Installation and setup manual
Electro-hydraulic control for serie PVplus
Pump design series 44-45-46, compensator design series 45
Effective: March 1st, 2017
Supersedes: July 1st, 2015

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Setup manual for electro hydraulic proportional controls for axial piston pumps, PV family

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Notes:
The compensator / control ordering codes shown represent the last three digits in the pump ordering code (digits 13 to 15).
1. Table of available electro hydraulic controls

<table>
<thead>
<tr>
<th>Code</th>
<th>Control designs</th>
</tr>
</thead>
<tbody>
<tr>
<td>FDV</td>
<td>closed loop displacement control with <strong>PVCMD1FB</strong>* valve, no pressure compensation, standard design from 07.2015</td>
</tr>
<tr>
<td>FPU</td>
<td>closed loop displacement control with <strong>PVCF*PV</strong> Ventil, keine Druckregelung, standard design up to 06.2015</td>
</tr>
<tr>
<td>UDP</td>
<td>closed loop displacement control with <strong>PVCMD1FB</strong>* valve, with pressure compensation, standard design from 07.2015</td>
</tr>
<tr>
<td>UPU</td>
<td>closed loop displacement control with <strong>PVCF*PV</strong> valve, with pressure compensation, standard design up to 06.2015</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Option</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>R</td>
<td>pilot operated pressure control, NG6 interface</td>
</tr>
<tr>
<td>K</td>
<td>as option R, additional proportional pressure valve <strong>PVACRE</strong>*K** mounted</td>
</tr>
<tr>
<td>M</td>
<td>as option K, additional pressure sensor <strong>PVACMS</strong> mounted for closed loop pressure control</td>
</tr>
<tr>
<td>P</td>
<td>pilot operated pressure control, NG6 interface, for pre load and quick unload manifold</td>
</tr>
<tr>
<td>F</td>
<td>as option P for pre load and quick unload manifold, additional <strong>PVACMS</strong> and <strong>PVACRE</strong>*K** mounted for closed loop pressure control</td>
</tr>
<tr>
<td>S</td>
<td>pilot operated pressure control, NG6 interface, for quick unload manifold</td>
</tr>
<tr>
<td>Q</td>
<td>as option S for quick unload manifold, additional <strong>PVACMS</strong> and <strong>PVACRE</strong>*K** mounted for closed loop pressure control</td>
</tr>
</tbody>
</table>

2. Proportional displacement control, code ...FDV (old: FPV)

**FDV Function description**

The proportional displacement control allows a continuous variation of the pump displacement according to an electrical input command. An inductive position transducer (LVDT) measures the position of the servo piston and provides an information on the actual displacement (signal, displacement) to the control electronic. The servo piston is kept by the servo spring and the pump outlet pressure on its annulus area at maximum displacement. The larger piston area is pressurized by the control valve. Figure 2 and 3 show the circuit diagram of a pump with this control.

![pQ Diagram ...FDV (old:FPV)](image-url)
The control valve contains a control spool, which is moved by two proportional solenoids. The valves hydraulic neutral point is given by the electronic control module. According to the area ratio of the servo piston, the control pressure $p_A$ is approximately 25% of the pump outlet pressure $p_1$.

Solenoid A is driven by the electronic module for a flow command of 100%. The spool connects thereby port A with the pump housing (Port T). The oil out of the large piston area drains off, the pump is swashing to maximum displacement. Solenoid B is activated in case of 0% flow command. The pump outlet pressure $p_1$ on the large servo piston area downstrokes the pump to minimum displacement. This requires a pump outlet pressure $p_1$ of at least 20 bar.

If this pressure cannot be maintained, special arrangements for a proper displacement control are required (please refer to chapter 4 and 5). Without an appropriate load pressure the pump will stay at full displacement.

The ordering code for a single control valve is: PVCMD1FB*** the first * indicates the mounting option (with interface plate / elbow manifold). The two * at the end indicate seal option and screws option (For details please see the compensator spare parts list PVI-PVC).
FPV - Function

The control valve contains a control spool, which is moved by a spring and a proportional solenoid into its control position. The control spool provides a pressure divider circuit in combination with the control orifice BD2 between control port A and return port L. This pressure divider circuit controls the pressure pA. According to the area ratio of the servo piston, the control pressure pA is approximately 25% of the pump outlet pressure p1.

At nominal current to the solenoid (1.3 A) the control spool is moved against the spring and connects control port A with the pump case (port T). The pump is working with full displacement, set by the displacement adjustment screw. At no current to the solenoid the control spool is moved by the spring against the solenoid and connects control port A with the pump outlet. The pump outlet pressure p1 on the large servo piston area downstrokes the pump to minimum displacement. This requires a pump outlet pressure p1 of at least 15 bar. If this pressure cannot be maintained, special arrangements for a proper displacement control are required (see chapter 4 and 5). Without an appropriate load pressure the pump will stay at full displacement.

The ordering code for a single control valve is: **PVCMPV**
The first * indicates the pump size:
- A stands for PV016 - PV046
- C stands for PV063 - PV092
- E stands for PV140 – PV360

The two * at the end indicate seal option and screws option (details see compensator spare parts list PVI-PVC).

Electronic module PQDXXA-Z10 – Function

To control the proportional solenoid the electronic module **PQDXXA-Z10** is offered. This module is able to control all PV sizes and all control option described in the following manual. Figure 4 shows this module from the outside, figure 5 the electronic control circuit.
The modules are designed for snap track mounting according to EN 50022. They require a power supply of 18 - 30 VDC. The module is connected to the LVDT (displacement feedback) and to the proportional solenoid of the displacement control valve according to the diagrams in chapter 9. A detailed functional description of the module and a installation instruction is given in Bulletin HY30-3255-INST/UK.

The electronic module provides a ramp function for soft approach to different working conditions. Beside that the working range of the pump can be individually adjusted. It also provides diagnosis signals to monitor pump and module functions. Both proportional displacement controls FDV and FPV do not include a pressure control / compensation. The hydraulic circuit has to be protected with a pressure relief valve, to avoid damage to the system by too high pressures.

**Figure 4: Electronic module PQDXXA-Z10**

**Circuit diagram**

- Displacement cmd. ($Q_{cmd}$) 0...+10 V or 4...20 mA
- Connect to terminal 11, 0 V
- Displacement transducer, 4...9 V
- Horse power command ($L_{cmd}$) 0...+10 V or 0
- Pressure command, ($p_{cmd}$) 0...+10 V or 4...20 mA
- Pressure transducer 0...+10 V or 4...20 mA
- 0 V
- Enable ramp, 24 V nominal
- Enable p/Q-control, 24 V nominal
- Enable power amplifier, 24 V nom.

**Figure 5: Circuit diagram for electronic module PQDXXA-Z10**
3. Proportional displacement control with pressure compensation, codes ...UDR, ...UDK (old: UPR, UPK)

The compensator codes ...UDR (PVCMD1FBU** + open NG6 pattern) / UPR (PVCM*PV** + open NG6 pattern), ...UDK (PVCMD1FBU** + PVACRE***K**) / UPK (PVCM*PV** + PVACRE***K**) include a pressure compensation, which can override the proportional displacement control. This is achieved by combining a second control valve (remote pressure compensator) with the displacement control valve. Figure 6 and figure 7 show the hydraulic circuit of the UDK and UPK.

Displacement control
Code PVCMD1FBU**

Pressure compensator
Stage, Code PVCM*U2**

Proportional pressure pilot valve, Code PVACRE***K**
(not included with code ...UPR)

Figure 6: Hydraulic Circuit of the ...UDR, ...UDK control

\[
\begin{align*}
X_Q & = \text{signal, displacement} \\
I_{Q:A} & = \text{solenoid current A, displacement control valve} \\
I_{Q:B} & = \text{solenoid current B, displacement control valve} \\
I_P & = \text{solenoid current, pressure pilot valve} \\
W_Q & = \text{command, displacement} \\
W_P & = \text{command, pressure}
\end{align*}
\]
Figure 7: Hydraulic circuit of the ...UPR, ...UPK control

- $X_Q$ = signal, displacement
- $I_{Q:A}$ = solenoid current, displacement control valve
- $I_P$ = solenoid current, pressure pilot Valve
- $W_Q$ = command, displacement
- $W_P$ = command, pressure
The position of the control spool of the pressure compensator is controlled by the pressure drop across the pilot orifice Bp and by the compensator spring. The nominal control pressure difference is factory-set to a value of 15 ± 1 bar.

As long as the pressure setting of the pilot valve (in figures 6 and 7: proportional pressure valve PVACRE***K**) is not yet reached, the control valve spring keeps the control spool in the position shown. The control port of the displacement control valve is connected to the large servo piston area and controls the position of the servo piston.

The displacement control operates as described in chapter 2. The adjustment of the control pressure is done between the control spool and control orifice D_B1.

When the set pressure of the pilot valve is reached, this valve opens and control flow from the pump outlet is passing the pilot orifice Bp and the pressure pilot valve before returning to the pump drain line. That creates a pressure drop across pilot orifice Bp. If this pressure drop reaches the 15 bar setting of the compensator, the control spool of the pressure stage is in its control position.

That leads to a reduction of the pump displacement in order to keep the pump outlet pressure constant. As the displacement control wants to keep the pump at the set displacement the proportional solenoid is powered with nominal current. That connects the control port of the displacement control valve with the pump case (port T).

The control spool of the pressure stage now controls the servo piston position by using the control orifice B_D2 for pressure dividing. Pressure control is achieved as with a standard remote compensator. It is mandatory, that the displacement setting of the displacement control stage is high enough, to cover the flow requirements of the system, the pump and the control valves to maintain the desired pressure.

The following valve is to be used with this module: PVACRE***K**. Other valve models can lead to instability problems or malfunction of the control. This valve is designed for a nominal pressure of 350 bar. By using the MAX adjustment at the control module, the input command range can easily be adjusted to any smaller nominal system pressure. In this way also for these lower pressures full resolution of the input command can be achieved. For basic adjustment of the control valves and the LVDT see chapter 10. For electrical connection and cable requirements see chapter 11.

Note: Parker has decided for this design with a separate hydraulic-mechanically operated remote pressure compensator, which overrides the proportional displacement control for three reasons:
1. Piston pumps of the PV series have a large servo piston. That offers several advantages. On the other hand the servo piston has a high flow demand for compensation. A hydraulic mechanical pressure compensator - as used here - can provide much higher control flows, than a proportional directional control valve used by other pump models, where this valve also provides pressure control basing of the signal of a pressure transducer.
2. The hydraulic-mechanical control valve „senses“ a pressure peak in the system, as the pressure acts direct on the control spool. Depending on the actual system pressure very high forces are available to operate the spool. Therefore this control rarely will tend to stick or malfunction, as proportional directional control valves may do under contaminated fluid conditions.
3. The pressure control using a proportional pressure control valve to pilot it, does not require a pressure sensor at the pump outlet. Nevertheless a closed loop pressure control can be offered if required (see next chapter).
4. Proportional displacement control with closed loop pressure control, code ...UDM (old: UPM)

With compensator ordering code ...UDM / UPM a pressure sensor and a proportional pressure valve is combined with the remote pressure control stage. That realizes a closed loop pressure control. It also offers the option of an electronic horse power limitation. The hydraulic circuit for these control option are shown in figure 8 and 9. The pressure sensor included in the shipment is of the Parker model PVACMS (SCP01-600-24-06). Also included in the shipment is a proportional pressure pilot valve of the ordering code PVACRE***K**. The hydraulic function is described in the recent chapter. There are no differences except the pressure sensor.

![Hydraulic Circuit Diagram](image)

**Figure 8:** Hydraulic Circuit of ...UDM control

- \(X_Q\) = signal, displacement
- \(I_{Q:A}\) = solenoid current A, displacement control valve
- \(I_{Q:B}\) = solenoid current B, displacement control valve
- \(X_P\) = signal, pressure
- \(I_P\) = solenoid current, pressure pilot Valve
- \(W_Q\) = command, displacement
- \(W_P\) = command, pressure
**Figure 9:** Hydraulic circuit of the ...UPM control

- $X_Q$ = signal, displacement
- $I_Q:A$ = solenoid current, displacement control valve
- $X_P$ = signal, pressure sensor
- $I_P$ = solenoid current, pressure pilot valve
- $W_Q$ = command, displacement
- $W_P$ = command, pressure
As shown in figures 8 and 9, the pressure sensor is positioned in the pilot circuit. According to the differential pressure adjusted at the compensator valve, the system pressure is higher than the controlled pressure.

This concept avoids stability problems with the control loop and the necessity of an external adjustment of the control loop. On the other hand there are additional measures necessary (e.g.: command signal correction), if linearity between input (command signal) and output (system pressure) is required.

Figure 10 shows the typical behaviour of pilot pressure $p_R$ and system pressure $p_1$ as function of the input signal.

The digital control module offers the required signal correction to compensate for this effect. The standard module parameter sets already include this feature for the factory set pressure differential of 15 bar.

For other differential settings see module operating instructions.

**Figure 10:** Pressures vs input signal

$p_1 =$ pressure at pump outlet, system pressure ($= p_P + \Delta p$)

$\Delta p =$ compensator differential (factory setting 15 bar)

$p_P =$ pressure at pilot valve, closed loop controlled pressure
5. Preload valve for proportional controlled pumps, code PVAPVV...

As already mentioned in chapter 1, a proportional controlled variable displacement pump needs always a minimum outlet pressure of approx. 20 bar, to down stroke the pump against the servo spring force.

In some applications and especially at small displacement settings that is not always given. Two possibilities to solve this issue are described in the following chapters:

If an external auxiliary pressure is available, this can be used to control the pump at low outlet pressure. This method is explained in chapter 6.

The other option is the use of a preload valve (sequence valve).

Figures 11 and 12 are showing the hydraulic circuit of a pump with ...UPR control, using a preload valve. The preload valve is offered as a manifold, that can directly be flanged to the pressure port of the pump. The ordering code is PVAPVV*. The * stands for the frame size of the pump, the screw option and the seal material.

The preload valve is also available as slip in cartridge valve according to DIN 24 342.

Because of the pilot valve characteristic the opening pressure p1 is approx. 20 bar. The port Mp1 can be used to get under all working conditions a pressure of 20 bar e.g. to pilot valves with external pilot pressure supply. At approx. 25 bar system pressure the valve is fully open (pressure drop < 1 bar).

**Figure 11:** Schaltschema des ...UDK Reglers mit Vorspannventil

- **XQ** = signal, displacement
- **IQ:A** = solenoid current A, displacement control valve
- **IQ:B** = solenoid current B, displacement control valve
- **XP** = signal, pressure sensor
- **IP** = solenoid current, pressure pilot Valve
- **WQ** = command, displacement
- **WP** = command, pressure
Figure 12: Hydraulic circuit of a pump with ...UPR control and preload valve

$X_Q =$ signal, displacement  
$I_{Q:A} =$ solenoid current A, displacement control valve  
$X_P =$ signal, pressure sensor  
$I_P =$ solenoid current, pressure pilot valve  
$W_Q =$ command, displacement  
$W_P =$ command, pressure

preload valve, code: PVAPVV*
Figure 13 shows the preload manifold for direct mounting to the pressure port of the pump. It takes screws with the length L to mount it to the pump. L includes the length screwed into the pump end cover.

**Note:** All auxiliary manifolds can also be supplied in US version (UNC threads and UNF ports) and with ports according to ISO 6149

Figure 13: Outside view of the preload manifold for direct pump mounting. Outlet optional to front (shaft side) or to the rear

Table 1: Main dimensions - preload manifold

<table>
<thead>
<tr>
<th>dimension</th>
<th>BG1</th>
<th>BG2</th>
<th>BG3</th>
<th>BG4</th>
<th>BG5</th>
<th>BG6*</th>
</tr>
</thead>
<tbody>
<tr>
<td>H [mm]</td>
<td>100</td>
<td>100</td>
<td>110</td>
<td>110</td>
<td>120</td>
<td>120</td>
</tr>
<tr>
<td>B [mm]</td>
<td>90</td>
<td>90</td>
<td>100</td>
<td>100</td>
<td>125</td>
<td>125</td>
</tr>
<tr>
<td>T [mm]</td>
<td>80</td>
<td>80</td>
<td>92</td>
<td>92</td>
<td>105</td>
<td>105</td>
</tr>
<tr>
<td>L [mm]</td>
<td>102</td>
<td>102</td>
<td>122(119*)</td>
<td>122(119*)</td>
<td>136</td>
<td>136</td>
</tr>
<tr>
<td>T1 [mm]</td>
<td>116</td>
<td>116</td>
<td>137</td>
<td>137</td>
<td>155</td>
<td>155</td>
</tr>
<tr>
<td>for size</td>
<td>PV016 - 028</td>
<td>PV032 - 046</td>
<td>PV063 - 092</td>
<td>PV140 - 180</td>
<td>PV270</td>
<td>PV360</td>
</tr>
<tr>
<td>DN [mm]</td>
<td>19 (3/4&quot;)</td>
<td>25 (1&quot;)</td>
<td>32 (1 ¼&quot;)</td>
<td>32 (1 ¼&quot;)</td>
<td>38 (1 ½&quot;)</td>
<td>38 (1 ½&quot;)</td>
</tr>
<tr>
<td>PN [bar]</td>
<td>400</td>
<td>400</td>
<td>400</td>
<td>400</td>
<td>400</td>
<td>400</td>
</tr>
<tr>
<td>M</td>
<td>M10</td>
<td>M12</td>
<td>M12 (M14*)</td>
<td>M12 (M14*)</td>
<td>M16</td>
<td>M16</td>
</tr>
<tr>
<td>Q_nominal [l/min]</td>
<td>160</td>
<td>160</td>
<td>300</td>
<td>300</td>
<td>550</td>
<td>550</td>
</tr>
</tbody>
</table>

*1) optional for PV063 - PV180, thread option 4; 2) L = clamping length for screws M

*2) for BG6 PV 360 the preload manifold of BG5 is used
6. External pilot pressure supply

The alternative solution is, to supply the control circuit from an external auxiliary pilot pressure supply circuit. The servo system is disconnected from the pump outlet (plug inside of the pump gage port). The pump outlet pressure is connected via a check valve to the pilot pressure port. An external source for auxiliary power (capable of a flow of 20 - 40 l/min (depending on pump size) at a pressure of 20 - 30 bar) is also connected via a check valve to the pilot port. Figure 9 shows the hydraulic circuit for this option.

As long as the pump outlet pressure is lower than the external supply pressure, the control circuit is powered by the external source. When the system pressure exceeds the auxiliary pressure, the control is internally pressurized.

Please note:
- for pressures below the auxiliary pressure a pressure control is not possible, because the control senses the supply pressure.
- using this option the pump can be operated at 0 bar and dead head. Under these conditions the pump does not provide drain flow and the pump can overheat. Case flushing is necessary.

Figure 14: Hydraulic circuit of a pump with external pilot pressure supply

\[ X_Q = \text{signal, displacement} \]
\[ I_{Q:A} = \text{solenoid current A, displacement control valve} \]
\[ X_P = \text{signal, pressure sensor} \]
\[ I_P = \text{solenoid current, pressure pilot valve} \]
\[ W_Q = \text{command, displacement} \]
\[ W_P = \text{command, pressure} \]
7. Quick pressure relief with quick unload valve, code PVAPSE* in combination with controls codes ...UPS resp. ...UPQ

When working with proportional pressure controlled pumps, the system pressure does not follow immediately the input signal when switching to a lower pressure setting. Reason for this is, that a pump can supply flow but cannot take flow to relieve a system. To decrease the pressure in a system, compression volume has to be taken away in order to reduce the pressure. A pump only can be down stroked to deadhead and pressure can only decrease due to leakage and pilot power requirements. That can take up to several seconds.

A direct mounted unload valve, Code R5V* (complete code, technical parameter and dimensions on request) solves this issue.

Figure 15 and 16 showing the hydraulic circuit of a pump with p-Q control and the quick unload valve. A 2-way SAE port mounted valve is inserted into the pilot line to the pressure compensator stage. The pilot flow to the proportional pressure pilot valve has to pass two orifices in the poppet and in the cover of this valve. The poppet is kept closed with a 9-bar-spring.

The pressure compensator stage has in this case not the control spool with the internal pilot orifice (Bp), because pilot flow is now supplied externally through the quick unload poppet. The ordering code for this compensator is PVCM*US**.

Figure 15: Hydraulic circuit of the ...UDS control with quick unload valve

- \( X_Q \) = signal, displacement
- \( I_Q:A \) = solenoid current A, displacement control valve
- \( I_Q:B \) = solenoid current B, displacement control valve
- \( X_P \) = signal, pressure sensor
- \( I_P \) = solenoid current, pressure pilot valve
- \( W_Q \) = command, displacement
- \( W_P \) = command, pressure
Figure 16: Hydraulic circuit of an ...UPS control with quick unload valve manifold

\[ X_Q = \text{signal, displacement} \]
\[ I_{Q:A} = \text{solenoid current A, displacement control valve} \]
\[ X_P = \text{signal, pressure sensor} \]
\[ I_P = \text{solenoid current, pressure pilot valve} \]
\[ W_Q = \text{command, displacement} \]
\[ W_P = \text{command, pressure} \]
8. Preload and quick unload manifold PVAPVE* in combination with compensator codes ...UPP resp. ...UPF

The pump accessory manifold code PVAPVE* combines preload and quick unload function.

This manifold is flanged direct to the pressure port of a PV pump. For functional description see the last chapters.

To ensure a correct function under all working conditions and to control immediately the load pressure, the control pressure has to be taken after the preload valve.

Sensing area of the control spool and spring chamber are both to be connected by pipe or hose to the control ports of this manifold. The hydraulic circuit diagrams in figure 17 and figure 18 display this. Both functions are built into one manifold. Figure 19 shows this manifold and table 3 lists the main dimensions.

The dimension L indicates the total length of the mounting bolts and includes the length screwed into the pump end cover.

The hydraulic connections between manifold and pump compensator (ps and pp) are not included in the pump shipment.

---

**Figure 17**: Hydraulic circuit of the ...UDP control with pre-load and quick unload manifold

- $X_Q$ = signal, displacement
- $I_{Q:A}$ = solenoid current A, displacement control valve
- $I_{Q:B}$ = solenoid current B, displacement control valve
- $X_P$ = signal, pressure sensor
- $I_P$ = solenoid current, pressure pilot valve
- $W_Q$ = command, displacement
- $W_P$ = command, pressure
Figure 18: Hydraulic circuit of the ...UPP control with preload and quick unload manifold

\[ X_Q \] = signal, displacement
\[ I_{Q,A} \] = solenoid current A, displacement control valve
\[ X_P \] = signal, pressure sensor
\[ I_P \] = solenoid current, pressure pilot valve
\[ W_Q \] = command, displacement
\[ W_P \] = command, pressure
Electro hydraulic proportional controls version 45 for axial piston pumps, PV series

Pump & Motor Division Europe
Chemnitz, Germany
Installation and setup manual
Bulletin HY30-3254-INST/UK

Max. pressure pilot valve
Flange ports ISO6162; DN, PN; fit to PV, frame size BG; thread M
Preload valve, insert DIN E NG1

Cover and insert DIN E NG2 quick unload valve

Return port TE, thread G

Alternative outlet port P2, thread G2

Also available in US-version (UNC threads and UNF ports) and with ports according to ISO 6149

Gage port MpS, system pressure, G1/4"
Port p system pressure, G1/4"
Port p, pilot pressure, G1/4"

Figure 19 Preload and quick unload manifold

Table 3: Main dimensions of the preload and quick unload manifold

<table>
<thead>
<tr>
<th>dimension</th>
<th>BG1</th>
<th>BG2</th>
<th>BG3</th>
<th>BG4</th>
<th>BG5</th>
<th>BG6*</th>
</tr>
</thead>
<tbody>
<tr>
<td>B[mm]</td>
<td>125</td>
<td>150</td>
<td>157</td>
<td>157</td>
<td>190</td>
<td>190</td>
</tr>
<tr>
<td>H[mm]</td>
<td>105</td>
<td>130</td>
<td>130</td>
<td>130</td>
<td>154</td>
<td>154</td>
</tr>
<tr>
<td>T[mm]</td>
<td>80</td>
<td>80</td>
<td>92</td>
<td>92</td>
<td>105</td>
<td>105</td>
</tr>
<tr>
<td>L[mm]</td>
<td>105</td>
<td>103</td>
<td>121</td>
<td>121</td>
<td>137,5</td>
<td>137,5</td>
</tr>
<tr>
<td>B1[mm]</td>
<td>189</td>
<td>189</td>
<td>196</td>
<td>196</td>
<td>239</td>
<td>239</td>
</tr>
<tr>
<td>H1[mm]</td>
<td>166</td>
<td>166</td>
<td>166</td>
<td>166</td>
<td>199</td>
<td>199</td>
</tr>
<tr>
<td>T1[mm]</td>
<td>116</td>
<td>116</td>
<td>137</td>
<td>137</td>
<td>155</td>
<td>155</td>
</tr>
<tr>
<td>for size</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DN[mm]</td>
<td>19 (3/4&quot;)</td>
<td>25 (1&quot;)</td>
<td>32 (1 ¼&quot;)</td>
<td>32 (1 ¼&quot;)</td>
<td>38 (1 ½&quot;)</td>
<td>38 (1 ½&quot;)</td>
</tr>
<tr>
<td>PN[bar]</td>
<td>400</td>
<td>400</td>
<td>400</td>
<td>400</td>
<td>400</td>
<td>400</td>
</tr>
<tr>
<td>M</td>
<td>M10</td>
<td>M12</td>
<td>M12 (M14*)</td>
<td>M12 (M14*)</td>
<td>M16</td>
<td>M16</td>
</tr>
<tr>
<td>valve insert NG1</td>
<td>DIN E16</td>
<td>DIN E16</td>
<td>DIN E25</td>
<td>DIN E25</td>
<td>DIN E32</td>
<td>DIN E32</td>
</tr>
<tr>
<td>Qnominal[l/min]</td>
<td>160</td>
<td>160</td>
<td>300</td>
<td>300</td>
<td>550</td>
<td>550</td>
</tr>
<tr>
<td>Qnominal[l/min]</td>
<td>160</td>
<td>160</td>
<td>160</td>
<td>160</td>
<td>300</td>
<td>300</td>
</tr>
<tr>
<td>G (port TE)</td>
<td>½&quot;</td>
<td>½&quot;</td>
<td>½&quot;</td>
<td>½&quot;</td>
<td>¾&quot;</td>
<td>¾&quot;</td>
</tr>
<tr>
<td>G2 (opt. outlet)</td>
<td>¾&quot;</td>
<td>1&quot;</td>
<td>1 ¼&quot;</td>
<td>1 ¼&quot;</td>
<td>1 ½&quot;</td>
<td>1 ½&quot;</td>
</tr>
</tbody>
</table>

*1) optional for PV063 - PV180, thread option 4
*2) for BG6 PV360 the manifold of BG5 is used
9. Basic adjustment of displacement feedback and compensator valves

The inductive position transducer for displacement feedback (LVDT) and the compensator valves are factory preset and the settings are secured. New or readjustment is only necessary after repair.

LVDT for displacement feedback:
Prior to a basic setting the adjustment of the armature length is to be checked / readjusted (see figure 14). The exact dimension for this setting is given in table 4:

<table>
<thead>
<tr>
<th>Size</th>
<th>Size Serie 45</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>PV016-028</td>
</tr>
<tr>
<td>2</td>
<td>PV032-046</td>
</tr>
<tr>
<td>3</td>
<td>PV063-092</td>
</tr>
<tr>
<td>4</td>
<td>PV140-180</td>
</tr>
<tr>
<td>5</td>
<td>PV270</td>
</tr>
<tr>
<td>6</td>
<td>PV360</td>
</tr>
</tbody>
</table>

The adjustment is secured by a removable glue. A new setting again has to be secured to avoid uncontrolled re-setting.

At full upstroked pump the mechanical adjustment can be verified: The voltage at the LVDT output (pin 25 at the control module) should have a value as given in the table below (± 0.2 V).

<table>
<thead>
<tr>
<th>Size</th>
<th>Voltage size</th>
</tr>
</thead>
<tbody>
<tr>
<td>PV016</td>
<td>6.34 V</td>
</tr>
<tr>
<td>PV020</td>
<td>6.06 V</td>
</tr>
<tr>
<td>PV023</td>
<td>5.87 V</td>
</tr>
<tr>
<td>PV028</td>
<td>5.50 V</td>
</tr>
<tr>
<td>PV032</td>
<td>6.40 V</td>
</tr>
<tr>
<td>PV040</td>
<td>5.70 V</td>
</tr>
<tr>
<td>PV046</td>
<td>5.43 V</td>
</tr>
</tbody>
</table>

Zero adjustment:

Next the zero adjustment of the LVDT is to be checked. The LVDT and the solenoid of the displacement control valve are to be connected according to chapter 9 to the electronic control module.

At running pump the command for the displacement is to be set to 0 and the pressure relief valve of the circuit / test rig has to be set to a pressure > 25 bar. All other connections / valves in the hydraulic circuit are to be closed.

The pump then will down stroke to deadhead at the minimum pump compensating pressure (10 ± 2 bar). By setting the zero adjustment potentiometer (see figure 21) at the LVDT the diagnosis output of the control module is to be set to 0 V, as the actual displacement is the minimum displacement that can be controlled. After adjustment the potentiometer must be sealed again.

MAX-adjustment:

Next the command for the displacement is to be increased, until the maximum displacement of the pump is reached. That can either be monitored by using the diagnosis output or a flow meter at the pump outlet. The maximum displacement is reached, if the displacement / flow does not further increase, even when the input command is still raised.
If the actual value gets 10V before the pump is full stroked, the LVDT parameter need to be reset. If the actual value is below 10V and the pump is already full stroked, the LVDT parameter need to be reset as well.

**Basic adjustment control valve PVCF*PV**: To adjust the displacement control valve, the protection cap is to be removed (figure 22).

After the adjustment the lock nut secures this setting and the cap nut covers the set screw.

See also Installation and Start-Up Manual for the digital control module PQDXXA-Z10.

Caution: the proportional displacement control, code ...FDV (old: FPV) does not include a pressure compensation. Therefore the hydraulic circuit needs to be protected with a pressure relief valve (safety valve). This valve has to be layed out for full pump flow.

The remote pressure compensation stage of the p-Q-controls codes ...UDR, ...UDK, ...UDM, ...UDS, ...UDP und ...UDF (old: ...UPR, ...UPK, ...UPM, ...UPS, ...UPQ, ...UPP und UPF), refered chapters 2 to 7, is adjusted as follows.

The factory setting for the differential pressure is 15 ± 1 bar. For re-adjustment two pressure gages / transducers are required. The differential pressure to be adjusted is the difference between the two pressures on both sides of the control spool of the pressure compensator stage in a control situation. For compensator codes ...UDP and UDF (old: UPP and UPF) this is the difference between the pressure \( p_F \) on the sensing side and the pilot pressure \( p_R \) (see figure 18).

For all other codes it is the difference between pump outlet pressure \( p_1 \) and pilot pressure \( p_R \).

The leads to a minimum compensation pressure of 15 bar at completely unloaded spring chamber.
10.1 Connecting diagram for proportional displacement control; Code ...FDV.

Base parameter sets for FDV are available with module firmware PQDXXA-Z10-r03 and higher.
(cable details see page 28 and 29)
10.2 Electrical connections and wiring of compensator and control Electronics

Connecting diagram for proportional displacement control; code ..FPV
(cable description see page 28 and 29)

- Displacement cmd, \( Q_{cmd} \) 0...+10 V or 4...20 mA
- Connect to terminal 11, 0 V
- Displacement transducer, 4...9 V
- 0 V
- Enable ramp, 24 V nominal
- Enable power amplifier, 24 V nominal
- Connect to terminal 11, 0 V
- Displacement transducer, 4...9 V
- 0 V
- Enable ramp, 24 V nominal
- Enable power amplifier, 24 V nominal

Cable 1 from LVDT

Cable 3a to proportional solenoid

Displacement control valve, code PVCF*PV**
11.1 Connecting diagram for p/Q-control; Codes .UDR, ...UDK, ...UDM, ...UDS, ...UDQ, ...UDP und ...UDF.

Base parameter sets for UD* are available with module firmware PQDXXA-Z10-r03 and higher.
(cable details see page 28 to 29)
11.2 Connecting diagram for p-Q-control; codes ...UPR, ...UPK, ...UPM, ...UPS, ...UPQ, ...UPP and ...UPF (cable descriptions see pages 28 and 29)

- Pressure sensor
  - PVACMS
  - SCP01-600-24-06 (for closed loop pressure control and horse power)
- Pressure compensator stage, code PVCM*U2**
  - with quick unload manifold: code PVCM*US**
  - with preload and quick unload manifold: code PVCM*UP**
- Displacement control stage, code PVCM*PV**
- Proportional pressure pilot valve code PVACRE**K**
- Cable 1 from LVDT
- Cable 3a to displacement Control stage solenoid
- Cable 4 to pressure Valve solenoid

<table>
<thead>
<tr>
<th>Cable 4 from pressure sensor</th>
<th>18...30 V power supply</th>
</tr>
</thead>
<tbody>
<tr>
<td>18...30 V power supply</td>
<td>0</td>
</tr>
<tr>
<td>18...30 V power supply</td>
<td>0</td>
</tr>
<tr>
<td>10 V reference output</td>
<td>0</td>
</tr>
<tr>
<td>10 V reference output</td>
<td>0</td>
</tr>
<tr>
<td>diagnosis, displacement, 0...+10 V</td>
<td>0</td>
</tr>
<tr>
<td>diagnosis, displacement, 0...+10 V</td>
<td>0</td>
</tr>
<tr>
<td>ready, 24 V nominal</td>
<td>0</td>
</tr>
<tr>
<td>status I, 24 V nominal</td>
<td>0</td>
</tr>
</tbody>
</table>

Specific connections and references:
- Connect to terminal 11, 0 V
- Displacement transducer, 4...9 V
- Horse power command \( I_{cmd} \): 0...+10 V or 0
- Pressure command, \( P_{cmd} \): 0...+10 V or 4...20 mA
- Pressure transducer: 0...+10 V or 4...20 mA
- 0 V
- Enable ramp, 24 V nominal
- Enable p/Q-control, 24 V nominal
- Enable power amplifier, 24 V nominal

Cable 4 from pressure sensor:
- \( \mu C \)
- PWM
- 12 V
- 5 V
- 12 V
- 5 V

Cable 3a to displacement Control stage solenoid:
- Pressure sensor
- \( PVACMS \)

Cable 4 to pressure Valve solenoid:
- \( PVACMS \)

Diagram elements:
- \( T \)
- \( P \)
- \( M \)
- \( S \)
- \( B_D \)
- \( B_A \)
- \( BD_2 \)
Cable 1 from LVDT (displacement transducer)

- LVDT
- PQ-module
- Cable: 4 x 0,5 mm², shielded, max. 50 m long
- Connector: round type M12 x 1; 5-pin angled version
- Protection class IP 65 for voltages up to 250 V

Alternative: shielded cable with molded connector; in different length and variations.

Cable 2 from pressure sensor (compensator codes ...UPM, ...UPF, ...UPQ)

- Pressure sensor
- PQ-module
- Cable: 3 x 0,5 mm², shielded, max. 50 m long
- Connector: according DIN 43 650, version AF, 4-pin protection class IP 65 for voltages up to 250 V
Cable 3 a/b to displacement control valve (displacement control)

Solenoid

P/Q-module

PIN 20 solenoid A / PIN 23 solenoid B

PIN 18 solenoid A / PIN 21 solenoid B

40 mm (dismantle)

4 mm (strip)

cable 3 a/b: 3 x 1,5 mm², max. 50 m long
connector: according DIN 43 650, version AF, 3-PIN
protection class IP 65 for voltages up to 250V

Cable 4 to proportional pressure pilot valve solenoid (not for compensator code ...FDV, ...UDR, ...UDP, ...UDS [old: ...FPV, ...UPR, ...UPP, ...UPS])

Solenoid

P/Q-module

PIN 19

PIN 17

40 mm (dismantle)

4 mm (strip)

cable: 3 x 1,5 mm², max. 50 m long
connector: according DIN 43 650, version AF, 3-pin
protection class IP 65 for voltages up to 250 V
### 12. Trouble shooting guide

<table>
<thead>
<tr>
<th>Pump delivers no output flow</th>
<th>Drive motor does not turn</th>
</tr>
</thead>
<tbody>
<tr>
<td>reason</td>
<td>Motor is not connected correctly or one of the three phases has failed. Motor does not turn smoothly when pump is disconnected from pump.</td>
</tr>
<tr>
<td>solution</td>
<td>Check motor connections, check electrical power supply.</td>
</tr>
</tbody>
</table>

| reason                      | Pump is mechanically blocked. Motor turns smoothly when disconnected from pump. |
| solution                    | Send pump for service to factory. |

#### Drive motor only turns at slow speed

| reason                      | Motor is not selected properly. Installed motor has not enough torque. |
| solution                    | Start pump at unloaded system. Use motor with more horse power. |

| reason                      | Pump is hydraulically blocked. No function of compensator, no pressure relief valve; Pump stops after e few turns. |
| solution                    | Check function of pump compensator (see below). Start pump at unloaded system. |

#### Drive motor turns, pump does not turn

| reason                      | Coupling is not or not correctly mounted. |
| solution                    | Check coupling assembly and correct it. |

#### Drive motor turns and pump turns

| reason                      | Wrong direction of rotation. |
| solution                    | Change direction of motor rotation. |

| reason                      | Fluid reservoir empty or not filled to level, suction line ends above fluid level. |
| solution                    | Fill reservoir to required level, if necessary increase suction pipe length. |

| reason                      | Suction line is blocked. E. g. by plugs, cleaning tissues, plastic-plugs. Ball valve in the suction line closed. Suction filter blocked. |
| solution                    | Check suction line for free flow. Open valves in suction line. Valves should be equipped with electrical indicator. Check suction filter. |

| reason                      | Suction line not gas tight, pump gets air into suction port. |
| solution                    | Seal suction line against air ingress. |

| reason                      | Pressure line / system is not able to bleed air out. |
| solution                    | Unload pressure port, unload system before start, bleed air from pressure line. |

#### Pump does not build up pressure, but delivers full flow at low pressure

| reason                      | Standard pressure compensator is set to minimum pressure. |
| solution                    | Adjust compensator setting to desired pressure. |

| reason                      | No pressure pilot valve connected. |
| solution                    | Install suitable pressure pilot valve and adjust it to the desired setting. |

| reason                      | Multiple pressure pilot selector valve is not energized; Pump works in stand-by. |
| solution                    | Energize selector valve solenoid. |

| reason                      | Differential pressure at compensator is adjusted properly (too low). |
| solution                    | Check differential pressure adjustment and correct it as described above. |
**Trouble shooting guide**

<table>
<thead>
<tr>
<th>Reason</th>
<th>Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Pump does not build up pressure, but delivers full flow at low pressure</strong></td>
<td></td>
</tr>
<tr>
<td>Horse power compensator setting changed.</td>
<td><em>Check setting of horse power compensator and correct it, if required.</em></td>
</tr>
<tr>
<td>Proportional displacement control is not connected as required.</td>
<td><em>Check wiring; connect according to installation manual for electronic module.</em></td>
</tr>
<tr>
<td>Displacement transducer (LVDT) adjustment changed.</td>
<td><em>Correct zero setting at displacement transducer.</em></td>
</tr>
<tr>
<td>Electronic module has no supply power.</td>
<td><em>Make sure module is powered with 22 - 36 V DC.</em></td>
</tr>
<tr>
<td>Cylinder block lifts from valve plate due to excessive wear.</td>
<td><em>Send pump to factory for service.</em></td>
</tr>
<tr>
<td><strong>Pump does not compensate</strong></td>
<td></td>
</tr>
<tr>
<td>No pressure pilot valve connected to compensator or valve is blocked.</td>
<td><em>Connect pressure pilot valve to compensator, make sure valve opens as required.</em></td>
</tr>
<tr>
<td>No or too low pressure at pump outlet port.</td>
<td><em>Pump outlet pressure must be at least 15 bar, because otherwise the bias spring in the pump cannot be compressed.</em></td>
</tr>
<tr>
<td><strong>Pump does not upstroke, sticks at zero displacement.</strong></td>
<td></td>
</tr>
<tr>
<td>Compensator is blocked due to contamination.</td>
<td><em>Clean hydraulic fluid, clean compensator valve.</em></td>
</tr>
<tr>
<td>Cable to LVDT or proportional solenoid is interrupted</td>
<td><em>Check wiring and make sure cable is ok. Replace if necessary.</em></td>
</tr>
<tr>
<td><strong>Compensator is unstable</strong></td>
<td></td>
</tr>
<tr>
<td>Compensator spool is sticking due to contamination of hydraulic fluid.</td>
<td><em>Clean hydraulic system, clean compensator valve.</em></td>
</tr>
<tr>
<td>Compensator differential pressure changed (too low or too high)</td>
<td><em>Adjust compensator differential pressure to required setting.</em></td>
</tr>
<tr>
<td>Wrong pilot orifice or pressure pilot valve improperly selected.</td>
<td><em>Select pilot orifice and pressure pilot valve as recommended.</em></td>
</tr>
<tr>
<td>Dynamic critical system, e. g.: pressure compensator combined with pressure reducing valve, load sensing (flow) compensator combined with flow control valve.</td>
<td><em>Use remote pressure compensator instead of standard pressure compensator.</em></td>
</tr>
</tbody>
</table>
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Dr. Hans Haas
General Manger
Pump & Motor Division Europe

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