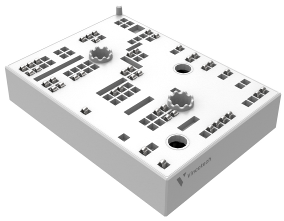
80-M312PNB050M7-K938C70
datasheet

MiniSKiiP® PIM 3 **1200 V / 50 A**

Features

- CI topology with splitted phase for switched reluctance motor applications
- IGBT M7 with low VCEsat and improved EMC behavior
- Solder-free spring contact technology
- Built-in NTC

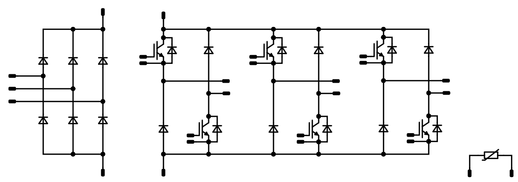
MiniSKiiP® 3 16 mm housing



Target applications

- Industrial Drives

Schematic



Types

- 80-M312PNB050M7-K938C70

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	68	A
Repetitive peak collector current	I_{CRM}	t_p limited by T_{jmax}		100	A
Total power dissipation	P_{tot}	$T_j = T_{jmax}$	T_s = 80 °C	151	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	9,5	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	55	A
Repetitive peak forward current	I_{FRM}	t_p limited by T_{jmax}		100	A
Total power dissipation	P_{tot}	$T_j = T_{jmax}$	T_s = 80 °C	105	W
Maximum junction temperature	T_{jmax}			175	°C
Inverter Sw. Prot. Diode					
Peak repetitive reverse voltage	V_{RRM}			1200	V
Forward current (DC current)	I_F	$T_j = T_{jmax}$	T_s = 80 °C	15	A
Repetitive peak forward current	I_{FRM}	t_p limited by T_{jmax}		10	A
Total power dissipation	P_{tot}	$T_j = T_{jmax}$	T_s = 80 °C	41	W
Maximum junction temperature	T_{jmax}			175	°C

Maximum Ratings

T_j = 25 °C, unless otherwise specified

Parameter	Symbol	Conditions		Value	Unit
Rectifier Diode					
Peak repetitive reverse voltage	V_{RRM}			1600	V
Forward current (DC current)	I_F	$T_j = T_{jmax}$	T_s = 80 °C	49	A
Surge (non-repetitive) forward current	I_{FSM}	Single Half Sine Wave, t_p = 10 ms	T_j = 150 °C	270	A
Surge current capability	I^2t			370	A^2s
Total power dissipation	P_{tot}	$T_j = T_{jmax}$	T_s = 80 °C	66	W
Maximum junction temperature	T_{jmax}			150	°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	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
Inverter Switch										
Static										
Gate-emitter threshold voltage	$V_{GE(th)}$			10	0,005	25	5,4	6	6,6	V
Collector-emitter saturation voltage	V_{CEsat}		15		50	25 125 150		1,55 1,77 1,83	1,9 (1)	V
Collector-emitter cut-off current	I_{CES}		0	1200		25			0,09	mA
Gate-emitter leakage current	I_{GES}		20	0		25			0,5	μA
Internal gate resistance	r_g							None		Ω
Input capacitance	C_{ies}		0	10		25		10000		pF
Output capacitance	C_{oes}		0	10		25		350		pF
Reverse transfer capacitance	C_{res}		0	10		25		130		pF
Gate charge	Q_g	V_{CC} = 600 V	15		50	25		380		nC
Thermal										
Thermal resistance junction to sink (2)	$R_{th(j-s)}$	λ_{paste} = 2,5 W/mK (HPTP)						0,63		K/W
Dynamic										
Turn-on delay time	$t_{d(on)}$	R_{gon} = 16 Ω R_{goff} = 16 Ω	±15	600	50	25 125 150		334 325 323		ns
Rise time	t_r	R_{gon} = 16 Ω R_{goff} = 16 Ω	±15	600	50	25 125 150		57,3 66,9 68,8		ns
Turn-off delay time	$t_{d(off)}$	R_{gon} = 16 Ω R_{goff} = 16 Ω	±15	600	50	25 125 150		265 294 301		ns
Fall time	t_f	R_{gon} = 16 Ω R_{goff} = 16 Ω	±15	600	50	25 125 150		103 127 137		ns
Turn-on energy (per pulse)	E_{on}	Q_{rFWD}=5,05 μC Q_{rFWD}=8,31 μC Q_{rFWD}=9,27 μC	±15	600	50	25 125 150		5,47 6,99 7,44		mWs
Turn-off energy (per pulse)	E_{off}		±15	600	50	25 125 150		4,04 5,56 5,86		mWs

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
Inverter Diode										
Static										
Forward voltage	V_F				50	25 125 150		1,66 1,78 1,79	2,1 (1)	V
Reverse leakage current	I_R	V_r = 1200 V				25			40	μA
Thermal										
Thermal resistance junction to sink (2)	$R_{th(j-s)}$	λ_{paste} = 2,5 W/mK (HPTP)						0,91		K/W
Dynamic										
Peak recovery current	I_{RRM}	d*i*/d*t*=878 A/μs d*i*/d*t*=681 A/μs d*i*/d*t*=672 A/μs	±15	600	50	25 125 150		33,77 36,2 37,28		A
Reverse recovery time	t_{rr}					25 125 150		322 483 528		ns
Recovered charge	Q_r					25 125 150		5,05 8,31 9,27		μC
Reverse recovered energy	E_{rec}					25 125 150		1,71 3,1 3,49		mWs
Peak rate of fall of recovery current	$(di_{rf}/dt)_{max}$					25 125 150		222 147 141		A/μs

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 Sw. Prot. Diode										
Static										
Forward voltage	V_F				5	25 125 150		1,57 1,65 1,65	2,1[1]	V
Reverse leakage current	I_R	V_r = 1200 V				25			20	µA
Thermal										
Thermal resistance junction to sink [2]	$R_{th(j-s)}$	λ_{paste} = 2,5 W/mK (HPTP)						2,31		K/W
Rectifier Diode										
Static										
Forward voltage	V_F				28	25 125		1,15 1,11	1,5[1]	V
Reverse leakage current	I_R	V_r = 1600 V				25 150			100 1000	µA
Thermal										
Thermal resistance junction to sink [2]	$R_{th(j-s)}$	λ_{paste} = 2,5 W/mK (HPTP)						1,06		K/W

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	
Thermistor										
Static										
Rated resistance	R					25		5		kΩ
Deviation of R_{100}	$\Delta_{R/R}$	R_{100} = 493 Ω				100	-5		5	%
Power dissipation	P							245		mW
Power dissipation constant	d					25		1,4		mW/K
B-value	$B_{(25/50)}$	Tol. ±2 %						3375		K
B-value	$B_{(25/100)}$	Tol. ±2 %						3437		K
Vincotech Thermistor Reference									K	

(1) Value at chip level

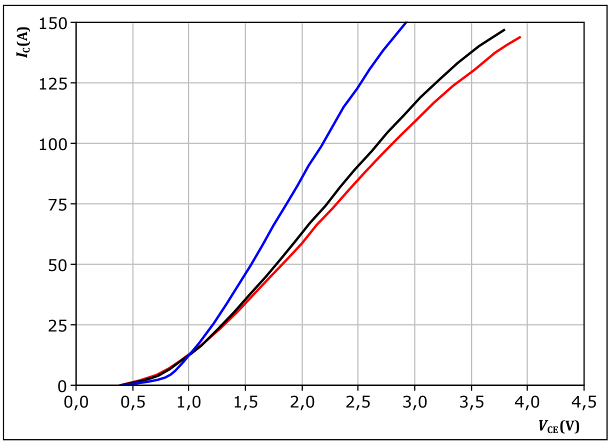
(2) Only valid with pre-applied Vincotech thermal interface material.

Inverter Switch Characteristics

figure 1. IGBT

Typical output characteristics

I_C = f(V_{CE})



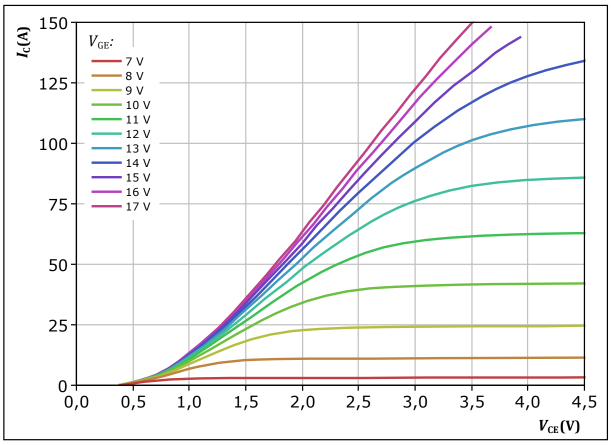
t_p =	250	µs
V_{GE} =	15	V

T_j: 25 °C, 125 °C, 150 °C

figure 2. IGBT

Typical output characteristics

I_C = f(V_{CE})



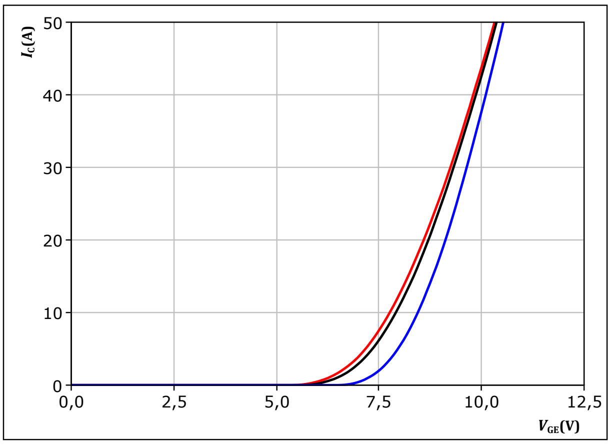
t_p =	250	µs
T_j =	150	°C

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

figure 3. IGBT

Typical transfer characteristics

I_C = f(V_{GE})



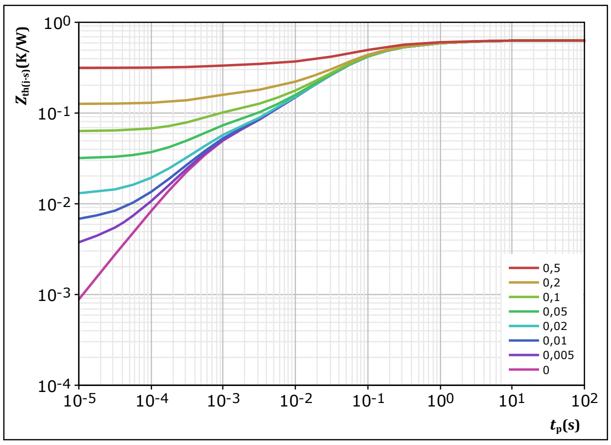
t_p =	250	µs
V_{CE} =	10	V

T_j: 25 °C, 125 °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	
$R_{th(j-s)}$ =	0,63	K/W

IGBT thermal model values

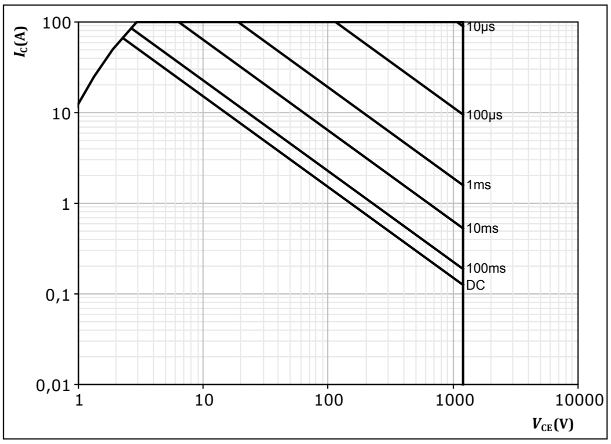
R (K/W)	τ (s)
5,38E-02	2,36E+00
1,33E-01	3,13E-01
3,14E-01	6,13E-02
8,40E-02	1,01E-02
4,51E-02	6,01E-04

Inverter Switch Characteristics

figure 5.	IGBT

Safe operating area

I_C = f(V_{CE})



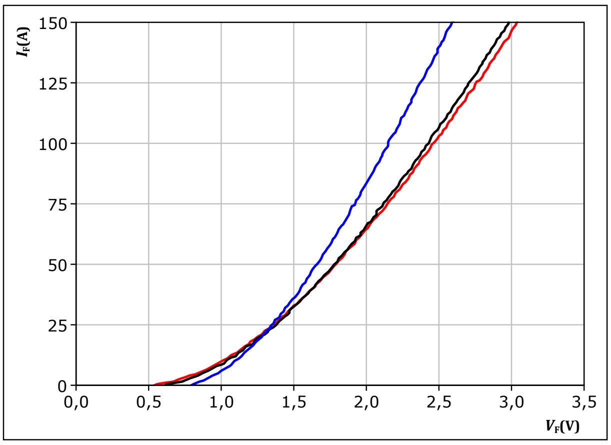
D =	single pulse	
T_s =	80	°C
V_{GE} =	15	V
T_j =	T_{jmax}	

Inverter Diode Characteristics

figure 6. **FWD**

Typical forward characteristics

I_F = f(V_F)



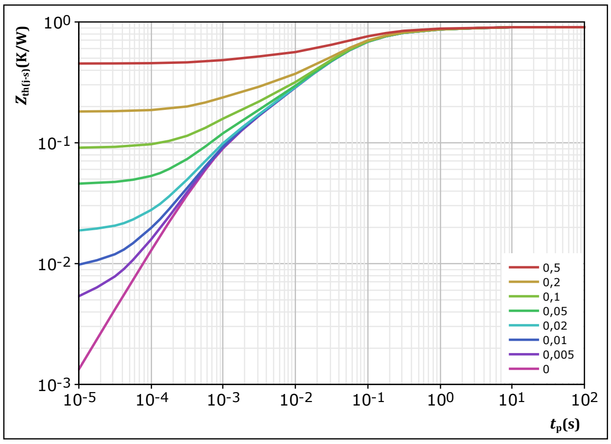
t_p = 250 µs

T_j: 25 °C, 125 °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

$R_{th(j-s)}$ = 0,905 K/W

FWD thermal model values

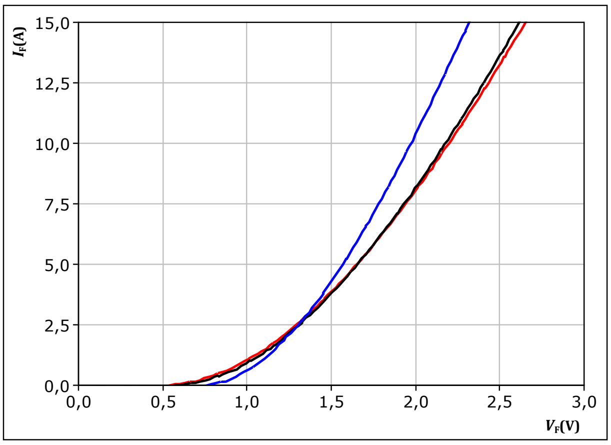
R (K/W)	τ (s)
5,27E-02	2,69E+00
1,50E-01	2,53E-01
4,30E-01	5,39E-02
1,76E-01	9,78E-03
9,64E-02	8,96E-04

Inverter Sw. Prot. Diode Characteristics

figure 8. FWD

Typical forward characteristics

I_F = f(V_F)



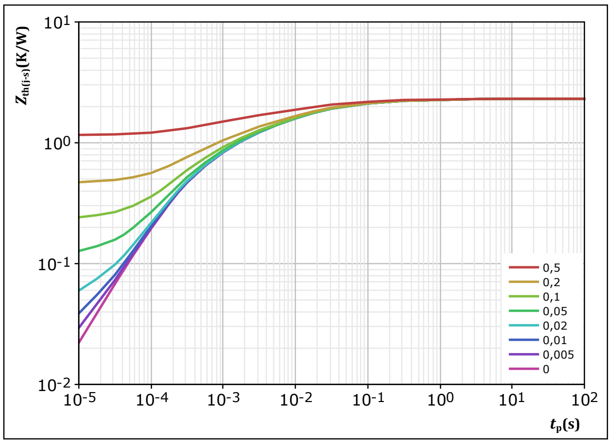
t_p =	250	µs

T_j: 25 °C, 125 °C, 150 °C

figure 9. FWD

Transient thermal impedance as a function of pulse width

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



D = t_p / T

$R_{th(j-s)}$ = 2,313 K/W

FWD thermal model values

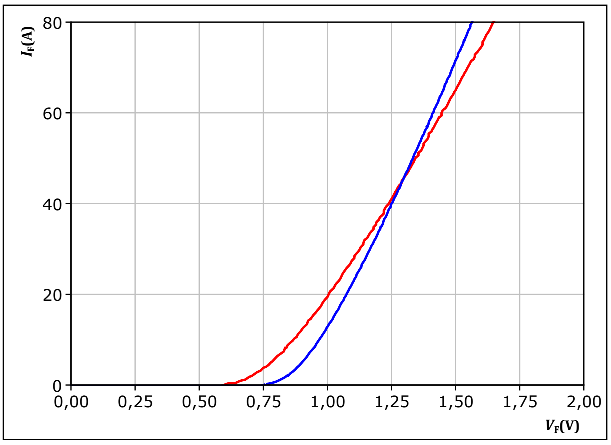
R (K/W)	τ (s)
1,03E-01	1,46E+00
4,16E-01	7,07E-02
7,17E-01	9,80E-03
6,03E-01	1,47E-03
4,75E-01	2,69E-04

Rectifier Diode Characteristics

figure 10. Rectifier

Typical forward characteristics

I_F = f(V_F)



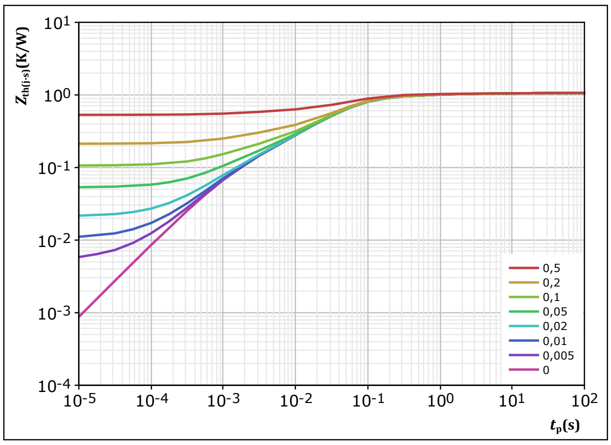
t_p = 250 µs

T_j: 25 °C, 125 °C

figure 11. Rectifier

Transient thermal impedance as a function of pulse width

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



D = t_p / T

$R_{th(j-s)}$ = 1,064 K/W

Rectifier thermal model values

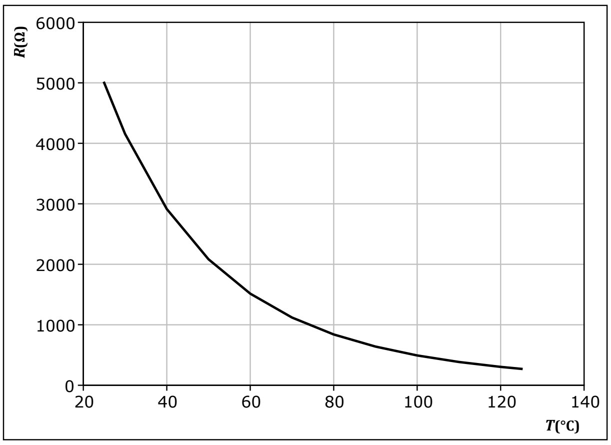
R (K/W)	τ (s)
3,96E-02	8,76E+00
7,42E-02	7,46E-01
1,97E-01	1,33E-01
5,70E-01	4,45E-02
1,06E-01	8,66E-03
7,14E-02	1,33E-03
4,92E-03	6,42E-04

Thermistor Characteristics

figure 12. **Thermistor**

Typical NTC characteristic as function of temperature

R_T = f(T)

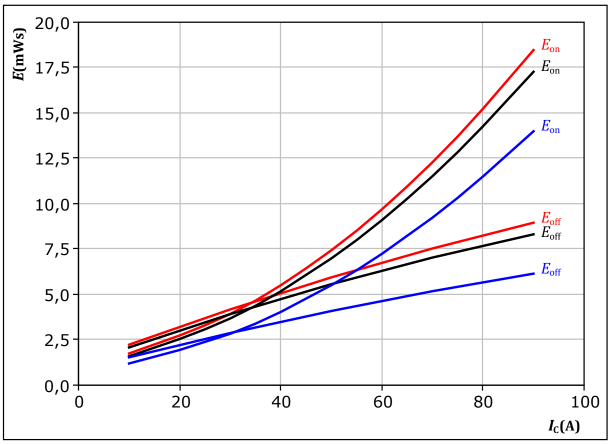


Inverter Switching Characteristics

figure 13. **IGBT**

Typical switching energy losses as a function of collector current

$E = f(I_C)$



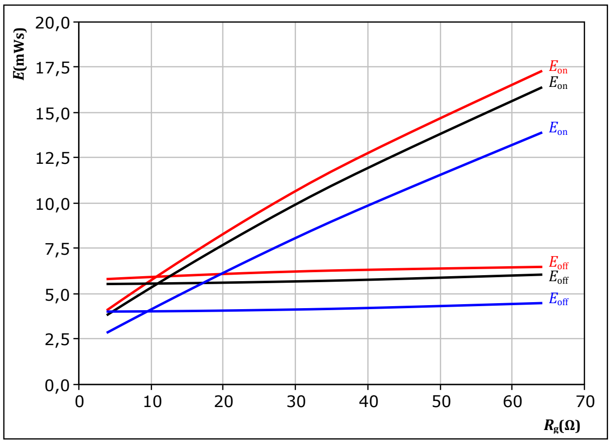
With an inductive load at

V_{CE} =	600	V	T_j:	25 °C
V_{GE} =	±15	V		125 °C
R_{gon} =	16	Ω		150 °C
R_{goff} =	16	Ω		

figure 14. **IGBT**

Typical switching energy losses as a function of gate resistor

$E = f(R_g)$



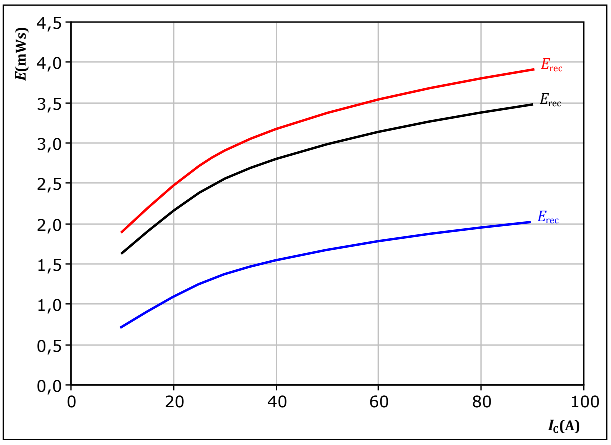
With an inductive load at

V_{CE} =	600	V	T_j:	25 °C
V_{GE} =	±15	V		125 °C
I_C =	50	A		150 °C

figure 15. **FWD**

Typical reverse recovered energy loss as a function of collector current

$E_{rec} = f(I_C)$



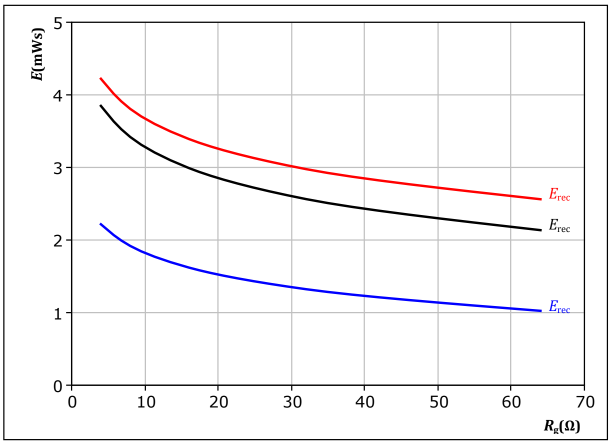
With an inductive load at

V_{CE} =	600	V	T_j:	25 °C
V_{GE} =	±15	V		125 °C
R_{gon} =	16	Ω		150 °C

figure 16. **FWD**

Typical reverse recovered energy loss as a function of gate resistor

$E_{rec} = f(R_g)$



With an inductive load at

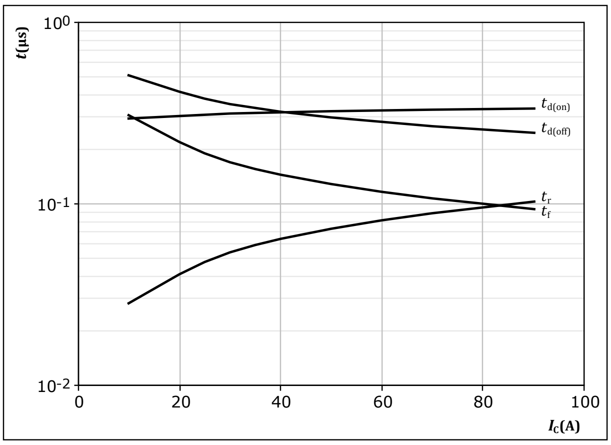
V_{CE} =	600	V	T_j:	25 °C
V_{GE} =	±15	V		125 °C
I_C =	50	A		150 °C

Inverter Switching Characteristics

figure 17. **IGBT**

Typical switching times as a function of collector current

t = f(I_C)



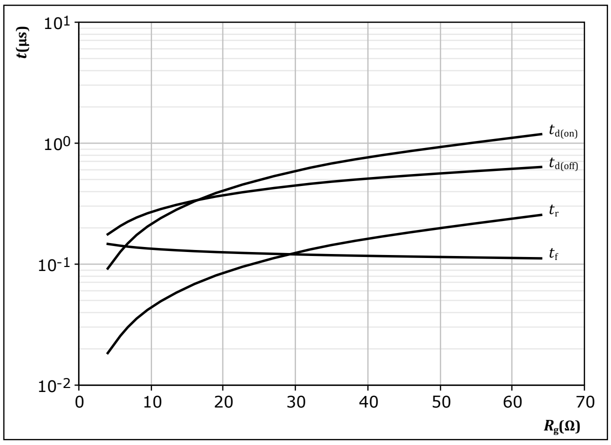
With an inductive load at

T_j =	150	°C
V_{CE} =	600	V
V_{GE} =	±15	V
R_{gon} =	16	Ω
R_{goff} =	16	Ω

figure 18. **IGBT**

Typical switching times as a function of gate resistor

t = f(R_g)



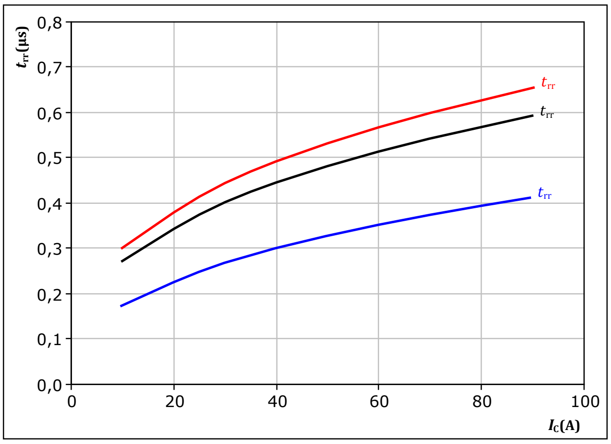
With an inductive load at

T_j =	150	°C
V_{CE} =	600	V
V_{GE} =	±15	V
I_C =	50	A

figure 19. **FWD**

Typical reverse recovery time as a function of collector current

t_{rr} = f(I_C)



With an inductive load at

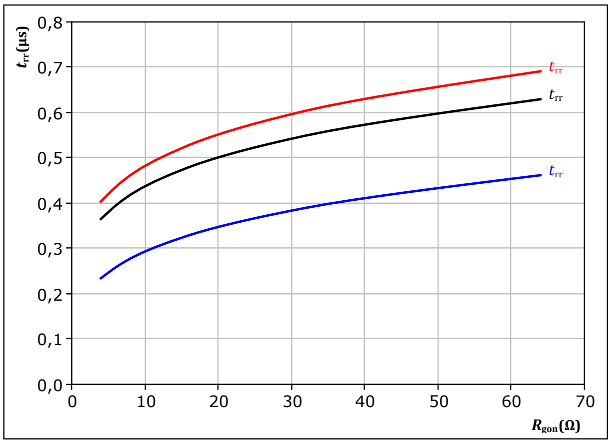
V_{CE} =	600	V
V_{GE} =	±15	V
R_{gon} =	16	Ω

T_j: 25 °C, 125 °C, 150 °C

figure 20. **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 =	50	A

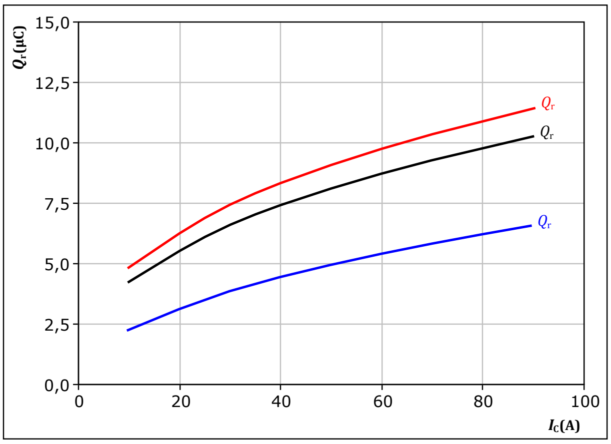
T_j: 25 °C, 125 °C, 150 °C

Inverter Switching Characteristics

figure 21. **FWD**

Typical recovered charge as a function of collector current

Q_r = f(I_C)



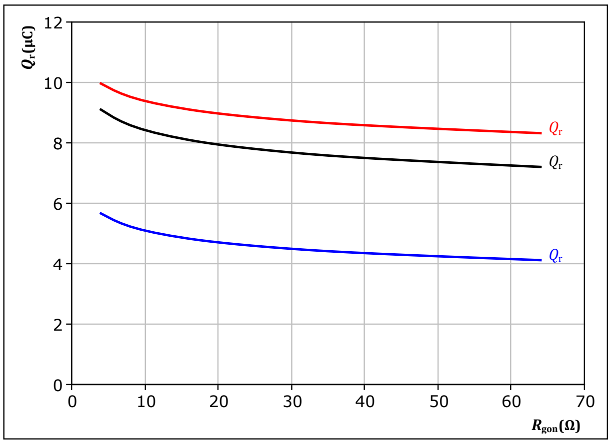
With an inductive load at

V_{CE} =	600	V	T_j:	25 °C
V_{GE} =	±15	V		125 °C
R_{gon} =	16	Ω		150 °C

figure 22. **FWD**

Typical recovered charge as a function of turn on gate resistor

Q_r = f(R_{gon})



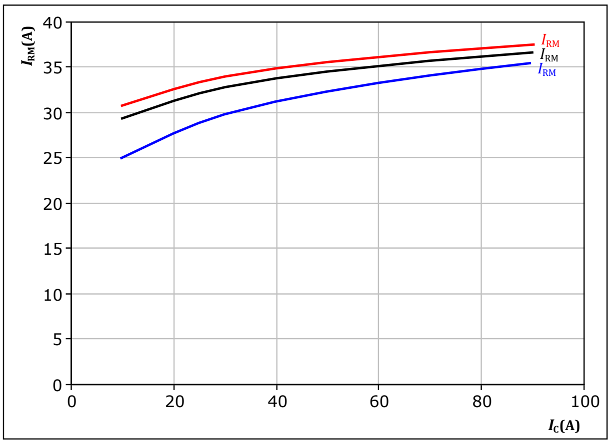
With an inductive load at

V_{CE} =	600	V	T_j:	25 °C
V_{GE} =	±15	V		125 °C
I_C =	50	A		150 °C

figure 23. **FWD**

Typical peak reverse recovery current as a function of collector current

I_{RM} = f(I_C)



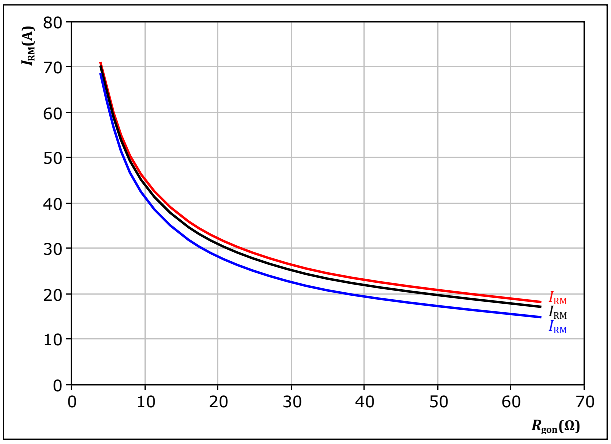
With an inductive load at

V_{CE} =	600	V	T_j:	25 °C
V_{GE} =	±15	V		125 °C
R_{gon} =	16	Ω		150 °C

figure 24. **FWD**

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

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



With an inductive load at

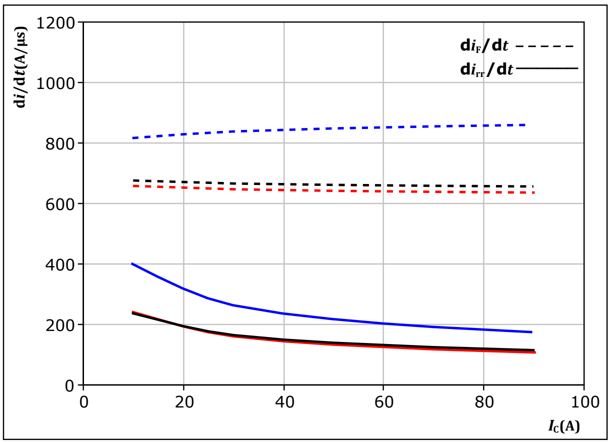
V_{CE} =	600	V	T_j:	25 °C
V_{GE} =	±15	V		125 °C
I_C =	50	A		150 °C

Inverter Switching Characteristics

figure 25. **FWD**

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

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



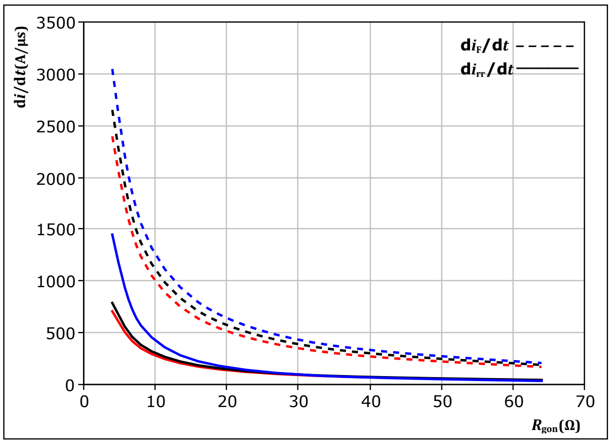
With an inductive load at

V_{CE} =	600	V	T_j: 25 °C
V_{GE} =	±15	V	125 °C
R_{gon} =	16	Ω	150 °C

figure 26. **FWD**

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

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



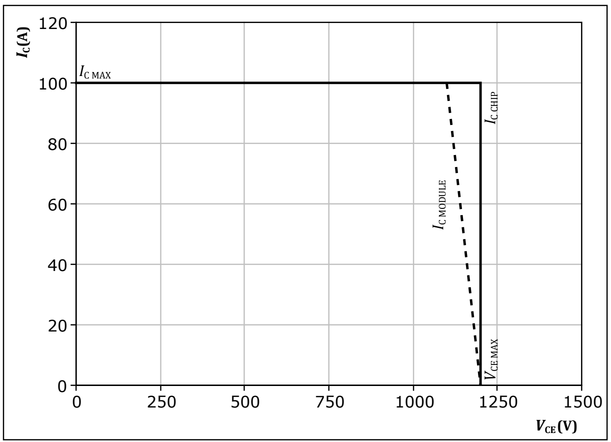
With an inductive load at

V_{CE} =	600	V	T_j: 25 °C
V_{GE} =	±15	V	125 °C
I_C =	50	A	150 °C

figure 27. **IGBT**

Reverse bias safe operating area

$I_C = f(V_{CE})$



At	T_j =	150	°C
	R_{gon} =	16	Ω
	R_{goff} =	16	Ω

Inverter Switching Definitions

figure 28. **IGBT**

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

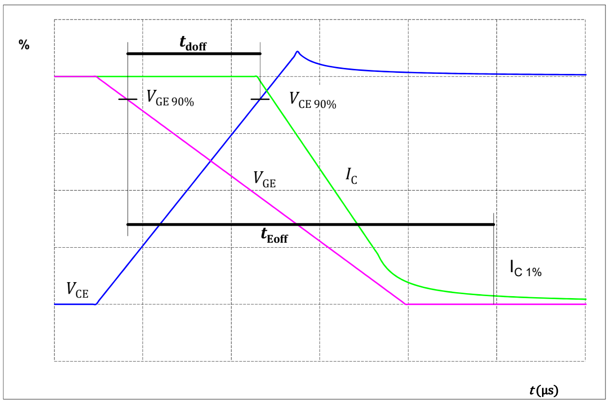


figure 29. **IGBT**

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

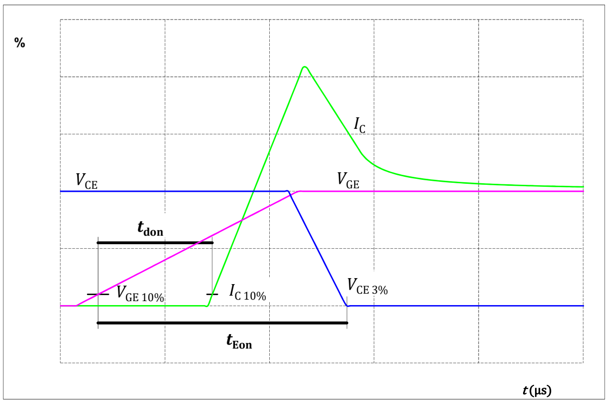


figure 30. **IGBT**

Turn-off Switching Waveforms & definition of t_f

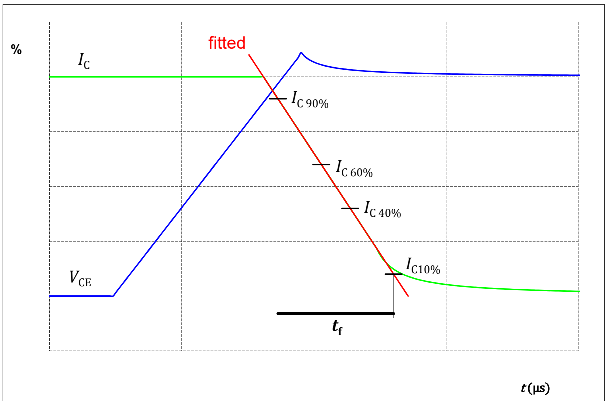
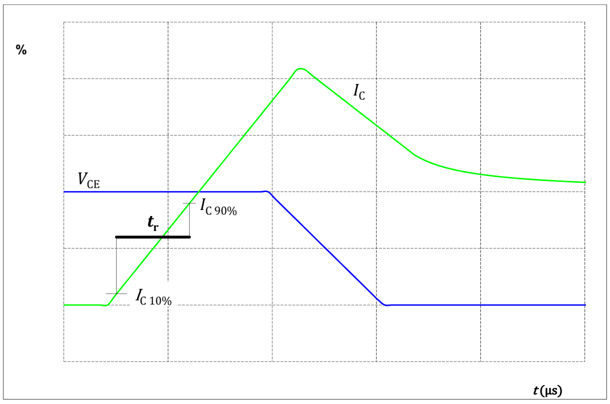


figure 31. **IGBT**

Turn-on Switching Waveforms & definition of t_r



Inverter Switching Definitions

figure 32. **FWD**

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

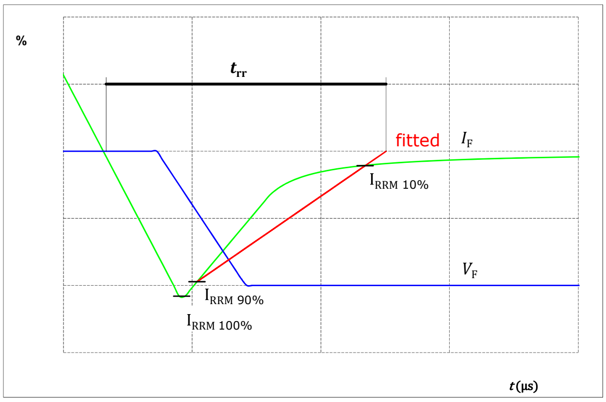
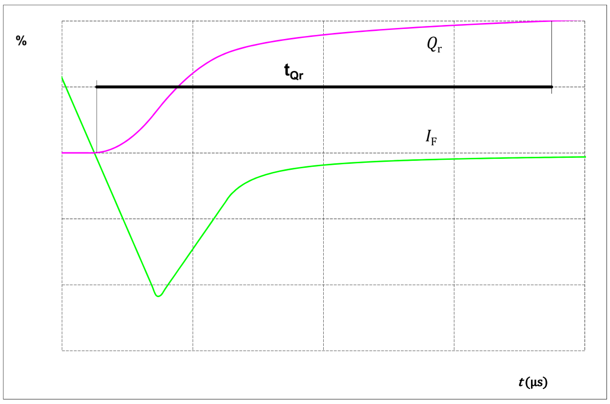


figure 33. **FWD**

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	80-M312PNB050M7-K938C70-/0A/
With thin lid (2.8mm height) + no thermal grease	80-M312PNB050M7-K938C70-/0B/
With std lid (6.5mm height) + thermal grease (0,8 W/mK, P12, silicone-based)	80-M312PNB050M7-K938C70-/1A/
With thin lid (2.8mm height) + thermal grease (0,8 W/mK, P12, silicone-based)	80-M312PNB050M7-K938C70-/1B/
With std lid (6.5mm height) + thermal grease (2,5 W/mK, TG20032, silicone-free)	80-M312PNB050M7-K938C70-/4A/
With thin lid (2.8mm height) + thermal grease (2,5 W/mK, TG20032, silicone-free)	80-M312PNB050M7-K938C70-/4B/
With std lid (6.5mm height) + thermal grease (2,5 W/mK, HPTP, silicone-based)	80-M312PNB050M7-K938C70-/5A/
With thin lid (2.8mm height) + thermal grease (2,5 W/mK, HPTP, silicone-based)	80-M312PNB050M7-K938C70-/5B/

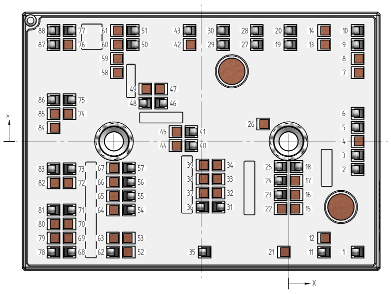
Marking

	Text	Name		Date code	UL & VIN	Lot	Serial
		NN-NNNNNNNNNNNNNN-TTTTTTTVV		WWYY	UL VIN	LLLLL	SSSS
	Datamatrix	Type&Ver	Lot number	Serial	Date code		
		TTTTTTTVV	LLLLL	SSSS	WWYY		

Outline

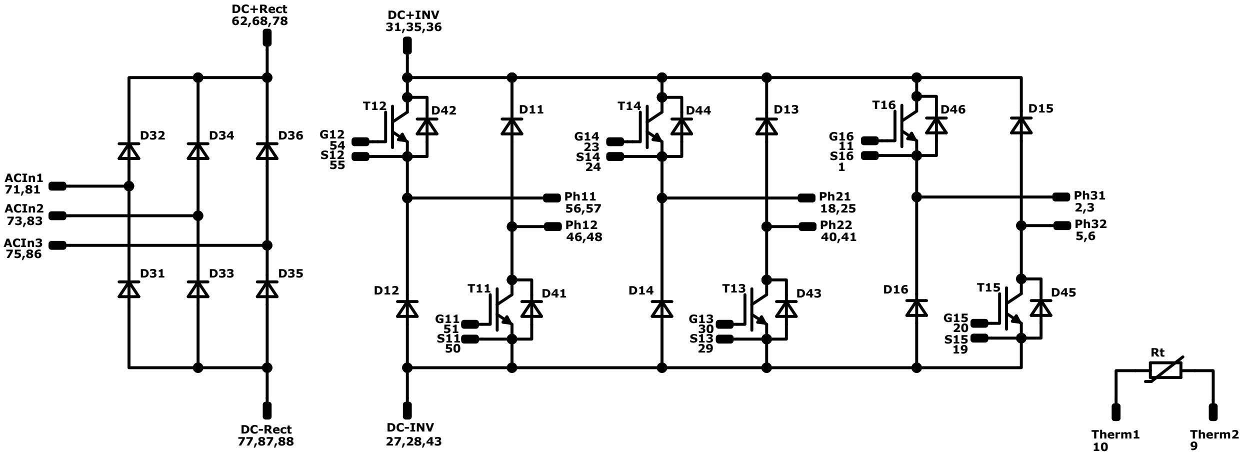
Pin table [mm]

Pin	X	Y	Function	Pin	X	Y	Function
				45	not assembled		
1	15,83	-25,3	S16	46	-29,18	8,7	Ph12
2	15,83	-6,4	Ph31	47	not assembled		
3	15,83	-3,2	Ph31	48	-32,82	8,7	Ph12
4	not assembled			49	not assembled		
5	15,83	3,2	Ph32	50	-35,68	22,1	S11
6	15,83	6,4	Ph32	51	-35,68	25,3	G11
7	not assembled			52	not assembled		
8	not assembled			53	not assembled		
9	15,83	22,1	Therm2	54	-36,58	-15,7	G12
10	15,83	25,3	Therm1	55	-36,58	-12,5	S12
11	8,13	-25,3	G16	56	-36,58	-9,3	Ph11
12	not assembled			57	-36,58	-6,1	Ph11
13	not assembled			58	not assembled		
14	not assembled			59	not assembled		
15	not assembled			60	not assembled		
16	not assembled			61	not assembled		
17	not assembled			62	-40,22	-25,3	DC+Rect
18	1,82	-5,79	Ph21	63	not assembled		
19	0,43	22,1	S15	64	not assembled		
20	0,43	25,3	G15	65	not assembled		
21	not assembled			66	not assembled		
22	not assembled			67	not assembled		
23	-1,82	-12,18	G14	68	-50,18	-25,3	DC+Rect
24	-1,82	-8,98	S14	69	not assembled		
25	-1,82	-5,79	Ph21	70	not assembled		
26	not assembled			71	-50,18	-15,7	ACin1
27	-7,27	22,1	DC-Inv	72	not assembled		
28	-7,27	25,3	DC-Inv	73	-50,18	-6,3	ACin2
29	-14,97	22,1	S13	74	not assembled		
30	-14,97	25,3	G13	75	-50,18	9,5	ACin3
31	-16,05	-15,02	DC+Inv	76	not assembled		
32	not assembled			77	-50,18	25,3	DC-Rect
33	not assembled			78	-53,82	-25,3	DC+Rect
34	not assembled			79	not assembled		
35	-19,22	-25,3	DC+Inv	80	not assembled		
36	-19,7	-15,02	DC+Inv	81	-53,82	-15,7	ACin1
37	not assembled			82	not assembled		
38	not assembled			83	-53,82	-6,3	ACin2
39	not assembled			84	not assembled		
40	-22,26	-1	Ph22	85	not assembled		
41	-22,26	2,2	Ph22	86	-53,82	9,5	ACin3
42	not assembled			87	-53,82	22,1	DC-Rect
43	-22,67	25,3	DC-Inv	88	-53,82	25,3	DC-Rect
44	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
T11, T12, T13, T14, T15, T16	IGBT	1200 V	50 A	Inverter Switch	
D11, D12, D13, D14, D15, D16	FWD	1200 V	50 A	Inverter Diode	
D41, D42, D43, D44, D45, D46	FWD	1200 V	5 A	Inverter Sw. Prot. Diode	
D31, D32, D33, D34, D35, D36	Rectifier	1600 V	28 A	Rectifier Diode	
Rt	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
80-M312PNB050M7-K938C70-D1-14	8 Mar. 2021		