Vincotech

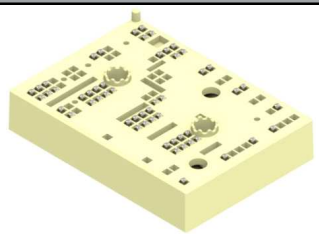
V23990-K430-F42-PM
datasheet

MiniSkiiP PACK 3 **1200 V / 150 A**

Features

- Solderless interconnection
- Trench Fieldstop IGBT4 technology
- Si3N4 ceramic material

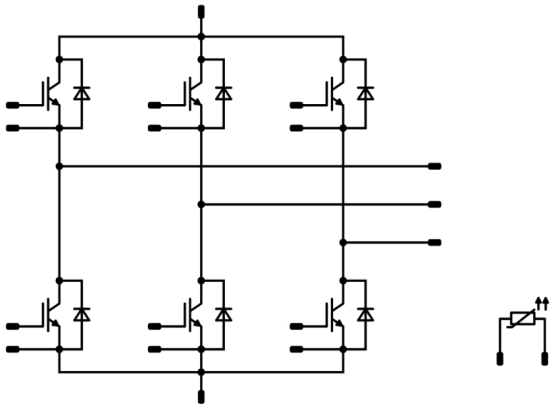
MiniSkiip 3 12 mm housing



Target applications

- Servo Drives
- Industrial Motor Drives
- UPS

Schematic



Types

- V23990-K430-F42-PM

Maximum Ratings

T_j = 25 °C, unless otherwise specified

Parameter	Symbol	Condition	Value	Unit
Inverter Switch				
Collector-emitter voltage	V_{CES}		1200	V
Collector current	I_C	T_j = T_{jmax} T_s = 80 °C	190	A
Repetitive peak collector current	I_{CRM}	t_p limited by T_{jmax}	450	A
Total power dissipation	P_{tot}	T_j = T_{jmax} T_s = 80 °C	559	W
Gate-emitter voltage	V_{GES}		±20	V
Short circuit ratings	t_{SC} V_{CC}	T_j ≤ 150 °C V_{GE} = 15 V	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					
Peak repetitive reverse voltage	V_{RRM}			1200	V
Continuous (direct) forward current	I_F	T_j = T_{jmax}	T_s = 80 °C	130	A
Surge (non-repetitive) forward current	I_{FSM}	50 Hz Single Half Sine Wave t_p = 10 ms	T_j = 150 °C	900	A
Surge current capability	I^2t			4050	A^2s
Total power dissipation	P_{tot}	T_j = T_{jmax}	T_s = 80 °C	306	W
Maximum junction temperature	T_{jmax}			175	°C
Module Properties					
Thermal Properties					
Storage temperature	T_{stg}			-40…+125	°C
Operation temperature under switching condition	T_{jop}			-40…(T_{jmax} - 25)	°C
Isolation Properties					
Isolation voltage	V_{isol}	DC Test Voltage*	t_p = 2 s	5500	V
		AC Voltage	t_p = 1 min	2500	V
Creepage distance				min. 12,7	mm
Clearance				min. 12,7	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	
Inverter Switch										
Static										
Gate-emitter threshold voltage	$V_{GE(th)}$	$V_{GE} = V_{CE}$			0,0052	25	5,3	5,8	6,3	V
Collector-emitter saturation voltage	V_{CEsat}		15		150	25 150	1,58	1,93 2,39	2,07	V
Collector-emitter cut-off current	I_{CES}		0	1200		25			2	µA
Gate-emitter leakage current	I_{GES}		20	0		25			240	nA
Internal gate resistance	r_g							5		Ω
Input capacitance	C_{ies}	f= 1 MHz	0	25		25		8600		pF
Reverse transfer capacitance	C_{res}							320		
Thermal										
Thermal resistance junction to sink	$R_{th(j-s)}$	Thermal grease λ = 2,5 W/mK (Silicone-based)						0,17		K/W
Dynamic										
Turn-on delay time	$t_{d(on)}$	R_{goff} = 2 Ω R_{gon} = 2 Ω	±15	600	151	25 150		175 193		ns
Rise time	t_r					25 150		46 53		
Turn-off delay time	$t_{d(off)}$					25 150		288 375		
Fall time	t_f					25 150		58 100		
Turn-on energy (per pulse)	E_{on}	Q_{rFWD} = 8 µC Q_{rFWD} = 24,3 µC				25 150		14,990 23,033		mWs
Turn-off energy (per pulse)	E_{off}					25 150		8,264 14,149		

Characteristic Values

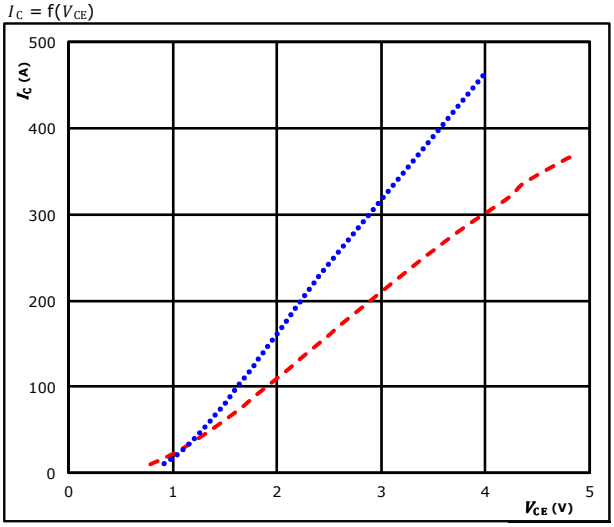
Parameter	Symbol	Conditions					Value			Unit
			V_{GE} [V] V_{GS} [V]	V_{CE} [V] V_{DS} [V] V_F [V]	I_C [A] I_D [A] I_F [A]	T_j [°C]	Min	Typ	Max	
Inverter Diode										
Static										
Forward voltage	V_F				150	25 150		2,50 2,53	2,7	V
Reverse leakage current	I_R			1200		25 150			180 28000	µA
Thermal										
Thermal resistance junction to sink	$R_{th(j-s)}$	Thermal grease λ = 2,5 W/mK (Silicone-based)						0,31		K/W
Dynamic										
Peak recovery current	I_{RRM}	di/dt = 2520 A/µs di/dt = 2365 A/µs	±15	600	151	25 150		77 107		A
Reverse recovery time	t_{rr}					25 150		125 492		ns
Recovered charge	Q_r					25 150		7,990 24,275		µC
Reverse recovered energy	E_{rec}					25 150		2,135 8,213		mWs
Peak rate of fall of recovery current	$(di_{rf}/dt)_{max}$					25 150		990 1268		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	

Inverter Switch Characteristics

figure 1. **IGBT**

Typical output characteristics

$I_C = f(V_{CE})$

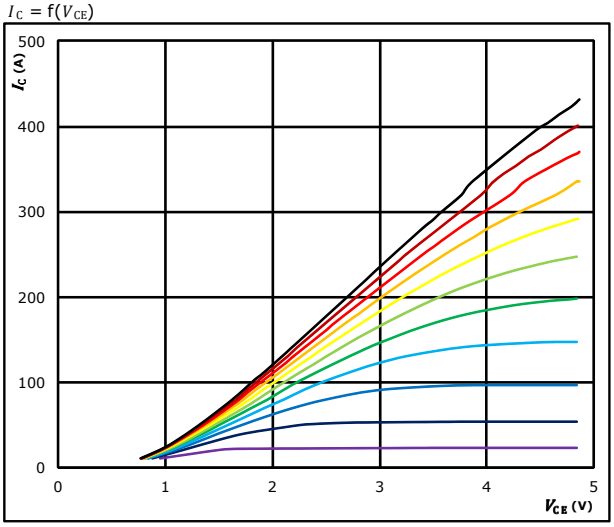


t_p =	250	µs		25 °C	
V_{GE} =	15	V	T_j:	150 °C	

figure 2. **IGBT**

Typical output characteristics

$I_C = f(V_{CE})$

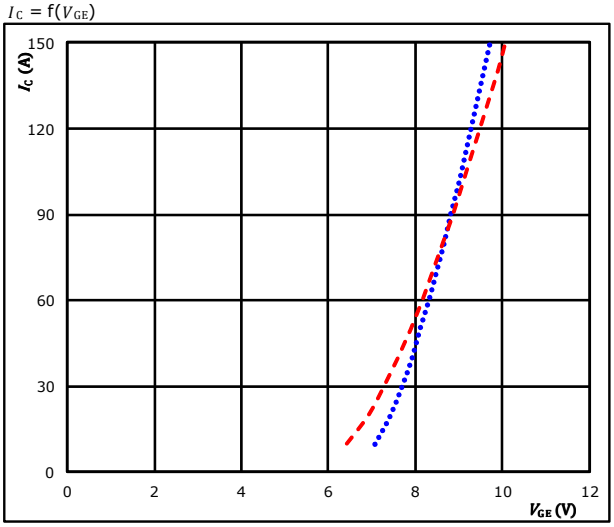


t_p =	250	µs
T_j =	150	°C
V_{GE} from	7 V to 17 V in steps of 1 V	

figure 3. **IGBT**

Typical transfer characteristics

$I_C = f(V_{GE})$

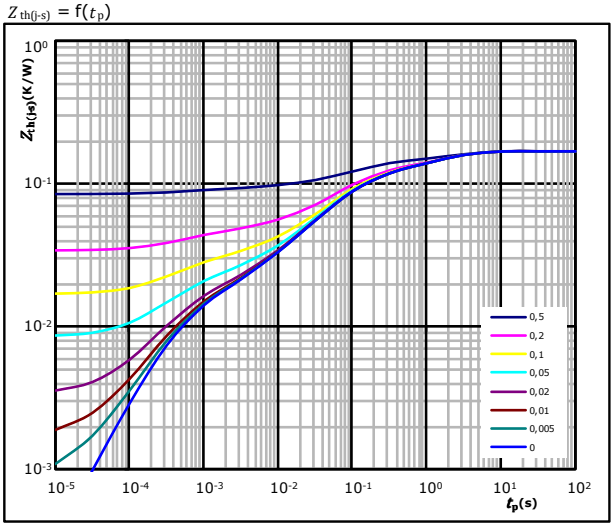


t_p =	100	µs		25 °C	
V_{CE} =	0	V	T_j:	150 °C	

figure 4. **IGBT**

Transient Thermal Impedance as function of Pulse duration

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



D =	t_p / T	
$R_{th(j-s)}$ =	0,17	K/W

IGBT thermal model values

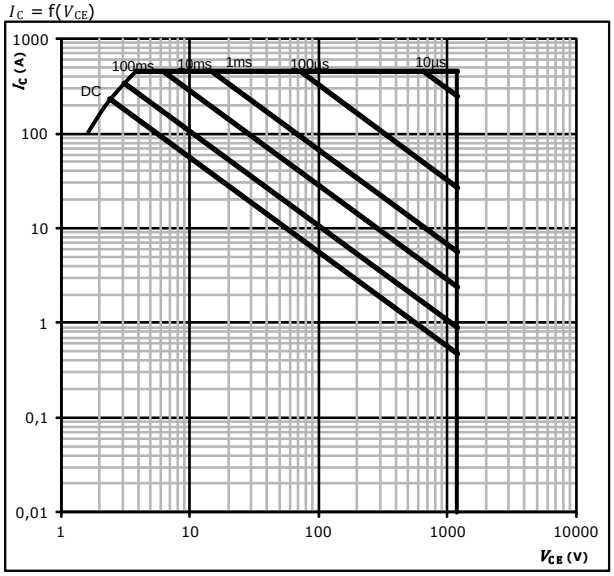
R (K/W)	τ (s)
4,70E-02	1,97E+00
2,42E-02	3,38E-01
6,55E-02	7,73E-02
1,51E-02	1,74E-02
7,58E-03	2,43E-03
1,07E-02	3,85E-04

Inverter Switch Characteristics

figure 5. **IGBT**

Safe operating area

$I_C = f(V_{CE})$



At

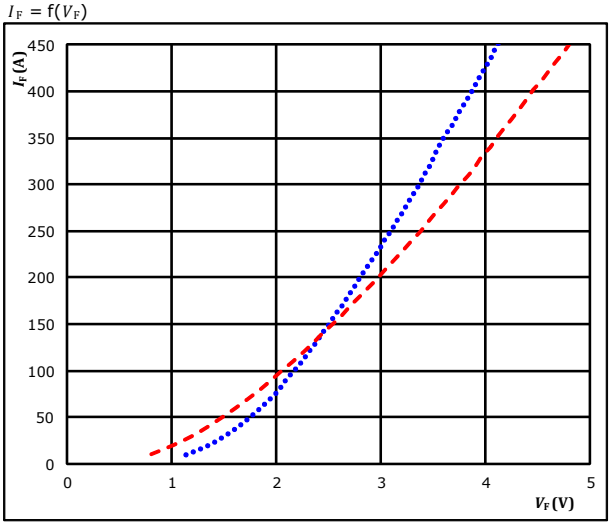
D =	single pulse	
T_s =	80	ºC
V_{GE} =	±15	V
T_j =	T_{jmax}	

Inverter Diode Characteristics

figure 1. **FWD**

Typical forward characteristics

$I_F = f(V_F)$



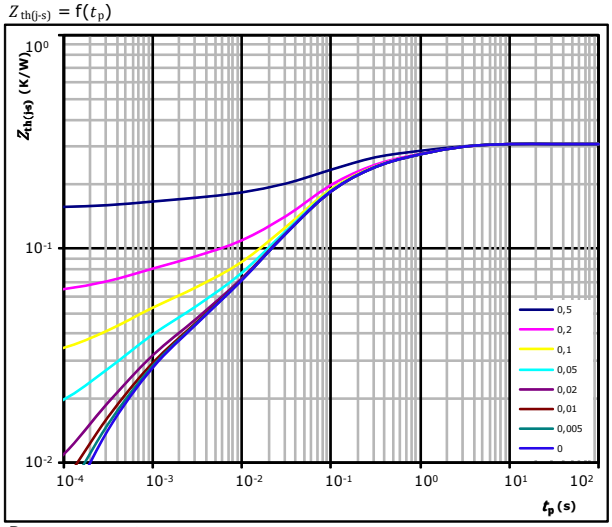
t_p = 250 µs

T_j: 25 °C, 150 °C

figure 2. **FWD**

Transient thermal impedance as a function of pulse width

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



D = t_p / T

$R_{th(j-s)}$ = 0,31 K/W

FWD thermal model values

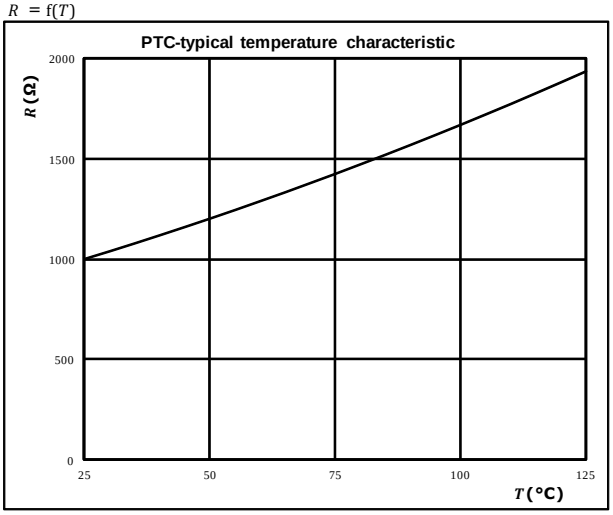
R (K/W)	τ (s)
5,61E-02	1,62E+00
5,67E-02	3,07E-01
1,31E-01	6,80E-02
3,13E-02	1,30E-02
1,79E-02	1,79E-03
1,66E-02	3,53E-04

Thermistor Characteristics

figure 1. **Thermistor**

Typical PTC characteristic as a function of temperature

$R = f(T)$

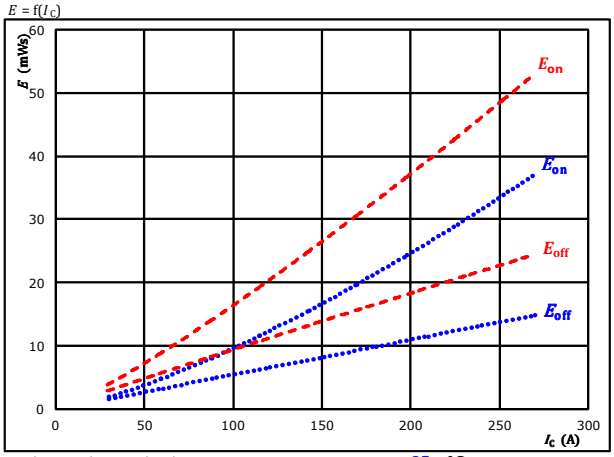


Inverter Switching Characteristics

figure 1. **IGBT**

Typical switching energy losses as a function of collector current

$E = f(I_C)$



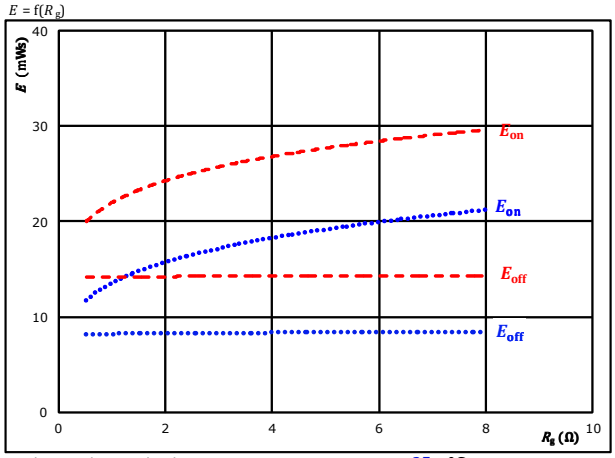
With an inductive load at

V_{CE} =	600	V	T_j:	25 °C	·····
V_{GE} =	±15	V		150 °C	— — —
R_{gon} =	2	Ω			
R_{goff} =	2	Ω			

figure 2. **IGBT**

Typical switching energy losses as a function of gate resistor

$E = f(R_g)$



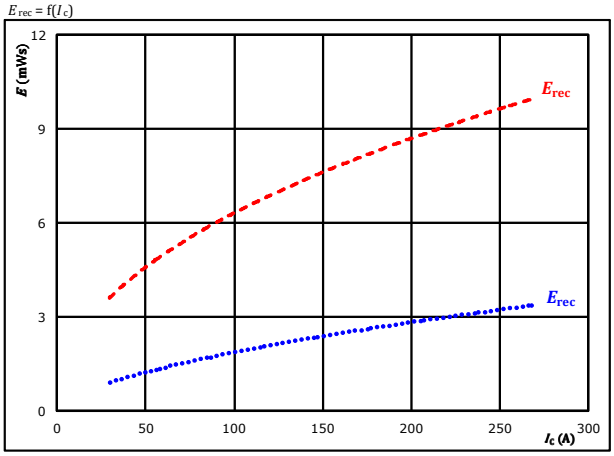
With an inductive load at

V_{CE} =	600	V	T_j:	25 °C	·····
V_{GE} =	±15	V		150 °C	— — —
I_C =	151	A			

figure 3. **FWD**

Typical reverse recovered energy loss as a function of collector current

$E_{rec} = f(I_C)$



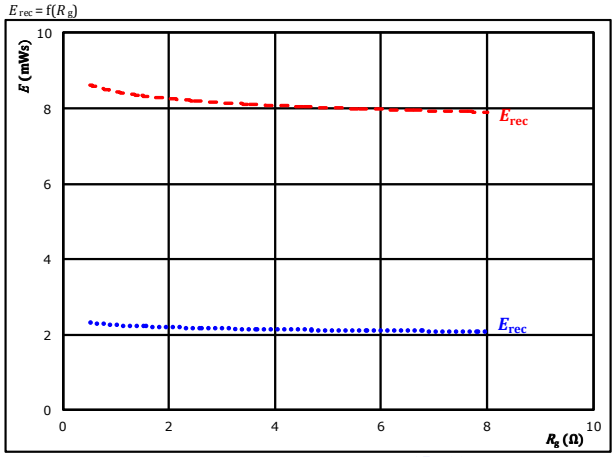
With an inductive load at

V_{CE} =	600	V	T_j:	25 °C	·····
V_{GE} =	±15	V		150 °C	— — —
R_{gon} =	2	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

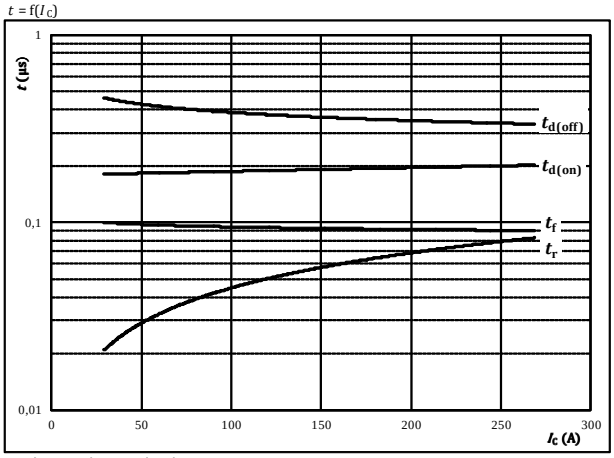
V_{CE} =	600	V	T_j:	25 °C	·····
V_{GE} =	±15	V		150 °C	— — —
I_C =	151	A			

Inverter Switching Characteristics

figure 5. **IGBT**

Typical switching times as a function of collector current

$t = f(I_C)$



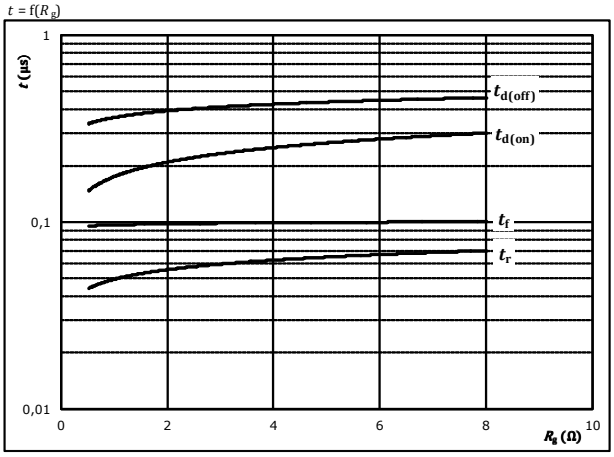
With an inductive load at

T_j =	150	°C
V_{CE} =	600	V
V_{GE} =	±15	V
R_{gon} =	2	Ω
R_{goff} =	2	Ω

figure 6. **IGBT**

Typical switching times as a function of gate resistor

$t = f(R_g)$



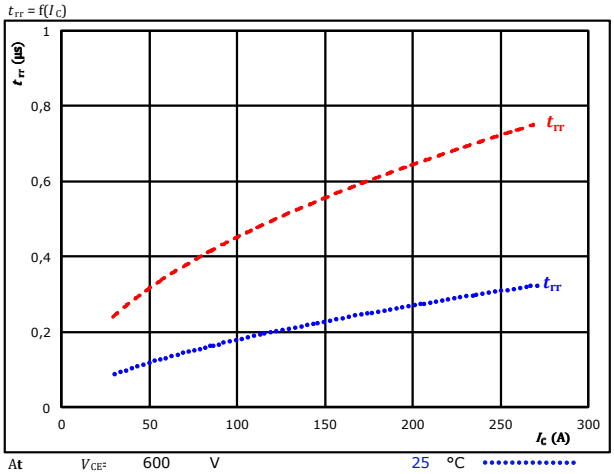
With an inductive load at

T_j =	150	°C
V_{CE} =	600	V
V_{GE} =	±15	V
I_C =	151	A

figure 7. **FWD**

Typical reverse recovery time as a function of collector current

$t_{rr} = f(I_C)$

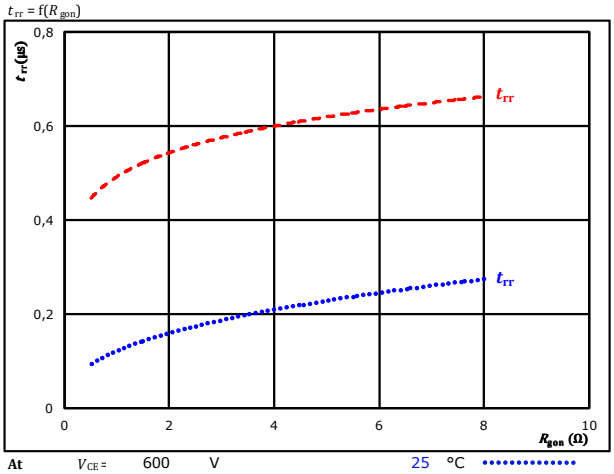


At					
	V_{CE} =	600	V		25 °C
	V_{GE} =	±15	V	T_j:	150 °C
	R_{gon} =	2	Ω		

figure 8. **FWD**

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

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



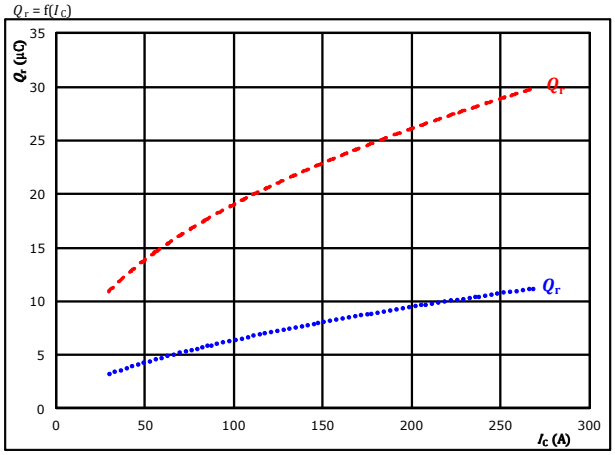
At					
	V_{CE} =	600	V		25 °C
	V_{GE} =	±15	V	T_j:	150 °C
	I_C =	151	A		

Inverter Switching Characteristics

figure 9. **FWD**

Typical recovered charge as a function of collector current

$Q_r = f(I_C)$

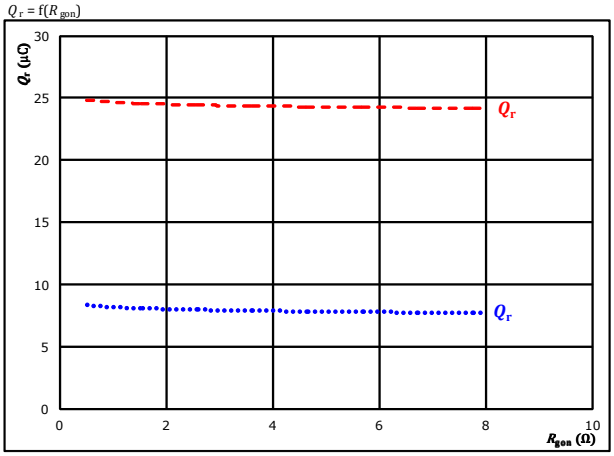


At						
	V_{CE} =	600	V		25 °C	
	V_{GE} =	±15	V	T_j:	150 °C	
	R_{gon} =	2	Ω			

figure 10. **FWD**

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

$Q_r = f(R_{gon})$

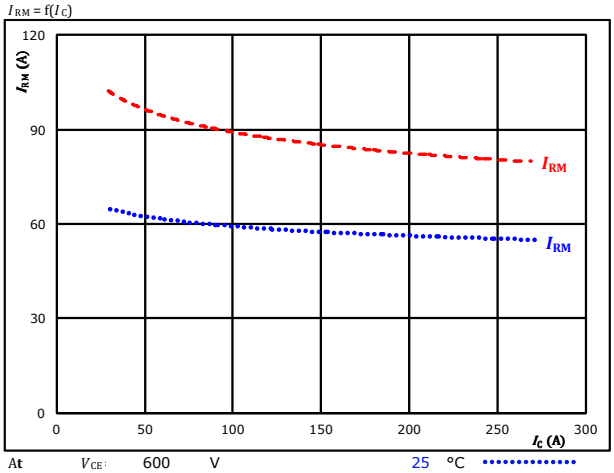


At						
	V_{CE}=	600	V		25 °C	
	V_{GE} =	±15	V	T_j:	150 °C	
	I_C=	151	A			

figure 11. **FWD**

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

$I_{RM} = f(I_C)$

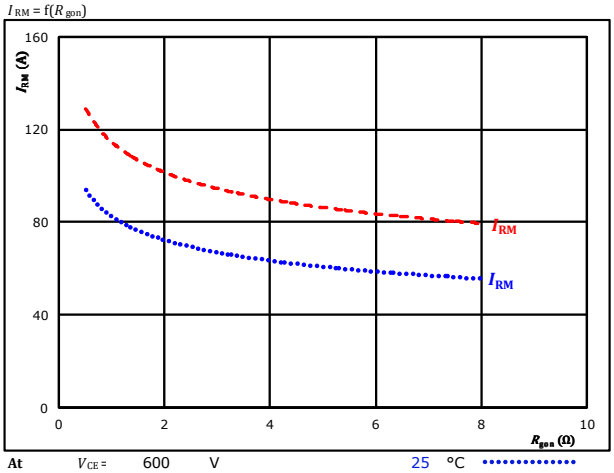


At						
	V_{CE}:	600	V		25 °C	
	V_{GE} =	±15	V	T_j:	150 °C	
	R_{gon} =	2	Ω			

figure 12. **FWD**

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

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



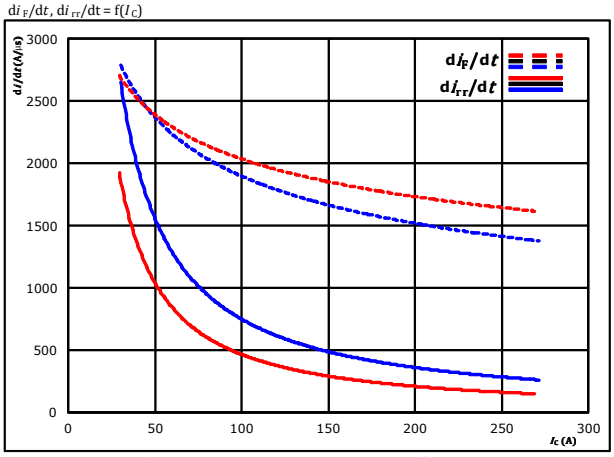
At						
	V_{CE} =	600	V		25 °C	
	V_{GE} =	±15	V	T_j:	150 °C	
	I_C =	151	A			

Inverter Switching Characteristics

figure 13. **FWD**

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

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



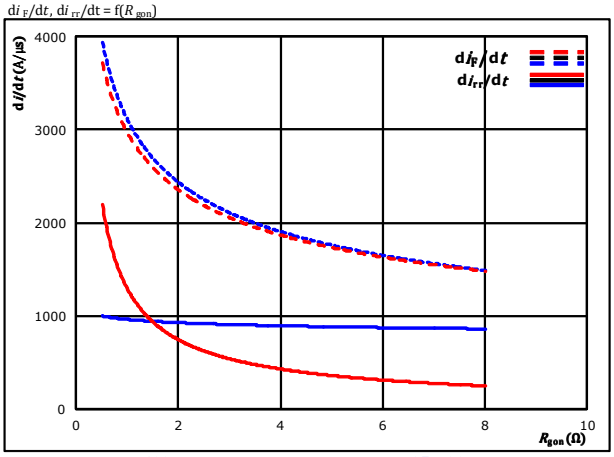
At

V_{CE} =	600	V	T_j:	25 °C	
V_{GE} =	±15	V		150 °C	
R_{gon} =	2	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, $di_{rr}/dt = f(R_{gon})$



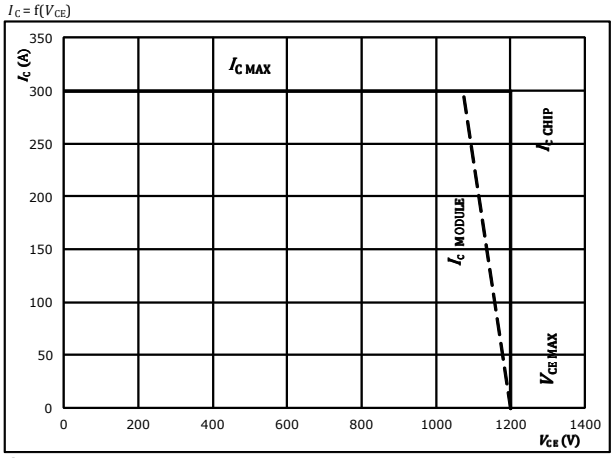
At

V_{CE} =	600	V	T_j:	25 °C	
V_{GE} =	±15	V		150 °C	
I_C =	151	A			

figure 15. **IGBT**

Reverse bias safe operating area

$I_C = f(V_{CE})$



At

T_j =	175	°C
R_{gon} =	2	Ω
R_{goff} =	2	Ω

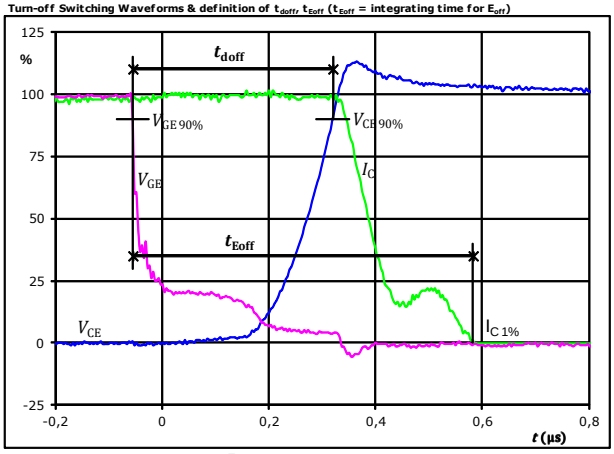
Inverter Switching Definitions

General conditions

T_j	=	**150 °C**
R_{gon}	=	**2 Ω**
R_{goff}	=	**2 Ω**

figure 1. **IGBT**

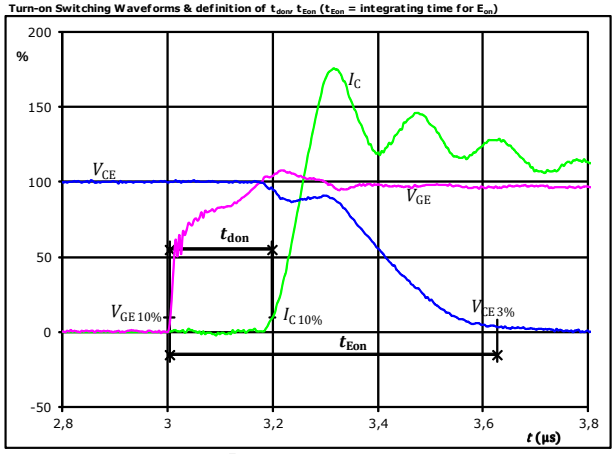
Turn-off Switching Waveforms & definition of t_{doff}, t_{Eoff} (t_{Eoff} = integrating time for E_{off})



$V_{GE}(0\%)$ =	-15	V
$V_{GE}(100\%)$ =	15	V
$V_C(100\%)$ =	600	V
$I_C(100\%)$ =	151	A
t_{doff} =	0,375	µs
t_{Eoff} =	0,638	µs

figure 2. **IGBT**

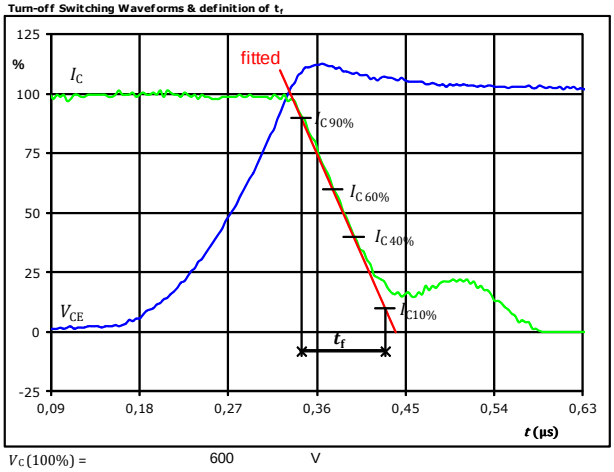
Turn-on Switching Waveforms & definition of t_{don}, t_{Eon} (t_{Eon} = integrating time for E_{on})



$V_{GE}(0\%)$ =	-15	V
$V_{GE}(100\%)$ =	15	V
$V_C(100\%)$ =	600	V
$I_C(100\%)$ =	151	A
t_{don} =	0,194	µs
t_{Eon} =	0,623	µs

figure 3. **IGBT**

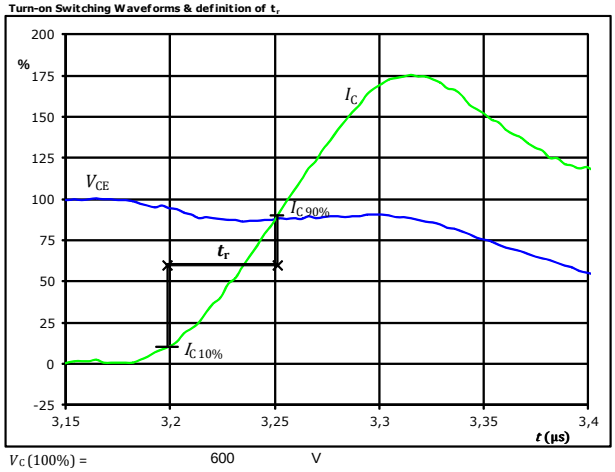
Turn-off Switching Waveforms & definition of t_f



$V_C(100\%)$ =	600	V
$I_C(100\%)$ =	151	A
t_f =	0,085	µs

figure 4. **IGBT**

Turn-on Switching Waveforms & definition of t_r

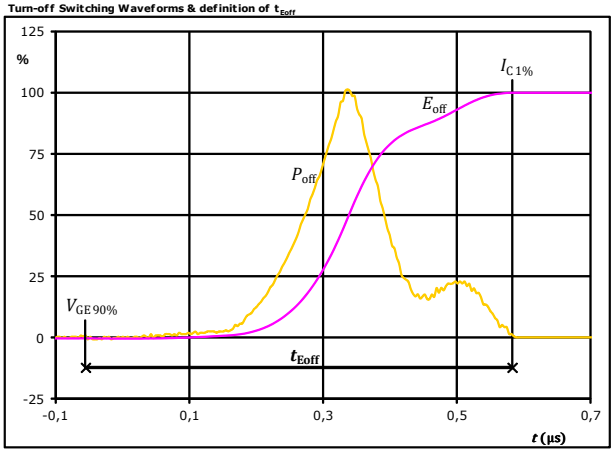


$V_C(100\%)$ =	600	V
$I_C(100\%)$ =	151	A
t_r =	0,053	µs

Inverter Switching Characteristics

figure 5. **IGBT**

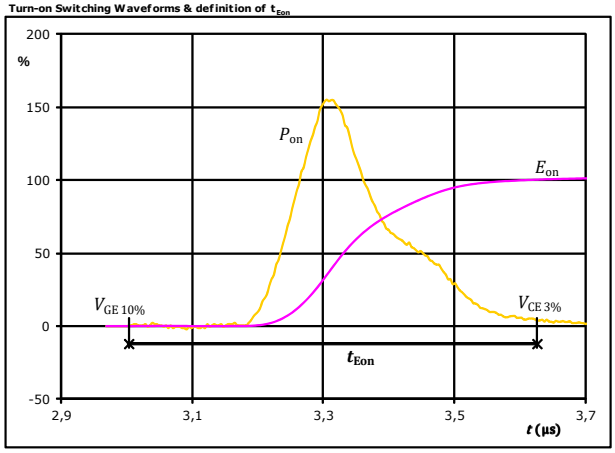
Turn-off Switching Waveforms & definition of t_{Eoff}



$P_{off}(100\%)$ =	90,54	kW
$E_{off}(100\%)$ =	13,82	mJ
t_{Eoff} =	0,64	µs

figure 6. **IGBT**

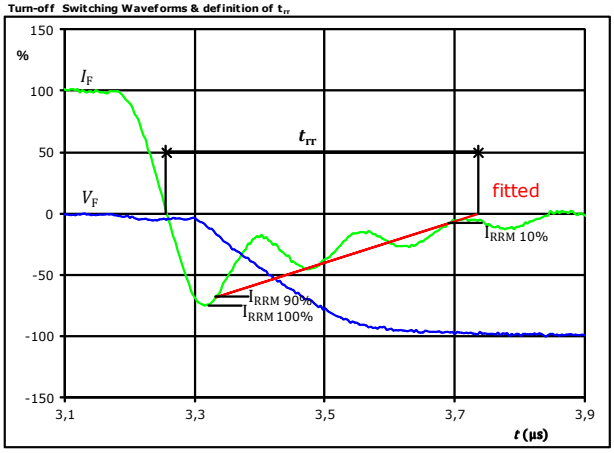
Turn-on Switching Waveforms & definition of t_{Eon}



$P_{on}(100\%)$ =	90,54	kW
$E_{on}(100\%)$ =	23,22	mJ
t_{Eon} =	0,62	µs

figure 7. **FWD**

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

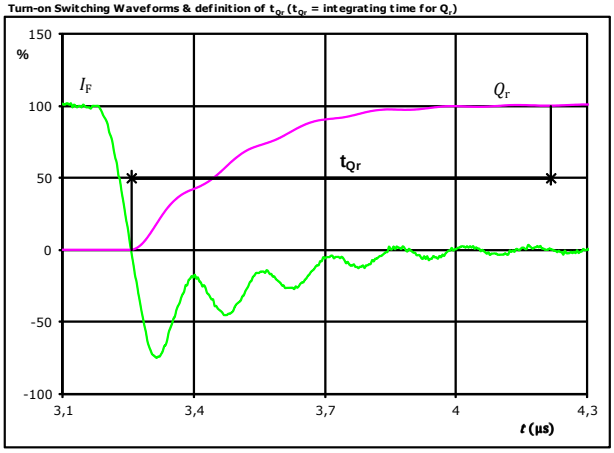


$V_F(100\%)$ =	600	V
$I_F(100\%)$ =	151	A
$I_{RRM}(100\%)$ =	-115	A
t_{rr} =	0,480	µs

Inverter Switching Characteristics

figure 8. **FWD**

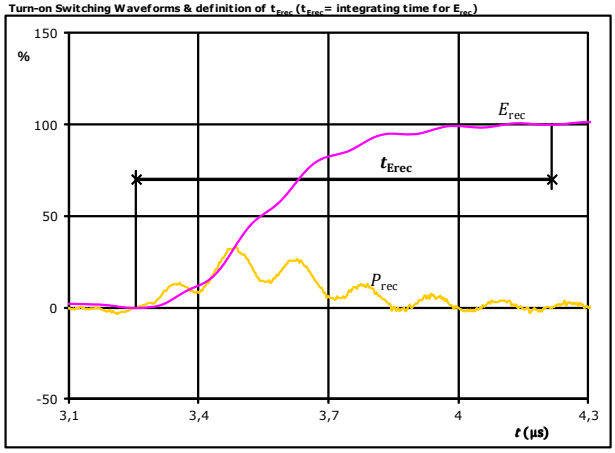
Turn-on Switching Waveforms & definition of t_{Qr} (t_{Qr} = integrating time for Q_r)



I_F (100%) =	151	A
Q_r (100%) =	24,43	µC
t_{Qr} =	0,96	µs

figure 9. **FWD**

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



P_{rec} (100%) =	90,54	kW
E_{rec} (100%) =	8,10	mJ
t_{Erec} =	0,96	µs

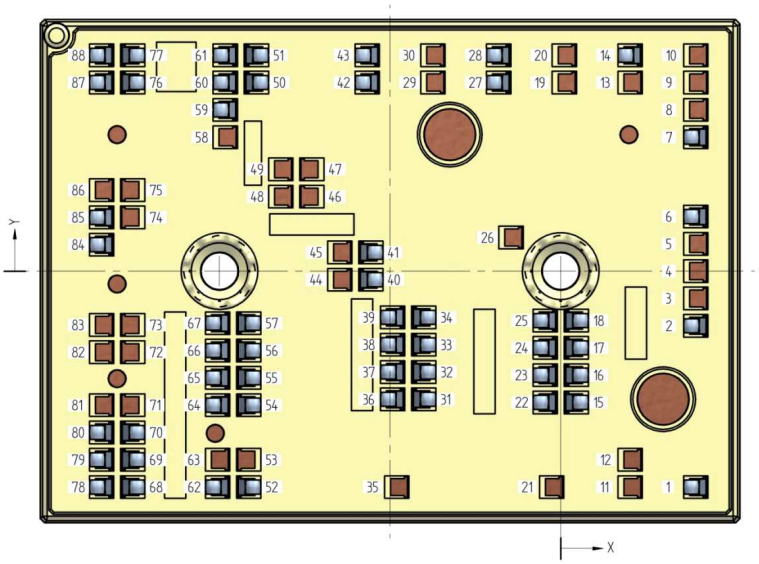
Ordering Code & Marking

Version	Ordering Code
with std lid (black V23990-K12-T-PM)+PCM	V23990-K430-F42-/3A/-PM
with std lid (black V23990-K12-T-PM)+thermal grease	V23990-K430-F42-/5A/-PM
with std lid (black V23990-K12-T-PM)	V23990-K430-F42-/0A/-PM

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

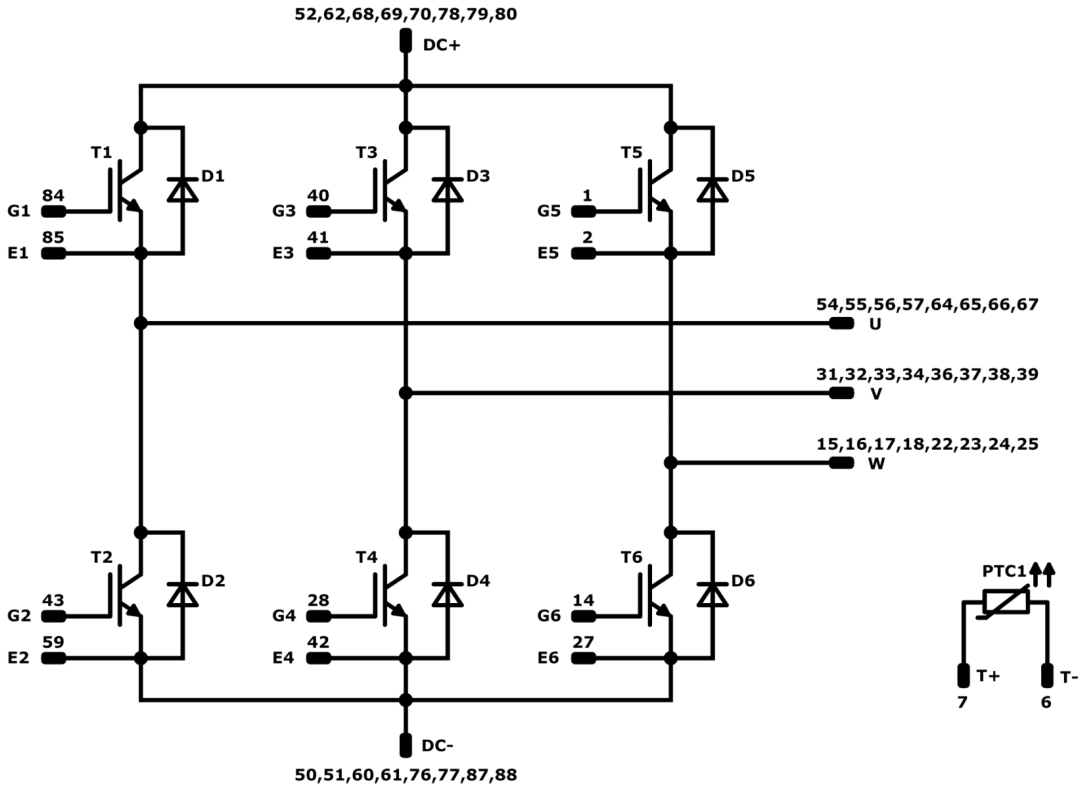
Outline

PCB pad table				PCB pad table			
Pin	X	Y	Function	Pin	X	Y	Function
1	15,83	-25,3	G5	52	3,42	-25,3	+DC
2	15,83	-6,4	E5	53	Not assembled		
3	Not assembled			54	3,42	-15,7	U
4	Not assembled			55	3,42	-12,5	U
5	Not assembled			56	3,42	-9,3	U
6	15,83	6,4	-T	57	3,42	-6,1	U
7	15,83	15,7	+T	58	Not assembled		
8	Not assembled			59	-39,32	18,9	E2
9	Not assembled			60	-39,32	22,1	-DC
10	Not assembled			61	-39,32	25,3	-DC
11	Not assembled			62	-40,22	-25,3	+DC
12	Not assembled			63	Not assembled		
13	Not assembled			64	-40,22	-15,7	U
14	8,13	25,3	G6	65	-40,22	-12,5	U
15	41,82	-15,38	W	66	-40,22	-9,3	U
16	41,82	-12,18	W	67	-40,22	-6,09	U
17	41,82	-8,98	W	68	-10,18	-25,3	+DC
18	41,82	-5,79	W	69	-10,18	-22,1	+DC
19	Not assembled			70	-10,18	-18,9	+DC
20	Not assembled			71	Not assembled		
21	Not assembled			72	Not assembled		
22	-1,82	-15,38	W	73	Not assembled		
23	-1,82	-12,18	W	74	Not assembled		
24	-1,82	-8,98	W	75	Not assembled		
25	-1,82	-5,79	W	76	-10,18	22,1	-DC
26	Not assembled			77	-10,18	25,3	-DC
27	-7,27	22,1	E6	78	-53,82	-25,3	+DC
28	-7,27	25,3	G4	79	-53,82	-22,1	+DC
29	Not assembled			80	-53,82	-18,9	+DC
30	Not assembled			81	Not assembled		
31	23,95	-15,02	V	82	Not assembled		
32	23,95	-11,82	V	83	Not assembled		
33	23,95	-8,63	V	84	-53,82	3,1	G1
34	23,95	-5,42	V	85	-53,82	6,3	E1
35	Not assembled			86	Not assembled		
36	-19,7	-15,02	V	87	-53,82	22,1	-DC
37	-19,7	-11,82	V	88	-53,82	25,3	-DC
38	-19,7	-8,62	V				
39	-19,7	-5,42	V				
40	17,74	-1	G3				
41	17,74	2,2	E3				
42	-22,67	22,1	E4				
43	-22,67	25,3	G2				
44	Not assembled						
45	Not assembled						
46	Not assembled						
47	Not assembled						
48	Not assembled						
49	Not assembled						
50	4,32	22,1	-DC				
51	4,32	25,3	-DC				



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

Pinout



Identification

ID	Component	Voltage	Current	Function	Comment
T1-T6	IGBT	1200 V	150 A	Inverter Switch	
D1-D6	FWD	1200 V	150 A	Inverter 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-K430-F42-D4-14	11 Aug. 2017		

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