Vincotech

80-M3166BA140SC02-K489G40
datasheet

MiniSKiiP CON 3 **1200 V / 140 A**

Topology features

- Three-phase Rectifier
- Brake Chopper
- Temperature sensor

Component features

- High inrush current capability

Housing features

- Base isolation: Al_2O_3
- Easy assembly in one mounting step
- Flexible PCB design w/o pin holes
- Rugged solderless spring contacts

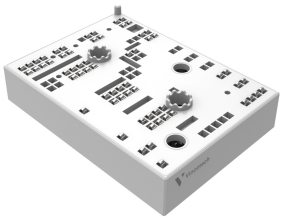
Target applications

- Motor Drivers
- Servo Drivers
- UPS

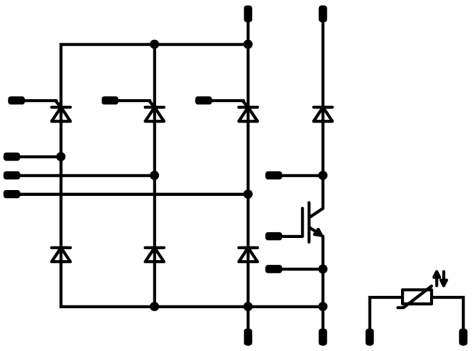
Types

- 80-M3166BA140SC02-K489G40

MiniSKiiP® 3 16 mm housing



Schematic



Maximum Ratings

T_j = 25 °C, unless otherwise specified

Parameter	Symbol	Conditions		Value	Unit
Brake Switch					
Collector-emitter voltage	V_{CES}			1200	V
Collector current (DC current)	I_C	$T_j = T_{jmax}$	T_s = 80 °C	164	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	427	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
Brake Diode					
Peak repetitive reverse voltage	V_{RRM}			1200	V
Forward current (DC current)	I_F	$T_j = T_{jmax}$	T_s = 80 °C	114	A
Surge (non-repetitive) forward current	I_{FSM}	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	252	W
Maximum junction temperature	T_{jmax}			175	°C
Rectifier Thyristor					
Repetitive peak reverse voltage	V_{RRM}			1600	V
Maximum RMS on-state current	I_{TRMSM}	$T_j = T_{jmax}$	T_s = 80 °C	95	A
Surge on-state current	I_{TSM}	Single Half Sine Wave, t_p = 10 ms	T_j = 130 °C	1250	A
I2t value	I^2t	Single Half Sine Wave, t_p = 10 ms	T_j = 130 °C	7810	A^2s
Mean total power loss	$P_{tot}(AV)$	$T_j = T_{jmax}$	T_s = 80 °C	169	W
Maximum Junction Temperature	T_{jmax}			130	°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	132	A
Surge (non-repetitive) forward current	I_{FSM}	Single Half Sine Wave, t_p = 10 ms	T_j = 150 °C	1380	A
Surge current capability	I^2t			9520	A^2s
Total power dissipation	P_{tot}	$T_j = T_{jmax}$	T_s = 80 °C	182	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			≥ 600	

*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	
Brake 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_{CEsat}		15		150	25 150	1,58	1,93 2,4	2,07(1)	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		pF
Gate charge	Q_g		±15		0	25		1140		nC
Thermal										
Thermal resistance junction to sink (2)	$R_{th(j-s)}$	λ_{paste} = 2,5 W/mK (HPTP)						0,22		K/W
Dynamic										
Turn-on delay time	$t_{d(on)}$	R_{gon} = 4 Ω R_{goff} = 4 Ω	0/15	700	150	25 125 150		64,2 65 66		ns
Rise time	t_r					25 125 150		70,8 71 70		ns
Turn-off delay time	$t_{d(off)}$					25 125 150		597 681 708		ns
Fall time	t_f					25 125 150		27,94 44,94 90,2		ns
Turn-on energy (per pulse)	E_{on}	Q_{rFWD}=9,61 µC Q_{rFWD}=19,74 µC Q_{rFWD}=24,48 µC				25 125 150		26,61 35,58 38,38		mWs
Turn-off energy (per pulse)	E_{off}					25 125 150		11,67 16,84 18,78		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	
Brake Diode										
Static										
Forward voltage	V_F				150	25 150		2,51 2,54	2,46(1) 2,38(1)	V
Reverse leakage current	I_R	V_r = 1200 V				25 150		14000	180 28000	µA
Thermal										
Thermal resistance junction to sink (2)	$R_{th(j-s)}$	λ_{paste} = 2,5 W/mK (HPTP)						0,38		K/W
Dynamic										
Peak recovery current	I_{RRM}	di/dt=800 A/µs di/dt=1170 A/µs di/dt=1197 A/µs	0/15	700	150	25 125 150		40,69 54,34 60,7		A
Reverse recovery time	t_{rr}					25 125 150		461,27 625,29 712,96		ns
Recovered charge	Q_r					25 125 150		9,61 19,74 24,48		µC
Reverse recovered energy	E_{rec}					25 125 150		3,57 7,41 9,26		mWs
Peak rate of fall of recovery current	$(di_{rf}/dt)_{max}$					25 125 150		97,86 60,59 65,54		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	
Rectifier Thyristor										
Static										
On-state voltage	V_T				110	25 125		1,09 1,02	1,5	V
Direct reverse current	I_{RD}	V_r = 1600 V				25			200	µA
Holding current	I_H					25			220	mA
Latching current	I_L	t_p = µs I_G = A di_G/dt = A/µs				25			550	mA
Gate trigger voltage	V_{GT}					25			1,98	V
Gate trigger current	I_{GT}					25			100	mA
Thermal										
Thermal resistance junction to sink (2)	$R_{th(j-s)}$	λ_{paste} = 2,5 W/mK (HPTP)						0,3		K/W
Rectifier Diode										
Static										
Forward voltage	V_F				77	25 125		1,2 1,11	1,21(1) 1,1(1)	V
Reverse leakage current	I_R	V_r = 1600 V				25			50	µA
Thermal										
Thermal resistance junction to sink (2)	$R_{th(j-s)}$	λ_{paste} = 2,5 W/mK (HPTP)						0,38		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		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	

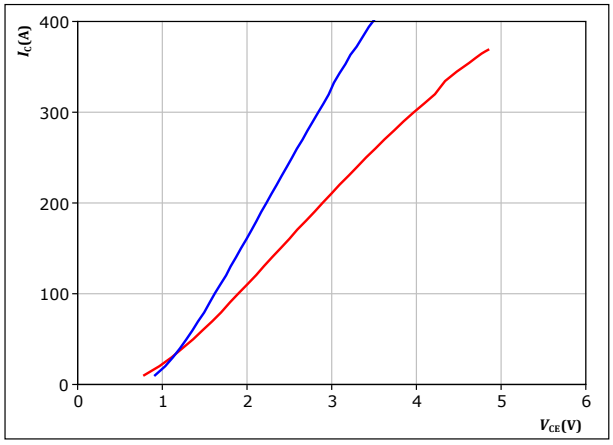
(1) Value at chip level
(2) Only valid with pre-applied Vincotech thermal interface material.

Brake Switch Characteristics

figure 1. **IGBT**

Typical output characteristics

$I_C = f(V_{CE})$

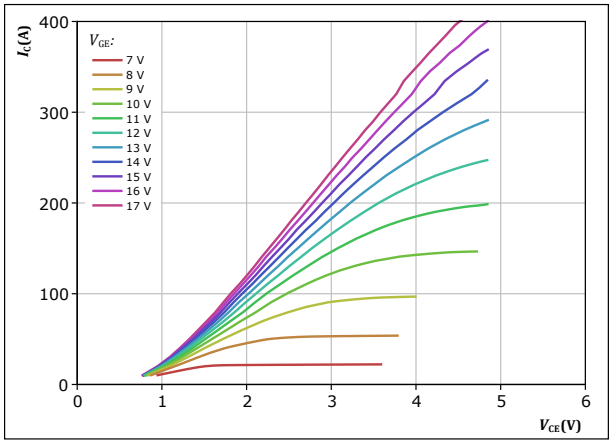


t_p =	250	µs	T_j:	25 °C
V_{GE} =	15	V		150 °C

figure 2. **IGBT**

Typical output characteristics

$I_C = f(V_{CE})$



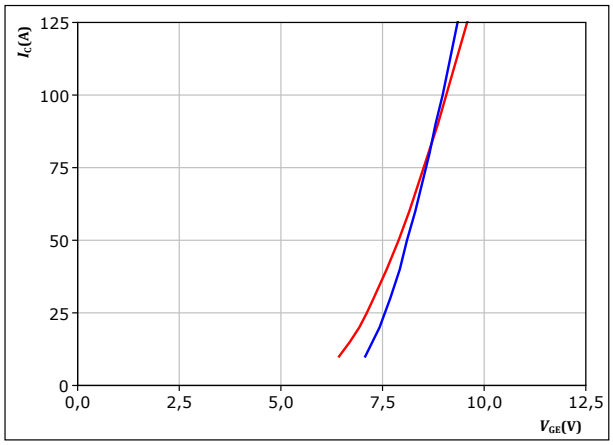
t_p =	250	µs
T_j =	150	°C

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

figure 3. **IGBT**

Typical transfer characteristics

$I_C = f(V_{GE})$

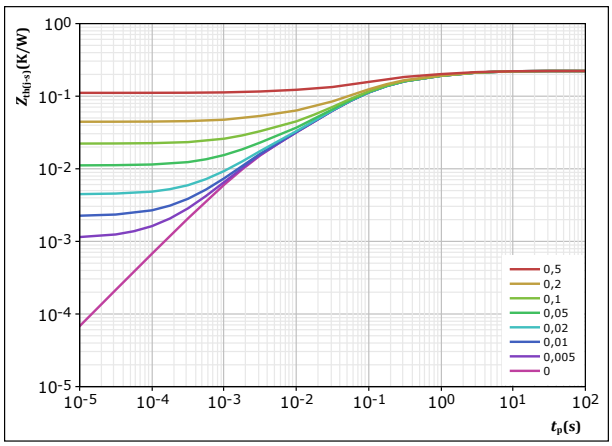


t_p =	250	µs	T_j:	25 °C
V_{CE} =	10	V		150 °C

figure 4. **IGBT**

Transient thermal impedance as a function of pulse width

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



D =	t_p / T	
$R_{th(j-s)}$ =	0,222	K/W

IGBT thermal model values

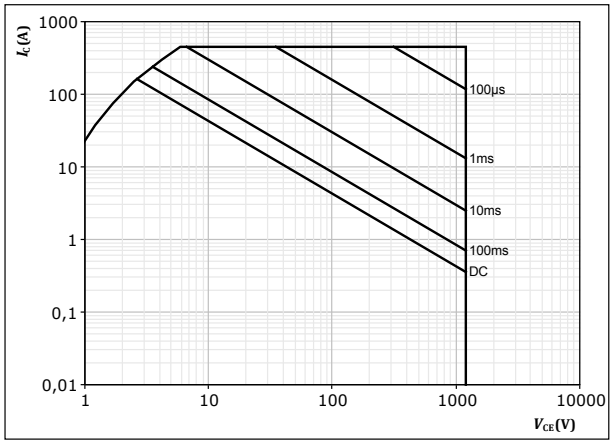
R (K/W)	τ (s)
1,55E-02	4,81E+00
4,93E-02	1,04E+00
9,20E-02	1,47E-01
5,29E-02	3,54E-02
1,25E-02	2,68E-03

Brake Switch Characteristics

figure 5. **IGBT**

Safe operating area

$I_C = f(V_{CE})$



D = single pulse

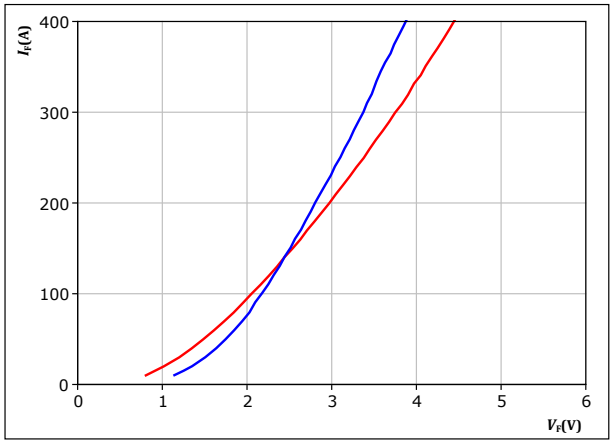
T_s =	80	°C
V_{GE} =	15	V
T_j =	T_{jmax}	

Brake Diode Characteristics

figure 6. **FWD**

Typical forward characteristics

$I_F = f(V_F)$



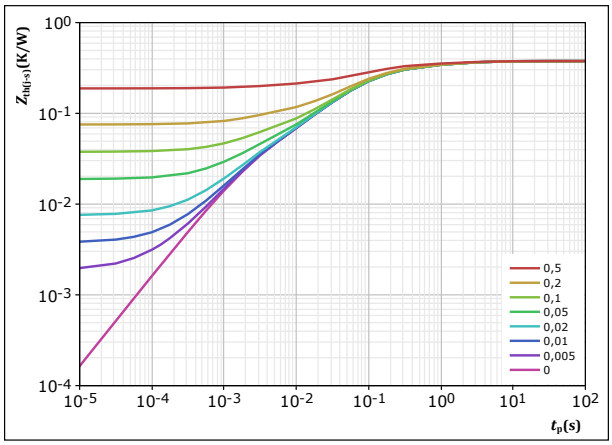
t_p = 250 µs

T_j: 25 °C, 150 °C

figure 7. **FWD**

Transient thermal impedance as a function of pulse width

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



D = t_p / T

$R_{th(j-s)}$ = 0,377 K/W

FWD thermal model values

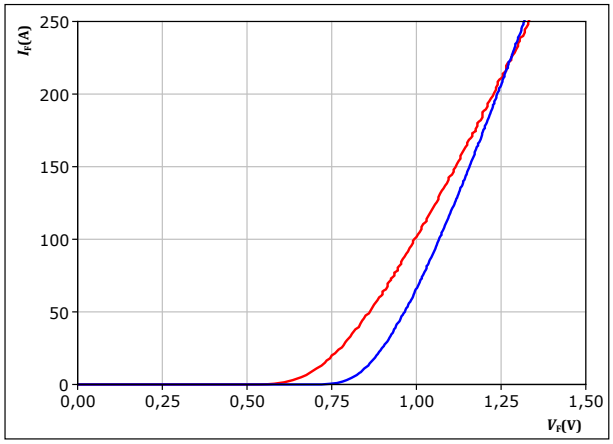
R (K/W)	τ (s)
2,99E-02	3,14E+00
6,92E-02	5,61E-01
1,77E-01	9,53E-02
7,45E-02	2,61E-02
2,66E-02	2,31E-03

Rectifier Thyristor Characteristics

figure 8. **Thyristor**

Typical forward characteristics

$I_F = f(V_F)$



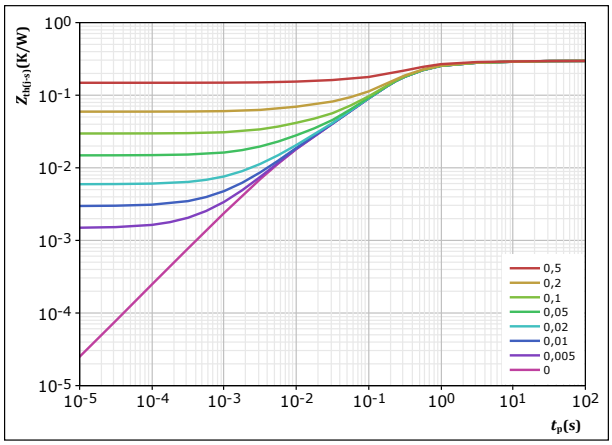
t_p = 250 µs

T_j: 25 °C, 125 °C

figure 9. **Thyristor**

Transient thermal impedance as a function of pulse width

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



D = t_p / T

$R_{th(j-s)}$ = 0,297 K/W

Thyristor thermal model values

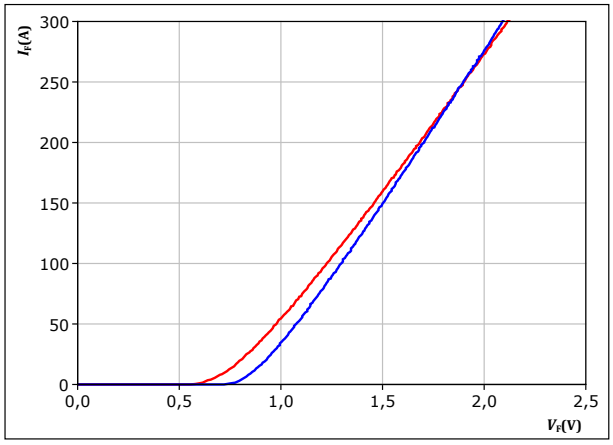
R (K/W)	τ (s)
1,68E-02	1,21E+01
5,61E-02	1,12E+00
1,84E-01	2,71E-01
2,80E-02	1,13E-01
1,20E-02	7,99E-03

Rectifier Diode Characteristics

figure 10. **Rectifier**

Typical forward characteristics

$I_F = f(V_F)$



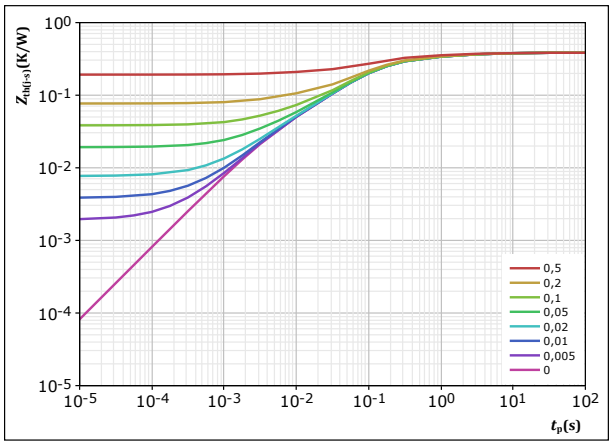
t_p = 250 µs

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

$R_{th(j-s)}$ = 0,384 K/W

Rectifier thermal model values

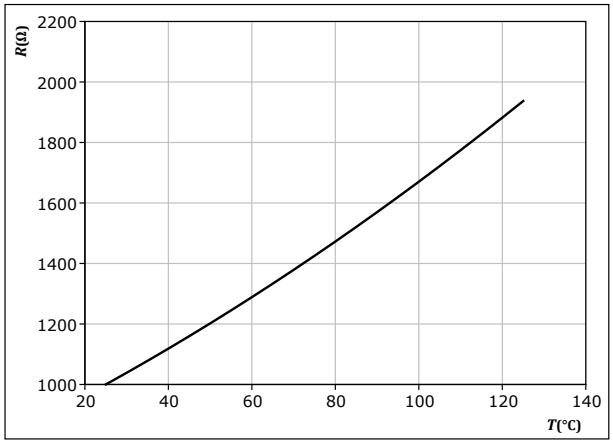
R (K/W)	τ (s)
2,93E-02	5,76E+00
7,73E-02	7,33E-01
1,90E-01	1,18E-01
6,48E-02	4,24E-02
2,27E-02	4,61E-03

Thermistor Characteristics

figure 12. **Thermistor**

Typical PTC characteristic as function of temperature

$R_T = f(T)$

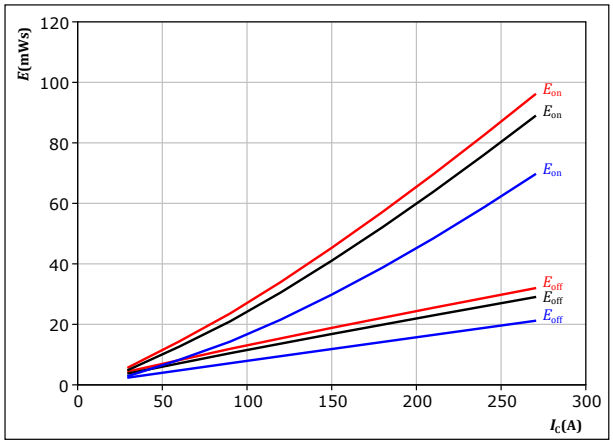


Brake Switching Characteristics

figure 13. **IGBT**

Typical switching energy losses as a function of collector current

$E = f(I_C)$



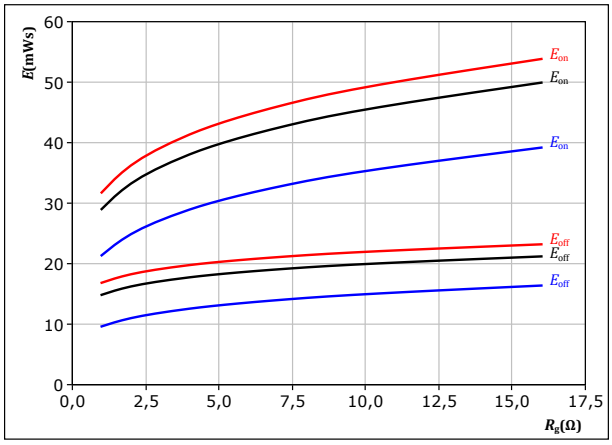
With an inductive load at

V_{CE} =	700	V	T_j:	25 °C
V_{GE} =	0/15	V		125 °C
R_{gon} =	4	Ω		150 °C
R_{goff} =	4	Ω		

figure 14. **IGBT**

Typical switching energy losses as a function of IGBT turn on gate resistor

$E = f(R_g)$



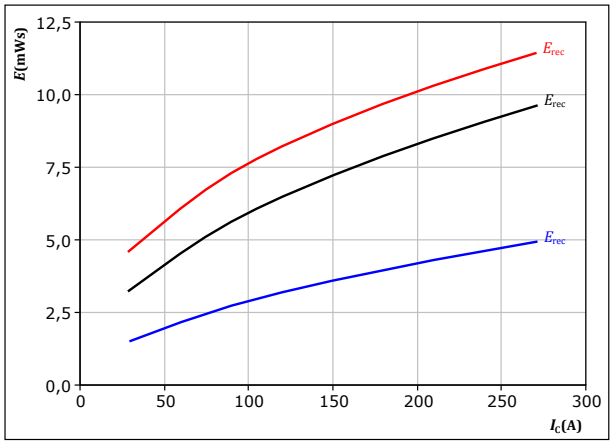
With an inductive load at

V_{CE} =	700	V	T_j:	25 °C
V_{GE} =	0/15	V		125 °C
I_C =	150	A		150 °C

figure 15. **FWD**

Typical reverse recovered energy loss as a function of collector current

$E_{rec} = f(I_C)$



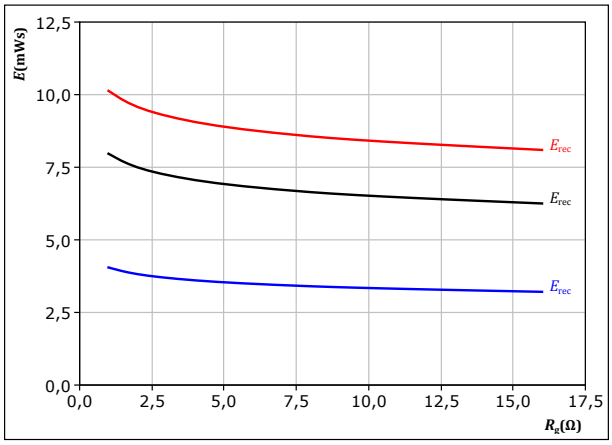
With an inductive load at

V_{CE} =	700	V	T_j:	25 °C
V_{GE} =	0/15	V		125 °C
R_{gon} =	4	Ω		150 °C

figure 16. **FWD**

Typical reverse recovered energy loss as a function of IGBT turn on gate resistor

$E_{rec} = f(R_g)$



With an inductive load at

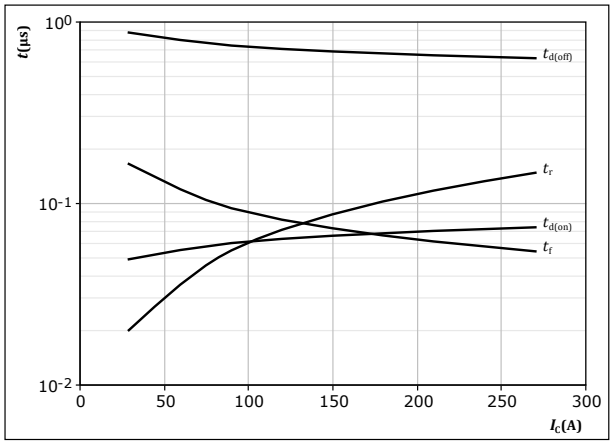
V_{CE} =	700	V	T_j:	25 °C
V_{GE} =	0/15	V		125 °C
I_C =	150	A		150 °C

Brake Switching Characteristics

figure 17. **IGBT**

Typical switching times as a function of collector current

$t = f(I_C)$



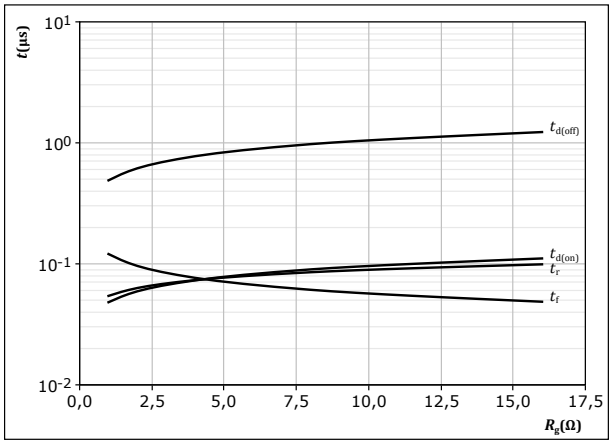
With an inductive load at

T_j =	150	°C
V_{CE} =	700	V
V_{GE} =	0/15	V
R_{gon} =	4	Ω
R_{goff} =	4	Ω

figure 18. **IGBT**

Typical switching times as a function of IGBT turn on gate resistor

$t = f(R_g)$



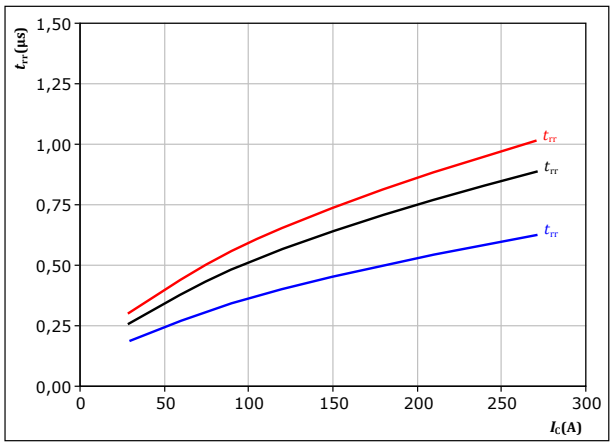
With an inductive load at

T_j =	150	°C
V_{CE} =	700	V
V_{GE} =	0/15	V
I_C =	150	A

figure 19. **FWD**

Typical reverse recovery time as a function of collector current

$t_{rr} = f(I_C)$



With an inductive load at

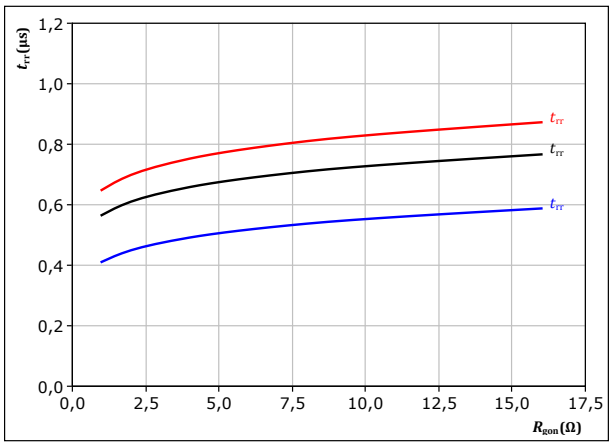
V_{CE} =	700	V
V_{GE} =	0/15	V
R_{gon} =	4	Ω

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} =	700	V
V_{GE} =	0/15	V
I_C =	150	A

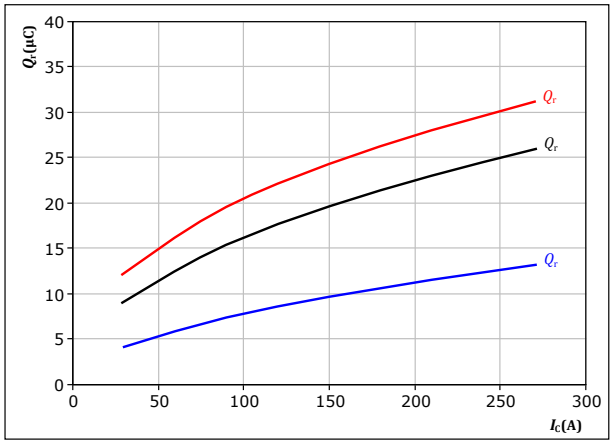
T_j: 25 °C, 125 °C, 150 °C

Brake Switching Characteristics

figure 21. **FWD**

Typical recovered charge as a function of collector current

$Q_r = f(I_C)$



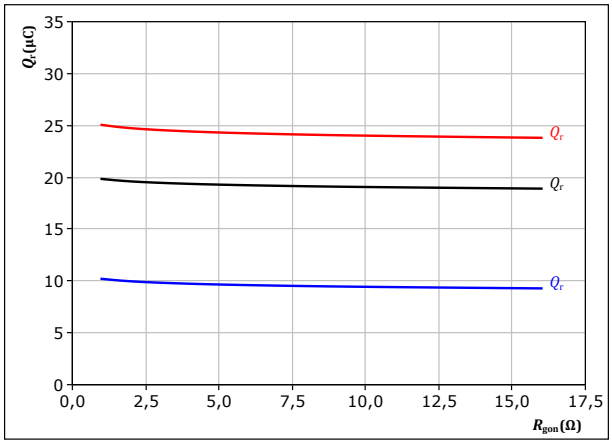
With an inductive load at

V_{CE} =	700	V	T_j:	25 °C
V_{GE} =	0/15	V		125 °C
R_{gon} =	4	Ω		150 °C

figure 22. **FWD**

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

$Q_r = f(R_{gon})$



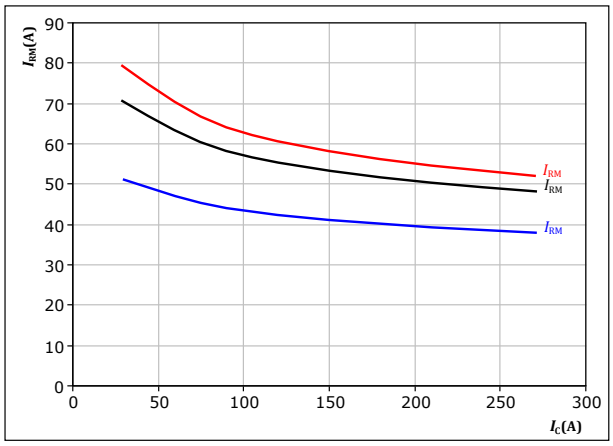
With an inductive load at

V_{CE} =	700	V	T_j:	25 °C
V_{GE} =	0/15	V		125 °C
I_C =	150	A		150 °C

figure 23. **FWD**

Typical peak reverse recovery current as a function of collector current

$I_{RM} = f(I_C)$



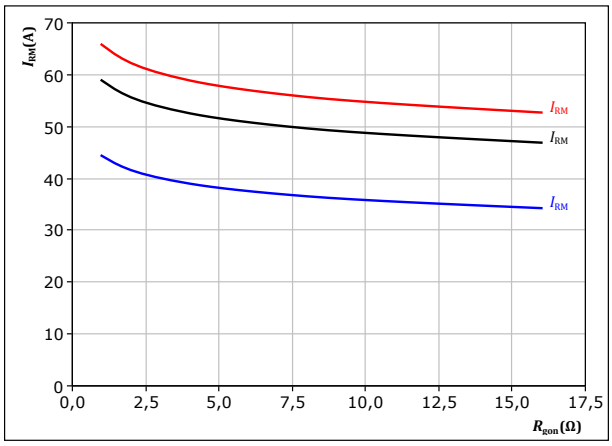
With an inductive load at

V_{CE} =	700	V	T_j:	25 °C
V_{GE} =	0/15	V		125 °C
R_{gon} =	4	Ω		150 °C

figure 24. **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

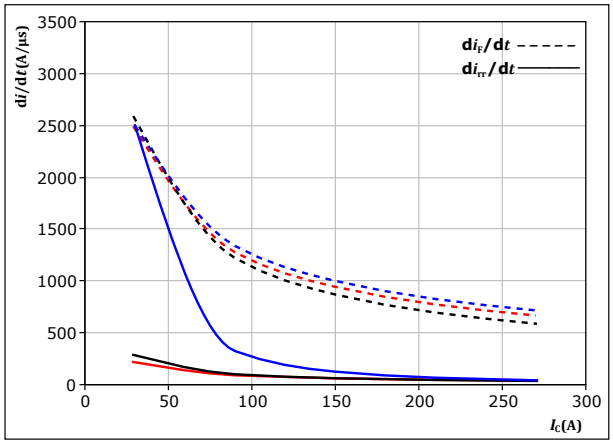
V_{CE} =	700	V	T_j:	25 °C
V_{GE} =	0/15	V		125 °C
I_C =	150	A		150 °C

Brake 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)



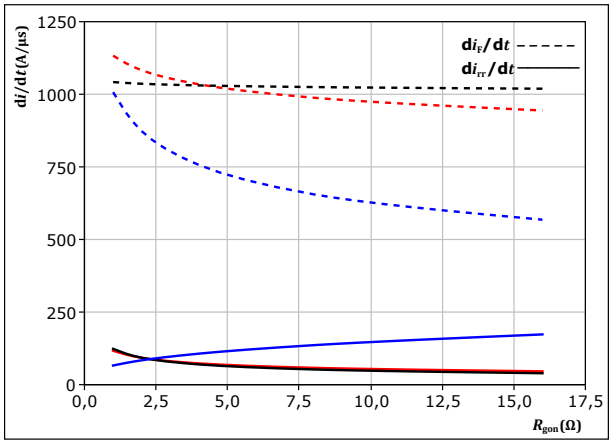
With an inductive load at

V_{CE} =	700	V	T_j:	25 °C
V_{GE} =	0/15	V		125 °C
R_{gon} =	4	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})



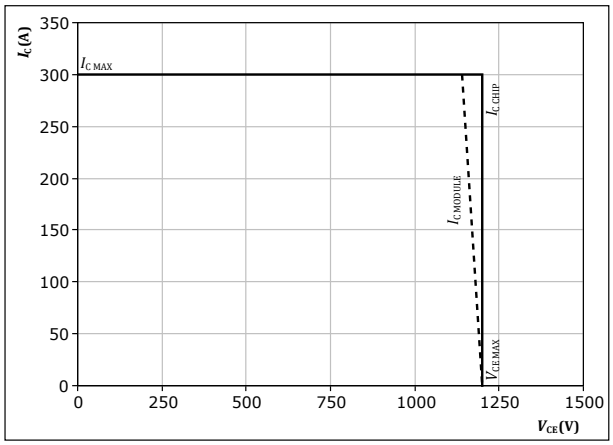
With an inductive load at

V_{CE} =	700	V	T_j:	25 °C
V_{GE} =	0/15	V		125 °C
I_C =	150	A		150 °C

figure 27. **IGBT**

Reverse bias safe operating area

I_C = f(V_{CE})



At

T_j =	150	°C
R_{gon} =	4	Ω
R_{goff} =	4	Ω

Brake Switching Definitions

figure 28. **IGBT**

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

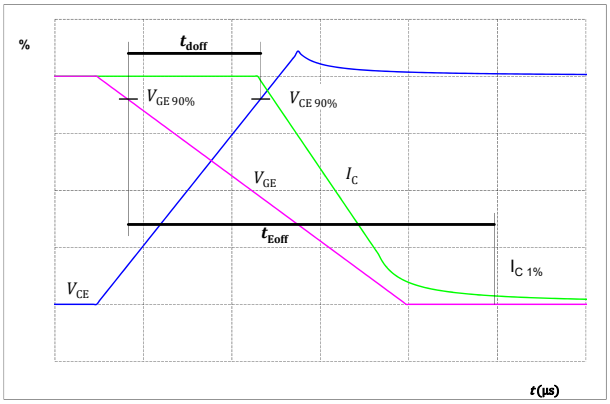


figure 29. **IGBT**

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

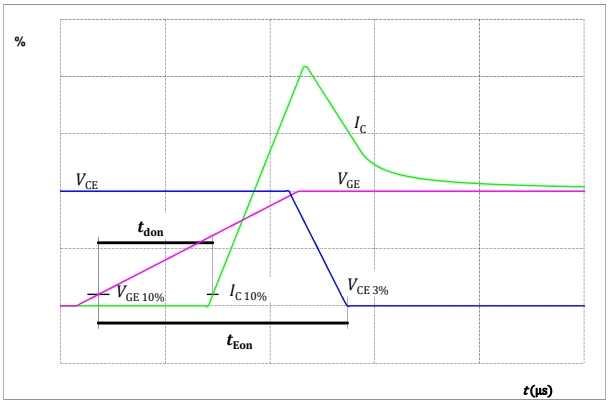


figure 30. **IGBT**

Turn-off Switching Waveforms & definition of t_f

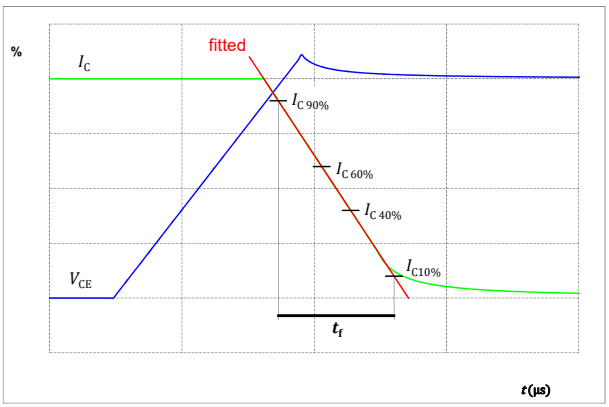
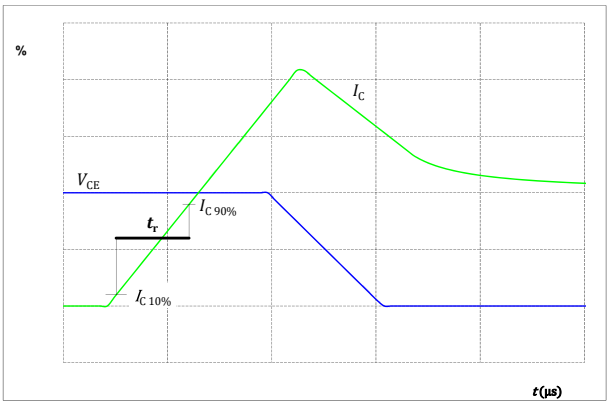


figure 31. **IGBT**

Turn-on Switching Waveforms & definition of t_r



Brake Switching Definitions

figure 32. **FWD**

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

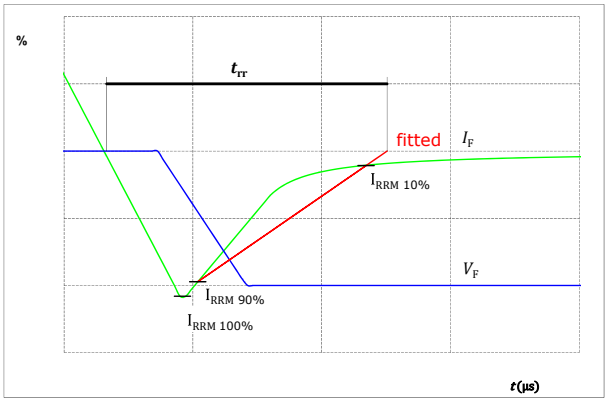
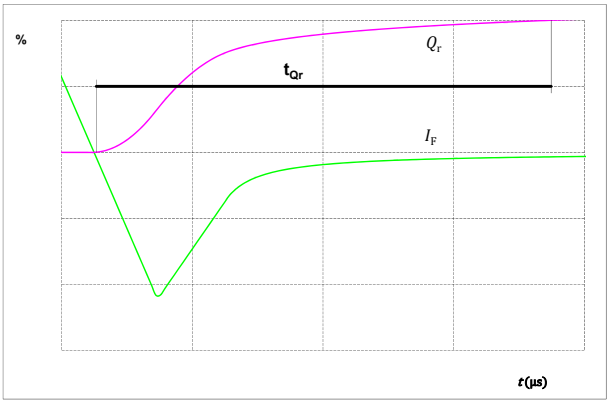


figure 33. **FWD**

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-M3166BA140SC02-K489G40-/0A/
With thin lid (2.8mm height) + no thermal grease	80-M3166BA140SC02-K489G40-/0B/
With std lid (6.5mm height) + thermal grease (0,8 W/mK, P12, silicone-based)	80-M3166BA140SC02-K489G40-/1A/
With thin lid (2.8mm height) + thermal grease (0,8 W/mK, P12, silicone-based)	80-M3166BA140SC02-K489G40-/1B/
With std lid (6.5mm height) + thermal grease (2,5 W/mK, TG20032, silicone-free)	80-M3166BA140SC02-K489G40-/4A/
With thin lid (2.8mm height) + thermal grease (2,5 W/mK, TG20032, silicone-free)	80-M3166BA140SC02-K489G40-/4B/
With std lid (6.5mm height) + thermal grease (2,5 W/mK, HPTP, silicone-based)	80-M3166BA140SC02-K489G40-/5A/
With thin lid (2.8mm height) + thermal grease (2,5 W/mK, HPTP, silicone-based)	80-M3166BA140SC02-K489G40-/5B/

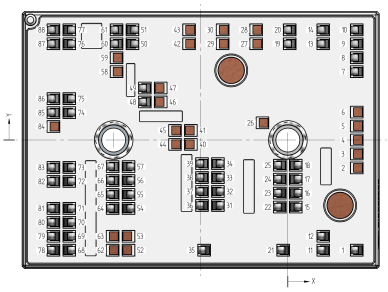
Marking

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

Outline

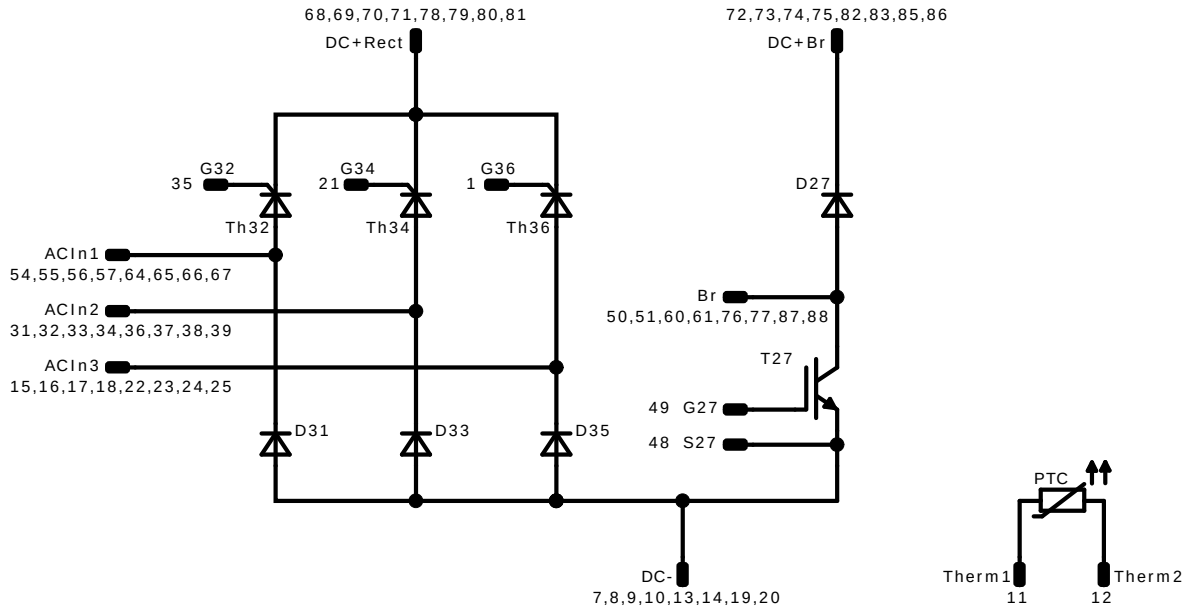
Pin table [mm]

Pin	X	Y	Function	Pin	X	Y	Function
1	15,83	-25,3	G36	46	not assembled		
2	not assembled			47	not assembled		
3	not assembled			48	-32,82	8,74	S27
4	not assembled			49	-32,82	11,94	G27
5	not assembled			50	-35,68	22,1	Br
6	not assembled			51	-35,68	25,3	Br
7	15,83	15,7	DC-	52	not assembled		
8	15,83	18,9	DC-	53	not assembled		
9	15,83	22,1	DC-	54	-36,58	-15,7	ACIn1
10	15,83	25,3	DC-	55	-36,58	-12,5	ACIn1
11	8,13	-25,3	Therm1	56	-36,58	-9,3	ACIn1
12	8,13	-22,1	Therm2	57	-36,58	-6,1	ACIn1
13	8,13	22,1	DC-	58	not assembled		
14	8,13	25,3	DC-	59	not assembled		
15	1,82	-15,38	ACIn3	60	-39,32	22,1	Br
16	1,82	-12,18	ACIn3	61	-39,32	25,3	Br
17	1,82	-8,98	ACIn3	62	not assembled		
18	1,82	-5,79	ACIn3	63	not assembled		
19	0,43	22,1	DC-	64	-40,22	-15,7	ACIn1
20	0,43	25,3	DC-	65	-40,22	-12,5	ACIn1
21	-1,07	-25,3	G34	66	-40,22	-9,3	ACIn1
22	-1,82	-15,38	ACIn3	67	-40,22	-6,09	ACIn1
23	-1,82	-12,18	ACIn3	68	-50,18	-25,3	DC+Rect
24	-1,82	-8,98	ACIn3	69	-50,18	-22,1	DC+Rect
25	-1,82	-5,79	ACIn3	70	-50,18	-18,9	DC+Rect
26	not assembled			71	-50,18	-15,7	DC+Rect
27	not assembled			72	-50,18	-9,5	DC+Br
28	not assembled			73	-50,18	-6,3	DC+Br
29	not assembled			74	-50,18	6,3	DC+Br
30	not assembled			75	-50,18	9,5	DC+Br
31	-16,05	-15,02	ACIn2	76	-50,18	22,1	Br
32	-16,05	-11,82	ACIn2	77	-50,18	25,3	Br
33	-16,05	-8,63	ACIn2	78	-53,82	-25,3	DC+Rect
34	-16,05	-5,42	ACIn2	79	-53,82	-22,1	DC+Rect
35	-19,22	-25,3	G32	80	-53,82	-18,9	DC+Rect
36	-19,7	-15,02	ACIn2	81	-53,82	-15,7	DC+Rect
37	-19,7	-11,82	ACIn2	82	-53,82	-9,5	DC+Br
38	-19,7	-8,62	ACIn2	83	-53,82	-6,3	DC+Br
39	-19,7	-5,42	ACIn2	84	not assembled		
40	not assembled			85	-53,82	6,3	DC+Br
41	not assembled			86	-53,82	9,5	DC+Br
42	not assembled			87	-53,82	22,1	Br
43	not assembled			88	-53,82	25,3	Br
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
T27	IGBT	1200 V	150 A	Brake Switch	
D27	FWD	1200 V	150 A	Brake Diode	
Th32, Th34, Th36	Thyristor	1600 V	95 A	Rectifier Thyristor	
D31, D33, D35	Rectifier	1600 V	140 A	Rectifier Diode	
PTC	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.

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-M3166BA140SC02-K489G40-D3-14	30 Apr. 2022	New Datasheet format, module is unchanged Correct tau values of thermal characteristic	