Vincotech

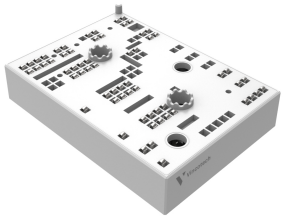
80-M3166BA125AS-K489G30
datasheet

MiniSKiiP® CON 3 **1200 V / 125 A**

Features

- 3-phase half controlled input rectifier with brake chopper
- Fast Trench IGBT
- Integrated PTC

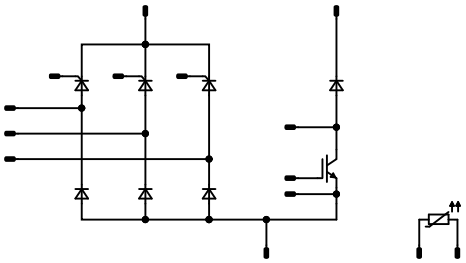
MiniSKiiP® 3 16 mm housing



Target applications

- Embedded Drives
- Industrial Drives

Schematic



Types

- 80-M3166BA125AS-K489G30

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	I_C	$T_j = T_{jmax}$	T_s = 80 °C	185	A
Repetitive peak collector current	I_{CRM}	t_p limited by T_{jmax}		280	A
Total power dissipation	P_{tot}	$T_j = T_{jmax}$	T_s = 80 °C	458	W
Gate-emitter voltage	V_{GES}			±20	V
Maximum junction temperature	T_{jmax}			150	°C
Brake Diode					
Peak repetitive reverse voltage	V_{RRM}			1200	V
Continuous (direct) forward current	I_F	$T_j = T_{jmax}$	T_s = 80 °C	127	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	249	W
Maximum junction temperature	T_{jmax}			175	°C
Rectifier Thyristor					
Repetitive peak reverse voltage	V_{RRM}			1600	V
Forward average current	I_{FAV}	$T_j = T_{jmax}$	T_s = 80 °C	150	A
Surge forward current	I_{FSM}	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	168	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 average current	I_{FAV}	T_j = T_{jmax} T_s = 80 °C	131	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	180	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}			0,006	25	5	5,8	6,5	V
Collector-emitter saturation voltage	V_{CEsat}		15		140	25 125	1,35	1,74 1,98	2,05(1)	V
Collector-emitter cut-off current	I_{CES}		0	1200		25			1000	µA
Gate-emitter leakage current	I_{GES}		30	0		25			2400	nA
Internal gate resistance	r_g							1,5		Ω
Input capacitance	C_{ies}	f = 1 Mhz	0	25		25		10120		pF
Output capacitance	C_{oes}							528		pF
Reverse transfer capacitance	C_{res}							460		pF
Thermal										
Thermal resistance junction to sink (2)	$R_{th(j-s)}$	λ_{paste} = 2,5 W/mK (HPTP)						0,15		K/W
Dynamic										
Turn-on delay time	$t_{d(on)}$	R_{gon} = 4 Ω R_{goff} = 4 Ω	0/15	700	140	25 125		63,4 62		ns
Rise time	t_r					25 125		27 29,8		ns
Turn-off delay time	$t_{d(off)}$					25 125		560 658		ns
Fall time	t_f					25 125		61,16 146,14		ns
Turn-on energy (per pulse)	E_{on}	Q_{rFWD}=10,66 µC Q_{rFWD}=20,25 µC				25 125		7,49 10,1		mWs
Turn-off energy (per pulse)	E_{off}					25 125		10,61 18,11		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	25 125 150		2,21 2,27 2,2	2,46[1] 2,38	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=6156 A/µs di/dt=5811 A/µs	0/15	700	140	25 125		184,03 229,76		A
Reverse recovery time	t_{rr}					25 125		118,34 270,6		ns
Recovered charge	Q_r					25 125		10,66 20,25		µC
Reverse recovered energy	E_{rec}					25 125		4,74 9,82		mWs
Peak rate of fall of recovery current	$(di_{rf}/dt)_{max}$					25 125		7043 5435		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										
Forward voltage	V_F				110	25 125		1,09 1,02	1,5(1)	V
Reverse blocking current	I_R	V_r = 1600 V				25			200	µA
Holding current	I_H					25			220	mA
Latching current	I_L	t_p = µs I_G = A $dI_{G/d}$ /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				110	25 125		1,34 1,27		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)						0,39		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	
PTC										
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	

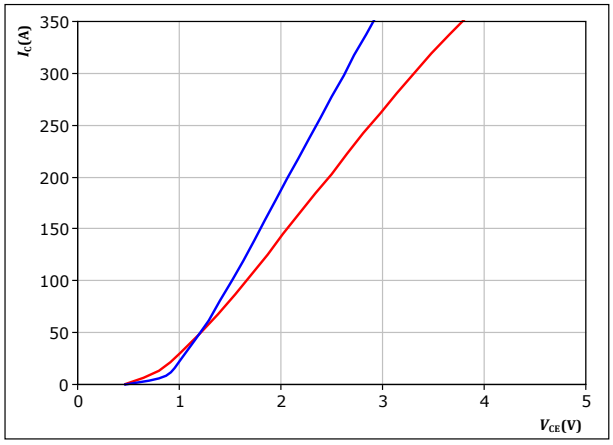
(1) Value at chip level
(2) Only valid with pre-applied Vincotech thermal interface material.

Brake Switch Characteristics

figure 1. **IGBT**

Typical output characteristics

$I_C = f(V_{CE})$

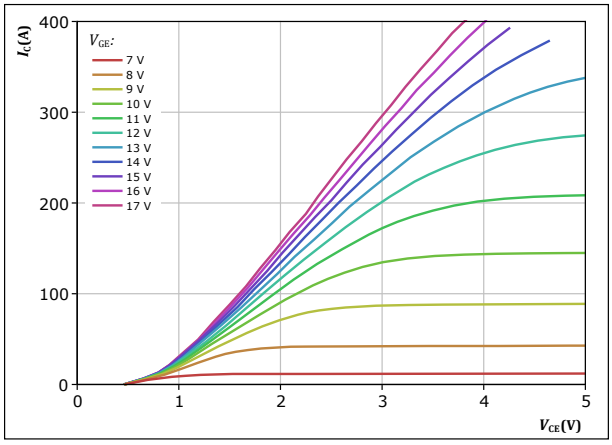


t_p =	250	µs	T_j:	25 °C
V_{GE} =	15	V		125 °C

figure 2. **IGBT**

Typical output characteristics

$I_C = f(V_{CE})$



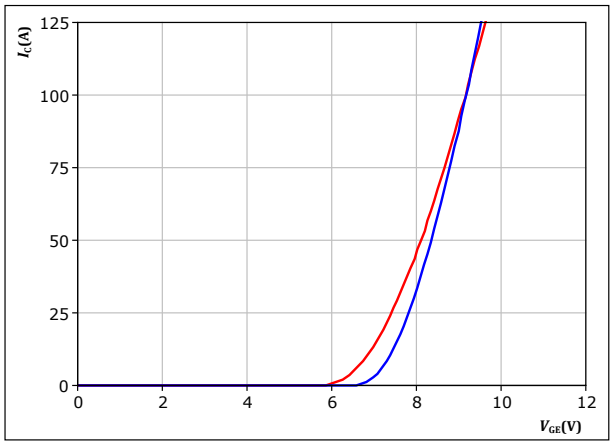
t_p =	250	µs
T_j =	125	°C

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

figure 3. **IGBT**

Typical transfer characteristics

$I_C = f(V_{GE})$

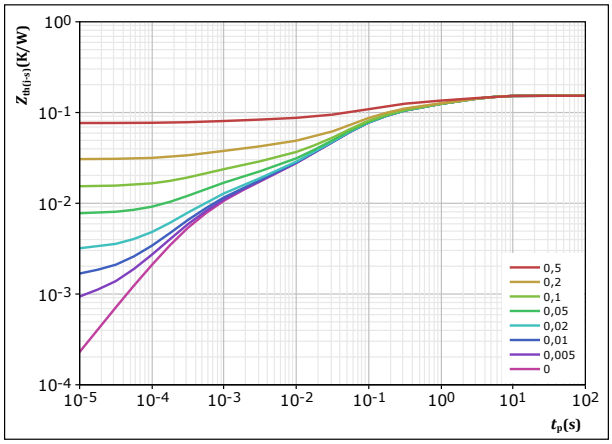


t_p =	250	µs	T_j:	25 °C
V_{CE} =	10	V		125 °C

figure 4. **IGBT**

Transient thermal impedance as a function of pulse width

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



D =	t_p / T	
$R_{th(j-s)}$ =	0,153	K/W

IGBT thermal model values

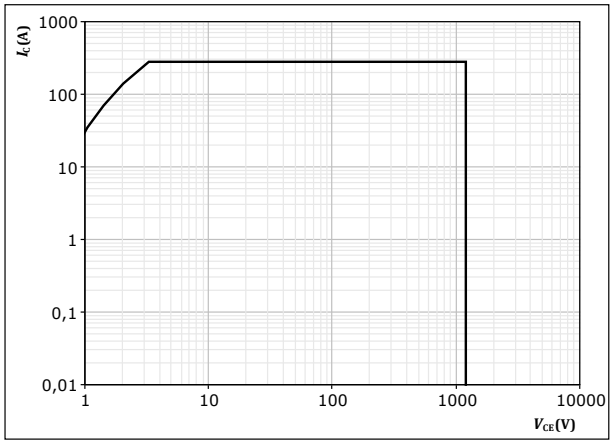
R (K/W)	τ (s)
4,20E-02	2,30E+00
3,05E-02	3,02E-01
5,85E-02	6,72E-02
9,84E-03	9,52E-03
6,93E-03	1,28E-03
5,23E-03	3,30E-04

Brake Switch Characteristics

figure 5. **IGBT**

Safe operating area

$I_C = f(V_{CE})$



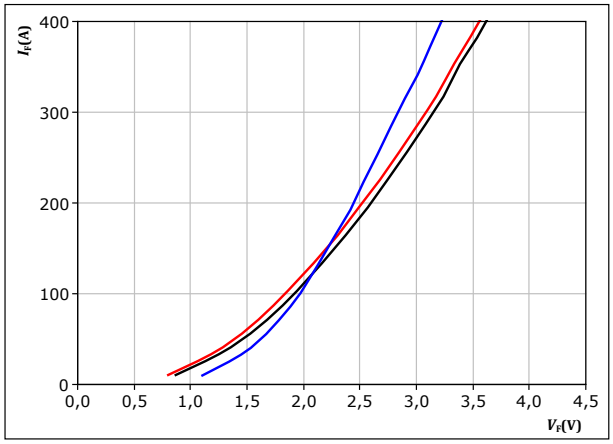
D = single pulse
T_s = 80 °C
V_{GE} = 15 V
T_j = T_{jmax}

Brake Diode Characteristics

figure 6. **FWD**

Typical forward characteristics

$I_F = f(V_F)$



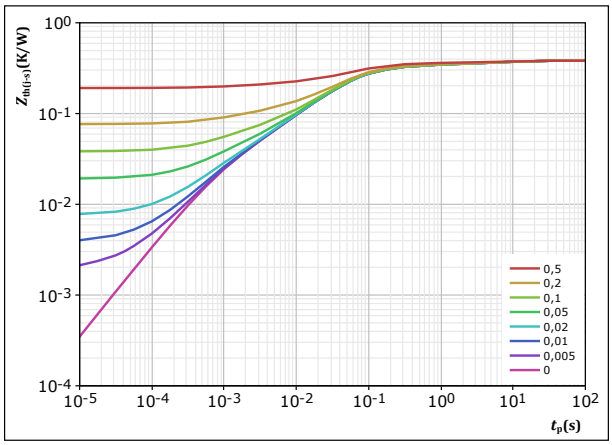
t_p = 250 µs

T_j: 25 °C, 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

$R_{th(j-s)}$ = 0,382 K/W

FWD thermal model values

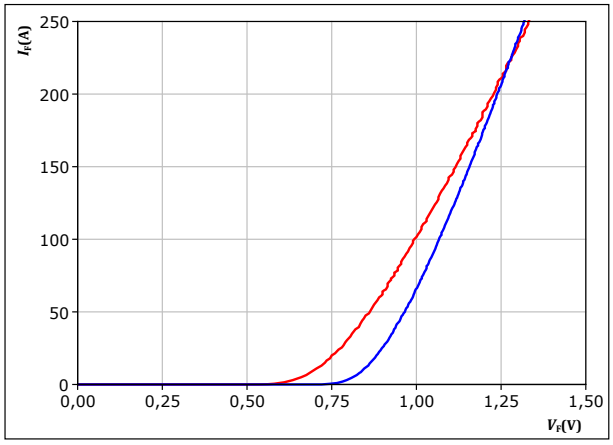
R (K/W)	τ (s)
3,56E-02	7,70E+00
4,06E-02	4,31E-01
1,80E-01	6,42E-02
8,26E-02	2,35E-02
2,65E-02	3,81E-03
1,64E-02	7,57E-04

Rectifier Thyristor Characteristics

figure 8. **Thyristor**

Typical forward characteristics

$I_F = f(V_F)$



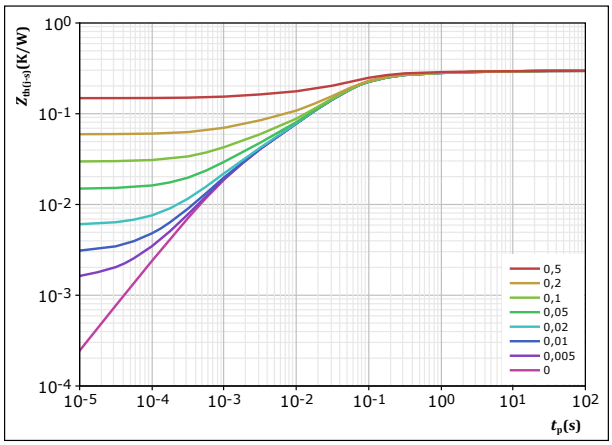
t_p = 250 µs

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

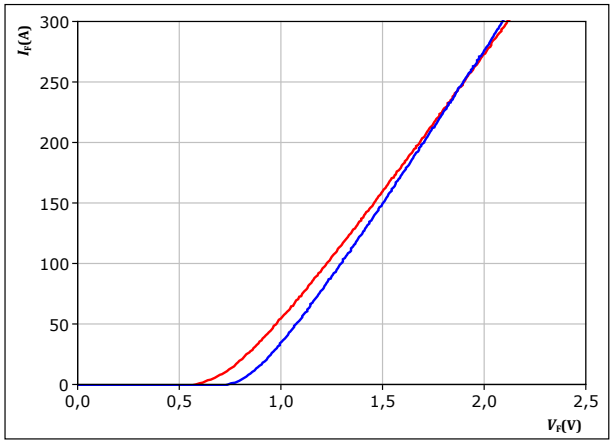
R (K/W)	τ (s)
1,11E-02	8,76E+00
2,07E-02	7,46E-01
5,50E-02	1,33E-01
1,59E-01	4,45E-02
2,97E-02	8,66E-03
1,99E-02	1,33E-03
1,37E-03	6,42E-04

Rectifier Diode Characteristics

figure 10. **Rectifier**

Typical forward characteristics

$I_F = f(V_F)$



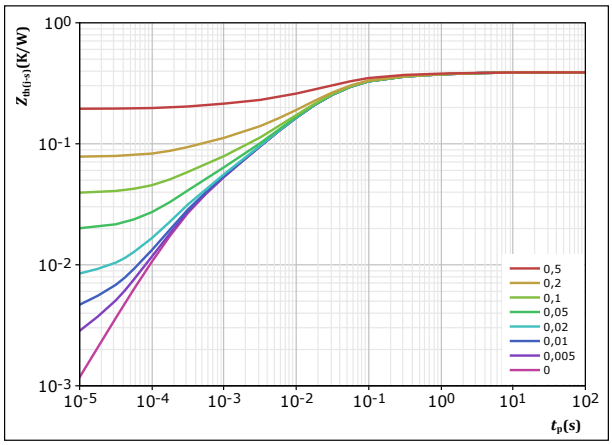
t_p = 250 µs

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

$R_{th(j-s)}$ = 0,389 K/W

Rectifier thermal model values

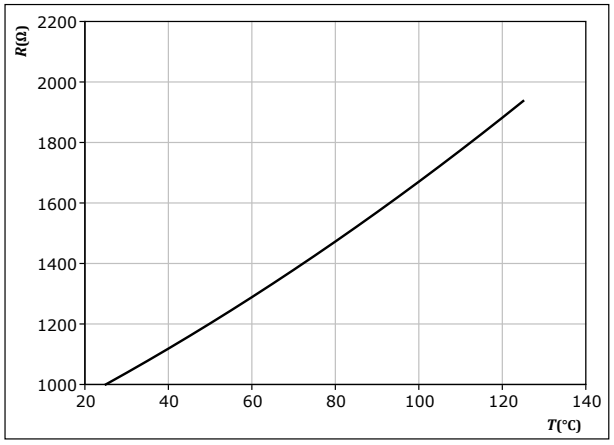
R (K/W)	τ (s)
1,70E-02	2,71E+00
3,38E-02	3,62E-01
1,27E-01	5,21E-02
1,27E-01	1,60E-02
5,54E-02	3,00E-03
2,86E-02	3,17E-04

PTC Characteristics

figure 12. **Thermistor**

Typical PTC characteristic as function of temperature

$R_T = f(T)$

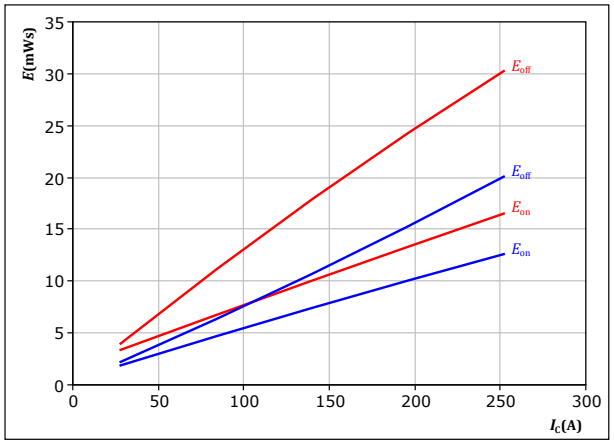


Brake Switching Characteristics

figure 13. **IGBT**

Typical switching energy losses as a function of collector current

$E = f(I_C)$



With an inductive load at

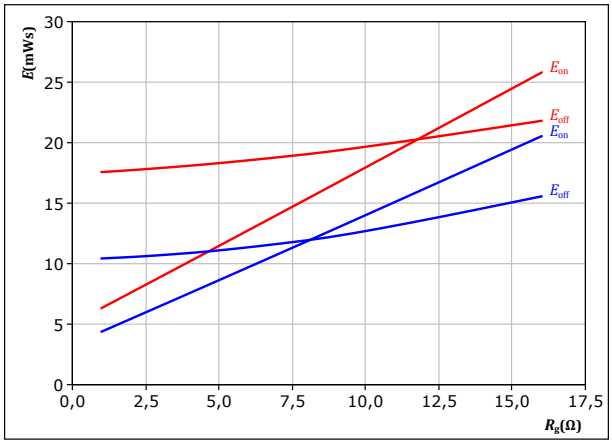
V_{CE} =	700	V
V_{GE} =	0/15	V
R_{gon} =	4	Ω
R_{goff} =	4	Ω

T_j: 25 °C, 125 °C

figure 14. **IGBT**

Typical switching energy losses as a function of gate resistor

$E = f(R_g)$



With an inductive load at

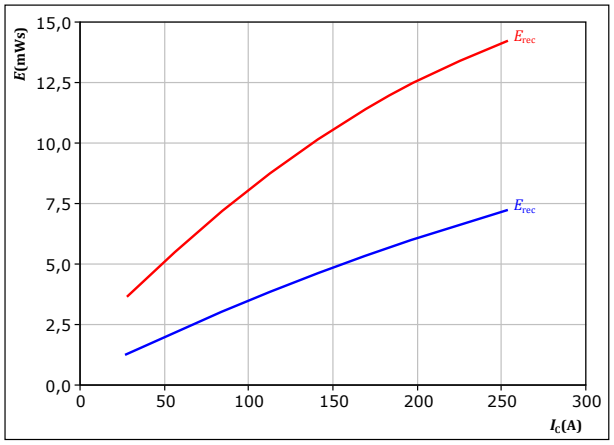
V_{CE} =	700	V
V_{GE} =	0/15	V
I_C =	140	A

T_j: 25 °C, 125 °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

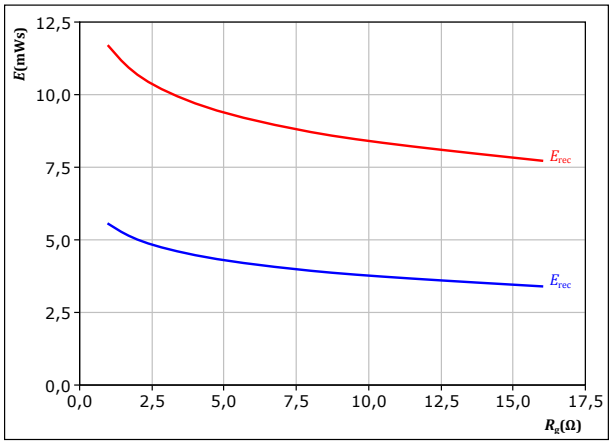
V_{CE} =	700	V
V_{GE} =	0/15	V
R_{gon} =	4	Ω

T_j: 25 °C, 125 °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} =	700	V
V_{GE} =	0/15	V
I_C =	140	A

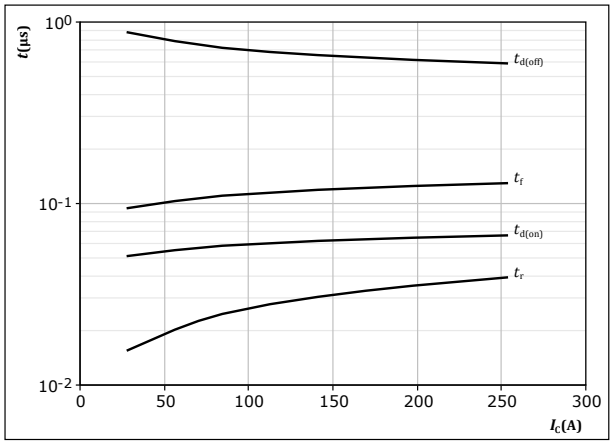
T_j: 25 °C, 125 °C

Brake Switching Characteristics

figure 17. **IGBT**

Typical switching times as a function of collector current

$t = f(I_C)$



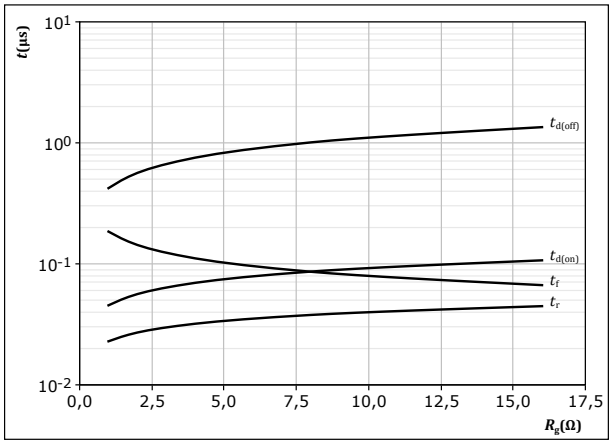
With an inductive load at

T_j =	125	°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 gate resistor

$t = f(R_g)$



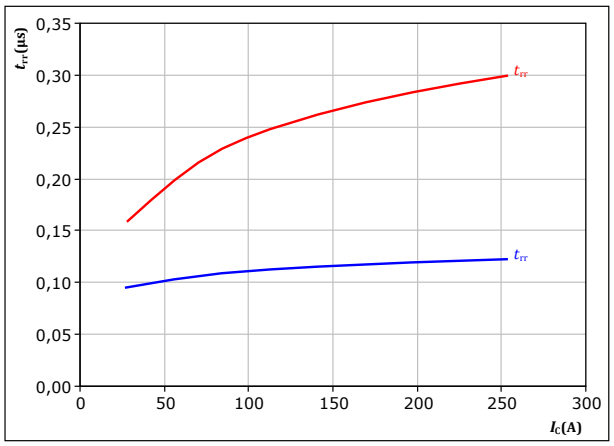
With an inductive load at

T_j =	125	°C
V_{CE} =	700	V
V_{GE} =	0/15	V
I_C =	140	A

figure 19. **FWD**

Typical reverse recovery time as a function of collector current

$t_{rr} = f(I_C)$



With an inductive load at

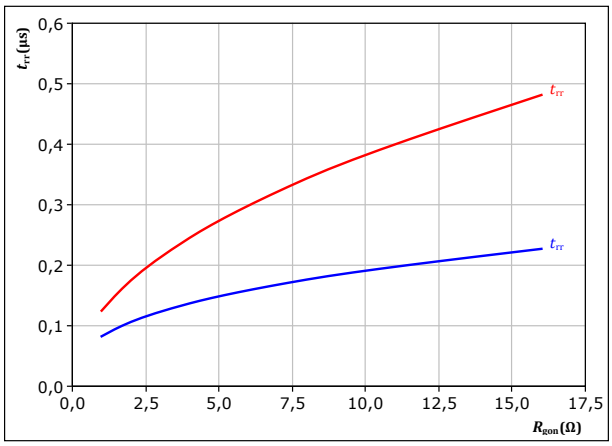
V_{CE} =	700	V
V_{GE} =	0/15	V
R_{gon} =	4	Ω

T_j: 25 °C, 125 °C

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 =	140	A

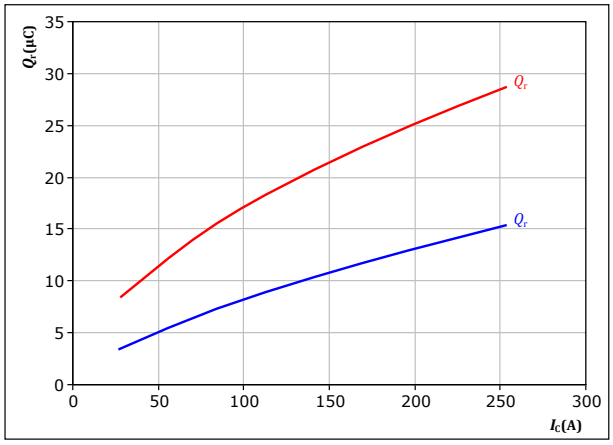
T_j: 25 °C, 125 °C

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

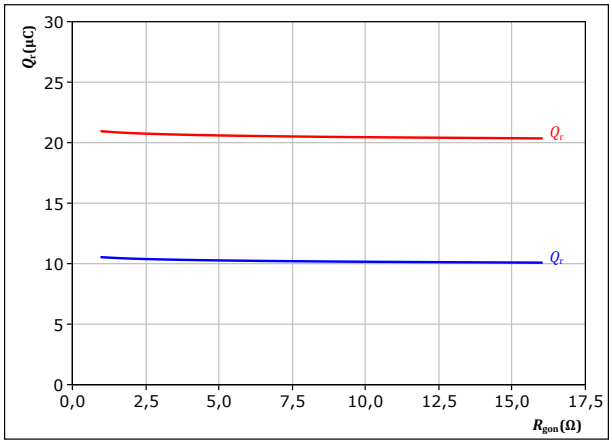
V_{CE} =	700	V
V_{GE} =	0/15	V
R_{gon} =	4	Ω

T_j: 25 °C, 125 °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

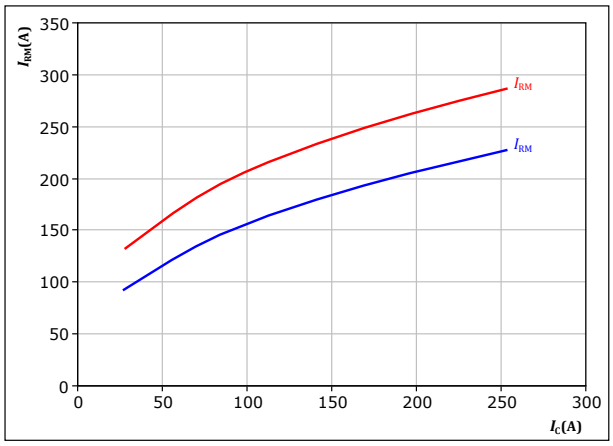
V_{CE} =	700	V
V_{GE} =	0/15	V
I_C =	140	A

T_j: 25 °C, 125 °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

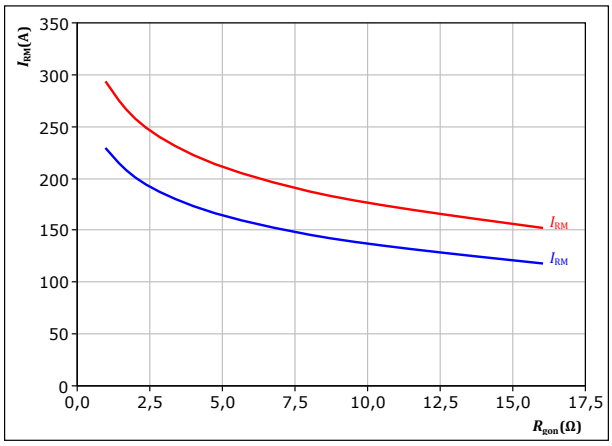
V_{CE} =	700	V
V_{GE} =	0/15	V
R_{gon} =	4	Ω

T_j: 25 °C, 125 °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} =	700	V
V_{GE} =	0/15	V
I_C =	140	A

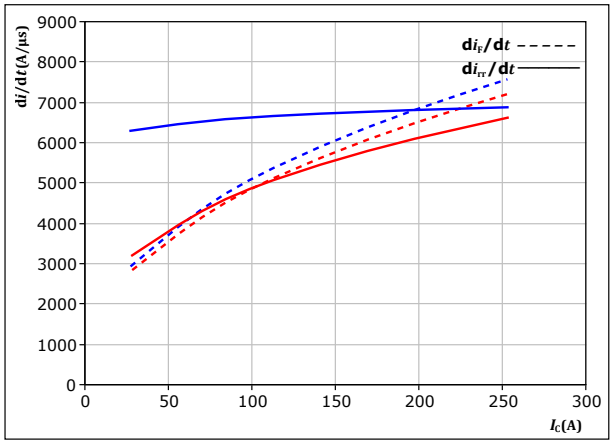
T_j: 25 °C, 125 °C

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

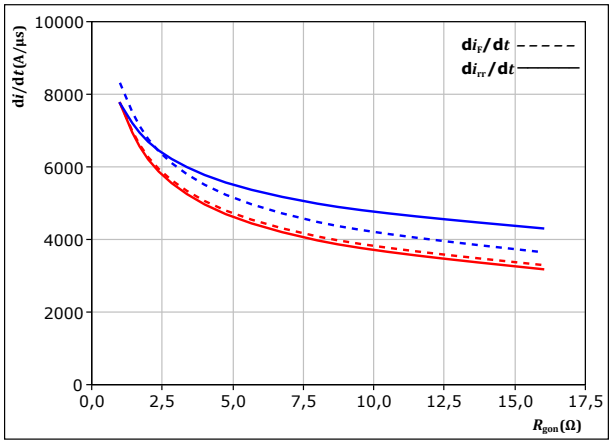
V_{CE} =	700	V
V_{GE} =	0/15	V
R_{gon} =	4	Ω

T_j: 25 °C, 125 °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

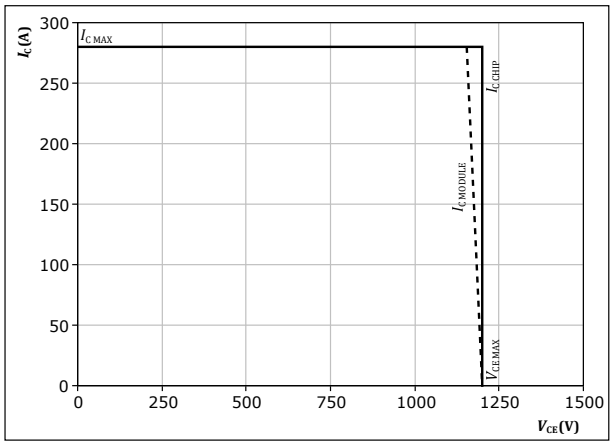
V_{CE} =	700	V
V_{GE} =	0/15	V
I_C =	140	A

T_j: 25 °C, 125 °C

figure 27. **IGBT**

Reverse bias safe operating area

I_C = f(V_{CE})



At

T_j =	125	°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})

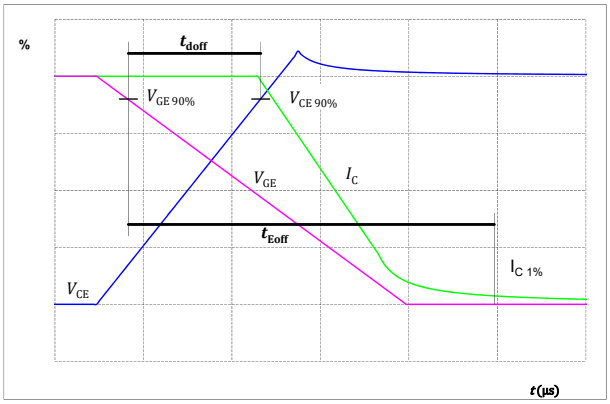


figure 29. **IGBT**

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

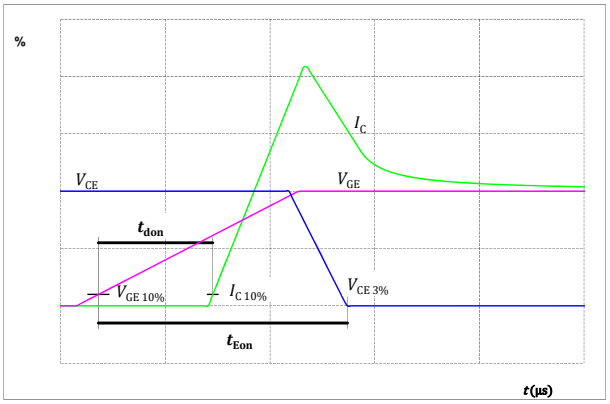


figure 30. **IGBT**

Turn-off Switching Waveforms & definition of t_f

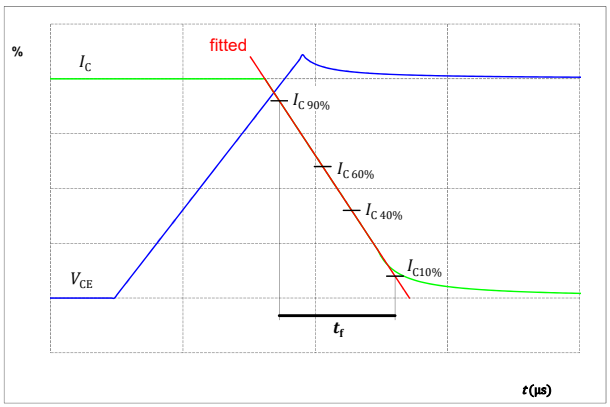
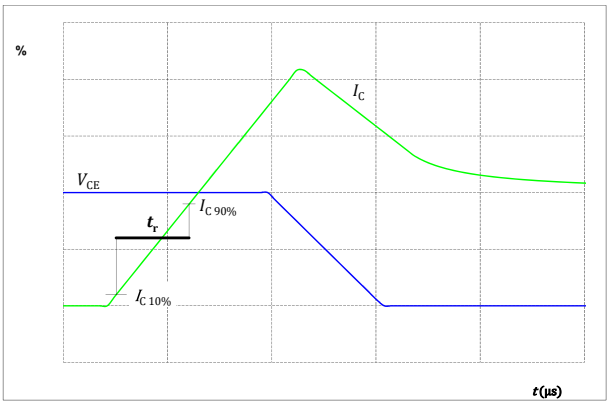


figure 31. **IGBT**

Turn-on Switching Waveforms & definition of t_r



Brake Switching Definitions

figure 32. **FWD**

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

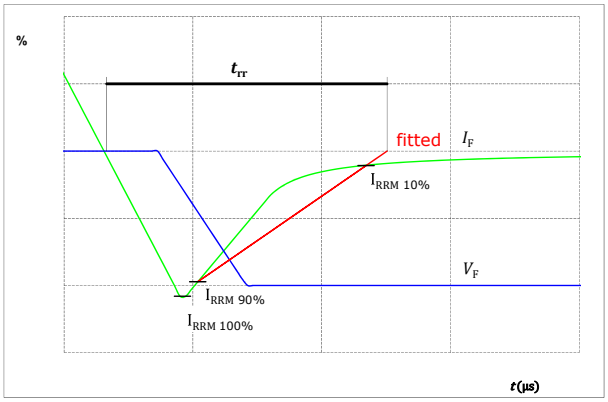
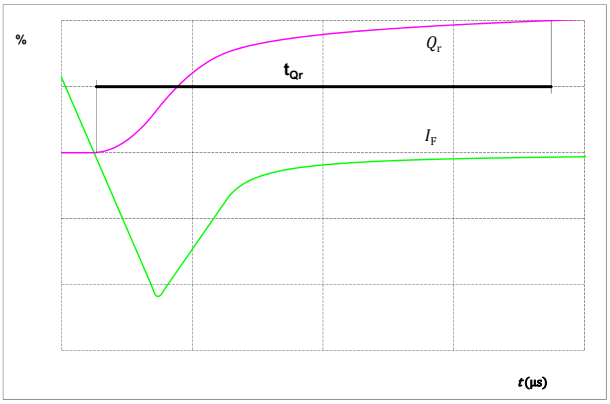


figure 33. **FWD**

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-M3166BA125AS-K489G30-/0A/
With thin lid (2.8mm height) + no thermal grease	80-M3166BA125AS-K489G30-/0B/
With std lid (6.5mm height) + thermal grease (0,8 W/mK, P12, silicone-based)	80-M3166BA125AS-K489G30-/1A/
With thin lid (2.8mm height) + thermal grease (0,8 W/mK, P12, silicone-based)	80-M3166BA125AS-K489G30-/1B/
With std lid (6.5mm height) + thermal grease (2,5 W/mK, TG20032, silicone-free)	80-M3166BA125AS-K489G30-/4A/
With thin lid (2.8mm height) + thermal grease (2,5 W/mK, TG20032, silicone-free)	80-M3166BA125AS-K489G30-/4B/
With std lid (6.5mm height) + thermal grease (2,5 W/mK, HPTP, silicone-based)	80-M3166BA125AS-K489G30-/5A/
With thin lid (2.8mm height) + thermal grease (2,5 W/mK, HPTP, silicone-based)	80-M3166BA125AS-K489G30-/5B/

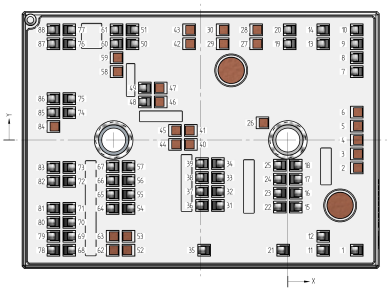
Marking

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

Outline

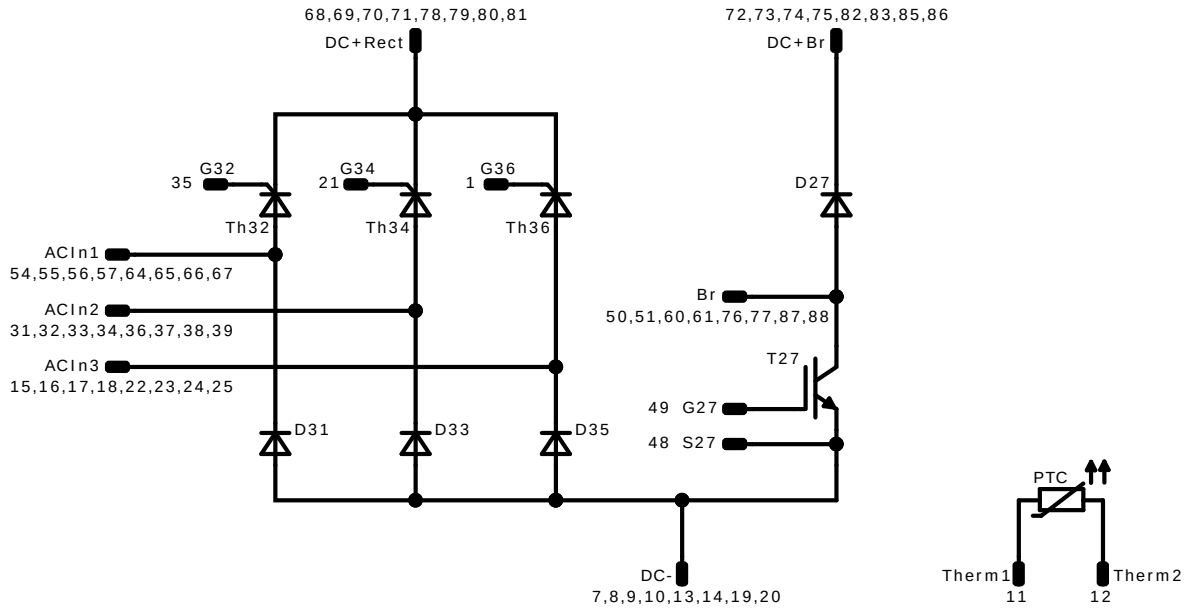
Pin table [mm]

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	4,32	22,1	Br
6	not assembled			51	4,32	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	3,42	-15,7	ACIn1
10	15,83	25,3	DC-	55	3,42	-12,5	ACIn1
11	8,13	-25,3	Therm1	56	3,42	-9,3	ACIn1
12	8,13	-22,1	Therm2	57	3,42	-6,1	ACIn1
13	8,13	22,1	DC-	58	not assembled		
14	8,13	25,3	DC-	59	not assembled		
15	41,82	-15,38	ACIn3	60	-39,32	22,1	Br
16	41,82	-12,18	ACIn3	61	-39,32	25,3	Br
17	41,82	-8,98	ACIn3	62	not assembled		
18	41,82	-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	-10,18	-25,3	DC+Rect
24	-1,82	-8,98	ACIn3	69	-10,18	-22,1	DC+Rect
25	-1,82	-5,79	ACIn3	70	-10,18	-18,9	DC+Rect
26	not assembled			71	-10,18	-15,7	DC+Rect
27	not assembled			72	-10,18	-9,5	DC+Br
28	not assembled			73	-10,18	-6,3	DC+Br
29	not assembled			74	-10,18	6,3	DC+Br
30	not assembled			75	-10,18	9,5	DC+Br
31	23,95	-15,02	ACIn2	76	-10,18	22,1	Br
32	23,95	-11,82	ACIn2	77	-10,18	25,3	Br
33	23,95	-8,63	ACIn2	78	-53,82	-25,3	DC+Rect
34	23,95	-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	140 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			PTC	

Packaging instruction				
Standard packaging quantity (SPQ) 48	>SPQ	Standard	<SPQ	Sample

Handling instruction
Handling instructions for MiniSKiiP® 3 packages see vincotech.com website.

Package data
Package data for MiniSKiiP® 3 packages see vincotech.com website.

UL recognition and file number
This device is certified according to UL 1557 standard, UL file number E192116. For more information see vincotech.com website.

Document No.:	Date:	Modification:	Pages
80-M3166BA125AS-K489G30-D1-14	19 Jun. 2020		