

flowPHASE0
600V/150A
Features

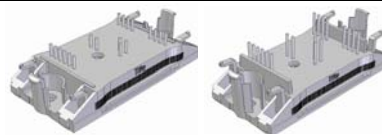
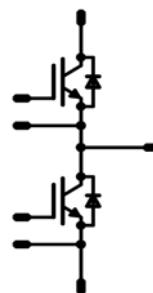
- Trench Fieldstop IGBT³ technology
- 2-clip housing in 12mm and 17mm height
- Compact and low inductance design

Target Applications

- Motor Drive
- UPS

Types

- FZ062PA150SA
- F0062PA150SA

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	$T_j = T_{jmax}$ $T_h = 80^\circ\text{C}$ $T_c = 80^\circ\text{C}$	86 113	A
Repetitive peak collector current	I_{Cpulse}	t_p limited by T_{jmax}	450	A
Power dissipation per IGBT	P_{tot}	$T_j = T_{jmax}$ $T_h = 80^\circ\text{C}$ $T_c = 80^\circ\text{C}$	125 189	W
Gate-emitter peak voltage	V_{GE}		± 20	V
Short circuit ratings	t_{SC} V_{CC}	$T_j \leq 150^\circ\text{C}$ $V_{GE} = 15V$	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	$T_j = T_{jmax}$ $T_h = 80^\circ\text{C}$ $T_c = 80^\circ\text{C}$	71 98	A
Repetitive peak forward current	I_{FRM}	t_p limited by T_{jmax}	450	A
Power dissipation per Diode	P_{tot}	$T_j = T_{jmax}$ $T_h = 80^\circ\text{C}$ $T_c = 80^\circ\text{C}$	85 129	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	$^{\circ}\text{C}$
Operation temperature under switching condition	T_{op}		-40...+($T_{j\text{max}}$ - 25)	$^{\circ}\text{C}$

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}			0,0024	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	1,61 1,87	2,2	V
Collector-emitter cut-off current incl. Diode	I _{CES}		0	600		T _j =25°C T _j =150°C			0,96	mA
Gate-emitter leakage current	I _{GES}		20	0		T _j =25°C T _j =150°C			700	nA
Integrated Gate resistor	R _{gint}							2		Ω
Turn-on delay time	t _{d(on)}	Rgoff=4 Ω Rgon=4 Ω	±15	300	150	T _j =25°C T _j =150°C		231 241		ns
Rise time	t _r					T _j =25°C T _j =150°C		32 37		
Turn-off delay time	t _{d(off)}					T _j =25°C T _j =150°C		296 329		
Fall time	t _f					T _j =25°C T _j =150°C		81 95		
Turn-on energy loss per pulse	E _{on}					T _j =25°C T _j =150°C		2,03 3		mWs
Turn-off energy loss per pulse	E _{off}					T _j =25°C T _j =150°C		3,88 5,21		
Input capacitance	C _{ies}	f=1MHz	0	25		T _j =25°C		9240		pF
Output capacitance	C _{oss}							576		
Reverse transfer capacitance	C _{rss}							274		
Gate charge	Q _{Gate}		±15			T _j =25°C		930		nC
Thermal resistance chip to heatsink per chip	R _{thJH}	Thermal grease thickness≤50um						0.76		K/W
Thermal resistance chip to case per chip	R _{thJC}	λ = 1 W/mK								
Inverter Diode										
Diode forward voltage	V _F				50	T _j =25°C T _j =150°C	1	1,71 1,6	2,2	V
Peak reverse recovery current	I _{RRM}	Rgon=4 Ω	±15	300	150	T _j =25°C T _j =150°C		123,92 161,1		A
Reverse recovery time	t _{rr}					T _j =25°C T _j =150°C		108,8 273,1		ns
Reverse recovered charge	Q _{rr}					T _j =25°C T _j =150°C		7,37 15,35		μC
Peak rate of fall of recovery current	di(rec)max /dt					T _j =25°C T _j =150°C		2262 2417		A/μs
Reverse recovered energy	E _{rec}					T _j =25°C T _j =150°C		1,62 3,48		mWs
Thermal resistance chip to heatsink per chip	R _{thJH}					Thermal grease thickness≤50um				
Thermal resistance chip to case per chip	R _{thJC}	λ = 1 W/mK								

Output Inverter

Figure 1 Output inverter IGBT

Typical output characteristics

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

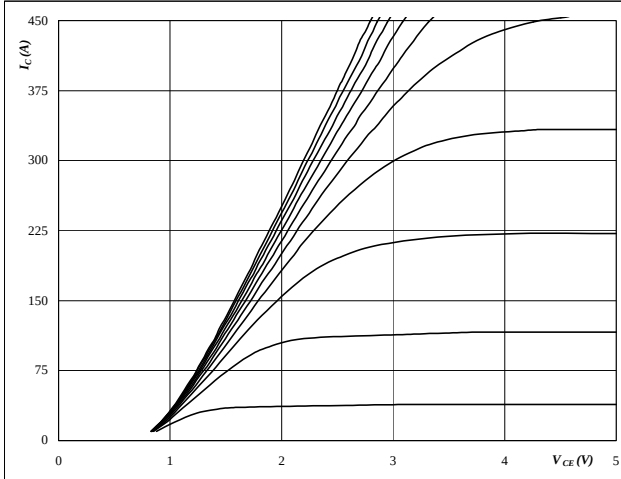

At
 $t_p = 350 \mu s$
 $T_J = 25^\circ C$
 V_{GE} from 7 V to 17 V in steps of 1 V

Figure 2 Output inverter IGBT

Typical output characteristics

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

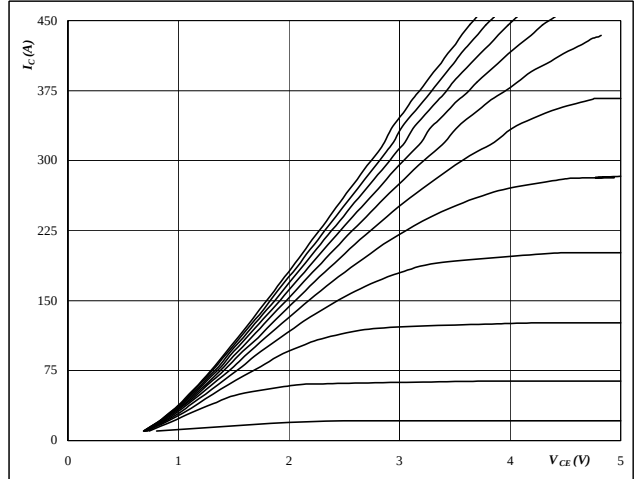
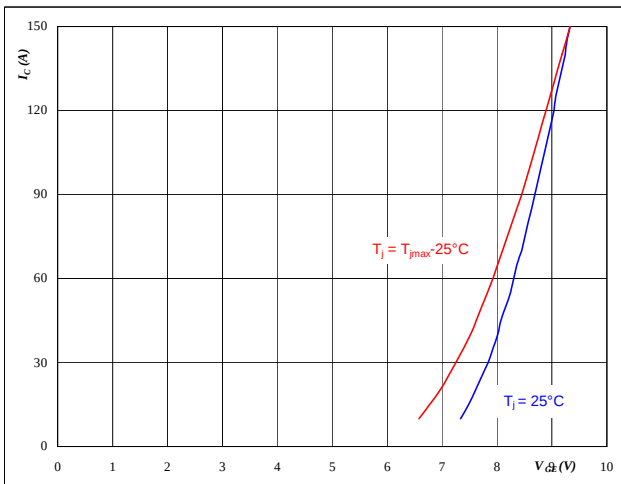

At
 $t_p = 350 \mu s$
 $T_J = 150^\circ C$
 V_{GE} from 7 V to 17 V in steps of 1 V

Figure 3 Output inverter IGBT

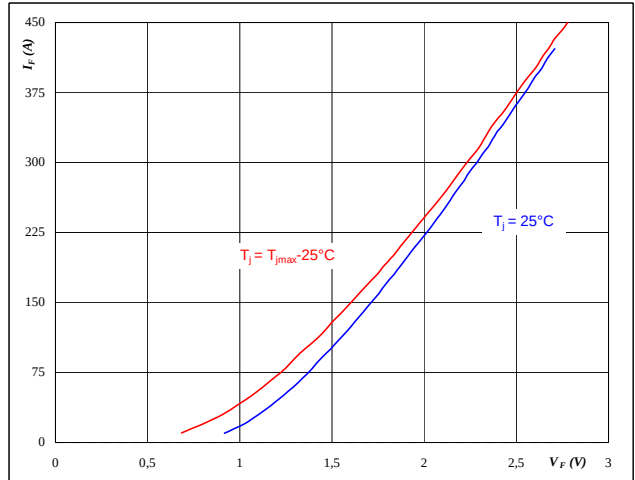
Typical transfer characteristics

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


At
 $t_p = 350 \mu s$
 $V_{CE} = 10 V$
Figure 4 Output inverter FRED

Typical diode forward current as a function of forward voltage

$$I_F = f(V_F)$$

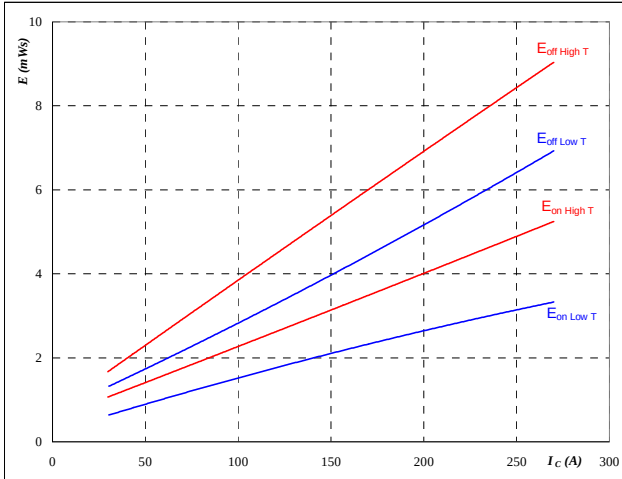

At
 $t_p = 350 \mu s$

Output Inverter

Figure 5 Output inverter IGBT

Typical switching energy losses
as a function of collector current

$$E = f(I_C)$$



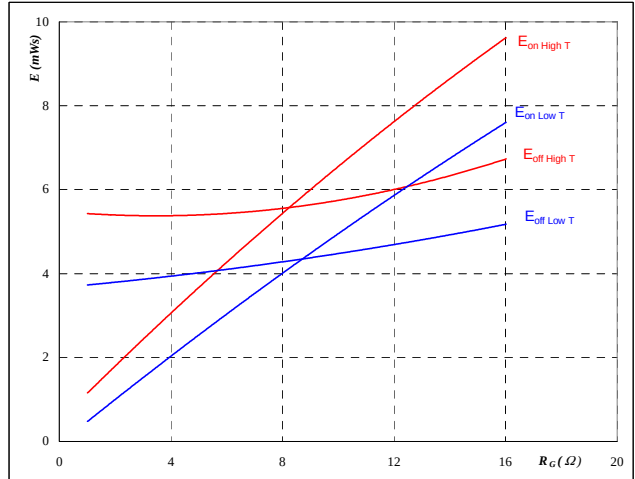
With an inductive load at

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

Figure 6 Output inverter IGBT

Typical switching energy losses
as a function of gate resistor

$$E = f(R_G)$$



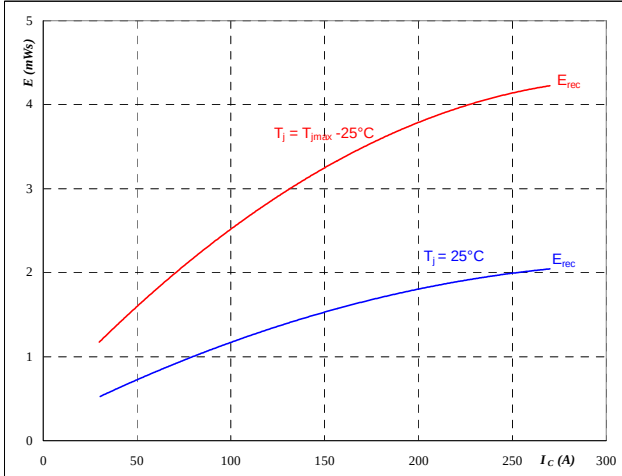
With an inductive load at

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

Figure 7 Output inverter IGBT

Typical reverse recovery energy loss
as a function of collector current

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



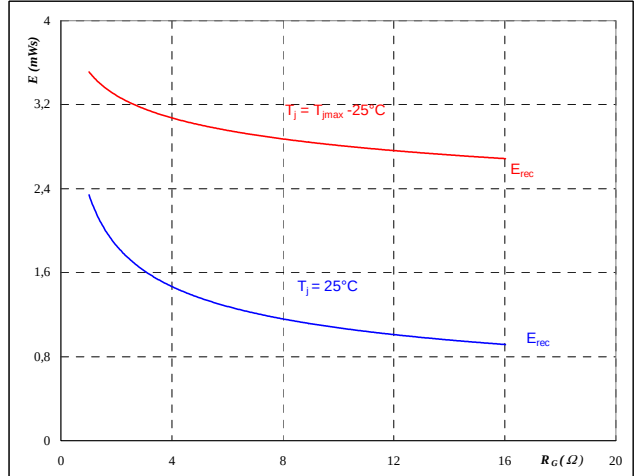
With an inductive load at

$T_J = 25/150$ °C
 $V_{CE} = 300$ V
 $V_{GE} = \pm 15$ 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

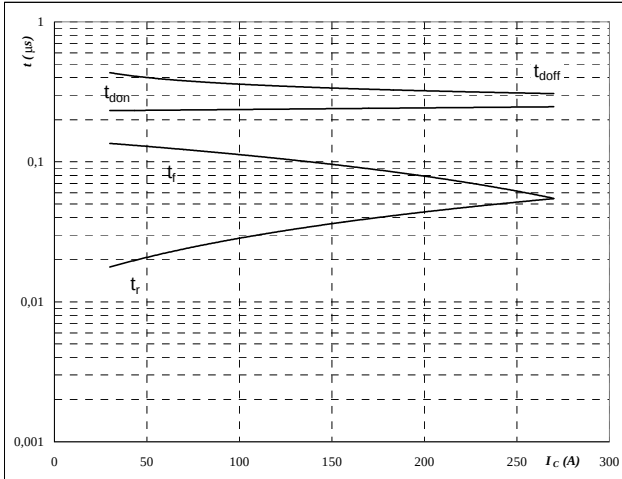
$T_J = 25/150$ °C
 $V_{CE} = 300$ V
 $V_{GE} = \pm 15$ V
 $I_C = 150$ A

Output Inverter

Figure 9 Output inverter IGBT

Typical switching times as a function of collector current

$$t = f(I_C)$$



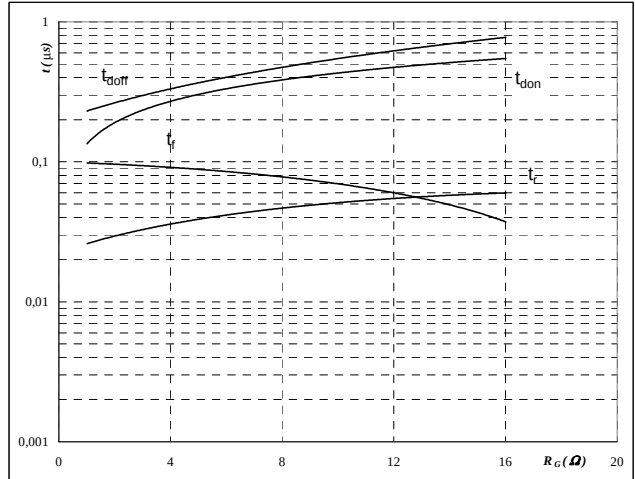
With an inductive load at

$T_J =$	150	°C
$V_{CE} =$	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

$$t = f(R_G)$$



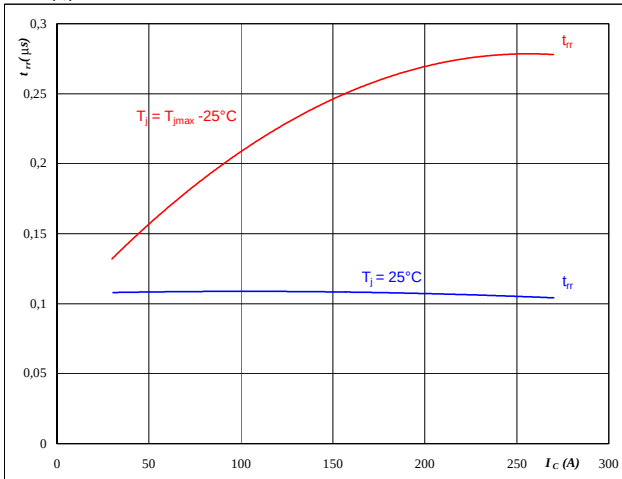
With an inductive load at

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

Figure 11 Output inverter FRED

Typical reverse recovery time as a function of collector current

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



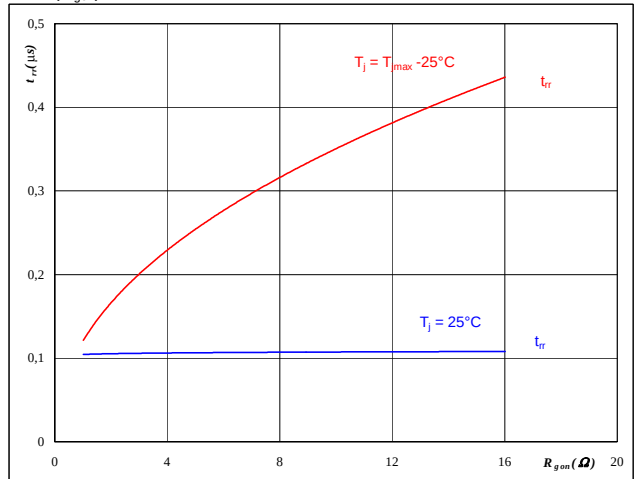
At

$T_J =$	25/150	°C
$V_{CE} =$	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

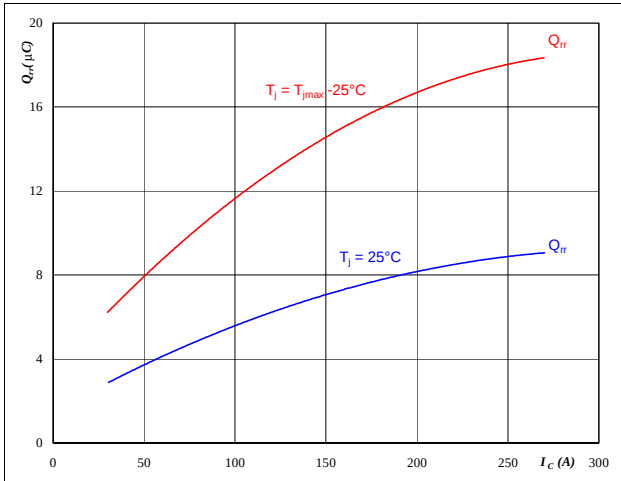
$T_J =$	25/150	°C
$V_R =$	300	V
$I_F =$	150	A
$V_{GE} =$	±15	V

Output Inverter

Figure 13 Output inverter FRED

Typical reverse recovery charge as a function of collector current

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

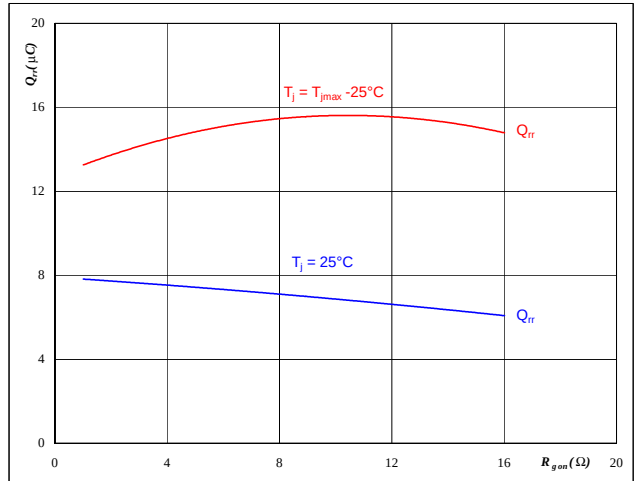


At
 $T_j = 25/150$ °C
 $V_{CE} = 300$ V
 $V_{GE} = \pm 15$ V
 $R_{gon} = 4$ Ω

Figure 14 Output inverter FRED

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

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

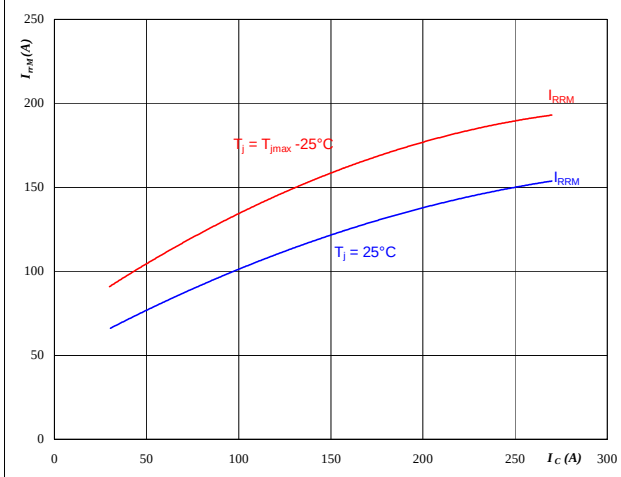


At
 $T_j = 25/150$ °C
 $V_R = 300$ V
 $I_F = 150$ A
 $V_{GE} = \pm 15$ V

Figure 15 Output inverter FRED

Typical reverse recovery current as a function of collector current

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

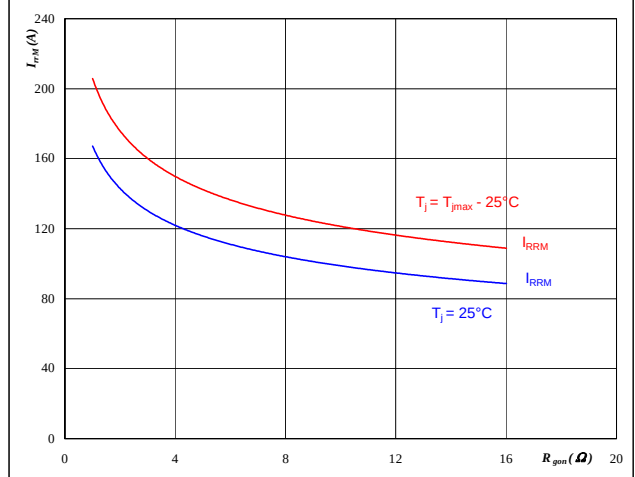


At
 $T_j = 25/150$ °C
 $V_{CE} = 300$ V
 $V_{GE} = \pm 15$ V
 $R_{gon} = 4$ Ω

Figure 16 Output inverter FRED

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

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



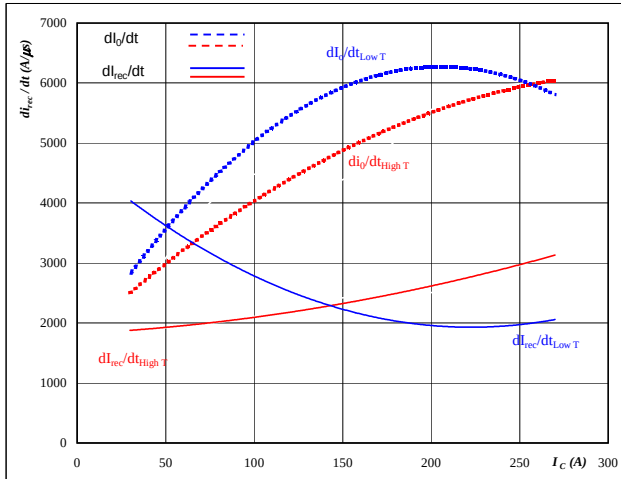
At
 $T_j = 25/150$ °C
 $V_R = 300$ V
 $I_F = 150$ A
 $V_{GE} = \pm 15$ V

Output Inverter

Figure 17 Output inverter FRED

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

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



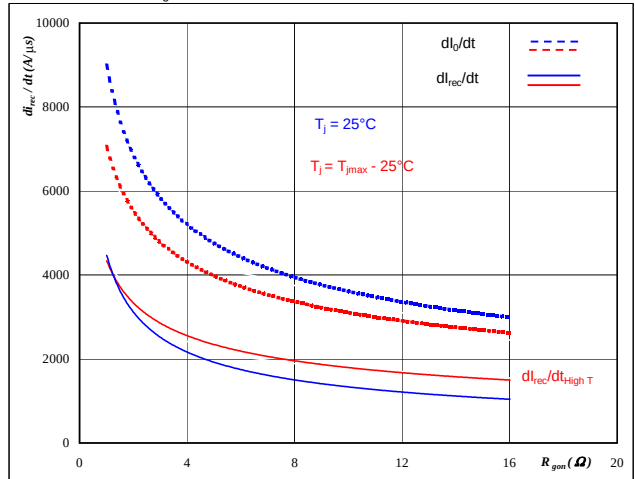
At

$T_J =$	25/150	°C
$V_{CE} =$	300	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

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



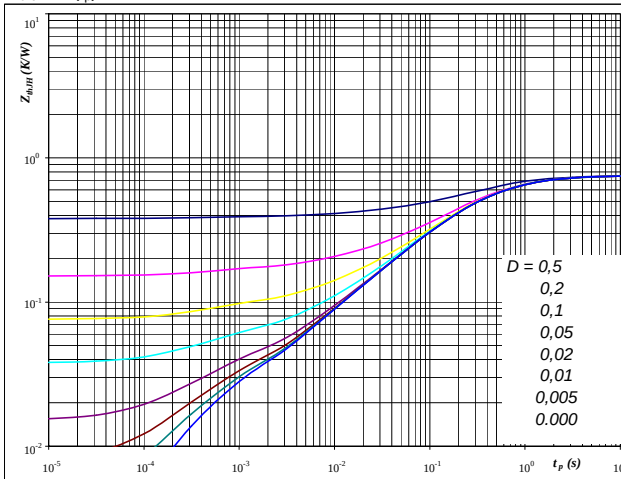
At

$T_J =$	25/150	°C
$V_R =$	300	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	
$R_{thJH} =$	0,76	K/W

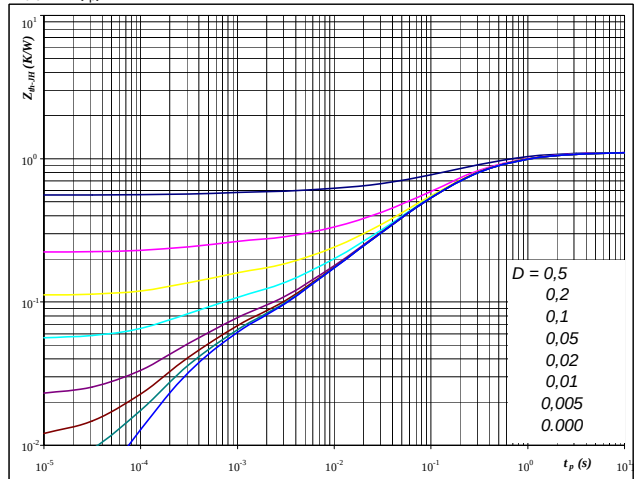
IGBT thermal model values

R (C/W)	Tau (s)
0,03	9,6E+00
0,15	1,3E+00
0,38	2,7E-01
0,13	5,3E-02
0,04	8,1E-03
0,02	4,4E-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	
$R_{thJH} =$	1,11	K/W

FRED thermal model values

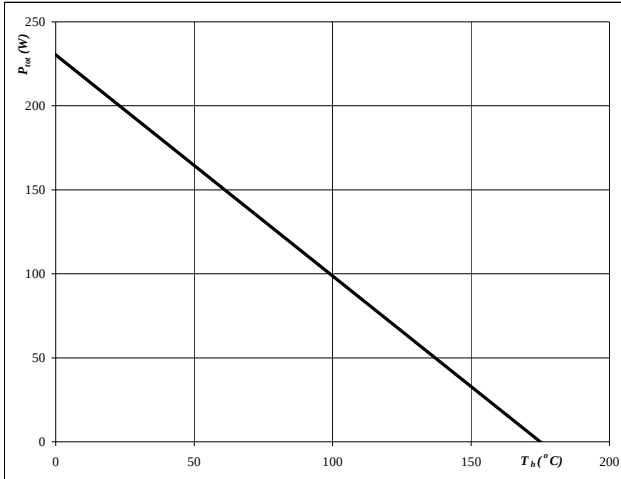
R (C/W)	Tau (s)
0,04	9,8E+00
0,22	9,7E-01
0,55	1,9E-01
0,20	3,6E-02
0,06	5,3E-03
0,05	3,7E-04

Output Inverter

Figure 21 Output inverter IGBT

Power dissipation as a function of heatsink temperature

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

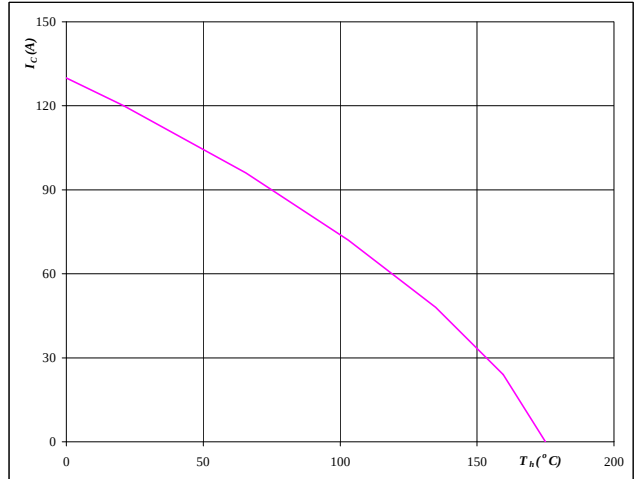


At $T_j = 175$ °C
 — single heating
 — overall heating

Figure 22 Output inverter IGBT

Collector current as a function of heatsink temperature

$$I_C = f(T_h)$$

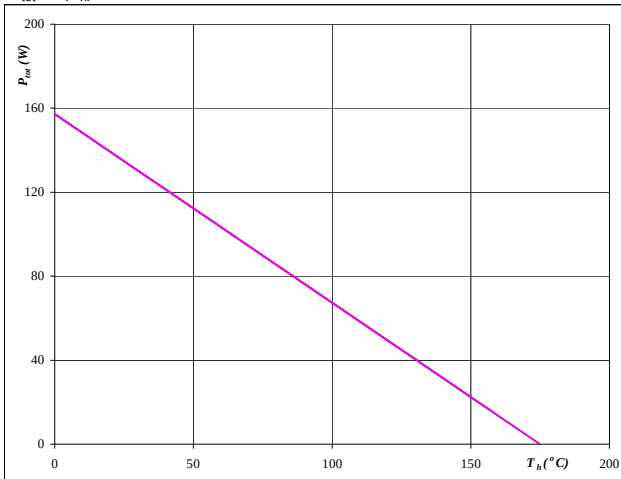


At $T_j = 175$ °C
 $V_{GE} = 15$ V

Figure 23 Output inverter FRED

Power dissipation as a function of heatsink temperature

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

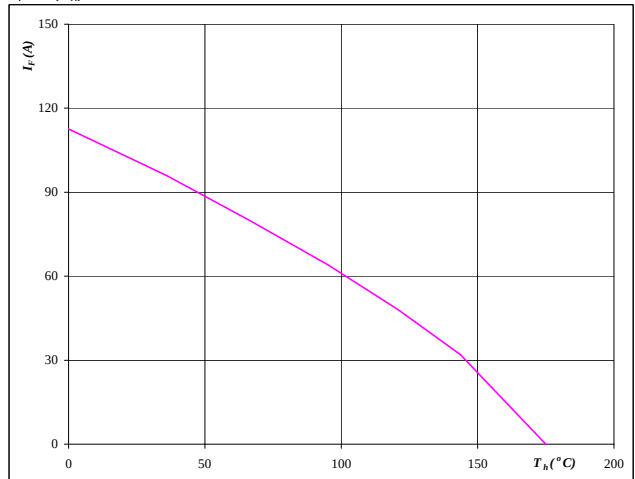


At $T_j = 175$ °C
 — single heating
 — overall heating

Figure 24 Output inverter FRED

Forward current as a function of heatsink temperature

$$I_F = f(T_h)$$



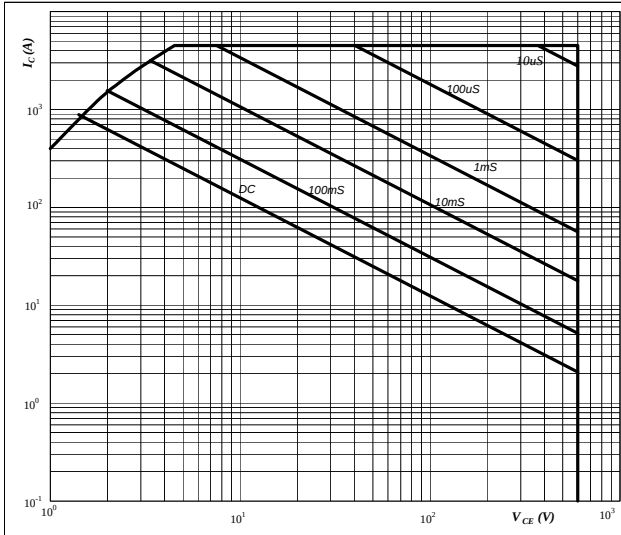
At $T_j = 175$ °C

Output Inverter

Figure 25 Output inverter IGBT

Safe operating area as a function
of collector-emitter voltage

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



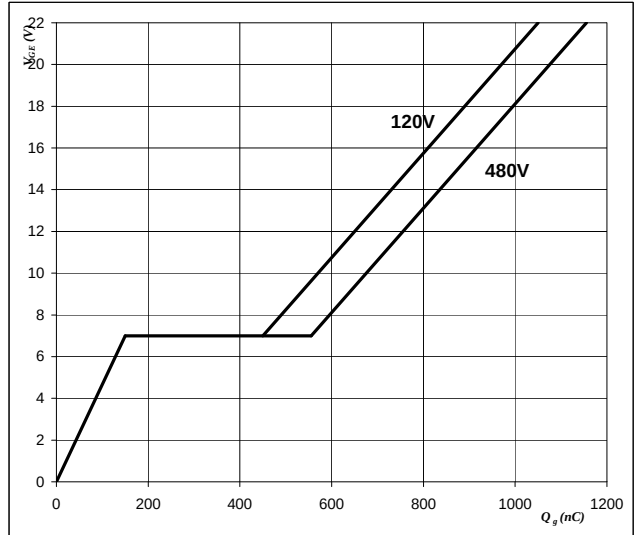
At

D = single pulse
 $T_h = 80$ °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

$I_C = 150$ A

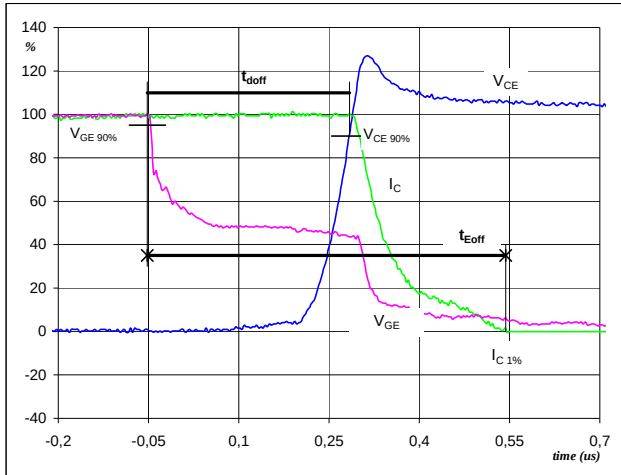
Switching Definitions Output Inverter

General conditions

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

Figure 1 Output inverter IGBT

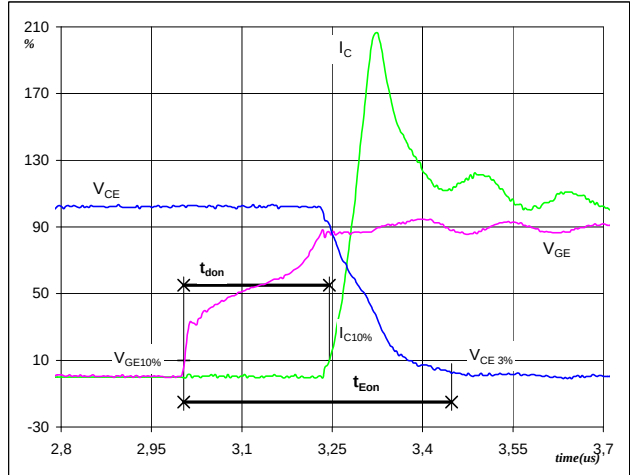
Turn-off Switching Waveforms & definition of t_{doff} , t_{Eoff}
 (t_{Eoff} = integrating time for E_{off})



$V_{GE}(0\%) =$	-15	V
$V_{GE}(100\%) =$	15	V
$V_C(100\%) =$	300	V
$I_C(100\%) =$	150	A
$t_{doff} =$	0,33	μs
$t_{Eoff} =$	0,60	μs

Figure 2 Output inverter IGBT

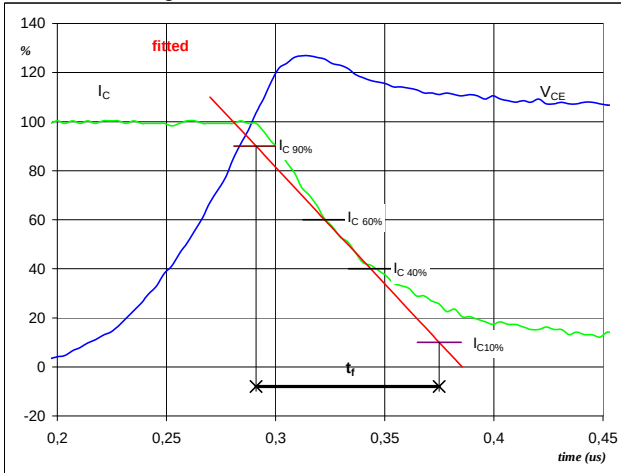
Turn-on Switching Waveforms & definition of t_{don} , t_{Eon}
 (t_{Eon} = integrating time for E_{on})



$V_{GE}(0\%) =$	-15	V
$V_{GE}(100\%) =$	15	V
$V_C(100\%) =$	300	V
$I_C(100\%) =$	150	A
$t_{don} =$	0,24	μs
$t_{Eon} =$	0,44	μs

Figure 3 Output inverter IGBT

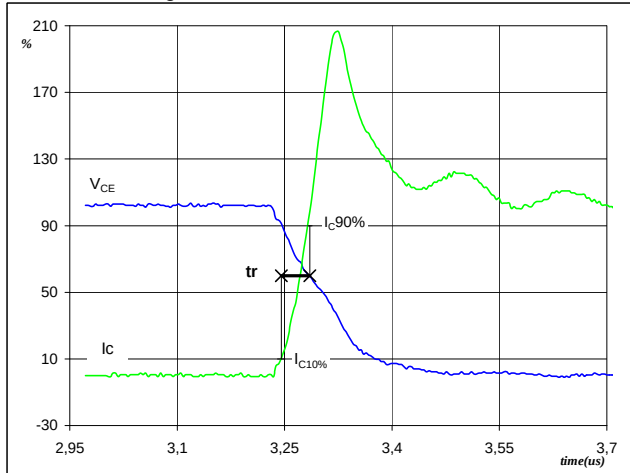
Turn-off Switching Waveforms & definition of t_f



$V_C(100\%) =$	300	V
$I_C(100\%) =$	150	A
$t_f =$	0,09	μs

Figure 4 Output inverter IGBT

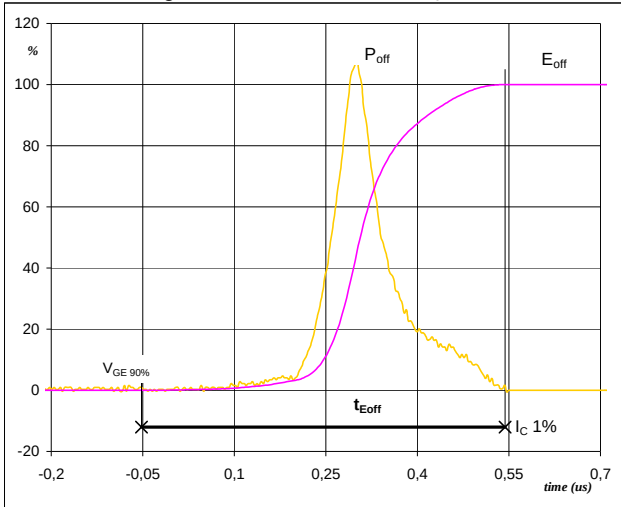
Turn-on Switching Waveforms & definition of t_r



$V_C(100\%) =$	300	V
$I_C(100\%) =$	150	A
$t_r =$	0,04	μs

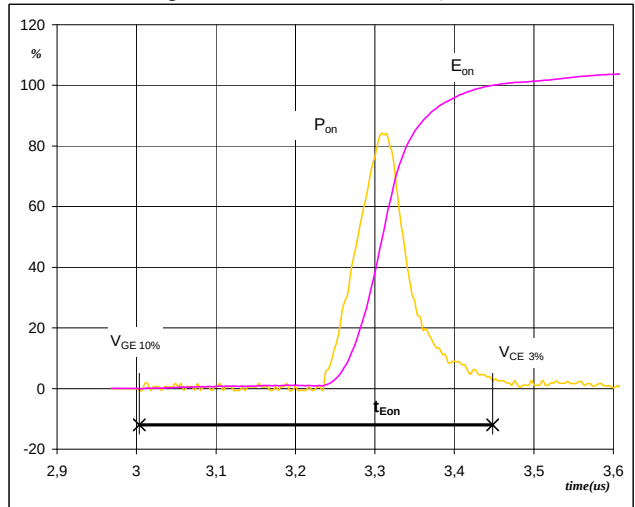
Switching Definitions Output Inverter

Figure 5 Output inverter IGBT

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


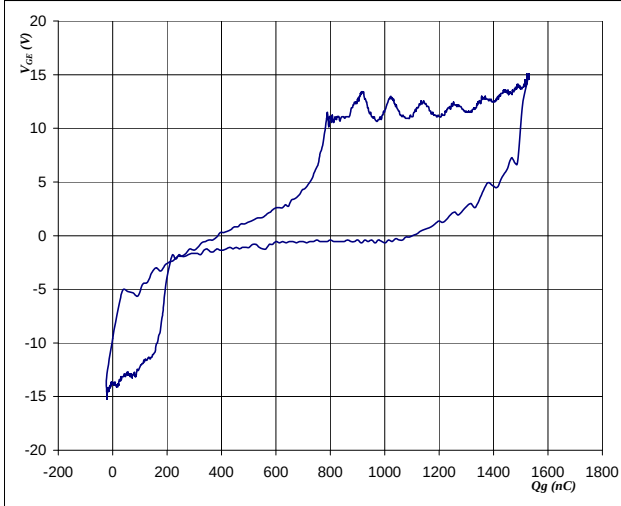
$P_{off}(100\%) = 45,00$ kW
 $E_{off}(100\%) = 5,23$ mJ
 $t_{Eoff} = 0,60$ μ s

Figure 6 Output inverter IGBT

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


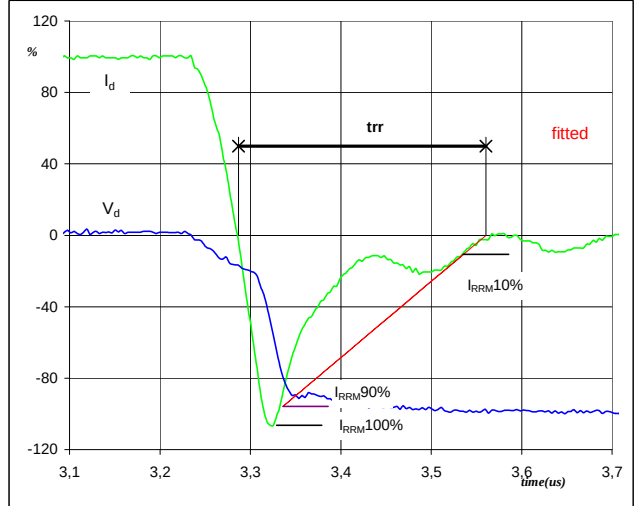
$P_{on}(100\%) = 45,00$ kW
 $E_{on}(100\%) = 3,02$ mJ
 $t_{Eon} = 0,44$ μ s

Figure 7 Output inverter FRED

Gate voltage vs Gate charge (measured)


$V_{GEoff} = -15$ V
 $V_{GEon} = 15$ V
 $V_C(100\%) = 300$ V
 $I_C(100\%) = 150$ A
 $Q_g = 5363,18$ nC

Figure 8 Output inverter IGBT

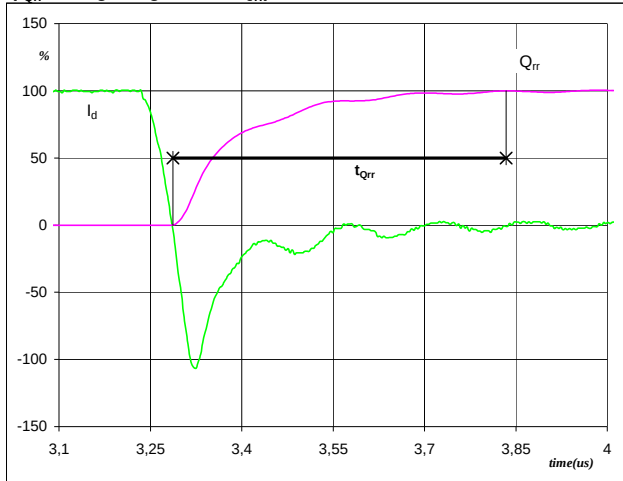
Turn-off Switching Waveforms & definition of t_{rr}


$V_d(100\%) = 300$ V
 $I_d(100\%) = 150$ A
 $I_{RRM}(100\%) = -161$ A
 $t_{rr} = 0,16$ μ s

Switching Definitions Output Inverter

Figure 9 Output inverter FRED

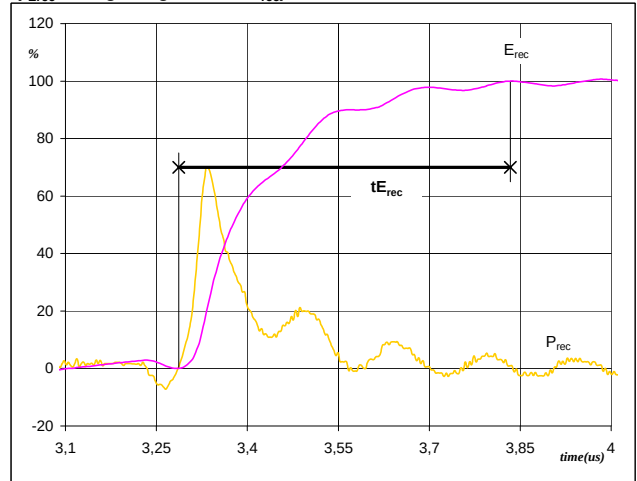
Turn-on Switching Waveforms & definition of t_{Qrr}
 (t_{Qrr} = integrating time for Q_{rr})



I_d (100%) = 150 A
 Q_{rr} (100%) = 13,55 μ C
 t_{Qrr} = 0,55 μ s

Figure 10 Output inverter FRED

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



P_{rec} (100%) = 45,00 kW
 E_{rec} (100%) = 2,95 mJ
 t_{Erec} = 0,55 μ s

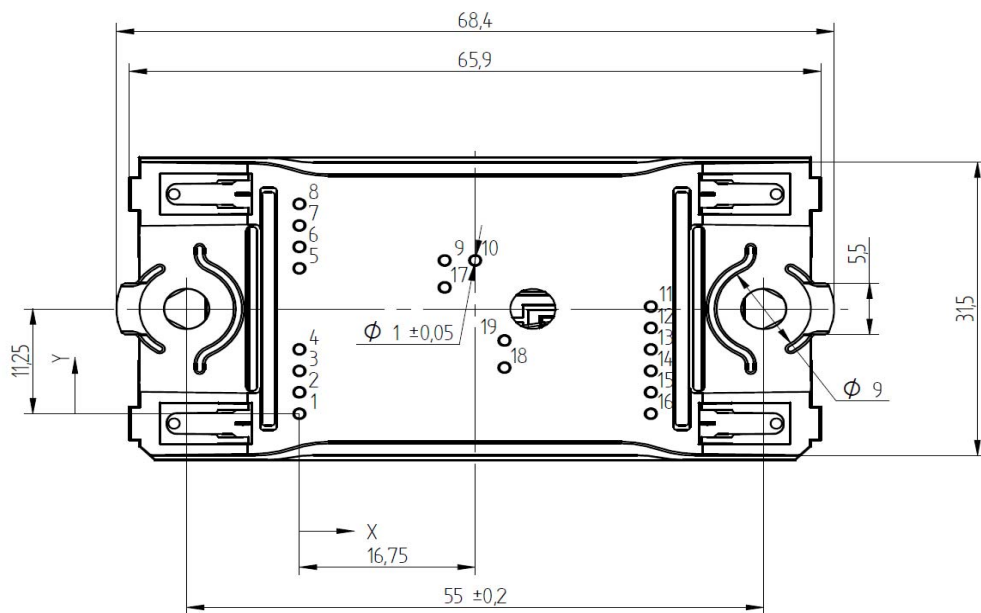
Ordering Code and Marking - Outline - Pinout

Ordering Code & Marking

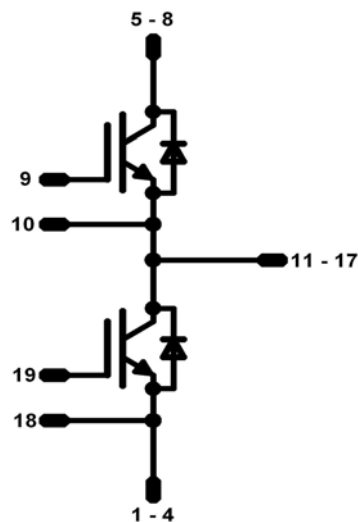
Version	Ordering Code	in DataMatrix as	in packaging barcode as
without thermal paste 12mm housing	10-FZ062PA150SC-P995F08	P995F08	P995F08
without thermal paste 17mm housing	10-F0062PA150SC-P995F09	P995F09	P995F09

Outline

Pin table		
Pin	X	Y
1	0	0
2	0	2,3
3	0	4,6
4	0	6,9
5	0	15,6
6	0	17,9
7	0	20,2
8	0	22,5
9	13,85	16,45
10	16,75	16,45
11	33,5	11,5
12	33,5	9,2
13	33,5	6,9
14	33,5	4,6
15	33,5	2,3
16	33,5	0
17	13,85	13,55
18	19,55	4,95
19	19,55	7,85



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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2. A critical component is any component of a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.