RADIAL PISTON PUMP WITH DIGITAL CONTROL RKP-D

DYNAMIC DISPLACEMENT AND PRESSURE CONTROL FOR DEMANDING APPLICATIONS

WHAT MOVES YOUR WORLD

MOOG

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This catalog is for users with technical knowledge. To ensure all necessary characteristics for function and safety of the system, the user has to check the suitability of the products described herein. The products described herein are subject to change without notice. In case of doubt, please contact Moog.

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PRODUCT OVERVIEW

Proven Pump Technology

Moog´s Radial Piston Pump product line (also known as RKP) is a high performance variable displacement pump for industrial applications. Based on a proven concept, RKP's robust and contamination-resistant design allows for long life and high reliability. Its ability to deliver rapid response time and high volumetric efficiencies, has made it the choice for many machines with demanding flow, pressure and power control needs.

Moog produces a wide range of Radial Piston Pumps in different sizes, single and multiple arrangements, and with various controls (mechanical, hydromechanical, electrohydraulic, digital and analog) in order to provide maximum flexibility to machine builders.

Digital or Analog Control

With this version, Moog has significantly improved the control technology of the RKP with an advanced closed-loop proportional valve with digital on-board electronics for displacement and pressure regulation, tuning and diagnostics. Moog´s RKP-D can be digitally controlled via a fieldbus interface or run as a purely analog device controlled by analog command signals. This provides maximum flexibility for compatibility with several PLC architectures.

Configuration Software

One key advantage of the new RKP-D is the ability of the user to perform fast and convenient commissioning, diagnostics, and configuration with the Moog Valve and Pump Configuration Software. This Microsoft Windows-based software communicates with the RKP-D via the CANopen or local CAN fieldbus. It can be installed either in the machine's PLC (using the Human Machine Interface (HMI)) or on a laptop computer. Set values, actual values, status information, and all relevant parameters are displayed graphically and may be modified easily or run with factory presets. Additional tools, such as the integrated oscilloscope and the function generator, help to facilitate the commissioning of the device. This software is free and available at http://www.moogsoftwaredownload.com/.

Applications

The high-performance, flexible control system used for RKP-D makes it the ideal solution for pressure, flow and power controlled hydraulic systems of any kind. It is especially valuable for sequential machine processes, which require adaptation of the RKP-D parameters during operation.

FEATURES AND BENEFITS

General

In addition to reliability and performance, the Radial Piston Pump is known for its modular functionality, which enables tailored pumps or combinations ideally suited to an application.

Features:

- Eight sizes between 19 and 250 cm³/rev (1.2 and 15.3 in³/rev)

- Large selection of controls

- Multiple pumps configurations by axial mounting

- Suitable for various hydraulic fluids

- Standard pressure series 280 bar (4,000 psi) and High pressure series 350 bar (5,000 psi) for mineral oil

- Short response time

- Compact design

- Good suction characteristics

- Low pressure ripple

- Low noise level

Precise Closed-Loop Control

The pilot valve with digital onboard-electronics provides more dynamics and improved precision control of displacement and pressure regulation, while offering a range of advanced functions. Machine processes driven by RKP-D have higher repeatability and better quality of the finished parts.

Analog or Fieldbus Operation

The ability to function as a fieldbus device or as a traditional analog device ensures compatibility with different PLC-structures. When operating as an analog device, the RKP-D uses pure analog command signals to control displacement and pressure and the user can select the matching parameter set. Consequently, this RKP-D provides many benefits of digital control without requiring a fieldbus interface into the machine´s PLC.

On-the-Fly Adjustment

In a sequential machine process, one single RKP-D typically drives different cylinders one after the other, with each requiring specific RKP-D settings. Now it is possible, to change the parameters of the RKP-D "on the fly", including setting of the pressure controller, activation of different operational modes and selection of different pressure sensors. This enables adaptation of the RKP-D behavior to the specific requirements of each cycle step. The end result is greater consistency and shorter cycle time of the whole machine process.

Optimized Multiple Pump System

The master-slave operation allows to combine multiple pumps hydraulically and to realize a stable and dynamic pressure control. The hybrid operation with the combination of a RKP-D and a fixed displacement pump is also possible.

Advanced Troubleshooting

Real-time diagnostics with full access to internal parameters via the Human Machine Interface (HMI) or a laptop PC improves uptime and reduces maintenance costs. In addition, the fail-safe-behavior of the RKP-D can be adapted to the requirements of the machine process.

Saving Space and Assembly Time

The basic RKP-D functions (p and Q) are preadjusted to save time during assembly and commissioning. Since all necessary electronic functions are integrated in the pilot valve, an additional external pQ-card with separate cabling is not required.

Warranty

The Moog RKP stands for reliability, low noise and durability. Under the conditions described in section "Technical Data" of the RKP catalog, warranty for mineral oil is covered for 10,000 operating hours or 24 months.

DESCRIPTION RADIAL PISTON PUMP WITH DIGITAL CONTROL

General Description of RKP-D

The RKP-D is an electro-hydraulically controlled Radial Piston Pump that has a closed-loop servo pilot valve with digital on-board electronics used for control of displacement and pressure. The valve electronics contain a microprocessor system, that executes all essential functions.

All control loops are processed by the software including:

*   Position control of the pilot valve

*   Position control of the stroke ring (displacement control)

*   Pressure control

The high performance and flexible control concept of this RKP-D offers broad functionality, making this an ideal solution for hydraulic systems with demanding requirements for flow and pressure control.

Mode of Operation

The shaft (5) transfers the drive torque to the star-shaped cylinder block (3) free of any transverse forces via a crossdisc coupling (4). The cylinder block is supported on the control journal (1). The radial pistons (9) in the cylinder block abut against the stroke ring (7) through hydrostatically balanced slipper pads (8). Piston and slipper pad are joined by a ball and socket joint, which is locked by a ring. The slipper pads are guided in the stroke ring by two retaining rings (2) and, when running, are forced against the stroke ring by centrifugal force and oil pressure. As the cylinder block rotates, the pistons perform a reciprocating motion due to the eccentric position of the stroke ring, the piston stroke being twice the eccentricity. The eccentric position of the stroke ring can be altered by means of two diametrically opposed control pistons (6, 10) in the pump body. The oil flow to and from the pump passes through ducts in the body and control journal, and is controlled by the suction and delivery ports in the latter. The rolling bearing, supporting the drive, shaft is subjected to external forces only. At the RKP-D the position of the stroke ring is detected by an LVDT (11) and high dynamically controlled by a servo pilot valve (12).
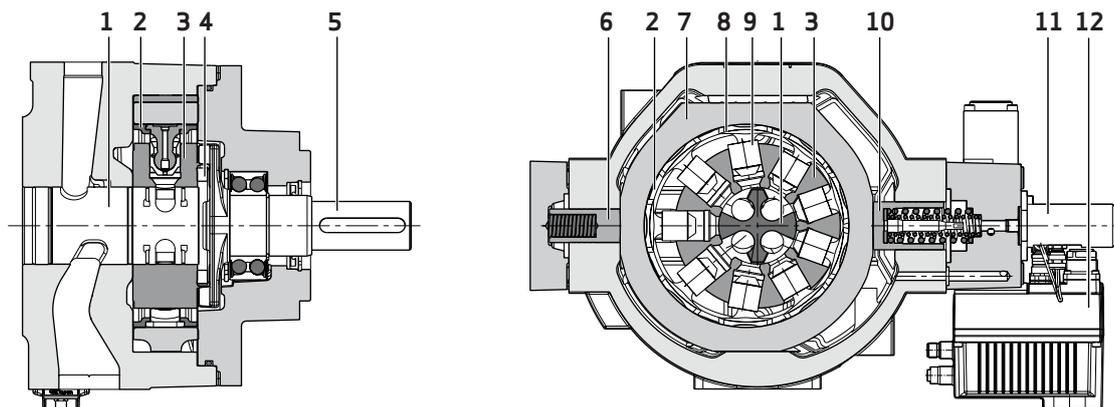
DESCRIPTION RADIAL PISTON PUMP WITH DIGITAL CONTROL

Flexible Control Options

Signals can be exchanged between the RKP-D and the machine controller either by means of the fieldbus interface (fieldbus mode) or as analog signals (analog mode). This type of pump can be easily integrated into machine control systems with either fieldbus interface or analog output signals.

The RKP-D offers easy integration into different control approaches to make it flexible for the widest range of machine requirements. Some available features include:

- **Factory settings:** The RKP-D comes from the factory set-up in an "analog mode." This allows it to be operated as a "plug and play" device commanded by analog setpoint signals for displacement and pressure as well as factory pre-sets for all key parameters. This enables easy and quick set-up for those users with basic requirements.

- **Analog operation mode selection:** Users that need a higher degree of adaptation to unique machine requirements, need only provide the RKP-D with an additional 0 to 10 V signal, to enable easy selection of parameter sets.

This feature greatly increases the options for adapting the RKP-D behavior to machine processes, including the transition from one operation mode to another "on the fly". While this option provides opportunities for much higher performance of the RKP-D, it is still an analog mode for easy operation and requires no knowledge of fieldbus systems or software.

- **Software configurable analog condition:** Users that want the full set of options in analog mode for modifying the RKP-D settings can also use the Moog Valve and Pump Configuration Software to modify the factory settings including the pre-defined parameter sets. Whether in commissioning or during operation, adjustments can be made based on the requirements of the specific machine process. The software is specially designed by Moog and is based on our extensive experience with hydraulic products. It is available at http://www.moogsoftwaredownload.com/

- **Fieldbus operating condition:** Pumps can also be fully controlled via a fieldbus interface and Moog Valve and Pump Configuration Software, thereby offering the full range of flexibility and functionality. This "fieldbus mode" is ideally suited to the most demanding requirements and allows knowledgeable users to program easily and discover new ways to optimize performance.

Structural Design of RKP-D
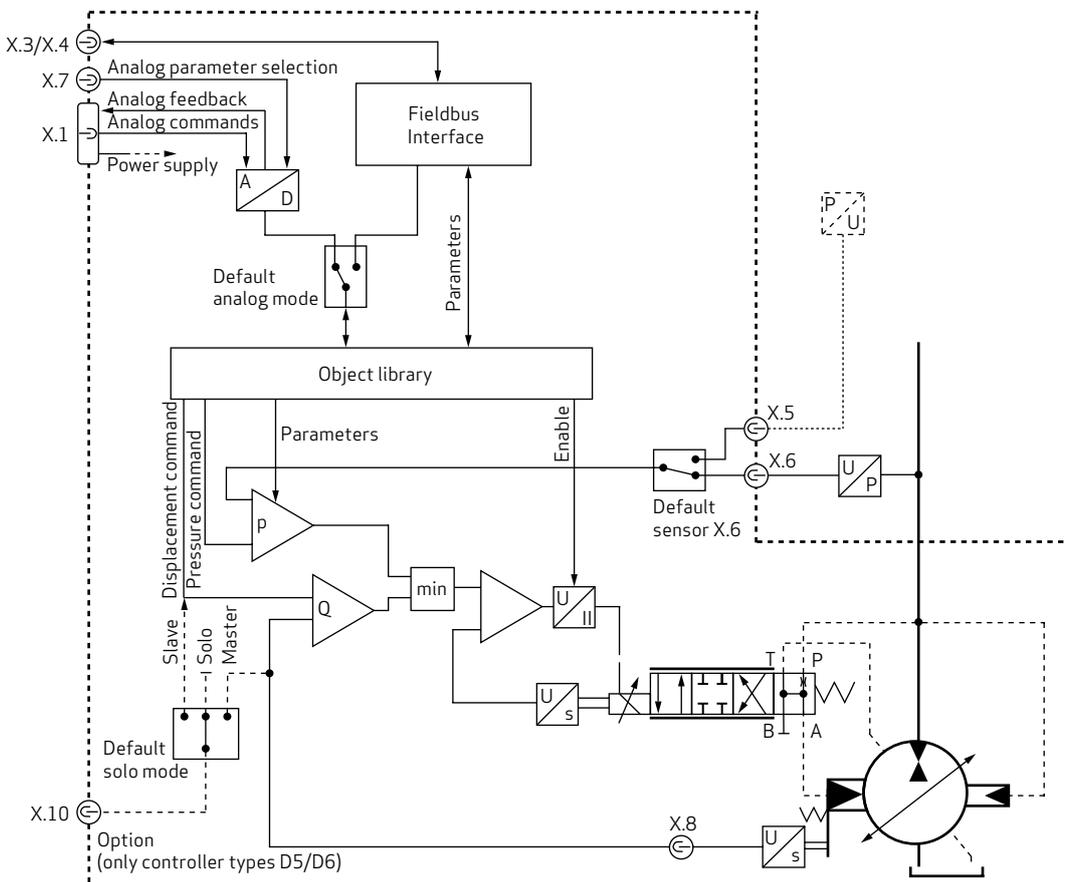
FUNCTIONALITY

Displacement Control

The RKP-D controls the position of the stroke ring in accordance with the specified displacement set point in a closed-loop regulation. Depending on the selected RKP size (19, 32, 45, 63, 80, 100, 140, 250 cm³/rev), a pump displacement of 0 to 100 % is made available.

The displacement setting is factory-calibrated, such that the RKP-D produces a flow rate of 0 % at a Q set point value of 0 V and a flow rate of 100 % at a Q set point value of 10 V.

The parameters for the digital Q controller are factory-set and cannot be altered by the user.

Pressure Control

The pressure control function works by continuously comparing the system pressure (determined via the pressure sensor) with the current pressure set point. If the system pressure exceeds the pressure set point, the RKP-D will reduce its displacement until the desired pressure is no longer exceeded. The RKP-D can switch into active suction mode (negative displacement) during pressure control, which allows fast pressure reduction in a connected oil volume.

The user can harmonize the parameters of the digital pressure controller with the existing hydraulic system. Sixteen complete parameter sets have been predefined to facilitate this procedure. They may be selected and also switched during operation via an analog 0 to 10 V signal or the fieldbus interface.

The user can choose from two pressure-sensor connections in order to achieve the target pressure. It is possible to switch between these two sensors during operation. The pressure-sensor inputs are configurable, thereby permitting the connection of several types of pressure sensors (4 to 20 mA; 0 to 10 V; 2-, 3- and 4-wire sensors).

Power Control

The power control function works by continuously computing the hydraulic power, which is a product of the current pressure (load) and the current stroke ring position (displacement).

Should the current power reach the pre-defined limit, the displacement can not be longer increased.

Leakage Compensation

As the pressure increases, pumps will produce increasing internal leakage that will be missing from the usable flow that is normally generated by the pump. The pump electronics contains a leakage-compensation function to cancel out this effect. As the system pressure increases, the displacement increases automatically so that the useable flow remains virtually constant. This function is preset at the factory, but can be adjusted to actual machine conditions (to compensate for system leakages) or switched off entirely depending on a customer's unique needs.

Internal Flushing Function

This special function is included in RKP-D models with an internal pressure supply (controller D1, D4, D5 and D8). The RKP-D monitors changes in the set points of pressure (p) and displacement (Q). If one of the setpoints is < 1 % for 3 minutes, the pilot valve is switched off, goes to its fail-safe-position, and flushes the RKP-D housing. This limits the temperature of the RKP-D. Housing temperatures up to 90 °C (195 °F) are acceptable and do not damage the RKP-D. To deactivate the flushing function, both set points have to be > 1 %.

Master-Slave Operation

Master-Slave operation may be used in set-ups where several pumps are combined into one system. In this case, there must be only one active pressure controller (master), while the remaining pumps (slaves) are purely displacement controlled by the master pump. During this Master-Slave operation, the master will communicate his displacement value via the local fieldbus to the slaves.

The advantages of the Master-Slave operation is the stable pressure control at a synchronous displacement. This operating mode can be switched on and off using the fieldbus interface, as well as by using analog selection of the corresponding parameter set.

Please note that only pumps with controller options D5 to D8 are equipped with a local CAN bus interface and thus are able to perform this Master-Slave operation.

Pleas note, the definition of which pump is the master and which is the slave in a multiple pump arrangement must be completed during initial commissioning of the RKP-D, using the Moog Valve and Pump Configuration Software or fieldbus.

FUNCTIONALITY

Hybrid Mode

In the hybrid mode, a RKP-D is merged with a fixed displacemet pump in a shared volume. In the standby-condition, the RKP-D must pump some or all of the flow from the fixed displacement pump back to the tank. This condition allows us both to adjust the flow rate and to control the pressure. Generally, a flow ratio of 100 : 80 (100 : 60 is ideal) between the RKP-D and the fixed displacement pump may not be exceeded.

The RKP-D's electronics afford the option of activating a second displacement calibration by switching to the hybrid mode, which makes the generation of negative set point values by the customer's control system unnecessary.

Please note that this second displacement adjustment is not factory preset and must be calibrated by the user during initial commissioning. For easy use, there is a predesigned menu for this adjustment in the Moog Valve and Pump Configuration Software. RKP-D's for hybrid operation have special design features and thus are identified by dedicated model codes (controller option D3, D4, D7 and D8).

The Principles of Hybrid Mode
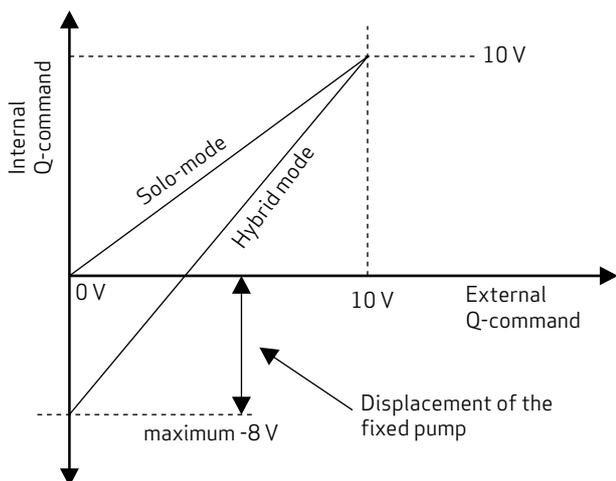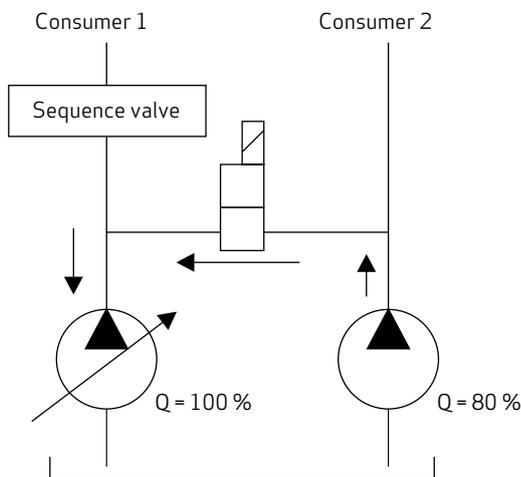
Local Switchover to Holding Pressurer

This special function provides a solution to a common problem encountered during the transition from the speed to the hold pressure phase, when controlling the injection process of injection molding machines. When operating the RKP-D in fieldbus mode, small but unavoidable delay times appear while transferring the set points between the machine's PLC and the RKP-D. These delay times, which may vary within certain limits, limit the repetitive accuracy of the hold pressure switchover of injection molding machines.

To overcome this problem, the RKP-D provides a special software function, called "Local Hold Pressure Switchover", which independently accomplishes the transition from the speed to the hold pressure phase in nearly real time using the control electronics. This happens without intervention by the superior PLC and therefore without disturbing signal running times over the fieldbus. This function can be used only during fieldbus operation of the RKP-D and is generally only needed in this operating mode.

Functional Principle of the Local Switchover to Holding Pressure
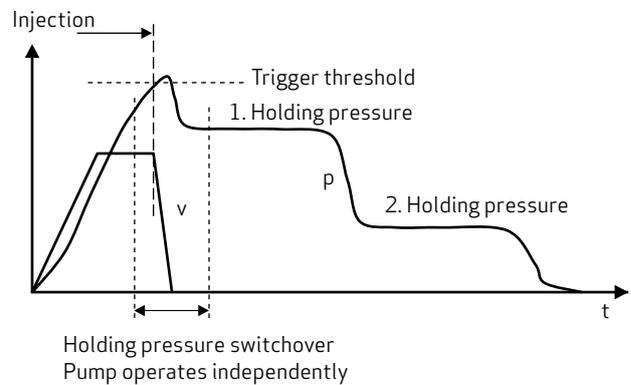
BASIC HYDRAULIC CIRCUITS

RKP-D with Internal Pressure Supply without Sequence Mainfold

The pilot valve (D930) controls the position of the stroke ring by influencing the pilot oil flow inside the large control piston. The p-port of the pilot valve, as well as the small control piston on the opposite side, are connected to the RKP-D pressure line.

In order to work properly, the pilot system of the RKP-D in models with internal pressure supply (controller options D1, D4, D5 and D8) needs to be supplied with a pilot pressure ≥14 bar (200 psi). Hence, in the configuration shown below, the output pressure of the RKP-D (load pressure of the attached cylinder or hydromotor) must never fall below 14 bar (200 psi), otherwise the pilot system looses control of the stroke ring position and the RKP-D goes for 100 % displacement.

This behavior protects the RKP-D in case of fail-safe-situations and is caused by the spring configuration of the stroke ring, which corresponds to a system pressure of approximately 11 bar (160 psi).

The pilot valve of the RKP-D versions with internal pressure supply is equipped with a special fail-safe position, allowing internal flushing of the RKP-D housing in standby-condition (command signals = 0).
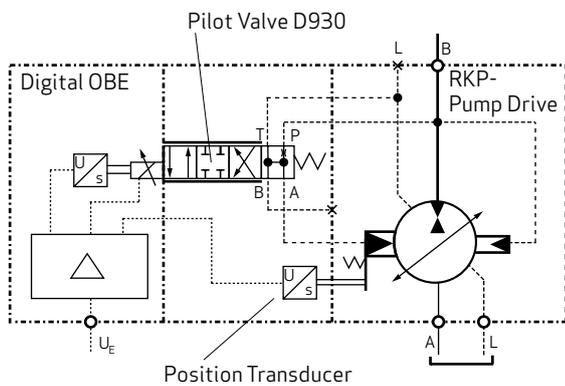
RKP-D with Internal Pressure Supply and Sequence Mainfold

In cases where the system pressure cannot be maintained continuously above 14 bar (200 psi) (e.g. with low friction cylinders moving at zero load), it is necessary to apply a pressure-sequence manifold, which is available as accessory. The built-in pressure sequence cartridge maintains the minimum required pilot pressure of 14 bar (200 psi), in case the system pressure falls below this value. The sequence cartridge does not have an impact on energy consumption due to its special design, which avoids any functional pressure drop above a static pressure level of 20 bar (290 psi). Additionally, the sequence cartridge allows a decrease of the system pressure down to 0 bar (0 psi), which would normally not occur, due to the natural spring pressure of about 11 bar (160 psi).

The sequence manifold is mounted directly on the outlet of the RKP-D and contains additional functions as follows:

- $p_{maximum}$-limitation (safety function)

- General-purpose measuring ports (e.g., assembling a pressure transducer)

- A check-valve to bypass the sequence cartridge during decompression of system pressure below 14 bar (200 psi).

Pilot Valve D930
Digital OBE
RKP-Pump Drive
Position Transducer

Pressure Sensor
Sequence Mainfold
14 bar (203 psi)
Pilot Valve
Digital OBE
RKP-Pump Drive
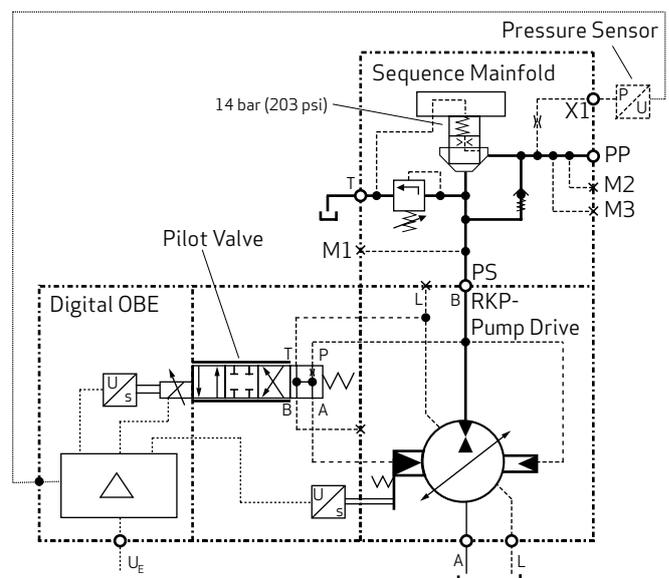
BASIC HYDRAULIC CIRCUITS

RKP-D with External Pressure Supply

The illustration below shows the application of a model with external pressure supply. This RKP-D version contains a shutter-valve in the p-line of the pilot valve and is equipped with different springs in the control pistons, which results in a low natural pressure of about 1 bar (15 psi).

To achieve sufficient RKP-D performance at low system pressures, it is required to apply an additional constant displacement pump, which ensures a minimum control pressure level. A cost-saving solution to this problem is to use the cooling and filtration circuit for this purpose, as shown below.

Due to the function of the shutter-valve, the pilot system is supplied directly from the RKP-D outlet at higher system pressures.

The recommendations for the selection of the supplementary pump (in general a gear pump) are as follows:

Pressure: 25 to 50 bar (363 to 725 psi) minimum flow rate:

- RKP-D 19 to 45 cm^3/rev => V= 6 l/min (1.6 gpm)

- RKP-D 63 to 100 cm^3/rev => V= 12 l/min (3.1 gpm)

- RKP-D 140 cm^3/rev => V= 16 l/min (4.2 gpm)

Please note that models with external pressure supply (controller option D2, D3, D6 and D7) do not include an automatic flushing function. Therefore the user of the RKP-D is responsible for the thermal balance of the RKP-D, especially in standby-condition. Depending on the specific circumstances, it may be necessary to flush the RKP-D externally (see also Set-up and Operating Instructions).
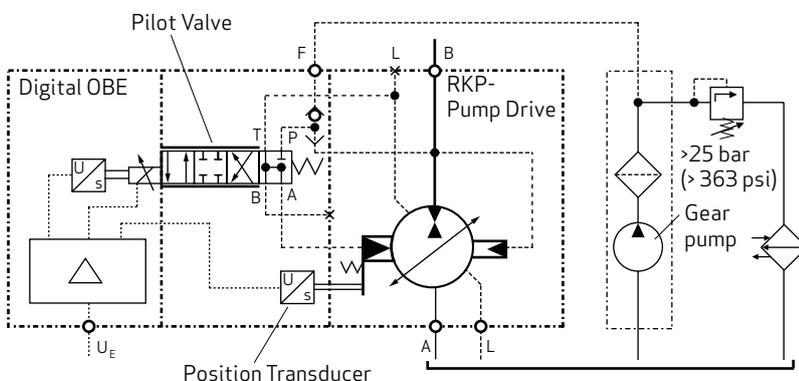
CONFIGURATION SOFTWARE

The Windows-based Moog Valve and Pump Configuration Software enables fast and convenient commissioning, diagnostics, and configuration of the RKP-D. The software communicates with the RKP-D via the CANopen or local CAN fieldbus. This requires a PC-installed CAN interface card to allow data to be exchanged between the PC and the RKP-D and for RKP-D settings to be recorded on the PC.

The RKP-D configuration is controlled via graphic control elements. Status information, set values, and actual values, as well as characteristic curves, are displayed graphically.

The operational behavior of the RKP-D can be visualized and recorded via an integrated oscilloscope/data logger.
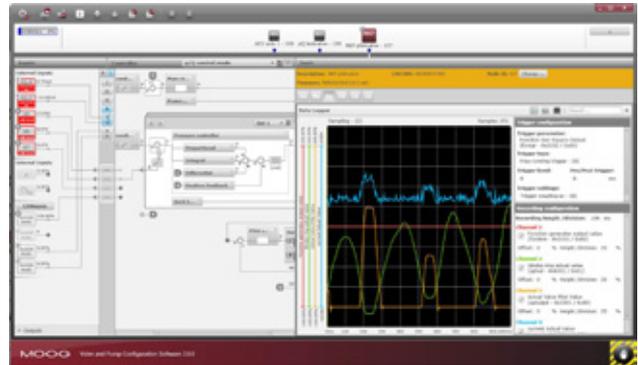
Moog Valve and Pump Configuration Software

System Requirements

The configuration software can be installed on a PC with the following minimum requirements:

• IBM PC-compatible

• Windows XP/7/8

• 1 GB RAM

• 1 GB free hard disk space

• Monitor resolution 1024 x 768 pixels

• Keyboard, mouse

The software is available free of charge from Moog. Please visit www.moogsoftwaredownload.com to download the software.

Moog Valve and Pump Configuration Software connected with the RKP-D via IXXAT interface card and CAN cable

To connect the software with the RKP-D, the following additional equipment is required:

• A free PCI/PCMCIA slot or USB port

• CAN interface card (PCI/PCMCIA/USB)
   Note: Interface card IXXAT USB-to-CANcompact recommended (Moog order code: C43094-001)

• CAN cable
   Note: CAN cable Sub-D to M12; with termination resistor recommended.
   Moog order code: TD3999-137

• M8 to M12 Adapter CA40934-001

• Power supply $24V_{DC}$/2A
   (supply for RKP-D electronics)

COMMUNICATION STANDARD

Analog Interface

In the factory preset analog mode of operation, the RKP-D receives its set points for pressure (p) and displacement (Q) as analog signals. Additionally, the user can take full advantage of the ability to alter operation modes during operation, including the following key abilities:

• To change the setting of the pressure controller

• To select from two possible pressure-sensor inputs

• To activate or deactivate the master-slave operation

• To activate or deactivate the hybrid mode

• To activate or deactivate the pressure controller

• To activate or deactivate the power limiter

In order to take advantage of all these possibilities, the machine´s PLC must provide the following 3 analog output signals:

• Displacement command signal 0 to 10 V (factory set) or 4 to 20 mA (software configurable)

• Pressure command signal 0 to 10 V (factory set) or 4 to 20 mA (software configurable)

• Operation mode 1 selection: 0 to 10 V

The actual values for displacement and pressure are reported back to the PLC by means of two 2 to 10 V (and 4 to 20 mA) – signal outputs of the RKP-D.

The Moog Valve and Pump Configuration Software can be used as a set-up tool, in order to modify the factory settings or to analyze the operational behavior of the RKP-D.
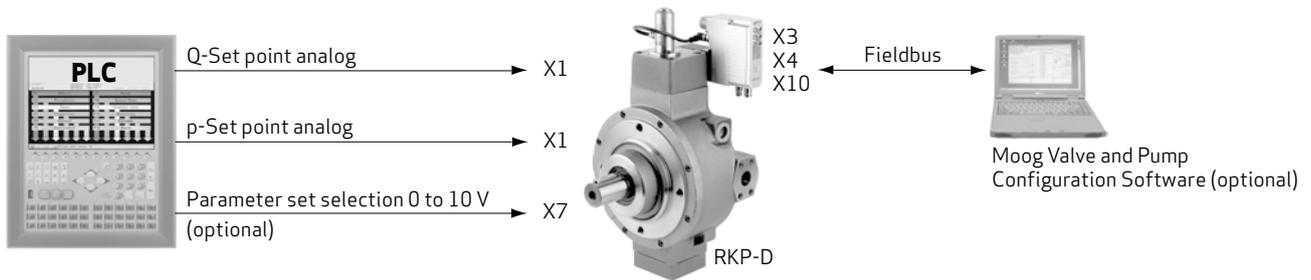
Fieldbus Interface

Operated by a fieldbus, the RKP can be parameterized, controlled/activated and monitored via the built-in fieldbus interface. These interfaces are according to the corresponding fieldbus standards.

1. CANopen Communication profile CiA301, Device Profile Fluid Power CiA408 and ISO11898

2. EtherCAT IEC/PAS 62407

Please note that details are available in the Moog User Manuals for RKP Firmware, CANopen Manual and the EtherCAT Manual.

Analog-Mode

Fieldbus-Mode

OPERATION MODES (ANALOG OPERATION ONLY)

One operation mode includes the following data and settings:

- 1 of 16 freely adjustable pressure controller parameter sets (set by default to various system oil volumes see table). The assignment of a pressure sensor is a component of the pressure controller parameter set (interface 1 on X5 or interface 2 on X6)

- ControlWord for the pump with status bits (ACTIVE, HOLD, DISABLED) and bits to activate: Pressure controller, leakage compensation, slave operation, power controller

The 16 operation modes of the RKP-D are factory-set as indicated in the table below. They can be selected in the analog operation modes with a 0 to 10 V signal at the input X7.

Operation mode	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Voltage U at X7 [3)] [V]	0 to 1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.5	6.0	6.5	7.0	7.5	8.0	8.5	9.0 to 10.0
Pressure parameter set	1	2	3	4	5	6	7	8	9	10	11	12	13	Not active	1	Not active
Sensor interface	X6													Not active	X6	Not active
Optimized for oil volume [l]	0.1	2.5	5.0	7.5	10.0	12.5	15.0	20.0	25.0	30.0	35.0	40.0	50.0	-	0.1	-
ControlWord valve status	ACTIVE															
ControlWord pressure controller	ON													OFF	ON	OFF
ControlWord leakage compensation	ON															OFF
ControlWord slave operation	OFF															ON [2)]
ControlWord power controller	OFF															
Hybrid mode	OFF														ON [1)]	OFF

[1)] Requires initial calibration of the hybrid displacement-adjustment by the end user.
[2)] The RKP-D stages initially need to be designated as master or slave by the end user.
[3)] Voltage levels applies ± 100 mV.

1 Liter = 0.264 gal (US)

The Moog Valve and Pump Configuration Software allows users to modify the default settings according to individual requirements.

General comments:

In cases where X7 is not connected electrically, operation mode 1 is activated automatically.

Step changes between different voltage levels must not exceed 1 ms.

ELECTRICAL INTERFACES
CAN

Designation of the Electrical Interfaces
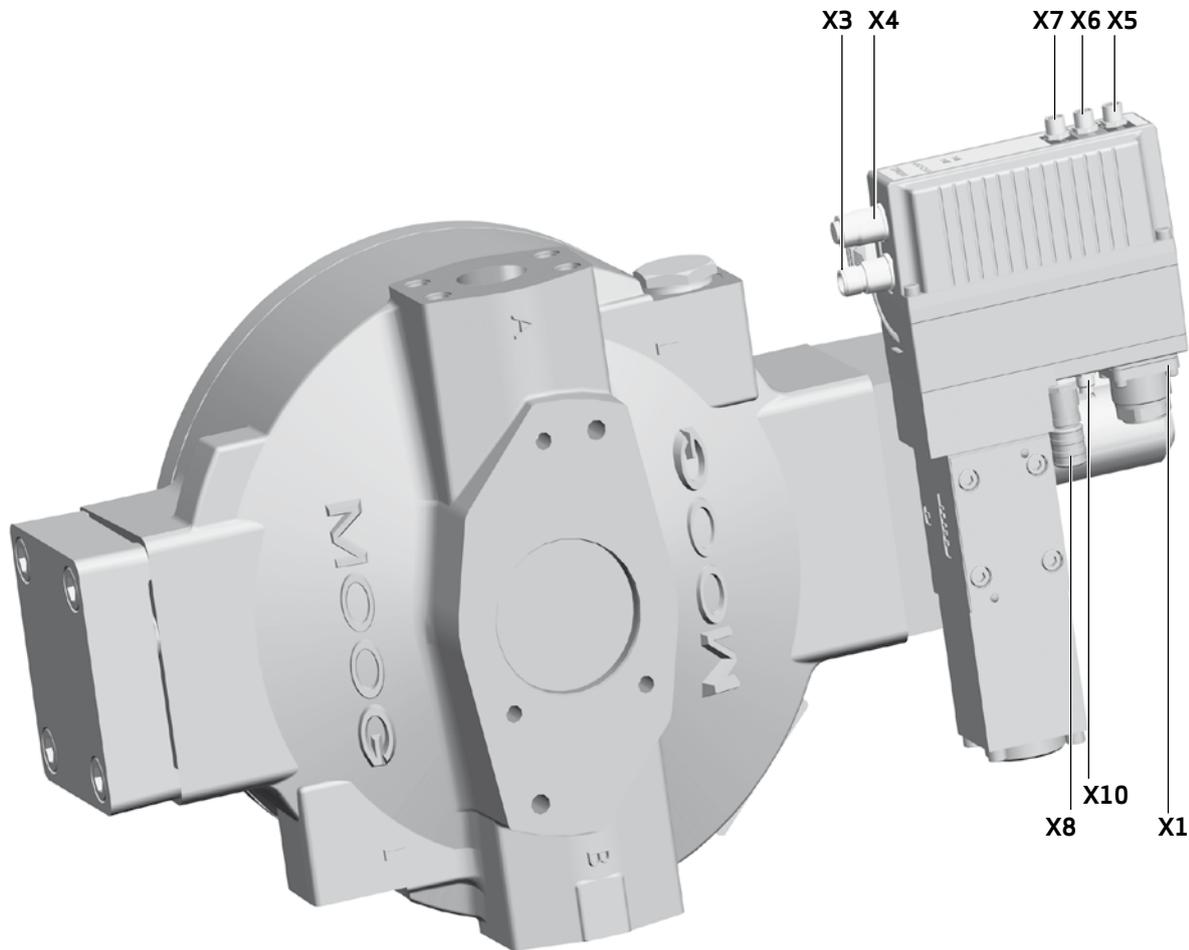
No.	Description	Type	
X1	Main connector	11+PE	11-pole pin contact with PE
X3	CAN/EtherCAT	M12 x 1	5-pole pin contact
X4	CAN/EtherCAT	M12 x 1	5-pole socket contact
X5	Pressure sensor 2	M8 x 1	4-pole socket contact
X6	Pressure sensor 1	M8 x 1	4-pole socket contact
X7	Analog Operation Mode Selection	M8 x 1	4-pole socket contact
X8	Linear Variable Displacement Transducer (LVDT)	M12 x 1	5-pole socket contact
X10	LocalCAN for master-slave operation and access via Moog Valve and Pump Configuration Software(optional)	M8 x 1	3-pole pin contact

Degree of protection for valve and LVDT: IP65
(with connected plugs or appropriate protecting caps)

ELECTRICAL INTERFACES
CAN

Status display LEDs

The network and the servo valve's status are indicated by multicolor status display LEDs on the electronic housing.
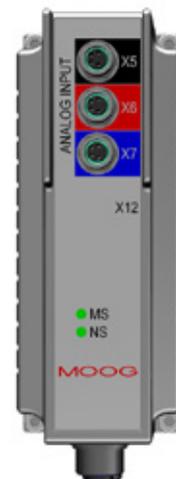
Network status LED «NS»

The network status LED displays the status of the network management (NMT) state machine.

Network status LED «NS»	NMT state machine (ESM)	Description
Off	Stopped	No power supply or not connected
Green blinking	'Initialization' or 'Pre-Operational'	Connected. SDO communication is possible
Green	'Operational'	Connected. SDO and PDO communication are possible
Red		A network major error has occurred

Module status LED «MS»

The module status LED displays the status of device state machine (DSM).

Module status LED «MS»	Valve State Machine (status word) (according to VDMA profile)	Description
Off		No supply power
Green blinking	'INIT' or 'DISABLED'	Servo valve standby mode
Green	'HOLD' or 'ACTIVE'	Normal operation
Red blinking	'FAULT_DISABLED' or 'FAULT_HOLD'	Recoverable error. Fault reactions 'FAULT_DISABLED', 'FAULT_HOLD'
Red	'NOT_READY'	Unrecoverable error. Fault reaction 'NOT_READY'

ELECTRICAL INTERFACES
EtherCAT

Status display LEDs

The network and the servo valve's status are indicated by multicolor status display LEDs on the electronic housing.

Network link/activity LED «L/A in» and «L/A out»

The network Link/Activity LEDs «L/A in» and «L/A out» display the status of the physical connection.

LEDs «L/A in» and «LA out»	Network Link/Activity State	Link	Activity
On	Physical connection established. No data transfer	Yes	No
Flickering	Physical connection established and data transfer	Yes	Yes
Off	No physical connection	No	No

Note: The LEDs «L/A in» and «LA out» blink fast to indicate an incomplete physical connection, often caused by a cable break of a single wire. This can be confused with the flickering state. To distinguish between these two states, stop the network master to avoid network traffic. If the LED «L/A in»/«LA out» is still blinking very fast, please check the cabling.

Module status LED «MS»

The module status LED displays the status of the device state machine (DSM).

Module status LED «MS»	Valve State Machine (status word) (according to VDMA profile)	Description
Off		No supply power
Green blinking	'INIT' or 'DISABLED'	Servo valve standby mode
Green	'HOLD' or 'ACTIVE'	Normal operation
Red blinking	'FAULT_DISABLED' or 'FAULT_HOLD'	Recoverable error. Fault reactions 'FAULT_DISABLED', 'FAULT_HOLD'
Red	'NOT_READY'	Unrecoverable error. Fault reaction 'NOT_READY'

ELECTRICAL INTERFACES
EtherCAT

Network Run LED «RUN»

The network Run LED «RUN» displays the status of the communication.

LED «RUN»	Network Link/Activity State
Off	Device is in state 'INIT'
Blinking	Device is in state 'PRE-OPERATIONAL'
Single flash	Device is in state 'SAFE-OPERATIONAL'
On	Device is in state 'OPERATIONAL'

ELECTRICAL INTERFACES

General Requirements for Pump Electronics

Supply	24 V_{DC}, minimum 18 V_{DC}, maximum 32 V_{DC}
Shielding	• All signal lines, including those applied in connection with external transducers, shielded • Shielding on power supply side connected radially to GND (0 V) and connected to the mating connector housing (because of EMC)
EMC	Meets the requirements of emission: EN 61000-4-4: 2001-10 and immunity: EN 61000-6-2:1999
External fusing	1.6 A slow blow for each pump
Duty cycle	100 %
Maximum power consumption	28.8 W (1.2 A at 24 V_{DC})
Minimum cross section of all leads	$\geq$ 0.75 mm^2 (18 AWG) Consider voltage losses between cabinet and RKP-D

Note: When making electric connections to the RKP-D (shield, protective earth), appropriate measures must be taken to ensure, that locally different grounding potentials do not result in excessive ground currents. See also Moog Technical Note TN353.

Command Signals and Wiring for RKP-D with Analog Operation

Command signals 0 to 10 V; floating (= factory setting)

The stroke ring position (= volumetric flow) of the RKP-D is proportional (U_4 - U_5) at the 11+PE connector (X1). The command signal (U_4 - U_5) = +10 V equals 100 % displacement, whereas (U_4 - U_5) = 0 V equals zero displacement.

The pressure function controls the pressure measured by an external pressure transducer. The pressure is proportional (U_7 - U_5) at 11+PE pole connector (X1). (U_7 - U_5) = +10 V equals 100 % regulated pressure. (U_7 - U_5) = 0 V results in 0 % regulated pressure.

The absolute size of 0 and 100 % pressure depends on the signal range of the assembled pressure transducer respectively the software adjustment of current input.

Command signals 4 to 20 mA; floating (= software adjustable)

The stroke ring position (= volumetric flow) of the RKP-D is proportional to I_4 at the 11+PE connector (X1). The command signal I_4 = 20 mA equals 100 % displacement, whereas I_4 = 4 mA equals zero displacement (or I_4 = 12 mA, depends from settings). The pressure function controls the pressure measured by an external pressure transducer.

The pressure is proportional to I_7 at 11+PE pole connector (X1). I_7 = 20 mA equals 100 % regulated pressure whereas I_7 = 4 mA results in 0 % regulated pressure. Pin 5 is the common return wire for I_4 and I_7, which means: I_4 + I_7 = -I_5 .

The absolute size of 0 and 100 % pressure depends on the signal range of the assembled pressure transducer respectively the software adjustment of current input.

Output actual value 2 to 10 V to GND (Note: Type of signal is fixed and not switchable via software), for CAN version only

The actual stroke ring position can be measured at pin 6, the actual pressure at pin 8 of the 11+PE pole connector (X1). These signals can be used for monitoring, fault detection and visualization purposes. The pressure range (0 to 100 %) and the displacement rate (-100 to +100 %) correspond to the output signal range of 2 to 10 V.

At 6 V (pin 6) the stroke ring is in its centered position and the RKP-D delivers zero flow; at 10 V (pin 6) the RKP-D delivers +100 % flow; at 2 V (pin 6) the RKP-D delivers -100 % flow. At 2 V (pin 8) the actual pressure corresponds to 0 %; at 10 V (pin 8) the actual pressure corresponds to 100 %. The actual output signal allows to detect a cable break, when U_6-10 = 0 V and U_8-10 = 0 V respectively.

Actual value feedback signals 4 to 20 mA, ground related (Note: Type of signal is fixed and not switchable via software)

The actual stroke ring position, can be measured at pin 6, the actual pressure can be measured at pin 8 at the 11+PE connector (X1). Those signals can be used for monitoring, fault reaction and visualization purposes. The stroke ring position respectively pressure range corresponds to 4 to 20 mA. At 12 mA (pin 6), the stroke ring is in centered position (= zero displacement).

ELECTRICAL INTERFACES

Continuation: Actual value feedback signals 4 to 20 mA, ground related (Note: Type of signal is fixed and not switchable via software)

- At 20 mA (pin 6), the RKP-D delivers +100 % flow, whereas at 4 mA (pin 6) the RKP-D delivers -100 % flow.

- At 4 mA (pin 8), the actual pressure corresponds to 0 %.

- At 20 mA (pin 8), the actual pressure corresponds to 100 %. The actual value signal outputs allow to detect a cable break, when I_6 = 0 mA, respectively I_8 = 0 mA.

Circuit diagram for measurement of actual value I_6 (strokering position) and I_8 (actual pressure) as voltage signals 2 to 10 V:
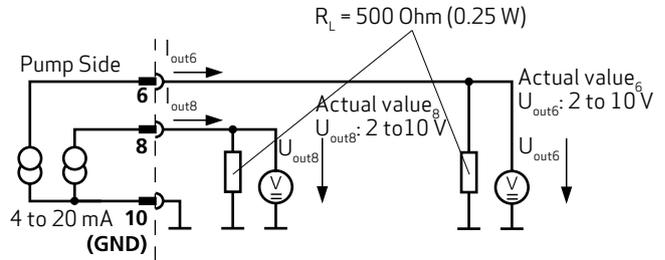
Wiring for 11-pole + PE Connector (X1)

Pin	Function	Factory Settings Differential Voltage Inputs 0 to 10 V; Floating	Configurable Settings Current Inputs 4 to 20 mA; Floating
1	Not used	-	-
2	Not used	-	-
3	Enable signal	8.5 to 32 V_{DC} based on pin 10: Operation of the pilot valve enabled < 6.5 V_{DC} based on pin 10: Pilot valve fail-safe condition	
4	Set point signal Q	$U_{in} = U_{4-5}$ R_{in} = 20 kΩ	$I_{in} = I_4 = - I_5$ (with I_7 = 0) [1] R_{in} = 200 Ω
5	Reference Input rated command	Reference to ground for pin 4 and 7	Common feedback for pin 4 and 7
6	Output [3] Actual stroke ring position	Voltage signal output: U_{out} = 2 to 10 V to GND. At 6 V the stroke ring is positioned in centered position. The RKP-D delivers 0 % flow. Current signal output: I_{out} = 4 to 20 mA to GND. I_{out} is proportional to actual stroke ring position. Output is short-circuit proof; R_L = 0 to 500 Ω	
7	Set point signal p	$U_{in} = U_{7-5}$ R_{in} = 20 kΩ	$I_{in} = I_7 = - I_5$ (bei I_4 = 0) [1] R_{in} = 200 Ω
8	Output [3] Actual pressure	Voltage signal output: U_{out} = 2 to 10 V to GND. 2 V corresponds to 0 % pressure. 10 V corresponds to 100 % pressure. Current signal output: I_{out} = 4 to 20 mA to GND. I_{out} is proportional to actual pressure. Output is short-circuit proof; R_L = 0 to 500 Ω	
9	Supply voltage	24 V_{DC} (18 to 32 V_{DC}); $p_{maximum}$ = 28.8 W	-
10	Supply ground	0 V (GND)	-
11	Fault indication	Error control: U < 0.5 V [2] means fault	-
⏚	Protective earth (PE)	Connected with valve body	

The potential difference from pin 4, 5 and 7 (measured against pin 10) each must be between -15 and +32 V.

[1] As pin 5 is the common feedback for pin 4 and pin 7, $-I_5 = I_4 + I_7$ applies.
[2] Reference to pin 10 (supply-ground).
[3] Note: Type of signal can NOT be switched via software and has to be specified when designating the model code (see model code position 12).

Suitable mating connector 11+PE:
Moog order code B97067-111

Important note:
Only the use of specified mating connector (metall shell) in combination with proper shielding to meet the EMC requirements.

ELECTRICAL INTERFACES

CAN Connector (X3 and X4)

Pin	Signal	
1	CAN_SHLD	Shield
2	CAN_V+	No connection in the valve
3	CAN_GND	
4	CAN_H	Transceiver H
5	CAN_L	Transceiver L

External thread,
pin contact

Internal thread,
socketcontact

View on CAN connector X3   View on CAN connector X4
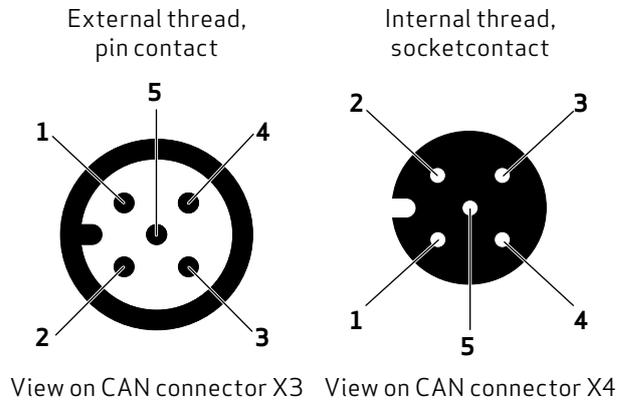
EtherCAT Connector (X3 and X4)

Pin	Signal X4 IN	Signal X3 OUT
1	TX + IN	TX + OUT
2	RX + IN	RX + OUT
3	TX – IN	TX – OUT
4	RX – IN	RX – OUT

Internal thread,
socket contact

Internal thread,
socket contact

View on EtherCAT
connector X3

View on EtherCAT
connector X4
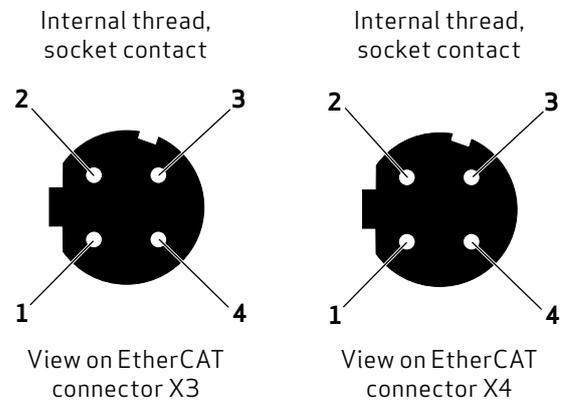
External Pressure Sensor Inputs (X5 and X6)

Factory settings: Sensor signal 0 to 10 V; 4-wire-type

Pin	Signal
1	Supply 24 V_{DC} (maximum 200 mA)
2	Signal GND
3	Supply GND
4	Pressure signal (0 to +10 V or 4 to 20 mA)

M8 x 1   4-pole

(WH) 2   4 (BK)
(BN) 1   3 (BU)

Front view on the cable
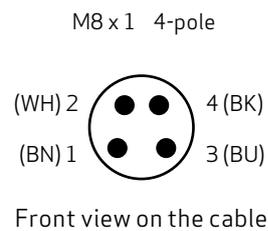
Supported Types of Pressure Sensors

| Option	Option	Option	Factory Setting	RKP-D
Supply 24 V DC — Signal (4 to 20 mA) — p / I — GND at 3-Wire Sensor	Supply 24 V DC — Signal (4 to 20 mA) — Signal GND — p / I — Supply GND	Supply 24 V DC — Signal (0 to 10 V) — p / U — GND	Supply 24 V DC — Signal (0 to 10 V) — Signal GND — p / U — Supply GND	1 / 4 / 2 / 3 X.5 X.6
2- and 3- Wire Sensor 4 to 20 mA	4 - Wire Sensor 4 to 20 mA	3 - Wire Sensor 0 to 10 V	4 - Wire Sensor 0 to 10 V	
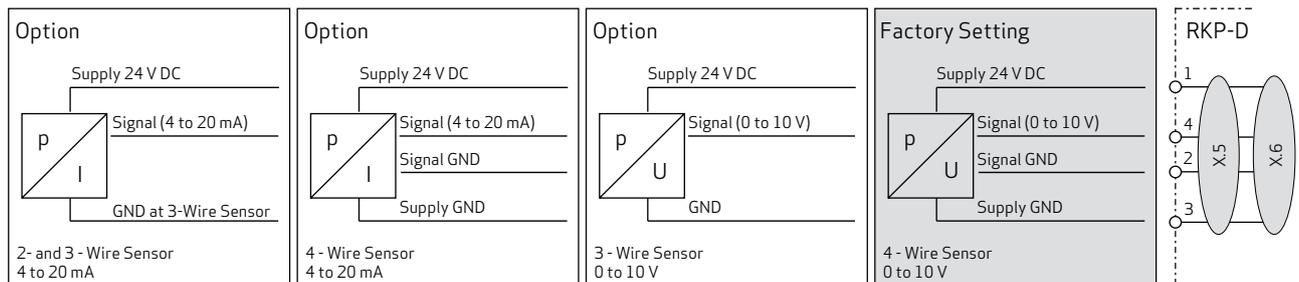
Note:
Each option requires adequate setting of the analog
interface via the Moog Valve and Pump Configuration
Software.

ELECTRICAL INTERFACES

Analog Operation Mode Selection (X7)

Factory settings: Differential input signal 0 to 10 V

Pin	Signal
1	Supply 24 V_{DC} (maximum 200 mA)
2	Signal GND
3	Supply GND
4	Signal (0 to +10 V)

M8 x 1   4-pole

Front view on the cable
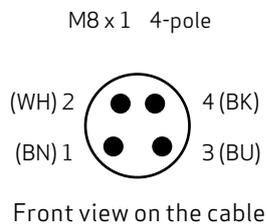
Mating Connector with Cable for Inputs X5, X6, X7

Available from Moog or C. Escha Bauelemente GmbH

L = 2.0 m (78.740):
Moog (Ordering No C72977-002)
or Escha (Type 8028332)

L = 5.0 m (196.850):
Moog (Ordering No C72977-005)
or Escha (Type 8028333)

Pin 1   Brown (BN)
Pin 2   White (WH)
Pin 3   Blue (BU)
Pin 4   Black (BK)

(IP65; 4 x 0.25 mm^2 (0.009); PUR; screened),
not included in delivery of RKP-D
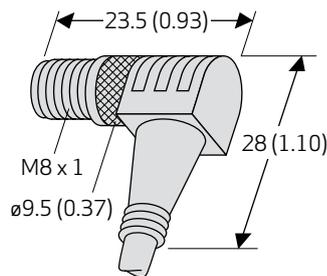
ELECTRICAL INTERFACES

**LocalCAN Connector for
Master-Slave Combinations X10**

Pin	Signal
1	CAN_H Transceiver H
3	CAN_GND
4	CAN_L Transceiver L

Front view on the cable
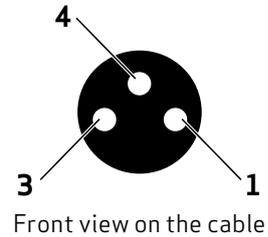
Junction Cable for Master-Slave Combinations X10

Available from Moog or C. Escha Bauelemente GmbH

L = 0.3 m (11.811):
Moog (Ordering No C43395-001)
or Escha (Type 8031233)

(IP65; 3 x 0.25 mm² (0.009); PUR; screened),
not included in delivery of RKP-D
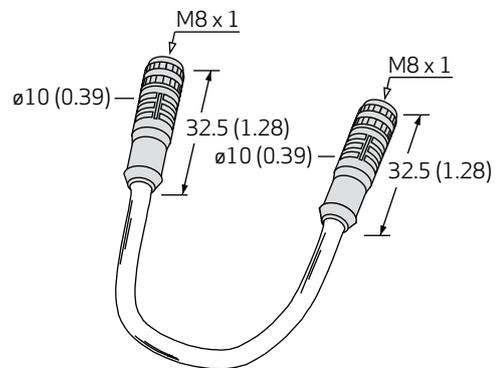
CONVERSION TABLE

General Conversion Table

1 bar	=	14.5038 psi (lb/in^2)
1 psi	=	0.06895 bar
1 mm	=	0.0394 in
1 in	=	25.4 mm
1 cm^3	=	0.0610 in^3 = 0.000264 gal (US)
1 in^3	=	16.3871 cm^3 = 0.004329 gal (US)
1 l (Liter)	=	0.26417 gal (US) = 61.024 in^3
1 gal (US)	=	3.7854 l (Liter) = 231 in^3
1 kg	=	2.2046 lb
1 lb	=	0.4536 kg
1 Nm	=	8.8507 lbf in
1 lbf in	=	0.1130 Nm
1 kW	=	1.3596 PS = 1.3410 hp (UK)
1 hp (UK)	=	1.0139 PS = 0.7457 kW
+1 °F	=	-17 °C
+1 °C	=	+34 °F
		(°F - 32) x 0.5556 = °C
		(°C/0.5556) + 32 = °F
0 °F	=	-18 °C
0 °C	=	+32 °F
+100 °F	=	+38 °C
+100 °C	=	+212 °F

Mass Moment of Inertia

1 kg cm^2	=	0.3417 lb in^2
1 lb in^2	=	2.9264 kg cm^2
1 kg cm^2	=	8.85 10^{-4} lbf in s^2
1 lbf in s^2	=	1,130 kg cm^2

Kinematic Viscosity

1 mm^2/s	=	1 cSt

Note: All dimensions in the catalog are in mm unless otherwise specified.

Calculation of Power Consumption

$$P = \frac{p \times Q}{6 \times \eta}$$

P [kW]

p [bar]

Q [l/min]

η [%]

Example: RKP 63 cm^3/rev, 280 bar, 1,450 rpm:

p = 280 bar

Q = (63 x 1.450) = 91.3 l/min

η = 95 %

P = 280 x 91.3 kW/(6 x 95)

P = 45 kW

Calculation of Drive Torque

$$M = \frac{1.59 \times V \times p}{\eta}$$

M [Nm]

V [cm^3/rev]

p [bar]

η [%]

Example: RKP 63 cm^3/rev, 280 bar:

V = 63 cm^3/rev

p = 280 bar

η = 95 %

M = 1.59 x 63 x 280 Nm/95

M = 295 Nm

ABOUT MOOG

Moog Inc. is a worldwide designer, manufacturer and integrator of precision control components and systems. Moog's Industrial Group designs and manufactures high performance motion control solutions combining electric, hydraulic, and hybrid technologies with expert consultative support in a range of applications including energy production and generation machinery, industrial production machinery and simulation and test equipment. We help performance-driven companies design and develop their next-generation machines. Moog Industrial Group, with fiscal year 2013 sales of USD 592 million and over 40 locations worldwide, is part of Moog Inc. (NYSE: MOG.A and MOG.B) which has sales of USD 2.61 billion.

Moog maintains facilities in 26 countries around the globe. This vast scope ensures that our engineers remain close to the needs of machine builders and provide flexible design solutions and technical expertise tailored to our customers' toughest challenges.

Moog experts work in close collaboration with machine builders and application engineers to design motion control systems for greater productivity, higher reliability, superior connectivity, less costly maintenance and more effective operations. Our regional presence, industry knowledge and design flexibility ensures Moog motion control solutions are tailored to their environment – from meeting operating regulations and performance standards, to taking machine performance to a higher level.

Products

At the heart of every Moog solution is an array of products engineered for precision, high performance and reliability. For more than six decades, Moog products have been specified for critical machine applications.

Some are developed specifically for unique operating environments. Others are standard equipment on machines across many industries. All are continuously improved to take advantage of the latest technology breakthroughs and advancements.

Moog products include:

• Servo Valves and Proportional Valves

• Servo Motors and Servo Drives

• Servo Controllers and Software

• Radial Piston Pumps

• Actuators

• Integrated Hydraulic Manifold Systems and Cartridge Valves

• Slip Rings

• Motion Bases

Servo Drives

Servo Motors

Servo Valves

Radial Piston Pumps

ABOUT MOOG

Hydraulic solutions

Since Bill Moog invented the first commercially viable Servo Valve in 1951, Moog has set the standard for world-class hydraulic technology. Today, Moog products are used in a variety of applications - providing high power, enhanced productivity and ever better performance for some of the worlds most demanding applications.

Electric solutions

Clean operation, low noise generation, less maintenance and reduced power consumption make Moog electric solutions ideal for applications worldwide. Moog is the ideal partner for applications where transitioning technologies requires special expertise.

Hybrid solutions

By incorporating the advantages of existing hydraulic and electric technologies - including modular flexibility, increased efficiency and cleanliness - into innovative hybrid solutions, Moog offers new performance potential in specialized applications.

Moog Global Support

Moog Global Support is our promise to offer world-class Repair and Maintenance Services delivered expertly by our trained technicians. With the reliability only available from a leading manufacturer with facilities around the world, Moog offers you service and expertise you can count on to keep your equipment operating as it should.

This promise offers many benefits to our customers including:

- Reduce your downtime by keeping critical machines running in peak performance

- Protect your investment by ensuring reliability, versatility and long-life of products

- Better plan your maintenance activities and make systematic upgrades

- Leverage our flexible programs to meet the unique service requirements of your facility

Look to Moog for global support including:

- Repair services using OEM parts are performed by trained technicians to the latest specifications

Flight Simulation

Formula One Simulation Table

- Stock management of spare parts and products to prevent unplanned downtime

- Flexible programs, tailored to your needs such as upgrades, preventative maintenance and annual/multi-year contracts

- On-site services bring the expertise to you, providing quicker commissioning, set-up and diagnostics

- Access to reliable services that are guaranteed to offer consistent quality anywhere in the world

For more information on Moog Global Support, visit **www.moog.com/industrial/service**

ACCESSORIES AND SPARE PARTS

Position	Part Description	Comments	Part Number
1	Mating connector 11+PE, EN175201, part 804	For X1	B97067-111
2	Mating connector M8 with connection cable L = 2.0 m (78.740 inch)	For X5, X6, X7	C72977-002
3	Mating connector M8 with connection cable L = 5.0 m (196.850 inch)	For X5, X6, X7	C72977-005
4	Connecting cable master-slave L = 0.3 m (11.811 inch)	X10	C43395-001
5	USB-to-CAN-Interface card	For usage with Moog Valve and Pump Configuration Software	C43094-001
6	CAN cable (Sub-D to M12)	For usage with Moog Valve and Pump Configuration Software	TD3999-137
7	Adaptor cable M8 connector to M12 connector	For configuration with the Moog Valve and Pump Configuration Software (not required for pumps with CANbus interface)	CA40934-001
8	Sequence manifold	For pump size 19 cm^3/rev	2517 430 601
9	Sequence manifold	For pump size 32/45 cm^3/rev	2517 430 602
10	Sequence manifold	For pump size 63/80 cm^3/rev	2517 430 603
11	Sequence manifold	For pump size 100 cm^3/rev	2517 430 604
12	Sequence manifold	For pump size 140 cm^3/rev	2517 430 605
13	Sequence cartridge NG16 - 14 bar (200 psi)	For pump size 19/80 cm^3/rev	XCB11555-000-00
14	DIN-Cover for position 13	For pump size 19/80 cm^3/rev	XEB17695-000-01
15	Sequence cartridge NG25 - 16 bar (230 psi)	For pump size 100/140 cm^3/rev	XCB11557-000-00
16	DIN-Cover for position 15	For pump size 100/140 cm^3/rev	XEB17709-000-01

The sequence manifolds contain the fixing screws and the O-Ring to assemble the block to the RKP-D outlet.

$1 cm^3 = 0.061 in^3$

ACCESSORIES AND SPARE PARTS

Part Designation	Description	Remark	Part Number
Radial Piston Pump RKP - User Manual	Manuals	Visit www.moog.com/industrial/literature to download a document using the part number in a search	CA53461
Radial Piston Pump RKP - Mounting and Installation Notes			CA57130
Radial Piston Pump RKP-D Application Manual			CA58548
Radial Piston Pump RKP-D with CANopen Firmware			B99224
Radial Piston Pump RKP-D with EtherCAT Interface			CDS39670
Radial Piston Pump RKP for Aviation Industry Hydraulic Fluids			
Moog Valve and Pump Configuration Software	Software	Download software free of charge at www.moogsoftwaredownload.com	

NOTES

MODEL CODE

The model code describes options of the RKP-D. The following typecode system allows customers to specify a variety of pump(s) in 8 sizes ranging between 19 and 250 cm^3/rev and define preferred options for design/ interfaces (e.g., mounting flange arrangement, drive shaft and ports), operating fluids (e.g., mineral oil, fire resistant HF fluid and cutting emulsions) and control principles.

Example

Position Number	1		2	3	4			
Drive	HP	–	R	18	B1	–		

Position Number	5	6	7	8	9	10	11	12
Pump 1	RKP	100	T	M	28	D1	Z	00
Pump 2	RKP	063	K	M	28	D2	Z	00
Pump 3	AZP	008	R	M	28	TP	0	00

Drive

Pos.	1		2	3	4
Sym.	HP		R	18	B1

Radial Piston Pump

5	6	7	8	9	10	11	12
RKP	100	T	M	28	D1	Z	00

Radial Piston Pump

5	6	7	8	9	10	11	12
RKP	063	K	M	28	D2	Z	00

Additional Pump Stage

5	6	7	8	9	10	11	12
AZP	008	R	M	28	TP	0	00

MODEL CODE

Position	Code	Radial Piston Pump
1	**HP** HK HZ	**Code** **Hydraulic Pump** ATEX Certified for Potentially Hazardous Environments[1] Pump with special features
2	**R** L	**Rotations** Clockwise, looking at drive shaft Counterclockwise, looking at drive shaft
3	18	**Speed** Maximum speed for low noise operation or rated speed for power controlled pumps, e. g. 18 => n = 1,800 min^{-1}
4	A1 B1 A7 B7 C3 D3 A5 C6 XX	**Drive flange** Straight key according to DIN 6885, metric round flange (not for RKP 140) Spline according to DIN 5482, metric round flange (not for RKP 140) Straight key according to DIN 6885, 4 holes ISO flange according to ISO 3019-2 (metric) Spline according to DIN 5480, 4 holes ISO flange according to ISO 3019-2 (metric) Straight key according to SAE 744 C, 2/4 holes SAE-flange according to ISO 3019-1 (inch) Spline according to SAE 744 C (ISO 3019-1), 2/4 holes SAE-flange according to ISO 3019-1 (inch) Straight key according to DIN 6885, metric round flange for polyurethane foam Straight key according to SAE 744 C, 2/4 holes SAE-flange according to ISO 3019-1 (inch) for polyurethane foam Intermediate flange RKP/RKP
5	RKP AZP DS1	**Pump type** Radial piston pump, variable displacement Moog gear pump with SAE-A and SAE-B flange **Attachment of other pumps** Heavy-duty through-drive for RKP attachment and adapter flange for SAE-A, SAE-B or SAE-C
6	019 032 045 063 080 100 140 250 005 008 011 016 019 023 031 033 044 050	**Displacement RKP** 19 cm³/rev 32 cm³/rev 45 cm³/rev 63 cm³/rev 80 cm³/rev 100 cm³/rev 140 cm³/rev 250 cm³/rev **Displacement and attachment flange of Moog gear pumps (AZP)** 5 cm³/rev SAE-A 8 cm³/rev SAE-A 11 cm³/rev SAE-A 16 cm³/rev SAE-A 19 cm³/rev SAE-A 23 cm³/rev SAE-A 31 cm³/rev SAE-A 33 cm³/rev SAE-B 44 cm³/rev SAE-B 50 cm³/rev SAE-B
7	**K** **T** T **S** H R	**Pump ports** **Medium pressure series (to 280 bar (4,000 psi) sizes 32, 45, 63 and 80 cm³/rev** **Medium pressure series (to 280 bar (4,000 psi) sizes 100 and 140 cm³/rev** High pressure series (to 350 bar (5,000 psi) sizes 32, 63, 80, 140 and 250 cm³/rev **Medium pressure series (to 280 bar (4,000 psi) size 19 cm³/rev** High pressure series (to 350 bar (5,000 psi) size 19 cm³/rev German 4 bolt flange (only for gear pumps)

1) Not with RKP-D
Note: Preferred configurations are highlighted

MODEL CODE

Position	Code	Radial Piston Pump
8	**M** A B C D E	**Operating fluid** **Mineral Oil** HFA (oil in water) HFB (oil in water) HFC (water glycol) HFD (synthetic esther) Cutting Emulsion
9	**28** 35	**Operating pressure** **Maximum operating pressure e.g., 28 => 280 bar (4,000 psi)** Maximum operating pressure e.g., 35 => 350 bar (5,000 psi)
10	**D1** **D2** D3 D4 D5 D6 D7 D8	**Control/Compensators** **RKP-D (electro-hydraulic control with digital on-board electronics), internal pressure supply** **RKP-D (electro-hydraulic control with digital on-board electronics), external pressure supply** RKP-D with external pressure supply, useable for hybrid operation RKP-D with internal pressure supply, useable for hybrid operation RKP-D with internal pressure supply useable for master/slave operation RKP-D with external pressure supply useable for master/slave operation RKP-D with external pressure supply useable for master/slave and hybrid operation RKP-D with internal pressure supply useable for master/slave and hybrid operation For RKP-D with EtherCAT only the options D5, D6,D7,D8 are available.
11	**Z** Y 0	**Additional equipment** **No Accessories** Maximum displacement limiter Only at gear pump
12	 00 **01** **A0** 05-50	**Additional information** For Compensators D1 to D8 CAN bus, Actual value 4 to 20 mA **CAN bus, Actual value 2 to 10 V (for CAN Filedbus only)** **EtherCAT bus, actual value 4 to 20mA** **For tandem gear pumps** Displacement of the 2nd gear pump 5 to 50 cm^3/rev

Note: Preferred configurations are highlighted

TAKE A CLOSER LOOK.

Moog designs a range of motion control products that complement the performance of those featured in this document. Visit our website for more information and contact the Moog facility nearest you.

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