

flowPACK 2 3rd gen
1200V/150A
Features

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

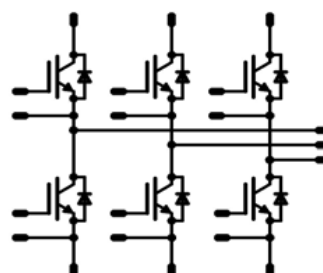
Target Applications

- Motor Drive
- Power Generation
- UPS

Types

- V23990-P680-F

flow2 housing

Schematic


Maximum Ratings

T_j=25°C, unless otherwise specified

Parameter	Symbol	Condition	Value	Unit
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Inverter Transistor

Collector-emitter break down voltage	V _{CE}		1200	V
DC collector current	I _C	T _j =T _{jmax} T _h =80°C T _c =80°C	134 150	A
Repetitive peak collector current	I _{Cpulse}	t _p limited by T _{jmax}	450	A
Power dissipation per IGBT	P _{tot}	T _j =T _{jmax} 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 _{jmax}		175	°C

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	110 145	A
Repetitive peak forward current	I _{FRM}	t _p limited by T _{jmax}	300	A
Power dissipation per Diode	P _{tot}	T _j =T _{jmax} T _h =80°C T _c =80°C	189 287	W
Maximum Junction Temperature	T _{jmax}		175	°C

Thermal Properties

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

Maximum Ratings

T_j=25°C, unless otherwise specified

Parameter	Symbol	Condition	Value	Unit
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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 _b [A]	T _j	Min	Typ	Max	
Inverter Transistor										
Gate emitter threshold voltage	V _{GE(th)}	VCE=VGE			0.006	T _j =25°C T _j =150°C	5	5.8	6.5	v
Collector-emitter saturation voltage	V _{CE(sat)}		15		150	T _j =25°C T _j =150°C	1.5	1.85	2.5	v
Collector-emitter cut-off current incl. Diode	I _{CES}		0	1200		T _j =25°C T _j =150°C			0.04	mA
Gate-emitter leakage current	I _{GES}		20	0		T _j =25°C T _j =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	T _j =25°C T _j =150°C		213 229		ns
Rise time	t _r					T _j =25°C T _j =150°C		35 44		
Turn-off delay time	t _{d(off)}					T _j =25°C T _j =150°C		326 410		
Fall time	t _f					T _j =25°C T _j =150°C		68 104		
Turn-on energy loss per pulse	E _{on}					T _j =25°C T _j =150°C		12.68 18.80		mWs
Turn-off energy loss per pulse	E _{off}					T _j =25°C T _j =150°C		8.07 12.85		
Input capacitance	C _{ies}	f=1MHz	0	25		T _j =25°C		8800		pF
Output capacitance	C _{oss}							580		
Reverse transfer capacitance	C _{rss}							470		
Gate charge	Q _{Gate}	Vcc=960V	±15		150	T _j =25°C		750		nC
Thermal resistance chip to heatsink per chip	R _{thJH}	Thermal grease thickness≤50um						0.30		K/W
Thermal resistance chip to case per chip	R _{thJC}	λ = 1 W/mK						0.20		
Inverter Diode										
Diode forward voltage	V _F				150	T _j =25°C T _j =150°C	1.3	1.94 1.98	2.5	v
Peak reverse recovery current	I _{RRM}	Rgon=4 Ω	±15	600	150	T _j =25°C T _j =150°C		143 168		A
Reverse recovery time	t _{rr}					T _j =25°C T _j =150°C		287 465		ns
Reverse recovered charge	Q _{rr}					T _j =25°C T _j =150°C		15.56 29.16		μC
Peak rate of fall of recovery current	di(rec)max /dt					T _j =25°C T _j =150°C		3267 1615		A/μs
Reverse recovered energy	E _{rec}					T _j =25°C T _j =150°C		5.71 10.81		mWs
Thermal resistance chip to heatsink per chip	R _{thJH}	Thermal grease thickness≤50um						0.50		K/W
Thermal resistance chip to case per chip	R _{thJC}	λ = 1 W/mK						0.33		

Output Inverter

Figure 1 Output inverter IGBT

Typical output characteristics

$$I_C = f(V_{CE})$$

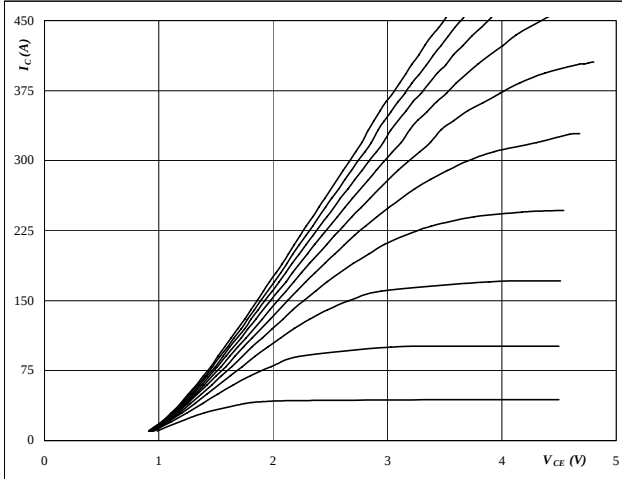

At
 $t_p = 250 \mu s$
 $T_j = 25^\circ C$
 V_{GE} from 7 V to 17 V in steps of 1 V

Figure 2 Output inverter IGBT

Typical output characteristics

$$I_C = f(V_{CE})$$

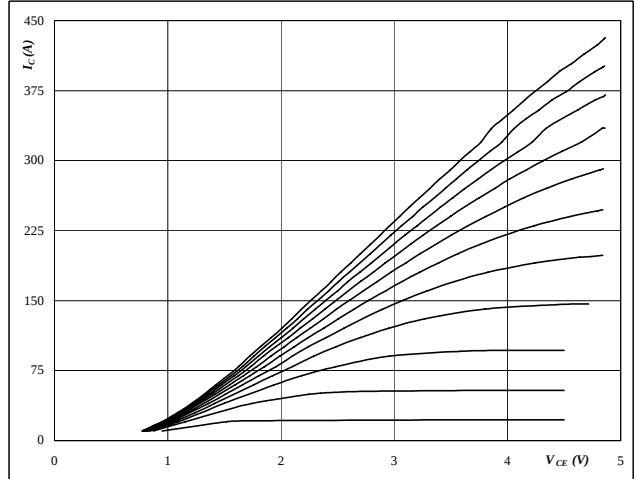
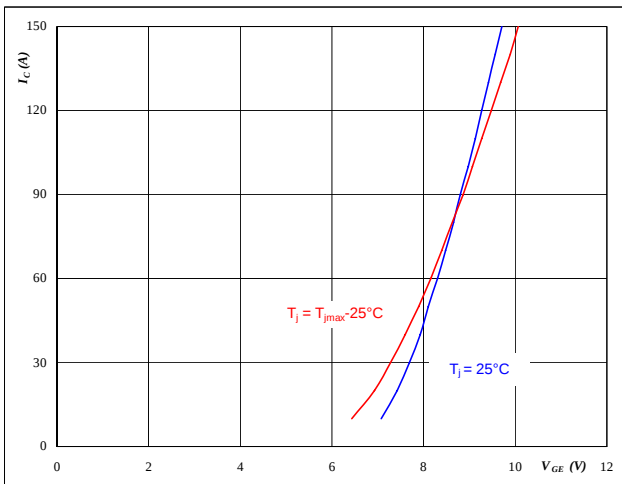

At
 $t_p = 250 \mu s$
 $T_j = 150^\circ C$
 V_{GE} from 7 V to 17 V in steps of 1 V

Figure 3 Output inverter IGBT

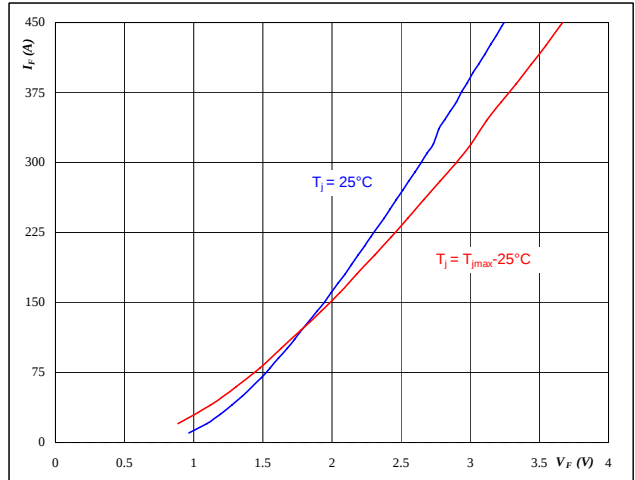
Typical transfer characteristics

$$I_C = f(V_{GE})$$


At
 $t_p = 250 \mu s$
 $V_{CE} = 0 V$
Figure 4 Output inverter FRED

Typical diode forward current as a function of forward voltage

$$I_F = f(V_F)$$

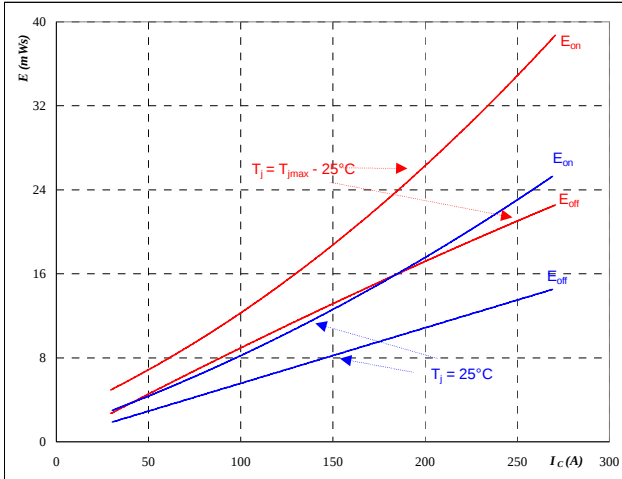

At
 $t_p = 250 \mu s$

Output Inverter

Figure 5 Output inverter IGBT

Typical switching energy losses
as a function of collector current

$$E = f(I_C)$$



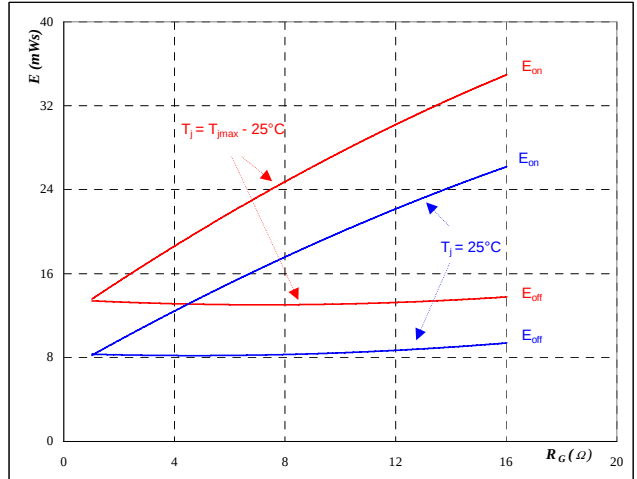
With an inductive load at

$T_j =$	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

$$E = f(R_G)$$



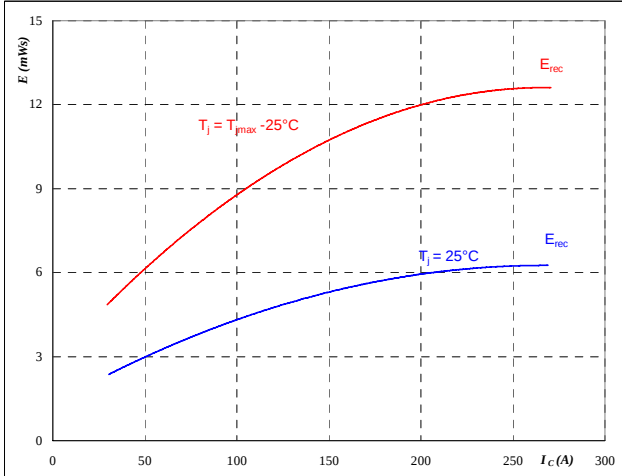
With an inductive load at

$T_j =$	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

$$E_{rec} = f(I_C)$$



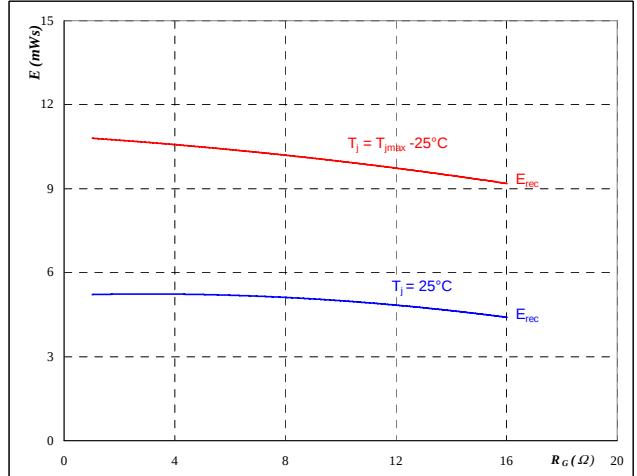
With an inductive load at

$T_j =$	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

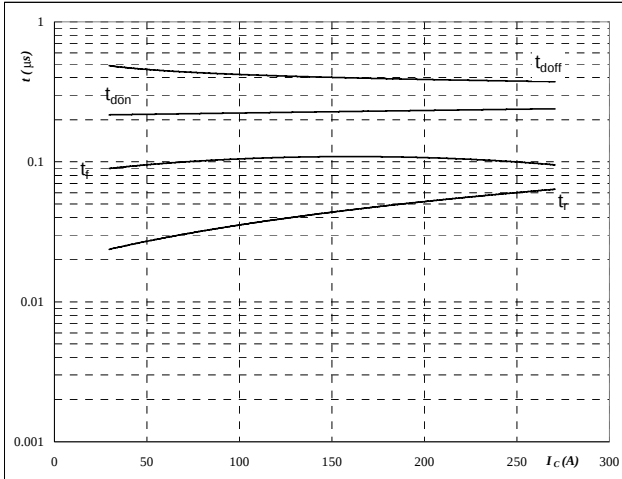
$T_j =$	25/150	°C
$V_{CE} =$	600	V
$V_{GE} =$	±15	V
$I_C =$	150	A

Output Inverter

Figure 9 Output inverter IGBT

Typical switching times as a function of collector current

$t = f(I_C)$



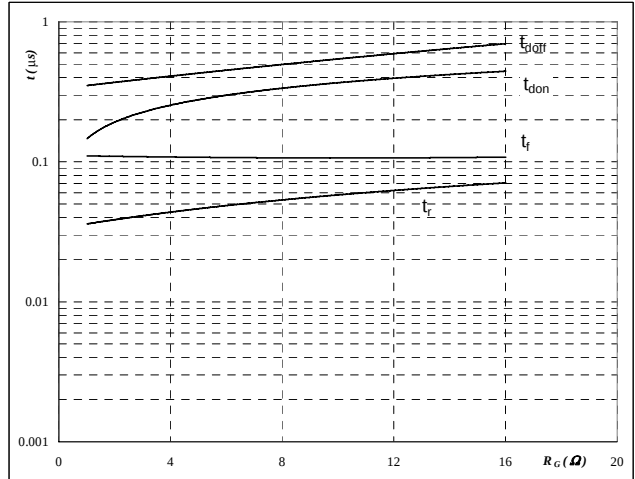
With an inductive load at

$T_J = 150$ °C
 $V_{CE} = 600$ V
 $V_{GE} = \pm 15$ V
 $R_{gon} = 4$ Ω
 $R_{goff} = 4$ Ω

Figure 10 Output inverter IGBT

Typical switching times as a function of gate resistor

$t = f(R_G)$



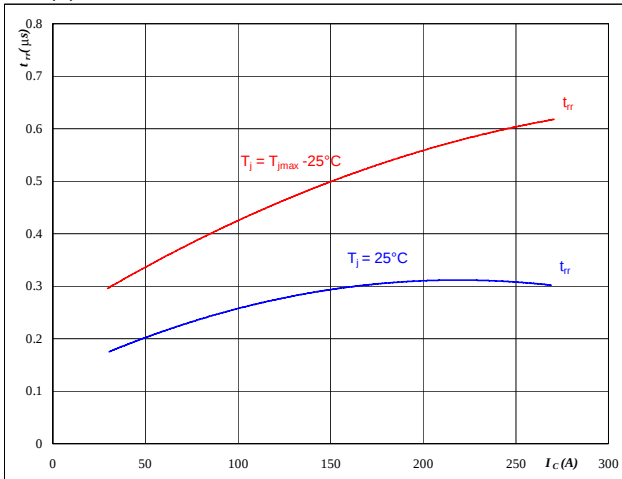
With an inductive load at

$T_J = 150$ °C
 $V_{CE} = 600$ V
 $V_{GE} = \pm 15$ V
 $I_C = 150$ A

Figure 11 Output inverter FRED

Typical reverse recovery time as a function of collector current

$t_{rr} = f(I_C)$



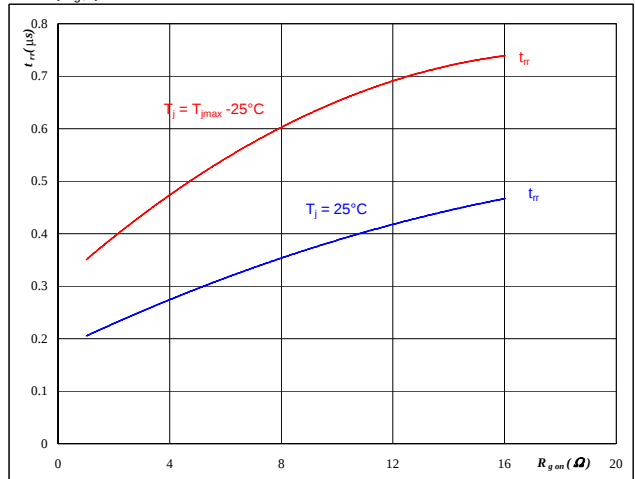
At

$T_J = 25/150$ °C
 $V_{CE} = 600$ V
 $V_{GE} = \pm 15$ 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

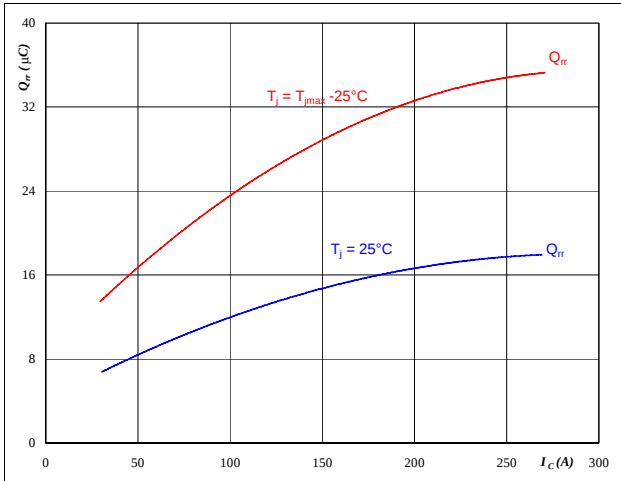
$T_J = 25/150$ °C
 $V_R = 600$ V
 $I_F = 150$ A
 $V_{GE} = \pm 15$ V

Output Inverter

Figure 13 Output inverter FRED

Typical reverse recovery charge as a function of collector current

$$Q_{rr} = f(I_C)$$

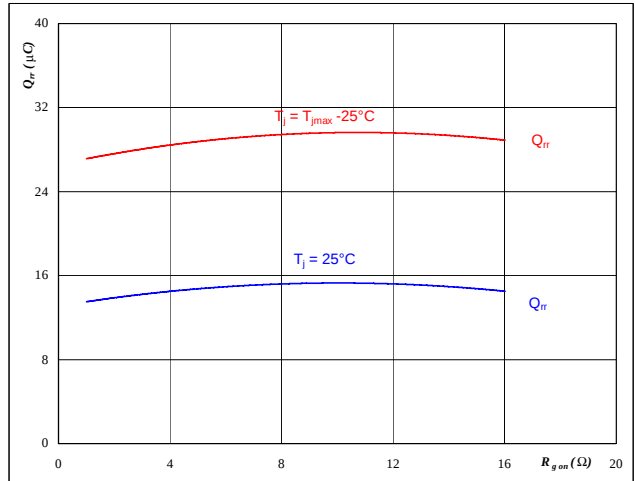


At
 $T_j = 25/150$ °C
 $V_{CE} = 600$ V
 $V_{GE} = \pm 15$ V
 $R_{gon} = 4$ Ω

Figure 14 Output inverter FRED

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

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

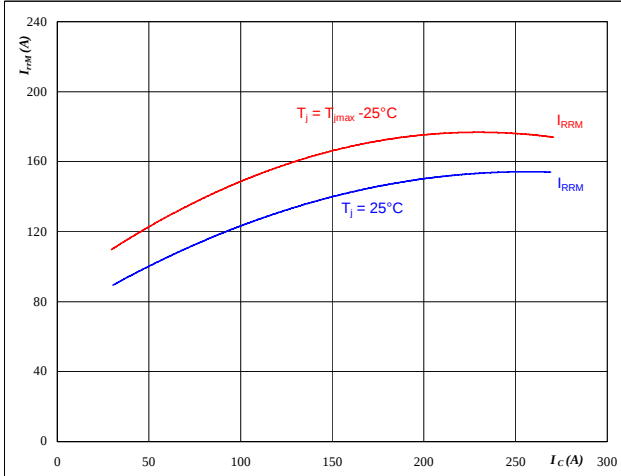


At
 $T_j = 25/150$ °C
 $V_R = 600$ V
 $I_F = 150$ A
 $V_{GE} = \pm 15$ V

Figure 15 Output inverter FRED

Typical reverse recovery current as a function of collector current

$$I_{RRM} = f(I_C)$$

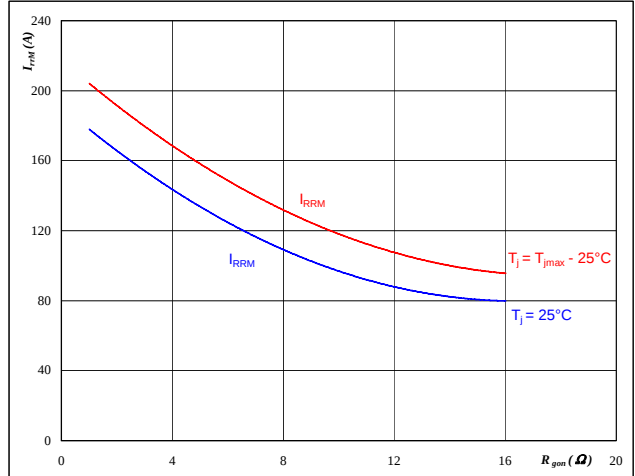


At
 $T_j = 25/150$ °C
 $V_{CE} = 600$ V
 $V_{GE} = \pm 15$ V
 $R_{gon} = 4$ Ω

Figure 16 Output inverter FRED

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

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



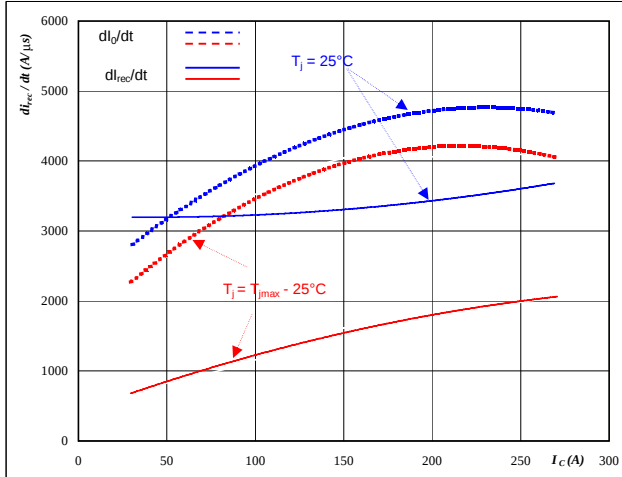
At
 $T_j = 25/150$ °C
 $V_R = 600$ V
 $I_F = 150$ A
 $V_{GE} = \pm 15$ V

Output Inverter

Figure 17 Output inverter FRED

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

$$di_o/dt, di_{rec}/dt = f(I_C)$$



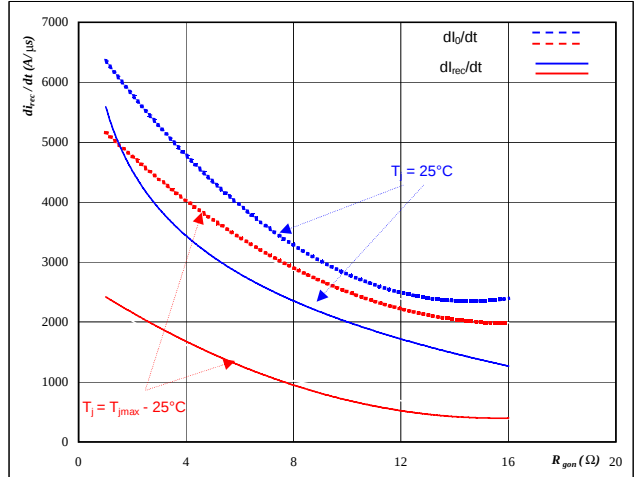
At

$T_j =$	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

$$di_o/dt, di_{rec}/dt = f(R_{gon})$$



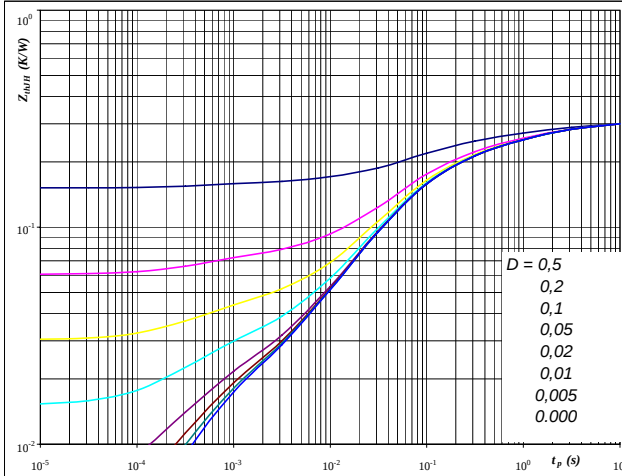
At

$T_j =$	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

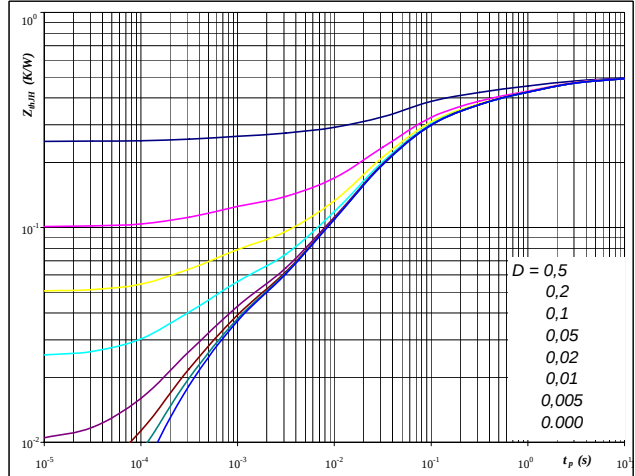
IGBT thermal model values

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

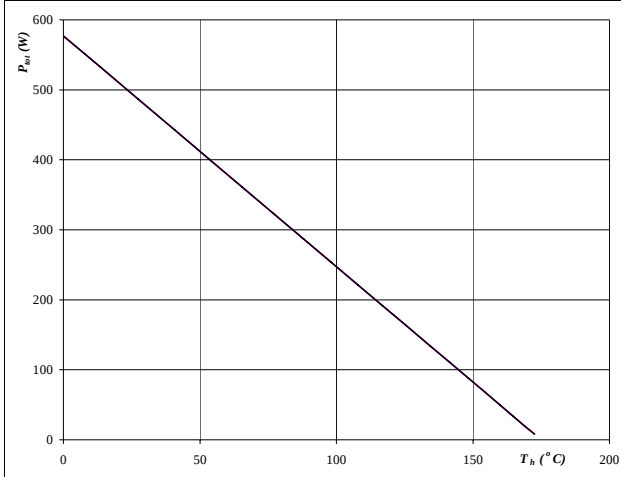
R (C/W)	Tau (s)
0.03	1.0E+01
0.10	1.4E+00
0.12	1.8E-01
0.19	3.3E-02
0.03	4.7E-03
0.03	4.2E-04

Output Inverter

Figure 21 Output inverter IGBT

Power dissipation as a function of heatsink temperature

$$P_{\text{tot}} = f(T_h)$$

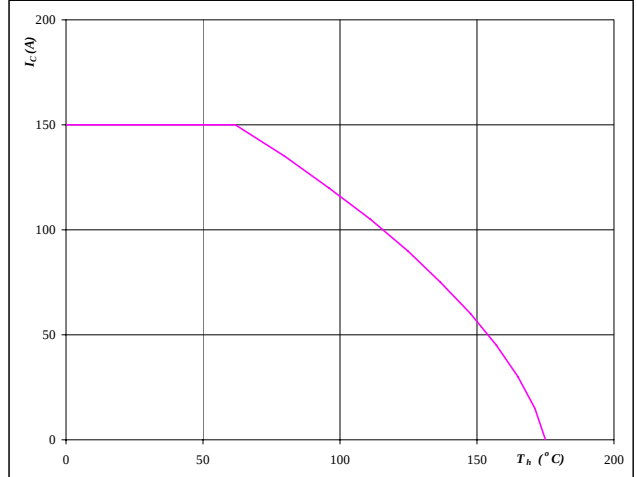


At $T_j = 175$ °C
 — single heating
 — overall heating

Figure 22 Output inverter IGBT

Collector current as a function of heatsink temperature

$$I_C = f(T_h)$$

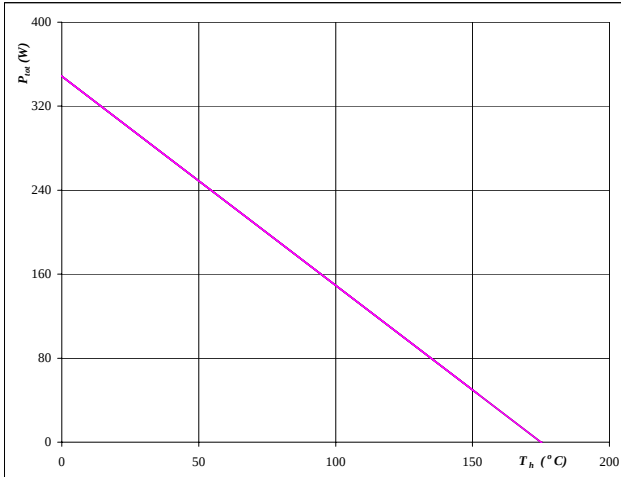


At $T_j = 175$ °C
 $V_{GE} = 15$ V

Figure 23 Output inverter FRED

Power dissipation as a function of heatsink temperature

$$P_{\text{tot}} = f(T_h)$$

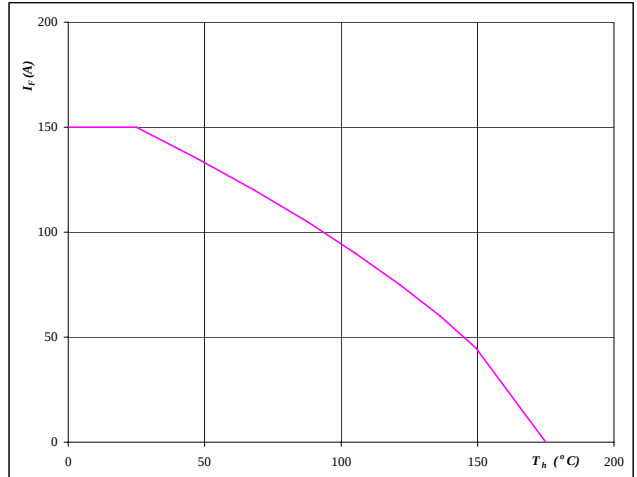


At $T_j = 175$ °C
 — single heating
 — overall heating

Figure 24 Output inverter FRED

Forward current as a function of heatsink temperature

$$I_F = f(T_h)$$



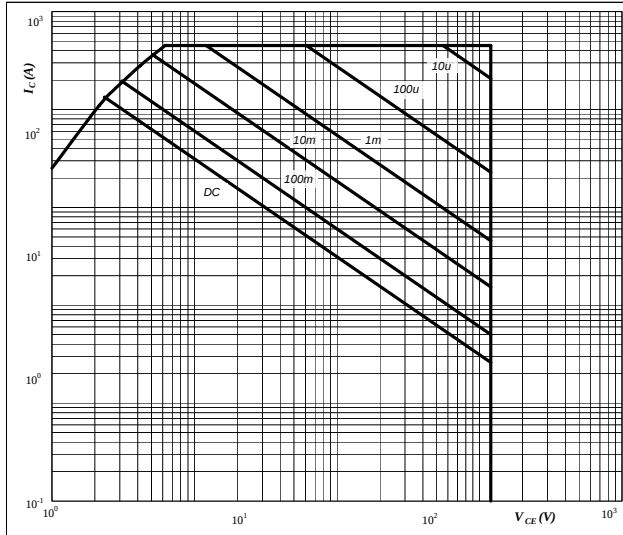
At $T_j = 175$ °C

Output Inverter

Figure 25 Output inverter IGBT

Safe operating area as a function
of collector-emitter voltage

$$I_C = f(V_{CE})$$



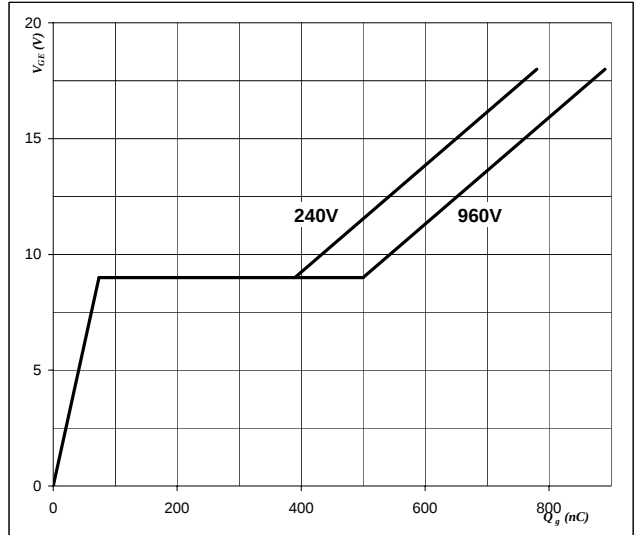
At

D = single pulse
 Th = 80 °C
 V_{GE} = ±15 V
 T_J = T_{Jmax} °C

Figure 26 Output inverter IGBT

Gate voltage vs Gate charge

$$V_{GE} = f(Q_g)$$



At

I_C = 150 A

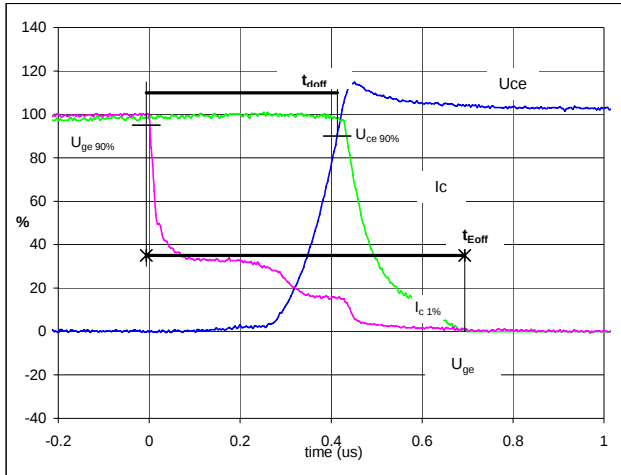
Switching Definitions Output Inverter

General conditions

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

Figure 1 Output inverter IGBT

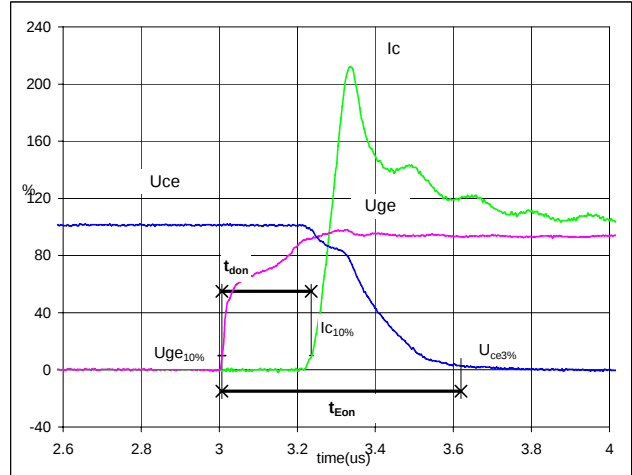
Turn-off Switching Waveforms & definition of t_{doff} , t_{Eoff}
 (t_{Eoff} = integrating time for E_{off})



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

Figure 2 Output inverter IGBT

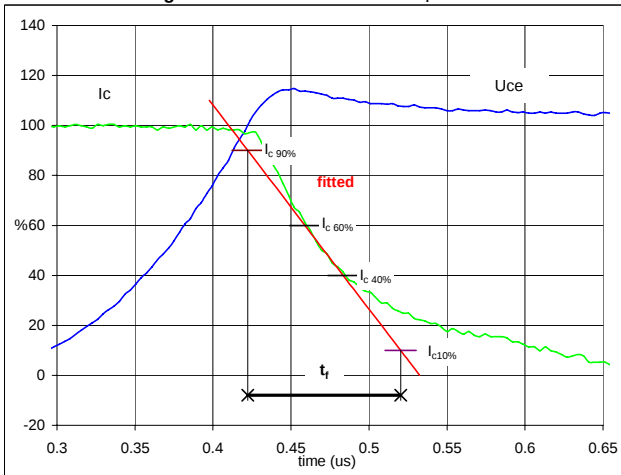
Turn-on Switching Waveforms & definition of t_{don} , t_{Eon}
 (t_{Eon} = integrating time for E_{on})



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

Figure 3 Output inverter IGBT

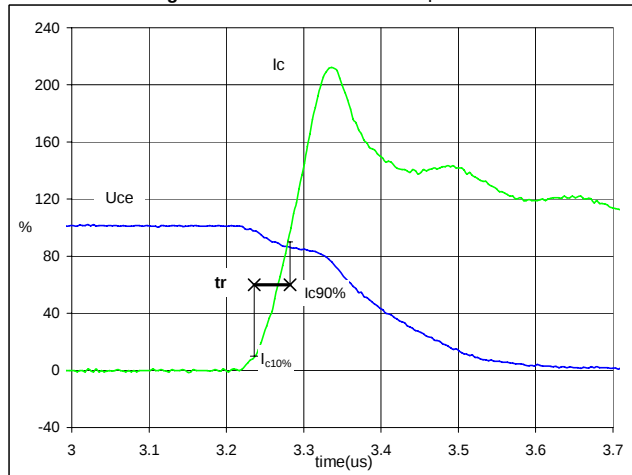
Turn-off Switching Waveforms & definition of t_f



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

Figure 4 Output inverter IGBT

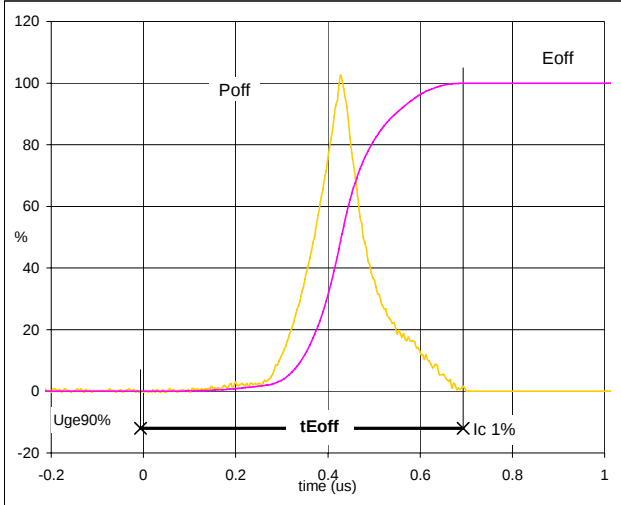
Turn-on Switching Waveforms & definition of t_r



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

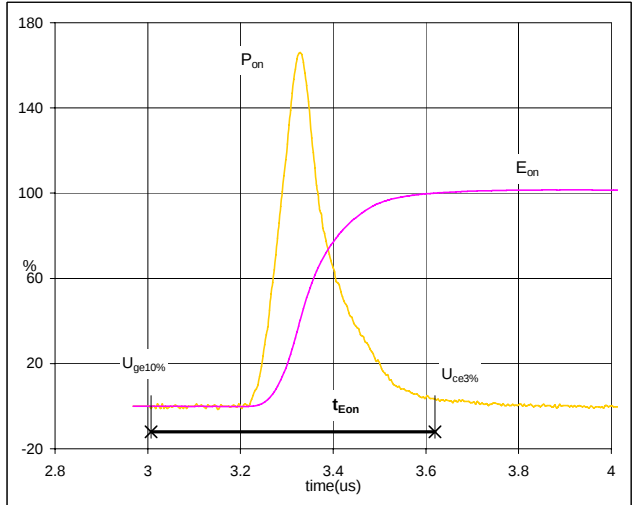
Switching Definitions Output Inverter

Figure 5 Output inverter IGBT

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


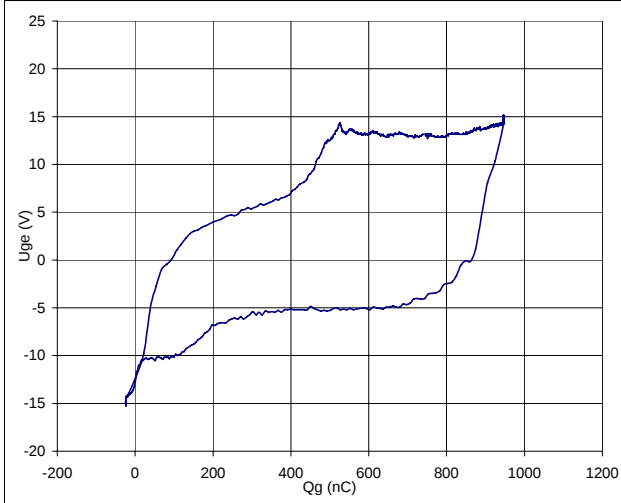
$P_{off}(100\%) = 89.53 \text{ kW}$
 $E_{off}(100\%) = 12.85 \text{ mJ}$
 $t_{Eoff} = 0.70 \text{ }\mu\text{s}$

Figure 6 Output inverter IGBT

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


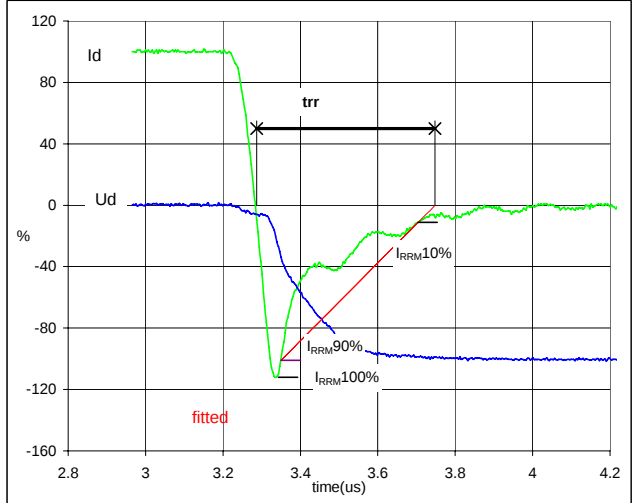
$P_{on}(100\%) = 89.53 \text{ kW}$
 $E_{on}(100\%) = 18.80 \text{ mJ}$
 $t_{Eon} = 0.61 \text{ }\mu\text{s}$

Figure 7 Output inverter FRED

Gate voltage vs Gate charge (measured)


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

Figure 8 Output inverter IGBT

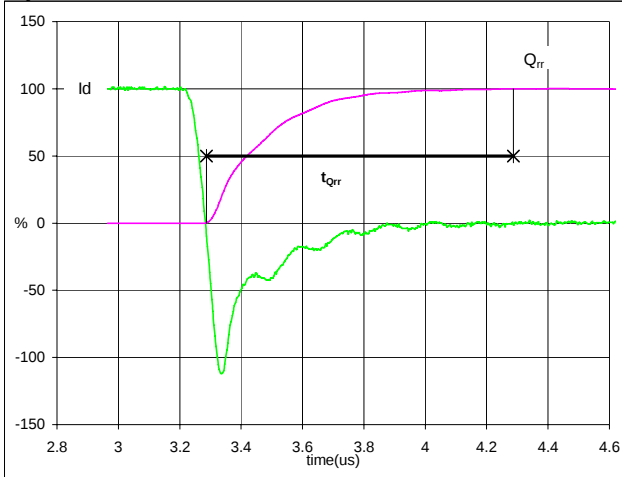
Turn-off Switching Waveforms & definition of t_{tr}


$V_d(100\%) = 600 \text{ V}$
 $I_d(100\%) = 149 \text{ A}$
 $I_{RRM}(100\%) = -168 \text{ A}$
 $t_{tr} = 0.47 \text{ }\mu\text{s}$

Switching Definitions Output Inverter

Figure 9 Output inverter FRED

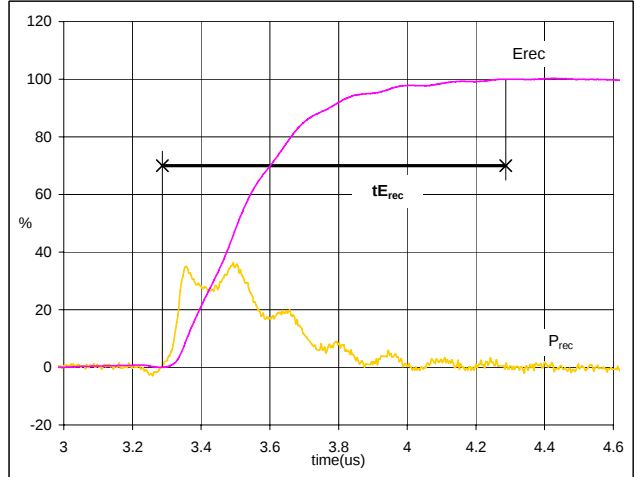
Turn-on Switching Waveforms & definition of t_{Qrr}
 (t_{Qrr} = integrating time for Q_{rr})



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

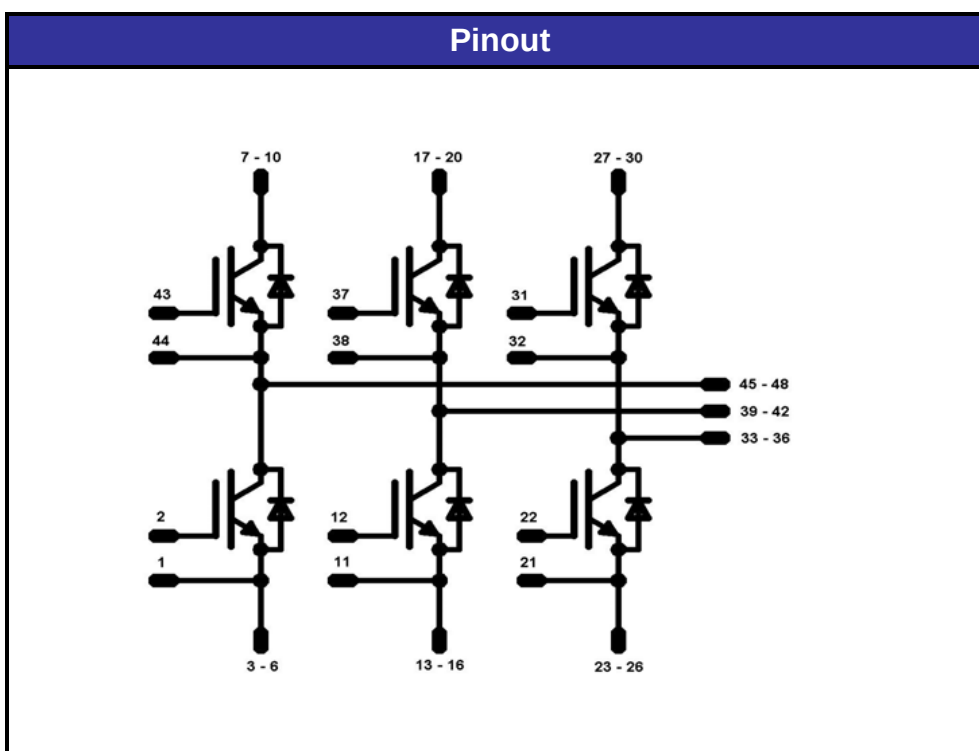
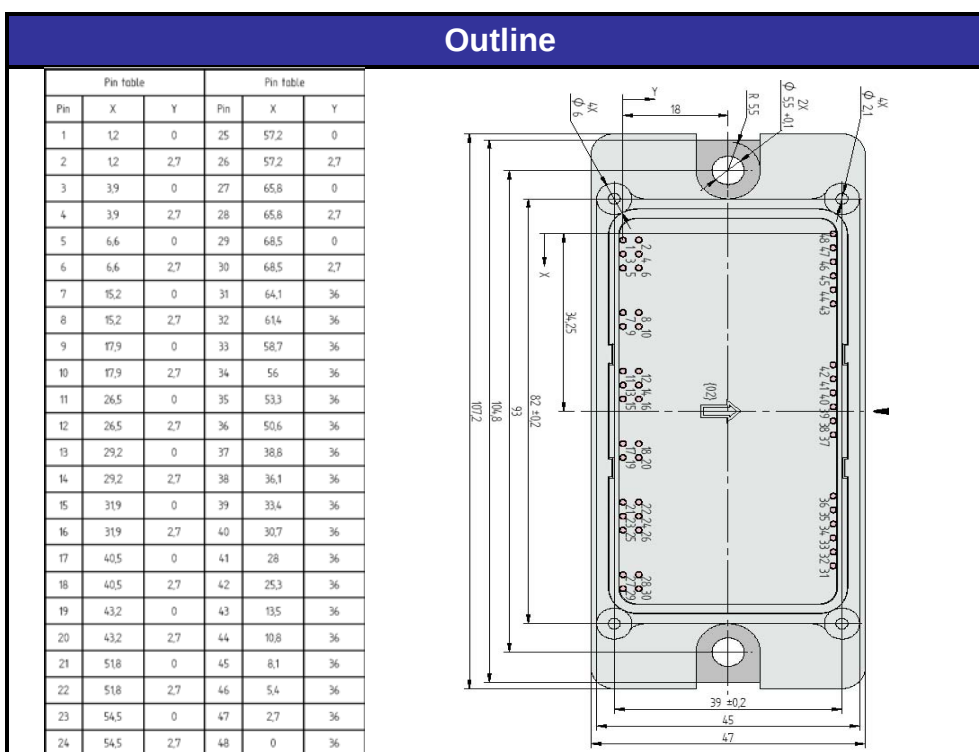
Figure 10 Output inverter FRED

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



PRODUCT STATUS DEFINITIONS

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.
Preliminary	First Production	This datasheet contains preliminary data, and supplementary data may be published at a later date. Vincotech reserves the right to make changes at any time without notice in order to improve design. The data contained is exclusively intended for technically trained staff.
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