

Haldex Traction Systems

Welcome



Haldex Limited Slip Coupling

Intelligence for AWD

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Latest News

Haldex
commissioned to
develop software
architecture for
next generation
AWD vehicles

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2002-02-26

Haldex commissioned to develop software architecture for next generation AWD vehicles

Haldex Traction Systems, a division in the Haldex group, has been commissioned by a European car manufacturer to jointly develop the software architecture in next generation's AWD vehicles. The objective for the joint development project is to integrate and expand the communication and cooperation between the vehicle's different electronically controlled systems, with the aim to further enhance performance and safety in future vehicles.

The vehicle industry is in the midst of an electronics revolution with no signs of stagnation. In order to better exploit potential synergies between various electronically controlled systems and to optimize the software structure in the vehicle, Haldex has been chosen as a partner to a European car manufacturer to jointly develop the software strategy for next generation's AWD vehicles. The project is expected to result in improvements in the area of vehicle dynamics and motion control.

In connection with the development of the Haldex AWD system, a significant body of know-how has been built up regarding vehicle dynamics and software. The present assignment also confirms that the electronically controlled AWD system has a key role in the complex task of coordinating software and subsystems within the area of vehicle dynamics.

Concept cars will be built during the year to test and calibrate various functions.

The Haldex group (www.haldex.com), with headquarters in Stockholm, Sweden, is an innovator in vehicle technology with emphasis on vehicle dynamics and supplies proprietary systems and products for trucks, cars and industrial vehicles on a global basis. Haldex is listed on the Stockholm Stock Exchange and has annual sales of approximately 7 billion Swedish Krona with 4,150 employees.

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phone +46 8 678 72 70

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Technical Information

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:



Six Dimensions

Six Dimensions

Main Qualities

Design Info

Control Samples

Performance Info

Enhanced Vehicle Traction

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

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.

Technical Information

Main Qualities

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.

Six Dimensions

Six Dimensions

Main Qualities

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Control Samples

In Control, Regardless the Driving Situation

Controllability of the vehicle is an important promotional factor for All-Wheel-Drive. AWD provides enhanced road handling and is safer in all driving conditions.

Meeting these requirements, the Haldex LSC offers fully controllable torque transfer characteristics and extremely rapid activation and deactivation - automatically.

Maximum performance and safety is achieved in all driving situations, as shown here:



Parking

Low or zero torque transfer enables easy and comfortable manoeuvring in parking situations.

Acceleration

High torque transfer for maximum traction, instantly, on all four wheels.



Driving on slippery/wet roads

Swift activation of the coupling for maximum traction and safety depending on the slip of the wheels. The coupling communicates on-line with other safety systems in the vehicle.

Different tyre wear and pressure conditions

An algorithm in the ECU detects differences in the diameters of the tyres and compensates the characteristics accordingly.



Braking/ABS

ABS braking overrules the coupling to ensure full function of the ABS system.

Brake testing

Coupling is not activated until a preset engine speed is exceeded. This means that the coupling is not activated, even if the ignition is on.



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Towing

Coupling is not activated until a preset engine speed is exceeded. The ignition can be on for lights etc. Towing with one axle lifted is not a problem.

ESP

Immediate deactivation on ESP signal to ensure full function of the ESP system. An alternative is to communicate with the ESP system to add the control possibility of the Haldex LSC to the ESP system.



Run-flat-tyre

Maintained traction capability and secured against damage.

Off-road

Instant activation with high torque transfer for maximum traction. Alternative, separate off-road mode (switch) to lock the coupling.



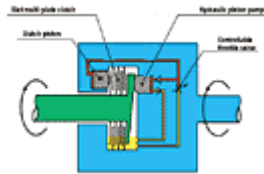
Technical Information

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

- 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.

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.

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Basic Function

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Coupling Control Concept

Electronic Control Unit

Installation in Vehicle

Coupling Lay-out

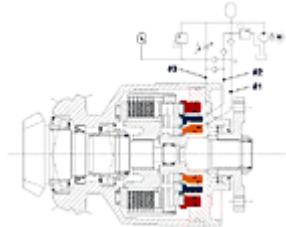
Technical Information

Actual Design

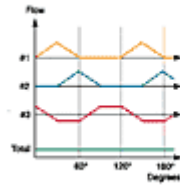
Mechanical - Hydraulic layout

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 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.

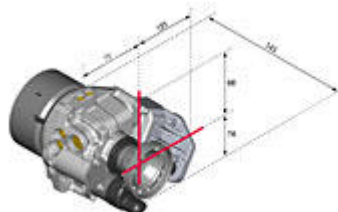
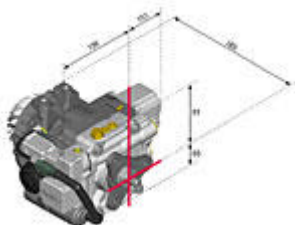


Haldex LSC has a built-in over-load protection valve in parallel to the controllable throttle valve. The over-load protection valve protects the entire drive-train from excessive peak load and is preset to the customer's specification.

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.



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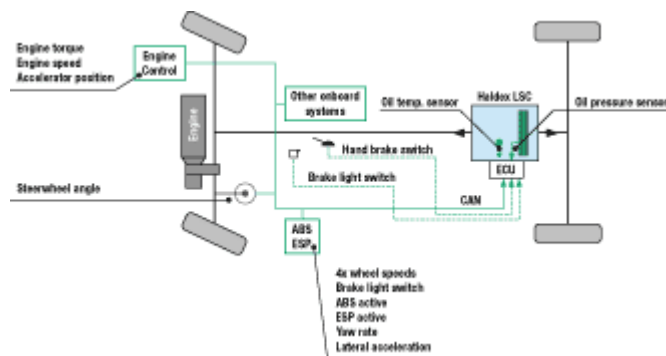
Coupling Lay-out

Technical Information

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.



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.

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Electronic Control Unit

The Electronic Control Unit (ECU), integrated into the housing of the Haldex LSC, has been developed and designed by Haldex and Siemens VDO Automotive. The ECU is designed and produced to endure the rough environments to which the drive-train is constantly subjected, including vibrations and thermal variations.

ECU Data

Infineon C167CS
16 bit RISC Controller
CPU clock 20 MHz
256 kB flash memory



The ECU controls a valve which directs the torque transfer characteristics, ranging from fully open to fully closed.

The open position is used during ABS operation and when Stability Control Systems are activated. The valve opens in less than 60 ms. The closed position is used when accelerating and driving on soft ground.

The software program determines the control of the coupling. It comprises two main parts: base software and application software.

The base software controls the internal functions of the Haldex LSC. One example is compensating for the variations in the viscosity of the oil, within the operating temperature.



The application software communicates with other active systems in the vehicle via a data bus. It determines the vehicle state with the help of the read signals. Examples of received signals are: engine torque, engine revs and wheel speeds. From this estimated vehicle state, the optimum torque distribution is determined in each condition. If the input signals are lost due to a failure in another ECU, the Haldex LSC enters a limp home mode, maintaining AWD. Every vehicle has its own requirement specification profile. This specification leads to different calibrations of the Haldex LSC. A multiple set of parameters are available in the software itself. Online, the application software will determine which set to use in the actual vehicle, e.g. estate or sports saloon.

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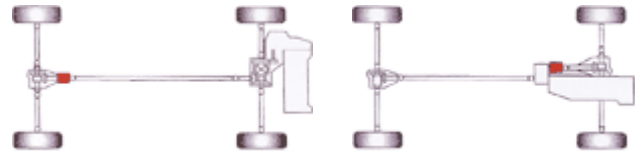
Coupling Lay-out

Technical Information

Installation in Vehicle

Haldex LSC is installed in the drive-train of the vehicle to distribute the torque between the front and rear axles.

In a basically front wheel driven vehicle, Haldex LSC will transfer the torque to the rear axle, and vice versa for a rear wheel driven vehicle.



Hang-on rear

Hang-on front

Examples of test and serial installation of the HLSC

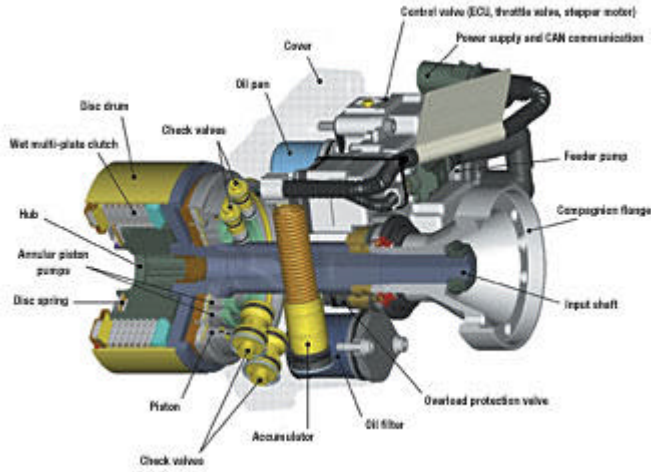


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Coupling Lay-out

Haldex Limited Slip Coupling:
State-of-the-art technology



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Torque Transfer Characteristics

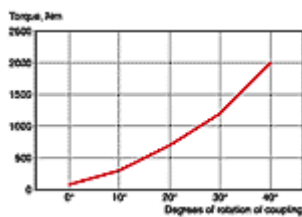
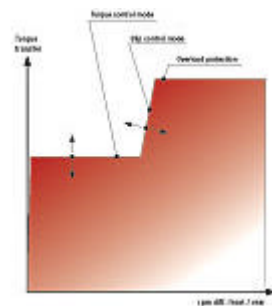
Haldex LSC is fast! With instant activation on differential speed, Haldex LSC provides high torque transfer within less than 15° wheel rotation.

The Haldex LSC needs very low difference rpm to maintain 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.



Torque Transfer / Degrees of coupling rotation



Achievable Torque Transfer / Degree of wheel rotation

Six Dimensions

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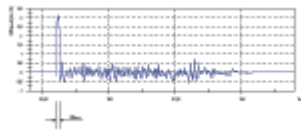
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Activation

Due to the design with piston pumps, the reaction at start is instant. The diagram shows a max. acceleration from still stand - after 150 ms the slip on the driving wheels is completely stopped.



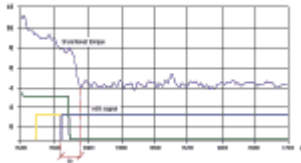
Deactivation on ABS signal

The diagram shows the pressure drop in the coupling when the ABS system is activated. The pressure, and thus the torque, decreases within 60 ms.

Green curve: Brake activation

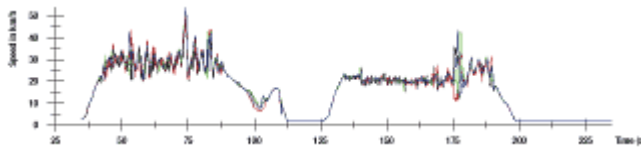
Yellow curve: ABS activation

Purple curve: Coupling pressure (base pressure is 4 bar).



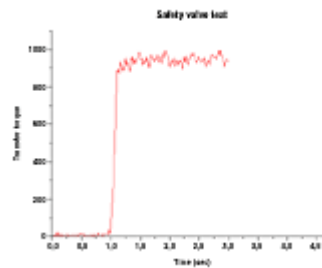
Driving in snow

When driving in snow or other difficult conditions, the coupling is almost in Lock-Up. The differential speed is only 1-2 rpm between the driving axle and the secondarily driven axle.



Activation of Over-load protection valve function

The diagram shows the torque transfer in a coupling where the torque limitation is set to 1000 Nm. When max. torque is reached, the over-load protection valve opens and the torque is maintained at the pre-set value.



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Real Life Tests

Haldex LSC has passed the toughest real-life tests

The design of the Haldex LSC has been adapted during years of development to meet the high demands on safety and performance required by the automotive industry. Haldex LSC has been subject to tough and intensive long-term tests on rally-cross competition tracks and in standard vehicles during conditions ranging from desert heat to arctic cold.



Haldex LSC has been tested over several years in extremely demanding conditions in the European Rally-Cross competition.



An extensive laboratory test program has been performed for verification of the design and performance of the Haldex LSC.



Temperature test



Vibration test

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Real Life Tests

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Ulf Ahlen-President
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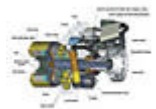
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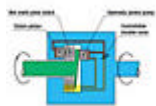
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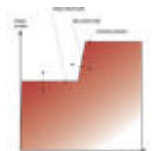
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About Us

Haldex Traction Systems

Within the Haldex Group, Haldex Traction AB is responsible for the manufacture and worldwide marketing of the advanced and flexible AWD-system designed and developed by Haldex.

Haldex Traction AB is located in the city of Landskrona, in the very south of Sweden. The Haldex Traction Division has 200 employees for product development, production and marketing. In Detroit, MI, Haldex has an office with engineers for support to US customers.



Haldex
Traction Systems

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The Volkswagen Group (VW, Audi, Seat and Skoda), is the first major manufacturer to integrate the Haldex AWD-system.

Currently the Haldex AWD-system is introduced on the following vehicle models

- Volkswagen Golf 4motion
- Volkswagen Bora 4motion
- Volkswagen Beetle Rsi
- Volkswagen Sharan
- Audi A3/S3 Quattro
- Audi TT Quattro
- Skoda Octavia 4x4
- Seat León
- Seat Alhambra
- Volvo S60 AWD
- Volvo V70 AWD
- Volvo XC 70
- Volvo XC 90
- Volvo S60R AWD
- Volvo V70R AWD

Vision

Haldex Traction shall be the No 1 supplier of AWD-systems.

Business Idea

To supply intelligent AWD-systems with premium vehicle dynamic performance.

Policy

Quality and Environment are integrated and obvious parts of all activities based on our three philosophies:

- Customer first
- Respect for the individual
- Elimination of waste



This means that all employees are responsible for:

- Customer satisfaction
- Continuous improvement
- Elimination of waste
- Prevention of pollution
- Creation of recyclable products
- Reduce health and safety risks in the workplace

We shall actively pursue the quality and environmental process by:

- Informing and educating our employees
- Create and follow up our quality and environmental goals and action plans
- Complying with requirements from customers, authority and in legislation

About Us

Haldex Group

Haldex is an innovator in vehicle technology - supplying proprietary systems and components for trucks, cars and industrial vehicles worldwide. The Group encompasses four technology/product areas, with emphasis on vehicle dynamics - a future growth area.

BRAKE SYSTEMS - develops and markets a broad range of products and sub systems for air-brakes and suspensions in heavy commercial vehicles.

HYDRAULIC SYSTEMS - develops and markets hydraulic systems for applications in industrial and commercial vehicles.

WIRE PRODUCTS - develops and markets advanced spring-wire products for applications in combustion engines.

TRACTION SYSTEMS - develops and markets controllable four wheel drive systems for cars.

With 4.100 employees and yearly sales exceeding 6 billion Swedish Kronor, Haldex is listed on the Stockholm Stock Exchange (www.haldex.com).

Haldex
Traction Systems

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Job Opportunities

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Job Opportunities

Haldex Traction har utvecklat ett system för 4-hjulsdrift som idag serielevereras till ett flertal bilmodeller inom Volkswagen-koncernen. Sedan juni 2001 serielevererar vi 4-hjulsdrift till Volvo.

Datorn i Haldex LSC (Limited Slip Coupling) kommunicerar med bilens säkerhetssystem för låsningsfria bromsar (ABS), stabilitetskontroll (ESP) och traktionsstyrning (TCS) och anpassar 4-hjulsdriften till varje körsituation. Detta ger bilen helt unika köregenskaper som ej kunnat åstadkommas med tidigare system.

Haldex Traction har tack vare dessa unika egenskaper uppnått en position som världens ledande leverantör av system för avancerad 4-hjulsdrift.

Vi söker nu en

Utvecklingsingenjör - Mjukvara

Vi söker Dig som kommer att vara med och utveckla mjukvaran till vårt realtidssystem. Du får delta i hela utvecklingskedjan, från specifikation via design och programmering till testning och provkörning med kund.

Du är:

- Civil- eller högskoleingenjör med kunskaper i C-programmering av inbyggda system.

Du kommer bland annat att ansvara för mjukvaran i kundprojekt, varvid vi ser att Du har erfarenhet av projektstyrning och kundrelation. Kunskaper om RTOS och objektorienterad programmering är meriterande.

I tjänsten ingår omfattande kontakter med världens biltillverkare, varför Du måste behärska engelska i både tal och skrift samt gärna ytterligare något språk.

För ytterligare information om tjänsten vänder Du dig till

Teknikchef Hans Engström
Telefon 0418-47 65 36

Gruppchef Elektronik/Mjukvara Dag Stomrud
Telefon 0418-47 65 59

Din ansökan skickar Du snarast,
dock senast 9 december 2002 till

HALDEX TRACTION AB
Pär Persson
Box 505,
261 24 LANDSKRONA
Alt: per.persson@haldex.com

Haldex
Traction Systems

About Us

Haldex Group

Job Opportunities

Contacts

Contact Us

You are welcome to contact us to discuss the Haldex LSC for your next generation of AWD system!

Contact Us **Contacts**

Online Message

Landskrona, Sweden

Mailing Address

Haldex Traction AB
Box 505
SE - 261 24 LANDSKRONA
Sweden

Visiting Address

Instrumentgatan 15
SE - 261 24 LANDSKRONA
Sweden

Telephone + 46 418 476500
Fax + 46 418 476599
E - mail info@htse.haldex.com



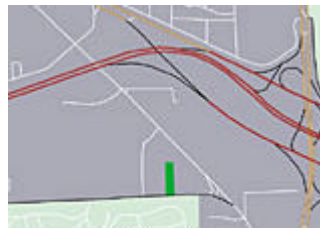
[Click to enlarge](#)

Detroit, MI, USA

Mailing / Visiting Address

Haldex Traction AB
27777 Franklin Rd, Suite 300
Southfield, MI 48034
USA

Telephone +1 248 213 0242
Fax +1 248 213 0362
E-mail info@htse.haldex.com



[Click to enlarge](#)

Contacts

Online Message

If you have any questions or remarks to us, please fill out your name, e-mail and the question below and click "Submit Question". The message will be sent by mail to Joakim Söderström (Product Manager) at Haldex Traction Systems and he'll get back to you with an answer as soon as possible.

Name

E-mail

Question

Submit Question

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Visual Web Structure

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- Newsletter

Technical Information

Six Dimensions

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- Main Qualities
- Control Samples

Design Info

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- Actual Design
- Coupling Control Concept
- Electronic Control Unit
- Installation in Vehicle
- Coupling Lay-out

Performance Info

- Torque Transfer Characteristics
- Performance Graphs
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Haldex Business Areas

Haldex AB

Haldex is an innovator in vehicle technology - supplying proprietary systems and components for trucks, cars and industrial vehicles worldwide. The Group encompasses four technology/product areas, with emphasis on vehicle dynamics - a future growth area.
<http://www.haldex.com>

Brake Systems

Haldex Brake Systems develops and markets a broad range of products and sub systems for air-brakes and suspensions in heavy commercial vehicles.
<http://www.brake-eu.haldex.com>

Hydraulic Systems

Haldex Hydraulic Systems develops and markets hydraulic systems for applications in industrial and commercial vehicles.
<http://www.haldexbarnes.com>

Wire Products

Haldex Wire Products develops and markets advanced spring-wire products for applications in combustion engines.
<http://www.hgse.haldex.com>

Haldex
Business Areas

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Customers

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Customers

Volkswagen Home Page

<http://www.vw.com>

Audi World Site

<http://www.audi.com>

SEAT International

<http://www.seat.com>

Skoda

<http://www.skoda.com>

Volvo

<http://www.volvo.com>

Hallex
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