

**Service** for all brands – including  
**Hybrid and Electric Vehicles**



**BOSCH**

Invented for life

# Hybrid technology from Bosch:

## Concepts and future prospects



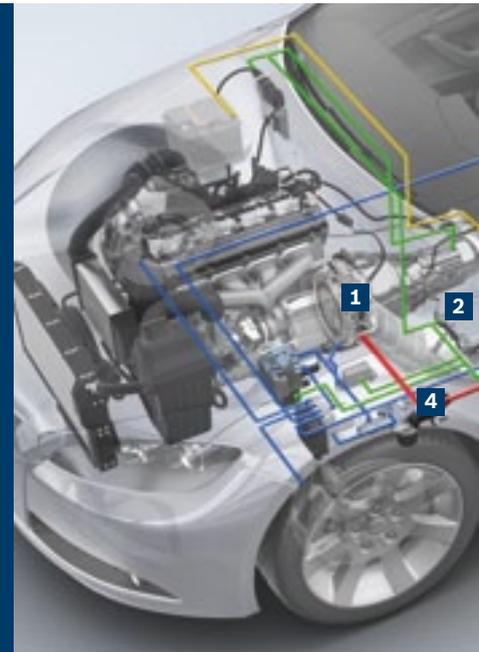
Cleanly into the mobile future

### Hybrid electric vehicle

- Power supply 12V
- Communication
- High voltage supply
- Hydraulic Tubes / brake system

### Components

- 1 E-Machine (motor/generator)
- 2 Inverter
- 3 High voltage battery
- 4 Regenerative braking system



### Hybrid: The way forward to the ultimate goal

Everyone is basically in agreement: Electric drive systems are the future of the automobile. In the meantime the internal combustion engine remains an essential factor until the vision of sustainable mobility can be put into practice. The aim must be to fully exploit the remaining scope for reducing CO<sub>2</sub> emissions. Hybrid technology is an important step along the road to powering vehicles entirely by electricity.

#### Zero-emission urban motoring:

##### With a sufficient range for holiday driving

Electric drive systems permit green driving in cities and can be used for longer distances when needed. At present this can only be achieved with the various types of hybrid technology available. The hybrid sector is developing into a significant market segment: By 2020 Bosch expect that there will be around 2.5 million electric vehicles and 3.1 million plug-in hybrids as well as 6.5 million full hybrid vehicles throughout the world.

Hybrid technology from the specialists: Drawing on a wealth of system expertise, Bosch can be relied upon to master the complexities of engine, electric drive system and clutch interaction. Using hybrid technology, fuel consumption and CO<sub>2</sub> emissions can be cut by 25 to 30 percent without having to adapt the engine. In future it will be possible to design smaller gasoline or diesel engines.

#### Practical extras for more pleasant driving

Hybrid means more than just economy: A combination of internal combustion engine and intelligent electric drive systems is not only a means of saving fuel and reducing emissions. It is also a way of enhancing vehicle dynamics, as can be seen from a variety of useful extra functions.

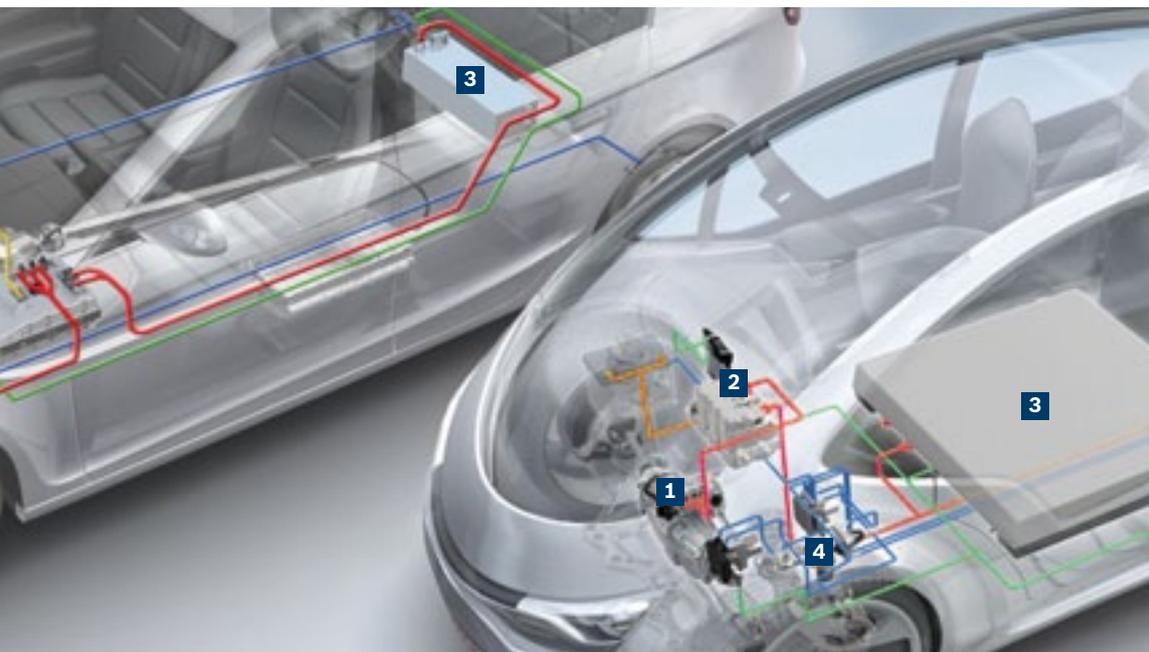
#### System expertise – the key to success

In association with motor vehicle manufacturers, the innovative ideas of Bosch play a crucial role in the development of high-performance hybrid systems. Thanks to two full hybrid concepts from Bosch, purely electric motoring is already possible over short distances:

- ▶ Parallel full hybrid (electric machine integrated into drive train between engine and transmission)
- ▶ Axle split hybrid (internal combustion engine at front axle and electric drive for rear axle. Positive extra effect: Additional all-wheel drive)

# Hybrid and electric vehicles:

## The future of mobility is green



**Left:** Parallel full hybrid with electric machine integrated into the drive train – between engine and transmission

**Rechts:** Electric vehicle with electric drive system for front axle

### Full hybrid (HEV)

In full hybrid vehicles, the engine is supplemented by an electric motor. The vehicle is driven by an internal combustion engine. Full hybrids can however also run entirely on electricity over short distances. The power required to do so is generated beforehand by the gasoline or diesel engine. In other words the battery is charged without the need for a mains supply.

### Plug-in hybrid (PHEV)

Plug-in hybrids can run on the electric drive system over longer distances without producing any emissions. The engine takes over as and when the battery charge is no longer sufficient. The battery can be charged straight from a power socket.

### Electric vehicle with Range Extender (EVRex)

Range extenders are compact internal combustion engines which re-charge the batteries of electric vehicles as and when the charge level diminishes. Unlike the plug-in hybrid, the range extender cannot drive the wheels directly. It does however maintain the mobility of electric vehicles – even if there is no charging point in the vicinity.

### Electric vehicle: Farewell to fuel (EV)

No fossil fuel is required for purely electric drive systems. In technical terms it is only a small step from a hybrid to an electric vehicle: Lower costs and a sufficient number of charging stations will however be essential to achieve widespread acceptance. At Bosch great efforts are being made to promote further development of the lithium-ion battery and create the prerequisites for an electric mobility infrastructure.

Product/Type of vehicle	HEV <sup>1</sup>	PHEV <sup>2</sup>	EVRex <sup>3</sup>	EV <sup>4</sup>
1 E-Machine (motor/generator)	●	●	●	●
2 Inverter	●	●	●	●
3 High voltage battery	●	●	●	●
4 Regenerative braking system	●	●	●	●
Charger	–	●	●	●
Reduced emissions	●	●	●	●
Zero emissions	–	–	–	●
Runs without fossil fuels	–	–	–	●

<sup>1</sup>Hybrid electric vehicle, <sup>2</sup>Plug-in hybrid electric vehicle, <sup>3</sup>Electric vehicle with range extender, <sup>4</sup>Electric vehicle

# Hybrid technologies from a single source: Innovative, intelligent, successful

Efficient electric motors for hybrid and electric vehicles come from the Hildesheim plant.

The series production of power electronics is based in Reutlingen.



The innovative systems developed by Bosch are crucial to the progress of electric mobility. We currently develop and manufacture technologies, components and systems for electric drive concepts. Bosch annually invests some 400 million euros in the creation of electric drive systems for automobiles. At Bosch, 800 people are working on the future of mobility.

## **The all-round supplier of core technologies for electric drive systems**

Although the internal combustion engine will remain the dominant automotive drive system in the years to come,

electric drive concepts will take over in the long run. Bosch can already supply a full range of electric mobility products, with the main aim being to create perfectly functioning systems rather than just developing and manufacturing individual components.

## **No waste of energy: Regenerative braking system**

In hybrid and electric vehicles, energy management for the drive train is handled by the power electronics. In hybrids, the important energy recovery function is controlled by the power electronics, thus reducing fuel consumption. On braking, the electric machine acts as a power generator and the vehicle is braked at the same time. The braking energy produces electrical energy, which is stored in the battery and later used to drive the vehicle.



No other supplier can provide such a wide range of components, system expertise and services in the field of electric mobility.

- ◀◀ Inverter
- ◀ Electric motor
- Cooperative regenerative braking system ▶



# Companies' electric fleets: eMobility Services



Bosch Software Innovations offers complete solutions for electric company fleets

## **Bosch links up the charging infrastructure and facilitates entry into companies' electric fleets**

Electromobility requires not only new systems and components in the vehicle, but also the expansion of adequate and networked charging infrastructure. Here, Bosch is opening up new areas of business. Bosch Software Innovations GmbH offers eMobility internet services, with which companies can operate the charging infrastructure for their electric service and business vehicles. With these internet services, charge spots can be monitored and serviced, drivers can find and reserve charge spots and the energy used can be invoiced. The software is already used in various projects around the world.

## **Internet services improve the cost efficiency of electromobility for company fleets**

eMobility internet services publicize charge spots for charging and topping up electric vehicles. Users in the

company, i.e. employees and drivers of company vehicles, have access to this information. Charge spots can also be made available to customers and other companies, to boost customer loyalty. The result is that more and more charge spots are announced, and the number of charging options rises – and is more widely distributed. The greater number of topping up stations provides e-cars with a larger action radius. At the same time, the overall costs of electromobility fall as the infrastructure is exploited more fully.

## **Complete solution for the electrification**

As well as internet services, together with qualified partners Bosch Software Innovations also offers complete solutions for the electrification of company fleets. This comprises electric vehicles, a charging infrastructure and its installation and maintenance, energy from renewable sources as well as eMobility internet services.



◀ Internet services can be accessed anywhere

The company's drivers, customers and partners can use the charging infrastructure ▶



# Joining forces for the environment:

## Cooperation with the automotive industry

Strategic cooperation for hybrid development



### Technology of the future



#### **Bosch winner of “Innovation” prize for PSA suppliers**

PSA Peugeot Citroën presented their “Suppliers’ Awards” for the seventh time in March 2011. Bosch won the coveted prize in the “Innovation” category for the Side View Assist system in the new Citroen C4 which provides better visibility in hazardous driving situations, as well as for the Hybrid4 technology in the Peugeot 3008, the world's first full hybrid diesel vehicle.



#### **Bosch honoured by US trade magazine Automotive News**

In 2011, the PACE Award (Premier Automotive Suppliers Contributions to Excellence) was presented to Bosch in Farmington Hills, America, for the P2 parallel full hybrid. In the P2 parallel full hybrid, the electric machine is integrated into the drive train by way of two clutches between the engine and transmission. This results in: An up to 25% reduction in CO<sub>2</sub> and fuel consumption.

### **Combined expertise promotes electric mobility**

Robert Bosch GmbH and Daimler AG have signed a contract to set up a joint venture under the name of EM-motive GmbH. This will enable all the expertise gained from years of experience to be invested in the development and manufacture of electric motors.

### **The target – to reach the million mark in eight years**

The idea behind the arrangement is to pool knowledge and abilities and so accelerate the development of high-grade electric motors. These traction units have been in use in Mercedes-Benz and smart electric vehicles since spring 2012, starting with the new smart fortwo electric. The prominent feature of the electric motors from the joint venture is their modular design: This enables Bosch to offer a broad range in various output categories – for electrically powered passenger cars, people carriers and even delivery vans. More than a million electric motors are planned by the year 2020.

# Service on hybrid vehicles: Easy with Diagnostics from Bosch



Safe and efficient: Service on hybrid vehicles



Test high voltage systems with the handheld FSA 050

## Full service in the workshop

Due to their reduced fuel consumption and CO<sub>2</sub> emissions, hybrid vehicles are all the rage. They can be seen on the roads and more frequently in workshops as customer vehicles. Normal workshop operations can still be carried out as before. However, the new powertrain technology and high voltage assemblies pose new challenges in terms of specialist knowledge and mechanics' skills. On a system that uses both combustion engine technology and electricity, diagnosis is therefore more complicated if little is known about the driving conditions. Even safe handling of the system with voltages up to 800 volts requires specialist knowledge. For motor vehicle workshops, the new technology offers an opportunity to become established as a skilled specialist centre in good time.

## Well equipped for the market of the future

Bosch can draw on a wealth of experience in the manufacture and development of hybrid components.

Workshops and their hybrid vehicle customers benefit from:

- ▶ Special test systems and extended ESI[tronic] 2.0 workshop software
- ▶ Well established know-how from practically-orientated training
- ▶ Competent service from the Technical Hotline

This equips the workshop well for service on modern hybrid vehicles. Not only does this affect familiar maintenance and repair measures on conventional vehicle components but also diagnosis of the hybrid system.

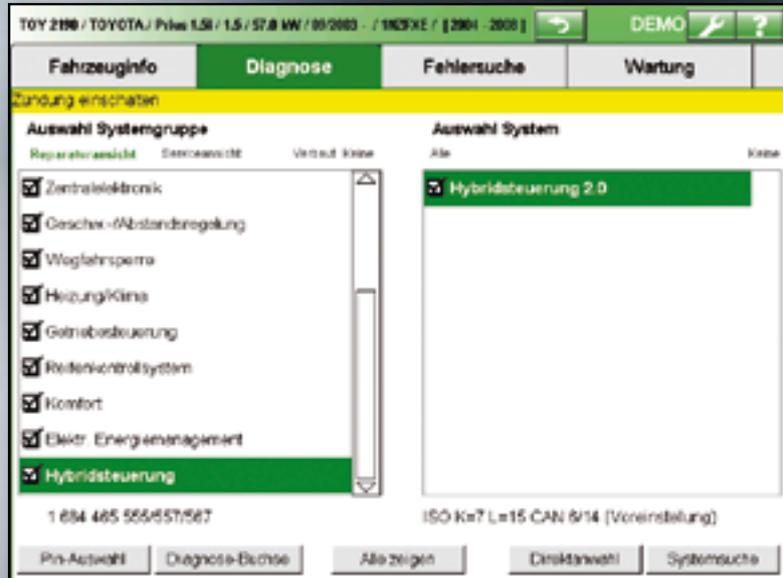
## Hybrid competence for the workshop

- ▶ Special diagnosis systems for high voltage systems: Hybrid tester FSA 050: Standalone or in combination with FSA 500 or FSA 7-series
- ▶ ESI[tronic] 2.0 enhanced with diagnostic software for hybrid vehicles
- ▶ Remote Diagnosis: Modern hotline support via the internet
- ▶ Special training on high voltage technology
- ▶ Targeted support from Technical Hotline on questions relating to hybrid vehicles

# Includes all the latest models:

## ESI[tronic] 2.0 – Diagnostic software for hybrids

Hybrid control  
(KTS 340)



### All the latest hybrid vehicles are already included into the ESI[tronic] 2.0 diagnostic software

The Bosch ESI[tronic] 2.0 workshop software covers all today's popular hybrid vehicle makes. Data is constantly being added for further vehicles, thus providing workshops with all the diagnosis options required for performing service work on hybrid vehicles as well.

### Rapid diagnosis – simple repair

- ▶ ESI[tronic] 2.0 provides full vehicle diagnosis: Control unit diagnosis (SD\*), trouble-shooting (SIS\*) and maintenance (M\*)
- ▶ New, intuitive screen concept with all information for quick and easy use
- ▶ Standard vehicle identification with integration of component repair instructions (K\*), work units (B\*), vehicle equipment (A\*) and convenience system circuit diagrams (P\*)

### New systems in ESI[tronic] 2.0

ESI[tronic] 2.0 provides efficient diagnosis for the new hybrid components. The following fault codes and actual values can be read out:

- ▶ Diagnosis for power electronics and electric motor
- ▶ Assessment of charging and discharging operations
- ▶ Assessment of battery as well as individual cells
- ▶ Assessment of operating statuses such as electric driving, boosting or recuperation

\*Code for the Info types in the ESI[tronic] 2.0 program



### ESI[tronic] 2.0 - the diagnostic software

- ▶ For all popular hybrid vehicle makes
- ▶ Constant updating of data to include further vehicle models
- ▶ All diagnostic options for performing service work on hybrid vehicles

# Competent insulation and high voltage test: Bosch FSA 050 and FSA 500



Competent insulation and high voltage test on high voltage systems in electric and hybrid vehicles – with handheld tester FSA 050

- ▶ Simple and safe use
- ▶ As standalone or special accessory

## Handheld FSA 050 for hybrid vehicles

New diagnosis instruments and functions have been developed by Bosch especially for diagnosis and service on hybrid vehicles. FSA 050 shows its strength on high voltage systems. The hand-held device can be linked wirelessly to the PC system or, optionally, to the FSA 500 or FSA 720/740/760 for documentation of the measurement results. Designed for quick use in the workshop, FSA 050 offers a means of testing insulation and high voltage on electric and hybrid drive systems as a standalone option.

### FSA 050: Quick, easy measurement

- ▶ High voltage and insulation tests
- ▶ Handheld unit with radio remote connection to PC system for documenting results
- ▶ Use as standalone unit or as special accessory for FSA 500 and units from FSA 7-series

## Measurement module FSA 500 – entry-level with all options

The new measurement module FSA 500 is ideal for all workshops looking for an economic and convenient solution for all standard diagnostic measures. As with the entire FSA 720/740/760 equipment series, it can be enhanced with handheld tester FSA 050 for testing on hybrid vehicles.

### FSA 500: Low cost basic measuring module

- ▶ Professional diagnosis on hybrid vehicles by enhancing equipment with FSA 050
- ▶ For all standard demands on electrical and electronics testing



### FSA 500 – All sensors included

- ▶ Inexpensive measurement module
- ▶ Simple operation
- ▶ Flexible handling on vehicle
- ▶ Convenient display of actual values from control unit diagnosis in conjunction with KTS module

# Hybrid vehicles – safe and sure:

## Service Training with practical orientation

Everything the workshop needs to know in terms of safe, efficient work on hybrid vehicles with high voltage systems (HV systems) – in practically-orientated Service Training from Bosch



### New training: High voltage systems (2 day)

The Service Training course “Safety procedures for specialist work on HV vehicles” is designed especially for motor vehicle mechanics, motor vehicle electricians, mechatronics technicians, bodywork and custom vehicle builders, mechanics for body repair technology and motor vehicle service technicians.

#### Authorization to perform service work on HV systems

Additional training course for work on inherently safe HV vehicles in service workshops. Authorized to isolate HV systems from power source and to work on HV components when isolated from power source.

#### Profit from comprehensive training course contents

Basic electrotechnical knowledge, alternative drive systems, HV vehicles, safety, protective measures, first aid, practical work on inherently safe HV vehicles.

### Hybrid vehicles: Working with high voltage

Hybrid is simply “a different world”. Not just in terms of diagnosis and maintenance work but also accident damage repair or simple engine compartment cleaning – on hybrid vehicles with high voltage systems, all of the safety specifications must be observed strictly and at all times. Find out what these are in the practically-orientated Service Training course from Bosch.

### Hybrid technology: Safety first

On the training course, experts provide workshop employees all of the important information about efficient and safe working on high voltage systems in a step-by-step manner. In addition to fundamental knowledge about electrotechnology and the functionality of hybrid vehicles, topics covering safety and protective measures are important elements of the course.



### Everything explained in detail

In theory and practice, participants discover how the complete HV system is isolated from the power source. For safe work on HV components.



# Hybrid problems – ask the expert: Know-how and Technical Hotline\*



Direct line to the Bosch hybrid experts: Workshops can obtain rapid assistance with diagnostic problems from the Technical Hotline

## Complex HV systems: Learn by doing

Course offer from 2011: With many practical “hands-on” exercises and demonstrations, intensive training is provided on the procedure for diagnosis and maintenance of the individual hybrid components: HV battery, wiring harness, inverter and electric motor. The way the electronic and conventional drive systems operate is a chief element of the training course. This prepares individuals exceptionally well for daily workshop operations.

## Professional training: Qualification for hybrid vehicles

On the Service Training course, employees are given fundamental and practically-orientated training that gives them the skills and qualification for all types of work on hybrid vehicles. This not only safeguards the working environment of the employees but also the projected success of the workshop.

## Hotline: Well prepared for new technology

Diagnosis and servicing tasks are becoming much more complex on hybrid vehicles. The interplay of two drive systems and having to carry out work in high voltage areas puts even well trained workshops on the spot sometimes. The specialists from the Technical Hotline know a great deal about hybrid systems and are quick to help with specific problems.

## Remote diagnosis: Quick glance over the shoulder

A new service from Bosch makes it possible: For difficult technical diagnoses, the hotline expert from Bosch will be able to offer support in the workshop with the aid of so-called remote diagnosis via the internet on the Bosch tester and perform the diagnosis on the vehicle in a supportive way.



- ▶ **Broad knowledge from development process:**  
Basis for practically-orientated training
- ▶ **Remote diagnosis**  
Hotline expert linked via internet for direct support



# Bosch: Bringing you the workshop of the future

For over 125 years, Bosch innovations have been keeping vehicles on the road and getting people to and from their destinations while improving safety and peace of mind along the way.

Bosch Automotive Aftermarket offers workshops and retailers a comprehensive portfolio of products that is unmatched worldwide:

- ▶ Efficient diagnostics
- ▶ Innovative workshop equipment
- ▶ Quick, reliable delivery
- ▶ The world's most comprehensive range of spare parts – including both new and remanufactured
- ▶ Workshop concepts to meet every requirement
- ▶ Comprehensive training
- ▶ Targeted sales and marketing support
- ▶ A competent service hotline
- ▶ 24-hour online workshop services
- ▶ Affordable leasing services for workshop equipment and software

From parts to scheduling, organization and results, our solutions are combined with additional services to ensure your needs will be perfectly met, helping you to maximize your potential.

## Workshop tip:

Hybrid vehicles offer new service opportunities. Completion of the Service Training course “Safety procedures for specialist work on HV vehicles” is essential to comply with the high safety standards required for working on high-voltage systems. Ask your Bosch Service Training Center for further information.

Your address for genuine Bosch quality:

For more information:  
[www.bosch.com](http://www.bosch.com)



## The world of Bosch:

- ▶ Diagnostics
- ▶ Diesel systems
- ▶ Gasoline systems
- ▶ Braking systems
- ▶ Spark plugs
- ▶ Energy systems
- ▶ Batteries
- ▶ Filters
- ▶ Wiper systems
- ▶ Lighting technology
- ▶ Comfort electronics
- ▶ Technical hotline
- ▶ Knowledge database
- ▶ Service training
- ▶ Workshop concepts

Technical changes and program modifications are reserved

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02.11.21

AA/MKI F 026 P02 651 / 201208



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