

The C4 with a 6-speed electronic gearbox system



Premiered on the C4 and mated to the HDi 110 DPFS engine, the 6-speed electronic gearbox system is of an entirely new design.

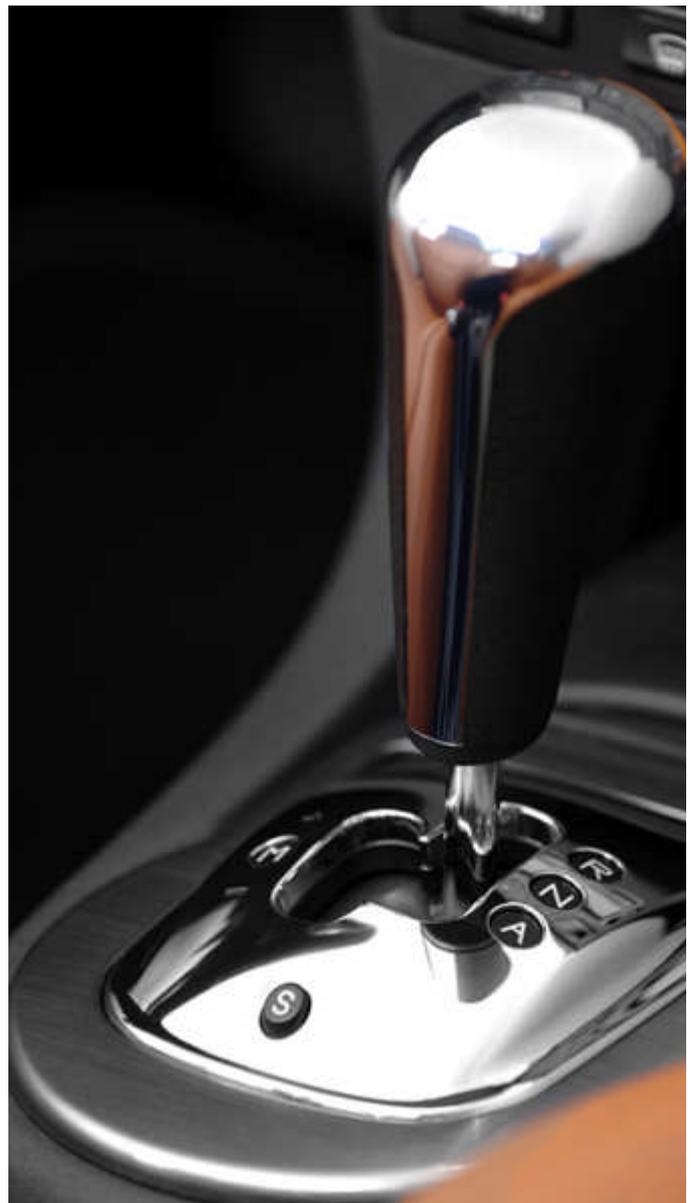
This highly driveable engine boasts a range of advantages. Electro-hydraulic gearbox control makes for smooth, fast gear changing. At the same time, automated gear and clutch management cuts fuel consumption by between 3% and 5%, compared with a conventional manual gearbox.

This new gearbox therefore provides a real alternative to manual and automatic transmissions, not only in terms of driveability and comfort, but also in terms of fuel economy and a particularly attractive customer price. It joins the long list of innovative equipment available on the C4, for safety, convenience and on-board comfort.

A vehicle of innovative design and features that has picked up an array of prizes (including "World Car Design 2006" at the recent New York International Motor Show), the C4 is enjoying considerable market success. More than 350,000 vehicles have been sold to date.

The C4 HDi 110 DPFS equipped with the new 6-speed electronic gearbox system will be available from June 2006.





By means of automating gear changes and clutch control, this new gearbox obtains a **reduction of**

This new gearbox expands the offer of automated manual gearboxes already available in the Citroën range. These are proposed in combination with petrol and diesel engines in the [C1](#), [C2](#), [C3](#) and [C3 Pluriel](#) models. Since its introduction in 2002, 130,000 of these subcompacts were sold with the [automated manual gearbox SensoDrive](#).



DRIVING PLEASURE IN MANUAL MODE AND IN AUTOMATED MODE

The electronic gearbox system gives the driver a choice between two driving modes:

- [a manual mode](#) in which he retains full control over gear changes by using the shift paddles behind the steering wheel or the sequential shift lever.
- [an automated mode](#) in which the gear selection is managed by the gearbox control unit.

At any time, the driver can switch from one mode to the other, depending on his preferences and his environment: main road, motorway, city, traffic jams.

Driving without constraints in manual mode
By activating manual mode, the driver decides at which moment he or she wants to change gears, while at the same time benefiting from the absence of the clutch pedal.



The driver is permanently informed about the selected gear by the information displayed on the instrument panel.

He or she can change gears with the help of two types of controls, which are perfectly substitutable:

- Shift paddles behind the steering wheel
The right-hand paddle is used to change up, and the left-hand paddle to change down. These paddles give access to the six forward speeds. For maximum comfort and safety, the paddles are fixed, irrespective of the position of the steering wheel.
- The sequential lever
On the shift gate, the manual mode is indicated by the letter M, accompanied by the signs + for changing up and – for changing down.

For safety reasons, only the shift lever can be used to put the car into neutral (N) or reverse (R). The reverse gear is available when the vehicle is moving at less than 3.5 kph.

The shift lever has stable positions which indicate to the driver the operating mode chosen – at the same time, this mode is always displayed on the instrument panel.

But even when the driver selects the manual mode, the automated manual gearbox ensures a high level of driving comfort.

When the car slows down and stops (for example, when approaching a stop sign or a traffic light), the gearbox changes down automatically until it reaches 1st gear.

Automatic downshifting is a function of several criteria that are managed by the control unit (insufficient engine speed, slope, sporty driving style, etc.).

The gearbox control unit also facilitates downshifting by increasing engine speed to make gear changes smoother and without jolts.

Stress-free driving in automated mode

In the automated mode, gear changes are managed electronically in order to optimise driving comfort and fuel consumption.



This mode is activated by placing the lever in position A on the shift gate. If the driver opts for this driving mode, the AUTO symbol is displayed on the instrument panel, together with the gear engaged.

The gearbox control unit then selects the gear that is best suited according to the auto-adapting shift patterns that are determined as a function of the driver's behaviour, the road type, engine rpm, vehicle speed and grip conditions.

The system thus prevents situations in which engine speed is too high or too low and proposes an economical shift pattern aimed at lowering fuel consumption. Optimised gear change management produces fuel savings on the order of 3 to 5% in comparison to a manual gearbox, depending on driving cycles.

However, certain specific situations are immediately recognized and taken into account by the gearbox. These include holding the engaged gear in phases of sustained acceleration, downshifting when the car is re-accelerating and holding the gear or downshifting to assist the motor brake. If the driver wants to take control of the gearbox while driving in automated mode (for instance in an emergency situation or while overtaking), he can do so immediately. He merely needs to touch one of the paddles, and his shift request is taken into account by the gearbox. If no additional manual command is issued by the driver during a short period thereafter (approx. 20 seconds), the gearbox switches back to automated mode.

ENHANCED DRIVING COMFORT, FUEL SAVINGS AND PEACE OF MIND

Six speeds for more drivability and lower fuel consumption

The presence of six speeds in the electronic gearbox system enables it to make optimal use of all the qualities of the engine and guarantees, in both manual and automated mode, perfect responsiveness and smooth operation of the gearbox as well as reduced fuel consumption and optimal acoustic comfort.

The design of the automated gearbox facilitates the use of these six speeds by the driver:

- In manual mode it is sufficient to apply pressure to the paddles (or to flick the shift lever) to shift to the desired gear. Changing gears no longer requires successive moves of the shift lever or repeated clutch work.
- In automated mode, the gearbox makes optimal use of the 6th gear to increase fuel savings.

Electro-hydraulic controls for smooth and speedy shifting

Due to the use of new electro-hydraulic actuators, the six-speed electronic gearbox system makes shifting gentle and smooth in both manual and automated mode.

Smooth shifting (with virtually no jolts) is not obtained at the expense of shifting speed. The six-speed electronic gearbox system reconciles both and distinguishes itself by the speed with which it manages gear changes.

The time for a gear change is:

- 0.8 seconds for changing a gear in manual mode,
- 1.2 seconds for changing a gear in automated mode.

In addition, the six-speed electronic gearbox system offers precise and easy dosage of acceleration during manoeuvres, particularly in reverse. The accelerator responds quickly to all demands, smoothly and without jolts.

A sport mode for even more responsiveness

The six-speed electronic gearbox system of the C4 also offers a sport mode. This mode, which is available with both manual and automated operation, constantly favours fast gear changes. The total time required for shifting is thus brought down to 0.4 seconds in manual mode and 0.5 seconds in automated mode.

In automated mode, the sport mode is obtained by implementing specific shift pattern: upshifts and downshifts are triggered at higher engine speeds than in normal operation. The sport mode is activated by the S button on the shift gate. Once selected, an S is displayed on the instrument panel.

Hill-hold control for more safety

For improved safety, the C4 with six-speed electronic gearbox system is equipped with a hill-hold control that facilitates starting off on a slope.

On a slope, the control holds the vehicle for two seconds after the driver has taken his foot off the brake. It thus makes it possible to safely accelerate the car when starting off or manoeuvring on a slope, and to re-start the car without any stress.

The ESP activates the hill-hold control and temporarily keeps the brakes applied when the driver takes his or her foot off the brake to accelerate.

This assistance is provided when starting on an uphill or downhill slope, both in forward gear and in reverse, and the hill-hold control is activated on slopes with a gradient of 3% and higher.

THE SIX-SPEED ELECTRONIC GEARBOX SYSTEM: A TECHNOLOGY DEDICATED TO DRIVING COMFORT

The six-speed electronic gearbox system combines a manual six-speed transmission with electronically controlled electro-hydraulic actuators.

This system reduces response times and proves optimal control for faster and more comfortable gear changes. In addition, the permanent exchange of information with the Electronic Stability Program (ESP) ensures a speedy response of the gearbox for perfect safety when the ESP is active.

Changing gears

The six-speed electronic gearbox system features electro-hydraulic controls of the clutch and the gear changes. As a result, there is no clutch pedal and the gear lever – which remains present – has no mechanical link with the gearbox.

The gearbox is managed by a control unit that controls the two actuators: one – the gearbox actuator – ensures the selection and engagement of the gears, and the other – the clutch actuator, controls the clutch.

Gear changes are made as follows:

- 1.** The driver requests a gear change



- either directly in manual mode by issuing a gear change command with the shift paddles or the shift lever,
- or indirectly in automated mode by depressing the accelerator, the brake or as a function of the gradient of the road, engine speed, vehicle speed and grip conditions.

2. The gearbox control unit detects the request and processes it.

3. The gearbox control unit takes control of the engine controller and the clutch actuator.

4. Engine torque is reduced and the clutch is opened progressively to avoid jolting.

5. When the clutch is open, the gearbox control unit activates the gearbox actuator.

6. The selector fork is disengaged, the new gear is selected and synchronized, the selector fork is reengaged.

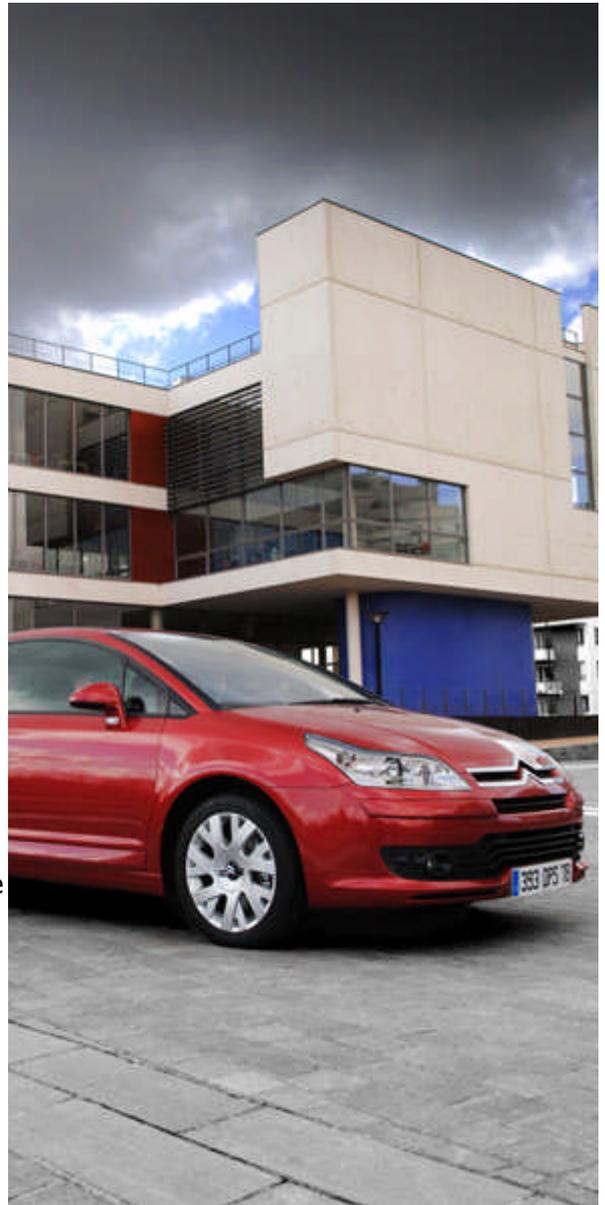
7. The gearbox control unit progressively closes the clutch and controls torque increase to complete the gear change without jolts or rebounds.

These steps are performed in rapid sequence to disrupt the power flow during acceleration or deceleration as briefly and imperceptibly as possible. When upshifting, between 0.4 and 1.2 seconds are required to go from step 1 to step 7.

The mechanical part

The automated manual gearbox of the electronic gearbox system is based on a manual 6-speed gearbox specially designed for being automated. It is characterized by its:

- Short response times
The actuator control system is mounted on the gearbox housing. This integration of the actuator inside the gearbox reduces the length of the lever arm and the play, and shortens the time required for changing gears.
- Reliability
The actuator control system is assembled at the Valenciennes factory to integrate the actuators into the gearbox. Thus, all gearboxes are tested before being shipped to the C4 assembly plant at Mulhouse.
- Quiet reverse
The reverse gear is very quiet during shifting and operation, which is due to the use of helical (and not straight) bevel gears, just as for the other gears.



- Compact form factor
The architecture of the gearbox is a 2.5-shaft architecture with a primary shaft connected to the engine through the clutch, a secondary shaft with a drive pinion positioned on either side of the bearing, and a very short half shaft used only for the reverse gear, which makes it possible to reduce the total length of the gearbox.

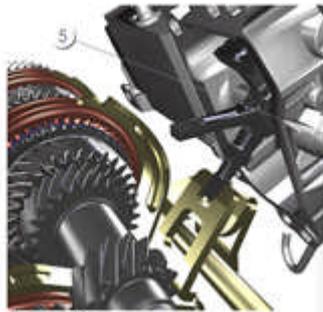
Electro-hydraulic control system

The mechanical unit is managed by an electro-hydraulic control system which ensures:

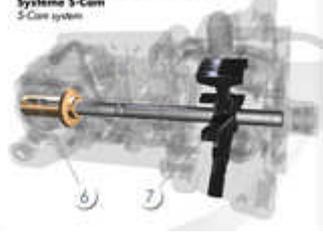
- Smooth gear changes
The gearbox control unit, which controls the two actuators, exchanges information with the engine control unit in order to manage engine speed and torque during the gear shifting process. It adapts the torque increase as a function of the differences between the requested torque and the actual torque, thereby optimising the comfort of changing gears.
- Lightning-fast gear changes
The gearbox actuator is equipped with a so-called S-CAM system that improves gear change times. With the activation of the S-CAM brake, changes from even to odd gears (N to 1st, 2nd to 3rd, 4th to 5th and vice-versa) are made diagonally, in a single movement and as easily as changes from odd to even gears (1st to 2nd, 3rd to 4th, 5th to 6th and vice-versa), which occur inline.
This results in very short upshift times of 0.8 seconds in manual mode and 1.2 seconds in automated mode.
- Good dosage for smooth manoeuvring
The clutch actuator has a concentric clutch release bearing with a position encoder that transmits its position to the control unit every two milliseconds. The transitions between gears are perfectly controlled and the car manoeuvres very smoothly.
- Optimal vehicle behaviour in all situations
The gearbox control unit also exchanges information with the ESP control unit to ensure optimal efficiency when the ESP, which is standard with this engine, is active (control of the brakes, the engine speed and the selected gear).

C4 HDi 110 FAP

Boîte Manuelle Pilotée 6 vitesses
6-speed Electronic Gearbox System



Système 5-Cam
5-Cam system



- 1 Axe primaire Input shaft
- 2 Axe secondaire Output shaft
- 3 Système de glissement des arbres avec lubrification électro-hydraulique (Electro-hydraulic clutch control system)
- 4 Clutch Kit (Clutch, Coverplate)
- 5 Boîte à vitesses Gearbox housing
- 6 5-Cam 5-Cam
- 7 Dog/throw-out lever

citroën
Présenté par le technicien@B

