

flowPACK 1 3rd gen

600V/75A

Features

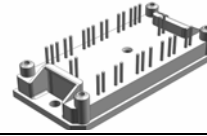
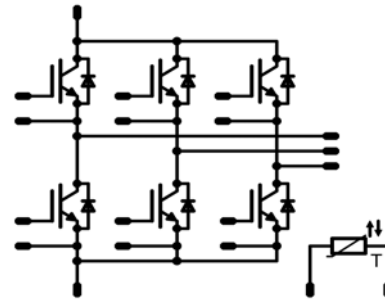
- Compact flow1 housing
- Compact and Low Inductance Design
- Built-in NTC

Target Applications

- Motor Drive
- Power Generation
- UPS

Types

- V23990-P824-F10

flow1 housing

Schematic


Maximum Ratings

 $T_j=25^\circ\text{C}$, unless otherwise specified

Parameter	Symbol	Condition	Value	Unit
Inverter Transistor				
Collector-emitter break down voltage	V_{CE}		600	V
DC collector current	I_C	$T_j=T_{jmax}$ $T_h=80^\circ\text{C}$ $T_c=80^\circ\text{C}$	59	A
Repetitive peak collector current	I_{Cpulse}	t_p limited by T_{jmax} $T_h=80^\circ\text{C}$ $T_c=80^\circ\text{C}$	225	A
Power dissipation per IGBT	P_{tot}	$T_j=T_{jmax}$ $T_h=80^\circ\text{C}$ $T_c=80^\circ\text{C}$	94	W
Gate-emitter peak voltage	V_{GE}		± 20	V
Short circuit ratings	t_{SC} V_{CC}	$T_j \leq 150^\circ\text{C}$ $V_{GE}=15\text{V}$	6 360	μs V
Maximum Junction Temperature	T_{jmax}		175	$^\circ\text{C}$

Inverter Diode

Peak Repetitive Reverse Voltage	V_{RRM}	$T_j=25^\circ\text{C}$	600	V
DC forward current	I_F	$T_j=T_{jmax}$ $T_h=80^\circ\text{C}$ $T_c=80^\circ\text{C}$	48	A
Repetitive peak forward current	I_{FRM}	t_p limited by T_{jmax} $T_h=80^\circ\text{C}$ $T_c=80^\circ\text{C}$	150	A
Power dissipation per Diode	P_{tot}	$T_j=T_{jmax}$ $T_h=80^\circ\text{C}$ $T_c=80^\circ\text{C}$	69	W
Maximum Junction Temperature	T_{jmax}		175	$^\circ\text{C}$

Thermal Properties

Storage temperature	T_{stg}		-40...+125	$^\circ\text{C}$
Operation temperature under switching condition	T_{op}		-40...+150	$^\circ\text{C}$

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=1min	4000	V _{DC}
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			0,0012	$T_j=25^{\circ}C$ $T_j=150^{\circ}C$	5	5,8	6,5	V
Collector-emitter saturation voltage	$V_{CE(sat)}$		15		75	$T_j=25^{\circ}C$ $T_j=150^{\circ}C$	1,1	1,54 1,79	2,2	V
Collector-emitter cut-off current incl. Diode	I_{CES}		0	600		$T_j=25^{\circ}C$ $T_j=150^{\circ}C$			0,5	mA
Gate-emitter leakage current	I_{GES}		20	0		$T_j=25^{\circ}C$ $T_j=150^{\circ}C$			650	nA
Integrated Gate resistor	R_{gnt}							4		Ω
Turn-on delay time	$t_{d(on)}$	Rgoff=4 Ω Rgon=4 Ω	± 15	300	75	$T_j=25^{\circ}C$		160		ns
Rise time	t_r					$T_j=150^{\circ}C$		162		
Turn-off delay time	$t_{d(off)}$					$T_j=25^{\circ}C$		21		
Fall time	t_f					$T_j=150^{\circ}C$		26		
Turn-on energy loss per pulse	E_{on}					$T_j=25^{\circ}C$		208		
Turn-off energy loss per pulse	E_{off}					$T_j=150^{\circ}C$		242		
Input capacitance	C_{iES}							4620		pF
Output capacitance	C_{oSS}	f=1MHz	0	25		$T_j=25^{\circ}C$		288		
Reverse transfer capacitance	C_{rSS}							137		
Gate charge	Q_{Gate}	VCC=480V	± 15		75	$T_j=25^{\circ}C$		470		nC
Thermal resistance chip to heatsink per chip	R_{thJH}	Thermal grease thickness $\leq 50\mu m$ $\lambda = 1 W/mK$						1,01		K/W
Inverter Diode										
Diode forward voltage	V_F				75	$T_j=25^{\circ}C$ $T_j=150^{\circ}C$	1,2	1,79 1,75	2,2	V
Peak reverse recovery current	I_{RRM}	Rgon=4 Ω	± 15	300	75	$T_j=25^{\circ}C$		58		A
Reverse recovery time	t_{rr}					$T_j=150^{\circ}C$		88		
Reverse recovered charge	Q_{rr}					$T_j=25^{\circ}C$		133		
Peak rate of fall of recovery current	$di(rec)max/dt$					$T_j=150^{\circ}C$		169		
Reverse recovered energy	E_{rec}					$T_j=25^{\circ}C$		2,23		
						$T_j=150^{\circ}C$		6,83		
Thermal resistance chip to heatsink per chip	R_{thJH}	Thermal grease thickness $\leq 50\mu m$ $\lambda = 1 W/mK$						1,38		K/W
Thermistor										
Rated resistance	R_{25}	Tol. $\pm 5\%$				$T_j=25^{\circ}C$	4,2	4,7	5,8	k Ω
Deviation of R100	$D_{R/R}$	R100=435 Ω				$T_c=100^{\circ}C$		2,6		%/K
Power dissipation given Epcos-Typ	P					$T_j=25^{\circ}C$		210		mW
B-value	$B_{(25/100)}$	Tol. $\pm 3\%$				$T_j=25^{\circ}C$		3530		K

Output Inverter

Figure 1 Output inverter IGBT

Typical output characteristics

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

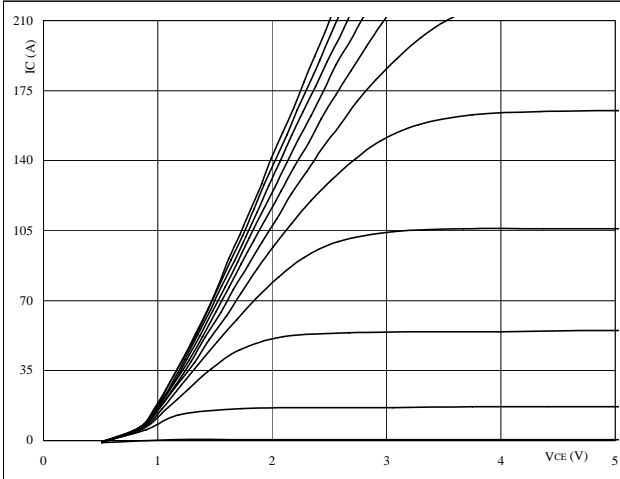

At
 $t_p = 250 \mu s$
 $T_J = 25 \text{ }^\circ C$
 V_{GE} from 7 V to 17 V in steps of 1 V

Figure 2 Output inverter IGBT

Typical output characteristics

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

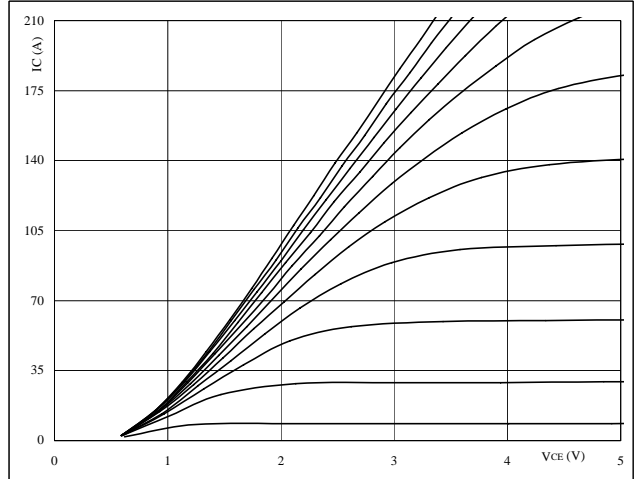
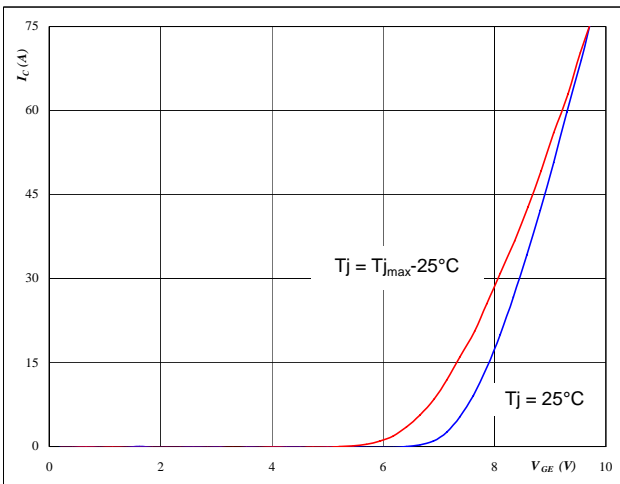

At
 $t_p = 250 \mu s$
 $T_J = 150 \text{ }^\circ C$
 V_{GE} from 7 V to 17 V in steps of 1 V

Figure 3 Output inverter IGBT

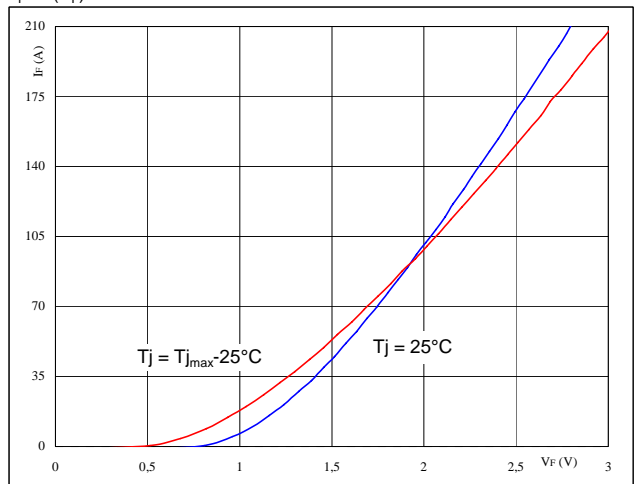
Typical transfer characteristics

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


At
 $t_p = 250 \mu s$
 $V_{CE} = 10 V$
Figure 4 Output inverter FRED

Typical diode forward current as a function of forward voltage

$$I_F = f(V_F)$$

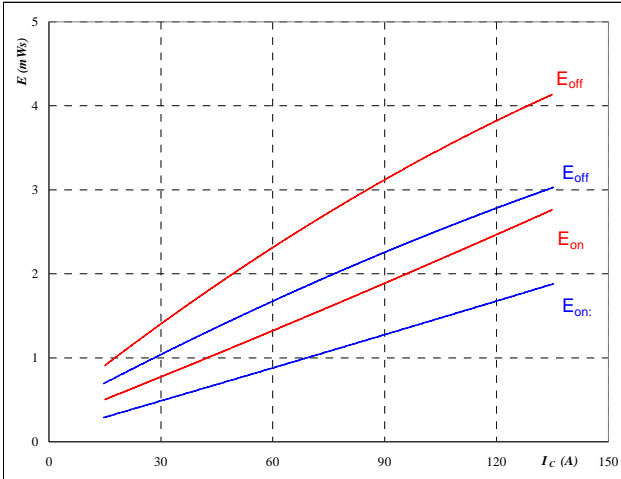

At
 $t_p = 250 \mu s$

Output Inverter

Figure 5 Output inverter IGBT

Typical switching energy losses as a function of collector current

$$E = f(I_C)$$



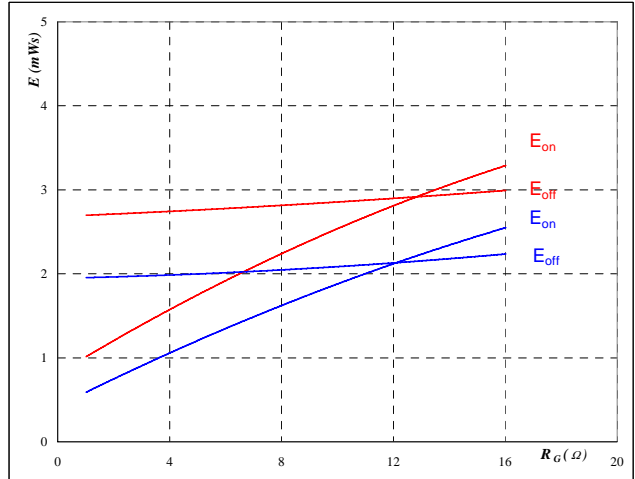
With an inductive load at

$T_j =$	25/150	°C
$V_{CE} =$	300	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

$$E = f(R_G)$$



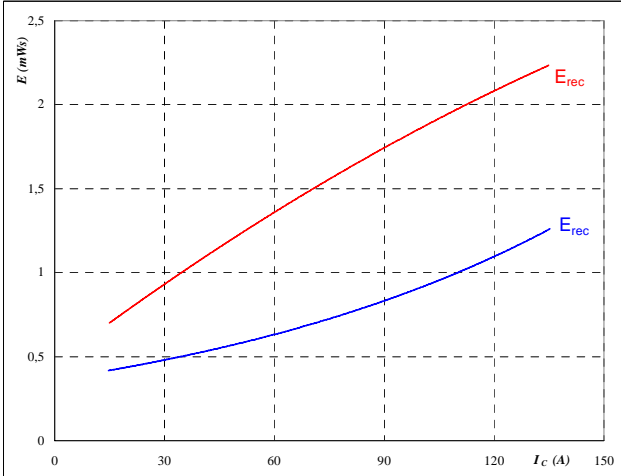
With an inductive load at

$T_j =$	25/150	°C
$V_{CE} =$	300	V
$V_{GE} =$	±15	V
$I_C =$	75	A

Figure 7 Output inverter IGBT

Typical reverse recovery energy loss as a function of collector current

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



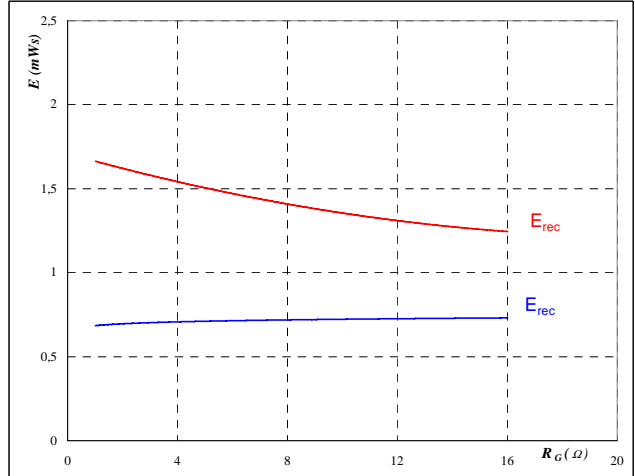
With an inductive load at

$T_j =$	25/150	°C
$V_{CE} =$	300	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

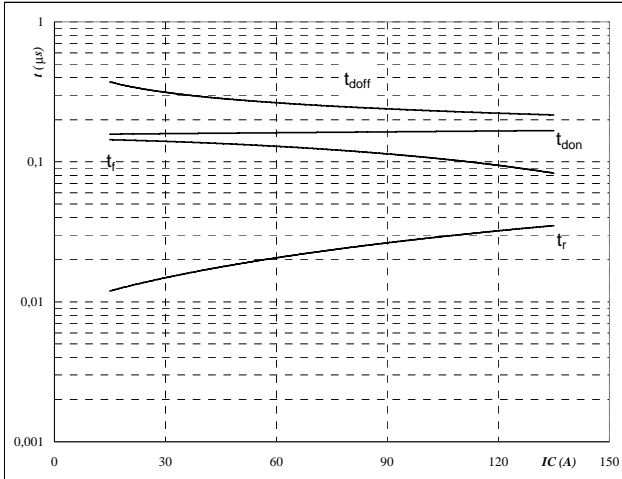
$T_j =$	25/150	°C
$V_{CE} =$	300	V
$V_{GE} =$	±15	V
$I_C =$	75	A

Output Inverter

Figure 9 Output inverter IGBT

Typical switching times as a function of collector current

$$t = f(I_C)$$



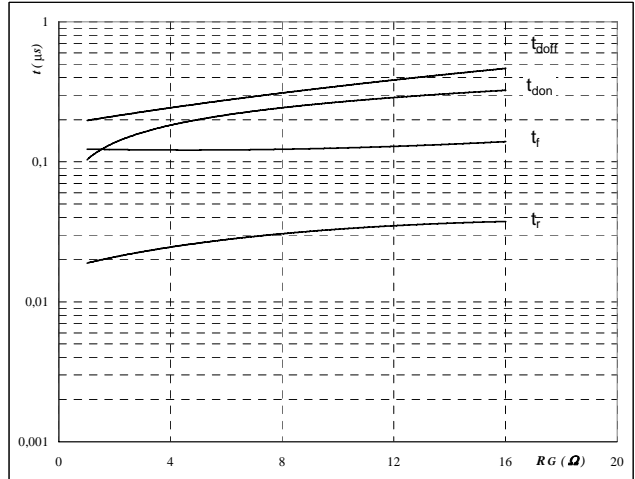
With an inductive load at

$T_J =$	150	°C
$V_{CE} =$	300	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

$$t = f(R_G)$$



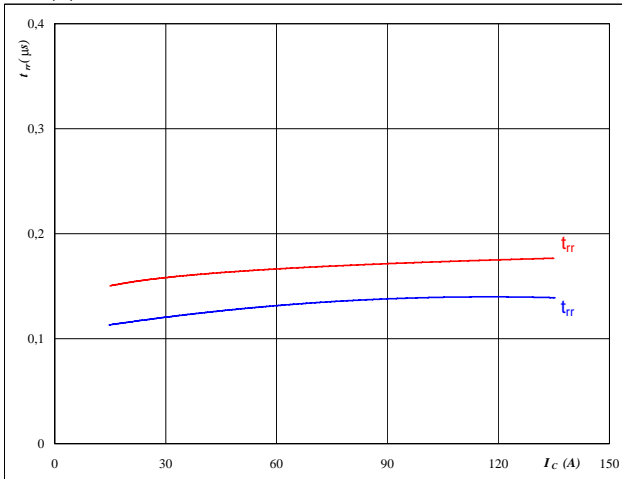
With an inductive load at

$T_J =$	150	°C
$V_{CE} =$	300	V
$V_{GE} =$	±15	V
$I_C =$	75	A

Figure 11 Output inverter FRED

Typical reverse recovery time as a function of collector current

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

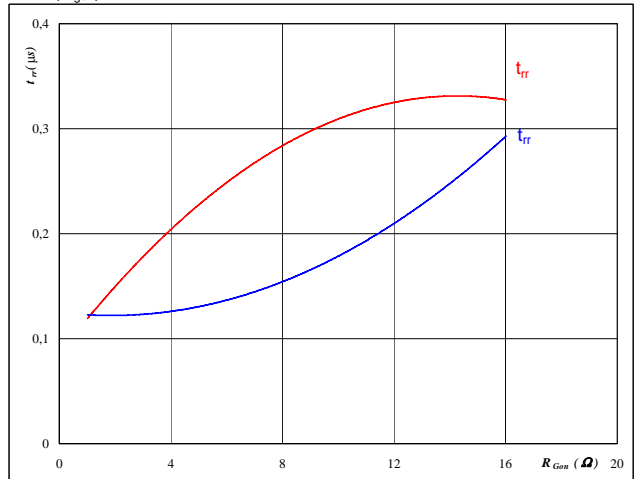

At

$T_J =$	25/150	°C
$V_{CE} =$	300	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

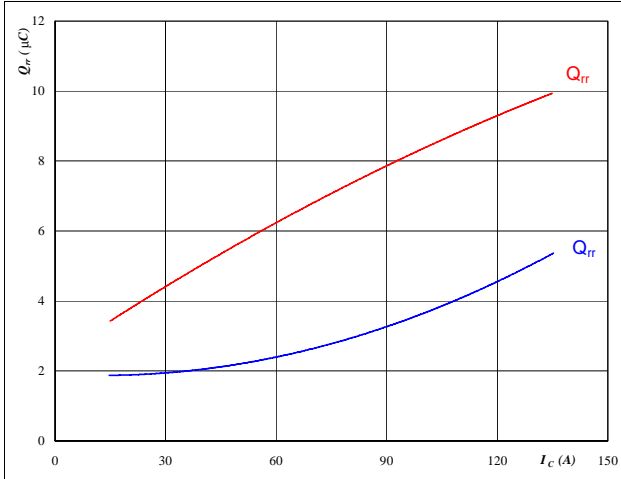
$T_J =$	25/150	°C
$V_R =$	300	V
$I_F =$	75	A
$V_{GE} =$	±15	V

Output Inverter

Figure 13 Output inverter FRED

Typical reverse recovery charge as a function of collector current

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

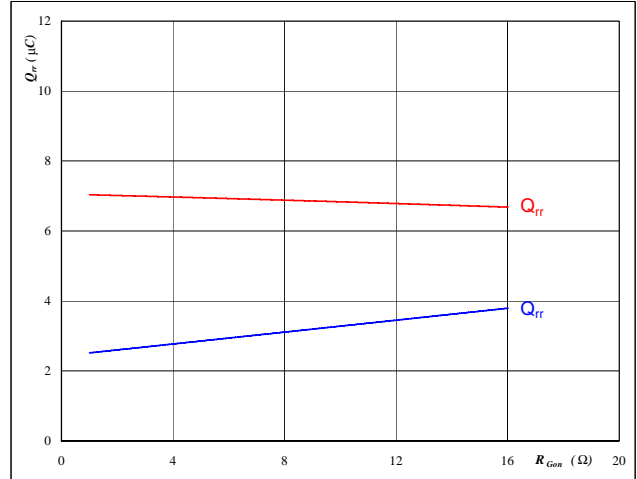


At
 $T_j = 25/150$ °C
 $V_{CE} = 300$ V
 $V_{GE} = \pm 15$ V
 $R_{gon} = 4$ Ω

Figure 14 Output inverter FRED

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

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

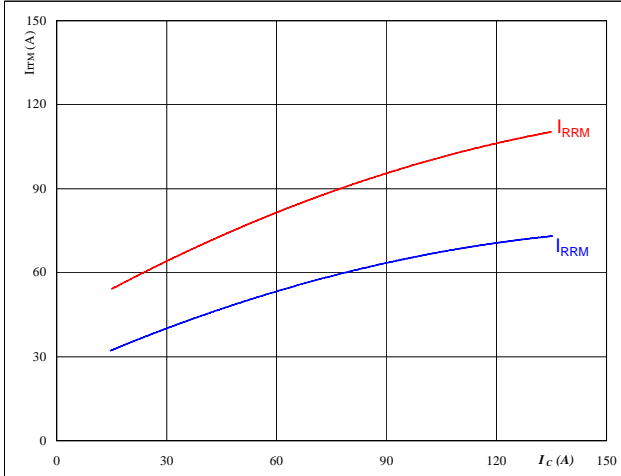


At
 $T_j = 25/150$ °C
 $V_R = 300$ V
 $I_F = 75$ A
 $V_{GE} = \pm 15$ V

Figure 15 Output inverter FRED

Typical reverse recovery current as a function of collector current

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

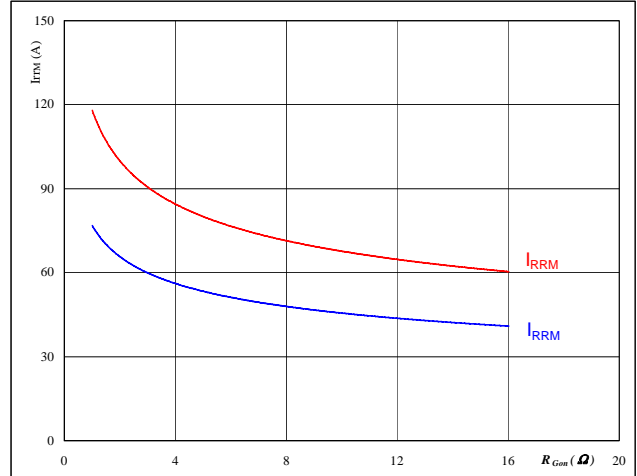


At
 $T_j = 25/150$ °C
 $V_{CE} = 300$ V
 $V_{GE} = \pm 15$ V
 $R_{gon} = 4$ Ω

Figure 16 Output inverter FRED

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

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



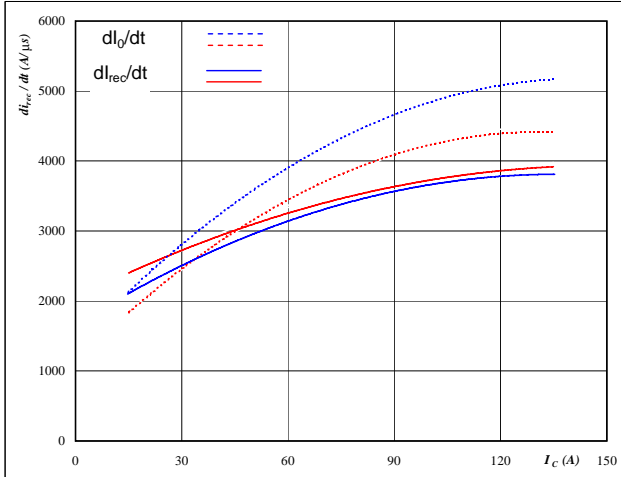
At
 $T_j = 25/150$ °C
 $V_R = 300$ V
 $I_F = 75$ A
 $V_{GE} = \pm 15$ V

Output Inverter

Figure 17 Output inverter FRED

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

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

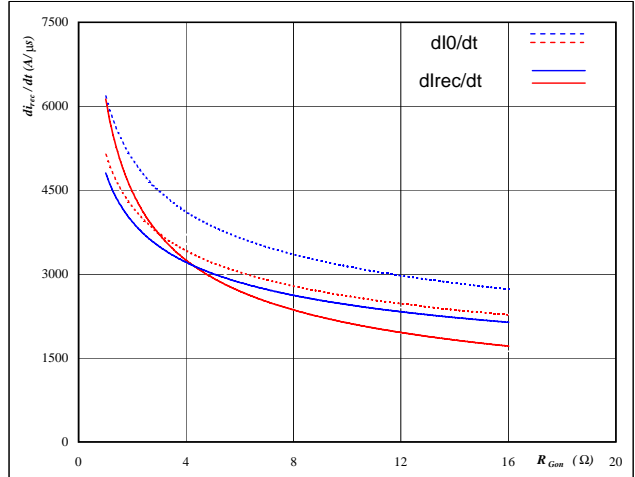


At
 $T_j = 25/150 \text{ } ^\circ\text{C}$
 $V_{CE} = 300 \text{ V}$
 $V_{GE} = \pm 15 \text{ V}$
 $R_{gon} = 4 \text{ } \Omega$

Figure 18 Output inverter FRED

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

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

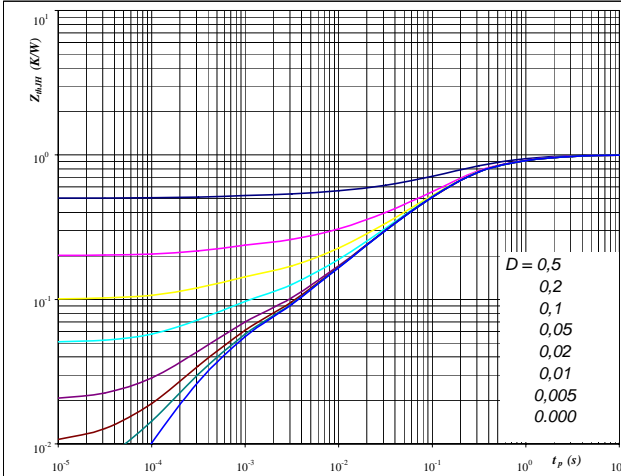


At
 $T_j = 25/150 \text{ } ^\circ\text{C}$
 $V_R = 300 \text{ V}$
 $I_F = 75 \text{ A}$
 $V_{GE} = \pm 15 \text{ V}$

Figure 19 Output inverter IGBT

IGBT transient thermal impedance as a function of pulse width

$$Z_{thJH} = f(tp)$$



At
 $D = tp / T$
 $R_{thJH} = 1,01 \text{ K/W}$

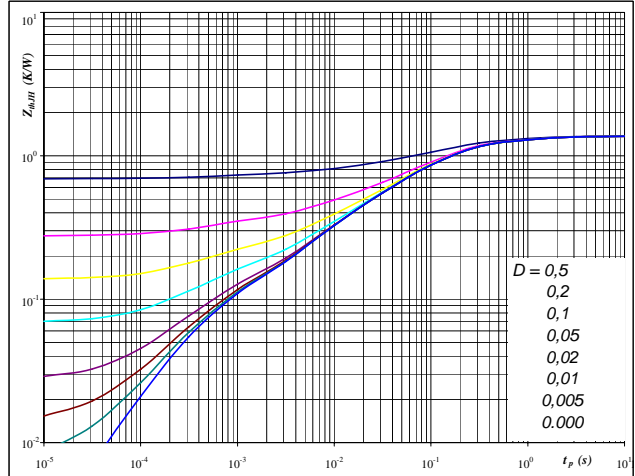
IGBT thermal model values

R (C/W)	Tau (s)
0,03	9,8E+00
0,16	1,1E+00
0,54	1,8E-01
0,18	3,3E-02
0,06	5,8E-03
0,04	4,6E-04

Figure 20 Output inverter FRED

FRED transient thermal impedance as a function of pulse width

$$Z_{thJH} = f(tp)$$



At
 $D = tp / T$
 $R_{thJH} = 1,38 \text{ K/W}$

FRED thermal model values

R (C/W)	Tau (s)
0,03	9,9E+00
0,17	1,0E+00
0,64	1,4E-01
0,31	3,3E-02
0,15	6,2E-03
0,08	4,2E-04

Output Inverter

Figure 21 Output inverter IGBT

Power dissipation as a function of heatsink temperature

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

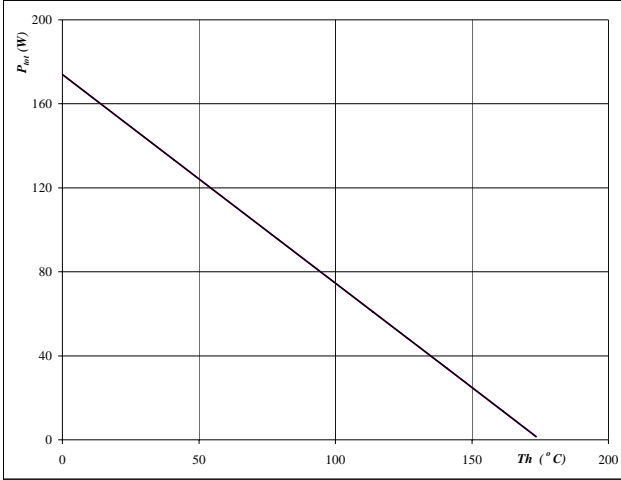
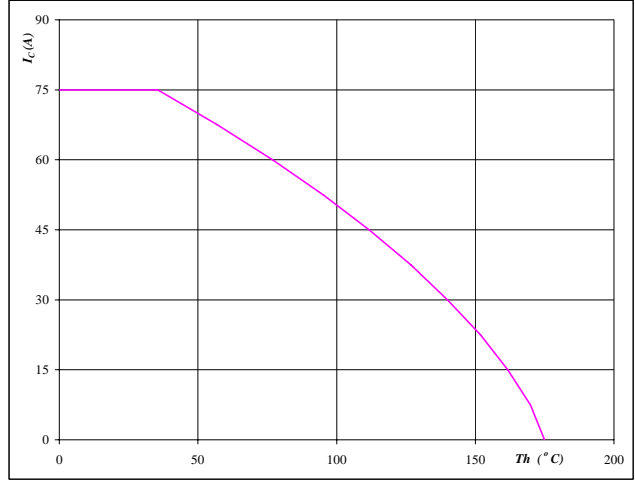

At
 $T_j = 175 \text{ } ^\circ\text{C}$
— single heating
— overall heating

Figure 22 Output inverter IGBT

Collector current as a function of heatsink temperature

$$I_C = f(T_h)$$


At
 $T_j = 175 \text{ } ^\circ\text{C}$
 $V_{GE} = 15 \text{ V}$
Figure 23 Output inverter FRED

Power dissipation as a function of heatsink temperature

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

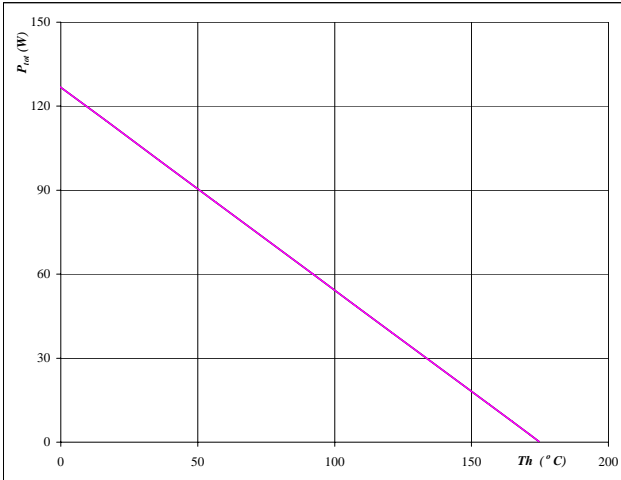
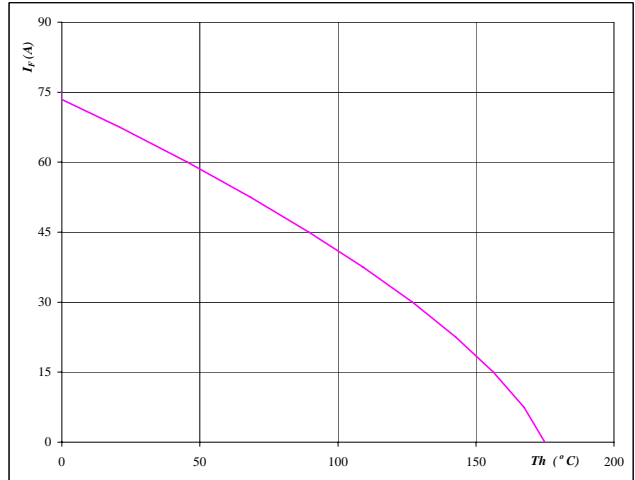

At
 $T_j = 175 \text{ } ^\circ\text{C}$
— single heating
— overall heating

Figure 24 Output inverter FRED

Forward current as a function of heatsink temperature

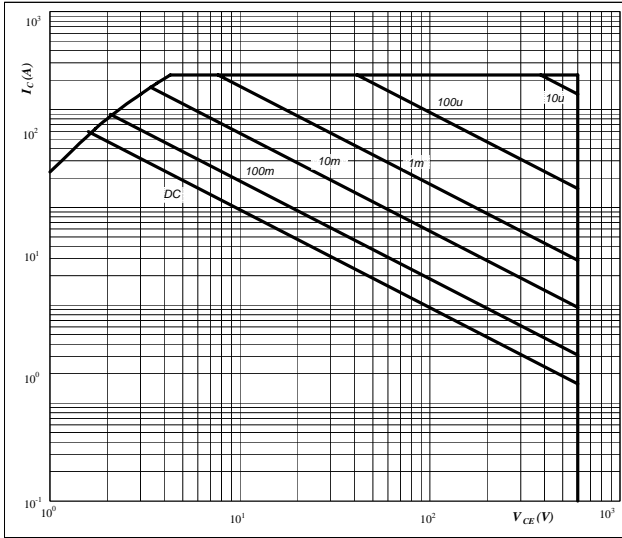
$$I_F = f(T_h)$$


At
 $T_j = 175 \text{ } ^\circ\text{C}$

Output Inverter

Figure 25 Output inverter IGBT

Safe operating area as a function of collector-emitter voltage
 $I_C = f(V_{CE})$

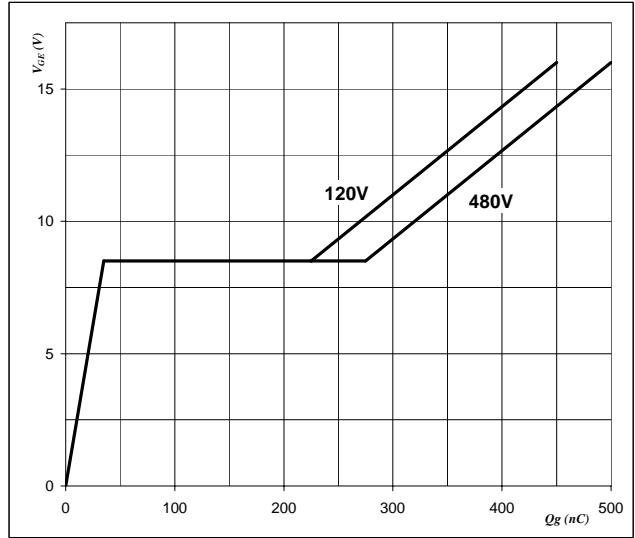


At
 D = single pulse
 Th = 80 °C
 V_{GE} = ±15 V
 T_j = T_{jmax} °C

Figure 26 Output inverter IGBT

Gate voltage vs Gate charge

$V_{GE} = f(Q_g)$



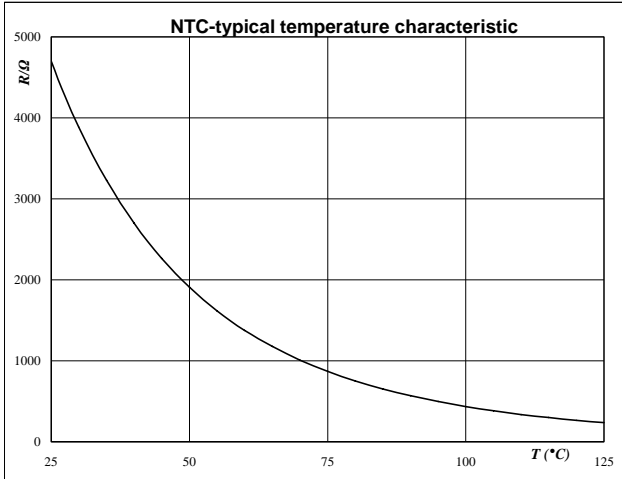
At
 I_C = 75 A

Thermistor

Figure 1 Thermistor

Typical NTC characteristic
as a function of temperature

$$R_T = f(T)$$

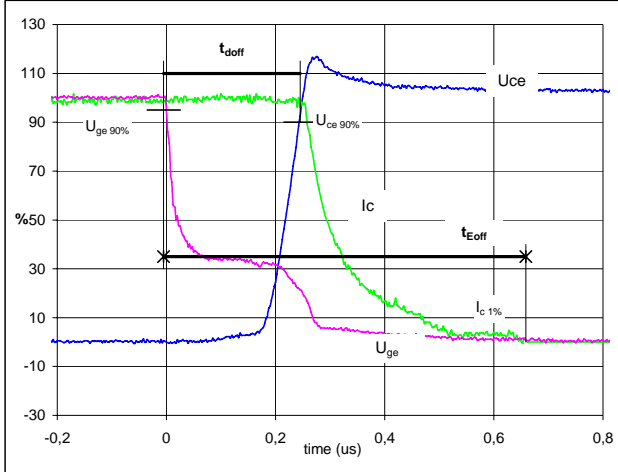


Switching Definitions Output Inverter

General conditions

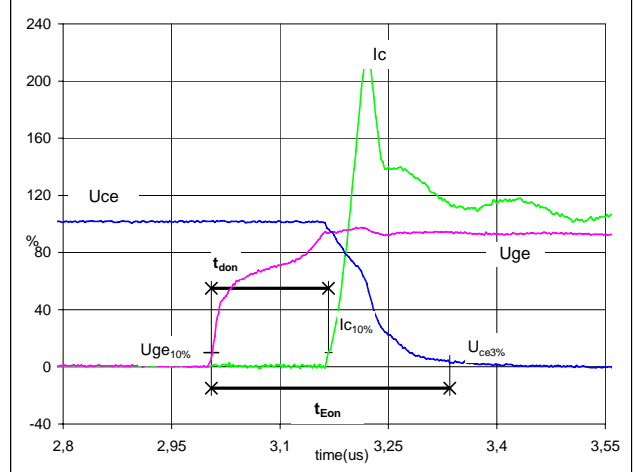
T_j	=	150 °C
R_{gon}	=	4 Ω
R_{goff}	=	4 Ω

Figure 1 Output inverter IGBT

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


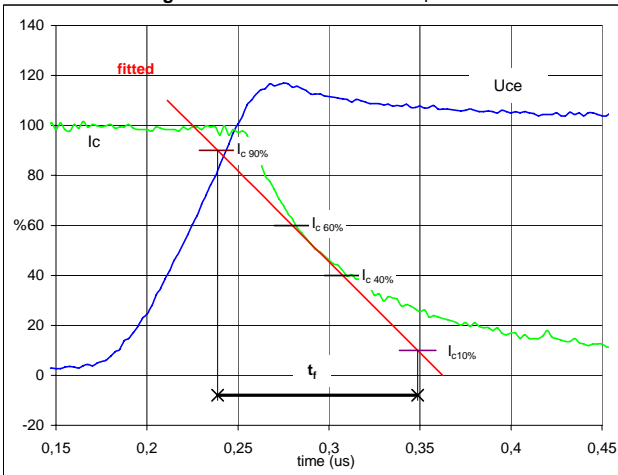
$V_{GE}(0\%)$	=	-15	V
$V_{GE}(100\%)$	=	15	V
$V_C(100\%)$	=	300	V
$I_C(100\%)$	=	75	A
t_{doff}	=	0,24	μ s
t_{Eoff}	=	0,66	μ s

Figure 2 Output inverter IGBT

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


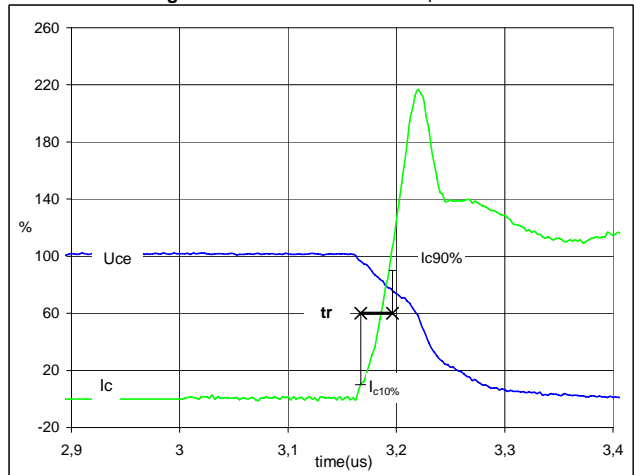
$V_{GE}(0\%)$	=	-15	V
$V_{GE}(100\%)$	=	15	V
$V_C(100\%)$	=	300	V
$I_C(100\%)$	=	75	A
t_{don}	=	0,16	μ s
t_{Eon}	=	0,33	μ s

Figure 3 Output inverter IGBT

Turn-off Switching Waveforms & definition of t_f


$V_C(100\%)$	=	300	V
$I_C(100\%)$	=	75	A
t_f	=	0,12	μ s

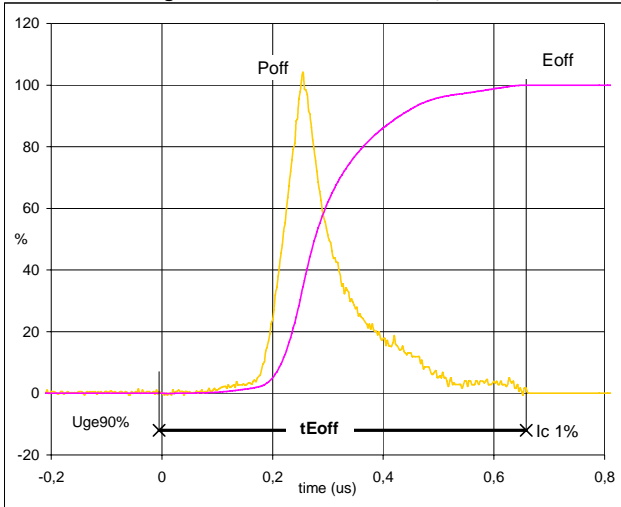
Figure 4 Output inverter IGBT

Turn-on Switching Waveforms & definition of t_r


$V_C(100\%)$	=	300	V
$I_C(100\%)$	=	75	A
t_r	=	0,03	μ s

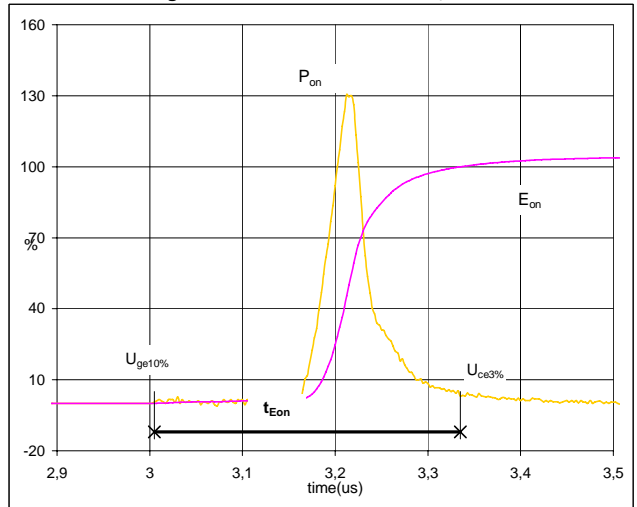
Switching Definitions Output Inverter

Figure 5 Output inverter IGBT

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


$P_{off} (100\%) =$	22,54	kW
$E_{off} (100\%) =$	2,76	mJ
$t_{Eoff} =$	0,66	μ s

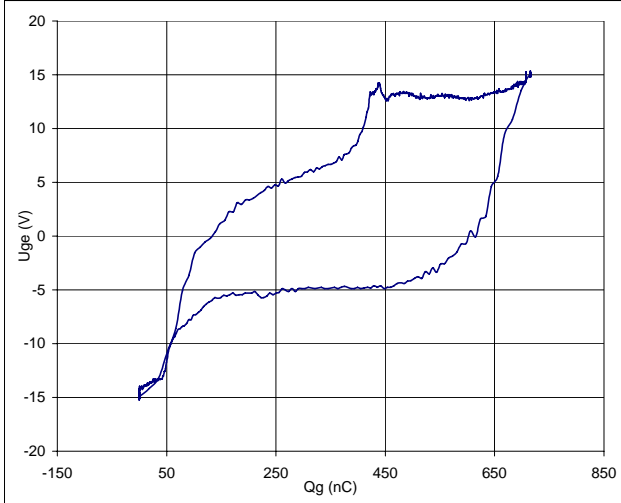
Figure 6 Output inverter IGBT

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


$P_{on} (100\%) =$	22,54	kW
$E_{on} (100\%) =$	1,60	mJ
$t_{Eon} =$	0,33	μ s

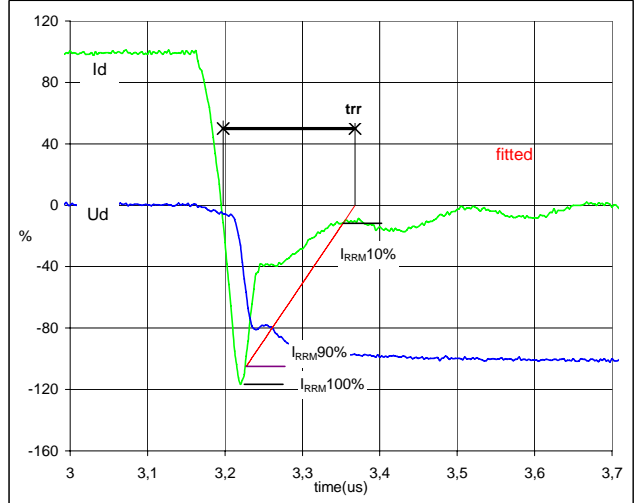
Figure 7 Output inverter FRED

Gate voltage vs Gate charge (measured)



$V_{GEoff} =$	-15	V
$V_{GEon} =$	15	V
$V_C (100\%) =$	300	V
$I_C (100\%) =$	75	A
$Q_g =$	715,15	nC

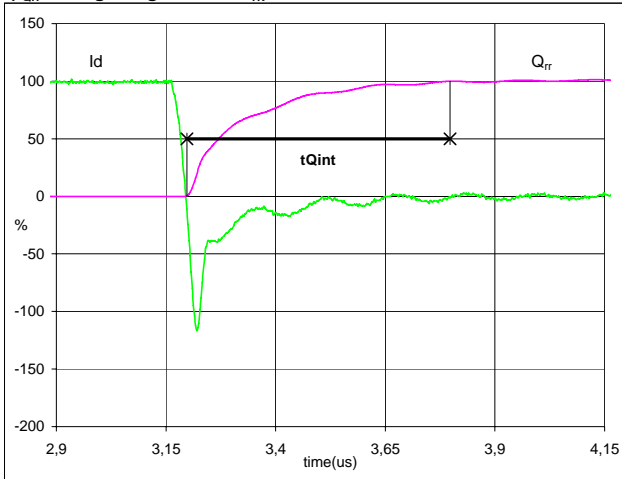
Figure 8 Output inverter IGBT

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


$V_d (100\%) =$	300	V
$I_d (100\%) =$	75	A
$I_{RRM} (100\%) =$	-88	A
$t_{rr} =$	0,17	μ s

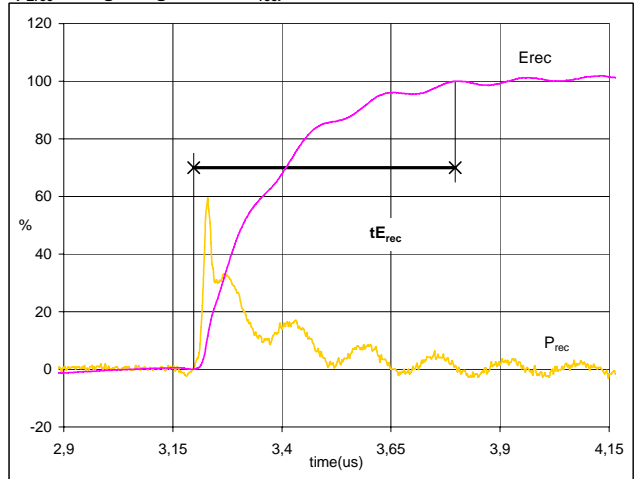
Switching Definitions Output Inverter

Figure 9 Output inverter FRED

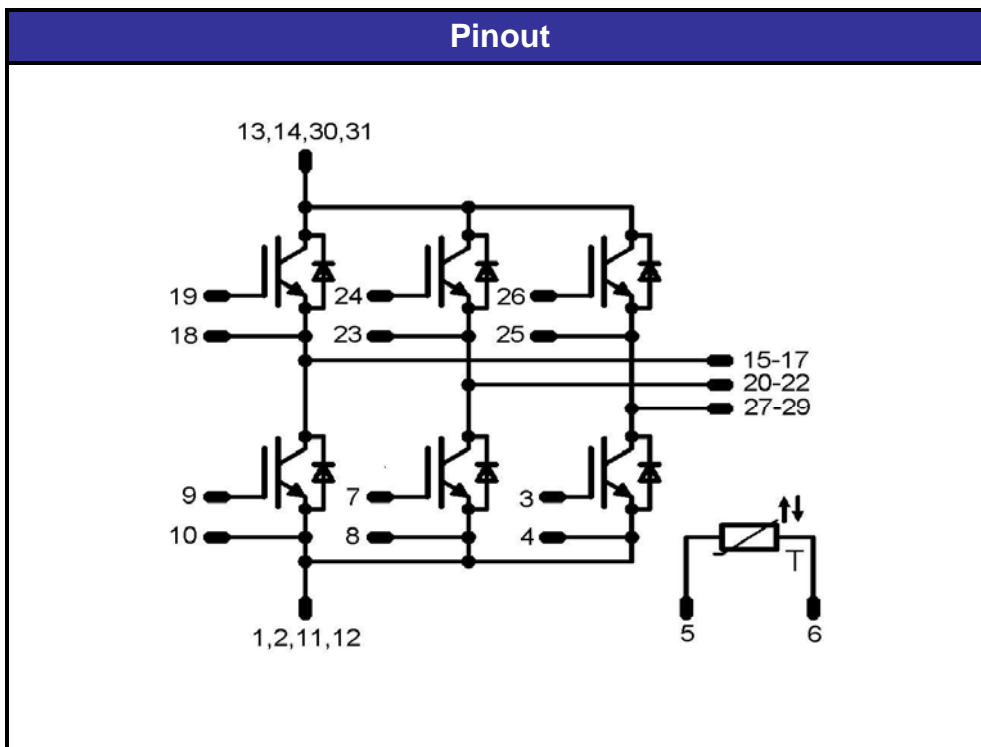
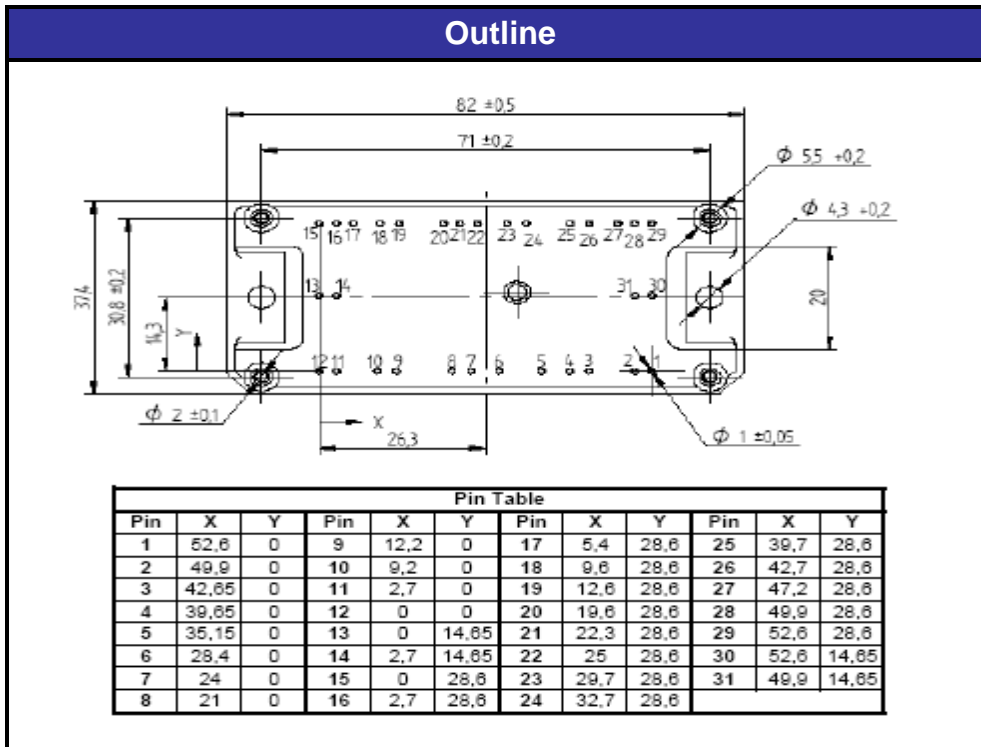
Turn-on Switching Waveforms & definition of t_{Qrr}
 (t_{Qrr} = integrating time for Q_{rr})


I_d (100%) =	75	A
Q_{rr} (100%) =	6,83	μC
t_{Qint} =	0,60	μs

Figure 10 Output inverter FRED

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


P_{rec} (100%) =	22,54	kW
E_{rec} (100%) =	1,50	mJ
t_{Erec} =	0,60	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.
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