

fastPACK0 H 2nd gen

V23990-P723-F04-01-14

Maximum Ratings / Höchstzulässige Werte
P723-F04 600V/60A

Parameter	Condition	Symbol	Datasheet values max.	Unit
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DC link Capacitor
DC link Kondensator

Max.DC voltage Max. Gleichspannung	T _c =25°C	U _{MAX}	500	V
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Transistor H-bridge(IGBT)
Transistor H-Brücke(IGBT)

Collector-emitter break down voltage Kollektor-Emitter-Sperrspannung		V _{CE}	600	V
DC collector current Kollektor-Dauergleichstrom	T _j =T _{jmax} Th=80°C, T _c =80°C	I _C	35	A
Repetitive peak collector current Periodischer Kollektorspitzenstrom	tp limited by T _j max	I _{cpuls}	224	A
Power dissipation per IGBT Verlustleistung pro IGBT	T _j =T _{jmax} Th=80°C T _c =80°C	P _{tot}	93	W
Gate-emitter peak voltage Gate-Emitter-Spitzenspannung		V _{GE}	±20	V
SC withstand time* Kurzschlußverhalten*	T _j =T _{jmax} V _{GE} =15V V _{CC} =360V	t _{SC}	6	us
max. Chip temperature max. Chiptemperatur		T _{jmax}	150	°C

Diode H-bridge
Diode H-Brücke

DC forward current Dauergleichstrom	T _j =T _{jmax} Th=80°C, T _c =80°C	I _F	34	A
Repetitive peak forward current Periodischer Spitzenstrom	tp limited by T _j max	I _{FRM}	150	A
Power dissipation per Diode Verlustleistung pro Diode	T _j =T _{jmax} Th=80°C T _c =80°C	P _{tot}	47	W
max. Chip temperature max. Chiptemperatur		T _{jmax}	150	°C

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Maximum Ratings / Höchstzulässige Werte		P723-F04 600V/60A		
Parameter	Condition	Symbol	Datasheet values max.	Unit
Thermal properties				
Thermische Eigenschaften				
Storage temperature Lagertemperatur		T_{stg}	-40...+125	°C
Operation temperature Betriebstemperatur		T_{op}	-40...+125	°C
Insulation properties				
Modulisation				
Insulation voltage Isolationsspannung	t=1min	V_{is}	4000	Vdc
Creepage distance Kriechstrecke			min 12,7	mm
Clearance Luftstrecke			min 12,7	mm

Additional notes and remarks:

<i>* Allowed number of short circuits must be less than 1000 times, and time duration between short circuits should be more than 1 second!</i>
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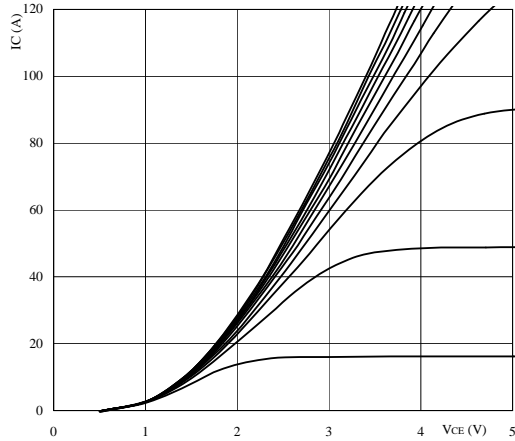
fastPACK0 H 2nd gen

V23990-P723-F04-01-14

Characteristic values/ Charakteristische Werte										
P723-F04										
Description	Symbol	Conditions					Datasheet values			Unit
		T(C°)	Other conditions (Rgon-Rgoff)	VGE(V) VGS(V)	VCE(V) VDS(V)	IC(A) IF(A) Id(A)	Min	Typ	Max	
Capacitor										
Kondensator										
C value	C						216	270	324	nF
C Wert										
Transistor H-bridge(IGBT)										
Transistor H-Brücke(IGBT)										
Gate emitter threshold voltage Gate-Schwellenspannung	V _{GE(th)}	T _J =25°C T _J =125°C	VCE=VGE			0.6m	3	4	5	V
Collector-emitter saturation voltage Kollektor-Emitter Sättigungsspannung	V _{CE(sat)}	T _J =25°C T _J =125°C		15	60			2.7 3.22	3.7	V
Collector-emitter cut-off Kollektor-Emitter Reststrom	I _{CES}	T _J =25°C T _J =125°C		0	600				0.35	mA
Gate-emitter leakage current Gate-Emitter Reststrom	I _{GES}	T _J =25°C T _J =125°C		20	0				300	nA
Integrated Gate resistor Integrierter Gate Widerstand	R _{gint}							none		Ω
Turn-on delay time Einschaltverzögerungszeit	t _{d(on)}	T _J =25°C T _J =125°C	Rgoff=2 Ω Rgon=4 Ω	15	400	60		18		ns
Rise time Anstiegszeit	t _r	T _J =25°C T _J =125°C	Rgoff=2 Ω Rgon=4 Ω	15	400	60		16		ns
Turn-off delay time Abschaltverzögerungszeit	t _{d(off)}	T _J =25°C T _J =125°C	Rgoff=2 Ω Rgon=4 Ω	15	400	60		206		ns
Fall time Fallzeit	t _f	T _J =25°C T _J =125°C	Rgoff=2 Ω Rgon=4 Ω	15	400	60		12		ns
Turn-on energy loss per pulse Einschaltverlustenergie pro Puls	E _{on}	T _J =25°C T _J =125°C	Rgoff=2 Ω Rgon=4 Ω	15	400	60		1.1		mWs
Turn-off energy loss per pulse Abschaltverlustenergie pro Puls	E _{off}	T _J =25°C T _J =125°C	Rgoff=2 Ω Rgon=4 Ω	15	400	60		0.96		mWs
Input capacitance Eingangskapazität	C _{ies}	T _J =25°C T _J =125°C	f=1MHz	0	25			3		nF
Output capacitance Ausgangskapazität	C _{oss}	T _J =25°C T _J =125°C	f=1MHz	0	25			0.3		nF
Reverse transfer capacitance Rückwirkungskapazität	C _{ies}	T _J =25°C T _J =125°C	f=1MHz	0	25			0.18		nF
Thermal resistance chip to heatsink per chip Wärmewiderstand Chip-Kühlkörper pro Chip	R _{th,CH}		Thermal grease thickness:50um warmeierpaste Dicke50um λ = 0.61 W/mK					0.76		K/W
Diode H-bridge										
Diode H-Brücke										
Diode forward voltage Durchlaßspannung	V _F	T _J =25°C T _J =125°C				60	1.2	1.6 1.56	2.3	V
Peak reverse recovery current Rückstromspitze	I _{RM}	T _J =25°C T _J =125°C	Rgon=4 Ω	15	400	60		100		A
Reverse recovery time Sperrverzögerungszeit	t _{rr}	T _J =25°C T _J =125°C	Rgon=4 Ω	15	400	60		126		ns
Reverse recovered charge Sperrverzögerungsladung	Q _{rr}	T _J =25°C T _J =125°C	Rgon=4 Ω	15	400	60		4.5		uC
Reverse recovered energy Sperrverzögerungsenergie	E _{rec}	T _J =25°C T _J =125°C	Rgon=4 Ω	15	400	60		1.32		mWs
Thermal resistance chip to heatsink per chip Wärmewiderstand Chip-Kühlkörper pro Chip	R _{th,CH}		Thermal grease thickness					1.49		K/W
Thermal resistance chip to case per chip Wärmewiderstand Chip-Gehäuse pro Chip	R _{th,JC}		WarmeleitpasteDicke50u							K/W
NTC-Thermistor										
NTC-Widerstand										
Rated resistance Nennwiderstand	R ₂₅	T _J =25°C	Tol. ±5%				20.9	22	23.1	kOhm
Deviation of R100 Abweichung von R100	D _{R/R}	T _C =100°C	R100=1503Ω					2.9		%K
Power dissipation given Epcos-Typ Verlustleistung Epcos-Typ angeben	P	T _J =25°C						210		mW
B-value B-Wert	B _(25/100)	T _J =25°C	Tol. ±3%					3980		K

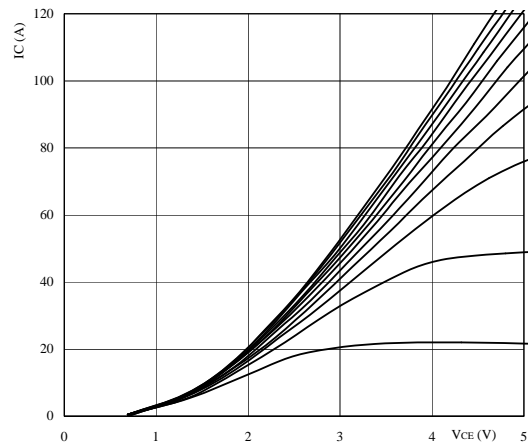
Output inverter

Figure 1. Typical output characteristics
Output inverter IGBT
 $I_c = f(V_{CE})$



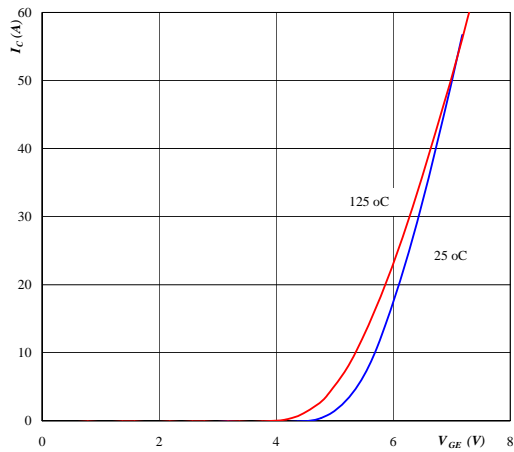
parameter: $t_p = 250 \text{ us}$ $T_j = 25 \text{ }^\circ\text{C}$
 V_{GE} parameter: from: 6 V to 16 V
 in 1 V steps

Figure 2. Typical output characteristics
Output inverter IGBT
 $I_c = f(V_{CE})$



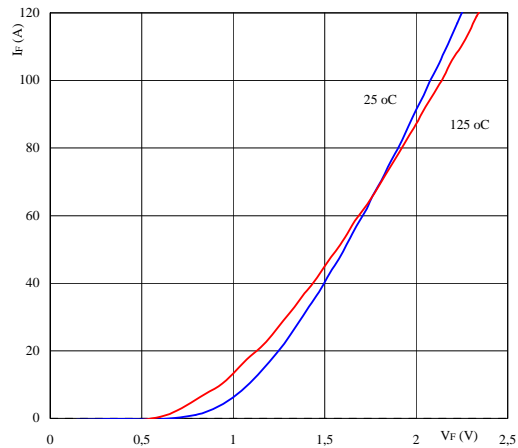
parameter: $t_p = 250 \text{ us}$ $T_j = 125 \text{ }^\circ\text{C}$
 V_{GE} parameter: from: 6 V to 16 V
 in 1 V steps

Figure 3. Typical transfer characteristics
Output inverter IGBT
 $I_c = f(V_{GE})$



parameter: $t_p = 250 \text{ us}$ $V_{CE} = 10 \text{ V}$

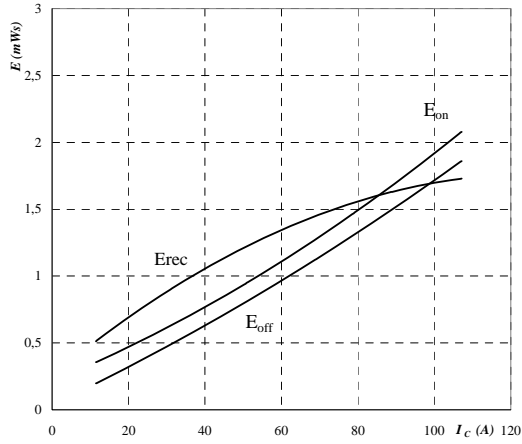
Figure 4. Typical diode forward current as a function of forward voltage
Output inverter FRED $I_F = f(V_F)$



parameter: $t_p = 250 \text{ us}$

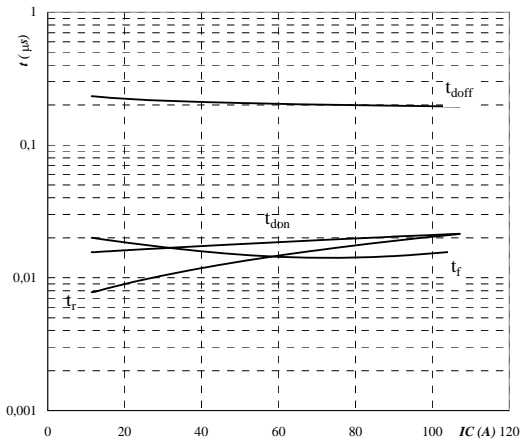
Output inverter

Figure 5. Typical switching energy losses as a function of collector current
 Output inverter IGBT
 $E = f(I_c)$



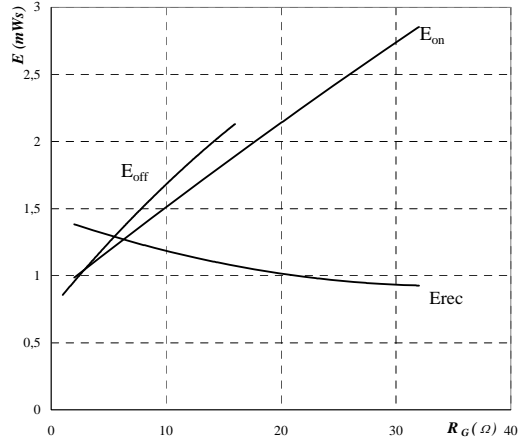
inductive load, $T_j = 125\text{ }^\circ\text{C}$
 $V_{CE} = 400\text{ V}$
 $V_{GE} = 15\text{ V}$
 $R_{gon} = 4\text{ }\Omega$
 $R_{goff} = 2\text{ }\Omega$

Figure 7. Typical switching times as a function of collector current
 Output inverter IGBT
 $t = f(I_c)$



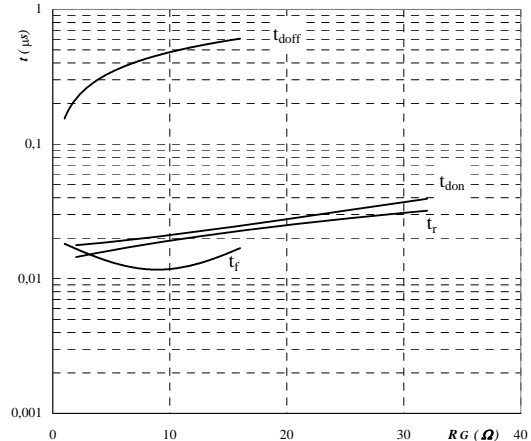
inductive load, $T_j = 125\text{ }^\circ\text{C}$
 $V_{CE} = 400\text{ V}$
 $V_{GE} = 15\text{ V}$
 $R_{gon} = 4\text{ }\Omega$
 $R_{goff} = 2\text{ }\Omega$

Figure 6. Typical switching energy losses as a function of gate resistor
 Output inverter IGBT
 $E = f(R_G)$



inductive load, $T_j = 125\text{ }^\circ\text{C}$
 $V_{CE} = 400\text{ V}$
 $V_{GE} = 15\text{ V}$
 $I_c = 60\text{ A}$

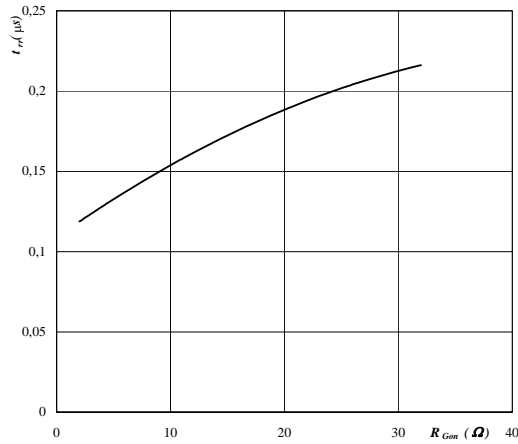
Figure 8. Typical switching times as a function of gate resistor
 Output inverter IGBT
 $t = f(R_G)$



inductive load, $T_j = 125\text{ }^\circ\text{C}$
 $V_{CE} = 400\text{ V}$
 $V_{GE} = 15\text{ V}$
 $I_c = 60\text{ A}$

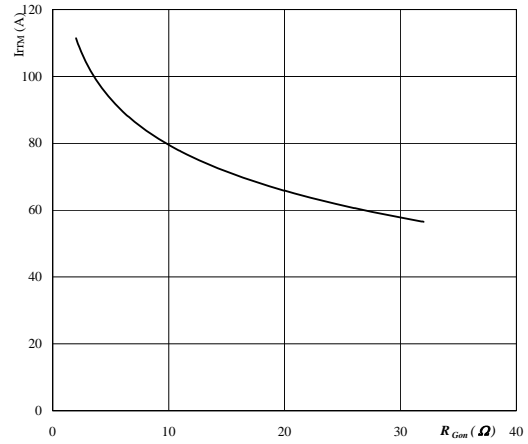
Output inverter

Figure 9. Typical reverse recovery time as a function of IGBT turn on gate resistor
 Output inverter FRED diode
 $t_{rr} = f(R_{gon})$



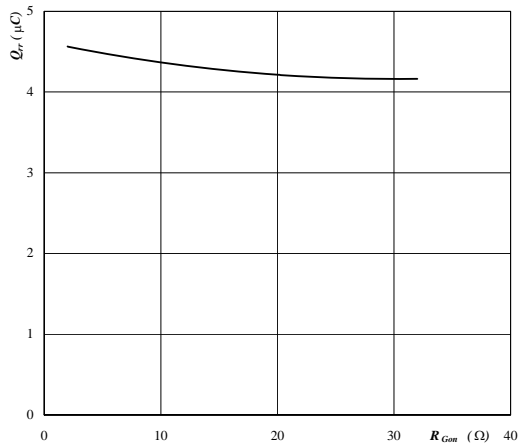
$T_j = 125\text{ }^\circ\text{C}$
 $V_R = 400\text{ V}$
 $I_F = 60\text{ A}$
 $V_{GE} = 15\text{ V}$

Figure 10. Typical reverse recovery current as a function of IGBT turn on gate resistor
 Output inverter FRED diode
 $I_{RRM} = f(R_{gon})$



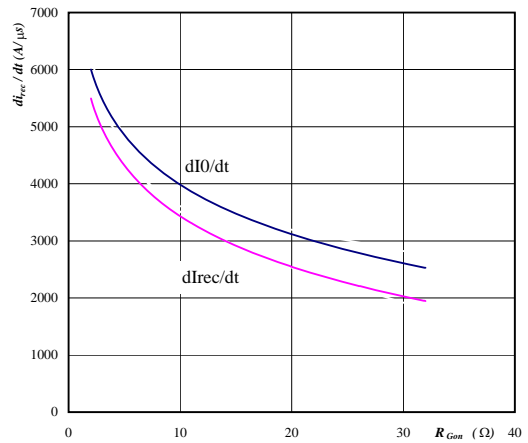
$T_j = 125\text{ }^\circ\text{C}$
 $V_R = 400\text{ V}$
 $I_F = 60\text{ A}$
 $V_{GE} = 15\text{ V}$

Figure 11. Typical reverse recovery charge as a function of IGBT turn on gate resistor
 Output inverter FRED diode
 $Q_{rr} = f(R_{gon})$



$T_j = 125\text{ }^\circ\text{C}$
 $V_R = 400\text{ V}$
 $I_F = 60\text{ A}$
 $V_{GE} = 15\text{ V}$

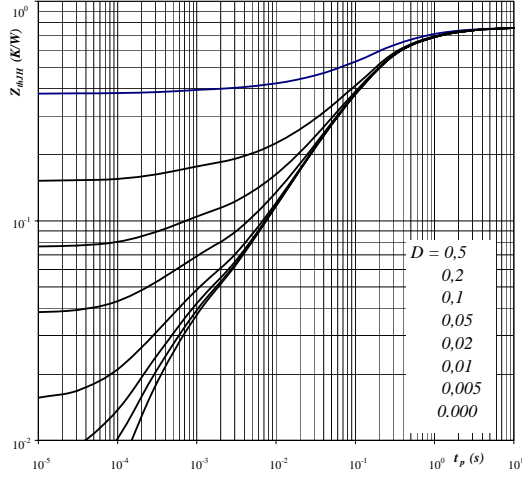
Figure 12. Typical rate of fall of forward and reverse recovery current as a function of IGBT turn on gate resistor
 Output inverter FRED diode
 $dI_0/dt, dI_{rec}/dt = f(R_{gon})$



$T_j = 125\text{ }^\circ\text{C}$
 $V_R = 400\text{ V}$
 $I_F = 60\text{ A}$
 $V_{GE} = 15\text{ V}$

Output inverter

Figure 13. IGBT transient thermal impedance as a function of pulse width
 $Z_{thJH} = f(t_p)$

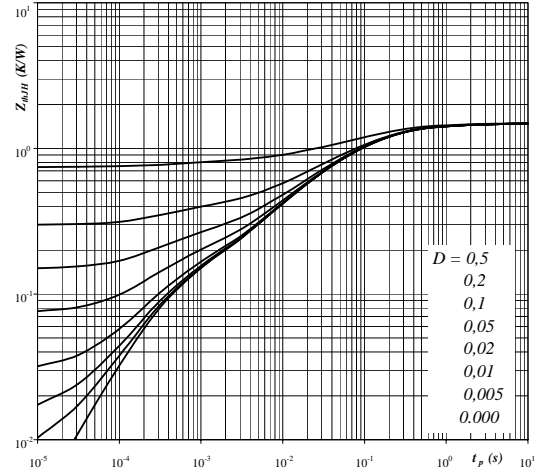


Parameter: $D = t_p / T$ $R_{thJH} = 0,76 \text{ K/W}$

IGBT thermal model values

R (C/W)	Tau (s)
0,04	4,9E+00
0,13	8,8E-01
0,41	1,7E-01
0,12	3,0E-02
0,03	4,9E-03
0,03	4,3E-04

Figure 14. FRED transient thermal impedance as a function of pulse width
 $Z_{thJH} = f(t_p)$



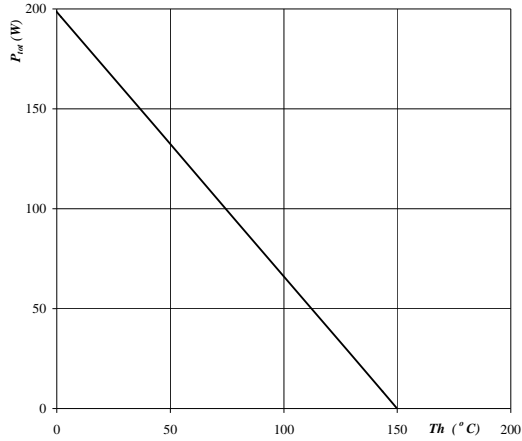
Parameter: $D = t_p / T$ $R_{thJH} = 1,49 \text{ K/W}$

FRED thermal model values

R (C/W)	Tau (s)
0,06	3,8E+00
0,20	5,1E-01
0,62	1,1E-01
0,39	2,2E-02
0,12	3,8E-03
0,10	3,3E-04

Output inverter
Figure 15. Power dissipation as a function of heatsink temperature

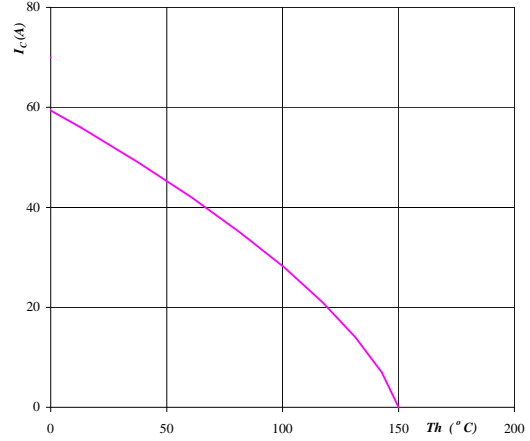
Output inverter IGBT
 $P_{tot} = f(Th)$



parameter: $T_j = 150^\circ\text{C}$

Figure 16. Collector current as a function of heatsink temperature

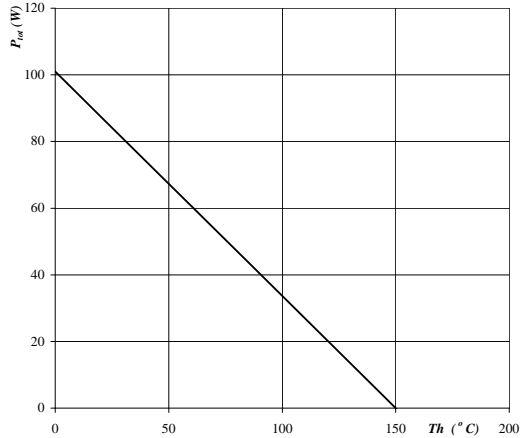
Output inverter IGBT
 $I_c = f(Th)$



parameter: $T_j = 150^\circ\text{C}$
 $V_{GE} = 15\text{ V}$

Figure 17. Power dissipation as a function of heatsink temperature

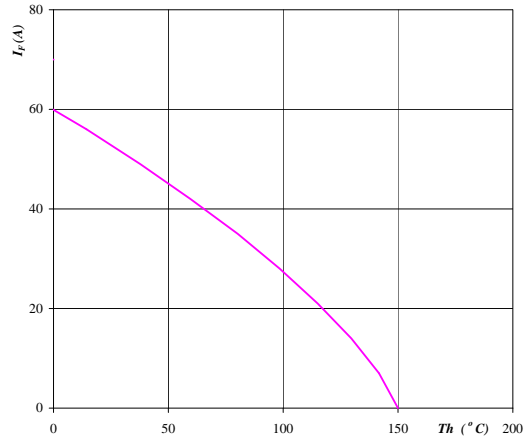
Output inverter FRED
 $P_{tot} = f(Th)$



parameter: $T_j = 150^\circ\text{C}$

Figure 18. Forward current as a function of heatsink temperature

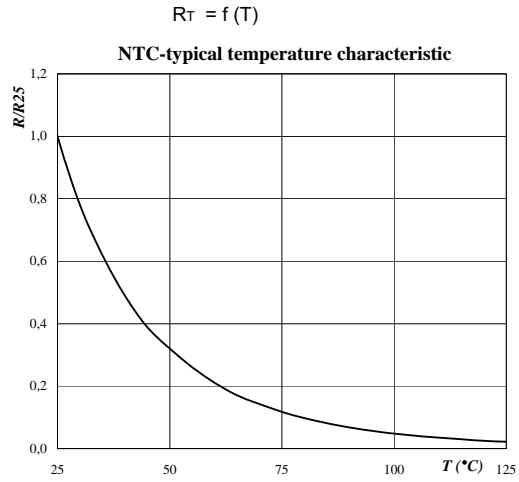
Output inverter FRED
 $I_F = f(Th)$



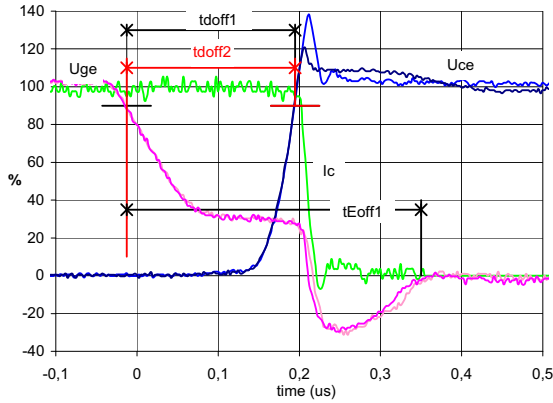
parameter: $T_j = 150^\circ\text{C}$

Thermistor

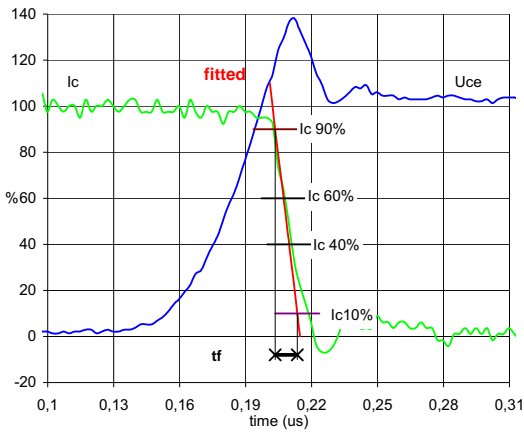
Figure 1. Typical NTC characteristic as a function of temperature



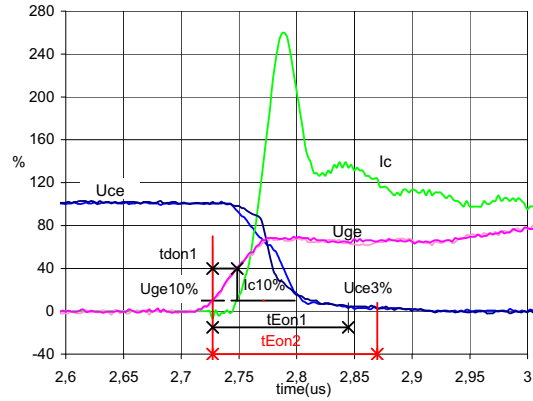
Switching definitions

 General conditions: $T_J = 125\text{ }^\circ\text{C}$
 $R_{gon} = 4\ \Omega$ $R_{goff} = 2\ \Omega$
Figure 1. Turn-off Switching Waveforms & definition of t_{doff} , t_{Eoff}
 (t_{Eoff} = integrating time for E_{off})
 Output inverter IGBT


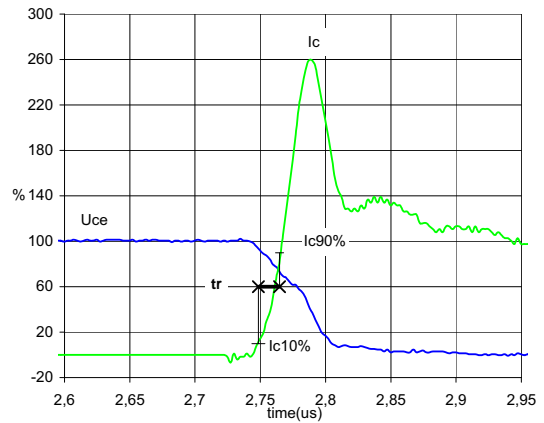
$U_{ge}(0\%) = 0\text{ V}$	without capacitor (P623-F04)
$U_{ge}(100\%) = 15\text{ V}$	with capacitor (P723-F04)
$U_c(100\%) = 400\text{ V}$	
$I_c(100\%) = 60\text{ A}$	
$t_{doff} = 0,21\text{ }\mu\text{s}$	
$t_{Eoff} = 0,37\text{ }\mu\text{s}$	

Figure 3. Turn-off Switching Waveforms & definition of t_f
 Output inverter IGBT


$U_c(100\%) = 400\text{ V}$
$I_c(100\%) = 60\text{ A}$
$t_f = 0,013\text{ }\mu\text{s}$

Figure 2. Turn-on Switching Waveforms & definition of t_{don} , t_{Eon}
 (t_{Eon} = integrating time for E_{on})
 Output inverter IGBT


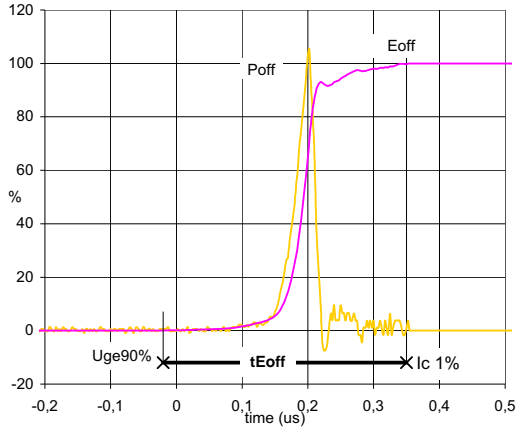
$U_{ge}(0\%) = 0\text{ V}$	without capacitor
$U_{ge}(100\%) = 15\text{ V}$	with capacitor
$U_c(100\%) = 400\text{ V}$	
$I_c(100\%) = 60\text{ A}$	
$t_{don} = 0,02\text{ }\mu\text{s}$	
$t_{Eon} = 0,12\text{ }\mu\text{s}$	

Figure 4. Turn-on Switching Waveforms & definition of t_r
 Output inverter IGBT


$U_c(100\%) = 400\text{ V}$
$I_c(100\%) = 60\text{ A}$
$t_r = 0,017\text{ }\mu\text{s}$

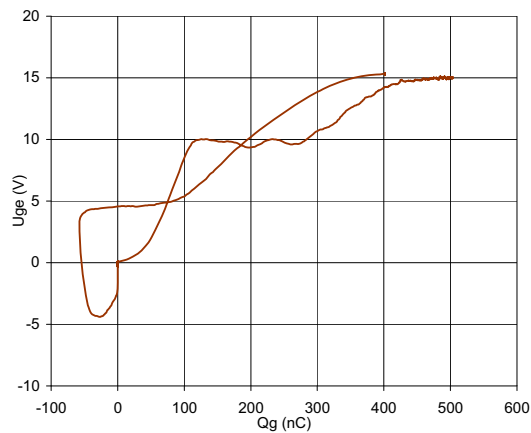
Switching definitions

Figure 5. Turn-off Switching Waveforms & definition of t_{Eoff}
Output inverter IGBT



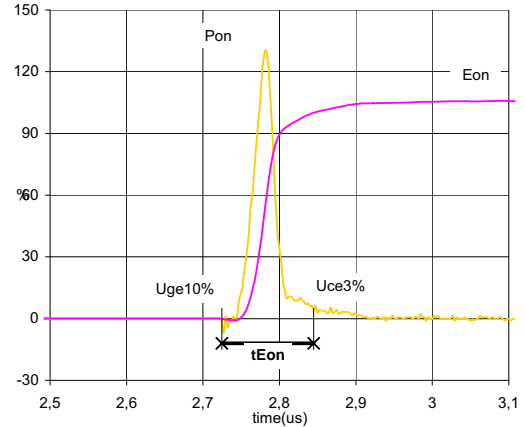
$P_{off}(100\%) = 23,96 \text{ kW}$
 $E_{off}(100\%) = 0,97 \text{ mJ}$
 $t_{Eoff} = 0,37 \text{ us}$

Figure 7. Gate voltage vs Gate charge
Output inverter IGBT



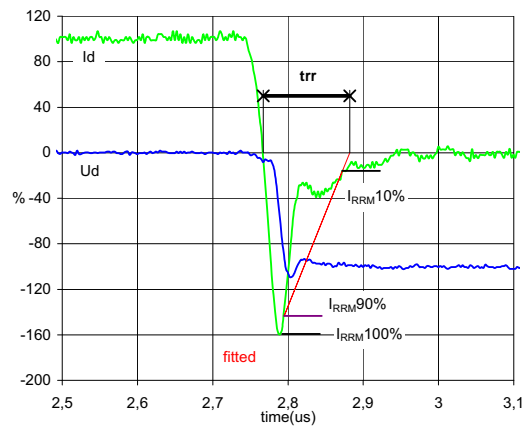
$U_{geoff} = 0 \text{ V}$
 $U_{geon} = 15 \text{ V}$
 $U_c(100\%) = 400 \text{ V}$
 $I_c(100\%) = 60 \text{ A}$
 $Q_g = 503,8 \text{ nC}$

Figure 6. Turn-on Switching Waveforms & definition of t_{Eon}
Output inverter IGBT



$P_{on}(100\%) = 24 \text{ kW}$
 $E_{on}(100\%) = 1,06 \text{ mJ}$
 $t_{Eon} = 0,12 \text{ us}$

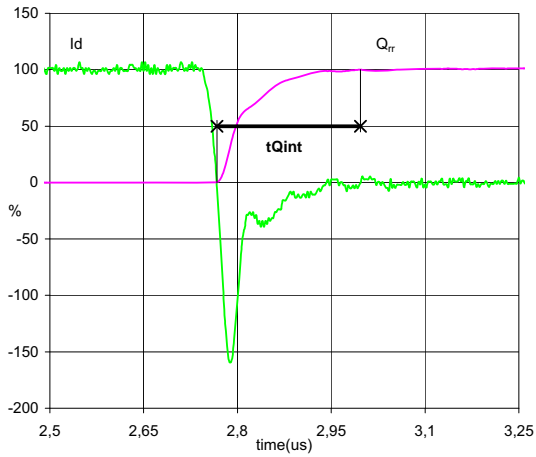
Figure 8. Turn-off Switching Waveforms & definition of t_{rr}
Output inverter FRED



$U_d(100\%) = 400 \text{ V}$
 $I_d(100\%) = 60 \text{ A}$
 $I_{RRM}(100\%) = 96 \text{ A}$
 $t_{rr} = 0,11 \text{ us}$

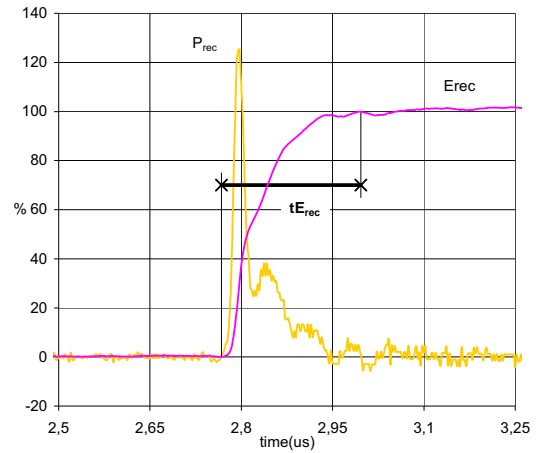
Switching definitions

Figure 9. Turn-on Switching Waveforms & definition of t_{Qrr}
 (t_{Qrr} = integrating time for Q_{rr})
 Output inverter FRED



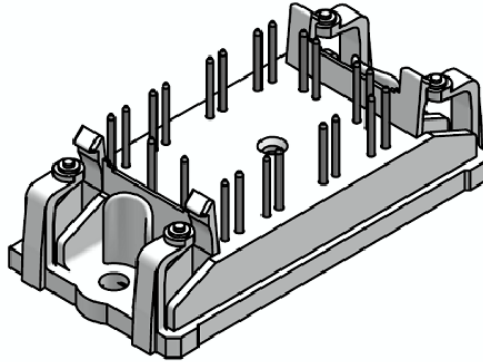
$I_d(100\%) = 60 \text{ A}$
 $Q_{rr}(100\%) = 4,211 \text{ uC}$
 $t_{Qint} = 0,23 \text{ us}$

Figure 10. Turn-on Switching Waveforms & definition of t_{Erec}
 (t_{Erec} = integrating time for E_{rec})
 Output inverter FRED



$P_{rec}(100\%) = 24 \text{ kW}$
 $E_{rec}(100\%) = 1,24 \text{ mJ}$
 $t_{Erec} = 0,23 \text{ us}$

Standard H-Bridge Module



*fast*PACK 0 H 2nd gen

Features

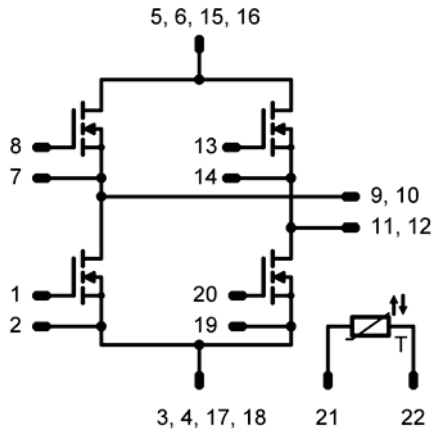
- H-bridge 600V..1200V / 20A..100A
- Standard- and high speed IGBT's or MOS-FET
- Ultra low inductive design
- Vincotech - Power Flow Through for simple PCB routing
- Vincotech - Clip In, the reliable interconnection between PCB, module and heatsink
- Temperature Sensor
- Easy paralleling to ½ bridge
- Optional capacitors

Module Types

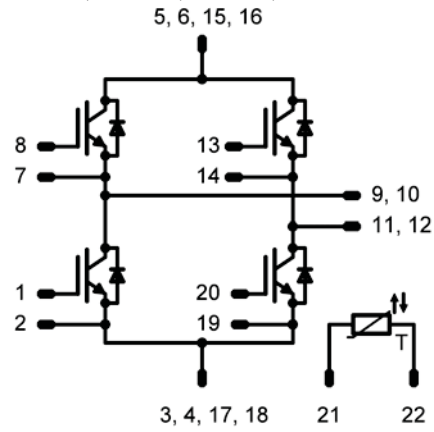
part – number V23990-	Voltage	Current
MOS-FET		
P622-F64-PM	600V	30A
P622-F74-PM high performance	600V	30A
high speed IGBT		
P623-F04-PM	600 V	60A
P623-F14-PM high performance	600 V	60A
Trench Fieldstop IGBT		
P623-F24-PM	600V	50A
P624-F24-PM	600V	75A
P625-F24-PM	600V	100A
Phantom Speed IGBT		
P629-F44-PM	1200V	25A
P629-F46-PM hyper fast FRED	1200V	25A
P629-F54-PM high performance	1200V	25A
P629-F56-PM high performance + hyper fast FRED	1200V	25A
with capacitor:		
MOS-FET		
P722-F64-PM	600V	30A
P722-F74-PM high performance	600V	30A
high speed IGBT		
P723-F04-PM	600 V	60A
P723-F14-PM high performance	600 V	60A
Phantom Speed IGBT		
P729-F44-PM	1200V	25A
P729-F46-PM hyper fast FRED	1200V	25A
P729-F54-PM high performance	1200V	25A
P729-F56-PM high performance + hyper fast FRED	1200V	25A

Schematics

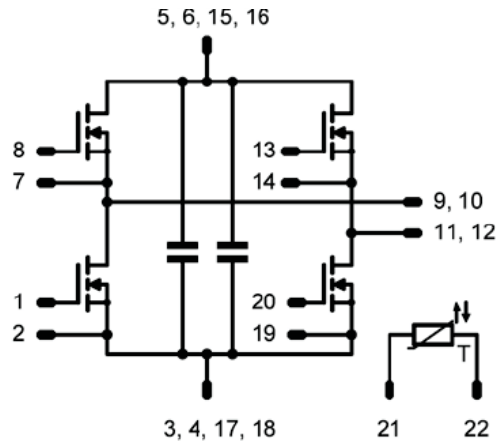
P622 modules:



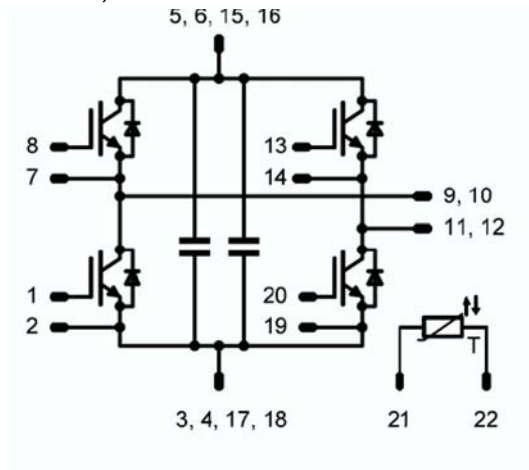
P623, P624, P625, P629 modules:



P722 modules:

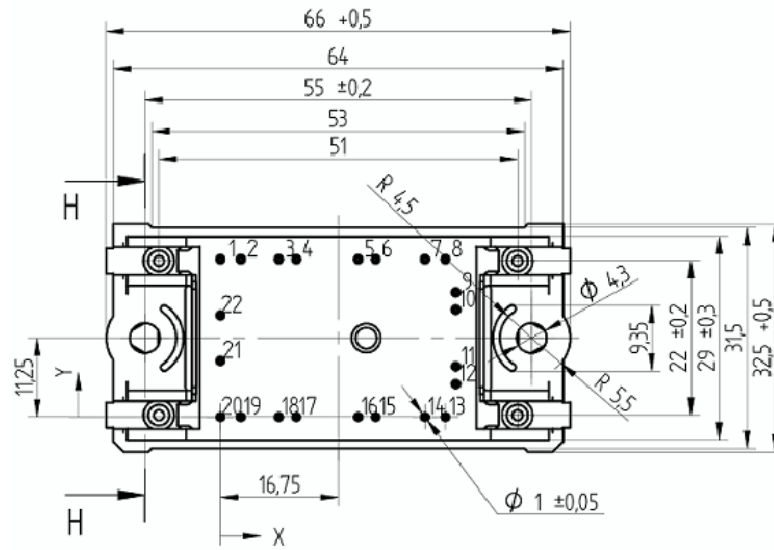


P723, P729 modules:

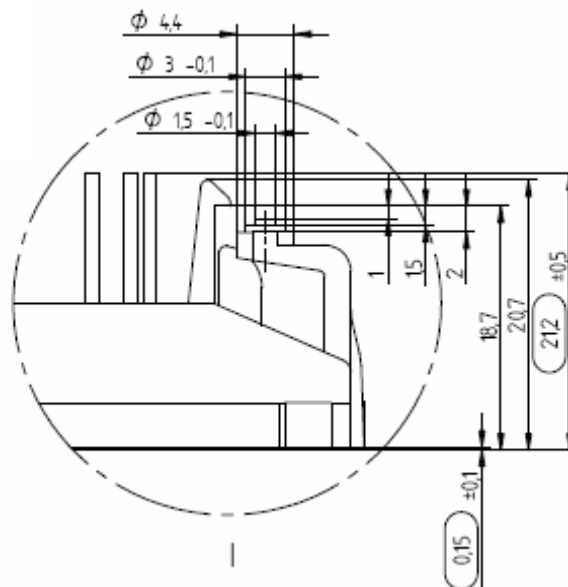


Outline / Pinout

Pin Table		
Pin	X	Y
1	0	22,5
2	2,9	22,5
3	8,3	22,5
4	10,8	22,5
5	19,6	22,5
6	22,1	22,5
7	29,1	22,5
8	32	22,5
9	33,5	17,8
10	33,5	15,3
11	33,5	7,2
12	33,5	4,7
13	32	0
14	29,1	0
15	22,1	0
16	19,6	0
17	10,8	0
18	8,3	0
19	2,9	0
20	0	0
21	0	8
22	0	14,5



Tolerance of pin positions: 0.5 mm at pinhead



Handling Instructions

PCB

- The module must be fixed to the PCB by clipping into the adequate holes before pin soldering. For further details see PCB holes and Mounting in document V23990-P-M111-*-31.
- After fixing all pins must be soldered into the PCB. For an appropriate solderprofile for module pins soldering see document, Typical heat profile for wave soldering on page 4 of V23990-P-M111-*-31.
- During assembly, at a max. module temperature of 25°C, the pins should not be drawn or pushed over ± 0.2 mm or loaded with higher force than 35N.
- At a maximum substrate-temperature of 100°C the load of the pin should not exceed ± 5 N.
- Vibration stress on pin is not allowed

heatsink

- the heatsink surface must be clean and particleless.
- the flatness must be < 0.05 mm for 100 mm continuous.
- the surface roughness should be less than: RZ 0.01mm.

thermal conduction material:

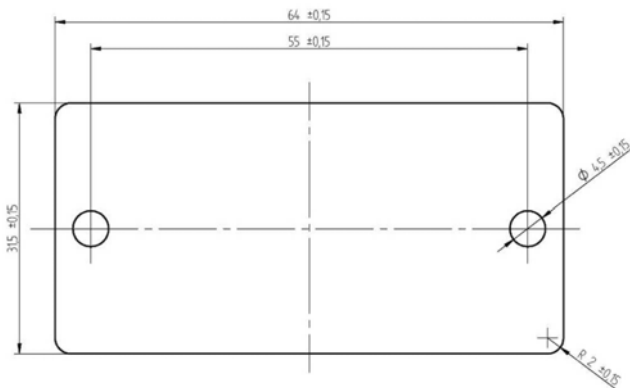
- OPTION 1: thermal paste Homogeneous applying of the thermal conductive paste over the whole module bottom with a thickness of max. 0.05 mm.

- OPTION 2: thermal foil

A thermal foil with a aluminium core layer and two outer layer made of phase change material should be used. The total thickness of the foil has to be less then 0,08mm / 0,003 inch. Thicker foils could cause braking of the ceramic substrate and will increase the thermal resistance.

Recommended foil type: *Kunze Folien KU-ALC5 or ALF5*

Recommended foil dimensions:



fastening screws to the heatsink if plain washer is used:

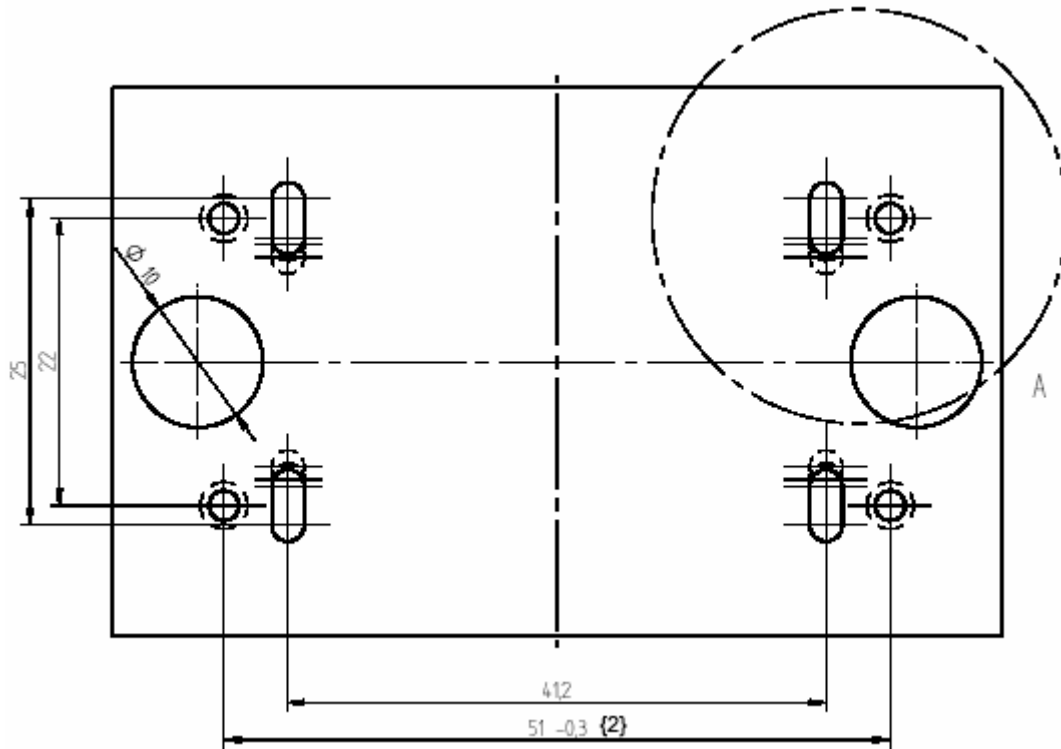
- Tighten both screws with the half torque first.
- Tighten both screws with max. torque second (if it is possible, tighten after 3 hours again). Flat washer DIN 125 or DIN 433, Screw M4 DIN 7985.

fastening screws to the heatsink if plain washer is used together with a spring lock washer (recommended mounting):

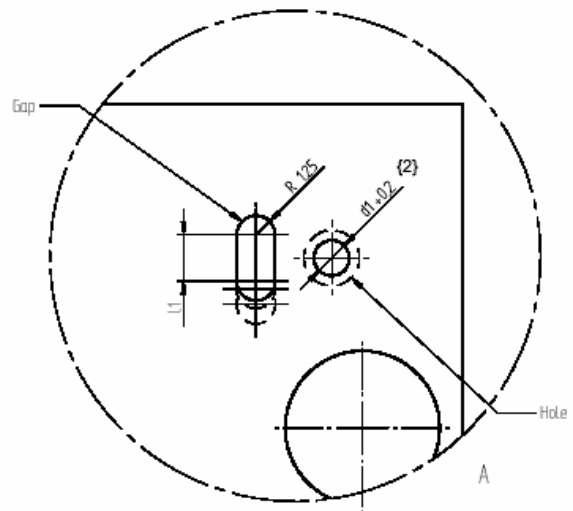
- Tighten both screws with max. torque. Flat washer DIN 125 or DIN 433, Spring washer DIN127 or DIN 128, Screw M4 DIN 7985.

Torque instructions for the heatsink:

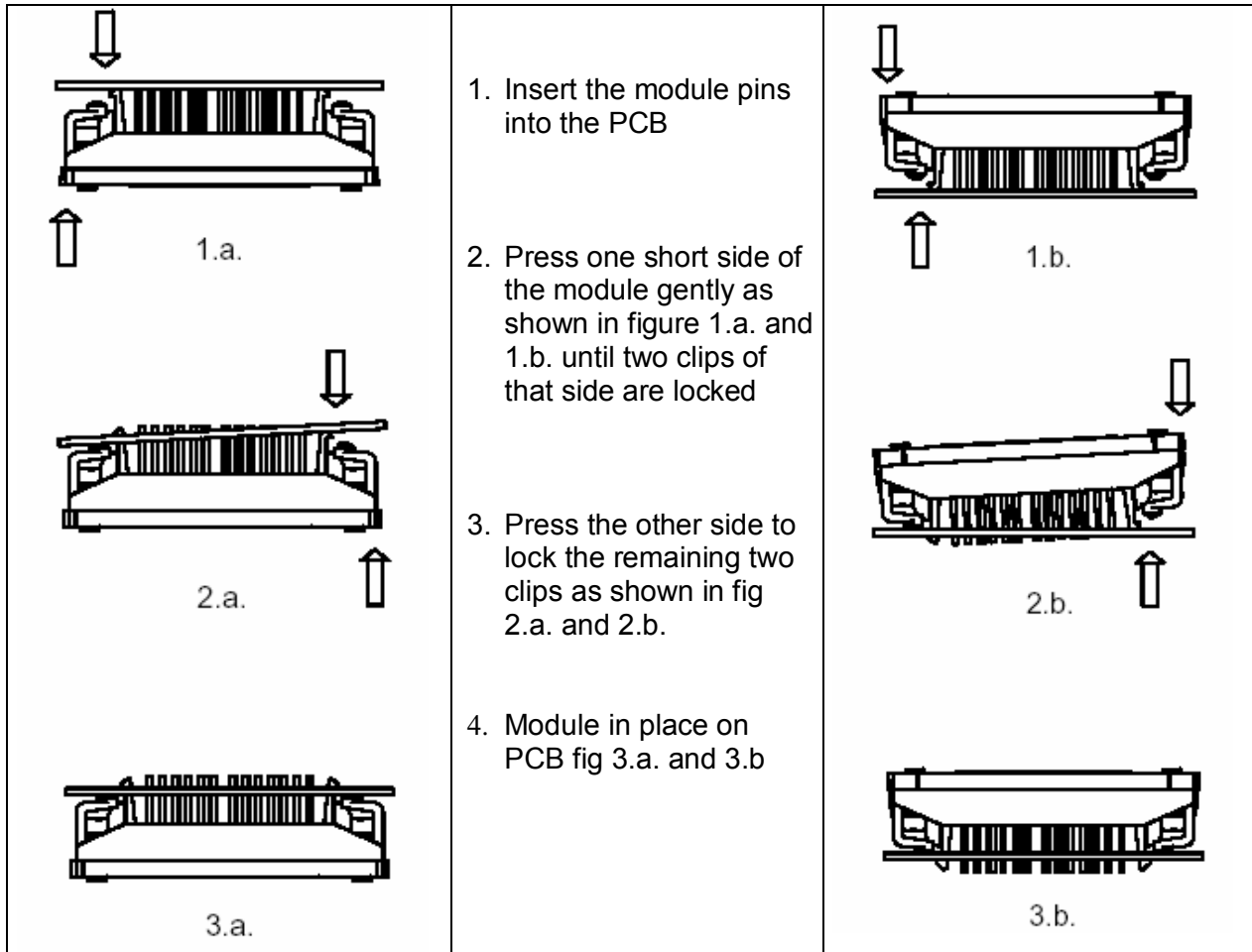
- Mounting torque $M_a = 2.0-2.2$ Nm

PCB holes


PCB thickness	d1	l1
1,5 mm	without holes	3 mm
2 mm	2,3 mm	3,5 mm
2,5 mm	3,6 mm	4,5 mm



Mounting



Vincotech does not recommend the use of its products for other applications. Especially it is not recommended to use the modules in life support applications where such use may directly threaten life or injure due to device failure or malfunction.

We reserve the right to make changes of the product at any time without notice, in order to supply the best possible product.