
THE HYBRID BONUS

Daniel W. Parker
Enerpulse, Inc.
www.pulstar.com
505-999-2002



Over a million Americans have purchased hybrids.

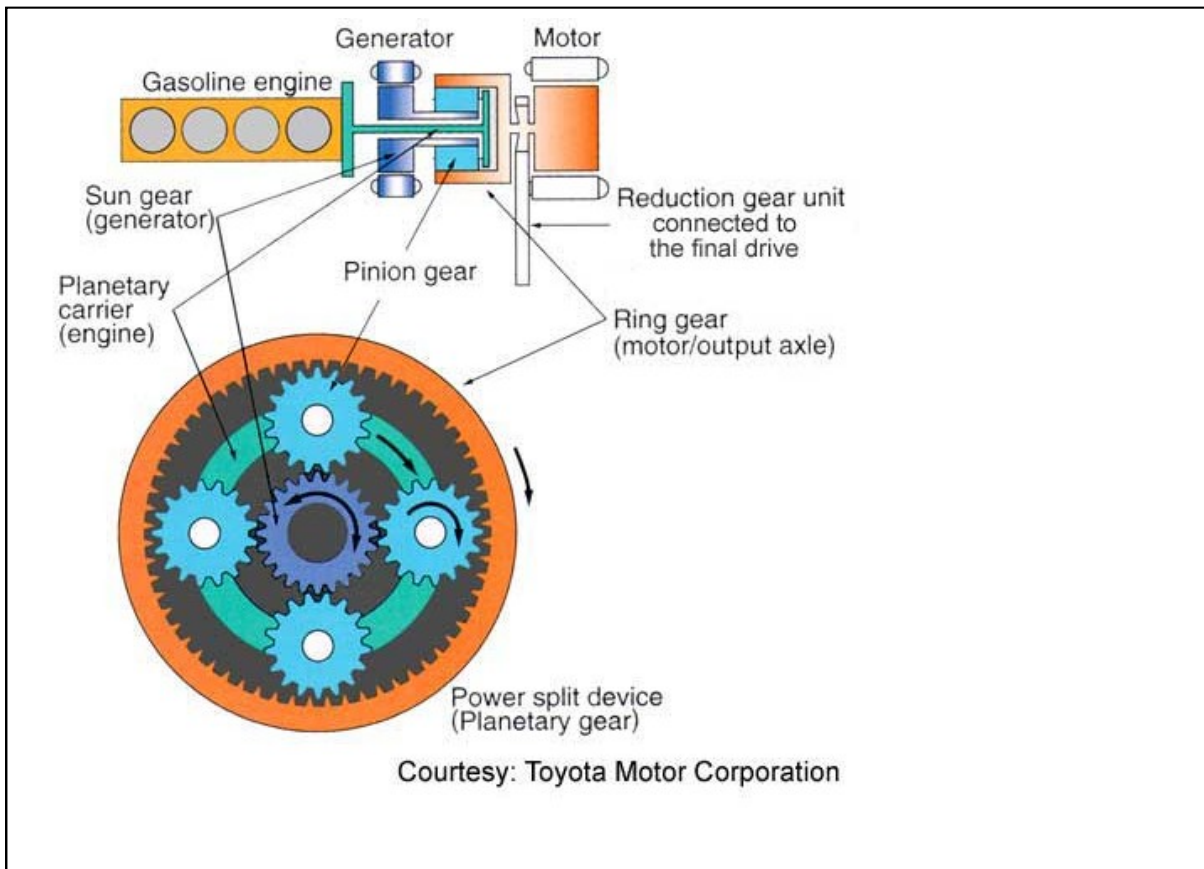
Hybrid cars are starting to make their way into the lexicon of the motoring public. Almost everyone knows that they are powered by a battery and an internal combustion engine and that somehow these two power sources cooperate to produce the hybrid's 40+ mile per gallon fuel economy. This is why over 1 million hybrids have been sold to American drivers who appreciate its fuel savings and a whole new driving experience as well.

HYBRIDS ARE DIFFERENT

One of the key differences in driving a hybrid versus most other cars is it doesn't seem to shift normally. That is to say its transmission doesn't have the normal gear shift points of traditional cars. In fact, shifting is an uneventful

experience leaving many hybrid owners wanting to control the machine with the usual clutch and shifter knob to manually shift their transmissions. Hybrids do this differently with a mechanical device developed by Leonardo da Vinci in 1490 called the stepless, continuous variable transmission or as it is called today the CVT (continuous variable transmission).

CVTs, instead of the 4, 5 or 6 gears typical of conventional transmissions, generate an infinite number of gear ratios seamlessly transitioning from one to the other with no hint of “shifting.” The goal of a CVT is to provide better fuel economy than other transmissions by enabling the engine to run at its most efficient revolutions per minute (RPM) for any range of vehicle speeds. So hybrids, thought to be efficient only for their combustion/electric motor combination, have another benefit to the consumer: the CVT.

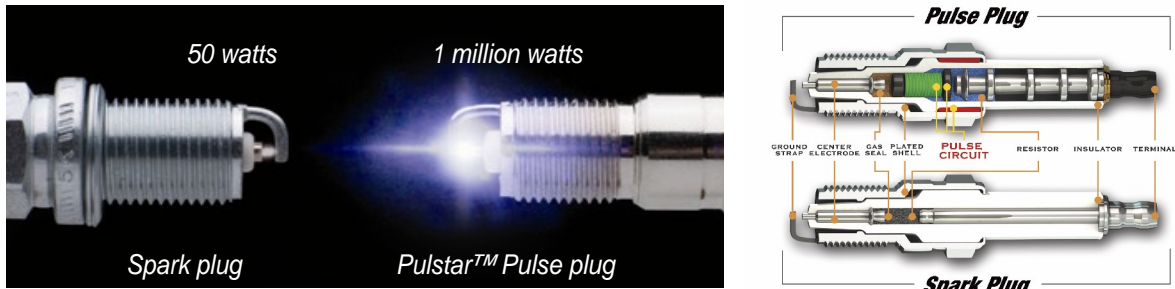


Continuous variable transmissions (CVTs) provide better fuel economy.

CVT equipped vehicles like the Toyota Prius, make ideal test candidates for evaluating performance enhancing aftermarket products. This is because any addition of torque to the engine will tend to reduce engine RPM directly reducing fuel consumption. Under acceleration, the effect of increased torque is multiplied because the engine operates at its peak performance RPM at wide open throttle allowing even small changes to be noticeable when measuring performance. This was confirmed in a series of tests conducted by Albuquerque, NM-based Enerpulse, Inc. whose new pulse plug technology branded, Pulstar™, has demonstrated significant results on CVT equipped vehicles.

PULSE PLUGS ARE DIFFERENT TOO

Pulse plugs are the first real breakthrough in spark plug technology in over 120 years. They look and fit like spark plugs, but contain an integrated electrical device called a capacitor. The capacitor boosts the energy of the spark much the same way a camera flash boosts light. Instead of just 50 watts of peak power typical of all spark plugs, pulse plugs generate up to 10 times more power. The resulting robust spark ignites fuel more efficiently liberating more torque from the engine.



Pulse plugs have 10 times the power of spark plugs.

Tests conducted at Enerpulse, Inc. demonstrate this capability. Two Toyota Prius hybrids, model years 2005 and 2007, were tested on a chassis dynamometer utilizing the Environmental Protection Agency's (EPA) US06 drive cycle, fuel economy protocol. Both vehicles were first tested with the

automaker's recommended spark plug and then with Pulstar™ model BE1 pulse plugs. To measure actual fuel flow, both vehicles were equipped with a digital flow meter with a resolution of 1/42,000th of a gallon.

The pulse plug improvement was quite dramatic and surprising for vehicles that are already designed for maximum fuel efficiency. The 2005 Prius fuel economy



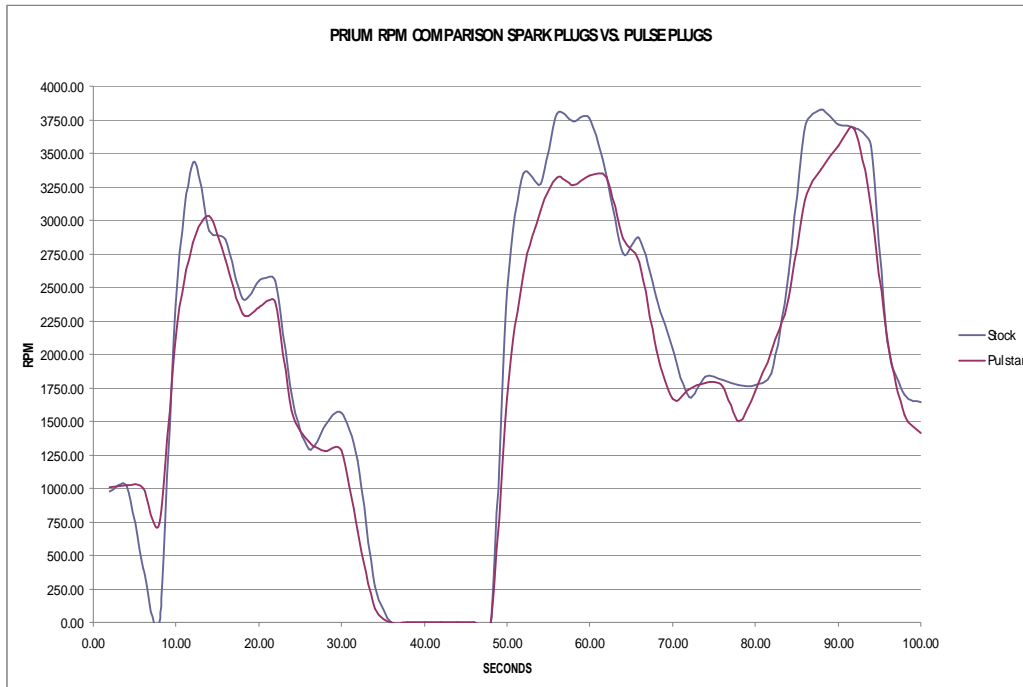
EPA testing procedures on a chasis dynamometer.

was improved by 6.7% while the 2007 Prius jumped by 8.8%. It was also noted that horsepower and torque increased by as much as 3.6%.

To verify the Prius results, Enerpulse also tested a 2008 Toyota Camry hybrid equipped with a CVT. The Camry has a slightly larger combustion engine than the Prius, but generated similar results of 6.2% improvement in fuel economy as compared to the stock spark plug.

CVT AND PULSTAR™ WORKING TOGETHER

Pulstar™ works with the CVT to reduce RPM as compared to the factory installed spark plugs for selected conditions in the US06 driving cycle. During aggressive acceleration the vehicle speed is achieved with lower RPM indicating the presence of the additional torque from Pulstar™ as recognized by the CVT (see chart below). Of course, lower RPM for a given speed translates into much better fuel economy, in this case an additional 4.5 miles per gallon. These are fairly impressive gains for a \$100 Pulstar™ investment.



Lower RPM (fuel consumption) is achieved with pulse plugs.

CVTs are becoming more and more popular, but they don't all work the same way. Some, like the Prius, sacrifice power for fuel economy while others like the Honda Civic hybrid are able to capture both. Recent Pulstar™ tests on a 2006 Civic hybrid only generated a 4% improvement in fuel economy, but generated a whopping 15% increase in horsepower as compared to stock spark plugs. Horsepower improvements of this magnitude make the Civic a lot more fun to drive.



Mitsubishi Lancer - CVT's are not limited to hybrids.

The use of CVTs is not limited to hybrids either. Several regular, non-hybrid vehicles have discovered the advantages of the CVT for fuel economy. One such vehicle, a 2008 Mitsubishi Lancer, fitted with Pulstar™ converted virtually all of the additional Pulstar™ torque into a stunning 12.5% fuel economy gain.

PULSE PLUGS VS. OE SPARK PLUGS					
% INCREASE					
MOEDL YEAR	MANUFACTURER	MODEL	ENGINE LITERS	FUEL ECONOMY	HORSEPOWER
2005	Toyota	Prius Hybrid	1.5	6.7	3.6
2007	Toyota	Prius Hybrid	1.5	8.8	1.4
2008	Toyota	Camry Hybrid	2.4	6.2	0.0
2006	Honda	Civic Hybrid	1.3	4.1	15.1
2008	Mitsubishi	Lancer	2.0	12.6	0.0

Surprising economy gains for vehicles already very efficient.

Pulstar™ is a simple and inexpensive method to increase fuel economy on most types of vehicles. CVTs, whether in hybrids or not, reduce inefficient driving habits that often negate technology benefits while directly transferring newly found engine torque produced by pulse plugs into lower RPM and subsequent fuel economy. Just when you thought hybrids couldn't get any more efficient, the combination of the CVT and Pulstar™ present you with even greater fuel economy.

