Hydraulik-Ring GmbH (A Hilite International Inc. Company)

Series Development and Manufacturing of Innovative Systems and Components for the Automotive Industry

Components for Transmission Applications
Transmission Control Systems, Actuators, Valves, Pressure Supplies
The innovative, global development partner and series supplier for the Automotive Industry

Hydraulik-Ring GmbH which belongs to the Hilite International Company has made big experiences with transmission applications since the 80’s.

Some of the first applications were e.g. the controls for the Porsche double clutch transmission and transmission controls for the Mercedes Benz Group C racing cars. In the middle of the 80’s Hydraulik-Ring manufactured Aluminium vane pumps for McLaren-Porsche who won the World Championship ‘85 and ‘86. This was the beginning of the triumphal procession of the Hydraulik-Ring valve technology. For the first time a Mercedes automatic transmission where the shift from the 4th to the 5th speed works with a proportional pressure control valve started in series production.

Nearly at the same time the Mannesmann Rexroth Fahrzeugtechnik (later Hydraulik-Ring) started with the series production of hydraulic pilot valves for the control plates of VW AG4 automatic transmissions.

At the beginning of the 90’s Hydraulik-Ring developed the first hydraulic controls and actuators for automated manual transmissions. The first series application of an automated manual transmission was realized in 1996 in the Ferrari F355 F1 with a combined pressure supply and control unit and a turn-shift actuator. In 1998 a shift operation unit started with series production in the Lupo 3L.

Today Hilite International is able to develop and produce different, complex components and modules for transmission applications in high volumes.

Transmission control in the Ferrari F355 F1
Development in Transmission Technology

The basic transmission concepts in the Automotive Industry are on the one hand the conventional manual transmissions with the following features:

- High efficiency
- Low costs
- Low comfort
- High wear
- Low weight

And on the other hand we have the conventional automatic transmissions with hydraulic converter and features like:

- Low efficiency
- High costs
- High comfort
- Low wear
- High weight

In transmission engineering it has for many years been a challenge to find an optimal compromise between these concepts. The target is a transmission with high efficiency, high comfort, low weight and low wear and all this at low cost.

One of the ideas is to use automated manual transmissions, which can be implemented very fast in ongoing series. These actuators are mounted on a transmission and do the shift operations. Shifting can be done either electro-mechanically or electro-hydraulically. But the practice shows that the electro-hydraulic solutions especially in applications with high torque (sports cars and trucks) have advantages against electro-mechanic solutions due to high requirements to powers, installation space and performance.

The next consequent step in transmission development was the further integration (Semi Add In) in the development of new transmissions.

This makes the design more compact, the medium is the same and the number of parts and thus the costs can be held low.

Also the development on CVT (Continuous Variable Transmission), IVT (Ininitely Variable Transmission), and toroidal transmissions continued. Thus Audi managed to use a CVT transmission for engines with a torque of up to 300 Nm. The problem in this concept is the continuously high hydraulic pressure which is needed to guarantee the pressing force for the chain. Only a small hydraulic failure here will lead to extreme wear and destruction of the transmission.

The latest and most promising concept at the moment is VW’s direct shift transmission (DKG). It is a double clutch transmission with hydraulic control. Both clutches are driven by the engine. The power is transferred through a hollow shaft and through a second shaft positioned within the first. Whenever a speed is selected, another speed can be pre-selected on the other shaft.

Much technical sensitivity is necessary to control both clutches exactly. This is where Hydraulik-Ring with its special valve technology comes in as the perfect partner for you.

Hydraulik-Ring has developed a Semi Add In transmission control with pressure supply, accumulator, valvecontrol with integrated TCU and central connector. Usable to control transmissions with single clutches and also with double clutches and double wet clutches.
## Hilite / Hydraulik–Ring Transmission Competence

### Valves

<table>
<thead>
<tr>
<th>Pressure valves</th>
<th>Directional valves</th>
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<tbody>
<tr>
<td>On / off valves</td>
<td>On / off valves</td>
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<tr>
<td>Pilot Direct</td>
<td>Pilot Direct</td>
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<table>
<thead>
<tr>
<th>Proportional valves</th>
<th>Proportional valves</th>
<th>Puls-modulated valves</th>
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<tbody>
<tr>
<td>Pilot Direct</td>
<td>Pilot Direct</td>
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### Actuators

<table>
<thead>
<tr>
<th>Turn actuators (Vane motor principle)</th>
<th>Shift actuators</th>
<th>Combined actuators</th>
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### Transmission Control Systems

<table>
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<th>Control with pressure supply and accumulator</th>
<th>Control, pressure supply, actuator for DCT</th>
<th>Control with actuator</th>
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Valve technology is the key technology for hydraulic transmission control systems. To control shift operations and especially for the control of clutches, variators of CVT-transmissions and toroidal variators, precisely working hydraulic valves are required. The least inaccuracies produce errors in the transmission control which can cause serious damage of the transmission.

The Hydraulik-Ring valves meet all of these requirements for high precision. Be it for use as a pressure control valve or as a directional control valve, as an on/off or a proportional valve, Hydraulik-Ring being one of the leading valve manufacturers can offer for each and every operation in electro-hydraulic transmission control systems the optimal, low cost solution.

### 3/2 On/off Valve

**Symbol**

- Pmax = 200 bar
- Switching time < 20 ms
- Q at ∆p 10 bar = 5 l/min
- Medium=ATF, Pentosin

### 3/2 Prop. Pressure Reduction Valve

**Symbol**

- Pmax = 200 bar
- Switching time < 20 ms
- Q at ∆p 10 bar = 5 l/min
- Medium=ATF, Pentosin

### Prop. Pilot Pressure Control Valve

**Symbol**

- P = 0-15 bar
- Q at ∆p 15 bar = 1 l/min
- Medium=BOT 154 BLM 3

**Techn. Data**

- Normally rising

### Prop. Pilot Pressure Control Valve

**Symbol**

- P = 25 - 0 bar
- Q at ∆p 15 bar = 1 l/min
- Medium=BOT / ATF

**Techn. Data**

- Normally falling

This is only a small extract of our possibilities. All Valves are abt for ambient temperatures ranging from -40 to 160 °C in single cases up to 180 °C. In the range of -40 to -20 °C the function may be restricted. Hilite customizes valves to meet customers’ requirements e.g. nominal voltage, current consumption, type of protection and connection.
**AMT – Applications**

**Gear selector:** Two parallel actuators control the shifting mechanism by means of a rocker switch and a lever.

**Field of application:** Passenger cars (3L Lupo, A2).

**AMT System:** Pressure supply with accumulator, tank and integrated clutch valve as well as turn-shift actuator with integrated hydraulic control.

**Field of application:** Passenger cars and light duty commercial vehicles.

**AMT System:** Pressure supply with accumulator, tank and integrated clutch valve, clutch actuator and gear selector with integrated hydraulic control (6 gears / 4 shifts).

**Field of application:** Passenger cars Demonstration vehicle Honda S2000.

**AMT System:** Pressure supply with accumulator and integrated transmission control and turn-shift actuator.

**Field of application:** Passenger car Ferrari F355.
Semi–Add–In, CVT, Haldex–Clutch

**Semi Add-In AMT System:** Adaptable control plate with integrated valve control and central connector for energy supply and CAN Bus (TCU) accumulator and pressure supply. Actuators positioned on the inside are also apt for DCT-controls.

**Field of application:** Passenger cars.

**Pressure supply and control for CVT:** Pressure compensated internal gear pump driven directly by the engine. Pressure control valves to control the pressure on the variants.

**Field of application:** Passenger cars with CVT, e.g. A6 multitronic.

**Control of a Haldex-clutch:** The Haldex-clutch can be controlled. It is not only the slip alone which is decisive for the distribution of driving power, but also the current dynamic condition of the vehicle. For immediate conversion of the sensor data we use a proportional pressure control valve.

**Double Clutch Applications**

**DCT System:** Transmission control with (FMU) Flow Management Unit, (CCU) Clutch Control Unit, slider plate with integrated solenoids.

**Field of application:** Control of 7-gear-double clutch transmission.

**DCT System:** Combined unit with integrated FMU (Flow Management Unit), CCU (Clutch Control Unit), ACU (Actuator Control Unit) 4 actuators with 3 positions.

**Field of application:** Control module: Valve module to control a double clutch transmission with dry clutch.

**DCT System:** Control plate of small dimensions for top functionality to control double clutch transmissions with wet clutches.

**Field of application:** Control of 7-gear-double clutch transmission (wet).

**Control module:** Vyncolit block with four integrated valves

**Field of application:** Valve module to control a double clutch transmission with dry clutch.

**Valves in the Bugatti DCT:** Proportional pressure control valves, directional valves as well as on/off valves made by Hydraulik-Ring are used to control the DCT in the Bugatti Veyron. The transmission can transfer powers up to 1250 Nm.