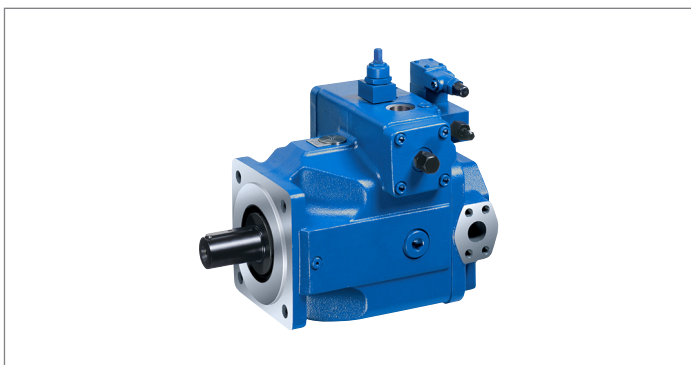


A4VSO, A4VBO power controller LR2, LR3 and LR2N, LR3N



- ▶ For variable pump A4VSO series 1 and 3
- ▶ Sizes 40 to 1000
- ▶ Nominal pressure 350 bar
- ▶ Maximum pressure 400 bar

- ▶ For variable pump A4VBO series 1 and 3
- ▶ Size 71, 125
- ▶ Nominal pressure 450 bar
- ▶ Maximum pressure 500 bar

Features

- ▶ Perfect power utilization thanks to precise control in accordance with the hyperbolic characteristic curve at constant rotational speed.
- ▶ The beginning of control is mechanically adjustable.
- ▶ Additional functions in a modular system for
 - Pressure control, fixed setting and remotely controllable
 - Flow control
 - Stroke control, hydraulic, mechanical, electric
 - Hydraulic two-point control
 - Electrical control of pilot pressure

Further information such as technical data, dimensions and notes regarding the relevant products can be found in the following data sheets:

Axial piston variable pump A4VSO, 92050

Axial piston variable pump A4VBO, 92122

Contents

Type code LR2 / LR3	2
Type code LR2N / LR3N	3
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LR.M – Power controller with mechanical stroke limiter	17
LR.D – Power controller with pressure controller	21
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LR.F – Power controller with flow control	27
LR.S – Power controller with load-sensing valve and pressure control, remote controlled	30
LR..Z – Power controller with hydraulic two-point control	33
LR..Y – Power controller with electric two-point control	39
LR.H – Power controller with hydraulic stroke limiter	42
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LR.NT – Power controller with electric stroke control	51
Combination example LR2GN	56
Combination example LR2GNT	61
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Type code LR2 / LR3

Basic pump setting $V_{g \max}$

01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16
		O		LR					/						

Hydraulic fluid

01	For details see data sheet 92050, 92122	
----	---	--

Axial piston unit

02	Variable swashplate design, nominal pressure 350 bar, maximum pressure 400 bar (see data sheet 92050)	A4VS
	Variable swashplate design, nominal pressure 450 bar, maximum pressure 500 bar (see data sheet 92122)	A4VB

Operating mode

03	Pump, open circuit	O
----	--------------------	----------

Size (NG)

04	Geometric displacement; see technical data in the relevant data sheets	A4VSO	40	71		125		180	250	355	500	750	1000
		A4VBO	–	–	71	–	125	–	–	–	–	–	–

Control devices

		40	71	71	125	125	180	250	355	500	750	1000	
05	Power controller with hyperbolic characteristic curve; Basic setting $V_{g \max}$	●	●	●	●	●	●	●	●	●	●	●	LR
06	Setting the power characteristics	40	71	71	125	125	180	250	355	500	750	1000	
	mechanically adjustable	●	●	●	●	●	●	●	●	●	●	●	2
	with hydraulic remote control	●	●	–	●	–	●	●	●	●	●	●	3
07	Pressure control	40	71	71	125	125	180	250	355	500	750	1000	
	without pressure control (without code)	●	●	●	●	●	●	●	●	●	●	●	
	with pressure control	●	●	–	●	–	●	●	●	●	●	●	D
	with pressure control, remote controlled	●	●	–	●	–	●	●	●	●	●	●	G
08	Flow control /limitation	40	71	71	125	125	180	250	355	500	750	1000	
	without flow control / limitation (without code)	●	●	●	●	●	●	●	●	●	●	●	
	with flow control	●	●	–	●	–	●	●	●	–	–	–	F²⁾
	with hydraulic stroke limiter, proportional, negative characteristic curve	●	●	–	●	–	●	●	●	●	●	●	H
	with hydraulic two-point control	●	●	–	●	–	●	●	●	●	●	○	Z
	with electric unloading valve as starting aid	●	●	–	●	–	●	●	●	○	○	○	Y
	with load-sensing and pressure control, remote controlled	●	●	–	●	–	●	●	●	–	–	–	S³⁾
09	Mechanical stroke limiter	40	71	71	125	125	180	250	355	500	750	1000	
	without mechanical stroke limiter (without code)	●	●	●	●	●	●	●	●	●	●	●	
	with mechanical stroke limiter	●	●	–	●	–	●	●	●	–	–	–	M

All other items and information can be found in the respective data sheets 92050 (A4VSO) and 92122 (A4VBO).

● = Available – = Not available ○ = On request

- 1) A4VBO is only available with the power controller combination LR2 and only in sizes 71 and 125.
- 2) Bosch Rexroth recommends using LR.S for dynamic controls.
- 3) Cannot be combined with pressure control D or G.

Type code LR2N / LR3N

Basic pump setting $V_{g \min}$

01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16
	A4VS	O		LR			N		/						

Hydraulic fluid

01	For details see data sheet 92050	
----	----------------------------------	--

Axial piston unit

02	Swashplate design, variable, nominal pressure 350 bar, maximum pressure 400 bar	A4VS
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Operating mode

03	Pump, open circuit	O
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Size (NG)

04	Geometric displacement see technical data in data sheet 92050	40	71	125	180	250	355	500	750	1000
----	--	-----------	-----------	------------	------------	------------	------------	------------	------------	-------------

Control device

		40	71	125	18	250	355	500	750	1000	
05	Power controller with hyperbolic characteristic curve; Basic setting $V_{g \min}$, pilot-pressure related	•	•	•	•	•	•	•	•	•	LR
06	Setting the power characteristics	40	71	125	18	250	355	500	750	1000	
	mechanically adjustable	•	•	•	•	•	•	•	•	•	2
	with hydraulic remote control	•	•	•	•	•	•	•	•	•	3
07	Pressure control	40	71	125	18	250	355	500	750	1000	
	without pressure control (without code)	•	•	•	•	•	•	•	•	•	
	with pressure control	•	•	•	•	•	•	•	•	•	D
	with pressure control, remote controlled	•	•	•	•	•	•	•	•	•	G
08	Hydraulic stroke control	40	71	125	18	250	355	500	750	1000	
	proportional, positive characteristic curve	•	•	•	•	•	•	•	•	•	N
09	Electrical control of pilot pressure	40	71	125	18	250	355	500	750	1000	
	without electrical control of pilot pressure (without code)	•	•	•	•	•	•	•	•	•	
	with electrical control of pilot pressure (DBEP 6)	•	•	•	•	•	•	•	•	•	T¹⁾

For operation with HF hydraulic fluid, please observe data sheet 29164 (Proportional pressure relief valve type DBEP).
All other items and information on A4VSO can be found in data sheet 92050.

• = Available - = Not available ○ = On request

¹⁾ Only available for clockwise rotation and with control combination LR..N

LR2 – Power controller with hyperbolic characteristic curve

Pump setting in depressurized state: $V_{g\ max}$

Depending on the working pressure, the displacement of the pump is controlled so that a given drive torque is not exceeded, i.e. at constant drive speed the accordingly specified drive power. Precise control in accordance with the hyperbolic characteristic curve, provides an optimum, hydraulic utilization of available power.

$p \cdot q_v = \text{constant}$

p Working pressure

[bar]

q_v Flow

[cm³]

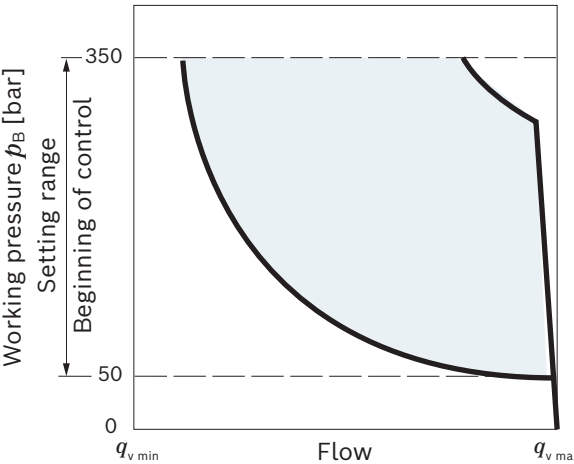
Supported by a spring, the working pressure acts on the stroking piston in direction $V_{g\ max}$. Via a rocker, the latter actuates the valve spool in the power limiting valve against the adjustment spring. If the working pressure in the chamber exceeds the set pressure of the adjustment spring, the large stroking chamber is filled with hydraulic fluid and swivels back in the $V_{g\ min}$ direction. When doing this, the lever length at the rocker shortens and the working pressure may rise in the same proportion as the displacement reduces without the drive power being exceeded ($p \cdot V_g = \text{constant}$).

The beginning of control is set mechanically.
By means of spring and setting screw, the beginning of control can be set within the entire setting range.
Setting range: 50¹⁾ to 350 bar beginning of control.
The power characteristic is set at the factory.
When ordering, please state in plain text:

- ▶ Drive power P in kW
- ▶ Drive speed n in rpm
- ▶ Maximum flow $q_{v\ max}$ in l/min (50 to 100% $V_{g\ max}$)
 - The default setting is 100%
- ▶ Minimum flow $q_{v\ min}$ in l/min (0 to 50% $V_{g\ max}$)
 - The default setting is 0%

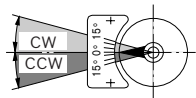
The minimum and maximum swivel angle limitations (up to 50% $V_{g\ max}$) are fixedly set at the factory.
When ordering, please state the desired values in the plain text.

▼ Characteristic curve LR2



Direction of rotation	Swivel direction ²⁾	Flow direction	High-pressure port
clockwise	counter-clockwise	S to B	B
counter-clockwise	clockwise	S to B	B

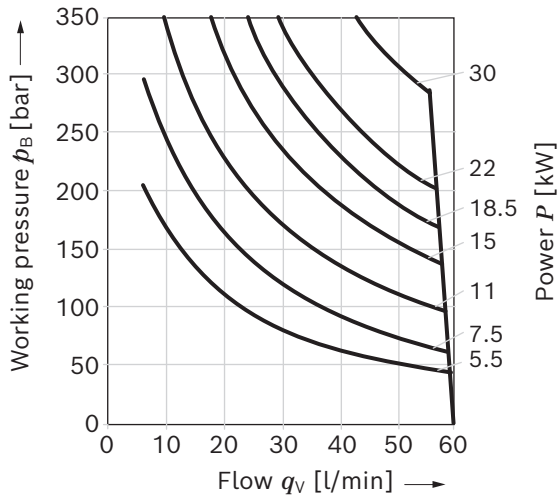
1) Beginning of control <50 bar upon request.
2) Cf. swivel angle indicator



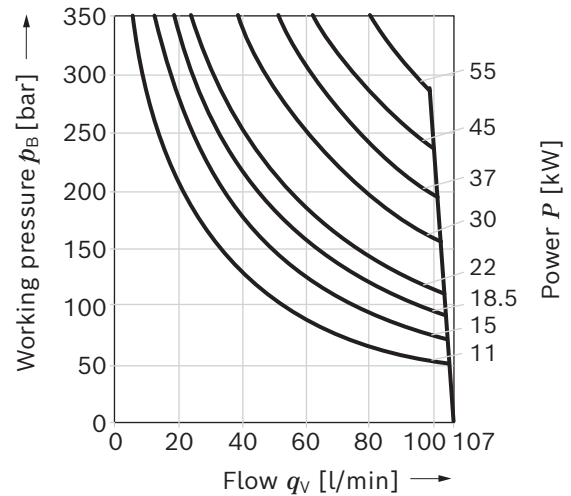
Characteristic power curves A4VSO

at 1500 rpm

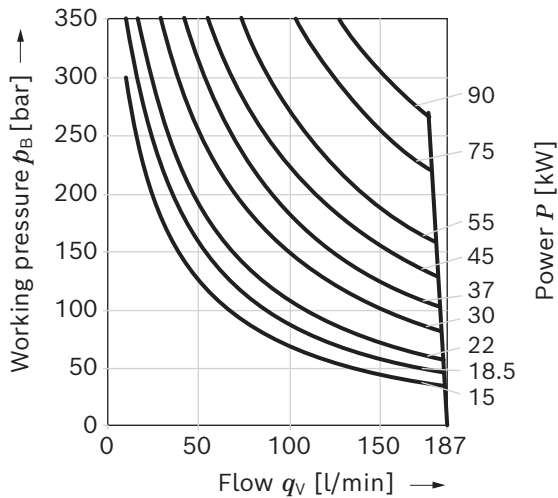
Size 40



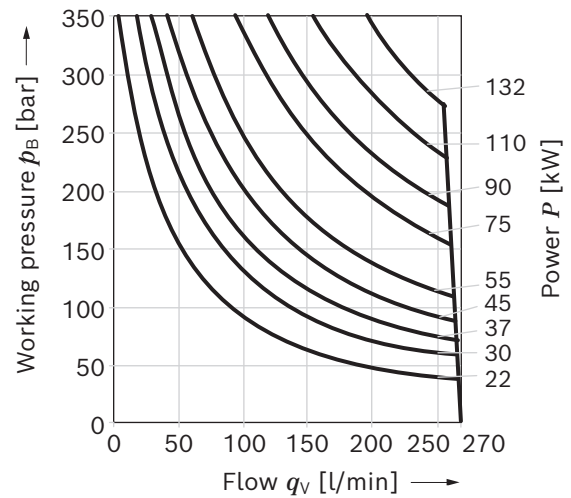
Size 71



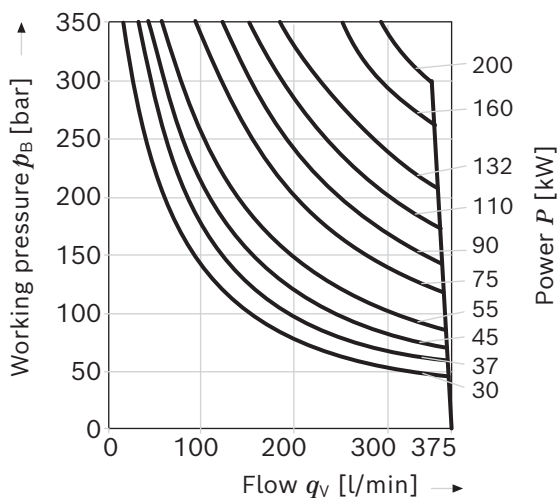
Size 125



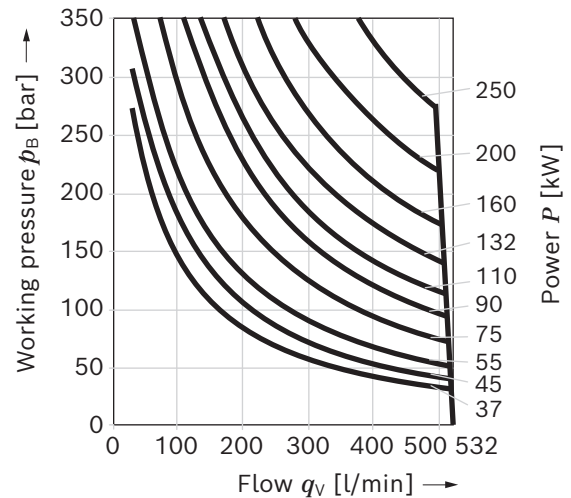
Size 180



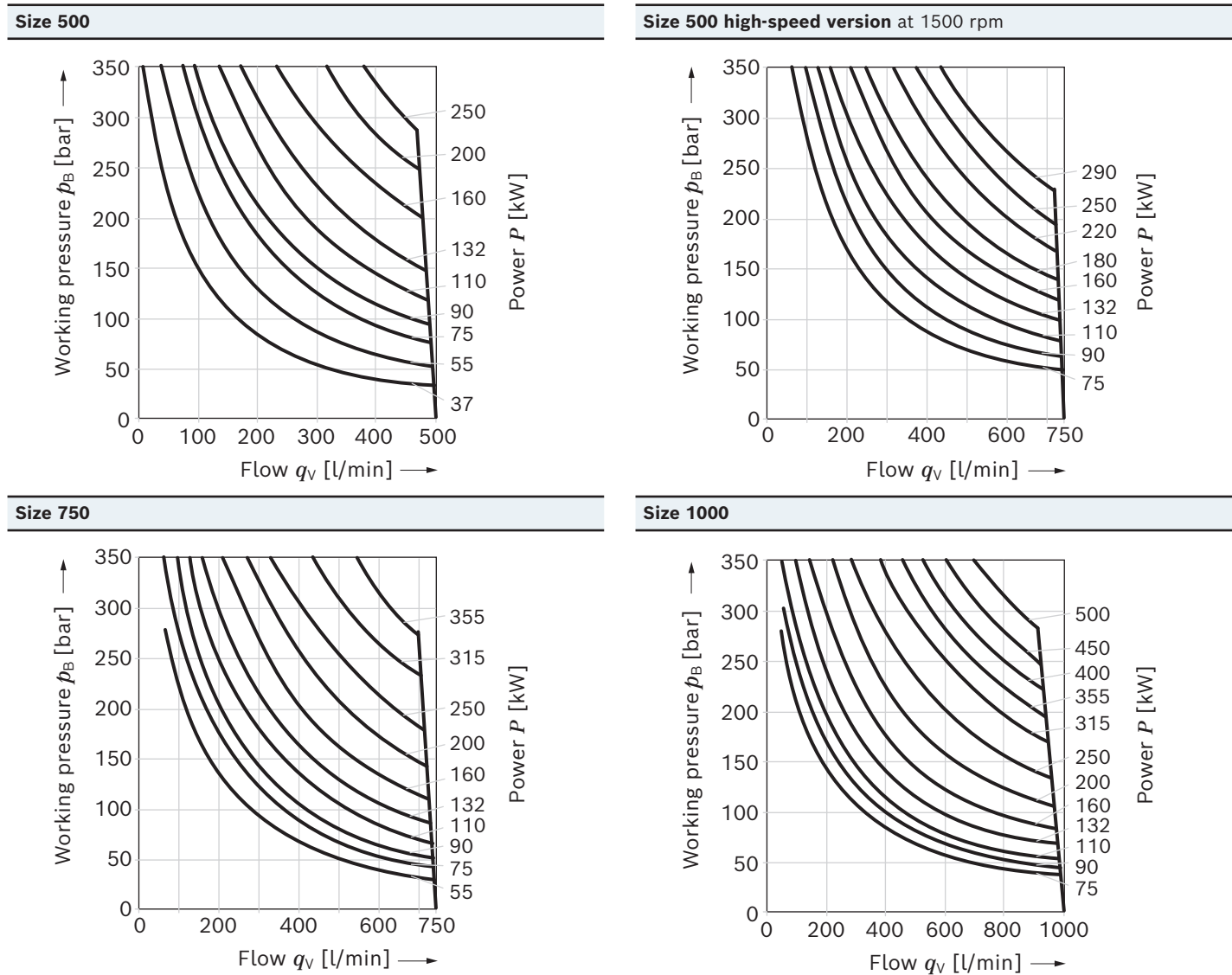
Size 250



Size 355

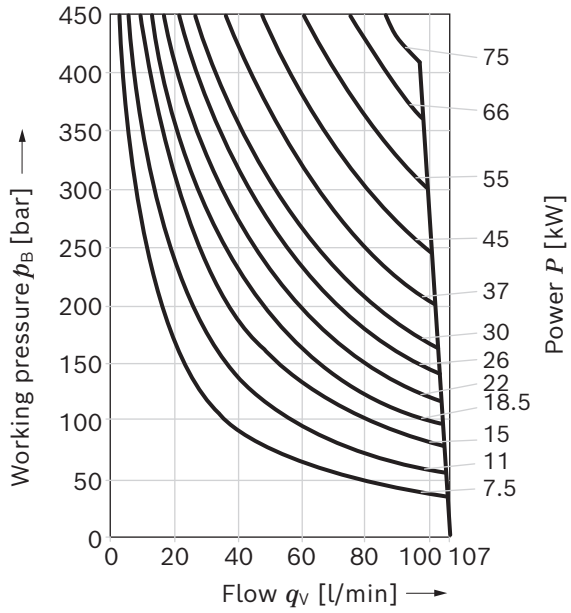


Characteristic power curves A4VSO
 at 1000 rpm

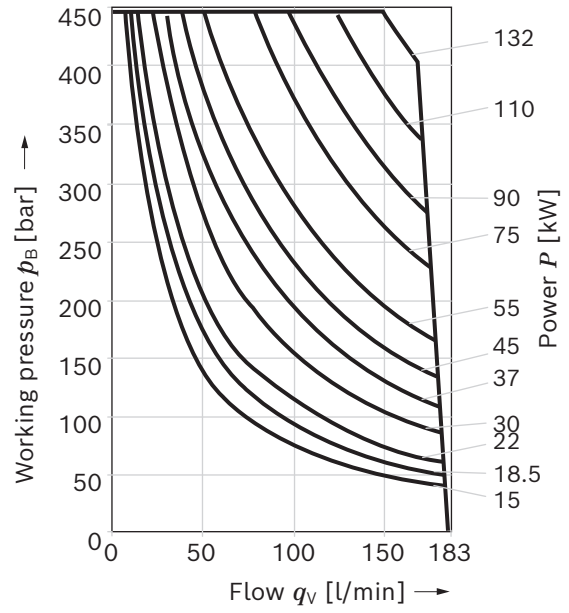


Characteristic power curves A4VBO
 at 1500 rpm

Size 71

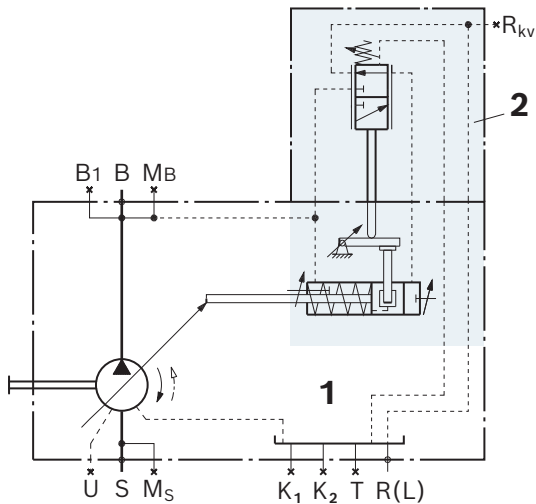


Size 125

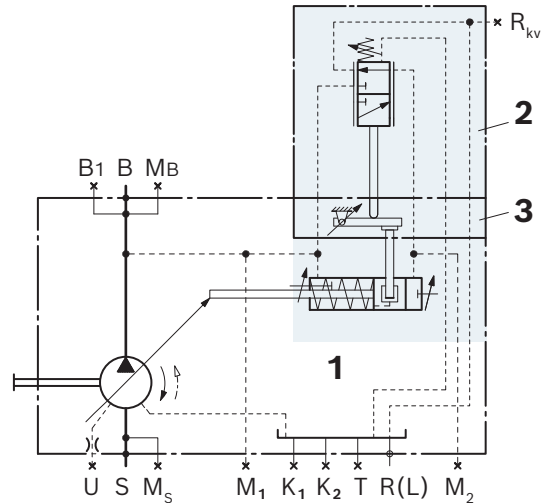


Circuit diagrams LR2

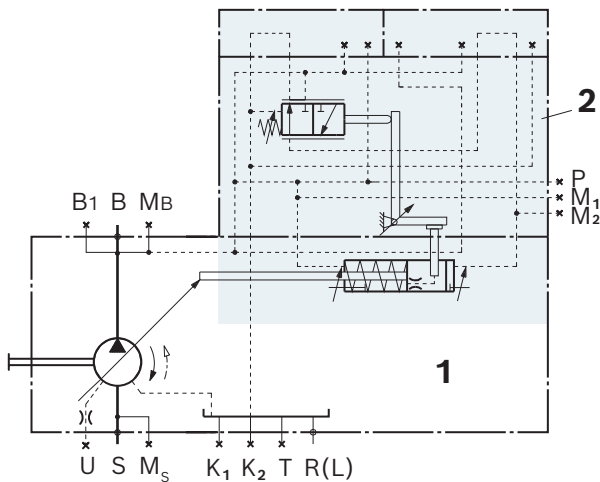
▼ A4VSO, sizes 40 and 71
 A4VBO, size 71¹⁾



▼ A4VSO, sizes 125 to 355
 A4VBO, size 125¹⁾



▼ A4VSO, sizes 500 to 1000

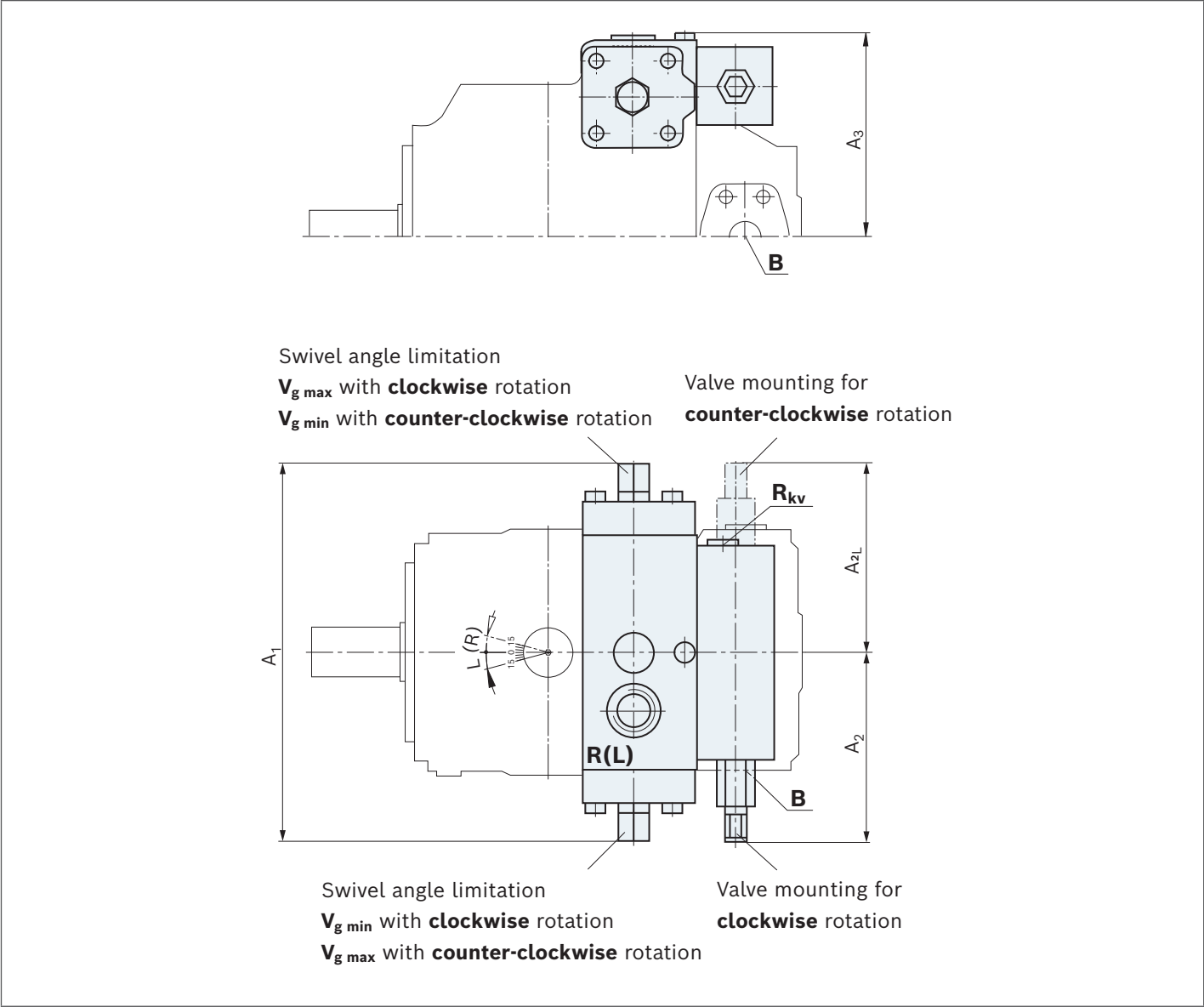


Components	
1	Pump with hydraulic control device
2	Power control valve
3	Intermediate plate NG125 to 355

1) With A4VBO, the $V_{g\ min}$ stop is omitted.

Dimensions LR2

A4VSO sizes 40 and 71; A4VBO size 71
Representation of clockwise rotation



NG	A1	A2	A2L ¹⁾	A3	
40	260	132	132	148	For detailed dimensions and technical data of the variable pump, see data sheet 92050 or 92122
71	296	132	132	165	

Ports		Standard	Size	p_{\max} [bar] ²⁾	State ³⁾
R _{kv}	Pilot pressure port	DIN 3852	M18 × 1.5; 12 deep	45	0

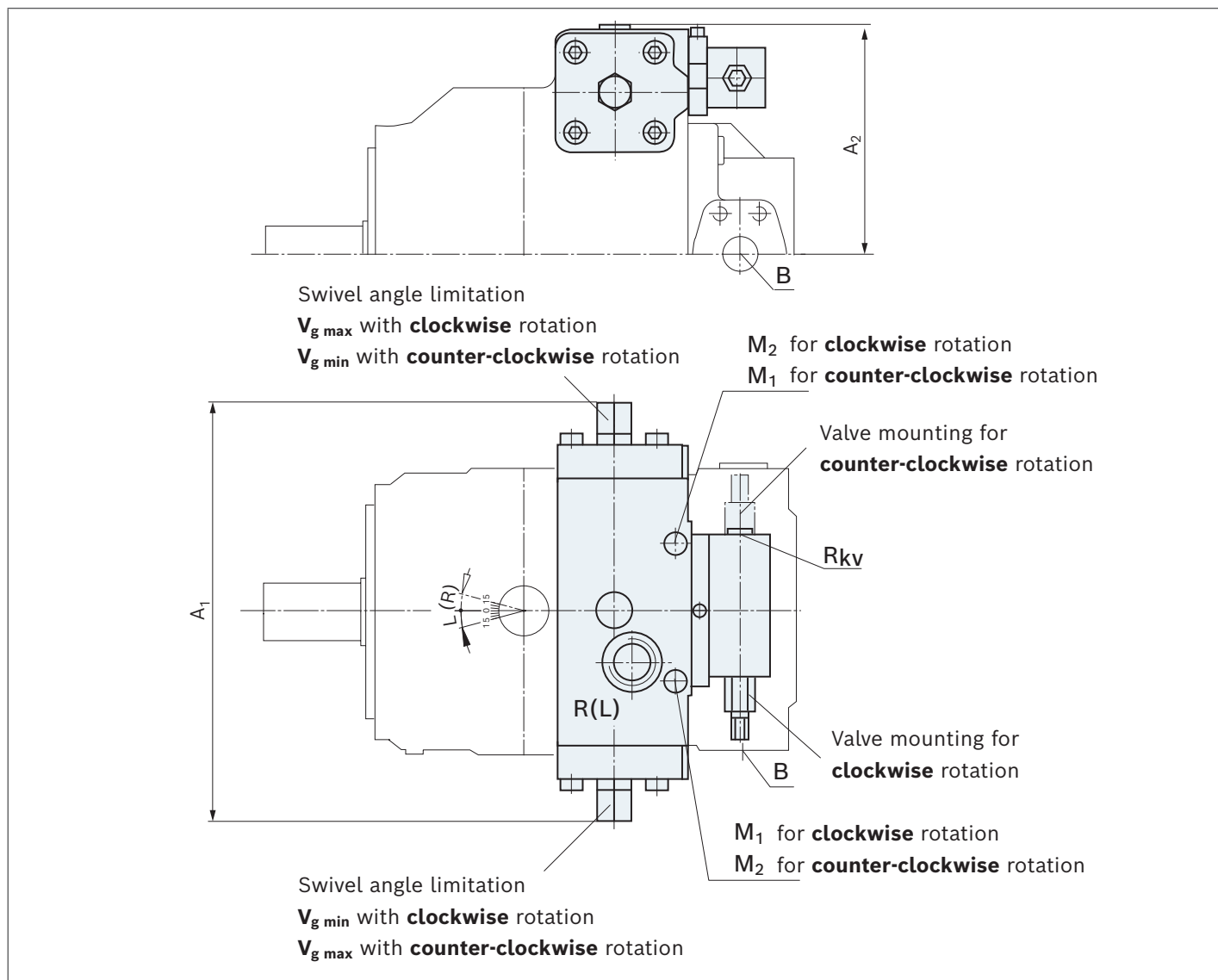
Components see Page 8

1) Dimensions for counter-clockwise rotation
2) Depending on the application, momentary pressure peaks can occur.
Keep this in mind when selecting measuring devices and fittings.
3) O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

Dimensions LR2

A4VSO sizes 125 to 355; A4VBO size 125

Representation of clockwise rotation



NG	A1	A2
125	354	195
180	354	195
250	424	238
355	424	238

For detailed dimensions and technical data of the variable pump, see data sheet 92050 or 92122

Ports		Standard	Size	p_{\max} [bar] ¹⁾	State ²⁾
R_{kv}	Pilot pressure port	DIN 3852	M18 × 1.5; 12 deep	100	X
M₁; M₂	Control pressure measuring	DIN 3852	M14 × 1.5; 12 deep (NG125 to 180)	350	X
			M18 × 1.5; 12 deep (NG250 to 355)	350	X

Components see Page 8

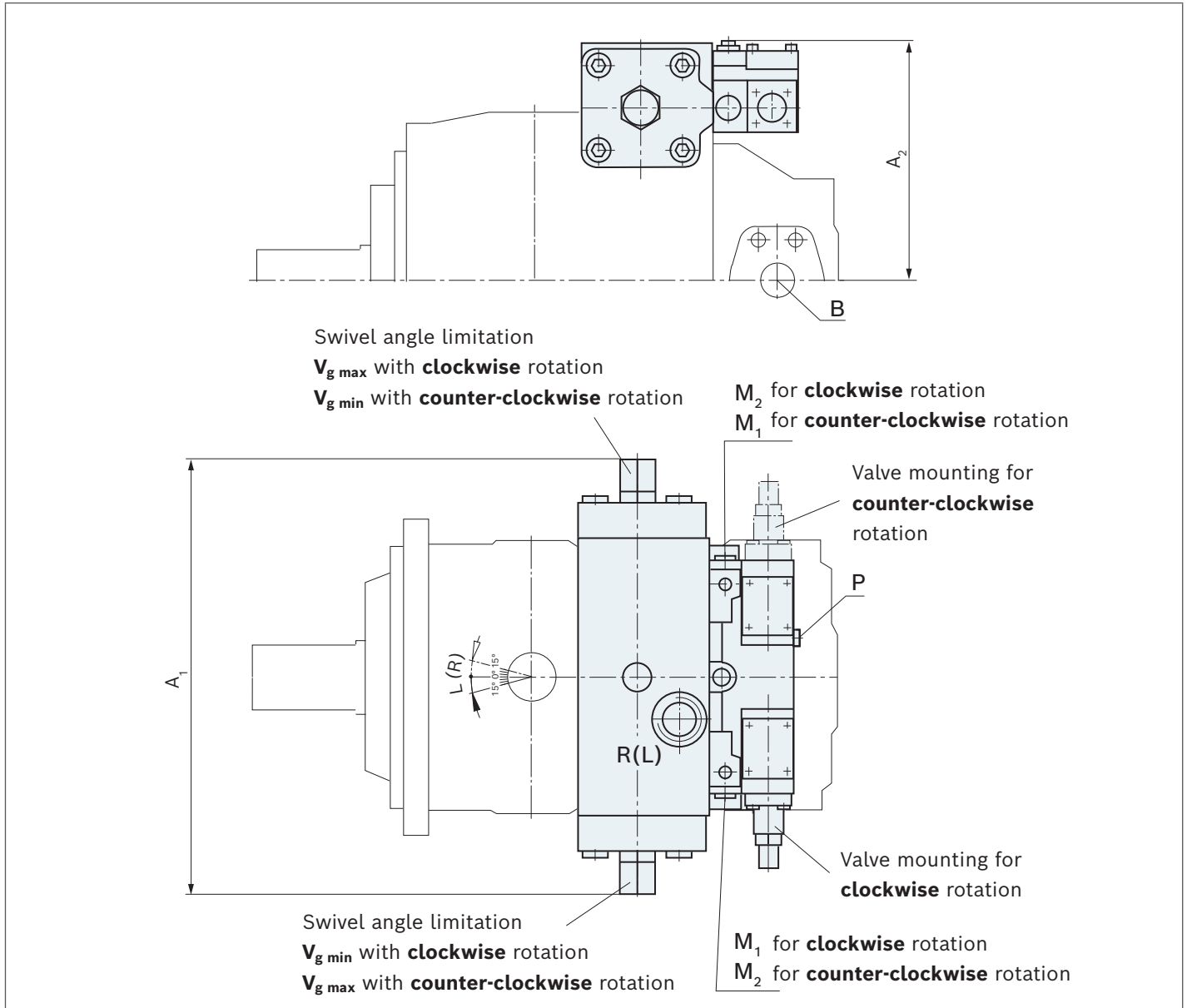
¹⁾ Depending on the application, momentary pressure peaks can occur.
Keep this in mind when selecting measuring devices and fittings.

²⁾ O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

Dimensions LR2

Sizes 500 to 1000

Representation of clockwise rotation



NG	A1	A2	
500	510	285	For detailed dimensions and technical data of the variable pump, see data sheet 92050
750	582	322	
1000	622	350	

Ports		Standard	Size	p_{\max} [bar] ¹⁾	State ²⁾
P	Pilot pressure port	DIN 3852	M22 × 1.5; 14 deep	100	X
M ₁ ; M ₂	Control pressure measuring	DIN 3852	M18 × 1.5; 12 deep	350	X

Components see Page 8

1) Depending on the application, momentary pressure peaks can occur.
Keep this in mind when selecting measuring devices and fittings.

2) O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

LR3 – Power controller with remotely controllable power characteristic

Pump setting in depressurized state: $V_{g \max}$

The power controller LR3 is suitable for remote control as an external pilot pressure (p_{St}) is applied to the spring chamber of the power control valve at port **X_{LR}**. Beginning of control can be changed proportionally to the applied pilot pressure.

The pilot pressure port **X_{LR}** must be connected.

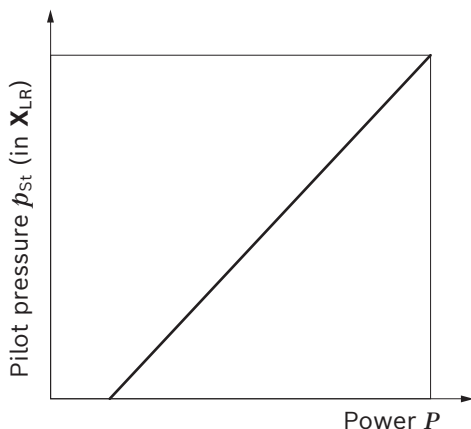
- ▶ Maximum external pilot pressure 100 bar
- ▶ Setting range of the beginning of control: 50²⁾... 350 bar
- ▶ Basic setting of the power characteristic curve is completed at the factory and refers to p_{St} in **X_{LR}** = 0 bar.
- ▶ Pilot fluid consumption up to 3.5 l/min

When ordering, please state in plain text:

- ▶ Drive speed n in rpm
- ▶ Drive power P in kW
at pilot pressure p_{St} = 0 bar in **X_{LR}**
- ▶ Maximum flow $q_{v \max}$ in l/min (50...100% $V_{g \max}$).

Power increase through pilot pressure in port **X_{LR}**

▼ Characteristic curve for pilot pressure



Power increase /pilot pressure (kW/bar)

NG	40	71	125	180	250	355	500	750	1000
at rotational speed ¹⁾ [rpm]									
1000	0.53	0.78	1.15	1.66	1.83	2.46	5.30	7.5	9.2
1200	0.64	0.94	1.38	1.99	2.19	2.95	6.40	9.0	11.0
1500	0.80	1.18	1.72	2.47	2.74	3.69	8.00	11.25	–
1800	0.96	1.41	2.07	2.98	3.29	4.42	9.60	–	–

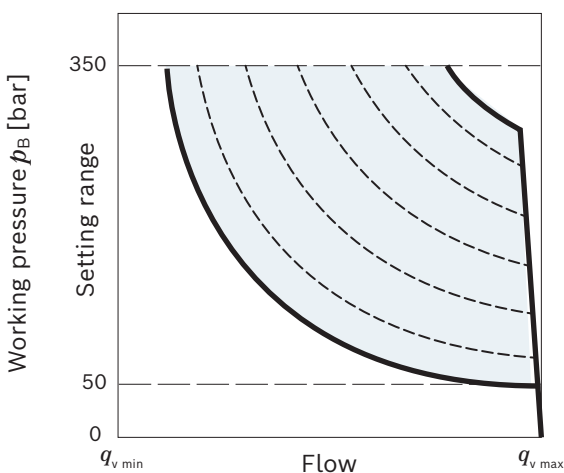
¹⁾ Observe the speed limits and permissible flow in data sheet 92050.

²⁾ Beginning of control <50 bar upon request.

More characteristics of the LR3 power controller are identical with those of the LR2 power controller.

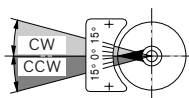
The minimum and maximum swivel angle limitations (up to 50% $V_{g \max}$) are fixedly set at the factory. When ordering, please state the desired values in the plain text.

▼ Characteristic curve LR3



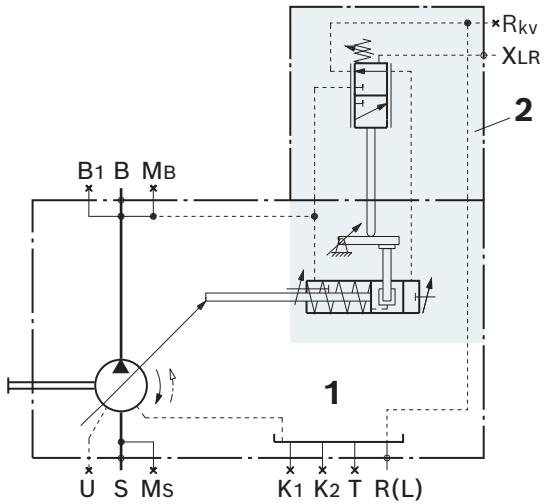
Direction of rotation	Swivel direction ³⁾	Flow direction	High-pressure port
clockwise	counter-clockwise	S to B	B
counter-clockwise	clockwise	S to B	B

³⁾ Cf. swivel angle indicator

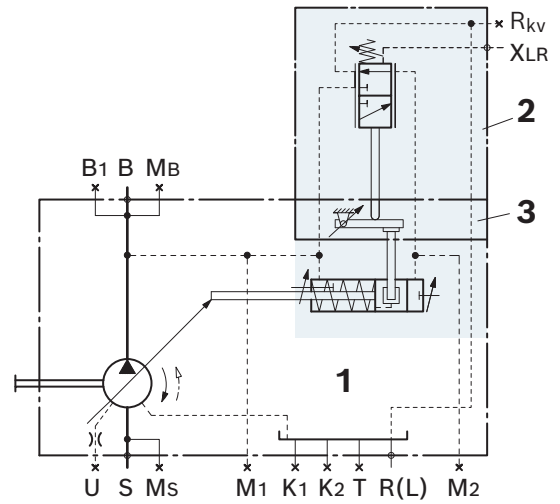


Circuit diagrams LR3

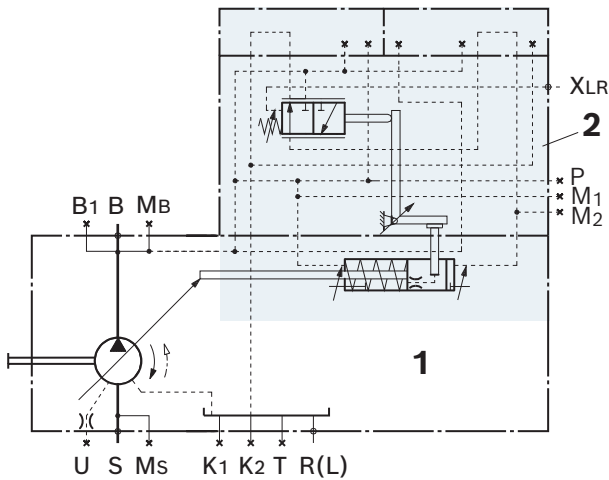
▼ A4VSO, sizes 40 and 71



▼ A4VSO, sizes 125 to 355



▼ A4VSO, sizes 500 to 1000

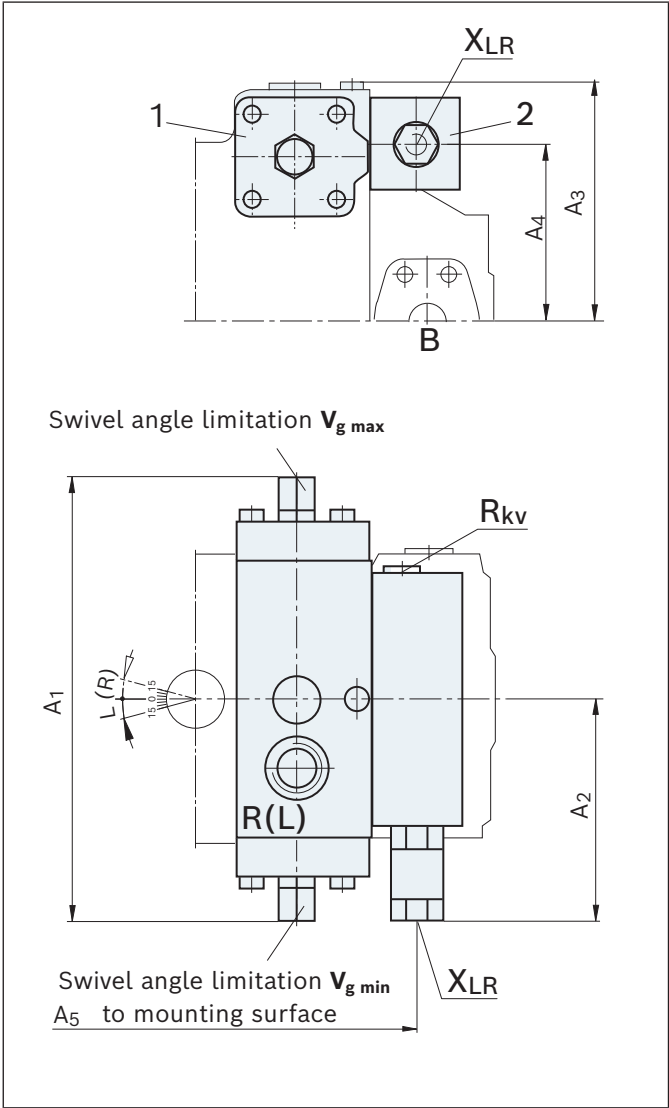


Components

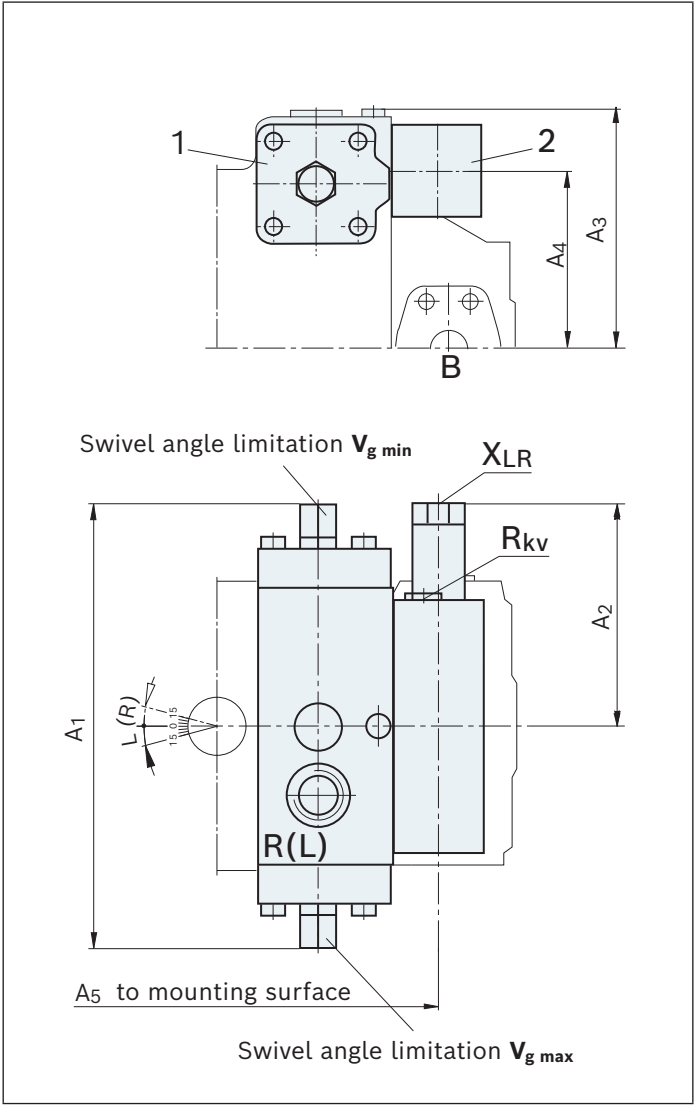
- | | |
|---|------------------------------------|
| 1 | Pump with hydraulic control device |
| 2 | Power control valve |
| 3 | Intermediate plate 125 to 355 |

Dimensions LR3

▼ A4VSO, sizes 40 and 71
Clockwise rotation



▼ A4VSO, sizes 40 and 71
Counter-clockwise rotation



NG	A ₁	A ₂	A ₃	A ₄	A ₅	
40	260	133	148	106	219	For detailed dimensions and technical data of the variable pump, see data sheet 92050
71	296	133	165	117	246	

Ports	Standard	Size	p _{max} [bar] ¹⁾	State ²⁾
R _{kv}	DIN 3852	M18 × 1.5; 12 deep	100	X
X _{LR}	DIN 3852	M14 × 1.5; 12 deep	100	O

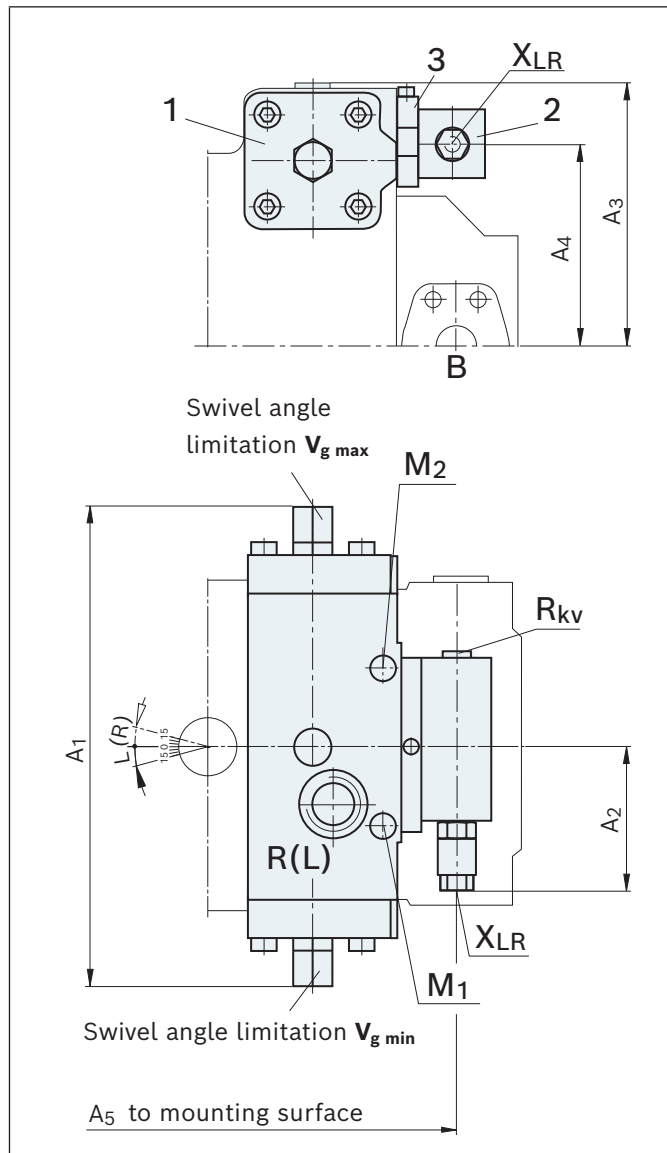
Components see Page 13

1) Depending on the application, momentary pressure peaks can occur.
Keep this in mind when selecting measuring devices and fittings.

2) O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

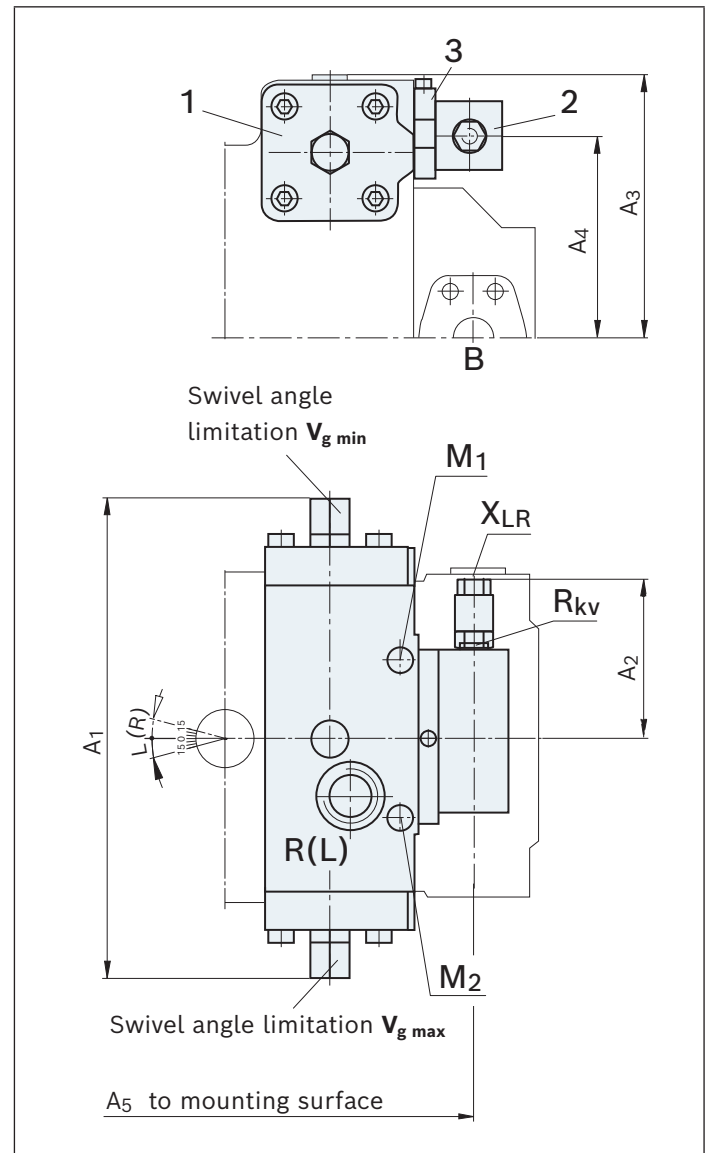
▼ A4VSO, sizes 125 to 355

Clockwise rotation



▼ A4VSO, sizes 125 and 355

Counter-clockwise rotation



NG	A ₁	A ₂	A ₃	A ₄	A ₅	
125/180	354	133	195	147	315	For detailed dimensions and technical data of the variable pump, see data sheet 92050
250/355	424	133	238	183	377	

Ports		Standard	Size	p_{\max} [bar] ¹⁾	State ²⁾
R _{kv}	Control fluid return flow	DIN 3852	M18 × 1.5; 12 deep	100	X
X _{LR}	Pilot pressure port	DIN 3852	M14 × 1.5; 12 deep	100	O
M ₁ ; M ₂	Measurement of stroking chamber pressure	DIN 3852	M14 × 1.5; 12 deep (NG125 to 180)	350	X
			M18 × 1.5; 12 deep (NG250 to 355)	350	

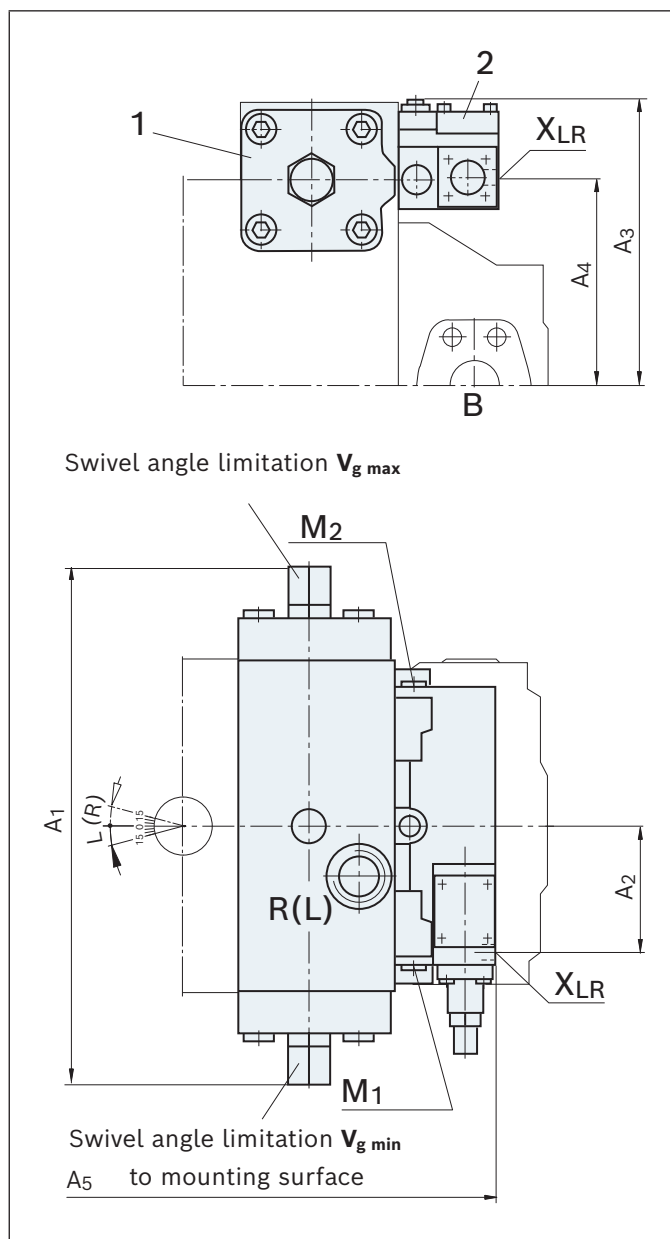
Components see Page 13

1) Depending on the application, momentary pressure peaks can occur.
Keep this in mind when selecting measuring devices and fittings.

2) O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

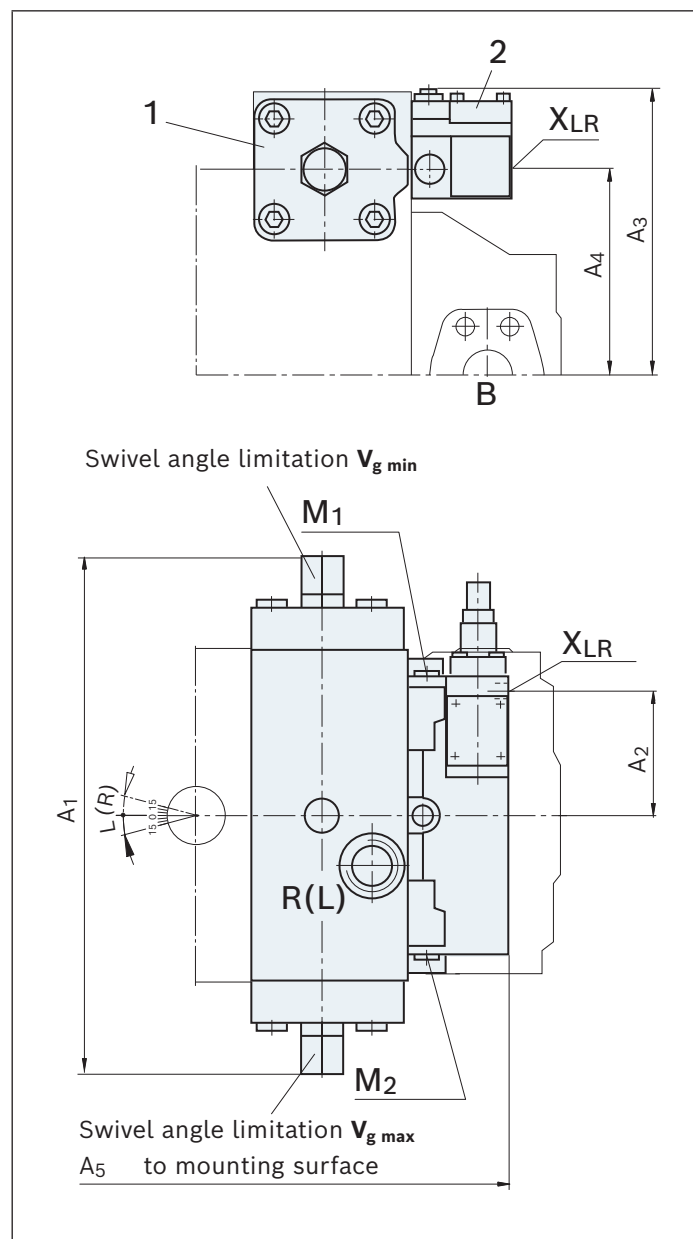
▼ **A4VSO, sizes 500 to 1000**

Clockwise rotation



▼ **A4VSO, sizes 500 and 1000**

Counter-clockwise rotation



NG	A ₁	A ₂	A ₃	A ₄	A ₅	
500	510	125	285	207	468	For detailed dimensions and technical data of the variable pump, see data sheet 92050
750	582	125	322	237	502	
1000	622	125	350	260	566	

Ports		Standard	Size	p_{\max} [bar] ¹⁾	State ²⁾
X_{LR}	Pilot pressure port	DIN 3852	M14 × 1.5; 12 deep	100	O
M₁; M₂	Measurement of stroking chamber pressure	DIN 3852	M18 × 1.5; 12 deep	350	X

Components see Page 13

1) Depending on the application, momentary pressure peaks can occur.
Keep this in mind when selecting measuring devices and fittings.

2) O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

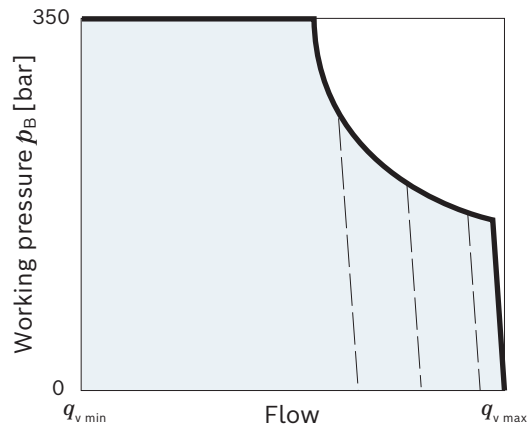
LR.M – Power controller with mechanical stroke limiter

Pump setting in depressurized state: $V_{g \max}$

In addition to the power control function, the displacement $V_{g \max}$ can be continuously set using a spindle. The setting must be made in the depressurized state.

- **Setting data for the stroke limiter $V_{g \max}$**
 Setting range: 100% $V_{g \max}$ to 0% $V_{g \max}$
 (may amount up to 104% of the maximum nominal displacement)
- Standard setting: Nominal $V_{g \max}$

▼ Characteristic curve LR.M

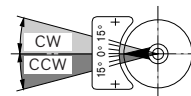


Direction of rotation	Swivel direction ¹⁾	Flow direction	High-pressure port
clockwise	counter-clockwise	S to B	B
counter-clockwise	clockwise	S to B	B

Size			40	71	125	180	250	355
Flow change/spindle rotation	V_g	cm ³ /r	4.3	6.3	9.1	13.1	14.4	20.6
Control stroke	s	mm	14.2	17.1	20.7	20.7	25.9	25.9

Direction of rotation (viewed on spindle)	Displacement
clockwise	increase
counter-clockwise	decrease

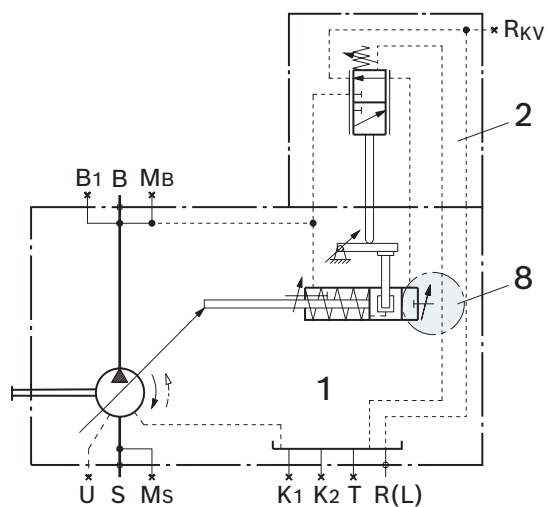
1) Cf. swivel angle indicator



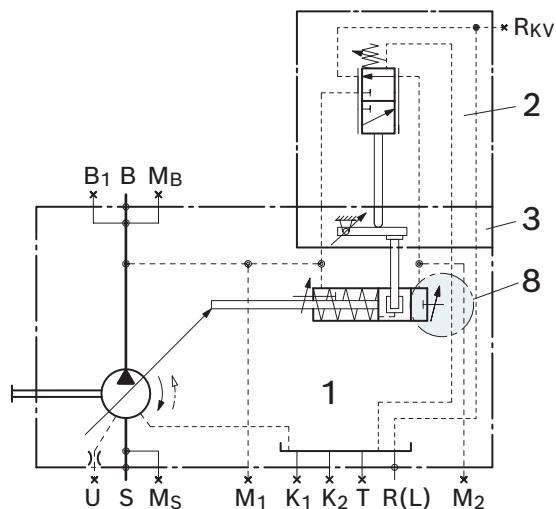
Circuit diagrams LR.M

Example: A4VSO...LR2M

▼ A4VSO, sizes 40 and 71

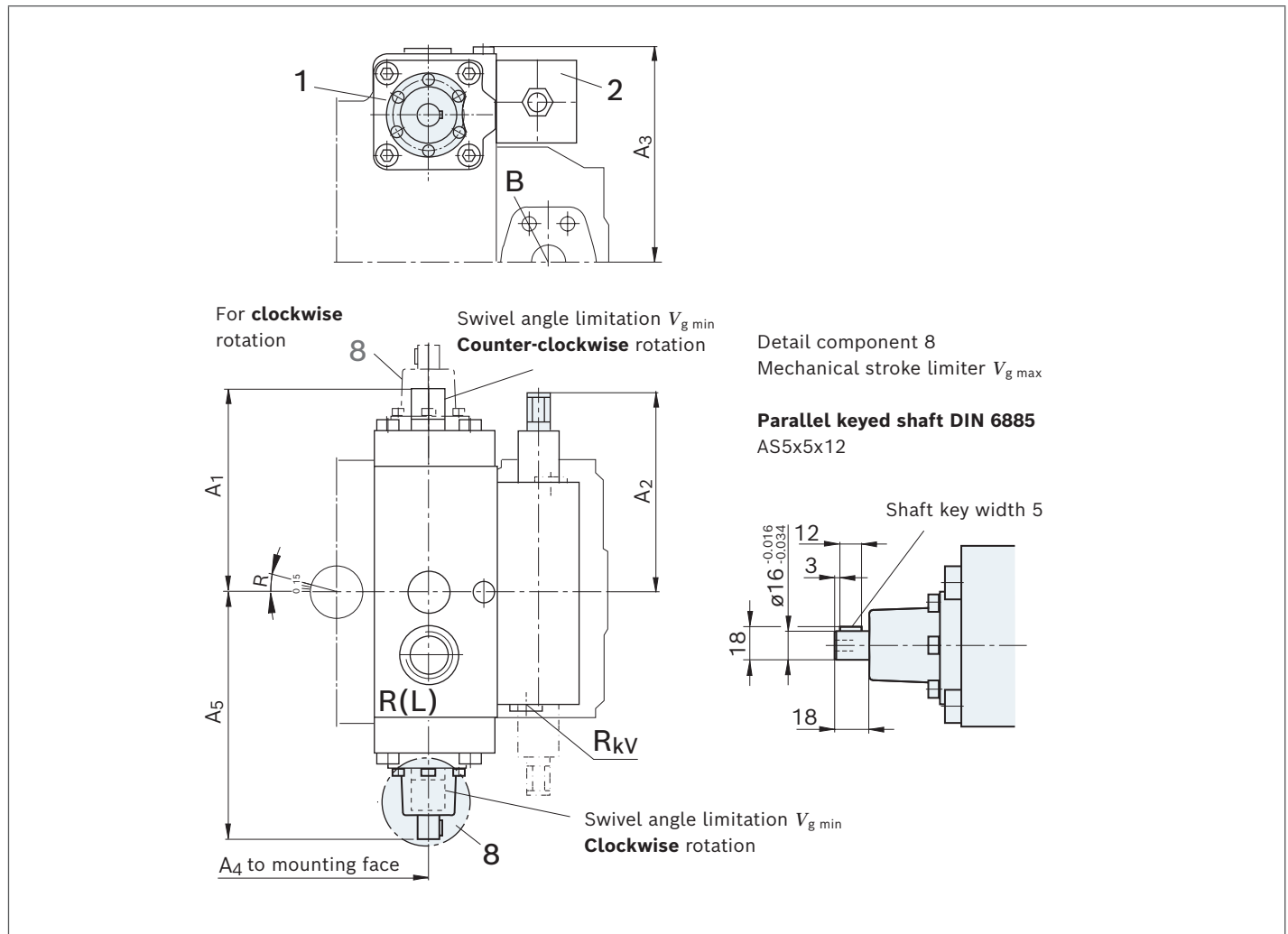


▼ A4VSO, sizes 125 to 355



Components

1	Pump with hydraulic control device
2	Power control valve
3	Intermediate plate NG125 to 355
4	mechanical stroke limiter $V_{g \max}$

Dimensions LR.M▼ **A4VSO, sizes 40 to 71**
Counter-clockwise rotation

NG	A1	A2	A3	A4	A5	
40	130	132	148	144	172	For detailed dimensions and technical data of the variable pump, see data sheet 92050
71	148	132	159	166	188	

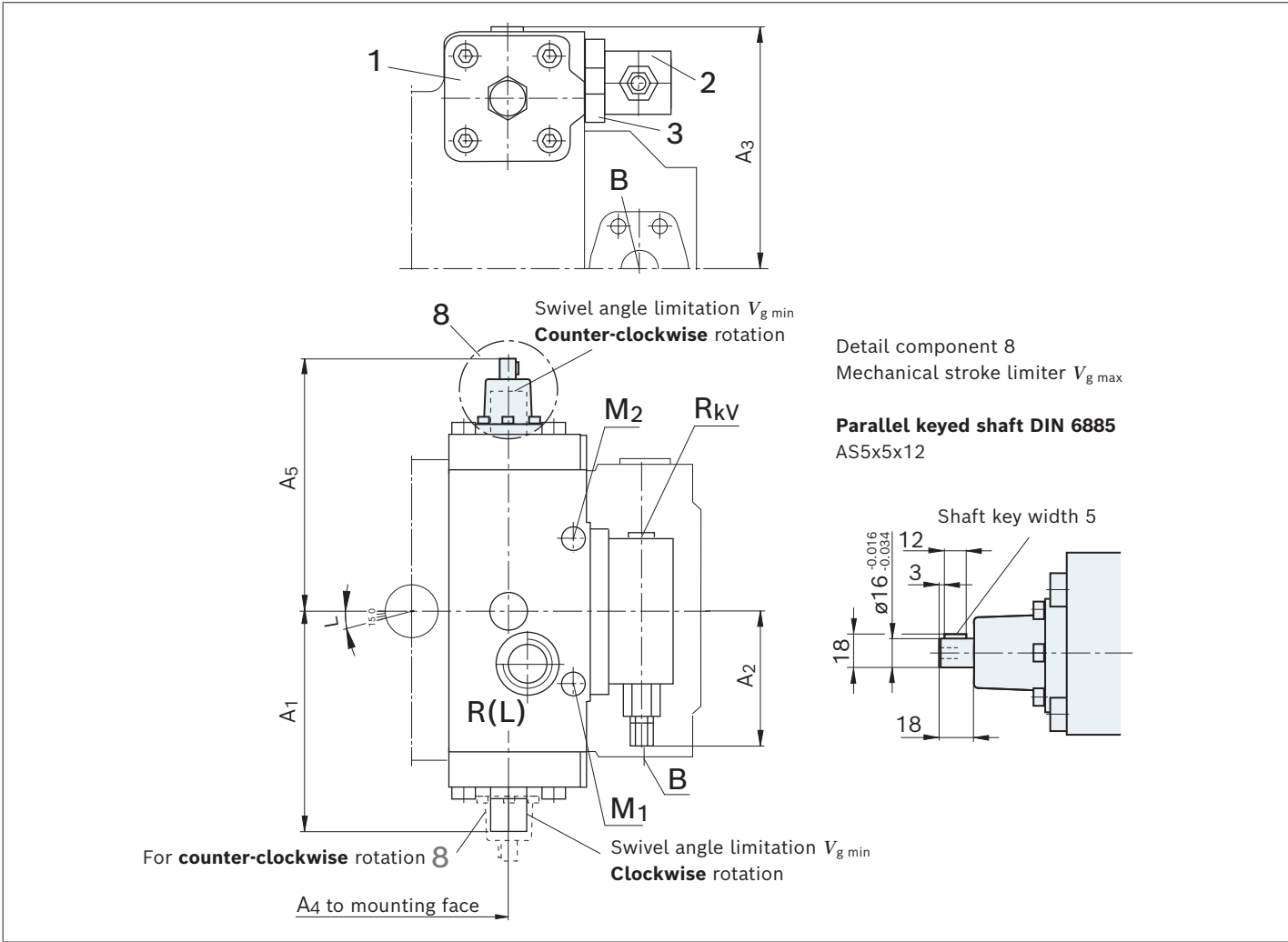
Ports		Standard	Size ¹⁾	$p_{\max \text{ abs}}$ [bar] ¹⁾	State ²⁾
R(L)	Return flow, air bleed	DIN 3852	M22 × 1.5; 12 deep (NG40)	4	O
		DIN 3852	M27 × 2; 12 deep (NG71)		
R_{KV}	Control fluid return flow	DIN 3852	M18 × 1.5; 12 deep	100	X

Components see Page 18

- 1) Depending on the application, momentary pressure peaks can occur.
Keep this in mind when selecting measuring devices and fittings.
- 2) O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

Dimensions LR.M

▼ **A4VSO, sizes 125 to 355**
Clockwise rotation



NG	A1	A2	A3	A4	A5	For detailed dimensions and technical data of the variable pump, see data sheet 92050
125/180	177	132	195	203	213	
250/355	212	132	238	248	243	

Ports	Standard	Size ¹⁾	p _{max} [bar] ¹⁾	State ²⁾
M ₁ ; M ₂	Stroke chamber measurement	DIN 3852 M14 x 1.5; 12 deep (NG 125 and 180) DIN 3852 M18 x 1.5; 12 deep (NG 250 and 355)	350	X
R _{KV}	Control fluid return flow	DIN 3852 M18 x 1.5; 12 deep	100	X

Components see Page 18

1) Depending on the application, momentary pressure peaks can occur.
Keep this in mind when selecting measuring devices and fittings.
2) O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

LR.D – Power controller with pressure controller

Pump setting in depressurized state: $V_{g \max}$

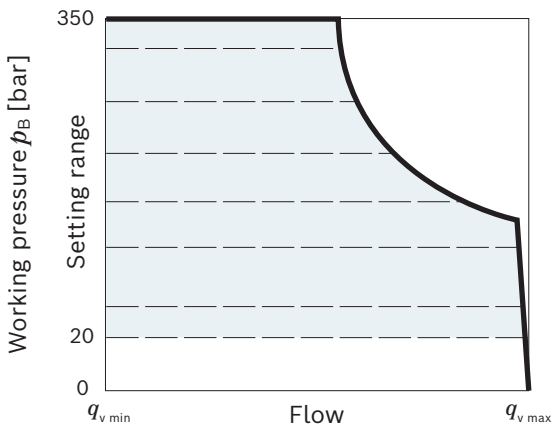
The pressure control takes priority over the power control, i.e. the power controller function is executed below the pressure command value.

If the pressure command value set at the pressure control valve is reached, the pump changes into pressure control mode and only delivers as much hydraulic fluid as is necessary to maintain the pressure.

Notice

- ▶ Pressure controllers are not safeguards against pressure overload.
Be sure to add a pressure relief valve to the hydraulic system.
 - ▶ Setting range of the pressure control 20...350 bar¹⁾
 - ▶ 350 bar is the standard setting.
- When ordering, please state other values in the plain text.

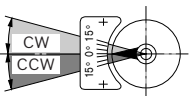
▼ Characteristic curve LR.D



Direction of rotation	Swivel direction ²⁾	Flow direction	High-pressure port
clockwise	counter-clockwise	S to B	B
counter-clockwise	clockwise	S to B	B

¹⁾ With very low power settings, the setting range may be limited.

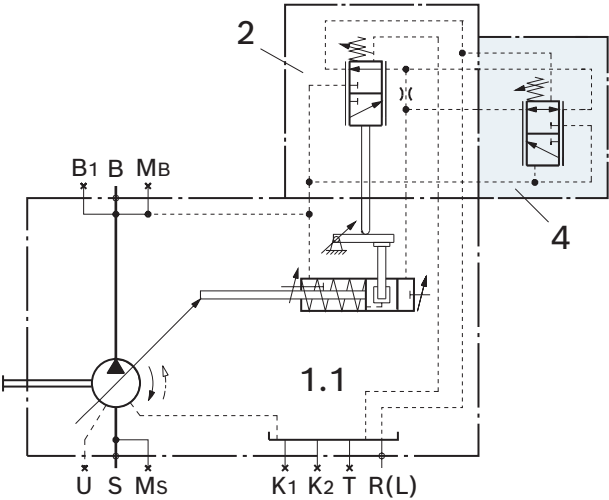
²⁾ Cf. swivel angle indicator



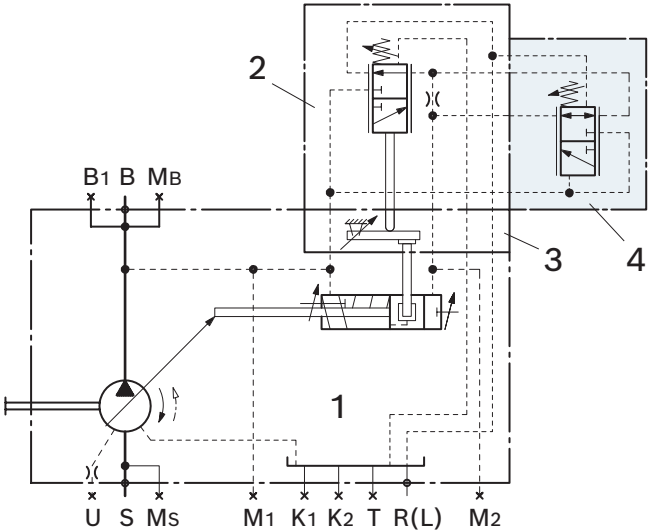
Circuit diagrams LR.D

Example: A4VSO...LR2D

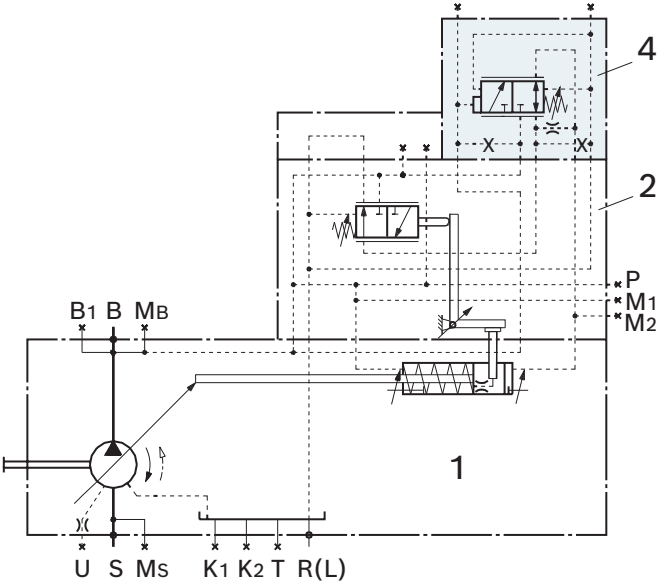
▼ A4VSO, sizes 40 and 71



▼ A4VSO, sizes 125 to 355



▼ A4VSO, sizes 500 to 1000



Components	
1	Pump with hydraulic control device
2	Power control valve
3	Intermediate plate NG125 to 355
4	Pressure control valve

LR.G – Power controller with pressure control, remote controlled

Pump setting in depressurized state: $V_{g \max}$

A pressure relief valve (item 5) can be piped up externally at port **X_D** for remote control. This is not included in the standard scope of delivery of the LR2G or LR3G control, can, however, be set up after consultation depending on the version. Alternatively, you can also use DBA(W) blocks according to data sheet 25891 to do so.

If the pressure control setting (pressure set at the pressure relief valve plus differential pressure at the pressure control valve) is reached, the pump switches into pressure control mode.

The differential pressure at the pressure control valve (item 4) is set to 20 bar as standard, the quantity of control liquid emerging at port **X_D** is then approx. 1.5 l/min.

If a different setting (recommended range 20...50 bar) is required, please state in the plain text when ordering.

Notice

- Pressure controllers are not safeguards against pressure overload.
- Be sure to add a pressure relief valve to the hydraulic system.

Bosch Rexroth recommends as separate pressure relief valve:

- DBD 6 (hydraulic) as per data sheet 25402.
- DBETR-SO 437 (electric) as per data sheet 29166
- DBETA (electric) as per data sheet 29262

The maximum line length should not exceed 2 m.

Notice

Setting the remote controlled pressure control:

The setting of the external pressure relief valve plus the differential pressure value Δp at the pressure control valve determines the level of pressure control.

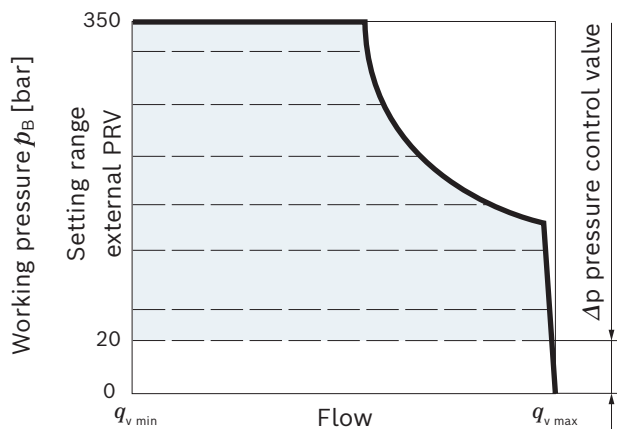
Example:

- external pressure relief valve 330 bar
- differential pressure on pressure control valve 20 bar
- resulting pressure control of $330 + 20 = 350$ bar.

Please note in case of combination with hydraulic stroke limiter (LR.GH or LR.GN):

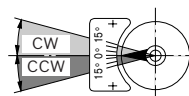
With a pressure control setting below the external control pressure p_{control} , the pump will - up to size 355 - remain at $V_{g \min}$ -mechanical and with sizes 500...1000, vibrations may occur.

▼ Characteristic curve LR.G



Direction of rotation	Swivel direction ¹⁾	Flow direction	High-pressure port
clockwise	counter-clockwise	S to B	B
counter-clockwise	clockwise	S to B	B

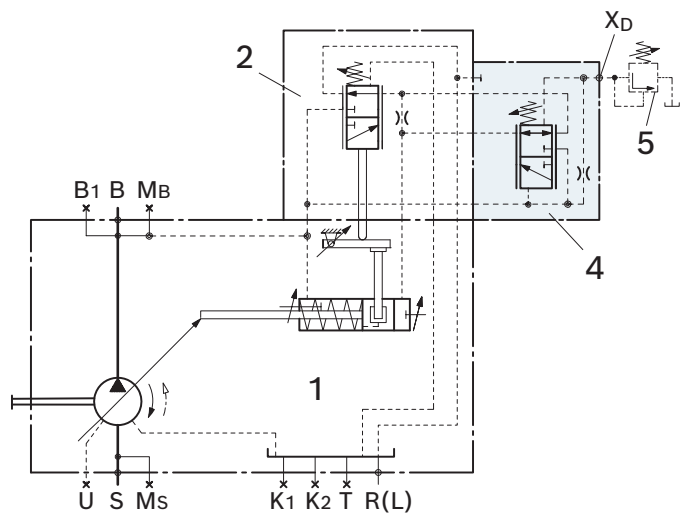
¹⁾ Cf. swivel angle indicator



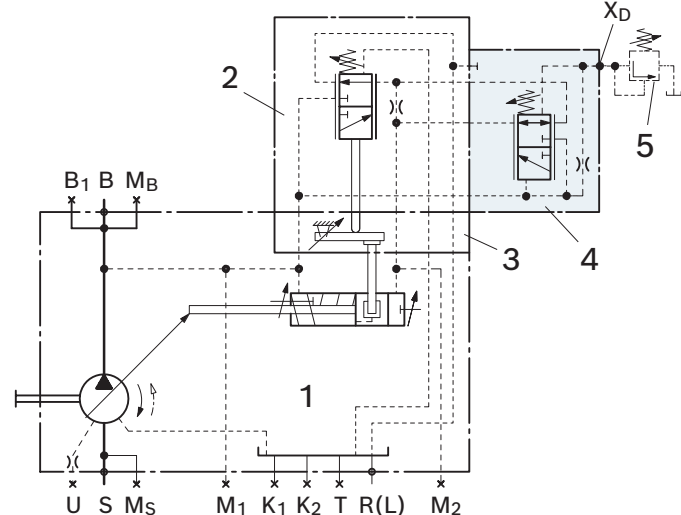
Circuit diagrams LR.G

Example: A4VSO...LR2G

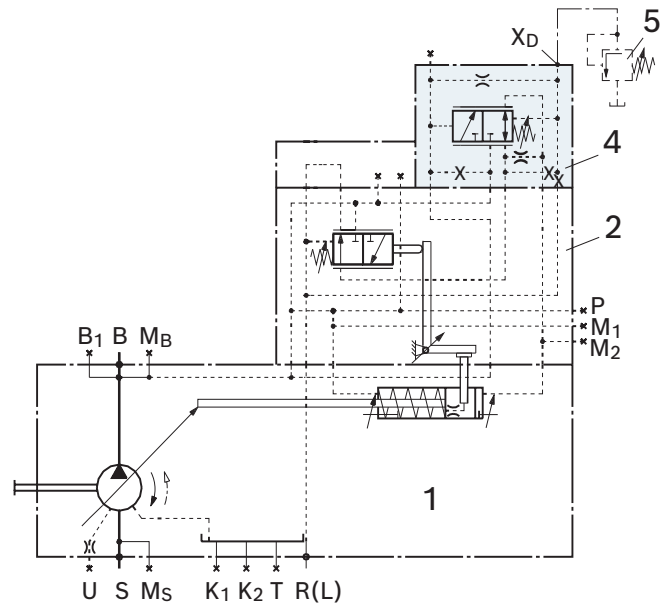
A4VSO, sizes 40 and 71



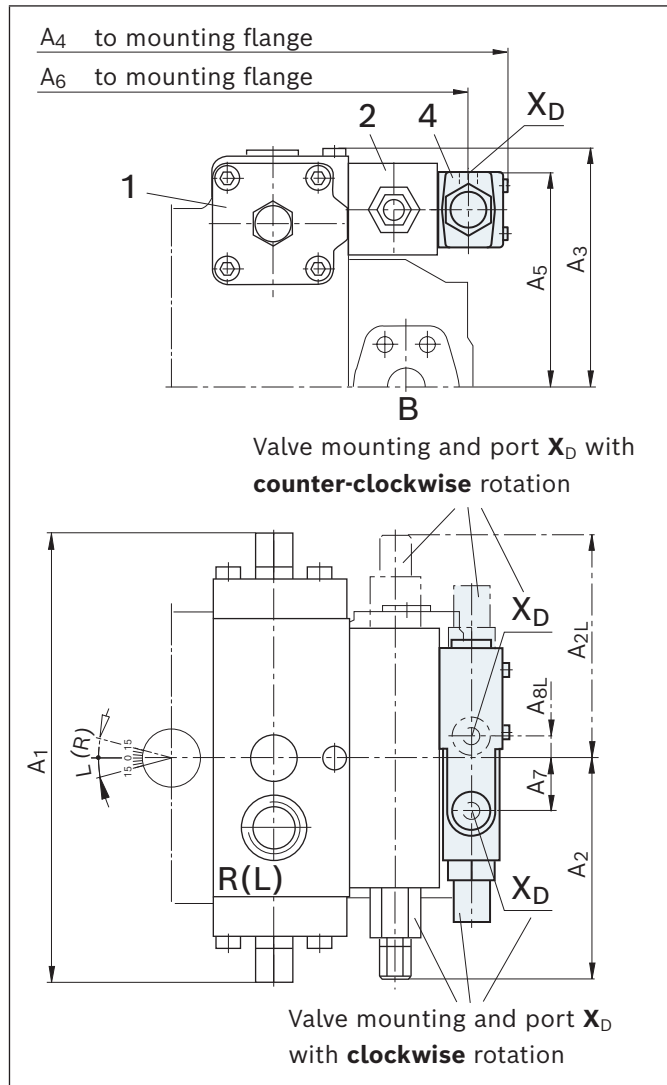
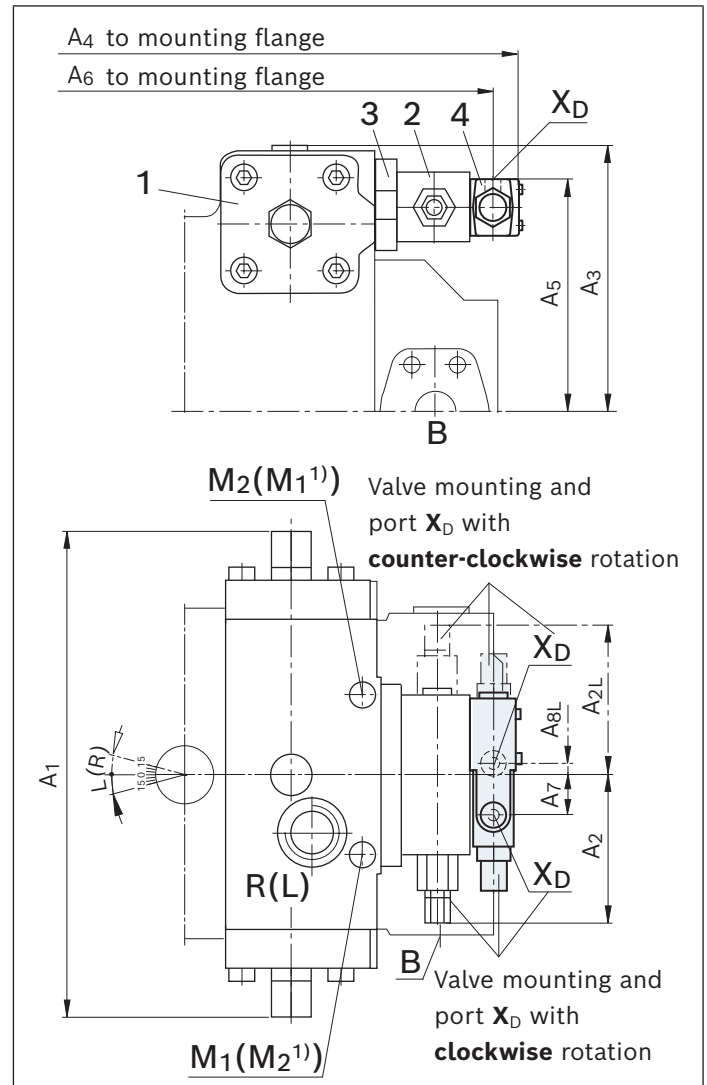
A4VSO, sizes 125 to 355



A4VSO, sizes 500 to 1000



Components	
1	Pump with hydraulic control device
2	Power control valve
3	Intermediate plate NG125 to 355
4	Pressure control valve
5	Pressure relief valve (not included in the scope of delivery)

Dimensions LR.D and LR.G▼ **A4VSO, sizes 40 and 71**▼ **A4VSO, sizes 125 to 355**

NG	A1	A2(L)	A3	A4	A5	A6	A7	A8L	
40	260	132	148	295	130	269	37	7	For detailed dimensions and technical data of the variable pump, see data sheet 92050
71	296	132	159	322	141	296	37	7	
125/180	354	132	195	391	171	365	37	7	
250/355	424	132	238	453	207	427	37	7	

Ports		Standard	Size	p_{\max} [bar] ²⁾	State ³⁾
X_D	Pilot pressure port for power controller – with pressure controller LR.D	DIN 3852	M14 × 1.5; 12 deep	350	X
	– with remote controlled pressure controller LR.G	DIN 3852	M14 × 1.5; 12 deep	350	O
M₁; M₂	Measurement of stroking chamber pressure	DIN 3852	M14 × 1.5; 12 deep (NG 125 and 180) M18 × 1.5; 12 deep (NG 250 and 355)	350	X

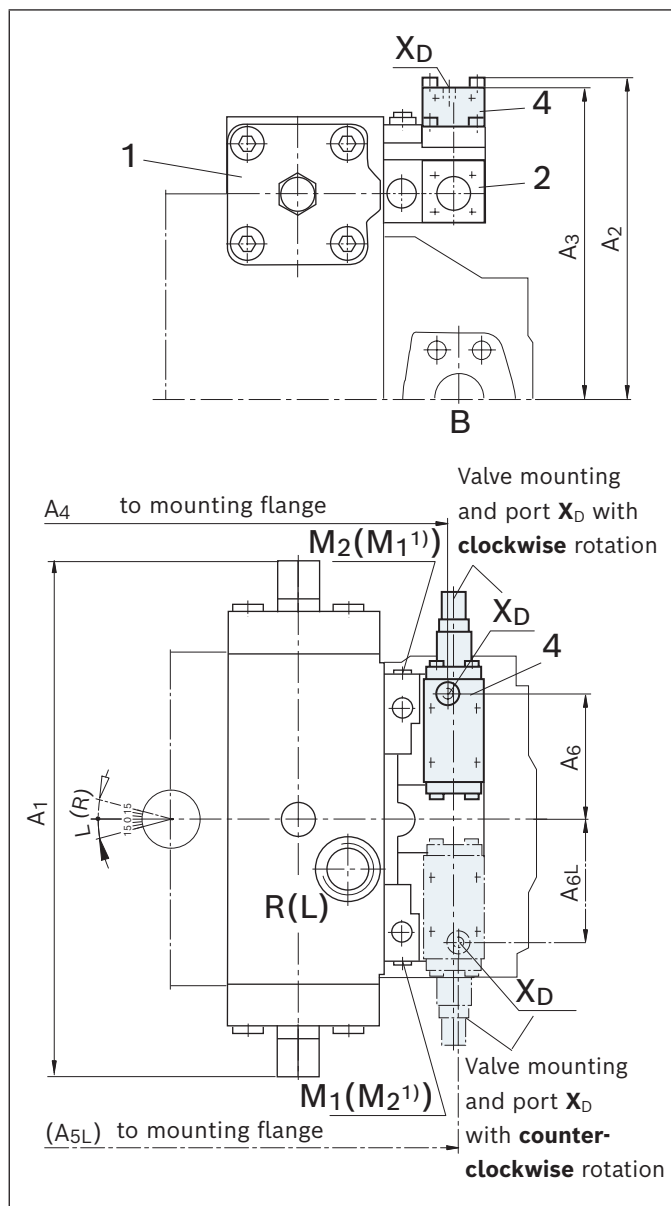
Components see Page 24

- 1) For counter-clockwise rotation
 2) Depending on the application, momentary pressure peaks can occur.
 Keep this in mind when selecting measuring devices and fittings.

- 3) O = Must be connected (plugged on delivery)
 X = Plugged (in normal operation)

Dimensions LR.D and LR.G

▼ A4VSO, sizes 500 to 1000



NG	A1	A2	A3	A4	A5L	A6(L)
500	510	320	311	430	441	125
750	582	350	342	462	473	125
1000	622	373	364	528	539	125

For detailed dimensions and technical data of the variable pump, see data sheet 92050

Ports		Standard	Size	p_{\max} [bar] ²⁾	State ³⁾
X _D	Pilot pressure port for power controller – with remote controlled pressure controller LR.G	DIN 3852	M14 × 1.5; 12 deep	350	O
M ₁ ; M ₂	Measurement of stroking chamber pressure	DIN 3852	M18 × 1.5; 12 deep (NG 250 and 355)	350	X

Components see Page 24

1) For counter-clockwise rotation

2) Depending on the application, momentary pressure peaks can occur.

Keep this in mind when selecting measuring devices and fittings.

3) O = Must be connected (plugged on delivery)

X = Plugged (in normal operation)

LR.F – Power controller with flow control

Pump setting in depressurized state: $V_{g \max}$

In addition to the power control function, it is possible to control the pump flow by means of a differential pressure, e.g. using an orifice between pump and consumer. The pump supplies only the fluid quantity actually required by the consumer.

The flow of the pump is then dependent on the cross section of the external metering orifice (item 7), which is located between the pump and the consumer. Below the power control and within the control range of the pump, the flow is nearly independent of the load pressure.

The opening cross-section of the metering orifice determines the flow of the pump.

The flow controller compares the pressure before the metering orifice with that after the orifice and keeps the pressure drop encountered here (differential pressure Δp) constant and thus controls the flow.

If the differential pressure Δp increases, the pump is swiveled back (towards $V_{g \min}$), if the differential pressure Δp decreases, the pump is swiveled out (towards $V_{g \max}$), until equilibrium in the valve is restored.

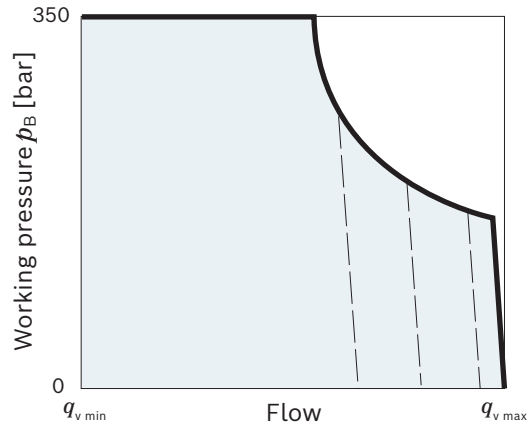
► $\Delta p_{\text{metering orifice}} = p_{\text{pump}} - p_{\text{consumer}}$

The standard setting at the flow control valve (item 6) for Δp is 14 bar. If a different setting (recommended range 14...25 bar) is required, please state in the plain text. Higher values on request.

Notice

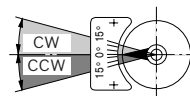
- For dynamic controls, we recommend using LR.S with load-sensing and remote controlled pressure control (see page 42)

▼ Characteristic curve LR.F



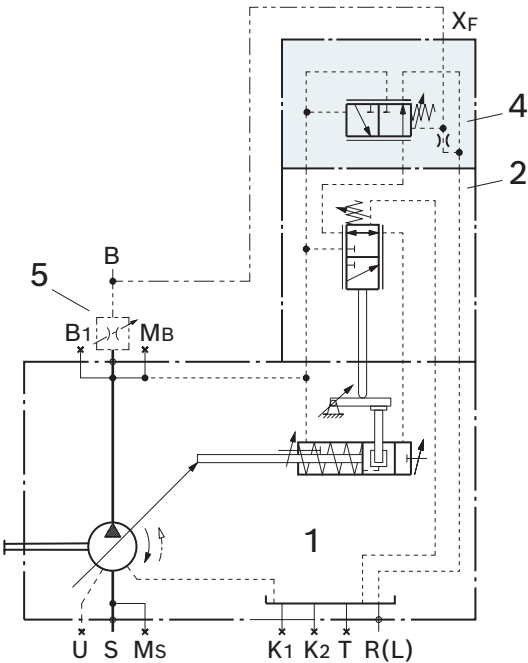
Direction of rotation	Swivel direction ¹⁾	Flow direction	High-pressure port
clockwise	counter-clockwise	S to B	B
counter-clockwise	clockwise	S to B	B

¹⁾ Cf. swivel angle indicator

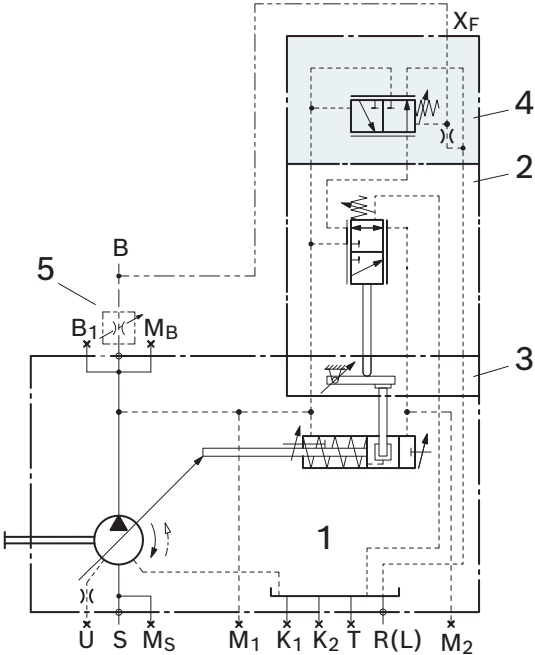


Circuit diagrams LR.F
Example: A4VSO...LR2F

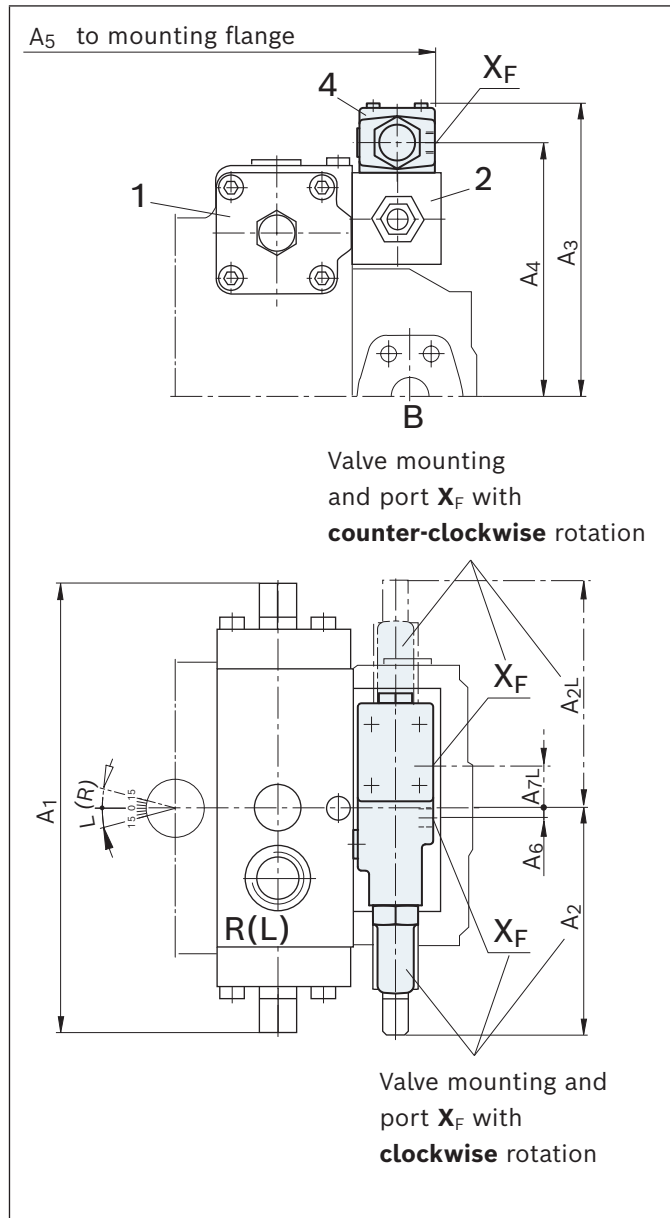
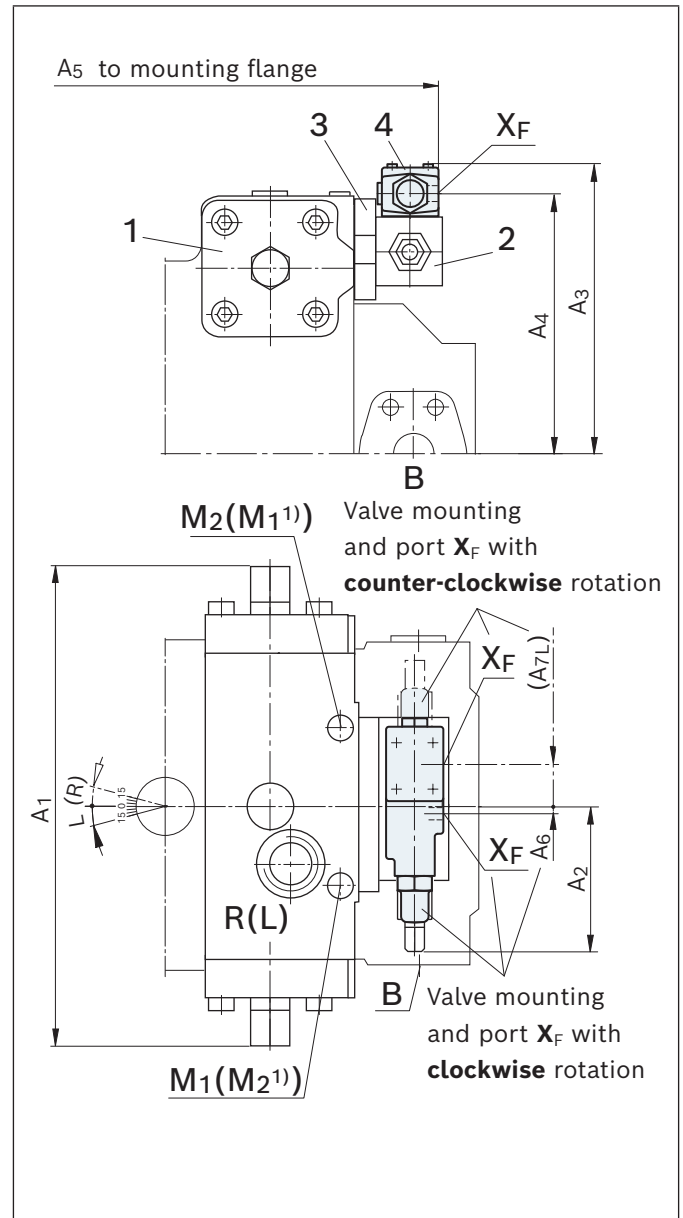
▼ A4VSO, sizes 40 and 71



▼ A4VSO, sizes 125 to 355



Components	
1	Pump with hydraulic control device
2	Power control valve
3	Intermediate plate NG125 to 355
4	Flow control valve
5	External metering orifice (not included in the scope of delivery)

Dimensions LR.F▼ **A4VSO, sizes 40 and 71**▼ **A4VSO, sizes 125 to 355**

NG	A1	A2 (A2L)	A3	A4	A5	A6	A7L
40	260	132	182	156	243	7	37
71	296	132	193	167	270	7	37
125/180	354	132	223	197	339	7	37
250/355	424	132	259	233	401	7	37

For detailed dimensions and technical data of the variable pump, see data sheet 92050

Ports	Standard	Size	p_{\max} [bar] ²⁾	State ³⁾
X_F Pilot pressure port	DIN 3852	M14 × 1.5; 12 deep	350	O
M₁; M₂ Measurement of stroking chamber pressure	DIN 3852	M18 × 1.5; 12 deep (NG 250 and 355)	350	X

Components see Page 28

1) For counter-clockwise rotation

2) Depending on the application, momentary pressure peaks can occur.

Keep this in mind when selecting measuring devices and fittings.

3) O = Must be connected (plugged on delivery)

X = Plugged (in normal operation)

LR.S – Power controller with load-sensing valve and pressure control, remote controlled

Pump setting in depressurized state: $V_{g\ max}$

The LR.S works as a load-pressure controlled flow controller and adjusts the pump delivery volume to the volume required by the consumer.

In this connection, the pump pressure at port **B** always exceeds the consumer pressure by the set Δp .

Here, the pump delivery volume depends on the external metering orifice item 4.1 (throttle, proportional valve or control block) installed between pump and consumer; it is, however, in the entire range below the power characteristic curve not influenced by the load pressure.

The load-sensing valve compares the working pressure in front of the external metering orifice item 4.1 (throttle, proportional valve or control block) with the working pressure after the external metering orifice and keeps the differential pressure Δp occurring here to the set value, i.e. the pump delivery volume is kept constant.

In case of change in the differential pressure at the orifice (item 4.1) triggered by dynamic change in the throttle opening, the pump delivery volume is adjusted to the new requirements. With increasing pressure differential, the pump swivels to a smaller displacement.

Optional pressure control (items 5 and 5.1)

If the load pressure set at the pressure relief valve (item 5) is reached, there is a transition into the pressure control range regardless of the pressure differential existing at the orifice (item 4.1). For this purpose, the orifice (item 5.1) is moreover required.

The differential pressure at the load-sensing valve (item 4.0) is by default set to $\Delta p = 14\text{ bar}$.

Upon actuation of the pressure relief valve (item 5), a control fluid quantity of approx. 1.3 l/min is consumed at a nozzle diameter of 0.8 mm (item 5.1) and a differential pressure of $\Delta p = 14\text{ bar}$.

Notice

► Pressure controllers are not safeguards against pressure overload.

Be sure to add a pressure relief valve to the hydraulic system.

Bosch Rexroth recommends as separate pressure relief valve:

- DBD 6 (hydraulic) as per data sheet 25402.
 - DBETR-SO 437 (electric) as per data sheet 29166
 - DBETA (electric) as per data sheet 29262
- The maximum line length should not exceed 2 m.

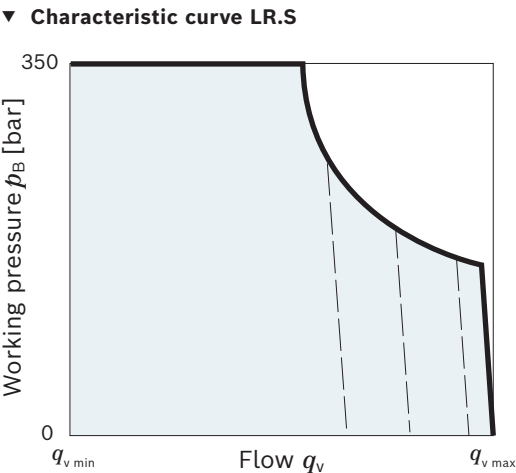
Notice

Setting the remote controlled pressure control:

The setting of the external pressure relief valve plus the differential pressure value Δp at the load-sensing valve determines the level of pressure control.

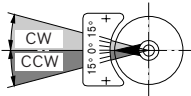
Example:

- external pressure relief valve 336 bar
- differential pressure on pressure control valve 14 bar
- resulting pressure control of $336 + 14 = 350\text{ bar}$.



Direction of rotation	Swivel direction ¹⁾	Flow direction	High-pressure port
clockwise	counter-clockwise	S to B	B
counter-clockwise	clockwise	S to B	B

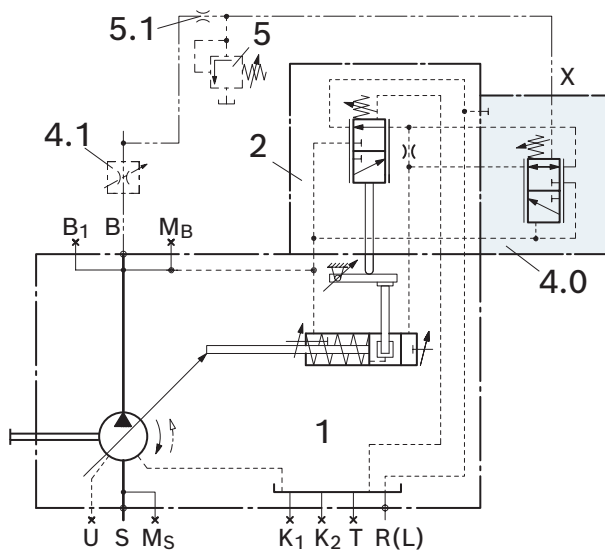
1) Cf. swivel angle indicator



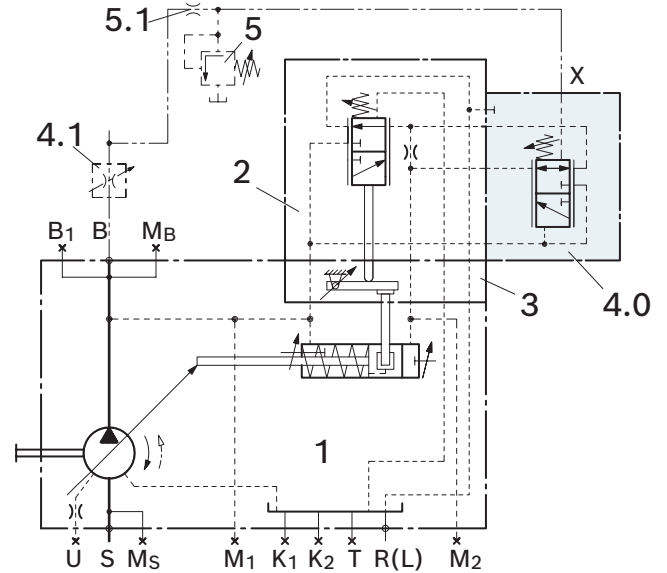
Circuit diagrams LR.S

Example: A4VSO...LR2S

▼ A4VSO, sizes 40 and 71



▼ A4VSO, sizes 125 to 355

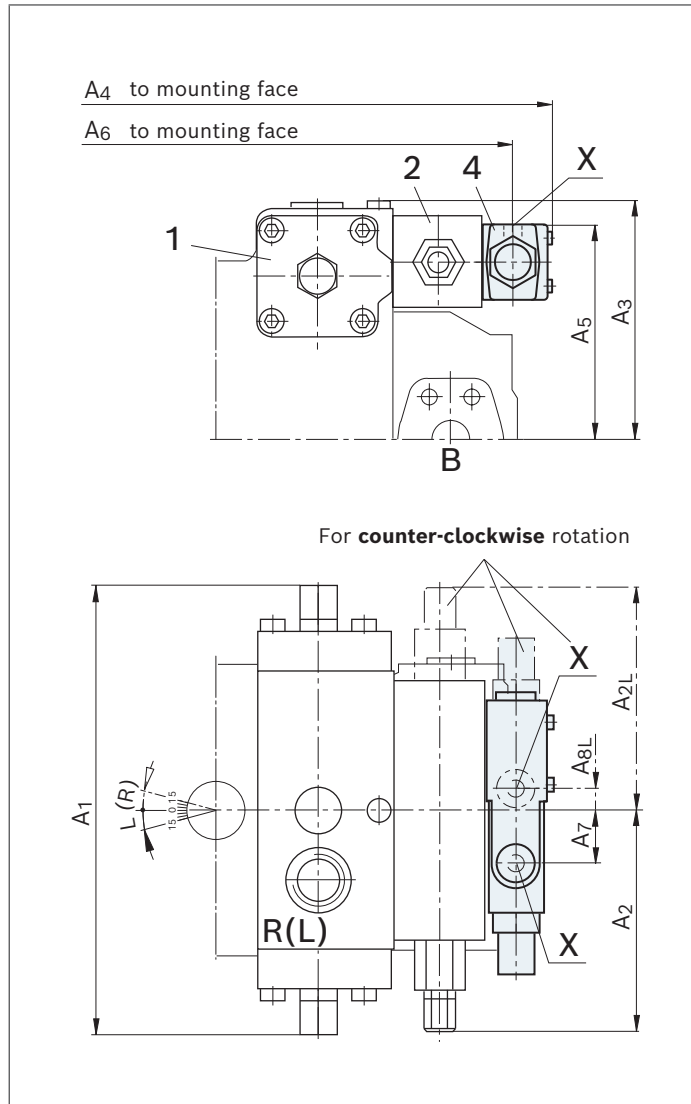


Components

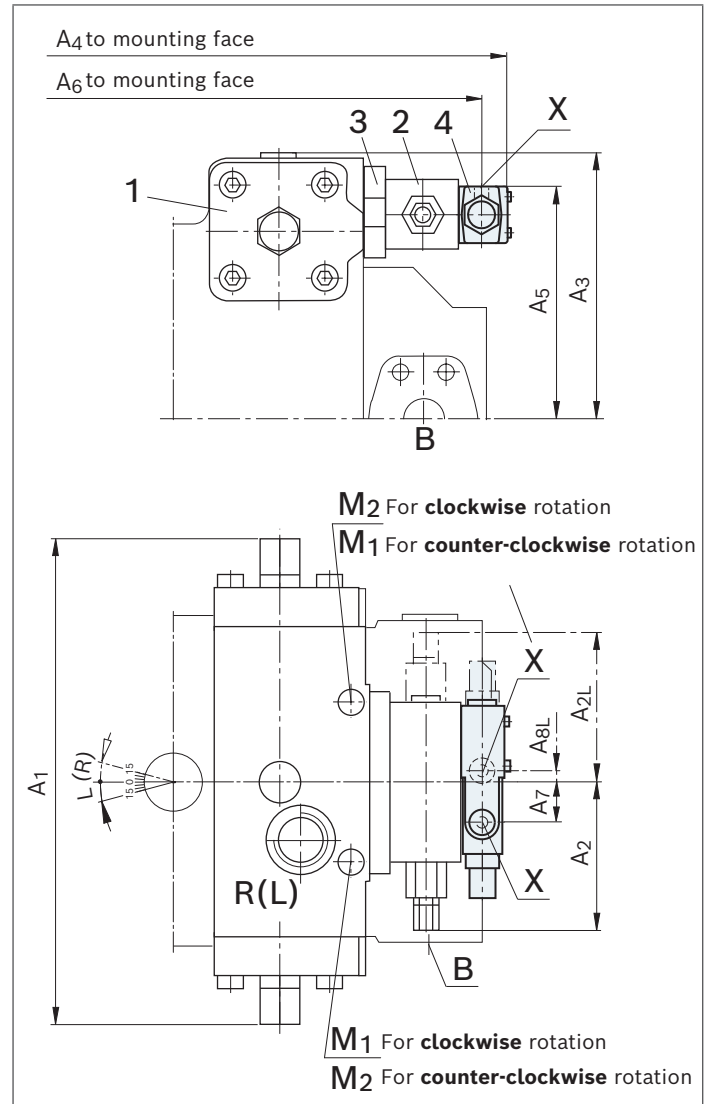
- | | |
|-----|---|
| 1 | Pump with hydraulic control device |
| 2 | Power control valve |
| 3 | Intermediate plate NG125 to 355 |
| 4.0 | Load-sensing valve |
| 4.1 | Orifice – load-sensing control
(not included in scope of delivery) |
| 5 | Pressure relief valve, optional
(not included in scope of delivery) |
| 5.1 | Orifice pressure control, optional
(not included in scope of delivery)
Recommendation 0.8 - 1 mm
depending on the load-sensing control,
the pressure increase may be up to 14 bar |

Dimensions LR.S

▼ A4VSO, sizes 40 to 71 Clockwise rotation



▼ A4VSG, sizes 125 to 355 Clockwise rotation



NG	A1	A2 (A2L)	A3	A4	A5	A6	A7	A8L	
40	260	132	148	295	130	269	37	7	For detailed dimensions and technical data of the variable pump, see data sheet 92050
71	296	132	159	322	141	296	37	7	
125/180	354	132	195	391	171	365	37	7	Components see Page 47
250/355	424	132	238	453	207	427	37	7	

Port		Standard	Size	p_{\max} [bar] ¹⁾	State ²⁾
X	Pilot pressure	DIN 3852	M14 × 1.5; 12 deep	350	O
M ₁ , M ₂	Measurement of stroking chamber pressure	DIN 3852	M14 × 1.5; 12 deep (NG 125 and 180)	350	X
		DIN 3852	M18 × 1.5; 12 deep (NG 250 and 355)	350	X

- 1) Depending on the application, momentary pressure peaks can occur.
Keep this in mind when selecting measuring devices and fittings.
- 2) O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

LR..Z – Power controller with hydraulic two-point control

Can be used as start-up circuit with external control fluid supply

Pump setting in depressurized state: $V_{g \max}$

LR2(3)Z is a simple 2-point control with overriding power control.

For the power and pressure control, port **R_{kv}** must be connected with the reservoir on the customer side.

In case of pressurization at port **R_{kv}**, the control device swivels back against the mechanically adjustable $V_{g \min}$ stop. In case of depressurization at port **R_{kv}**, the pump swivels into the LR2(3) control function.

A start-up circuit for reduction of the start-up torque of the pump can be realized.

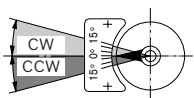
$$p_{St} = \frac{\text{Working pressure } p_{HD}}{2} \text{ At least, however, 20 bar}$$

- The $V_{g \min}$ stop is fixedly set at the factory (0...50% $V_{g \max}$).
 When ordering, please state value in the plain text.

In case of longer operation in zero stroke, Bosch Rexroth recommends using LR.G with external pilot pressure relief (see "LR.G – Power controller with pressure control, remote controlled" on page 23).

Direction of rotation	Swivel direction ¹⁾	Flow direction	High-pressure port
clockwise	counter-clockwise	S to B	B
counter-clockwise	clockwise	S to B	B

¹⁾ Cf. swivel angle indicator

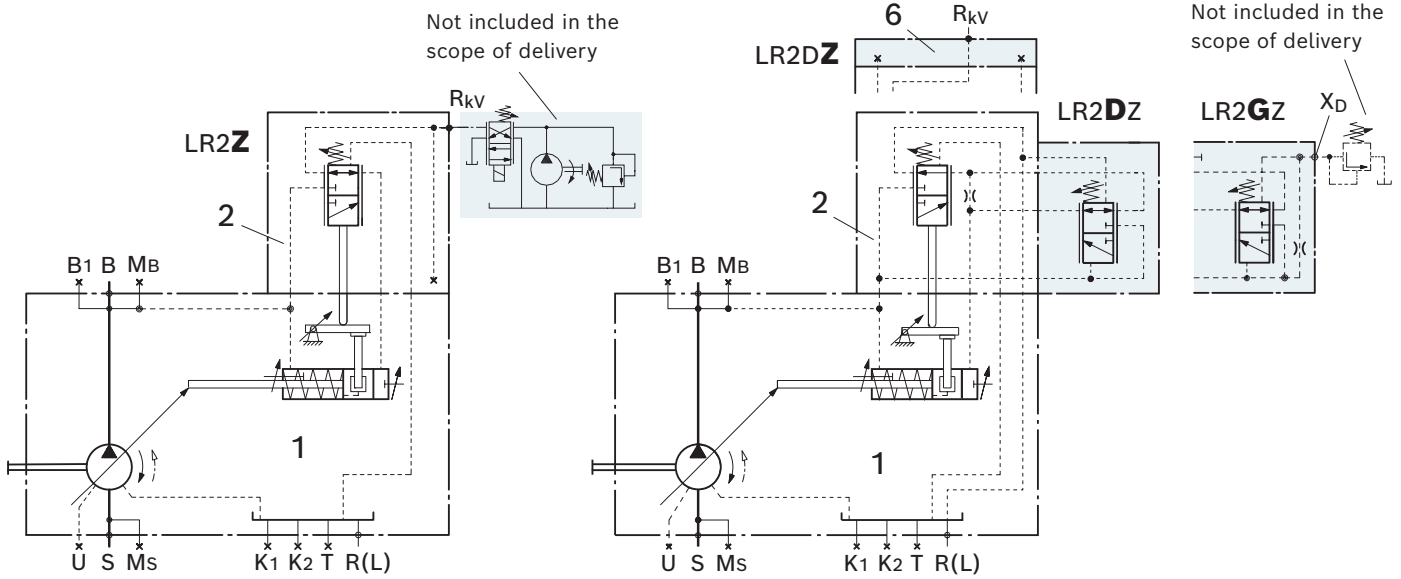


Circuit diagrams LR..Z

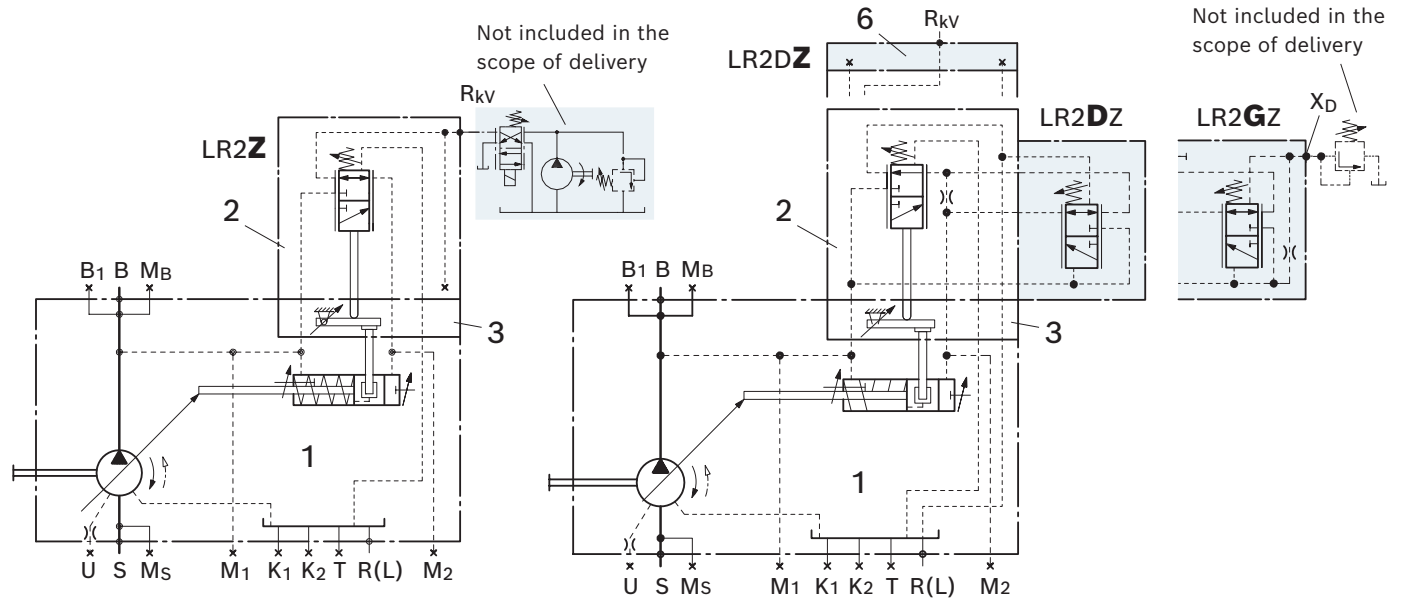
Can be used as start-up circuit with external control fluid supply

Example: A4VSO...LR2Z, LD2DZ, LR2GZ

▼ **A4VSO, sizes 40 and 71**



▼ **A4VSO, sizes 125 to 355**



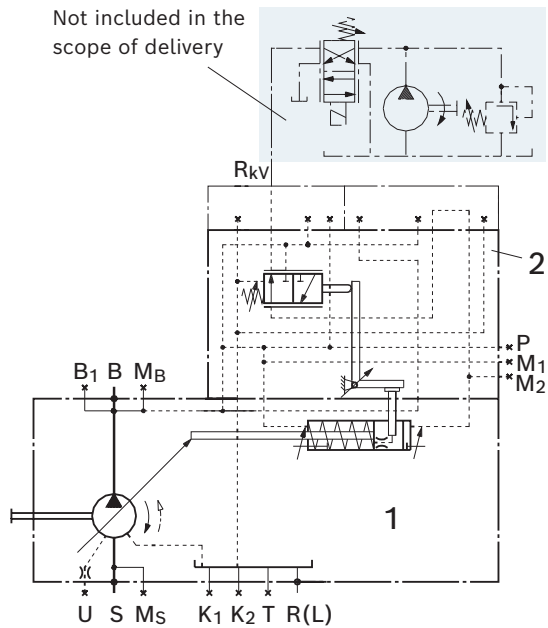
Components	
1	Pump with hydraulic control device
2	Power control valve
3	Intermediate plate NG125 to 355
6	Port plate R_{KV} with LR.DZ and LR.GZ (NG40 to 355)

Circuit diagrams LR.Z

Can be used as start-up circuit with external control fluid supply

Example: A4VSO...LR2Z

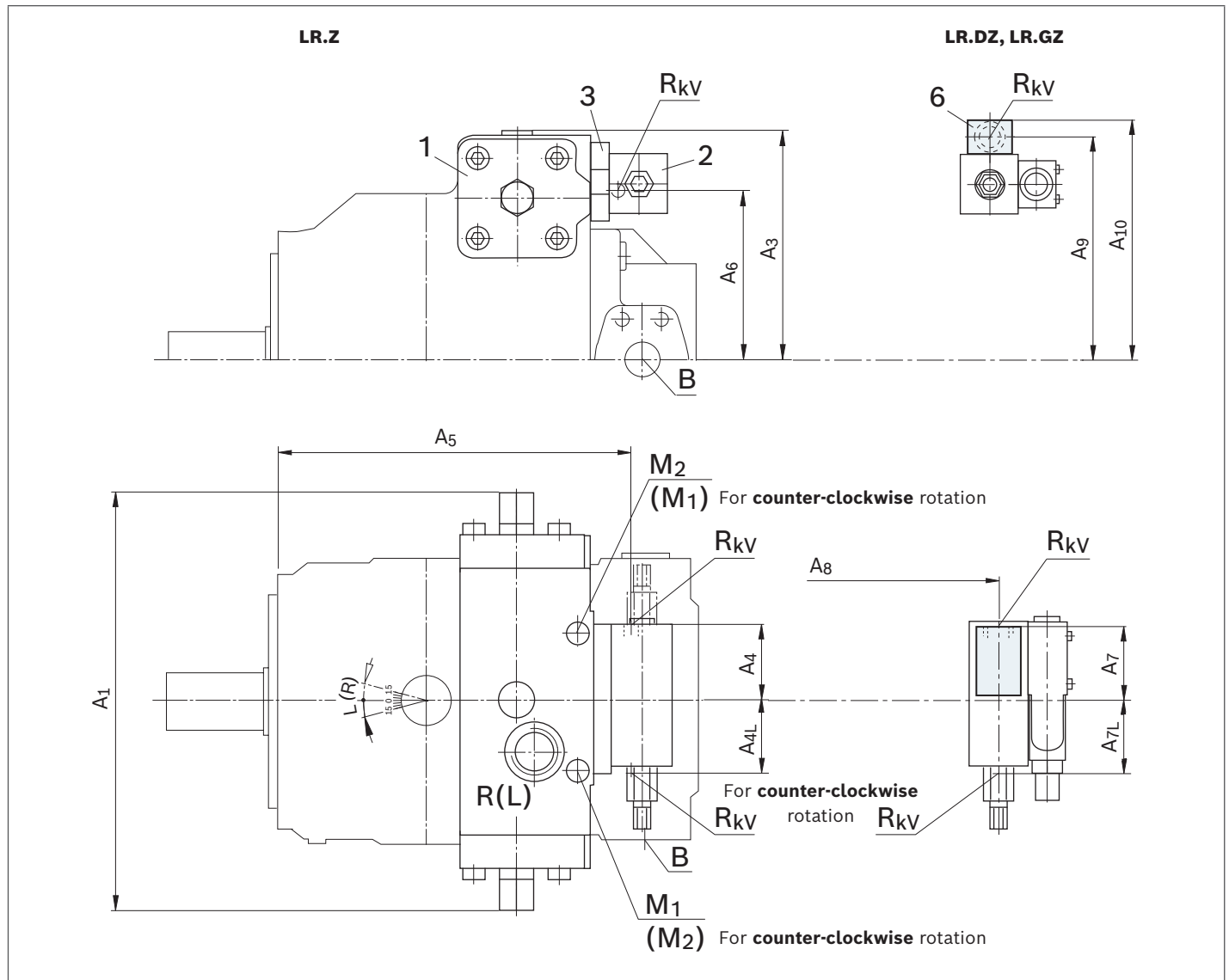
▼ A4VSO, sizes 500 to 1000



Components

- | | |
|---|------------------------------------|
| 1 | Pump with hydraulic control device |
| 2 | Power control valve |

NG	A1	A2(L)	A3	A4(L)	A5	A6	A7(L)	A8	A9	A10	For detailed dimensions and technical data of the variable pump, see data sheet 92050		
40	260	132	149	80	209	114	63	219	152	168			
71	296	132	159	80	236	125	63	246	163	184			
Port								Standard		Size ²⁾		p_{\max} [bar] ³⁾	State ⁴⁾
R _{kV}		Control fluid return flow						DIN 3852		M18 × 1.5; 12 deep		350	O

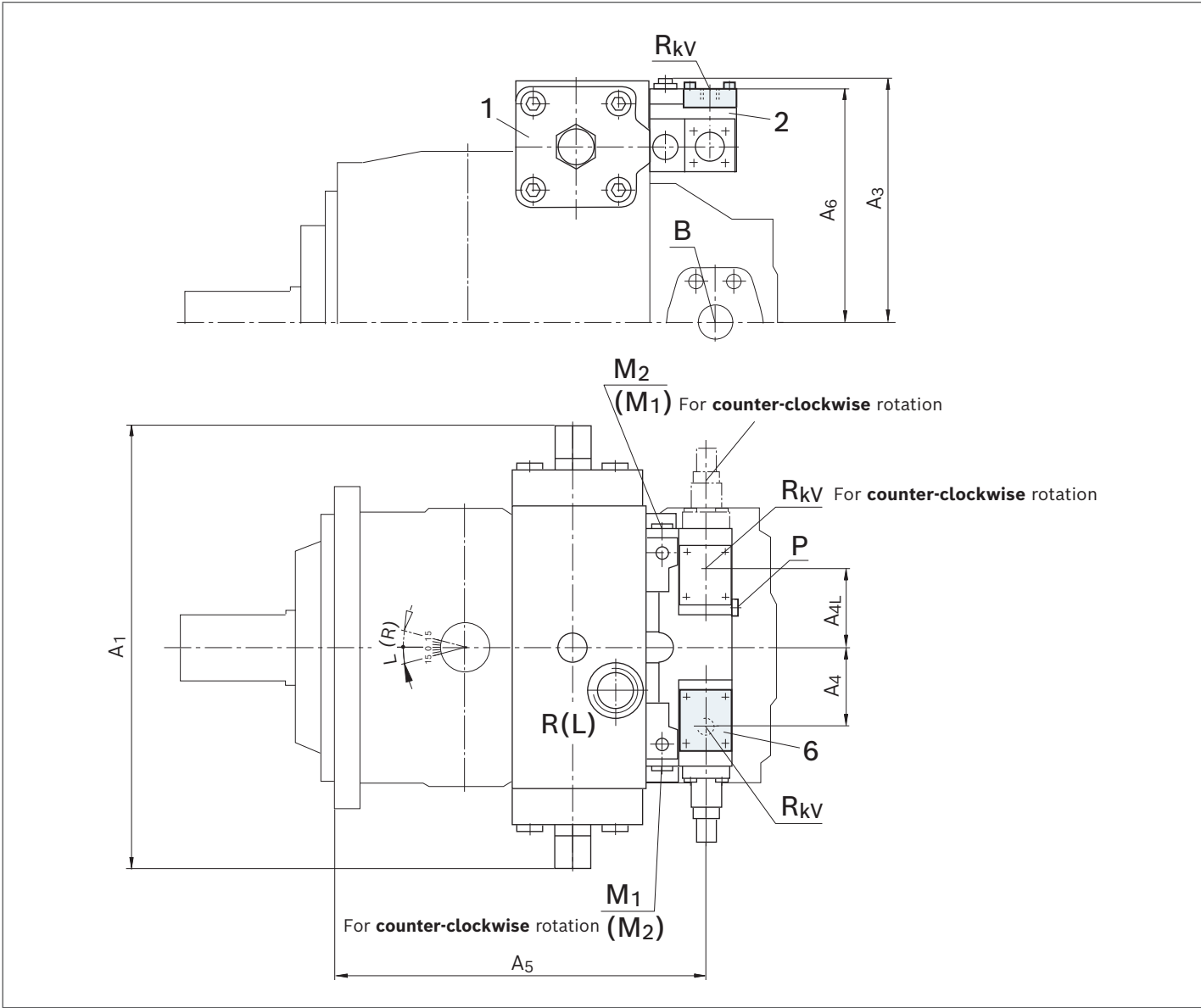
Dimensions LR.Z▼ **A4VSO, sizes 125 to 355**
Clockwise rotation

NG	A1	A3	A4(L)	A5	A6	A7(L)	A8	A9	A10	For detailed dimensions and technical data of the variable pump, see data sheet 92050
125/180	354	195	80	305	155	63	315	193	209	
250/355	424	238	80	367	191	63	377	229	250	

Port		Standard	Size ²⁾	p _{max} [bar] ³⁾	State ⁴⁾
R _{kv}	Control fluid return flow	DIN 3852	M18 × 1.5; 12 deep	350	O
M ₁ ; M ₂	Stroking chamber measurement	DIN 3852	M14 x 1.5; 12 deep (NG 125 and 180)	350	X
		DIN 3852	M18 × 1.5; 12 deep (NG 250 and 355)		

Dimensions LR.Z

▼ **A4VSO, sizes 500 to 1000**
Clockwise rotation



NG	A1	A3	A4 (A4L)	A5	A6		
500	510	285	94	433	277	For detailed dimensions and technical data of the variable pump, see data sheet 92050	
750	582	322	94	465	307		
1000	622	350	94	532	330		
Port				Standard	Size ²⁾	p _{max} [bar] ³⁾	State ⁴⁾
R _{kv}	Control fluid return flow			DIN 3852	M18 × 1.5; 12 deep	350	O
M ₁ ; M ₂	Stroking chamber measurement			DIN 3852	M18 × 1.5; 12 deep	350	X

LR..Y – Power controller with electric two-point control

With internal control fluid supply

Pump setting in depressurized state: $V_{g \max}$

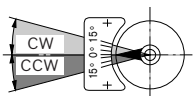
LR2(3)Y is an electric two-point control with override power control and internal control fluid supply. The control fluid required for the control is taken from the high-pressure side.

Valve function:

Solenoid de-energized	=	Start-up circuit, pump is swiveled back to $V_{g \min}$ as soon as a working pressure of approx. 4...10 bar is built up
Solenoid energized	=	Pump works in the power control function

Direction of rotation	Swivel direction ¹⁾	Flow direction	High-pressure port
clockwise	counter-clockwise	S to B	B
counter-clockwise	clockwise	S to B	B

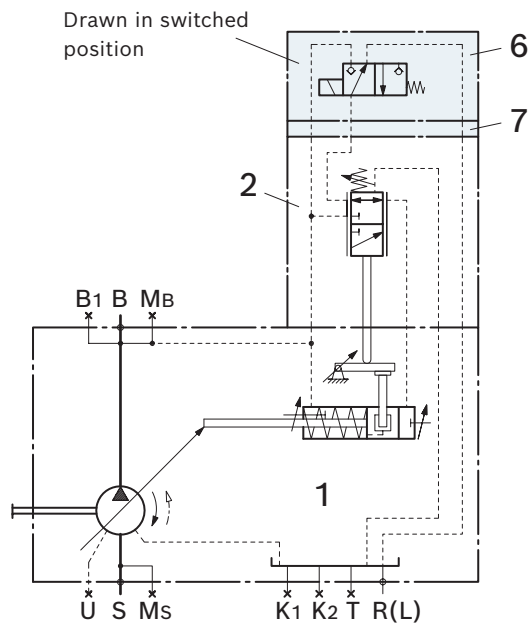
¹⁾ Cf. swivel angle indicator



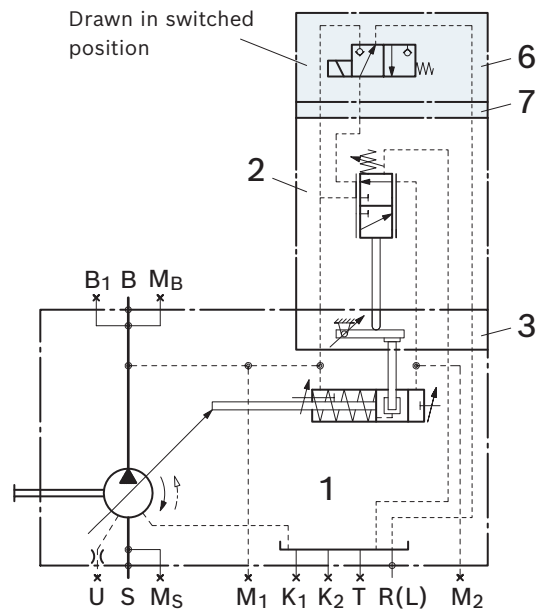
Circuit diagrams LR.Y

Example: A4VSO...LR2Y

▼ A4VSO, sizes 40 and 71



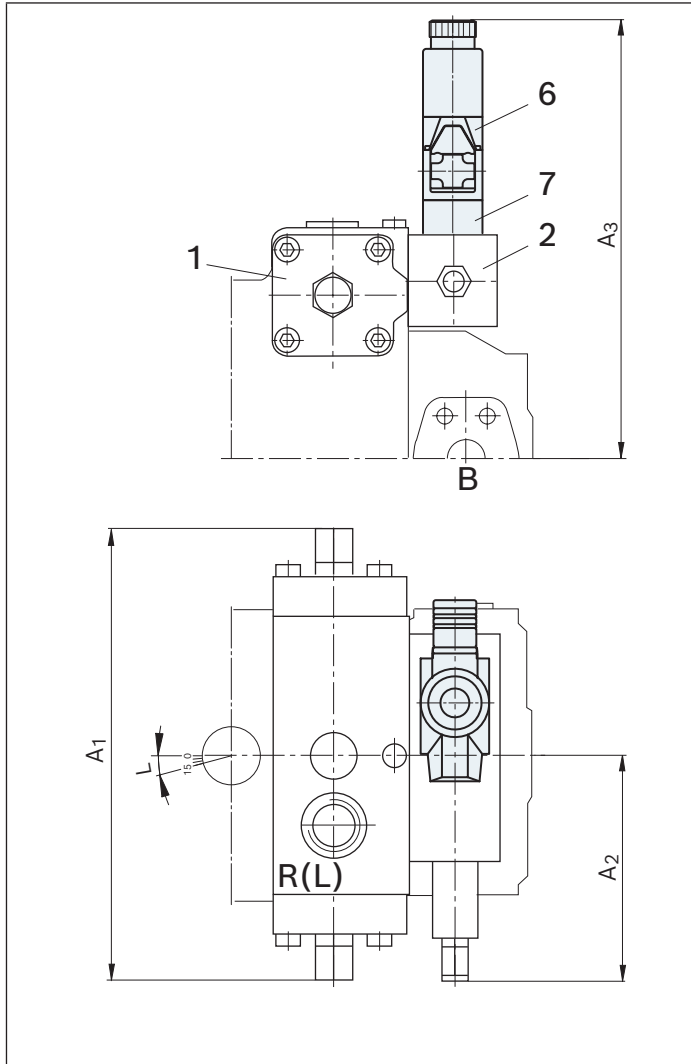
▼ A4VSO, sizes 125 to 355



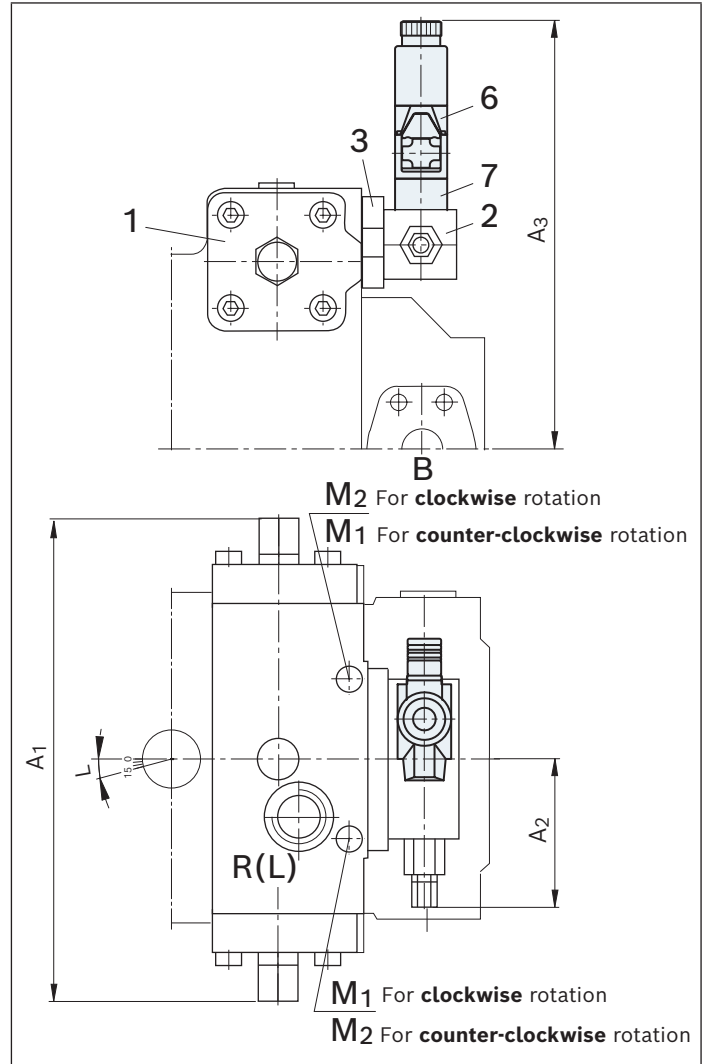
Components	
1	Pump with hydraulic control device
2	Power control valve
3	Intermediate plate NG125 to 355
6	3/2 directional seat valve see data sheet 22058 (for NG 40...355)
Type	
M-3SEW6U3X/420MG24N9K4	
For information see "Connector for solenoids" on page 65	
7	Intermediate plate

Dimensions LR.Y

▼ A4VSO, sizes 40 and 71 Clockwise rotation



▼ A4VSO, sizes 125 to 355 Clockwise rotation



For counter-clockwise rotation, valve set-up items 2, 6 and 7 set-up turned through 180°

NG	A1	A2	A3	
40	260	132	292	For detailed dimensions and technical data of the variable pump, see data sheet 92050
71	296	132	308	
125/180	354	132	338	Components see Page 40
250/355	424	132	374	

Ports	Standard	Size	p_{\max} [bar] ¹⁾	State ²⁾
M ₁ ; M ₂	Measurement of stroking chamber pressure	DIN 3852	M14 x 1.5; 12 deep (NG 125 and 180)	X
			M18 x 1.5; 12 deep (NG 250 and 355)	X

LR.H – Power controller with hydraulic stroke limiter

Pump setting in depressurized state: $V_{g \max}$

For this control, an external pressurization with the control pressure is required at port **P**.

The displacement is reduced proportionally to an external pilot pressure in P_{St} .

The hyperbola power controller is superimposed on the pilot pressure signal and keeps the specified drive power constant.

$$p \cdot q_v = \text{constant}$$

p Working pressure [bar]
 q_v Flow [cm³]

Displacement limitation is possible via:

- Swivel angle limitation at the stroking piston (Item 1) - **mechanical**
- Additional stroke limiter at the pilot control valve (Item 6.1) - **hydraulic**

Setting ranges, mechanical

Swivel angle limitation at the stroking piston:

$V_{g \min}$ 0 to 50% $V_{g \max}$ $V_{g \max}$ 100 to 50% $V_{g \max}$

Setting ranges, hydraulic

Stroke limiter at the pilot control valve:

$V_{g \min}$ 0 to 100% $V_{g \max}$ $V_{g \max}$ 100 to 0% $V_{g \max}$

The minimum and maximum mechanical swivel angle limitations are fixedly set at the factory. When ordering, please state the desired values in the plain text:
The hydraulic stroke limiter is set by default so that the above-mentioned mechanical $V_{g \min}$ and $V_{g \max}$ settings are reached.

When ordering, please state other desired settings in the plain text.

Notice

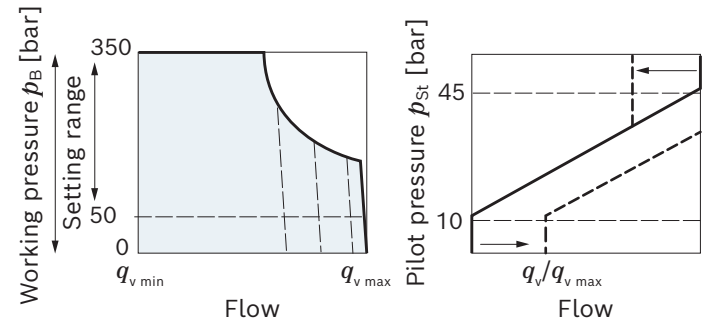
- In case of combination with remote controlled pressure control (LR2GH and LR3GH), please note the following:
With a pressure control setting below the external control pressure p_{control} , the pump will - up to size 355 - remain at $V_{g \min}$ -mechanical and with sizes 500...1000, vibrations may occur.

Table of values, LR.H

Size			40	71	125	180	250	355	500	750	1000
Control volume	$V_{1\max}$	cm ³	11.4	21.5	37.5	37.5	73.2	73.2	125.0	210.0	263.3
Control volume	$V_{2\max}$	cm ³	2.9	5.4	9.4	9.4	18.3	18.3	31.4	51.3	65.8
Differential volume	$V_1 - V_2$	cm ³	8.5	16.1	28.1	28.1	54.9	54.9	94.1	158.7	197.5

1) Beginning of control <50 bar upon request.

▼ Characteristic curve LR.H

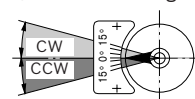


Direction of rotation	Swivel direction ¹⁾	Flow direction	High-pressure port
clockwise	counter-clockwise	S to B	B
counter-clockwise	clockwise	S to B	B

Technical data

Minimum required control pressure in P	$p_{\text{control min}}$	bar	35
Maximum permissible control pressure in P	$p_{\text{control max}}$	bar	100
Maximum control pressure ≤ LR beginning of control			
Minimum required control fluid flow		l/min	1.5
Control fluid loss in P (with $p = 50$ bar)		l/min	max. 4
Pilot pressure range in P_{St}	p_{pilot}	bar	10...45
Maximum pilot pressure in P_{St}	$p_{\text{pilot max}}$	bar	100
Beginning of control of the power characteristic curve, however, only above control pressure p_{control}	p	bar	50 ¹⁾ ...350
Hysteresis			≤ ± 2% of $V_{g \max}$

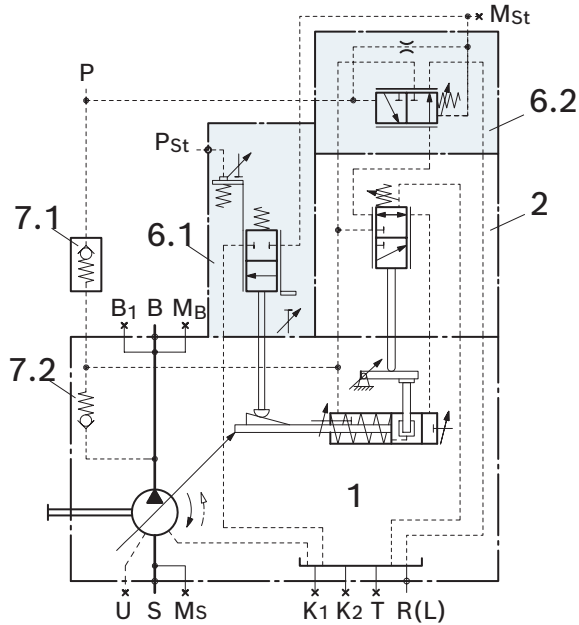
2) Cf. swivel angle indicator



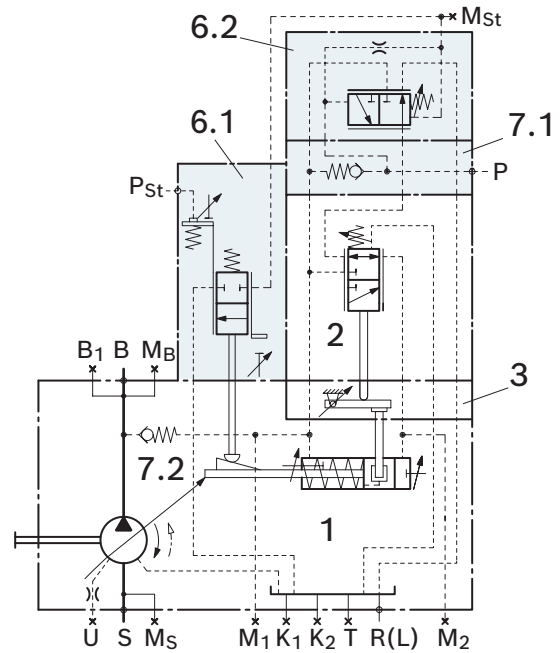
Circuit diagrams LR.H

Example: A4VSO...LR2H

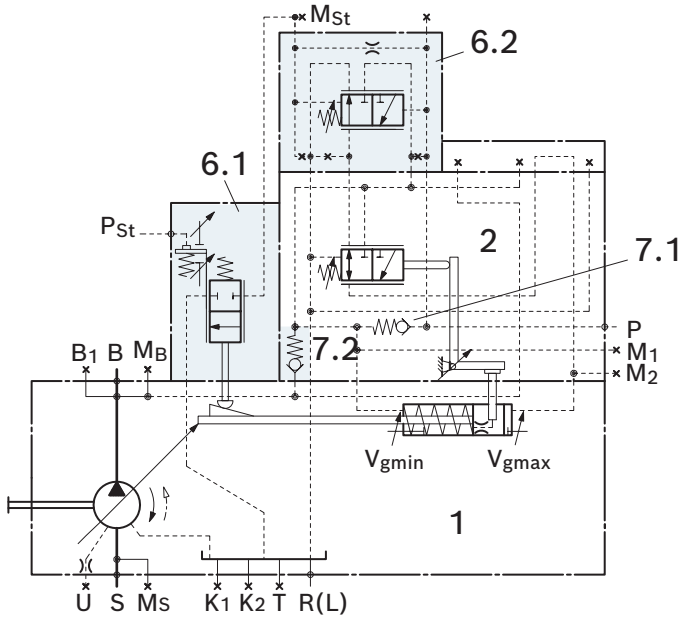
▼ A4VSO, sizes 40 and 71



▼ A4VSO, sizes 125 to 355



▼ A4VSO, sizes 500 to 1000

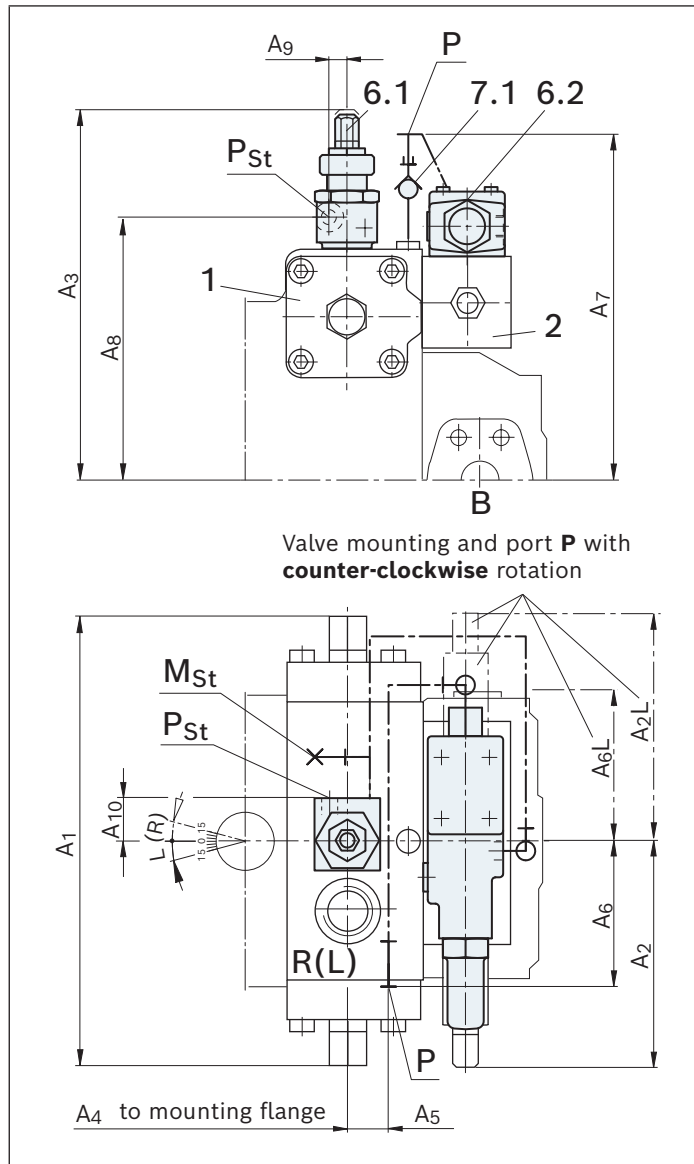


Components

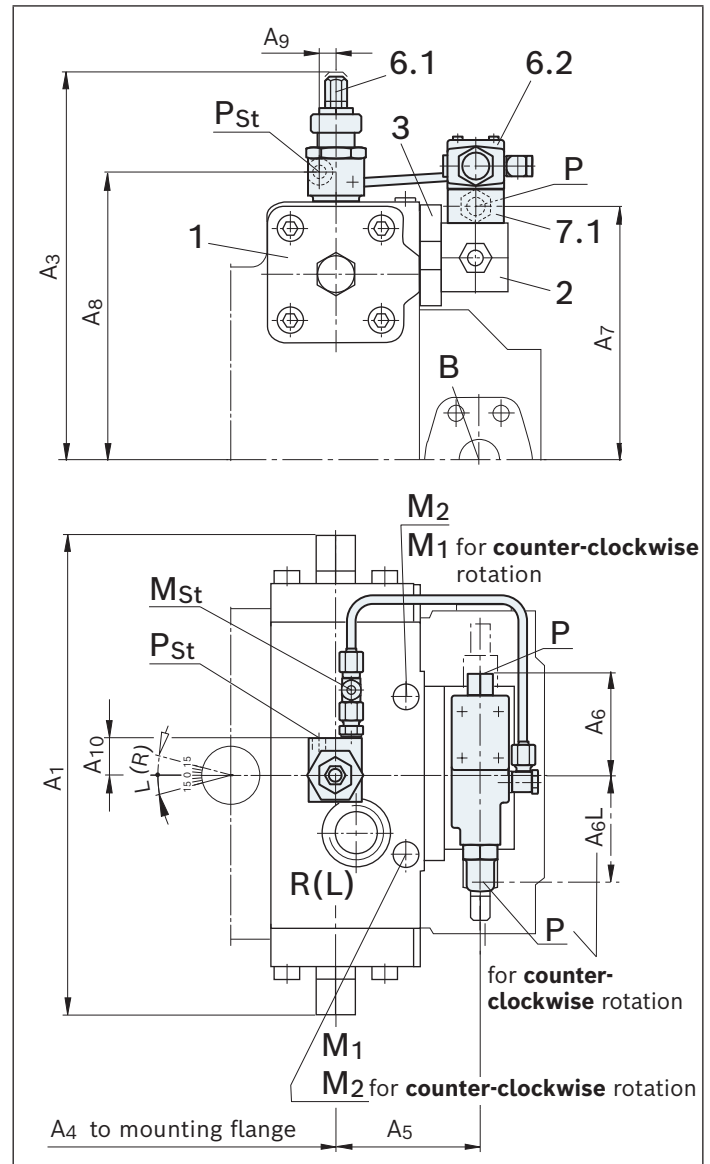
1	Pump with hydraulic control device
2	Power control valve
3	Intermediate plate 125 to 355
6.1	Pilot control valve
6.2	Control valve
7.1	Check valve (with NG40 to 71 external, with NG125 to 1000 integrated)
7.2	Check valve integrated

Dimensions LR.H

▼ A4VSO, sizes 40 and 71



▼ A4VSO, sizes 125 to 355



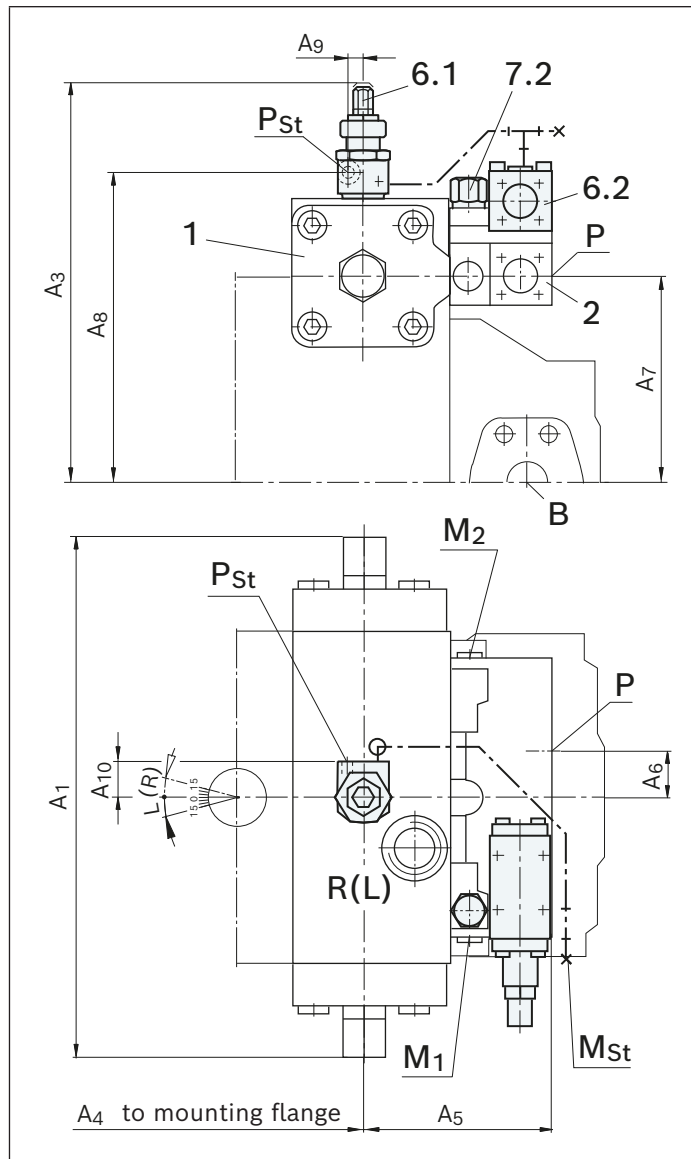
NG	A1	A2(L)	A3	A4	A5	A6(L)	A7	A8	A9	A10	
40	260	132	254	144	34	83	198	163	15	35	For detailed dimensions and technical data of the variable pump, see data sheet 92050
71	296	132	268	166	39	83	215	178	15	35	
125/180	354	–	304	203	112	88	192	214	15	35	Components see Page 43
250/355	424	–	352	248	129	88	228	261	15	35	

Ports	Standard	Size	p _{max} [bar] ¹⁾	State ²⁾
P	DIN 3853	S8 form W (NG 40 and 71)	100	O
P	DIN 3852	M18 × 1.5; 12 deep (NG 125 to 355)	100	O
P _{St}	DIN 3852	M14 × 1.5; 12 deep	50	O
M _{St}	DIN 3853	S8 form W	100	X
M ₁ ; M ₂	DIN 3852	M14 × 1.5; 12 deep (NG 125 and 180)	350	X
		M18 × 1.5; 12 deep (NG 250 and 355)	350	X

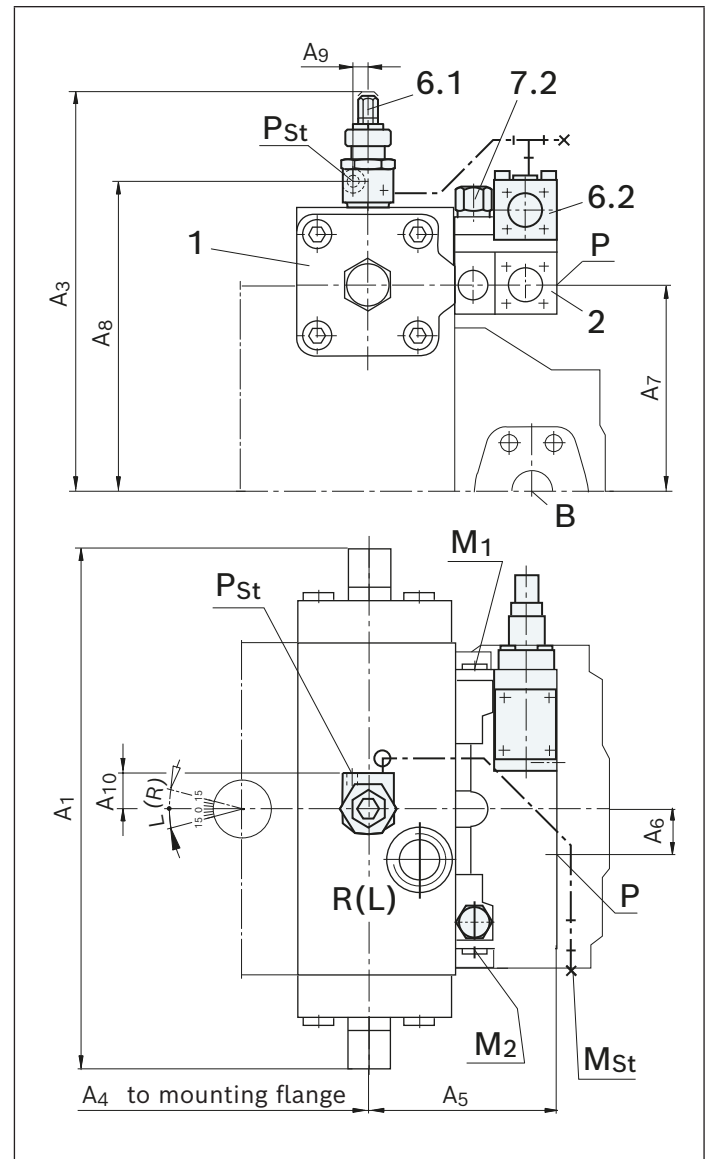
1) Depending on the application, momentary pressure peaks can occur.
Keep this in mind when selecting measuring devices and fittings.

2) O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

▼ A4VSO, sizes 500 to 1000

Clockwise rotation

▼ A4VSO, sizes 500 to 1000

Counter-clockwise rotation

NG	A1	A3	A4	A5	A6	A7	A8	A9	A10	
500	510	397	279	185	47	202	306	15	35	For detailed dimensions and technical data of the variable pump, see data sheet 92050 Components see Page 43
750	582	435	301	196	47	232	345	15	35	
1000	622	463	360	202	47	255	372	15	35	

Ports		Standard	Size	p_{\max} [bar] ¹⁾	State ²⁾
P	Control pressure port	DIN 3852	M22 × 1.5; 14 deep	100	O
P _{St}	Pilot pressure port	DIN 3852	M14 × 1.5; 12 deep	50	O
M _{St}	Pilot pressure measuring	DIN 3853	S8 form W	100	X
M ₁ ; M ₂	Measurement of stroking chamber pressure	DIN 3852	M18 × 1.5; 12 deep	350	X

1) Depending on the application, momentary pressure peaks can occur.
Keep this in mind when selecting measuring devices and fittings.

2) O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

LR.N – Power controller stroke control, pilot-pressure related

Pump setting in depressurized state: $V_{g \min}$

For this control, an external control pressure supply is required at port **P**.

The displacement is increased proportionally to an external pilot pressure in P_{St} .

The hyperbola power controller is superimposed on the pilot pressure signal and keeps the specified drive power constant.

$$p \cdot q_v = \text{constant}$$

p Working pressure [bar]
 q_v Flow [cm³]

Displacement limitation is possible via:

- Swivel angle limitation at the stroking piston (Item 1) - **mechanical**
- Additional stroke limiter at the pilot control valve (Item 6.1) - **hydraulic**

Setting ranges, mechanical

Swivel angle limitation at the stroking piston:

$V_{g \min}$ 0 to 50% $V_{g \max}$ $V_{g \max}$ 100 to 50% $V_{g \max}$

Setting ranges, hydraulic

Stroke limiter at the pilot control valve:

$V_{g \min}$ 0 to 100% $V_{g \max}$ $V_{g \max}$ 100 to 0% $V_{g \max}$

The minimum and maximum mechanical swivel angle limitations are fixedly set at the factory. When ordering, please state the desired values in the plain text:

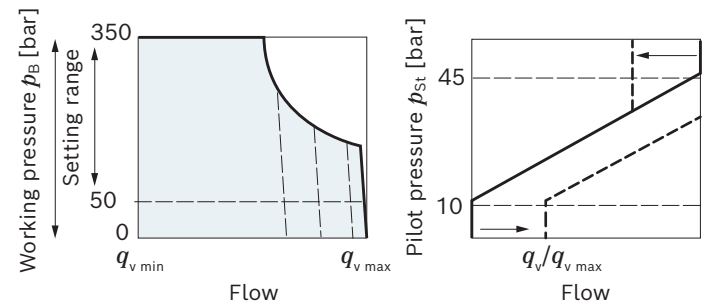
The hydraulic stroke limiter is set by default so that the above-mentioned mechanical $V_{g \min}$ and $V_{g \max}$ settings are reached.

When ordering, please state other desired settings in the plain text.

It has to be ensured by the superior machine control that the minimum pressure at port **B** is guaranteed.

Please observe the notice on LR2GN on page Page 56.

▼ Characteristic curve LR.N

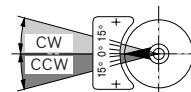


Direction of rotation	Swivel direction ¹⁾	Flow direction	High-pressure port
clockwise	counter-clockwise	S to B	B
counter-clockwise	clockwise	S to B	B

Technical data

Minimum required control pressure in P	$p_{\text{control min}}$ bar	35
Maximum permissible control pressure in P Maximum control pressure ≤ LR beginning of control	$p_{\text{control max}}$ bar	100
Minimum required control fluid flow	l/min	1.5
Control fluid loss in P (with $p = 50$ bar)	l/min	max. 4
Pilot pressure range in P_{St}	p_{pilot} bar	10...45
Maximum pilot pressure in P_{St}	$p_{\text{pilot max}}$ bar	100
Beginning of control of the power characteristic curve, however, only above control pressure p_{control}	p bar	50 ²⁾ ...350
Hysteresis		≤ ± 2% of $V_{g \max}$

1) Cf. swivel angle indicator



2) Beginning of control <50 bar upon request.

Table of values

Size			40	71	125	180	250	355	500	750	1000
Control volume	$V_{1 \max}$	cm ³	11.4	21.5	37.5	37.5	73.2	73.2	125.0	210.0	263.3
Control volume	$V_{2 \max}$	cm ³	2.9	5.4	12.7	12.7	24.9	24.9	40.1	72.6	88.0
Differential volume	$V_1 - V_2$	cm ³	8.5	16.1	24.8	24.8	48.3	48.3	84.9	137.4	175.3

Control fluid requirement for swiveling in at

control pressure $p_{\text{control}} = 50$ bar;

working pressure $p < 50$ bar;

Beginning of power control $p > 50$ bar

l/min 5.16 6.44 7.44 7.44 9.66 9.66 10.13 11.00 10.50

Notice:

For the design of the control pressure supply, losses of the pilot control of approx. 4 l/min must additionally be considered.

with swiveling in time s 0.10 0.15 0.20 0.20 0.30 0.30 0.50 0.75 1.00

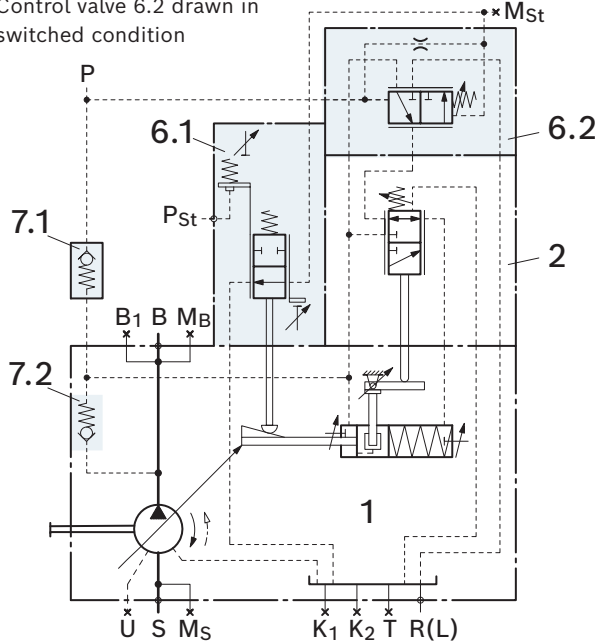
Circuit diagrams LR.N

Example: A4VSO...LR2N

▼ A4VSO, sizes 40 and 71

P pressurized

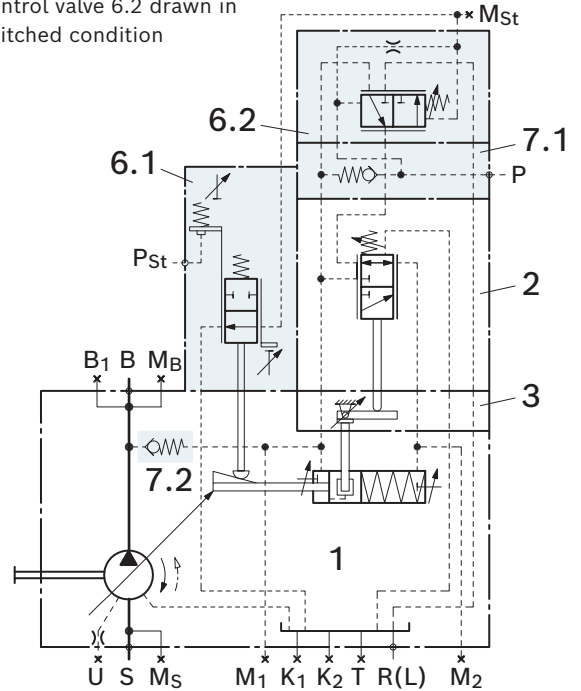
Control valve 6.2 drawn in
switched condition



▼ A4VSO, sizes 125 to 355

P pressurized

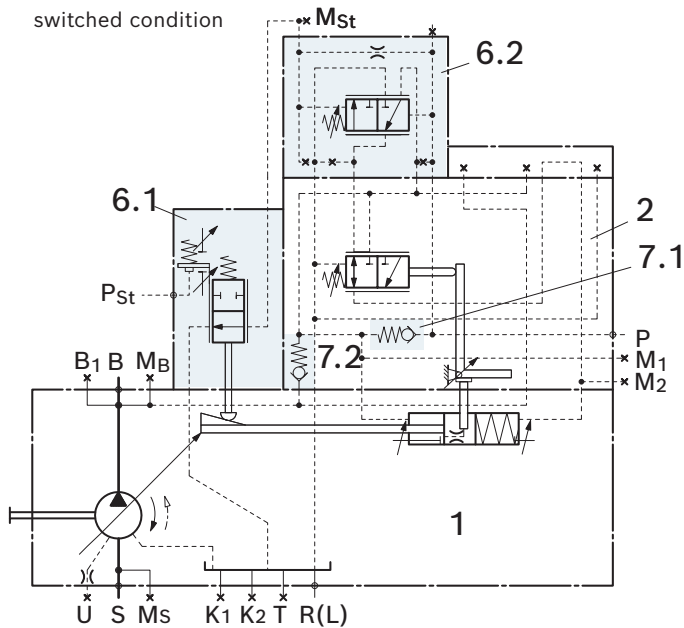
Control valve 6.2 drawn in
switched condition



▼ A4VSO, sizes 500 to 1000

P pressurized

Control valve 6.2 drawn in
switched condition

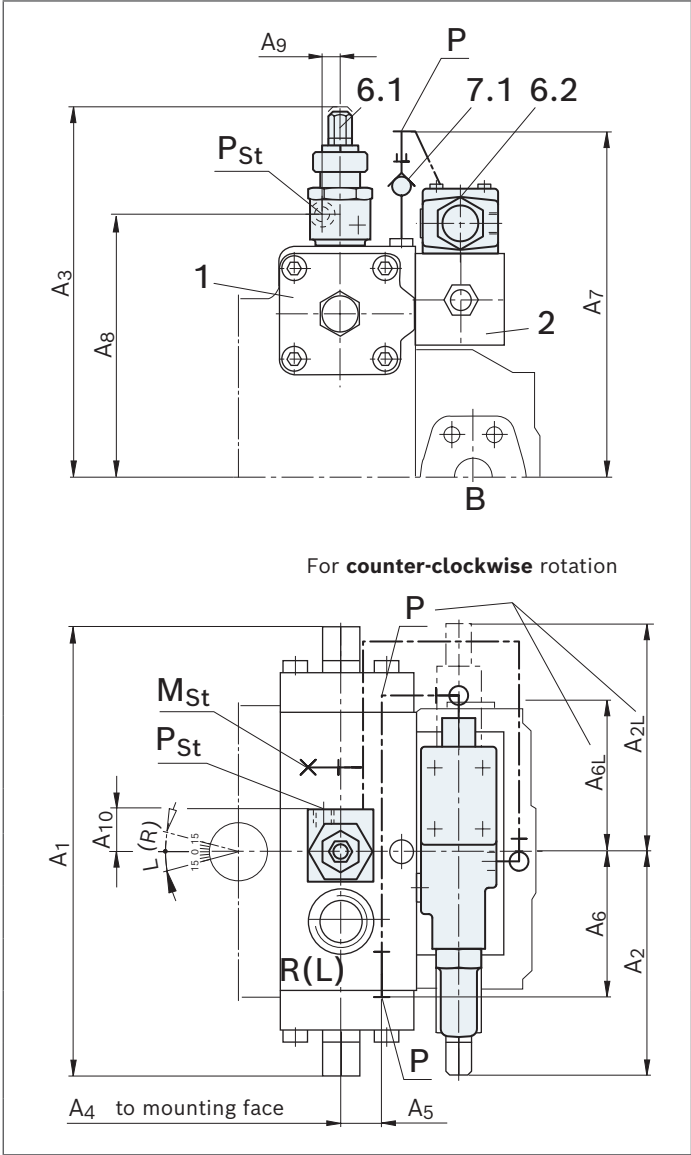


Components

1	Pump with hydraulic control device
2	Power control valve
3	Intermediate plate NG125 to 355
6.1	Pilot control valve
6.2	Control valve
7.1	Check valve (with NG40 to 71 external, with NG125 to 1000 integrated)
7.2	Check valve integrated

Dimensions LR.N

▼ **A4VSO, sizes 40 to 71**
Clockwise rotation

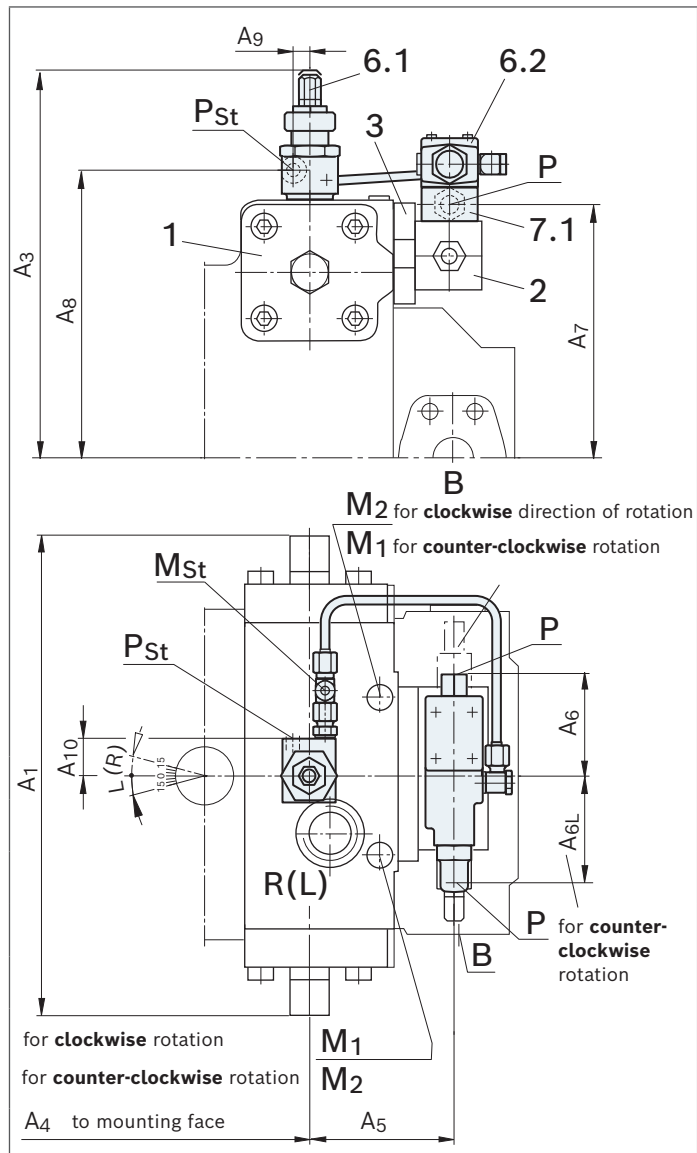


Components	
1	Pump with hydraulic control device
2	Power control valve
6.1	Pilot control valve
6.2	Control valve
7.1	Check valve (for NG40 to 71 external)
7.2	Check valve integrated

NG	A1	A2(L)	A3	A4	A5	A6(L)	A7	A8	A9	A10	
40	260	132	248	144	34	83	198	163	15	35	For detailed dimensions and technical data of the variable pump, see data sheet 92050
71	296	132	264	166	39	83	215	180	15	35	

Port	Standard	Size	p_{max} [bar] ¹⁾	State ²⁾
P	Control pressure	DIN 3853	S8 form W	O
P _{St}	Pilot pressure	DIN 3852	M14 × 1.5; 12 deep	O
M _{St}	Pilot pressure measuring	DIN 3853	S8 form W	X

1) Depending on the application, momentary pressure peaks can occur.
Keep this in mind when selecting measuring devices and fittings.
2) O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

▼ **A4VSO, sizes 125 to 355****Clockwise** rotation**Components**

Components	
1	Pump with hydraulic control device
2	Power control valve
3	Intermediate plate NG125 to 355
6.1	Pilot control valve
6.2	Control valve
7.1	Check valve (for NG125 to 1000 integrated)
7.2	Check valve integrated

NG	A1	A3	A4	A5	A6(L)	A7	A8	A9	A10	
125/180	354	298	203	112	88	192	214	15	35	For detailed dimensions and technical data of the variable pump, see data sheet 92050
250/355	424	346	248	129	88	228	261	15	35	

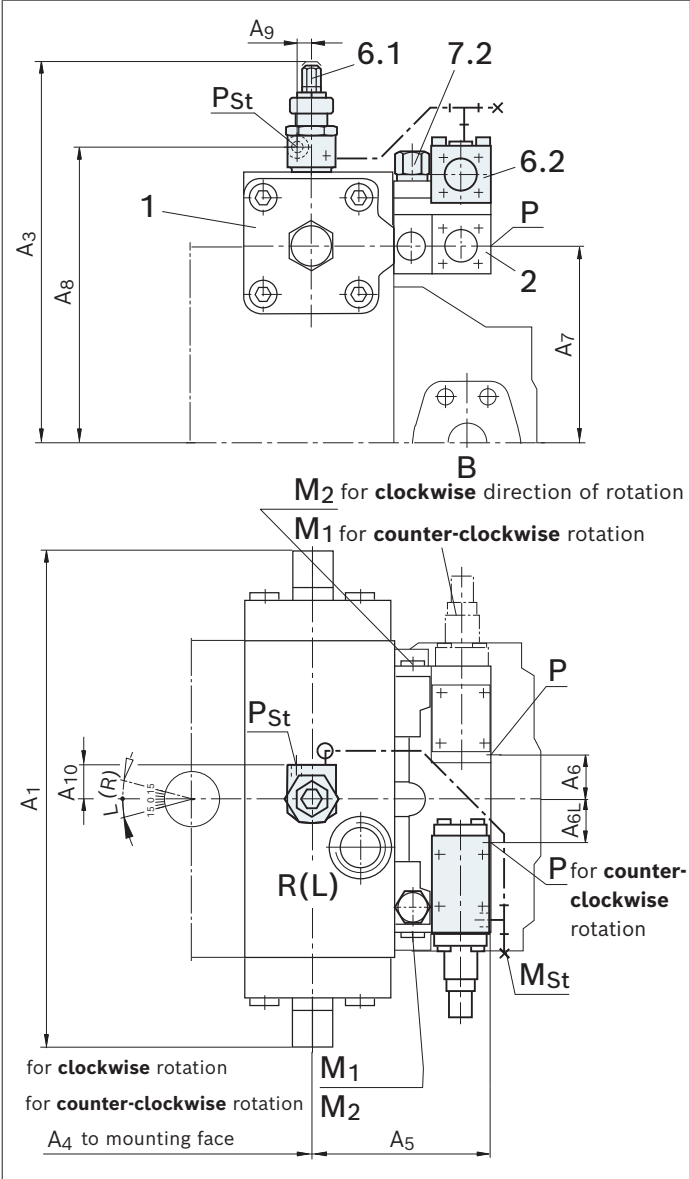
Port		Standard	Size	p_{\max} [bar] ¹⁾	State ²⁾
P	Control pressure	DIN 3852	M18 × 1.5; 12 deep	100	O
P _{St}	Pilot pressure	DIN 3852	M14 × 1.5; 12 deep	50	O
M _{St}	Pilot pressure measuring	DIN 3853	S8 form W	100	X
M ₁ , M ₂	Stroking chamber measurement	DIN 3852	M14 x 1.5; 12 deep (NG 125 and 180)	350	X
			M18 × 1.5; 12 deep (NG 250 and 355)	350	X

1) Depending on the application, momentary pressure peaks can occur.
Keep this in mind when selecting measuring devices and fittings.

2) O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

Dimensions LR.N

▼ **A4VSO, sizes 500 to 1000**
Clockwise rotation



NG	A1	A3	A4	A5	A6(L)	A7	A8	A9	A10	
500	510	392	279	185	47	202	306	15	35	For detailed dimensions and technical data of the variable pump, see data sheet 92050
750	582	430	301	195	47	232	345	15	35	
1000	622	456	360	203	47	255	372	15	35	

Port		Standard	Size	p_{max} [bar] ¹⁾	State ²⁾
P	Control pressure	DIN 3852	M22 × 1.5; 14 deep	100	O
P _{St}	Pilot pressure	DIN 3852	M14 × 1.5; 12 deep	50	O
M _{St}	Pilot pressure measuring	DIN 3853	S8 form W	100	X
M ₁ , M ₂	Stroke chamber measurement	DIN 3852	M18 × 1.5; 12 deep	350	X

Components see Page 47

1) Depending on the application, momentary pressure peaks can occur.
Keep this in mind when selecting measuring devices and fittings.

2) O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

LR.NT – Power controller with electric stroke control

Pump setting in depressurized state: $V_{g \min}$
 Only available in clockwise rotation.

For this control, an external control pressure supply is required at port **P**.

The corresponding control chamber at **P_{St}** is supplied with pilot pressure proportional to the current applied to the solenoids of the proportional valve DBEP6 (as per data sheet 29164).

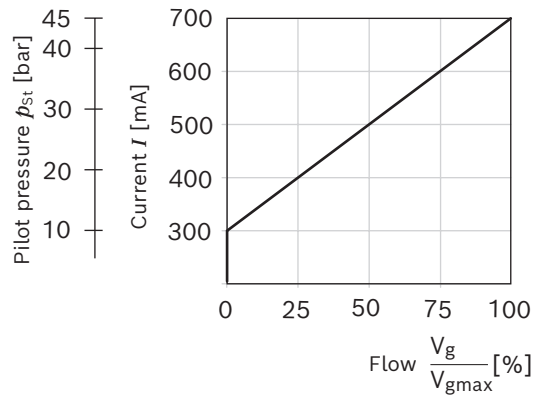
The solenoid current limits the hydraulic pilot pressure. Control by means of an electric setpoint value.

Current control by means of pulse width modulation.

Analog or digital amplifiers can be used to control the solenoids, e.g. proportional amplifier VT MSPA2-2x with 170 Hz (see data sheet 30232). Please order separately.

For more information on the selection of the control electronics and hydraulic fluid, description of the function and manual override as well as more technical data, please observe data sheet 29164.

▼ Characteristic curve LR.NT

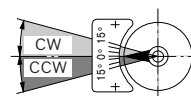


Direction of rotation	Swivel direction ¹⁾	Flow direction	High-pressure port
clockwise	counter-clockwise	S to B	B

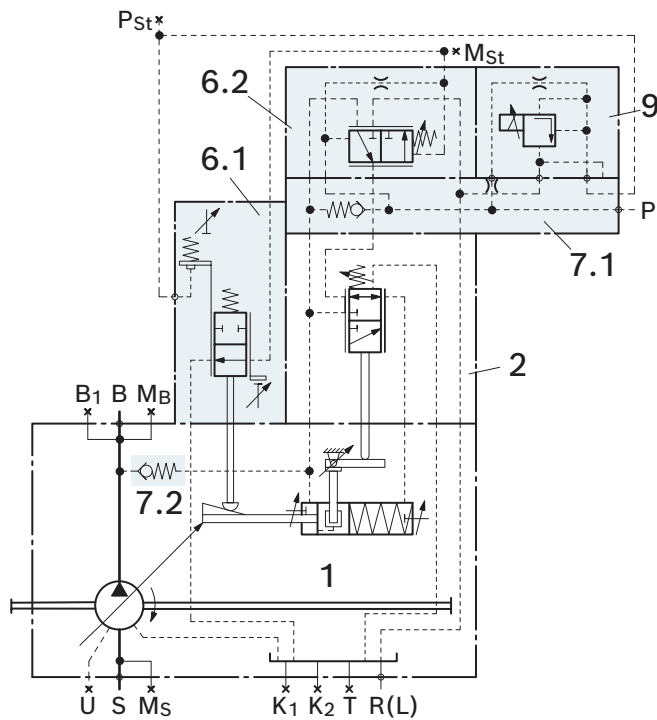
Technical data – electric	
Voltage	24 V
Rated current	700 mA
Control current	700 mA
Beginning of control at V_{g0} and 10 bar pilot pressure	300 mA
End of control at $V_{g \max}$ and 45 bar pilot pressure	700 mA
Nominal resistance (at 20 °C)	19 Ω
Manual override	available
Duty cycle	100%
Type of protection and control electronics see connector version page 65	
Operating temperature range at valve -20 °C to +150 °C	

Technical data – electric			
control pressure in P	p_{\min}	bar	50
	p_{\max}	bar	100
Hysteresis	$\leq \pm 4\%$ of $V_{g \max}$		
Repeat accuracy	$\leq 2\%$ of $V_{g \max}$		
Pilot fluid consumption (Consider design in case of flow in P .)	e.g. 4 l/min at 50 bar		

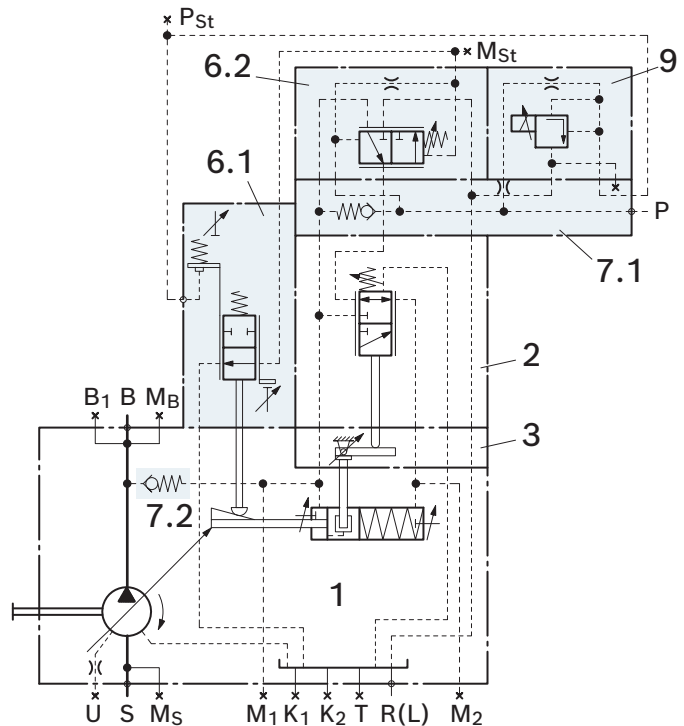
1) cf. swivel angle indicator



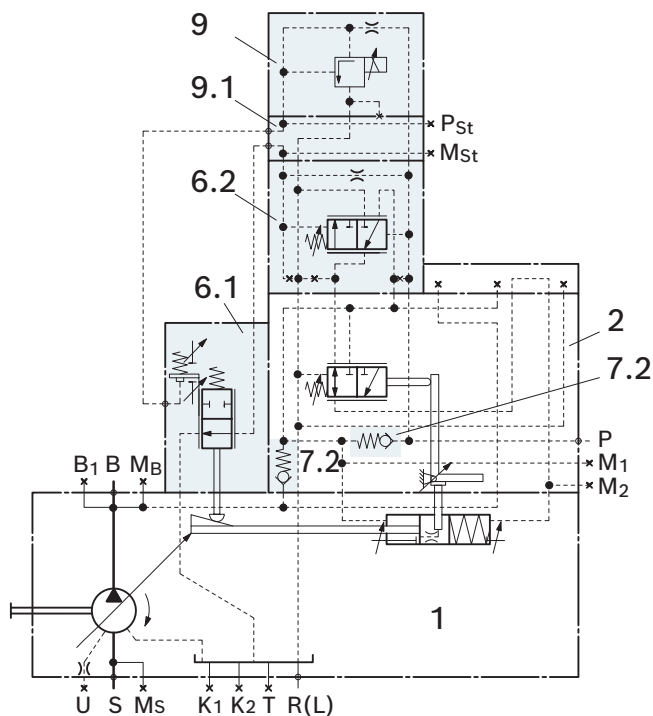
P pressurized
Control valve 6.2 drawn in switched condition



P pressurized
Control valve 6.2 drawn in switched condition



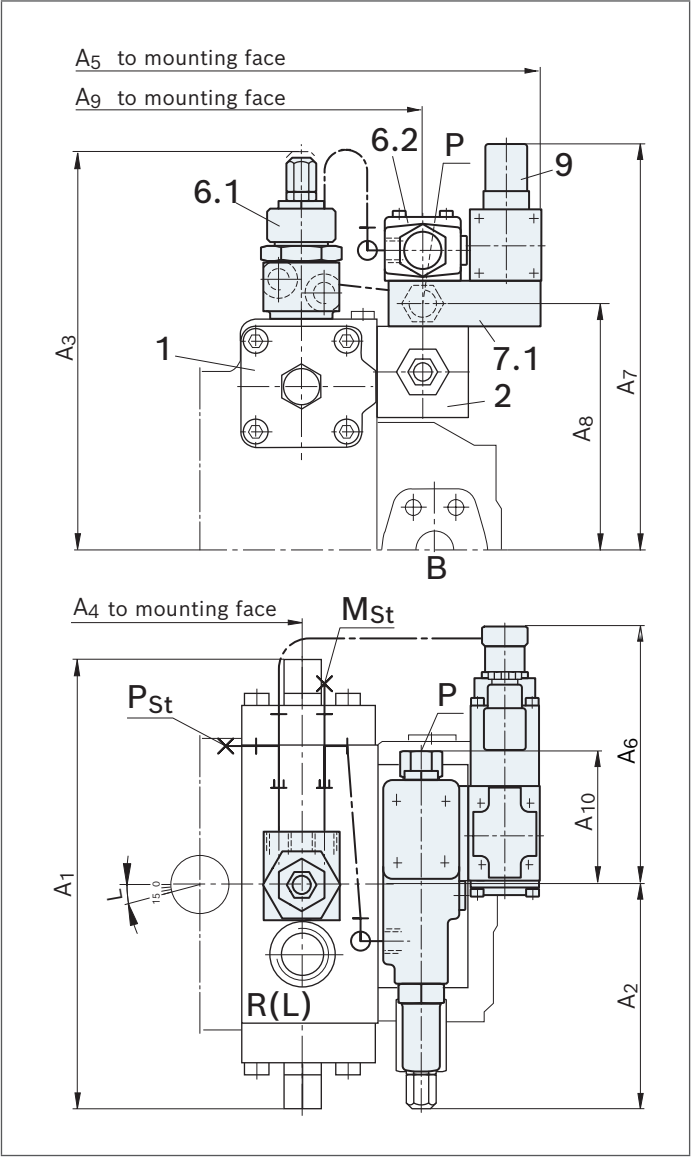
P pressurized
Control valve 6.2 drawn in switched condition



Components		
1		Pump with hydraulic control device
2		Power control valve
3		Intermediate plate NG125 to 355
6.1		Pilot control valve
6.2		Control valve
7.1		Intermediate plate for proportional valve mounting with check valve
7.2		Check valve integrated
9		Proportional pressure relief valve with inlet nozzle Ø1.0 mm
	NG71 to 355	DBEP6 B06-1X/45AG24NZ4M-382
	NG500 to 1000	DBEP6 A06-1X/45AG24NZ4M-382
9.1	NG500 to 1000	Intermediate plate for proportional valve mounting

Dimensions LR.NT

▼ **A4VSO, sizes 40 to 71**
Clockwise rotation



NG	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	
40	260	132	248	144	297	173	256	151	219	88	For detailed dimensions and technical data of the variable pump, see data sheet 92050
71	296	132	264	166	324	173	267	162	246	88	

Port		Standard	Size	p_{\max} [bar] ¹⁾	State ²⁾
P	Control pressure	DIN 3852	M18 × 1.5; 12 deep	100	O
P _{St}	Pilot pressure	DIN 3853	S8 form W	50	X
M _{St}	Pilot pressure measuring	DIN 3853	S8 form W	100	X

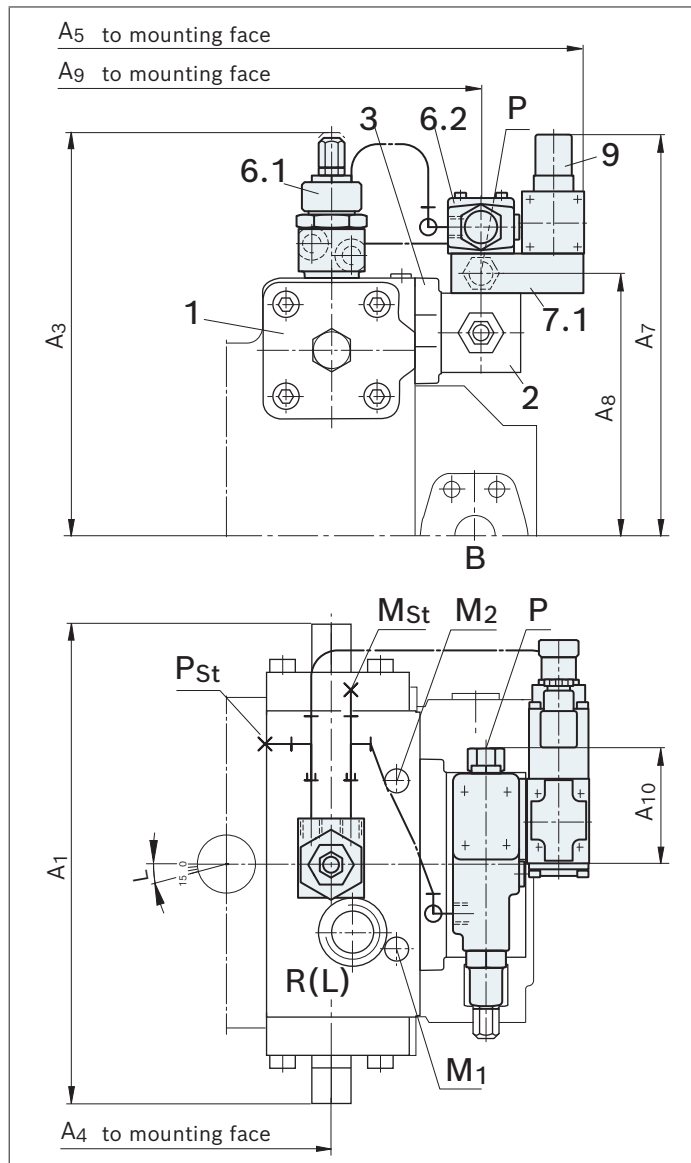
Components see Page 52

1) Depending on the application, momentary pressure peaks can occur.
Keep this in mind when selecting measuring devices and fittings.

2) O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

Dimensions LR.NT

▼ A4VSO, sizes 125 to 355 Clockwise rotation



NG	A1	A3	A4	A5	A7	A8	A9	A10	
125/180	354	298	203	393	297	192	315	88	For detailed dimensions and technical data of the variable pump, see data sheet 92050
250/355	424	346	248	455	333	228	377	88	

Port		Standard	Size	p_{\max} [bar] ¹⁾	State ²⁾
P	Control pressure	DIN 3852	M18 × 1.5; 12 deep	100	O
P _{St}	Pilot pressure	DIN 3853	S8 form W	50	X
M _{St}	Pilot pressure measuring	DIN 3853	S8 form W	100	X
M ₁ , M ₂	Stroking chamber measurement	DIN 3852	M14 × 1.5; 12 deep (NG 125 and 180) M18 × 1.5; 12 deep (NG 250 and 355)	350 350	X X

Components see Page 52

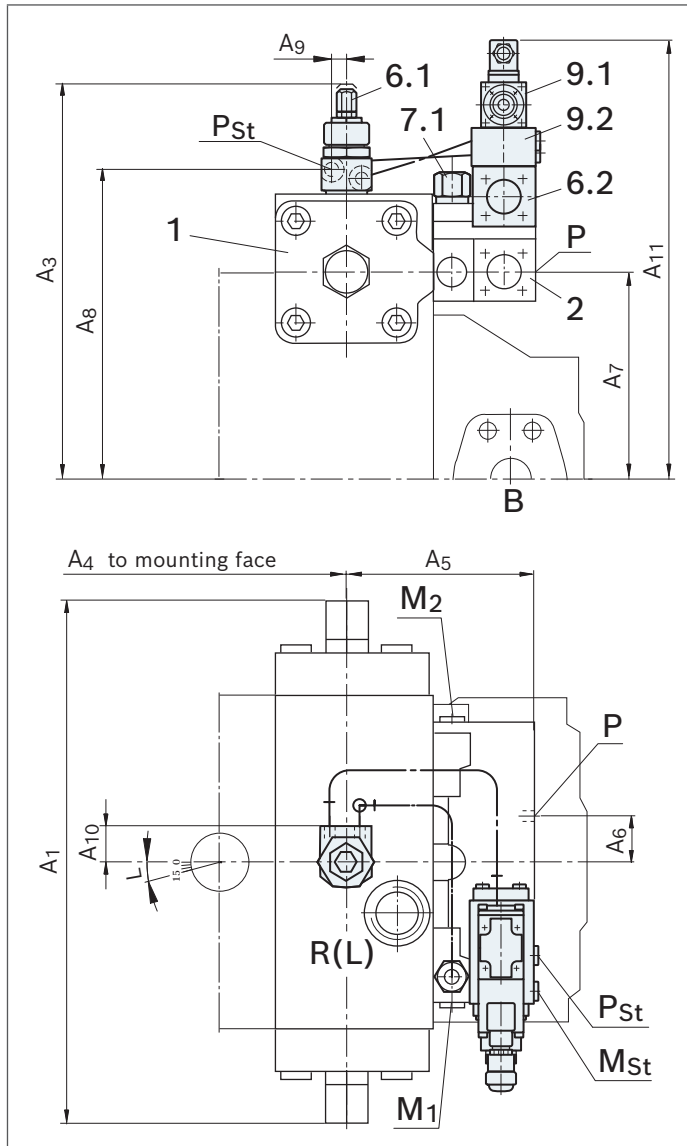
1) Depending on the application, momentary pressure peaks can occur.
Keep this in mind when selecting measuring devices and fittings.

2) O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

Dimensions LR.NT

▼ A4VSO, sizes 500 to 1000

Clockwise rotation



NG	A1	A3	A4	A5	A6	A7	A8	A9	A10	A11	
500	510	392	279	185	47	202	306	15	35	438	For detailed dimensions and technical data of the variable pump, see data sheet 92050
750	582	430	301	196	47	232	345	15	35	468	
1000	622	456	360	203	47	255	372	15	35	491	

Port		Standard	Size	p_{\max} [bar] ¹⁾	State ²⁾
P	Control pressure	DIN 3852	M22 × 1.5; 14 deep	100	O
P _{St}	Pilot pressure	DIN 3852	M14 × 1.5; 12 deep	50	X
M _{St}	Pilot pressure measuring	DIN 3853	M14 × 1.5; 12 deep	100	X
M ₁ , M ₂	Stroking chamber measurement	DIN 3852	M18 × 1.5; 12 deep	350	X

Components see Page 52

1) Depending on the application, momentary pressure peaks can occur.
Keep this in mind when selecting measuring devices and fittings.

2) O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

Combination example LR2GN

LR2GN – Power controller with hydraulic stroke control and pressure controller, remote controlled

Pump setting in depressurized state: $V_{g \min}$

For the description and the technical data, please refer to the following pages:

Controller	Code	Side
Power controller	LR2	4
remote controlled pressure controller	G	23
hydraulic stroke control	N	46

For this control, an external pressurization with the control pressure is required at port **P**.

Notice

- Pressure controllers are not safeguards against pressure overload.
Be sure to add a pressure relief valve to the hydraulic system.
- **Please note for LR2GN and LR3GN:**
With a pressure control setting below the external control pressure p_{control} , the pump will - up to size 355 - remain at $V_{g \min}$ -mechanical and with sizes 500 to 1000, vibrations may occur.

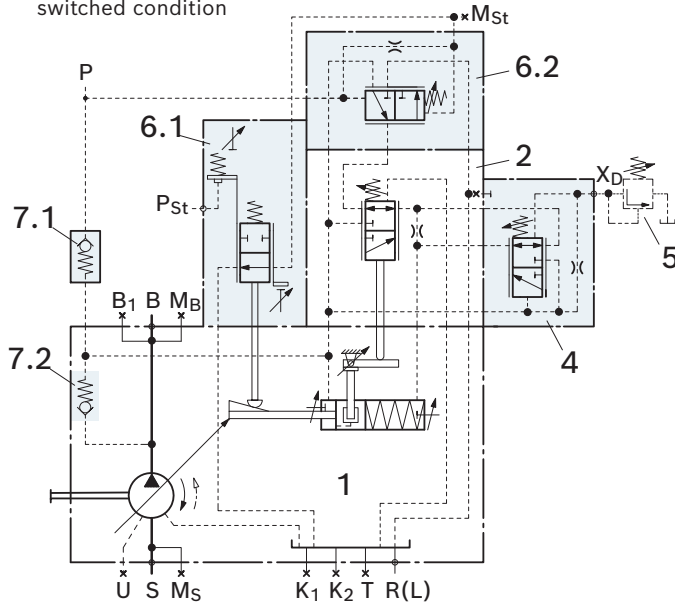
Circuit diagrams LR.GN

Example: A4VSO...LR2GN

▼ A4VSO, sizes 40 and 71

P pressurized

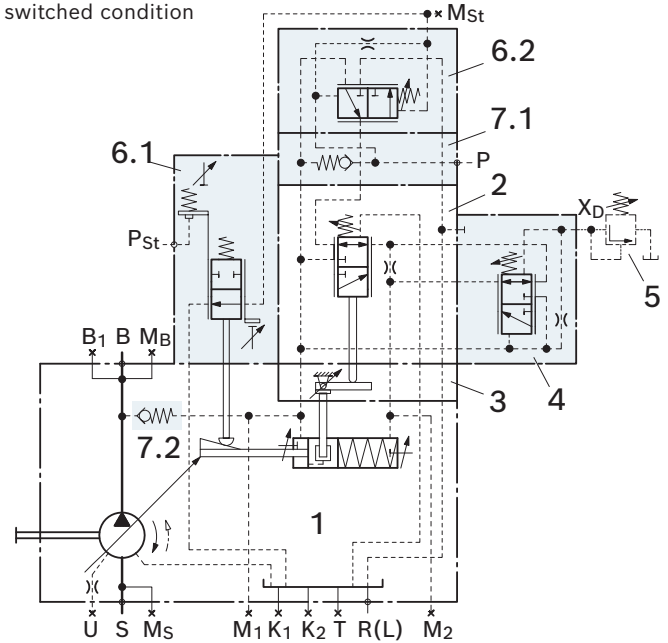
Control valve 6.2 drawn in switched condition



▼ A4VSO, sizes 125 to 355

P pressurized

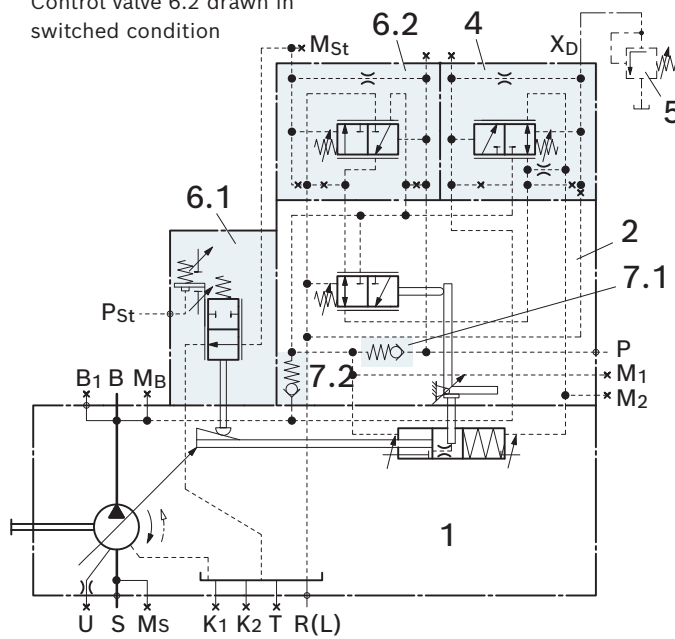
Control valve 6.2 drawn in switched condition



▼ A4VSO, sizes 500 to 1000

P pressurized

Control valve 6.2 drawn in switched condition

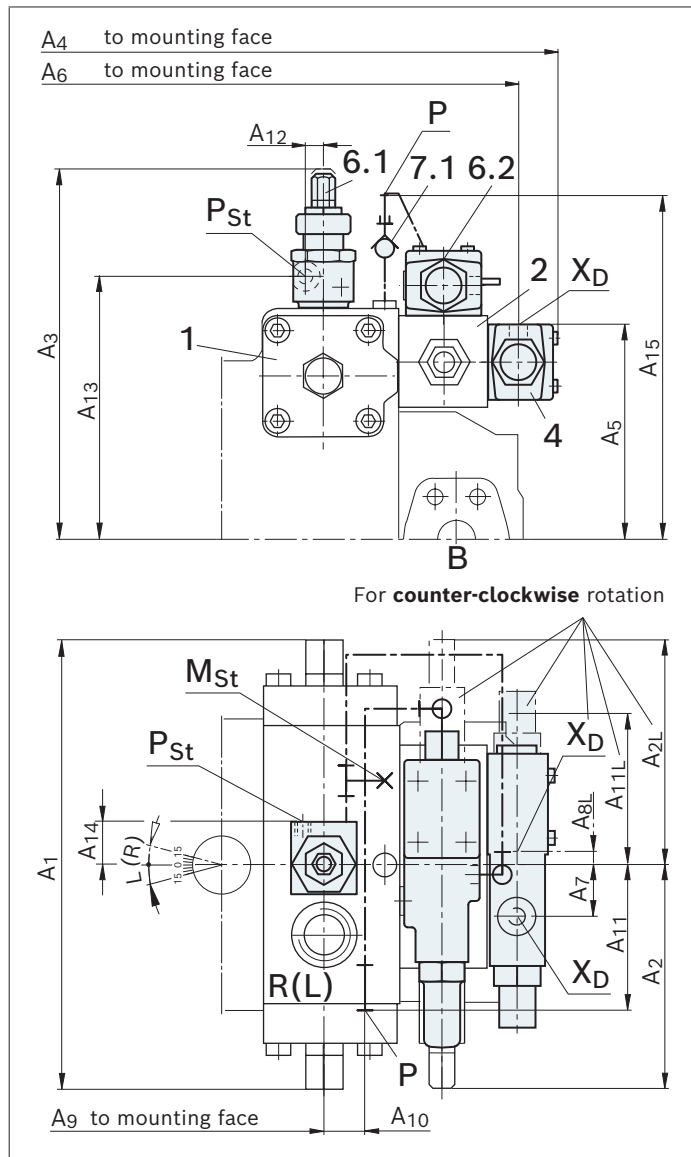


Components

1	Pump with hydraulic control device
2	Power control valve
3	Intermediate plate NG125 to 355
4	Pressure control valve
5	Pressure relief valve (not included in the scope of delivery)
6.1	Pilot control valve
6.2	Control valve
7.1	Check valve (with NG40 to 71 external, with NG125 to 1000 integrated)
7.2	Check valve integrated

Dimensions LR.GN

▼ A4VSO, sizes 40 to 71 Clockwise rotation



NG	A1	A2(L)	A3	A4	A5	A6	A7	A8L	A9	A10	A11(L)	A12	A13	A14	A15	
40	260	132	248	295	130	269	37	7	144	34	83	15	163	35	198	Dimensions and technical data
71	296	132	258	322	146	296	37	7	166	39	83	15	180	35	215	see data sheet 92050

Port		Standard	Size	p_{\max} [bar] ¹⁾	State ²⁾
X_D	Pilot pressure port; remote controlled pressure controller	DIN 3852	M14 × 1.5; 12 deep	50	O
P	Control pressure	DIN 3853	S8 form W	100	O
P_{St}	Pilot pressure	DIN 3852	M14 × 1.5; 12 deep	50	O
M_{St}	Pilot pressure measuring	DIN 3853	S8 form W	100	X

Components see Page 57

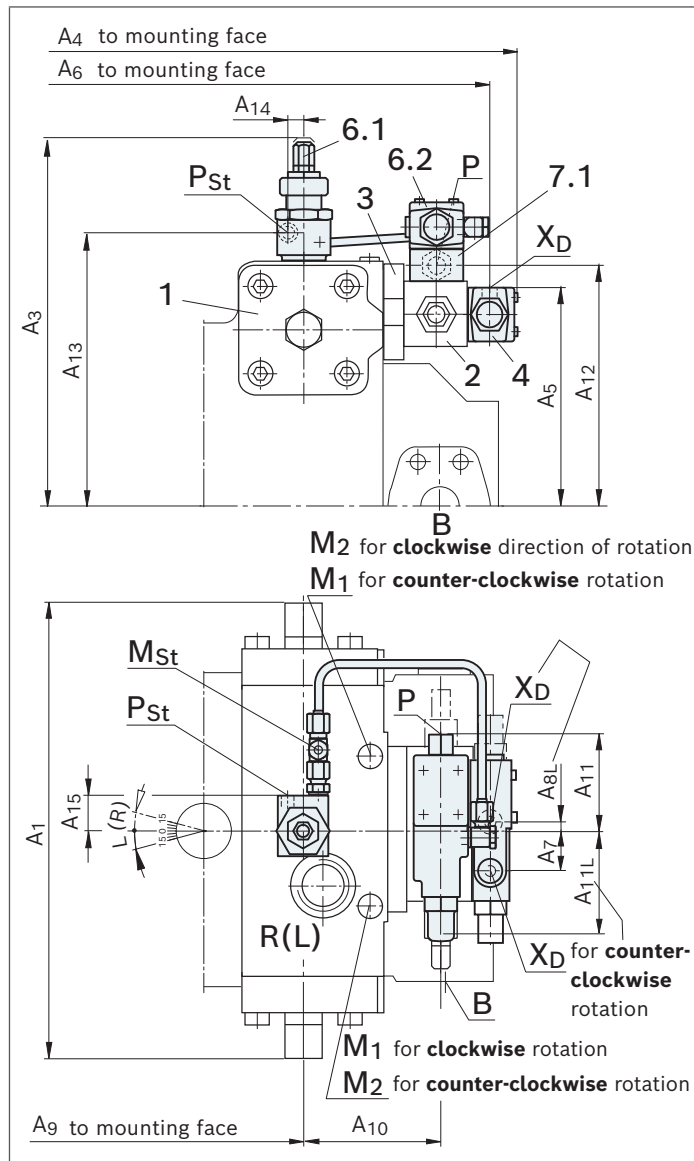
1) Depending on the application, momentary pressure peaks can occur.
Keep this in mind when selecting measuring devices and fittings.

2) O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

Dimensions LR.GN

▼ A4VSO, sizes 125 to 355

Clockwise rotation



NG	A1	A3	A4	A5	A6	A7	A8L	A9	A10	A11(L)	A12	A13	A14	A15	
125/180	354	299	391	171	365	37	7	203	112	88	192	214	15	35	Dimensions and technical data see data sheet 92050
250/355	424	346	453	207	427	37	7	248	129	88	228	261	15	35	

Port	Standard	Size	p_{\max} [bar] ¹⁾	State ²⁾
X_D	Pilot pressure port; remote controlled pressure controller	DIN 3852 M14 × 1.5; 12 deep	50	O
P	Control pressure	DIN 3852 M18 × 1.5; 12 deep	100	O
P_{St}	Pilot pressure	DIN 3852 M14 × 1.5; 12 deep	50	O
M_{St}	Pilot pressure measuring	DIN 3853 S8 form W	100	X
M₁, M₂	Stroke chamber measurement	DIN 3852 M14 × 1.5; 12 deep (NG 125 and 180)	350	X
		M18 × 1.5; 12 deep (NG 250 and 355)	350	X

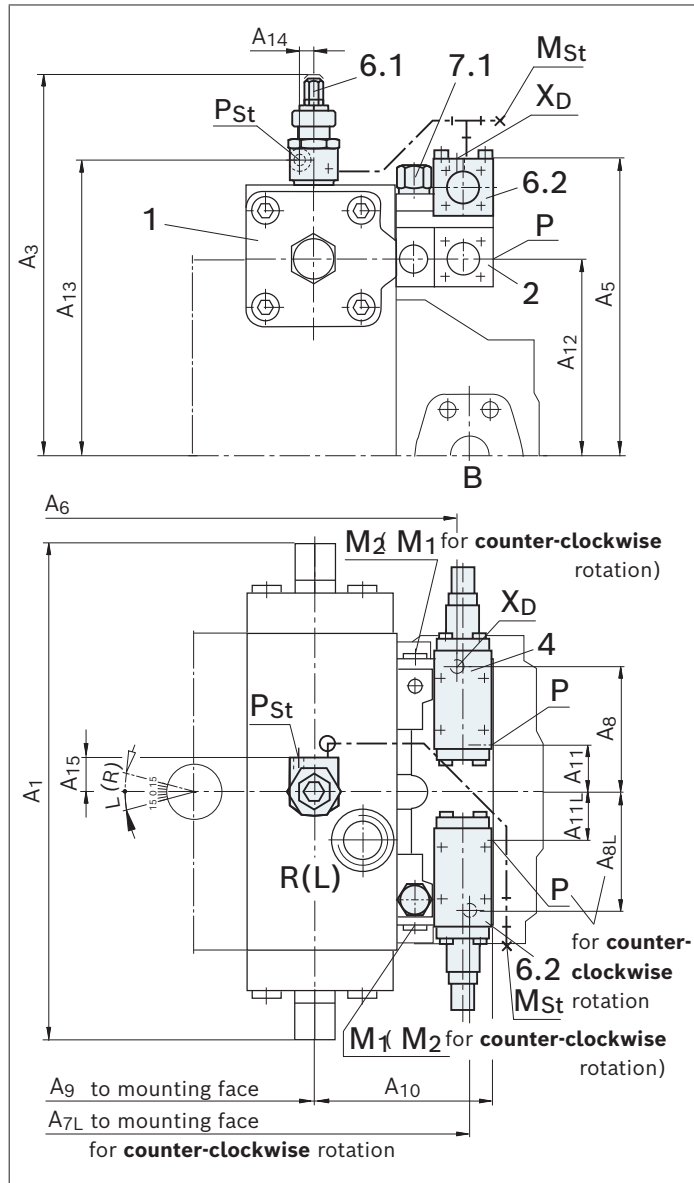
Components see Page 57

1) Depending on the application, momentary pressure peaks can occur.
Keep this in mind when selecting measuring devices and fittings.

2) O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

Dimensions LR.GN

▼ A4VSO, sizes 500 to 1000 Clockwise rotation



NG	A1	A3	A5	A6(L)	A7L	A8(L)	A9	A10	A11(L)	A12	A13	A14	A15	Dimensions and technical data see data sheet 92050
500	510	392	311	430	441	125	279	186	47	202	306	15	35	
750	582	430	342	462	473	125	301	195	47	232	345	15	35	
1000	622	456	364	528	539	125	360	203	47	255	372	15	35	

Port	Standard	Size	p_{\max} [bar] ¹⁾	State ²⁾
X_D	DIN 3852	M14 × 1.5; 12 deep	50	O
P	DIN 3852	M22 × 1.5; 14 deep	100	O
P_{St}	DIN 3852	M14 × 1.5; 12 deep	50	O
M_{St}	DIN 3853	S8 form W	100	X
M₁, M₂	DIN 3852	M18 × 1.5; 12 deep	350	X

Components see Page 57

1) Depending on the application, momentary pressure peaks can occur.
Keep this in mind when selecting measuring devices and fittings.

2) O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

Combination example LR2GNT

LR2GNT – Power controller with hydraulic stroke control and pressure controller, remote controlled

Pump setting in depressurized state: $V_{g\ min}$

For the description and the technical data, please refer to the following pages:

Controller	Code	Side
Power controller	LR2	4
remote controlled pressure controller	G	23
hydraulic stroke control	N	46
electric stroke control	T	51

For this control, an external pressurization with the control pressure is required at port **P**.

Notice

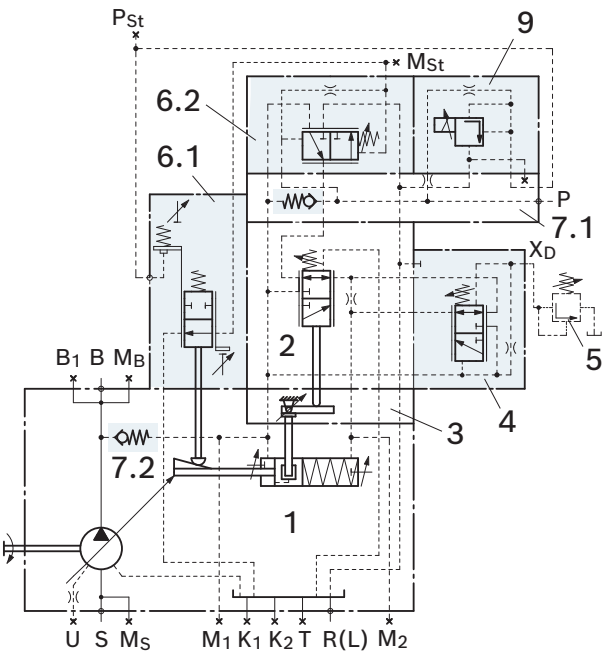
- ▶ Pressure controllers are not safeguards against pressure overload.
Be sure to add a pressure relief valve to the hydraulic system.
- ▶ **Please note for LR2GNT and LR3GNT:**
With a pressure control setting below the external control pressure $p_{control}$, the pump will - up to size 355 - remain at $V_{g\ min}$ -mechanical and with sizes 500 to 1000, vibrations may occur.

Circuit diagrams LR.GNT

Example: A4VSO...LR2GNT

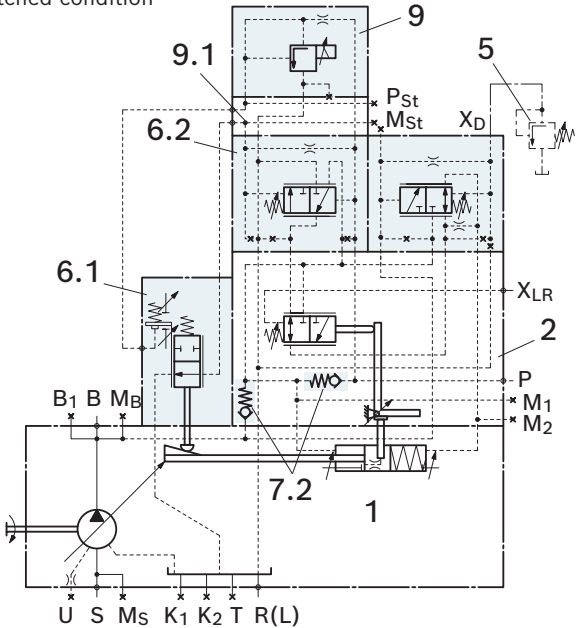
▼ A4VSO, sizes 125 to 355

P pressurized
Control valve 6.2 drawn in
switched condition



▼ A4VSO, size 500

P pressurized
Control valve 6.2 drawn in
switched condition

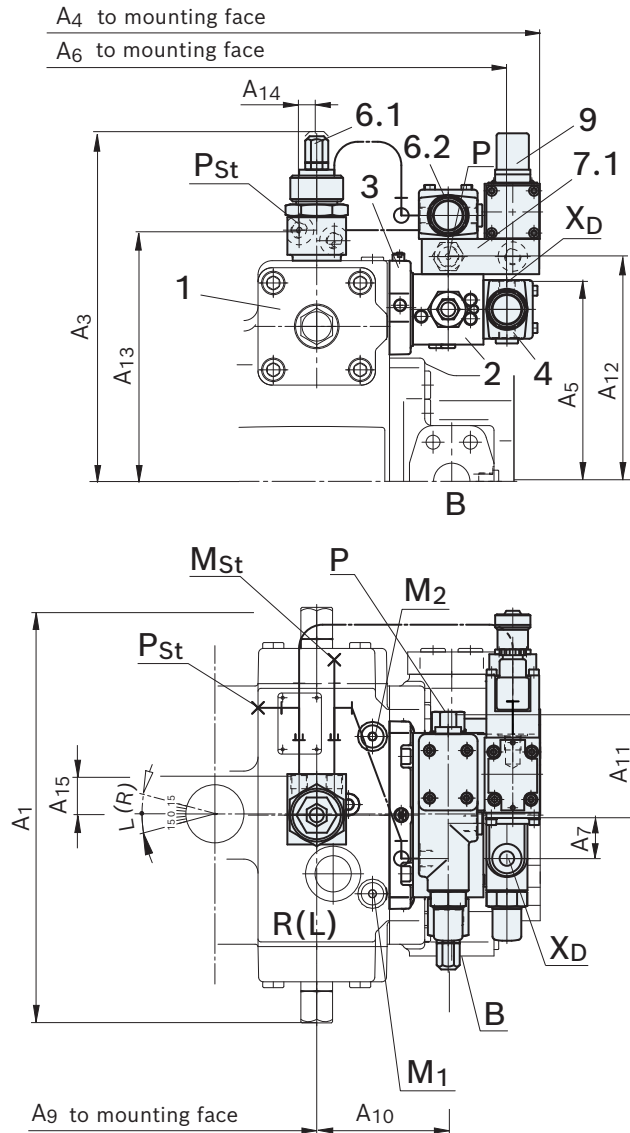


Components	
1	Pump with hydraulic control device
2	Power control valve
3	Intermediate plate NG125 to 355
4	Pressure control valve
5	Pressure relief valve (not included in scope of delivery)
6.1	Pilot control valve
6.2	Control valve
7.1	Intermediate plate for proportional valve mounting with check valve
7.2	Check valve integrated
9	Proportional pressure relief valve with inlet nozzle Ø1.0 mm
NG71 to 355	DBEP6 B06-1X/45AG24NZ4M-382
NG500	DBEP6 A06-1X/45AG24NZ4M-382
9.1 NG500	Intermediate plate for proportional valve mounting

Dimensions LR.GNT

▼ A4VSO, sizes 125 to 355

Clockwise rotation



NG	A1	A3	A4	A5	A6	A7	A9	A10	A11	A12	A13	A14	A15	Dimensions and technical data see data sheet 92050
125/180	354	299	393	171	365	37	203	112	88	192	214	15	35	
250/355	424	346	455	207	427	37	248	129	88	228	261	15	35	

Port	Standard	Size	p_{max} [bar] ¹⁾	State ²⁾
X_D	Pilot pressure port; remote controlled pressure controller	DIN 3852 M14 × 1.5; 12 deep	50	O
P	Control pressure	DIN 3852 M18 × 1.5; 12 deep	100	O
P_{St}	Pilot pressure	DIN 3852 M14 × 1.5; 12 deep	50	O
M_{St}	Pilot pressure measuring	DIN 3853 S8 form W	100	X
M₁, M₂	Stroke chamber measurement	DIN 3852 M14 × 1.5; 12 deep (NG 125 and 180)	350	X
		M18 × 1.5; 12 deep (NG 250 and 355)	350	X

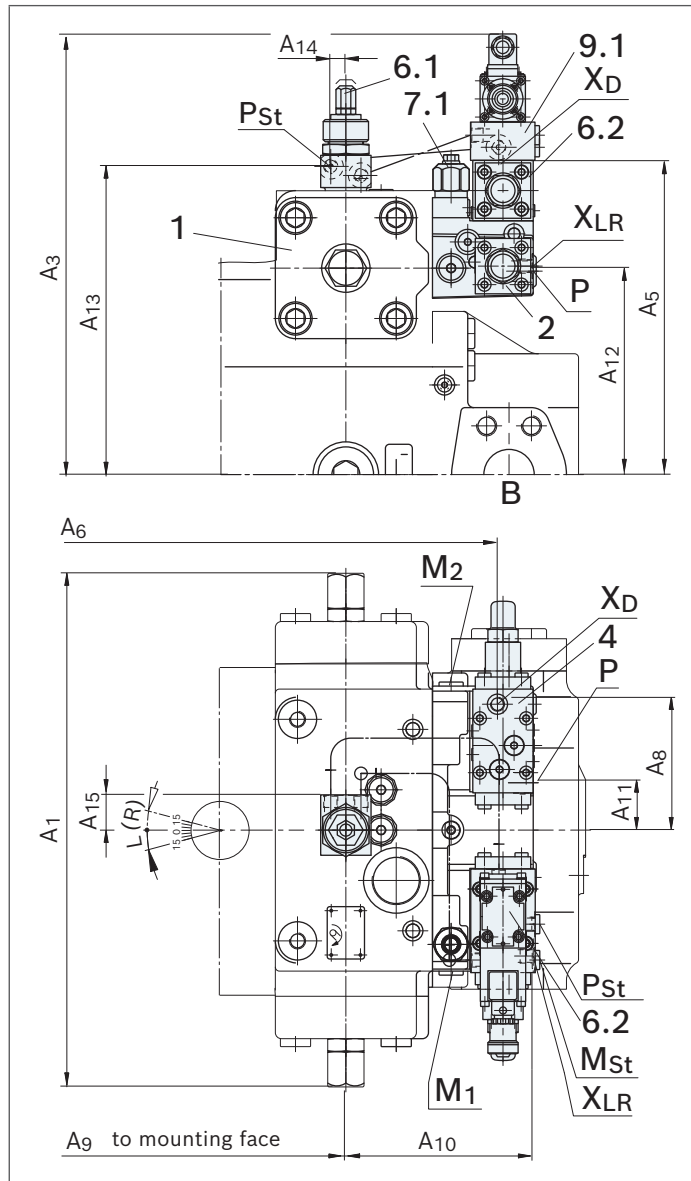
Components see Page 61

1) Depending on the application, momentary pressure peaks can occur.
Keep this in mind when selecting measuring devices and fittings.

2) O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

Dimensions LR.GNT

► A4VSO, size 500 Clockwise rotation



NG	A1	A3	A5	A6	A8	A9	A10	A11	A12	A13	A14	A15	
500	510	437.5	311	430	125	279	186	47	202	306	15	35	For further information, see data sheet 92050

Port		Standard	Size	p_{\max} [bar] ¹⁾	State ²⁾
X _D	Pilot pressure port; remote controlled pressure controller	DIN 3852	M14 × 1.5; 12 deep	50	O
X _{LR}	Pilot pressure port; remote controlled power controller	DIN 3852	M14 × 1.5; 12 deep	50	O
P	Control pressure	DIN 3852	M22 × 1.5; 14 deep	100	O
P _{St}	Pilot pressure	DIN 3852	M14 × 1.5; 12 deep	50	O
M _{St}	Pilot pressure measuring	DIN 3853	S8 form W	100	X
M ₁ , M ₂	Stroke chamber measurement	DIN 3852	M18 × 1.5; 12 deep	350	X

Components see Page 61

1) Depending on the application, momentary pressure peaks can occur.
Keep this in mind when selecting measuring devices and fittings.

2) O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

Connector for solenoids

HIRSCHMANN DIN EN 175 301-803-A /ISO 4400

Without bidirectional suppressor diode _____ H

The seal ring in the cable fitting is suitable for lines of diameter 4.5mm to 10mm.

The plug-in connector is not included in the scope of delivery.

It can be supplied by Bosch Rexroth on request.

Bosch Rexroth material number: R902602623.

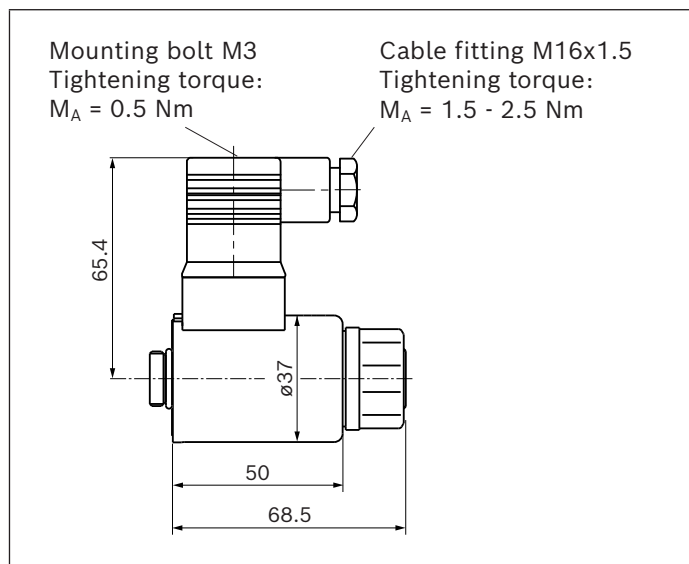
With correctly mounted mating connector, the following type of protection can be achieved:

► IP65 (DIN/EN 60529)

Notice

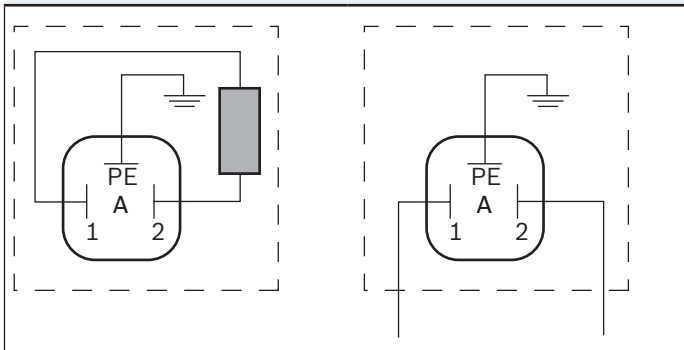
If necessary, you can change the position of the connector by turning the solenoid body.

The procedure is defined in the instruction manual 92122-01-B.



**Connector on solenoid
according to DIN 43650**

**Plug-in connector
DIN EN 175301-803-A
Line screw fitting M16x1.5**



Project planning notes

- ▶ The hydraulic control LR... is intended for use in the open circuit (A4VSO, A4VBO).
- ▶ The project planning, installation and commissioning of the axial piston unit requires the involvement of skilled personnel.
- ▶ Before using the axial piston unit, please read the corresponding instruction manual completely and thoroughly. If necessary, this can be requested from Bosch Rexroth.
- ▶ Before finalizing your design, please request a binding installation drawing.
- ▶ The specified data and notes contained herein must be observed.
- ▶ Depending on the operating conditions of the axial piston unit (working pressure, fluid temperature), the characteristic curve may shift.
- ▶ Preservation: Our axial piston units are supplied as standard with preservation protection for a maximum of 12 months. If longer preservation protection is required (maximum 24 months), please specify this in plain text when placing your order. The preservation periods apply under optimal storage conditions, details of which can be found in the data sheet 90312 or the instruction manual.
- ▶ Depending on the type of control used, electromagnetic effects can be produced when using solenoids. Use of the recommended direct current (DC) on the electromagnet does not produce any electromagnetic interference (EMI) nor is the electromagnet influenced by EMI. A possible electromagnetic interference (EMI) exists if the solenoid is supplied with modulated direct current (e.g. PWM signal). The machine manufacturer should conduct appropriate tests and take appropriate measures to ensure that other components or operators (e.g. with a pacemaker) are not affected by this potentiality.
- ▶ Pressure controllers are not safeguards against pressure overload. Be sure to add a pressure relief valve to the hydraulic system.
- ▶ To achieve the necessary pilot pressures for the controller function, sufficient control fluid quantity must be provided.
Due to the component tolerances, controllers in their new condition have a minimum control fluid requirement. Due to the wear over the service life, that is to be expected, an increase in the minimum control fluid requirement has to be anticipated. The design of the control fluid supply must thus be sufficiently large. If the control fluid quantities are too small, the controller function may be impaired and undesired system behavior may result.
- ▶ In drives, the natural frequency of the hydraulic system can be stimulated by the excitation frequency of the pump (rotational speed frequency $\times 9$). This can be prevented with suitably designed hydraulic lines.
- ▶ Working ports:
 - The ports and fastening threads are designed for the specified maximum pressure. The machine or system manufacturer must ensure that the connecting elements and lines correspond to the specified application conditions (pressure, flow, hydraulic fluid, temperature) with the necessary safety factors.
 - The service ports and function ports are only intended to accommodate hydraulic lines.

Safety instructions

- ▶ During and shortly after operation, there is a risk of getting burnt on the axial piston unit and especially on the solenoids. Take the appropriate safety measures (e.g. by wearing protective clothing).
- ▶ Moving parts in control equipment (e.g. valve spools) can, under certain circumstances, get stuck in position as a result of contamination (e.g. contaminated hydraulic fluid, abrasion, or residual dirt from components). As a result, the hydraulic fluid flow and the build-up of torque in the axial piston unit can no longer respond correctly to the operator's specifications. Even the use of various filter elements (external or internal flow filtration) will not rule out a fault but merely reduce the risk. The machine/system manufacturer should test whether additional measures are required on the machine for the relevant application in order to bring the driven consumer into a safe position (e.g. safe stop) and make sure any measures are properly implemented.

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