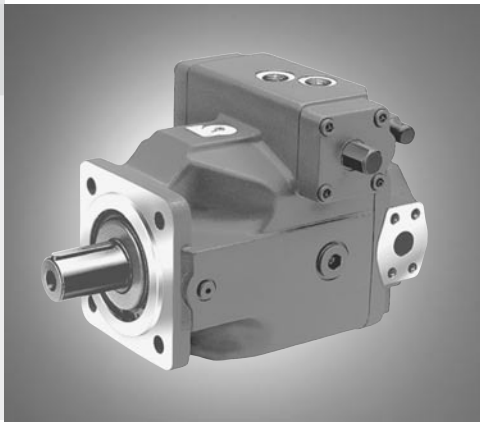
# Control devices
# DR, DP, FR and DFR

**RA 92 060/12.06** **1**/36
Replaces: 05.95

**Technical Data Sheet**



for the variable pumps
(A)A4VSO and (A)A4VSG Series 1 and 3
open and closed circuits

## Contents



## Features

- Control devices for the variable pumps (A)A4VSO and (A)A4VSG
- Control of pressure and flow
- Optional remote control
- Optional control for parallel operation
- Mechanical limitation of $V_{g\ min}$ and $V_{g\ max}$
- Special versions for mooring, over center operation and decompression via the pump are possible

Further information:

| | | |
|---|---|---|
| Variable pump (A)A4VSO | Size 40...1000 | RA 92050 |
| Variable pump (A)A4VSG | Size 40...1000 | RA 92100 |
| Control devices DR, DP, FR and DFR ISO Version | Size 40...1000 | RE 92060 |

# Ordering code – Standard program (A)A4VSO

| | (A)A4VS | O | | | / | | | | – | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 01 | 02 | 03 | 04 | 05 | | 06 | 07 | 08 | | 09 | 10 | 11 | 12 | 13 |

| | |
|---|---|
| 01 | **Hydraulic fluid** (for detailed information see RA 92050) |

**Axial piston unit**

| | | | |
|---|---|---|---|
| 02 | Swash plate design, variable | Size 40...355 | **AA4VS** |
| | | Size 500...1000 | **A4VS** |

**Type of operation**

| | | |
|---|---|---|
| 03 | Pump, open circuit operation (see RA 92050) | **O** |

| | **Size** | | **40** | **71** | **125** | **180** | **250** | **355** | **500** | **750** | **1000** |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 04 | Displacement $V_{g\,max}$ | $in^3$/rev | 2.44 | 4.33 | 7.63 | 10.98 | 15.26 | 21.66 | 30.51 | 45.76 | 61.02 |
| | | $cm^3$/rev | 40 | 71 | 125 | 180 | 250 | 355 | 500 | 750 | 1000 |

**Control and regulating devices**

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 05 | **Pressure control** | DR | | | ● | ● | ● | ● | ● | ● | ● | ● | ● | **DR** |
| | remotely controlled | DR | G | | ● | ● | ● | ● | ● | ● | ● | ● | ● | **DRG** |
| | **Press. control for parallel operation** | DP | | | ● | ● | ● | ● | ● | ● | ● | ● | ● | **DP** |
| | with flow control | DP | F | | – | – | ● | ● | ● | ● | – | – | – | **DPF** |
| | **Flow control** | FR | | | ● | ● | ● | ● | ● | ● | – | – | – | **FR** |
| | with remote pressure control | FR | G | | ● | ● | ● | ● | ● | ● | – | – | – | **FRG** |
| | FR no connection betw. $X_F$ to tank | FR | | 1 | ● | ● | ● | ● | ● | ● | – | – | – | **FR1** |
| | FRG no connection betw. $X_F$ to tank | FRG | | 1 | ● | ● | ● | ● | ● | ● | – | – | – | **FRG1** |
| | **Pressure and flow control** | DFR | | | ● | ● | ● | ● | ● | ● | – | – | – | **DFR** |
| | no connection between $X_F$ to tank | DFR | | 1 | ● | ● | ● | ● | ● | ● | – | – | – | **DFR1** |

**Series**

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 06 | | ● | ● | – | – | – | – | – | – | – | **10** |
| | | – | – | ● | ● | ● | ● | ● | ● | ● | **30** |

| | |
|---|---|
| 07 | **Direction of rotation** |
| 08 | **Seals** |
| 09 | **Shaft end** |
| 10 | **Mounting flange** |
| 11 | **Service port connections** |
| 12 | **Through drive** |
| 13 | **Filtration** |

For detailed information see:
RA 92050 – (A)A4VSO

● available – not available

Ordering code – standard program of (A)A4VSG see page 3

# Ordering code – Standard program (A)A4VSG

| | (A)A4VS | G | | | / | | | | – | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 01 | 02 | 03 | 04 | 05 | | 06 | 07 | 08 | | 09 | 10 | 11 | 12 | 13 | 14 |

| | |
|---|---|
| 01 | **Hydraulic fluid** (for detailed information see RA 92100) |

**Axial piston unit**

| | | | |
|---|---|---|---|
| 02 | Swash plate design, variable | **Size 40...355** | **AA4VS** |
| | | **Size 500...1000** | **A4VS** |

**Type of operation**

| | | |
|---|---|---|
| 03 | Pump closed circuit operation (see RA 92100) | **G** |

| | **Size** | | **40** | **71** | **125** | **180** | **250** | **355** | **500** | **750** | **1000** |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 04 | Displacement $V_{g\,max}$ | $in^3$/rev | 2.44 | 4.33 | 7.63 | 10.98 | 15.26 | 21.66 | 30.51 | 45.76 | 61.02 |
| | | $cm^3$/rev | 40 | 71 | 125 | 180 | 250 | 355 | 500 | 750 | 1000 |

**Control and regulating devices**

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 05 | **Pressure control for one side of center** | DR | | | ● | ● | ● | ● | ● | ● | ● | ● | ● | **DR** |
| | remotely controlled | DR | G | | ● | ● | ● | ● | ● | ● | ● | ● | ● | **DRG** |
| | **Pressure control for parallel operation** for one side of center | DP | | | ● | ● | ● | ● | ● | ● | ● | ● | ● | **DP** |

**Series**

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 06 | | ● | ● | – | – | – | – | – | – | – | **10** |
| | | – | – | ● | ● | ● | ● | ● | ○ | ● | **30** |

**Direction of rotation**

| | | | |
|---|---|---|---|
| 07 | with view on shaft end | clockwise | **R** |
| | (no bi-directional rotation possible) | counter clockwise | **L** |

| | |
|---|---|
| 08 | **Seals** |
| 09 | **Shaft end** |
| 10 | **Mounting flange** |
| 11 | **Service port connections** |
| 12 | **Through drive** |
| 13 | **Valves** |
| 14 | **Filtration** |

For detailed information see: RA 92100 – (A)A4VSG

● available ○ in preparation – not available

Ordering code – standard program of (A)A4VSO see page 2

# DR pressure control, swivel on one side

The pressure control keeps the pressure in the pumps pressure outlet constant within the control range of the pump. Therefore, the pump only delivers as much fluid, as required by the actuators. The pressure can be steplessly set at the control valve.

**Recommended setting range 725...5075 psi (50...350 bar)**
Standard setting 5075 psi (350 bar). If another setting is required, please state in clear text when ordering.

**Home position** in pressureless condition: $\mathbf{V_{g\ max}}$

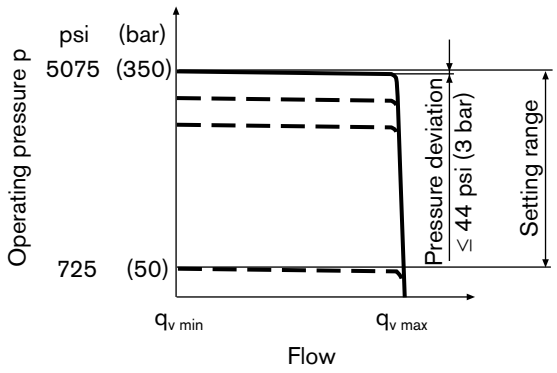
Min. and max. **swivel angle limitation** mechanically adjustable to 50 % of $V_{g\ max}$.
The $V_{g\ min}$-stop is set so that a pressure level of 217...290 psi (15...20) bar is reached in a closed pressure port B.
The $V_{g\ max}$-stop is set to the nominal $V_{g\ max}$ value. If another setting is required, please state in clear text when ordering.

The pressure control is available in (A)A4VSO and (A)A4VSG however only for swivel on one side of center.
On request also versions for **mooring or over center operation** are available.
For fast decompression of the pressurized outlet, the pump can swivel momentarily over center and swallow some fluid.

Remote adjustment of pressure control DRG see page 7, pressure control for parallel operation DP see page.12.

## (A)A4VSO - open circuit

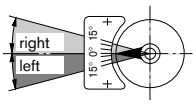
**Static characteristic**




**Direction of flow S to B**

| Pump direction of rotation | Swivel range [1] | Pressure port |
|---|---|---|
| clockwise | left hand | B |
| counter clockwise | right hand | B |

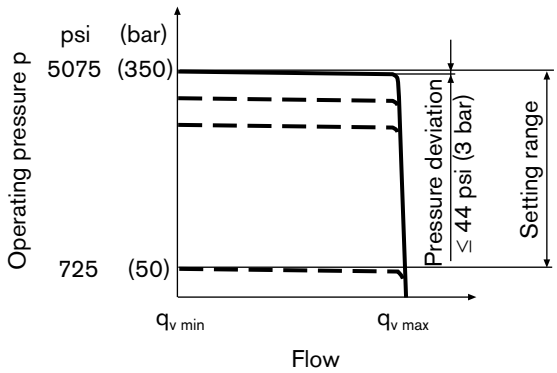
[1] compare swivel angle indicator




## (A)A4VSG - closed circuit

Pressure control DR only for swivel on one side.
No bi-directional rotation possible.

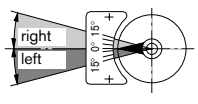
**Static characteristic**




**Direction of flow A to B**

| Pump direction of rotation | Swivel range [1] | Pressure port |
|---|---|---|
| clockwise | left hand | B |
| counter clockwise | right hand | B |

[1] compare swivel angle indicator



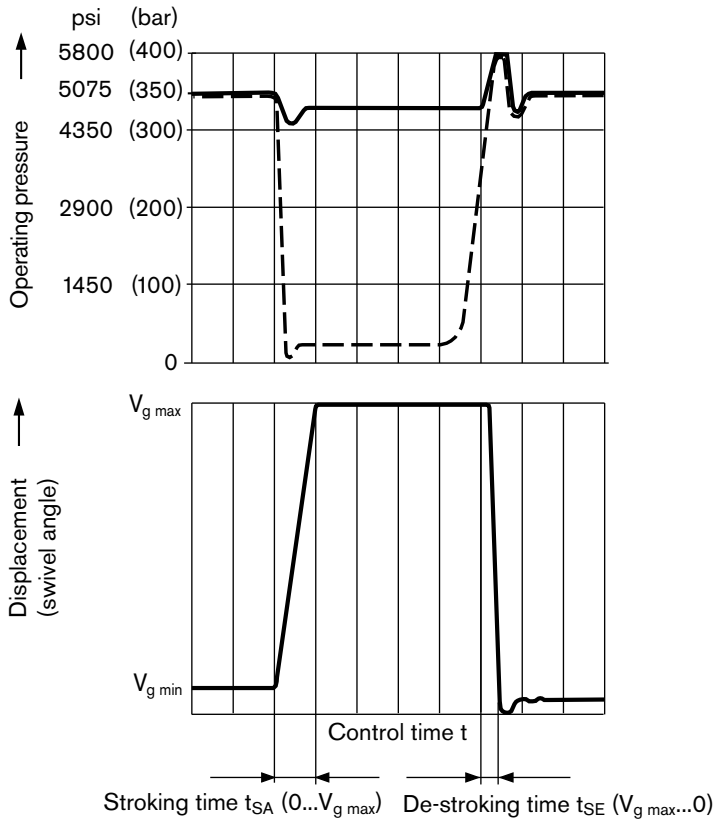
# DR pressure control, swivel on one side

## Dynamic characteristics

The curves show measured average values.

Conditions: n = 1500/1800 rpm
$t_{oil}$ = 122°F (50° C)
Main line relief set at 5800 psi (400 bar)

Load jump accomlished through sudden opening and closing of the pressure outlet with a relief valve as load valve, situated 1 m downstream of the pressure port on the axial piston unit.




| Size | $t_{SA}$ [s] at 290 psi (20 bar) | $t_{SA}$ [s] at 4785 psi (330 bar) | $t_{SE}$ [s] Standby at 5075 psi (350 bar) |
|---|---|---|---|
| **40** | approx. 0,12 | approx. 0,08 | 0,02 |
| **71** | approx. 0,20 | approx. 0,10 | 0,03 |
| **125** | approx. 0,30 | approx. 0,20 | 0,04 |
| **180** | approx. 0,30 | approx. 0,20 | 0,05 |
| **250** | approx. 0,40 | approx. 0,30 | 0,06 |
| **355** | approx. 0,40 | approx. 0,30 | 0,08 |
| **500** | approx. 0,50 | approx. 0,30 | 0,10 |
| **750** | approx. 1,00 | approx. 0,60 | 0,15 |
| **1000** | approx. 1,50 | approx. 0,90 | 0,20 |

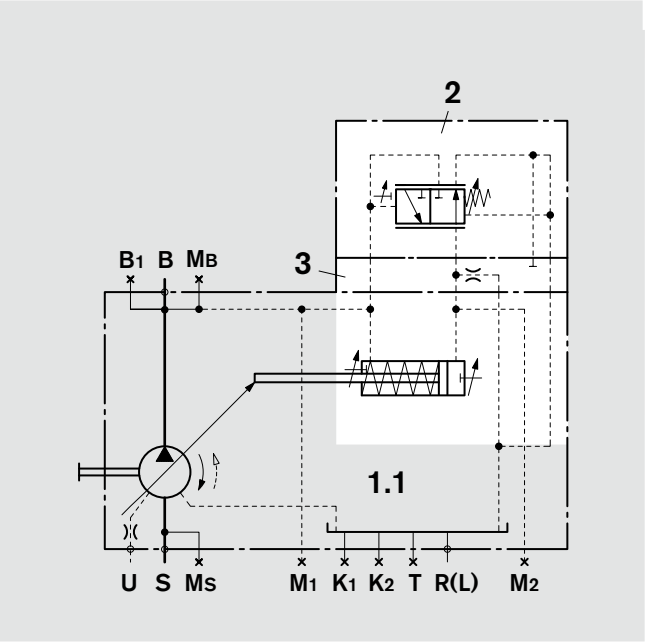
The **stroking time** $t_{SA}$ ($V_{g\ min} \rightarrow V_{g\ max}$) can be steplessly adjusted, without influencing the de-stroking time $t_{SE}$.
Standard setting see table. If needed, these values can be reduced by a factor of 2...3 (please consult us).

# Schematics DR

**Control device (shown in area with white background) valid for (A)A4VSO and (A)A4VSG**

### Size 40 and 71

Example: AA4VSO

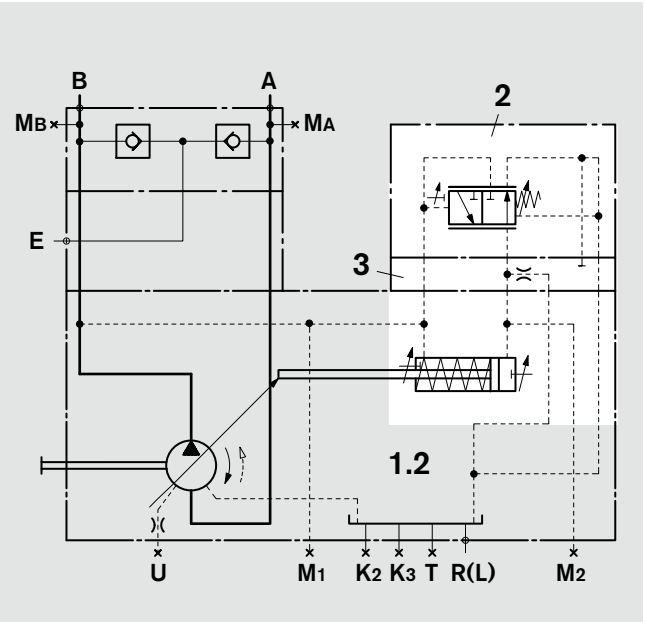



### Size 125...355

Example: AA4VSO

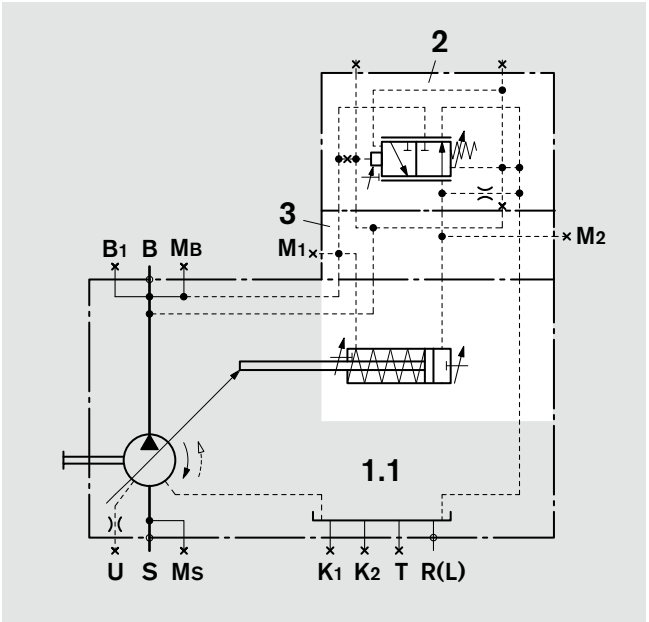
### Size 125...355

Example: AA4VSG




### Size 500...1000

Example: A4VSO




### Ports

$M_1$, $M_2$ Gauging port control chamber pressure (Size 125...1000)

### Sub assemblies

**1** Pump with hydraulic control device
**1.1** (A)A4VSO (see RA 92050)
**1.2** (A)A4VSG (see RA 92100)
**2** Pressure control valve
**3** Sandwich plate (Size 125...1000)

# DRG remotely controlled pressure control

Function and execution as DR.

A pressure relief valve (item 4) can be piped externally to port $X_D$, but it is not part of in the supply of the DRG control.
A special version with a built on pressure relief valve is available upon request.

The differential pressure at the pressure control valve (item 2) is set as standard to 290 psi (20 bar), which results in a pilot flow out of $X_D$ of approx. 0.4 gpm (1,5 L/min). If a different setting (recommended range 290...725 psi (20...50 bar)) is required, please state in clear text when ordering.
As a separate pressure relief valve we recommend:
– DBD 6 (hydraulic) to RA 25402.
– DBETR-SO 437 (electric) to RA 29166

The maximum line lenght should not exceed 7 ft. (2 m).

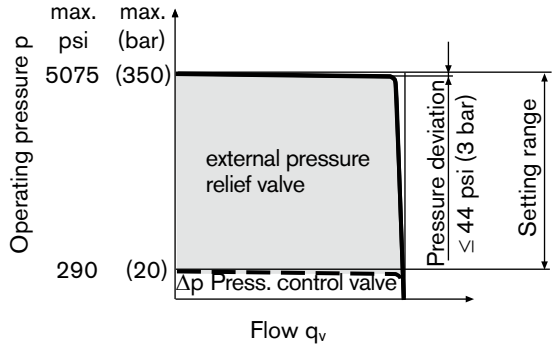
## Notes to the setting of the remote pressure control:

The overall output pressure level is the result of the setting of the separate pressure relief valve plus the value of the control valve´s differential pressure.

Example: setting external pressure relief valve 4785 psi (330 bar)

differential pressure at control valve 290 psi (20 bar)

results in control pressure level of 4785 + 290 = 5075 psi (330 + 20 = 350 bar)



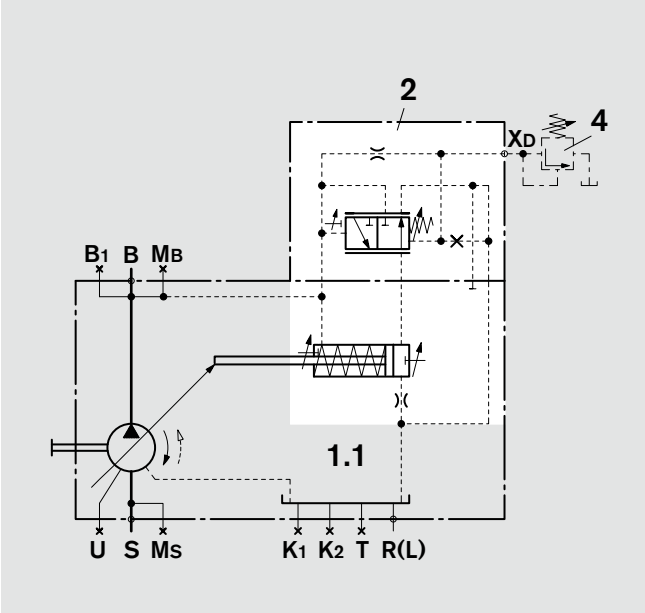

Function, description and stroking times of pressure control DR see page 4 and 5.

# Schematics DRG

**Control device (shown in area with white background) valid for (A)A4VSO and (A)A4VSG**

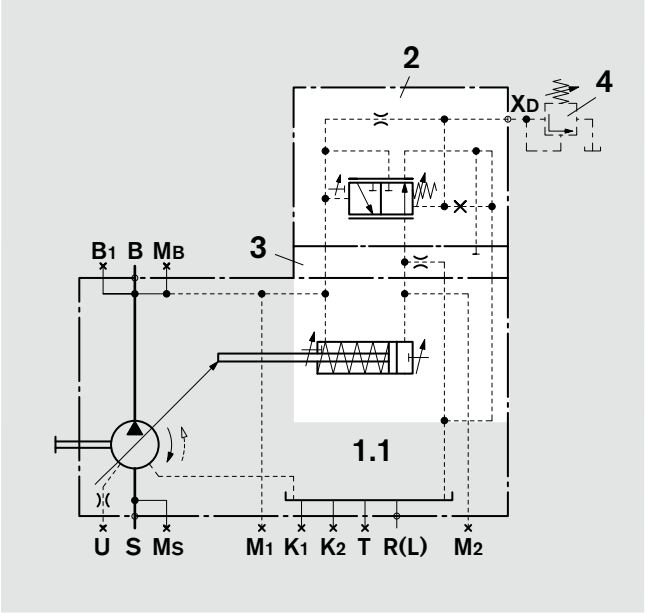
### Size 40 and 71

Example: AA4VSO



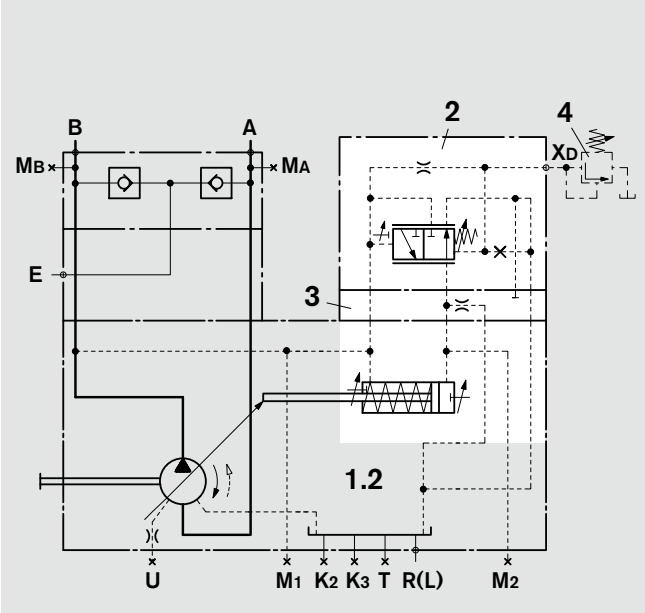

### Size 125...355

Example: AA4VSO



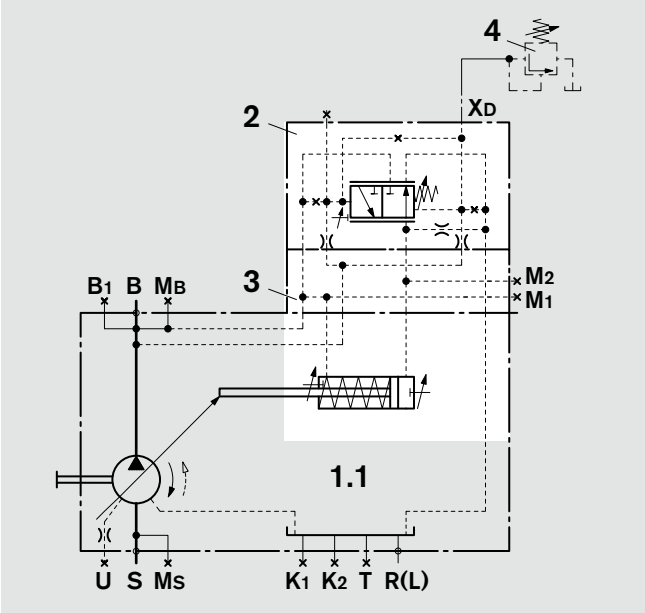

### Size 125...355

Example: AA4VSG




### Size 500...1000

Example: A4VSO




## Ports

| | |
|---|---|
| $X_D$ | Pilot pressure port for remote pressure relief valve |
| $M_1$, $M_2$ | Gauging port control chamber pressure (Size125...1000) |

## Sub assemblies

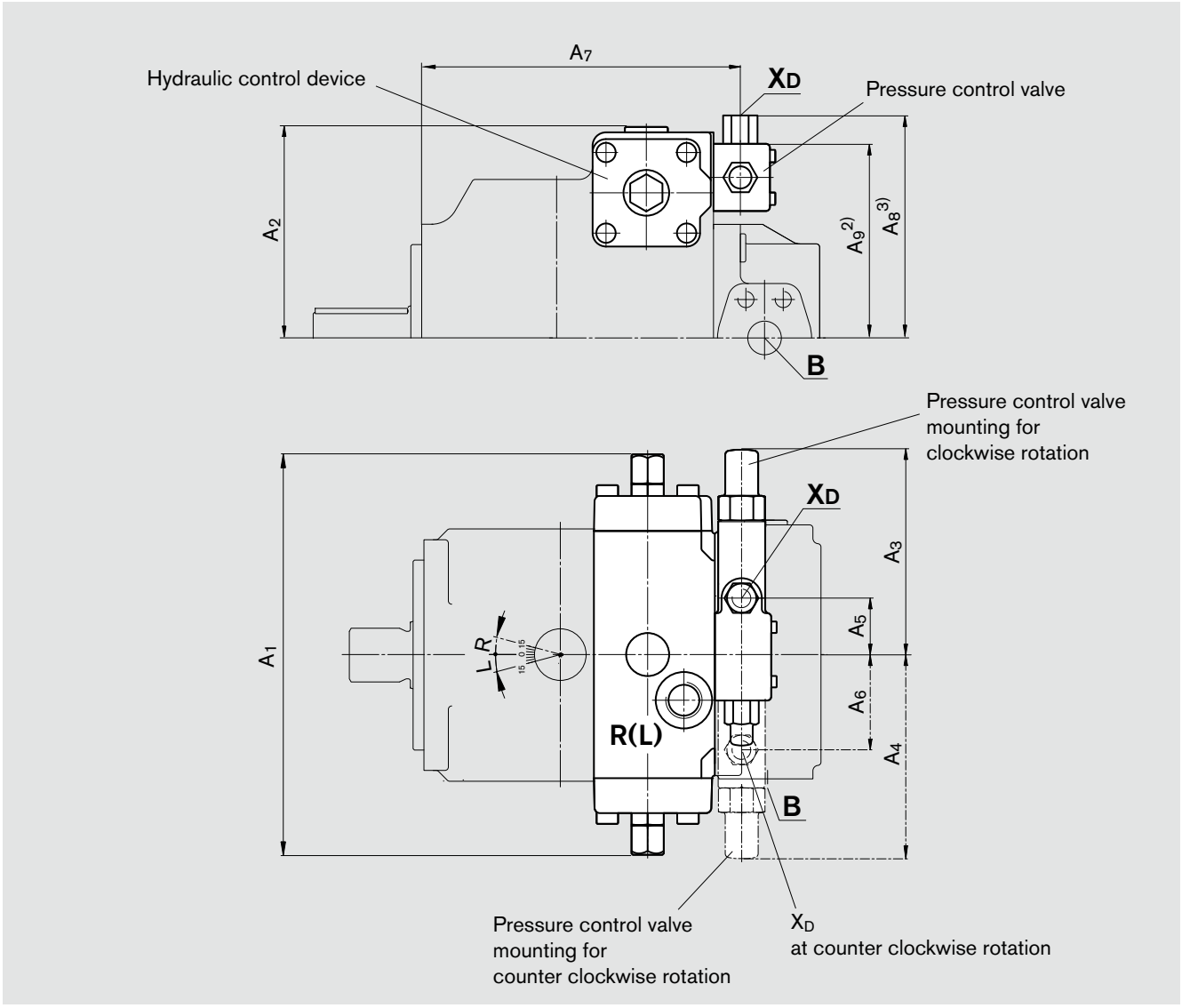
| | |
|---|---|
| **1** | Pump with hydraulic control device |
| **1.1** | (A)A4VSO (see RA 92050) |
| **1.2** | (A)A4VSG (see RA 92100) |
| **2** | Pressure control valvel |
| **3** | Sandwich plate (Size 125...1000) |
| **4** | External pressure relief valve (is not part of supply) |

# Unit dimensions DR / DRG

Before finalising your design please request a certified installation drawing. Dimensions in inches and (millimeters)

**Dimensions valid for AA4VSO and AA4VSG**

## Size 40 and 71




## Ports

| | | | | max. tightening torque [1] |
|---|---|---|---|---|
| $X_D$ | Pilot pressure port for remote pressure relief valve | ISO 11926 | 9/16-18UNF-2B; 0.51 (13) deep; plugged at DR control | 59 lb-ft (80 Nm) |

## Unit dimensions

| Size | $A_1$ | $A_2$ | $A_3$ | $A_4$ | $A_5$ | $A_6$ | $A_7$ | $A_8$ [3] | $A_9$ [2] | |
|---|---|---|---|---|---|---|---|---|---|---|
| 40 | 10.24 (260) | 5.51 (140) | 5.79 (147) | 5.39 (137) | 1.85 (47) | 2.64 (67) | 8.31 (211) | 5.91 (150) | 5.04 (128) | For detailed unit dimensions and technical data on the variable pumps see the technical data sheets AA4VSO RA 92050 and AA4VSG RA 92100 |
| 71 | 11.73 (298) | 6.18 (157) | 5.59 (142) | 5.59 (142) | 1.65 (42) | 2.83 (72) | 9.37 (238) | 6.64 (166) | 5.67 (144) | |

[1] see general notes [2] valid for DR control [3] valid for DRG control

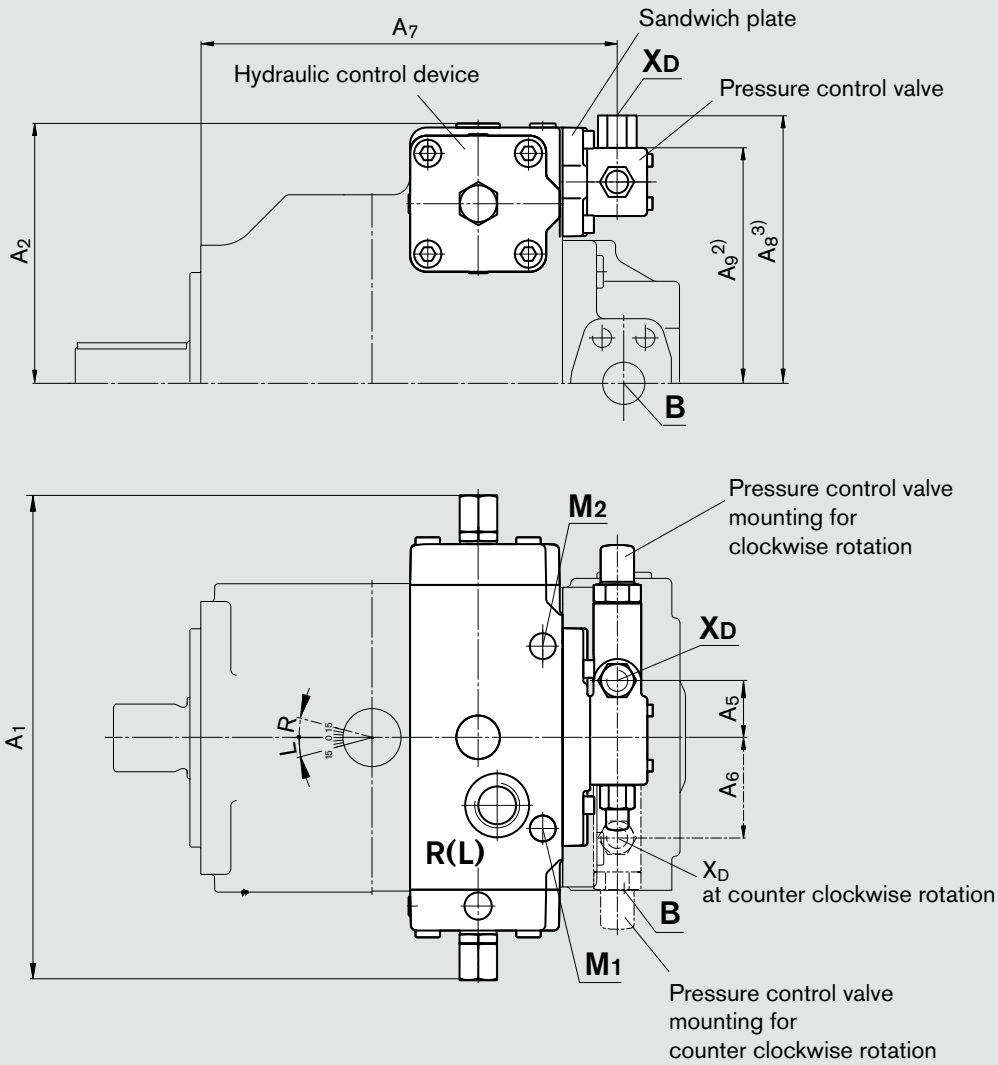
Size 125...1000 see page 10 and 11

# Unit dimensions DR / DRG

Before finalising your design please request a certified installation drawing. Dimensions in inches and (millimeters)

**Dimensions valid for AA4VSO and AA4VSG**

## Size 125...355




## Ports

| | | | | max. tightening torque [1] |
|---|---|---|---|---|
| $X_D$ | Pilot pressure port for remote pressure relief valve | ISO 11926 | 9/16-18UNF-2B; 0.51 (13) deep; plugged at DR control | 59 lb/ft (80 Nm) |
| $M_1$; $M_2$ | Gauging port control chamber pressure | DIN 3852 | M14x1,5; 0.47 (12) deep; plugged (Size 125...180)<br>M18x1,5; 0.47 (12) deep; plugged (Size 250...355) | 59 lb/ft (80 Nm)<br>103 lb/ft (140 Nm) |

## Unit dimensions

| Size | $A_1$ | $A_2$ | $A_5$ | $A_6$ | $A_7$ | $A_8$ [3] | $A_9$ [2] | |
|---|---|---|---|---|---|---|---|---|
| **125/180** | 13.94 (354) | 7.52 (191) | 1.61 (41) | 2.80 (71) | 12.09 (307) | 7.64 (194) | 6.77 (172) | For detailed unit dimensions and technical data of the variable pumps see the technical data sheets AA4VSO RA 92050 and AA4VSG RA 92100 |
| **250/355** | 16.69 (424) | 9.37 (238) | 1.61 (41) | 2.80 (71) | 14.53 (369) | 9.06 (230) | 8.19 (208) | |

[1] see general notes [2] valid for DR control [3] valid for DRG control

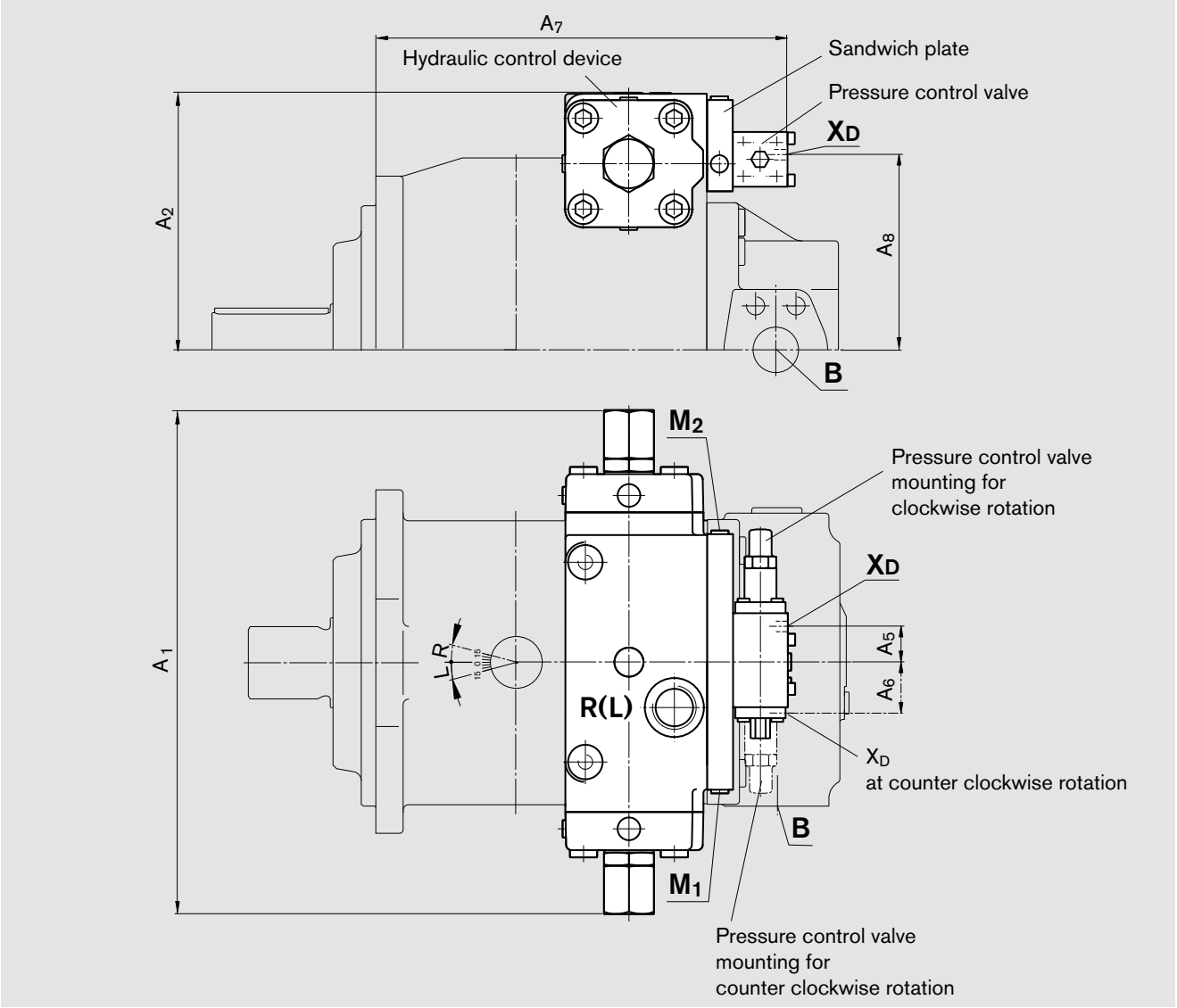
Size 40 and 71 see page 9; size 500...1000 see page 11

# Unit dimensions DR / DRG

Before finalising your design please request a certified installation drawing. Dimensions in inches and (millimeters)

**Dimensions valid for A4VSO and A4VSG**

## Size 500...1000




## Ports

| | | | | max. tightening torque [1] |
|---|---|---|---|---|
| $X_D$ | Pilot pressure port for remote pressure relief valver | DIN 3852 | M14x1,5; 0.47(12) deep; plugged at DR control | 59 lb-ft (80 Nm) |
| $M_1$; $M_2$ | Gauging port control chamber pressure | DIN 3852 | M18x1,5; 0.47(12) deep; plugged | 103 lb-ft (140 Nm) |

## Unit dimensions

| Size | $A_1$ | $A_2$ | $A_5$ | $A_6$ | $A_7$ | $A_8$ |
|---|---|---|---|---|---|---|
| **500** | 20.09 (510) | 11.14 (283) | 1.61 (41) | 2.01 (51) | 17.80 (452) | 8.50 (216) |
| **750** | 22.91 (582) | 12.68 (322) | 1.61 (41) | 2.01 (51) | 19.06 (484) | 9.25 (235) |
| **1000** | 24.49 (622) | 13.78 (350) | 1.61 (41) | 2.01 (51) | 21.65 (550) | 10.59 (269) |

For detailed unit dimensions and technical data of the variable pumps see the technical data sheets A4VSO RA 92050 and A4VSG RA 92100

[1] see general notes

Size 40 and 71 see page 9; size 125...355 see page 10

# DP pressure control for parallel operation

Suitable for pressure control of several axial piston units (A)A4VS in parallel operation (feeding into one common pressure header).

An external pressure relief valve (item 4) is used to control several axial piston units simultaneously via their X-ports. The relevant throttle valve (item 5) ensures control of the required pressure increase, which is proportional to the actual pump displacement.

**Home position** in pressureless condition: $\mathbf{V_{g\ max}}$

**Setting of differential pressure for DP-control**
The standard setting of the differential pressure over control valve (item 2) plus throttle valve (item 5) amounts to 480 psi (33 bar), with port $X_D$ unloaded to tank. The pilot oil flow out of port $X_D$ amounts to approx. 0.4 gpm (1,5 L/min).

The pressure setting of the external relief valve plus the overall differential pressure over item 2 and 5 determine the total pressure control level. The pressure rise during the de-stroking of the pump is independent of the pressure relief valve setting and causes a slight swivel angle deviation of all commonly controlled pumps.

Make sure that the lines between the ports $X_D$ and the pressure relief valve are as much as possible of the same lenght.

Min. and max. **swivel angle limitation** mechanically adjustable to 50 % of $V_{g\ max}$.
The $V_{g\ min}$-stop is set so that a pressure level of 220...290 psi (15...20 bar) is reached in a closed pressure port B.
The $V_{g\ max}$-stop is set to the nominal $V_{g\ max}$ value. If another setting is required, please state in clear text when ordering.

The pressure relief valve (item 4) is not part of the supply of the DP control - please order separately.
We recommend: DBD 6 (hydraulic) RA 25402

The max. number of commonly controlled pumps is limited by the flow capacity of the used pilot valve.

If needed, it is possible to unload individual pumps to the differential pressure level through an unloading valve (item 6). In this case an additional check valve is necessary in the pump outlet (item 7) Both valves are not part of the supply of the DP control.

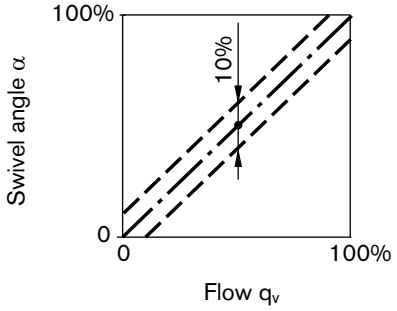
On request it is possible to mount the unloading valve (item 6) directly onto the pump.

This pressure control is available on the (A)A4VSO and (A)A4VSG, however only for swivel on one side of center.

On request, it is also available for **Mooring-or over center operation**.
For fast decompression of the pressurized outlet, the pump can then swivel momentarily over center and swallow some fluid.

Stroking times like DR see page 5.

Flow control is optionally available – DPF see page 19

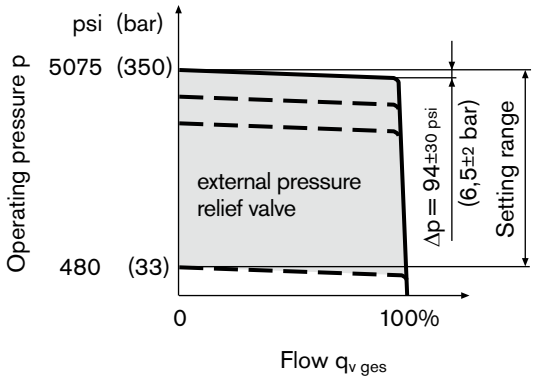



Swivel angle deviation ± 10% of ideal curve

# DP pressure control for parallel operation

## (A)A4VSO - open circuit

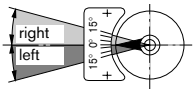
**Static characteristic**




**Direction of flow S** to **B**

| Pump direction of rotation | Swivel range [1] | Pressure port |
|---|---|---|
| clockwise | left hand | B |
| counter clockwise | right hand | B |

[1] compare swivel angle indicator

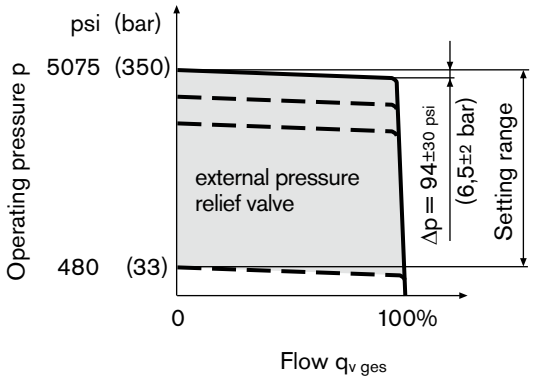



## (A)A4VSG - closed circuit

Pressure control DP can swivel on one side of center only.

No bi-directional rotation possible.

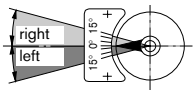
**Static characteristic**




**Direction of flow A** to **B**

| Pump direction of rotation | Swivel range [1] | Pressure port |
|---|---|---|
| clockwise | left hand | B |
| counter clockwise | right hand | B |

[1] compare swivel angle indicator



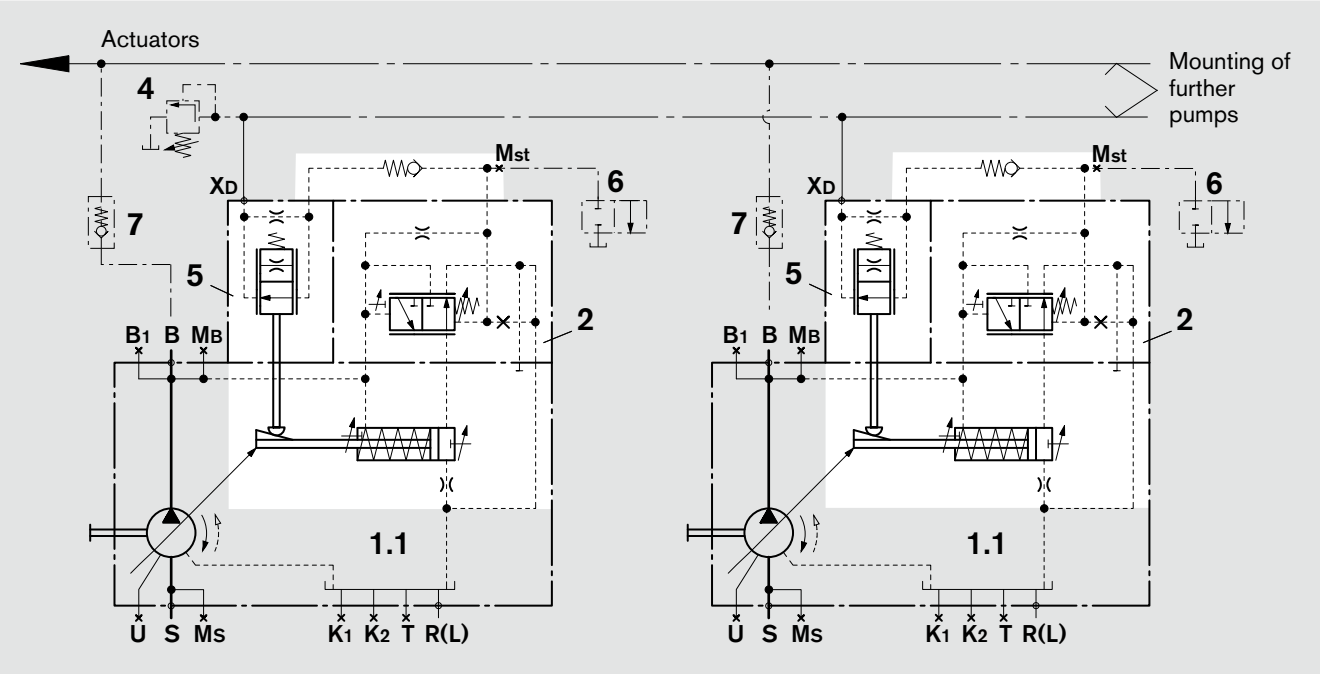

**Dynamic characteristic see** DR control page 5

# Schematics DP

**Control device (shown in area with white background) valid for AA4VSO and AA4VSG**

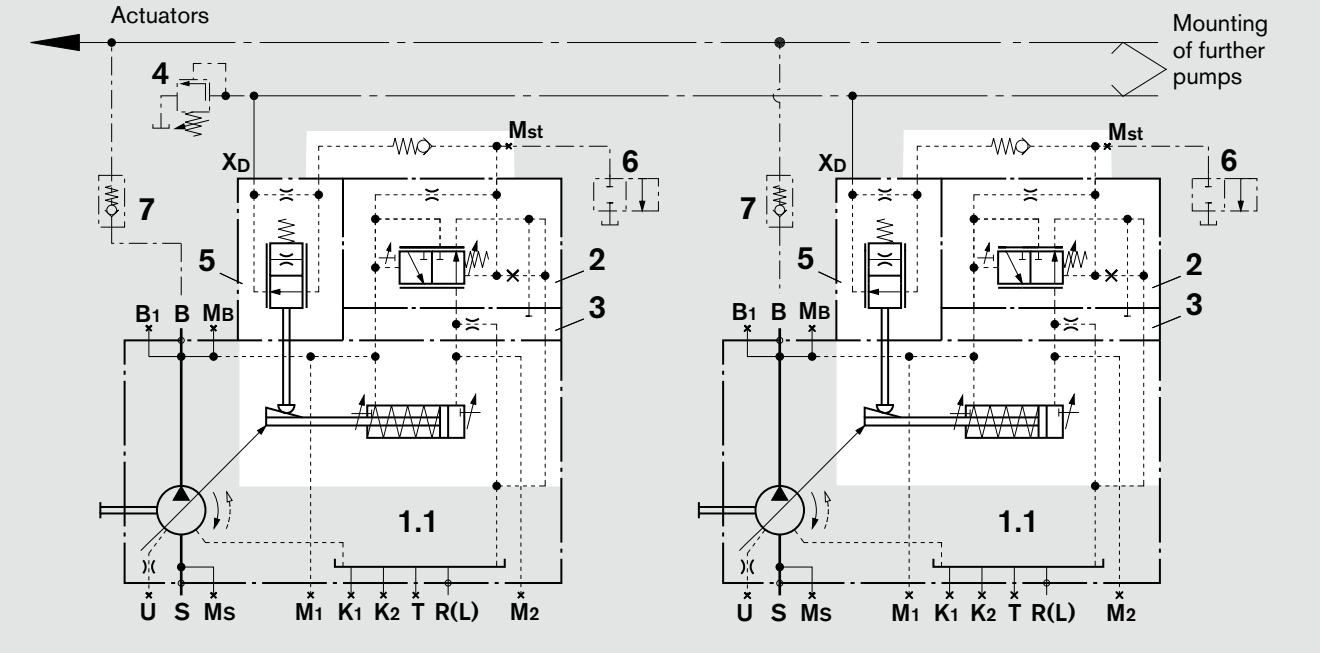
## Size 40 and 71

Example: AA4VSO




## Size 125...355

Example: AA4VSO




## Ports

| | |
|---|---|
| $X_D$ | Pilot pressure port DP control |
| $M_{St}$ | Gauging port pilot pressure |
| $M_1$, $M_2$ | Gauging port control chamber pressure (Size 125...355) |

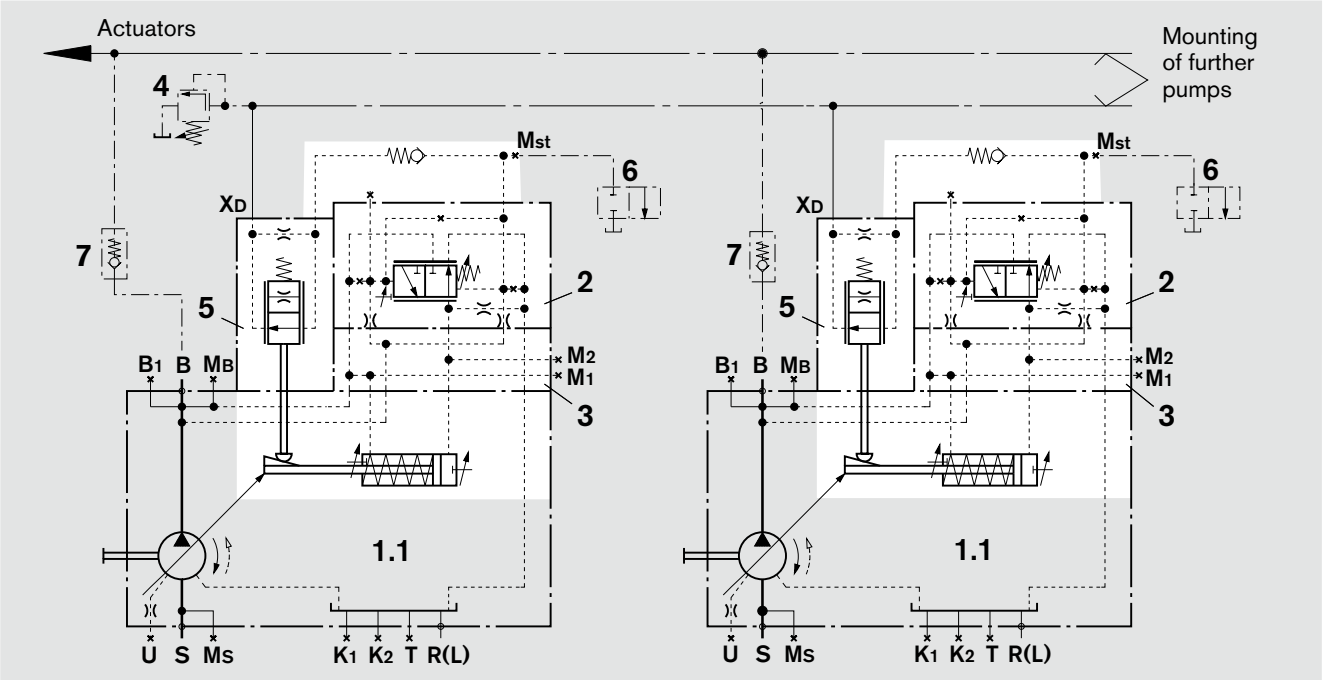
**Sub assemblies** see page 15

# Schematics DP

**Control device (shown in area with white background) valid for A4VSO and A4VSG**

## Size 500...1000

Example: A4VSO




### Ports

| | |
|---|---|
| $X_D$ | Pilot pressure port DP control |
| $M_{St}$ | Gauging port pilot pressure |
| $M_1$, $M_2$ | Gauging port control chamber pressure |

### Sub assemblies

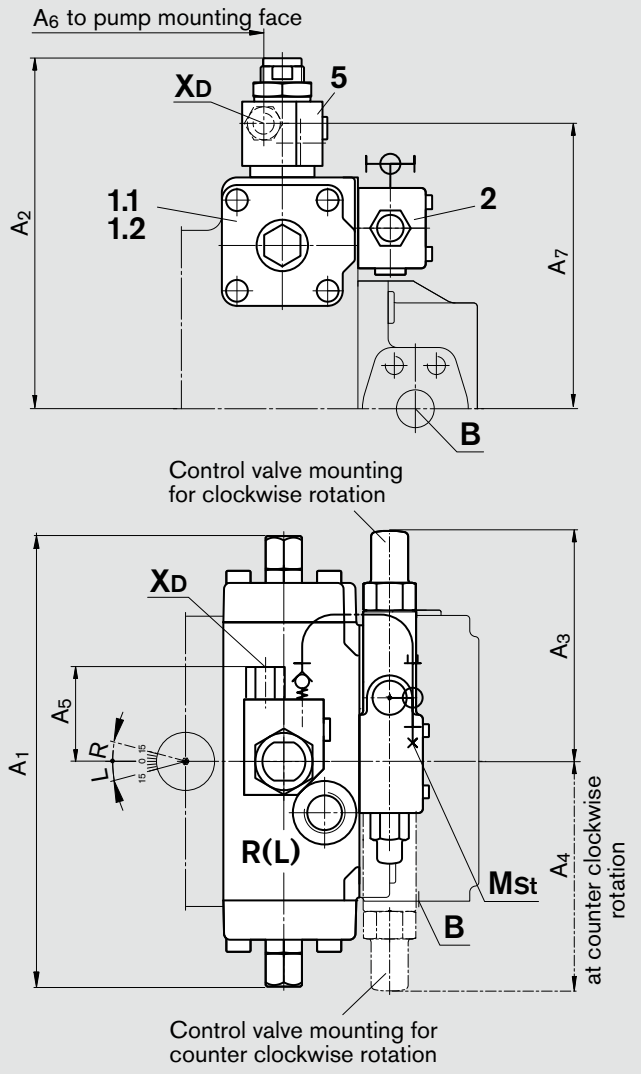
| | |
|---|---|
| **1** | Pump with hydraulic control device |
| **1.1** | A4VSO (see RA 92050) |
| **1.2** | A4VSG (see RA 92100) |
| **2** | Control valve with pressure compensator |
| **3** | Sandwich plate (Size 125...1000) |
| **4** | Pressure relief valve (not part of supply) |
| **5** | Throttle valve |
| **6** | Unloading valve (not part of supply) |
| **7** | Check valve (not part of supply) required only in conjunction with unloading valve |

# Unit dimensions DP

Before finalising your design please request a certified installation drawing. Dimensions in inches and (millimeters)

**Dimensions valid for AA4VSO and AA4VSG**

## Size 40 and 71




## Sub assemblies

| | |
|---|---|
| **1** | Pump with hydraulic control device |
| **1.1** | A4VSO (see RA 92050) |
| **1.2** | A4VSG (see RA 92100) |
| **2** | Control valve with pressure compensator |
| **5** | Throttle valve |

## Ports

| | | | max. tightening torque [1] |
|---|---|---|---|
| $X_D$ | Pilot pressure port DP control | ISO 11926 9/16-18UNF-2B; 0.51(13) deep | 59 lb-ft (80 Nm) |
| $M_{St}$ | Gauging port pilot pressure | Tube dia 8x1.5mm (DIN 3853 S8 Form W) (closed) | 37 lb-ft (50 Nm) |

## Unit dimensions

| Size | $A_1$ | $A_2$ | $A_3$ | $A_4$ | $A_5$ | $A_6$ | $A_7$ | |
|---|---|---|---|---|---|---|---|---|
| **40** | 10.24 (260) | 8.27 (210) | 5.79 (147) | 5.39 (137) | 2.36 (60) | 5.31 (135) | 6.69 (170) | For detailed unit dimensions and technical data of the variable pumps see the technical data sheets AA4VSO RA 92050 and AA4VSG RA 92100 |
| **71** | 11.65 (296) | 8.86 (225) | 5.59 (142) | 5.59 (142) | 2.36 (60) | 6.18 (157) | 7.36 (187) | |

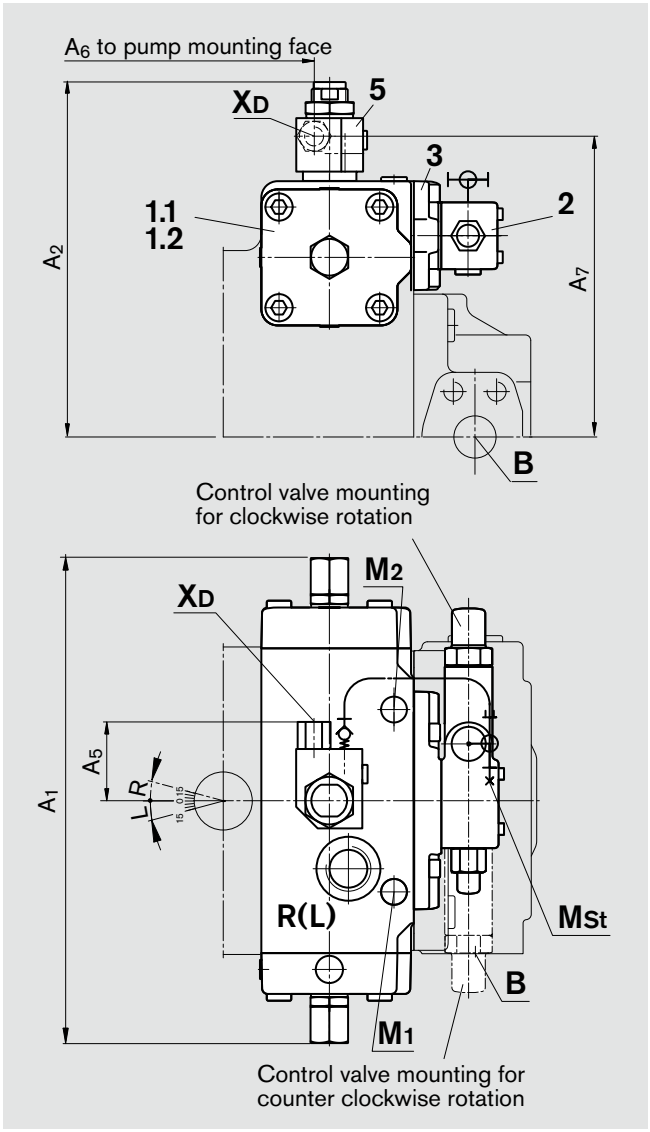
[1] see general notes

# Unit dimensions DP

Before finalising your design please request a certified installation drawing. Dimensions in inches and (millimeters)

**Dimensions valid for AA4VSO and AA4VSG**

## Size 125...355




## Sub assemblies

| | |
|---|---|
| **1** | Pump with hydraulic control device |
| **1.1** | A4VSO (see RA 92050) |
| **1.2** | A4VSG (see RA 92100) |
| **2** | Control valve with pressure compensator |
| **3** | Sandwich plate |
| **5** | Throttle valve |

## Ports

| | | | | max. tightening torque [1] |
|---|---|---|---|---|
| $X_D$ | Pilot pressure port DP control | ISO 11926 | 9/16-18UNF-2B; 0.51(13) deep | 59 lb-ft (80 Nm) |
| $M_{St}$ | Gauging port pilot pressure | Tube dia 8x1.5mm (DIN 3853 S8 Form W) (closed) | | 37 lb-ft (50 Nm) |
| $M_1$; $M_2$ | Gauging port control chamber pressure | DIN 3852 | M14x1,5; 0.47(12)deep; plugged (Size 125 a. 180) | 59 lb-ft (80 Nm) |
| | | | M18x1,5; 0.47(12)deep; plugged (Size 250 a. 355) | 103 lb-ft (140 Nm) |

## Unit dimensions

| Size | $A_1$ | $A_2$ | $A_5$ | $A_6$ | $A_7$ |
|---|---|---|---|---|---|
| **125/180** | 13.94 (354) | 10.28 (261) | 2.36 (60) | 7.64 (194) | 8.70 (221) |
| **250/355** | 16.69 (424) | 12.05 (306) | 2.36 (60) | 9.41 (239) | 10.55 (268) |

For detailed unit dimensions and technical data of the variable pumps see the technical data sheets AA4VSO RA 92050 and AA4VSG RA 92100

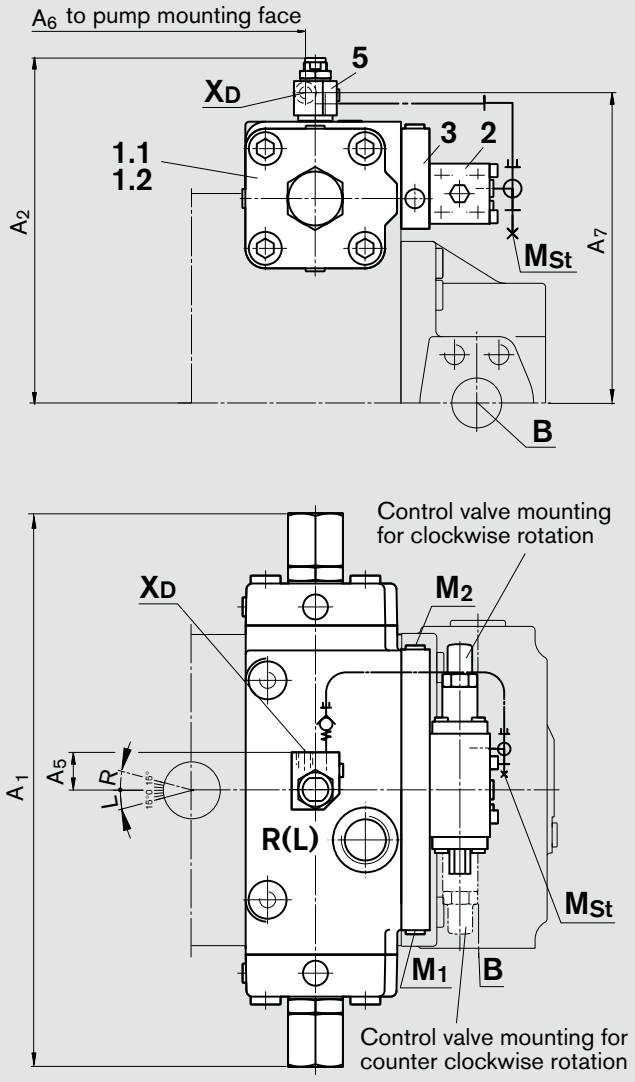
[1] see general notes

# Unit dimensions DP

Before finalising your design please request a certified installation drawing.
Dimensions in inches and (millimeters)

**Dimensions valid for A4VSO and A4VSG**

## Size 500...1000




## Sub assemblies

| | |
|---|---|
| **1** | Pump with hydraulic control device |
| **1.1** | A4VSO (see RA 92050) |
| **1.2** | A4VSG (see RA 92100) |
| **2** | Control valve with pressure compensator |
| **3** | Sandwich plate |
| **5** | Throttle valve |

## Ports

| | | | max. tightening torque [1] |
|---|---|---|---|
| $X_D$ | Pilot pressure port DP control | DIN 3852 M14x1,5; 0.47 (12) deep | 59 lb-ft (80 Nm) |
| $M_{St}$ | Gauging port pilot pressure | Tube dia 8x1.5mm (DIN 3853 S8 Form W) (closed) | 37 lb-ft (50 Nm) |
| $M_1$; $M_2$ | Gauging port control chamber pressure | DIN 3852 M18x1,5; 0.47 (12) deep; plugged | 103 lb-ft (140 Nm) |

## Unit dimensions

| Size | $A_1$ | $A_2$ | $A_5$ | $A_6$ | $A_7$ | |
|---|---|---|---|---|---|---|
| **500** | 20.09 (510) | 13.90 (353) | 1.54 (39) | 10.55 (268) | 12.32 (313) | For detailed unit dimensions and technical data of the variable pumps see the technical data sheets A4VSO RA 92050 and A4VSG RA 92100 |
| **750** | 22.91 (582) | 15.43 (392) | 1.54 (39) | 11.42 (290) | 13.86 (352) | |
| **1000** | 24.49 (622) | 16.50 (419) | 1.54 (39) | 13.74 (349) | 14.92 (379) | |

[1] see general notes

# DPF with flow control

In addition to the pressure control function the flow from pumps to actuators may be varied via a differential pressure e.g. over an orifice. The pumps supply only the amount of flow as required by the actuator.

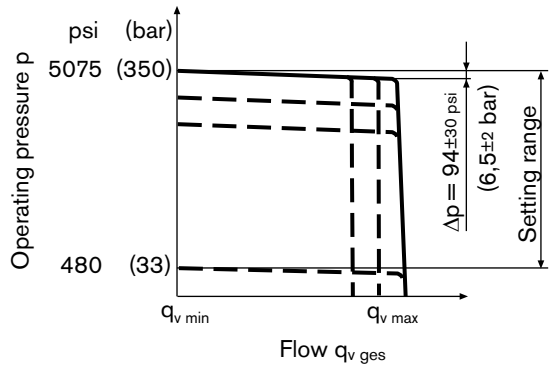
The flow depends only on the size of cross section in the control orifice (item 9) mounted between pumps and actuator. Below the setting of the pressure control and within the control range of the pumps, the flow is virtually independent of the actual operating pressure.

Description of the flow control see FR page 22.

Function and technical data of the pressure control for parallel operation DP see page 12.

## AA4VSO - open circuit

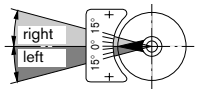
**Static characteristic**




**Direction of flow S** to **B**

| Pump direction of rotation | Swivel range [1] | Pressure port |
|---|---|---|
| clockwise | left hand | B |
| counter clockwise | right hand | B |

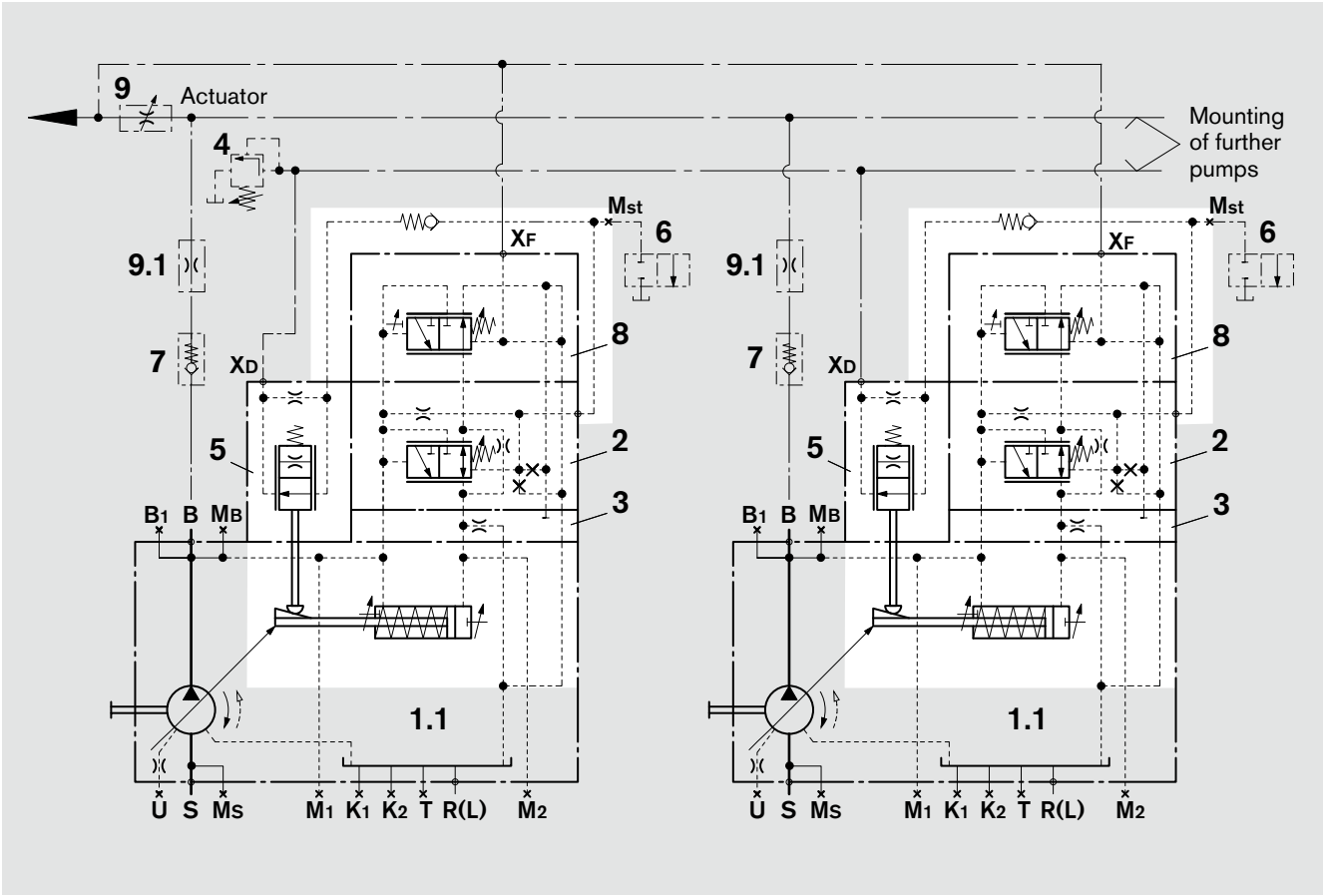
[1] compare swivel angle indicator



# Schematics DPF

### Size 125...355

AA4VSO




## Ports

| | |
|---|---|
| $X_D$ | Pilot pressure port DP control |
| $X_F$ | Pilot pressure port flow control |
| $M_{St}$ | Gauging port pilot pressure DP control |
| $M_1$, $M_2$ | Gauging port control chamber pressure (Size 125...355) |

## Sub assemblies

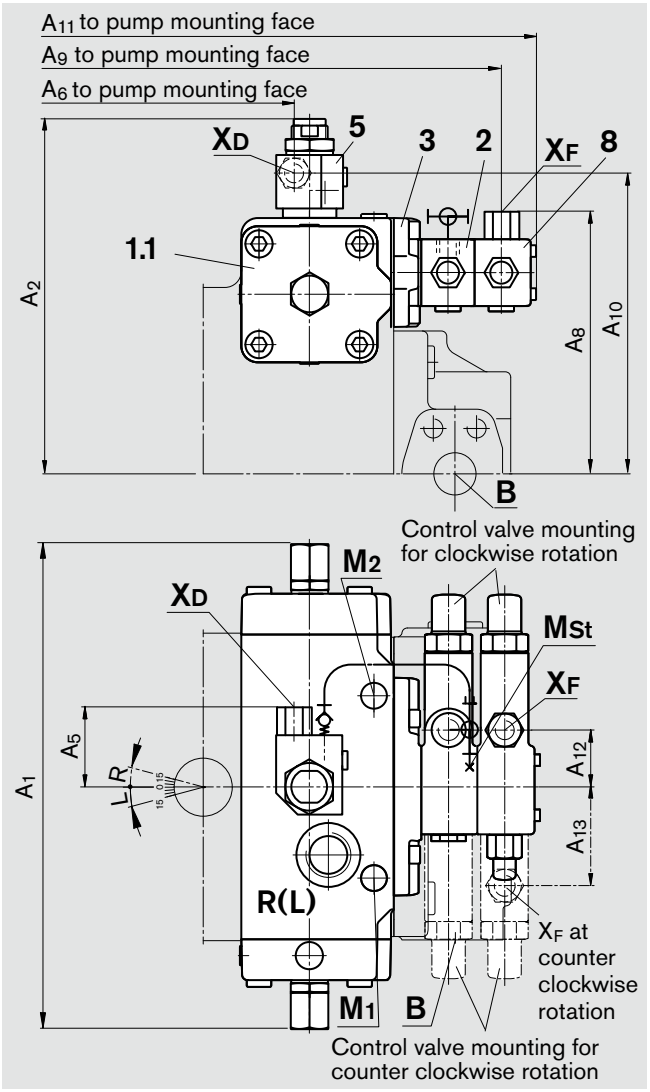
| | |
|---|---|
| **1** | Pump with hydraulic control device |
| **1.1** | AA4VSO (see RA 92050) |
| **2** | Control valve with pressure compensator |
| **3** | Sandwich plate |
| 4 | Pressure relief valve (not part of supply) |
| 5 | Throttle valve |
| 6 | Unloading valve (not part of supply) |
| 7 | Check valve (not part of supply)<br>only required in conjunction with unloading valve |
| 8 | Flow control valve |
| 9 | External orifice (not part of supply) |
| 9.1 | is needed, when parallel stroking for flow control function is necessary (not part of supply) |

# Unit dimensions DPF

Before finalising your design please request a certified installation drawing. Dimensions in inches and (millimeters)

**Dimensions valid for AA4VSO**

## Size 125…355




## Sub assemblies

| | |
|---|---|
| **1** | Pump with hydraulic control device |
| **1.1** | AA4VSO (see RA 92050) |
| **2** | Control valve with pressure compensator |
| **3** | Sandwich plate |
| 5 | Throttle valve |
| 8 | Flow control valve |

## Ports

| | | | | max. tightening torque [1] |
|---|---|---|---|---|
| $X_D$ | Pilot pressure port DP control | ISO 11926 | 9/16-18UNF-2B; 0.51(13) deep | 59 lb-ft (80 Nm) |
| $X_F$ | Pilot pressure port flow control | ISO 11926 | 9/16-18UNF-2B; 0.51(13) deep | 59 lb-ft (80 Nm) |
| $M_{St}$ | Gauging port pilot press. DP control | Tube dia 8x1.5mm (DIN 3853 S8 Form W) (closed) | | 37 lb-ft (50 Nm) |
| $M_1$, $M_2$ | Gauging port control chamber pressure | DIN 3852 | M14x1,5;0.47(12)deep; plugged(Size125 a.180)<br>M18x1,5;0.47(12)deep; plugged(Size250 a.355) | 59 lb-ft (80 Nm)<br>103 lb-ft (140 N |

## Unit dimensions

| Size | $A_1$ | $A_2$ | $A_5$ | $A_6$ | $A_8$ | $A_9$ | $A_{10}$ | $A_{11}$ | $A_{12}$ | $A_{13}$ | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **125/180** | 13.94 (354) | 10.28 (261) | 2.36 (60) | 7.56 (194) | 6.77 (172) | 13.58 (347) | 8.70 (221) | 14.61 (373) | 1.61 (41) | 2.80 (71) | For detailed unit dimensions and technical data of the variable pumps see the technical data sheets AA4VSO RA 92050 or AA4VSG RA 92100 |
| **250/355** | 16.69 (424) | 12.05 (306) | 2.36 (60) | 9.33 (239) | 8.19 (208) | 16.02 (409) | 10.55 (268) | 17.05 (435) | 1.61 (41) | 2.01 (51) | |

[1] see general notes

# FR/FR1 flow control

The flow control matches the pump displacement with the actual flow requirements of the actuators.

The pump flow depends only on the size of cross section in the orifice (item 4), mounted between pump and actuators. Within the control range of the pump, the flow is virtually independent of the actual load pressure (see max. flow deviation below).

The cross section in the orifice determines the pump flow.

The flow controller compares the pressure upstream of the orifice with the pressure after the orifice and keeps the pressure drop (differential pressure $\Delta p$) over the orifice constant, thereby controlling the flow.

An increase of differential pressure $\Delta p$ causes the pump to de-stroke (direction to $V_{g\,min}$), and a decrease in differential pressure $\Delta p$ results in a larger pump swivel angle (direction to $V_{g\,max}$), till the flow control valvespool is in balance again.

$\Delta p_{orifice} = p_{pump} - p_{actuator}$

The standard $\Delta p$ setting at the flow control spool (item 2) amounts to 203 psi (14 bar). If another setting (recommended range 203...362 psi (14...25 bar)) is required, please state in clear text when ordering. Higher values on request.

The stand by pressure at low pressure standby (orifice closed and pilot port $X_F$ pressureless) is slightly higher than the $\Delta p$-setting.

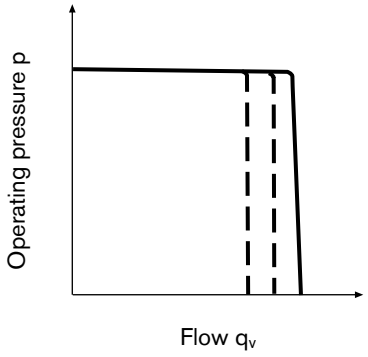
With the control version FR1 there is no connection from $X_F$ to tank.

**Home position** in pressureless condition: $\mathbf{V_{g\,max}}$

Min. and max. **swivel angle limitation** mechanically adjustable to 50 % of $V_{g\,max}$.
The $V_{g\,min}$-stop is set so that a pressure level of 217...290 psi (15...20 bar) is reached in a closed pressure port B.
The $V_{g\,max}$-stop is set to the nominal $V_{g\,max}$ value. If another setting is required, please state in clear text when ordering.

## AA4VSO - open circuit

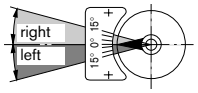
**Static characteristic**



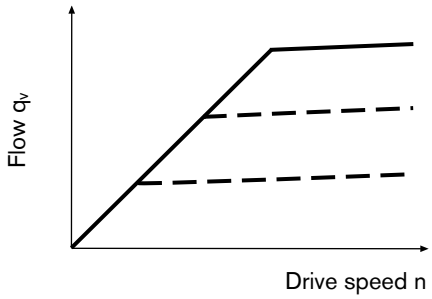

**Direction of flow S** to **B**

| Pump direction of rotation | Swivel range [1] | Pressure port |
|---|---|---|
| clockwise | left hand | B |
| counter clockwise | right hand | B |

[1] compare swivel angle indicator




**Static characteristic at variable drive speed**




**Max. flow deviation**

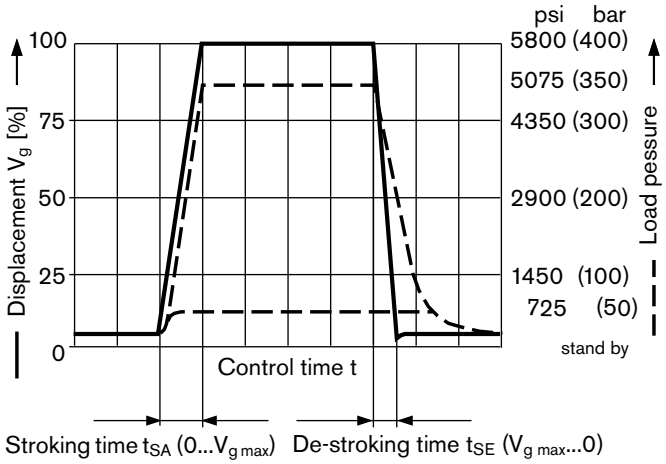
measured at drive speed of n = 1500 rpm

| Size | | 40 | 71 | 125 | 180 | 250 | 355 |
|---|---|---|---|---|---|---|---|
| $\Delta q_v$ | gpm | 0.5 | 0.8 | 1.3 | 1.6 | 2.1 | 2.6 |
| | (L/min) | (2) | (3) | (5) | (6) | (8) | (10) |

# FR/FR1 flow control

**Dynamic characteristics**

The curves are measured average values.
Flow jump stand by / $q_{v\,max}$ through unloading of X-port to tank.



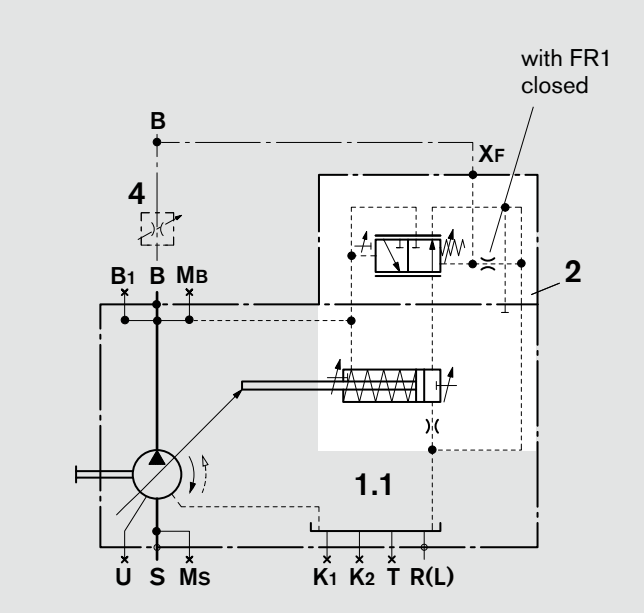

| Size | $t_{SA}$ [s] stand by...5075 psi (350 bar) | $t_{SE}$ [s] 5075 psi (350 bar)...stand by | $t_{SE}$ [s] 725 psi (50 bar)...stand by |
|---|---|---|---|
| **40** | approx. 0,1 | 0,02 | 0,050 |
| **71** | approx. 0,2 | 0,03 | 0,075 |
| **125** | approx. 0,3 | 0,04 | 0,100 |
| **180** | approx. 0,4 | 0,05 | 0,120 |
| **250** | approx. 0,4 | 0,06 | 0,150 |
| **355** | approx. 0,5 | 0,07 | 0,180 |

The **stroking time** $t_{SA}$ ($V_{g\,min} \rightarrow V_{g\,max}$) can be steplessly adjusted, without influencing the de-stroking time $t_{SE}$.
Standard setting see table. If needed, these values can be reduced by a factor of 2...3 (please consult us).

# Schematics FR/FR1

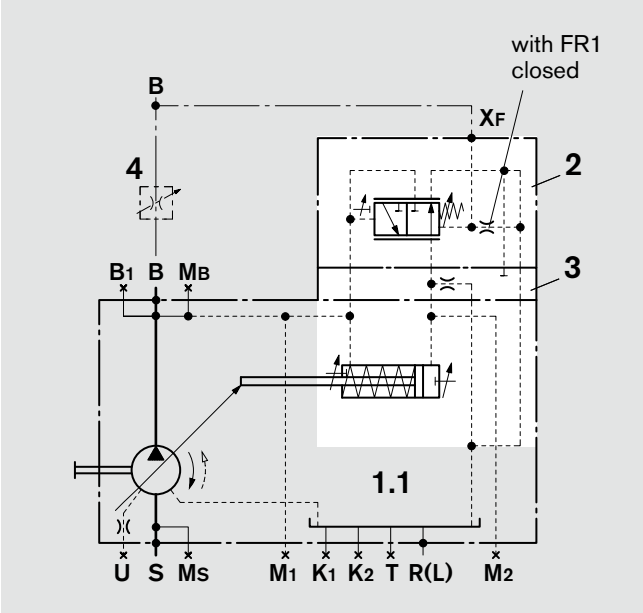
### Size 40 and 71

AA4VSO




### Size 125...355

AA4VSO




### Ports

| | |
|---|---|
| $X_F$ | Pilot pressure port flow control |
| $M_1$, $M_2$ | Gauging port control chamber pressure (Size 125...355) |

### Sub assemblies

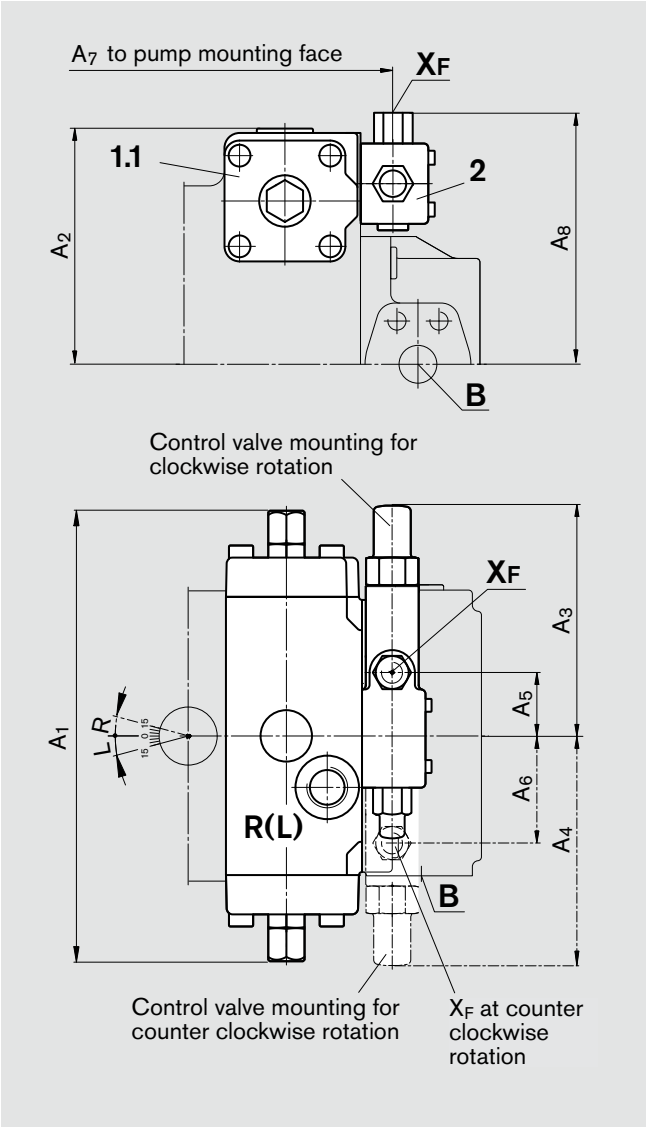
| | |
|---|---|
| **1** | Pump with hydraulic control device |
| **1.1** | AA4VSO (see RA 92050) |
| **2** | Flow control valve |
| **3** | Sandwich plate (Size 125...355) |
| **4** | External orifice (not part of supply) |

# Unit dimensions FR/FR1

Before finalising your design please request a certified installation drawing. Dimensions in inches and (millimeters)

**Dimensions valid for AA4VSO**

## Size 40 and 71




## Sub assemblies

**1** Pump with hydraulic control device
**1.1** AA4VSO (see RA 92050)

**2** Flow control valve

## Ports

| | | | max. tightening torque [1] |
|---|---|---|---|
| $X_F$ | Pilot pressure port flow control | ISO 11926 9/16-18UNF-2B; 0.51(13) deep | 59 lb-ft (80 Nm) |

## Unit dimensions

| Size | $A_1$ | $A_2$ | $A_3$ | $A_4$ | $A_5$ | $A_6$ | $A_7$ | $A_8$ | |
|---|---|---|---|---|---|---|---|---|---|
| **40** | 10.24 (260) | 5.51 (140) | 5.79 (147) | 5.39 (137) | 1.85 (47) | 2.64 (67) | 8.31 (211) | 5.91 (150) | For detailed unit dimensions and technical data of the variable pumps see the technical data sheets AA4VSO RA 92050 or AA4VSG RA 92100 |
| **71** | 11.73 (298) | 6.18 (157) | 5.59 (142) | 5.59 (142) | 1.65 (42) | 2.83 (72) | 9.37 (238) | 6.54 (166) | |

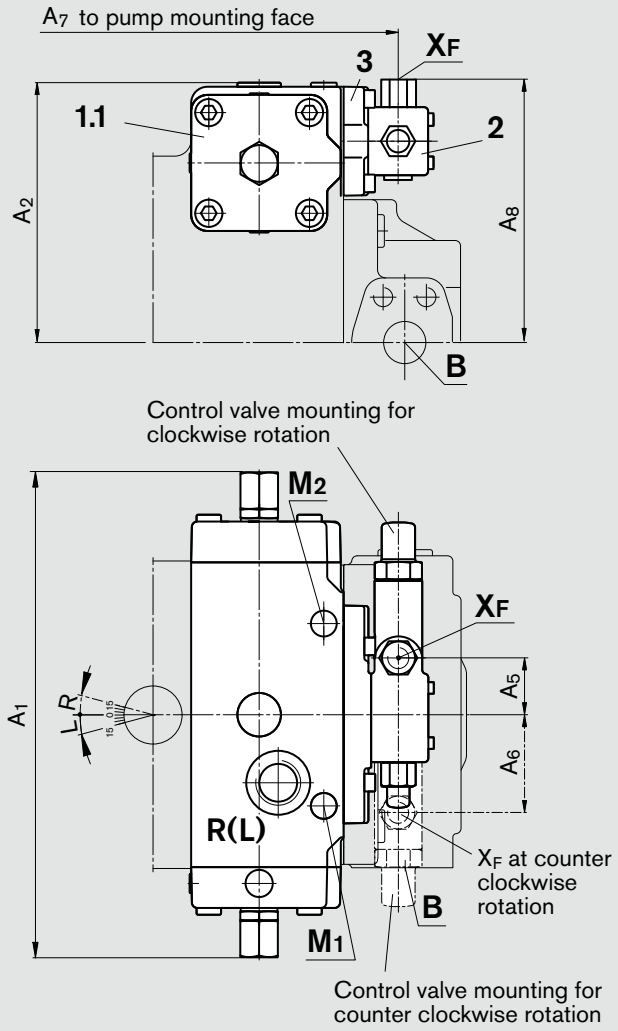
[1] see general notes

# Unit dimensions FR/FR1

Before finalising your design please request a certified installation drawing. Dimensions in inches and (millimeters)

**Dimensions valid for AA4VSO**

## Size125...355




## Sub assemblies

| | |
|---|---|
| **1** | Pump with hydraulic control device |
| **1.1** | AA4VSO (see RA 92050) |
| **2** | Flow control valve |
| **3** | Sandwich plate |

## Ports

| | | | | **max. tightening torque** [1] |
|---|---|---|---|---|
| $X_F$ | Pilot pressure port flow control | ISO 11926 | 9/16-18UNF-2B; 0.51(13) deep | 59 lb-ft (80 Nm) |
| $M_1$, $M_2$ | Gauging port control chamber pressure | DIN 3852 | M14x1,5; 0.47(12)deep; plugged (Size 125 a.180) | 59 lb-ft (80 Nm) |
| | | | M18x1,5; 0.47(12)deep; plugged (Size 250 a.355) | 103 lb-ft (140 Nm) |

## Unit dimensions

| Size | $A_1$ | $A_2$ | $A_5$ | $A_6$ | $A_7$ | $A_8$ | |
|---|---|---|---|---|---|---|---|
| **125/180** | 13.94 (354) | 7.52 (191) | 1.61 (41) | 2.80 (71) | 12.09 (307) | 7.64 (194) | For detailed unit dimensions and technical data of the variable pumps see the technical data sheets AA4VSO RA 92050 or AA4VSG RA 92100 |
| **250/355** | 16.69 (424) | 9.37 (238) | 1.61 (41) | 2.80 (71) | 14.53 (369) | 9.06 (230) | |

[1] see general notes

# FRG/FRG1 with remote pressure control

The pressure/flow control FRG is a combination of FR (FR1) and DRG.
The pressure control overrides the flow control. The pressure control level can be remotely set with a separate pressure relief valve (item 4).

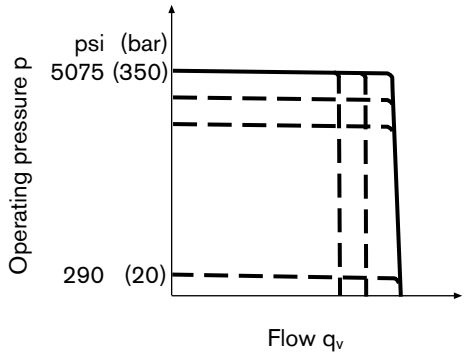
Function and technical data of the remotely adjustable pressure control see page 7.

Function and technical data of flow control FR see page 22 and 23.

With the control version FRG1 there is no connection from $X_F$ to tank.

## AA4VSO - open circuit

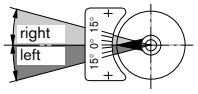
**Characteristic**




**Direction of flow S** to **B**

| Pump direction of rotation | Swivel range [1] | Pressure port |
|---|---|---|
| clockwise | left hand | B |
| counter clockwise | right hand | B |

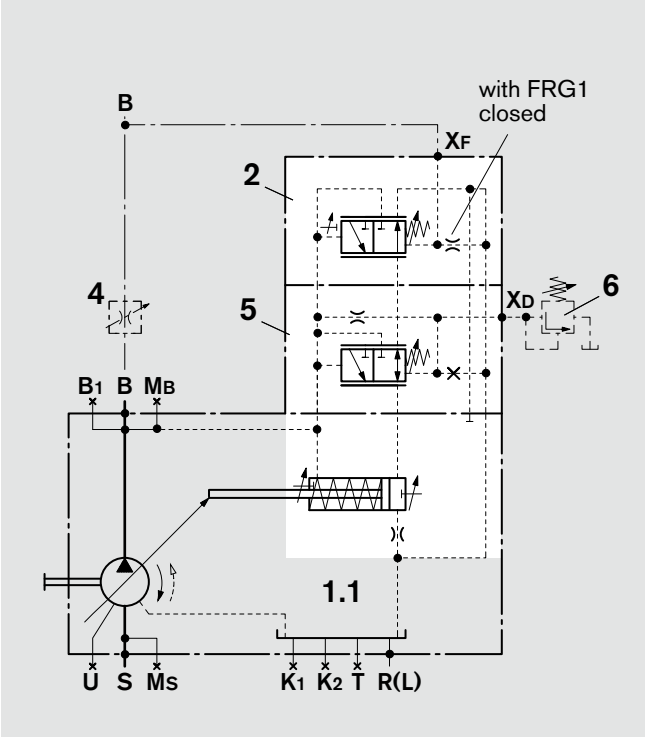
[1] compare swivel angle indicator



# Schematics FRG/FRG1

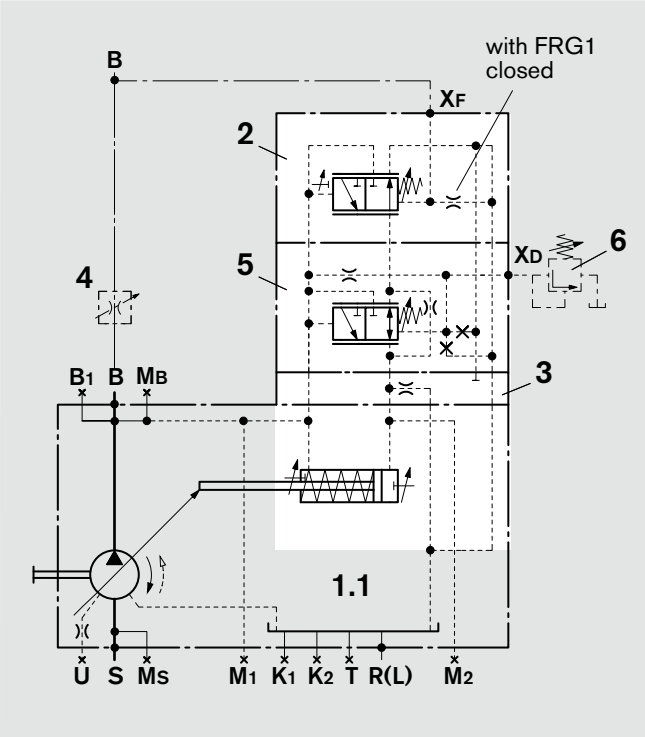
### Size 40 and 71

AA4VSO




### Size 125...355

AA4VSO




## Ports

| | |
|---|---|
| $X_D$ | Pilot pressure port remote pressure control |
| $X_F$ | Pilot pressure port flow control |
| $M_1$, $M_2$ | Gauging port control chamber pressure (Size 125...355) |

## Sub assemblies

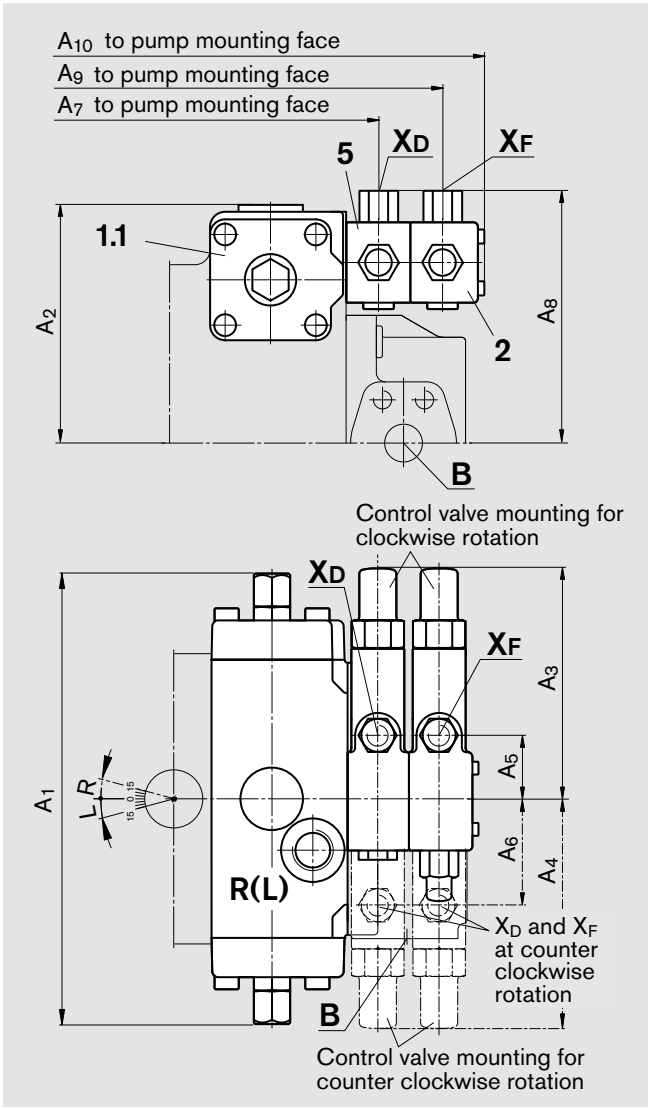
| | |
|---|---|
| **1** | Pump with hydraulic control device |
| **1.1** | AA4VSO (see RA 92050) |
| **2** | Flow control valve |
| **3** | Sandwich plate (Size 125...355) |
| **4** | External orifice (not part of supply) |
| **5** | Pressure control valve |
| **6** | External pressure relief valve (not part of supply) |

# Unit dimensions FRG/FRG1

Before finalising your design please request a certified installation drawing. Dimensions in inches and (millimeters)

**Dimensions valid for AA4VSO**

## Size 40 and 71




## Sub assemblies

**1** Pump with hydraulic control device
**1.1** AA4VSO (see RA 92050)
**2** Flow control valve
**5** Pressure control valve

## Ports

| | | | max. tightening torque [1] |
|---|---|---|---|
| $X_D$ | Pilot pressure port remote pressure control | ISO 11926 9/16-18UNF-2B; 0.51(13) deep | 59 lb-ft (80 Nm) |
| $X_F$ | Pilot pressure port flow control | ISO 11926 9/16-18UNF-2B; 0.51(13) deep | 59 lb-ft (80 Nm) |

## Unit dimensions

| Size | $A_1$ | $A_2$ | $A_3$ | $A_4$ | $A_5$ | $A_6$ | $A_7$ | $A_8$ | $A_9$ | $A_{10}$ | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **40** | 10.24 (260) | 5.51 (140) | 5.79 (147) | 5.39 (137) | 1.85 (47) | 2.64 (67) | 8.31 (211) | 5.91 (150) | 9.88 (251) | 10.91 (277) | For detailed unit dimensions and technical data of the variable pumps see the technical data sheets AA4VSO RA 92050 or AA4VSG RA 92100 |
| **71** | 11.73 (298) | 6.18 (157) | 5.59 (142) | 5.59 (142) | 1.65 (42) | 2.83 (72) | 9.37 (238) | 6.54 (166) | 10.94 (278) | 11.97 (304) | |

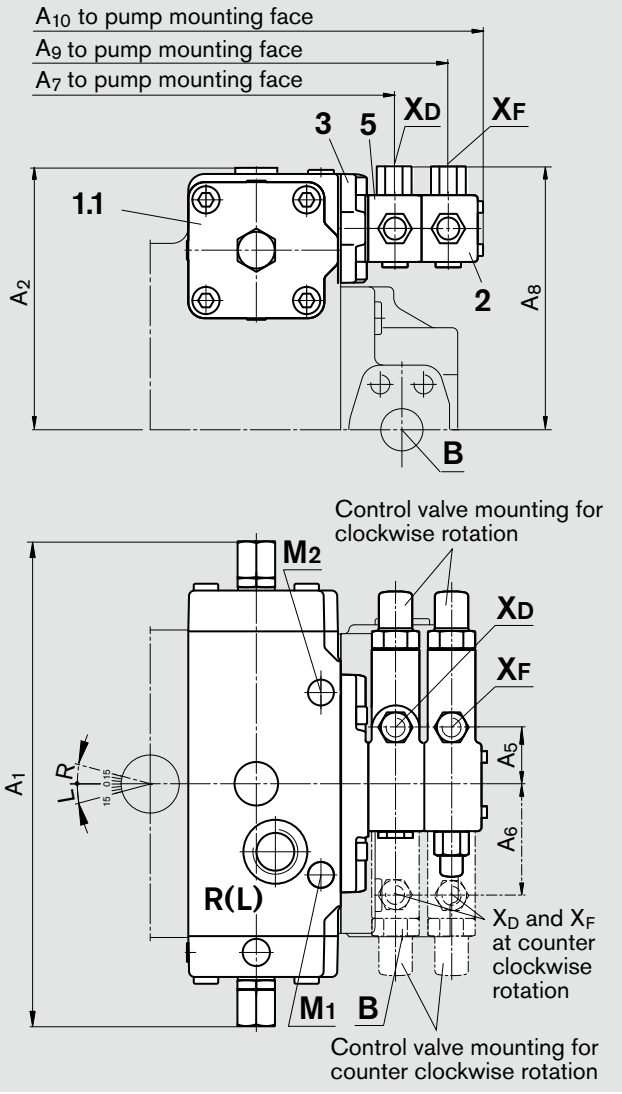
[1] see general notes

# Unit dimensions FRG/FRG1

Before finalising your design please request a certified installation drawing.
Dimensions in inches and (millimeters)

**Dimensions valid for AA4VSO**

## Size 125...355




## Sub assemblies

| | |
|---|---|
| **1** | Pump with hydraulic control device |
| **1.1** | AA4VSO (see RA 92050) |
| **2** | Flow control valve |
| **3** | Sandwich plate |
| **5** | Pressure control valve |

## Ports

| | | | | max. tightening torque [1] |
|---|---|---|---|---|
| $X_D$ | Pilot pressure port remote pressure control | ISO 11926 | 9/16-18UNF-2B; 0.51(13) deep | 59 lb-ft (80 Nm) |
| $X_F$ | Pilot pressure port flow control | ISO 11926 | 9/16-18UNF-2B; 0.51(13) deep | 59 lb-ft (80 Nm) |
| $M_1$, $M_2$ | Gauging port control chamber pressure | DIN 3852 | M14x1,5; 0.47(12) deep; plugged (Size 125 a. 180) | 59 lb-ft (80 Nm) |
| | | | M18x1,5; 0.47(12) deep; plugged (Size 250 a. 355) | 103 lb-ft (140 Nm) |

## Unit dimensions

| Size | $A_1$ | $A_2$ | $A_5$ | $A_6$ | $A_7$ | $A_8$ | $A_9$ | $A_{10}$ | |
|---|---|---|---|---|---|---|---|---|---|
| **125/180** | 13.94 (354) | 7.52 (191) | 1.61 (41) | 2.80 (71) | 12.09 (307) | 7.64 (194) | 13.66 (347) | 14.69 (373) | For detailed unit dimensions and technical data of the variable pumps see the technical data sheets AA4VSO RA 92050 or AA4VSG RA 92100 |
| **250/355** | 16.69 (424) | 9.37 (238) | 1.61 (41) | 2.80 (71) | 14.53 (369) | 9.06 (230) | 16.10 (409) | 17.13 (435) | |

[1] see general notes

# DFR/DFR1 pressure and flow control

Pressure and flow control DFR is a combination of pressure control DR and flow control FR.

Function and technical data see DR (page 4) and FR (page 22).

With the control version DFR1 there is no connection from $X_F$ to tank.

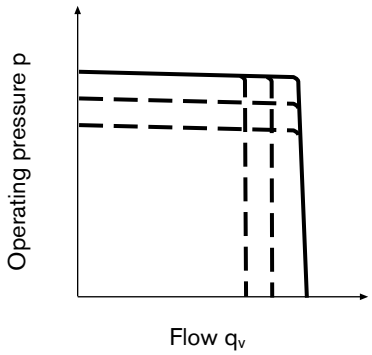
Min. and max. swivel angle limitation mechanically adjustable to 50 % of $V_{g\,max}$.

**Home position in pressureless condition**: $\mathbf{V_{g\,max}}$

Min. and max. **swivel angle limitation** mechanically adjustable to 50 % of $V_{g\,max}$.
The $V_{g\,min}$-stop is set so that a pressure level of 217...290 psi (15...20 bar) is reached in a closed pressure port B
The $V_{g\,max}$-stop is set to the nominal $V_{g\,max}$ value. If another setting is required, please state in clear text when ordering.

## AA4VSO - open circuit

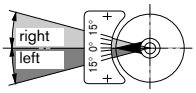
**Static characteristic**




**Direction of flow S to B**

| Pump direction of rotation | Swivel range [1] | Pressure port |
|---|---|---|
| clockwise | left hand | B |
| counter clockwise | right hand | B |

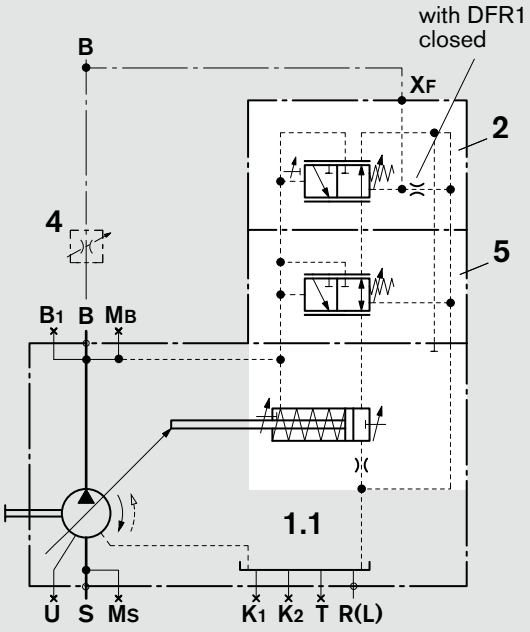
[1] compare swivel angle indicator



# Schematics DFR/DFR1

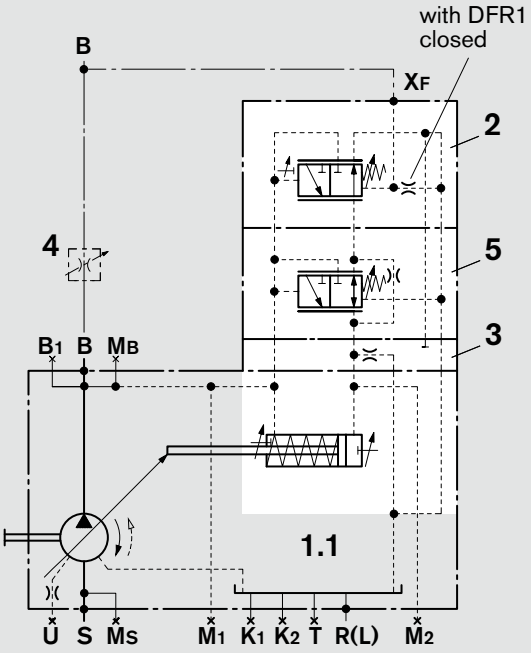
### Size 40 and 71

AA4VSO




### Size 125...355

AA4VSO




### Ports

| | |
|---|---|
| $X_F$ | Pilot pressure port flow control |
| $M_1$, $M_2$ | Gauging port control chamber pressure (Size 125...355) |

### Sub assemblies

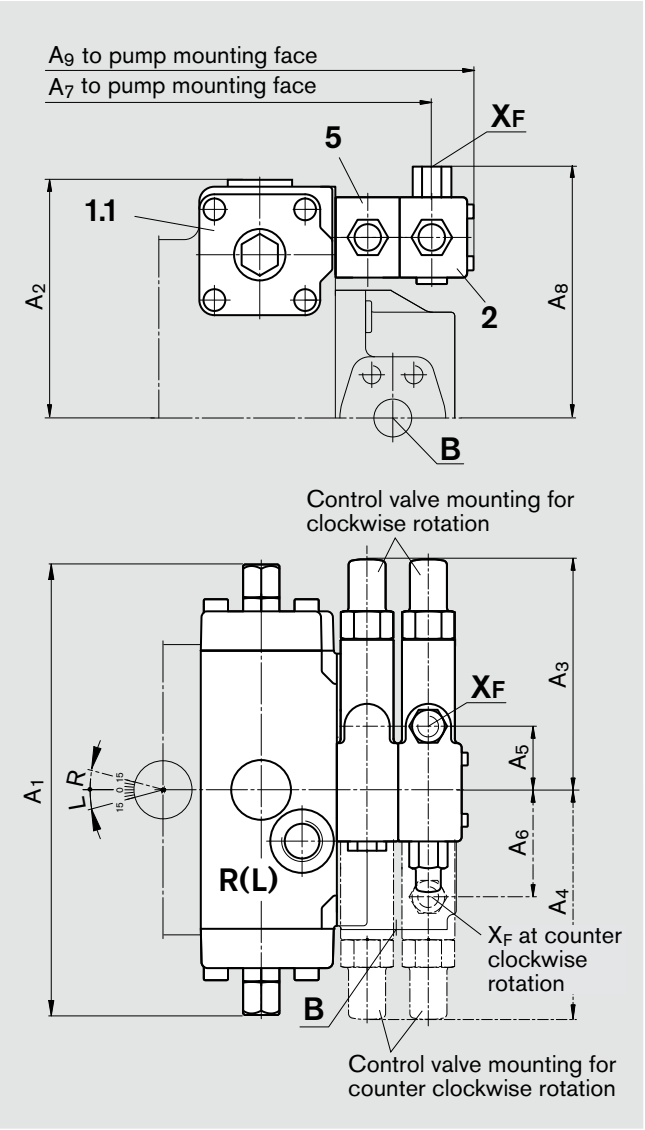
| | |
|---|---|
| **1** | Pump with hydraulic control device |
| **1.1** | AA4VSO (see RA 92050) |
| **2** | Flow control valve |
| **3** | Sandwich plate (Size 125...355) |
| **4** | External orifice (not part of supply) |
| **5** | Pressure control valve |

# Unit dimensions DFR/DFR1

Before finalising your design please request a certified installation drawing. Dimensions in inches and (millimeters)

**Dimensions valid for AA4VSO**

## Size 40 and 71




### Sub assemblies

| | |
|---|---|
| **1** | Pump with hydraulic control device |
| **1.1** | AA4VSO (see RA 92050) |
| **2** | Flow control valve |
| **5** | Pressure control valve |

### Ports

| | | | **max. tightening torque** [1] |
|---|---|---|---|
| $X_F$ | Pilot pressure port flow control | ISO 11926 9/16-18UNF-2B; 0.51(13) deep | 59 lb-ft (80 Nm) |

### Unit dimensions

| Size | $A_1$ | $A_2$ | $A_3$ | $A_4$ | $A_5$ | $A_6$ | $A_7$ | $A_8$ | $A_9$ | |
|---|---|---|---|---|---|---|---|---|---|---|
| **40** | 10.24 (260) | 5.51 (140) | 5.79 (147) | 5.39 (137) | 1.85 (47) | 2.64 (67) | 9.88 (251) | 5.91 (150) | 10.91 (277) | For detailed unit dimensions and technical data of the variable pumps see the technical data sheets AA4VSO RA 92050 or AA4VSG RA 92100 |
| **71** | 11.73 (298) | 6.18 (157) | 5.59 (142) | 5.52 (142) | 1.65 (42) | 2.83 (72) | 10.94 (278) | 6.54 (166) | 11.97 (304) | |

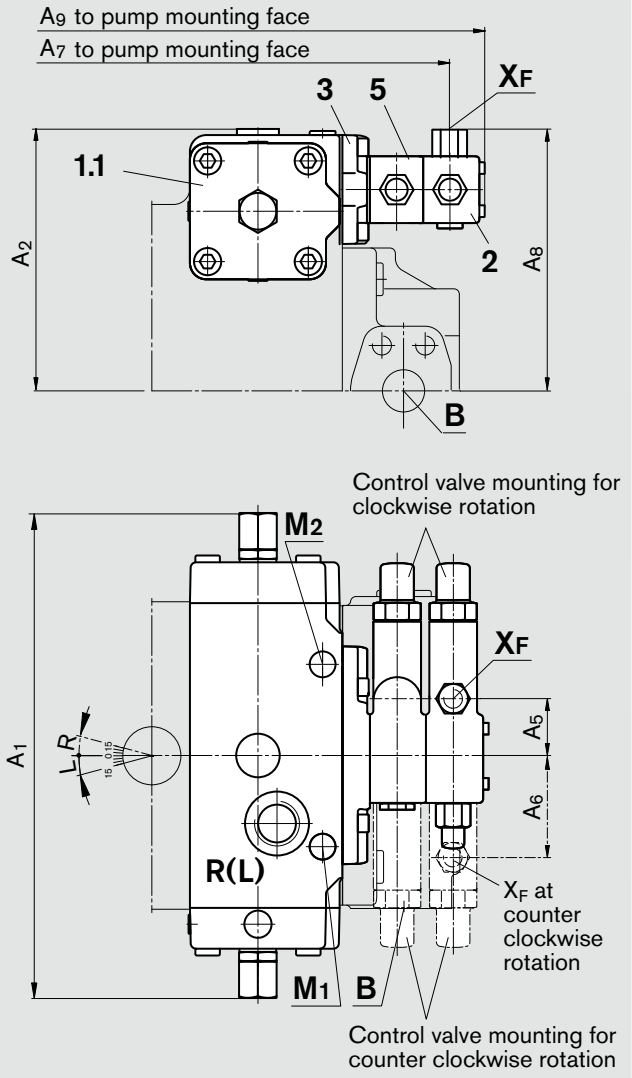
[1] See general notes

# Unit dimensions DFR/DFR1

Before finalising your design please request a certified installation drawing.
Dimensions in inches and (millimeters)

**Dimensions valid for AA4VSO**

## Size 125…355




### Sub assemblies

| | |
|---|---|
| **1** | Pump with hydraulic control device |
| **1.1** | AA4VSO (see RA 92050) |
| **2** | Flow control valve |
| **3** | Sandwich plate |
| **5** | Pressure control valve |

### Ports

| | | | | **max. tightening torque** [1] |
|---|---|---|---|---|
| $X_F$ | Pilot pressure port flow control | ISO 11926 | 9/16-18UNF-2B; 0.51(13) deep | 59 lb-ft (80 Nm) |
| $M_1$, $M_2$ | Gauging port control chamber pressure | DIN 3852 | M14x1,5; 0.47 (12) deep; plugged (Size 125 a. 180) | 59 lb-ft (80 Nm) |
| | | | M18x1,5; 0.47 (12) deep; plugged (Size 250 a. 355) | 103 lb-ft (140 Nm) |

### Unit dimensions

| Size | $A_1$ | $A_2$ | $A_5$ | $A_6$ | $A_7$ | $A_8$ | $A_9$ | |
|---|---|---|---|---|---|---|---|---|
| **125/180** | 13.94 (354) | 7.52 (191) | 1.61 (41) | 2.80 (71) | 13.66 (347) | 7.64 (194) | 14.69 (373) | For detailed unit dimensions and technical data of the variable pumps see the technical data sheets AA4VSO RA 92050 or AA4VSG RA 92100 |
| **250/355** | 16.69 (424) | 9.37 (238) | 1.61 (41) | 2.80 (71) | 16.10 (409) | 9.06 (230) | 17.13 (435) | |

[1] See general notes

# Notes

# General notes

– The control devices DR, DP, FR and DFR are intended to be used together with the pump (A)A4VSO in open circuit applications, and the control devices DR and DP together with the pump (A)A4VSG in closed circuit applications.

– Project planning, assembly, and commissioning of the pump require the involvement of qualified personnel.

– The service line ports and function ports are only designed to accommodate hydraulic lines.

– 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 fittings must be observed!
For DIN 13 / ISO 68 fixing screws we recommend checking the tightening torque individually according to VDI 2230 Edition 2003.

– During and shortly after operation of a pump the housing can be extremly hot, avoid being burned! Take suitable safety precautions, e.g. wear protective clothing.

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

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