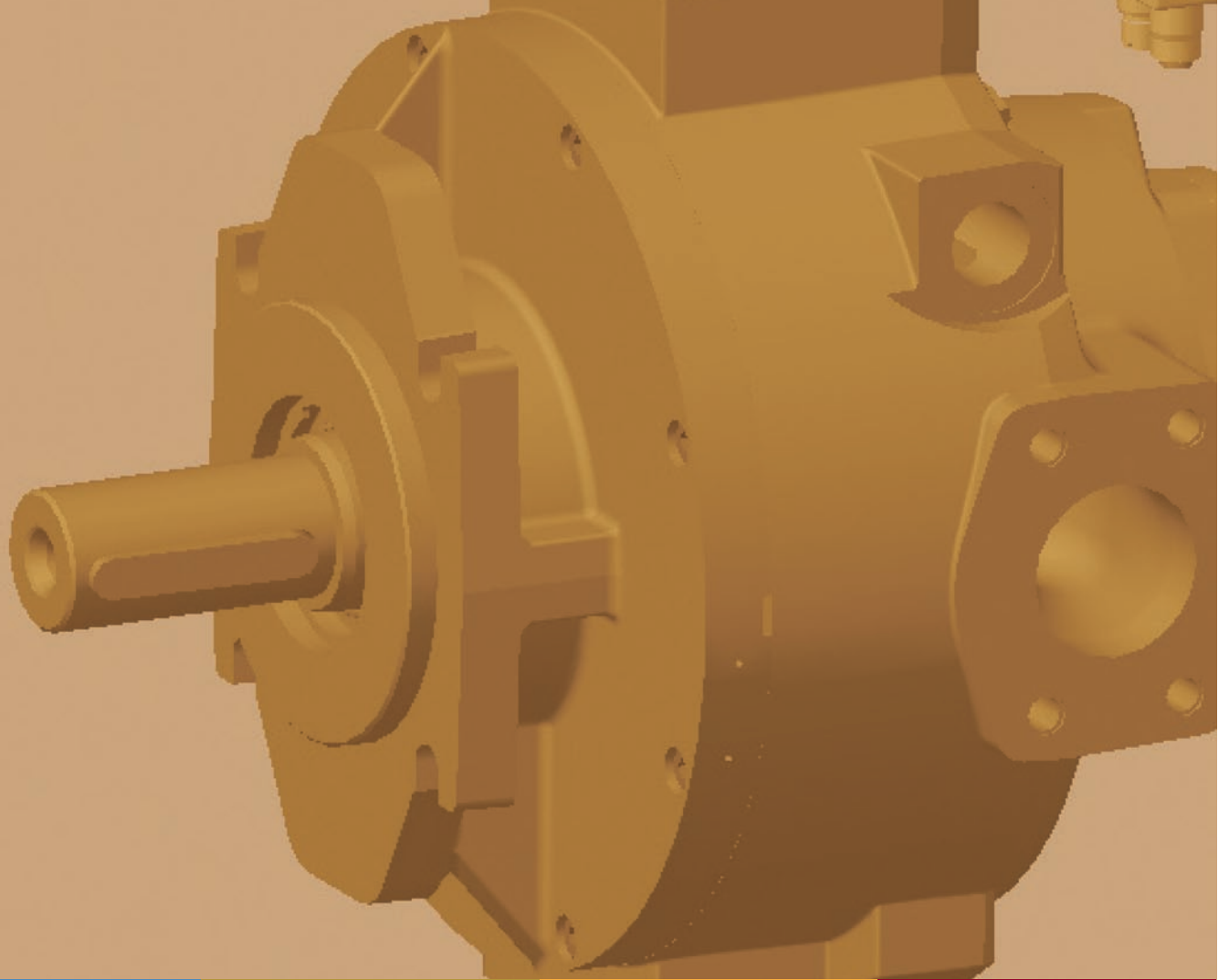


RADIAL PISTON PUMP

RKP-D



Rev. 1.1, August 2010

RADIAL PISTON PUMP WITH DIGITAL CONTROL

RADIAL PISTON PUMP WITH DIGITAL CONTROL (RKP-D)

INTRODUCTION

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IMPORTANT NOTE

The information contained herein is intended for users with some technical knowledge of RKP pumps. To ensure that all necessary characteristics for function and safety are covered, the user must check the suitability of the products described herein. Additional technical information and operating instruction can be found in the main RKP catalogs available from Moog. These products are subject to change without notice.

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EXCELLENCE IN MOTION CONTROL

For over 50 years, Moog has been a leader in motion control technology, specializing in manufacturing and applying high performance products. Today, Moog continues to incorporate the latest motion control technology to offer innovative products that can help customers, to achieve new levels of machine performance.

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 new version, Moog has significantly improved the control technology of the RKP with a new closed-loop proportional valve with digital on-board electronics for flow and pressure regulation, tuning, and diagnostics. Moog's new RKP-D can be digitally controlled via a CANopen interface or run as a purely analog device controlled by analog command signals. This provides maximum flexibility for compatibility with several PLC architectures. Described in this document are details about the significant benefits available from running the RKP-D in either analog or CANopen modes.

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 Configuration Software. This Microsoft Windows®-based software communicates with the RKP-D via the CANopen 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 can be requested by Moog.

APPLICATIONS

The high-performance, flexible control system used for this new 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.

RADIAL PISTON PUMP WITH DIGITAL CONTROL (RKP-D)

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:

- Seven sizes between 1.9 and 140 cm³/rev (1.2 and 8.5 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
- Rapid response time
- Compact design
- Good suction characteristics
- Low pressure ripple
- Low noise level

Precise Closed-Loop Control

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

Analog or CAN-bus Operation

The ability to function as a CANopen device or as a traditional analog device ensures compatibility with different PLC-structures. When operating as an analog device, the RKP-D uses purely analog command signals to control flow and pressure and can select the matching parameter set. Consequently, this RKP-D provides many benefits of digital control without requiring a CAN-bus 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

With the introduction of the new master-slave mode, it is now possible to combine multiple servopump-stages in one common oil volume, while provides superior pressure control. This is an innovation, provide for the most flexible use of double- or triple pumps in complex machine processes. This option allows either separate pump stages for parallel movements or to combine flows, in order to achieve highest velocities in isolated motions. Both cases take advantage of the superior pressure regulation possibilities of RKP-D. This feature enables users to arrange axis motions with a high degree of flexibility, without being forced to compromise the quality of the pressure control.

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 external pO-card is not required and therefore no need to provide cabling to/from the RKP-D.

Warranty

The Moog Radial Piston Pump stands for reliability, low noise and durability. This is underlined by its extended warranty. Under the conditions described in section "Technical Data" of the main catalogues RKP and RKP-II, warranty for mineral oil is covered for 10,000 operating hours or 24 months.

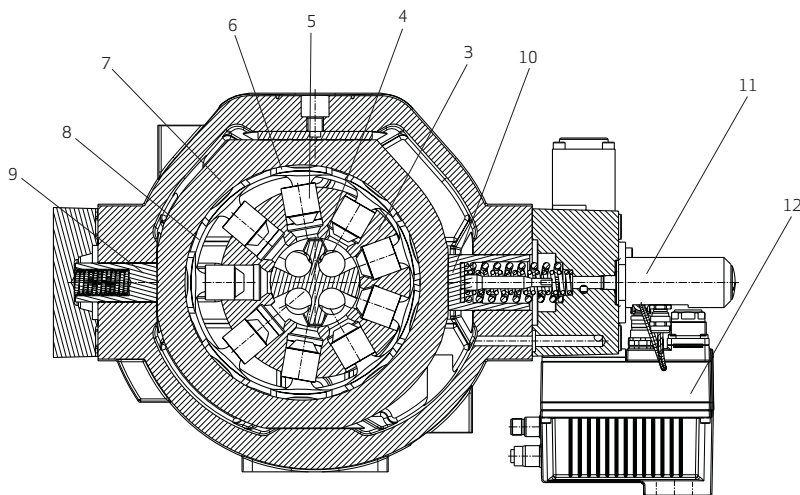
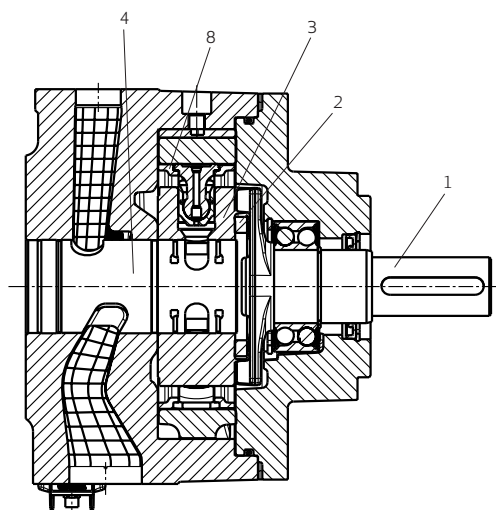
RADIAL PISTON PUMP WITH DIGITAL CONTROL (RKP-D)

DESCRIPTION RADIAL PISTON PUMP

MODE OF OPERATION

The shaft (1) transfers the drive torque to the star-shaped cylinder block (3) free of any transverse forces via a cross-disc coupling (2). The cylinder block is supported on the control journal (4). The radial pistons (5) in the cylinder block abut against the stroke ring (7) through hydrostatically balanced slipper pads (6). 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 overlapping rings (8) 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 (9, 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).



GENERAL DESCRIPTION OF RKP-D

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

All control circuits are processed by the software including:

- Position control of the pilot valve
- Position control of the stroke ring (flow 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.

RADIAL PISTON PUMP WITH DIGITAL CONTROL (RKP-D)

DESCRIPTION DIGITAL CONTROL VERSION

FLEXIBLE CONTROL OPTIONS

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

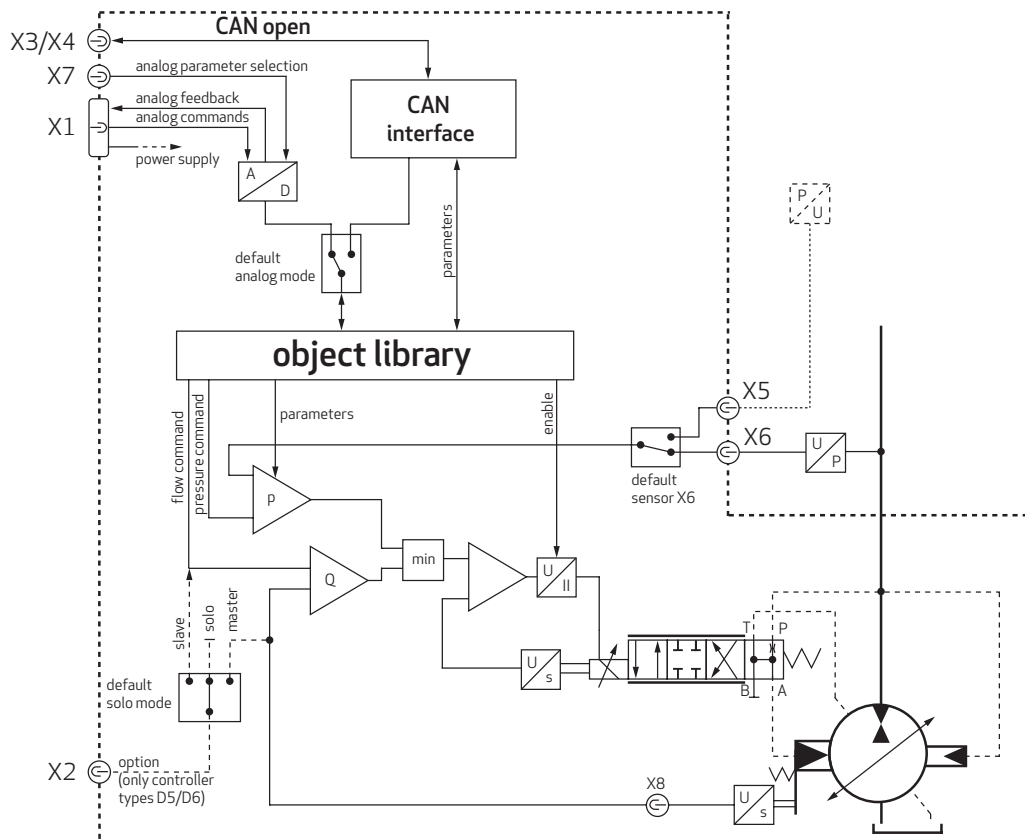
The RKP-D with digital control offers easy integration into different control approaches to make it flexible for the widest range of machine requirements. Some available options include:

- Factory-Preset Analog Condition:** 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 flow 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.
- Parameter Set Selection Analog Condition:** Users that need a higher degree of adaptation to unique machine requirements, need only provide the RKP-D with an additional 0 ... 10V 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 parameter set 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 CAN-bus 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 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 on request as part of the package.
- CAN-bus Operating Condition:** Pumps can also be fully controlled via a CAN-bus interface and Moog Configuration Software, thereby offering the full range of flexibility and functionality. This “CAN-bus 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



RADIAL PISTON PUMP WITH DIGITAL CONTROL (RKP-D)

FUNCTIONALITY

FUNCTIONS OF THE RADIAL PISTON PUMP WITH DIGITAL CONTROL

Flow Control

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

The flow-rate 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 flow until the desired pressure is no longer exceeded. The RKP-D can switch into active suction mode (negative flow) 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 CAN-bus 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 ... 20 mA; 0 ... 10 V; 2-, 3- and 4-wire sensors).

Pressure 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 (flow).

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

Leakage Compensation

As the pressure increases, pumps will produce increasing internal leakage that will be missing from the usable volume flow that is normally generated by the pump. The pump electronics contain a leak-compensation function to cancel out this effect. As the system pressure increases, the flow volume increases automatically so that the useful volume 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 volumetric flow rate (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 flow controlled by the master pump. During this Master-Slave operation, the master will communicate his flow value via the local CAN-bus to the slaves.

The advantages of the Master-Slave operation is the stable pressure control at a synchronous flow. This operating mode can be switched on and off using the CAN-bus 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 and thus are able to perform this Master-Slave operation.

Further, 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 Configuration Software or CAN-bus.

RADIAL PISTON PUMP WITH DIGITAL CONTROL (RKP-D)

FUNCTIONALITY

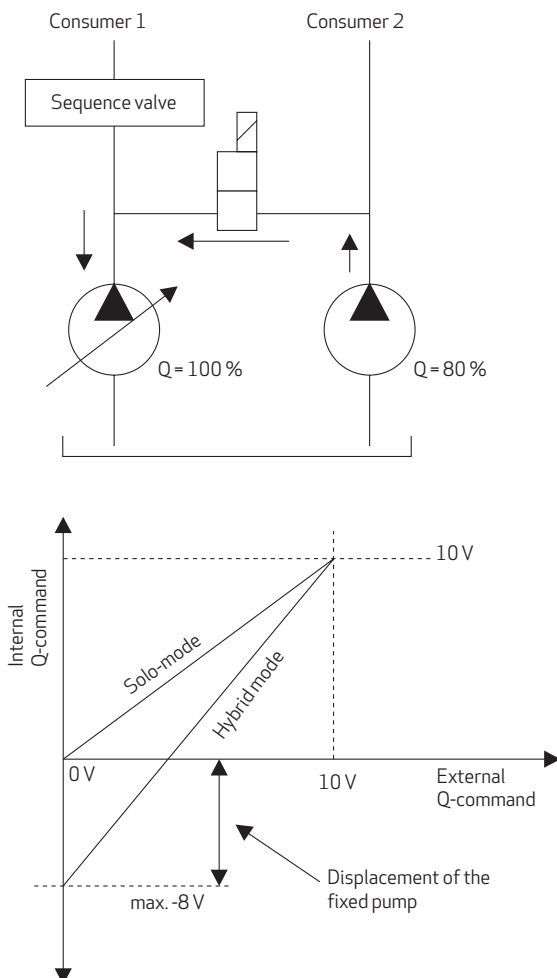
Hybrid Mode

In the hybrid mode, a RKP-D is merged with a constant pump in a shared volume. In the standby-condition, the RKP-D must pump to the tank (in a negative flow direction) some or all of the constant pump's flow volume. 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 constant pump may not be exceeded.

The RKP-D's electronics afford the option of activating a second flow 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 flow adjustment (gain and offset) is not factory preset and must be calibrated by the user during initial commissioning. For easy use, there is a pre-designed menu for flow adjustment in the Moog 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

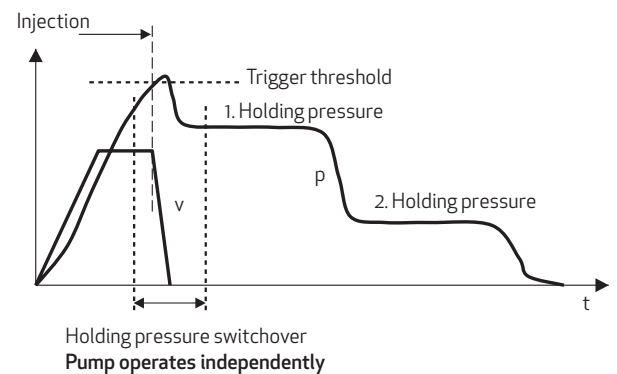


Special Feature for Injection Molding - Local Holding Pressure Switchover

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 CAN-bus 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 almost real time using the control electronics. This happens without intervention by the superior PLC and therefore without disturbing signal running times over the CAN-bus. This function can be used only during CAN-bus operation of the RKP-D and is generally only needed in this operating mode.

Functional Principle of the Local Holding Pressure Switchover



RADIAL PISTON PUMP WITH DIGITAL CONTROL (RKP-D)

BASIC HYDRAULIC CIRCUITS

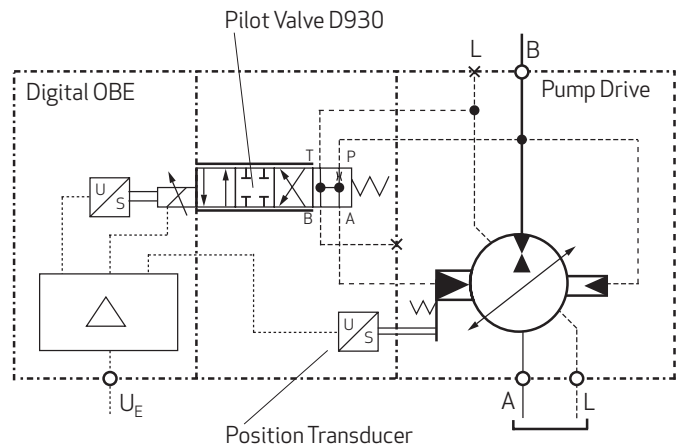
RKP-D WITH INTERNAL PRESSURE SUPPLY WITHOUT SEQUENCE MANIFOLD

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 loses control of the stroke ring position and the RKP-D goes for 100% flow.

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).



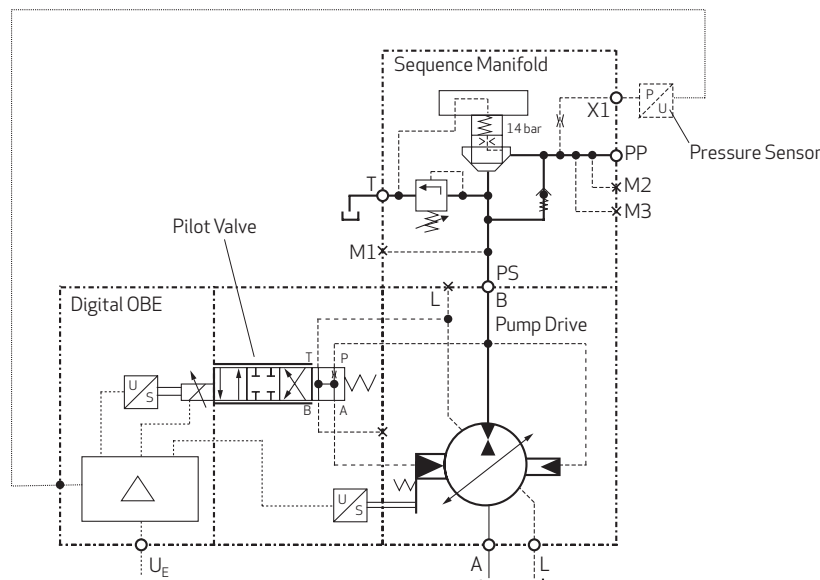
RKP-D WITH INTERNAL PRESSURE SUPPLY WITH SEQUENCE MANIFOLD

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_{max} -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 (200psi).



RADIAL PISTON PUMP WITH DIGITAL CONTROL (RKP-D)

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).

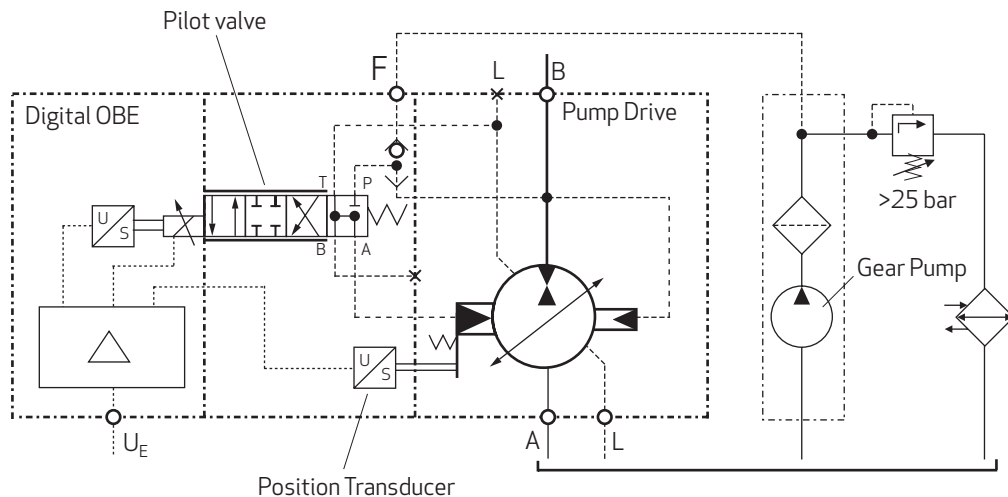
To achieve sufficient RKP-D performance at low system pressures, it is required to apply an additional constant displacement pump, which ensures a minimum control pressure level. A cost-saving solution to this problem is to use the cooling and filtration circuit for this purpose, as shown below.

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 ... 50 bar (363 ... 725 psi)
minimum displacement:
- RKP-D 19 ... 45 cm³/rev => V = 6 l/min (1.6 gpm)
- RKP-D 63 ... 100 cm³/rev => V = 12 l/min (3.1 gpm)
- RKP-D 140 cm³/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).



RADIAL PISTON PUMP WITH DIGITAL CONTROL (RKP-D)

CONFIGURATION SOFTWARE

GENERAL

The Windows®-based Moog Configuration Software enables fast and convenient commissioning, diagnostics, and configuration of the RKP-D. The software communicates with the RKP-D via the CANopen 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 CONFIGURATION SOFTWARE

The configuration software can be configured on a PC with the following minimal requirements:

- IBM compatible PC with 133 MHz
- Windows® 95/98/ME, Windows® 2000/XP
- 64 MB RAM
- 20 MB free hard disk memory
- Monitor 800 x 600 pixel resolution
- Keyboard, mouse, CD-ROM

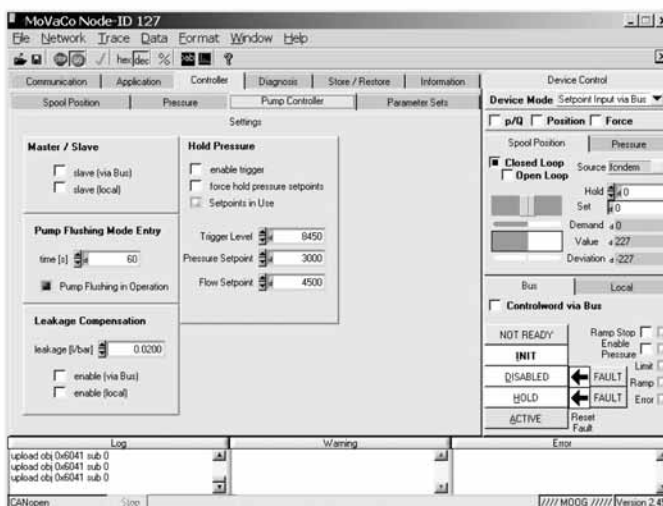
Recommended requirements:

- IBM compatible PC with 300 MHz
- Windows® 2000/XP

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
- Power supply 24V DC/2A (supply for RKP-D electronics)

Screenshot "Moog Configuration Software"



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



RADIAL PISTON PUMP WITH DIGITAL CONTROL (RKP-D)

COMMUNICATION STANDARD

ANALOG OPERATION

In the factory preset analog mode of operation, the RKP-D receives its set points for pressure (p) and flow (Q) as analog signals. Additionally, the user can take full advantage of the ability to alter parameter sets in mid-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

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

- Flow command signal 0 ... 10 V (factory set) or 4 ... 20 mA (software configurable)
- Pressure command signal 0 ... 10V (factory set) or 4 ... 20 mA (software configurable)
- Parameter set selection: 0 ... 10V

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

The Moog 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.

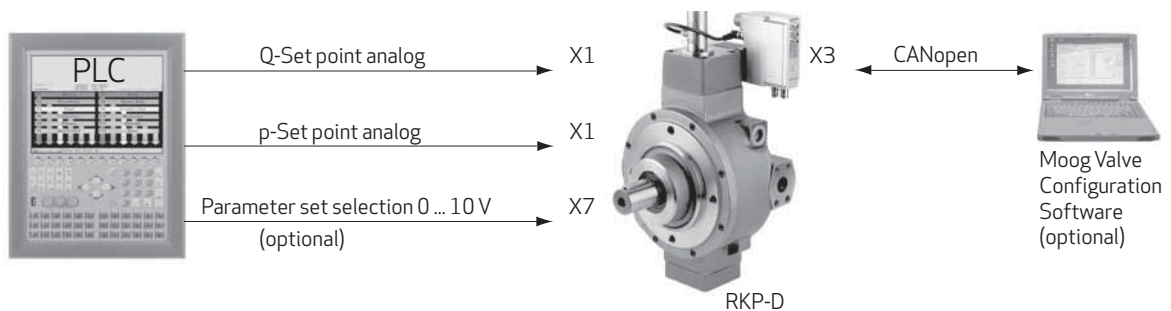
CAN-BUS DIGITAL OPERATION

In this software configurable CAN-bus mode, the RKP-D is parameterized, activated and monitored via the built-in CANopen-interface in accordance with international standards (CIA-standard DS408 device profile fluid power technology ISO 11898).

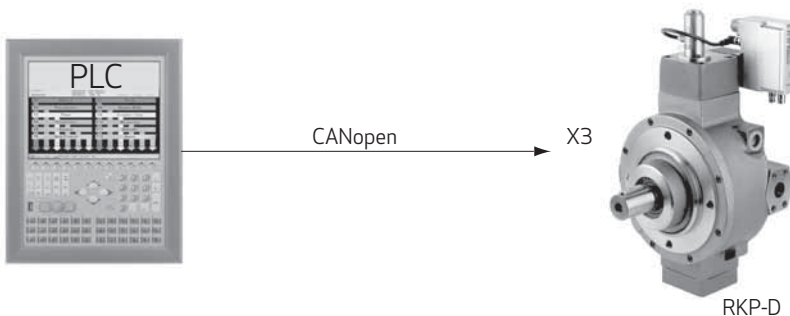
The CAN-communication of the RKP-D (including the individual pump stages of multiple pumps) is factory-set as follows: Node-ID = 127; Bitrate = 500 kbit/sec.

Please note that details are available in Moog CAN-bus Operating Manual.

Analog Actuation



CAN-bus Actuation



RADIAL PISTON PUMP WITH DIGITAL CONTROL (RKP-D)

PARAMETER SETS

PARAMETER SETS

The 16 parameter sets of the RKP are factory-set as indicated in the table below. In the factory preset analog condition these parameter sets can be selected by a 0 ... 10V-signal, applied at analog input X7 (see page 13 for electrical interfaces).

Parameter Set	Oil Volume	Control Mode	Operational Mode	Pressure Sensor	U at X7 ³⁾
1	0.1 liters	p/Q	Solo	Input X6	0 ... 1.5 V
2	2.5 liters	p/Q	Solo	Input X6	2.0 V
3	5.0 liters	p/Q	Solo	Input X6	2.5 V
4	7.5 liters	p/Q	Solo	Input X6	3.0 V
5	10.0 liters	p/Q	Solo	Input X6	3.5 V
6	12.5 liters	p/Q	Solo	Input X6	4.0 V
7	15.0 liters	p/Q	Solo	Input X6	4.5 V
8	20.0 liters	p/Q	Solo	Input X6	5.0 V
9	25.0 liters	p/Q	Solo	Input X6	5.5 V
10	30.0 liters	p/Q	Solo	Input X6	6.0 V
11	35.0 liters	p/Q	Solo	Input X6	6.5 V
12	40.0 liters	p/Q	Solo	Input X6	7.0 V
13	50.0 liters	p/Q	Solo	Input X6	7.5 V
14	p-regulator off	Q	Solo	-	8.0 V
15	0.1 liters	p/Q	Hybrid ¹⁾	Input X6	8.5 V
16	p-regulator off	Q	Solo (Slave) ²⁾	-	9.0 ... 10 V

1 liter = 0.264 gal (US)

- 1) Requires initial calibration of the hybrid flow-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.

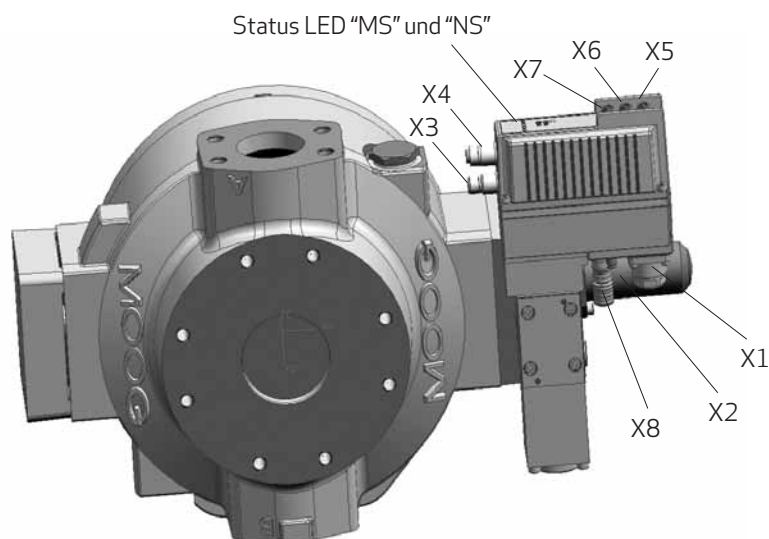
General comments:

The Moog Configuration Software allows users to modify the default settings according to individual requirements. In cases where X7 is not connected electrically, parameter set 1 is activated automatically. Step changes between different voltage levels must not exceed 1 ms.

RADIAL PISTON PUMP WITH DIGITAL CONTROL (RKP-D)

ELECTRICAL INTERFACES

DESIGNATION OF THE ELECTRICAL INTERFACES



No.	Description	Type
X1	Main Connector	11+PE
X2	Local CAN for Master/Slave operation (optional)	M8 x 1 3 pin
X3	CAN	M12x1 5 pin
X4	CAN	M12x1 5 slots
X5	Pressure Sensor 2	M8 x 1 4 slots
X6	Pressure Sensor 1	M8 x 1 4 slots
X7	Analog Parameter Set Selection	M8 x 1 4 slots
X8	Linear Variable Displacement Transducer (LVDT)	M12x1 5 slots

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

MODUL STATUS LED (MS)

The Module Status LED displays operational and error states.

Module status LED (MS)	Condition
off	no supply power
green	normal operation
blinking green	valve standby mode
blinking red	correctable error
red	unrecoverable error
blinking red-green	self-test

NETWORK STATUS LED (NS)

The network status LED displays the status of the CAN network.

Network status LED (NS)	Condition
off	no supply power / not online
blinking green	online, but not connected to other CAN bus nodes
green	online and connected to other CAN bus nodes
blinking red	time overrun
red	major error
blinking red-green	self-test

RADIAL PISTON PUMP WITH DIGITAL CONTROL (RKP-D)

ELECTRICAL INTERFACES

GENERAL REQUIREMENTS FOR PUMP ELECTRONICS

Supply	24 V DC, min. 18 V DC, max. 32 V DC
Shielding	<ul style="list-style-type: none">• All signal lines, including those applied in connection with external transducers, shielded• Shielding on power supply side connected radially to GND (0V) and connected to the mating connector housing (because of EMC)
EMC	Meets the requirements of emission: EN61000-4-4: 2001-10 and immunity: EN61000-6-2:1999
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	$\geq 0.75\text{mm}^2$ (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 earth potentials do not result in excessive ground currents. See also Moog Technical Note TN353.

COMMAND SIGNALS AND WIRING FOR RKP-D WITH ANALOG ACTIVATION

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 ($U_4 - U_5$) = + 10V equals 100% flow, whereas ($U_4 - U_5$) = 0V equals zero flow.

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). ($U_7 - U_5$) = + 10V equals 100% regulated pressure. ($U_7 - U_5$) = 0V 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% flow, whereas $I_4 = 4$ mA equals zero flow (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)

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 ... 100%) and the flow rate (-100% ... +100%) correspond to the output signal range of 2 ... 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) (see diagrams in page 15). 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 flow).

RADIAL PISTON PUMP WITH DIGITAL CONTROL (RKP-D)

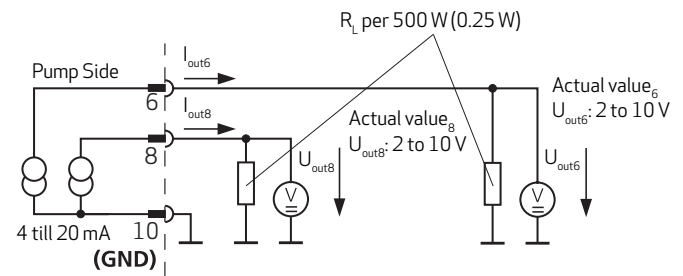
ELECTRICAL INTERFACES

Continuation:

Actual Value feedback signals 4 to 20 mA, ground related
(Note: Type of signal is fix 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 (stroke ring position) and I_8 (actual pressure) as voltage signals 2 ... 10 V:



WIRING FOR 11+PE POLE 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	$U_{in} = U_{4-5}$ $R_{in} = 20 \text{ k} \Omega$	$I_{in} = I_4 = -I_5$ (with $I_7 = 0$) ¹⁾ $R_{in} = 200 \Omega$
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	$U_{in} = U_{7-5}$ $R_{in} = 20 \text{ k} \Omega$	$I_{in} = I_7 = -I_5$ (with $I_4 = 0$) ¹⁾ $R_{in} = 200 \Omega$
8	Output ³⁾ Actual pressure	Voltage signal output: $U_{out} = 2$ bis 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)	
10	Supply ground	0 V (GND)	
11	Fault indication	Error control: $U < 0.5 \text{ V}$ ²⁾ means fault	
⊕	Protective conductor contact		

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 pos. 12).

Suitable Mating Connector 11+PE:
 Moog Order Code B97067-111

Important note:

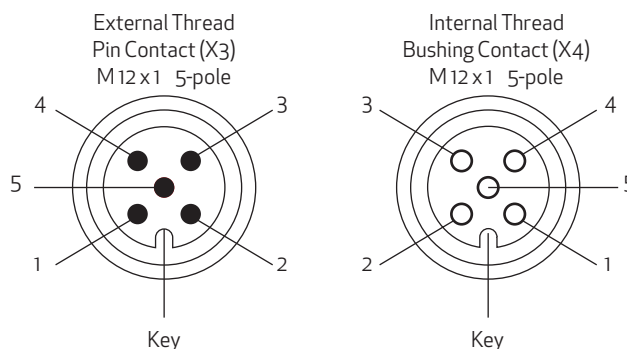
Only the use of specified mating connector (metall shell) in combination with proper shielding to meet the EMC requirements.

RADIAL PISTON PUMP WITH DIGITAL CONTROL (RKP-D)

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 PRESSURE SENSOR INPUTS (X5 AND X6)

Factory settings: sensor signal 0 ... 10 V; 4-wire-type

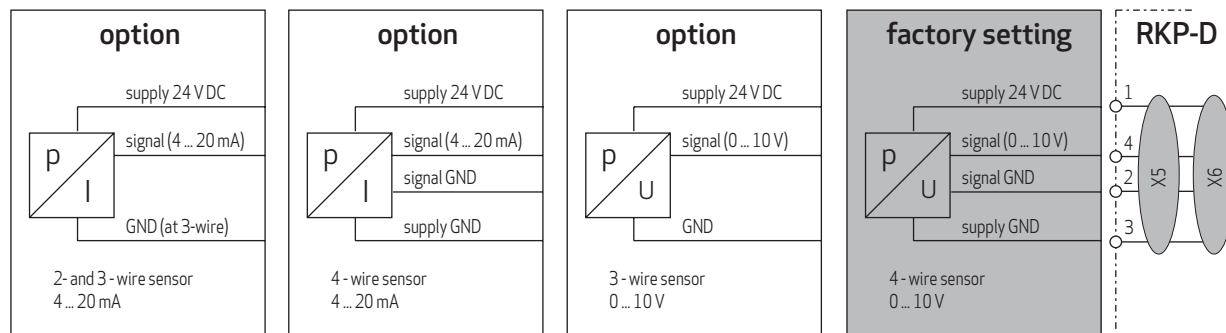
Pin	Signal
1	Supply 24 V DC
2	Signal GND
3	Supply GND
4	Pressure signal (0 ... +10 V or 4 ... 20 mA)

M8 x 1 / 4-pole



Front view on the cable

SUPPORTED TYPES OF PRESSURE SENSORS



Note: Each option requires adequate setting of the analog interface via the Moog Configuration Software

ANALOG PARAMETER SET SWITCHING (X7)

Factory settings: Differential input signal 0 ... 10 V

Pin	Signal
1	(Supply 24 V DC)
2	Signal ground
3	(Supply GND)
4	Signal (0 ... +10 V)

M8 x 1 / 4-pole



Front view on the cable

RADIAL PISTON PUMP WITH DIGITAL CONTROL (RKP-D)

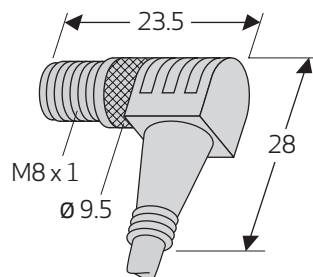
ELECTRICAL INTERFACES

MATE CONNECTOR WITH CONNECTION CABLE FOR INPUTS X5, X6, X7

Available from Moog or C. Escha Bauelemente GmbH

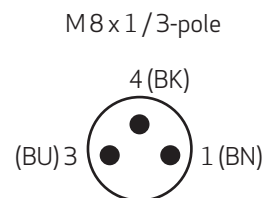
L = 2 m: Moog (Ordering No C72977-002) or Escha (Type 8028332)
 L = 5 m: Moog (Ordering No C72977-005) or Escha (Type 8028333)
 (IP65; 4 x 0.25 mm²; PUR; screened),
 not included in delivery of RKP-D.

Pin 1: brown (BN)
 Pin 2: white (WH)
 Pin 3: blue (BU)
 Pin 4: black (BK)



LOCAL-CAN CONNECTOR FOR MASTER-SLAVE COMBINATIONS X2

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

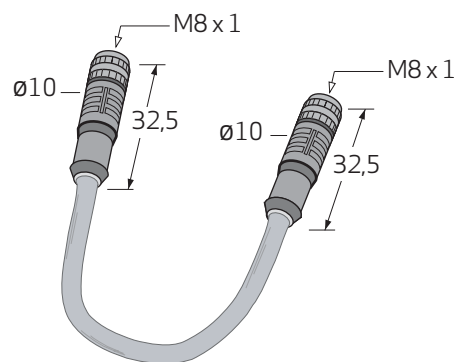


Front view on the cable

JUNCTION CABLE FOR MASTER-SLAVE COMBINATIONS X2

Available from Moog or C. Escha Bauelemente GmbH

L = 0.3 m: Moog (Ordering No C43395-001)
 or Escha (Type 8031233)
 (IP65; 3 x 0.25 mm²; PUR; screened),
 not included in delivery of RKP-D.



RADIAL PISTON PUMP WITH DIGITAL CONTROL (RKP-D)

ACCESSORIES

Position	Part Description	Comments	Part Number
1	Mating Connector 11+PE, EN175201, part 804	For X1	B97067-111
2	Mate Connector M8 with connection cable L = 2 m	For X5, X6, X7	C72977-002
3	Mate Connector M8 with connection cable L = 5 m	For X5, X6, X7	C72977-005
4	Connecting Cable Master-Slave L = 0,3 m	X2	C43395-001
5	USB-to-CAN-Interface Card	For usage with Moog Valve Configuration Software	C43094-001
6	CAN cable (Sub-D to M12)	For usage with Moog Valve Configuration Software	TD3999-137
7	Sequence Manifold	for Pump Size 19 cm ³ /rev	2517 430 601
8	Sequence Manifold	for Pump Sizes 32/45 cm ³ /rev	2517 430 602
9	Sequence Manifold	for Pump Sizes 63/80 cm ³ /rev	2517 430 603
10	Sequence Manifold	for Pump Sizes 100 cm ³ /rev	2517 430 604
11	Sequence Manifold	for Pump Sizes 140 cm ³ /rev	2517 430 605
12	Sequence Cartridge NG16 - 14 bar (200 psi)	for Pump Sizes 19/80 cm ³ /rev	XCB11555-000-00
13	DIN-Cover for Pos.12	for Pump Sizes 19/80 cm ³ /rev	XEB17695-000-01
14	Sequence Cartridge NG25 - 16 bar (230 psi)	for Pump Sizes 100/140 cm ³ /rev	XCB11557-000-00
15	DIN-Cover for Pos.14	for Pump Sizes 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 cm³ = 0.061 in³

RADIAL PISTON PUMP WITH DIGITAL CONTROL (RKP-D)

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 seven sizes ranging between 19 and 140 cm³/rev with options in design interface (e.g., mounting

flange arrangement, drive shaft and ports), operating fluid (e.g., mineral oil, fire resistant HF fluid and cutting emulsions) and control principle.

EXAMPLE

Pos. No.	1		2	3	4			
Drive	HP	-	R	18	B1	-		
Pos. No	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

Pos.	Drive			
	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		

Pos.	Sym.	Drive
1	HP HZ	Code Hydraulic Pump Pump with special features
2	R L	Rotations Clockwise, looking at drive shaft Counterclockwise, looking at drive shaft
3	18	Speed max. speed for low noise operation or rated speed for power controlled pumps e.g. 18 = n = 1800 min ⁻¹
4	A1 B1 A7 B7 C3 D3 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 DIN ISO 3019/2 (metric) Spline according to DIN 5480, 4 holes ISO flange according to DIN ISO 3019/2 (metric) Straight key according to SAE 744 C, 2/4 holes SAE-flange according to DIN ISO 3019/1 (inch) Spline according to SAE 744 C (ISO 3019/1), 2/4 holes SAE-flange according to DIN ISO 3019/1 (inch) Intermediate flange RKP/RKP

RADIAL PISTON PUMP WITH DIGITAL CONTROL (RKP-D)

MODEL CODE

Pos.	Sym.	Radial Piston Pump
5	RKP AZP DS1	<p>Pump type</p> <p>Radial piston pump, variable displacement Moog gear pump with SAE-A and SAE-B flange</p> <p>Attachment of other pumps</p> <p>Heavy-duty through-drive for RKP attachment and adapter flange for SAE-A and SAE-B</p>
6	019 032 045 063 080 100 140 005 008 011 016 019 023 031 033 044 050	<p>Displacement RKP-II</p> <p>19 cm³/rev 32 cm³/rev 45 cm³/rev 63 cm³/rev 80 cm³/rev 100 cm³/rev 140 cm³/rev</p> <p>Displacement and attachment flange of Moog gear pumps (AZP)</p> <p>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</p>
7	K T S H R	<p>Pump ports</p> <p>Medium pressure serie (up to 280 bar/4000 psi) pump sizes 32, 45, 63 und 80 cm³/rev Medium pressure serie (up to 280 bar/4000 psi) pump sizes 100 and 140 cm³/rev High pressure serie (up to 350 bar/5000 psi) pump sizes 32, 63 and 80 cm³/rev Medium pressure serie (up to 280 bar/4000 psi) pump size 19 cm³/U High pressure serie (up to 350 bar/5000 psi) pump size 19 cm³/U German 4 bolt flange (only for gear pumps), metrical threads</p>
8	M A B C D E	<p>Operating fluid</p> <p>Mineral Oil HFA (oil in water) HFB (oil in water) HFC (water glycol) HFD (synthetic esther) Cutting Emulsion</p>
9	28 35	<p>Operating pressure</p> <p>Maximum operating pressure e.g. = 280 bar = 28 Maximum operating pressure e.g. = 350 bar = 35</p>

RADIAL PISTON PUMP WITH DIGITAL CONTROL (RKP-D)

MODEL CODE

Pos.	Sym.	Radial Piston Pump
10		Control/Compensators
	D1	RKP-D (electro-hydraulic control with digital on-board electronics), analog or digital activation and internal pressure supply
	D2	RKP-D (electro-hydraulic control with digital on-board electronics), analog or digital activation and external pressure supply
	D3	RKP-D with external pressure supply, useable for hybrid operation
	D4	RKP-D with internal pressure supply, useable for hybrid operation
	D5	RKP-D with internal pressure supply useable for master/slave operation
	D6	RKP-D with external pressure supply useable for master/slave operation
	D7	RKP-D with external pressure supply useable for master/slave and hybrid operation
	D8	RKP-D with internal pressure supply useable for master/slave and hybrid operation
	TP	At gear pump only
11		Additional equipment
	Z	No Accessories
	Y	Limitation of max volume flow
	0	At gear pump only
12		Additional information
	00	Actual output 4 ... 20 mA
	01	Actual output 2 ... 10 V
		At double gear pump: Displacement of second gear pump stage
	05	5 cm ³ /rev
	08	8 cm ³ /rev
	11	11 cm ³ /rev
	16	16 cm ³ /rev
	19	19 cm ³ /rev
	23	23 cm ³ /rev
	31	31 cm ³ /rev
	33	33 cm ³ /rev
	44	44 cm ³ /rev
50	50 cm ³ /rev	

RADIAL PISTON PUMP WITH DIGITAL CONTROL (RKP-D)

CONVERSION TABLE

GENERAL CONVERSION TABLE

1 bar	=	14.5038 lb/in ² (PSI)
1 PSI	=	0.0689 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 Liter	=	0.26417 gal (US) = 61.024 in ³
1 gal (US)	=	3.7854 Liter [l] = 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	=	0.5556 °C
1 °C	=	1.8 °F
		(°F-32) x 0.5556 = °C
		(°C/0.5556) + 32 = °F
0 °F	=	-17.778 °C
0 °C	=	32 °F
100 °F	=	37.778 °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

KINEMATIC VISCOSITY

1 mm ² /s	=	1 cSt = 0.00155 in ² /s
1 in ² /s	=	645.16 cSt = 645.16 mm ² /s

CALCULATION OF POWER CONSUMPTION OF A PUMP

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

P [kW]

p [bar]

Q [l/min]

η [%]

Example: RKP 63 cm³/rev, 280 bar, 1450 rpm:

p = 280 bar

Q = (63 x 1,450) = 91,3 l/min

η = 95 %

P = 280 x 91,3 / (6 x 95)

P = 45 kW

CALCULATION OF DRIVE TORQUE

$$M = \frac{1,59 \times V \times p}{\eta}$$

M [Nm]

V [cm³/U]

p [bar]

η [%]

Example: RKP 63cm³/rev, 280 bar:

V = 63 cm³/U

p = 280 bar

η = 95 %

M = 1,59 x 63 x 280 / 95

M = 295 Nm

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

RADIAL PISTON PUMP WITH DIGITAL CONTROL (RKP-D)

GLOBAL SUPPORT

GLOBAL SUPPORT

As a recognized leader in motion control technologies, Moog offers a full range of services to support our products and ensure that they meet the expectations of customers. Moog experts are the best at helping customers select the right products and ensuring that they run reliably for a long time. When it is time for new machine commissioning, refurbishment or routine maintenance, our engineers can help to optimize machine performance, minimize downtime and ensure the smooth application of our products.

Known for the ability to customize products for the unique needs of our customers, we are uniquely able to handle customer needs and supply services throughout the life cycle of the product. **Moog Authentic Repair**® is designed to provide the highest quality repair services using original equipment parts, the latest design specifications, and highly trained technicians. This ensures that our repaired products will run as well as when they were new.

With facilities in over 25 countries, Moog is committed to offering convenient local service to our customers.

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