Powertrain

# PRODUCT CATALOGUE

Turning Power into Motion

HYDRAULIC PASSION
SINCE 1904
WWW.LHY.COM

www.lhy.com

# HYDRAULICS MANUFACTURER WITH PASSION

We have always had a passion for converting power into motion and this passion is driven by customer care, a thirst for knowledge and a love of innovation. We combine components suchs as hydraulic motors, hydraulic pumps, valves and electronic control units into a single system and create efficient overall solutions thanks to our intelligent blend of hydraulics, electronics and mechanics. Our aspiration can be summed up by one simple concept: We insure added value for our customers which is tailored to the customer and can be maintained over the long term. Experience, system expertise and the pursuit of perfection form the basis for our joint success. We power ideas, machines and markets, both today and in the future. This explains our formula: **Turning Power into Motion.**

Güldner | Linde Hydraulik | Linde Hydraulik | Linde Antriebstechnik | Linde | Linde Hydraulics | LHY Powertrain

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# LHY Product Catalogue
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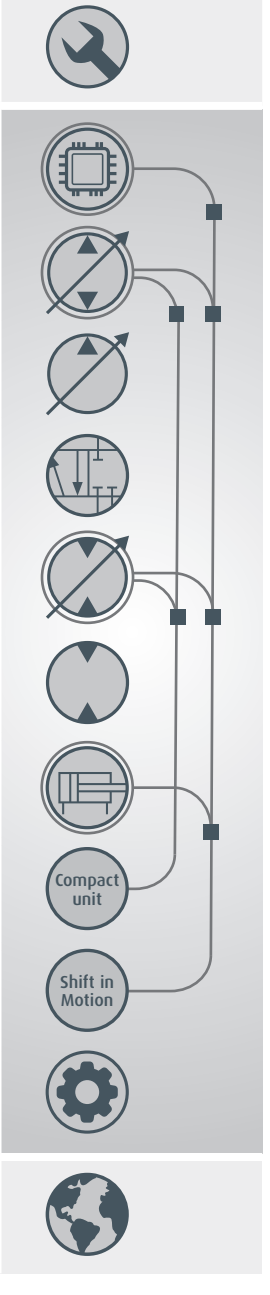

# Our Services
# LHY Powertrain Lifecycle

## INQUIRY & LAYOUT

### Regardless of whether you contact us in person or by other means, with us you will always find your solution as quickly as possible.

LHY Powertrain offers you a wide range of solutions for your construction, forestry or agricultural machinery. Get an overview on our website. In the download area you will not only find layout examples for your application, but also data and fact sheets with technical details of our portfolio. In addition, 3D (step) models of our products can be used to determine the required installation space. A global network of sales partners always offers you a local contact person – together with our team of application engineers we will support and verify your layout.

**→ You can find a sales partner close to you on our website at www.lhy.com/network**

## DEVELOPMENT & APPLICATION ENGINEERING

### Regardless of whether you need standard or customized solutions, our engineers will develop what brings you forward – under all operating conditions.

Benefit from our expertise and the wealth of experience of our engineers in every step of the product development process:

- Common product development
- Worldwide project support
- Pulse and endurance testing beyond the application requirements
- Customized project coaching
- System training for specific applications

Compact unit
Shift in Motion
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# Our Services
# LHY Powertrain Lifecycle

## COMMISSIONING & SERIES PRODUCTION

### Regardless of being at the prototyping and commissioning stage or series production, with systems and expert knowledge, we always ensure high quality and reliability.

We are already well prepared before we come to you to commission your machine. During the development of the iCon® controller, for example, we use the design parameters of your machine to create a simulation model, with which a majority of the functions can already be programmed and tested by computer. During commissioning on site, we can then fully concentrate on the fine adjustment of the parameters. The so-called partial integration by means of Hardware-In-The-Loop test systems significantly shortens the development period of the controls and offers you more flexibility in designing your machine functions.

Even when our products are finally ready for series production, we do not lean back or rest on the fact that we have a very competent and experienced team. With a holistic quality concept, we ensure consistently high quality and reliability – completely independent of variance or quantity.

## SPARE PARTS & REMANUFACTURING

### You matter to us! We are there for you – for more than one lifetime.

In case you have to hurry! With our outstanding parts availability, our global network of service partners and the accustomed LHY quality, we are there for you when you need us. It doesn't matter whether you need a single part in the event of a break-down or whether we prepare your units for the next harvest.

**→ For repair and remanufacturing services you can find a service partner close to you on our website at www.lhy.com/network**

Compact unit
Shift in Motion
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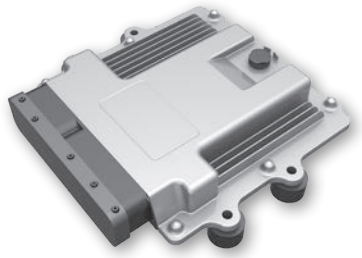
# Controllers
# iCon®

## Design characteristics

- Controller family with function and safety controller
- Various network capabilities
- Compact and robust design

## Product advantages

- Cost-efficient configuration of manifold functions: from simple controls to complex and safety-critical systems
- Demand-oriented extension and simple implementation into overall vehicle network
- Wide range of applications



## Fields of application

| iCon® | CB 16-01 | CD 88-01 |
|---|---|---|
| Simple controls | ✓ | ✓ |
| Underspeed control | ✓ | ✓ |
| Dual path drive | | ✓ |
| On-road drive | | ✓ |
| Complex controls | | ✓ |

## General technical data

| | | Controller | | Connector | Outputs | | | | | | | | Inputs | | | | | | | Comm. | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Safety level | Function | Safety | Pincount | HighSide Out, max. 3 A | HighSide Out (switched in groups) | LowSide Out | LowSide current controller | Sens. power supply, 5 V at 150 mA | Sens. power supply, 2V - 10V at 250 mA | Sens. power supply, 10V at 250 mA | Sens. power supply, 24V at 1000 mA | Analog In, 0-5 V | Frequency In | Inductive sensors (frequency) | PWM In | Digital PullUp | Digital PullDown | Ignition | CAN | Ethernet 100 |
| CB 16-01 | PLb | ✓ | | 48 | 0 | 2 | 0 | 4 | 2 | | | 1 | 8 | 2 | 0 | | 0 | 0 | 1 | 1 | 1 |
| CD 88-01 | PLd | ✓ | ✓ | 154 | 6 | 10 | 2 | 22 | 2 | | 1 | | 19 | 7 | 1 | | 10 | 12 | 1 | 3 | |

Compact unit

Shift in Motion

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With the new platform, LHY creates the smart integration of the electronic control system into the overall vehicle. The initial simulation of your machine with regard to software, hardware and hydraulics shortens the development period enormously. This also means a very high degree of flexibility and high cost efficiency for you. As a result, a library of modularly programmed functions is then ready to be compiled – individually and tailored to your needs. The controller is delivered either already flashed or unflashed to keep your storage costs low.

Thanks to standardized protocols, you are not tied to specific diagnostic systems and can freely choose the use of conventional tools.

This applies not only to the control of overall vehicle systems, but also to the control of subordinate systems, which in turn can become part of a complex control concept thanks to their network capability.

## Design characteristics

- Software & Hardware in the loop (SIL/HIL)
- Modular software architecture
- Use of standardized protocols for flashing/(parameter) configuration/diagnosis

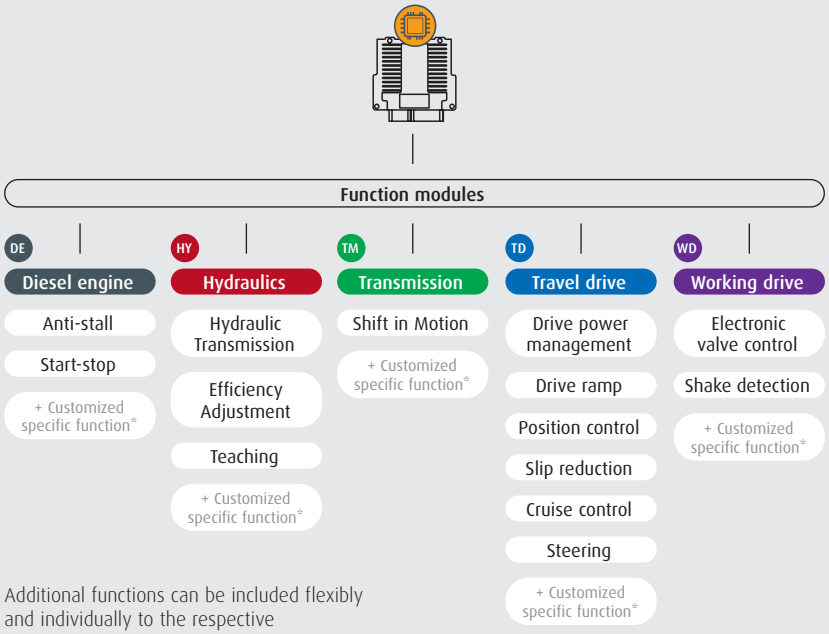
## Product advantages

- Greatly reduced development periods and increased flexibility in the design of functions
- Highly flexible configuration of the scope of functions
- Minimal effort for software updates and subsequent addition of functional modules

## General functional description

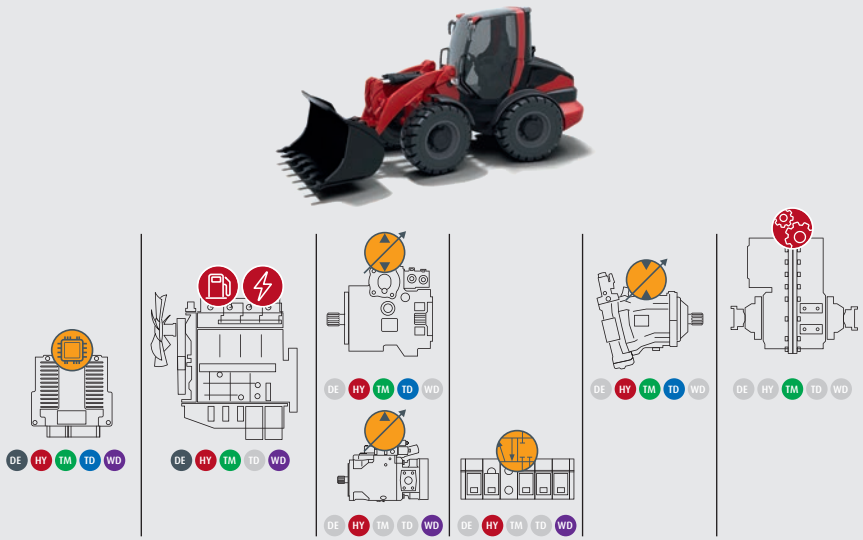
### Application example in context of a wheeled loader

#### Application software architecture




* Additional functions can be included flexibly and individually to the respective function module

#### Function modules integrated in the powertrain



By taking a holistic view of the drivetrain, the control system can initially evaluate the respective operating status of the machine better. Thanks to the well-coordinated interaction of various sub-systems, the control system can now take specific measures to ensure safe and efficient operation.

Compact unit
Shift in Motion
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# Closed Circuit | Variable Displacement Pump
# CPV

## Design characteristics

- Modularity (e.g. controller, peripherical parts, etc.)
- Maintenance and repair friendliness
- High integration
- Controller with and without position feedback

## Product advantages

- Highly flexible compilation of individual configurations
- Cost-effective repair and conversions
- Versatile applications
- Extremely compact pump

With the new generation of swash plate pumps for the closed hydraulic circuit, LHY Powertrain combines the many years of experience of the 02 series with today's diverse market requirements for a closed circuit pump. With its modular concept, it offers a wide range of options and globally standardized interfaces with minimum space requirements. Thanks to the robust and proven rotative group of the 02 series and its optimized flow concept, the pump specifically reduces flow losses and noise emissions and thus achieves a very high level of efficiency in relation to the market without compromising on durability. In terms of efficiency, the CPV has, among others, a new assembly concept that allows wear parts to be replaced individually without dismantling the pump.

## General technical data

| CPV | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Nominal size** | | | **65** | **85** | **100** | **115** | **145** | **175** |
| Displacement | Max. displacement | cc/rev | 65 | 85 | 100 | 115 | 145 | 175 |
| Speed | Max. operating speed | rpm | 3900 | 3600 | 3450 | 3300 | 3100 | 2900 |
| | Max. speed* | rpm | 4100 | 3800 | 3650 | 3500 | 3300 | 3050 |
| Pressure | Nominal pressure | bar | 450 | 450 | 420 | 450 | 450 | 450 |
| | Max. pressure** | bar | 500 | 500 | 470 | 500 | 500 | 500 |
| | Max. housing pressure | bar | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 |
| Torque | Torque ($\Delta p$=430 bar; charge press.=20 bar) | Nm | 444 | 581 | 684 | 786 | 991 | 1196 |
| Corner power (theor.) ($V_{max}$ x $n_{max}$ x $\Delta p$ 430 bar) | | kW | 182 | 219 | 230 | 272 | 322 | 364 |
| Weight (approx.) (with EP-control, without oil) | | kg | 59.5 | 65.4 | 65.4 | 81 | upon request | upon request |

## Customer interfaces

**Control options**** 

| | Proportional | Direct | 3-Position | Pressure cut-off | Enable function | Torque Control |
|---|---|---|---|---|---|---|
| Electro-hydraulic | ✓ | ✓ | | ✓ | ✓ | |
| Hydraulic | | | | | | |
| Mechanic | | | | | | |

**Sensors**

| Swash angle | Pressure |
|---|---|
| ✓ | ✓ |

**Flanges**

| | 2 hole | 2 hole, 4 additional threads M12 | 2 hole, 4 additional threads M16 | 2 hole, additional holes (d=17,5mm) | 4 hole |
|---|---|---|---|---|---|
| SAE-B | | | | | |
| SAE-C | ✓ | | | | ✓ |
| SAE-D | ✓ | | | | ✓ |
| SAE-E | | | | | ✓ |

**Shafts**** 

| ISO 3019-1 (SAE) 744) ANSI B92.1-1970 | Compagnion flange SAE J 1946 Typ A | DIN 5480 |
|---|---|---|
| ✓ | ✓ | ✓ |

**PTO**

| Power take-off |
|---|
| ✓ |

**Ports**

| | ISO 6162-2 Radial twin ports | ISO 6149-1 |
|---|---|---|
| Work ports | ✓ | |
| Threaded ports | | ✓ |

* highest transient speed, that can temporarily occur | ** highest transient pressure, that can temporarily occur | **** Availability depends on nominal size

Compact unit

Shift in Motion

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# Closed Circuit | Variable Displacement Pump
# HPV-02

All the controls used in the Series 02 are based on a load-independent control mechanism. No matter which control is used: identical commands always result in the same response in the machine. The sensitive and precise machine control makes work easier and increases productivity. Various customer system options for mechanical, hydraulic and electric input solutions are available. Further special regulating features like torque control and pressure cut-off are also available. The reliable control of the pump can easily be integrated into any kind of vehicle management control system.

## Design characteristics

- Axial piston pump in swashplate design
- Clockwise or counter clockwise rotation
- Integrated high pressure relief valves with charge function
- Hydrostatic plain bearing of the swashplate

## Product advantages

- Precise and load-independent
- High power density
- Long service life

## General technical data

| HPV-02 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Nominal size** | | | **55** | **75** | **105** | **135** | **165** | **210** | **280** |
| Displacement | Max. displacement | cc/rev | 54.7 | 75.9 | 105 | 135.7 | 165.6 | 210.1 | 281.9 |
| Speed | Max. operating speed | rpm | 3900 | 3400 | 3200 | 3000 | 2750 | 2300 | 2400 |
| | Max. speed* | rpm | 4150 | 3600 | 3400 | 3200 | 2950 | 2500 | 2550 |
| Pressure | Nominal pressure | bar | 450 | 450 | 450 | 450 | 450 | 450 | 450 |
| | Max. pressure** | bar | 500 | 500 | 500 | 500 | 500 | 500 | 500 |
| | Max. housing pressure | bar | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 |
| Torque | Torque ($\Delta p$=430 bar; charge press.=20 bar) | Nm | 374 | 519 | 719 | 929 | 1133 | 1438 | 1929 |
| Corner power (theor.) ($V_{max}$ x $n_{max}$ x $\Delta p$ 430 bar) | | kW | 153 | 185 | 241 | 292 | 326 | 346 | 485 |
| Weight (approx.)*** (with H1-control, without oil) | | kg | 46 | 49 | 66 | 72 | 113 | 132 | 164 |

## Customer interfaces

**Control options****

| | Proportional | Direct | 3-Position | Pressure cut-off | Enable function | Torque Control |
|---|---|---|---|---|---|---|
| Electro-hydraulic | ✓ | | ✓ | ✓ | ✓ | ✓ |
| Hydraulic | ✓ | | ✓ | ✓ | ✓ | ✓ |
| Mechanic | ✓ | | | | ✓ | |

**Sensors**

| Swash angle | Pressure |
|---|---|
| ✓ | ✓ |

**Flanges**

| | 2 hole | 2 hole, 4 additional threads M12 | 2 hole, 4 additional threads M16 | 2 hole, additional holes (d=17,5mm) | 4 hole |
|---|---|---|---|---|---|
| SAE-B | | | | | |
| SAE-C | ✓ | ✓ | | | |
| SAE-D | ✓ | | ✓ | ✓ | |
| SAE-E | | | | | ✓ |

**Shafts****

| ISO 3019-1 (SAE J 744) ANSI B92.1-1970 | Compagnion flange SAE J 1946 Typ A | DIN 5480 |
|---|---|---|
| ✓ | ✓ | ✓ |

**PTO**

| Power take-off |
|---|
| ✓ |

**Ports**

| | ISO 6162-2 Radial twin ports | ISO 6149-1 |
|---|---|---|
| Work ports | ✓ | |
| Threaded ports | | ✓ |

* highest transient speed, that can temporarily occur | ** highest transient pressure, that can temporarily occur | *** inclusive internal gear pump (size 55-135) or external gear pump (size 165-280) | **** Availability depends on nominal size

Compact unit
Shift in Motion
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# Open Circuit | Self-Regulating Pump
# HPR-02

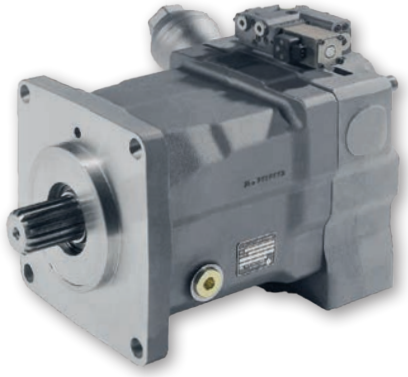
## Design characteristics

- Axial piston pump in swashplate design
- Exact controllers with and without position feedback
- Adaptive noise optimization SPU
- Hydrostatic plain bearing of the swashplate

## Product advantages

- Excellent suction up to rated speed
- High power density
- Energy saving operation by 'flow on demand'- control

Legal emission regulations force manufacturers of mobile machinery to optimize the noise emission of their products. Since secondary measures tend to be expensive and less efficient LHY prefers to fight the noise where it is generated: by optimally connecting an additional volume directly next to the commutation of the HPR-02 pump, LHY invented the SPU silencer. The adaptive SPU reduces pressure pulsations in the regulating pump over the entire range of operation – without loss of power.



## General technical data

| HPR-02 | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Nominal size** | | | **55** | **75** | **95** | **105** | **135** | **165** | **210** | **249** | **280** | **105 D** | **125 D** | **165 D** |
| Displacement | Max. displacement | cc/rev | 55 | 75.9 | 94.7 | 105 | 135.7 | 163.6 | 210.1 | 249.9 | 281.9 | 210 | 2x125 | 2x165 |
| Speed | Max. operating speed (without tank pressurization) | rpm | 2700 | 2500 | 2500 | 2500 | 2350 | 2400 | 2100 | 2250 | 2000 | 2450 | 2400 | 2100 |
| Volume flow | Max. volume flow* | l/min | 148.5 | 189.8 | 237.5 | 246.8 | 312.1 | 392.6 | 441.2 | 563 | 563.8 | 514.5 | 600.0 | 695.5 |
| Pressure | Nominal pressure | bar | 420 | 420 | 350 | 420 | 420 | 350 | 420 | 350 | 420 | 420 | 350 | 420 |
| | Max. pressure** | bar | 500 | 500 | 420 | 500 | 500 | 420 | 500 | 420 | 500 | 500 | 420 | 500 |
| | Max. housing pressure | bar | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 |
| Torque | Torque | Nm | 368 | 507 | 528 | 702 | 907 | 911 | 1404 | 1392 | 1884 | 1245 | 1392 | 1964 |
| Corner power (theoretical) | | kW | 104 | 132.8 | 138 | 172.7 | 218.5 | 229 | 308.8 | 328 | 394.7 | 319.4 | 337 | 431.8 |
| Weight (approx.) (without oil) | | kg | 39 | 39 | 44.5 | 50 | 65 | 74 | 116 | 125 | 165 | 96 | 113 | 177 |

## Customer interfaces

| Control options**** | | | | | | | | Sensors | | Shafts**** | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | pressure cut-off | hydraulic ΔpLS – override | electrical ΔpLS – override | electric stroke limiter and pressure cut-off | hyperbolic power limiter | hyperbolic power limiter and pressure cut-off | Swash angle | Speed sensor | ISO 3019-1 (SAE J 744) ANSI B92.1-1970 | Compagnion flange SAE J 1946 Typ A | DIN 5480 |
| Load sensing | | ✓ | ✓ | ✓ | ✓ | ✓ | | ✓ | | ✓ | ✓ | ✓ |
| Electro-proportional | ✓ | | | | | | ✓ | | | | | |

* theoretical data of a single unit without efficiency effects | ** highest transient pressure, that can temporarily occur | **** Availability depends on nominal size

Compact unit

Shift in Motion

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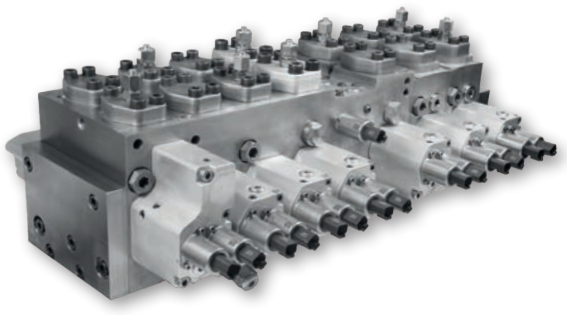
# Open Circuit
# Monoblock Control Valves



Five directional control valves in a common housing form the base of the manifold valve plate in monoblock design. This results in the most compact package.

With its latest LSC generation, LHY combines the design characteristics of the proven LSC system with the benefits of the electric control. The powerful electronic control unit recognises the operator's command by the amplitude and the speed with which the joysticks are being moved. It then sets the pump and the valves according to the dynamic demand. Due to the overlaid, classic load-sensing control mechanism, no sensors are needed.

All components are provided by a single source and matched perfectly with each other. The operator can change the system's behaviour electronically with regard to its dynamics and fine control, as well as its dependency or independency on the load. This enables multi-purpose machines which can quickly be optimized to the specific use by the operator. With completely opened valves, the actuators can be controlled exclusively via the pump's control to achieve the maximum possible efficiency.

## Design characteristics

- Basic block: five directional control valves of identical nominal size in one cast housing
- Designed for the LHY Synchron Control (LSC) - Load Sensing System
- Nominal sizes 30, 25, 22 and 18
- Flows up to 600 l/min (size 30)
- Broad dimensioned diameters and flow-optimized design of the supply channels
- Extendable with directional control valves in sandwich design, in identical or differing nominal size
- Pressure cut-off and additional functions integrated in connection plate
- Special functions via intermediate plates
- Optionally with hydraulic or electric piloting

## Product advantages

- All advantages of the LSC valve technology
- Compact design
- Full-size expandability
- High efficiency achieved by flow-optimized channels even for applications with numerous actuators

Compact unit
Shift in Motion
LEARN MORE

# Open Circuit
# **Modular Control Valves**

## Design characteristics

- Directional control valves available as sub plate
- mounted valves
- Designed for the LHY Synchron Control (LSC) – Load Sensing System
- Nominal sizes 25 and 30
- Flows up to 600 l/min (size 30)
- Modular design for the configuration of valve plates for 1-8 actuators
- Optionally with hydraulic, electric or combined piloting

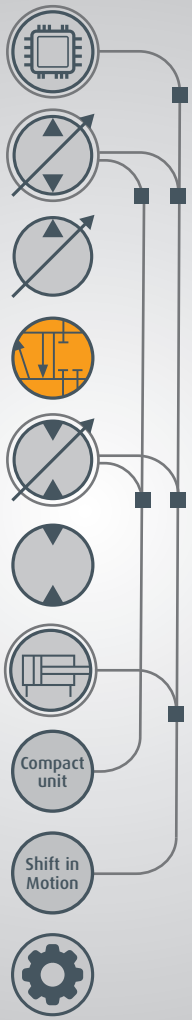
## Product advantages

- All advantages of the LSC valve technology
- Easy to configure building block system
- Adjustable to the target application
- Quick availability
- Ideal for machines with low production volume

Manifold valve plates of series VT modular are made up of individual components of a modular building block system. This is why manifold valve plates can be configured to optimally match any application with one up to eight actuators.

The directional control valves are at the core of every manifold plate in LSC technology. Compared to other load sensing directional control valves, LSC directional control valves stand apart, in particular, thanks to the integrated downstream pressure compensators and pressure copiers. This arrangement prevents the actuator from lowering when the function starts.

As a result of the compact design, the oil flow only needs to pass through the valve once and not several times. This ensures optimized flow passages in the directional control valve. Due to the high-precision production of the directional control valves, there is only minimal leakage even at high load, which is beneficial to the load holding function of the valves.

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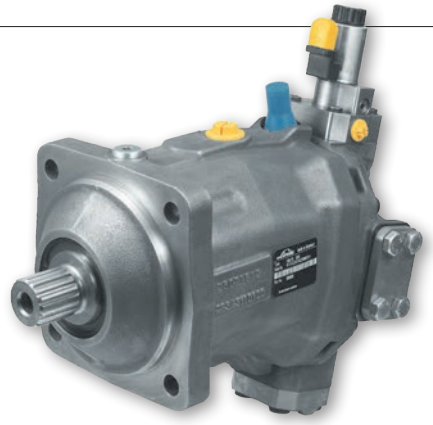
# Open & Closed Circuit | Variable Displacement Motor
# CMV



With the next generation of the bent axis motors, LHY expands its customer oriented portfolio of high-quality components for hydraulic systems. Due to their standardized interfaces, e.g. the plug-in flange according to ISO, the CMV and CMF fit a high variety of applications, without the need of adaptors. The motors enable a more cost effective operation of the respective applications thanks to low windage losses and lighter weight.

## Design characteristics

- Axial piston motor in bent axis design
- Standardized interfaces
- Speed sensor optional

## Product advantages

- High speeds
- High power density
- Low windage losses

## General technical data

| CMV | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Nominal size** | | | **60** | **85** | **115** | **140** | **170** | **215** |
| Displacement | Max. displacement | cc/rev | 62 | 87.7 | 115.3 | 144.1 | 170 | 217.9 |
| Speed | Max. operating speed at $V_{max}$ | rpm | 4450 | 3900 | 3550 | 3250 | 3100 | 2900 |
| | Max. speed at $V_{max}$* | rpm | upon request | | | | | |
| | Max. operating speed at $V_{min}$ | rpm | 7200 | 6800 | 6150 | 5600 | 4900 | 4600 |
| | Max. speed at $V_{min}$* | rpm | upon request | | | | | |
| Pressure | Nominal pressure | bar | 450 | 450 | 450 | 450 | 450 | 450 |
| | Max. pressure** | bar | 500 | 500 | 500 | 500 | 500 | 500 |
| | Max. housing pressure | bar | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 |
| Torque | Output torque ($\Delta p$=430 bar and Vmax) | Nm | 411 | 582 | 787 | 958 | 1163 | 1471 |
| Corner power (theor.) | (Vmax x nmax at Vmin x $\Delta p$ 430 bar) | kW | 320 | 427 | 508 | 578 | 597 | 718 |
| Weight | approx. (without oil) | kg | 27.7 | 36.3 | 44.8 | 59.2 | 62.1 | 76.4 |

## Customer interfaces

**Control options**

| | Proportional | 2-Position | default = Vmin (positive control) | default = Vmax (negative control) | Pressure override |
|---|---|---|---|---|---|
| Electro-hydraulic | ✓ | ✓ | ✓ | ✓ | ✓ |
| Hydraulic | ✓ | ✓ | ✓ | ✓ | ✓ |

**Sensors**

| | Speed | |
|---|---|---|
| Electro-hydraulic | ✓ | |
| Hydraulic | | |

**Flanges**

| | ISO 3019-1 (SAE) 744) | ISO 3019 – 2 (metric) | Plug-in ISO 3019 – 2 |
|---|---|---|---|
| Electro-hydraulic | ✓ | ✓ | ✓ |
| Hydraulic | ✓ | ✓ | ✓ |

**Shafts******

| | ISO 3019-1 (SAE) 744) ANSI B92.1-1970 | Compagnion flange SAE J 1946 Typ A | DIN 5480 |
|---|---|---|---|
| Electro-hydraulic | ✓ | ✓ | ✓ |
| Hydraulic | ✓ | ✓ | ✓ |

**Ports******

| | ISO 6162-2 Side ports | ISO 6162-2 Twin ports (rear) | ISO 6149 – 1 |
|---|---|---|---|
| Work ports | ✓ | ✓ | |
| Threaded ports | | | ✓ |

* highest transient speed, that can temporarily occur | ** highest transient pressure, that can temporarily occur | **** Availability depends on nominal size

Compact unit
Shift in Motion
LEARN MORE

# Open & Closed Circuit | Variable Displacement Motor
# HMV-02

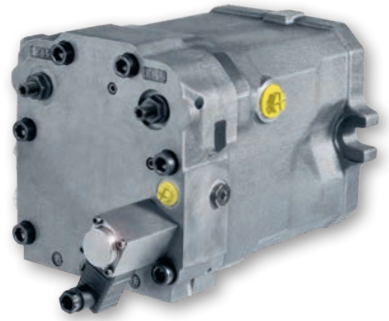
## Design characteristics

- Axial piston motor in swashplate design
- Optimized starting and low speed behaviour
- Swiveling to 0 cc/rev

## Product advantages

- PTO through-drive motor
- Jerk-free low speed
- Large conversion range
- Extremely high angular acceleration possible

Standard hydraulic motors at low speeds in their starting phase cannot generate the necessary torque. Therefore, the power of the fast spinning hydraulic motors has to be reduced by means of several step gearboxes down to the speed needed on the wheel. Somewhat higher windage losses and poorer mechanical efficiency are benevolently accepted in this context. Quite the opposite holds true for the motors by LHY: The motors of the Series 02 are capable of transmitting the required torque even at low speed and make it possible to start smoothly and sensitively.



## General technical data

| HMV-02 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Nominal size** | | | **55** | **75** | **105** | **135** | **165** | **210** | **280** |
| Displacement | Max. displacement | cc/rev | 54.7 | 75.9 | 105 | 135.6 | 165.6 | 210 | 281.9 |
| Speed | Max. operating speed at $V_{max}$ | rpm | 4300 | 3800 | 3700 | 3200 | 3100 | 2700 | 2400 |
| | Max. speed at $V_{max}$* | rpm | 4400 | 4100 | 3800 | 3500 | 3400 | 3000 | 2700 |
| | Max. operating speed at $V_{min}$ | rpm | 4700 | 4400 | 4100 | 3700 | 3500 | 3200 | 2900 |
| | Max. speed at $V_{min}$* | rpm | 5300 | 5000 | 4700 | 4000 | 3900 | 3500 | 3200 |
| Pressure | Nominal pressure | bar | 450 | 450 | 450 | 450 | 450 | 450 | 450 |
| | Max. pressure** | bar | 500 | 500 | 500 | 500 | 500 | 500 | 500 |
| | Max. housing pressure | bar | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 |
| Torque | Output torque ($\Delta p$=430 bar and Vmax) | Nm | 374 | 519 | 719 | 928 | 1133 | 1438 | 1929 |
| Corner power (theor.) | (Vmax x nmax at Vmin x $\Delta p$ 430 bar) | kW | 184 | 239 | 309 | 360 | 415 | 482 | 586 |
| Weight | approx. (without oil) | kg | 28 | 32 | 42 | 56 | 76 | 101 | 146 |

## Customer interfaces

| Control options | | | | | | |
|---|---|---|---|---|---|---|
| | Proportional | 2-Position | default= Vmin | default= Vmax | Pressure override | Pressure side selection |
| Electro-hydraulic | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Hydraulic | ✓ | ✓ | | ✓ | ✓ | |

| Sensors | |
|---|---|
| | Speed |
| | ✓ |

| Flanges | | |
|---|---|---|
| | 2 hole | 4 hole |
| SAE-C | ✓ | |
| SAE-D | ✓ | |
| SAE-E | | ✓ |

| Shafts**** | | |
|---|---|---|
| ISO 3019-1 (SAEJ 744) ANSI B92.1-1970 | Compagnion flange SAE J 1946 Typ A | DIN 5480 |
| ✓ | ✓ | ✓ |

| Through drive |
|---|
| Only for nominal sizes 105, 135, 165, 210, 280, 105D, 165D |
| ✓ |

| Ports**** | | | |
|---|---|---|---|
| | ISO 6162-2 Radial | ISO 6162-2 Axial | ISO 6149 – 1 |
| Work ports | ✓ | ✓ | |
| Threaded ports | | | ✓ |

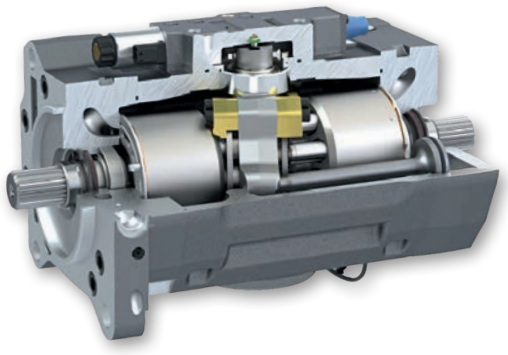
* highest transient speed, that can temporarily occur | ** highest transient pressure, that can temporarily occur | **** Availability depends on nominal size

Compact unit

Shift in Motion

LEARN MORE

# Open & Closed Circuit | Variable Displacement Motor
# HMV-02 D



This axial piston double motor has been developed by LHY to achieve maximum speeds higher than conventional swash plate designs. Additionally, a large displacement volume in a compact design means wider transmission speed ranges, normally achieved with modular transmissions, are possible. The HMV-02 D is about 30 % lighter than a motor combined with transfer gear box, and has a smaller footprint.

However, maximum efficiency is achieved with suction of the leakage from the housing. The so called "dry case" significantly reduces the windage losses and thus also the power required to drive the double motor.

## Design characteristics

- Axial piston double motor in swash plate design
- "Dry case" capability
- Through-drive motor

## Product advantages

- High starting torque and maximum speed
- Maximum efficiency
- No gearbox required

## General technical data

| HMV-02 D | | | | |
|---|---|---|---|---|
| **Nominal size** | | | **105 D** | **165 D** |
| Displacement | Max. displacement | cc/rev | 210 | 331.2 |
| Speed | Max. operating speed at $V_{max}$ | rpm | 3300 | 2900 |
| | Max. speed at $V_{max}$* | rpm | 3400 | 3100 |
| | Max. operating speed at $V_{min}$ | rpm | 4100 | 3500 |
| | Max. speed at $V_{min}$* | rpm | 4400 | 3700 |
| Pressure | Nominal pressure | bar | 450 | 450 |
| | Max. pressure** | bar | 500 | 500 |
| | Max. housing pressure | bar | 2.5 | 2.5 |
| Torque | Output torque ($\Delta$p=430 bar and Vmax) | Nm | 1437 | 2267 |
| Corner power (theor.) | (Vmax x nmax at Vmin x $\Delta$p 430 bar) | kW | 677 | 878 |
| Weight | approx. (without oil) | kg | 98 | 149 |

## Customer interfaces

**Control options**

| | Proportional | 2-Position | default= Vmin | default= Vmax | Pressure override | Pressure side selection |
|---|---|---|---|---|---|---|
| Electro-hydraulic | ✓ | | ✓ | | | |
| Hydraulic | | | | | | |

**Sensors**

| | Speed | |
|---|---|---|
| | ✓ | |

**Flanges******

| | 2 hole | 4 hole |
|---|---|---|
| SAE-C | | |
| SAE-D | | ✓ |
| SAE-E | | ✓ |

**Shafts**** 

| ISO 3019-1 (SAE J 744) ANSI B92.1-1970 | DIN 5480 | Compagnion flange SAE J 1946 Typ A |
|---|---|---|
| ✓ | | ✓ |

**Through drive**

| Through drive |
|---|
| ✓ |

**Ports**** 

| | ISO 6162-2 Radial | ISO 6162-2 Axial | ISO 6149 – 1 |
|---|---|---|---|
| Work ports | ✓ | | |
| Threaded ports | | | ✓ |

* highest transient speed, that can temporarily occur | ** highest transient pressure, that can temporarily occur | **** Availability depends on nominal size

Compact unit
Shift in Motion
LEARN MORE

# Open & Closed Circuit | Fixed Displacement Motor
# CMF

## Design characteristics

- Fixed displacement bent axis motor
- Standardized interfaces
- Plug-in flange available

## Product advantages

- High power density
- High speeds
- Very small dimensions

With the next generation of the bent axis motors, LHY expands its customer oriented portfolio of high-quality components for hydraulic systems. The fixed displacement motor CMF is characterized by its high external load and speed capacity. Due to its standardized interfaces, e.g. the plug-in flange according to ISO, the CMF fits a high variety of applications, without the need of adaptors. Low windage losses in combination with the low weight of the motor support the cost-effective operation of the application.

## General technical data

| CMF | | | |
|---|---|---|---|
| **Nominal size** | | | **80** |
| Displacement | | cc/rev | 80 |
| Speed | Max. operating speed | rpm | 4500 |
| | Max. speed* | rpm | 5000 |
| Pressure | Nominal pressure | bar | 450 |
| | Max. pressure** | bar | 500 |
| | Max. housing pressure | bar | 2.5 |
| Torque | ($\Delta p$=430 bar; charge press.=20 bar) | Nm | 547 |
| Corner power (theor.) ($V_{max}$ x $n_{max}$ x $\Delta p$ 430 bar) | | kW | 258 |
| Weight (approx.)*** (without oil) | | kg | 23.0 |

## Customer interfaces

| Sensors | | Flanges | | | Shafts**** | | | Ports**** | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Speed | | ISO 3019-1 / SAE J744, SAE C 4-bolt: 127-4 | ISO 3019-2 metric, 140 mm, 4-bolt | Plug-in, similar to ISO 3019-2, 190 mm, 2-bolt | ISO 3019-1 (SAE J744) ANSI B92.1-1970 | Compagnion flange SAE J 1946 Typ A | DIN 5480 | | ISO 6162-2 Radial twin ports | ISO 6162-2 Side ports | ISO 6149 – 1 |
| ✓ | | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | Work ports | ✓ | ✓ | |
| | | | | | | | | Threaded ports | | | ✓ |

* highest transient speed, that can temporarily occur | ** highest transient pressure, that can temporarily occur | **** Availability depends on nominal size

Compact unit

Shift in Motion

LEARN MORE

# Open & Closed Circuit | Fixed Displacement Motor
# HMF-02/HMA-02

## Design characteristics

- Fixed displacement swashplate motor
- High pressure relief valves set fixed or variable opt.
- Robust and simple design

## Product advantages

- Steady low speed
- High power density
- Reliable and easy to maintain

## General technical data

| HMF-02/HMA-02 | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Nominal size** | | | **35** | **55** | **63** | **75** | **85** | **105** | **135** | **165** | **210** | **280** |
| Displacement | | cc/rev | 35.6 | 54.7 | 63 | 75.9 | 85.6 | 105 | 135.6 | 165.6 | 210 | 281.9 |
| Speed | Max. operating speed | rpm | 4500 | 4100 | 3900 | 3800 | 3600 | 3500 | 3200 | 3100 | 2700 | 2400 |
| | Max. speed* | rpm | 4800 | 4400 | 4200 | 4100 | 3850 | 3800 | 3500 | 3400 | 3000 | 2700 |
| Pressure | Nominal pressure | bar | 450 | 450 | 450 | 450 | 450 | 450 | 450 | 450 | 450 | 450 |
| | Max. pressure** | bar | 500 | 500 | 500 | 500 | 500 | 500 | 500 | 500 | 500 | 500 |
| | Max. housing pressure | bar | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 |
| Torque | ($\Delta p$=430 bar; charge press.=20 bar) | Nm | 244 | 374 | 431 | 519 | 586 | 719 | 928 | 1133 | 1438 | 1929 |
| Corner power (theor.) | ($V_{max}$ x $n_{max}$ x $\Delta p$ 430 bar) | kW | 115 | 161 | 176 | 207 | 221 | 263 | 311 | 368 | 407 | 485 |
| Weight (approx.)*** | (without oil) | kg | 16 | 19 | 24 | 26 | 33 | 33 | 39 | 76 | 101 | 146 |

## Customer interfaces

| Sensors | |
|---|---|
| Speed | |
| ✓ | |

| Flanges | | |
|---|---|---|
| | 2 hole | 4 hole |
| SAE-B | ✓ | |
| SAE-C | ✓ | |
| SAE-D | ✓ | |
| SAE-E | | ✓ |

| Shafts**** | | |
|---|---|---|
| ISO 3019-1 (SAEJ 744) ANSI B92.1-1970 | Compagnion flange SAE J 1946 Typ A | DIN 5480 |
| ✓ | ✓ | ✓ |

| Through drive |
|---|
| Only for nominal sizes 210, 280 |
| ✓ |

| Ports**** | | |
|---|---|---|
| | ISO 6162-2 Radial | ISO 6149 – 1 |
| Work ports | ✓ | |
| Threaded ports | | ✓ |

* highest transient speed, that can temporarily occur | ** highest transient pressure, that can temporarily occur | **** Availability depends on nominal size

Compact unit
Shift in Motion
LEARN MORE

# Closed Circuit | Shift Actuator
# **Actuator**

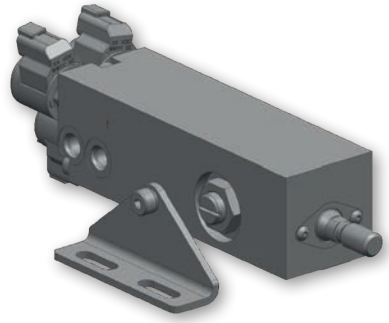
## Design characteristics

- Electro-hydraulic multi-position cylinder (3 positions)
- Prepared for mounting of clevis or spherical head
- Simple and robust design

## Product advantages

- Defined and exact switching operations
- Easy implementation in conventional gearboxes
- Small space requirement and high reliability

The use of hydraulic cylinders for shifting gears requires not only fast and precise shifting processes, but also defined and electronically sensable rest positions as well as a defined behavior in case of system failure. The actuator from LHY combines all these properties and accommodates them in a robust and compact housing. Together with the shift rod, which is prepared to accommodate conventional connections, all requirements for easy implementation are met. More information can be found in the "Shift in Motion" section.



## General technical data

| Actuator | | | |
|---|---|---|---|
| Force | Shifting force | N | 1000 +/- 300 |
| | Detent force | N | 450 +/- 100 |
| Stroke | Shifting stroke | mm | ±9.5 |
| Pressure | Supply pressure | bar | 25±5 (Typically, this is charge pressure of the drive system) |
| | Tank pressure | bar | ≤<2 |
| Positions | | | 3 (1-N-2) |

## Customer interfaces

| Control options | | | | |
|---|---|---|---|---|
| | 12 V | 24 V | AMP Connector | Deutsch Connector |
| Electro-hydraulic | ✓ | ✓ | | ✓ |

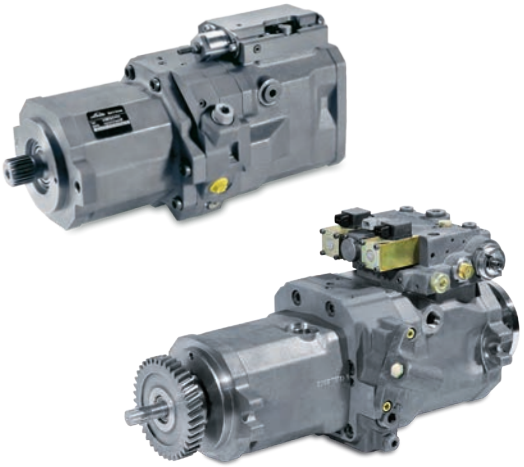
| Thread of the shift rod | |
|---|---|
| | M 16 |
| Metric thread | ✓ |

| Ports | |
|---|---|
| | ISO 6149-1, M14 x 1.5 |
| Threaded ports | ✓ |

| Sensors |
|---|
| Proportional position sensor |
| ✓ |

Compact unit
Shift in Motion
LEARN MORE

# Closed Circuit | Pump/Motor - Compact Unit
# K-02



Together with the customer LHY defines new standards in technology. Advanced modular drive technology, realised in hydrostatic variators for variable speed transmission, form the core of power split gearboxes.

Compact units with a hollow shafts are available for mounting to conventional gearboxes in smaller machines. These compact units are used as fully hydrostatic systems with additional mechanical PTO drive. In this way, a further function can be operated independently of the travel function.

With customer-specific developments, LHY supports the change from power shift to continuous variable transmission technology.

## Design characteristics

- HPV-02 and HMF-02 back-to-back in common unit
- Version for powersplit transmission and direct drive solutions (e.g. orchard tractors)
- Integrated high pressure relief valves with charge and purge function

## Product advantages

- Precise crawling speed
- Compact design
- Low fuel consumption over entire operating range
- Mechanical throughdrive (in addition to travel drive)

## General technical data

| K-02 | | | | | |
|---|---|---|---|---|---|
| **Nominal size** | | | **55/55** | **75/75** | **105/105** |
| Displacement | Max. displacement | cc/rev | 55/55 | 75/75 | 105/105 |
| Speed | Max. operating speed | rpm | 3900 | 3400 | 3200 |
| | Max. speed* | rpm | 4150 | 3600 | 3400 |
| Pressure | Nominal pressure | bar | 450 | 450 | 450 |
| | Max. pressure** | bar | 500 | 500 | 500 |
| | Max. housing pressure | bar | 2.5 | 2.5 | 2.5 |
| Torque | Torque ($\Delta$p=430 bar; charge press.=20 bar) | Nm | 374 | 519 | 719 |
| Corner power (theor.) | ($V_{max}$ x $n_{max}$ x $\Delta$p 430 bar) | kW | 153 | 185 | 241 |

## Customer interfaces

**Control option**

| | Proportional | 3-Position | Pressure cut-off | Enable function | | |
|---|---|---|---|---|---|---|
| Electro-hydraulic | ✓ | | | ✓ | | |

**Sensors**

| Swash angle | Speed sensor |
|---|---|
| ✓ | ✓ |

**Flanges**

| | 2 hole | 2 hole, 4 additional threads M12 | 2 hole, 4 additional threads M16 | 2 hole, additional holes (d=17,5mm) | 4 hole |
|---|---|---|---|---|---|
| SAE-B | | | | | |
| SAE-C | ✓ | | | | |
| SAE-D | | | | | |
| SAE-E | | | | | |

**Shafts**[****]

| ISO 3019-1 (SAE) 744) ANSI B92.1-1970 | Compagnion flange SAE J 1946 Typ A |
|---|---|
| ✓ | ✓ |

**Ports**

| | ISO 6162-2 Side ports | ISO 6162-2 Twin ports | ISO 6149-1 |
|---|---|---|---|
| Work ports | | | |
| Threaded ports | | | ✓ |

* highest transient speed, that can temporarily occur | ** highest transient pressure, that can temporarily occur | **** Availability depends on nominal size

Compact unit
Shift in Motion
LEARN MORE

# Closed Circuit | Hydrostatic Drive
# **Shift in Motion**

Compact unit
Shift in Motion

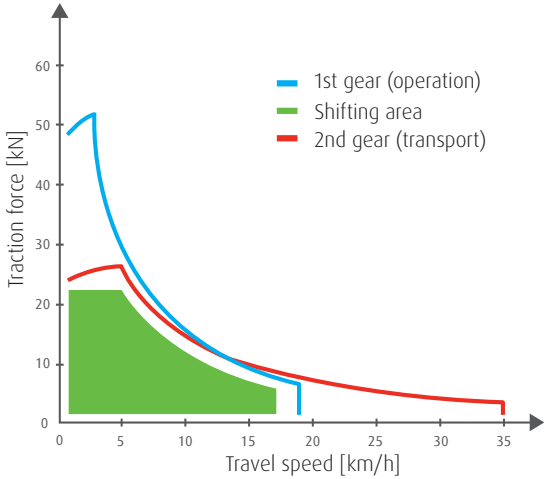
## Design characteristics

- Hydrostatically controlled synchronization of stop to shift gearboxes
- Full utilization of the kinetic energy while changing the gears
- The system includes only two additional components compared to conventional drives

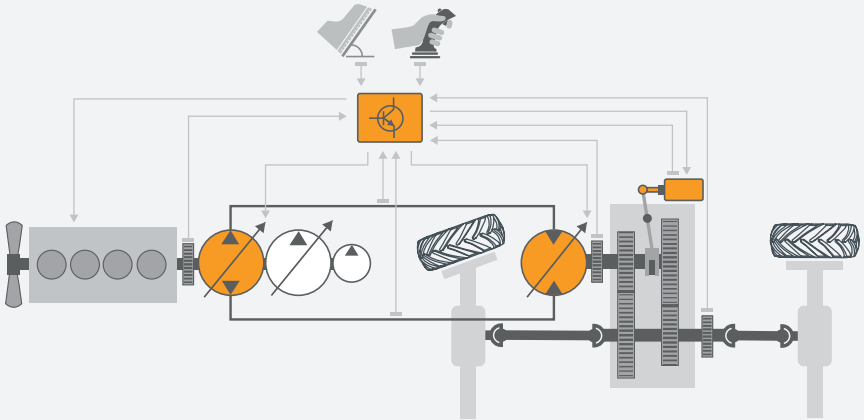
## Product advantages

- Autom. and jerkless gear changes (<0.7 sec.) without standstill and the need of expensive synchromesh gear boxes
- Considerable reduction of fuel consumption and noise emission
- Minimum space requirement

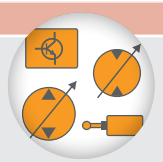
Shift in Motion enables shifting procedures in a moving machine, equipped with a manual transmission that is intended to be shifted at standstill by electro-hydraulically synchronising the drivetrain. This system is particularly suitable for vehicles that often change between transport and operation, i.e. vehicles that require both high tractive effort and a high top speed above 25 kilometres per hour. The shifting procedure is load-free thanks to electro-hydraulically synchronised gears and the ability to adjust the drive component's speed and torque. This makes the shifting procedures wear-free and also increases the transmission's efficiency.




## Concept



## Implementation



| LHY components | |
|---|---|
| Electronic control unit | iCon® |
| Variable displacement pump | HPV-02 |
| Variable displacement motor | HMV-02 |
| Shift actuator | Actuator |

| Customer interface |
|---|
| Shift rod with clevis or spherical head |
| Multiple positions of rest and analog position signal |
| Defined default behavior |

| System requirements |
|---|
| Stop to shift gearbox with two or more gears and defined neutral position |
| Admissible tractive effort interruption of <0.7 sec |

LEARN MORE

# Closed Circuit | Hydrostatic Drive
# **Shift in Motion**

## Application examples


### Category

45 kW — **70 kW** — 250 kW

| Equipment | |
|---|---|
| A | 1 x HPV 75-02 E2 |
| B | 1 x HMV 105-02 E6 |
| C | 1 x iCon® |
| D | 1 x Actuator |

### Category

35 kW — **90 kW** — 250 kW

| Equipment | |
|---|---|
| A | 1 x HPV 105-02 E2 |
| B | 1 x HMV 135-02 E6 |
| C | 1 x iCon® |
| D | 1 x Actuator |

# Closed Circuit | Innovative Functions
# **Torque Control**

## Design characteristics*

- Swing drive provided by independent closed circuit
- Torque sensitive control of the pump
- Use of the moving mass of the upper carriage for energy recuperation during deceleration

## Product advantages*

- Up to 20% reduction in fuel consumption compared to open circuit swing drives
- Extremely sensitive and precise control of the swing drive and no drifting at standstill

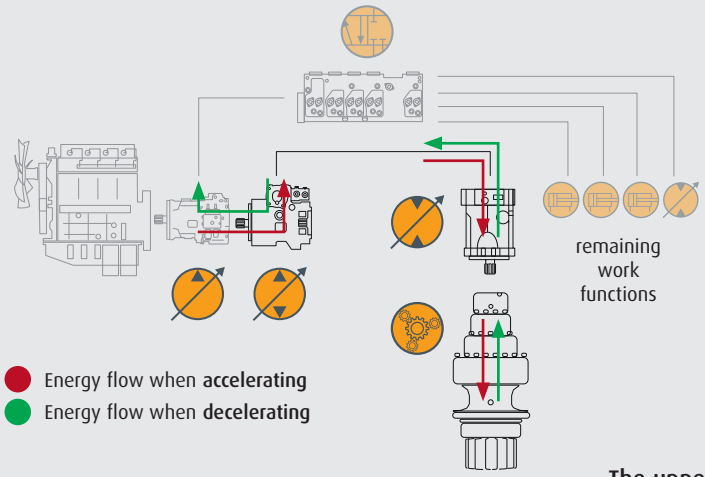
Achieving a constant torque in a hydraulic drive is often a major challenge. Especially when, for example, a winch drive should always provide a constant tractive force - even under varying working conditions - or a swing drive should precisely follow the operator's commands. Torque control for actuating rotating drives makes this possible in a very efficient way. In the field of construction machinery, most work functions are performed in an open hydraulic circuit. Actuation in conjunction with torque control, on the other hand, enables individual functions to be performed in closed circuit. This offers several advantages.

As a specific comparison, a swing drive in a Material Handler is used here. Conventionally, this is provided via open circuit. When the upper carriage is accelerating, the hydraulic motor is supplied via a control valve. This is inherently associated with flow losses. When the upper carriage is decelerating, the kinetic energy also remains completely unused. As rotating is a very dominant motion sequence in a Material Handler, the power loss is considerable. In contrast, there is the alternative of providing this function via closed circuit and torque control. This means that no control valve is required and the kinetic energy is fed back to the diesel engine when the upper carriage decelerates.

## General functional description*

**Torque control in context of swing drive**

**Setup and functional principle**




### Setup

The basis is a variable displacement pump in a closed circuit arranged parallel to the open hydraulic circuit. The pump is equipped with torque control. The pump actuates a fixed displacement motor according to the operator's commands.

### The upper carriage is being accelerated

The operator sends a signal to the torque control via joystick. The fixed displacement motor is driven accordingly. When the signal is changed, the pump follows the operator's command precisely and without latency – ensuring a jerk- and rocking-free motion sequence.

### The upper carriage is being decelerated

The operator uses the joystick to initiate deceleration. The torque control swivels the pump back towards zero and the heavy upper carriage, which is already in motion, now drives the fixed displacement motor. The motor now operates in pump mode and in turn drives the variable displacement pump. In this way, the diesel engine is back-driven until the swing drive comes to a standstill. Recuperation thus actively provides drive energy to supply the functions in the open circuit.

* Information refers to application example with swing drive

Compact unit
Shift in Motion
LEARN MORE

# Closed Circuit | Innovative Functions
# Fast Swiveling Pump

High and steady concrete flow characterizes a premium concrete pump. It benefits from the smooth running behaviour of the LHY components, which help to reduce mast vibrations and noise emissions to a minimum. The assembly provides up to 36 conveying cycles per minute which results in an almost constant concrete flow. Each pump features 210 cc/rev displacement and is optimized to this application. This is done by an optimized signal flow and an increased control pressure of 40 bar which enables the pumps to swivel between the two displacement maxima in only 210 ms.
This makes them one of the fastest pumps on the market in this scale. By operating in a closed hydraulic circuit, the system only needs a small amount of circulating oil.

## Design characteristics

- Exact synchronization of the pumps
- High filling level of the delivery cylinders
- Swiveling from $+Q_{max}$ to $-Q_{max}$ within 200 ms

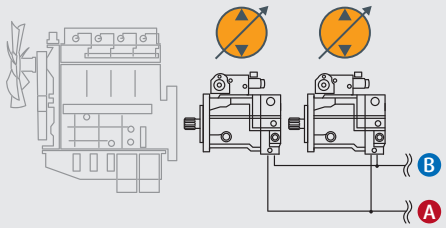
## Product advantages

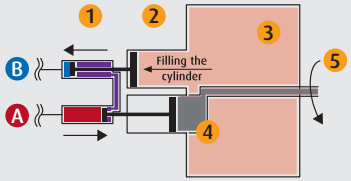
- High conveying capacity
- Almost uninterrupted / continuous conveying
- Extremely low mast vibrations

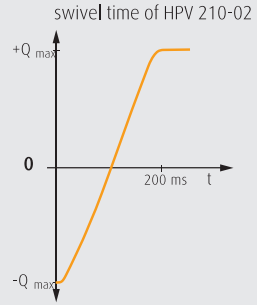
## General functional description

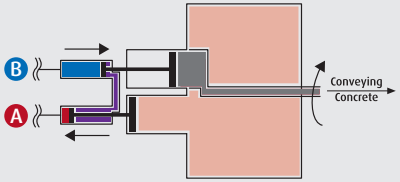
### Fast Swiveling Pump

#### Setup and functional principle




**Setup**
Two variable displacement pumps in a closed circuit ensure a sufficiently high flow rate to supply two hydraulic cylinders **(1)**. These in turn drive two conveying cylinders **(2)**, which take in concrete from the hopper **(3)** and feed it to the boom via a conveying line **(5)**. A movable transfer tube **(4)**, which swivels cyclically back and forth between the two cylinders, controls the inflow and outflow of concrete.

**1. Filling the cylinder**
Both variable displacement pumps synchronously supply port **A**. With a high flow rate, the hydraulic cylinder is extended correspondingly quickly and in turn retracts the opposite hydraulic cylinder. The movement of the conveying cylinder coupled to this in turn takes in the concrete and fills the conveying cylinder until it reaches dead center.

**2. Fast swiveling**
If a dead center of a cylinder pair is reached, the pumps swivel synchronously and extremely quickly to the opposite side (e.g. $VG_{max}$ > - $VG_{max}$, in order to be able to provide the full flow rate at port **B** after the shortest possible interruption in movement. In coordination with the pumps the transfer tube moves in front of the now freshly filled cylinder to pick up the concrete.

**3. Conveying concrete**
Both variable displacement pumps now synchronously supply port **B**. With a high flow rate, the hydraulic cylinder is extended correspondingly quickly and in turn retracts the opposite hydraulic cylinder. The movement of the conveying cylinder coupled to this in turn makes the previously sucked concrete available to the boom via the transfer tube and the conveying line.

Compact unit
Shift in Motion
LEARN MORE

# Open & Closed Circuit | Innovative Functions
# Dry Case

## Design characteristics

- Significant reduction of windage losses by suction of leakage from housing
- Maintaining lubrication via active bearing lubrication

## Product advantages

- Maximization of efficiency
- Significantly reduced energy consumption
- Greatly improved performance
- No adverse effects on operation or service life

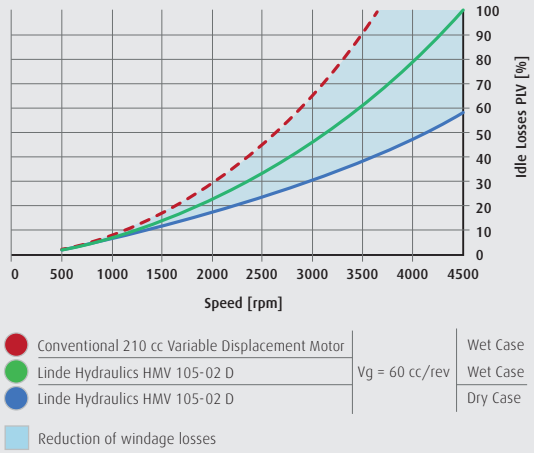
Besides the output power, the operation of machines is also generally associated with power loss. In the case of axial piston machines, the power loss is composed of flow, friction and windage losses.

LHY has now developed the ability to run the motors without oil in the housing. The moving parts of the motor rotating in the housing are thus hardly affected by circulating oil. This procedure significantly reduces windage losses and considerably increases efficiency. The active bearing lubrication ensures the supply of oil to the relevant points, that the so called "dry case" operation is guaranteed without any adverse effects.

## General functional description

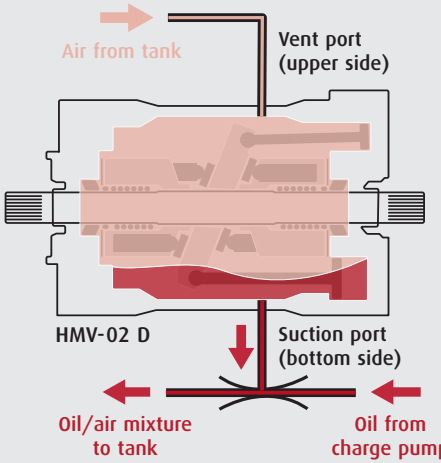
**Dry Case**

**Setup and functional principle**



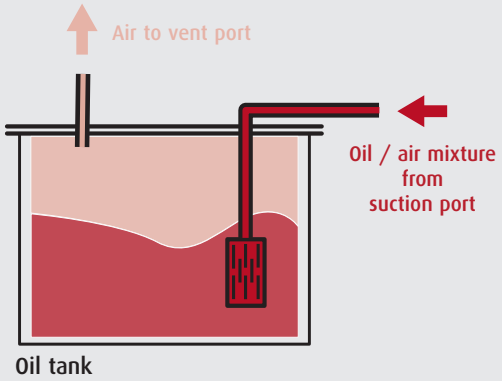

### Idle losses

Idle losses are composed of flow losses in canals and kidneys, friction losses in gaps and bearings and windage losses. The diagram above shows the comparison between the losses of two motor concepts and the great effects of "dry case" under identical conditions.




### Suction of leakage

The feed flow generates a vacuum via the venturi nozzle. Oil is sucked up on motor bottom side. Air to fill the vacuum is filled in on motor upper side.




### Separation and suction of air

The oil/air mixture is returned to tank via diffuser/ filter. Oil/air mixture is calmed – air is separated out. The air for filling the motor housing is drawn from the tank above the liquid level.

Compact unit
Shift in Motion
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# Open & Closed Circuit | Innovative Functions
## Dry Case


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- Development projects
- Application engineering
- Commissioning
- Series production

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Compact unit

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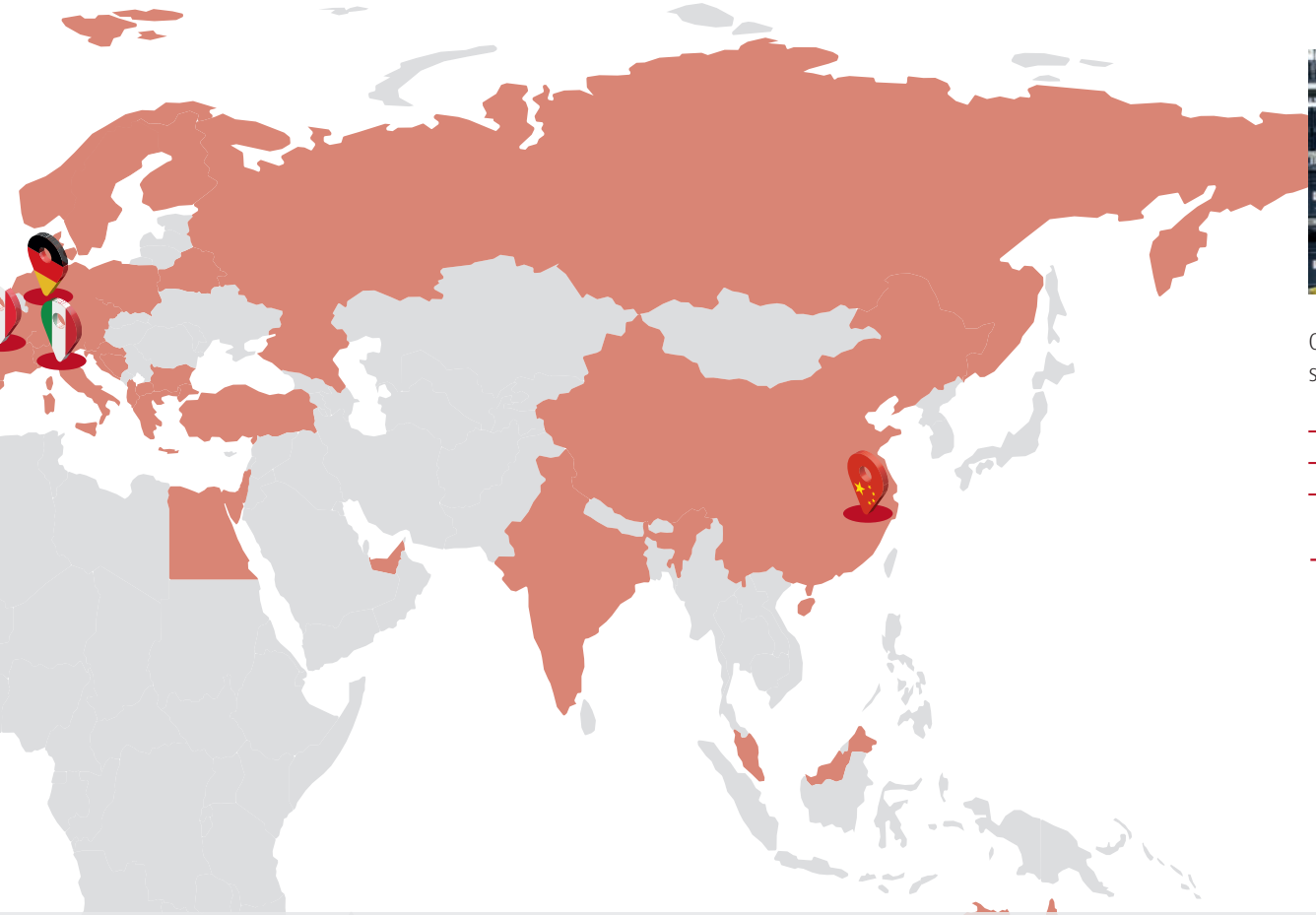

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