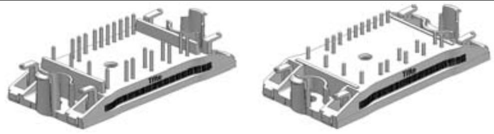
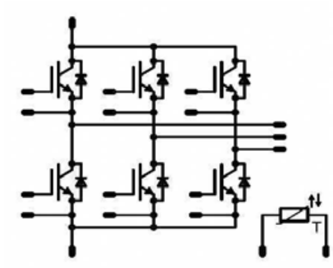
flowPACK 0 3rd gen — 1200V/35A

Features
- 2 clip housing in 12mm and 17mm height
- Trench Fieldstop IGBT4 technology
- Compact and low inductance design
- Built-in NTC

flow0 housing


Target Applications
- Motor Drives
- Power Generation
- UPS

Schematic


Types
- V23990-P860-F49-PM: 17mm height
- V23990-P860-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}		1200	V
DC collector current	I_C	$T_j=T_{jmax}$ T_h=80°C / T_c=80°C	34	A
Repetitive peak collector current	I_{Cpulse}	t_p limited by T_{jmax}	105	A
Power dissipation per IGBT	P_{tot}	$T_j=T_{jmax}$ T_h=80°C / T_c=80°C	80	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	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}	T_j=25°C	1200	V
DC forward current	I_F	$T_j=T_{jmax}$ T_h=80°C / T_c=80°C	35	A
Repetitive peak forward current	I_{FRM}	t_p limited by T_{jmax}	70	A
Power dissipation per Diode	P_{tot}	$T_j=T_{jmax}$ T_h=80°C / T_c=80°C	61	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

Tj=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			min.12,7	mm

Characteristic Values

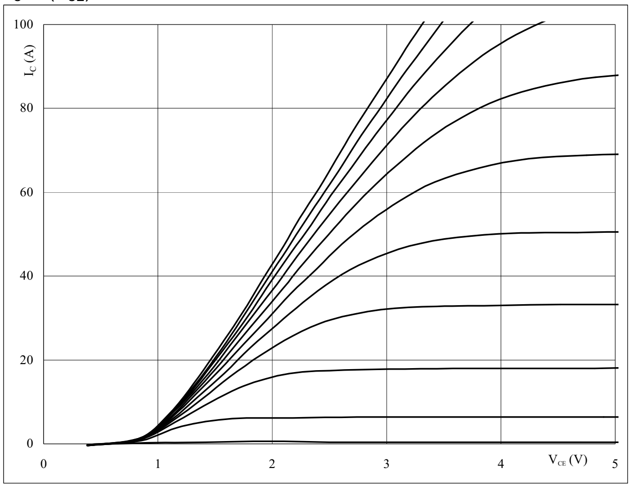
Parameter	Symbol	Conditions	V_{GE} [V] or V_{GS} [V]	V_r [V] or V_{CE} [V] or V_{DS} [V]	I_C [A] or I_F [A] or I_D [A]	T_j	Value Min	Typ	Max	Unit
Inverter Transistor										
Gate emitter threshold voltage	$V_{GE(th)}$	VCE=VGE			0,0012	Tj=25°C Tj=150°C	5	5,8	6,5	V
Collector-emitter saturation voltage	$V_{CE(sat)}$		15		35	Tj=25°C Tj=150°C		1,9 2,33	2,3	V
Collector-emitter cut-off current incl. Diode	I_{CES}		0	1200		Tj=25°C Tj=150°C			15	μA
Gate-emitter leakage current	I_{GES}		20	0		Tj=25°C Tj=150°C			200	nA
Integrated Gate resistor	R_{gint}							none		Ω
Turn-on delay time	$t_{d(on)}$	Rgon=16Ω Rgoff=16Ω	±15	600	35	Tj=25°C Tj=150°C		85 88		ns
Rise time	t_r					Tj=25°C Tj=150°C		22 26		ns
Turn-off delay time	$t_{d(off)}$					Tj=25°C Tj=150°C		199 259		ns
Fall time	t_f					Tj=25°C Tj=150°C		73 115		ns
Turn-on energy loss per pulse	E_{on}					Tj=25°C Tj=150°C		2,48 3,71		mWs
Turn-off energy loss per pulse	E_{off}					Tj=25°C Tj=150°C		1,83 2,9		mWs
Input capacitance	C_{ies}	f=1MHz	0	25		Tj=25°C		1950		pF
Output capacitance	C_{oss}							155		pF
Reverse transfer capacitance	C_{rss}							115		pF
Gate charge	Q_{Gate}		15	960	35	Tj=25°C		197		nC
Thermal resistance chip to heatsink per chip	R_{thJH}	Thermal grease thickness≤50um λ = 0,61 W/mK						1,19		K/W
Inverter Diode										
Diode forward voltage	V_F				35	Tj=25°C Tj=150°C		1,79 1,76	2,3	V
Reverse leakage current	I_R	Rgon=16Ω	±15	600	35	Tj=25°C Tj=150°C			15	μA
Peak reverse recovery current	I_{RRM}					Tj=25°C Tj=150°C		30,4 34,5		A
Reverse recovery time	t_{rr}					Tj=25°C Tj=150°C		298 493		ns
Reverse recovered charge	Q_{rr}					Tj=25°C Tj=150°C		3,79 7,00		μC
Peak rate of fall of recovery current	di(rec)max /dt					Tj=25°C Tj=150°C		122 105		A/μs
Reverse recovered energy	E_{rec}					Tj=150°C		2,806		mWs
Thermal resistance chip to heatsink per chip	R_{thJH}	Thermal grease thickness≤50um						1,55		K/Wn
Thermistor										
Rated resistance	R_{25}	Tol. ±5%				Tj=25°C	20,9	22	23,1	kΩ
Deviation of R100	ΔR/R	R100=1486Ω				Tj=100°C		2,9		%/K
Power dissipation	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

$I_C = f(V_{CE})$

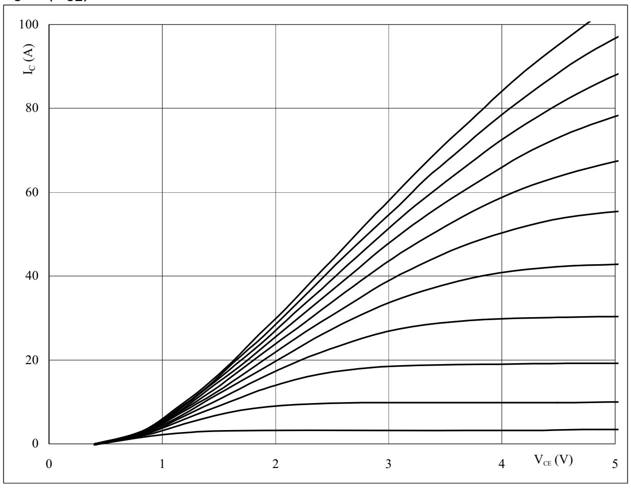


t_p =	250	μs
T_j =	25	°C
V_{GE} from	7 V to 17 V in steps of 1 V	

Figure 2 Output inverter IGBT

Typical output characteristics

$I_C = f(V_{CE})$

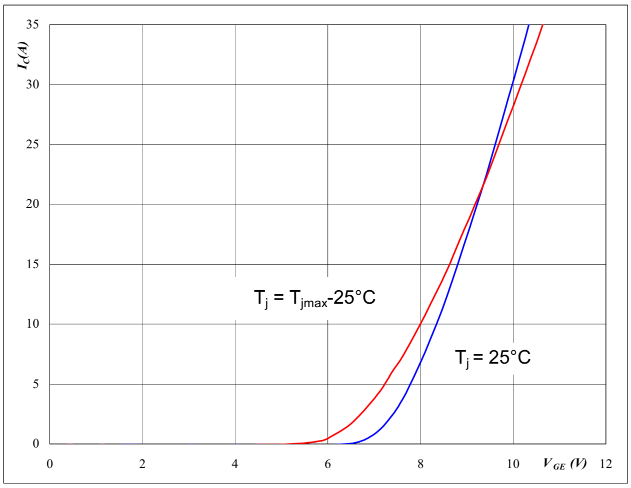


t_p =	250	μs
T_j =	150	°C
V_{GE} from	7 V to 17 V in steps of 1 V	

Figure 3 Output inverter IGBT

Typical transfer characteristics

$I_C = f(V_{GE})$

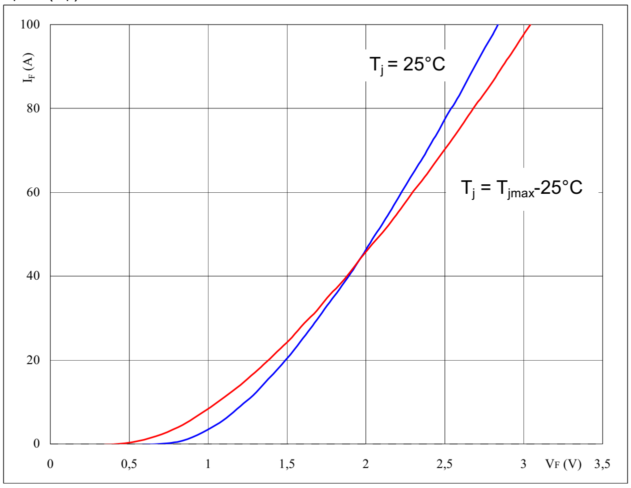


t_p =	250	μs
V_{CE} =	10	V

Figure 4 Output inverter FRED

Typical diode forward current as a function of forward voltage

$I_F = f(V_F)$



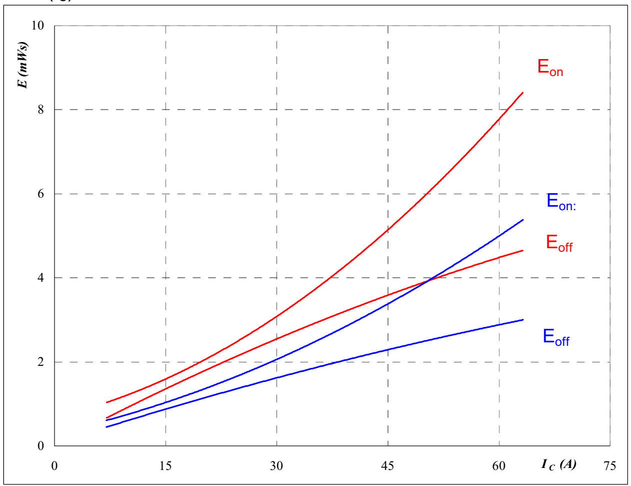
t_p =	250	μs

Output Inverter

Figure 5 Output inverter IGBT

Typical switching energy losses
as a function of collector current

$E = f(I_C)$



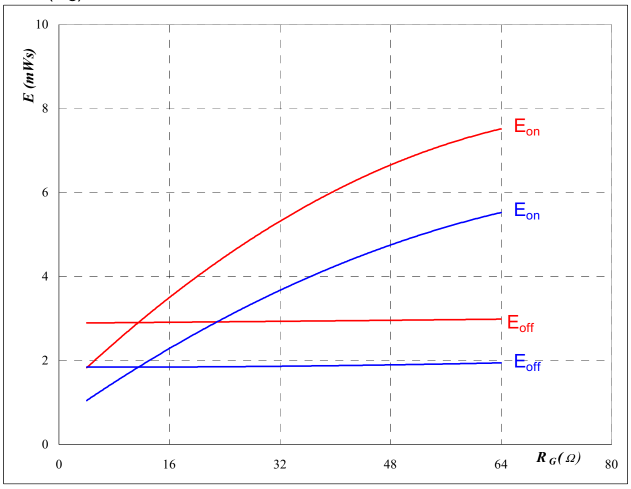
inductive load

T_j =	25/150	°C
V_{CE} =	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

$E = f(R_G)$



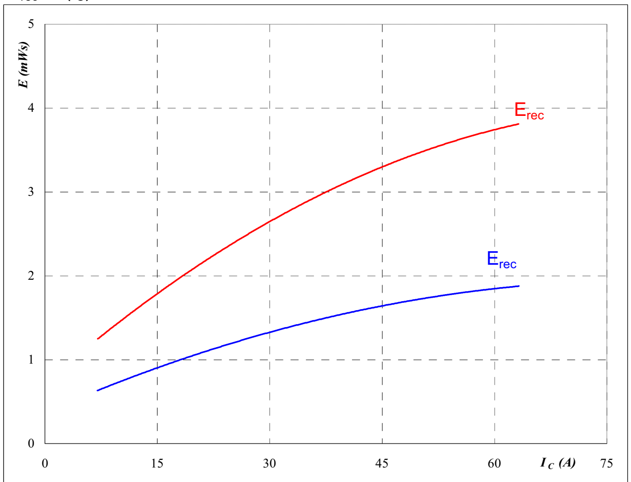
inductive load

T_j =	25/150	°C
V_{CE} =	600	V
V_{GE} =	±15	V
I_C =	35	A

Figure 7 Output inverter IGBT

Typical reverse recovery energy loss
as a function of collector current

$E_{rec} = f(I_C)$



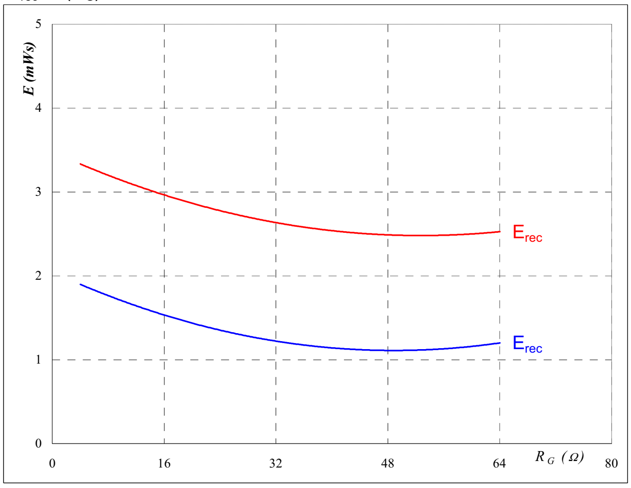
inductive load

T_j =	25/150	°C
V_{CE} =	600	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

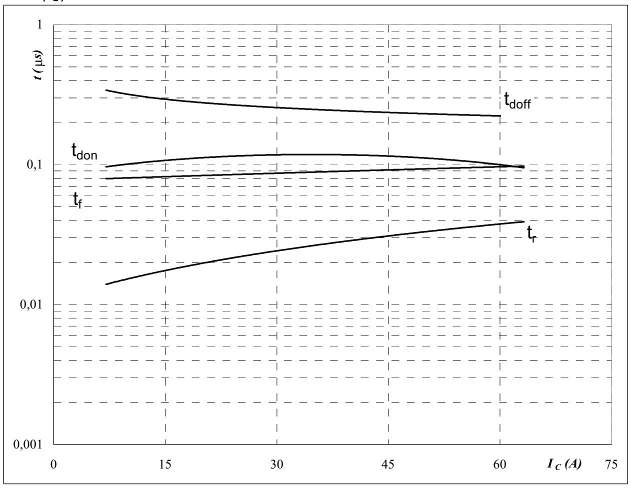
T_j =	25/150	°C
V_{CE} =	600	V
V_{GE} =	±15	V
I_C =	35	A

Output Inverter

Figure 9 Output inverter IGBT

Typical switching times as a function of collector current

$t = f(I_C)$



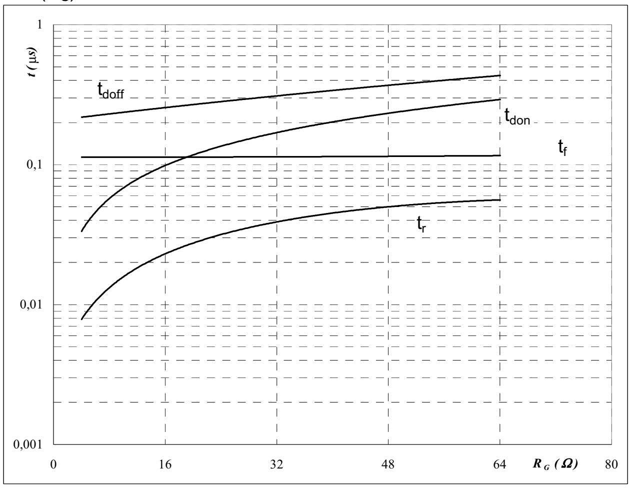
inductive load

T_j =	150	°C
V_{CE} =	600	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

$t = f(R_G)$



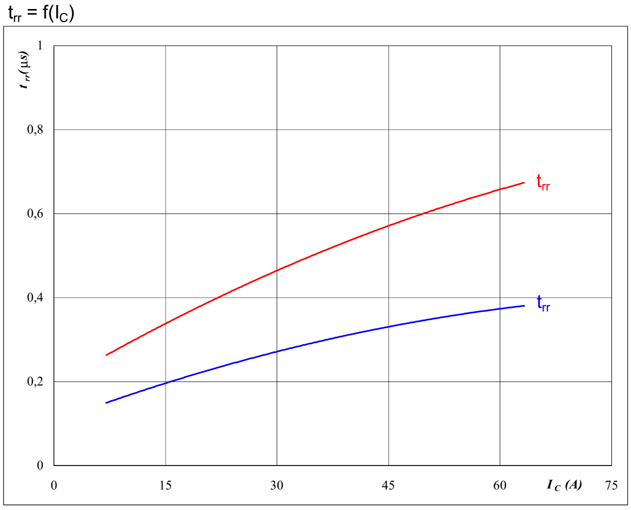
inductive load

T_j =	150	°C
V_{CE} =	600	V
V_{GE} =	±15	V
I_C =	35	A

Figure 11 Output inverter FRED

Typical reverse recovery time as a function of collector current

$t_{rr} = f(I_C)$

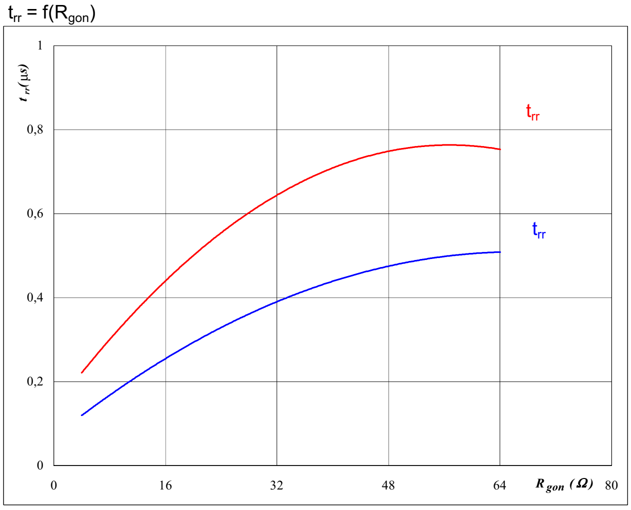


T_j =	25/150	°C
V_{CE} =	600	V
V_{GE} =	±15	V
R_{gon} =	16	Ω

Figure 12 Output inverter FRED

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

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



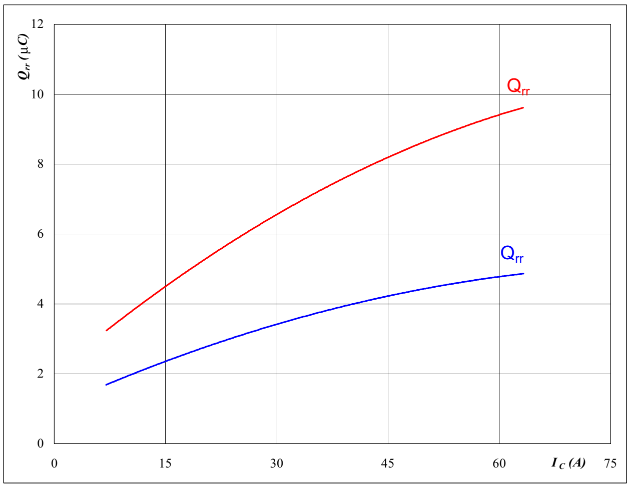
T_j =	25/150	°C
V_R =	600	V
I_F =	35	A
V_{GE} =	±15	V

Output Inverter

Figure 13 Output inverter FRED

Typical reverse recovery charge as a function of collector current

$Q_{rr} = f(I_C)$

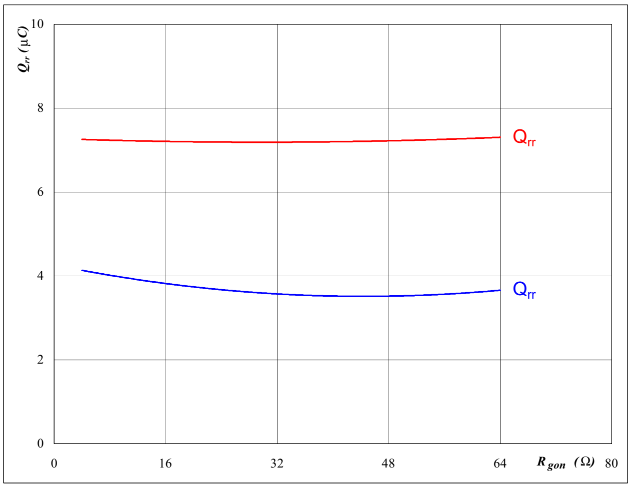


T_j =	25/150	°C
V_{CE} =	600	V
V_{GE} =	±15	V
R_{gon} =	16	Ω

Figure 14 Output inverter FRED

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

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

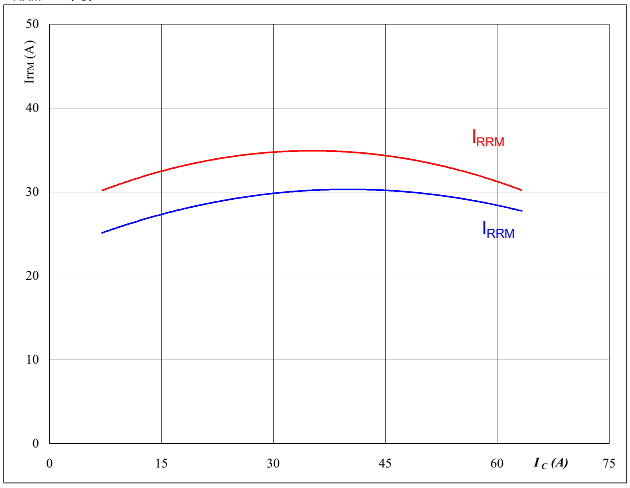


T_j =	25/150	°C
V_R =	600	V
I_F =	35	A
V_{GE} =	±15	V

Figure 15 Output inverter FRED

Typical reverse recovery current as a function of collector current

$I_{RRM} = f(I_C)$

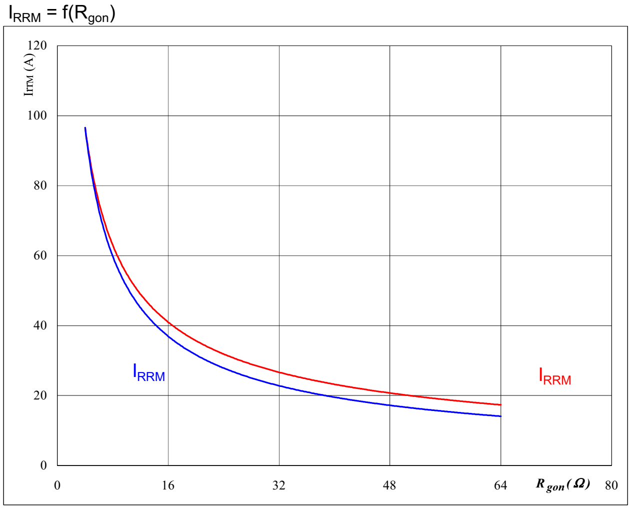


T_j =	25/150	°C
V_{CE} =	600	V
V_{GE} =	±15	V
R_{gon} =	16	Ω

Figure 16 Output inverter FRED

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

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



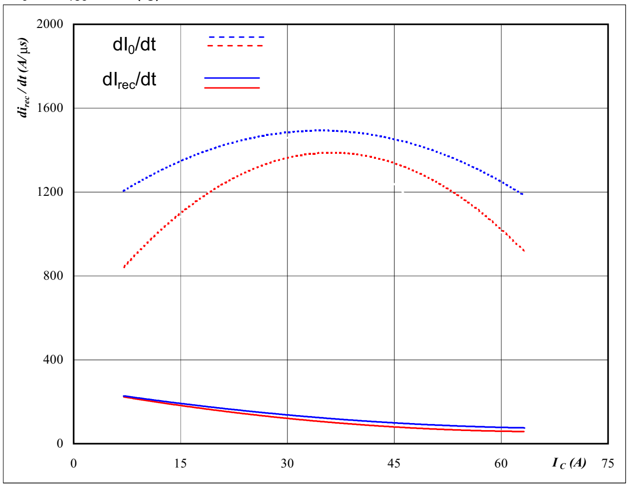
T_j =	25/150	°C
V_R =	600	V
I_F =	35	A
V_{GE} =	±15	V

Output Inverter

Figure 17 Output inverter FRED

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

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

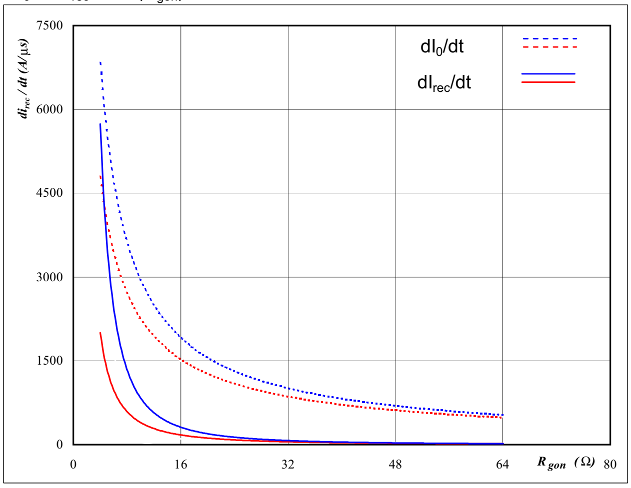


T_j =	25/150	°C
V_{CE} =	600	V
V_{GE} =	±15	V
R_{gon} =	16	Ω

Figure 18 Output inverter FRED

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

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

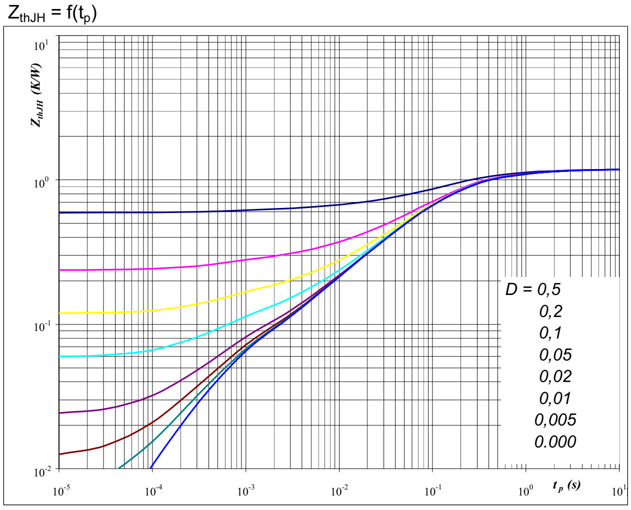


T_j =	25/150	°C
V_R =	600	V
I_F =	35	A
V_{GE} =	±15	V

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} =	1,19	K/W

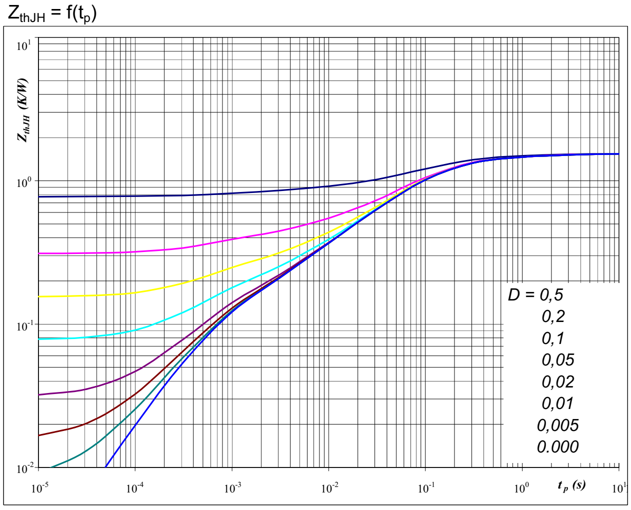
IGBT thermal model values

R (C/W)	Tau (s)
0,03	6,8E+00
0,16	1,0E+00
0,60	1,6E-01
0,25	4,0E-02
0,09	7,1E-03
0,05	5,9E-04

Figure 20 Output inverter FRED

FRED transient thermal impedance as a function of pulse width

$Z_{thJH} = f(t_p)$



D =	t_p / T	
R_{thJH} =	1,55	K/W

FRED thermal model values

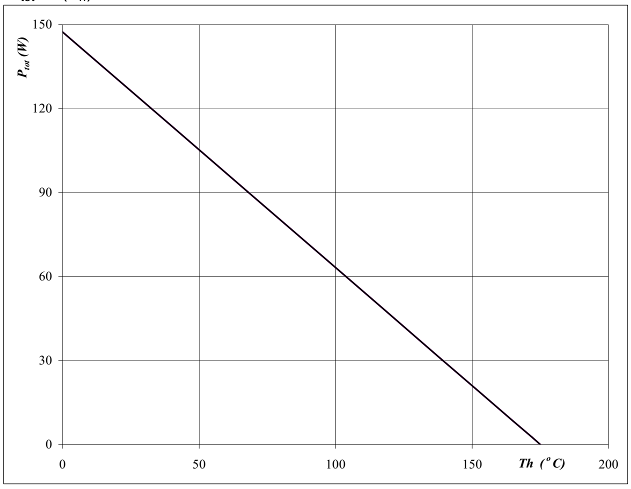
R (C/W)	Tau (s)
0,03	9,8E+00
0,16	9,8E-01
0,65	1,4E-01
0,47	4,0E-02
0,14	6,0E-03
0,10	6,2E-04

Output Inverter

Figure 21 Output inverter IGBT

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_h)$

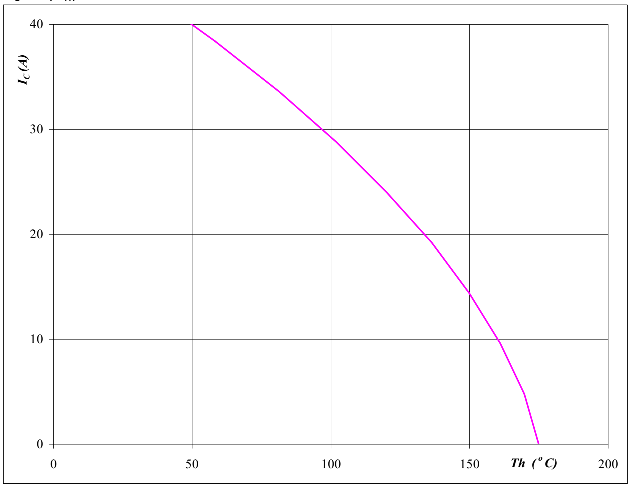


T_j = 175 °C

Figure 22 Output inverter IGBT

Collector current as a function of heatsink temperature

$I_C = f(T_h)$



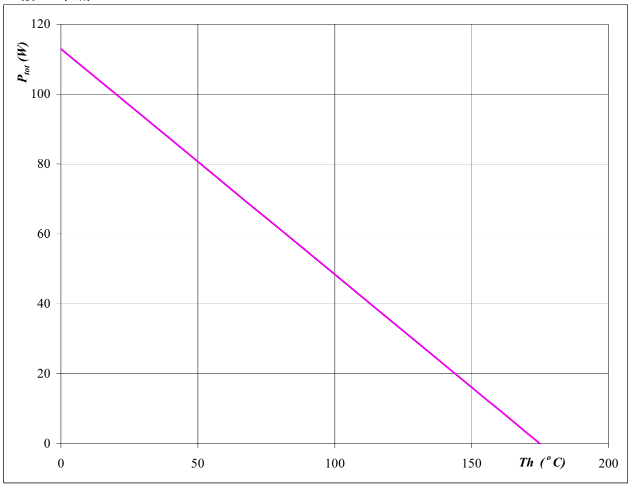
T_j = 175 °C

V_{GE} = 15 V

Figure 23 Output inverter FRED

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_h)$

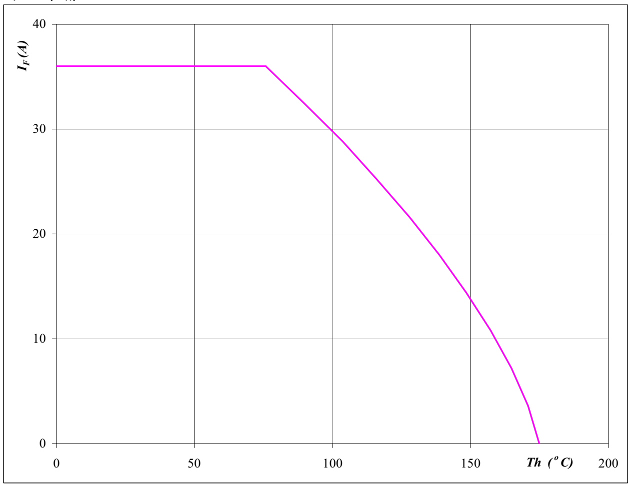


T_j = 175 °C

Figure 24 Output inverter FRED

Forward current as a function of heatsink temperature

$I_F = f(T_h)$



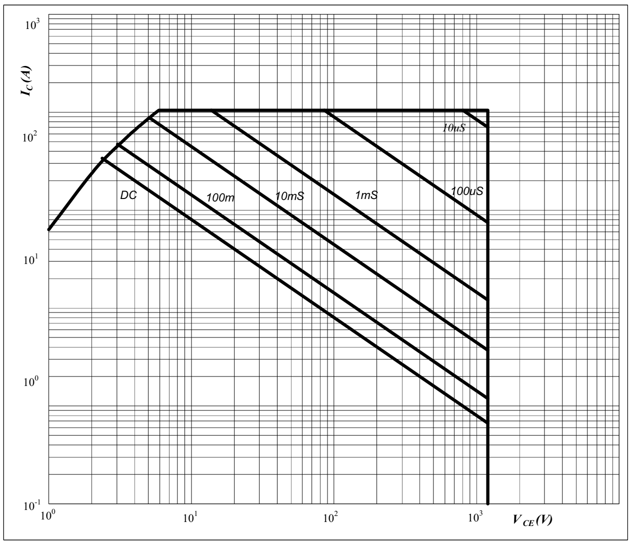
T_j = 175 °C

Output Inverter

Figure 25 Output inverter IGBT

Safe operating area as a function of collector-emitter voltage

$I_C = f(V_{CE})$

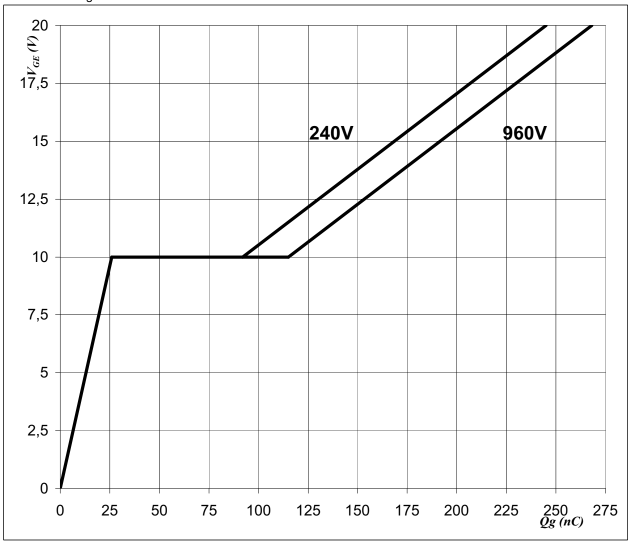


D =	single pulse	
T_h =	80	ºC
V_{GE} =	±15	V
T_j =	T_{jmax}	ºC

Figure 26 Output inverter IGBT

Gate voltage vs Gate charge

$V_{GE} = f(Q_g)$



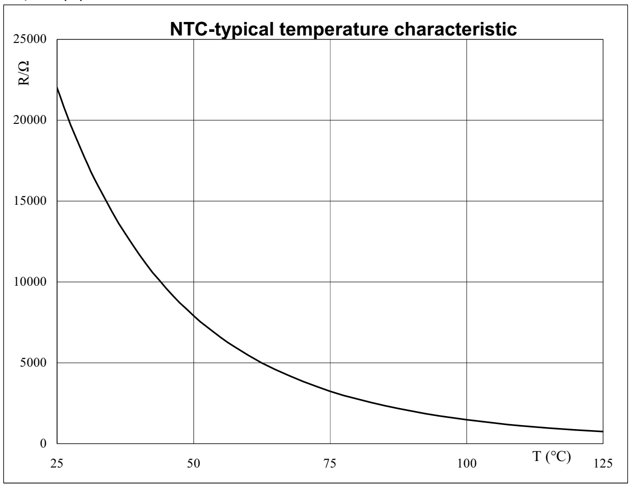
I_C =	35	A

Thermistor

Figure 1 Thermistor

Typical NTC characteristic as a function of temperature

$R_T = f(T)$

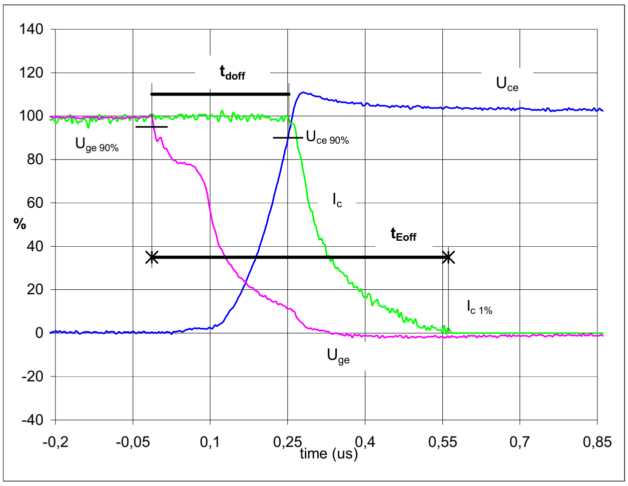


Switching Definitions Output Inverter

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

Figure 1 Output inverter IGBT

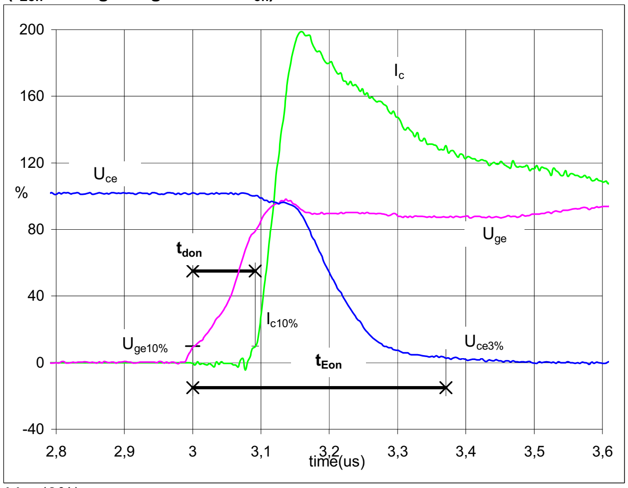
Turn-off Switching Waveforms & definition of t_{doff}, t_{Eoff}
(t_{Eoff} = integrating time for E_{off})



V_{GE} (0%) =	-15	V
V_{GE} (100%) =	15	V
V_C (100%) =	600	V
I_C (100%) =	35	A
t_{doff} =	0,26	µs
t_{Eoff} =	0,57	µs

Figure 2 Output inverter IGBT

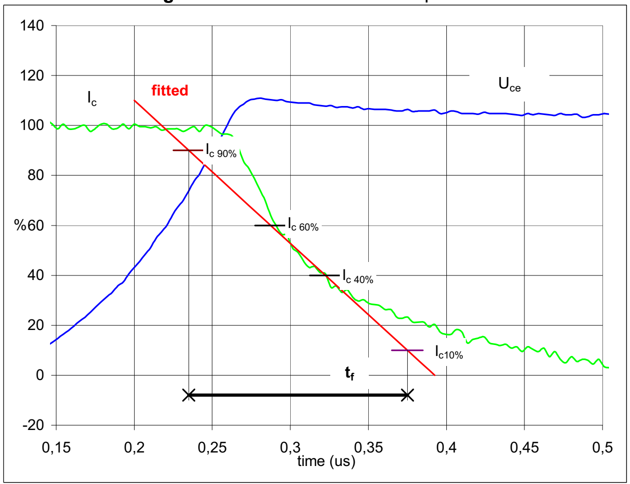
Turn-on Switching Waveforms & definition of t_{don}, t_{Eon}
(t_{Eon} = integrating time for E_{on})



V_{GE} (0%) =	-15	V
V_{GE} (100%) =	15	V
V_C (100%) =	600	V
I_C (100%) =	35	A
t_{don} =	0,09	µs
t_{Eon} =	0,37	µs

Figure 3 Output inverter IGBT

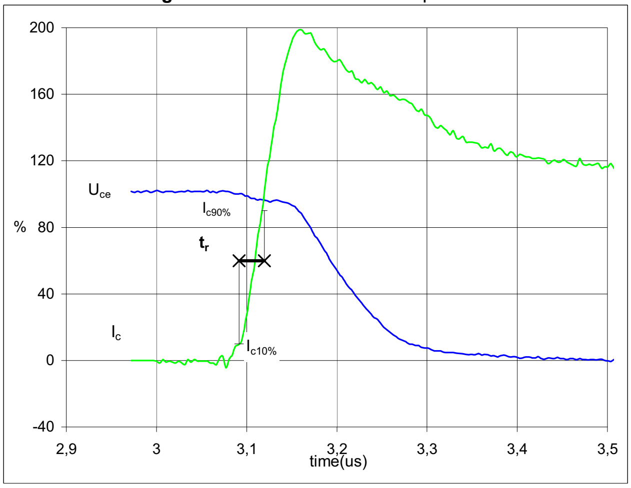
Turn-off Switching Waveforms & definition of t_f



V_C (100%) =	600	V
I_C (100%) =	35	A
t_f =	0,12	µs

Figure 4 Output inverter IGBT

Turn-on Switching Waveforms & definition of t_r

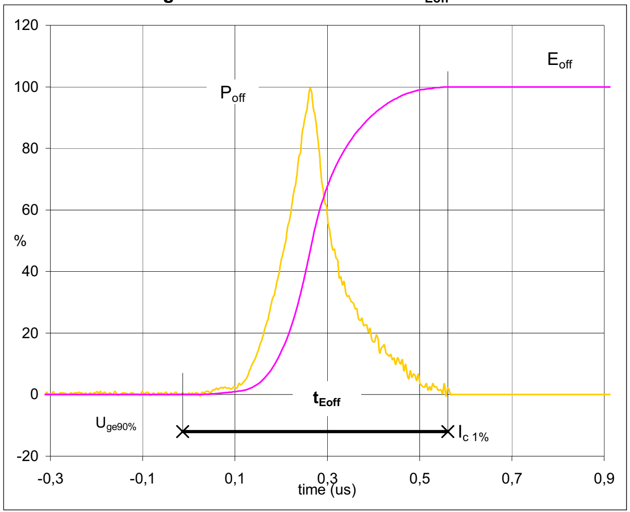


V_C (100%) =	600	V
I_C (100%) =	35	A
t_r =	0,03	µs

Switching Definitions Output Inverter

Figure 5 Output inverter IGBT

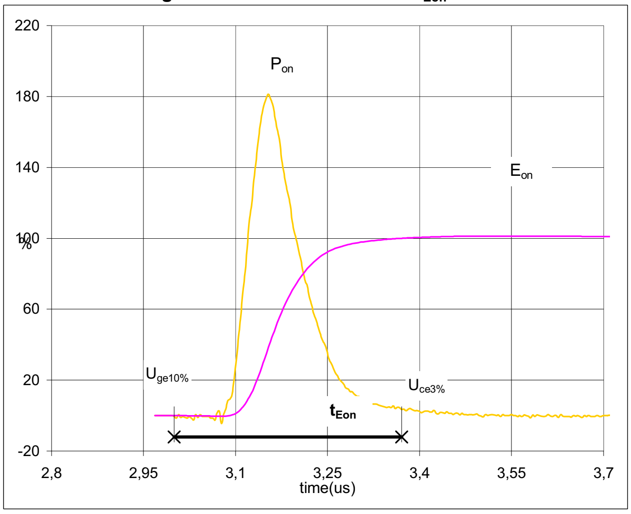
Turn-off Switching Waveforms & definition of t_{Eoff}



P_{off} (100%) =	21,08	kW
E_{off} (100%) =	2,91	mJ
t_{Eoff} =	0,57	μs

Figure 6 Output inverter IGBT

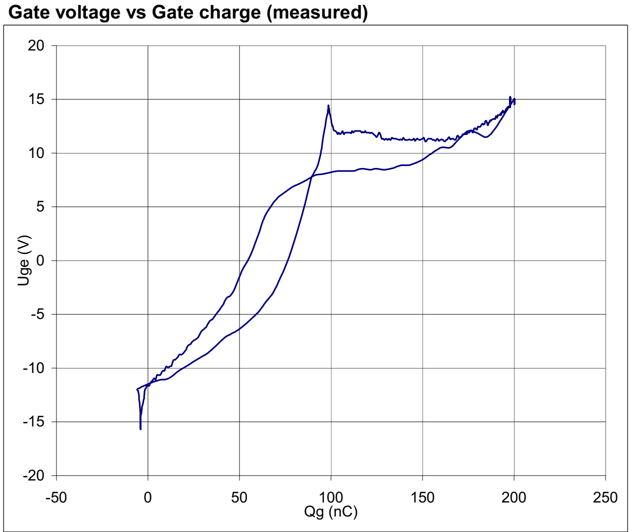
Turn-on Switching Waveforms & definition of t_{Eon}



P_{on} (100%) =	21,08	kW
E_{on} (100%) =	3,71	mJ
t_{Eon} =	0,37	μs

Figure 7 Output inverter FRED

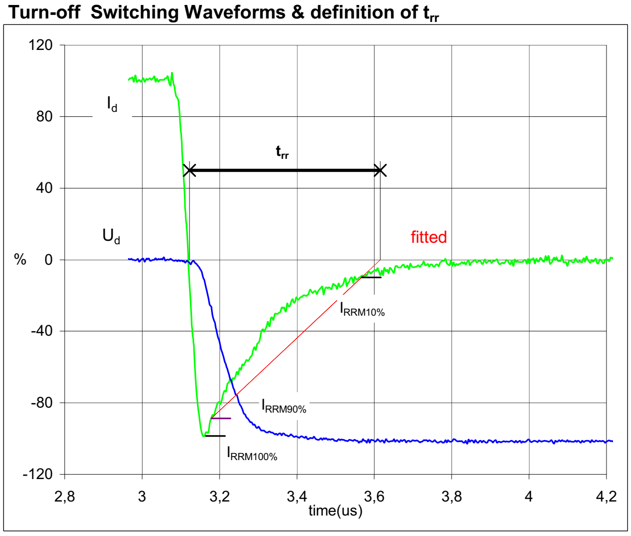
Gate voltage vs Gate charge (measured)



V_{GEoff} =	-15	V
V_{GEon} =	15	V
V_C (100%) =	600	V
I_C (100%) =	35	A
Q_g =	1132	nC

Figure 8 Output inverter IGBT

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

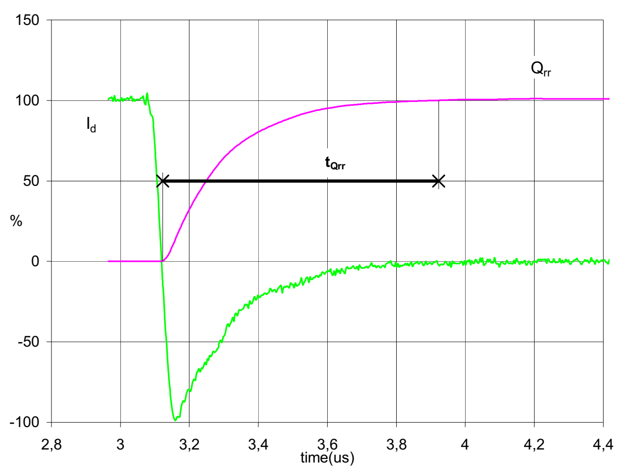


V_d (100%) =	600	V
I_d (100%) =	35	A
I_{RRM} (100%) =	-34	A
t_{rr} =	0,49	μs

Switching Definitions Output Inverter

Figure 9 Output inverter FRED

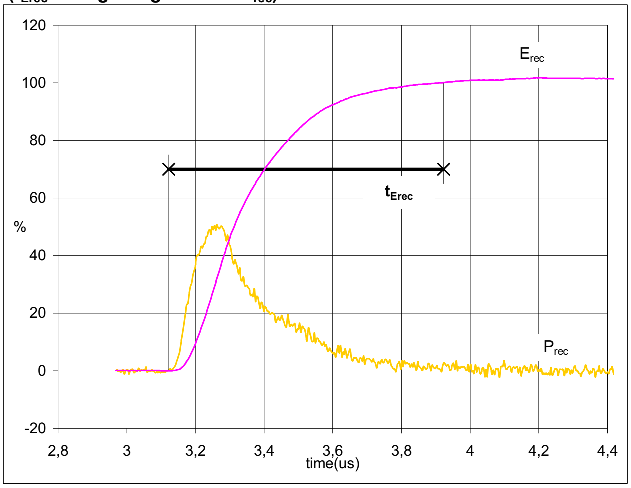
Turn-on Switching Waveforms & definition of t_{Qrr}
(t_{Qrr} = integrating time for Q_{rr})



I_d (100%) =	35	A
Q_{rr} (100%) =	7,00	µC
t_{Qrr} =	0,80	µs

Figure 10 Output inverter FRED

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

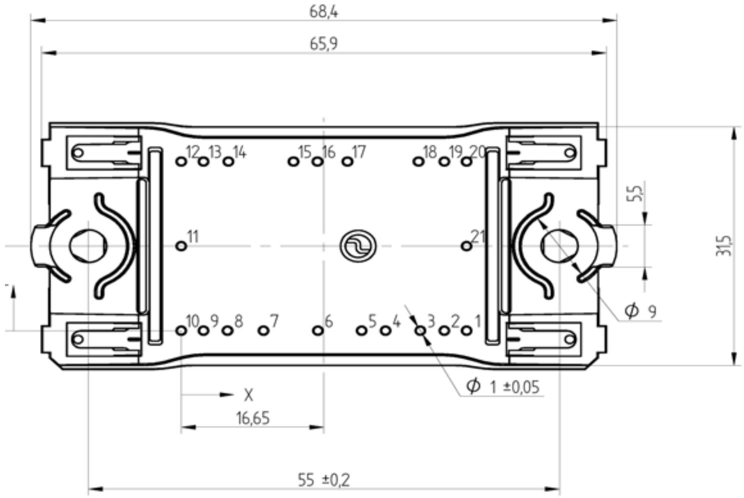


P_{rec} (100%) =	21,08	kW
E_{rec} (100%) =	2,81	mJ
t_{Erec} =	0,80	µs

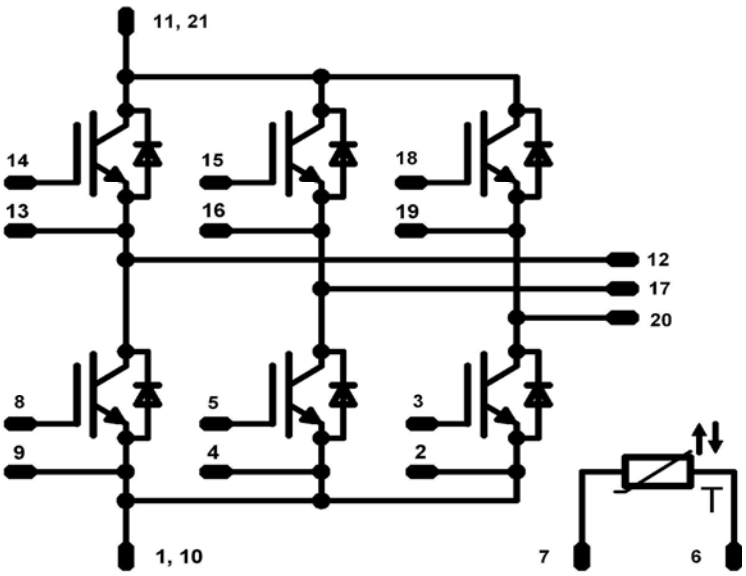
Package Outline and Pinout

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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Datasheet Status	Product Status	Definition
Target	Formative or In Design	This datasheet contains the design specifications for product development. Specifications may change in any manner without notice. The data contained is exclusively intended for technically trained staff.
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