September 2009

MY10 VE and WM

PRODUCT INFORMATION

3.0L and 3.6L SIDI V6 Engines

Overview

The Global V6 engine family was launched by General Motors in 2003 to fulfil its strategy to build a new generation of engines for flexible worldwide application in premium and high-performance vehicles.

Today GM Powertrain's all-alloy 60-degree double overhead cam (DOHC) Global V6 engines power a variety of vehicles around the world.

GM Holden is a producer as well as a user of Global V6 engines. In 2003 its newly commissioned $400 million Port Melbourne V6 engine plant began building Global V6 engines for export. In August 2004 Alloytec Global V6 engines were introduced to the Australian market with the Holden VZ Commodore and WL Caprice and Statesman model ranges.

The latest evolution of the Global V6 is the **S**park **I**gnition **D**irect **I**njection SIDI V6; which offers advanced direct combustion chamber fuel injection.

Like its predecessor, the SIDI V6 applies highly developed engine technologies such as state-of-the-art casting processes, full four-cam phasing, ultra-fast data processing and torque-based engine management.

GM Holden engineers jointly assisted in the architectural development of the SIDI V6 with colleagues from GM technical centres in North America and Germany.

The 3.0L and 3.6L SIDI V6 engines introduced with the MY10 Holden Commodore, Berlina, Calais, Sportwagon, Ute, Statesman and Caprice model ranges combine with smooth-shifting six-speed automatic transmission and dual exhaust specified as standard*.

They deliver a balance of improved operating refinement with first-rate noise and vibration control, good specific output, high torque over a broad rpm band, fuel economy and low emissions, exclusive durability-enhancing features and very low maintenance.

(*excepting Omega Ute)

Development

Introduction of the advanced new powertrains required an intensive engineering development and localisation program in order to meet rigorous all-round performance and durability objectives.

GM Holden's V6 Powertrain Engineering team devoted more than 30 months to complex calibration work, clocking up more than 1.1 million test kilometres and nearly 11,000 engine dynamometer hours in the process. A further 300,000 kilometres were expended on full systems integration and component durability testing.

Feature highlights; 3.0L SIDI V6 (LFI) and 3.6L SIDI V6 (LLT)

- Advanced multi-point fuel injectors for direct injection into the combustion chamber
- High-pressure engine-driven fuel pump for multiple injection events
- Cam phasing coupled with direct injection further reduces exhaust emissions
- High power and high efficiency 11.7:1 compression ratio for the 3.0 litre SIDI and 11.3:1 compression ratio for the 3.6 litre SIDI.

Advanced multi-outlet fuel injectors for direct combustion chamber fuel injection

Conventional port-injected engines inject fuel upstream of the intake valve into the intake port and this fuel and air mixture enters the combustion chamber when the intake valve opens. On the direct-injection V6 engines, fuel is injected directly into the combustion chamber during the intake stroke, at which time only air flows through the intake system and into the combustion chamber when the intake valve opens.

During the subsequent compression stroke, the fuel and air mixture now in the combustion chamber is ignited conventionally by the spark plug. As the fuel vaporises in the cylinder, the air and fuel mixture is cooled.

This enables the use of a higher compression ratio in the combustion chamber, which improves engine performance and efficiency. Less fuel is required to produce the equivalent power, especially at normal cruising speeds, of a conventional port-injection combustion system. Also, the use of unique pistons with the direct-injection system helps reduce cold-start hydrocarbon emissions.

The special injectors that inject fuel directly into the combustion chamber are located beneath the intake ports, which transfer only air. Because the ports are not used to mix the fuel and air, efficiency of the air flow is increased.

In addition, the accuracy in which the fuel can be injected through special direct injectors is greater, resulting in better fuel consumption at all throttle openings and better mixture control which allows higher compression. The higher compression ratio also increases combustion efficiency over a conventionally injected engine.

The special direct injectors have been developed to withstand the greater heat and pressure inside the combustion chamber. They also utilise multiple outlets for best injection control.

High pressure engine-driven fuel pump for multiple injection events

To overcome higher pressures inside the combustion chamber and to supply the multiple injection points of the direct injection nozzles, an engine-driven high pressure pump supplies fuel to the injectors.

This high pressure pump feeds a high strength fuel rail that in turn feeds a continuously variable pressure fuel rail attached to the injectors. Driven by the exhaust cam, it is mounted on the end of the cylinder head and supplied by a conventional pump mounted in the fuel tank.

3.0L SIDI fuel pump pressures are controlled between 2 and 15MPa, based on operating conditions, and 3.6L SIDI pressures are controlled between 3.8 and 12MPa, based on operating conditions. For example, at idle the fuel system is regulated to about 508 psi (35 bar) and increases with demand.

The engine management system uses a new controller to drive the new high pressure fuel injectors and the fuel pump and to provide software and calibration capability to fully utilise the capabilities of the hardware.

Cam phasing coupled with direct injection further reduces exhaust emissions

Cam phasing pays big dividends in reducing exhaust emissions by optimising exhaust valve overlap and eliminating the need for a separate exhaust gas recirculation (EGR) system.

By closing the exhaust valves late at appropriate times, the cam phasers allow the engine to draw the desired amount of exhaust gas back into the combustion chamber, reducing unburned hydrocarbon emissions.

The return of exhaust gases also decreases peak temperatures and contributes to the reduction of oxides of nitrogen (NOx) emissions.

Engine Control Module

SIDI V6 engines are managed by advanced new Engine Control Modules which employ torque-based control strategies and include special drivers to operate the higher voltage direct injectors.

Management functions include:

- Cam phasing
- Electronic throttle control – for traction control and ESP.
- Returnless fuel injection system with injection and spark timing adjustments for various grades of fuel.
- Limp-home mode. If sensor systems fail, the ECU continues to control ignition timing based on data from the functioning sensors and advises the driver with a warning light. It also provides coolant loss protection, allowing the SIDI V6 to operate safely at reduced power so the driver can reach a secure location.

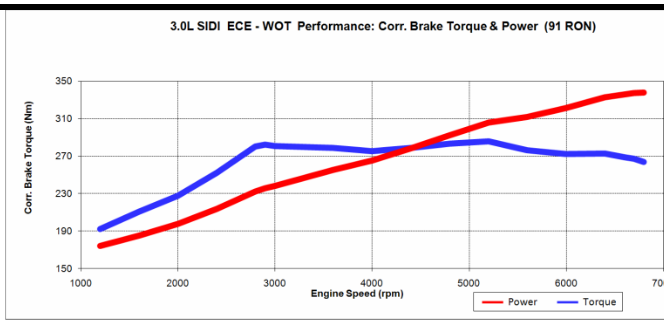
Cylinder heads and mass reduction

New-design A319 aluminium alloy cylinder heads accommodate higher compression ratios, direct injectors and high-pressure fuel pump.

The 3.0L SIDI engine utilises an intake manifold of lightweight composite material and an integrated exhaust manifold which eliminates the need for a separate component.

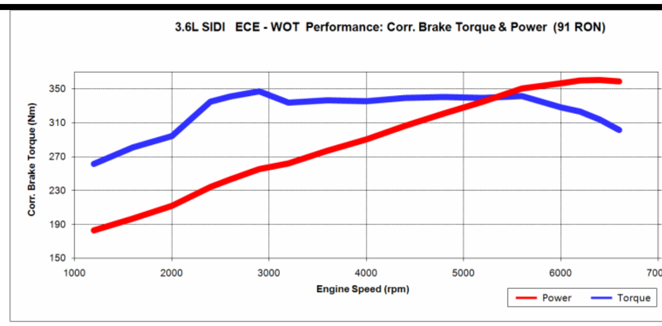
Benefits include mass reduction for improved fuel economy and reduced emissions due to faster catalytic converter light-off. (The 3.6L SIDI engine retains the Alloytec cast iron external manifold).

Power and Torque



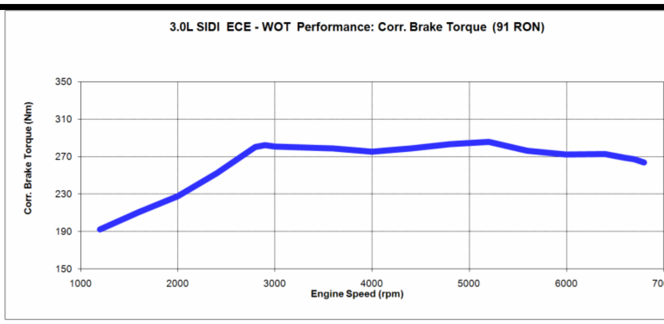
Power & Torque Curve – 3.0L V6 SIDI
Max power @ 6700 RPM (190kW)

Max torque @ 2900 RPM (290Nm)

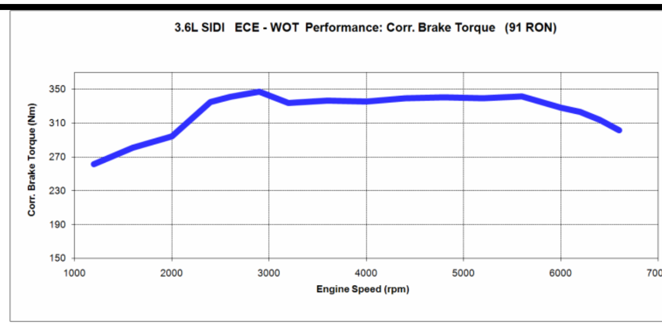


Power & Torque Curve – 3.6L V6 SIDI
Max power @ 6400 RPM (210kW)

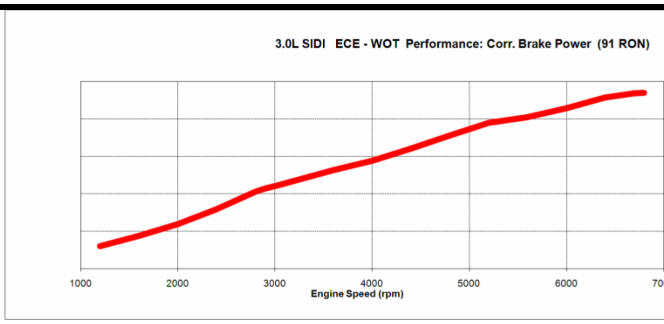
Max torque @ 2900 RPM (350Nm)



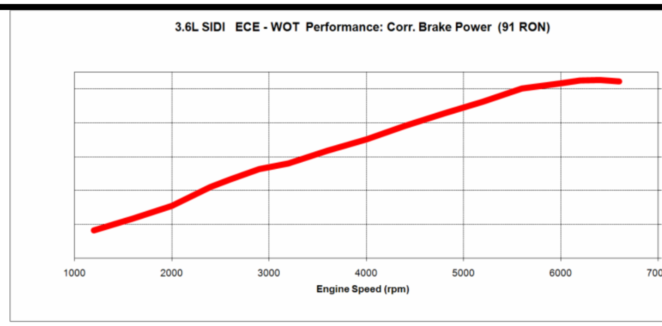
Torque Curve – 3.0L V6 SIDI
Max torque @ 2900 RPM (290Nm)



Torque Curve – 3.6L V6 SIDI
Max torque @ 2900 RPM (350Nm)



Power Curve – 3.0L V6 SIDI
Max power @ 6700 RPM (190kW)



Power Curve – 3.6L V6 SIDI
Max power @ 6400 RPM (210kW)

HOLDEN

MY10 VE and WM

PRODUCT INFORMATION

MY10 6L50 six-speed automatic transmissions

The 6L50 is the second variant chosen by Holden from GM Powertrain's six-speed automatic transmission family. It benefits from expertise developed with the larger 6L80 rear-wheel drive six-speed transmission introduced on GM Holden's V8-engined VE and WM models in 2006.

Compared with a conventional four-speed automatic, advantages of a six-speed include improved fuel economy and performance coupled with a seamless shift feel.

The 6L50 six-speed enhances performance because smaller 'steps' are used between gears, allowing the transmission to quickly select the gear most suited to vehicle speed and road conditions.

It features advanced electronic controls and a gearset configuration that enables a wider range of ratios compared to previous automatic transmissions.

The GM Powertrain six-speed automatic transmission family is designed to accept different engines and different mounting locations and mates to transfer cases for all-wheel-drive capability. Its modular concept reflects requirements for common components and manufacturing tooling among variants.

Advanced operation

The 6L50 uses technically advanced clutch-to-clutch operation which reduces complexity and enables compact packaging

Gear changes from second to sixth gear ratios are accomplished with the clutch-to-clutch action, where an 'oncoming' clutch is engaged and an 'offgoing' clutch is released in a precise manner to achieve the ratio change.

The first-to-second upshift is a freewheeling action, where the second gear clutch engages while the first gear one-way clutch spins freely, allowing a greater degree of smoothness at lower vehicle speeds.

There are three gear sets: a simple input planetary gear set, and two output gear sets, one of which is a compound gear set with three pairs of two pinion gears on the output carrier, one pair meshing with the sun gear and the other with the ring gear. The arrangement allows for optimal ratio steps with the 6.03:1 overall spread.

Adaptive shift controls

Available control features are:

- Multiple shift patterns (full auto, sport auto, tap up/ tap down and cruise)
- Driver Shift Control - tap up/tap down allows the driver to shift the transmission like a clutchless manual gearbox.
- Performance Mode Lift Foot - detects sporty driving and either holds gear or selects a lower gear.
- Reverse Lockout
- Automatic grade braking - recognises long downgrades and selects a lower gear.
- Altitude and temperature compensation.

Transmission Control Module (TCM)

The 32-bit TCM is located inside the transmission, protecting it against harsh environmental conditions.

It monitors transmission performance and compensates for normal wear in components such as clutch plates so performance remains consistent for the life of the transmission. The control module also ‘tests’ transmission components following assembly to optimise their interaction.

Torque converter

The 258mm diameter torque converter features a lockup clutch which also makes use of GM's proprietary Electronic Controlled Capacity Clutch (ECCC) technology.

ECCC uses a small, regulated amount of slip to dampen out engine pulses while benefiting from efficiency gains of almost direct coupling to the engine. This creates a smoother-running drivetrain, especially during shift events.

The torque converter also features a turbine damper between the turbine and input shaft to dampen out engine pulses and allow the engine to operate at its most efficient fuel consumption operating points.

Transmission fluid

Premium fluid is validated to improve durability and shift stability over the life of the transmission.

Manufacture

The 6L50 is produced in Strasbourg, France, and Silao, Mexico.

Other Applications

2010 Cadillac CTS and CTS Wagon, STS and Chevrolet Camaro.

6L50 Specifications	
Type:	Six speed RWD / AWD, electronically controlled automatic overdrive transmission with torque converter clutch. Clutch-to-clutch architecture, with integral Electro / Hydraulic Controls Module

Gear ratios:	
First:	4.065
Second:	2.371
Third:	1.551
Fourth:	1.157
Fifth:	0.853
Sixth:	0.674
Reverse:	3.2
Case description:	three-piece (Bell, main, extension)
Case material:	diecast aluminium
Shift pattern:	(2) Three-way on/off solenoids
Shift quality:	Five variable bleed solenoid
Torque converter clutch:	Variable Bleed Solenoid ECCC
Converter size:	258 mm
Fluid type:	DEXRON® VI
Transmission weight:	wet: 89.2 kg

Fuel Economy

Vehicle	**Engine**	**Transmission**	**Alloytec MY9.5**	**SIDI MY10**	**Improvement**
Omega sedan	3.0L SIDI	Auto	10.6	9.3	12%
Berlina sedan	3.0L SIDI	Auto	10.6	9.3	12%
SV6 sedan	3.6L SIDI	Manual	11.0	10.2	7%
SV6 sedan	3.6L SIDI	Auto	11.2	10.1	10%
Calais sedan	3.6L SIDI	Auto	11.2	9.9	12%
Calais V sedan	3.6L SIDI	Auto	11.4	10.1	11%
Omega Sportwagon	3.0L SIDI	Auto	10.7	9.3	13%
Berlina Sportwagon	3.0L SIDI	Auto	10.7	9.6	10%
SV6 Sportwagon	3.6L SIDI	Auto	11.3	10.3	9%
Calais Sportwagon	3.6L SIDI	Auto	11.3	10.3	9%
Calais V Sportwagon	3.6L SIDI	Auto	11.3	10.3	9%
SV6 Ute	3.6L SIDI	Manual	11.4	10.2	11%
SV6 Ute	3.6L SIDI	Auto	11.6	10.1	13%
Statesman	3.6L SIDI	Auto	11.5	10.3	10%
Caprice	3.6L SIDI	Auto	11.5	10.3	10%

Fuel efficiency enablers:

Tyre technology

- Bridgestone Turanza lower rolling resistance tyres standard on the 16- and 17-inch tyres.

- New tyre compound and construction decrease friction, improving fuel efficiency as less energy is required to travel the same distance.

- Differences in construction and compound contribute to a weight saving of approximately two kilograms per tyre.

- Tyre pressure on models fitted with 16-inch tyres increased from 250kpa to 270kpa to further improve rolling resistance.

Reduced idle speed

- SIDI V6 is tuned to idle at 550rpm (50rpm lower that than 3.6 litre Alloytec). Reduction in engine rpm reduces demand for fuel flow at idle.

- Achieved via sophisticated electronics, including a steering wheel sensor which allows the vehicle to sense how much torque reserve is required and increase idle speed if for example the steering wheel is at full lock.

High efficiency alternator

- New high-efficiency alternator is smaller, lighter and more efficient.

- Helps improve fuel economy by reducing generator loading due to more efficient design of windings and rectifiers - means lower resistance, improved efficiency.

Regulated voltage control

- RVC allows greater use of the battery because it monitors the state of charge, allowing power to be drawn from the battery rather than the alternator under certain conditions.

- Accomplished by reducing system voltage when battery state of charge is in the appropriate range.

- When this mode is active, battery is no longer providing a load to the generator and the vehicle electrical loads are also operating at the reduced voltage.

- Lowering system voltage reduces current draw of most other vehicle loads, which reduces alternator torque loads caused by these devices.

- Once this voltage level is reached the RVC 4.1 regulator voltage is controlled to maintain near zero current to the battery.

- This bolsters fuel efficiency by reducing engine load required to run the alternator.

Deceleration fuel cut

- Operating range of this feature has been optimised for minimal fuel consumption at MY10.

- When decelerating or coasting downhill, fuel supply to the engine is seamlessly cut where fuel is sequentially cut off per cylinder.

- At a certain speed and load input, fuel is seamlessly reinstated when required.

Turbine damper

- Smooths out subtle instabilities, allowing engine to operate in most efficient low rpm/high torque range.
- Purpose of design is improved torsional vibration isolation between engine and driveline - achieved by radial spring configuration that disconnects turbine inertia from transmission input shaft.

- Damping allows more aggressive fuel economy calibrations, running the engine at lower operating speeds more frequently while still meeting N&V targets.

Emissions

- The new technology conforms to strict Euro IV Plus emissions standards – currently the highest possible air pollution rating a petrol or diesel-powered vehicle can achieve in Australia.

- Using the Federal Government's Green Vehicle Guide as a measure, the Omega, Berlina sedan and Sportwagon and Calais sedan models achieve a 5.5 Greenhouse Rating and four stars.

			CO2 Emissions (g/km)		
Vehicle	**Engine**	**Transmission**	**MY9.5 Alloytec**	**MY10**	**Improvement**
Omega sedan	3.0L SIDI	Auto	252	221	**12%**
Berlina sedan	3.0L SIDI	Auto	252	221	**12%**
SV6 sedan	3.6L SIDI	Manual	260	242	**7%**
SV6 sedan	3.6L SIDI	Auto	266	241	**9%**
Calais sedan	3.6L SIDI	Auto	266	236	**11%**
Calais V sedan	3.6L SIDI	Auto	270	241	**11%**
Omega Sportwagon	3.0L SIDI	Auto	256	221	**14%**
Berlina Sportwagon	3.0L SIDI	Auto	256	228	**11%**
SV6 Sportwagon	3.6L SIDI	Auto	269	245	**9%**
Calais Sportwagon	3.6L SIDI	Auto	269	245	**9%**
Calais V Sportwagon	3.6L SIDI	Auto	269	245	**9%**
SV6 Ute	3.6L SIDI	Manual	269	242	**10%**
SV6 Ute	3.6L SIDI	Auto	274	241	**12%**
Statesman	3.6L SIDI	Auto	272	245	**10%**
Caprice	3.6L SIDI	Auto	272	245	**10%**

Servicing

- Cam drive and valve train components require no scheduled maintenance.
- Spark plugs have dual-platinum electrodes and a service life of 160,000 kilometres.
- Coolant retains its cooling and corrosion-inhibiting properties for 160,000 kilometres in normal use.
- Accessory drive belts are scheduled for first inspection at 160,000 kilometres.
- The oil filter requires only element replacement.

Global V6 Feature Highlights

- Like the conventionally injected Alloytec V6, the SIDI V6 engine is an aluminium-intensive basic design. The cylinder block and heads are cast with sand moulds from A319 aluminum alloy, with strong cast-in iron bore liners, six-bolt main bearing journals and inter-bay breather vents.
- Aluminum pistons have a high-tech polymer coating and floating wristpins to increase durability and reduce noise and harshness.
- Further features include pressure-actuated oil squirters in all applications. Three jet assemblies in the block hold a pair of oil-squirting nozzles that drench the underside of each piston and the surrounding cylinder wall with an extra layer of cooling, friction-reducing oil. The jets reduce piston temperature, which in turn allows the engine to produce more power without reducing long-term durability.

Manufacture

- The 3.0L SIDI V6 (LFI) and 3.6L SIDI V6 (LLT) engines are assembled at the GM Holden Global V6 plant in Port Melbourne.
- Core Global V6 engine components are designed for common application whenever possible. While different vehicles require different oil pans, mating surfaces with the engine block and transmission are common in all cases. The net result is streamlined procurement practices, fewer tool changes, shorter assembly time and improved quality.

Flexible Design

- SIDI V6 engines can meet emission requirements anywhere in the world. Designed for transverse or longitudinal mounting, they can be readily configured to power an array of platforms, drive orientations and future-technology adaptations such as plug-in hybrids.
- In 2010, GM Holden will begin production of a Flex Fuel E85 ethanol-compatible SIDI V6.

Export

- Holden Engine Operations V6 plant at Port Melbourne manufactures a family of engines for the world that come in four displacement sizes – 2.8 litre, 3.0 litre, 3.2 litre and 3.6 litre. Among Global V6 export customers in 2009 were China, Korea, Thailand, Germany, Sweden, Mexico and South Africa for brands including Buick, Cadillac, Chevrolet, Vauxhall, Opel and Saab.

HOLDEN

MY10 VE

PRODUCT INFORMATION

Six-speed manual transmissions

Six-speed Aisin AY6 manual transmission (SV6 models)

A new 257mm higher clamp-load (+27%) clutch is specified to match the SIDI 3.6L engine's higher torque and general performance.

To maintain shift feel with the new clutch, improvements have been made to 5th and 6th gear synchronisers.

Six-speed Tremec TR6060 manual transmission (V8 applications)

For MY10 a new Tremec TR6060 six-speed manual transmission has wider gearsets for improved torque capacity and durability and shorter throws. Upgraded synchronisers ensure lighter efforts and more precise changes. Gear ratios are unchanged.

A new 290mm higher clamp-load (+24%) clutch is specified to improve torque reserve. Master cylinder and clutch pedal ratio are also changed to maintain pedal feel.

Other Tremec TR6060 applications include HSV LS3 vehicles, Chevrolet Corvette and Chevrolet Camaro.

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MY10 VE and WM

PRODUCT INFORMATION

Safety

- Comprehensive three-year MY10 safety system test program refined advancements made with VE Commodore, WM Statesman and Caprice..

- Virtual crash modelling program included a further 50 simulated full vehicle tests, complemented biggest ever VE test program (5000 virtual barrier tests).

- Six full vehicle barrier crash tests complemented intensive VE program hardware testing (80 physical barrier tests).

- MY10 Holden Ute equipped with side impact and curtain airbags as standard – additional to safety systems such as dual stage driver and passenger airbags, high-strength rigid body structure and standard Electronic Stability Control.

- Passenger seat belt reminder and energy-absorbing steering column modification which helps protect against knee injury now standard across the range.

- Maximum five-star ANCAP rating applies over entire locally manufactured sedan and Sportwagon model range.

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PRODUCT INFORMATION

Noise and Vibration Refinement

Contributors to significant noise and vibration improvements at MY10 include:

- Low rolling resistance Bridgestone Turanza tyres on models fitted with 16- and 17-inch wheels.
- Suspension has been re-tuned with the addition of new cross axis ball joints in the rear suspension in place of a rubber bush in the rear lower control arm outer position at the knuckle.
- The ball joint increases high speed stability and emergency manoeuvre performance. It also improves on-centre steering precision by improving the rear suspension's lateral force stiffness and steering response.
- The cross axis ball joint is fitted to all vehicles and delivers handling improvement for 18-inch and 19-inch tyres, with a larger 20mm rear sway bar on sport sedans.
- ESC calibration is also re-tuned to compensate for the low rolling resistance tyres.
- Noise dampening refinements include a new front-of-dash and engine bay acoustic package.
- The larger muffler volume of the new dual exhaust system is specifically tuned to be quieter in the city and when highway cruising. The mufflers include an advanced back pressure control.

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PRODUCT INFORMATION

MY10 Dual Fuel LPG Commodore Omega

- The MY10 dual fuel LPG Omega sedan (equipped with 175kW 3.6 litre Alloytec V6) returns13.4l/100km - a six per cent improvement in fuel economy compared with the MY 9.5 figure of14.1/100km.

- C02 emissions are reduced from 230g/km to 217g/km, achieving a 6 out of 10 greenhouse rating.