

*flow*PHASE0

600V/200A

Features

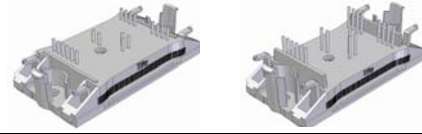
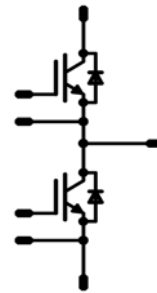
- Trench Fieldstop IGBT³ technology
- 2-clip housing in 12mm and 17mm height
- Compact and low inductance design
- AlN substrate for improved performance

Target Applications

- Motor Drive
- UPS

Types

- FZ062PA200SA01
- F0062PA200SA01

flow0 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	$T_j=T_{jmax}$ $T_h=80^{\circ}\text{C}$	159	A
Repetitive peak collector current	I_{Cpulse}	t_p limited by T_{jmax}	600	A
Power dissipation per IGBT	P_{tot}	$T_j=T_{jmax}$ $T_h=80^{\circ}\text{C}$ $T_c=80^{\circ}\text{C}$	288 436	W
Gate-emitter peak voltage	V_{GE}		± 20	V
Short circuit ratings	t_{SC} V_{CC}	$T_j \leq 150^{\circ}\text{C}$ $V_{GE} = 15\text{V}$	5 360	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	$T_j=T_{jmax}$ $T_h=80^{\circ}\text{C}$	141	A
Repetitive peak forward current	I_{FRM}	t_p limited by T_{jmax}	400	A
Power dissipation per Diode	P_{tot}	$T_j=T_{jmax}$ $T_h=80^{\circ}\text{C}$ $T_c=80^{\circ}\text{C}$	203 308	W
Maximum Junction Temperature	T_{jmax}		175	$^{\circ}\text{C}$

Maximum Ratings

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

Parameter	Symbol	Condition	Value	Unit
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Thermal Properties

Storage temperature	T_{stg}		-40...+125	°C
Operation temperature under switching condition	T_{op}		-40...+150	°C

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

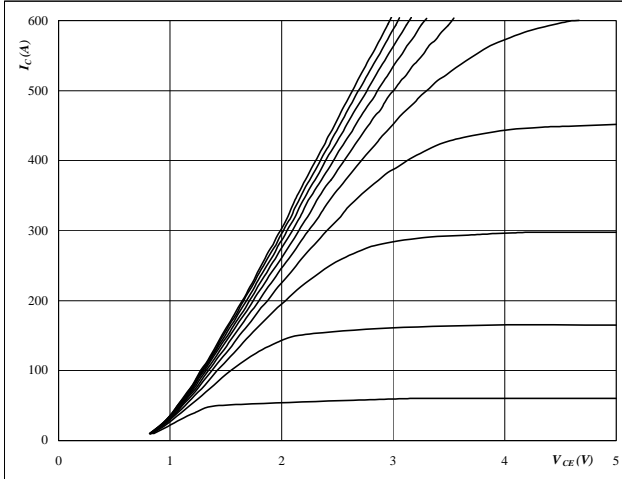
Parameter	Symbol	Conditions					Value			Unit	
		$V_{GE}[V]$ or $V_{GS}[V]$	$V_r[V]$ or $V_{CE}[V]$ or $V_{DS}[V]$	$I_c[A]$ or $I_F[A]$ or $I_b[A]$	T_j	Min	Typ	Max			
Inverter Transistor											
Gate emitter threshold voltage	$V_{GE(th)}$	$V_{CE}=V_{GE}$			0,0032	$T_j=25^\circ C$ $T_j=150^\circ C$	5	5,8	6,5	V	
Collector-emitter saturation voltage	$V_{CE(sat)}$		15		200	$T_j=25^\circ C$ $T_j=150^\circ C$	1	1,68 1,99	2,3	V	
Collector-emitter cut-off current incl. Diode	I_{CES}		0	600		$T_j=25^\circ C$ $T_j=150^\circ C$			1,25	mA	
Gate-emitter leakage current	I_{GES}		20	0		$T_j=25^\circ C$ $T_j=150^\circ C$	0		1000	nA	
Integrated Gate resistor	R_{gint}							2		Ω	
Turn-on delay time	$t_{d(on)}$	$R_{goff}=4 \Omega$ $R_{gon}=4 \Omega$	± 15	300	200	$T_j=25^\circ C$		209		ns	
Rise time	t_r					$T_j=150^\circ C$		222			
Turn-off delay time	$t_{d(off)}$					$T_j=25^\circ C$		32			
Fall time	t_f					$T_j=150^\circ C$		38			
Turn-on energy loss per pulse	E_{on}					$T_j=25^\circ C$		267			
Turn-off energy loss per pulse	E_{off}					$T_j=150^\circ C$		301			
Input capacitance	C_{ies}										
Output capacitance	C_{oss}	$f=1MHz$	0	25		$T_j=25^\circ C$		769			
Reverse transfer capacitance	C_{rss}							366			
Gate charge	Q_{Gate}		± 15	480	200	$T_j=25^\circ C$			1240	nC	
Thermal resistance chip to heatsink per chip	R_{thJH}	Thermal foil thickness=76um Kunze foil KU-ALF5								0,33	K/W
Inverter Diode											
Diode forward voltage	V_F				200	$T_j=25^\circ C$ $T_j=150^\circ C$	1	1,73 1,7	2,3	V	
Peak reverse recovery current	I_{RRM}	$R_{goff}=4 \Omega$	0	300	200	$T_j=25^\circ C$		160,7		A	
Reverse recovery time	t_{rr}					$T_j=150^\circ C$		209,6			
Reverse recovered charge	Q_{rr}					$T_j=25^\circ C$		117			
Peak rate of fall of recovery current	$di(rec)max/dt$					$T_j=150^\circ C$		142,4			
Reverse recovered energy	E_{rec}					$T_j=25^\circ C$		9,51			
						$T_j=150^\circ C$		17,79			
Thermal resistance chip to heatsink per chip	R_{thJH}	Thermal foil thickness=76um Kunze foil KU-ALF5								0,47	K/W

Output Inverter

Figure 1 Output inverter IGBT

Typical output characteristics

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

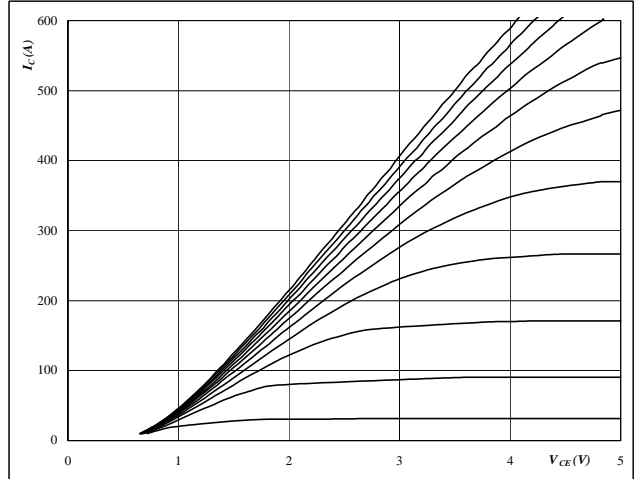


At
 $t_p = 350 \mu s$
 $T_j = 25 \text{ }^\circ C$
 V_{GE} from 7 V to 17 V in steps of 1 V

Figure 2 Output inverter IGBT

Typical output characteristics

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

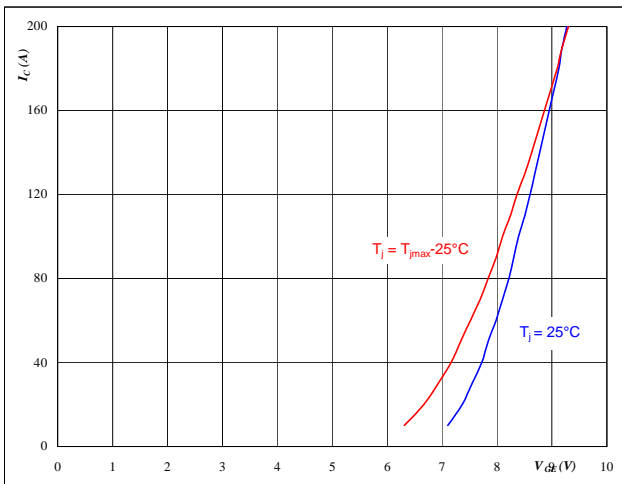


At
 $t_p = 350 \mu s$
 $T_j = 150 \text{ }^\circ C$
 V_{GE} from 7 V to 17 V in steps of 1 V

Figure 3 Output inverter IGBT

Typical transfer characteristics

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

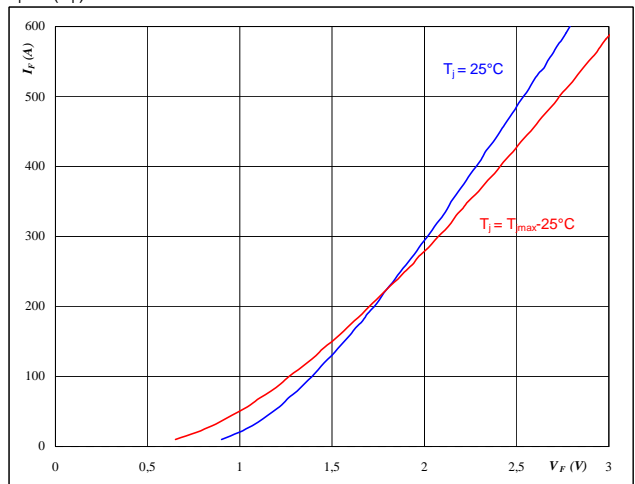


At
 $t_p = 350 \mu s$
 $V_{CE} = 10 V$

Figure 4 Output inverter FRED

Typical diode forward current as a function of forward voltage

$$I_F = f(V_F)$$



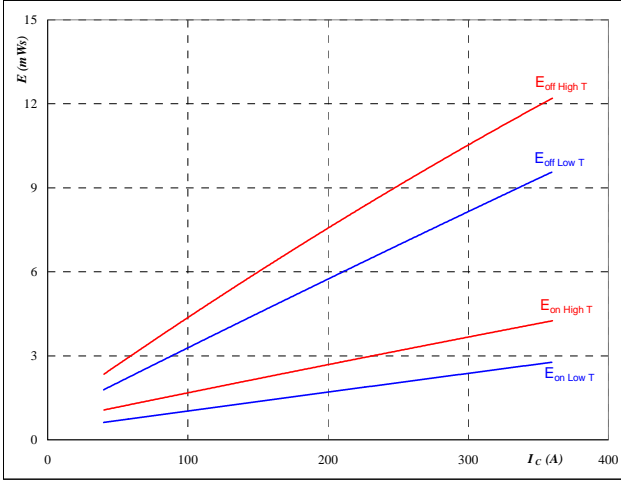
At
 $t_p = 350 \mu s$

Output Inverter

Figure 5 Output inverter IGBT

Typical switching energy losses as a function of collector current

$$E = f(I_C)$$



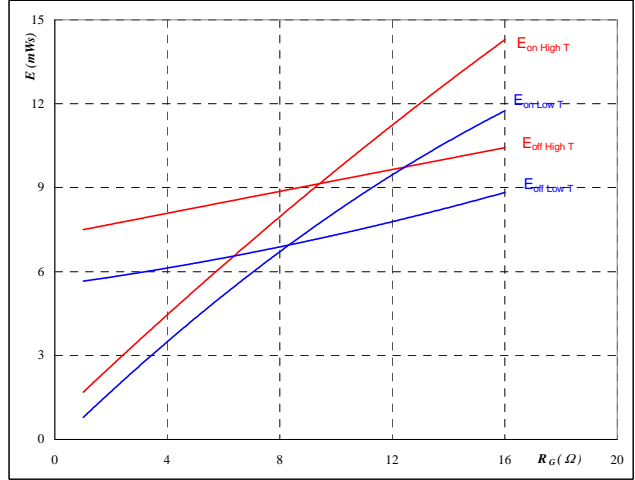
With an inductive load at

$T_J =$	25/150	°C
$V_{CE} =$	300	V
$V_{GE} =$	±15	V
$R_{gon} =$	2	Ω
$R_{goff} =$	2	Ω

Figure 6 Output inverter IGBT

Typical switching energy losses as a function of gate resistor

$$E = f(R_G)$$



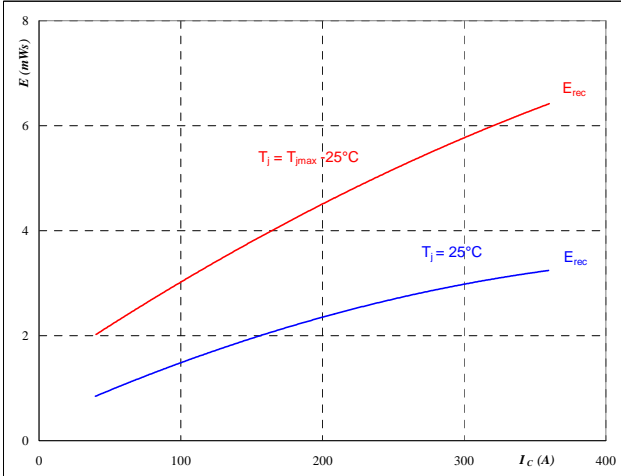
With an inductive load at

$T_J =$	25/150	°C
$V_{CE} =$	300	V
$V_{GE} =$	±15	V
$I_C =$	200	A

Figure 7 Output inverter IGBT

Typical reverse recovery energy loss as a function of collector current

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



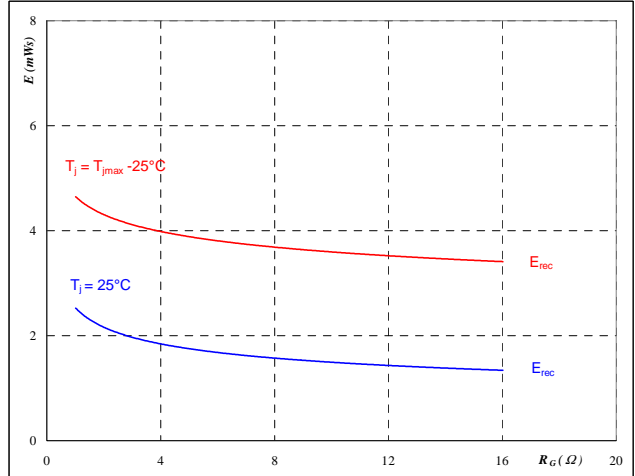
With an inductive load at

$T_J =$	25/150	°C
$V_{CE} =$	300	V
$V_{GE} =$	±15	V
$R_{gon} =$	2	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

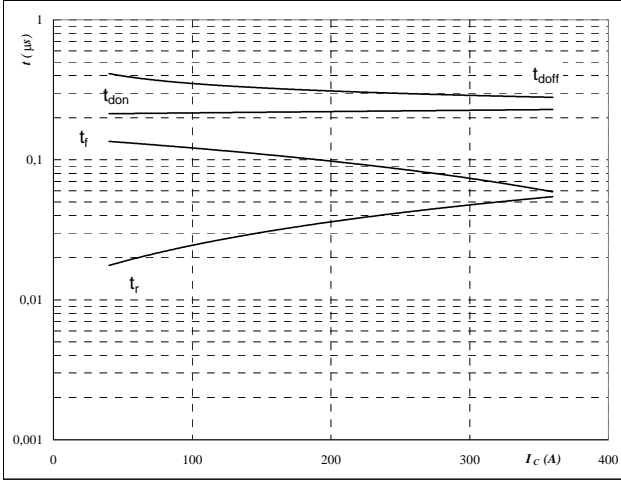
$T_J =$	25/150	°C
$V_{CE} =$	300	V
$V_{GE} =$	±15	V
$I_C =$	200	A

Output Inverter

Figure 9 Output inverter IGBT

Typical switching times as a function of collector current

$$t = f(I_C)$$



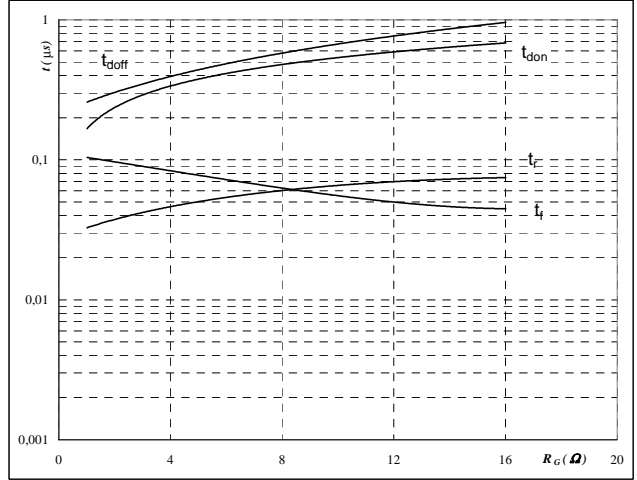
With an inductive load at

$T_J =$	150	°C
$V_{CE} =$	300	V
$V_{GE} =$	±15	V
$R_{gon} =$	2	Ω
$R_{goff} =$	2	Ω

Figure 10 Output inverter IGBT

Typical switching times as a function of gate resistor

$$t = f(R_G)$$



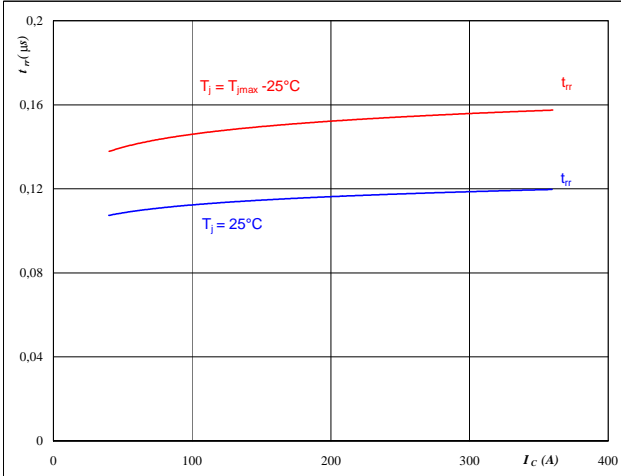
With an inductive load at

$T_J =$	150	°C
$V_{CE} =$	300	V
$V_{GE} =$	±15	V
$I_C =$	200	A

Figure 11 Output inverter FRED

Typical reverse recovery time as a function of collector current

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



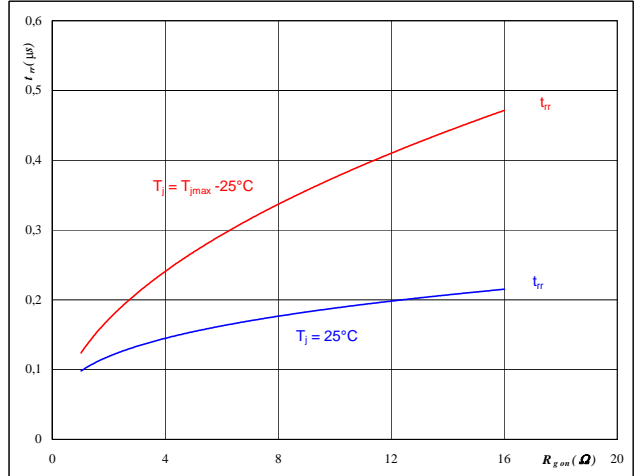
At

$T_J =$	25/150	°C
$V_{CE} =$	300	V
$V_{GE} =$	±15	V
$R_{gon} =$	2	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

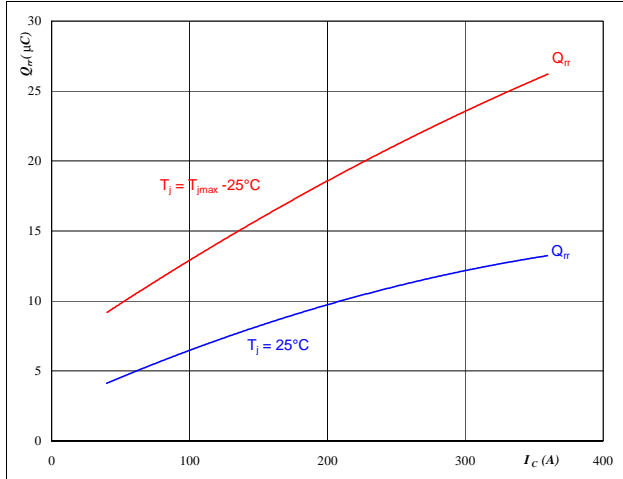
$T_J =$	25/150	°C
$V_R =$	300	V
$I_F =$	200	A
$V_{GE} =$	±15	V

Output Inverter

Figure 13 Output inverter FRED

Typical reverse recovery charge as a function of collector current

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



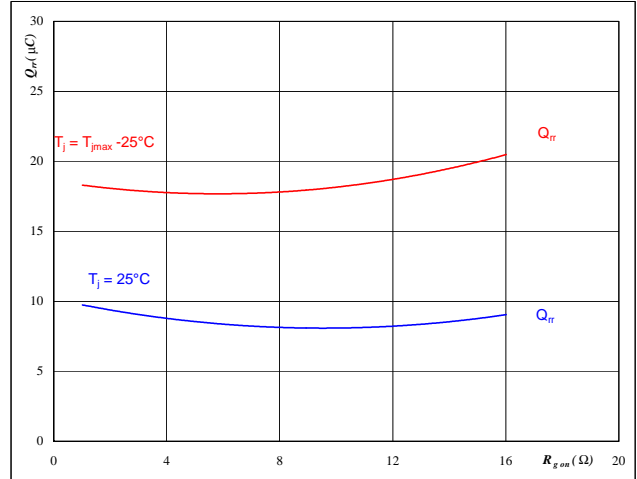
At

$T_j =$	25/150	°C
$V_{CE} =$	300	V
$V_{GE} =$	±15	V
$R_{gon} =$	2	Ω

Figure 14 Output inverter FRED

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

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



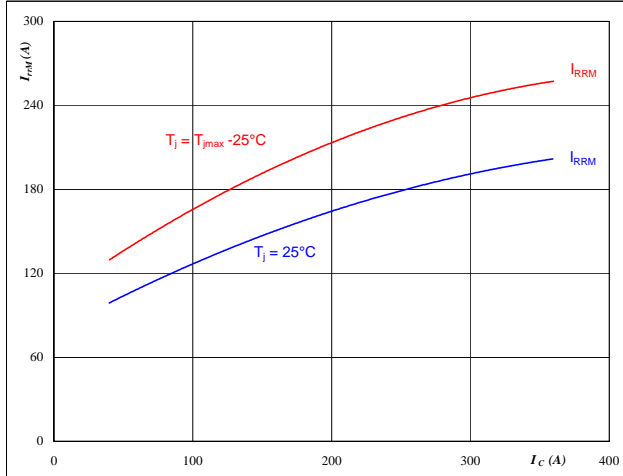
At

$T_j =$	25/150	°C
$V_R =$	300	V
$I_F =$	200	A
$V_{GE} =$	±15	V

Figure 15 Output inverter FRED

Typical reverse recovery current as a function of collector current

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



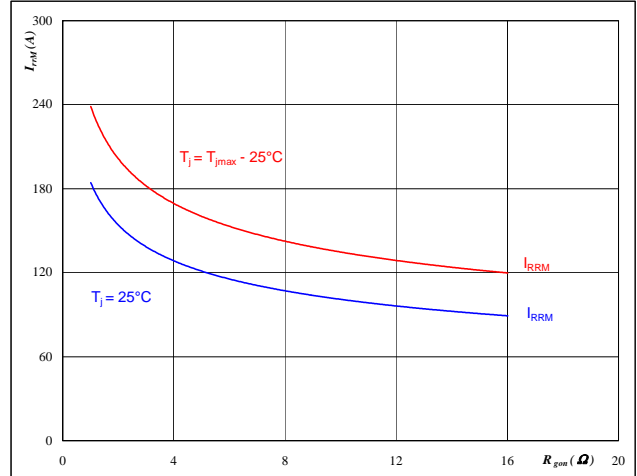
At

$T_j =$	25/150	°C
$V_{CE} =$	300	V
$V_{GE} =$	±15	V
$R_{gon} =$	2	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

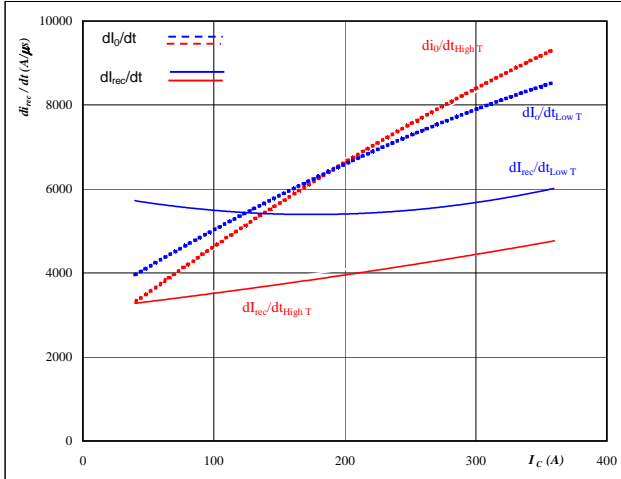
$T_j =$	25/150	°C
$V_R =$	300	V
$I_F =$	200	A
$V_{GE} =$	±15	V

Output Inverter

Figure 17 Output inverter FRED

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

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

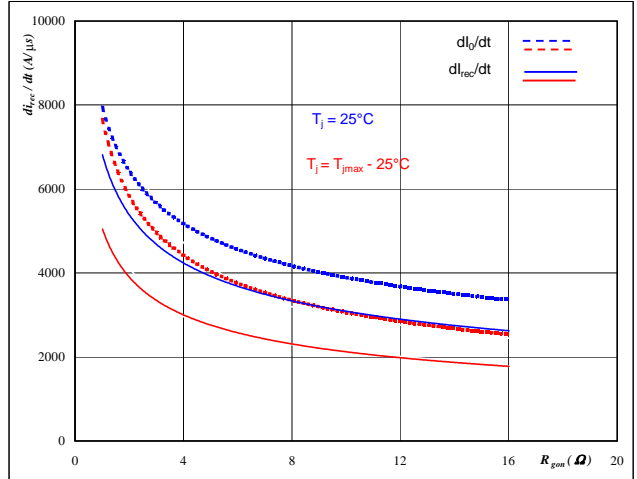


At
 $T_j = 25/150 \text{ } ^\circ\text{C}$
 $V_{CE} = 300 \text{ V}$
 $V_{GE} = \pm 15 \text{ V}$
 $R_{gon} = 2 \text{ } \Omega$

Figure 18 Output inverter FRED

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

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

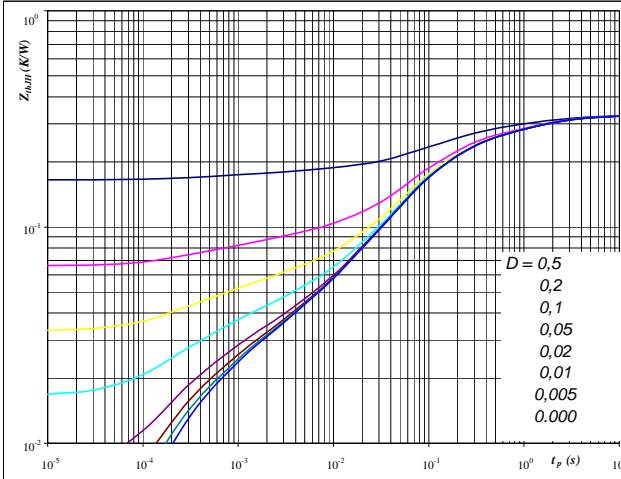


At
 $T_j = 25/150 \text{ } ^\circ\text{C}$
 $V_R = 300 \text{ V}$
 $I_F = 200 \text{ A}$
 $V_{GE} = \pm 15 \text{ V}$

Figure 19 Output inverter IGBT

IGBT transient thermal impedance as a function of pulse width

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



At
 $D = t_p / T$
 $R_{thJH} = 0,33 \text{ K/W}$

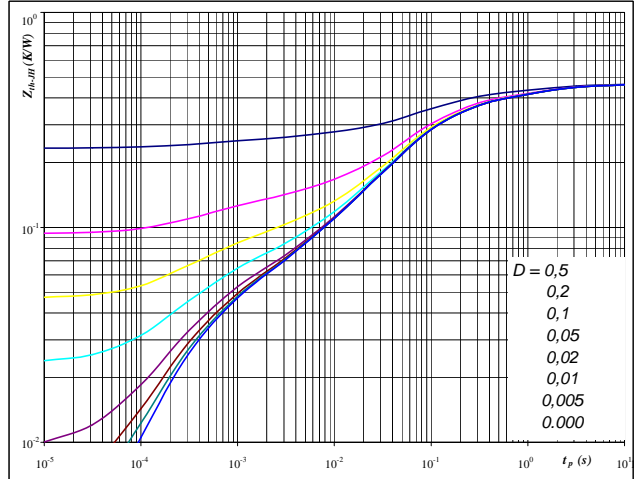
IGBT thermal model values

R (C/W)	Tau (s)
0,01	9,3E+00
0,07	1,4E+00
0,12	1,9E-01
0,09	4,7E-02
0,02	2,5E-03
0,02	2,9E-04

Figure 20 Output inverter FRED

FRED transient thermal impedance as a function of pulse width

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



At
 $D = t_p / T$
 $R_{thJH} = 0,47 \text{ K/W}$

FRED thermal model values

R (C/W)	Tau (s)
0,02	9,4E+00
0,08	1,2E+00
0,15	1,5E-01
0,15	4,0E-02
0,03	3,0E-03
0,03	3,3E-04

Output Inverter

Figure 21 Output inverter IGBT

Power dissipation as a function of heatsink temperature

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

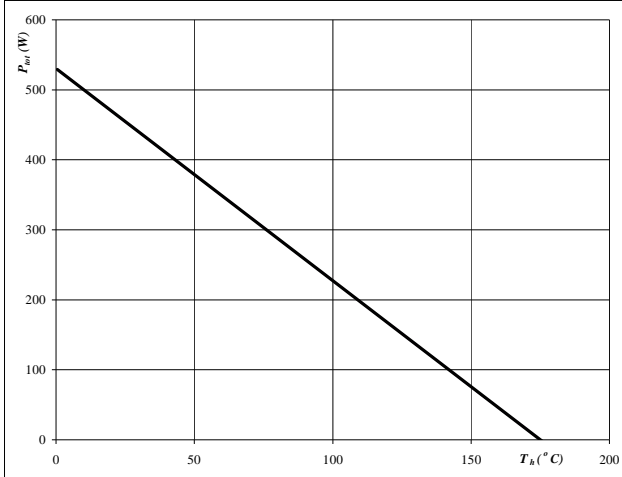

At
 $T_j = 175$ °C
 — single heating
 — overall heating

Figure 22 Output inverter IGBT

Collector current as a function of heatsink temperature

$$I_C = f(T_h)$$

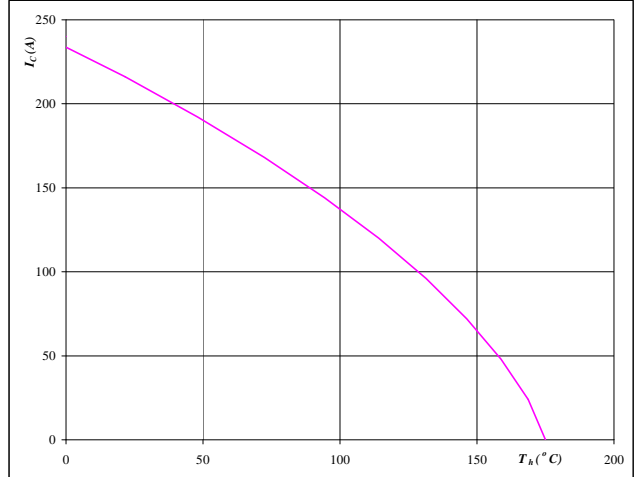

At
 $T_j = 175$ °C
 $V_{GE} = 15$ V

Figure 23 Output inverter FRED

Power dissipation as a function of heatsink temperature

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

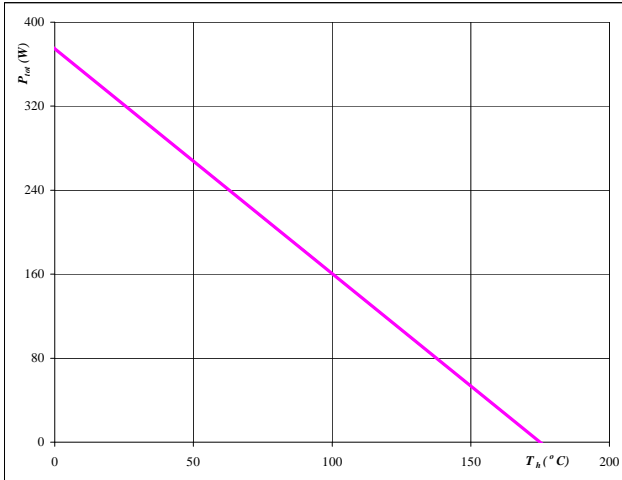
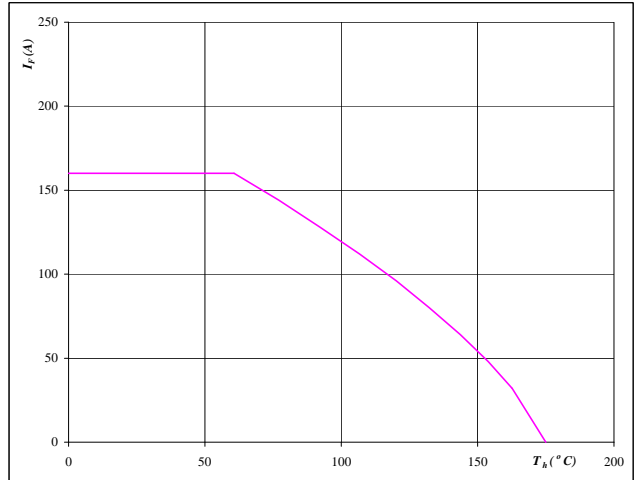

At
 $T_j = 175$ °C
 — single heating
 — overall heating

Figure 24 Output inverter FRED

Forward current as a function of heatsink temperature

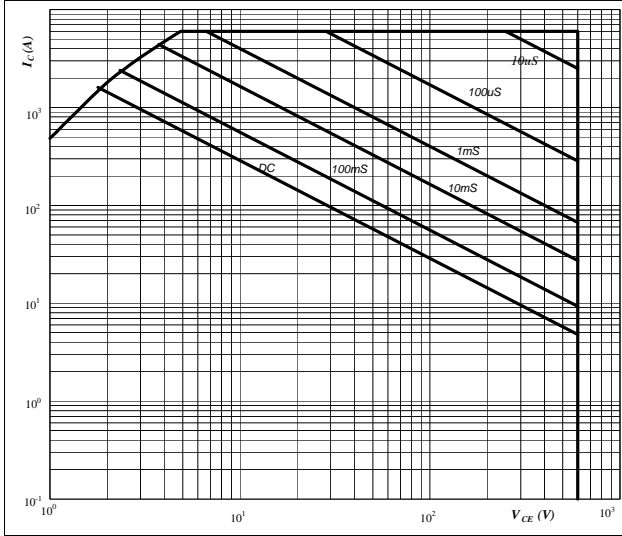
$$I_F = f(T_h)$$


At
 $T_j = 175$ °C

Output Inverter

Figure 25 Output inverter IGBT

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

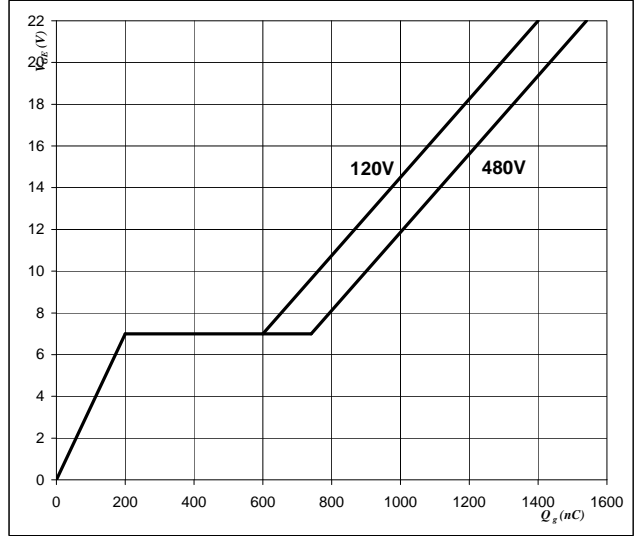


At
 D = single pulse
 $T_n = 80$ °C
 $V_{GE} = \pm 15$ V
 $T_j = T_{jmax}$ °C

Figure 26 Output inverter IGBT

Gate voltage vs Gate charge

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

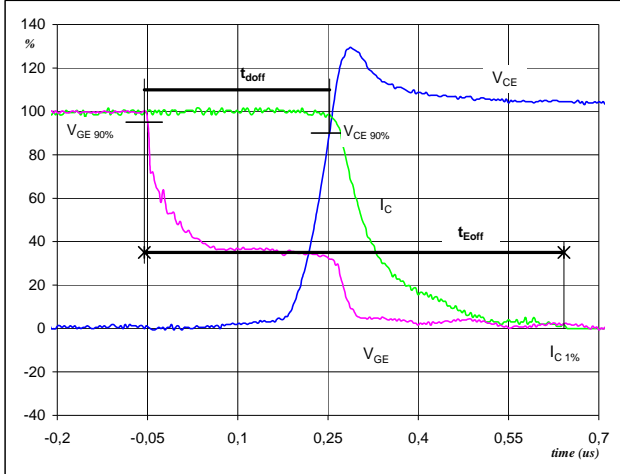


At
 $I_C = 200$ A

Switching Definitions Output Inverter

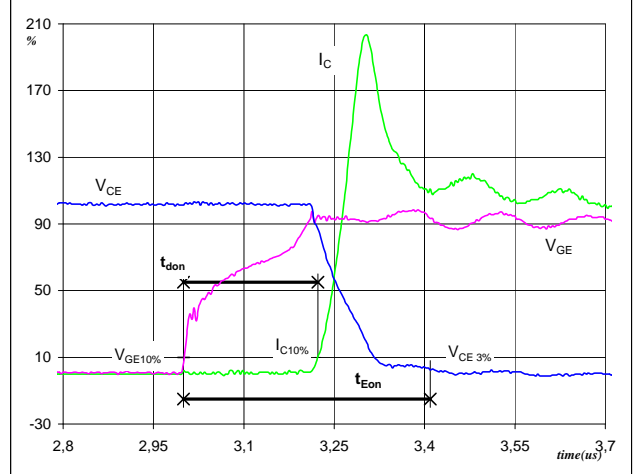
General conditions	
T_j	= 150 °C
R_{gon}	= 2 Ω
R_{goff}	= 2 Ω

Figure 1 Output inverter IGBT

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


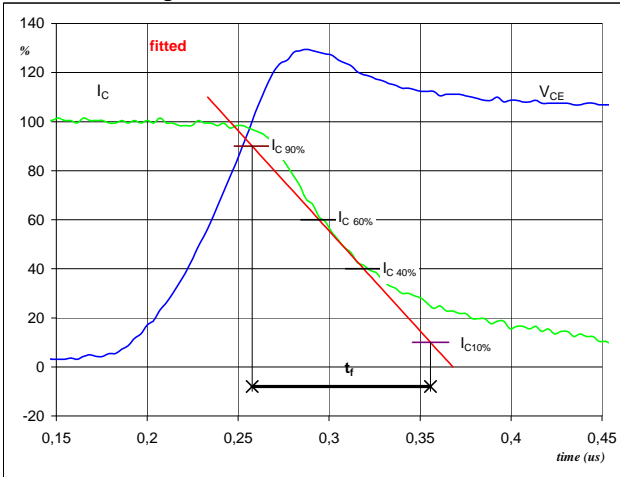
$V_{GE}(0\%) =$	-15	V
$V_{GE}(100\%) =$	15	V
$V_C(100\%) =$	300	V
$I_C(100\%) =$	203	A
$t_{doff} =$	0,30	μs
$t_{Eoff} =$	0,70	μs

Figure 2 Output inverter IGBT

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


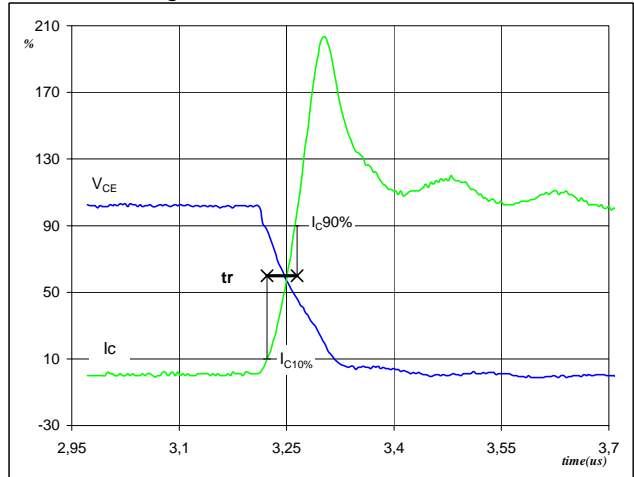
$V_{GE}(0\%) =$	-15	V
$V_{GE}(100\%) =$	15	V
$V_C(100\%) =$	300	V
$I_C(100\%) =$	203	A
$t_{don} =$	0,22	μs
$t_{Eon} =$	0,41	μs

Figure 3 Output inverter IGBT

Turn-off Switching Waveforms & definition of t_f


$V_C(100\%) =$	300	V
$I_C(100\%) =$	203	A
$t_f =$	0,10	μs

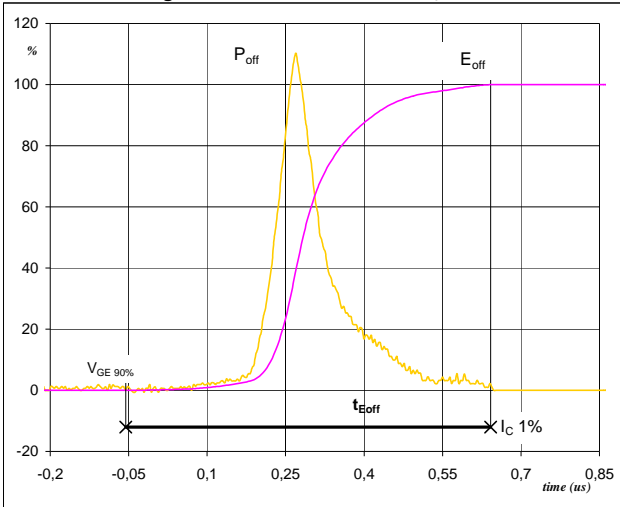
Figure 4 Output inverter IGBT

Turn-on Switching Waveforms & definition of t_r


$V_C(100\%) =$	300	V
$I_C(100\%) =$	203	A
$t_r =$	0,04	μs

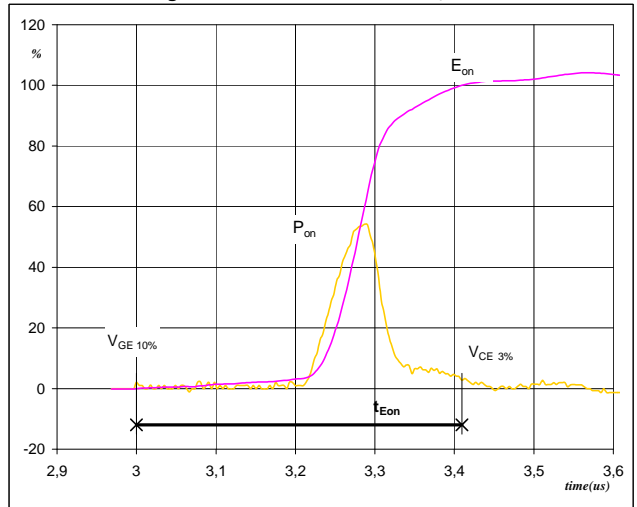
Switching Definitions Output Inverter

Figure 5 Output inverter IGBT

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


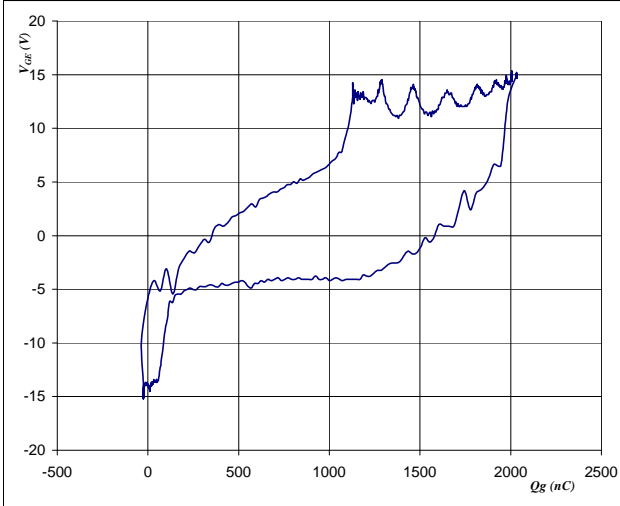
$P_{off} (100\%) = 60,82 \text{ kW}$
 $E_{off} (100\%) = 7,80 \text{ mJ}$
 $t_{Eoff} = 0,70 \text{ }\mu\text{s}$

Figure 6 Output inverter IGBT

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


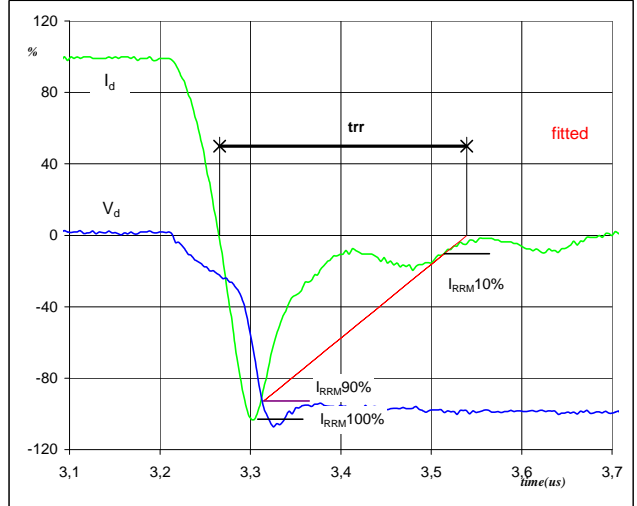
$P_{on} (100\%) = 60,82 \text{ kW}$
 $E_{on} (100\%) = 2,63 \text{ mJ}$
 $t_{Eon} = 0,41 \text{ }\mu\text{s}$

Figure 7 Output inverter FRED

Gate voltage vs Gate charge (measured)


$V_{GEoff} = -15 \text{ V}$
 $V_{GEon} = 15 \text{ V}$
 $V_C (100\%) = 300 \text{ V}$
 $I_C (100\%) = 203 \text{ A}$
 $Q_g = 9547,24 \text{ nC}$

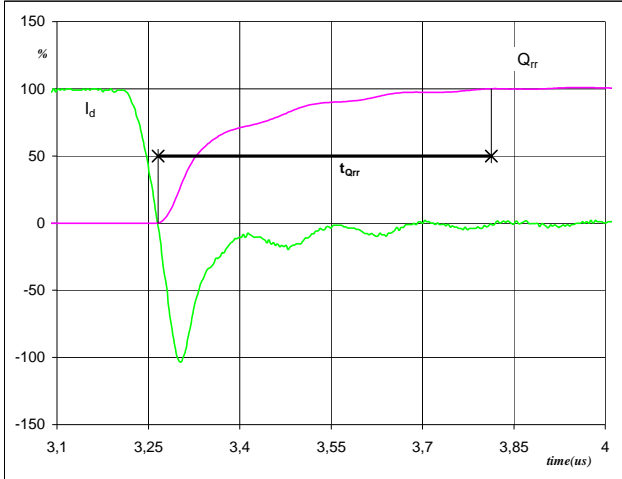
Figure 8 Output inverter IGBT

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


$V_d (100\%) = 300 \text{ V}$
 $I_d (100\%) = 203 \text{ A}$
 $I_{RRM} (100\%) = -211 \text{ A}$
 $t_{rr} = 0,14 \text{ }\mu\text{s}$

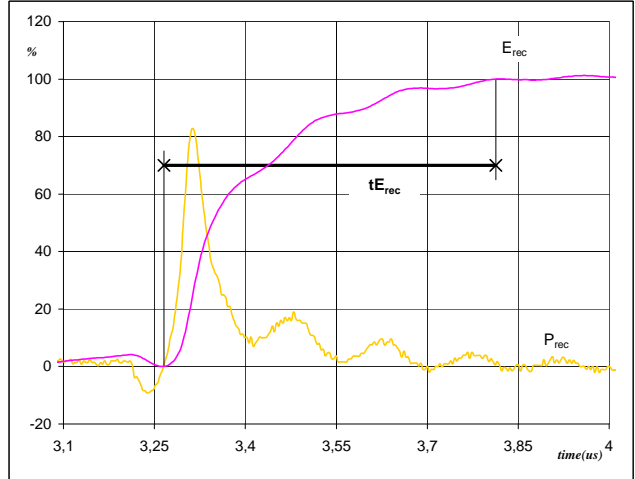
Switching Definitions Output Inverter

Figure 9 Output inverter FRED

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


I_d (100%) =	203	A
Q_{rr} (100%) =	16,33	μC
t_{Qrr} =	0,55	μs

Figure 10 Output inverter FRED

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


P_{rec} (100%) =	60,82	kW
E_{rec} (100%) =	3,89	mJ
t_{Erec} =	0,55	μs

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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