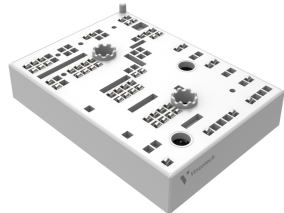
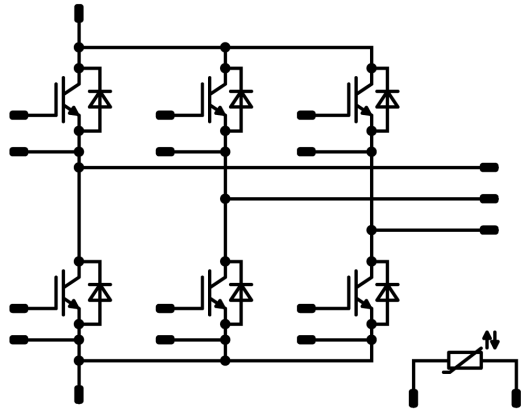




MiniSKiiP PACK 3		1200 V / 75 A
Features <ul style="list-style-type: none">• Solderless interconnection• Trench Fieldstop IGBT4 technology	MiniSKiiP® 3 16 mm housing 	
Target applications <ul style="list-style-type: none">• Servo Drives• Industrial Motor Drives• UPS	Schematic 	
Types <ul style="list-style-type: none">• V23990-K438-F40-PM		



Maximum Ratings

$T_j = 25\text{ °C}$, unless otherwise specified

Parameter	Symbol	Conditions	Value	Unit
Inverter Switch				
Collector-emitter voltage	V_{CES}		1200	V
Collector current (DC current)	I_C	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	71	A
Repetitive peak collector current	I_{CRM}	t_p limited by T_{jmax}	225	A
Total power dissipation	P_{tot}	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	162	W
Gate-emitter voltage	V_{GES}		±20	V
Short circuit ratings	t_{SC}	$V_{GE} = 15\text{ V}$, $V_{CC} = 800\text{ V}$ $T_j = 150\text{ °C}$	10	µs
Maximum junction temperature	T_{jmax}		175	°C

Inverter Diode				
Peak repetitive reverse voltage	V_{RRM}		1200	V
Forward current (DC current)	I_F	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	65	A
Surge (non-repetitive) forward current	I_{FSM}	Single Half Sine Wave, $t_p = 10\text{ ms}$ $T_j = 150\text{ °C}$	430	A
Surge current capability	I^2t		925	A ² s
Total power dissipation	P_{tot}	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	127	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* $t_p = 2\text{ s}$	5500	V
Isolation voltage	V_{isol}	AC Voltage $t_p = 1\text{ min}$	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_{GS} [V]	V_{GE} [V]	V_{DS} [V]	V_F [V]	I_C [A] I_D [A] I_F [A]	T_j [°C]	Min	Typ	

Inverter Switch

Static

Gate-emitter threshold voltage	$V_{GE(th)}$	$V_{CE} = V_{GE}$			0,0026	25	5,3	5,8	6,3	V
Collector-emitter saturation voltage	$V_{CE(sat)}$		15		75	25 150	1,58	1,87 2,29	2,07 ⁽¹⁾	V
Collector-emitter cut-off current	I_{CES}		0	1200		25			1	μA
Gate-emitter leakage current	I_{GES}		20	0		25			120	nA
Internal gate resistance	r_g							10		Ω
Input capacitance	C_{ies}	$f = 1 \text{ Mhz}$	0	25		25		4300		pF
Reverse transfer capacitance	C_{res}							160		pF
Gate charge	Q_g		15		0	25		570		nC

Thermal

Thermal resistance junction to sink ⁽²⁾	$R_{th(j-s)}$	$\lambda_{paste} = 1 \text{ W/mK (P12)}$						0,58		K/W
--	---------------	--	--	--	--	--	--	------	--	-----

Dynamic

Turn-on delay time	$t_{d(on)}$	$R_{gon} = 4 \Omega$ $R_{goff} = 4 \Omega$	±15	600	75	25		168,4		ns
Rise time	t_r					150		187		ns
Turn-off delay time	$t_{d(off)}$					25		275,6		ns
Fall time	t_f					150		364,6		ns
Turn-on energy (per pulse)	E_{on}					25		64,18		mWs
						150		100,72		mWs
Turn-off energy (per pulse)	E_{off}					25		7,56		mWs
		150		11,56		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		

Inverter Diode

Static

Forward voltage	V_F				75	25 150		2,02 2,05	2,49 ⁽¹⁾ 2,42 ⁽¹⁾	V
Reverse leakage current	I_R	$V_i = 1200$ V				25 150		7000	120 14000	μA

Thermal

Thermal resistance junction to sink ⁽²⁾	$R_{th(j-s)}$	$\lambda_{paste} = 1$ W/mK (P12)						0,75		K/W
--	---------------	----------------------------------	--	--	--	--	--	------	--	-----

Dynamic

Peak recovery current	I_{RRM}	$di/dt=1675$ A/μs $di/dt=1682$ A/μs	±15	600	75	25		47,19		A
Reverse recovery time	t_{rr}					150		67,68		
						25		138,56		ns
Recovered charge	Q_r					150		487,17		
						25		5,28		μC
Reverse recovered energy	E_{rec}					150		14		
		25		1,53		mWs				
Peak rate of fall of recovery current	$(di_{rr}/dt)_{max}$	150		4,99						
		25		424,02		A/μs				
						150		769,15		



Characteristic Values

Parameter	Symbol	Conditions					Values			Unit
		V_{GS} [V]	V_{GE} [V]	V_{DS} [V]	V_{CE} [V]	I_D [A]	I_C [A]	T_j [°C]	Min	

Thermistor

Static

Rated resistance	R					25		1		kΩ
Deviation of R_{100}	$A_{R/R}$	$R_{100} = 1670 \Omega$				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.

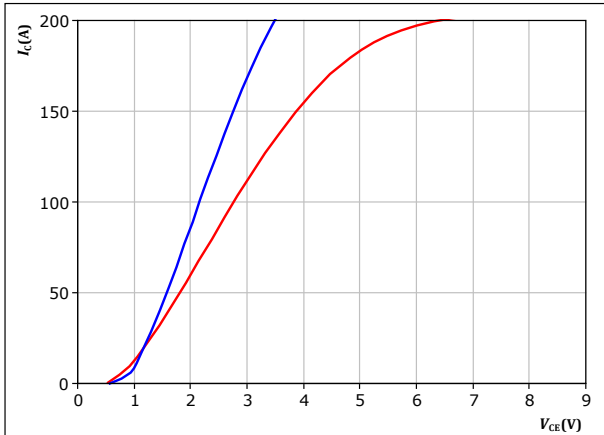


Inverter Switch Characteristics

figure 1. IGBT

Typical output characteristics

$$I_C = f(V_{CE})$$

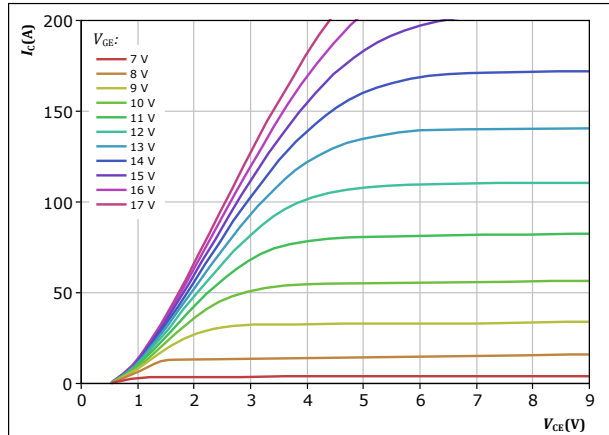


$t_p = 250 \mu s$
 $V_{GE} = 15 V$
 $T_j: 25^\circ C$ (blue line)
 $150^\circ C$ (red line)

figure 2. IGBT

Typical output characteristics

$$I_C = f(V_{CE})$$

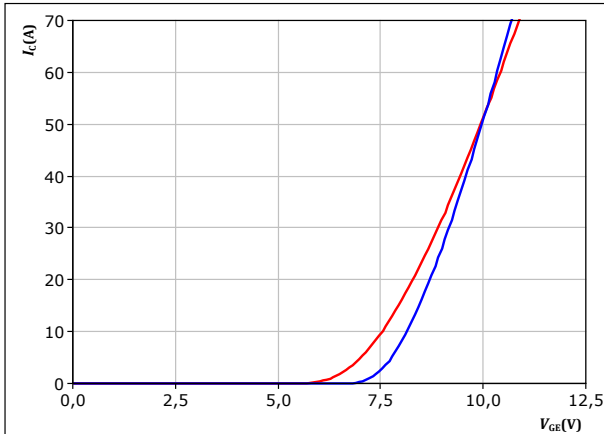


$t_p = 250 \mu s$
 $T_j = 150^\circ C$
 V_{GE} from 7 V to 17 V in steps of 1 V

figure 3. IGBT

Typical transfer characteristics

$$I_C = f(V_{GE})$$

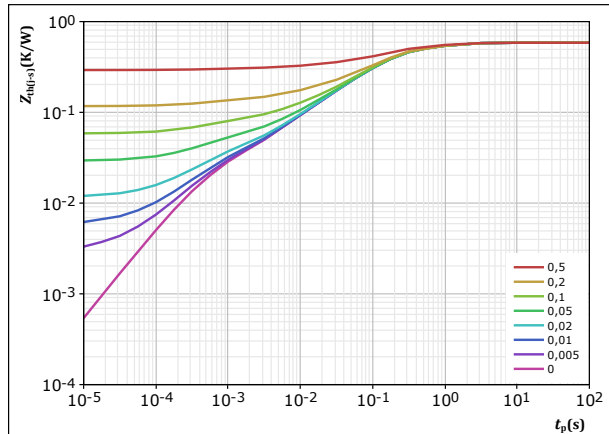


$t_p = 250 \mu s$
 $V_{CE} = 10 V$
 $T_j: 25^\circ C$ (blue line)
 $150^\circ C$ (red line)

figure 4. IGBT

Transient thermal impedance as a function of pulse width

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



$D = t_p / T$
 $R_{th(j-s)} = 0,585 K/W$
 IGBT thermal model values

R (K/W)	τ (s)
1,12E-01	1,05E+00
3,33E-01	1,51E-01
7,79E-02	3,57E-02
3,97E-02	7,25E-03
2,20E-02	4,95E-04

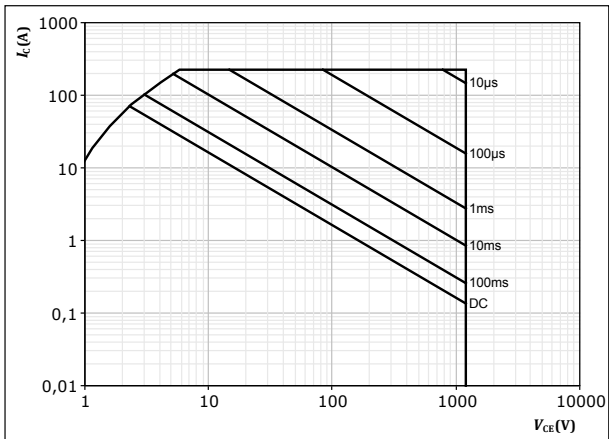


Inverter Switch Characteristics

figure 5. IGBT

Safe operating area

$$I_C = f(V_{CE})$$



$D =$ single pulse
 $T_s = 80 \text{ } ^\circ\text{C}$
 $V_{GE} = 15 \text{ V}$
 $T_j = T_{jmax}$



Inverter Diode Characteristics

figure 6. FWD

Typical forward characteristics

$$I_F = f(V_F)$$

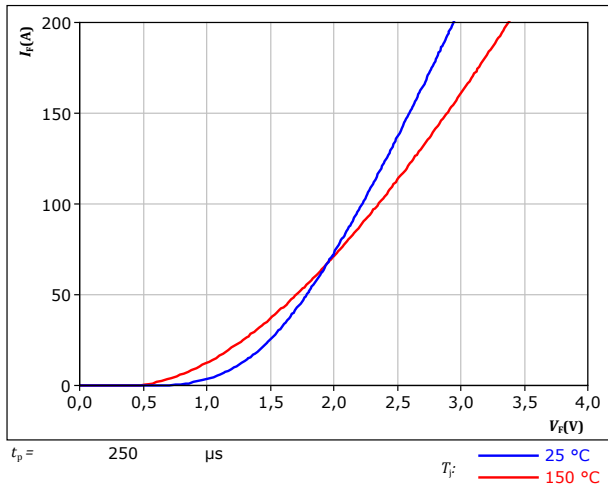
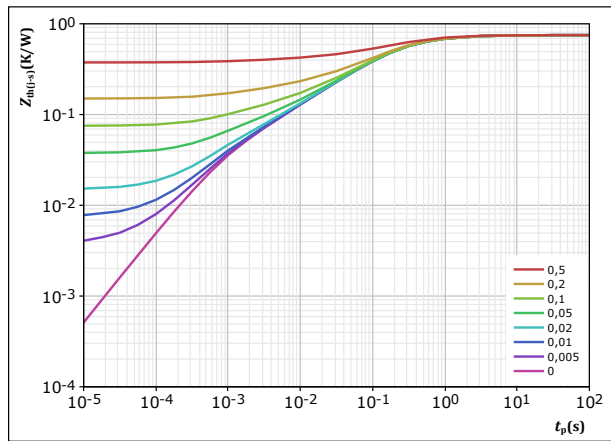


figure 7. FWD

Transient thermal impedance as a function of pulse width

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



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

R (K/W)	τ (s)
1,93E-02	8,29E+00
1,28E-01	9,82E-01
3,82E-01	1,84E-01
1,42E-01	3,45E-02
4,85E-02	5,27E-03
3,05E-02	8,56E-04

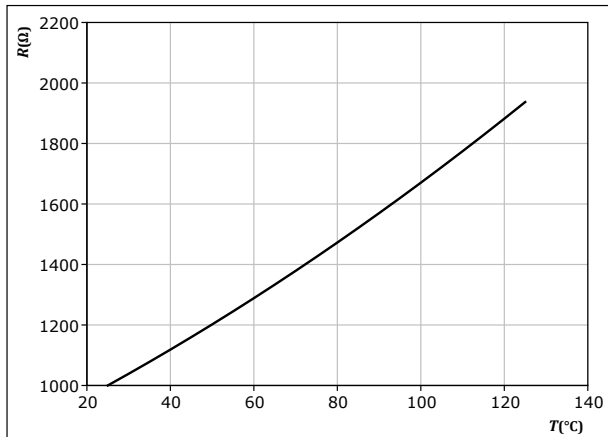


Thermistor Characteristics

figure 8. Thermistor

Typical PTC characteristic as function of temperature

$$R_T = f(T)$$

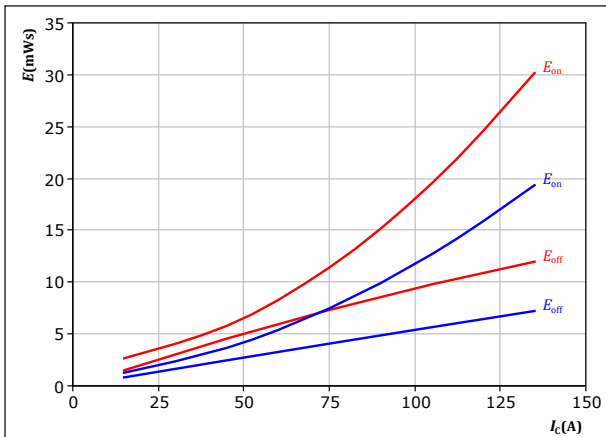




Inverter Switching Characteristics

figure 9. IGBT

Typical switching energy losses as a function of collector current
 $E = f(I_c)$



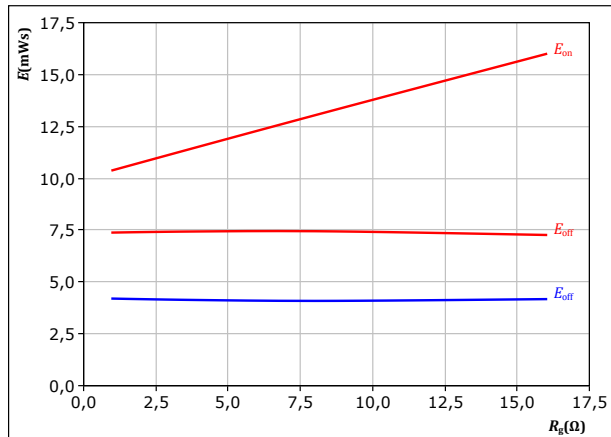
With an inductive load at

$V_{CE} = 600$ V
 $V_{GE} = \pm 15$ V
 $R_{gon} = 4$ Ω
 $R_{goff} = 4$ Ω

T_j : — 25 °C
 — 150 °C

figure 10. IGBT

Typical switching energy losses as a function of gate resistor
 $E = f(R_g)$



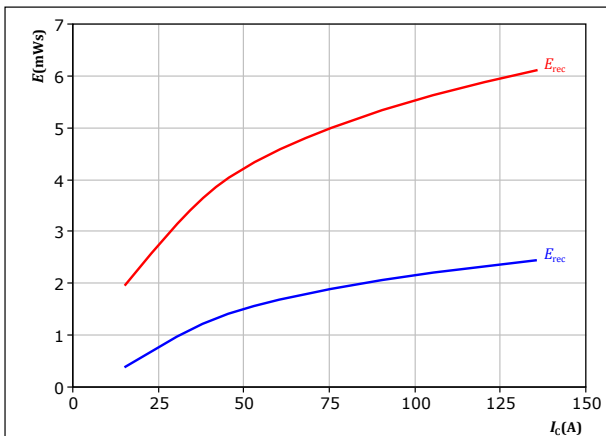
With an inductive load at

$V_{CE} = 600$ V
 $V_{GE} = \pm 15$ V
 $I_c = 75$ A

T_j : — 25 °C
 — 150 °C

figure 11. FWD

Typical reverse recovered energy loss as a function of collector current
 $E_{rec} = f(I_c)$



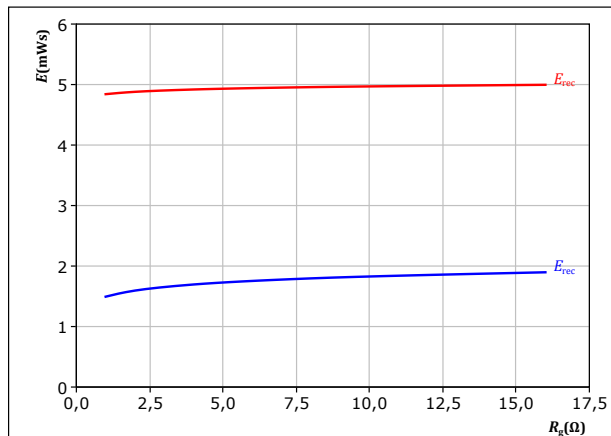
With an inductive load at

$V_{CE} = 600$ V
 $V_{GE} = \pm 15$ V
 $R_{gon} = 4$ Ω

T_j : — 25 °C
 — 150 °C

figure 12. FWD

Typical reverse recovered energy loss as a function of gate resistor
 $E_{rec} = f(R_g)$



With an inductive load at

$V_{CE} = 600$ V
 $V_{GE} = \pm 15$ V
 $I_c = 75$ A

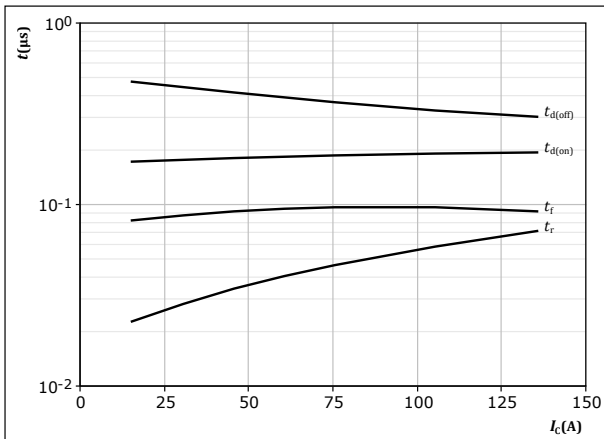
T_j : — 25 °C
 — 150 °C



Inverter Switching Characteristics

figure 13. IGBT

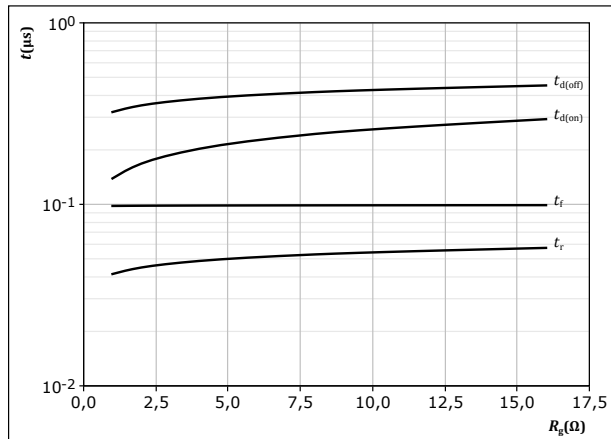
Typical switching times as a function of collector current
 $t = f(I_c)$



With an inductive load at
 $T_j = 150$ °C
 $V_{CE} = 600$ V
 $V_{GE} = \pm 15$ V
 $R_{gon} = 4$ Ω
 $R_{goff} = 4$ Ω

figure 14. IGBT

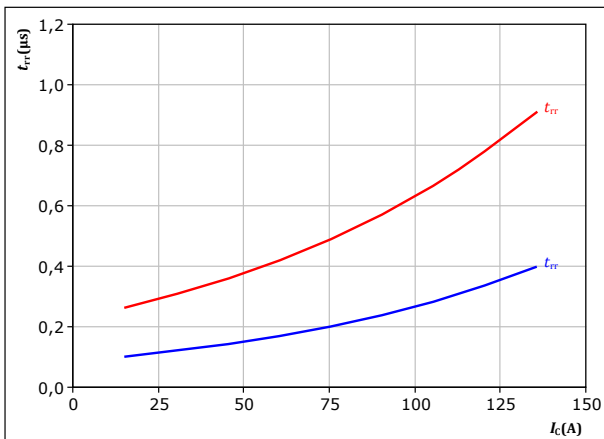
Typical switching times as a function of gate resistor
 $t = f(R_g)$



With an inductive load at
 $T_j = 150$ °C
 $V_{CE} = 600$ V
 $V_{GE} = \pm 15$ V
 $I_c = 75$ A

figure 15. FWD

Typical reverse recovery time as a function of collector current
 $t_{rr} = f(I_c)$

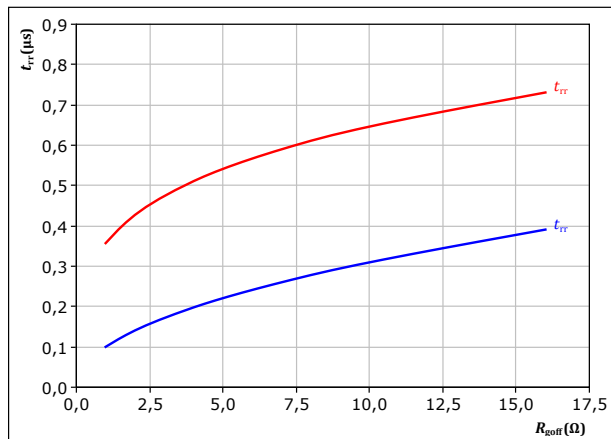


With an inductive load at
 $V_{CE} = 600$ V
 $V_{GE} = \pm 15$ V
 $R_{gon} = 4$ Ω

T_j : — 25 °C
— 150 °C

figure 16. FWD

Typical reverse recovery time as a function of IGBT turn off gate resistor
 $t_{rr} = f(R_{goff})$



With an inductive load at
 $V_{CE} = 600$ V
 $V_{GE} = \pm 15$ V
 $I_c = 75$ A

T_j : — 25 °C
— 150 °C

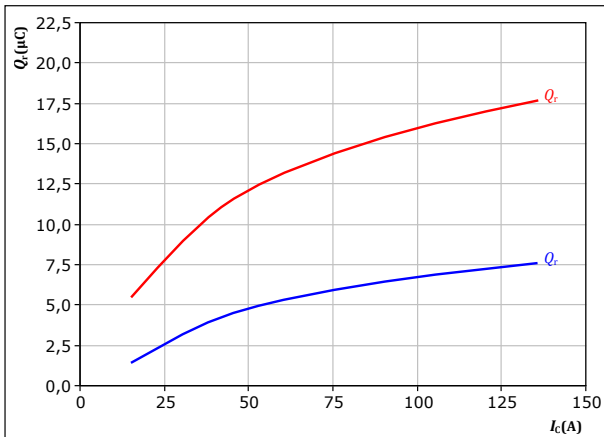


Inverter Switching Characteristics

figure 17. FWD

Typical recovered charge as a function of collector current

$$Q_r = f(I_c)$$



With an inductive load at

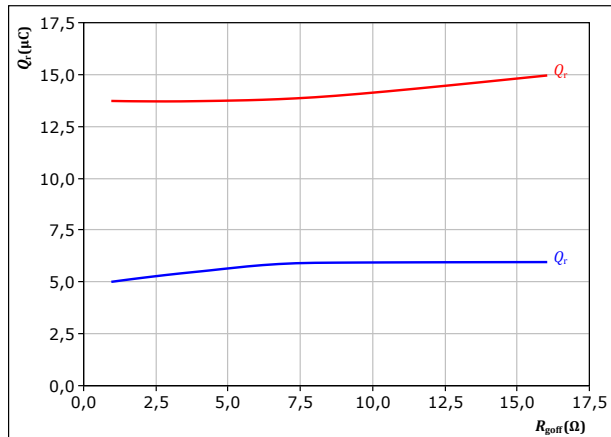
$V_{CE} = 600$ V
 $V_{GE} = \pm 15$ V
 $R_{goff} = 4$ Ω

T_j : — 25 °C
— 150 °C

figure 18. FWD

Typical recovered charge as a function of turn off gate resistor

$$Q_r = f(R_{goff})$$



With an inductive load at

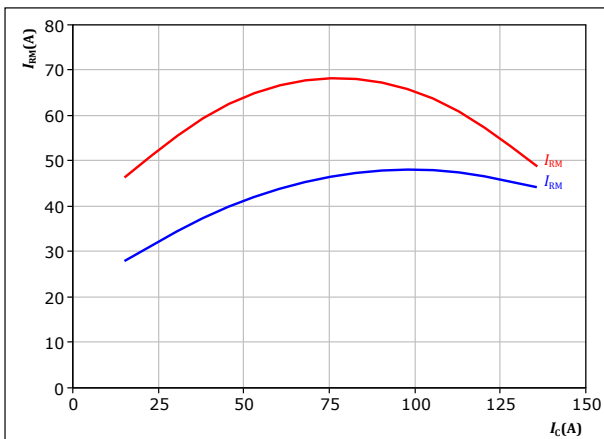
$V_{CE} = 600$ V
 $V_{GE} = \pm 15$ V
 $I_c = 75$ A

T_j : — 25 °C
— 150 °C

figure 19. FWD

Typical peak reverse recovery current as a function of collector current

$$I_{RM} = f(I_c)$$



With an inductive load at

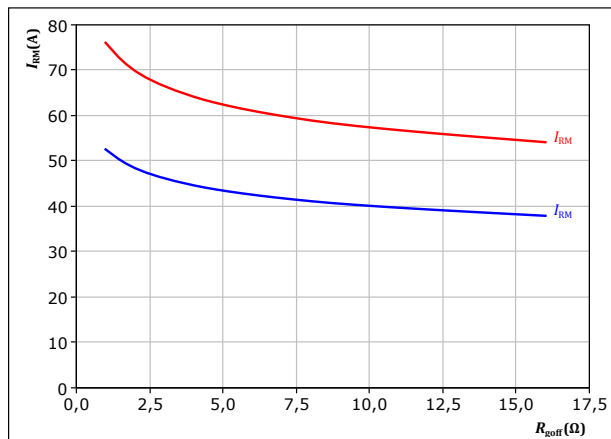
$V_{CE} = 600$ V
 $V_{GE} = \pm 15$ V
 $R_{goff} = 4$ Ω

T_j : — 25 °C
— 150 °C

figure 20. FWD

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

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



With an inductive load at

$V_{CE} = 600$ V
 $V_{GE} = \pm 15$ V
 $I_c = 75$ A

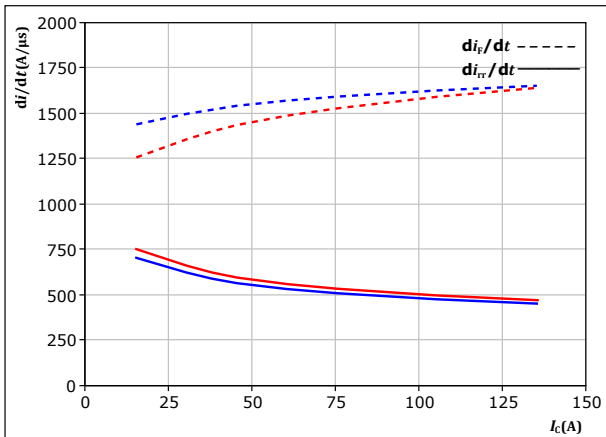
T_j : — 25 °C
— 150 °C



Inverter Switching Characteristics

figure 21. FWD

Typical rate of fall of forward and reverse recovery current as a function of collector current
 $di_f/dt, di_{rr}/dt = f(I_c)$



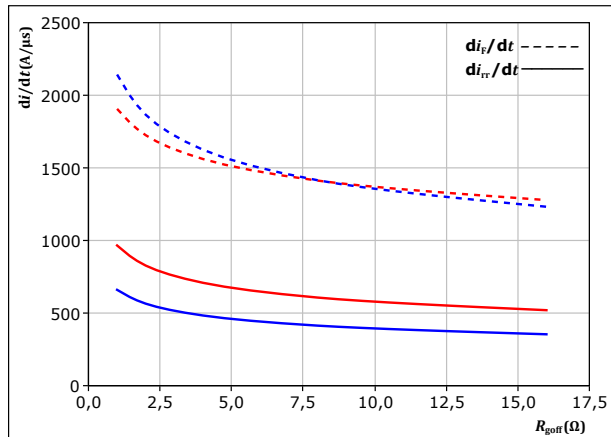
With an inductive load at

$V_{CE} = 600 \text{ V}$
 $V_{GE} = \pm 15 \text{ V}$
 $R_{goff} = 4 \text{ } \Omega$

T_j : — 25 °C
 — 150 °C

figure 22. FWD

Typical rate of fall of forward and reverse recovery current as a function of turn off gate resistor
 $di_f/dt, di_{rr}/dt = f(R_{goff})$



With an inductive load at

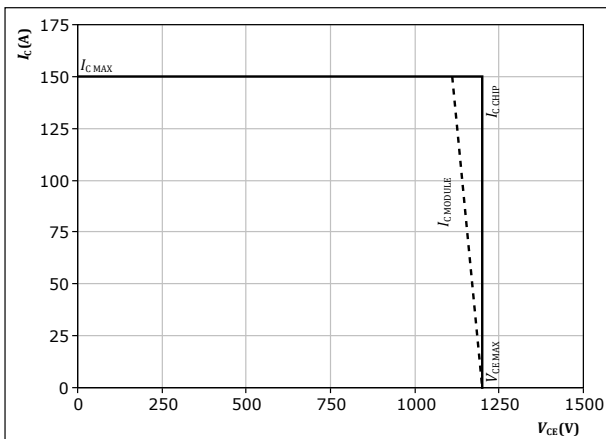
$V_{CE} = 600 \text{ V}$
 $V_{GE} = \pm 15 \text{ V}$
 $I_c = 75 \text{ A}$

T_j : — 25 °C
 — 150 °C

figure 23. IGBT

Reverse bias safe operating area

$I_c = f(V_{CE})$



At $T_j = 150 \text{ } ^\circ\text{C}$
 $R_{goff} = 4 \text{ } \Omega$
 $R_{goff} = 4 \text{ } \Omega$



Inverter Switching Definitions

figure 24. IGBT
Turn-off Switching Waveforms & definition of t_{doff} , t_{Eoff} (t_{Eoff} = integrating time for E_{off})

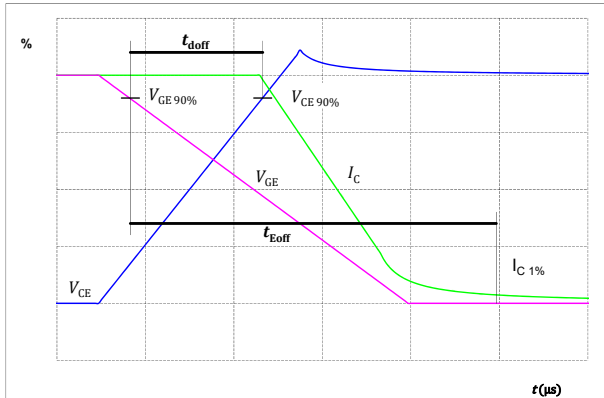


figure 25. IGBT
Turn-on Switching Waveforms & definition of t_{don} , t_{Eon} (t_{Eon} = integrating time for E_{on})

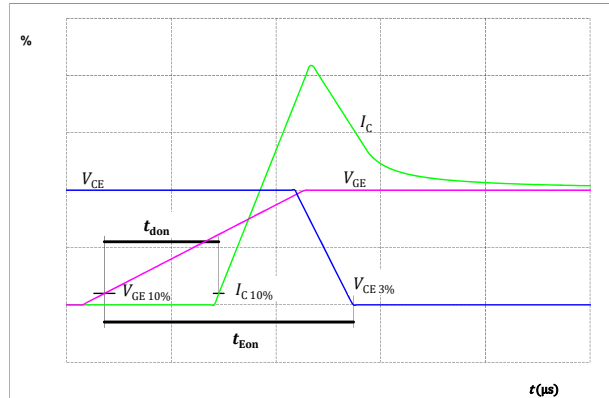


figure 26. IGBT
Turn-off Switching Waveforms & definition of t_f

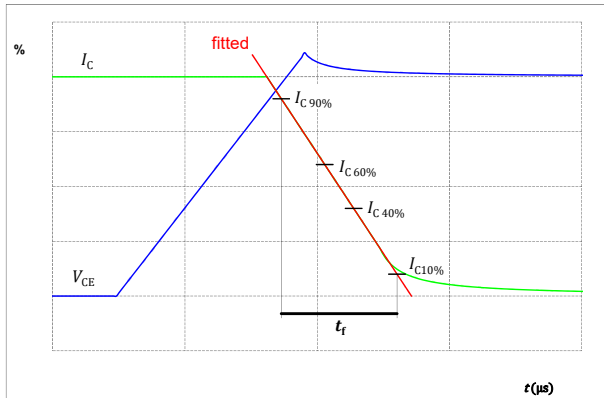
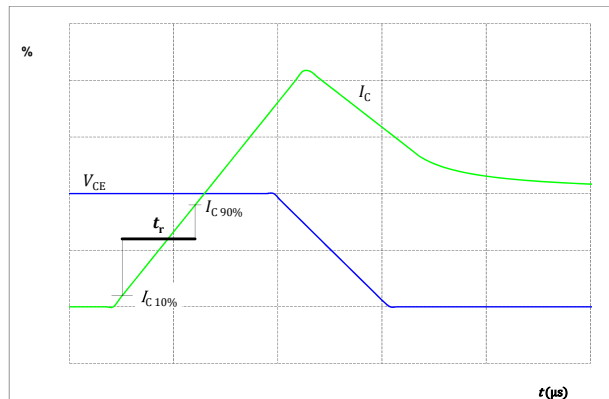


figure 27. IGBT
Turn-on Switching Waveforms & definition of t_r





Inverter Switching Definitions

figure 28. FWD

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

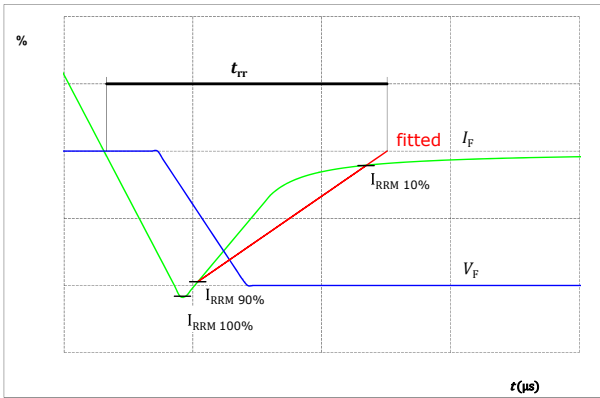
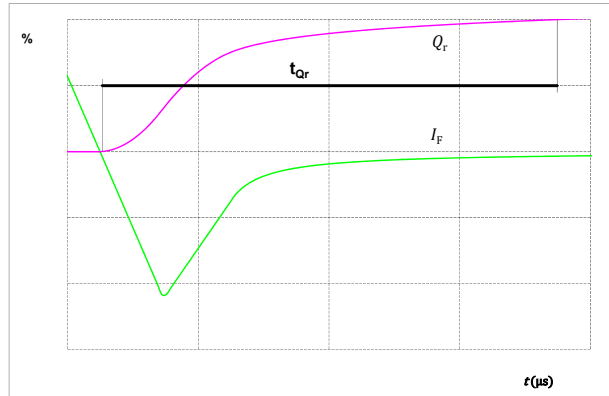


figure 29. FWD

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



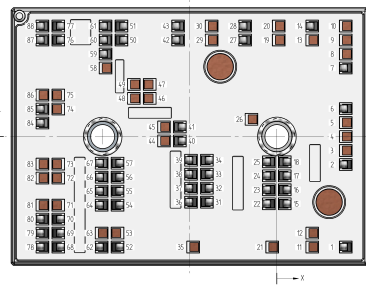


Vincotech

Ordering Code	
Version	Ordering Code
With std lid (6.5mm height) + no thermal grease	V23990-K438-F40-/0A/-PM
With thin lid (2.8mm height) + no thermal grease	V23990-K438-F40-/0B/-PM
With std lid (6.5mm height) + thermal grease (0,8 W/mK, P12, silicone-based)	V23990-K438-F40-/1A/-PM
With thin lid (2.8mm height) + thermal grease (0,8 W/mK, P12, silicone-based)	V23990-K438-F40-/1B/-PM
With std lid (6.5mm height) + thermal grease (2,5 W/mK, TG20032, silicone-free)	V23990-K438-F40-/4A/-PM
With thin lid (2.8mm height) + thermal grease (2,5 W/mK, TG20032, silicone-free)	V23990-K438-F40-/4B/-PM
With std lid (6.5mm height) + thermal grease (2,5 W/mK, HPTP, silicone-based)	V23990-K438-F40-/5A/-PM
With thin lid (2.8mm height) + thermal grease (2,5 W/mK, HPTP, silicone-based)	V23990-K438-F40-/5B/-PM

Marking							
	Text	VIN	Date code	Type&Ver	UL	Lot	Serial
	Datamatrix	VIN	WWYY	TTTTTTTV	UL	LLLLL	SSSS
		Type&Ver	Lot number	Serial	Date code		
		TTTTTTTV	LLLLL	SSSS	WWYY		

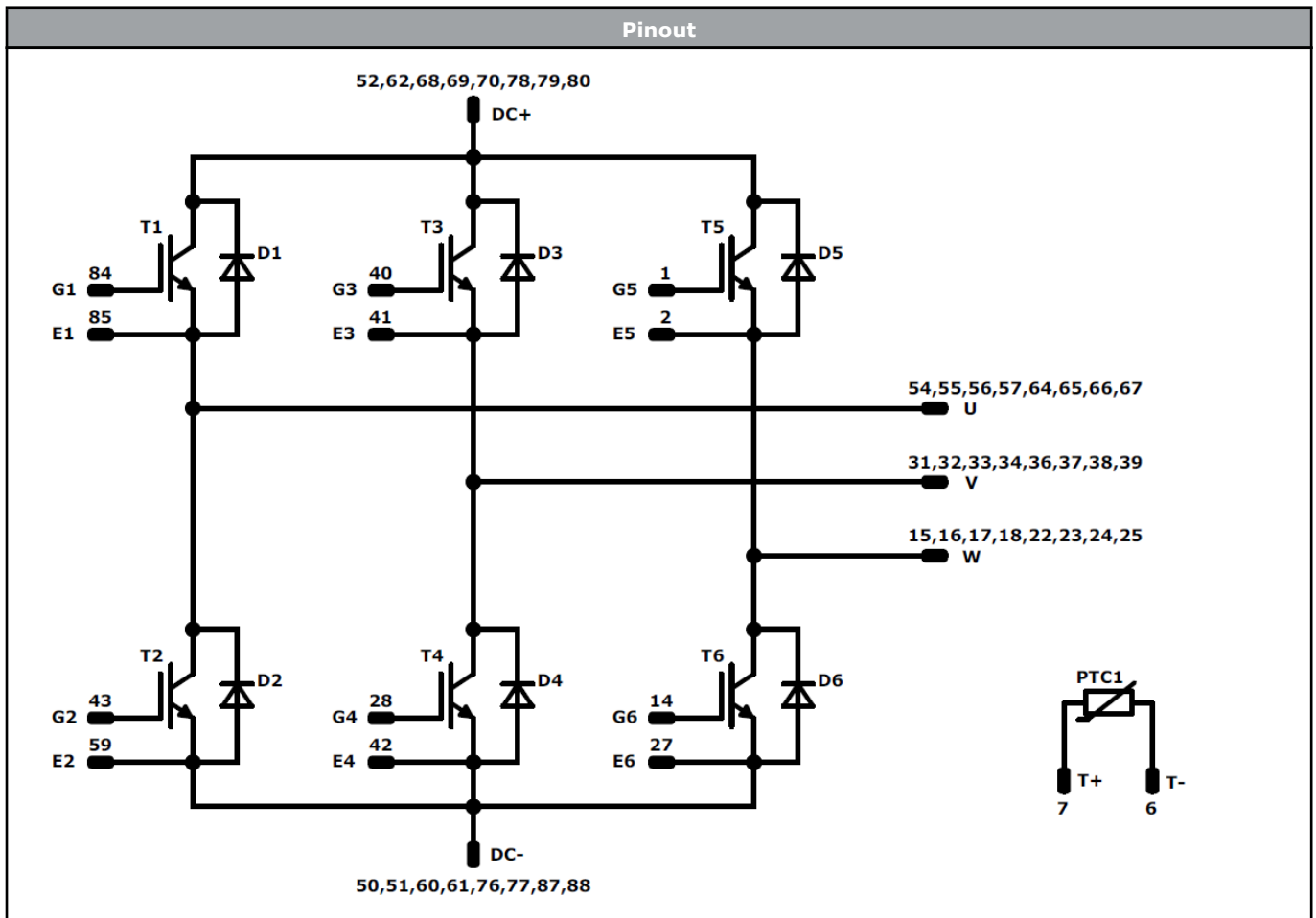
Outline							
Pin table [mm]							
Pin	X	Y	Function	45			
1	15,83	-25,3	G5	45	not assembled		
2	15,83	-6,4	E5	46	not assembled		
3				47	not assembled		
4				48	not assembled		
5				49	not assembled		
6	15,83	6,4	-T	50	-35,68	22,1	-DC
7	15,83	15,7	+T	51	-35,68	25,3	-DC
8				52	-36,58	-25,3	+DC
9				53	not assembled		
10				54	-36,58	-15,7	U
11				55	-36,58	-12,5	U
12				56	-36,58	-9,3	U
13				57	-36,58	-6,1	U
14	8,13	25,3	G6	58	not assembled		
15	1,82	-15,38	W	59	-39,32	18,9	E2
16	1,82	-12,18	W	60	-39,32	22,1	-DC
17	1,82	-8,98	W	61	-39,32	25,3	-DC
18	1,82	-5,79	W	62	-40,22	-25,3	+DC
19				63	not assembled		
20				64	-40,22	-15,7	U
21				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	-50,18	-25,3	+DC
25	-1,82	-5,79	W	69	-50,18	-22,1	+DC
26				70	-50,18	-18,9	+DC
27				71	not assembled		
28	-7,27	22,1	E6	72	not assembled		
29	-7,27	25,3	G4	73	not assembled		
30				74	not assembled		
31	-16,05	-15,02	V	75	not assembled		
32	-16,05	-11,82	V	76	-50,18	22,1	-DC
33	-16,05	-8,63	V	77	-50,18	25,3	-DC
34	-16,05	-5,42	V	78	-53,82	-25,3	+DC
35				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	-22,26	-1	G3	84	-53,82	3,1	G1
41	-22,26	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				88	-53,82	25,3	-DC



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



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Identification					
ID	Component	Voltage	Current	Function	Comment
T2, T1, T4, T3, T6, T5	IGBT	1200 V	75 A	Inverter Switch	
D1, D2, D3, D4, D5, D6	FWD	1200 V	75 A	Inverter Diode	
PTC1	Thermistor			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.

Vincotech thermistor reference
See Vincotech thermistor reference table at 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-K438-F40-PM-D3-14	30 Sep. 2021	Change of Isolation voltage Change of Creepage and Clearance distances Change of Inverter Diode R-Tau values	

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1. Life support devices or systems are devices or systems which, (a) are intended for surgical implant into the body, or (b) support or sustain life, or (c) whose failure to perform when properly used in accordance with instructions for use provided in labelling can be reasonably expected to result in significant injury to the user.
2. A critical component is any component of a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.