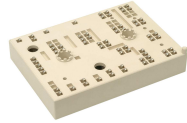
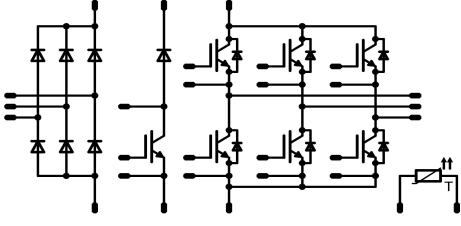




Vincotech

MiniSKiiP® 3 PIM	1200 V / 75 A
<div style="background-color: #eee; padding: 2px; margin-bottom: 5px;">Features</div> <ul style="list-style-type: none"> Solderless interconnection Trench Fieldstop IGBT4 technology 	<div style="background-color: #eee; padding: 2px; margin-bottom: 5px;">MiniSKiiP® 3 housing</div> 
<div style="background-color: #eee; padding: 2px; margin-bottom: 5px;">Target Applications</div> <ul style="list-style-type: none"> Industrial Motor Drives 	<div style="background-color: #eee; padding: 2px; margin-bottom: 5px;">Schematic</div> 
<div style="background-color: #eee; padding: 2px; margin-bottom: 5px;">Types</div> <ul style="list-style-type: none"> V23990-K429-A40-PM 	

Maximum Ratings

$T_j = 25\text{ °C}$, unless otherwise specified

Parameter	Symbol	Condition	Value	Unit
Rectifier Diode				
Repetitive peak reverse voltage	V_{RRM}		1600	V
DC forward current	I_{FAV}	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	69	A
Surge (non-repetitive) forward current	I_{FSM}	$t_p = 10\text{ ms}$ $T_j = 25\text{ °C}$	450	A
I^2t -value	I^2t		1020	A^2s
Power dissipation	P_{tot}	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	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	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	68	A
Repetitive peak collector current	I_{CRM}	t_p limited by T_{jmax}	225	A
Power dissipation	P_{tot}	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	162	W
Gate-emitter peak voltage	V_{GE}		±20	V
Short circuit ratings	t_{SC} V_{CC}	$T_j = 150\text{ °C}$ $V_{GE} = 15\text{ V}$	10 800	μs V
Maximum Junction Temperature	T_{jmax}		175	°C



Maximum Ratings

$T_j = 25\text{ °C}$, unless otherwise specified

Parameter	Symbol	Condition	Value	Unit
Inverter Diode / Brake Diode				
Repetitive peak reverse voltage	V_{RRM}		1200	V
DC forward current	I_F	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	67	A
Repetitive peak forward current	I_{FRM}	t_p limited by T_{jmax}	225	A
Power dissipation	P_{tot}	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	131	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}	$t = 2\text{ s}$ 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				35	25 125	0,8	1,03 0,93	1,35	V
Threshold voltage (for power loss calc. only)	V_{to}					25 125		0,92 0,79		V
Slope resistance (for power loss calc. only)	r_t					25 125		0,004 0,005		Ω
Reverse current	I_r			1500		25 125			0,1 1,1	mA
Thermal resistance junction to sink	$R_{th(j-s)}$	Thermal grease thickness ≤ 50 μm λ = 1 W/mK						0,90		K/W

Inverter Switch / Brake Switch

Gate emitter threshold voltage	$V_{GE(th)}$	$V_{CE} = V_{GE}$			0,003	25 150		5	5,8	6,5	V
Collector-emitter saturation voltage	$V_{CE(sat)}$		15		75	25 150	1,6	1,97 2,42	2,4		V
Collector-emitter cut-off current incl. Diode	I_{CES}		0	1200		25 150			0,1		mA
Gate-emitter leakage current	I_{GES}		20	0		25 150			600		nA
Integrated Gate resistor	R_{gint}							10			Ω
Turn-on delay time	$t_{d(on)}$	$R_{gon} = 4 \Omega$	±15	600	75	25		173		ns	
Rise time	t_r					150		189			
Turn-off delay time	$t_{d(off)}$					25		284			
Fall time	t_f					150		359			
Turn-on energy loss	E_{on}					25		78			
Turn-off energy loss	E_{off}	150		120		6,51 10,61				mWs	
Input capacitance	C_{ies}	$f = 1 \text{ MHz}$	0	25	25			4400		pF	
Output capacitance	C_{oss}							290			
Reverse transfer capacitance	C_{rss}							235			
Gate charge	Q_G		±15			25		570		nC	
Thermal resistance junction to sink	$R_{th(j-s)}$	Thermal grease thickness ≤ 50 μm λ = 1 W/mK						0,58		K/W	

Inverter Diode / Brake Diode

Diode forward voltage	V_F				75	25 150	1,5	2,01 2,05	2,8	V
Peak reverse recovery current	I_{RRM}	$R_{gon} = 4 \Omega$	±15	600	75	25		57,3		A
Reverse recovery time	t_{rr}					150		68,4		
Reverse recovered charge	Q_{rr}					25		310		
Peak rate of fall of recovery current	$(di_{rr}/dt)_{max}$					150		602		
Reverse recovered energy	E_{rec}					25		6,29 14,8		
Thermal resistance junction to sink	$R_{th(j-s)}$	Thermal grease thickness ≤ 50 μm λ = 1 W/mK						0,75		K/W

Thermistor

Rated resistance	R					25		1000		Ω
Deviation of R_{100}	$\Delta_{R/R}$	$R_{100} = 1670 \Omega$				100	-3		3	%
R_{100}	P					100		1670,3125		Ω
Power dissipation constant						25				mW/K
A-value	$B_{(25/50)}$	Tol. %				25		$7,635 \cdot 10^{-3}$		1/K
B-value	$B_{(25/100)}$	Tol. %				25		$1,731 \cdot 10^{-5}$		1/K ²
Vincotech PTC Reference									E	

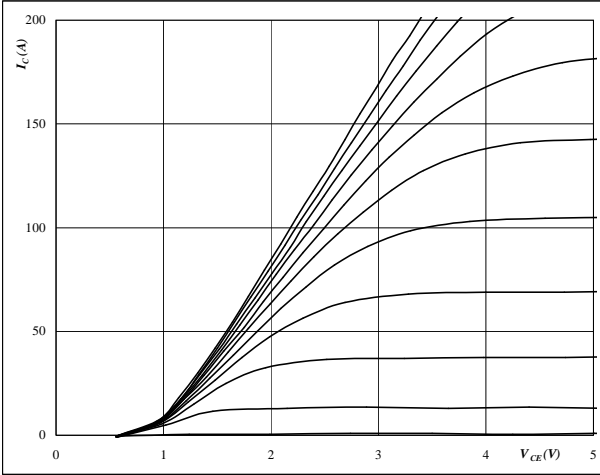


Inverter / Brake Characteristics

Figure 1 IGBT

Typical output characteristics

$I_C = f(V_{CE})$



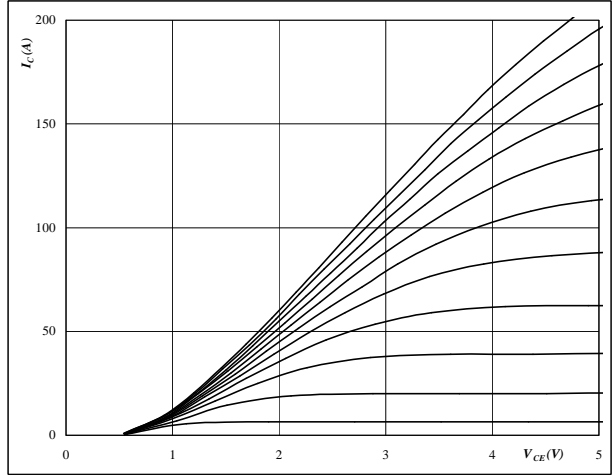
At

$t_p = 250 \mu s$
 $T_j = 25 \text{ } ^\circ C$
 V_{GE} from 7 V to 17 V in steps of 1 V

Figure 2 IGBT

Typical output characteristics

$I_C = f(V_{CE})$



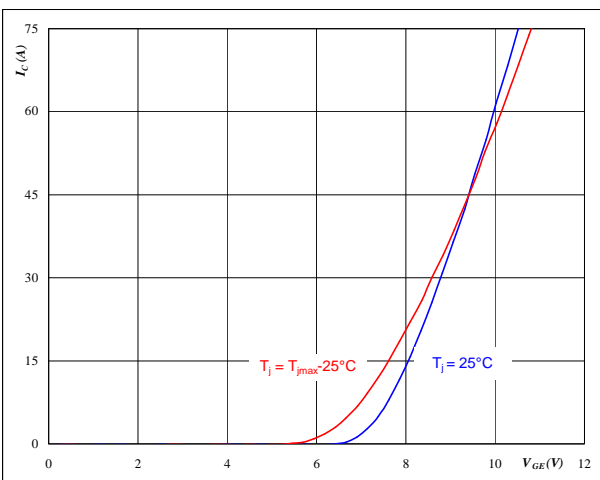
At

$t_p = 250 \mu s$
 $T_j = 150 \text{ } ^\circ C$
 V_{GE} from 7 V to 17 V in steps of 1 V

Figure 3 IGBT

Typical transfer characteristics

$I_C = f(V_{GE})$



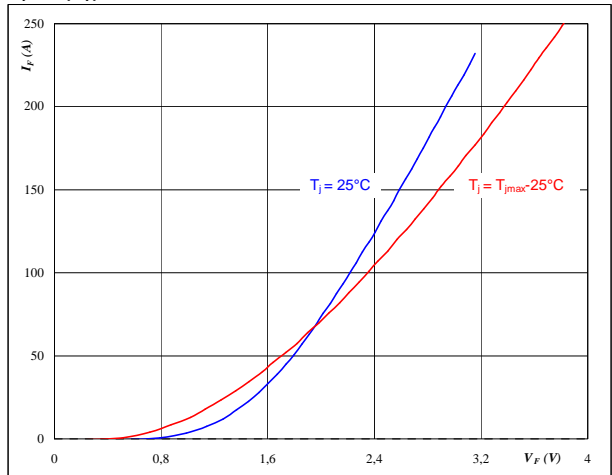
At

$t_p = 250 \mu s$
 $V_{CE} = 10 V$

Figure 4 FWD

Typical diode forward current as a function of forward voltage

$I_F = f(V_F)$



At

$t_p = 250 \mu s$

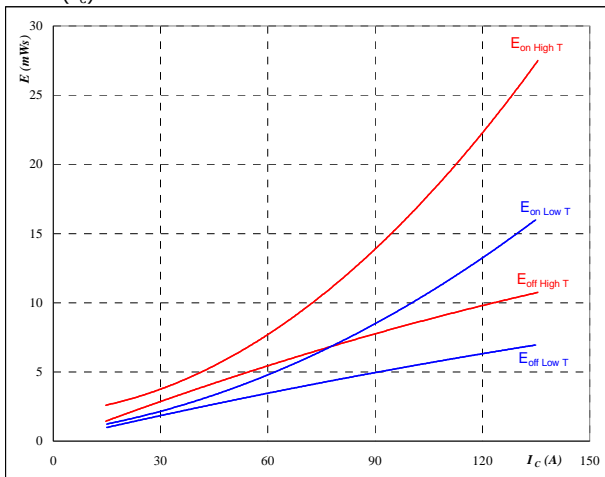


Inverter / Brake Characteristics

Figure 5 IGBT

Typical switching energy losses
as a function of collector current

$$E = f(I_C)$$



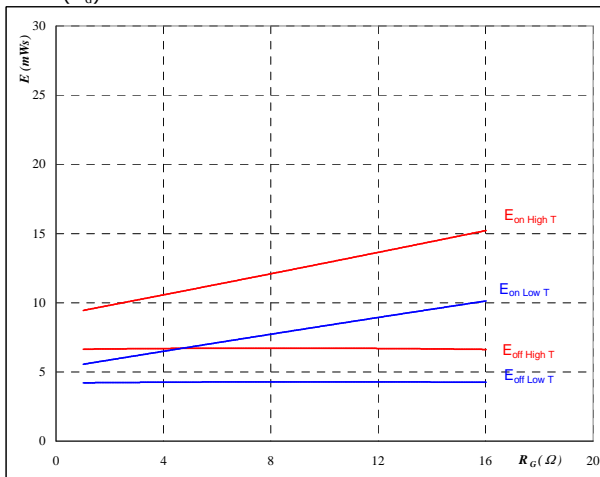
With an inductive load at

$T_j = 25/150$ °C
 $V_{CE} = 600$ V
 $V_{GE} = \pm 15$ V
 $R_{gon} = 4$ Ω
 $R_{goff} = 4$ Ω

Figure 6 IGBT

Typical switching energy losses
as a function of gate resistor

$$E = f(R_G)$$



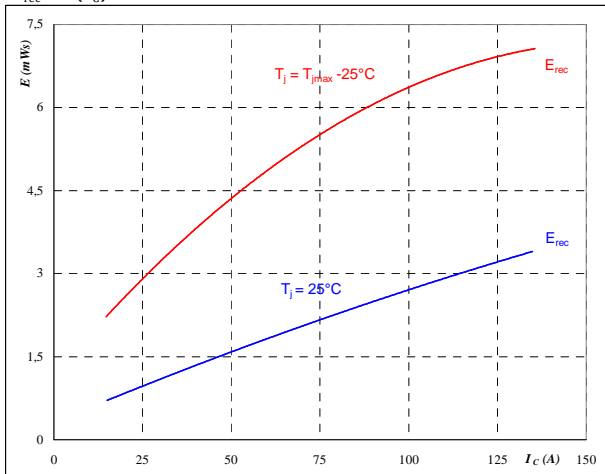
With an inductive load at

$T_j = 25/150$ °C
 $V_{CE} = 600$ V
 $V_{GE} = \pm 15$ V
 $I_C = 75$ A

Figure 7 FWD

Typical reverse recovery energy loss
as a function of collector current

$$E_{rec} = f(I_C)$$



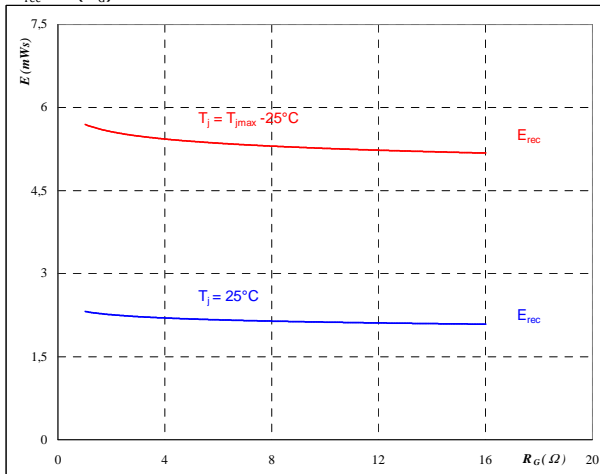
With an inductive load at

$T_j = 25/150$ °C
 $V_{CE} = 600$ V
 $V_{GE} = \pm 15$ V
 $R_{gon} = 4$ Ω

Figure 8 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
 $V_{GE} = \pm 15$ V
 $I_C = 75$ A

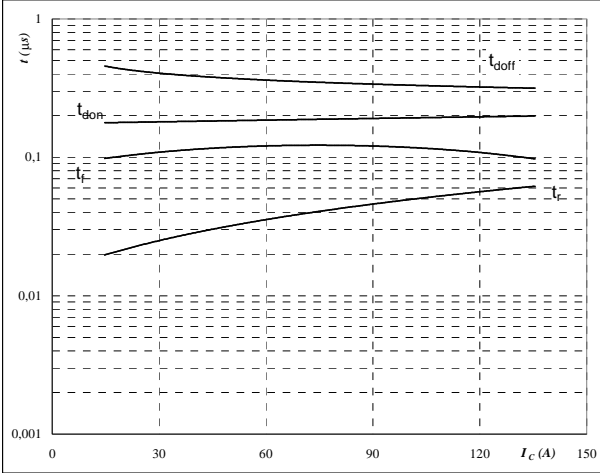


Inverter / Brake Characteristics

Figure 9 IGBT

Typical switching times as a function of collector current

$$t = f(I_C)$$



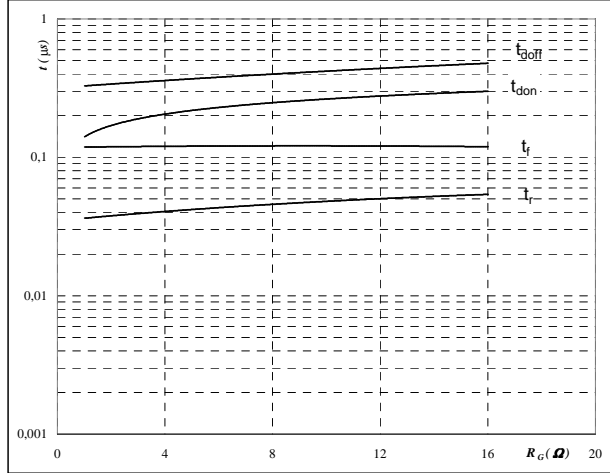
With an inductive load at

$T_j =$	150	°C
$V_{CE} =$	600	V
$V_{GE} =$	±15	V
$R_{gon} =$	4	Ω
$R_{goff} =$	4	Ω

Figure 10 IGBT

Typical switching times as a function of gate resistor

$$t = f(R_G)$$



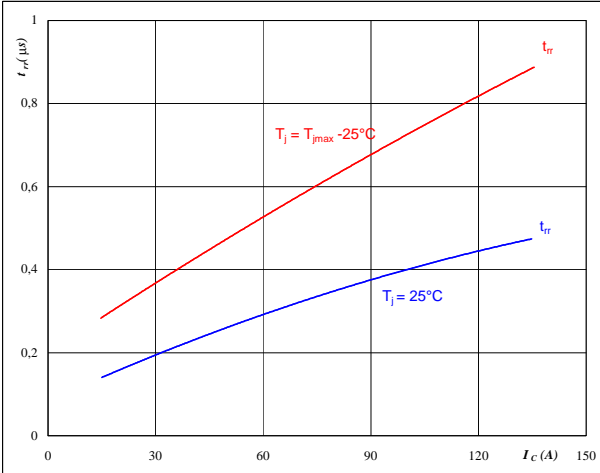
With an inductive load at

$T_j =$	150	°C
$V_{CE} =$	600	V
$V_{GE} =$	±15	V
$I_C =$	75	A

Figure 11 FWD

Typical reverse recovery time as a function of collector current

$$t_{rr} = f(I_C)$$



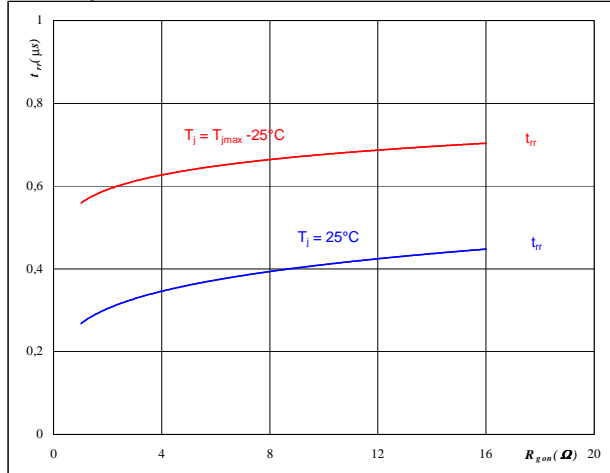
At

$T_j =$	25/150	°C
$V_{CE} =$	600	V
$V_{GE} =$	±15	V
$R_{gon} =$	4	Ω

Figure 12 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
$I_F =$	75	A
$V_{GE} =$	±15	V

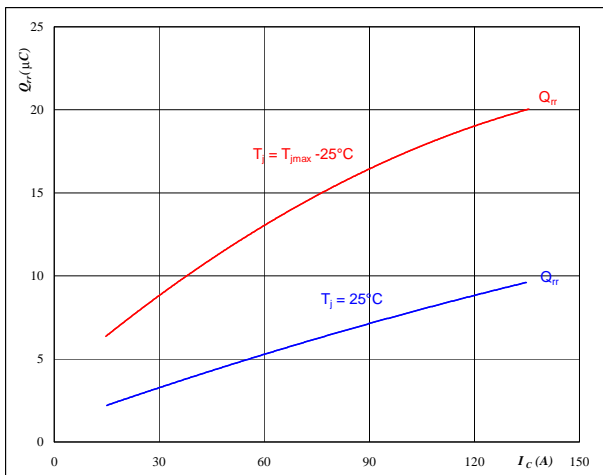


Inverter / Brake Characteristics

Figure 13 FWD

Typical reverse recovery charge as a function of collector current

$$Q_{rr} = f(I_c)$$



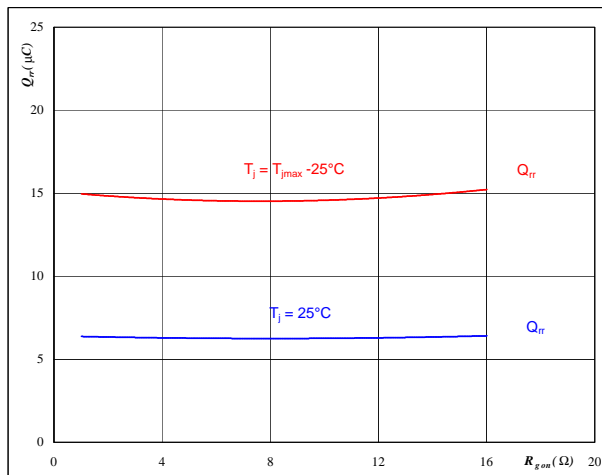
At

$T_j =$	25/150	°C
$V_{CE} =$	600	V
$V_{GE} =$	±15	V
$R_{gon} =$	4	Ω

Figure 14 FWD

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

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



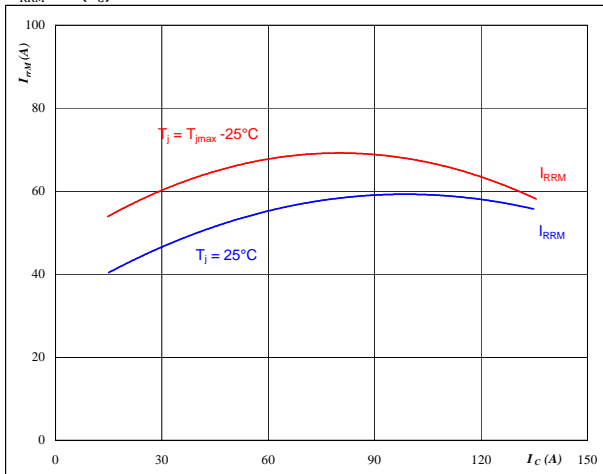
At

$T_j =$	25/150	°C
$V_R =$	600	V
$I_F =$	75	A
$V_{GE} =$	±15	V

Figure 15 FWD

Typical reverse recovery current as a function of collector current

$$I_{RRM} = f(I_c)$$



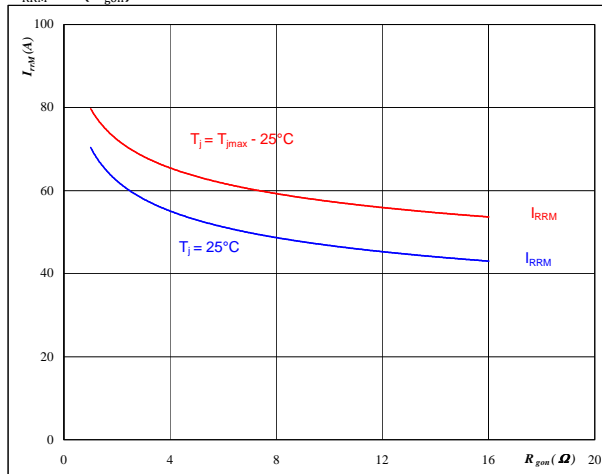
At

$T_j =$	25/150	°C
$V_{CE} =$	600	V
$V_{GE} =$	±15	V
$R_{gon} =$	4	Ω

Figure 16 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
$I_F =$	75	A
$V_{GE} =$	±15	V

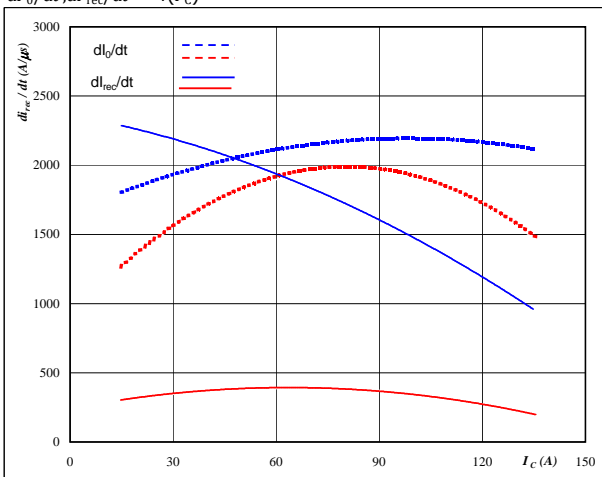


Inverter / Brake Characteristics

Figure 17 FWD

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

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

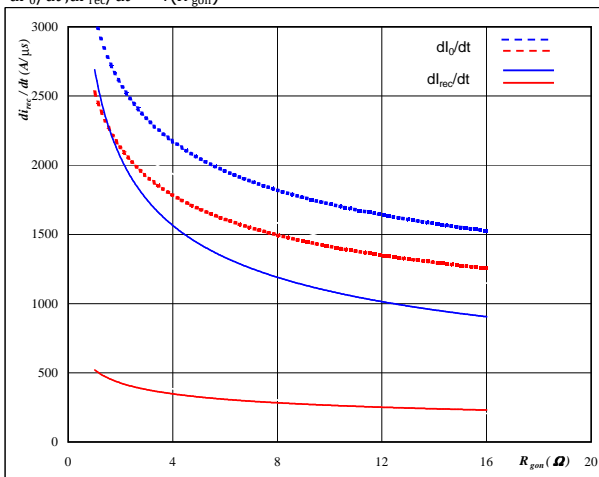


At
 $T_j = 25/150$ °C
 $V_{CE} = 600$ V
 $V_{GE} = \pm 15$ V
 $R_{gon} = 4$ Ω

Figure 18 FWD

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

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

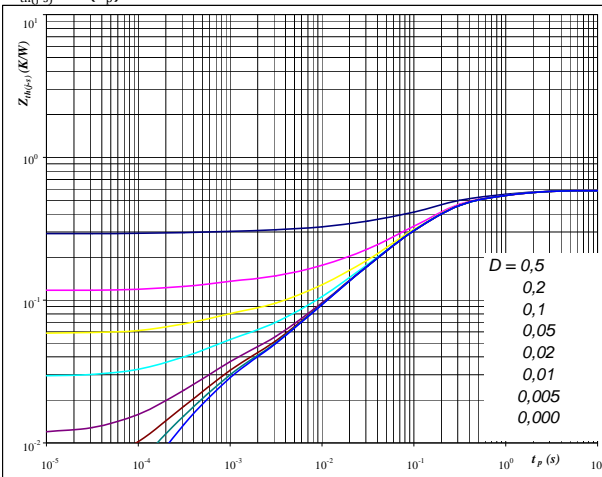


At
 $T_j = 25/150$ °C
 $V_R = 600$ V
 $I_F = 75$ A
 $V_{GE} = \pm 15$ V

Figure 19 IGBT

IGBT transient thermal impedance as a function of pulse width

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



At
 $D = t_p / T$
 $R_{th(j-s)} = 0,58$ K/W

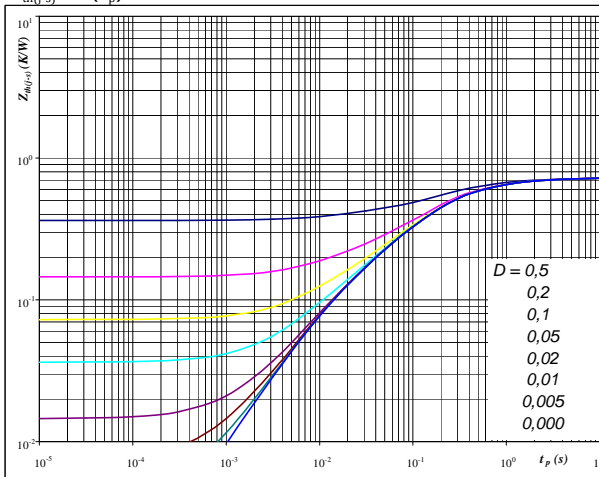
IGBT thermal model values

R (K/W)	Tau (s)
0,11	1,0E+00
0,33	1,5E-01
0,08	3,6E-02
0,04	7,3E-03
0,02	4,9E-04

Figure 20 FWD

FWD transient thermal impedance as a function of pulse width

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



At
 $D = t_p / T$
 $R_{th(j-s)} = 0,75$ K/W

FWD thermal model values

R (K/W)	Tau (s)
0,04	5,1E+00
0,12	9,5E-01
0,38	2,0E-01
0,12	6,1E-02
0,07	1,1E-02

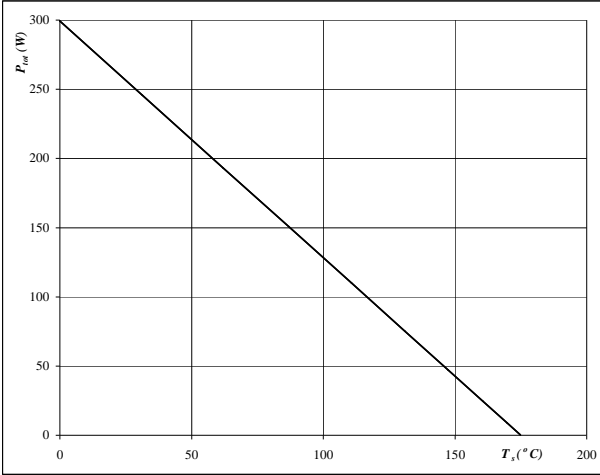


Inverter / Brake Characteristics

Figure 21 IGBT

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_s)$

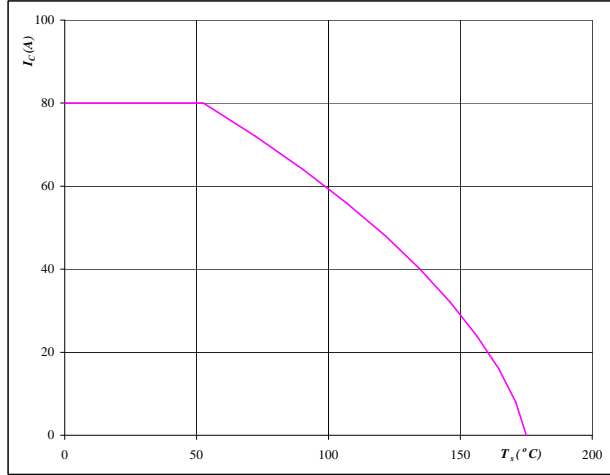


At
 $T_j = 175$ °C

Figure 22 IGBT

Collector current as a function of heatsink temperature

$I_c = f(T_s)$

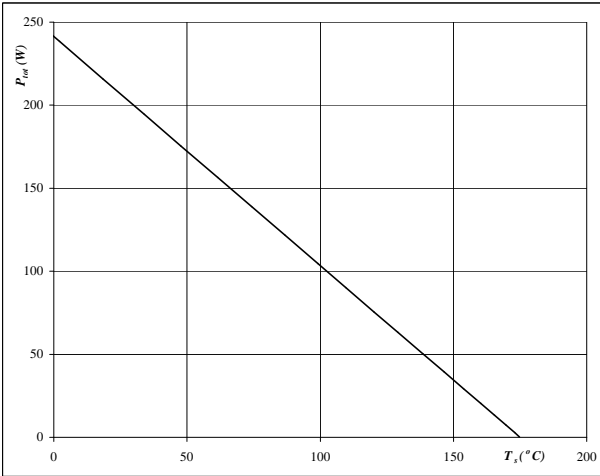


At
 $T_j = 175$ °C
 $V_{GE} = 15$ V

Figure 23 FWD

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_s)$

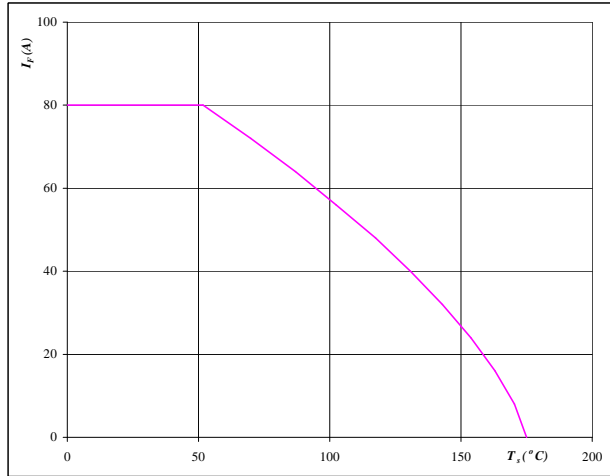


At
 $T_j = 175$ °C

Figure 24 FWD

Forward current as a function of heatsink temperature

$I_F = f(T_s)$



At
 $T_j = 175$ °C

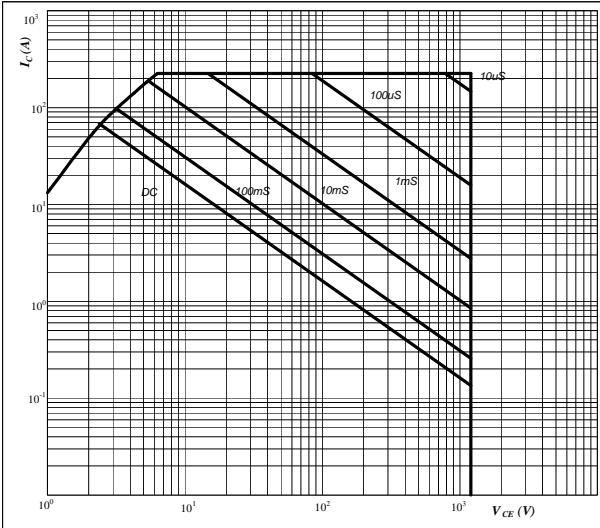


Inverter / Brake Characteristics

Figure 25 IGBT

Safe operating area as a function of collector-emitter voltage

$$I_C = f(V_{CE})$$

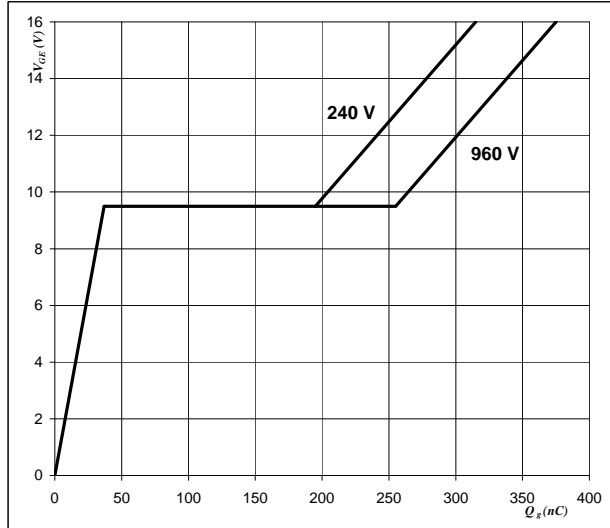


At
 $D =$ single pulse
 $T_s = 80$ °C
 $V_{GE} = \pm 15$ V
 $T_j = T_{jmax}$

Figure 26 IGBT

Gate voltage vs Gate charge

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



At
 $I_C = 75$ A

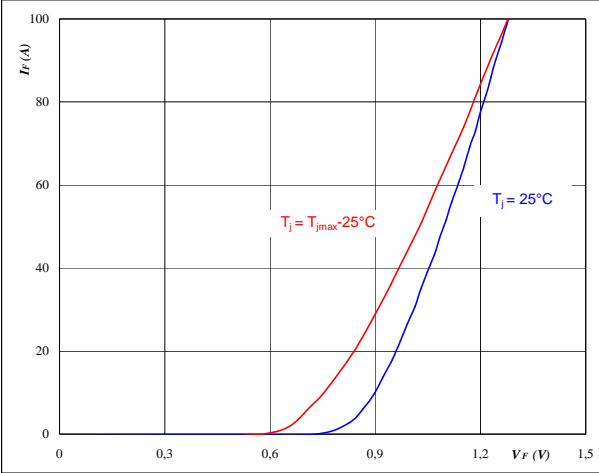


Rectifier Diode

Figure 1 Diode

Typical diode forward current as a function of forward voltage

$$I_F = f(V_F)$$

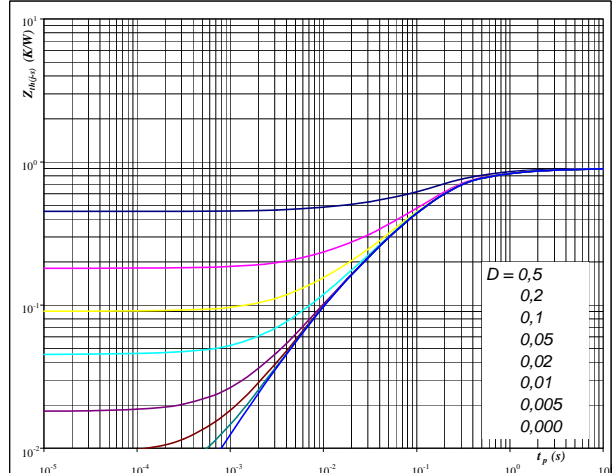


At $t_p = 250 \mu s$

Figure 2 Diode

Diode transient thermal impedance as a function of pulse width

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

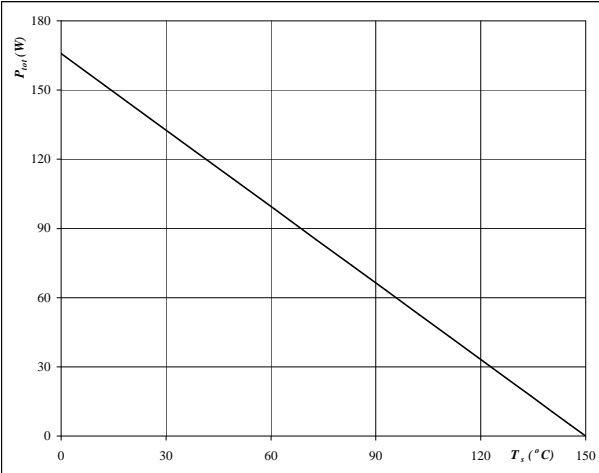


At $D = t_p / T$
 $R_{th(j-s)} = 0,90 \text{ K/W}$

Figure 3 Diode

Power dissipation as a function of heatsink temperature

$$P_{tot} = f(T_s)$$

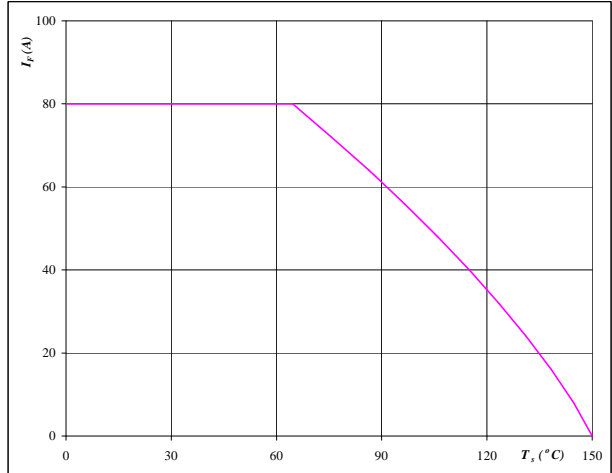


At $T_j = 150 \text{ °C}$

Figure 4 Diode

Forward current as a function of heatsink temperature

$$I_F = f(T_s)$$



At $T_j = 150 \text{ °C}$

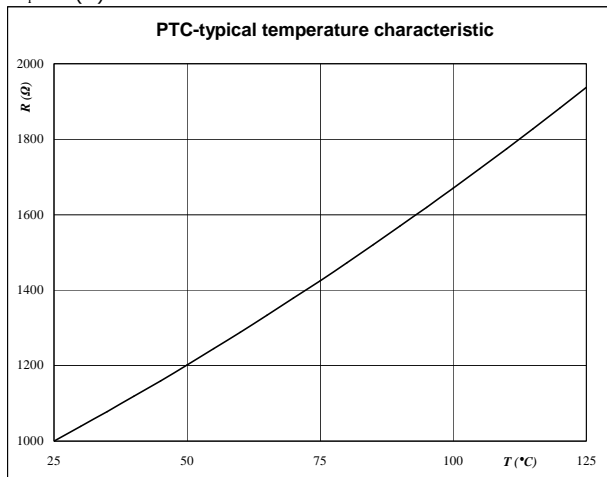


Thermistor

Figure 1 Thermistor

**Typical PTC characteristic
as a function of temperature**

$$R_T = f(T)$$





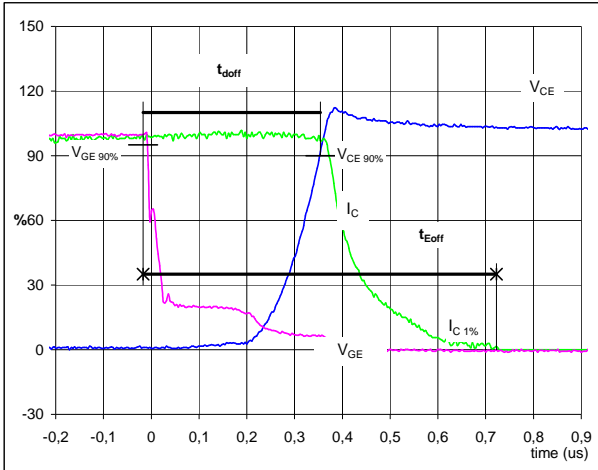
Switching Definitions Inverter

General conditions

T_j	=	150 °C
R_{gon}	=	4 Ω
R_{goff}	=	4 Ω

Figure 1 IGBT

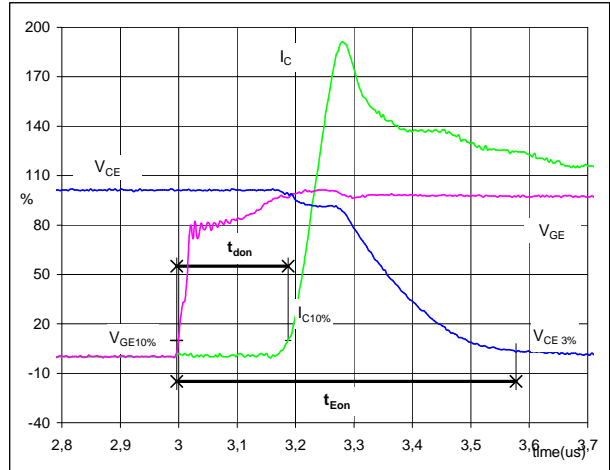
Turn-off Switching Waveforms & definition of t_{doff} , t_{Eoff}
(t_{Eoff} = integrating time for E_{off})



V_{GE} (0%) =	-15	V
V_{GE} (100%) =	15	V
V_C (100%) =	600	V
I_C (100%) =	75	A
t_{doff} =	0,36	μs
t_{Eoff} =	0,74	μs

Figure 2 IGBT

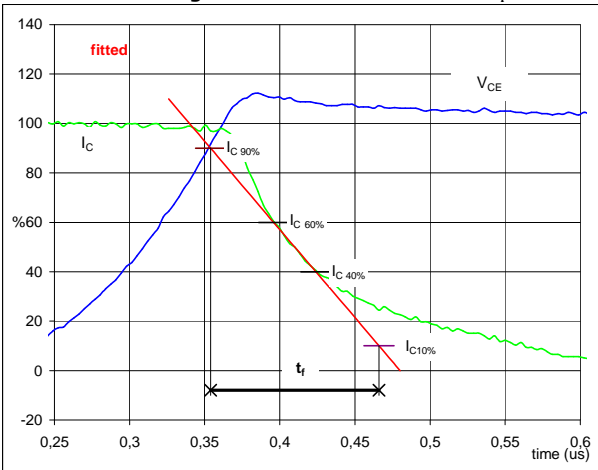
Turn-on Switching Waveforms & definition of t_{donr} , t_{Eon}
(t_{Eon} = integrating time for E_{on})



V_{GE} (0%) =	-15	V
V_{GE} (100%) =	15	V
V_C (100%) =	600	V
I_C (100%) =	75	A
t_{donr} =	0,19	μs
t_{Eon} =	0,58	μs

Figure 3 IGBT

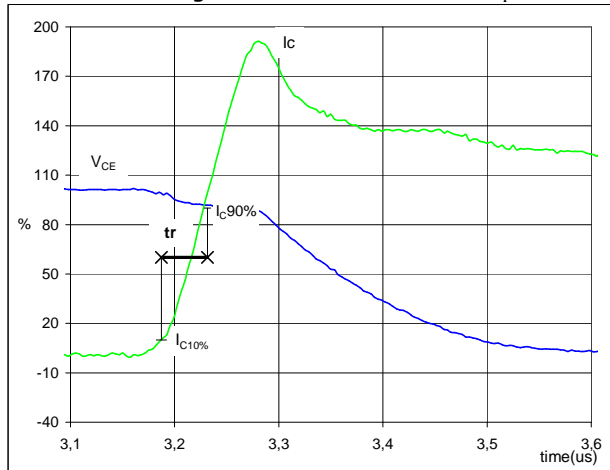
Turn-off Switching Waveforms & definition of t_f



V_C (100%) =	600	V
I_C (100%) =	75	A
t_f =	0,12	μs

Figure 4 IGBT

Turn-on Switching Waveforms & definition of t_r

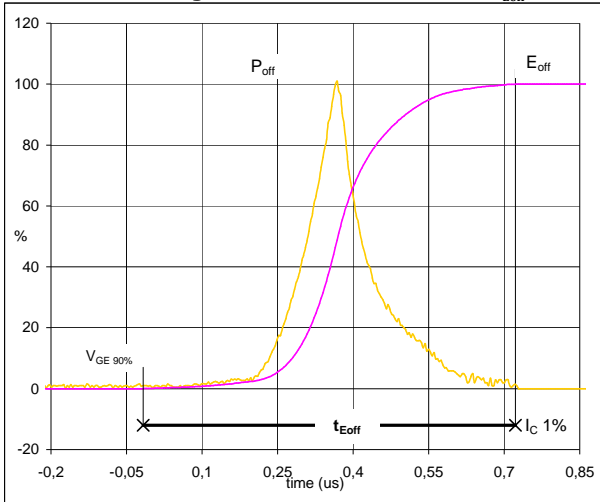


V_C (100%) =	600	V
I_C (100%) =	75	A
t_r =	0,04	μs



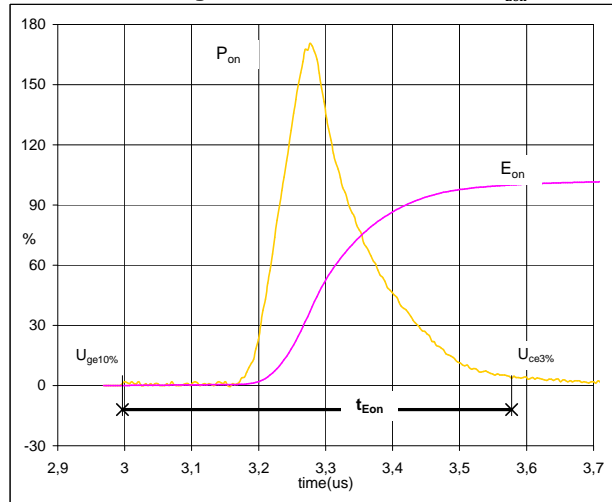
Switching Definitions Inverter

Figure 5 IGBT
Turn-off Switching Waveforms & definition of t_{Eoff}



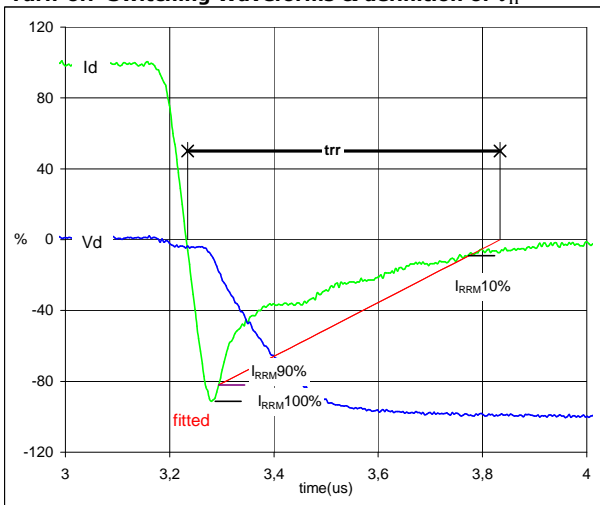
$P_{off} (100\%) = 45,10 \text{ kW}$
 $E_{off} (100\%) = 6,68 \text{ mJ}$
 $t_{Eoff} = 0,74 \text{ } \mu\text{s}$

Figure 6 IGBT
Turn-on Switching Waveforms & definition of t_{Eon}



$P_{on} (100\%) = 45,10 \text{ kW}$
 $E_{on} (100\%) = 10,61 \text{ mJ}$
 $t_{Eon} = 0,58 \text{ } \mu\text{s}$

Figure 7 FWD
Turn-off Switching Waveforms & definition of t_{tr}



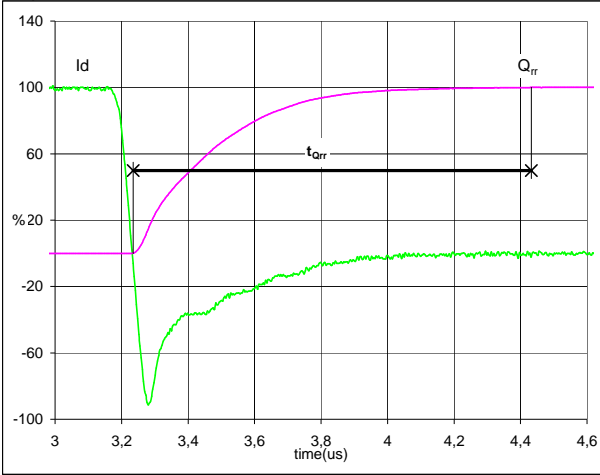
$V_d (100\%) = 600 \text{ V}$
 $I_d (100\%) = 75 \text{ A}$
 $I_{RRM} (100\%) = -68 \text{ A}$
 $t_{tr} = 0,60 \text{ } \mu\text{s}$



Switching Definitions Inverter

Figure 8 FWD

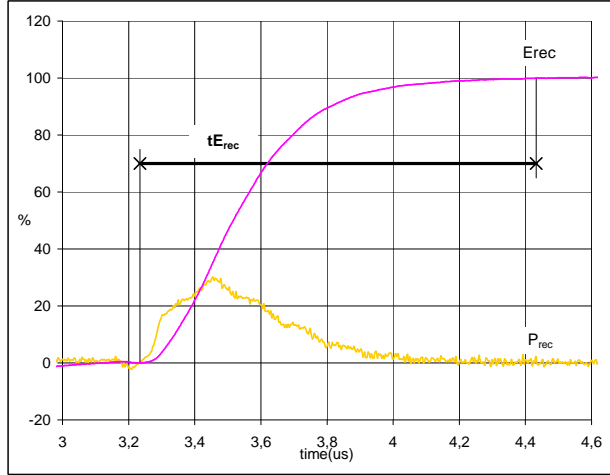
Turn-on Switching Waveforms & definition of t_{Qrr}
(t_{Qrr} = integrating time for Q_{rr})



I_d (100%) =	75	A
Q_{rr} (100%) =	14,81	μC
t_{Qrr} =	1,20	μs

Figure 9 FWD

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

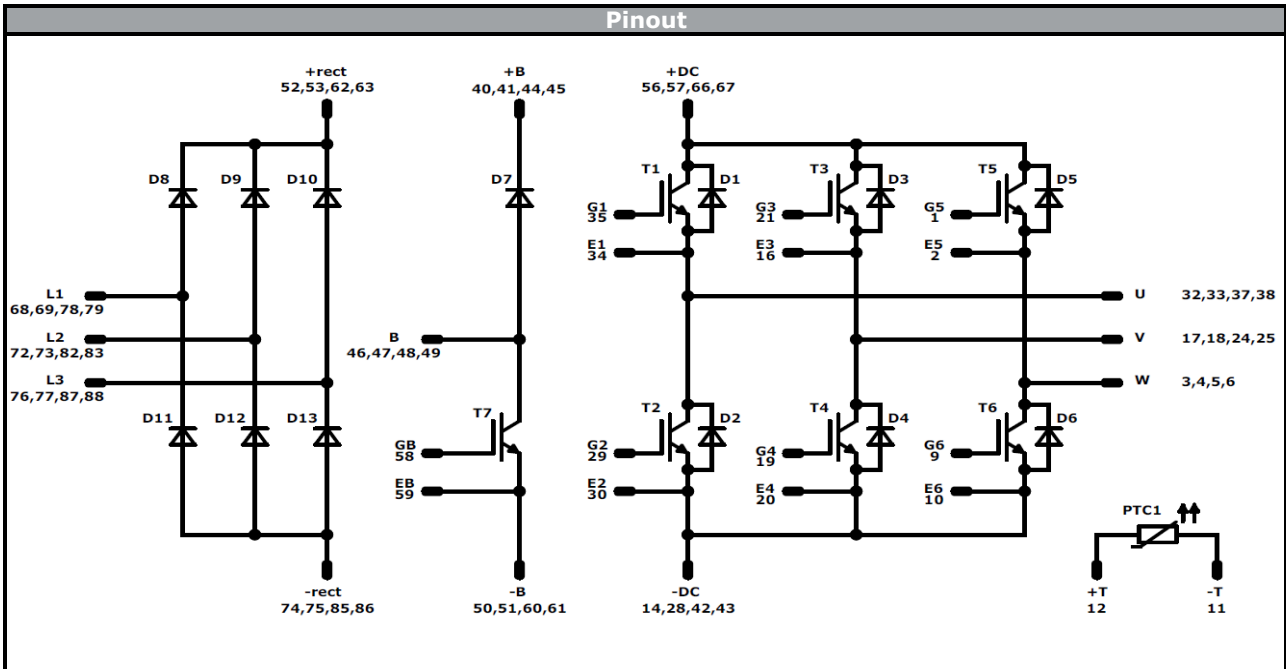
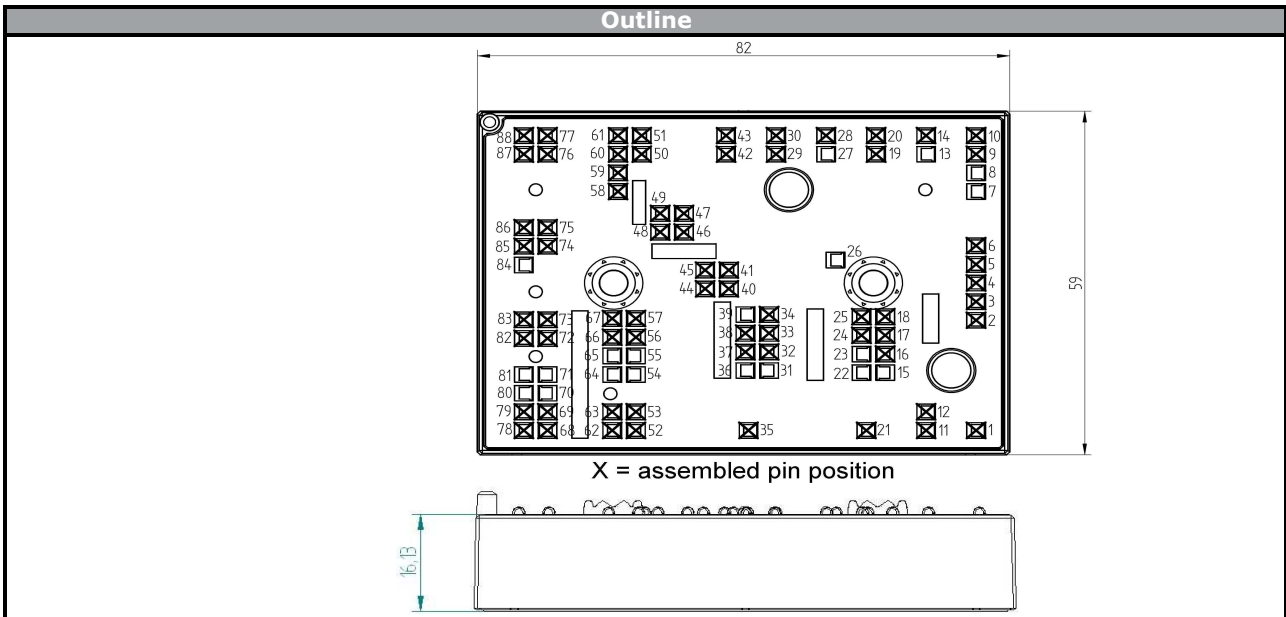


P_{rec} (100%) =	45,10	kW
E_{rec} (100%) =	5,51	mJ
t_{Erec} =	1,20	μs



Ordering Code and Marking - Outline - Pinout

Ordering Code & Marking																											
Version	Ordering Code																										
with std lid (black V23990-K32-T-PM)	V23990-K429-A40-/0A/-PM																										
with std lid (black V23990-K32-T-PM) and P12	V23990-K429-A40-/1A/-PM																										
with thin lid (white V23990-K33-T-PM)	V23990-K429-A40-/0B/-PM																										
with thin lid (white V23990-K33-T-PM) and P12	V23990-K429-A40-/1B/-PM																										
	<table border="1"> <tr> <td rowspan="2">Text</td> <td>VIN</td> <td>Date code</td> <td>Name&Ver</td> <td>UL</td> <td>Lot</td> <td>Serial</td> </tr> <tr> <td>VIN</td> <td>WYYY</td> <td>NNNNNV</td> <td>UL</td> <td>LLLL</td> <td>SSSS</td> </tr> <tr> <td rowspan="2">Datamatrix</td> <td>Type&Ver</td> <td>Lot number</td> <td>Serial</td> <td>Date code</td> <td></td> <td></td> </tr> <tr> <td>TTTTTIV</td> <td>LLLL</td> <td>SSSS</td> <td>WYYY</td> <td></td> <td></td> </tr> </table>	Text	VIN	Date code	Name&Ver	UL	Lot	Serial	VIN	WYYY	NNNNNV	UL	LLLL	SSSS	Datamatrix	Type&Ver	Lot number	Serial	Date code			TTTTTIV	LLLL	SSSS	WYYY		
	Text		VIN	Date code	Name&Ver	UL	Lot	Serial																			
VIN		WYYY	NNNNNV	UL	LLLL	SSSS																					
Datamatrix	Type&Ver	Lot number	Serial	Date code																							
	TTTTTIV	LLLL	SSSS	WYYY																							




Identification					
ID	Component	Voltage	Current	Function	Comment
T1,T2,T3,T4,T5,T6	IGBT	1200 V	75 A	Inverter Switch	
D1,D2,D3,D4,D5,D6	FWD	1200 V	75 A	Inverter Diode	
T7	IGBT	1200 V	75 A	Brake Switch	
D7	FWD	1200 V	75 A	Brake Diode	
D8,D9,D10,D11,D12,D13	Rectifier	1600 V	50 A	Rectifier Diode	
PTC1	PTC			Thermistor	



Packaging instruction			
Standard packaging quantity (SPQ)	120	>SPQ Standard	<SPQ Sample

Handling instruction
Handling instructions for MiniSkiiP® 1 packages see vincotech.com website.

Package data
Package data for MiniSkiiP® 1 packages see vincotech.com website.

UL recognition and file number
This device is certified according to UL 1557 standard, UL file number E192116. For more information see vincotech.com website. 

Document No.:	Date:	Modification:	Pages
V23990-K429-A40-D6-14	29 Jun. 2016		

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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.