Hybrid Electric Propulsion for Light Aircraft & UAS

Electric Propulsion, Power Generation, Energy Storage and Systems Management
Our Team

• Transdigm Companies
  – Avionic Instruments
    • Power Electronics, Motor Control, Processing, Systems Integration, Program Management
  – Skurka Aerospace
    • Electric Machines, Sensors, Actuators
  – Acme Aerospace
    • Advanced Battery Systems, Chargers, Cell Controllers
Avionic Instruments

- **Aerospace Electric Power Conversion & Management** (>35 years)

- **Avionic Instruments Power Products – New Jersey**
  - 50,000 Square Feet
  - 195 Employees

- **Key Processes In House**
  - Sales & Marketing
  - Engineering
  - Production
    - Magnetics
    - PCB
    - Final Assembly
  - Quality & Reliability
  - Procurement
  - Accounting
  - Repair & Support
Skurka Aerospace

- **Aerospace Electromechanical Components & Control Units (>60 years)**

- **Location – Camarillo, CA**
  - 70,000 square feet
  - 130 Employees

- **Products**
  - **Electric Motor Products**
    - Would Field & Shaft Rotor Assembly
    - Brush DC Motor
    - Brushless DC Motor
    - AC Induction Motor
  - **Control Units / Controllers**
    - DC and AC Types
  - **Starter Generators**
  - **Starter Motors**
  - **PM Generators/Alternators**

- **In-house capabilities**
  - 20+ engineers on staff
  - Analytical design & modeling
  - Test systems simulation
  - Repair & overhaul
Acme Aerospace

- Fulfilling Battery and Charger needs (> 50 years)
- Acme Battery - Arizona
  - 40,000 ft²
  - 80 Employees
- Key Processes In House
  - Sales & Marketing
  - Engineering
  - Production
    - Magnetics
    - PCB
    - Final Assembly
  - Quality & Reliability
  - Procurement
  - Accounting
  - Repair & Support
Team Goals

• **Energy Efficiency**
  
  – Hybrid (Turbine/Battery) more Efficient than Piston ICE

• **Low Noise**
  
  – Hybrid Mode, Battery (Silent) Mode

• **Low Maintenance Cost**
  
  – Much lower Cost/Hanger Time

• **Minimize Environmental Impacts**
  
  – Lower Fuel Usage (Depending on Mission)
  
  – Lower Emissions
Markets Served

- **GA, Private, Recreational**
  - Personal use,

- **Air Taxi**
  - Intercity Short Run Taxi Service

- **Trainer**
  - Civil, Military Primary Flight Training

- **Special Mission Military**
  - Quiet, Low, Slow

- **UAS**
  - Civil, Military Low Signature ISR
Architectures

• **Battery Electric**
  – Ground Recharge Li-ion Battery

• **Fuel Cell Hybrid**
  – SOFC to Augment On-wing battery

• **Turbine Hybrid**
  – On-wing Recharging, Direct Motor Drive Power
Battery Electric

- Power Inverter
- 100 kW 500VDC Motor 3KRPM
- AC-DC/DC Control
- GROUND POWER RECHARGE
- 500VOLT Li-Ion BATTERY
- PROPULSION MANAGEMENT COMPUTER
Fuel Cell Hybrid

Diagram showing the components of a fuel cell hybrid system, including a power inverter, SOFC, propulsion management computer, and connections for hydrogen and 500 VOLT Li-Ion battery.
Turbine Hybrid

- Power Inverter
- 100 kW 550VDC Motor 3kRPM
- AC-DC/DCG Control
- 550 Volt Li-ion Battery
- TURBO ALTERNATOR
- FADEC
- RECOUPERATOR
- 4H FC
- TRIP
- 115/400
- 28VDC
- Cold Fuel
- Jet-AQPB/ Bio-Jet
- #2 Engine
- Propulsion Management Computer
- Bypass Return
- Hot Fuel
- To Combustor
- From Compressor
- Waste Heat
- Option
**Propulsor Architecture**

Ducted Fan (Propulsor)—Applied to Battery, FC, Hybrid Propulsion Schemes
Sizing, Objective System

- **Target Performance**
  - **Shaft Power:** 150SHP @ 2,400 RPM (112KW)
  - **Takeoff/Climb:** 110% (123KW)
  - **Cruise Power:** 65%-75% (78KW)
  - **Cruise Speed:** 130MPH
  - **Ceiling:** 13,000Ft
  - **Range:** 400NM (Battery + Alternator, 45Min Reserve)
    - 10 Gallons/Hour Benchmark
System Objectives

• **Retrofit** – *Targeted Airframes, MRO Kits*
  – Light GA, Air Taxi

• **OEM** – *Bespoke Solutions, Fully Integrated*
  – GA Systems
  – UAS Systems
  – UUV/ROV Systems