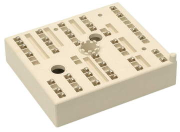
MiniSKiiP® 2 PIM | **1200 V / 35 A**

Features

- Solderless interconnection
- Trench Fieldstop IGBT4 technology
- Enhanced input rectifier

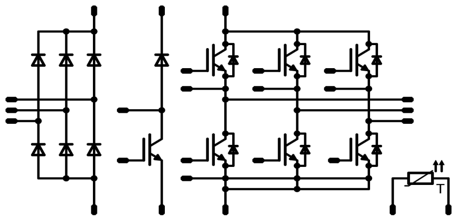
MiniSKiiP® 2 housing



Target Applications

- Industrial Motor Drives

Schematic



Types

- V23990-K220-A41-PM

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	45	A
Surge forward current	I_{FSM}	t_p=10ms	T_j=150°C	450	A
I2t-value	I^2t			1020	A^2s
Power dissipation	P_{tot}	$T_j=T_{jmax}$	T_s=80°C	77	W
Maximum Junction Temperature	T_{jmax}			150	°C
Inverter Switch\Brake Switch					
Collector-emitter break down voltage	V_{CE}			1200	V
DC collector current	I_C	$T_j=T_{jmax}$	T_s=80°C	38	A
Repetitive peak collector current	I_{CRM}	t_p limited by T_{jmax}		105	A
Power dissipation	P_{tot}	$T_j=T_{jmax}$	T_s=80°C	96	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

Maximum Ratings

T_j=25°C, unless otherwise specified

Parameter	Symbol	Condition		Value	Unit
Inverter Diode\Brake Diode					
Peak Repetitive Reverse Voltage	V_{RRM}			1200	V
DC forward current	I_F	$T_j=T_{jmax}$	T_s=80°C	25	A
Repetitive peak forward current	I_{FRM}	t_p=10ms half sine		225	A
Power dissipation	P_{tot}	$T_j=T_{jmax}$	T_s=80°C	62	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
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

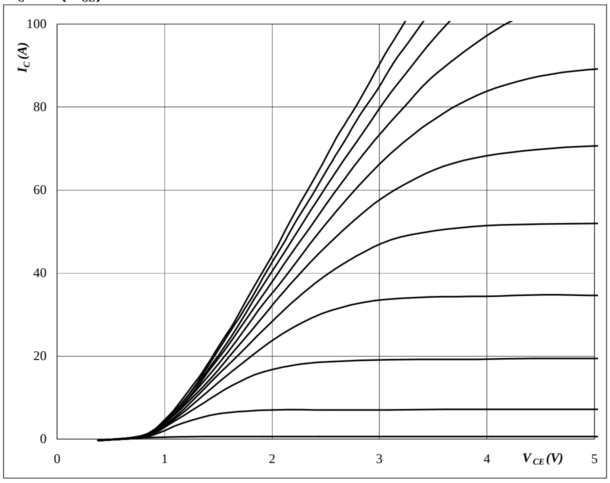
Parameter	Symbol	Conditions					Value			Unit
			V_{GE} [V] or V_{GS} [V]	V_r [V] or V_{CE} [V] or V_{DS} [V]	I_C [A] or I_F [A] or I_D [A]	T_j [°C]	Min	Typ	Max	
Rectifier Diode										
Forward voltage	V_F				25	25 125	0,8	1,2 1,12	1,35	V
Threshold voltage (for power loss calc. only)	V_{to}					25 125		0,85 0,73		V
Slope resistance (for power loss calc. only)	r_t					25 125		14 15		mΩ
Reverse current	I_r			1600		25 125			0,1 1,1	mA
Thermal resistance chip to heatsink per chip	$R_{th(j-s)}$	Thermal grease thickness≤50µm λ=1W/mK						0,90		K/W
Inverter Switch\Brake Switch										
Gate emitter threshold voltage	$V_{GE(th)}$	$V_{CE}=V_{GE}$			0,0012	25 150	5	5,8	6,5	V
Collector-emitter saturation voltage	V_{CEsat}		15		35	25 150	1,6	1,87 2,3	2,15	V
Collector-emitter cut-off current incl. diode	I_{CES}		0	1200		25 150			0,05	mA
Gate-emitter leakage current	I_{GES}		20	0		25 150			300	nA
Integrated Gate resistor	R_{gint}							-		Ω
Turn-on delay time	$t_{d(on)}$	R_{goff}=16Ω R_{gon}=16Ω	±15	600	35	25 150		78 79		ns
Rise time	t_r					25 150		24 29		
Turn-off delay time	$t_{d(off)}$					25 150		196 268		
Fall time	t_f					25 150		77 131		
Turn-on energy loss per pulse	E_{on}					25 150		2,54 3,84		mWs
Turn-off energy loss per pulse	E_{off}					25 150		1,92 3,18		
Input capacitance	C_{ies}	f=1MHz	0	25		25		1950		pF
Output capacitance	C_{oss}							155		
Reverse transfer capacitance	C_{rss}							115		
Gate charge	Q_G	Vcc=960V	15		40	25		192		nC
Thermal resistance chip to heatsink per chip	$R_{th(j-s)}$	Thermal grease thickness≤50µm λ=1W/mK						1,07		K/W
Inverter Diode\Brake Diode										
Diode forward voltage	V_F				35	25 150	1,5	2,36 2,34	2,65	V
Peak reverse recovery current	I_{RRM}	R_{gon}=16Ω	±15	600	35	25 150		16 22,6		A
Reverse recovery time	t_{rr}					25 150		336 550		ns
Reverse recovered charge	Q_{rr}					25 150		2,2 5,36		µC
Peak rate of fall of recovery current	$(di_{rf}/dt)_{max}$					25 150		63 67		A/µs
Reverse recovered energy	E_{rec}					25 150		0,77 2,07		mWs
Thermal resistance chip to heatsink per chip	$R_{th(j-s)}$	Thermal grease thickness≤50µm λ=1W/mK						1,52		K/W
Thermistor										
Rated resistance	R					T=25		1000		Ω
Deviation of R100	$\Delta_{R/R}$	R_{100}=1670 Ω				T=100	-3		3	%
R100	P					T=100		1670,3125		Ω
Power dissipation constant						T=25				mW/K
A-value	$B_{(25/50)}$	Tol. %				T=25		7,635*10-3		1/K
B-value	$B_{(25/100)}$	Tol. %				T=25		1,731*10-5		1/K²
Vincotech NTC Reference									E	

Inverter\Brake Characteristics

Figure 1 Inverter Switch\Brake Switch

Typical output characteristics

$I_C = f(V_{CE})$



At

t_p = 250 µs

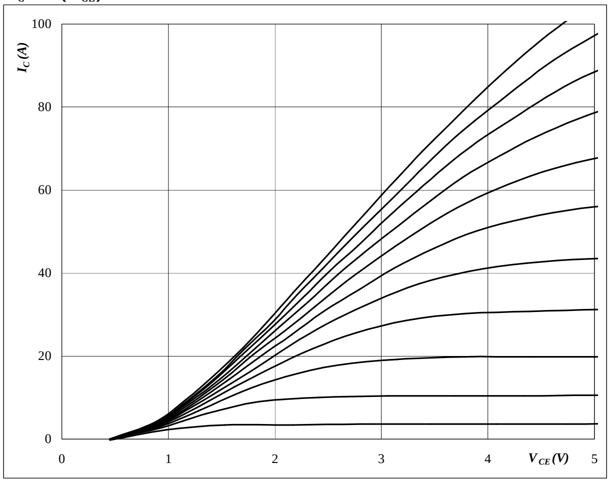
T_j = 25 °C

V_{GE} from 7 V to 17 V in steps of 1 V

Figure 2 Inverter Switch\Brake Switch

Typical output characteristics

$I_C = f(V_{CE})$



At

t_p = 250 µs

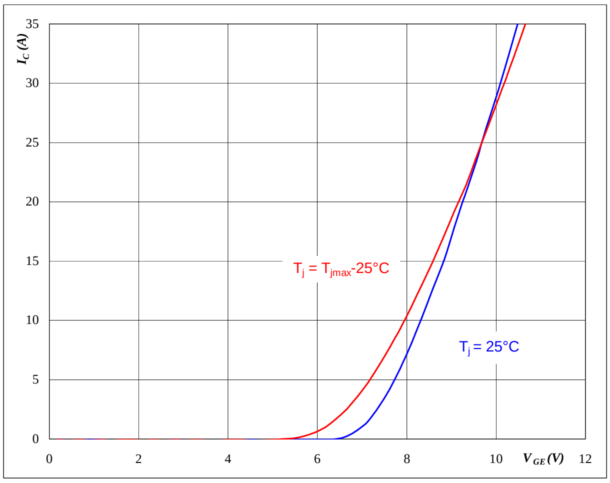
T_j = 150 °C

V_{GE} from 7 V to 17 V in steps of 1 V

Figure 3 Inverter Switch\Brake Switch

Typical transfer characteristics

$I_C = f(V_{GE})$



At

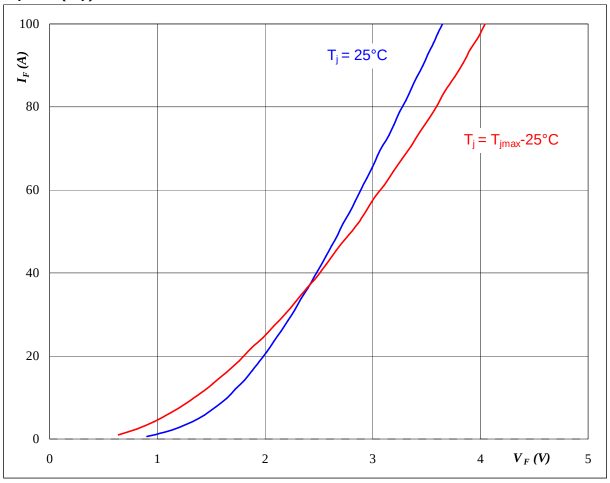
t_p = 250 µs

V_{CE} = 10 V

Figure 4 Inverter Diode\Brake Diode

Typical diode forward current as a function of forward voltage

$I_F = f(V_F)$



At

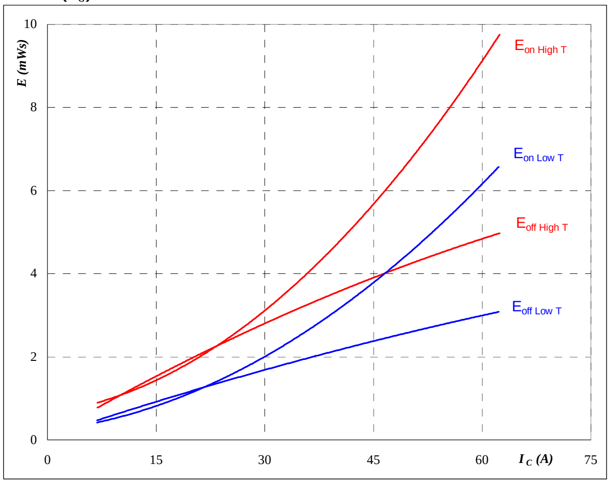
t_p = 250 µs

Inverter\Brake Characteristics

Figure 5 Inverter Switch\Brake Switch

Typical switching energy losses as a function of collector current

$E = f(I_C)$



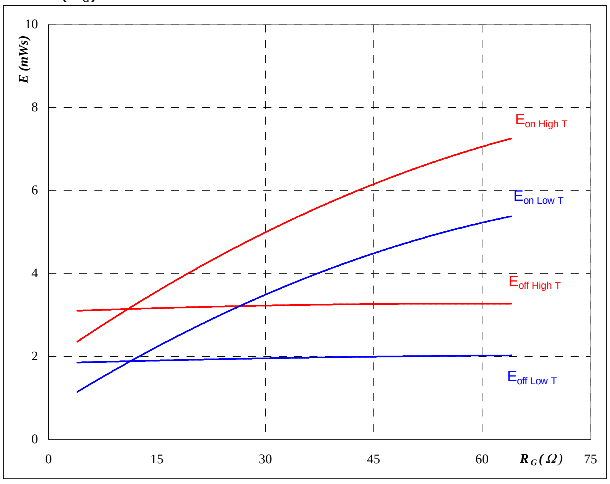
With an inductive load at

T_j =	25/150	°C
V_{CE} =	600	V
V_{GE} =	±15	V
R_{gon} =	16	Ω
R_{goff} =	16	Ω

Figure 6 Inverter Switch\Brake Switch

Typical switching energy losses as a function of gate resistor

$E = f(R_G)$



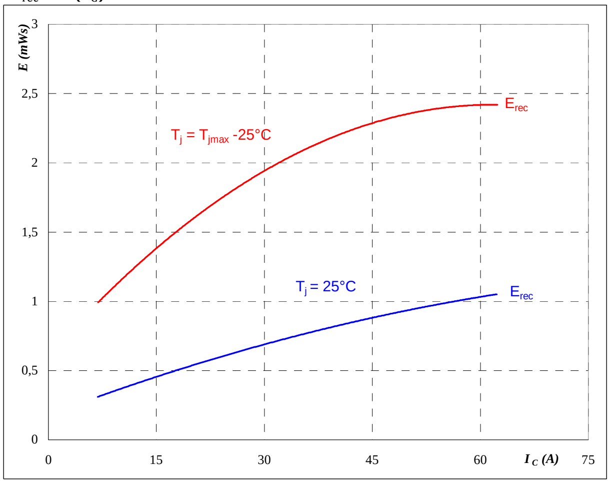
With an inductive load at

T_j =	25/150	°C
V_{CE} =	600	V
V_{GE} =	±15	V
I_C =	35	A

Figure 7 Inverter Switch\Brake Switch

Typical reverse recovery energy loss as a function of collector current

$E_{rec} = f(I_C)$



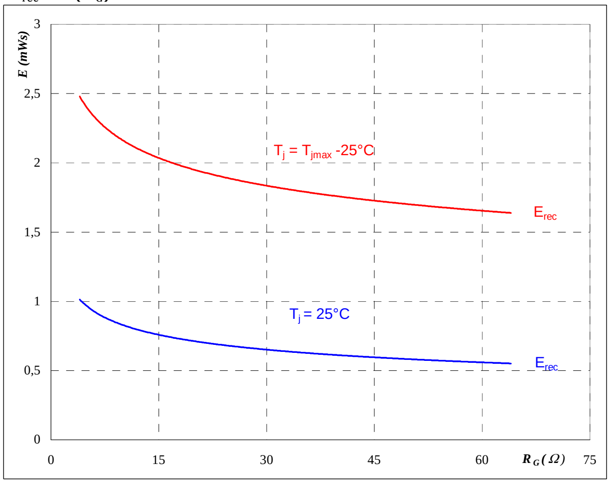
With an inductive load at

T_j =	25/150	°C
V_{CE} =	600	V
V_{GE} =	±15	V
R_{gon} =	16	Ω

Figure 8 Inverter Switch\Brake Switch

Typical reverse recovery energy loss as a function of gate resistor

$E_{rec} = f(R_G)$



With an inductive load at

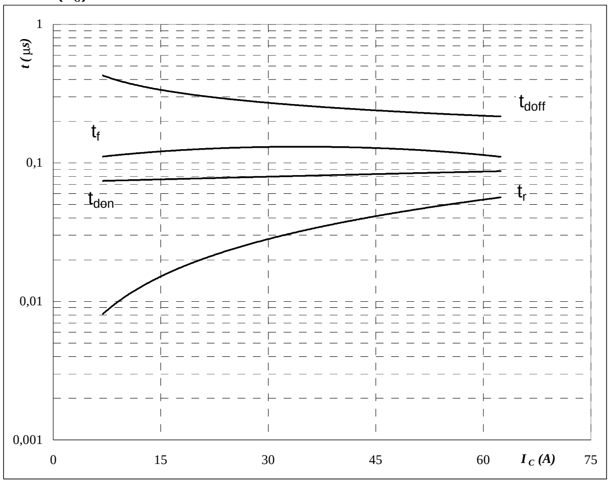
T_j =	25/150	°C
V_{CE} =	600	V
V_{GE} =	±15	V
I_C =	35	A

Inverter\Brake Characteristics

Figure 9 Inverter Switch\Brake Switch

Typical switching times as a function of collector current

$t = f(I_C)$



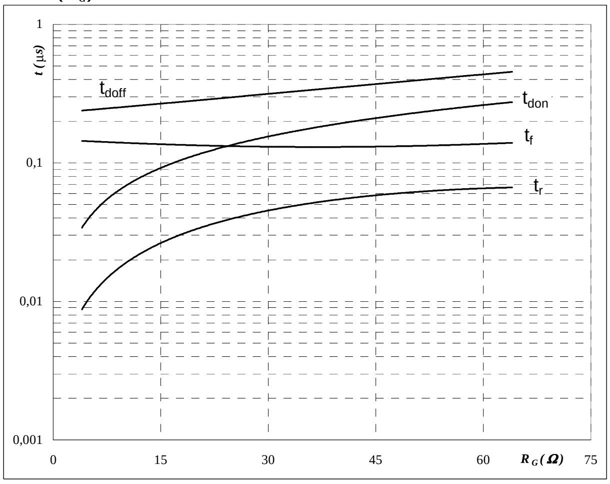
With an inductive load at

T_j =	150	°C
V_{CE} =	600	V
V_{GE} =	±15	V
R_{gon} =	16	Ω
R_{goff} =	16	Ω

Figure 10 Inverter Switch\Brake Switch

Typical switching times as a function of gate resistor

$t = f(R_G)$



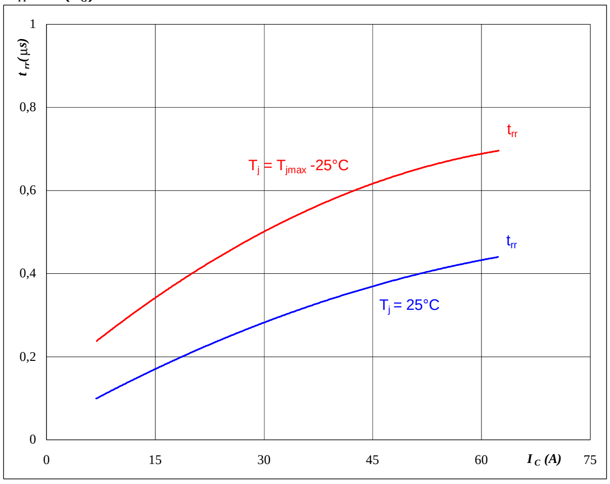
With an inductive load at

T_j =	150	°C
V_{CE} =	600	V
V_{GE} =	±15	V
I_C =	35	A

Figure 11 Inverter Diode\Brake Diode

Typical reverse recovery time as a function of collector current

$t_{rr} = f(I_C)$



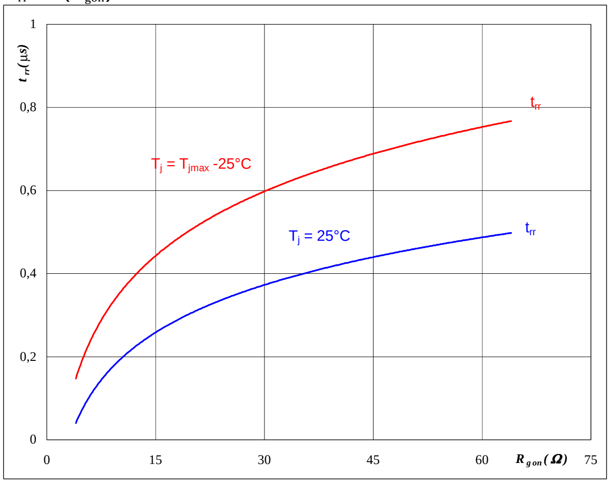
At

T_j =	25/150	°C
V_{CE} =	600	V
V_{GE} =	±15	V
R_{gon} =	16	Ω

Figure 12 Inverter Diode\Brake Diode

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

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



At

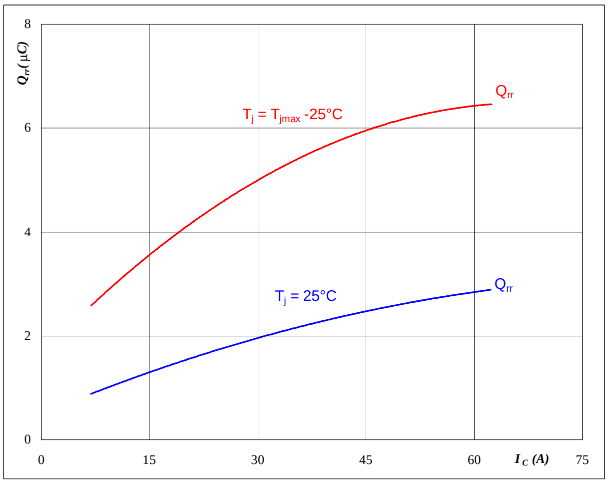
T_j =	25/150	°C
V_R =	600	V
I_F =	35	A
V_{GE} =	±15	V

Inverter\Brake Characteristics

Figure 13 Inverter Diode\Brake Diode

Typical reverse recovery charge as a function of collector current

$Q_{rr} = f(I_C)$



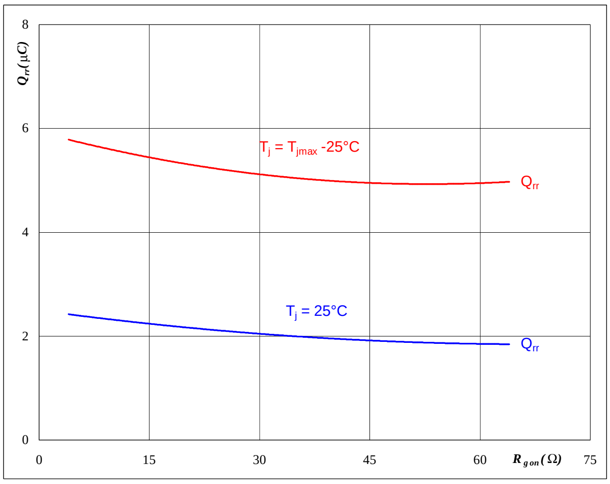
At

T_j =	25/150	°C
V_{CE} =	600	V
V_{GE} =	±15	V
R_{gon} =	16	Ω

Figure 14 Inverter Diode\Brake Diode

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

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



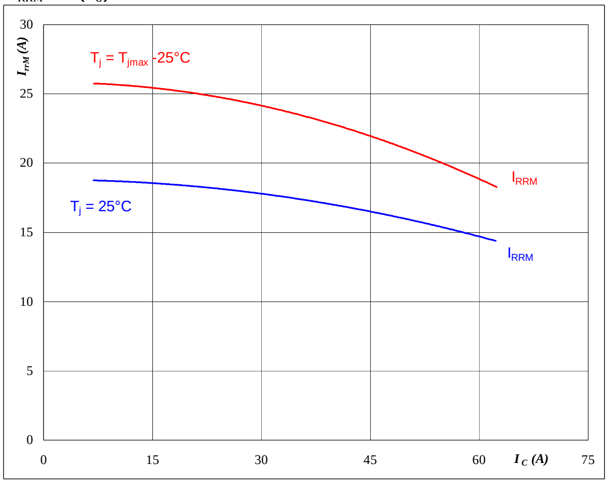
At

T_j =	25/150	°C
V_R =	600	V
I_F =	35	A
V_{GE} =	±15	V

Figure 15 Inverter Diode\Brake Diode

Typical reverse recovery current as a function of collector current

$I_{RRM} = f(I_C)$



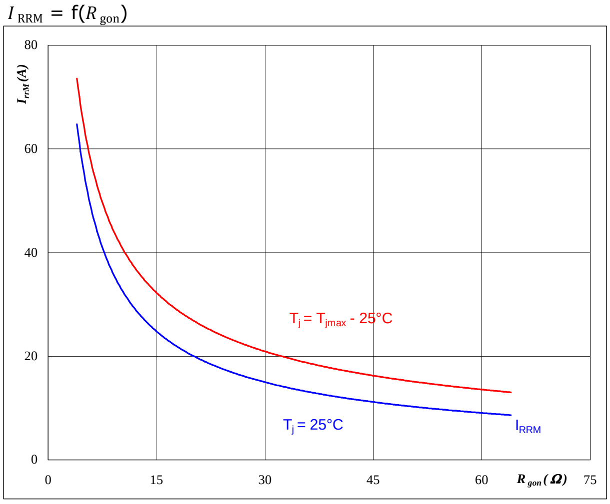
At

T_j =	25/150	°C
V_{CE} =	600	V
V_{GE} =	±15	V
R_{gon} =	16	Ω

Figure 16 Inverter Diode\Brake Diode

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

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



At

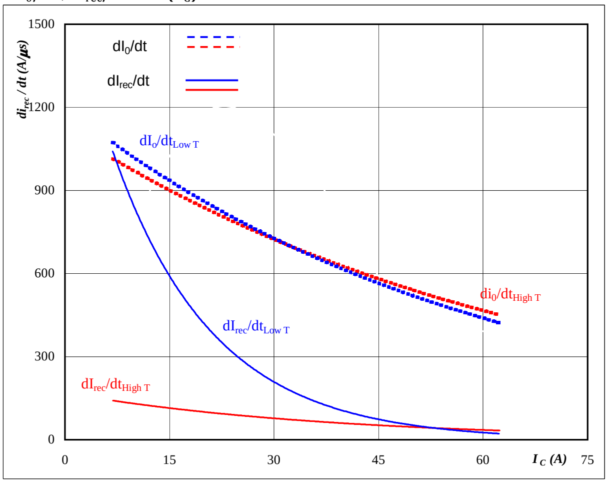
T_j =	25/150	°C
V_R =	600	V
I_F =	35	A
V_{GE} =	±15	V

Inverter\Brake Characteristics

Figure 17 Inverter Diode\Brake Diode

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

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



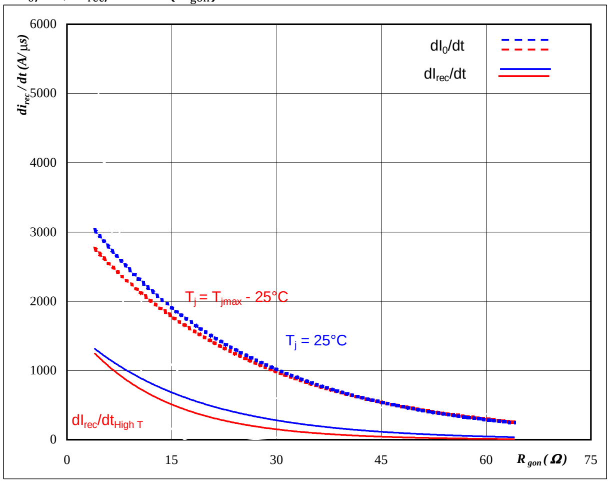
At

T_j =	25/150	°C
V_{CE} =	600	V
V_{GE} =	±15	V
R_{gon} =	16	Ω

Figure 18 Inverter Diode\Brake Diode

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

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



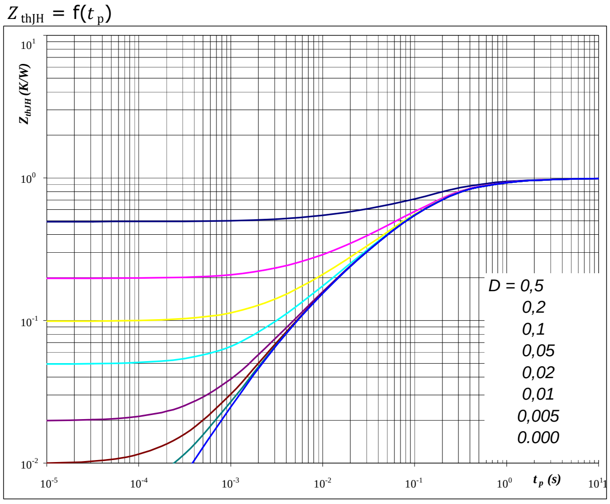
At

T_j =	25/150	°C
V_R =	600	V
I_F =	35	A
V_{GE} =	±15	V

Figure 19 Inverter Switch\Brake Switch

IGBT transient thermal impedance as a function of pulse width

$Z_{thJH} = f(t_p)$



At

D =	t_p / T	
R_{thJH} =	0,99	K/W

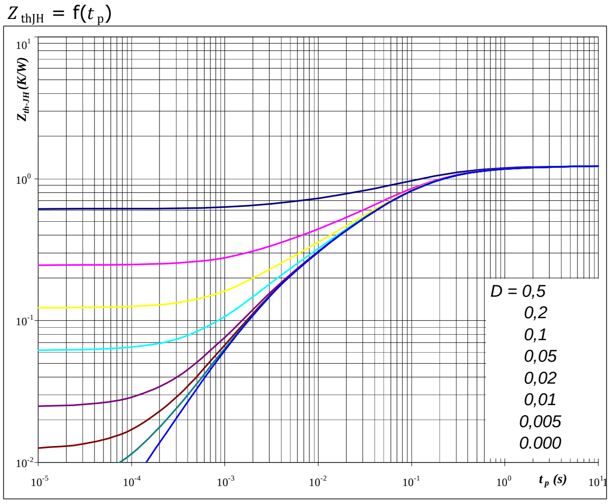
IGBT thermal model values

R (K/W)	Tau (s)
0,10	1,5E+00
0,31	2,7E-01
0,41	8,9E-02
0,13	1,4E-02
0,03	2,8E-03

Figure 20 Inverter Diode\Brake Diode

FWD transient thermal impedance as a function of pulse width

$Z_{thJH} = f(t_p)$



At

D =	t_p / T	
R_{thJH} =	1,23	K/W

FWD thermal model values

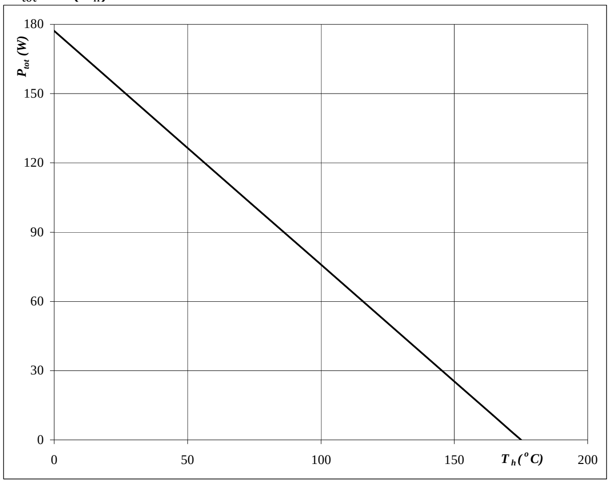
R (K/W)	Tau (s)
0,08	2,1E+00
0,33	2,4E-01
0,50	6,6E-02
0,22	1,3E-02
0,10	2,3E-03

Inverter\Brake Characteristics

Figure 21 Inverter Switch\Brake Switch

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_h)$



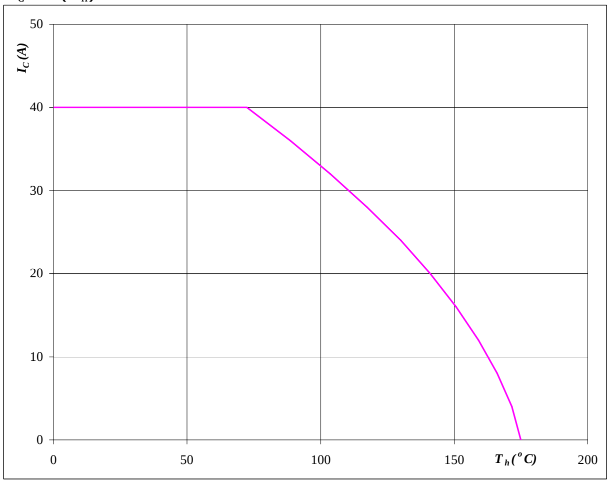
At

T_j = 175 °C

Figure 22 Inverter Switch\Brake Switch

Collector current as a function of heatsink temperature

$I_C = f(T_h)$



At

T_j = 175 °C

V_{GE} = 15 V

Figure 23 Inverter Diode\Brake Diode FWD

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_h)$

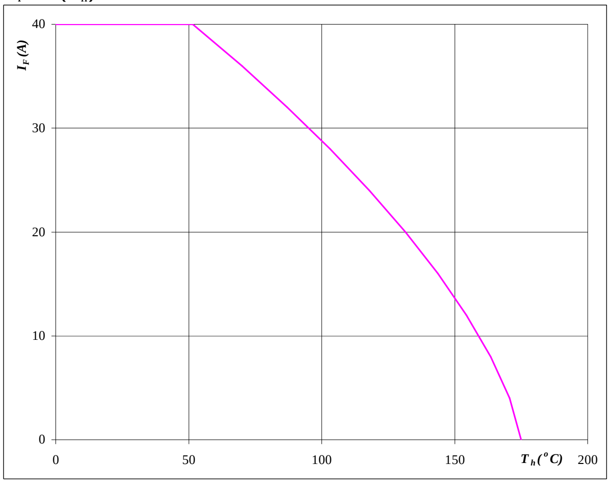
At

T_j = 175 °C

Figure 24 Inverter Diode\Brake Diode FWD

Forward current as a function of heatsink temperature

$I_F = f(T_h)$



At

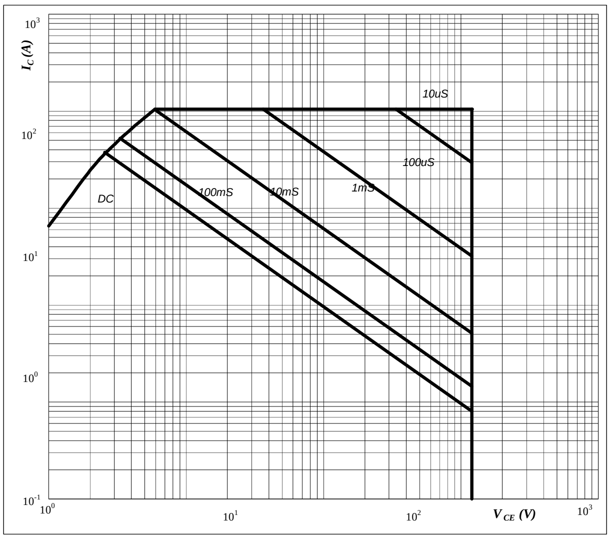
T_j = 175 °C

Inverter\Brake Characteristics

Figure 25 Inverter Switch\Brake Switch

Safe operating area as a function of collector-emitter voltage

$I_C = f(V_{CE})$



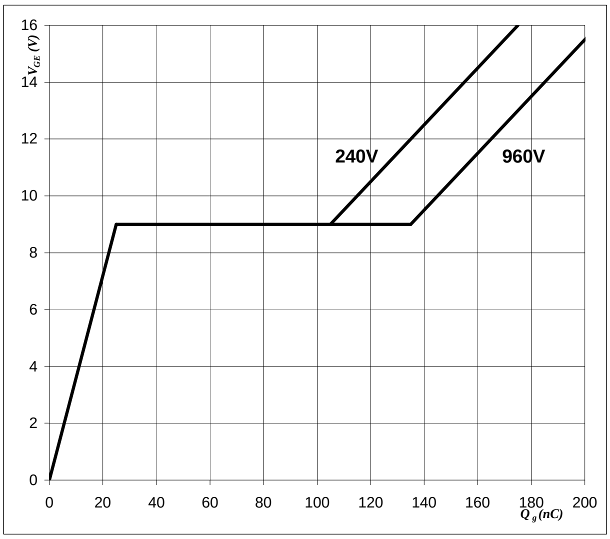
At

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

Figure 26 Inverter Switch\Brake Switch

Gate voltage vs Gate charge

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



At

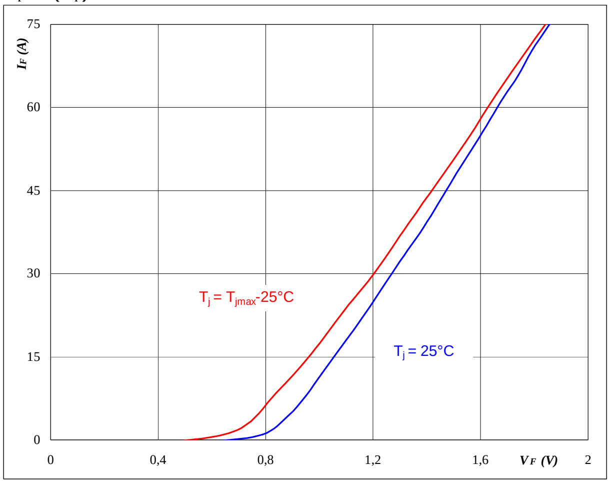
I_C =	35	A

Rectifier Diode

Figure 1 Rectifier Diode diode

Typical diode forward current as a function of forward voltage

$I_F = f(V_F)$



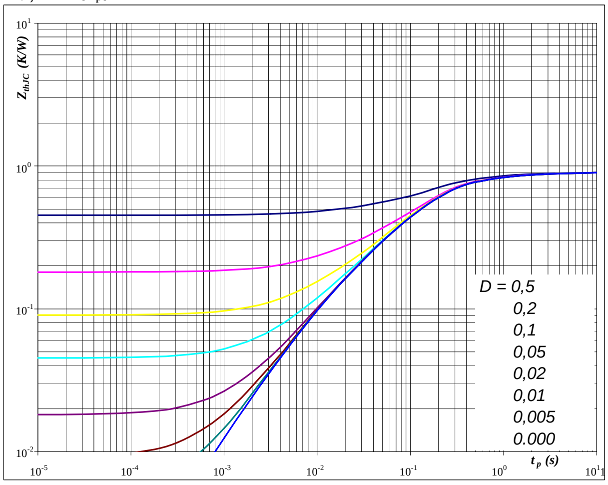
At

t_p = 250 µs

Figure 2 Rectifier Diode diode

Diode transient thermal impedance as a function of pulse width

$Z_{thJH} = f(t_p)$



At

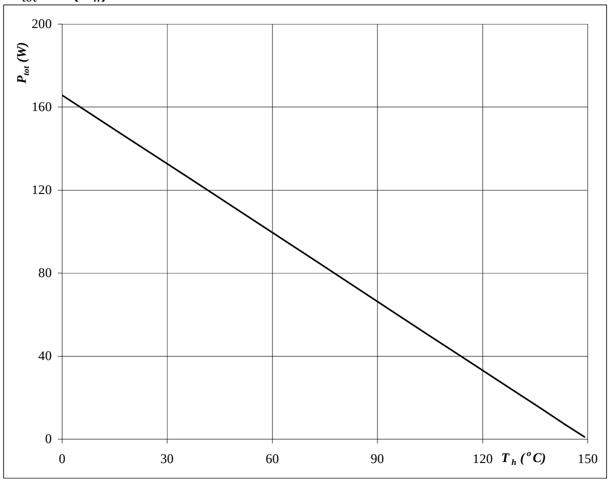
$D = t_p / T$

R_{thJH} = 0,905 K/W

Figure 3 Rectifier Diode diode

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_h)$



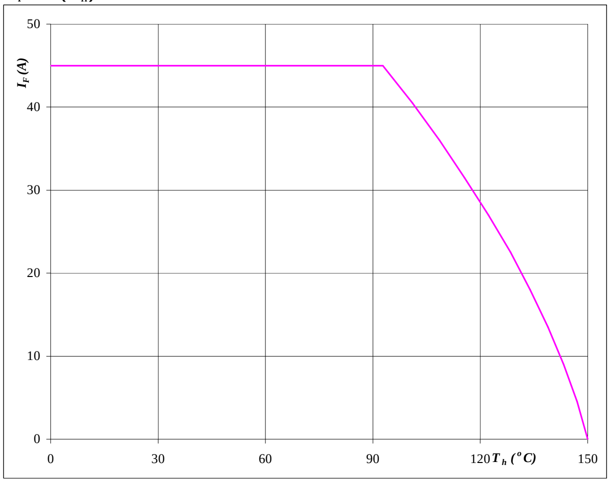
At

T_j = 150 ºC

Figure 4 Rectifier Diode diode

Forward current as a function of heatsink temperature

$I_F = f(T_h)$



At

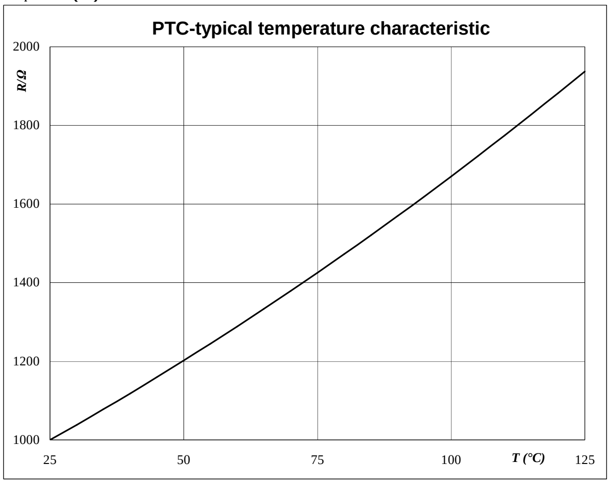
T_j = 150 ºC

Thermistor

Figure 1 Thermistor

Typical PTC characteristic
as a function of temperature

$R_T = f(T)$



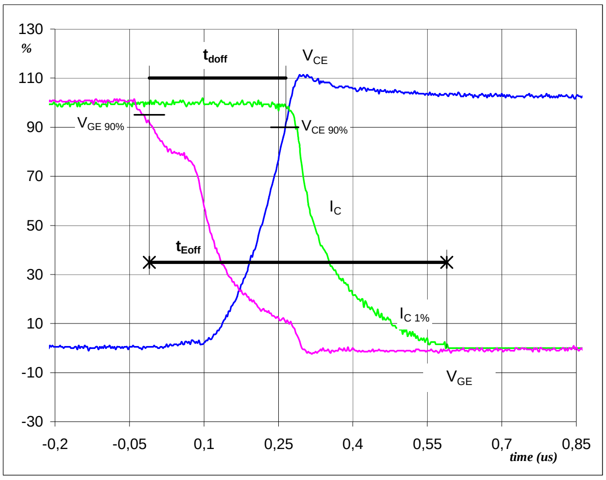
Switching Definitions Inverter

General conditions

T_j	=	150 °C
R_{gon}	=	16 Ω
R_{goff}	=	16 Ω

Figure 1 IGBT

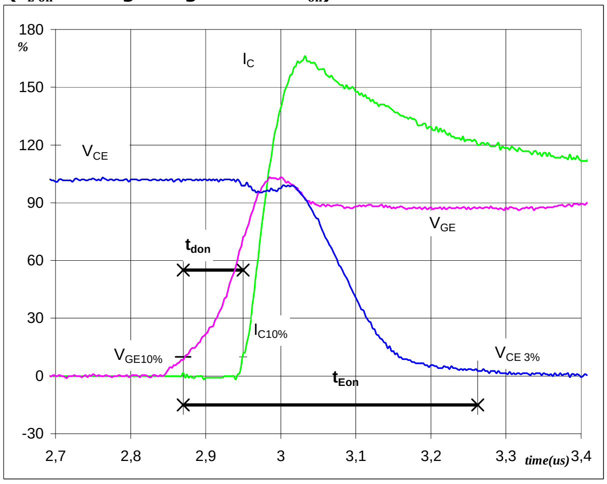
Turn-off Switching Waveforms & definition of t_{doff}, t_{Eoff}
($t_{E\,off}$ = integrating time for E_{off})



V_{GE} (0%) =	-15	V
V_{GE} (100%) =	15	V
V_C (100%) =	600	V
I_C (100%) =	35	A
t_{doff} =	0,27	μs
$t_{E\,off}$ =	0,60	μs

Figure 2 IGBT

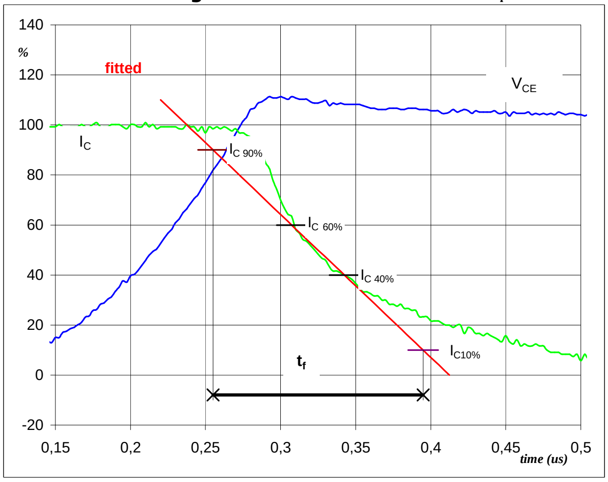
Turn-on Switching Waveforms & definition of t_{don}, t_{Eon}
($t_{E\,on}$ = integrating time for E_{on})



V_{GE} (0%) =	-15	V
V_{GE} (100%) =	15	V
V_C (100%) =	600	V
I_C (100%) =	35	A
t_{don} =	0,08	μs
$t_{E\,on}$ =	0,39	μs

Figure 3 IGBT

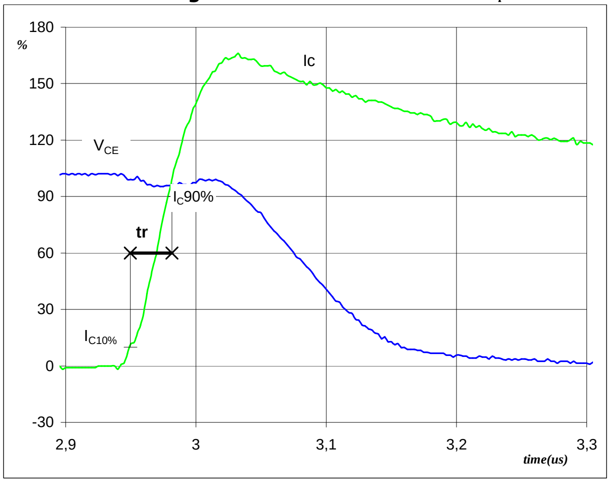
Turn-off Switching Waveforms & definition of t_f



V_C (100%) =	600	V
I_C (100%) =	35	A
t_f =	0,13	μs

Figure 4 IGBT

Turn-on Switching Waveforms & definition of t_r

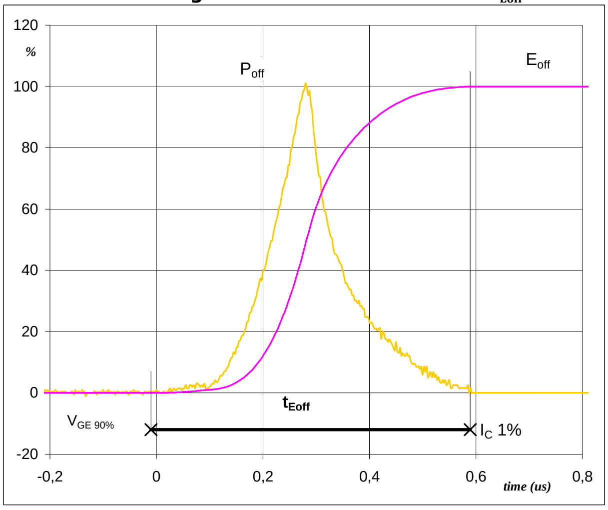


V_C (100%) =	600	V
I_C (100%) =	35	A
t_r =	0,03	μs

Switching Definitions Inverter

Figure 5 IGBT

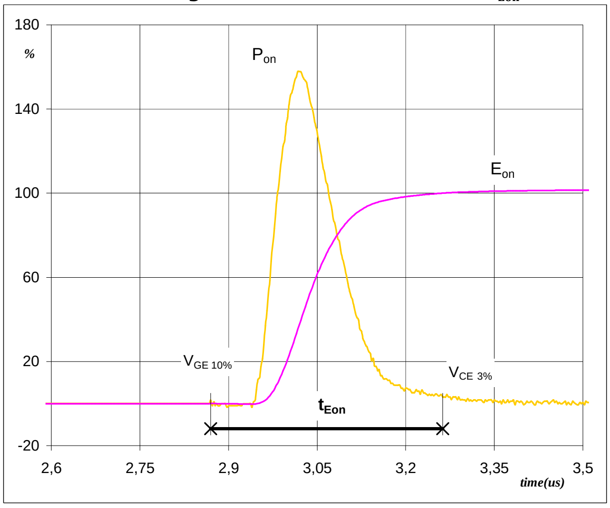
Turn-off Switching Waveforms & definition of t_{Eoff}



P_{off} (100%) =	20,88	kW
E_{off} (100%) =	3,18	mJ
$t_{E\,off}$ =	0,60	μs

Figure 6 IGBT

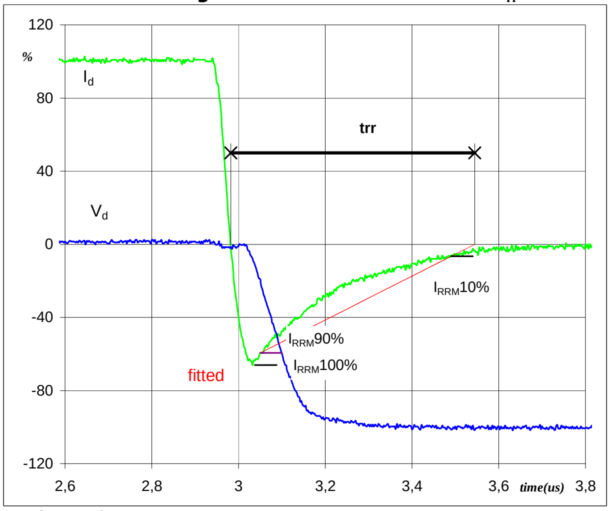
Turn-on Switching Waveforms & definition of t_{Eon}



P_{on} (100%) =	20,88	kW
E_{on} (100%) =	3,84	mJ
$t_{E\,on}$ =	0,39	μs

Figure 7 FWD

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

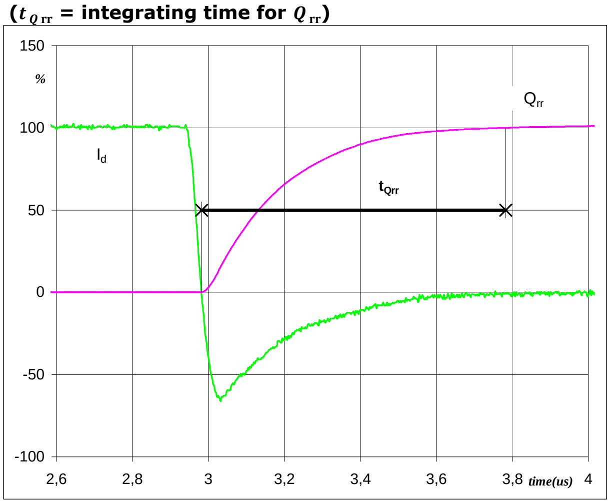


V_d (100%) =	600	V
I_d (100%) =	35	A
I_{RRM} (100%) =	23	A
t_{rr} =	0,57	μs

Switching Definitions Inverter

Figure 8 FWD

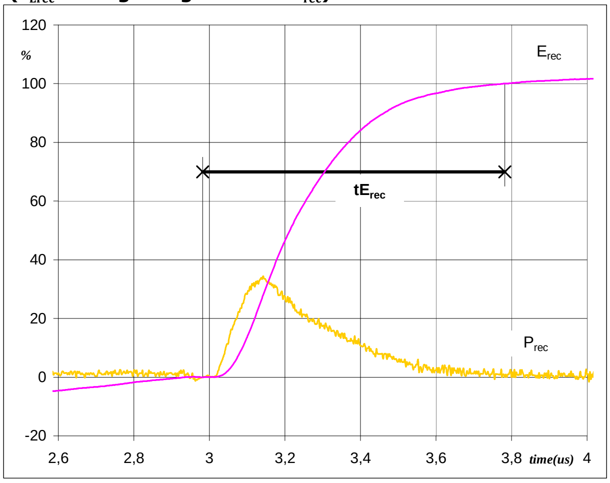
Turn-on Switching Waveforms & definition of t_{Qrr}
($t_{Q\,rr}$ = integrating time for Q_{rr})



I_d (100%) =	35	A
Q_{rr} (100%) =	5,40	µC
$t_{Q\,rr}$ =	0,80	µs

Figure 9 FWD

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



P_{rec} (100%) =	20,88	kW
E_{rec} (100%) =	2,10	mJ
$t_{E\,rec}$ =	0,80	µs

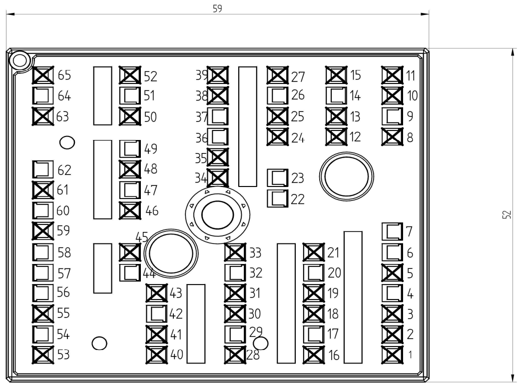
Ordering Code and Marking - Outline - Pinout

Ordering Code & Marking

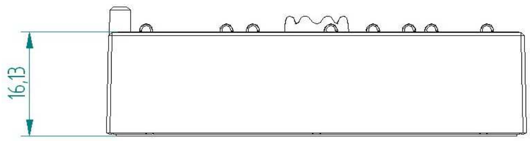
Version	Ordering Code
with std lid (black V23990-K12-T-PM)	V23990-K220-A41-/0A/-PM
with std lid (black V23990-K12-T-PM) and P12	V23990-K220-A41-/1A/-PM
with thin lid (white V23990-K13-T-PM)	V23990-K220-A41-/0B/-PM
with thin lid (white V23990-K13-T-PM) and P12	V23990-K220-A41-/1B/-PM

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

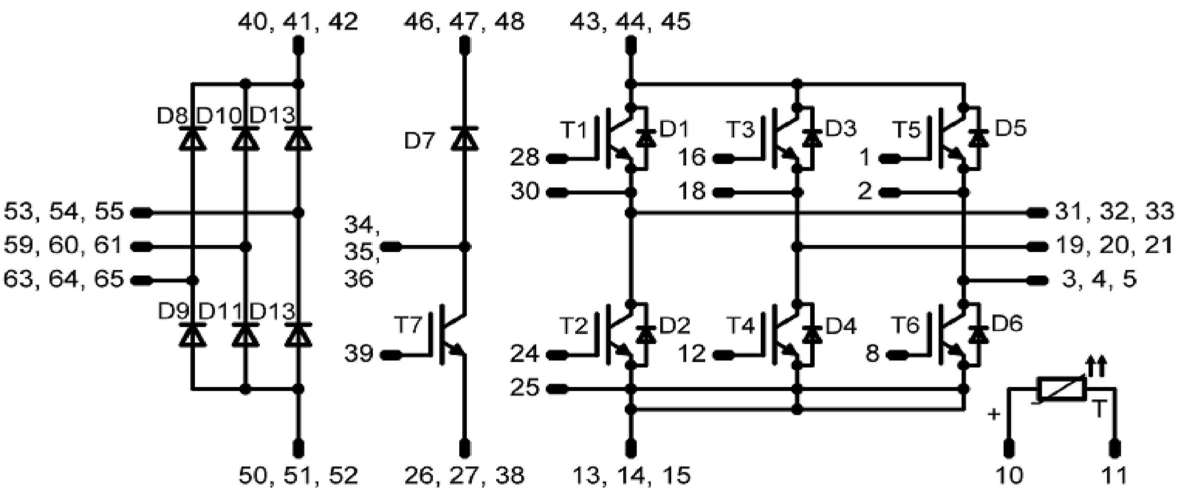
Outline



X = assembled pin position



Pinout



Identification

ID	Component	Voltage	Current	Function	Comment
T1,T2,T3,T4,T5,T6	IGBT	1200 V	35 A	Inverter Switch	
D1,D2,D3,D4,D5,D6	FWD	1200 V	35 A	Inverter Diode	
T7	IGBT	1200 V	35 A	Brake Switch	
D7	FWD	1200 V	35 A	Brake Diode	
D8,D9,D10,D11,D12,D13	Rectifier	1600 V	25 A	Rectifier Diode	
T	PTC			Thermistor	

Packaging instruction			
Standard packaging quantity (SPQ)	**72**	>SPQ Standard	<SPQ Sample

Handling instruction
Handling instructions for MiniSkiiP® 2 packages see vincotech.com website.

Package data
Package data for MiniSkiiP® 2 packages see vincotech.com website.

Document No.:	Date:	Modification:	Pages
V23990-K220-A41-D4-14	26 Feb. 2016	New brand, Disclaimer	all

DISCLAIMER
The information, specifications, procedures, methods and recommendations herein (together "information") are presented by Vincotech to reader in good faith, are believed to be accurate and reliable, but may well be incomplete and/or not applicable to all conditions or situations that may exist or occur. Vincotech reserves the right to make any changes without further notice to any products to improve reliability, function or design. No representation, guarantee or warranty is made to reader as to the accuracy, reliability or completeness of said information or that the application or use of any of the same will avoid hazards, accidents, losses, damages or injury of any kind to persons or property or that the same will not infringe third parties rights or give desired results. It is reader's sole responsibility to test and determine the suitability of the information and the product for reader's intended use.

LIFE SUPPORT POLICY
Vincotech products are not authorised for use as critical components in life support devices or systems without the express written approval of Vincotech.

As used herein:

1. Life support devices or systems are devices or systems which, (a) are intended for surgical implant into the body, or (b) support or sustain life, or (c) whose failure to perform when properly used in accordance with instructions for use provided in labelling can be reasonably expected to result in significant injury to the user.

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.