***flow* PACK 2**	**1200V/100A**

Features

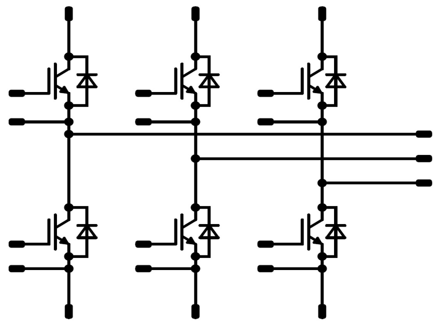
- High power flow2 housing
- Trench Fieldstop Technology IGBT4
- Compact and low inductive design

flow 2 17mm housing

Target Applications

- Motor Drive
- Power Generation
- UPS

Schematic



Types

- V23990-P689-F

Maximum Ratings

T_j = 25 °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 °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 °C	270	W
Gate-emitter peak voltage	V_{GE}		±20	V
Short circuit ratings	t_{SC} V_{CC}	T_j ≤ 150 °C V_{GE} = 15 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 °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 °C	160	W
Maximum Junction Temperature	T_{jmax}		175	°C

Maximum Ratings

T_j = 25 °C, unless otherwise specified

Parameter	Symbol	Condition		Value	Unit
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 s	4000	V
		AC Voltage	t_p = 1 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

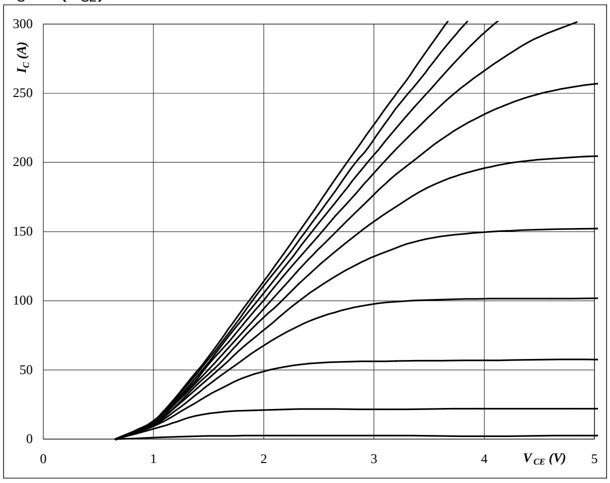
Parameter	Symbol	Conditions					Value			Unit
			V_{GE} [V] V_{GS} [V]	V_r [V] V_{CE} [V] V_{DS} [V]	I_C [A] I_F [A] I_D [A]	T_j [°C]	Min	Typ	Max	
Inverter Switch										
Gate emitter threshold voltage	$V_{GE(th)}$	$V_{CE} = V_{GE}$			0,0034	25	5	5,8	6,5	V
Collector-emitter saturation voltage	V_{CEsat}		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	$t_{d(on)}$	R_{goff} = 8 Ω R_{gon} = 8 Ω	±15	600	100	25 150		104 108		ns
Rise time	t_r					25 150		18 23		
Turn-off delay time	$t_{d(off)}$					25 150		219 293		
Fall time	t_f					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}	f = 1 MHz	0	25		25		5540		pF
Output capacitance	C_{oss}							410		
Reverse transfer capacitance	C_{rss}							320		
Gate charge	Q_G	Vcc=960	±15		100	25		480		nC
Thermal resistance chip to heatsink per chip	$R_{th(j-s)}$	Thermal grease thickness ≤ 50um λ = 1 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}	R_{gon} = 8 Ω	±15	600	100	25 150		164 187		A
Reverse recovery time	t_{rr}					25 150		130 294		ns
Reverse recovered charge	Q_{rr}					25 150		9,32 18,66		μC
Peak rate of fall of recovery current	$(di_{rf}/dt)_{max}$					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 ≤ 50um λ = 1 W/mK						0,60		K/W

Inverter

Figure 1 Inverter IGBT

Typical output characteristics

$I_C = f(V_{CE})$



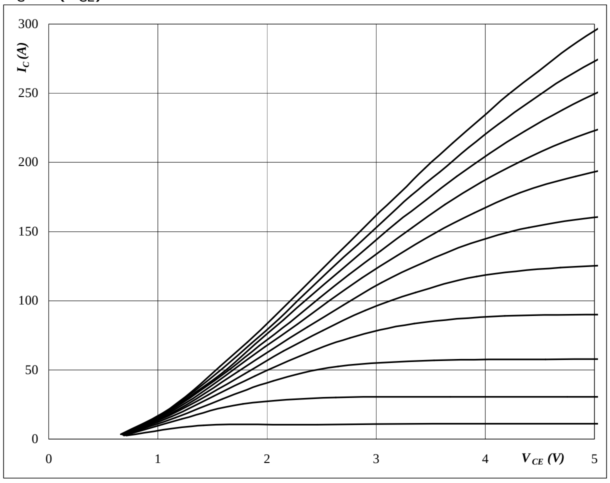
At

t_p =	250	μs
T_j =	25	°C
V_{GE} from	7 V to 17 V in steps of 1 V	

Figure 2 Inverter IGBT

Typical output characteristics

$I_C = f(V_{CE})$



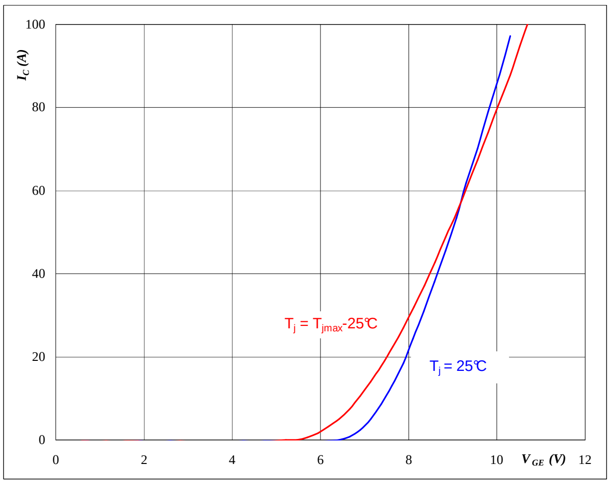
At

t_p =	250	μs
T_j =	150	°C
V_{GE} from	7 V to 17 V in steps of 1 V	

Figure 3 Inverter IGBT

Typical transfer characteristics

$I_C = f(V_{GE})$



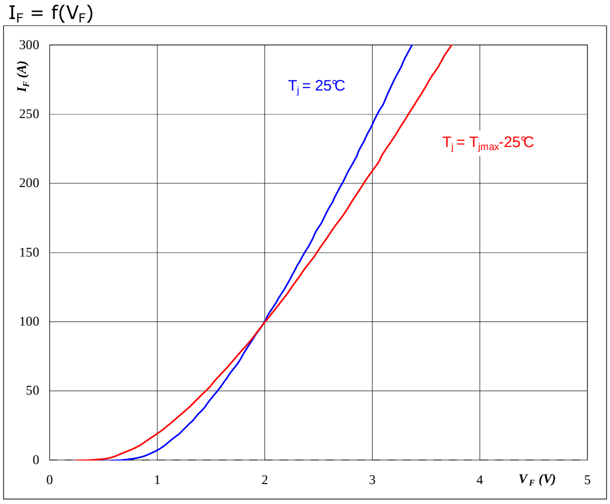
At

t_p =	250	μs
V_{CE} =	10	V

Figure 4 Inverter FRED

Typical diode forward current as a function of forward voltage

$I_F = f(V_F)$



At

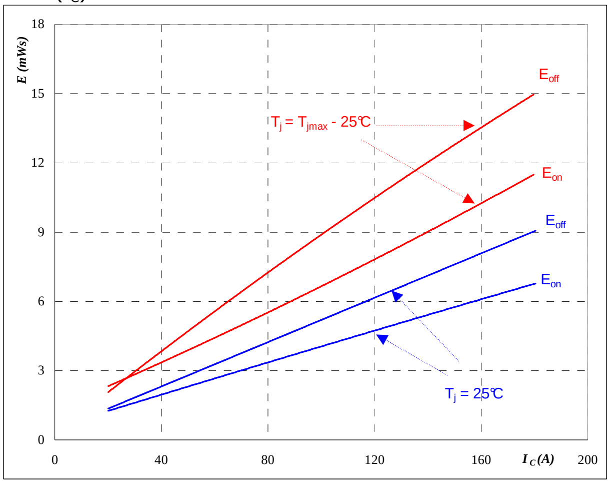
t_p =	250	μs

Inverter

Figure 5 Inverter IGBT

Typical switching energy losses as a function of collector current

$E = f(I_C)$



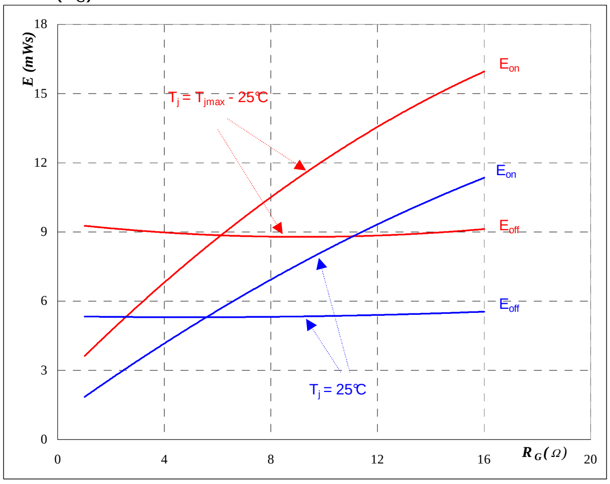
With an inductive load at

T_j =	25/150	°C
V_{CE} =	600	V
V_{GE} =	±15	V
R_{gon} =	4	Ω
R_{goff} =	4	Ω

Figure 6 Inverter IGBT

Typical switching energy losses as a function of gate resistor

$E = f(R_G)$



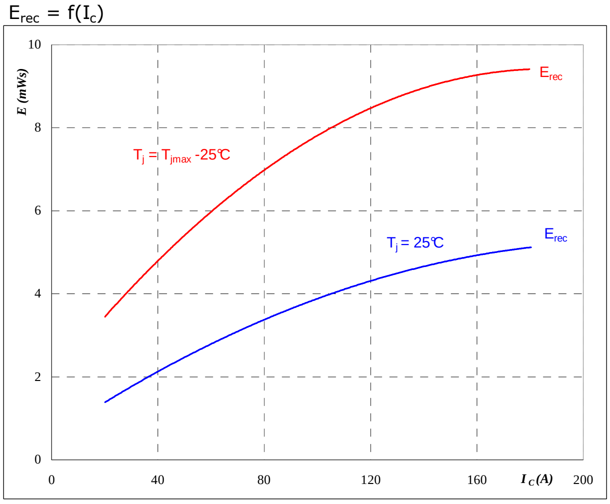
With an inductive load at

T_j =	25/150	°C
V_{CE} =	600	V
V_{GE} =	±15	V
I_C =	100	A

Figure 7 Inverter IGBT

Typical reverse recovery energy loss as a function of collector current

$E_{rec} = f(I_c)$



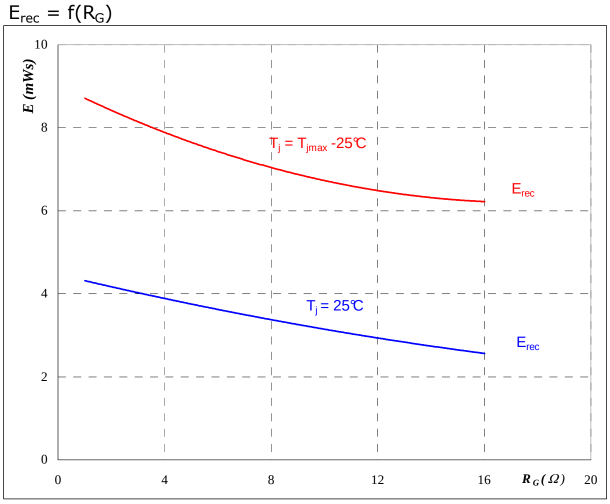
With an inductive load at

T_j =	25/150	°C
V_{CE} =	600	V
V_{GE} =	±15	V
R_{gon} =	4	Ω

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

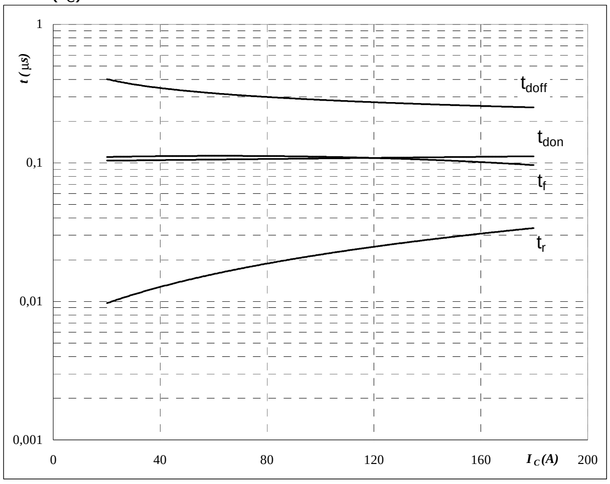
T_j =	25/150	°C
V_{CE} =	600	V
V_{GE} =	±15	V
I_C =	100	A

Inverter

Figure 9 Inverter IGBT

Typical switching times as a function of collector current

t = f(I_C)



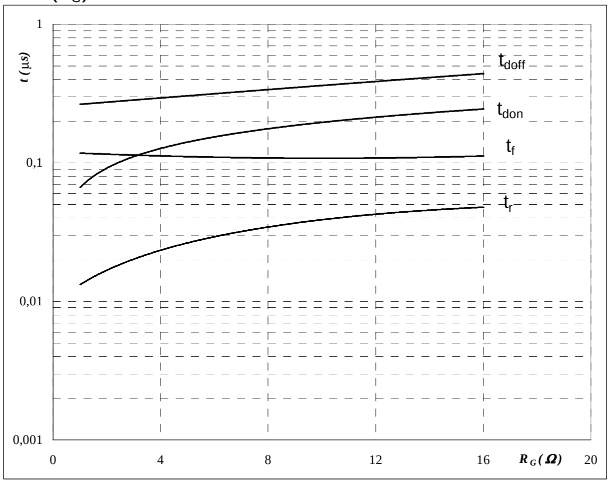
With an inductive load at

T_j =	150	°C
V_{CE} =	600	V
V_{GE} =	±15	V
R_{gon} =	4	Ω
R_{goff} =	4	Ω

Figure 10 Inverter IGBT

Typical switching times as a function of gate resistor

t = f(R_G)



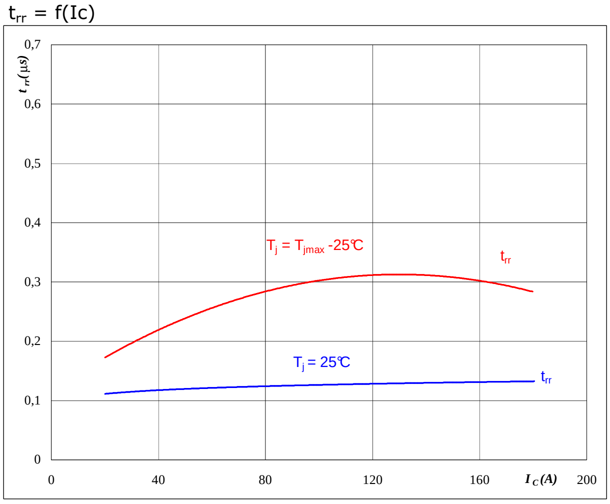
With an inductive load at

T_j =	150	°C
V_{CE} =	600	V
V_{GE} =	±15	V
I_C =	100	A

Figure 11 Inverter FRED

Typical reverse recovery time as a function of collector current

t_{rr} = f(Ic)



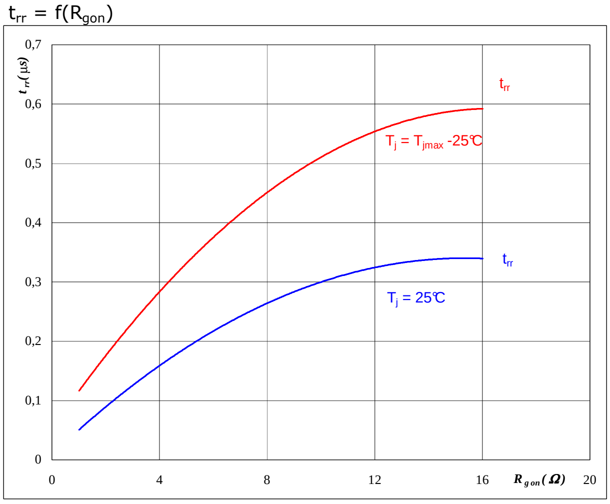
At

T_j =	25/150	°C
V_{CE} =	600	V
V_{GE} =	±15	V
R_{gon} =	4	Ω

Figure 12 Inverter FRED

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

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



At

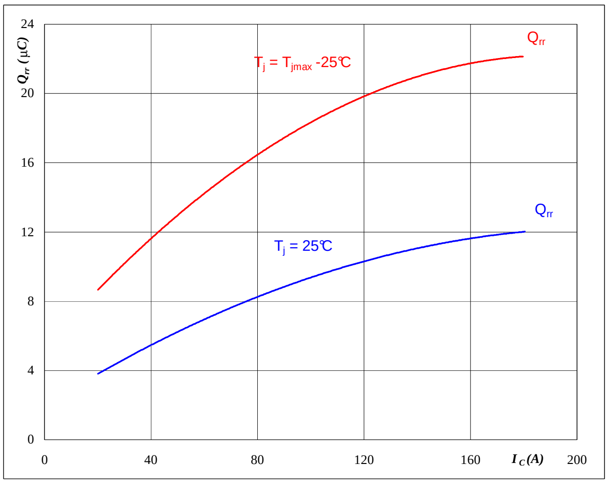
T_j =	25/150	°C
V_R =	600	V
I_F =	100	A
V_{GE} =	±15	V

Inverter

Figure 13	Inverter FRED

Typical reverse recovery charge as a function of collector current

$Q_{rr} = f(I_C)$



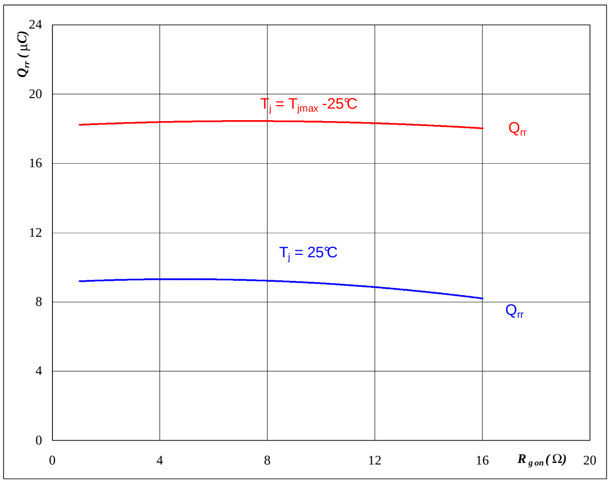
At

T_j =	25/150	°C
V_{CE} =	600	V
V_{GE} =	±15	V
R_{gon} =	4	Ω

Figure 14	Inverter FRED

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

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



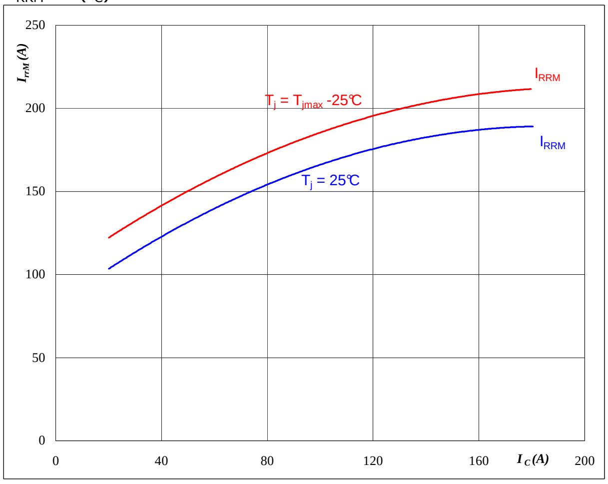
At

T_j =	25/150	°C
V_R =	600	V
I_F =	100	A
V_{GE} =	±15	V

Figure 15	Inverter FRED

Typical reverse recovery current as a function of collector current

$I_{RRM} = f(I_C)$



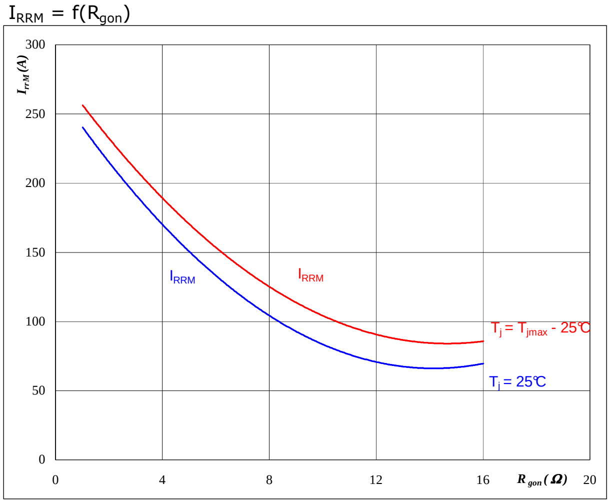
At

T_j =	25/150	°C
V_{CE} =	600	V
V_{GE} =	±15	V
R_{gon} =	4	Ω

Figure 16	Inverter FRED

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

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



At

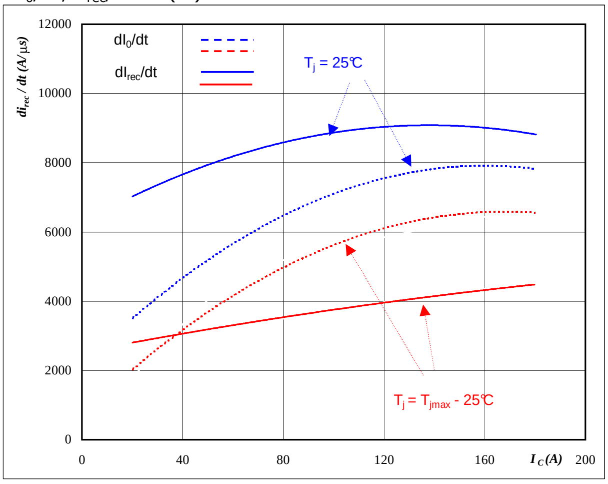
T_j =	25/150	°C
V_R =	600	V
I_F =	100	A
V_{GE} =	±15	V

Inverter

Figure 17 Inverter FRED

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

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



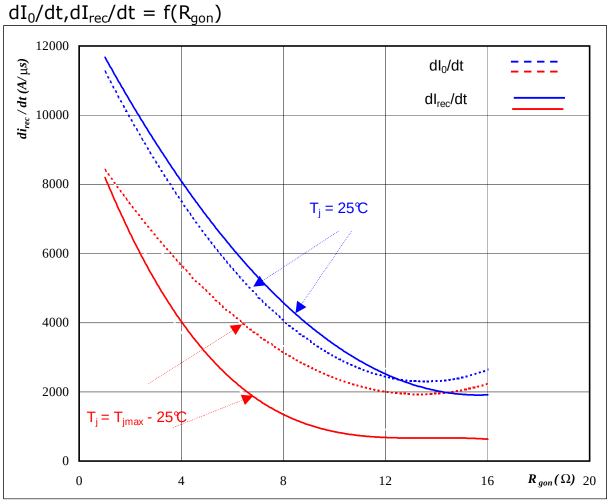
At

T_j =	25/150	°C
V_{CE} =	600	V
V_{GE} =	±15	V
R_{gon} =	4	Ω

Figure 18 Inverter FRED

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

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



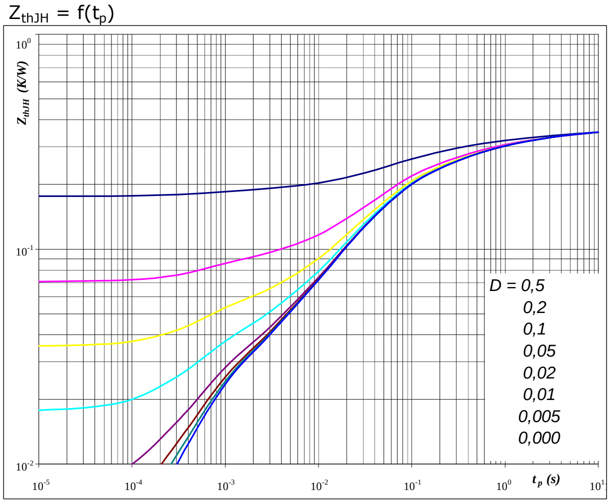
At

T_j =	25/150	°C
V_R =	600	V
I_F =	100	A
V_{GE} =	±15	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	K/W

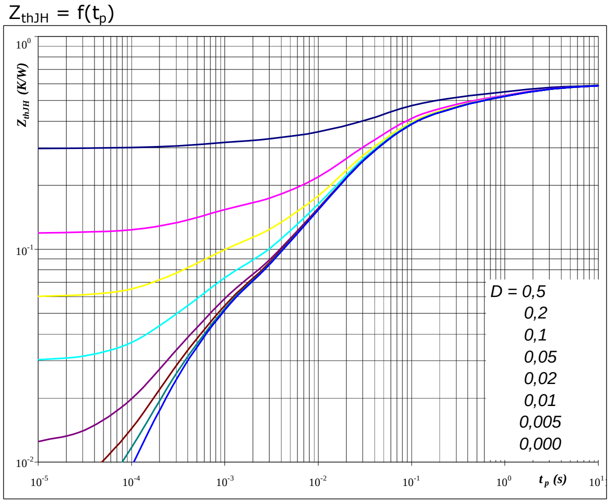
IGBT thermal model values

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	K/W

FRED thermal model values

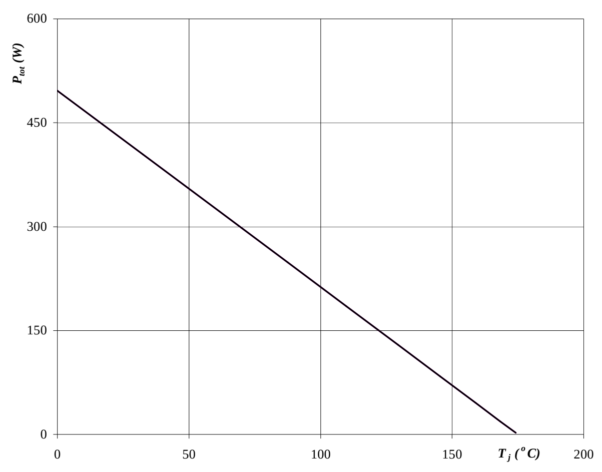
R (C/W)	Tau (s)
0,03	9,1E+00
0,10	1,3E+00
0,14	1,7E-01
0,25	3,1E-02
0,04	4,4E-03
0,04	4,5E-04

Inverter

Figure 21	Inverter IGBT

Power dissipation as a function of heatsink temperature

$P_{tot} = f(Tj)$



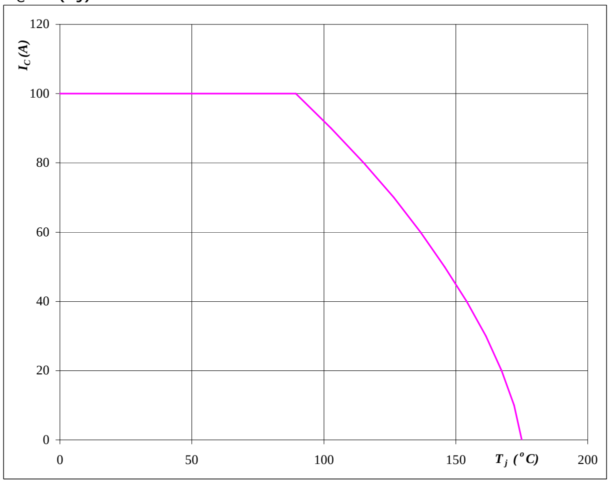
At

T_j =	175	°C

Figure 22	Inverter IGBT

Collector current as a function of heatsink temperature

$I_C = f(Tj)$



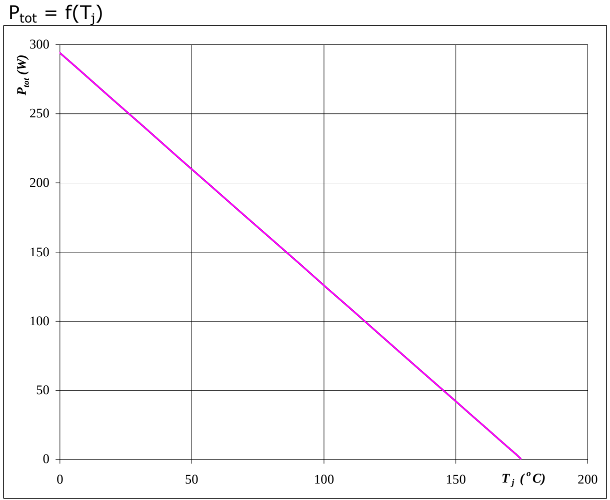
At

T_j =	175	°C
V_{GE} =	15	V

Figure 23	Inverter FRED

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_j)$



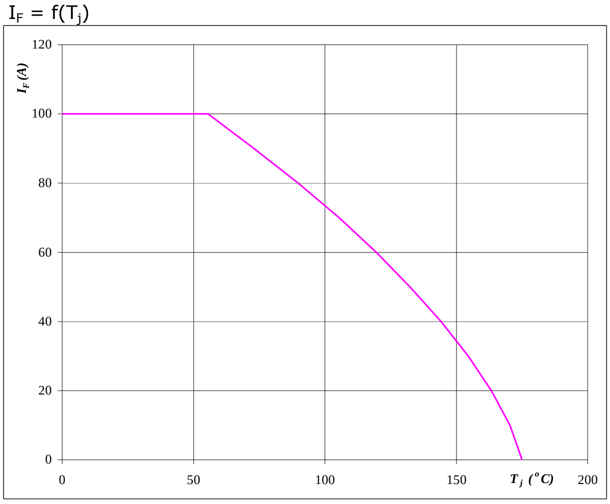
At

T_j =	175	°C

Figure 24	Inverter FRED

Forward current as a function of heatsink temperature

$I_F = f(T_j)$



At

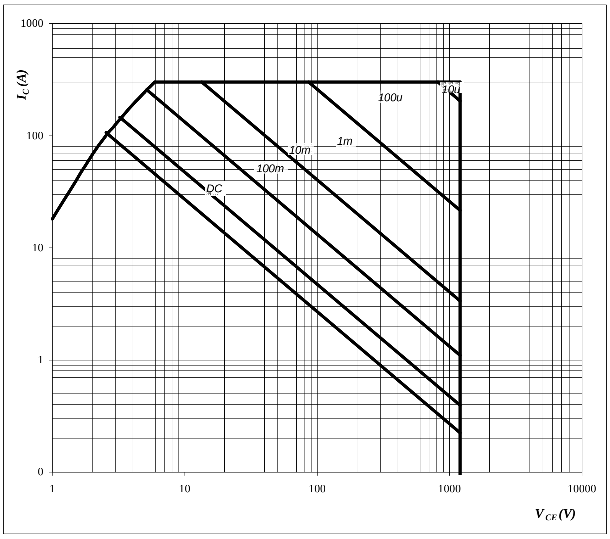
T_j =	175	°C

Inverter

Figure 25	Inverter IGBT

Safe operating area as a function of collector-emitter voltage

$I_C = f(V_{CE})$



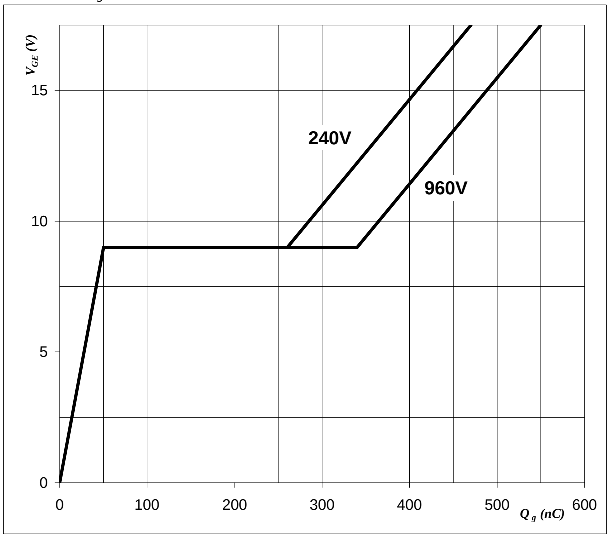
At

D =	single pulse	
Th =	80	ºC
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

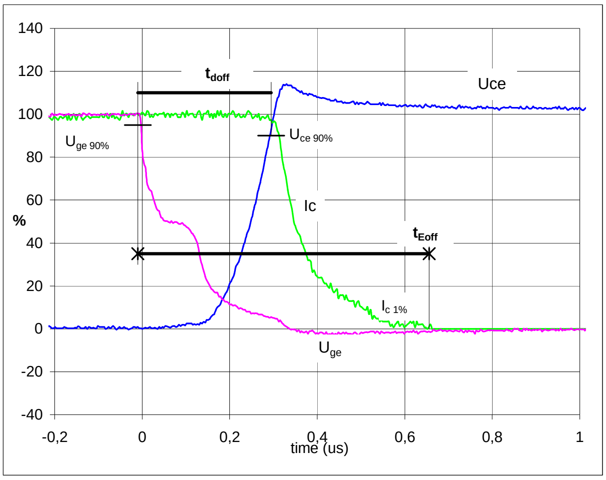
Switching Definitions Inverter

General conditions

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

Figure 1 Inverter IGBT

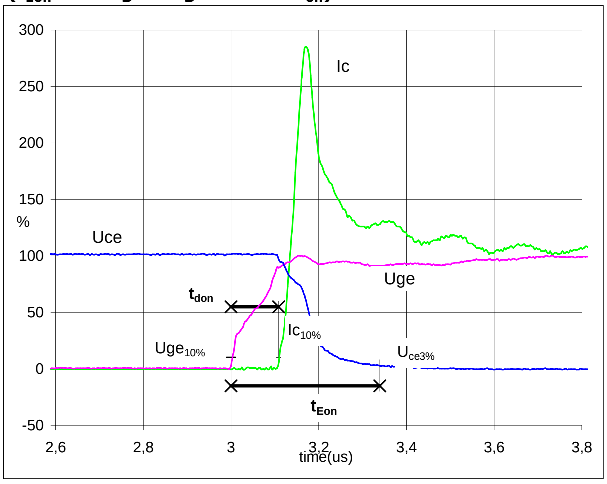
Turn-off Switching Waveforms & definition of tdoff, tEoff
(t_{Eoff} = integrating time for E_{off})



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

Figure 2 Inverter IGBT

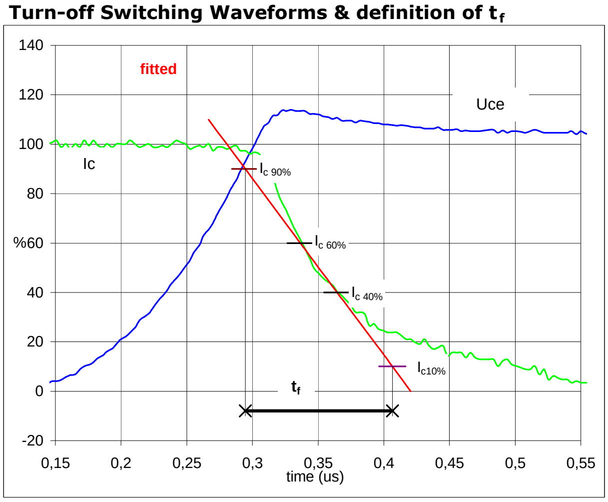
Turn-on Switching Waveforms & definition of tdon, tEon
(t_{Eon} = integrating time for E_{on})



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

Figure 3 Inverter IGBT

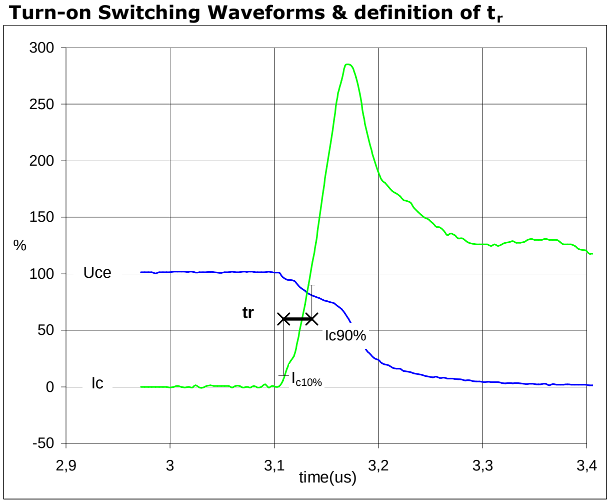
Turn-off Switching Waveforms & definition of t_f



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

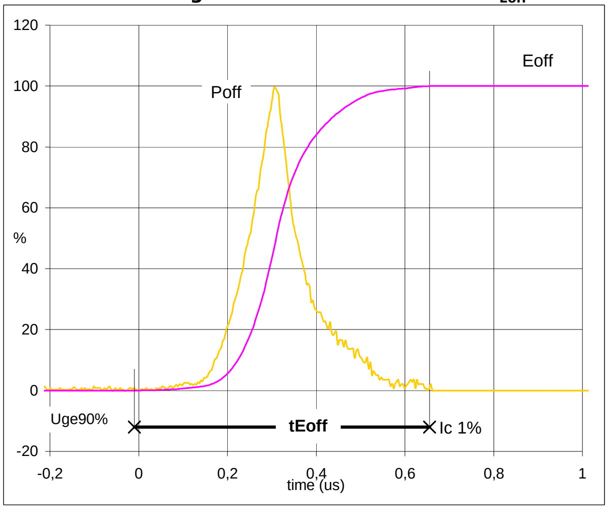


V_C (100%) =	600	V
I_C (100%) =	100	A
t_r =	0,02	μs

Switching Definitions Inverter

Figure 5 Inverter IGBT

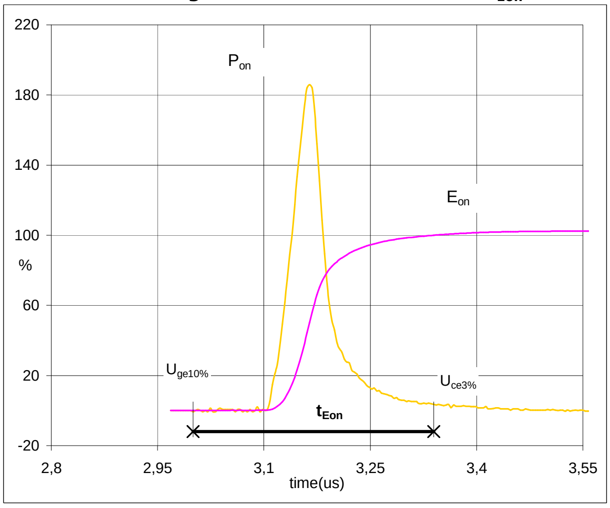
Turn-off Switching Waveforms & definition of t_{Eoff}



P_{off} (100%) =	60,25	kW
E_{off} (100%) =	8,77	mJ
t_{Eoff} =	0,67	μs

Figure 6 Inverter IGBT

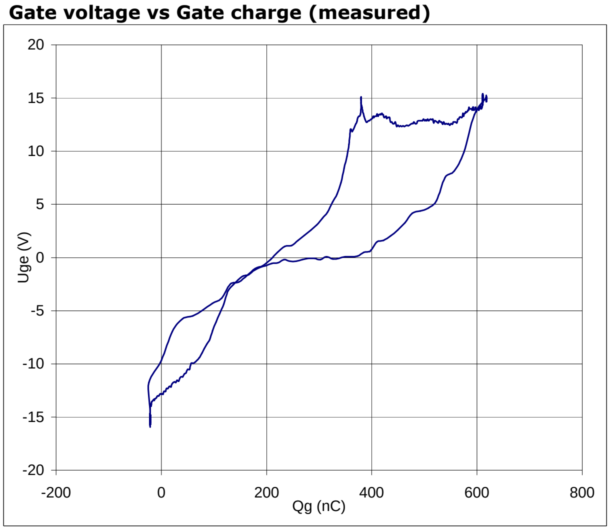
Turn-on Switching Waveforms & definition of t_{Eon}



P_{on} (100%) =	60,25	kW
E_{on} (100%) =	6,73	mJ
t_{Eon} =	0,34	μs

Figure 7 Inverter FRED

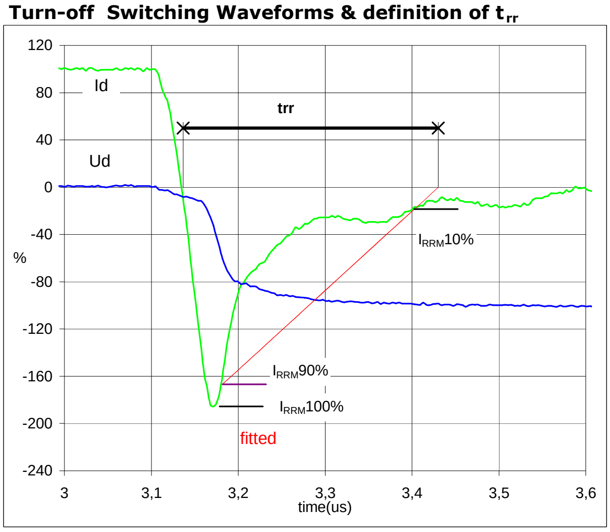
Gate voltage vs Gate charge (measured)



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

Figure 8 Inverter IGBT

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

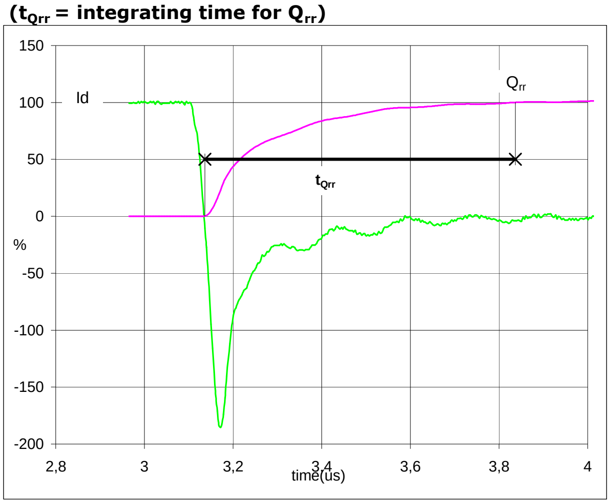


V_d (100%) =	600	V
I_d (100%) =	100	A
I_{RRM} (100%) =	-187	A
t_{rr} =	0,29	μs

Switching Definitions Inverter

Figure 9 Inverter FRED

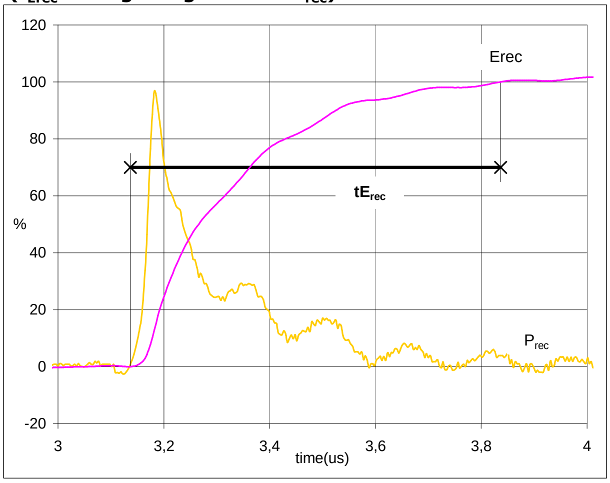
Turn-on Switching Waveforms & definition of t_{Qrr}
(t_{Qrr} = integrating time for Q_{rr})



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

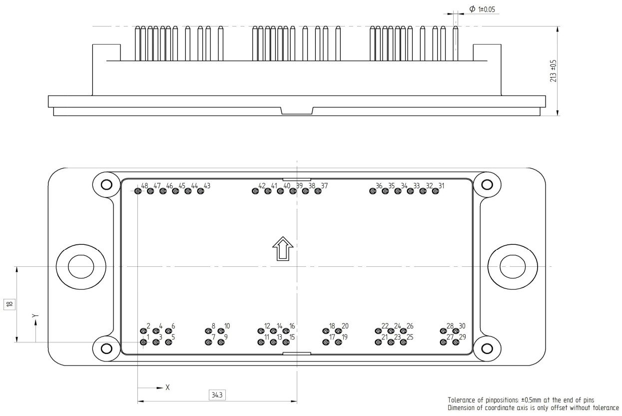
Ordering Code & Marking

Version	Ordering Code
without thermal paste 17mm housing	V23990-P689-F
with thermal paste 17mm housing	V23990-P689-F-/3/

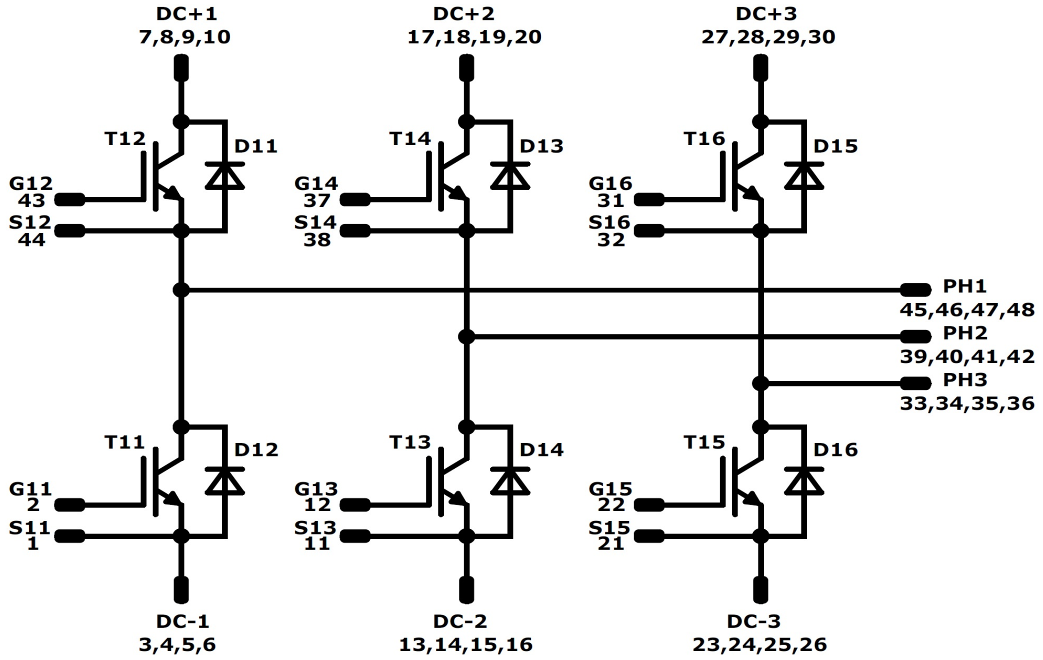
		VIN	Date code	Name&Ver	UL	Lot	Serial
	Text	VIN	WWYY	NNNNNNNVV	UL	LLLLL	SSSS
	Datamatrix	Type&Ver	Lot number	Serial	Date code		
		TTTTTTTVV	LLLLL	SSSS	WWYY		

Outline

Pin table [mm]				Pin table [mm]			
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



Pinout



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

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