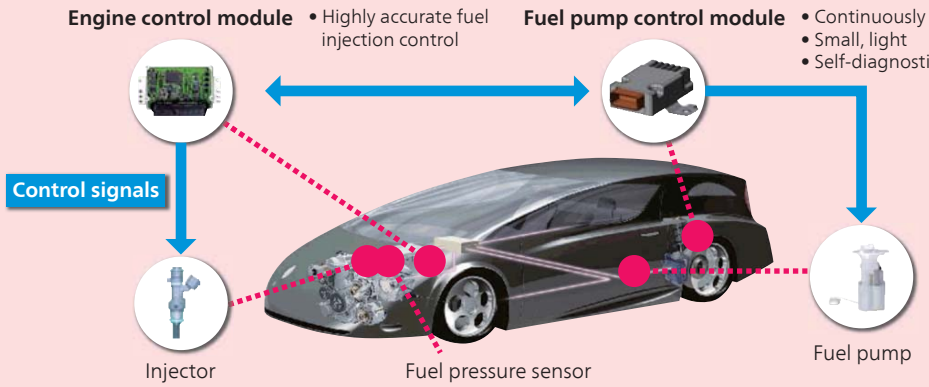
Automotive Systems



1 Fuel pressure control system

1 Fuel Pressure Control System

The fuel pressure control system (FPCS) was developed to comply with increasingly strict fuel-efficiency and emissions regulations by improving fuel economy and reducing emissions. It controls the discharge flow rate of the fuel pump and fuel injection pressure in accordance with engine operating conditions.

Past fuel supply systems have operated the fuel pump at maximum flow rate and maintained a constant fuel injection pressure, regardless of engine operating conditions. In contrast, the new system improves fuel economy in situations such as idling (when the required amount of fuel injection is low) by lowering the discharge flow rate so that the fuel pump power consumption is reduced. It also boosts the fuel injection pressure when cold-starting the engine to atomize the injected fuel and reduce hydrocarbon (HC) emissions.

The system components have the following features.

(1) Fuel pump control module: designed for smaller size and lighter weight, it provides a continuously variable fuel pump output and supports large capacity fuel pumps.

(2) Engine control module: high level of accuracy for control of fuel injection pressure.

(3) Fuel pump: controls costs by minimizing changes from previous fuel pumps.

(Hitachi Automotive Systems, Ltd.)

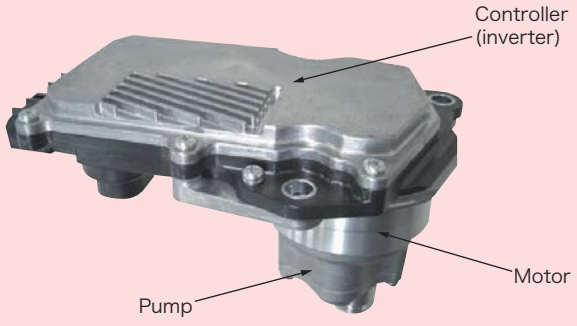
(Date of initial production: September 2013)

2 Electric Oil Pump with Built-in Electrics

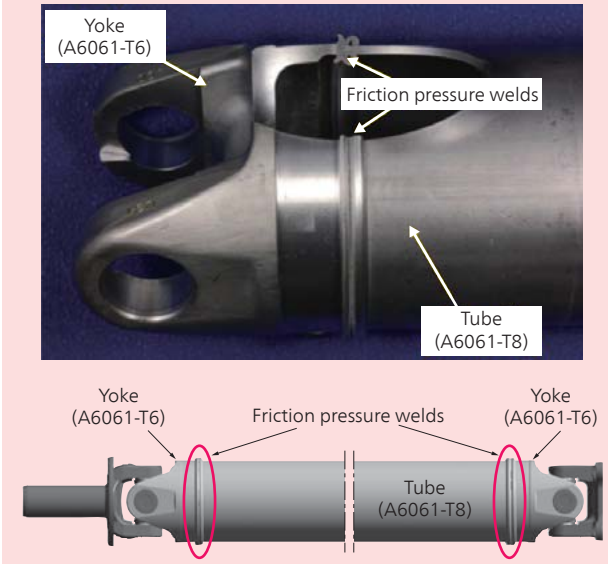
This electric oil pump was developed for cooling the transmission in a hybrid car. The new pump features low cost and is easy to install on the transmission thanks to a design that integrates the pump motor and controller (inverter) into the pump housing. The unit also features a proprietary Hitachi motor drive technique that does not require a position sensor for the motor rotor. Instead, the technique estimates the rotor position by taking advantage of the tiny changes in winding inductance that occur in response to changing rotor position. The technique also overcomes the problem of low torque at slow speeds to ensure good performance even at very low oil temperatures.

(Hitachi Automotive Systems, Ltd.)

(Date of initial production: February 2013)



2 Electric oil pump with built-in electrics



3 Cut sample of friction pressure weld on aluminum propeller shaft (top) and aluminum propeller shaft for NV350 Caravan (bottom)

3 Welding Technique for Lightweight Aluminum Propeller Shaft

Amid demand for improving vehicle fuel efficiency, a newly developed propeller shaft has been made considerably lighter than its predecessors by using aluminum in place of steel.

A propeller shaft transmits engine torque to the rear wheels and therefore needs to be strong and reliable. The new shaft uses A6061 heat-treated aluminum for the yoke and tube, two parts that have an important role in weight reduction. The major technical challenge, however, is how to ensure weld strength as a high level of heat input when the parts are welded together diminishes the strength of the base material.

In response, Hitachi has adopted a friction pressure welding technique that utilizes the friction heat generated when the yoke and tube are pressed together and rotated. While optimizing welding conditions for aluminum is a difficult technical challenge, Hitachi succeeded in achieving the target strength by performing a sensitivity analysis of the welding parameters (pressure, speed of rotation, and time) and observing the weld cross section. Also, while problems were experienced with welding variability affecting shaft length accuracy, the new propeller shaft was successfully put into full production by switching equipment control from hydraulics to a numerical controlled (NC) servo.

The first vehicle to adopt the new aluminum propeller shaft in Japan has been the NV350 Caravan made by Nissan Motor Co., Ltd.

In the future, Hitachi intends to respond to demand from customers for wider use of aluminum engineering as a key technology for reducing weight.

(Hitachi Automotive Systems, Ltd.)

(Date of initial production: July 2012)

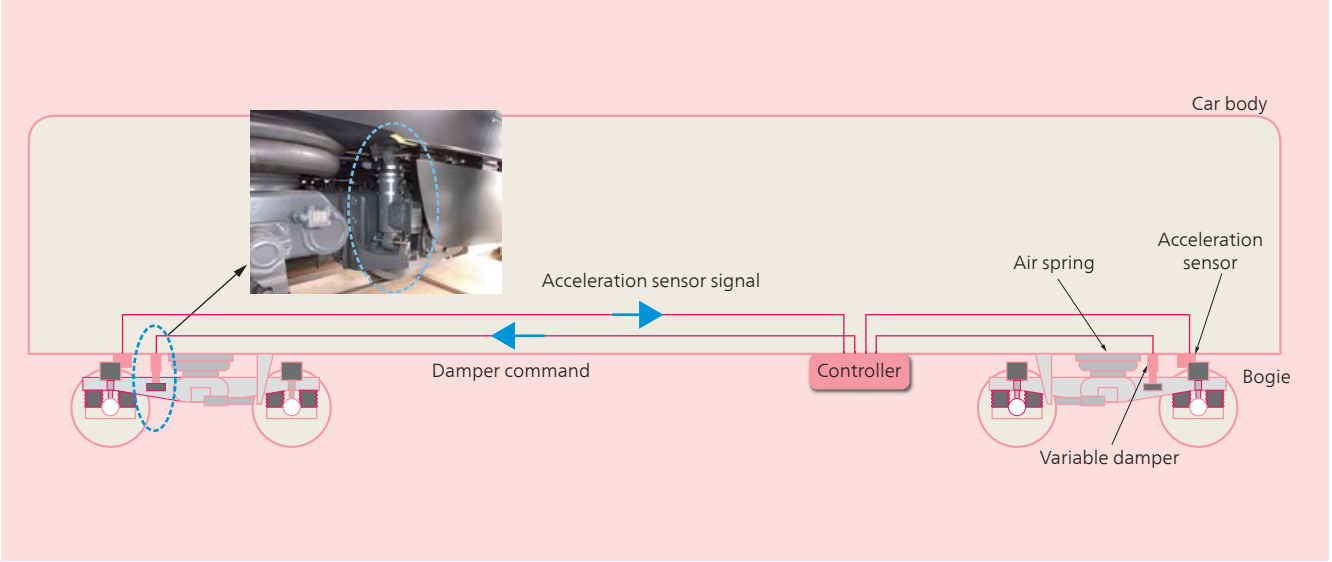
4 Variable Damper System for Rolling Stock

This variable damper system for rolling stock uses air springs between the bogie and car body and was developed in collaboration with the Railway Technical Research Institute. The damper improves ride comfort by using an array of air springs to damp vertical vibration of the car body (vertical movement, pitching, and rolling). The new dampers have been fitted on the luxury sleepers of the Seven Stars in Kyushu, a "cruise train" in Kyushu, Japan, operated by the Kyushu Railway Company, and entered commercial operation in October 2013.

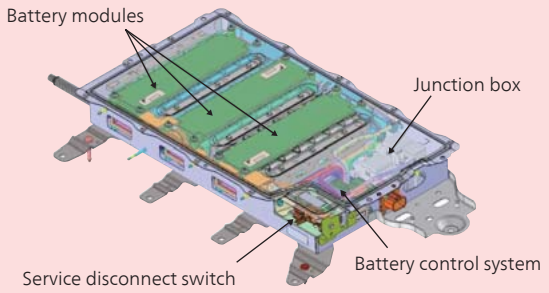
The new system was developed by modifying the damper design and control technique used by the dampers on the Ibusuki no Tamatebako tourist train, which is already in commercial operation, resulting in improved damping force characteristics and responsiveness. In particular, the new system provides a way to improve ride comfort on a particular train set or car without doing anything to the track.

Hitachi hopes to have the dampers adopted on new trains, particularly sleeper cars that are planned for the future.

(Hitachi Automotive Systems, Ltd.)



4 Variable damper system for rolling stock



Main battery pack specifications	
Energy capacity	634 Wh
Capacity	4.4 Ah
Voltage	144 V
Input power	19 kW
Output power	17 kW
Operating temperature	–30 to +60°C
Weight	29 kg or less
Dimensions	744 mm (W) × 427 mm (D) × 93 mm (H)

5 Battery pack structure and main specifications (top) and finished battery pack (bottom)

5 Lithium-ion Battery for Electric Vehicles

In response to growing awareness of the environment, nations around the world are adopting stricter vehicle emission standards. In addition to improvements in the fuel economy of gasoline vehicles, complying with these standards will also require the widespread introduction of hybrid and other electric vehicles. In response, Hitachi has developed its generation 3.5 battery pack for use in hybrid cars for the North American market.

The battery pack includes functions for power assist during acceleration, assistance with engine starting, and absorbing regenerated energy during deceleration or braking. The packs combine a number of components in a box-shaped case, including the battery modules (which use cylindrical battery cells), battery control system, junction box, and service disconnect switch. Production has already commenced at the Kentucky plant of Hitachi Automotive Systems Americas, Inc.

In the future, Hitachi intends to continue satisfying customer needs through its market-proven reliability technology and other advanced technologies such as high energy materials.

(Hitachi Vehicle Energy, Ltd.)

(Date of initial production: July 2013)

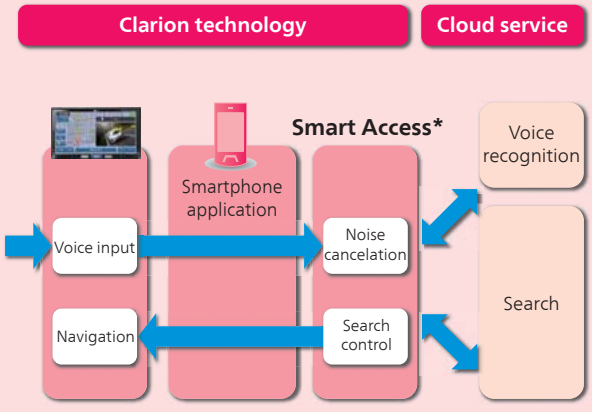
6 Cloud-based Voice Recognition for Vehicle IT Devices

While voice recognition requires advanced data processing and algorithms, the processor capacity and memory available in car navigation and other embedded systems tends to be limited. Accordingly, although car navigation systems started using voice recognition in the early 1990s, the recognition accuracy remained low and little progress was made on functionality. Meanwhile, cloud-based voice recognition started to be adopted in consumer electronics during the 2000s, including in smartphones, and this has led to the technique coming to be seen once again as an important form of human-machine interface (HMI).

Along with the introduction of cloud-based voice recognition, the use of cloud-based processing and algorithms has also achieved a step up in the performance of other forms of audio processing (such as noise cancellation) that were already used in vehicle-mounted devices. The adoption of features such as cloud-based agent functions and large data clouds has also brought a dramatic improvement in the performance of the search functions that form an important part of navigation.

In the future, Hitachi hopes to bring even greater convenience to vehicles by making further enhancements to cloud-based voice recognition and working towards its use in interactive voice control.

(Clarion Co., Ltd.)



* Smart Access is a trademark of Clarion Co., Ltd.

6 Block diagram of cloud-based voice recognition system