This press pack accompanied the UK launch of the first Lexus LS 600h, a flagship for the fourth generation LS range, in October 2007. Some changes were made to the model range during its time on sale, which can be tracked using the Timeline feature available on the LS archive web page. Additional assets and information relating to the LS range may be obtained from the Lexus press office if required.

THE LEXUS 600h

KEY POINTS

- A new flagship for the Lexus brand
- The world's first full-time all-wheel drive full hybrid V8 powertrain
- Performance to match a conventional petrol V12, with fuel consumption and emissions to rival the segment's best diesels
- All-new 5.0-litre V8 petrol engine, the most technically advanced yet built by Lexus
- Maximum system output 439bhp (445 DIN hp), giving nought to 62mph in 6.3 seconds
- Combined cycle fuel consumption 30.4mpg, carbon dioxide emissions 219g/km
- First Lexus to be offered with a long wheelbase – the LS 600h L
- Added luxury for LS 600h L with optional Rear Seat Relaxation Pack
- World's first application of LED low beam headlight technology
- Full, advanced Pre-Crash Safety system provides unparalleled preventive safety protection
- Standard features include four-zone climate control, semi-aniline leather upholstery and trim, Intelligent Parking Assist and 19-speaker Mark Levinson Reference Surround Sound system
- LS 600 h and LS 600h L rated in insurance group 20E
- On sale in the UK from 1 October
- Prices to be announced at Dynamic Media Launch

SHORT STORY

The LS 600h is a new flagship for the Lexus brand, delivering a unique driving experience with the highest standards of quality, refinement, luxury, safety and performance.

It follows the RX 400h premium SUV and GS 450h executive sports saloon as the third Lexus model to use Lexus Hybrid Drive, a powertrain technology that is more advanced than any other in its segment. The system gives performance that can be compared to that of a

conventional petrol V12 engine, while returning fuel consumption and exhaust emission figures that rival those of more modestly performing diesels.

INTRODUCTION

By Osamu Sadakata, Chief Engineer of the Lexus LS 600h

“When we set out to develop this car, we had many discussions to identify what it means for a car to attain the ultimate, and what route the Lexus flagship should take. The answers generated by this process represent the culmination of the Lexus philosophy and the ultimate expression of the Lexus brand: the LS 600h.

“The LS 600h is made possible by Lexus’s state-of-the-art technology and embodies the evolution of the premium car to confidently accommodate changes in customers’ lifestyles and values, while meeting society’s demands for safe and environmentally friendly product designs. That evolution has given rise to a new dimension in performance that is unmatched by any other car, a pinnacle of technological accomplishment reached as the result of the Lexus pursuit of the ideal premium car.

“The LS 600h’s hybrid system provides the customer with a previously unimaginable level of excitement and experience, befitting a flagship, while the LS 600h L treats rear seat passengers to the ultimate in hospitality through painstaking attention to detail and an extended wheelbase to offer the most spacious and relaxing environment.

“By giving the Lexus pursuit of the ‘essence of luxury’ its highest expression, I am confident that the LS 600h, with its position at the pinnacle of the Lexus brand, will not only exceed our customers’ high expectations, but will also represent a level of innovation that sets a new direction for the premium car segment. I believe this will play a key role in raising the Lexus brand to new heights.”

POWERTRAIN AND PERFORMANCE

The LS 600h is the first vehicle in the world to use a full hybrid V8 powertrain. Designed for supreme power, smoothness and ultra-quiet running, it achieves its aim of performance to rival a conventional petrol V12, while returning fuel consumption and emissions levels that challenge the luxury segment’s best diesels

The drivetrain combines a new, technologically advanced 5.0-litre V8 petrol engine with a powerful, high output electric motor. The system also features a new, high capacity battery pack; dual-stage electronically controlled continuously variable transmission and permanent all-wheel drive.

New V8 Engine

The V8 engine is the most advanced internal combustion engine yet developed by Lexus and is derived from the 4.6-litre unit deployed in the LS 460. Advanced design, materials and assembly techniques are combined with the hand, eye and ear skills of master craftsmen in the manufacturing process to ensure top precision and quality in every unit.

The power plant uses the latest generation valve timing technology, with Dual VVT-i on the intake and exhaust valves and VVT-iE (Variable Valve Timing – intelligent Electric) on intake. This improves low and high-end torque and contributes to a significant reduction in exhaust emissions. It also benefits from D-4S, a direct injection system that uses two injectors per cylinder, to improve efficiency and torque delivery throughout the engine's power range.

The engine produces a maximum 389bhp (394 DIN hp) at 6,400rpm and maximum torque of 520Nm at 4,000rpm.

Hybrid System Components

The primary hybrid components are:

- A compact, high-output, water cooled permanent magnet electric motor
- A generator
- A high-performance nickel metal hydride (Ni-MH) battery
- A power split device, which, using planetary gears, combines and reallocates power from the engine, drive axle and generator, according to driving requirements
- A Power Control Unit (PCU), to govern the high-speed interaction of the system's components

The electric motor is compact, but produces an unprecedented amount of power: operating on a 650-volt current, it delivers more than 221bhp (224 DIN hp). This contributes to a total power output from the Lexus Hybrid Drive system of 439bhp (445 DIN hp).

One of the benefits of using a motor as a source of drive power is that maximum torque is generated immediately on start-up, from zero rpm. This gives the LS 600h impressive, yet near-silent acceleration off the line and significantly improves engine power under high throttle loads.

Lexus Hybrid Drive in Operation

Over the course of any journey, Lexus Hybrid Drive operates in several different modes to maximise efficiency. At start-up and low to mid-range speeds, the vehicle runs on the electric motors alone, eradicating both engine noise and carbon dioxide emissions.

In normal driving conditions, the V8 engine is the main power source, with output divided by the power split device, both to drive the wheels and power the generator, which in turn charges the high-voltage battery. This power allocation is constantly monitored and adjusted between the engine and electric motor to maximise efficiency.

When full acceleration is required, engine and electric motor again work in tandem, with extra power supplied by the battery to boost acceleration.

During deceleration, the engine switches off as the driver lifts off the throttle and the electric motor acts as a second generator to initiate regenerative braking, recovering energy that would normally be lost as heat as electrical energy for storage in the battery.

Hybrid Transmission

The LS 600h has an electrically controlled continuously variable transmission, with a choice of three power settings: Hybrid, for the best balance of power and traction; Power for quick response acceleration; and Snow for better traction in slippery conditions. These can be engaged by the driver, operating a Mode Select switch on the centre console.

Performance

The LS 600h can accelerate from rest to 62mph in 6.3 seconds. More impressive still is a 4.3-second time for typical overtaking acceleration from 50 to 75mph. The stop speed is electronically limited to 155mph.

The car is alone in the premium segment in being able to match this kind of performance with low fuel consumption and exhaust emissions. In combined cycle driving, it returns 30.4mpg, with 219g/km of carbon dioxide emissions. In heavy urban traffic, the LS 600h can run for a certain distance on its electric motor alone, cutting exhaust pollution to zero.

DRIVING DYNAMICS

The LS 600h has the smooth, refined and near-silent running that is a hallmark of Lexus, ensuring a quiet and comfortable cabin environment in all driving conditions. The permanent all-wheel drive system has a rear-wheel bias, that gives the vehicle the handling appeal and dynamics that are typical of rear-wheel drive premium saloons.

All-wheel Drive

The LS 600h has permanent four-wheel drive, with a specially designed central limited slip differential. Rather than the usual 50:50 torque split, it gives a 40:60 rear axle bias, giving the car the ride comfort and stability under acceleration that are typical of premium rear-wheel drive saloons.

To ensure the best grip, traction and cornering stability, the drive can automatically be varied between 48:52 and 31:69 front to rear, according to conditions.

Adaptive Variable Suspension

To cope with the high power produced by the all-wheel drive hybrid transmission, the LS 600h has a revised multilink front suspension design. Pneumatic cylinders with monotube shock absorbers work with the Adaptive Variable suspension to synchronise the vehicle's roll and pitch when cornering, to maintain passenger comfort.

The driver can fine-tune the AVS by selecting any of three damper settings: Normal, Comfort and sport. In any mode, AVS automatically adjusts suspension performance at all four wheels independently through a sequence of nine incremental steps to suit driving conditions.

Electric Power Steering with Variable Gear Ratio Steering

The LS 600h is equipped with speed-sensitive Electric Power Steering (EPS), which operates noise free and gives the driver seamless, linear feedback. Assistance characteristics adjust in line with vehicle speed.

EPS features Variable Gear Ratio Steering, which alters the steering gear ratio according to vehicle speed, by up to 30 per cent. At low speeds the ratio gives lock-to-lock performance in 2.3 turns, while at high speed the figure increases to 3.7 turns, ensuring a gentle response to steering inputs and helping maintain vehicle stability. VGRS also plays a key role in the LS 600h's Vehicle Dynamics Integrated Management (VDIM) system (see below).

Electronically Controlled Braking

the LS 600h has an electro-hydraulic braking system that not only saves weight, but also gives more precise brakeforce distribution, helping the VDIM system achieve peak performance.

Ventilated discs, 357mm diameter at the front and 335mm at the rear are fitted. Better brake pedal feel and responsiveness are gained through revisions to the ECB system and a new ECU with quicker processing. Independent braking power can be applied to each wheel independently, with stopping performance aided by the development of bespoke 245/45R19 tyres.

SAFETY AND DRIVER ASSISTANCE

The LS 600h benefits from the highest content of advanced preventive, active and passive safety features of any production car. Building on the ground-breaking achievements of the LS 460, it is the first car in the world to offer LED technology for low-beam headlights.

Advanced Pre-Crash Safety System

An Advanced Pre-Crash Safety system brings together a series of features which can recognise a potentially dangerous situation and help the driver take avoiding action and reduce the risk of a collision happening. If there is an impact, they also work to help minimise the consequences.

The system is fitted as standard on the LS 600h and LS 600h L and includes the following features:

- Advanced Obstacle Detection System: a front-mounted millimetre-wave radar and an infrared camera detect obstacles in the vehicle's path, including pedestrians and animals, by day or night (depending on weather conditions).
- Emergency Steering Assist: if a collision is deemed likely, the steering gear ratio is automatically adjusted to enable a rapid evasion manoeuvre and stiffer damper settings are adopted to minimise body roll and maintain stability.
- Driver Monitoring System: A miniature camera mounted on top of the steering column plots the features on the driver's face and constantly monitors side-to-side head movement. If it recognises that the driver is looking away when a hazard is detected in the road ahead, an automatic warning buzzer is sounded and brakes are briefly applied.

- Rear Pre-Crash Safety System: a rear-mounted miniature camera constantly monitors the area around the back of the car. If it detects an imminent collision, the front seat headrests are automatically moved up and forwards to cushion the occupants' heads and help prevent whiplash injury. The system operates whether the car is moving or stationary.

Active Safety

The active safety systems fitted as standard to the LS 600h include ABS, Electronic Brakeforce Distribution (EBD), Brake Assist System (BAS), Traction Control (TRC) and Vehicle Stability Control (VSC).

Lexus goes beyond the active safety provisions of its segment rivals with the latest development of its Vehicle Dynamics Integrated Management (VDIM) system. This simultaneously co-ordinates the braking, stability and steering systems to keep the vehicle smoothly under control as it nears the limits of its performance envelope. Conventional systems are only able to govern one system at a time, causing more abrupt intervention and potentially significant delays.

The Variable Gear Ratio Steering (VGRS) cooperates with the VDIM to adjust the steering ratio to help maintain stability in dangerous conditions, for example when braking or accelerating or braking on surfaces where there is a difference in grip on either side of the vehicle.

Passive Safety

The LS 600h has been developed around the Lexus Advanced Compatibility Safety Structure. This not only provides protection for driver and passengers through effective absorption and distribution of impact forces in the event of a collision, it also helps reduce the risks to other parties in accidents with smaller vehicles or pedestrians.

The cabin is equipped with the most comprehensive array of airbags in the segment, including driver and front passenger front and knee airbags, front and rear side airbags and full-length curtain airbags.

The passenger front airbag has a twin-chamber design that cradles the face in a central depression, while spreading the force of inflation across other parts of the head and shoulders. Deployment of the front airbags is automatically adjusted according to vehicle

speed, while crash sensors in the B and C-pillars ensure rapid activation of side airbags and enable selective operation, according to the point of impact.

Driver Assistance

Life on board is made easier and more convenient with a number of innovative driver assistance systems. These include Intelligent Parking Assist (IPA), which automatically controls the steering for reverse manoeuvres into series and parallel parking spaces, and a new Adaptive Cruise Control (ACC) system that can operate at any speed, from zero to more than 100mph.

A low speed mode allows ACC to work in slow moving traffic for the first time. It can bring the car to a standstill, then accelerate away again when the road is clear.

The LS 600h is the first car in the world to feature LED technology for low beam headlight operation. It offers exceptional illumination power across the full width of the road, without causing glare for oncoming traffic. The units use less power than conventional lamps and light up almost instantaneously. Their design, with a transparent blue ring around each of the three projector lenses, gives the LS 600h an unmistakeable headlamp signature.

The effectiveness of the headlights is further increased by the Intelligent Adaptive Front-lighting System (AFS), which swivels the headlamp units in line with vehicle speed and steering angle to improve illumination through bends at junctions and when turning into parking places.

LUXURY SPECIFICATION

The LS 600h exemplifies the luxury and attention to detail that are intrinsic to the Lexus brand. In this flagship model, the quality reaches new heights with a standard specification unmatched by its premium segment rivals.

Highlights of the equipment specification include a 19-speaker Mark Levinson Reference Surround Sound system; an independent DVD player for the rear of the cabin, with a nine-inch, roof-mounted VGA screen; a four-zone climate control system, with roof diffusers and independent rear left/right temperature controls; semi-aniline leather upholstery; leather trimmed dashboard and door panels; Alcantara finish for the roof lining and pillars; and air conditioned front and rear seats.

LS 600h L – the ultimate LS

The LS 600h is also the first Lexus to be offered with the option of a long wheelbase. The LS 600h L is 120mm longer than the standard model, with all of that length dedicated to providing extra legroom for the rear seat passengers.

In line with its position at the pinnacle of the Lexus model range, the LS 600h L benefits from an even higher specification, designed to provide a truly first class travelling experience.

A Rear Seat Relaxation Pack is exclusively available for the LS 600h L. This equips the left hand rear seat (on right-hand drive models) with an electric recline function, an electrically adjustable ottoman foot and thigh rest and an adjustable massage function that can replicate techniques from Shiatsu to acupressure. The seat is fitted with seat cushion airbag and, to give a clear view, the front passenger headrest can be electrically folded down.

In addition, the pack provides a more sophisticated climate control system that monitors the passengers' body temperature for more effective control of the cabin environment. A fixed centre console is provided with a built-in cool box, DVD and CD store and a retracting and adjustable wood inlaid tray.

LS 600h AND THE UK MARKET

The Lexus LS 600h will be offered in the UK in two highly specified versions: the LS 600h and the long wheelbase LS 600h L. The only optional equipment is the Relaxation Pack, exclusive to the LS 600h L.

This year Lexus aims to sell 275 units, with approximately a 30/70 per cent split between standard and long wheelbase versions.

The low emissions performance of the hybrid powertrain yields tax benefits for company car drivers, compared to rival models. Output of 219g/km of carbon dioxide attracts a P11D rate of 27 per cent, giving a monthly tax bill for drivers of the LS 600h of about £750. Competitor models attract higher tax rates. For example, a Mercedes-Benz S500, specified to match as near as possible the standard equipment list of the LS 600h, would face a monthly bill of a few pence less than £1,000, as well as the higher fuel costs demanded by a car that does no better than 24mpg in combined cycle driving. A similarly specified Audi A8 4.2 quattro SE breaks through the thousand-pound mark, emitting 259g/km of CO_2 and thus attracting the top 35 per cent tax rate. The BMW 750i and Jaguar XJ Sovereign Supercharged 4.2 V8 also represent less value when taking additional specification and tax costs into account.

CONCEPT

From the outset, the Lexus philosophy has been to develop cars that establish new frontiers in quality, luxury and performance, by taking a radical approach to advanced vehicle design, while emphasising the absolute customer focus at the heart of the brand.

Each new Lexus hybrid model further emphasises the importance of hybrid drive systems as Lexus's core powertrain technology. Hybrid encapsulates the driving characteristics that are the hallmark of Lexus drivetrain engineering, utilising the ultimate in high technology to provide customers with a sophisticated and intelligent driving experience that is exceptionally powerful, smooth and refined, without the usual penalties of high fuel consumption and emissions levels.

Lexus remains the first and only premium manufacturer to offer a comprehensive hybrid model range.

The Lexus Hybrid Range

The RX 400h all-wheel drive SUV was the world's first hybrid petrol-electric powered car in the premium segment. Lexus engineers created a completely new hybrid system, with redesigned and refined electrics, mechanical driving components and control elements, ensuring the RX 400h achieved the power and performance appropriate for the brand and for the premium SUV market.

This ground-breaking development featured the world's first series/parallel hybrid system to employ three powerful electric motors and a highly efficient V6 petrol engine, working together to provide an 'intelligent' electric all-wheel drive capability and significantly improve low to mid-speed acceleration, braking, fuel efficiency and CO_2 emissions.

The Lexus GS 450h, introduced in 2006, is the world's first hybrid performance saloon and the first full hybrid vehicle to use a front-mounted V6 engine with sporting rear-wheel drive. It defies the conventions of the luxury car market by combining the kind of seamless performance comparable to V8-engined rivals with fuel efficiency typical of vehicles from two segments down, giving a driving range of more than 500 miles on a full tank.

The LS 600h introduces Lexus's revolutionary high performance hybrid technology to the flagship of the brand. The LS 600h is the world's first vehicle to feature a full hybrid V8 powertrain, combining a technologically peerless 5.0-litre petrol engine with a powerful, high

output electric motor, a newly designed large capacity battery pack, an electronically controlled continuously variable transmission (or hybrid transmission) with a two two-stage motor speed reduction device and all-wheel drive.

The LS 600h is named ‘600’ not to indicate the engine’s cubic capacity, but in recognition of power output that is comparable to that from a conventional 6.0-litre petrol engine. The ‘h’ suffix indicates the Lexus Hybrid Drive system.

Thanks to the improvements in noise and vibration levels inherent in its hybrid powertrain, the LS 600h is designed to set new standards in the premium segment for silent running, with an unparalleled depth and density of cabin quietness. It is quite possibly the quietest car in the world.

The hybrid drive system generates a peak combined output of 439bhp (445 DIN hp), but is substantially more fuel-frugal than comparable luxury saloons, returning a class-leading combined consumption of 30.4mpg (9.3l/100km), a figure that is on a par with six-cylinder engines. Moreover, carbon dioxide emissions are 219g/km and emissions of nitrogen oxides are very low.

The LS 600h L goes further in terms of providing first class travelling luxury, with 120mm added to the wheelbase. This space is dedicated entirely to providing extra rear passenger legroom and comfort.

Rear Seat Relaxation Pack is exclusively available for the LS 600h L. This equips the left hand rear seat (on right-hand drive models) with an electric recline function, an electrically adjustable ottoman foot and thigh rest and an adjustable massage function that can replicate techniques from Shiatsu to acupressure. The seat is fitted with seat cushion airbag and, to give a clear view, the front passenger headrest can be electrically folded down.

In addition, the pack provides an independent rear DVD player and a more sophisticated climate control system that monitors the passengers’ body temperature for more effective control of the cabin environment. A fixed centre console is provided with a built-in cool box, DVD and CD store and a retracting and adjustable wood inlaid tray.

POWERTRAIN

The Lexus LS 600h is a full hybrid, capable of operating with its petrol engine or electric motors alone, or with a combination of both. With a maximum system output of 439bhp (445 DIN hp), the hybrid system gives the car an unparalleled balance of performance, quietness and environmental efficiency.

PERFORMANCE

Combining the 389bhp (394 DIN hp) power of a 5.0-litre V8 with an electric motor producing 221bhp (224 DIN hp) gives the hybrid system a peak output of 439bhp (445 DIN hp). The LS 600h will accelerate from nought to 62mph in 6.3 seconds and attain an electronically limited top speed of 155mph.

Equally impressive is the potent mid-range torque gained from the electric motor. Working in parallel with the V8 petrol engine, it is capable of instantaneously and seamlessly delivering a maximum 300Nm from standstill. This characteristic is most beneficial in mid-range performance when overtaking – acceleration from 50 to 75mph takes just 4.3 seconds.

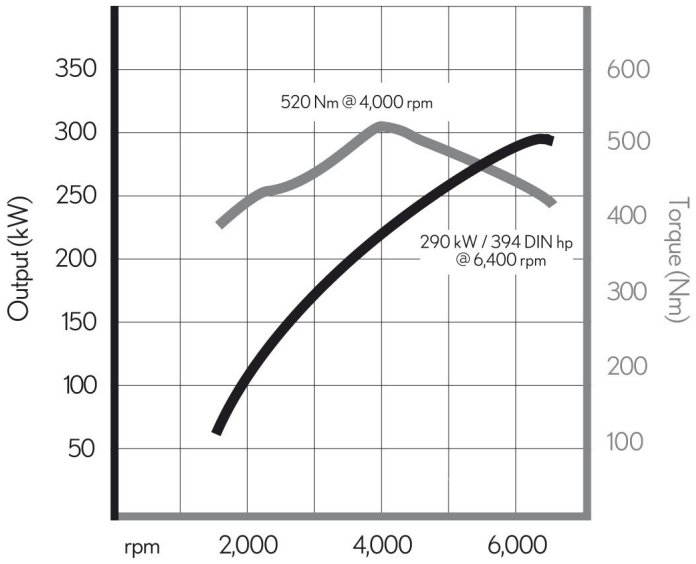
Conversely, the LS 600h is substantially more frugal than comparable luxury saloons, returning a class-leading 30.4mpg, which is on a par with most economical six-cylinder cars in the premium segment.

Carbon dioxide emissions of 219g/km are markedly less than rival models with similar engine power. In addition, a combination of D-4S (direct injection 4-stroke petrol Superior version) and VVT-iE (Variable Valve Timing – intelligent Electric on intake) engine technologies and the adoption of hexagonal cell catalysts in the exhaust manifolds create exceptionally clean exhaust gases, with a particular reduction in nitrogen oxides.

5.0-litre V8 ENGINE

The new 5.0-litre V8 engine was developed for the LS 600h's hybrid system. It is a showcase of precision mechanical engineering and the most technologically advanced internal combustion engine to have been developed by Lexus. It produces a maximum 389bhp (394 DIN hp) at 6,400rpm and maximum torque of 520Nm at 4,000rpm.

Painstaking development of high rigidity components, optimum balance in all moving parts, minimisation of friction and unprecedented precision in assembly give the engine world-leading performance in terms of refinement, quietness and durability.



The 4,969cc V8 is derived from the 4.6-litre unit which powers the Lexus LS 460, with the stroke extended by 6.5mm to 89.5mm – intended to just reach the design limit – and the bore unchanged. As well as the increase in capacity, the 5.0-litre engine has undergone significant component modification to handle the greater power output, accommodate the hybrid system and minimise emissions.

These modifications include revisions to the pistons, crankshaft, connecting rods, damper pulley, VVT-iE and exhaust manifold, as well as a redesign of the oil pan and engine mounting bracket in order to accommodate all-wheel drive.

To counter the fuel economy penalties inherent in both an increase in engine capacity and all-wheel drive, Lexus engineers also fine-tuned many aspects of engine operation, including adjusting the operating angle of the VVT-iE, to achieve a consumption figure of 30.4mpg (combined cycle), like that of a six-cylinder engine.

CONSTRUCTION AND PRECISION ASSEMBLY

Lexus engineers set themselves the goal of optimum engine performance through the absolute minimisation of friction and the ultimate in precision assembly. To achieve this they developed comprehensive computerised design models, with measurements to the nearest micron. For the first time, they also successfully simulated the thermal deformation of the cylinder bore and piston, allowing them to incorporate ‘real use’ conditions into the design data. This re-informed several aspects of the design and production process to achieve an unmatched combination of power and smoothness.

To reduce overall engine weight, the cylinder block is die cast from a lightweight, high-strength aluminium alloy. The block structure and rib reinforcement design were finalised by using cylinder combustion pressure data to minimise vibration and noise. Aluminium alloy was also adopted for the crank bearings and connecting rod bearings. The head cover is constructed in a lightweight magnesium alloy, and resin is used for the intake manifold, helping lower the engine's centre of gravity.

To achieve a significant camshaft weight reduction, and, hence, a reduction in energy lost in rotating the shaft, a conventional, integrated casting was rejected in favour of a hollow, lightweight shaft with a separate cam lobe. The camshaft is cooled by liquid nitrogen before shrink attachment of the cam lobes, a construction technique that allows for the machining and polishing of a more exact cam profile, further enhancing power output and reducing noise and vibration.

Within the cylinder heads, care was taken to eliminate variations in torque equilibrium caused by discrepancies in cylinder wall resistance and fractional differences in the air/fuel mixture delivered to each cylinder. Minimal resistance intake and exhaust pipes were developed to optimise the flow of combustion gas. A bespoke three-dimensional device that measures the cylinder inner wall is used in place of conventional point location measurement. This ensures that the gap between the cylinder lining and piston meets the strictest design parameters throughout the stroke cycle.

To minimise the friction generated when the vertical movement of the pistons is converted to rotational movement by the crankshaft and, thus, achieve an exceptional rotational balance, every area is polished to a mirror finish, including the friction points of the crankshaft and piston pins. A special burr erosion system was developed to ensure oil is smoothly delivered throughout the engine with minimal resistance. A newly-designed high-pressure nozzle delivers smoothing liquid incorporating ultra-fine alumina particles to thoroughly polish previously unreachable areas such as the crankshaft lubrication holes.

The V8 further benefits from a new engine cooling technique, Partial Head Pre-cooling. Radiator coolant is fed into the cylinder head, cooling the periphery of the combustion chamber. The heated coolant from the exhaust side – which tends to absorb the most heat – is then fed through the water jackets of the block, achieving a homogenous heat distribution. The resultant control of bore deformation reduces mechanical friction loss and contributes to better NV performance.

As a result of these unprecedented production technologies, the engine achieves the lowest level of mechanical friction loss among V8 units.

In addition to a significant increase in individual component production precision, the highest possible levels of assembly precision were also required in order to meet Lexus's exacting design requirements.

New dual-arm precision robots were developed specifically for the LS production line, and a rigorous inspection process was introduced to check assembly tolerances against design parameters every time high-precision parts are combined.

Immediately before the final elements of the assembly process, an electric motor is used to crank the engine and check for inconsistencies. Finally, the complete engine is tested under its own power. An accelerometer is mounted to both the front and rear of the crankshaft, measuring accelerational differences between the crankshaft extremities under load to ensure the smoothest possible operational balance has been achieved.

ULTRA QUIET RUNNING

Particular attention has been paid to absolute minimisation of noise and vibration, as befits the quiet operation of the Lexus hybrid system. Lexus engineers focused on reducing NV by minimising engine friction, enhanced rotational balance and increased absorption of vibration by the engine mounts.

Extensive computer aided design analysis, incorporating thermal deformation data from a running powerplant, was used to develop the highest possible rigidity in the cylinder block and oil pan structures. Precise location of the crankshaft within its journals elicits perfect rotational balance, and even the angle of cross-hatched honing marks on the inner bore wall of the cylinder block has been optimised at 30 degrees against the bore axis, to minimise wear and reduce lash between piston and cylinder to the least degree.

The periodical stopping and starting of the engine is inherent in the operation of the hybrid system. To minimise stop/start vibration, the VVT-iE intake valve timing has been designed to lower the compression ratio during restarts by adjusting to the latest possible cam position. Under all running conditions, noise has been further reduced by optimal control of the VVT-iE cam position and equalisation of the in-cylinder direct injection. Insulation materials have been applied to the cylinder head covers, and damper and pulley tension have been reduced by adopting a dual mass crank pulley that also features torsional and

bending dampers. The size and location of the engine mounts have been optimised and a dynamic engine mount damper has been incorporated to further suppress vibration.

Finally, a master craftsman makes a detailed vibration check on each engine, using a stethoscope to listen for any minute, abnormal sounds while the engine is running. Any necessary adjustments are made, ensuring that every engine not only conforms to its precise, micron-exact design specification, but also produces a pleasing tonal quality, appropriate for the Lexus flagship model.

DUAL-PIPE AIR INTAKE SYSTEM

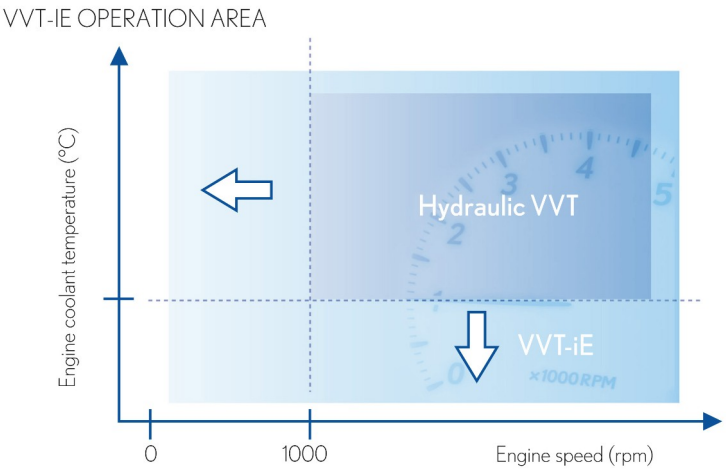
To ensure the best air intake flow to support the increase in engine power, the new V8 features an over-the-engine dual-Pipe Intake System with compact air filter elements and Acoustic Control Induction System (ACIS). ACIS is a high-speed, electrically activated system which varies air induction by automatically switching to the optimum intake pipe length according to engine rpm, so delivering the best possible fuel/air mixture to further boost torque across the full rev range.

By adopting a single inlet design, Lexus has eliminated even the tiniest inconsistencies in air intake volumes between the two cylinder banks that result from using independent left and right intake ducts.

DUAL VVT-i WITH VVT-iE ON INTAKE CAMSHAFTS

The new 5.0-litre V8 engine features Lexus's third-generation Dual VVT-i, an optimised, low pressure loss, variable intake and exhaust timing system, which allows a greater intake/exhaust valve overlap appropriate to any running conditions. This benefits low and high-end torque and contributes to a significant reduction in exhaust emissions, such as NOx and HC (hydrocarbons).

The system incorporated the world's first electrically controlled, continuously variable valve timing system on the intake camshafts. Hydraulic valve timing cannot operate at less than 1,000rpm, or with engine temperatures below 30°C. However, the Electric Motor Drive VVT system can operate across the full range of engine revolutions and temperature, with fast cam response speed of 150 degrees per second towards the advances phase and 50 degrees per second towards the lag phase.



Great care has been take in the production of components for the compact, high-performance electric VVT-iE drive motor, from the coil diameter and optimum magnet position, to the uniform winding of the high-density coils to ensure perfectly matched magnetisation within each stator core. Precision milling of the motor shaft bearings further ensures that VVT-iE operates with negligible vibration.

It is difficult to halt the cam at the optimum position for engine re-start using the electric motor alone, due to cam phase shifts that occur even when the engine stops. To counter this issue, Lexus has developed a resistance mechanism and speed reduction gearing to hold the cam phase in the ideal position.

To transmit the motor's particularly high rotational torque, a high-precision finish plate and narrow pins are used at the interface between the speed reduction gear and phase converter. These elements are exceptionally hard and require a unique cutting and polishing technology. A scroll machine, which uses similar mechanics to a tool used for cutting air conditioner parts, guarantees base cutting precision; a low air pressure grindstone is employed to polish with a weak but consistent pressure, giving a mirror finish surface accurate to one micron.

D4-S FUEL INJECTION SYSTEM

D4-S, which features two injectors per cylinder, is the latest evolution of Lexus's stoichiometric, four-stroke, direct injection technology. With one injector in the combustion chamber and a second mounted in the intake port, it combines the strengths of both direct and port injection, giving optimum engine efficiency throughout the power band, improving torque delivery across the rev range and reducing fuel consumption and emissions. D-4S

also substantially reduces combustion fluctuations in comparison with any conventional direct or port injection system.

The port injectors have 12 spray holes to inject fuel at a maximum pressure of 4bar. The in-cylinder injectors have twin, high-pressure W-slit nozzles, which produce a highly atomised, double fan injection pattern to give the most homogenous fuel-air mixture possible.

During cold starts, D-4S employs port injection firing and direct injection during compression, producing an air-fuel mixture of between 14 and 15:1. This richer mixture helps the two thin-wall catalysts to warm up quickly. The warm-up time is further improved by the hybrid system's electronic management maintaining a constant engine idling speed.

When idling, the engine runs on direct injection alone, due to its higher efficiency. When running under a low to medium load at lower speeds, both direct and port injection systems are used during the intake stroke. This creates a homogenous, 12-15:1 stoichiometric air-fuel ratio to stabilise combustion, improve fuel efficiency and reduce emissions.

The direct injection system alone is used when the engine is running under heavy loads. This achieves an intake cooling effect by injecting fuel directly into the combustion chamber, improving the efficiency of each charge. It also allows for a higher engine compression ratio of 11.8:1, reducing pre-ignition tendencies and improving engine output and performance. Once again, a 12-15:1 stoichiometric air-fuel ratio is effected during the intake stroke.

PRIMARY HYBRID SYSTEM COMPONENTS

In addition to the new 5.0-litre V8 engine, the LS 600h's hybrid system also comprises:

- A compact, high-output, water cooled permanent magnet electric motor
- A generator
- A high-performance Nickel Metal Hydride (Ni-MH) battery
- A power split device, which, using planetary gears, combines and reallocates power from the engine, drive axle and generator, according to driving requirements
- A Power Control Unit (PCU), to govern the high-speed interaction of the system's components

As in the GS 450h, the electric motor, generator, power split planetary gear mechanism and motor speed reduction gearing are all housed in a single, compact transmission casing. Bringing these components together in a unit that is comparable in size to a conventional

gearbox is fundamental to the successful installation of the sophisticated Lexus hybrid system in a front-engine saloon platform.

Electric motor

In order to meet its performance targets, the LS 600h's hybrid system uses a three-phase, water/oil cooled, permanent magnet AC synchronous type motor that is very compact and produces an unprecedented amount of power. To offer the best efficiency, the DC motor unit has a brushless design and operates on a 650V supply, processed by the PCU.

The high voltage generated by the PCU's voltage step-up converter, together with improved cooling efficiency, has increased the motor's maximum output to 221bhp (224 DIN hp) and 300Nm of instant torque. At the same time, the unit size is the same as that in the GS 450h. Also, the electric current has increased, improving maximum output and torque.

The benefit of using a motor as a source of drive power is that maximum torque is generated instantaneously on start-up, from zero rpm, giving the LS 600h powerful, yet near-silent acceleration off the line and significantly enhancing engine power under high throttle loads.

Generator

The water/oil cooled generator, which uses engine power to generate electricity, is AC synchronous-type (like the electric motor) and supplies power to the high-output motor and battery.

High-voltage battery

The hybrid system has a high-output, 20-module, Ni-MH 288V battery, housed over the rear axle. The impact of the battery pack on boot space has been minimised by using a stable, metal case battery cell.

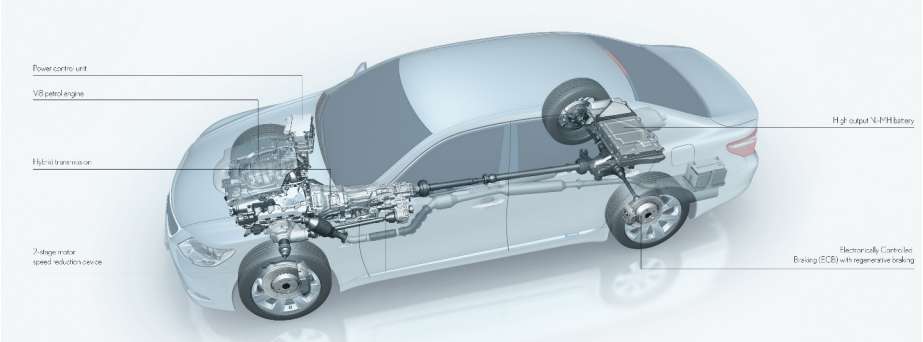
The battery is linked to a monitoring unit with a Hybrid Vehicle-Electronic Control Unit (HV-ECU). This monitors battery recharging conditions, detects problems, performs fail-safe system management and controls the battery cooling system.

The battery installation features a new air conditioner co-ordinated cooling system to enhance its efficiency, with ventilation pattern mapping to optimise cool air distribution in all operating conditions. When the battery pack is cold and under light loads, cooling air is blower-fed from the cabin. When the pack is under high load, cold air is ducted directly from

the rear cooler of the LS 600h's air conditioning system. This cooling capacity permits a reduced battery capacity to be used, which in turn allows for a smaller, lighter battery unit to be designed. The improved cooling efficiency also means a smaller, vehicle speed-sensitive fan can be adopted.

Power Control Unit (PCU)

The PCU comprises a voltage boost converter and inverter, and is controlled by a motor generator ECU that receives commands from the HV-ECU. The inverter (voltage boost converter) in the hybrid system's PCU converts a 288V direct current from the battery into a 650V alternating current to drive the electric motor.



To obtain the maximum electric motor power, without penalties in size or weight, a layered inverter structure has been adopted, with a dual-side power transistor cooling system. Special attention was paid in the design of this highly compact unit to the clearance between the high-rigidity housing case and the internal unit, to ensure the lowest possible vibration sound levels.

Power Split Device

The power split device is at the heart of the LS 600h's hybrid system. It uses a differential-type planetary gear set, which gives a two-way torque split between engine, drive axle and generator.

The device is connected by two output shafts to the generator on one hand and the electric motor and wheels on the other. This lets engine power be transmitted along two separate routes: a mechanical route, incorporating torque from the electric motor, to drive the wheels; and an electrical route to the generator.

The planetary gear set (so called because the gears orbit a centrally positioned sun gear, like a solar system) divides engine power between the two routes. The generator is

connected to the sun gear; the engine is connected to the planetary carrier; and the electric motor is connected to the outer, ring gear, itself directly connected to the differential, which drives the wheels. Hence, with power from the engine, the electric motor, or a combination of both, the rotational speed of the ring gear determines the vehicle's seamless acceleration.

The planetary gear set allows for the hybrid system's inherent full range of power transmission options. During initial start-up and at slow speeds, the engine is not running and the planetary pinion gear carrier is stationary. Powered by the electric motor, the ring gear revolves, driving the wheels and, via the pinion gears revolving on the stationary carrier, rotating the sun gear attached to the generator.

To start the engine as vehicle speed increases, a momentary stopping of the sun gear's rotation generates sufficient force (via the ring gear's rotation of the planetary gears) to set the planetary pinion gear carrier in motion, turning the engine crankshaft. Once the engine has started, it transmits power back through the pinion gears on the revolving carrier to both the outer ring gear, driving the wheels, and the inner sun gear. Rotated by the sun gear, the generator supplies electric power via the PCU to either recharge the battery or to drive the motor.

During full acceleration, when both the engine and the electric motor operate together to drive the wheels, the battery supplies more power to the motor and total output increases.

Two-stage motor speed reduction device

The secret of the new electric motor's compact dimensions lies in its connection to a second, dedicated Ravigneaux planetary reduction gear (formed by a double set of planetary gears), which is also aligned with the power split device and generator inside the hybrid transmission casing . This allows torque to be modulated by the two-stage motor speed reduction gearing.

A hydraulic control unit incorporated in the electrically controlled CVT operates two independently controlled brakes to automatically switch the gearing of the electric motor between Low (3.900:1) and High (1.900:1) motor reduction ratio settings, optimising the motor torque distribution over a wide range of vehicle speeds, up to 155mph.

During acceleration in normal conditions, the reduction system performs an almost unnoticeable gear change at approximately 53mph (85km/h). When decelerating, a downshift will occur at about 31mph (50km/h). Thus, the twin-stage gearing generates

maximum low-gear torque for significantly enhanced acceleration, as well as extended high-gear performance.

Hybrid transmission and sequential shift mode

In conjunction with its sophisticated hybrid technology and permanent all-wheel drive, the new LS 600h is equipped with an electrically controlled continuously variable transmission. As the hybrid ECU selectively controls both engine and electric motor rpm, the transmission simulates a continuous variation of the transmission's current ratio to give perfectly linear acceleration.

The new transmission offers a choice of three power settings, chosen by the driver using a Mode Select switch on the centre console. Hybrid gives the best balance of power and traction; Power gives quick response acceleration; and Snow provides better traction in slippery conditions.

The LS 600h's hybrid system can be switched to operate in EV (electric vehicle) mode, letting the car run on the power of its electric motor alone. EV mode (indicated by a light in the instrument control panel), gives near-silent manoeuvring and low-speed running over a range dictated by the level of battery charge. A dashboard light and warning buzzer warn the driver when EV mode cannot be activated, due to excessive throttle demand or insufficient battery charge.

The transmission also offers a sequential shift mode, accessed by moving the gearlever to the S position. This gives eight-step engine braking and shift control akin to that of a conventional automatic. With all up-shift changes taking place automatically, even when the gear selector is in S, each of the seven sequential downshift steps in gearing gives sharper throttle response and engine brake force like a conventional transmission, improving vehicle control and enhancing the driving experience.

LEXUS HYBRID DRIVE IN OPERATION

Over the course of any journey, Lexus Hybrid Drive operates in several different modes to maximise the LS 600h's overall efficiency. In low efficiency conditions, such as at start-up and low to mid-range speeds, the vehicle runs on the electric motors alone, eradicating both engine noise and carbon dioxide emissions.

In normal conditions, the V8 engine serves as the main power source. Engine output is divided by the power split device, both to drive the wheels directly and power the generator,

which in turn charges the high-voltagebattery. In these circumstances, power allocation is constantly monitored and adjusted between the engine and electric motor to maximise efficiency.

When full acceleration is required, engine and electric motor again work in tandem, with extra power supplied from the battery to boost acceleration.

During deceleration, the engine switches off as the driver lifts off the throttle and the electric motor acts as a second generator to effect regenerative braking. This optimises energy management in the hybrid system by recovering kinetic energy, normally wasted as heat under braking and deceleration, as electrical energy for storage in the battery.

When the footbrake is simultaneously engaged, the hybrid system automatically co-ordinates both energy regeneration and braking, prioritising the former to achieve efficient energy regeneration even at low vehicle speeds. Allied to the LS 600h's all-wheel drive, this function operates on all four wheels, not only improving fuel efficiency by charging the hybrid battery under deceleration, but also improving vehicle stability under braking. At lower speeds, for instance, most of the brake force is actually provided by the regenerative braking function.

When the engine is cold and the ignition is switched on, the system will start the engine to warm the unit and the catalytic converters. After that the engine will stop automatically when the vehicle is at rest, to conserve fuel. However, if the vehicle is at idle for prolonged periods, the engine will automatically crank up whenever necessary to charge the high-voltage battery via the generator.

Furthermore, in all driving conditions, the level of battery power is constantly managed by a dedicated ECU, preventing it from reaching extremes.

The Lexus hybrid powertrain delivers smooth, linear acceleration, avoiding the familiar 'jumps' between gears that occur in a conventional drivetrain, and in all conditions and at all speeds, it delivers a significantly higher level of refinement.

DRIVING DYNAMICS

The Lexus LS 600h benefits from a highly rigid, lightweight body, aerodynamically styled to achieve a class-leading drag coefficient. It also uses Adaptive Variable Suspension (AVS) with vehicle posture control, active stabiliser control and the latest generation of Lexus's Vehicle Dynamics Integrated Management (VDIM) system, incorporating Variable Gear Ratio Steering (VGRS).

BODY STRUCTURE

The LS 600h's body is constructed from a combination of high-tensile steel and aluminium components, giving it exceptional rigidity and torsional stiffness with a light weight.

Ultra-high-tensile steels account for about 40 per cent of the body, with different types used in specific areas, such as the front member, B-pillar, rocker and roof sides, to further reduce weight, increase rigidity and provide class-leading safety performance in a collision.

The Lexus LS 400 was the world's first car to use high-precision laser welding in the build process. Use of this technique has doubled since the previous generation LS, contributing to both greater manufacturing accuracy and increased rigidity. A combination of spot and laser welding to the door opening crank area and room partition area maximises the cabin's torsional strength.

AERODYNAMICS

Seventeen years ago, the LS 400 achieved a drag coefficient of 0.29. Since then, each successive LS generation has maintained class-leading aerodynamics, a reputation upheld by the new LS 600h, which has a Cd of 0.27.

The sleek, flowing bodywork has exceptionally narrow panel gaps and minimal protrusions. Flush bonnet, headlight and windscreen surface surrounds minimise separation of the airflow; even the door mirrors are tailored to reduce turbulence around the A-pillar. At the rear, clean passage of air to reduce drag is promoted by the smooth convergence of the tapering waistline and sweeping C-pillar at the duck-tailed boot, and careful integration of the twin exhausts in the rear bumper, which itself is profiled to incorporate two discreet diffusers.

Front and rear lift balance has been optimised and the addition of numerous aerodynamic under-body elements creates a smooth, flat surface to enhance high-speed vehicle stability and reduce wind noise to a minimum. These elements include a deep front spoiler, side skirts, bespoke front and rear tyre fairings and covers for the cabin floor, hybrid transmission

and fuel tank. Even the body attachment points are designed with a flat concave seating to help minimise wind turbulence. The fully flat central undercover has exceptional noise absorption qualities, particularly at higher frequencies, when compared with the LS 600h's direct competitors.

The result of all this is front and rear coefficient of lift figures of 0.02 and 0.01 respectively. The rear coefficient of lift – fundamental to high-speed cornering ability, is 0.06 lower than that of any competitor, as measured by Lexus in its in-house testing.

ALL-WHEEL DRIVE

The LS 600h's all-wheel drive has a three-differential configuration and a propeller shaft, coupled directly to the hybrid transmission. A central, permanently engaged Torsen limited slip differential distributes drive power between the front and rear axles.

Because both Type A and Type B Torsen differentials provide an equal 50:50 torque distribution, Lexus engineers developed a highly compact Type C Torsen differential for the LS 600h. This gives a 40:60 rear axle bias that successfully suppresses understeer and gives the ride comfort and stability under acceleration that are characteristic of rear-wheel drive and fundamental to a premium segment saloon. The Type C differential's highly responsive torque distribution qualities are continuously controlled and, according to driving conditions, can be varied from a 48:52 to 31:69 split between the front and rear axles. This helps enhance grip, traction and cornering stability under acceleration to class-leading levels.

In order to accommodate the gear transfer without sacrificing legroom in the cabin, Lexus rejected even the smallest and lightest Torsen system currently available. It took three years to develop a new unit that is smaller and lighter than any other available, with both elements of the transfer and differential gearing housed in a single casing.

The new transfer replaces conventional chain-drive with a compact three-axis gear configuration that is also quieter overall. Further reduction in noise from gear engagement was achieved by precision polishing of the gear teeth. Also, the optimum number of teeth was determined, to negate resonance.

Further noise and vibration reductions have been achieved by adopting a cross-grooved, uniform velocity joint for the front propeller shaft and three-joint flexible coupling shaft to the rear.

AIR SUSPENSION AND ADAPTIVE VARIABLE SUSPENSION

The LS 600h has a significantly revised front suspension design, in order to harness the greater power from the all-wheel drive transmission. The multilink front and rear design uses new-design pneumatic cylinders with monotube shock absorbers. These operate in conjunction with an improved Adaptive Variable Suspension system (AVS), which features a vehicle posture control system to synchronise vehicle roll and pitch when cornering.

Front suspension

The LS 600h has an upper and lower double joint front suspension derived from that used by the LS 460, with revisions to the lower arm layout to accommodate the all-wheel drive system.

There are two key geometric features of this format. First, an increase in the big kingpin angle has improved jack-up torque within the forward-mounted steering gear, enhancing steering main shaft torque and bringing a considerably more prompt response to steering input. Second, the centre kingpin offset has been reduced by 16 per cent, from 61.6 to 51.9mm. This not only elicits a flatter ride, it also reduces the transmission of disturbing torque reactions from the tyres under braking.

Rear suspension

At the rear, the proven multilink set-up combines stiffer component materials with a reduction in unsprung mass for greater ride comfort with exceptional cornering stability. All five suspension arms and the pneumatic shock absorber upper support ring are forged in aluminium.

The rear geometry has been designed to generate a particularly linear toe-control curve, with the toe control link installed to the rear of the axle to offer a high level of straight-line stability. In addition, the adoption of two, fully independent upper arms greatly enhances the compliance steer response time of the tyres. Each upper arm controls both lateral and longitudinal forces, while the lower rear arm controls lateral and the front rear arm longitudinal forces. This configuration introduces vertical force steer to the wheel, lowering the side force rising time and reducing response delay almost 50 per cent. This brings improvements in both steering response and stability through the normal speed range.

Adaptive Variable Suspension

The dynamic characteristics of the Adaptive Variable Suspension (AVS) system's pneumatic dampers have been enhanced by increasing air pressure by 20 per cent compared to the previous generation LS. This gives the LS 600h sharper handling and better system response to changing road conditions. A revised design features a metal cylinder that limits air expansion to reduce pneumatic hysteresis and improve high-frequency ride comfort. Movement of the sprung mass has been further controlled by optimising bound stopper clearance.

AVS is designed to suppress vibration in the vehicle's sprung mass and further hone precision damping force control. The system detects jarring and irregular frequencies through a vertical acceleration sensor, and resonance frequencies in the unsprung mass via the wheel speed sensors. It suppresses vibration in several modes: it will reduce the degree of damping force when driving on rough roads to give a smooth and comfortable ride; similarly, it increases the damping force as appropriate when resonance is detected in the unsprung mass. VDIM co-operative control adjusts the damping force in conjunction with the vehicle's stability control system to maximise efficiency.

AVS allows the drive to fine-tune the LS 600h's ride characteristics with a choice of three damper settings, selected using a switch next to the gear lever. Normal mode is for everyday driving; Comfort gives improved comfort on rougher surfaces; and Sport improves body control and gives precise steering response when cornering.

In any mode, AVS automatically adjusts suspension performance at all four wheels independently. Analysing data from sensors monitoring the engine speed, wheel speed, steering, stop lamp, front and rear vertical height and vertical acceleration (G-force), the system computer continuously optimises the damping force of each shock absorber through nine incremental steps.

In this way, AVS responds to driving characteristics, vehicle body motion and road surface conditions by activating the adjustable damping force shock absorbers to fulfil a wide range of specific control functions.

- Vehicle speed-sensitive control gradually increases damping force as speed rises, combing low-speed comfort with high-speed driveability and stability.
- Anti-dive control increases the front end damping force under braking to reduce dive.

- Anti-squat control increases rear end damping force to minimise squat during acceleration.
- Roll control optimises vehicle posture and stability by adjusting the damping force to both inner and outer shock absorbers as the vehicle passes through a bend.

In addition, a vehicle height control function automatically maintains optimum ground clearance, regardless of load weight and passenger distribution. This control also features a switchable vehicle height mode, which lets the drive choose a normal or high setting. It also automatically lowers the vehicle when driving at high speed to optimise the vehicle's aerodynamic efficiency and stability.

Selecting the AVS's Sport mode automatically increases the difference between inner and outer shock absorber damping through corners to further reduce roll. At the same time, the Active Stabiliser system engages the front and rear anti-roll bars, and the Variable Gear Ratio Steering (VGRS) reduces the steering gear ratio by approximately 10 per cent. The Electric Power Steering (EPS) increases steering assist torque by about four per cent. These measures work together to minimise body roll, sharpen handling and optimise steering feel.

H ∞ control system

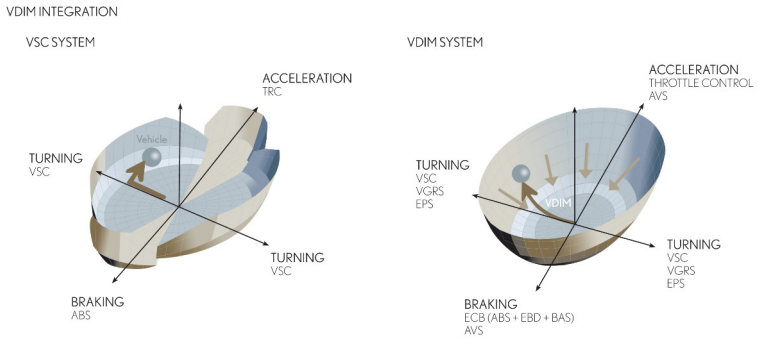
The AVS incorporates a new H ∞ control system damping force control logic to minimise the phase difference between body roll and pitch angles during cornering. Research by Lexus engineers revealed that a large phase difference between roll and pitch angles can cause passenger discomfort, as it exacerbates the perception of vehicle body roll.

This new control logic estimates both pitch and roll angles from the G-sensor value on the spring mass, computing a target pitch angle from the resulting roll angle. Vehicle posture control applies feedback control via the pneumatic dampers to minimise differences between target and actual pitch angle. This in turn minimises the phase difference between roll and pitch angles. This phase synchronisation brings a smooth, controlled roll when cornering, with a well matched vehicle response to steering, yaw and roll, and an enhanced perception of rear tyre grip.

Vehicle Dynamics Integrated Management

The new LS 600h is equipped with the latest generation of Lexus's Vehicle Dynamics Integrated Management (VDIM). Discussed fully in the Safety section of this press pack, this version of VDIM has been specifically developed in conjunction with the LS 600h's all-wheel

drive transmission to improve traction control and stability. With comprehensive status data provided by sensors throughout the vehicle, VDIM integrates the Electronically Controlled Braking (ECB), anti-lock brakes (ABS), Electronic Brakeforce Distribution (EBD), Traction Control (TRC) and Vehicle Stability Control (VSC) active safety systems with the Adaptive Variable Suspension (AVS), Electric Power Steering (EPS) and Variable Gear Ratio Steering (VGRS).

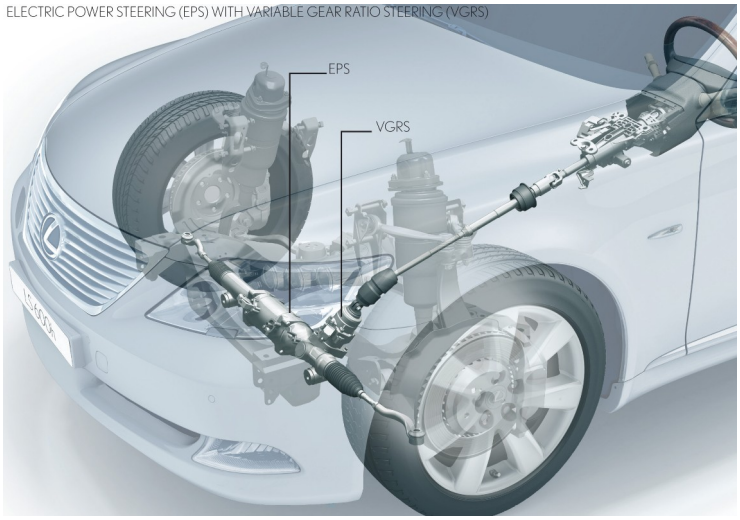


The Driving Response and Acceleration Management System is unique to the LS 600h, giving VDIM unprecedented interaction with both engine and transmission. This employs engine and electric motor output control to effect a faster, smoother and more precise response to situations where there is a risk of loss of traction, such as unwanted mid-corner gear changes.

Whereas conventional active safety systems are only activated immediately after the limit of a vehicle's performance has been reached, VDIM progressively engages before that threshold is reached. As a result, it gives smoother vehicle behaviour through less obtrusive intervention.

ELECTRIC POWER STEERING WITH VARIABLE GEAR RATIO STEERING

The LS 600h is equipped with a high-power, speed-sensitive Electric Power Steering (EPS) system, featuring Variable Gear Ratio Steering (VGRS). This electrically assisted steering system offers noise-free operation and seamless, linear feedback, smoothly changing assistance characteristics depending on vehicle speed. These systems form an integral part of the Vehicle Dynamics Integrated Management and the Pre-Crash Safety System's Emergency Steering Assist function.



The new EPS is designed specifically for the LS 600h's front multilink suspension design and 19-inch tyres. It has a newly developed step-up DC-DC power converter that increases output from 27 to 46 volts and a bespoke, 110mm diameter high-output brushless motor. Assembled with high precision, the smooth running motor has approximately double the output capacity of a conventional power steering unit.

The adoption of a new, high-rigidity steering intermediate shaft and a slider joint with zero rotational clearance gives the LS 600h an exceptionally smooth, direct steering feel, with agile and linear yaw response and very detailed feedback.

VGRS employs an actuator attached to the intermediate steering column shaft, which alters the steering gear ratio according to vehicle speed. The ratio can be varied by up to 30 per cent, representing a 130-degree phase in steering wheel angle. At very low speeds, the gear ratio is at its lowest – 2.3 rotations lock-to-lock – to reduce both the steering input and effort required during tight cornering and parking manoeuvres.

At medium speed, the ratio is optimised for light, accurate vehicle response when cornering. And at high speed the ratio is at its highest – 3.7 turns lock-to-lock – to ensure gentle response to inputs and maximum vehicle stability.

The VGRS actuator is connected directly to the EPS gear. The small, high-output motor has a hollow structure to accommodate the torque sensor shaft. The VGRS system promotes excellent driver feedback, with refined steering wheel operation at very low speeds, reduced understeer feel, enhanced steering adjustment response when cornering and minimal steering angle adjustment required when changing lanes.

The actuator is also linked to the VDIM system. The VDIM constantly re-evaluates the steering gear ratio as the vehicle reaches the limits of its performance envelope, to optimise

the front wheel steering angle and so maintain vehicle stability with minimum driver input. VGRS also cooperates with the Emergency Steering Assist system in providing a quicker steering response when an obstacle has been detected in front of the car.

In addition to the numerous technical improvements made to improve steering feel and response in all conditions, Lexus also ensured the LS 600h has excellent manoeuvrability with a 5.7-metre turning radius (5.9m for the LS 600h L).

ELECTRONICALLY CONTROLLED BRAKING AND BESPOKE TYRES

The LS 600h has an electro-hydraulic braking system. This not only reduces the overall weight of the brake system, it also allows for more precise brakeforce distribution, which in turn supports optimum operation of the VDIM system, and the ABS, EBD, Brake Assist Systems (BAS), Traction Control (TRC) and Vehicle Stability Control (VSC) functions.

The ECB features powerful 357mm front and 335mm rear discs, both with spiral fin ventilation, high heat radiation architecture and high grip coefficient brake pads to further increase judder-free high-speed braking efficiency. The system generates unparalleled stopping power with four-pot callipers at the front and two-pot callipers at the rear, both made of aluminium to help reduce the unsprung weight.

As with the LS 460, the LS 600h features a revised ECB system with a new ECU that has a significantly faster processing speed than the previous unit, installed in the Lexus GS. The revised ECB gives more precise control of the brake hydraulic pressure and improves responsiveness. Pedal feel is also improved with greater rigidity and a reduction in both the variation in braking forces and the operational lag time after brake application.

With the system, independent hydraulic braking power can be applied to each of the four wheels. Once engaged, a sensor detects the amount of force applied to the brake pedal. Hydraulic power is then calculated and applied to each as wheel as necessary, by ECU adjustment of the pressure at the hydraulic source.

In order to achieve class-leading braking performance, development focused not only on optimum ABS performance, but also on the road surface resistance of the 245/45R19 tyres. In cooperation with Lexus engineers, tyre manufacturers tested a significant number of prototypes to achieve the required level of surface resistance, allied to the steering stability, ride comfort and minimal noise and vibration appropriate to the flagship of the Lexus brand.

DESIGN AND REFINEMENT

The new LS 600h is the ultimate expression of Lexus's L-finesse design philosophy, demonstrating that a premium saloon can be understated, yet inspiring.

L-finesse is a ground-breaking design rationale that is deeply rooted in Japanese culture, both ancient and modern. Its direction expresses three fundamental elements: Incisive Simplicity, perhaps best explained as purity; Intriguing Elegance, a sense of depth that appeals to the emotions; and Seamless Anticipation, part and parcel of traditional Japanese hospitality, wherein experience and care are essential to anticipating the needs of your guest.

In this way L-finesse not only reflects the perfect harmony of simplicity and complexity inherent in traditional Japanese aesthetics, it also represents a commitment to the pursuit of unique human machine interface solutions, achieving the ultimate in luxury through pre-emptive anticipation of passenger requirements.

The new LS 600h embraces this design direction with styling that is vivid and forceful, yet at the same time warm, inviting and entirely contemporary. With its long cabin, broad, purposeful, ground-hugging stance and elegantly sculpted, streamlined body contours, the LS 600h emphasises simplicity and style in a stunning modern package.

On board, the LS 600h's flagship status can be witnessed in the painstakingly crafted full-leather dashboard and instrument panel and the peerless finish of the real wood highlights, for example on the gear shift lever, grab handles and heated steering wheel rim.

EXTERIOR DESIGN

The LS 600h shares numerous L-finesse design cues with the Lexus GS and IS, but achieves a unique harmony of simplicity and complexity through the dynamics of contrast. It marries the Incisive Simplicity of powerful, sweeping lines with the Intriguing Elegance of natural but sudden contrasts in form, allied to convex and concave shadow surfacing. This reinforces the central principles of the new design philosophy and subtly conveys the car's power and dynamism.

At the front, the wide, horizontally latticed grille immediately identifies the vehicle as a Lexus. A transparent blue coating on the 'L' emblem hallmarks the LS 600h as the hybrid flagship of

the LS model range. It is the first car in the world to feature low beam LED headlight technology and a transparent blue ring is fitted around the circumference of the three powerful projector lenses, which, with the new white LED clearance lamps, give the LS 600h a unique and easily identifiable headlamp signature.

The large, purposeful headlights are positioned on a higher plane than the grille, creating a frontal balance that reinforces the car's dynamism. The carefully considered disposition of the key frontal elements is characteristic of L-finesse design, creating a resolute and imposing appearance.

The Incisive Simplicity of a strong arrowhead shape in the headlamp glazing generates a strong coachwork line that sweeps seamlessly into the A-pillar. This key L-finesse motif expresses dynamism through a rapid, yet fluid change in direction, creating an analogy to Japanese calligraphy, or the stroke of a Samurai sword. It is further evident in both the arrowhead and slingshot sculpting of a number of exterior details.

In profile, both the bonnet line – extending over the roof – and the belt line are uninterrupted for the full length of the vehicle. The latter highlights the Intriguing Elegance of both the front wings and the shadow surfacing of the door panels.

The proportions of the extended cabin express L-finesse design philosophy, with the base of the windscreen and the base of the rear window proportionally equidistant from the vertical axis of their respective wheel hubs, further reinforcing the vehicle's generous interior dimensions.
The blacked-out B-pillar emphasises the clean homogeny of the side glazing, which is framed by an elegant, one-piece zinc moulding that features both a trademark slingshot graphic at the rear and strong arrowhead motif detailing at the A and C-pillars. A Hybrid emblem is located on the side rocker moulding, denoting the hybrid drivetrain, and the vehicle rides on bespoke 19-inch alloy wheels.

At the rear, the roofline flows smoothly into the surface of the boot lid. The belt line, having defined the upper edge of the large, wrap-around tail-light clusters, terminates at the top of a sharply truncated rear boot panel, which itself is deeply incised into the rear bumper. Intriguing Elegance is again expressed through harmony of simplicity and complexity: the overall simplicity of the broad, muscular design, enriched by the detailed complexity of the slingshot motif shaping the LED lamp clusters. An innovative exhaust design seamlessly

integrates the tailpipes within the bodywork, while cleverly mirroring the arrowhead fog lamp and air intake detailing in the front spoiler.

So successfully are design and functionality combined in the LS 600h, it boasts a class-leading drag coefficient of 0.27.

EXTERIOR DETAIL HIGHLIGHTS

The exterior design of the LS 600h is more than a pure exercise in style, it is the result of close cooperation between the Lexus Design Division and Development Centre and the Tahara plant, which worked together to bring to life the fluidity and emotion shown in the initial design sketches.

LED Low Beam Headlamps

The LS 600h is available with the world's first application of low beam LED headlight technology, giving excellent illumination and lasting significantly longer compared to conventional systems. The LED lamps illuminate in about one tenth of a second and emit a white light closest to natural daylight. For more information on the lights, please refer to the technical glossary.

Paint Finish

The LS 600h production line combines latest generation robotised paint coating technology with the master craftsmanship of two hand polishing techniques. The vertical surfaces are wet-sand hand polished after each foundation coat application and are checked by eye as well as digitally to achieve the highest perceived quality. This is followed by water polishing of the entire foundation coat, by hand, before the top, clear coating process. This ensures both a physically and visually unmatched finish quality.

To improve paint durability, an acid rain-resistant coat is applied to the body, along with a scratch-resistant coat for dark colours. The bumpers are treated with two layers of liquid clear coating.

A range of 10 colours is available, including new Obsidian Black mica, a jet black finish which reveals blue and purple undertones in bright sunlight and which is exclusive to the LS 600h.

Seamless Door Mouldings

The side glazing surrounds are fundamental to the LS 600h's elegant, sweeping profile. They are finished in a seamless, integrated zinc die cast moulding, with a differing section width along its length. Creating this unique design element required the complete remodelling of production equipment and the restoration of an old manufacturing technique for injection moulding molten zinc, originally used for the first-generation LS400.

To meet the exceptional standards required for the LS 600h, engineers at the Tahara plant opted for high pressure injected casting. A high vacuum depressurisation system was employed to instantaneously extract the formed gas, simultaneously with the injection of the zinc, ensuring a high quality, cavity-free casting. Once again, the skill of master craftsmen has been essential, for the hand buffing of sections that cannot be reached by robots and for the sub-millimetric precision of component fit.

INTERIOR DESIGN

The interior of the LS 600h has been designed to reflect the car's high content of ground breaking safety features, with sculpted designs that convey a sense of security and luxury. The cabin is clearly divided into four independent areas, with seats and door trims shaped to give each passenger the feeling of being securely enveloped.

The L-finesse design philosophy can be seen in many areas, including the top of the centre console and in the fluidity of the seam line of the front door trim, which extends up to the belt line. The detailing in the door trim and optional full leather dashboard give the interior a consistent appearance, achieved by painstaking matching of materials with identical graining and finish.

The wide centre console, which grows from the transmission tunnel and extends laterally across the dashboard and into the front and rear door panel trims, effectively ties the entire cabin design together. The synergy between the interior and exterior designs can also be seen in the EMV touch screen surround, which repeats the contrasts struck in the headlamp, grille and glazing frames.

Five interior colour combinations are available, each with complimentary upper and lower dashboard leather finishes and co-ordinated real wood highlights in walnut, ash burr or birdseye maple.

The interior surfaces express a richness of craftsmanship that is fundamental to the Japanese aesthetic tradition. The highest quality wood, leather and elegant metal highlights

are combined with unprecedented precision management of fit and finish. Component gaps have been refined and reduced by more than 50 per cent compared to the previous generation LS. With some fittings, the tolerance level has been reduced to a previously unattainable 0.5mm.

Superb ergonomics and tactile, functionally intuitive switchgear are a further hallmark of the interior. The complex profile of the centre console demonstrates Lexus's scrupulous attention to ergonomic detail. The outer sections to the top of the centre cluster are flat, so that buttons can be seen from both sides of the cabin, but lower down these edges become curved, to coincide with the temperature control buttons, which are independent for each seat. The surface of each has been shaped to alternate between concave – for accurate use – and convex – for easy location on the console. The attention to the smallest detail can also be witnessed in the way every lid in the console opens in the same direction and at the same speed, with consistent damping, whatever the ambient temperature.

The LS 600h's human machine interface (HMI) is an eight-inch, touch-sensitive Electro Multi Vision screen with 32,000-colour VGA graphics. It is designed to be particularly user-friendly, allowing any operation to be effected in a maximum of just three steps.

INTERIOR DETAIL HIGHLIGHTS

Great care has been taken to guarantee ergonomic excellence, tactile quality and seamless activation of controls and switchgear throughout the cabin, as well as making all the instrumentation clearly visible. Every mechanism has been designed to improve its tactile, visual and aural qualities when activated.

Full Leather Dashboard

The full-leather dashboard, available in the Upholstery Upgrade Pack, is created by combining state-of-the-art technology with the skills of master craftsmen, using the finest hides sourced from around the world.

Traditional, two-dimensional leather cutting patterns can lead to unsightly stretching when they are applied to a curved surface. To remedy this problem, Lexus engineers developed a three-dimensional technique, which conforms to the curve of the dashboard right from the outset. The finest stitching quality has also been perfected, using cross-hatched seams over folded back sheer edges to ensure the sewn area does not bulge, even where four separate sheets of leather meet. A machine cannot accomplish this level of complex stitch-work, so

each individual phase is carried out by expert craftsmen, guided by a laser pointer to give an accurate line.

The inserts to which the leather is bonded are cleaned in advance using ultra violet light and oil content on the surface is eliminated, to ensure optimum bonding. To avoid marking the leather during bonding, uniform pressure is applied with a rod-shaped balloon, while warm air is blown from behind the dashboard base material to melt the adhesive. The balloon itself is filled with cool air, to protect the leather surface from any risk of heat damage.

Steering Wheel Leather

The four-spoke steering wheel is trimmed in a leather specially chosen for its smooth surface. The leather treatment process has been completely redesigned for the new-generation LS, being buffed twice before being pressed for twice as long – from one-and-a-half to three hours – to achieve the best durability, feel and grip. The stitching pattern inside the rim has been changed from baseball to cross stitching for better gap control and comfort. Particular attention has been paid to the thumb contact area, with both the stitch pattern and position revised to give the smoothest possible feel.

Craftsmanship in wood

Nowhere in the LS 600h is the combining of modern technology and traditional craftsmanship skills more successfully demonstrated than in the cabin's real wood trim highlights.

The woods – ash burr, walnut and birdseye maple – are sourced from sustainable plantations in Canada. Each piece is laminated to an aluminium backing plate to provide rigidity, then treated with multiple coats of lacquers to give an ultra-high gloss, scratch-resistant finish.

Interior Mechanisms

Close attention has been paid to the shape, feel and legibility of every interior switch and they are rationally grouped according to their function. More than that, each has a different activation pressure in line with their purpose, so that those which are critical from a safety perspective require the firmest pressure, precisely matched across the switching group.

The operational speed and feel of different features such as the centre console, door pockets, coin and glove boxes, ashtray, assist grips, sunglasses holder, rear vanity mirror and coat hooks have been carefully matched to give a stable, uniform and visually appealing

opening action, with a consistent feel, minimal noise and clean stop action. For easier operation, both the glove box and centre console lids now have a purely mechanical, semi-automatic opening and closing system.

Extensive durability testing has been carried out on these interior components and attention paid to the movement and the sound made by all motor driven features, such as the windows, mirrors, sunshades, sunroof, seats, wipers and even the steering lock and DVD player. Each power unit has been developed exclusively for the vehicle, with the emphasis on smoothness and quietness rather than speed of operation, with a uniform loudness and tone quality.

Hybrid System Indicator and Energy Monitor

A discreet hybrid system meter is incorporated in the LS 600h's Optitron instrument binnacle. Its dial is divided into Eco and Charge segments, indicating when the driver is achieving low fuel consumption and the hybrid system is regenerating energy.

A separate energy monitor can be called up on the multi-information display screen, allowing the driver to monitor in real time both the energy flow through the hybrid system and the charge status of the battery.

The Optitron meters themselves have a new design, with a thinner construction and a low-reflectance paint. Higher-intensity LEDs provide more uniform illumination and better all-round visibility. In addition, the luminosity of both the Optitron meters and the colour multi-information display changes in relation to peripheral light levels, varying through several graded increments rather than just two, as previously. This means instrument panel visibility adapts perfectly to the widest range of ambient light conditions.

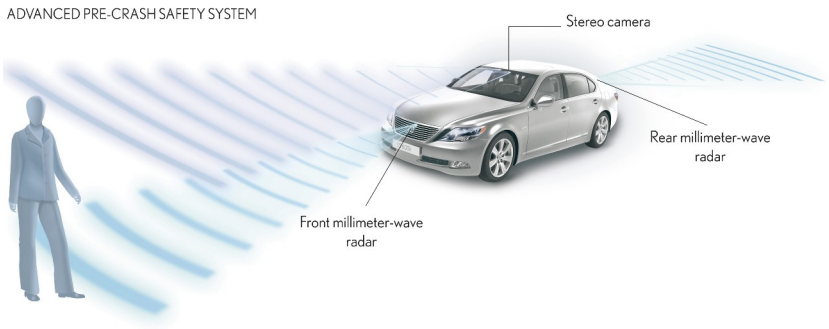
SAFETY AND DRIVER ASSISTANCE

Through its development of revolutionary safety systems based on the principle of accident avoidance through intelligent anticipation, Lexus now offers the highest content of sophisticated preventive, active and passive safety technology in the world. The new LS 600h extends the class-leading achievements of the latest-generation LS range by becoming the first car in the world to use low-beam LED headlamp technology.

ADVANCED PRE-CRASH SAFETY SYSTEM

The new LS600h takes anticipatory, preventive safety to new heights. Its unprecedented combination of leading edge features is designed to give advance recognition of potentially dangerous situations, and help the driver reduce the chances of an actual collision and its consequences. At the same time, the best possible protection is provided not only for the vehicle occupants, but also for pedestrians.

Engineers at the Lexus Development Centre incorporated new features in the already sophisticated Pre-Crash Safety (PCS) system that anticipate and automatically react to several types of impending collision. Pre-Crash Safety, with Adaptive Cruise Control (details below), is fitted as standard to the LS 600h and LS 600h L.



Advanced Obstacle Detection System

Subject to weather conditions, the PCS Advanced Obstacle Detection System can recognise a wide range of obstacles in the vehicle's path, including pedestrians, by day or night.

The system combines information gathered by both a millimetre-wave radar and an infrared stereo camera. The 76GHz radar is mounted behind the grille and scans the road ahead. The camera consists of two near-infrared CCD lenses, mounted 350mm apart at the head of the windscreen and generates digital video data by capturing the near-infrared radiation generated by dedicated emitters built into the headlamps' high beam projectors, when it is reflected by objects directly ahead of the car. According to local conditions, the camera has the ability to detect pedestrians and animals, even after dark.

Emergency Steering Assist

Emergency Steering Assist improves the vehicle's response to driver steering input when a collision is deemed likely, increasing the chances of avoiding the obstacle. This is achieved through close interaction between the Variable Gear Ratio Steering (VGRS), Vehicle Dynamics Integrated Management (VDIM) and Adaptive Variable Suspension (AVS).

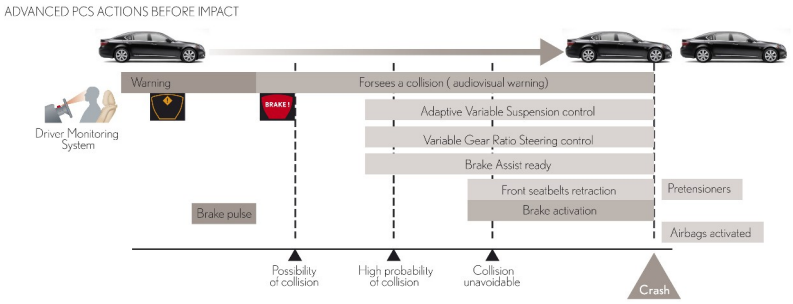
Emergency Steering Assist selects the most appropriate steering gear ratio for a rapid evasion manoeuvre. The VGRS actuator, which is attached directly to the intermediate steering column shaft, reduces the ratio to provide more direct steering, improving response to driver inputs. The AVS simultaneously adopts a stiffer damper setting to minimise body roll, optimising chassis balance for improved vehicle response. In addition, VDIM offers selective brake control to efficiently govern the car's yaw rate, allowing quick changes of direction without threatening overall vehicle stability.

Driver Monitoring System

The Advanced Pre-Crash Safety system features the world's first Driver Monitoring System. This uses a CCD camera mounted on top of the consistent detection performance by day and night.

The system uses an algorithm to map the position of the driver's facial features and measure the width and centre line of the face. Using this information it is then able to monitor movement of the driver's head when he or she looks from side to side. If the driver's head is turned away from the road at an angle of more than 15 degrees and an obstacle is detected ahead, the system automatically activates the Pre-Crash warning buzzer and briefly applies the brakes to warn of the danger.

The system operates regardless of the driver's seat position or facial characteristics, even if the driver is wearing sunglasses, as long as the face is in clear line of sight of the camera.



PCS Actions Before a Frontal Impact

Once the Advanced Obstacle Detection System has identified a hazard in front of the vehicle, PCS assesses the likelihood of a collision based on the position, speed and trajectory of the object. If it calculates a high collision probability, it activates a warning buzzer and a red screen BRAKE alert on the Multi Information Display.

After testing the reaction of numerous different drivers, Lexus engineers determined the most appropriate engagement timing for all Pre-Crash functions, to substantially improve the chances of the driver reacting in time to avoid a collision.

Therefore, just before impact, the advanced PCS will automatically activate several integrated safety systems:

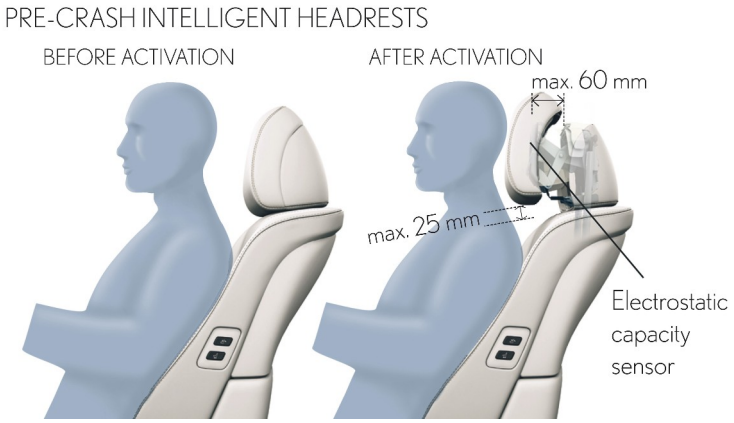
- Pre-Crash Brake Assist is put on stand-by, providing maximum braking pressure the moment the driver activates the brakes.
- Emergency Steering Assist reduces the steering ratio and stiffens the suspension
- VDIM ensures vehicle stability to allow for the most effective evasion manoeuvre

If the system subsequently determines that a collision is unavoidable, PCS then activates the Pre-Crash Seatbelt, pre-tensioning the front belts by motorised uptake of any slack, to maximise their initial restraint performance. Pre-Crash Brake automatically engages the brakes to reduce vehicle speed at the point of impact and, hence, reduce the consequences of the collision.

On a dry road surface, the maximum deceleration offered by the Pre-Crash Brake is between 0.6 and 0.7G. Internal testing has revealed that intervention by the system can substantially reduce impact energy.
A further feature of the PCS system is automatic activation of the Pre-Crash Seatbelt pretensioners, should the vehicle's yaw rate rise above a certain threshold.

Rear Pre-Crash Safety System
The LS600h is fitted as standard with the world's first Rear Pre-Crash Safety system. The system operates both when the vehicle is moving and when stationary.

A 76Ghz millimetre-wave radar installed in the rear bumper constantly scans the area around the back of the vehicle. If a collision is deemed unavoidable, the system automatically activates the front seat Pre-Crash intelligent Headrests, which move by up to 60mm forwards and 25mm upwards to cushion the occupant's head in anticipation of an impact, greatly reducing the risk of whiplash injury. The headrest incorporates an electrostatic capacity sensor to calculate the distance between the passenger's head and the headrest, so that it automatically stops before making substantial contact with the head.



ACTIVE SAFETY

The LS 600h's comprehensive active safety equipment includes two segment firsts: Lexus's unique Vehicle Dynamics Integrated Management (VDIM) system and Variable Gear Ratio Steering (VGRS) establish an unprecedented link between active and preventive safety measures. And not only do they provide additional protection, they also add to the car's pure driving pleasure.

Vehicle Dynamics Integrated Management (VDIM)

The LS 600h is equipped with the most recent evolution of Lexus's Vehicle Dynamics Integrated Management (VDIM), to enhance performance, traction control and vehicle stability. VDIM integrates the Electronically Controlled Braking (ECB), ABS, Electronic Brakeforce Distribution (EBD), Traction Control (TRC) and Vehicle Stability Control (VSC) active safety systems with the Adaptive Variable Suspension (AVS), Electric Power Steering (EPS) and Variable Gear Ratio Steering (VGRS).

The Driving Response and Acceleration Management System (DRAMS), unique to the LS 600h's drivetrain, enables VDIM unprecedented interaction with the engine and transmission, using engine and electric motor output control to effect a faster, smoother and more precise response to situations where there is a risk of loss of traction, such as mid-corner gear changes.

VDIM was the first stability control system on the market to fully integrate all these functions within a single system. Whereas a conventional system can only govern one active safety feature at a time – potentially causing significant delays – VDIM gives integrated, simultaneous commands to every appropriate function to achieve independent wheel control and keep the vehicle to its desired trajectory.

VDIM activates control functions in stages, before the vehicle reaches the limit of its performance. This is made possible by a built-in ECB actuator that can control the hydraulic brake pressure on each wheel independently and progressively, maintaining smooth vehicle behaviour.

VDIM can adapt when snow chains and winter tyres are fitted, by reading the road parameters and acting appropriately to minimise loss of grip. Communication between VDIM and other body controls is via a large capacity network with three CAN multiplex units.

Creation of an adequate control logic was crucial to development of the latest version of VDIM. Compatibility tests were carried out continuously until the final development stage of each control system and reliability test programmes spanning a range of thousands of patterns were incorporated in the VDIM ECU. The number of test cycles was substantially increased and, to test the system's robustness, several long-run trials were conducted in several different countries.

Variable Gear Ratio Steering (VGRS) and VDIM Cooperation

The Variable Gear Ratio Steering (VGRS) employs an actuator attached to the EPS gear housing, which alters the ratio according to vehicle speed. At very low speeds, the gear ratio is at its lowest, 11.7:1, to reduce the input and effort required for tight cornering and parking manoeuvres. At medium speeds the ratio is optimised for light, accurate vehicle response when cornering. And at high speed the ratio is at its highest, 18.4:1, to ensure a gentle response to inputs and maximum vehicle stability.

VGRS cooperates fully with the VDIM system to ensure the most rapid and appropriate steering response to a range of vehicle stability threshold conditions. For example, on a road surface with different degrees of grip on either side of the vehicle, sudden braking will cause the car to pull towards the side with the higher friction coefficient. As well as optimising the efficiency of the Electronically Controlled Brake (ECB) system, VDIM simultaneously activates the EPS and VGRS systems to automatically regulate the steering angle and counteract the different left and right-side braking forces, minimising the input required from the driver to maintain straight-line braking. Similarly, when differing levels of grip cause the vehicle to pull towards the side with a lower friction coefficient under acceleration, VDIM automatically regulates the steering angle to maintain stability with minimum driver input.

In the event of oversteer, VDIM activates independent wheel brake control through the ECB and, in cooperation with the EPS and VGRS, engages a counter-steer function to help the

driver control the vehicle's direction. In such conditions, the combined use of brake and steering control reduces the deceleration inherent in traditional braking systems, promoting a smoother and more dynamic driving experience.

In the case of excessive understeer, an increase in the steering gear ratio by the VGRS, together with steering torque assistance from the EPS, automatically curbs excessive steering and, in conjunction with the VDIM system's engine output and brake controls, maintains optimum vehicle stability.

In all the above scenarios, VDIM uses VGRS and EPS to assist the driver in making the right steering input, helping him or her maintain vehicle stability. Moreover, simultaneous VDIM control of the Adaptive Variable Suspension (AVS) automatically regulates the shock absorber rates to optimise body control under extreme conditions and minimise vehicle nose dive during emergency braking.

Electronically Controlled Brake (ECB) system

The LS is the only car in its segment to feature an electro-hydraulic braking system. Using this electronic control achieves a reduction in the overall weight of the brake system and allows for more precise brake distribution. Closer cooperation is achieved with related vehicle systems, which benefits VDIM operation, aided by a new ECU with twice the processing speed of the previous system installed in the Lexus GS.

PASSIVE SAFETY

The Lexus LS 600h has been created with the express aim of achieving class-leading safety in terms of full-frontal, offset, side and rear collisions. Internal testing confirms it has the potential to achieve a maximum five-star rating for adult occupant protection in the Euro NCAP crash test programme.

Safety Structure

Reflecting Lexus's stringent car-to-car compatibility standards, the LS 600h has been developed around a Lexus Advanced Compatibility Safety Structure, an all-new, high-rigidity platform with a robust structure capable of absorbing a high degree of impact energy.

The quantity of high-tensile steel used in the body has been increased to produce a lighter, high-stiffness structure capable of superior energy absorption. The frontal energy absorption structure combines a four-compartment profile aluminium crush box with a lower, four-compartment aluminium member that is an extension of the crushable front suspension

member. Careful positioning of the compartmentalising plates with both the main crush box and the ancillary member optimises load distribution to ensure an even deformation of the structures. This also increases energy absorption by minimising the buckling of the crush box walls that usually occurs in a collision.

Operating in tandem, the main crush box and ancillary lower member not only maximise occupant protection, they also give the LS 600h a higher collision compatibility with smaller vehicles and pedestrians. Impact load is distributed and absorbed over a wider surface, effectively absorbing energy in different collision patterns and reducing damage to the other party. The lower member serves to prevent the car riding up over smaller vehicles, as well as reducing the chances of a pedestrian's legs becoming trapped beneath it.

Pedestrian protection performance is enhanced by a reduction in size of the air filters mounted directly on top of the engine. This maintains the right space between the underside of the bonnet and the engine to achieve maximum deformation in the event of an impact.

The highly rigid bodyshell has numerous structural reinforcements to improve its collision performance. Extensive bracing in the floor platform gives better torsional rigidity, significantly improving impact safety. The use of tailored materials keeps weight down and promotes a high skeletal strength.

Following car-to-car side impact testing at 35mph (56km/h), it was shown that localised deformation was reduced by dispersing impact energy over a wider area.

Airbags

The Lexus LS 600h benefits from the most comprehensive range of airbags in its segment: two-stage Dual Supplemental Restraint System front airbags, including a twin-chamber passenger airbag; driver and front passenger knee airbags; front and rear side airbags; and full-length side curtain airbags.

Deployment of the front airbags varies according to impact severity. The front knee airbags not only protect the occupants' knees, but work with the front airbags and seatbelts to achieve a better distribution of the loads imposed on the body by the restraint systems in the event of severe impact deceleration.

Crash sensors are installed in the B and C-pillars, for the fastest possible activation of the side and curtain airbags. They also allow for a more accurate assessment of which airbags to trigger in any given impact.

Based on the Lexus Omni-Support concept, the front passenger airbag has a unique twin-chamber design. Lexus introduced the twin-chamber bag in the new generation IS and now brings it to the luxury segment for the first time in the LS 600h. Once inflated, the twin chambers create a depression in the centre of the airbag, effectively cradling the nose and mouth while allowing the physical impact of the bag to be dispersed across other contact points on the head and shoulder.

Immediately after the activation of any airbag, all four windows automatically open slightly to help clear pyrotechnic gases from the cabin.

DRIVER ASSISTANCE SYSTEMS

In keeping with its status as a premium segment flagship, the LS 600h features a series of innovative driver assistance systems to simplify life on board. Intelligent Park Assist helps with parallel and series parking manoeuvres, and a new Adaptive Cruise Control (ACC) system can operate at any speed from 0 to 106mph. World-first low-beam LED headlight technology ensures excellent illumination of the road ahead and a Brake Hold function cuts the burden on the driver in frequent stop-start driving.

Intelligent Parking Assist (IPA)

Lexus Intelligent Parking Assist (IPA) can help the drive manoeuvre into parallel or series parking places. It uses a rear-mounted camera and ultrasonic sensors to identify a viable parking space and then calculate the appropriate steering angle to guide the vehicle into place.

Once the driver has confirmed the manoeuvre, IPA controls the steering to automatically guide the vehicle into the target parking position. No steering input is required from the driver, who simply controls vehicle speed – up to a maximum 2.5mph.

The rear view camera is mounted next to the rear number plate, with a side sensor mounted each side of the front bumper. When wishing to parallel park, the driver slowly drives past the intended space, allowing the sonar sensors to detect the space available, before stopping just beyond the space in the normal manner. After shifting into reverse gear and selecting the parallel parking option, the IPA control unit determines the target parking

position from the space previously detected by the sensors. It then calculates both parking trajectory and required parking angle, while giving a view of the target position on the Electro Multi Vision screen on the centre console.

The driver confirms acceptance of the target position and system activation. When the driver releases the brake pedal, the vehicle begins to reverse at low speed. Monitoring vehicle speed via the drivetrain and brake system ECUs, IPA automatically controls the Electric Power Steering to guide the LS 600 into place.

IPA can help execute series parking manoeuvres in a similar fashion. The driver pulls up at a diagonal to the target parking position, shifts to reverse gear and selects series park to activate IPA's ultrasonic parking space detection and image recognition function via the rear camera. The driver then confirms system activation for a series parking manoeuvre and IPA controls the EPS to guide the car into the designated space.

While IPA automatically controls the steering during either manoeuvre, the driver is responsible for controlling the speed and stopping the vehicle, using the brake pedal. IPA can be deactivated at any time during the process, using either the throttle or steering inputs.

Adaptive Cruise Control with Full-speed Following Function

The LS 600h is equipped with a new Adaptive Cruise Control (ACC) system, featuring a new low speed mode. As with standard ACC, it has two modes: constant speed control and vehicle-to-vehicle distance control, but the system is now capable of operating at any vehicle speed between zero and 106mph.

The vehicle-to-vehicle distance control employs the Advanced Obstacle Detection system's millimetre-wave radar and stereo imaging camera. Low Speed mode enables ACC to operate for the first time in slow or congested traffic, thanks to the system's low speed, close proximity distance measuring ability, and can bring the LS 600h to a complete standstill, then accelerate away again when the road ahead is clear.

LED Low-beam Headlamps

The LS 600h benefits from the world's first application of low beam LED headlight technology, which gives excellent illumination and significantly improved durability compared to conventional lighting systems.

Based on the multiple LED lamp design principles explored in the LF-X concept car, the new system employs a four-lamp, twin-tier low beam configuration. Three upward oriented LED

lamps focus high intensity illumination directly ahead, via an overlapping horizontal array of three projector lenses. The remaining twin-chip downward oriented LED lamp uses a shielded parabolic cylinder to create wide angle light projection, with a sharp horizontal cut-off to prevent glare affecting oncoming drivers.

To prevent LED light distribution falling off through excessive heat build-up, the new system features die-cast aluminium radiating fins. In addition the circumference of each of the three projector lenses is fitted with a transparent blue ring, which, with the new white LED clearance lamps, gives the LS 600h a unique and easily identifiable headlamp signature.

The low beam LED lamps provide instantaneous illumination, lighting up in about one tenth of a second and emitting a white-light colour closest to that of natural daylight. The combination of a three-lamp projector array and twin-lamp parabolic reflector optimises illumination across the full width of the road ahead, significantly improving visibility of the opposite side of the road with no increase in glare for oncoming traffic.

The Intelligent Adaptive Front-lighting System (AFS) swivels the headlamps to improve illumination as the driver turns into a bend, junction or parking space. At low speeds – up to 19mph – such as when turning at an intersection, the illumination axis of the headlamp on the turning side increases by a maximum 10 degrees. At speeds above 19mph, the illumination axis of both headlamps increases: in right hand corners by up to 10 degrees on the right side and five degrees on the left; and in left hand corners by up to 15 degrees on the left side and 7.5 degrees on the right.

The low beam LED lights are also low on power consumption, at just 50W/12V.

Brake Hold

The new LS 600h has a Brake Hold function that automatically controls brake force to hold the vehicle in place when it comes to a stop.

With the Brake Hold standby switch activated, Brake Hold is engaged when the vehicle comes to a halt, automatically controlling the hydraulic brake pressure of each wheel and relieving the driver of the need to maintain pressure on the brake pedal.

Brake Hold is controlled by the Electronically Controlled Braking ECU and cooperates with the electric parking brake. The parking brake will automatically engage during Brake Hold if

the driver gets out of the vehicle, or if the boot or bonnet is opened, or if a significant time has passed since the system was activated.

To restart the vehicle after a temporary stop with Brake Hold, the driver only has to operate the accelerator.

LS 600h TECHNICAL GLOSSARY

Advanced Craftsmanship

Advanced Craftsmanship is a new production process for the LS 600h at Lexus's Tahara factory. It integrates Lexus's legendary manufacturing quality with human skills. Several techniques are unique within the automotive industry, bringing together state-of-the-art automated operations and the ultimate in digital measurement, with the expertise and exquisite craftsmanship of rigorously trained, highly skilled master craftsmen at every stage of development, production and quality control.

Advanced Multi-zone Automatic Climate Control

The LS 600h L benefits from the world's first human body temperature-sensing control within its four-zone air conditioning system. It uses a roof-mounted infrared sensor to measure the temperature in six different cabin matrix cells, including the area around each passenger seat. Measuring the body temperature of each occupant enables the system to assess their specific thermal comfort and then instigate appropriate adjustments to each of the air conditioning system's four independent zones.

Advanced Pre-Crash Safety System

An enhanced Pre-Crash Safety System gives the driver maximum assistance in collision avoidance, by day or night. PCS incorporates an Advanced Obstacle Detection System, Driver Monitoring System, Emergency Steering Assist and Pre-Crash Brake (PCB) to warn the driver of an impending collision and ensure optimum vehicle responsiveness to avoidance manoeuvres. If necessary, it will automatically engage the brakes to reduce vehicle speed at the point of impact.

Advanced Obstacle Detection System

The Advanced Obstacle Detection system combines information picked up by a millimetre-wave radar and an infrared stereo camera. The 76GHz radar is mounted in the front grille

and scans the road ahead. The camera consists of two near-infrared CCD lenses mounted 350mm apart at the head of the windscreen, transmitting digital video images generated by near- infrared projectors built into the headlamps' low beam function. Subject to weather conditions, the system can detect a wide range of obstacles in front of the vehicle by day or night, including, for the first time, pedestrians and animals.

All-wheel Drive

The LS 600h has the world's first full-time, all-wheel drive hybrid powertrain. The system has a three-differential configuration and a propeller shaft connected directly to the hybrid transmission. A highly compact Torsen limited slip differential distributes drive power at a ratio of 40 per cent to the front wheels and 60 per cent to the rear. However, torque distribution is continuously controlled and can be varied from a 48:52 to 31:69 split between the front and rear axles.

Adaptive Variable Suspension

The multilink suspension features pneumatic cylinders with monotube shock absorbers, which work in cooperation with the Adaptive Variable Suspension (AVS) system. Improved by a 20 per cent increase in air pressure, AVS suppresses vibration in the vehicle's sprung mass and hones the system's precision damping force control. Selecting the AVS system's Sport mode automatically increases the difference between inner and outer shock absorber damping through corners to further reduce body roll.

Brake Hold

The Brake Hold function is controlled by the Electrically Controlled Brake (ECB) ECU and cooperates with the electric parking brake. When the Brake Hold standby switch is activated, Brake Hold is engaged whenever the vehicle stops, obviating the need for the driver to maintain pressure on the brake pedal. To set the car moving again after a temporary stop with Brake Hold activate, the driver needs only to depress the accelerator.

D-4S

D-4S is the latest evolution of Lexus's stoichiometric, four-stroke direct injection technology. It features two injectors per cylinder, one in the combustion chamber and the other mounted in the intake port. It combines the strengths of both direct and port injection, realising optimum engine efficiency throughout the power band and improving torque across the rev range, while at the same time minimising fuel consumption and emissions.

Electronically Controlled Brake System (ECB)

The LS600h has an electro-hydraulic braking system, which saves weight and also allows for more precise brakeforce distribution. This latter quality favours optimum operation of the Vehicle Dynamics Integrated Management (VDIM) in its co-ordinated control of the braking and stability systems.

Electric Motor

The hybrid system includes a highly compact, three-phase, water/oil cooled, permanent magnet, AC synchronous electric motor. The benefit of using an electric motor as a source of drive power is that maximum torque is available from 0rpm, giving powerful, yet near-silent acceleration and significantly better performance under higher throttle load.

Electric Power Steering (EPS)

The Electric Power Steering features a newly developed step-up DC-DC power converter that increases output from 27 to 46 volts, and a bespoke, 110mm diameter, high-output brushless motor. EPS gives the LS 600h a class-leading 5.5-metre turning radius and gives noise-free operation and seamless, linear feedback, smoothly changing assistance characteristics according to vehicle speed.

Emergency Steering Assist

Through close interaction between the EPS Variable Gear Ratio Steering (VGRS), Vehicle Dynamics Integrated Management (VDIM) and Adaptive Variable Suspension (AVS) systems, Emergency Steering Assist substantially improves the vehicle's response to driver steering inputs when a collision risk has been detected, increasing the chances of avoiding an impact.

Energy Monitor

The energy monitor can be called up on the Electro Multi Vision display screen, enabling the driver to have a real-time view of both the energy flow through the hybrid system and the battery charge status.

Front Passenger Twin-chamber Airbag

The Front Passenger Twin-chamber Airbag has an advanced shape based on the Lexus Omni-Support concept. Once inflated, the twin chambers create a depression in the centre

of the airbag, effectively cradling the nose and mouth and allowing the physical impact of the bag to be dispersed across other contact points on the head and shoulders.

Generator

The AC synchronous, water/oil cooled generator uses engine power to generate electricity. It supplies power to the high-output motor and the hybrid battery.

Human Machine Interface (HMI)

The LS 600h's advanced on-board technology is easy to control using the most intuitive, user-friendly human machine interface (HMI) in the segment. The system combines the advantages of touch screen and voice command to control several functions of the navigation, audio and air conditioning systems, and Bluetooth hands-free telephone use. The touch screen functions on the eight-inch Electro Multi Vision display let the user reach any function or command in a maximum of three steps. Operated by a single switch on the steering wheel, the voice command system covers a wide range of vehicle functions, responding to more than 200 spoken commands.

Hybrid Battery

The Lexus hybrid system features a compact, high-output, 20-module, nickel metal hydride (Ni-MH) 288-volt battery, housed over the rear axle. The installation features a new air conditioner-co-ordinated cooling system to enhance its efficiency and a smaller, vehicle speed-sensitive fan to improve quietness when running.

Hybrid System Indicator

A discreet hybrid system indicator is located in the Optitron instrument display. With a dial divided into Eco and Charge segments, it continuously monitors the driver's use of the throttle, showing both when low fuel consumption driving is being achieved and when energy is being regenerated by the hybrid system.

Hybrid Transmission

The hybrid transmission's ECU selectively controls engine and electric motor rpm to simulate a continuous variation of the current ratio and thus provide entirely linear acceleration. It further incorporates a sporting, sequential shift mode, which is accessed by moving the gear lever into the 'S' position in the gate. This gives eight-step engine braking and control, like that of a conventional automatic transmission.

Intelligent Parking Assist (IPA)

Intelligent Parking Assist (IPA) can assist the driver to enter either parallel or series (side-by-side) parking places. IPA employs a rear camera and ultrasonic sensors to identify viable parking spaces and then input the appropriate steering to guide the vehicle automatically into the target parking position. No steering input is required from the driver, but he or she maintains control of the throttle and brake during the manoeuvre.

LED Low-beam Headlamps

The LS 600h is fitted with the world's first instantaneous lighting, low-beam LED headlight technology. This new system uses a four-lamp, twin-tier low-beam configuration. Three upward pointing LED lamps focus high-intensity illumination directly ahead, via an overlapping horizontal array of three projector lenses. The remaining twin-chip, downward pointing LED lamp uses a shielded parabolic cylinder to create wide angle light projection with a sharp horizontal cut-off to prevent glare affecting oncoming vehicles. The Intelligent Adaptive Front Lighting System (AFS) is integral to the new LED low-beam system, swivelling the headlamps in line with vehicle speed and steering inputs to help illuminate the car's path through a bend.

Lexus Hybrid Drive

The LS 600h is a full hybrid, capable of operating in both petrol or electric modes alone, as well as a combination of both. The system comprises a 5.0-litre V8 petrol engine, electric motor, generator, high performance battery, power split planetary gear mechanism and Power Control Unit, which governs the high-speed interaction of the different components. The electric motor, generator power split device and motor speed reduction gearing are housed in a single, compact and lightweight transmission casing.

Parking Assist Monitor

The Parking Assist Monitor features a video camera mounted in the rear number plate surround, which feeds a full colour, real-time view of the area around the back of the car to the EMV display screen on the centre console. Manoeuvring accuracy s helped by steering guidelines generated on the screen that indicate the prospective path of the vehicle, based on the current steering position, both for parallel and series parking.

Power Control Unit (PCU)

The Power Control Unit comprises a voltage boost converter and inverter. It is controlled by a motor generator ECU, which receives commands from the Hybrid Vehicle ECU. The

inverter converts a 288-volt direct current from the battery into 650-volt alternating current to drive the electric motor.

Power Split Device

The power split device is at the heart of the hybrid system. It features a differential-type planetary gear set (so called because the planetary gears orbit a central sun gear like the solar system), which gives a two-way torque split between engine, drive axle and generator.

Rear Pre-crash Safety System

The Rear Pre-crash Safety system operates whether the vehicle is moving or stationary. A 76GHz millimetre-wave radar installed in the rear bumper scans the area around the back of the vehicle. If a collision from behind is deemed unavoidable, the system automatically activates the Pre-Crash Intelligent front headrests, which move forwards and upwards to cushion the occupant's head in anticipation of an impact, greatly reducing the risk of whiplash injury.

Rear Seat Entertainment System

The Rear Seat Entertainment system features a separate DVD/CD player and retractable, ceiling-mounted, nine-inch full-colour VGA screen giving 5.1 home theatre reproduction, as part of the Mark Levinson Reference Surround System. The rear centre console has a compartment for storing discs and headphones, a five-litre cool box, cup holders, a retractable table, remote controls for the seat massage programme and the entertainment system and a control panel for air conditioning, adjustable seats and rear and side window sunshades.

Rear Seat Relaxation System

Coupled with a conventional vibration massage system, the rear seat diagonally opposite the driver in the LS 600h L is equipped with a new air-assisted massage function. Eight pneumatic chambers cover the occupant's shoulder, back and hip area and together they reproduce professional massage techniques with a range of different programmes, including Shiatsu and shoulder and lower back acupressure, with intensity controlled by the user.

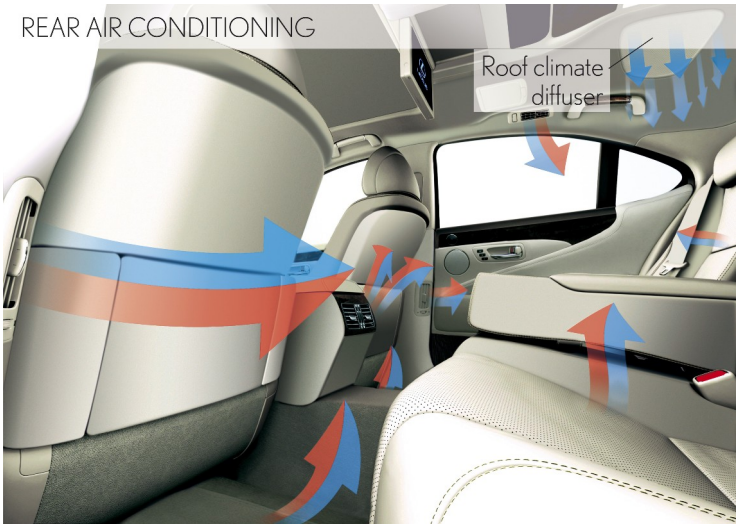
Reclining Rear Seat with Leg and Footrest

The rear seat diagonally opposite the driver in the LS 600h L can be reclined to a maximum 45 degrees and it features a fully retractable ottoman-style thigh and footrest for supreme comfort. One touch of a button on the rear centre console automatically reclines the seat and

extends the ottoman to a memory setting, while simultaneously folding down the front seat headrest and moving the entire seat forward to its furthest point of travel.

Roof Climate Diffusers

Large Roof Climate Diffusers are mounted above each outer rear seat, giving quicker and more comfortable climate control by diffusing high-volume, low-velocity, fresh, cooling air directly around the rear passengers' heads to counteract the effects of solar radiant heat absorbed through the roof and rear window.



Smart Keyless Entry with Card Key

The Smart Keyless Entry System has an electronic Card Key. Just 3.35mm thick, it can be carried in a pocket or wallet while driving. When the Card Key comes within 0.7 to one metre of the vehicle, it communicates with a transmitter built into the door handle and matches ID codes, whereupon a touch of the handle will either lock or unlock the door.

Rear Seat Cushion Airbag

The LS 600h L's ottoman rear seat incorporates a new seat cushion airbag – unique in the segment – which activates in a frontal impact. It inflates the front of the seat base to reduce forward and downward submarining motion of the occupant's pelvis and thus reduce the risk of abdominal injury.

Two-stage Motor Speed Reduction Gear

The hybrid drive's electric motor is connected to a second, dedicated Ravigneaux planetary reduction gear, aligned with the power split device and generator on the engine crankshaft within the hybrid transmission casing. It controls electric motor torque through two-stage

motor speed reduction gearing. A hydraulic control unit, incorporated in the hybrid transmission, operates two independently controlled brakes to automatically switch the gearing between Low (3.900) and High (1.900) motor reduction ratio settings. This optimises the motor's torque distribution over the widest possible range of vehicle speeds.

Variable Gear Ratio Steering (VGRS)

Variable Gear Ratio Steering, linked to the LS 600h's sophisticated Vehicle Dynamics Integrated Management (VDIM) system, employs an actuator attached directly to the Electric Power Steering (EPS) gear, which alters the steering gear ratio according to vehicle speed. The system can vary the ratio by up to 30 percent, from 2.3 to 3.7 turns lock-to-lock. VGRS also co-operates with the Emergency Steering Assist system in providing quicker steering response once an obstacle has been detected in the path ahead of the vehicle.

Vehicle Dynamics Integrated Management (VDIM)

VDIM integrates the Electronically Controlled Braking (ECB), ABS, Electronic Brakeforce Distribution (EBD), Traction Control (TRC), and Vehicle Stability Control (VSC) active safety systems with the Adaptive Variable Suspension (AVS), Electric Power Steering (EPS) and Variable Gear Ratio Steering (VGRS) systems. It provides smoother, more predictable dynamic control as the vehicle approaches the limits of its performance envelope.

VVTi-E

VVTi-E is a new, electrically controlled continuously variable valve timing system to the intake camshafts and is integral to the V8 engine's Dual VVT-i. Unlike hydraulically controlled systems, the electric motor driven VVT system will operate across the full spectrum of engine rpm and temperatures, with a cam response speed of about 50 degrees per second towards the lag phase and 150 degrees per second towards the advance phase.

LEXUS LS 600h TECHNICAL SPECIFICATIONS

HYBRID SYSTEM	
Type	Series/parallel, full hybrid
Combined power (bhp/DIN hp)	439/445
ENGINE	
Engine code	2UR-FSE
Type	V8, longitudinally mounted
Valve mechanism	4 valves per cylinder DOHC, chain drive, dual VVT-i, VVT-iE for intake
Bore x stroke (mm)	94.0 x 89.5

Displacement (cc)		4,969	
Compression ratio		11.8:1	
Fuel system		D-4S direct injection, two injectors per cylinder	
Fuel type		95 octane petrol, or higher	
Max. power (bhp/DIN hp @ rpm)		389 (394) @ 6,400	
Max. torque (Nm @ rpm)		520 @ 4,000	
ELECTRIC MOTOR			
Type		AC synchronous, permanent magnet	
Max. power (bhp/DIN hp)		221 (224)	
Max. torque (Nm)		300	
Voltage (V)		650	
ELECTRIC GENERATOR			
Type		AC synchronous, permanent magnet	
Voltage (V)		650	
TRANSMISSION			
Type		E-CVT	
Drive		Permanent 4-wheel drive with Torsen limited slip differential	
2-speed motor reduction gear ratios	Low	3.900	
	High	1.900	
Final drive ratio front/rear		3.357	
HIGH VOLTAGE BATTERY			
Type		Nickel metal-hydride (Ni-MH)	
Number of cells		240 (6 x 40 modules)	
Voltage (V)		288	
Capacity (Ah)		6.5	
PERFORMANCE			
0-62mph (sec)		6.3	
50-75mph (sec)		4.3	
Maximum speed (mph)		155	
FUEL ECONOMY/EMISSIONS			
Urban (mpg)		25.0	
Extra urban (mpg)		35.3	
Combined (mpg)		30.4	
CO2 emissions (g/km)		219	
Nitrogen oxides (NOx, g/km)		0.02	
Hydrocarbons (HC, g/km)		0.02	
Carbon monoxide (CO, g/km)		0.41	
VED band		F	
DIMENSIONS & CAPACITIES		**LS 600h**	**LS 600h L**
Overall length (mm)		5,030	5,150
Overall width (mm)		1,875	1,875
Overall height (mm)		1,480	1,480
Wheelbase (mm)		2,970	3,090
Track – front (mm)		1,610	1,610

Track – rear (mm)	1,610	1,610
Overhang – front (mm)	885	885
Overhang – rear (mm)	1,175	1,175
Coefficient of drag (Cd)	0.27	0.27
Luggage compartment capacity (l)	330	330
Fuel tank capacity (l)	84	84
WEIGHTS	**LS 600h**	**LS 600h L**
Kerb weight (kg)	2,270	2,320 (5 seats) 2,410 (4 seats)
Gross vehicle weight (kg)	2,730	2,750 (5 seats) 2,730 (4 seats)
Max. roof load (kg)	100	100
SUSPENSION		
Front	Multilink	
Rear	Multilink	
Shock absorbers	Monotube	
Additional features	Air suspension with Adaptive Variable Suspension (AVS)	
BRAKES & STABILITY CONTROL		
Front (diameter x thickness, mm)	357 x 34 ventilated discs	
Rear (diameter x thickness, mm)	335 x 22 ventilated discs	
Additional features	ABS with Brake Assist System (BAS) Electronic Brakeforce Distribution (EBD) Electronically Controlled Braking (ECB) Traction Control (TRC) Vehicle Stability Control (VSC) Vehicle Dynamics Integrated Management (VDIM) Regenerative brake system	
STEERING		
Steering gear type	Rack and pinion Electric Power Steering with Variable Gear Ratio Steering	
Ratio	11.7 – 18.4:1	
Turns lock-to-lock	2.3 – 3.7	
Minimum turning radius – tyre (m)	5.7 (5.9 LS 600h L)	
WHEELS AND TYRES		
Wheels	Alloy 19x8.0J	

LEXUS LS 600h EQUIPMENT SPECIFICATIONS

SAFETY & DRIVING DYNAMICS	LS 600h	LS 600h L
ABS	✓	✓

Brake Assist System (BAS)	✓	✓
Electronic Brakeforce Distribution (EBD)	✓	✓
Emergency Brake Signal	✓	✓
Electronically Controlled Braking (ECB)	✓	✓
Traction control (TRC)	✓	✓
Vehicle Stability Control (VSC) with cut-off switch	✓	✓
Variable Gear Ratio Steering (VGRS)	✓	✓
Vehicle Dynamics Integrated Management (VDIM)	✓	✓
Adaptive Cruise Control (ACC) and Pre-Crash Safety (PCS) system	✓	✓
Advanced Obstacle Detection system	✓	✓
Rear Pre-Crash Safety system	✓	✓
Driver Monitoring System	✓	✓
Emergency Steering Assist	✓	✓
Two-stage driver and front passenger airbags	✓	✓
Twin-chamber front passenger airbag with cut-off switch	✓	✓
Front passenger airbag cut-off switch	✓	✓
Driver and front passenger knee airbags	✓	✓
Front and rear curtain shield airbags	✓	✓
Rear side airbags	✓	✓
Thorax-Abdomen-Pelvis (TAP) front side airbags	✓	✓
Whiplash Injury Lessening (WIL) front seats	✓	✓
Front and outer rear seatbelt pretensioners	✓	✓
ISOFIX child seat mounts, outer rear seats	✓	✓

Audible/visible seatbelt reminder	✓	✓
Air suspension	✓	✓
Adaptable Variable Suspension (AVS)	✓	✓
Electric Power Steering (EPS), speed sensitive	✓	✓
Electronic Parking Brake (EPB)	✓	✓
Tyre Pressure Warning System (TPWS)	✓	✓
SECURITY	**LS 600h**	**LS 600h L**
Anti-theft system with immobiliser, intrusion sensor, inclination sensor and siren	✓	✓
Double door locks	✓	✓
Auto door locking	✓	✓
Laminated windscreen and side window glass	✓	✓
ENTERTAINMENT, INFORMATION & COMMUNICATIONS	**LS 600h**	**LS 600h L**
Mark Levinson 19-speaker premium Hi-Fi with in-dash 6-disc DVD changer	✓	✓
Bluetooth connectivity	✓	✓
8in touch-screen Electro Multi Vision (EMV) display	✓	✓
Colour TFT multi-information display	✓	✓
DVD satellite navigation with dynamic Route Guidance (DRG)	✓	✓
Steering wheel controls for audio, phone and voice control	✓	✓
Voice command function for audio, navigation, telephone and climate control operation	✓	✓
Optitron instrumentation	✓	✓
Parking assist sensors	✓	✓

Intelligent Park Assist system	✓	✓
Rear Seat Entertainment, DVD player with roof-mounted 9in screen	✓	✓
COMFORT & CONVENIENCE	**LS 600h**	**LS 600h L**
Smart entry and start system with key card	✓	✓
Illuminated entry system with puddle lights	✓	✓
Illuminated front and rear vanity mirrors	✓	✓
LED interior lighting	✓	✓
LED low beam headlights with cleaners and auto-levelling	✓	✓
HID (high-intensity discharge) high-beam headlamps	✓	✓
Adaptive Cruise Control (ACC)	✓	✓
Electric multi-adjustable steering wheel	✓	✓
Electric boot closer	✓	✓
Easy exit & entry auto-retracting steering wheel	✓	✓
Auto-dimming rear-view mirror	✓	✓
Electric windows with one-touch operation	✓	✓
Electric steering wheel adjustment	✓	✓
Electric rear sunshade	✓	✓
Sunroof	✓	✓
VENTILATION	**LS 600h**	**LS 600h L**
Electronic dual zone climate control with separate driver/passenger controls	✓	✓
Automatic recirculation mode	✓	✓
Clean air filter with pollen removal mode	✓	✓

4-zone climate control with rear left/right temperature control		✓	✓
Roof-mounted diffusers		✓	✓
SEATING, UPHOLSTERY & TRIM		**LS 600h**	**LS 600h L**
Semi-aniline leather upholstery		✓	✓
Alcantara roof lining and pillar trim		✓	✓
Leather dashboard, door panels and door armrests		✓	✓
Heated and air conditioned front seats		✓	✓
Heated rear seats		✓	✓
Air conditioned rear seats		✓	✓
10-way electrically adjustable driver's seat and headrests		✓	✓
SEATING, UPHOLSTERY & TRIM		**LS 600h**	**LS 600h L**
8-way electrically adjustable front passenger seat and headrests		✓	✓
Memory function for front seats, steering wheel and door mirrors with three pre-sets		✓	✓
Front seat lumbar support		✓	✓
Electrically adjustable rear headrests		✓	✓
Electric rear seat adjustment with memory		✓	✓
Electrically adjustable front seatbelt height with memory on driver's side		✓	✓
Heated leather and wood steering wheel		✓	✓
Wood trim inlays		✓	✓
Rear cool box		✓	✓
Rear centre armrest		✓	✓
Rear multi-function centre armrest		✓	✓
Rear Seat Relaxation	Electric reclining rear seats		

Pack	Ottoman thigh and leg rest for left rear seat	×	Opt
	Electric folding front passenger headrest		
	Rear left seat massage functions with remote control		
	Seat cushion airbag in rear left hand seat		
	Fixed rear centre console with wood inlay		
	Body temperature sensing climate control		
	Independent rear DVD player		
BODY & EXTERIOR		**LS 600h**	**LS 600h L**
7-spoke 19in alloy wheels		✓	✓
Full-size alloy spare wheel		✓	✓
Auto dimming electrically adjustable heated and folding door mirrors		✓	✓
Easy door and boot closer		✓	✓
Adaptive Front-lighting System (AFS)		✓	✓
Front foglights		✓	✓
LED brake, tail and licence plate lights		✓	✓
Rain-sensing wipers		✓	✓
UV and heat-insulating tinted glass		✓	✓
Water-repellent front side window glass		✓	✓