



*10 years in motion*

## Six Dimensions

Fully integrated into the control management system of the vehicle, Haldex LSC offers advanced and attractive features to the new generation of All-Wheel-Drive (AWD) vehicles:

### Enhanced Vehicle Traction

- Torque transfer up to 2.400 Nm on prop shaft.
- Built-in torque transfer limitation.
- Full function in reverse.
- Instant activation independent of differential speed.



### Enhanced Vehicle Dynamics

- Improved vehicle dynamics control during acceleration and deceleration.
- Rapid activation and deactivation.
- Fully controllable torque transfer characteristics.

### Enhanced Safety

- Full integration with brake systems (like ABS) and stability systems (like ESP). On demand, the system can be deactivated in less than 60 ms.
- Limited/full AWD function with Run-flat-tyres.

### Enhanced Vehicle System Compatibility

- Fully compatible with ABS, ESP and TCS without freewheel or additional clutch.
- On-line communication with the CAN system.
- No extra sensors needed. All required information obtained from the CAN system.

### Enhanced Vehicle Driving Comfort and Transparency

- No wind-up during tight cornering and parking.
- Optimal traction during acceleration.
- No functional problems with tyres having uneven wear, pressure or size (mini spare).
- No functional problems when towing with one axle lifted.
- Transparent actuation.

- [www.haldex.com](http://www.haldex.com)

- [www.haldex-xwd.com](http://www.haldex-xwd.com)

Enhanced Optimisation of Weight and Fuel Consumption

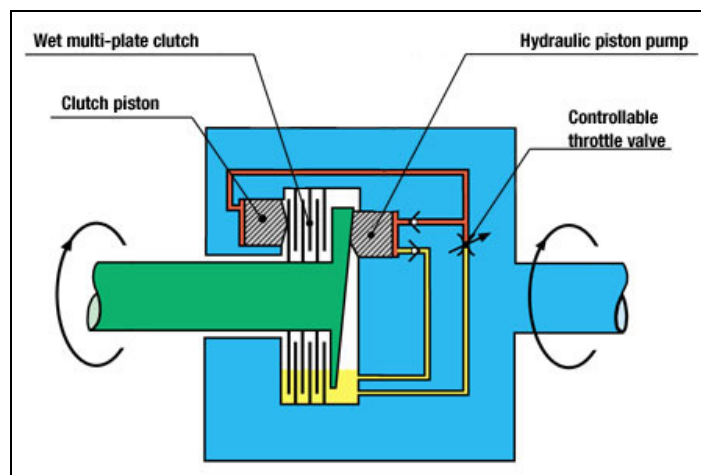
- The built in overload protection valve, in combination with
- the fully controllable torque transfer characteristics,
- decreases the design requirements of the complete
- AWD drive line, resulting in reduced weight and
- reduced fuel consumption.

## Basic Function

The design of the Haldex LSC is based on a Swedish patent acquired by the Haldex Group.

The unique design of the Haldex LSC comprises three functional parts

- The hydraulic pump driven by
- the slip between the
- axles/wheels.
- The wet multi-plate clutch
- The controllable throttle valve
- with its electronics.



The unit can be viewed as a hydraulic pump in which the housing and an annular piston are connected to one shaft and a piston actuator is connected to the other.

The two shafts are connected via the wet multi-plate clutch pack, normally unloaded and thus transferring no torque between the shafts.

When both shafts are rotating at the same speed, there is no pumping action. When a speed difference occurs, the pumping starts immediately to generate oil flow. It is a piston pump, so there is a virtually instant reaction with no low-speed pumping loss.

- [www.haldex.com](http://www.haldex.com)
- [www.haldex-xwd.com](http://www.haldex-xwd.com)



*10 years in motion*

The oil flows to a clutch piston, compressing the clutch pack and braking the speed difference between the axles. The oil returns to the reservoir via a controllable valve, which adjusts the oil pressure and the force on the clutch package.

In traction/high slip conditions, a high pressure is delivered: in tight curves (i.e. parking), or at high speeds - a much lower pressure is provided.

## **Full Controllability - Rapid Activation**

### **- Rapid Deactivation**

An important pre-requisite of the AWD systems as part of the vehicle's active safety system is compatibility with other systems for active safety, such as ABS (Brake control), TCS (Traction control) and ESP (Stability control) in all possible driving situations.

Full compatibility puts two main demands on the AWD systems: they should be controllable and react rapidly on activation and deactivation.

Haldex LSC is superior  
in meeting these requirements

In a full acceleration from start, the Haldex LSC distributes all available torque between the axles for best performance - automatically.

Cruising smoothly, the car feels and acts stable. The Haldex LSC has reduced the torque transfer to minimum - automatically.

In tricky and dangerous driving conditions (snow, ice), the Haldex LSC activates/deactivates rapidly and automatically to ensure maximum safety.

Haldex LSC is:

- a compact stand-alone component for advanced torque
- transfer between two axles;
- a mechanical/hydraulic unit with integrated electronic
- control unit.

## **Actual Design**

Mechanical - Hydraulic layout

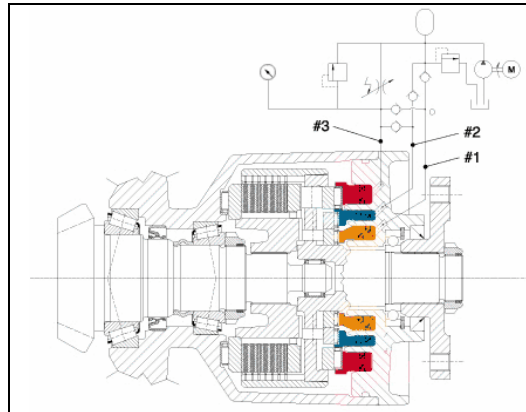
The input shaft (on the right in the figure), has a flange in which rollers are positioned. The rollers operate between a cam curve at the end of the output shaft (on the left in the figure), and the annular pistons positioned in the housing.

Haldex LSC is equipped with three hydraulic pumping pistons. Pistons #1 and #2 are activated by differential speed between the input and output shafts. They start pumping oil to piston #3, which

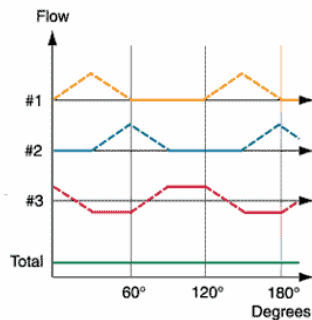
- [www.haldex.com](http://www.haldex.com)

- [www.haldex-xwd.com](http://www.haldex-xwd.com)

compresses the clutch package. The pumping is generated by rollers, and the pumping sequence is designed to create constant flow.



The oil flow is proportional to the speed difference. The higher the differential speed, the higher the oil flow. Actuation of the clutch package reduces the differential speed until it reaches equilibrium. The slip and the torque can be controlled by the integrated pressure sensor. The system is a closed loop.



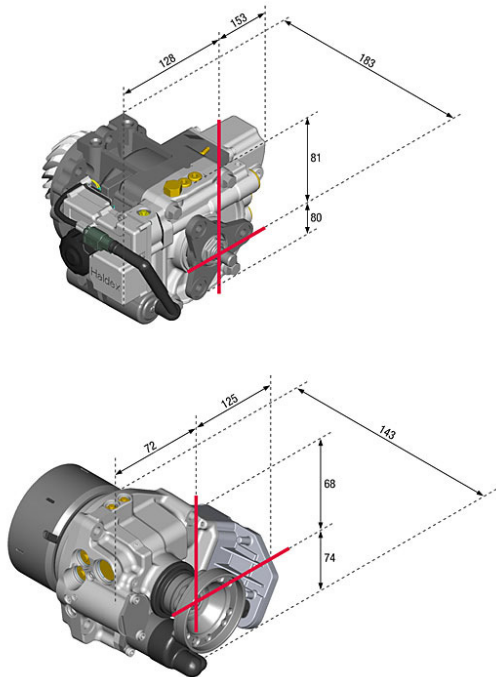
Haldex LSC has a built-in over-load protection valve in parallel to the controllable throttle valve. The over-load protection valve protects the entire drive-train from excessive peak load and is preset to the customer's specification.

To ensure the function and minimum activation time, the annular pistons are constantly in contact with the rollers via a low pressure, maintained by a small electric pump in the coupling. The pump works only when the vehicle's engine is running. The coupling is deactivated when the engine is off, making it possible to tow the vehicle with one axle lifted.

#### Dimensions

Haldex LSC can be adapted to the available packaging space in the vehicle. Installation dimensions for two models are shown as examples.

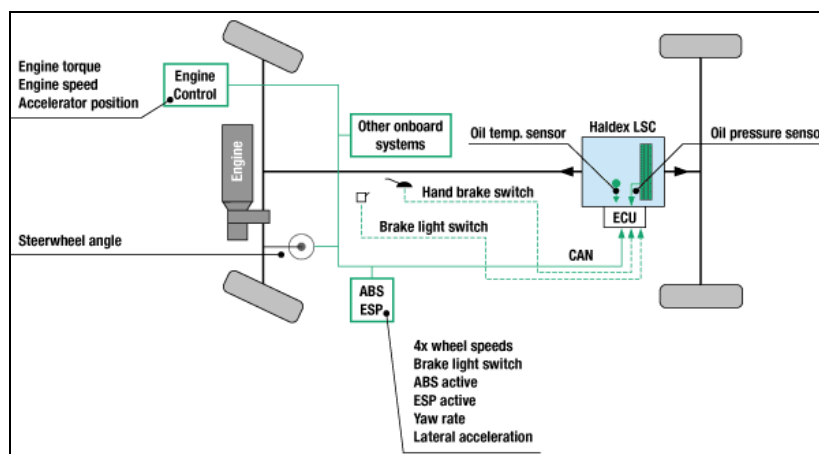
- [www.haldex.com](http://www.haldex.com)
- [www.haldex-xwd.com](http://www.haldex-xwd.com)



## Coupling Control Concept

Haldex LSC connects to the vehicle's electrical system and to the data communication bus (i.e. the CAN-system), transmitting information on the driver's actions, the engine, the transmission, the brakes and other on board systems.

Haldex LSC uses this information entirely for its control without the need for additional sensors. The available signals are received by the coupling's processor and interpreted by the software. Continuous analysis of these data adjusts the characteristics of the coupling according to actual demand, without any active intervention by the driver.





*10 years in motion*

The function of the coupling is automatically adjusted to prevailing conditions. When starting in sand for example, the shafts are coupled together as firmly as possible to obtain the best traction. When close cornering, i.e. parking, the shafts are uncoupled to allow easy manoeuvring.

The controllability of the Haldex LSC also makes it possible to use differently worn tyres, to tow the vehicle with one axle raised, and to maintain function when using Run-flat-tyres or Mini-Spare.

Haldex LSC can use any suitable signal available on CAN. Signals from the ABS and ESP systems and the engine control are vital for performance. For enhanced performance, signals from a steering wheel sensor, yaw sensor, lateral acceleration sensor can be used if available.

## **Torque Transfer Characteristics**

Haldex LSC is fast! With instant activation independent on differential speed, Haldex LSC with PreX provides high torque transfer from stationary independent of any wheel rotation.

The Haldex LSC with PreX do not need any difference rpm to generate high torque transfer.

Haldex LSC is activated regardless of whether the input shaft is rotating faster or slower than the output shaft. This is a major advantage for the dynamic stability of the vehicle in acceleration or deceleration in combination with cornering or manoeuvring.

The torque transfer characteristics are controlled by the ECU, using the vehicle management information to adjust oil pressure via the throttle valve. With the controllable torque transfer characteristics of Haldex LSC, the vehicle performance does not need to be a compromise between traction, demanding high torque transfer, and manoeuvrability, demanding low torque transfer. The torque transfer is optimised for each driving situation - ensuring maximum safety and performance.

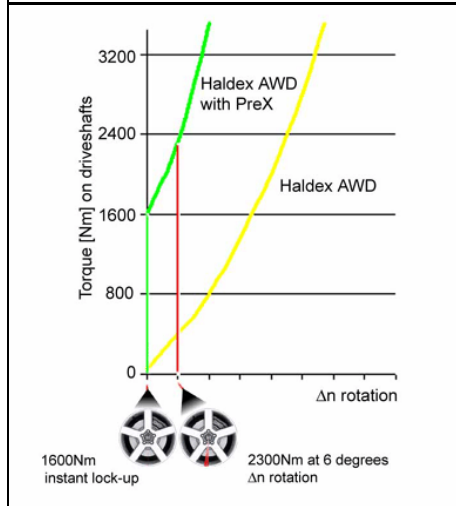
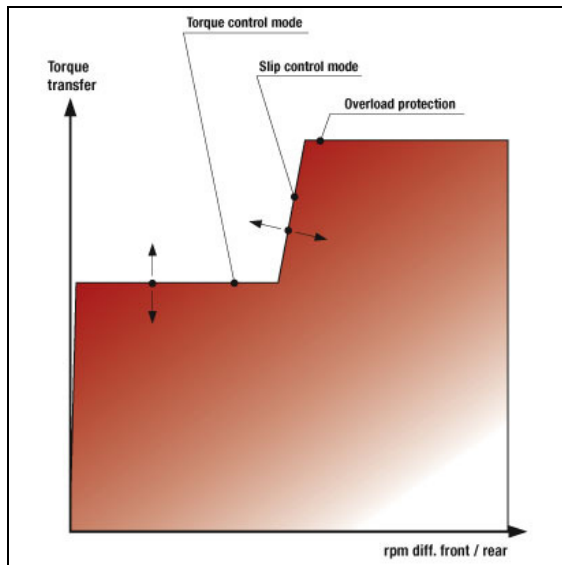
Torque transfer characteristics of the Haldex LSC. In normal driving conditions, the torque over the unit is controlled by the ECU. When a wheel start to spin, the coupling automatically and instantly stops the spinning. The maximum torque is set by the overload protection valve according to the vehicle manufacturer's specification.

- [www.haldex.com](http://www.haldex.com)

- [www.haldex-xwd.com](http://www.haldex-xwd.com)



10 years in motion



Torque Transfer / Degrees of coupling rotation

- [www.haldex.com](http://www.haldex.com)
- [www.haldex-xwd.com](http://www.haldex-xwd.com)