

Environmental Reliability BERGQUIST GAP PAD TGP 12000ULM

Henkel Reliability Laboratory Testing

This report outlines Henkel's BERGQUIST brand laboratory results of the environmental reliability testing conducted on GAP PAD TGP 12000ULM. GAP PAD TGP 12000ULM is an extremely soft gap filling material rated at a thermal conductivity of 12.0 W/m-K. It is specially formulated for high performance applications requiring low assembly stress. The material offers exceptional thermal performance at low pressures due to the unique filler package and ultra-low modulus resin formulation. It is highly conformal, even to surfaces with high roughness and/or topography, allowing for excellent interfacing and wet-out characteristics. Expect consistent and reliable thermal performance with GAP PAD TGP 12000ULM, even when exposed to extreme environments.

The Henkel Laboratory tests Thermal Interface Materials (TIMs) in the following environments: 85°C/85% Relative Humidity (RH), Continuous Bake (85°C, 100°C and 125°C) and Thermal Cycling (-40°C to 125°C at 30-minute intervals).

The 85°C/85% RH test is the harshest test condition as this environment can quickly degrade test materials that react with water and/or tend to oxidize. The High Temperature Continuous Bake environment accelerates changes in material characteristics for TIMs with temperature sensitivity. The TO-220 Thermal Test Vehicle utilizes copper and aluminum components, simulating real-world applications. In the Thermal Cycling environment, the CTE mismatch of metals creates a great deal of stress, in turn inducing significant internal and external stress upon the test material, potentially resulting in a reduction in performance.

The goal of the environmental reliability testing is to accelerate aging of the TIM and determine the effect on the key thermal performance while in a controlled laboratory setting. GAP PAD TGP 12000ULM is subjected to constant pressure throughout the test via spring clip (about 35 psi) on the TO-220 testing. The thermal test vehicle is removed at each time interval for testing from the oven chamber. Thermocouples are utilized to measure the transistor junction, transistor base, heat sink and ambient temperatures. Thermal

Performance is reported as the temperature delta between the transistor junction and the heat sink divided by the power dissipated by the TO-220. GAP PAD TGP 12000ULM was exposed to 85°C/85% Relative Humidity, Continuous Bake and Thermal Cycling tests for 1000 hours. Reliability testing over time are reported below. Due to the numerous of thicknesses available, customers are always advised to test in their applications for their specific testing.



Figure 1: Typical environmental chamber

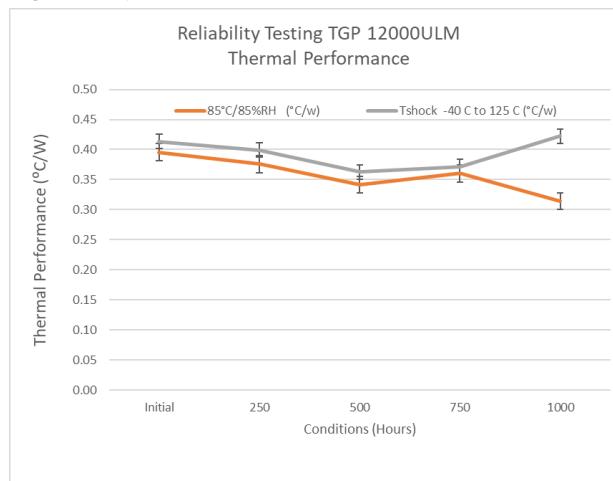


Figure 2: TO-220 Thermal Performance Testing (Relative Humidity and Thermal Cycling)

Application Note

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TGP12000ULM Thermal Performance		
	85°C/85% RH (°C/w)	T _{shock} - 40 C to 125 C (°C/w)
Initial	0.40	0.41
250	0.38	0.40
500	0.34	0.36
750	0.36	0.37
1000	0.31	0.42

Table 1: TO-220 Thermal Performance Testing (RH and TC)

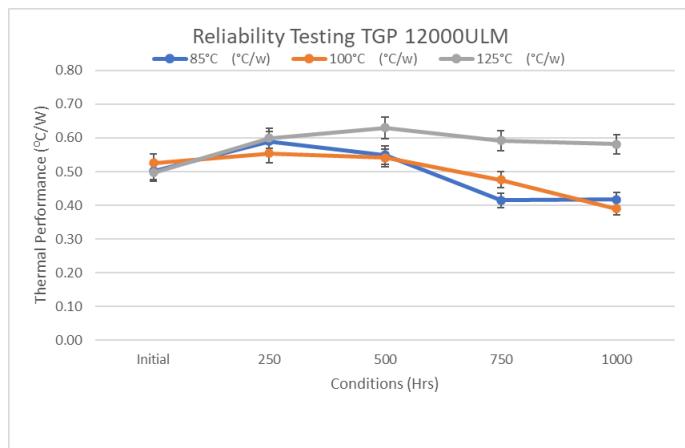


Figure 2: TO-220 Thermal Performance Testing (Continuous Bake)

TGP12000ULM Thermal Performance			
	85°C (°C/w)	100°C (°C/w)	125°C (°C/w)
Initial	0.50	0.53	0.50
250	0.59	0.55	0.60
500	0.55	0.54	0.63
750	0.41	0.48	0.59
1000	0.42	0.39	0.58

For the calculation on the Thermal Performance is as follow:
The final transistor temperature (Tr), specimen heat sink temperature (Ts), and transistor power dissipation (W) are recorded and the Thermal Performance is calculated (°C/W). The formula for Thermal Performance is shown below:

$$\text{Thermal Performance} (\text{°C/W}) = \frac{\text{Tr} - \text{Ts}}{\text{W}}$$

Conclusion

Overall, GAP PAD TGP 12000ULM exhibits minimal changes over the extended 1000 hours of testing across the 40 mil thickness. GAP PAD TGP 12000ULM consistently provided superior thermal performance throughout the duration of the Henkel laboratory environmental reliability testing.

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