Vincotech

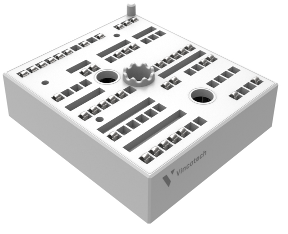
V23990-K230-F40-PM
datasheet

MiniSKiiP® PACK 2 **1200 V / 70 A**

Features

- Solder less interconnection
- Designed for motor drives up to 7 kW
- Temperature sensor
- Standard (6.5mm) and thin (2.8mm) lids, 16mm housing
- Optional with pre-applied thermal grease

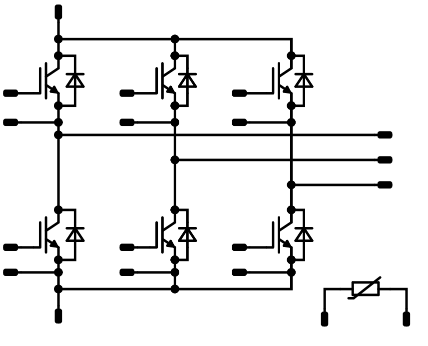
MiniSKiiP® 2 16 m



Target applications

- Servo Drives
- Industrial Motor Drives
- UPS

Schematic



Types

- V23990-K230-F40-PM

Maximum Ratings

T_j = 25 °C, unless otherwise specified

Parameter	Symbol	Conditions		Value	Unit
Inverter Switch					
Collector-emitter voltage	V_{CES}			1200	V
Collector current (DC current)	I_C	$T_j = T_{jmax}$	T_s = 80 °C	87	A
Repetitive peak collector current	I_{CRM}	t_p limited by T_{jmax}		210	A
Total power dissipation	P_{tot}	$T_j = T_{jmax}$	T_s = 80 °C	246	W
Gate-emitter voltage	V_{GES}			±20	V
Short circuit ratings	t_{SC}	V_{GE} = 15 V, V_{CC} = 800 V	T_j = 150 °C	10	µs
Maximum junction temperature	T_{jmax}			175	°C
Inverter Diode					
Peak repetitive reverse voltage	V_{RRM}			1200	V
Forward current (DC current)	I_F	$T_j = T_{jmax}$	T_s = 80 °C	71	A
Surge (non-repetitive) forward current	I_{FSM}	Single Half Sine Wave, t_p = 10 ms	T_j = 150 °C	430	A
Surge current capability	I^2t			925	A^2s
Total power dissipation	P_{tot}	$T_j = T_{jmax}$	T_s = 80 °C	154	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
Isolation voltage	V_{isol}	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					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	
Inverter Switch										
Static										
Gate-emitter threshold voltage	$V_{GE(th)}$	$V_{CE} = V_{GE}$			0,0024	25	5,3	5,8	6,3	V
Collector-emitter saturation voltage	V_{CEsat}		15		70	25 150	1,58	1,94 2,33	2,07(1)	V
Collector-emitter cut-off current	I_{CES}		0	1200		25			10	µA
Gate-emitter leakage current	I_{GES}		20	0		25			240	nA
Internal gate resistance	r_g							None		Ω
Input capacitance	C_{ies}	f = 1 Mhz	0	25		25		4000		pF
Reverse transfer capacitance	C_{res}							140		pF
Gate charge	Q_g		15		0	25		540		nC
Thermal										
Thermal resistance junction to sink (2)	$R_{th(j-s)}$	λ_{paste} = 2,5 W/mK (HPTP)						0,39		K/W
Dynamic										
Turn-on delay time	$t_{d(on)}$	R_{gon} = 8 Ω R_{goff} = 8 Ω	±15	600	70	25 150		97,6 98,4		ns
Rise time	t_r					25 150		21,4 26,8		ns
Turn-off delay time	$t_{d(off)}$					25 150		217,4 284,8		ns
Fall time	t_f					25 150		87,31 126,27		ns
Turn-on energy (per pulse)	E_{on}	Q_{rFWD}=4,46 µC Q_{rFWD}=11,54 µC				25 150		3,74 6,38		mWs
Turn-off energy (per pulse)	E_{off}					25 150		4,09 6,63		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	
Inverter Diode										
Static										
Forward voltage	V_F				75	25 150		2,33 2,26	2,49(1) 2,42(1)	V
Reverse leakage current	I_R	V_r = 1200 V				25 150		7000	120 14000	µA
Thermal										
Thermal resistance junction to sink (2)	$R_{th(j\text{-}s)}$	λ_{paste} = 2,5 W/mK (HPTP)						0,62		K/W
Dynamic										
Peak recovery current	I_{RRM}	d*i*/d*t*=3024 A/µs d*i*/d*t*=2913 A/µs	±15	600	70	25 150		66,85 85,41		A
Reverse recovery time	t_{rr}					25 150		128,62 311,52		ns
Recovered charge	Q_r					25 150		4,46 11,54		µC
Reverse recovered energy	E_{rec}					25 150		1,59 4,43		mWs
Peak rate of fall of recovery current	$(di_{rf}/dt)_{max}$					25 150		3099 606,24		A/µs

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
Thermistor										
Static										
Rated resistance	R					25		1		kΩ
Deviation of R_{100}	$\Delta_{R/R}$	R_{100} = 1670 Ω				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							$1{,}73 \times 10^{-5}$		$1/K^2$
Vincotech Thermistor Reference									E	

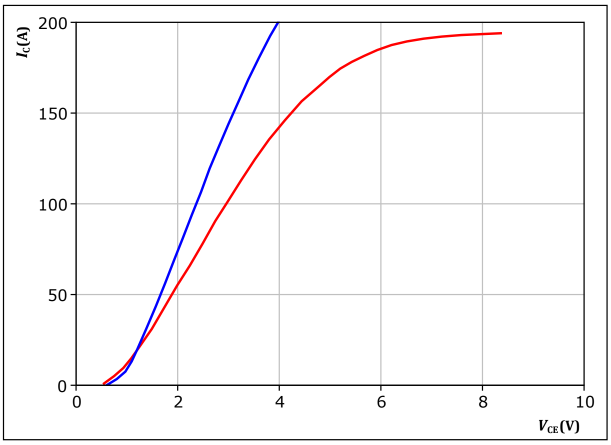
(1) Value at chip level
(2) Only valid with pre-applied Vincotech thermal interface material.

Inverter Switch Characteristics

figure 1. **IGBT**

Typical output characteristics

I_C = f(V_{CE})

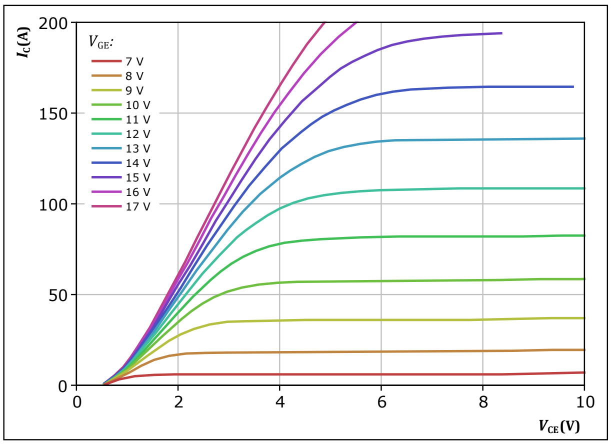


t_p = 250 μs
V_{GE} = 15 V
T_j: 25 °C
150 °C

figure 2. **IGBT**

Typical output characteristics

I_C = f(V_{CE})

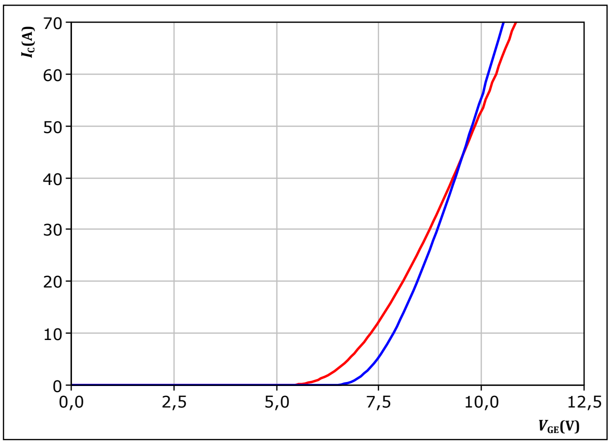


t_p = 250 μs
T_j = 150 °C
V_{GE} from 7 V to 17 V in steps of 1 V

figure 3. **IGBT**

Typical transfer characteristics

I_C = f(V_{GE})

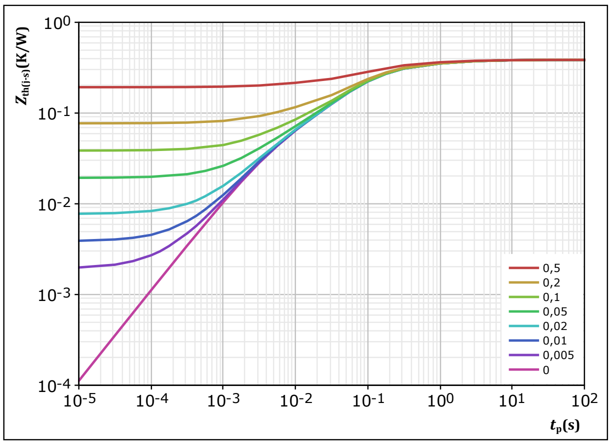


t_p = 250 μs
V_{CE} = 10 V
T_j: 25 °C
150 °C

figure 4. **IGBT**

Transient thermal impedance as a function of pulse width

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



D = t_p / T
$R_{th(j-s)}$ = 0,386 K/W

IGBT thermal model values

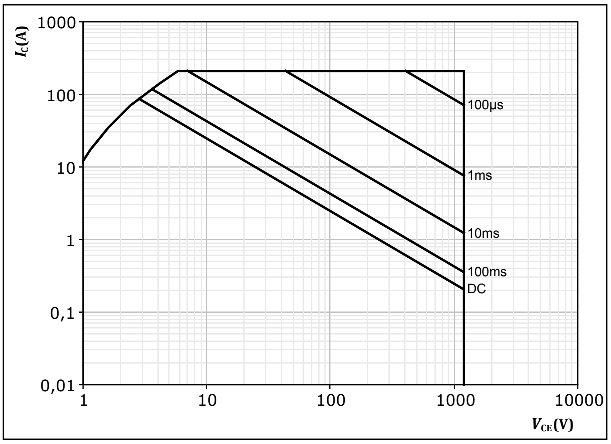
R (K/W)	τ (s)
1,44E-02	6,52E+00
5,56E-02	1,03E+00
1,65E-01	1,54E-01
1,19E-01	4,32E-02
3,22E-02	4,38E-03

Inverter Switch Characteristics

figure 5.	IGBT

Safe operating area

I_C = f(V_{CE})



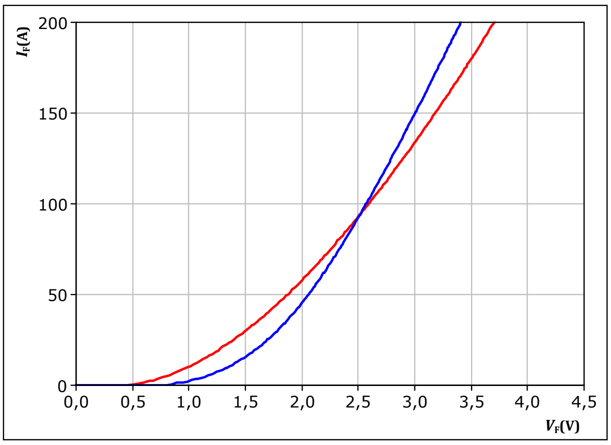
D =	single pulse	
T_s =	80	°C
V_{GE} =	15	V
T_j =	T_{jmax}	

Inverter Diode Characteristics

figure 6. **FWD**

Typical forward characteristics

$I_F = f(V_F)$



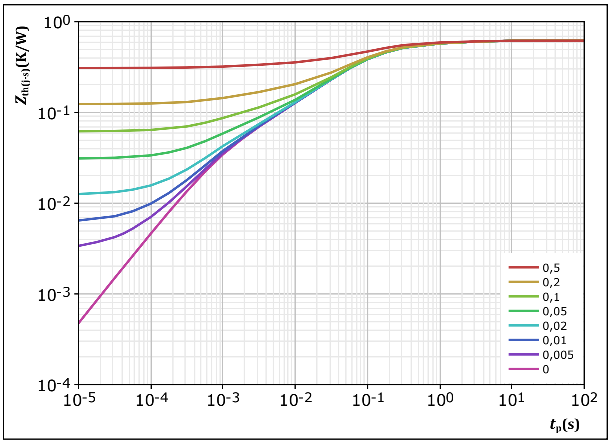
t_p = 250 µs

T_j: 25 °C, 150 °C

figure 7. **FWD**

Transient thermal impedance as a function of pulse width

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



$D = t_p / T$

$R_{th(j\text{-}s)}$ = 0,618 K/W

FWD thermal model values

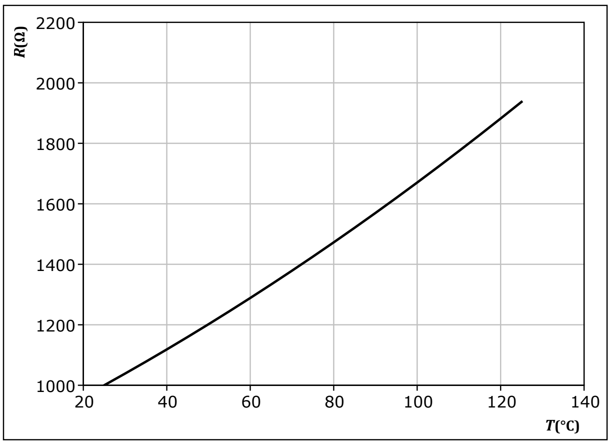
R (K/W)	τ (s)
5,60E-02	2,33E+00
1,24E-01	3,33E-01
3,31E-01	7,46E-02
7,04E-02	9,60E-03
3,68E-02	1,03E-03

Thermistor Characteristics

figure 8.	Thermistor

Typical PTC characteristic as function of temperature

R_T = f(T)

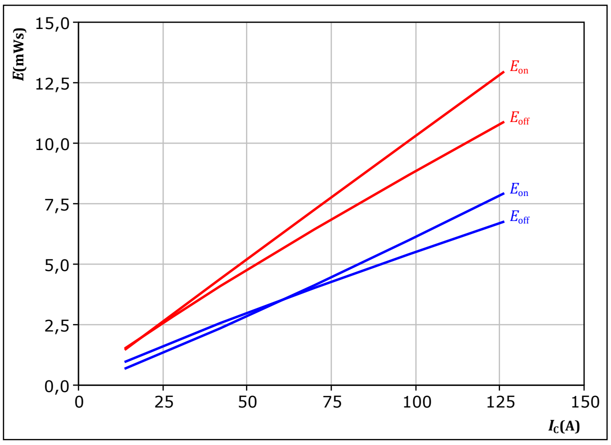


Inverter Switching Characteristics

figure 9. **IGBT**

Typical switching energy losses as a function of collector current

E = f(I_C)



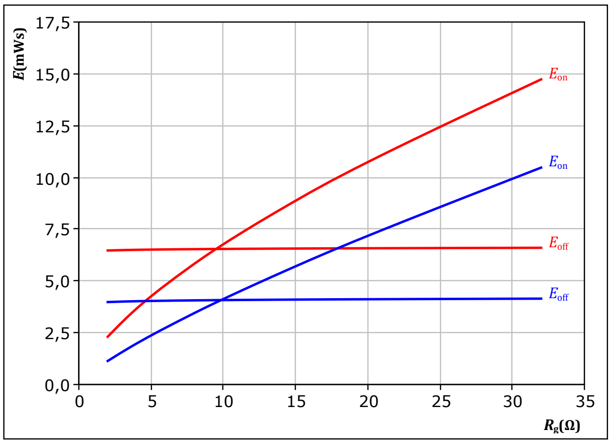
With an inductive load at

V_{CE} =	600	V	T_j: 25 °C (blue), 150 °C (red)
V_{GE} =	±15	V	
R_{gon} =	8	Ω	
R_{goff} =	8	Ω	

figure 10. **IGBT**

Typical switching energy losses as a function of gate resistor

E = f(R_g)



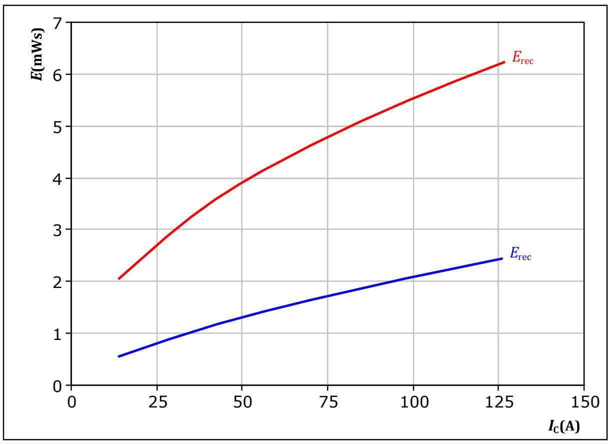
With an inductive load at

V_{CE} =	600	V	T_j: 25 °C (blue), 150 °C (red)
V_{GE} =	±15	V	
I_C =	70	A	

figure 11. **FWD**

Typical reverse recovered energy loss as a function of collector current

E_{rec} = f(I_C)



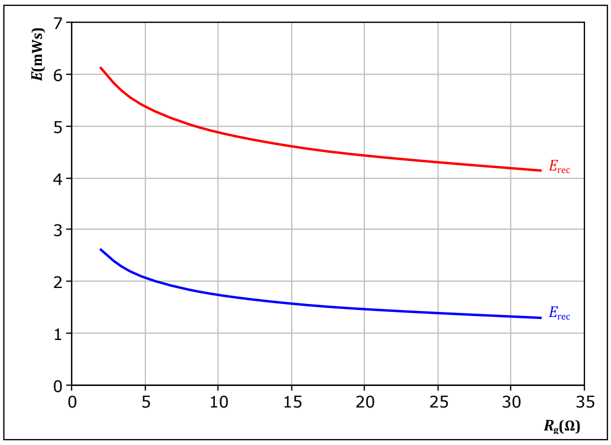
With an inductive load at

V_{CE} =	600	V	T_j: 25 °C (blue), 150 °C (red)
V_{GE} =	±15	V	
R_{gon} =	8	Ω	

figure 12. **FWD**

Typical reverse recovered energy loss as a function of gate resistor

E_{rec} = f(R_g)



With an inductive load at

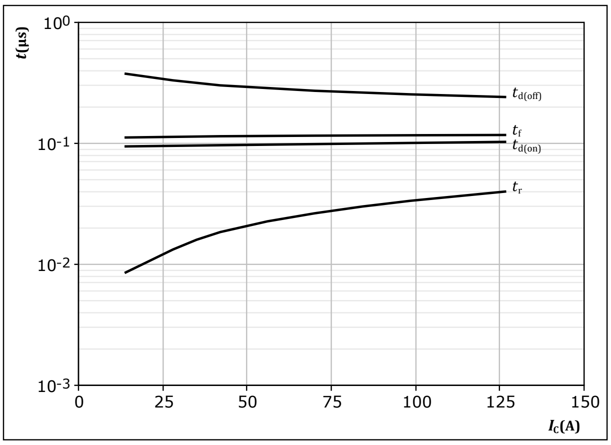
V_{CE} =	600	V	T_j: 25 °C (blue), 150 °C (red)
V_{GE} =	±15	V	
I_C =	70	A	

Inverter Switching Characteristics

figure 13. **IGBT**

Typical switching times as a function of collector current

$t = f(I_C)$



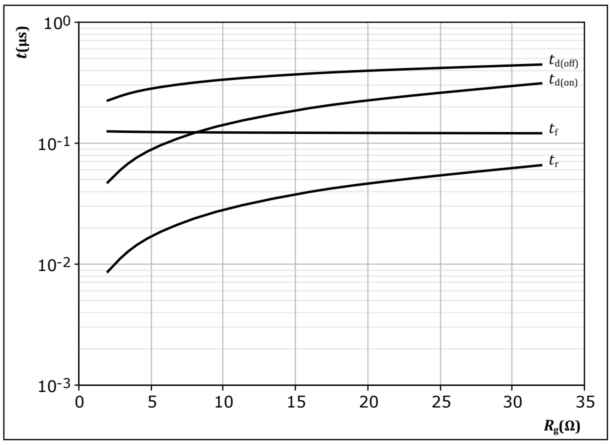
With an inductive load at

T_j =	150	°C
V_{CE} =	600	V
V_{GE} =	±15	V
R_{gon} =	8	Ω
R_{goff} =	8	Ω

figure 14. **IGBT**

Typical switching times as a function of gate resistor

$t = f(R_g)$



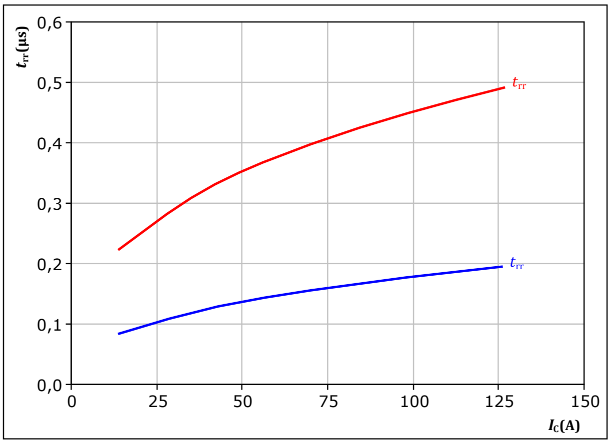
With an inductive load at

T_j =	150	°C
V_{CE} =	600	V
V_{GE} =	±15	V
I_C =	70	A

figure 15. **FWD**

Typical reverse recovery time as a function of collector current

$t_{rr} = f(I_C)$



With an inductive load at

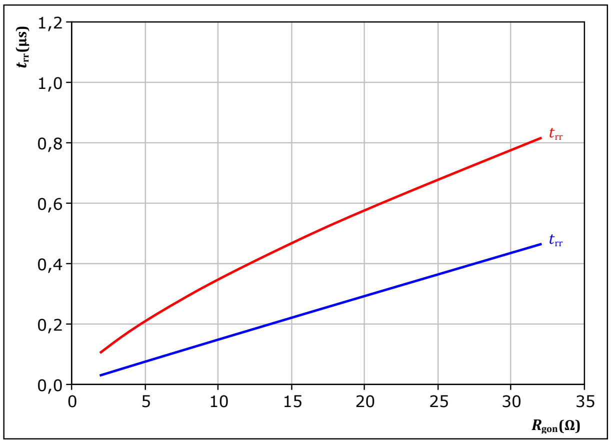
V_{CE} =	600	V
V_{GE} =	±15	V
R_{gon} =	8	Ω

T_j: 25 °C, 150 °C

figure 16. **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} =	600	V
V_{GE} =	±15	V
I_C =	70	A

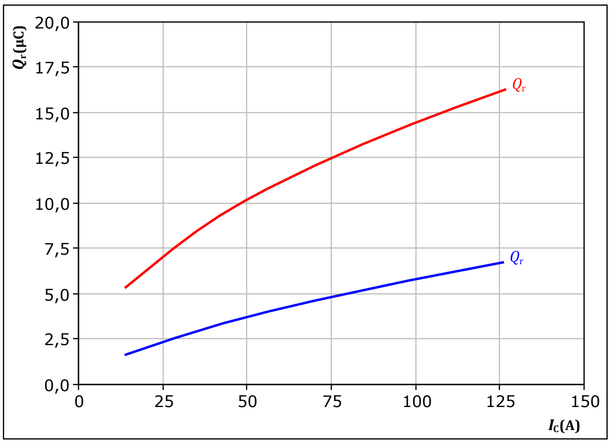
T_j: 25 °C, 150 °C

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

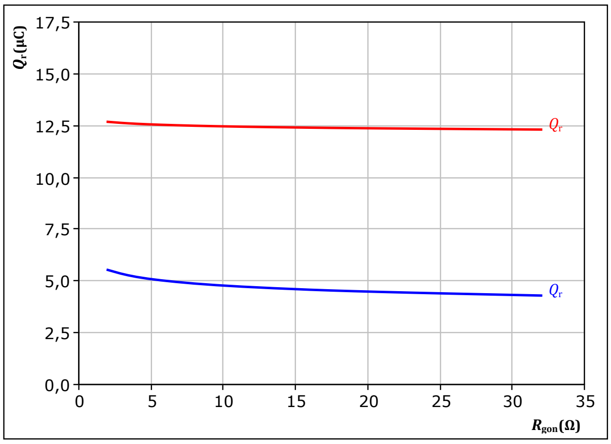
T_j: 25 °C / 150 °C

V_{CE} =	600	V
V_{GE} =	±15	V
R_{gon} =	8	Ω

figure 18. **FWD**

Typical recovered charge as a function of turn on gate resistor

Q_r = f(R_{gon})



With an inductive load at

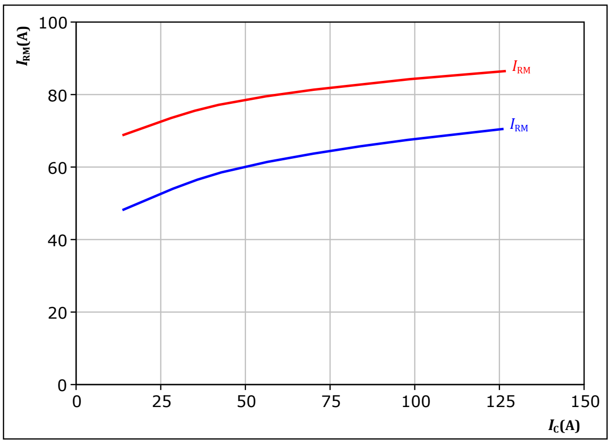
T_j: 25 °C / 150 °C

V_{CE} =	600	V
V_{GE} =	±15	V
I_C =	70	A

figure 19. **FWD**

Typical peak reverse recovery current as a function of collector current

I_{RM} = f(I_C)



With an inductive load at

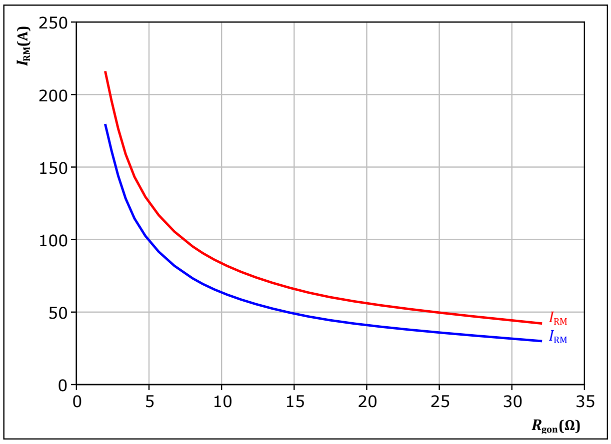
T_j: 25 °C / 150 °C

V_{CE} =	600	V
V_{GE} =	±15	V
R_{gon} =	8	Ω

figure 20. **FWD**

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

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



With an inductive load at

T_j: 25 °C / 150 °C

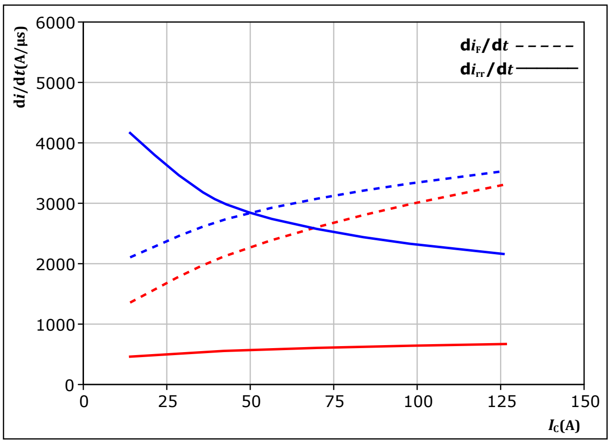
V_{CE} =	600	V
V_{GE} =	±15	V
I_C =	70	A

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_{rr}/dt = f(I_C)



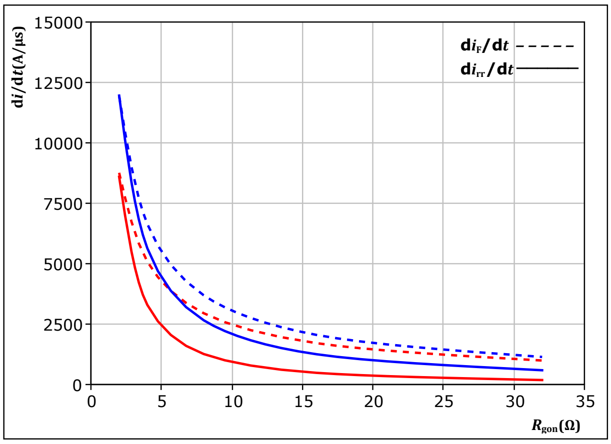
With an inductive load at

V_{CE} =	600	V	T_j:	25 °C
V_{GE} =	±15	V		150 °C
R_{gon} =	8	Ω		

figure 22. **FWD**

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

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



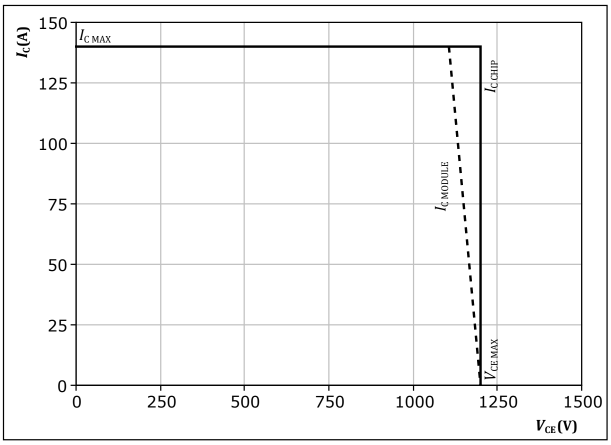
With an inductive load at

V_{CE} =	600	V	T_j:	25 °C
V_{GE} =	±15	V		150 °C
I_C =	70	A		

figure 23. **IGBT**

Reverse bias safe operating area

I_C = f(V_{CE})



At	T_j =	150	°C
	R_{gon} =	8	Ω
	R_{goff} =	8	Ω

Inverter Switching Definitions

figure 24. **IGBT**

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

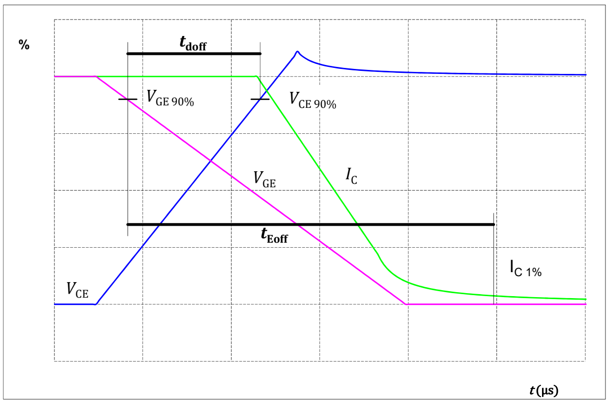


figure 25. **IGBT**

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

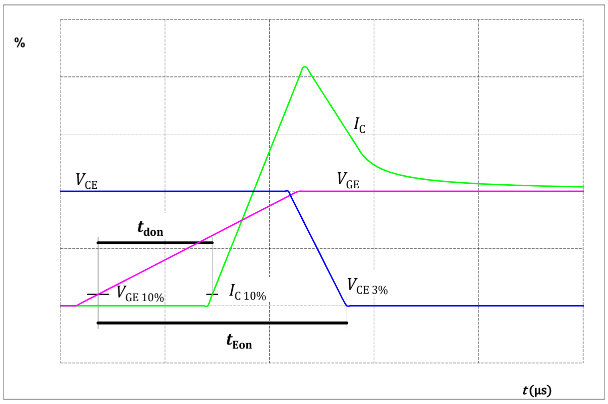


figure 26. **IGBT**

Turn-off Switching Waveforms & definition of t_f

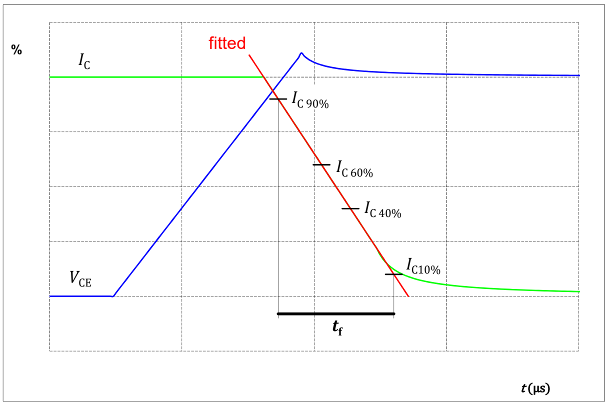
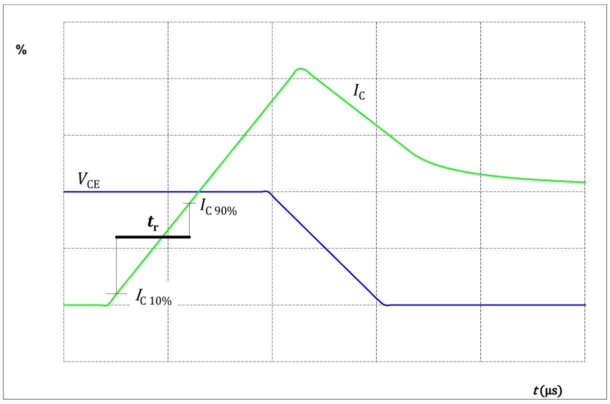


figure 27. **IGBT**

Turn-on Switching Waveforms & definition of t_r



Inverter Switching Definitions

figure 28. **FWD**

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

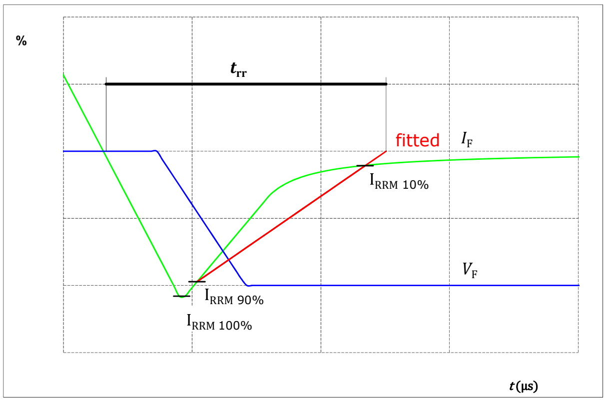
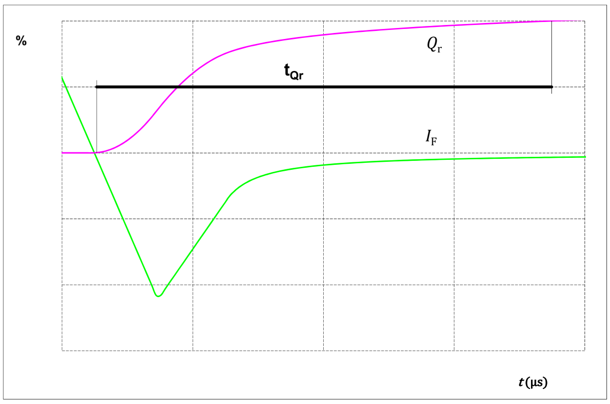


figure 29. **FWD**

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



Ordering Code

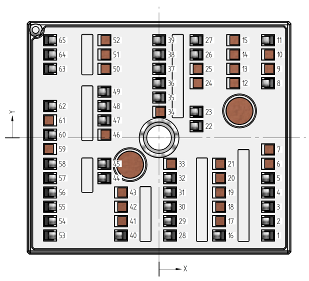
Version	Ordering Code
With std lid (6.5mm height) + no thermal grease	V23990-K230-F40-/0A/-PM
With thin lid (2.8mm height) + no thermal grease	V23990-K230-F40-/0B/-PM
With std lid (6.5mm height) + thermal grease (0,8 W/mK, P12, silicone-based)	V23990-K230-F40-/1A/-PM
With thin lid (2.8mm height) + thermal grease (0,8 W/mK, P12, silicone-based)	V23990-K230-F40-/1B/-PM
With std lid (6.5mm height) + thermal grease (2,5 W/mK, TG20032, silicone-free)	V23990-K230-F40-/4A/-PM
With thin lid (2.8mm height) + thermal grease (2,5 W/mK, TG20032, silicone-free)	V23990-K230-F40-/4B/-PM
With std lid (6.5mm height) + thermal grease (2,5 W/mK, HPTP, silicone-based)	V23990-K230-F40-/5A/-PM
With thin lid (2.8mm height) + thermal grease (2,5 W/mK, HPTP, silicone-based)	V23990-K230-F40-/5B/-PM

Marking

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		

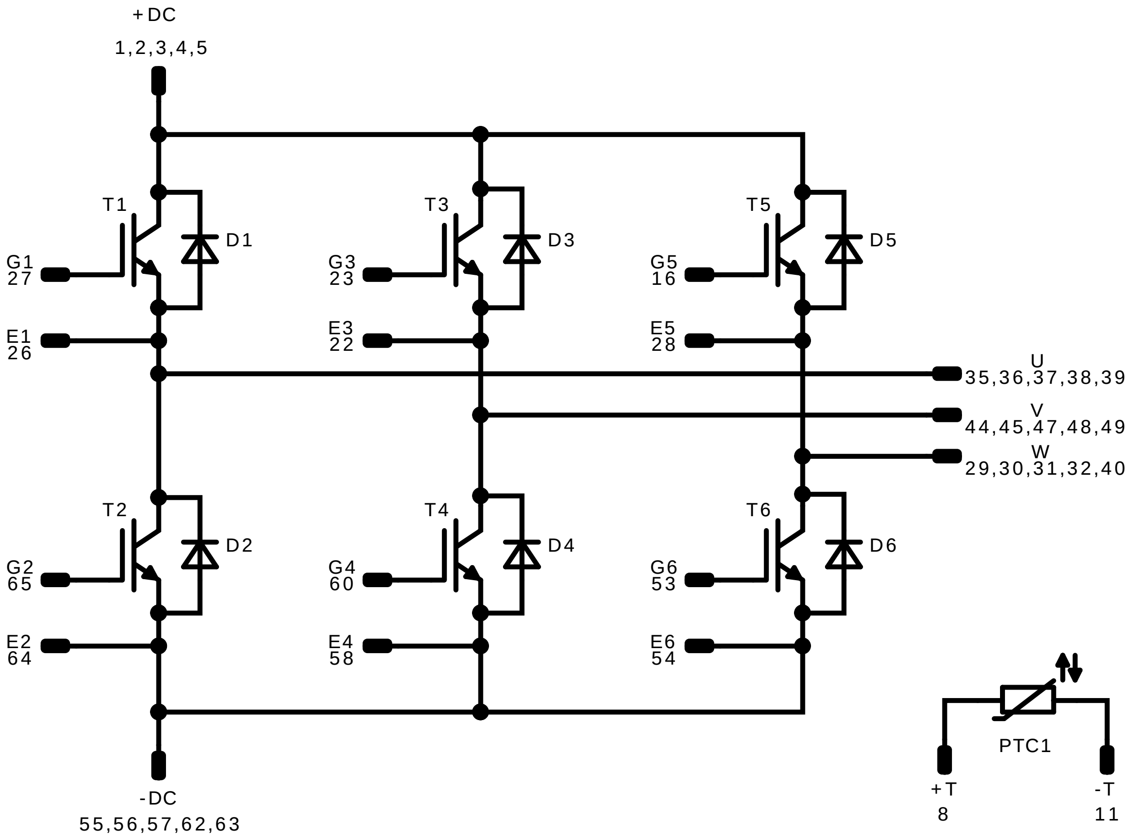
Outline

Pin table [mm]							
Pin	X	Y	Function	34	not assembled		
1	24,38	-21,8	+DC	35	0,03	9	U
2	24,38	-18,6	+DC	36	0,03	12,2	U
3	24,38	-15,4	+DC	37	0,03	15,4	U
4	24,38	-12,2	+DC	38	0,03	18,6	U
5	24,38	-9	+DC	39	0,03	21,8	U
6	not assembled			40	-8,5	-21,8	W
7	not assembled			41	not assembled		
8	24,38	12,2	+T	42	not assembled		
9	not assembled			43	not assembled		
10	not assembled			44	-12,22	-9	V
11	24,38	21,8	-T	45	-12,22	-5,8	V
12	not assembled			46	not assembled		
13	not assembled			47	-12,22	3,9	V
14	not assembled			48	-12,22	7,1	V
15	not assembled			49	-12,22	10,3	V
16	13,42	-21,8	G5	50	not assembled		
17	not assembled			51	not assembled		
18	not assembled			52	not assembled		
19	not assembled			53	-24,38	-21,8	G6
20	not assembled			54	-24,38	-18,6	E6
21	not assembled			55	-24,38	-15,4	-DC
22	8,38	2,6	E3	56	-24,38	-12,2	-DC
23	8,38	5,8	G3	57	-24,38	-9	-DC
24	not assembled			58	-24,38	-5,8	E4
25	not assembled			59	not assembled		
26	8,38	18,6	E1	60	-24,38	0,7	G4
27	8,38	21,8	G1	61	not assembled		
28	2,46	-21,8	E5	62	-24,38	7,1	-DC
29	2,46	-18,6	W	63	-24,38	15,4	-DC
30	2,46	-15,4	W	64	-24,38	18,6	E2
31	2,46	-12,2	W	65	-24,38	21,8	G2
32	2,46	-9	W				
33	not assembled						



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

Pinout



Identification

ID	Component	Voltage	Current	Function	Comment
T2, T1, T4, T3, T6, T5	IGBT	1200 V	70 A	Inverter Switch	
D1, D2, D3, D4, D5, D6	FWD	1200 V	75 A	Inverter Diode	
Rt	PTC			Thermistor	

Packaging instruction				
Standard packaging quantity (SPQ) 72	>SPQ	Standard	<SPQ	Sample

Handling instruction
Handling instructions for MiniSKiiP® 2 packages see vincotech.com website.

Package data
Package data for MiniSKiiP® 2 packages see vincotech.com website.

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-K230-F40-PM-D4-14	01 Mar. 2019	Correction of Ic/If values	2
V23990-K230-F40-PM-D5-14	29 Oct. 2020	Thermal values correction	2,6,8