Enabling Zero-Emission Flight: Towards Electric Aviation

Cinergia's B2C+ critical role in Dovetail's system validation

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ELECTRIC AVIATION

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Introduction

Dovetail Electric Aviation is pioneering the electrification of regional aircraft by converting conventional platforms into zero-emission vehicles.

At Dovetail's Open Day, we showcased the first public demonstration of our hydrogen-electric propulsion system. This event brought together industry leaders, partners, and institutional representatives to witness the functional testing of the ground test rig, including the integrated electric motor, inverter, battery system, and hydrogen fuel cell.

A key enabler of these tests was Cinergia's bidirectional DC power supply, which played a critical role in system commissioning and validation. By providing a stable, programmablev power source, Cinergia's equipment allowed us to safely integrate and fine-tune our propulsion system before transitioning to in-aircraft implementation.

Rigorous ground testing is essential to ensure the reliability, safety, and seamless integration of complex propulsion systems. By simulating real-world operating conditions in a controlled environment, we can validate the behavior of every subsystem—ranging from the electric motor and inverter to the battery and hydrogen fuel cell interfaces. This approach allows us to capture detailed telemetry data, identify potential issues early, and fine-tune our control algorithms prior to flight certification.

Dovetail's hydrogen-electric propulsion system prototype

Cinergia's DC Power Supply

The B2C+ is the CINERGIA's regenerative DC power supply, providing controlled DC source and load capabilities. It offers bidirectional, programmable, and grid-tied operation, with up to 92% energy recovery.

- 3 Independent Channels
- Simultaneous Voltage/Current/Power Modes
- 2Q and 4Q Configuration
- 13 Models from 7.5 kW to 160 kW
- Scalable up to 1.3 MW
- Voltage Range up to 800V and 1500V
- Power Amplifier Mode, Battery Pack Testing, PV Panel Emulation, Battery Emulation

Download the complete datasheet:
https://cinergiapower.com/en/products/bidirectional-dc-converter

B2C+ integration into our testing platform

Cinergia's power supply was designed for high-voltage operation up to 800V DC, providing the necessary headroom for testing electric propulsion systems. It is capable of delivering up to 160KW of power continuous or 240KW during 1 min (subject to site supply limitations), ensuring robust performance under dynamic loads.

It offers bidirectional functionality, enabling both power delivery and energy recovery during battery cycle tests.

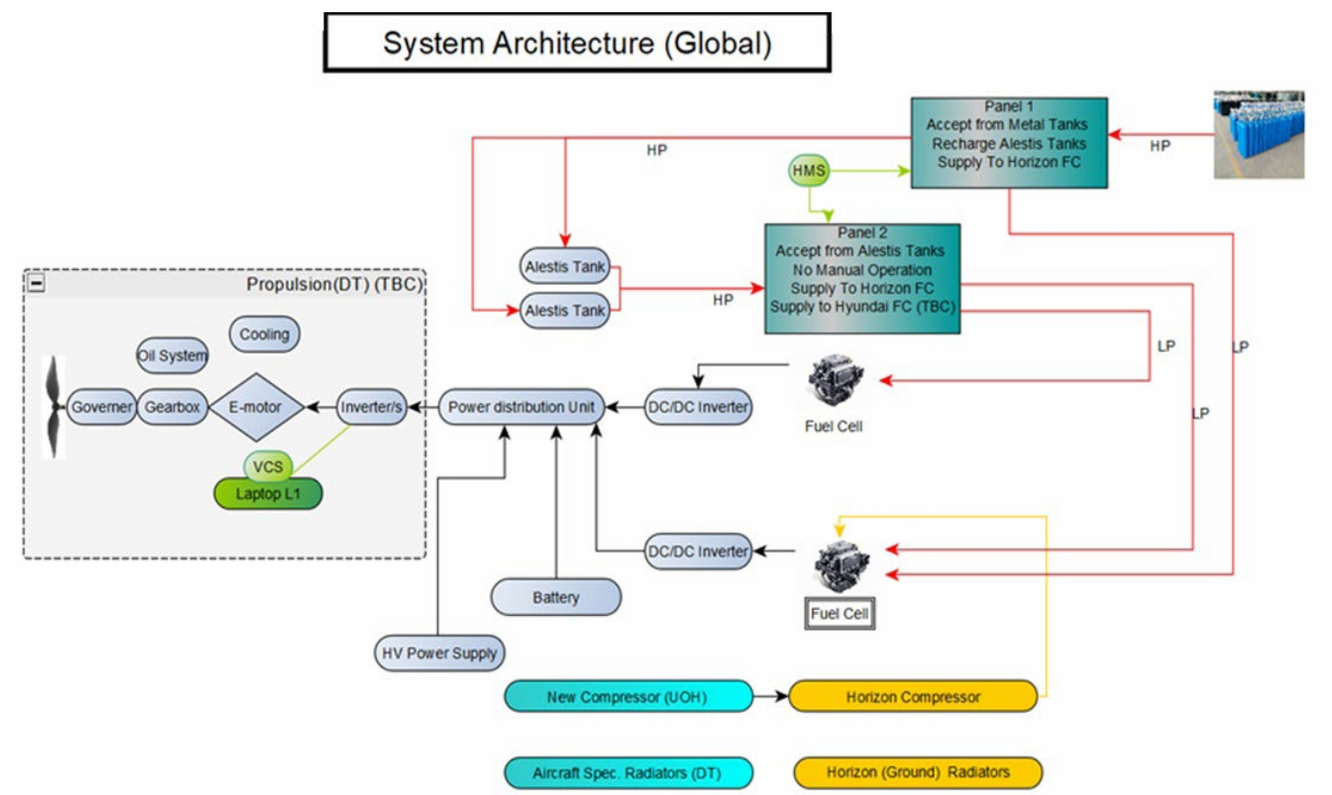
Additionally, it incorporates precise current and voltage limiting with a controlled ramp rate of 50V/s, which is critical for safe and gradual system energization.

These features were deliberately selected to mirror the electrical characteristics of an aircraft's power system. The 800V DC capability and high power output simulate realistic operating conditions, while the adjustable ramp rate and limit settings allow us to safely precharge the system and control transient behaviors.

This precise control is essential for replicating various flight profiles and ensuring that all integrated components perform optimally during rapid load changes.

Testing rig and setup

The test rig showcased is a modular platform that replicates the complete powertrain environment of an electrified aircraft, in this case tailored for a King Air.



Key components include:

- Cinergia's bidirectional DC power supply.
- Battery simulation modules (including prototypes of our custom battery packs).
- Fuel cell simulation interfaces for hybrid testing.
- Electric motor and inverter assembly.
- Power Distribution Unit (PDU) and integrated cooling and lubrication systems.
- Data Acquisition System (DAQ) with extensive telemetry for real-time monitoring.
- Safety sensors (temperature, current, voltage) and redundant interlock systems.

Cinergia's power supply is directly connected to the high-voltage bus of the test rig. It is interfaced with our control software, which allows remote programming of voltage and current limits, ramp rates, and dynamic response settings.

This integration enables the power supply to function as the primary energy source during testing—emulating both battery behavior and providing a stable DC feed to the propulsion system.

(Left: Cinergia's Software Supervision; Right: Battery Management System)

Methodology

Details of the testing process:

Multiple operational scenarios were simulated, including:

- A gradual power-up sequence mimicking system precharge and startup.
- Dynamic load changes to test the system's response to transient events.
- Battery cycle scenarios where the power supply emulated both charging and discharging conditions.
- Integration tests where the fuel cell and battery modules were alternately substituted by the power supply to validate hybrid control strategies.

Tests were conducted over extended sessions — lasting several hours — to replicate both short-duration takeoff conditions and longer sustained flight profiles. The controlled environment ensured that ambient conditions (temperature, humidity, and pressure) were monitored, enabling accurate correlation between simulated flight conditions and test outcomes.

Data captured during the process:

Extensive telemetry was recorded during all test phases. Key data points included:

- Voltage and current profiles during the ramp-up phase.
- Temperature readings across critical components.
- Power output stability and transient response data.
- Comparative data from the power supply software and the battery management system (BMS) during discharge cycles.

This data was used to verify that the system's performance met design expectations and to refine our control algorithms. This was done by programming the power supply in the following steps:

The **power supply** was set to voltage control mode.

1. Voltage and current limits were configured to 800V and 5A, respectively.
2. A controlled voltage ramp of 50V/s was initiated to gradually energize the system.

3. Once the target voltage was reached and the system precharged, the power supply was switched to run mode.
4. Telemetry was continuously monitored via both the power supply's software and the test rig DAQ to detect any deviations.
5. Upon confirmation of stable conditions, the current limit was incrementally raised to simulate specific operational loads.

For **battery cycle tests**, the process was as follows:

1. Charge the battery to the target state-of-charge (SOC) and voltage.
2. Allow a rest period until the cell temperature stabilizes at the desired level.
3. Discharge the battery using a programmed power draw based on realistic flight mission data, with the power supply emulating load conditions.
4. Capture bus voltage and current datathrough the power supply software, cross-checking against BMS readings to validate performance consistency.

Results

The final milestone of the project was the public demonstration of our hydrogen-electric propulsion system on the Open Day. This event gathered industry partners, media, and institutional representatives, providing a platform showcasing the full functionality of our powerplant.

During the demonstration, the system—including the fuel cell, battery modules, electric motor, power electronics, and all auxiliary systems—was successfully operated at power levels sufficient to spin the propeller at speeds equivalent to those required for takeoff and flight. This marked a critical validation of our system's integration and operational safety, reinforcing the feasibility of applying this technology to future zero-emission aircraft.

Cinergia's power supply played a pivotal role in this achievement, providing precise control over voltage and current throughout the testing phases. The ability to gradually ramp up power, set precise voltage and current limits, and monitor telemetry in real-time was crucial in ensuring safe and stable system operation during commissioning and live demonstrations. The bidirectional capabilities of the power supply also allowed for battery cycling and hybrid energy management tests, simulating real-world flight scenarios.

Beyond the technical validation, the Open Day also attracted interest from industry players and potential customers, reinforcing Dovetail's position as a leader in electric aviation. The demonstration of a fully integrated and functional hydrogen-electric propulsion system not only proved the concept's viability but also laid the groundwork for future iterations leading up to flight testing and certification.

Insights gained from the tests that advance our goals

Test Rig testing:

Provided the ability to test each element of the system by providing a reliable bidirectional DC supply of electricity. This enabled the testing of each system element in isolation before fully integrating in the rig. This was key in being able to achieve project goals in a very compressed timeline.

These activities included:

- FC start up and control tests
- Motor and inverter tuning
- PDU function testing
- Initial low power EPU and propeller test
- Battery integration in the system

Battery testing:

The B2C provided the means to charge and discharge our prototype battery with precise control. The power supply software provided robust data collection and allowed for current and voltage limits to be set depending on the test being performed. This allowed us to simulate the actual flight profile in isolation from the aircraft or ground test rig. With this capability we can test multiple scenarios quickly and validate our modules with representative data. This is particularly important for thermal management because it requires complex simulations.

Graph of temperature vs. time

Impact and future plans

The successful testing represents a pivotal step toward our targeted first flight in 2025. The ability to safely and accurately control the integrated propulsion system not only confirms the viability of our current design but also lays the foundation for future iterations and scale-up. The data collected has already informed improvements in our system integration and control strategies, accelerating our timeline toward certification.

Beyond immediate flight milestones, these tests have broader implications for the evolution of hybrid propulsion systems. The integration of Cinergia's power supply has proven essential for validating both battery and fuel cell interfaces.

Looking ahead, we plan to extend the testing framework to incorporate higher power ranges and parallel operation of multiple power supplies. This will support endurance testing and further development of hydrogen-electric systems—ensuring our continued leadership in the electrification of aviation.

Access to high-quality, bidirectional DC power supplies has been critical for rapid development and system integration. As our technology evolves, these tools will remain integral in the transition from battery-powered prototypes to fully operational hydrogen-electric flight systems.

dovetail ELECTRIC AVIATION

Dovetail Electric Aviation is a company pioneering disruptive electric aviation concepts including both battery and hydrogen powerplants to convert conventional regional fixed wing aircraft into electric enabling aviation operators to fly regional routes in zero-emission, electric-powered aircraft.

https://dovetail.aero/

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Cinergia specializes in regenerative power electronics, delivering innovative solutions that drive electrification and energy transition through advanced power converters for testing and measurement in key markets like electric vehicles, renewable energy, and smart grids.

https://cinergiapower.com/