Improved Thermal Interface for Direct Pressed Power Modules

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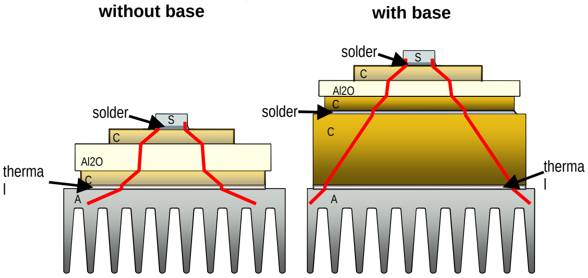
The grease causes about half of the total value of the thermal resistant between junction and heat sink. The thermal resistance of the Vincotech flow0 and flow1 modules given in the datasheet is based on standard thermal grease. But now are new materials available which offer better performance. The improvement of this thermal interface will lead to extended power rating of the module.

Thermal Model

Direct pressed modules have higher requisitions into the thermal interface than modules with base plate. Solutions with base plate have compared with direct pressed modules a better heat spreading before the thermal grease have to conduct the thermal power.

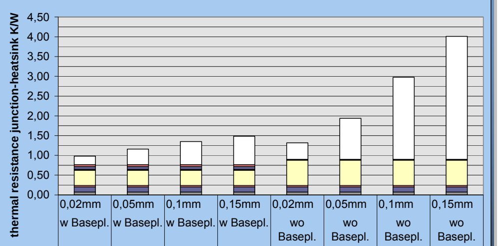


But this only true if the thermal cross coupling is neglected. This is valid in special operating conditions e.g. in motor drive applications at 0Hz motor frequency. This is in some applications the limiting operation mode and here are only 3 of the 6 IGBT´s active.

The following table shows the influence of the thermal grease into the total thermal resistance of modules with and without base plate:

Heatresistance

different thicknesses of thermal grease from junction to heatsink, 25mm² Chip



	0,02mm w Basepl.	0,05mm w Basepl.	0,1mm w Basepl.	0,15mm w Basepl.	0,02mm wo Basepl.	0,05mm wo Basepl.	0,1mm wo Basepl.	0,15mm wo Basepl.
Thermal grease Rth K/W	0,21	0,39	0,58	0,72	0,41	1,04	2,07	3,11
Cu Rth K/W	0,05	0,05	0,05	0,05				
solder Rth K/W	0,07	0,07	0,07	0,07				
Cu Rth K/W	0,02	0,02	0,02	0,02	0,02	0,02	0,02	0,02
Al2O3 Rth K/W	0,39	0,39	0,39	0,39	0,64	0,64	0,64	0,64
Cu Rth K/W	0,03	0,03	0,03	0,03	0,03	0,03	0,03	0,03
solder Rth K/W	0,13	0,13	0,13	0,13	0,13	0,13	0,13	0,13
Si Rth K/W	0,07	0,07	0,07	0,07	0,07	0,07	0,07	0,07

Thermal Interface Materiel Benchmark

For direct pressed power modules have the thermal interface a significant influence into the total thermal performance of the module. In the following is a comparison of different materials of the Vincotech flowPIM1 (V23990-P580-A).

The following materials are compared:

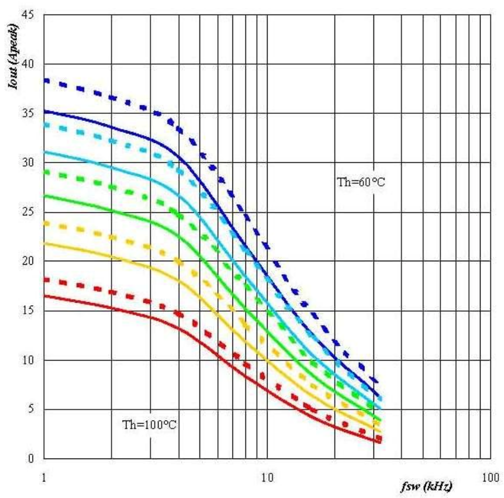
- ⇨ standard thermal grease: thickness = 50um, λ=0,61 W/mK
- ⇨ advanced thermal grease: thickness = 50um, λ=1,00 W/mK
- ⇨ foil: "Kunze Folien KU-ALF5"

Standard grease vs. advanced grease:

In the following standard grease with a thermal conductivity of 0,65W/mK (solid line) is compared with an advanced material with 1W/mK (dashed line).

Typical available 0Hz output current as a function of switching frequency

Phase Ioutpeak=f(fsw)

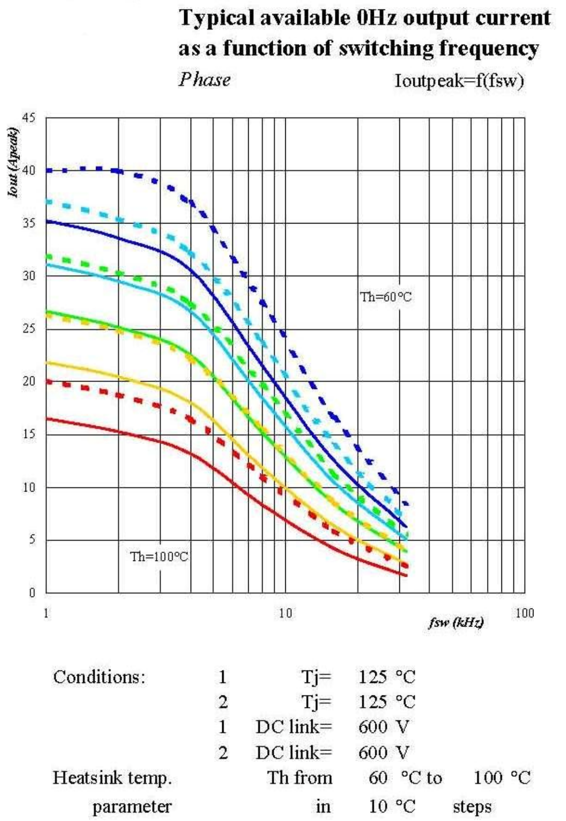


Conditions:	1	Tj=	125 °C
	2	Tj=	125 °C
	1	DC link=	600 V
	2	DC link=	600 V
Heatsink temp.		Th from	60 °C to 100 °C
parameter		in	10 °C steps

Result:

At a heat sink temperature of 80°C (green lines) is the difference more than 10%. At 4kHz the max. continuous output current is 22,5A and with the advanced material 24,9A.

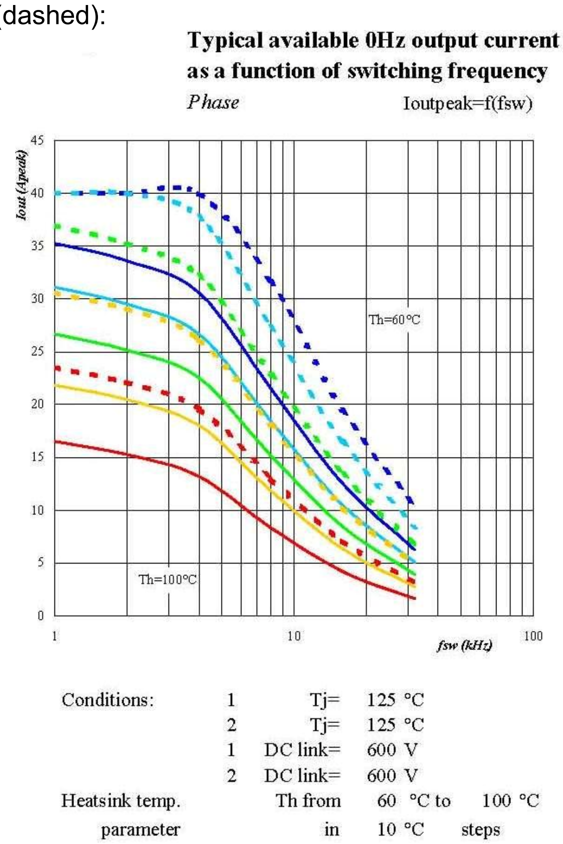
standard grease vs. thermal foil
In the next comparison is the standard grease (solid) compared with a thermal foil (dashed):



Result:
At a heat sink temperature of 80°C (green lines) is the difference more than 20%. At 4kHz the max. continuous output current is 22,5A and with the foil 27,2A.

standard grease vs. thermal foil + AIN-substrate

In the next comparison is the standard grease (solid) compared with a thermal foil on a module with a high performance AIN DBC substrate (dashed):



Result:
At a heat sink temperature of 80°C (green lines) is the difference more than 40%. At 4kHz the max. continuous output current is 22,5A and with the foil in addition with the AIN DBC substrate: 32A.

Conclusion

The thermal interface have significantly influence into the total thermal performance and with relatively low additional effort is an improvement of 10% (advanced grease) and 20% (thermal foil) possible. Additional improvement up to a total of 40% is with high performance AIN DBC substrates possible.