

fastPHASE0
1200V/100A
Features

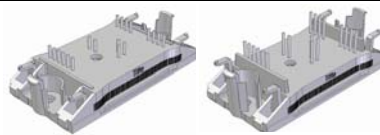
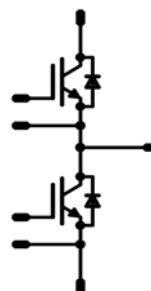
- Fast IGBT² technology
- 2-clip housing in 12mm and 17mm height
- Compact and low inductance design
- AlN substrate for improved performance

Target Applications

- Power Generation
- UPS
- Welding

Types

- 10-FZ122PA100FC01-P999F58
- 10-F0122PA100FC01-P999F59

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}		1200	V
DC collector current	I_C	$T_j=T_{jmax}$ $T_h=80^{\circ}\text{C}$ $T_c=80^{\circ}\text{C}$	70 93	A
Repetitive peak collector current	I_{Cpulse}	t_p limited by T_{jmax}	300	A
Power dissipation per IGBT	P_{tot}	$T_j=T_{jmax}$ $T_h=80^{\circ}\text{C}$ $T_c=80^{\circ}\text{C}$	267 405	W
Gate-emitter peak voltage	V_{GE}		± 20	V
Short circuit ratings	t_{SC} V_{CC}	$T_j \leq 150^{\circ}\text{C}$ $V_{GE}=15\text{V}$	10 800	μs V
Maximum Junction Temperature	T_{jmax}		150	$^{\circ}\text{C}$
Inverter Diode				
Peak Repetitive Reverse Voltage	V_{RRM}	$T_j=25^{\circ}\text{C}$	1200	V
DC forward current	I_F	$T_j=T_{jmax}$ $T_h=80^{\circ}\text{C}$ $T_c=80^{\circ}\text{C}$	75 101	A
Repetitive peak forward current	I_{FRM}	t_p limited by T_{jmax}	200	A
Power dissipation per Diode	P_{tot}	$T_j=T_{jmax}$ $T_h=80^{\circ}\text{C}$ $T_c=80^{\circ}\text{C}$	119 181	W
Maximum Junction Temperature	T_{jmax}		150	$^{\circ}\text{C}$

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 $I_D[A]$	T_j	Min	Typ	Max	

Inverter Transistor

Gate emitter threshold voltage	$V_{GE(th)}$	$V_{CE}=V_{GE}$			0.0008	$T_j=25^{\circ}C$ $T_j=125^{\circ}C$	4.5	5.5	6.5	V
Collector-emitter saturation voltage	$V_{CE(sat)}$		15		100	$T_j=25^{\circ}C$ $T_j=125^{\circ}C$	2.5	3.47 4.21	4	V
Collector-emitter cut-off current incl. Diode	I_{CES}		0	1200		$T_j=25^{\circ}C$ $T_j=125^{\circ}C$			0.035	mA
Gate-emitter leakage current	I_{GES}		20	0		$T_j=25^{\circ}C$ $T_j=125^{\circ}C$			700	nA
Integrated Gate resistor	R_{gint}							5		Ω
Turn-on delay time	$t_{d(on)}$	Rgoff=4 Ω Rgon=4 Ω	± 15	600	100	$T_j=25^{\circ}C$ $T_j=125^{\circ}C$		202 211		ns
Rise time	t_r					$T_j=25^{\circ}C$ $T_j=125^{\circ}C$		36 38		
Turn-off delay time	$t_{d(off)}$					$T_j=25^{\circ}C$ $T_j=125^{\circ}C$		265 300		
Fall time	t_f					$T_j=25^{\circ}C$ $T_j=125^{\circ}C$		12 27		
Turn-on energy loss per pulse	E_{on}					$T_j=25^{\circ}C$ $T_j=125^{\circ}C$		7.07 9.96		mWs
Turn-off energy loss per pulse	E_{off}					$T_j=25^{\circ}C$ $T_j=125^{\circ}C$		2.48 3.81		
Input capacitance	C_{ies}	f=1MHz	0	25		$T_j=25^{\circ}C$		6500		pF
Output capacitance	C_{oss}							1000		
Reverse transfer capacitance	C_{rss}							500		
Gate charge	Q_{Gate}		± 15			$T_j=25^{\circ}C$		1100		nC
Thermal resistance chip to heatsink per chip	R_{thJH}	Thermal foil thickness=76um Kunze foil KU-ALF5						0.26		K/W
Thermal resistance chip to case per chip	R_{thJC}							0.17		

Inverter Diode

Diode forward voltage	V_F				100	$T_j=25^{\circ}C$ $T_j=125^{\circ}C$	1	1.8 1.78	2.3	V
Peak reverse recovery current	I_{RRM}	Rgoff=4 Ω	± 15	600	100	$T_j=25^{\circ}C$ $T_j=125^{\circ}C$		108.4 128.4		A
Reverse recovery time	t_{rr}					$T_j=25^{\circ}C$ $T_j=125^{\circ}C$		274.8 313		ns
Reverse recovered charge	Q_{rr}					$T_j=25^{\circ}C$ $T_j=125^{\circ}C$		9.71 16.39		μC
Peak rate of fall of recovery current	$di(rec)max/dt$					$T_j=25^{\circ}C$ $T_j=125^{\circ}C$		2827 1148		A/ μs
Reverse recovered energy	E_{rec}					$T_j=25^{\circ}C$ $T_j=125^{\circ}C$		3.61 6.19		mWs
Thermal resistance chip to heatsink per chip	R_{thJH}	Thermal foil thickness=76um Kunze foil KU-ALF5						0.59		K/W
Thermal resistance chip to case per chip	R_{thJC}							0.39		

Output Inverter

Figure 1 Output inverter IGBT

Typical output characteristics

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

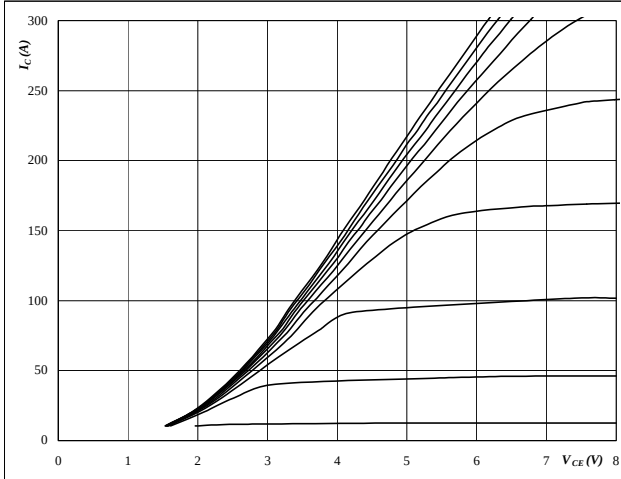

At
 $t_p = 350 \mu s$
 $T_J = 25^\circ C$
 V_{GE} from 7 V to 17 V in steps of 1 V

Figure 2 Output inverter IGBT

Typical output characteristics

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

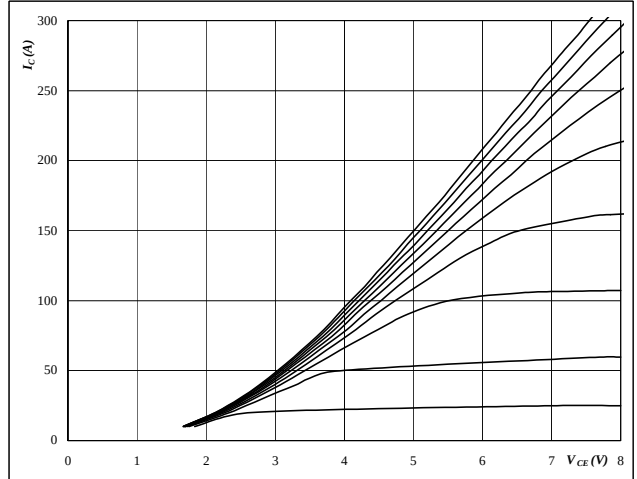
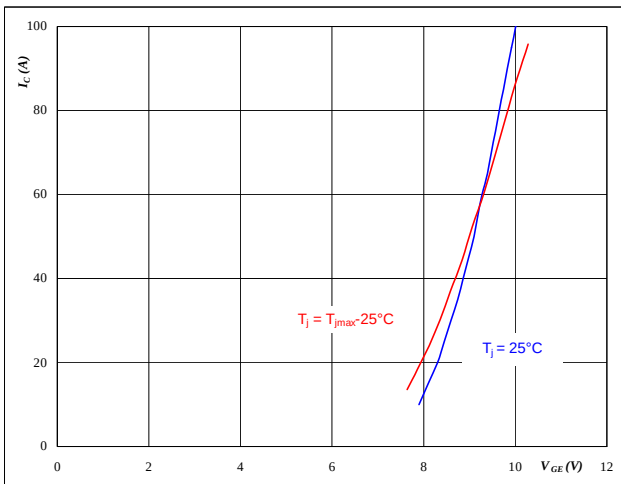

At
 $t_p = 350 \mu s$
 $T_J = 125^\circ C$
 V_{GE} from 7 V to 17 V in steps of 1 V

Figure 3 Output inverter IGBT

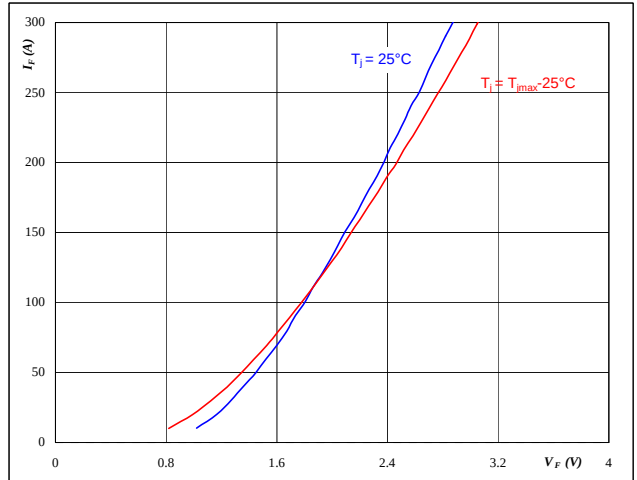
Typical transfer characteristics

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


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

$$I_F = f(V_F)$$

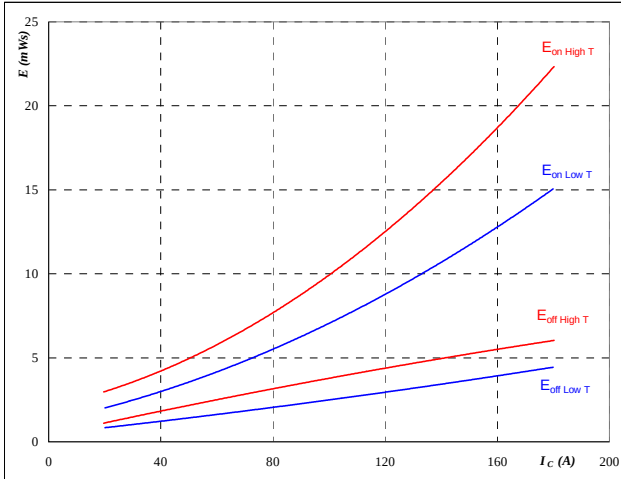

At
 $t_p = 350 \mu s$

Output Inverter

Figure 5 Output inverter IGBT

Typical switching energy losses
as a function of collector current

$$E = f(I_C)$$



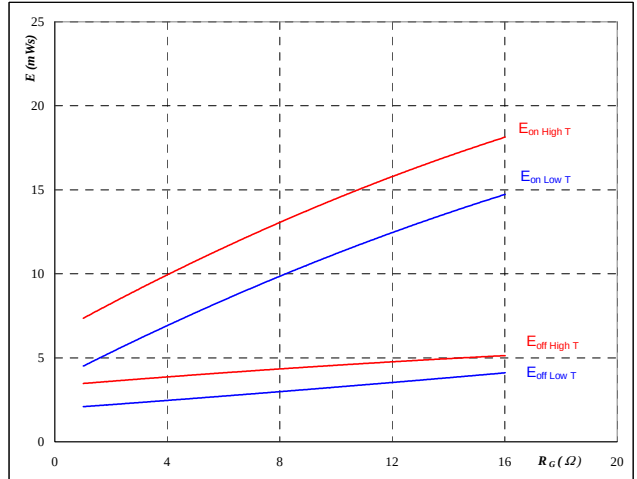
With an inductive load at

$T_J = 25/125$ °C
 $V_{CE} = 600$ 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

$$E = f(R_G)$$



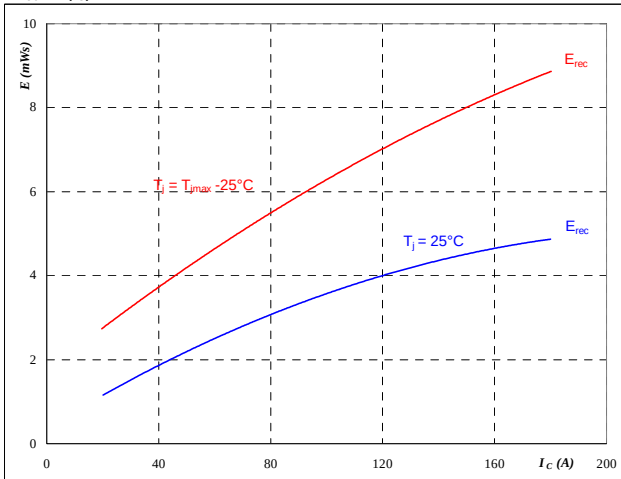
With an inductive load at

$T_J = 25/125$ °C
 $V_{CE} = 600$ V
 $V_{GE} = \pm 15$ V
 $I_C = 100$ A

Figure 7 Output inverter IGBT

Typical reverse recovery energy loss
as a function of collector current

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



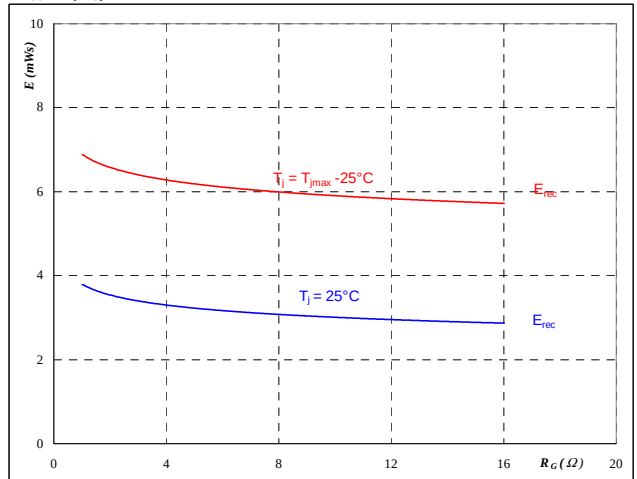
With an inductive load at

$T_J = 25/125$ °C
 $V_{CE} = 600$ 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

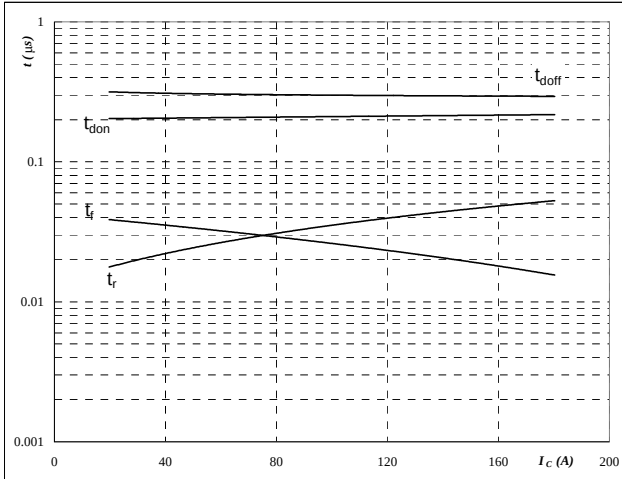
$T_J = 25/125$ °C
 $V_{CE} = 600$ V
 $V_{GE} = \pm 15$ V
 $I_C = 100$ A

Output Inverter

Figure 9 Output inverter IGBT

Typical switching times as a function of collector current

$$t = f(I_C)$$



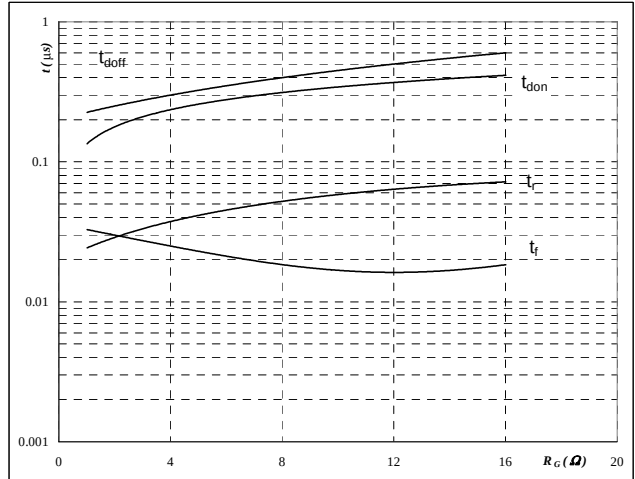
With an inductive load at

$T_J = 125$ °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

$$t = f(R_G)$$



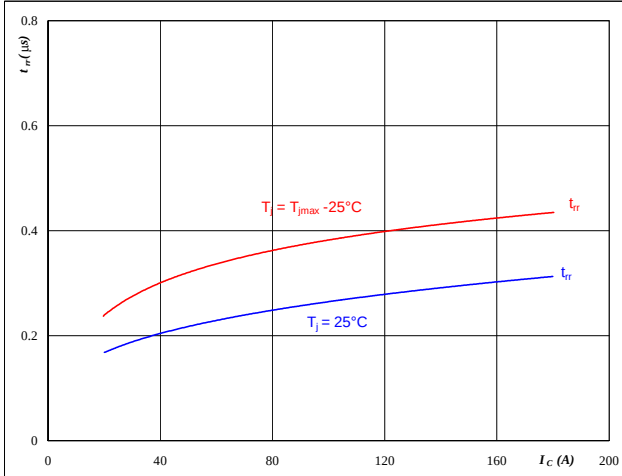
With an inductive load at

$T_J = 125$ °C
 $V_{CE} = 600$ V
 $V_{GE} = \pm 15$ V
 $I_C = 100$ A

Figure 11 Output inverter FRED

Typical reverse recovery time as a function of collector current

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



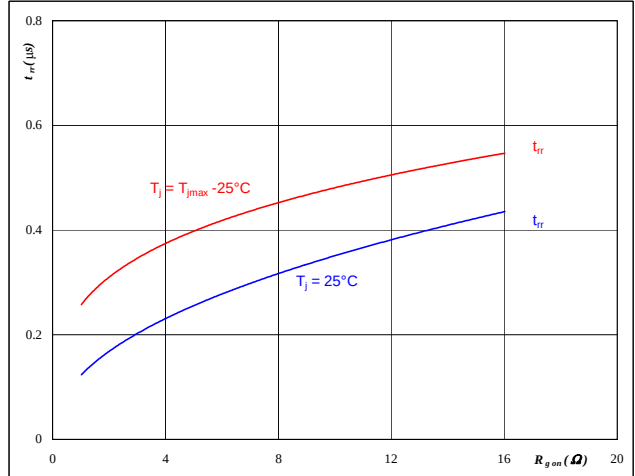
At

$T_J = 25/125$ °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

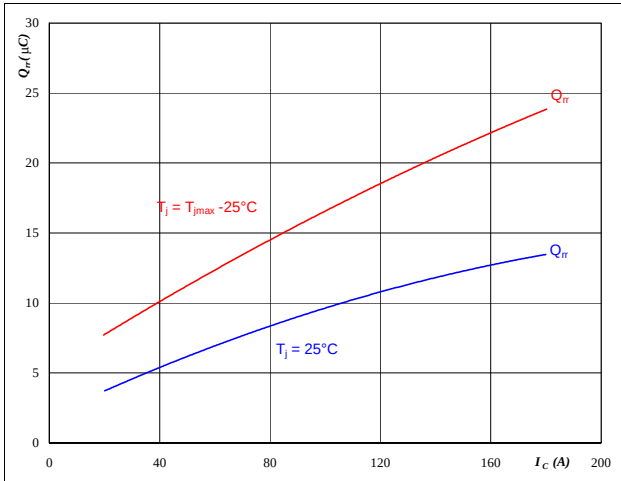
$T_J = 25/125$ °C
 $V_R = 600$ V
 $I_F = 100$ A
 $V_{GE} = \pm 15$ V

Output Inverter

Figure 13 Output inverter FRED

Typical reverse recovery charge as a function of collector current

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

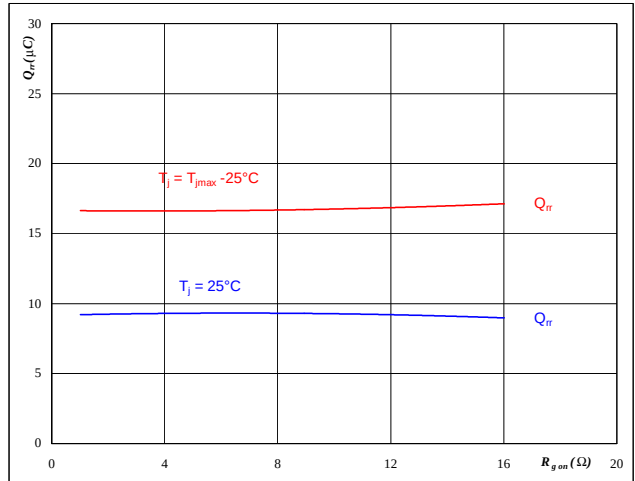


At
 $T_j = 25/125$ °C
 $V_{CE} = 600$ V
 $V_{GE} = \pm 15$ V
 $R_{gon} = 4$ Ω

Figure 14 Output inverter FRED

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

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

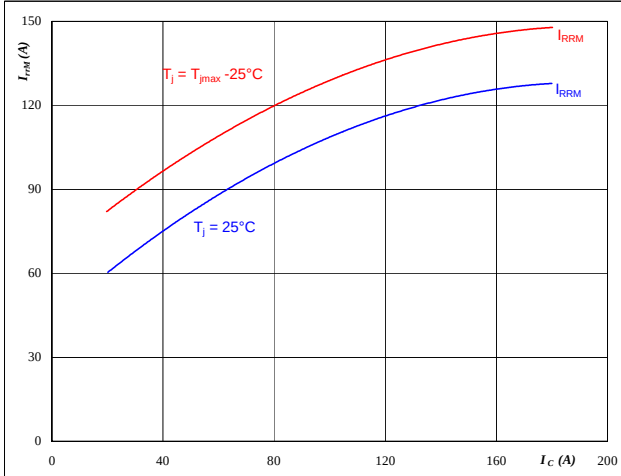


At
 $T_j = 25/125$ °C
 $V_R = 600$ V
 $I_F = 100$ A
 $V_{GE} = \pm 15$ V

Figure 15 Output inverter FRED

Typical reverse recovery current as a function of collector current

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

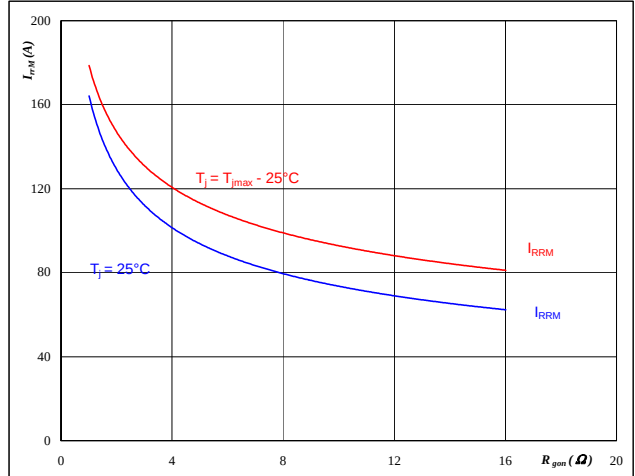


At
 $T_j = 25/125$ °C
 $V_{CE} = 600$ V
 $V_{GE} = \pm 15$ V
 $R_{gon} = 4$ Ω

Figure 16 Output inverter FRED

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

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



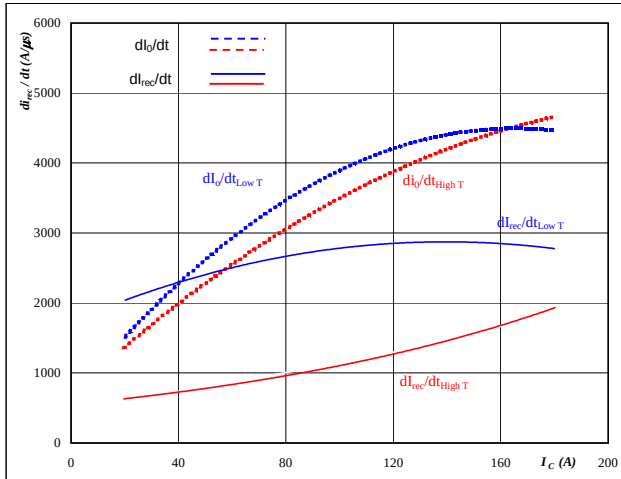
At
 $T_j = 25/125$ °C
 $V_R = 600$ V
 $I_F = 100$ A
 $V_{GE} = \pm 15$ V

Output Inverter

Figure 17 Output inverter FRED

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

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

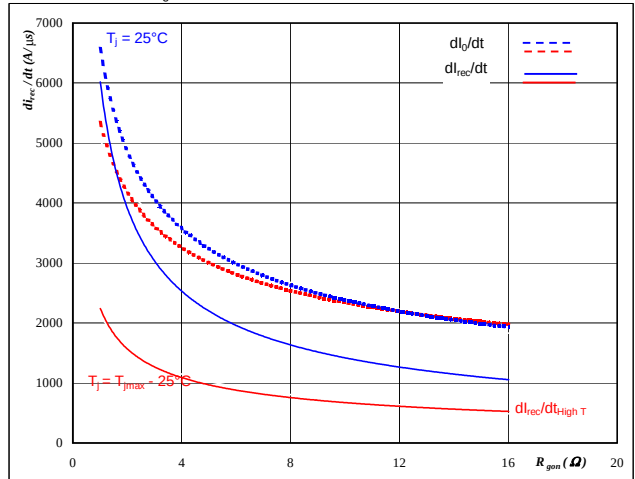


At
 $T_j = 25/125$ °C
 $V_{CE} = 600$ V
 $V_{GE} = \pm 15$ V
 $R_{gon} = 4$ Ω

Figure 18 Output inverter FRED

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

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

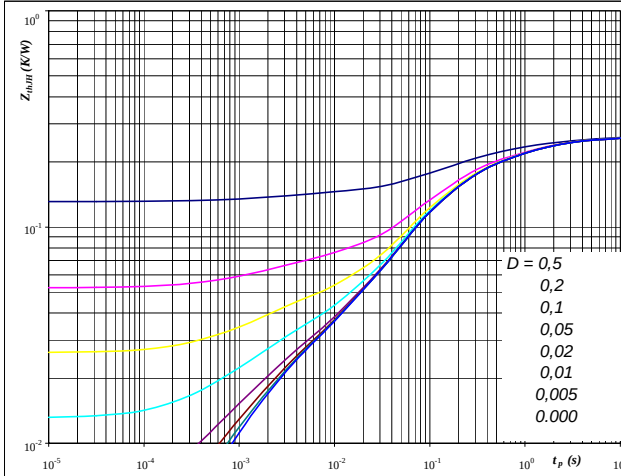


At
 $T_j = 25/125$ °C
 $V_R = 600$ V
 $I_F = 100$ A
 $V_{GE} = \pm 15$ V

Figure 19 Output inverter IGBT

IGBT transient thermal impedance
as a function of pulse width

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



At
 $D = t_p / T$
 $R_{thJH} = 0.26$ K/W

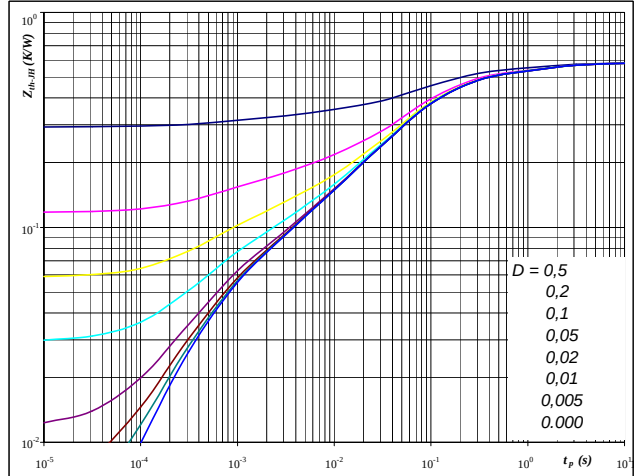
IGBT thermal model values

R (C/W)	Tau (s)
0.01	9.5E+00
0.06	1.4E+00
0.10	2.2E-01
0.07	5.9E-02
0.02	2.6E-03
0.00	4.6E-04

Figure 20 Output inverter FRED

FRED transient thermal impedance
as a function of pulse width

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



At
 $D = t_p / T$
 $R_{thJH} = 0.59$ K/W

FRED thermal model values

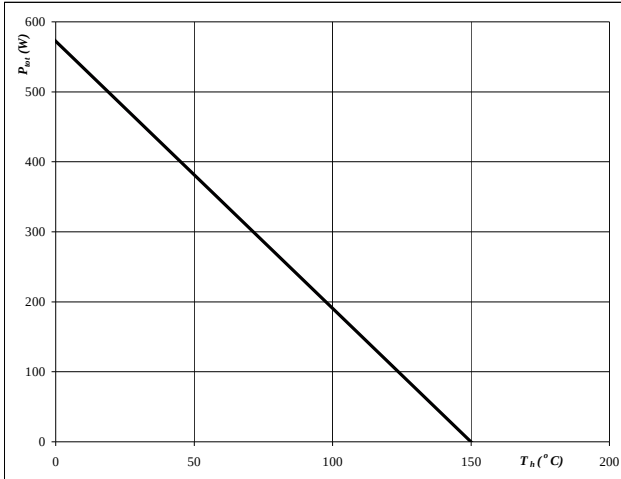
R (C/W)	Tau (s)
0.02	9.9E+00
0.08	1.2E+00
0.22	1.4E-01
0.18	3.8E-02
0.05	3.4E-03
0.04	4.7E-04

Output Inverter

Figure 21 Output inverter IGBT

Power dissipation as a function of heatsink temperature

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

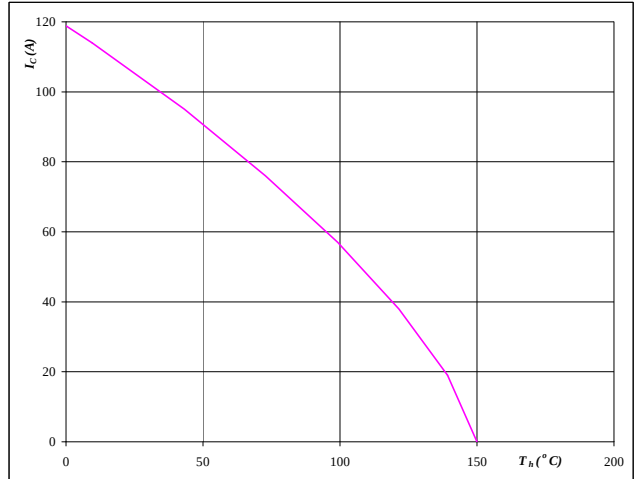


At $T_j = 150$ °C
 — single heating
 — overall heating

Figure 22 Output inverter IGBT

Collector current as a function of heatsink temperature

$$I_C = f(T_h)$$

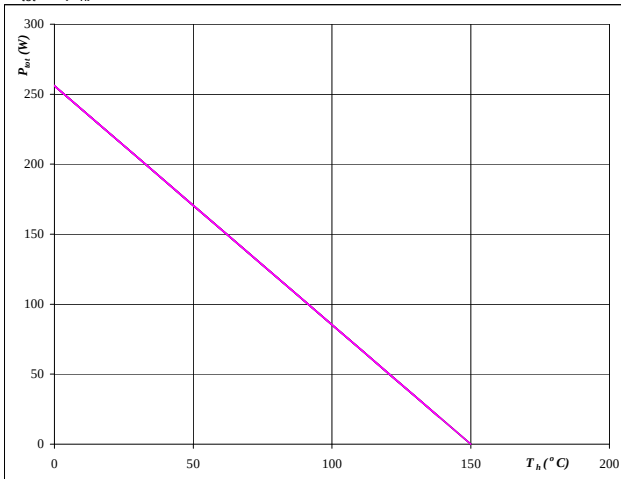


At $T_j = 150$ °C
 $V_{GE} = 15$ V

Figure 23 Output inverter FRED

Power dissipation as a function of heatsink temperature

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

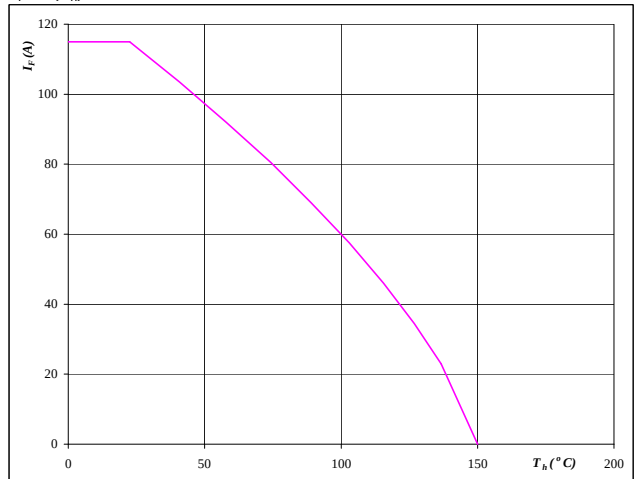


At $T_j = 150$ °C
 — single heating
 — overall heating

Figure 24 Output inverter FRED

Forward current as a function of heatsink temperature

$$I_F = f(T_h)$$



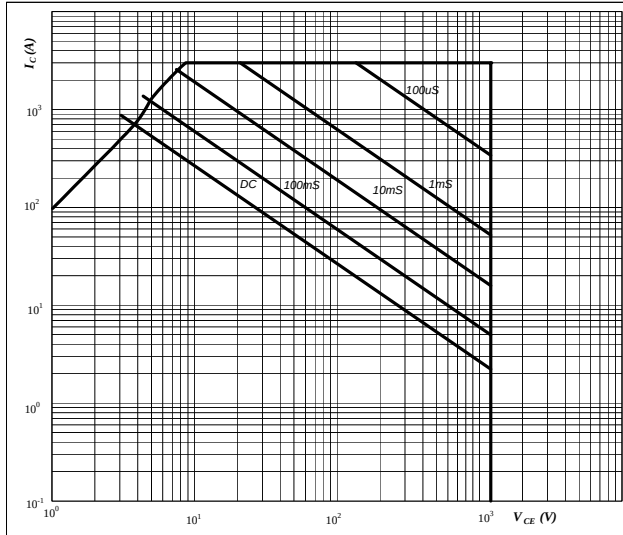
At $T_j = 150$ °C

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

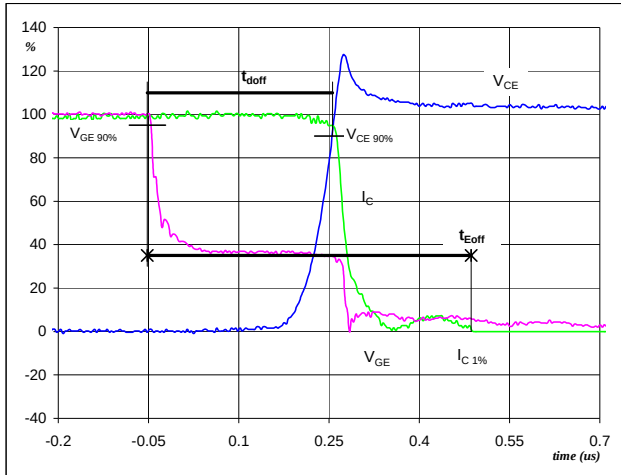
Switching Definitions Output Inverter

General conditions

T_j	=	125 °C
R_{gon}	=	4 Ω
R_{goff}	=	4 Ω

Figure 1 Output inverter IGBT

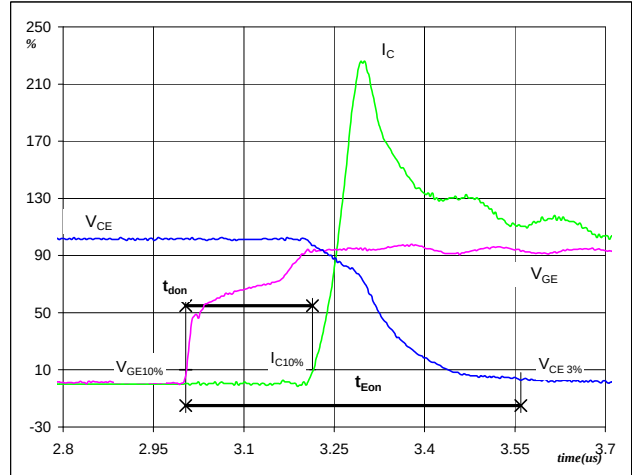
Turn-off Switching Waveforms & definition of t_{doff} , t_{Eoff}
(t_{Eoff} = integrating time for E_{off})



$V_{GE}(0\%) =$	-15	V
$V_{GE}(100\%) =$	15	V
$V_C(100\%) =$	600	V
$I_C(100\%) =$	101	A
$t_{doff} =$	0.30	μs
$t_{Eoff} =$	0.54	μs

Figure 2 Output inverter IGBT

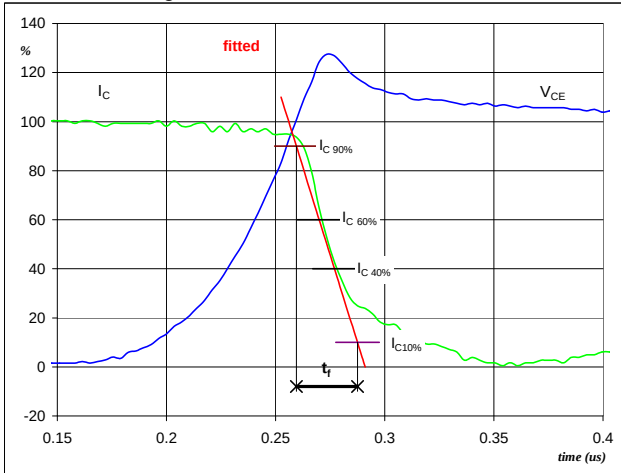
Turn-on Switching Waveforms & definition of t_{don} , t_{Eon}
(t_{Eon} = integrating time for E_{on})



$V_{GE}(0\%) =$	-15	V
$V_{GE}(100\%) =$	15	V
$V_C(100\%) =$	600	V
$I_C(100\%) =$	101	A
$t_{don} =$	0.21	μs
$t_{Eon} =$	0.56	μs

Figure 3 Output inverter IGBT

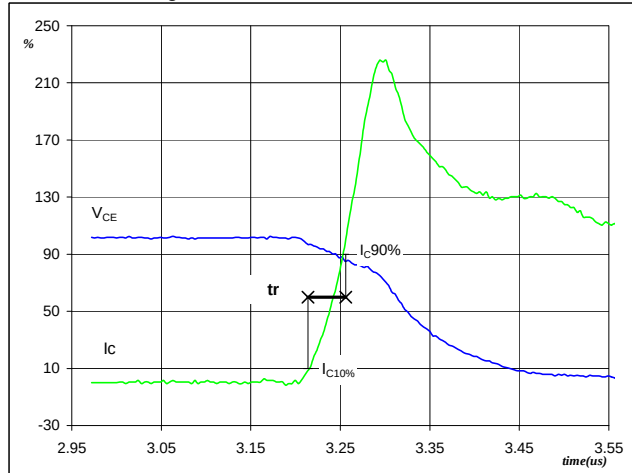
Turn-off Switching Waveforms & definition of t_f



$V_C(100\%) =$	600	V
$I_C(100\%) =$	101	A
$t_f =$	0.03	μs

Figure 4 Output inverter IGBT

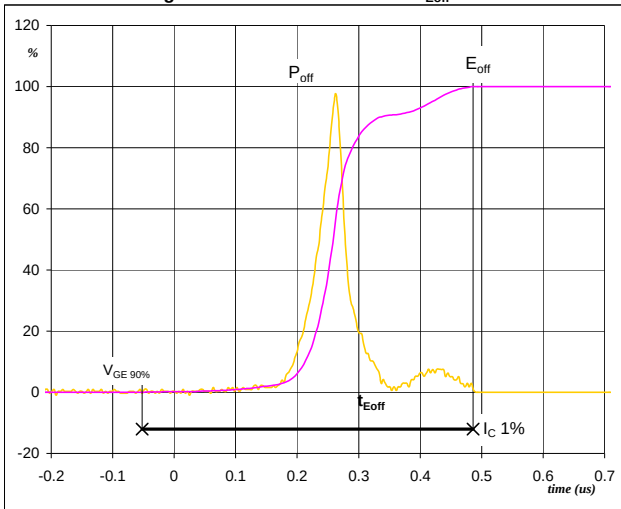
Turn-on Switching Waveforms & definition of t_r



$V_C(100\%) =$	600	V
$I_C(100\%) =$	101	A
$t_r =$	0.04	μs

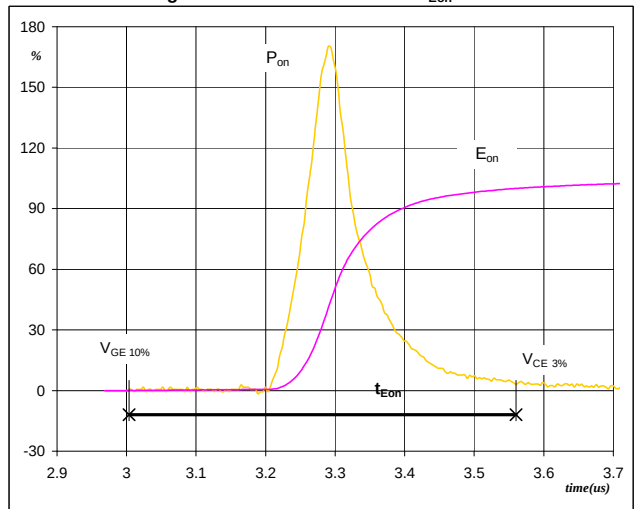
Switching Definitions Output Inverter

Figure 5 Output inverter IGBT
Turn-off Switching Waveforms & definition of t_{Eoff}



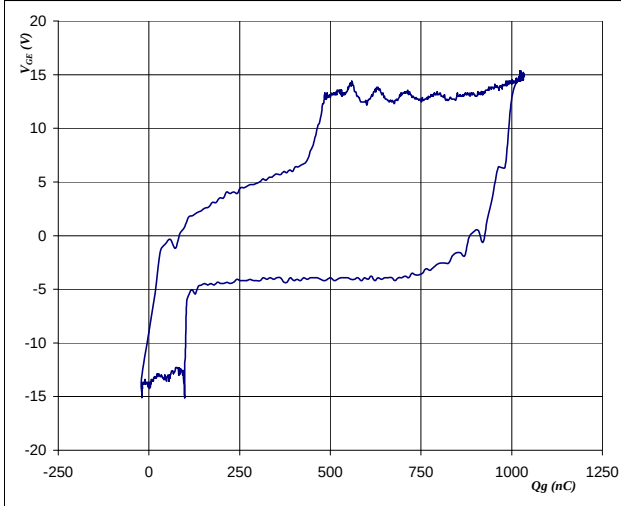
$P_{off}(100\%) = 60.58 \text{ kW}$
 $E_{off}(100\%) = 3.87 \text{ mJ}$
 $t_{Eoff} = 0.54 \text{ }\mu\text{s}$

Figure 6 Output inverter IGBT
Turn-on Switching Waveforms & definition of t_{Eon}



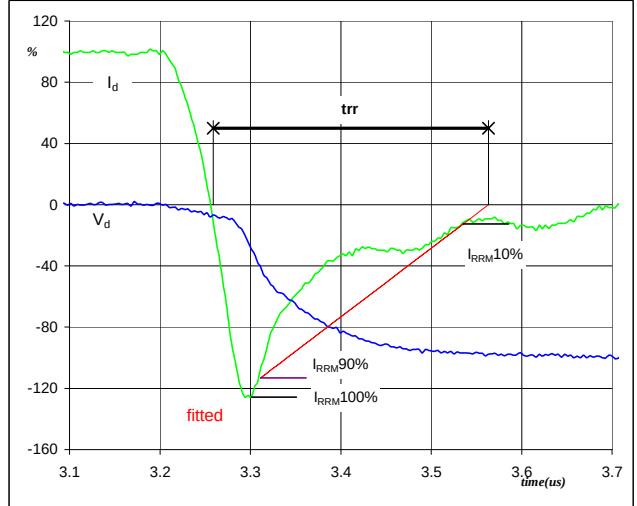
$P_{on}(100\%) = 60.58 \text{ kW}$
 $E_{on}(100\%) = 10.05 \text{ mJ}$
 $t_{Eon} = 0.56 \text{ }\mu\text{s}$

Figure 7 Output inverter IGBT
Gate voltage vs Gate charge (measured)



$V_{GEoff} = -15 \text{ V}$
 $V_{GEon} = 15 \text{ V}$
 $V_C(100\%) = 600 \text{ V}$
 $I_C(100\%) = 101 \text{ A}$
 $Q_g = 1032.03 \text{ nC}$

Figure 8 Output inverter FRED
Turn-off Switching Waveforms & definition of t_{tr}

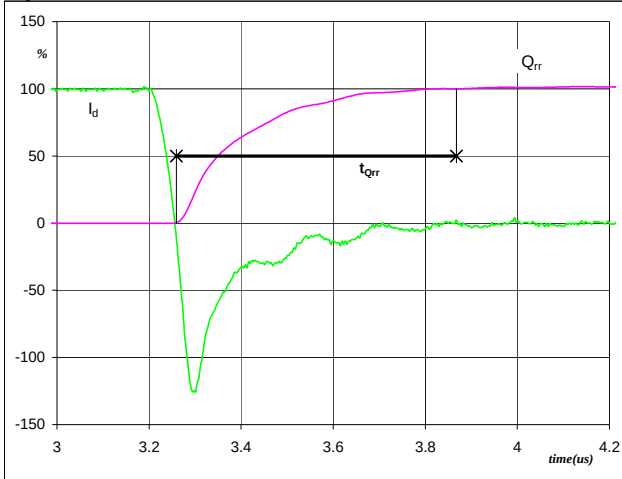


$V_d(100\%) = 600 \text{ V}$
 $I_d(100\%) = 101 \text{ A}$
 $I_{RRM}(100\%) = -128 \text{ A}$
 $t_{tr} = 0.31 \text{ }\mu\text{s}$

Switching Definitions Output Inverter

Figure 9 Output inverter FRED

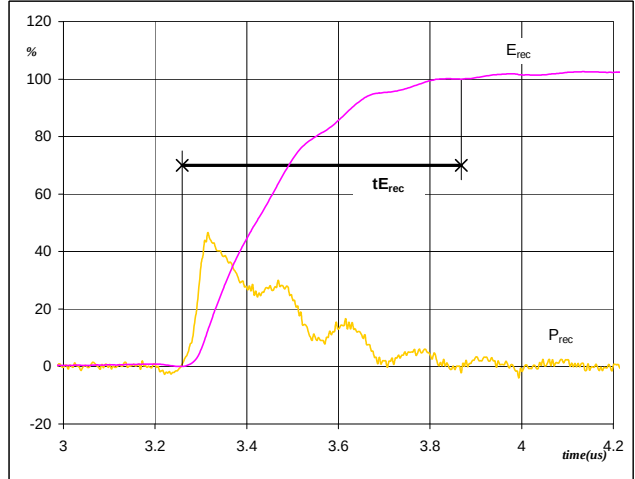
Turn-on Switching Waveforms & definition of t_{Qrr}
(t_{Qrr} = integrating time for Q_{rr})



I_d (100%) = 101 A
 Q_{rr} (100%) = 16.09 μC
 t_{Qrr} = 0.61 μs

Figure 10 Output inverter FRED

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



P_{rec} (100%) = 60.58 kW
 E_{rec} (100%) = 5.99 mJ
 t_{Erec} = 0.61 μs

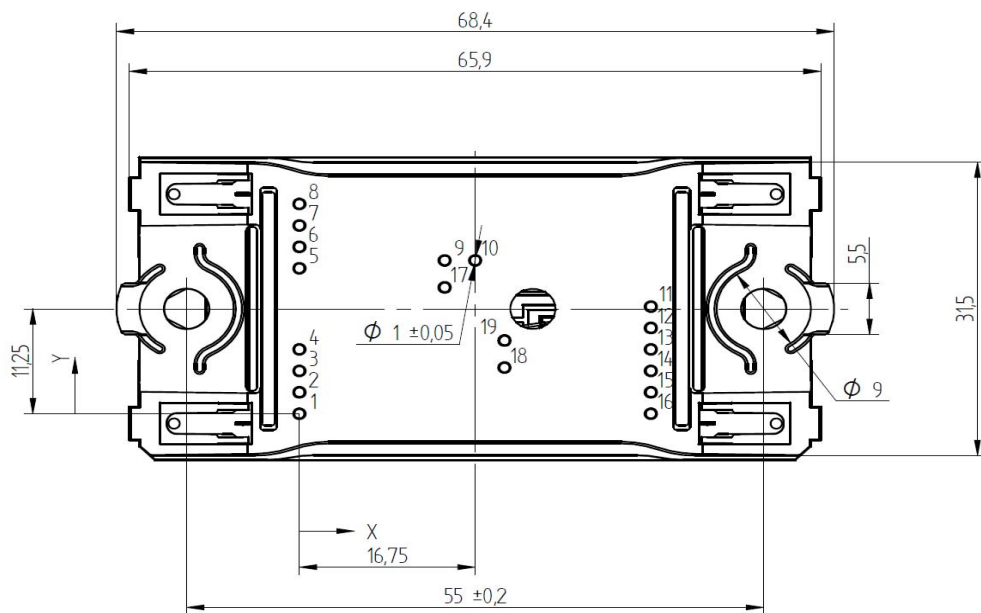
Ordering Code and Marking - Outline - Pinout

Ordering Code & Marking

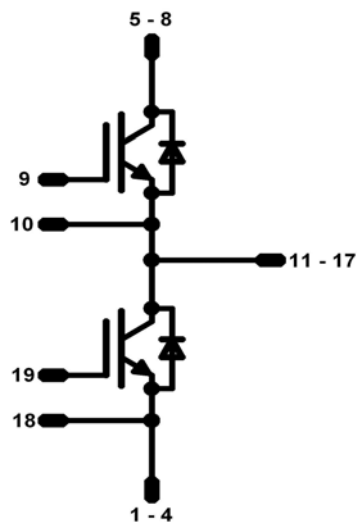
Version	Ordering Code	in DataMatrix as	in packaging barcode as
without thermal paste 12mm housing	10-FZ122PA100FC01-P999F58	P999F58	P999F58
without thermal paste 17mm housing	10-F0122PA100FC01-P999F59	P999F59	P999F59

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.
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