

Unique strategies for smoother auto start-stop control yield more than 25 patent applications for Ford

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2013 Ford Fusion

In the quest to deliver better fuel efficiency for millions of drivers, Ford engineers have more than 25 patents pending for the \$295 Auto Start-Stop on the all-new 2013 Ford Fusion. The best technology improves your life by doing its job effectively and then getting out of the way.

“We set out to make [Auto](#) Start-Stop in the 2013 Fusion as seamless to drivers as possible,” said Birgit Sorgenfrei, [Ford](#)’s Auto Start-Stop program manager. “We wanted the system to improve [fuel efficiency](#) but otherwise remain transparent, so we developed a number of unique control strategies to smooth out the performance.”

The ability to shut down the engine when the car isn't moving has always been one of the most popular features of hybrid vehicles and it will be available on the new Fusion with the 1.6-liter EcoBoost four-cylinder engine.

At its most basic level, Auto Start-Stop switches off the engine when the car stops and instantly restarts it when the driver releases the brake pedal. Scratch below the surface though and there is actually a lot more going on. Auto Start-Stop engineering supervisor Kirk Pebley and his team have filed more than 25 patent applications for innovations developed in the electronic control strategy.

Until now, most non-hybrid vehicles with Auto Start-Stop have only been available with manual transmissions, but American drivers overwhelmingly opt for automatic transmissions. The new Fusion is the first Ford vehicle to offer Auto Start-Stop with a self-shifting gearbox. Since an automatic transmission needs to maintain internal hydraulic pressure even with the engine off, Ford added an electrically driven pump to the transmission along with the upgraded starter motor and the absorbed glass mat battery.

The challenge of combining Auto Start-Stop technology with an automatic transmission went beyond just adding the electric pump. In order to minimize launch delays after a restart, the engineers wanted to keep the transmission in gear even with the engine off as opposed to shifting it into neutral.

“We had to develop some unique control algorithms for the engine and transmission to overcome this obstacle and still ensure an extremely quick, smooth and quiet restart,” said Sorgenfrei.

“As the vehicle slows down, the brains of Auto Start-Stop are already hard at work even before the Fusion comes to a standstill,” said Pebley.

“One of many keys to getting a robust engine restart is to make sure the battery has enough power to spin it back up.”

The control software includes a simulation model of the electrical system that constantly monitors the accessory loads. The model factors in the current draw from features like headlights, climate control, audio system and window defoggers to predict how much power will be available with the engine off and how fast the battery will drain. If the electrical load is demanding too much from the battery, Auto Start-Stop may be disabled to prevent a rough restart or being stuck with a flat battery.

Voltage blending is another feature the United States Patent and Trademark Office is now evaluating. While the engine is running, the alternator produces about 14 to 15 volts, but the battery only produces 12 volts with a full charge. When the Fusion is slowing down with Auto Start-Stop enabled, the load model tracks the vehicle speed and deceleration and then calculates when to ramp down the voltage from the alternator to the battery-only level before the Fusion stops. This blending helps to ensure the driver doesn't experience any light dimming or sudden fluctuations in ventilation fan speed.

The Auto Start-Stop team has filed several patent applications related to the sophisticated signal monitoring and controls for the climate control system. On hot summer days, the sun's energy can heat up a car interior within minutes, quickly making things uncomfortable for the driver and passengers. In addition to the cabin temperature and humidity, Auto Start-Stop monitors the temperature of the evaporator core that starts to rise before the occupants even feel a change inside the car. When this happens, the engine will restart sooner, enabling cooler heads to prevail.

No matter what type of propulsion system moves a vehicle, driver behavior plays a big part in determining ultimate efficiency. A better-informed driver can make smarter choices that help save dollars at the

gas pump. When the current-generation Fusion Hybrid debuted in 2009, the innovative SmartGauge instrument cluster provided drivers with an unprecedented degree of information about energy use in the vehicle.

“When Auto Start-Stop is disabled because of a high accessory load, we wanted drivers to understand why so that they could opt to switch some things off if it’s appropriate,” said Pebley. “If the rear defrost is still on but the window is clear, they can switch it off to gain the efficiency benefit of shutting down the engine when the car stops.”

The 2013 Fusion with Auto Start-Stop is unique in providing this sort of coaching on non-hybrid vehicles.

“Smart decisions are born from having more complete information,” said Sorgenfrei. “Whether it’s the messages we provide to drivers or the dozens of signals that help the control system look ahead in time, the 2013 Fusion Auto Start-Stop helps drivers save on gas without getting in the way.”

Ford is bringing this capability found on German luxury cars costing tens of thousands of dollars more to the Fusion for just \$295. Best of all, even though drivers might not feel it working, the fuel savings of up to 10 percent can save up to \$1,100 compared to other midsize sedans over five years of driving.

Provided by Ford Motor Company

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