$ $\lambda = 1 \text{ W/mK}$								0,60		K/W

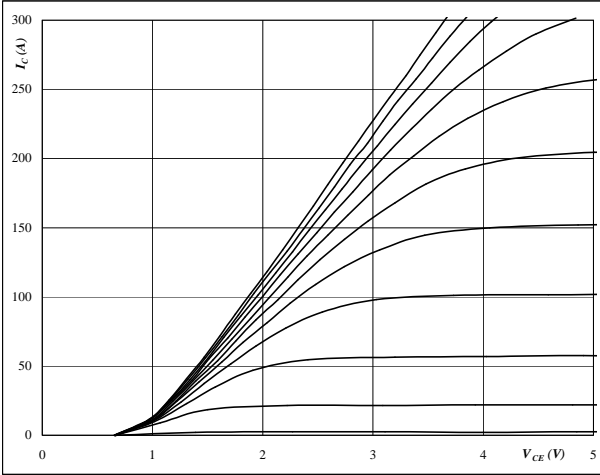


Inverter

Figure 1 Inverter IGBT

Typical output characteristics

$I_C = f(V_{CE})$



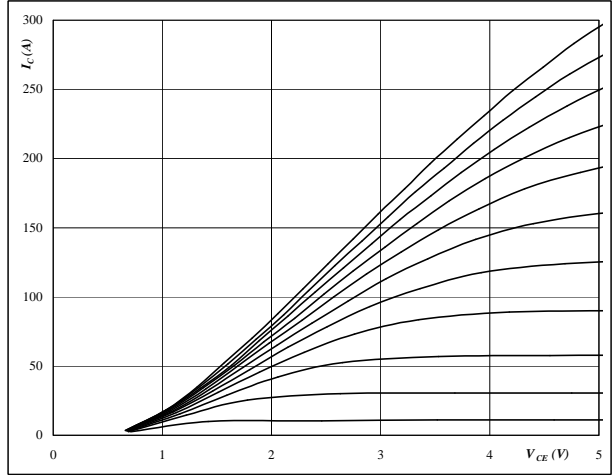
At

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

Figure 2 Inverter IGBT

Typical output characteristics

$I_C = f(V_{CE})$



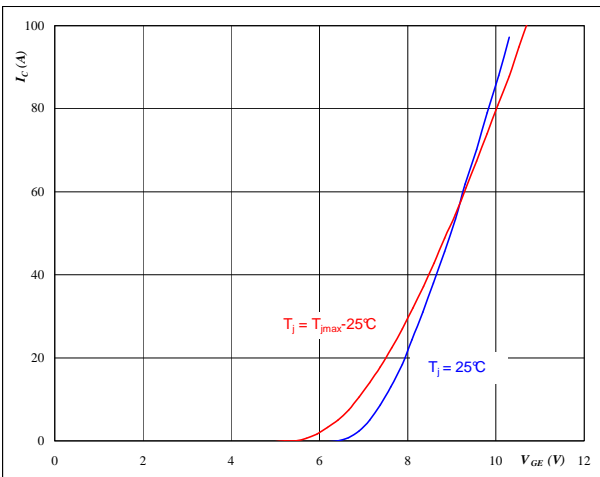
At

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

Figure 3 Inverter IGBT

Typical transfer characteristics

$I_C = f(V_{GE})$



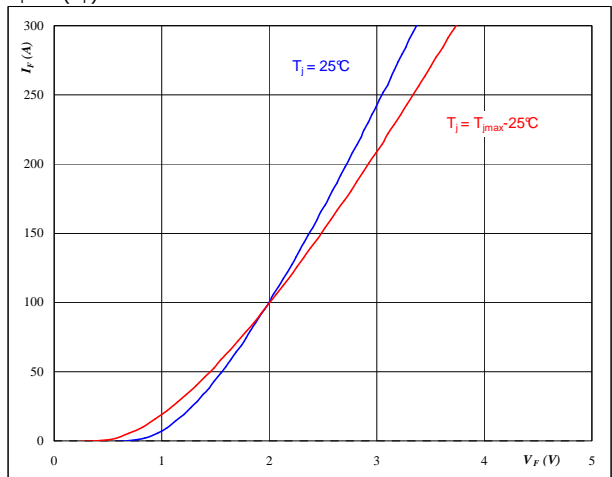
At

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

Figure 4 Inverter FRED

Typical diode forward current as a function of forward voltage

$I_F = f(V_F)$



At

$t_p = 250 \mu s$

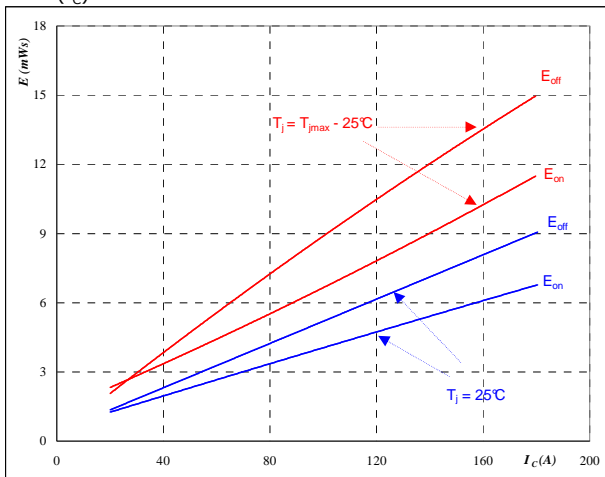


Inverter

Figure 5 Inverter IGBT

Typical switching energy losses as a function of collector current

$E = f(I_C)$



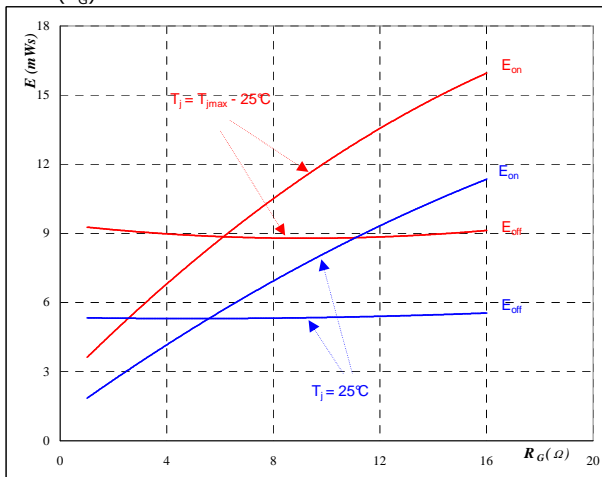
With an inductive load at

- $T_j = 25/150 \text{ } ^\circ\text{C}$
- $V_{CE} = 600 \text{ V}$
- $V_{GE} = \pm 15 \text{ V}$
- $R_{gon} = 4 \text{ } \Omega$
- $R_{goff} = 4 \text{ } \Omega$

Figure 6 Inverter IGBT

Typical switching energy losses as a function of gate resistor

$E = f(R_G)$



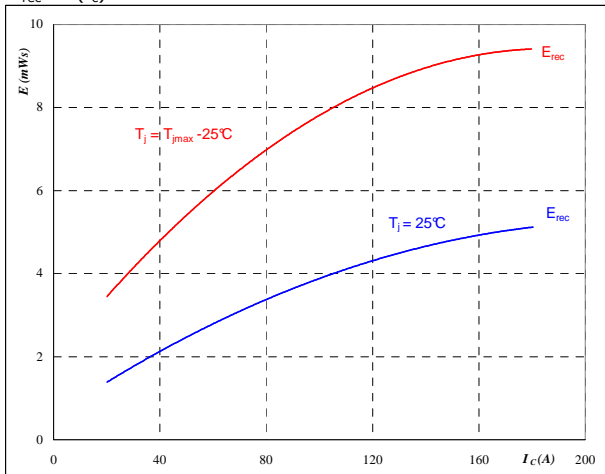
With an inductive load at

- $T_j = 25/150 \text{ } ^\circ\text{C}$
- $V_{CE} = 600 \text{ V}$
- $V_{GE} = \pm 15 \text{ V}$
- $I_C = 100 \text{ A}$

Figure 7 Inverter IGBT

Typical reverse recovery energy loss as a function of collector current

$E_{rec} = f(I_C)$



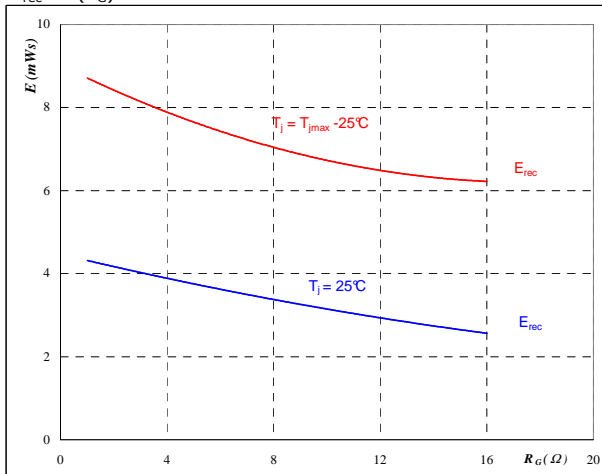
With an inductive load at

- $T_j = 25/150 \text{ } ^\circ\text{C}$
- $V_{CE} = 600 \text{ V}$
- $V_{GE} = \pm 15 \text{ V}$
- $R_{gon} = 4 \text{ } \Omega$

Figure 8 Inverter IGBT

Typical reverse recovery energy loss as a function of gate resistor

$E_{rec} = f(R_G)$



With an inductive load at

- $T_j = 25/150 \text{ } ^\circ\text{C}$
- $V_{CE} = 600 \text{ V}$
- $V_{GE} = \pm 15 \text{ V}$
- $I_C = 100 \text{ A}$

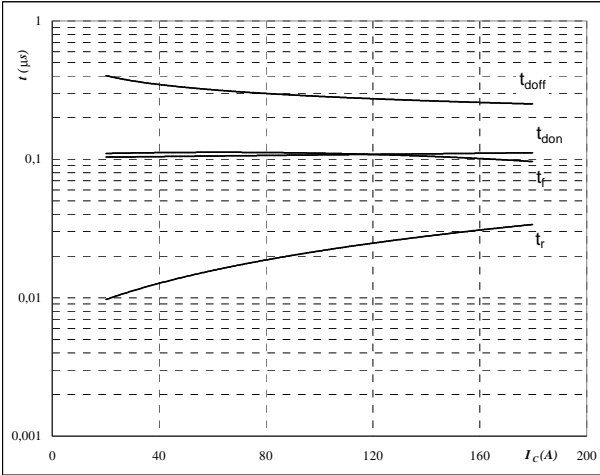


Inverter

Figure 9 Inverter IGBT

Typical switching times as a function of collector current

$t = f(I_C)$



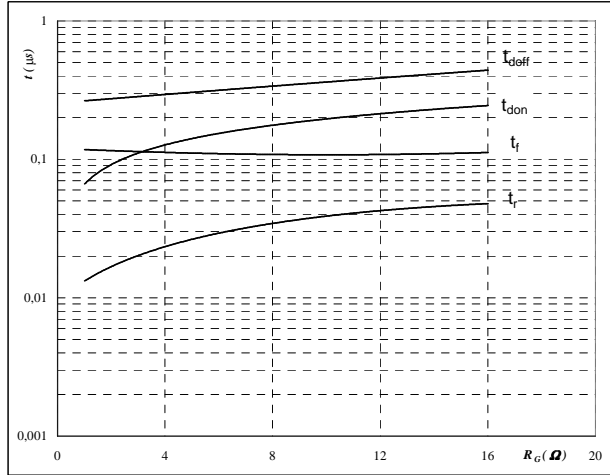
With an inductive load at

- $T_j = 150 \text{ } ^\circ\text{C}$
- $V_{CE} = 600 \text{ V}$
- $V_{GE} = \pm 15 \text{ V}$
- $R_{gon} = 4 \text{ } \Omega$
- $R_{goff} = 4 \text{ } \Omega$

Figure 10 Inverter IGBT

Typical switching times as a function of gate resistor

$t = f(R_G)$



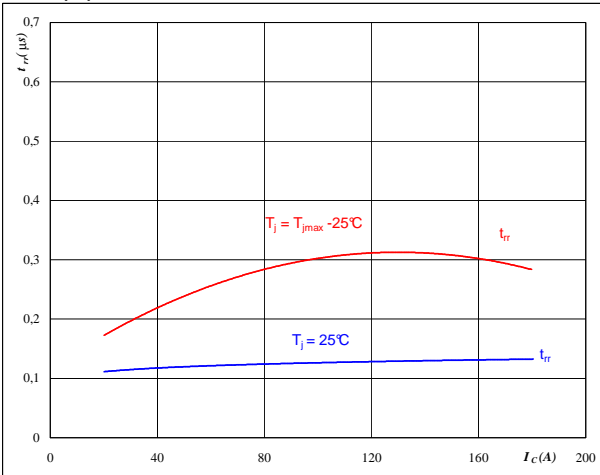
With an inductive load at

- $T_j = 150 \text{ } ^\circ\text{C}$
- $V_{CE} = 600 \text{ V}$
- $V_{GE} = \pm 15 \text{ V}$
- $I_C = 100 \text{ A}$

Figure 11 Inverter FRED

Typical reverse recovery time as a function of collector current

$t_{rr} = f(I_C)$



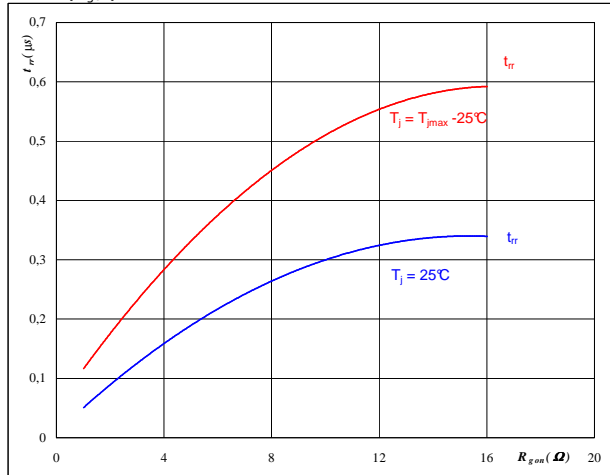
At

- $T_j = 25/150 \text{ } ^\circ\text{C}$
- $V_{CE} = 600 \text{ V}$
- $V_{GE} = \pm 15 \text{ V}$
- $R_{gon} = 4 \text{ } \Omega$

Figure 12 Inverter FRED

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

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



At

- $T_j = 25/150 \text{ } ^\circ\text{C}$
- $V_R = 600 \text{ V}$
- $I_F = 100 \text{ A}$
- $V_{GE} = \pm 15 \text{ V}$

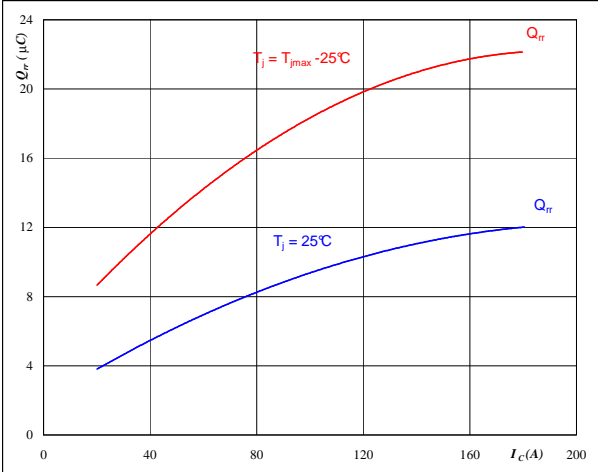


Inverter

Figure 13 Inverter FRED

Typical reverse recovery charge as a function of collector current

$Q_{rr} = f(I_C)$

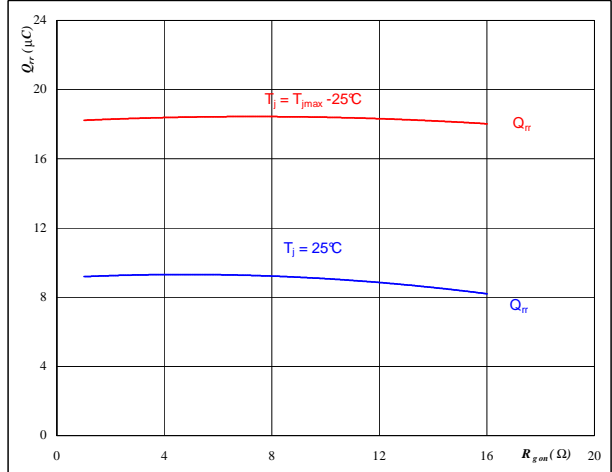


At
 $T_j = 25/150 \text{ } ^\circ\text{C}$
 $V_{CE} = 600 \text{ V}$
 $V_{GE} = \pm 15 \text{ V}$
 $R_{gon} = 4 \text{ } \Omega$

Figure 14 Inverter FRED

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

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

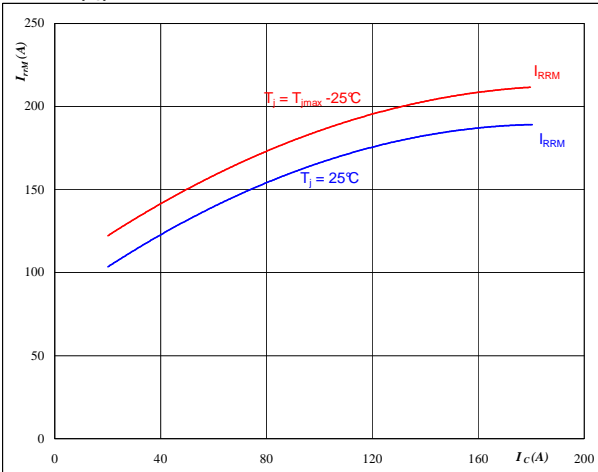


At
 $T_j = 25/150 \text{ } ^\circ\text{C}$
 $V_R = 600 \text{ V}$
 $I_F = 100 \text{ A}$
 $V_{GE} = \pm 15 \text{ V}$

Figure 15 Inverter FRED

Typical reverse recovery current as a function of collector current

$I_{RRM} = f(I_C)$

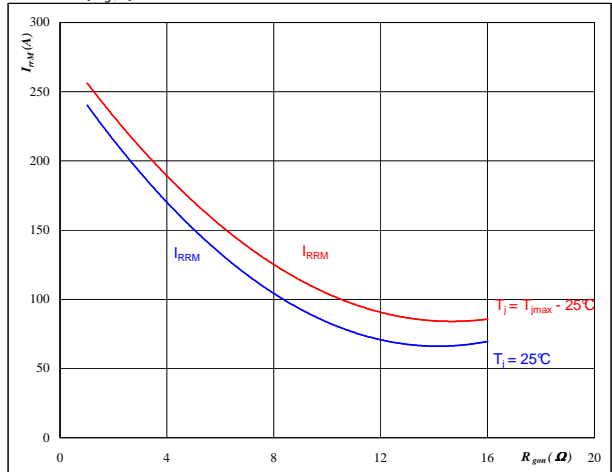


At
 $T_j = 25/150 \text{ } ^\circ\text{C}$
 $V_{CE} = 600 \text{ V}$
 $V_{GE} = \pm 15 \text{ V}$
 $R_{gon} = 4 \text{ } \Omega$

Figure 16 Inverter FRED

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

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



At
 $T_j = 25/150 \text{ } ^\circ\text{C}$
 $V_R = 600 \text{ V}$
 $I_F = 100 \text{ A}$
 $V_{GE} = \pm 15 \text{ V}$

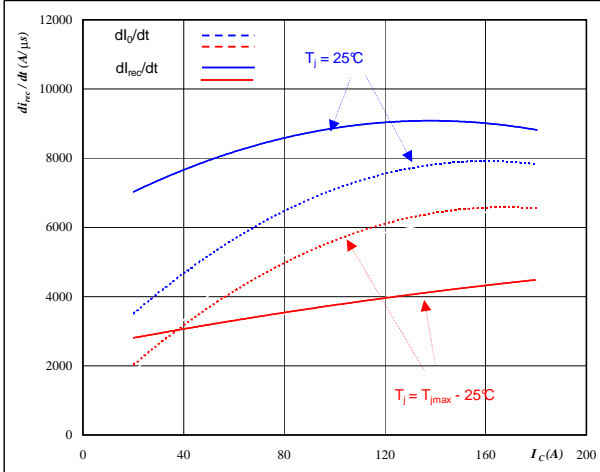


Inverter

Figure 17 Inverter FRED

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

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

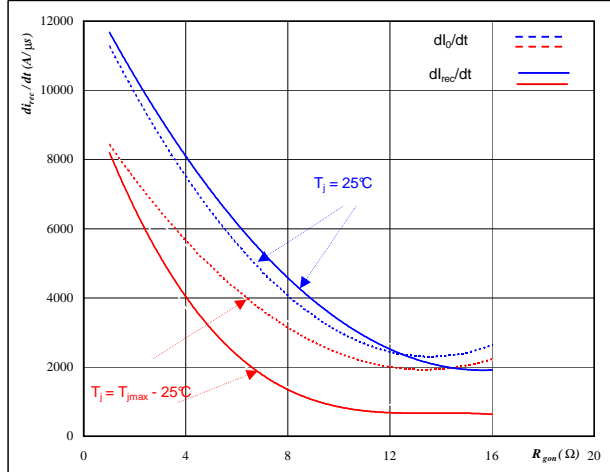


At
 $T_j = 25/150 \text{ } ^\circ\text{C}$
 $V_{CE} = 600 \text{ V}$
 $V_{GE} = \pm 15 \text{ V}$
 $R_{gon} = 4 \text{ } \Omega$

Figure 18 Inverter FRED

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

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

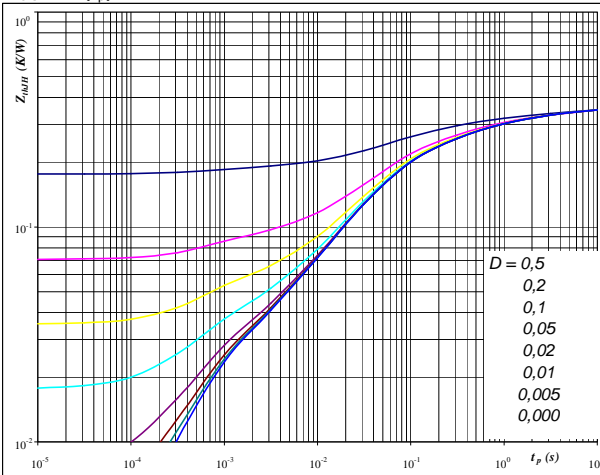


At
 $T_j = 25/150 \text{ } ^\circ\text{C}$
 $V_R = 600 \text{ V}$
 $I_F = 100 \text{ A}$
 $V_{GE} = \pm 15 \text{ V}$

Figure 19 Inverter IGBT

IGBT transient thermal impedance as a function of pulse width

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



At
 $D = t_p / T$
 $R_{thJH} = 0,35 \text{ K/W}$

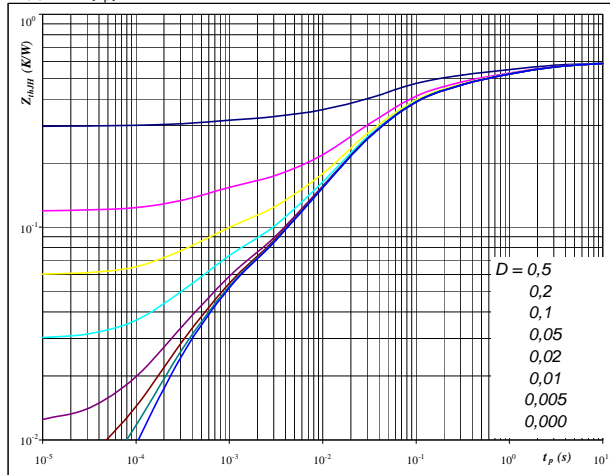
IGBT thermal model values

R (C/W)	Tau (s)
0,06	3,1E+00
0,09	4,1E-01
0,14	6,1E-02
0,05	1,2E-02
0,02	7,0E-04

Figure 20 Inverter FRED

FRED transient thermal impedance as a function of pulse width

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



At
 $D = t_p / T$
 $R_{thJH} = 0,60 \text{ K/W}$

FRED thermal model values

R (C/W)	Tau (s)
0,03	9,1E+00
0,10	1,3E+00
0,14	1,7E-01
0,25	3,1E-02
0,04	4,4E-03
0,04	4,5E-04

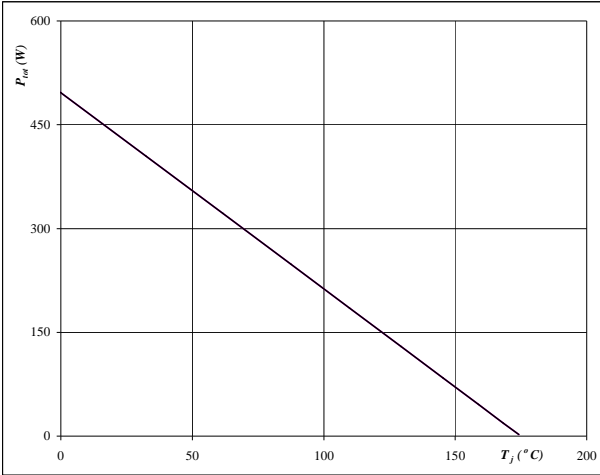


Inverter

Figure 21 Inverter IGBT

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_j)$

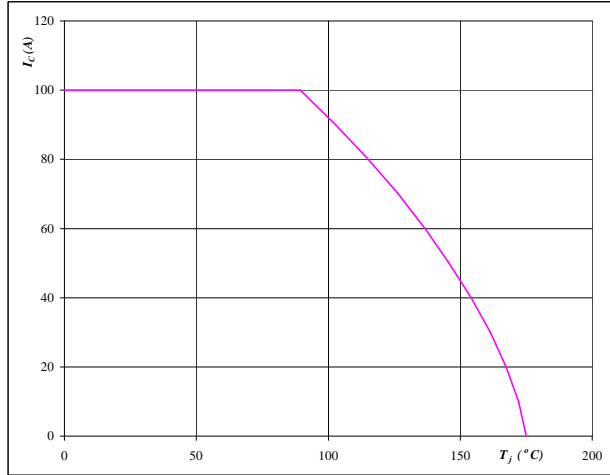


At
T_j = 175 °C

Figure 22 Inverter IGBT

Collector current as a function of heatsink temperature

$I_C = f(T_j)$

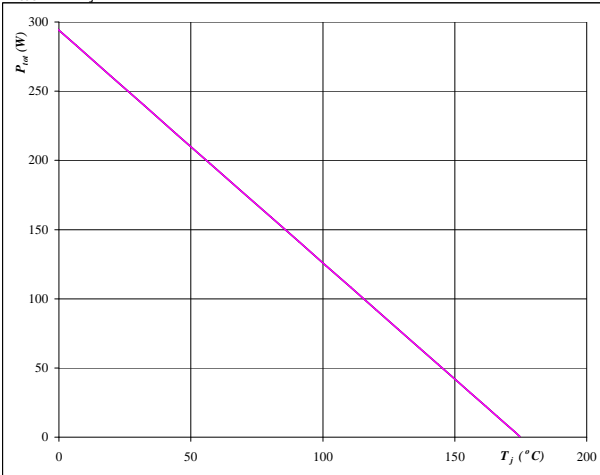


At
T_j = 175 °C
V_{GE} = 15 V

Figure 23 Inverter FRED

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_j)$

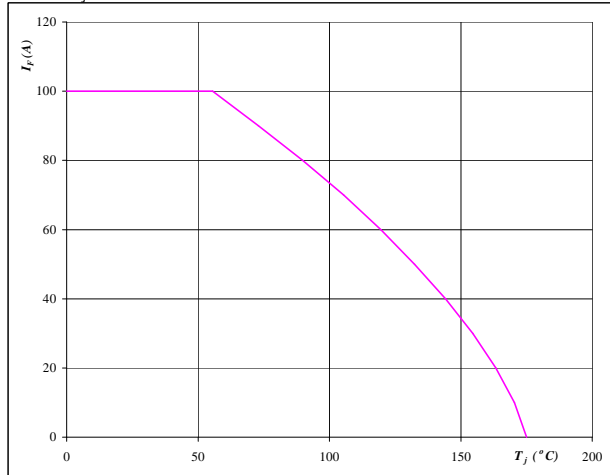


At
T_j = 175 °C

Figure 24 Inverter FRED

Forward current as a function of heatsink temperature

$I_F = f(T_j)$



At
T_j = 175 °C

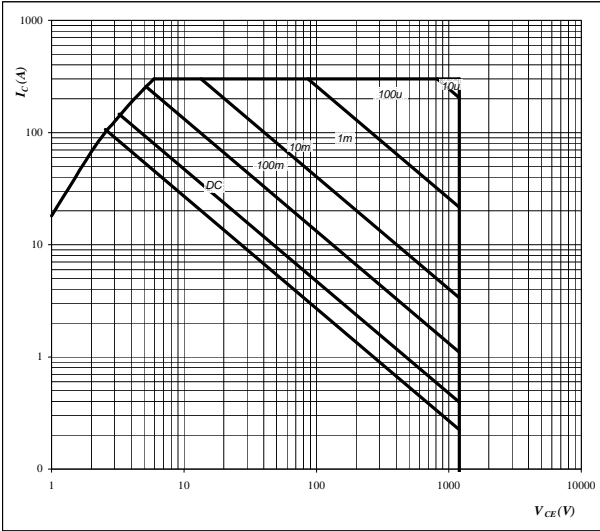


Inverter

Figure 25 Inverter IGBT

Safe operating area as a function of collector-emitter voltage

$I_C = f(V_{CE})$

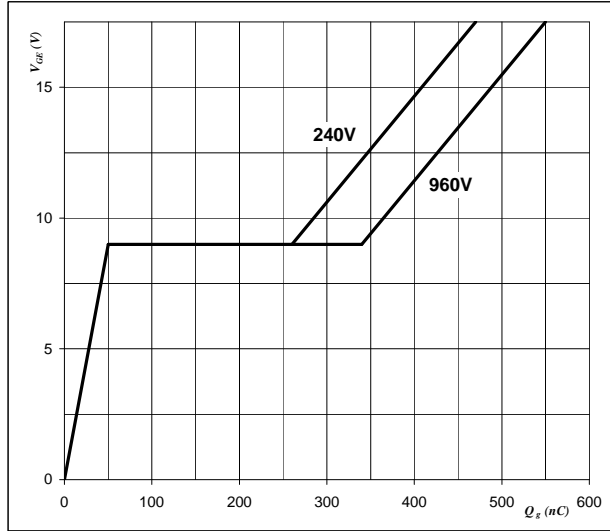


At
 D = single pulse
 Th = 80 °C
 V_{GE} = ±15 V
 T_j = T_{jmax}

Figure 26 Inverter IGBT

Gate voltage vs Gate charge

$V_{GE} = f(Q_g)$



At
 I_C = 100 A



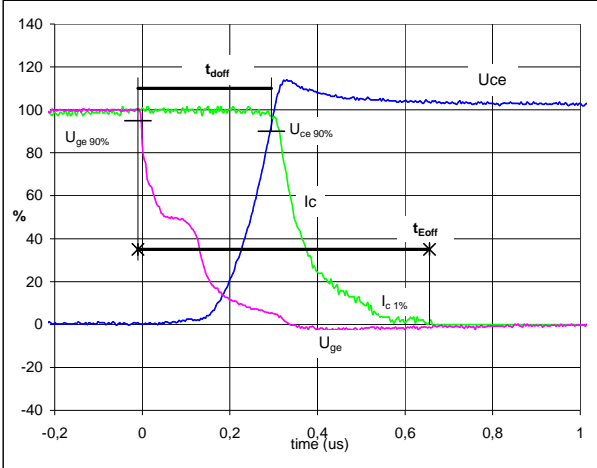
Switching Definitions Inverter

General conditions

T_j	=	150 °C
R_{gon}	=	4 Ω
R_{goff}	=	4 Ω

Figure 1 Inverter IGBT

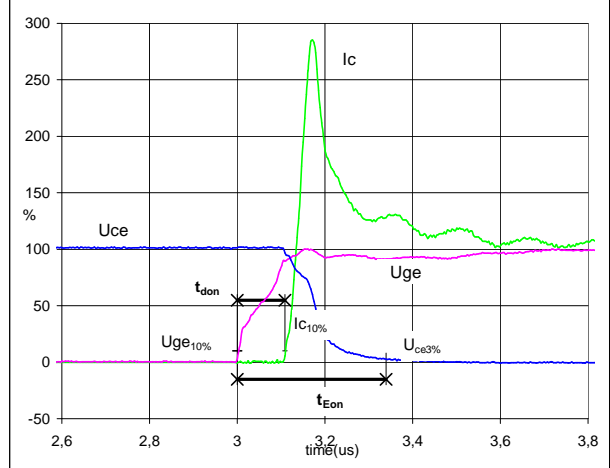
Turn-off Switching Waveforms & definition of t_{doff} , t_{Eoff}
(t_{Eoff} = integrating time for E_{off})



$V_{GE} (0\%) =$	-15	V
$V_{GE} (100\%) =$	15	V
$V_C (100\%) =$	600	V
$I_C (100\%) =$	100	A
$t_{doff} =$	0,29	μs
$t_{Eoff} =$	0,67	μs

Figure 2 Inverter IGBT

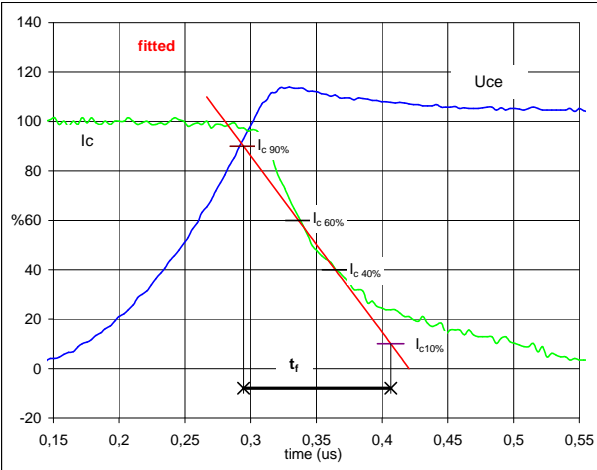
Turn-on Switching Waveforms & definition of t_{don} , t_{Eon}
(t_{Eon} = integrating time for E_{on})



$V_{GE} (0\%) =$	-15	V
$V_{GE} (100\%) =$	15	V
$V_C (100\%) =$	600	V
$I_C (100\%) =$	100	A
$t_{don} =$	0,11	μs
$t_{Eon} =$	0,34	μs

Figure 3 Inverter IGBT

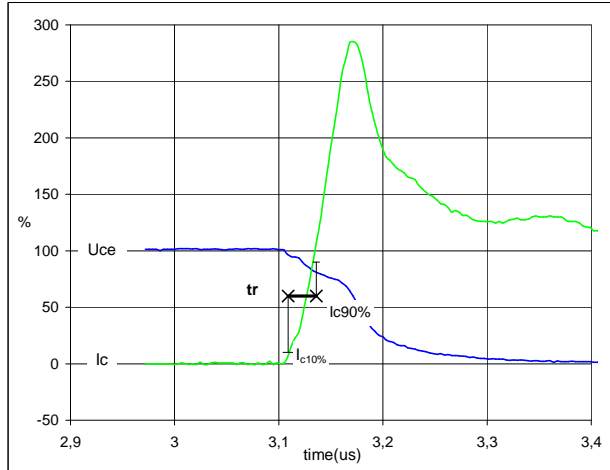
Turn-off Switching Waveforms & definition of t_f



$V_C (100\%) =$	600	V
$I_C (100\%) =$	100	A
$t_f =$	0,11	μs

Figure 4 Inverter IGBT

Turn-on Switching Waveforms & definition of t_r



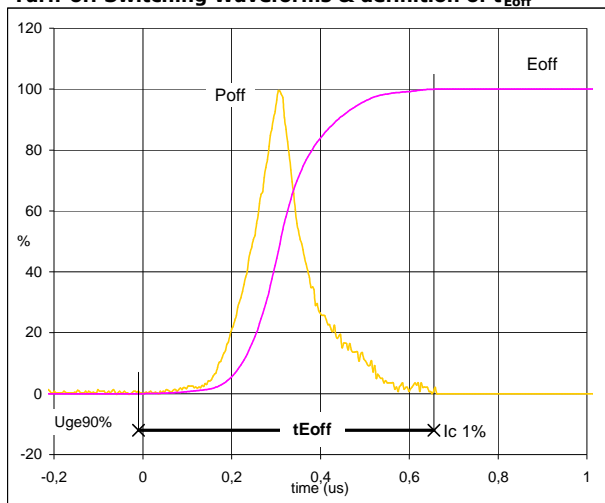
$V_C (100\%) =$	600	V
$I_C (100\%) =$	100	A
$t_r =$	0,02	μs



Switching Definitions Inverter

Figure 5 Inverter IGBT

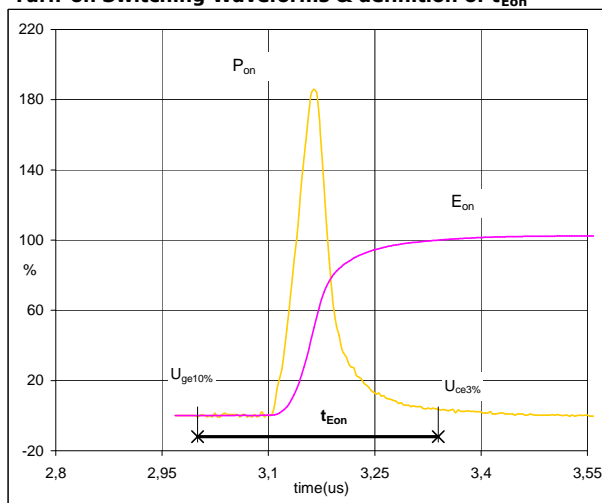
Turn-off Switching Waveforms & definition of t_{Eoff}



$P_{off} (100\%) = 60,25 \text{ kW}$
 $E_{off} (100\%) = 8,77 \text{ mJ}$
 $t_{Eoff} = 0,67 \text{ } \mu\text{s}$

Figure 6 Inverter IGBT

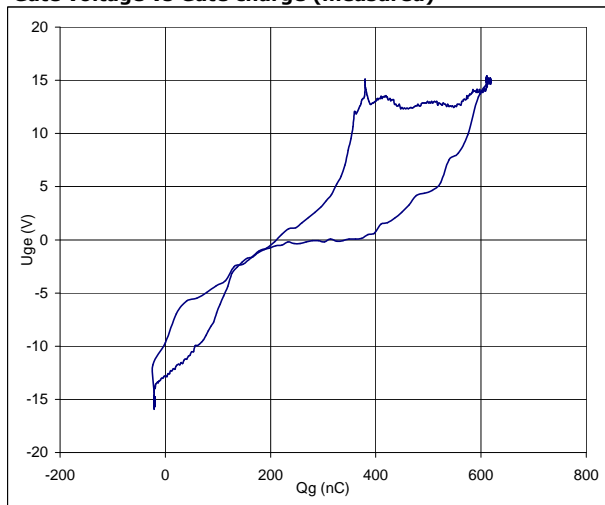
Turn-on Switching Waveforms & definition of t_{Eon}



$P_{on} (100\%) = 60,25 \text{ kW}$
 $E_{on} (100\%) = 6,73 \text{ mJ}$
 $t_{Eon} = 0,34 \text{ } \mu\text{s}$

Figure 7 Inverter FRED

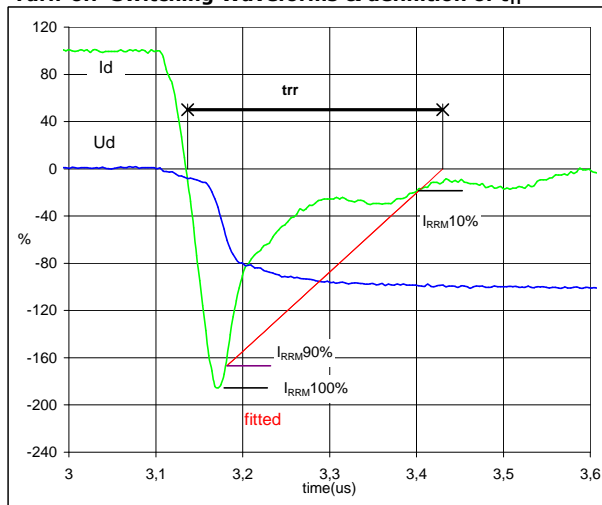
Gate voltage vs Gate charge (measured)



$V_{GEoff} = -15 \text{ V}$
 $V_{GEon} = 15 \text{ V}$
 $V_C (100\%) = 600 \text{ V}$
 $I_C (100\%) = 100 \text{ A}$
 $Q_g = 4658,95 \text{ nC}$

Figure 8 Inverter IGBT

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



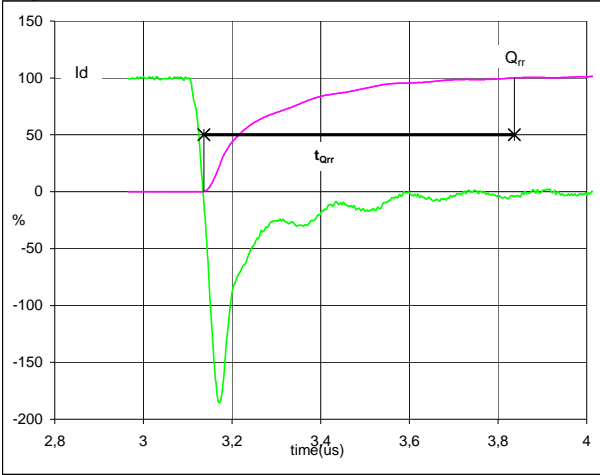
$V_d (100\%) = 600 \text{ V}$
 $I_d (100\%) = 100 \text{ A}$
 $I_{RRM} (100\%) = -187 \text{ A}$
 $t_{rr} = 0,29 \text{ } \mu\text{s}$



Switching Definitions Inverter

Figure 9 Inverter FRED

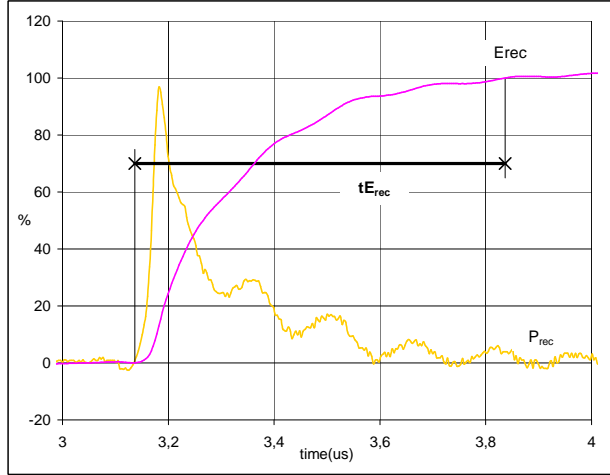
Turn-on Switching Waveforms & definition of t_{Qrr}
(t_{Qrr} = integrating time for Q_{rr})



I_d (100%) =	100	A
Q_{rr} (100%) =	18,66	μC
t_{Qrr} =	0,70	μs

Figure 10 Inverter FRED

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

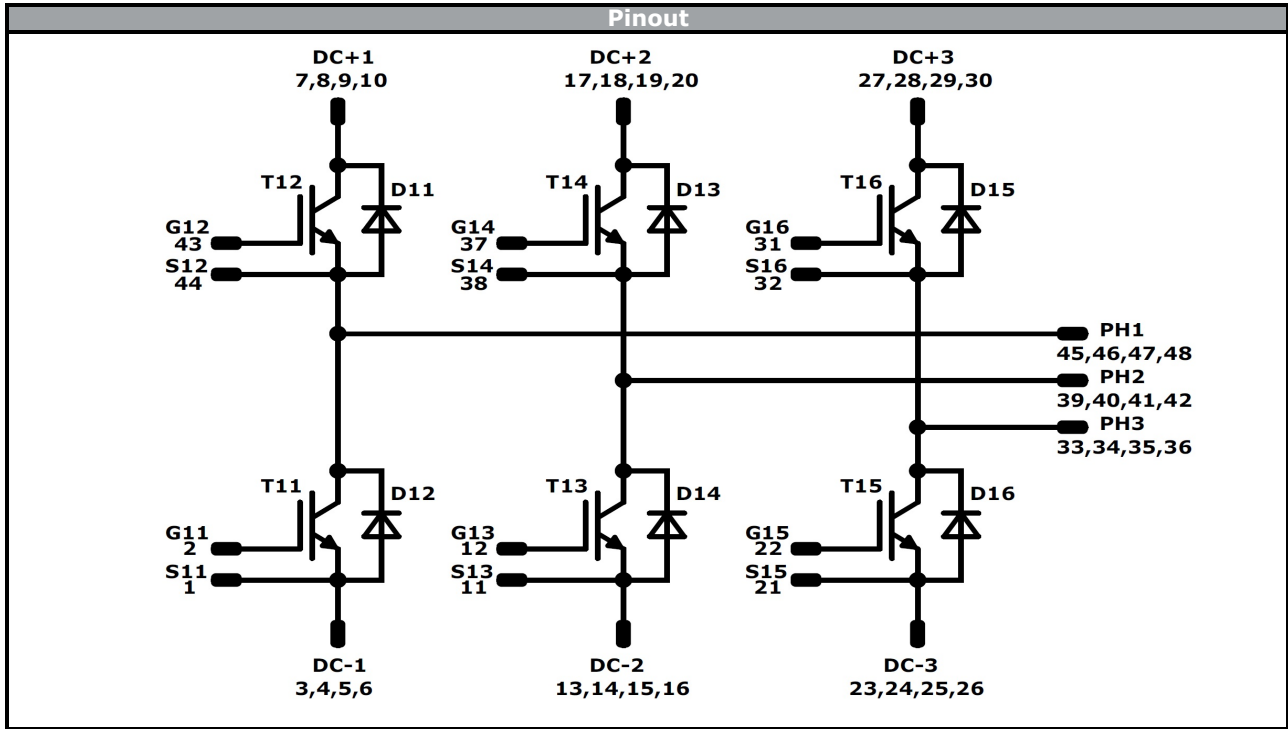


P_{rec} (100%) =	60,25	kW
E_{rec} (100%) =	7,96	mJ
t_{Erec} =	0,70	μs



Ordering Code & Marking						
Version			Ordering Code			
without thermal paste 17mm housing			V23990-P689-F			
with thermal paste 17mm housing			V23990-P689-F-/3/			
			Text	VIN	Date code	Name&Ver
				VIN	WWYY	NNNNNNVV
			Datamatrix	Type&Ver	Lot number	Serial
				TTTTTTTV	LLLLL	SSSS
					UL	Lot
					UL	LLLLL
					Date code	Serial
					WWYY	SSSS

Outline								
Pin table [mm]				Pin table [mm]				<p>Tolerance of positions: ±0.05mm of the end of pin Direction of coordinate axis is only effect without tolerance</p>
Pin	X	Y	Function	Pin	X	Y	Function	
1	1,2	0	S11	25	57,2	0	DC-3	
2	1,2	2,7	G11	26	57,2	2,7	DC-3	
3	3,9	0	DC-1	27	65,8	0	DC+3	
4	3,9	2,7	DC-1	28	65,8	2,7	DC+3	
5	6,6	0	DC-1	29	68,5	0	DC+3	
6	6,6	2,7	DC-1	30	68,5	2,7	DC+3	
7	15,2	0	DC+1	31	64,1	36	G16	
8	15,2	2,7	DC+1	32	61,4	36	S16	
9	17,9	0	DC+1	33	58,7	36	Ph3	
10	17,9	2,7	DC+1	34	56	36	Ph3	
11	26,5	0	S13	35	53,3	36	Ph3	
12	26,5	2,7	G13	36	50,6	36	Ph3	
13	29,2	0	DC-2	37	38,8	36	G14	
14	29,2	2,7	DC-2	38	36,1	36	S14	
15	31,9	0	DC-2	39	33,4	36	Ph2	
16	31,9	2,7	DC-2	40	30,7	36	Ph2	
17	40,5	0	DC+2	41	28	36	Ph2	
18	40,5	2,7	DC+2	42	25,3	36	Ph2	
19	43,2	0	DC+2	43	13,5	36	G12	
20	43,2	2,7	DC+2	44	10,8	36	S12	
21	51,8	0	S15	45	8,1	36	Ph1	
22	51,8	2,7	G15	46	5,4	36	Ph1	
23	54,5	0	DC-3	47	2,7	36	Ph1	
24	54,5	2,7	DC-3	48	0	36	Ph1	



Identification					
ID	Component	Voltage	Current	Function	Comment
T11 - T16	IGBT	1200	100	Inverter Switch	
D11 - D16	FWD	1200	100	Inverter Diode	

**Packaging instruction**

Standard packaging quantity (SPQ)	36	>SPQ	Standard	<SPQ	Sample
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Handling instruction

Handling instructions for *flow 2* packages see vincotech.com website.

Package data

Package data for *flow 2* packages see vincotech.com website.

UL recognition and file number

This device is certified according to UL 1557 standard, UL file number E192116. For more information see vincotech.com website.



Document No.:	Date:	Modification:	Pages
V23990-P689-F-D3-14	07 Mar. 2019	flow2 frame modification	1,14

Product status definition**DISCLAIMER**

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2. A critical component is any component of a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.