Vincotech

FZ12 / F0122PA050SC01
preliminary datasheet

| flowPHASE0 | 1200V/50A |

Features

- Trench Fieldstop IGBT[4] technology
- 2-clip housing in 12mm and 17mm height
- Compact and low inductance design
- AIN substrate for improved performance

flow0 housing

Target Applications

- Motor Drive
- UPS

Schematic

Types

- FZ122PA050SC01
- F0122PA050SC01
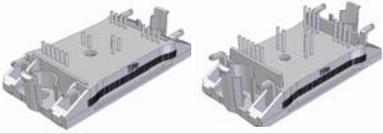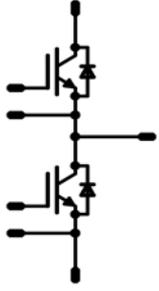
Maximum Ratings

T_j=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	69	A
			T_c=80°C	86	
Repetitive peak collector current	I_{Cpulse}	t_p limited by $T_j$max		150	A
Power dissipation per IGBT	P_{tot}	T_j=$T_j$max	T_h=80°C	211	W
			T_c=80°C	320	
Gate-emitter peak voltage	V_{GE}			±20	V
Short circuit ratings	t_{SC}	T_j≤150°C		10	µs
	V_{CC}	V_{GE}=15V		800	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	69	A
			T_c=80°C	90	
Repetitive peak forward current	I_{FRM}	t_p limited by $T_j$max		100	A
Power dissipation per Diode	P_{tot}	T_j=$T_j$max	T_h=80°C	149	W
			T_c=80°C	226	
Maximum Junction Temperature	$T_j$max			175	°C

Maximum Ratings

T_j=25°C, unless otherwise specified

Parameter	Symbol	Condition		Value	Unit
Thermal Properties					
Storage temperature	T_{stg}			-40…+125	°C
Operation temperature under switching condition	T_{op}			-40…+(Tjmax - 25)	°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_D [A]	T_j	Min	Typ	Max	
Inverter Transistor									
Gate emitter threshold voltage	$V_{GE(th)}$	$V_{CE}=V_{GE}$			0,0018	Tj=25°C / Tj=150°C	5	5,8	6,5	V
Collector-emitter saturation voltage	$V_{CE(sat)}$		15		50	Tj=25°C / Tj=150°C	1,5	1,96 / 2,33	2,3	V
Collector-emitter cut-off current incl. Diode	I_{CES}		0	1200		Tj=25°C / Tj=150°C			0,02	mA
Gate-emitter leakage current	I_{GES}		20	0		Tj=25°C / Tj=150°C			700	nA
Integrated Gate resistor	R_{gint}							4		Ω
Turn-on delay time	$t_{d(on)}$					Tj=25°C / Tj=150°C		102 / 106		ns
Rise time	t_r					Tj=25°C / Tj=150°C		17 / 24		
Turn-off delay time	$t_{d(off)}$	Rgoff=8 Ω Rgon=8 Ω	±15	600	50	Tj=25°C / Tj=150°C		225 / 289		
Fall time	t_f					Tj=25°C / Tj=150°C		97 / 131		
Turn-on energy loss per pulse	E_{on}					Tj=25°C / Tj=150°C		2,49 / 4,04		mWs
Turn-off energy loss per pulse	E_{off}					Tj=25°C / Tj=150°C		2,88 / 4,63		
Input capacitance	C_{ies}							2770		pF
Output capacitance	C_{oss}	f=1MHz	0	25		Tj=25°C		205		
Reverse transfer capacitance	C_{rss}							160		
Gate charge	Q_{Gate}		±15			Tj=25°C		193		nC
Thermal resistance chip to heatsink per chip	R_{thJH}	Thermal foil thickness=76um Kunze foil KU-ALF5						0,45		K/W
Thermal resistance chip to case per chip	R_{thJC}									
Inverter Diode									
Diode forward voltage	V_F				50	Tj=25°C / Tj=150°C	1	1,76 / 1,69	2,2	V
Peak reverse recovery current	I_{RRM}					Tj=25°C / Tj=150°C		80,03 / 87		A
Reverse recovery time	t_{rr}					Tj=25°C / Tj=150°C		128,7 / 290,7		ns
Reverse recovered charge	Q_{rr}	Rgon=8 Ω	±15	600	50	Tj=25°C / Tj=150°C		4,26 / 8,9		µC
Peak rate of fall of recovery current	di(rec)max /dt					Tj=25°C / Tj=150°C		4953 / 1407		A/µs
Reverse recovered energy	Erec					Tj=25°C / Tj=150°C		1,57 / 3,55		mWs
Thermal resistance chip to heatsink per chip	R_{thJH}	Thermal foil thickness=76um Kunze foil KU-ALF5						0,64		K/W
Thermal resistance chip to case per chip	R_{thJC}									

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Output Inverter

Figure 1	Output inverter IGBT

Typical output characteristics
$I_C = f(V_{CE})$
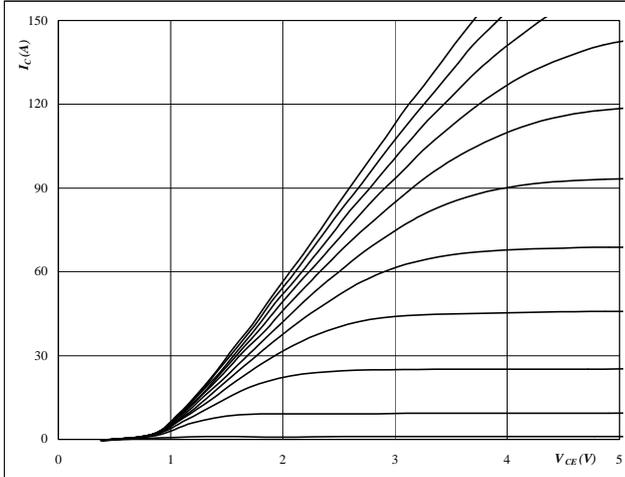
At
$t_p =$ 350 µs
$T_j =$ 25 °C
V_{GE} from 7 V to 17 V in steps of 1 V

Figure 2	Output inverter IGBT

Typical output characteristics
$I_C = f(V_{CE})$
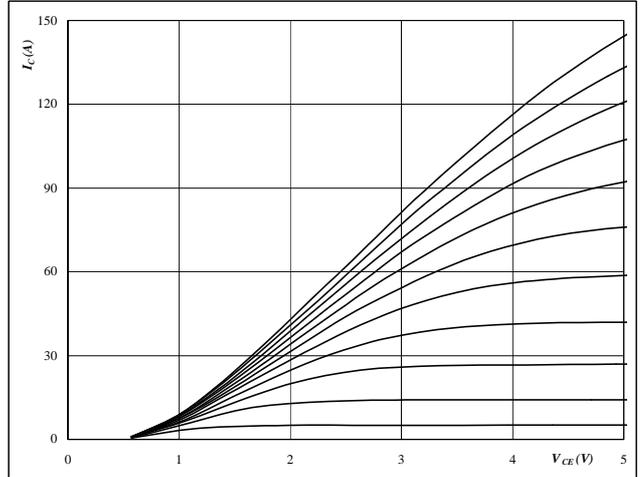
At
$t_p =$ 350 µs
$T_j =$ 150 °C
V_{GE} from 7 V to 17 V in steps of 1 V

Figure 3	Output inverter IGBT

Typical transfer characteristics
$I_C = f(V_{GE})$

$T_j = T_{jmax} = 25°C$
$T_j = 25°C$
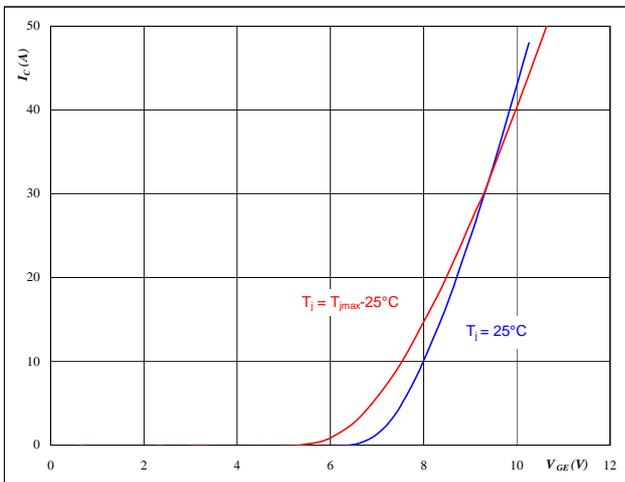
At
$t_p =$ 350 µs
$V_{CE} =$ 10 V

Figure 4	Output inverter FRED

**Typical diode forward current as
a function of forward voltage**
$I_F = f(V_F)$
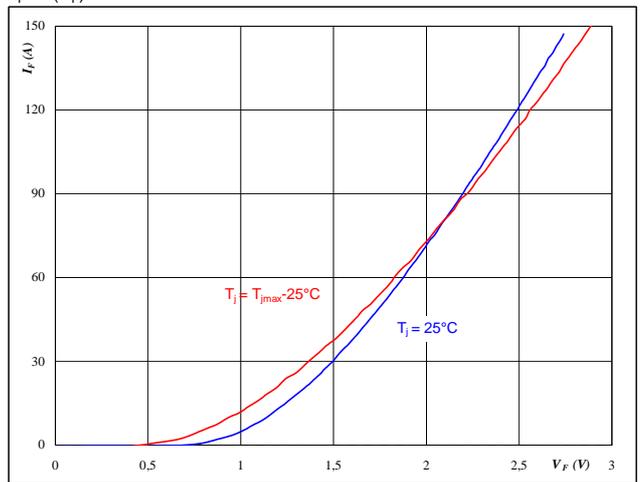
$T_j = T_{jmax} = 25°C$
$T_j = 25°C$

At
$t_p =$ 350 µs

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Output Inverter

Figure 5 — Output inverter IGBT

**Typical switching energy losses
as a function of collector current**

$E = f(I_C)$
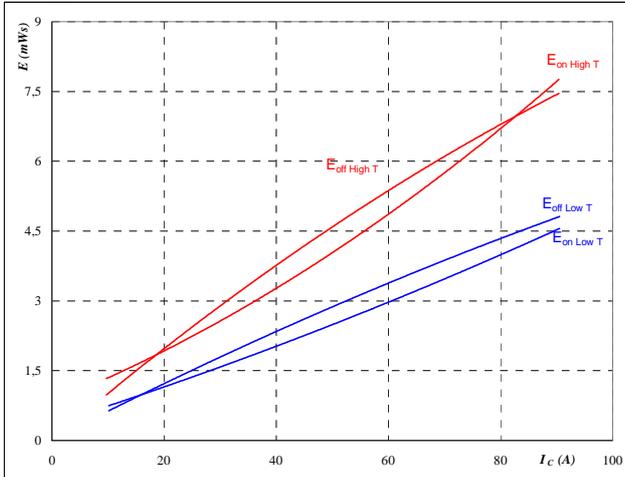
With an inductive load at

$T_j =$	25/150	°C
$V_{CE} =$	600	V
$V_{GE} =$	±15	V
$R_{gon} =$	8	Ω
$R_{goff} =$	8	Ω

Figure 6 — Output inverter IGBT

**Typical switching energy losses
as a function of gate resistor**

$E = f(R_G)$
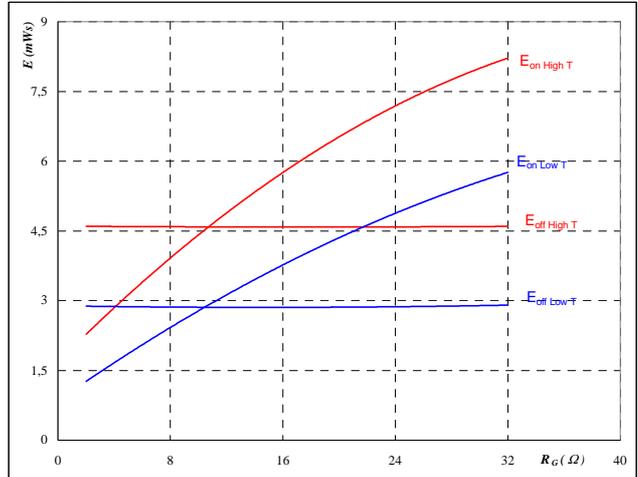
With an inductive load at

$T_j =$	25/150	°C
$V_{CE} =$	600	V
$V_{GE} =$	±15	V
$I_C =$	50	A

Figure 7 — Output inverter IGBT

**Typical reverse recovery energy loss
as a function of collector current**

$E_{rec} = f(I_C)$
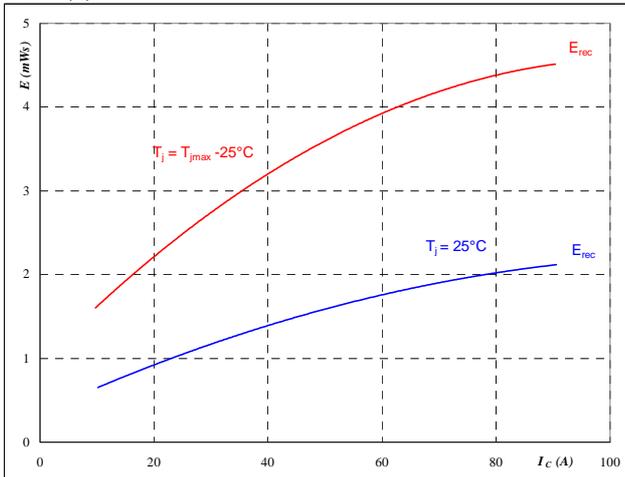
With an inductive load at

$T_j =$	25/150	°C
$V_{CE} =$	600	V
$V_{GE} =$	±15	V
$R_{gon} =$	8	Ω

Figure 8 — Output inverter IGBT

**Typical reverse recovery energy loss
as a function of gate resistor**

$E_{rec} = f(R_G)$
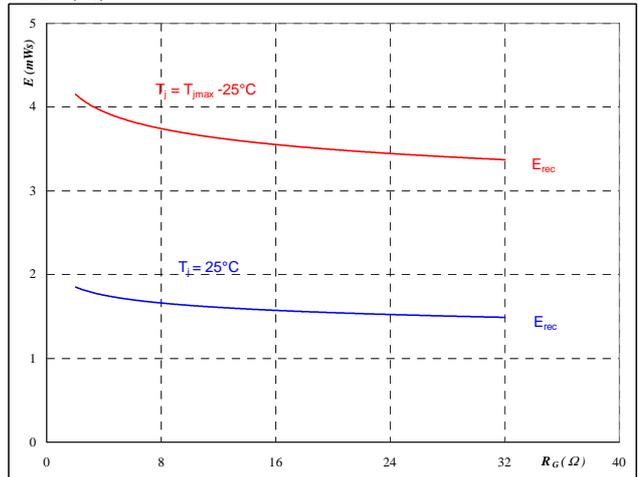
With an inductive load at

$T_j =$	25/150	°C
$V_{CE} =$	600	V
$V_{GE} =$	±15	V
$I_C =$	50	A

Output Inverter

Figure 9	Output inverter IGBT

**Typical switching times as a
function of collector current**

$t = f(I_C)$
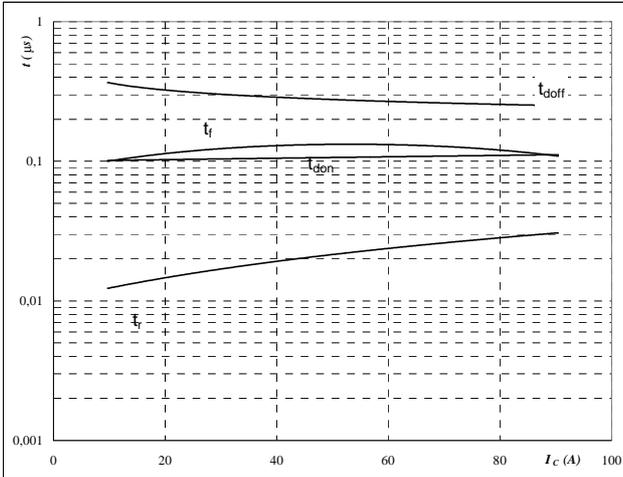
With an inductive load at

$T_j =$	150	°C
$V_{CE} =$	600	V
$V_{GE} =$	±15	V
$R_{gon} =$	8	Ω
$R_{goff} =$	8	Ω

Figure 10	Output inverter IGBT

**Typical switching times as a
function of gate resistor**

$t = f(R_G)$
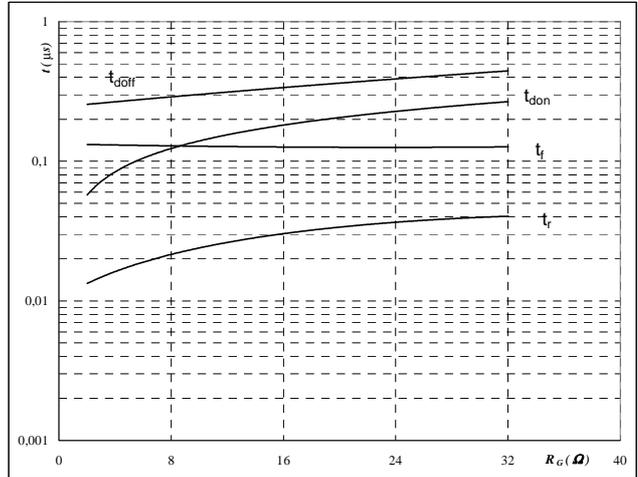
With an inductive load at

$T_j =$	150	°C
$V_{CE} =$	600	V
$V_{GE} =$	±15	V
$I_C =$	50	A

Figure 11	Output inverter FRED

**Typical reverse recovery time as a
function of collector current**

$t_{rr} = f(I_C)$

At
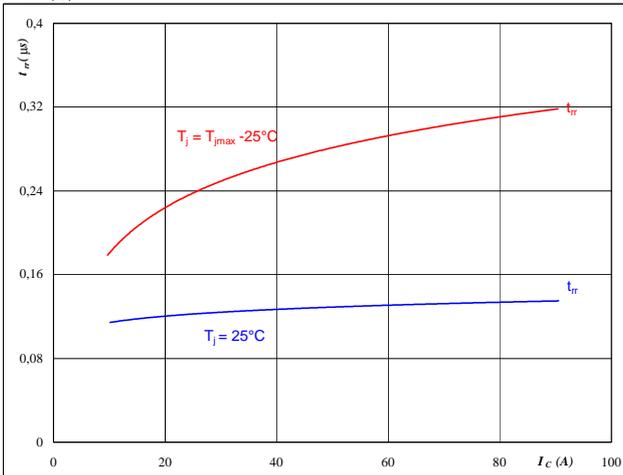
$T_j =$	25/150	°C
$V_{CE} =$	600	V
$V_{GE} =$	±15	V
$R_{gon} =$	8	Ω

Figure 12	Output inverter FRED

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

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

At
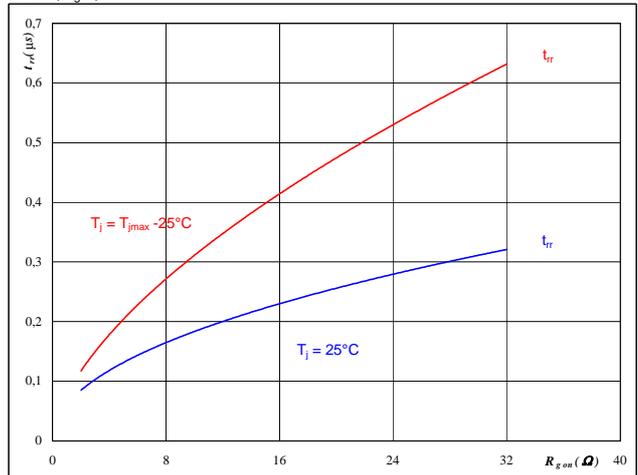
$T_j =$	25/150	°C
$V_R =$	600	V
$I_F =$	50	A
$V_{GE} =$	±15	V

Output Inverter

Figure 13	Output inverter FRED

Typical reverse recovery charge as a function of collector current

$Q_{rr} = f(I_C)$

At
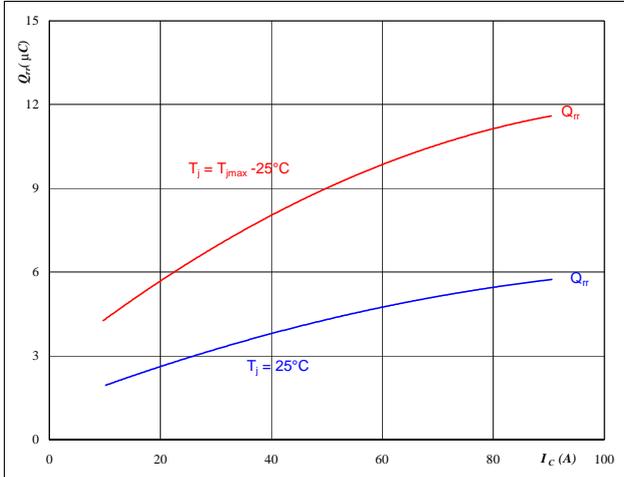
$T_j =$	25/150	°C
$V_{CE} =$	600	V
$V_{GE} =$	±15	V
$R_{gon} =$	8	Ω

Figure 14	Output inverter FRED

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

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

At
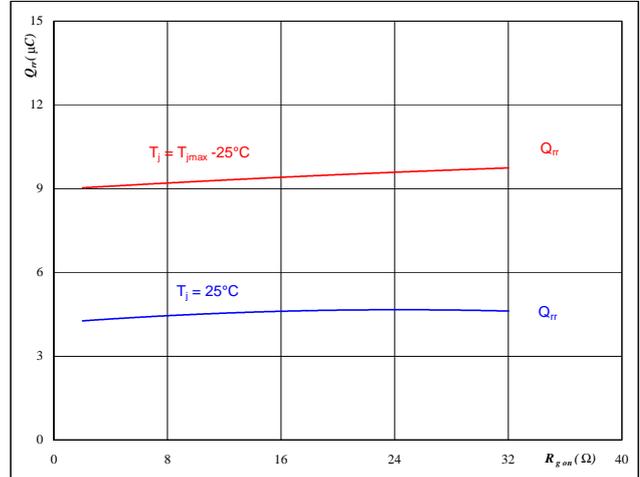
$T_j =$	25/150	°C
$V_R =$	600	V
$I_F =$	50	A
$V_{GE} =$	±15	V

Figure 15	Output inverter FRED

Typical reverse recovery current as a function of collector current

$I_{RRM} = f(I_C)$

At
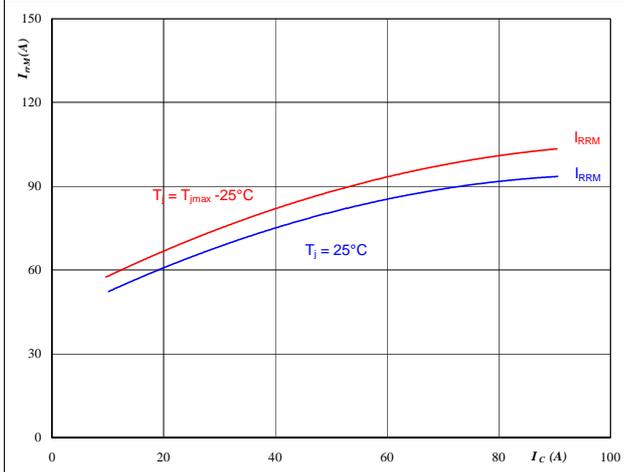
$T_j =$	25/150	°C
$V_{CE} =$	600	V
$V_{GE} =$	±15	V
$R_{gon} =$	8	Ω

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
$I_F =$	50	A
$V_{GE} =$	±15	V

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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
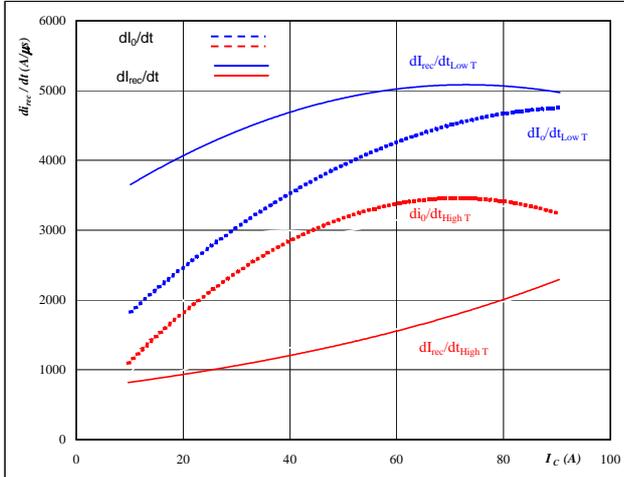
|		
$T_j =$	25/150	°C
$V_{CE} =$	600	V
$V_{GE} =$	±15	V
$R_{gon} =$	8	Ω

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
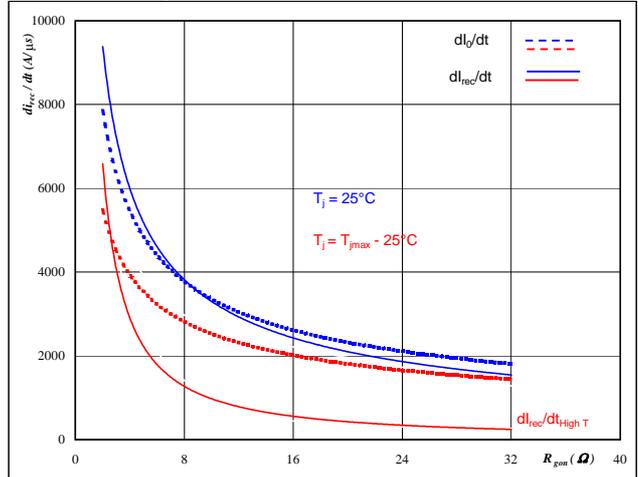
$T_j =$	25/150	°C
$V_R =$	600	V
$I_F =$	50	A
$V_{GE} =$	±15	V

Figure 19	Output inverter IGBT

**IGBT transient thermal impedance
as a function of pulse width**
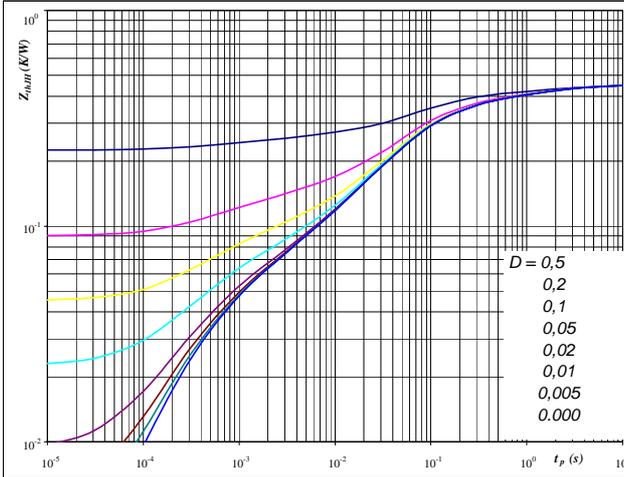
$Z_{thJH} = f(t_p)$

At

$D =$	t_p / T	
$R_{thJH} =$	0,45	K/W

IGBT thermal model values

R (C/W)	Tau (s)
0,04	2,8E+00
0,07	5,6E-01
0,16	8,6E-02
0,10	3,0E-02
0,04	2,7E-03
0,03	3,7E-04

Figure 20	Output inverter FRED

**FRED transient thermal impedance
as a function of pulse width**

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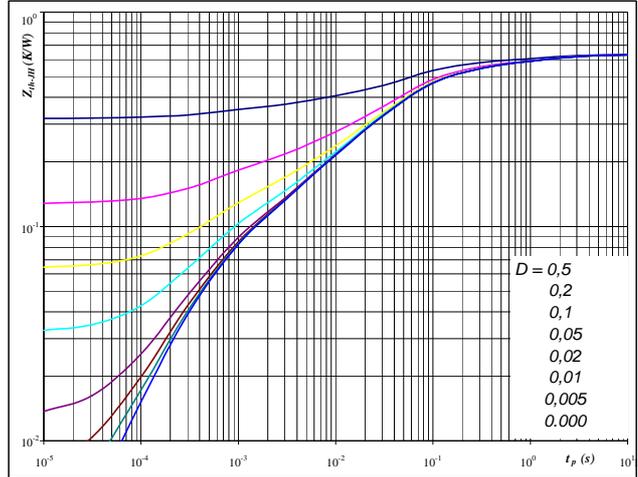
At

$D =$	t_p / T	
$R_{thJH} =$	0,64	K/W

FRED thermal model values

R (C/W)	Tau (s)
0,02	9,5E+00
0,08	1,1E+00
0,14	1,4E-01
0,26	3,4E-02
0,08	3,9E-03
0,06	4,6E-04

Output Inverter

Figure 21	Output inverter IGBT

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_h)$

At
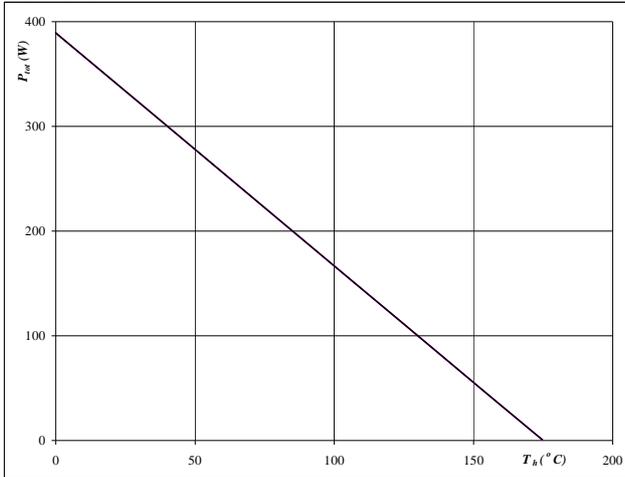
T_j = 175 °C   ——— single heating

     ——— overall heating

Figure 22	Output inverter IGBT

**Collector current as a function of heatsink temperature**

$I_C = f(T_h)$
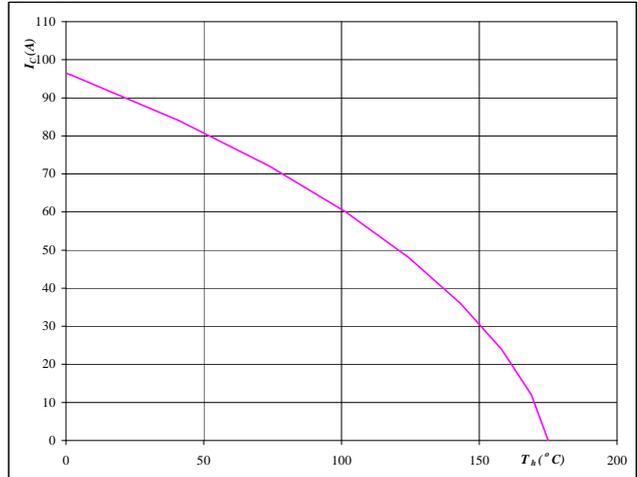
At

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
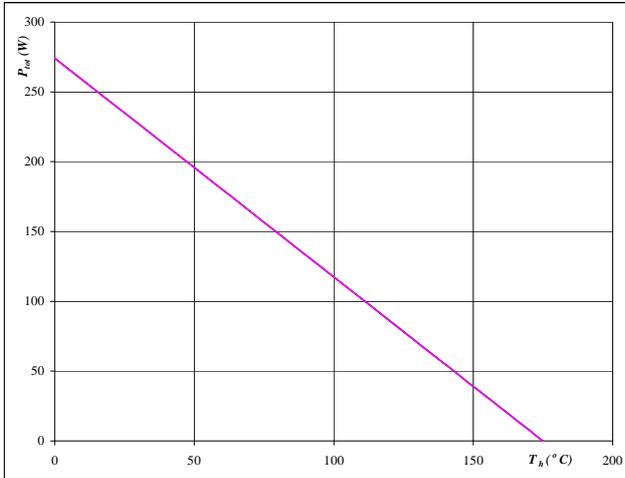
T_j = 175 °C   ——— single heating

     ——— 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

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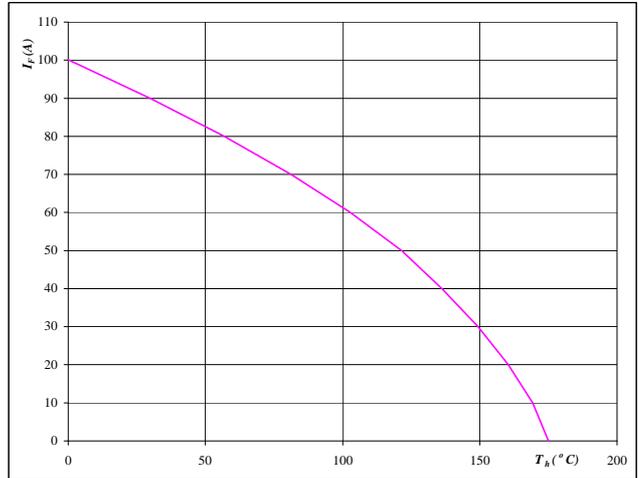
Output Inverter

Figure 25	Output inverter IGBT

**Safe operating area as a function
of collector-emitter voltage**

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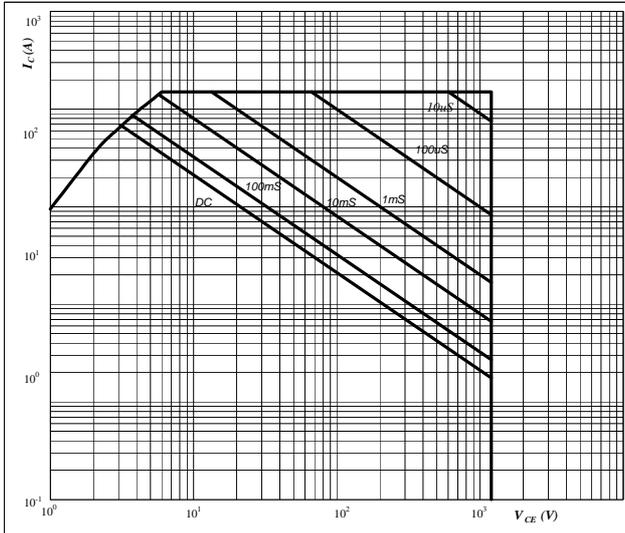
At

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

Figure 26	Output inverter IGBT

Gate voltage vs Gate charge

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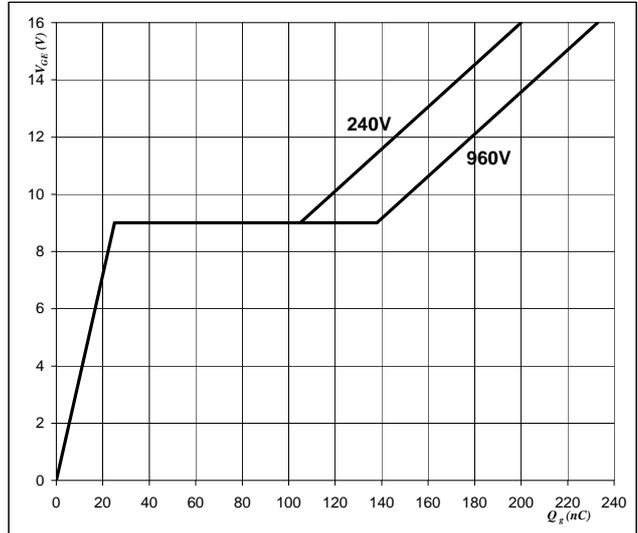
At

I_C =	50	A

Switching Definitions Output Inverter

General conditions

T_j	=	150 °C
R_{gon}	=	8 Ω
R_{goff}	=	8 Ω

Figure 1	Output inverter IGBT

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

(t_{Eoff} = integrating time for E_{off})
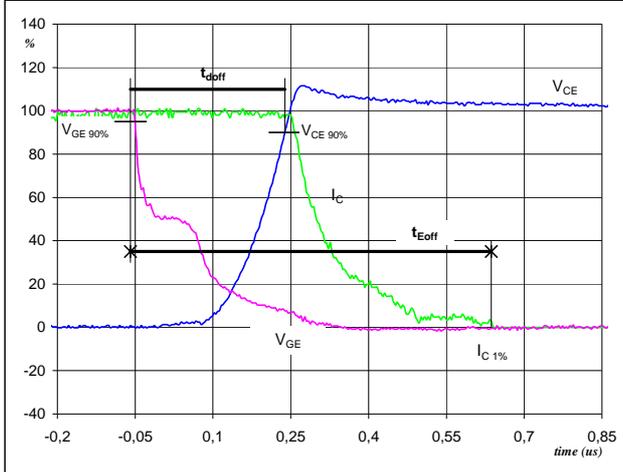
V_{GE} (0%) =	-15	V
V_{GE} (100%) =	15	V
V_C (100%) =	600	V
I_C (100%) =	50	A
t_{doff} =	0,29	µs
t_{Eoff} =	0,70	µs

Figure 2	Output inverter IGBT

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

(t_{Eon} = integrating time for E_{on})
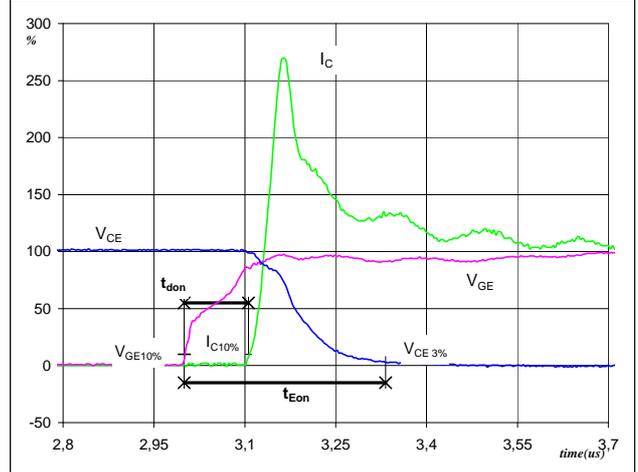
V_{GE} (0%) =	-15	V
V_{GE} (100%) =	15	V
V_C (100%) =	600	V
I_C (100%) =	50	A
t_{don} =	0,10	µs
t_{Eon} =	0,33	µs

Figure 3	Output inverter IGBT

Turn-off Switching Waveforms & definition of t_f
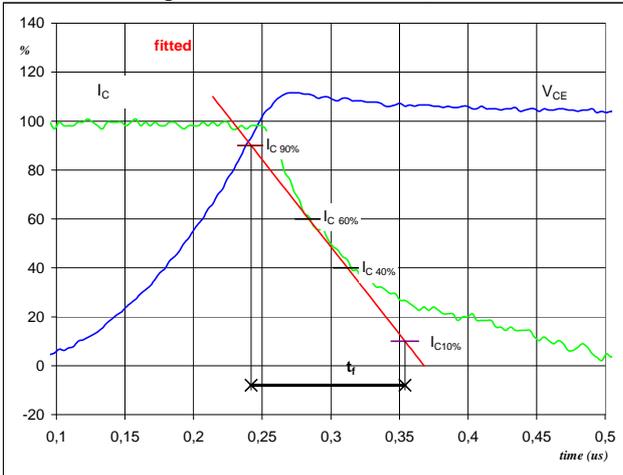
V_C (100%) =	600	V
I_C (100%) =	50	A
t_f =	0,13	µs

Figure 4	Output inverter IGBT

Turn-on Switching Waveforms & definition of t_r
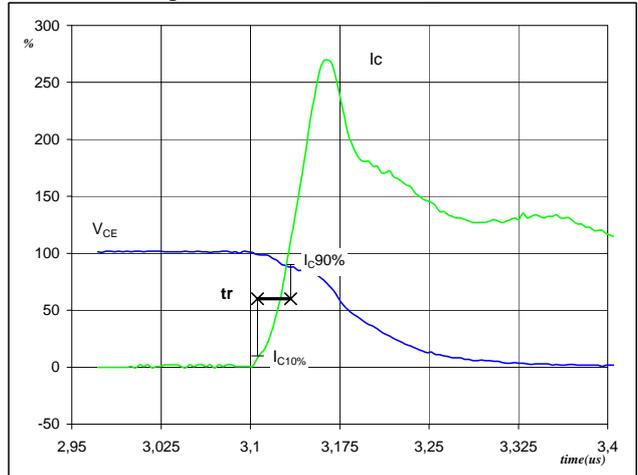
V_C (100%) =	600	V
I_C (100%) =	50	A
t_r =	0,03	µs

Switching Definitions Output Inverter

Figure 5	Output inverter IGBT

Turn-off Switching Waveforms & definition of t_{Eoff}
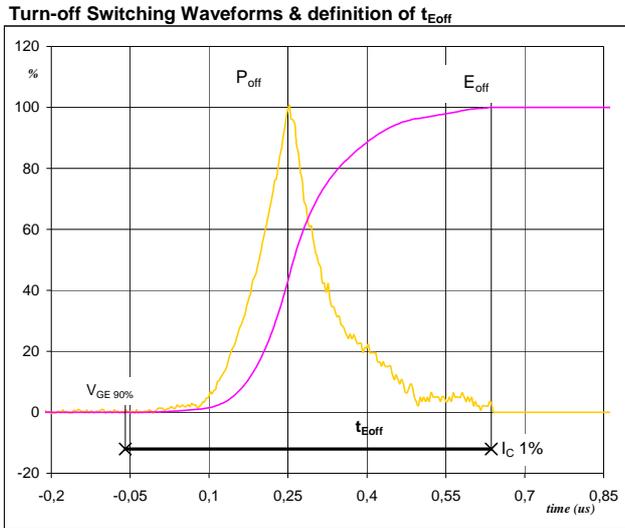
P_{off} (100%) =	30,25	kW
E_{off} (100%) =	4,66	mJ
t_{Eoff} =	0,70	µs

Figure 6	Output inverter IGBT

Turn-on Switching Waveforms & definition of t_{Eon}
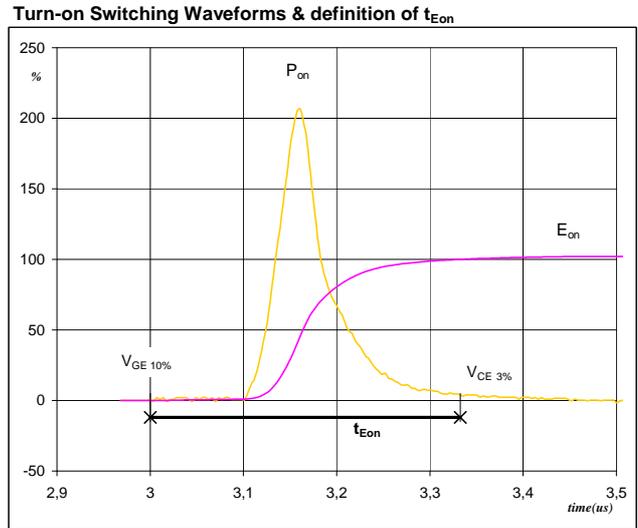
P_{on} (100%) =	30,25	kW
E_{on} (100%) =	4,02	mJ
t_{Eon} =	0,33	µs

Figure 7	Output inverter FRED

Gate voltage vs Gate charge (measured)
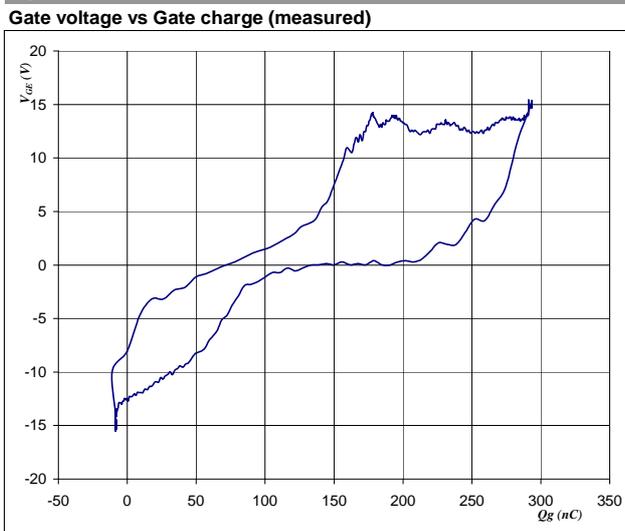
V_{GEoff} =	-15	V
V_{GEon} =	15	V
V_C (100%) =	600	V
I_C (100%) =	50	A
Q_g =	2286,11	nC

Figure 8	Output inverter IGBT

Turn-off Switching Waveforms & definition of t_{rr}
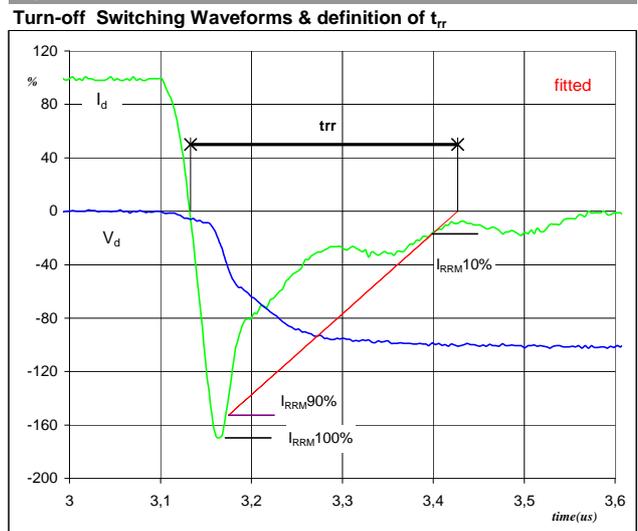
|		
V_d (100%) =	600	V
I_d (100%) =	50	A
I_{RRM} (100%) =	-87	A
t_{rr} =	0,29	µs

Switching Definitions Output Inverter

Figure 9 — Output inverter FRED

Turn-on Switching Waveforms & definition of t$_{Qrr}$
(t$_{Qrr}$ = integrating time for Q$_{rr}$)
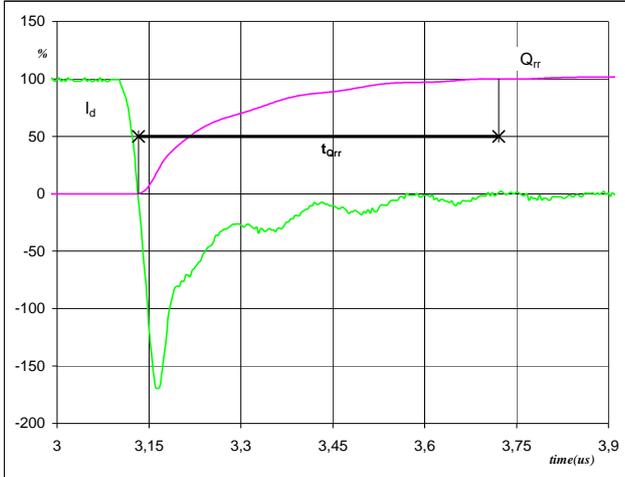
I$_d$ (100%) =	50	A
Q$_{rr}$ (100%) =	8,75	µC
t$_{Qrr}$ =	0,59	µs

Figure 10 — Output inverter FRED

Turn-on Switching Waveforms & definition of t$_{Erec}$
**(t$_{Erec}$= integrating time for E$_{rec}$)**
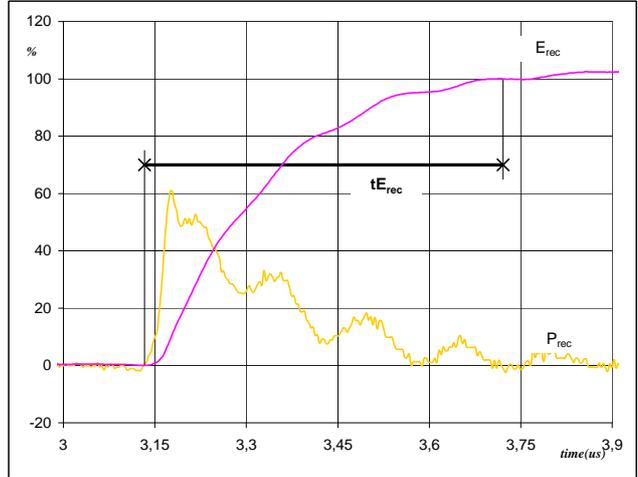
P$_{rec}$ (100%) =	30,25	kW
E$_{rec}$ (100%) =	3,45	mJ
t$_{Erec}$ =	0,59	µs

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-FZ122PA050SC01-P997F18	P997F18	P997F18
without thermal paste 17mm housing	10-F0122PA050SC01-P997F19	P997F19	P997F19

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
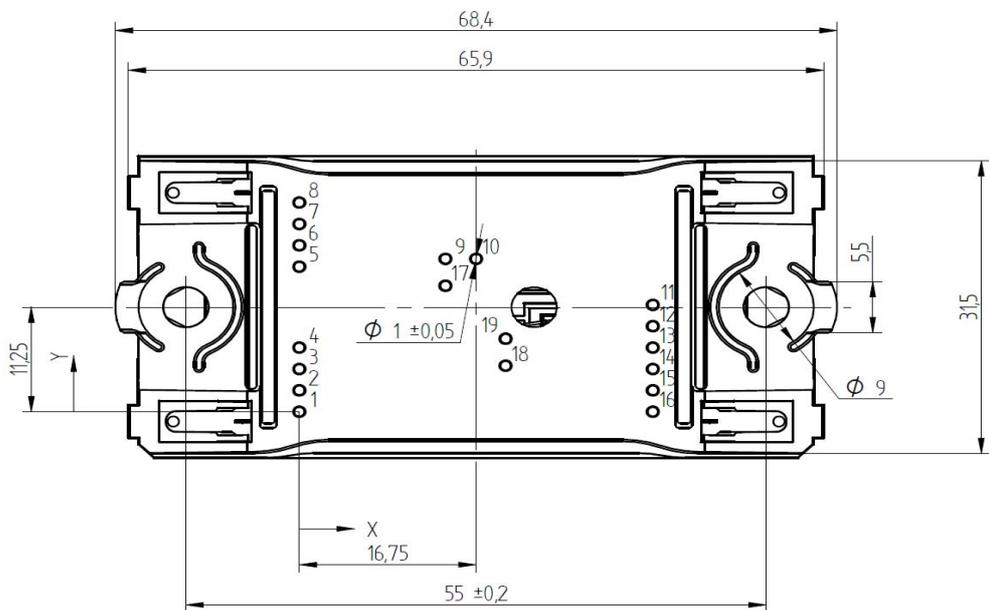
Pinout
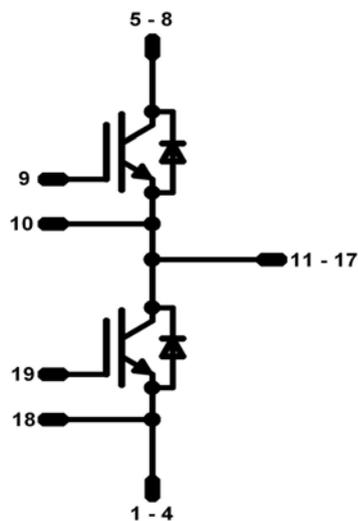
PRODUCT STATUS DEFINITIONS

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.
Final	Full Production	This datasheet contains final specifications. 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.