V23990-K200-A-PM
datasheet

Vincotech

MiniSkiip® 1 PIM	1200 V / 15 A

Features

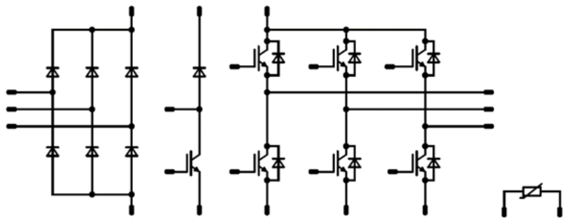
- Solderless interconnection
- Trench Fieldstop IGBT3 technology

MiniSkiip® 1 housing

Target applications

- Industrial drives

Schematic



Types

- V23990-K200-A-PM

Maximum Ratings

T_j = 25 °C, unless otherwise specified

Parameter	Symbol	Condition		Value	Unit
Rectifier Diode					
Peak repetitive reverse voltage	V_{RRM}			1600	V
Continuous (direct) forward current	I_F	$T_j = T_{jmax}$	T_s = 80 °C	29	A
Surge (non-repetitive) forward current	I_{FSM}	t_p = 10 ms Half Sine Wave	T_j = 25 °C	220	A
Surge current capability	I^2t			240	A^2s
Total power dissipation	P_{tot}	$T_j = T_{jmax}$	T_s = 80 °C	51	W
Maximum junction temperature	T_{jmax}			150	°C

Maximum Ratings

T_j = 25 °C, unless otherwise specified

Parameter	Symbol	Condition	Value	Unit
Inverter, Brake Switch				
Collector-emitter voltage	V_{CES}		1200	V
Collector current	I_C	$T_j = T_{jmax}$ T_s = 80 °C	20	A
Repetitive peak collector current	I_{CRM}	t_p limited by T_{jmax}	45	A
Total power dissipation	P_{tot}	$T_j = T_{jmax}$ T_s = 80 °C	93	W
Gate-emitter voltage	V_{GES}		±20	V
Short circuit ratings	t_{SC}	T_j ≤ 150 °C Vcc = 900 V V_{GE} = 15 V	10	μs
Maximum junction temperature	T_{jmax}		175	°C
Inverter, Brake Diode				
Peak repetitive reverse voltage	V_{RRM}		1200	V
Continuous (direct) forward current	I_F	$T_j = T_{jmax}$ T_s = 80 °C	20	A
Repetitive peak forward current	I_{FRM}	t_p limited by T_{jmax}	42	A
Total power dissipation	P_{tot}	$T_j = T_{jmax}$ T_s = 80 °C	66	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 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					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 Diode										
Static										
Forward voltage	V_F				25	25 125		1,51 1,42		V
Reverse leakage current	I_R			1500		25			50	µA
Thermal										
Thermal resistance junction to sink	$R_{th(j\text{-}s)}$	λ_{paste} = 2,5 W/mK (HPTP)						1,37		K/W
Inverter, Brake Switch										
Static										
Gate-emitter threshold voltage	$V_{GE(th)}$	$V_{GE} = V_{CE}$			0,0006	25	5	5,8	6,5	V
Collector-emitter saturation voltage	V_{CEsat}		15		15	25 125	1,4	1,86 2,11	2,1	V
Collector-emitter cut-off current	I_{CES}		0	1200		25			2,2	µA
Gate-emitter leakage current	I_{GES}		20	0		25			120	nA
Internal gate resistance	r_g							none		Ω
Input capacitance	C_{ies}		0	20		25		1100		pF
Output capacitance	C_{oes}							100		
Reverse transfer capacitance	C_{res}							50		
Gate charge	Q_g		±15			25		108		nC
Thermal										
Thermal resistance junction to sink	$R_{th(j\text{-}s)}$	λ_{paste} = 2,5 W/mK (HPTP)						1,02		K/W
Dynamic										
Turn-on delay time	$t_{d(on)}$	R_{gon} = 54 Ω R_{goff} = 54 Ω	±15	600	15	25 125		48 46		ns
Rise time	t_r					25 125		27 33		
Turn-off delay time	$t_{d(off)}$					25 125		348 424		
Fall time	t_f					25 125		121 221		
Turn-on energy (per pulse)	E_{on}	Q_{rFWD} = 2 µC Q_{rFWD} = 3,4 µC				25 125		1,54 2,04		mWs
Turn-off energy (per pulse)	E_{off}					25 125		1,06 1,66		

Characteristic Values

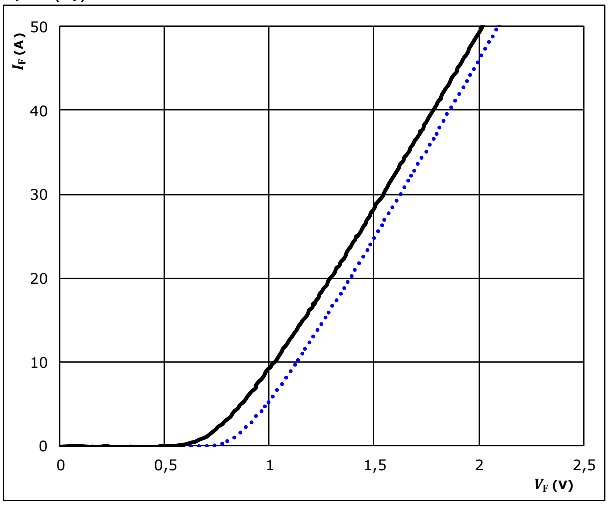
Parameter	Symbol	Conditions	V_{GE} [V] V_{GS} [V]	V_{CE} [V] V_{DS} [V] V_F [V]	I_C [A] I_D [A] I_F [A]	T_j [°C]	Min	Typ	Max	Unit
Inverter, Brake Diode										
Static										
Forward voltage	V_F				15	25 125		1,80 1,87		V
Thermal										
Thermal resistance junction to sink	$R_{th(j-s)}$	λ_{paste} = 3,4 W/mK (HPTP)						1,44		K/W
Dynamic										
Peak recovery current	I_{RRM}	di/dt = 400 A/µs di/dt = 429 A/µs	±15	600	15	25 125		12 14		A
Reverse recovery time	t_{rr}					25 125		477 651		ns
Recovered charge	Q_r					25 125		2,03 3,38		µC
Reverse recovered energy	E_{rec}					25 125		0,77 1,35		mWs
Peak rate of fall of recovery current	$(di_{rf}/dt)_{max}$					25 125		91 36		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		$7{,}635 \cdot 10^{-3}$		1/K
B-value	$B_{(25/100)}$					25		$1{,}731 \cdot 10^{-5}$		1/K²
Vincotech PTC Reference									E	

Rectifier Diode Characteristics

figure 1. **FWD**

Typical forward characteristics

$I_F = f(V_F)$



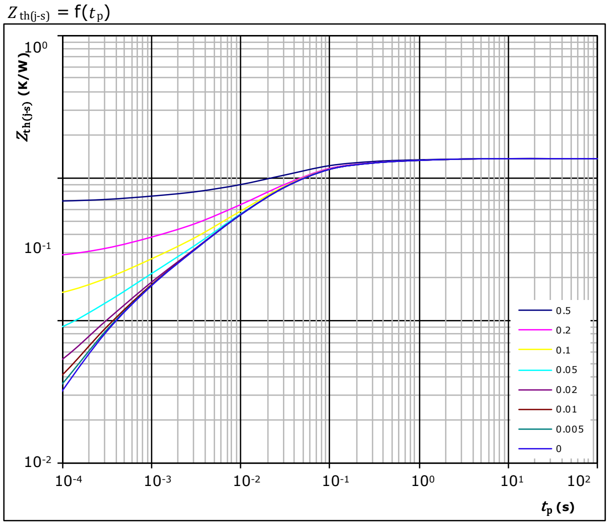
t_p = 250 µs

T_j: 25 °C (dotted), 125 °C (solid)

figure 2. **FWD**

Transient thermal impedance as a function of pulse width

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



$D = t_p / T$

$R_{th(j-s)}$ = 1,37 K/W

FWD thermal model values

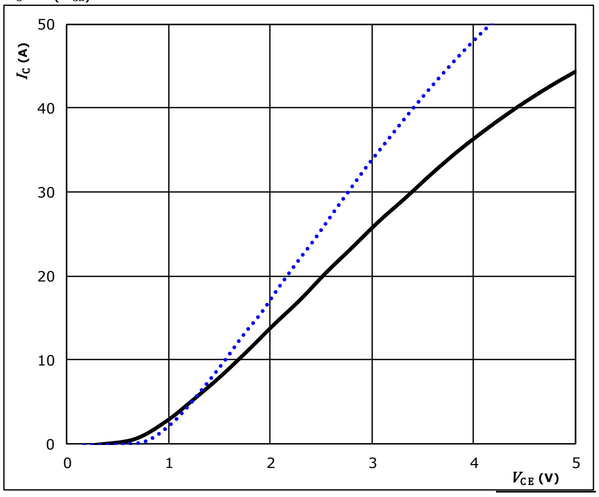
R (K/W)	τ (s)
6,75E-02	1,27E+00
1,34E-01	1,97E-01
6,34E-01	3,60E-02
3,25E-01	8,05E-03
1,24E-01	1,73E-03
8,71E-02	2,91E-04

Inverter, Brake Switch Characteristics

figure 1. **IGBT**

Typical output characteristics

$I_C = f(V_{CE})$

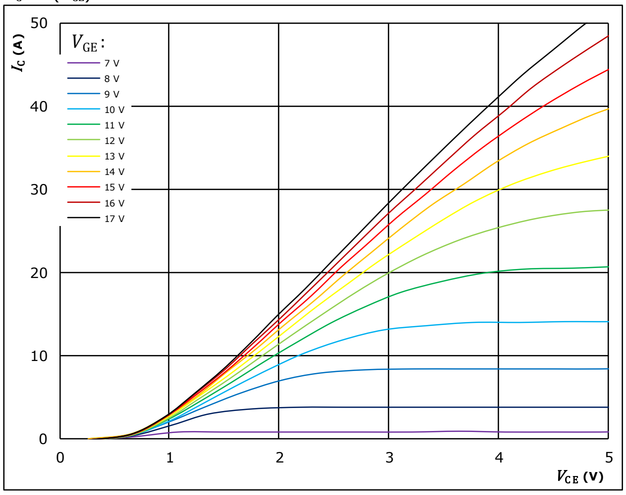


t_p =	250	µs	T_j:	25	°C	dotted line
V_{GE} =	15	V		125	°C	solid line

figure 2. **IGBT**

Typical output characteristics

$I_C = f(V_{CE})$

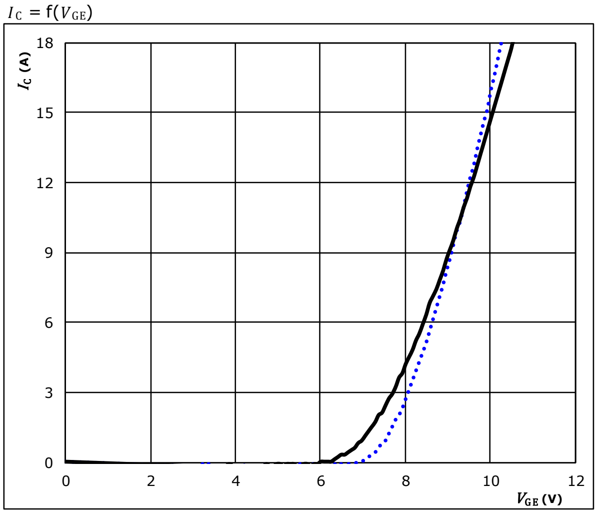


t_p =	250	µs
T_j =	125	°C
V_{GE} from	7 V to 17 V in steps of 1 V	

figure 3. **IGBT**

Typical transfer characteristics

$I_C = f(V_{GE})$

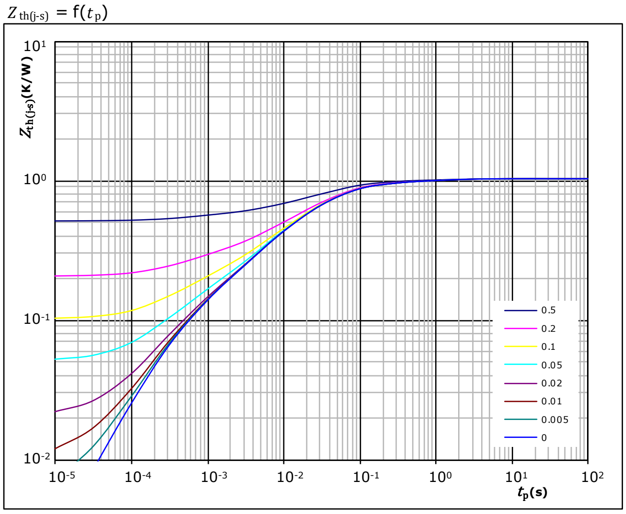


t_p =	100	µs	T_j:	25	°C	dotted line
V_{CE} =	10	V		125	°C	solid line

figure 4. **IGBT**

Transient thermal impedance as function of pulse duration

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



D =	t_p / T	
$R_{th(j-s)}$ =	1,02	K/W

IGBT thermal model values

R (K/W)	τ (s)
5,71E-02	1,00E+00
9,69E-02	1,53E-01
4,24E-01	2,98E-02
2,55E-01	7,88E-03
1,14E-01	1,91E-03
7,71E-02	2,62E-04

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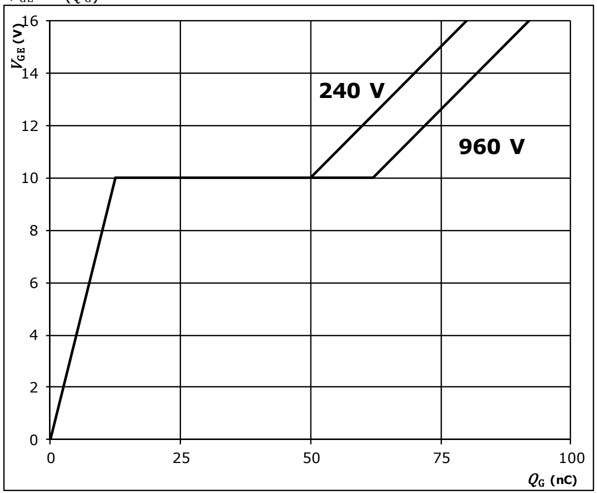
Inverter, Brake Switch Characteristics

figure 5. **IGBT**

Gate voltage vs gate charge

$V_{GE} = f(Q_G)$

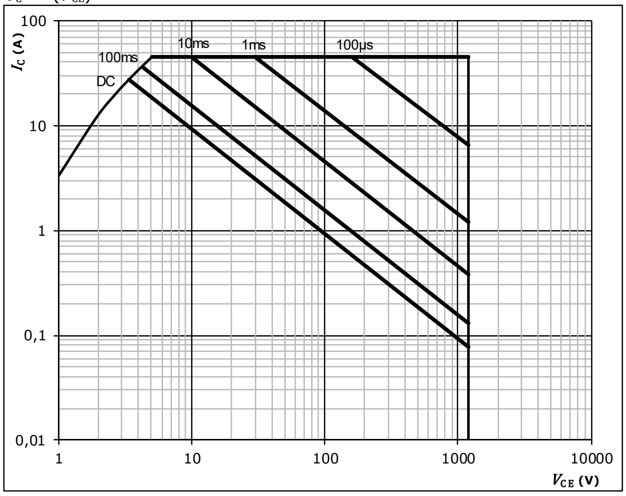


I_C =	15	A

figure 6. **IGBT**

Safe operating area

$I_C = f(V_{CE})$



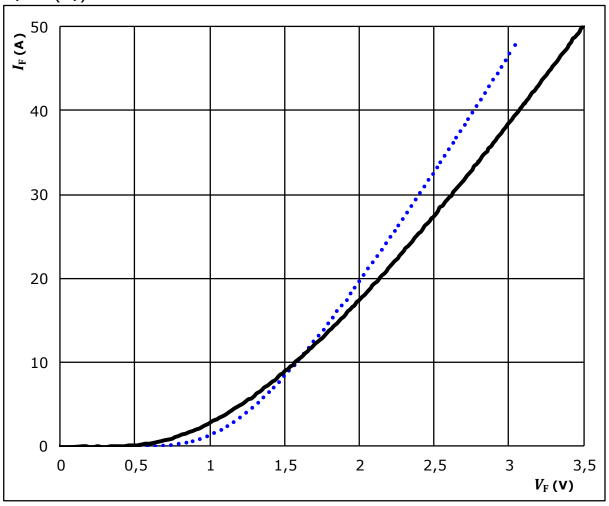
D =	single pulse	
T_s =	80	ºC
V_{GE} =	±15	V
T_j =	T_{jmax}	

Inverter, Brake Diode Characteristics

figure 1. **FWD**

Typical forward characteristics

$I_F = f(V_F)$



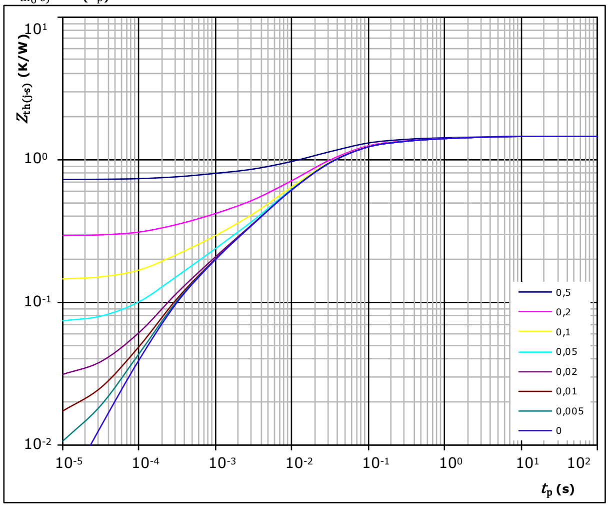
t_p = 250 µs

T_j: 25 °C (dotted line); 125 °C (solid line)

figure 2. **FWD**

Transient thermal impedance as a function of pulse width

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



$D = t_p / T$

$R_{th(j-s)}$ = 1,44 K/W

FWD thermal model values

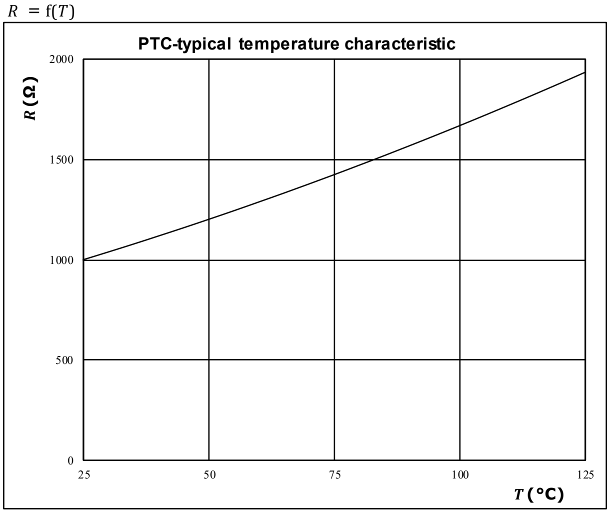
R (K/W)	τ (s)
6,32E-02	2,64E+00
1,25E-01	3,53E-01
4,72E-01	5,08E-02
4,72E-01	1,55E-02
2,06E-01	2,93E-03
1,06E-01	3,09E-04

Thermistor Characteristics

figure 1. **Thermistor**

Typical PTC characteristic as a function of temperature

$R = f(T)$

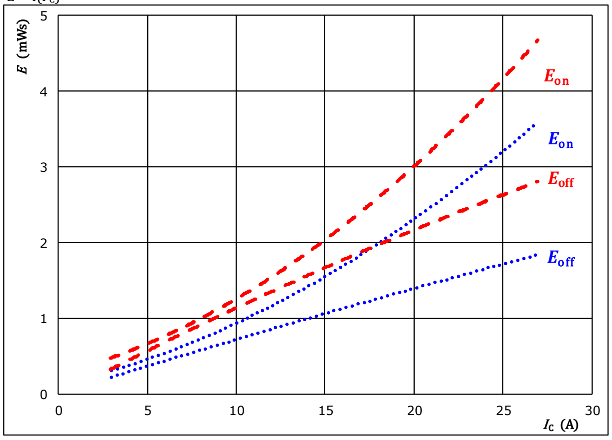


Switching Characteristics

figure 1. IGBT

Typical switching energy losses as a function of collector current

$E = f(I_C)$



With an inductive load at

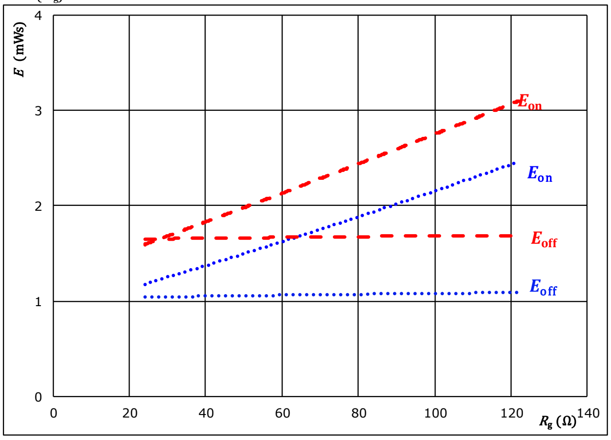
T_j: 25 °C (dotted), 125 °C (dashed)

V_{CE} =	600	V
V_{GE} =	±15	V
R_{gon} =	54	Ω
R_{goff} =	54	Ω

figure 2. IGBT

Typical switching energy losses as a function of gate resistor

$E = f(R_g)$



With an inductive load at

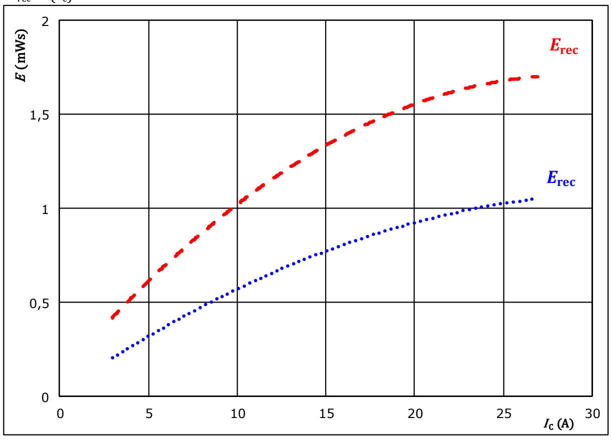
T_j: 25 °C (dotted), 125 °C (dashed)

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

figure 3. FWD

Typical reverse recovered energy loss as a function of collector current

$E_{rec} = f(I_c)$



With an inductive load at

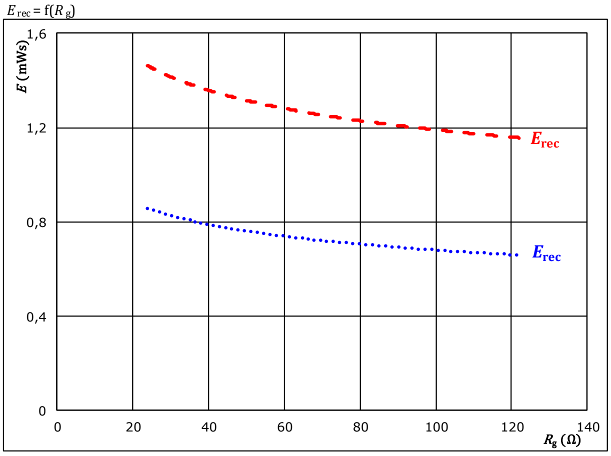
T_j: 25 °C (dotted), 125 °C (dashed)

V_{CE} =	600	V
V_{GE} =	±15	V
R_{gon} =	54	Ω

figure 4. FWD

Typical reverse recovered energy loss as a function of gate resistor

$E_{rec} = f(R_g)$



With an inductive load at

T_j: 25 °C (dotted), 125 °C (dashed)

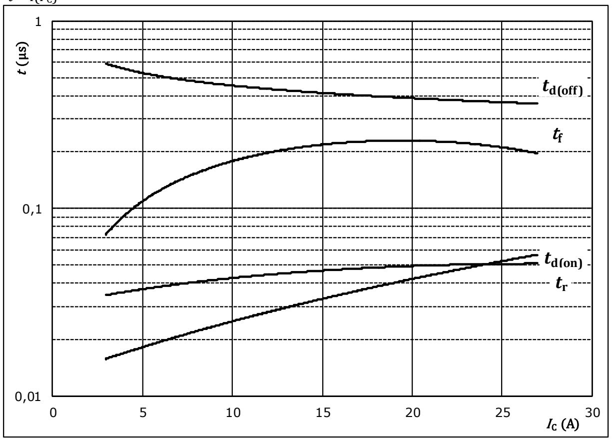
V_{CE} =	600	V
V_{GE} =	±15	V
I_C =	15	A

Switching Characteristics

figure 5. **IGBT**

Typical switching times as a function of collector current

$t = f(I_C)$



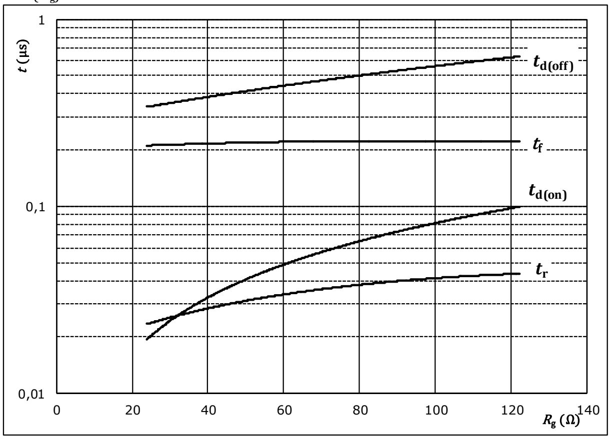
With an inductive load at

T_j =	125	°C
V_{CE} =	600	V
V_{GE} =	±15	V
R_{gon} =	54	Ω
R_{goff} =	54	Ω

figure 6. **IGBT**

Typical switching times as a function of gate resistor

$t = f(R_g)$



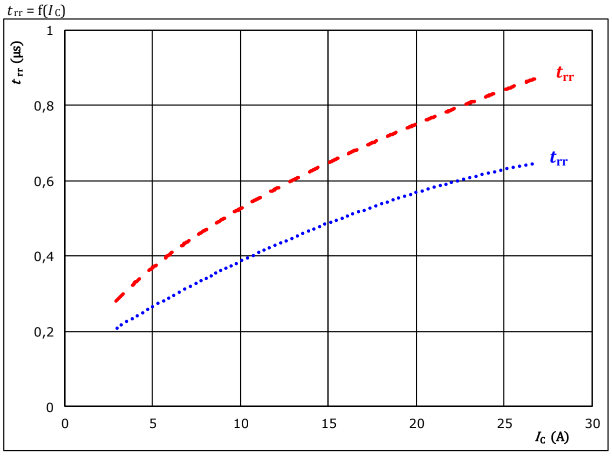
With an inductive load at

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

figure 7. **FWD**

Typical reverse recovery time as a function of collector current

$t_{rr} = f(I_C)$



With an inductive load at

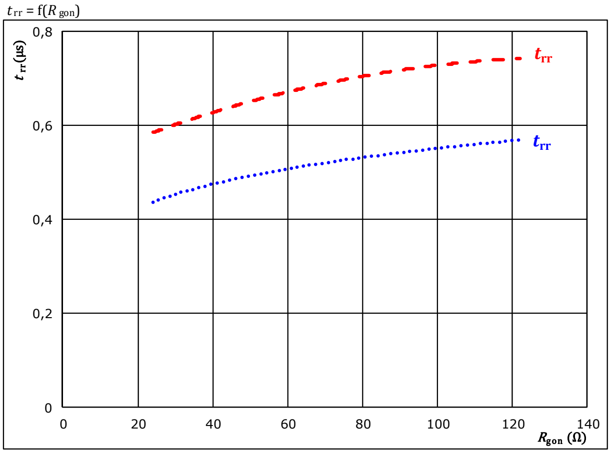
V_{CE}=	600	V
V_{GE} =	±15	V
R_{gon} =	54	Ω

T_j: 25 °C (dotted), 125 °C (dashed)

figure 8. **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 =	15	A

T_j: 25 °C (dotted), 125 °C (dashed)

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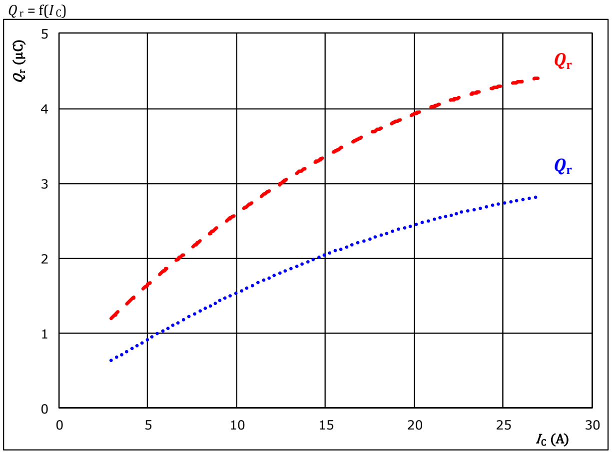
Switching Characteristics

figure 9. **FWD**

Typical recovered charge as a function of collector current

$Q_r = f(I_C)$



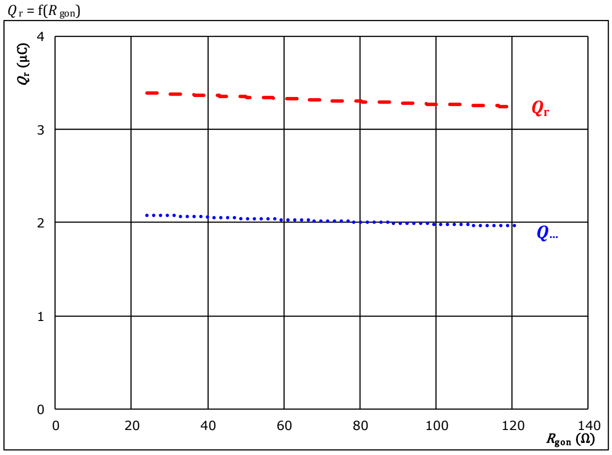
With an inductive load at

V_{CE} =	600	V	T_j:	25 °C	············
V_{GE} =	±15	V		125 °C	– – – –
R_{gon} =	54	Ω			

figure 10. **FWD**

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

$Q_r = f(R_{gon})$



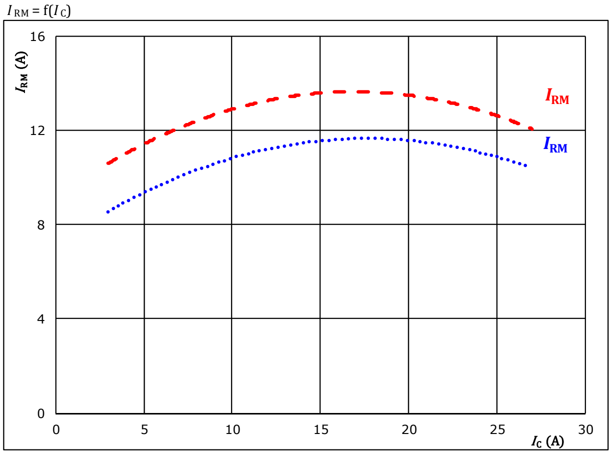
With an inductive load at

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

figure 11. **FWD**

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

$I_{RM} = f(I_C)$



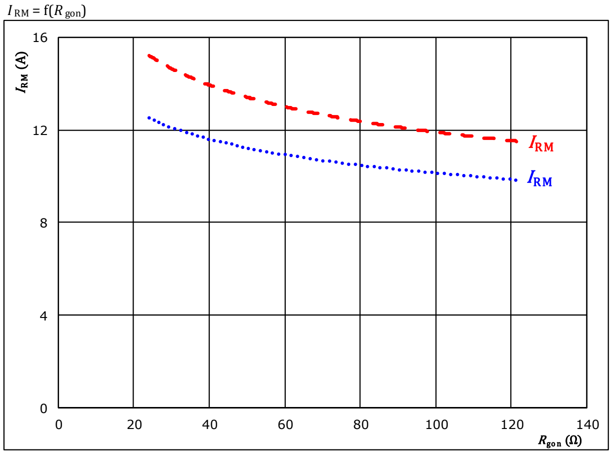
With an inductive load at

V_{CE} =	600	V	T_j:	25 °C	············
V_{GE} =	±15	V		125 °C	– – – –
R_{gon} =	54	Ω			

figure 12. **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

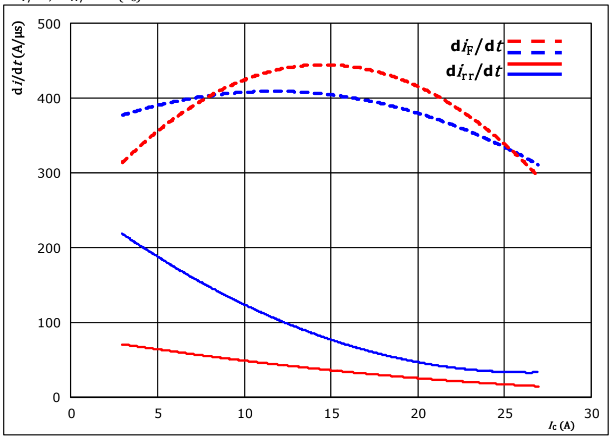
V_{CE} =	600	V	T_j:	25 °C	············
V_{GE} =	±15	V		125 °C	– – – –
I_C =	15	A			

Switching Characteristics

figure 13. FWD

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

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



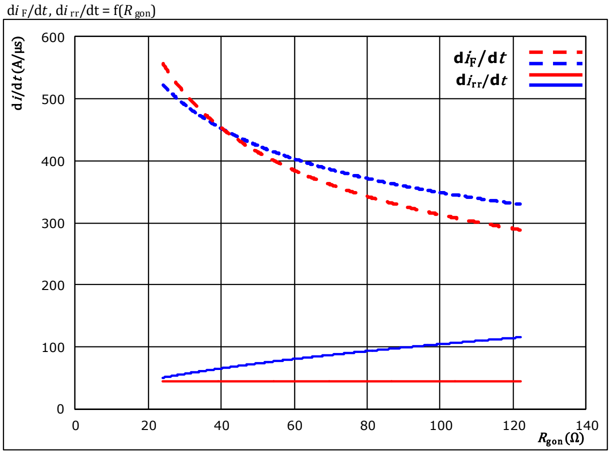
With an inductive load at

V_{CE} =	600	V	T_j: 25 °C
V_{GE} =	±15	V	125 °C
R_{gon} =	54	Ω	

figure 14. FWD

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

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



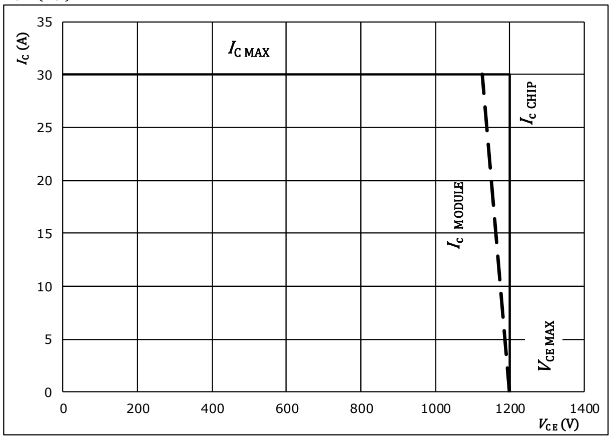
With an inductive load at

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

figure 15. IGBT

Reverse bias safe operating area

$I_C = f(V_{CE})$



At

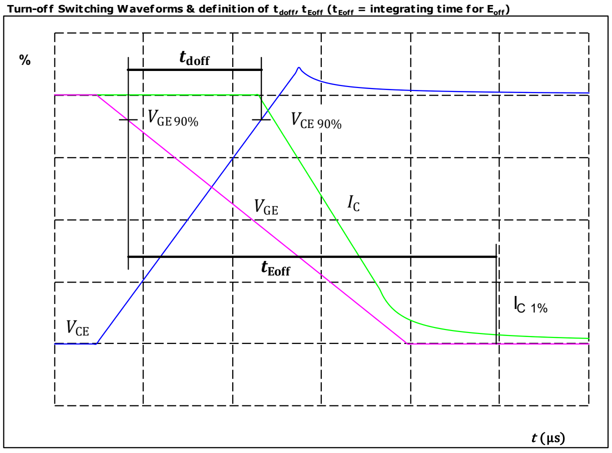
T_j =	125	°C
R_{gon} =	54	Ω
R_{goff} =	54	Ω

Switching Definitions

General conditions		
T_j	=	125 °C
R_{gon}	=	54 Ω
R_{goff}	=	54 Ω

figure 1. IGBT

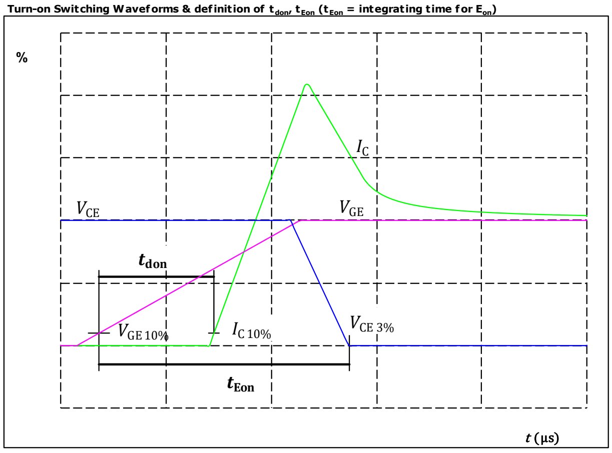
Turn-off Switching Waveforms & definition of t_{doff}, t_{Eoff} (t_{Eoff} = integrating time for E_{off})



$V_{GE}(0\%)$ =	-15	V
$V_{GE}(100\%)$ =	15	V
$V_C(100\%)$ =	600	V
$I_C(100\%)$ =	15	A
t_{doff} =	424	ns

figure 2. IGBT

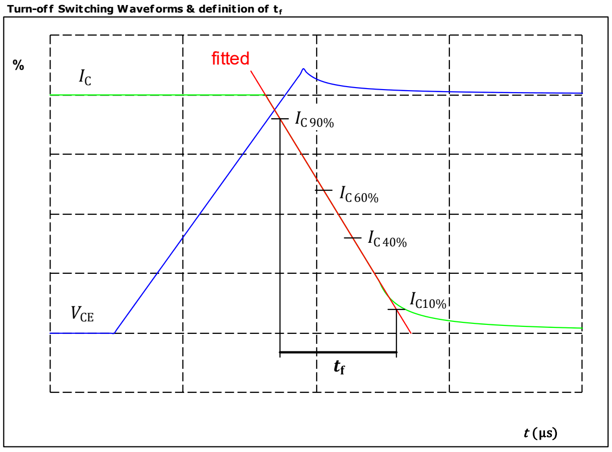
Turn-on Switching Waveforms & definition of t_{don}, t_{Eon} (t_{Eon} = integrating time for E_{on})



$V_{GE}(0\%)$ =	-15	V
$V_{GE}(100\%)$ =	15	V
$V_C(100\%)$ =	600	V
$I_C(100\%)$ =	15	A
t_{don} =	46	ns

figure 3. IGBT

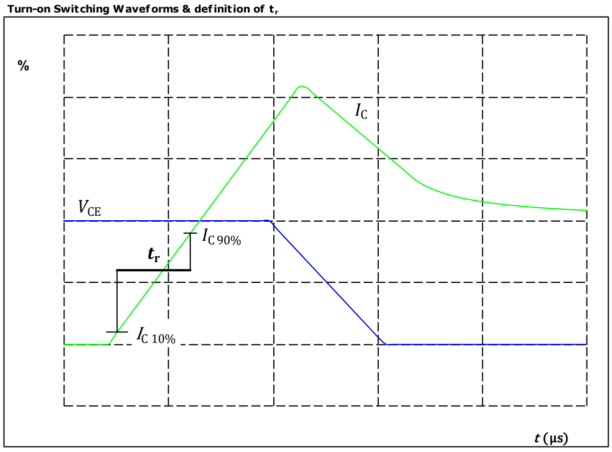
Turn-off Switching Waveforms & definition of t_f



$V_C(100\%)$ =	600	V
$I_C(100\%)$ =	15	A
t_f =	221	ns

figure 4. IGBT

Turn-on Switching Waveforms & definition of t_r

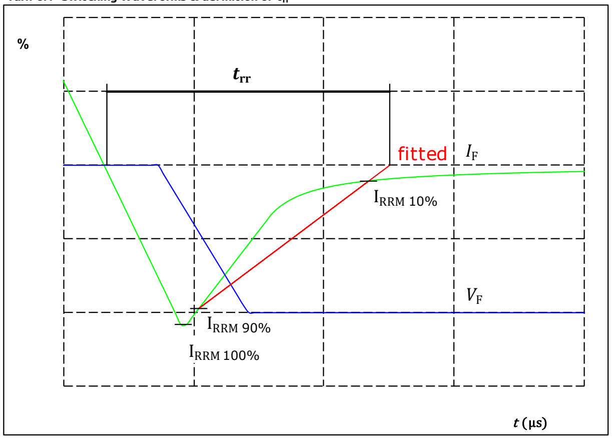


$V_C(100\%)$ =	600	V
$I_C(100\%)$ =	15	A
t_r =	33	ns

Switching Characteristics

figure 5. **FWD**

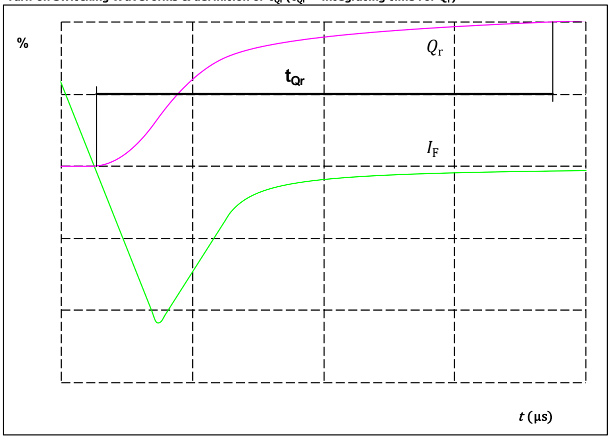
Turn-off Switching Waveforms & definition of t_{rr}



V_F (100%) =	600	V
I_F (100%) =	15	A
I_{RRM} (100%) =	14	A
t_{rr} =	651	ns

figure 6. **FWD**

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



I_F (100%) =	15	A
Q_r (100%) =	3,38	µC

Ordering Code & Marking

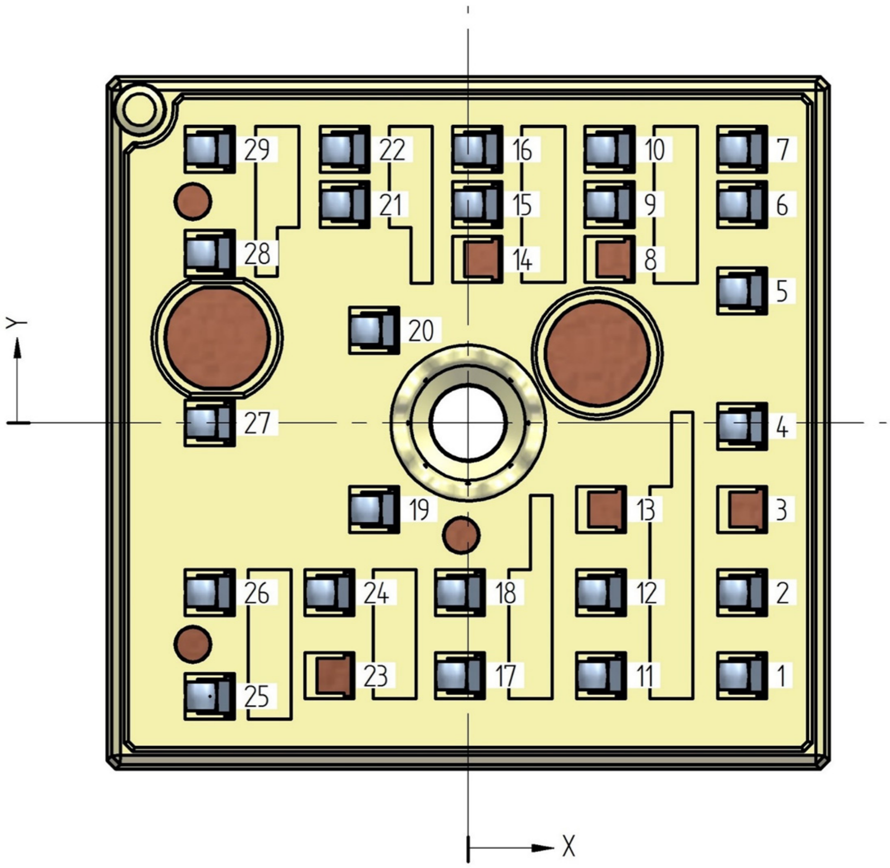
Version	Ordering Code
With std lid (6.5mm height) + no thermal grease	V23990-K200-A-/0A/-PM
With thin lid (2.8mm height) + no thermal grease	V23990-K200-A-/0B/-PM
With std lid (6.5mm height) + thermal grease (0,8 W/mK, P12, silicone-based)	V23990-K200-A-/1A/-PM
With thin lid (2.8mm height) + thermal grease (0,8 W/mK, P12, silicone-based)	V23990-K200-A-/1B/-PM
With std lid (6.5mm height) + thermal grease (2,5 W/mK, TG20032, silicone-free)	V23990-K200-A-/4A/-PM
With thin lid (2.8mm height) + thermal grease (2,5 W/mK, TG20032, silicone-free)	V23990-K200-A-/4B/-PM
With std lid (6.5mm height) + thermal grease (2,5 W/mK, HPTP, silicone-based)	V23990-K200-A-/5A/-PM
With thin lid (2.8mm height) + thermal grease (2,5 W/mK, HPTP, silicone-based)	V23990-K200-A-/5B/-PM

Text	**VIN**	**Date code**	**Name&Ver**	**UL**	**Lot**	**Serial**
	VIN	WWYY	NNNNNNNNVV	UL	LLLLL	SSSS
Datamatrix	**Type&Ver**	**Lot number**	**Serial**	**Date code**		
	NNNNNNNNVV	LLLLL	SSSS	WWYY		

Outline

PCB pad table

Pin	X	Y	Function
1	15,93	-14,6	G5
2	15,93	-9,8	W
3	Not assembled		
4	15,93	-0,2	+T
5	15,93	7,62	-T
6	15,93	12,62	G6
7	15,93	15,8	-DC/W
8	Not assembled		
9	8,23	12,62	G4
10	8,23	15,8	-DC/V
11	7,73	-14,6	G3
12	7,73	-9,8	V
13	Not assembled		
14	Not assembled		
15	0,53	12,62	G2
16	0,53	15,8	-DC/U
17	-0,47	-14,6	G1
18	-0,47	-9,8	U
19	-5,47	-5	+B
20	-5,47	5,35	B
21	-7,17	12,62	GB
22	-7,17	15,8	-B
23	Not assembled		
24	-8,07	-9,8	+DC
25	-15,02	-15,8	+RECT
26	-15,02	-9,8	L3
27	-15,02	0	L2
28	-15,02	9,8	L1
29	-15,02	15,8	-RECT



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

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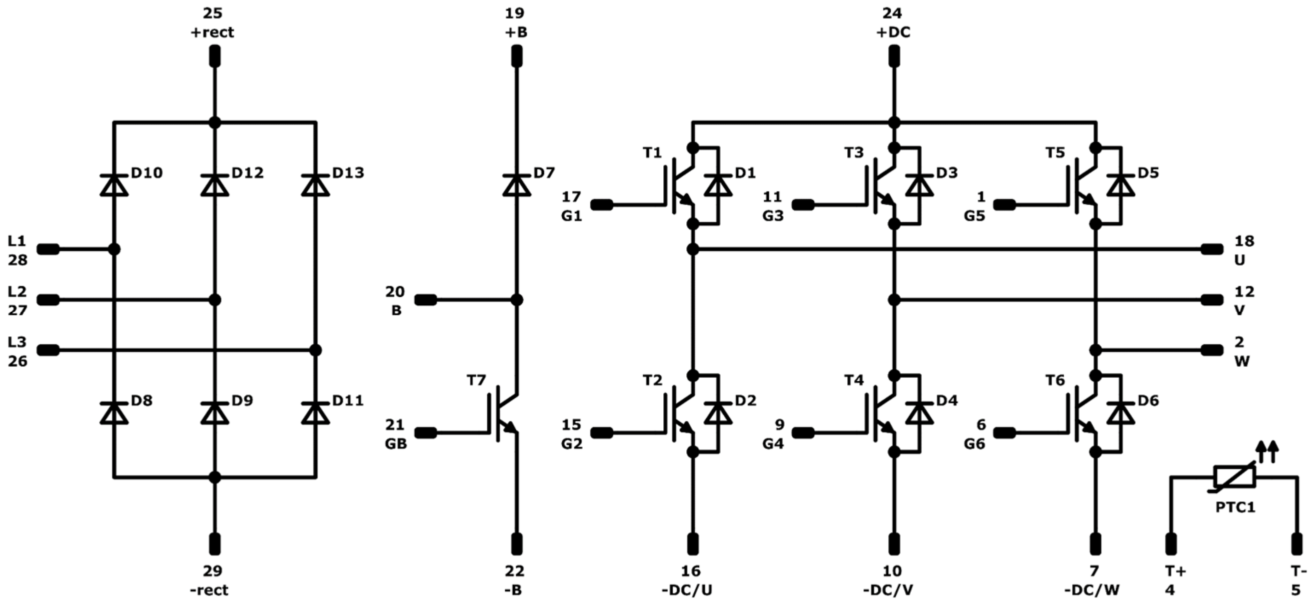
Pinout



Identification

ID	Component	Voltage	Current	Function	Comment
D8, D9, D10, D11, D12, D13	Rectifier	1600 V	25 A	Rectifier Diode	
T1, T2, T3, T4, T5, T6, T7	IGBT	1200 V	15 A	Inverter Switch	
D1, D2, D3, D4, D5, D6, D7	FWD	1200 V	20 A	Inverter Diode	
PTC1	Thermistor			Thermistor	

Packaging instruction				
Standard packaging quantity (SPQ) 120	>SPQ	Standard	<SPQ	Sample

Handling instruction
Handling instructions for MiniSkiiP® 1 packages see vincotech.com website.

Package data
Package data for MiniSkiiP® 1 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
V23990-K200-A-D5-14	12 Jul. 2018	Thermal interface changed to HPTP	

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