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**Date:** February 27, 1998  
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**To:** Distribution

## **Vacuum Oven Study**

### **Abstract**

Motorola Israel has used a vacuum oven to bake reeled moisture sensitive devices for over three (3) years with no delamination issues. The vacuum oven eliminates the need to unreel and re-reel devices because the oven's temperature is set at 70°C which will not effect the polystyrene reels. Based upon a study performed by Israel and Plantation, the iDEN factory purchased a vacuum oven (Vacuum Oven Study 8/25/97). An experiment was performed on iDEN's vacuum oven to insure that it performed properly and to the expectations set by the first experiment on Israel's vacuum oven. It is concluded from this experiment that the iDEN vacuum oven is performing to expectation.

### **Introduction:**

Motorola Israel has been using the vacuum oven for four (4) years to dry out moisture sensitive devices that have exceeded their exposure time to ambient conditions. By using the vacuum oven there is no need to unreel and re-reel the devices because the vacuum oven temperature is 70°C and the temperature is low enough to not physically or dimensionally effect the polystyrene reels.

Based on a joint study (Vacuum Oven Study, August 25, 1997) by LMPS Plantation and Israel, iDEN in LMPS Plantation bought a vacuum oven.

### **Experimental:**

In order to insure that the oven purchased by iDEN in Plantation, performed properly and to the expectations set by the first experiment on Israel's vacuum oven an experiment was conducted using the new vacuum oven.

The experiment consisted of using reeled devices that had exceeded their prescribed time at ambient conditions and were already loaded into the vacuum oven. The oven was filled with eighteen (18) reels that represented ten (10) different part numbers. The 10 devices consisted of the following package types: 2 glob top (BGA), 2 QFP, 2 SOIC, 4 TSOP, and 1 OMPAC. After 24 hours in the vacuum oven, twenty (20) parts of each part number were removed from the reel and weighed, using a Sartorius analytical scale, and recorded. Ten of each part number was then placed in a 125°C conventional oven for 24 hours and then weighed and recorded. This was done to determine the amount of moisture that the vacuum oven left in the parts after 24 hours in a vacuum oven (see FIGURE 1). The other 10 of each part number was left at ambient conditions for 5 days, weighed and recorded, and then reflowed. A C-mode Scanning Acoustical Microscope (C-SAM) was used to determine if delamination occurred after exposure to ambient conditions and reflow.

### **Results and Discussion:**

The residual moisture, by weight, that had been left in the devices after 24 hours in the vacuum oven ranged from a low of 0.00003 grams (0.017%) for a QFP package to a high of 0.00067 grams (0.079%) for an OMPAC package. The average moisture content for all package types was 0.000146 grams.

C-SAM analysis revealed that the 10 devices of each part number that were exposed to 5 days of ambient conditions and reflowed after 24 hours in a vacuum oven had no delamination. The moisture absorption (see FIGURE 2) was not significant enough to cause delamination which proves that devices that are dried using the vacuum oven for 24 hours have had enough moisture removed by the vacuum oven to not delaminate.

### **Conclusion:**

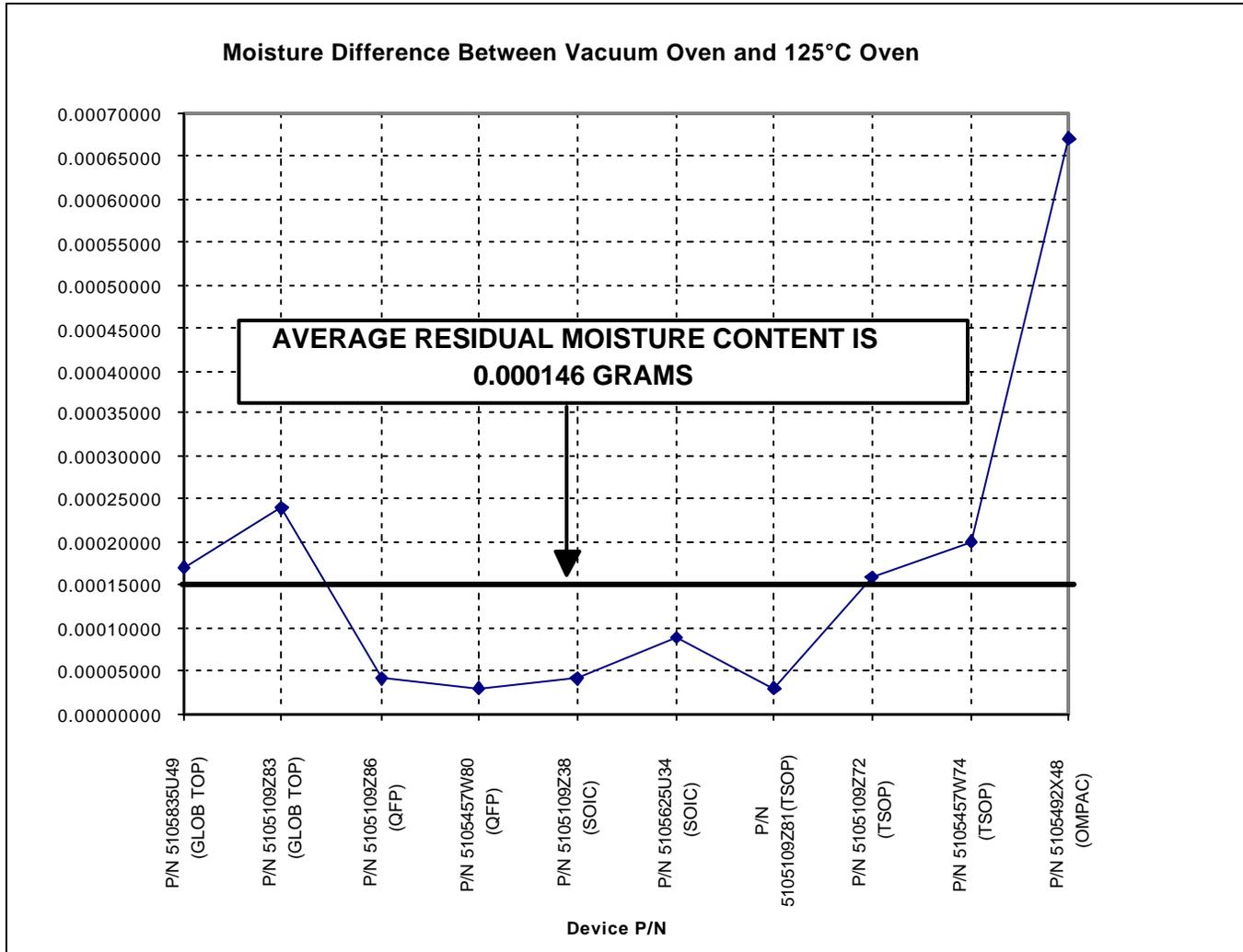
The vacuum oven set at 70°C for 24 hours definitely removes enough moisture to eliminate the problem of delamination. The results confirm that although the vacuum oven does not remove as much moisture as the conventional oven set at 125°C, the moisture that it does remove is sufficient to eliminate the delamination problem. The vacuum oven purchased by the iDEN factory performs to the expectations set by the vacuum oven experiment done in Israel. The vacuum oven in iDEN has been in use for 5 months with no incidents of delamination in the factory. By using this oven, the iDEN factory has reduced cycle time of drying devices on the reel from 7 days to 1 day. (They use to use an oven set at 40°C for 7 days in order to leave the devices on the reel.) Also by using the vacuum oven they have eliminated the need to un-reel and re-reel parts in order to have a faster turn around time. The elimination of handling the devices also reduces incidents of ESD, lead damage, and lost parts.

### **Acknowledgments:**

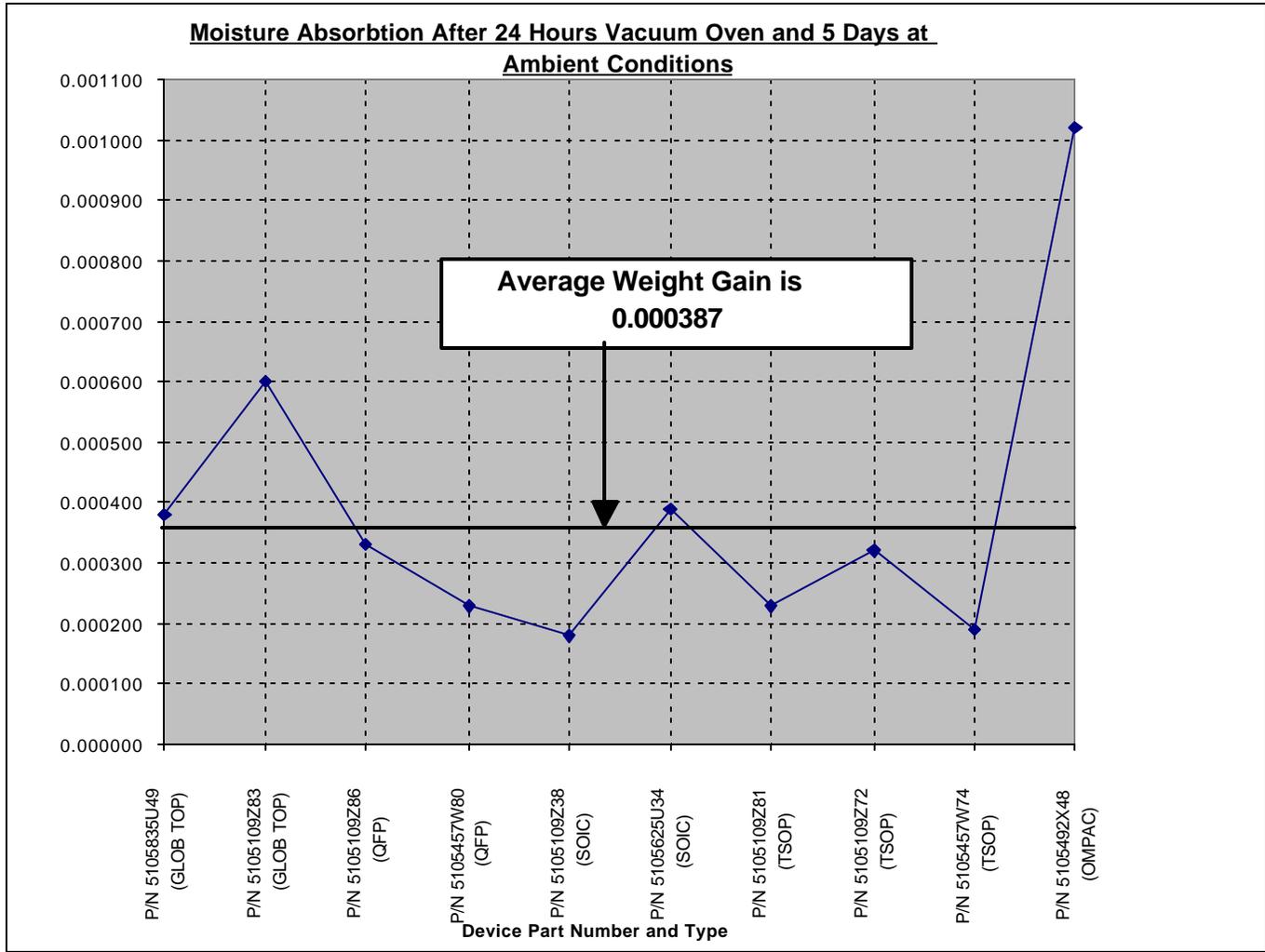
Mike Valdez and Philip Morris for their help with the vacuum oven.

**Distribution:** Kingshuk Banerji, Lonnie Bernardoni, Lynne Bernardoni, Larry Bond, Edwin Bradley, Michelle Boulanger, Hal Canter, Bill Dixon, Faris Habbaba, Amnon Hadar, Meir Halevi, Sterling Holmes, Abraham Huli, Jim Huryan, Ileana Isern-Flecha, Pradeep Lall, Paul Lieb, Hank Liebman, Alex

Marron, Chris Mikulski, Greg Milano, Aharon Mirsky, Bob Perez , Dolev Rafaeli, John Restrepo, Jim Santiago, Yossi Sela, Dick Smith, Jim Tidwell, Israel Trefler, Mike Valdez, Warren Waller, and Gil Werner.



**FIGURE 1**



**FIGURE 2**