MiniSkiip 0 — 600V/10A

Features

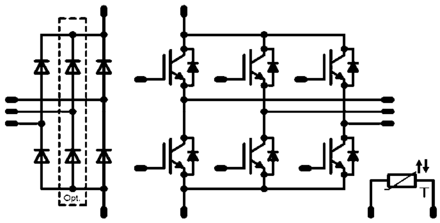
- Solderless interconnection
- Trench Fieldstop IGBT's for low saturation losses
- Optional 2- and 3-leg rectifier

Miniskiip0 housing

Target Applications

- Industrial Drives
- Embedded Drives

Schematic



Types

80-M006PNB010SA01-K615D, 2-leg rectifier
80-M006PNB010SA-K615C, 3-leg rectifier

Maximum Ratings

T_j=25°C, unless otherwise specified

Parameter	Symbol	Condition		Value	Unit
Input Rectifier Diode					
Repetitive peak reverse voltage	V_{RRM}			1600	V
DC forward current	I_{FAV}	$T_j=T_jmax$	T_h=80°C T_c=80°C	25 25	A
Surge forward current	I_{FSM}	t_p=10ms	T_j=25°C	220	A
I2t-value	I^2t			240	A^2s
Power dissipation per Diode	P_{tot}	$T_j=T_jmax$	T_h=80°C T_c=80°C	38 58	W
Maximum Junction Temperature	T_jmax			150	°C
Inverter Transistor					
Collector-emitter break down voltage	V_{CE}			600	V
DC collector current	I_C	$T_j=T_jmax$	T_h=80°C T_c=80°C	15 15	A
Repetitive peak collector current	I_{Cpulse}	t_p limited by T_jmax		30	A
Turn off safe operating area		VCE ≤ 1200V, Tj ≤ Top max		30	A
Power dissipation per IGBT	P_{tot}	$T_j=T_jmax$	T_h=80°C T_c=80°C	39 59	W
Gate-emitter peak voltage	V_{GE}			±20	V
Short circuit ratings	t_{SC} V_{CC}	T_j≤150°C V_{GE}=15V		6 360	μs V
Maximum Junction Temperature	T_jmax			175	°C

Maximum Ratings

T_j=25°C, unless otherwise specified

Parameter	Symbol	Condition		Value	Unit
Inverter Diode					
Peak Repetitive Reverse Voltage	V_{RRM}	T_j=25°C		600	V
DC forward current	I_F	T_j=$T_j$max	T_h=80°C T_c=80°C	15 15	A
Repetitive peak forward current	I_{FRM}	t_p limited by $T_j$max	T_h=80°C T_c=80°C	30	A
Power dissipation per Diode	P_{tot}	T_j=$T_j$max	T_h=80°C T_c=80°C	33 49	W
Maximum Junction Temperature	$T_j$max			175	°C
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

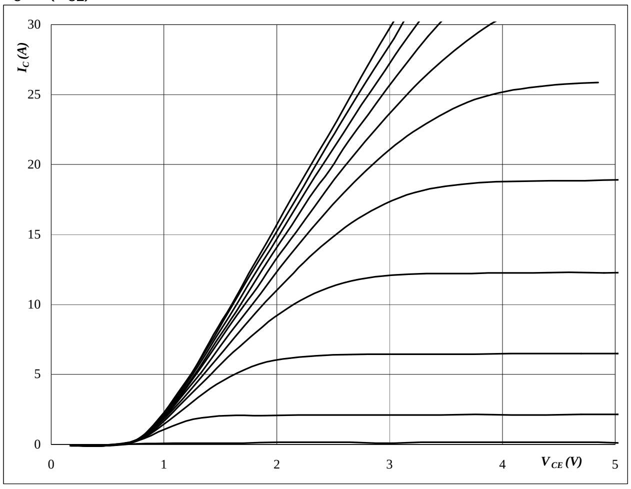
Parameter	Symbol	Conditions					Value			Unit
			V_{GE} [V] or V_{GS} [V]	V_r [V] or V_{CE} [V] or V_{DS} [V]	I_C [A] or I_F [A] or I_D [A]	T_j	Min	Typ	Max	
Input Rectifier Diode										
Forward voltage	V_F				25	Tj=25°C Tj=125°C		1,43 1,44	1,64	V
Threshold voltage (for power loss calc. only)	V_{to}				25	Tj=25°C Tj=125°C		0,92 0,79		V
Slope resistance (for power loss calc. only)	r_t				25	Tj=25°C Tj=125°C		20,29 26,11		mΩ
Reverse current	I_r			1600		Tj=25°C Tj=125°C			0,05	mA
Thermal resistance chip to heatsink per chip	R_{thJH}	Thermal grease thickness≤50um λ = 1 W/mK						1,83		K/W
Inverter Transistor										
Gate emitter threshold voltage	$V_{GE(th)}$	$V_{CE}=V_{GE}$			0,00015	Tj=25°C Tj=150°C	5	5,8	6,5	V
Collector-emitter saturation voltage	$V_{CE(sat)}$		15		10	Tj=25°C Tj=150°C	1,19	1,64 1,89	1,99	V
Collector-emitter cut-off current incl. Diode	I_{CES}		0	600		Tj=25°C Tj=150°C			0,0006	mA
Gate-emitter leakage current	I_{GES}		20	0		Tj=25°C Tj=150°C			300	nA
Integrated Gate resistor	R_{gint}									Ω
Turn-on delay time	$t_{d(on)}$	Rgoff=64 Ω Rgon=64 Ω	±15	300	10	Tj=25°C Tj=150°C		90 91		ns
Rise time	t_r					Tj=25°C Tj=150°C		22 25		
Turn-off delay time	$t_{d(off)}$					Tj=25°C Tj=150°C		133 156		
Fall time	t_f					Tj=25°C Tj=150°C		120 144		
Turn-on energy loss per pulse	E_{on}					Tj=25°C Tj=150°C		0,26 0,38		mWs
Turn-off energy loss per pulse	E_{off}					Tj=25°C Tj=150°C		0,26 0,34		
Input capacitance	C_{ies}	f=1MHz	0	25		Tj=25°C		551		pF
Output capacitance	C_{oss}							40		
Reverse transfer capacitance	C_{rss}							17		
Gate charge	Q_{Gate}		±15			Tj=25°C		55	62	nC
Thermal resistance chip to heatsink per chip	R_{thJH}	Thermal grease thickness≤50um λ = 1 W/mK						2,46		K/W
Inverter Diode										
Diode forward voltage	V_F				10	Tj=25°C Tj=150°C		1,39 1,32		V
Peak reverse recovery current	I_{RRM}	Rgon=64 Ω	±15	300	10	Tj=25°C Tj=150°C		6,77 9,87		A
Reverse recovery time	t_{rr}					Tj=25°C Tj=150°C		233 352		ns
Reverse recovered charge	Q_{rr}					Tj=25°C Tj=150°C		0,66 1,46		μC
Peak rate of fall of recovery current	di(rec)max /dt					Tj=25°C Tj=150°C		105 109		A/μs
Reverse recovered energy	Erec					Tj=25°C Tj=150°C		0,13 0,30		mWs
Thermal resistance chip to heatsink per chip	R_{thJH}	Thermal grease thickness≤50um λ = 1 W/mK						2,92		K/W
Thermistor										
Rated resistance	R					Tr=25°C		1000		Ω
Deviation of R	ΔR/R	R25=1000 Ω R100=1670 Ω				Tr=25°C Tr=100°C	-3 -2		3 2	%
R100	R_{100}					Tr=25°C		1670		Ω
Temperature coefficient								0,76		% /K
A-value	$B_{(25/50)}$	Tol. %				Tr=25°C		7,635*10-3		1/K
B-value	$B_{(25/100)}$	Tol. %				Tr=25°C		1,731*10-5		1/K²
Vincotech NTC Reference									E	

Output Inverter

Figure 1 Output inverter IGBT

Typical output characteristics

$I_C = f(V_{CE})$

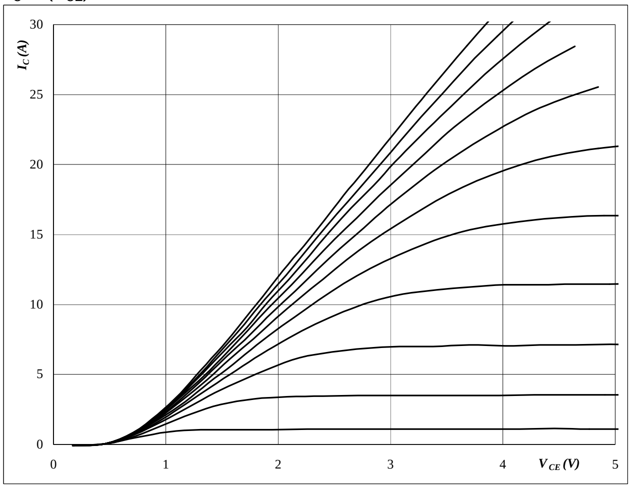


t_p =	250	μs
T_j =	25	°C
V_{GE} from	7 V to 17 V in steps of 1 V	

Figure 2 Output inverter IGBT

Typical output characteristics

$I_C = f(V_{CE})$

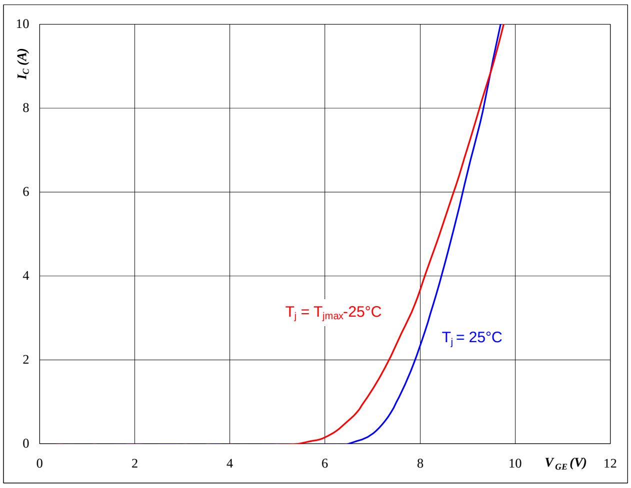


t_p =	250	μs
T_j =	150	°C
V_{GE} from	7 V to 17 V in steps of 1 V	

Figure 3 Output inverter IGBT

Typical transfer characteristics

$I_C = f(V_{GE})$

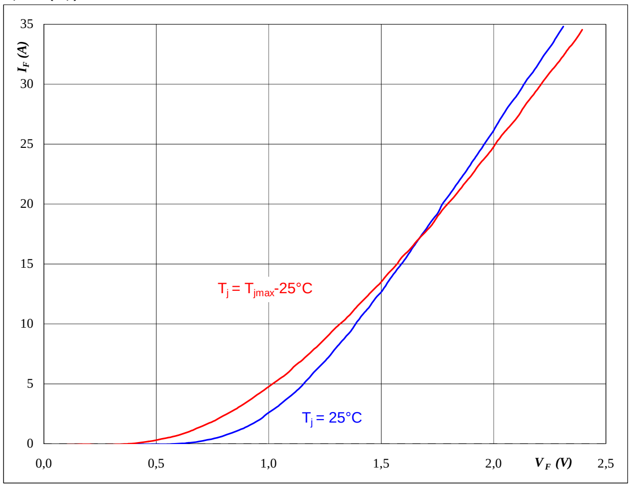


t_p =	250	μs
V_{CE} =	10	V

Figure 4 Output inverter FWD

Typical diode forward current as a function of forward voltage

$I_F = f(V_F)$



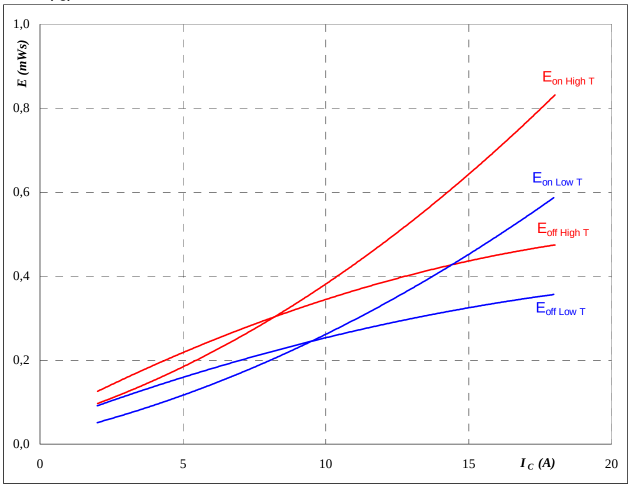
t_p =	250	μs

Output Inverter

Figure 5 Output inverter IGBT

Typical switching energy losses
as a function of collector current

$E = f(I_C)$



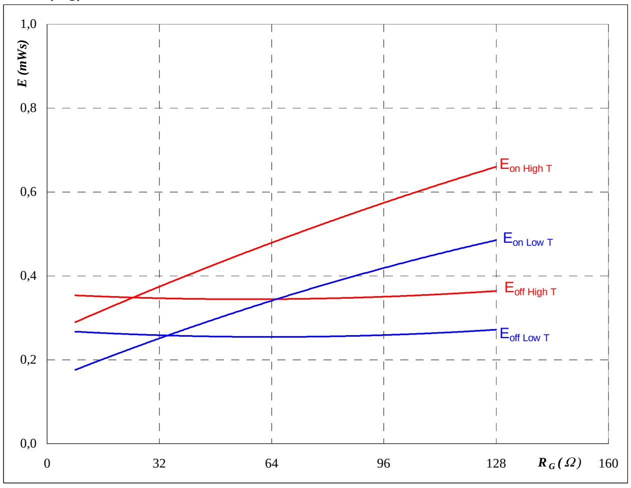
inductive load

T_j =	25/150	°C
V_{CE} =	300	V
V_{GE} =	±15	V
R_{gon} =	32	Ω
R_{goff} =	32	Ω

Figure 6 Output inverter IGBT

Typical switching energy losses
as a function of gate resistor

$E = f(R_G)$



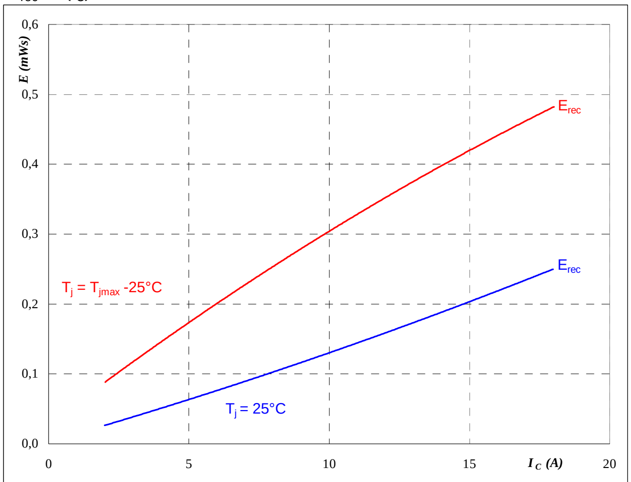
inductive load

T_j =	25/150	°C
V_{CE} =	300	V
V_{GE} =	±15	V
I_C =	10	A

Figure 7 Output inverter FWD

Typical reverse recovery energy loss
as a function of collector current

$E_{rec} = f(I_C)$



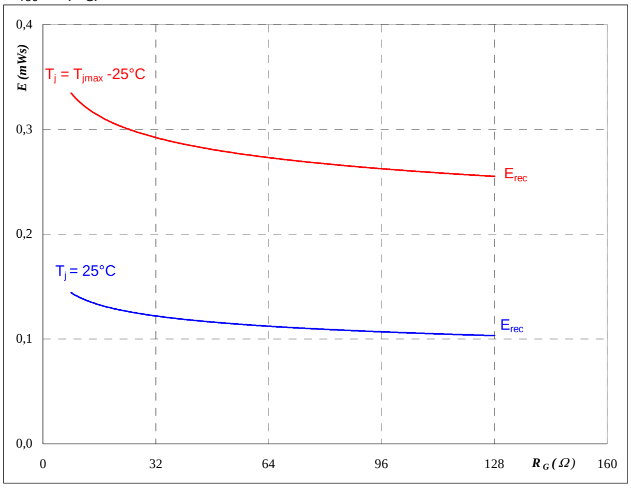
inductive load

T_j =	25/150	°C
V_{CE} =	300	V
V_{GE} =	±15	V
R_{gon} =	32	Ω

Figure 8 Output inverter FWD

Typical reverse recovery energy loss
as a function of gate resistor

$E_{rec} = f(R_G)$



inductive load

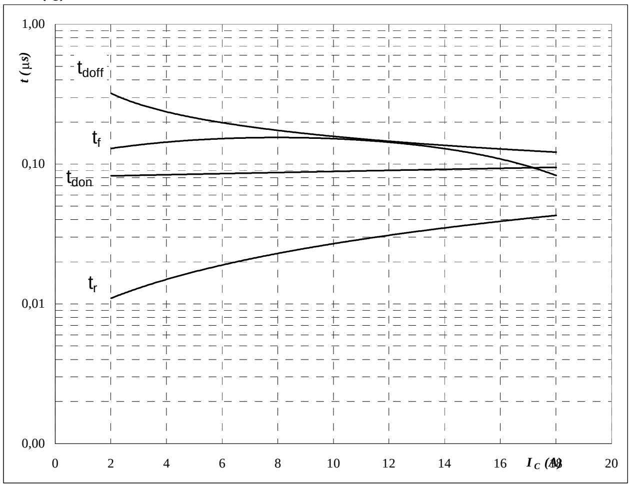
T_j =	25/150	°C
V_{CE} =	300	V
V_{GE} =	±15	V
I_C =	10	A

Output Inverter

Figure 9 Output inverter IGBT

Typical switching times as a function of collector current

t = f(I_C)



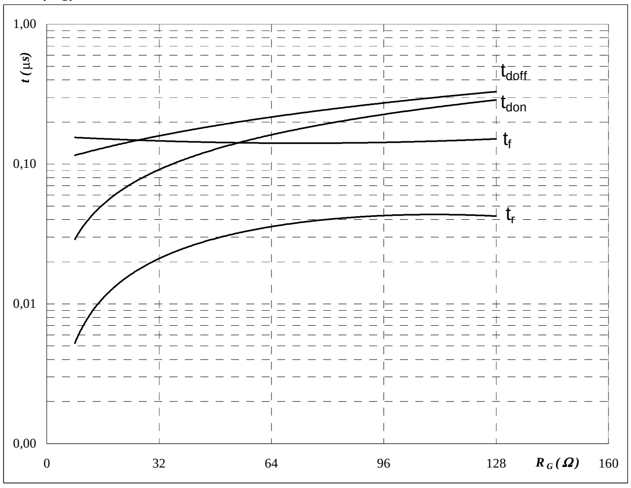
inductive load

T_j =	150	°C
V_{CE} =	300	V
V_{GE} =	±15	V
R_{gon} =	32	Ω
R_{goff} =	32	Ω

Figure 10 Output inverter IGBT

Typical switching times as a function of gate resistor

t = f(R_G)



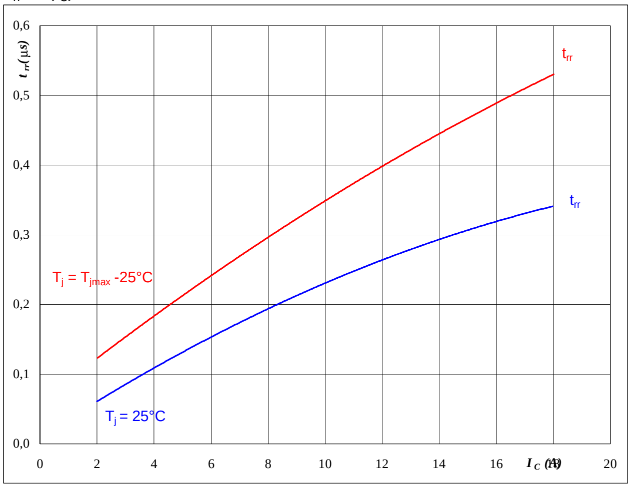
inductive load

T_j =	150	°C
V_{CE} =	300	V
V_{GE} =	±15	V
I_C =	10	A

Figure 11 Output inverter FWD

Typical reverse recovery time as a function of collector current

t_{rr} = f(I_C)

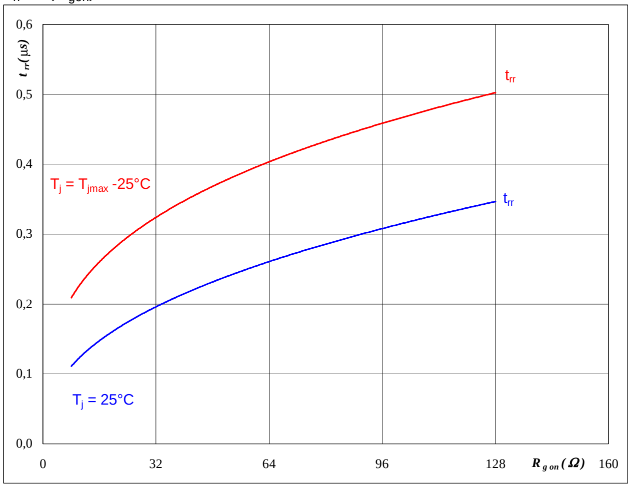


T_j =	25/150	°C
V_{CE} =	300	V
V_{GE} =	±15	V
R_{gon} =	32	Ω

Figure 12 Output inverter FWD

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

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



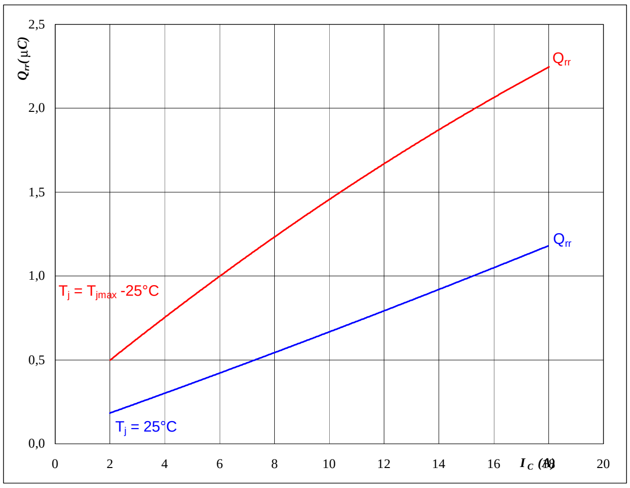
T_j =	25/150	°C
V_R =	300	V
I_F =	10	A
V_{GE} =	±15	V

Output Inverter

Figure 13 Output inverter FWD

Typical reverse recovery charge as a function of collector current

$Q_{rr} = f(I_C)$

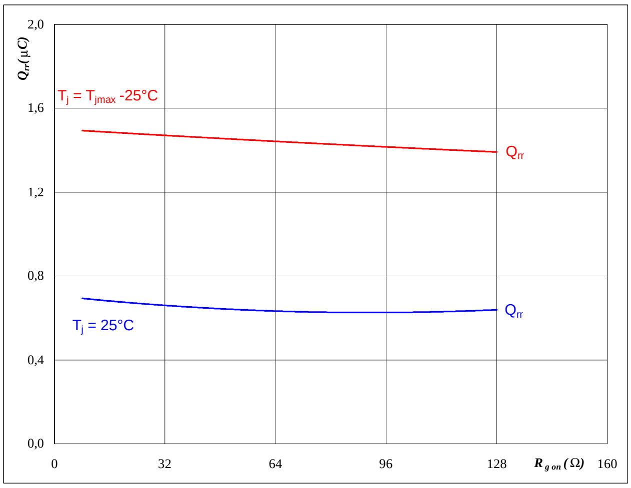


T_j =	25/150	°C
V_{CE} =	300	V
V_{GE} =	±15	V
R_{gon} =	32	Ω

Figure 14 Output inverter FWD

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

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

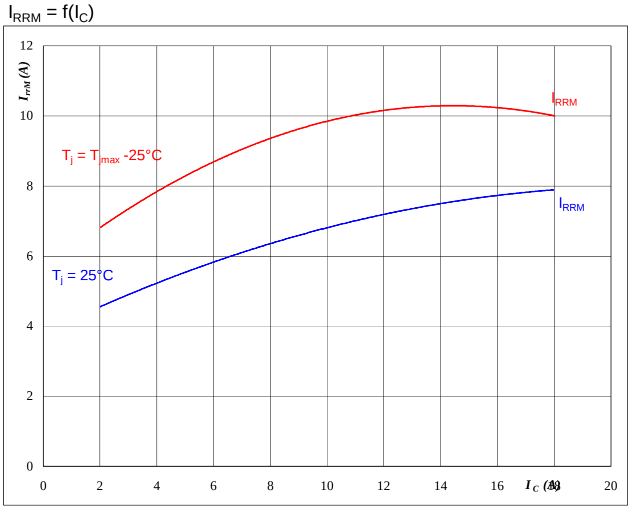


T_j =	25/150	°C
V_R =	300	V
I_F =	10	A
V_{GE} =	±15	V

Figure 15 Output inverter FWD

Typical reverse recovery current as a function of collector current

$I_{RRM} = f(I_C)$

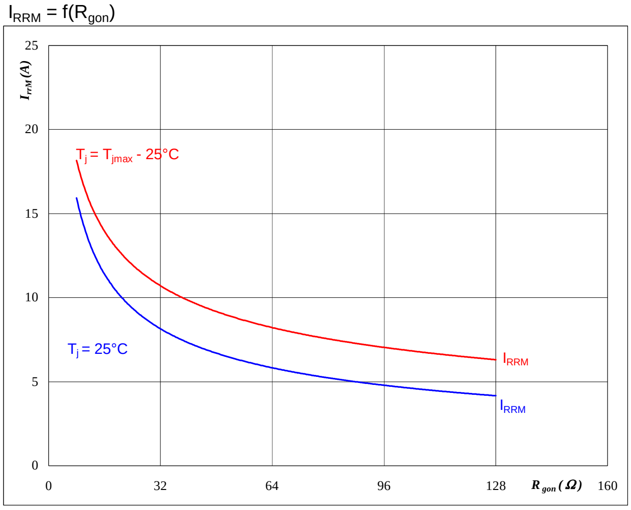


T_j =	25/150	°C
V_{CE} =	300	V
V_{GE} =	±15	V
R_{gon} =	32	Ω

Figure 16 Output inverter FWD

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

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



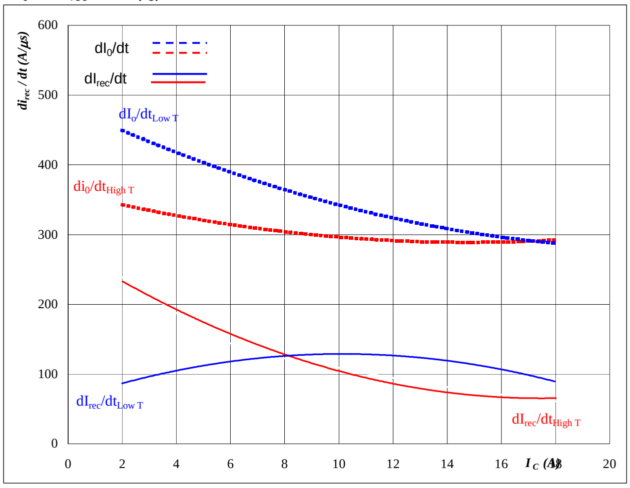
T_j =	25/150	°C
V_R =	300	V
I_F =	10	A
V_{GE} =	±15	V

Output Inverter

Figure 17 Output inverter FWD

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

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

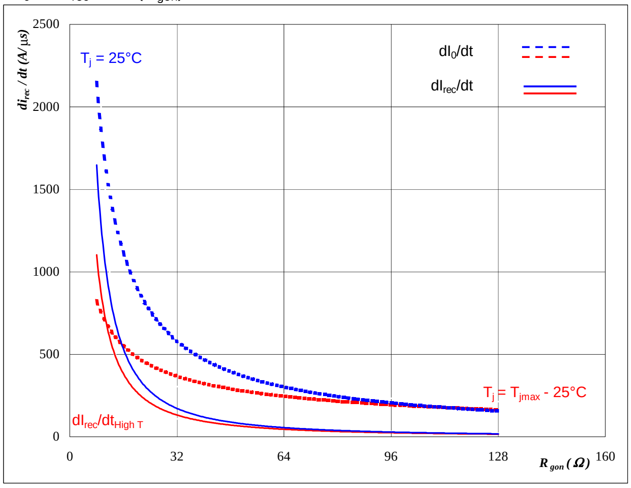


T_j =	25/150	°C
V_{CE} =	300	V
V_{GE} =	±15	V
R_{gon} =	32	Ω

Figure 18 Output inverter FWD

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

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

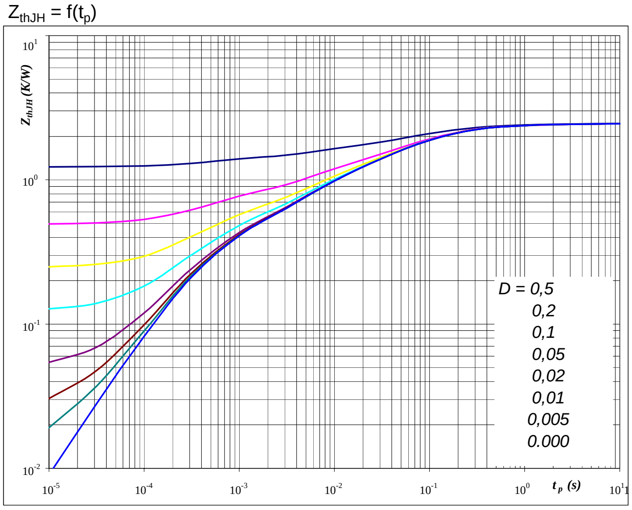


T_j =	25/150	°C
V_R =	300	V
I_F =	10	A
V_{GE} =	±15	V

Figure 19 Output inverter IGBT

IGBT transient thermal impedance as a function of pulse width

$Z_{thJH} = f(t_p)$



D =	t_p / T		
R_{thJH} =	2,46	K/W	1,99

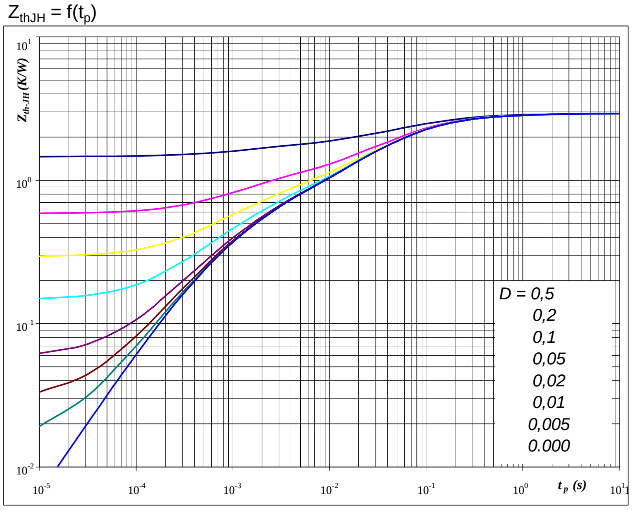
IGBT thermal model values

Thermal grease R (C/W)	Thermal grease Tau (s)	Phase change interface R (C/W)	Phase change interface Tau (s)
0,13	1,9E+00	0,11	1,5E+00
0,80	1,6E-01	0,65	1,3E-01
0,76	3,0E-02	0,61	2,5E-02
0,45	4,5E-03	0,37	3,6E-03
0,32	4,0E-04	0,26	3,3E-04

Figure 20 Output inverter FWD

FWD transient thermal impedance as a function of pulse width

$Z_{thJH} = f(t_p)$



D =	t_p / T		
R_{thJH} =	2,92	K/W	2,37

FWD thermal model values

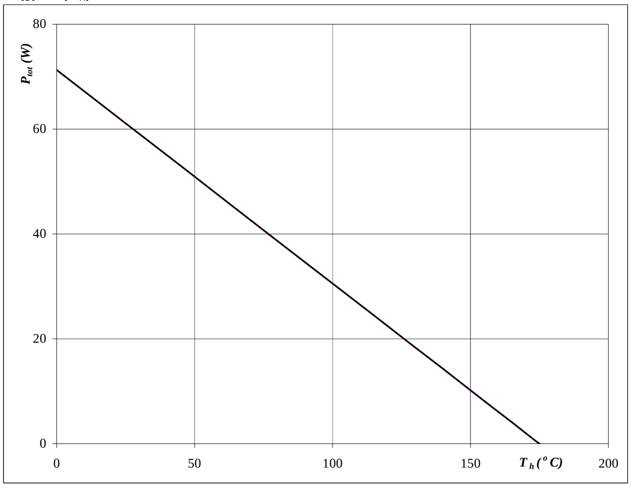
Thermal grease R (C/W)	Thermal grease Tau (s)	Phase change interface R (C/W)	Phase change interface Tau (s)
0,14	1,8E+00	0,11	1,5E+00
0,70	1,8E-01	0,57	1,4E-01
1,13	4,6E-02	0,92	3,7E-02
0,48	9,5E-03	0,39	7,7E-03
0,40	1,2E-03	0,32	9,8E-04
0,07	2,9E-04	0,06	2,4E-04

Output Inverter

Figure 21 Output inverter IGBT

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_h)$

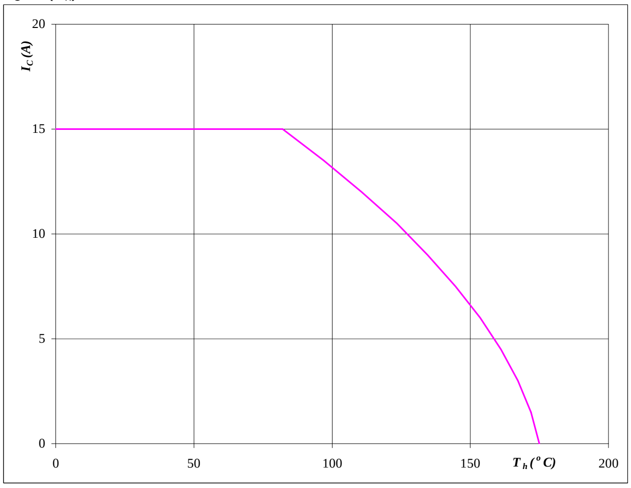


T_j = 175 °C

Figure 22 Output inverter IGBT

Collector current as a function of heatsink temperature

$I_C = f(T_h)$

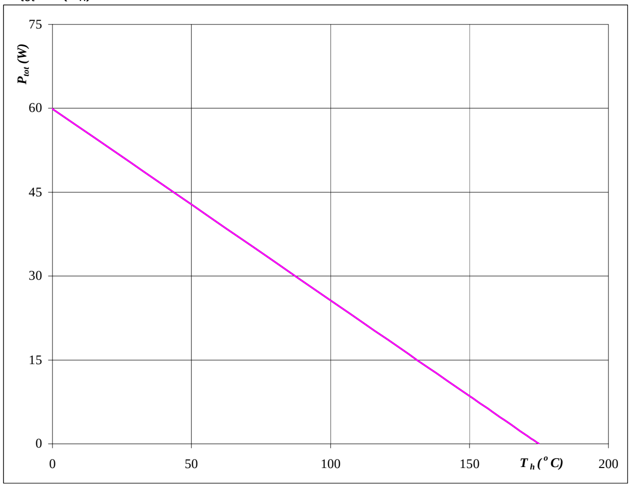


T_j = 175 °C
V_{GE} = 15 V

Figure 23 Output inverter FWD

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_h)$

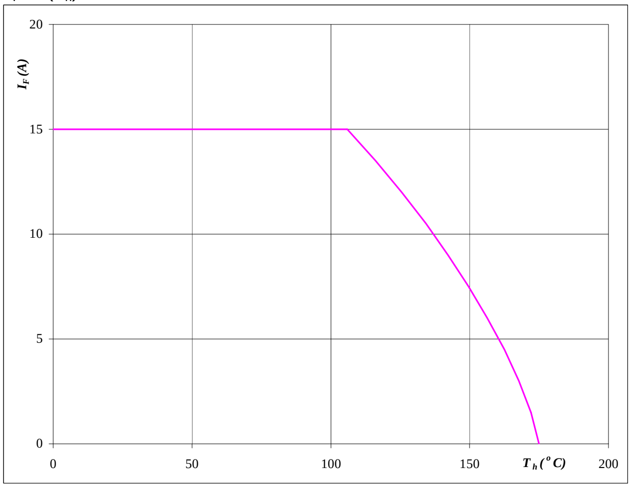


T_j = 175 °C

Figure 24 Output inverter FWD

Forward current as a function of heatsink temperature

$I_F = f(T_h)$



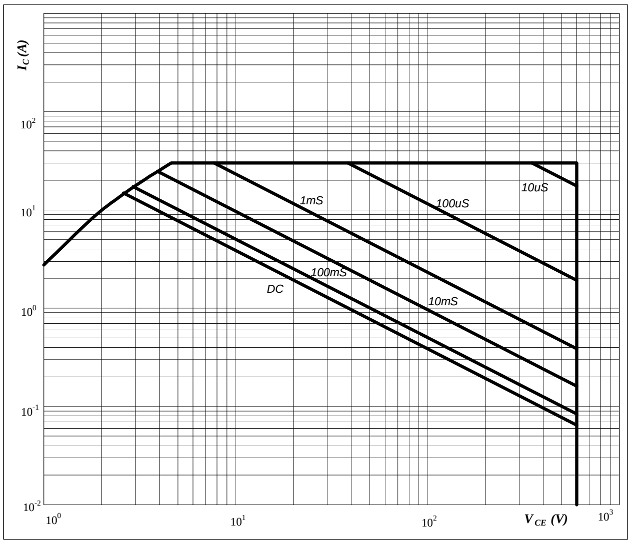
T_j = 175 °C

Output Inverter

Figure 25 Output inverter IGBT

Safe operating area as a function of collector-emitter voltage

$I_C = f(V_{CE})$

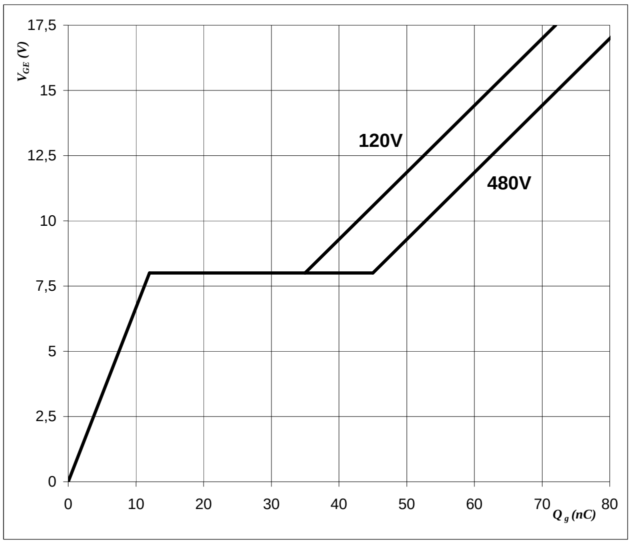


D =	single pulse	
T_h =	80	ºC
V_{GE} =	±15	V
T_j =	T_{jmax}	ºC

Figure 26 Output inverter IGBT

Gate voltage vs Gate charge

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

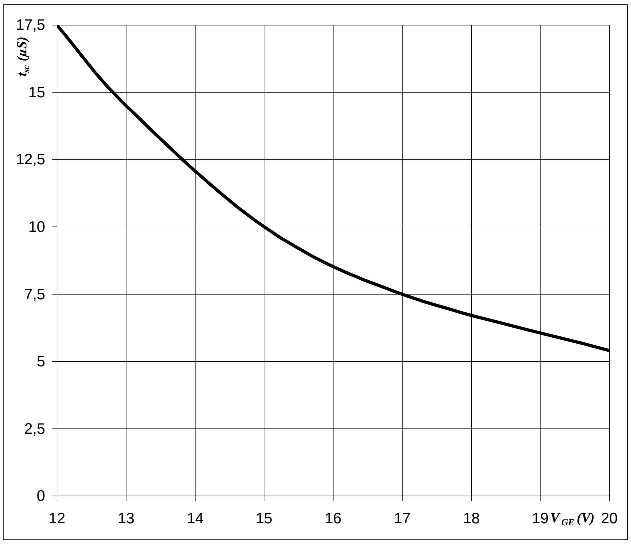


I_C =	10	A

Figure 27 Output inverter IGBT

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

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

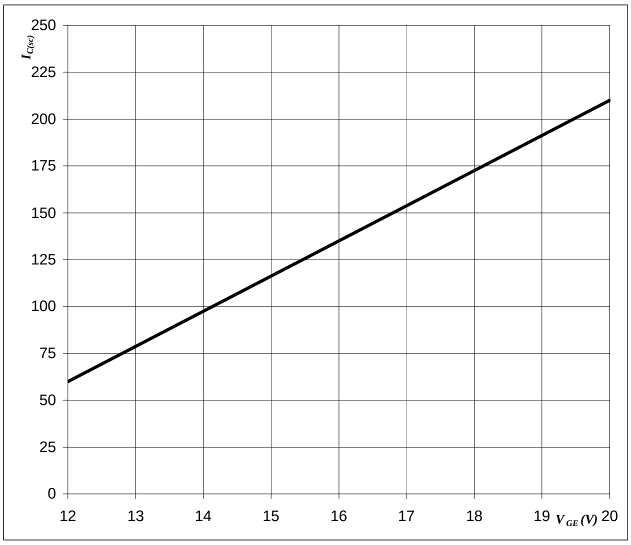


V_{CE} =	600	V
T_j ≤	175	ºC

Figure 28 Output inverter IGBT

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

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



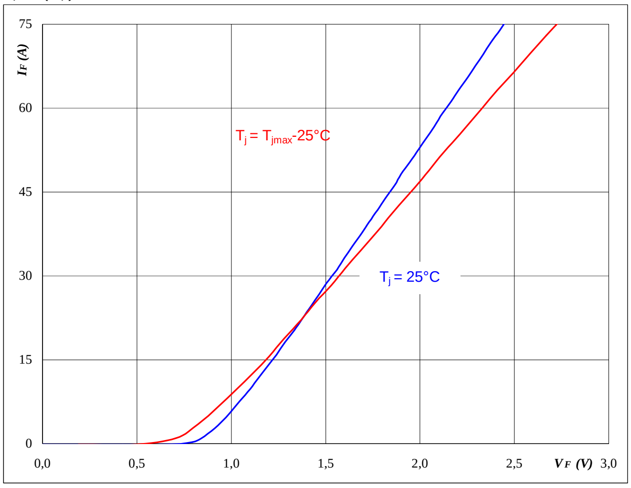
V_{CE} ≤	600	V
T_j =	175	ºC

Input Rectifier Bridge

Figure 1 Rectifier diode

Typical diode forward current as a function of forward voltage

$I_F = f(V_F)$

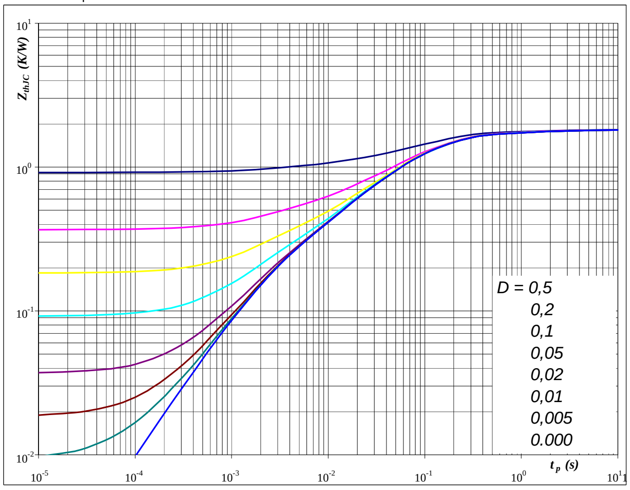


t_p = 250 μs

Figure 2 Rectifier diode

Diode transient thermal impedance as a function of pulse width

$Z_{thJH} = f(t_p)$

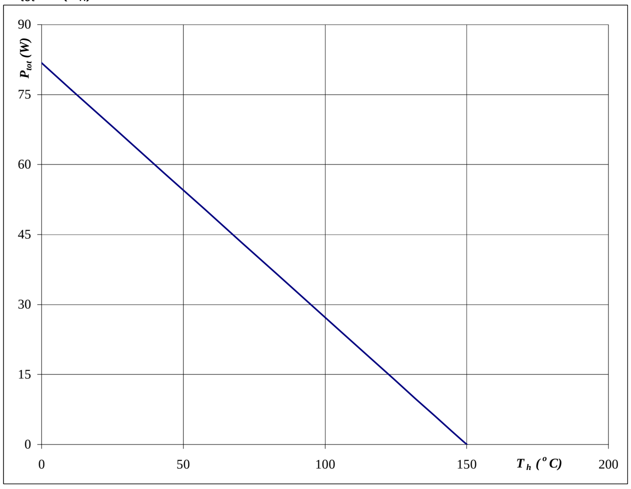


D = t_p / T
R_{thJH} = 1,834 K/W

Figure 3 Rectifier diode

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_h)$

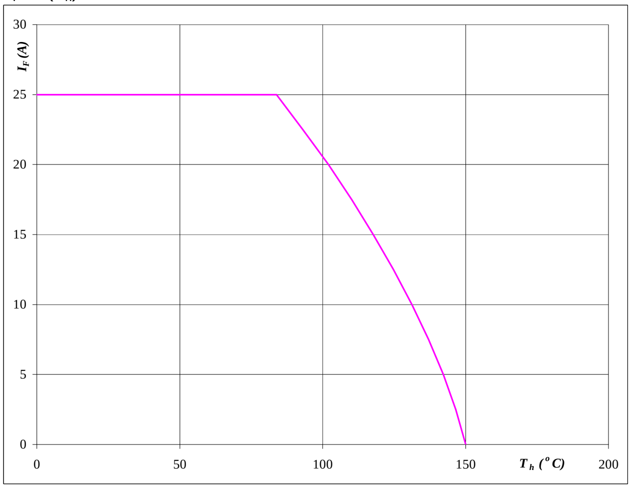


T_j = 150 ºC

Figure 4 Rectifier diode

Forward current as a function of heatsink temperature

$I_F = f(T_h)$

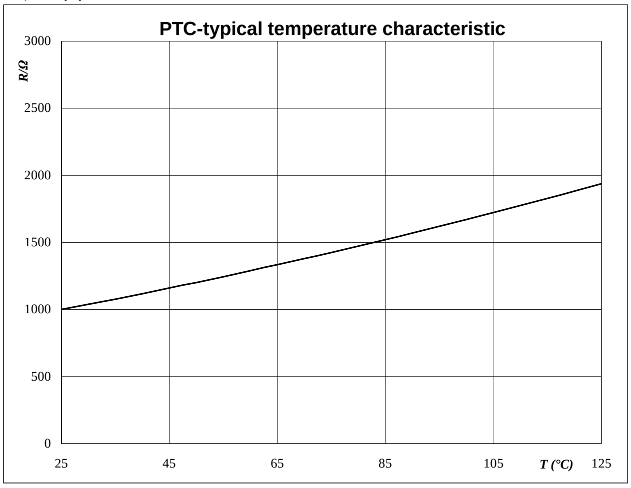


T_j = 150 ºC

Thermistor

Figure 1	Thermistor

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



	Thermistor

Equation of PTC resistance temperature dependency

$$R(T) = 1000\ \Omega[1+ A^*(T-25°C) +B^*(T-25°C)^2] \qquad [\Omega]$$

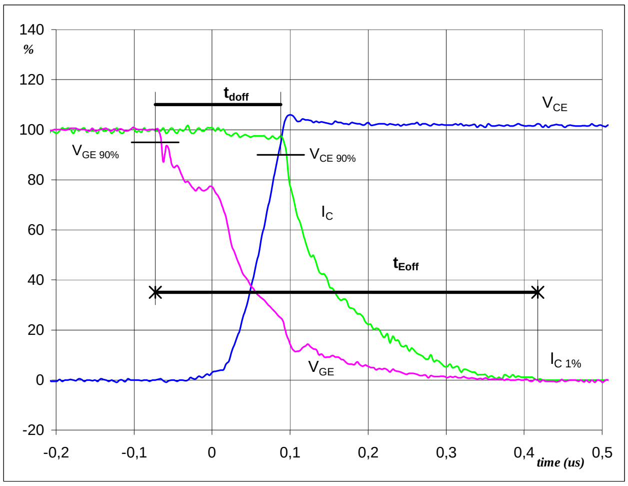
Switching Definitions Output Inverter

General conditions

T_j	=	150 °C
R_{gon}	=	32 Ω
R_{goff}	=	32 Ω

Figure 1 Output inverter IGBT

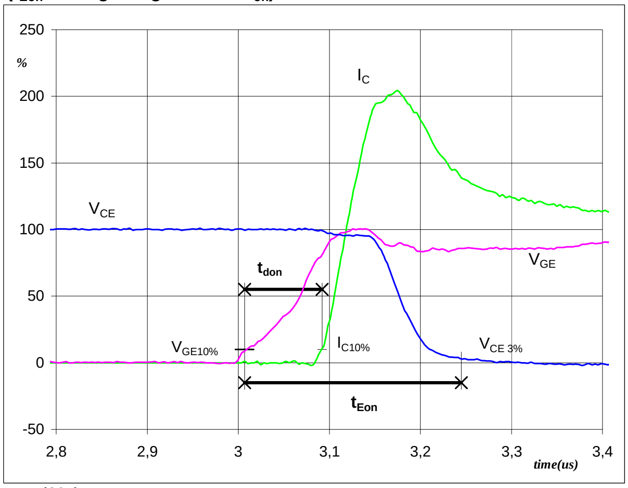
Turn-off Switching Waveforms & definition of t_{doff}, t_{Eoff}
(t_{Eoff} = integrating time for E_{off})



V_{GE} (0%) =	-15	V
V_{GE} (100%) =	15	V
V_C (100%) =	300	V
I_C (100%) =	10	A
t_{doff} =	0,15	µs
t_{Eoff} =	0,49	µs

Figure 2 Output inverter IGBT

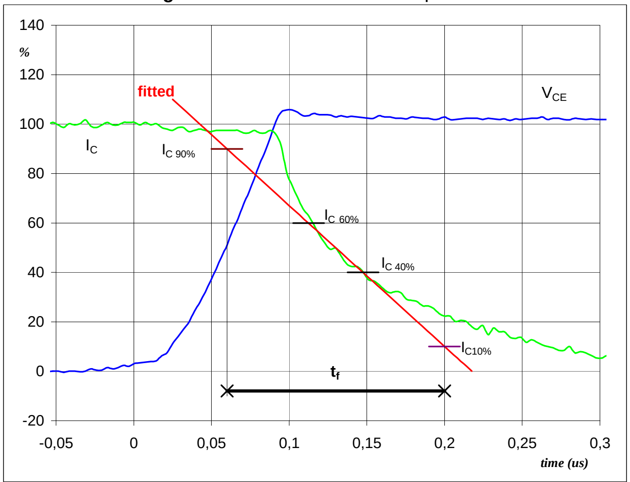
Turn-on Switching Waveforms & definition of tdon, t_{Eon}
(t_{Eon} = integrating time for E_{on})



V_{GE} (0%) =	-15	V
V_{GE} (100%) =	15	V
V_C (100%) =	300	V
I_C (100%) =	10	A
t_{don} =	0,09	µs
t_{Eon} =	0,24	µs

Figure 3 Output inverter IGBT

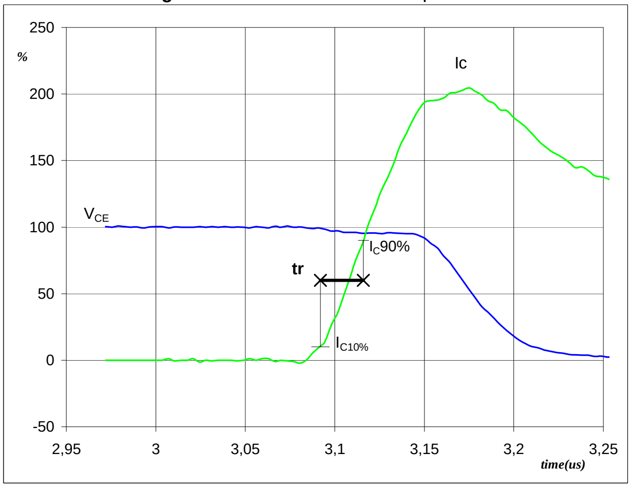
Turn-off Switching Waveforms & definition of t_f



V_C (100%) =	300	V
I_C (100%) =	10	A
t_f =	0,13	µs

Figure 4 Output inverter IGBT

Turn-on Switching Waveforms & definition of t_r

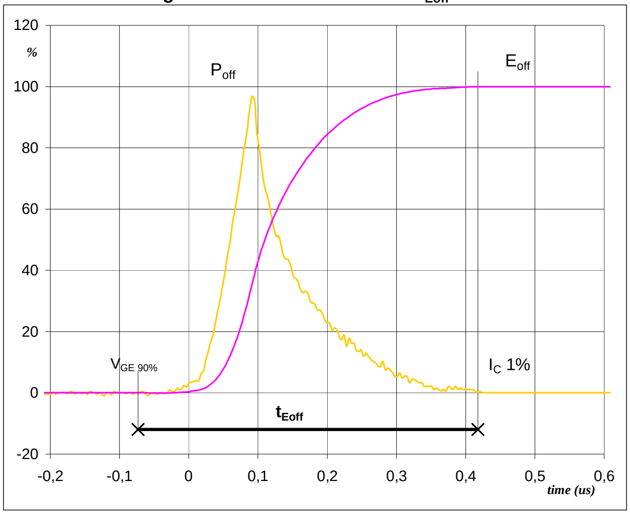


V_C (100%) =	300	V
I_C (100%) =	10	A
t_r =	0,02	µs

Switching Definitions Output Inverter

Figure 5 Output inverter IGBT

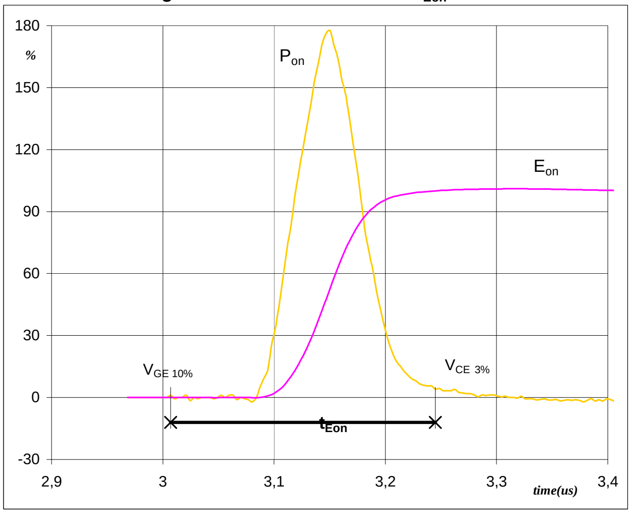
Turn-off Switching Waveforms & definition of t_{Eoff}



P_{off} (100%) =	3,01	kW
E_{off} (100%) =	0,32	mJ
t_{Eoff} =	0,49	μs

Figure 6 Output inverter IGBT

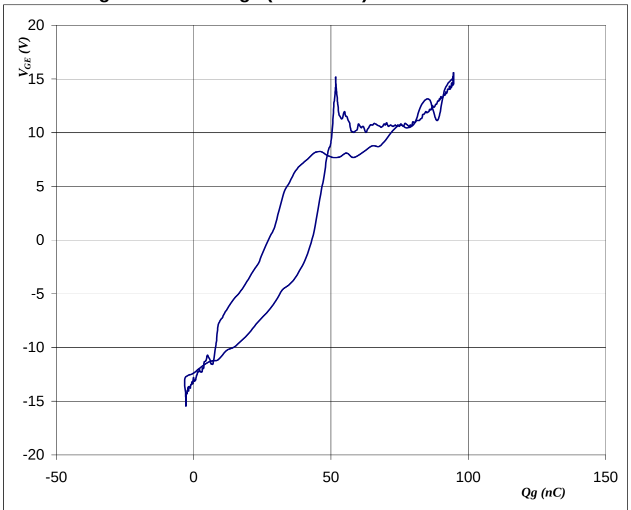
Turn-on Switching Waveforms & definition of t_{Eon}



P_{on} (100%) =	3,01	kW
E_{on} (100%) =	0,36	mJ
t_{Eon} =	0,24	μs

Figure 7 Output inverter FWD

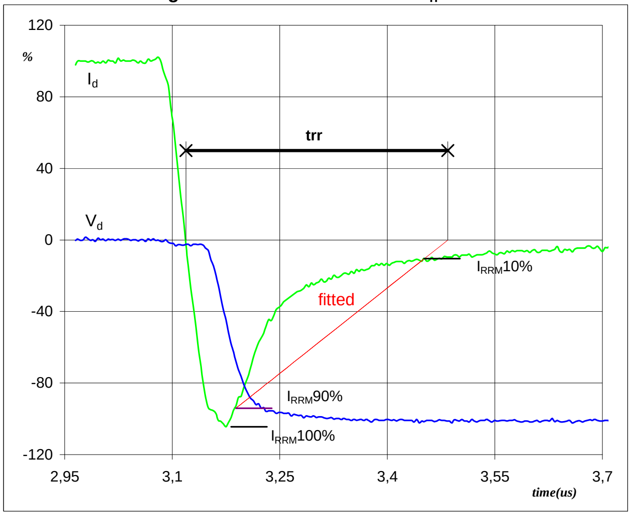
Gate voltage vs Gate charge (measured)



V_{GEoff} =	-15	V
V_{GEon} =	15	V
V_C (100%) =	300	V
I_C (100%) =	10	A
Q_g =	1073,31	nC

Figure 8 Output inverter IGBT

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

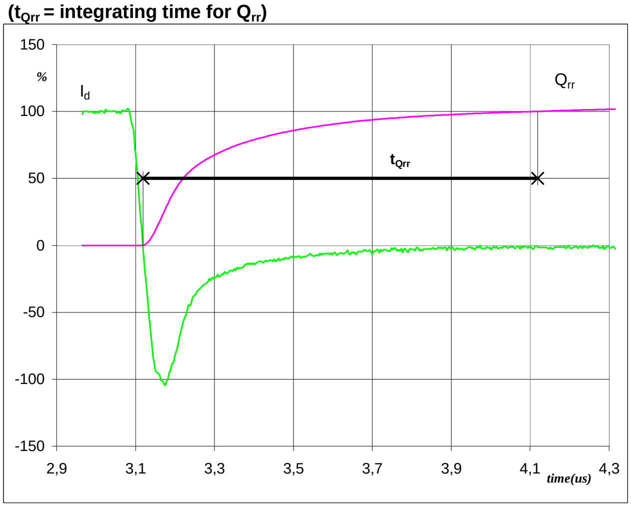


V_d (100%) =	300	V
I_d (100%) =	10	A
I_{RRM} (100%) =	-10	A
t_{rr} =	0,34	μs

Switching Definitions Output Inverter

Figure 9 Output inverter FWD

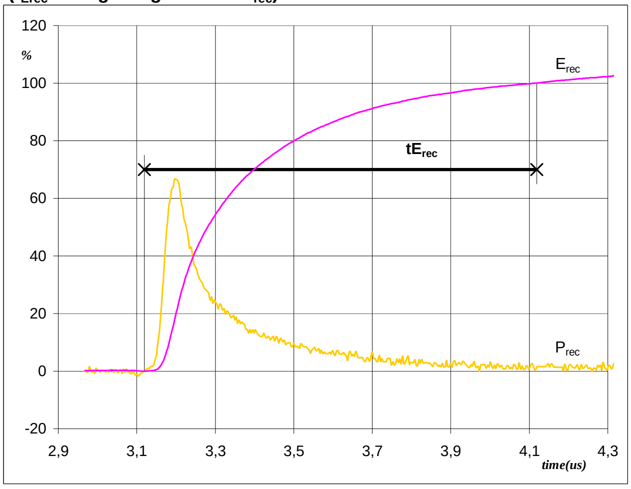
Turn-on Switching Waveforms & definition of t_{Qrr}
(t_{Qrr} = integrating time for Q_{rr})



I_d (100%) =	10	A
Q_{rr} (100%) =	1,50	µC
t_{Qrr} =	1,00	µs

Figure 10 Output inverter FWD

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



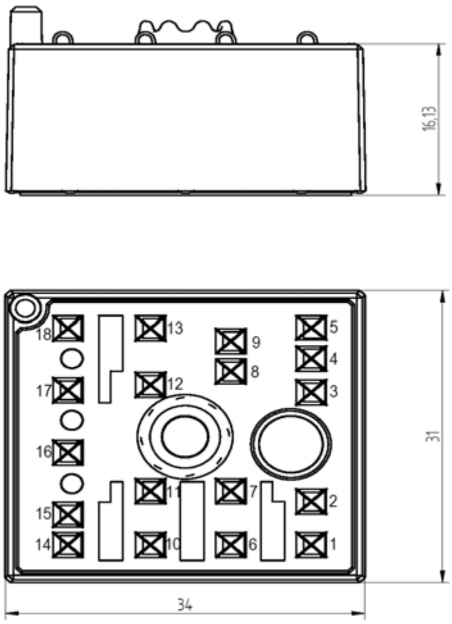
P_{rec} (100%) =	3,01	kW
E_{rec} (100%) =	0,32	mJ
t_{Erec} =	1,00	µs

Ordering Code and Marking - Outline - Pinout

Ordering Code & Marking

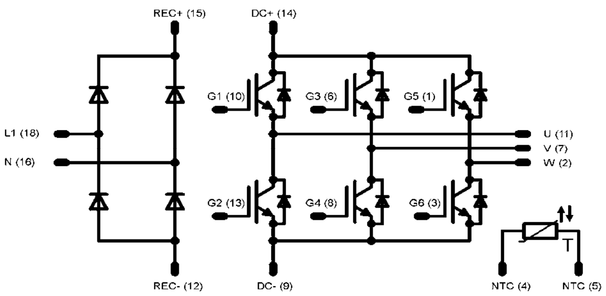
Version	Ordering Code	in DataMatrix as	in packaging barcode as
2-leg rectifier	80-M006PNB010SA01-K615D	K615D	K615D
3-leg rectifier	80-M006PNB010SA-K615C	K615C	K615C

Outline

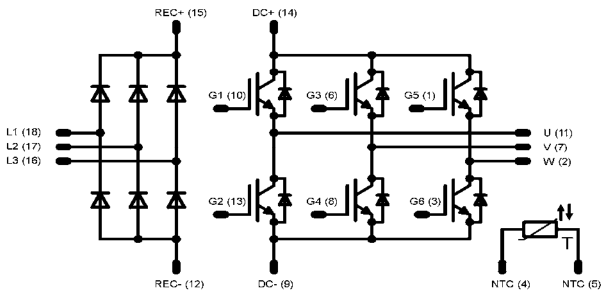


Pinout

for K61x-Dxx types



for K61x-Cxx types



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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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