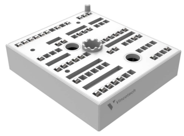
MiniSKiiP® 2 PACK | **600 V / 75 A**

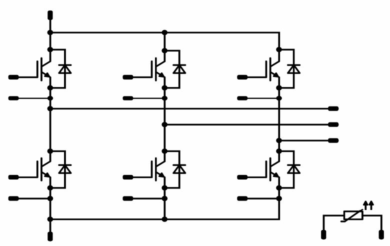
Features

- SixPack (inverter) topology
- Solder less interconnection
- Designed for motor drives up to 7 kW
- Fully compatible with Semikron pedant 27AC066V1
- Temperature sensor
- Standard (6,5mm) and thin (2,8mm) lids, 16 mm housing
- Optional with pre-applied thermal grease

MiniSKiiP® 2 housing



Schematic



Target Applications

- Industrial Motor Drives
- Power Generation
- UPS

Types

- V23990-K233-F-PM

Maximum Ratings

T_j = 25 °C, unless otherwise specified

Parameter	Symbol	Condition		Value	Unit
Inverter Switch					
Collector-emitter break down voltage	V_{CE}			600	V
DC collector current	I_C	$T_j = T_{jmax}$	T_s = 80 °C	70	A
Repetitive peak collector current	I_{CRM}	t_p limited by T_{jmax}		225	A
Power dissipation	P_{tot}	$T_j = T_{jmax}$	T_s = 80 °C	127	W
Gate-emitter peak voltage	V_{GE}			±20	V
Short circuit ratings	t_{SC} V_{CC}	T_j ≤ 150 °C V_{GE} = 15 V		6 360	μs V
Maximum Junction Temperature	T_{jmax}			175	°C
Inverter Diode					
Peak Repetitive Reverse Voltage	V_{RRM}			600	V
DC forward current	I_F	$T_j = T_{jmax}$	T_s = 80 °C	59	A
Repetitive peak forward current	I_{FRM}	t_p limited by T_{jmax}		118	A
Power dissipation	P_{tot}	$T_j = T_{jmax}$	T_s = 80 °C	78	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_{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 information see handling instructions		6,3	mm
Clearance		With std lid for more information see handling instructions		6,3	mm
Comparative Tracking Index	CTI			>200	

*100% tested in production

Characteristic Values

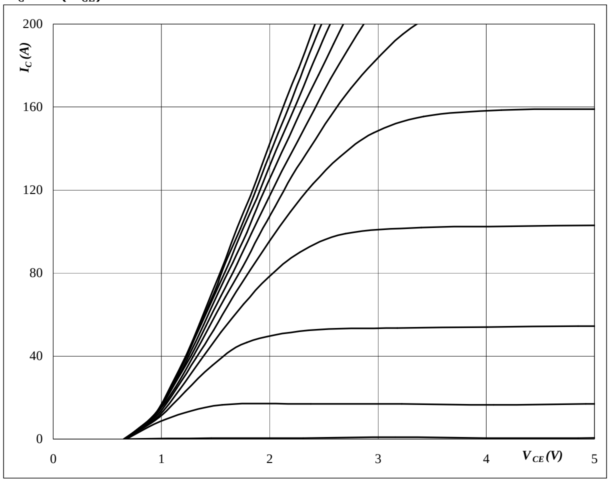
Parameter	Symbol	Conditions	V_{GE} [V] V_{GS} [V]	V_r [V] V_{CE} [V] V_{DS} [V]	I_C [A] I_F [A] I_D [A]	T_j [°C]	Value Min	Value Typ	Value Max	Unit
Inverter Switch										
Gate emitter threshold voltage	$V_{GE(th)}$	$V_{CE} = V_{GE}$			0,0012	25	5	5,8	6,5	V
Collector-emitter saturation voltage	V_{CEsat}		15		75	25 125		1,54 1,76		V
Collector-emitter cut-off current incl. Diode	I_{CES}		0	612		25			0,2	mA
Gate-emitter leakage current	I_{GES}		20	0		25			700	nA
Integrated Gate resistor	R_{gint}							4		Ω
Turn-on delay time	$t_{d(on)}$	$R_{goff} = 8$ Ω $R_{gon} = 8$ Ω	±15	300	75	25 125		215 222		ns
Rise time	t_r					25 125		26 30		ns
Turn-off delay time	$t_{d(off)}$					25 125		255 274		ns
Fall time	t_f					25 125		45 92		ns
Turn-on energy loss per pulse	E_{on}					25 125		1,82 2,42		mWs
Turn-off energy loss per pulse	E_{off}					25 125		1,72 2,22		mWs
Input capacitance	C_{ies}	f = 1 MHz	0	25		25		4700		pF
Output capacitance	C_{oss}							300		pF
Reverse transfer capacitance	C_{rss}							145		pF
Thermal resistance chip to heatsink	$R_{th(j\text{-}s)}$	λ_{paste} = 0,8 W/mK (P12)						0,75		K/W
Inverter Diode										
Diode forward voltage	V_F				75	25 125		1,39 1,43		V
Peak reverse recovery current	I_{RRM}	$R_{goff} = 8$ Ω	±15	300	75	25 125		72 82		A
Reverse recovery time	t_{rr}					25 125		203 333		ns
Reverse recovered charge	Q_{rr}					25 125		5,70 9,14		µC
Peak rate of fall of recovery current	$(di_{rf}/dt)_{max}$					25 125		2458 1983		A/µs
Reverse recovered energy	E_{rec}					25 125		1,15 1,93		mWs
Thermal resistance chip to heatsink	$R_{th(j\text{-}s)}$	λ_{paste} = 0,8 W/mK (P12)						1,2		K/W
Thermistor										
Rated resistance	R					25		1000		Ω
Deviation of R_{100}	$\Delta_{R/R}$	R_{100} = 1670 Ω				100	-3		3	%
R_{100}	P					100		1670		Ω
A-value	$B_{(25/50)}$	Tol. %				25		$7{,}635 \cdot 10^{-3}$		1/K
B-value	$B_{(25/100)}$	Tol. %				25		$1{,}731 \cdot 10^{-5}$		1/K²
Vincotech NTC Reference									E	

Output Inverter

figure 1. **IGBT**

Typical output characteristics

$I_C = f(V_{CE})$



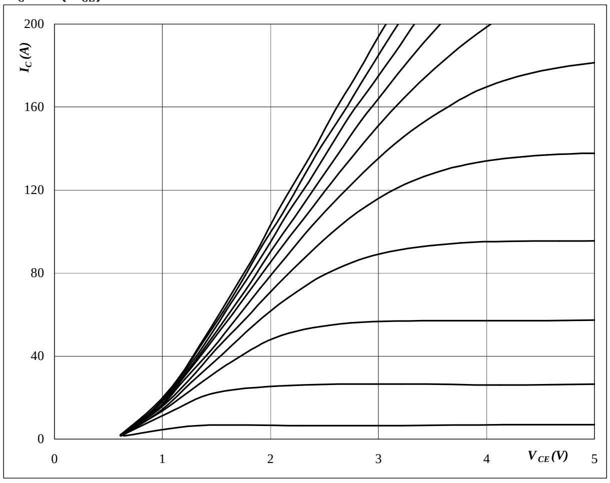
At

t_p =	250	μs
T_j =	25	°C
V_{GE} from	7 V to 17 V in steps of 1 V	

figure 2. **IGBT**

Typical output characteristics

$I_C = f(V_{CE})$



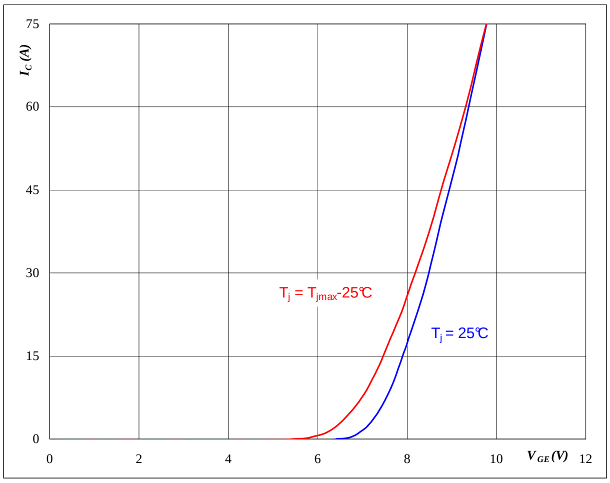
At

t_p =	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

$I_C = f(V_{GE})$



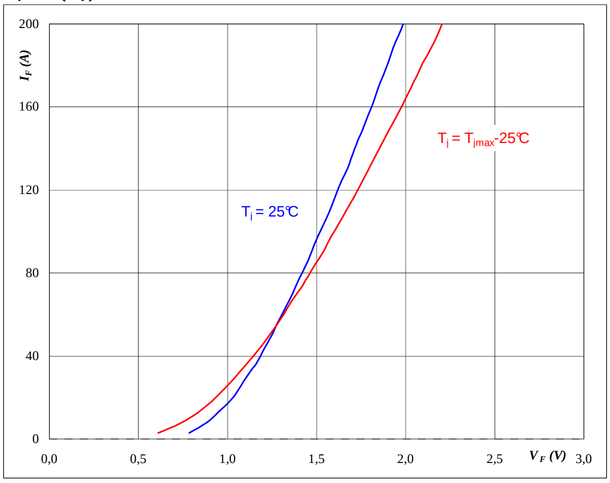
At

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

figure 4. **FWD**

Typical diode forward current as a function of forward voltage

$I_F = f(V_F)$



At

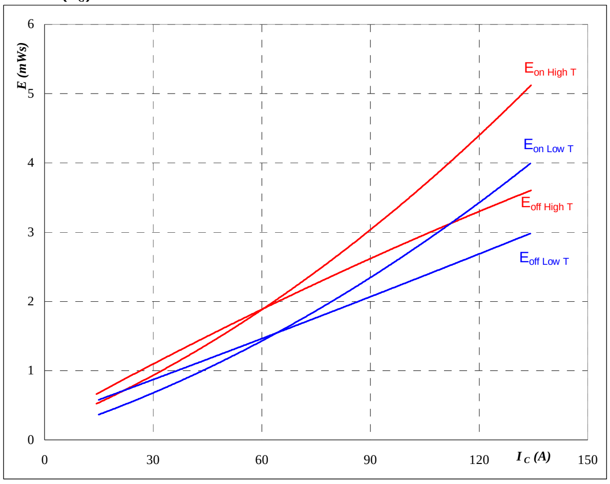
t_p =	250	μs

Output Inverter

figure 5.	IGBT

Typical switching energy losses
as a function of collector current

$E = f(I_C)$



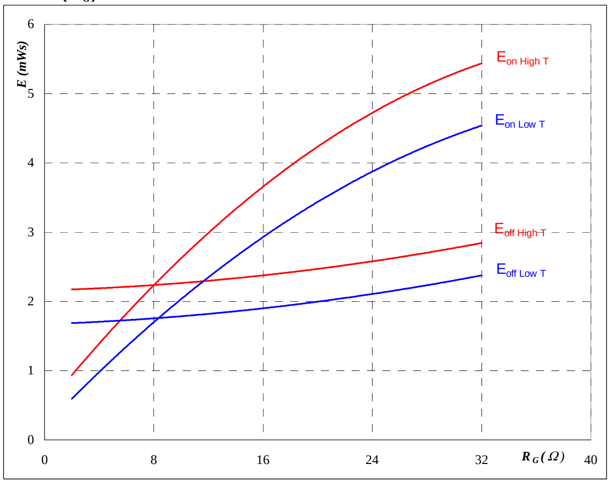
With an inductive load at

T_j =	25/125	°C
V_{CE} =	300	V
V_{GE} =	±15	V
R_{gon} =	8	Ω
R_{goff} =	8	Ω

figure 6.	IGBT

Typical switching energy losses
as a function of gate resistor

$E = f(R_G)$



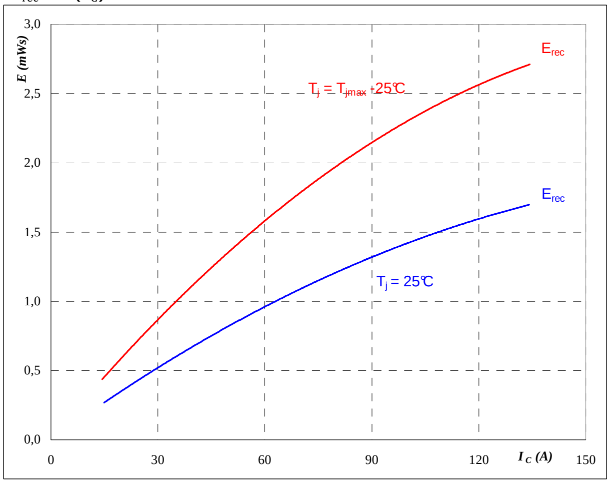
With an inductive load at

T_j =	25/125	°C
V_{CE} =	300	V
V_{GE} =	±15	V
I_C =	75	A

figure 7.	FWD

Typical reverse recovery energy loss
as a function of collector current

$E_{rec} = f(I_C)$



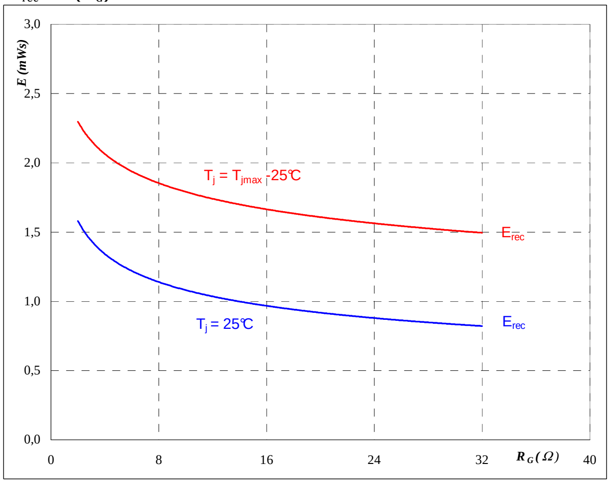
With an inductive load at

T_j =	25/125	°C
V_{CE} =	300	V
V_{GE} =	±15	V
R_{gon} =	8	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

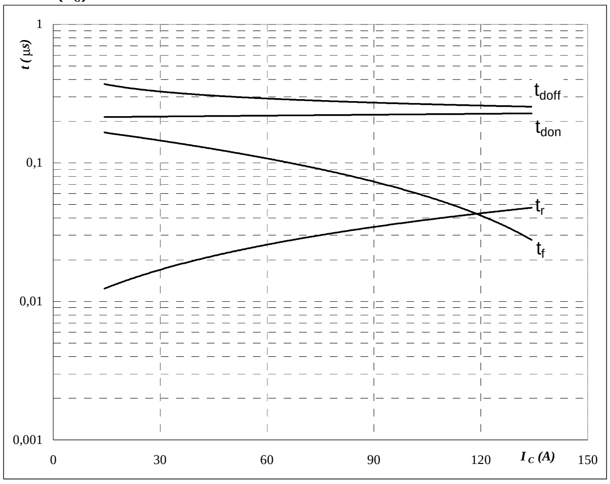
T_j =	25/125	°C
V_{CE} =	300	V
V_{GE} =	±15	V
I_C =	75	A

Output Inverter

figure 9. **IGBT**

Typical switching times as a function of collector current

$t = f(I_C)$



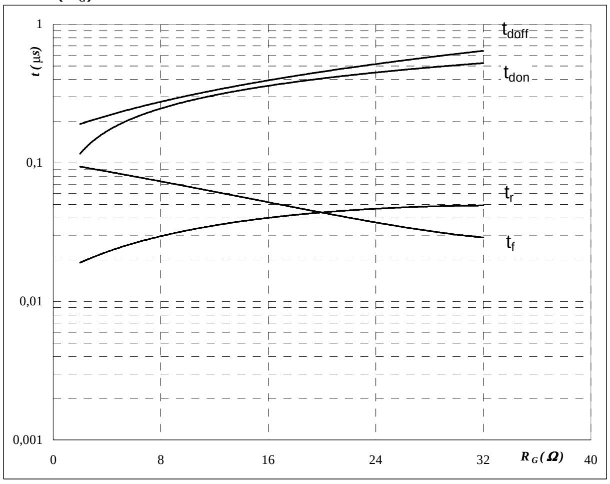
With an inductive load at

T_j =	125	°C
V_{CE} =	300	V
V_{GE} =	±15	V
R_{gon} =	8	Ω
R_{goff} =	8	Ω

figure 10. **IGBT**

Typical switching times as a function of gate resistor

$t = f(R_G)$



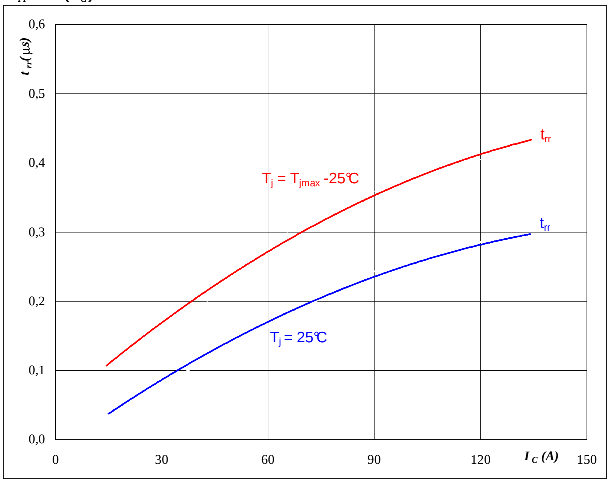
With an inductive load at

T_j =	125	°C
V_{CE} =	300	V
V_{GE} =	±15	V
I_C =	75	A

figure 11. **FWD**

Typical reverse recovery time as a function of collector current

$t_{rr} = f(I_C)$



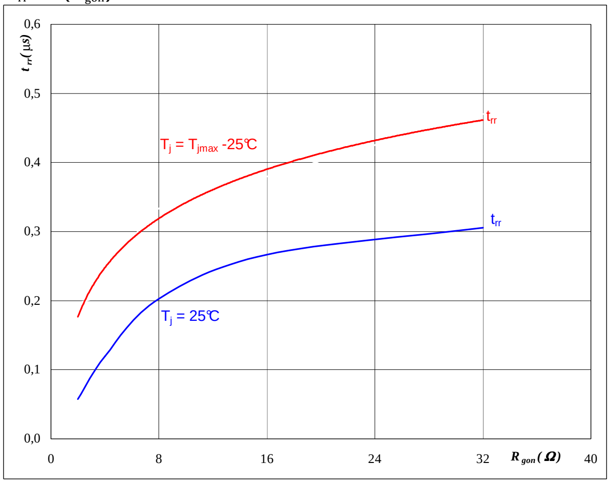
At

T_j =	25/125	°C
V_{CE} =	300	V
V_{GE} =	±15	V
R_{gon} =	8	Ω

figure 12. **FWD**

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

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



At

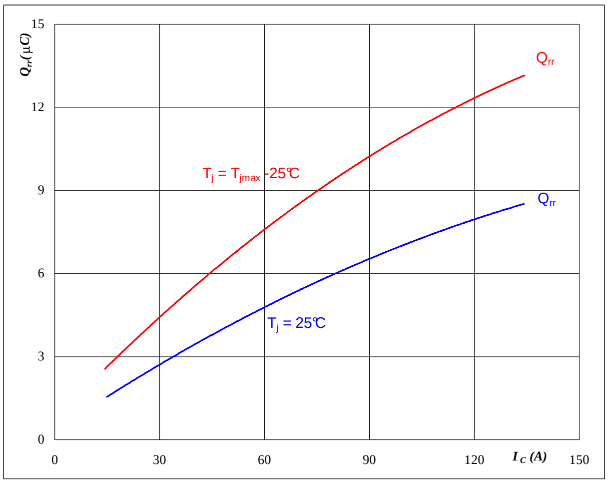
T_j =	25/125	°C
V_R =	300	V
I_F =	75	A
V_{GE} =	±15	V

Output Inverter

figure 13. **FWD**

Typical reverse recovery charge as a function of collector current

$Q_{rr} = f(I_C)$



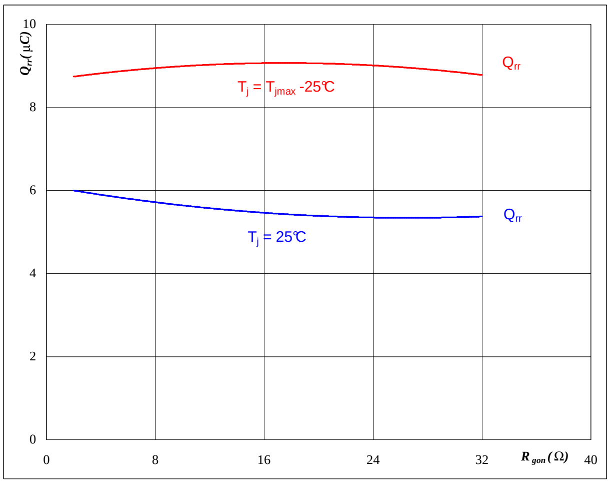
At

T_j =	25/125	°C
V_{CE} =	300	V
V_{GE} =	±15	V
R_{gon} =	8	Ω

figure 14. **FWD**

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

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



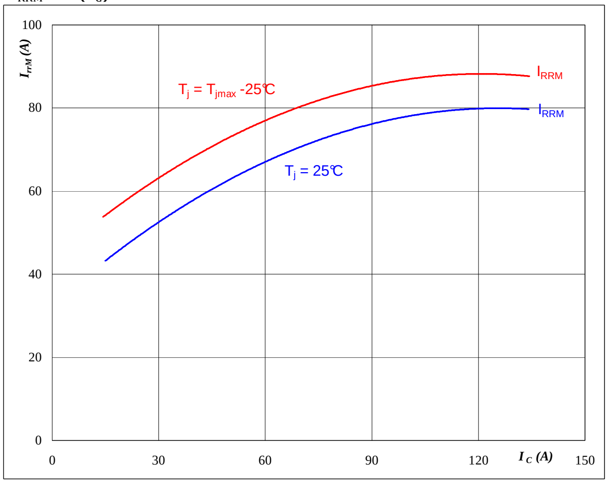
At

T_j =	25/125	°C
V_R =	300	V
I_F =	75	A
V_{GE} =	±15	V

figure 15. **FWD**

Typical reverse recovery current as a function of collector current

$I_{RRM} = f(I_C)$



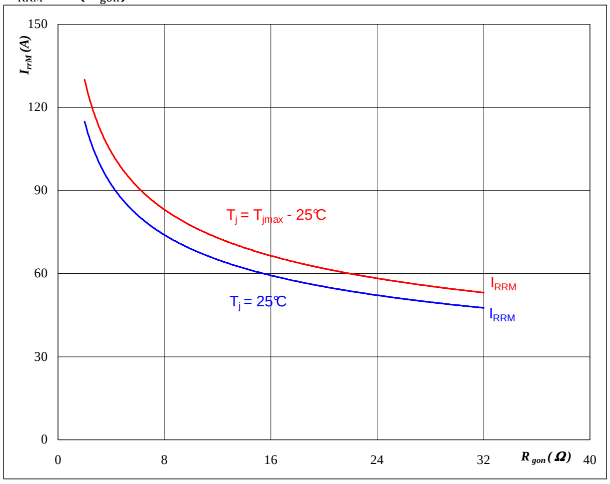
At

T_j =	25/125	°C
V_{CE} =	300	V
V_{GE} =	±15	V
R_{gon} =	8	Ω

figure 16. **FWD**

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

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



At

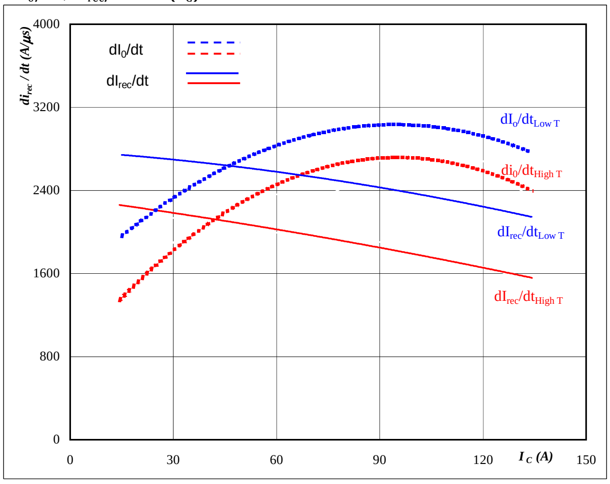
T_j =	25/125	°C
V_R =	300	V
I_F =	75	A
V_{GE} =	±15	V

Output Inverter

figure 17.	FWD

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

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



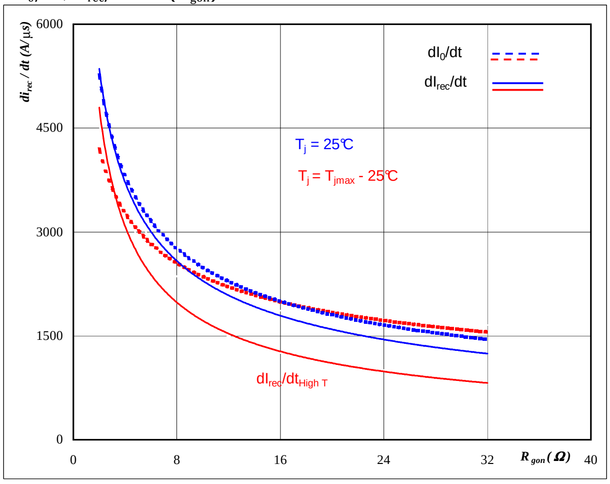
At

T_j =	25/125	°C
V_{CE} =	300	V
V_{GE} =	±15	V
R_{gon} =	8	Ω

figure 18.	FWD

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

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



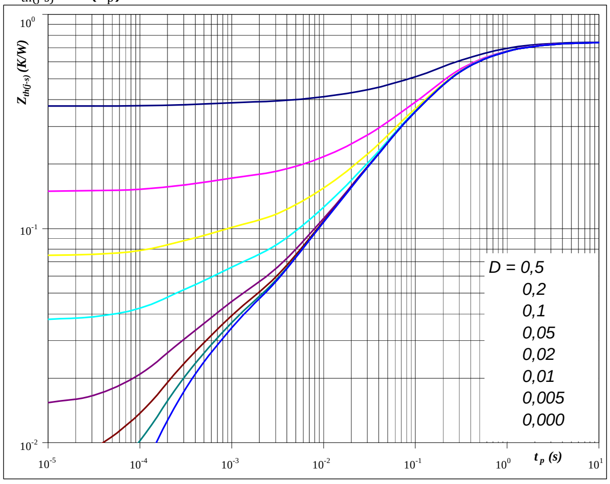
At

T_j =	25/125	°C
V_R =	300	V
I_F =	75	A
V_{GE} =	±15	V

figure 19.	IGBT

IGBT transient thermal impedance as a function of pulse width

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



At

D =	t_p / T	
$R_{th(j\text{-}s)}$ =	0,75	K/W

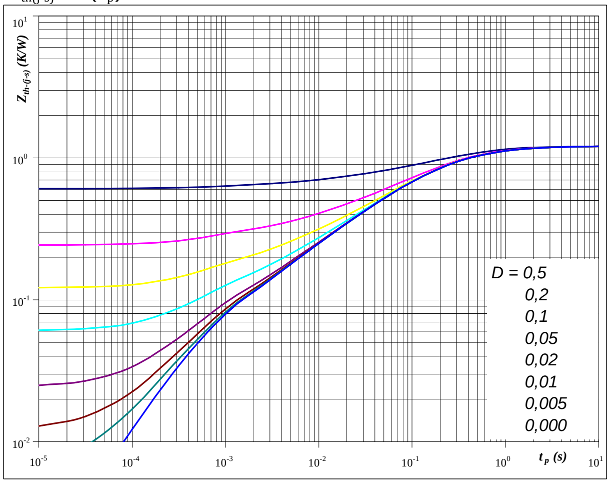
IGBT thermal model values

R (K/W)	Tau (s)
2,52E-02	8,15E+00
1,46E-01	9,38E-01
3,96E-01	1,88E-01
1,14E-01	3,57E-02
4,05E-02	6,16E-03
2,47E-02	3,71E-04

figure 20.	FWD

FWD transient thermal impedance as a function of pulse width

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



At

D =	t_p / T	
$R_{th(j\text{-}s)}$ =	1,21	K/W

FWD thermal model values

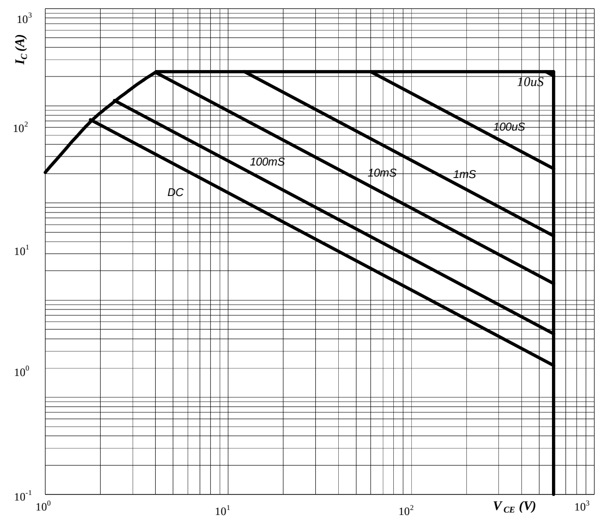
R (K/W)	Tau (s)
2,29E-02	9,22E+00
1,66E-01	1,07E+00
5,46E-01	2,04E-01
2,82E-01	4,28E-02
1,25E-01	7,24E-03
6,92E-02	6,71E-04

Output Inverter

figure 21. **IGBT**

Safe operating area as a function of collector-emitter voltage

$I_C = f(V_{CE})$



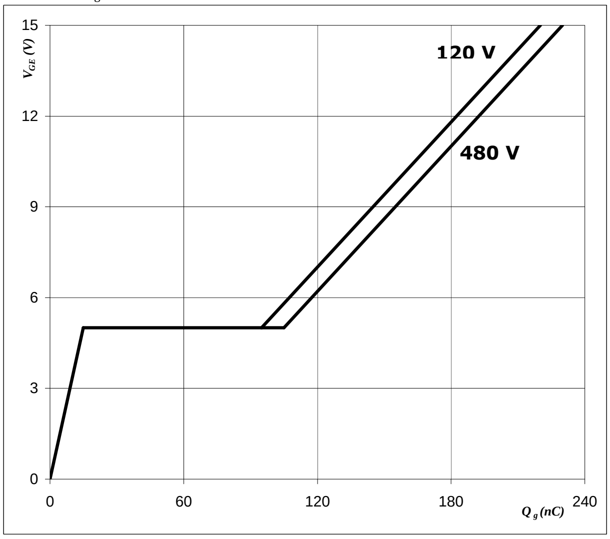
At

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

figure 22. **IGBT**

Gate voltage vs Gate charge

$V_{GE} = f(Q_g)$



At

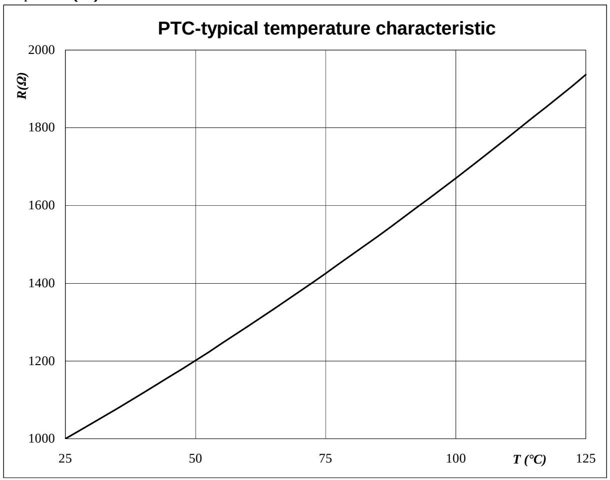
I_C =	75	A

Thermistor

figure 1. **Thermistor**

Typical PTC characteristic as a function of temperature

$R_T = f(T)$



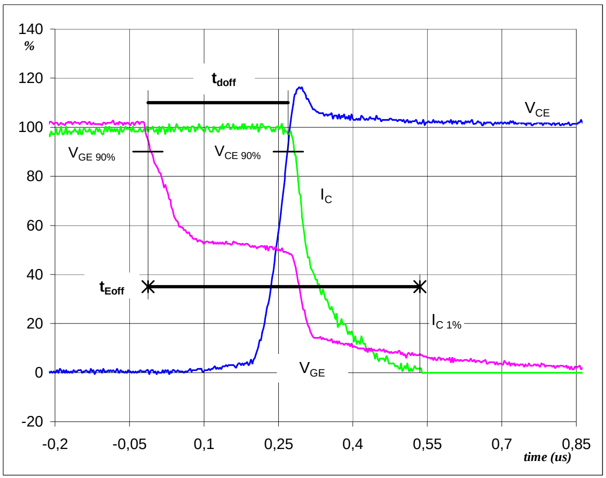
Switching Definitions Output Inverter

General conditions

T_j	=	125 °C
R_{gon}	=	8 Ω
R_{goff}	=	8 Ω

figure 1. **IGBT**

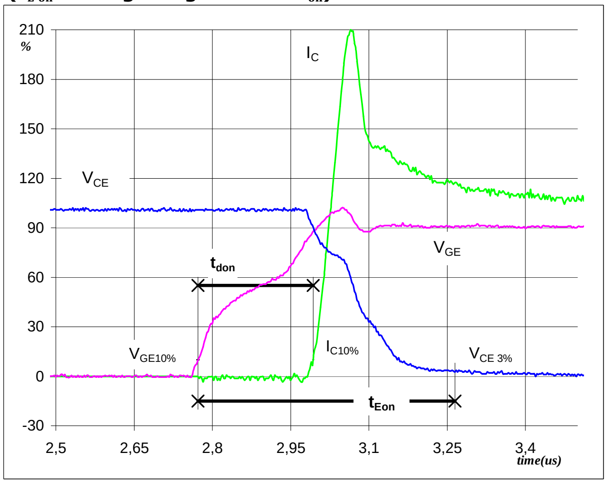
Turn-off Switching Waveforms & definition of t_{doff}, t_{Eoff}
($t_{E\,off}$ = integrating time for E_{off})



V_{GE} (0%) =	-15	V
V_{GE} (100%) =	15	V
V_C (100%) =	300	V
I_C (100%) =	75	A
t_{doff} =	0,27	µs
$t_{E\,off}$ =	0,55	µs

figure 2. **IGBT**

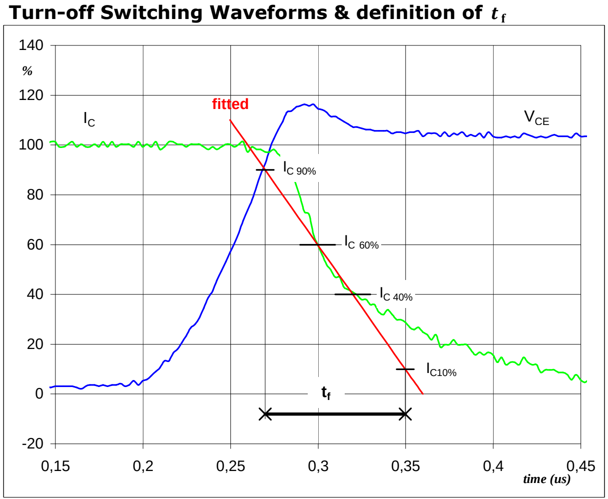
Turn-on Switching Waveforms & definition of t_{don}, t_{Eon}
($t_{E\,on}$ = integrating time for E_{on})



V_{GE} (0%) =	-15	V
V_{GE} (100%) =	15	V
V_C (100%) =	300	V
I_C (100%) =	75	A
t_{don} =	0,22	µs
$t_{E\,on}$ =	0,49	µs

figure 3. **IGBT**

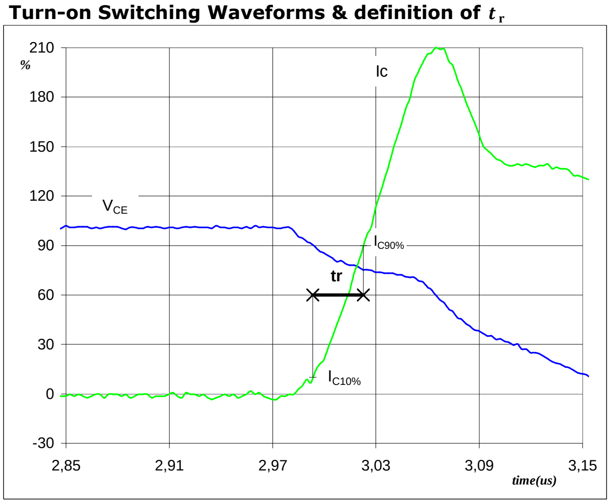
Turn-off Switching Waveforms & definition of t_f



V_C (100%) =	300	V
I_C (100%) =	75	A
t_f =	0,09	µs

figure 4. **IGBT**

Turn-on Switching Waveforms & definition of t_r

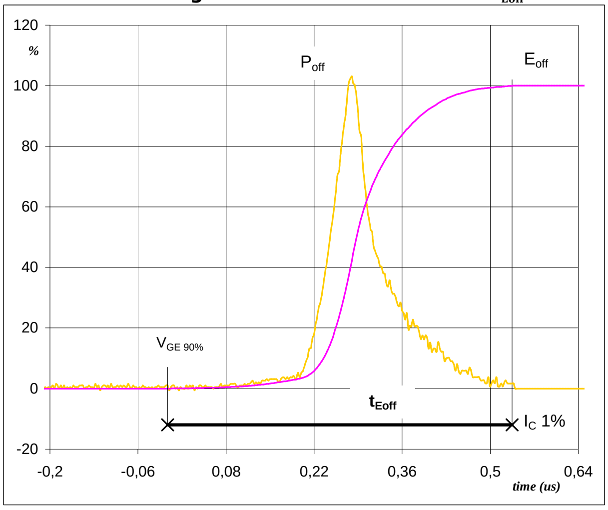


V_C (100%) =	300	V
I_C (100%) =	75	A
t_r =	0,03	µs

Switching Definitions Output Inverter

figure 5. **IGBT**

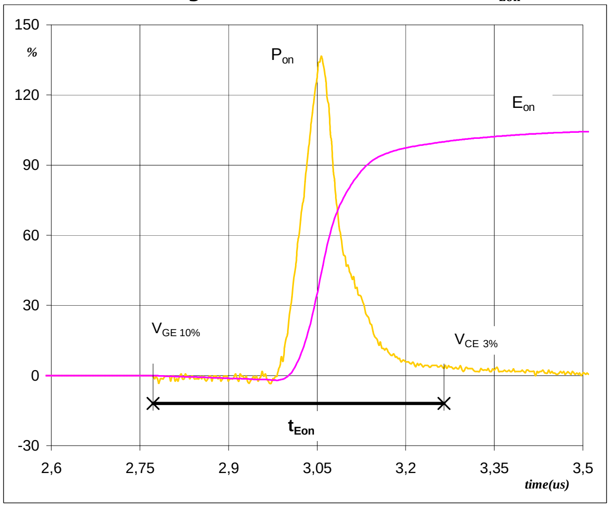
Turn-off Switching Waveforms & definition of t_{Eoff}



P_{off} (100%) =	22,36	kW
E_{off} (100%) =	2,22	mJ
$t_{E\,off}$ =	0,55	μs

figure 6. **IGBT**

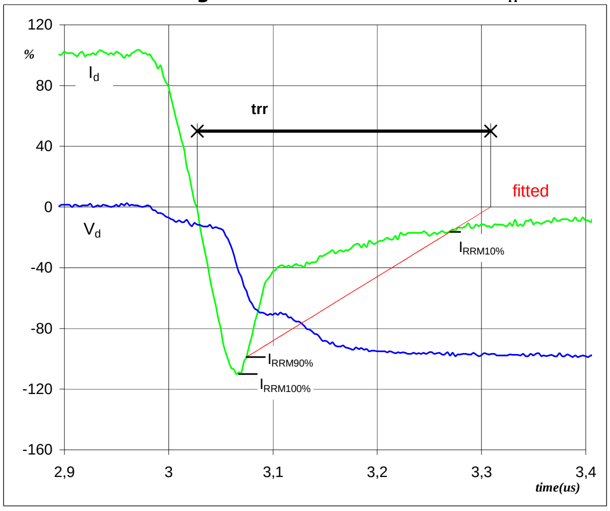
Turn-on Switching Waveforms & definition of t_{Eon}



P_{on} (100%) =	22,36	kW
E_{on} (100%) =	2,42	mJ
$t_{E\,on}$ =	0,49	μs

figure 7. **FWD**

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

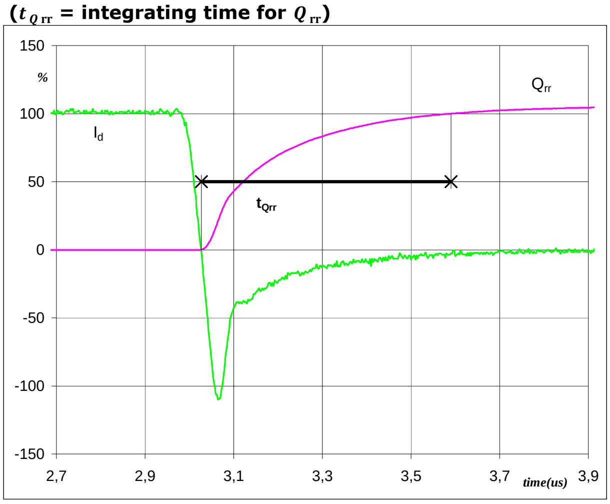


V_d (100%) =	300	V
I_d (100%) =	75	A
I_{RRM} (100%) =	82	A
t_{rr} =	0,33	μs

Switching Definitions Output Inverter

figure 8. **FWD**

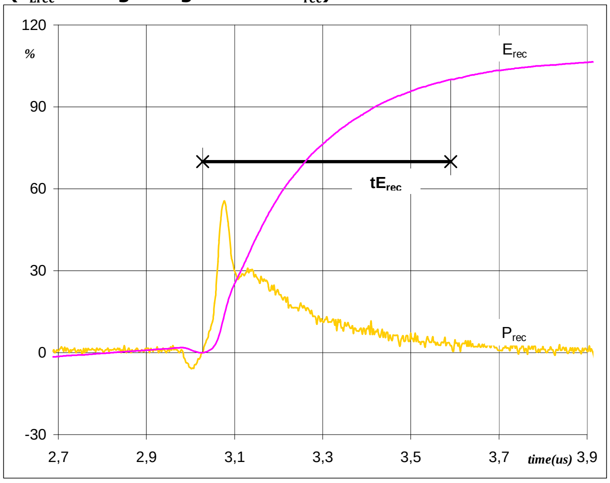
Turn-on Switching Waveforms & definition of t_{Qrr}
($t_{Q rr}$ = integrating time for Q_{rr})



I_d (100%) =	75	A
Q_{rr} (100%) =	9,14	µC
$t_{Q rr}$ =	0,56	µs

figure 9. **FWD**

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



P_{rec} (100%) =	22,36	kW
E_{rec} (100%) =	1,93	mJ
$t_{E rec}$ =	0,56	µs

Ordering Code & Marking

Version	Ordering Code
With std lid (6,5 mm height) + no thermal grease	V23990-K233-F-PM-/0A/
With thin lid (2,8 mm height) + no thermal grease	V23990-K233-F-PM-/0B/
With std lid (6,5 mm height) + thermal grease (0,8 W/mK, P12, silicone-based)	V23990-K233-F-PM-/1A/
With thin lid (2,8 mm height) + thermal grease (0,8 W/mK, P12, silicone-based)	V23990-K233-F-PM-/1B/
With std lid (6,5 mm height) + thermal grease (2,5 W/mK, TG20032, silicone-free)	V23990-K233-F-PM-/4A/
With thin lid (2,8 mm height) + thermal grease (2,5 W/mK, TG20032, silicone-free)	V23990-K233-F-PM-/4B/
With std lid (6,5 mm height) + thermal grease (2,5 W/mK, HPTP, silicone-based)	V23990-K233-F-PM-/5A/
With thin lid (2,8 mm height) + thermal grease (2,5 W/mK, HPTP, silicone-based)	V23990-K233-F-PM-/5B/

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		

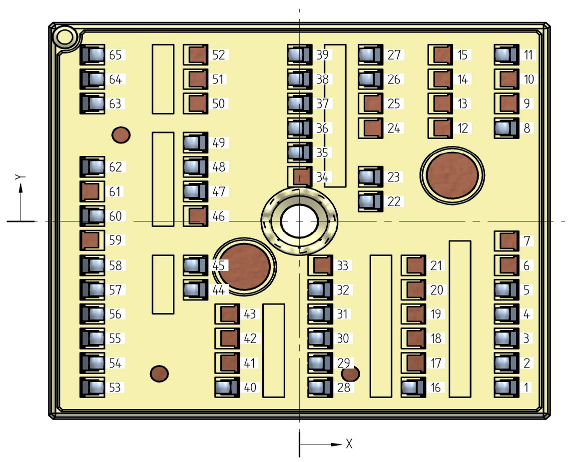
Outline

Pin table [mm]

Pin	X	Y	Function
1	24,38	-21,8	+DC
2	24,38	-18,6	+DC
3	24,38	-15,4	+DC
4	24,38	-12,2	+DC
5	24,38	-9	+DC
6	Not assembled		
7	Not assembled		
8	24,38	12,2	+T
9	Not assembled		
10	Not assembled		
11	24,38	21,8	-T
12	Not assembled		
13	Not assembled		
14	Not assembled		
15	Not assembled		
16	13,42	-21,8	G5
17	Not assembled		
18	Not assembled		
19	Not assembled		
20	Not assembled		
21	Not assembled		
22	8,38	2,6	E3
23	8,38	5,8	G3
24	Not assembled		
25	Not assembled		
26	8,38	18,6	E1
27	8,38	21,8	G1
28	2,46	-21,8	E5
29	2,46	-18,6	W
30	2,46	-15,4	W
31	2,46	-12,2	W
32	2,46	-9	W
33	Not assembled		

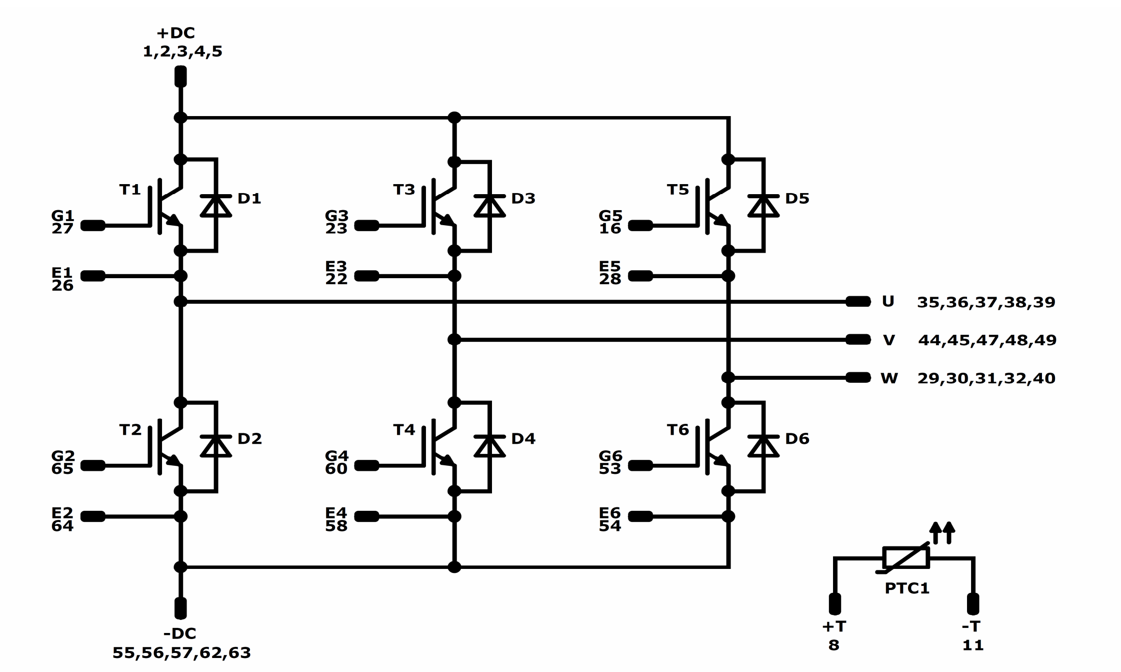
Pin table [mm]

Pin	X	Y	Function
34	Not assembled		
35	0,03	9	U
36	0,03	12,2	U
37	0,03	15,4	U
38	0,03	18,6	U
39	0,03	21,8	U
40	-8,5	-21,8	W
41	Not assembled		
42	Not assembled		
43	Not assembled		
44	-12,22	-9	V
45	-12,22	-5,8	V
46	Not assembled		
47	-12,22	3,9	V
48	-12,22	7,1	V
49	-12,22	10,3	V
50	Not assembled		
51	Not assembled		
52	Not assembled		
53	-24,38	-21,8	G6
54	-24,38	-18,6	E6
55	-24,38	-15,4	-DC
56	-24,38	-12,2	-DC
57	-24,38	-9	-DC
58	-24,38	-5,8	E4
59	Not assembled		
60	-24,38	0,7	G4
61	Not assembled		
62	-24,38	7,1	-DC
63	-24,38	15,4	-DC
64	-24,38	18,6	E2
65	-24,38	21,8	G2



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,T2,T3,T4,T5,T6	IGBT	600 V	75 A	Inverter Switch	
D1,D2,D3,D4,D5,D6	FWD	600 V	75 A	Inverter Diode	
PTC1	PTC			Thermistor	

Packaging instruction					
Standard packaging quantity (SPQ)	**72**	>SPQ	Standard	<SPQ	Sample

Handling instruction
Handling instructions for MiniSkiiP® 2 packages see vincotech.com website.

Package data
Package data for MiniSkiiP® 2 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-K233-F-D4-14	06 Feb. 2018		