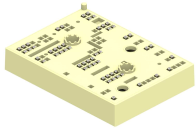
Vincotech

MiniSKiiP®3 PACK **1200 V / 150 A**

Features

- Solderless interconnection
- Trench Fieldstop IGBT4 technology

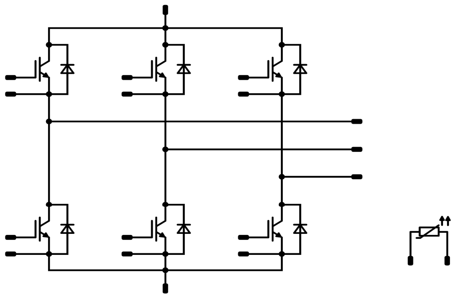
MiniSKiiP®3 housing



Target Applications

- Servo Drives
- Industrial Motor Drives
- UPS

Schematic



Types

- V23990-K430-F40-PM

Maximum Ratings

T_j = 25 °C, unless otherwise specified

Parameter	Symbol	Condition	Value	Unit
Inverter Switch				
Collector-emitter break down voltage	V_{CE}		1200	V
DC collector current	I_C	$T_j = T_{jmax}$ T_s = 80 °C	163	A
Repetitive peak collector current	I_{CRM}	t_p limited by T_{jmax}	450	A
Turn off safe operating area		$V_{CE} \leq$ 1200 V, $T_j \leq T_{op\ max}$	300	A
Power dissipation per IGBT	P_{tot}	$T_j = T_{jmax}$ T_s = 80 °C	452	W
Gate-emitter peak voltage	V_{GE}		±20	V
Short circuit ratings	t_{SC} V_{CC}	$T_j \leq$ 150 °C V_{GE} = 15 V	10 600	μs V
Maximum Junction Temperature	T_{jmax}		175	°C
Inverter Diode				
Peak Repetitive Reverse Voltage	V_{RRM}		1200	V
DC forward current	I_F	$T_j = T_{jmax}$ T_s = 80 °C	110	A
Repetitive peak forward current	I_{FRM}	t_p limited by T_{jmax}	300	A
Power dissipation per Diode	P_{tot}	$T_j = T_{jmax}$ T_s = 80 °C	244	W
Maximum Junction Temperature	T_{jmax}		175	°C

Maximum Ratings

T_j = 25 °C, unless otherwise specified

Parameter	Symbol	Condition		Value	Unit
Thermal Properties					
Storage temperature	T_{stg}			-40…+125	°C
Operation temperature under switching condition	T_{op}			-40…+(T_{jmax} - 25)	°C
Insulation Properties					
Insulation voltage	V_{is}	DC Test Voltage*	t_p = 2 s	5500	V
		AC Voltage	t_p = 1 min	2500	V
Creepage distance				min 12.7	mm
Clearance				min 12.7	mm
Comparative Tracting Index	CTI			>200	

*100 % tested in production

Characteristic Values

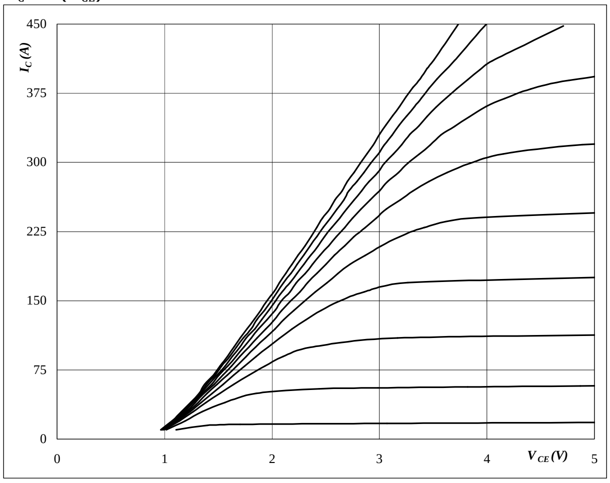
Parameter	Symbol	Conditions					Value			Unit
			V_{GE} [V] V_{GS} [V]	V_r [V] V_{CE} [V] V_{DS} [V]	I_C [A] I_F [A] I_D [A]	T_j [°C]	Min	Typ	Max	
Inverter Switch										
Gate emitter threshold voltage	$V_{GE(th)}$	$V_{CE} = V_{GE}$			0,006	25	5	5,8	6,5	V
Collector-emitter saturation voltage	V_{CEsat}		15		150	25 150	1,6	2,04 2,5	2,2	V
Collector-emitter cut-off current incl. Diode	I_{CES}		0	1200		25			0,2	mA
Gate-emitter leakage current	I_{GES}		±20	0		25			650	nA
Integrated Gate resistor	R_{gint}							5		Ω
Turn-on delay time	$t_{d(on)}$	$R_{goff} = 2\ \Omega$ $R_{gon} = 2\ \Omega$	±15	600	150	25 150		175 193		ns
Rise time	t_r					25 150		46 53		
Turn-off delay time	$t_{d(off)}$					25 150		288 375		
Fall time	t_f					25 150		58 100		
Turn-on energy loss per pulse	E_{on}					25 150		15 23		mWs
Turn-off energy loss per pulse	E_{off}					25 150		8,26 14,15		
Input capacitance	C_{ies}	$f = 1$ MHz	0	25		25		8800		pF
Output capacitance	C_{oss}							580		
Reverse transfer capacitance	C_{rss}							470		
Gate charge	Q_G		±15			25		1250		nC
Thermal resistance junction to sink	$R_{th(j-s)}$	Thermal grease λ = 2,5 W/mK (Silicone-based)						0,21		K/W
Inverter Diode										
Diode forward voltage	V_F				150	25 150	1,5	2,5 2,53	2,7	V
Peak reverse recovery current	I_{RRM}	$R_{gon} = 2\ \Omega$	±15	600	150	25 150		77 107		A
Reverse recovery time	t_{rr}					25 150		125 492		ns
Reverse recovered charge	Q_{rr}					25 150		7,99 24,3		μC
Peak rate of fall of recovery current	$(di_{rf}/dt)_{max}$					25 150		237 1268		A/μs
Reverse recovered energy	E_{rec}					25 150		2,14 8,21		mWs
Thermal resistance junction to sink	$R_{th(j-s)}$	Thermal grease λ = 2,5 W/mK (Silicone-based)						0,39		K/W
Thermistor										
Rated resistance	R					25		1000		Ω
Deviation of R_{100}	$\Delta_{R/R}$	$R_{100} = 1670\ \Omega$				100	-2		2	%
R_{100}	P					100		1670		Ω
A-value	$B_{(25/50)}$					25		7,635*10-3		1/K
B-value	$B_{(25/100)}$					25		1,731*10-5		1/K²
Vincotech PTC Reference									E	

Inverter Switch / Inverter Diode

figure 1. **IGBT**

Typical output characteristics

$I_C = f(V_{CE})$



At

t_p = 350 µs

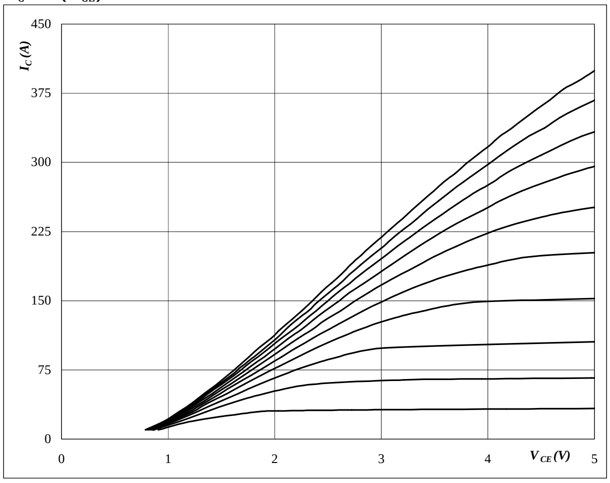
T_j = 25 °C

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

figure 2. **IGBT**

Typical output characteristics

$I_C = f(V_{CE})$



At

t_p = 350 µs

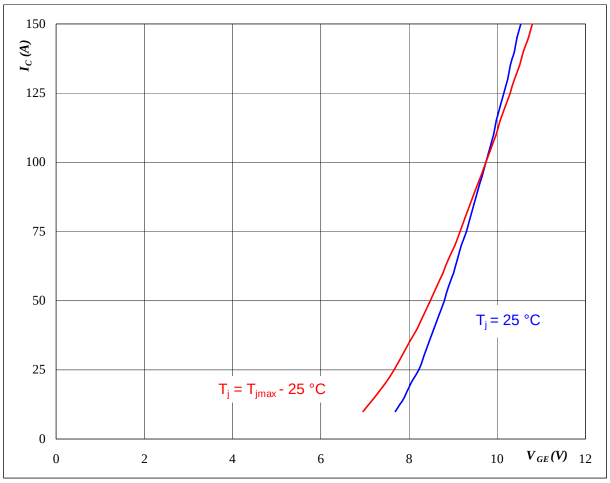
T_j = 150 °C

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

figure 3. **IGBT**

Typical transfer characteristics

$I_C = f(V_{GE})$



At

T_j = 25/150 °C

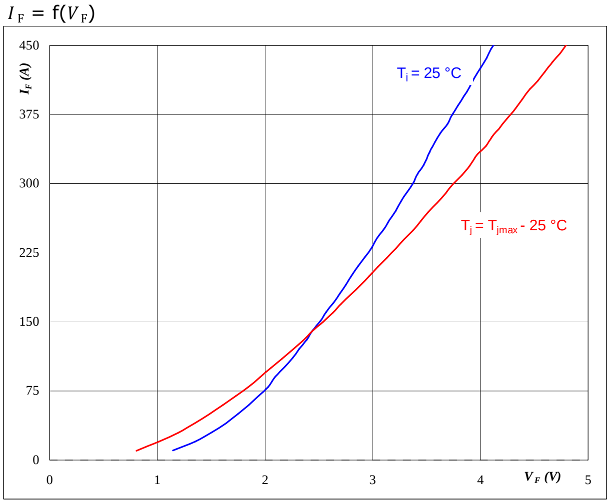
t_p = 350 µs

V_{CE} = 10 V

figure 4. **FWD**

Typical diode forward current as a function of forward voltage

$I_F = f(V_F)$



At

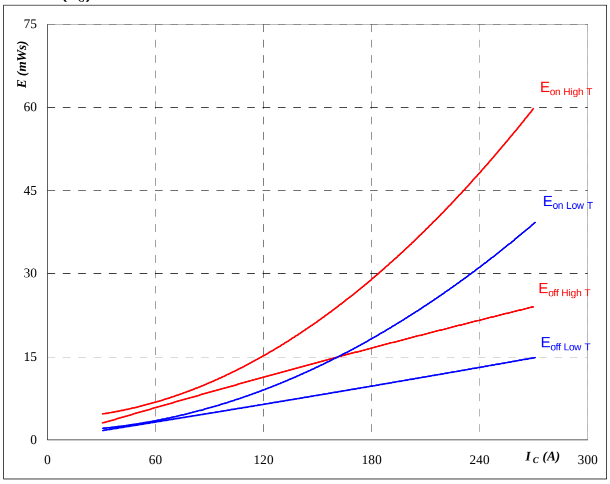
t_p = 350 µs

Inverter Switch / Inverter Diode

figure 5. **IGBT**

Typical switching energy losses as a function of collector current

$E = f(I_C)$



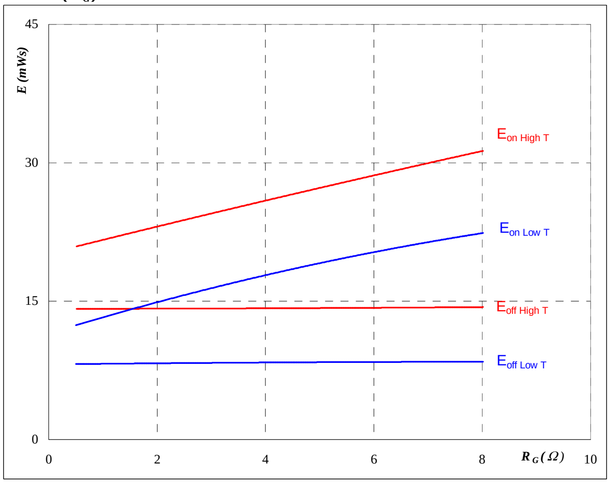
With an inductive load at

T_j =	25/150	°C
V_{CE} =	600	V
V_{GE} =	±15	V
R_{gon} =	1	Ω
R_{goff} =	1	Ω

figure 6. **IGBT**

Typical switching energy losses as a function of gate resistor

$E = f(R_G)$



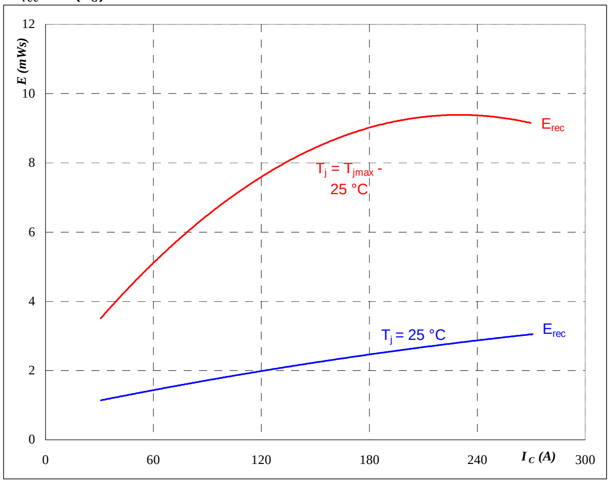
With an inductive load at

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

figure 7. **FWD**

Typical reverse recovery energy loss as a function of collector current

$E_{rec} = f(I_C)$



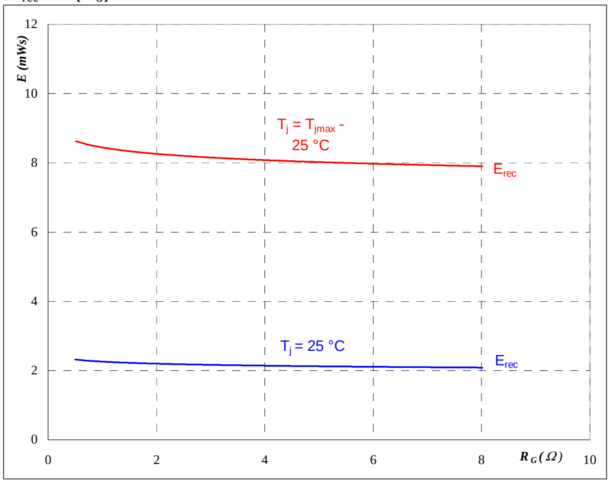
With an inductive load at

T_j =	25/150	°C
V_{CE} =	600	V
V_{GE} =	±15	V
R_{gon} =	1	Ω

figure 8. **FWD**

Typical reverse recovery energy loss as a function of gate resistor

$E_{rec} = f(R_G)$



With an inductive load at

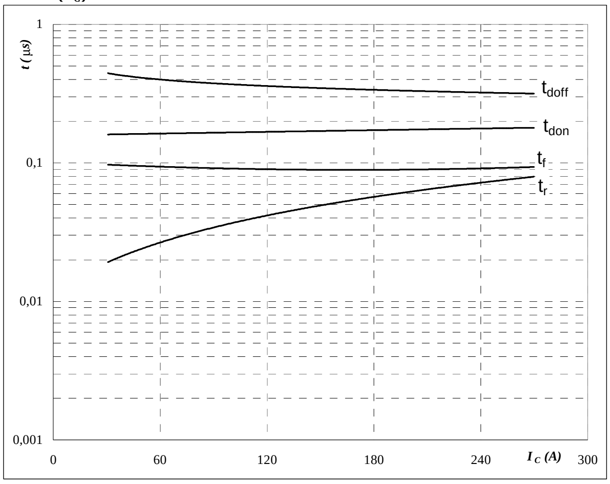
T_j =	25/150	°C
V_{CE} =	600	V
V_{GE} =	±15	V
I_C =	150	A

Inverter Switch / Inverter Diode

figure 9. **IGBT**

Typical switching times as a function of collector current

$t = f(I_C)$



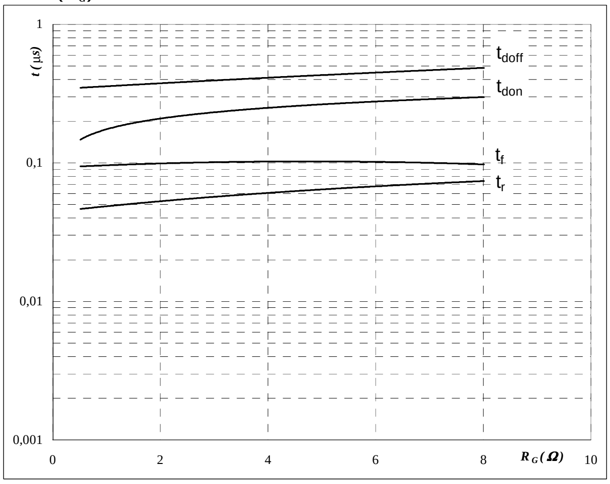
With an inductive load at

T_j =	150	°C
V_{CE} =	600	V
V_{GE} =	±15	V
R_{gon} =	1	Ω
R_{goff} =	1	Ω

figure 10. **IGBT**

Typical switching times as a function of gate resistor

$t = f(R_G)$



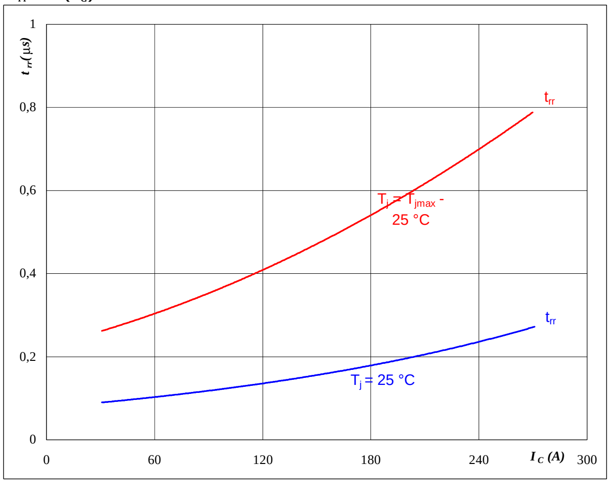
With an inductive load at

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

figure 11. **FWD**

Typical reverse recovery time as a function of collector current

$t_{rr} = f(I_C)$



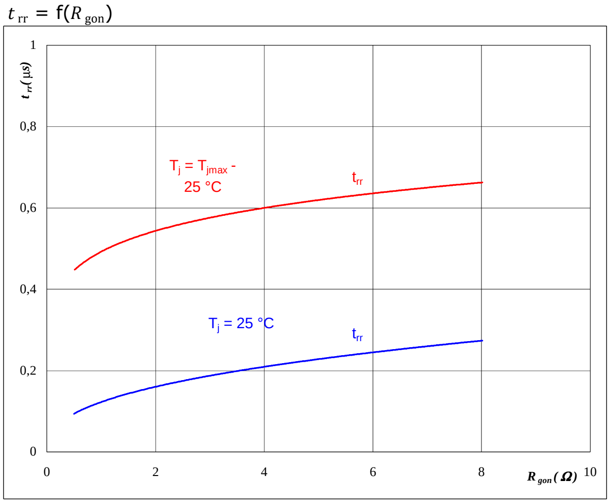
At

T_j =	25/150	°C
V_{CE} =	600	V
V_{GE} =	±15	V
R_{gon} =	1	Ω

figure 12. **FWD**

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

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



At

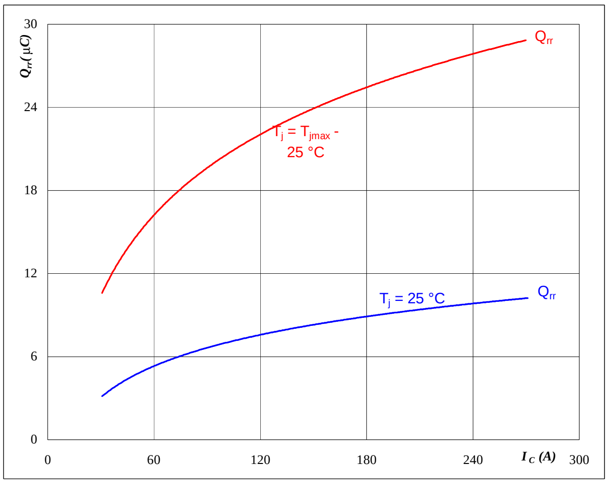
T_j =	25/150	°C
V_R =	600	V
I_F =	150	A
V_{GE} =	±15	V

Inverter Switch / Inverter Diode

figure 13. **FWD**

Typical reverse recovery charge as a function of collector current

$Q_{rr} = f(I_C)$



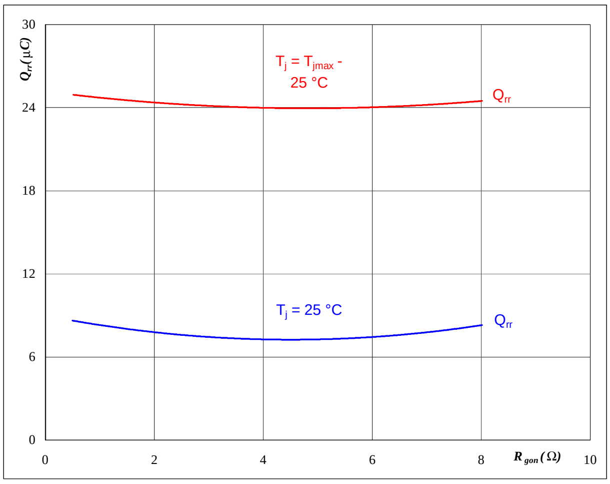
At

T_j =	25/150	°C
V_{CE} =	600	V
V_{GE} =	±15	V
R_{gon} =	1	Ω

figure 14. **FWD**

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

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



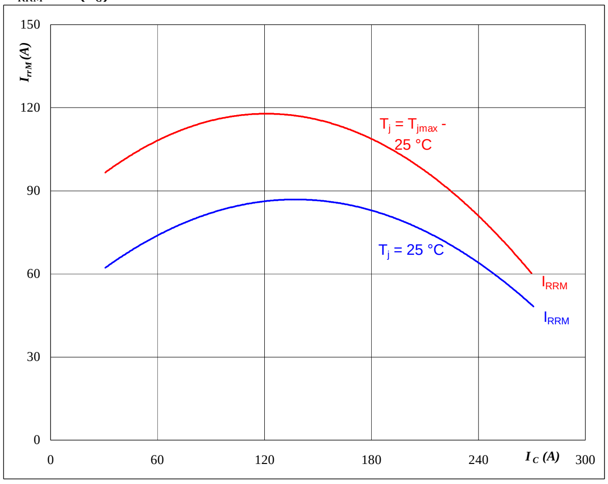
At

T_j =	25/150	°C
V_R =	600	V
I_F =	150	A
V_{GE} =	±15	V

figure 15. **FWD**

Typical reverse recovery current as a function of collector current

$I_{RRM} = f(I_C)$



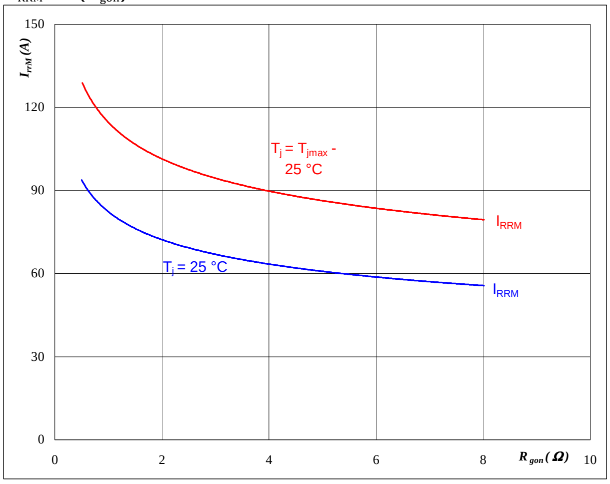
At

T_j =	25/150	°C
V_{CE} =	600	V
V_{GE} =	±15	V
R_{gon} =	1	Ω

figure 16. **FWD**

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

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



At

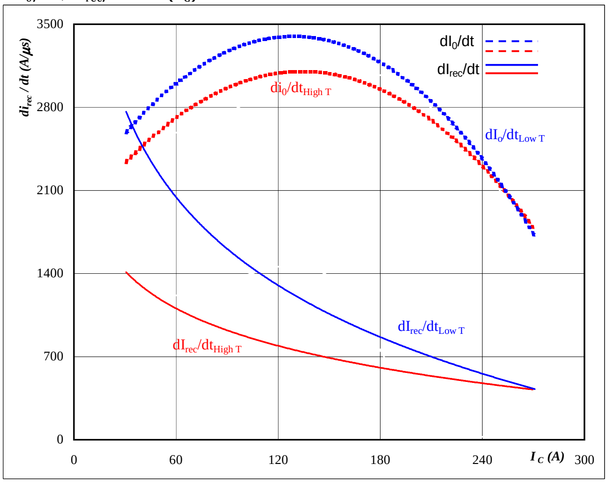
T_j =	25/150	°C
V_R =	600	V
I_F =	150	A
V_{GE} =	±15	V

Inverter Switch / Inverter Diode

figure 17. **FWD**

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

$dI_0/dt, dI_{rec}/dt = f(I_C)$



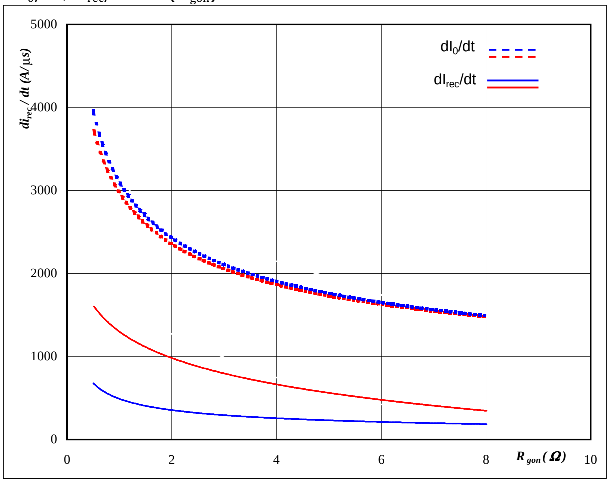
At

T_j =	25/150	°C
V_{CE} =	600	V
V_{GE} =	±15	V
R_{gon} =	1	Ω

figure 18. **FWD**

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

$dI_0/dt, dI_{rec}/dt = f(R_{gon})$



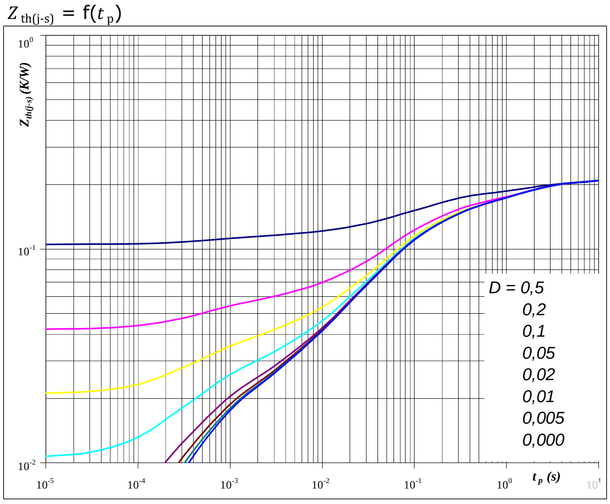
At

T_j =	25/150	°C
V_R =	600	V
I_F =	150	A
V_{GE} =	±15	V

figure 19. **IGBT**

IGBT transient thermal impedance as a function of pulse width

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



At

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

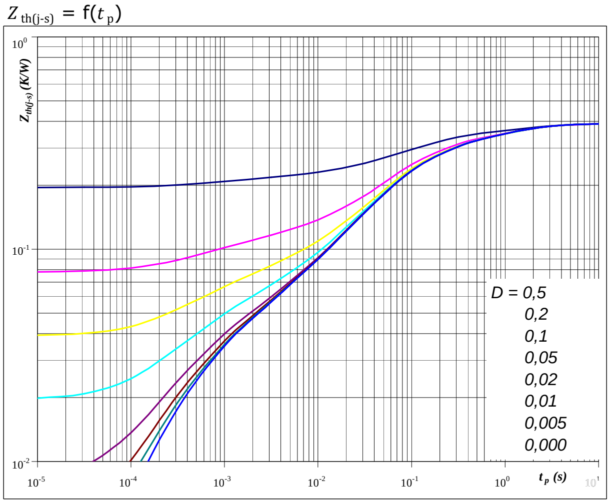
IGBT thermal model values

R (K/W)	τ (s)
4,51E-02	1,97E+00
2,32E-02	3,38E-01
6,28E-02	7,73E-02
1,45E-02	1,74E-02
7,28E-03	2,43E-03
1,02E-02	3,85E-04

figure 20. **FWD**

FWD transient thermal impedance as a function of pulse width

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



At

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

FWD thermal model values

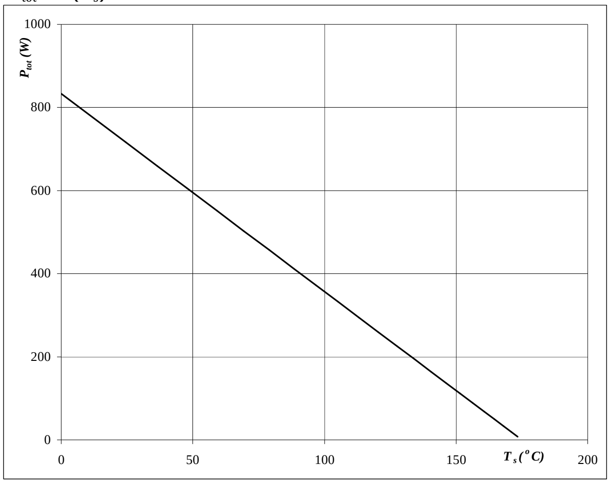
R (K/W)	τ (s)
4,42E-02	1,62E+00
4,47E-02	3,07E-01
1,03E-01	6,80E-02
2,46E-02	1,30E-02
1,41E-02	1,79E-03
1,31E-02	3,53E-04

Inverter Switch / Inverter Diode

figure 21. **IGBT**

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_s)$



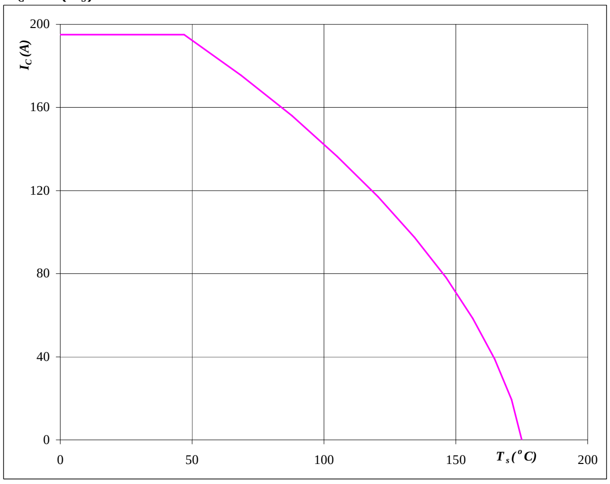
At

T_j = 175 °C

figure 22. **IGBT**

Collector current as a function of heatsink temperature

$I_C = f(T_s)$



At

T_j = 175 °C

V_{GE} = 15 V

figure 23. **FWD**

Power dissipation as a function of heatsink temperature

$P_{tot} = f(T_s)$

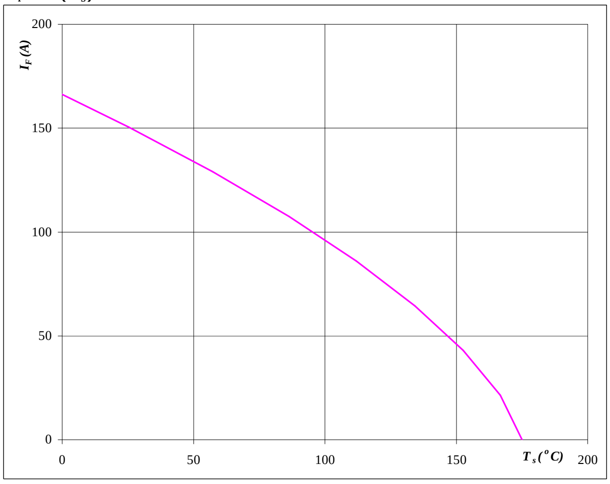
At

T_j = 175 °C

figure 24. **FWD**

Forward current as a function of heatsink temperature

$I_F = f(T_s)$



At

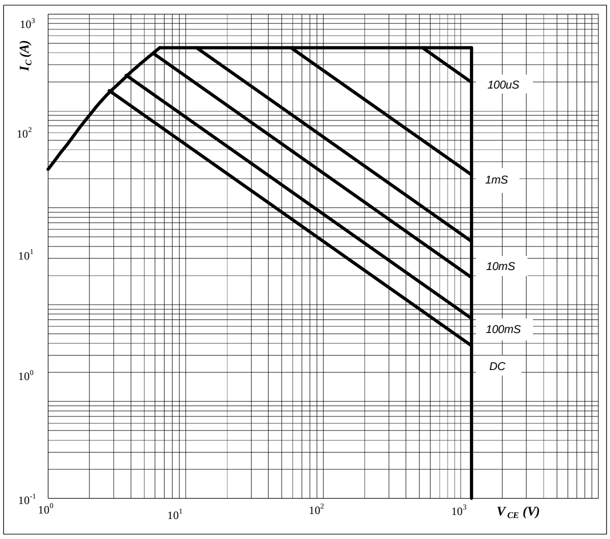
T_j = 175 °C

Inverter Switch / Inverter Diode

figure 25.	IGBT

Safe operating area as a function of collector-emitter voltage

$I_C = f(V_{CE})$



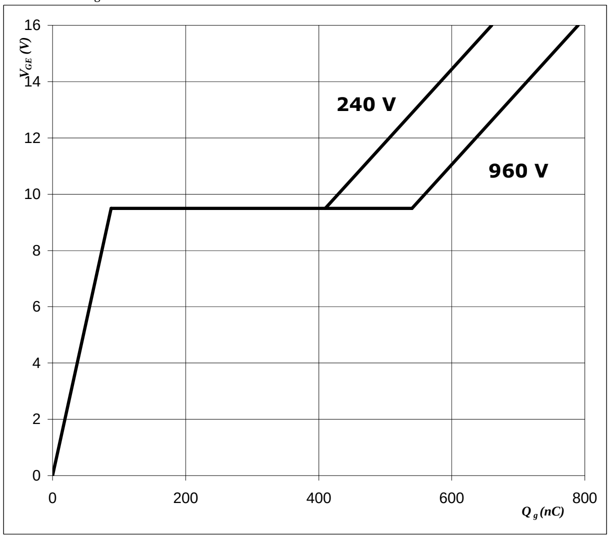
At

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

figure 26.	IGBT

Gate voltage vs Gate charge

$V_{GE} = f(Q_g)$



At

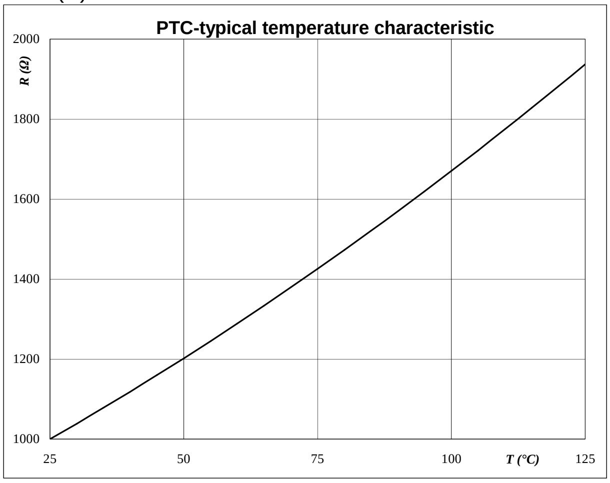
I_C =	150	A

Thermistor

figure 1.	Thermistor

Typical PTC characteristic as a function of temperature

$R = f(T)$



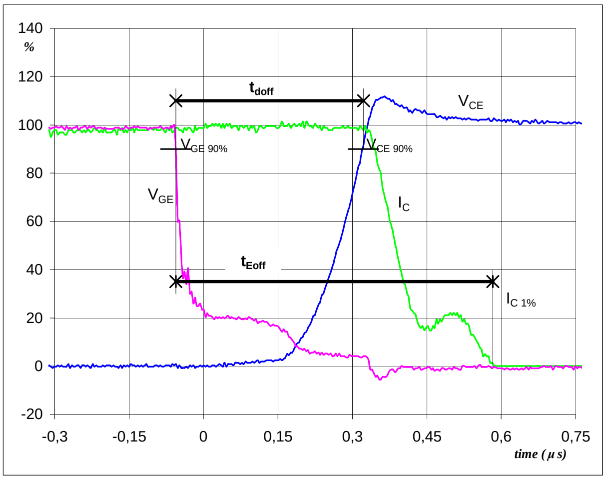
Switching Definitions Output Inverter

General conditions

T_j	=	150 °C
R_{gon}	=	2 Ω
R_{goff}	=	2 Ω

figure 1. IGBT

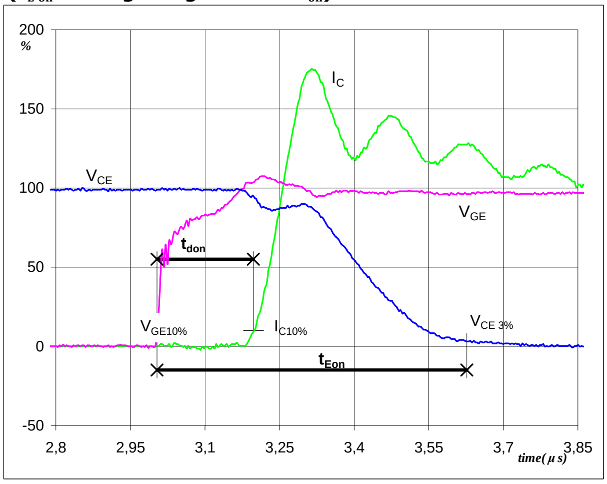
Turn-off Switching Waveforms & definition of t_{doff}, t_{Eoff}
(t_{Eoff} = integrating time for E_{off})



V_{GE} (0%) =	-15	V
V_{GE} (100%) =	15	V
V_C (100%) =	600	V
I_C (100%) =	151	A
t_{doff} =	0,38	μs
t_{Eoff} =	0,64	μs

figure 2. IGBT

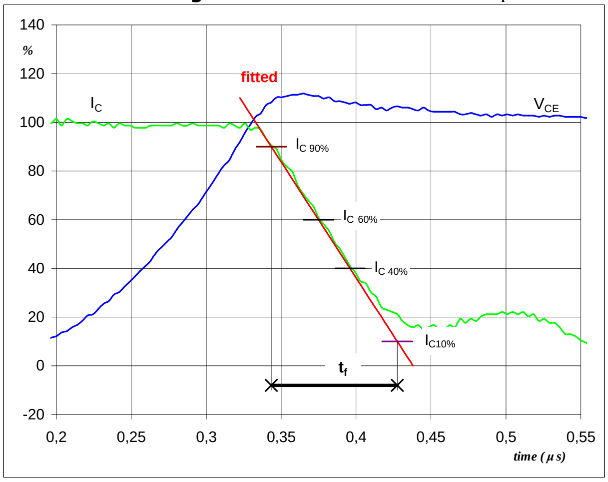
Turn-on Switching Waveforms & definition of t_{don}, t_{Eon}
(t_{Eon} = integrating time for E_{on})



V_{GE} (0%) =	-15	V
V_{GE} (100%) =	15	V
V_C (100%) =	600	V
I_C (100%) =	151	A
t_{don} =	0,19	μs
t_{Eon} =	0,62	μs

figure 3. IGBT

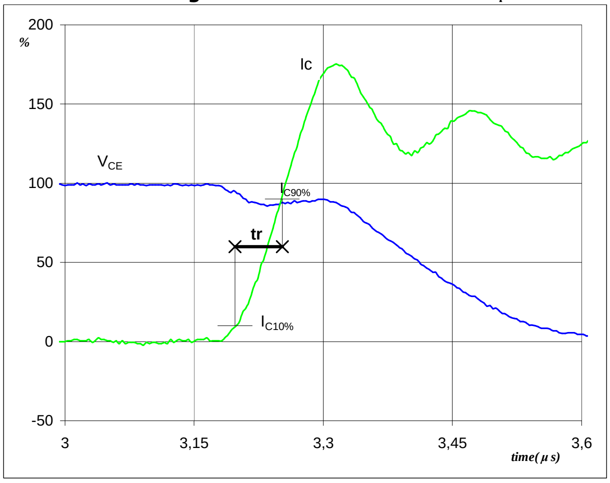
Turn-off Switching Waveforms & definition of t_f



V_C (100%) =	600	V
I_C (100%) =	151	A
t_f =	0,09	μs

figure 4. IGBT

Turn-on Switching Waveforms & definition of t_r

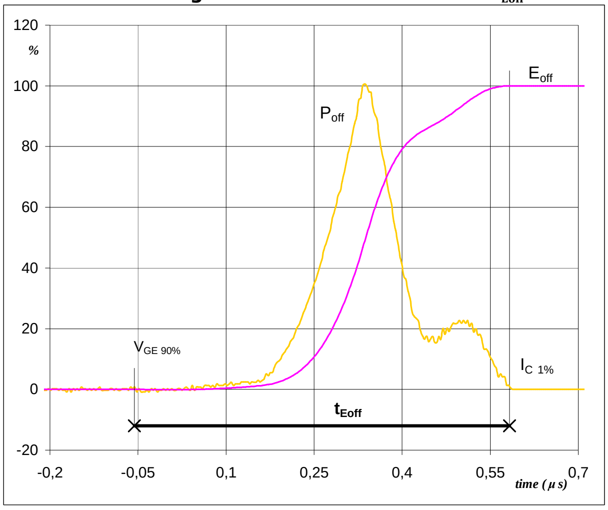


V_C (100%) =	600	V
I_C (100%) =	151	A
t_r =	0,05	μs

Switching Definitions Output Inverter

figure 5. **IGBT**

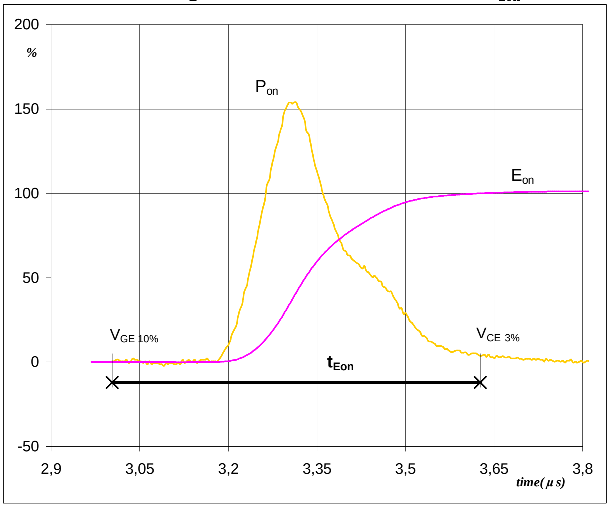
Turn-off Switching Waveforms & definition of t_{Eoff}



P_{off} (100%) =	90,54	kW
E_{off} (100%) =	13,82	mJ
$t_{E\,off}$ =	0,64	μs

figure 6. **IGBT**

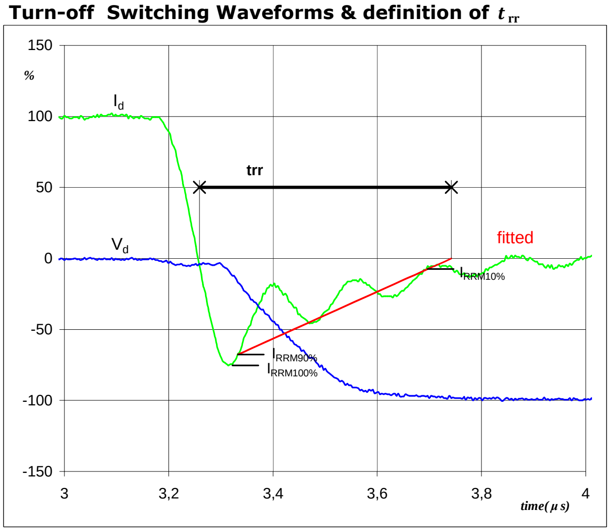
Turn-on Switching Waveforms & definition of t_{Eon}



P_{on} (100%) =	90,54	kW
E_{on} (100%) =	23,22	mJ
$t_{E\,on}$ =	0,62	μs

figure 7. **IGBT**

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

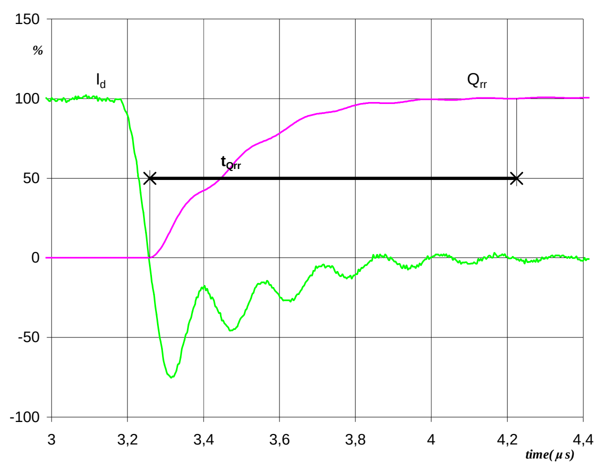


V_d (100%) =	600	V
I_d (100%) =	151	A
I_{RRM} (100%) =	-115	A
t_{rr} =	0,48	μs

Switching Definitions Output Inverter

figure 9. **FWD**

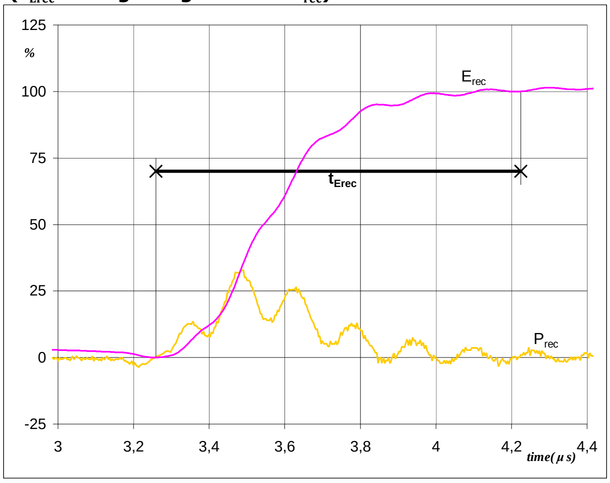
Turn-on Switching Waveforms & definition of t_{Qrr}
($t_{Q rr}$ = integrating time for Q_{rr})



I_d (100%) =	151	A
Q_{rr} (100%) =	24,43	μC
$t_{Q rr}$ =	0,97	μs

figure 10. **FWD**

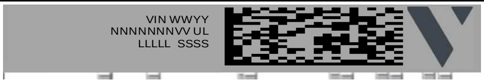
Turn-on Switching Waveforms & definition of t_{Erec}
(t_{Erec}= integrating time for E_{rec})



P_{rec} (100%) =	90,54	kW
E_{rec} (100%) =	8,10	mJ
$t_{E rec}$ =	0,97	μs

Ordering Code & Marking

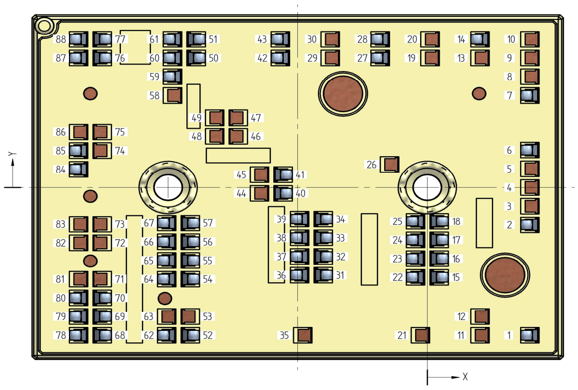
Version	Ordering Code
with std lid (black V23990-K32-T-PM)	V23990-K430-F40-/0A/-PM
with std lid (black V23990-K32-T-PM) and P12	V23990-K430-F40-/1A/-PM
with std lid (black V23990-K32-T-PM) and thermal grease	V23990-K430-F40-/5A/-PM
with thin lid (white V23990-K33-T-PM)	V23990-K430-F40-/0B/-PM
with thin lid (white V23990-K33-T-PM) and P12	V23990-K430-F40-/1B/-PM
with thin lid (white V23990-K33-T-PM) and thermal grease	V23990-K430-F40-/5B/-PM



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

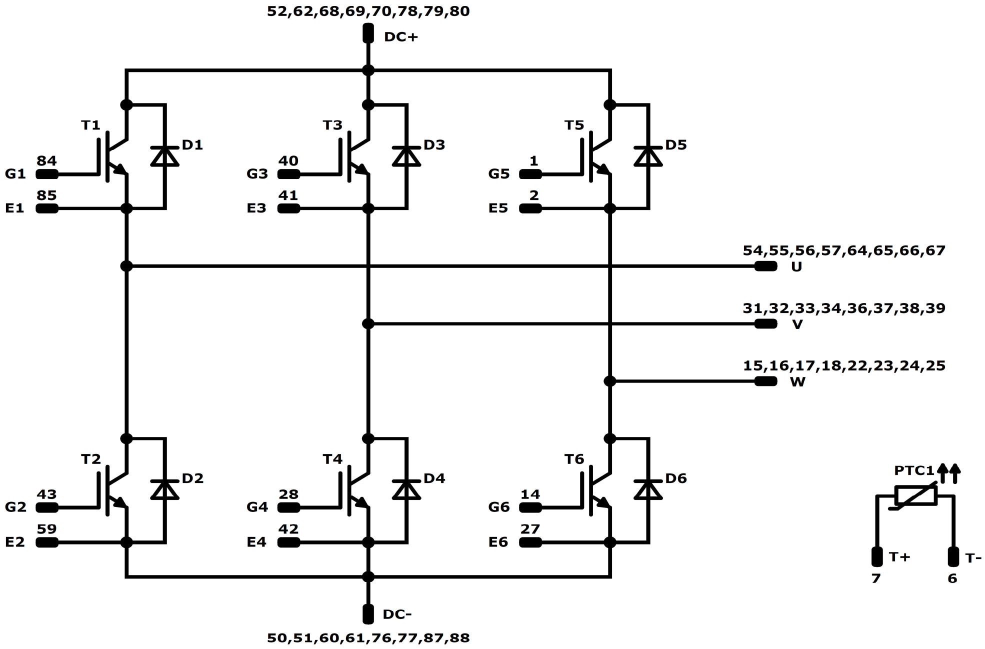
Outline

PCB pad table				PCB pad table			
Pad	X	Y	Function	Pad	X	Y	Function
1	15,83	-25,3	G5	45	Not assembled		
2	15,83	-6,4	E5	46	Not assembled		
3	Not assembled			47	Not assembled		
4	Not assembled			48	Not assembled		
5	Not assembled			49	Not assembled		
6	15,83	6,4	-T	50	4,32	22,1	-DC
7	15,83	15,7	+T	51	4,32	25,3	-DC
8	Not assembled			52	3,42	-25,3	+DC
9	Not assembled			53	Not assembled		
10	Not assembled			54	3,42	-15,7	U
11	Not assembled			55	3,42	-12,5	U
12	Not assembled			56	3,42	-9,3	U
13	Not assembled			57	3,42	-6,1	U
14	8,13	25,3	G6	58	Not assembled		
15	41,82	-15,38	W	59	-39,32	18,9	E2
16	41,82	-12,18	W	60	-39,32	22,1	-DC
17	41,82	-8,98	W	61	-39,32	25,3	-DC
18	41,82	-5,79	W	62	-40,22	-25,3	+DC
19	Not assembled			63	Not assembled		
20	Not assembled			64	-40,22	-15,7	U
21	Not assembled			65	-40,22	-12,5	U
22	-1,82	-15,38	W	66	-40,22	-9,3	U
23	-1,82	-12,18	W	67	-40,22	-6,09	U
24	-1,82	-8,98	W	68	-10,18	-25,3	+DC
25	-1,82	-5,79	W	69	-10,18	-22,1	+DC
26	Not assembled			70	-10,18	-18,9	+DC
27	-7,27	22,1	E6	71	Not assembled		
28	-7,27	25,3	G4	72	Not assembled		
29	Not assembled			73	Not assembled		
30	Not assembled			74	Not assembled		
31	23,95	-15,02	V	75	Not assembled		
32	23,95	-11,82	V	76	-10,18	22,1	-DC
33	23,95	-8,63	V	77	-10,18	25,3	-DC
34	23,95	-5,42	V	78	-53,82	-25,3	+DC
35	Not assembled			79	-53,82	-22,1	+DC
36	-19,7	-15,02	V	80	-53,82	-18,9	+DC
37	-19,7	-11,82	V	81	Not assembled		
38	-19,7	-8,62	V	82	Not assembled		
39	-19,7	-5,42	V	83	Not assembled		
40	17,74	-1	G3	84	-53,82	3,1	G1
41	17,74	2,2	E3	85	-53,82	6,3	E1
42	-22,67	22,1	E4	86	Not assembled		
43	-22,67	25,3	G2	87	-53,82	22,1	-DC
44	Not assembled			88	-53,82	25,3	-DC



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

Pinout



Identification

ID	Component	Voltage	Current	Function	Comment
T1-T6	IGBT	1200 V	150 A	Inverter Switch	
D1-D6	FWD	1200 V	150 A	Inverter Diode	
PTC1	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
V23990-K430-F40-D3-14	10 Aug. 2017	New thermal paste version	