



## Delta Motorsport: Developing a Micro-Turbine EV Range Extender Using ATI Products



Electric Vehicles (EVs) must overcome their range limitations if they are ever to become wholly practical replacements for existing internal combustion (IC) powered vehicles. One of the most promising and exciting projects to address this obstacle has been undertaken by UK-based Delta Motorsport, a small but rapidly expanding high technology company with its origins in motorsport engineering consultancy.

With assistance from Accurate Technologies' (ATI's) measurement, calibration and diagnostics products, Delta Motorsport has developed a micro-turbine range extender, MiTRE, to free EVs from the constraints of limited range and frequent re-charging. Able to run on petrol, diesel or bio-fuel, it can keep an EV running at sustained highway speeds for as long as there is fuel in the tank, and when refuelling is required, it is no further away than the next filling station.



**About MiTRE**

MiTRE is not connected to the wheels or driveline of the vehicle; it simply provides electrical power to maintain the state-of-charge of the battery pack. The key advantages of MiTRE are its low cost, emissions combustion and tiny packaging space. In volume manufacture, it is projected to add less than £1000 to the vehicle cost and much of this can be offset by using a smaller, cheaper battery pack.

MiTRE can be so compact because its shaft speed is so much higher than an IC engine. This enables the use of an ultra-compact generator as the torque required drops with increasing speed. The development of reliable high speed e-machines in recent years, such as those used in electric vehicles or for electric forced induction systems, has made this approach feasible.

In order to increase the turbine efficiency to the same level as an IC engine, the exhaust gas from the turbine passes through a heat exchanger that pre-heats compressed air to around 600°C on its way to the combustor.

Originally developed under a four-year collaborative program, led by Delta and partially-funded to the tune of £1.5m by Innovate UK, the first MiTRE prototypes produced an output of 17kW, enough to enable a small EV to cruise at 70mph without depleting the battery charge level. The prototypes were shown at last year's LCV event and used on Delta's E-4 coupe EV to demonstrate extended range. Hardware for a 35kW range extender is now being procured and will be developed over next two years.

Initial development was carried out at sub-system level for the combustor, e-machine, inverter and heat exchanger. All sub-systems were brought together for testing at the University of Bath, a partner in the program, where the engineers were using ATI's VISION software.



## How ATI products helped Delta meet the development challenges

Delta was quick to recognize the value of ATI's VISION software and DLX DAQ hardware in managing the complex development tasks ahead, according to Scott Herring, Delta's Senior Engineering Manager. "One of the biggest challenges was to monitor and adjust a wide range of parameters in real time, including air/fuel ratio, e-machine demand, power, multiple temperatures, fuel pressure and flow," he explained. "Maximum efficiency requires the combustor temperature to be kept as high as possible (typically 1050°C at the outlet) but juggling multiple displays of fluctuating numerical data was impractical; ATI's user configurable interface is so intuitive and user-friendly that we could customize our data views allowing us to understand the information instantly and interact with the necessary speed to maintain the required test conditions."



Herring found benefits on the hardware side too. "Because ATI's DLX Datalogger is so highly configurable, it's easy to switch the functions of different channels which allows us to keep the hardware breakout boxes to a minimum. The convenience of ATI's products also helps to reduce the need for the most highly skilled and specialized control engineers to resolve compatibility and communication issues, so they can use their expertise on more essential aspects of the program," he said.



One of those aspects was cold starting. The MiTRE range extender is currently fueled by gasoline using a low emissions combustion strategy and cold starting presented a significant emissions challenge. According to Herring, ATI's products helped Delta to understand and visualize the conditions arising during cold start and manage the machine speed, fueling and temperatures to optimize the strategy.

ATI's data logging and display functions have also been useful, enabling Delta to document and time-align an extensive range of data from multiple sources around the CAN network. Herring was able to quantify the benefits. "Without ATI's VISION and DLX, I doubt we would have met the program timing for the 17kW prototypes; it probably cut the time required by half and the manpower by a third," he said.

## Future Plans

Delta is in the process of rolling out ATI products onto other projects as the 'preferred tool' for developing new control systems. The company's lead control engineer, Chung Mo, believes the system is ideal for any applications that are normally highly code-intensive, such as battery pack thermal management or active chassis system development. "ATI's VISION software helps us to make development changes quickly and reliably; it's a great portal for gaining access to the ECU and allows quick, easy and robust re-flashing," he said. "It provides us with the flexibility to continue using the open ECUs we're familiar with, such as the Pi Inno, while adopting VISION as the interface."

For further information on Delta Motorsport or ATI visit their respective websites:

[www.delta-motorsport.com](http://www.delta-motorsport.com)

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