S2122PA200SC
preliminary datasheet

flowPhase 2 S	1200V/200A

Features

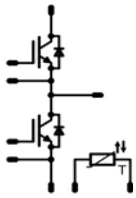
- 1/2 bridge
- Low inductive
- Screw package
- NTC

flowScrew 2 housing

Target Applications

- Motor drive
- UPS
- Solar

Schematic



Types

- S2122PA200SC

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	$T_j=T_jmax$	T_h=80°C T_c=80°C	177 226	A
Repetitive peak collector current	I_{Cpulse}	t_p limited by T_jmax		300	A
Turn off safe operating area		VCE ≤ 1200V, Tj ≤ Top max		400	A
Power dissipation per IGBT	P_{tot}	$T_j=T_jmax$	T_h=80°C T_c=80°C	431 653	W
Gate-emitter peak voltage	V_{GE}			±20	V
Short circuit ratings	t_{SC} V_{CC}	T_j≤150°C V_{GE}=15V		10 800	μs V
Maximum Junction Temperature	T_jmax			175	°C
Inverter Diode					
Peak Repetitive Reverse Voltage	V_{RRM}	T_j=25°C		1200	V
DC forward current	I_F	$T_j=T_jmax$	T_h=80°C T_c=80°C	137 182	A
Repetitive peak forward current	I_{FRM}	t_p limited by T_jmax		1430	A
Power dissipation per Diode	P_{tot}	$T_j=T_jmax$	T_h=80°C T_c=80°C	286 434	W
Maximum Junction Temperature	T_jmax			175	°C
Thermal Properties					
Storage temperature	T_{stg}			-40…+125	°C
Operation temperature under switching condition	T_{op}			-40…+(Tjmax - 25)	°C

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Maximum Ratings

T_j=25°C, unless otherwise specified

Parameter	Symbol	Condition		Value	Unit
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	$V_{GE(th)}$	$V_{CE}=V_{GE}$			0,0152	Tj=25°C Tj=150°C	5	5,8	6,5	V
Collector-emitter saturation voltage	$V_{CE(sat)}$		15		200	Tj=25°C Tj=150°C	1,5	2 2,51	2,2	V
Collector-emitter cut-off current incl. Diode	I_{CES}		0	1200		Tj=25°C Tj=150°C			0,14	mA
Gate-emitter leakage current	I_{GES}		20	0		Tj=25°C Tj=150°C			650	nA
Integrated Gate resistor	R_{gint}							7,5		Ω
Turn-on delay time	$t_{d(on)}$	Rgoff=2 Ω Rgon=2 Ω	±15	600	200	Tj=25°C Tj=150°C		203 220		ns
Rise time	t_r					Tj=25°C Tj=150°C		29 36		
Turn-off delay time	$t_{d(off)}$					Tj=25°C Tj=150°C		306 397		
Fall time	t_f					Tj=25°C Tj=150°C		88 122		
Turn-on energy loss per pulse	E_{on}					Tj=25°C Tj=150°C		13 20		mWs
Turn-off energy loss per pulse	E_{off}					Tj=25°C Tj=150°C		11 18		
Input capacitance	C_{ies}	f=1MHz	0	25		Tj=25°C		12300		pF
Output capacitance	C_{oss}							810		
Reverse transfer capacitance	C_{rss}							690		
Gate charge	Q_{Gate}		±15		200	Tj=25°C		960		nC
Thermal resistance chip to heatsink per chip	R_{thJH}	Thermal grease thickness≤50um λ = 1 W/mK						0,22		K/W
Thermal resistance chip to case per chip	R_{thJC}							0,15		
Inverter Diode										
Diode forward voltage	V_F				200	Tj=25°C Tj=150°C		2,45 2,43		V
Peak reverse recovery current	I_{RRM}	Rgon=2 Ω	±15	600	200	Tj=25°C Tj=150°C		191 246		A
Reverse recovery time	t_{rr}					Tj=25°C Tj=150°C		53 337		ns
Reverse recovered charge	Q_{rr}					Tj=25°C Tj=150°C		8 30		μC
Peak rate of fall of recovery current	di(rec)max /dt					Tj=25°C Tj=150°C		10909 5400		A/μs
Reverse recovered energy	Erec					Tj=25°C Tj=150°C		2 11		mWs
Thermal resistance chip to heatsink per chip	R_{thJH}	Thermal grease thickness≤50um λ = 1 W/mK						0,33		K/W
Thermal resistance chip to case per chip	R_{thJC}							0,22		
Thermistor										
Rated resistance	R					Tj=25°C		4700		Ω
Deviation of R25	ΔR/R	R100=1503Ω				Tc=100°C	-5		5	%
Power dissipation	P					Tc=100°C		210		mW
Power dissipation constant						Tj=25°C		3,5		mW/K
B-value	$B_{(25/50)}$	Tol. ±3%				Tj=25°C		3590		K
B-value	$B_{(25/100)}$	Tol. ±3%				Tj=25°C		3650		K
Vincotech NTC Reference						Tj=25°C			D	

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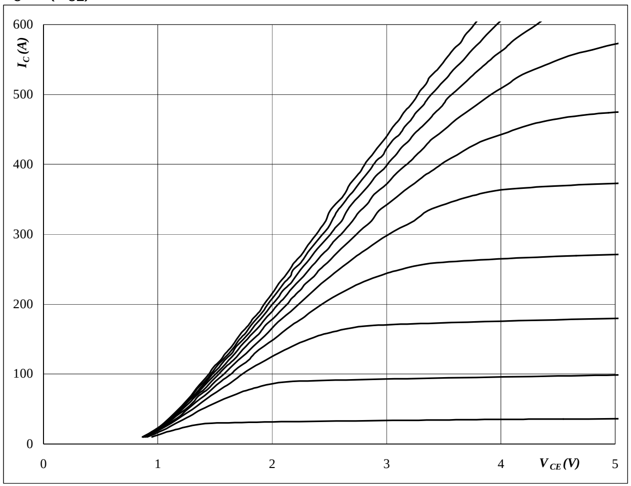
Output Inverter

Figure 1 — Output inverter IGBT

Typical output characteristics

$I_C = f(V_{CE})$



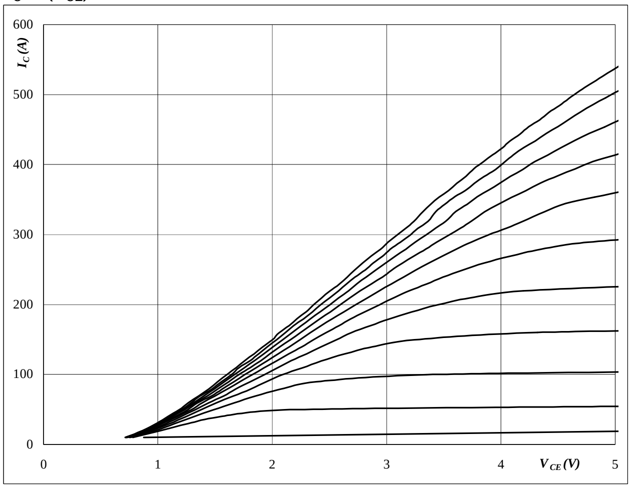
At

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

$I_C = f(V_{CE})$



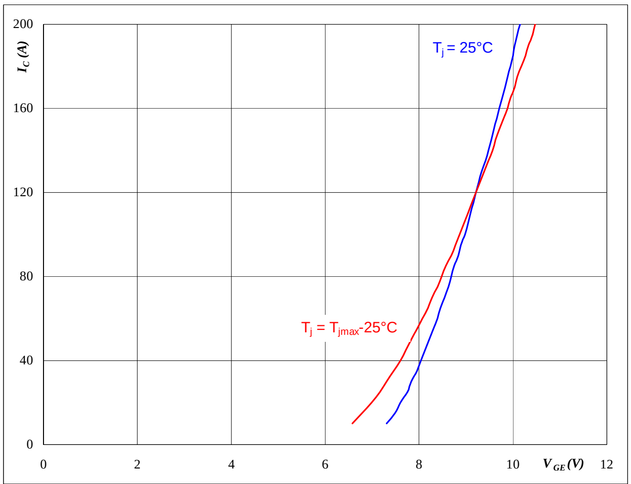
At

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

$I_C = f(V_{GE})$



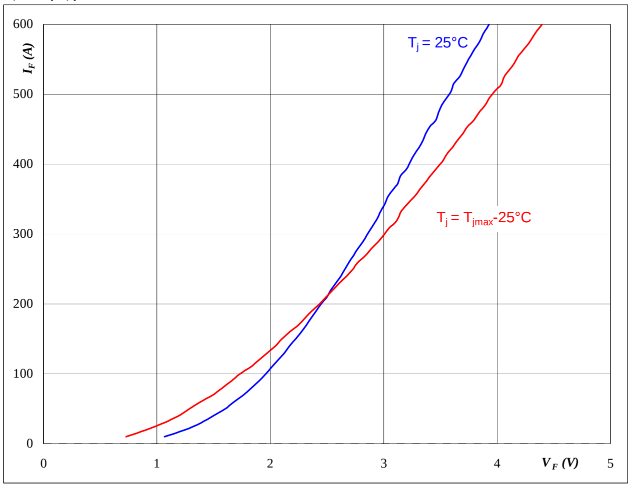
At

t_p =	350	μs
V_{CE} =	10	V

Figure 4 — Output inverter FWD

Typical diode forward current as a function of forward voltage

$I_F = f(V_F)$



At

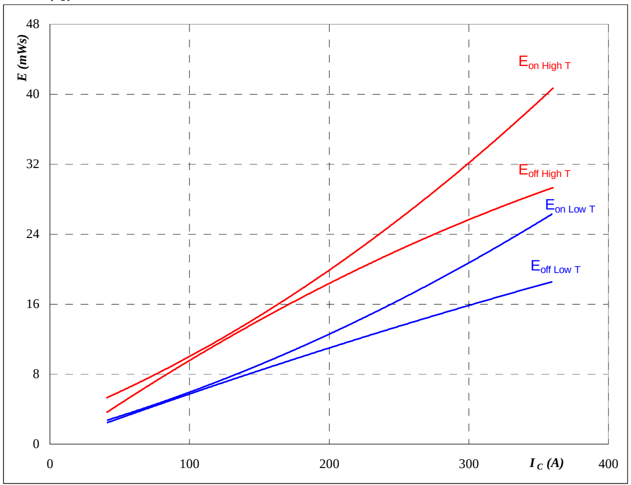
t_p =	350	μs

Output Inverter

Figure 5 Output inverter IGBT

Typical switching energy losses as a function of collector current

E = f(I_C)



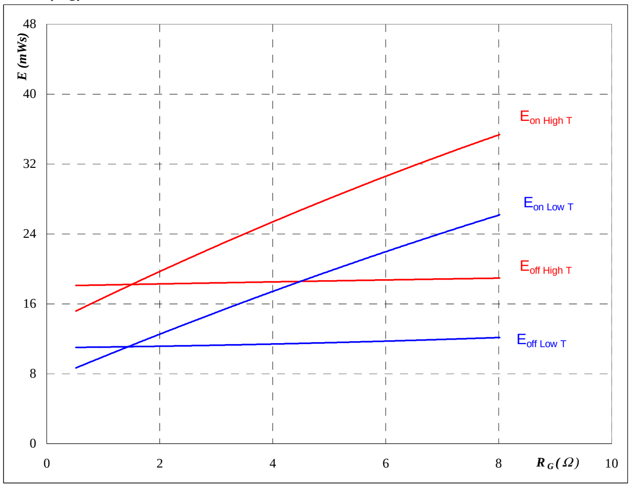
With an inductive load at

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



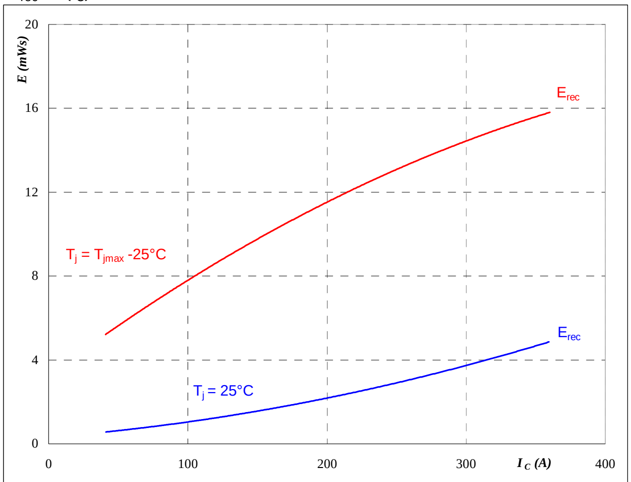
With an inductive load at

T_j =	25/150	°C
V_{CE} =	600	V
V_{GE} =	±15	V
I_C =	200	A

Figure 7 Output inverter FWD

Typical reverse recovery energy loss as a function of collector current

E_{rec} = f(I_C)



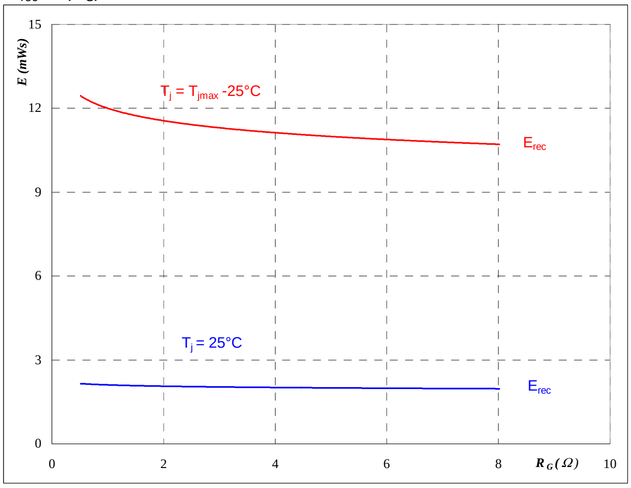
With an inductive load at

T_j =	25/150	°C
V_{CE} =	600	V
V_{GE} =	±15	V
R_{gon} =	2	Ω

Figure 8 Output inverter FWD

Typical reverse recovery energy loss as a function of gate resistor

E_{rec} = f(R_G)



With an inductive load at

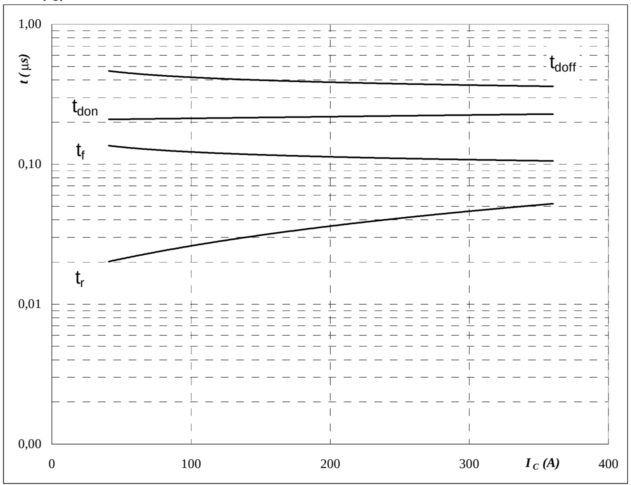
T_j =	25/150	°C
V_{CE} =	600	V
V_{GE} =	±15	V
I_C =	200	A

Output Inverter

Figure 9 Output inverter IGBT

Typical switching times as a function of collector current

$t = f(I_C)$



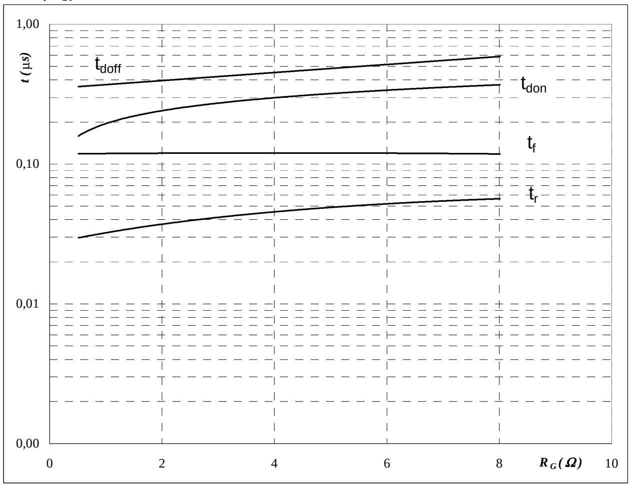
With an inductive load at

T_j =	150	°C
V_{CE} =	600	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

$t = f(R_G)$



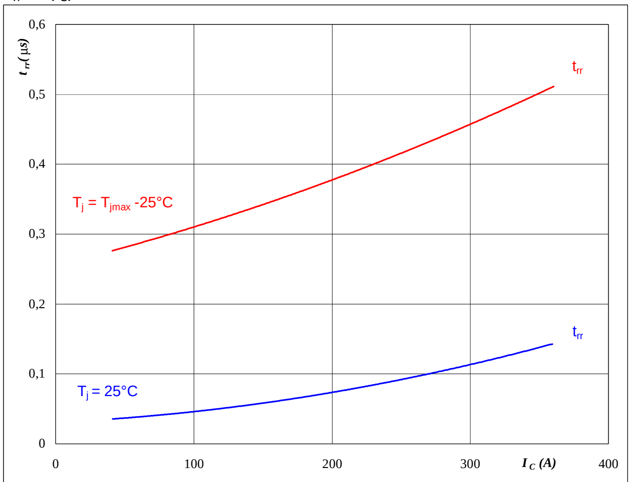
With an inductive load at

T_j =	150	°C
V_{CE} =	600	V
V_{GE} =	±15	V
I_C =	200	A

Figure 11 Output inverter FWD

Typical reverse recovery time as a function of collector current

$t_{rr} = f(I_C)$



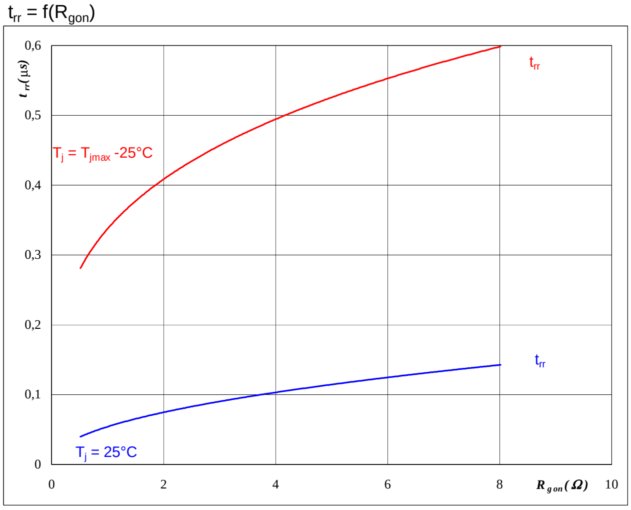
At

T_j =	25/150	°C
V_{CE} =	600	V
V_{GE} =	±15	V
R_{gon} =	2	Ω

Figure 12 Output inverter FWD

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

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



At

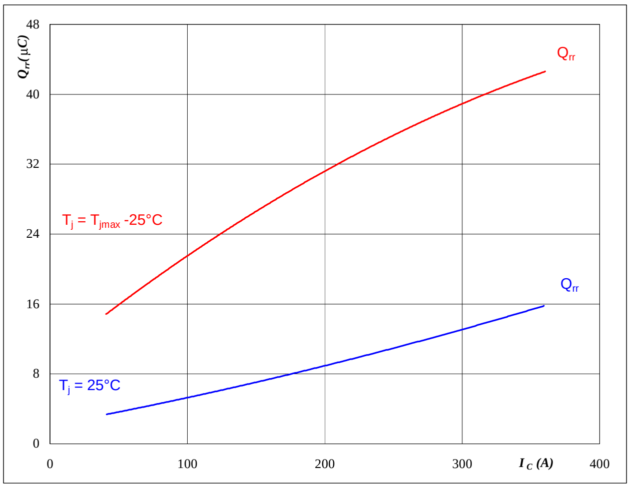
T_j =	25/150	°C
V_R =	600	V
I_F =	200	A
V_{GE} =	±15	V

Output Inverter

Figure 13	Output inverter FWD

Typical reverse recovery charge as a function of collector current

$Q_{rr} = f(I_C)$



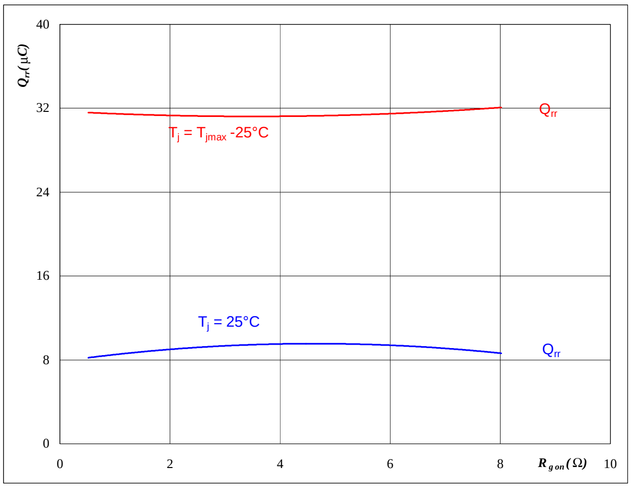
At

T_j =	25/150	°C
V_{CE} =	600	V
V_{GE} =	±15	V
R_{gon} =	2	Ω

Figure 14	Output inverter FWD

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

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



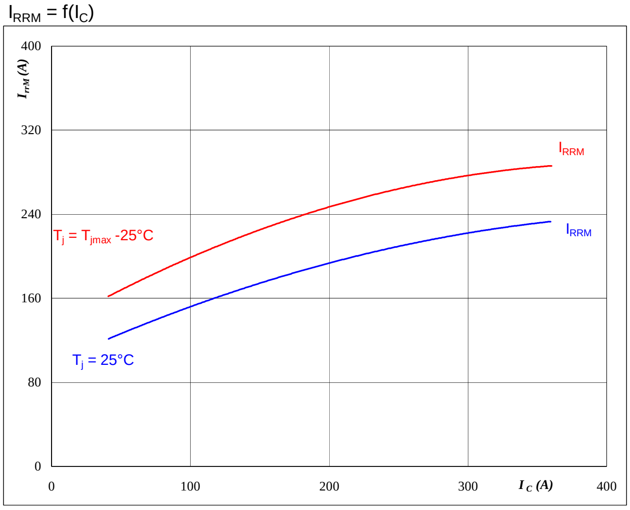
At

T_j =	25/150	°C
V_R =	600	V
I_F =	200	A
V_{GE} =	±15	V

Figure 15	Output inverter FWD

Typical reverse recovery current as a function of collector current

$I_{RRM} = f(I_C)$



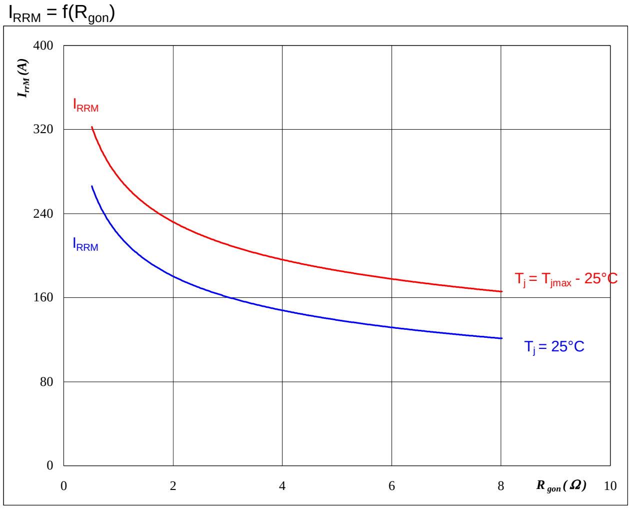
At

T_j =	25/150	°C
V_{CE} =	600	V
V_{GE} =	±15	V
R_{gon} =	2	Ω

Figure 16	Output inverter FWD

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

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



At

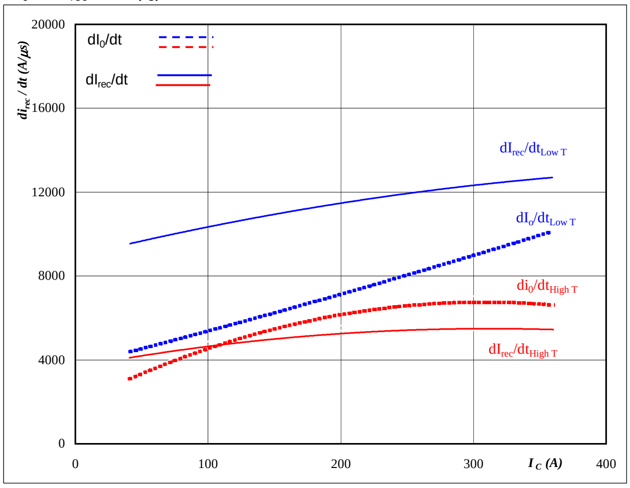
T_j =	25/150	°C
V_R =	600	V
I_F =	200	A
V_{GE} =	±15	V

Output Inverter

Figure 17 Output inverter FWD

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

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



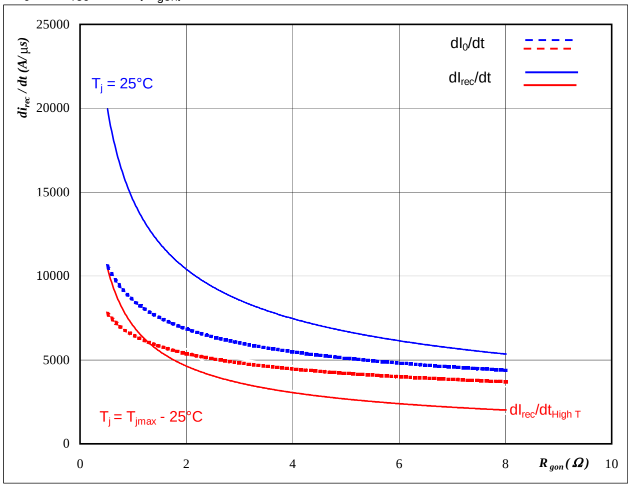
At

T_j =	25/150	°C
V_{CE} =	600	V
V_{GE} =	±15	V
R_{gon} =	2	Ω

Figure 18 Output inverter FWD

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

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



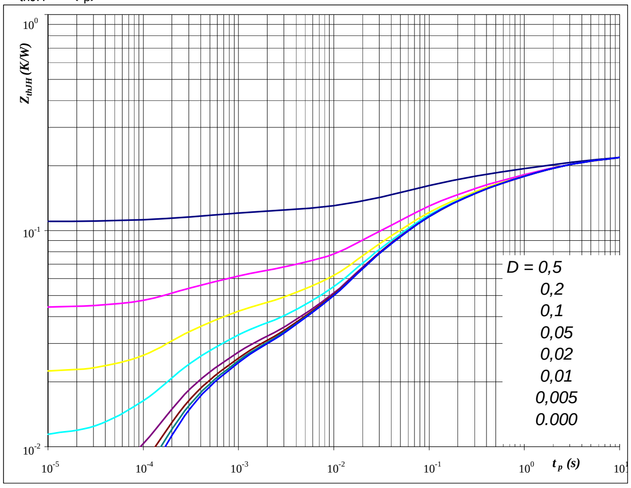
At

T_j =	25/150	°C
V_R =	600	V
I_F =	200	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} =	0,22	K/W	RthJH =	0,20	K/W

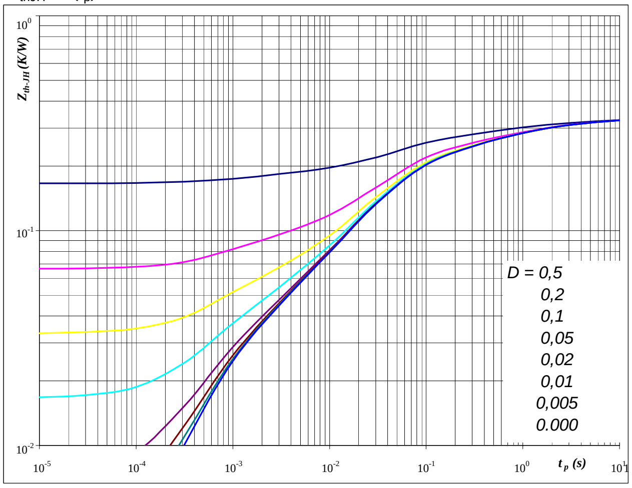
IGBT thermal model values

Thermal grease		Phase change interface	
R (C/W)	Tau (s)	R (C/W)	Tau (s)
0,05	3,1E+00	0,05	3,0E+00
0,05	5,5E-01	0,04	5,3E-01
0,05	9,8E-02	0,05	9,6E-02
0,05	2,3E-02	0,05	2,2E-02
0,01	1,7E-03	0,01	1,6E-03
0,02	2,6E-04	0,02	2,5E-04

Figure 20 Output inverter FWD

FWD transient thermal impedance as a function of pulse width

$Z_{thJH} = f(t_p)$



At

D =	t_p / T				
R_{thJH} =	0,33	K/W	RthJH =	0,28	K/W

FWD thermal model values

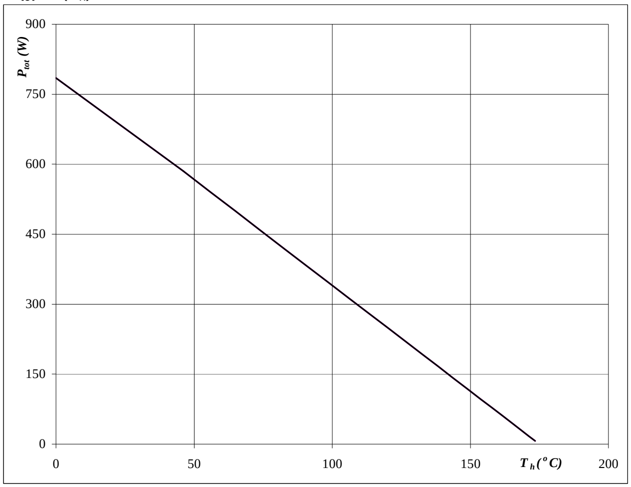
Thermal grease		Phase change interface	
R (C/W)	Tau (s)	R (C/W)	Tau (s)
0,02	9,9E+00	0,02	9,6E+00
0,06	1,8E+00	0,05	1,7E+00
0,07	2,8E-01	0,07	2,7E-01
0,13	4,3E-02	0,13	4,2E-02
0,03	8,0E-03	0,03	7,7E-03
0,03	8,8E-04	0,02	8,5E-04

Output Inverter

Figure 21	Output inverter IGBT

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_h)$



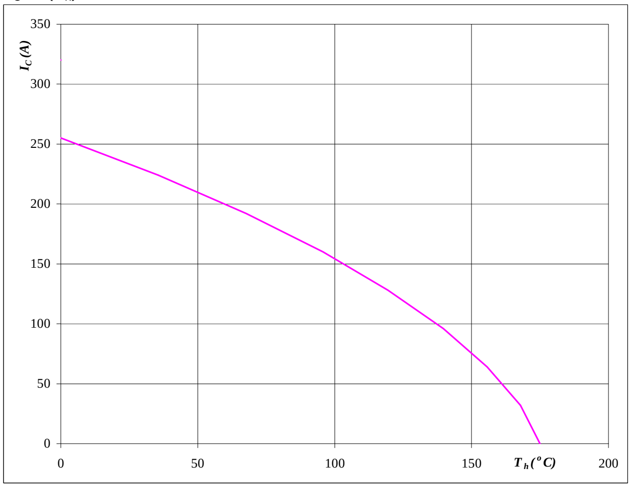
At

T_j =	175	°C	single heating
			overall heating

Figure 22	Output inverter IGBT

Collector current as a function of heatsink temperature

$I_C = f(T_h)$



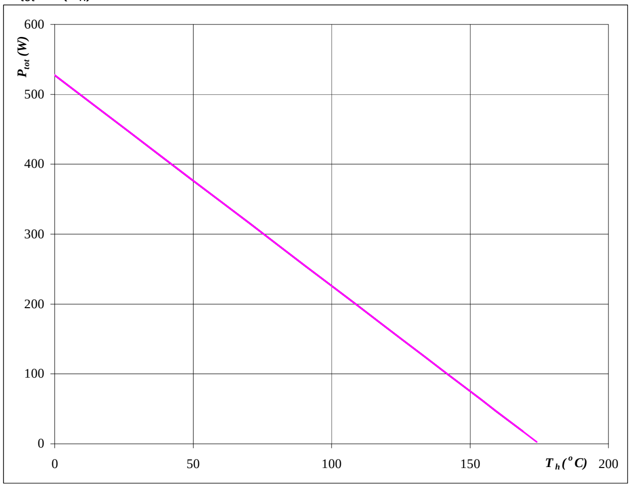
At

T_j =	175	°C
V_{GE} =	15	V

Figure 23	Output inverter FWD

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_h)$



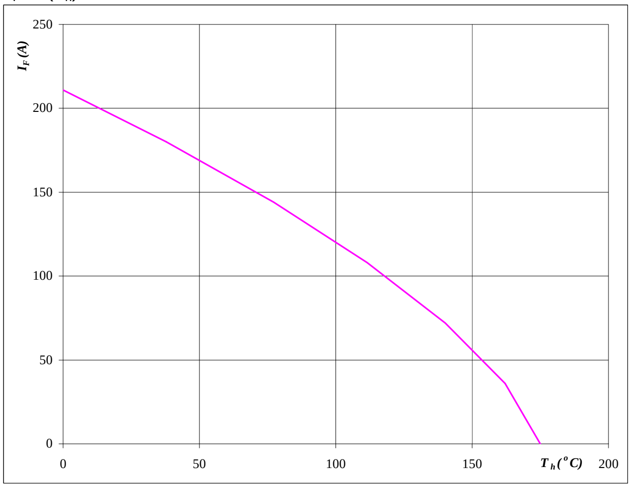
At

T_j =	175	°C	single heating
			overall heating

Figure 24	Output inverter FWD

Forward current as a function of heatsink temperature

$I_F = f(T_h)$



At

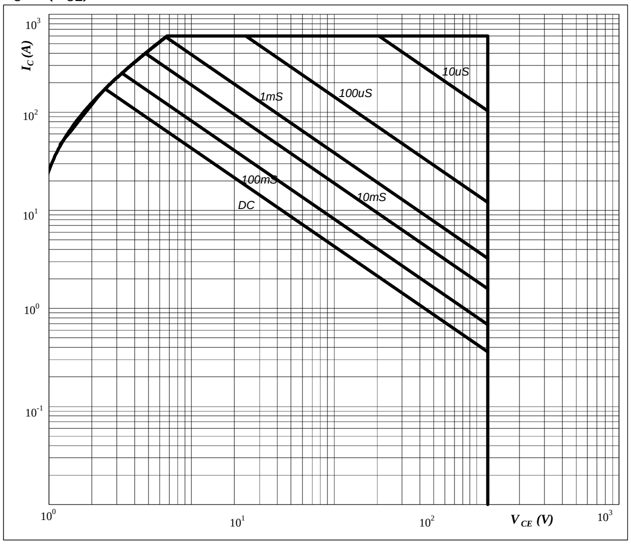
T_j =	175	°C

Output Inverter

Figure 25	Output inverter IGBT

Safe operating area as a function of collector-emitter voltage

$I_C = f(V_{CE})$



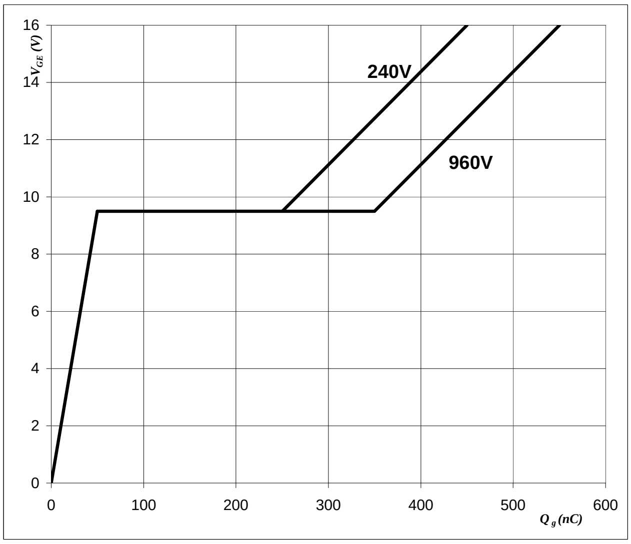
At

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

Figure 26	Output inverter IGBT

Gate voltage vs Gate charge

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



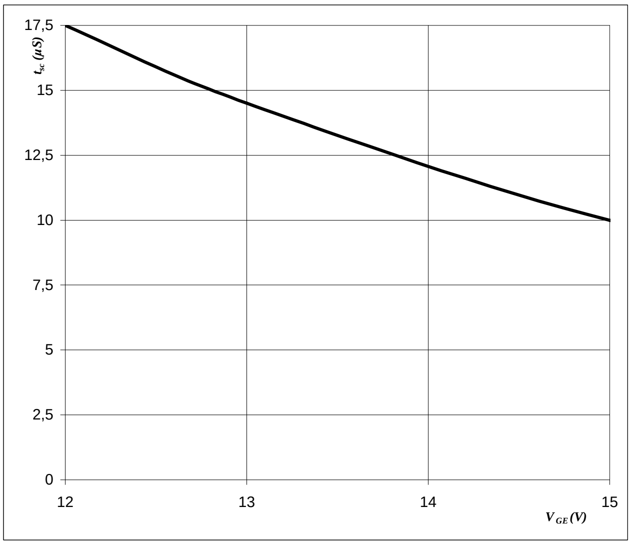
At

I_C =	200	A

Figure 27	Output inverter IGBT

Short circuit withstand time as a function of gate-emitter voltage

$t_{sc} = f(V_{GE})$



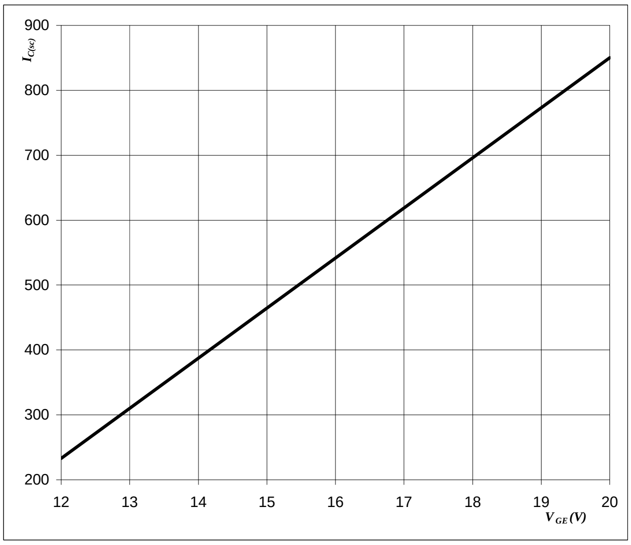
At

V_{CE} =	600	V
T_j ≤	175	ºC

Figure 28	Output inverter IGBT

Typical short circuit collector current as a function of gate-emitter voltage

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



At

V_{CE} ≤	600	V
T_j =	175	ºC

Thermistor

Figure 1 Thermistor

Typical NTC characteristic
as a function of temperature
$R_T = f(T)$

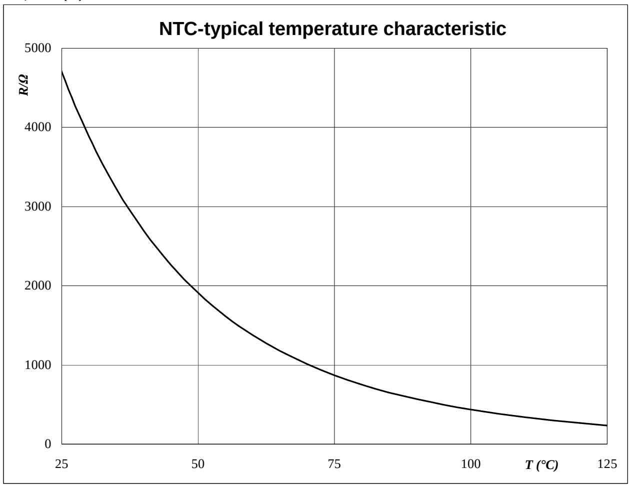


Figure 2 Thermistor

Typical NTC resistance values

$$R(T) = R_{25} \cdot e^{\left(B_{25/100} \cdot \left(\frac{1}{T} - \frac{1}{T_{25}}\right)\right)} \quad [\Omega]$$

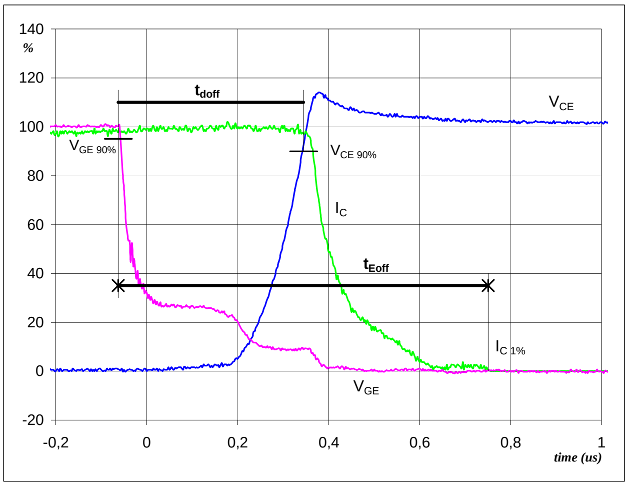
Switching Definitions Output Inverter

General conditions

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

Figure 1 Output inverter IGBT

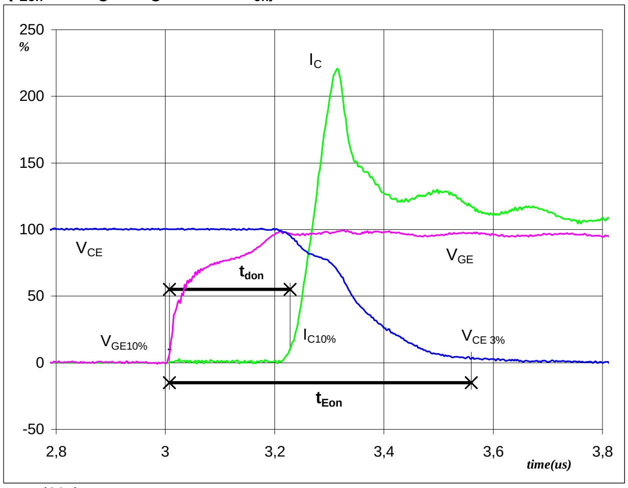
Turn-off Switching Waveforms & definition of t_{doff}, t_{Eoff}
(t_{Eoff} = integrating time for E_{off})



V_{GE} (0%) =	-15	V
V_{GE} (100%) =	15	V
V_C (100%) =	600	V
I_C (100%) =	201	A
t_{doff} =	0,40	μs
t_{Eoff} =	0,81	μs

Figure 2 Output inverter IGBT

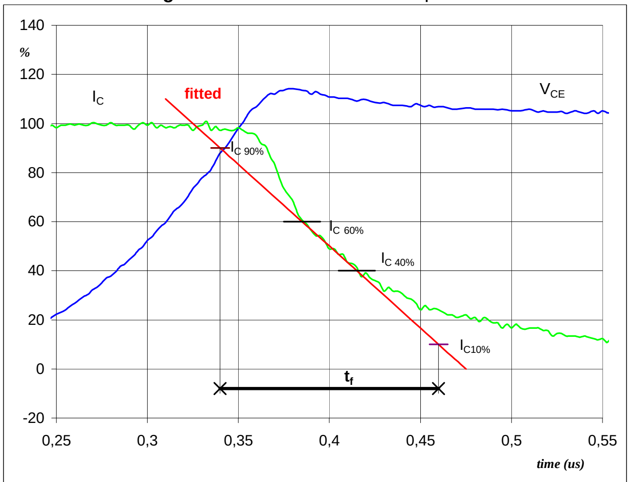
Turn-on Switching Waveforms & definition of tdon, t_{Eon}
(t_{Eon} = integrating time for E_{on})



V_{GE} (0%) =	-15	V
V_{GE} (100%) =	15	V
V_C (100%) =	600	V
I_C (100%) =	201	A
t_{don} =	0,22	μs
t_{Eon} =	0,55	μs

Figure 3 Output inverter IGBT

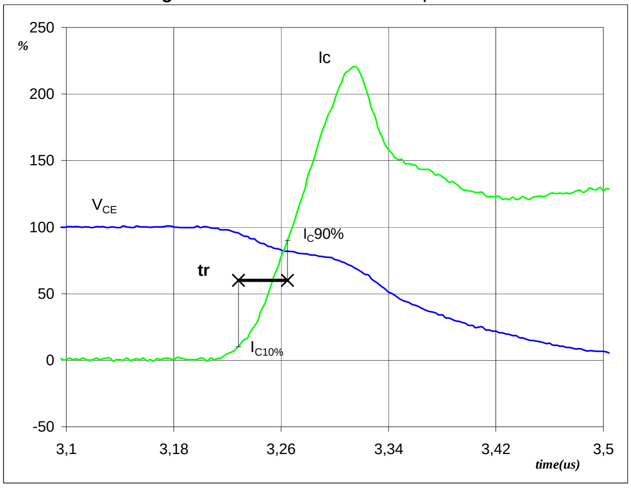
Turn-off Switching Waveforms & definition of t_f



V_C (100%) =	600	V
I_C (100%) =	201	A
t_f =	0,12	μs

Figure 4 Output inverter IGBT

Turn-on Switching Waveforms & definition of t_r

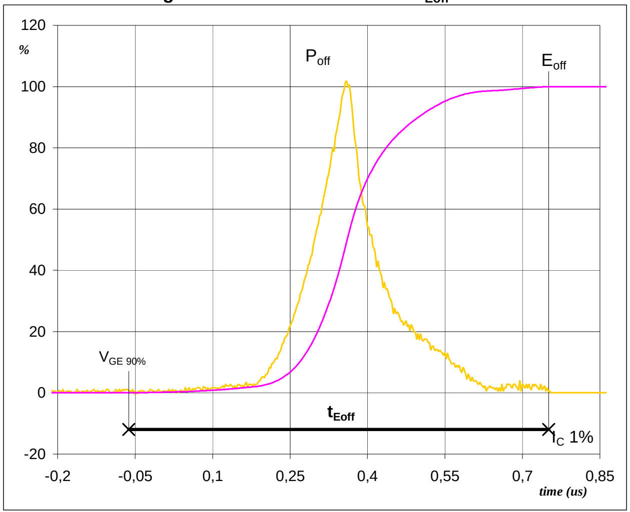


V_C (100%) =	600	V
I_C (100%) =	201	A
t_r =	0,04	μs

Switching Definitions Output Inverter

Figure 5 Output inverter IGBT

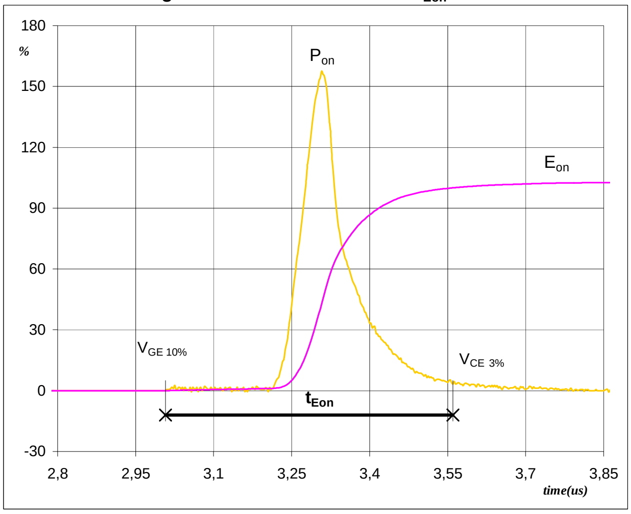
Turn-off Switching Waveforms & definition of t_{Eoff}



P_{off} (100%) =	120,72	kW
E_{off} (100%) =	18,32	mJ
t_{Eoff} =	0,81	μs

Figure 6 Output inverter IGBT

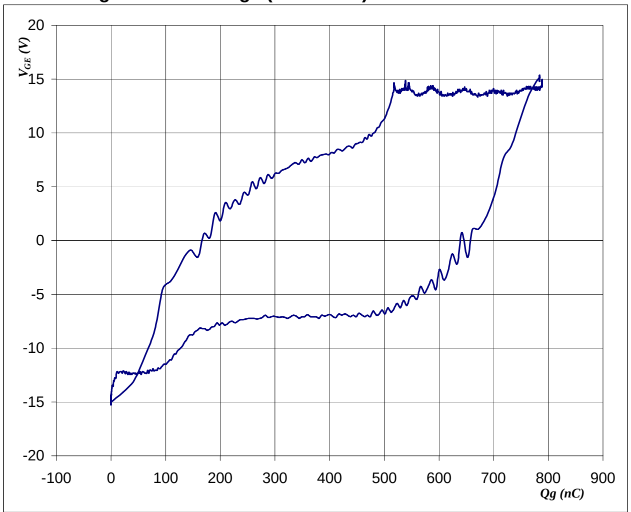
Turn-on Switching Waveforms & definition of t_{Eon}



P_{on} (100%) =	120,72	kW
E_{on} (100%) =	19,87	mJ
t_{Eon} =	0,55	μs

Figure 7 Output inverter FRED

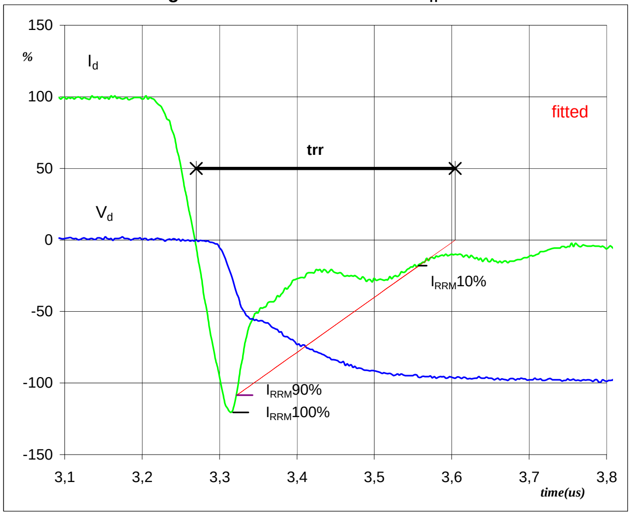
Gate voltage vs Gate charge (measured)



V_{GEoff} =	-15	V
V_{GEon} =	15	V
V_C (100%) =	600	V
I_C (100%) =	201	A
Q_g =	788,86	nC

Figure 8 Output inverter IGBT

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

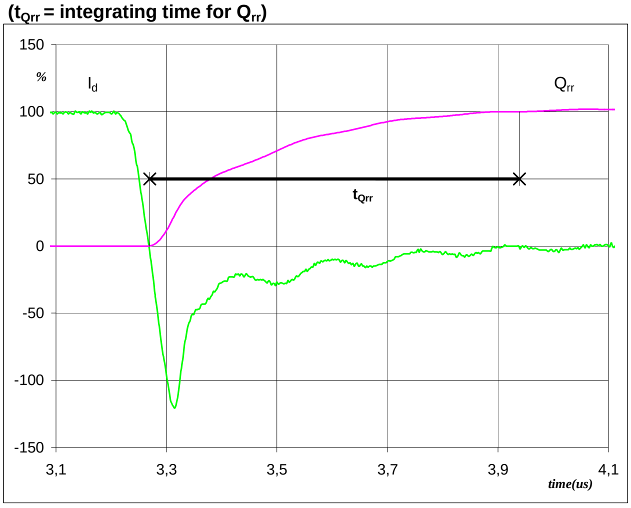


V_d (100%) =	600	V
I_d (100%) =	201	A
I_{RRM} (100%) =	-246	A
t_{rr} =	0,34	μs

Switching Definitions Output Inverter

Figure 9 Output inverter FRED

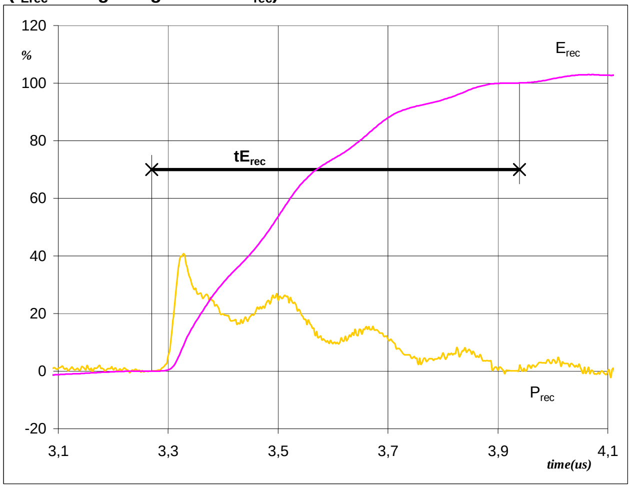
Turn-on Switching Waveforms & definition of t_{Qrr}
(t_{Qrr} = integrating time for Q_{rr})



I_d (100%) =	201	A
Q_{rr} (100%) =	30,06	μC
t_{Qrr} =	0,67	μs

Figure 10 Output inverter FRED

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



P_{rec} (100%) =	120,72	kW
E_{rec} (100%) =	10,94	mJ
t_{Erec} =	0,67	μs

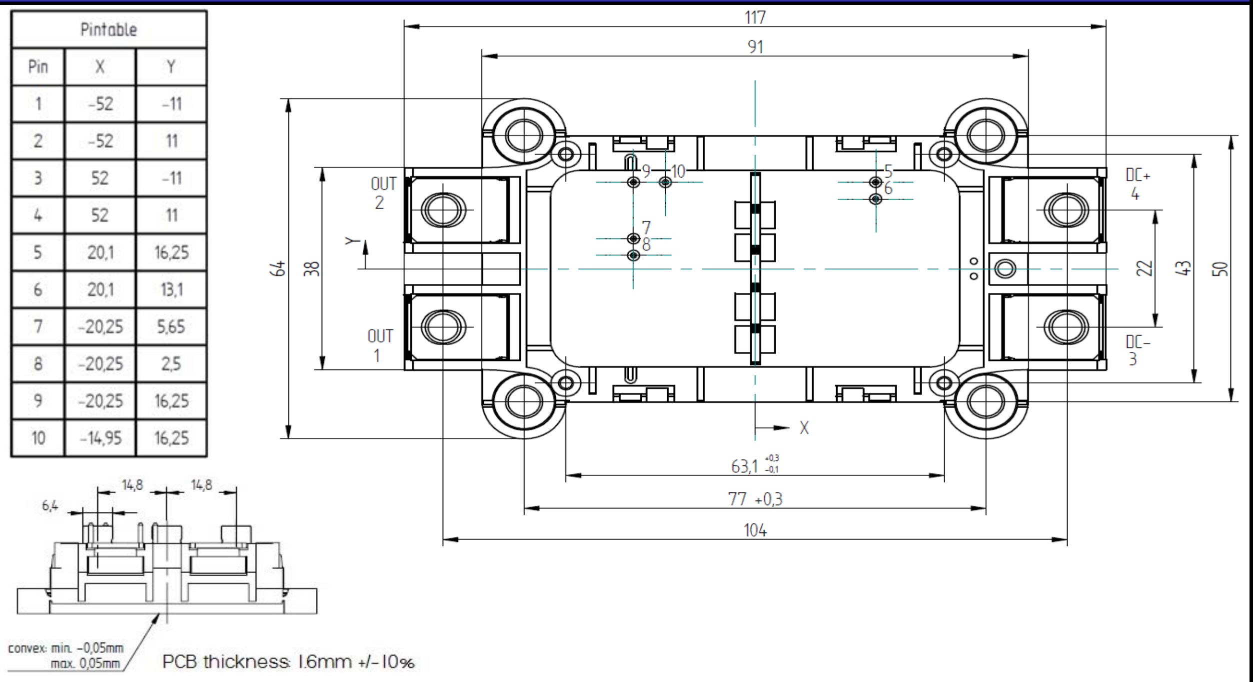
Ordering Code and Marking - Outline - Pinout

Ordering Code & Marking

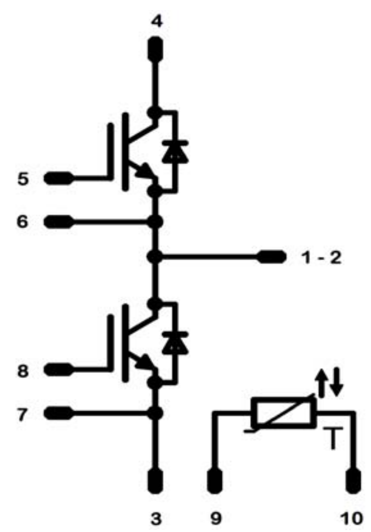
Version	Ordering Code	in DataMatrix as	in packaging barcode as
without thermal paste 17mm housing	70-S2122PA200SC-P818F	P818F	P818F

Outline

Pintable		
Pin	X	Y
1	-52	-11
2	-52	11
3	52	-11
4	52	11
5	20,1	16,25
6	20,1	13,1
7	-20,25	5,65
8	-20,25	2,5
9	-20,25	16,25
10	-14,95	16,25



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.

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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.