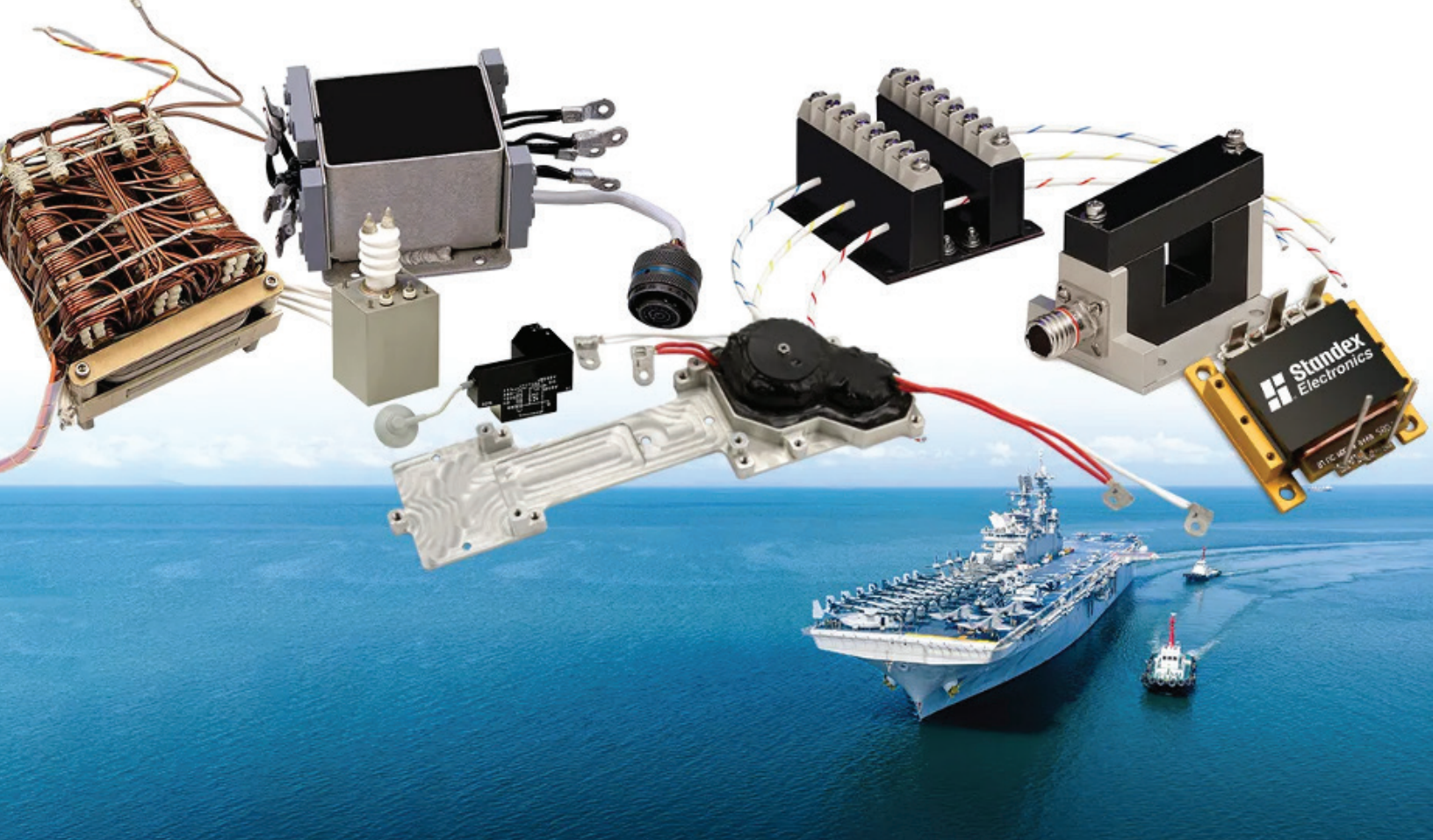




**Proper Magnetic Component
Selection for Military and
Aerospace Applications is
Key to Performance**



Advanced military and aerospace systems require the latest magnetic component solutions at every level, and using devices that leverage the latest technologies can address the increasing demand for optimum circuit performance.

CONTENTS

- 03 Magnetic Component Considerations
- 03 Planar Magnetics and Custom Devices
- 03 Design Considerations
- 04 Fielding Solutions
- 04 Moving Forward

The current situation in Eastern Europe has underscored more than ever the importance of precision munitions and the advanced platforms to carry them.

From the warfighter's battlefield gear to the satellites monitoring the military situation, advanced mil/aero electronics solutions are now a necessity in modern combat. Everything must operate with the highest levels of functionality in extreme environments with a high level of safety and reliability. This is especially the case for the transformers and inductors in the power systems driving them, as a failure or lack of performance in your magnetics can have significantly negative effects on the circuit.

These next-generation systems present multiple challenges to the embedded electronics designer, as they have aggressive power and performance demands. Many of these demands have been addressed with the latest solutions based on recently commercialized advanced core technologies. These solutions include transistors made from wide-bandgap semiconductor materials and digitally-driven circuit topologies. However, these high-power and fast-switching solutions place pressure on all of the other devices on the board, demanding the best in passive and magnetic components to serve them.

One example of this can be found in the driver electronics for the latest mil/aero phased-array radar and LIDAR systems, which require magnetics to handle high current and high frequency. On top of the demands placed upon it to drive the functionality of the system itself is the further need to do so while meeting mil/aero standards and requirements for reliability, safety, and harsh-environment. Only components rated to handle such demands can be trusted in these circuits.

Systems operating in mil/aero-grade environments using cheaper, lower-caliber components can adversely impact operational lifespan and performance, even though they may reduce the initial cost of the product. Durability, environmental sealing, and solution size are very important considerations for ruggedized mil/aero applications. Ruggedization, including robust resistance to vibration and shock, is crucial.

Magnetic Component Considerations

Magnetic components can be split into two main groups, transformers and inductors. Transformers step voltage up or down, while inductors introduce resistance and store current. Depending on their configuration and function, they fall into categories based on frequency and power. There are magnetic components available in a variety of designs and configurations, each suitable for specific use cases.

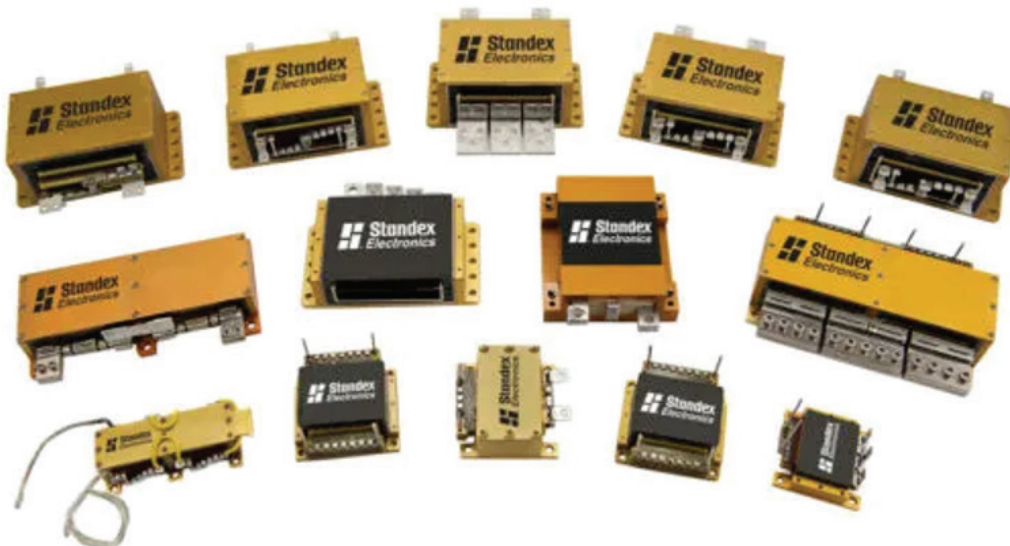
There are many factors to keep in mind when designing-in and selecting a transformer, to ensure the circuit created functions as intended. Key considerations include the winding design, as the way a transformer core is wound significantly affects its coupling, parasitics, and thermal dissipation characteristics. Core and winding material selection is also critical to optimize transformer and inductor efficiency for specific operating frequencies and temperatures.

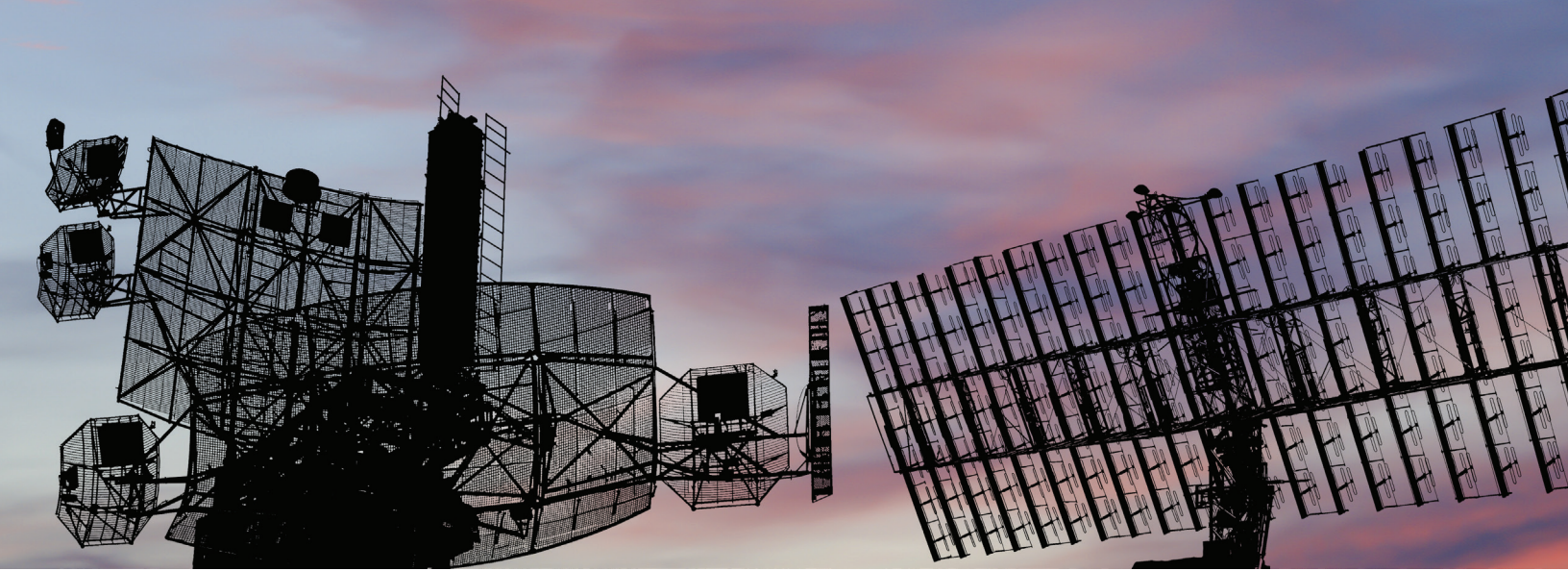
Planar Magnetics and Custom Devices

The advanced nature of next-generation mil/aero systems often means using sophisticated or customized solutions to address them. This often means the use of planar magnetics and/or custom devices created specifically for that application. Planar magnetics offer several advantages over legacy designs beyond the obvious lower profile (**Figure 1**).

These include a low leakage inductance, efficiencies as high as 98-99% from 40 kHz to 500kHz, and reduced high-frequency AC losses, as well as having improved weight, space, cooling, and enhanced performance due to their flattened configuration. In addition, planar components are pre-tooled, so they exhibit excellent repeatability and are able to offer custom terminations in standard and custom sizes and designs optimized for low core loss, with a reduced number of turns for low winding loss as well.

Figure 1 Planar magnetics offer several advantages over legacy designs beyond the obvious lower profile





Design Considerations

In addition to addressing aspects such as optimizing performance, mil/aero magnetic components must also contribute to SWaP (Size Weight and Power) reductions, delivering high performance requirements in a very small size, with low power use and light in weight. Lower SWaP components are critical for highly efficient military and aerospace systems.

Ruggedization is another major factor. While the burden of harsh-environment resistance is placed mostly on the system enclosure and its cabling and interconnects, the components on the board must be able to resist damage or performance loss due to vibration and shock. Proper mounting is key, but in the case of compound devices like wire-wound coils, the potential negative impact of vibration cannot be understated. Beyond resistance to mechanical, shock, and vibration, components and circuits for mil/aero apps must also address thermal shock and temperature cycling, as well as solderability, verified by burn-in and life-cycle testing to ensure compliance.

Magnetic components used in mil/aero solutions must be able to comply with the various military standards and regulations that exist to ensure this performance, safety, and reliability under a variety of conditions. Transformers and inductors can fall under a variety of standards depending on the application they are used in. Applicable transformer and inductor standards fall into the following: MIL-STD-981, MIL-PRF-27 and EEE-INST-002.

Fielding Solutions

The number of mil/aero systems requiring high-performance solutions are myriad. In aircraft alone, the number of places where advanced magnetic components can add value include almost everything in the cockpit, from the control panel guidance, orientation, navigation, and electronic warfare systems to the critical flight control avionics, braking systems, lighting, indicators, auxiliary power systems, and fuel management. Advanced magnetics help these systems perform at their optimal levels.

On the ground, the application spaces are literally everywhere, from the soldier's tactical electronics. To anti-aircraft and other surveillance radar, to electronic warfare systems. This doesn't even consider the smart weapons systems and intelligent combat platforms of every kind needed to carry, deploy, and maintain them. These systems must be especially rugged and reliable as they are the most used and exposed to both harsh environments and enemy contact. Here, in addition to providing the circuit performance needed, advanced magnetic components also enable smaller form factors and longer battery life through higher efficiency.

At sea, the issue isn't as much energy conservation as energy management in the high-power systems employed on a modern combat vessel. From the radar systems to the weapons platforms to the command and control electronics and infrastructure on the ship, sophisticated magnetic components address all the issues of reliability, power handling, and efficiency needed to ensure optimal performance of all systems under a variety of demanding conditions.

Moving Forward

Having the right design partner can help you achieve these difficult and challenging goals. A good development partner can help you with their IP and experience in mil/aero applications. They can also help you address supply-chain issues with their experience in sourcing and manufacturing, as well as providing compliance competence to ease procurement issues. In addition, the right partner will also be able to provide design, engineering, and verification support.

Creating the weapons systems, platforms, vehicles, combat gear, and ships needed to serve the needs of a country's defensive force is a critical application area, as there is no second place in war. Only the best solutions are satisfactory when lives are on the line, and the electronics serving and supporting those lives must be of the highest quality and performance available. Knowing the needs of the application and the magnetic component solutions able to address it is literally a matter of life and death.

PARTNER | SOLVE | DELIVER®



Standex Electronics
Worldwide Headquarters

4150 Thunderbird Lane
Fairfield, OH 45014 USA
+1.866.STANDEX (782.6339)
info@standexelectronics.com

Agile Americas (NH)
+1.800.805.8991
info@agilemagco.com

Northlake Americas (WI)
+1.262.857.9600
sales@northlake-eng.com

Renco Americas (FL)
+1.800.645.5828
sales@rencousa.com

Standex Meder Europe (Germany)
+49.7731.8399.0
salesemea@standexelectronics.com

Standex-Meder Asia (Shanghai)
+86.21.37606000
salesasia@standexelectronics.com

Standex Electronics India (Chennai)
+91.98867.57533
salesindia@standexelectronics.com

Standex Electronics Japan (Kofu)
+81.42.698.0026
sej-sales@standex.co.jp



standexelectronics.com