Permanent Magnet (PM) Motor & Alternator Elements for Small Gas Turbine Engines

PM Electro-Magnetic Elements
Permanent Magnet (PM) Motors and Generators are the most common choice for both land-based turbo-machinery and for airborne applications; however, small gas turbine engines present special challenges because of weight restrictions, power density requirements, cooling issues and high rotational speeds.

PM rotors wrapped with carbon fiber (CFRP) offer high efficiencies, high speeds, large rotor bores, low rotor temperatures and significant power densities.

e+a Applications in Small Gas Turbine Engines
- UAV Propulsion & Power
- Turbine Electric Hybrid Drive
- Portable Field Generator

For the ultimate in integration, magnets and CFRP sleeve are fitted directly onto a customer-supplied shaft (see picture at left). This allows for a larger shaft diameter compared to the tapered sleeve system; integrating the rotor and shaft into a single unit results in a stiffer shaft, lower system weight & increased SFC.

PM Rotor/Stator with ALKA end caps (resin potting under an aluminum covering), and CFRP rotor sleeve. Multiple end-turn treatments are available for different cooling strategies.

High Level of Integration
PM elements allow much higher levels of integration than stand-alone machines. The motor/generator can be placed directly inside the turbine; it can share the same shaft, and magnets can even be integrated onto the turbine shaft and wound with a carbon fiber sleeve to provide an in-situ capability for the best performance-to-weight ratio, and ultimately increased Specific Fuel Consumption (SFC).

Customization
Motors & alternators can be customized by e+a in numerous ways to fit a particular application: smaller or larger stator diameter, longer or shorter rotors & stators, 2, 4, 6 or 8-pole configurations, voltage levels from 12V – 600V, higher or lower speeds (to 600K+ RPM), different end-turn treatments (plain, resin potted, ALKA - see above picture), etc.

CFRP sleeve rotors can be installed quickly without prior thermal treatment of the rotor or shaft, and PM rotors can be removed and reused.

Energy Densities
The green shaded rotor/stator below is a 4-pole starter motor/alternator weighing less than 1 lb. but producing 9.5 HP output in a volume of less than 6.3 cu-in, and supporting a shaft size of slightly less than ¾ in.

The yellow highlighted entry is for higher power applications, producing 34 HP in a 41 cu-in package that weighs 4.4 lb. Higher and lower power machines are available.

e+a PM rotor/stators are not complete motor/generators; they require bearings, cooling, a shaft and electronics to drive or condition the output. All can be used as a motor, generator, or both (engine start, switch to alternator).

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<td>0.98</td>
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<td>0.83</td>
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