

Electronics Manufacturers Turn To Converters For Help In Handling Hot Components and EMI/RFI Shielding Challenges



Electronics manufacturers face numerous challenges, including how to dissipate heat from today's advanced components as well as how to shield sensitive digital circuits from internal and external emissions that can impair product performance, and contain potentially harmful emissions from these same circuits.

Figure 1. Engineered thermal transfer materials offer high thermal conductivity and low thermal impedance.

For expert assistance in meeting their thermal-management and EMI/RFI shielding needs, many electronics manufacturers partner with firms specializing in the conversion of flexible materials, such as Fabrico of Kennesaw, GA, USA. Fabrico identifies and procures the materials for a wide variety of electronics applications. They also provide critical design and custom conversion services to ensure optimal fit, performance, and reliability of the chosen materials.

Today's Advanced Components Are Hot...Literally

To meet the never-ending demand for improved performance, electronics manufacturers are packing more and more hardware onto printed circuit boards and fitting additional components into shrinking chassis. But along with better performance comes a serious problem for manufacturers: as electronic assemblies become smaller and more powerful, they generate increasing amounts of heat. So today's hot new products are literally hot, resulting in higher internal temperatures.

Dissipation of this heat, accomplished by thermal management techniques, is necessary to keep device temperatures within safe operating limits. Effective thermal management prevents damage to temperature-sensitive internal components, as well as premature shutdown and even system failure. In addition, it can improve performance by enabling electronic assemblies to run at higher speeds. Reduced operating costs and extended product life are direct benefits.



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Thermal Management Fundamentals

Thermal management schemes transfer heat from electronic components to a heat sink and then to the ambient environment. In order to attach an electronic package to a heat sink, the surfaces of the two components must be brought into intimate contact with one another. Micro surface roughness of the device and heat sink must be accounted for in order for the *contact* area to be free of air gaps, which are highly resistant to heat flow.

Therefore, manufacturers use materials to bridge the gaps between the two surfaces, forcing air out of the gaps and improving the pathways for heat to travel. One common material that performs these functions is thermal grease, which is inexpensive and effective in eliminating air barriers. However, application of grease is messy and never uniform. Grease is also less stable than solid materials and dissipates over time, reducing its effectiveness.

Dissatisfied with grease, many electronics manufacturers are turning to a better option: engineered thermal transfer materials. Offering high thermal conductivity and low thermal impedance, these flexible materials are more stable and longer-lasting than grease. In addition, solid thermal transfer materials provide the means to handle new designs requiring wider gap contact areas. Thickness consistency and elimination of the messy process of applying grease are added benefits.

Table 1. Thermal Materials vs. Grease

	Thermal Conductivity	Thermal Impedance	Ease of Use	Stability	Durability	Cost
Grease	High	Low	Messy	Poor	Short term	Inexpensive
Phase Change Materials	High	Low	Easy	Good	Good	Medium
Insulating Pads	High	Low	Easy	Very Good	Very Good	Medium
Gap Fillers	Moderate	Moderate	Easy	Good	Good	Medium

Thermal Material Options

Today, electronics manufacturers can choose from a number of different thermal management materials. These include:

- **Phase-change materials.**

These materials offer the thermal performance of grease but start out as solid sheets typically no thicker than 7 mils, allowing easy application between electronic components and heat sinks. Once in place and exposed to heat, phase-change materials melt and flow into the gaps between surfaces, driving out air and improving thermal pathways.

- **Insulating pads.** Such pads provide both thermal conductivity and electrical insulation between electronic components and heat sinks. Insulating pads often include a silicone binder, which provides both thermal conductivity and high dielectric strength, and glass mesh reinforcement, which provides tear resistance. Reinforcement prevents debris, such as solder balls present on many circuit boards, from puncturing through pads, which can result in rapid thermal failure or electrical shorting.

In some cases, insulating pads are composites rather than single-layer structures. These composites consist of a film dielectric barrier with thermal management material on both sides.

- **Gap fillers.** These elastomers are used to conduct heat across gaps that are relatively large and vary significantly in size. With soft silicone gel binders, the materials are flexible enough to fill large gaps with wide tolerance ranges without overstressing components. But gap fillers provide only moderate thermal conductivity, which usually limits them to applications requiring low to moderate heat dissipation.

Converted Materials

With many options, how do electronics manufacturers choose the best thermal management solution for their application? Help in making this crucial decision is provided by leading converters, like Fabrico, who have in-house teams who help analyze the product, available space, and heat dissipation requirements.

Early in the design process, Fabrico teams up with a customer's device engineers to identify a material that can handle the thermal challenges posed by a particular product. To prevent puncturing of the thermal management layer, for example, Fabrico might recommend a glass-reinforced material and then test several different types to find the one that is best suited to meet the application requirement. There are also some thermal transfer schemes that are effective but do not lend themselves to close tolerance die-cutting. Fabrico has the engineering resources to spot such problems and suggest alternatives that will still meet the customer's thermal management requirements.

In addition to helping with new products, Fabrico can make recommendations for solving thermal management problems experienced by products already in the field. For example, by assessing whether a particular failure mode was caused by improper material selection or installation/assembly problems,

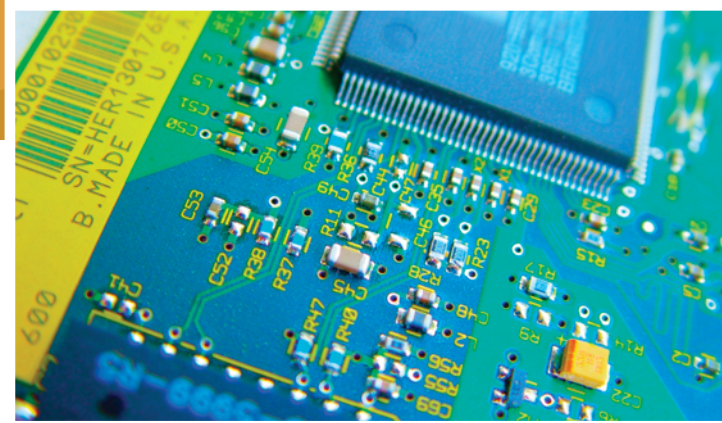


Figure 2. Converters analyze the product, available space, and heat dissipation requirements.

Fabrico might recommend a material that addresses these issues.

The contract manufacturer can then take this recommendation to the product designers for their consideration.

Turning Designs Into Solutions

Once an approach has been decided on, customers have access to a large network of well-known suppliers, such as 3M, Chomerics, Saint Gobain, Laird, Von Roll, Berquist, and DuPont, who can provide a variety of thermally conductive materials for a range of applications.

After procuring the chosen materials, Fabrico performs custom conversion tasks such as lamination and close-tolerance die-cutting to produce the required thermal management solution. For example, Fabrico may need to die-cut thermally conductive materials into a variety of shapes, ranging from gasket-type configurations to scored die-cut parts that can be folded up to fit into an enclosure.

In some cases, the best solution may be a combination of materials—for instance, a composite consisting of a piece of thermal management material and a dielectric film. By laminating the two together, Fabrico provides electronics

manufacturers a single sheet of material to meet both their heat-dissipation and electrical-insulation needs, thereby reducing handling requirements and increasing manufacturing efficiency.

Multi-step processes are also frequently required to create more complex products that provide both thermal conductivity and dielectric properties.

For assistance with challenging thermal management applications, electronics manufacturers should look for more in a partner than just converting capabilities. Fabrico can help electronics firms choose the right thermally conductive materials for a device, procure those materials, and then provide design and manufacturing expertise to help turn them into innovative thermal management products.

Crucial Help in EMI/RFI Shielding

Manufacturers of electronic devices employ EMI/RFI shielding to (1) protect the sensitive digital circuits inside devices from external emissions that can impair product performance and (2) contain potentially harmful emissions from their products. But electronics manufacturers face critical challenges in complying with EMI/RFI shielding requirements. These include both material selection and converting chosen materials into effective shielding components.

For help in meeting these challenges, many OEMs turn to outside firms who specialize in the conversion of flexible materials. In the early stages of a project, top firms provide critical engineering support to improve product design and manufacturability. Leading converters, like Fabrico, also have the automated equipment and trained personnel necessary to perform the breadth of converting operations required in this industry.

Shielding Basics

EMI/RFI shielding is required in consumer electronics items such as televisions, radios, cell phones, and computers, as well as devices used in medical and aerospace applications. Shielding for these devices is provided by Faraday cages that surround components and serve as barriers to electronic emissions.

Table 2. Common EMI/RFI Materials

	Fabrication	Shielding Properties	Heat Capabilities	Gap Filling Cushion	Weight
Foil Tapes	Easy	Good	Good	Good	Light
Metal-Filled Elastomers	Easy	Good	Good	Very Good	Light
Wire Mesh	Harder	Best	Best	Good	Heavy

Faraday cages are made of a number of flexible materials supplied by manufacturers such as 3M, Parker Chomerics, Laird Technologies, Saint-Gobain, and Intertape Polymer Group. Common EMI/RFI materials include:

- **Foil tapes.** Relatively easy to fabricate, tapes with aluminum- and copper-foil backings eliminate the need for costly metal plating of enclosures to provide shielding properties.
- **Metal-filled elastomers.** These materials are suitable for shielding applications that require gap-filling and cushioning.
- **Wire mesh.** Used for EMI gaskets, mesh materials handle heat better than foils but are also heavier and take up more space.

Help From the Right Converter

Converters need a comprehensive selection of flexible shielding materials provided by leading suppliers. At the outset of a project, Fabrico's engineering teams help OEMs select materials that are best suited for a particular shielding application. Material selection is based on reference data from material suppliers and Fabrico's deep experience in shielding applications.

To get an idea of the potential value of this input, consider a situation where an OEM specifies a copper EMI/RFI material as a shielding strategy. Copper provides excellent shielding properties and is heavy enough to withstand soldering for the attachment of wires. But it is also relatively expensive. In a case like this, Fabrico might determine that aluminum foil tape, which is much less costly than copper alternatives, will do the trick.

In other cases, a converter's engineering team might recommend concurrent testing of more and less robust shielding options. This gives customers the option of going with the less robust (and less expensive) option if tests show that it meets the shielding requirements of the application.

At the request of a customer, Fabrico can arrange with the material supplier to provide EMI/RFI testing services. Sometimes, such testing might show that the customer's original design provides inadequate shielding. When this happens, Fabrico's engineers might assist by recommending a foil tape to enhance the shielding.

Other Design Services

Using well-known 2D and 3D solid-modeling software, Fabrico's engineers can work with the OEM's electronic designs and also generate their own drawings. These capabilities allow Fabrico to help customers turn concepts into actual products and easily point out problems with proposed shielding configurations.

Sometimes, OEMs with little or no shielding experience will come up with designs that are difficult and/or expensive to manufacture in volume because of overly tight tolerances, an impractical configuration, or some other reason. With its engineering resources and manufacturing expertise, Fabrico can quickly spot such problems and suggest alternative manufacturing strategies that still meet the OEM's shielding requirements.

Also critical are quick-turnaround sampling and rapid prototyping of shielding designs at no charge to customers. This service helps OEMs develop better shielding solutions and also gives their converting partners a chance to test the manufacturing processes required to support full-scale production.

Engineers at Fabrico work with custom samples, hand sketches, or full engineering drawings to provide samples for testing and evaluation. Equipped with state-of-the-art devices such as lasers, water jets, and Zund flatbed prototyping machines, small



Figure 3. Quick turnaround sampling and rapid prototyping of shielding designs are critical.

numbers of prototypes are produced without tooling in 48 hours or less.

Many prototyping processes require several iterations in order to produce final designs that meet all requirements. Throughout such processes, Fabrico's engineers help OEMs adjust their designs until they are satisfied with form, fit, and function.

Turning Designs Into Products

Once a design is completed, Fabrico procures the necessary materials and turns them into shielding products. Common converting processes produce slit rolls of foil tapes and die-cut parts of various shapes. In addition, some converters have advanced production machines such as lasers and water jets, which can cut intricate designs into a variety of materials.

Fabrico can also laminate multiple materials together to produce finished products. Fabrico is equipped with wide- and narrow-width machines that allow it to laminate a variety of materials with different adhesives. Laminating capabilities range from one-step processes to multiple-material operations incorporating final finishing such as punching and cutting. Fabrico can laminate up to four individual materials

together in one pass. Laminated products can include one material for EMI/RFI shielding and another that provides electrical insulation or some other necessary property.

In some applications, very close-tolerance die-cut parts and complex shielding configurations are required, such as a composite consisting of an insulator like Mylar® with a die-cut shielding patch "island" placed on it. Or a multilayer product comprised of a foil, an adhesive, and a specialty liner that allows easy removal by the OEM's pick-and-place machine during final assembly. Fabrico would laminate these three elements together and then die-cut the lamination to produce the finished product.

When a shielding application calls for a box-shaped part, Fabrico can provide customers with creased or scored materials. This allows OEMs to easily produce the needed shape by folding flat materials along the crease or score lines.

Leading converters, such as Fabrico also offer printing capabilities that can handle everything from basic one-color applications to intricate multi-color designs. They can print on a variety of shielding materials using both water-based and UV-cured inks.

Conclusion

The multifaceted task of shielding sensitive components from EMI/RFI can be made easier by firms who specialize in the conversion of flexible materials. Leading converters, such as Fabrico, have the in-house engineering resources to help electronics manufacturers choose the best materials and designs for shielding applications. After procuring the selected raw materials from a network of leading suppliers, Fabrico uses a variety of manufacturing processes to turn them into shielding products. In many cases, Fabrico uses multiple materials and techniques to produce effective solutions for the toughest shielding problems posed by a variety of industries.



Figure 4. Selecting the right materials and applying the appropriate manufacturing processes produce solutions for the toughest EMI/RFI shielding challenges.



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Fabrico Headquarters

4175 Royal Drive, Suite 800
Kennesaw, GA 30144
Phone: 678-202-2700
Fax: 678-202-2702
Toll Free: 800-351-8273
E-mail: info@fabrico.com