Intelligent Battery Charging Technology
Better working batteries and longer lasting battery-powered equipment with GEM Power
Mission
GEM Power’s mission is to revolutionize battery charging technology, solve power management problems, reduce cost, and increase levels of preparedness and reliability through the development of our Intelligent Battery Charging Technology.

Core Competencies
GEM Power, LLC develops firmware that intelligently controls battery charging, and energy management of battery powered applications. Our technologies adapt to multiple battery types and sizes through software. No separate hardware is needed for different battery types.

GEM Power’s passive battery charging application, designed for integration into vehicle and aircraft electrical systems, can alert a pilot, driver or maintenance personnel of a battery’s operational ability, reducing downtime, and eliminate the unnecessary replacement of batteries on fixed schedules – saving both time and money. This application is a fit for any aircraft, ground vehicles (gas or electric), electronic devices including hand-held devices, in both DoD related applications as well as commercial applications.

Specific Benefits Realized with GEM Power Intelligent Charging Technology:

- Extends functional battery life by two to three times
  - Reduces Costs - Fewer batteries need to be purchased
  - Environment Benefits - Fewer batteries require disposal

- Increases charging speed of batteries by two to three times than currently available chargers
  - Reduces Costs - Fewer spare batteries required to be held in inventory
  - Increases Level of Preparedness – A fully charged battery is always available

- Predicts the end of the battery life prior to failure
  - Reduces Maintenance Costs - Associated equipment failure can be reduced or eliminated
  - Increases Level of Preparedness – Eliminates downtime due to battery failure and/or availability

- Significantly surpasses the technology of currently available “state-of-the-art” chargers
  - Applies to all battery chemistries and their associated charging issues
  - Applies to a tremendous number of unattended and remote sensors, portable systems and manned/unmanned mobility platforms
  - Benefits realized through the increase in battery life and consistency in capacity from charge to charge

- Batteries come close to achieving their design life – extending their functional life by two to three times, and battery capacity remains consistent from charge to charge increasing:
  - Readiness
  - Operational reliability
  - Range of the portable equipment in use by the Armed Services, Homeland Defense, and First Responders

GEM Power’s Passive Battery Charging Technology

<table>
<thead>
<tr>
<th>Feature</th>
<th>Advantage</th>
<th>Benefit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Passive Device</td>
<td>Does not interfere with aircraft system</td>
<td>Easy retrofit</td>
</tr>
<tr>
<td>Determine Battery Capacity</td>
<td>Early notification of pending battery failure</td>
<td>Increase Mission Readiness Decrease Cost</td>
</tr>
<tr>
<td>Determine State of Charge</td>
<td>Early notification of battery/system maintenance</td>
<td>Increase Mission Readiness</td>
</tr>
<tr>
<td>Battery Power Capability</td>
<td>Early notification of pending battery failure</td>
<td>Increase Mission Readiness Decrease Cost</td>
</tr>
<tr>
<td>Alert Need for Replacement</td>
<td>Early notification for pending battery replacement</td>
<td>Reduce Need for Spares Decrease Cost</td>
</tr>
<tr>
<td>Small PCB Firmware</td>
<td>Easy Retrofit</td>
<td>Early Signs of Battery Failure</td>
</tr>
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As a process: Software and hardware for the diagnostics and prognostics of batteries in which a basic State of Health determination, including capacity, state of charge and state of life, can be made in 30 to 90 seconds.

In an on-board application: GEM Power’s intelligent battery charging and active diagnostic technology and approach is used as the foundation for passive technology that monitors system loads where currents and voltages are recorded, treated, and analyzed to determine battery performance capabilities and readiness.

As a function of the diagnostic and prognostic procedure: a determination of impending battery failure prior to actual battery and equipment failure can be made.

Battery status can be reported immediately through an alert system or it can be stored for later recovery by maintenance personnel.

Batteries can then be replaced when needed, reducing costs, eliminating unscheduled down time and associated costs, and increasing mission safety and readiness.

Early Signs Prognostic/Diagnostic Firmware with battery condition output examples

Early Signs technology acts as a vehicle’s health usage management system. It operates in a passive mode, “listening” to the signals between a battery and the device being powered.

Uses

- Early Signs will initially be demonstrated for use in an F/A-18. With minor modifications, it is intended for use in all other DoD aircraft applications including the Joint Strike Fighter.

- Beyond military applications, GEM Power’s device has multiple commercial applications such as commercial aircraft, ground vehicles, handheld electronics, gas/electric automobiles, personal electronic vehicles, and larger battery dependent equipment such as forklifts.

Examples of Early Signs Application Areas – Current Customer Criteria

- NAVAIR is the immediate identified customer with a desire to improve overall aircraft and force readiness. Early Signs mitigates the need to replace batteries before prescribed maintenance schedule, thereby increasing battery airworthiness mission readiness.

- Performance criteria and requirements describe a device that will passively determine the state of several critical battery parameters including capacity, state of charge and power capability, both in preflight and inflight conditions. The device must also signal impending need for battery replacement before a battery actually fails and becomes non-airworthy.

- Overall goal is to have a device that moves batteries into an “on condition” maintenance status, resulting in overall higher readiness status.

Only Early Signs meets all of these performance criteria.

<table>
<thead>
<tr>
<th>Feature/Advantage/Benefit</th>
<th>Early Signs</th>
<th>Other Systems / Current Baseline</th>
</tr>
</thead>
<tbody>
<tr>
<td>Improved Battery Airworthiness</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Increased Mission Readiness</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Passive Device</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Place Battery in “On-Condition” Maintenance Status</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Determine Critical Battery Parameters</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Capacity</td>
<td>Yes</td>
<td>Some – Active not Passive</td>
</tr>
<tr>
<td>State of Charge</td>
<td>Yes</td>
<td>Some – Active not Passive</td>
</tr>
<tr>
<td>Power Capability</td>
<td>Yes</td>
<td>Some – Active not Passive</td>
</tr>
<tr>
<td>Alert of Need for Replacement</td>
<td>Yes</td>
<td>No</td>
</tr>
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3500 Watt Intelligent Charger (WIC)
GEM Power developed Intelligent Charging Technology for the Navy (NAVAIR maintenance facility) and delivered the first 3500WIC charger in 2004. The 3500WIC is a diagnostic charger that can rapid-charge lead acid, nickel cadmium and nickel metal hydride batteries (5 to 200 ampere hours). The 3500WIC automatically differentiates the size and type of battery, and determines the necessary charge.

The 3500WIC is software controlled, and easily field upgradeable. The 3500WIC supports both 110V (50/60 Hz) and 200V (single phase). The DC output will charge from 6V to 24V batteries. The 3500WIC operating panel features an On/Off switch, a 4 line x 20 character LCD display, a 16 button alphanumeric keypad and the battery charging cable.

First Responders’ DC-DC Charger
Using GEM Power’s FR DC-DC charger, First Responders can charge various battery sizes and chemistries with a single charger, and charge these batteries at the fastest possible rate as determined by the battery and its internal design. The FR charger automatically differentiates the size and type of the battery and determines the necessary charge.

When powered up, the FR DC-DC charger automatically performs a charging operation. It determines the type of battery attached, performs diagnostics to determine the charge required, and charges the battery in ½ hour to 1 hour, depending upon the size of the battery, and the amount of charge required. Batteries can be inserted and removed from the charger during the charging process at various states of charge with no negative impact on memory or battery capacity.

Once the charge is completed, the FR DC-DC charger shuts off the battery charge current, eliminating the danger of overcharging the battery, as well as the need to monitor the charging process.

In the monitoring mode, the FR DC-DC charger monitors the battery to determine when and if additional charging is required. During the monitoring mode, no current is applied to the battery.

The charger can be disconnected and immediately reconnected without damage to the battery, or at the risk of over-charging.
Company Profile
GEM Power is a privately held business, incorporated in 2000, and located in a recently expanded facility in Redlands, California. GEM Power was founded by our Chairman Robert Richards, President and CEO John James, and Chief Financial Officer J. Montgomery Dill.

Our first research and development contract from the Navy began in 2002 - working with NAVAIR to develop intelligent battery charging technology and related battery diagnostic and prognostic management technologies. At the time, NAVAIR was suffering many ill effects from the use of the currently available battery chargers on a variety of Navy batteries. They were intrigued by the possibility of our new technique. This development work has led to other technical applications, including a contract with the U.S. Army with whom we are continuing to work with and have a current contract with provisions for follow-ons.

Markets
We are currently focused on serving areas within DoD including:
- NAVAIR
- U.S. Army
- ONR
- U.S. Air Force

Our battery charging technologies have a wide-ranging area of applications and we envision future areas of focus will include virtually any area that could benefit from intelligent battery technologies:
- First Responders
- Commercial Aviation and Aircraft Manufacturers
- Automobiles
- Medical Devices
- Marine Industry Manufacturers
- Personal Electronic Device Manufacturers

Management and Technical Expertise

Robert Richards
Chairman, Managing Member
Mr. Richards was formerly CEO for Irvine Sensors in Costa Mesa, CA, from 1999 to 2005. He served as President of Aerogroup General, Electronics Systems Division, Azusa, CA from December 1987 to February, 1993. Under his guidance, the division reached $250M in sales and 2,000 employees. On the path to President, he was V.P. of Engineering, having started as Chief Engineer working on design and development of operational infrared and millimeter wave systems.

John James
President and CEO, Managing Member
Mr. James was formerly President and General Manager of Teledyne Battery Products in Redlands, CA, from 1989 to 1998. His corporate responsibilities included sales, marketing and product development, with operational responsibilities for production, warehousing and distribution, and interfaced with aircraft manufacturers such as Cessna, Beech, and Learjet. Prior to his term as President, he was the Vice President of Engineering for Teledyne Battery Products.

J. Montgomery Dill
Chief Financial Officer, Managing Member
Mr. Dill was formerly a consultant with Dill Financial Analysis of Redlands, CA from 1996 to 2000, consulting on computer system implementations and financial solutions to businesses regarding operational weakness. Prior to founding Dill Financial Analysis he was Operations Manager for Dill Lumber from 1986 to 1996, overseeing multiple locations. From 1983 to 1986 he was Regional Controller for Mattel Toys in Tijuana, Mexico with responsibilities for accounting, purchasing and management information systems in three Mexican and two American manufacturing facilities. Duties included financial statements, standard cost system maintenance, customs documentation, financial forecasting and budgeting, AR, AP and product sourcing. Mr. Dill rose to Regional Controller from his prior position as Plant Controller with Mattel Toys in the City of Industry, CA.

Dr. Boris Tsenter holds a Ph.D. in Chemical Engineering and is the inventor of the nickel-hydrogen battery widely used in space applications. He is the author of six battery books and many technical papers, and holds more than 100 US and international patents. Dr. Tsenter has extensive battery expertise in NiCd, NiMH, Pb/PbO2 and Li chemistries for telecommunication, HEV, EV, military and other applications. Before coming to the U.S. and receiving his U.S. citizenship, Dr. Tsenter was head of the Space Battery Development Program of the former USSR.