# THIN-FILM SELECTIVE PLATING

**A new method of selective electroless plating offers design alternatives to traditional plastic shielding technology.**

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## INTRODUCTION

Several factors determine the optimum shielding method when designing molded enclosures. The most critical issue has been the choice between an in-color molded plastic or a painted exterior. Many design engineers have opted for the in-color molded plastic for specific performance and cost factors.

Although many methods of selectively shielding plastic enclosures are available, each has disadvantages. The most widely-used mediums for selectively shielding plastic are conductive paints, which provide a readily available, low-cost method of selective shielding. However, the application of conductive paints can be inconsistent and require a thick application (1 to 3 mils or 1,000 to 3,000 micro-inches) to meet current regulations and adequately shield today's computers. In order to comply with future regulations and increasingly powerful computers, even thicker layers may be necessary.

## OVERVIEW OF SHIELDING METHODS

Currently, the four most common methods of shielding plastic enclosures are: vacuum metallizing, internal metal shrouds, conductive paints, and electroless plating. Advantages and disadvantages of the various methods are described in Table 1.

*Vacuum metallization* is the deposition of a thin layer of metallic film by evaporation in a high vacuum atmosphere (i.e., chamber). The plastic is treated with a base coat of lacquer or enamel to promote adhesion and loaded into a chamber. Then, a heated metal, usually aluminum, is vaporized and condensed onto the plastic surface in a film 20 to 50 micro-inches thick. A final coating is then applied to the metal surface for protection.

*The internal metal shroud* is a solid or perforated metal mini-enclosure that surrounds the electronic components to eliminate both the emission of, or susceptibility to, EMI/RFI. If the shroud is used for shielding purposes only, the material can be a thin gauge aluminum or steel. In most cases, the design engineer uses a metal shroud for both shielding effectiveness and to increase the structural stability of the enclosure. The conventional materials used to serve this dual purpose are the same as that of metal cabinets: a 12 to 14 gauge cold rolled steel sheet for the frame and 14 to 18 gauge cold rolled steel for the sides.

*Conductive coatings* are organic coatings that contain conductive powders or flakes such as nickel, copper, silver, or graphite to provide the level of required conductivity. The coating is applied to the plastic surface with conventional paint spray equipment in high volume or with aerosol cans in low volume. Usually the coating is only applied to the interior of the surface at a thickness of 1 to 3 mils. Areas to be left uncoated can be masked.

*Electroless plating* is the immersion of the plastic part in a series of etching and chemical deposition baths similar to the process used by electroplaters to preplate plastics for subsequent electroplating. The process applies two coatings: a copper coating applied 40 micro-inches thick for shielding purposes, and a nickel coating applied 10 micro-inches thick for corrosion and abrasion resistance.

Comparative costs of various methods are shown in Table 2.

## CHANGING MARKET

Today's design engineers are faced with the seemingly impossible task of increasing a computer's power, speed, and shielding effectiveness while at the same time decreasing the computer's size, weight, and cost.

The new notebook computers are a perfect example of the demands being placed on the design engineer. The demand for notebooks is directly related to the design engineer's ability to put maximum power in the minimum amount of size and weight. Size is no longer measured in inches, but fractions of an inch; weight is no longer measured in pounds, but in ounces. In the notebook and laptop computer market, the ability to manufacture the smallest or lightest computer gives that manufacturer a significant marketing advantage over its competition. Success or failure of a program can be directly related to these two factors.

| | Advantages | Disadvantages |
|---|---|---|
| **Vacuum Metallizing** | Excellent conductivity (60-120 dB) | Limited to simple design |
| | Good Adhesion | Difficult to mask |
| | Uniform thin-film coating (50 micro-inches) | Size limitations due to chamber |
| **Internal Metal Shroud** | Permits in-color molding | Adds weight to unit |
| | Provides shielding and structure | Limited to simple geometry |
| | Excellent conductivity (75-85 dB) | Corrosion-resistant coating or galvanized steel required to prevent interference with electronic circuits |
| **Conductive Paints** | Permits in-color molding | Thick-film coating (1-3 mils) |
| | Adequate conductivity for current requirements (40-80 dB) | May require thicker layers to meet future requirements |
| | Low cost | Inconsistent thicknesses |
| | Ease of application | Oxidation may occur with copper paints |
| **Electroless Plating** | Uniform thin-film coating (60 micro-inches) | Conventional plating systems require masking or thick coatings |
| | Excellent conductivity (65-120 dB) | Conventional plating systems degrade plastic |
| | Excellent adhesion | |
| | Corrosion-resistance | |

Table 1. Comparison of Shielding Methods.

The demands being placed on the design engineer from government regulatory agencies and the increasingly competitive marketplace require a thin-filmed, low cost, lightweight, highly conductive shielding method. However, if the design engineer wants to mold in color, current methods require labor-intensive masking of the plastic enclosure, thereby increasing the cost. (One method that may be cost-effective requires the use of a thick coating, thereby forcing a trade-off between thickness and cost.)

## THIN-FILMED SELECTIVE PLATING

A method of selective electroless plating called thin-filmed selective plating has been developed. The process is simple and does not require special equipment. The surface to be shielded is sprayed with a proprietary coating (approximately 100 micro-inches thick), cured for thirty minutes, and then racked and dipped in the electroless plating baths as if it were to be plated entirely.

The electroless plate is a combination of nickel (10 micro-inches) over copper (50 micro-inches) and adheres only to the proprietary coating. No surface degradation appears on

| Method | Cost ($/sq. ft.) |
|---|---|
| Vacuum Metallizing | $2.50 - 3.00 |
| Internal Metal Shroud | 0.50 - 1.00 |
| Conductive Coatings | 1.15 - 3.25 |
| Electroless Plating | 1.00 - 1.75 |

Table 2. Cost of EMI/RFI Shielding Methods.

the exterior (non-coated) surface of the plastic enclosure. (This is important since the reason for selective shielding is to mold in color and prevent painting the exterior.)

## ADVANTAGES OF THIN-FILMED SELECTIVE PLATING

A thin-filmed selective plating process combines the advantages of electroless plating with those of conductive paints. These include:

- excellent conductivity (will meet current and future requirements);
- uniform thin-filmed coating (160 micro-inches);
- a nickel layer which provides corrosion resistance;
- excellent adhesion;
- an electroless coat which provides abrasion resistance, aiding in assembly operations;
- low cost.

This plating process has enormous potential in the computer and electronics industries. Not only does the process solve many of the design engineer's problems now, but it could have even greater impact on the design of plastic enclosures in the future.

Advanced plastics materials and new processing technology make volume production of three-dimensional circuit boards possible. The next step in the development of circuit boards will be laying the circuits on the interior surface of the enclosure. For this to happen, the exterior surface would have to be selectively shielded and painted. Thin-filmed selective plating enables the selective shielding of an exterior surface, which can then accept the application of paint. Prototypes of simple enclosures using this process are currently being developed.

## SUMMARY

Design engineers are faced with increasing demands from government regulatory agencies and an increasingly competitive marketplace. Many current methods of shielding are unable to satisfy the need for a cost-effective, thin-filmed, highly conductive selective coating process to shield against radio frequency interference in molded in-color enclosures. A thin-filmed selective plating process meets the needs of the design engineer and is the next step in the development of totally-functional enclosures. ■