THE DRIVING FORCE BEHIND START-STOP.
INNOVATIVE START-STOP BATTERIES FROM VARTA.
Everyone’s talking about protecting our climate and reducing CO₂ emissions – topics that present the car industry with enormous challenges. From 2012, new EU regulations will not only reduce maximum levels of vehicle CO₂ emissions across Europe to 130 g/km, but will also increase the demands on vehicle batteries. That’s because meeting this target is going to take more than just improved engine management – innovative battery technologies are absolutely key.

This makes the issue of hybrid technology more relevant than ever before. Car manufacturers use the term “hybrid” to emphasise the eco-friendly characteristics of their vehicles. There are various types of hybrid technology such as micro hybrid (Start-Stop), mild hybrid and full hybrid. Of these, Start-Stop is set to become the most important. Start-Stop vehicles are forecast to represent 70% of all vehicles produced in Europe by 2015.

The car industry uses the term “micro hybrid”, amongst others, to describe Start-Stop technology.

So it makes perfect sense to be prepared for the future today – with VARTA Start-Stop and Start-Stop Plus batteries from Johnson Controls.
GEARED FOR THE FUTURE WITH JOHNSON CONTROLS.

As market leader, Johnson Controls is significantly involved in the development of a whole host of future technologies, from AGM through to lithium-ion technology – with the sole aim of providing car manufacturers with advanced batteries that help reduce CO₂ emissions and fuel consumption, and protect the environment as much as possible. Johnson Controls has been working closely with leading companies in this field for a number of years, including a joint venture with Saft. Johnson Controls-Saft is a leading global supplier of advanced hybrid battery systems: providing the lithium-ion battery systems for vehicles such as the Mercedes S-Class HYBRID and the BMW ActiveHybrid 7. The company Johnson Controls also provides the aftermarket with the latest technological developments through the supply of VARTA products. In this way, Johnson Controls helps its clients to save energy, reduce pollution and fuel consumption, and recycle more.
# CAR MANUFACTURERS’ FUTURE TECHNOLOGIES AT A GLANCE.

## Internal Combustion Engine
Conventional vehicles without Start-Stop features.

**Technology focus:**
- Includes biofuels, natural gas and diesel technologies
- Market shift to smaller vehicles and more efficient engines
- Weight reduction and improved aerodynamics

**Battery requirements:**
- Primary battery function is engine starting
- **Battery technology:** Predominately traditional lead-acid technology

## Start-Stop
With Start-Stop vehicles, the engine is switched off during short stops – for instance at traffic lights – in order to save fuel and to reduce CO₂ emissions by 5–10%.

**Technology focus:**
- Responding to CO₂ reduction targets set by EU
- Allows engine to be shut off instead of idling while the vehicle is stopped
- Nearly all vehicle manufacturers launching Start-Stop platforms in Europe

**Battery requirements:**
- Battery is required to start engine more frequently and provide energy for device support whilst in “stop” mode
- Battery is integrated within a sophisticated energy and battery management system
- **Battery technology:** Absorbent Glass Mat (AGM) and Enhanced Flooded Battery (EFB)

## Mild and Full Hybrid Vehicles
Alongside Start-Stop technology, an electric motor can be used that assists the internal combustion engine, for example on acceleration. Full hybrid is used in particular in luxury vehicles and SUVs as well as in markets without diesel technology in order to save fuel.

**Technology focus:**
- Significant reduction in both fuel consumption and CO₂-emissions
- Mild hybrid engine is always running, the battery is there to support the powertrain (engine) and devices during stop phases
- Full hybrid combustion and electric engines can operate independently

**Battery requirements:**
- Battery becomes part of powertrain supporting the engine
- **Battery technology:** nickel-metal hydride or lithium-ion

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Johnson Controls are the leading original-equipment supplier in this sector.

Johnson Controls-Saft are the first manufacturer of lithium-ion batteries to the automotive manufacturers and supply batteries for the Mercedes Benz S-class hybrid and BMW ActiveHybrid 7.
PLUG-IN ELECTRIC VEHICLE

A plug-in hybrid electric vehicle is a hybrid vehicle with rechargeable batteries that can be restored to full charge by connecting a plug to the electric grid – e.g. home recharging.

Technology focus:
- Has an electric motor and maybe an internal combustion engine
- Requires a battery with more energy and power
- Battery can be charged through standard outlet

Battery requirements:
- Battery is primary (or only) power source for vehicle
- Battery technology: lithium-ion

Johnson Controls-Saft is a global leader in advanced battery technology for hybrid, plug-in and electric vehicles.
START-STOP.
THE BASIC PRINCIPLES.

When the driver stops the vehicle and takes it out of gear, for example, at a red light or in slow traffic, the system switches the engine off. This reduces fuel consumption and CO₂ emissions.

The battery is then the sole source of power to all the car’s electrical devices, such as air conditioning, the radio and the satellite navigation system.

**START**
Battery starts the vehicle.

**STOPPING AND ENGINE OFF**
Whenever the vehicle comes to a stop at red lights or in a traffic jam, for example, and is put into neutral, the system switches off the engine, reducing fuel consumption and CO₂ emissions to zero.

**DRIVING ON**
When the driver presses down on the clutch pedal ready to pull away, the engine automatically restarts.

**Battery requirements:**
The battery supplies the car’s electrical devices such as air conditioning, the radio and the satellite navigation system on its own. The engine only runs when it’s absolutely necessary. Battery needs to be in a sufficient state of charge to enable “engine off”.

**Battery requirements:**
Battery must have sufficient energy to restart the engine.
VARTA START-STOP.

THE RIGHT POWER FOR ENTRY-LEVEL START-STOP FUNCTION.

VARTA Start-Stop batteries with EFB technology are perfect for vehicles with a standard, entry-level Start-Stop function. When the engine is switched off, they provide the vehicle’s electrical devices system with a reliable power supply and ensure that the engine restarts in a fraction of a second. Furthermore, they boast twice as much cyclic stability as conventional batteries and can be more discharged without any loss of functionality.

THE BENEFITS OF VARTA START-STOP AT A GLANCE:

- Optimised EFB (Enhanced Flooded Battery) Technology with “polyester scrim”
- Latest OE technology for standard entry-level Start-Stop vehicles
- Improved charge acceptance for recovering energy more quickly during driving phase
- Twice the cycle life of standard lead-acid starter batteries
- Spill-proof to 55°
- Good starting performance
- Longer lifespan
- Totally maintenance-free

THE CONSTRUCTION OF VARTA START-STOP BATTERIES WITH EFB TECHNOLOGY.

- EFB stands for “Enhanced Flooded Battery”
- Specially developed for standard entry-level Start-Stop vehicles
- EFB batteries come with an additional polyfleece “scrim” and thicker plates than conventional wet-cell batteries
- Use of special polyfleece “scrim” holds additional active material in the plate
- Enhanced cycle performance versus conventional flooded batteries
- Scrim material applies a uniform low contact pressure on the active mass
- This reduces the loss of active material
- Current vehicle models to feature the technology include the Fiat 500 Start-Stop version, the Toyota Yaris Start-Stop version and the Ford ECOncetic
The battery is the heart of the Start-Stop system, with vehicle manufacturers using a choice of two advanced battery technologies:

- VARTA Start-Stop Plus with AGM for cars with brake energy recuperation and other additional innovative fuel-saving technologies
- VARTA Start-Stop with EFB technology designed for entry-level Start-Stop vehicles
1. BATTERY: Special VARTA Start-Stop Plus with AGM Technology

2. ALTERNATOR: High-efficiency generator which converts the brake recuperation energy back into the battery

3. ENHANCED STARTER MOTOR: Enhanced Starter Motor for significantly more engine starts

4. ENERGY MANAGEMENT SYSTEM (EMS): Manages all the energy systems and controls all the energy and vehicle systems

5. CONSUMERS: The CO₂-reducing and fuel-saving technologies are entirely dependent on the battery’s ability to provide continuous energy to the vehicle’s electrical consumers while the engine and/or generator is switched off.

6. WHEEL SENSOR: Measures the speed of the car and informs the energy management system when it is OK to turn off the engine. Here, the battery must provide critical safety power to the vehicle steering and braking systems while the engine is off and until the vehicle comes to a complete stop.

7. INTELLIGENT BATTERY SENSOR: Determines the state of charge, the health of the battery and sends this information to the EMS.
VARTA START-STOP PLUS.

THE RIGHT POWER FOR ADVANCED START-STOP FUNCTIONS.

VARTA Start-Stop Plus batteries are the perfect solution for vehicles featuring advanced Start-Stop technology with regenerative braking and additional fuel-saving technologies. Only the specially developed VARTA Start-Stop Plus batteries with AGM technology can meet the challenges imposed by these systems. Compared to VARTA Start-Stop batteries, VARTA Start-Stop Plus batteries offer even greater performance and versatility, and are capable of reliably supplying power to an even greater range of devices.

THE BENEFITS OF VARTA START-STOP PLUS AT A GLANCE:

- Innovative AGM Technology (Absorbent Glass Mat) with high-compression fleece separator
- Latest OE technology for advanced Start-Stop vehicles
- Has at least three to four times more cycle life and can meet the demands of all Start-Stop vehicles and high-end luxury vehicles
- High charging acceptance for absorbing large surges of electrical energy generated via brake energy recuperation
- 100% leak-proof and spill-proof to 360°
- Excellent starting power, so you can rely on the engine starting – even at a low state of charge
- Longer lifespan
- Totally maintenance-free

THE CONSTRUCTION OF VARTA START-STOP PLUS BATTERIES WITH AGM TECHNOLOGY.

- AGM stands for Absorbent Glass Mat
- AGM technology, with its Absorbent Glass Mat, is the most advanced development of lead technology
- The electrolyte is held permanently in the glass fleece separator and exerts a uniformly high contact pressure on the active mass
- This significantly reduces loss of active mass to an absolute minimum
- This technology does not suffer from acid stratification – the main failure mode in these applications
- Highest performance, extreme cycle life and spill-proof
- The perfect solution for vehicles with Start-Stop technology, brake energy recuperation and further fuel-savings technologies, e.g. BMW EfficientDynamics, VW BlueMotion
START-STOP PLUS.
FOR VEHICLES WITH START-STOP TECHNOLOGY WITH REGENERATIVE BRAKING AND ADDITIONAL FUEL-SAVING TECHNOLOGIES.

Whenever Start-Stop technology is used in conjunction with additional systems such as regenerative braking, an advanced energy management system, or passive boost, increased demands are placed on the battery. Situations like these call for VARTA Start-Stop Plus with AGM Technology. This plays a significant role in making sure the various Start-Stop systems all run smoothly and ensure maximum reduction in fuel consumption and CO₂ emissions.

**DRIVING & ACCELERATING**

An advanced energy management system decouples the alternator during acceleration and under normal driving conditions. This means more of the engine’s power is available to the wheels. The alternator is only recoupled again when the battery’s state of charge falls below a predefined threshold.

**Battery requirement:**
Battery is being discharged and charged and must supply all electronic devices on its own.

**BRAKING**

Regenerative braking allows the vehicle’s kinetic energy partially to be converted into electrical energy, which is then fed back into the battery.

**Battery requirement:**
The battery needs to be recharged quickly and have sufficient capacity for the additional energy. The battery must be capable of functioning at a lower state of charge.

**STOP AND ENGINE OFF**

The vehicle comes to a stop and the Start-Stop System switches off the engine.

**Battery requirement:**
Even when discharged, the battery must still supply the starter motor generator with sufficient starting power to start the engine again.
### Comparison of the Different Battery Systems

<table>
<thead>
<tr>
<th>Energy Flow</th>
<th>Energy Flow</th>
<th>Energy Flow</th>
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</thead>
<tbody>
<tr>
<td>Start-Stop Plus Battery</td>
<td>Start-Stop Battery</td>
<td>Conventional Battery</td>
</tr>
</tbody>
</table>

#### Expert Advice from VARTA:

Vehicles with Start-Stop technology require specific Start-Stop batteries. The wrong battery not only impairs the Start-Stop function with environmental consequences, but also reduces the service life of the battery itself. Tests have shown that conventional flooded batteries lose between 7 and 16% of their available capacity after just one week of being used in an automatic Start-Stop vehicle.

<table>
<thead>
<tr>
<th>Primary Function</th>
<th>Start-Stop Plus Battery</th>
<th>Start-Stop Battery</th>
<th>Conventional Battery</th>
</tr>
</thead>
<tbody>
<tr>
<td>High number of engine starts</td>
<td>High number of engine starts</td>
<td>Engine Starting</td>
<td></td>
</tr>
<tr>
<td>Extended “engine off” period</td>
<td>Limited “engine off” period</td>
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<table>
<thead>
<tr>
<th>Start-Stop Technologies</th>
<th>Start-Stop Plus Battery</th>
<th>Start-Stop Battery</th>
<th>Conventional Battery</th>
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<tbody>
<tr>
<td>Engine Start-Stop</td>
<td>Engine Start-Stop</td>
<td>None</td>
<td></td>
</tr>
<tr>
<td>Plus brake energy recuperation</td>
<td>Plus passive boost</td>
<td></td>
<td></td>
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<tr>
<td>Advanced Energy Management System</td>
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<table>
<thead>
<tr>
<th>Cycling Ability</th>
<th>Start-Stop Plus Battery</th>
<th>Start-Stop Battery</th>
<th>Conventional Battery</th>
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<tbody>
<tr>
<td>Extreme/+350%</td>
<td>Enhanced/200%</td>
<td>Standard/100%</td>
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<tr>
<th>CO₂ Savings</th>
<th>Start-Stop Plus Battery</th>
<th>Start-Stop Battery</th>
<th>Conventional Battery</th>
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</thead>
<tbody>
<tr>
<td>High*/approx. 5–10%</td>
<td>Moderate* approx. 2–5%</td>
<td>none</td>
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</table>

<table>
<thead>
<tr>
<th>Fuel Savings</th>
<th>Start-Stop Plus Battery</th>
<th>Start-Stop Battery</th>
<th>Conventional Battery</th>
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<tbody>
<tr>
<td>High*/approx. 5–10%</td>
<td>Moderate* approx. 2–5%</td>
<td>none</td>
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<table>
<thead>
<tr>
<th>Battery Technology</th>
<th>Start-Stop Plus Battery</th>
<th>Start-Stop Battery</th>
<th>Conventional Battery</th>
</tr>
</thead>
<tbody>
<tr>
<td>AGM (Absorbent Glass Mat)</td>
<td>EFB (Enhanced Flooded Battery)</td>
<td>Traditional lead-acid battery</td>
<td></td>
</tr>
</tbody>
</table>

*Based on the vehicle’s Start-Stop System
TOP PERFORMANCE – WHATEVER THE APPLICATION.

VARTA Start-Stop Plus batteries are designed to meet the highest energy requirements, i.e. in vehicles such as taxis and ambulances. For short journeys, journeys with frequent stops or high consumption whilst the vehicle is stationary, VARTA Start-Stop Plus batteries deliver constant power, maximum energy supply and optimum starting performance.

THE ADVANTAGES AT A GLANCE:
- OE specifications for high performance and luxury vehicles
- Specially designed for extreme power demands
- Extra long service life
- Totally maintenance-free
- Spill and leak-proof

PERFECT FOR:
- Police/emergency vehicles
- Taxis
- High-end luxury cars
- High-performance cars
- Executive class vehicles with high equipment levels
- Start-Stop vehicles
- Hybrid vehicles (12V)
VARTA. THE DRIVING FORCE BEHIND START-STOP.

Whatever the future of Start-Stop vehicles brings, you’ll be able to rely on VARTA. 80% of car manufacturers already place their trust in VARTA, and with good reason. That’s because they know that only VARTA possesses the knowledge and technological expertise to prepare their cars for the future of motoring.
SUPPLIER OF 80% OF ALL BATTERIES FITTED TO NEW START-STOP VEHICLES.

In close partnership with leading vehicle manufacturers like Audi, BMW, Ford, Mercedes-Benz, Volvo and VW, VARTA has developed innovative battery solutions to support Start-Stop systems. That’s why at VARTA, we have years of experience of working with leading manufacturers.

OE CONTRACTS AT A GLANCE

- AUDI e
- BMW EfficientDynamics
- FORD ECOncetic
- GM ecoFLEX
- HYUNDAI Blue Drive
- KIA EcoDynamics
- Land Rover E
- Mercedes-Benz BlueEFFICIENCY
- MINI MINIMALISM
- SEAT Ecomotive
- SMART micro hybrid drive
- Volvo DRIVe
- VW BlueMotion

VARTA. The driving force behind Start-Stop.
THE VARTA START-STOP PLUS AND VARTA START-STOP BATTERY RANGE.

VARTA START-STOP PLUS WITH AGM TECHNOLOGY

<table>
<thead>
<tr>
<th>VARTA code</th>
<th>Short code</th>
<th>Capacity (C20)</th>
<th>CCA (EN)</th>
<th>Layout</th>
<th>Terminal</th>
<th>Dimensions (mm)</th>
<th>Hold-down</th>
<th>Weight (kg)</th>
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<td>560 901 068</td>
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<td>60</td>
<td>680</td>
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<td>760</td>
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<td>096AGM</td>
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<td>80</td>
<td>800</td>
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VARTA START-STOP PLUS WITH EFB TECHNOLOGY

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<td>315 175 190</td>
<td>B13</td>
<td>21.3</td>
<td>115EFB</td>
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</tbody>
</table>

TECHNICAL INFORMATION:

![Diagram of battery terminal and hold-down](image)

Johnson Controls Batteries Ltd.
Broadwater Park
North Orbital Road
Denham
Uxbridge, Middlesex
United Kingdom
Tel: ++44 (0)1895 838991/93
Fax: ++44 (0)1895 838981
www.varta-automotive.com

Johnson Controls Autobatterie GmbH
Export
Am Leineufer 51
Germany - 30419 Hannover
Tel.: +49 (0) 511 975 - 0
Fax: +49 (0) 511 975 - 1544
E-Mail: export@varta-automotive.com
www.varta-automotive.com

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