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Aging stability of various heat-conducting pastes for use with modules without baseplates

Heat-conducting pastes from various manufacturers were tested for their aging stability in conjunction with an EasyPIM2 module. The four pastes tested were:

- Austerlitz WPS 50GR
- Assmann V6515
- Wacker P12
- DOW CORNING 340

Description of the test:

To determine the aging stability of various heat-conducting pastes, four pastes from different manufacturers were subjected to a thermal cycling test (TC with ΔT_C = 80 K and a cycle duration of $t_{Cycl.}$ of approx. 6 min.) over 5000 cycles on each of two EasyPIM2 modules, i.e. on a total of eight modules.

The thermal contact resistance Rth was measured before and after each test. Only the central IGBT was stressed during the test. The temperature measurement required for the Rth determination was also performed centrally below the stressed IGBT.

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The heat-conducting paste to be tested was applied to the baseplate of the respective EasyPIM2, the module was fixed onto an adapter with eupec screw clamps and the adapter was then mounted onto a TC test bench. The adapter is an aluminum plate containing a drill-hole located parallel to the module for receiving the temperature sensor whose end is positioned directly below the stressed IGBT.

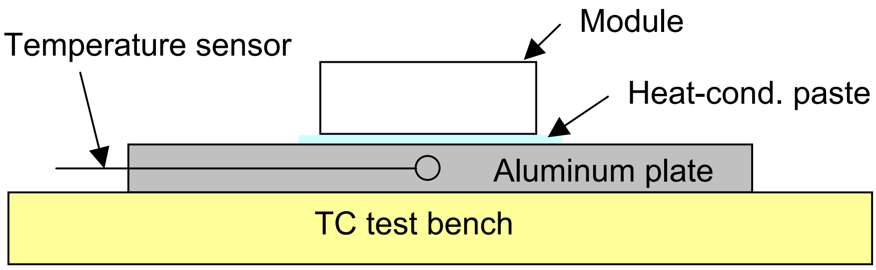


Fig 1: Test set-up

The test set-up ensures approximately identical and thus reproducible test conditions for all modules.

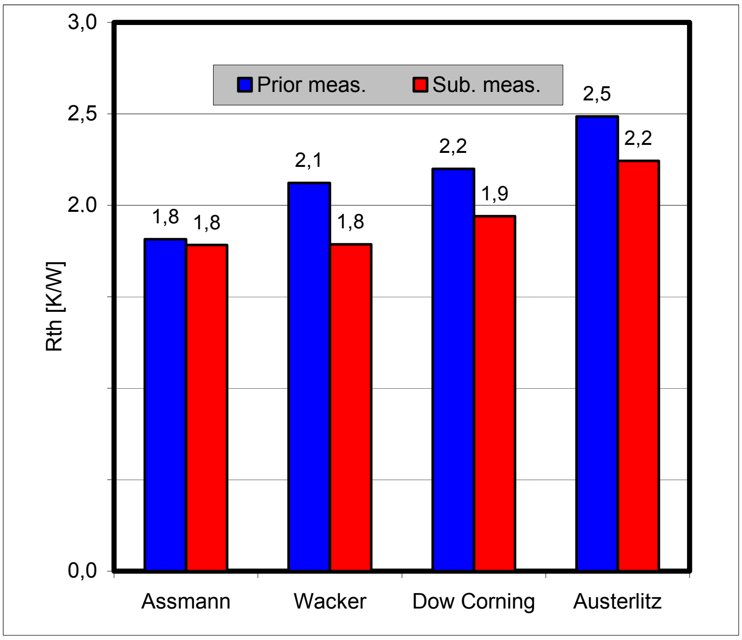
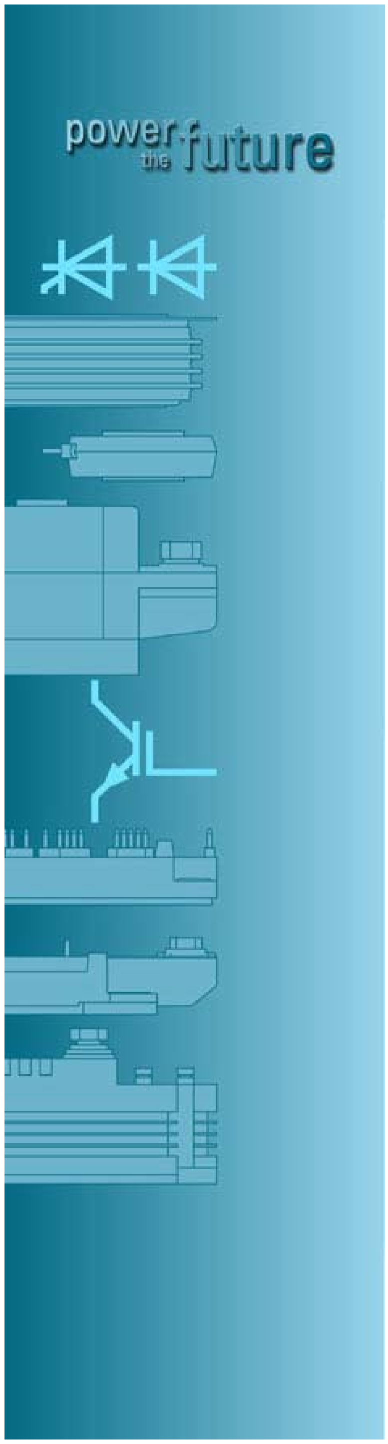
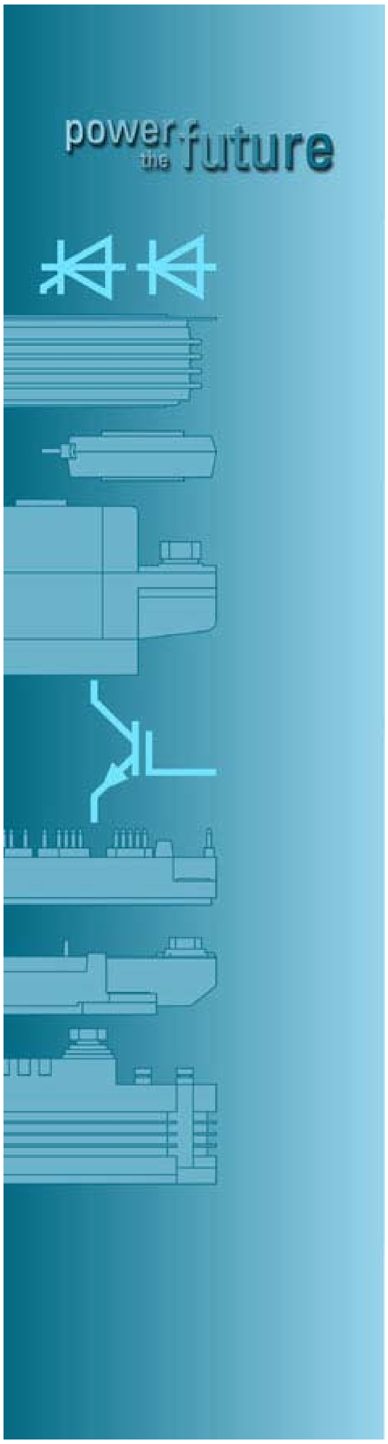


Fig. 2: Results of the Rth measurements





Test results:

The best thermal contact resistance was recorded for the Assmann paste which is silicon-free.

The tested heat-conducting pastes containing silicon (Wacker and Dow Corning) showed a lower Rth than the Austerlitz paste which is silicon-free.

Better thermal contact resistances were recorded for all four heat-conducting pastes after the test. This is because any excess paste is pressed out and the application surface of the module flattens out with time due to relaxation [Fig. 2].

The conclusion of the Rth measurement is that none of the tested heat-conducting pastes differ significantly so that all of them are suitable for use in relevant applications.

The silicon-free Austerlitz paste is not recommended for thermally critical applications, as its Rth is higher than the Rth of the other tested pastes.

The following conditions apply to the application of all heat-conducting pastes:

An application thickness of 100 µm represents an absolute minimum. A thicker application (up to about +50%) is not problematic, as any excess paste is pressed out. The paste may be applied with a roller or by serigraphy.

Subjective impression:

The silicon-free Assmann paste and the heat-conducting pastes containing silicon behave in a similar way to modeling compounds, so that almost homogeneous layers can be achieved even if the application is performed manually.

The application and thus an estimate of the layer thickness is not quite so straightforward in the case of the Austerlitz paste because of its rather tough and sticky consistency.

A visual inspection of the baseplates gave the impression of complete wetting by all heat-conducting pastes. No signs of drying-out were observed either.

As a rule, heat-conducting pastes containing silicon are more expensive than silicon-free ones.

Conclusion:

- All the heat-conducting pastes tested are usable.
- The Assmann paste showed the best thermal conductivity.
- An application thickness of 100 µm represents an absolute minimum in order to ensure complete wetting. Both in this case and with a thicker application, any excess paste is pressed out.