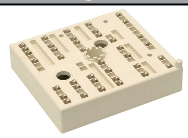
Vincotech

MiniSKiiP® 2 PIM **1200 V / 35 A**

Features

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

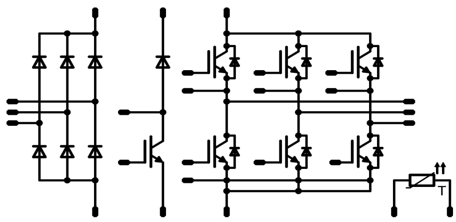
MiniSKiiP® 2 housing



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	t_p=10ms	T_j=150°C	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

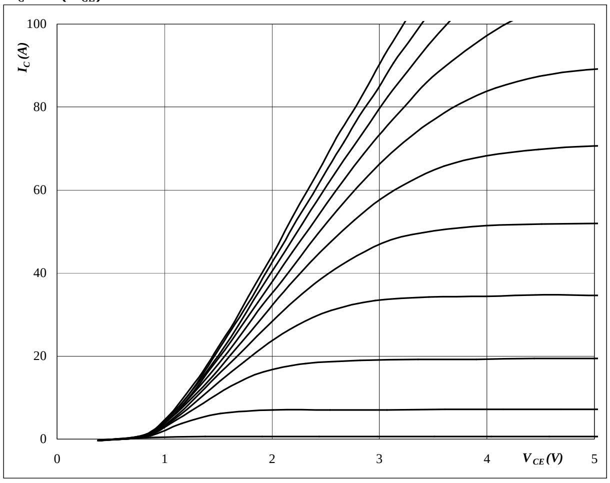
Parameter	Symbol	Conditions					Value			Unit
			V_{GE} [V] or V_{GS} [V]	V_r [V] or V_{CE} [V] or V_{DS} [V]	I_C [A] or I_F [A] or I_D [A]	T_j [°C]	Min	Typ	Max	
Rectifier Diode										
Forward voltage	V_F				25	25 125	0,8	1,2 1,12	1,35	V
Threshold voltage (for power loss calc. only)	V_{to}					25 125		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

$I_C = f(V_{CE})$



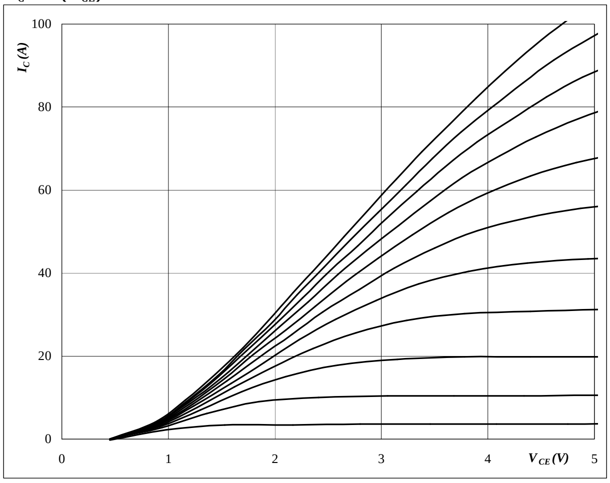
At

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

$I_C = f(V_{CE})$



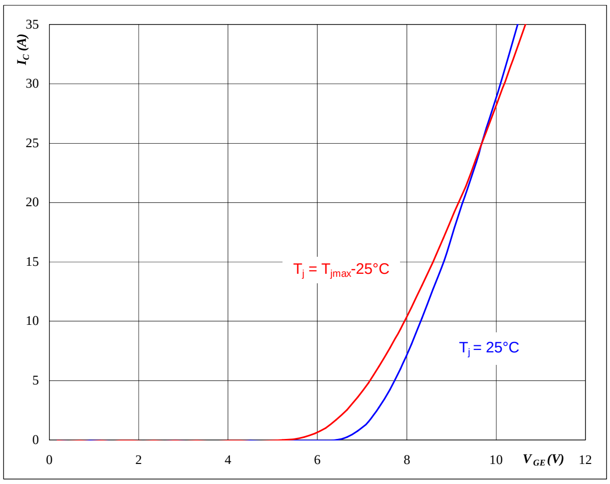
At

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

$I_C = f(V_{GE})$



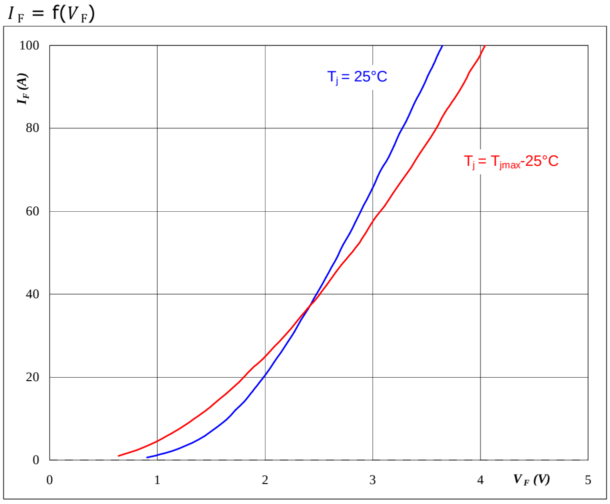
At

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

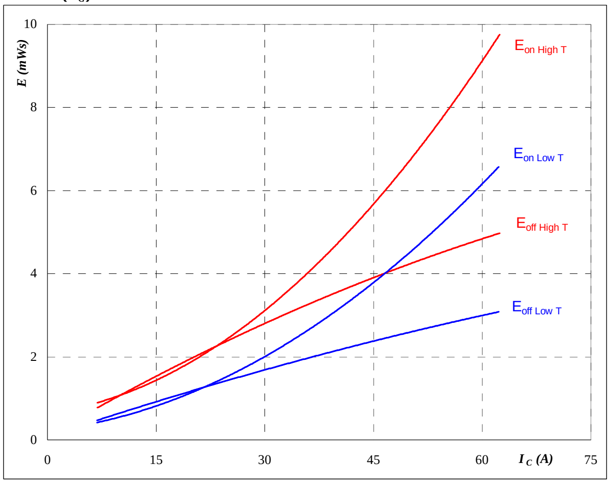
t_p =	250	µs

Inverter\Brake Characteristics

Figure 5 Inverter Switch\Brake Switch

Typical switching energy losses
as a function of collector current

$E = f(I_C)$



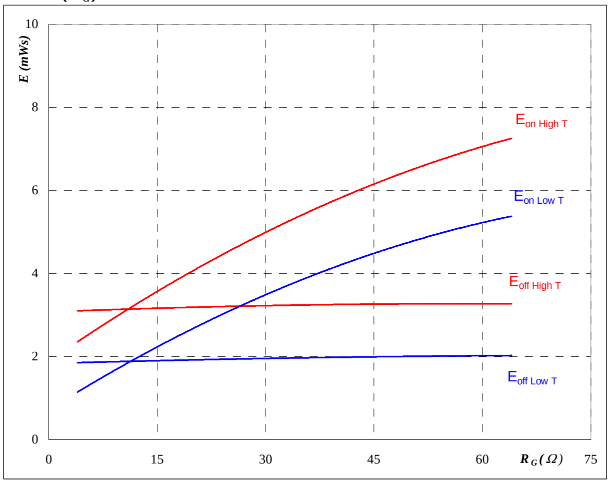
With an inductive load at

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

$E = f(R_G)$



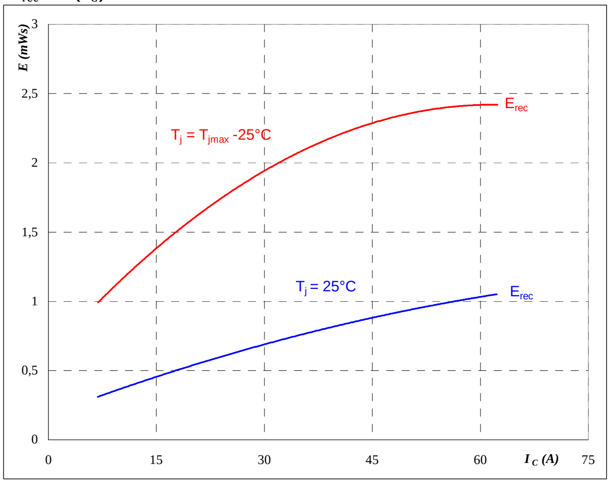
With an inductive load at

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

$E_{rec} = f(I_C)$



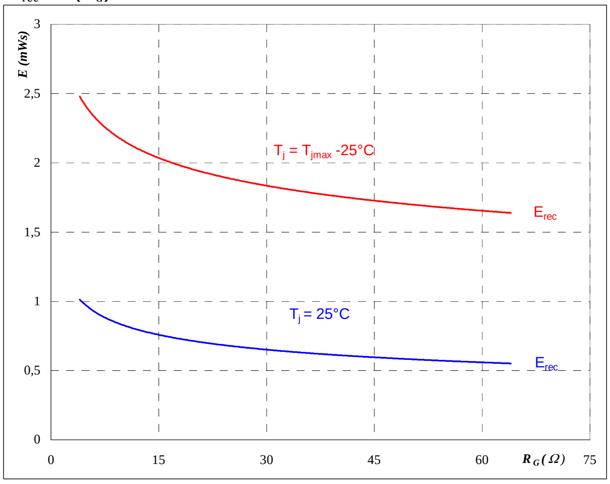
With an inductive load at

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

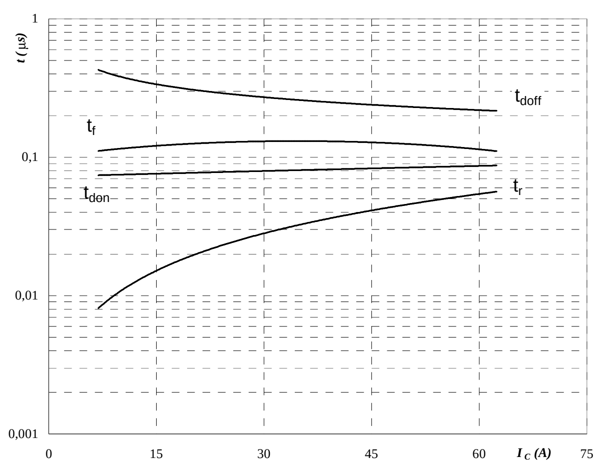
T_j =	25/150	°C
V_{CE} =	600	V
V_{GE} =	±15	V
I_C =	35	A

Inverter\Brake Characteristics

Figure 9 Inverter Switch\Brake Switch

Typical switching times as a function of collector current

$t = f(I_C)$



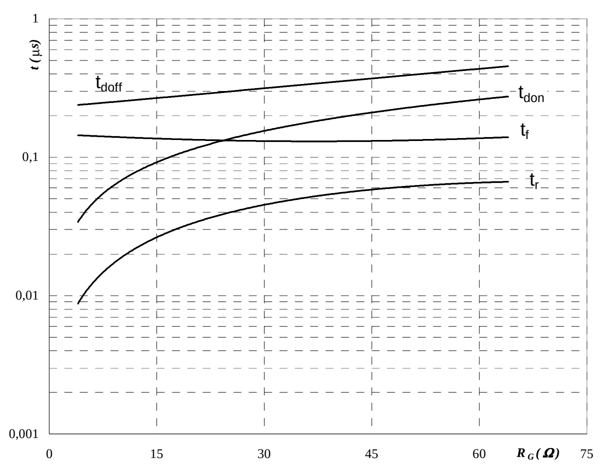
With an inductive load at

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

$t = f(R_G)$



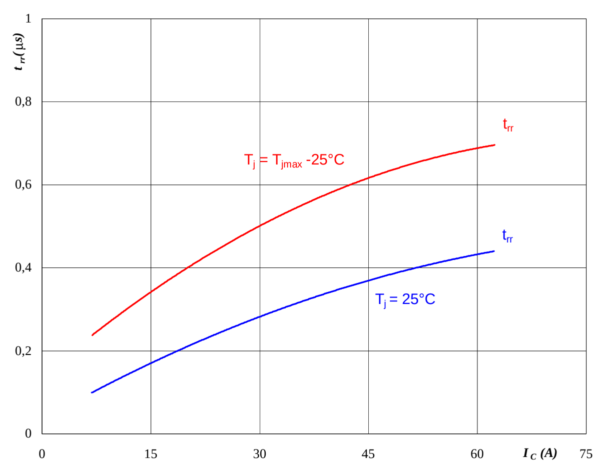
With an inductive load at

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

$t_{rr} = f(I_C)$



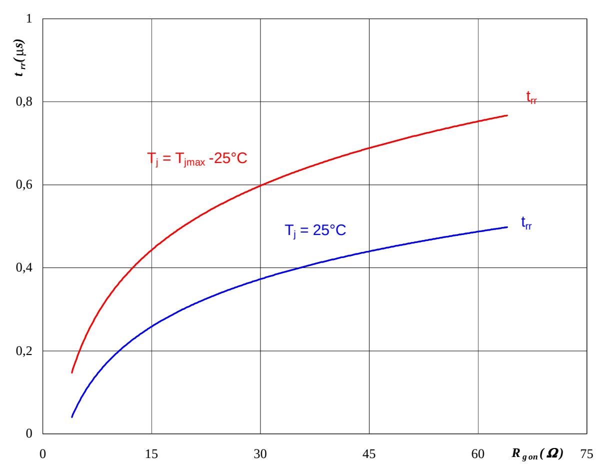
At

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

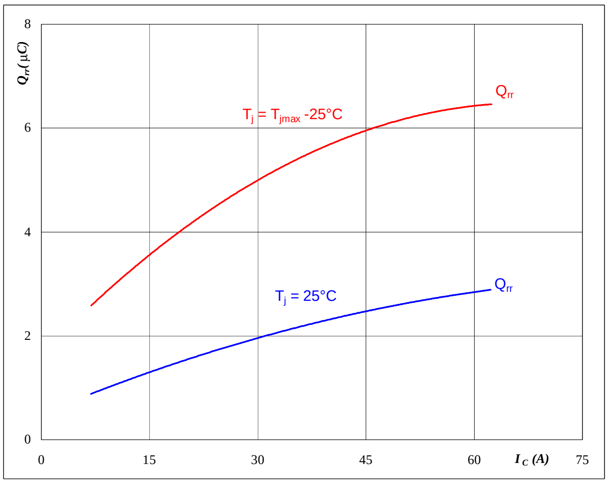
T_j =	25/150	°C
V_R =	600	V
I_F =	35	A
V_{GE} =	±15	V

Inverter\Brake Characteristics

Figure 13 Inverter Diode\Brake Diode

Typical reverse recovery charge as a function of collector current

$Q_{rr} = f(I_C)$



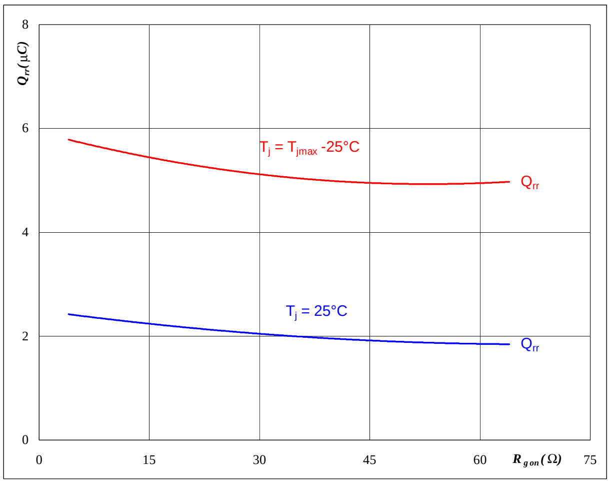
At

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

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



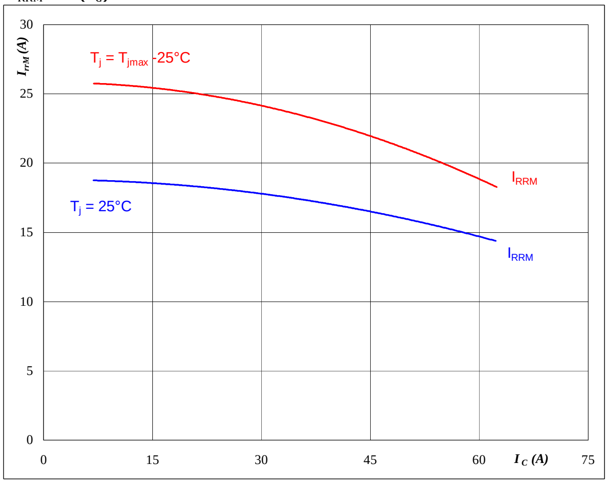
At

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

$I_{RRM} = f(I_C)$



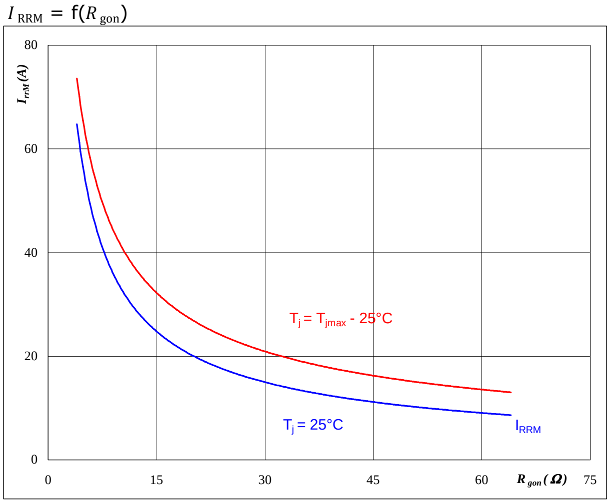
At

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

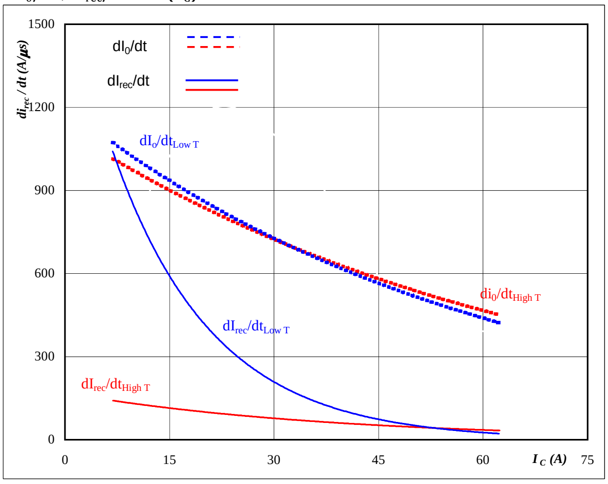
T_j =	25/150	°C
V_R =	600	V
I_F =	35	A
V_{GE} =	±15	V

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

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



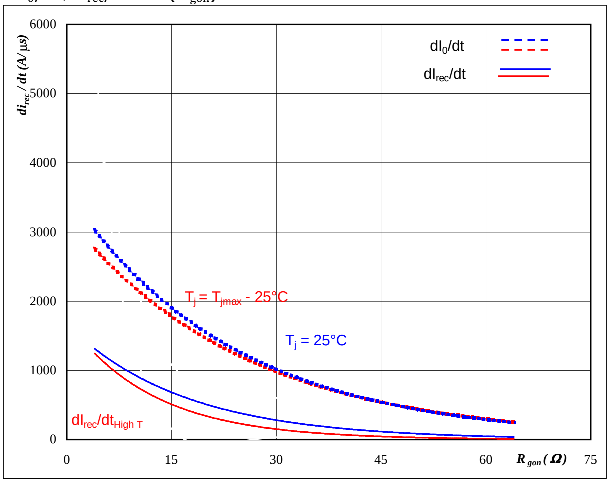
At

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

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



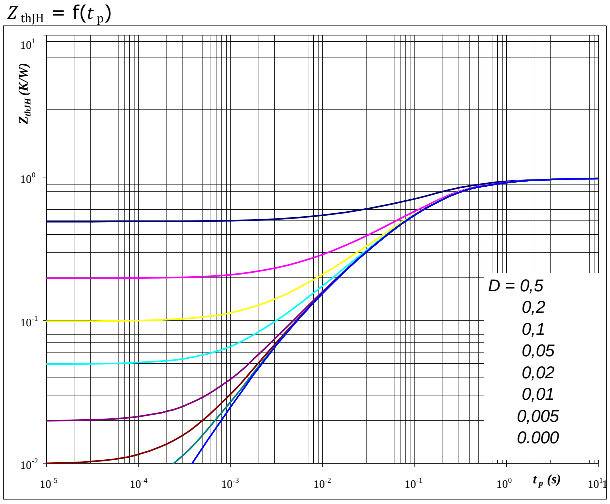
At

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

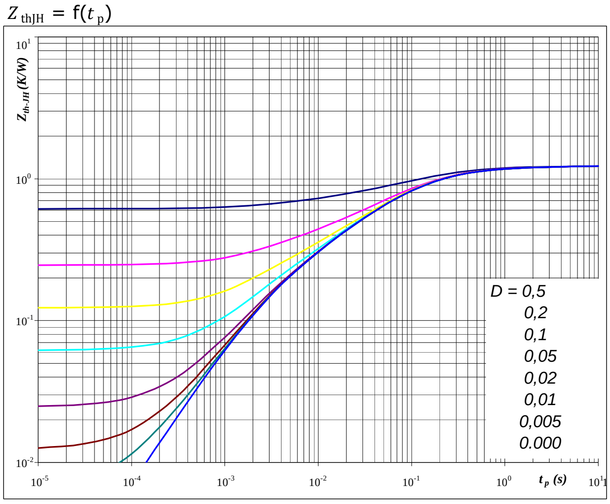
IGBT thermal model values

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

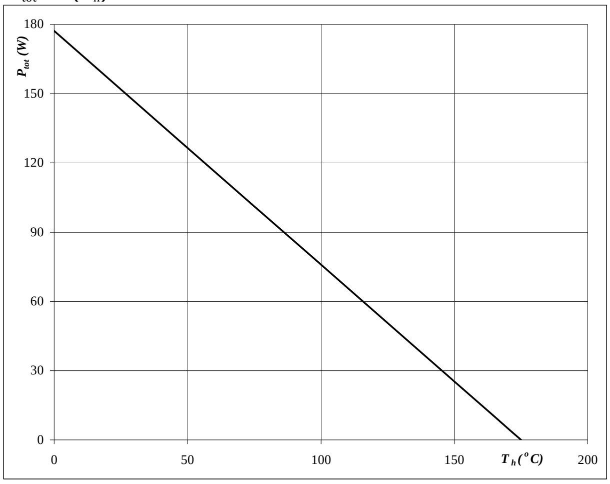
R (K/W)	Tau (s)
0,08	2,1E+00
0,33	2,4E-01
0,50	6,6E-02
0,22	1,3E-02
0,10	2,3E-03

Inverter\Brake Characteristics

Figure 21 Inverter Switch\Brake Switch

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_h)$



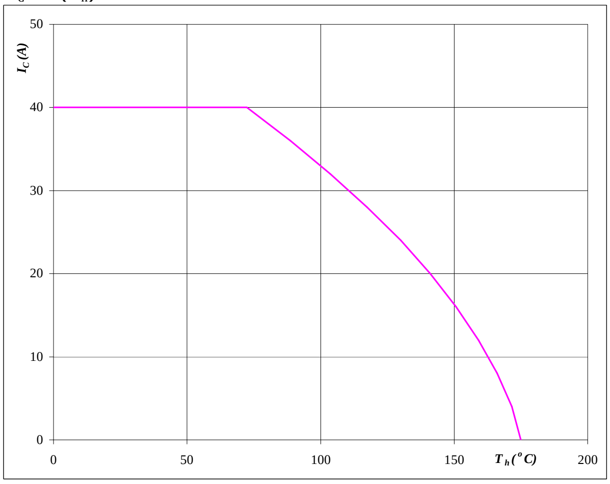
At

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

$P_{tot} = f(T_h)$

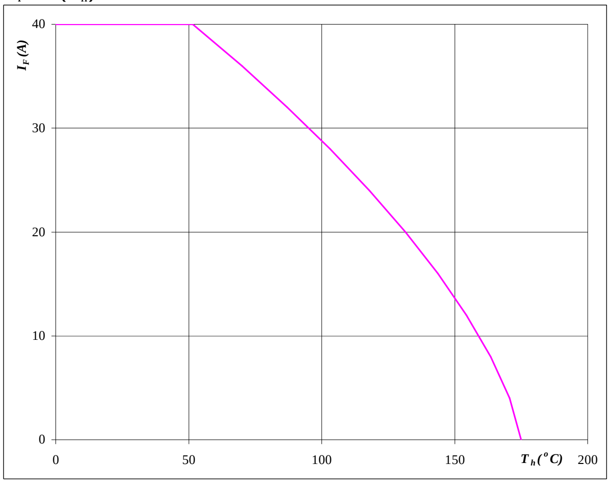
At

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

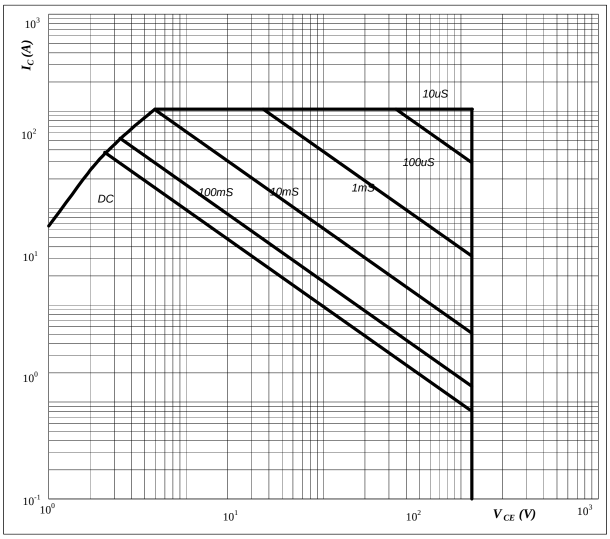
T_j = 175 °C

Inverter\Brake Characteristics

Figure 25	Inverter Switch\Brake Switch

Safe operating area as a function of collector-emitter voltage

$I_C = f(V_{CE})$



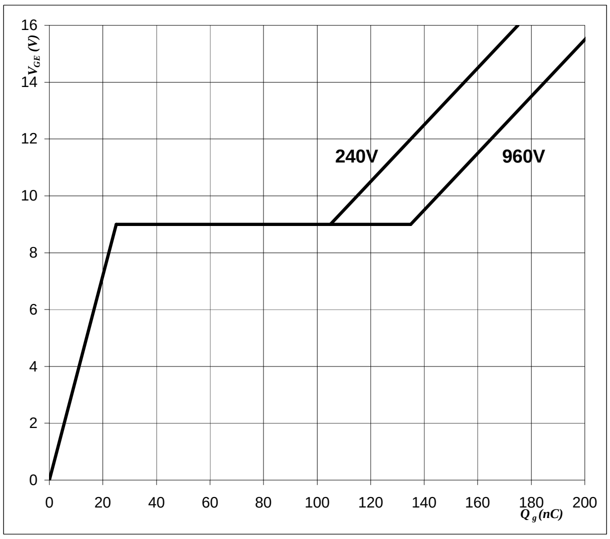
At

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

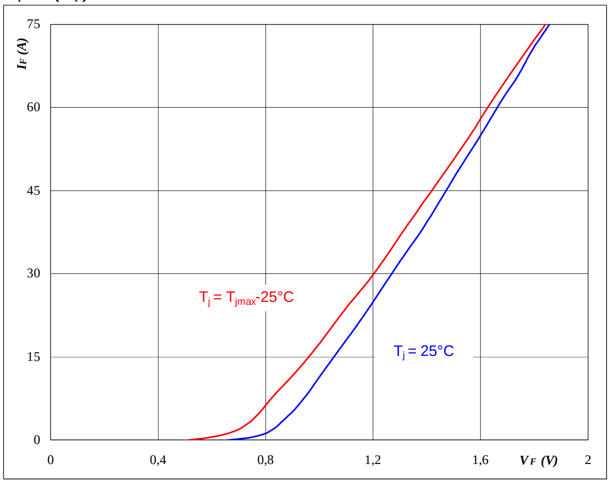
I_C =	35	A

Rectifier Diode

Figure 1 Rectifier Diode diode

Typical diode forward current as a function of forward voltage

$I_F = f(V_F)$



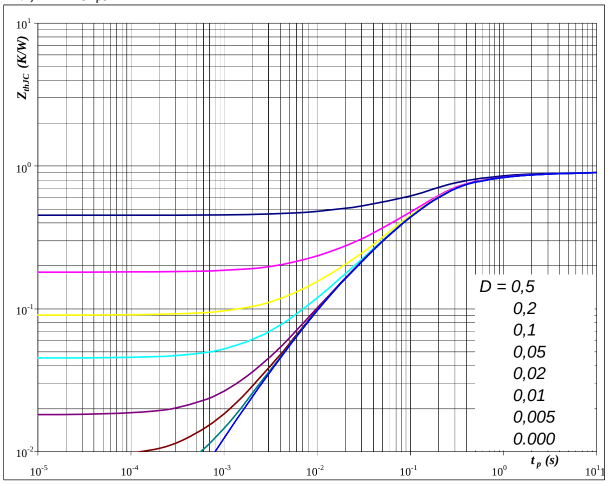
At

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

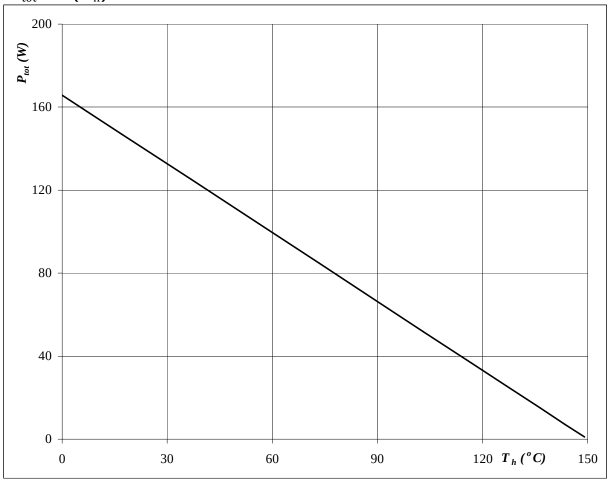
$D = t_p / T$

R_{thJH} = 0,905 K/W

Figure 3 Rectifier Diode diode

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_h)$



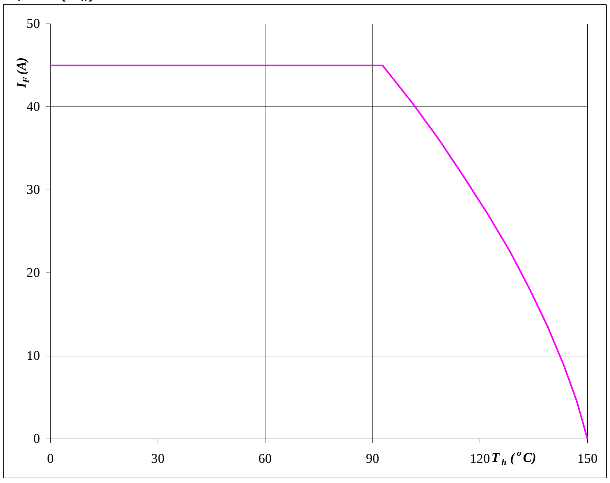
At

T_j = 150 ºC

Figure 4 Rectifier Diode diode

Forward current as a function of heatsink temperature

$I_F = f(T_h)$



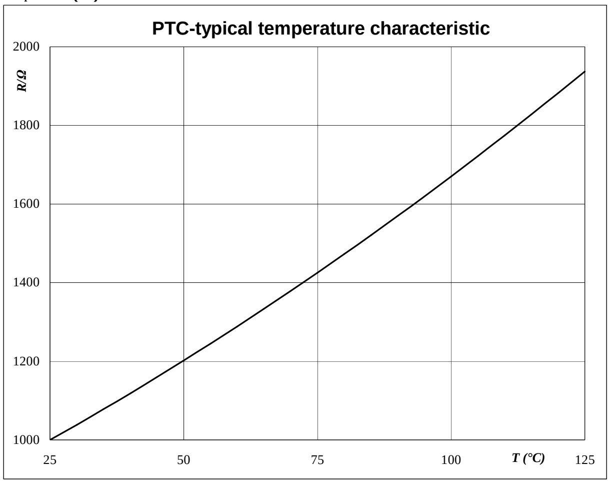
At

T_j = 150 ºC

Thermistor

Figure 1	Thermistor

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



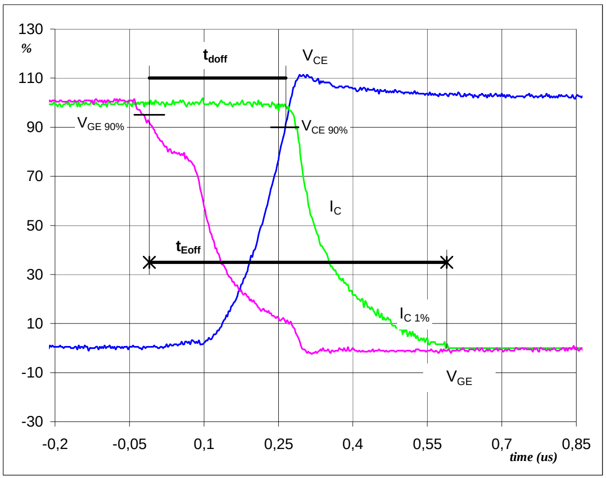
Switching Definitions Inverter

General conditions

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

Figure 1 IGBT

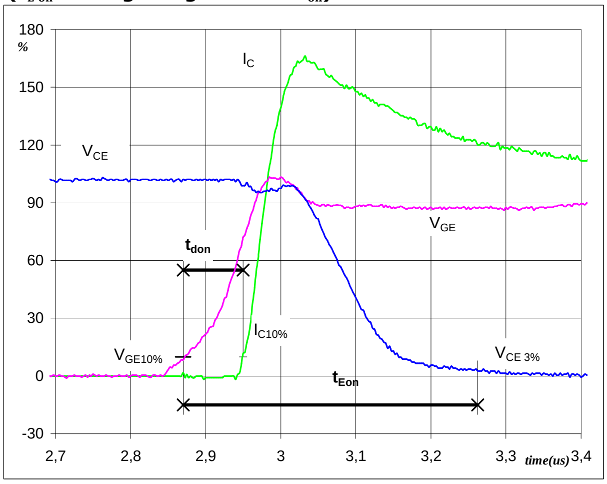
Turn-off Switching Waveforms & definition of t_{doff}, t_{Eoff}
($t_{E\,off}$ = integrating time for E_{off})



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

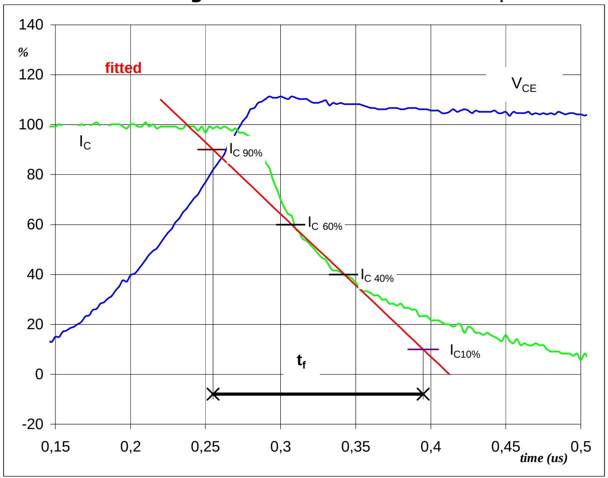
Turn-on Switching Waveforms & definition of t_{don}, t_{Eon}
($t_{E\,on}$ = integrating time for E_{on})



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

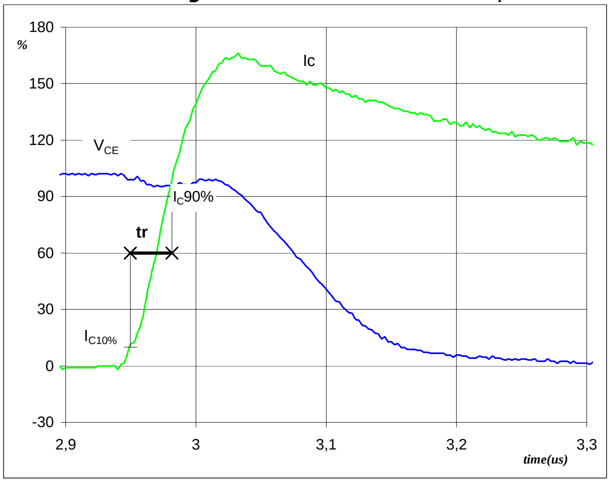
Turn-off Switching Waveforms & definition of t_f



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

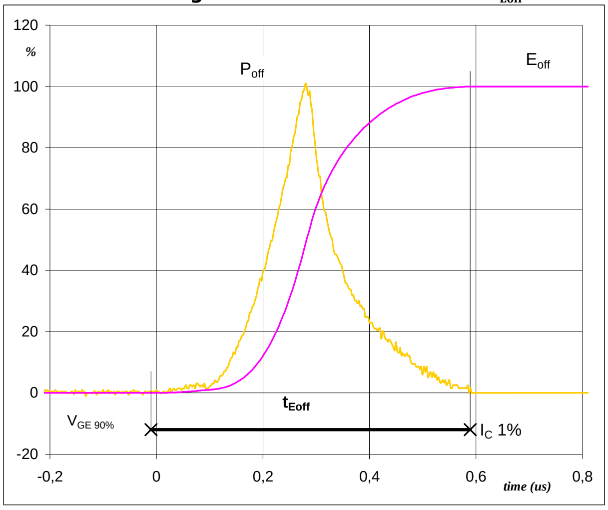


V_C (100%) =	600	V
I_C (100%) =	35	A
t_r =	0,03	µs

Switching Definitions Inverter

Figure 5 IGBT

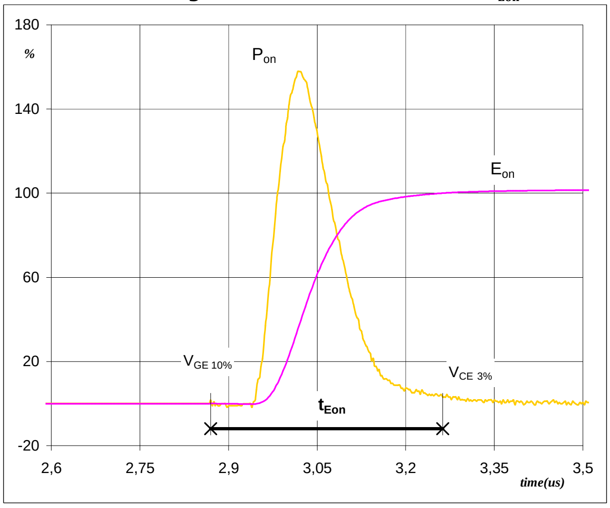
Turn-off Switching Waveforms & definition of t_{Eoff}



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

Figure 6 IGBT

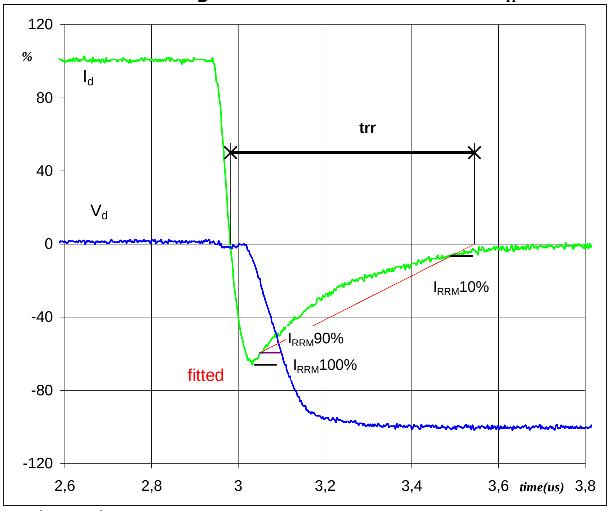
Turn-on Switching Waveforms & definition of t_{Eon}



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}

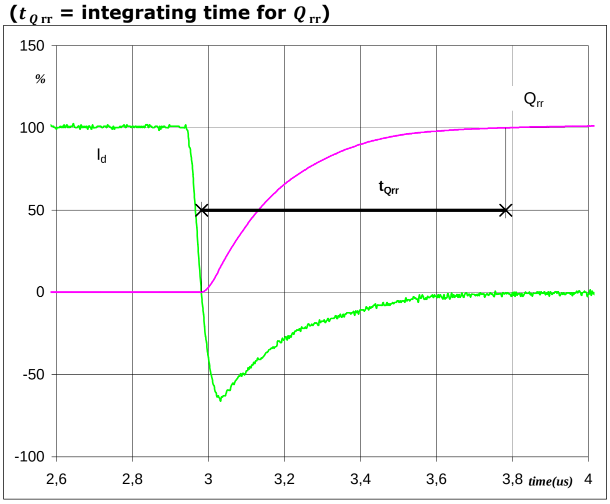


V_d (100%) =	600	V
I_d (100%) =	35	A
I_{RRM} (100%) =	23	A
t_{rr} =	0,57	μs

Switching Definitions Inverter

Figure 8 FWD

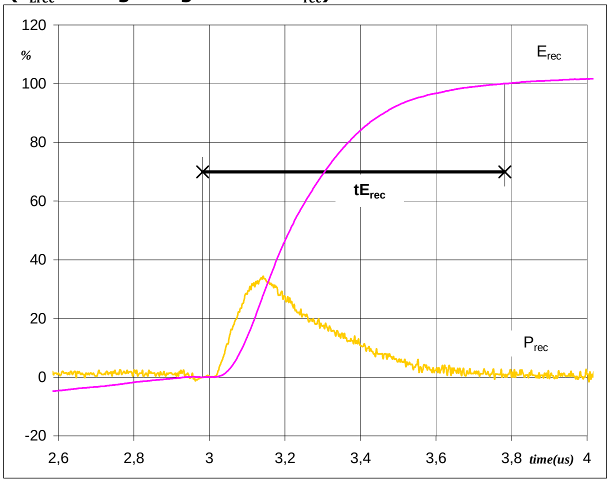
Turn-on Switching Waveforms & definition of t_{Qrr}
($t_{Q\,rr}$ = integrating time for Q_{rr})



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

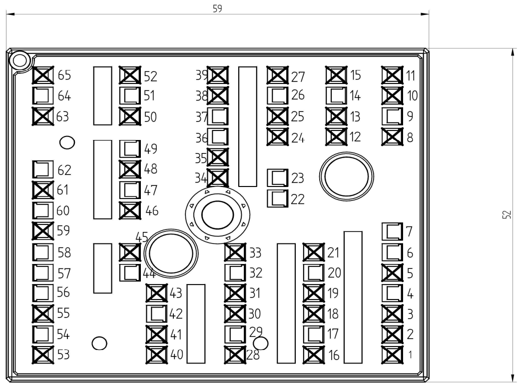
Ordering Code and Marking - Outline - Pinout

Ordering Code & Marking

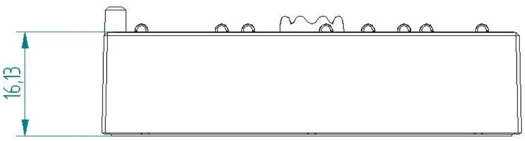
Version	Ordering Code
with std lid (black V23990-K12-T-PM)	V23990-K220-A41-/0A/-PM
with std lid (black V23990-K12-T-PM) and P12	V23990-K220-A41-/1A/-PM
with thin lid (white V23990-K13-T-PM)	V23990-K220-A41-/0B/-PM
with thin lid (white V23990-K13-T-PM) and P12	V23990-K220-A41-/1B/-PM

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

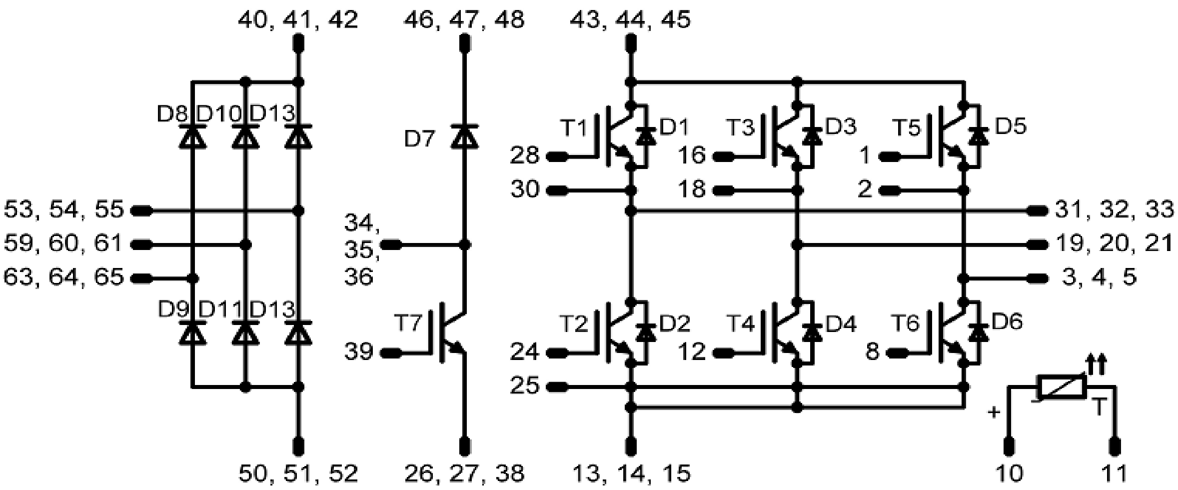
Outline



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