Vincotech

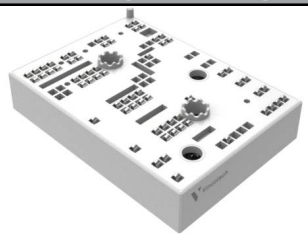
80-M3166BA125AS02-K849G32
datasheet

MiniSKiiP® CON 3 **1600 V / 125 A**

Features

- 3-phase full controlled input rectifier with brake chopper
- Fast Trench IGBT
- Temperature sensor integrated

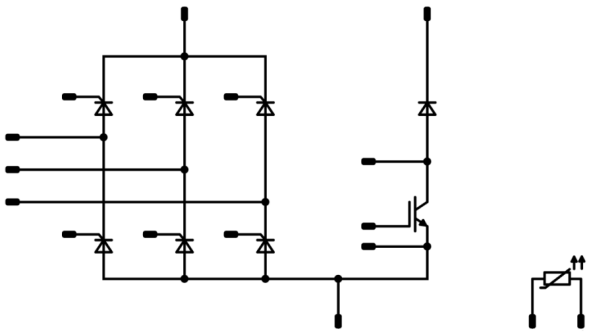
MiniSkiip® 3 housing



Target applications

- Industrial Drives

Schematic



Types

- 80-M3166BA125AS02-K849G32

Maximum Ratings

T_j = 25 °C, unless otherwise specified

Parameter	Symbol	Condition	Value	Unit
Rectifier Thyristor				
Repetitive peak reverse voltage	V_{RRM}		1600	V
Forward average current	I_{FAV}		125	A
Surge forward current	I_{FSM}	t_p = 10 ms, T_j = 130 °C	1250	A
I^2t value	I^2t	t_p = 10 ms, T_j = 130 °C	7810	A^2s
Power dissipation	P_{tot}	$T_j = T_{jmax}$, T_s = 80 °C	168	W
Maximum Junction Temperature	T_{jmax}		130	°C

Maximum Ratings

T_j = 25 °C, unless otherwise specified

Parameter	Symbol	Condition	Value	Unit
Brake Switch				
Collector-emitter voltage	V_{CES}		1200	V
Collector current	I_C		150	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	453	W
Gate-emitter voltage	V_{GES}		±20	V
Short circuit ratings	t_{SC} V_{CC}	T_j ≤ 150 °C V_{GE} = 15 V	10 800	µs V
Maximum junction temperature	T_{jmax}		175	°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	112	A
Surge (non-repetitive) forward current	I_{FSM}	50 Hz Single Half Sine Wave T_j = 150 °C t_p = 10 ms	900	A
Surge current capability	I^2t		4050	A^2s
Total power dissipation	P_{tot}	T_j = T_{jmax} T_s = 80 °C	244	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
		AC Voltage t_p = 1 min	2500	V
Creepage distance		With std lid For more informations see handling instruction	6,3	mm
Clearance		With std lid For more informations see handling instruction	6,3	mm
Comparative Tracking Index	CTI		> 200	

*100 % tested in production

Characteristic Values

Parameter	Symbol	Conditions					Value			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				125	25 125		1,11 1,06	1,4	V
Threshold voltage (for power loss calc. only)	V_{to}					130			0,85	V
Slope resistance (for power loss calc. only)	r_t					130			3,2	mΩ
Critical rate of rise of off-state voltage	$(dv/dt)_{cr}$					130			1000	V/µs
Critical rate of rise of on-state current	$(di/dt)_{cr}$					130			100	A/µs
Circuit commutated turn-off time	t_q					130		150		µs
Holding current	I_H					25			220	mA
Latching current	I_L					25			550	mA
Gate trigger voltage	V_{GT}					25			1,98	V
Gate trigger current	I_{GT}					25			100	mA
Gate non-trigger voltage	V_{GD}					130	0,25			V
Gate non-trigger current	I_{GD}					115	6			mA
Thermal										
Thermal resistance chip to sink	$R_{th(j-s)}$	λpaste = 2,5 W/mK (HPTP)						0,30		K/W

Characteristic Values

Parameter	Symbol	Conditions					Value			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	$V_{GE(th)}$	$V_{GE} = V_{CE}$			0,0052	25	5,3	5,8	6,4	V
Collector-emitter saturation voltage	V_{CEsat}		15		150	25 125 150	1,58	2,72 3,48 3,68	2,07	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		
Thermal										
Thermal resistance junction to sink	$R_{th(j-s)}$	λpaste = 2,5 W/mK (HPTP)						0,22		K/W
Dynamic										
Turn-on delay time	$t_{d(on)}$	R_{goff} = 4 Ω R_{gon} = 4 Ω	15/0	700	149	25 125 150		64 65 66		ns
Rise time	t_r					25 125 150		71 71 70		
Turn-off delay time	$t_{d(off)}$					25 125 150		597 681 708		
Fall time	t_f					25 125 150		28 45 90		
Turn-on energy (per pulse)	E_{on}	Q_{rFWD} = 9,6 µC Q_{rFWD} = 19,7 µC Q_{rFWD} = 24,5 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		

Characteristic Values

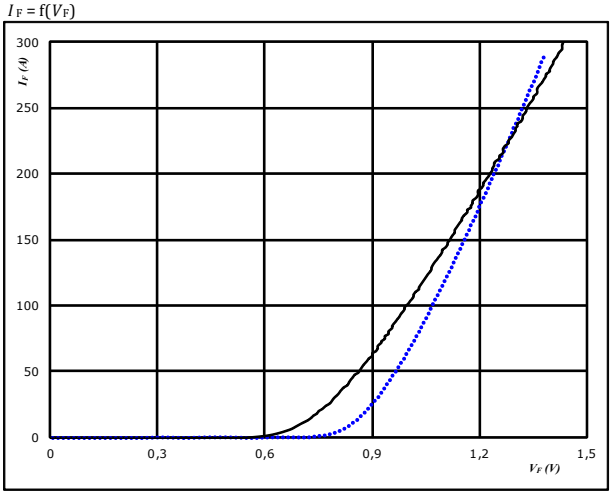
Parameter	Symbol	Conditions					Value			Unit
			V_{GE} [V] V_{GS} [V]	V_{CE} [V] V_{DS} [V] V_F [V]	I_C [A] I_D [A] I_F [A]	T_j [°C]	Min	Typ	Max	
Brake Diode										
Static										
Forward voltage	V_F				150	25 150		2,50 2,53	2,7	V
Reverse leakage current	I_R			1200		25 150			180 28000	µA
Thermal										
Thermal resistance junction to sink	$R_{th(j-s)}$	λpaste = 2,5 W/mK (HPTP)						0,39		K/W
Dynamic										
Peak recovery current	I_{RRM}	di/dt = 800 A/µs di/dt = 1170 A/µs di/dt = 1197 A/µs	15/0	700	149	25 125 150		41 54 61		A
Reverse recovery time	t_{rr}					25 125 150		461 625 713		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		98 61 66		A/µs
Thermistor										
Rated resistance	R					25		1		kΩ
Deviation of R_{100}	$\Delta_{R/R}$	R_{100} = 1670 Ω				100	-2		+2	%
R_{100}	R					100		1670		Ω
Power dissipation constant						25		0,76		mW/K
A-value	$A_{(25/50)}$					25		$7,635*10^{-3}$		1/K
B-value	$B_{(25/100)}$					25		$1,731*10^{-5}$		1/K²
Vincotech PTC Reference									E	

Rectifier Thyristor Characteristics

figure 1. **Thyristor**

Typical forward characteristics

$I_F = f(V_F)$



t_p = 250 µs

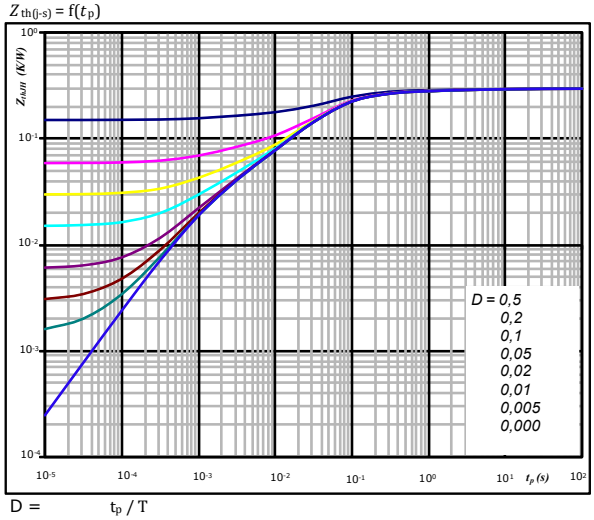
T_j: 25 °C

125 °C

figure 2. **Thyristor**

Transient thermal impedance as a function of pulse width

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



D = t_p / T

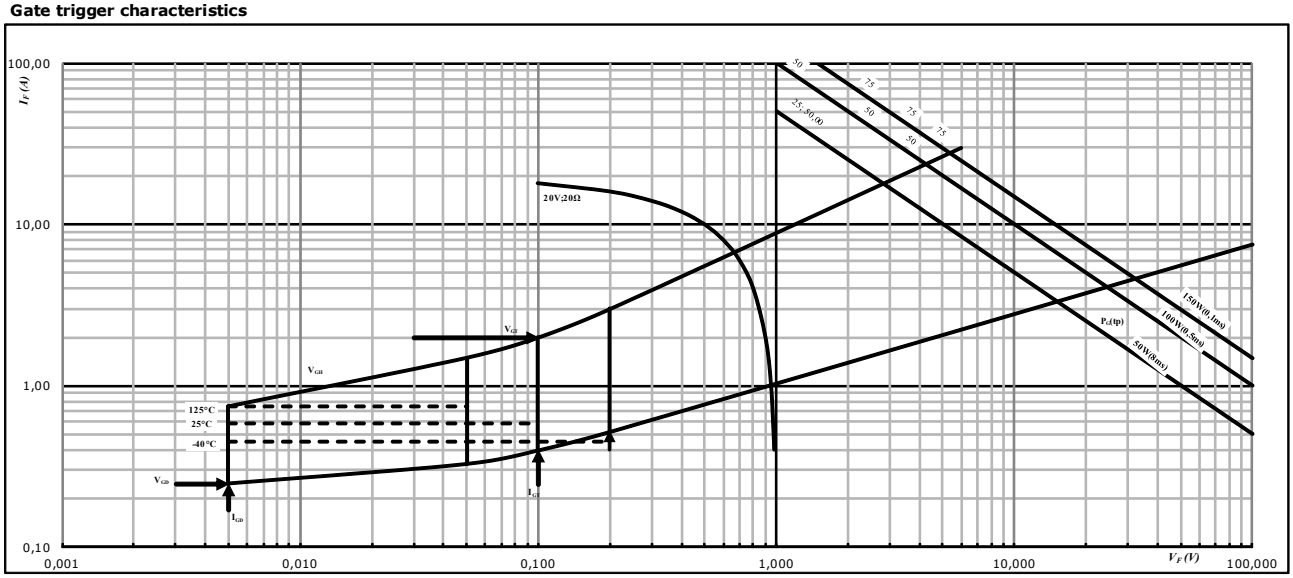
$R_{th(j-s)}$ = 0,30 K/W

FWD thermal model values

R (K/W)	Tau (s)
1,10E-02	8,76E+00
2,07E-02	7,46E-01
5,49E-02	1,33E-01
1,59E-01	4,45E-02
2,97E-02	8,66E-03
7,88E-02	1,33E-03

figure 3. **Thyristor**

Gate trigger characteristics

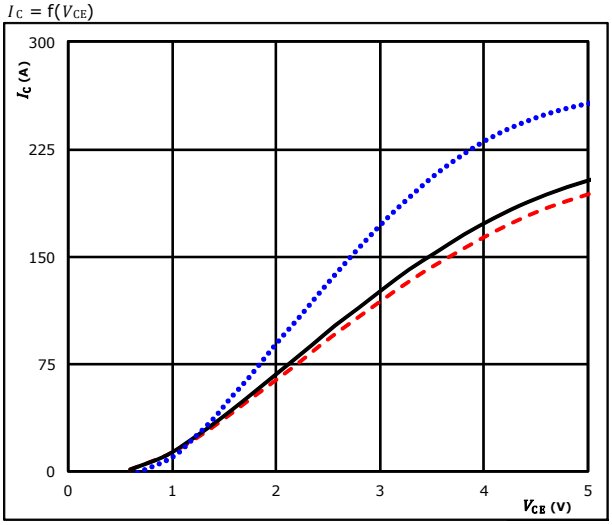


Brake Switch Characteristics

figure 1. **IGBT**

Typical output characteristics

$I_C = f(V_{CE})$

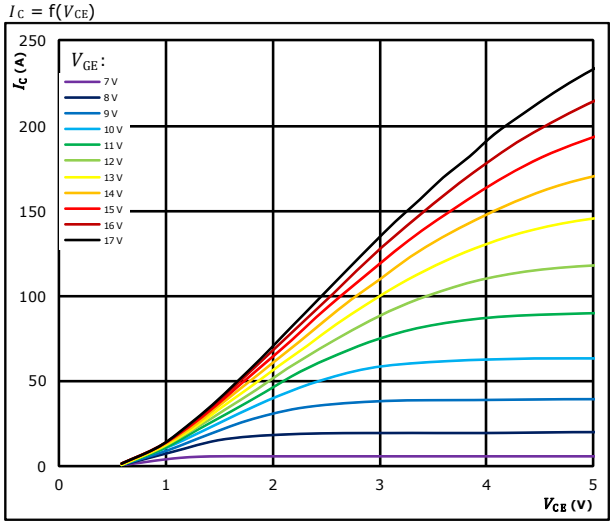


t_p =	250	µs		25 °C	
V_{GE} =	15	V	T_j:	125 °C	
				150 °C	

figure 2. **IGBT**

Typical output characteristics

$I_C = f(V_{CE})$

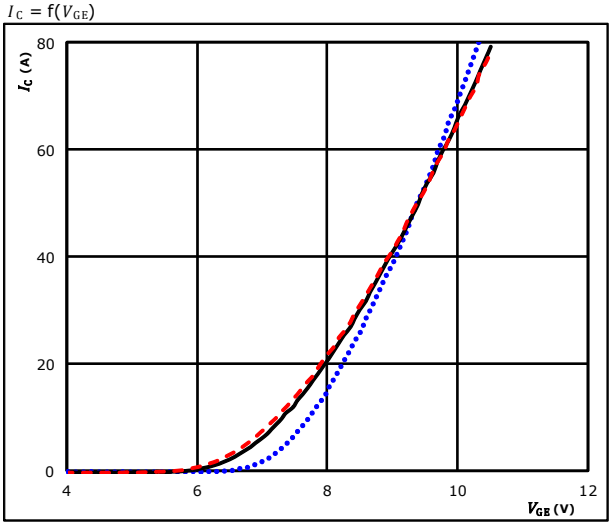


t_p =	250	µs
T_j =	150	°C
V_{GE} from	7 V to 17 V in steps of 1 V	

figure 3. **IGBT**

Typical transfer characteristics

$I_C = f(V_{GE})$

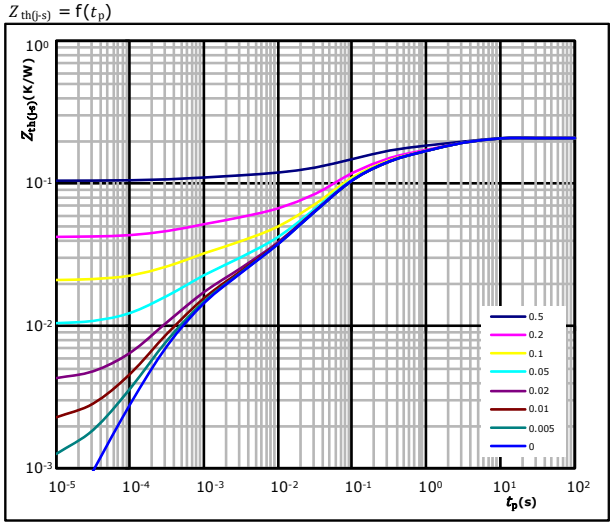


t_p =	100	µs		25 °C	
V_{CE} =	10	V	T_j:	125 °C	
				150 °C	

figure 4. **IGBT**

Transient thermal impedance as function of pulse duration

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



D =	t_p / T	
$R_{th(j-s)}$ =	0,21	K/W

IGBT thermal model values

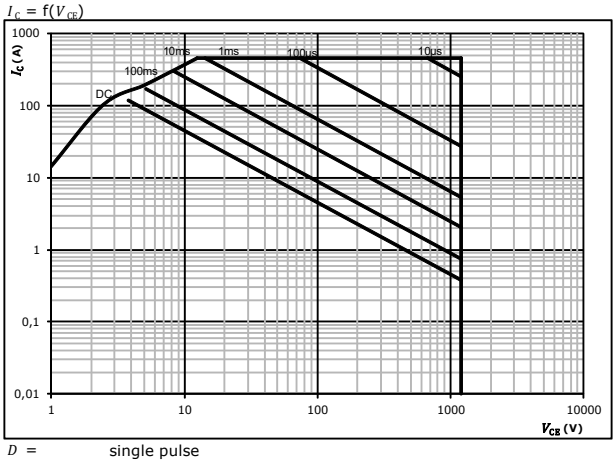
R (K/W)	τ (s)
5,76E-02	2,91E+00
4,18E-02	3,82E-01
8,02E-02	8,51E-02
1,35E-02	1,20E-02
9,50E-03	1,62E-03
7,18E-03	4,17E-04

Brake Switch Characteristics

figure 5. **IGBT**

Safe operating area

$I_C = f(V_{CE})$



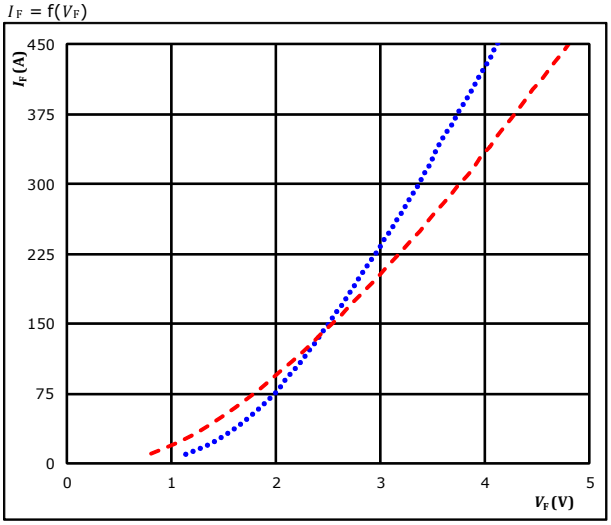
D =	single pulse	
T_s =	80	ºC
V_{GE} =	±15	V
T_j =	T_{jmax}	

Brake Diode Characteristics

figure 1. **FWD**

Typical forward characteristics

$I_F = f(V_F)$



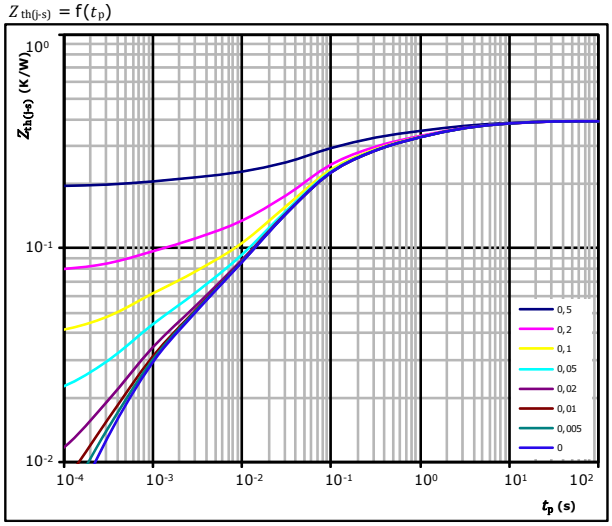
t_p = 250 µs

T_j: 25 °C, 150 °C

figure 2. **FWD**

Transient thermal impedance as a function of pulse width

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



D = t_p / T

$R_{th(j-s)}$ = 0,39 K/W

FWD thermal model values

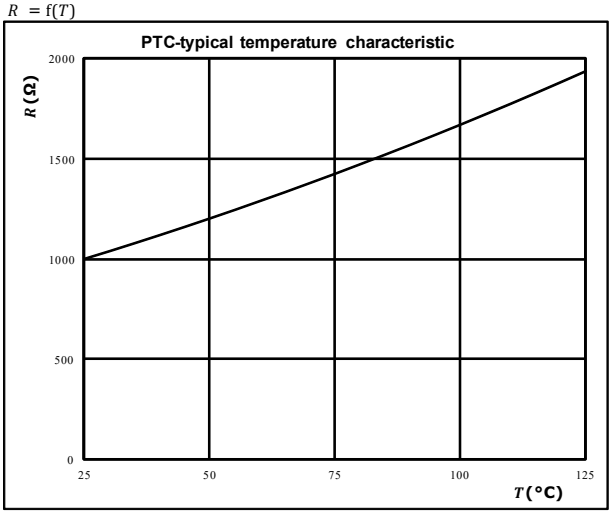
R (K/W)	τ (s)
3,07E-02	8,01E+00
6,95E-02	1,36E+00
7,63E-02	2,37E-01
1,50E-01	4,99E-02
3,25E-02	7,73E-03
1,77E-02	1,17E-03
1,32E-02	4,59E-04

Thermistor Characteristics

figure 1. **Thermistor**

Typical PTC characteristic
as a function of temperature

$R = f(T)$

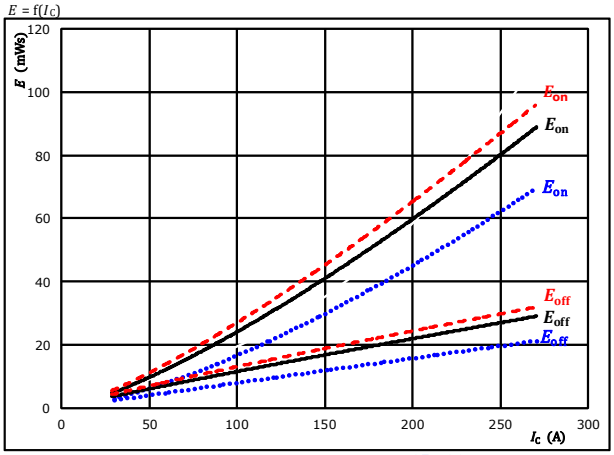


Brake Switching Characteristics

figure 1. **IGBT**

Typical switching energy losses as a function of collector current

$E = f(I_C)$



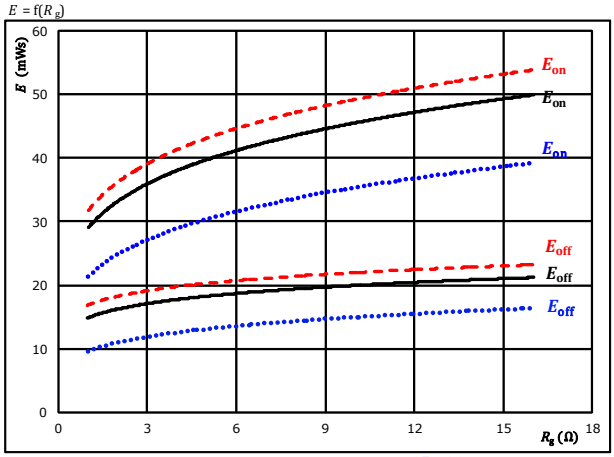
With an inductive load at

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

figure 2. **IGBT**

Typical switching energy losses as a function of gate resistor

$E = f(R_g)$



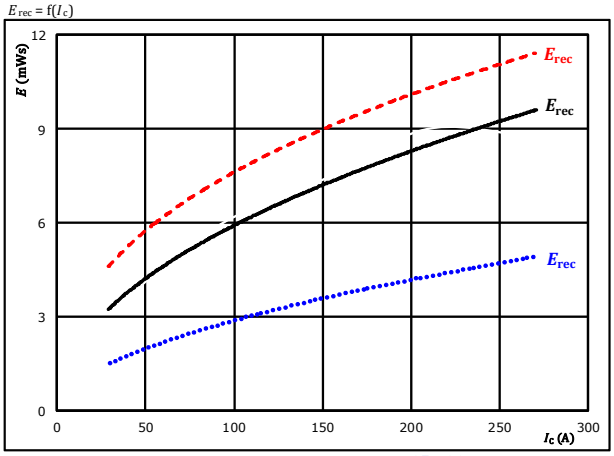
With an inductive load at

V_{CE} =	700	V	T_j:	25 °C	
V_{GE} =	15/0	V		125 °C	
I_C =	149	A		150 °C	

figure 3. **FWD**

Typical reverse recovered energy loss as a function of collector current

$E_{rec} = f(I_c)$



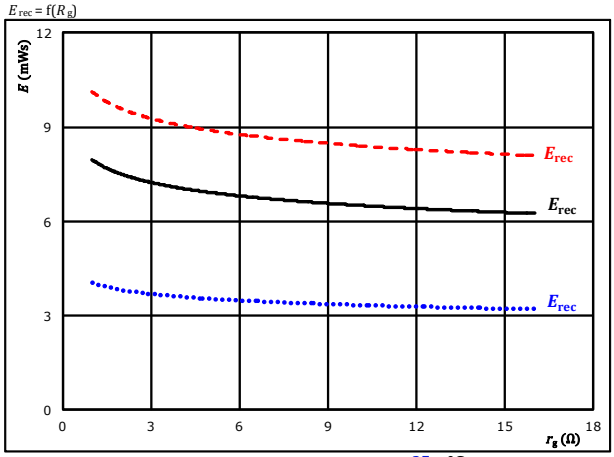
With an inductive load at

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

figure 4. **FWD**

Typical reverse recovered energy loss as a function of gate resistor

$E_{rec} = f(R_g)$



With an inductive load at

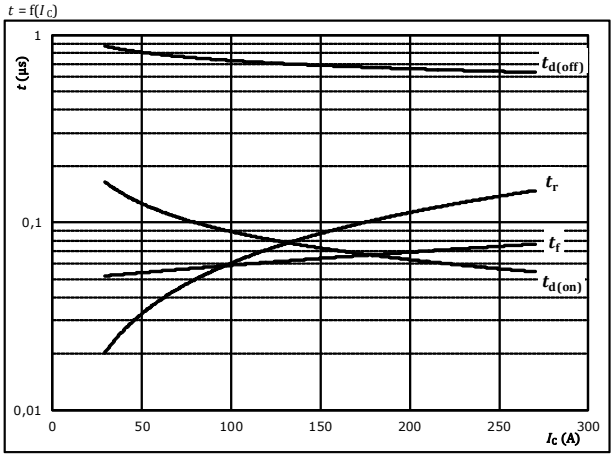
V_{CE} =	700	V	T_j:	25 °C	
V_{GE} =	15/0	V		125 °C	
I_C =	149	A		150 °C	

Brake Switching Characteristics

figure 5. **IGBT**

Typical switching times as a function of collector current

$t = f(I_C)$



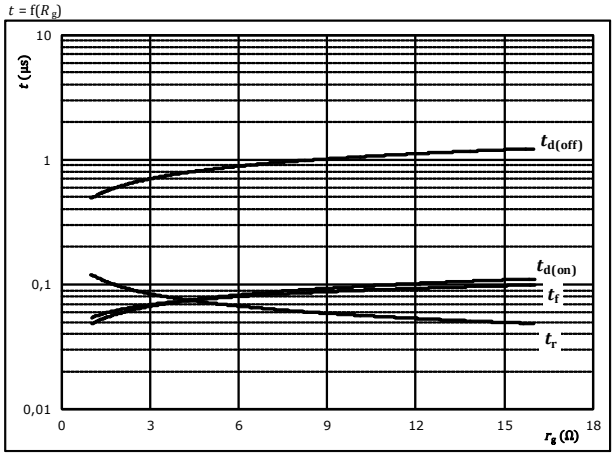
With an inductive load at

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

figure 6. **IGBT**

Typical switching times as a function of gate resistor

$t = f(R_g)$



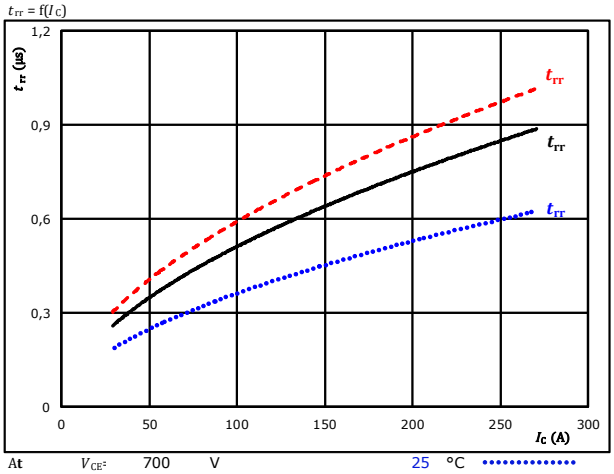
With an inductive load at

T_j =	150	°C
V_{CE} =	700	V
V_{GE} =	15/0	V
I_C =	149	A

figure 7. **FWD**

Typical reverse recovery time as a function of collector current

$t_{rr} = f(I_C)$



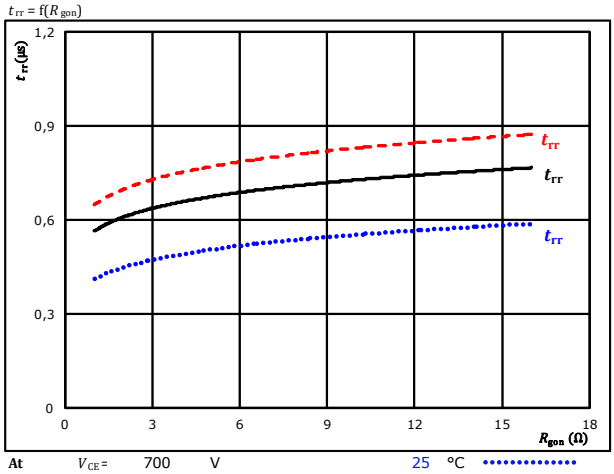
At

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

figure 8. **FWD**

Typical reverse recovery time as a function of IGBT turn on gate resistor

$t_{rr} = f(R_{gon})$



At

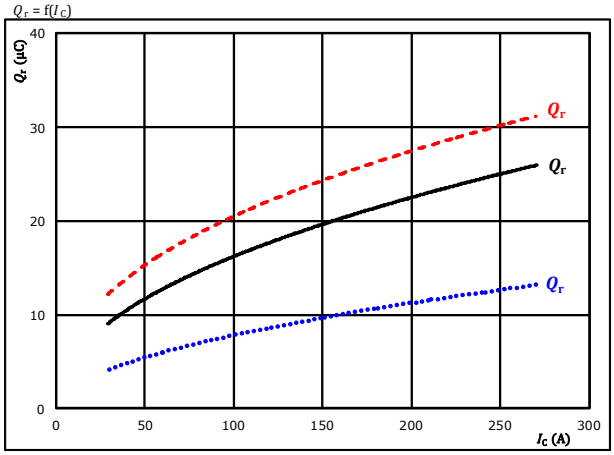
V_{CE} =	700	V		25	°C
V_{GE} =	15/0	V	T_j:	125	°C
I_C =	149	A		150	°C

Brake Switching Characteristics

figure 9. **FWD**

Typical recovered charge as a function of collector current

$Q_r = f(I_C)$

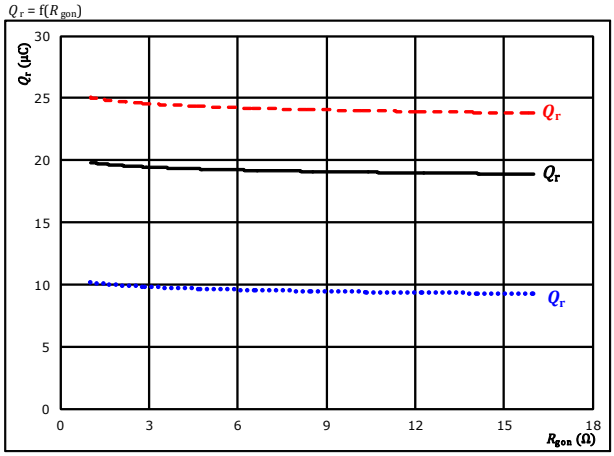


At						
	V_{CE} =	700	V		25 °C	
	V_{GE} =	15/0	V	T_j:	125 °C	
	R_{gon} =	4	Ω		150 °C	

figure 10. **FWD**

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

$Q_r = f(R_{gon})$

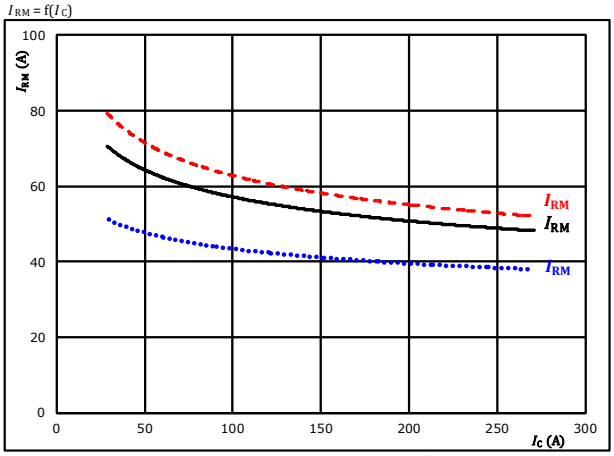


At						
	V_{CE}=	700	V		25 °C	
	V_{GE} =	15/0	V	T_j:	125 °C	
	I_C=	149	A		150 °C	

figure 11. **FWD**

Typical peak reverse recovery current current as a function of collector current

$I_{RM} = f(I_C)$

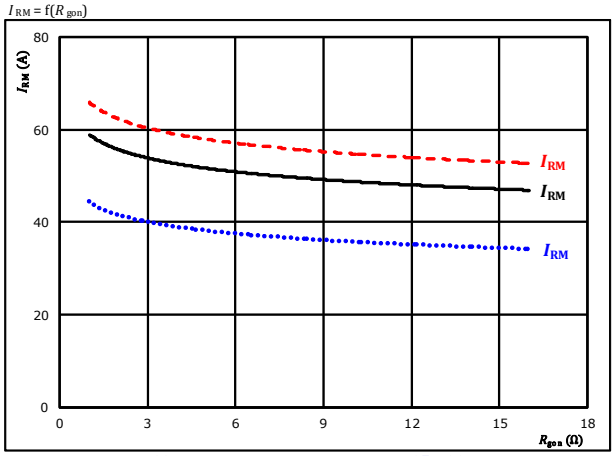


At						
	V_{CE}:	700	V		25 °C	
	V_{GE} =	15/0	V	T_j:	125 °C	
	R_{gon} =	4	Ω		150 °C	

figure 12. **FWD**

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

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



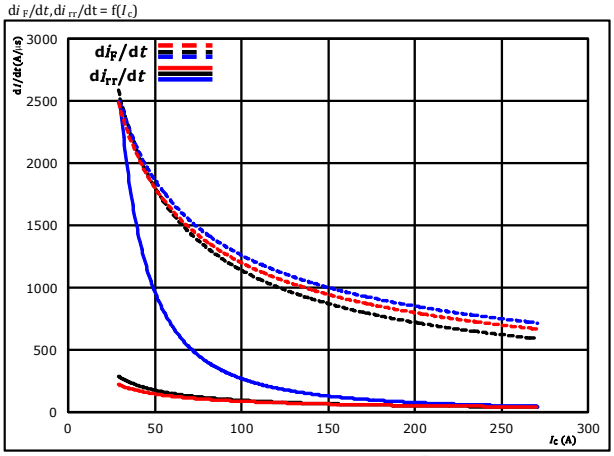
At						
	V_{CE} =	700	V		25 °C	
	V_{GE} =	15/0	V	T_j:	125 °C	
	I_C =	149	A		150 °C	

Brake Switching Characteristics

figure 13. **FWD**

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

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

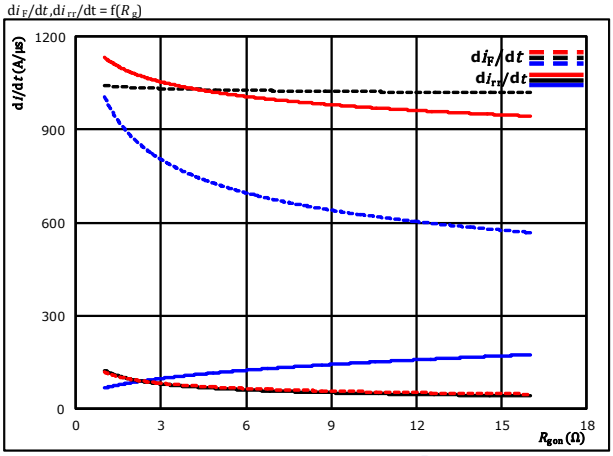


At						
V_{CE}:	700	V		25	°C	•••••••••••••••
V_{GE} =	15/0	V	T_j:	125	°C	———
R_{gon} =	4	Ω		150	°C	– – – –

figure 14. **FWD**

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

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

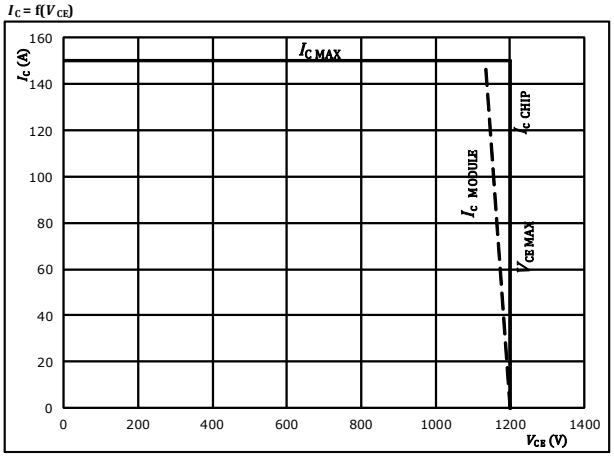


At						
V_{CE} =	700	V		25	°C	•••••••••••••••
V_{GE} =	15/0	V	T_j:	125	°C	———
I_C =	149	A		150	°C	– – – –

figure 15. **IGBT**

Reverse bias safe operating area

$I_C = f(V_{CE})$



At

T_j =	175	°C
R_{gon} =	4	Ω
R_{goff} =	4	Ω

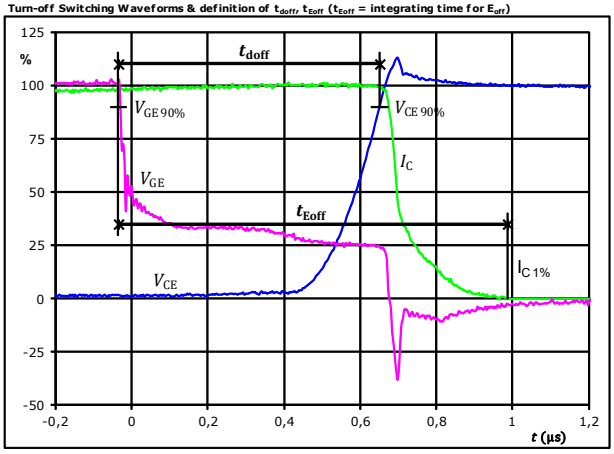
Brake Switching Definitions

General conditions

T_j	=	125 °C
R_{gon}	=	4 Ω
R_{goff}	=	4 Ω

figure 1. IGBT

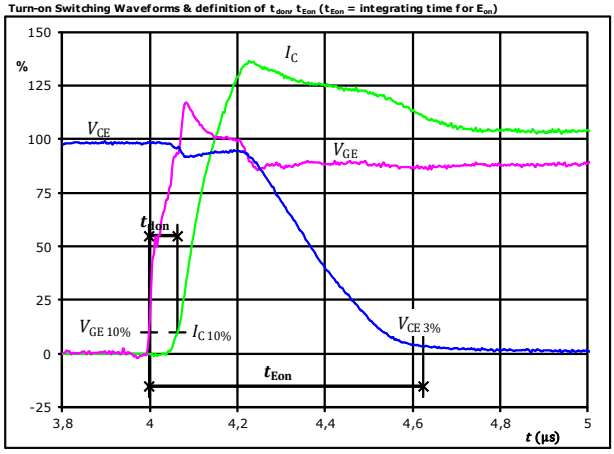
Turn-off Switching Waveforms & definition of t_{doff}, t_{Eoff} (t_{Eoff} = integrating time for E_{off})



$V_{GE}(0\%)$ =	0	V
$V_{GE}(100\%)$ =	15	V
$V_C(100\%)$ =	700	V
$I_C(100\%)$ =	151	A
t_{doff} =	0,681	µs
t_{Eoff} =	1,021	µs

figure 2. IGBT

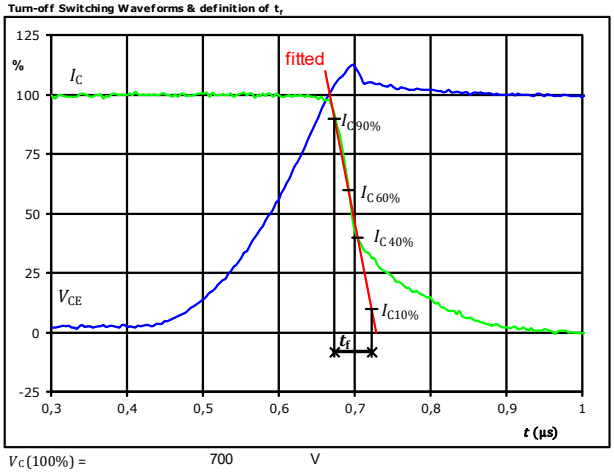
Turn-on Switching Waveforms & definition of t_{don} t_{Eon} (t_{Eon} = integrating time for E_{on})



$V_{GE}(0\%)$ =	0	V
$V_{GE}(100\%)$ =	15	V
$V_C(100\%)$ =	700	V
$I_C(100\%)$ =	151	A
t_{don} =	0,065	µs
t_{Eon} =	0,626	µs

figure 3. IGBT

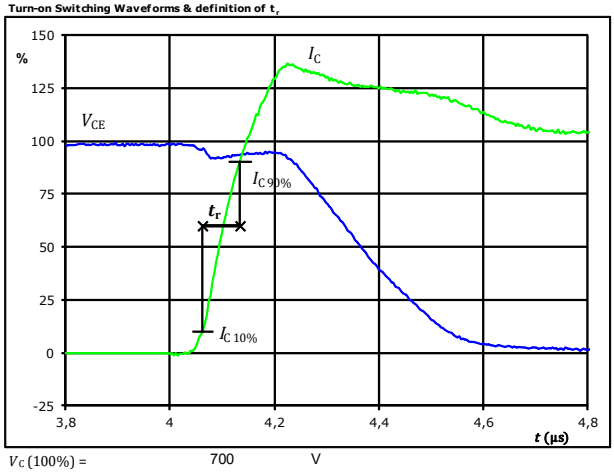
Turn-off Switching Waveforms & definition of t_f



$V_C(100\%)$ =	700	V
$I_C(100\%)$ =	151	A
t_f =	0,045	µs

figure 4. IGBT

Turn-on Switching Waveforms & definition of t_r

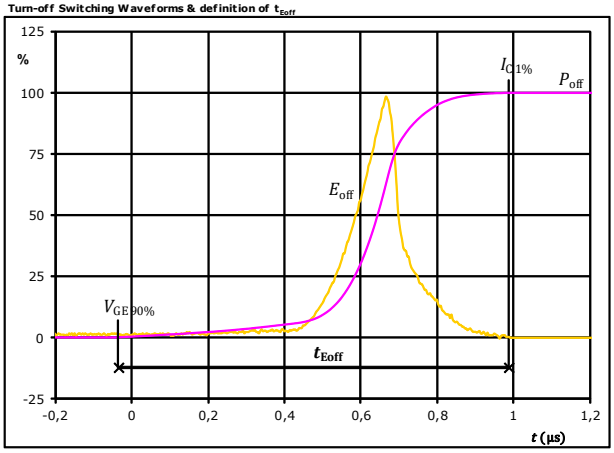


$V_C(100\%)$ =	700	V
$I_C(100\%)$ =	151	A
t_r =	0,071	µs

Brake Switching Characteristics

figure 5. **IGBT**

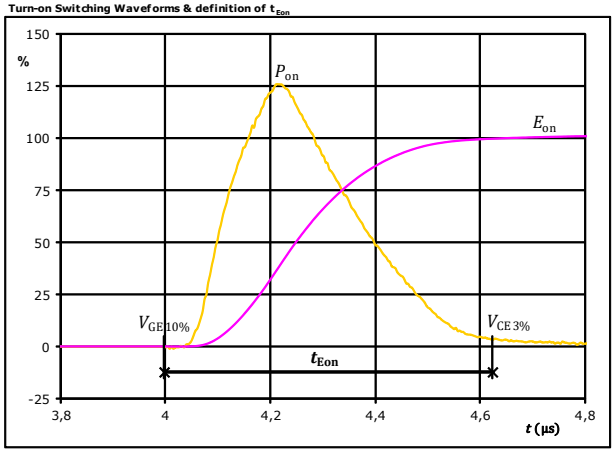
Turn-off Switching Waveforms & definition of t_{Eoff}



$P_{off}(100\%)$ =	105,38	kW
$E_{off}(100\%)$ =	16,84	mJ
t_{Eoff} =	1,02	µs

figure 6. **IGBT**

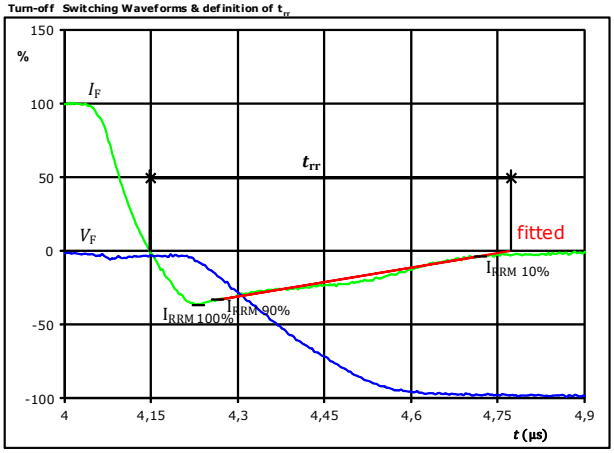
Turn-on Switching Waveforms & definition of t_{Eon}



$P_{on}(100\%)$ =	105,38	kW
$E_{on}(100\%)$ =	35,58	mJ
t_{Eon} =	0,63	µs

figure 7. **FWD**

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

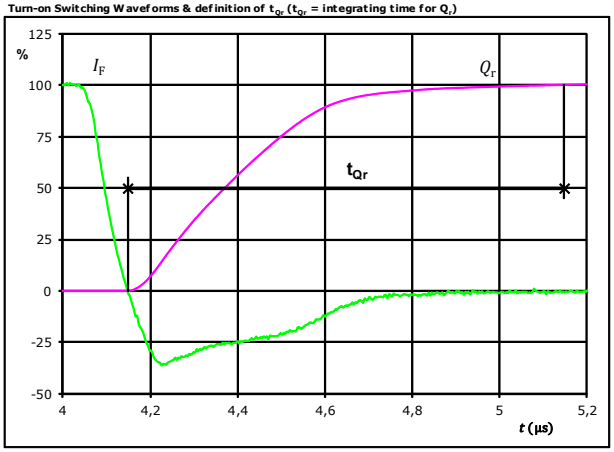


$V_F(100\%)$ =	700	V
$I_F(100\%)$ =	151	A
$I_{RRM}(100\%)$ =	-54	A
t_{rr} =	0,625	µs

Brake Switching Characteristics

figure 8. **FWD**

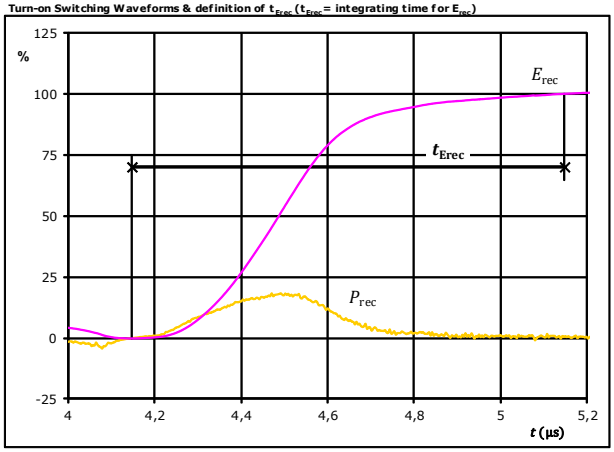
Turn-on Switching Waveforms & definition of t_{Qr} (t_{Qr} = integrating time for Q_r)



I_F (100%) =	151	A
Q_r (100%) =	19,74	µC
t_{Qr} =	1,00	µs

figure 9. **FWD**

Turn-on Switching Waveforms & definition of t_{Erec} (t_{Erec} = integrating time for E_{rec})



P_{rec} (100%) =	105,38	kW
E_{rec} (100%) =	7,41	mJ
t_{Erec} =	1,00	µs

Vincotech

Ordering Code & Marking

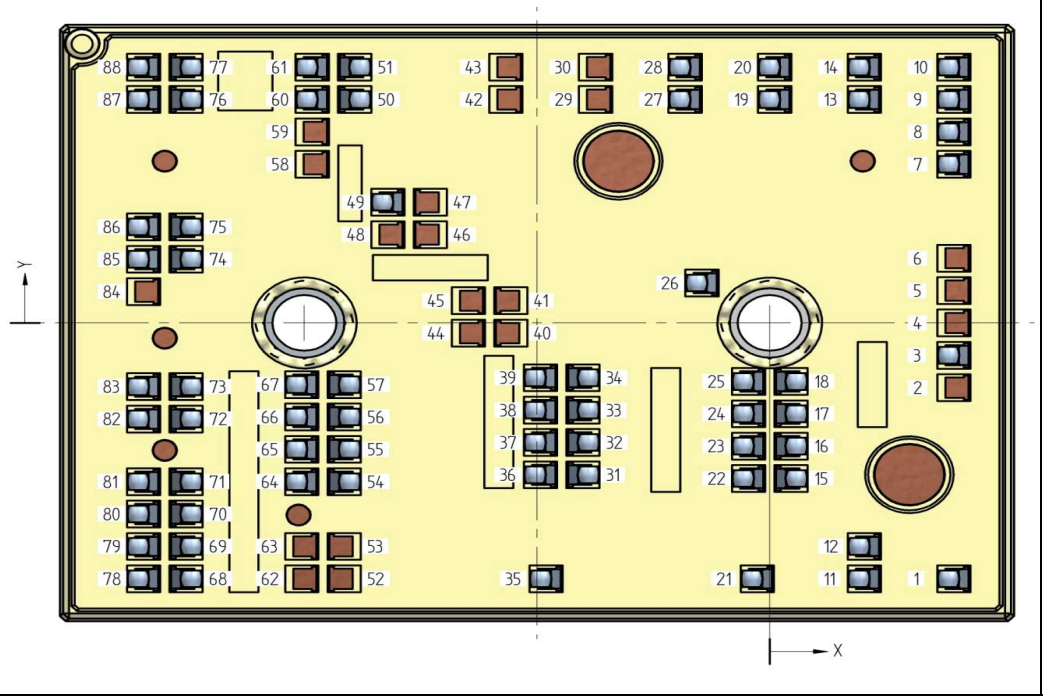
Version	Ordering Code
With std lid (6.5mm height) + no thermal grease	80-M3166BA125AS02-K849G32-/0A/
With thin lid (2.8mm height) + no thermal grease	80-M3166BA125AS02-K849G32-/0B/
With std lid (6.5mm height) + thermal grease (0,8 W/mK, P12, silicone-based)	80-M3166BA125AS02-K849G32-/1A/
With thin lid (2.8mm height) + thermal grease (0,8 W/mK, P12, silicone-based)	80-M3166BA125AS02-K849G32-/1B/
With std lid (6.5mm height) + thermal grease (2,5 W/mK, TG20032, silicone-free)	80-M3166BA125AS02-K849G32-/4A/
With thin lid (2.8mm height) + thermal grease (2,5 W/mK, TG20032, silicone-free)	80-M3166BA125AS02-K849G32-/4B/
With std lid (6.5mm height) + thermal grease (2,5 W/mK, HPTP, silicone-based)	80-M3166BA125AS02-K849G32-/5A/
With thin lid (2.8mm height) + thermal grease (2,5 W/mK, HPTP, silicone-based)	80-M3166BA125AS02-K849G32-/5B/

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

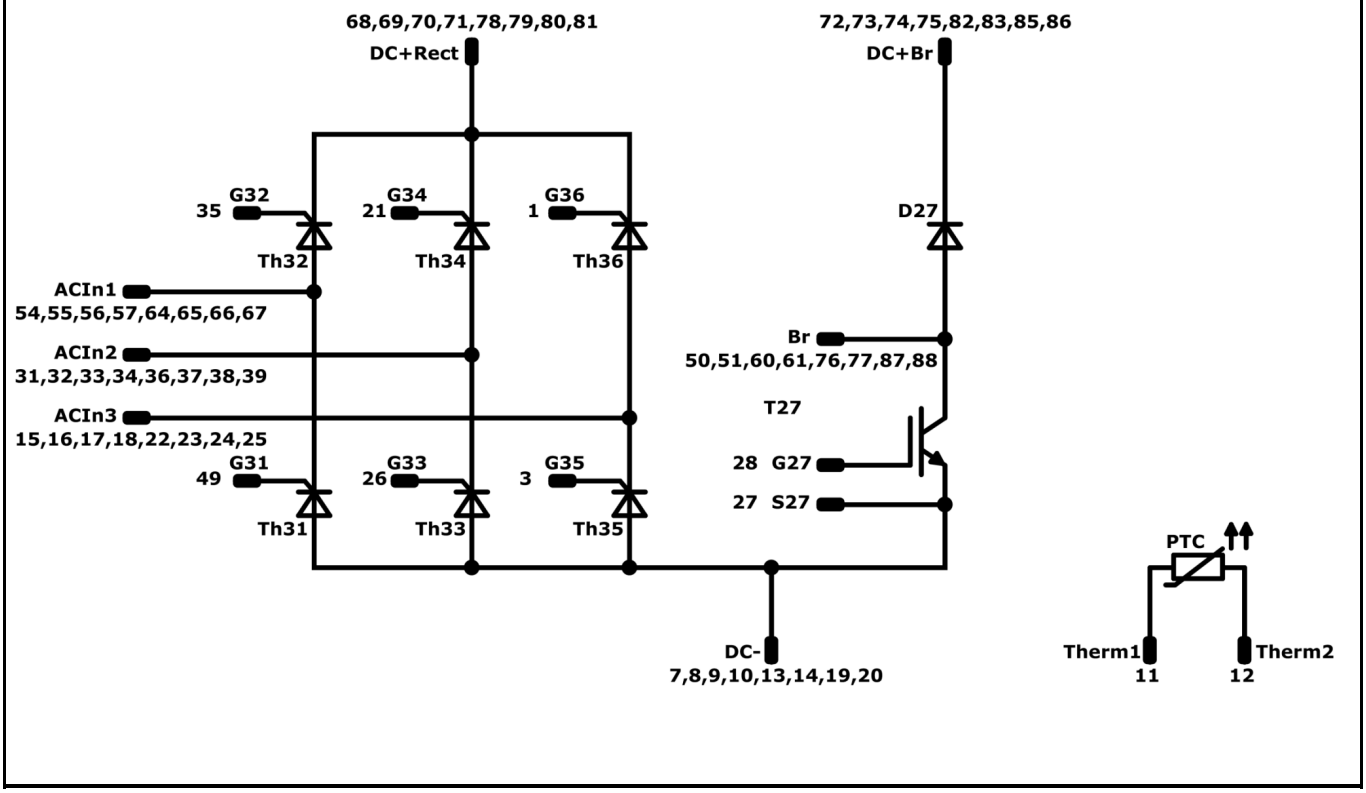
Outline

PCB pad table

Pin	X	Y	Function	Pin	X	Y	Function
1	15,83	-25,3	G36	62	Not assembled		
2	Not assembled			63			
3	15,83	-3,2	G35	64	-40,22	-15,7	ACIn1
4	Not assembled			65	-40,22	-12,5	ACIn1
5				66	-40,22	-9,3	ACIn1
6				67	-40,22	-6,09	ACIn1
7	15,83	15,7	DC-	68	-50,18	-25,3	DC+Rect
8	15,83	18,9	DC-	69	-50,18	-22,1	DC+Rect
9	15,83	22,1	DC-	70	-50,18	-18,9	DC+Rect
10	15,83	25,3	DC-	71	-50,18	-15,7	DC+Rect
11	8,13	-25,3	Therm1	72	-50,18	-9,5	DC+Br
12	8,13	-22,1	Therm2	73	-50,18	-6,3	DC+Br
13	8,13	22,1	DC-	74	-50,18	6,3	DC+Br
14	8,13	25,3	DC-	75	-50,18	9,5	DC+Br
15	1,82	-15,38	ACIn3	76	-50,18	22,1	Br
16	1,82	-12,18	ACIn3	77	-50,18	25,3	Br
17	1,82	-8,98	ACIn3	78	-53,82	-25,3	DC+Rect
18	1,82	-5,79	ACIn3	79	-53,82	-22,1	DC+Rect
19	0,43	22,1	DC-	80	-53,82	-18,9	DC+Rect
20	0,43	25,3	DC-	81	-53,82	-15,7	DC+Rect
21	-1,07	-25,3	G34	82	-53,82	-9,5	DC+Br
22	-1,82	-15,38	ACIn3	83	-53,82	-6,3	DC+Br
23	-1,82	-12,18	ACIn3	84	Not assembled		
24	-1,82	-8,98	ACIn3	85	-53,82	6,3	DC+Br
25	-1,82	-5,79	ACIn3	86	-53,82	9,5	DC+Br
26	-5,82	3,95	G33	87	-53,82	22,1	Br
27	-7,27	22,1	S27	88	-53,82	25,3	Br
28	-7,27	25,3	G27				
29	Not assembled						
30							
31	-16,05	-15,02	ACIn2				
32	-16,05	-11,82	ACIn2				
33	-16,05	-8,63	ACIn2				
34	-16,05	-5,42	ACIn2				
35	-19,22	-25,3	G32				
36	-19,7	-15,02	ACIn2				
37	-19,7	-11,82	ACIn2				
38	-19,7	-8,62	ACIn2				
39	-19,7	-5,42	ACIn2				
40	Not assembled						
41							
42							
43							
44							
45							
46							
47							
48	Not assembled						
49	-32,82	11,94	G31				
50	-35,68	22,1	Br				
51	-35,68	25,3	Br				
52	Not assembled						
53							
54	-36,58	-15,7	ACIn1				
55	-36,58	-12,5	ACIn1				
56	-36,58	-9,3	ACIn1				
57	-36,58	-6,1	ACIn1				
58	Not assembled						
59							
60	-39,32	22,1	Br				
61	-39,32	25,3	Br				



Pinout



Identification					
ID	**Component**	**Voltage**	**Current**	**Function**	**Comment**
Th31, Th32, Th33, Th34, Th35, Th36	Rectifier Thyristor	1600 V	125 A	Rectifier Thyristor	
T27	IGBT	1200 V	150 A	Brake Switch	
D27	FWD	1200 V	150 A	Brake Diode	
Rt	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.

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-M3166BA125AS02-K849G32-D1-14	11 Dec. 2017		