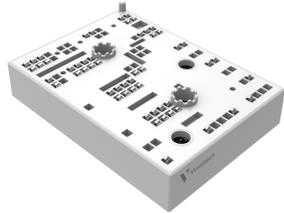
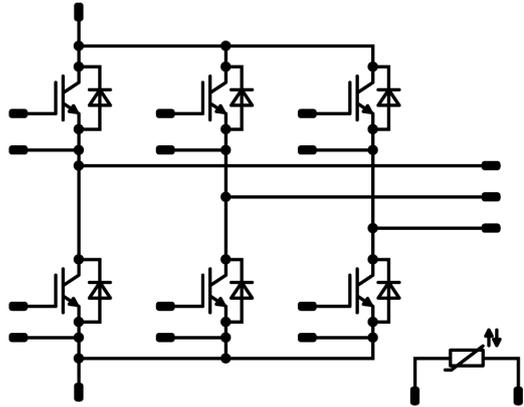




MiniSKiiP PACK 3		1200 V / 150 A
<b>Features</b> <ul style="list-style-type: none"><li>• Solderless interconnection</li><li>• Trench Fieldstop IGBT4 technology</li><li>• Si<sub>3</sub>N<sub>4</sub> ceramic material</li></ul>	<b>MiniSKiiP® 3 16 mm housing</b> 	
<b>Target applications</b> <ul style="list-style-type: none"><li>• Servo Drives</li><li>• Industrial Motor Drives</li><li>• UPS</li></ul>	<b>Schematic</b> 	
<b>Types</b> <ul style="list-style-type: none"><li>• V23990-K430-F42-PM</li></ul>		



## Maximum Ratings

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

Parameter	Symbol	Conditions	Value	Unit
<b>Inverter Switch</b>				
Collector-emitter voltage	$V_{CES}$		1200	V
Collector current (DC current)	$I_C$	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	179	A
Repetitive peak collector current	$I_{CRM}$	$t_p$ limited by $T_{jmax}$	450	A
Total power dissipation	$P_{tot}$	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	500	W
Gate-emitter voltage	$V_{GES}$		±20	V
Short circuit ratings	$t_{SC}$	$V_{GE} = 15\text{ V}$ , $V_{CC} = 800\text{ V}$ $T_j = 150\text{ °C}$	10	µs
Maximum junction temperature	$T_{jmax}$		175	°C

<b>Inverter Diode</b>				
Peak repetitive reverse voltage	$V_{RRM}$		1200	V
Forward current (DC current)	$I_F$	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	127	A
Surge (non-repetitive) forward current	$I_{FSM}$	Single Half Sine Wave, $t_p = 10\text{ ms}$ $T_j = 150\text{ °C}$	900	A
Surge current capability	$I^2t$		4050	A <sup>2</sup> s
Total power dissipation	$P_{tot}$	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	297	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* $t_p = 2\text{ s}$	5500	V
Isolation voltage	$V_{isol}$	AC Voltage $t_p = 1\text{ min}$	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		≥ 600	

\*100 % tested in production



### Characteristic Values

Parameter	Symbol	Conditions					Values			Unit
		$V_{GS}$ [V]	$V_{GE}$ [V]	$V_{DS}$ [V]	$I_D$ [A]	$T_j$ [°C]	Min	Typ	Max	

#### Inverter Switch

##### Static

Gate-emitter threshold voltage	$V_{GE(th)}$	$V_{CE} = V_{GE}$			0,0052	25	5,3	5,8	6,3	V
Collector-emitter saturation voltage	$V_{CE(sat)}$		15		150	25 150	1,58	1,93 2,4	2,07 <sup>(1)</sup>	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	$C_{ies}$	$f = 1 \text{ Mhz}$	0	25		25		8600		pF
Reverse transfer capacitance	$C_{res}$							320		pF
Gate charge	$Q_g$		15		0	25		1140		nC

##### Thermal

Thermal resistance junction to sink <sup>(2)</sup>	$R_{th(j-s)}$	$\lambda_{paste} = 2,5 \text{ W/mK}$ (HPTP)						0,19		K/W
--	---------------	--	--	--	--	--	--	------	--	-----

##### Dynamic

Turn-on delay time	$t_{d(on)}$	$R_{gon} = 2 \Omega$ $R_{goff} = 2 \Omega$	±15	600	150	25		175		ns
Rise time	$t_r$					150		192,6		ns
Turn-off delay time	$t_{d(off)}$					25		288,4		ns
Fall time	$t_f$					150		375,4		ns
Turn-on energy (per pulse)	$E_{on}$					25		58,36		mWs
Turn-off energy (per pulse)	$E_{off}$					150		99,6		mWs
						25		14,99		mWs
		150		23,03		mWs				
		25		8,26		mWs				
		150		14,15		mWs				



### Characteristic Values

Parameter	Symbol	Conditions					Values			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		
<b>Inverter Diode</b>										
<b>Static</b>										
Forward voltage	$V_F$			150	25 150		2,51 2,54	2,46 <sup>(1)</sup> 2,38 <sup>(1)</sup>		V
Reverse leakage current	$I_R$	$V_i = 1200$ V			25 150			180 28000		$\mu$ A
<b>Thermal</b>										
Thermal resistance junction to sink <sup>(2)</sup>	$R_{th(j-s)}$	$\lambda_{paste} = 2,5$ W/mK (HPTP)						0,32		K/W
<b>Dynamic</b>										
Peak recovery current	$I_{RRM}$	$di/dt=2520$ A/ $\mu$ s $di/dt=2365$ A/ $\mu$ s	$\pm 15$	600	150	25		76,98		A
Reverse recovery time	$t_{rr}$					150		106,92		ns
						25		124,75		
Recovered charge	$Q_r$					150		491,64		$\mu$ C
						25		7,99		
Reverse recovered energy	$E_{rec}$					150		24,28		mWs
		25		2,13						
Peak rate of fall of recovery current	$(di_{rr}/dt)_{max}$	150		990		A/ $\mu$ s				
		25		1268						



### Characteristic Values

Parameter	Symbol	Conditions					Values			Unit
		$V_{GS}$ [V]	$V_{GE}$ [V]	$V_{DS}$ [V]	$V_{CE}$ [V]	$I_D$ [A] $I_F$ [A]	$T_j$ [°C]	Min	Typ	

### Thermistor

#### Static

Rated resistance	$R$					25		1		kΩ
Deviation of $R_{100}$	$A_{R/R}$	$R_{100} = 1670 \Omega$				100	-2		2	%
Maximum Current	$I_{max}$							3		mA
Power dissipation constant	$d$					25		0,76		mW/K
A-value	$A$							$7,635 \times 10^{-3}$		1/K
B-value	$B$							$1,73 \times 10^{-5}$		1/K <sup>2</sup>
Vincotech Thermistor Reference									E	

<sup>(1)</sup> Value at chip level

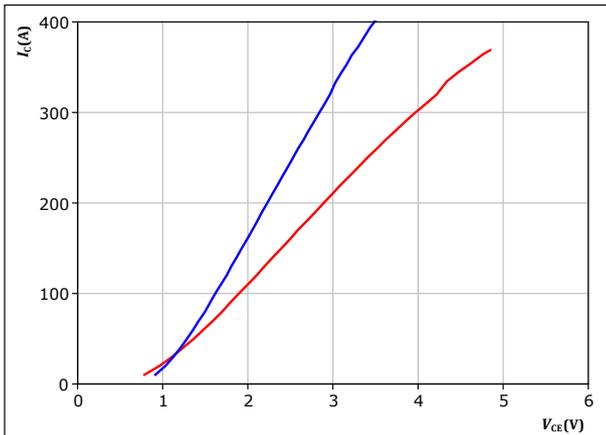
<sup>(2)</sup> Only valid with pre-applied Vincotech thermal interface material.



## Inverter Switch Characteristics

**figure 1.** IGBT

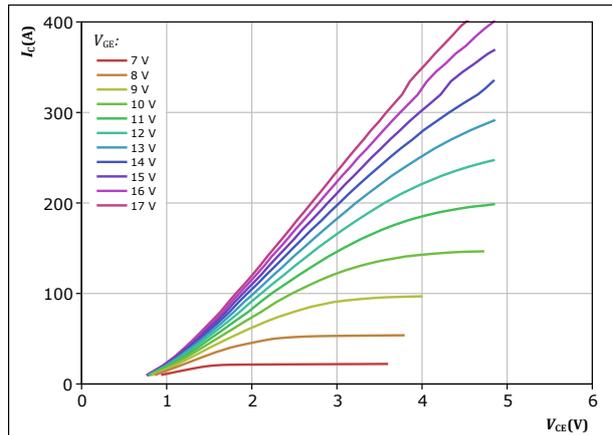
Typical output characteristics  
 $I_C = f(V_{CE})$



$t_p = 250 \mu s$   
 $V_{GE} = 15 V$   
 $T_j: \text{ — } 25 \text{ }^\circ C$   
 $\text{ — } 150 \text{ }^\circ C$

**figure 2.** IGBT

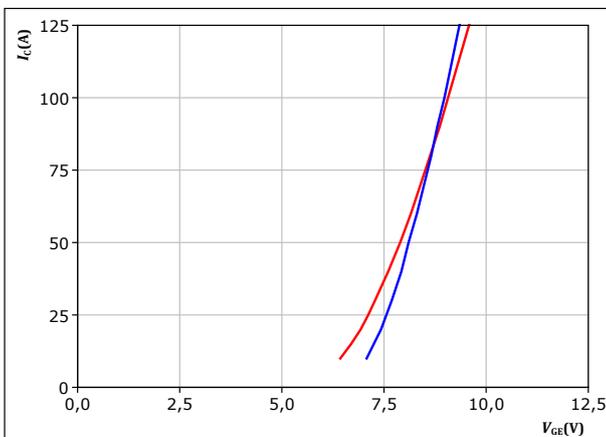
Typical output characteristics  
 $I_C = f(V_{CE})$



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

**figure 3.** IGBT

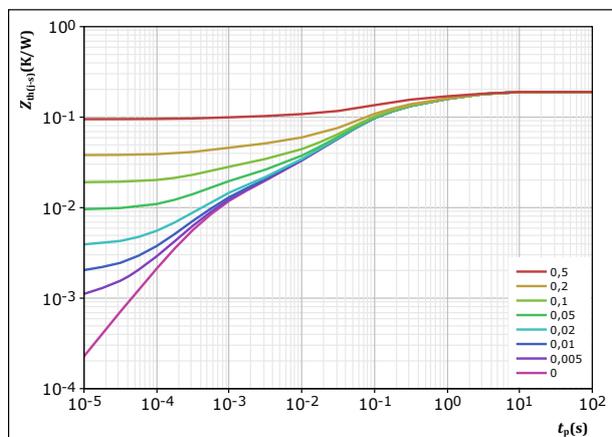
Typical transfer characteristics  
 $I_C = f(V_{GE})$



$t_p = 250 \mu s$   
 $V_{CE} = 10 V$   
 $T_j: \text{ — } 25 \text{ }^\circ C$   
 $\text{ — } 150 \text{ }^\circ C$

**figure 4.** IGBT

Transient thermal impedance as a function of pulse width  
 $Z_{th(j-s)} = f(t_p)$



$D = t_p / T$   
 $R_{th(j-s)} = 0,19 \text{ K/W}$   
IGBT thermal model values

R (K/W)	$\tau$ (s)
4,61E-02	2,08E+00
3,85E-02	3,68E-01
7,15E-02	7,51E-02
1,54E-02	2,46E-02
9,57E-03	3,29E-03
8,83E-03	4,80E-04

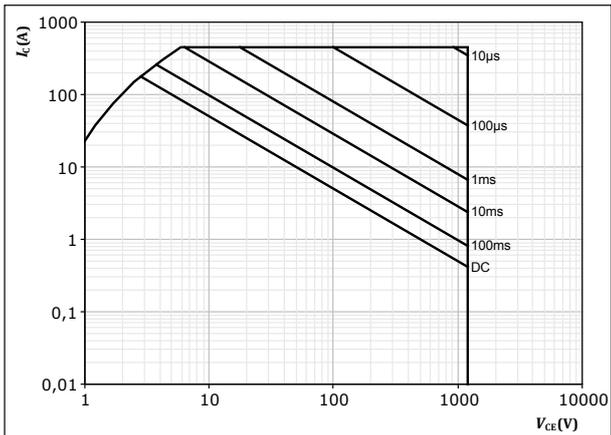


### Inverter Switch Characteristics

figure 5. IGBT

Safe operating area

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



$D =$  single pulse  
 $T_s = 80 \text{ } ^\circ\text{C}$   
 $V_{GE} = 15 \text{ V}$   
 $T_j = T_{jmax}$

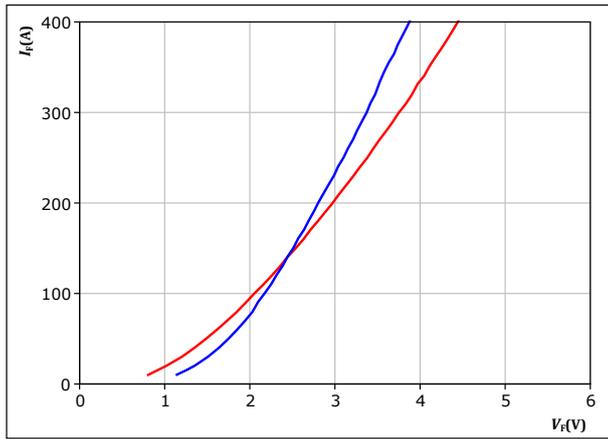


## Inverter Diode Characteristics

figure 6. FWD

Typical forward characteristics

$$I_F = f(V_F)$$

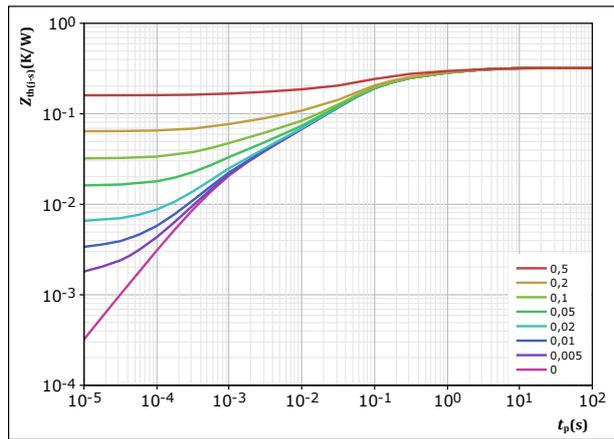


$t_p = 250 \mu s$   
 $T_j$ : — 25 °C  
— 150 °C

figure 7. FWD

Transient thermal impedance as a function of pulse width

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



$D = t_p / T$   
 $R_{th(j-s)} = 0,32 \text{ K/W}$   
FWD thermal model values

$R$ (K/W)	$\tau$ (s)
3,42E-02	2,90E+00
4,33E-02	7,45E-01
8,49E-02	1,59E-01
1,17E-01	4,42E-02
2,41E-02	3,98E-03
1,62E-02	7,03E-04

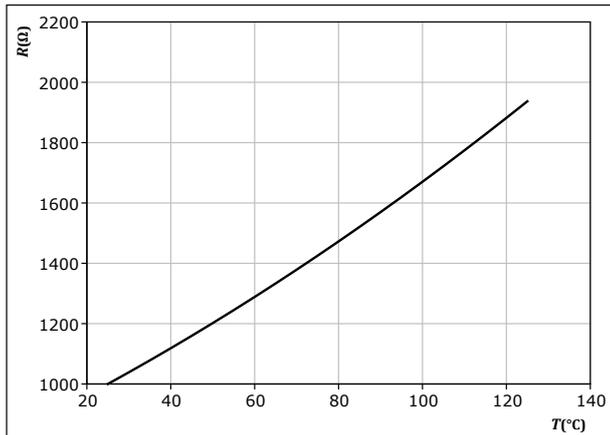


## Thermistor Characteristics

figure 8. Thermistor

Typical PTC characteristic as function of temperature

$$R_T = f(T)$$

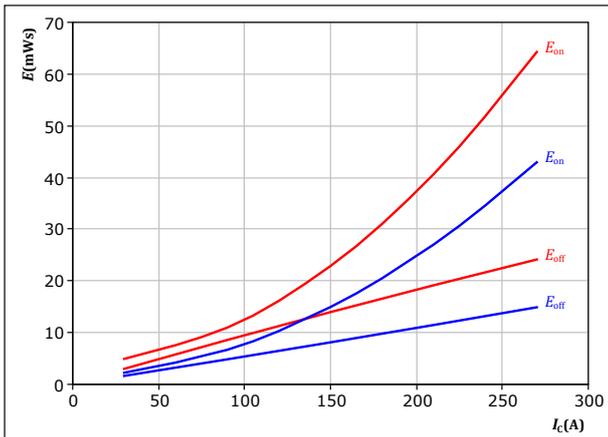




## Inverter Switching Characteristics

**figure 9.** IGBT

Typical switching energy losses as a function of collector current  
 $E = f(I_c)$



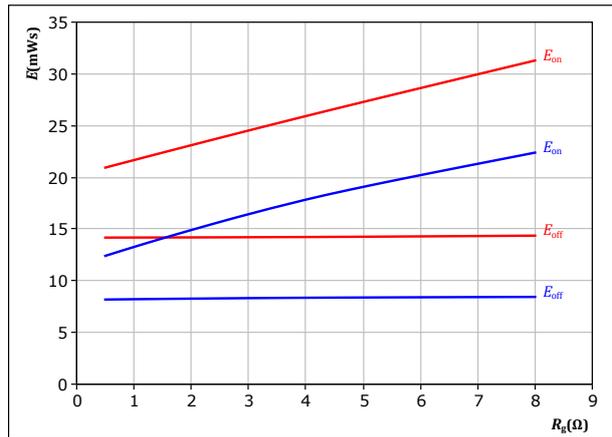
With an inductive load at

$V_{CE} = 600$  V  
 $V_{GE} = \pm 15$  V  
 $R_{gon} = 2$   $\Omega$   
 $R_{goff} = 2$   $\Omega$

$T_j$ : — 25 °C  
 — 150 °C

**figure 10.** IGBT

Typical switching energy losses as a function of gate resistor  
 $E = f(R_g)$



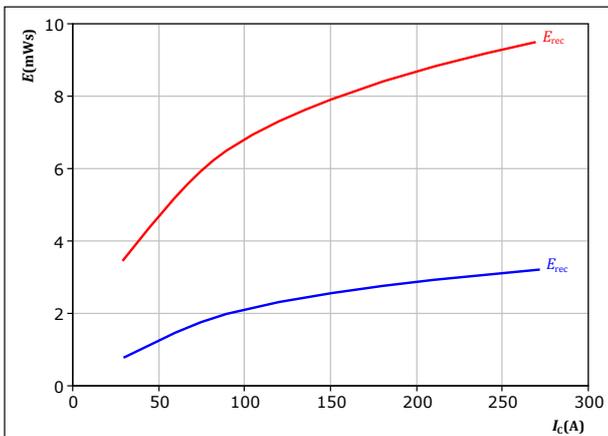
With an inductive load at

$V_{CE} = 600$  V  
 $V_{GE} = \pm 15$  V  
 $I_c = 150$  A

$T_j$ : — 25 °C  
 — 150 °C

**figure 11.** FWD

Typical reverse recovered energy loss as a function of collector current  
 $E_{rec} = f(I_c)$



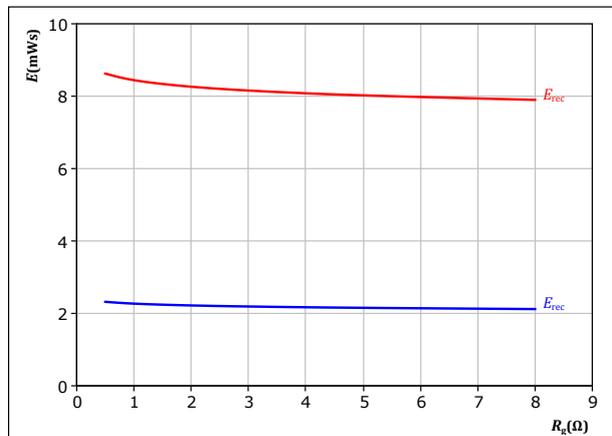
With an inductive load at

$V_{CE} = 600$  V  
 $V_{GE} = \pm 15$  V  
 $R_{gon} = 2$   $\Omega$

$T_j$ : — 25 °C  
 — 150 °C

**figure 12.** 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  
 $V_{GE} = \pm 15$  V  
 $I_c = 150$  A

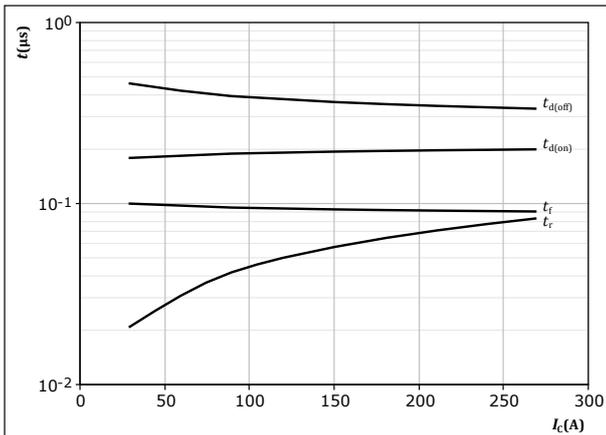
$T_j$ : — 25 °C  
 — 150 °C



## Inverter Switching Characteristics

**figure 13.** IGBT

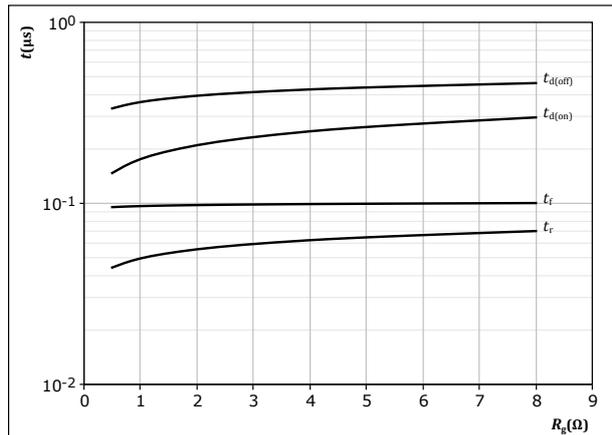
Typical switching times as a function of collector current  
 $t = f(I_c)$



With an inductive load at  
 $T_j = 150 \text{ }^\circ\text{C}$   
 $V_{CE} = 600 \text{ V}$   
 $V_{GE} = \pm 15 \text{ V}$   
 $R_{g(on)} = 2 \text{ } \Omega$   
 $R_{g(off)} = 2 \text{ } \Omega$

**figure 14.** IGBT

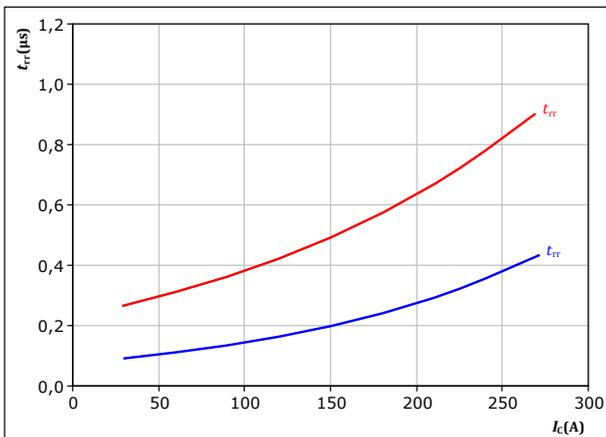
Typical switching times as a function of gate resistor  
 $t = f(R_g)$



With an inductive load at  
 $T_j = 150 \text{ }^\circ\text{C}$   
 $V_{CE} = 600 \text{ V}$   
 $V_{GE} = \pm 15 \text{ V}$   
 $I_c = 150 \text{ A}$

**figure 15.** FWD

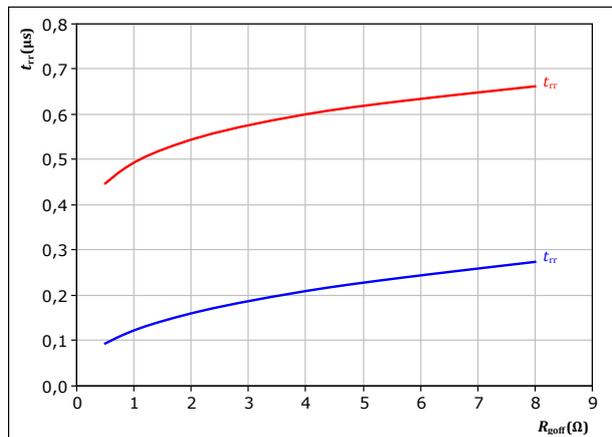
Typical reverse recovery time as a function of collector current  
 $t_{rr} = f(I_c)$



With an inductive load at  
 $V_{CE} = 600 \text{ V}$   
 $V_{GE} = \pm 15 \text{ V}$   
 $R_{g(on)} = 2 \text{ } \Omega$   
 $T_j$ : — 25  $^\circ\text{C}$   
           — 150  $^\circ\text{C}$

**figure 16.** FWD

Typical reverse recovery time as a function of IGBT turn off gate resistor  
 $t_{rr} = f(R_{g(off)})$



With an inductive load at  
 $V_{CE} = 600 \text{ V}$   
 $V_{GE} = \pm 15 \text{ V}$   
 $I_c = 150 \text{ A}$   
 $T_j$ : — 25  $^\circ\text{C}$   
           — 150  $^\circ\text{C}$

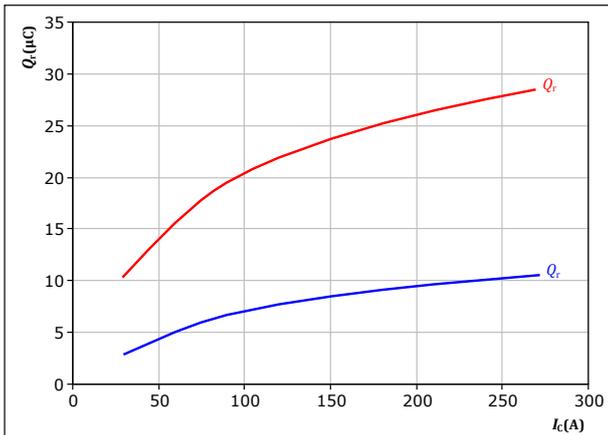


## Inverter Switching Characteristics

**figure 17.** FWD

Typical recovered charge as a function of collector current

$$Q_r = f(I_c)$$



With an inductive load at

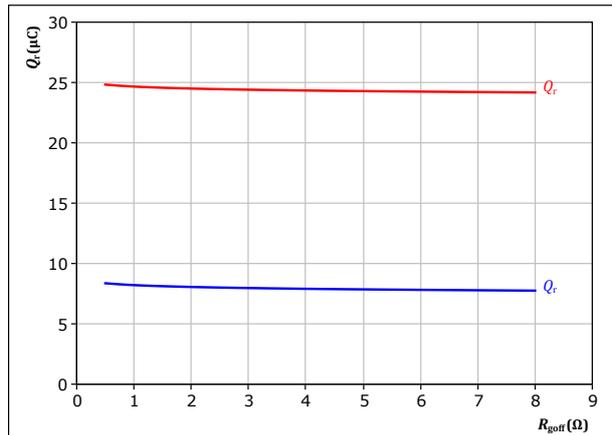
$V_{CE} = 600$  V  
 $V_{GE} = \pm 15$  V  
 $R_{goff} = 2$  Ω

$T_j$ : — 25 °C  
— 150 °C

**figure 18.** FWD

Typical recovered charge as a function of turn off gate resistor

$$Q_r = f(R_{goff})$$



With an inductive load at

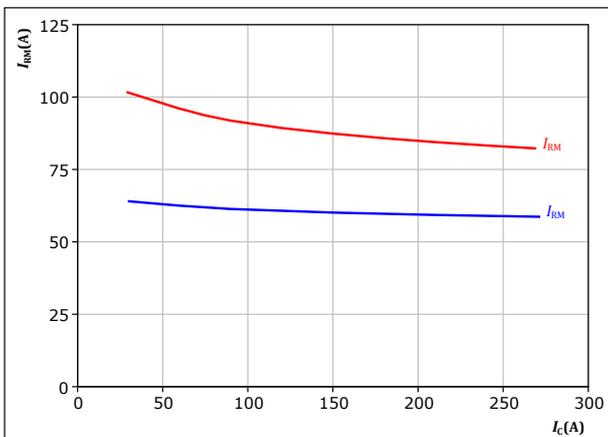
$V_{CE} = 600$  V  
 $V_{GE} = \pm 15$  V  
 $I_c = 150$  A

$T_j$ : — 25 °C  
— 150 °C

**figure 19.** FWD

Typical peak reverse recovery current as a function of collector current

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



With an inductive load at

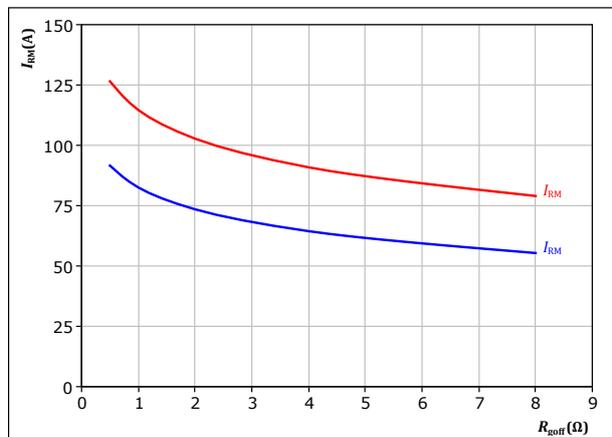
$V_{CE} = 600$  V  
 $V_{GE} = \pm 15$  V  
 $R_{goff} = 2$  Ω

$T_j$ : — 25 °C  
— 150 °C

**figure 20.** FWD

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

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



With an inductive load at

$V_{CE} = 600$  V  
 $V_{GE} = \pm 15$  V  
 $I_c = 150$  A

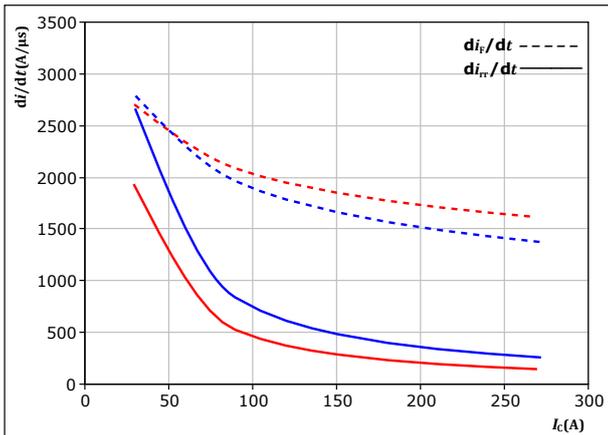
$T_j$ : — 25 °C  
— 150 °C



## Inverter Switching Characteristics

**figure 21.** FWD

Typical rate of fall of forward and reverse recovery current as a function of collector current  
 $di_f/dt, di_r/dt = f(I_c)$



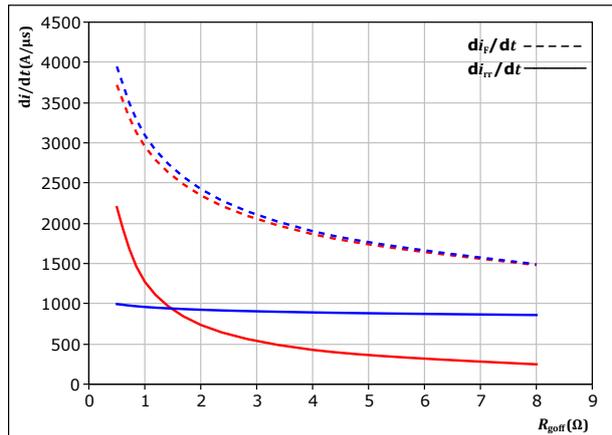
With an inductive load at

$V_{CE} = 600 \text{ V}$   
 $V_{GE} = \pm 15 \text{ V}$   
 $R_{goff} = 2 \text{ } \Omega$

$T_j$ : — 25 °C  
 — 150 °C

**figure 22.** FWD

Typical rate of fall of forward and reverse recovery current as a function of turn off gate resistor  
 $di_f/dt, di_r/dt = f(R_{goff})$



With an inductive load at

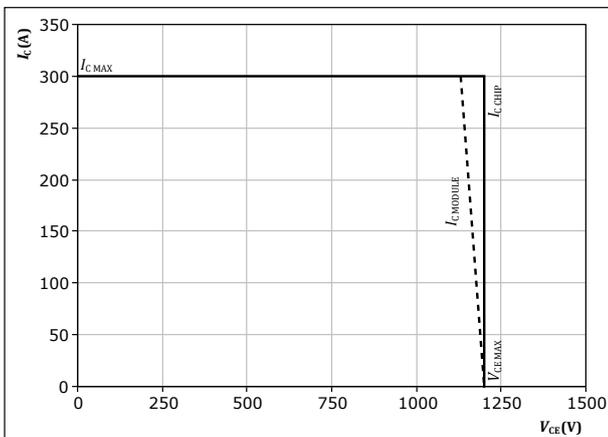
$V_{CE} = 600 \text{ V}$   
 $V_{GE} = \pm 15 \text{ V}$   
 $I_c = 150 \text{ A}$

$T_j$ : — 25 °C  
 — 150 °C

**figure 23.** IGBT

Reverse bias safe operating area

$I_c = f(V_{CE})$

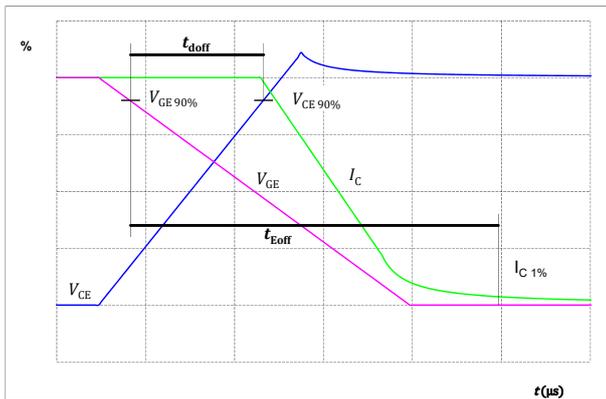


At  $T_j = 150 \text{ } ^\circ\text{C}$   
 $R_{goff} = 2 \text{ } \Omega$   
 $R_{goff} = 2 \text{ } \Omega$

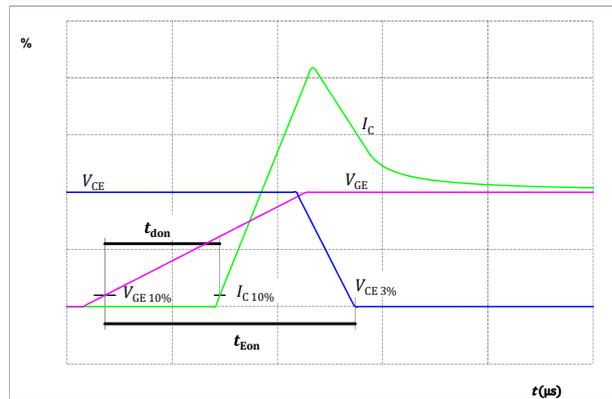


## Inverter Switching Definitions

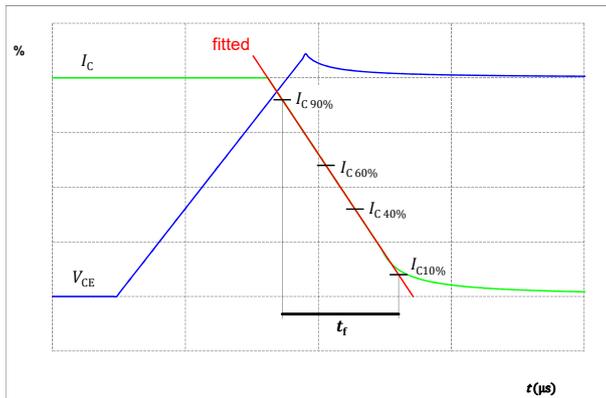
**figure 24.** IGBT  
Turn-off Switching Waveforms & definition of  $t_{doff}$ ,  $t_{Eoff}$  ( $t_{Eoff}$  = integrating time for  $E_{off}$ )



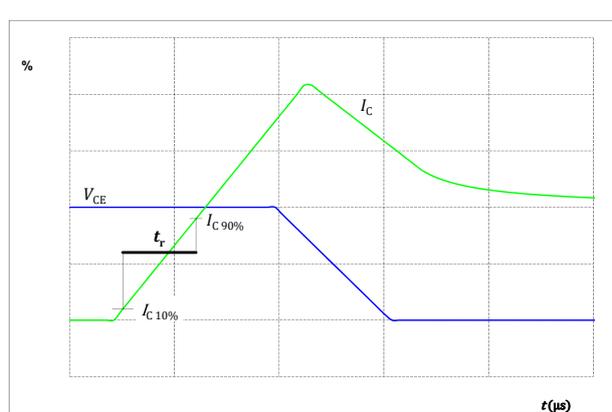
**figure 25.** IGBT  
Turn-on Switching Waveforms & definition of  $t_{don}$ ,  $t_{Eon}$  ( $t_{Eon}$  = integrating time for  $E_{on}$ )



**figure 26.** IGBT  
Turn-off Switching Waveforms & definition of  $t_f$



**figure 27.** IGBT  
Turn-on Switching Waveforms & definition of  $t_r$





### Inverter Switching Definitions

figure 28. FWD

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

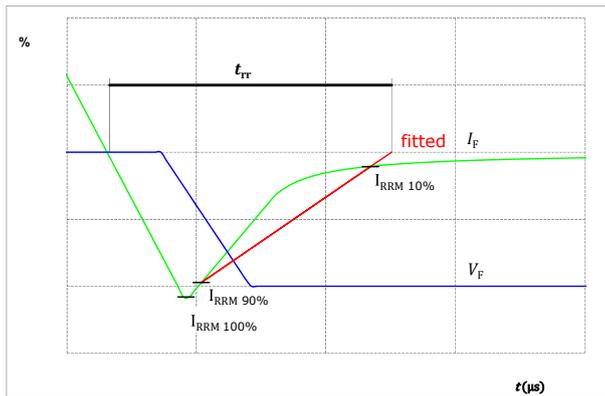
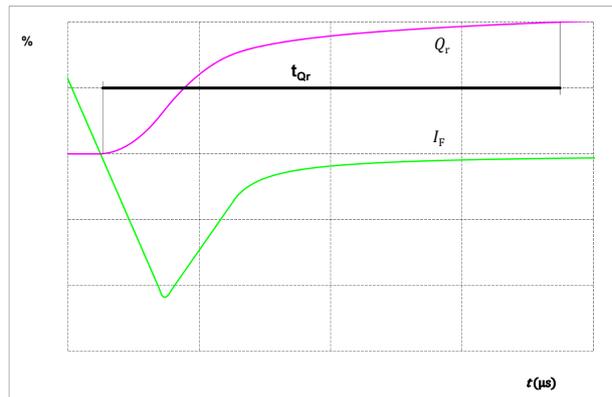


figure 29. FWD

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



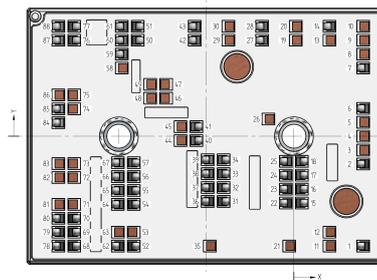


Vincotech

Ordering Code	
Version	Ordering Code
With std lid (6.5mm height) + no thermal grease	V23990-K430-F42-/0A/-PM
With thin lid (2.8mm height) + no thermal grease	V23990-K430-F42-/0B/-PM
With std lid (6.5mm height) + thermal grease (0,8 W/mK, P12, silicone-based)	V23990-K430-F42-/1A/-PM
With thin lid (2.8mm height) + thermal grease (0,8 W/mK, P12, silicone-based)	V23990-K430-F42-/1B/-PM
With std lid (6.5mm height) + thermal grease (3,4 W/mK, PSX-P7, silicone-free)	V23990-K430-F42-/3A/-PM
With thin lid (2.8mm height) + thermal grease (3,4 W/mK, PSX-P7, silicone-free)	V23990-K430-F42-/3B/-PM
With std lid (6.5mm height) + thermal grease (2,5 W/mK, TG20032, silicone-free)	V23990-K430-F42-/4A/-PM
With thin lid (2.8mm height) + thermal grease (2,5 W/mK, TG20032, silicone-free)	V23990-K430-F42-/4B/-PM
With std lid (6.5mm height) + thermal grease (2,5 W/mK, HPTP, silicone-based)	V23990-K430-F42-/5A/-PM
With thin lid (2.8mm height) + thermal grease (2,5 W/mK, HPTP, silicone-based)	V23990-K430-F42-/5B/-PM

Marking							
Text	VIN	Date code	Type&Ver	UL	Lot	Serial	
	VIN	WWYY	TTTTTTTV	UL	LLLLL	SSSS	
Datamatrix	Type&Ver	Lot number	Serial	Date code			
	TTTTTTTV	LLLLL	SSSS	WWYY			

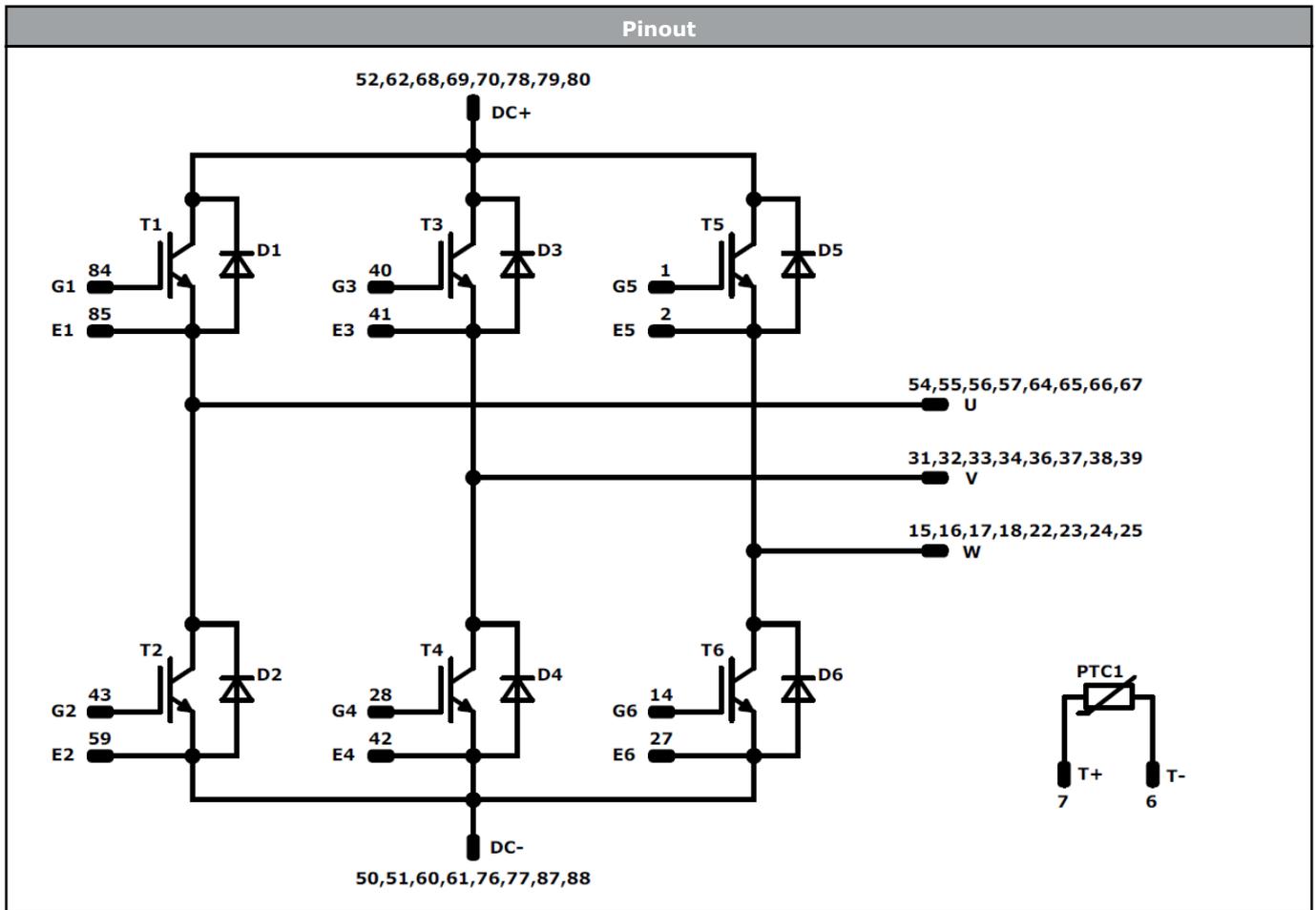
Outline								
Pin table [mm]								
Pin	X	Y	Function					
1	15,83	-25,3	G5	45	not assembled			
2	15,83	-6,4	E5	46	not assembled			
3	not assembled			47	not assembled			
4	not assembled			48	not assembled			
5	not assembled			49	not assembled			
6	15,83	6,4	-T	50	-35,68	22,1	-DC	
7	15,83	15,7	+T	51	-35,68	25,3	-DC	
8	not assembled			52	-36,58	-25,3	+DC	
9	not assembled			53	not assembled			
10	not assembled			54	-36,58	-15,7	U	
11	not assembled			55	-36,58	-12,5	U	
12	not assembled			56	-36,58	-9,3	U	
13	not assembled			57	-36,58	-6,1	U	
14	8,13	25,3	G6	58	not assembled			
15	1,82	-15,38	W	59	-39,32	18,9	E2	
16	1,82	-12,18	W	60	-39,32	22,1	-DC	
17	1,82	-8,98	W	61	-39,32	25,3	-DC	
18	1,82	-5,79	W	62	-40,22	-25,3	+DC	
19	not assembled			63	not assembled			
20	not assembled			64	-40,22	-15,7	U	
21	not assembled			65	-40,22	-12,5	U	
22	-1,82	-15,38	W	66	-40,22	-9,3	U	
23	-1,82	-12,18	W	67	-40,22	-6,09	U	
24	-1,82	-8,98	W	68	-50,18	-25,3	+DC	
25	-1,82	-5,79	W	69	-50,18	-22,1	+DC	
26	not assembled			70	-50,18	-18,9	+DC	
27	-7,27	22,1	E6	71	not assembled			
28	-7,27	25,3	G4	72	not assembled			
29	not assembled			73	not assembled			
30	not assembled			74	not assembled			
31	-16,05	-15,02	V	75	not assembled			
32	-16,05	-11,82	V	76	-50,18	22,1	-DC	
33	-16,05	-8,63	V	77	-50,18	25,3	-DC	
34	-16,05	-5,42	V	78	-53,82	-25,3	+DC	
35	not assembled			79	-53,82	-22,1	+DC	
36	-19,7	-15,02	V	80	-53,82	-18,9	+DC	
37	-19,7	-11,82	V	81	not assembled			
38	-19,7	-8,62	V	82	not assembled			
39	-19,7	-5,42	V	83	not assembled			
40	-22,26	-1	G3	84	-53,82	3,1	G1	
41	-22,26	2,2	E3	85	-53,82	6,3	E1	
42	-22,67	22,1	E4	86	not assembled			
43	-22,67	25,3	G2	87	-53,82	22,1	-DC	
44	not assembled			88	-53,82	25,3	-DC	



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



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Identification					
ID	Component	Voltage	Current	Function	Comment
T2, T1, T4, T3, T6, T5	IGBT	1200 V	150 A	Inverter Switch	
D1, D2, D3, D4, D5, D6	FWD	1200 V	150 A	Inverter Diode	
PTC1	Thermistor			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.

Vincotech thermistor reference
See Vincotech thermistor reference table at 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-PM-D5-14	29 Sep. 2021	Change of CTI value Change of Creepage and Clearance distance Change of Inverter Switch and Diode Rth value	

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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.