Are We There Yet?

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When I was growing up, mail was delivered in a Grumman Kurbwatt Electric Van. Today, the Kurbwatt is gone and mail is delivered by foot. Perhaps this is a rare example of bipartisanship, as both the green believers and non-believers can count this as a success. Nevertheless, the Kurbwatt reminds us that electric vehicles have always been around, even if not noticed. In fact, references to the electric car can be found all the way back to the early 1800s. The first electric cars used non-rechargeable batteries, and with each improvement in the battery came a more practical version. In fact, more than a hundred years ago, the Belgian-built electric racing car "La Jamais Contente" set a world record for land speed at 68 mph[1]. Electric cars were popular in the early 1900s for the advantages they offered over gasoline cars; no vibration, smell or noise from the internal combustion engine (ICE), and no hand cranking or a gear shifting required. Unfortunately for the EV, battery technology could not evolve fast enough to match the combustion engine, with its use of cheap and abundant gasoline Battery technology was then and now the most critical element of the electric vehicle's success. Without the market drivers, it's no surprise that development of the electric vehicle battery system slowed to a crawl for most of the 20th century.

The time has now come when the cost of petroleum (in terms of dollars and environment) is forcing

the world to diversify its energy usage. Electricity is the key to make this happen, and the electric vehicle must play a role in this paradigm. Electricity can be generated from virtually any available energy source (nuclear, solar, wind, geo-thermal, coal, gas, diesel, ethanol, hydrogen, buffalo chips, etc). Electricity is, in some sense, a Lingua Franca. Global standardization on electric vehicles could simultaneously enable economies of scale, and eliminate the massive infrastructure supporting localized fuel consumption. In addition, electric vehicles are much more energy efficient than combustion vehicles. The variable loading of automotive driving favors the electric motor over the combustion engine since it offers high torque at low speeds. Combustion engines operate most efficiently within a narrow speed and load range. Therefore, in order to meet peak acceleration demands, the engine must be oversized and the engine's efficiency for converting gasoline energy to motion is typically 20 percent. On the other hand, the electric motor converts electrical energy to motion with a typical efficiency of 90 percent. Furthermore, the electric motor does not have to waste energy idling at stops, and an electric system offers the potential to recover mechanical energy through re-generative braking.

Nonetheless, realizing a true gasoline competitor will require many improvements in battery technology. With new battery chemistries capable of big increases in energy and power density, comes significant complexity in battery management to enable their practical use. Charge cycling, lot-to-lot differences and different environmental conditions cause individual battery cell capacities to diminish and diverge over time. Compounding this, the electrical environment in a high powered drive train includes enormous electrical noise, transient spikes, high voltages and wide operating temperatures. Also, the electronics must have extremely high reliability and life span, since customers are accustomed to the high-performance, long lasting ICE vehicles of today and will demand the same of any alternative technology.

Stepping up to this challenge, Linear Technology has released ground-breaking electronic devices for the EV and HEV market. Linear Technology introduced the LTC6802 in 2008, a single IC that enables precision monitoring of the large high voltage battery stacks required in an electric vehicle drive train. This battery monitoring IC shrinks the data acquisition task into a single device, capable of supporting long strings of battery cells. The result is vastly improved performance, cost effectiveness and space usage over the discrete solutions of the past. This complete battery measuring IC includes a 12-bit ADC, a precision voltage reference, a high voltage input multiplexer and a serial interface. Each LTC6802 can measure up to 12 individual battery cells in series; the device's proprietary design allows for multiple LTC6802s to be stacked in series without optocouplers or isolators, permitting precision voltage monitoring of every cell in long strings of series-connected batteries. In 2009, Linear Technology introduced the LTC6801 as a companion to the LTC6802, providing redundant monitoring for these high voltage battery packs. After two years of production and a road-proven design, Linear Technology recently introduced the LTC6803, a second generation battery monitoring IC. With real automotive experience, the second generation addressed the demands for more noise immunity, compatibility to a wider range of battery cells, lower power consumption, and extensive self-test capability for safe/reliable operation.

Electric vehicles are headed into the mainstream and sophisticated measurement devices are essential to their success. Not only are these devices required to provide accurate measurement, monitoring and control, they must also operate reliably for a long period under very difficult conditions. The LTC6803 is proving what's possible, and next generation devices are on the horizon for battery management, monitoring, balancing, power management and more. In the not too distant future, we can finally eliminate the vibration, smell and noise from the combustion engine, and move forward without regret. Today's internal combustion vehicles benefit from more than a century of focused development. I'm confident that as the spotlight is refocused on electric vehicles, they will prove their worthiness in a relatively short time.

[1] http://inventors.about.com/od/cstartinventions/a/History-Of-Electric-Vehicles.htm [1]

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