V23990-K243-A-PM
datasheet

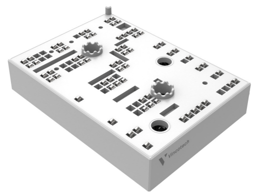
Vincotech

MiniSKiiP® PIM 3	600 V / 100 A

Features

- IGBT3 technology for low saturation losses
- Solderless spring contact mounting system

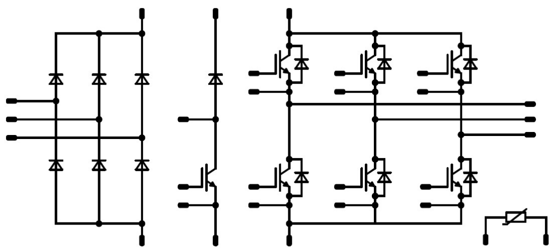
MiniSkiip® 3 housing



Target applications

- Industrial motor drives

Schematic



Types

- V23990-K243-A-PM

Maximum Ratings

T_j = 25 °C, unless otherwise specified

Parameter	Symbol	Condition		Value	Unit
D8,D9,D10,D11,D12,D13					
Peak repetitive reverse voltage	V_{RRM}			1600	V
Continuous (direct) forward current	I_F	$T_j = T_{jmax}$	T_s = 80 °C	71	A
Surge (non-repetitive) forward current	I_{FSM}	t_p = 10 ms	T_j = 25°C	700	A
Surge current capability	I^2t			2450	A^2s
Total power dissipation	P_{tot}	$T_j = T_{jmax}$	T_s = 80 °C	93	W
Maximum junction temperature	T_{jmax}			150	°C

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Maximum Ratings

T_j = 25 °C, unless otherwise specified

Parameter	Symbol	Condition	Value	Unit
T1,T2,T3,T4,T5,T6,T7				
Collector-emitter voltage	V_{CES}		600	V
Collector current	I_C	$T_j = T_{jmax}$ T_s = 80 °C	104	A
Repetitive peak collector current	I_{CRM}	t_p limited by T_{jmax}	300	A
Turn off safe operating area		V_{CE} ≤ 1200 V, $T_j \leq T_{op}$ max	300	A
Total power dissipation	P_{tot}	$T_j = T_{jmax}$ T_s = 80 °C	201	W
Gate-emitter voltage	V_{GES}		±20	V
Short circuit ratings	t_{SC}	V_{GE} = 15 V Vcc = 360 V T_j = 150 °C	6	μs
Maximum junction temperature	T_{jmax}		175	°C
D1,D2,D3,D4,D5,D6,D7				
Peak repetitive reverse voltage	V_{RRM}		600	V
Continuous (direct) forward current	I_F	$T_j = T_{jmax}$ T_s = 80 °C	103	A
Repetitive peak forward current	I_{FRM}	t_p limited by T_{jmax}	985	A
Total power dissipation	P_{tot}	$T_j = T_{jmax}$ T_s = 80 °C	147	W
Maximum junction temperature	T_{jmax}		175	°C

Module Properties

Thermal Properties

Parameter	Symbol	Condition	Value	Unit
Storage temperature	T_{stg}		-40…+125	°C
Operation temperature under switching condition	T_{jop}		-40…(T_{jmax} - 25)	°C

Isolation Properties

Parameter	Symbol	Condition	Value	Unit
Isolation voltage	V_{isol}	DC Test Voltage* t_p = 2 s	5500	V
		AC Voltage t_p = 1 min	2500	V
Creepage distance		With std lid For more informations see handling instructions	6,3	mm
Clearance		With std lid For more informations see handling instructions	6,3	mm
Comparative Tracking Index	CTI		> 200	

*100 % tested in production

Characteristic Values

Parameter	Symbol	Conditions					Value			Unit
			V_{GE} [V] V_{GS} [V]	V_{CE} [V] V_{DS} [V] V_F [V]	I_C [A] I_D [A] I_F [A]	T_j [°C]	Min	Typ	Max	
D8,D9,D10,D11,D12,D13										
Static										
Forward voltage	V_F				35	25 125	0,8	1,02 0,94	1,35	V
Reverse leakage current	I_R			1500		25 125			100 2000	µA
Thermal										
Thermal resistance junction to sink	$R_{th(j-s)}$	λ_{paste} = 2,5 W/mK (HPTP)						0,75		K/W
T1,T2,T3,T4,T5,T6,T7										
Static										
Gate-emitter threshold voltage	$V_{GE(th)}$	$V_{GE} = V_{CE}$			0,0016	25	5	5,8	6,5	V
Collector-emitter saturation voltage	V_{CEsat}		15		100	25 125	1,05	1,58 1,78	1,85	V
Collector-emitter cut-off current	I_{CES}		0	600		25			5,2	µA
Gate-emitter leakage current	I_{GES}		±25	0		25			1200	nA
Internal gate resistance	r_g							none		Ω
Input capacitance	C_{ies}	f = 1 Mhz	0	25		25		6280		pF
Output capacitance	C_{oes}							400		
Reverse transfer capacitance	C_{res}							186		
Gate charge	Q_g		±15	480	100	25		620		nC
Thermal										
Thermal resistance junction to sink	$R_{th(j-s)}$	λ_{paste} = 2,5 W/mK (HPTP)						0,47		K/W
Dynamic										
Turn-on delay time	$t_{d(on)}$	R_{gon} = 8 Ω R_{goff} = 8 Ω	±15	300	100	25 125		187 187		ns
Rise time	t_r					25 125		31,5 32,8		
Turn-off delay time	$t_{d(off)}$					25 125		223 242		
Fall time	t_f					25 125		53,3 86,9		
Turn-on energy (per pulse)	E_{on}	Q_{rFWD} = 5,9 µC Q_{rFWD} = 10,5 µC				25 125		2,29 2,92		mWs
Turn-off energy (per pulse)	E_{off}					25 125		2,43 3,08		

Characteristic Values

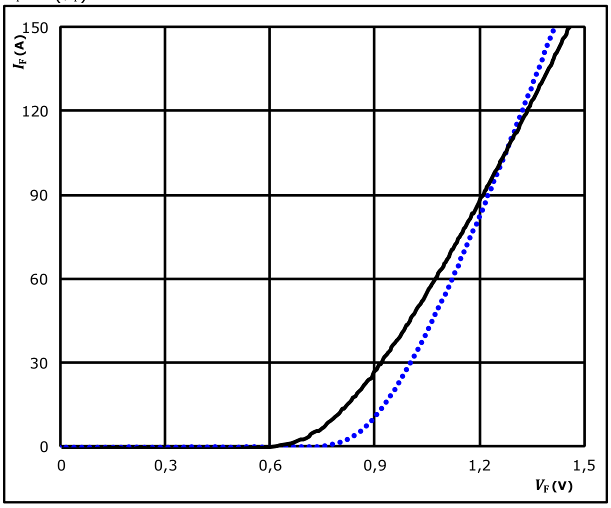
Parameter	Symbol	Conditions	V_{GE} [V] V_{GS} [V]	V_{CE} [V] V_{DS} [V] V_F [V]	I_C [A] I_D [A] I_F [A]	T_j [°C]	Min	Typ	Max	Unit
D1,D2,D3,D4,D5,D6,D7										
Static										
Forward voltage	V_F				100	25 125	1	1,38 1,4	1,9	V
Reverse leakage current	I_R			600		25			200	µA
Thermal										
Thermal resistance junction to sink	$R_{th(j-s)}$	λ_{paste} = 2,5 W/mK (HPTP)						0,64		K/W
Dynamic										
Peak recovery current	I_{RRM}	di/dt = 2890 A/µs di/dt = 2940 A/µs	±15	300	100	25 125		93 113		A
Reverse recovery time	t_{rr}					25 125		168 248		ns
Recovered charge	Q_r					25 125		5,85 10,5		µC
Reverse recovered energy	E_{rec}					25 125		1,1 2,15		mWs
Peak rate of fall of recovery current	$(di_{rf}/dt)_{max}$					25 125		3180 2580		A/µs
Thermistor										
Rated resistance	R					25		1		kΩ
Deviation of R_{100}	$\Delta_{R/R}$	R_{100} = 1670 Ω				100	-2		+2	%
R_{100}	R					100		1670		Ω
Power dissipation constant						25		0,76		mW/K
A-value	$A_{(25/50)}$					25		$7,635*10^{-3}$		1/K
B-value	$B_{(25/100)}$					25		$1,731*10^{-5}$		1/K²
Vincotech PTC Reference									E	

D8,D9,D10,D11,D12,D13

figure 1. **Rectifier**

Typical forward characteristics

$I_F = f(V_F)$



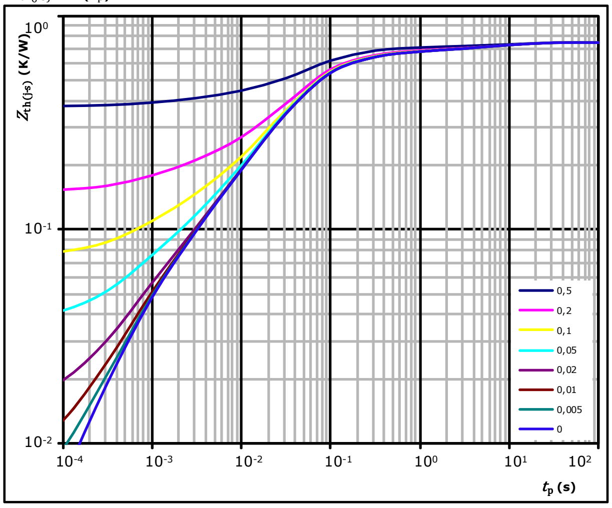
t_p = 250 µs

T_j: 25 °C (dotted), 125 °C (solid)

figure 2. **Rectifier**

Transient thermal impedance as a function of pulse width

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



D = t_p / T

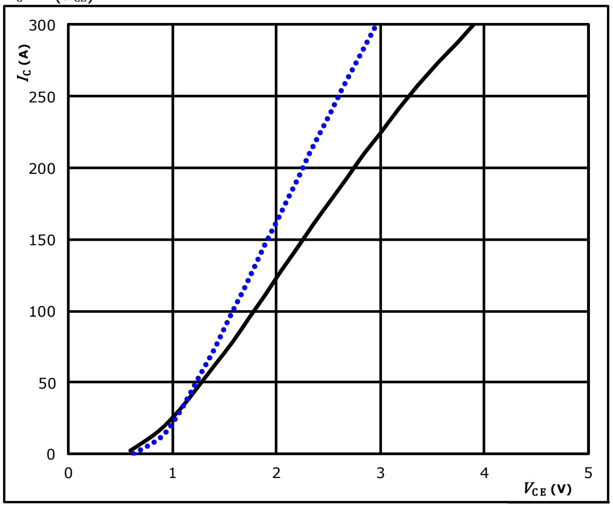
$R_{th(j-s)}$ = 0,75 K/W

T1,T2,T3,T4,T5,T6,T7

figure 1. **IGBT**

Typical output characteristics

$I_C = f(V_{CE})$

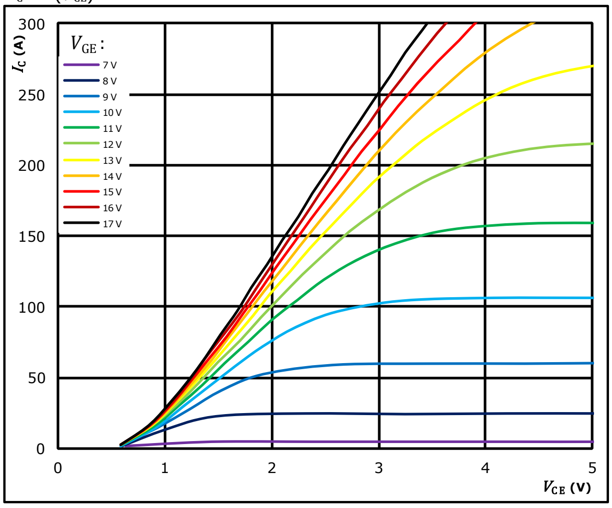


t_p =	250	µs	T_j:	25 °C	············
V_{GE} =	15	V		125 °C	———

figure 2. **IGBT**

Typical output characteristics

$I_C = f(V_{CE})$



t_p = 250 µs

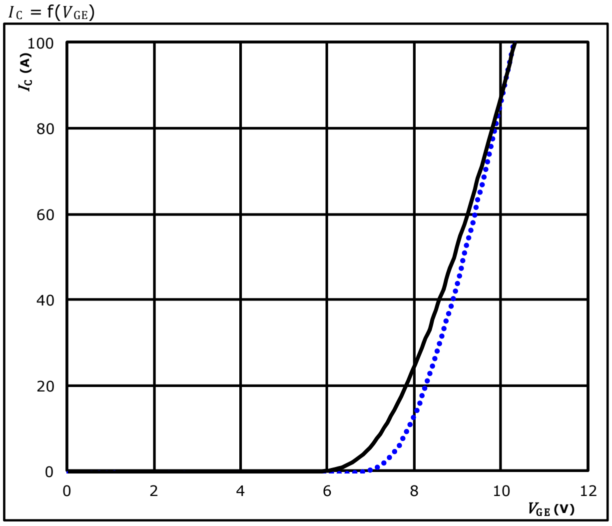
T_j = 125 °C

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

figure 3. **IGBT**

Typical transfer characteristics

$I_C = f(V_{GE})$

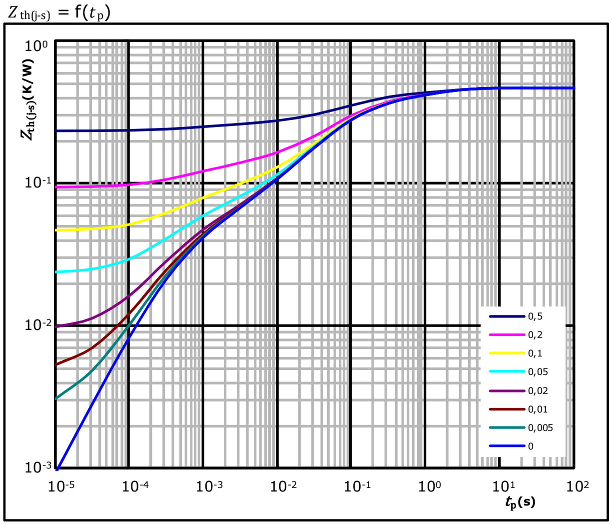


t_p =	100	µs	T_j:	25 °C	············
V_{CE} =	10	V		125 °C	———

figure 4. **IGBT**

Transient thermal impedance as function of pulse duration

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



D = t_p / T

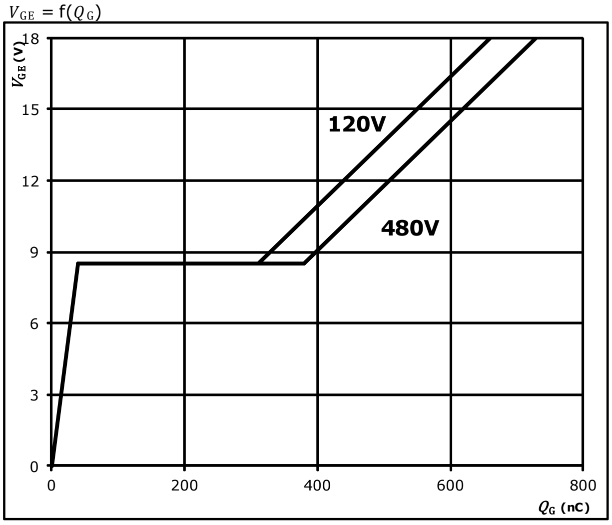
$R_{th(j\text{-}s)}$ = 0,47 K/W

T1,T2,T3,T4,T5,T6,T7

figure 5.	IGBT

Gate voltage vs gate charge

$V_{GE} = f(Q_G)$

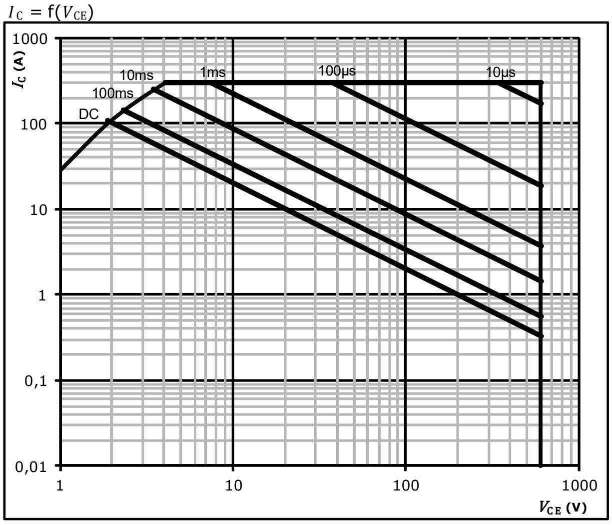


$I_C =$ 100 A

figure 6.	IGBT

Safe operating area

$I_C = f(V_{CE})$



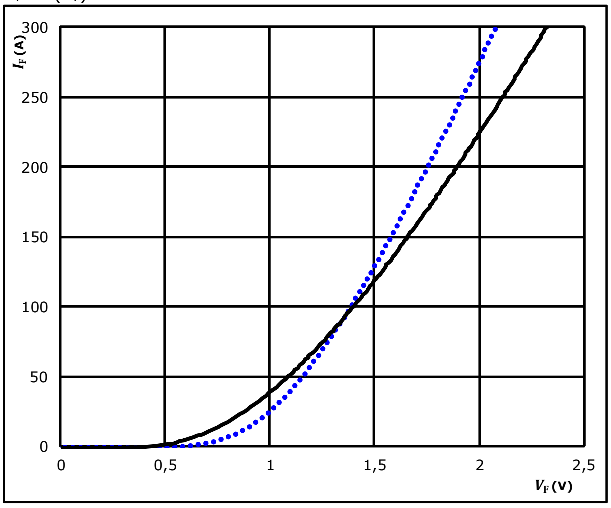
D =	single pulse	
T_s =	80	ºC
V_{GE} =	±15	V
T_j =	T_{jmax}	

D1,D2,D3,D4,D5,D6,D7

figure 1. **FWD**

Typical forward characteristics

$I_F = f(V_F)$



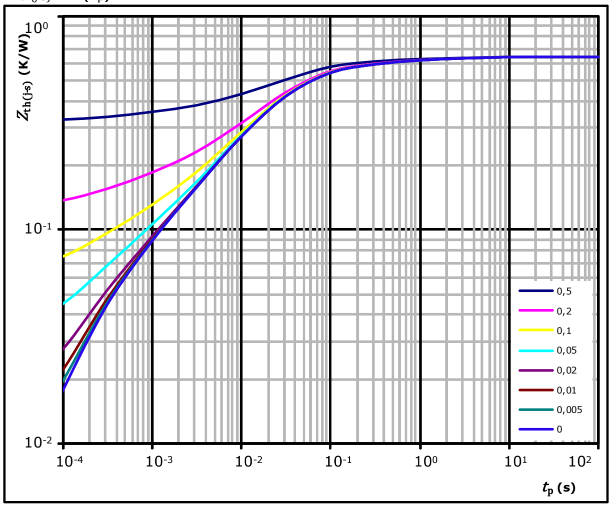
t_p = 250 μs

T_j: 25 °C (dotted line); 125 °C (solid line)

figure 2. **FWD**

Transient thermal impedance as a function of pulse width

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



$D = t_p / T$

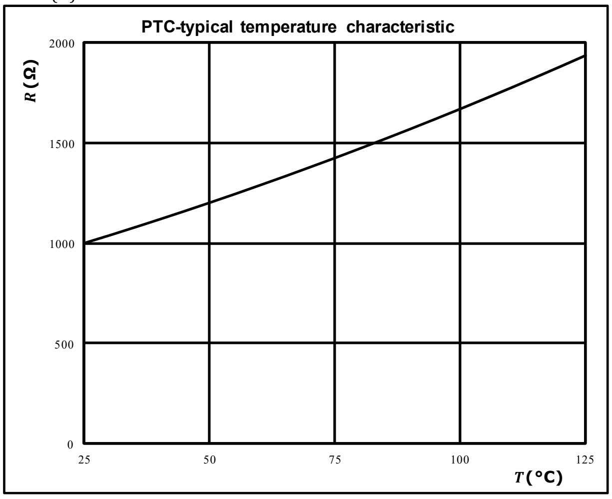
$R_{th(j-s)}$ = 0,64 K/W

Thermistor Characteristics

figure 1. **Thermistor**

Typical PTC characteristic as a function of temperature

$R = f(T)$

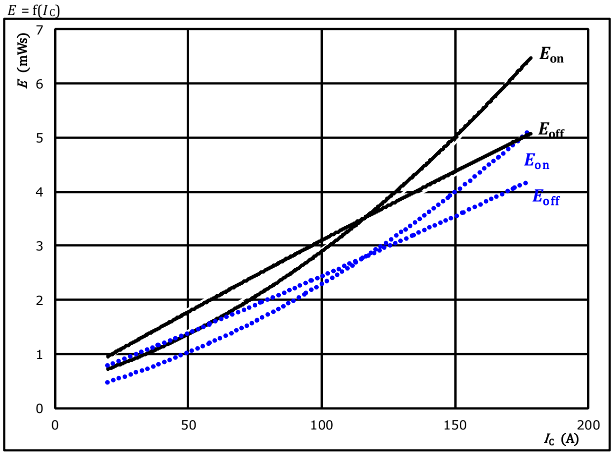


T1,T2,T3,T4,T5,T6,T7/D1,D2,D3,D4,D5,D6,D7

figure 1. **IGBT**

Typical switching energy losses as a function of collector current

$E = f(I_C)$



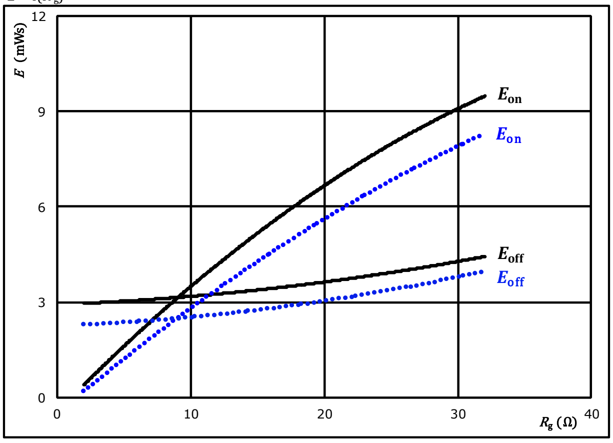
With an inductive load at

V_{CE} =	300	V	T_j: 25 °C	············
V_{GE} =	±15	V	125 °C	————
R_{gon} =	8	Ω		
R_{goff} =	8	Ω		

figure 2. **IGBT**

Typical switching energy losses as a function of gate resistor

$E = f(R_g)$



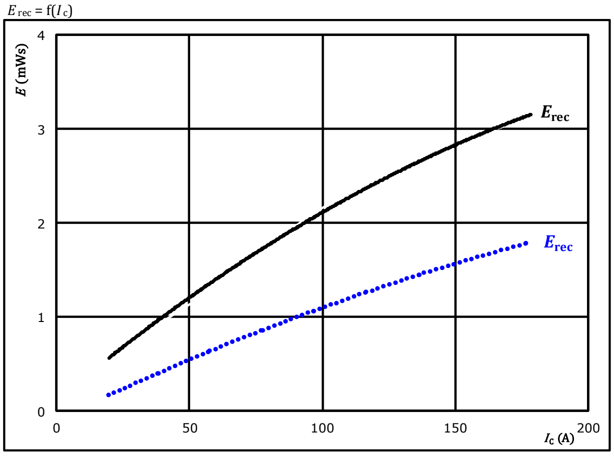
With an inductive load at

V_{CE} =	300	V	T_j: 25 °C	············
V_{GE} =	±15	V	125 °C	————
I_C =	100	A		

figure 3. **FWD**

Typical reverse recovered energy loss as a function of collector current

$E_{rec} = f(I_C)$



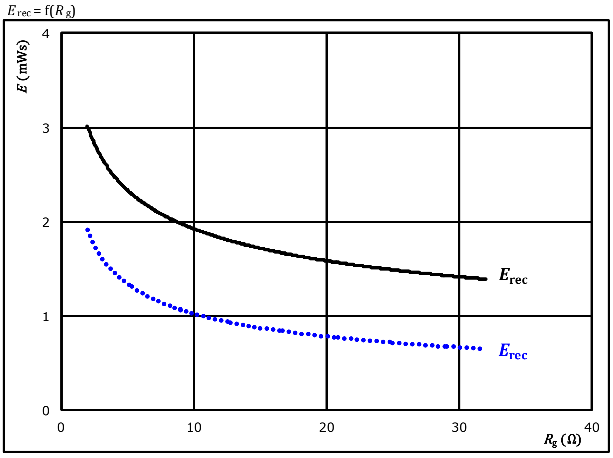
With an inductive load at

V_{CE} =	300	V	T_j: 25 °C	············
V_{GE} =	±15	V	125 °C	————
R_{gon} =	8	Ω		

figure 4. **FWD**

Typical reverse recovered energy loss as a function of gate resistor

$E_{rec} = f(R_g)$



With an inductive load at

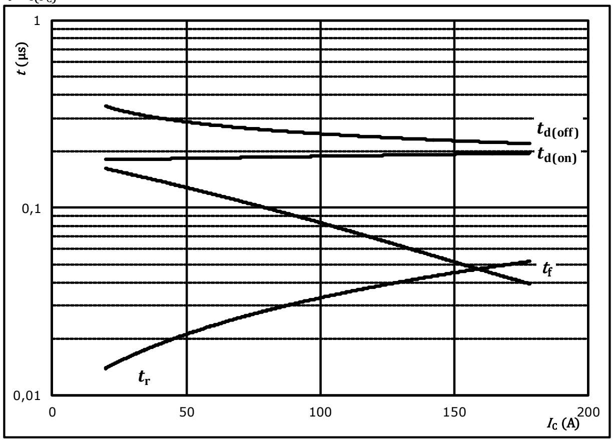
V_{CE} =	300	V	T_j: 25 °C	············
V_{GE} =	±15	V	125 °C	————
I_C =	100	A		

T1,T2,T3,T4,T5,T6,T7/D1,D2,D3,D4,D5,D6,D7

figure 5. IGBT

Typical switching times as a function of collector current

$t = f(I_C)$



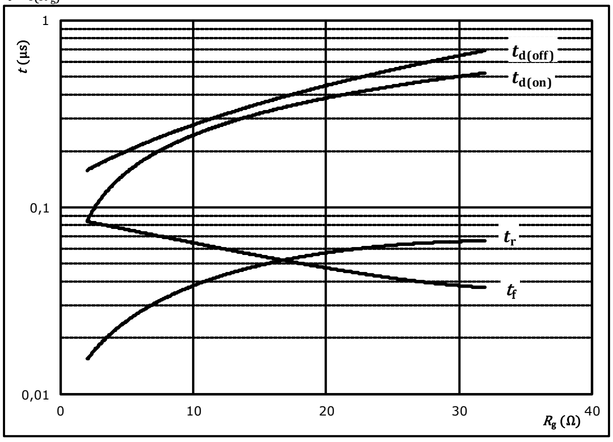
With an inductive load at

T_j =	125	°C
V_{CE} =	300	V
V_{GE} =	±15	V
R_{gon} =	8	Ω
R_{goff} =	8	Ω

figure 6. IGBT

Typical switching times as a function of gate resistor

$t = f(R_g)$



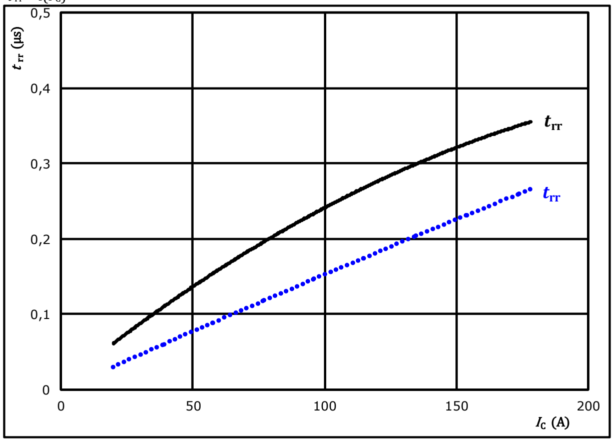
With an inductive load at

T_j =	125	°C
V_{CE} =	300	V
V_{GE} =	±15	V
I_C =	100	A

figure 7. FWD

Typical reverse recovery time as a function of collector current

$t_{rr} = f(I_C)$



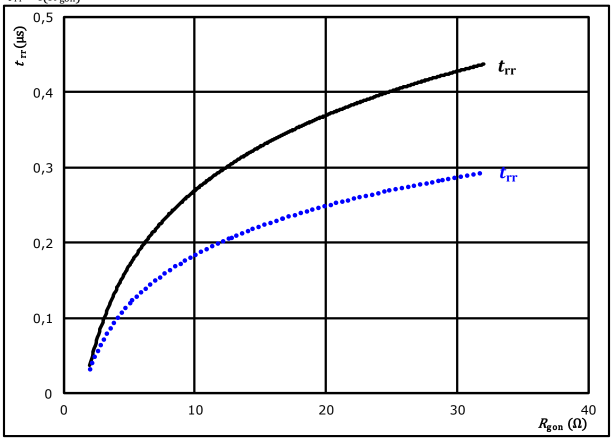
With an inductive load at

V_{CE}=	300	V	T_j:	25 °C	dotted
V_{GE}=	±15	V		125 °C	solid
R_{gon} =	8	Ω			

figure 8. FWD

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

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



With an inductive load at

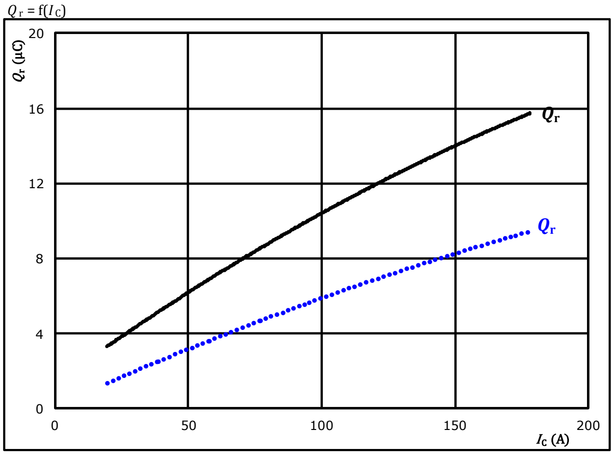
V_{CE}=	300	V	T_j:	25 °C	dotted
V_{GE}=	±15	V		125 °C	solid
I_C =	100	A			

T1,T2,T3,T4,T5,T6,T7/D1,D2,D3,D4,D5,D6,D7

figure 9. **FWD**

Typical recovered charge as a function of collector current

$Q_r = f(I_C)$



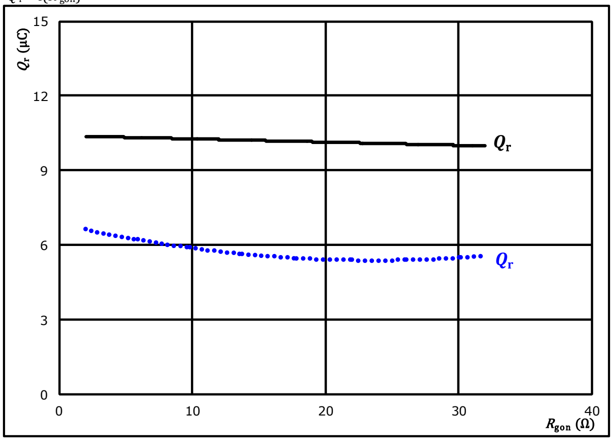
With an inductive load at

V_{CE} =	300	V	T_j:	25 °C	dotted
V_{GE} =	±15	V		125 °C	solid
R_{gon} =	8	Ω			

figure 10. **FWD**

Typical recovered charge as a function of IGBT turn on gate resistor

$Q_r = f(R_{gon})$



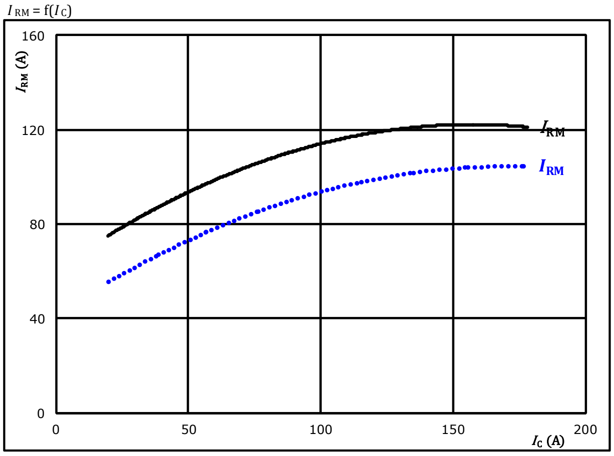
With an inductive load at

V_{CE}=	300	V	T_j:	25 °C	dotted
V_{GE} =	±15	V		125 °C	solid
I_C=	100	A			

figure 11. **FWD**

Typical peak reverse recovery current current as a function of collector current

$I_{RM} = f(I_C)$



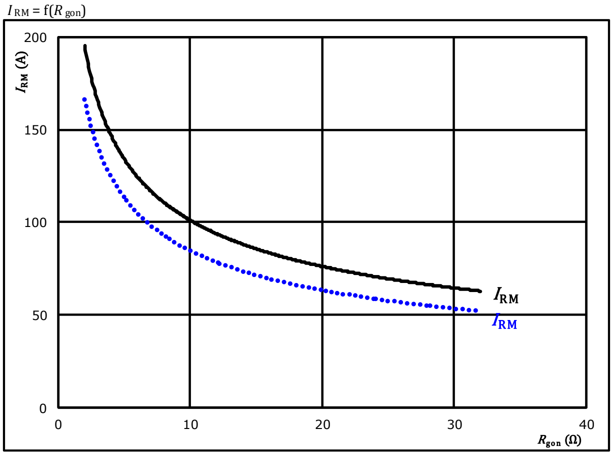
With an inductive load at

V_{CE} =	300	V	T_j:	25 °C	dotted
V_{GE} =	±15	V		125 °C	solid
R_{gon} =	8	Ω			

figure 12. **FWD**

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

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



With an inductive load at

V_{CE}=	300	V	T_j:	25 °C	dotted
V_{GE} =	±15	V		125 °C	solid
I_C=	100	A			

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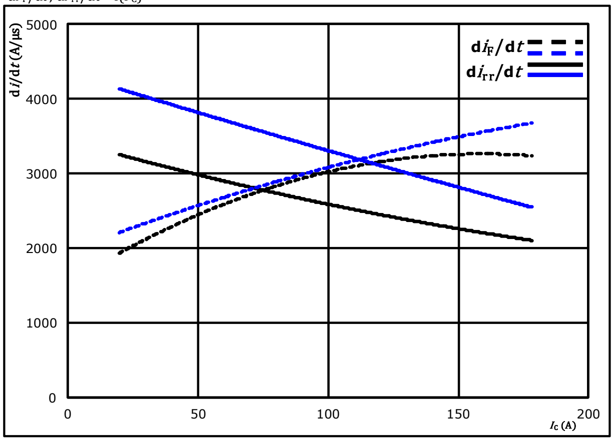
T1,T2,T3,T4,T5,T6,T7/D1,D2,D3,D4,D5,D6,D7

figure 13. FWD

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

di_F/dt, $di_{rr}/dt = f(I_C)$



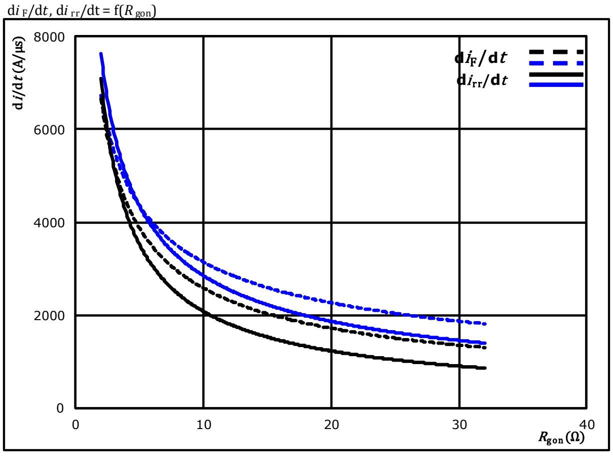
With an inductive load at

V_{CE} =	300	V	T_j:	25 °C
V_{GE} =	±15	V		125 °C
R_{gon} =	8	Ω		

figure 14. FWD

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

di_F/dt, $di_{rr}/dt = f(R_{gon})$



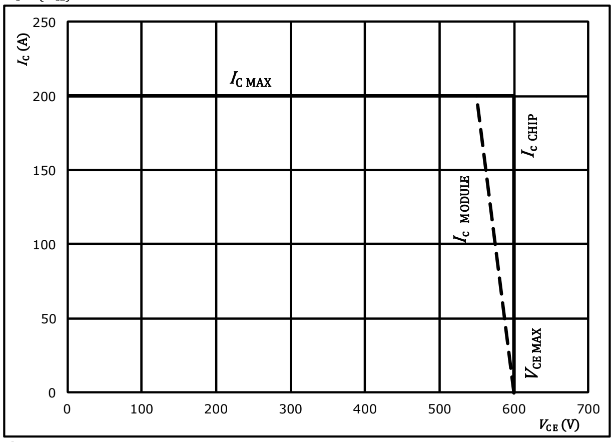
With an inductive load at

V_{CE} =	300	V	T_j:	25 °C
V_{GE} =	±15	V		125 °C
I_C=	100	A		

figure 15. IGBT

Reverse bias safe operating area

$I_C = f(V_{CE})$



At

T_j =	125	°C
R_{gon} =	8	Ω
R_{goff} =	8	Ω

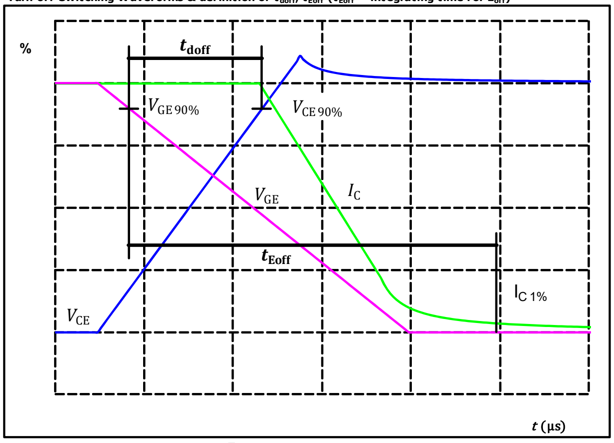
Switching Definitions Output Inverter

General conditions

T_j	=	125 °C
R_{gon}	=	8 Ω
R_{goff}	=	8 Ω

figure 1. IGBT

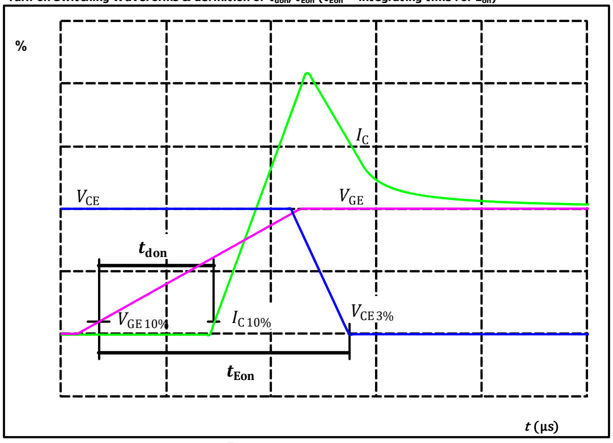
Turn-off Switching Waveforms & definition of t_{doff}, t_{Eoff} (t_{Eoff} = integrating time for E_{off})



$V_{GE}(0\%)$ =	-15	V
$V_{GE}(100\%)$ =	15	V
$V_C(100\%)$ =	300	V
$I_C(100\%)$ =	100	A
t_{doff} =	242	ns

figure 2. IGBT

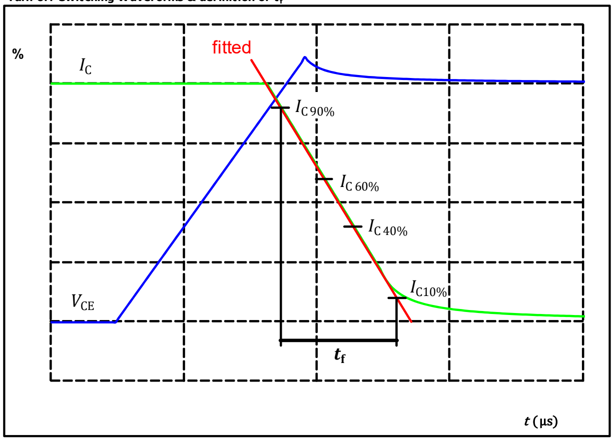
Turn-on Switching Waveforms & definition of t_{don}, t_{Eon} (t_{Eon} = integrating time for E_{on})



$V_{GE}(0\%)$ =	-15	V
$V_{GE}(100\%)$ =	15	V
$V_C(100\%)$ =	300	V
$I_C(100\%)$ =	100	A
t_{don} =	187	ns

figure 3. IGBT

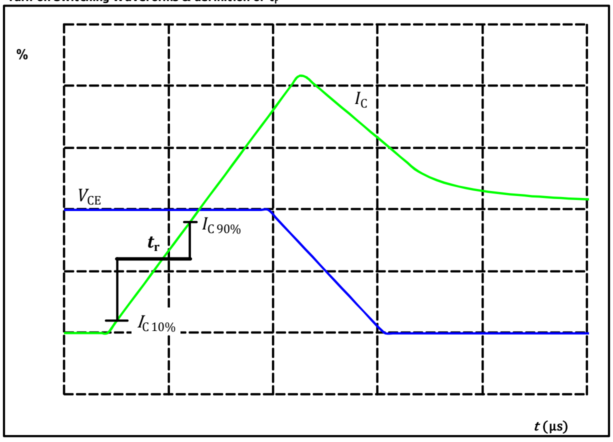
Turn-off Switching Waveforms & definition of t_f



$V_C(100\%)$ =	300	V
$I_C(100\%)$ =	100	A
t_f =	87	ns

figure 4. IGBT

Turn-on Switching Waveforms & definition of t_r



$V_C(100\%)$ =	300	V
$I_C(100\%)$ =	100	A
t_r =	33	ns

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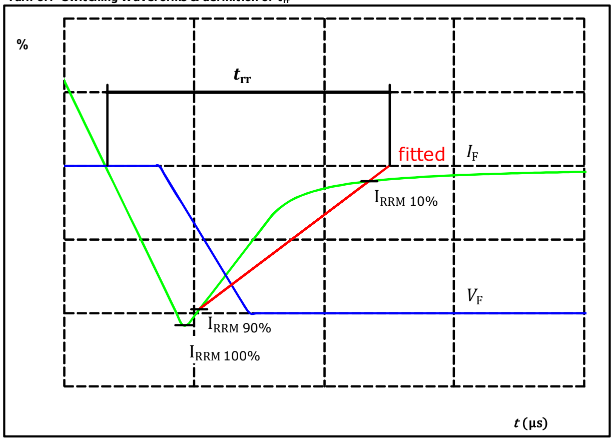
Switching Definitions Output Inverter

figure 5.	FWD

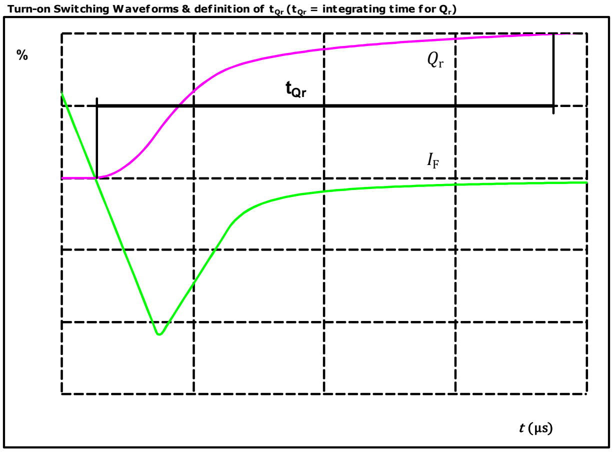
Turn-off Switching Waveforms & definition of t_{rr}



V_F (100%) =	300	V
I_F (100%) =	100	A
I_{RRM} (100%) =	113	A
t_{rr} =	248	ns

figure 6.	FWD

Turn-on Switching Waveforms & definition of t_{Qr} (t_{Qr} = integrating time for Q_r)



I_F (100%) =	100	A
Q_r (100%) =	10,50	µC

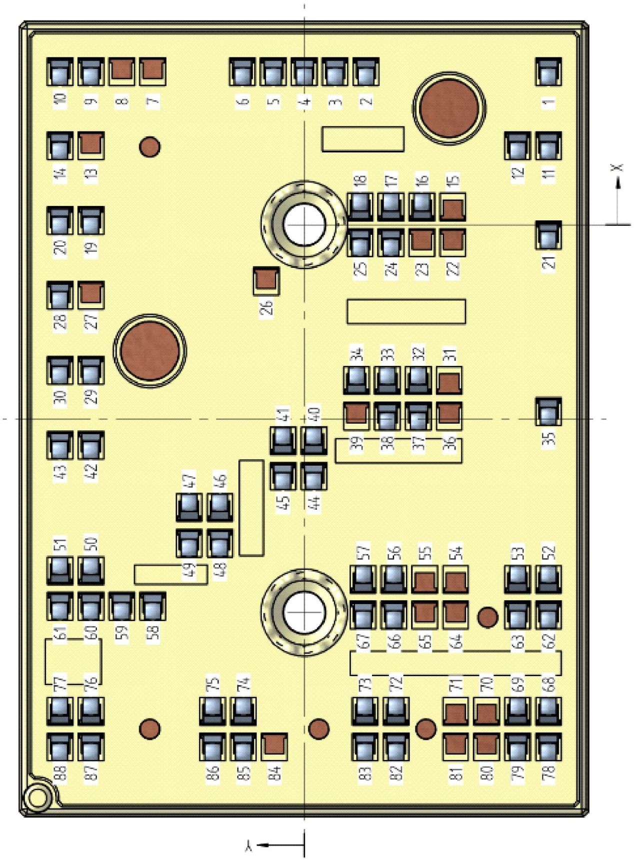
Ordering Code & Marking

Version	Ordering Code
With std lid (6.5mm height) + no thermal grease	V23990-K243-A-/0A/-PM
With thin lid (2.8mm height) + no thermal grease	V23990-K243-A-/0B/-PM
With std lid (6.5mm height) + thermal grease (0,8 W/mK, P12, silicone-based)	V23990-K243-A-/1A/-PM
With thin lid (2.8mm height) + thermal grease (0,8 W/mK, P12, silicone-based)	V23990-K243-A-/1B/-PM
With std lid (6.5mm height) + thermal grease (2,5 W/mK, TG20032, silicone-free)	V23990-K243-A-/4A/-PM
With thin lid (2.8mm height) + thermal grease (2,5 W/mK, TG20032, silicone-free)	V23990-K243-A-/4B/-PM
With std lid (6.5mm height) + thermal grease (2,5 W/mK, HPTP, silicone-based)	V23990-K243-A-/5A/-PM
With thin lid (2.8mm height) + thermal grease (2,5 W/mK, HPTP, silicone-based)	V23990-K243-A-/5B/-PM

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

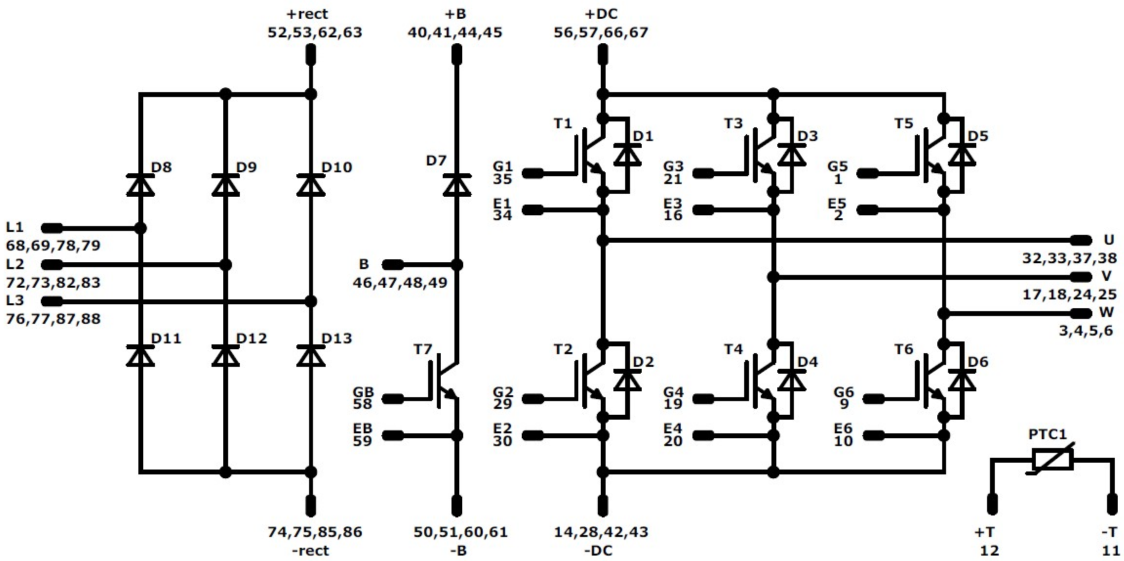
Outline

PCB pad table				PCB pad table			
Pin	X	Y	Function	Pin	X	Y	Function
1	15,83	-25,3	G5	48	-32,82	8,74	B
2	15,83	-6,4	E5	49	-32,82	11,94	B
3	15,83	-3,2	W	50	4,32	22,1	-B
4	15,83	0	W	51	4,32	25,3	-B
5	15,83	3,2	W	52	3,42	-25,3	+rect
6	15,83	6,4	W	53	3,42	-22,1	+rect
7	Not assembled			54	Not assembled		
8	Not assembled			55	Not assembled		
9	15,83	22,1	G6	56	3,42	-9,3	+DC
10	15,83	25,3	E6	57	3,42	-6,1	+DC
11	8,13	-25,3	-T	58	-39,32	15,7	GB
12	8,13	-22,1	+T	59	-39,32	18,9	EB
13	Not assembled			60	-39,32	22,1	-B
14	8,13	25,3	-DC	61	-39,32	25,3	-B
15	Not assembled			62	-40,22	-25,3	+rect
16	41,82	-12,18	E3	63	-40,22	-22,1	+rect
17	41,82	-8,98	V	64	Not assembled		
18	41,82	-5,79	V	65	Not assembled		
19	0,43	22,1	G4	66	-40,22	-9,3	+DC
20	0,43	25,3	E4	67	-40,22	-6,09	+DC
21	-1,07	-25,3	G3	68	-10,18	-25,3	L1
22	Not assembled			69	-10,18	-22,1	L1
23	Not assembled			70	Not assembled		
24	-1,82	-8,98	V	71	Not assembled		
25	-1,82	-5,79	V	72	-10,18	-9,5	L2
26	Not assembled			73	-10,18	-6,3	L2
27	Not assembled			74	-10,18	6,3	-rect
28	-7,27	25,3	-DC	75	-10,18	9,5	-rect
29	-14,97	22,1	G2	76	-10,18	22,1	L3
30	-14,97	25,3	E2	77	-10,18	25,3	L3
31	Not assembled			78	-53,82	-25,3	L1
32	23,95	-11,82	U	79	-53,82	-22,1	L1
33	23,95	-8,63	U	80	Not assembled		
34	23,95	-5,42	E1	81	Not assembled		
35	-19,22	-25,3	G1	82	-53,82	-9,5	L2
36	Not assembled			83	-53,82	-6,3	L2
37	-19,7	-11,82	U	84	Not assembled		
38	-19,7	-8,62	U	85	-53,82	6,3	-rect
39	Not assembled			86	-53,82	9,5	-rect
40	17,74	-1	+B	87	-53,82	22,1	L3
41	17,74	2,2	+B	88	-53,82	25,3	L3
42	-22,67	22,1	-DC				
43	-22,67	25,3	-DC				
44	-25,9	-1	+B				
45	-25,9	2,2	+B				
46	10,82	8,74	B				
47	10,82	11,94	B				



Pad positions refers to center point. For more informations on pad design please see package data

Pinout



Identification

ID	Component	Voltage	Current	Function	Comment
D8, D9, D10, D11, D12, D13	Rectifier	1600 V	50 A	Rectifier Diode	
T1, T2, T3, T4, T5, T6	IGBT	600 V	100 A	Inverter Switch	
D1, D2, D3, D4, D5, D6	FWD	600 V	100 A	Inverter Diode	
T7	IGBT	600 V	100 A	Brake Switch	
D7	FWD	600 V	100 A	Brake Diode	
PTC1	PTC			Thermistor	

Packaging instruction				
Standard packaging quantity (SPQ) 48	>SPQ	Standard	<SPQ	Sample

Handling instruction
Handling instructions for MiniSkiiP® 3 packages see vincotech.com website.

Package data
Package data for MiniSkiiP® 3 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-K243-A-D5-14	01 Mar. 2019	Correction of I_c/I_f values	1,2

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