## BATTERY PACK AND BMS

LaunchPoint Technologies is working with our sister company LEAP (LaunchPoint Energy and Power) on high-reliability battery packs and Battery Management Systems (BMS).

LEAP's key technology is its patented BMS technology which can provide a fail-operational BMS that is tolerant to all single failures and some second and third failures, while still providing full performance. This fail-operational capability of the BMS will allow electric aircraft to have a "continued safe flight and landing" response to any single failure in the BMS.

Redundancy in the BMS system can extend the useful life of a small UAV pack before repair/ maintenance by allowing the pack to continue to be used after one (or more) faults within the BMS circuitry; which is the most complicated and failure-prone part of the pack.
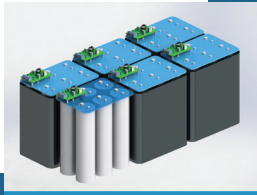
"LaunchPoint is doing some of the best engineering I have ever seen."

-John Woodard, PhD, Senior Vice President of Scientific Affairs, World Heart Corporation

Contact us today for more information.
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LaunchPoint Technologies specializes in tackling the most difficult engineering design challenges. Our interdisciplinary team of engineers, along with a suite of in-house capabilities, gives us an edge in providing innovative solutions in a timely and cost-effective manner.

CLIENTS & PARTNERS

Aerospace
- NASA
- ES AERO
- Army
- Raytheon Systems
- DARPA
- NAVY
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Medical Devices
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- Magnetecs, Inc.
- Carnegie Mellon University
- University of Pittsburgh
- Children's Hospital of Pittsburgh
- WorldHeart, Inc. (formerly MedQuest Products, Inc.)

Transportation
- Applied Levitation LLC
- Magnovate Technologies, Inc.

Energy & Energy Storage
- Gravity Power, LLC
- Global Energy Sciences, LLC
- LaunchPoint Energy and Power, LLC

Nanotechnology
- California NanoSystems Institute, UCLA

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LAUNCHPOINT ™ TECHNOLOGIES

Your Partner in Innovation

Whether you want help with a portion of your design work or require complete system development, LaunchPoint engineers have the expertise to get your project off the ground.

First there was "Fly By Wire"... now there is "Propulsion By Wire"!

▶ PROPULSION BY WIRE TECHNOLOGY

LaunchPoint Technologies is developing a suite of technologies to enable safe, reliable, and airworthy electric and hybrid electric flight. These technologies are based on applying the redundancy management and fault isolation/ fault tolerant design techniques of "Fly By Wire" technology to the new field of electric aircraft propulsion. We call the resulting system "Propulsion By Wire"

The Propulsion By Wire effort at LaunchPoint consists of the following key R&D areas

- Hybrid System Architecture, integration, and vehicle "micro-grid" control
- Advanced motor and generator controllers/drives
- Gen-sets
- High Specific Power electric machines
- High reliability battery packs

"In Fly-By-Wire all the aircraft flight-control authority passes through the "wires" instead of through mechanical systems. With electric propulsion we are doing the same thing for the vehicle propulsion power. Instead of flowing through mechanical connections—pressures, air foils, pistons, and shafts—the propulsion power will flow from the energy source to the propulsion units in wires. The same design principles that make Fly-By-Wire more reliable than mechanical flight controls will make Propulsion By Wire safer and more reliable than conventional propulsion."

– Mike Ricci
Vice President of Engineering
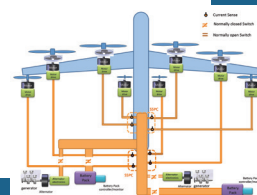*LaunchPoint Technologies*

▶ HYBRID BUS AND VEHICLE MICRO-GRID CONTROL

The dc bus in a hybrid electric vehicle is actually a small vehicle micro grid with multiple energy sources and sinks.

There are numerous possible topologies and technological solutions to integrating the power sources and electrical loads while providing the ability to regulate the micro-grid. Each different solution has different performance characteristics, costs, weights, and efficiencies associated. The correct design depends heavily on the mission and vehicle characteristics.

LaunchPoint has developed the expertise to select the correct architecture to meet mission requirements with minimum mass and maximum performance and reliability.

▶ HIGH SPECIFIC POWER, HIGH EFFICIENCY ELECTRIC MACHINES

LaunchPoint Technologies has been developing high specific power, high efficiency electric machines for demanding, high-reliabilty applica- tions. The machines are an axial flux ("pancake") design based on dual-halbach-array magnet rotors and ironless stators. This combination of design features allows for an extremely high efficiency motor with good specific power. The motors are air cooled and create their own air flow so no additional cooling system or fan is required.

Visit our website for more details:

- 82kW machine in development
- 7.5" 6kW alternator intergrated with gen-set
- Proposed 1MW motor

▶ ADVANCED MOTOR DRIVE/ GENERATOR CONTROLLERS

LaunchPoint Technologies is developing a line of motor drives and generator controllers for our Propulsion By Wire system. These power electronic modules will be designed for the unique requirements of electric aircraft propulsion.

Our controllers will feature advanced sensorless commutation algorithms and high switching frequencies for smooth start-ups, clean current waveforms, and quiet vibration-free efficient operation with the highest performance motors.

The controllers will have built-in fault detection and sensing that integrate with our Propulsion-By-Wire system controller to enable reliable electric flight and facilitate effective vehicle micro-grid power management.
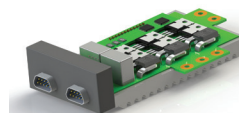
▶ GEN-SETS

LaunchPoint Technologies is developing gen-sets based on reciprocating engines for aircraft hybrid power sources. Reciprocating engines have much higher efficiency that turbine engines. Mission durations longer than 1-1.5 hours demand lower combined fuel and engine mass than what turbine-based gen-sets can provide. Our high specific power/efficiency generator combined with an efficient reciprocating engine can meet the challenge.

We presently have prototypes in-process for 1.5 kW, 6 kW, 12 kW and 40 kW gen-set units.

Our hybrid bus controller is integrated with the engine controls and generator controller to provide seamless management of power resources on the bus and maintain engine speed and bus voltage during transient events.