

Airborne Power Density

How Custom Low Profile, Vibration-Proof Magnetics Help
Optimize Avionics and Unmanned Aerial Systems



MILITARY AIRCRAFT POWER USAGE

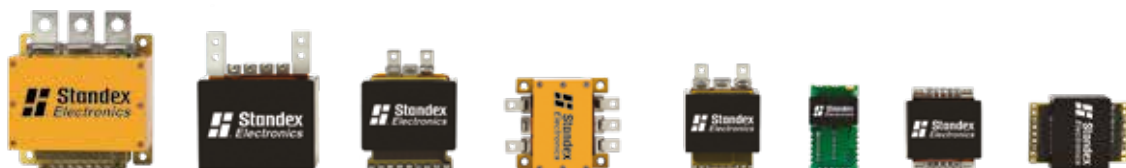


Introduction

The rapid evolution of military aircraft, unmanned aerial vehicles (UAVs), loitering munitions, hypersonic platforms, and advanced avionics is driving unprecedented demand for higher airborne power density. Designers are under constant pressure to reduce Size, Weight, Power, and Cost (SWaP-C) while simultaneously improving reliability in harsh operating environments.

Traditional wire-wound magnetics often become a limiting factor in modern airborne power architectures due to their size, weight, thermal constraints, and susceptibility to mechanical stresses. Custom planar transformer technology offers a compelling alternative by delivering high power density, low-profile packaging, improved thermal performance, and exceptional resistance to shock and vibration.

Standex Edge custom planar transformers are engineered specifically for mission-critical aerospace and defense applications, providing compact, high-efficiency power conversion solutions that meet stringent military and aerospace requirements. These solutions support applications ranging from avionics and flight controls to UAV power systems, radar electronics, satellite payloads, and next-generation defense platforms.



The Airborne Power Density Challenge

Modern airborne platforms are becoming increasingly electrified. Examples include:

- Advanced flight control systems
- AESA radar systems
- Electronic warfare systems
- Secure communications
- Autonomous navigation systems
- Sensor fusion platforms
- Directed energy technologies
- UAV propulsion and control electronics

Each subsystem demands more power while occupying less space than previous generations.

For military aircraft and drones, every gram matters. Designers must continuously improve:

- Power density (W/cm^3)
- Weight reduction
- Thermal management
- Reliability
- Electromagnetic compatibility
- Environmental survivability

The challenge becomes even greater when electronics must operate in environments characterized by:

- Continuous vibration
- Long mission durations
- Mechanical shock
- Rapid temperature cycling
- High altitude operation
- EMI/EMC exposure

Conventional magnetics frequently struggle to meet these requirements without increasing system size or weight. The graphic below illustrates a few of the systems in which Planar Magnetics are the superior option to traditional magnetics and the specific characteristics in which they excel.



Why Magnetics Matter

Power conversion systems are the backbone of airborne electronics. Every avionics subsystem relies on magnetic components to:

- Step voltages up or down
- Manage transient conditions
- Regulate power flow
- Provide galvanic isolation
- Filter noise

Historically, these functions have been performed using wire-wound transformers and inductors. While effective, traditional magnetic designs introduce several challenges:

Challenge	Impact
Bulky winding structures	Increased weight
Tall component profiles	Packaging limitations
Air gaps and winding movement	Vibration sensitivity
Limited thermal paths	Hot spots
High parasitics	Reduced efficiency



As defense and aerospace systems continue to shrink, these limitations become increasingly significant.

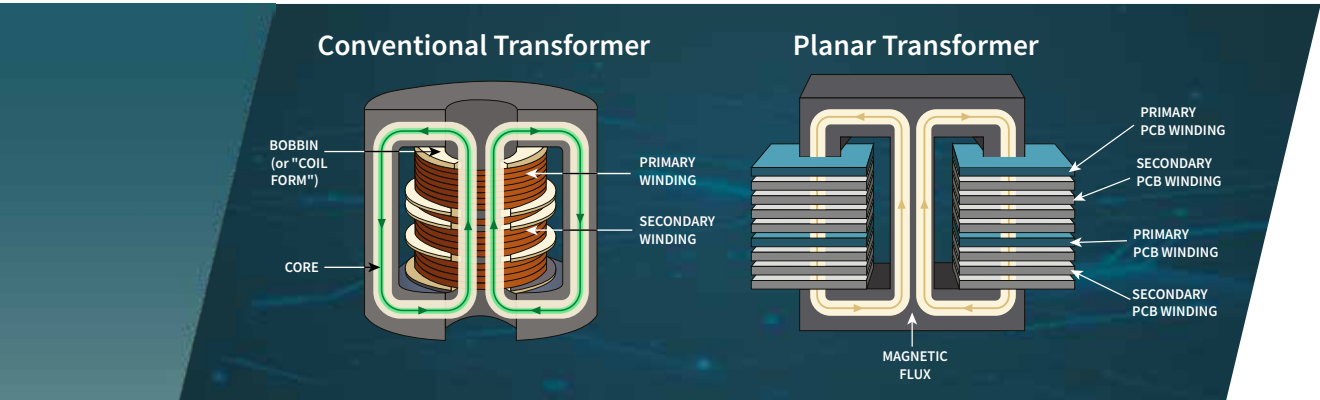
The Rise of Planar Transformer Technology

Planar transformer technology replaces conventional round-wire windings with precisely etched copper conductors embedded within multilayer PCB structures.

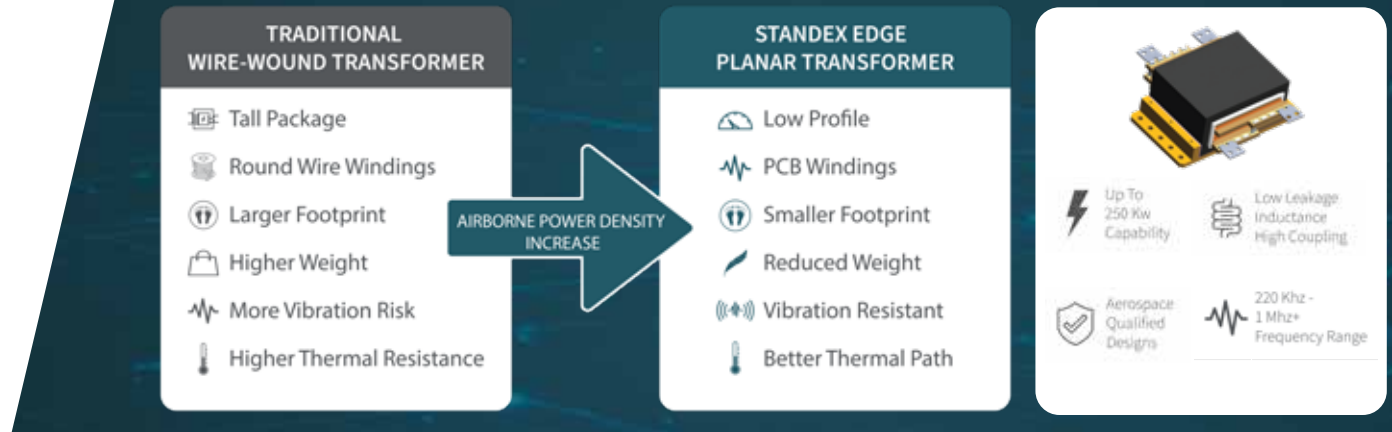
The result is a magnetic component that is inherently:

- Lower profile
- Better thermally managed
- Highly repeatable
- More mechanically stable
- Easier to integrate into compact power architectures

Standex Edge planar transformers are available across power ranges from approximately 25 W to 250 kW and frequencies extending beyond 1 MHz, enabling deployment across a broad range of aerospace and defense systems.



WIRE-WOUND TRANSFORMERS vs PLANAR TRANSFORMERS



Advantages for Defense and Aerospace Systems

1. Low Profile Design

Airborne electronics increasingly utilize stacked PCB architectures and densely packed enclosures. Planar Transformers feature:

- Flat package geometries
- Reduced overall height
- Low aspect ratios
- Enhanced packaging flexibility

This enables designers to maximize volumetric efficiency without sacrificing electrical performance.

Compared to traditional wire-wound magnetics, planar solutions significantly reduce occupied board space while supporting high-power operation.

2. Superior Vibration Resistance

Aircraft, helicopters, UAVs, missiles, and hypersonic platforms are continuously exposed to severe vibration profiles. Traditional wound magnetics may experience:

- Wire movement
- Mechanical fatigue
- Insulation wear
- Long-term reliability degradation

Planar Transformer construction inherently minimizes these risks because conductors are fixed within rigid PCB layers. Benefits include:

- Increased mechanical robustness
- Improved fatigue resistance
- Reduced winding movement
- Greater long-term reliability

Standex Edge further enhances durability through encapsulation, impregnation, casting, moulding, and vacuum potting techniques developed specifically for military environments.

3. Enhanced Thermal Management

Heat is one of the primary reliability challenges in airborne electronics. Planar transformer technology

provides superior thermal performance because heat is distributed across large copper surfaces and transferred efficiently into surrounding substrates and heatsinks. Advantages include:

- Lower hotspot temperatures
- Increased power density
- Extended component life
- Improved thermal spreading
- Higher conversion efficiency

Standex Edge planar solutions utilize optimized thermal pathways that support high-power defense and aerospace applications.

4. Higher Efficiency

Power losses translate directly into additional cooling requirements, increased fuel consumption, reduced mission endurance, and lower system reliability. Planar transformer designs offer:

- Lower leakage inductance
- Strong magnetic coupling
- Reduced AC winding losses
- Optimized high-frequency performance

Some aerospace power architectures achieve efficiencies exceeding 99% when leveraging advanced planar magnetic solutions.

5. SWaP Optimization

Size, Weight, and Power (SWaP) remain critical design metrics for defense OEMs. Planar transformers support SWaP goals through:

- Weight reduction
- Improved thermal efficiency
- Reduced component volume
- Simplified mechanical integration

This makes them ideal for UAVs, satellite systems, missile electronics, military aircraft, and electronic warfare platforms. Standex Edge specifically identifies planar magnetics as SWaP-optimized solutions for defense and aerospace systems.

Applications in Modern Airborne Platforms

Avionics Power Supplies

Modern avionics require highly reliable isolated power conversion. Planar transformers support DC-DC converters, auxiliary power systems, navigation electronics, and cockpit systems. Their compact footprint allows integration into densely populated avionics assemblies.

Unmanned Aerial Systems (UAS)

Drone platforms require maximum endurance, reduced weight, and high reliability. Planar transformers contribute by minimizing power conversion losses while maintaining ruggedness under continuous vibration and varying environmental conditions. Standex identifies UAV electrical power and control systems among key application areas.

Radar and Electronic Warfare

Electronic warfare systems demand high-frequency operation, compact packaging, and excellent thermal performance. Planar magnetics help achieve these objectives while supporting mission-critical reliability requirements.

Missiles and Hypersonic Systems

Missile and hypersonic platforms experience: extreme acceleration, high vibration, and severe thermal stress. Planar transformer architectures provide a mechanically robust solution capable of maintaining performance under demanding operational conditions.

Space and Satellite Systems

Space-borne electronics require high reliability, minimal mass, and compact packaging. Standex Edge has developed custom aerospace solutions integrating planar transformers and inductors into unified assemblies, achieving substantial space savings compared to traditional magnetic implementations.

Qualification for Mission-Critical Environments

Defense and aerospace systems demand rigorous qualification testing. Standex Edge supports these requirements through compliance and testing capabilities including:

- MIL-STD-202
- DO-160
- ITAR Registration
- Vibration testing
- MIL-STD-981
- AS9100
- Thermal shock testing
- Burn-in testing
- MIL-PRF-27
- Humidity and environmental testing

These capabilities help ensure consistent performance in airborne and defense applications where failure is not an option.



WHY PARTNER WITH STANDEX EDGE?

Standex Edge combines decades of magnetic design expertise with a collaborative "Innovate, Consult, Engineer, & Deliver" approach. Our capabilities include:

- Fully custom Planar Transformer design
- High-frequency magnetic optimization
- Mechanical ruggedization
- Military & Aerospace compliance expertise
- Rapid prototyping
- Qualification support
- Thermal management engineering

The company's custom planar transformer portfolio spans applications from low-power avionics systems to high-power aerospace conversion platforms, enabling customers to achieve aggressive airborne power density targets without compromising reliability.

Conclusion

As defense and aerospace platforms become increasingly electrified, achieving higher airborne power density is no longer optional—it is essential. Custom planar transformers provide a proven route toward:

- Reduced size and weight
- Superior vibration resistance
- Higher power density
- Improved thermal performance
- Enhanced reliability
- More effective missions

For avionics, UAVs, radar systems, missiles, and next-generation aerospace platforms, planar magnetics represent a transformative technology that aligns directly with modern SWaP objectives. Standex Edge custom planar transformers help defense and aerospace designers overcome the limitations of conventional magnetics, enabling compact, efficient, and mission-ready power conversion systems built for the most demanding environments.



A Standex **Electronics** Business

The pathway to usable electrical power begins with generation, continues through high-voltage transmission to urban and industrial centers, and extends to the distribution of lower-voltage electricity to businesses and homes, where it's ultimately consumed in countless applications.

At the **Edge** of this energy cycle, Standex Electronics engineers open up a virtually infinite range of possibilities to power the world's most demanding electrical devices. From concept to production, we deliver custom magnetic solutions that convert, condition, and control energy with precision and reliability.

Our expertise spans transformers, inductors, current sensors, and other advanced magnetic components used across industries, from automotive and industrial to medical and aerospace. Combining decades of engineering innovation with global manufacturing capabilities, Standex Electronics stands at the **Edge** of innovation, where energy meets possibility.

Welcome to **Standex Edge**.

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