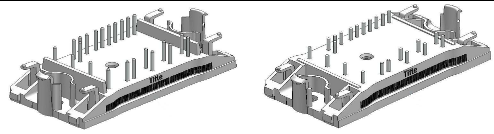
V23990-P864-F49-PM
V23990-P864-F48-PM
datasheet

flow PACK 0 3rd gen — 600 V / 30 A

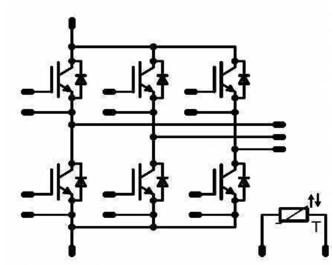
Features
- 2 clip housing in 12mm and 17mm height
- Trench Fieldstop IGBT[3] technology
- Compact and low inductance design
- Built-in NTC

flow 0 housing



Target Applications
- Motor Drives
- Power Generation
- UPS

Schematic



Types
- V23990-P864-F49-PM: 17mm height
- V23990-P864-F48-PM: 12mm height

Maximum Ratings

T_j=25°C, unless otherwise specified

Parameter	Symbol	Condition	Value	Unit
Inverter Transistor				
Collector-emitter voltage	V_{CE}		600	V
DC collector current	I_C	$T_j=T_{jmax}$ $T_h=80°C$	31	A
Repetitive peak collector current	I_{CRM}	t_p limited by T_{jmax}	90	A
Power dissipation	P_{tot}	$T_j=T_{jmax}$ $T_h=80°C$	60	W
Gate-emitter peak voltage	V_{GE}		±20	V
Short circuit ratings*	t_{SC} V_{CC}	$T_j≤150°C$ $V_{GE}=15V$	6 360	µs V
Maximum Junction Temperature	T_{jmax}		175	°C

* It is recommended to not exceed 1000 short circuit situations in the lifetime of the module and to allow at least 1s between short circuits

Parameter	Symbol	Condition	Value	Unit
Inverter Diode				
Peak Repetitive Reverse Voltage	V_{RRM}		600	V
DC forward current	I_F	$T_j=T_{jmax}$ $T_h=80°C$	30	A
Repetitive peak forward current	I_{FRM}	t_p limited by T_{jmax}	60	A
Power dissipation	P_{tot}	$T_j=T_{jmax}$ $T_h=80°C$	46	W
Maximum Junction Temperature	T_{jmax}		175	°C
Thermal properties				
Storage temperature	T_{stg}		-40…..+125	°C
Operation junction temperature	T_{op}		-40…..+Tjmax-25	°C

Maximum Ratings

T_j=25°C, unless otherwise specified

Parameter	Symbol	Condition		Value	Unit
Insulation properties					
Insulation voltage	V_{is}	t=2s	DC voltage	4000	V
Creepage distance				min.12,7	mm
Clearance		12mm height		min.9,22	mm
Clearance		17mm height		min.12,7	mm

Characteristic Values

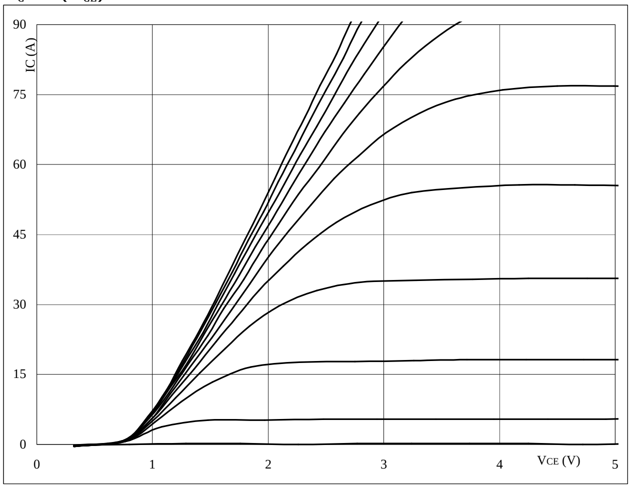
Parameter	Symbol	Conditions	V_{GE} [V] or V_{GS} [V]	V_r [V] or V_{CE} [V] or V_{DS} [V]	I_C [A] or I_F [A] or I_D [A]	T_j	Min	Typ	Max	Unit
Inverter Transistor										
Gate emitter threshold voltage	$V_{GE(th)}$	VCE=VGE			0,00043	Tj=25°C Tj=150°C	5	5,8	6,5	V
Collector-emitter saturation voltage	V_{CEsat}		15		30	Tj=25°C Tj=150°C		1,57 1,79	2,15	V
Collector-emitter cut-off current incl. Diode	I_{CES}		0	600		Tj=25°C Tj=150°C			200	mA
Gate-emitter leakage current	I_{GES}		20	0		Tj=25°C Tj=150°C			350	nA
Integrated Gate resistor	R_{gint}							none		Ω
Turn-on delay time	$t_{d(on)}$	Rgon=16Ω Rgoff=16Ω	±15	300	30	Tj=25°C Tj=150°C		106 104		ns
Rise time	t_r					Tj=25°C Tj=150°C		14 20		
Turn-off delay time	$t_{d(off)}$					Tj=25°C Tj=150°C		146 171		
Fall time	t_f					Tj=25°C Tj=150°C		92 112		
Turn-on energy loss	E_{on}					Tj=25°C Tj=150°C		0,47 0,66		mWs
Turn-off energy loss	E_{off}					Tj=25°C Tj=150°C		0,67 0,91		
Input capacitance	C_{ies}	f=1MHz	0	25		Tj=25°C		1630		pF
Output capacitance	C_{oss}							108		
Reverse transfer capacitance	C_{rss}							50		
Gate charge	Q_G		15	480	30	Tj=25°C		167		nC
Thermal resistance chip to heatsink	$R_{th(jh)}$	Thermal grease thickness≤50um λ = 1 W/mK						1,60		K/W
Inverter Diode										
Diode forward voltage	V_F				30	Tj=25°C Tj=150°C		1,64 1,55	2,2	V
Reverse leakage current	I_R	Rgon=16Ω	±15	300	30	Tj=25°C Tj=150°C			200	mA
Peak reverse recovery current	I_{RRM}					Tj=25°C Tj=150°C		27 34		A
Reverse recovery time	t_{rr}					Tj=25°C Tj=150°C		146 253		ns
Reverse recovered charge	Q_{rr}					Tj=25°C Tj=150°C		1,34 2,65		mC
Peak rate of fall of recovery current	$(di_{rf}/dt)_{max}$					Tj=25°C Tj=150°C		1752 815		A/ms
Reverse recovered energy	E_{rec}					Tj=150°C		0,57		mWs
Thermal resistance chip to heatsink	$R_{th(jh)}$	Thermal grease thickness≤50um λ = 1 W/mK						2,08		K/W
Thermistor										
Rated resistance	R					Tj=25°C		21,5		kΩ
Deviation of R100	$\Delta_{R/R}$	R100=1486 Ω				Tj=100°C	-4,5		4,5	%
Power dissipation	P					Tj=25°C		210		mW
Power dissipation constant						Tj=25°C		3,5		mW/K
B-value	$B_{(25/50)}$					Tj=25°C		3884		K
B-value	$B_{(25/100)}$					Tj=25°C		3964		K
Vincotech NTC Reference									F	

Output Inverter

Figure 1 Output inverter IGBT

Typical output characteristics

$I_C = f(V_{CE})$

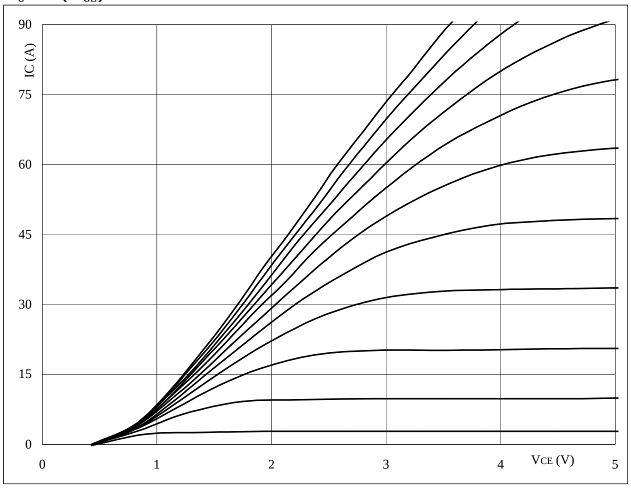


t_p =	250	μs
T_j =	25	°C
V_{GE} from	7 V to 17 V in steps of 1 V	

Figure 2 Output inverter IGBT

Typical output characteristics

$I_C = f(V_{CE})$

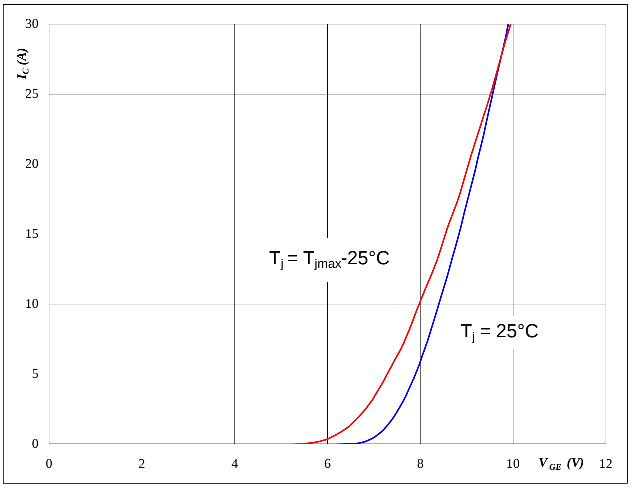


t_p =	250	μs
T_j =	150	°C
V_{GE} from	7 V to 17 V in steps of 1 V	

Figure 3 Output inverter IGBT

Typical transfer characteristics

$I_C = f(V_{GE})$

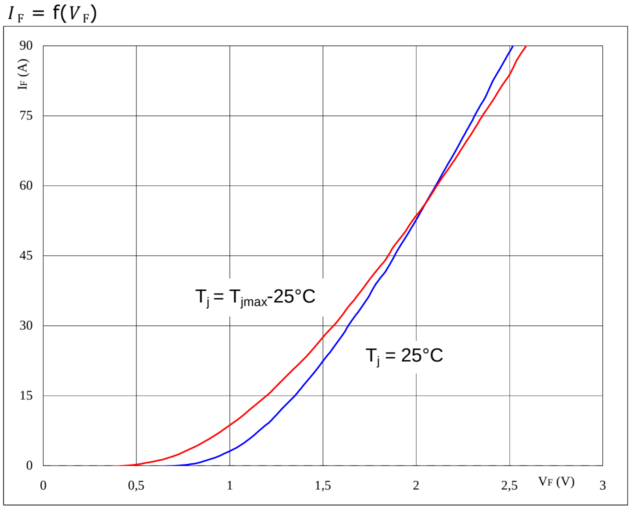


t_p =	250	μs
V_{CE} =	10	V

Figure 4 Output inverter FWD

Typical diode forward current as a function of forward voltage

$I_F = f(V_F)$



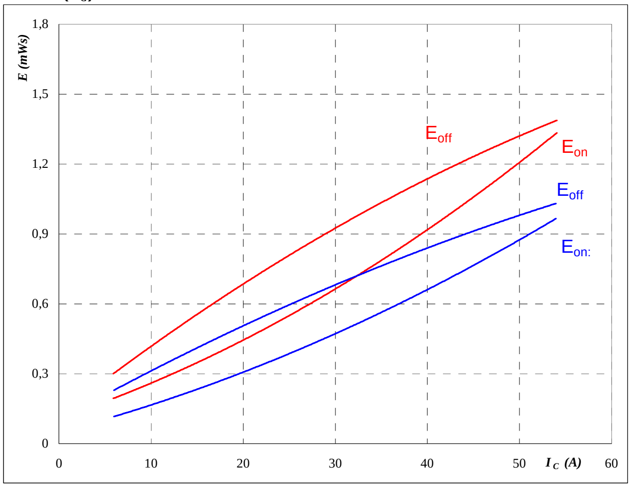
t_p =	250	μs

Output Inverter

Figure 5 Output inverter IGBT

Typical switching energy losses as a function of collector current

$E = f(I_C)$



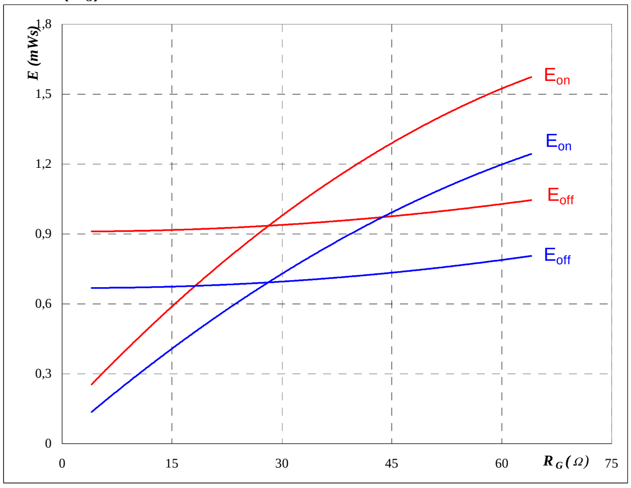
inductive load

T_j =	25/150	°C
V_{CE} =	300	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

$E = f(R_G)$



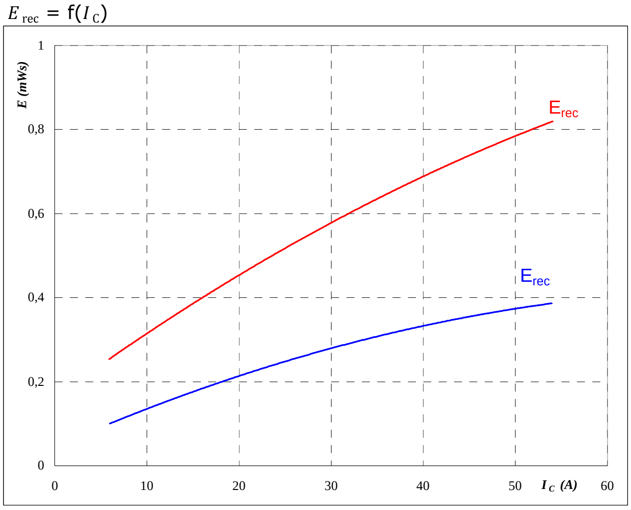
inductive load

T_j =	25/150	°C
V_{CE} =	300	V
V_{GE} =	±15	V
I_C =	30	A

Figure 7 Output inverter IGBT

Typical reverse recovery energy loss as a function of collector current

$E_{rec} = f(I_C)$



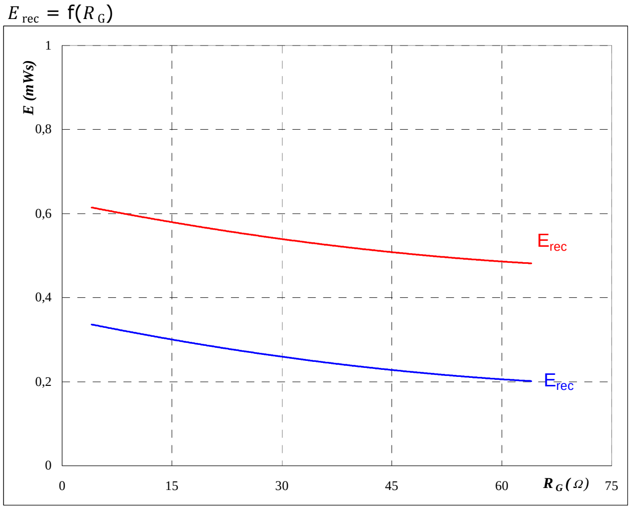
inductive load

T_j =	25/150	°C
V_{CE} =	300	V
V_{GE} =	±15	V
R_{gon} =	16	Ω

Figure 8 Output inverter IGBT

Typical reverse recovery energy loss as a function of gate resistor

$E_{rec} = f(R_G)$



inductive load

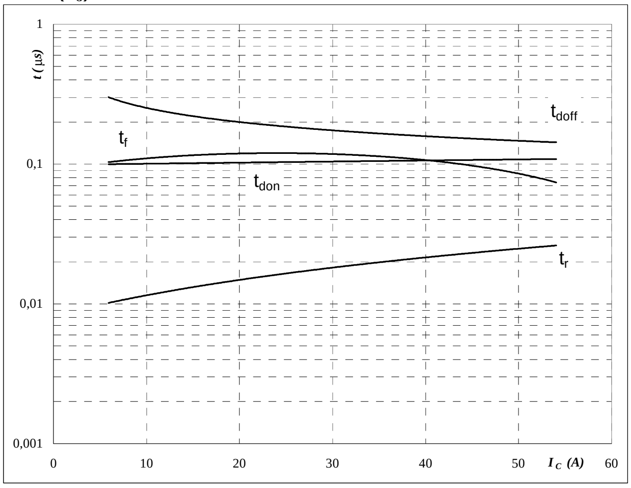
T_j =	25/150	°C
V_{CE} =	300	V
V_{GE} =	±15	V
I_C =	30	A

Output Inverter

Figure 9 Output inverter IGBT

Typical switching times as a function of collector current

$t = f(I_C)$



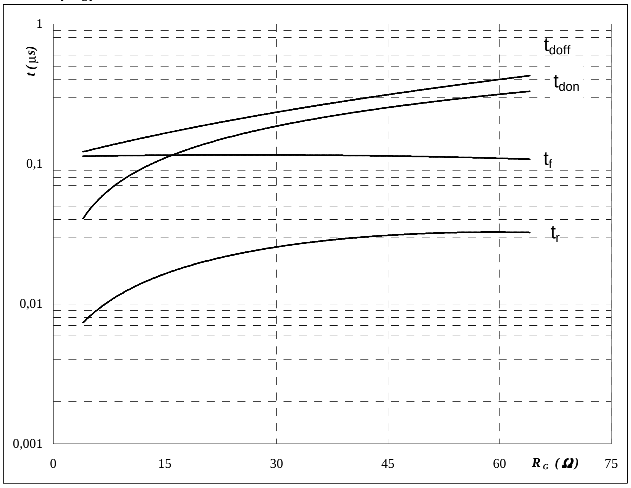
inductive load

T_j =	150	°C
V_{CE} =	300	V
V_{GE} =	±15	V
R_{gon} =	16	Ω
R_{goff} =	16	Ω

Figure 10 Output inverter IGBT

Typical switching times as a function of gate resistor

$t = f(R_G)$



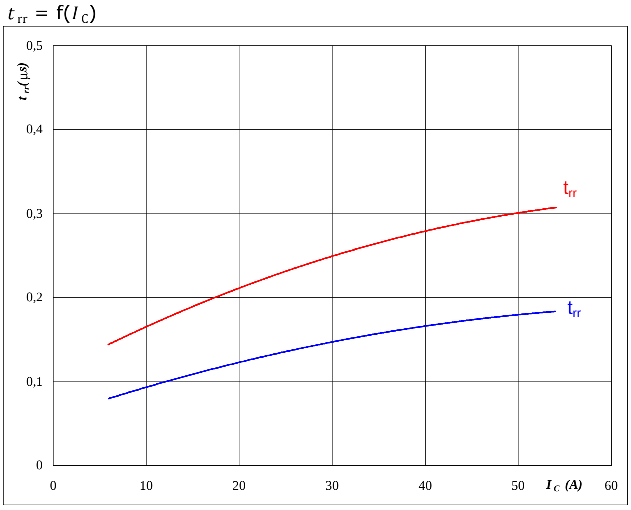
inductive load

T_j =	150	°C
V_{CE} =	300	V
V_{GE} =	±15	V
I_C =	30	A

Figure 11 Output inverter FWD

Typical reverse recovery time as a function of collector current

$t_{rr} = f(I_C)$

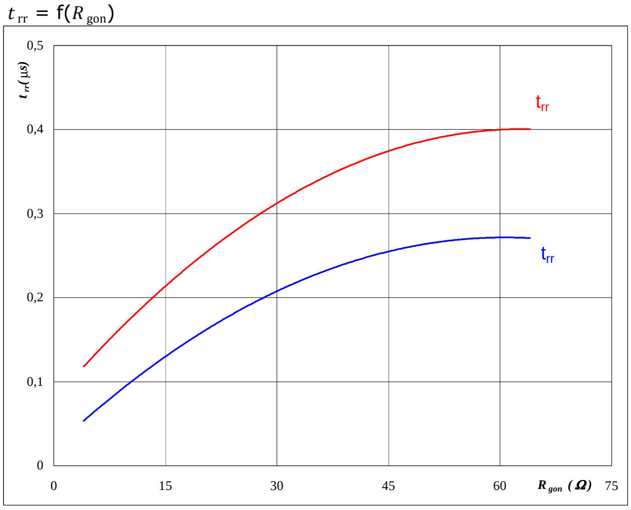


T_j =	25/150	°C
V_{CE} =	300	V
V_{GE} =	±15	V
R_{gon} =	16	Ω

Figure 12 Output inverter FWD

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

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



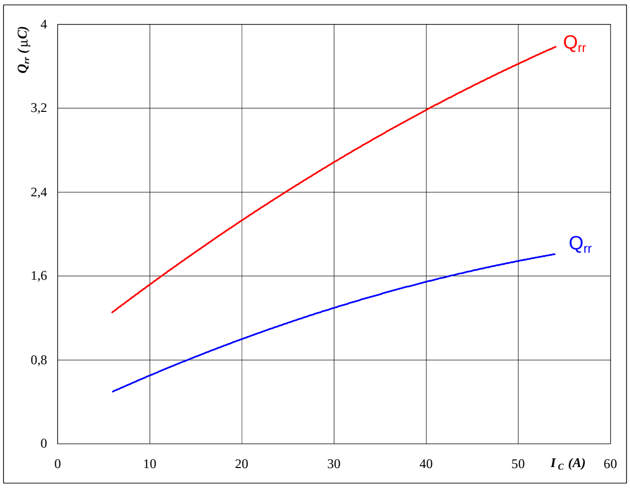
T_j =	25/150	°C
V_R =	300	V
I_F =	30	A
V_{GE} =	±15	V

Output Inverter

Figure 13 Output inverter FWD

Typical reverse recovery charge as a function of collector current

$Q_{rr} = f(I_C)$

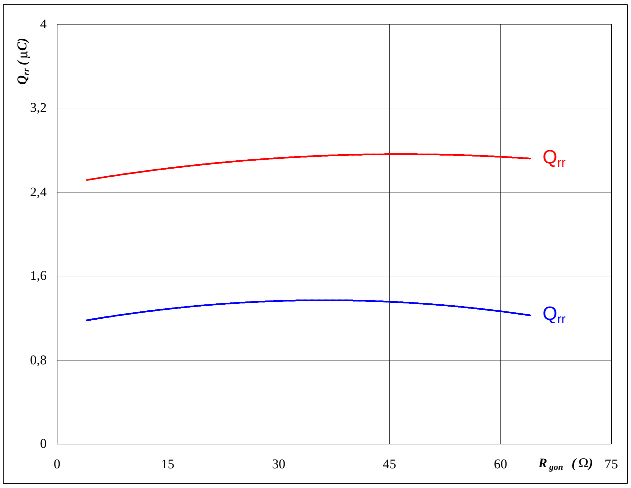


T_j =	25/150	°C
V_{CE} =	300	V
V_{GE} =	±15	V
R_{gon} =	16	Ω

Figure 14 Output inverter FWD

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

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

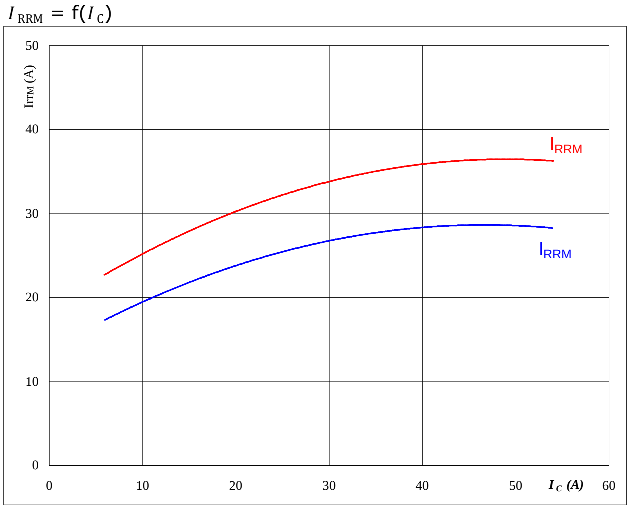


T_j =	25/150	°C
V_R =	300	V
I_F =	30	A
V_{GE} =	±15	V

Figure 15 Output inverter FWD

Typical reverse recovery current as a function of collector current

$I_{RRM} = f(I_C)$

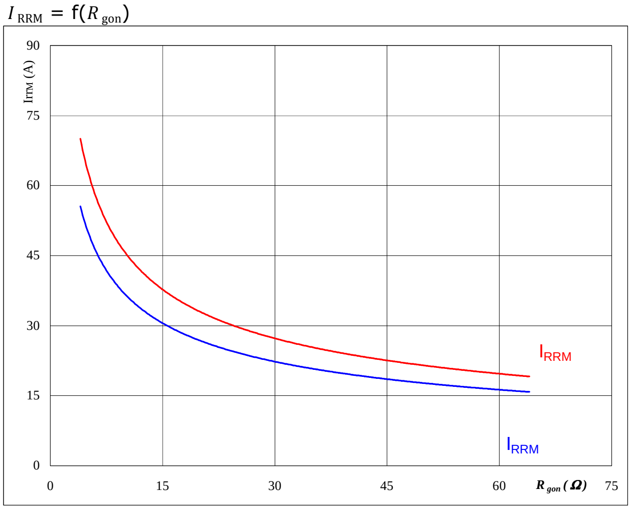


T_j =	25/150	°C
V_{CE} =	300	V
V_{GE} =	±15	V
R_{gon} =	16	Ω

Figure 16 Output inverter FWD

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

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



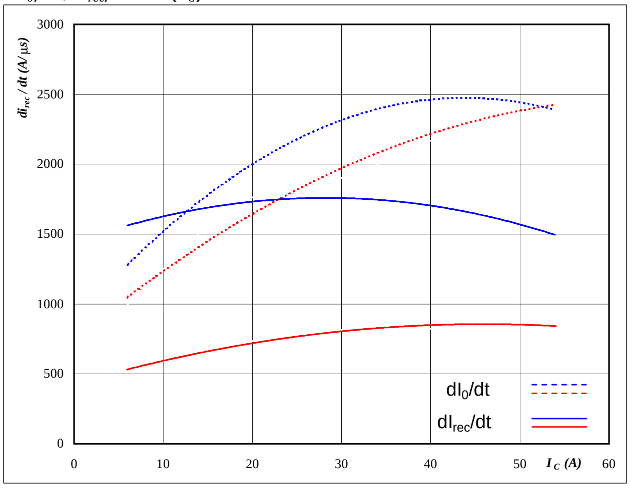
T_j =	25/150	°C
V_R =	300	V
I_F =	30	A
V_{GE} =	±15	V

Output Inverter

Figure 17 Output inverter FWD

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

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

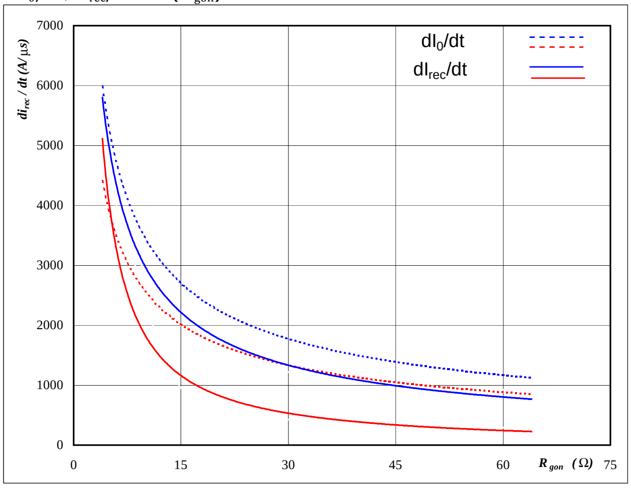


T_j =	25/150	°C
V_{CE} =	300	V
V_{GE} =	±15	V
R_{gon} =	16	Ω

Figure 18 Output inverter FWD

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

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

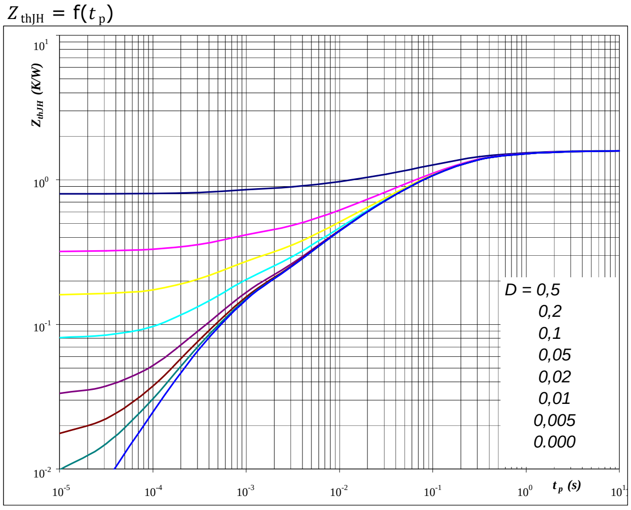


T_j =	25/150	°C
V_R =	300	V
I_F =	30	A
V_{GE} =	±15	V

Figure 19 Output inverter IGBT

IGBT transient thermal impedance as a function of pulse width

$Z_{thJH} = f(t_p)$



D =	t_p / T	
R_{thJH} =	1,60	K/W

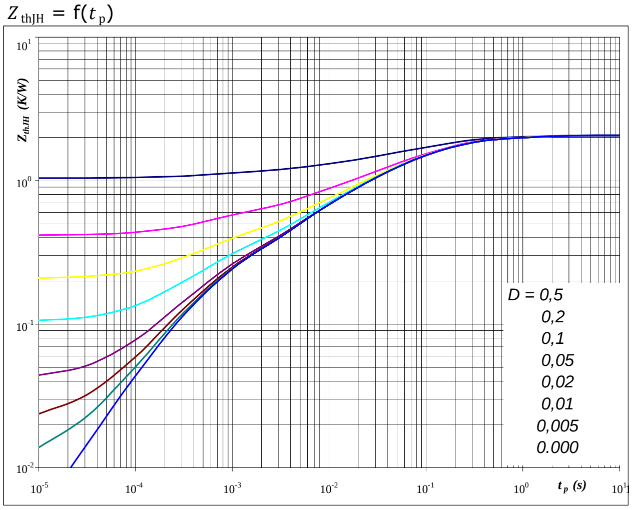
IGBT thermal model values

R (K/W)	Tau (s)
0,03	9,7E+00
0,16	9,7E-01
0,67	1,5E-01
0,40	3,3E-02
0,23	6,7E-03
0,12	5,5E-04

Figure 20 Output inverter FWD

FWD transient thermal impedance as a function of pulse width

$Z_{thJH} = f(t_p)$



D =	t_p / T	
R_{thJH} =	2,08	K/W

FWD thermal model values

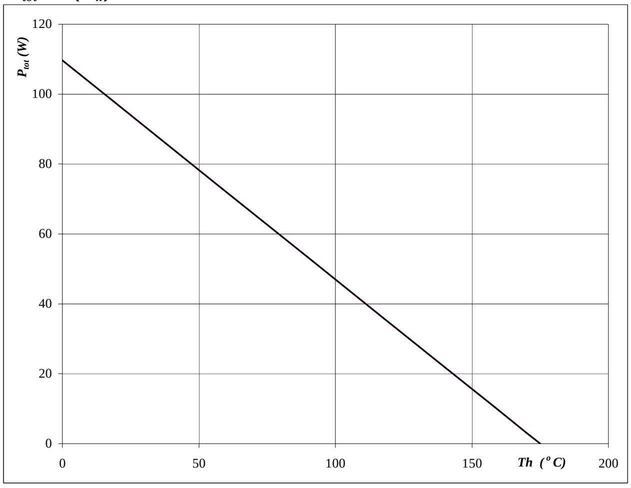
R (K/W)	Tau (s)
0,03	9,7E+00
0,19	8,1E-01
0,81	1,3E-01
0,57	2,7E-02
0,30	5,1E-03
0,18	4,7E-04

Output Inverter

Figure 21 Output inverter IGBT

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_h)$

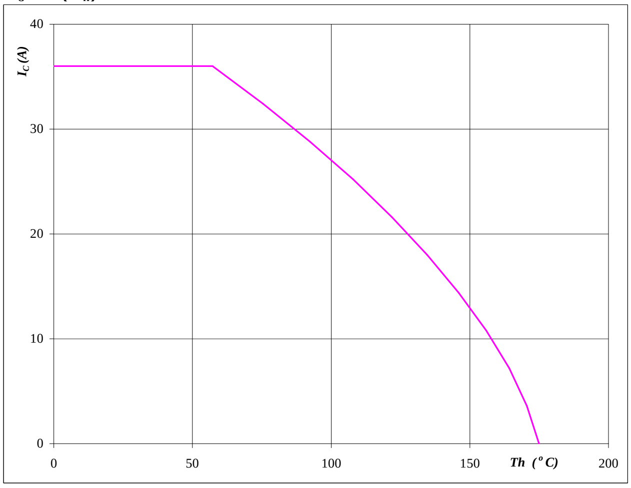


T_j = 175 °C

Figure 22 Output inverter IGBT

Collector current as a function of heatsink temperature

$I_C = f(T_h)$



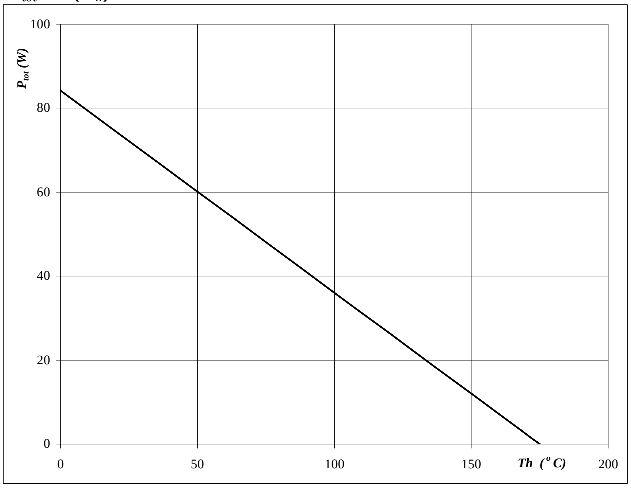
T_j = 175 °C

V_{GE} = 15 V

Figure 23 Output inverter FWD

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_h)$

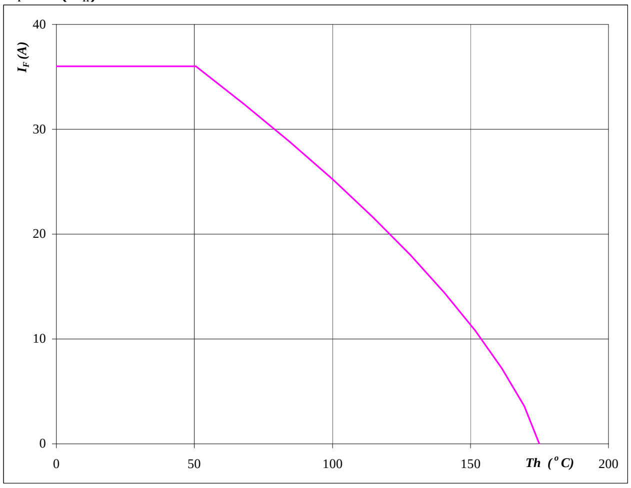


T_j = 175 °C

Figure 24 Output inverter FWD

Forward current as a function of heatsink temperature

$I_F = f(T_h)$



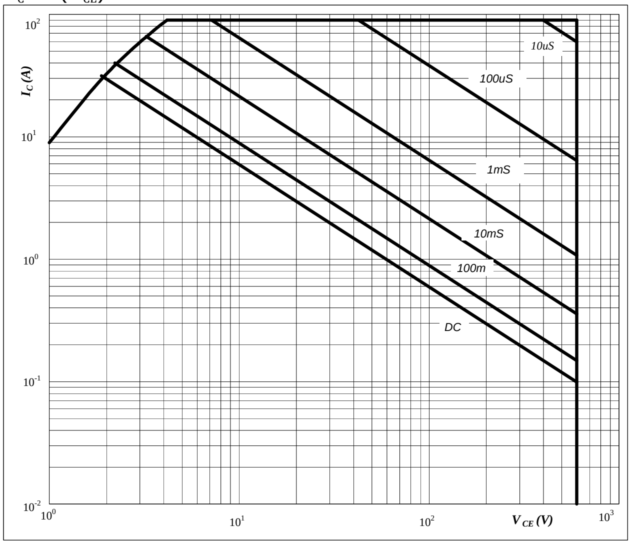
T_j = 175 °C

Output Inverter

Figure 25	Output inverter IGBT

Safe operating area as a function of collector-emitter voltage

$I_C = f(V_{CE})$

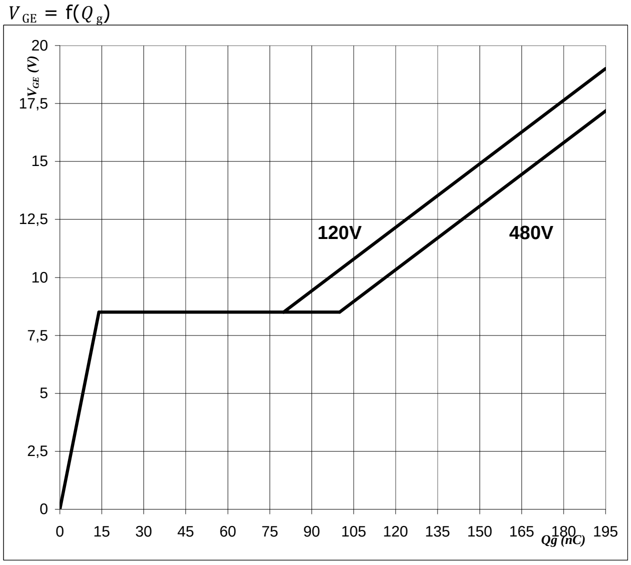


D =	single pulse	
T_h =	80	ºC
V_{GE} =	±15	V
T_j =	T_{jmax}	ºC

Figure 26	Output inverter IGBT

Gate voltage vs Gate charge

$V_{GE} = f(Q_g)$



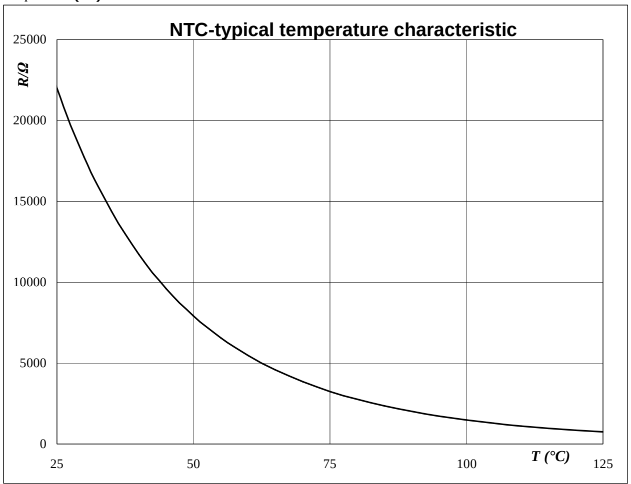
I_C =	30	A

Thermistor

Figure 1	Thermistor

Typical NTC characteristic as a function of temperature

$R_T = f(T)$



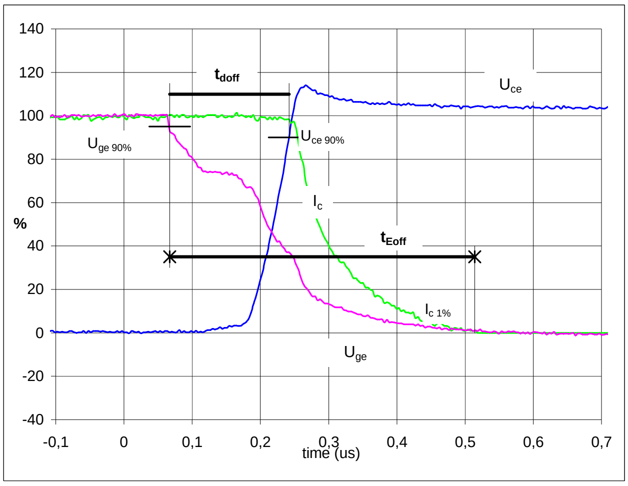
Switching Definitions Output Inverter

General conditions

T_j	=	150 °C
R_{gon}	=	16 Ω
R_{goff}	=	16 Ω

Figure 1 Output inverter IGBT

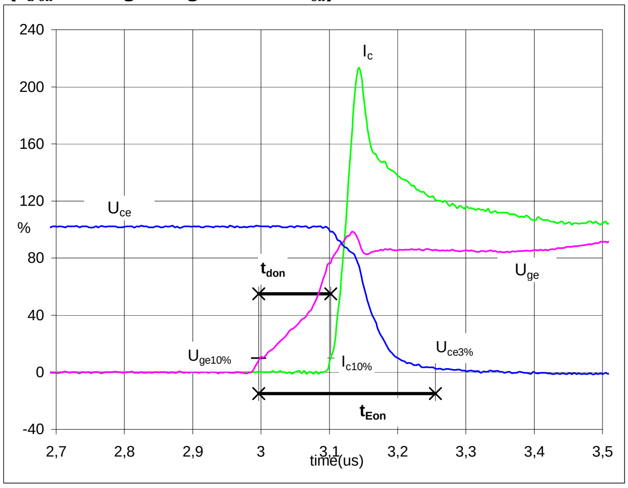
Turn-off Switching Waveforms & definition of t_{doff}, t_{Eoff}
($t_{E\ off}$ = integrating time for E_{off})



V_{GE} (0%) =	-15	V
V_{GE} (100%) =	15	V
V_C (100%) =	300	V
I_C (100%) =	30	A
t_{doff} =	0,17	µs
$t_{E\ off}$ =	0,45	µs

Figure 2 Output inverter IGBT

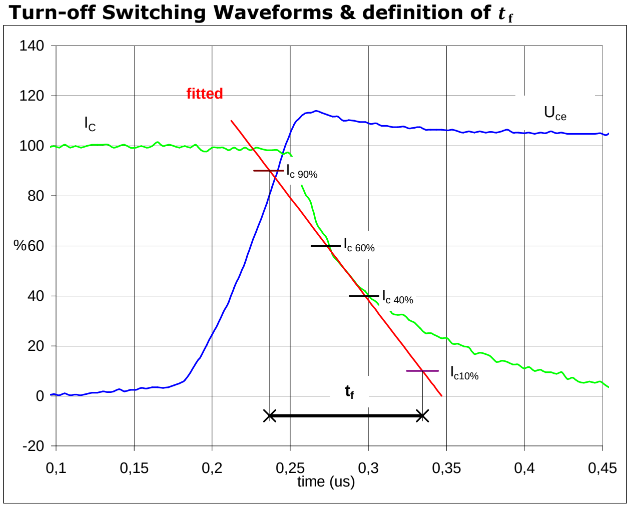
Turn-on Switching Waveforms & definition of t_{don}, t_{Eon}
($t_{E\ on}$ = integrating time for E_{on})



V_{GE} (0%) =	-15	V
V_{GE} (100%) =	15	V
V_C (100%) =	300	V
I_C (100%) =	30	A
t_{don} =	0,10	µs
$t_{E\ on}$ =	0,26	µs

Figure 3 Output inverter IGBT

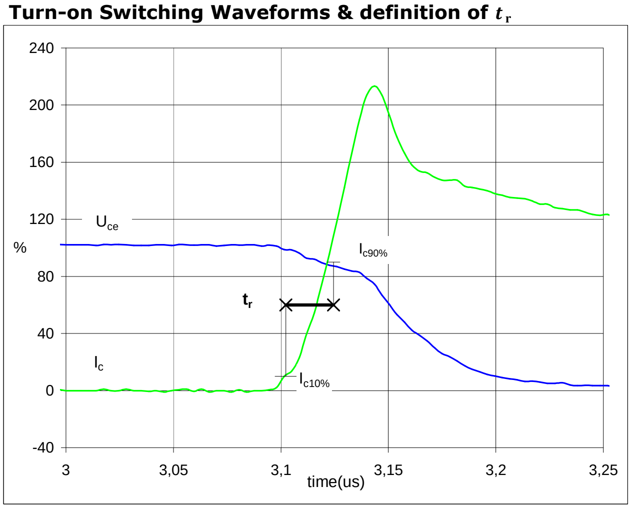
Turn-off Switching Waveforms & definition of t_f



V_C (100%) =	300	V
I_C (100%) =	30	A
t_f =	0,11	µs

Figure 4 Output inverter IGBT

Turn-on Switching Waveforms & definition of t_r

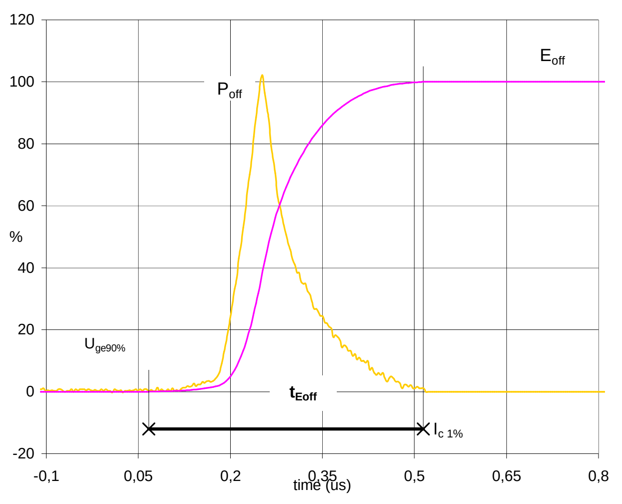


V_C (100%) =	300	V
I_C (100%) =	30	A
t_r =	0,02	µs

Switching Definitions Output Inverter

Figure 5 Output inverter IGBT

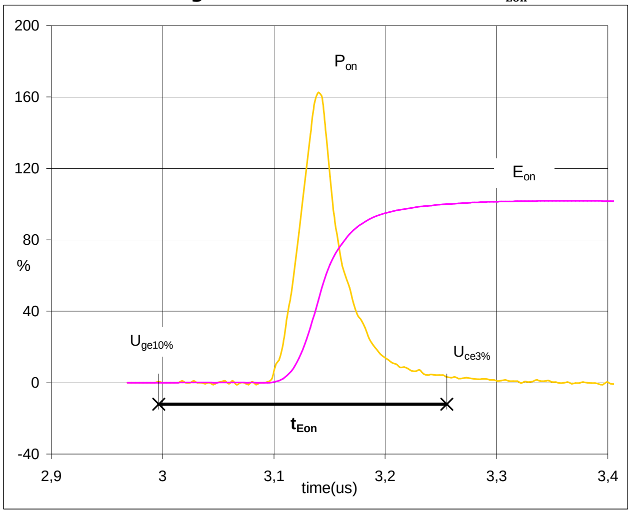
Turn-off Switching Waveforms & definition of t_{Eoff}



P_{off} (100%) =	9,01	kW
E_{off} (100%) =	0,91	mJ
$t_{E\,off}$ =	0,45	μs

Figure 6 Output inverter IGBT

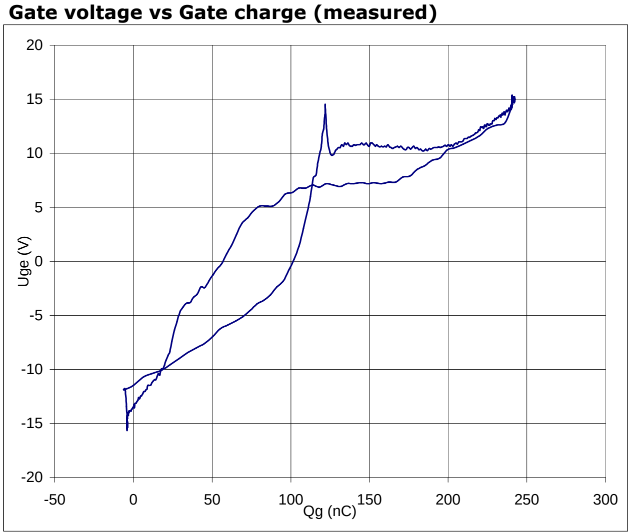
Turn-on Switching Waveforms & definition of t_{Eon}



P_{on} (100%) =	9,01	kW
E_{on} (100%) =	0,67	mJ
$t_{E\,on}$ =	0,26	μs

Figure 7 Output inverter FWD

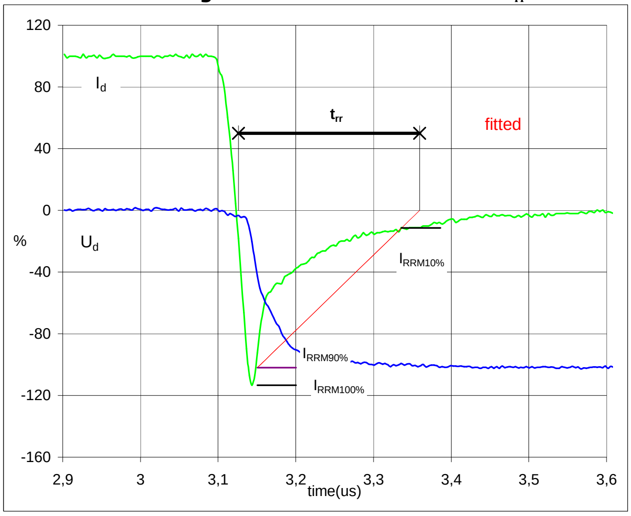
Gate voltage vs Gate charge (measured)



$V_{GE\,off}$ =	-15	V
$V_{GE\,on}$ =	15	V
V_C (100%) =	300	V
I_C (100%) =	30	A
Q_g =	1737	nC

Figure 8 Output inverter IGBT

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

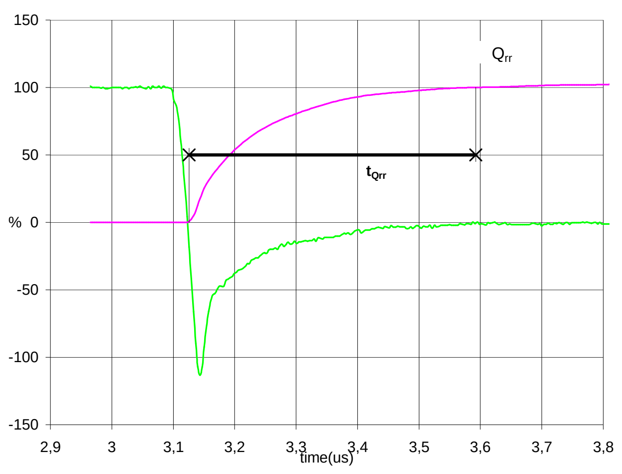


V_d (100%) =	300	V
I_d (100%) =	30	A
I_{RRM} (100%) =	-34	A
t_{rr} =	0,25	μs

Switching Definitions Output Inverter

Figure 9 Output inverter FWD

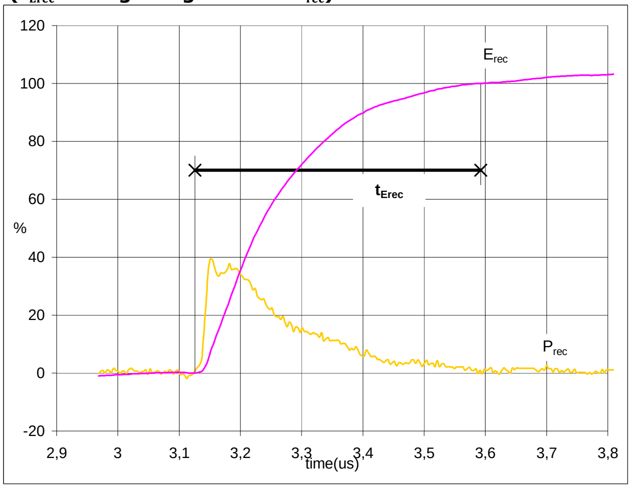
Turn-on Switching Waveforms & definition of t_{Qrr}
($t_{Q\,rr}$ = integrating time for Q_{rr})



I_d (100%) =	30	A
Q_{rr} (100%) =	2,65	μC
$t_{Q\,rr}$ =	0,47	μs

Figure 10 Output inverter FWD

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



P_{rec} (100%) =	9,01	kW
E_{rec} (100%) =	0,57	mJ
$t_{E\,rec}$ =	0,47	μs

Ordering Code and Marking - Outline - Pinout

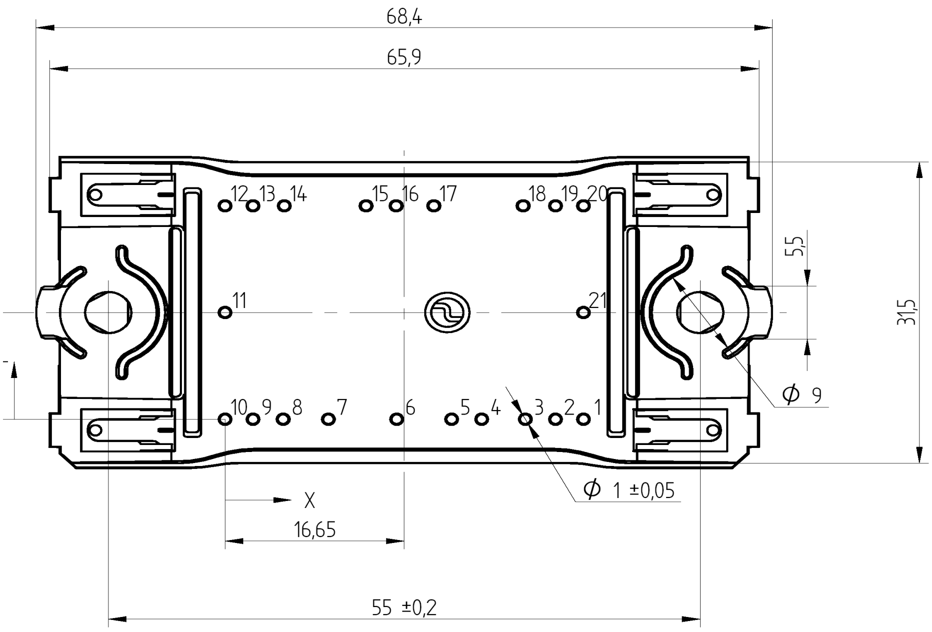
Ordering Code & Marking

Version	Ordering Code	in DataMatrix as	in packaging barcode as
without thermal paste 17mm housing	V23990-P864-F49-PM	P864F49	P864F49
without thermal paste 12mm housing	V23990-P864-F48-PM	P864F48	P864F48

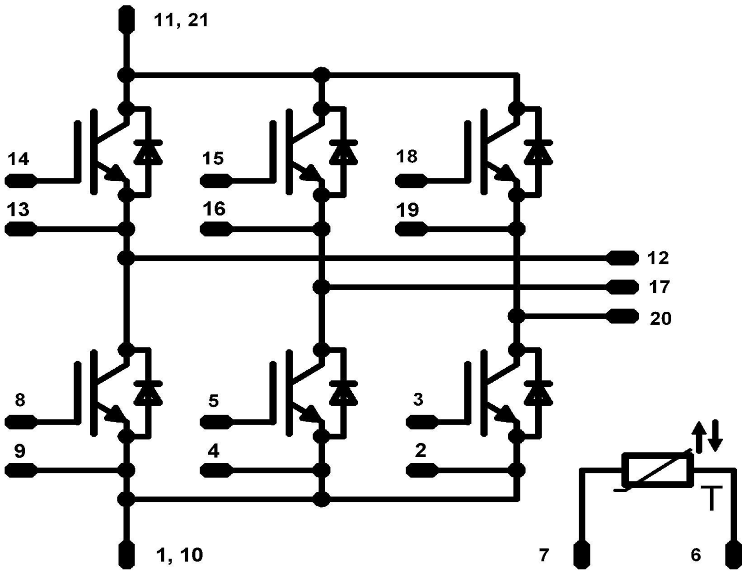
Outline

Pin table

Pin	X	Y
1	33,3	0
2	30,7	0
3	27,9	0
4	23,85	0
5	21,05	0
6	15,95	0
7	9,6	0
8	5,4	0
9	2,6	0
10	0	0
11	0	11,15
12	0	22,3
13	2,6	22,3
14	5,5	22,3
15	13,1	22,3
16	15,9	22,3
17	19,4	22,3
18	27,7	22,3
19	30,7	22,3
20	33,3	22,3
21	33,3	11,15



Pinout



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