How Military Vehicle Engineering Teams Can Bridge the Design Wall

When marathoners describe the discomfort and stress they feel as they finish the 20th out of the 26.2 miles of the race, they call it hitting the wall. They feel exhausted and think about quitting, wondering how the devil they ended up there in the first place.

In electronic design for military vehicles that come under mil-spec demands and imposing contractual considerations, there is also a wall. Or, rather, two walls. This duo includes a long-established approach to design that, while offering advantages, can result in siloed design choices that create adverse interactions and require additional engineering and troubleshooting. The ultimate result can, at the very least, make projects more difficult and less profitable than need be. At the worst, the issues can endanger projects and relationships with now unhappy and irritable contract officers.

However, there is a different approach manufacturers and designers can take that creates more efficient results, reduces problems, and increases the chances of timely success.

Hitting the Walls

The first of the two walls is a natural outgrowth of any military vehicle's fundamental requirements: a physical shell that is the barrier between the outside and inside. The shell, or wall, is its own sphere as well, representing a transition point between what the inside and outside must accomplish.

The exterior has one set of design requirements, such as maintaining physical integrity, resisting harsh environmental conditions like temperature extremes or corrosive substances, and often resisting or evading detection. Simultaneously, it also must enable the reception and transmission of signals vital to operations through antennas.

The interior has complex electronics in boxes that need protection from heat and electromagnetic interference (EMI) as well as vibration and physical shocks.

The shell is the wall between the two sides and has yet another set of requirements, insulation each from effects the other can present while ensuring physical integrity and the necessary transmissions of signals inward and outward.

As a result, each sphere typically has its own design team that is experienced in the associated requirements, typical problems, and associated solutions. The teams are effectively separated by an organizational equivalent of the same wall, addressing its own needs. The designers who deal with physical issues like temperature and corrosion, as an example, may be different from those looking at EMI.

Projects do have system architects controlling overall design, but their involvement typically comes in the earlier phases of a project. By the time specific design tradeoffs happen in real time, the architects are generally off to other work.

The physical and conceptual wall paradigm has worked for many years. Splitting a design into different spheres allows engineers with certain expertise to focus on their areas of strength. The organizational approach also should enable faster development because different areas can proceed in parallel rather than the serial approach of working on one side of the wall, then the other, and finally reconciliation in the middle.

But few things are wholly good or bad, and the wall paradigm has some limitations. It inherently assumes that both sides of the physical and functional walls are independent. Choices made on one side are supposed to be like a vacation in Las Vegas, where what happens stays there.

Only, that is impossible because it brings along a tendency toward suboptimization. Few parts of any design can be guaranteed not to have an impact on other aspects. Increase the amount of EMI shielding and the result, by the nature of physics, has to include elimination of stray signals, typically in the form of thermal energy. Perhaps that extra amount of heat will be relatively negligible and something that can be safely ignored. However, it could also be that the new thermal differential might cross a boundary and cause additional problems.

Solving one matter and, in the process, creating conditions that introduce a new concern in another part of the overall design leads to an incremental experience that reads like the famous W. Edwards Deming funnel experiment. Holding a funnel over a target and dropping ball bearings through probably won't hit the center, but it's likely to create a cluster that can be analyzed as a whole. Try to shift the funnel each time to get closer and the opposite happens, with bearings widely scattered. The latter approach introduces constant variations that always change the nature of the problem and what would need to be the matching solutions.

Not only do the silos complicate system architecture, but they are not optimum to encourage design for manufacturing and time-wasting and costly surprises once a project moves from design and prototyping into production.

Walking Around the Walls

There are good reasons why aspects of the walls that aren't going to change. The physical walls of the vehicles still exist. So do the needs on both the inside and outside, as well as the requirement to pass information through the wall without compromising any form of integrity.

Also, there will continue to be specialized groups in silos that concentrate on aspects of a design because of the need to move projects along by working in parallel rather than serial.

Instead of trying to knock the wall down, the most effective solution is to walk around them. That starts with education of staff. While working on their own responsibilities, they need to have a secondary larger awareness of how their choices can have an impact on the work of other groups.

A practical way to achieve this is the introduction of multifunctional problem-solving, using materials and components that can address more than one aspect of a design. By keeping aware of the needs of other involved teams, engineers can address their own design concerns while reducing the potential impact on other aspects of the overall design. Here are some examples of how multifunctional concepts and components can change the intra-silo dynamic, improving problem resolution and reducing delays.

CoolZorb is a homogenous compressible pad material that combines thermal transfer and microwave absorption. It reduces EMI noise radiation and also provides a thermal path to remove heat. Additionally, CoolZorb products can help establish EMI compliance and thermal management from a specific board, acting as a board-level shield without investment in tooling, so offering potentially lower costs.

CoolShield-Flex is a stack-up film of thermal interface materials. Used with a board level shielding frame, it can perform both thermal transmission and shielding for ICs in electronics devices. The solution is also thinner in comparison to others, so excellent for compact spaces.

CoolShield-R integrates thermal products into board level shielding covers so that they can provide both EMI shielding and heat transmission for ICs on electronics devices. The shielding cover can be a piece of stamped metal, a deep draw cover, or even a die casting part while the thermal management product can vary according to application requirements, including thermal pads, thermal grease, thermal gel, or phase change material.

HeatsinX is a diecast, deep drawn, or stamped heatsink that has been enhanced for its design needs with a combination of thermal interface material, CoolZorb, form-in-place EMI gaskets, RF absorbers, or EMI shielding solutions.

The **Graphite-over-Foam** (GOF) compressible thermal transfer gasket enables device insertion or heat transfer over large gaps with high thermal conductivity, with or without electrical conductivity. The compact thermal gaskets are ideal for large gaps, repeatable compression, sliding thermal joints, and heat transfer between insertable components.

Kzorb is a microwave absorber and dielectric sheet that can be applied directly to the printed circuit board with no effect on trace impedance. The product family consist of a flexible dielectric silicone layer and a flexible microwave absorbing layer, providing RF and microwave insulation and absorption simultaneously.

ShieldZorb R is a combination EMI shield and absorption system that integrates absorbers with board level shielding (BLS). It can dampen cavity resonance and reduce unwanted coupling of electronic components in the BLS and/or coupling between components in the BLS and nearby RF antennas. At high frequencies, cavity resonance of BLS can cause serious deterioration of its shielding effectiveness at the cavity resonance frequency. Unwanted coupling with nearby RF antennas or cross talk within the BLS might lead to desensitization of those RF components. ShieldZorb solutions can effectively fix those problems.

Electrically conductive Elastomers (EcE) sealing gaskets are made of conductive particles dispersed in an elastomeric matrix. They provide an environmental and EMI seal for electronic housings, hatches, panels, or other areas where EMI must not escape or enter. They can also incorporate a conductive or non-conductive fabric reinforcement for enhanced strength and performance.

Conclusion

Multifunctional design, made possible by the range of specialized multifunctional materials, offers tremendous advantages to military projects. The overarching difficulty is when one group of decisions aggravate conditions in other parts of a design, which then require mitigation that, if done without regard to the first choices, might undo those improvements, setting off round after round of uncontrolled process feedback, escalating costs and causing delays.

Instead, by using multifunctional design and properly chosen components, engineers can address what arises in their own areas while protecting the work of others. Multifunctional components make possible the correction or protection of multiple considerations in a single application. The benefits are more efficient design processes, reduced costs, and greater likelihood of meeting contractual deadlines.

To learn more about how your teams can employ a multifunctional strategy and the components and products that can make it possible, contact Laird today at **inside.sales@laird.com.**

About Laird Performance Materials (Laird)

Laird Performance Materials, integrated into DuPont Electronics & Industrial's Interconnect Solutions (ICS) business, solves signal integrity and power transmission issues. We enable high-performance electronics by creating protection solutions for advanced interconnects and systems. World-leading technology brands rely on Laird for improved protection and helping accelerate their products' time-to-market. A global brand, Laird solves design issues by providing Laird™ branded innovative products such as EMI suppression or absorption materials, thermal interface materials, structural and precision metals, magnetic ceramic products, and multi-functional solutions (MFS). The Laird™ MFS product family solves multiple EMI, thermal and structural design issues simultaneously using a single process design. Visit Laird at **https://www.laird.com**.