

RED A03 Series Hybrid Generator

Powering a new age of series hybrid aviation

The Application

Series hybrid powertrains are key to realising many hybrid electric aircraft designs. In these powertrains, an aircraft's propulsors are completely electrified, and draw power from the on-board battery. Battery charge is maintained during flight by an on-board generator – consisting of an engine and an electric motor – which efficiently converts fuel into electrical energy.

Compared to batteries, aviation fuel stores roughly 40-60x more energy per kilogram, which means series hybrids can achieve ranges comparable to conventional aircraft. At the same time, series hybrids significantly reduce emissions and fuel burn compared to conventional aircraft, since they allow engines to operate continuously at their most efficient operating window.



The Challenge

Currently, there are very few generator solutions optimised for series hybrid flight. Typically, the available solutions are either:

- Iterations on existing Hybrid Generator Units / Auxiliary Power Units (APUs), which in conventional aircraft are optimised to produce electrical energy alongside bleed air for engine starts and air conditioning. While low-mass, owing to their use of aerospace-grade materials and technologies, these solutions are both location-constrained and based on architectures that were not designed as efficient high power generators.
- Derived from generation solutions outside of aviation, such as automotive. These solutions are efficient electric generators but were not originally designed with aerospace-grade materials and technologies. This means that these units are comparably high-mass, bringing down series hybrid powertrain efficiency.

Identifying this solution gap, the team at RED Aircraft, a German supplier of high-performance piston engines for aircraft, is partnering with Helix to develop a new series hybrid generator and APU. Using the proven, ultra-lightweight RED A03 V12 diesel engine, RED Aircraft and Helix are developing an integrated series hybrid generator that combines unprecedented efficiency with a market-leading power-to-weight ratio.

SPX177-137D data

Peak power:
420kW

Continuous power:
327kW

Mass:
21.7kg

Diameter:
192mm

Length:
258mm

Peak efficiency:
97%



The Solution

To be viable, RED Aircraft need their series hybrid generator units to offer a significant mass and efficiency premium over any existing solution: combining the low mass of APU-derived solutions with the efficiency of a dedicated electrical generator. This meant complementing the RED A03 with an incredibly lightweight motor with a high continuous power rating, demanding a power density at the very frontier of electrical engineering.

The ideal solution comes in the form of Helix's **SPX177-137D** motor: a durable, ultra-lightweight radial flux system designed specifically for high-power applications where weight or space are at a premium. A 2x3-phase synchronous permanent magnet machine, the SPX177-137D leverages Helix's leadership in electromagnetic design and thermal management to produce one of the most power-dense volume production motors in the world: 19.4kW/kg, at peak output.

The Results

By combining the Helix SPX177-137D, the RED A03, and a 1:5.4 transmission, RED Aircraft will be able to achieve their vision with the **RED A03 Series Hybrid Generator**. With a max continuous power of nearly 330kW, the RED A03 Series Hybrid Generator brings to aviation an electricity generation capability on par with 2,000kg+ industrial or marine power generation solutions – despite a dry weight of just 350kg.

Because of the exceptional engineering of RED Aircraft and Helix, the RED A03 Series Hybrid Generator achieves an exceptional electrical power density of 1.08kW/kg. This is nearly three times greater than the electrical power density of one of the most efficient APUs on the market today – the Honeywell HGT1700, used on the Airbus A350.

The RED A03 Series Hybrid Generator marks a fundamental shift in hybrid aviation. By bringing together the precision engineering of RED Aircraft and Helix, the sweeps away the inefficiencies that have held back series hybrid aircraft by reducing their mass – meaning a complete step-change in range and fuel economy.

RED A03 Series Hybrid Generator

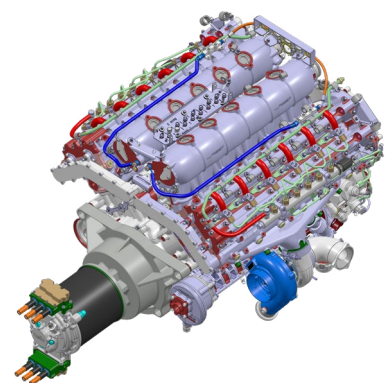
Peak power:
380kW

Continuous power:
327kW

Dry mass:
350kg

Fuel burn:
77kg/h

Fuel efficiency (BSFC):
218g/kWh



System	Dry mass	Peak electrical power	Power density	Dry mass required to output 380kW
Honeywell HGT1700	346kg	120kW*	0.34kW/kg	1,099kg
RED A03 Series Hybrid Generator	350kg	380kW	1.08kW/kg	350kg

*Assumes a power factor of 0.8, based on vendor's 150kVA apparent power rating.

