Peak Performance

Racing to the top with standard car parts: the MiEV Evolution II

Electric vehicles are no “snail-paced” eco-mobiles, as Mitsubishi proved at the tough Pikes Peak mountain race in the USA. Based on standard parts from the i-MiEV, the MiEV Evolution II is a bundle of electric energy that excels on the race track. Its electronics command center is a MicroAutoBox II from dSPACE.

Figures 1-4: From top to down: Fine-tuning the controllers on the MicroAutoBox; The Pikes Peak racing team; Drivers Greg Tracy (left) and Hiroshi Masuoka (right) with their trophies for 2nd and 3rd place; The MiEV Evolution II on the track

The Pikes Peak International Hill Climb

Mitsubishi's entry in this year's legendary Pikes Peak International Hill Climb in the USA was MiEV Evolution II, the special race version of their electric road car i-MiEV. Cars have been racing up this 4,300-meter-high mountain in Colorado since 1916, covering a difference in altitude of more than 1,500 meters along its winding road. Climate is also a challenge: as the cars and their drivers speed to the top, they face constantly changing air pressure, atmospheric conditions and temperatures.

Experienced Race Drivers

Mitsubishi's two racing prototypes were driven by Hiroshi Masuoka (Japan) and Greg Tracy (USA). Masuoka is a true motor racing great, having taken part in the Dakar Rally no fewer than 21 times and winning it in two consecutive years, 2002 and 2003. Greg Tracy has an equally impressive track record with six wins in the Pikes Peak motorbike class.

Production Vehicle

Like its predecessor the i-MiEV Evolution in 2012, the Mitsubishi MiEV Evolution II has numerous production vehicle parts installed, combined with specially developed high-powered electric motors and batteries. Its body is made of carbon fiber and has been specially adapted to racing requirements – it is extremely light and has excellent aerodynamics.

Drive and Performance

Four electric motors drive the MiEV Evolution II – two at the front and two at the back, with a total power of 400 kW (544 HP). Based on the experience gained in last year's race, this year the developers integrated the Super All-Wheel Control (S-AWC) vehicle dynamics system with curve and stability control. This regulates the driving and braking forces on each wheel separately to transmit the forces to the track safely and ensure maximum dynamics. High driving power with reduced air resistance was ensured by slicks – approved for use for the first time in 2013 – and by aerodynamic adjustments to the body.

Central Control

To implement the new control algorithms in the vehicle quickly, Mitsubishi used dSPACE's prototyping system MicroAutoBox II, which acts as the central control unit.

> "The MicroAutoBox II is a compact and highly reliable unit in a challenging on-vehicle environment. We were able to use it worry-free for the Pikes Peak vehicle that had to run up from an altitude of 2800 m to 4300 m within about 10 minutes."

Tetsuya Furuichi, Assistant Manager, EV System Advanced Research, EV Component Research Department, Development Engineering Office, MITSUBISHI MOTORS CORPORATION

The MicroAutoBox II is mounted in the vehicle as an ECU which coordinates and controls the four electric motors and brake systems in the MiEV Evolution II. It estimates motor running and drive battery conditions using information collected from a variety of sensors and ECUs, thus optimizing control of the four electric motors and brake systems and enabling safe and stable high-speed running conditions for the MiEV Evolution II. The production ECU from the i-MiEV performs battery management.

Impressive Results

The concept of the MiEV Evolution II is definitely a winner: The two cars took the 2nd and 3rd places in the Electric class at the 2013 Pikes Peak – an achievement that speaks for itself. This powerful race car has potential for further development and provides valuable knowledge that benefits the development of electric road vehicles. A win-win situation for electromobility. ■

Video: Presentation of the race track. http://www.youtube.com/watch?v=ub6l2CTu6co

Technical Data for MiEV Evolution II

Full length	4,870 mm
Full width	1,900 mm
Full height	1,390 mm
Wheel base	2,700 mm
Drive system	4WD (Fr: LSD, Rr: right/left independently driven)
Motor/Inverter (From Meidensha)	Hardware and control software were upgraded based on those for i-MiEV
Maximum output / torque	400kW/800 Nm (100kW/200 Nm x 4)
Battery (From LEJ)	Advanced prototype 50kWh
Chassis	Dedicated tube frame
Cowl (From Toray)	Carbon fiber (CFRP)
Suspension type	Front and rear double wishbone
Steering assist device	Column assist EPS (For Outlander)
Tire size (from Dunlop)	260/660R18

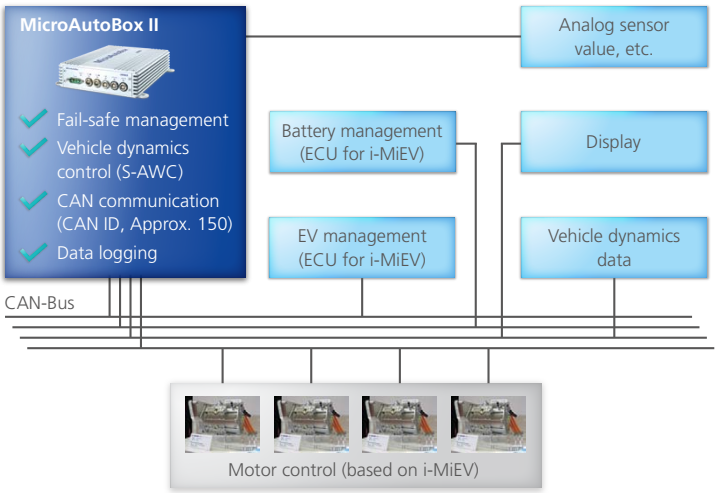

Figure 5: Schematic View of the control system based on the MicroAutoBox II.

"By using the dSPACE prototyping system, we were able to develop the Vehicle Dynamics Integrated Control System for MiEV Evolution II in a short period of time."

Akira Hashizaka, EV/Powertrain System Design, EV/Powertrain System Engineering Department, Development Engineering Office, MITSUBISHI MOTORS CORPORATION