EMI OPTICAL FILTER RESOLUTION ENHANCEMENT

Innovative design parameters and application methods of conductive mesh improve optical clarity while protecting the EM radiation of alphanumeric display devices.

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As visual display devices have become more sophisticated, the utilization of conductive fine wire mesh to control electromagnetic radiation has increasingly posed serious problems to the design engineer. Attenuation goals are adequately achieved at a drastic cost of optical clarity and with a serious reduction of visual transmission. High resolution color CRTs and other demanding alpha numeric display devices have especially suffered.

This loss results for several reasons. In the case of CRTs, the fine wire threads are simply not fine enough and occlude portions of the pixels, with obvious results. Coupled with this problem is the generation of moire patterns which are not limited to a color CRT shadow mask confliction. These patterns are particularly disturbing to the viewer who constantly changes his viewing angle.

A third and not necessarily less important factor is the reduction of visual transmission. High ambient light conditions are immediately affected unless, as in the case of the CRT, it is driven harder, the results of which are often phosphor burn and considerably shortened display life.

A logical approach in eliminating these problems, and simultaneously retaining the required EMI attenuation, would appear to be the application of conductive optical coatings. However, investigation reveals several discouraging design factors. Long vacuum cycle time results in questionable economics when attempting to achieve the high level attenuation specified for high performance EMI applications. The coating thickness required to meet this performance level seriously reduces visual transmission. Again, the CRT must be driven harder, resulting in phosphor burn and shorter tube life.

The relatively heavy deposition of the conductive metal coating also has shown durability problems such as cracking. Long-term testing results do not appear promising. At this point, if internal suppression proves impossible, or too expensive, reinvestigating wire mesh becomes necessary.

Knitted mesh has some disadvantages. It is difficult to laminate and hold in a uniform geometry. The knitted harsh appearance can distract the viewer, thereby limiting its display usage. However, in some applications, it is specified mainly due to its ready availability and proven shielding performance.

For most applications, 0.001-inch, 100-mesh wire has proven to be quite acceptable, but it usually develops a loss of resolution. This mesh is readily available and appears to be a good selection from which to proceed with optical evaluations. Orienting the wire at an angle that reduces moires, a common approach, is somewhat effective. Unfortunately, a loss of resolution is also ordinarily experienced.

A reconsideration of woven mesh indicates that in addition to several basic design parameters, the woven mesh qualities must be rigidly controlled before and after plating, as in the case of stainless weaves. Thread diameter is critical. Even what may ordinarily be considered slight variations are found to have an enormous effect on transmission, resolution and moire generation. "Heavier" plating increases thread diameter, but does not demonstrate an appreciable improvement in EMI suppression.

Higher mesh counts, such as 145, effectively control moires; however, the visual transmission is seriously reduced. Again, the CRT has to be driven harder, with the obvious cost of tube life.

Mesh counts lower than 100 are evaluated and are found to perform well in respect to EMI attenuation. Visual transmission also improves, as was predicted. Unfortunately, other problems appear, such as difficulty in weaving, quality, price and delivery. It is also found that a more open mesh results in a problem similar to the harshness problem of the knits.

Further evaluation of 100-mesh, 0.001-inch stainless steel, and the standard diffusion (etched) filter surface finish leads to the application of expanded technology. The different diffusion levels developed for standard optical windows are intensely appraised in conjunction with moire and resolution control. Combinations of various levels are also evaluated. For instance, one diffusion finish is applied to the inside and another to the outside. Acrylic laminates are initially evaluated. The ease of varying finishes ranges from any point between a ground glass and a polished optical flat.

The technological approach described above works remarkably well. Different CRTs respond to different combinations of finishes. Color requirements vary according to the shadow mask geometry. Moire control by wire orientation is also significantly improved, or moires are eliminated altogether. Etched CRTs are also evaluated, and respond equally well.

At this point, another design factor is evaluated, and it is found that the variation of filter thickness affects the focal length and improves the resolution of some displays.

Flat displays are developed, as described above, and are also combined with an in-house patented surface shield. This design locates the mesh within 0.001 inch of the filter surface. The proximity of the mesh to the display surface adds another

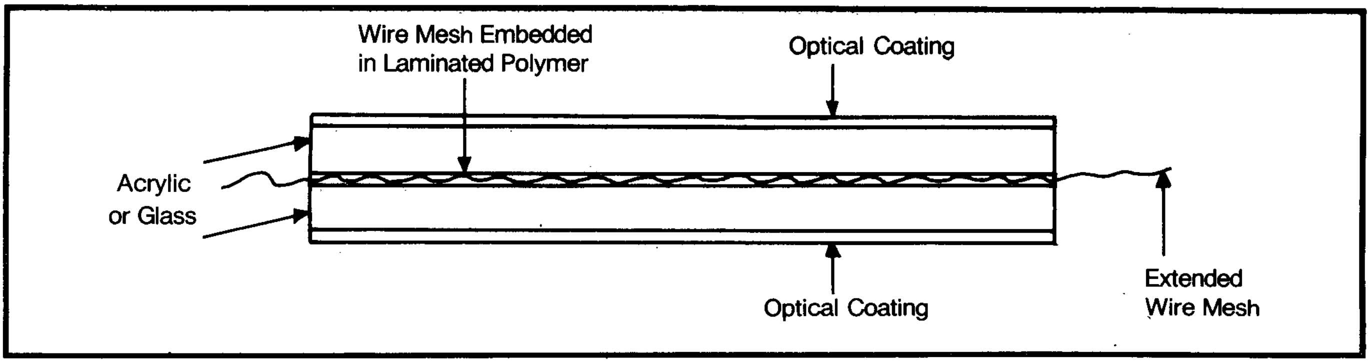

Figure 1. EMI Optically Enhanced Filter.

element of control. The loss of resolution that has occurred with wire mesh is now capable of being controlled. Objections to acrylic filters, due to the contrast with the durability of glass, are adequately resolved by the inherent abrasion-toughness of the diffusion polymers.

Resolution test chips with the various combinations of finishes are available to determine the maximum resolution recovery and moire control. Molded EMI acrylic filters in a wide range of colors, even narrowband pass P43 are supplied. Flat filters with optical finishes are produced up to 20 inches by 28 inches. It may be worth noting that high performance EMI filters, without optical finishes, but fully laminated with wire mesh, are produced in sizes up to 4 feet by 8 feet. Sagged optical glass filters are also manufactured, but not with the extensive acrylic optical enhancement capabilities.

With these design developments and application methods, attenuation goals as well as improved visual transmission, especially of high resolution CRTs, can be assured. ■