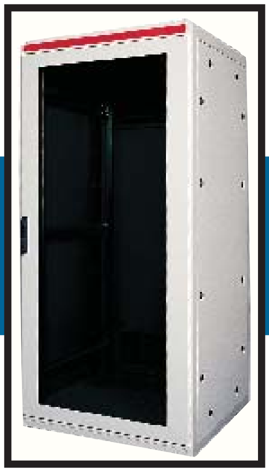
A White Paper by Optima EPS, An Elma Company

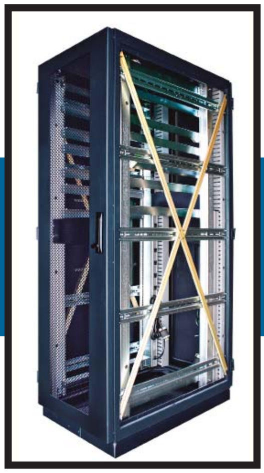
Optima EPS
Cabinets & Enclosures
An Elma Company

The EMC Challenge: Balancing Advanced Attenuation With Cost Concerns

Introduction

In a recent application at Optima EPS, An Elma Company the customer required a minimum electric field attenuation of 60 DB of shielding effectiveness from 100 KHZ to 1 GHZ decreasing to a minimum of 55 DB at 10 GHZ. As the enclosure was quite large (70" H by 36" D), using certain techniques was not cost-effective. Optima's challenge was to solve the EMI problem while keeping costs reasonably low.





The Application

This application is for network-centric communications and satellite control with the use of various X- and Ka-band antenna and terminals. The rack goes into fixed and mobile shelters and requires a high level of shielding to protect against internal and external electromagnetic interference.

The Challenge

How could Optima provide advanced shielding for a large cabinet enclosure that met the customer's specifications, while keeping costs low? Of course, plating the rack with copper or gold would be far too expensive. Tin is highly conductive, but a much lower cost and just key surface areas of the enclosure would need to be plated. So, tin (roughly 5%) over nickel (approx 95%) on the steel construction was used. By using a surface with superior electrical continuity properties, it could help reduce offending radiated emissions. For lower levels of EMC, Optima's typical enclosure would use zinc over steel. The process is a simpler and more cost-effective solution. However, this plating process is not easy for all manufacturers to handle. It takes a special skill-set and experience to work the process.

Process Steps

The tin plating process has four main steps. The first is to etch the metal. The acid-based chemical primes the metal and prepares it for plating. Step two desmuts the metal. Step three is to apply the nickel plating. Step four is the application of the tin. Low voltage is applied to a covered graphite probe for each of the step of the process. A positive polarity is utilized for step 1 and 2 and negative polarity for steps 3 and 4. The enclosure is finished with various types of steel wool and other pads to remove any remaining barbs and residue while providing a keen shine. Figure 1 shows the cabinet after Step 4. With the core of the enclosure tin-plated for electrical continuity, the next step was looking at the covers and gasketing.

Figure 1: Photo of the cabinet enclosure going through the tin-plating process to improve electrical conductivity. The plating was applied with graphite probes as the enclosure was too large for a dip-bath.

Next Step – Gasketing & Filters

In the 60 DB challenge, the next step was to add wire-mesh gaskets along the seams. These gaskets have two layers of double-knit tin-plated copper mesh mounted to NEMA 12/UL 508 gasket. They have dynamic mechanical properties that yield a high deflection range and eliminate compression set so the gasket won't lose its form. This covered the main parts of the enclosure, but to fully reduce EMI, 6 EMI filters were employed. These were also tin plated, but since they are not very large, they were dipped into tanks rather than using a probe for application. The honeycomb filter would allow significant air intake/exhaust for cooling while suppressing EMI. The filters were located above and below the unit as well as on the rear cabinet door.

Fine-Tuning

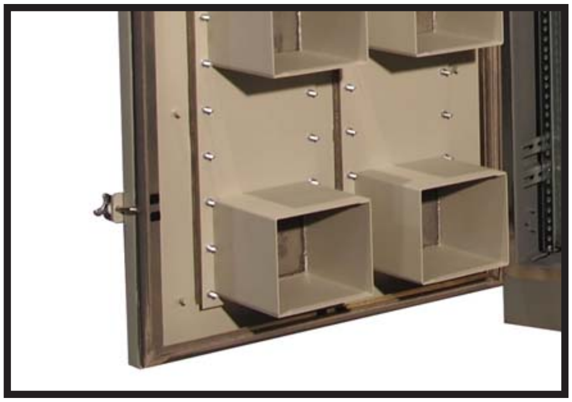
Once the enclosure had EMC protection for its main construction, strip gasketing for seams, and several EMI filters, it was time to fine-tune the cabinet. Extra gasketing was applied to any susceptible areas, including the door handle which tended to act as an antenna. So, a metal O-ring was applied to the handle which solved the problem.

By using enhancing electrical continuity with the tin process and adding gasketing in key areas, the enclosure was able to pass the 6O DB requirements. In addition, utilizing tin plating on the EMI filters and fine tuning areas such as the door handle were keys to solving this shielding challenge. Metallic gasket strips were not used in the application, but they are commonly used for medium to advanced levels of EMC in many enclosures.

Solving EMI challenges

Each cabinet enclosure application brings its own set of EMC challenges. There are several gasketing techniques to solve these problems including stamping directly into the sheet metal before bending, adding metal BeCu fingers or strips, or strip versions with wire meshed foam gaskets. Plating processes using conductive metals such as tin can also be highly effective. In other applications coatings can help provide electrical continuity to solve the problem. In applying these techniques, Optima EPS balances other factors such as cooling, weight, size constraints, and desired pricing points to meet our customer's goals.

Front door hinge, inside.



Interior rear filter.

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