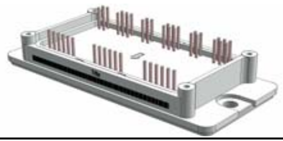
flowPACK 2 3rd gen 1200V/150A

Features

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

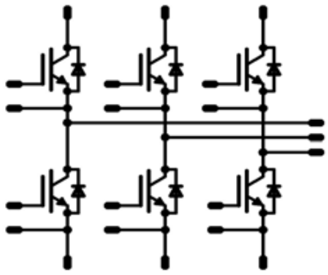
flow2 housing



Target Applications

- Motor Drive
- Power Generation
- UPS

Schematic



Types

- V23990-P680-F

Maximum Ratings

Tj=25°C, unless otherwise specified

Parameter	Symbol	Condition		Value	Unit
Inverter Transistor					
Collector-emitter break down voltage	V_{CE}			1200	V
DC collector current	I_C	$T_j=T_j$max	$T_h=80°C$ $T_c=80°C$	134 150	A
Repetitive peak collector current	I_{Cpulse}	t_p limited by $T_j$max		450	A
Power dissipation per IGBT	P_{tot}	$T_j=T_j$max	$T_h=80°C$ $T_c=80°C$	313 475	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	$T_j$max			175	°C
Inverter Diode					
Peak Repetitive Reverse Voltage	V_{RRM}	$T_j=25°C$		1200	V
DC forward current	I_F	$T_j=T_j$max	$T_h=80°C$ $T_c=80°C$	110 145	A
Repetitive peak forward current	I_{FRM}	t_p limited by $T_j$max		300	A
Power dissipation per Diode	P_{tot}	$T_j=T_j$max	$T_h=80°C$ $T_c=80°C$	189 287	W
Maximum Junction Temperature	$T_j$max			175	°C
Thermal Properties					
Storage temperature	T_{stg}			-40…+125	°C
Operation temperature under switching condition	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

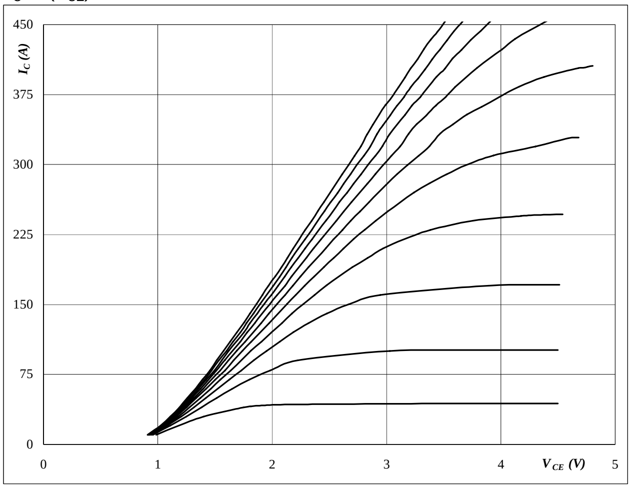
Parameter	Symbol	Conditions					Value			Unit
			V_{GE} [V] or V_{GS} [V]	V_r [V] or V_{CE} [V] or V_{DS} [V]	I_C [A] or I_F [A] or I_D [A]	T_j	Min	Typ	Max	
Inverter Transistor										
Gate emitter threshold voltage	$V_{GE(th)}$	VCE=VGE			0.006	Tj=25°C Tj=150°C	5	5.8	6.5	V
Collector-emitter saturation voltage	$V_{CE(sat)}$		15		150	Tj=25°C Tj=150°C	1.5	1.85	2.5	V
Collector-emitter cut-off current incl. Diode	I_{CES}		0	1200		Tj=25°C Tj=150°C			0.04	mA
Gate-emitter leakage current	I_{GES}		20	0		Tj=25°C Tj=150°C			700	nA
Integrated Gate resistor	R_{gint}							5		Ω
Turn-on delay time	$t_{d(on)}$	Rgoff=4 Ω Rgon=4 Ω	±15	600	150	Tj=25°C Tj=150°C		213 229		ns
Rise time	t_r					Tj=25°C Tj=150°C		35 44		
Turn-off delay time	$t_{d(off)}$					Tj=25°C Tj=150°C		326 410		
Fall time	t_f					Tj=25°C Tj=150°C		68 104		
Turn-on energy loss per pulse	E_{on}					Tj=25°C Tj=150°C		12.68 18.80		mWs
Turn-off energy loss per pulse	E_{off}					Tj=25°C Tj=150°C		8.07 12.85		
Input capacitance	C_{ies}	f=1MHz	0	25		Tj=25°C		8800		pF
Output capacitance	C_{oss}							580		
Reverse transfer capacitance	C_{rss}							470		
Gate charge	Q_{Gate}	Vcc=960V	±15		150	Tj=25°C		750		nC
Thermal resistance chip to heatsink per chip	R_{thJH}	Thermal grease thickness≤50um λ = 1 W/mK						0.30		K/W
Thermal resistance chip to case per chip	R_{thJC}							0.20		
Inverter Diode										
Diode forward voltage	V_F				150	Tj=25°C Tj=150°C	1.3	1.94 1.98	2.5	V
Peak reverse recovery current	I_{RRM}	Rgon=4 Ω	±15	600	150	Tj=25°C Tj=150°C		143 168		A
Reverse recovery time	t_{rr}					Tj=25°C Tj=150°C		287 465		ns
Reverse recovered charge	Q_{rr}					Tj=25°C Tj=150°C		15.56 29.16		μC
Peak rate of fall of recovery current	di(rec)max /dt					Tj=25°C Tj=150°C		3267 1615		A/μs
Reverse recovered energy	Erec					Tj=25°C Tj=150°C		5.71 10.81		mWs
Thermal resistance chip to heatsink per chip	R_{thJH}	Thermal grease thickness≤50um λ = 1 W/mK						0.50		K/W
Thermal resistance chip to case per chip	R_{thJC}							0.33		

Output Inverter

Figure 1 Output inverter IGBT

Typical output characteristics

$I_C = f(V_{CE})$



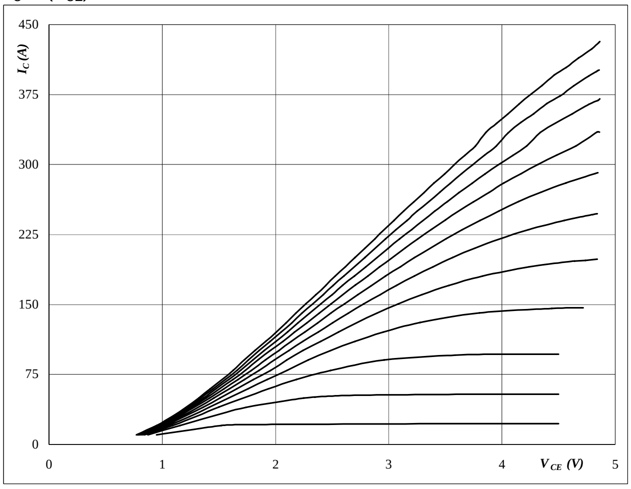
At

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

Figure 2 Output inverter IGBT

Typical output characteristics

$I_C = f(V_{CE})$



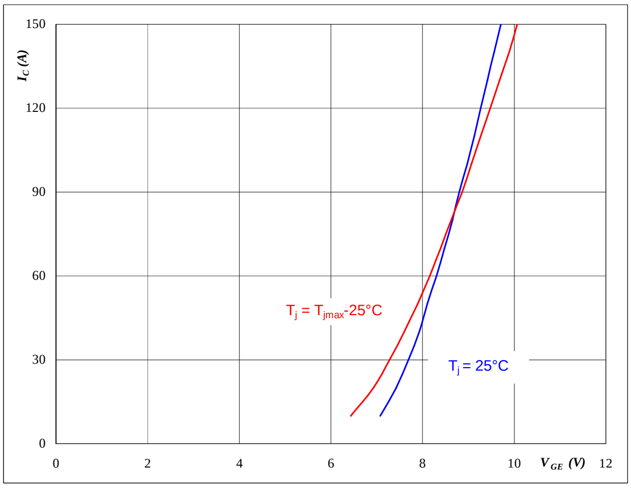
At

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

Figure 3 Output inverter IGBT

Typical transfer characteristics

$I_C = f(V_{GE})$



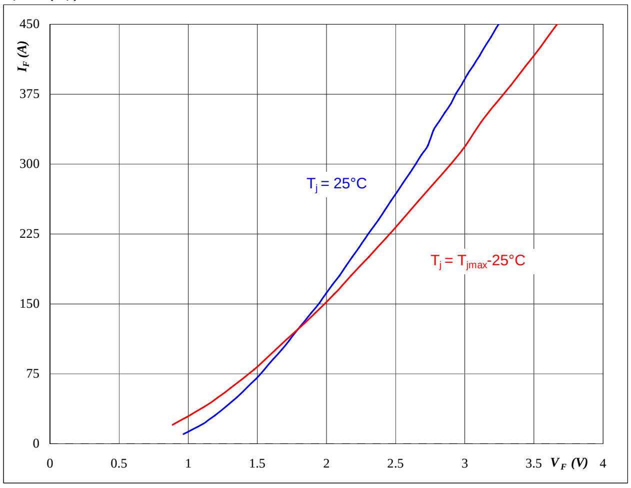
At

t_p =	250	μs
V_{CE} =	0	V

Figure 4 Output inverter FRED

Typical diode forward current as a function of forward voltage

$I_F = f(V_F)$



At

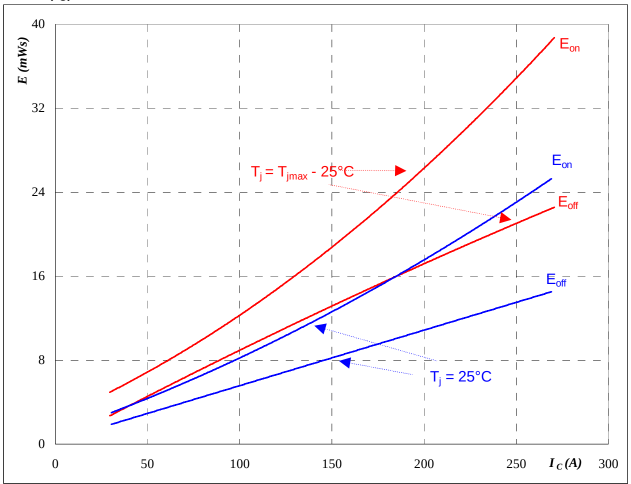
t_p =	250	μs

Output Inverter

Figure 5 Output inverter IGBT

Typical switching energy losses as a function of collector current

E = f(I_C)



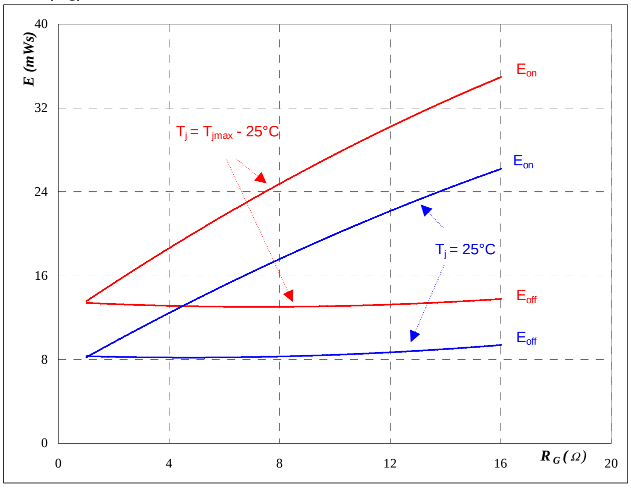
With an inductive load at

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

Figure 6 Output inverter IGBT

Typical switching energy losses as a function of gate resistor

E = f(R_G)



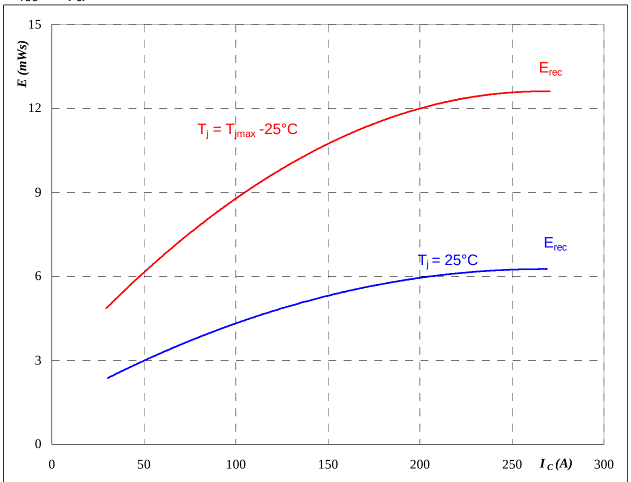
With an inductive load at

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

Figure 7 Output inverter IGBT

Typical reverse recovery energy loss as a function of collector current

E_{rec} = f(I_c)



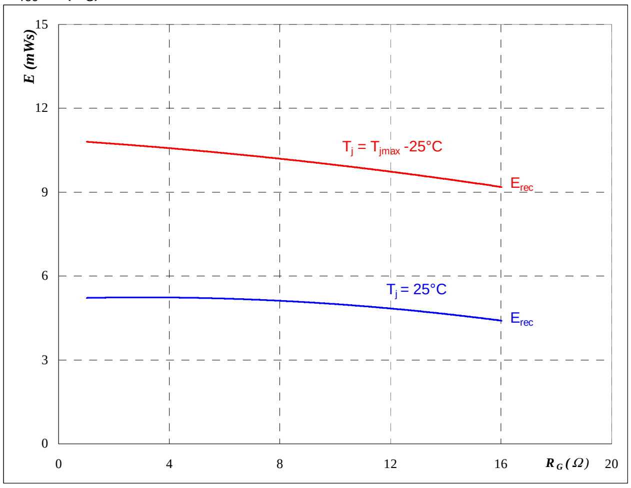
With an inductive load at

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

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

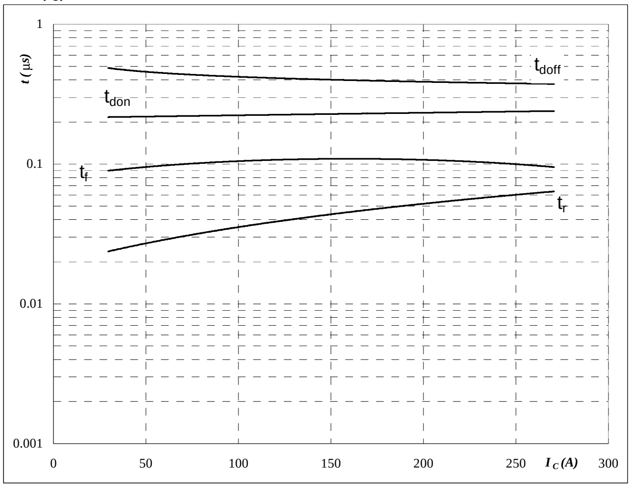
T_j =	25/150	°C
V_{CE} =	600	V
V_{GE} =	±15	V
I_C =	150	A

Output Inverter

Figure 9 Output inverter IGBT

Typical switching times as a function of collector current

t = f(I_C)



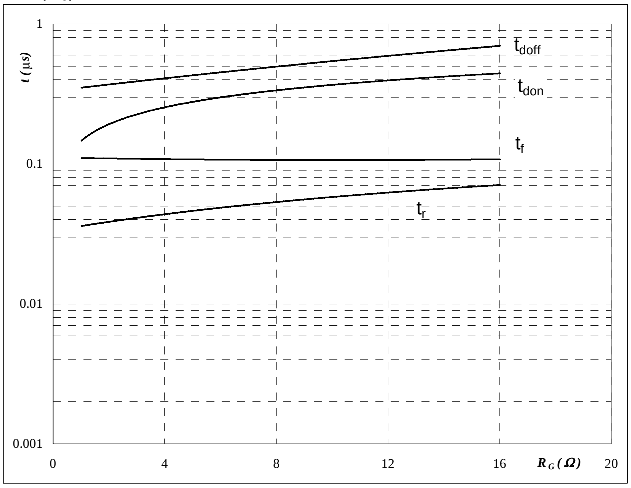
With an inductive load at

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

Figure 10 Output inverter IGBT

Typical switching times as a function of gate resistor

t = f(R_G)



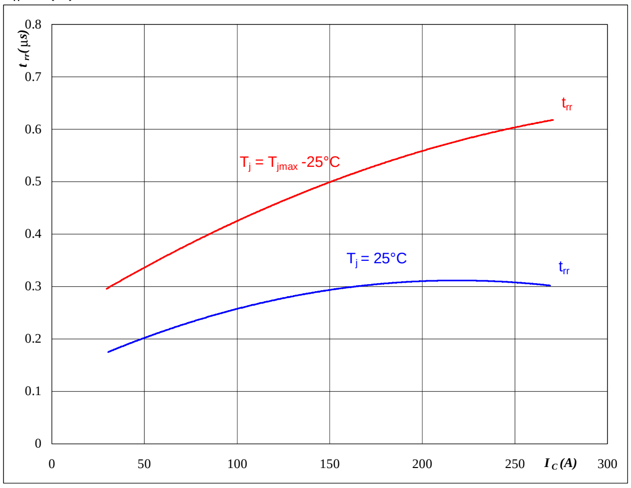
With an inductive load at

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

Figure 11 Output inverter FRED

Typical reverse recovery time as a function of collector current

t_{rr} = f(Ic)



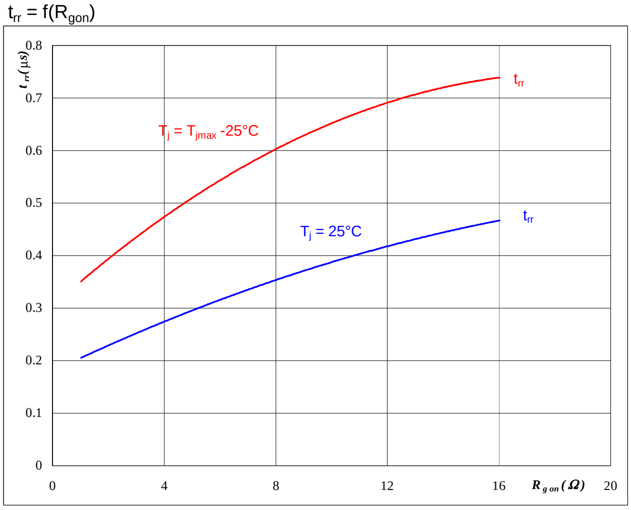
At

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

Figure 12 Output inverter FRED

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

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



At

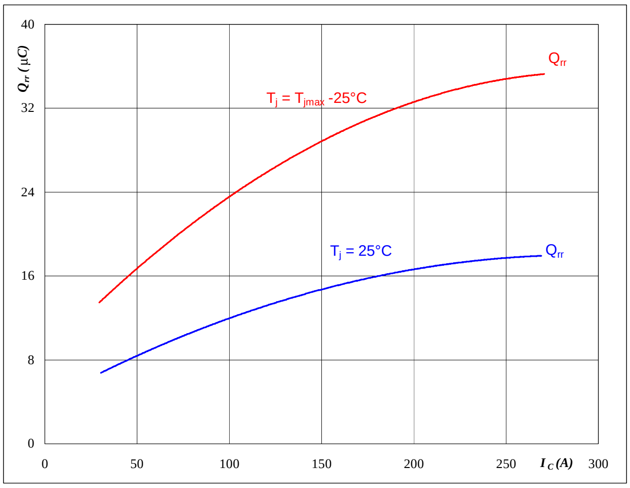
T_j =	25/150	°C
V_R =	600	V
I_F =	150	A
V_{GE} =	±15	V

Output Inverter

Figure 13 Output inverter FRED

Typical reverse recovery charge as a function of collector current

$Q_{rr} = f(I_C)$



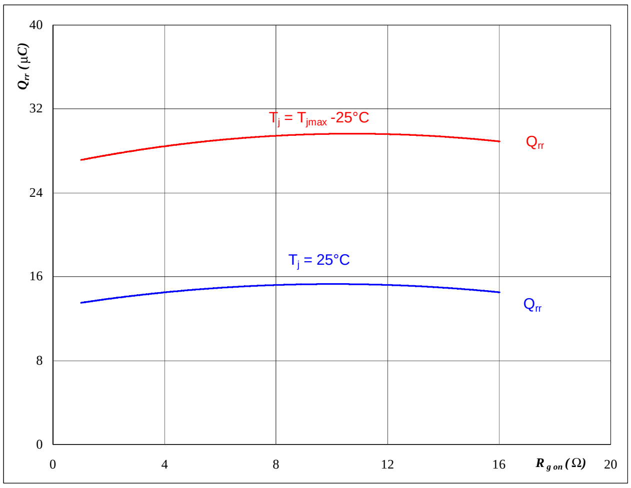
At

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

Figure 14 Output inverter FRED

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

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



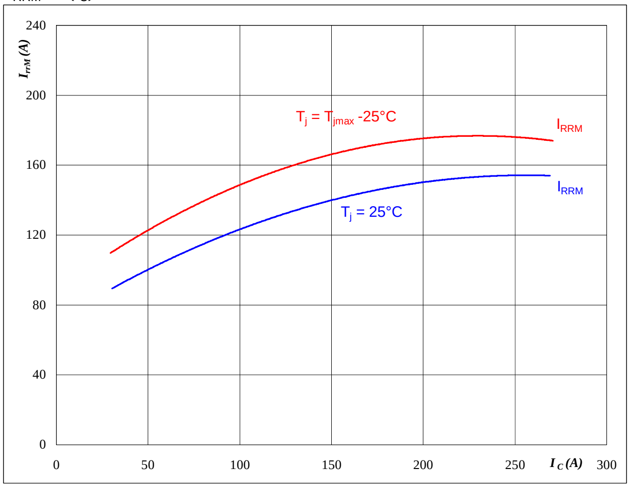
At

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

Figure 15 Output inverter FRED

Typical reverse recovery current as a function of collector current

$I_{RRM} = f(I_C)$



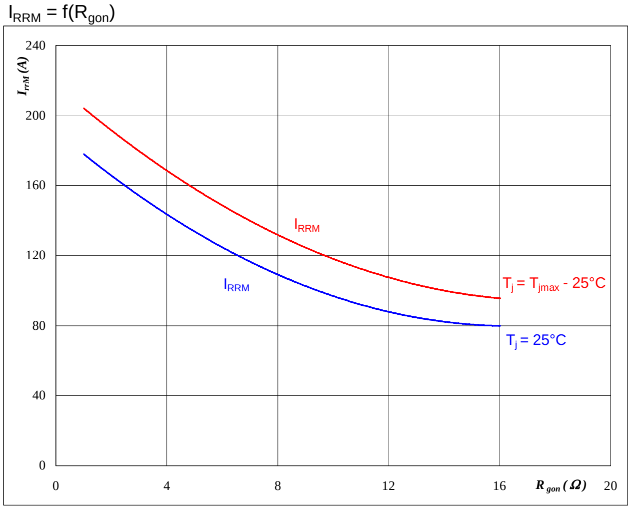
At

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

Figure 16 Output inverter FRED

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

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



At

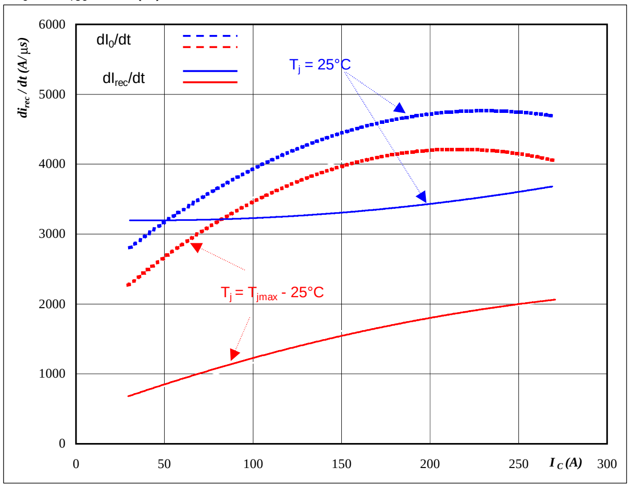
T_j =	25/150	°C
V_R =	600	V
I_F =	150	A
V_{GE} =	±15	V

Output Inverter

Figure 17 Output inverter FRED

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

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



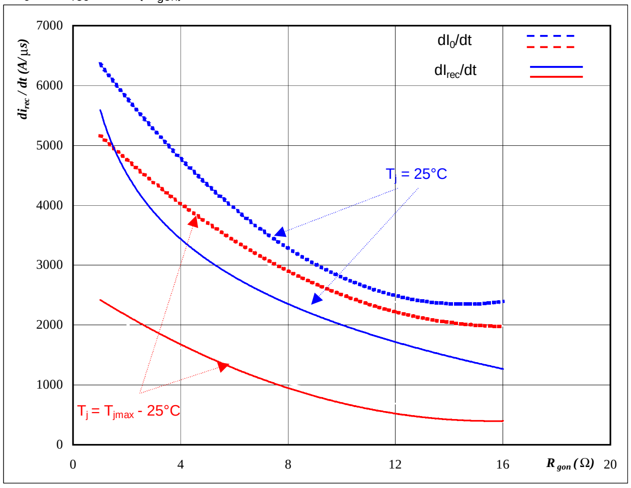
At

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

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



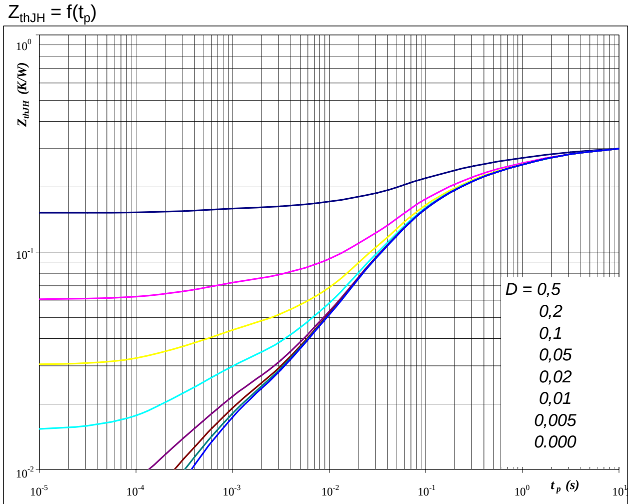
At

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

Figure 19 Output inverter IGBT

IGBT transient thermal impedance as a function of pulse width

$Z_{thJH} = f(t_p)$



At

D =	t_p / T	
R_{thJH} =	0.30	K/W

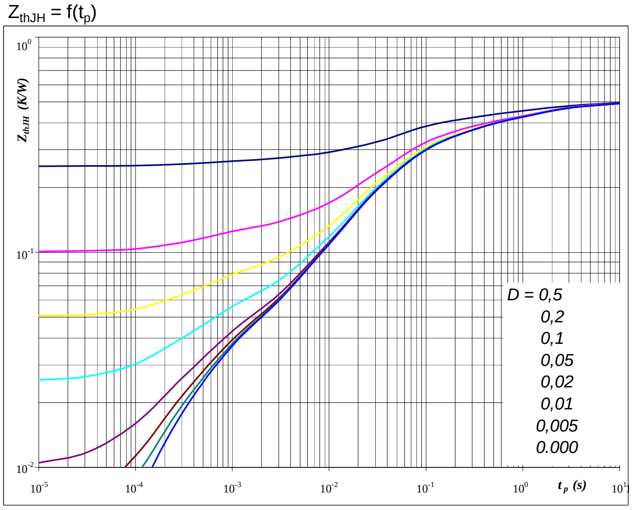
IGBT thermal model values

R (C/W)	Tau (s)
0.03	4.8E+00
0.06	1.1E+00
0.10	1.8E-01
0.09	3.7E-02
0.01	3.8E-03
0.01	3.9E-04

Figure 20 Output inverter FRED

FRED transient thermal impedance as a function of pulse width

$Z_{thJH} = f(t_p)$



At

D =	t_p / T	
R_{thJH} =	0.50	K/W

FRED thermal model values

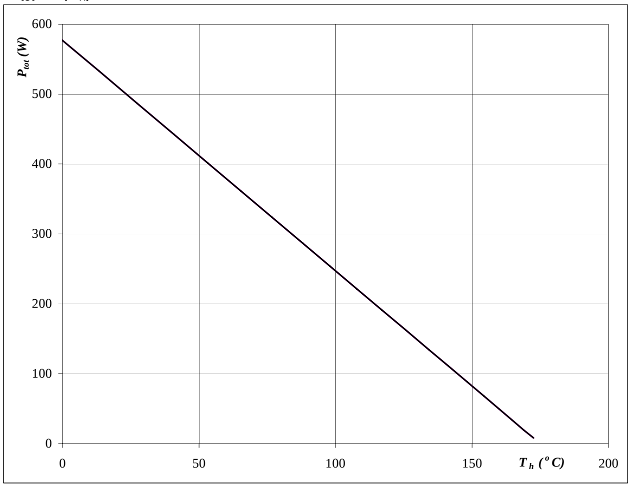
R (C/W)	Tau (s)
0.03	1.0E+01
0.10	1.4E+00
0.12	1.8E-01
0.19	3.3E-02
0.03	4.7E-03
0.03	4.2E-04

Output Inverter

Figure 21 Output inverter IGBT

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_h)$



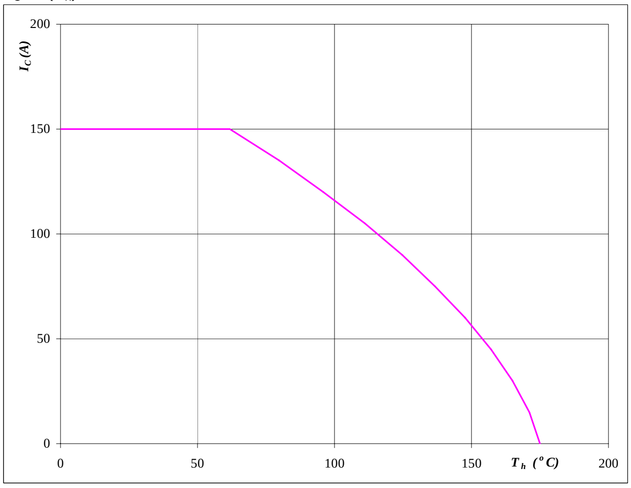
At

T_j =	175	°C	single heating
			overall heating

Figure 22 Output inverter IGBT

Collector current as a function of heatsink temperature

$I_C = f(T_h)$



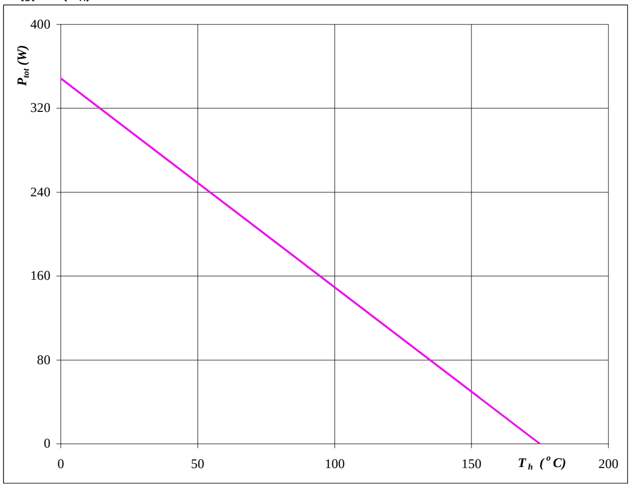
At

T_j =	175	°C
V_{GE} =	15	V

Figure 23 Output inverter FRED

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_h)$



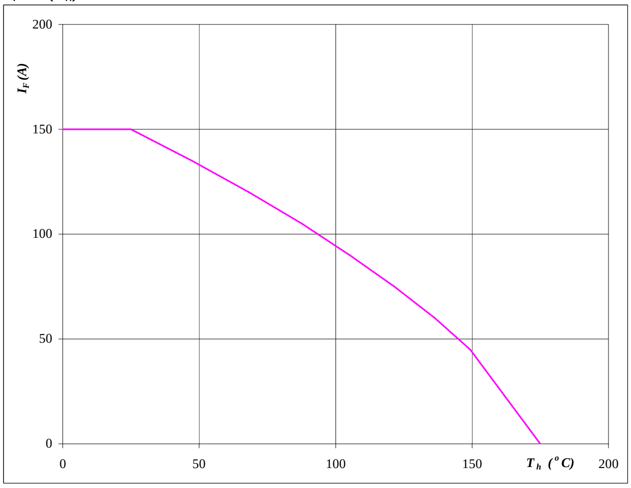
At

T_j =	175	°C	single heating
			overall heating

Figure 24 Output inverter FRED

Forward current as a function of heatsink temperature

$I_F = f(T_h)$



At

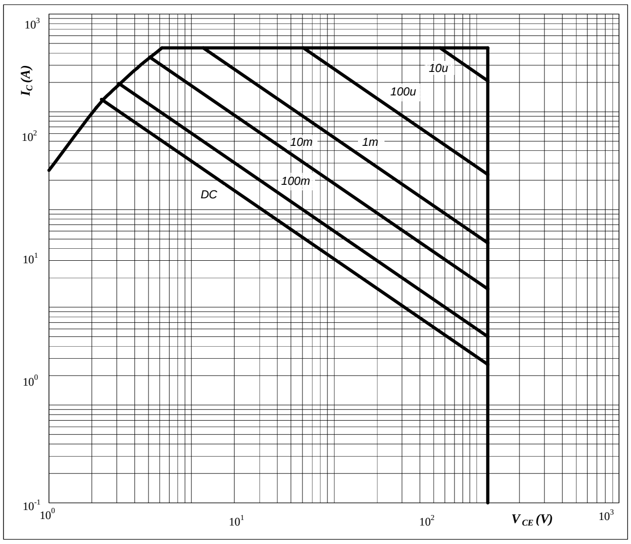
T_j =	175	°C

Output Inverter

Figure 25 Output inverter IGBT

Safe operating area as a function of collector-emitter voltage

$I_C = f(V_{CE})$



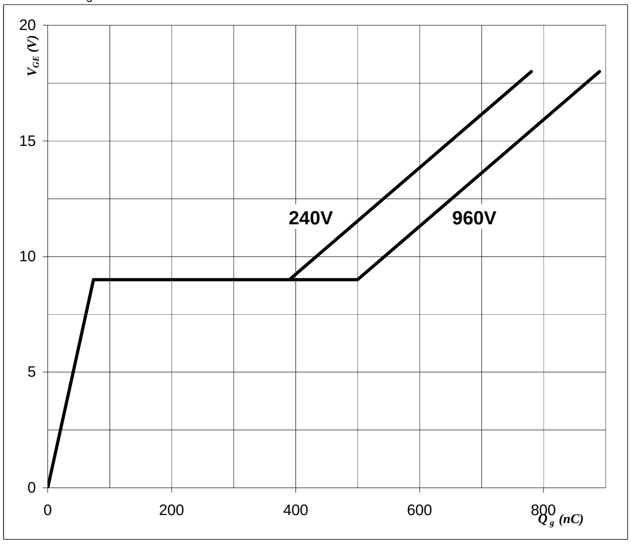
At

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

Figure 26 Output inverter IGBT

Gate voltage vs Gate charge

$V_{GE} = f(Q_g)$



At

I_C =	150	A

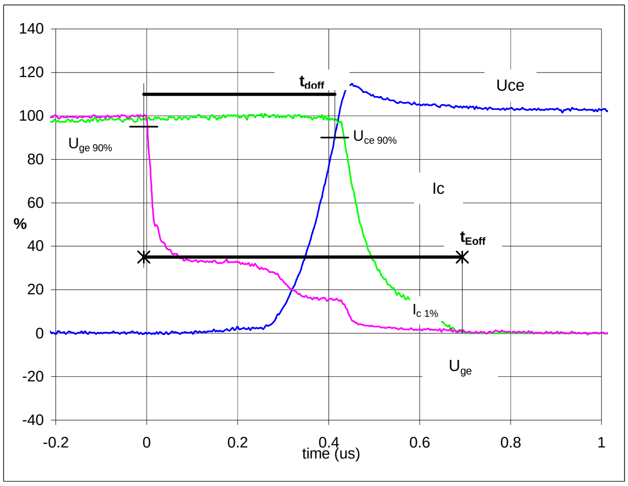
Switching Definitions Output Inverter

General conditions

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

Figure 1 Output inverter IGBT

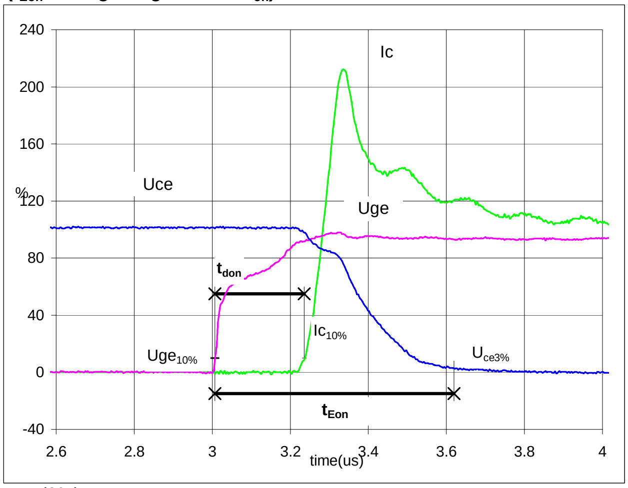
Turn-off Switching Waveforms & definition of tdoff, tEoff
(t_{Eoff} = integrating time for E_{off})



V_{GE} (0%) =	-15	V
V_{GE} (100%) =	15	V
V_C (100%) =	600	V
I_C (100%) =	149	A
t_{doff} =	0.41	μs
t_{Eoff} =	0.70	μs

Figure 2 Output inverter IGBT

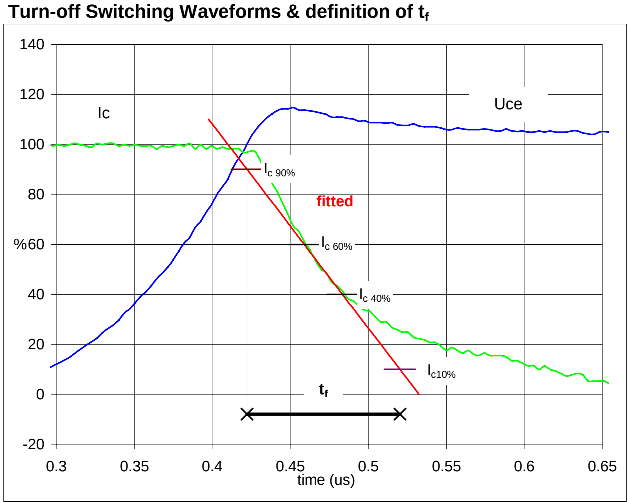
Turn-on Switching Waveforms & definition of tdon, tEon
(t_{Eon} = integrating time for E_{on})



V_{GE} (0%) =	-15	V
V_{GE} (100%) =	15	V
V_C (100%) =	600	V
I_C (100%) =	149	A
t_{don} =	0.23	μs
t_{Eon} =	0.61	μs

Figure 3 Output inverter IGBT

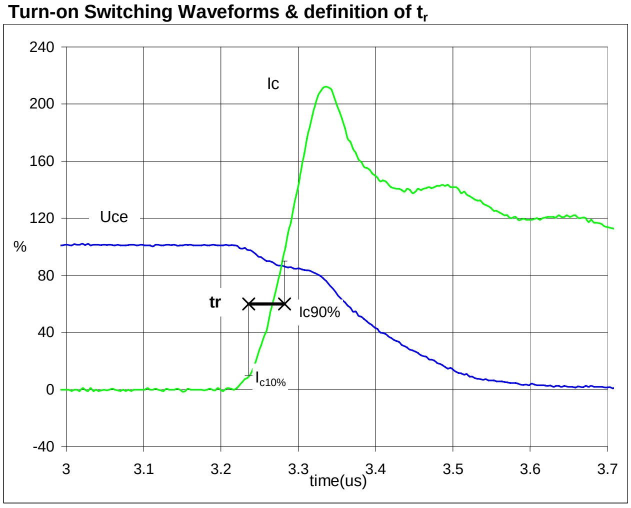
Turn-off Switching Waveforms & definition of t_f



V_C (100%) =	600	V
I_C (100%) =	149	A
t_f =	0.10	μs

Figure 4 Output inverter IGBT

Turn-on Switching Waveforms & definition of t_r

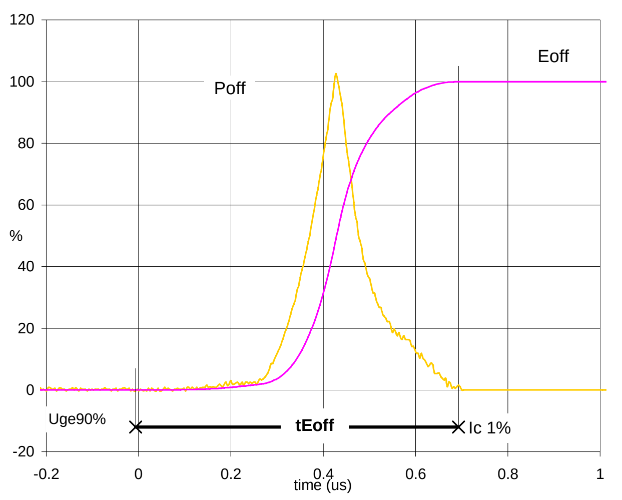


V_C (100%) =	600	V
I_C (100%) =	149	A
t_r =	0.04	μs

Switching Definitions Output Inverter

Figure 5 Output inverter IGBT

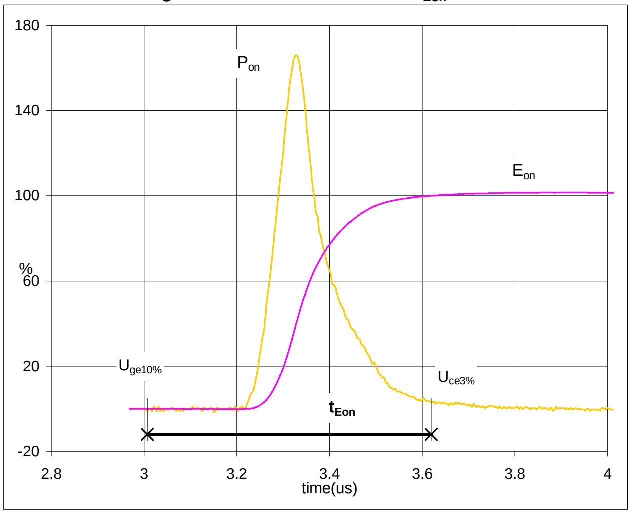
Turn-off Switching Waveforms & definition of t_{Eoff}



P_{off} (100%) =	89.53	kW
E_{off} (100%) =	12.85	mJ
t_{Eoff} =	0.70	μs

Figure 6 Output inverter IGBT

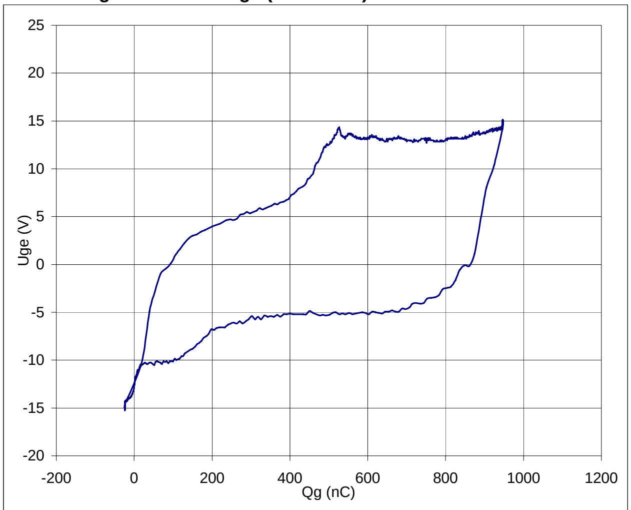
Turn-on Switching Waveforms & definition of t_{Eon}



P_{on} (100%) =	89.53	kW
E_{on} (100%) =	18.80	mJ
t_{Eon} =	0.61	μs

Figure 7 Output inverter FRED

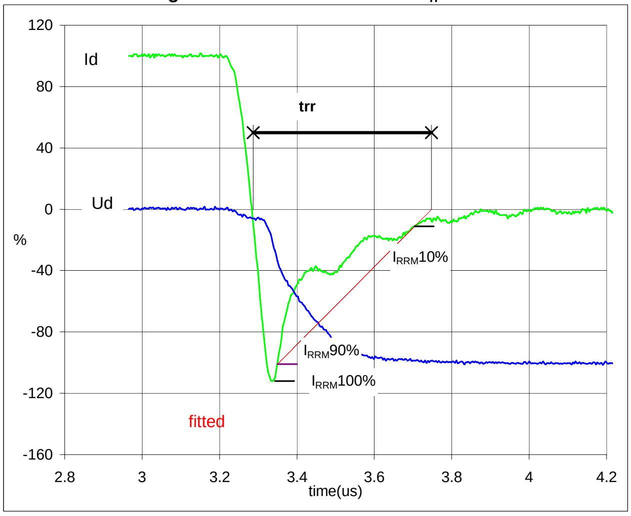
Gate voltage vs Gate charge (measured)



V_{GEoff} =	-15	V
V_{GEon} =	15	V
V_C (100%) =	600	V
I_C (100%) =	149	A
Q_g =	4677.76	nC

Figure 8 Output inverter IGBT

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

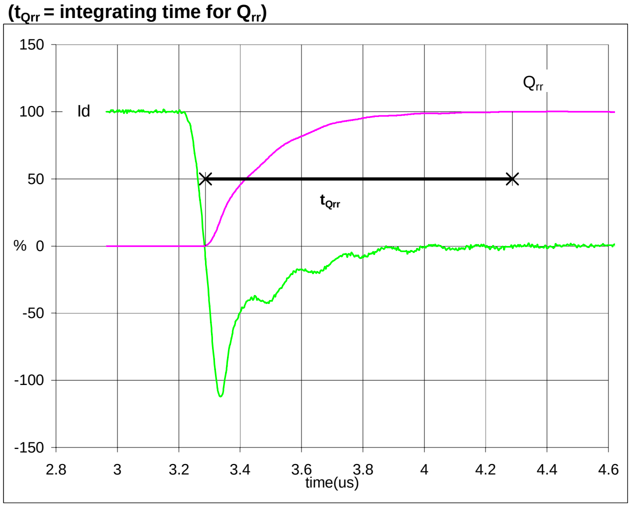


V_d (100%) =	600	V
I_d (100%) =	149	A
I_{RRM} (100%) =	-168	A
t_{rr} =	0.47	μs

Switching Definitions Output Inverter

Figure 9 Output inverter FRED

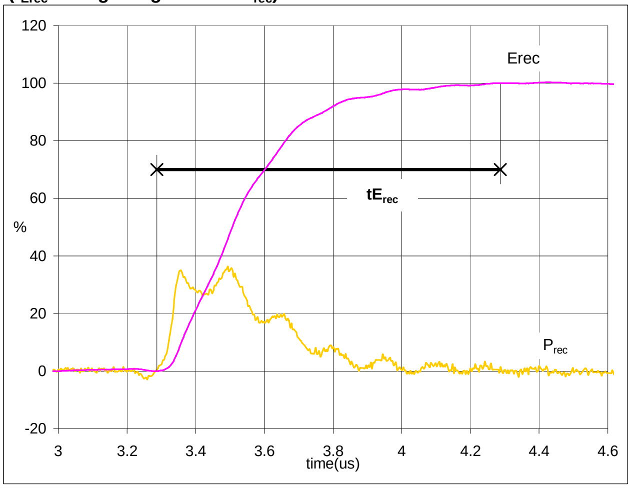
Turn-on Switching Waveforms & definition of t_{Qrr}
(t_{Qrr} = integrating time for Q_{rr})



I_d (100%) =	149	A
Q_{rr} (100%) =	29.16	µC
t_{Qrr} =	1.00	µs

Figure 10 Output inverter FRED

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

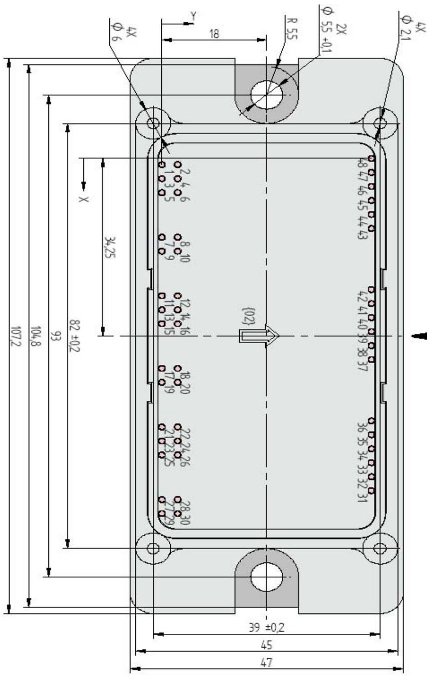


P_{rec} (100%) =	89.53	kW
E_{rec} (100%) =	10.81	mJ
t_{Erec} =	1.00	µs

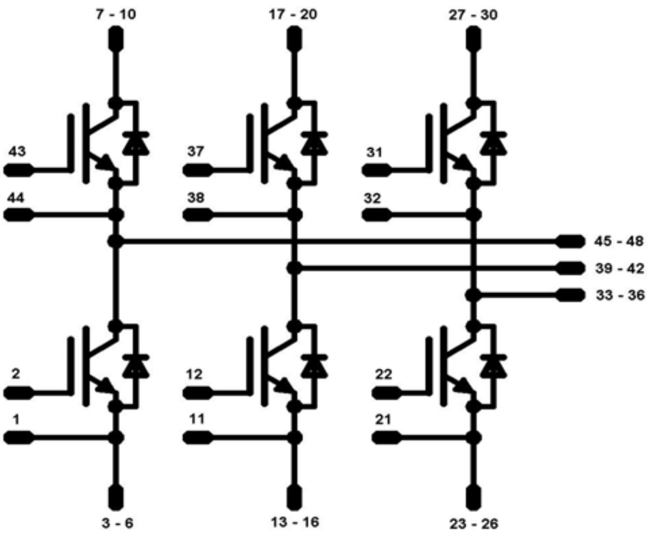
Package Outline and Pinout

Outline

Pin table			Pin table		
Pin	X	Y	Pin	X	Y
1	1,2	0	25	57,2	0
2	1,2	2,7	26	57,2	2,7
3	3,9	0	27	65,8	0
4	3,9	2,7	28	65,8	2,7
5	6,6	0	29	68,5	0
6	6,6	2,7	30	68,5	2,7
7	15,2	0	31	64,1	36
8	15,2	2,7	32	61,4	36
9	17,9	0	33	58,7	36
10	17,9	2,7	34	56	36
11	26,5	0	35	53,3	36
12	26,5	2,7	36	50,6	36
13	29,2	0	37	38,8	36
14	29,2	2,7	38	36,1	36
15	31,9	0	39	33,4	36
16	31,9	2,7	40	30,7	36
17	40,5	0	41	28	36
18	40,5	2,7	42	25,3	36
19	43,2	0	43	13,5	36
20	43,2	2,7	44	10,8	36
21	51,8	0	45	8,1	36
22	51,8	2,7	46	5,4	36
23	54,5	0	47	2,7	36
24	54,5	2,7	48	0	36



Pinout



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Datasheet Status	Product Status	Definition
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