MiniSKiiP® PIM 0 **600 V / 10 A**

Features

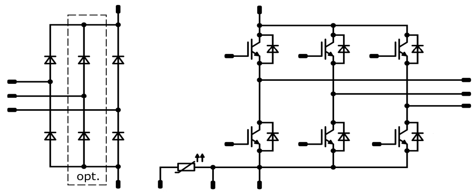
- Solderless interconnection
- Trench Fieldstop IGBT's for low saturation losses
- Optional 2- and 3-leg rectifier

MiniSKiiP®0 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
Rectifier Diode					
Repetitive peak reverse voltage	V_{RRM}			1600	V
DC forward current	I_{FAV}	$T_j = T_{jmax}$	T_s = 80 °C T_c = 80 °C	25 25	A
Surge (non-repetitive) forward current	I_{FSM}	t_p = 10 ms	T_j = 25 °C	220	A
I^2t-value	I^2t			240	A^2s
Power dissipation	P_{tot}	$T_j = T_{jmax}$	T_s = 80 °C T_c = 80 °C	46 70	W
Maximum Junction Temperature	T_{jmax}			150	°C
Inverter Switch					
Collector-emitter break down voltage	V_{CE}			600	V
DC collector current	I_C	$T_j = T_{jmax}$	T_s = 80 °C T_c = 80 °C	15 15	A
Repetitive peak collector current	I_{CRM}	t_p limited by T_{jmax}		30	A
Turn off safe operating area		V_{CE} ≤ 1200V, $T_j \le T_{op}$ max		30	A
Power dissipation	P_{tot}	$T_j = T_{jmax}$	T_s = 80 °C T_c = 80 °C	48 72	W
Gate-emitter peak voltage	V_{GE}			±20	V
Short circuit ratings	t_{SC} V_{CC}	T_j ≤ 150 °C V_{GE} = 15 V		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}			600	V
DC forward current	I_F	T_j=T_{jmax}	T_s = 80 °C T_c = 80 °C	15 15	A
Repetitive peak forward current	I_{FRM}	t_p limited by T_{jmax}	T_s = 25 °C	30	A
Power dissipation	P_{tot}	T_j=T_{jmax}	T_s = 80 °C T_c = 80 °C	38 57	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…+(T_{jmax} - 25)	°C
Isolation Properties					
Insulation voltage	V_{is}	DC Voltage	t_p=2s	4000	V
Creepage distance				min 12,7	mm
Clearance				min 12,7	mm
Comparative Tracking Index	CTI			>200	

Characteristic Values

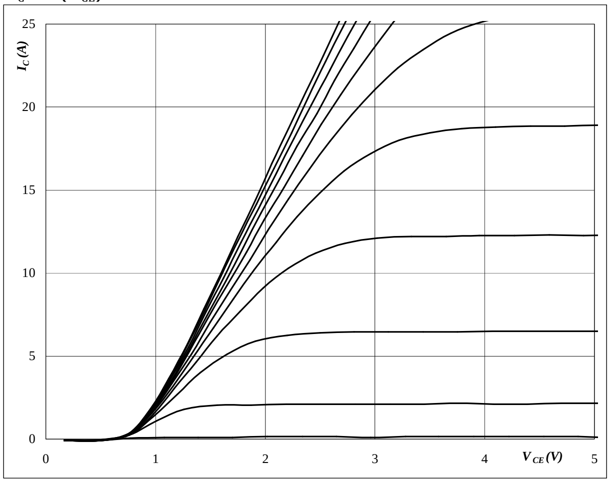
Parameter	Symbol	Conditions					Value			Unit
			V_{GE} [V] or V_{GS} [V]	V_r [V] or V_{CE} [V] or V_{DS} [V]	I_C [A] or I_F [A] or I_D [A]	T_j [°C]	Min	Typ	Max	
Rectifier Diode										
Forward voltage	V_F				25	25 125		1,43 1,44	1,64	V
Threshold voltage (for power loss calc. only)	V_{to}				25	25 125		0,92 0,79		V
Slope resistance (for power loss calc. only)	r_t				25	25 125		20,29 26,11		mΩ
Reverse current	I_r			1500		25 125			0,05	mA
Thermal resistance junction to sink	$R_{th(j-s)}$	Thermal grease thickness≤50um λ = 1 W/mK						1,5		K/W
Inverter Switch										
Gate emitter threshold voltage	$V_{GE(th)}$	$V_{CE}=V_{GE}$			0,00015	25 150	5	5,8	6,5	V
Collector-emitter saturation voltage	V_{CEsat}		15		10	25 150	1,19	1,64 1,89	1,99	V
Collector-emitter cut-off current incl. Diode	I_{CES}		0	600		25 150			0,0006	mA
Gate-emitter leakage current	I_{GES}		20	0		25 150			300	nA
Integrated Gate resistor	R_{gint}							none		Ω
Turn-on delay time	$t_{d(on)}$					25 150		90 91		ns
Rise time	t_r					25 150		22 25		
Turn-off delay time	$t_{d(off)}$	R_{goff} = 32 Ω R_{gon} = 32 Ω	±15	300	10	25 150		133 156		
Fall time	t_f					25 150		120 144		
Turn-on energy loss	E_{on}					25 150		0,26 0,38		mWs
Turn-off energy loss	E_{off}					25 150		0,26 0,34		
Input capacitance	C_{ies}							551		
Output capacitance	C_{oss}	f = 1 MHz	0	25		25		40		pF
Reverse transfer capacitance	C_{rss}							17		
Gate charge	Q_G		±15			25		55	62	nC
Thermal resistance junction to sink	$R_{th(j-s)}$	Thermal grease thickness≤50um λ = 1 W/mK						2		K/W
Inverter Diode										
Diode forward voltage	V_F				10	25 150		1,39 1,32		V
Peak reverse recovery current	I_{RRM}					25 150		6,77 9,87		A
Reverse recovery time	t_{rr}					25 150		233 352		ns
Reverse recovered charge	Q_{rr}	R_{gon} = 32 Ω	±15	300	10	25 150		0,66 1,46		μC
Peak rate of fall of recovery current	$(di_{rf}/dt)_{max}$					25 150		105 109		A/μs
Reverse recovered energy	E_{rec}					25 150		0,13 0,30		mWs
Thermal resistance junction to sink	$R_{th(j-s)}$	Thermal grease thickness≤50um λ = 1 W/mK						2,5		K/W
Thermistor										
Rated resistance	R					25		1000		Ω
Deviation of R	$\Delta_{R/R}$	R_{25} = 1000 Ω R_{100} = 1670 Ω				25 100	-3 -2		3 2	%
R100	R_{100}					25		1670		Ω
Temperature coefficient								0,76		% /K
A-value	$B_{(25/50)}$					25		7,635*10^{-3}		1/K
B-value	$B_{(25/100)}$					25		1,731*10^{-5}		1/K²
Vincotech PTC Reference									E	

Inverter Switch / Inverter Diode

Figure 1 IGBT

Typical output characteristics

$I_C = f(V_{CE})$

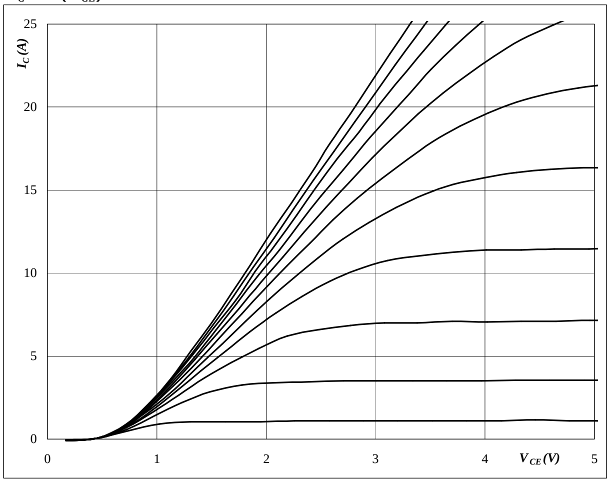


t_p = 250 µs
T_j = 25 °C
V_{GE} from 7 V to 17 V in steps of 1 V

Figure 2 IGBT

Typical output characteristics

$I_C = f(V_{CE})$

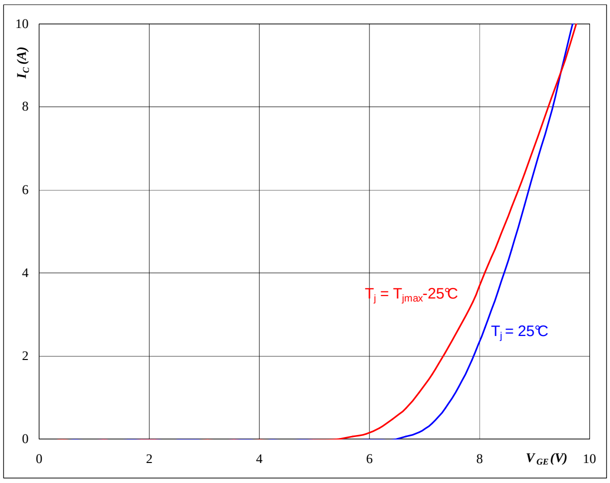


t_p = 250 µs
T_j = 150 °C
V_{GE} from 7 V to 17 V in steps of 1 V

Figure 3 IGBT

Typical transfer characteristics

$I_C = f(V_{GE})$

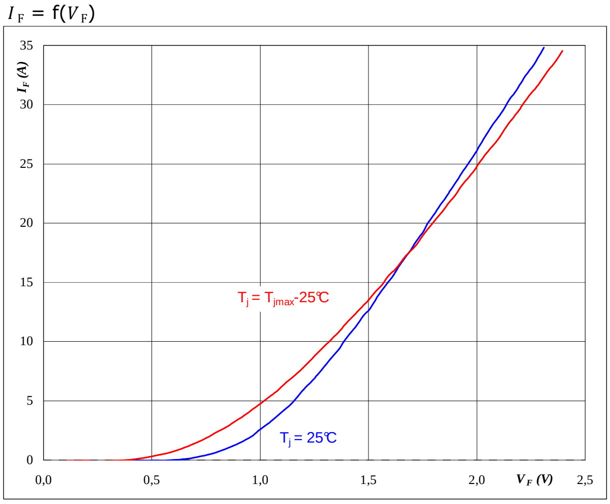


t_p = 250 µs
V_{CE} = 10 V

Figure 4 FWD

Typical diode forward current as a function of forward voltage

$I_F = f(V_F)$



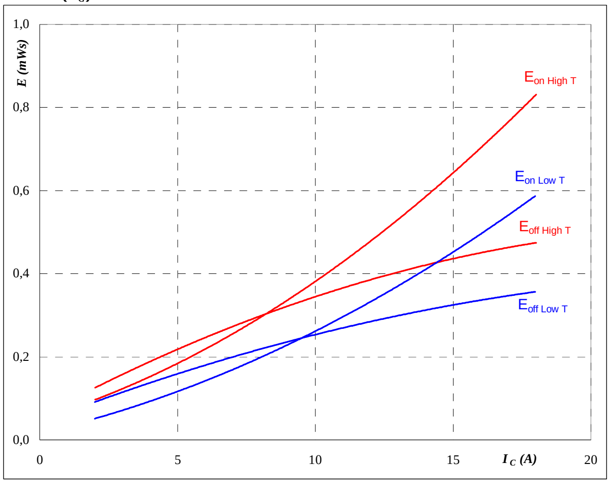
t_p = 250 µs

Inverter Switch / Inverter Diode

Figure 5 IGBT

Typical switching energy losses as a function of collector current

$E = f(I_C)$



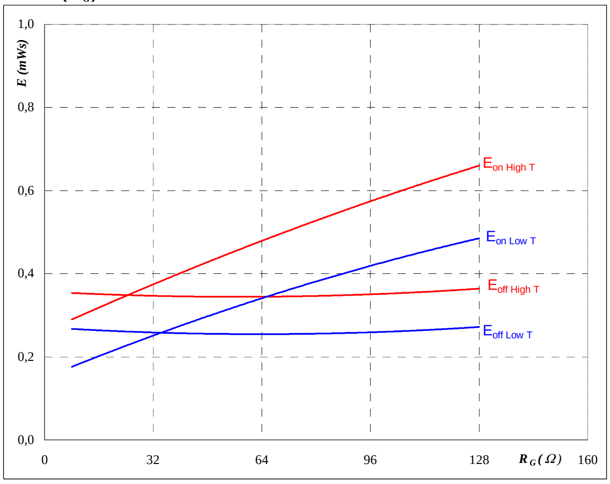
inductive load

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

Figure 6 IGBT

Typical switching energy losses as a function of gate resistor

$E = f(R_G)$



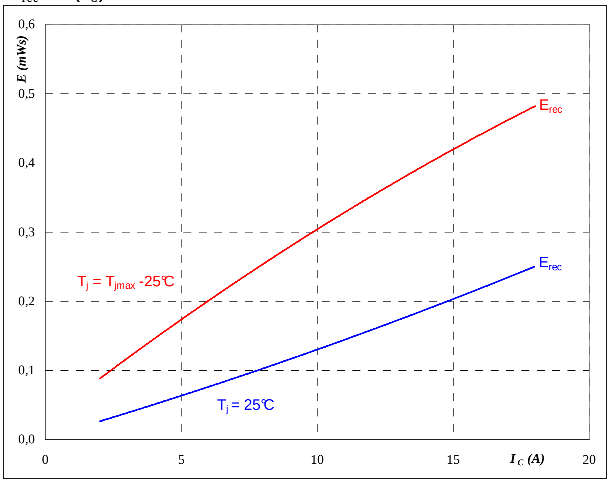
inductive load

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

Figure 7 FWD

Typical reverse recovery energy loss as a function of collector current

$E_{rec} = f(I_C)$



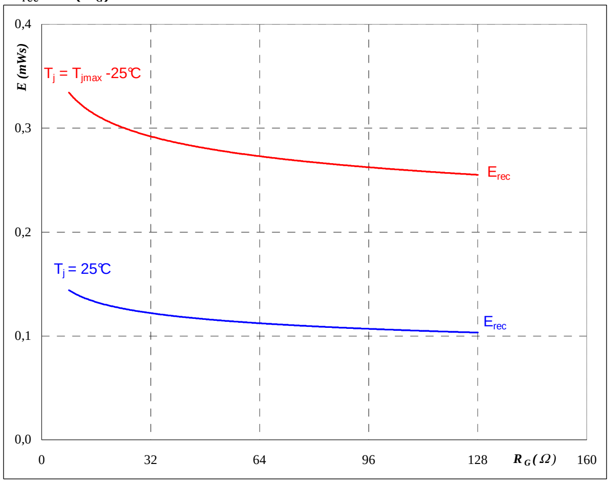
inductive load

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

Figure 8 FWD

Typical reverse recovery energy loss as a function of gate resistor

$E_{rec} = f(R_G)$



inductive load

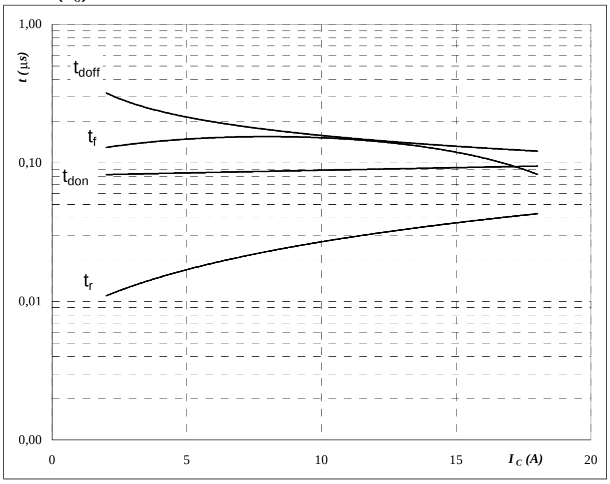
T_j =	25/150	°C
V_{CE} =	300	V
V_{GE} =	±15	V
I_C =	10	A

Inverter Switch / Inverter Diode

Figure 9	IGBT

Typical switching times as a function of collector current

$t = f(I_C)$



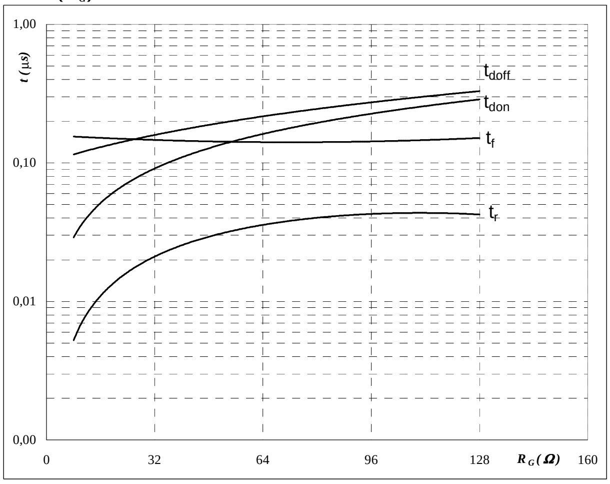
inductive load

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

Figure 10	IGBT

Typical switching times as a function of gate resistor

$t = f(R_G)$



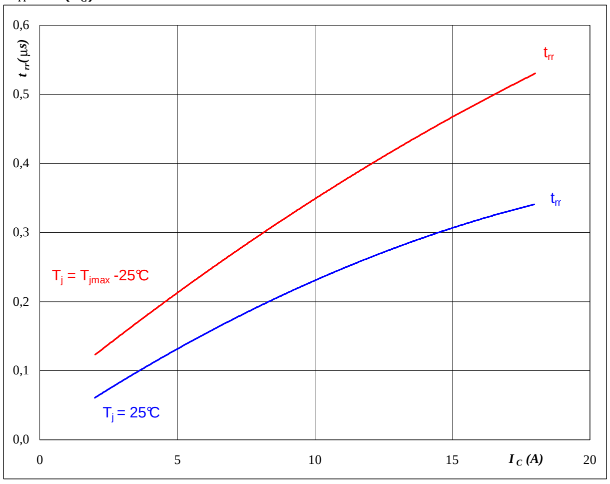
inductive load

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

Figure 11	FWD

Typical reverse recovery time as a function of collector current

$t_{rr} = f(I_C)$

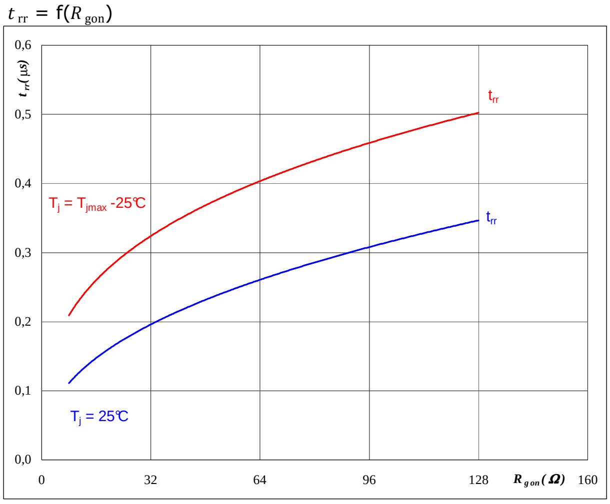


T_j =	25/150	°C
V_{CE} =	300	V
V_{GE} =	±15	V
R_{gon} =	32	Ω

Figure 12	FWD

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

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



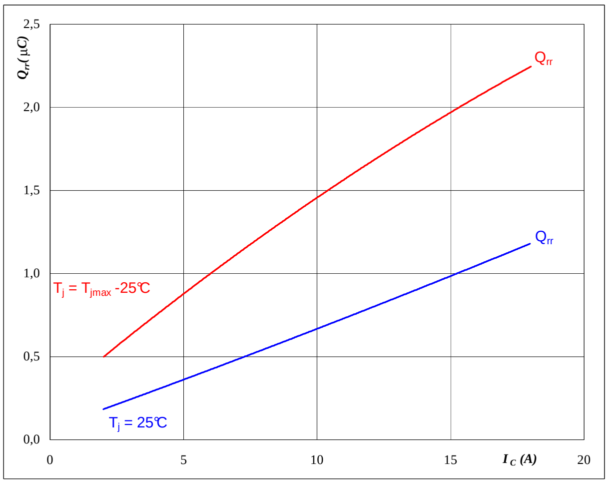
T_j =	25/150	°C
V_R =	300	V
I_F =	10	A
V_{GE} =	±15	V

Inverter Switch / Inverter Diode

Figure 13	FWD

Typical reverse recovery charge as a function of collector current

$Q_{rr} = f(I_C)$

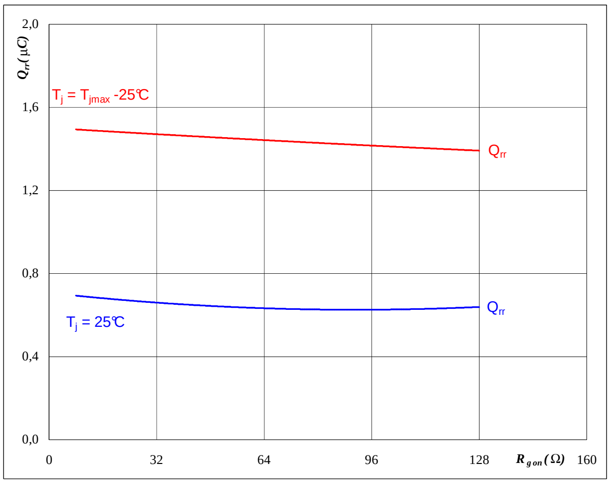


T_j =	25/150	°C
V_{CE} =	300	V
V_{GE} =	±15	V
R_{gon} =	32	Ω

Figure 14	FWD

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

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

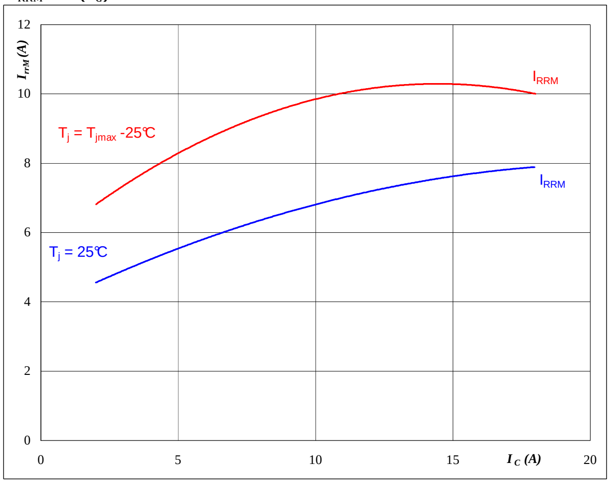


T_j =	25/150	°C
V_R =	300	V
I_F =	10	A
V_{GE} =	±15	V

Figure 15	FWD

Typical reverse recovery current as a function of collector current

$I_{RRM} = f(I_C)$

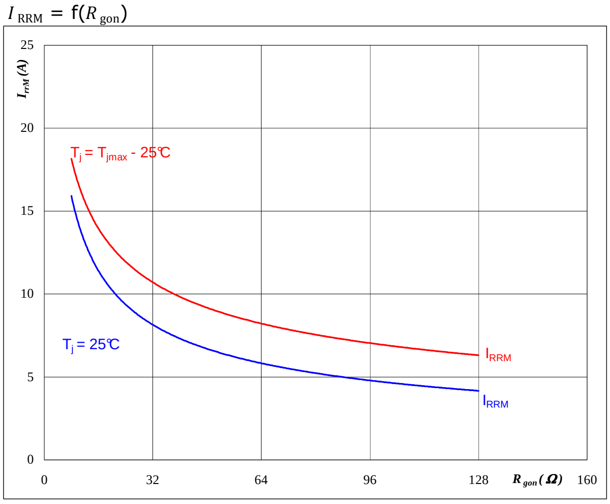


T_j =	25/150	°C
V_{CE} =	300	V
V_{GE} =	±15	V
R_{gon} =	32	Ω

Figure 16	FWD

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

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



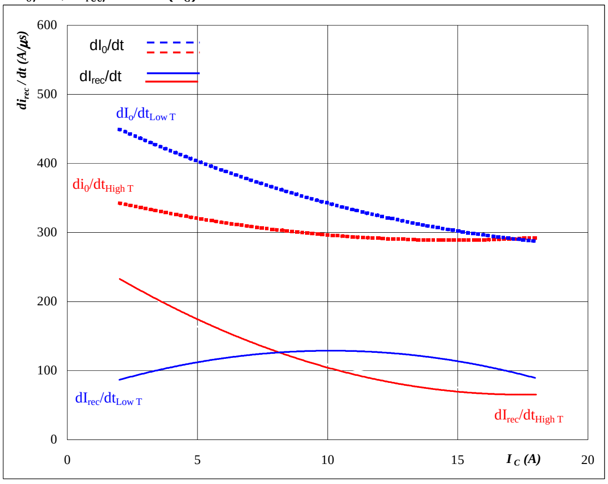
T_j =	25/150	°C
V_R =	300	V
I_F =	10	A
V_{GE} =	±15	V

Inverter Switch / Inverter Diode

Figure 17 — FWD

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

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

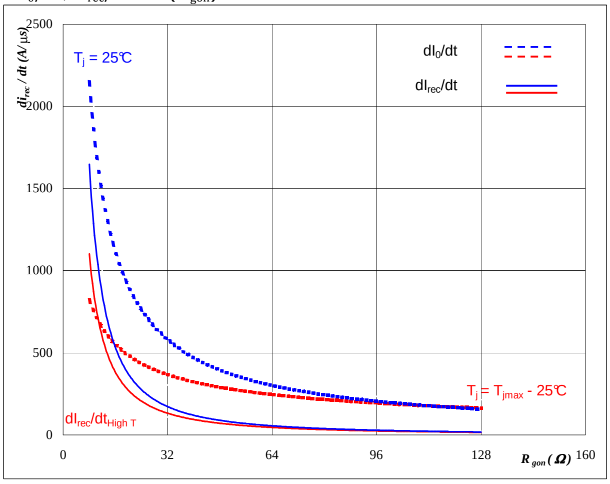


T_j =	25/150	°C
V_{CE} =	300	V
V_{GE} =	±15	V
R_{gon} =	32	Ω

Figure 18 — FWD

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

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

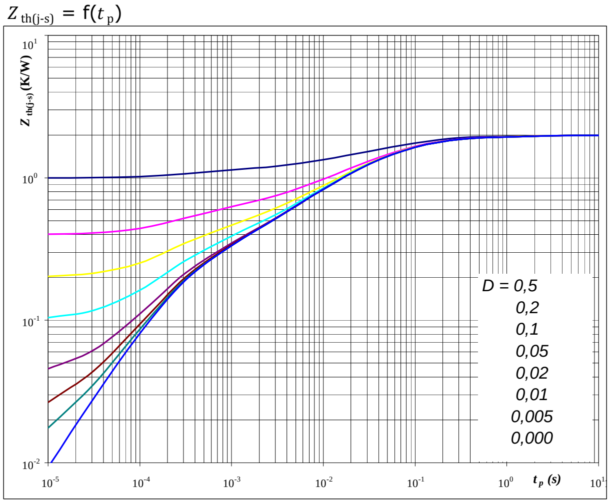


T_j =	25/150	°C
V_R =	300	V
I_F =	10	A
V_{GE} =	±15	V

Figure 19 — IGBT

IGBT transient thermal impedance as a function of pulse width

$Z_{th(j\text{-}s)} = f(t_p)$



D =	t_p / T	
$R_{th(j\text{-}s)}$ =	2	K/W

IGBT thermal model values

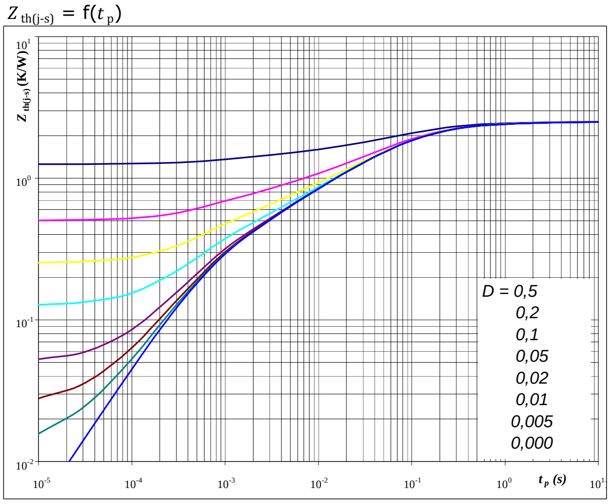
Thermal grease

R (K/W)	τ (s)
0,04	5,9E+00
0,15	5,2E-01
0,71	7,5E-02
0,61	1,8E-02
0,26	2,8E-03
0,22	2,7E-04

Figure 20 — FWD

FWD transient thermal impedance as a function of pulse width

$Z_{th(j\text{-}s)} = f(t_p)$



D =	t_p / T	
$R_{th(j\text{-}s)}$ =	2,5	K/W

FWD thermal model values

Thermal grease

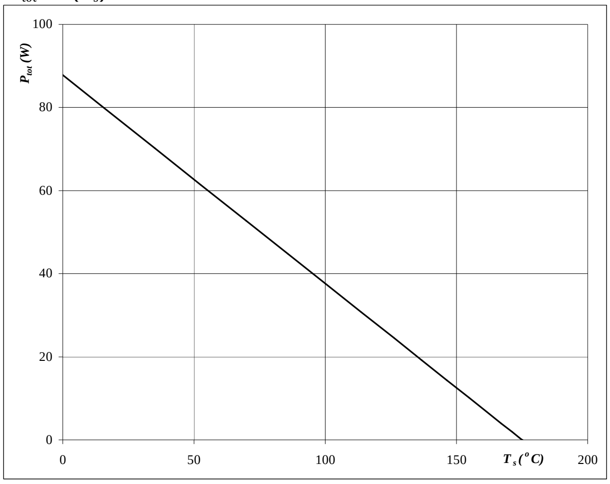
R (K/W)	τ (s)
0,05	9,0E+00
0,25	6,6E-01
0,88	1,2E-01
0,73	2,9E-02
0,33	4,8E-03
0,26	6,9E-04

Inverter Switch / Inverter Diode

Figure 21 IGBT

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_s)$

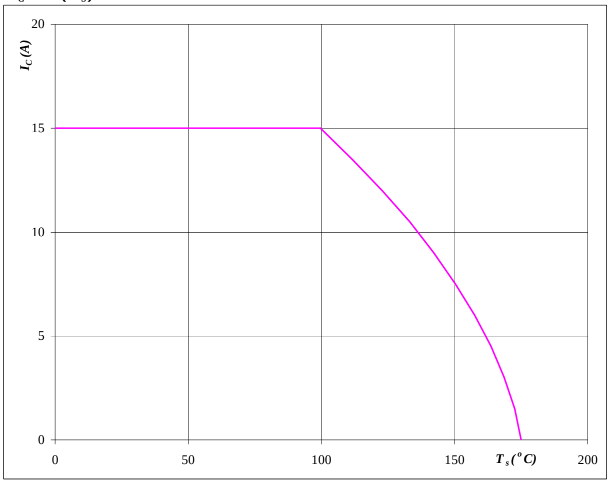


T_j = 175 °C

Figure 22 IGBT

Collector current as a function of heatsink temperature

$I_C = f(T_s)$

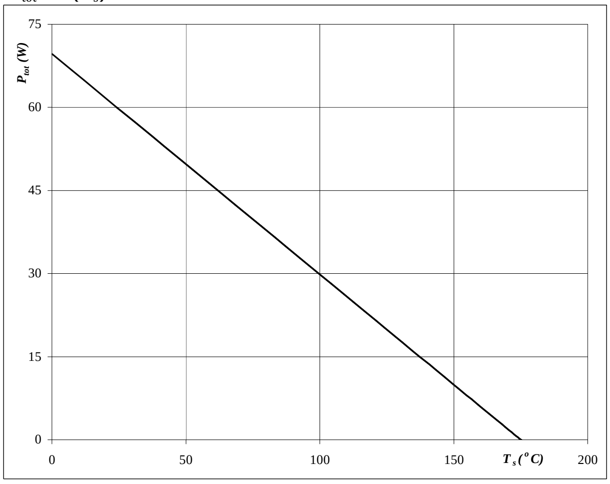


T_j = 175 °C
V_{GE} = 15 V

Figure 23 FWD

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_s)$

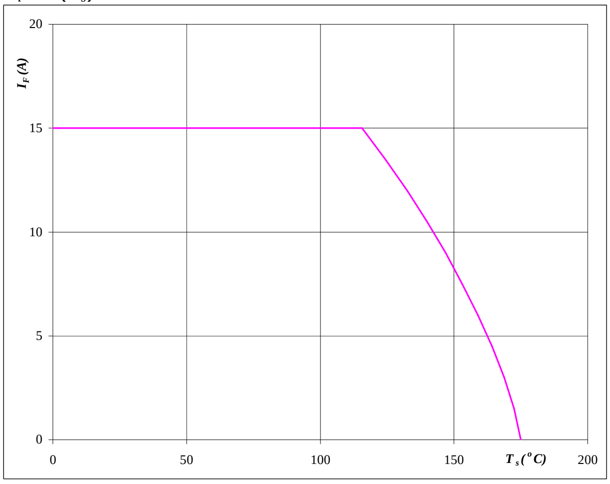


T_j = 175 °C

Figure 24 FWD

Forward current as a function of heatsink temperature

$I_F = f(T_s)$



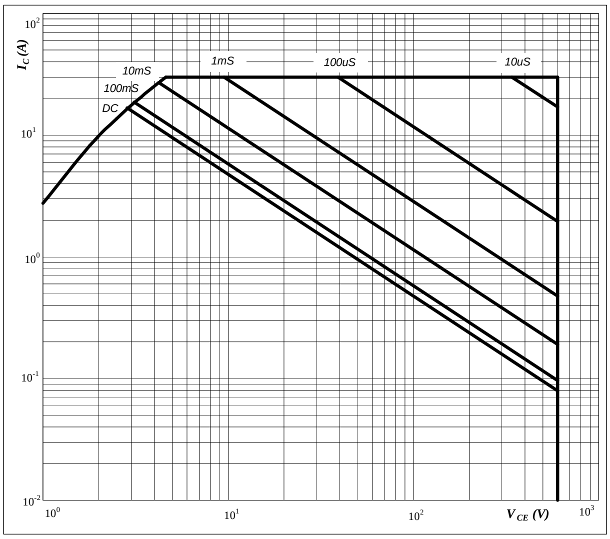
T_j = 175 °C

Inverter Switch / Inverter Diode

Figure 25 IGBT

Safe operating area as a function of collector-emitter voltage

$I_C = f(V_{CE})$

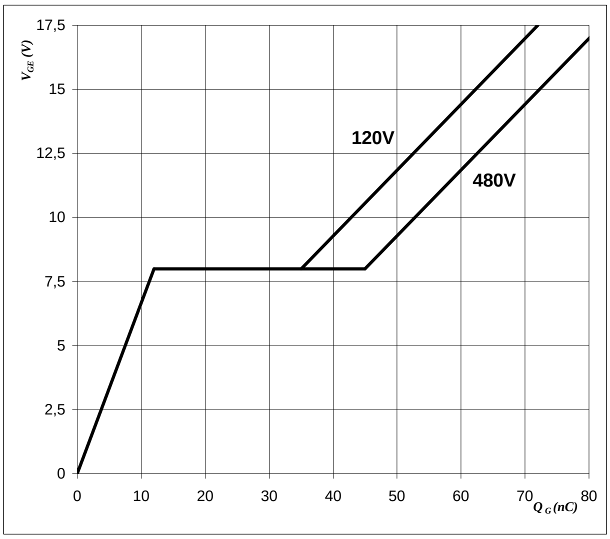


D =	single pulse	
T_h =	80	ºC
V_{GE} =	±15	V
T_j =	T_{jmax}	ºC

Figure 26 IGBT

Gate voltage vs Gate charge

$V_{GE} = f(Q_G)$

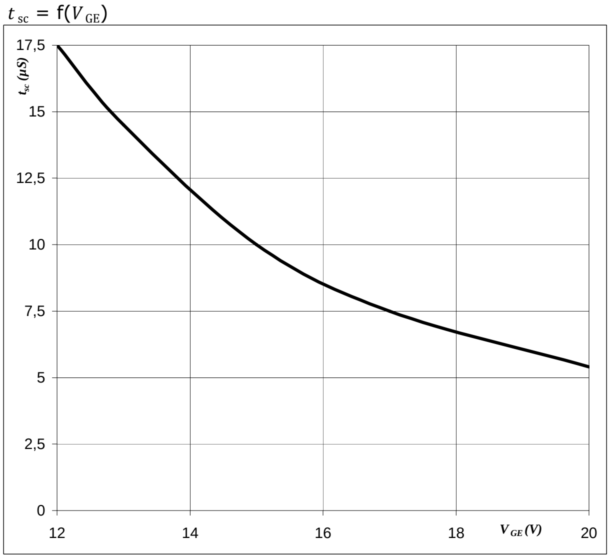


I_C =	10	A

Figure 27 IGBT

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

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

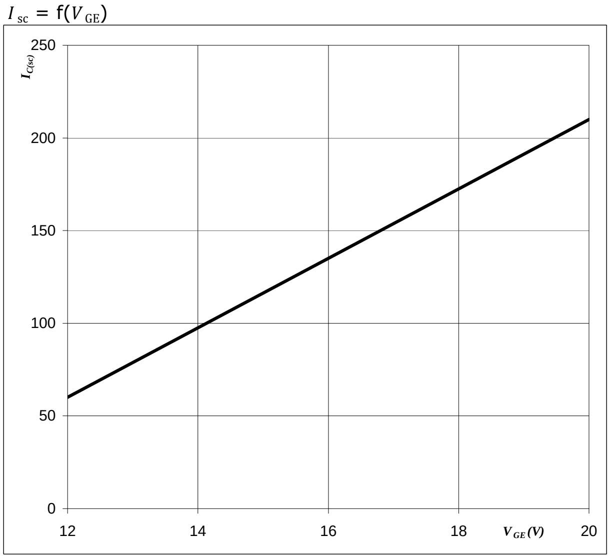


V_{CE} =	600	V
T_j ≤	175	ºC

Figure 28 IGBT

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

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



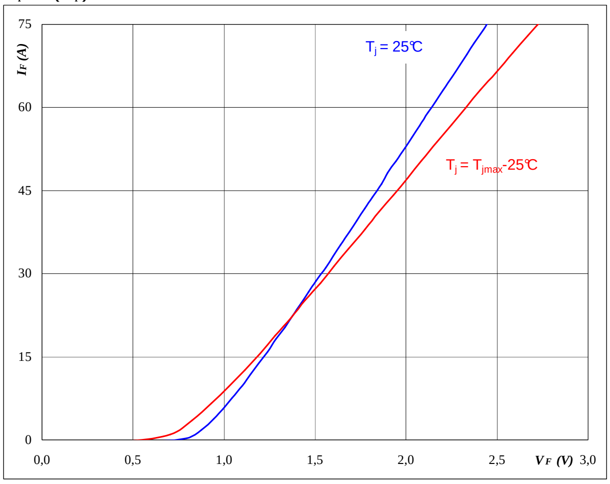
V_{CE} ≤	600	V
T_j =	175	ºC

Rectifier Diode

Figure 1 Rectifier Diode

Typical diode forward current as a function of forward voltage

$I_F = f(V_F)$

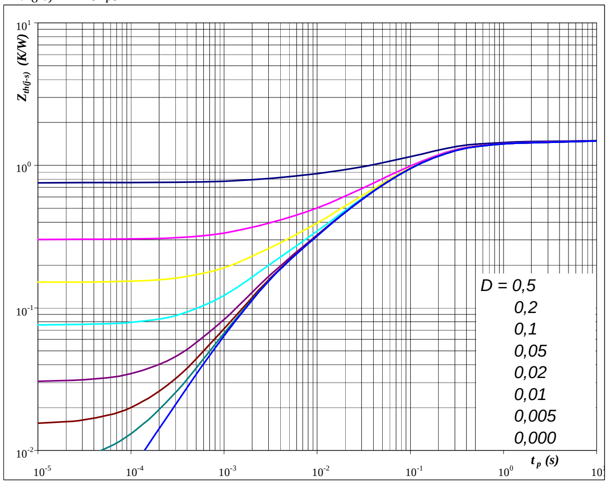


t_p = 250 µs

Figure 2 Rectifier Diode

Diode transient thermal impedance as a function of pulse width

$Z_{th(j-s)} = f(t_p)$



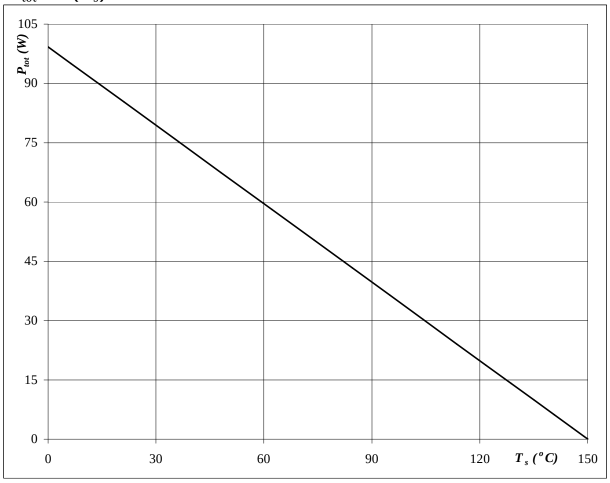
$D = t_p / T$

$R_{th(j-s)}$ = 1,5 K/W

Figure 3 Rectifier Diode

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_s)$

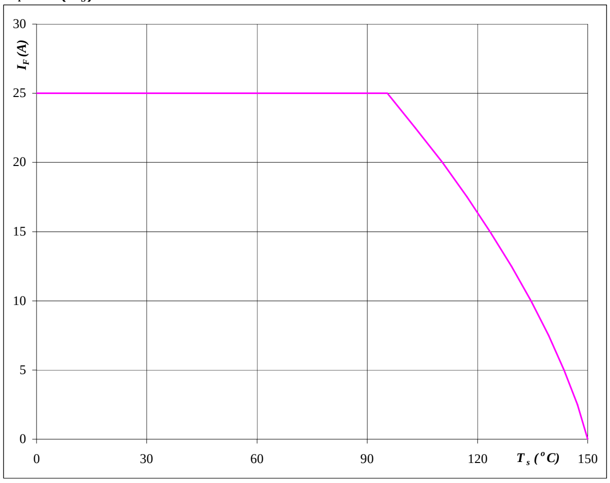


T_j = 150 ºC

Figure 4 Rectifier Diode

Forward current as a function of heatsink temperature

$I_F = f(T_s)$



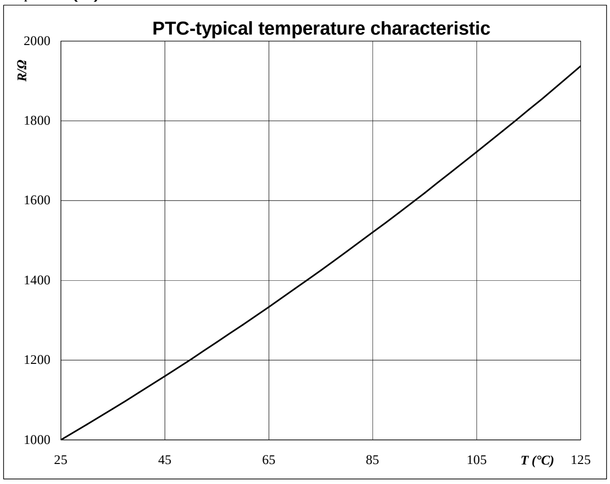
T_j = 150 ºC

Thermistor

Figure 1 Thermistor

Typical PTC characteristic as a function of temperature

$R_T = f(T)$



Thermistor

Equation of PTC resistance temperature dependency

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

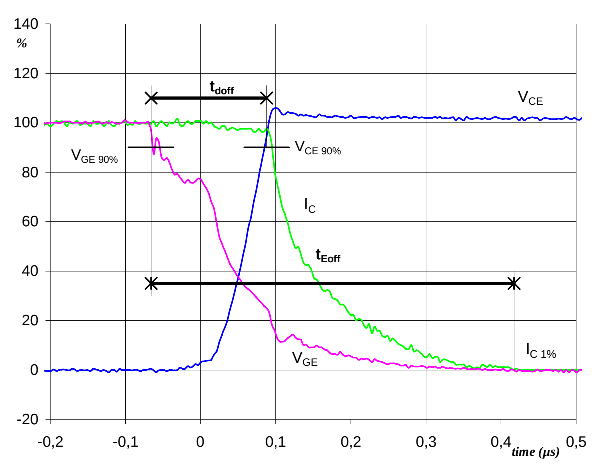
Switching Definitions Output Inverter

General conditions

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

Figure 1 Output inverter IGBT

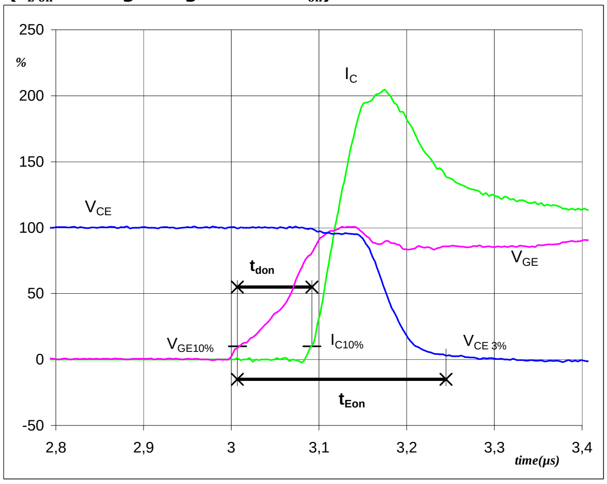
Turn-off Switching Waveforms & definition of t_{doff}, t_{Eoff}
($t_{E\,off}$ = integrating time for E_{off})



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
$t_{E\,off}$ =	0,48	µs

Figure 2 Output inverter IGBT

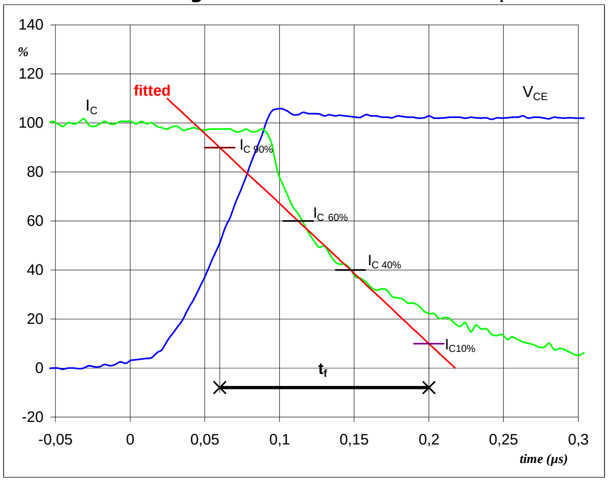
Turn-on Switching Waveforms & definition of t_{don}, t_{Eon}
($t_{E\,on}$ = integrating time for E_{on})



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
$t_{E\,on}$ =	0,24	µs

Figure 3 Output inverter IGBT

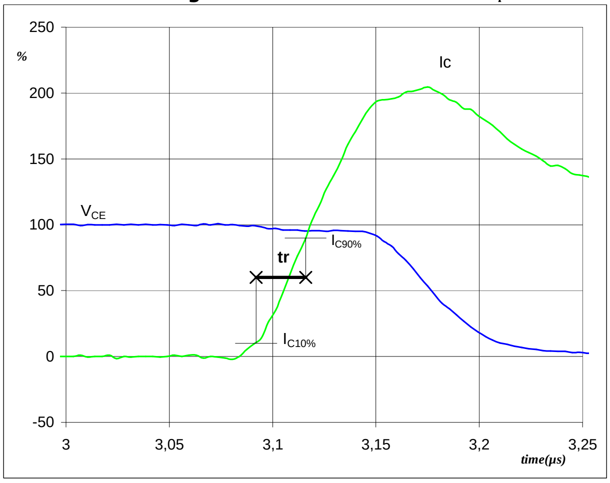
Turn-off Switching Waveforms & definition of t_f



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

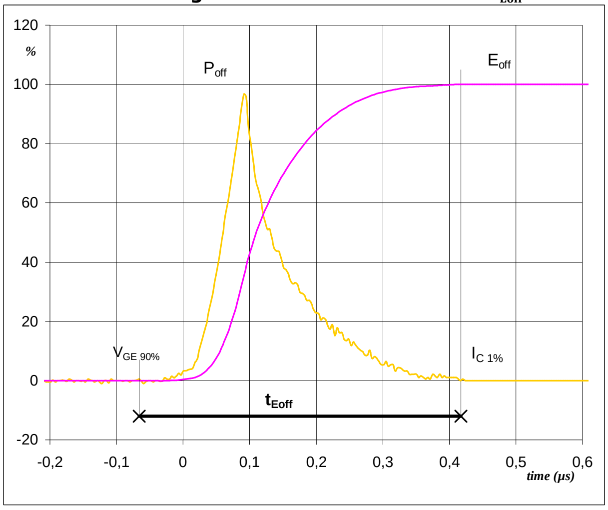


V_C (100%) =	300	V
I_C (100%) =	10	A
t_r =	0,02	µs

Switching Definitions Output Inverter

Figure 5 Output inverter IGBT

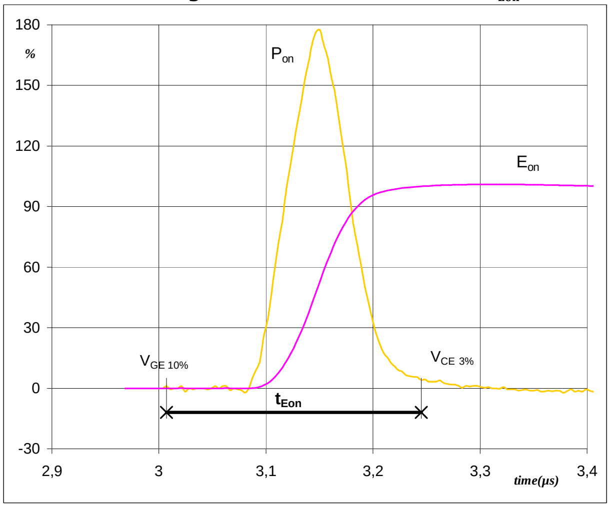
Turn-off Switching Waveforms & definition of t_{Eoff}



P_{off} (100%) =	3,01	kW
E_{off} (100%) =	0,32	mJ
$t_{E\ off}$ =	0,48	µs

Figure 6 Output inverter IGBT

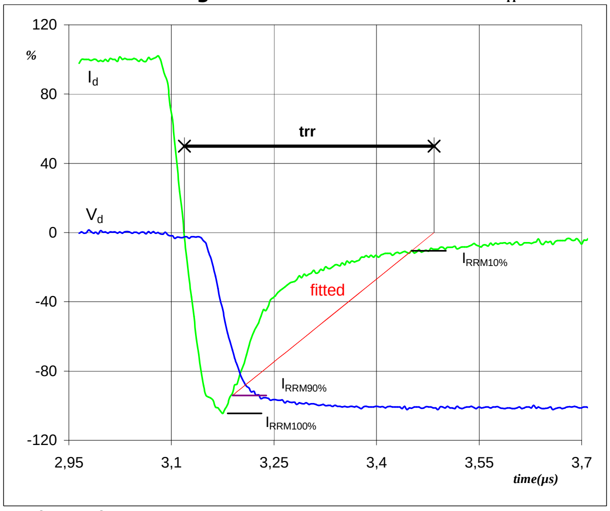
Turn-on Switching Waveforms & definition of t_{Eon}



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

Figure 7 Output inverter FWD

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

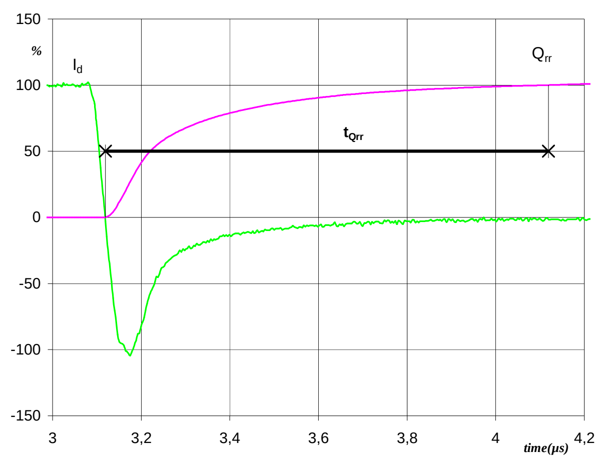


V_d (100%) =	300	V
I_d (100%) =	10	A
I_{RRM} (100%) =	-10	A
t_{rr} =	0,34	µs

Switching Definitions Output Inverter

Figure 8 Output inverter FWD

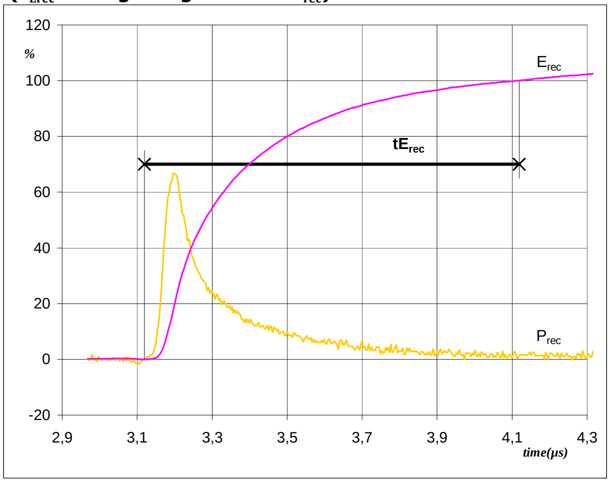
Turn-on Switching Waveforms & definition of t_{Qrr}
($t_{Q\,rr}$ = integrating time for Q_{rr})



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

Figure 9 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
$t_{E\,rec}$ =	1,00	µs

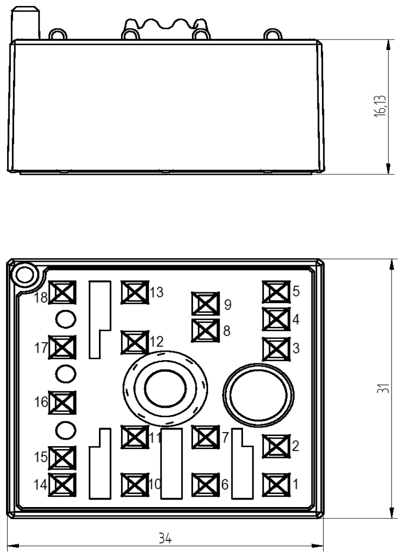
Ordering Code and Marking - Outline - Pinout - Identification

Ordering Code & Marking

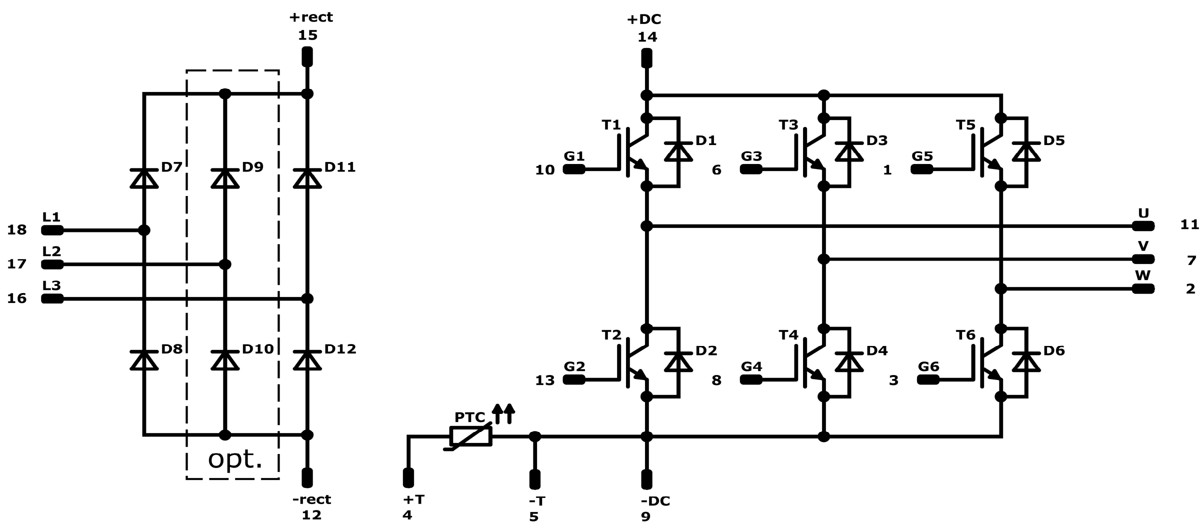
Version	Ordering Code
with 2-leg rectifier, std lid (black V23990-K02-T-PM)	80-M006PNB010SA01-K615D-/0A/
with 2-leg rectifier, std lid (black V23990-K02-T-PM) and P12	80-M006PNB010SA01-K615D-/1A/
with 2-leg rectifier, thin lid (white V23990-K03-T-PM)	80-M006PNB010SA01-K615D-/0B/
with 2-leg rectifier, thin lid (white V23990-K03-T-PM) and P12	80-M006PNB010SA01-K615D-/1B/
with 3-leg rectifier, std lid (black V23990-K02-T-PM)	80-M006PNB010SA-K615C-/0A/
with 3-leg rectifier, std lid (black V23990-K02-T-PM) and P12	80-M006PNB010SA-K615C-/1A/
with 3-leg rectifier, thin lid (white V23990-K03-T-PM)	80-M006PNB010SA-K615C-/0B/
with 3-leg rectifier, thin lid (white V23990-K03-T-PM) and P12	80-M006PNB010SA-K615C-/1B/

Text	Name		Type&Ver	Date code	Vinco&Lot	Serial&UL
	NN-NNNNNNNNNNNNNN		TTTTTTTVV	WWYY	Vinco LLLLL	SSSS UL
Datamatrix	Type&Ver	Lot number	Serial	Date code		
	TTTTTTTVV	LLLLL	SSSS	WWYY		

Outline



Pinout



Identification

ID	Component	Voltage	Current	Function	Comment
T1-T6	IGBT	600 V	10 A	Inverter Switch	
D1-D6	FWD	600 V	10 A	Inverter Diode	
D7-D12	Rectifier Diode	1600 V	25 A	Rectifier Diode	
PTC	PTC	-	-	Thermistor	

Packaging instruction					
Standard packaging quantity (SPQ)	**198**	>SPQ	Standard	<SPQ	Sample

Handling instruction
Handling instructions for MiniSkiiP® 0 packages see vincotech.com website.

Package data
Package data for MiniSkiiP® 0 packages see vincotech.com website.

Document No.:	Date:	Modification:	Pages
80-M006PNB010SAx-K615x-D3-14	12 Jan. 2016		