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CORROSION-RESISTANT SHIELD FOR CIRCUIT BOARD APPLICATIONS

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ABSTRACT

Networking equipment can be deployed in environments involving polluted airspaces and other non-optimal environments involving humidity, high temperature, high pollution content, etc. Additionally, a significant factor that can be corrosive to electronic devices is the presence of sulfur-dioxide, which can be found in many forms of air pollution. Although it is often recommended to control such environmental conditions/factors, some locations and/or circumstances may limit the ability to control environmental conditions/factors. To improve the operability of electronic devices in caustic/corrosive environments, a corrosion-resistant shield is presented herein that provides a new approach to facilitate corrosion protection for electronic devices instead of conventional conformal coatings. The corrosion-resistant shield can be produced from an affordable material that is replaceable, customizable, and can be targeted to a wide-range of electronic products that may be deployed in moderately corrosive environments.

DETAILED DESCRIPTION

Typical solutions to limit the effects of corrosion in polluted environments often involve a conformal coating applied to electronic circuitry/printed circuit boards (PCBs) of electronic devices and/or encasing electronic components within a sealed or air-proof enclosure. However, air-proof enclosures can be cost prohibitive for small products and may not be feasible for many larger products that rely on airflow for cooling. Although conformal coating solutions are typically cheaper, such solutions struggle with uneven coatings and are not easily re-worked. Thus, although the current solutions are used in industry, they have limitations and are not ideal for many situations.

This proposal provides a solution that involves a corrosion-resistive or resistant (CR) shield that can cover a PCB, which can be made from a fire-retardant or noncombustible, non-conductive fabric. Figure 1, below, illustrates example details that may be associated with the CR shield.

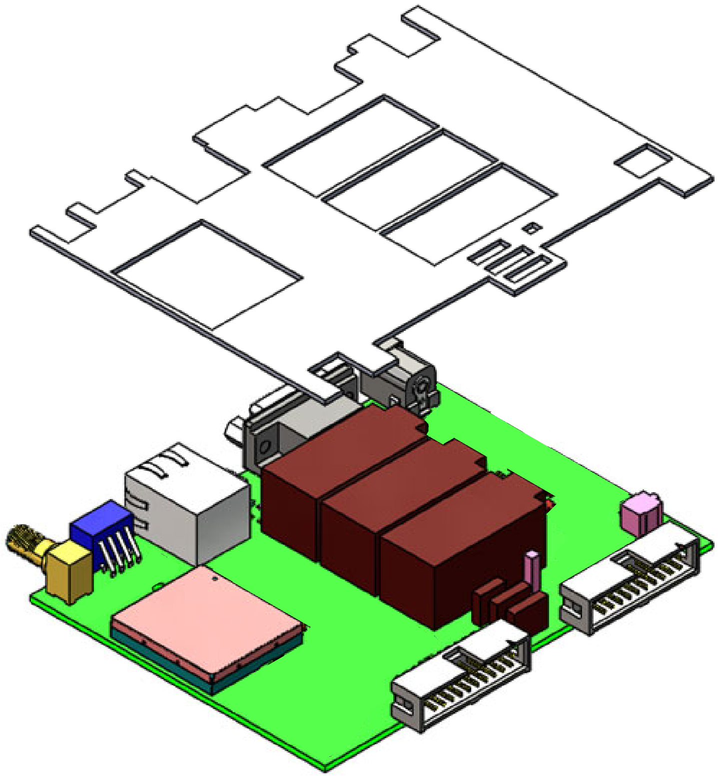

Figure 1: Example PCB CR Shield

As illustrated in Figure 1, the CR shield can be cut or otherwise formed to custom-fit any PCB, around heat sink components, and/or tall components to reduce airflow across the most corrosion-vulnerable portions of a PCB while still allowing for airflow to cool critical components. Limiting airflow across corrosion-vulnerable components is crucial for preventing corrosion since the rate of corrosion depends on the number of pollutant particles that come in contact with an exposed metal.

In some instances, the CR Shield can be enhanced with compounds incorporated into the fabric that can react with any contaminants that make their way through the fibers or around the shield. Further, in some instances, customized fabric, thread, coating, etc. can be created for a particular environment. For example, products in a particular country or location that struggle with certain corrosive agent(s) in the environment can incorporate specific compounds that better shield electronics from such corrosive agent(s).

Various customizations that can be incorporated into a fabric can include, but not be limited to, use of coated fibers, use of fabric wraps, customizations that are sputtered, sprayed or gassed onto fabrics, combinations thereof, and/or the like. Other customizations, which may involve 'weave in' materials can include, but not be limited to, using thermal conductivity fibers (to facilitate releasing heat from smaller components and a PCB), using silica gel fibers (to absorb excess moisture before it is able to fully penetrate through a fabric), using dry fly ash/CaO/CaSO4, using potassium-based sorbents, combinations thereof, and/or the like.

Beyond fabric customizations, different mounting options may be utilized including, but not limited to, using PCB through-hole hooks, using clamps that attach to an enclosure, using adhesive pads, combinations thereof, and/or the like. In some instances, a full sleeve that wraps around the sides of a PCB can be envisioned, although challenges with system assembly may be involved for such an application.

As noted above, the CR shield can include cut-out portions that may improve thermal cooling for various components, such as Application-Specific Integrated Circuits (ASICs), optics, and/or high-powered components, and, in some instances may allow for heat sinks to be mounted above the CR shield.

Thermal simulation results indicate that a rise of approximately 4-6 degrees Celsius (C) may be experienced for a device including the CR shield, however, this may vary for different product and/or fabric materials. For the example, simulations indicate a temperature drop of approximately 4.5°C when the CR shield is removed. When running other simulations using a 60°C ambient temperature, the temperature change fluctuated around a similar delta.

In addition to thermal considerations, other considerations may impact material selection for a CR shield. For example, shelf-life of a CR shield may depend on compounds added to the general cloth/fabric. Repeatability may allow for this to be less than the product's life cycle. Regarding cost, manufacturing/fabrication cost a CR shield may be impacted by the material/compounds incorporated into a shield and/or complexity of the template utilized for different products/applications (e.g., to define size, cut-outs, etc.), however cost savings for any manufacturing/fabrication costs may be realized by the improved ability to rework products utilizing a CR shield as opposed to a conformal coating.

Level of protection needed for a specific product and/or environment may be another consideration. Although catalytic/compound "weave in" materials may add extra protection from a CR shield, it is likely that such materials may not provide the same protection as an airtight seal. However, a CR shield is not meant to be a 1:1 replacement for conformal coating in exceptionally harsh environments. There are certainly applications, such as industrial applications, in which contamination levels could be above what might be feasible for a CR shield to prevent. However, a CR shield would likely be a great solution for devices that are to be deployed in low to medium harsh environments, where a conformal coating would be too expensive, limiting and over protective.

Various advantages may be realized by a CR shield as described herein. For example, a CR shield may offer a cheaper and more flexible alternative to conformal coatings and can be customized to address specific pollutants of interest for a given environment. Further, a CR shield will reduce the occurrence of resulting corrosion while also allowing for easy rework-ability. Although a CR shield may not outperform conformal coatings, especially in very harsh environments with high levels of pollutants or humidity, the CR shield solution can be geared toward products that could be exposed to semi-harsh environments. For instance, a data center that uses unfiltered outdoor air for cooling during the night may be an environment in which a CR shield may provide adequate protection for devices.

In summary, a corrosion-resistant shield is presented herein that provides a new approach to facilitate corrosion protection for electronic devices instead of conventional conformal coatings. The corrosion-resistant shield can be produced from an affordable material that is replaceable, customizable, and can be targeted to a wide-range of electronic products that may be deployed in moderately corrosive environments.