

# Solving Problems with PCB Conformal Coatings

By Andrew G. Bachmann, president, Dymax Corp., Torrington, Conn.

The most common types of conformal coatings for protecting electronic circuitry have been urethane, acrylic, or silicone resins dissolved in solvent. There is a need to increase the productivity of applying these coatings, as well as to eliminate the potential hazard and air pollution problems resulting from evaporating solvents. Although most solvents can be evaporated in ovens within a few hours, it is not uncommon for smaller circuit board manufacturers to use systems requiring several days to complete solvent evaporation and/or complete the cure of the resin systems.

Ultraviolet (UV) inks and coatings have been available since the early 1970's. However, these products traditionally have exhibited low adhesion or poor environmental resistance properties. In addition, they did not cure underneath components on circuit boards. Despite these shortcomings, many attempts have been made to use products

from the UV ink and coating industry as conformal coatings.

Two- and three-part, solvent-containing UV resin systems — which, after evaporation cure by UV light — recently have become available. These so-called 'shadow curing' coatings do not introduce any significant advantages over normal solvent-type systems, except that there is faster resin cure when the solvent has evaporated.

In 1987 a single component, solventless (100 percent solids), no-mix UV light carrying conformal coating was introduced. This coating is applied by spray, dip, or other application technique. It then may be cured in as little as 5 seconds using high powered UV lights. This translates to line speeds as much as 15 ft./min. The use of additional lamps may result in even higher line speeds.

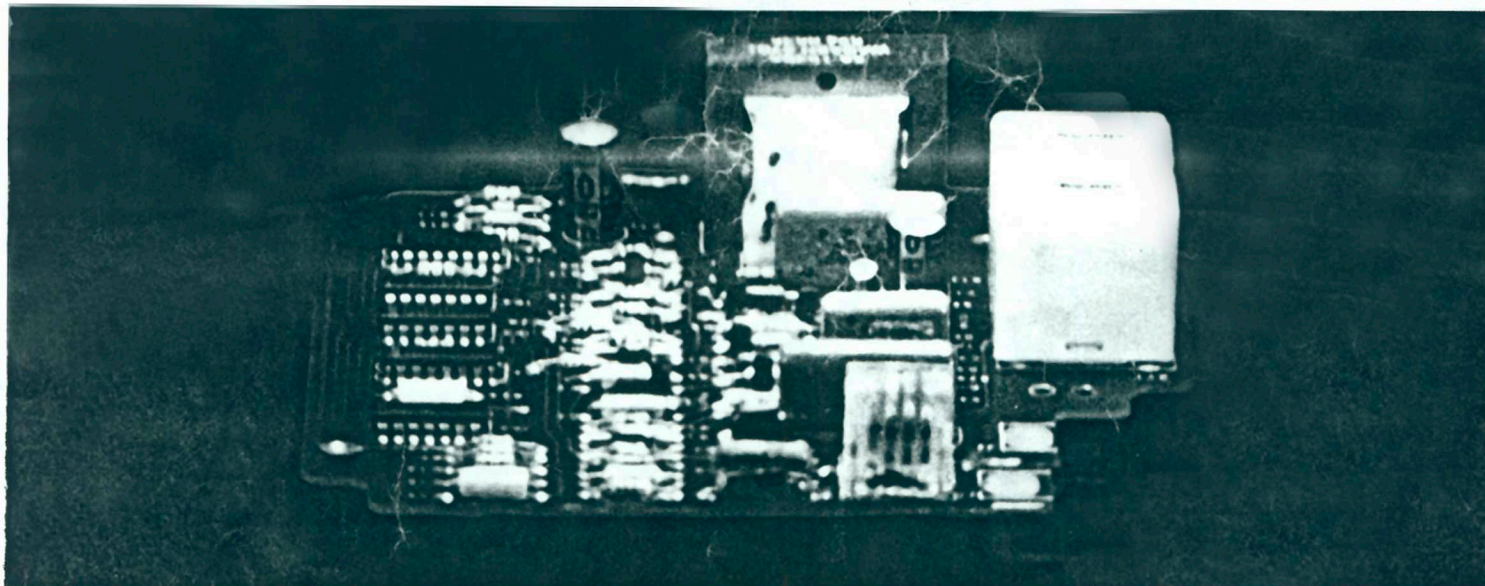
In addition, there are simple desktop lamp systems available that will cure coatings up to 9 x 9" in 15-120 sec., depending on the lamp model used. These desktop curing units, costing less than

\$1000, are convenient either for laboratory evaluation or for low volume production applications.

## Coating Problems

An independent, southern U.S. manufacturer of circuit boards used in automobile cruise controls was experiencing a serious problem with a three-part urethane in a solvent conformal coating system. While this system had been in use for several years, concerns had been raised over the safety of the solvents, compliance with solvent emission regulations, and the cost involved in the size and complexity of the machinery needed to apply the coating and then safely evaporate the solvent. The two-hour oven evaporation system also limited the board types that could be coated, and was a severe handicap in planning for short runs.

The circuit boards now are manufactured by spraying on a urethane/acrylic coating\* and conveying the coated boards under a high intensity electrodeless UV light for 5



*Moderate intensity UV lamp cures conformal coating on printed circuit board.*

sec. The lamp is shielded to protect workers from any stray UV light and the area is ventilated with an 'elephant trunk' evacuation system.

The manufacturer now is able to produce short runs quickly and economically. The space and time required for the previous solvent-based coating has been eliminated. It has been estimated that the total cost savings in this application has been approximately \$1 per board, even though the UV light resins are more expensive on a pound-for-pound basis than the previously used solvent coating.

For a northern U.S. manufacturer of U.L.-approved refrigerator control boards, there was a problem with a new design. The previously used, solvent-based silicone conformal coating was not acceptable for this new board, because the manufacturer could not install a solvent evaporation and recovery system, nor could they allow the required 24-hour silicone cure cycle after solvent evaporation to complete the cure. A flame retardant conformal coating\*\* was used in conjunction

with a 30-second UV lamp system.

Serious parts delay problems plagued a large, north central OEM automobile manufacturer producing under-the-hood control boards. The delay was due to the time required to evaporate solvents and then to cure the urethane resin that made the conformal coating.

The company switched to a two-part, solvent-based, UV-type coating in an attempt to eliminate some of the delay time. After a six-month trial, this proved to be ineffective because of the lack of consistency of the materials, the difficulty in mixing two parts, and setup problems in the mix-meter spray heads, resulting in significant downtime and high maintenance costs. The two-part UV system also did not allow for easy repair work.

A switch was made to the urethane/acrylic conformal coating. There was no need to change the spray coating system on the UV light system. The stuffed boards are transferred to a spray station, coated 360° around the board, and then transported under high pow-

ered electrodeless UV lights. Cure is complete in approximately 5 sec.

These conformal coatings seem to provide a solution to the very prevalent problem in the electronics industry, that is, the requirement for a fast, single-component coating system.

Additionally, repairs can be made with the urethane/acrylic coating by applying a drop of the conformal coating over the repair spot and then briefly exposing the board to a UV light. A small, fiber optic-guided UV light, combined with a resin dispenser, is available for this special purpose. Quality control is made easy by the presence of a fluorescent dye.