Axial Piston Variable Motor
AA6VM (A6VM)

Data sheet

Series 6
Size Nominal pressure/Peak pressure
28 to 200 5800 ps (400 bar) / 6500 psi (450 bar)
250 to 1000 5100 psi (350 bar) / 5800 psi (400 bar)
Open and closed circuits

Features
- Variable motor with an axial tapered piston rotary group of bent-axis design for hydrostatic drives in open and closed circuits
- For use in mobile and stationary application areas
- The wide control range enables the variable motor to satisfy the requirement for high speed and high torque.
- The displacement is infinitely variable from \( V_{g_{\text{max}}} \) to \( V_{g_{\text{min}}} = 0 \).
- The output speed depends on the flow of the pump and the displacement of the motor.
- The output torque increases with the pressure differential between the high and low pressure side and with increasing displacement.
- Wide control range with hydrostatic transmission
- Wide selection of control devices
- Cost savings through elimination of gear shifts and possibility of using smaller pumps
- Compact, robust bearing system with long service life
- High power density
- Good starting characteristics
- Low moment of inertia

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### Hydraulic fluid

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>01</td>
<td>Mineral oil and HFD. HFD for sizes 250 to 1000 only in combination with long-life bearing &quot;L&quot; (without code)</td>
<td></td>
</tr>
<tr>
<td>02</td>
<td>HFB, HFC hydraulic fluid</td>
<td>Sizes 28 to 200 (without code)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Sizes 250 to 1000 (only in combination with long-life bearing &quot;L&quot;)</td>
</tr>
</tbody>
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### Axial piston unit

<table>
<thead>
<tr>
<th>Size</th>
<th>28</th>
<th>55</th>
<th>80</th>
<th>107</th>
<th>140</th>
<th>160</th>
<th>200</th>
<th>250</th>
<th>355</th>
<th>500</th>
<th>1000</th>
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<tbody>
<tr>
<td>Bent-axis design, variable</td>
<td>Version SAE</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
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<td>-</td>
<td>-</td>
<td>AA6V</td>
</tr>
<tr>
<td></td>
<td>Version ISO</td>
<td>-</td>
<td>1</td>
<td>1</td>
<td>1</td>
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### Drive shaft bearing

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<th>250</th>
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<th>500</th>
<th>1000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard bearing (without code)</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>L</td>
</tr>
<tr>
<td>Long-life bearing</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>L</td>
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### Operation mode

| Motor (plug-in-motor A6VE see RE 91608) | M |

### Size

<table>
<thead>
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<th>Code</th>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>05</td>
<td>Displacement ( V_{g\text{ max}} )</td>
<td>in(^3) / rev</td>
</tr>
<tr>
<td></td>
<td></td>
<td>in cm(^3) / rev</td>
</tr>
<tr>
<td></td>
<td></td>
<td>28</td>
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<td>1.71</td>
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### Control device

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<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Hydraulic control, pilot-pressure related</td>
<td>( \Delta p = 145 \text{ psi (10 bar)} )</td>
</tr>
<tr>
<td></td>
<td></td>
<td>( \Delta p = 365 \text{ psi (25 bar)} )</td>
</tr>
<tr>
<td></td>
<td></td>
<td>( \Delta p = 510 \text{ psi (35 bar)} )</td>
</tr>
<tr>
<td></td>
<td>Hydraulic two-point control</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Electric control, proportional</td>
<td>12V</td>
</tr>
<tr>
<td></td>
<td></td>
<td>24V</td>
</tr>
<tr>
<td></td>
<td>Electric two-point control</td>
<td>12V</td>
</tr>
<tr>
<td></td>
<td></td>
<td>24V</td>
</tr>
<tr>
<td></td>
<td>Automatic control, high-pressure related</td>
<td>Without pressure increase</td>
</tr>
<tr>
<td></td>
<td></td>
<td>With pressure increase ( \Delta p = 1450 \text{ psi (100 bar)} )</td>
</tr>
<tr>
<td></td>
<td>Hydraulic control, speed related</td>
<td>( P_{\text{St}} / P_{\text{HD}} = 3/100, ) Hydraulic travel direction valve</td>
</tr>
<tr>
<td></td>
<td></td>
<td>( P_{\text{St}} / P_{\text{HD}} = 5/100, ) Hydraulic travel direction valve</td>
</tr>
<tr>
<td></td>
<td></td>
<td>( P_{\text{St}} / P_{\text{HD}} = 8/100, ) Hydraulic travel direction valve</td>
</tr>
<tr>
<td></td>
<td>Electric control direction valve + el. ( V_{g\text{ max}} ) control</td>
<td>12V</td>
</tr>
<tr>
<td></td>
<td></td>
<td>24V</td>
</tr>
<tr>
<td></td>
<td>Pressure control (only for HD, EP)</td>
<td>28</td>
</tr>
<tr>
<td></td>
<td>Without pressure control (without code)</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Direct</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Direct, with 2nd pressure setting</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Remote</td>
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</tbody>
</table>

### Pressure control (only for HD, EP)

<table>
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<th>Value</th>
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<tr>
<td>07</td>
<td>Without pressure control (without code)</td>
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</tr>
<tr>
<td></td>
<td>Direct</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Direct, with 2nd pressure setting</td>
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<tr>
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<td>Remote</td>
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### Pressure control

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<tr>
<td></td>
<td>Without pressure control (without code)</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Direct</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Direct, with 2nd pressure setting</td>
<td>-</td>
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<tr>
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<td>Remote</td>
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# Ordering code / Standard program

<table>
<thead>
<tr>
<th>AA6V</th>
<th>M</th>
<th>/ 63 W</th>
<th>–</th>
<th>V</th>
<th>12</th>
<th>13</th>
<th>14</th>
<th>15</th>
<th>16</th>
<th>17</th>
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<tr>
<td>01</td>
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<td>03</td>
<td>04</td>
<td>05</td>
<td>06</td>
<td>07</td>
<td>08</td>
<td>09</td>
<td>10</td>
<td>11</td>
<td>12</td>
<td>13</td>
<td>14</td>
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</table>

**Ordering code / Standard program**

## Overriding HA control (for HA1, HA2 only)

<table>
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<th>80</th>
<th>107</th>
<th>140</th>
<th>160</th>
<th>200</th>
<th>250</th>
<th>355</th>
<th>500</th>
<th>1000</th>
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</thead>
<tbody>
<tr>
<td>08</td>
<td>Without override (without code)</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
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<td>–</td>
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<tr>
<td></td>
<td>Hydraulic override</td>
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<td>●</td>
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<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>T</td>
<td>–</td>
</tr>
<tr>
<td></td>
<td>Electric override</td>
<td>12V</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>U1</td>
<td>–</td>
</tr>
<tr>
<td></td>
<td></td>
<td>24V</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>U2</td>
<td>–</td>
</tr>
<tr>
<td></td>
<td>Electric override + travel</td>
<td>12V</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
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<td>R1</td>
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<tr>
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<td>direction valve</td>
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<td>–</td>
<td>R2</td>
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## Series

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<tr>
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<th>200</th>
<th>250</th>
<th>355</th>
<th>500</th>
<th>1000</th>
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<tbody>
<tr>
<td>09</td>
<td>Series 6, index 3</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
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<td>●</td>
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## Direction of rotation

<table>
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<th>107</th>
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<th>160</th>
<th>200</th>
<th>250</th>
<th>355</th>
<th>500</th>
<th>1000</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>Viewed from shaft end, alternating</td>
<td>W</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
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</table>

## Setting range for displacement

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
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<th>55</th>
<th>80</th>
<th>107</th>
<th>140</th>
<th>160</th>
<th>200</th>
<th>250</th>
<th>355</th>
<th>500</th>
<th>1000</th>
</tr>
</thead>
<tbody>
<tr>
<td>11</td>
<td>Vg_min = 0 to 0.7 Vg_max (without code)</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td></td>
<td>Vg_min = 0 to 0.4 Vg_max</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
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<td>–</td>
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<td>–</td>
<td>–</td>
<td>–</td>
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</tr>
<tr>
<td></td>
<td>Vg_min &gt; 0.4 Vg_max to 0.8 Vg_max</td>
<td>–</td>
<td>–</td>
<td>–</td>
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<td>–</td>
<td>–</td>
<td>1</td>
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<tr>
<td></td>
<td>Vg_max = Vg_max to 0.8 Vg_max</td>
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## Seals

<table>
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<th>107</th>
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<th>200</th>
<th>250</th>
<th>355</th>
<th>500</th>
<th>1000</th>
</tr>
</thead>
<tbody>
<tr>
<td>12</td>
<td>FKM (fluor-caoutchouc)</td>
<td>V</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
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## Shaft end

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<th>107</th>
<th>140</th>
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<th>200</th>
<th>250</th>
<th>355</th>
<th>500</th>
<th>1000</th>
</tr>
</thead>
<tbody>
<tr>
<td>13</td>
<td>Version SAE (AA6VM) Splined shaft ANSI B92.1a-1976</td>
<td>–</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
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<td></td>
<td>Version ISO Splined shaft DIN 5480 (A6VM)</td>
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</tr>
<tr>
<td></td>
<td>Parallel keyed DIN 6885</td>
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## Mounting flange

<table>
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<tr>
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<th>80</th>
<th>107</th>
<th>140</th>
<th>160</th>
<th>200</th>
<th>250</th>
<th>355</th>
<th>500</th>
<th>1000</th>
</tr>
</thead>
<tbody>
<tr>
<td>14</td>
<td>Version SAE (AA6VM) SAE J744 – 2-bolt</td>
<td>–</td>
<td>–</td>
<td>●</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
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</tr>
<tr>
<td></td>
<td>Version SAE (A6VM) SAE J744 – 4-bolt</td>
<td>–</td>
<td>–</td>
<td>●</td>
<td>–</td>
<td>–</td>
<td>●</td>
<td>–</td>
<td>–</td>
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<td>–</td>
<td>–</td>
</tr>
<tr>
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<td>Version ISO (A6VM) ISO 3019-2 – 8-hole</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>●</td>
<td>●</td>
<td>●</td>
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## Service line port

<table>
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<tr>
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<th>80</th>
<th>107</th>
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<th>200</th>
<th>250</th>
<th>355</th>
<th>500</th>
<th>1000</th>
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<tbody>
<tr>
<td>15</td>
<td>Version SAE (AA6VM) SAE flange ports</td>
<td>51</td>
<td>0</td>
<td>–</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>–</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>510</td>
</tr>
<tr>
<td></td>
<td>Version SAE (A6VM) A/B, rear (UN threads)</td>
<td>7</td>
<td>–</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>–</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>–</td>
<td>517</td>
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<tr>
<td></td>
<td>Version SAE (A6VM) A/B side, opposite (UN threads)</td>
<td>7</td>
<td>–</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>–</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>–</td>
<td>527</td>
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<tr>
<td></td>
<td>Port plate with pressure-relief valves,</td>
<td>37</td>
<td>0</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>●</td>
<td>–</td>
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<td>370</td>
</tr>
<tr>
<td></td>
<td>For mounting a counterbalance valve</td>
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<td>380</td>
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<td>–</td>
<td>●</td>
<td>–</td>
<td>–</td>
<td>●</td>
<td>010</td>
</tr>
<tr>
<td></td>
<td>Version ISO A/B, rear (metric threads)</td>
<td>7</td>
<td>●</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>●</td>
<td>–</td>
<td>–</td>
<td>●</td>
<td>●</td>
<td>017</td>
</tr>
<tr>
<td></td>
<td>Version ISO A/B side, opposite (metrics threads)</td>
<td>7</td>
<td>●</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>●</td>
<td>–</td>
<td>–</td>
<td>●</td>
<td>●</td>
<td>027</td>
</tr>
<tr>
<td></td>
<td>Version ISO A/B side, opposite + rear</td>
<td>15</td>
<td>0</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>●</td>
<td>150</td>
</tr>
</tbody>
</table>

## Valves

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
<th>28</th>
<th>55</th>
<th>80</th>
<th>107</th>
<th>140</th>
<th>160</th>
<th>200</th>
<th>250</th>
<th>355</th>
<th>500</th>
<th>1000</th>
</tr>
</thead>
<tbody>
<tr>
<td>16</td>
<td>Without valve</td>
<td>0</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td></td>
<td>With flush and boost pressure valve</td>
<td>7</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
</tbody>
</table>
## Ordering code / Standard program

| AA6V | M | / | 63 | W | – | V | – | – | – | – | – | – | – | – | – | – | – | – |

### Speed measurement
- Without speed measurement (without code): ●●●●●●●●●●●
- Prepared for speed measurement (ID): ●●●●●●●●● – – – D
- Prepared for speed measurement (HDD): –●●●●●●●●●●● – F

### Swivel angle indicator
- Without swivel angle indicator (without code): ●●●●●●●●●● –
- With optical swivel angle indicator: – – – – – – ●●●●●●●●● V
- With Electric swivel angle indicator: – – – – – – ●●●●●●●●● E

### Connector for solenoids (only sizes 28 to 200)
- EP1/2, EZ1/2, EZ3/4, HA.U., HA.R., DA.
- DEUTSCH - molded connector, 2-pin – without suppressor diode: ●●●●●●●●●●● P
- DEUTSCH - molded connector, 2-pin – with suppressor diode: –●●●●●●●●●●● Q
- HIRSCHMANN - connector – without suppressor diode: ▲▲▲▲▲▲▲▲▲▲▲ H

### Start of control
- At Vg min (standard for HA): ●●●●●●●●●●● A
- At Vg max (standard for HD, HZ, EP, EZ, DA): ●●●●●●●●●●● B

### Standard / special version
- Standard version (without code): ●●●●●●●●●●●
- With attachment part combined: -K
- Special version: -S
- With attachment part combined: -SK

---

1) ISO-Version see RE 91604
2) Supplied as standard with version D (sizes 250 to 1000)
3) Please specify precise setting for Vg min and Vg max in plain text when ordering: Vg min = ... cm³, Vg max = ... cm³
4) Metric fixing thread
5) Only possible in combination with HD, EP, HA control
6) Complete order recommended, counterbalance valve pages 68...70
7) Complete order recommended, speed sensor page 72...73
8) The HIRSCHMANN connector – without suppressor diode is only standard with sizes 250 to 1000 (without code)
9) With HA.R1 and HA.R2 for the 2nd solenoid (DIA 45), the version with DEUTSCH molded connector is available on request.
10) Adjustment data are included in the material number

● = available  ○ = on request  ▲ = not for new projects  – = not available

= preferred program
Technical data

Hydraulic fluid

Before starting project planning, please refer to our data sheets RE 90220 (mineral oil), RE 90221 (environmentally acceptable hydraulic fluids) and RE 90223 (HF hydraulic fluids) for detailed information regarding the choice of hydraulic fluid and application conditions.

The (A)A6VM variable motor is not suitable for operation with HFA. If HFB, HFC and HFD or environmentally acceptable hydraulic fluids are being used, the limitations regarding technical data and seals mentioned in RE 90221 and RE 90223 must be observed.

When ordering, please indicate the used hydraulic fluid.

Operating viscosity range

For optimum efficiency and service life, select an operating viscosity (at operating temperature) within the optimum range of

\[ \nu_{\text{opt}} = \text{optimum operating viscosity} \ 80...170 \text{ SUS (16 to 36 mm}^2/\text{s)} \]

depending on the circuit temperature (closed circuit) and tank temperature (open circuit).

Limits of viscosity range

The limiting values for viscosity are as follows:

Sizes 28 to 200:

\[ \nu_{\text{min}} = 42 \text{ SUS (5 mm}^2/\text{s)} \]

short-term (t < 3 min)

at max. perm. temperature of \( t_{\text{max}} = +240^\circ \text{F (115}^\circ \text{C)} \)

\[ \nu_{\text{max}} = 7400 \text{ SUS (1600 mm}^2/\text{s)} \]

short-term (t < 3 min)

at cold start (p \leq 435 \text{ psi / 30 bar, n \leq 1000 rpm, } t_{\text{min}} = -40^\circ \text{F / -40}^\circ \text{C})

Only for starting up without load. Optimum operating viscosity must be reached within approx. 15 minutes.

Sizes 250 to 1000:

\[ \nu_{\text{min}} = 60 \text{ SUS (10 mm}^2/\text{s)} \]

short-term (t < 3 min)

at max. perm. temperature of \( t_{\text{max}} = +195^\circ \text{F (90}^\circ \text{C)} \)

\[ \nu_{\text{max}} = 4600 \text{ SUS (1000 mm}^2/\text{s)} \]

short-term (t < 3 min)

at cold start (p \leq 435 \text{ psi / 30 bar, n \leq 1000 rpm, } t_{\text{min}} = -13^\circ \text{F / -25}^\circ \text{C})

Only for starting up without load. Optimum operating viscosity must be reached within approx. 15 minutes.

Note that the maximum hydraulic fluid temperature of 240°F (115°C) (+195°F / +90°C for size 250 to 1000) must not be exceeded locally either (e.g. in the bearing area). The temperature in the bearing area is - depending on pressure and speed - up to 22°F (12 K) higher than the average case drain temperature.

Special measures are necessary in the temperature range from -40°F and -13°F (-40°C and -25°C). Please contact us.

For detailed information about use at low temperatures, see RE 90300-03-B.

Details regarding the choice of hydraulic fluid

The correct choice of hydraulic fluid requires knowledge of the operating temperature in relation to the ambient temperature:

- in a closed circuit the circuit temperature, in an open circuit the tank temperature.

The hydraulic fluid should be chosen so that the operating viscosity in the operating temperature range is within the optimum range (\( \nu_{\text{opt}} \)) - the shaded area of the selection diagram. We recommend that the higher viscosity class be selected in each case.

Example: At an ambient temperature of X°C an operating temperature of 140°F (60°C) is set. In the optimum operating viscosity range (\( \nu_{\text{opt}} \); shaded area) this corresponds to the viscosity classes VG 46 or VG 68; to be selected: VG 68.

Please note:

The case drain temperature, which is affected by pressure and speed, is always higher than the circuit temperature or tank temperature. At no point in the system may the temperature be higher than 240°F (115°C) for sizes 28 to 200 or 195°F (90°C) for sizes 250 to 1000.

If the above conditions cannot be maintained due to extreme operating parameters, we recommend flushing the case at port U or using a flush and boost pressure valve (see pages 66-67).
Technical data

Filtration

The finer the filtration, the higher the cleanliness level of the hydraulic fluid and the longer the service life of the axial piston unit.

To ensure functional reliability of the axial piston unit, the hydraulic fluid must have a cleanliness level of at least 20/18/15 according to ISO 4406.

At very high hydraulic fluid temperatures (195°F to max. 240°F / 90°C to max. 115°C) at least cleanliness level 19/17/14 according to ISO 4406 is required.

If the classes specified above cannot be maintained, please contact us.

Operating pressure range

Maximum pressure on port A or B (pressure data in according to DIN 24312)

for sizes 28 to 200
Nominal pressure \( p_N \) __________________ 5800 psi (400 bar)*
Peak pressure \( p_{\text{max}} \) _________________ 6500 psi (450 bar)*
Total pressure (press. A + press. B) \( p_{\text{max}} \) __ 10150 psi (700 bar)

*) Size 80: \( p_N = 5100 \) psi (350 bar), \( p_{\text{max}} = 5800 \) psi (400 bar)

for sizes 250 to 1000
Nominal pressure \( p_N \) __________________ 5100 psi (350 bar)
Peak pressure \( p_{\text{max}} \) _________________ 5800 psi (400 bar)
Total pressure (press. A + press. B) \( p_{\text{max}} \) __ 10150 psi (700 bar)

Please note:
Sizes 28 to 200: With shaft end S or Z, a nominal pressure of \( p_N = 4550 \) psi (315 bar) (\( p_{\text{max}} = 5100 \) psi (350 bar)) is permissible for drives with radial loading of the drive shaft (pinions, V-belts)!
Size 80: \( p_N = 2900 \) psi (200 bar). Please contact us.
Sizes 250 to 1000: Please contact us.

In cases of pulsating loading above 4550 psi (315 bar), we recommend the version with splined shaft Z (sizes 250 to 1000).

Direction of flow

Direction of rotation, viewed from shaft end clockwise ____________ counter-clockwise ____________

A to B __________________________________________ B to A

Speed range

No limit to minimum speed \( n_{\text{min}} \). If uniformity of motion is required, speed \( n_{\text{min}} \) must not be less than 50 rpm. See table of values on page 7 for maximum speed.

Long-Life bearing (sizes 250 to 1000)

For long service life and use with HF hydraulic fluids. Same external dimensions as motor with standard bearing. A long-life bearing can be specified. Flushing of bearing and case via port U recommended.

Flushing volumes (recommended)

<table>
<thead>
<tr>
<th>Size</th>
<th>250</th>
<th>355</th>
<th>500</th>
<th>1000</th>
</tr>
</thead>
<tbody>
<tr>
<td>( q_v ) flush (gpm)</td>
<td>2.6</td>
<td>4.2</td>
<td>4.2</td>
<td>4.2</td>
</tr>
<tr>
<td>(l/min)</td>
<td>10</td>
<td>16</td>
<td>16</td>
<td>16</td>
</tr>
</tbody>
</table>

Shaft seal ring

Permissible pressure load

The service life of the shaft seal ring is affected by the speed of the motor and the case drain pressure. It is recommended that the average, continuous case drain pressure at operating temperature 45 psi (3 bar) absolute not be exceeded (max. permissible case drain pressure 90 psi (6 bar) absolute at reduced speed, see diagram). Short-term (\( t < 0.1 \) s) pressure spikes of up to 145 psi (10 bar) absolute are permitted. The service life of the shaft seal ring decreases with an increase in the frequency of pressure spikes.

The case pressure must be equal to or greater than the external pressure on the shaft seal ring.

Sizes 28 to 200

Size 250

<table>
<thead>
<tr>
<th>( p_{\text{abs}} ) max (psi)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Size 28</td>
</tr>
<tr>
<td>500</td>
</tr>
<tr>
<td>1000</td>
</tr>
</tbody>
</table>

Sizes 250 to 1000

Size 250

<table>
<thead>
<tr>
<th>( p_{\text{abs}} ) max (psi)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Size 500</td>
</tr>
<tr>
<td>500</td>
</tr>
<tr>
<td>1000</td>
</tr>
</tbody>
</table>

Temperature range

The FKM shaft seal ring is permissible for case temperatures of -13 °F to 240 °F (-25 °C to +115 °C) for sizes 28 to 200 and -13 °F to 195 °F (-25 °C to +90 °C) for sizes 250 to 1000.

Note:
For application cases below -13 °F (-25 °C), an NBR shaft seal ring is necessary (permissible temperature range: -40 °F to 195 °F (-40 °C to +90 °C.) Please state NBR shaft seal ring in plain text when ordering. Please contact us.

Effect of case pressure on start of control

An increase in the case pressure has an effect on the following controls when control of the variable motor begins:

HA1T (sizes 28 to 200) _________________________ increase
HD, EP, HA, HA.R, HA.U, HA.T (sizes 250 to 1000) __ increase
DA __________________________________________ decrease

The start of control is set in the factory at a case pressure of \( p_{\text{abs}} = 30 \) psi (2 bar) for sizes 28 to 200 and \( p_{\text{abs}} = 15 \) psi (1 bar) for sizes 250 to 1000.
Technical Data

Table of values (theoretical values, without efficiency and tolerances; values rounded)

<table>
<thead>
<tr>
<th>Size</th>
<th>Vg max</th>
<th>Vg 0</th>
</tr>
</thead>
<tbody>
<tr>
<td>NG</td>
<td>Vg max</td>
<td>in³</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>28</td>
<td>1.71</td>
<td>3.34</td>
</tr>
<tr>
<td>55</td>
<td>6.53</td>
<td>8.54</td>
</tr>
<tr>
<td>80</td>
<td>12.20</td>
<td>15.25</td>
</tr>
<tr>
<td>107</td>
<td>25.52</td>
<td></td>
</tr>
<tr>
<td>140</td>
<td>30.51</td>
<td></td>
</tr>
<tr>
<td>160</td>
<td>35.52</td>
<td></td>
</tr>
<tr>
<td>200</td>
<td>40.52</td>
<td></td>
</tr>
<tr>
<td>250</td>
<td>45.52</td>
<td></td>
</tr>
<tr>
<td>355</td>
<td>55.52</td>
<td></td>
</tr>
<tr>
<td>500</td>
<td>65.52</td>
<td></td>
</tr>
<tr>
<td>1000</td>
<td>100.00</td>
<td></td>
</tr>
</tbody>
</table>

Max. speed (while adhering to max. permissible flow)

<table>
<thead>
<tr>
<th>Size</th>
<th>Vg max</th>
<th>Vg 0</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n max</td>
<td>rpm</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>28</td>
<td>5550</td>
<td>4500</td>
</tr>
<tr>
<td>55</td>
<td>7000</td>
<td>6100</td>
</tr>
<tr>
<td>80</td>
<td>7500</td>
<td>6500</td>
</tr>
<tr>
<td>107</td>
<td>8500</td>
<td>7500</td>
</tr>
<tr>
<td>140</td>
<td>9500</td>
<td>8500</td>
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<tr>
<td>160</td>
<td>10500</td>
<td>9500</td>
</tr>
<tr>
<td>200</td>
<td>11500</td>
<td>10500</td>
</tr>
<tr>
<td>250</td>
<td>12500</td>
<td>11500</td>
</tr>
<tr>
<td>355</td>
<td>16500</td>
<td>15500</td>
</tr>
<tr>
<td>500</td>
<td>19500</td>
<td>18500</td>
</tr>
<tr>
<td>1000</td>
<td>22500</td>
<td>21500</td>
</tr>
</tbody>
</table>

Max. flow

<table>
<thead>
<tr>
<th>Size</th>
<th>qV max</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>l/min</td>
</tr>
<tr>
<td>28</td>
<td>156</td>
</tr>
<tr>
<td>55</td>
<td>244</td>
</tr>
<tr>
<td>80</td>
<td>312</td>
</tr>
<tr>
<td>107</td>
<td>380</td>
</tr>
<tr>
<td>140</td>
<td>455</td>
</tr>
<tr>
<td>160</td>
<td>580</td>
</tr>
<tr>
<td>200</td>
<td>675</td>
</tr>
<tr>
<td>250</td>
<td>795</td>
</tr>
<tr>
<td>355</td>
<td>1000</td>
</tr>
<tr>
<td>500</td>
<td>1600</td>
</tr>
</tbody>
</table>

Max. torque

<table>
<thead>
<tr>
<th>Size</th>
<th>T max</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>lb-ft</td>
</tr>
<tr>
<td>28</td>
<td>132</td>
</tr>
<tr>
<td>55</td>
<td>257</td>
</tr>
<tr>
<td>80</td>
<td>375</td>
</tr>
<tr>
<td>107</td>
<td>502</td>
</tr>
<tr>
<td>140</td>
<td>657</td>
</tr>
<tr>
<td>160</td>
<td>752</td>
</tr>
<tr>
<td>200</td>
<td>939</td>
</tr>
<tr>
<td>250</td>
<td>1026</td>
</tr>
<tr>
<td>355</td>
<td>1459</td>
</tr>
<tr>
<td>500</td>
<td>2054</td>
</tr>
<tr>
<td>1000</td>
<td>4109</td>
</tr>
</tbody>
</table>

Caution: Exceeding the permissible limit values may result in a loss of function, a reduction in service life or in the destruction of the axial piston unit.

Other permissible limit values with respect to speed variation, reduced angular acceleration as a function of the frequency and the permissible startup angular acceleration (lower than the maximum angular acceleration) can be found in data sheet RE 90261.
Minimum inlet pressure on service line port A(B)

To prevent damage to the variable motor, there must be a minimum inlet pressure in the inlet area. The minimum inlet pressure is dependent on the speed and swivel angle (displacement) of the variable motor.

Please contact us if these conditions cannot be satisfied.

1) for NG 28 to 200
2) for NG 250 to 1000
Technical data

Permissible radial and axial loading on the drive shaft

The specified values are maximum values and do not apply to continuous operation.

<table>
<thead>
<tr>
<th>Size</th>
<th>NG 28</th>
<th>55</th>
<th>80</th>
<th>107</th>
<th>140</th>
<th>160</th>
<th>200</th>
<th>250</th>
<th>355</th>
<th>500</th>
<th>1000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Radial force, max. (^1) at distance a (from shaft collar)</td>
<td>(F_{q_{\text{max}}})</td>
<td>lb</td>
<td>1280</td>
<td>2347</td>
<td>2948</td>
<td>3434</td>
<td>4003</td>
<td>4568</td>
<td>5147</td>
<td>2700 (^2)</td>
<td>3370 (^2)</td>
</tr>
<tr>
<td>N</td>
<td>in</td>
<td>5696</td>
<td>10440</td>
<td>13114</td>
<td>15278</td>
<td>17808</td>
<td>20320</td>
<td>22896</td>
<td>12000 (^2)</td>
<td>15000 (^2)</td>
<td>19000 (^2)</td>
</tr>
<tr>
<td>a</td>
<td>mm</td>
<td>0.49</td>
<td>0.59</td>
<td>0.69</td>
<td>0.79</td>
<td>0.89</td>
<td>0.89</td>
<td>0.98</td>
<td>1.61</td>
<td>2.07</td>
<td>2.07</td>
</tr>
<tr>
<td>Axial force, max. (^3)</td>
<td>(F_{a_{\text{ax max}}})</td>
<td>lb</td>
<td>71</td>
<td>112</td>
<td>160</td>
<td>202</td>
<td>234</td>
<td>252</td>
<td>281</td>
<td>270</td>
<td>337</td>
</tr>
<tr>
<td>N</td>
<td>315</td>
<td>500</td>
<td>710</td>
<td>900</td>
<td>1030</td>
<td>1120</td>
<td>1250</td>
<td>1200</td>
<td>1500</td>
<td>1900</td>
<td>2600</td>
</tr>
<tr>
<td>Permissible axial force/bar operating pressure</td>
<td>(F_{a_{\text{ax max}}} \text{ per./bar} )</td>
<td>lb/psi</td>
<td>0.07</td>
<td>0.12</td>
<td>0.15</td>
<td>0.18</td>
<td>0.21</td>
<td>0.23</td>
<td>0.26</td>
<td>4)</td>
<td>4)</td>
</tr>
<tr>
<td>N/bar</td>
<td>4.6</td>
<td>7.5</td>
<td>9.6</td>
<td>11.3</td>
<td>13.3</td>
<td>15.1</td>
<td>17.0</td>
<td>4)</td>
<td>4)</td>
<td>4)</td>
<td>4)</td>
</tr>
</tbody>
</table>

1\) during intermittent operation (sizes 28 to 200).
2\) when at a standstill or when axial piston unit operating in depressurized condition. Higher forces are permissible when under pressure. Please contact us.
3\) max. permissible axial force when at a standstill or when axial piston unit operating in depressurized condition.
4\) please contact us.

When considering the permissible axial force, the force-transfer direction must be taken into account.

\(- F_{a_{\text{ax max}}} = \) increase in service life of bearings
\(+ F_{a_{\text{ax max}}} = \) reduction in service life of bearings (avoid)

Effect of radial force \(F_q\) on the service life of bearings

By selecting a suitable force-transfer direction of \(F_q\), the stress on the bearings caused by the internal transmission forces can be reduced, thus achieving the optimum service life of the bearings. Recommended position of mating gear is dependent on direction of rotation. Examples:

**Toothed gear drive**

- \(\phi_{\text{opt}} = 45^\circ\)
- \(\phi = 45^\circ\)

**V-belt drive**

- \(\phi_{\text{opt}} = 70^\circ\)
- \(\phi = 70^\circ\)

Determining the size

- Flow \(q_v = \frac{V_g \cdot n}{231 \cdot \eta_v}\) gpm
- Speed \(n = \frac{q_v \cdot 231 \cdot \eta_v}{V_g}\) rpm
- Torque \(T = \frac{V_g \cdot \Delta p \cdot \eta_{\text{mh}}}{24 \cdot \pi}\) lb-ft
- Power \(P = \frac{2 \cdot \pi \cdot T \cdot n}{33000} = \frac{q_v \cdot \Delta p \cdot \eta_v}{1714}\) HP

\(V_g\) = Displacement per revolution in in\(^3\) (cm\(^3\))
\(\Delta p\) = Differential pressure in psi (bar)
\(n\) = Speed in rpm
\(\eta_v\) = Volumetric efficiency
\(\eta_{\text{mh}}\) = Mechanical-hydraulic efficiency
\(\eta_t\) = Overall efficiency
The pilot-pressure related hydraulic control permits infinite control of the displacement according to the pilot-pressure signal. The displacement is proportional to the pilot pressure applied to port X.

**Standard configuration:**
- Start of control at $V_g \text{ max}$ (max. torque, min. speed)
- End of control at $V_g \text{ min}$ (min. torque, max. permitted speed)

**Please note:**
- Maximum permissible pilot pressure: 1450 psi (100 bar)
- For reliable control, an operating pressure of at least 435 psi (30 bar) is necessary in A (B). If a control operation is performed at an operating pressure < 435 psi (30 bar), an auxiliary pressure of at least 435 psi (30 bar) must be applied at port G via an external check valve. Lower pressures may be adequate in individual cases.
- Please state the desired start of control in plain text when ordering, e.g.: start of control at 145 psi (10 bar).

The following only applies to sizes 250 to 1000:
- The start of control and the HD characteristic are influenced by the case pressure. An increase in the case pressure causes an increase in the start of control (see page 6) and thus a parallel displacement of the characteristic.
- Fluid escapes from port X at the rate of max. 0.08 gpm (0.3 l/min) due to internal leakage (operating pressure > pilot pressure).

To prevent a build-up in pilot pressure, port X must be vented to tank.

**HD1 pilot pressure increase $\Delta p_S = 145$ psi (10 bar)**

An increase in pilot pressure of 145 psi (10 bar) on port X causes a reduction in the displacement from $V_g \text{ max}$ to 0 cm$^3$ (sizes 28 to 200) or from $V_g \text{ max}$ to 0.2 $V_g \text{ max}$ (sizes 250 to 1000).

Start of control (setting range) ____ 30 – 290 psi (2 – 20 bar)  
Default setting:  
start of control at 45 psi (3 bar) (end of control at 190 psi (13 bar))

**Characteristic HD1**

**HD2 pilot pressure increase $\Delta p_S = 365$ psi (25 bar)**

An increase in pilot pressure of 365 psi (25 bar) on port X causes a reduction in the displacement from $V_g \text{ max}$ to 0 cm$^3$ (sizes 28 to 200) or from $V_g \text{ max}$ to 0.2 $V_g \text{ max}$ (sizes 250 to 1000).

Start of control, setting range ____ 75 – 725 psi (5 – 50 bar)  
Default setting:  
start of control at 145 psi (10 bar) (end of control at 510 psi (35 bar))

**Characteristic HD2**

**HD3 pilot pressure increase $\Delta p_S = 510$ psi (35 bar)**

An increase in pilot pressure of 510 psi (35 bar) on port X causes a reduction in the displacement from $V_g \text{ max}$ to 0.2 $V_g \text{ max}$ (sizes 250 to 1000).

Start of control, setting range ____ 100 – 725 psi (7 – 50 bar)  
Default setting:  
start of control at 145 psi (10 bar) (end of control at 650 psi (45 bar))
HD - Hydraulic control, pilot-pressure related

Circuit diagram HD, HD2, HD3
Sizes 28 to 200

Sizes 250 to 1000

Note
The spring return feature in the control unit is not a safety device

The spool valve inside the control unit can get stuck in an undefined position by internal contamination (contaminated hydraulic fluid, abrasion or residual contamination from system components). As a result, the axial piston unit can no longer supply the flow specified by the operator.

Check whether your application requires that remedial measures be taken on your machine in order to bring the driven consumer into a safe position (e.g. immediate stop).

HD.D Pressure control, direct

The pressure control overlays the HD function. If the load increases, or a reduction in the swivel angle of the motor causes the system pressure to increase, the motor will start to swivel to a greater angle when the pressure reaches the setpoint value of the pressure control.

The increase in the displacement and the resulting reduction in pressure cause the control deviation to decrease. With the increase in displacement the motor develops more torque, while the pressure remains constant.

Setting range on the pressure control valve:
Sizes 28 to 200 ____________1150 – 5800 psi (80 – 400 bar)
Sizes 250 to 1000 __________ 1150 – 5100 psi (80 – 350 bar)

Circuit diagram HD.D
Sizes 28 to 200

Sizes 250 to 1000
**HD - Hydraulic control, pilot-pressure related**

### HD.E  Pressure control, direct with 2nd pressure setting

**Sizes 28 to 200**

Connecting an external pilot pressure to port G2 allows the pressure controller setting to be over-ridden and a 2nd pressure setting to be used.

Required pilot pressure on port G2:

Sizes 28 to 200 \( p_{St} = 290 - 725 \text{ psi (20 – 50 bar)} \)

Please specify the 2nd pressure setting in plain text when ordering.

**Circuit diagram HD.E**

**Sizes 28 to 200**

#### HD.G  Pressure control, remote

**Sizes 250 to 1000**

When the set pressure value is reached, the remote pressure control regulates the motor continuously up to the maximum displacement \( V_{g \text{ max}} \). A pressure-relief valve (not supplied) controls the internal pressure cut-off valve. The pressure-relief valve is separate from the motor and is connected to X3.

As long as operating pressure is below the set point of the external pressure-relief valve (1150 – 5100 psi / 80 – 350 bar), the pressure is equal on both sides of the internal pressure cut-off valve, and spring force keeps it closed. The external relief valve opens when the operating pressure exceeds the set point, and the pressure on the spring end of the pressure cut-off valve is reduced.

The pressure cut-off valve then modulates the motor displacement (i.e.-swivelling towards maximum displacement) to limit operating pressure.

The standard differential pressure setting of the internal pressure cut-off valve is 365 psi (25 bar). We recommend the following for use as the external (i.e.-remote control) pressure-relief valve:

**DBD 6 (hydraulic) according to RE 25402**

The max. line length must not exceed 6 ft (2 m).

**Circuit diagram HD.G**

**Sizes 250 to 1000**
**HZ - Hydraulic two-point control**

Hydraulic two-point control allows the displacement to be set to $V_{g\min}$ or $V_{g\max}$ by switching the pilot pressure at port X on or off.

- No pilot pressure: $\Delta$ position at $V_{g\max}$
- Pilot pressure switched ($>145$ psi (10 bar)): $\triangleright$ position at $V_{g\min}$

**Standard configuration:**
- Start of control at $V_{g\max}$ (max. torque, min. speed)
- End of control at $V_{g\min}$ (min. torque, max. permitted speed)

**Characteristic HZ**

<table>
<thead>
<tr>
<th>Displacement</th>
<th>$V_{g\min}$</th>
<th>$V_{g\max}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$V_{g\max}$</td>
<td>0</td>
<td>145 (10)</td>
</tr>
<tr>
<td>$V_{g\min}$</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

**Pilot pressure** $\Delta p_S$ in psi (bar)

**Please note:**
- Maximum permissible pilot pressure: 1450 psi (100 bar)
- For reliable control, an operating pressure of at least 435 psi (30 bar) is necessary in A (B). If a control operation is performed at an operating pressure $<435$ psi (30 bar), an auxiliary pressure of at least 435 psi (30 bar) is to be applied at port G via an external check valve. Lower pressures may be adequate in individual cases.

**The following only applies to sizes 250 to 1000:**
- Fluid escapes from port X at the rate of max. 0.08 gpm (0.3 l/min) due to internal leakage (operating pressure $>\Delta p_S$). To prevent a build-up in pilot pressure, port X must be vented to tank.

**Circuit diagram HZ1**

Sizes 28, 140, 160, 200

**Circuit diagram HZ3**

Sizes 55, 80, 107

**Circuit diagram HZ**

Sizes 250 to 1000
Electric control using a proportional solenoid (sizes 28 to 200) or proportional valve (sizes 250 to 1000) permits continuous control of the displacement according to an electric signal. The control is proportional to the applied electric control current. For sizes 250 to 1000, an external pressure of \( p_{\text{min}} = 435 \text{ psi} \) (30 bar) is necessary for the control oil supply to port \( P \) (\( p_{\text{max}} = 1450 \text{ psi} \) (100 bar)).

Standard configuration:
- Start of control at \( V_{g_{\text{max}}} \) (max. torque, min. speed)
- End of control at \( V_{g_{\min}} \) (min. torque, max. permitted speed)

Characteristic EP

![Characteristic EP graph](chart.png)

Please note:
- For reliable control, an operating pressure of at least 435 psi (30 bar) is necessary in A (B). If a control operation is performed at an operating pressure < 435 psi (30 bar), an auxiliary pressure of at least 435 psi (30 bar) is to be applied at port G via an external check valve. Lower pressures may be adequate in individual cases.

The following only applies to sizes 250 to 1000:
- The start of control and the EP characteristic are influenced by the case pressure. An increase in the case pressure causes an increase in the start of control (see page 6) and thus a parallel displacement of the characteristic.

### Technical data, solenoid for EP1, EP2
(sizes 28 to 200)

<table>
<thead>
<tr>
<th></th>
<th>EP1</th>
<th>EP2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voltage</td>
<td>12 V (±20 %)</td>
<td>24 V (±20 %)</td>
</tr>
<tr>
<td>Control current</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Start of control at ( V_{g_{\text{max}}} )</td>
<td>400 mA</td>
<td>200 mA</td>
</tr>
<tr>
<td>End of control at ( V_{g_{\min}} )</td>
<td>1200 mA</td>
<td>600 mA</td>
</tr>
<tr>
<td>Limiting current</td>
<td>1.54 A</td>
<td>0.77 A</td>
</tr>
<tr>
<td>Nominal resistance (at 68°F (20°C))</td>
<td>5.5 ( \Omega )</td>
<td>22.7 ( \Omega )</td>
</tr>
<tr>
<td>Dither frequency</td>
<td>100 Hz</td>
<td>100 Hz</td>
</tr>
<tr>
<td>Actuated time</td>
<td>100 %</td>
<td>100 %</td>
</tr>
<tr>
<td>Type of protection</td>
<td>See connector design, page 74</td>
<td></td>
</tr>
</tbody>
</table>

The following electronic controllers and amplifiers are available for controlling the proportional solenoids (sizes 28 to 200) (information is also available on the Internet at www.boschrexroth.com/mobile-electronics):
- BODAS controller RC
  - series 20 ______ RE 95200
  - series 21 ______ RE 95201
  - series 22 ______ RE 95202
  - series 30 ______ RE 95203
  - and application software
- Analog amplifier RA ______ RE 95230
- VT 2000 electric amplifier, series 5X _____ RE 29904
  (for stationary application)

### Technical data, proportional valve for EP1, EP2
(sizes 250 to 1000)

<table>
<thead>
<tr>
<th></th>
<th>EP1</th>
<th>EP2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voltage</td>
<td>12 V (±20 %)</td>
<td>24 V (±20 %)</td>
</tr>
<tr>
<td>Control current</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Start of control at ( V_{g_{\text{max}}} )</td>
<td>900 mA</td>
<td>450 mA</td>
</tr>
<tr>
<td>End of control at ( V_{g_{\min}} )</td>
<td>1400 mA</td>
<td>700 mA</td>
</tr>
<tr>
<td>Limiting current</td>
<td>2.2 A</td>
<td>1.0 A</td>
</tr>
<tr>
<td>Nominal resistance (at 68°F (20°C))</td>
<td>2.4 ( \Omega )</td>
<td>12 ( \Omega )</td>
</tr>
<tr>
<td>Actuated time</td>
<td>100 %</td>
<td>100 %</td>
</tr>
<tr>
<td>Type of protection</td>
<td>See connector design, page 74</td>
<td></td>
</tr>
</tbody>
</table>

See also proportional pressure-reduction valve DRE 4K (RE 29 181).

### Note
The spring return feature in the control unit is not a safety device

The spool valve inside the control unit can get stuck in an undefined position by internal contamination (contaminated hydraulic fluid, abrasion or residual contamination from system components). As a result, the axial piston unit can no longer supply the flow specified by the operator.

Check whether your application requires that remedial measures be taken on your machine in order to bring the driven consumer into a safe position (e. g. immediate stop).
**EP - Electric control with proportional solenoid**

**Circuit diagram EP1, EP2**
Sizes 28 to 200

**EP.D Electric control with pressure control, direct**

The pressure control overlays the EP function. If the load increases or a reduction in the swivel angle of the motor causes the system pressure to increase, the motor will start to swivel to a greater angle when the pressure reaches the setpoint value of the pressure control.

The increase in the displacement and the resulting reduction in pressure cause the control deviation to decrease. With the increase in displacement the motor develops more torque, while the pressure remains constant.

Setting range on the pressure-control valve:
Sizes 28 to 200 ______ 1150 – 5800 psi (80 – 400 bar)
Sizes 250 to 1000 ______ 1160 – 5100 psi (80 – 350 bar)

**Circuit diagram EP.D**
Sizes 28 to 200

**Sizes 250 to 1000**

Proportional pressure-reduction valve DRE 4K (see RE 29181)
EP - Electric control with proportional solenoid

**EPE**  Pressure control, direct with 2nd pressure setting

Sizes 28 to 200

Connecting an external pilot pressure to port G2 allows the pressure controller setting to be overridden and a 2nd pressure setting to be used.

Required pilot pressure on port G2:
Sizes 28 to 200 \( p_{St} = 290 - 725 \) psi (20 – 50 bar)

Please specify the 2nd pressure setting in plain text when ordering.

Circuit diagram EPE
Sizes 28 to 200

---

**EP.G**  Electric control with pressure control, remote

Sizes 250 to 1000

When the set pressure value is reached, the remote pressure control regulates the motor continuously up to the maximum displacement \( V_{g_{max}} \). A pressure-relief valve (not supplied) controls the internal pressure cut-off valve. The pressure-relief valve is separate from the motor and is connected to X3.

As long as operating pressure is below the set point of the external pressure-relief valve (1150 – 5100 psi / 80 – 350 bar), the pressure is equal on both sides of the internal pressure cut-off valve, and spring force keeps it closed. The external relief valve opens when the operating pressure exceeds the set point, and the pressure on the spring end of the pressure cut-off valve is reduced.

The pressure cut-off valve then modulates the motor displacement (i.e.-swivelling towards maximum displacement) to limit operating pressure.

The standard differential pressure setting of the internal pressure cut-off valve is 365 psi (25 bar). We recommend the following for use as the external (i.e.-remote control) pressure-relief valve:

\[ \text{DBD 6 (hydraulic) according to RE 25402} \]

The max. line length must not exceed 6 ft (2 m).

Circuit diagram EP.G
Sizes 250 to 1000

---

Sizes 250 to 1000 (EP.D)
Pressure control with 2nd pressure setting provided as standard with EP.D (see circuit diagram, page 14).

Connecting an external pilot pressure to port G2 allows the pressure controller setting to be overridden and a 2nd pressure setting to be used.

Required pilot pressure on port G2:
Sizes 250 to 1000 \( p_{St} \geq 1450 \) psi (100 bar)

Please specify the 2nd pressure setting in plain text when ordering.
EZ - Electric two-point control, with switching solenoid

The electric control with switching solenoid (sizes 28 to 200) or switching valve (sizes 250 to 1000) permits setting the displacement to \( V_{g\min} \) or \( V_{g\max} \) by switching the electric current to the switching solenoid or switching valve on or off.

**Please note:**
- For reliable control, an operating pressure of at least 435 psi (30 bar) is necessary in A (B). If a control operation is performed at an operating pressure < 435 psi (30 bar), an auxiliary pressure of at least 435 psi (30 bar) is to be applied at port G via an external check valve. Lower pressures may be adequate in individual cases.

### Technical data, solenoid with EZ1, EZ2 with dia. 37
(sizes 28, 140, 160, 200)

<table>
<thead>
<tr>
<th></th>
<th>EZ1</th>
<th>EZ2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voltage</td>
<td>12 V (±20 %)</td>
<td>24 V (±20 %)</td>
</tr>
<tr>
<td>Position ( V_{g\max} )</td>
<td>de-energized</td>
<td>de-energized</td>
</tr>
<tr>
<td>Position ( V_{g\min} )</td>
<td>current switched on</td>
<td>current switched on</td>
</tr>
<tr>
<td>Nominal resistance (at 68°F (20°C))</td>
<td>5.5 Ω</td>
<td>21.7 Ω</td>
</tr>
<tr>
<td>Nominal output</td>
<td>26.2 W</td>
<td>26.5 W</td>
</tr>
<tr>
<td>Active current, min. necessary</td>
<td>1.32 A</td>
<td>0.67 A</td>
</tr>
<tr>
<td>Actuated time</td>
<td>100 %</td>
<td>100 %</td>
</tr>
<tr>
<td>Type of protection</td>
<td>See connector design, page 74</td>
<td></td>
</tr>
</tbody>
</table>

### Technical data, solenoid with EZ3, EZ4 with dia. 45
(sizes 55, 80, 107)

<table>
<thead>
<tr>
<th></th>
<th>EZ3</th>
<th>EZ4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voltage</td>
<td>12 V (±20 %)</td>
<td>24 V (±20 %)</td>
</tr>
<tr>
<td>Position ( V_{g\max} )</td>
<td>de-energized</td>
<td>de-energized</td>
</tr>
<tr>
<td>Position ( V_{g\min} )</td>
<td>current switched on</td>
<td>current switched on</td>
</tr>
<tr>
<td>Nominal resistance (at 68°F (20°C))</td>
<td>4.8 Ω</td>
<td>19.2 Ω</td>
</tr>
<tr>
<td>Nominal output</td>
<td>30 W</td>
<td>30 W</td>
</tr>
<tr>
<td>Active current, min. necessary</td>
<td>1.5 A</td>
<td>0.75 A</td>
</tr>
<tr>
<td>Actuated time</td>
<td>100 %</td>
<td>100 %</td>
</tr>
<tr>
<td>Type of protection</td>
<td>See connector design, page 74</td>
<td></td>
</tr>
</tbody>
</table>

### Technical data, switching valve with EZ1, EZ2
(sizes 250 to 1000)

<table>
<thead>
<tr>
<th></th>
<th>EZ1</th>
<th>EZ2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voltage</td>
<td>12 V (±20 %)</td>
<td>24 V (±20 %)</td>
</tr>
<tr>
<td>Position ( V_{g\max} )</td>
<td>de-energized</td>
<td>de-energized</td>
</tr>
<tr>
<td>Position ( V_{g\min} )</td>
<td>current switched on</td>
<td>current switched on</td>
</tr>
<tr>
<td>Nominal resistance (at 68°F (20°C))</td>
<td>6 Ω</td>
<td>23 Ω</td>
</tr>
<tr>
<td>Nominal output</td>
<td>26 W</td>
<td>26 W</td>
</tr>
<tr>
<td>Active current, min. necessary</td>
<td>2 A</td>
<td>1.04 A</td>
</tr>
<tr>
<td>Actuated time</td>
<td>100 %</td>
<td>100 %</td>
</tr>
<tr>
<td>Type of protection</td>
<td>See connector design, page 74</td>
<td></td>
</tr>
</tbody>
</table>
HA - Automatic control, high-pressure related

With the automatic high-pressure related control, the motor displacement is adjusted automatically depending on the operating pressure.

The control unit internally measures the operating pressure at A or B (no control line required) and, when the pressure reaches the set pressure value, the controller swivels the motor with increasing operating pressure from $V_{g\ min}$ to $V_{g\ max}$.

Standard configuration HA1, HA2:
Start of control at $V_{g\ min}$ (min. torque, max. speed)
End of control at $V_{g\ max}$ (max. torque, min. speed)

Please note:
- For safety reasons, winch drives are not permissible with start of control at $V_{g\ min}$ (standard for HA).
- For reliable control, an operating pressure of at least 435 psi (30 bar) is necessary in A (B). If a control operation is performed at an operating pressure < 435 psi (30 bar), an auxiliary pressure of at least 435 psi (30 bar) is to be applied at port G via an external check valve. Lower pressures may be adequate in individual cases.
- The start of control and the HA characteristic are influenced by the case pressure. An increase in the case pressure causes an increase in the start of control (see page 6) and thus a parallel displacement of the characteristic. Only with HA1, HA2, HA.T, HA.R, HA.U (sizes 250 to 1000) and with HA1T (sizes 28 to 200).

The following only applies to sizes 250 to 1000:
- Fluid escape from port X at the rate of 0.08 gpm (0.3 l/min) due to internal leakage (operating pressure > pilot pressure). To prevent a build-up in pilot pressure, port X must be vented to tank.
  Only with HA.T control.
HA - automatic control, high-pressure related

HA1  Approximate without pressure increase

An increase in operating pressure of \( \Delta p \leq 145 \text{ psi} \) (10 bar) causes an increase in the displacement from 0 cm\(^3\) to \( V_g_{\text{max}} \) (sizes 28 to 200) or from 0.2 \( V_g_{\text{max}} \) to \( V_g_{\text{max}} \) (sizes 250 to 1000).

Start of control, setting range

Sizes 28 to 200 1160 – 5100 psi (80 – 350 bar)
Sizes 250 to 1000 1160 – 4930 psi (80 – 340 bar)

Please state the desired start of control in plain text when ordering, e.g.: start of control at 4350 psi (300 bar)

Characteristic HA

<table>
<thead>
<tr>
<th>psi (bar)</th>
<th>( V_g )</th>
<th>( V_g / V_g_{\text{max}} )</th>
</tr>
</thead>
<tbody>
<tr>
<td>5100 (350)</td>
<td>( V_g ) max</td>
<td>( V_g / V_g_{\text{max}} )</td>
</tr>
<tr>
<td>4350 (300)</td>
<td>( V_g )</td>
<td>( V_g / V_g_{\text{max}} )</td>
</tr>
<tr>
<td>3600 (250)</td>
<td>( V_g )</td>
<td>( V_g / V_g_{\text{max}} )</td>
</tr>
<tr>
<td>2900 (200)</td>
<td>( V_g )</td>
<td>( V_g / V_g_{\text{max}} )</td>
</tr>
<tr>
<td>2200 (150)</td>
<td>( V_g )</td>
<td>( V_g / V_g_{\text{max}} )</td>
</tr>
<tr>
<td>1450 (100)</td>
<td>( V_g )</td>
<td>( V_g / V_g_{\text{max}} )</td>
</tr>
<tr>
<td>1160 (80)</td>
<td>( V_g )</td>
<td>( V_g / V_g_{\text{max}} )</td>
</tr>
<tr>
<td>725 (50)</td>
<td>( V_g )</td>
<td>( V_g / V_g_{\text{max}} )</td>
</tr>
<tr>
<td>0</td>
<td>( V_g )</td>
<td>( V_g / V_g_{\text{max}} )</td>
</tr>
</tbody>
</table>

Circuit diagram HA1

Sizes 28 to 200

Sizes 250 to 1000
HA - Automatic control, high-pressure related

**HA2  Pressure increase \( \Delta p = 1450 \text{ psi (100 bar)} \)**

An increase in operating pressure of \( \Delta p = 1450 \text{ psi (100 bar)} \) causes an increase in the displacement from 0 cm\(^3\) to \( V_{g \max} \) (sizes 28 to 200) or from 0.2 \( V_{g \max} \) to \( V_{g \max} \) (sizes 250 to 1000).

Start of control, setting range

Sizes 28 to 200 \( \text{________________________} \) 1160 – 5100 psi (80 – 350 bar)
Sizes 250 to 1000 \( \text{________} \) 1160 – 3600 psi (80 – 250 bar)

Please state the desired start of control in plain text when ordering, e.g.: start of control at 2900 psi (200 bar)

**Characteristic HA2**

![Characteristic HA2 graph]

Sizes 250 to 1000

![Circuit diagram HA2 Sizes 250 to 1000]

**Circuit diagram HA2**

Sizes 28 to 200

![Circuit diagram HA2 Sizes 28 to 200]
HA - Automatic control, high-pressure related (override)

HA.T  Hydraulic override of pressure setting

With the HA.T control, the start of control can be influenced by applying a pilot pressure to port X.

For each 15 psi (1 bar) of pilot pressure, the start of control is reduced by 250 psi (17 bar) for sizes 28 to 200 or 115 psi (8 bar) for sizes 250 to 1000.

Examples (sizes 28 to 200):

<table>
<thead>
<tr>
<th>Start of control adjustment</th>
<th>4350 psi (300 bar)</th>
<th>4350 psi (300 bar)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pilot pressure at port X</td>
<td>0 psi (0 bar)</td>
<td>145 psi (10 bar)</td>
</tr>
</tbody>
</table>

Start of control at 4350 psi (300 bar) 1885 psi (130 bar)

Note:
- Max. permissible pilot pressure 1450 psi (100 bar)

Circuit diagram HA1.T
Sizes 28 to 200

HA.U1, Electric override of pressure setting

With the HA.U1 or HA.U2 control, the start of control can be overridden by an electric signal to an switching solenoid. When the over-ride solenoid is energized, the variable motor swivels to the maximum swivel angle without stopping at an intermediate position. The start of control can be set to between 1160 and 4350 psi (80 and 300 bar) (specify required setting in clear text when ordering).

Technical data, solenoid b with dia. 45 (el. override)

<table>
<thead>
<tr>
<th>U1</th>
<th>U2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voltage</td>
<td>12 V (±20 %)</td>
</tr>
<tr>
<td>No override</td>
<td>de-energized</td>
</tr>
<tr>
<td>Position $V_g \text{ max}$</td>
<td>current switched on</td>
</tr>
<tr>
<td>Nominal resistance (at 68°F (20°C))</td>
<td>4.8 Ω</td>
</tr>
<tr>
<td>Nominal output</td>
<td>30 W</td>
</tr>
<tr>
<td>Active current, min. necessary</td>
<td>1.5 A</td>
</tr>
<tr>
<td>Actuated time</td>
<td>100 %</td>
</tr>
<tr>
<td>Type of protection</td>
<td>See connector design, page 74</td>
</tr>
</tbody>
</table>

Circuit diagram HA1U1, HA1U2
Sizes 28 to 200

Circuit diagram HA2U1, HA2U2
Sizes 28 to 200
HA - Automatic control, high-pressure related (override)

HA.R1, Electric override of HA.R2 pressure setting, with elect. travel direction valve
(see page 25)

With the HA.R1 or HA.R2 control, the high-pressure related closed loop control can be overridden by an electric signal to switching solenoid b. When the over-ride solenoid is energized, the variable motor swivels to the maximum swivel angle without stopping at an intermediate position.

The travel direction valve ensures that the preselected pressure side of the hydraulic motor always controls the swivel angle, even if the high-pressure side changes (e.g. travel drive during a descent). This therefore prevents an undesirable swiveling of the variable motor to a larger displacement.

Depending on the direction of rotation (direction of travel), the travel direction valve (see page 25) can be actuated through the pressure spring or switching solenoid a.

### Technical data, solenoid a with dia. 37 (travel direction valve)

<table>
<thead>
<tr>
<th></th>
<th>R1</th>
<th>R2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voltage</td>
<td>12 V (±20 %)</td>
<td>24 V (±20 %)</td>
</tr>
<tr>
<td>No override</td>
<td>de-energized</td>
<td>de-energized</td>
</tr>
<tr>
<td>Direction of rotation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>counter-clockwise</td>
<td>B</td>
<td>actuated</td>
</tr>
<tr>
<td>clockwise</td>
<td>A</td>
<td>de-energized</td>
</tr>
<tr>
<td>Nominal resistance (at 68°F (20°C))</td>
<td>5.5 Ω</td>
<td>21.7 Ω</td>
</tr>
<tr>
<td>Nominal output</td>
<td>26.2 W</td>
<td>26.5 W</td>
</tr>
<tr>
<td>Active current, min. necessary</td>
<td>1.32 A</td>
<td>0.67 A</td>
</tr>
<tr>
<td>Actuated time</td>
<td>100 %</td>
<td>100 %</td>
</tr>
<tr>
<td>Type of protection</td>
<td>See connector design, page 74</td>
<td></td>
</tr>
</tbody>
</table>

### Technical data, solenoid b with dia. 45¹ (el. override)

<table>
<thead>
<tr>
<th></th>
<th>R1</th>
<th>R2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voltage</td>
<td>12 V (±20 %)</td>
<td>24 V (±20 %)</td>
</tr>
<tr>
<td>No override</td>
<td>de-energized</td>
<td>de-energized</td>
</tr>
<tr>
<td>Position $V_{g \max}$</td>
<td>current switched on</td>
<td>current switched on</td>
</tr>
<tr>
<td>Nominal resistance (at 68°F (20°C))</td>
<td>4.8 Ω</td>
<td>19.2 Ω</td>
</tr>
<tr>
<td>Nominal output</td>
<td>30 W</td>
<td>30 W</td>
</tr>
<tr>
<td>Active current, min. necessary</td>
<td>1.5 A</td>
<td>0.75 A</td>
</tr>
<tr>
<td>Actuated time</td>
<td>100 %</td>
<td>100 %</td>
</tr>
<tr>
<td>Type of protection</td>
<td>See connector design, page 74</td>
<td></td>
</tr>
</tbody>
</table>

¹) for solenoids with dia. 45, the version "DEUTSCH - molded connector" is available on request.
DA - Hydraulic control, speed related

The (A)A6VM variable motor with speed-related hydraulic control is best used for hydrostatic drives in combination with the AA4VG variable pump with DA control.

The pilot pressure derived from the drive speed of the AA4VG variable pump, together with the operating pressure, regulate the swivel angle of the hydraulic motor.

Increasing drive speed, i.e. increasing pilot pressure, causes the motor to swivel to a smaller displacement (lower torque, higher speed), depending on the operating pressure.

If the operating pressure increase above the pressure setting of the controller, the variable motor swivels to a larger displacement (higher torque, lower speed).

The design of a drive with DA control must be carried out using the technical data relating to the AA4VG variable pump with DA control.

Detailed information can be obtained from our sales departments and on the Internet at www.boschrexroth.com/da-control.

Please note:
- The start of control and the DA characteristic are influenced by the case pressure. An increase in the case pressure causes a drop in the start of control (see page 6) and thus a parallel displacement of the characteristic.
DA - Hydraulic control, speed related

DA, DA1, DA4  Hydraulic control speed related with hydr. travel direction valve

The travel direction valve is operated according to the direction of rotation (direction of travel) using the pilot pressures X₁ or X₂.

<table>
<thead>
<tr>
<th>Direction of rotation</th>
<th>Operating pressure in</th>
<th>Pilot pressure in</th>
</tr>
</thead>
<tbody>
<tr>
<td>clockwise</td>
<td>A</td>
<td>X₁</td>
</tr>
<tr>
<td>counter-clockwise</td>
<td>B</td>
<td>X₂</td>
</tr>
</tbody>
</table>

Circuit diagram DA, DA1, DA4
Sizes 28 to 200

DA2, DA3, DA5, DA6  Hydraulic control speed related with electr. travel direction valve + electr. V₉₉₉ max control

Depending on the direction of rotation (direction of travel), the travel direction valve can be actuated through the pressure spring or switching solenoid a.

By connecting an electric current to switching solenoid b, the closed loop control can be overridden and the motor adjusted to max. displacement (high torque, low speed) (electric V₉₉₉ max circuit).

Technical data, solenoid A/B

<table>
<thead>
<tr>
<th>Voltage</th>
<th>DA2, DA5</th>
<th>DA3, DA6</th>
</tr>
</thead>
<tbody>
<tr>
<td>12 V (±20%)</td>
<td>24 V (±20%)</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Direction of rotation</th>
<th>Operating pressure in switching solenoid a</th>
</tr>
</thead>
<tbody>
<tr>
<td>counter-clockwise</td>
<td>B de-energized</td>
</tr>
<tr>
<td>clockwise</td>
<td>A actuated</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Nominal resistance (at 68°F (20°C))</th>
<th>5.5 Ω</th>
<th>21.7 Ω</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nominal output</td>
<td>26.2 W</td>
<td>26.5 W</td>
</tr>
<tr>
<td>Active current, min. necessary</td>
<td>1.32 A</td>
<td>0.67 A</td>
</tr>
<tr>
<td>Actuated time</td>
<td>100 %</td>
<td>100 %</td>
</tr>
<tr>
<td>Type of protection</td>
<td>See connector design, page 74</td>
<td></td>
</tr>
</tbody>
</table>

Circuit diagram DA2, DA3, DA5, DA6
Sizes 28 to 200

DA - Hydraulic control, speed related

DA2, DA3, DA5, DA6  Hydraulic control speed related with electr. travel direction valve + electr. V₉₉₉ max control

Depending on the direction of rotation (direction of travel), the travel direction valve can be actuated through the pressure spring or switching solenoid a.

By connecting an electric current to switching solenoid b, the closed loop control can be overridden and the motor adjusted to max. displacement (high torque, low speed) (electric V₉₉₉ max circuit).

Technical data, solenoid A/B

<table>
<thead>
<tr>
<th>Voltage</th>
<th>DA2, DA5</th>
<th>DA3, DA6</th>
</tr>
</thead>
<tbody>
<tr>
<td>12 V (±20%)</td>
<td>24 V (±20%)</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Direction of rotation</th>
<th>Operating pressure in switching solenoid a</th>
</tr>
</thead>
<tbody>
<tr>
<td>counter-clockwise</td>
<td>B de-energized</td>
</tr>
<tr>
<td>clockwise</td>
<td>A actuated</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Nominal resistance (at 68°F (20°C))</th>
<th>5.5 Ω</th>
<th>21.7 Ω</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nominal output</td>
<td>26.2 W</td>
<td>26.5 W</td>
</tr>
<tr>
<td>Active current, min. necessary</td>
<td>1.32 A</td>
<td>0.67 A</td>
</tr>
<tr>
<td>Actuated time</td>
<td>100 %</td>
<td>100 %</td>
</tr>
<tr>
<td>Type of protection</td>
<td>See connector design, page 74</td>
<td></td>
</tr>
</tbody>
</table>

Circuit diagram DA2, DA3, DA5, DA6
Sizes 28 to 200
Electric travel direction valve (for DA, HA.R)

Application in travel drives in closed circuits. The travel direction valve of the motor is switched using the 4/3-directional valve on the control device of the driving pump.

When the pump (AA4VG, AA10VG) is switched to the neutral position or into reverse, the vehicle may experience impulsive braking depending on the vehicle’s mass and current speed.

This impulsive braking is prevented through the use of the following electric circuit.

With this control, when the pump (AA4VG, AA10VG) is switched
1. to the neutral position: the previous travel direction is retained.
2. to reverse: the motor switches to the other travel direction following a time delay (approx. 0.8 s) with respect to the pump.

Electric travel direction valve circuit diagram

DA2, DA3, DA5, DA6 control (see page 24)

HA1R., HA2R. control (see page 22)
Unit dimensions, size 28 (ISO Version)

HD1, HD2 Hydraulic control, pilot-pressure related
HZ1 Hydraulic two-point control
SAE flange ports A/B side, opposite (02)

View Z

Before finalizing your design, please request a binding installation drawing. Dimensions in inches and (mm).

1) With service line ports A/B rear (plate 01)
Unit dimensions, size 28 (ISO Version)

Shaft ends

<table>
<thead>
<tr>
<th>A</th>
<th>Splined shaft DIN 5480</th>
<th>W30x2x30x14x9g</th>
</tr>
</thead>
<tbody>
<tr>
<td>Z</td>
<td>Splined shaft DIN 5480</td>
<td>W25x1.25x30x18x9g</td>
</tr>
</tbody>
</table>

Ports

<table>
<thead>
<tr>
<th>A, B</th>
<th>Service line ports (high-pressure series)</th>
<th>SAE J518</th>
<th>3/4 in</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Fixing thread A/B</td>
<td>DIN 13</td>
<td>M10x1.5; 0.67 (17) deep</td>
</tr>
<tr>
<td>T1</td>
<td>Case drain port</td>
<td>DIN 3852</td>
<td>M18x1.5; 0.47 (12) deep 100 lb-ft (140 Nm)</td>
</tr>
<tr>
<td>T2</td>
<td>Case drain port</td>
<td>DIN 3852</td>
<td>M18x1.5; 0.47 (12) deep 100 lb-ft (140 Nm)</td>
</tr>
<tr>
<td>X, X1, X3</td>
<td>Pilot-pressure port</td>
<td>DIN 3852</td>
<td>M14x1.5; 0.47 (12) deep 60 lb-ft (80 Nm)</td>
</tr>
<tr>
<td>G</td>
<td>Port for synchronous control of multiple units and for remote control pressure</td>
<td>DIN 3852</td>
<td>M14x1.5; 0.47 (12) deep 60 lb-ft (80 Nm)</td>
</tr>
<tr>
<td>G2</td>
<td>Port for 2nd pressure setting</td>
<td>DIN 3852</td>
<td>M14x1.5; 0.47 (12) deep 60 lb-ft (80 Nm)</td>
</tr>
<tr>
<td>U</td>
<td>Flow port</td>
<td>DIN 3852</td>
<td>M16x1.5; 0.47 (12) deep 70 lb-ft (100 Nm)</td>
</tr>
<tr>
<td>M1</td>
<td>Gauge port for control pressure</td>
<td>DIN 3852</td>
<td>M14x1.5; 0.47 (12) deep 60 lb-ft (80 Nm)</td>
</tr>
</tbody>
</table>

1) Center bore according to DIN 332 (thread according to DIN 13)
2) Please observe the general notes for the max. tightening torques on page 76
3) Plugged

Before finalizing your design, please request a binding installation drawing. Dimensions in inches and (mm).
Unit dimensions, size 28 (ISO Version)

Before finalizing your design, please request a binding installation drawing. Dimensions in inches and (mm).

**HD.D**
Hydraulic control, pilot-pressure related, with pressure control, direct

**HD.E**
Hydraulic control, pilot-pressure related, with pressure control, direct and 2nd pressure setting

**EP1, EP2**
Electric control with proportional solenoid

**EP.D**
Electric control (proportional solenoid) with pressure control, direct

**EP.E**
Electric control (proportional solenoid) with pressure control, direct and 2nd pressure setting

Observe the note on page 74
Unit dimensions, size 28

**EZ1, EZ2**
Electric two-point control with switching solenoid

**HA1, HA2 / HA1T, HA2T**
Automatic control, high-pressure related / high-pressure related and hydraulic override

**HA1U1, HA2U2**
Automatic control, high-pressure related and electric override

**HA1R1, HA2R2**
Automatic control, high-pressure related, electric override and electric travel direction valve

**DA1, DA4**
Hydraulic control, speed related and hydraulic travel direction valve

**DA2, DA3, DA5, DA6**
Hydraulic control, speed related, el. travel direction valve and el. $V_{g\text{ max}}$ control

Before finalizing your design, please request a binding installation drawing. Dimensions in inches and (mm).
Unit dimensions, size 55 (SAE Version)

HD1, HD2 Hydraulic control, pilot-pressure related
SAE flange ports A/B side, opposite (52)

Before finalizing your design, please request a binding installation drawing. Dimensions in inches and (mm).

View Z

SAE flange ports
A/B side, opposite (52)

SAE flange ports
A/B rear (51)

SAE flange ports
A/B side, opposite with HZ3, EZ3 (52)

SAE flange ports
A/B rear with HZ3, EZ3 (51)

1) With service line ports A/B rear (plate 51)
Unit dimensions, size 55 (SAE Version)

Shaft end

Ports

<table>
<thead>
<tr>
<th>Port</th>
<th>Description</th>
<th>Standard</th>
<th>Fixed Diameter</th>
<th>Length</th>
<th>Torque</th>
</tr>
</thead>
<tbody>
<tr>
<td>A, B</td>
<td>Service line ports (high-pressure series)</td>
<td>SAE J518</td>
<td>3/4 in</td>
<td></td>
<td></td>
</tr>
<tr>
<td>T1</td>
<td>Case drain port</td>
<td>ISO 11926</td>
<td>1 1/16 in -12 UNF-2B</td>
<td>0.79 (20) deep</td>
<td>265 lb-ft (360 Nm)</td>
</tr>
<tr>
<td>T2</td>
<td>Case drain port</td>
<td>ISO 11926</td>
<td>1 1/16 in -12 UNF-2B</td>
<td>0.79 (20) deep</td>
<td>265 lb-ft (360 Nm)</td>
</tr>
<tr>
<td>X, X1, X3</td>
<td>Pilot-pressure port</td>
<td>ISO 11926</td>
<td>9/16 in -18 UNF-2B</td>
<td>0.51 (13) deep</td>
<td>60 lb-ft (80 Nm)</td>
</tr>
<tr>
<td>G</td>
<td>Port for synchronous control of multiple units and for remote control pressure</td>
<td>ISO 11926</td>
<td>9/16 in -18 UNF-2B</td>
<td>0.51 (13) deep</td>
<td>60 lb-ft (80 Nm)</td>
</tr>
<tr>
<td>G2</td>
<td>Port for 2nd pressure setting</td>
<td>ISO 11926</td>
<td>9/16 in -18 UNF-2B</td>
<td>0.51 (13) deep</td>
<td>60 lb-ft (80 Nm)</td>
</tr>
<tr>
<td>U</td>
<td>Flow port</td>
<td>ISO 11926</td>
<td>7/8 in -14 UNF-2B</td>
<td>0.67 (17) deep</td>
<td>180 lb-ft (240 Nm)</td>
</tr>
<tr>
<td>M1</td>
<td>Gauge port for control pressure</td>
<td>ISO 11926</td>
<td>9/16 in -18 UNF-2B</td>
<td>0.51 (13) deep</td>
<td>60 lb-ft (80 Nm)</td>
</tr>
</tbody>
</table>

1) ANSI B92.1a-1976, pressure angle 30°, flat root, side fit, tolerance class 5
2) please observe the general notes for the max. tightening torques on page 76
3) plugged

Before finalizing your design, please request a binding installation drawing. Dimensions in inches and (mm).
Unit dimensions, size 55 (SAE Version)

**HD.D**
Hydraulic control, pilot-pressure related, with pressure control, direct

Before finalizing your design, please request a binding installation drawing. Dimensions in inches and (mm).

**HD.E**
Hydraulic control, pilot-pressure related, with pressure control, direct and 2nd pressure setting

Observe the note on page 74

**HZ3**
Hydraulic two-point control

Observe the note on page 74

**EP1, EP2**
Electric control with proportional solenoid

Observe the note on page 74

**EP.D**
Electric control (proportional solenoid) with pressure control, direct

Observe the note on page 74

**EP.E**
Electric control (proportional solenoid) with pressure control, direct and 2nd pressure setting

Observe the note on page 74
Unit dimensions, size 55 (SAE Version)

**EZ3, EZ4**
Electric two-point control with switching solenoid

**HA1, HA2 / HA1T, HA2T**
Automatic control, high-pressure related / high-pressure related and hydraulic override

**HA1U1, HA2U2**
Automatic control, high-pressure related and electric override

**HA1R1, HA2R2**
Automatic control, high-pressure related, electric override and electric travel direction valve

**DA1, DA4**
Hydraulic control, speed related and hydraulic travel direction valve

**DA2, DA3, DA5, DA6**
Hydraulic control, speed related, el. travel direction valve and el. $V_{g\text{ max}}$ control

X₁, X₂ with fitting 8B-ST according to DIN 2353-CL

Before finalizing your design, please request a binding installation drawing. Dimensions in inches and (mm).
Unit Dimensions, Size 80 (SAE Version)

HD1, HD2 Hydraulic control, pilot pressure dependent

SAE flange ports A/B at side, opposite (52)

Before finalizing your design, please request a binding installation drawing. Dimensions in inches and (mm).

1) With service line ports A/B rear (plate 51)
Unit dimensions, size 80 (SAE Version)

Shaft end

![Diagram of shaft end]

Ports

<table>
<thead>
<tr>
<th>Port</th>
<th>Description</th>
<th>Thread</th>
<th>Diameter</th>
<th>Depth</th>
<th>Torque</th>
</tr>
</thead>
<tbody>
<tr>
<td>A, B</td>
<td>Service line ports (high-pressure series)</td>
<td>SAE J518</td>
<td>1 in</td>
<td>0.87 (22) deep</td>
<td>265 lb-ft (360 Nm)</td>
</tr>
<tr>
<td></td>
<td>Fixing thread A/B</td>
<td>ISO 68</td>
<td>7/16 -14 UNC-2B</td>
<td>0.79 (20) deep</td>
<td>265 lb-ft (360 Nm)</td>
</tr>
<tr>
<td>T₁</td>
<td>Case drain port ¹)</td>
<td>ISO 11926</td>
<td>1 in -16 UN-2B</td>
<td>0.79 (20) deep</td>
<td>265 lb-ft (360 Nm)</td>
</tr>
<tr>
<td>T₂</td>
<td>Case drain port</td>
<td>ISO 11926</td>
<td>1 in -12 UN-2B</td>
<td>0.79 (20) deep</td>
<td>265 lb-ft (360 Nm)</td>
</tr>
<tr>
<td>X₁, X₃</td>
<td>Pilot-pressure port</td>
<td>ISO 11926</td>
<td>9/16 in -18 UNF-2B</td>
<td>0.51 (13) deep</td>
<td>60 lb-ft (80 Nm)</td>
</tr>
<tr>
<td>G</td>
<td>Port for synchronous control of multiple units and for remote control pressure ³)</td>
<td>ISO 11926</td>
<td>9/16 in -18 UNF-2B</td>
<td>0.51 (13) deep</td>
<td>60 lb-ft (80 Nm)</td>
</tr>
<tr>
<td>G₂</td>
<td>Port for 2nd pressure setting ³)</td>
<td>ISO 11926</td>
<td>9/16 in -18 UNF-2B</td>
<td>0.51 (13) deep</td>
<td>60 lb-ft (80 Nm)</td>
</tr>
<tr>
<td>U</td>
<td>Flow port ³)</td>
<td>ISO 11926</td>
<td>7/8 in -14 UNF-2B</td>
<td>0.67 (17) deep</td>
<td>180 lb-ft (240 Nm)</td>
</tr>
<tr>
<td>M₁</td>
<td>Gauge port for control pressure ³)</td>
<td>ISO 11926</td>
<td>9/16 in -18 UNF-2B</td>
<td>0.51 (13) deep</td>
<td>60 lb-ft (80 Nm)</td>
</tr>
</tbody>
</table>

¹) ANSI B92.1a-1976, pressure angle 30°, flat root, side fit, tolerance class 5

²) please observe the general notes for the max. tightening torques on page 76

³) plugged

Before finalizing your design, please request a binding installation drawing. Dimensions in inches and (mm).
Unit dimensions, size 80 (SAE Version)

**HD.D**
Hydraulic control, pilot-pressure related, with pressure control, direct

**HD.E**
Hydraulic control, pilot-pressure related, with pressure control, direct and 2nd pressure setting

**HZ3**
Hydraulic two-point control

**EP1, EP2**
Electric control with proportional solenoid

**EP.D**
Electric control (proportional solenoid) with pressure control, direct

**EP.E**
Electric control (proportional solenoid) with pressure control, direct and 2nd pressure setting

Before finalizing your design, please request a binding installation drawing. Dimensions in inches and (mm).

Observe the note on page 74
Unit dimensions, size 80 (SAE Version)

**EZ3, EZ4**
Electric two-point control with switching solenoid

**HA1, HA2 / HA1T, HA2T**
Automatic control, high-pressure related / high-pressure related and hydraulic override

**HA1U1, HA2U2**
Automatic control, high-pressure related and electric override

**HA1R1, HA2R2**
Automatic control, high-pressure related, electric override and electric travel direction valve

**DA1, DA4**
Hydraulic control, speed related and hydraulic travel direction valve

**DA2, DA3, DA5, DA6**
Hydraulic control, speed related, el. travel direction valve and el. $V_g_{\text{max}}$ control

Before finalizing your design, please request a binding installation drawing. Dimensions in inches and (mm).

Observe the note on page 74

$X_1, X_2$ with fitting 8B-ST according to DIN 2353-CL
Unit dimensions, size 107 (SAE Version)

HD1, HD2 Hydraulic control, pilot-pressure related

SAE flange ports A/B side, opposite (52)

Before finalizing your design, please request a binding installation drawing. Dimensions in inches and (mm).

View Z

SAE flange ports A/B side, opposite (52)

SAE flange ports A/B, rear (51)

SAE flange ports A/B side, opposite with HZ3, EZ3 (52)

SAE flange ports A/B, rear with HZ3, EZ3 (51)

1) With service line ports A/B rear (plate 51)
Unit dimensions, size 107 (SAE Version)

Shaft end

Ports

<table>
<thead>
<tr>
<th>Port</th>
<th>Description</th>
<th>Threads/Size</th>
<th>Diameter/Depth</th>
<th>Torque</th>
</tr>
</thead>
<tbody>
<tr>
<td>A, B</td>
<td>Service line ports (high-pressure series)</td>
<td>SAE J518 1 in</td>
<td>2.64 (67)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Fixing thread A/B</td>
<td>ISO 68 7/16 in -14 UN-2B</td>
<td>0.87 (22) deep</td>
<td></td>
</tr>
<tr>
<td>T_1</td>
<td>Case drain port ³</td>
<td>ISO 11926 1 1/16 in -12 UN-2B</td>
<td>0.79 (20) deep</td>
<td>265 lb-ft (360 Nm)</td>
</tr>
<tr>
<td>T_2</td>
<td>Case drain port ³</td>
<td>ISO 11926 1 1/16 in -12 UN-2B</td>
<td>0.79 (20) deep</td>
<td>265 lb-ft (360 Nm)</td>
</tr>
<tr>
<td>X, X_1, X_3</td>
<td>Pilot-pressure port ³</td>
<td>ISO 11926 9/16 in -18 UNF-2B</td>
<td>0.51 (13) deep</td>
<td>60 lb-ft (80 Nm)</td>
</tr>
<tr>
<td>G</td>
<td>Port for synchronous control of multiple units and for remote control pressure ³</td>
<td>ISO 11926 9/16 in -18 UNF-2B</td>
<td>0.51 (13) deep</td>
<td>60 lb-ft (80 Nm)</td>
</tr>
<tr>
<td>G_2</td>
<td>Port for 2nd pressure setting ³</td>
<td>ISO 11926 9/16 in -18 UNF-2B</td>
<td>0.51 (13) deep</td>
<td>60 lb-ft (80 Nm)</td>
</tr>
<tr>
<td>U</td>
<td>Flow port ³</td>
<td>ISO 11926 7/8 in -14 UNF-2B</td>
<td>0.67 (17) deep</td>
<td>180 lb-ft (240 Nm)</td>
</tr>
<tr>
<td>M_1</td>
<td>Gauge port for control pressure ³</td>
<td>ISO 11926 9/16 in -18 UNF-2B</td>
<td>0.51 (13) deep</td>
<td>60 lb-ft (80 Nm)</td>
</tr>
</tbody>
</table>

¹) ANSI B92.1a-1976, pressure angle 30°, flat root, side fit, tolerance class 5
²) please observe the general notes for the max. tightening torques on page 76
³) plugged

Before finalizing your design, please request a binding installation drawing. Dimensions in inches and (mm).
Unit Dimensions, Size 107 (SAE Version)

Before finalizing your design, please request a binding installation drawing. Dimensions in inches and (mm).

**HD.D**
Hydraulic control, pilot-pressure related, with pressure control, direct

**HD.E**
Hydraulic control, pilot-pressure related, with pressure control, direct and 2nd pressure setting

**HZ3**
Hydraulic two-point control

**EP1, EP2**
Electric control with proportional solenoid

**EP.D**
Electric control (proportional solenoid) with pressure control, direct

**EP.E**
Electric control (proportional solenoid) with pressure control, direct and 2nd pressure setting

Observe the note on page 74
Unit Dimensions, Size 107 (SAE Version)

Before finalizing your design, please request a binding installation drawing. Dimensions in inches and (mm).

**EZ3, EZ4**
Electric two-point control with switching solenoid

**HA1, HA2 / HA1T, HA2T**
Automatic control, high-pressure related / high-pressure related and hydraulic override

**HA1U1, HA2U2**
Automatic control, high-pressure related and electric override

**HA1R1, HA2R2**
Automatic control, high-pressure related, electric override and electric travel direction valve

**DA1, DA4**
Hydraulic control, speed related and hydraulic travel direction valve

**DA2, DA3, DA5, DA6**
Hydraulic control, speed related, el. travel direction valve and el. \( V_{g\ max} \) control

X1, X2 with fitting 8B-ST according to DIN 2353-CL
Unit dimensions, size 140 (ISO Version)

HD1, HD2 Hydraulic control, pilot-pressure related
HZ1 Hydraulic two-point control
SAE flange ports A/B side, opposite (02)

View Z
SAE flange ports
A/B side, opposite (02)

Before finalizing your design, please request a binding installation drawing. Dimensions in inches and (mm).

1) With service line ports A/B rear (plate 01)
### Unit dimensions, size 140 (ISO Version)

#### Shaft end

![Diagram of shaft end with dimensions labeled Z, Ports A, B, T1, T2, X, X1, X3, G, G2, U, and M1 with corresponding tolerances and thread information.]

#### Ports

<table>
<thead>
<tr>
<th>Port</th>
<th>Description</th>
<th>Thread</th>
<th>Diameter/Depth</th>
<th>Torque</th>
</tr>
</thead>
<tbody>
<tr>
<td>A, B</td>
<td>Service line ports (high-pressure series)</td>
<td>SAE J518</td>
<td>1 1/4 in</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Fixing thread A/B</td>
<td>DIN 13</td>
<td>M14x2; 0.75 (19) deep</td>
<td></td>
</tr>
<tr>
<td>T1</td>
<td>Case drain port (^3)</td>
<td>DIN 3852</td>
<td>M26x1.5; 0.63 (16) deep</td>
<td>170 lb-ft (230 Nm) (^2)</td>
</tr>
<tr>
<td>T2</td>
<td>Case drain port</td>
<td>DIN 3852</td>
<td>M26x1.5; 0.63 (16) deep</td>
<td>170 lb-ft (230 Nm) (^2)</td>
</tr>
<tr>
<td>X, X1, X3</td>
<td>Pilot-pressure port</td>
<td>DIN 3852</td>
<td>M14x1.5; 0.47 (12) deep</td>
<td>60 lb-ft (80 Nm) (^2)</td>
</tr>
<tr>
<td>G</td>
<td>Port for synchronous control of multiple units and for remote control pressure (^3)</td>
<td>DIN 3852</td>
<td>M14x1.5; 0.47 (12) deep</td>
<td>60 lb-ft (80 Nm) (^2)</td>
</tr>
<tr>
<td>G2</td>
<td>Port for 2nd pressure setting (^3)</td>
<td>DIN 3852</td>
<td>M14x1.5; 0.47 (12) deep</td>
<td>60 lb-ft (80 Nm) (^2)</td>
</tr>
<tr>
<td>U</td>
<td>Flow port (^3)</td>
<td>DIN 3852</td>
<td>M22x1.5; 0.55 (14) deep</td>
<td>70 lb-ft (210 Nm) (^2)</td>
</tr>
<tr>
<td>M1</td>
<td>Gauge port for control pressure (^3)</td>
<td>DIN 3852</td>
<td>M14x1.5; 0.47 (12) deep</td>
<td>60 lb-ft (80 Nm) (^2)</td>
</tr>
</tbody>
</table>

\(^1\) Center bore according to DIN 332 (thread according to DIN 13)

\(^2\) Please observe the general notes for the max. tightening torques on page 76

\(^3\) Plugged

Before finalizing your design, please request a binding installation drawing. Dimensions in inches and (mm).
Unit dimensions, size 140 (ISO Version)

**HD.D**
Hydraulic control, pilot-pressure related, with pressure control, direct

Before finalizing your design, please request a binding installation drawing. Dimensions in inches and (mm).

**HD.E**
Hydraulic control, pilot-pressure related, with pressure control, direct and 2nd pressure setting

**EP1, EP2**
Electric control with proportional solenoid

Observe the note on page 74

**EP.D**
Electric control (proportional solenoid) with pressure control, direct

Observe the note on page 74

**EP.E**
Electric control (proportional solenoid) with pressure control, direct and 2nd pressure setting

Observe the note on page 74
Unit dimensions, size 140 (ISO Version)

**EZ1, EZ2**
Electric two-point control with switching solenoid

**HA1, HA2 / HA1T, HA2T**
Automatic control, high-pressure related / high-pressure related and hydraulic override

**HA1U1, HA2U2**
Automatic control, high-pressure related and electric override

**HA1R1, HA2R2**
Automatic control, high-pressure related, electric override and electric travel direction valve

**DA1, DA4**
Hydraulic control, speed related and hydraulic travel direction valve

**DA2, DA3, DA5, DA6**
Hydraulic control, speed related, el. travel direction valve and el. V_{g max} control

Before finalizing your design, please request a binding installation drawing. Dimensions in inches and (mm).
Unit dimensions, size 160 (SAE Version)

HD1, HD2 Hydraulic control, pilot-pressure related
HZ1 Hydraulic two-point control
SAE flange ports A/B side, opposite (52)

Before finalizing your design, please request a binding installation drawing. Dimensions in inches and (mm).

View Z
SAE flange ports
A/B side, opposite (52)

1) With service line ports A/B rear (plate 51)
Unit dimensions, size 160 (SAE Version)

Shaft end

<table>
<thead>
<tr>
<th>Port</th>
<th>Description</th>
<th>Thread Specification</th>
<th>Size</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>S</td>
<td>Splined shaft 1 3/4in 13T 8/16DP (^1)</td>
<td>SAE J744 - 44-4 (D)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(SAE J744 - 44-4 (D))</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>T1</td>
<td>Case drain port (^3)</td>
<td>ISO 11926</td>
<td>1 1/16</td>
<td>0.79 (20) deep 265 lb-ft (360 Nm) (^2)</td>
</tr>
<tr>
<td>T2</td>
<td>Case drain port</td>
<td>ISO 11926</td>
<td>1 1/16</td>
<td>0.79 (20) deep 265 lb-ft (360 Nm) (^2)</td>
</tr>
<tr>
<td>X, X1, X3</td>
<td>Pilot-pressure port</td>
<td>ISO 11926</td>
<td>9/16</td>
<td>0.51 (13) deep 60 lb-ft (80 Nm) (^2)</td>
</tr>
<tr>
<td>G</td>
<td>Port for synchronous control of multiple units</td>
<td>ISO 11926</td>
<td>9/16</td>
<td>0.51 (13) deep 60 lb-ft (80 Nm) (^2)</td>
</tr>
<tr>
<td></td>
<td>and for remote control pressure (^3)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>G2</td>
<td>Port for 2nd pressure setting (^3)</td>
<td>ISO 11926</td>
<td>9/16</td>
<td>0.51 (13) deep 60 lb-ft (80 Nm) (^2)</td>
</tr>
<tr>
<td>U</td>
<td>Flow port (^3)</td>
<td>ISO 11926</td>
<td>7/8</td>
<td>0.67 (17) deep 180 lb-ft (240 Nm) (^2)</td>
</tr>
<tr>
<td>M1</td>
<td>Gauge port for control pressure (^3)</td>
<td>ISO 11926</td>
<td>9/16</td>
<td>0.51 (13) deep 60 lb-ft (80 Nm) (^2)</td>
</tr>
</tbody>
</table>

\(^1\) ANSI B92.1a-1976, pressure angle 30°, flat root, side fit, tolerance class 5

\(^2\) please observe the general notes for the max. tightening torques on page 76

\(^3\) plugged

Before finalizing your design, please request a binding installation drawing. Dimensions in inches and (mm).
Unit dimensions, size 160 (SAE Version)

**HD.D**
Hydraulic control, pilot-pressure related, with pressure control, direct

**HD.E**
Hydraulic control, pilot-pressure related, with pressure control, direct and 2nd pressure setting

**EP1, EP2**
Electric control with proportional solenoid

**EP.D**
Electric control (proportional solenoid) with pressure control, direct

**EP.E**
Electric control (proportional solenoid) with pressure control, direct and 2nd pressure setting

Before finalizing your design, please request a binding installation drawing. Dimensions in inches and (mm).

Observe the note on page 74
Unit dimensions, size 160 (SAE Version)

**EZ1, EZ2**
Electric two-point control with switching solenoid

**HA1, HA2 / HA1T, HA2T**
Automatic control, high-pressure related / high-pressure related and hydraulic override

**HA1U1, HA2U2**
Automatic control, high-pressure related and electric override

**HA1R1, HA2R2**
Automatic control, high-pressure related, electric override and electric travel direction valve

**DA1, DA4**
Hydraulic control, speed related and hydraulic travel direction valve

**DA2, DA3, DA5, DA6**
Hydraulic control, speed related, el. travel direction valve and el. V_{g\text{ max}} control

Before finalizing your design, please request a binding installation drawing. Dimensions in inches and (mm).

Observe the note on page 74

X₁, X₂ with fitting 8B-ST according to DIN 2353-CL
Unit dimensions, size 200 (SAE Version)

HD1, HD2 Hydraulic control, pilot-pressure related
HZ1 Hydraulic two-point control

SAE flange ports A/B side, opposite (52)

Before finalizing your design, please request a binding installation drawing. Dimensions in inches and (mm).

View Z

SAE flange ports
A/B side, opposite (52)

SAE flange ports
A/B rear (51)
Unit dimensions, size 200 (SAE Version)

Shaft end

Splined shaft 2in 15T 8/16DP

Similar to SAE J744 – 50-4 (F)

Length (2.64 in) deviates from standard (3.125 in)

Ports

<table>
<thead>
<tr>
<th>Port</th>
<th>Description</th>
<th>Thread</th>
<th>Length</th>
<th>Torque</th>
</tr>
</thead>
<tbody>
<tr>
<td>A, B</td>
<td>Service line ports (high-pressure series)</td>
<td>SAE J518</td>
<td>1/4 in</td>
<td>60 lb-ft (80 Nm)</td>
</tr>
<tr>
<td></td>
<td>Fixing thread</td>
<td>ISO 68</td>
<td>1/2 in -13 UNC-2B</td>
<td>0.75 (19) deep</td>
</tr>
<tr>
<td>T1</td>
<td>Case drain port</td>
<td>ISO 11926</td>
<td>1/16 in -12 UN-2B</td>
<td>0.79 (20) deep</td>
</tr>
<tr>
<td>T2</td>
<td>Case drain port</td>
<td>ISO 11926</td>
<td>1/16 in -12 UN-2B</td>
<td>0.79 (20) deep</td>
</tr>
<tr>
<td>X, X1, X3</td>
<td>Pilot-pressure port</td>
<td>ISO 11926</td>
<td>9/16 in -18 UNF-2B</td>
<td>0.51 (13) deep</td>
</tr>
<tr>
<td>G</td>
<td>Port for synchronous control of multiple units and for remote control pressure</td>
<td>ISO 11926</td>
<td>9/16 in -18 UNF-2B</td>
<td>0.51 (13) deep</td>
</tr>
<tr>
<td>G2</td>
<td>Port for 2nd pressure setting</td>
<td>ISO 11926</td>
<td>9/16 in -18 UNF-2B</td>
<td>0.51 (13) deep</td>
</tr>
<tr>
<td>U</td>
<td>Flow port</td>
<td>ISO 11926</td>
<td>7/8 in -14 UNF-2B</td>
<td>0.67 (17) deep</td>
</tr>
<tr>
<td>M1</td>
<td>Gauge port for control pressure</td>
<td>ISO 11926</td>
<td>9/16 in -18 UNF-2B</td>
<td>0.51 (13) deep</td>
</tr>
</tbody>
</table>

1) ANSI B92.1a-1976, pressure angle 30°, flat root side, tolerance class 5
2) please observe the general notes for the max. tightening torques on page 76
3) plugged

Before finalizing your design, please request a binding installation drawing. Dimensions in inches and (mm).
Unit dimensions, size 200 (SAE Version)

**HD.D**
Hydraulic control, pilot-pressure related, with pressure control, direct

**HD.E**
Hydraulic control, pilot-pressure related, with pressure control, direct and 2nd pressure setting

**EP1, EP2**
Electric control with proportional solenoid

**EP.D**
Electric control (proportional solenoid) with pressure control, direct

**EP.E**
Electric control (proportional solenoid) with pressure control, direct and 2nd pressure setting

Dimensions in inches and (mm).

Before finalizing your design, please request a binding installation drawing.

Observe the note on page 74.
Unit dimensions, size 200 (SAE Version)

**EZ1, EZ2**
Electric two-point control with switching solenoid

**HA1, HA2 / HA1T, HA2T**
Automatic control, high-pressure related / high-pressure related and hydraulic override

**HA1U1, HA2U2**
Automatic control, high-pressure related and Electric override

**HA1R1, HA2R2**
Automatic control, high-pressure related, electric override and electric travel direction valve

**DA1, DA4**
Hydraulic control, speed related and hydraulic travel direction valve

**DA2, DA3, DA5, DA6**
Hydraulic control, speed related, el. travel direction valve and el. $V_{g\ max}$ control

Before finalizing your design, please request a binding installation drawing. Dimensions in inches and (mm).
Unit dimensions, size 250 (SAE Version)

HD1, HD2 Hydraulic control, pilot-pressure related
HZ - Hydraulic two-point control
SAE flange ports A/B side, opposite (52)

Before finalizing your design, please request a binding installation drawing. Dimensions in inches and (mm).

View Z
SAE flange ports A/B side, opposite (52)
SAE flange ports A/B rear (51)

1) With service line ports A/B rear (plate 51)
Unit dimensions, size 250 (SAE Version)

Shaft end

**S** Splined shaft 2in 15T 8/16DP ¹)

*Similar to SAE J744 – 50-4 (F)*

Length (2.64 in) deviates from standard (3.125 in)

Ports

- **A, B** Service line ports (high-pressure series) SAE J518 1 1/4 in
  - Fixing thread A/B ISO 68 1/2 in-13 UNC-2B; 0.75 (19) deep ²)
- **T₁** Case drain port ISO 11926 7/8 in -14 UNF-2B; 0.67 (17) deep 180 lb-ft(240 Nm) ²)
- **T₂** Case drain port ³)
- **X** Pilot-pressure port ISO 11926 9/16 in -14 UNF-2B; 0.51 (13) deep 180 lb-ft(240 Nm) ²)
- **X₃** Port for remote control valve ISO 11926 9/16 in -14 UNF-2B; 0.51 (13) deep 180 lb-ft(240 Nm) ²)
- **P** Port for control oil supply ISO 11926 9/16 in -14 UNF-2B; 0.51 (13) deep 180 lb-ft(240 Nm) ²)
- **G** Port for synchronous control of multiple units and for remote control pressure ³)
  - ISO 11926 9/16 in -14 UNF-2B; 0.51 (13) deep 180 lb-ft(240 Nm) ²)
- **G₂** Port for 2nd pressure setting ³)
  - ISO 11926 9/16 in -14 UNF-2B; 0.51 (13) deep 180 lb-ft(240 Nm) ²)
- **U** Flow port ³)
  - ISO 11926 9/16 in -14 UNF-2B; 0.51 (13) deep 180 lb-ft(240 Nm) ²)
- **M**, **Mₐ**, **Mₜ** Gauge port for control pressure ³)
  - ISO 11926 9/16 in -14 UNF-2B; 0.51 (13) deep 180 lb-ft(240 Nm) ²)
- **Mₚₗt** Gauge port for pilot pressure ³)
  - ISO 11926 9/16 in -14 UNF-2B; 0.51 (13) deep 180 lb-ft(240 Nm) ²)

¹) ANSI B92.1a-1976, pressure angle 30°, flat root side, tolerance class 5
²) please observe the general notes for the max. tightening torques on page 76
³) plugged
Unit dimensions, size 250

**HD.D**
Hydraulic control pilot-pressure related, with pressure control, direct; HD.G remote

**EP1, EP2**
Electric control, with proportional valve

**EZ1, EZ2**
Electric two-point control with switching valve

**HA1, HA2 / HA1T, HA2T**
Automatic control, high-pressure related / high-pressure related and hydraulic override

**DA**
Hydraulic control, speed related and with hydraulic travel direction valve

Before finalizing your design, please request a binding installation drawing. Dimensions in inches and (mm).
Unit dimensions, size 355 (ISO Version)

HD1, HD2 Hydraulic control, pilot-pressure related

HZ - Hydraulic two-point control

SAE flange ports A/B side, opposite (02)

Before finalizing your design, please request a binding installation drawing. Dimensions in inches and (mm).

View Z

SAE flange ports A/B side, opposite (02)

SAE flange ports A/B rear (01)

SAE flange ports A/B side, opposite + A1/B1 rear (15)
Unit dimensions, size 355 (ISO Version)

Shaft ends

**A** Splined shaft DIN 5480
- W60x2x30x28x9g
- 1.65 (42)
- 0.59 (15)
- M20x2.5 (11)
- DIA2.76 (ø70)
- 0.43 (11)
- 3.23 (82)

**P** Parallel shaft with key DIN 6885, AS18x11x100
- 1.65 (42)
- 0.59 (15)
- M20x2.5 (11)
- DIA2.76 (ø70)
- 2.52 (64)
- 4.13 (105)

Ports

- **A, B** Service line ports (high-pressure series) SAE J518 1 1/2 in
- **A1, B1** Additional service line ports with plate 15 SAE J518 1 1/2 in
- **A/B and A1/B1** Fixing thread DIN 13 M16x2; 0.94 (24) deep ²)
- **T1** Case drain port ³) DIN 3852 M33x2; 0.71 (18) deep 400 lb-ft (540 Nm) ²)
- **T2** Case drain port DIN 3852 M33x2; 0.71 (18) deep 400 lb-ft (540 Nm) ²)
- **X, X1, X2** Pilot-pressure port DIN 3852 M14x1.5; 0.47 (12) deep 60 lb-ft (80 Nm) ²)
- **X3** Port for remote control valve DIN 3852 M14x1.5; 0.47 (12) deep 60 lb-ft (80 Nm) ²)
- **P** Port for control oil supply DIN 3852 M14x1.5; 0.47 (12) deep 60 lb-ft (80 Nm) ²)
- **G** Port for synchronous control of multiple units and for remote control pressure ³)
- **G2** Port for 2nd pressure setting ³) DIN 3852 M14x1.5; 0.47 (12) deep 60 lb-ft (80 Nm) ²)
- **U** Flow port ³) DIN 3852 M14x1.5; 0.47 (12) deep 60 lb-ft (80 Nm) ²)
- **M** Gauge port for control pressure ³) DIN 3852 M14x1.5; 0.47 (12) deep 60 lb-ft (80 Nm) ²)
- **Ma, Mb** Gauge port for operating pressure ³) DIN 3852 M14x1.5; 0.47 (12) deep 60 lb-ft (80 Nm) ²)
- **Mc** Gauge port for pilot pressure ³) DIN 3852 M14x1.5; 0.47 (12) deep 60 lb-ft (80 Nm) ²)

¹) center bore according to DIN 332 (thread according to DIN 13)
²) please observe the general notes for the max. tightening torques on page 76
³) plugged

Before finalizing your design, please request a binding installation drawing. Dimensions in inches and (mm).
Unit dimensions, size 355 (ISO Version)

**HD.D**
Hydraulic control pilot-pressure related, with pressure control, direct; HD.G remote

**EP1, EP2**
Electric control, with proportional valve

**EZ1, EZ2**
Electric two-point control with switching valve

**HA1, HA2 / HA1T, HA2T**
Automatic control, high-pressure related / high-pressure related and hydraulic override

**DA**
Hydraulic control, speed related and with hydraulic travel direction valve

Before finalizing your design, please request a binding installation drawing. Dimensions in inches and (mm).
Unit dimensions, size 500 (ISO Version)

HD1, HD2 Hydraulic control, pilot-pressure related
HZ - Hydraulic two-point control
SAE flange ports A/B side, opposite (02)

Before finalizing your design, please request a binding installation drawing. Dimensions in inches and (mm).

View Z

SAE flange ports
A/B side, opposite (02)

SAE flange ports
A/B rear (01)

SAE flange ports
A/B side, opposite + A1/B1 rear (15)

1) With service line ports A/B rear (plate 01/15)
Unit dimensions, size 500 (ISO Version)

Shaft ends

A  Splined shaft DIN 5480
   W70x3x30x22x9g
   1.65  0.59  3.15
   M20(2.5,1.2)

P  Parallel shaft with key
   DIN 6885, AS20x12x100
   1.65  0.59
   M20(2.5,1.2)

Ports

A, B  Service line ports (high-pressure series)  SAE J518  1 1/2 in
A₁, B₁ Additional service line ports with plate 15  SAE J518  1 1/2 in
Fixing thread A/B and A₁/B₁  DIN 13 M16x2;  0.94 (24 deep) ²)
T₁  Case drain port  DIN 3852 M33x2;  0.71 (18) deep  400 lb-ft (540 Nm) ²)
T₂  Case drain port ³)
X, X₁, X₂  Pilot-pressure port  DIN 3852 M14x1.5;  0.47 (12) deep  60 lb-ft (80 Nm) ³)
X₃  Port for remote control valve  DIN 3852 M14x1.5;  0.47 (12) deep  60 lb-ft (80 Nm) ³)
P  Port for control oil supply  DIN 3852 M14x1.5;  0.47 (12) deep  60 lb-ft (80 Nm) ³)
G  Port for synchronous control of multiple units and for remote control pressure ³)
G₂  Port for 2nd pressure setting ³)
U  Flow port ³)
M  Gauge port for control pressure ³)
Mₘₐ, Mₘₑ  Gauge port for operating pressure ³)
Mₘₜ  Gauge port for pilot pressure ³)

1) center bore according to DIN 332 (thread according to DIN 13)
2) please observe the general notes for the max. tightening torques on page 76
3) plugged

Before finalizing your design, please request a binding installation drawing. Dimensions in inches and (mm).
Unit dimensions, size 500 (ISO Version)

Before finalizing your design, please request a binding installation drawing. Dimensions in inches and (mm).

**HD.D**
Hydraulic control pilot-pressure related, with pressure control, direct; HD.G remote

**EP1, EP2**
Electric control, with proportional valve

**EZ1, EZ2**
Electric two-point control with switching valve

**HA1, HA2 / HA1T, HA2T**
Automatic control, high-pressure related / high-pressure related and hydraulic override

**DA**
Hydraulic control, speed related and with hydraulic travel direction valve
Unit dimensions, size 1000 (ISO Version)

HD1, HD2 Hydraulic control, pilot-pressure related
HZ Hydraulic two-point control
SAE flange ports A/B side, opposite (02)

View Z

Before finalizing your design, please request a binding installation drawing. Dimensions in inches and (mm).

1) With service line ports A/B rear (plate 01/15)
Unit dimensions, size 1000 (ISO Version)

Shaft ends

A  Splined shaft DIN 5480
   W90x3x30x28x9g
   
   1.97 (50)
   0.71 (18)
   M24x3 (1)
   0.55 (14)
   4.13 (105)

P  Parallel shaft with key
   DIN 8885, AS25x14x125
   
   1.97 (50)
   0.71 (18)
   M24x3 (1)
   3.74 (85)
   5.12 (130)

Ports

A, B  Service line ports (high-pressure series)  SAE J518  2 in
A1, B1 Additional service line ports with plate 15  SAE J518  2 in
   Fixing thread A/B and A1/B1  DIN 13  M20x2.5; 0.94 (24) deep  2)
   Case drain port  DIN 3852  M42x2; 0.79 (20) deep  530 lb-ft (720 Nm)  2)
   Case drain port  3)  DIN 3852  M42x2; 0.79 (20) deep  530 lb-ft (720 Nm)  2)
   Pilot-pressure port  DIN 3852 M14x1.5; 0.47 (12) deep  60 lb-ft (80 Nm)  2)
   Port for remote control valve  DIN 3852 M14x1.5; 0.47 (12) deep  60 lb-ft (80 Nm)  2)
   Port for control oil supply  DIN 3852 M14x1.5; 0.47 (12) deep  60 lb-ft (80 Nm)  2)
   Port for synchronous control of multiple units and for remote control pressure  3)
   Port for 2nd pressure setting  3)  DIN 3852 M18x1.5; 0.47 (12) deep  100 lb-ft (140 Nm)  2)
   Flow port  3)  DIN 3852 M18x1.5; 0.47 (12) deep  100 lb-ft (140 Nm)  2)
   Gauge port for control pressure  3)  DIN 3852 M14x1.5; 0.47 (12) deep  60 lb-ft (80 Nm)  2)
   Gauge port for operating pressure  3)  DIN 3852 M14x1.5; 0.47 (12) deep  60 lb-ft (80 Nm)  2)
   Gauge port for pilot pressure  3)  DIN 3852 M14x1.5; 0.47 (12) deep  60 lb-ft (80 Nm)  2)

1) center bore according to DIN 332 (thread according to DIN 13)
2) please observe the general notes for the max. tightening torques on page 76
3) plugged

Before finalizing your design, please request a binding installation drawing. Dimensions in inches and (mm).
Unit dimensions, size 1000 (ISO Version)

**HD.D**
Hydraulic control pilot-pressure related, with pressure control, direct; **HD.G** remote

**EP1, EP2**
Electric control, with proportional valve

**EZ1, EZ2**
Electric two-point control with switching valve

Before finalizing your design, please request a binding installation drawing. Dimensions in inches and (mm).
Flush and boost pressure valve

The flush and boost pressure valve is used to remove heat from the closed circuit and to ensure that a minimum boost pressure is present (opening pressure 230 psi (16 bar), fixed; note when setting primary valve). A side effect is flushing of the case.

Warm hydraulic fluid is removed from the respective low pressure side into the motor case. This is then fed into the tank, together with the case drain fluid. The hydraulic fluid drawn out of the closed circuit in this way must be replaced by cooled hydraulic fluid that is pumped in by the boost pump.

In the open circuit, the flush and boost pressure valve is used solely to flush the case from the return line.

The valve is mounted to the variable motor or integrated into the control unit (depending on the type of control and the size).

Orifices can be used to adjust the flushing volumes as required.

**Standard flushing volumes** (at low pressure $\Delta p_{LP} = 365$ psi (25 bar))

<table>
<thead>
<tr>
<th>Size</th>
<th>Flushing volume</th>
<th>Mat. no. of the orifice</th>
</tr>
</thead>
<tbody>
<tr>
<td>28, 55</td>
<td>0.9 gpm (3.5 l/min)</td>
<td>R09651766</td>
</tr>
<tr>
<td>80</td>
<td>1.3 gpm (5 l/min)</td>
<td>R09419695</td>
</tr>
<tr>
<td>107</td>
<td>2.1 gpm (8 l/min)</td>
<td>R09419696</td>
</tr>
<tr>
<td>140, 160, 200</td>
<td>2.6 gpm (10 l/min)</td>
<td>R09419697</td>
</tr>
<tr>
<td>250</td>
<td>2.6 gpm (10 l/min)</td>
<td>R09419697</td>
</tr>
<tr>
<td>355, 500, 1000</td>
<td>4.2 gpm (16 l/min)</td>
<td>R91803019</td>
</tr>
</tbody>
</table>

For sizes 28 to 200, orifices for flushing volumes of 1.3 - 2.6 gpm (3.5 - 10 l/min) can be supplied. In the case of non-standard flushing volumes, please specify the desired flushing volume when ordering. The flushing volume without orifice is approx. 3.17 to 3.70 gpm (12 to 14 l) at low pressure $\Delta p_{LP} = 365$ psi (25 bar).
Flush and boost pressure valve

Dimensions

Sizes 28 to 200

<table>
<thead>
<tr>
<th>Size</th>
<th>A1</th>
<th>A2</th>
<th>A3</th>
<th>A4</th>
</tr>
</thead>
<tbody>
<tr>
<td>A6VM</td>
<td>28</td>
<td>8.43 (214)</td>
<td>4.92 (125)</td>
<td>6.34 (161)</td>
</tr>
<tr>
<td></td>
<td>140</td>
<td>12.64 (321)</td>
<td>6.06 (154)</td>
<td>8.58 (218)</td>
</tr>
<tr>
<td>AA6VM</td>
<td>55</td>
<td>10.51 (267)</td>
<td>5.24 (133)</td>
<td>6.93 (176)</td>
</tr>
<tr>
<td></td>
<td>80</td>
<td>11.69 (297)</td>
<td>5.59 (142)</td>
<td>7.60 (193)</td>
</tr>
<tr>
<td></td>
<td>107</td>
<td>12.60 (320)</td>
<td>5.67 (144)</td>
<td>7.87 (200)</td>
</tr>
<tr>
<td></td>
<td>160</td>
<td>14.17 (360)</td>
<td>6.06 (154)</td>
<td>8.66 (220)</td>
</tr>
<tr>
<td></td>
<td>200</td>
<td>14.84 (377)</td>
<td>6.30 (160)</td>
<td>9.09 (231)</td>
</tr>
</tbody>
</table>

Sizes 250 to 1000

<table>
<thead>
<tr>
<th>Size</th>
<th>A1</th>
<th>A2</th>
</tr>
</thead>
<tbody>
<tr>
<td>A6VM</td>
<td>250</td>
<td>15.71 (399)</td>
</tr>
<tr>
<td></td>
<td>355</td>
<td>15.63 (397)</td>
</tr>
<tr>
<td></td>
<td>500</td>
<td>17.32 (440)</td>
</tr>
<tr>
<td></td>
<td>1000</td>
<td>21.73 (552)</td>
</tr>
</tbody>
</table>
BVD counterbalance valve (sizes 55 to 160)

Function
Driving/winch counterbalance valves are designed to reduce the danger of overspeeding and cavitation of axial piston motors in open circuits. Cavitation occurs if the motor speed is greater than it should be for the given flow during braking, downhill travel or decrease in motor load.

Please note
- The BVD counterbalance valve must be specified explicitly in the order. We recommend ordering the counterbalance valve and the motor as a set. Ordering example: AA6VM80HA1T/63W–VSC380A + BVD20F27S/41B–V03K16D0400S12
- For safety reasons, winch drives are forbidden with start of control at \( V_{g_{\text{min}}} \) (e.g. HA)!
- The counterbalance valve does not replace the mechanical service brake and parking brake.
- Note the detailed information about the BVD counterbalance valve in RE 95522

Driving counterbalance valve BVD...F
Example of application
- Travel drive on wheeled excavators

Winch counterbalance valve BVD...W
Typical applications
- Winch drives in cranes
- Track drive in excavator crawlers

Example circuit diagram for travel drive on wheeled excavators
AA6VM80HA1T/63W–VSC380A + BVD20F27S/41B–V03K16D0400S12

Example circuit diagram for winch gears in cranes
AA6VM80HD1D/63W–VSC380B + BVD20W27L/41B–V01K00D0600S00
BVD counterbalance valve (sizes 55 to 160)

Before finalizing your design, please request a binding installation drawing. Dimensions in inches and (mm).

**Dimensions**

(A)A6VM to HA

![Diagram of A6VM to HA counterbalance valve](image)

(A)A6VM to HD and EP

![Diagram of A6VM to HD and EP counterbalance valve](image)

**Ports on the counterbalance valve**

A, B Service line ports
S Boosting (plugged)
Gext. Brake release, high pressure, plugged
Br Brake release, reduced high pressure, open

1) In the installation version for the HD and EP controls, the molded connection designations on the brake valve do not correspond with the connection designation of the A6VM. The designation of the connections on the engine installation drawing is binding!

2) Ports on the counterbalance valve

A, B Service line ports
S Boosting (plugged)
Gext. Brake release, high pressure, plugged
Br Brake release, reduced high pressure, open

Version S "Port for brake release with high pressure"
Version L "Port for brake release with reduced high pressure"
BVD counterbalance valve (sizes 55 to 160)

Attaching the counterbalance valve

When delivered, the counterbalance valve is attached to the motor using 2 tacking screws. Do not remove the tacking screws when connecting the service lines. If the counterbalance valve and motor are delivered separately, the counterbalance valve must first be attached to the motor port plate using the provided tacking screws. In both cases, the final attachment of the counterbalance valve to the motor is by the connection of the service lines, e.g. using SAE 4-bolt flanges. A total of 6 screws with thread lengths B1+B2+B3 and 2 screws with thread lengths B3+B4 are required.

When tightening the screws, it is imperative that the sequence 1 to 8 (as shown in the adjacent diagram) be adhered to and carried out in two phases.

In the first phase the screws should be tightened to 50% of their tightening torque before being tightened to maximum tightening torque in the second phase (see table below).

<table>
<thead>
<tr>
<th>Thread</th>
<th>Property class</th>
<th>Tightening torque in lb-ft (Nm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>M10</td>
<td>10.9</td>
<td>55 (75)</td>
</tr>
<tr>
<td>M12</td>
<td>10.9</td>
<td>95 (130)</td>
</tr>
<tr>
<td>M14</td>
<td>10.9</td>
<td>150 (205)</td>
</tr>
</tbody>
</table>

1) Flange, e.g. SAE flange

<table>
<thead>
<tr>
<th>Size...Plate</th>
<th>55...38</th>
<th>80...38</th>
<th>107, 140, 160...38</th>
</tr>
</thead>
<tbody>
<tr>
<td>B1 2)</td>
<td>M10x1.5</td>
<td>M12x1.75</td>
<td>M14x2</td>
</tr>
<tr>
<td></td>
<td>0.67 (17) deep</td>
<td>0.59 (15) deep</td>
<td>0.75 (19) deep</td>
</tr>
<tr>
<td>B2</td>
<td>2.68 (68)</td>
<td>2.68 (68)</td>
<td>3.35 (85)</td>
</tr>
<tr>
<td>B3</td>
<td>Customer specific</td>
<td></td>
<td></td>
</tr>
<tr>
<td>B4</td>
<td>M10x1.5</td>
<td>M12x1.75</td>
<td>M14x2</td>
</tr>
<tr>
<td></td>
<td>0.59 (15) deep</td>
<td>0.63 (16) deep</td>
<td>0.75 (19) deep</td>
</tr>
</tbody>
</table>

2) Minimum required reach 1 x DIA. thread

Before finalizing your design, please request a binding installation drawing. Dimensions in inches and (mm).
Swivel angle indicator (Sizes 250 to 1000)

Optical swivel angle indicator (V)

The swivel position is indicated by a pin on the side of the port plate. The length of the protruding pin is dependent on the position of the lens plate.

If the pin is flush with the port plate, the motor is positioned at the start of control. At max. swivel, the pin length is 0.31 in (8 mm) (visible after removing the cap nut).

Sizes 250 to 1000

Example: Start of control at $V_g$ min

<table>
<thead>
<tr>
<th>Size</th>
<th>A1</th>
<th>A2</th>
<th>A3</th>
<th>A4</th>
<th>A5</th>
<th>A6</th>
</tr>
</thead>
<tbody>
<tr>
<td>AA6-</td>
<td>5.37</td>
<td>11.73</td>
<td>2.87</td>
<td>11.02</td>
<td>0.43</td>
<td>0.20</td>
</tr>
<tr>
<td>AA6VM</td>
<td>6.28</td>
<td>11.34</td>
<td>3.31</td>
<td>10.47</td>
<td>0.43</td>
<td>0.31</td>
</tr>
<tr>
<td>500</td>
<td>6.79</td>
<td>13.03</td>
<td>3.50</td>
<td>12.17</td>
<td>0.43</td>
<td>0.12</td>
</tr>
<tr>
<td>1000</td>
<td>8.21</td>
<td>16.93</td>
<td>4.49</td>
<td>15.83</td>
<td>0.43</td>
<td>0.12</td>
</tr>
</tbody>
</table>

1) Width across flats
2) Distance to mounting flange
3) Clearance required for removing the cap nut

Electric swivel angle indicator (E)

The motor position is measured by an inductive pos. transducer. It converts the stroke of the control device to an electric signal.

This signal can be used to pass the swivel position to an electric controller.

Inductive pos. transducer type IW9–03–01
Type of protection according to DIN/EN 60529: IP65

Sizes 250 to 1000

Example: Start of control at $V_g$ max

Before finalizing your design, please request a binding installation drawing. Dimensions in inches and (mm).
Speed measurement (sizes 28 to 500)

The (A)A6VM...D and (A)A6VM...F ("prepared for speed measurement", i.e. without sensor) versions have teeth on the rotary group. The rotating, toothed rotary group generates a signal in proportion to the speed. The signal is picked up by a sensor and can be forwarded for evaluation.

Note

- For sizes 28 to 200 with speed measurement, only port T2 may be used to drain the case drain.

Version "D" (NG 28 to 200)

Suitable for mounting the inductive speed sensor ID (see RE 95130). The ID sensor is screwed into the upper case drain port T1. The spacer ring (sizes 28 to 107) or threaded-reducing connector stud (sizes 140 to 200) required for the inductive speed sensor ID is included in the supply volume of the sensor (only when ordering, speed sensor with installation parts).

Version "F" (NG 55 to 500)

Suitable for mounting the HDD Hall-effect speed sensor (see RE 95135). With sizes 55 to 200, the HDD sensor is flanged onto the upper case drain port T1; with size 250 to 500, it is flanged onto the port provided for this purpose with two fixing screws. In the standard version, the port is plugged with a pressure-resistant flange cover.

We recommend ordering the (A)A6VM variable motor complete with mounted sensor. Please specify the ordering code for the sensor separately.

Circuit diagram (A)A6VM 28 to 200 EP

Circuit diagram (A)A6VM 250 to 500 EP

Before finalizing your design, please request a binding installation drawing. Dimensions in inches and (mm).
Speed measurement (sizes 28 to 500)

Version "F" (sizes 55 to 200): with HDD sensor

<table>
<thead>
<tr>
<th>Size</th>
<th>28</th>
<th>55</th>
<th>80</th>
<th>107</th>
<th>140</th>
<th>160</th>
<th>200</th>
<th>250</th>
<th>355</th>
<th>500</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of teeth</td>
<td>40</td>
<td>54</td>
<td>58</td>
<td>67</td>
<td>72</td>
<td>75</td>
<td>80</td>
<td>78</td>
<td>90</td>
<td>99</td>
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</table>

HDD

A Insertion depth (tolerance ± 0.1)

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<tr>
<th>Size</th>
<th>28</th>
<th>55</th>
<th>80</th>
<th>107</th>
<th>140</th>
<th>160</th>
<th>200</th>
<th>250</th>
<th>355</th>
<th>500</th>
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<tbody>
<tr>
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<td>0.63</td>
<td>0.63</td>
<td>0.63</td>
<td>0.63</td>
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<td>1.27</td>
<td>1.27</td>
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<tr>
<td>(16)</td>
<td>(16)</td>
<td>(16)</td>
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<td>(16)</td>
<td>(16)</td>
<td>(16)</td>
<td>(32.5)</td>
<td>(32.5)</td>
<td>(32.5)</td>
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</table>

B Contact surface

<table>
<thead>
<tr>
<th>Size</th>
<th>28</th>
<th>55</th>
<th>80</th>
<th>107</th>
<th>140</th>
<th>160</th>
<th>200</th>
<th>250</th>
<th>355</th>
<th>500</th>
</tr>
</thead>
<tbody>
<tr>
<td>(72.6)</td>
<td>(76.6)</td>
<td>(85.6)</td>
<td>(90.6)</td>
<td>(93.6)</td>
<td>(98.6)</td>
<td>(110.5)</td>
<td>(122.5)</td>
<td>(132.5)</td>
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</table>

C (without mating connector)

<table>
<thead>
<tr>
<th>Size</th>
<th>28</th>
<th>55</th>
<th>80</th>
<th>107</th>
<th>140</th>
<th>160</th>
<th>200</th>
<th>250</th>
<th>355</th>
<th>500</th>
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<tbody>
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<td>(100)</td>
<td>(110)</td>
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<td>(124.5)</td>
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<td>(93)</td>
<td>(113)</td>
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D (with 90° mating connector)

<table>
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<th>80</th>
<th>107</th>
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<tr>
<td>(60)</td>
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<td>(99)</td>
<td>(102)</td>
<td>(107)</td>
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</tr>
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ID

A Insertion depth (tolerance ± 0.1)

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<th>80</th>
<th>107</th>
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<th>200</th>
<th>250</th>
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<td>0.69</td>
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<td>(17.5)</td>
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<td>(40)</td>
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B Contact surface

<table>
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<tr>
<th>Size</th>
<th>28</th>
<th>55</th>
<th>80</th>
<th>107</th>
<th>140</th>
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<th>500</th>
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C (without mating connector)

<table>
<thead>
<tr>
<th>Size</th>
<th>28</th>
<th>55</th>
<th>80</th>
<th>107</th>
<th>140</th>
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<td>(165)</td>
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C1 (with 90° mating connector)

<table>
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<td>(189)</td>
<td>(193)</td>
<td>(202)</td>
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<td>(215)</td>
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C2 (with 180° mating connector)

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<td>(197.5)</td>
<td>(201.5)</td>
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D

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</table>

Before finalizing your design, please request a binding installation drawing. Dimensions in inches and (mm).
Connectors for solenoids (for EP, EZ, HA.U, HA.R, DA only)

DEUTSCH DT04-2P-EP04, 2-pin
Molded, without bidirectional suppressor diode
(for EP, EZ1/2, DA) ___________________________ P
Molded, with bidirectional suppressor diode
(for switching solenoid for the EZ1/2, DA control units) ______ Q
Type of protection according to DIN/EN 60529: IP65 and IP69K

The protection circuit with a bidirectional suppressor diode is necessary for limiting overvoltages. Overvoltages are generated by disconnecting the current using switches, relay contacts or by unplugging an energized mating connector.

Switching symbol

Without bidirectional suppressor diode

With bidirectional suppressor diode

Mating connector
DEUTSCH DT06-2S-EP04
Rexroth Mat. No. R902601804
Consisting of:
- 1 case DT-Designation
- 1 wedge W2S
- 2 sockets 0462-201-16141
The mating connector is not included in supply.
This can be supplied by Rexroth on request.

HIRSCHMANN DIN EN 175 301-803-A/ISO 4400
(not for new projects with sizes 28 - 200)
Without bidirectional suppressor diode
(for EP, EZ, HA.U, HA.R, DA) ___________________________ H
Type of protection according to DIN/EN 60529: IP65
The seal ring in the cable fitting is suitable for line diameters from 0.18 in to 0.39 in (4.5 mm to 10 mm).
The HIRSCHMANN connector is included in the supply volume for the motor.

Fixing screw M3
Tightening torque
\[ M_k = 0.37 \text{ lb-ft (0.5 Nm)} \]
Cable fitting M16x1.5
Tightening torque
\[ M_k = 1.11 - 1.84 \text{ lb-ft (1.5 - 2.5 Nm)} \]

2) Solenoid with DIA 1.77 (ø45) for following controls: HA.U, HA.R (for elec. override), EZ3 and EZ4.

Note for cylindric solenoids:
The position of the connector can be changed by turning the solenoid body.
The following procedure is to be observed:
1. Loosen the fixing nut (1)
2. Turn the solenoid body (2) to the desired position
3. Tighten the fixing nut
   - Tightening torque of the fixing nut: \[ 3.69^{+0.74} \text{ lb-ft (5+1 Nm)} \]
   - (width across flats WAF26, 12-sided DIN 3124)

We reserve the right to change the position of the solenoid connector from that depicted in the brochure or drawing during assembly of the solenoid.
Installation instructions

General
During commissioning and operation, the axial piston unit must be filled with hydraulic fluid and air bled. This is also to be observed following a relatively long standstill as the system may empty via the hydraulic lines.
The case drain inside the case interior must be drained to the tank via the highest case drain port.
In all operating states, the case drain line must flow into the tank below the minimum fluid level.

Installation position
See examples below. Additional installation positions are available upon request.

Below-tank installation (standard)
Motor below the minimum fluid level of the tank.
Recommended installation positions: 1 and 2.

Above-tank installation
Motor above the min. fluid level of the tank
- Note: Installation position 8 (shaft up)
In this installation position, if the case interior is only partially drained, lubrication of the bearings will no longer be adequate. A check valve (opening pressure 7.25 psi (0.5 bar)) in the case drain line can prevent the system emptying through the case drain line.

<table>
<thead>
<tr>
<th>Installation position</th>
<th>Air bleeding</th>
<th>Filling</th>
<th>Installation position</th>
<th>Air bleeding</th>
<th>Filling</th>
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<td>5</td>
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<td>T₁ (L₁)</td>
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<td>–</td>
<td>T₂ (L₁)</td>
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<td>T₂ (L₁)</td>
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<td>T₁ (L₁)</td>
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<td>U</td>
<td>T₁ (L₁)</td>
<td>8</td>
<td>U</td>
<td>T₁ (L₁)</td>
</tr>
</tbody>
</table>
General instructions

- The (A)A6VM motor is designed to be used in open and closed circuits.
- Project planning, assembly, and commissioning of the motor require the involvement of qualified personnel.
- The service line ports and function ports are only designed to mounting hydraulic lines.
- During and shortly after operation, there is a risk of burns on the motor and especially on the solenoids. Take suitable safety precautions, e.g. wear protective clothing.
- There may be shifts in the characteristic depending on the operating state of the motor (operating pressure, fluid temperature).

Tightening torques:
  - The tightening torques specified in this data sheet are maximum values and must not be exceeded (maximum values for screw thread).
  - Manufacturer’s instruction for the max. permissible tightening torques of the used armatures must be observed!
  - For ISO68 / DIN 13 fixing screws, we recommend checking the tightening torque individually according to VDI 2230 Edition 2003.

- The data and information contained herein must be adhered to.