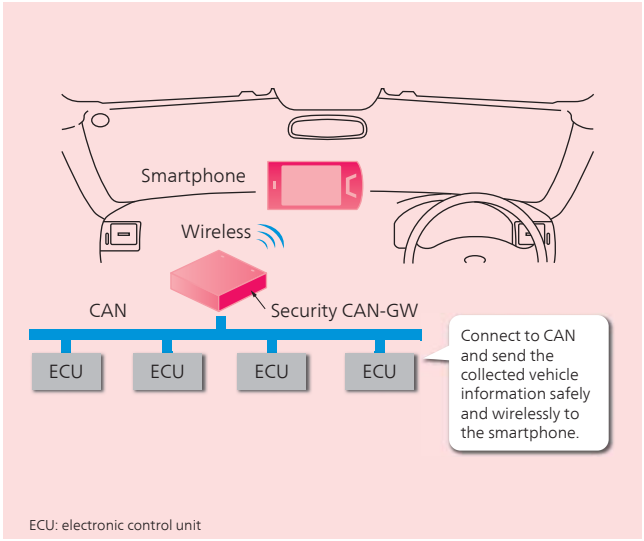
Automotive Systems



1 Security CAN-GW system configuration

1 Security CAN-GW

Security controller area network—gateway (CAN-GW) is an onboard gateway device that can provide the vehicle information that is flowing on the CAN onboard network, safely, and matched to the user's purpose. With the enhancement of network environments and the spread of smartphones in recent years, ways of connecting cars to the Internet and of using the vehicle information, such as sensor information, that is available on cars are being considered. On the other hand, connecting cars with various networks has raised the issue of ensuring information security, in the same way as other information technology (IT) devices.

Security CAN-GW addresses this issue with security functions that are based on the results of security analysis produced using Hitachi's proprietary methods, and on the study of risk countermeasures to ensure safety.

The main functions are as follows.

(1) Vehicle information collection and transmission functions

Connect to the vehicle's CAN and collect vehicle information. Transmit the collected information wirelessly to a smartphone.

(2) Security functions

Perform device authentication and smartphone app authentication between security CAN-GW and the smartphone, and encrypt data.

(3) Gateway functions

Select vehicle information, convert formats, and edit data.

(Hitachi Automotive Systems, Ltd.)

(Start of mass production: August 2014)

2 Inverter and DC-DC Converter for P-HEVs, for Daimler (S-Class)

Hitachi has developed the P2-85 inverter and direct current (DC)-DC converter for the S-Class S550 plug-in hybrid from the high-end German brand, Mercedes-Benz*.

This plug-in hybrid electric vehicle (P-HEV) system is a high-output, low fuel consumption system that combines a gasoline engine and an 85-kW electric motor to deliver a maximum output of 325 kW/650 Nm at 35.7 km/L (European combined mode fuel consumption).

The newly-developed inverter controls motor drive and regeneration, to deliver a maximum rating of 432 V/ 290 Arms by using in-house power modules with double-sided cooling as the heart of the system. The structure is built to last for 15 years in an onboard environment of 105°C and the IPX7 immersion specification.

The DC-DC converter converts power from the high-voltage battery to run the low-voltage (LV) system. It is essential for electrified vehicles. This newly-developed product is compact but has a maximum output of 3 kW (14 V, 210 A), and achieves 94% efficiency.

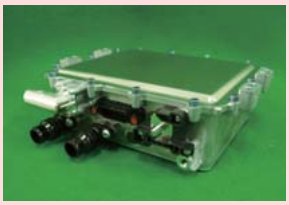
In the future, Hitachi plans to expand the variations that are available and extend them to new models.

(Hitachi Automotive Systems, Ltd.)

(Start of mass production: June 2014)

* See "Trademarks" on page 146.


P2-85 inverter


P2-85 DC-DC converter


Power module
with double-sided cooling

2 Inverter and DC-DC converter for P-HEVs, for Daimler AG (S-Class)

3 Stereo Camera

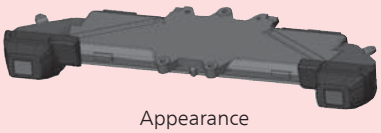
Hitachi supplies stereo cameras to FUJI HEAVY INDUSTRIES LTD. as sensors for external recognition and driving systems that are able to recognize the outside world and the vehicle's driving conditions. These systems are intended to prevent car accidents and mitigate damage by detecting objects such as pedestrians and bicycles, and controlling the brakes.

Next-generation cameras employ high-definition color imaging elements and a newly-developed 3D image processing engine to expand the detection area by approximately 40%, while also enhancing the functions of various recognition applications.

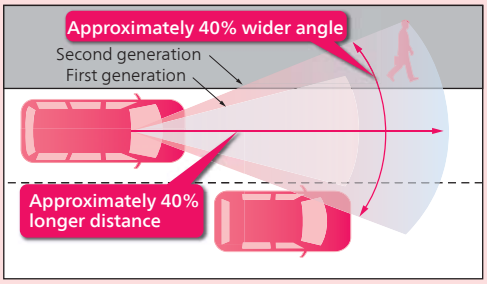
In the future, Hitachi will continue to pursue development towards higher precision and higher functionality as well as more compact components.

(Hitachi Automotive Systems, Ltd.)

Onboard status



Appearance



Comparison of detection areas

3 Stereo camera

4 Motorized VTC Systems

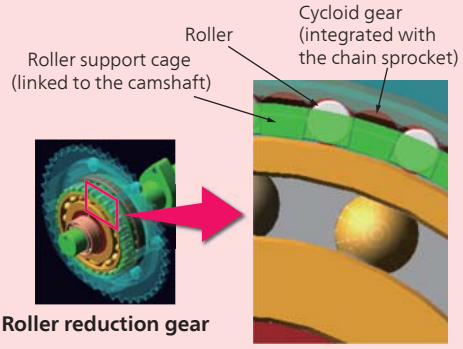
As environmental and fuel consumption regulations are being toughened, there is demand for higher engine efficiency, including in the base engines of hybrid electric vehicles (HEVs). This creates a growing need for motorized valve timing control (VTC) as a highly functional variable valve device that is able to achieve that enhanced efficiency.

Hitachi's motorized VTC is the world's first system* to combine a DC brush motor and roller reduction gear in a single unit, achieving a compact size, low price, reduced power consumption, and reduced friction. Integration of the motor and reduction gear makes the system more compact, while eliminating the following drive for the rotation of the motor camshaft saves power and achieves a high level of responsivity. This drive load reduction also enables the use of an inexpensive brush motor. The reduced rolling contact of the roller reduction gear reduces friction, and combines with the flattening of the structure to reduce size and save power.

Since 2014, Hitachi has been mass producing these systems to supply to Hyundai Motor Company. Hitachi plans to expand its application as a key technology for future variable valves in order to meet customer needs globally.

(Hitachi Automotive Systems, Ltd.)

* Investigated by Hitachi Automotive Systems.



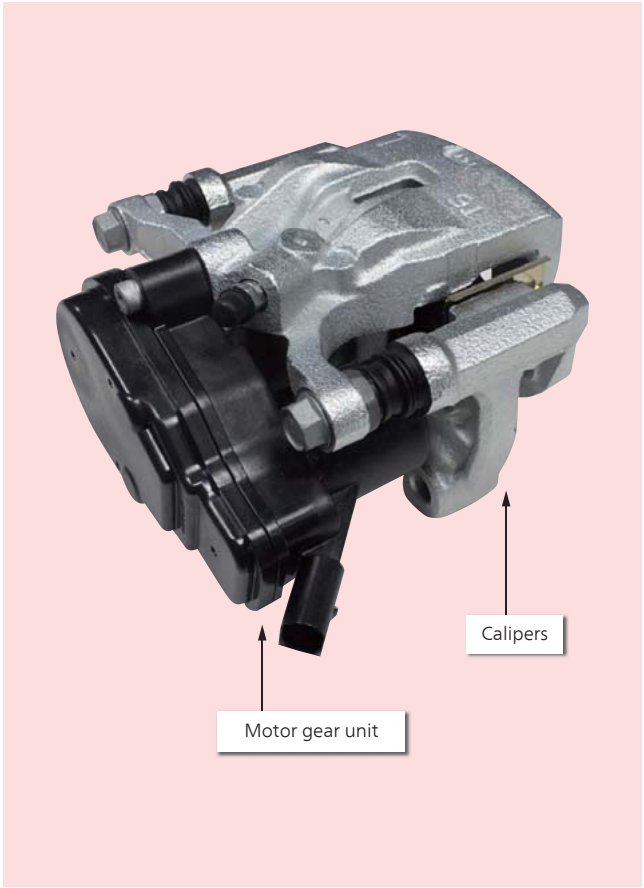
4 Integrated structure for a motorized VTC system with a DC brush motor and roller reduction gear (top) and roller reduction gear (bottom)

5 Electric Parking Brakes

In recent years there has been growing market demand for electric parking brakes in order to meet requirements for freer car interior layouts, safety, environmental performance, and greater convenience. Hitachi has addressed this need with a fusion of braking technologies it has built up in built-in calipers, compact vehicular motor technology, and electronic control unit (ECU) control technology. The result is motorized parking brakes characterized by small size, low current consumption, high responsivity, and low braking noise, which are now in mass production.

Electric parking brakes must provide frequent parking operations in diverse situations. Low current consumption reduces power consumption, high responsivity improves linkage with the hydraulic brakes, and low braking noise allows repeated use without annoyance. These benefits contribute to broader vehicular applications. Also, linking this with electronic stability control (ESC), a system to prevent the vehicle from skidding sideways, stereo cameras, the power train, and other vehicular systems maintains vehicle stop-holding, enabling improved safety, fuel economy, and convenience.

In the future, Hitachi will expand the product lineup and the range of applicable vehicles through even higher performance, and through compliance with functional safety regulations and German Association of the Automotive Industry (VDA) standards.
(Hitachi Automotive Systems, Ltd.)
(Start of production: October 2014)



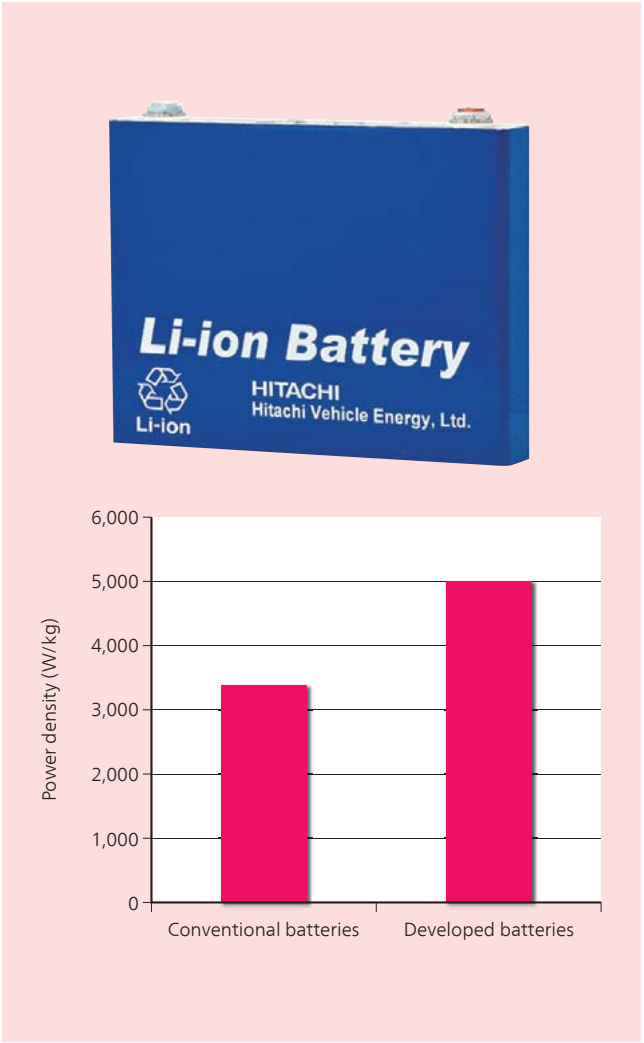
5 Electric parking brakes

6 Lithium Ion Batteries for Electric Vehicles

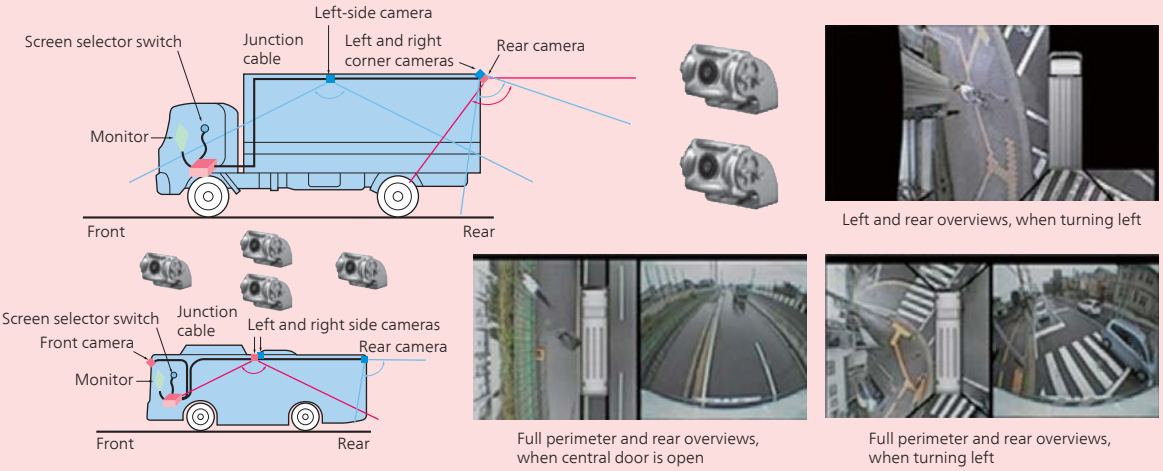
Hitachi Vehicle Energy, Ltd. began mass production of lithium ion batteries for hybrid vehicles in 2005. As of now, it has a track record of mass-producing over five million cells for over 120,000 vehicles. As environmental regulations are being toughened in many countries, lithium ion batteries for hybrid cars are being asked to deliver higher power to expand the range of motor assistance.

One effective way to increase power is to reduce cell internal resistance by making the electrodes thinner, however, simply thinning the electrodes increases the volume ratio of materials such as separators, reducing the storage capacity accordingly. Hitachi has applied high-capacity anode and cathode materials to achieve both power and capacity at the same time. Now, Hitachi has developed a high-power cell that increases the power to 1.5 times the previous level while keeping capacity on a par with the highest levels in the world. It does so while continuing to maintain charge-discharge cycle lifetime and safety.

In the future, Hitachi will roll out the developed cells globally while meeting customer needs.
(Hitachi Automotive Systems, Ltd., Hitachi Vehicle Energy, Ltd.)



6 Lithium ion batteries developed by Hitachi, and their power characteristics



7 SurroundEye two-camera system and four-camera system

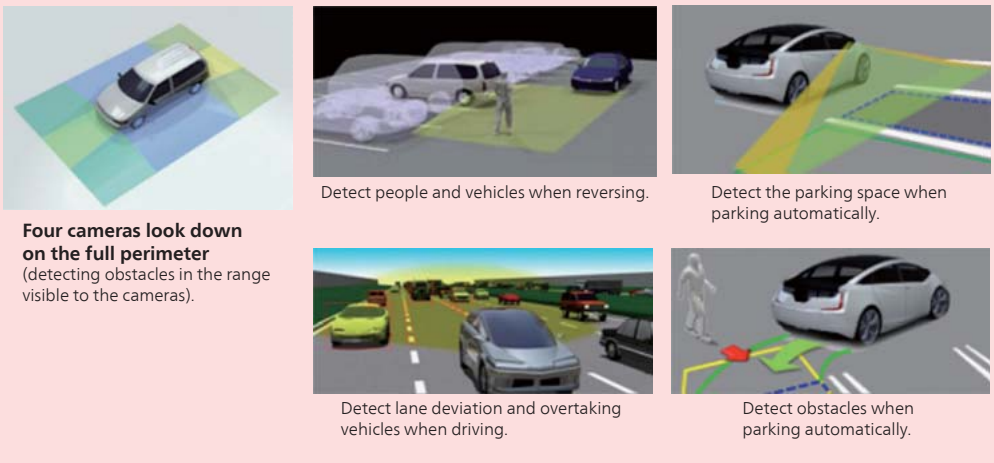
7 SurroundEye and Full Perimeter Sensing

SurroundEye was registered as a trademark by Clarion Co., Ltd. in January 2014. It consists of multiple vehicle-mounted cameras to check the vehicle's surroundings and a monitor that combines and displays the images from the cameras. The system assists with safe driving by showing the driver the areas that are in blind spots. It had been only commercialized for use in cars, however, systems for trucks and route buses were announced in May 2014.

The basic version is a two-camera system consisting of two cameras, mounted on the passenger side and at the rear, an ECU that combines the images, and a 7-inch monitor. Supplementary information for the rear left, which is a blind spot from the driving seat of a truck, helps to prevent trapping accidents due to inner wheel differential, accidental contact with vehicles to the rear left, etc. For route buses, the system uses four cameras mounted on the front, left, right, and rear, to provide a 360° overview of the surrounding area. The system helps to check for safety around its parked position when stopping and departing, to check vehicle positioning when approaching guard rails and road shoulders when stopping, to check for bicycles approaching from the rear, and to check the status and safety of passengers boarding and alighting near the central doors. All of these operations are performed with mirrors and line of sight from the driving seat.

For passenger cars, a system has been commercialized that applies image recognition technology to the camera images in order to detect obstacles around the vehicle and to warn the driver. Four cameras on the front, left, right, and rear provide 360° sensing around the car. Even with only the rear camera, the system is able to notify the driver of the approach of vehicles or people when parking or departing, warn the driver of lane deviation while driving, and issue warnings in situations such as when being overtaken by a vehicle from the rear. This 360° sensing was made more advanced in 2013, and applied to automatic parking systems. These systems recognize the parking boundaries to identify the parking space, detect pedestrians and other obstacles during automatic parking, and can pause the vehicle's motion. The control systems were developed jointly between Hitachi Automotive Systems, Ltd. and Clarion.

In the future, Hitachi will evolve the system further and develop 360° sensing functions that can be used in automatic driving.
(Clarion Co., Ltd.)



7 Full perimeter sensing